

**UNIVERSIDAD PRIVADA ANTENOR ORREGO**  
**FACULTAD DE INGENIERÍA**  
**ESCUELA PROFESIONAL DE INGENIERÍA ELECTRÓNICA**



---

**“PROPUESTA DE DISEÑO DE UN SISTEMA DE ARRANQUE REMOTO  
Y CONTROL DE LLENADO DE CISTERNAS DE AGUA TRATADA  
PARA LA EMPRESA DANPER S.A. FUNDO MUCHIK”**

---

**TESIS PARA OBTENER EL TÍTULO PROFESIONAL DE  
INGENIERO ELECTRÓNICO**

**LINEA DE INVESTIGACIÓN: AUTOMATIZACIÓN Y CONTROL**

**AUTOR:** Br. JHON CÁRDENAS RAMÍREZ

**ASESOR:** Ing. SAUL N. LINARES VÉRTIZ

**TRUJILLO - PERÚ**

**2015**

# **TESIS PARA OBTENER EL TÍTULO PROFESIONAL DE**

## **INGENIERO ELECTRÓNICO**

### **TÍTULO:**

PROPUESTA DE DISEÑO DE UN SISTEMA DE ARRANQUE REMOTO Y CONTROL DE LLENADO DE CISTERNAS DE AGUA TRATADA PARA LA EMPRESA DANPER S.A. FUNDO MUCHIK

### **DESARROLLADO POR:**

---

Br. Jhon Cárdenas Ramírez  
Tesista

### **APROBADO POR:**

---

Ing. Lenin H. Llanos León  
Presidente  
Nº CIP: 139213

---

Ing. Oscar M. De La Cruz Rodríguez  
Secretario  
Nº CIP: 85598

---

Ing. Luis E. Alvarado Rodríguez  
Vocal  
Nº CIP: 149200

---

Ing. Saul N. Linares Vértiz  
Asesor  
Nº CIP: 142213

## **Presentación**

**Señores miembros del jurado:**

De conformidad a lo estipulado en el Reglamento de Grados y Títulos de la Universidad Privada Antenor Orrego, pongo a vuestra consideración el trabajo de investigación titulado:

**"PROPUESTA DE DISEÑO DE UN SISTEMA DE ARRANQUE REMOTO Y CONTROL DE LLENADO DE CISTERNAS DE AGUA TRATADA PARA LA EMPRESA DANPER S.A. FUNDO MUCHIK".**

A fin de ser evaluado.

Espero que el presente trabajo logre cubrir las expectativas que tienen al respecto, excusándome de antemano por los errores involuntarios incurridos en el desarrollo del mismo.

Br. Jhon Cárdenas Ramírez

## **Dedicatoria**

**Dedico este proyecto mi papá Mario Cárdenas Daza y a mi mamá Lila Ramírez Saldaña.**

## **Agradecimientos**

**Expreso un sincero agradecimiento a:**

**Los docentes de la escuela de Ingeniería Electrónica que compartieron sus conocimientos, a mis hermanos Mario y Jhim por estar siempre ahí, a todas las personas que de alguna manera u otra me apoyan y confían en mí, por último aprovecho en recordar que tengo agradecimientos infinitos para mis padres Mario y Lila por su apoyo incondicional.**

## **RESUMEN**

El presente trabajo de investigación tiene por objetivo disminuir los tiempos de respuesta al cerrado de válvulas en el llenado de tanques cisternas de la empresa Danper del Fundo Muchik, para ello se realiza un levantamiento de información a base de encuestas al personal involucrado y visitas a la planta, se determinan las distancias donde se encuentran los elementos a controlar, luego se determinan los requerimientos del sistema y se selecciona la instrumentación adecuada.

La disminución del tiempo de respuesta se determina en base a las características técnicas de los equipos involucrados, en la que se evidencia que el tiempo máximo de la respuesta es de 100ms.

## **ABSTRACT**

This research aims to reduce response times to the closed valves on the tanks cisterns filled Company Danper the farm Muchik for gathering information it is done based on surveys involved staff and visitors to the plant, distances where the control elements are determined, then the system requirements are determined and appropriate instrumentation is selected.

Decreased response time is determined based on the technical characteristics of the equipment involved, which is evidence that the maximum response time is 100ms.

## INDICE

<b>1.</b>	<b>DISEÑO DE LA INVESTIGACIÓN</b>	<b>1</b>
<b>1.1.</b>	<b>Planteamiento del problema</b>	<b>1</b>
<b>1.2.</b>	<b>Definición del problema</b>	<b>3</b>
<b>1.3.</b>	<b>Justificación de la investigación</b>	<b>4</b>
<b>1.4.</b>	<b>Aportes</b>	<b>4</b>
<b>2.</b>	<b>MARCO TEÓRICO</b>	<b>5</b>
<b>2.1.</b>	<b>Antecedentes de la investigación</b>	<b>5</b>
<b>2.2.</b>	<b>Variadores de velocidad</b>	<b>5</b>
<b>2.3.</b>	<b>Controlador lógico programable</b>	<b>13</b>
<b>2.4.</b>	<b>Siemens Simatic</b>	<b>16</b>
<b>2.5.</b>	<b>Tia portal</b>	<b>20</b>
<b>2.6.</b>	<b>Sistemas de control</b>	<b>21</b>
<b>2.7.</b>	<b>Tecnologías de comunicación industrial</b>	<b>22</b>
<b>2.8.</b>	<b>Modelo OSI</b>	<b>23</b>
<b>2.9.</b>	<b>Protocolo de comunicación</b>	<b>24</b>
<b>3.</b>	<b>HIPOTESIS</b>	<b>27</b>
<b>4.</b>	<b>OBJETIVOS</b>	<b>28</b>
<b>5.</b>	<b>MATERIALES Y PROCEDIMIENTOS</b>	<b>29</b>
<b>5.1.</b>	<b>Materiales</b>	<b>29</b>
<b>5.1.1.</b>	<b>Reporte de tiempo de respuesta para llenado de cisterna</b>	<b>29</b>
<b>5.1.2.</b>	<b>Planos de ubicación de las cisternas y las bombas</b>	<b>30</b>
<b>5.1.3.</b>	<b>Profundidad de los pozos y cisternas</b>	<b>32</b>
<b>5.1.4.</b>	<b>Equipos presentes</b>	<b>32</b>
<b>5.2.</b>	<b>Procedimiento</b>	<b>32</b>

<b>5.2.1.</b>	<b>Determinación de obstáculos</b>	<b>32</b>
<b>5.2.2.</b>	<b>Requerimiento de los equipos</b>	<b>33</b>
<b>5.2.2.1.</b>	<b>Determinación de la tecnología para la comunicación remota</b>	<b>33</b>
<b>5.2.2.2.</b>	<b>Requerimiento para el control de los pozos de bombeo</b>	<b>33</b>
<b>5.2.2.3.</b>	<b>Requerimiento para la planta de tratamiento</b>	<b>34</b>
<b>5.2.2.4.</b>	<b>Requerimiento para llenado de cisternas</b>	<b>34</b>
<b>5.3.</b>	<b>Plano de instrumentación</b>	<b>35</b>
<b>5.4.</b>	<b>Selección de los equipos</b>	<b>36</b>
<b>5.4.1.</b>	<b>Selección del controlador</b>	<b>36</b>
<b>5.4.2.</b>	<b>Selección de los módulos analógicos</b>	<b>37</b>
<b>5.4.3.</b>	<b>Selección del módulo para el equipo de comunicaciones</b>	<b>37</b>
<b>5.4.4.</b>	<b>Selección del panel HMI</b>	<b>38</b>
<b>5.4.5.</b>	<b>Selección del switch</b>	<b>39</b>
<b>5.4.6.</b>	<b>Selección del variador de velocidad</b>	<b>40</b>
<b>5.4.7.</b>	<b>Selección del sensor de nivel</b>	<b>42</b>
<b>5.4.8.</b>	<b>Selección de la válvula de control</b>	<b>43</b>
<b>5.4.9.</b>	<b>Selección del sensor de presión</b>	<b>44</b>
<b>5.4.10</b>	<b>Cálculo del tiempo de respuesta del sistema</b>	<b>45</b>
<b>5.5.</b>	<b>Resultados</b>	<b>46</b>
<b>6.</b>	<b>Conclusiones</b>	<b>47</b>
<b>7.</b>	<b>Recomendaciones</b>	<b>47</b>
<b>8.</b>	<b>Referencias Bibliográficas</b>	<b>48</b>

## **INDICE DE TABLAS**

<b>1. Consumo de agua</b>	<b>2</b>
<b>2. Variable independiente</b>	<b>27</b>
<b>3. Variable dependiente</b>	<b>28</b>
<b>4. Tiempos de respuesta</b>	<b>29</b>
<b>5. Equipos presentes</b>	<b>32</b>
<b>6. Características del controlador</b>	<b>36</b>
<b>7. Características del switch</b>	<b>40</b>
<b>8. Selección de equipos</b>	<b>46</b>

## INDICE DE FIGURAS

<b>1.</b>	<b>Diagrama de flujo del proceso de inspección</b>	<b>1</b>
<b>2.</b>	<b>Estructura básica de un PLC</b>	<b>14</b>
<b>3.</b>	<b>Ciclo de ejecución de un PLC</b>	<b>14</b>
<b>4.</b>	<b>SIMATIC S7-200</b>	<b>16</b>
<b>5.</b>	<b>SIMATIC S7-1200</b>	<b>17</b>
<b>6.</b>	<b>SIMATIC S7-300</b>	<b>18</b>
<b>7.</b>	<b>SIMATIC S7-400</b>	<b>19</b>
<b>8.</b>	<b>SIMATIC S7-1500</b>	<b>19</b>
<b>9.</b>	<b>Lazo de control abierto</b>	<b>21</b>
<b>10.</b>	<b>Lazo de control cerrado</b>	<b>22</b>
<b>11.</b>	<b>Elementos fundamentales de comunicación</b>	<b>22</b>
<b>12.</b>	<b>Porcentaje de tiempo de respuesta al llenado de cisterna</b>	<b>30</b>
<b>13.</b>	<b>Ubicación de zonas a automatizar</b>	<b>30</b>
<b>14.</b>	<b>Distancia de la zona de bombeo hasta la zona de tratamiento</b>	<b>31</b>
<b>15.</b>	<b>Zona de cisterna</b>	<b>31</b>
<b>16.</b>	<b>Determinación de obstáculos</b>	<b>33</b>
<b>17.</b>	<b>Plano de la instrumentación</b>	<b>35</b>
<b>18.</b>	<b>S71200 CPU1215</b>	<b>36</b>
<b>19.</b>	<b>Módulo analógico</b>	<b>37</b>
<b>20.</b>	<b>Módulo de comunicaciones</b>	<b>37</b>
<b>21.</b>	<b>Antena</b>	<b>38</b>
<b>22.</b>	<b>Panel HMI</b>	<b>38</b>
<b>23.</b>	<b>Conexionado de panel HMI</b>	<b>39</b>

<b>24.</b>	<b>Switch industrial</b>	<b>39</b>
<b>25.</b>	<b>Unidad de potencia</b>	<b>41</b>
<b>26.</b>	<b>Unidad de control</b>	<b>41</b>
<b>27.</b>	<b>Reactancia</b>	<b>42</b>
<b>28.</b>	<b>Sensor de nivel</b>	<b>43</b>
<b>29.</b>	<b>Válvula de control</b>	<b>43</b>
<b>30.</b>	<b>Sensor de presión</b>	<b>44</b>

## I. DISEÑO DE LA INVESTIGACIÓN

### 1. EL PROBLEMA

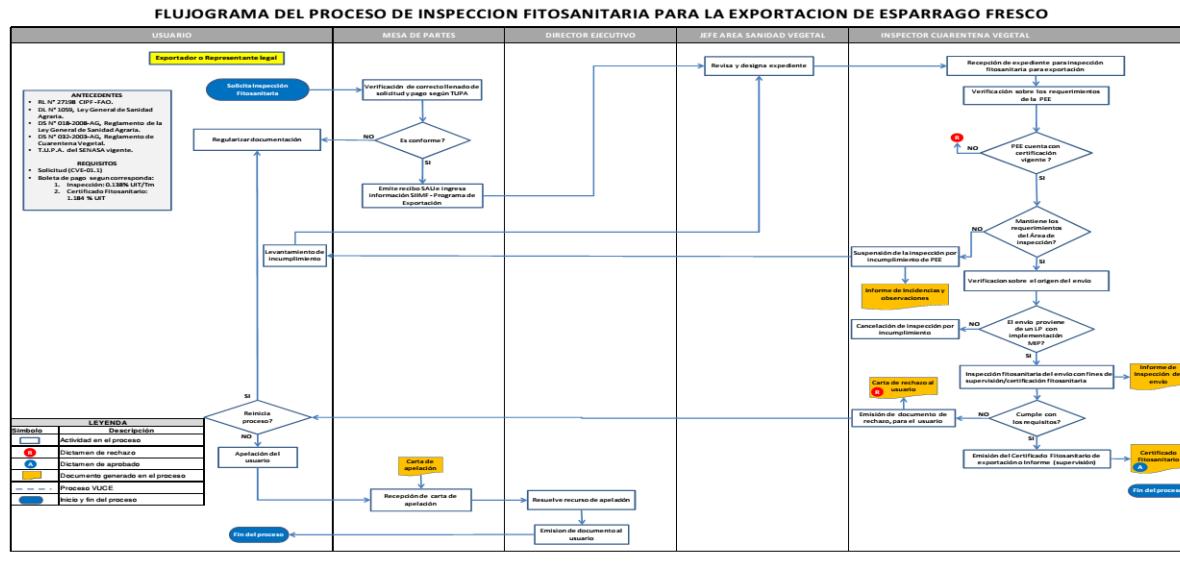
#### 1.1. Planteamiento del problema

Un informe de Scotiabank revela que el Perú es el segundo exportador mundial de espárragos en conservas, con el 43% del volumen total exportado, precedido por China con 45%. La analista senior del Departamento de Estudios Económicos de esta entidad financiera, Erika Manchego, añadió que, durante el primer semestre de 2014, las exportaciones de espárragos en conservas alcanzaron los US\$70 millones, y se mantuvo estable respecto al mismo período del 2013.

“Es probable que los espárragos en conserva sigan teniendo buenos precios debido a la disminución de la oferta peruana y china, lo que compensa el menor volumen exportado” [web 01]

Actualmente la demanda de la exportación de productos verdes ha permitido el auge de las empresas que se dedican al cultivo y empaque de productos frescos.

Tal demanda de frescos acarrea un mayor consumo de agua, ya que este es una de las materias primas para el proceso limpieza y desinfección tal como se muestra en el siguiente cuadro.



Servicio Nacional de Sanidad Agraria - Sede Central / Av. La Molina N° 1915 – Lima 12  
Central Telefónica: 3133300 – Anexo 2000 Central de Fax- 3401486 Anexo 2000  
Pág. Web: [www.senasa.gob.pe](http://www.senasa.gob.pe)

Fig 1: Diagrama de Flujo del proceso de inspección

El consumo de agua de Danper en sus plantas de conservas, planta de congelado, planta de empaque de fresco y sus dos Fundos Muchik y compositán se detalla a continuación en la Tabla 1:

Fuente de agua	Planta Trujillo (m <sup>3</sup> )	Planta Fresco (m <sup>3</sup> )	Fundo Muchik (m <sup>3</sup> )	Fundo Compositán (m <sup>3</sup> )	Total (m <sup>3</sup> )
<b>Subterráneas</b>	574,986	0	0	11,652,893	<b>12'227,879</b>
<b>Superficiales</b>	0	85,987	3,447,201	0	<b>3'533,188</b>
<b>Suministro otras empresas</b>	0	16,500	0	0	<b>16,500</b>
<b>Total m<sup>3</sup></b>	<b>574,986</b>	<b>102,487</b>	<b>3'447,201</b>	<b>11'652,893</b>	<b>15'777,567</b>

Tabla1: Consumo de agua

El mayor consumo de agua proviene de los Fundos Muchik y Compositán, debido a la actividad agrícola propia del sembrado y cosecha de los productos de Danper. A continuación se explica el tipo de abastecimiento de agua para el fundo en el que se enfoca este trabajo:

### Fundo Muchik

El Fundo Muchik está ubicado en el límite de los valles de Virú y Moche y es abastecido con agua superficial del canal propiedad del Proyecto de Irrigación CHAVIMOCHIC, la cual proviene de la Cordillera de los Andes (Callejón de Huaylas – Huaraz) y de las lagunas Aguash y Conococha. El agua fluye a través de canales que irrigan los valles de Chao, Virú y Moche. La captación de agua se realiza a través del canal de irrigación del Sector V-B2 (retención Salaverry), mediante una compuerta principal, para luego efectuar un posterior tratamiento de floculación y sedimentación. Danper trabaja con un estándar promedio entre 30 a 50 NTU, 25 en lo referente a turbidez del agua, dependiendo de la estación del año. Los valores permisibles, para los sólidos en suspensión, se controlan entre los 50 a 80 ppm.

El agua del Proyecto Chavimochic es administrada por la Autoridad Nacional del Agua (ANA), la cual a su vez, coordina con la Junta de Usuarios de Riego Presurizado del Valle de Virú para su distribución entre los usuarios. La Empresa solicita dotación de agua para sus campos de cultivo a esta Junta, para lo cual presenta un plan de cultivo anual y realiza mediciones del consumo a través de medidores de caudal, los cuales se calibran anualmente.

✓ **Delimitación**

El presente trabajo de investigación se delimita a realizar la propuesta de diseño para el arranque remoto de bombas y control de nivel de las cisternas de agua del Fundo Muchik de la empresa Danper.

La planta Muchik tiene instalada 2 bombas de agua en un pozo ubicado a 600 metros de la planta de tratamiento, en el mismo lugar se encuentra el tablero de mando. Cuando la planta requiere mayor cantidad de agua trabajan las 2 bombas simultáneamente, esto provoca que cuando el nivel de producción baja, el agua tratada sobrante se desperdicie acarreando para la empresa pérdidas, no sólo del líquido sino también de energía por estar las bombas activadas. Existe un personal que tiene la función de controlar este proceso, pero algunas veces se encuentra desarrollando otras tareas por lo que no se percata de lo sucedido. La situación se complica si esto ocurre durante la noche, pues el camino hasta el tablero de control no cuenta con iluminación adecuada, lo que acarrea tiempo en llegar hasta el tablero además de posibles accidentes.

✓ **Características**

- Aumento del volumen de producción.
- Tiempos muertos en el control de llenado de cisternas.

✓ **Análisis**

Debido al aumento de la demanda de productos frescos, la empresa Danper consume mayor cantidad de agua para el tratamiento de sus productos tal como se observa en la Tabla 1.

Debido a que el técnico encargado no está dedicado al 100% al control de las bombas y al llenado de las cisternas, se pierde tiempo y agua, esto empeora durante las noches, ya que el lugar no está iluminado correctamente por ser sembradío.

## **1.2. Definición del problema**

El problema se define en estudiar la forma como disminuir el tiempo de respuesta en el control de las bombas de agua y el llenado de las cisternas del Fundo Muchik de la empresa Danper.

### **Formulación del problema**

¿De qué manera se podrá disminuir los tiempos de respuesta en el control de activación de las bombas de agua y el llenado de las cisternas de la planta de tratamiento de agua del Fundo Muchik de la empresa Danper?

### **Alcance**

Esta investigación abarca la propuesta de diseño de un sistema que permita reducir los tiempos para controlar la activación de las bombas de agua y el llenado de las cisternas de la planta de tratamiento de agua del Fundo Muchik de la empresa Danper.

### **1.3. Justificación de la investigación**

En lo social:

Esta investigación permitirá un mejor aprovechamiento de las aguas captadas del río Moche.

En lo académico:

Permitirá a los investigadores proponer una solución al control de arranque a distancia de acuerdo con los avances tecnológicos.

En lo económico:

Permitirá a la empresa Danper disminuir sus costos en el consumo de energía y aprovechar el consumo de agua.

### **1.4. Aportes**

En lo tecnológico, brindar un diseño de sistema de control de activación remoto usando tecnología actualizada.

En lo social, brindar un clima laboral positivo con referencia al trabajo del técnico encargado y al área de mantenimiento.

En lo académico, brindar nuevas propuestas para el control a distancia en sistemas industriales.

## **2. MARCO TEÓRICO**

### **2.1. Antecedentes de la Investigación**

**"SISTEMA DE CONTROL AUTOMATICO PARA EL PROCESO DE LAVADO Y PREPARACION DE CAÑA DE AZUCAR EN EL LAVADERO B DE LA EMPRESA AGROINDUSTRIAL CASA GRANDE". Jorge Mariano Díaz Nanfuñay – Universidad privada Antenor Orrego - Perú - Tesis. 2014.**

El proyecto contempla la metodología para seleccionar el tipo de instrumentos en una automatización, también aporta un concepto para la estrategia de control en sistemas que deben ser automatizados.

**"DISEÑO E IMPLEMENTACION DE LA INSTRUMENTACION DE LA PLANTA DE DESTILERIA DE ALCOHOL N°2 IPE - COAZUCAR". Frank Mijael Espina Villajulca – Universidad privada Antenor Orrego - Perú - Tesis. 2013.**

El proyecto contempla la selección del bus de comunicaciones para que los instrumentos automatizados estén en RED. Además brinda información sobre la selección de los variadores de velocidad.

### **2.2. Variadores de velocidad**

Los Convertidores de Frecuencia, también llamados Variadores de Frecuencia (VDF) o Inversores (Inverters) (aunque realmente este nombre corresponde a una parte del VDF, por constituir el componente principal. Muchos fabricantes usan esta denominación), han venido a resolver el problema de poder usar los motores a velocidades variables sin disminuir mayormente su eficiencia, con lo que ahora estos motores conectados a estos equipos permiten ser usados en aplicaciones especiales.

Estos dispositivos forman parte de la familia denominada Drivers en AC (AC Drivers), la cual está constituida por otros equipos para comando de motores de corriente alterna, tales como Partidores Suaves, que se emplean sólo para la partida y parada de los motores, y no para modificar la velocidad en régimen permanente.

#### **2.2.1 Principio de funcionamiento**

En definitiva, estos dispositivos entregan voltaje y frecuencia variable conforme a la necesidad del motor y la carga a él conectada. Para tal efecto, toma la alimentación eléctrica de la red, la cual tiene voltaje y frecuencia fija, la transforma en un voltaje continuo (Rectificador más Filtro) y luego lo transforma en voltaje alterno trifásico de magnitud y frecuencia variable por medio de un Inversor. Contando sólo con esta última etapa (Inversor) es posible también alimentar estos motores a partir de un suministro de corriente continua (por ejemplo baterías). También se puede contar con un rectificador monofásico de

modo de poder alimentar un motor trifásico a partir de una fuente de alimentación monofásica. La forma de onda del voltaje de salida en estricto rigor no es una sinusoida perfecta, toda vez que entregan una señal de pulso modulada a partir de una frecuencia de conmutación alta. En todo caso con los equipos actuales, donde podemos encontrar frecuencias de conmutación del orden de los 50 KHz, los contenidos de armónica son bastante bajos, por lo que agregando filtros pasivos cumplen las exigencias normativas impuestas por muchos países. La relación frecuencia voltaje es configurada por el usuario según la aplicación, siendo las más usuales una relación lineal, la cual produce un torque constante en todo el rango de velocidad; o una relación cuadrática, en la que el torque disminuye a medida que baja la velocidad. En definitiva, conforme a la consigna de frecuencia que se le otorgue al equipo, la cual puede ser un comando en el mismo equipo o una señal externa, se entregará al motor un voltaje de magnitud según la relación V/F configurada y de frecuencia conforme a la consigna. Esto hará que el motor gire a una velocidad proporcional a la frecuencia.

### **2.2.2 Funciones Adicionales**

Los equipos que se fabrican en la actualidad aprovechan de incorporar varias funciones adicionales, como las protecciones al motor y funciones de control para distintas aplicaciones, como controles PID y controles lógicos y secuenciales. Para permitir estas funciones encontraremos en estos dispositivos una gran cantidad de terminales de control para conectar entradas y salidas digitales y análogas, puertas de comunicación de datos y una gran cantidad de parámetros de configuración.

### **2.2.3 Selección de un Variador de Velocidad**

Siempre que estamos hablando de un CF, debemos tener presente que sólo estamos hablando de la tercera parte del sistema; el motor también debe ser estudiado durante este proceso (no es el objeto de este artículo, pero es tan importante como lo aquí detallado). La mejor y más sencilla manera de hacer una correcta selección es a través de preguntas simples, pero con respuestas complejas.

- a) ¿Qué hace la máquina? Las cargas son clasificadas dependiendo del comportamiento de su torque en función de la velocidad. En general, tenemos: Torque constante: Extrusoras, trefiladoras, compresores reciprocatantes, bandas transportadoras. Torque lineal: Prensas, calandras. Torque cuadrático: Bombas

centrífugas y ventiladores. Torque hiperbólico: Máquinas bobinadoras y desembobinadoras. Torque indefinido: Mesas alimentadoras. Para efectos de selección de motor y de variador de velocidad, la gran mayoría de aplicaciones son consideradas como cargas de torque constante. Mientras que sólo las bombas (de agua potable) y ventiladores son considerados como torque cuadrático (también definido coloquialmente como variable o parabólico).

- b) ¿Es una modernización a la aplicación actual o es un proyecto nuevo? De manera electrónica, el CF logra aplicar al motor frecuencias desde 0.1 Hz hasta 200 Hz sin mayor problema. En muchos procesos la limitación no es el driver, sino el motor, el sistema de transmisión o posiblemente el proceso mismo. Algunas cargas no soportarán el uso de variadores de velocidad en todo el rango de velocidad que el CF puede dar; en estos casos, es importante ver los detalles y tomar las precauciones adecuadas (generalmente cambios mecánicos en la máquina).
- c) ¿Es estrictamente necesario controlar la velocidad del equipo? Algunos textos o fuentes de información catalogan el CF como un método más de arranque de motores. Esto es correcto, es un buen método de arranque, pero su uso no debe ser indiscriminado. Frente a métodos de arranque convencionales como el arranque directo, el arranque estrella triángulo y el arranque por auto-transformador, tiene ventajas inobjetables, como son la disminución de la corriente de arranque y la mejora del factor de potencia; aspectos conducentes a aumentar la estabilidad de las redes. Esto sumado a que el motor puede desarrollar torques de arranque altos, indicaría que es la mejor selección. Debe recordarse que el desarrollo tecnológico de la electrónica de potencia, también ha introducido a la industria el arrancador electrónico suave (SS por sus siglas en inglés: SoftStarter), hoy en día un dispositivo de control digital capaz de realizar arranques y paradas suaves eléctrica y mecánicamente. No hay una regla clara al respecto, pero podemos anotar que durante la decisión de utilización de un CF o un SS, deben evaluarse varios aspectos técnicos de los indicados en este texto; y los económicos también deberán tenerse en cuenta.

d) ¿Cuál es el rango de variación de velocidad? Superado el punto anterior, pasamos a otro igualmente importante, que definirá fundamentalmente el tipo de control que el CF aplicará al motor para controlar la velocidad. Cuanto más grande sea este rango, mayor cuidado deberá tenerse en el motor. Abajo del 50% de la velocidad nominal el motor estándar reduce su capacidad de refrigeración por disminuir el caudal de aire: si la carga asociada es estrictamente de torque constante, muy posible se hará necesario dar al motor un medio de ventilación independiente de su eje. Abajo del 10% de la velocidad nominal, el torque producido por el conjunto driver-motor se ve reducido en drivers convencionales que solo ofrecen control escalar. Los CF de tecnología más avanzada ofrecen control vectorial, mediante el cual el CF sabe por cálculo o por medición directa la necesidad de torque dependiendo del requerimiento de la carga.

e) ¿Cuál es el ciclo de trabajo? Punto a considerar de manera simultánea con el anterior. Es usual oír que por debajo del 50% de la velocidad nominal se requiere uso de ventilación forzada en el motor. También es usual oír que por debajo del 10% de la velocidad nominal el motor debe llevar encoder (el CF debe tener la opción de realizar control vectorial en lazo cerrado) para garantizar un perfecto control y gran precisión. Realmente estos dos detalles dependerán del ciclo de trabajo. Esto es: cuánto porcentaje del tiempo total de operación estará el motor a una determinada velocidad. Debe compararse el torque del motor contra el torque de la carga y evaluar contra el ciclo de carga: no hay otra forma de determinar la utilización de estos accesorios. En este punto hay que determinar con la mayor precisión posible cuál será el comportamiento dinámico del sistema completo, incluyendo motor, sistema de transmisión y carga asociada: los tiempos de aceleración, tiempos de desaceleración, torque de arranque de motor, tipo de transición de torque desde motor hacia carga, etc. No todas las cargas se comportan igual; a pesar de que los CFs tienen muchas capacidades por firmware y software, no todas estas son aplicables a todas las cargas de manera simultánea. Por ejemplo, no es usual que un sistema de velocidad variable se aplique a una bomba centrífuga y se pretenda bajar la velocidad por debajo del 70% de su velocidad nominal, ni subir la velocidad por encima de

su velocidad nominal. Velocidades más bajas traen como consecuencia presiones muy bajas y cero conducción de fluido, con el consecuente daño mecánico de la bomba; velocidades muy altas traen como consecuencia una sobrecarga elevada en motor, con la inmediata consecuencia de salida de funcionamiento del sistema completo por sobrecorriente o sobrecarga.

- f) ¿Cuáles son los datos nominales del motor? Hablando de motores eléctricos, es una costumbre referirse a ellos solamente relacionando la potencia. Yendo más a fondo, hay que tener en cuenta los siguientes parámetros de motor: Potencia en kilovatios (kW) o en caballos de potencia (HP) Tensión nominal en voltios (V) Frecuencia nominal en ciclos por segundo (Hz) Corriente nominal en amperios (A) Velocidad nominal en revoluciones por minuto (rpm) El dato de potencia en un CF es indicativo y generalmente está relacionado con un motor estándar de 2 o 4 polos. Motores especiales, o motores de 6 o más polos tienen menores niveles de eficiencia y factor de potencia; con un valor de corriente generalmente mayor. Siempre debe hacerse la selección de manera que la corriente del variador de velocidad sea superior a la corriente nominal del motor. Como se indica en otras partes del presente artículo, hay un capítulo aparte para la correcta selección de motor; pero son especialmente importantes el torque de partida nominal y el torque máximo. De esta forma se logra un proyecto casi completo.
- g) ¿Cuáles son los datos nominales de la red eléctrica? En nuestro mercado las principales tensiones en redes industriales en baja tensión son 220 V, 440 V, 460 V. Otros niveles de tensión son utilizados, pero no son tan comunes. El motor jaula de ardilla fácilmente puede tener un diseño interno que mediante un arreglo determinado de los cables puede ser conectado en tensiones 220 V ó 440 V. Por la manera en que está construido un variador de velocidad no puede conectarse indistintamente en cualquiera de las redes indicadas previamente. Se consiguen usualmente equipos con rango de tensión de 200 a 240 V, de 220 a 230 V, de 380 a 480 V o de 575 a 690 V (este último casi no aplicable en Colombia). También debemos recordar que para niveles de potencia superiores (por encima de

500 HP), los motores tienden a ser especificados en media tensión, es decir, 4160 V. Cuando se piensa en estos niveles de tensión, lo más importante es encontrar un conjunto drivermotor que nos ofrezca amigabilidad, flexibilidad, eficiencia y confiabilidad. Las redes en Europa y en otros países son en 50 Hz y algunas muy pocas industrias en Colombia también tienen sus sistemas eléctricos en 50 Hz. Las redes en Estados Unidos, Centro y Suramérica son en 60 Hz. Otra más de las ganancias con el uso de los variadores de velocidad es la posibilidad de utilizar máquinas diseñadas para redes de 50 ó 60 Hz, en redes con la otra frecuencia nominal, pues el CF puede dar en la salida una tensión y frecuencia diferentes de la tensión y frecuencia de entrada (red).

- h) ¿Cómo son las condiciones medio ambientales? Al igual que los motores eléctricos convencionales, los variadores de velocidad tienen un sistema de refrigeración que depende del aire de ventilación. De esta manera, las condiciones de altura sobre el nivel del mar y temperatura ambiente afectarán positiva o negativamente la refrigeración del variador. Usualmente deberá hacerse una disminución de potencia efectiva del equipo si se sobrepasan las condiciones de norma (1000 msnm y 40°C). También tenemos otros aspectos asociados como son las características propias del aire ambiente. Dentro de estas podemos mencionar: Polvo magnético, Polvo conductor, Humedad, Área clasificada. En la gran mayoría de los casos, los variadores de velocidad deberán ser instalados dentro de tableros o gabinetes que deberán cumplir unas características mínimas. Para que el equipo tenga un funcionamiento libre de errores “fatales” las recomendaciones del fabricante deben seguirse detalladamente según el manual de usuario.
- i) ¿Cómo será controlado y monitoreado el equipo? Desde la operación manual hasta la integración con un sistema superior de control como un PLC o un DCS, el CF está en capacidad de responder. Dependiendo de cuántas órdenes queremos que el equipo reciba y ejecute; y de cuántas variables sea necesario monitorear del equipo y del proceso, será considerada la cantidad de I/Os del equipo. Mediante las entradas digitales (contactos abiertos o cerrados) se da al CF

órdenes tales como: habilitación general de funcionamiento, marcha/paro con selectores, marcha/paro con pulsadores, cambio de sentido de giro (posible en un CF sin necesidad de contactores), marcha en velocidades predeterminadas (tener en cuenta cuántas se requerirán), marcha en velocidad de prueba, indicación de error externo, selección de lugar de control, control de velocidad del tipo de potenciómetro electrónico, activación de controlador PID, entre otras. Los CF modernos tienen 4 ó 6 DI, siendo posible ampliar este número con el uso de tarjetas expansoras de entradas. Las entradas analógicas (señales de 0 a 10 V DC o de 0 a 20 mA DC) son usadas para dar referencia de velocidad al CF. Esta referencia puede provenir sencillamente de un potenciómetro industrial, como también de un PLC o directamente de un transductor de alguna variable de proceso: presión, caudal, nivel, temperatura, humedad relativa, masa, velocidad lineal, etc. En el caso del controlador PID interno, esta señal será considerada como valor real. Es común encontrar CF con 1 AI ó 2 AI; también es posible ampliar este número con tarjetas expansoras. Las salidas de relé o salidas digitales tienen el objetivo de visualizar el estado del CF así como ciertos eventos que se quiere visualizar o indicar al sistema superior. Las siguientes son las indicaciones que generalmente se pueden dar a través de estas salidas: convertidor listo, en marcha, con error, velocidad real igual a una velocidad predeterminada, velocidad real superior/inferior a una velocidad predeterminada, torque igual a un torque predeterminado, torque superior/inferior a un torque predeterminado. La cantidad de ROs y DOs del equipo varía dependiendo de la línea de CF, pero también puede ser expandible. Las salidas analógicas son proporcionales a ciertas variables del CF. Es posible dar indicación a mandos externos de los siguientes parámetros: corriente de convertidor, velocidad de referencia, velocidad de salida, tensión en el circuito intermedio, tensión aplicada a motor, potencia de salida, torque de salida, variable proporcional a la velocidad (variable de proceso: no directamente sino por proporcionalidad a la velocidad de salida), etc. Un ejemplo muy sencillo del uso de las I/Os es el siguiente: supongamos que tenemos un PLC que antes de dar marcha al motor, requiere saber si el CF está listo; además, para controlar la velocidad sobre la velocidad

mínima, requiere que el CF le indique que está en marcha. Encadenamos así: si el CF está listo, activa una RO, que se realimenta al PLC; el PLC recibe esta indicación y envía una señal de marcha al CF que llega como una DI; el CFW ejecuta su acción de marcha y activa una RO con la indicación de que está en marcha; el PLC recibe esta realimentación y da orden de cambiar la velocidad mediante la modificación de una salida analógica que se convierte en entrada analógica para el CF. También es posible llevar al PLC la indicación, por ejemplo, del nivel de corriente del equipo, para que ante un aumento súbito, sea el PLC quien tome la decisión de qué hacer. A estas señales I/Os las clasificamos en general con el nombre de recursos de control. El éxito en la utilización de estos recursos está en la pericia del programador para utilizarlas al máximo. En ocasiones es posible hacer una buena configuración con las I/Os de un CF básico, pero para ello es necesario conocerlo muy bien. En caso de limitación en estos recursos, queda la opción de complementar ciertos comandos con controles convencionales, como pulsadores con retención, electores externos, acción directa sobre contactores o interruptores asociados.

#### 2.2.4 Consideraciones finales

Todas las preguntas realizadas previamente deben tener respuestas concretas, posibles de tabular en una hoja técnica de selección. Especificar un variador de velocidad simplemente por su potencia y tensión, no es lo más correcto, porque cualquier detalle no considerado se puede convertir fácilmente en una incompatibilidad entre la necesidad inicial y la ejecución final. Junto con el CF deben escogerse los dispositivos de maniobra, pues de nada sirve tener un excelente equipo en la aplicación, si sus accesorios y elementos asociados no cumplen los mismos niveles de calidad y confiabilidad. Debe siempre tenerse presente que el CF está encaminado a controlar un motor y un proceso; por tanto, su selección nunca podrá ser aislada.

## 2.3. Controlador Lógico Programable

### 2.3.1 Definición

“Es un dispositivo digital electrónico con una memoria programable para el almacenamiento de instrucciones, permitiendo la implementación de funciones específicas tales como: lógicas, secuenciales, temporizadas, de conteo y aritmética; con el objeto de controlar máquinas y procesos.” [W07].

### 2.3.2 Estructura de un PLC

La estructura básica de un PLC está compuesta por:

- ✓ **Fuente de alimentación**

La fuente de alimentación proporciona las tensiones necesarias para el funcionamiento de los distintos circuitos del sistema. La alimentación a la CPU frecuentemente es de 24 Vcc, o de 110/220 Vca.

- ✓ **CPU**

Es la parte inteligente del sistema. Interpreta las instrucciones del programa de usuario y consulta el estado de las entradas. Dependiendo de dichos estados y del programa, ordena la activación de las salidas deseadas.

- ✓ **Periféricos de entradas y salidas**

Entradas: Corresponde al elemento o interfaz por el cual ingresan los datos que son adaptados y codificados en forma comprensible para la CPU.

Salidas: Trabaja con las señales entregadas de la CPU, decodificándolas y amplificándolas para manejar distintos tipos de actuadores.

- ✓ **Memorias**

Esta etapa es la encargada de almacenar la información del programa y los datos con los cuales trabaja la CPU. Dependiendo de la función se utilizarán distintos tipos de memoria, como por ejemplo: memoria de usuario, memoria de tabla de datos, memoria de sistema y memoria de almacenamiento.

Memoria ROM: Es una memoria de sólo lectura que contiene el sistema operativo (firmware) con el que opera el controlador.

**Memoria RAM:** Es una memoria volátil y de aplicación, ya que en ésta se ubica el programa de usuario.

✓ **Unidad de programación**

Es un terminal a modo de ordenador que proporciona una forma más favorable de realizar el programa de usuario y observar parámetros internos del autómata.

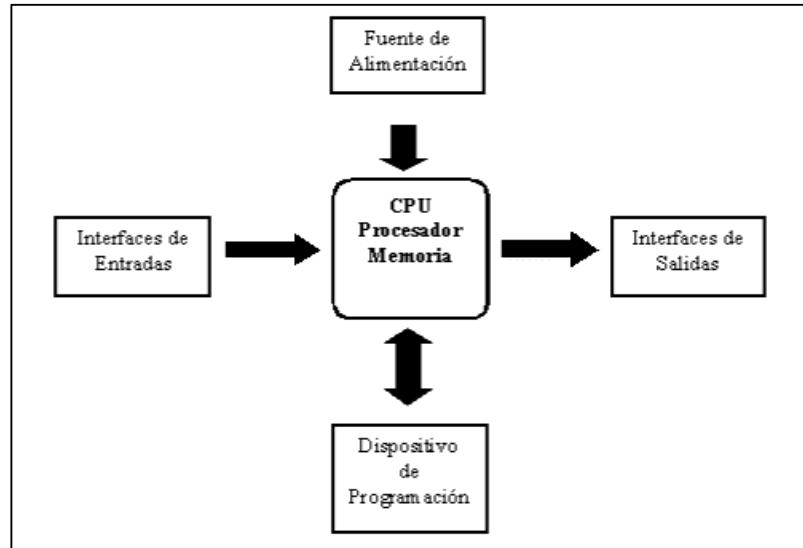


Fig 2: Estructura básica de un PLC

### 2.3.3 Ciclo de ejecución de un PLC

Al iniciar el ciclo la CPU lee el estado de las entradas, posteriormente ejecuta la aplicación empleando el último estado leído. Una vez completado el programa, la CPU ejecutará tareas internas de diagnóstico y comunicación. Al final del ciclo se actualizan las salidas. El tiempo de ciclo depende del tamaño del programa, del número de E/S y de la comunicación requerida. En la Figura 3, se muestra el ciclo de ejecución de un Controlador lógico programable.

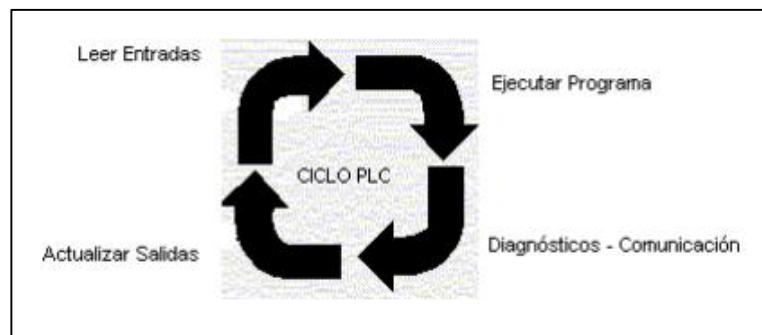


Fig 3: Ciclo de ejecución por el PLC

### 2.3.4 Lenguajes de programación para PLC

#### ✓ KOP

Sigue los principios del lenguaje "Esquema de contactos" (en inglés Ladder Logic). En el lenguaje KOP, las operaciones lógicas con bits operan con dos dígitos, 1 y 0. Estos dos dígitos constituyen la base de un sistema numérico denominado sistema binario. En el ámbito de los contactos y bobinas, un 1 significa activado ("conductor") y un 0 significa desactivado ("no conductor"). La nomenclatura que utiliza este lenguaje es el siguiente:

---   ---	Contacto normalmente abierto.
---  /  ---	Contacto normalmente cerrado.
---( )---	Bobina de relé, salida.

Las operaciones lógicas con bits interpretan los estados de señal 1 y 0, y los combinan de acuerdo con la lógica de Boole. Estas combinaciones producen un 1 o un 0 como resultado y se denominan "resultado lógico" (RLO). Las operaciones lógicas con bits permiten ejecutar las más diversas funciones.

#### ✓ AWL

El lenguaje de programación AWL (lista de instrucciones) es un lenguaje textual orientado a la máquina. Las diversas instrucciones equivalen a los pasos de trabajo con los que la CPU ejecuta el programa y éstas se pueden reunir en segmentos. Con este lenguaje se puede editar bloques S7 de forma incremental o crear su programa en una fuente AWL con un editor orientado a la fuente para compilarlo luego en bloques.

Las instrucciones AWL se dividen en:

OPERACION: indica la instrucción que se ha de realizar (ej. AND).

OPERANDO: indica una constante o dirección con la que debe trabajar la operación. Si se trata de una dirección se puede manejar en modo bit, byte o palabra.

#### ✓ FUP

Sigue los principios del lenguaje "Diagrama de funciones" fijados en la norma DIN EN-61131-3 (int. IEC 1131-3). Es un lenguaje gráfico que utiliza los cuadros del álgebra booleana para representar la lógica. Asimismo, permite representar funciones

complejas (por ejemplo, funciones matemáticas) mediante cuadros lógicos. Cuando hay mucha lógica booleana en serie suele ser más compacto y más fácil de ver el segmento completo.

## 2.4. SIEMENS SIMATIC

SIEMENS SIMATIC es el amplio portafolio de productos para todos los requisitos de la automatización manufacturera, desde el nivel de campo hasta el nivel de gestión y control de la producción. Así mismo SIEMENS SIMATIC presenta una familia de autómatas programables (PLC) compuesta de gran cantidad de componentes tales como, equipos de programación, módulos/tarjetas, paneles HMI, Sistemas SCADA, etc.

### 2.4.1 SIEMENS SIMATIC S7

#### 2.4.1.1 SIMATIC S7-200

El micro PLC SIMATIC S7-200 es una solución compacta y robusta para aplicaciones que no requieren mucha complejidad. El S7-200 combina un microprocesador, una fuente de alimentación integrada, circuitos de entrada y salida en un chasis compacto. (Ver Figura 4).



Fig 4: SIMATIC S7-200

El autómata S7-200 posee un único puerto de comunicaciones que permite conectar el autómata a otras unidades programables. Principalmente se utiliza para conectar la consola de programación o el PC con el autómata para cargar el programa de control.

La CPU S7-200 ofrece diversos métodos para garantizar que el programa, los datos del mismo y los datos de configuración de la CPU se almacenen de forma segura.

- La CPU dispone de una EEPROM no volátil para almacenar todo el programa, así como las áreas de datos de usuario y la configuración de la CPU.
- La CPU dispone de un condensador de alto rendimiento que conserva todo el contenido de la memoria RAM después de un corte de alimentación. Según el tipo de CPU, el condensador puede respaldar la memoria durante varios días.
- La CPU soporta un cartucho de pila opcional que prolonga el tiempo durante el que se puede respaldar la memoria RAM después de un corte de alimentación. El cartucho de pila se activa sólo cuando se descarga el condensador de alto rendimiento.

#### **2.4.2 SIMATIC S7-1200**

El SIMATIC S7-1200 (Ver Figura 5) es un controlador para tareas de lazo abierto y cerrado; en tareas de la fabricación de equipo mecánico y la construcción de la planta, es el sucesor del S7-200. El SIMATIC S7-1200 es el modelo modular y compacto para pequeños sistemas de automatización que requieran funciones simples o avanzadas para lógica, HMI o redes. Gracias a su diseño compacto, su bajo coste y sus potentes funciones, los sistemas de automatización S7-1200 son idóneos para controlar tareas sencillas.



Fig 5: SIMATIC S7-1200

El hardware SIMATIC S7-1200 ha sido diseñado especialmente para ahorrar espacio en el armario eléctrico. La interfaz integrada de SIMATIC S7-1200 hace posible una integración sin fisuras de los equipos de otros fabricantes. Los protocolos abiertos de Ethernet TCP/IP nativo e ISO-on-TCP hacen posible la conexión y la comunicación con varios equipos de otros fabricantes.

#### **2.4.3 SIMATIC S7-300**

El SIMATIC S7-300 es un PLC modular para aplicaciones pequeñas y medianas, el cual puede ser expandido sin problemas si la tarea se incrementa. Es un PLC de uso flexible a través de la fácil implementación de estructuras distribuidas y capacidad de networking versátil. (Ver Figura 6).



Fig 6: SIMATIC S7-300

El S7-300 contiene en el bastidor, una CPU y grupos de entradas y salidas. Normalmente contiene también procesadores de comunicación y módulos de funciones para tareas especiales, como la regulación de un motor. El grupo de Entradas y Salidas se comunica con el programa S7 a través de las direcciones de entrada y salida.

#### **2.4.4 SIMATIC S7-400**

El S7-400 es el PLC de mayor rendimiento de los controladores SIMATIC y permite implementar sin la menor dificultad tareas de automatización con TIA Portal. (Ver Figura 7).

El S7-400 es una plataforma de automatización para soluciones de sistema propias de la industria manufacturera y la ingeniería de procesos que se destaca, sobre todo, por su gran modularidad y sus enormes reservas de potencia. Algunas de las características del S7-400 son:

- Aplicación flexible gracias a la fácil implementación de estructuras descentralizadas (distribuidas).
- Posibilidades óptimas de comunicación y conexión en red.
- Cómodo de aplicar gracias a su facilidad de uso y a su instalación simple y sin necesidad de ventilación.

- Ampliable sin problemas en el caso de que aumenten las tareas.
- Ingeniería y diagnóstico: Sobre todo cuando se trata de implementar soluciones de automatización de gran amplitud con una parte de ingeniería considerable, la configuración y programación del S7-400 resulta muy eficiente con las herramientas de ingeniería SIMATIC. Para ello se dispone, por ejemplo, de lenguajes de alto nivel como SCL y herramientas de ingeniería gráficas para controles secuenciales, gráficos de estado y esquemas tecnológicos.



Fig 7: SIMATIC S7-400

#### 2.4.5 SIMATIC S7-1500

El SIMATIC S7-1500 (ver Figura 8) es un sistema modular, escalable y de aplicación universal con grado de protección IP20. La solución de sistema para una variedad de aplicaciones de automatización de gran complejidad.



Fig 8: SIMATIC S7-1500

El S7-1500 posee comunicación potente:

- PROFINET IO (switch de 2 puertos) como interfaz estándar.

- Interfaz PROFINET adicional opcional, por ejemplo, para el aislamiento de la red de comunicación.
- Ampliable con módulos de comunicaciones para sistemas de bus y conexiones punto a punto.

Las funciones tecnológicas integradas al S7-1500 son:

- Numerosas funciones Trace para todas las variables de CPU para el diagnóstico en tiempo real y para la detección de errores esporádica; para una puesta en marcha efectiva y una rápida optimización de accionamientos y regulaciones.
- Numerosas funcionalidades de regulación, como bloques configurables sencillos para la optimización automática de los parámetros de regulación, para una calidad de regulación óptima.
- Funciones adicionales mediante módulos tecnológicos utilizables: por ejemplo, conteo rápido, captación de la posición o funciones de medición para señales de hasta 1 MHz.

## 2.5. TIA PORTAL

TIA Portal (Totally Integrated Automation Portal) es el sistema de Automatización que SIEMENS ha sacado al mercado para integrar desde una sola plataforma de programación sus productos de automatización, integra el software de programación Step7 y WinCC, lo cual nos facilita y simplifica la programación de sistemas de automatización entre PLCs y Pantallas, como también la creación de interconexiones en red.

Algunas de las características del TIA Portal son:

- Esfuerzos de formación reducidos.
- Acceso directo a las herramientas más importantes.
- Idéntica ingeniería para tareas de seguridad y tareas estándar.
- En el mismo momento en que se inicia un proyecto, los usuarios pueden elegir entre una vista del portal en la que se guía al usuario paso a paso o una vista del proyecto con acceso directo a todas las herramientas más importantes.

Todos los editores de software contenidos en el TIA Portal están diseñados siguiendo las mismas pautas de diseño y navegación. Tanto si se trata de un editor para configurar hardware, efectuar programaciones lógicas, parametrizar un convertidor de frecuencias o diseñar pantallas de la HMI, todos los entornos comparten un diseño similar e igual de intuitivo. Las funciones, propiedades y librerías se despliegan de forma automática con la vista más intuitiva y apropiada para cada ocasión.

El TIA Portal es una arquitectura de software avanzada diseñada a partir de la base de un esquema de navegación muy sencillo. La ergonomía sofisticada asegura la máxima eficiencia y un importante ahorro de tiempo. Todos los editores están claramente ordenados, son personalizables y se puede acceder fácilmente a ellos. El usuario disfrutará en todo momento de una visión completa de todo el proyecto sin necesidad de adentrarse en menús complicados o estructuras de ventanas.

La configuración de todo el hardware y redes tiene lugar desde una perspectiva completamente gráfica de redes y dispositivos. De esta manera, los controladores, los equipos HMI o también los ordenadores y accionamientos se conectan a través de una configuración gráfica y sencilla de las conexiones.

## 2.6. SISTEMAS DE CONTROL

### 2.6.1 SISTEMAS DE CONTROL EN LAZO ABIERTO

En ellos la señal de salida no influye sobre la señal de entrada. La exactitud de estos sistemas depende de su programación previa. Es preciso prever las relaciones que deben darse entre los diferentes componentes del sistema, a fin de tratar de conseguir que la salida alcance el valor deseado con la exactitud prevista.

El diagrama de bloque de un sistema en lazo abierto es:



Fig 9: Lazo de control abierto

### 2.6.2 SISTEMAS DE CONTROL EN LAZO CERRADO

El control retroalimentado o a lazo cerrado tiene la característica de que medimos cierta cantidad de la salida y luego la comparamos con un valor deseado, y el error resultante lo utilizamos para corregir la salida del sistema.

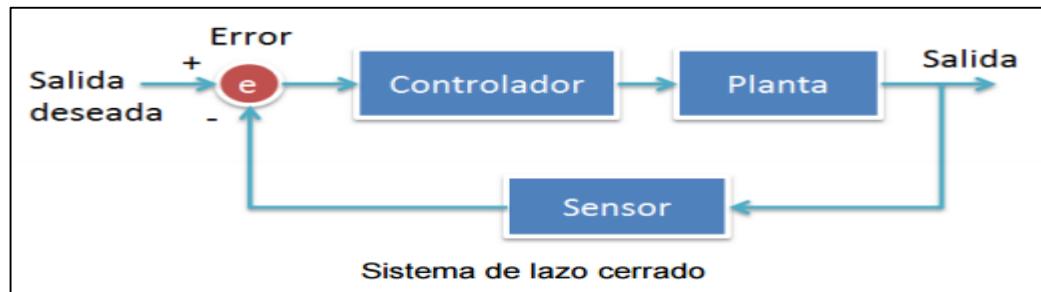
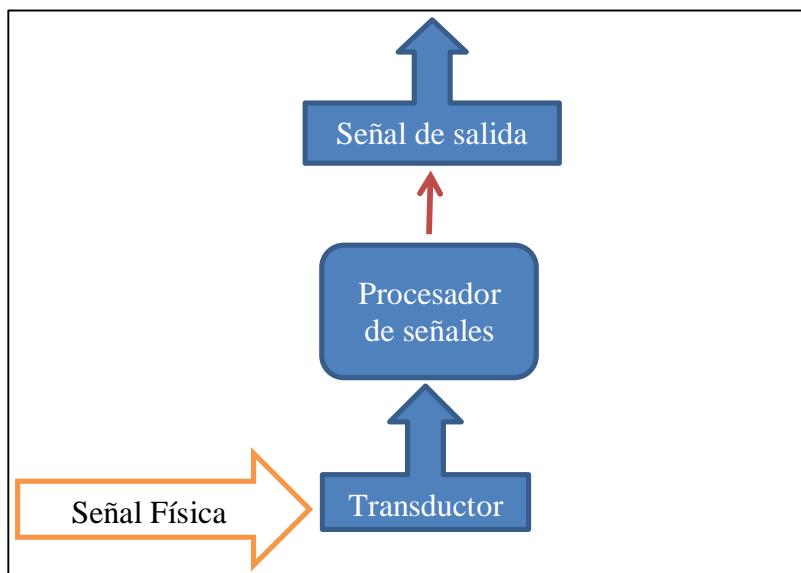


Fig 10: Lazo de control cerrado

## 2.7. Tecnologías de comunicación industrial

Los equipos que encontramos usualmente en campo (sensores, actuadores) no suelen, en un principio, producir o recibir señales que sean usables. Es por ello que en la industria es fundamental disponer de tecnologías de comunicación disponibles para poder transducir la señal recibida o intercambiada entre los diferentes elementos de campo y controladores en valores inteligibles, los cuales sean posibles de transportar. Entre las herramientas que se utilizan para poder transportar información de un dispositivo a otro, los buses de campo son los que han demostrado ser los más eficaces en un proceso automatizado. En toda comunicación siempre deben existir, al menos, tres elementos fundamentales (ver Figura 11), estos son: transductor, procesador de señal y señal de salida.



Fuente: Elaboración propia

Fig 11: Elementos fundamentales de comunicación

### 2.7.1 Comunicación Analógica

En los tipos de comunicación analógica disponible, podemos encontrar:

Señal de 4 – 20 mA: Señal de corriente con valores continuos en el tiempo que representan 0 – 100% en el rango de un instrumento de campo, donde 4 mA sería el valor más bajo del rango y 20 mA el más alto. Además, tiene un 0 flotante (4mA) el cuál puede servir de alarma si muestra un valor inferior a 4mA y superior a 20 mA.

### 2.7.2 Comunicación Digital

Tipo de comunicación en la que se tienen cambios en pasos discretos (señal no continua). Esta señal se obtiene a partir de señal analógica, tomando un número de muestras por segundo causando que la señal obtenida sea discreta.

## 2.8. Modelo OSI

El modelo OSI se divide en las siguientes capas:

- ✓ **Capa Física:** “Especifica las características mecánicas y eléctricas del sistema físico de transporte (cable de par trenzado, cable coaxial, etc.) y de las interfaces que permiten la conexión física de los equipos a dicho sistema de transporte. Define las tecnologías aceptadas y el modo de emisión.”<sup>1</sup>(Guerrero / Yuste / Martínez, 2008).
- ✓ **Capa de Enlace de Datos:** “Establece la forma de agrupar los datos en paquetes de longitud adecuada y añade los mecanismos necesarios para poder controlar la transmisión de información y detectar y corregir errores. Debe realizar el control de envío y recepción de información en el bus, teniendo en cuenta que puede haber más de un interlocutor, y debe garantizar el acceso a todos los equipos conectados a la red.”<sup>2</sup>(Guerrero / Yuste / Martínez, 2008).
- ✓ **Capa de Red:** “La capa de red se ocupa del direccionamiento a través de sistemas mediante técnicas de encaminamiento (routing) y de control de flujo. Aquí se aplican algoritmos de control de tráfico y optimización, de manera que un mensaje puede estar fragmentado en varios paquetes que no tienen por qué seguir el mismo camino. Cada paquete seguirá el camino óptimo determinado por los controladores de la red, atendiendo a variables tales como la disponibilidad de equipos y el estado del tráfico de la red en cada momento.”<sup>3</sup>(Guerrero / Yuste / Martínez, 2008).

---

<sup>1</sup> Página 25

<sup>2</sup> Página 25

<sup>3</sup> Página 28

- ✓ **Capa de Transporte:** “Tiene la misión de garantizar un enlace fiable entre terminales. Divide la información en paquetes manejables por el sistema de transmisión. Controla la gestión de los paquetes de información (orden de envío y recepción, formatos de transmisión, peticiones de reenvío en caso de error, etc.). Esta capa no es indispensable en el caso de un bus de campo, pues sus servicios ya los soportan las capas 1, 2 y 3.”<sup>4</sup>(Guerrero / Yuste / Martínez, 2008).
- ✓ **Capa de Sesión:** “Administra las comunicaciones entre equipos. Se ocupa de coordinar las comunicaciones mediante el establecimiento de comunicación, su mantenimiento y su finalización de una forma ordenada. Al igual que la capa 4, es necesaria en el caso de un bus de campo”<sup>5</sup>(Guerrero / Yuste / Martínez, 2008).
- ✓ **Capa de Presentación:** “Realiza la conversión de datos a un formato común, entendible por todos los equipos. En este nivel deberían situarse las normas que definen los “Aparatos Virtuales” que respetarían las mismas órdenes y la misma codificación de las variables, haciendo la aplicación transparente para el usuario. Para los buses de campo, no hay formas oficiales para la representación de las informaciones del proceso.”<sup>6</sup>(Guerrero / Yuste / Martínez, 2008).
- ✓ **Capa de Aplicación:** “Capa de campo libre para los fabricantes y usuarios. Localiza las funciones de usuario y los servicios de comunicación. Presta servicios al usuario, que comprenden la interacción directa con los procesos de aplicación, manejando las transferencias de ficheros, base de datos, correo electrónico, etc.”<sup>7</sup>(Guerrero / Yuste / Martínez, 2008).

## 2.9. Protocolos de Comunicación

- ✓ **Hart:** Siglas de Highway Adressable Remote Transducer desarrollado por Rosemount, hoy en día parte de Emerson Process Management, en los años 80's. Este tipo de protocolo se superpone en la señal de corriente de 4-20 mA, mediante técnica de modulación FSK (Frequency Shift Keying).
- ✓ **Foundation Fieldbus:** Protocolo de comunicación digital desarrollado por la organización del mismo nombre. Creado con el fin de tener un bus

---

<sup>4</sup> Página 29

<sup>5</sup> Página 29

<sup>6</sup> Página 29

<sup>7</sup> Página 29

de campo único y abierto para conectar diferentes dispositivos de control de proceso en una sola red.

Foundation Fieldbus se divide en tres capas:

- ❖ Capa Física: Se basa en IEC 11158-2, compatible con Profibus-PA. Maneja las conexiones físicas necesarias para la comunicación. Este segmento puede ser:
  - H1: Opera a 31.25 Kbits/s para integrar dispositivos de control de procesos. H1 está optimizado para aplicaciones de control de procesos tradicionales, usando par trenzado con transmisión Half-Duplex.
  - HSE: Opera a 100 Mbits/s, pudiendo llegar a 1Gb/s. H2 fue diseñado para la transmisión de datos a gran escala e integración de sistemas.
- ❖ La Pila de Comunicaciones: maneja la comunicación en una red FOUNDATION Fieldbus, manteniendo solicitudes de mensajes salientes, recibiendo mensajes entrantes, programa el tiempo en la red para la repartición de los mensajes y negocia mandando mensajes de red no programados. Abarca los niveles de capa 2 al 7.
- ❖ La capa de usuario: controla los elementos de interfaz humano-máquina, como la configuración de un transmisor y las alarmas.
- ✓ **Profibus**, Según Guerrero / Yuste / Martínez (2008), “Profibus es un protocolo que proporciona una solución de uso general para las tareas de comunicación Maestro-Esclavo y Perfiles de Protocolo de las industrias de Automatización de Procesos, Seguridad y Control de Movimiento.” <sup>8</sup>

Dentro de Profibus, hay tres familias diferenciadas pero compatibles entre sí:

- ❖ Profibus-DP (Descentralized Periphery): “Se dispuso en la Parte 3 de la Norma DIN E 19245 y se integró en la Norma Europea de bus de campo EN 50170. Ajustado a los requisitos de intercambio de datos más rápido y eficiente requerido por los elementos de automatización (Actuadores, Sensores, Entradas y Salidas Digitales y Analógicas)” <sup>9</sup>(Guerrero / Yuste / Martínez, 2008).

Sus características principales son:

- Acceso al bus por Paso de testigo entre Maestros y Maestro-Esclavo con el resto de estaciones.
- Permite sistemas mono Maestro o multi Maestro.
- Comunicación cíclica Maestro-Esclavo.
- Comunicación Punto a punto o multicast.

---

<sup>8</sup> Página 23

<sup>9</sup> Página 23

- Tiempo de ciclo típico: 5 a 10 ms.
  - Hasta 32 estaciones por segmento.
  - Hasta 127 estaciones en total, con 0 a 246 bytes de datos de usuario.
  - Velocidad: 9.6 Kbaud a 12 Mbaud.
  - Los módulos de bus pueden conectarse y desconectarse en marcha.
  - Transmisión: RS-485 o por fibra óptica.
  - El bus se puede ampliar mediante repetidores.
  - La topología de un segmento es lineal (hasta 1200 m). Con repetidores, se puede elaborar una estructura de árbol.
  - Hasta 12 km con cables y hasta 23.8 km con fibra óptica.
- ❖ Profibus-PA (Process Automation): “Variante de Profibus para la automatización en la ingeniería de procesos. Originalmente se especificó bajo la ISP 3.0 (Proyecto de Sistemas Interoperativos) y pasó a llamarse Profibus-ISP. Fue en 1995 cuando su nombre cambió a Profibus-PA. Su uso específico es en Zonas Ex, seguridad intrínseca”<sup>10</sup>(Guerrero / Yuste / Martínez, 2008).
- Las características de Profibus-PA son:
- Transmisión digital síncrona
  - Velocidad: 31,25 Kbit/s.
  - Alimentación de potencia (VDC) en el cable de bus.
  - Topología Lineal, Árbol y Estrella.
  - Hasta 32 estaciones por segmento.
  - Longitud de segmento hasta 1900 m (sin repetidor).
  - Bus expandible con un máximo de 4 repetidores por segmento.
- ✓ **Industrial Ethernet:** Constituye una red eléctrica sobre la base de una línea coaxial apantallada, un cableado Twisted Pair o una red óptica sobre la base de un conductor de fibras ópticas. Industrial Ethernet está definida por el estándar internacional IEEE 802.3. En el sistema de comunicación abierto SIMATIC NET, Industrial Ethernet es la red para el nivel de control y para el nivel de célula.

---

<sup>10</sup> Páginas 233

### 3. HIPOTESIS

#### 3.1 General

Un sistema de control de arranque remoto de las bombas de agua y llenado de las cisternas de la planta de tratamiento de agua permitirá reducir los tiempos de respuesta en la activación de las bombas y en el llenado de cisternas.

**Variable independiente:**

Sistema de control a distancia.

**Variable dependiente:**

Reducción de tiempos de respuesta.

#### 3.2 Operacionalización de las variables

Operacionalización de la variable independiente

VARIABLE	DEFINICION CONCEPTUAL	DEFINICION OPERACIONAL	INDICADORES	INSTRUMENTO	FORMULA	UNIDADES DE MEDIDA
Sistema de control a distancia	Son aquellos que permiten controlar equipos remotamente	Conjunto de equipos que permiten controlar un sistema de control en forma remota	Variables a monitorear	P&ID	-----	-----
			Equipos a controlar	P&ID	-----	-----
			Instrumentos	Hoja técnica del equipo	-----	-----

Fuente: Elaboración Propia  
Tabla 2: Variable Independiente

## Operacionalización de la variable dependiente

VARIABLE	DEFINICION CONCEPTUAL	DEFINICION OPERACIONAL	INDICADORES	INSTRUMENTO	FORMULA	UNIDADES DE MEDIDA
Reducción de tiempos de respuesta	Disminución de los tiempos de activación y desactivación de equipos	La disminución de los tiempos en que las bombas se activa y desactivan	Incidencias registradas en el bombeo de agua hacia planta de tratamiento	Reporte semanal	-----	-----
			Tiempo de atención ante una activación o desactivación	Reporte semanal	-----	Minutos

Fuente: Elaboración Propia  
 Tabla 3: Variable Dependiente

## 4. OBJETIVOS

### 4.1 General

- Diseñar un sistema de control de arranque remoto para reducir los tiempos de respuesta en la activación de las bombas de agua y en el llenado de las cisternas de la planta de tratamiento de agua del Fundo Muchik de la empresa Danper.

### 4.2 Específicos

- Determinar la tecnología que permita realizar el control a distancia.
- Supervisar el llenado de las cisternas de agua.
- Seleccionar los equipos adecuados para el control de las bombas y el nivel del tanque
- Disminuir el tiempo de respuesta en la activación de las bombas y llenado de tanque.

## 5. MATERIAL Y PROCEDIMIENTOS

### 5.1. Materiales:

#### 5.1.1 Reporte de tiempo de respuesta para detener el llenado de cisternas.

De acuerdo a las encuestas realizadas al personal de mantenimiento sobre los tiempos que tardan en realizar el control de llenado de las cisternas se sabe que éstas tardan aproximadamente en el día 20 minutos y por la noche de 40 a 90 minutos. Esto se debe a que por las noches la iluminación existente es deficiente, la zona de tránsito no es adecuada y además el personal está realizando diversas tareas por lo tanto pierde la noción del tiempo.

A continuación se presenta un reporte de tiempos de respuesta durante 30 días.

Día	Respuesta Diurna en minutos	Respuesta Nocturna en minutos
1	20	86
2	20	50
3	23	71
4	22	63
5	18	78
6	22	48
7	21	73
8	18	86
9	20	48
10	23	44
11	18	44
12	21	65
13	21	45
14	21	40
15	23	54
16	20	68
17	17	40
18	20	90
19	20	49
20	20	55
21	19	42
22	22	68
23	18	64
24	17	57
25	23	45
26	17	44
27	18	89
28	20	50

29	18	77
30	23	41
	20.1	59.13333333

Fuente: Elaboración Propia  
Tabla 4: Tiempos de respuesta

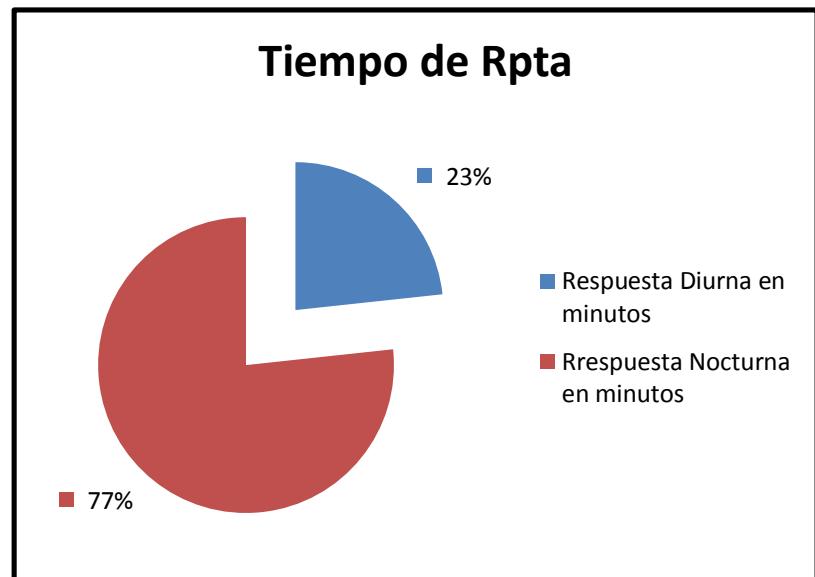


Fig 12: Porcentajes de tiempo de respuesta al llenando de cisternas

### 5.1.2 Planos de ubicación de las cisternas y las bombas

En la presente imagen se muestra la ubicación de los pozos donde se bombea el agua hacia la planta de tratamiento.

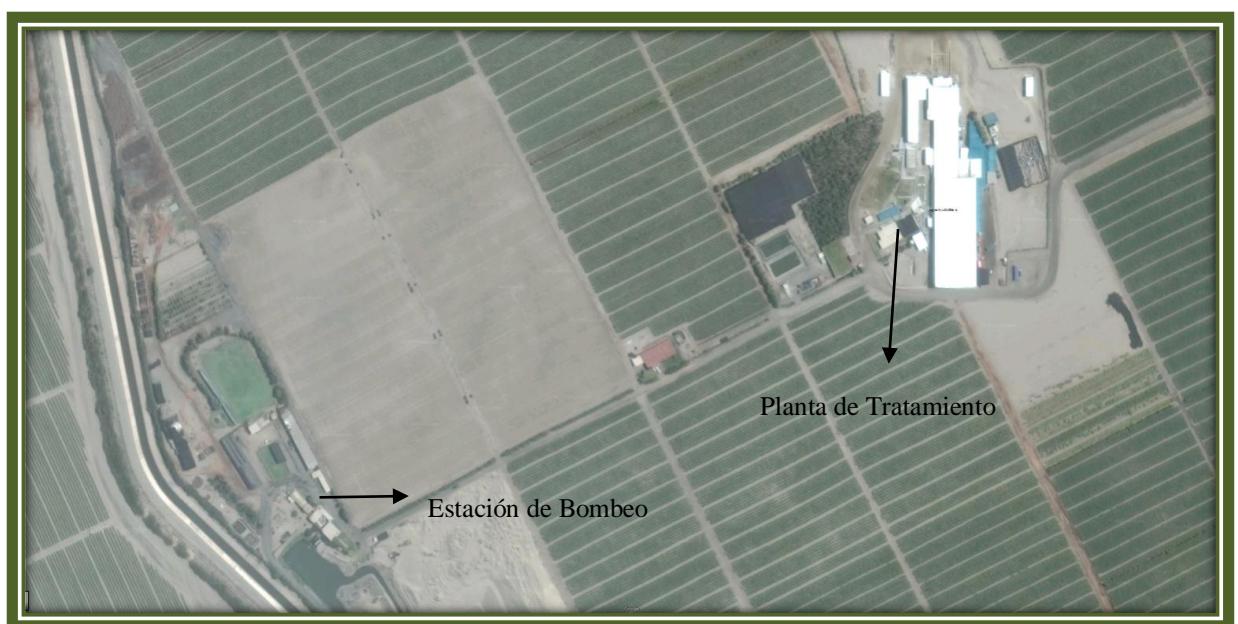


Fig 13: Ubicación de las zonas a automatizar



Fig 14: Distancia de la zona de bombeo hasta la zona de tratamiento



Fig 15: Zona de Cisternas

### **5.1.3 Profundidad de los pozos y cisternas**

De acuerdo a los datos proporcionados por el personal de mantenimiento se tiene que:

- Profundidad del pozo de la zona de bombeo es de 5 metros.
- Profundidad de las cisternas es de 4 metros.

### **5.1.4 Equipos presentes**

Descripción	Potencia	Cantidad	Ubicación
Motores trifásicos 380V de bombas de pozo	20 Hp	2	Zona de bombeo
Motores trifásicos 380V de Cisternas	15 Hp	3	Zona de llenado
Motores trifásicos 380V de Cisternas	20 Hp	1	Zona de llenado
Variador de velocidad	25 Hp	1	Zona de llenado
Tablero de mando		2	Zona de llenado Zona de Bombeo
Válvulas		7	Zona de llenado Zona de Bombeo Planta de Tratamiento

Tabla 5: Equipos presentes

## **5.2. Procedimiento**

### **5.2.1 Determinación de obstáculos**

Como se observa en la Figura 16, no existe obstáculo entre la estación de bombeo y la planta de tratamiento de agua, además se consultó con el personal de mantenimiento si es que a futuro se pretende realizar alguna edificación en esa zona y la respuesta fue que no, porque es una zona destinada para sembrar.



Fig 16: Determinación de Obstáculos

### 5.2.2 Requerimientos de los equipos

#### 5.2.2.1 Determinación de la tecnología para la comunicación remota

Debido que la zona es de cultivo podrían crecer árboles en la línea de vista, lo cual desvanecería la señal mediante un radio enlace.

La empresa Danper posee una línea de telefonía celular corporativa de un determinado proveedor, por lo que es más favorable utilizar la red celular para el control de las bombas.

Como se indicó anteriormente en el numeral 5.2.1, no hay obstáculos entre la zona de bombeo y la planta de tratamiento de agua, la distancia es de 566 m.

#### 5.2.2.2 Requerimientos para el control de los pozos de bombeo

Para realizar el control de los pozos de bombeo, es necesario el uso de variadores de velocidad de carga variable, ya que esto depende del requerimiento de volumen de agua que requiera la planta de procesamiento.

Se debe tener un control manual en caso que el sistema de comunicaciones caiga.

- Variador de velocidad de 20 Hp.
- Tensión de I/O 380V.
- Control de carga variable.
- Controlado por corriente y voltaje.
- Controlador de campo.
- Panel de visualización.
- Tablero de control para acción manual.

#### **5.2.2.3 Requerimientos para la planta de tratamiento**

En la planta de tratamiento debe existir una válvula Check para evitar la contrapresión y forzar al variador, en la tubería principal debe tener un sensor de presión a fin de determinar si se ha producido alguna ruptura.

#### **5.2.2.4 Requerimientos para el llenado de las cisternas**

Para el control de llenado de las cisternas se debe tener en cuenta lo siguiente:

- Detección de cisterna llena.
- Cerrado de la válvula de dosificación de forma manual y automática.
- Visualización actual de la altura de agua en la cisterna.
- Cálculo del volumen total en las cisternas.
- Control de la dosificación hacia planta en forma manual y automática.
- Censado de la presión de descarga a planta.
- Diámetro de tubería 2".

### 5.3. Plano de instrumentación

De acuerdo a los requerimientos en 5.2 se propone la siguiente distribución de instrumentos.

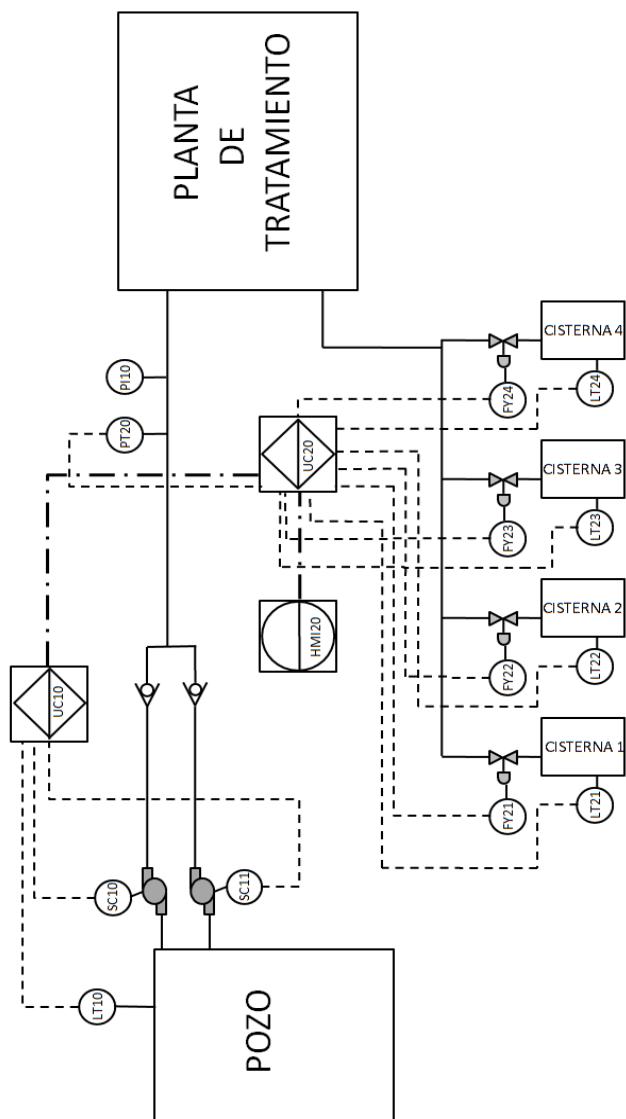


Fig 17: Plano de instrumentación

## 5.4. Selección de los equipos

### 5.4.1 Selección del controlador

Para el controlador del proceso se ha elegido el PLC S7-1200 de la marca Siemens el cual cuenta con las siguientes características:

Carácteristicas CPU	CPU 1212C	CPU 1214C	CPU 1215C	CPU 1217C
Alimentación:	3 tipos: DC/DC/DC, AC/DC/RLY, DC/DC/RLY (Alimentación/Entradas/Salidas)			DC/DC/DC
Características únicas:	Reloj de tiempo real integrado, libre de mantenimiento, no requiere baterías			
Rango temp. Trabajo		-20°C a + 60°C		
Velocidad de ejecución:				
- Operación Booleana		0.085 us/ instrucción		
- Operación "Move word"		1,7 us/ instrucción		
Memoria de trabajo (Internas)	50 KB	75 KB	100 KB	125 KB
Memoria de carga (Internas)	1 MB	4 MB	4 MB	4 MB
Memoria remanente (internas)	10KB	10KB	10KB	10 KB
E/S Digitales Integradas	8 Entradas/6 Salidas	14 Entradas/10 Salidas	14 Entradas/10 Salidas	
E/S Análogas Integradas		2 Entradas (0-10vdc)	2 Entradas (0-10vdc) / 2 salidas (0 - 20mA)	
Cartucho de señales		1 Máx.		
Módulos de señales	2 Máx.	8 Máx.	8 Máx.	8 Máx.
Máx. E/S - Digitales	82	284	284	284
Máx. E/S - Análogas	19	67	69	69
Contadores rápidos:	5 total (6 con SB)	6 total	6 total	6 total
- Fase simple	3@100 kHz y 1@30 kHz (ó 2@30kHz con SB)	3@100 kHz y 3@30 kHz	3@100 kHz y 3@30 kHz	1@1MHz, 3@100 kHz y 3@30 kHz
- Fase doble cuadratura	3@80kHz y 1@20kHz (ó 2@20kHz con SB)	3@80kHz y 3@20kHz	3@80kHz y 3@20kHz	1@1MHz, 3@80kHz y 1@20kHz
Salidas de pulsos	4 @ 100 kHz (unicamente Salidas DC)			4@1MHz
Interrupciones cíclicas	4 en total con resolución 1ms			
Interrupciones por flancos	8 ascend. y 8 descend	12 ascend. y 12 descend.	12 ascend. y 12 descend.	12 ascend. y 12 descend.
Lazos PID		16		
Puertos de comunicación	5 máx (por medio de módulos)	5 máx (por medio de módulos)	6 máx (por medio de módulos)	6 máx (por medio de módulos)
Módulos de comunicación		3 módulos máximo por configuración		
Puerto Industrial ETHERNET Integrado	1	1	2	2
- Protocolos:	Industrial Ethernet estándar - TCP/IP - ISO on TCP - UDP - Modbus TCP/IP - S7 como servidor			
Puerto serial Industrial	Serial RS232, RS485, Asi, PROFIBUS DP, DNP3 por medio de módulo de comunicación.			
- Protocolos:	USS - Modbus RTU maestro/slavo, ASCII,ASI, PROFIBUS maestro, PROFIBUS esclavo, DNP3 y Free port.			

Fuente: Siemens

Tabla 6: Características del controlador

De las tres series se ha elegido el que tiene CPU 1215C AC-DC, lo que permite tener la fuente integrada y además tiene 2 entradas y salidas analógicas.

Cuenta con puerto Profinet nativo y puede manejar hasta 16 lazos PID



Fig 18: S7 1200 CPU 1215

#### **5.4.2 Selección de los módulos analógicos**

Se ha seleccionado el modulo SM 1231 que cuenta con 8 entradas analógicas configurables en corriente y tensión (+/-10V, +/-5V, +/-2.5V, 0..20mA x 12 BIT + Signo)



Fig 19: Modulo analógico

#### **5.4.3 Selección del módulo para el equipo de comunicaciones**

Para las comunicaciones se ha seleccionado la marca Siemens debido a que la empresa Danper en sus fundos está estandarizado sus equipos a esta marca.

- CP 1242-7, módulo GPRS para el S7-1200.



Fig 20: Modulo de comunicaciones

- Antena ANT 794-4MR de banda cuádruple, omnidireccional con cable de 5m.



Fig 21: Antena

#### 5.4.4 Selección del panel HMI

Se ha seleccionado una pantalla táctil de la marca Siemens de 7 pulgadas a color que soporta comunicación Profinet.

- SIMATIC HMI KTP700 COMFORT, COMFORT PANEL, TOUCH OPERATION, 7" WIDESCREEN TFT-DISPLAY, 16 MIL. COLORS, PROFINET INTERFACE, MPI/PROFIBUS DP INTERFACE, 12 MB USER MEMORY, WINDOWS CE 6.0, CONFIGURABLE FROM WINCC COMFORT V11



Fig 22: Panel HMI

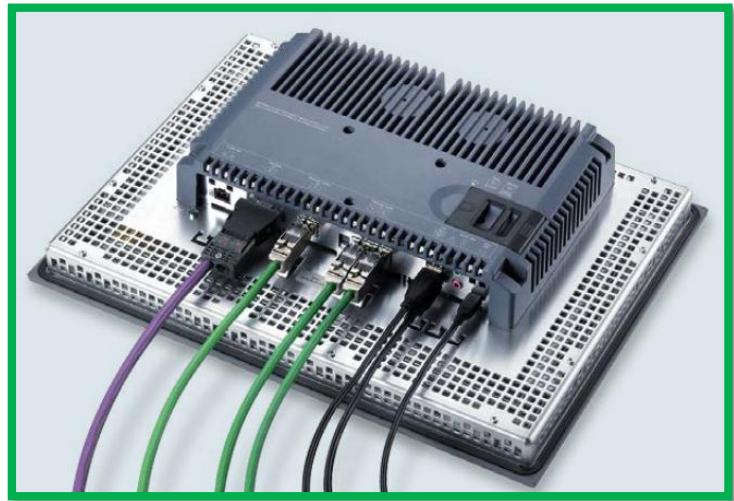


Fig 23: Conexión de panel HMI

#### 5.4.5 Selección del Switch

Para tener comunicación entre el panel HMI y el PLC además de integrarse a una red Futura se hace necesario la utilización de un Switch con un mínimo de 3 puertos, por tal motivo se seleccionó un Switch industrial que sea compatible con el PLC S7-1200.

- CSM 1277, Switch industrial Ethernet no administrable, 10/100MBIT/ S. 4 puertos RJ45, alimentación 24VDC. LED diagnóstico



Fig 24: Switch Industrial

Connectors	
Attachment of end devices or network components over twisted pair	4 x RJ-45 sockets with MDI-X pinning 10/100 Mbps (half/ full duplex), floating
Connector for power supply	3-pin plug-in terminal block
Electrical data	
Power supply	Power supply 24 V DC (limit: 19.2 to 28.8 V DC) safety extra-low voltage (SELV) Functional ground
Power loss at 24 V DC	1.6 W
Current consumption at rated voltage	70 mA
Oversupply protection at input	PTC resettable fuse (0.5 A / 60 V)
Permitted cable lengths	
Connection over Industrial Ethernet FC TP cables 0 – 100 m	Industrial Ethernet FC TP standard cable with IE FC RJ-45 plug 180 or over Industrial Ethernet FC outlet RJ-45 with 0 - 90 m Industrial Ethernet FC TP standard cable + 10 m TP cord
0 – 85 m	Industrial Ethernet FC TP marine/trailing cable with IE FC RJ-45 plug 180 or 0 - 75 m Industrial Ethernet FC TP marine/trailing cable + 10 m TP cord
Learnable MAC addresses / Aging Time	
Learnable MAC addresses	2048
Aging time	280 seconds
Permitted ambient conditions	
Operating temperature	0°C through +60°C
Storage/transport temperature	-40°C through +70°C
Relative humidity in operation	< 95% (no condensation)
Operating altitude	2000 m at max 56 °C ambient temperature 3000 m at max. 50 °C ambient temperature
Immunity	EN 61000-6-2
Emission	EN 61000-6-4
Degree of protection	IP20
MTBF	
MTBF	273 years

Fuente: Siemens

Tabla 7: Características del Switch

#### 5.4.6 Selección del variador de velocidad

Como se indica en el punto 5.2.2.2 el variador debe tener una potencia mínima de 20Hp, se optó por un variador SINAMICS G120 25Hp de la marca Siemens. Consta de la unidad de potencia, unidad de control y reactancia para la protección de red.

- Variador Sinamics G120 25Hp Sinamics G120; power module pm240 sin filtro con freno chopper integrado; 3AC 380-480V +10/-10% 47- 63Hz; potencia alta sobrecarga: 18,5kW; a 200% 3s,150% 57s,100% 240s temperatura ambiente -10 hasta +50 °C; potencia baja sobrecarga: 22kW; a 150% 3s,110% 57s,100% 240s.
- Sinamics G120; control unit cu240e-2 pn Tipo E safety integrated sto profinet; 6di, 3do, 2ai, 2ao, max 1fdi; interfaz ptc/kty interfaz usb- y sd/mmc grado de protección IP20;

temperatura ambiente 0 hasta +50 °C; sin power module y sin bop.

- Sinamics reactancia de red para power module fsd; 18,5 y 22 kW, potencia de tipo sobre la base, montable en muebles



Fig 25: Unidad de Potencia



Fig 26: Unidad de control



Fig 27: Reactancia

#### 5.4.7 Selección del sensor de nivel

Se ha seleccionado un sensor ultrasónico de la marca MILLTRONICS que tiene un alcance máximo de 5m lo cual cumple con los requerimientos y tiene las siguientes especificaciones:

- Tensión de alimentación 12 a 28V DC, max 0.1A.
- Corriente de bucle máximo 4 a 20 mA.
- Condiciones ambientales: Ubicación: interior / exterior.
- Altitud: max. 2000 m.
- Temperatura continua: -40 a +60°C (-40 a +140°F) ambiente: -20°C (-5°F) con montaje metálico.
- Humedad relativa: apto para aplicaciones en exterior (caja Tipo 4X / NEMA 4X / IP65).
- 0,25 a 5 m (0,8 a 16,4 pies) (Líquidos únicamente).
- Ángulo de emisión: 10° a -3 dB.
- Display / indicador: Tres dígitos de 9 mm (0,35") para lectura de la distancia, en metros, entre la cara del transductor y el material.
- Rango: 4 - 20 mA.
- Span / alcance: proporcional o inversamente proporcional.
- Precisión: 0,25% del rango.
- Resolución: 3 mm (0,125").
- Carga: máxima 600 ohmios, suministro eléctrico 24 V DC.
- Grado de protección IP65.



Fig 28: Sensor de nivel

#### 5.4.8 Selección de la válvula de control

Cada cisterna está alimentada a través de una tubería de 2" por lo que será necesaria una válvula pinch por cada cisterna.

Se ha elegido la marca Hunter.

Características:

- Diseño de junta de diafragma con doble reborde para un rendimiento superior sin pérdida.
- Los solenoides tipo "latch" DC admiten los programadores Hunter con pilas.
- Solenoide encapsulado de 24VCA con émbolo cautivo para un mantenimiento sin problemas.
- Temperatura: 66 °C.



Fig 29: Válvula de control

#### **5.4.9 Selección del sensor de presión**

El sensor de presión debe tener un rango hasta 5 bar, se ha seleccionado un sensor de la marca Schneider Modelo XMLG010Q21TQ y tiene las siguientes características:

- Capacidad de presión 10bar.
- Presión máxima permitida 22 bar.
- Salida de 4 a 20 mA.
- Conexión al fluido G 1/4 macho.
- Fluido controlado.

Fluido corrosivo -15...125 °C

Aqua salada -15...125 °C

Aqua fresca -15...125 °C

- Grado de protección IP65.



Fig 30: Sensor de Presión

#### 5.4.10 Cálculo del tiempo de respuesta del sistema

Para el cálculo del tiempo de respuesta del sistema podemos indicar que en la hoja de datos del PLC en el numeral 5.4.1 nos indica que para la ejecución de una instrucción Move el tiempo es de 1.7uS, además los sensores de nivel tienen la opción de enviar los datos censados en forma inmediata tal como lo indica su hoja de datos.

La válvula tiene una velocidad de respuesta de 50mS.

$$T_r = N(1.7\mu S) + 50mS = 50 + N(0.0017)mS$$

*N = numero de instrucciones*

El número de instrucciones máximo para que el tiempo aproximado de respuesta se de 50ms es:

$$N \leq \frac{5}{0.0017} = 2941 \text{ instrucciones}$$
$$T_r \cong 50mS$$

Para que el tiempo de respuesta se duplique y llegue a 100ms el número de instrucciones máximo se debe de multiplicar por 10.

$$2941 \leq N \leq 29410 \text{ instrucciones}$$
$$50mS \leq T_r \leq 100mS$$
$$T_{r_{MAX}} = 100mS$$

## 5.5. RESULTADOS

### 5.5.1. Los equipos seleccionados fueron:

ITEM	DESCRIPCIÓN	CARACTERÍSTICAS	CANTIDAD
1	CONTROLADOR LÓGICO PROGRAMABLE	CPU 1215C AC-DC, 2 E/S ANALÓGICAS, 14 Entradas y 10 Salidas Discretas	2
2	MÓDULO DE ENTRADA ANALÓGICO	SM 1231 que cuenta con 8 entradas analógicas configurables en corriente y tensión (+/-10V, +/-5V, +/-2.5V, 0..20mA x 12 BIT + Signo)	1
3	MÓDULO DE COMUNICACIONES GPRS	CP 1242-7, módulo GPRS para el S7-1200 Antena ANT 794-4MR de banda cuádruple, omnidireccional con cable de 5m	2
4	PANEL HMI	Ø SIMATIC HMI KTP700 COMFORT, COMFORT PANEL, TOUCH OPERATION, 7"	1
5	SWITCH INDUSTRIAL	Ø CSM 1277, Switch industrial Ethernet no administrable, 10/100MBIT/ S. 4 puertos RJ45, alimentación 24VDC	1
6	VARIADOR DE VELOCIDAD	Variador Sinamics G120 25Hp Sinamics G120; control unit CU240E Sinamics reactancia de red para power module fsd; 18,5 y 22 kW, potencia	2
7	SENSOR DE NIVEL	THE PROBE MILLTRONICS, distancia de medida 5m, salida de 4 a 20 mA	5
8	VALVULA PINCH	MARCA HUNTER, 24V, selenoide latch	4
9	SENSOR DE PRESIÓN	XMLG010Q21TQ, RANGO DE MEDIDA HASTA 10 BAR, SALIDA DE 4 A 20 mA	2

Fuente: Elaboración Propia  
 Tabla 8: Selección de Equipos

### **5.5.2. Tiempo de respuesta máximo**

De acuerdo con la ecuación anterior del numeral 5.4.10, el máximo tiempo que tardaría el sistema en responder sería de 100mS.

## **6. CONCLUSIONES.**

- a) Como se indica en el numeral 5.1.2, se determinó que la tecnología a usar para el control a distancia es el uso de datos por GPRS. (General Packet Radio Service).
- b) La supervisión del proceso se realiza a través del panel HMI CONFORT de 7 pulgadas, el cual cuenta con interface Profinet para enlazarse con el PLC, esto se evidencia en el plano de instrumentación en el numeral 5.3.
- c) La selección de los equipos de instrumentación se realizó en el numeral 5.4 de acuerdo a los requerimientos del numeral 5.3.
- d) El tiempo de respuesta del sistema se redujo a un máximo de 100mS debido principalmente a la velocidad de respuesta del PLC y de la válvula Latch, el cual se muestra en el numeral 5.4.10.

## **7. RECOMENDACIONES**

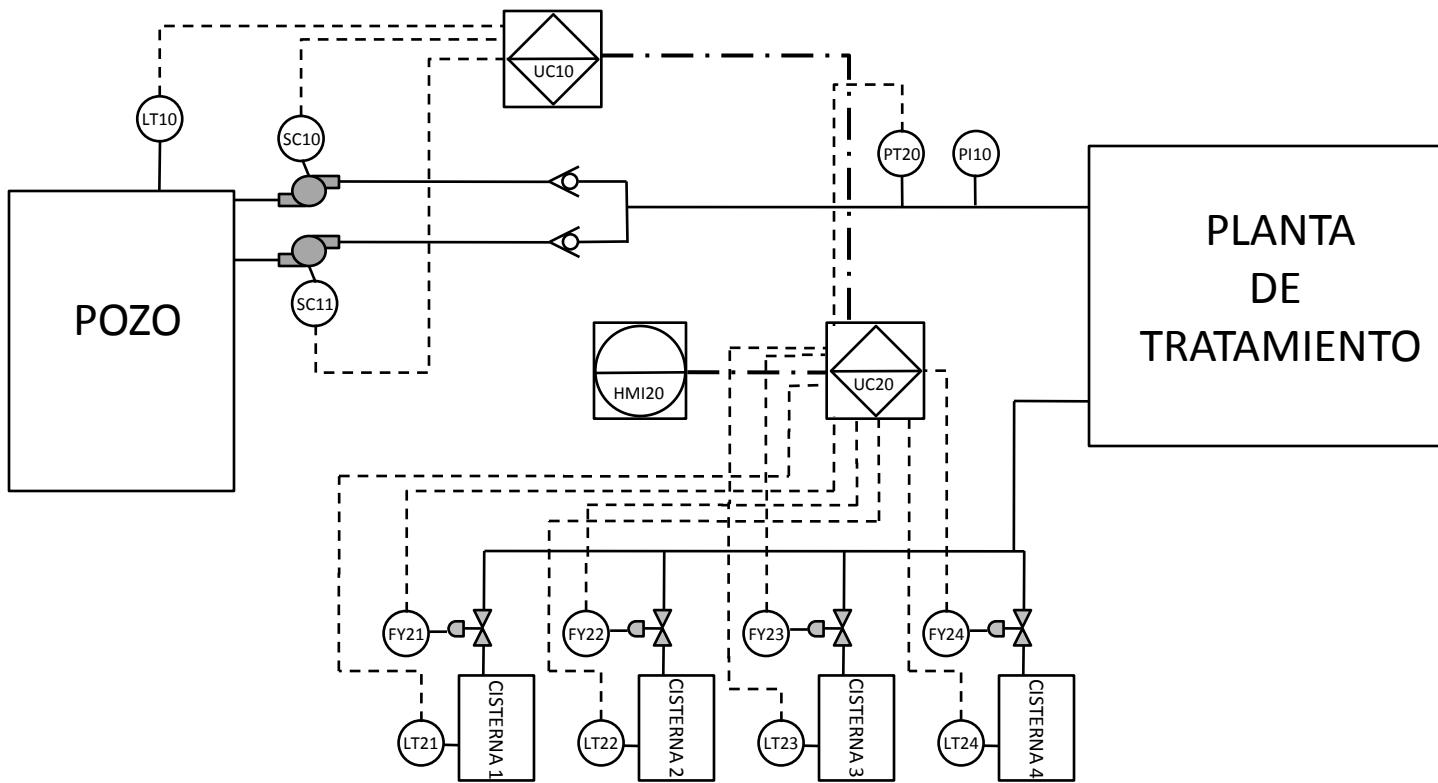
- Implementar el sistema propuesto ya que disminuye considerablemente el tiempo de respuesta.
- Implementar un sistema de arranque a los variadores en forma manual en caso de problemas en la comunicación.
- Implementar un sistema de comunicación con la estación remota mediante interface RS485, el cual permite un alcance de hasta 1000m, pero a su vez contemplar módulos de comunicación Profibus.
- Controlar el sistema de dosificación de agua hacia la planta e integrarlo al sistema propuesto.

## **8. REFERENCIAS BIBLIOGRÁFICAS**

- Guerrero, V. / Yuste, R. / Martínez, L. (2008) Comunicaciones Industriales. España, Ediciones MARCOMBO.
- Bailey, D. / Wright, E. (2003) Practical SCADA for Industry, IDC Technologies.
- Siemens (2009) S7 Controlador Programable S7-1200, Siemens AG 2009.
- CURSO 061 > CONTROLADOR LÓGICO PROGRAMABLE  
<http://dataoteca.unad.edu.co/contenidos/299013/Manual061ControladorLgicoProgramablePLC.pdf>. Consultado el 10 de Agosto, 2015.
- SIMATIC S-1200. Página Web: <http://www.appliedc.com/images/S7%201200.jpg>  
Consultado el 22 de Agosto, 2015.
- Tipos de control de lazo abierto y cerrado, Página web:  
[http://www.lazocerrado.com/info/Control\\_de\\_lazo\\_abierto%20y%20cerrado.pdf](http://www.lazocerrado.com/info/Control_de_lazo_abierto%20y%20cerrado.pdf)  
Consultado el 12 de Abril, 2015.

## **ANEXOS**

**ANEXO 1**  
**PLANO DE INSTRUMENTACION**



**ANEXO 2**

**S71200**

## General specifications and features

Table 1 General

Technical data	CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Order number	6ES7 215-1BG31-0XB0	6ES7 215-1HG31-0XB0	6ES7 215-1AG31-0XB0
Dimensions W x H x D (mm)	130 x 100 x 75	130 x 100 x 75	130 x 100 x 75
Shipping weight	550 grams	585 grams	520 grams
Power dissipation	14 W	12 W	12 W
Current available (SM and CM bus)	1600 mA max. (5 VDC)	1600 mA max. (5 VDC)	1600 mA max. (5 VDC)
Current available (24 VDC)	400 mA max. (sensor power)	400 mA max. (sensor power)	400 mA max. (sensor power)
Digital input current consumption (24VDC)	4 mA/input used	4 mA/input used	4 mA/input used

Table 2 CPU features

Technical data	Description
User memory <sup>1</sup>	Work
	Load
	Retentive
On-board digital I/O	14 inputs/10 outputs
On-board analog I/O	2 inputs/2 outputs
Process image size	1024 bytes of inputs (I)/1024 bytes of outputs (Q)
Bit memory (M)	8192 bytes
Temporary (local) memory	<ul style="list-style-type: none"> <li>• 16 Kbytes for startup and program cycle (including associated FBs and FCs)</li> <li>• 4 Kbytes for standard interrupt events including FBs and FCs</li> <li>• 4 Kbytes for error interrupt events including FBs and FCs</li> </ul>
Signal modules expansion	8 SMs max.
SB, CB, BB expansion	1 max.
Communication module expansion	3 CMs max.
High-speed counters	<p>6 total, see table <a href="#">HSC input assignments for CPU 1215C</a></p> <ul style="list-style-type: none"> <li>• Single phase: 3 at 100 kHz and 3 at 30 kHz clock rate</li> <li>• Quadrature phase: 3 at 80 kHz and 3 at 20 kHz clock rate</li> </ul>
Pulse outputs <sup>2</sup>	4
Pulse catch inputs	14

Technical data	Description
Time delay / cyclic interrupts	4 total with 1 ms resolution
Edge interrupts	12 rising and 12 falling (14 and 14 with optional signal board)
Memory card	SIMATIC Memory Card (optional)
Real time clock accuracy	+/- 60 seconds/month
Real time clock retention time	20 days typ./12 days min. at 40°C (maintenance-free Super Capacitor)

<sup>1</sup> The size of the user program, data, and configuration is limited by the available load memory and work memory in the CPU. There is no specific limit to the number of OB, FC, FB and DB blocks supported or to the size of a particular block; the only limit is due to overall memory size.

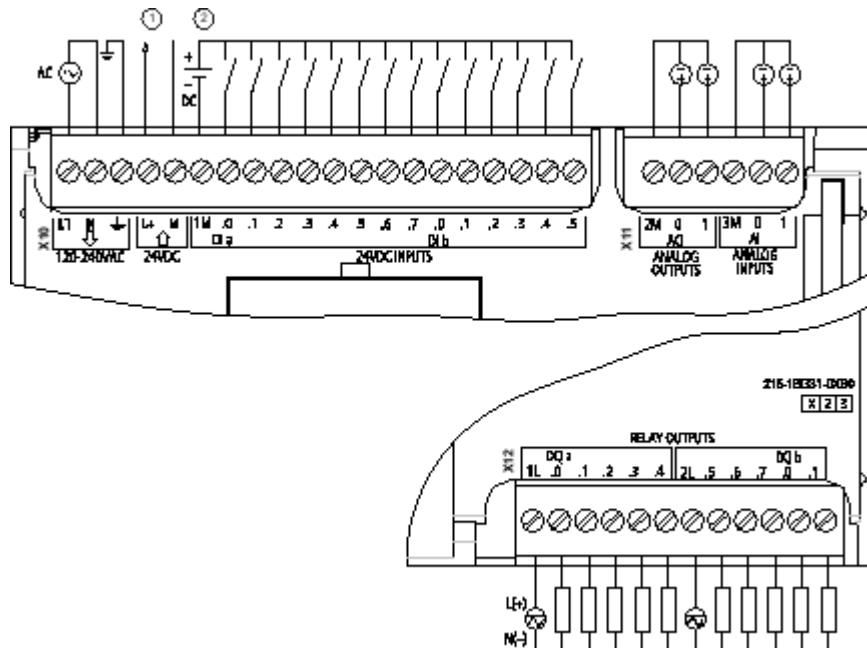
<sup>2</sup> For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

Table 3 Performance

Type of instruction	Execution speed
Boolean	0.08 µs/instruction
Move Word	1.7 µs/instruction
Real math	2.3 µs/instruction

## CPU 1215C Wiring Diagrams

Table 1 CPU 1215C AC/DC/Relay (6ES7 215-1BG31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

For sourcing inputs, connect "+" to "M".

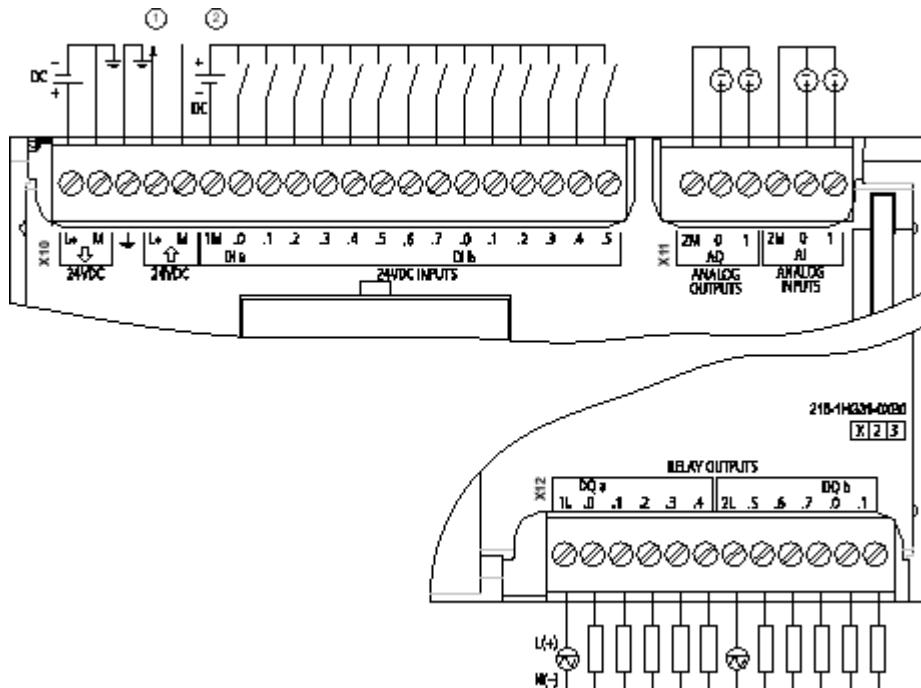
Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table 2 Connector pin locations for CPU 1215C AC/DC/Relay (6ES7 215-1BG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L1 /120-240 VAC	2 M	1L
2	N / 120 - 240 VAC	AQ 0	DQ a.0
3	Functional Earth	AQ 1	DQ a.1
4	L+ / 24VDC Sensor Out	3M	DQ a.2
5	M / 24VDC Sensor Out	AI 0	DQ a.3
6	1M	AI 1	DQ a.4
7	DI a.0	--	2L
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7

Pin	X10	X11 (gold)	X12
11	DI a.4	--	DQ b.0
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	--
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--
19	DI b.4	--	--
20	DI b.5	--	--

Table 3 CPU 1215C DC/DC/Relay (6ES7 215-1HG31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

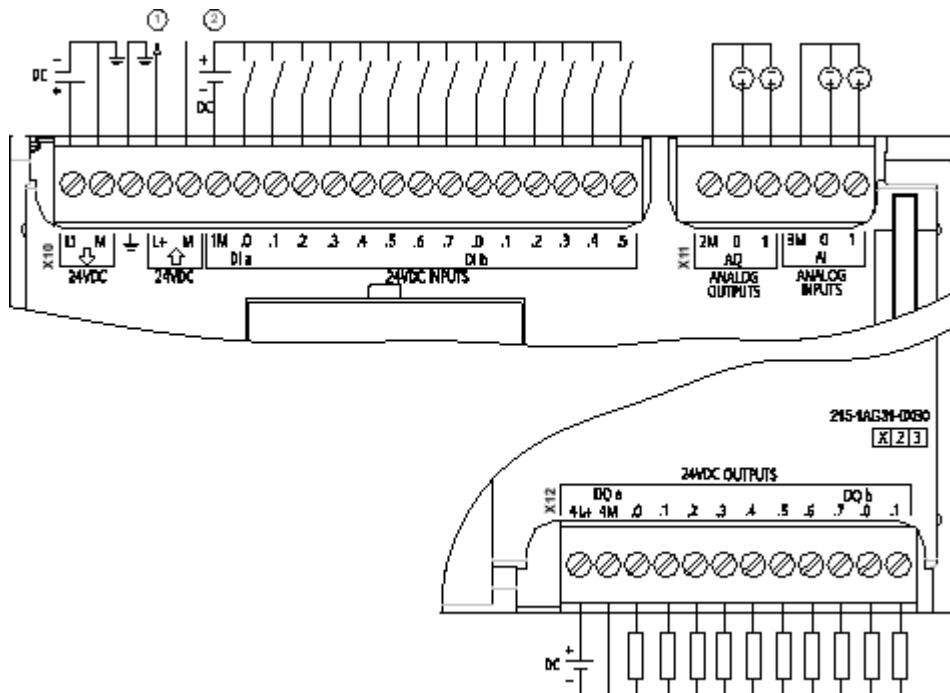
② For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table 4 Connector pin locations for CPU 1215C DC/DC/Relay (6ES7 215-1HG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L+ / 24VDC	2 M	1L
2	M / 24VDC	AQ 0	DQ a.0
3	Functional Earth	AQ 1	DQ a.1
4	L+ / 24VDC Sensor Out	2M	DQ a.2
5	M / 24VDC Sensor Out	AI 0	DQ a.3
6	1M	AI 1	DQ a.4
7	DI a.0	--	2L
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7
11	DI a.4	--	DQ b.0
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	--
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--
19	DI b.4	--	--
20	DI b.5	--	--

Table 5 CPU 1215C DC/DC/DC (6ES7 215-1AG31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table 6 Connector pin locations for CPU 1215C DC/DC/DC (6ES7 215-1AG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L1 / 24VDC	2 M	4L+
2	M / 24VDC	AQ 0	4M
3	Functional Earth	AQ 1	DQ a.0
4	L+ / 24VDC Sensor Out	3M	DQ a.1
5	M / 24VDC Sensor Out	AI 0	DQ a.2
6	1M	AI 1	DQ a.3
7	DI a.0	--	DQ a.4
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7
11	DI a.4	--	DQ b.0

Pin	X10	X11 (gold)	X12
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	--
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--
19	DI b.4	--	--
20	DI b.5	--	--

---

**Note**

Unused analog inputs should be shorted.

---

## Analog output specifications

### Analog outputs

Table 1 Analog outputs

Technical data	Description
Number of outputs	2
Type	Current
Full-scale range	0 to 20 mA
Full-scale range (data word)	0 to 27648
Overshoot range	20.01 to 23.52 mA <sup>1</sup>
Overshoot range (data word)	27,649 to 32,511
Overflow range	see footnote <sup>2</sup>
Overflow range data word	32,512 to 32,767
Resolution	10 bits
Output drive impedance	≤500 Ω max.
Isolation (field side to logic)	None
Accuracy (25°C / -20 to 60°C)	3.0% / 3.5% of full-scale
Settling time	2 ms
Cable length (meters)	100 m, shielded twisted pair

<sup>1</sup> For the CPU 1215C with DC power supply: at supply voltage 20.4 VDC, up to 400 Ω output drive impedance is supported in overshoot range.

<sup>2</sup> In an overflow condition, analog outputs will behave according to the device configuration properties settings. In the "Reaction to CPU STOP" parameter, select either: Use substitute value or Keep last value.

## Sample time for the built-in analog ports of the CPU

Table 1 Sample time for built-in analog inputs of the CPU

Rejection frequency (Integration time selection)	Sample time
60 Hz (16.6 ms)	4.17 ms
50 Hz (20 ms)	5 ms
10 Hz (100 ms)	25 ms

## Step response of the built-in analog inputs of the CPU

Table 1 Step Response (ms), 0V to 10V measured at 95%

Smoothing selection (sample averaging)	Rejection frequency (Integration time)		
	60 Hz	50 Hz	10 Hz
None (1 cycle): No averaging	50 ms	50 ms	100 ms
Weak (4 cycles): 4 samples	60ms	70 ms	200 ms
Medium (16 cycles): 16 samples	200 ms	240 ms	1150 ms
Strong (32 cycles): 32 samples	400 ms	480 ms	2300 ms
<b>Sample time</b>	<b>4.17 ms</b>	<b>5 ms</b>	<b>25 ms</b>

## Analog inputs

Table 1 Analog inputs

Technical data	Description
Number of inputs	2
Type	Voltage (single-ended)
Full-scale range	0 to 10 V
Full-scale range (data word)	0 to 27648
Overshoot range	10.001 to 11.759 V
Overshoot range (data word)	27,649 to 32,511
Overflow range	11.760 to 11.852 V
Overflow range (data word)	32,512 to 32,767
Resolution	10 bits
Maximum withstand voltage	35 VDC
Smoothing	None, Weak, Medium, or Strong See the table for <u>step response (ms) for the analog inputs of the CPU</u> .
Noise rejection	10, 50, or 60 Hz
Impedance	$\geq 100 \text{ k}\Omega$
Isolation (field side to logic)	None
Accuracy ( $25^\circ\text{C}$ / -20 to $60^\circ\text{C}$ )	3.0% / 3.5% of full-scale
Cable length (meters)	100 m, shielded twisted pair

## Digital inputs and outputs

Table 1 Digital inputs

Technical data	CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Number of inputs	14		
Type	Sink/Source (IEC Type 1 sink)		
Rated voltage	24 VDC at 4 mA, nominal		
Continuous permissible voltage	30 VDC, max.		
Surge voltage	35 VDC for 0.5 sec.		
Logic 1 signal (min.)	15 VDC at 2.5 mA		
Logic 0 signal (max.)	5 VDC at 1 mA		
Isolation (field side to logic)	500 VAC for 1 minute		
Isolation groups	1		
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms (selectable in groups of 4)		
HSC clock input rates (max.) (Logic 1 Level = 15 to 26 VDC)	Single phase: 100 KHz (Ia.0 to Ia.5) and 30 KHz (Ia.6 to Ib.5) Quadrature phase: 80 KHz (Ia.0 to Ia.5) and 20 KHz (Ia.6 to Ib.5)		
Number of inputs on simultaneously	<ul style="list-style-type: none"> <li>• 7 (no adjacent points) at 60° C horizontal or 50° C vertical</li> <li>• 14 at 55° C horizontal or 45° C vertical</li> </ul>		
Cable length (meters)	500 m shielded, 300 m unshielded, 50 m shielded for HSC inputs		

Table 2 Digital outputs

Technical data	CPU 1215C AC/DC/Relay and CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Number of outputs	10	10
Type	Relay, dry contact	Solid state - MOSFET (sourcing)
Voltage range	5 to 30 VDC or 5 to 250 VAC	20.4 to 28.8 VDC
Logic 1 signal at max. current	--	20 VDC min.
Logic 0 signal with 10 KΩ load	--	0.1 VDC max.
Current (max.)	2.0 A	0.5 A
Lamp load	30 W DC / 200 W AC	5 W
ON state resistance	0.2 Ω max. when new	0.6 Ω max.
Leakage current per point	--	10 μA max.
Surge current	7 A with contacts closed	8 A for 100 ms max.
Overload protection	No	No

Technical data	CPU 1215C AC/DC/Relay and CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)	500 VAC for 1 minute
Isolation resistance	100 MΩ min. when new	--
Isolation between open contacts	750 VAC for 1 minute	--
Isolation groups	2	1
Inductive clamp voltage	--	L+ minus 48 VDC, 1 W dissipation
Switching delay (Qa.0 to Qa.3)	10 ms max.	1.0 µs max., off to on 3.0 µs max., on to off
Switching delay (Qa.4 to Qb.1)	10 ms max.	50 µs max., off to on 200 µs max., on to off
Maximum relay switching frequency	1 Hz	--
Pulse Train Output rate (Qa.0 and Qa.2)	Not recommended <sup>1</sup>	100 KHz max., 2 Hz min. <sup>2</sup>
Lifetime mechanical (no load)	10,000,000 open/close cycles	--
Lifetime contacts at rated load	100,000 open/close cycles	--
Behavior on RUN to STOP	Last value or substitute value (default value 0)	
Number of outputs on simultaneously	<ul style="list-style-type: none"> <li>• 5 (no adjacent points) at 60° C horizontal or 50° C vertical</li> <li>• 10 at 55° C horizontal or 45° C vertical</li> </ul>	
Cable length (meters)	500 m shielded, 150 m unshielded	

<sup>1</sup> For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

<sup>2</sup> Depending on your pulse receiver and cable, an additional load resistor (at least 10% of rated current) may improve pulse signal quality and noise immunity.

## Timers, counters and code blocks supported by CPU 1215C

Table 1 Blocks, timers and counters supported by CPU 1215C

Element	Description	
Blocks	Type	OB, FB, FC, DB
	Size	64 Kbytes
	Quantity	Up to 1024 blocks total (OBs + FBs + FCs + DBs)
	Address range for FBs, FCs, and DBs	1 to 65535 (such as FB 1 to FB 65535)
	Nesting depth	16 from the program cycle or start up OB; 4 from the time delay interrupt, time-of-day interrupt, cyclic interrupt, hardware interrupt, time error interrupt, or diagnostic error interrupt OB
	Monitoring	Status of 2 code blocks can be monitored simultaneously
OBs	Program cycle	Multiple: OB 1, OB 200 to OB 65535
	Startup	Multiple: OB 100, OB 200 to OB 65535
	Time-delay interrupts and cyclic interrupts	4 <sup>1</sup> (1 per event): OB 200 to OB 65535
	Hardware interrupts (edges and HSC)	50 (1 per event): OB 200 to OB 65535
	Time error interrupts	1: OB 80
	Diagnostic error interrupts	1: OB 82
Timers	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, 16 bytes per timer
Counters	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, size dependent upon count type <ul style="list-style-type: none"> <li>• SInt, USInt: 3 bytes</li> <li>• Int, UInt: 6 bytes</li> <li>• DInt, UDInt: 12 bytes</li> </ul>

<sup>1</sup> Time-delay and cyclic interrupts use the same resources in the CPU. You can have only a total of 4 of these interrupts (time-delay plus cyclic interrupts). You cannot have 4 time-delay interrupts and 4 cyclic interrupts.

Table 2 Communication

Technical data	Description
Number of ports	2

Technical data	Description
Type	Ethernet
HMI device <sup>1</sup>	3
Programming device (PG)	1
Connections	<ul style="list-style-type: none"> <li>8 for Open User Communication (active or passive): TSEND_C, TRCV_C, TCON, TDISCON, TSEND, and TRCV</li> <li>3 for server GET/PUT (CPU-to-CPU) S7 communication</li> <li>8 for client GET/PUT (CPU-to-CPU) S7 communication</li> </ul>
Data rates	10/100 Mb/s
Isolation (external signal to PLC logic)	Transformer isolated, 1500 VAC, for short term event safety only
Cable type	CAT5e shielded

<sup>1</sup> The CPU provides dedicated HMI connections to support up to 3 HMI devices. (You can have up to 2 SIMATIC Comfort panels.) The total number of HMI is affected by the types of HMI panels in your configuration. For example, you could have up to three SIMATIC Basic panels connected to your CPU, or you could have up to two SIMATIC Comfort panels with one additional Basic panel.

Table 3 Power supply

Technical data	CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Voltage range	85 to 264 VAC	20.4 VDC to 28.8 VDC 22.0 VDC to 28.8 VDC for ambient temperature -20° C to 0° C	
Line frequency	47 to 63 Hz	--	
Input current (max. load)	CPU only	100 mA at 120 VAC 50 mA at 240 VAC	500 mA at 24 VDC
	CPU with all expansion accessories	300 mA at 120 VAC 150 mA at 240 VAC	1500 mA at 24 VDC
Inrush current (max.)	20 A at 264 VAC	12 A at 28.8 VDC	
Isolation (input power to logic)	1500 VAC	Not isolated	
Ground leakage, AC line to functional earth	0.5 mA max.	-	
Hold up time (loss of power)	20 ms at 120 VAC 80 ms at 240 VAC	10 ms at 24 VDC	
Internal fuse, not user replaceable	3 A, 250 V, slow blow		

Table 4 Sensor power

Technical data	CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Voltage range	20.4 to 28.8 VDC	L+ minus 4 VDC min. L+ minus 5 VDC min. for ambient temperature -20° C to 0° C	
Output current rating (max.)	400 mA (short circuit protected)		
Maximum ripple noise (<10 MHz)	< 1 V peak to peak	Same as input line	
Isolation (CPU logic to sensor power)	Not isolated		

**ANEXO 3**  
**SENSOR DE PRESION**

# Ficha de producto

## Características

# XMLG010Q21TQ

Captador de presión XML-G 0..10 bar - G 1/4 A  
(gas macho) - 24 V - 4...20 mA



### Main

Rango de producto	Nautilus
Tipo de producto o componente	Sensores presión electrónicos
Nombre del sensor de presión	XMLG
Tipo de circuito eléctrico	Circuito de control
Capacidad de presión	10 bar
Tipo de conexión de fluido	G 1/4 macho (BSPP) ISO 228
Presión máxima permitida - sob	22 bar
Presión de destrucción	25 bar
Conexión eléctrica	Acoplamiento rápido de tipo Qu
Tipo de señal de salida	Analógico
Fluido controlado (Tabular)	Aire -15...125 °C Fluido corrosivo -15...125 °C Aceite hidráulico -15...125 °C Agua salada -15...125 °C Agua fresca -15...125 °C
Materiales en contacto con flu	FPM PPS Acero inoxidable tipo AISI 303 Cerámica
Cantidad por juego	Juego de 25
Diámetro	22,8 mm

### Complementary

Visualización local	Sin
Tensión suministro (tabular)	12/24 V CC 8...33 V
Consumo de corriente	< 20 mA
Tipo de protección	Cortocircuito de carga Polaridad inversa
Resistencia a sobretensiones	1 kV 42 Ohm EN 61000-4-5 500 kV 12 Ohm EN 61000-4-5
Tensión res. impulsos nominal	0,5 kV
Tiempo resp. en sal. (tabular)	< 2 ms
Desviación de la sensibilidad	< +/- 0,015% rango medición/°C
Desviación del punto cero	< +/- 0,015% del rango medic./°C
Precisión de medición	< +/- 0,3% del rango de medic.
Precisión de repetición	+/- 0,1 %
Vida útil mecánica	≥ 10000000 cycles
Tipo de paquete	Grupo
Peso del producto	0,095 kg
Longitud	76 mm

La información disponible en este documento contiene descripciones generales y/o características técnicas de los productos adjuntos. En razón de la evolución de las normativas y del material, las características indicadas por el texto y las imágenes de este documento no nos comprometemos hasta después de una confirmación por parte de nuestros servicios. Esta es el deber de cada usuario o integrador de efectuar un completo y apropiado análisis de riesgos, evaluación y testeo de los productos con respecto a la aplicación específica o uso de los productos. Schneider Electric Industries SAS ni sus filiales comerciales se responsabilizan de la incorrecta interpretación de la información aquí contenida.

## Environment

Estándares	CE EN 50081-1 EN 50082-2 EN 61000-6-2 EN/IEC 60947-1 EN/IEC 60947-5-1
Certificados de producto	CSA UL
Tratamiento de protección	TC
Temperatura del aire ambiente	-15...85 °C
Temp. aire almacenam.	-40...85 °C
Posición de funcionamiento	Cualquier posición
Resistencia a las vibraciones	20 gn 9...2000 Hz IEC 60068-2-6
Resistencia a las descargas	25 gn 11 ms IEC 60068-2-27
Resistencia a descargas electr	15 kV en aire EN 61000-4-2 8 kV en contacto EN 61000-4-2
Resistencia de campos electrom	200 V/m 80...1000 Hz EN 61000-4-3
Resistencia a transitorios ráp	4 kV EN 61000-4-4
Resistencia a perturbaciones c	30 V 0,15...80 Hz EN 61000-4-6
Resist. campo magn. (tabular)	30 A/m 50 Hz EN 61000-4-8
Protección IP (Tabular)	IP66 EN/IEC 60529 IP67 EN/IEC 60529
Grado de protección NEMA	NEMA 4

## Garantía contractual

Período	18 meses
---------	----------

**ANEXO 4**  
**VARIADOR DE VELOCIDAD**

# SINAMICS G120

## Standard inverters

### 0.37 kW to 250 kW (0.5 hp to 400 hp)



<b>4/2</b>	<b>SINAMICS G120 standard inverters</b>	<b>4/74</b>	<b>Line-side power components</b>
4/2	Overview	4/74	Line filters
4/4	Benefits	4/77	Line reactors
4/4	Applications	4/81	Recommended line components
4/4	Design		
4/9	Configuration	<b>4/83</b>	<b>DC link components</b>
4/10	Technical specifications	4/83	Braking resistors
		4/86	Braking Modules
<b>4/12</b>	<b>CU230 Control Units</b>	<b>4/88</b>	<b>Load-side power components</b>
4/12	Overview	4/88	Output reactors
4/12	Selection and ordering data	4/95	Sine-wave filters
4/12	Function		
4/13	Design	<b>4/102</b>	<b>Supplementary system components</b>
4/14	Integration	4/102	Intelligent Operator Panel IOP
4/17	Technical specifications	4/104	Basic Operator Panel BOP
		4/105	MMC memory card
<b>4/19</b>	<b>CU240 Control Units</b>	4/106	CM240NE chemical industry module
4/19	Overview	4/108	PC Connection Kit -2
4/19	Selection and ordering data	4/108	PC Connection Kit
4/20	Design	4/109	Brake relay
4/22	Integration	4/110	Safe Brake Relay
4/28	Technical specifications	4/111	Adapter for mounting on DIN rails
		4/111	Shield Connection Kit
<b>4/30</b>	<b>PM240 Power Modules</b> <b>0.37 kW to 250 kW (0.5 hp to 400 hp)</b>	4/112	Shield Connection Kit 1 for CU230P-2 Control Units
4/30	Overview	4/112	Shield Connection Kit for CU240S Control Units
4/31	Selection and ordering data		
4/32	Integration		
4/36	Technical specifications	<b>4/113</b>	<b>Spare parts</b>
4/42	Characteristic curves	4/113	CU240 Spare Parts Kit
4/44	Dimensional drawings	4/113	Replacement door for PM240 frame size FSGX
		4/114	Terminal Cover Kit for frame sizes FSD and FSE
<b>4/50</b>	<b>PM250 Power Modules</b> <b>7.5 kW to 75 kW (10 hp to 100 hp)</b>	4/114	Terminal Cover Kit for frame size FSF
4/50	Overview	4/115	Replacement connector
4/51	Selection and ordering data	4/116	Replacement fan
4/52	Integration		
4/55	Technical specifications		
4/59	Characteristic curves		
4/60	Dimensional drawings		
<b>4/64</b>	<b>PM260 Power Modules</b> <b>11 kW to 55 kW (15 hp to 75 hp)</b>		
4/64	Overview		
4/65	Selection and ordering data		
4/66	Integration		
4/68	Technical specifications		
4/71	Characteristic curves		
4/72	Dimensional drawings		
<b>4/73</b>	<b>Compact inverters</b> <b>0.37 kW to 15 kW (0.5 hp to 20 hp)</b>		
4/73	Overview		
4/73	Selection and ordering data		

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## SINAMICS G120 standard inverters

### Overview

The SINAMICS G120 frequency inverter is designed to provide precise and cost-effective speed/torque control of AC motors.

With different device versions (frame sizes FSA to FSGX) in a power range from 0.37 kW to 250 kW (0.5 hp to 400 hp), it is suitable for a wide variety of drive solutions.



Examples of SINAMICS G120, frame sizes FSA, FSB and FSC; each with Power Module, Control Unit and Basic Operator Panel



Examples of SINAMICS G120, frame sizes FSD, FSE and FSF; each with Power Module, Control Unit and Basic Operator Panel

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### SINAMICS G120 standard inverters

#### Overview



Examples of SINAMICS G120, frame size FSGX; with Power Module

#### Modularity

SINAMICS G120 is a modular inverter system comprising a variety of functional units. The main units are:

- the Control Unit (CU)
- the Power Module (PM)

The Control Unit controls and monitors the Power Module and the connected motor using several different control types that can be selected. It supports communication with a local or central control and monitoring devices.

The Power Module supplies the motor in a power range 0.37 kW to 250 kW (0.5 hp to 400 hp). The Power Module is controlled by a microprocessor in the Control Unit. State-of-the-art IGBT technology with pulse-width modulation is used to achieve the highest degree of reliability and flexible motor operation. Comprehensive protection functions provide a high degree of protection for the Power Module and the motor.

Furthermore, a large number of additional components are available, such as:

- Intelligent Operator Panel (IOP) for parameterizing, diagnosing, controlling and copying drive parameters
- Basic Operator Panel (BOP) for parameterizing, diagnosing, controlling and copying drive parameters
- Line filters, Classes A and B
- Line reactors
- Braking resistors
- Sine-wave filters
- Output reactors

#### Safety Integrated

The SINAMICS G120 standard inverters are available in a number of different versions for safety-related applications. All Power Modules are already designed for Safety Integrated. A Safety Integrated Drive can be created by combining a Power Module with the appropriate Fail-safe Control Unit.

The SINAMICS G120 fail-safe frequency inverter provides four safety functions, certified in accordance with EN 954-1, Category 3 and IEC 61508 SIL 2:

- Safe Torque Off (STO) to protect against active movement of the drive
- Safe Stop 1 (SS1) for continuous monitoring of a safe braking ramp
- Safely Limited Speed (SLS) for protection against dangerous movements when a speed limit is exceeded
- Safe Brake Control (SBC) for controlling motor brakes that are active in the de-energized state, e.g. motor holding brakes

The functions "Safe Stop 1" and "Safely Limited Speed" can both be implemented without having to use a motor sensor or encoder; the implementation cost is minimal. Existing systems in particular can be updated with safety technology without the need to change the motor or mechanical system.

The safety functions "Safely Limited Speed" and "Safe Stop 1" are not certified for pull-through loads as in the case of lifting gear and winders.

Additional information is provided in the part Highlights, section Safety Integrated.

#### Efficient Infeed Technology

The innovative Efficient Infeed Technology is used in PM250 and PM260 Power Modules. This technology allows the energy produced by motors operating in generator mode connected to standard inverters to be fed back into the supply system. Additional cooling and additional space requirement in the control cabinet can be avoided as components such as braking resistors, brake choppers and line reactors are not required. Further, wiring and engineering costs are significantly reduced. At the same time, considerable savings can be achieved in terms of energy consumption and operating costs.

Additional information is included in the part Highlights, section Efficient Infeed Technology.

#### Innovative cooling concept and coated electronic modules

The innovative cooling concept and coated electronic modules significantly increase the service life and usage time of the device. These features are based on the following principles:

- The power loss is exclusively dissipated using an external heat sink
- Electronic modules not located in air duct
- Standardized convection cooling of Control Unit
- All cooling air from the fan is directed through the heat sink

#### STARTER commissioning tool

The STARTER commissioning tool simplifies the commissioning and maintenance of SINAMICS G120 inverters. The operator guidance combined with comprehensive, user-friendly functions for the relevant drive solution allow you to commission the device quickly and easily.

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### SINAMICS G120 standard inverters

#### Benefits

- Modularity ensures flexibility for a drive concept that is fit-for-the-future
  - Modules can be replaced under voltage (hot swapping)
  - Pluggable terminals
  - The modules can be easily replaced, which makes the system extremely service friendly.
- The safety functions make it easier to integrate drives into safety-oriented machines or plants
- Communications-capable via PROFINET or PROFIBUS with PROFIdrive Profile 4.0
  - Reduced number of interfaces
  - Plantwide engineering
  - Easy to handle
- The innovative circuit design (bidirectional input rectifier with "pared-down" DC link) allows the kinetic energy of a load to be fed back into the supply system when Power Modules PM250 and PM260 are used. This feedback capability provides enormous potential for savings because generated energy no longer has to be converted into heat in a braking resistor
- Innovative SiC semiconductor technology ensures that when a PM260 Power Module is used, the inverter is more compact than a comparable standard converter with an optional sine-wave filter for the same power rating
- An innovative cooling concept and coated electronic modules increase robustness and service life
  - External heatsink
  - Electronic components are not located in air duct
  - Control Unit that is completely cooled by convection
  - Additional coating of the most important components
- Simple unit replacement and quick copying of parameters using the optional Basic Operator Panel or the optional MMC memory card
- Quiet motor operation as a result of the high pulse frequency
- Compact, space-saving design
- Software parameters for simple adaptation to 50 Hz or 60 Hz motors (IEC or NEMA motors)
- 2-/3-wire control (static/pulsed signals) for universal control via digital inputs (only CU240 Control Units)
- Engineering and commissioning with uniform engineering tools such as SIZER, STARTER, and Drive ES: ensure fast engineering and easy commissioning – STARTER is integrated in STEP 7 with Drive ES Basic with all the advantages of central data storage and totally integrated communication
- Certified worldwide for compliance with CE, UL, cUL, c-tick and Safety Integrated according to IEC 61508 SIL 2

4

#### Applications

SINAMICS G120 is ideally suited

- as a universal drive in all industrial and commercial applications
- e.g. in the automotive, textile, printing and chemical industries
- for higher-level applications, e.g. in conveyor systems

#### Design

SINAMICS G120 standard inverters are modular frequency inverters for standard drives. Each SINAMICS G120 comprises two operative units – the Power Module and Control Unit. Each Control Unit can be combined with each Power Module.

#### Guidelines for module selection

The procedure to select a complete SINAMICS G120 frequency inverter should be as follows:

1. Select a suitable Control Unit (depending on the required communication, hardware and software version and safety functionality)
2. Select a suitable Power Module (depending on the power and technology required)
3. Select the optional and additional components. There are a large number of components for expanding the system (e.g. line-side power components, DC link components, load-side power components, and supplementary system components). However, it should be noted that not all of the components are required for all of the Power Modules (example: Braking resistors are not required for the PM250 and PM260 Power Modules!). The precise data is provided in the technical specifications tables of the particular components.

#### Control Units

The Control Unit performs closed-loop control functions for the inverter. In addition to the closed-loop control, it has additional functions that can be adapted to the particular application through parameterization.

Two series of Control Units are available for SINAMICS G120 corresponding to their software packages (CU230 and CU240). Each Control Unit comprises a defined I/O quantity structure, a special fieldbus interface and possible additional safety functions. The following Control Units and accessories are available for standard SINAMICS G120 inverters:

#### CU230 Control Units

The CU230P-2 Control Units have been specifically designed for pump, fan and compressor applications. The following three versions are available:

- CU230P-2 HVAC
- CU230P-2 DP
- CU230P-2 CAN

#### CU240 Control Units

Several Control Units are available in different versions:

- CU240E
- CU240S
- CU240S DP
- CU240S DP-F
- CU240S PN
- CU240S PN-F

## Design

### *Power Modules*

The following Power Modules are available for the SINAMICS G120 standard inverters:

#### PM240 Power Modules

PM240 Power Modules (0.37 kW to 250 kW / 0.5 hp to 400 hp) feature an integrated brake chopper (for frame size FSGX external) and are designed for drives without energy recovery capability. Generator energy produced during braking is converted to heat via externally connected braking resistors.

#### PM250 Power Modules

PM250 Power Modules (7.5 kW to 90 kW / 10 hp to 125 hp) have an innovative circuit design which allows line-commutated energy recovery back into the line supply. This innovative circuit permits generator energy to be fed back into the supply system and therefore saves energy.

#### PM260 Power Modules

PM260 Power Modules (11 kW to 55 kW / 15 hp to 75 hp) also have an innovative circuit design which allows line-commutated energy recovery back into the line supply. This innovative circuit permits generator energy to be fed back into the supply system and therefore saves energy. The PM260 Power Modules also have an integrated sine-wave filter that limits the rate of rise of voltage and the capacitive charging/discharging currents usually associated with inverter operation.

### *Line-side power components*

The following line-side power components are available for SINAMICS G120 standard inverters:

#### Line filters

With one of the additional line filters, the Power Module reaches a higher radio interference class.

#### Line reactors (for PM240 Power Modules only)

A line reactor reduces the system perturbations caused by harmonics. This particularly applies in the case of weak line supplies (line supply short-circuit power  $u_K > 1\%$ ).

#### Recommended line components

This is a recommendation for additional line-side components, such as fuses and circuit-breakers (line-side components must be dimensioned in accordance with IEC standards). Additional information about the listed fuses and circuit breakers can be found in Catalogs LV 1 and LV 1 T.

### *DC link components*

The following DC link components are available for the SINAMICS G120 standard inverters:

#### Braking Modules (only for PM240 Power Modules, frame size FSGX)

A Braking Module and the matching external braking resistor are required to bring drives with a PM240 Power Module, frame size FSGX to a controlled standstill in the event of a power failure (e.g. emergency retraction or EMERGENCY STOP Category 1) or limit the DC link voltage during a short period of generator operation. The Braking Module includes the power electronics and the associated control circuit.

#### Braking resistors (for PM240 Power Modules only)

Excess energy in the DC link is dissipated in the braking resistor. The braking resistors are designed for use with PM240 Power Modules. They are equipped with an integrated brake chopper (electronic switch). There is an optional plug-in Braking Module for frame size FSGX.

### *Load-side power components*

The following load-side power components are available for the SINAMICS G120 standard inverters. This means that during operation with output reactors or sine-wave filters, longer, shielded motor cables are possible and the motor service life can be extended:

#### Output reactors (for PM240 and PM250 Power Modules only)

Output reactors reduce the voltage stress on the motor windings. At the same time, the capacitive charging/discharging currents, which place an additional load on the power unit when long motor cables are used, are reduced.

#### Sine-wave filter (not for PM260 Power Modules)

The sine-wave filter limits the rate of rise of voltage and the capacitive charging/discharging currents that usually occur with inverter operation. An output reactor is not required.

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## SINAMICS G120 standard inverters

### Design

*Power and DC link components which are optionally available depending on the Power Module used*

The following line-side power components, DC link components and load-side power components are optionally available in the appropriate frame sizes for the Power Modules:

	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM240 Power Module with integrated brake chopper</b>							
Available frame sizes	✓	✓	✓	✓	✓	✓	✓
<b>Line-side power components</b>							
Line filter, class A	U	F	F	F	F	F/S <sup>3)</sup>	S <sup>3)</sup>
Line filter, class B	U	U	U	–	–	–	–
Line reactor	U	U	U	U	U	S	S
<b>DC link components</b>							
Braking resistor	U	U	S	S	S	S	S
Braking Module	–	–	–	–	–	–	I (Option)
<b>Load-side power components</b>							
Output reactor	U	U	U	S	S	S	S
Sine-wave filter	U	U	U	S	S	S	S
<b>PM250 Power Module with line-commutated energy recovery</b>							
Available frame sizes	–	–	✓	✓	✓	✓	–
<b>Line-side power components</b>							
Line filter, class A	–	–	I	F	F	F	–
Line filter, class B	–	–	U	–	–	–	–
Line reactor <sup>1)</sup>	–	–	– <sup>1)</sup>	– <sup>1)</sup>	– <sup>1)</sup>	– <sup>1)</sup>	– <sup>1)</sup>
<b>DC link components</b>							
Braking resistor <sup>2)</sup>	–	–	– <sup>2)</sup>	– <sup>2)</sup>	– <sup>2)</sup>	– <sup>2)</sup>	–
<b>Load-side power components</b>							
Output reactor	–	–	U	S	S	S	–
Sine-wave filter	–	–	U	S	S	S	–
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>							
Available frame sizes	–	–	–	✓	–	✓	–
<b>Line-side power components</b>							
Line filter, class A	–	–	–	F	–	F	–
Line filter, class B	–	–	–	–	–	–	–
Line reactor <sup>1)</sup>	–	–	–	– <sup>1)</sup>	–	– <sup>1)</sup>	–
<b>DC link components</b>							
Braking resistor <sup>2)</sup>	–	–	–	– <sup>2)</sup>	–	– <sup>2)</sup>	–
<b>Load-side power components</b>							
Output reactor	–	–	–	–	–	–	–
Sine-wave filter	–	–	–	I	–	I	–

U = Base component

S = Lateral mounting

I = Integrated

– = Not possible

F = Power Modules available with and without integrated class A filter

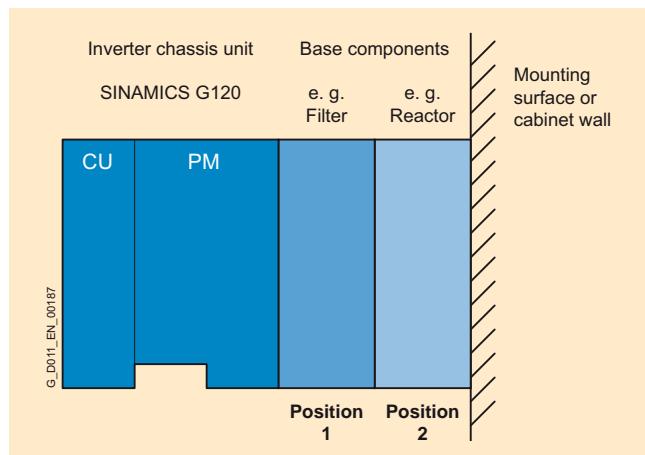
<sup>1)</sup> A line reactor is not required and must not be used in conjunction with a PM250 or PM260 Power Module.

<sup>2)</sup> Line-commutated energy recovery is possible in conjunction with a PM250 or PM260 Power Module. A braking resistor cannot be connected and is not necessary.

<sup>3)</sup> PM240 FSF Power Modules, from 110 kW (150 hp) and higher and FSGX are only available without an integrated class A filter. An optional class A line filter for side mounting is available instead.

## Design

### General design information



Frequency inverters comprising a Power Module (PM) and a Control Unit (CU) and two base components at position 1 and position 2 (side view)

- A maximum of two base components plus inverter are possible.
- The line filter has to be mounted directly below the frequency inverter (position 1).
- With lateral mounting, the line-side components have to be mounted on the left side of the frequency inverter and the load-side components on the right side.
- Braking resistors have to be mounted directly on the control cabinet wall due to heating issues.

### Recommended installation combinations of the inverter and optional power and DC link components

Power Modules	Base		Lateral mounting		
	Frame size	Position 1	Position 2	left of the inverter (for line-side power components)	right of the inverter (for load-side power components and DC link components)
FSA and FSB	Line filter	Line reactor	–	Output reactor or sine-wave filter and/or braking resistor	Braking resistor
	Line filter or line reactor	Output reactor or sine-wave filter	–	–	–
	Line filter or line reactor	Braking resistor	–	–	–
	Line filter or line reactor or braking resistor	–	–	–	–
FSC	Line filter	Line reactor	–	Output reactor or sine-wave filter and/or braking resistor	Braking resistor
	Line filter or line reactor	Output reactor or sine-wave filter	–	–	–
FSD and FSE	Line reactor	–	Line filter	Output reactor or sine-wave filter and/or braking resistor	Output reactor or sine-wave filter and/or braking resistor
FSF	–	–	Line filter and/or line reactor	Output reactor or sine-wave filter and/or braking resistor	Output reactor or sine-wave filter and/or braking resistor
FSGX	–	–	Line filter and/or line reactor	Output reactor or sine-wave filter and/or braking resistor	Output reactor or sine-wave filter and/or braking resistor

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## SINAMICS G120 standard inverters

### Design

*Maximum permissible cable lengths from the motor to the inverter when using output reactors or sine-wave filters depending on the voltage range and the Power Module being used*

The following load-side power components in the appropriate frame sizes are optionally available for the Power Modules and result in the following maximum cable lengths:

	Maximum permissible motor cable lengths (shielded/unshielded) in m						
	Frame sizes						
	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM240 Power Module with integrated brake chopper</b>							
Available frame sizes	✓	✓	✓	✓	✓	✓	✓
Without output reactor/sine-wave filter	50/100	50/100	50/100	50/100	100/100	150/150	300/450
With optional output reactor							
• at 380 V (- 10 %) to 400 V 3 AC	150/225	150/225	150/225	200/300	200/300	200/300	300/450
• at 401 V to 480 V (+ 10 %) 3 AC	100/150	100/150	100/150	200/300	200/300	200/300	300/450
With optional sine-wave filter							
• at 380 V (- 10 %) to 400 V 3 AC	200/300	200/300	200/300	200/300	200/300	200/300	300/450
• at 401 V to 480 V (+ 10 %) 3 AC	200/300	200/300	200/300	200/300	200/300	200/300	300/450
<b>PM250 Power Module with line-commutated energy recovery</b>							
Available frame sizes	-	-	✓	✓	✓	✓	-
Without output reactor/sine-wave filter	-	-	50/100	50/100	50/100	50/100	-
With optional output reactor							
• at 380 V (- 10 %) to 400 V 3 AC	-	-	150/225	200/300	200/300	200/300	-
• at 401 V to 480 V (+ 10 %) 3 AC	-	-	100/150	200/300	200/300	200/300	-
With optional sine-wave filter							
• at 380 V (- 10 %) to 400 V 3 AC	-	-	200/300	200/300	200/300	200/300	-
• at 401 V to 480 V (+ 10 %) 3 AC	-	-	200/300	200/300	200/300	200/300	-
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>							
Available frame sizes	-	-	-	✓	-	✓	-
With integrated sine-wave filter							
• at 500 V to 690 V 3 AC ( $\pm 10\%$ )	-	-	-	200/300	-	200/300	-

## SINAMICS G120 standard inverters

**Design*****Supplementary system components***

The following supplementary system components are available for the SINAMICS G120 standard inverters:

**Intelligent Operator Panel IOP**

The IOP supports both entry-level personnel and drive experts. Thanks to the large plain text display, the menu prompting and the Application Wizards, it is easy to commission, diagnose and locally control standard drives.

**Operator Panel BOP (not for CU230P-2 Control Units)**

The Basic Operator Panel BOP can be plugged onto the Control Unit and can be used to commission drives, monitor drives in operation and input individual parameter settings. The BOP also provides a function to quickly copy parameters.

**MMC memory card (not for CU240E Control Units)**

The parameter settings for an inverter can be stored on the MMC memory card. When service is required, e.g. after the inverter has been replaced and the data have been downloaded from the memory card the drive system is immediately ready for use again. The associated slot is located on the top of the Control Unit.

**CM240NE chemical industry module**

Inverters for 400 V / 500 V and 690 V are required in the chemical industry that meet the special demands and requirements of this industry sector. The essential requirements and demands of the chemical industry are fulfilled using the SINAMICS G120 series of inverters supplemented by the CM240NE chemical industry module (with ATEX-certified PTC evaluation and a NAMUR terminal strip).

**PC Inverter Connection Kit**

For controlling and commissioning an inverter directly from a PC if the appropriate software (STARTER commissioning tool) has been installed.

The STARTER commissioning tool on DVD is included in the PC Inverter Connection Kit.

**Brake Relay**

The Brake Relay allows the Power Module to be connected to an electromechanical motor brake, thereby allowing the motor brake to be driven directly by the Control Unit.

**Safe Brake Relay**

The Safe Brake Relay allows the Power Module to be connected to an electromechanical motor brake, allowing the brake to be directly and safely controlled from the Control Unit in accordance with EN 954-1 Category 3 and IEC 61508 SIL 2.

**Adapter for mounting on DIN rails**

The adapter for mounting on DIN rails can be used to mount inverters of the sizes FSA and FSB on DIN mounting rails (2 units with a center-to-center distance of 100 mm).

**Shield Connection Kit**

The Shield Connection Kit makes it easier to connect the shields of supply and control cables, offers mechanical strain relief and thus ensures optimum EMC performance.

**Shield Connection Kit for CU240S and CU230P-2**

The Shield Connection Kit offers optimum shield connection and strain relief for all signal and communication cables. It includes a matching shield bonding plate and all of the necessary connecting and retaining elements for mounting.

***Spare parts*****Spare Parts Kit for CU240**

The kit includes a replacement cover for the terminals, a suitable shield bar for the CU240E Control Unit including screws, replacement connector for the CU240S Control Unit, protective element of the MMC card slot and screws to attach the shield bonding plate of the CU240S Control Unit.

**Terminal Cover Kit**

The kit includes a replacement cover for the terminals. The kit can be ordered for PM240 Power Modules, frame sizes FSD, FSE and FSF, as well as for the PM260, frame size FSF.

**PM260 replacement connector**

This spare part includes a connector for the input and output sides for the PM260 Power Module, frame size FSD.

**SINAMICS G120 PM240 FSGX replacement door**

A complete replacement door can be ordered for the PM240 Power Module, frame size FSGX.

**Replacement fan**

The Power Module fans are designed for extra long service life. Replacement fans can be ordered for special applications.

***Configuration***

The following electronic configuring and engineering tools are available for the SINAMICS G120 standard inverters:

***Selection guide, SD Configurator***

More than 100000 products with approximately 5 million possible product versions from the area of drive technology are listed in the interactive Catalog CA 01 – the Offline Mall from Siemens IA&DT. In order to make it easier to select the optimum motor and/or inverter from the wide range of Standard Drives, the SD Configurator was developed, which is integrated as "Selection guide" in this catalog on the DVD together with the selection and engineering tools.

**Online SD Configurator**

In addition, the SD Configurator can be used in the Internet without requiring any installation. The SD Configurator can be found in the Siemens Mall under the following address:

<http://www.siemens.com/dt-configurator>

***SIZER configuration tool***

The SIZER PC tool makes it easy to configure the SINAMICS and MICROMASTER 4 drive family. It provides support when selecting the hardware and firmware components necessary to implement a drive task. SIZER supports the configuration of the complete drive system, from simple single-motor drives up to complex multi-axis applications.

***STARTER commissioning tool***

The STARTER commissioning tool is used to commission, optimize and diagnose drives in a menu-prompted fashion. In addition to SINAMICS drives, STARTER is also suitable for MICROMASTER 4 units and the frequency converters for the distributed I/O SIMATIC ET 200S FC and SIMATIC ET 200pro FC.

***Drive ES engineering system***

Drive ES is the engineering system used to integrate the communication, configuration and data management functions of Siemens drive technology into the SIMATIC automation world easily, efficiently and cost-effectively. The STEP 7 Manager user interface forms the basis. Various software packages are available for SINAMICS:

Drive ES Basic, Drive ES SIMATIC and Drive ES PCS 7.

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### SINAMICS G120 standard inverters

#### Technical specifications

Unless explicitly specified otherwise, the following technical specifications are valid for all the following components of the SINAMICS G120 standard inverters.

#### Mechanical specifications

##### Vibratory load

• Transport <sup>1)</sup> acc. to EN 60721-3-2 - All units and components except frame size FSGX - Units with frame size FSGX	Class 2M3
• Operation Test values acc. to EN 60068-2-6	Class 2M2  Test Fc: 10 ... 58 Hz: Constant deflection 0.075 mm 58 ... 150 Hz: Constant acceleration = 9.81 m/s <sup>2</sup> (1 g)
• Operation Test values acc. to EN 60068-2-6	Test Fc: 10 ... 58 Hz: Constant deflection 0.075 mm 58 ... 150 Hz: Constant acceleration = 9.81 m/s <sup>2</sup> (1 g)
• Operation Test values acc. to EN 60068-2-6	Test Ea: 147 m/s <sup>2</sup> (15 g)/11 ms 49 m/s <sup>2</sup> (5 g)/30 ms 98 m/s <sup>2</sup> (10 g)/20 ms

##### Shock load

• Transport <sup>1)</sup> acc. to EN 60721-3-2 - All units and components except frame size FSGX - Units with frame size FSGX	Class 2M3
• Operation Test values acc. to EN 60068-2-27 - Frame sizes FSA to FSC - Frame sizes FSD to FSF - Frame size FSGX	Class 2M2  Test Ea: 147 m/s <sup>2</sup> (15 g)/11 ms 49 m/s <sup>2</sup> (5 g)/30 ms 98 m/s <sup>2</sup> (10 g)/20 ms
• Operation Test values acc. to EN 60068-2-27 - Frame sizes FSA to FSC - Frame sizes FSD to FSF - Frame size FSGX	Test Ea: 147 m/s <sup>2</sup> (15 g)/11 ms 49 m/s <sup>2</sup> (5 g)/30 ms 98 m/s <sup>2</sup> (10 g)/20 ms

#### Ambient conditions

<b>Protection class</b> acc. to EN 61800-5-1	Class I (with protective conductor system) and Class III (PELV)
<b>Touch protection</b> acc. to EN 61800-5-1	For the intended purpose
<b>Permissible ambient and coolant temperature (air) during operation for line-side power components and Power Modules</b>	
• High overload (HO)	0 ... 50 °C (32 ... 122 °F) without derating (for PM240, frame size FSGX: 0 ... 40 °C), > 50 ... 60 °C see derating characteristics
• Light overload (LO)	0 ... 40 °C (32 ... 104 °F) without derating (for PM240, frame size FSGX: 0 ... 40 °C), > 40 ... 60 °C see derating characteristics
<b>Permissible ambient and coolant temperature (air) during operation for Control Units, additional system components and DC-link components</b>	-10 ... +50 °C (14 ... 122 °F) with CU240S DP-F: 0 ... 45 °C with CU240S PN-F: 0 ... 40 °C with IOP: 0 ... 50 °C up to 2000 m above sea level

#### Climatic ambient conditions

• Storage <sup>1)</sup> acc. to EN 60721-3-1	Class 1K3 temperature -25 ... +55 °C
• Transport <sup>1)</sup> acc. to EN 60721-3-2	Class 2K4 temperature -40 ... +70 °C max. humidity 95 % at 40 °C
• Operation acc. to EN 60721-3-3	Class 3K5 <sup>4)</sup> Condensation, splashwater and ice formation not permitted (EN 60204, Part 1)

<sup>1)</sup> In transport packaging.

<sup>2)</sup> Unfiltered inverters can be used in industrial environments as long as they are part of a system that contains line filters on the higher-level infeed side. As a consequence, a PDS (Power Drive System) can be installed according to C3.

#### Ambient conditions (continued)

##### Environmental class/harmful chemical substances

• Storage <sup>1)</sup> acc. to EN 60721-3-1	Class 1C2
• Transport <sup>1)</sup> acc. to EN 60721-3-2	Class 2C2
• Operation acc. to EN 60721-3-3	Class 3C2

##### Organic/biological influences

• Storage <sup>1)</sup> acc. to EN 60721-3-1	Class 1B1
• Transport <sup>1)</sup> acc. to EN 60721-3-2	Class 2B1
• Operation acc. to EN 60721-3-3	Class 3B1

##### Degree of pollution

acc. to EN 61800-5-1	2
----------------------	---

#### Certification for fail-safe versions

Applies to CU240 DP-F and CU240 PN-F Control Units. The values include Control Unit, Power Module and Safe Brake Relay.	
• Category acc. to EN 954-1	3
• SIL CI acc. to IEC 61508	2
• PL acc. to ISO 13849	Available soon
• PFH <sub>D</sub>	5 × 10 <sup>-8</sup>
• T1	10 Years

#### Standards

##### Standards conformance

<b>CE mark</b>	According to Low-Voltage Directive 73/23/EEC and Machinery Directive 98/37/EC
----------------	---

##### EMC Directive acc. to EN 61800-3

• Frame sizes FSA to FSGX without integrated line filter class A	Category C3 <sup>2)</sup>
• Frame sizes FSB to FSF with integrated line filter class A	Category C2 <sup>3)</sup> (corresponds to class A acc. to EN 55011 for conducted interference emission)
• Frame size FSA without integrated line filter and with additional line filter class A	Category C2 <sup>3)</sup> (corresponds to class A acc. to EN 55011 for conducted interference emission)
• Frame size FSA with additional line filter class A and with additional line filter class B	Category C2 <sup>3)</sup> (corresponds to class B acc. to EN 55011 for conducted interference emission)
• Frame sizes FSB and FSC with additional line filter class A and with additional line filter class B	Category C2 <sup>3)</sup> (corresponds to class B acc. to EN 55011 for conducted interference emission)

Note: The EMC product standard EN 61800-3 does not apply directly to a frequency inverter but to a PDS (Power Drive System), which comprises the complete circuitry, motor and cables in addition to the frequency inverters. The frequency inverters on their own do not generally require identification according to the EMC Directive.

<sup>3)</sup> With shielded motor cable up to 25 m.

<sup>4)</sup> For Intelligent Operator Panel IOP, class 3K3.

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### SINAMICS G120 standard inverters

#### Technical specifications

##### Compliance with standards

##### CE mark



The SINAMICS G120 inverters meet the requirements of the Low-Voltage Directive 73/23/EEC.

##### Low-Voltage Directive

The inverters comply with the following standards listed in the official journal of the EU:

- EN 60204  
Safety of Machinery, electrical equipment of machines
- EN 61800-5-1  
Electrical power drive systems with variable speed – Part 5-1: Requirements regarding safety – electrical, thermal, and energy requirements

##### UL listing



Inverter devices in UL category NMMS certified to UL and cUL, in compliance with UL508C. UL list numbers E121068 and E192450.

For use in environments with pollution degree 2.

Also see the Internet under <http://www.ul.com>

##### Machinery Directive

The inverters are suitable for installation in machines. Compliance with the Machinery Directive 98/37/EC requires a separate certificate of conformity. This must be provided by the plant construction company or the organization marketing the machine.

##### EMC Directive

- EN 61800-3  
Variable-speed electric drives  
Part 3: EMC product standard including specific test methods

The EMC product standard EN 61800-3 has been valid for electric drive systems since 07/01/2005. The transition period for the predecessor standard EN 61800-3/A11 from February 2001 ended on October 1, 2007. The following information applies to SINAMICS G120 frequency inverters from Siemens:

- The EMC product standard EN 61800-3 does not apply directly to a frequency inverter but to a PDS (Power Drive System), which comprises the complete circuitry, motor and cables in addition to the inverter.
- Frequency inverters are normally only supplied to experts for installation in machines or systems. A frequency inverter must, therefore, only be considered as a component which, on its own, is not subject to the EMC product standard EN 61800-3. The inverter's operating manual, however, specifies the conditions regarding compliance with the product standard if the frequency inverter is expanded to become a PDS. For a PDS, the EMC Directive in the EU is complied with by observing the product standard EN 61800-3 for variable-speed electric drive systems. The frequency inverters on their own do not generally require identification according to the EMC Directive.
- In the Standard EN 61800-3 from July 2005, a distinction is no longer made between "general availability" and "restricted availability". Instead, different categories C1 to C4 have been defined in accordance with the environment of the PDS at the operating location:

- **Category C1:** Drive systems for rated voltages < 1000 V for use in the first environment

- **Category C2:** Stationary drive systems not connected by means of a plug connector for rated voltages < 1000 V. When used in the first environment, the system must be installed and commissioned by personnel familiar with EMC requirements. A warning note is required.

- **Category C3:** Drive systems for rated voltages < 1000 V for exclusive use in the second environment. A warning note is required.

- **Category C4:** Drive systems for rated voltages  $\geq$  1000 V or for rated currents  $\geq$  400 A or for use in complex systems in the second environment. An EMC plan must be generated.

- The EMC product standard EN 61800-3 also defines limit values for conducted interference and radiated interference for the so-called "second environment" (= industrial power supply systems that do not supply households). These limit values are below the limit values of filter class A to EN 55011. Unfiltered inverters can be used in industrial environments as long as they are part of a system that contains line filters on the higher-level infeed side.
- With SINAMICS G120, Power Drive Systems (PDS) that fulfill the EMC product standard EN 61800-3 can be configured when observing the installation instructions in the product documentation.
- A differentiation must be made between the product standards for electrical drive systems (PDS) of the range of standards EN 61800 (of which Part 3 covers EMC topics) and the product standards for the devices/systems/machines, etc. This will probably not result in any changes in the practical use of frequency inverters. Since frequency inverters are always part of a PDS and these are part of a machine, the machine manufacturer must observe various standards depending on their type and environment (e.g. EN 61000-3-2 for line harmonics and EN 55011 for radio interference). The product standard for PDS on its own is, therefore, either insufficient or irrelevant.
- With respect to the compliance with limits for line supply harmonics, the EMC product standard EN 61800-3 for PDS refers to compliance with the EN 61000-3-2 and EN 61000-3-12 standards.
- Regardless of the configuration with SINAMICS G120 and its components, the machine construction company (OEM) can also apply other measures to ensure that the machine complies with the EU EMC Directive. The EU EMC Directive is generally fulfilled when the relevant EMC product standards are observed. If they are not available, the generic standards (e.g. DIN EN 61000-x-x) can be used instead. It is important that the conducted and emitted interference at the line connection point and outside the machine remain below the relevant limit values. Any suitable technical measures can be applied to ensure this.

##### SEMI F47

SEMI F47 is an industry standard relating to the immunity to voltage dips. This includes the requirement that industrial equipment must be able to tolerate defined dips or drops of the line supply voltage. As a result, industrial equipment that fulfills this standard is more reliable and productive. In the SINAMICS G120 product family, the PM240 and PM250 Power Modules fulfill the latest SEMI F47-0706 standard. In the case of a voltage dip, defined in accordance with SEMI F47-0706, these drives either continue to supply a defined output current, or using an automatic restart function, continue to operate as expected.

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## CU230 Control Units

### Overview



The CU230P-2 Control Units are especially suitable for drives with integrated technological functions for pump, fan and compressor applications. The I/O interface, the fieldbus interfaces and the additional software functions optimally support these applications. The integration of technological functions is a significant differentiating feature to the other Control Units of the SINAMICS G120 drive family.

# 4

Example: CU230P-2 HVAC Control Unit with Intelligent Operator Panel IOP on the PM240 Power Module, frame size FSC

### Selection and ordering data

Communication	Digital inputs	Digital outputs	Analog inputs	Analog outputs	Designation	Control Unit Order No.
<b>Standard</b>						
RS485/USS; Modbus RTU	6	3	4	2	CU230P-2 HVAC	<span style="color: orange;">new</span> <b>6SL3243-0BA30-1HA0</b>
PROFIBUS DP	6	3	4	2	CU230P-2 DP	<span style="color: orange;">new</span> <b>6SL3243-0BA30-1PA0</b>
CANopen	6	3	4	2	CU230P-2 CAN	<span style="color: orange;">new</span> <b>6SL3243-0BA30-1CA0</b>

### Function

#### Closed-loop control

- Linear and square torque characteristics for fluid flow and positive displacement machines
- ECO mode for additional energy saving
- Vector control without encoder for sophisticated control tasks

#### Connections

- Two analog inputs (current/voltage can be selected) to directly connect pressure/level sensors
- Two additional analog inputs to connect NI1000/PT1000 temperature sensors
- Direct control of valves and flaps using two 230 V relays

#### Interfaces

- PROFIBUS, USS, CANopen and Modbus RTU communication

#### Software functions

- Automatic restart function after power failure
- Flying restart
- Kinetic buffering ( $V_{dc\ min}$  control)
- PID controller for temperature, pressure, air quality, level
- Energy saving using the "hibernation mode"
- Load check function to monitor belts and flow
- Real time clock with three time generators

#### IOP wizards for special applications such as e.g.

- Pumps: Positive displacement (constant load torque) and centrifugal pumps (square load torque) with and without PID controller
- Fans: Radial and axial fans (square load torque) with and without PID controller
- Compressors: Positive displacement (constant load torque) and fluid flow machines (square load torque) with and without PID controller

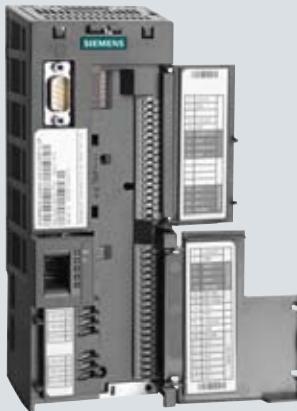
# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### CU230 Control Units

#### Design

**CU230P-2 HVAC, CU230P-2 DP, CU230P-2 CAN Control Units**



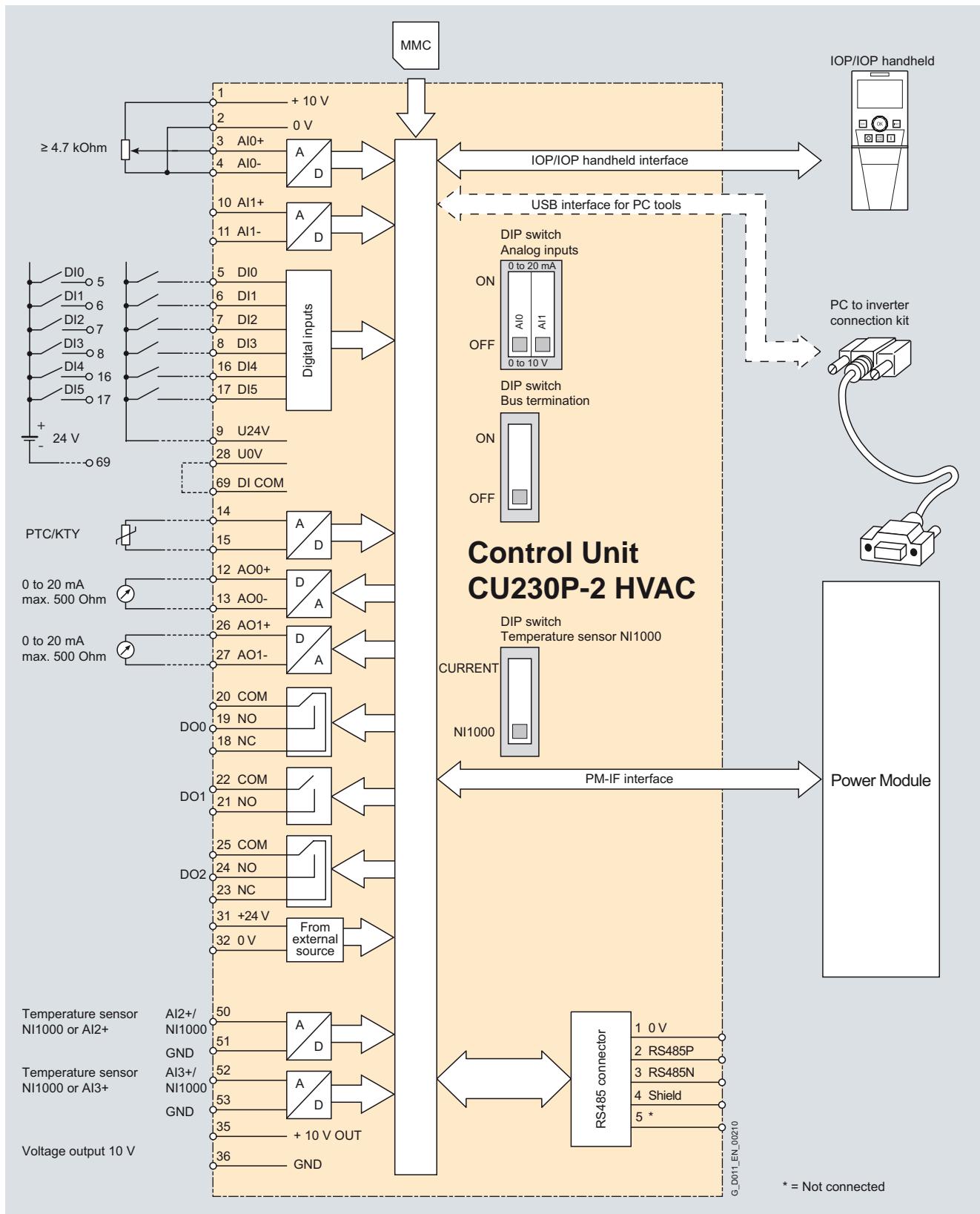
Example: CU230P-2 DP Control Unit with open terminal covers

Terminal No.	Signal	Features
<b>Digital inputs (DI) – Standard</b>		
69	DI Com	Reference potential for digital inputs
5 ... 8, 16.17	DIO ... DI5	Freely programmable isolated, inputs in compliance with IEC 61131-2
<b>Digital outputs (DO)</b>		
18	DO0, NC	Relay output 1 NC contact (2 A, 230 V AC)
19	DO0, NO	Relay output 1 NO contact (2 A, 230 V AC)
20	DO0, COM	Relay output 1 Common contact (2 A, 230 V AC)
21	DO1, NO	Relay output 2 NO contact (0.5 A, 30 V DC)
22	DO1, COM	Relay output 2 Common contact (0.5 A, 30 V DC)
23	DO2, NC	Relay output 3 NC contact (2 A, 230 V AC)
24	DO2, NO	Relay output 3 NO contact (2 A, 230 V AC)
25	DO2, COM	Relay output 3 Common contact (2 A, 230 V AC)

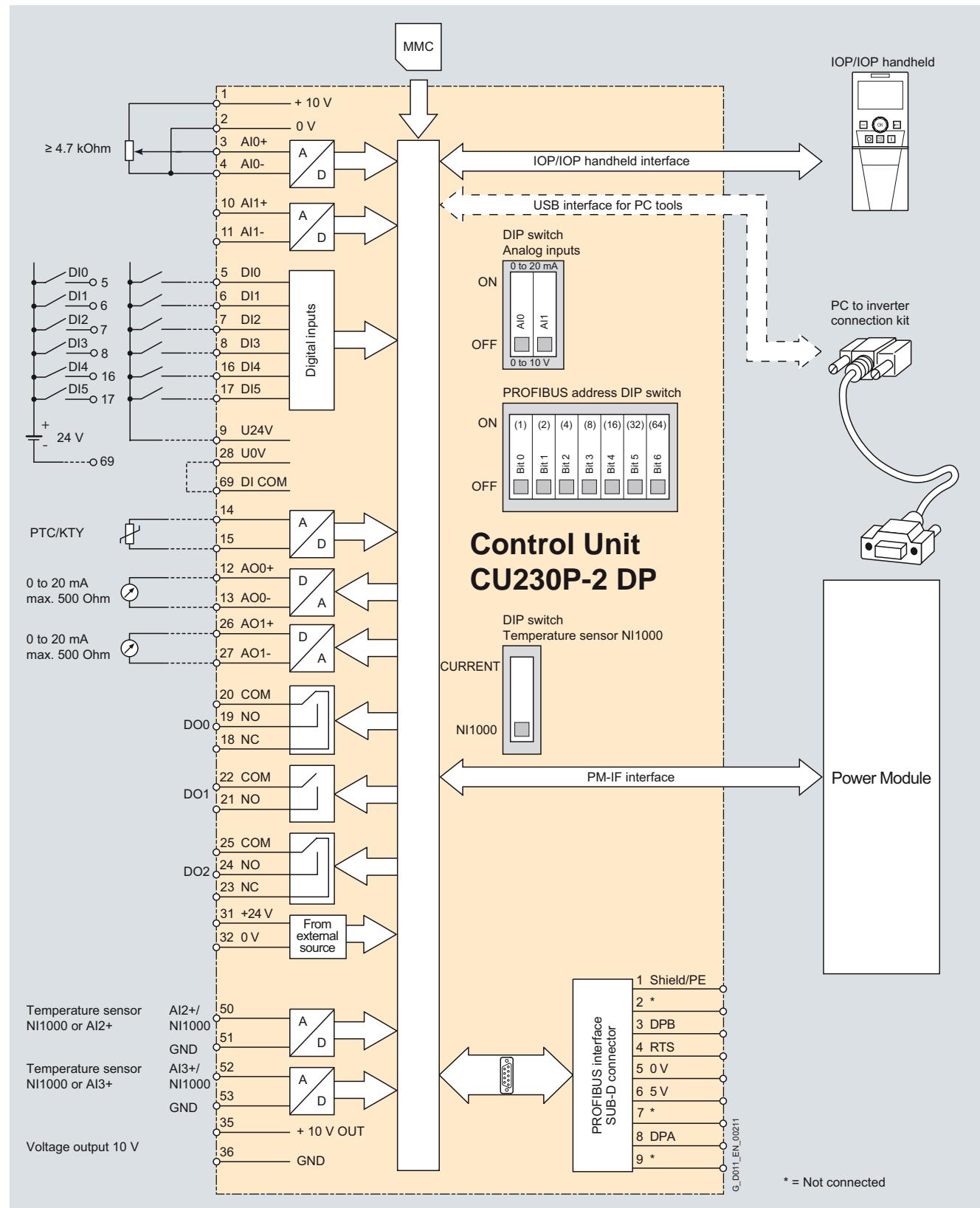
Terminal No.	Signal	Features
<b>Analog inputs (AI)</b>		
3	AI0+	Differential input, switchable between current, voltage
4	AI0-	Value range: 0 ... 10 V, -10 ... +10 V, 0/2 ... 10 V, 0/4 ... 20 mA
10	AI1+	Differential input, switchable between current, voltage
11	AI1-	Value range: 0 ... 10 V, -10 ... +10 V, 0/2 ... 10 V, 0/4 ... 20 mA
50	AI2+/NI1000	Non-isolated input, switchable between current, temperature sensors, type PT1000, NI1000 Value range: 0/4 ... 20 mA, PT1000 -50 ... +250 °C; NI1000 -50 ... +150 °C
51	GND	Reference potential of the AI2/internal electronics ground
52	AI3+/NI1000	Non-isolated input for temperature sensors, Type PT1000, NI1000 Value range: PT1000 -50 ... +250 °C; NI1000 -50 ... +150 °C
53	GND	Reference potential of the AI3/internal electronics ground
<b>Analog outputs (AO)</b>		
12	AO0+	Non-isolated output Freely programmable Value range: 0 ... 10 V; 0/4 ... 20 mA
13	AO GND	Reference potential of the AO0/internal electronics ground
26	AO1+	Non-isolated output Freely programmable Value range: 0 ... 10 V; 0/4 ... 20 mA
27	AO GND	Reference potential of the AO1/internal electronics ground
<b>Motor temperature sensor interface</b>		
14	T1 motor	Positive input for motor temperature sensor Type: PTC, KTY sensor, Thermo-Click
15	T2 motor	Negative input for motor temperature sensor
<b>Power supply</b>		
9	+24 V OUT	Power supply output 24 V DC, max. 200 mA
28	GND	Reference potential of the power supply/internal electronics ground
1	+10 V OUT	Power supply output 10 V DC ±0.5 V, max. 10 mA
2	GND	Reference potential of the power supply/internal electronics ground
31	+24 V IN	Power supply input 18 ... 30 V DC, max. 1500 mA
32	GND IN	Reference potential of the power supply input
35	+10 V OUT	Power supply output 10 V DC ±0.5 V max. 10 mA
36	GND	Reference potential of the power supply/internal electronics ground

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**CU230 Control Units****Integration**

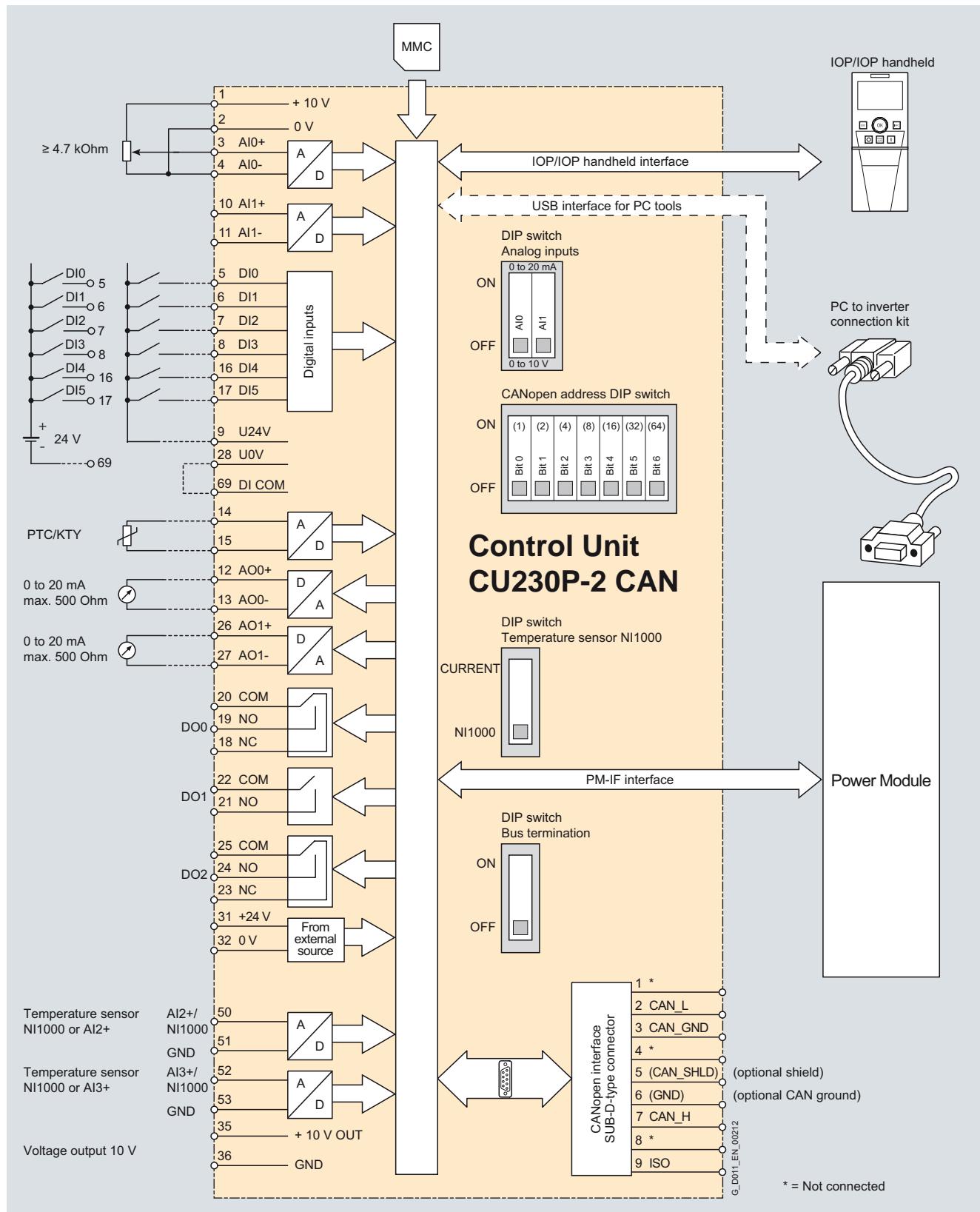
CU230P-2 HVAC Control Unit connection diagram

**Integration**

CU230P-2 DP Control Unit connection diagram

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**CU230 Control Units****Integration**

CU230P-2 CAN Control Unit connection diagram

## Technical specifications

Control Unit	CU230P-2 HVAC 6SL3243-0BA30-1HA0	CU230P-2 DP 6SL3243-0BA30-1PA0	CU230P-2 CAN 6SL3243-0BA30-1CA0
<b>Electrical specifications</b>			
<b>Operating voltage</b>	24 V DC from the Power Module or from the connection of an external power supply 18 ... 30 V DC		
<b>Current consumption</b>	Max. 0.5 A		
<b>Protective insulation</b>	PELV according to EN 50178 Protective separation from the line supply using double/reinforced insulation		
<b>Power loss</b>	<5.5 W		
<b>Interfaces</b>			
<b>Digital inputs – Standard</b>	6 isolated inputs, optically isolated; free reference potential (own potential group) NPN/PNP logic can be selected using the wiring Switching level: 0 → 1: 11 V Switching level: 1 → 0: 5 V Max. input current 15 mA		
<b>Digital outputs</b>	2 relay change-over contacts 250 V AC 2 A (inductive load), 30 V DC 5 A (ohmic load) 1 relay NO contact 30 V DC, 0.5 A (ohmic load)		
<b>Analog inputs</b>	2 differential inputs, switchable between voltage and current using DIP switch: -10 ... +10 V, 0/4 ... 20 mA, 10-bit resolution 1 non-isolated input, switchable using DIP switch between current and temperature sensor, type NI1000/PT1000, 0/4 ... 20 mA; 10-bit resolution 1 non-isolated input, temperature sensor, type NI1000/PT1000, 10-bit resolution The two differential analog inputs can be configured as additional digital inputs. Switching thresholds: 0 → 1: Rated voltage 4 V 1 → 0: Rated voltage 1.6 V Analog inputs are protected against inputs in a voltage range of ±30 V and have a common-mode voltage in the ±15 V range.		
<b>Analog outputs</b>	2 non-isolated outputs, switchable between voltage and current using parameter setting: 0 ... 10 V; 0/4 ... 20 mA Voltage mode: 10 V, min. burden 10 kΩ current mode: 20 mA, max. burden 500 Ω The analog outputs have short circuit protection		
<b>PTC/KTY interface</b>	1 motor temperature sensor input, sensors that can be connected PTC, KTY and Thermo-Click, accuracy ±5 °C		
<b>Bus interface</b>			
<b>Type</b>	<b>RS485</b>	<b>PROFIBUS DP</b>	<b>CANopen</b>
<b>Protocols</b>	USS Modbus RTU (switchable per software)	ProfiDrive profile V4.1	CANopen
<b>Hardware</b>	Terminal Insulated USS: max. 187.5 kBaud Modbus RTU: 19.2 kBaud bus terminating resistors can be switched in	9-pin SUB-D connector Insulated Max. 12 Mbit/s Slave address can be set using DIP switches	9-pin SUB-D socket Insulated Max. 1 Mbit/s
<b>Tool interfaces</b>			
<b>Memory card</b>	1 MicroMemoryCard		
<b>Operator panels</b>	IOP supported connection options between CU230P and IOP: can be directly plugged on, door mounting or handheld BOP not possible		
<b>PC interface</b>	USB		
<b>Open-loop/closed-loop control techniques</b>			
<b>V/f linear/square/parameterizable</b>	✓		
<b>V/f with flux current control (FCC)</b>	✓		
<b>V/f ECCO linear/square</b>	✓		
<b>Vector control, without encoder</b>	✓		
<b>Vector control, with encoder</b>	–		
<b>Torque control, without encoder</b>	✓		
<b>Torque control, with encoder</b>	–		

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**CU230 Control Units****Technical specifications**

Control Unit	CU230P-2 HVAC 6SL3243-0BA30-1HA0	CU230P-2 DP 6SL3243-0BA30-1PA0	CU230P-2 CAN 6SL3243-0BA30-1CA0
<b>Software functions</b>			
<b>Setpoint input</b>	✓		
<b>Fixed frequencies</b>	16, parameterizable		
<b>JOG</b>	✓		
<b>Digital motorized potentiometer (MOP)</b>	✓		
<b>Ramp smoothing</b>	✓		
<b>Extended ramp-function generator (with ramp smoothing Off3)</b>	✓		
<b>Positioning down ramp</b>	—		
<b>Slip compensation</b>	✓		
<b>Signal interconnection with BICO technology</b>	✓		
<b>Free function blocks (FFB) for logic and arithmetic operations</b>	—		
<b>Switchable drive data sets (DDS)</b>	✓ (4)		
<b>Switchable command data sets (CDS)</b>	✓ (4)		
<b>Flying restart</b>	✓		
<b>Automatic restart after line supply failure or operating fault (AR)</b>	✓		
<b>Technology controller (internal PID)</b>	✓		
<b>Energy-saving function (hibernation) with internal PID controller</b>	✓		
<b>Energy-saving function (hibernation) with external PID controller</b>	✓		
<b>Belt monitoring with and without sensor (load torque monitoring)</b>	✓		
<b>Dry pump monitoring (load torque monitoring)</b>	✓		
<b>Thermal motor protection</b>	✓ ( $\dot{P}t$ , sensor: PTC/KTY/Thermo-Click)		
<b>Thermal inverter protection</b>	✓		
<b>Motor identification</b>	✓		
<b>Motor holding brake</b>	—		
<b>Auto-ramping (<math>V_{dcmax}</math> controller)</b>	✓ (only with PM240 Power Module)		
<b>Kinetic buffering (<math>V_{dcmax}</math> controller)</b>	✓ (only with PM240 Power Module)		
<b>Braking functions for</b>	✓ (only with PM240 Power Module)		
• DC braking			
• Compound braking			
• Dynamic braking with integrated brake chopper			
<b>Mechanical specifications and ambient conditions</b>			
<b>Degree of protection</b>	IP20		
<b>Signal cable cross-section</b>			
• min.	0.15 mm <sup>2</sup> (AWG28)		
• max.	1.5 mm <sup>2</sup> (AWG16)		
<b>Operating temperature</b>	-10 ... +60 °C (14 ... 140 °F)		
<b>Storage temperature</b>	-40 ... +70 °C (-40 ... +158 °F)		
<b>Relative humidity</b>	<95 % RH, condensation not permissible		
<b>Dimensions</b>			
• Width	73 mm		
• Height	199 mm		
• Depth	65.5 mm		
<b>Weight, approx.</b>	0.61 kg		

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### CU240 Control Units

#### Overview



Example of CU240S DP-F Control Unit

The Control Unit performs closed-loop control functions for the inverter. In addition to the closed-loop control, it has additional functions that can be adapted to the particular application through parameterization. Several Control Units are available in different versions:

- CU240E
- CU240S
- CU240S DP
- CU240S DP-F
- CU240S PN
- CU240S PN-F

#### *Safety Integrated functions*

The following Safety Integrated functions are integrated in the CU240S DP-F and CU240S PN-F Control Units and, with the exception of the "Safe Brake Control", can be implemented without external circuit elements:

The SINAMICS G120 fail-safe frequency inverter provides four safety functions, certified in accordance with EN 954-1, Category 3 and IEC 61508 SIL 2:

- Safe Torque Off (STO) to protect against active movement of the drive
- Safe Stop 1 (SS1) for continuous monitoring of a safe braking ramp
- Safely Limited Speed (SLS) for protection against dangerous movements when a speed limit is exceeded
- Safe Brake Control (SBC) for controlling motor brakes that are active in the de-energized state, e.g. motor holding brakes

The functions "Safe Stop 1" and "Safely Limited Speed" can both be implemented without having to use a motor sensor or encoder; the implementation cost is minimal. Existing systems in particular can be simply updated with safety technology without the need to change the motor or mechanical system.

The safety functions "Safely Limited Speed" and "Safe Stop 1" are not certified for pull-through loads as in the case of lifting gear and winders.

Safety functions have been extended with firmware V3.2.

Additional information is provided in the part Highlights, section Safety Integrated.

#### Selection and ordering data

Communication	Digital inputs Standard	Digital inputs Fail-safe	Digital outputs	Encoder interfaces	Designation	Control Unit Order No.
<b>Standard</b>						
RS485/USS	6	–	3	–	CU240E	<b>6SL3244-0BA10-0BA0</b>
RS485/USS	9	–	3	1	CU240S	<b>6SL3244-0BA20-1BA0</b>
PROFIBUS DP	9	–	3	1	CU240S DP	<b>6SL3244-0BA20-1PA0</b>
PROFINET	9	–	3	1	CU240S PN	<b>6SL3244-0BA20-1FA0</b>
<b>Fail-safe for Safety Integrated</b>						
PROFIBUS DP	6	2	3	1	CU240S DP-F	<b>6SL3244-0BA21-1PA0</b>
PROFINET	6	2	3	1	CU240S PN-F	<b>6SL3244-0BA21-1FA0</b>

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## CU240 Control Units

### Design

#### *CU240E Control Unit*



CU240E Control Unit without terminal cover

Terminal No.	Signal	Features
<b>Digital inputs (DI)</b>		
5 ... 8, 16/17	DI0 ... DI5	Freely programmable (isolated) 5.5 mA/24 V
<b>Digital outputs (DO)</b>		
18	DO0, NC	Relay output 1 NC contact (0.5 A, 30 V DC)
19	DO0, NO	Relay output 1 NO contact (0.5 A, 30 V DC)
20	DO0, COM	Relay output 1 Common contact (0.5 A, 30 V DC)
21	DO1, NO	Relay output 2 NO contact (0.5 A, 30 V DC)
22	DO1, COM	Relay output 2 Common contact (0.5 A, 30 V DC)
23	DO2, NC	Relay output 3 NC contact (0.5 A, 30 V DC)
24	DO2, NO	Relay output 3 NO contact (0.5 A, 30 V DC)
25	DO2, COM	Relay output 3 Common contact (0.5 A, 30 V DC)
<b>Analog inputs (AI)</b>		
3	AI0+	0 ... 10 V, -10 ... +10 V, 0/2 ... 10 V or 0/4 ... 20 mA
4	AI0-	
10	AI1+	0 ... 10 V, 0 ... 20 mA
11	AI1-	
<b>Analog outputs (AO)</b>		
12	AO0+	Freely programmable (0/4 ... 20 mA with max. 500 Ω, 0/2 ... 10 V with min. 500 Ω)
13	AO0-	M
26	AO1+	Freely programmable (0/4 ... 20 mA with max. 500 Ω)
27	AO1-	M
<b>PTC/KTY interface</b>		
14	PTC+	Positive PTC/KTY input
15	PTC-	Negative PTC/KTY input
<b>Serial RS485 interface</b>		
29	P+	RS485 A, USS protocol
30	N-	RS485 B, USS protocol
<b>Power supply</b>		
9	U 24 V	Isolated user power supply +24 V at 100 mA
28	U 0 V	Isolated user reference voltage
1	+10 V	Non-isolated, regulated 10 V power supply for I/O – max. 10 mA
2	0 V	Power supply reference

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### CU240 Control Units

#### Design

**CU240S, CU240S DP, CU240S DP-F, CU240S PN and CU240S PN-F Control Units**



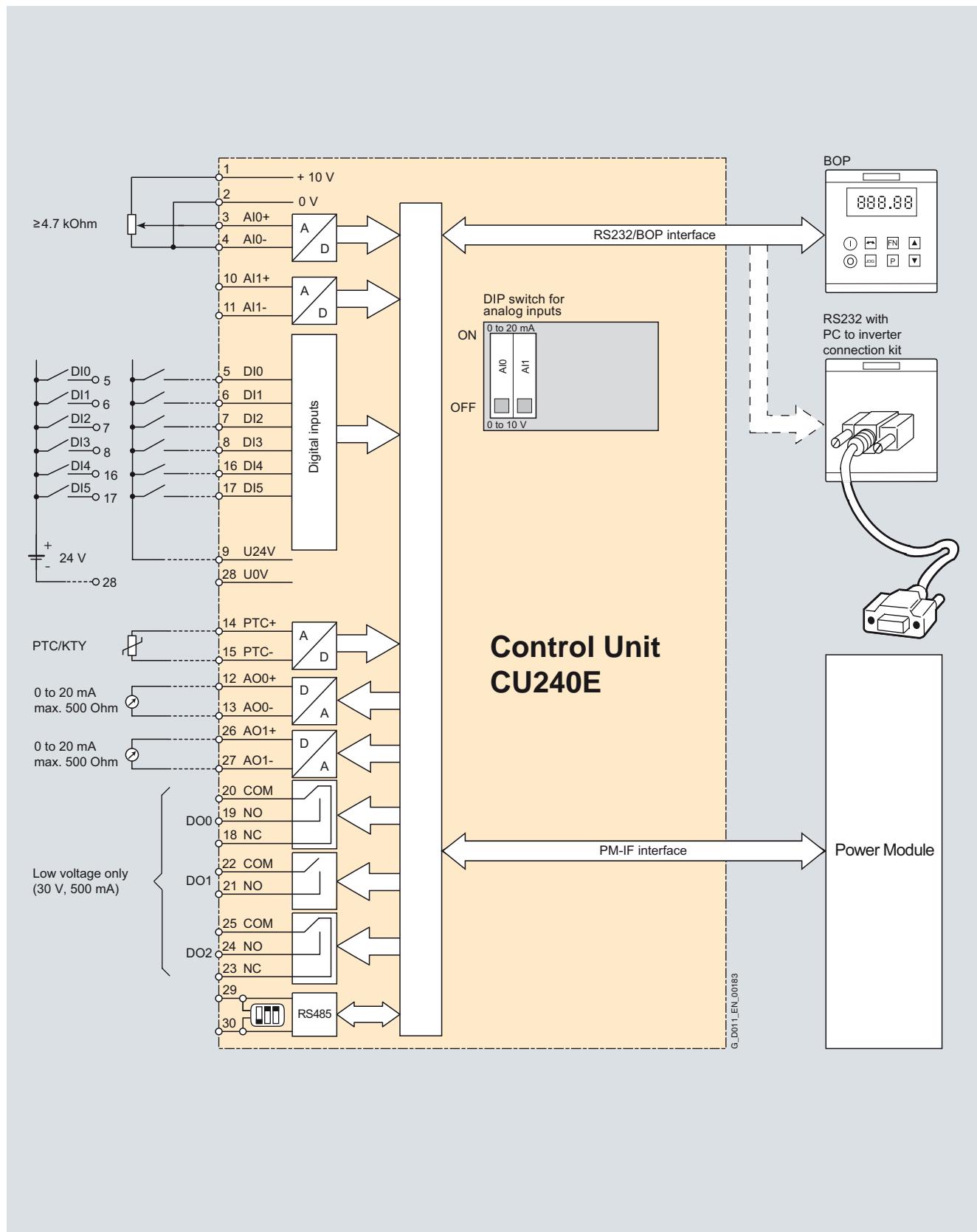
Example: CU240S DP-F Control Unit (right without terminal cover, with pluggable terminals)

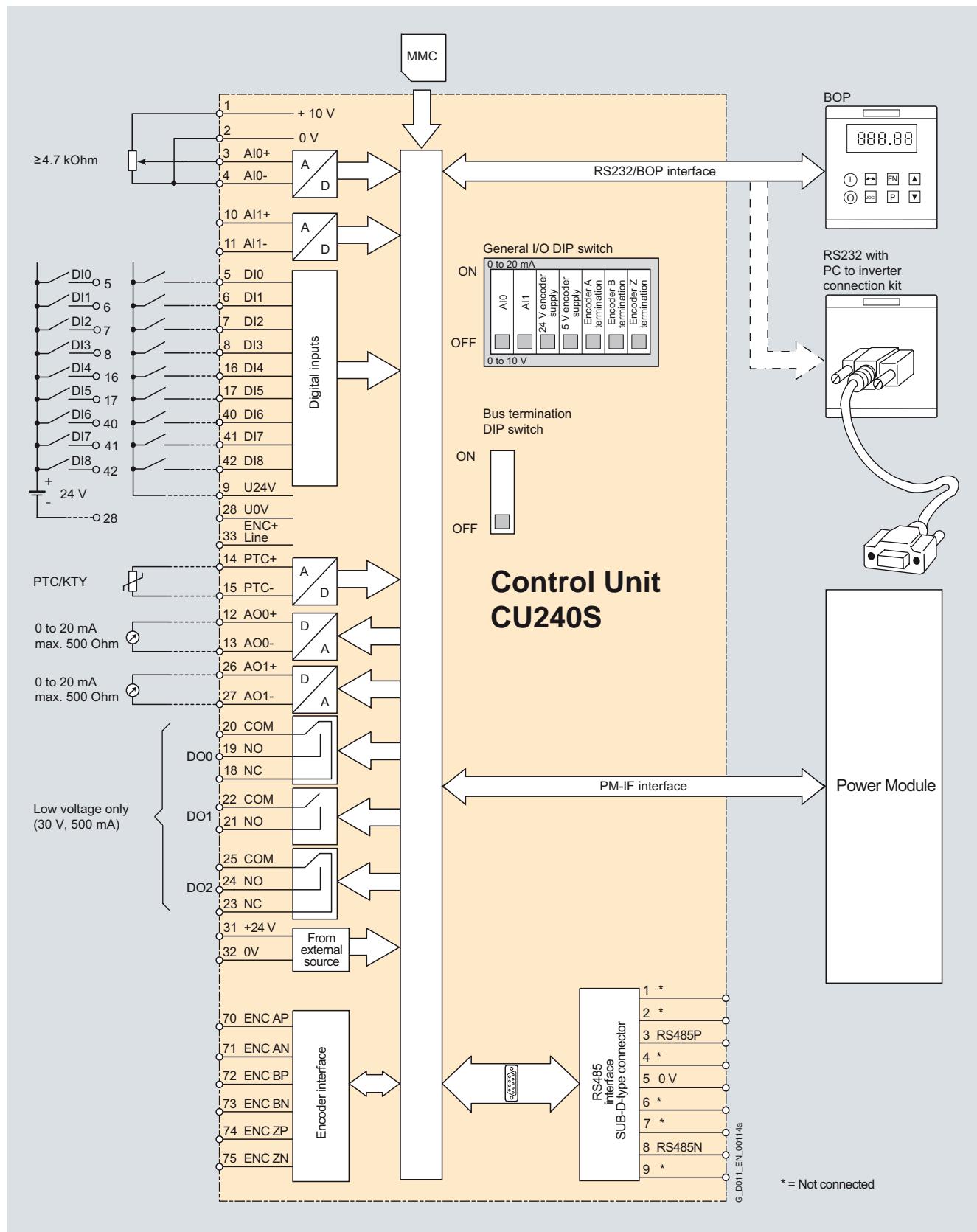
Terminal No.	Signal	Features
<b>Digital inputs (DI) – Standard</b>		
5 ... 8, 16.17	DI0 ... DI5	Freely programmable (isolated) 5.5 mA/24 V
40 ... 42 (only for CU240S, CU240S DP and CU240S PN)	DI6 ... DI8	Freely programmable (isolated) 5.5 mA/24 V
<b>Digital inputs (DI) – Fail-safe (for CU240S DP-F and CU240S PN-F only)</b>		
60 ... 63 (for CU240S DP-F and CU240S PN-F only)	FDI0A FDI0B FDI1A FDI1B	Fail-safe digital inputs, 2 channels (redundant), freely programmable (isolated) 5.5 mA/24 V
<b>Digital outputs (DO)</b>		
18	DO0, NC	Relay output 1 NC contact (0.5 A, 30 V DC)
19	DO0, NO	Relay output 1 NO contact (0.5 A, 30 V DC)
20	DO0, COM	Relay output 1 Common contact (0.5 A, 30 V DC)
21	DO1, NO	Relay output 2 NO contact (0.5 A, 30 V DC)
22	DO1, COM	Relay output 2 Common contact (0.5 A, 30 V DC)
23	DO2, NC	Relay output 3 NC contact (0.5 A, 30 V DC)
24	DO2, NO	Relay output 3 NO contact (0.5 A, 30 V DC)
25	DO2, COM	Relay output 3 Common contact (0.5 A, 30 V DC)

Terminal No.	Signal	Features
<b>Analog inputs (AI)</b>		
3	AI0+	0 ... 10 V, -10 ... +10 V, 0/2 ... 10 V or 0/4 ... 20 mA
4	AI0-	
10	AI1+	0 ... 10 V, 0 ... 20 mA
11	AI1-	
<b>Analog outputs (AO)</b>		
12	AO0+	Freely programmable (0/4 ... 20 mA with max. 500 Ω, 0/2 ... 10 V with min. 500 Ω)
13	AO0-	M
26	AO1+	Freely programmable (0/4 ... 20 mA with max. 500 Ω)
27	AO1-	M
<b>Encoder interface</b>		
70	ENC AP	Encoder AP Channel A non-inverting input
71	ENC AN	Encoder AN Channel A inverting input
72	ENC BP	Encoder BP Channel B non-inverting input
73	ENC BN	Encoder BN Channel B inverting input
74	ENC ZP	Encoder ZP Zero pulse non-inverting input
75	ENC ZN	Encoder ZN Zero pulse inverting input
<b>PTC/KTY interface</b>		
14	PTC+	Positive PTC/KTY input
15	PTC-	Negative PTC/KTY input
<b>Power supply</b>		
33	ENC+ line supply	Isolated encoder power supply (+24 V at 100 mA, +5 V at 300 mA), configured using DIP switch
9	U 24 V	Isolated user power supply +24 V at 100 mA
28	U 0 V	Isolated encoder power supply and user reference voltage
1	+10 V	Non-isolated, regulated 10 V power supply for I/O – max. 10 mA
2	0 V	Power supply reference
31	+24 V	24 V power supply input
32	0 V	24 V power supply reference

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

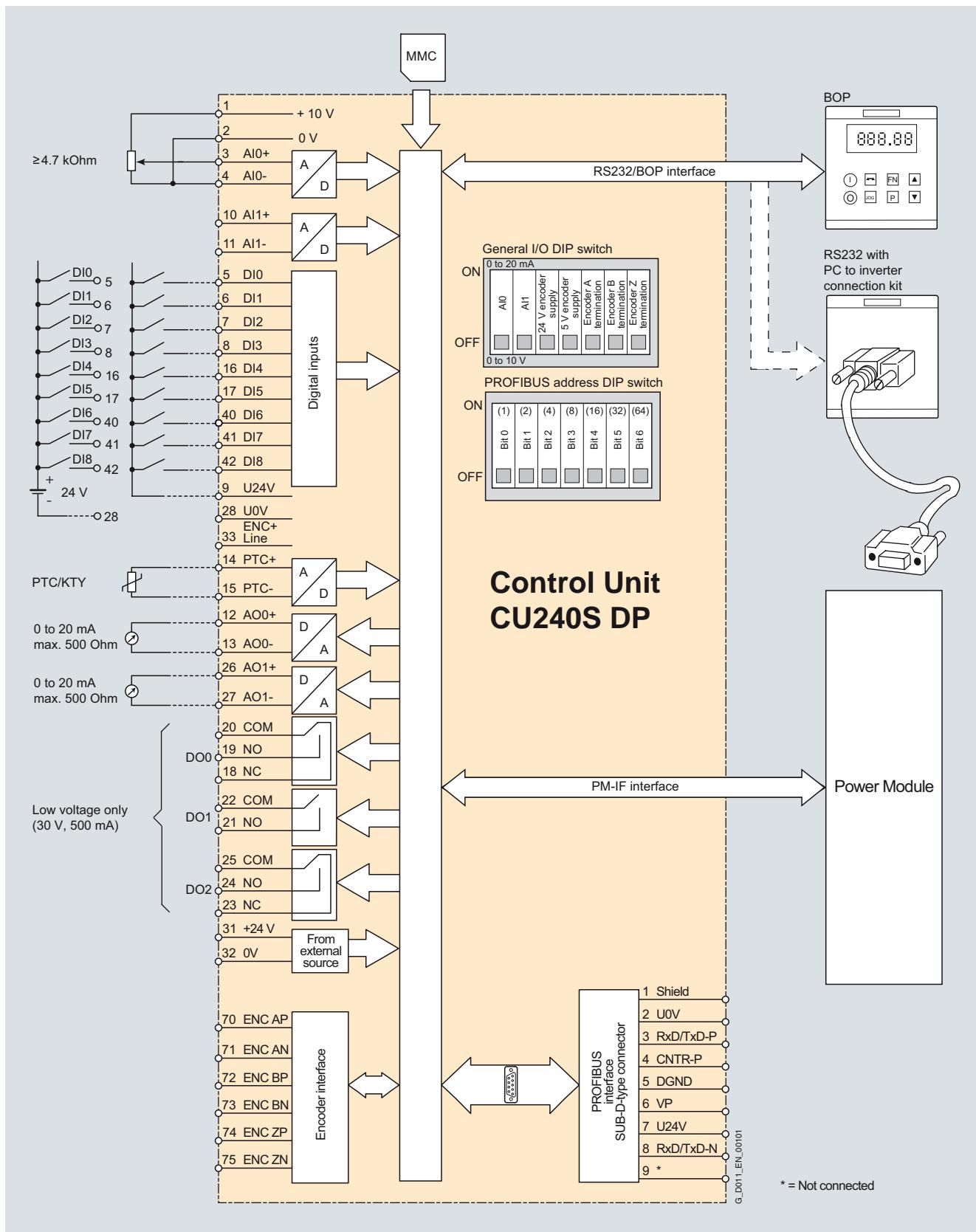
**CU240 Control Units****Integration**

**Integration**

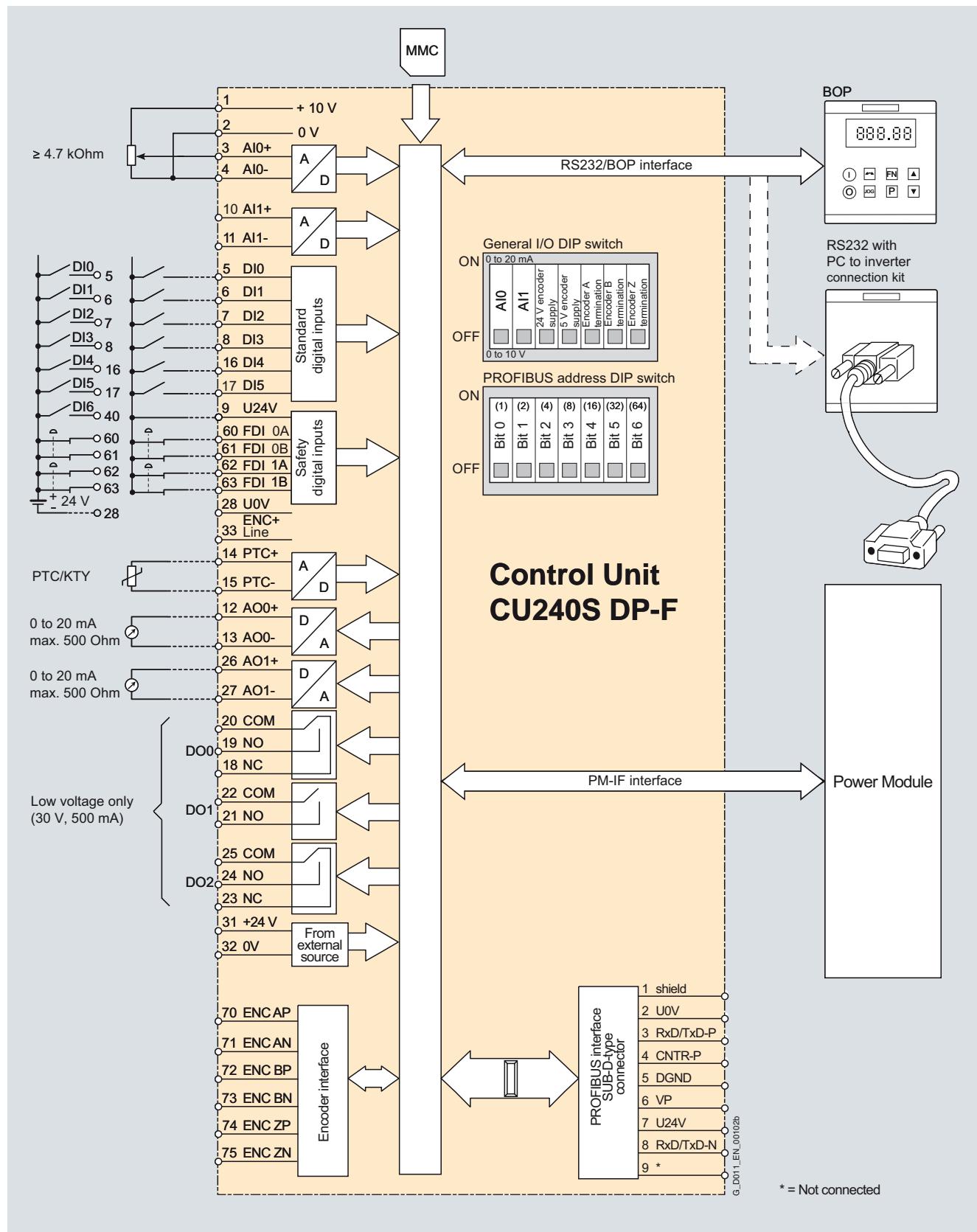
CU240S Control Unit connection diagram

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**CU240 Control Units****Integration**

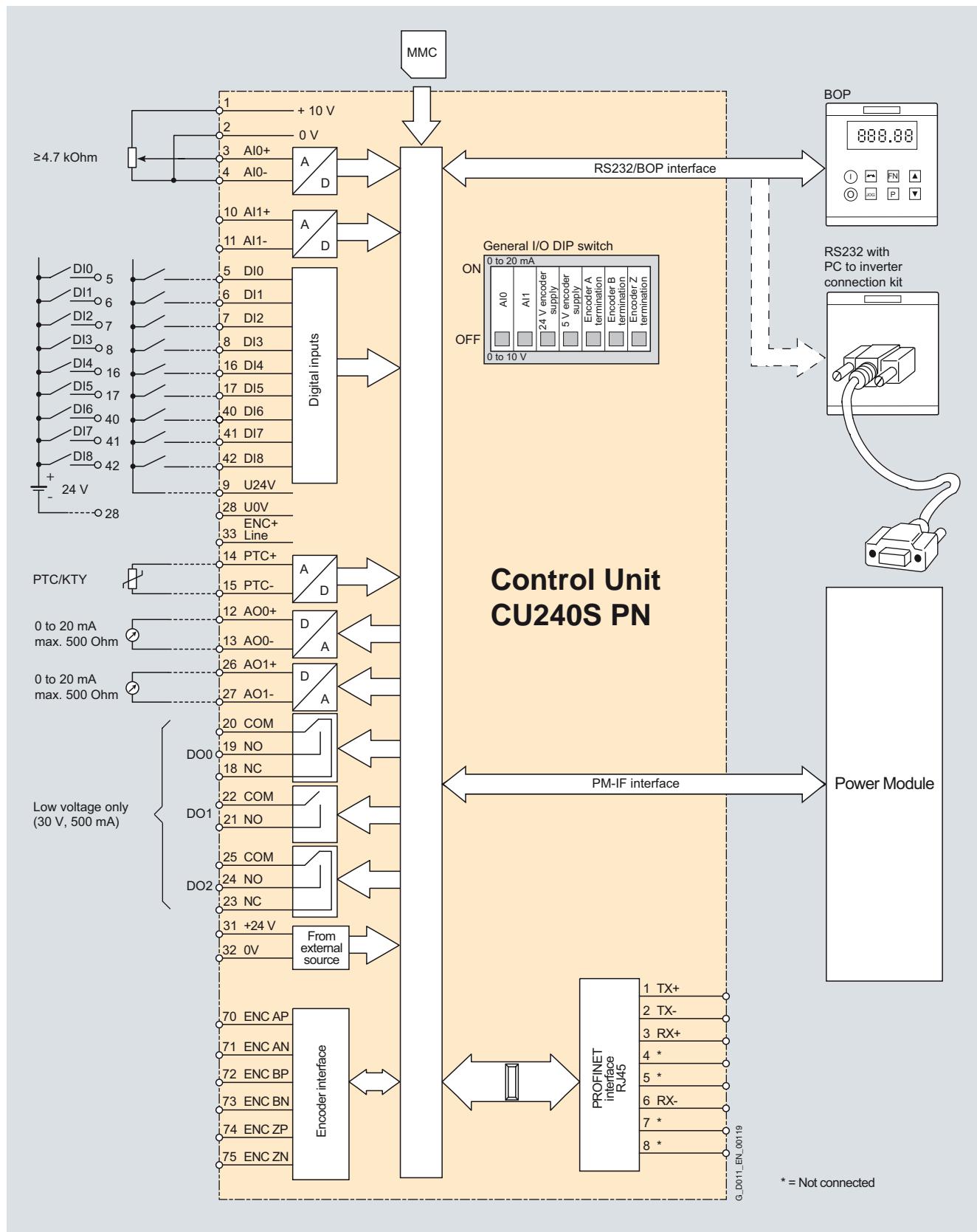
CU240S DP Control Unit connection diagram

**Integration**

CU240S DP-F Control Unit connection diagram

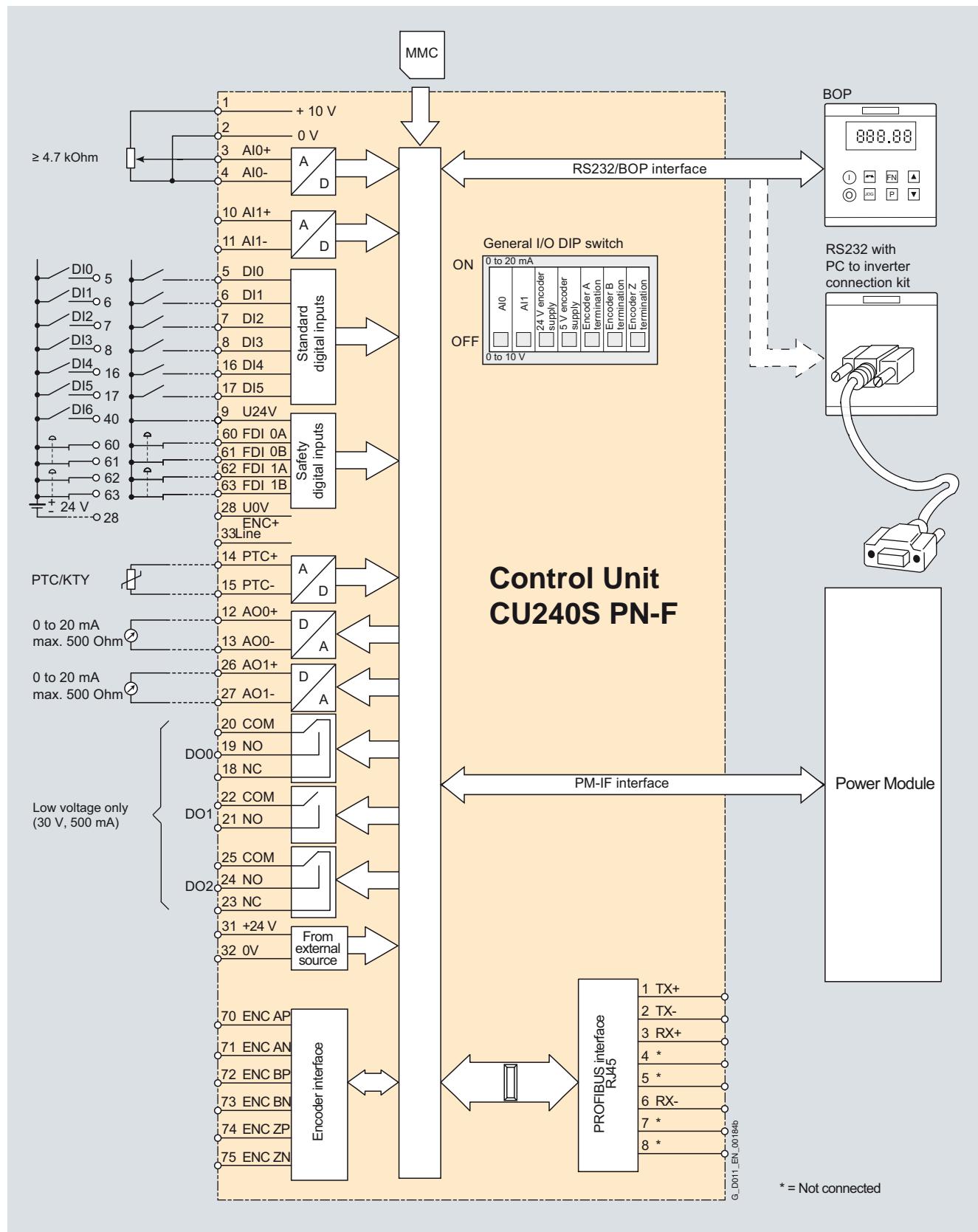
**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**CU240 Control Units****Integration**

CU240S PN Control Unit connection diagram

## Integration



CU240S PN-F Control Unit connection diagram

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**CU240 Control Units****Technical specifications**

Control Unit	CU240E 6SL3244- 0BA10-0BA0	CU240S 6SL3244- 0BA20-1BA0	CU240S DP 6SL3244- 0BA20-1PA0	CU240S PN 6SL3244- 0BA20-1FA0	CU240S DP-F 6SL3244- 0BA21-1PA0	CU240S PN-F 6SL3244- 0BA21-1FA0
<b>Electrical specifications</b>						
<b>Operating voltage</b>	24 V DC via the Power Module	24 V DC via the Power Module or external 24 V DC	24 V DC via the Power Module or external 24 V DC	24 V DC via the Power Module or external 24 V DC	24 V DC via the Power Module or external 24 V DC	24 V DC via the Power Module or external 24 V DC
<b>Current drain from the 24 V supply</b>	Available soon	Max. 0.5 A	Max. 0.5 A	Max. 0.7 A	Max. 0.7 A	Max. 0.7 A
<b>Power loss (full load)</b>	< 5.5 W	< 5.5 W	< 5.5 W	< 13 W	< 16 W	< 17 W
<b>Interfaces</b>						
<b>Digital inputs – Standard</b>	6	9	9	9	6	6
<b>Digital inputs – Fail-safe</b>	–	–	–	–	2	2
<b>Digital outputs</b>	3	3	3	3	3	3
<b>Analog inputs</b>	2	2	2	2	2	2
	Both analog inputs can be configured as supplementary digital inputs if an additional function is required. Switching thresholds: 0 → 1: Rated voltage 2 V 1 → 0: Rated voltage 0.8 V					
	Analog inputs are protected against inputs in a voltage range of ±30 V and have a common-mode voltage in the ±15 V range.					
<b>Analog outputs</b>	2	2	2	2	2	2
	Analog outputs have short-circuit protection, but are not isolated. Maximum output voltage = 10 V in the current mode, maximum output current = 20 mA in the voltage mode. The response time should be approximately 1 ms at a load of max. 10 kΩ in the voltage mode.					
<b>Bus interface</b>	RS485/USS	RS485/USS	PROFIBUS DP	PROFINET	PROFIBUS DP, PROFIsafe	PROFINET, PROFIsafe
<b>Encoder interfaces</b>	–	1	1	1	1	1
<b>PTC/KTY interface</b>	✓	✓	✓	✓	✓	✓
<b>Brake Relay interface or Safe Brake Relay interface (connected via Power Module)</b>	✓	✓	✓	✓	✓	✓
<b>MMC memory card slot</b>	–	✓	✓	✓	✓	✓
<b>Operator panels that can be used</b>	BOP, IOP Hand-held (via PC Inverter Connection Kit)	BOP, IOP Hand-held (via PC Inverter Connection Kit)	BOP, IOP Hand-held (via PC Inverter Connection Kit)	BOP, IOP Hand-held (via PC Inverter Connection Kit)	BOP, IOP Hand-held (via PC Inverter Connection Kit)	BOP, IOP Hand-held (via PC Inverter Connection Kit)
<b>RS232/USS interface (connection via PC Inverter Connection Kit)</b>	✓	✓	✓	✓	✓	✓
<b>Safety functions</b>						
<b>Integrated safety functions acc. to Category 3 of EN 954-1 and acc. to SIL 2 of IEC 61508</b>	–	–	–	–	<ul style="list-style-type: none"> <li>• Safe Stop 1 (SS1)</li> <li>• Safely Limited Speed (SLS)</li> <li>• Safe Brake Control (SBC)</li> <li>• Safe Torque Off (STO)</li> </ul>	
<b>Open-loop/closed-loop control techniques</b>						
<b>V/f linear/square/parameterizable</b>	✓	✓	✓	✓	✓	✓
<b>V/f with flux current control (FCC)</b>	✓	✓	✓	✓	✓	✓
<b>Vector control, without encoder</b>	✓	✓	✓	✓	✓	✓
<b>Vector control, with encoder</b>	–	✓	✓	✓	✓	✓
<b>Torque control, without encoder</b>	✓	✓	✓	✓	✓	✓
<b>Torque control, with encoder</b>	–	✓	✓	✓	✓	✓

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### CU240 Control Units

#### Technical specifications

Control Unit	CU240E 6SL3244- 0BA10-0BA0	CU240S 6SL3244- 0BA20-1BA0	CU240S DP 6SL3244- 0BA20-1PA0	CU240S PN 6SL3244- 0BA20-1FA0	CU240S DP-F 6SL3244- 0BA21-1PA0	CU240S PN-F 6SL3244- 0BA21-1FA0
<b>Software functions</b>						
<b>Fixed frequencies</b>	16, parameterizable					
Signal interconnection with BICO technology	✓	✓	✓	✓	✓	✓
Automatic restart after line supply failure or operational fault	✓	✓	✓	✓	✓	✓
Positioning down ramp	✓	✓	✓	✓	✓	✓
Slip compensation	✓	✓	✓	✓	✓	✓
Free function blocks (FFB) for logic and arithmetic operations	✓	✓	✓	✓	✓	✓
Ramp smoothing	✓	✓	✓	✓	✓	✓
3 selectable drive data sets	✓	✓	✓	✓	✓	✓
3 selectable command data sets (CDS) (manual/auto)	✓	✓	✓	✓	✓	✓
Flying restart	✓	✓	✓	✓	✓	✓
JOG	✓	✓	✓	✓	✓	✓
Technology controller (PID)	✓	✓	✓	✓	✓	✓
Thermal motor protection	✓	✓	✓	✓	✓	✓
Thermal inverter protection	✓	✓	✓	✓	✓	✓
Setpoint input	✓	✓	✓	✓	✓	✓
Motor identification	✓	✓	✓	✓	✓	✓
Motor holding brake	✓	✓	✓	✓	✓	✓
$V_{dcmax}$ controller	✓ (only with PM240)					
Kinetic buffering	✓ (only with PM240)					
<b>Braking functions for</b> • DC braking • Compound braking • Dynamic braking with integrated brake chopper	✓ (only with PM240)					
<b>Mechanical specifications and ambient conditions</b>						
<b>Degree of protection</b>	IP20	IP20	IP20	IP20	IP20	IP20
<b>Signal cable cross-section</b>						
• min.	0.05 mm <sup>2</sup> (AWG30)					
• max.	2 mm <sup>2</sup> (AWG14)					
<b>Operating temperature</b>	-10 ... +50 °C (14 ... 122 °F)	0 ... 45 °C (32 ... 113 °F)	0 ... 40 °C (32 ... 104 °F)			
<b>Storage temperature</b>	-40 ... +70 °C (-40 ... +158 °F)					
<b>Relative humidity</b>	< 95 % RH, condensation not permissible					
<b>Dimensions</b>						
• Width	73 mm					
• Height	195 mm	177 mm				
• Depth	31 mm	63 mm				
<b>Weight, approx.</b>	0.21 kg	0.52 kg				

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM240 Power Modules –  
0.37 kW to 250 kW (0.5 hp to 400 hp)**

## Overview



Example: SINAMICS G120, frame sizes FSA to FSF



Example: SINAMICS G120, frame size FSGX

PM240 Power Modules, frame sizes FSA to FSF have an integrated brake chopper to which an external braking resistor can be connected via terminals DCP/R1 and R2 (see DC link components).

PM240 Power Modules, frame size FSGX do not have an integrated brake chopper. For these devices, there is an optional pluggable braking module to connect a braking resistor.

The PM240 Power Module can be used to couple the DC links of up to 10 Power Modules. This functionality is used for applications such as safe power-down after power failure or kinetic buffering (the DC link is supplied in the generator mode with the kinetic energy of the load so that the DC link voltage can be maintained).

The PM240 Power Module is also designed for safety-oriented applications. In conjunction with a Fail-safe Control Unit, the drive can be turned into a Safety Integrated Drive (see Control Units).

The permissible cable lengths between inverter and motor are limited. Longer cables can be used if output reactors are connected (see load-side power components).

Line reactors are available to minimize line harmonics (see line-side components).

Frame size FSA of the PM240 Power Module is available only without integrated line filter to class A. A base filter is therefore available so that class A can be achieved. A class B base filter is also available so that class B can be achieved (see line-side power components).

Frame sizes FSB and FSC of the PM240 Power Module are available both with and without integrated class A line filter. For compliance with class B, PM240 Power Modules with integrated class A line filter must be fitted additionally with a class B base filter (see line-side components).

Power Modules with integrated class A line filter are suitable for connection to TN supply systems. Power Modules without integrated line filter can be connected to grounded (TN, TT) and non-grounded (IT) supply systems.

## Selection and ordering data

To ensure that a suitable Power Module is selected, the following currents should be used for applications:

- **rated output current for applications with light overload (LO)**
- **base load current for applications with high overload (HO)**

With reference to the rated output current, the modules support at least 2-pole to 6-pole low-voltage motors, e.g. the new 1LE1 motor series (please refer to the Appendix for further information). The rated power is merely a guide value. For a description of the overload performance, please refer to the general technical specifications of the Power Modules.

Rated power <sup>1)</sup>		Rated output current <sup>2)</sup> $I_{\text{rated}}$		Power based on the base load current <sup>3)</sup>		Base load current <sup>3)</sup> $I_H$	Frame size	SINAMICS G120 PM240 Power Module without integrated line filter	SINAMICS G120 PM240 Power Module with integrated class A line filter
kW	hp	A	kW	hp	A		Order No.	Order No.	
<b>380 ... 480 V 3 AC</b>									
0.37	0.50	1.3	0.37	0.50	1.3	FSA	6SL3224-0BE13-7UA0	–	
0.55	0.75	1.7	0.55	0.75	1.7	FSA	6SL3224-0BE15-5UA0	–	
0.75	1.0	2.2	0.75	1.0	2.2	FSA	6SL3224-0BE17-5UA0	–	
1.1	1.5	3.1	1.1	1.5	3.1	FSA	6SL3224-0BE21-1UA0	–	
1.5	2.0	4.1	1.5	2.0	4.1	FSA	6SL3224-0BE21-5UA0	–	
2.2	3.0	5.9	2.2	3.0	5.9	FSB	6SL3224-0BE22-2UA0	6SL3224-0BE22-2AA0	
3.0	4.0	7.7	3.0	4.0	7.7	FSB	6SL3224-0BE23-0UA0	6SL3224-0BE23-0AA0	
4.0	5.0	10.2	4.0	5.0	10.2	FSB	6SL3224-0BE24-0UA0	6SL3224-0BE24-0AA0	
7.5	10	18	5.5	7.5	13.2	FSC	6SL3224-0BE25-5UA0	6SL3224-0BE25-5AA0	
11.0	15	25	7.5	10	19	FSC	6SL3224-0BE27-5UA0	6SL3224-0BE27-5AA0	
15.0	20	32	11.0	15	26	FSC	6SL3224-0BE31-1UA0	6SL3224-0BE31-1AA0	
18.5	25	38	15.0	20	32	FSD	6SL3224-0BE31-5UA0	6SL3224-0BE31-5AA0	
22	30	45	18.5	25	38	FSD	6SL3224-0BE31-8UA0	6SL3224-0BE31-8AA0	
30	40	60	22	30	45	FSD	6SL3224-0BE32-2UA0	6SL3224-0BE32-2AA0	
37	50	75	30	40	60	FSE	6SL3224-0BE33-0UA0	6SL3224-0BE33-0AA0	
45	60	90	37	50	75	FSE	6SL3224-0BE33-7UA0	6SL3224-0BE33-7AA0	
55	75	110	45	60	90	FSF	6SL3224-0BE34-5UA0	6SL3224-0BE34-5AA0	
75	100	145	55	75	110	FSF	6SL3224-0BE35-5UA0	6SL3224-0BE35-5AA0	
90	125	178	75	100	145	FSF	6SL3224-0BE37-5UA0	6SL3224-0BE37-5AA0	
110	150	205	90	125	178	FSF	6SL3224-0BE38-8UA0	–	
132	200	250	110	150	205	FSF	6SL3224-0BE41-1UA0	–	
160	250	302	132	200	250	FSGX	new 6SL3224-0XE41-3UA0	–	
200	300	370	160	250	302	FSGX	new 6SL3224-0XE41-6UA0	–	
250	400	477	200	300	370	FSGX	new 6SL3224-0XE42-0UA0	–	

<sup>1)</sup> Rated power based on the rated output current  $I_{\text{rated}}$ . The rated output current  $I_{\text{rated}}$  is based on the duty cycle for light overload (LO).

<sup>2)</sup> The rated output current  $I_{\text{rated}}$  is based on the duty cycle for light overload (LO). These current values are valid for 400 V and are stamped on the rating plate of the Power Module.

<sup>3)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## PM240 Power Modules – 0.37 kW to 250 kW (0.5 hp to 400 hp)

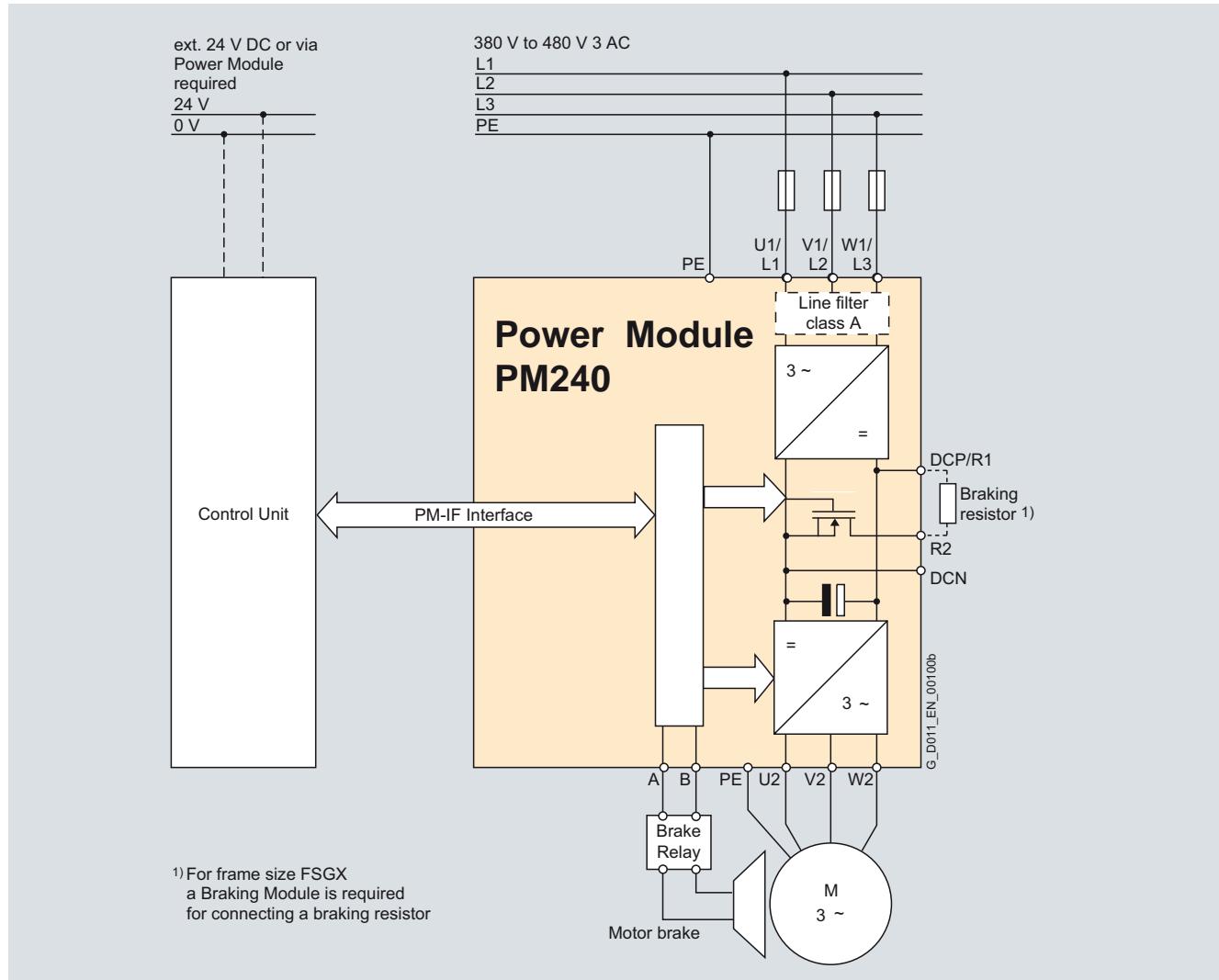
### Integration

PM240 Power Modules communicate with the Control Unit via the PM-IF interface.

PM240 Power Modules have the following interfaces as standard:

- PM-IF interface to connect the PM240 Power Module to the Control Unit. The PM240 Power Module also supplies power to the Control Unit using an integrated power supply

- Terminals DCP/R1 and R2 for connection of an external braking resistor, valid up to frame size FSF. For frame size FSGX, an external plug-in braking unit (Braking Module) is required to connect a braking resistor
- Motor connection using screw terminals or screw studs
- Control for the Brake Relay or the Safe Brake Relay for controlling a motor brake
- 2 PE/protective conductor connections



PM240 Power Module connection diagram with or without integrated class A line filter

## Integration

*Power and DC link components which are optionally available depending on the Power Module used*

The following line-side power components, DC link components and load-side power components are optionally available in the appropriate frame sizes for the Power Modules:

	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM240 Power Module with integrated brake chopper</b>							
Available frame sizes	✓	✓	✓	✓	✓	✓	✓
<b>Line-side power components</b>							
Line filter, class A	U	F	F	F	F	F/S <sup>1)</sup>	S <sup>1)</sup>
Line filter, class B	U	U	U	–	–	–	–
Line reactor	U	U	U	U	U	S	S
<b>DC link components</b>							
Braking resistor	U	U	S	S	S	S	S
Braking Module	–	–	–	–	–	–	I (Option)
<b>Load-side power components</b>							
Output reactor	U	U	U	S	S	S	S
Sine-wave filter	U	U	U	S	S	S	S

U = Base component

S = Lateral mounting

I = Integrated

– = Not possible

F = Power Modules available with and without integrated class A filter

<sup>1)</sup> PM240 FSF Power Modules from 110 kW (150 hp) and higher and FSGX are only available without an integrated class A filter. An optional class A line filter for side mounting is available instead.

# SINAMICS G120

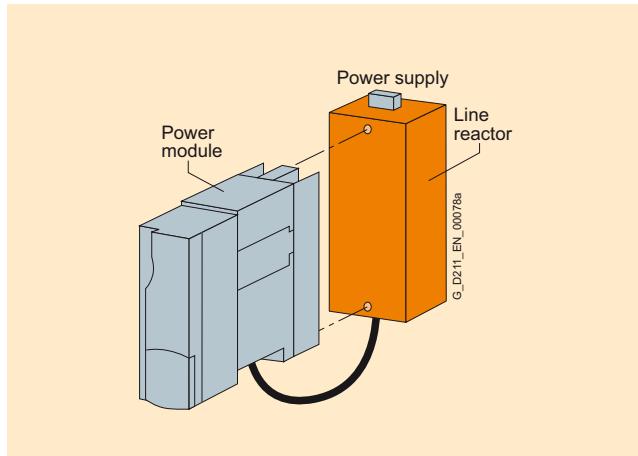
Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM240 Power Modules –  
0.37 kW to 250 kW (0.5 hp to 400 hp)**

## Integration

Many system components for PM240 Power Modules are designed as base components, that is, the component is mounted on the baseplate and the PM240 Power Module above it in a space-saving design. Up to two base components can be mounted above one another.

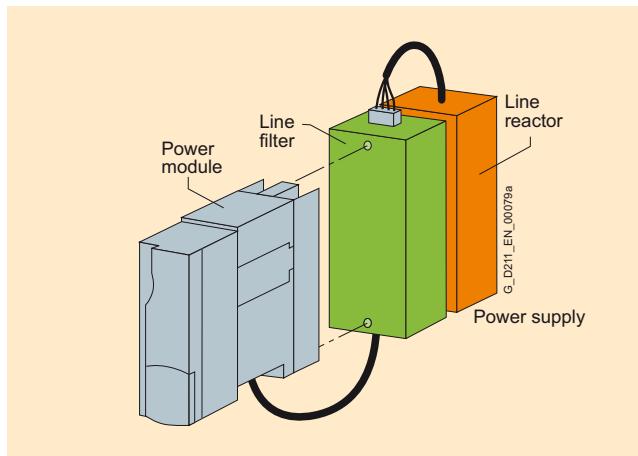
The following diagram shows the basic layout of a PM240 Power Module with line reactor as base component. On the line side, the line-side reactors have terminals and on the Power Module side, they have a pre-fabricated cable. For frame sizes FSA to FSC, when installed, the line terminals are at the top, for frame sizes FSD to FSE they are at the bottom.



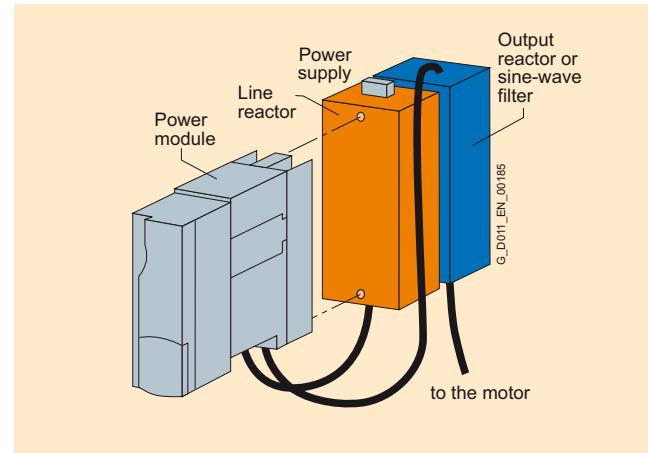
Basic layout of a PM240 Power Module with line reactor as base component

If a class A line filter is installed in addition to the line reactor on frame size FSA, the components must be arranged as shown in the diagram below. In this case, the line connection is from below.

Power Modules, from frame size FSB and higher are available with integrated class A line filters (an external class A line filter is not required in this case).

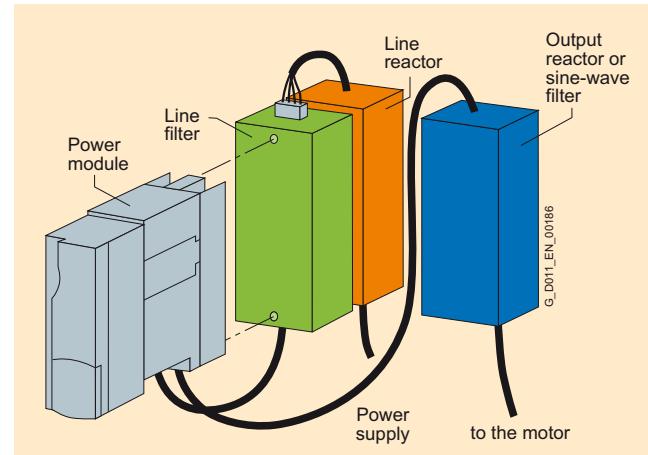


PM240 Power Module frame size FSA with line reactor and class A line filter



PM240 Power Module frame size FSA with line reactor and output reactor or sine-wave filter

For configurations involving more than two base-type system components, e.g. line filter + line reactor + output reactor, individual components must be mounted to the side of the Power Modules. In this case, the line reactor and line filter must be installed under the Power Module and the output reactor to the righthand side.



PM240 Power Module frame size FSA with line reactor, line filter and output reactor or sine-wave filter

## Integration

**Maximum permissible cable lengths from the motor to the inverter when using output reactors or sine-wave filters depending on the voltage range**

The following load-side power components are optionally available in the appropriate frame sizes and result in the following maximum cable lengths:

Frame sizes	Maximum permissible motor cable lengths (shielded/unshielded) in m						without integrated brake chopper
	FSA	FSB	FSC	FSD	FSE	FSF	
<b>PM240 Power Module with integrated brake chopper</b>							
Available frame sizes	✓	✓	✓	✓	✓	✓	✓
Without output reactor/sine-wave filter	50/100	50/100	50/100	50/100	100/100	150/150	300/450
With optional output reactor							
• at 380 V (-10 %) to 400 V 3 AC	150/225	150/225	150/225	200/300	200/300	200/300	300/450
• at 401 V to 480 V (+10 %) 3 AC	100/150	100/150	100/150	200/300	200/300	200/300	300/450
With optional sine-wave filter							
• at 380 V (-10 %) to 400 V 3 AC	150/225	150/225	150/225	200/300	200/300	200/300	300/450
• at 401 V to 480 V (+10 %) 3 AC	100/150	100/150	100/150	200/300	200/300	200/300	300/450

## Derating data

The following inverter output currents can still be implemented for long motor cables without output reactor and sine-wave filter.

Derating for PM240 Power Modules, frame sizes FSA to FSF for shielded motor cables. From frame size FSD and higher, only the particular main Power Module types were tested. The values also apply to the other Power Modules of the particular frame size.

Rated power (at $I_H$ )	Frame size		Base load current $I_H$	Rated current $I_{rated}$	Motor con- nection cross- section	Current derating			
	kW	hp				of the output current as a % of the base load current for the cable lengths (MOTION-CONNECT)			
0.37	0.50	FSA	1.3	1.3	2.5	100 %	–	–	–
0.55	0.75	FSA	1.7	1.7	2.5	100 %	–	–	–
0.75	1.0	FSA	2.2	2.2	2.5	100 %	–	–	–
1.1	1.5	FSA	3.1	3.1	2.5	100 %	–	–	–
1.5	2.0	FSA	4.1	4.1	2.5	100 %	–	–	–
2.2	3.0	FSB	5.9	5.9	6	100 %	60 %	–	–
3.0	4.0	FSB	7.7	7.7	6	100 %	60 %	–	–
4.0	5.0	FSB	10.2	10.2	6	100 %	70 %	–	–
5.5	7.5	FSC	13.2	18	10	100 %	70 %	45 %	–
7.5	10	FSC	19	25	10	100 %	90 %	80 %	–
11.0	15	FSC	26	32	10	100 %	90 %	80 %	–
22.0	30	FSD	45	60	35	100 %	95 %	90 %	85 %
37.0	50	FSE	75	90	35	100 %	100 %	95 %	90 %
75.0	100	FSF	145	178	95	100 %	100 %	100 %	95 %

– Not possible

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### PM240 Power Modules – 0.37 kW to 250 kW (0.5 hp to 400 hp)

#### Technical specifications

##### General technical specifications

PM240 Power Modules	
<b>System operating voltage</b>	380 ... 480 V 3 AC ±10 %
<b>Line supply requirements</b>	at $u_K > 1\%$ , a line reactor is recommended
<b>Line short circuit voltage <math>u_K</math></b>	
<b>Input frequency</b>	47 ... 63 Hz
<b>Output frequency</b>	
• Control type V/f	0 ... 650 Hz
• Control type Vector	0 ... 200 Hz
<b>Pulse frequency</b>	to 75 kW HO: 4 kHz from 90 kW HO: 2 kHz for higher pulse frequencies up to 16 kHz see the derating data
<b>Power factor</b>	0.7 ... 0.85
<b>Inverter efficiency</b>	95 ... 97 %
<b>Modulation depth</b>	93 %
<b>Overload capability</b>	
• High overload (HO) - 0.37 ... 75 kW	1.5 × rated output current (i.e. 150 % overload) for 57 s with a cycle time of 300 s 2 × rated output current (i.e. 200 % overload) for 3 s with a cycle time of 300 s
- 90 ... 200 kW	1.36 × rated output current (i.e. 136 % overload) for 57 s with a cycle time of 300 s 1.6 × rated output current (i.e. 160 % overload) for 3 s with a cycle time of 300 s
• Light overload (LO) - 0.37 ... 250 kW	1.1 × rated output current (i.e. 110 % overload) for 57 s with a cycle time of 300 s 1.5 × rated output current (i.e. 150 % overload) for 3 s with a cycle time of 300 s
<b>Electromagnetic compatibility</b>	Optional class A or B line filter acc. to EN 55011 is available
<b>Possible braking methods</b>	• DC braking • Compound braking • Dynamic braking with integrated brake chopper (optional for frame size FSGX)
<b>Degree of protection</b>	IP20
<b>Operating temperature</b>	
• High overload (HO) - Frame sizes FSD to FSF	0 ... 50 °C (32 ... 122 °F) without derating, > 50 ... 60 °C see derating characteristics
- Frame size FSGX	0 ... 40 °C (32 ... 104 °F) without derating, > 40 ... 55 °C see derating characteristics
• Light overload (LO)	0 ... 40 °C (32 ... 104 °F) without derating, > 40 ... 60 °C (> 40 ... 55 °C for frame size FSGX) see derating characteristics
<b>Storage temperature</b>	-40 ... +70 °C (-40 ... +158 °F)
<b>Relative humidity</b>	< 95 % RH, condensation not permissible
<b>Cooling</b>	Internal air cooling, power units with increased air cooling using integrated fans
<b>Installation altitude</b>	up to 1000 m above sea level without power reduction, > 1000 m see derating characteristics
<b>Standard SCCR (Short Circuit Current Rating)<sup>1)</sup></b>	FSA, FSB, FSC: 10 kA FSD, FSE, FSF, FSGX: 42 kA
<b>Protection functions</b>	• Undervoltage • Overvoltage • Overcontrol/overload • Ground fault • Short circuit • Stall protection • Motor blocking protection • Motor overtemperature • Inverter overtemperature • Parameter locking
<b>Standards conformance</b>	UL, cUL, CE, c-tick, SEMI F47
<b>CE mark</b>	According to Low-Voltage Directive 73/23/EEC and Machinery Directive 98/37/EC

<sup>1)</sup> Applies to industrial control cabinet installations to NEC Article 409/UL 508A. For further information, visit us on the Internet at:  
<http://support.automation.siemens.com/WW/view/en/23995621>

**Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		PM240 Power Modules				
Without integrated line filter		6SL3224-0BE13-7UA0	6SL3224-0BE15-5UA0	6SL3224-0BE17-5UA0	6SL3224-0BE21-1UA0	6SL3224-0BE21-5UA0
<b>Output current at 50 Hz 400 V 3 AC</b>						
• Rated current $I_{rated}^{1)}$	A	1.3	1.7	2.2	3.1	4.1
• Base load current $I_L^{1)}$	A	1.3	1.7	2.2	3.1	4.1
• Base load current $I_H^{2)}$	A	1.3	1.7	2.2	3.1	4.1
• $I_{max}$	A	2.6	3.4	4.4	6.2	8.2
<b>Rated power</b>						
• based on $I_L$	kW (hp)	0.37 (0.5)	0.55 (0.75)	0.75 (1.0)	1.1 (1.5)	1.5 (2.0)
• based on $I_H$	kW (hp)	0.37 (0.5)	0.55 (0.75)	0.75 (1.0)	1.1 (1.5)	1.5 (2.0)
<b>Rated pulse frequency</b>	kHz	4	4	4	4	4
<b>Efficiency <math>\eta</math></b>		0.97	0.97	0.97	0.97	0.97
<b>Power loss (at rated current)</b>	kW	0.09	0.1	0.1	0.1	0.11
<b>Cooling air requirement</b>	$m^3/s$	0.005	0.005	0.005	0.005	0.005
<b>Sound pressure level <math>L_{pA}</math> (1 m)</b>	dB	< 45	< 45	< 45	< 45	< 45
<b>24 V DC power supply for Control Unit</b>	A	1	1	1	1	1
<b>Rated input current <sup>3)</sup></b>						
• with line reactor	A	1.4	1.8	2.3	3.2	4.3
• without line reactor	A	1.7	2.1	2.6	3.9	4.9
<b>Max. length of cable to brake resistor</b>	m	15	15	15	15	15
<b>Line supply connection U1/L1, V1/L2, W1/L3</b>		Screw terminals				
• Conductor cross-section	$mm^2$	1 ... 2.5	1 ... 2.5	1 ... 2.5	1 ... 2.5	1 ... 2.5
<b>Motor connection U2, V2, W2</b>		Screw terminals				
• Conductor cross-section	$mm^2$	1 ... 2.5	1 ... 2.5	1 ... 2.5	1 ... 2.5	1 ... 2.5
<b>DC link connection, connection for the braking resistor</b>		Screw terminals				
DCP/R1, DCN, R2						
• Conductor cross-section	$mm^2$	1 ... 2.5	1 ... 2.5	1 ... 2.5	1 ... 2.5	1 ... 2.5
<b>PE connection</b>		On housing with M4 screw				
<b>Motor cable length <sup>4)</sup>, max.</b>						
• Shielded	m	50	50	50	50	50
• Unshielded	m	100	100	100	100	100
<b>Degree of protection</b>		IP20	IP20	IP20	IP20	IP20
<b>Dimensions</b>						
• Width	mm	73	73	73	73	73
• Height	mm	173	173	173	173	173
• Depth						
- without Control Unit	mm	145	145	145	145	145
- with Control Unit	mm	210	210	210	210	210
<b>Frame size</b>		FSA	FSA	FSA	FSA	FSA
<b>Weight, approx.</b>	kg	1.1	1.1	1.1	1.1	1.1

<sup>1)</sup> The rated output current  $I_{rated}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).

<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

<sup>3)</sup> The input current depends on the motor load and line impedance. The input currents apply for a load at rated power (based on  $I_{rated}$ ) for a line impedance corresponding to  $u_K = 1\%$ . These current values without line reactor are stamped on the rating plate of the Power Module.

<sup>4)</sup> Max. motor cable length 25 m (shielded) for PM240 Power Modules with integrated line filter to maintain the limit values of EN 61800-3 Category C2.

**SINAMICS G120****Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)****PM240 Power Modules –  
0.37 kW to 250 kW (0.5 hp to 400 hp)****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		PM240 Power Modules				
Without integrated line filter		6SL3224-0BE22-2UA0	6SL3224-0BE23-0UA0	6SL3224-0BE24-0UA0	6SL3224-0BE25-5UA0	6SL3224-0BE27-5UA0
With integrated line filter		6SL3224-0BE22-2AA0	6SL3224-0BE23-0AA0	6SL3224-0BE24-0AA0	6SL3224-0BE25-5AA0	6SL3224-0BE27-5AA0
Output current at 50 Hz 400 V 3 AC						
• Rated current $I_{\text{rated}}^{1)}$	A	5.9	7.7	10.2	18	25
• Base load current $I_L^{1)}$	A	5.9	7.7	10.2	18	25
• Base load current $I_H^{1,2)}$	A	5.9	7.7	10.2	13.2	19
• $I_{\text{max}}$	A	11.8	15.4	20.4	26.4	38
Rated power						
• based on $I_L$	kW (hp)	2.2 (3.0)	3 (4)	4 (5)	7.5 (10)	11 (15)
• based on $I_H$	kW (hp)	2.2 (3.0)	3 (4)	4 (5)	5.5 (7.5)	7.5 (10)
Rated pulse frequency		kHz	4	4	4	4
Efficiency $\eta$		0.95	0.95	0.95	0.95	0.95
Power loss (at rated current)		kW	0.14	0.16	0.18	0.24
Cooling air requirement		m <sup>3</sup> /s	0.024	0.024	0.055	0.055
Sound pressure level $L_{\text{PA}}$ (1 m)		dB	< 50	< 50	< 60	< 60
24 V DC power supply for Control Unit		A	1	1	1	1
Rated input current <sup>3)</sup>						
• with line reactor	A	6.1	8	10.4	18.7	26
• without line reactor	A	7.6	10.2	13.4	21.9	31.5
Max. length of cable to braking resistor		m	15	15	15	15
Line supply connection U1/L1, V1/L2, W1/L3		Screw terminals				
• Conductor cross-section	mm <sup>2</sup>	1 ... 6	1 ... 6	1 ... 6	2.5 ... 10	2.5 ... 10
Motor connection U2, V2, W2		Screw terminals				
• Conductor cross-section	mm <sup>2</sup>	1 ... 6	1 ... 6	1 ... 6	2.5 ... 10	2.5 ... 10
DC link connection, connection for the braking resistor		Screw terminals				
DCP/R1, DCN, R2						
• Conductor cross-section	mm <sup>2</sup>	1 ... 6	1 ... 6	1 ... 6	2.5 ... 10	2.5 ... 10
PE connection		On housing with M5 screw				
Motor cable length <sup>4)</sup> , max.						
• Shielded	m	50	50	50	50	50
• Unshielded	m	100	100	100	100	100
Degree of protection		IP20	IP20	IP20	IP20	IP20
Dimensions						
• Width	mm	153	153	153	189	189
• Height	mm	270	270	270	334	334
• Depth						
- without Control Unit	mm	165	165	165	185	185
- with Control Unit	mm	230	230	230	250	250
Frame size		FSB	FSB	FSB	FSC	FSC
Weight, approx.		kg	4	4	7	7

<sup>1)</sup> The rated output current  $I_{\text{rated}}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).

<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

<sup>3)</sup> The input current depends on the motor load and line impedance. The input currents apply for a load at rated power (based on  $I_{\text{rated}}$ ) for a line impedance corresponding to  $U_K = 1 \%$ . These current values without line reactor are stamped on the rating plate of the Power Module.

<sup>4)</sup> Max. motor cable length 25 m (shielded) for PM240 Power Modules with integrated line filter to maintain the limit values of EN 61800-3 Category C2.

**Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		PM240 Power Modules				
Without integrated line filter		6SL3224-0BE31-1UA0	6SL3224-0BE31-5UA0	6SL3224-0BE31-8UA0	6SL3224-0BE32-2UA0	6SL3224-0BE33-0UA0
With integrated line filter		6SL3224-0BE31-1AA0	6SL3224-0BE31-5AA0	6SL3224-0BE31-8AA0	6SL3224-0BE32-2AA0	6SL3224-0BE33-0AA0
Output current at 50 Hz 400 V 3 AC						
• Rated current $I_{\text{rated}}^{1)}$	A	32	38	45	60	75
• Base load current $I_L^{1)}$	A	32	38	45	60	75
• Base load current $I_H^{2)}$	A	26	32	38	45	60
• $I_{\text{max}}$	A	52	64	76	90	124
Rated power						
• based on $I_L$	kW (hp)	15 (20)	18.5 (25)	22 (30)	30 (40)	37 (50)
• based on $I_H$	kW (hp)	11 (15)	15 (20)	18.5 (25)	22 (30)	30 (40)
Rated pulse frequency		kHz	4	4	4	4
Efficiency $\eta$			> 0.97	> 0.97	> 0.97	> 0.97
Power loss (at rated current)		kW	0.4	0.42	0.52	0.69
Cooling air requirement		m³/s	0.055	0.055	0.055	0.055
Sound pressure level $L_{\text{pA}}$ (1 m)		dB	< 60	< 60	< 60	< 61
24 V DC power supply for Control Unit		A	1	1	1	1
Rated input current <sup>3)</sup>						
• with line reactor	A	33	40	47	63	78
• without line reactor	A	39	46	53	72	88
Max. length of cable to braking resistor		m	15	15	15	15
Line supply connection U1/L1, V1/L2, W1/L3		Screw terminals	M6 screw studs	M6 screw studs	M6 screw studs	M6 screw studs
• Conductor cross-section	mm²	2.5 ... 10	10 ... 50	10 ... 50	10 ... 50	10 ... 50
Motor connection U2, V2, W2		Screw terminals	M6 screw studs	M6 screw studs	M6 screw studs	M6 screw studs
• Conductor cross-section	mm²	2.5 ... 10	10 ... 50	10 ... 50	10 ... 50	10 ... 50
DC link connection, connection for the braking resistor		Screw terminals	M6 screw studs	M6 screw studs	M6 screw studs	M6 screw studs
DCP/R1, DCN, R2						
• Conductor cross-section	mm²	2.5 ... 10	10 ... 50	10 ... 50	10 ... 50	10 ... 50
PE connection		On housing with M5 screw	On housing with M6 screw			
Motor cable length <sup>4)</sup> , max.						
• Shielded	m	50	50	50	50	100
• Unshielded	m	100	100	100	100	100
Degree of protection		IP20	IP20	IP20	IP20	IP20
Dimensions						
• Width	mm	189	275	275	275	275
• Height						
- without integrated filter	mm	334	419	419	419	499
- with integrated filter	mm	334	512	512	512	635
• Depth						
- without Control Unit	mm	185	204	204	204	204
- with Control Unit	mm	250	260	260	260	260
Frame size		FSC	FSD	FSD	FSD	FSE
Weight, approx.						
• without integrated filter	kg	7	13	13	13	16
• with integrated filter	kg	7	16	16	16	23

<sup>1)</sup> The rated output current  $I_{\text{rated}}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).

<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

<sup>3)</sup> The input current depends on the motor load and line impedance. The input currents apply for a load at rated power (based on  $I_{\text{rated}}$ ) for a line impedance corresponding to  $U_K = 1\%$ . These current values without line reactor are stamped on the rating plate of the Power Module.

<sup>4)</sup> Max. motor cable length 25 m (shielded) for PM240 Power Modules with integrated line filter to maintain the limit values of EN 61800-3 Category C2.

**SINAMICS G120****Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)****PM240 Power Modules –  
0.37 kW to 250 kW (0.5 hp to 400 hp)****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		PM240 Power Modules					
Without integrated line filter		6SL3224-0BE33-7UA0	6SL3224-0BE34-5UA0	6SL3224-0BE35-5UA0	6SL3224-0BE37-5UA0	6SL3224-0BE38-8UA0	6SL3224-0BE41-1UA0
With integrated line filter		6SL3224-0BE33-7AA0	6SL3224-0BE34-5AA0	6SL3224-0BE35-5AA0	6SL3224-0BE37-5AA0	–	–
Output current at 50 Hz 400 V 3 AC							
• Rated current $I_{\text{rated}}^{1)}$	A	90	110	145	178	205	250
• Base load current $I_L^{1)}$	A	90	110	145	178	205	250
• Base load current $I_H^{2)}$	A	75	90	110	145	178	205
• $I_{\text{max}}$	A	150	180	220	290	308	375
Rated power							
• based on $I_L$	kW (hp)	45 (60)	55 (75)	75 (100)	90 (125)	110 (150)	132 (200)
• based on $I_H$	kW (hp)	37 (50)	45 (60)	55 (75)	75 (100)	90 (125)	110 (150)
Rated pulse frequency							
	kHz	4	4	4	4	2	2
Efficiency $\eta$							
		> 0.97	> 0.97	> 0.97	> 0.97	> 0.97	> 0.97
Power loss (at rated current)							
	kW	1.21	1.42	1.93	2.31	2.43	2.53
Cooling air requirement							
	$\text{m}^3/\text{s}$	$2 \times 0.055$	0.15	0.15	0.15	0.15	0.15
Sound pressure level $L_{\text{pA}}$ (1 m)							
	dB	< 62	< 60	< 60	< 65	< 65	< 65
24 V DC power supply for Control Unit							
Rated input current <sup>3)</sup>							
• with line reactor	A	94	115	151	186	210	250
• without line reactor	A	105	129	168	204	245	299
Max. length of cable to braking resistor							
	m	15	15	15	15	15	15
Line supply connection U1/L1, V1/L2, W1/L3		M6 screw studs	M8 screw studs				
• Conductor cross-section	$\text{mm}^2$	10 ... 50	25 ... 120	25 ... 120	25 ... 120	25 ... 120	25 ... 120
Motor connection U2, V2, W2		M6 screw studs	M8 screw studs				
• Conductor cross-section	$\text{mm}^2$	10 ... 50	25 ... 120	25 ... 120	25 ... 120	25 ... 120	25 ... 120
DC link connection, connection for the braking resistor		M6 screw studs	M8 screw studs				
DCP/R1, DCN, R2							
• Conductor cross-section	$\text{mm}^2$	10 ... 50	25 ... 120	25 ... 120	25 ... 120	25 ... 120	25 ... 120
PE connection		On housing with M6 screw	On housing with M8 screw				
Motor cable length <sup>4)</sup> , max.							
• Shielded	m	100	150	150	150	150	150
• Unshielded	m	100	150	150	150	150	150
Degree of protection		IP20	IP20	IP20	IP20	IP20	IP20
Dimensions							
• Width	mm	275	350	350	350	350	350
• Height							
- without integrated filter	mm	499	634	634	634	634	634
- with integrated filter	mm	635	934	934	–	–	–
• Depth							
- without Control Unit	mm	204	316	316	316	316	316
- with Control Unit	mm	260	372	372	372	372	372
Frame size		FSE	FSF	FSF	FSF	FSF	FSF
Weight, approx.							
• without integrated filter	kg	16	36	36	36	39	39
• with integrated filter	kg	23	52	52	52	–	–

<sup>1)</sup> The rated output current  $I_{\text{rated}}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).<sup>3)</sup> The input current depends on the motor load and line impedance. The input currents apply for a load at rated power (based on  $I_{\text{rated}}$ ) for a line impedance corresponding to  $u_K = 1\%$ . These current values without line reactor are stamped on the rating plate of the Power Module.<sup>4)</sup> Max. motor cable length 25 m (shielded) for PM240 Power Modules with integrated line filter to maintain the limit values of EN 61800-3 Category C2.

**Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		PM240 Power Modules		
Without integrated line filter		6SL3224-0XE41-3UA0	6SL3224-0XE41-6UA0	6SL3224-0XE42-0UA0
<b>Output current at 50 Hz 400 V 3 AC</b>				
• Rated current $I_{\text{rated}}^{1)}$	A	302	370	477
• Base load current $I_L^{1)}$	A	302	370	477
• Base load current $I_H^{2)}$	A	250	302	370
• $I_{\max}$	A	400	483	592
<b>Rated power</b>				
• based on $I_L$	kW (hp)	160 (250)	200 (300)	250 (400)
• based on $I_H$	kW (hp)	132 (200)	160 (215)	200 (300)
<b>Rated pulse frequency</b> kHz				
<b>Efficiency <math>\eta</math></b>				
<b>Power loss</b> kW				
(at rated current)		3.9	4.4	5.5
<b>Cooling air requirement</b> m <sup>3</sup> /s				
<b>Sound pressure level <math>L_{\text{pA}}</math></b> (1 m) dB				
<b>24 V DC power supply for Control Unit</b> A				
<b>Rated input current</b> <sup>3)</sup> A				
• with line reactor	A	245	297	354
• without line reactor	A	297	354	442
<b>Max. length of cable to braking resistor</b> m				
<b>Line supply connection</b> U1/L1, V1/L2, W1/L3				
• Conductor cross-section	mm <sup>2</sup>	2 × 240	2 × 240	2 × 240
<b>Motor connection</b> U2, V2, W2				
• Conductor cross-section	mm <sup>2</sup>	2 × 240	2 × 240	2 × 240
<b>PE connection</b>				
On housing with M10 screw				
<b>Motor cable length</b> <sup>4)</sup> , max. m				
• Shielded	m	300	300	300
• Unshielded	m	450	450	450
<b>Degree of protection</b>				
<b>Dimensions</b>				
• Width	mm	326	326	326
• Height	mm	1533	1533	1533
• Depth	mm	547	547	547
<b>Frame size</b>				
<b>Weight, approx.</b> kg				

<sup>1)</sup> The rated output current  $I_{\text{rated}}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).

<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

<sup>3)</sup> The input current depends on the motor load and line impedance. The input currents apply for a load at rated power (based on  $I_{\text{rated}}$ ) for a line impedance corresponding to  $U_K = 1\%$ . These current values without line reactor are stamped on the rating plate of the Power Module.

<sup>4)</sup> Max. motor cable length 25 m (shielded) for PM240 Power Modules with integrated line filter to maintain the limit values of EN 61800-3 Category C2.

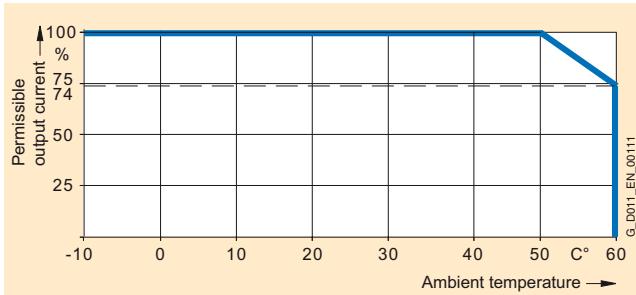
**SINAMICS G120****Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)****PM240 Power Modules –  
0.37 kW to 250 kW (0.5 hp to 400 hp)****Characteristic curves****Derating data****Pulse frequency**

<b>Rated power at 400 V 3 AC</b>		<b>Rated output current in A at a pulse frequency of</b>							
<b>kW</b>	<b>hp</b>	2 kHz	4 kHz	6 kHz	8 kHz	10 kHz	12 kHz	14 kHz	16 kHz
<b>0.37</b>	0.50	–	1.3	1.1	0.9	0.8	0.7	0.6	0.5
<b>0.55</b>	0.75	–	1.7	1.4	1.2	1.0	0.9	0.8	0.7
<b>0.75</b>	1.0	–	2.2	1.9	1.5	1.3	1.1	1.0	0.9
<b>1.1</b>	1.5	–	3.1	2.6	2.2	1.9	1.6	1.4	1.2
<b>1.5</b>	2.0	–	4.1	3.5	2.9	2.5	2.1	1.8	1.6
<b>2.2</b>	3.0	–	5.9	5.0	4.1	3.5	3.0	2.7	2.4
<b>3.0</b>	4.0	–	7.7	6.5	5.4	4.6	3.9	3.5	3.1
<b>4.0</b>	5.0	–	10.2	8.7	7.1	6.1	5.1	4.6	4.1
<b>7.5</b>	10	–	18.0	16.2	13.3	11.4	9.5	8.6	7.6
<b>11.0</b>	15	–	25.0	22.1	18.2	15.6	13.0	11.7	10.4
<b>15.0</b>	20	–	32.0	27.2	22.4	19.2	16.0	14.4	12.8
<b>18.5</b>	25	–	38.0	32.3	26.6	22.8	19.0	17.1	15.2
<b>22.0</b>	30	–	45.0	38.3	31.5	27.0	22.5	20.3	18.0
<b>30.0</b>	40	–	62.0	52.7	43.4	37.2	31.0	27.9	24.8
<b>37.0</b>	50	–	75.0	63.8	52.5	45.0	37.5	33.8	30.0
<b>45.0</b>	60	–	90.0	76.5	63.0	54.0	45.0	40.5	36.0
<b>55.0</b>	75	–	110.0	93.5	77.0	–	–	–	–
<b>75.0</b>	100	–	145.0	123.3	101.5	–	–	–	–
<b>90.0</b>	125	–	178.0	151.3	124.6	–	–	–	–
<b>110.0</b>	150	205.0 <sup>1)</sup>	178.0	–	–	–	–	–	–
<b>132.0</b>	200	250.0 <sup>1)</sup>	202.0	–	–	–	–	–	–
<b>160.0</b>	250	302.0 <sup>1)</sup>	250.0	–	–	–	–	–	–
<b>200.0</b>	300	370.0 <sup>1)</sup>	302.0	–	–	–	–	–	–
<b>250.0</b>	400	477.0 <sup>1)</sup>	370.0	–	–	–	–	–	–

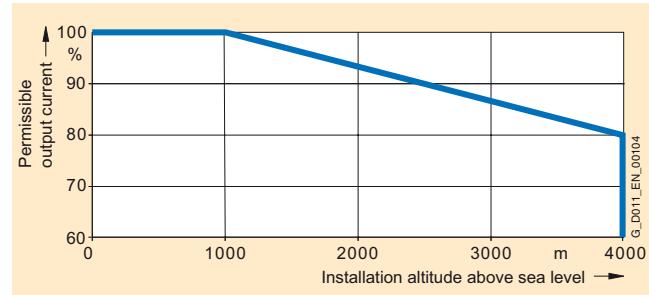
<sup>1)</sup> The pulse frequency can be switched over from 4 kHz (default) to 2 kHz only for the light overload (LO) duty cycle.

## Characteristic curves

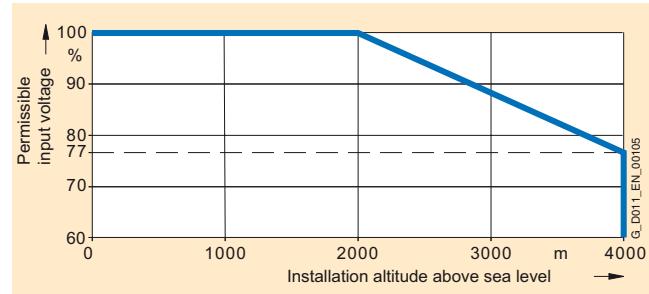
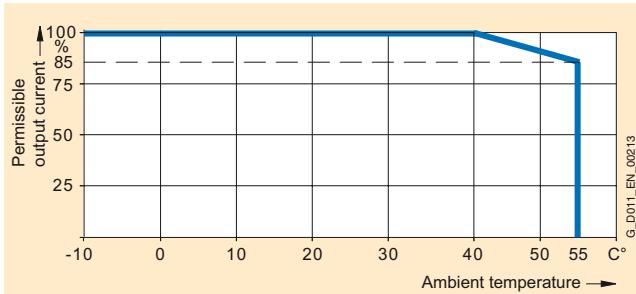
Ambient temperature



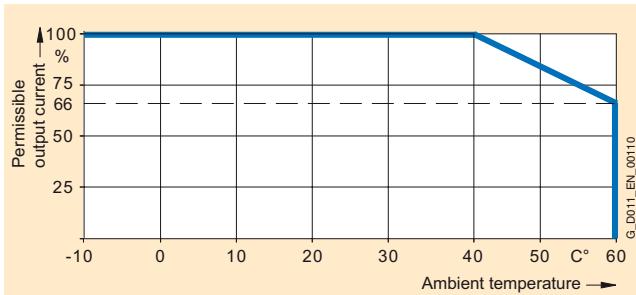
Installation altitude



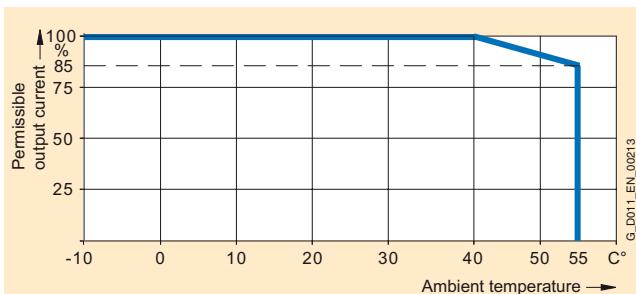
High overload (HO) PM240 Power Modules frame sizes FSD to FSF



High overload (HO) PM240 Power Modules frame size FSGX



Light overload (LO) PM240 Power Modules frame sizes FSD to FSF



Light overload (LO) PM240 Power Modules frame size FSGX

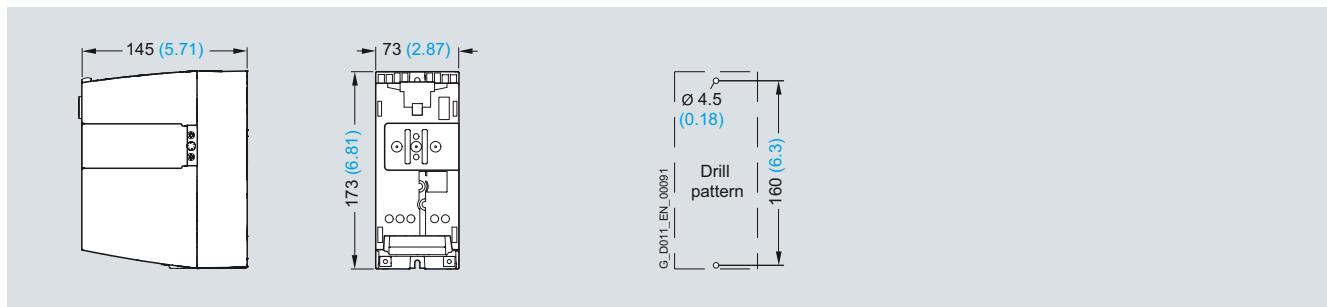
Note: The operating temperature ranges of the Control Units should be taken into account. The temperature ranges are specified in the technical specifications under Control Units.

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM240 Power Modules –**  
**0.37 kW to 250 kW (0.5 hp to 400 hp)**

## Dimensional drawings



PM240 Power Module frame size FSA

Mounted with 2 M4 studs, 2 M4 nuts, 2 M4 washers.

Ventilation clearance required at top and bottom: 100 mm (3.94 inches).

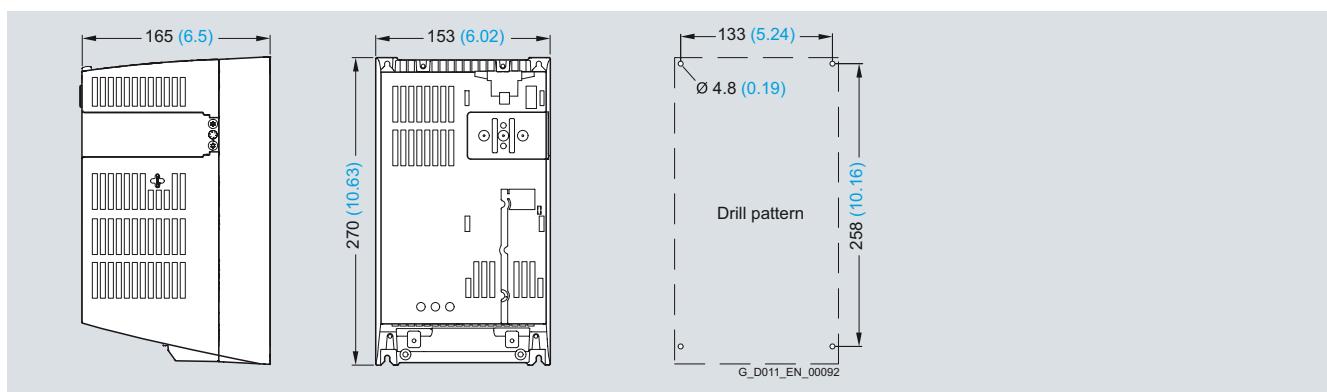
Ventilation clearance required at sides:

- Ambient temperature  $\leq 40^{\circ}\text{C}$ : 0 mm (0 inches).
- Ambient temperature  $> 40^{\circ}\text{C}$ : 30 mm (1.18 inches).

When the Control Unit is plugged on, the mounting depth increases by 65 mm (2.56 inches) and the total height by 14 mm (0.55 inches).

Exception: for CU240E, mounting depth +31 mm (+1.22 inches), total height +32 mm (+1.26 inches).

All dimensions in mm (values in brackets are in inches).



PM240 Power Module frame size FSB

Mounted with 4 M4 studs, 4 M4 nuts, 4 M4 washers.

Ventilation clearance required at top and bottom: 100 mm (3.94 inches).

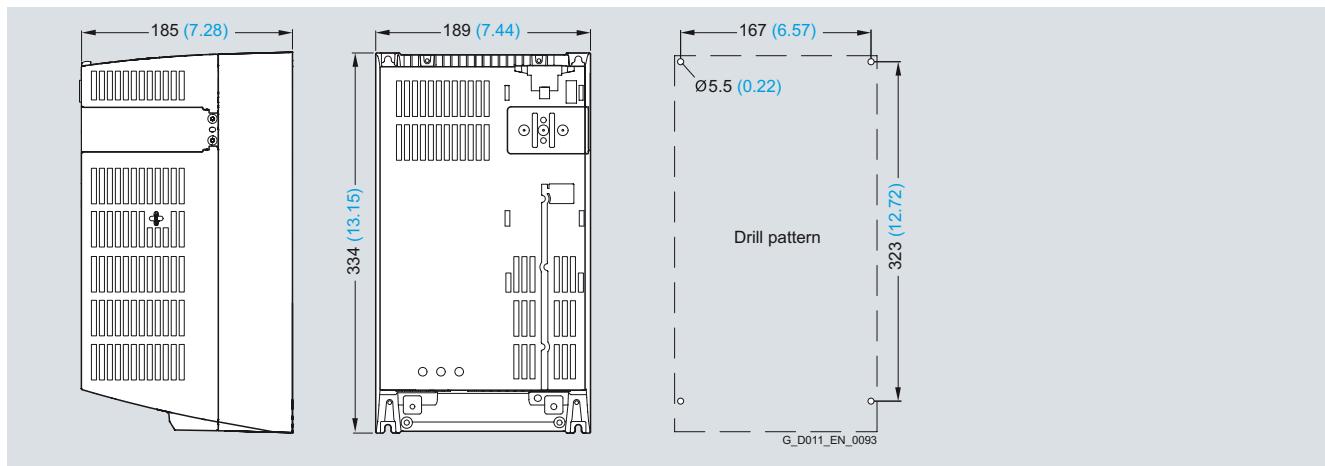
Ventilation clearance required at sides:

- Ambient temperature  $\leq 40^{\circ}\text{C}$ : 0 mm (0 inches).
- Ambient temperature  $> 40^{\circ}\text{C}$ : 40 mm (1.57 inches).

When the Control Unit is plugged on, the mounting depth increases by 65 mm (2.56 inches).

Exception: for CU240E, mounting depth +31 mm (+1.22 inches).

All dimensions in mm (values in brackets are in inches).

**Dimensional drawings**

PM240 Power Module frame size FSC

Mounted with 4 M5 studs, 4 M5 nuts, 4 M5 washers.

Ventilation clearance required at top and bottom: 100 mm (3.94 inches).

Ventilation clearance required at sides:

- Ambient temperature  $\leq 40^{\circ}\text{C}$ : 0 mm (0 inches).
- Ambient temperature  $> 40^{\circ}\text{C}$ : 50 mm (1.97 inches).

When the Control Unit is plugged on, the mounting depth increases by 65 mm (2.56 inches).

Exception: for CU240E, mounting depth +31 mm (+1.22 inches).

All dimensions in mm (values in brackets are in inches).

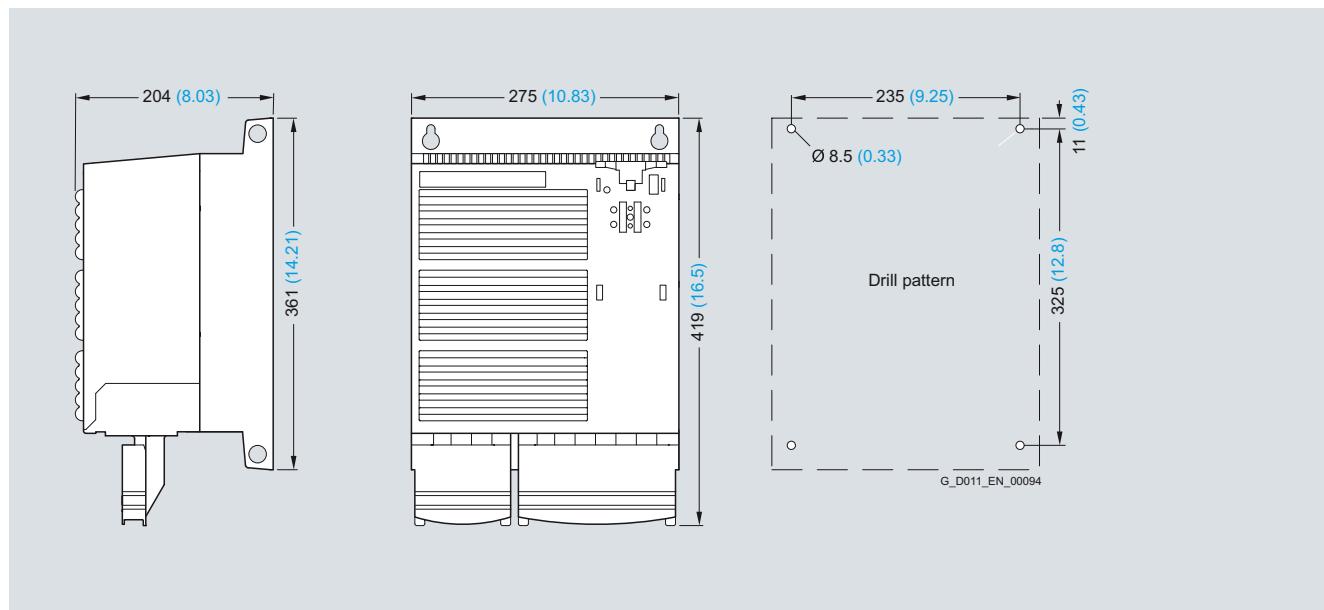
# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

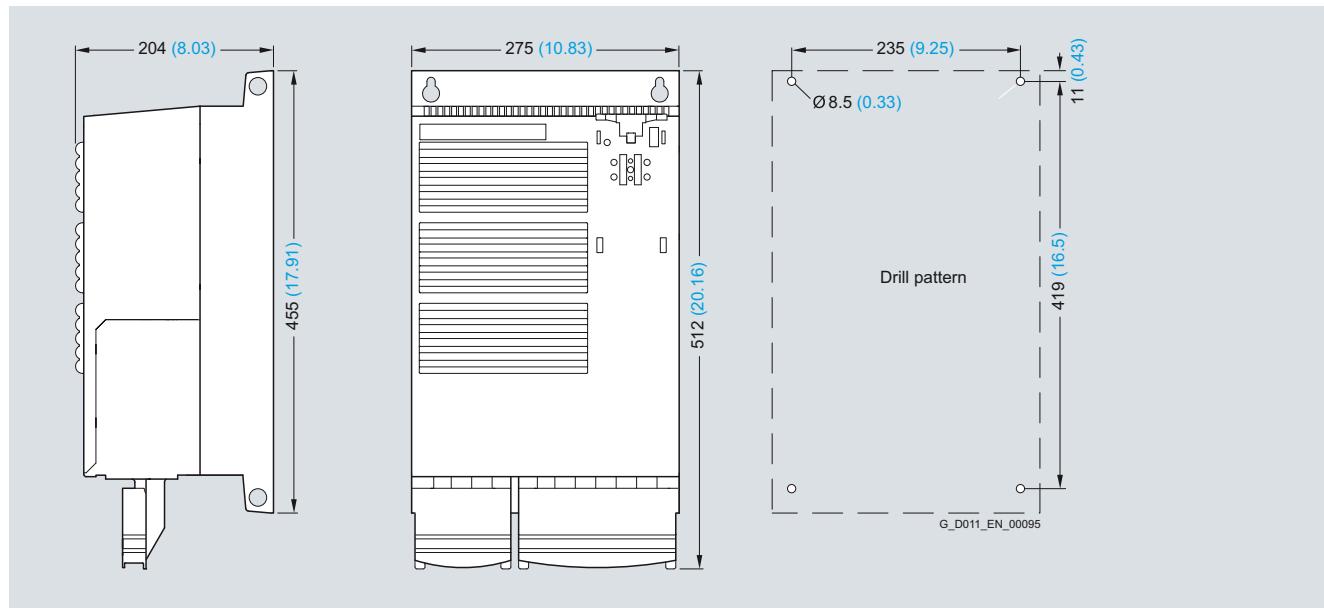
## PM240 Power Modules –

0.37 kW to 250 kW (0.5 hp to 400 hp)

### Dimensional drawings



PM240 Power Module frame size FSD without line filter



PM240 Power Module frame size FSD with integrated class A line filter

Mounted with 4 M8 studs, 4 M8 nuts, 4 M8 washers.

Ventilation clearance required at top and bottom: 300 mm (11.81 inches).

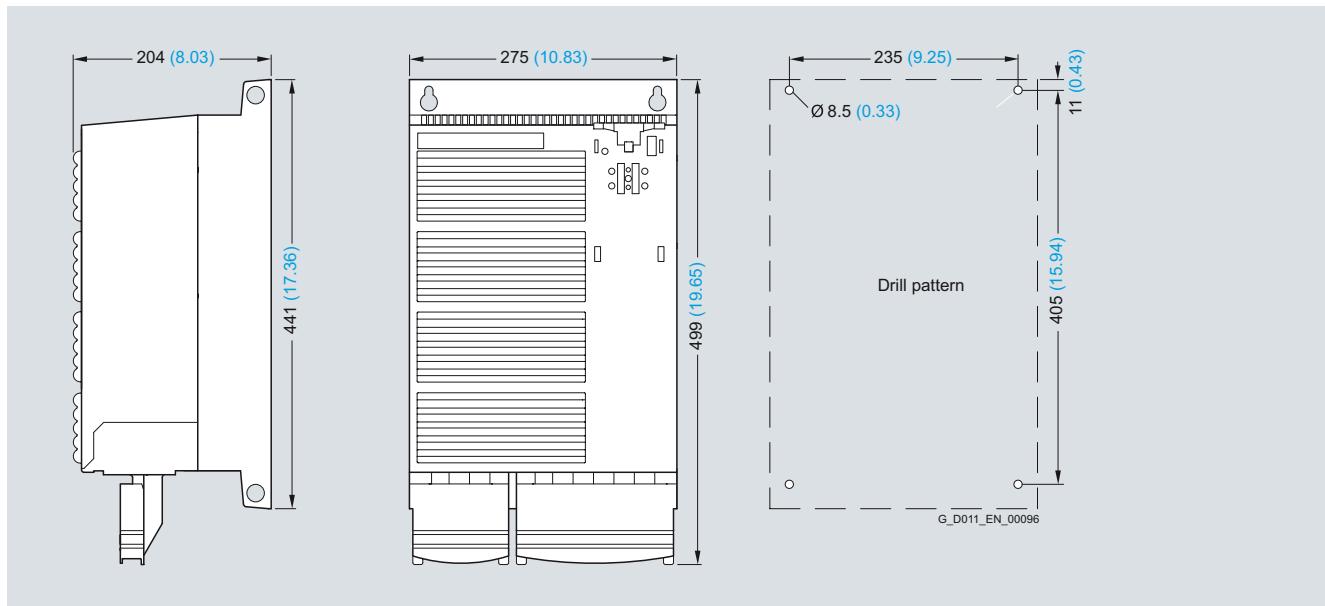
Ventilation clearance required at front: 28 mm (1.1 inches).

Ventilation clearance required at sides: 0 mm (0 inches).

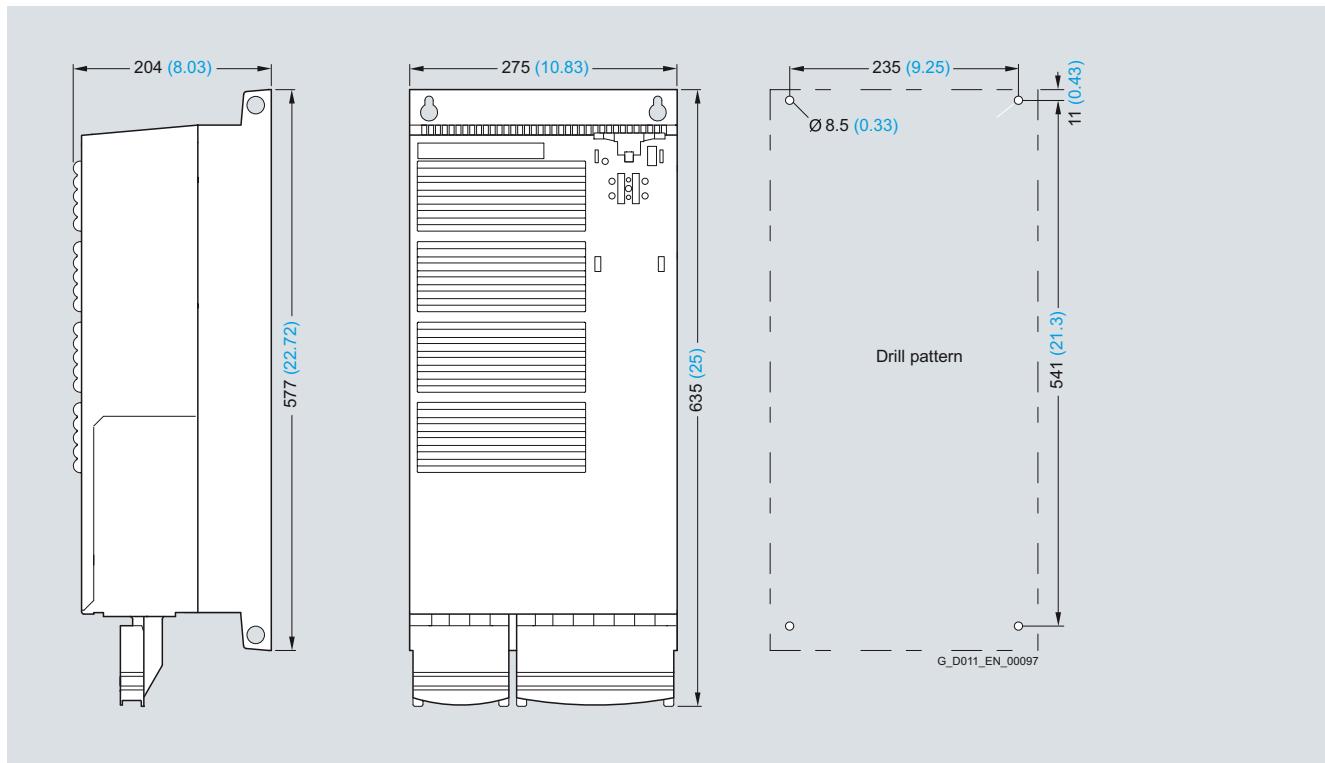
When the Control Unit is plugged on, the mounting depth increases by 56 mm (2.2 inches).

Exception: for CU240E, mounting depth +22 mm (+0.87 inches).

All dimensions in mm (values in brackets are in inches).

**Dimensional drawings**

PM240 Power Module frame size FSE without line filter



PM240 Power Module frame size FSE with integrated class A line filter

Mounted with 4 M8 studs, 4 M8 nuts, 4 M8 washers.

Ventilation clearance required at top and bottom: 300 mm (11.81 inches).

Ventilation clearance required at front: 28 mm (1.1 inches).

Ventilation clearance required at sides: 0 mm (0 inches).

When the Control Unit is plugged on, the mounting depth increases by 56 mm (2.2 inches).

Exception: for CU240E, mounting depth +22 mm (+0.87 inches).

All dimensions in mm (values in brackets are in inches).

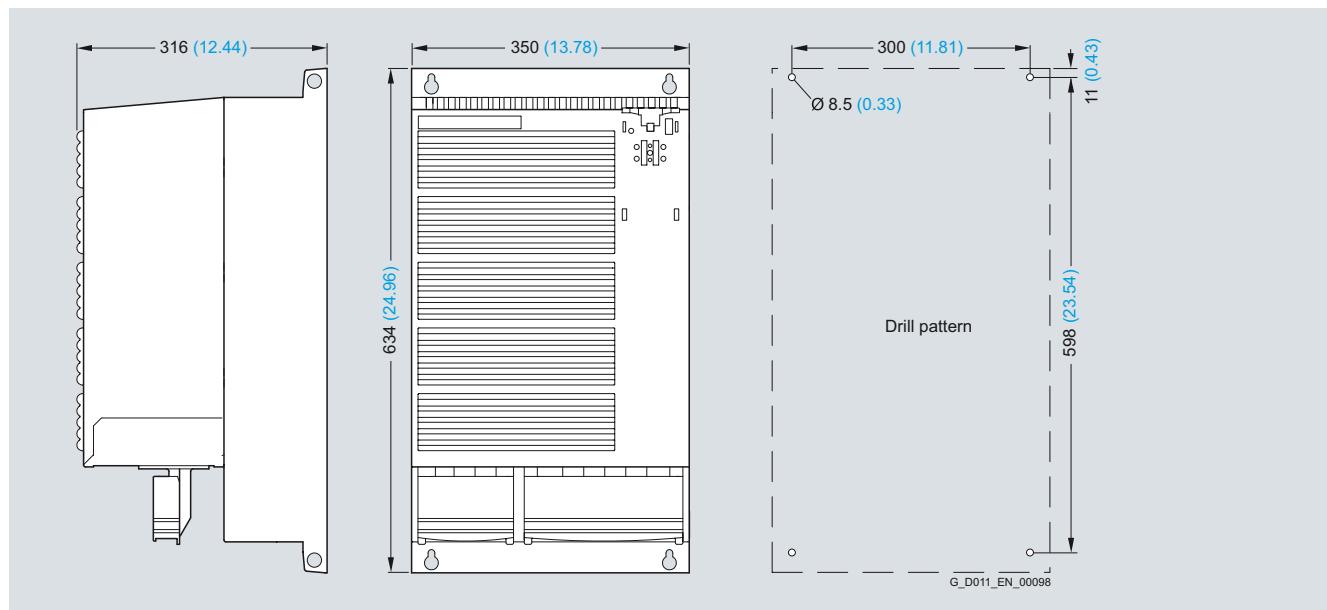
# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

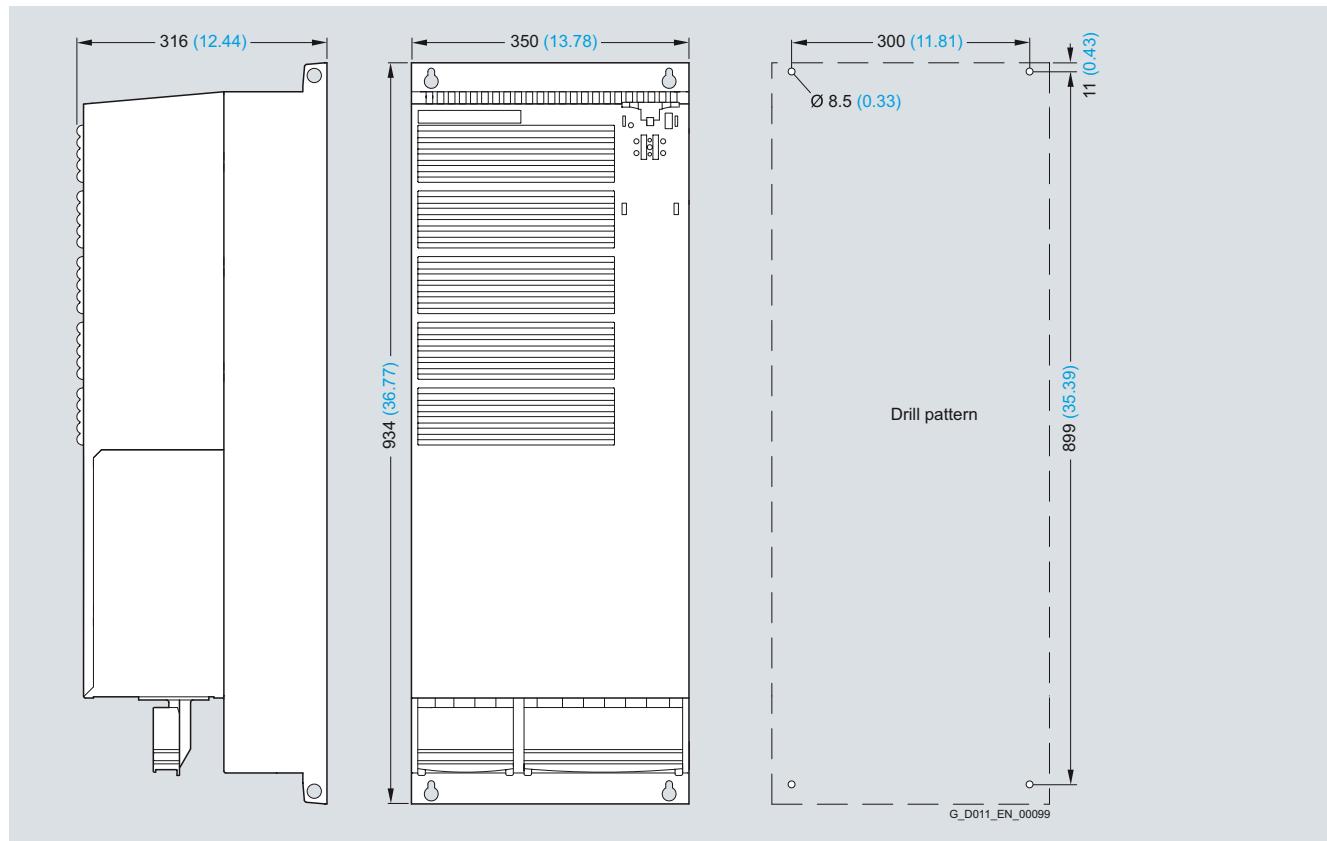
### PM240 Power Modules –

#### 0.37 kW to 250 kW (0.5 hp to 400 hp)

#### Dimensional drawings



PM240 Power Module frame size FSF without line filter



PM240 Power Module frame size FSF with integrated class A line filter

Mounted with 4 M8 studs, 4 M8 nuts, 4 M8 washers.

Ventilation clearance required at top and bottom: 350 mm (13.78 inches).

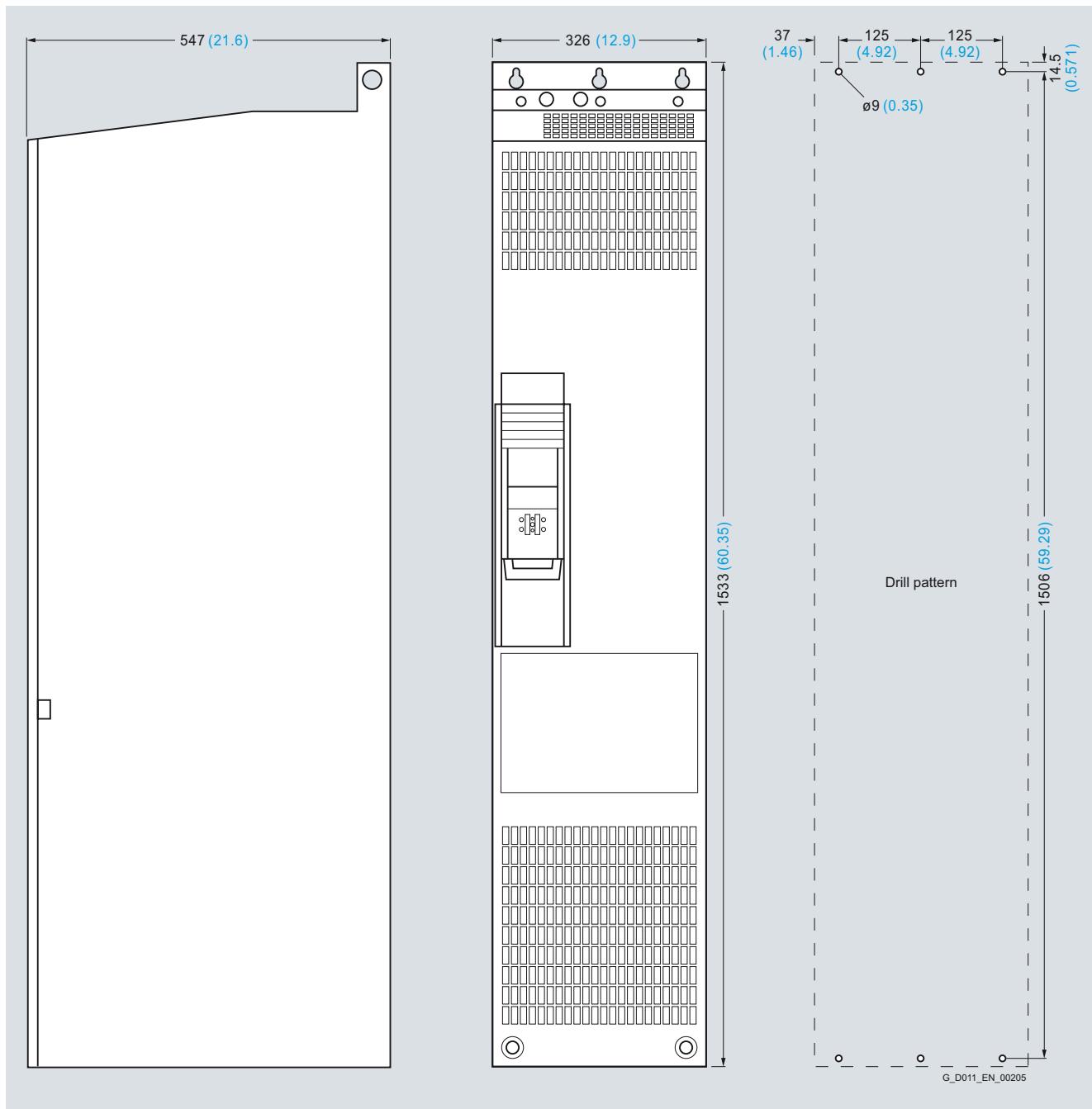
Ventilation clearance required at front: 28 mm (1.1 inches).

Ventilation clearance required at sides: 0 mm (0 inches).

When the Control Unit is plugged on, the mounting depth increases by 56 mm (2.2 inches).

Exception: for CU240E, mounting depth +22 mm (+0.87 inches).

All dimensions in mm (values in brackets are in inches).

**Dimensional drawings**

PM240 Power Module frame size FSGX without line filter

Mounted with 6 M8 studs, 6 M8 nuts, 6 M8 washers.

Ventilation clearance required at the top: 250 mm (9.84 inches).

Ventilation clearance required at the bottom: 150 mm (5.91 inches).

Ventilation clearance required at front: 50 mm (1.97 inches).

Ventilation clearance required at sides: 0 mm (0 inches).

When the Control Unit is plugged on, the mounting depth does not increase.

All dimensions in mm (values in brackets are in inches).

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM250 Power Modules –  
7.5 kW to 75 kW (10 hp to 100 hp)**

## Overview



Example: PM250 Power Modules frame sizes FSC to FSF

The PM250 Power Module features an absolutely unique technology – Efficient Infeed Technology. This feature provides the ability to feed energy back into the supply system in the generator mode (electronic braking) so that the energy is not wasted in a braking resistor. This saves space in the control cabinet. The time-consuming process of dimensioning the braking resistor and the expense of the extra wiring are eliminated. Furthermore, heat losses in the control cabinet are reduced.

The innovative circuit design used in Efficient Infeed Technology reduces the line harmonics. There is no need to use an optional line reactor at the supply infeed. This saves space and costs for engineering and procurement.

The PM250 Power Module is also suitable for use in safety-oriented applications. In conjunction with a Fail-safe Control Unit, the drive can be turned into a Safety Integrated Drive (see Control Units).

The permissible cable lengths between inverter and motor are limited. Longer cables can be used if output reactors are connected (see load-side power components).

Frame sizes FSD to FSF of the PM250 Power Modules are available both with as well as without integrated class A line filter.

For frame size FSC of PM250 Power Module with an integrated class A line filter, an additional class B base filter is available for achieving class B (see line-side power components).

The PM250 Power Modules with integrated class A line filter are suitable for connection to TN supply systems. Power Modules without integrated line filter can be connected to grounded (TN, TT) and non-grounded (IT) supply systems.

## Overview of how customers benefit from Efficient Infeed Technology

For more detailed information, please refer to the part Highlights, in section Efficient Infeed Technology.

	Standard Technology	Efficient Infeed Technology
Line reactor		Required 
Braking resistor		Required 
Configuration overhead		Standard 
Generated harmonics		Standard 
Heat generated when braking		Yes 
Power infeed		Standard  Approx. 22% less
Power consumption		Standard  Approx. 22% less
Energy efficiency		Standard  Good
Reactive power compensation		No 
Installation outlay		Standard  Low

G\_D011\_EN\_00182

## Selection and ordering data

To ensure that a suitable Power Module is selected, the following currents should be used for applications:

- **rated output current for applications with light overload (LO)**
- **base load current for applications with high overload (HO)**

With reference to the rated output current, the modules support at least 2-pole to 6-pole low-voltage motors, e.g. the new 1LE1 motor series (please refer to the Appendix for further information). The rated power is merely a guide value. For a description of the overload performance, please refer to the general technical specifications of the Power Modules.

Rated power <sup>1)</sup>		Rated output current <sup>2)</sup> $I_{\text{rated}}$		Power based on the base load current <sup>3)</sup>		Base load current <sup>3)</sup> $I_H$		Frame size	SINAMICS G120 PM250 Power Module without integrated line filter	SINAMICS G120 PM250 Power Module with integrated class A line filter
kW	hp	A	kW	hp	A			Order No.	Order No.	
<b>380 ... 480 V 3 AC</b>										
7.5	10	18	5.5	7.5	13.2	FSC	–	6SL3225-0BE25-5AA0		
11.0	15	25	7.5	10	19	FSC	–	6SL3225-0BE27-5AA0		
15.0	20	32	11.0	15	26	FSC	–	6SL3225-0BE31-1AA0		
18.5	25	38	15.0	20	32	FSD	new	6SL3225-0BE31-5UA0	6SL3225-0BE31-5AA0	
22	30	45	18.5	25	38	FSD	new	6SL3225-0BE31-8UA0	6SL3225-0BE31-8AA0	
30	40	60	22	30	45	FSD	new	6SL3225-0BE32-2UA0	6SL3225-0BE32-2AA0	
37	50	75	30	40	60	FSE	new	6SL3225-0BE33-0UA0	6SL3225-0BE33-0AA0	
45	60	90	37	50	75	FSE	new	6SL3225-0BE33-7UA0	6SL3225-0BE33-7AA0	
55	75	110	45	60	90	FSF	new	6SL3225-0BE34-5UA0	6SL3225-0BE34-5AA0	
75	100	145	55	75	110	FSF	new	6SL3225-0BE35-5UA0	6SL3225-0BE35-5AA0	
90	125	178	75	100	145	FSF	new	6SL3225-0BE37-5UA0	6SL3225-0BE37-5AA0	

<sup>1)</sup> Rated power based on the rated output current  $I_{\text{rated}}$ . The rated output current  $I_{\text{rated}}$  is based on the duty cycle for light overload (LO).

<sup>2)</sup> The rated output current  $I_{\text{rated}}$  is based on the duty cycle for light overload (LO). These current values are valid for 400 V and are stamped on the rating plate of the Power Module.

<sup>3)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM250 Power Modules –  
7.5 kW to 75 kW (10 hp to 100 hp)**

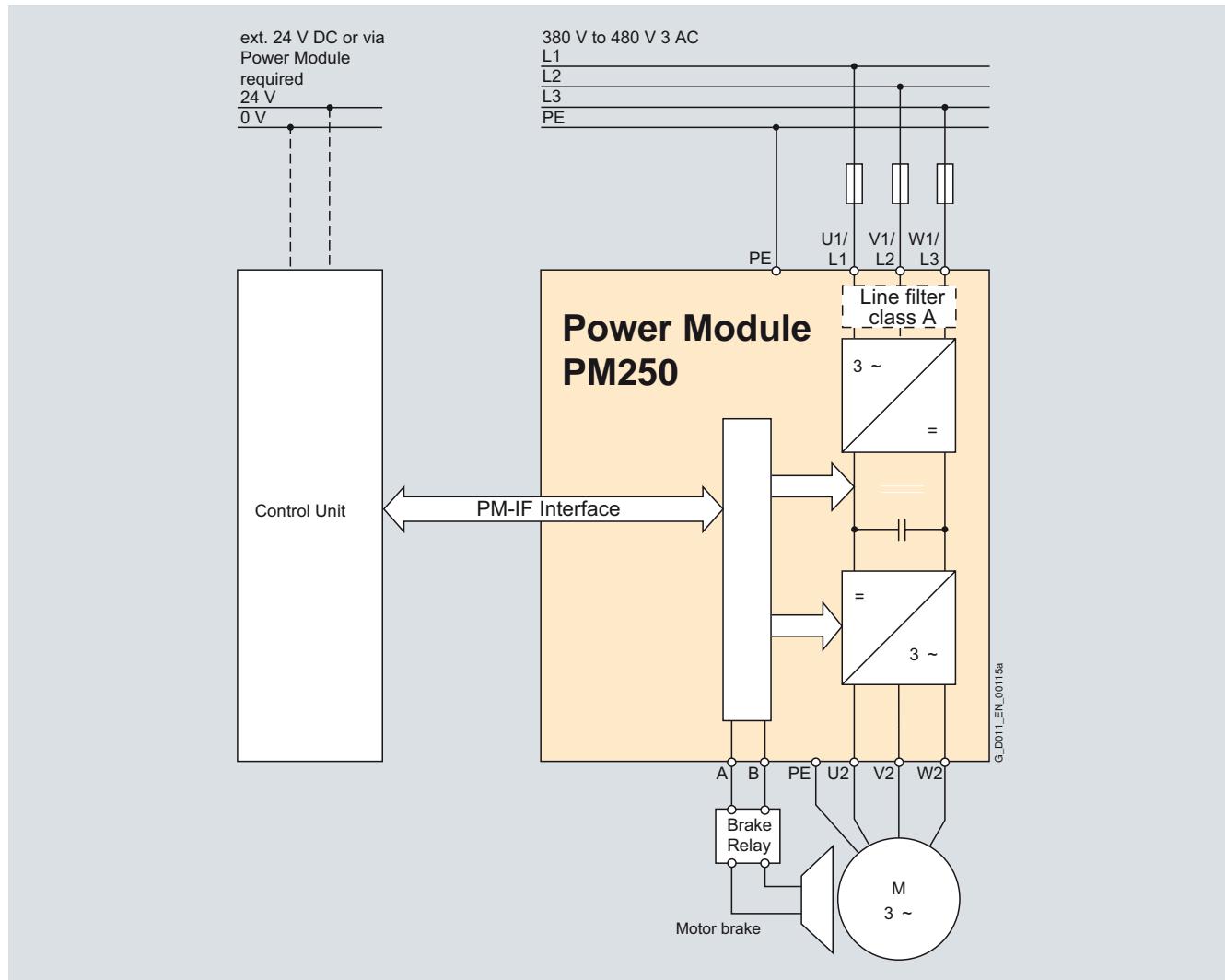
## Integration

PM250 Power Modules communicate with the Control Unit via the PM-IF interface.

PM250 Power Modules feature the following interfaces as standard:

- PM-IF interface to connect the PM250 Power Module to the Control Unit. The PM250 Power Module also supplies power to the Control Unit using an integrated power supply

- Motor connected using screw terminals or screw studs
- Control for the Brake Relay or the Safe Brake Relay for controlling a motor brake
- 2 PE/protective conductor connections



PM250 Power Module connection diagram with or without integrated class A line filter

## Integration

*Power and DC link components which are optionally available depending on the Power Module used*

The following line-side power components, DC link components and load-side power components are optionally available in the appropriate frame sizes for the Power Modules:

	Frame size	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM250 Power Module with line-commutated energy recovery</b>								
Available frame sizes	–	–	✓	✓	✓	✓	✓	–
<b>Line-side power components</b>								
Line filter, class A	–	–	I	F	F	F	–	–
Line filter, class B	–	–	U	–	–	–	–	–
Line reactor <sup>1)</sup>	–	–	– <sup>1)</sup>	–				
<b>DC link components</b>								
Braking resistor <sup>2)</sup>	–	–	– <sup>2)</sup>	–				
<b>Load-side power components</b>								
Output reactor	–	–	U	S	S	S	–	–
Sine-wave filter	–	–	U	S	S	S	–	–

U = Base component

S = Lateral mounting

I = Integrated

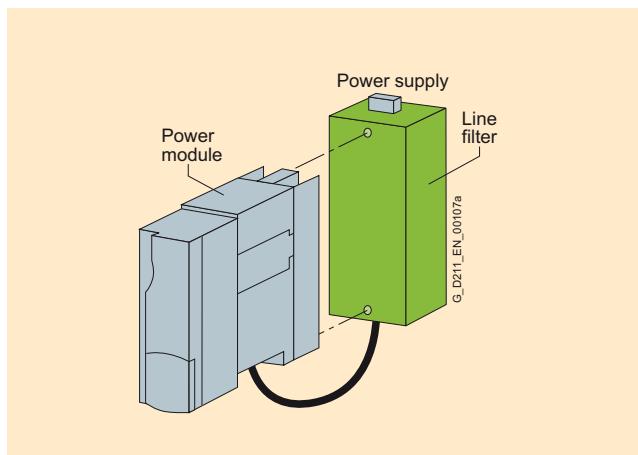
– = Not possible

F = Power Modules available with and without integrated class A filter

### Available as base components

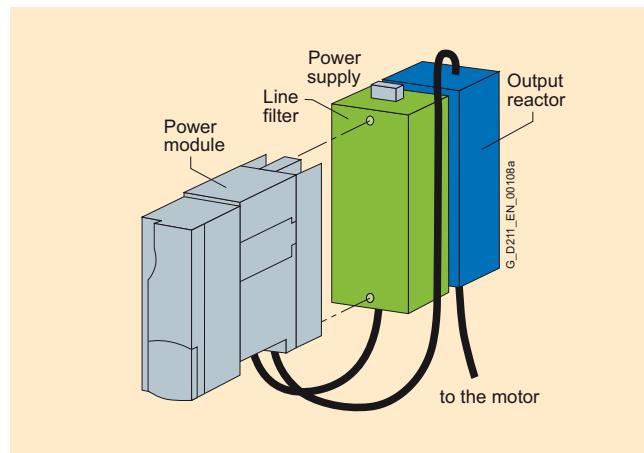
Many system components for PM250 Power Modules are designed as base components, that is, the component is mounted on the baseplate and the PM250 Power Module above it in a space-saving design. Up to two base components can be mounted above one another.

The following diagram shows the basic layout of a PM250 Power Module with additional class B line filter as base component:



Basic layout of a PM250 Power Module with class B line filter as base component

The following example shows the structure for two base components:



Basic layout of a PM250 Power Module with class B line filter as base component and output reactor

<sup>1)</sup> A line reactor is not required and must not be used in conjunction with a PM250 or PM260 Power Module.

<sup>2)</sup> Line-commutated energy recovery is possible in conjunction with a PM250 or PM260 Power Module. A braking resistor cannot be connected and is not necessary.

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM250 Power Modules –**

**7.5 kW to 75 kW (10 hp to 100 hp)**

## Integration

*Maximum permissible cable lengths from the motor to the inverter when using output reactors or sine-wave filters depending on the voltage range*

The following load-side power components in the appropriate frame sizes are optionally available for the Power Modules and result in the following maximum cable lengths:

Maximum permissible motor cable lengths (shielded/unshielded) in m							
	Frame sizes						
	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM250 Power Module with line-commutated energy recovery</b>							
Available frame sizes	–	–	✓	✓	✓	✓	–
Without output reactor/sine-wave filter	–	–	50/100	50/100	50/100	50/100	–
With optional output reactor							
• at 380 V (–10 %) to 400 V 3 AC	–	–	150/225	200/300	200/300	200/300	–
• at 401 V to 480 V (+10 %) 3 AC	–	–	100/150	200/300	200/300	200/300	–
With optional sine-wave filter							
• at 380 V (–10 %) to 400 V 3 AC	–	–	200/300	200/300	200/300	200/300	–
• at 401 V to 480 V (+10 %) 3 AC	–	–	200/300	200/300	200/300	200/300	–

## Derating data

The following inverter output currents can still be implemented for long motor cables without output reactor and sine-wave filter.

Derating for PM250 Power Modules, frame sizes FSC to FSF for shielded motor cables. From frame size FSD and higher, only the particular main Power Module types were tested. The values also apply to the other Power Modules of the particular frame size.

Rated power (at $I_H$ )		Frame size	Base load current $I_H$	Rated output current $I_{rated}$	Motor con- nection cross- section	Current derating			
kW	hp		A	A	mm <sup>2</sup>	50 m	100 m	150 m	200 m
5.5	7.5	FSC	13.2	18	10	100 %	70 %	45 %	–
7.5	10	FSC	19	25	10	100 %	90 %	80 %	–
11.0	15	FSC	26	32	10	100 %	90 %	80 %	–
22.0	30	FSD	45	60	35	100 %	95 %	90 %	85 %
37.0	50	FSE	75	90	35	100 %	100 %	95 %	90 %
75.0	100	FSF	145	178	95	100 %	100 %	100 %	95 %

– Not possible

## Technical specifications

### General technical specifications

PM250 Power Modules	
<b>System operating voltage</b>	380 ... 480 V 3 AC ±10 %
<b>Line supply requirements</b>	≤ 1 %
<b>Line short circuit voltage <math>u_K</math></b>	
<b>Input frequency</b>	47 ... 63 Hz
<b>Output frequency</b>	
• Control type V/f	0 ... 650 Hz
• Control type Vector	0 ... 200 Hz
<b>Pulse frequency</b>	4 kHz (standard), higher pulse frequencies up to 16 kHz, see the derating data
<b>Power factor</b>	0.9
<b>Inverter efficiency</b>	95 ... 97 %
<b>Modulation depth</b>	87 %
<b>Overload capability</b>	
• High overload (HO)	1.5 × rated output current (i.e. 150 % overload) for 57 s with a cycle time of 300 s 2 × rated output current (i.e. 200 % overload) for 3 s with a cycle time of 300 s
• Light overload (LO)	1.1 × rated output current (i.e. 110 % overload) for 57 s with a cycle time of 300 s 1.5 × rated output current (i.e. 150 % overload) for 3 s with a cycle time of 300 s
<b>Electromagnetic compatibility</b>	Optional class A or B line filter acc. to EN 55011 is available
<b>Possible braking methods</b>	Energy recovery in the generator mode
<b>Degree of protection</b>	IP20
<b>Operating temperature</b>	
• High overload (HO)	0 ... 50 °C (32 ... 122 °F) without derating, > 50 ... 60 °C see derating characteristics
• Light overload (LO)	0 ... 40 °C (32 ... 104 °F) without derating, > 40 ... 60 °C see derating characteristics
<b>Storage temperature</b>	-40 ... +70 °C (-40 ... +158 °F)
<b>Relative humidity</b>	< 95 % RH, condensation not permissible
<b>Cooling</b>	Internal air cooling, power units with increased air cooling using integrated fans
<b>Installation altitude</b>	up to 1000 m above sea level without power reduction, > 1000 m see derating characteristics
<b>Standard SCCR (Short Circuit Current Rating)<sup>1)</sup></b>	FSC: 10 kA FSD, FSE, FSF: 42 kA
<b>Protection functions</b>	<ul style="list-style-type: none"> <li>• Undervoltage</li> <li>• Overvoltage</li> <li>• Overcontrol/overload</li> <li>• Ground fault</li> <li>• Short circuit</li> <li>• Stall protection</li> <li>• Motor blocking protection</li> <li>• Motor overtemperature</li> <li>• Inverter overtemperature</li> <li>• Parameter locking</li> </ul>
<b>Standards conformance</b>	UL, cUL, CE, c-tick
<b>CE mark</b>	According to Low-Voltage Directive 73/23/EEC and Machinery Directive 98/37/EC

<sup>1)</sup> Applies to industrial control cabinet installations to NEC Article 409/UL 508A. For further information, visit us on the Internet at: <http://support.automation.siemens.com/WW/view/en/23995621>

**SINAMICS G120****Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)****PM250 Power Modules –  
7.5 kW to 75 kW (10 hp to 100 hp)****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		PM250 Power Modules		
With integrated line filter		6SL3225-0BE25-5AA0	6SL3225-0BE27-5AA0	6SL3225-0BE31-1AA0
<b>Output current at 50 Hz 400 V 3 AC</b>				
• Rated current $I_{rated}$ <sup>1)</sup>	A	18	25	32
• Base load current $I_L$ <sup>1)</sup>	A	18	25	32
• Base load current $I_H$ <sup>2)</sup>	A	13.2	19	26
• $I_{max}$	A	26.4	38	52
<b>Rated power</b>				
• based on $I_L$	kW (hp)	7.5 (10)	11 (15)	15 (20)
• based on $I_H$	kW (hp)	5.5 (7.5)	7.5 (10)	11 (15)
<b>Rated pulse frequency</b>	kHz	4	4	4
<b>Efficiency <math>\eta</math></b>		0.95	0.95	0.95
<b>Power loss</b> (at rated current)	kW	0.26	0.28	0.31
<b>Cooling air requirement</b>	m <sup>3</sup> /s	0.038	0.038	0.038
<b>Sound pressure level <math>L_{pA}</math> (1 m)</b>	dB	Available soon	Available soon	Available soon
<b>24 V DC power supply for Control Unit</b>	A	1	1	1
<b>Input current</b> <sup>3)</sup>				
• Rated current	A	18	25	32
• Current based on $I_H$	A	13.2	19	26
<b>Line supply connection</b> U1/L1, V1/L2, W1/L3		Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	2.5 ... 10	2.5 ... 10	2.5 ... 10
<b>Motor connection</b> U2, V2, W2		Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	2.5 ... 10	2.5 ... 10	2.5 ... 10
<b>PE connection</b>		On housing with M5 screw	On housing with M5 screw	On housing with M5 screw
<b>Motor cable length, max.</b> <sup>4)</sup>				
• Shielded	m	50	50	50
• Unshielded	m	100	100	100
<b>Degree of protection</b>		IP20	IP20	IP20
<b>Dimensions</b>				
• Width	mm	189	189	189
• Height	mm	334	334	334
• Depth				
- without Control Unit	mm	185	185	185
- with Control Unit	mm	250	250	250
<b>Frame size</b>		FSC	FSC	FSC
<b>Weight, approx.</b>	kg	7.5	7.5	7.5

<sup>1)</sup> The rated output current  $I_{rated}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).

<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

<sup>3)</sup> The input current depends on the motor load and is valid for a line impedance corresponding to  $u_K = 1\%$ . The rated input currents apply for a load at the rated power (based on  $I_{rated}$ ) – these current values are specified on the rating plate.

**Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		PM250 Power Modules		
Without integrated line filter		<b>6SL3225-0BE31-5UA0</b>	<b>6SL3225-0BE31-8UA0</b>	<b>6SL3225-0BE32-2UA0</b>
With integrated line filter		<b>6SL3225-0BE31-5AA0</b>	<b>6SL3225-0BE31-8AA0</b>	<b>6SL3225-0BE32-2AA0</b>
<b>Output current at 50 Hz 400 V 3 AC</b>				
• Rated current $I_{\text{rated}}^{1)}$	A	38	45	60
• Base load current $I_L^{1)}$	A	38	45	60
• Base load current $I_H^{2)}$	A	32	38	45
• $I_{\max}$	A	64	76	90
<b>Rated power</b>				
• based on $I_L$	kW (hp)	18.5 (25)	22 (30)	30 (40)
• based on $I_H$	kW (hp)	15 (20)	18.5 (25)	22 (30)
<b>Rated pulse frequency</b>		kHz	4	4
<b>Efficiency <math>\eta</math></b>			> 0.97	> 0.97
<b>Power loss</b> (at rated current)		kW	0.42	0.52
<b>Cooling air requirement</b>		$\text{m}^3/\text{s}$	0.022	0.039
<b>Sound pressure level <math>L_{\text{pA}}</math> (1 m)</b>		dB	< 60	< 61
24 V DC power supply for Control Unit	A	1	1	1
<b>Input current<sup>3)</sup></b>				
• Rated current	A	36	42	56
• based on $I_H$	A	30	36	42
<b>Line supply connection</b> U1/L1, V1/L2, W1/L3		M6 screw studs	M6 screw studs	M6 screw studs
• Conductor cross-section	$\text{mm}^2$	10 ... 35	10 ... 35	10 ... 35
<b>Motor connection</b> U2, V2, W2		M6 screw studs	M6 screw studs	M6 screw studs
• Conductor cross-section	$\text{mm}^2$	10 ... 35	10 ... 35	10 ... 35
<b>PE connection</b>		On housing with M6 screw	On housing with M6 screw	On housing with M6 screw
<b>Motor cable length, max.<sup>4)</sup></b>				
• Shielded	m	50	50	50
• Unshielded	m	100	100	100
<b>Degree of protection</b>		IP20	IP20	IP20
<b>Dimensions</b>				
• Width	mm	275	275	275
• Height				
- without integrated line filter	mm	419	419	419
- With integrated line filter	mm	512	512	512
• Depth				
- without Control Unit	mm	204	204	204
- with Control Unit	mm	260	260	260
<b>Frame size</b>		FSD	FSD	FSD
<b>Weight, approx.</b>				
• Without integrated line filter	kg	13	13	13
• With integrated line filter	kg	15	15	16

<sup>1)</sup> The rated output current  $I_{\text{rated}}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).

<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

<sup>3)</sup> The input current depends on the motor load and is valid for a line impedance corresponding to  $U_K = 1\%$ . The rated input currents apply for a load at the rated power (based on  $I_{\text{rated}}$ ) – these current values are specified on the rating plate.

<sup>4)</sup> Max motor cable length 25 m (shielded) for PM250 Power Modules with integrated line filter to maintain the limit values of EN 61800-3 Category C2.

**SINAMICS G120****Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)****PM250 Power Modules –  
7.5 kW to 75 kW (10 hp to 100 hp)****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		PM250 Power Modules				
Without integrated line filter	6SL3225-0BE33-0UA0	6SL3225-0BE33-7UA0	6SL3225-0BE34-5UA0	6SL3225-0BE35-5UA0	6SL3225-0BE37-5UA0	
With integrated line filter	6SL3225-0BE33-0AA0	6SL3225-0BE33-7AA0	6SL3225-0BE34-5AA0	6SL3225-0BE35-5AA0	6SL3225-0BE37-5AA0	
Output current at 50 Hz 400 V 3 AC						
• Rated current $I_{\text{rated}}^1)$	A	75	90	110	145	178
• Base load current $I_L^1)$	A	75	90	110	145	178
• Base load current $I_H^2)$	A	60	75	90	110	145
• $I_{\max}$	A	120	150	180	220	290
Rated power						
• based on $I_L$	kW (hp)	37 (50)	45 (60)	55 (75)	75 (100)	90 (125)
• based on $I_H$	kW (hp)	30 (40)	37 (50)	45 (60)	55 (75)	75 (100)
Rated pulse frequency						
kHz		4	4	4	4	4
Efficiency $\eta$						
> 0.97		> 0.97	> 0.97	> 0.97	> 0.97	> 0.97
Power loss (at rated current)						
kW		0.99	1.21	1.42	1.93	2.31
Cooling air requirement						
m³/s		0.022	0.039	0.094	0.094	0.117
Sound pressure level $L_{pA}$ (1 m)						
dB		< 60	< 62	< 60	< 60	< 65
24 V DC power supply for Control Unit	A	1	1	1	1	1
Input current <sup>3)</sup>						
• Rated current	A	70	84	102	135	166
• based on $I_H$	A	56	70	84	102	135
Line supply connection U1/L1, V1/L2, W1/L3						
• Max. conductor cross-sect.	mm²	10 ... 50	10 ... 50	25 ... 120	25 ... 120	25 ... 120
Motor connection U2, V2, W2						
• Max. conductor cross-sect.	mm²	10 ... 50	10 ... 50	25 ... 120	25 ... 120	25 ... 120
PE connection						
On housing with M6 screw		On housing with M6 screw	On housing with M8 screw			
Motor cable length, max. <sup>4)</sup>						
• Shielded	m	50	50	50	50	50
• Unshielded	m	100	100	100	100	100
Degree of protection						
IP20		IP20	IP20	IP20	IP20	IP20
Dimensions						
• Width	mm	275	275	350	350	350
• Height						
- without integrated line filter	mm	499	499	634	634	634
- With integrated line filter	mm	635	635	934	934	934
• Depth						
- without Control Unit	mm	204	204	316	316	316
- with Control Unit	mm	260	260	372	372	372
Frame size						
FSE		FSE	FSF	FSF	FSF	
Weight, approx.						
• Without integrated line filter	kg	14	14	35	35	35
• With integrated line filter	kg	21	21	51	51	51

<sup>1)</sup> The rated output current  $I_{\text{rated}}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).<sup>3)</sup> The input current depends on the motor load and is valid for a line impedance corresponding to  $U_K = 1\%$ . The rated input currents apply for a load at the rated power (based on  $I_{\text{rated}}$ ) – these current values are specified on the rating plate.<sup>4)</sup> Max motor cable length 25 m (shielded) for PM250 Power Modules with integrated line filter to maintain the limit values of EN 61800-3 Category C2.

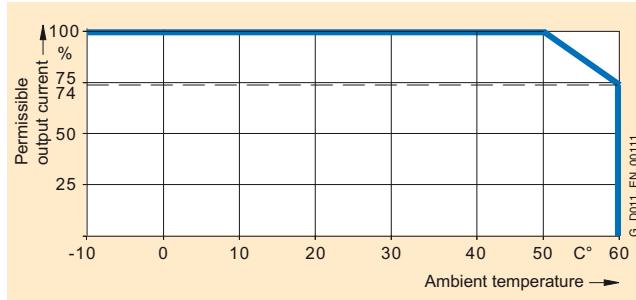
## Characteristic curves

### Derating data

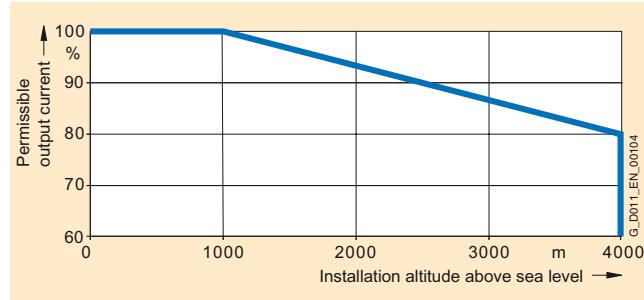
#### Pulse frequency

Rated power at 400 V 3 AC		Rated output current in A at a pulse frequency of						
kW	hp	4 kHz	6 kHz	8 kHz	10 kHz	12 kHz	14 kHz	16 kHz
<b>7.5</b>	10	18	12.5	11.9	10.6	9.2	7.9	6.6
<b>11.0</b>	15	25	18.1	17.1	15.2	13.3	11.4	9.5
<b>15.0</b>	20	32	24.7	23.4	20.8	18.2	15.6	13
<b>18.5</b>	25	38	32	27	23	19	17	15
<b>22.0</b>	30	45	38	32	27	23	20	18
<b>30.0</b>	40	60	51	42	36	30	27	24
<b>37.0</b>	50	75	64	53	45	38	34	30
<b>45.0</b>	60	90	77	63	54	45	41	36
<b>55.0</b>	75	110	94	77	–	–	–	–
<b>75.0</b>	100	145	123	102	–	–	–	–
<b>90.0</b>	125	178	151	125	–	–	–	–

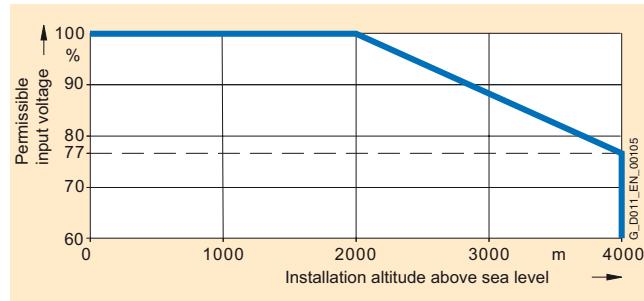
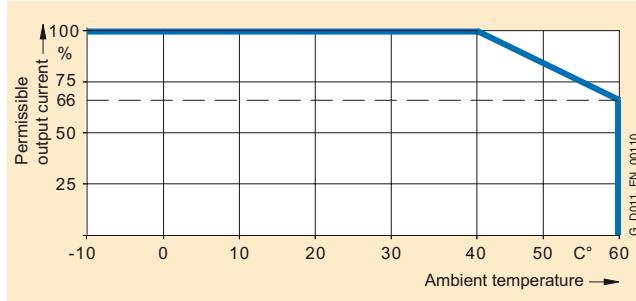
#### Ambient temperature



#### Installation altitude



#### High overload (HO)



#### Light overload (LO)

Note: The operating temperature ranges of the Control Units should be taken into account. The temperature ranges are specified in the technical specifications under Control Units.

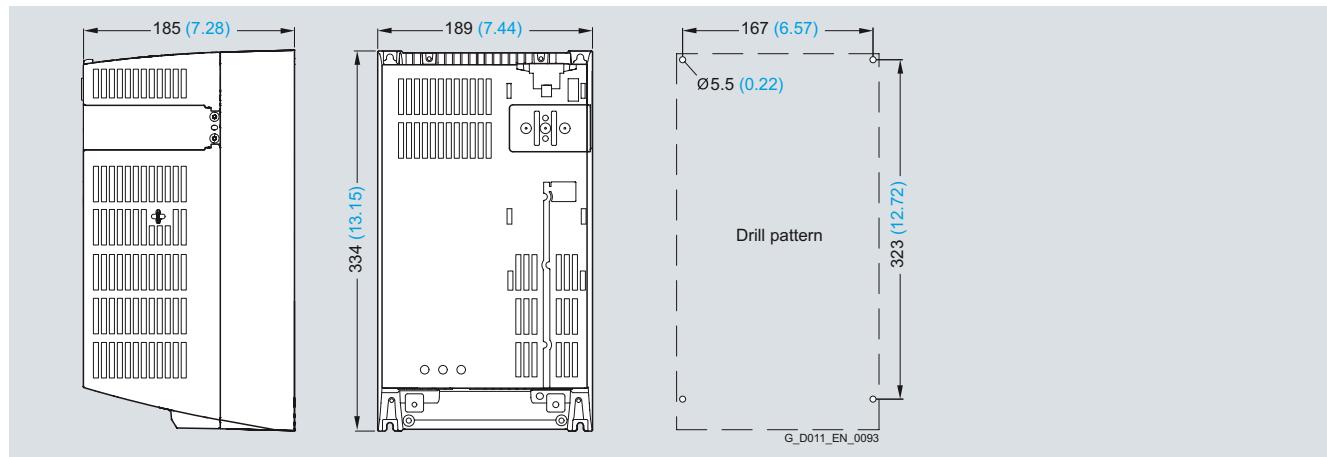
# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM250 Power Modules –**

**7.5 kW to 75 kW (10 hp to 100 hp)**

## Dimensional drawings



PM250 Power Module frame size FSC with integrated class A line filter

Mounted with 4 M5 studs, 4 M5 nuts, 4 M5 washers.

Ventilation clearance required at top and bottom: 125 mm (4.92 inches).

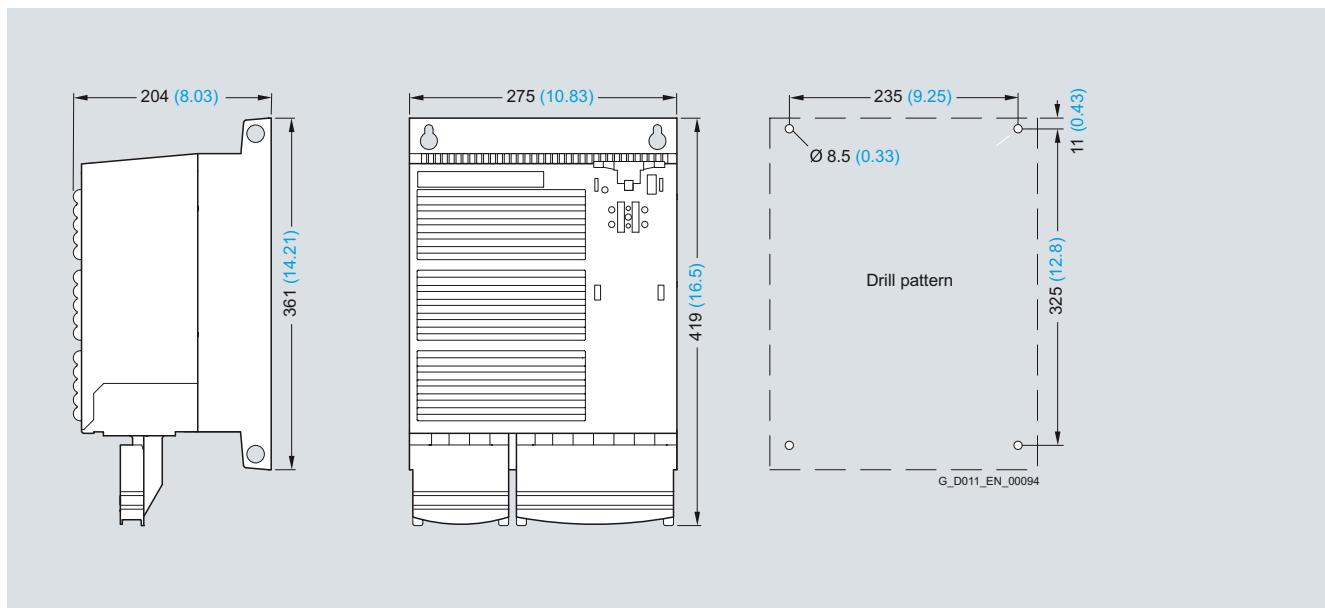
Ventilation clearance required at sides:

- Ambient temperature  $\leq 40^{\circ}\text{C}$ : 0 mm (0 inches).
- Ambient temperature  $> 40^{\circ}\text{C}$ : 50 mm (1.97 inches).

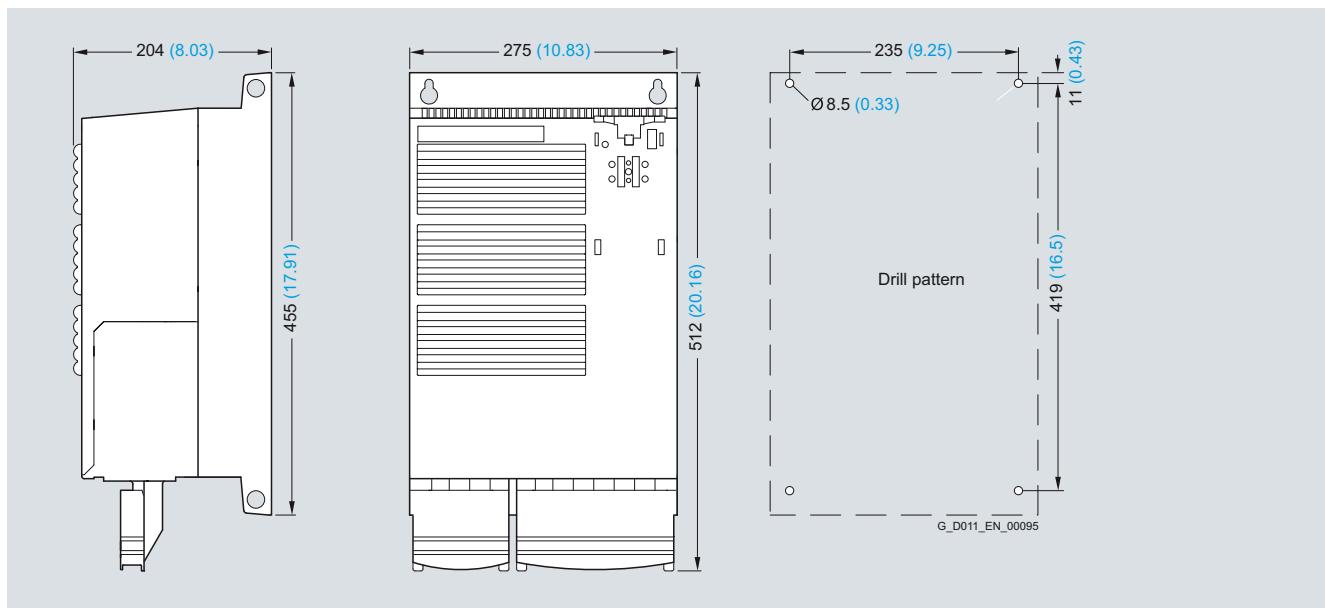
When the Control Unit is plugged on, the mounting depth increases by 65 mm (2.56 inches).

Exception: for CU240E, mounting depth +31 mm (+1.22 inches).

All dimensions in mm (values in brackets are in inches).

**Dimensional drawings**

PM250 Power Module frame size FSD without line filter



PM250 Power Module frame size FSD with integrated class A line filter

Mounted with 4 M8 studs, 4 M8 nuts, 4 M8 washers.

Ventilation clearance required at top and bottom: 300 mm  
(11.81 inches).

Ventilation clearance required at sides: 0 mm (0 inches).

When the Control Unit is plugged on, the mounting depth increases by 56 mm (2.2 inches).

Exception: for CU240E, mounting depth +22 mm  
(+0.87 inches).

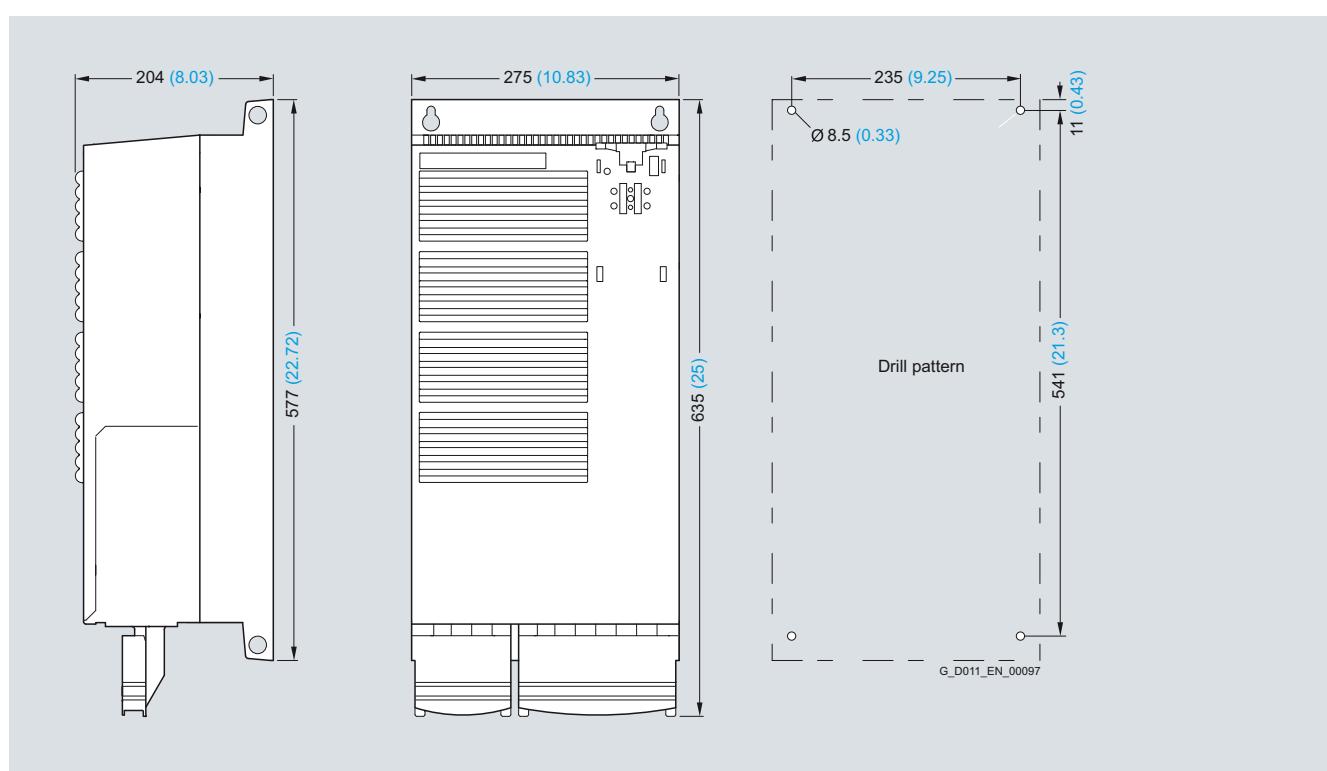
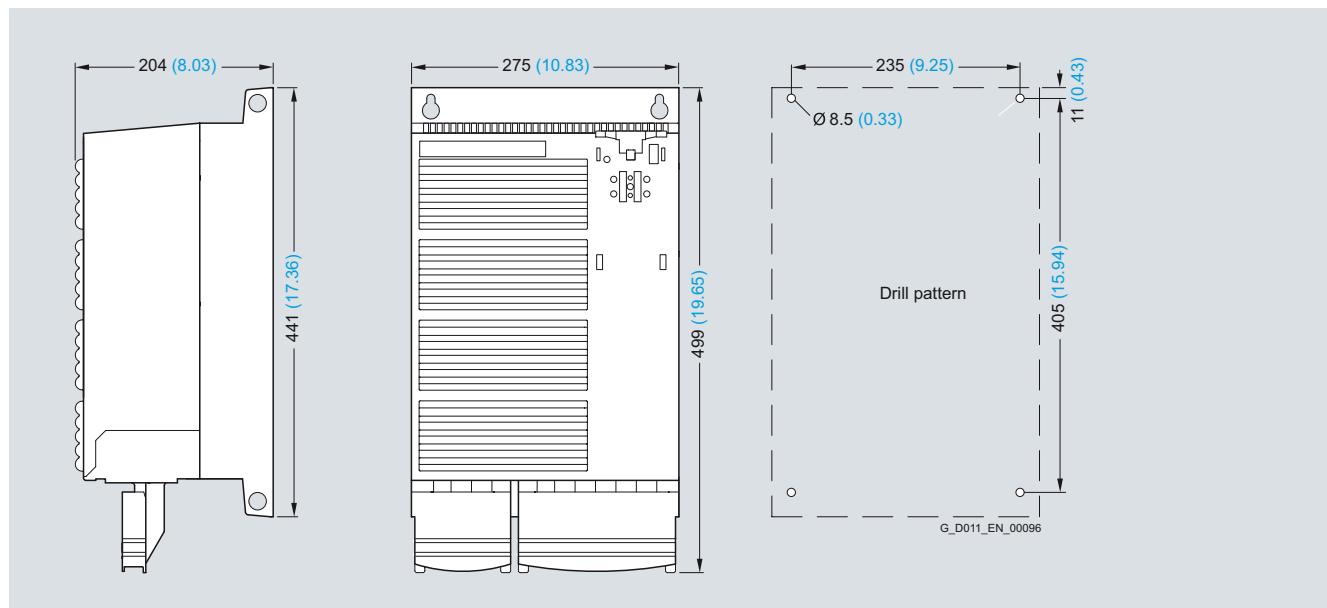
All dimensions in mm (values in brackets are in inches).

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

PM250 Power Modules –

7.5 kW to 75 kW (10 hp to 100 hp)

**Dimensional drawings**

Mounted with 4 M8 studs, 4 M8 nuts, 4 M8 washers.

Ventilation clearance required at top and bottom: 300 mm  
(11.81 inches).

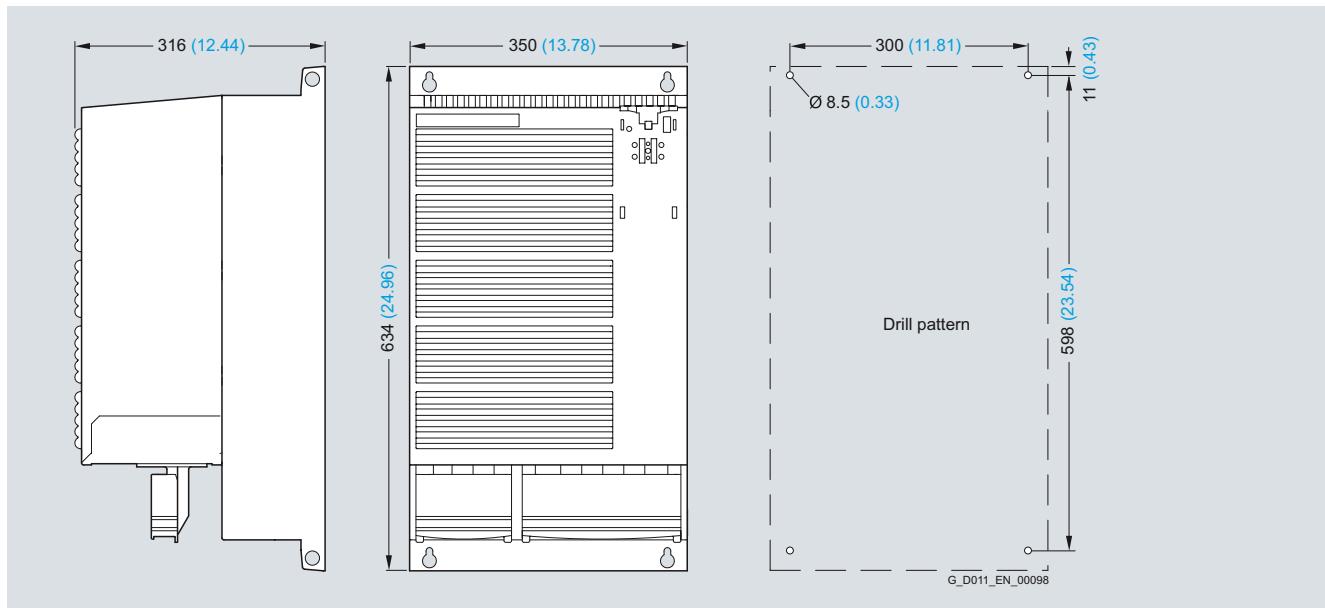
Ventilation clearance required at sides: 0 mm (0 inches).

When the Control Unit is plugged on, the mounting depth increases by 56 mm (2.2 inches).

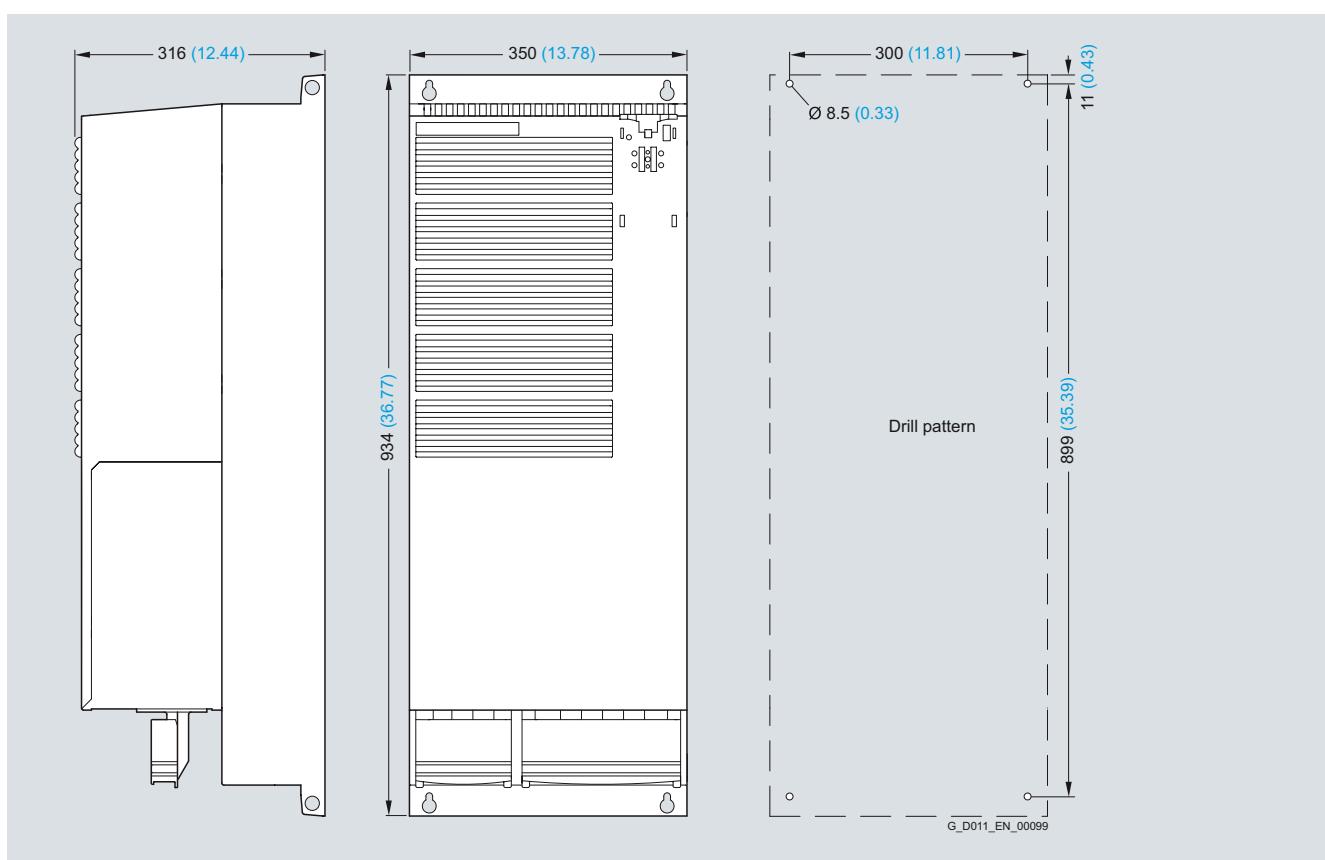
Exception: for CU240E, mounting depth +22 mm  
(+0.87 inches).

All dimensions in mm (values in brackets are in inches).

## Dimensional drawings



4



PM250 Power Module frame size FSF with integrated class A line filter

Mounted with 4 M8 studs, 4 M8 nuts, 4 M8 washers.

Ventilation clearance required at top and bottom: 350 mm (13.78 inches).

Ventilation clearance required at sides: 0 mm (0 inches).

When the Control Unit is plugged on, the mounting depth increases by 56 mm (2.2 inches).

Exception: for CU240E, mounting depth +22 mm (+0.87 inches).

All dimensions in mm (values in brackets are in inches).

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM260 Power Modules –  
11 kW to 55 kW (15 hp to 75 hp)**

## Overview



Example: PM260 FSD Power Module

The PM260 Power Module features an absolutely unique technology – Efficient Infeed Technology. This feature provides the ability to feed energy back into the supply system in the generator mode (electronic braking) so that the energy is not wasted in a braking resistor. This saves space in the control cabinet. The time-consuming process of dimensioning the braking resistor and the expense of the extra wiring are eliminated. Furthermore, heat losses in the control cabinet are reduced.

The innovative circuit design used in Efficient Infeed Technology reduces the line harmonics. There is no need to use an optional line reactor at the supply infeed. This saves space and costs for engineering and procurement.

The PM260 Power Modules are also characterized by a higher rated pulse frequency combined with a high efficiency and an integrated sine-wave filter. The integrated sine-wave filter ensures that the inverter output current is sinusoidal and supports cable lengths of up to 200 m shielded and 300 m unshielded. An output reactor is therefore not required. Furthermore, lower bearing currents and voltage stress are generated that reduces the overall stress on the motor.

The use of SiC free-wheeling diodes – an absolutely unique innovation – makes the PM260 Power Module extremely compact. It is also highly resistant to thermal loading and operates very quietly as a result of the high clock frequencies.

Standard motors can be used in conjunction with the PM260 Power Module. The winding system insulation strength does not have to be increased.

The PM260 Power Module is suitable for safety-oriented applications. In conjunction with a Fail-safe Control Unit, the drive can be turned into a Safety Integrated Drive (see Control Units).

The PM260 Power Modules with integrated class A line filter are suitable for connection to TN supply systems. Power Modules without integrated line filter can be connected to grounded (TN, TT) and non-grounded (IT) supply systems.

## Overview of how customers benefit from Efficient Infeed Technology

For more detailed information, please refer to the part Highlights, in section Efficient Infeed Technology.

	Standard Technology	Efficient Infeed Technology	
Line reactor		Required	
Braking resistor		Required	
Configuration overhead		Standard	
Generated harmonics		Standard	
Heat generated when braking		Yes	
Power infeed		Standard	
Power consumption		Standard	
Energy efficiency		Standard	
Reactive power compensation		No	
Installation outlay		Standard	

G\_D011\_EN\_00182

## Overview of how customers benefit from SiC free-wheeling diodes

- Low switching losses at high fundamental frequency
- High speeds possible
- Quiet operation thanks to pulse frequency = 16 kHz
- High thermal load capacity (small heatsinks)
- Very compact units
- Increased ruggedness
- High efficiency
- Low forward losses
- Power unit with regenerative feedback capability
- Integrated sine-wave filter, long unshielded cables can be used
- Can be used with motors without a special insulation
- Very low bearing currents, no bearing insulation required

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM260 Power Modules –  
11 kW to 55 kW (15 hp to 75 hp)**

### Selection and ordering data

To ensure that a suitable Power Module is selected, the following currents should be used for applications:

- **rated output current for applications with light overload (LO)**
- **base load current for applications with high overload (HO)**

With reference to the rated output current, the modules support at least 2-pole to 6-pole low-voltage motors, e.g. the new 1LE1 motor series (please refer to the Appendix for further information). The rated power is merely a guide value. For a description of the overload performance, please refer to the general technical specifications of the Power Modules.

Rated power <sup>1)</sup>		Rated output current <sup>2)</sup> $I_{rated}$	Power based on the base load current <sup>3)</sup>		Base load current <sup>3)</sup> $I_H$	Frame size	<b>SINAMICS G120 PM260 Power Module without integrated line filter</b>	<b>SINAMICS G120 PM260 Power Module with integrated class A line filter</b>
kW	hp	A	kW	hp	A		Order No.	Order No.
<b>500 ... 690 V 3 AC</b>								
<b>11.0</b>	15	14	<b>7.5</b>	10	10	FSD	<b>new</b> <b>6SL3225-0BH27-5UA1</b>	<b>new</b> <b>6SL3225-0BH27-5AA1</b>
<b>15.0</b>	20	19	<b>11</b>	15	14	FSD	<b>new</b> <b>6SL3225-0BH31-1UA1</b>	<b>new</b> <b>6SL3225-0BH31-1AA1</b>
<b>18.5</b>	25	23	<b>15</b>	20	19	FSD	<b>new</b> <b>6SL3225-0BH31-5UA1</b>	<b>new</b> <b>6SL3225-0BH31-5AA1</b>
<b>30</b>	40	35	<b>22</b>	30	26	FSF	<b>new</b> <b>6SL3225-0BH32-2UA1</b>	<b>new</b> <b>6SL3225-0BH32-2AA1</b>
<b>37</b>	50	42	<b>30</b>	40	35	FSF	<b>new</b> <b>6SL3225-0BH33-0UA1</b>	<b>new</b> <b>6SL3225-0BH33-0AA1</b>
<b>55</b>	75	62	<b>37</b>	50	42	FSF	<b>new</b> <b>6SL3225-0BH33-7UA1</b>	<b>new</b> <b>6SL3225-0BH33-7AA1</b>

<sup>1)</sup> Rated power based on the rated output current  $I_{rated}$ . The rated output current  $I_{rated}$  is based on the duty cycle for light overload (LO).

<sup>2)</sup> The rated output current  $I_{rated}$  is based on the duty cycle for light overload (LO). These current values are valid for 690 V and are stamped on the rating plate of the Power Module.

<sup>3)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM260 Power Modules –  
11 kW to 55 kW (15 hp to 75 hp)**

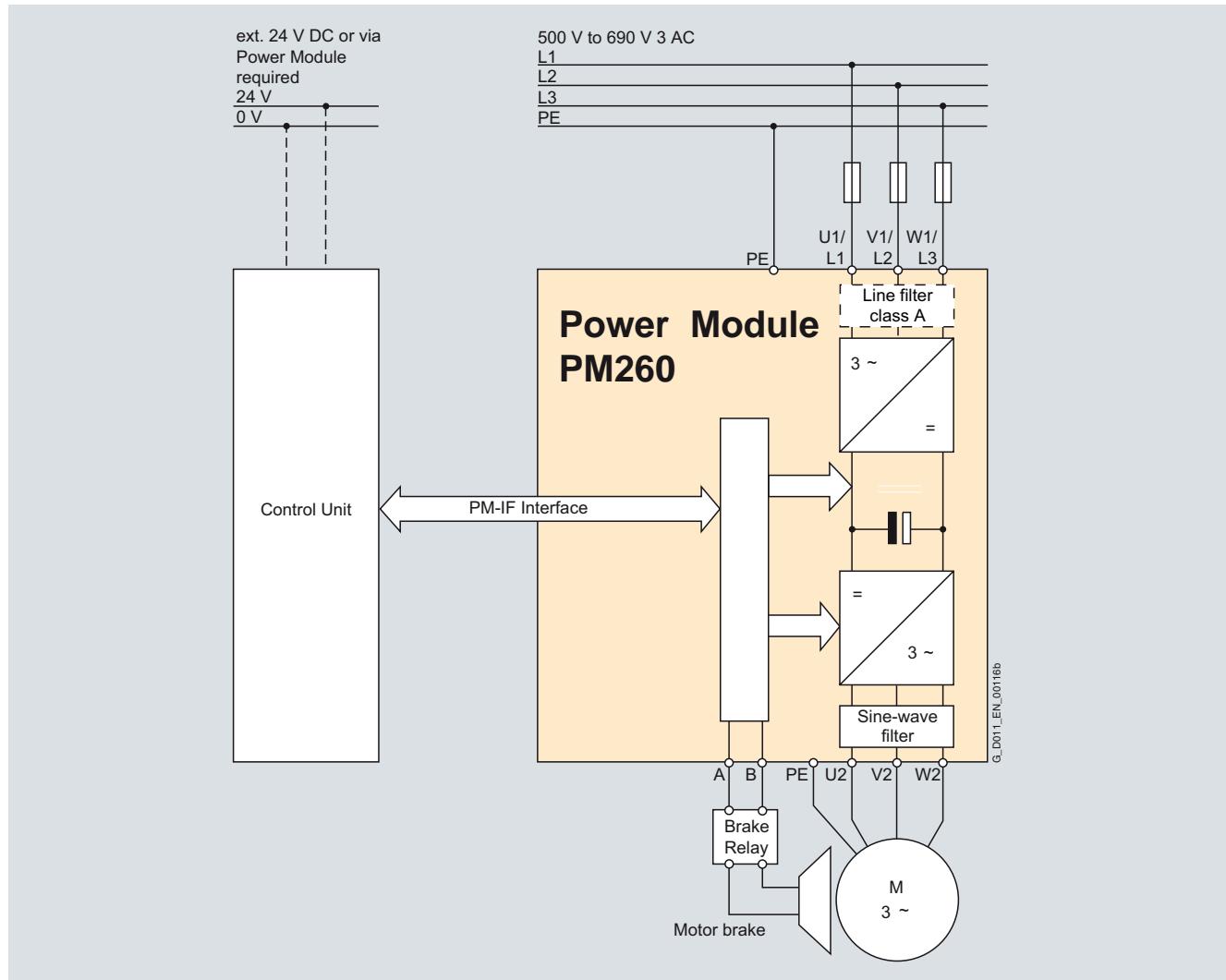
## Integration

PM260 Power Modules communicate with the Control Unit via the PM-IF interface.

PM260 Power Modules feature the following interfaces as standard:

- PM-IF interface to connect the PM260 Power Module to the Control Unit. The PM260 Power Module also supplies power to the Control Unit using the integrated power supply

- Motor connected using screw terminals or screw studs
- Control for the Brake Relay or the Safe Brake Relay for controlling a motor brake
- 2 PE/protective conductor connections



PM260 Power Module connection diagram with or without integrated class A line filter

## Integration

*Power and DC link components which are optionally available depending on the Power Module used*

The following line-side power components, DC link components and load-side power components are optionally available in the appropriate frame sizes for the Power Modules:

	Frame size						
	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>							
Available frame sizes	–	–	–	✓	–	✓	–
<b>Line-side power components</b>							
Line filter, class A	–	–	–	F	–	F	–
Line filter, class B	–	–	–	–	–	–	–
Line reactor <sup>1)</sup>	–	–	–	– <sup>1)</sup>	–	– <sup>1)</sup>	–
<b>DC link components</b>							
Braking resistor <sup>2)</sup>	–	–	–	– <sup>2)</sup>	–	– <sup>2)</sup>	–
<b>Load-side power components</b>							
Output reactor	–	–	–	–	–	–	–
Sine-wave filter	–	–	–		–		–

I = Integrated

– = Not possible

F = Power Modules available with and without integrated class A filter

*Maximum permissible cable lengths from the motor to the inverter when using output reactors or sine-wave filters depending on the voltage range*

The following load-side power components in the appropriate frame sizes are optionally available for the Power Modules and result in the following maximum cable lengths:

	Maximum permissible motor cable lengths (shielded/unshielded) in m						
	Frame sizes						
	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>							
Available frame sizes	–	–	–	✓	–	✓	–
With integrated sine-wave filter	–	–	–	200/300	–	200/300	–
• at 500 V to 690 V 3 AC ( $\pm 10\%$ )	–	–	–	200/300	–	200/300	–

<sup>1)</sup> A line reactor is not required and must not be used in conjunction with a PM250 or PM260 Power Module.

<sup>2)</sup> Line-commutated energy recovery is possible in conjunction with a PM250 or PM260 Power Module. A braking resistor cannot be connected and is not necessary.

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM260 Power Modules –  
11 kW to 55 kW (15 hp to 75 hp)**

## Technical specifications

### General technical specifications

<b>PM260 Power Modules</b>	
<b>System operating voltage</b>	500 ... 690 V 3 AC $\pm 10\%$ For operation from 500 V –10 % linearly reduced – see derating characteristics
<b>Line supply requirements</b> <b>Line short circuit voltage <math>u_K</math></b>	$\leq 1\%$
<b>Input frequency</b>	47 ... 63 Hz
<b>Output frequency</b>	
• Control type V/f	0 ... 200 Hz
• Control type Vector	0 ... 200 Hz
<b>Pulse frequency</b>	16 kHz (standard)
<b>Power factor</b>	0.95
<b>Inverter efficiency</b>	95 ... 97 %
<b>Modulation depth</b>	87 %
<b>Overload capability</b>	
• High overload (HO)	1.5 x rated output current (i.e. 150 % overload) for 57 s with a cycle time of 300 s 2 x rated output current (i.e. 200 % overload) for 3 s with a cycle time of 300 s
• Light overload (LO)	1.1 x rated output current (i.e. 110 % overload) for 57 s with a cycle time of 300 s 1.4 x rated output current (i.e. 140 % overload) for 3 s with a cycle time of 300 s
<b>Electromagnetic compatibility</b>	Optional class A line filter according to EN 55011 is available
<b>Possible braking methods</b>	Energy recovery in the generator mode
<b>Degree of protection</b>	IP20
<b>Operating temperature</b>	
• High overload (HO)	0 ... 50 °C (32 ... 122 °F) without derating, > 50 ... 60 °C see derating characteristics
• Light overload (LO)	0 ... 40 °C (32 ... 104 °F) without derating, > 40 ... 60 °C see derating characteristics
<b>Storage temperature</b>	-40 ... +70 °C (-40 ... +158 °F)
<b>Relative humidity</b>	< 95 % RH, condensation not permissible
<b>Cooling</b>	Internal air cooling, power units with increased air cooling using integrated fans
<b>Installation altitude</b>	up to 1000 m above sea level without power reduction, > 1000 m see derating characteristics
<b>Standard SCCR (Short Circuit Current Rating)<sup>1)</sup></b>	42 kA
<b>Protection functions</b>	<ul style="list-style-type: none"> <li>• Undervoltage</li> <li>• Overvoltage</li> <li>• Overcontrol/overload</li> <li>• Ground fault</li> <li>• Short circuit</li> <li>• Stall protection</li> <li>• Motor blocking protection</li> <li>• Motor overtemperature</li> <li>• Inverter overtemperature</li> <li>• Parameter locking</li> </ul>
<b>Standards conformance</b>	CE
<b>CE mark</b>	According to Low-Voltage Directive 73/23/EEC and Machinery Directive 98/37/EC

<sup>1)</sup> Applies to industrial control cabinet installations to NEC Article 409/UL 508A. For further information, visit us on the Internet at: <http://support.automation.siemens.com/WW/view/en/23995621>

**Technical specifications**

Line supply voltage 500 ... 690 V 3 AC		PM260 Power Modules		
Without integrated line filter		<b>6SL3225-0BH27-5UA1</b>	<b>6SL3225-0BH31-1UA1</b>	<b>6SL3225-0BH31-5UA1</b>
With integrated line filter		<b>6SL3225-0BH27-5AA1</b>	<b>6SL3225-0BH31-1AA1</b>	<b>6SL3225-0BH31-5AA1</b>
<b>Output current at 50 Hz 690 V 3 AC</b>				
• Rated current $I_{\text{rated}}^{\text{1)}} \text{ A}$	14		19	23
• Base load current $I_L^{\text{1)}} \text{ A}$	14		19	23
• Base load current $I_H^{\text{2)}} \text{ A}$	10		14	19
• $I_{\max} \text{ A}$	20		28	38
<b>Rated power</b>				
• based on $I_L \text{ kW (hp)}$	11 (15)		15 (20)	18.5 (25)
• based on $I_H \text{ kW (hp)}$	7.5 (10)		11 (15)	15 (20)
<b>Rated pulse frequency</b>		kHz	16	16
<b>Efficiency <math>\eta</math></b>			0.95	0.95
<b>Power loss</b>		kW	0.58	0.72
(at rated current)				0.82
<b>Cooling air requirement</b>		$\text{m}^3/\text{s}$	0.044	0.044
<b>Sound pressure level <math>L_{\text{pA}}</math> (1 m)</b>		dB	< 64	< 64
<b>24 V DC power supply for Control Unit</b>		A	1	1
<b>Input current <sup>3)</sup></b>				
• Rated current	A	13	18	22
• based on $I_H$	A	10	13	18
<b>Line supply connection</b>		U1/L1, V1/L2, W1/L3	Terminal strip	Terminal strip
• Conductor cross-section	$\text{mm}^2$	2.5 ... 16	2.5 ... 16	2.5 ... 16
<b>Motor connection</b>		U2, V2, W2	Terminal block	Terminal block
• Conductor cross-section	$\text{mm}^2$	2.5 ... 16	2.5 ... 16	2.5 ... 16
<b>PE connection</b>		On housing with M6 screw	On housing with M6 screw	On housing with M6 screw
<b>Motor cable length, max.<sup>4)</sup></b>				
• Shielded	m	200	200	200
• Unshielded	m	300	300	300
<b>Degree of protection</b>		IP20	IP20	IP20
<b>Dimensions</b>				
• Width	mm	275	275	275
• Height	mm	512	512	512
• Depth				
- without Control Unit	mm	204	204	204
- with Control Unit	mm	260	260	260
<b>Frame size</b>		FSD	FSD	FSD
<b>Weight, approx.</b>				
• without integrated filter	kg	22	22	22
• with integrated filter	kg	23	23	23

<sup>1)</sup> The rated output current  $I_{\text{rated}}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).

<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

<sup>3)</sup> The input current depends on the motor load and is valid for a line impedance corresponding to  $u_K = 1\%$ . The rated input currents apply for a load at the rated power (based on  $I_{\text{rated}}$ ) – these current values are specified on the rating plate.

<sup>4)</sup> Shielded motor cables must be used in order to maintain the limit values for field-conducted disturbances according to EN 61800-3 Class C2.

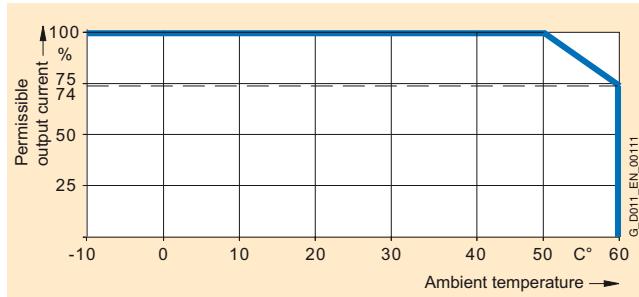
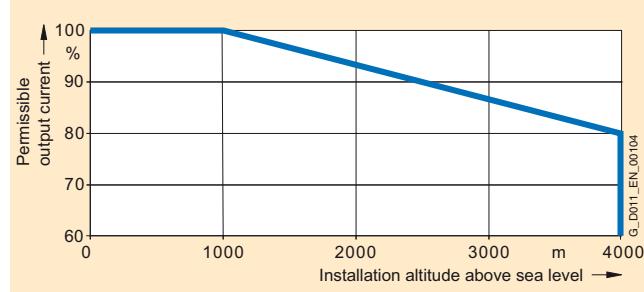
**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

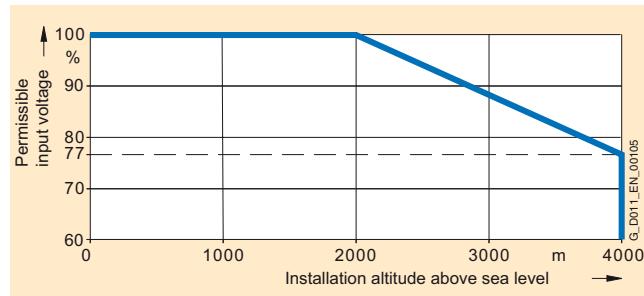
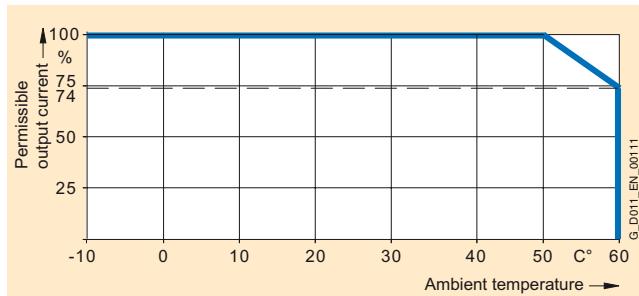
**PM260 Power Modules –  
11 kW to 55 kW (15 hp to 75 hp)****Technical specifications**

Line supply voltage 500 ... 690 V 3 AC		PM260 Power Modules		
Without integrated line filter		<b>6SL3225-0BH32-2UA1</b>	<b>6SL3225-0BH33-0UA1</b>	<b>6SL3225-0BH33-7UA1</b>
With integrated line filter		<b>6SL3225-0BH32-2AA1</b>	<b>6SL3225-0BH33-0AA1</b>	<b>6SL3225-0BH33-7AA1</b>
<b>Output current at 50 Hz 690 V 3 AC</b>				
• Rated current $I_{\text{rated}}^{\text{1)}} \text{ A}$	35		42	62
• Base load current $I_L^{\text{1)}} \text{ A}$	35		42	62
• Base load current $I_H^{\text{2)}} \text{ A}$	26		35	42
• $I_{\text{max}}$ $\text{A}$	52		70	84
<b>Rated power</b>				
• based on $I_L$ $\text{kW (hp)}$	30 (40)		37 (50)	55 (75)
• based on $I_H$ $\text{kW (hp)}$	22 (30)		30 (40)	37 (50)
<b>Rated pulse frequency</b> kHz		16	16	16
<b>Efficiency <math>\eta</math></b>		0.95	0.95	0.95
<b>Power loss</b> kW		1.13	1.29	1.73
(at rated current)				
<b>Cooling air requirement</b> $\text{m}^3/\text{s}$		0.131	0.131	0.131
<b>Sound pressure level <math>L_{\text{pA}}</math></b> dB (1 m)		< 70	< 70	< 70
24 V DC power supply for Control Unit	A	1	1	1
<b>Input current</b> <sup>3)</sup>				
• Rated current	A	34	41	60
• based on $I_H$	A	26	34	41
<b>Line supply connection</b>		M6 screw studs	M6 screw studs	M6 screw studs
U1/L1, V1/L2, W1/L3				
• Conductor cross-section	$\text{mm}^2$	10 ... 50	10 ... 50	10 ... 50
<b>Motor connection</b>		M6 screw studs	M6 screw studs	M6 screw studs
U2, V2, W2				
• Conductor cross-section	$\text{mm}^2$	10 ... 50	10 ... 50	10 ... 50
<b>PE connection</b>		On housing with M6 screw	On housing with M6 screw	On housing with M6 screw
<b>Motor cable length, max.</b> <sup>4)</sup>				
• Shielded	m	200	200	200
• Unshielded	m	300	300	300
<b>Degree of protection</b>		IP20	IP20	IP20
<b>Dimensions</b>				
• Width	mm	350	350	350
• Height	mm	634	634	634
• Depth				
- without Control Unit	mm	316	316	316
- with Control Unit	mm	372	372	372
<b>Frame size</b>		FSF	FSF	FSF
<b>Weight, approx.</b>				
• without integrated filter	kg	56	56	56
• with integrated filter	kg	58	58	58

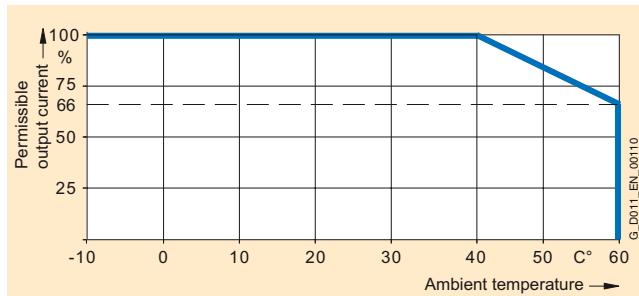
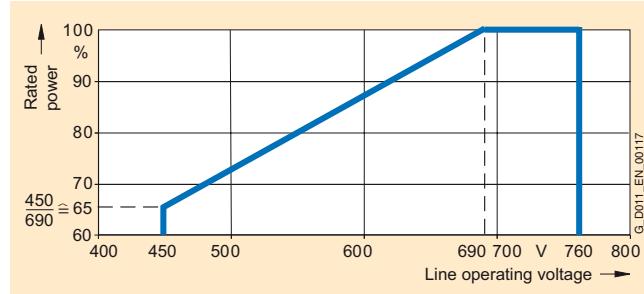
<sup>1)</sup> The rated output current  $I_{\text{rated}}$  and the base load current  $I_L$  are based on the duty cycle for light overload (LO).<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).<sup>3)</sup> The input current depends on the motor load and is valid for a line impedance corresponding to  $u_K = 1\%$ . The rated input currents apply for a load at the rated power (based on  $I_{\text{rated}}$ ) – these current values are specified on the rating plate.<sup>4)</sup> Shielded motor cables must be used in order to maintain the limit values for field-conducted disturbances according to EN 61800-3 Class C2.

**Characteristic curves****Derating data**Ambient temperatureInstallation altitude

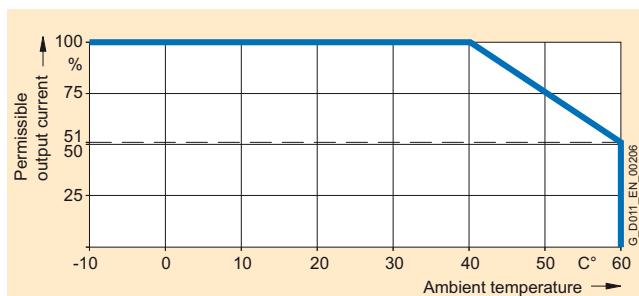
## High overload (HO) PM260 frame size FSD



## High overload (HO) PM260 frame size FSF

System operating voltage

## Light overload (LO) PM260 frame size FSD



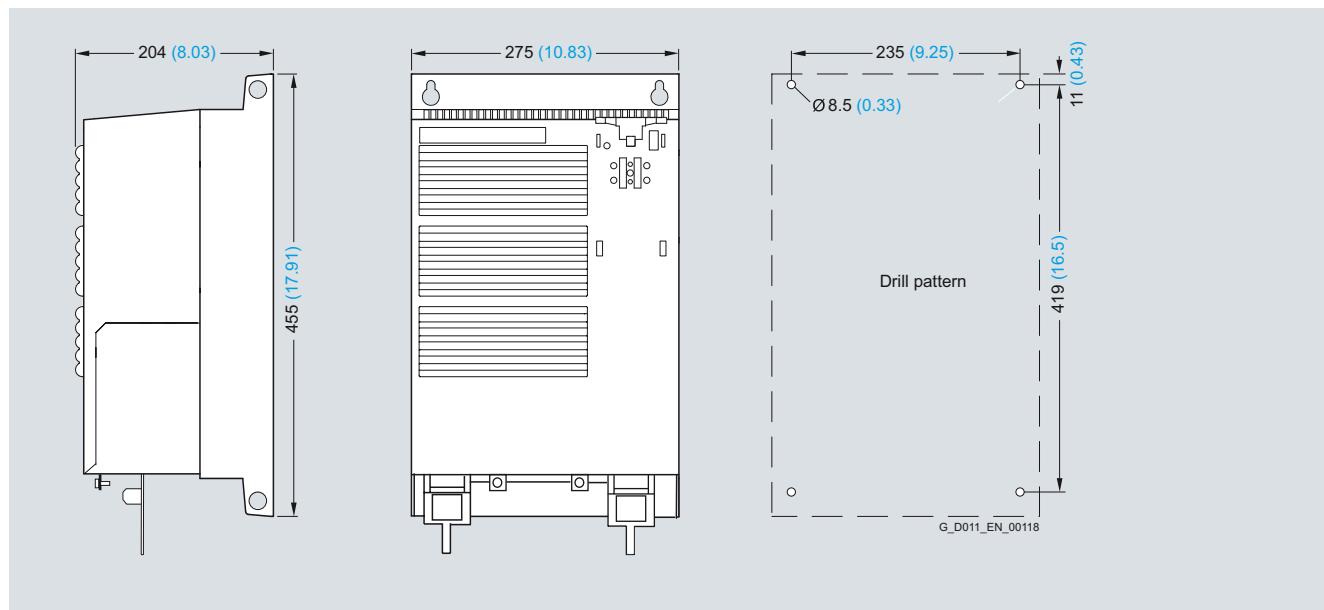
## Light overload (LO) PM260 frame size FSF

Note: The operating temperature ranges of the Control Units should be taken into account. The temperature ranges are specified in the technical specifications under Control Units.

The power units can be operated with 500 V – 10 %. In this case, the power is reduced linearly as required.

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**PM260 Power Modules –**  
**11 kW to 55 kW (15 hp to 75 hp)****Dimensional drawings**

PM260 Power Module frame size FSD with and without integrated class A line filter

Mounted with 4 M6 studs, 4 M6 nuts, 4 M6 washers.

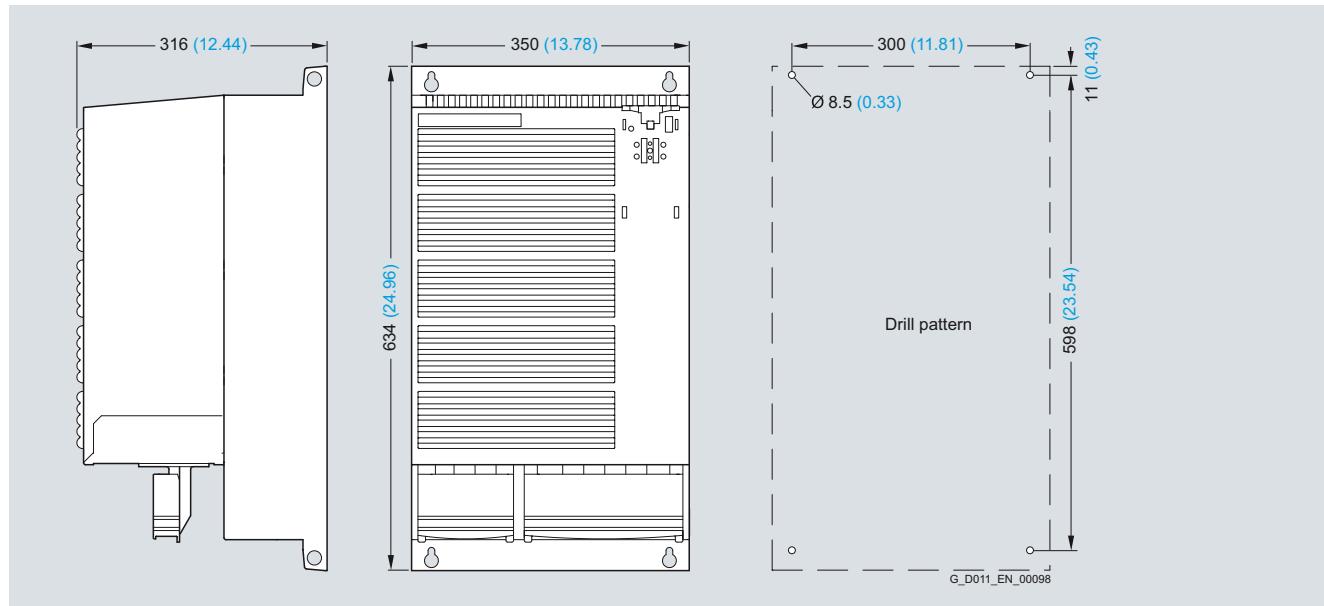
Ventilation clearance required at top and bottom: 300 mm  
(11.81 inches).

Ventilation clearance required at sides: 0 mm (0 inches).

When the Control Unit is plugged on, the mounting depth increases by 56 mm (2.2 inches).

Exception: for CU240E, mounting depth +22 mm  
(+0.87 inches).

All dimensions in mm (values in brackets are in inches).



PM260 Power Module frame size FSF with and without integrated line filter class A

Mounted with 4 M8 studs, 4 M8 nuts, 4 M8 washers.

Ventilation clearance required at top and bottom: 350 mm  
(13.78 inches).

Ventilation clearance required at sides: 0 mm (0 inches).

When the Control Unit is plugged on, the mounting depth increases by 56 mm (2.2 inches).

Exception: for CU240E, mounting depth +22 mm  
(+0.87 inches).

All dimensions in mm (values in brackets are in inches).

**Overview**

Example: Compact inverters, SINAMICS G120 with PM240 Power Module frame size FSB, CU240E Control Unit and BOP

The entry into SINAMICS G120 with an already assembled compact inverter

Three components can be ordered, completely assembled, with one Order No.: The PM240 Power Module with integrated brake choppers, the CU240E Control Unit and the BOP operator panel.

The compact inverter is suitable for applications in which the advantages of a compact inverter prevail (only one Order No., simpler to order). In this case, the advantages of a consistently modular system no longer apply (lower stockkeeping, high degree of flexibility).

The individual components of the compact inverter still remain completely modular. After they have been received, they can be separated at any time.

**Selection and ordering data**

Rated power <sup>1)</sup> kW      hp				Power based on the base load current $I_H$ <sup>2)</sup> kW      hp	Frame size and dimensions (H × W × D) mm	SINAMICS G120 compact inverter without integrated line filter Order No.	SINAMICS G120 compact inverter with integrated class A line filter Order No.
<b>47 ... 63 Hz 380 ... 480 V 3 AC ±10 %</b>							
0.37	0.50	0.37	0.50	FSA	173 × 73 × 177	<b>new</b> 6SL3214-3AE13-7UB0	-
0.55	0.75	0.55	0.75			<b>new</b> 6SL3214-3AE15-5UB0	-
0.75	1.0	0.75	1.0			<b>new</b> 6SL3214-3AE17-5UB0	-
1.1	1.5	1.1	1.5			<b>new</b> 6SL3214-3AE21-1UB0	-
1.5	2.0	1.5	2.0			<b>new</b> 6SL3214-3AE21-5UB0	-
2.2	3.0	2.2	3.0	FSB	270 × 153 × 204	<b>new</b> 6SL3214-3AE22-2UB0	<b>new</b> 6SL3214-3AE22-2AB0
3.0	4.0	3.0	4.0			<b>new</b> 6SL3214-3AE23-0UB0	<b>new</b> 6SL3214-3AE23-0AB0
4.0	5.0	4.0	5.0			<b>new</b> 6SL3214-3AE24-0UB0	<b>new</b> 6SL3214-3AE24-0AB0
7.5	10	5.5	7.5	FSC	334 × 189 × 224	<b>new</b> 6SL3214-3AE25-5UB0	<b>new</b> 6SL3214-3AE25-5AB0
11.0	15	7.5	10			<b>new</b> 6SL3214-3AE27-5UB0	<b>new</b> 6SL3214-3AE27-5AB0
15.0	20	11.0	15			<b>new</b> 6SL3214-3AE31-1UB0	<b>new</b> 6SL3214-3AE31-1AB0

<sup>1)</sup> Rated power based on the rated output current  $I_{rated}$ .  
The rated output current  $I_{rated}$  is based on the duty cycle for light overload (LO).  
These current values are stamped on the rating plate of the Power Module.

<sup>2)</sup> The base load current  $I_H$  is based on the duty cycle for high overload (HO).

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## Line-side power components

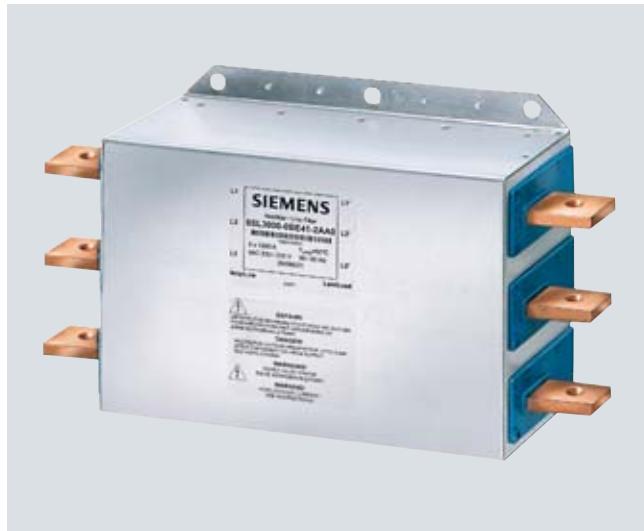
### Line filters

#### Overview

With one of the additional line filters, the Power Module reaches a higher radio interference class.



Example: Line filter for Power Modules frame size FSA



Example: Line filter for PM240 Power Modules frame size FSGX

#### Selection and ordering data

Rated power		SINAMICS G120 <u>PM240</u> Power Module		Class A line filter acc. to EN 55011
kW	hp	Type	Frame size	Order No.
<b>380 ... 480 V 3 AC</b>				
0.37	0.50	OBE13-7UA0	FSA	<b>6SE6400-2FA00-6AD0</b>
0.55	0.75	OBE15-5UA0	FSA	
0.75	1.0	OBE17-5UA0	FSA	
1.1	1.5	OBE21-1UA0	FSA	
1.5	2.0	OBE21-5UA0	FSA	
110	150	OBE38-8UA0	FSF	<b>6SL3203-0BE32-5AA0</b>
132	200	OBE41-1UA0	FSF	
160	250	OXE41-3UA0	FSGX	<b>6SL3000-0BE34-4AA0</b>
200	300	OXE41-6UA0	FSGX	
250	400	OXE42-0UA0	FSGX	<b>6SL3000-0BE36-0AA0</b>

Rated power		SINAMICS G120 <u>PM240</u> Power Module		Class B line filter acc. to EN 55011
kW	hp	Type	Frame size	Order No.
<b>380 ... 480 V 3 AC</b>				
0.37	0.50	OBE13-7UA0	FSA	<b>6SE6400-2FB00-6AD0</b>
0.55	0.75	OBE15-5UA0	FSA	
0.75	1.0	OBE17-5UA0	FSA	
1.1	1.5	OBE21-1UA0	FSA	
1.5	2	OBE21-5UA0	FSA	
2.2	3	OBE22-2AA0	FSB	<b>6SL3203-0BE21-6SA0</b>
3.0	4	OBE23-0AA0	FSB	
4.0	5	OBE24-0AA0	FSB	
7.5	10	OBE25-5AA0	FSC	<b>6SL3203-0BD23-8SA0</b>
11	15	OBE27-5AA0	FSC	
15	20	OBE31-1AA0	FSC	

Rated power		SINAMICS G120 <u>PM250</u> Power Module		Class B line filter acc. to EN 55011
kW	hp	Type	Frame size	Order No.
<b>380 ... 480 V 3 AC</b>				
7.5	10	OBE25-5AA0	FSC	<b>6SL3203-0BD23-8SA0</b>
11	15	OBE27-5AA0	FSC	
15	20	OBE31-1AA0	FSC	

## Integration

Frame size FSA of the PM240 Power Module is available only without integrated class A line filter. A base filter is therefore available so that class A can be achieved. A class B base filter is also available so that class B can be achieved.

Frame sizes FSB and FSC of the PM240 Power Module are available both with and without integrated class A line filter. For compliance with class B, PM240 Power Modules with integrated class A line filter must be fitted additionally with a base filter to class B.

An external class A line filter is available for frame size FSGX of the PM240 Power Module.

Frame sizes FSC of the PM250 Power Module are available only with integrated class A line filter. For compliance with class B, PM250 Power Modules must be fitted additionally with a class B base filter.

No additional Class B line filters are available for the PM260 Power Module.

### *Line filters which are optionally available depending on the Power Module used*

	Frame size							
	FSA	FSB	FSC	FSD	FSE	FSF	FSGX	
<b>PM240 Power Module with integrated brake chopper</b>								<b>without integrated brake chopper</b>
Available frame sizes	✓	✓	✓	✓	✓	✓	✓	✓
<b>Line-side power components</b>								
Line filter, class A	U	F	F	F	F	F/S <sup>1)</sup>	S <sup>1)</sup>	
Line filter, class B	U	U	U	–	–	–	–	
<b>PM250 Power Module with line-commutated energy recovery</b>								
Available frame sizes	–	–	✓	✓	✓	✓	–	
<b>Line-side power components</b>								
Line filter, class A	–	–	I	F	F	F	–	
Line filter, class B	–	–	U	–	–	–	–	
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>								
Available frame sizes	–	–	–	✓	–	✓	–	
<b>Line-side power components</b>								
Line filter, class A	–	–	–	F	–	F	–	
Line filter, class B	–	–	–	–	–	–	–	

U = Base component

S = Lateral mounting

I = Integrated

– = Not possible

F = Power Modules available with and without integrated class A filter

<sup>1)</sup> PM240 FSF Power Modules, from 110 kW (150 hp) and higher and FSGX are available only without an integrated class A filter. An optional class A line filter for side mounting is available instead.

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Line-side power components****Line filters****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Line filter class A			
		6SE6400-2FA00-6AD0	6SL3203-0BE32-5AA0	6SL3000-0BE34-4AA0	6SL3000-0BE36-0AA0
<b>Rated current</b>	A	6	250	440	600
<b>Line supply connection</b> L1, L2, L3		Screw terminals	On housing with M8 screw studs	1 × hole for M10 Provided for busbar connection	1 × hole for M10 Provided for busbar connection
• Conductor cross-section	mm <sup>2</sup>	2.5	–	–	–
<b>Load connection</b> U, V, W		Shielded cable	On housing with M8 screw studs	On housing with M10 screw studs	On housing with M10 screw studs
• Conductor cross-section	mm <sup>2</sup>	3 × 2.5	–	–	–
• Length	m	0.4	–	–	–
<b>PE connection</b>		On housing with M4 screw studs	Flat connector for M10 screw	1 × hole for M8	1 × hole for M10
<b>Degree of protection</b>		IP20	IP00	IP00	IP00
<b>Dimensions</b>					
• Width	mm	73	240	360	400
• Height	mm	200	360	240	265
• Depth	mm	42.5	116	116	140
<b>Possible as base component</b>		yes	no	no	no
<b>Weight, approx.</b>	kg	0.5	12.4	12.3	19
Suitable for PM240 Power Module	Type	6SL3224-0BE13-7UA0 6SL3224-0BE15-5UA0 6SL3224-0BE17-5UA0 6SL3224-0BE21-1UA0 6SL3224-0BE21-5UA0	6SL3224-0BE38-8UA0 6SL3224-0BE41-1UA0	6SL3224-0XE41-3UA0 6SL3224-0XE41-6UA0	6SL3224-0XE42-0UA0
Suitable for PM250 Power Module		–	–	–	–
Frame size		FSA	FSF	FSGX	FSGX

Line supply voltage 380 ... 480 V 3 AC		Line filter class B		
		6SE6400-2FB00-6AD0	6SL3203-0BE21-6SA0	6SL3203-0BD23-8SA0
<b>Rated current</b>	A	6	10.2	39.4
<b>Line supply connection</b> L1, L2, L3		Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	2.5	2.5	4
<b>Load connection</b> U, V, W		Shielded cable	Shielded cable	Shielded cable
• Conductor cross-section	mm <sup>2</sup>	3 × 2.5	3 × 2.5	3 × 4
• Length	m	0.4	0.4	0.4
<b>PE connection</b>		On housing with M4 screw studs	On housing with M4 screw studs	On housing with M4 screw studs
<b>Degree of protection</b>		IP20	IP20	IP20
<b>Dimensions</b>				
• Width	mm	73	153	190
• Height	mm	200	296	362
• Depth	mm	42.5	50	55
<b>Possible as base component</b>		yes	yes	yes
<b>Weight, approx.</b>	kg	0.5	1.5	2.3
Suitable for PM240 Power Module	Type	6SL3224-0BE13-7UA0 6SL3224-0BE15-5UA0 6SL3224-0BE17-5UA0 6SL3224-0BE21-1UA0 6SL3224-0BE21-5UA0	6SL3224-0BE22-2AA0 6SL3224-0BE23-0AA0 6SL3224-0BE24-0AA0	6SL3224-0BE25-5AA0 6SL3224-0BE27-5AA0 6SL3224-0BE31-1AA0
Suitable for PM250 Power Module		–	–	6SL3225-0BE25-5AA0 6SL3225-0BE27-5AA0 6SL3225-0BE31-1AA0
Frame size		FSA	FSB	FSC

## Overview

A line reactor reduces the system perturbations caused by harmonics. This particularly applies in the case of weak line supplies (line supply short-circuit power  $u_K > 1\%$ ).



Example: Line reactors for Power Modules frame sizes FSA to FSE



Example: Power Module frame size FSB with base line reactor and shield bonding plate

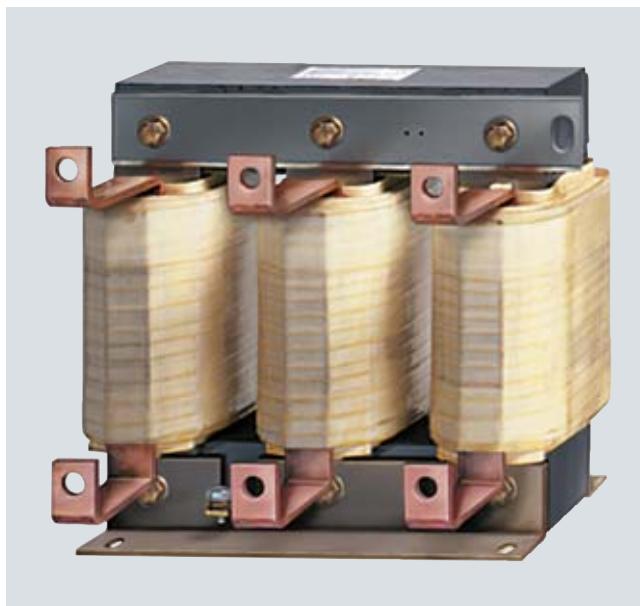
Note: A line reactor must not be used in combination with a PM250 or PM260 Power Module.

4

## Benefits

Only AC reactors are available as reactors for the inverter.

- Only an AC reactor provides protection for the input rectifier of the inverter.
- The capacitor lifetime of the inverter increases when using an AC reactor by a factor of 2 when compared to the lifetime when using a DC reactor.
- The harmonic behavior of AC reactors remain almost constant over the complete lifetime. Over time (months), the harmonic behavior of DC reactors changes.
- An AC reactor reduces possible dissymmetries between the current phases. In this case, a DC reactor would not be effective.



Example: Line reactor for PM240 Power Modules frame size FSGX

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## Line-side power components

### Line reactors

#### Selection and ordering data

Rated power kW	Rated power hp	Power Module Type 6SL3224-...	Frame size	Line reactor Order No.
<b>380 ... 480 V 3 AC</b>				
0.37	0.50	OBE13-7UA0	FSA	<b>6SE6400-3CC00-2AD3</b>
0.55	0.75	OBE15-5UA0	FSA	
0.75	1.0	OBE17-5UA0	FSA	<b>6SE6400-3CC00-4AD3</b>
1.1	1.5	OBE21-1UA0	FSA	
1.5	2	OBE21-5UA0	FSA	<b>6SE6400-3CC00-6AD3</b>
2.2	3	OBE22-2 . A0	FSB	<b>6SL3203-0CD21-0AA0</b>
3.0	4	OBE23-0 . A0	FSB	
4.0	5	OBE24-0 . A0	FSB	<b>6SL3203-0CD21-4AA0</b>
7.5	10	OBE25-5 . A0	FSC	<b>6SL3203-0CD22-2AA0</b>
11.0	15	OBE27-5 . A0	FSC	
15.0	20	OBE31-1 . A0	FSC	<b>6SL3203-0CD23-5AA0</b>
18.5	25	OBE31-5 . A0	FSD	<b>6SL3203-0CJ24-5AA0</b>
22	30	OBE31-8 . A0	FSD	
30	40	OBE32-2 . A0	FSD	<b>6SL3203-0CD25-3AA0</b>
37	50	OBE33-0 . A0	FSE	<b>6SL3203-0CJ28-6AA0</b>
45	60	OBE33-7 . A0	FSE	
55	75	OBE34-5 . A0	FSF	<b>6SE6400-3CC11-2FD0</b>
75	100	OBE35-5 . A0	FSF	
90	125	OBE37-5 . A0	FSF	<b>6SE6400-3CC11-7FD0</b>
110	150	OBE38-8UA0	FSF	<b>6SL3000-0CE32-3AA0</b>
132	200	OBE41-1UA0	FSF	<b>6SL3000-0CE32-8AA0</b>
160	250	OXE41-3UA0	FSGX	<b>new 6SL3000-0CE33-3AA0</b>
200	300	OXE41-6UA0	FSGX	<b>new 6SL3000-0CE35-1AA0</b>
250	400	OXE42-0UA0	FSGX	

#### Integration

The line reactors for PM240 Power Modules, frame sizes FSA to FSE, are designed as base components. The line reactor is attached to the mounting surface and the Power Module is mounted directly on the line reactor in a space-saving fashion.

The cables to the Power Module are already connected at the line reactor.

The line reactor is connected to the line supply through terminals.

#### Line reactors which are optionally available depending on the Power Module used

	Frame size FSA	Frame size FSB	Frame size FSC	Frame size FSD	Frame size FSE	Frame size FSF	Frame size FSGX	without integrated brake chopper
<b>PM240 Power Module with integrated brake chopper</b>								
Available frame sizes	✓	✓	✓	✓	✓	✓	✓	
<b>Line-side power components</b>								
Line reactor	U	U	U	U	U	S	S	
<b>PM250 Power Module with line-commutated energy recovery</b>								
Available frame sizes	-	-	✓	✓	✓	✓	-	
<b>Line-side power components</b>								
Line reactor <sup>1)</sup>	-	-	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>	-	
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>								
Available frame sizes	-	-	-	✓	-	✓	-	
<b>Line-side power components</b>								
Line reactor <sup>1)</sup>	-	-	-	- <sup>1)</sup>	-	- <sup>1)</sup>	-	

U = Base component

S = Lateral mounting

- = Not possible

<sup>1)</sup> A line reactor is not required and must not be used in conjunction with a PM250 or PM260 Power Module.

## Technical specifications

Line supply voltage 380 ... 480 V 3 AC		Line reactor			
		6SE6400-3CC00-2AD3	6SE6400-3CC00-4AD3	6SE6400-3CC00-6AD3	6SL3203-0CD21-0AA0
<b>Rated current</b>	A	1.9	3.5	4.8	9
<b>Power loss</b> at 50/60 Hz, approx.	W	6/7	12.5/15	7.5/9	9/11
<b>Line supply connection</b> U1, V1, W1		Screw terminals	Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	6	6	6	6
<b>Load connection</b>		Cable	Cable	Cable	Cable
• Conductor cross-section		4 × AWG16 (1.5 mm <sup>2</sup> )	4 × AWG16 (1.5 mm <sup>2</sup> )	4 × AWG16 (1.5 mm <sup>2</sup> )	4 × AWG16 (1.5 mm <sup>2</sup> )
• Length, approx.	m	0.38	0.38	0.38	0.46
<b>PE connection</b>		On housing with M5 screw studs	On housing with M5 screw studs	On housing with M5 screw studs	On housing with M5 screw studs
<b>Degree of protection</b>		IP20	IP20	IP20	IP20
<b>Dimensions</b>					
• Width	mm	75.5	75.5	75.5	153
• Height	mm	200	200	200	290
• Depth	mm	50	50	50	50
<b>Possible as base component</b>		yes	yes	yes	yes
<b>Weight, approx.</b>	kg	0.6	0.8	0.6	3.4
Suitable for PM240 Power Module	Type	6SL3224-0BE13-7UA0 6SL3224-0BE15-5UA0	6SL3224-0BE17-5UA0 6SL3224-0BE21-1UA0	6SL3224-0BE21-5UA0	6SL3224-0BE22-2 . A0 6SL3224-0BE23-0 . A0
Frame size		FSA	FSA	FSA	FSB

Line supply voltage 380 ... 480 V 3 AC		Line reactor			
		6SL3203-0CD21-4AA0	6SL3203-0CD22-2AA0	6SL3203-0CD23-5AA0	6SL3203-0CJ24-5AA0
<b>Rated current</b>	A	11.6	25	31.3	47
<b>Power loss</b> at 50/60 Hz, approx.	W	27/32	98/118	37/44	90/115
<b>Line supply connection</b> U1, V1, W1		Screw terminals	Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	6	6	16	16
<b>Load connection</b>		Cable	Cable	Cable	Cable
• Conductor cross-section		4 × AWG16 (1.5 mm <sup>2</sup> )	4 × AWG10 (2.5 mm <sup>2</sup> )	4 × AWG10 (2.5 mm <sup>2</sup> )	4 × 16 mm <sup>2</sup>
• Length, approx.	m	0.46	0.49	0.49	0.7
<b>PE connection</b>		On housing with M5 screw studs	On housing with M5 screw studs	On housing with M5 screw studs	On housing with M8 screw
<b>Degree of protection</b>		IP20	IP20	IP20	IP20
<b>Dimensions</b>					
• Width	mm	153	189	189	275
• Height	mm	290	371	371	455
• Depth	mm	50	50	50	84
<b>Possible as base component</b>		yes	yes	yes	yes
<b>Weight, approx.</b>	kg	3.4	5.2	5.9	13
Suitable for PM240 Power Module	Type	6SL3224-0BE24-0 . A0	6SL3224-0BE25-5 . A0 6SL3224-0BE27-5 . A0	6SL3224-0BE31-1 . A0	6SL3224-0BE31-5 . A0 6SL3224-0BE31-8 . A0
Frame size		FSB	FSC	FSC	FSD

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Line-side power components****Line reactors****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Line reactor					
		6SL3203-0CD25-3AA0	6SL3203-0CJ28-6AA0	6SE6400-3CC11-2FD0	6SE6400-3CC11-7FD0	6SL3000-0CE32-3AA0	6SL3000-0CE32-8AA0
<b>Rated current</b>	A	63	94	151	186	224	278
<b>Power loss</b> at 50/60 Hz, approx.	W	90/115	170/215	280/360	280/360	240/270	210/250
<b>Line supply connection</b> U1, V1, W1		Screw terminals	Screw terminals	Flat connector for M10 cable lug	Flat connector for M10 cable lug	Flat connector for M10 screw	Flat connector for M10 screw
• Conductor cross-section	mm <sup>2</sup>	16	50	–	–	–	–
<b>Load connection</b>		Cable	Cable	Flat connector for M10 cable lug	Flat connector for M10 cable lug	Flat connector for M10 screw	Flat connector for M10 screw
• Conductor cross-section	mm <sup>2</sup>	4 × 16	4 × 35	–	–	–	–
• Length, approx.	m	0.7	0.7	–	–	–	–
<b>PE connection</b>		On housing with M8 screw	On housing with M8 screw	On housing with M8 screw stud	On housing with M8 screw stud	M6 screw	M6 screw
<b>Degree of protection</b>		IP20	IP20	IP00	IP00	IP00	IP00
<b>Dimensions</b>							
• Width	mm	275	275	240	240	270	270
• Height	mm	455	577	228	228	248	248
• Depth	mm	84	94	141	141	200	200
<b>Possible as base component</b>		yes	yes	no	no	no	no
<b>Weight, approx.</b>	kg	13	19	25	25	24	24
Suitable for PM240 Power Module	Type	6SL3224-0BE32-2 . A0	6SL3224-0BE33-0 . A0	6SL3224-0BE34-5 . A0	6SL3224-0BE37-5 . A0	6SL3224-0BE38-8UA0	6SL3224-0BE41-1UA0
6SL3224-0BE33-7 . A0		6SL3224-0BE33-7 . A0	6SL3224-0BE35-5 . A0				
Frame size		FSD	FSE	FSF	FSF	FSF	FSF

Line supply voltage 380 ... 480 V 3 AC		Line reactor	
		6SL3000-0CE33-3AA0	6SL3000-0CE33-5AA0
<b>Rated current</b>	A	331	508
<b>Power loss</b> at 50/60 Hz, approx.	W	0.267	0.365
<b>Line supply connection</b> U1, V1, W1		1 × hole for M10	1 × hole for M12
• Conductor cross-section	mm <sup>2</sup>	provided for busbar connection	provided for busbar connection
<b>Load connection</b>			
• Conductor cross-section	mm <sup>2</sup>	provided for busbar connection	provided for busbar connection
<b>PE connection</b>		M6 screw	M6 screw
<b>Degree of protection</b>		IP00	IP00
<b>Dimensions</b>			
• Width	mm	270	300
• Height	mm	248	269
• Depth	mm	200	212
<b>Possible as base component</b>		no	no
<b>Weight, approx.</b>	kg	27.8	38.0
Suitable for PM240 Power Module	Type	6SL3224-0XE41-3UA0	6SL3224-0XE41-6UA0 6SL3224-0XE42-0UA0
Frame size		FSGX	FSGX

**Overview**

The following table lists recommendations for additional line-side components, such as fuses and circuit breakers (line-side components dimensioned in accordance with IEC standards). The specified circuit breakers are UL-certified.

3NA3 fuses are recommended for European countries. The 3NE1 fuses are UL-compliant (corresponds to RU). The values in the table take into account the overload capability of the inverter.

Additional information about the listed fuses and circuit breakers can be found in Catalogs LV 1 and LV 1 T.

**Selection and ordering data**

Rated power	SINAMICS G120 PM240 Power Modules			Fuse	Circuit breaker
kW	hp	Type 6SL3224-...	Frame size	Type 3NA3 Order No.	Type 3NE1 (RU) Order No. Order No.
<b>380 ... 480 V 3 AC</b>					
0.37	0.50	OBE13-7UA0	FSA	<b>3NA3803</b>	<b>3RV1021-1CA10</b>
0.55	0.75	OBE15-5UA0	FSA		<b>3RV1021-1DA10</b>
0.75	1.0	OBE17-5UA0	FSA		<b>3RV1021-1FA10</b>
1.1	1.5	OBE21-1UA0	FSA		<b>3RV1021-1GA10</b>
1.5	2	OBE21-5UA0	FSA		<b>3RV1021-1JA10</b>
2.2	3	OBE22-2 . A0	FSB	<b>3NA3805</b>	<b>3RV1021-1KA10</b>
3.0	4	OBE23-0 . A0	FSB		<b>3RV1021-4AA10</b>
4.0	5	OBE24-0 . A0	FSB	<b>3NA3807</b>	<b>3RV1021-4BA10</b>
7.5	10	OBE25-5 . A0	FSC		<b>3RV1031-4EA10</b>
11.0	15	OBE27-5 . A0	FSC	<b>3NA3812</b>	<b>3RV1031-4FA10</b>
15.0	20	OBE31-1 . A0	FSC	<b>3NA3814</b>	<b>3RV1031-4HA10</b>
18.5	25	OBE31-5 . A0	FSD	<b>3NA3820</b>	<b>3RV1042-4KA10</b>
22	30	OBE31-8 . A0	FSD	<b>3NA3822</b>	<b>3NE1818-0</b>
30	40	OBE32-2 . A0	FSD	<b>3NA3824</b>	<b>3NE1820-0</b>
37	50	OBE33-0 . A0	FSE	<b>3NA3830</b>	<b>3NE1021-0</b>
45	60	OBE33-7 . A0	FSE	<b>3NA3832</b>	<b>3NE1022-0</b>
55	75	OBE34-5 . A0	FSF	<b>3NA3836</b>	<b>3NE1224-0</b>
75	100	OBE35-5 . A0	FSF	<b>3NA3140</b>	<b>3NE1225-0</b>
90	125	OBE37-5 . A0	FSF	<b>3NA3144</b>	<b>3NE1227-0</b>
110	150	OBE38-8UA0	FSF	—	
132	200	OBE41-1UA0	FSF	—	<b>3NE1230-0</b>
160	250	OXE41-3UA0	FSGX	<b>3NA3254</b>	<b>3NE1333-2</b>
200	300	OBE41-6UA0	FSGX	<b>3NA3260</b>	<b>3NE1436-2</b>
250	400	OBE42-0UA0	FSGX	<b>3NA3372</b>	<b>3NE1436-2</b>

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Line-side power components**  
**Recommended line components**

**Selection and ordering data**

Rated power		SINAMICS G120 <u>PM250</u> Power Modules		<b>Fuse</b>		<b>Circuit breaker</b>	
kW	hp	Type 6SL3225-...	Frame size	Type 3NA3	Order No.	Type 3NE1 (RU)	Order No.
<b>380 ... 480 V 3 AC</b>							
7.5	10	0BE25-5AA0	FSC	<b>3NA3807</b>		UL-listed fuses such as the Class NON fuse series from Bussmann are required for North America.	<b>3RV1031-4EA10</b>
11.0	15	0BE27-5AA0	FSC	<b>3NA3812</b>			<b>3RV1031-4FA10</b>
15.0	20	0BE31-1AA0	FSC	<b>3NA3814</b>			<b>3RV1031-4HA10</b>
18.5	25	0BE31-5 . A0	FSD	<b>3NA3820</b>		<b>3NE1817-0</b>	<b>3RV1042-4KA10</b>
22	30	0BE31-8 . A0	FSD	<b>3NA3822</b>		<b>3NE1818-0</b>	
30	40	0BE32-2 . A0	FSD	<b>3NA3824</b>		<b>3NE1820-0</b>	<b>3RV1042-4MA10</b>
37	50	0BE33-0 . A0	FSE	<b>3NA3830</b>		<b>3NE1021-0</b>	<b>3VL1712-DD33-....</b>
45	60	0BE33-7 . A0	FSE	<b>3NA3832</b>		<b>3NE1022-0</b>	<b>3VL1716-DD33-....</b>
55	75	0BE34-5 . A0	FSF	<b>3NA3836</b>		<b>3NE1224-0</b>	<b>3VL3720-DC36-....</b>
75	100	0BE35-5 . A0	FSF	<b>3NA3140</b>		<b>3NE1225-0</b>	<b>3VL3725-DC36-....</b>
90	125	0BE37-5 . A0	FSF	<b>3NA3144</b>		<b>3NE1227-0</b>	<b>3VL4731-DC36-....</b>

Rated power		SINAMICS G120 <u>PM260</u> Power Modules		<b>Fuse</b>		<b>Circuit breaker</b>	
kW	hp	Type 6SL3225-...	Frame size	Type 3NA3	Order No.	Type 3NE1 (RU)	Order No.
<b>500 ... 690 V 3 AC</b>							
11.0	15	0BH27-5 . A1	FSD	<b>3NA3120-6</b>		-	<b>3RV1041-4FA10</b>
15.0	20	0BH31-1 . A1	FSD				
18.5	25	0BH31-5 . A1	FSD				
30	40	0BH32-2 . A1	FSF	<b>3NA3122-6</b>			<b>3RV1041-4JA10</b>
37	50	0BH33-0 . A1	FSE				<b>3RV1041-4KA10</b>
55	75	0BH33-7 . A1	FSF	<b>3NA3130-6</b>			<b>3RV1041-4MA10</b>

**Overview**

Example: Braking resistors for Power Modules, frame sizes FSA and FSC



Example: Braking resistor for PM240 Power Modules frame size FSGX

Excess energy in the DC link is dissipated in the braking resistor. The braking resistors are intended for use with PM240 Power Modules which feature an integrated brake chopper, but cannot regenerate energy to the supply system. There is an optional plug-in Braking Module for frame size FSGX. For generator operation, e.g. the braking of a rotating mass with high moment of inertia, a braking resistor must be connected to convert the resulting energy into heat.

The braking resistors can be installed at the side of the PM240 Power Modules. The braking resistors for the FSA and FSB frame sizes are designed as base components. If the PM240 Power Modules, frame size FSA or FSB, are operated without line reactor, the braking resistors can also be installed under the Power Modules.

The braking resistors for the Power Modules, frame sizes FSC to FSGX, should be placed outside the control cabinet or outside the switchgear room so that the heat is dissipated away from the Power Modules. The level of air conditioning required is therefore reduced.

Every braking resistor has a temperature switch (UL-listed). The temperature switch can be evaluated to prevent consequential damage if the braking resistor overheats.

**Selection and ordering data**

Rated power kW	Rated power hp	Type	SINAMICS G120 PM240 Power Module	Frame size	Braking resistor Order No.
<b>380 ... 480 V 3 AC</b>					
0.37	0.50	OBE13-7UA0	FSA		<b>6SE6400-4BD11-0AA0</b>
0.55	0.75	OBE15-5UA0	FSA		
0.75	1.0	OBE17-5UA0	FSA		
1.1	1.5	OBE21-1UA0	FSA		
1.5	2	OBE21-5UA0	FSA		
2.2	3	OBE22-2 . A0	FSB		<b>6SL3201-0BE12-0AA0</b>
3.0	4	OBE23-0 . A0	FSB		
4.0	5	OBE24-0 . A0	FSB		
7.5	10	OBE25-5 . A0	FSC		<b>6SE6400-4BD16-5CA0</b>
11.0	15	OBE27-5 . A0	FSC		
15.0	20	OBE31-1 . A0	FSC		
18.5	25	OBE31-5 . A0	FSD		<b>6SE6400-4BD21-2DA0</b>
22	30	OBE31-8 . A0	FSD		
30	40	OBE32-2 . A0	FSD		
37	50	OBE33-0 . A0	FSE	new	<b>6SE6400-4BD22-2EA1</b>
45	60	OBE33-7 . A0	FSE		
55	75	OBE34-5 . A0	FSF		<b>6SE6400-4BD24-0FA0</b>
75	100	OBE35-5 . A0	FSF		
90	125	OBE37-5 . A0	FSF		
110	150	OBE38-8UA0	FSF		<b>6SE6400-4BD26-0FA0</b>
132	200	OBE41-1UA0	FSF		
160	250	OXE41-3UA0	FSGX <sup>1)</sup> new		<b>6SL3000-1BE31-3AA0</b>
200	300	OXE41-6UA0	FSGX <sup>1)</sup> new		<b>6SL3000-1BE32-5AA0</b>
250	400	OXE42-0UA0	FSGX <sup>1)</sup>		

<sup>1)</sup> A Braking Module must be additionally ordered for connection.

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## DC link components Braking resistors

### Integration

*Braking resistors which are optionally available depending on the Power Module used*

	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM240 Power Module with integrated brake chopper</b>							
Available frame sizes	✓	✓	✓	✓	✓	✓	✓
<b>DC link components</b>							
Braking resistor	U	U	S	S	S	S	S
<b>PM250 Power Module with line-commutated energy recovery</b>							
Available frame sizes	–	–	✓	✓	✓	✓	–
<b>DC link components</b>							
Braking resistor <sup>1)</sup>	–	–	– 1)	– 1)	– 1)	– 1)	–
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>							
Available frame sizes	–	–	–	✓	–	✓	–
<b>DC link components</b>							
Braking resistor <sup>1)</sup>	–	–	–	– 1)	–	– 1)	–

U = Base component

S = Lateral mounting

– = Not possible

### Technical specifications

Line supply voltage 380 V ... 480 V 3 AC		Braking resistor		
		6SE6400-4BD11-0AA0	6SL3201-0BE12-0AA0	6SE6400-4BD16-5CA0
<b>Resistor</b>	Ω	390	160	56
<b>Rated power <math>P_{DB}</math></b>	kW (hp)	0.1 (0.13)	0.2 (0.27)	0.65 (0.87)
<b>Peak power <math>P_{max}</math> (cycle time 12 s)</b>	kW	2	4	11
<b>Power connections</b>		Shielded cable	Shielded cable	Shielded cable
• Conductor cross-section	mm <sup>2</sup>	3 × 2.5	3 × 2.5	3 × 2.5
• Length	m	0.5	0.5	0.9
<b>Thermostatic switch (NC contact) Max. contact load</b>		250 V AC/2.5 A	250 V AC/2.5 A	250 V AC/2.5 A
<b>Degree of protection</b>		IP20	IP20	IP20
<b>Frame size</b>		FSA	FSB	FSC
<b>Dimensions</b>				
• Width	mm	72	153	185
• Height	mm	230	329	285
• Depth	mm	43.5	43.5	150
<b>Possible as base component</b>		yes	yes	no
<b>Weight, approx.</b>	kg	1	2	3.8
Suitable for PM240 Power Module	Type	6SL3224-0BE13-7UA0	6SL3224-0BE22-2.A0	6SL3224-0BE25-5.A0
		6SL3224-0BE15-5UA0	6SL3224-0BE23-0.A0	6SL3224-0BE27-5.A0
		6SL3224-0BE17-5UA0	6SL3224-0BE24-0.A0	6SL3224-0BE31-1.A0
		6SL3224-0BE21-1UA0		
		6SL3224-0BE21-5UA0		
Frame size		FSA	FSB	FSC

<sup>1)</sup> Line-commutated energy recovery is possible in conjunction with a PM250 or PM260 Power Module. A braking resistor cannot be connected and is not necessary.

## Technical specifications

Line supply voltage 380 V ... 480 V 3 AC		Braking resistor			
		6SE6400- 4BD21-2DA0	6SE6400- 4BD22-2EA1	6SE6400- 4BD24-0FA0	6SE6400- 4BD26-0FA0
<b>Resistor</b>	Ω	27	15	8.2	5.5
<b>Rated power <math>P_{DB}</math></b>	kW (hp)	1.2 (1.6)	2.2 (3.0)	4 (5)	5.6 (7.5)
<b>Peak power <math>P_{max}</math> (cycle time 12 s)</b>	kW	24	44	80	120
<b>Power connections</b>		M6 screw studs	M6 screw studs	M6 screw studs	M6 screw studs
<b>Thermostatic switch (NC contact) Max. contact load</b>		250 V AC/2.5 A	250 V AC/2.5 A	250 V AC/2.5 A	250 V AC/2.5 A
<b>Degree of protection</b>		IP20	IP20	IP20	IP20
<b>Frame size</b>		FSD	FSE	FSF	FSF
<b>Dimensions</b>					
• Width	mm	270	326	395	526
• Height	mm	515	301	650	301
• Depth	mm	175	484	315	484
<b>Possible as base component</b>		no	no	no	no
<b>Weight, approx.</b>	kg	7.4	11	16.7	17.5
Suitable for PM240 Power Module	Type	6SL3224-0BE31-5.A0 6SL3224-0BE31-8.A0 6SL3224-0BE32-2.A0	6SL3224-0BE33-0.A0 6SL3224-0BE33-7.A0	6SL3224-0BE34-5.A0 6SL3224-0BE35-5.A0 6SL3224-0BE37-5.A0	6SL3224-0BE38-8UA0 6SL3224-0BE41-1UA0
Frame size		FSD	FSE	FSF	FSF

Line supply voltage 380 V ... 480 V 3 AC		Braking resistor	
		6SL3000-1BE31-3AA0	6SL3000-1BE32-5AA0
<b>Resistor</b>	Ω	4.4	2.2
<b>Rated power <math>P_{DB}</math></b>	kW (hp)	25 (34)	50 (67)
<b>Peak power <math>P_{max}</math> (cycle time 15 s every 90 s)</b>	kW	125	250
<b>Power connections</b>		M10 screw stud	M10 screw stud
<b>Thermostatic switch (NC contact) Max. contact load</b>		250 V AC/2.5 A	250 V AC/2.5 A
<b>Degree of protection</b>		IP20	IP20
<b>Frame size</b>		FSGX	FSGX
<b>Dimensions</b>			
• Width	mm	740	810
• Height	mm	605	1325
• Depth	mm	485	485
<b>Possible as base component</b>		no	no
<b>Weight, approx.</b>	kg	50	120
Suitable for PM240 Power Module	Type	6SL3224-0XE41-3UA0	6SL3224-0XE41-6UA0 6SL3224-0XE42-0UA0
Frame size		FSGX	FSGX

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## DC link components Braking Modules

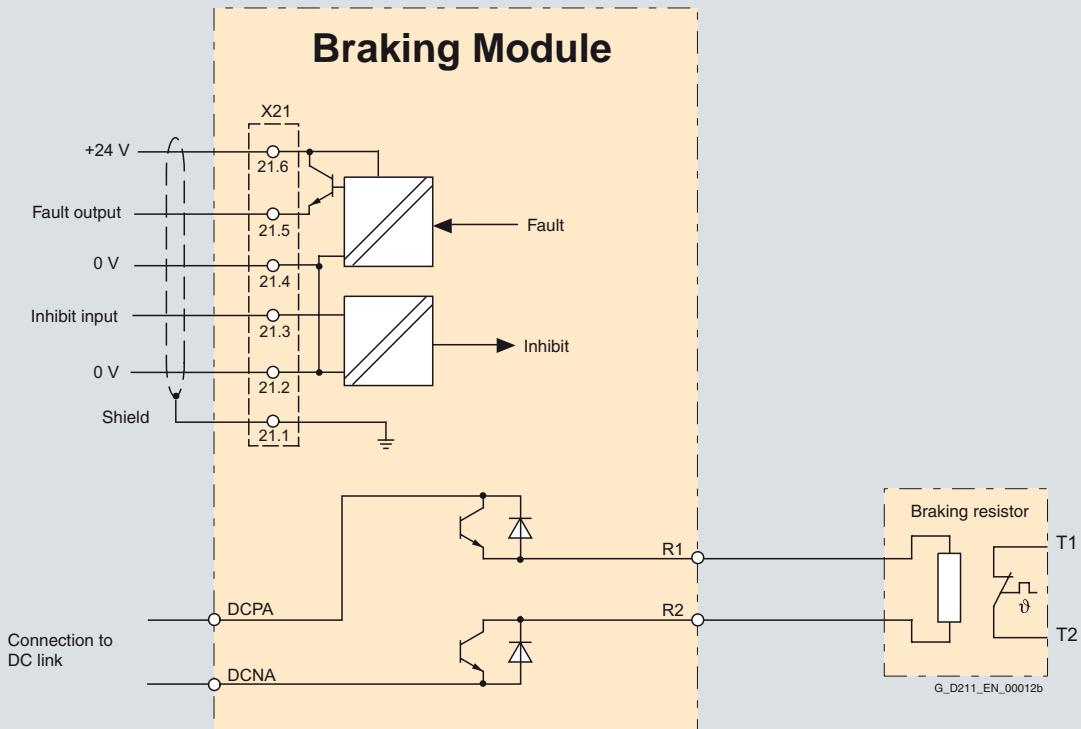
### Overview



A Braking Module and the matching external braking resistor are required to bring drives to a controlled standstill in the event of a power failure (e.g. emergency retraction or EMERGENCY STOP Category 1) or limit the DC link voltage for brief periods of generator operation. The Braking Module includes the power electronics and the associated control circuit. During operation, the DC link energy is converted to heat loss in an external braking resistor. Braking Modules function autonomously.

4

### Integration



Connection example of a Braking Module

The Braking Module is designed for installation in PM240 Power Modules, frame size FSGX and is cooled by the Power Module fan. The supply voltage for the electronics is taken from the DC link. The Braking Module is connected to the DC link using the busbar sets included in the scope of delivery.

The activation threshold of the Braking Module can be adjusted by means of a DIP switch. The braking power values specified in the technical specifications apply to the upper activation threshold.

### Selection and ordering data

Description	Order No.
<b>DC link voltage 510 ... 720 V DC</b>	
<b>Braking Module 50 kW/250 kW</b>	<b>new 6SL3300-1AE32-5AA0</b>

### Design

The Braking Module has the following interfaces as standard:

- 1 DC link connection
- 1 braking resistor connection
- 1 digital input (inhibit Braking Module/acknowledge fault)
- 1 digital output (Braking Module inhibited)
- 1 DIP switch for adjusting the activation threshold

**Technical specifications**

<b>DC link voltage 510 ... 720 V DC</b>	<b>Braking Module</b> <b>6SL3300-1AE32-5AA0</b>
<b>Power</b>	
• Rated power $P_{DB}$	50 kW (67 hp)
• Peak power $P_{15}$	250 kW
• Power $P_{20}$	200 kW
• Power $P_{40}$	100 kW
<b>Activation thresholds</b> (adjustable via DIP switch)	774 V (factory setting) or 673 V
<b>Length of cable</b> to braking resistor, max.	50 m
<b>Digital inputs</b> In accordance with IEC 61131-2 Type 1	
• Voltage	-3 ... +30 V
• Low level (an open-circuit digital input is interpreted as "low")	-3 ... +5 V
• High Level	15 ... 30 V
• Current consumption at 24 V DC, typ.	10 mA
• Max. conductor cross-section	1.5 mm <sup>2</sup>
<b>Digital outputs</b> (continuously short-circuit proof)	
• Voltage	24 V DC
• Load current per digital output, max.	500 mA
• Max. conductor cross-section	1.5 mm <sup>2</sup>
<b>R1/R2 connection</b>	M8 screw
• Max. conductor cross-section	50 mm <sup>2</sup>
<b>Weight, approx.</b>	7.3 kg
<b>Approvals</b>	cURus (File No.: E192450)
<b>Suitable for installation in a PM240 Power Module</b>	Frame size FSGX

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## Load-side power components

### Output reactors

#### Overview

Output reactors reduce the voltage stress on the motor windings. At the same time, the capacitive charging/discharging currents, which place an additional load on the power unit when long motor cables are used, are reduced.

Output reactors are only provided for the PM240 and PM250 Power Modules. An output reactor is not required for the PM260 Power Module due to its integrated sine-wave filter.

The maximum permissible output frequency is 150 Hz when an output reactor is used – the pulse frequency must not exceed 4 kHz.

The output reactor must be installed as close as possible to the Power Module.

Output reactors are approved for use only in conjunction with "Vector" and "V/f control" modes.

4



Example: Output reactors for Power Modules frame sizes FSA and FSB



Example: Output reactor for PM240 Power Modules frame size FSGX

#### Selection and ordering data

Rated power kW	Rated power hp	Type	Frame size	Output reactor Order No.
<b>380 ... 480 V 3 AC</b>				
0.37	0.50	OBE13-7UA0	FSA	<b>6SE6400-3TC00-4AD2</b>
0.55	0.75	OBE15-5UA0	FSA	
0.75	1.0	OBE17-5UA0	FSA	
1.1	1.5	OBE21-1UA0	FSA	
1.5	2	OBE21-5UA0	FSA	
2.2	3	OBE22-2 . A0	FSB	<b>6SL3202-0AE21-0CA0</b>
3.0	4	OBE23-0 . A0	FSB	
4.0	5	OBE24-0 . A0	FSB	
7.5	10	OBE25-5 . A0	FSC	<b>6SL3202-0AJ23-2CA0</b>
11.0	15	OBE27-5 . A0	FSC	
15.0	20	OBE31-1 . A0	FSC	
18.5	25	OBE31-5 . A0	FSD	<b>6SE6400-3TC05-4DD0</b>
22	30	OBE31-8 . A0	FSD	<b>6SE6400-3TC03-8DD0</b>
30	40	OBE32-2 . A0	FSD	<b>6SE6400-3TC05-4DD0</b>
37	50	OBE33-0 . A0	FSE	<b>6SE6400-3TC08-0ED0</b>
45	60	OBE33-7 . A0	FSE	<b>6SE6400-3TC07-5ED0</b>
55	75	OBE34-5 . A0	FSF	<b>6SE6400-3TC14-5FD0</b>
75	100	OBE35-5 . A0	FSF	<b>6SE6400-3TC15-4FD0</b>
90	125	OBE37-5 . A0	FSF	<b>6SE6400-3TC14-5FD0</b>
110	150	OBE38-8UA0	FSF	<b>6SL3000-2BE32-1AA0</b>
132	200	OBE41-1UA0	FSF	<b>6SL3000-2BE32-6AA0</b>
160	250	OXE41-3UA0	FSGX	<b>new 6SL3000-2BE33-2AA0</b>
200	300	OXE41-6UA0	FSGX	<b>new 6SL3000-2BE33-8AA0</b>
250	400	OXE42-0UA0	FSGX	<b>new 6SL3000-2BE35-0AA0</b>

Rated power kW	Rated power hp	Type	Frame size	Output reactor Order No.
<b>380 ... 480 V 3 AC</b>				
7.5	10	OBE25-5AA0	FSC	<b>6SL3202-0AJ23-2CA0</b>
11.0	15	OBE27-5AA0	FSC	
15.0	20	OBE31-1AA0	FSC	
18.5	25	OBE31-5 . A0	FSD	<b>6SE6400-3TC05-4DD0</b>
22	30	OBE31-8 . A0	FSD	<b>6SE6400-3TC03-8DD0</b>
30	40	OBE32-2 . A0	FSD	<b>6SE6400-3TC05-4DD0</b>
37	50	OBE33-0 . A0	FSE	<b>6SE6400-3TC08-0ED0</b>
45	60	OBE33-7 . A0	FSE	<b>6SE6400-3TC07-5ED0</b>
55	75	OBE34-5 . A0	FSF	<b>6SE6400-3TC14-5FD0</b>
75	100	OBE35-5 . A0	FSF	<b>6SE6400-3TC15-4FD0</b>
90	125	OBE37-5 . A0	FSF	<b>6SE6400-3TC14-5FD0</b>

**Integration**

*Output reactors which are optionally available depending on the Power Module used*

The following line-side power components, DC link components and load-side power components are optionally available in the appropriate frame sizes for the Power Modules:

	Frame size						
	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM240 Power Module with integrated brake chopper</b>							
Available frame sizes	✓	✓	✓	✓	✓	✓	✓
<b>Load-side power components</b>							
Output reactor	U	U	U	S	S	S	S
<b>PM250 Power Module with line-commutated energy recovery</b>							
Available frame sizes	-	-	✓	✓	✓	✓	-
<b>Load-side power components</b>							
Output reactor	-	-	U	S	S	S	-
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>							
Available frame sizes	-	-	-	✓	-	✓	-
<b>Load-side power components</b>							
Output reactor <sup>1)</sup>	-	-	-	-	-	-	-

U = Base component

S = Lateral mounting

- = Not possible

<sup>1)</sup> PM260 Power Modules do not require output reactors as they are already equipped with sine-wave filters.

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Load-side power components****Output reactors****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Output reactor (for a 4 kHz pulse frequency) <b>6SE6400-3TC00-4AD2</b>				
<b>Rated current</b>	A	4	4	4	4	4
<b>Power loss</b>	kW	0.005	0.005	0.005	0.005	0.005
<b>Connection to the Power Module</b>		Cable	Cable	Cable	Cable	Cable
• Conductor cross-section		4 x AWG16 (1.5 mm <sup>2</sup> )	4 x AWG16 (1.5 mm <sup>2</sup> )	4 x AWG16 (1.5 mm <sup>2</sup> )	4 x AWG16 (1.5 mm <sup>2</sup> )	4 x AWG16 (1.5 mm <sup>2</sup> )
• Length, approx.	m	0.3	0.3	0.3	0.3	0.3
<b>Motor connection</b>		Screw terminals	Screw terminals	Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	6	6	6	6	6
<b>PE connection</b>		M5 screw studs	M5 screw studs	M5 screw studs	M5 screw studs	M5 screw studs
<b>Cable length, max.</b>						
between output reactor and motor						
• 380 V (– 10 %) ... 400 V 3 AC						
- Shielded	m	150	150	150	150	150
- Unshielded	m	225	225	225	225	225
• 401 V... 480 V (+ 10 %) 3 AC						
- Shielded	m	100	100	100	100	100
- Unshielded	m	150	150	150	150	150
<b>Dimensions</b>						
• Width	mm	75.5	75.5	75.5	75.5	75.5
• Height	mm	200	200	200	200	200
• Depth	mm	110	110	110	110	110
<b>Possible as base component</b>		yes	yes	yes	yes	yes
<b>Degree of protection</b>		IP00	IP00	IP00	IP00	IP00
<b>Weight, approx.</b>	kg	2	2	2	2	2
Suitable for PM240 Power Module	Type	6SL3224-0BE13-7UA0	6SL3224-0BE15-5UA0	6SL3224-0BE17-5UA0	6SL3224-0BE21-1UA0	6SL3224-0BE21-5UA0
Rated power of the Power Module	kW (hp)	0.37 (0.5)	0.55 (0.75)	0.75 (1.0)	1.1 (1.5)	1.5 (2.0)
Rated current $I_{\text{rated}}$ of the Power Module	A	1.3	1.7	2.2	3.1	4.1
Frame size		FSA	FSA	FSA	FSA	FSA

**Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Output reactor (for a 4 kHz pulse frequency)					
		6SL3202-0AE21-0CA0			6SL3202-0AJ23-2CA0		
<b>Rated current</b>	A	9.4	9.4	9.4	32	32	32
<b>Power loss</b>	kW	0.02	0.02	0.02	0.06	0.06	0.06
<b>Connection to the Power Module</b>		Cable	Cable	Cable	Cable	Cable	Cable
• Conductor cross-section		4 x AWG14 (1.5 mm <sup>2</sup> )	4 x AWG14 (1.5 mm <sup>2</sup> )	4 x AWG14 (1.5 mm <sup>2</sup> )	4 x AWG14 (1.5 mm <sup>2</sup> )	4 x AWG14 (1.5 mm <sup>2</sup> )	4 x AWG14 (1.5 mm <sup>2</sup> )
• Length, approx.	m	0.4	0.4	0.4	0.35	0.35	0.35
<b>Motor connection</b>		Screw terminals	Screw terminals	Screw terminals	Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	6	6	6	6	6	6
<b>PE connection</b>		M5 screw studs	M5 screw studs	M5 screw studs	M5 screw studs	M5 screw studs	M5 screw studs
<b>Cable length, max.</b>							
between output reactor and motor							
• 380 V (-10 %) ... 400 V 3 AC							
- Shielded	m	150	150	150	150	150	150
- Unshielded	m	225	225	225	225	225	225
• 401 V ... 480 V (+10 %) 3 AC							
- Shielded	m	100	100	100	100	100	100
- Unshielded	m	150	150	150	150	150	150
<b>Dimensions</b>							
• Width	mm	154	154	154	189	189	189
• Height	mm	270	270	270	334	334	334
• Depth	mm	70	70	70	80	80	80
<b>Possible as base component</b>		yes	yes	yes	yes	yes	yes
<b>Degree of protection</b>		IP00	IP00	IP00	IP00	IP00	IP00
<b>Weight, approx.</b>	kg	4.4	4.4	4.4	9.1	9.1	9.1
Suitable for PM240 Power Module	Type	6SL3224-0BE22-2UA0	6SL3224-0BE23-0UA0	6SL3224-0BE24-0UA0	6SL3224-0BE25-5UA0	6SL3224-0BE27-5UA0	6SL3224-0BE31-1UA0
		6SL3224-0BE22-2AA0	6SL3224-0BE23-0AA0	6SL3224-0BE24-0AA0	6SL3224-0BE25-5AA0	6SL3224-0BE27-5AA0	6SL3224-0BE31-1AA0
Suitable for PM250 Power Module	Type	–	–	–	6SL3225-0BE25-5AA0	6SL3225-0BE27-5AA0	6SL3225-0BE31-1AA0
Rated power of the Power Module	kW (hp)	2.2 (3.0)	3 (4)	4 (5)	7.5 (10)	11 (15)	15 (20)
Rated current $I_{rated}$ of the Power Module	A	5.9	7.7	10.2	18	25	32
Frame size		FSB	FSB	FSC	FSC	FSC	FSC

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Load-side power components****Output reactors****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Output reactor (for a 4 kHz pulse frequency)				
		6SE6400- 3TC05-4DD0	6SE6400- 3TC03-8DD0	6SE6400- 3TC05-4DD0	6SE6400- 3TC08-0ED0	6SE6400- 3TC07-5ED0
<b>Rated current</b>	A	68 <sup>1)</sup>	45 <sup>1)</sup>	68 <sup>1)</sup>	104 <sup>1)</sup>	90 <sup>1)</sup>
<b>Power loss</b>	kW	0.2	0.2	0.2	0.17	0.27
<b>Connection to the Power Module</b>		Flat connector for M6 cable lug	Flat connector for M6 cable lug	Flat connector for M6 cable lug	Flat connector for M6 cable lug	Flat connector for M6 cable lug
<b>Motor connection</b>		Flat connector for M6 cable lug	Flat connector for M6 cable lug	Flat connector for M6 cable lug	Flat connector for M6 cable lug	Flat connector for M6 cable lug
<b>PE connection</b>		M6 screw	M6 screw	M6 screw	M6 screw	M6 screw
<b>Cable length, max.</b>						
between output reactor and motor						
• 380 V (– 10 %) ... 400 V 3 AC						
- Shielded	m	200	200	200	200	200
- Unshielded	m	300	300	300	300	300
• 401 V ... 480 V (+ 10 %) 3 AC						
- Shielded	m	200	200	200	200	200
- Unshielded	m	300	300	300	300	300
<b>Dimensions</b>						
• Width	mm	225	225	225	225	270
• Height	mm	210	210	210	210	248
• Depth	mm	150	179	150	150	209
<b>Possible as base component</b>		no	no	no	no	no
<b>Degree of protection</b>		IP00	IP00	IP00	IP00	IP00
<b>Weight, approx.</b>	kg	10.7	16.1	10.7	10.4	24.9
Suitable for PM240 Power Module	Type	6SL3224-0BE31-5UA0 6SL3224-0BE31-5AA0	6SL3224-0BE31-8UA0 6SL3224-0BE31-8AA0	6SL3224-0BE32-2UA0 6SL3224-0BE32-2AA0	6SL3224-0BE33-0UA0 6SL3224-0BE33-0AA0	6SL3224-0BE33-7UA0 6SL3224-0BE33-7AA0
Suitable for PM250 Power Module	Type	6SL3225-0BE31-5 . A0	6SL3225-0BE31-8 . A0	6SL3225-0BE32-2 . A0	6SL3225-0BE33-0 . A0	6SL3225-0BE33-7 . A0
Rated power of the Power Module	kW (hp)	18.5 (25)	22 (30)	30 (40)	37 (50)	45 (60)
Rated current $I_{\text{rated}}$ of the Power Module	A	38	45	60	75	90
Frame size		FSD	FSD	FSD	FSE	FSE

<sup>1)</sup> On the rating plate of the reactor the current is displayed according to High Overload HO, which is lower than the indicated value for the Light Overload current of the Power Module.

## Technical specifications

Line supply voltage 380 ... 480 V 3 AC		Output reactor (for a 4 kHz pulse frequency)				
		6SE6400- 3TC14-5FD0	6SE6400- 3TC15-4FD0	6SE6400- 3TC14-5FD0	6SL3000- 2BE32-1AA0	6SL3000- 2BE32-6AA0
<b>Rated current</b>	A	178 <sup>1)</sup>	178 <sup>1)</sup>	178 <sup>1)</sup>	210	260
<b>Power loss</b>	kW	0.47	0.25	0.47	0.49	0.5
<b>Connection to the Power Module</b>		Flat connector for M8 cable lug	Flat connector for M8 cable lug	Flat connector for M8 cable lug	Flat connector for M10 screw	Flat connector for M10 screw
<b>Motor connection</b>		Flat connector for M8 cable lug	Flat connector for M8 cable lug	Flat connector for M8 cable lug	Flat connector for M10 screw	Flat connector for M10 screw
<b>PE connection</b>		M8 screw	M6 screw	M8 screw	M8 screw	M8 screw
<b>Cable length, max.</b>						
between output reactor and motor						
• 380 V (– 10 %) ... 400 V 3 AC						
- Shielded	m	200	200	200	200	200
- Unshielded	m	300	300	300	300	300
• 401 V ... 480 V (+ 10 %) 3 AC						
- Shielded	m	200	200	200	200	200
- Unshielded	m	300	300	300	300	300
<b>Dimensions</b>						
• Width	mm	350	270	350	300	300
• Height	mm	321	248	321	285	315
• Depth	mm	288	209	288	257	277
<b>Possible as base component</b>		no	no	no	no	no
<b>Degree of protection</b>		IP00	IP00	IP00	IP00	IP00
<b>Weight, approx.</b>	kg	51.5	24	51.5	60	66
Suitable for PM240 Power Module	Type	6SL3224-0BE34-5UA0 6SL3224-0BE34-5AA0	6SL3224-0BE35-5UA0 6SL3224-0BE35-5AA0	6SL3224-0BE37-5UA0 6SL3224-0BE37-5AA0	6SL3224-0BE38-8UA0	6SL3224-0BE41-1UA0
Suitable for PM250 Power Module	Type	6SL3225-0BE34-5 . A0	6SL3225-0BE35-5 . A0	6SL3225-0BE37-5 . A0	–	–
Rated power of the Power Module	kW (hp)	55 (75)	75 (100)	90 (125)	110 (150)	132 (200)
Rated current $I_{\text{rated}}$ of the Power Module	A	110	145	178	205	250
Frame size		FSF	FSF	FSF	FSF	FSF

<sup>1)</sup> On the rating plate of the reactor the current is displayed according to High Overload HO, which is lower than the indicated value for the Light Overload current of the Power Module.

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Load-side power components****Output reactors****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Output reactor (for a 4 kHz pulse frequency)		
		<b>6SL3000-2BE33-2AA0</b>	<b>6SL3000-2BE33-8AA0</b>	<b>6SL3000-2BE35-0AA0</b>
<b>Rated current</b>	A	310	380	490
<b>Power loss</b>	kW	0.470	0.500	0.500
<b>Connection to the Power Module</b>		1 × hole for M10	1 × hole for M10	1 × hole for M12
<b>Motor connection</b>		1 × hole for M10	1 × hole for M10	1 × hole for M12
<b>PE connection</b>		M6 screw	M6 screw	M6 screw
<b>Cable length, max.</b>				
between output reactor and motor				
• 380 V (– 10 %) ... 400 V 3 AC				
- Shielded	m	300	300	300
- Unshielded	m	450	450	450
• 401 V ... 480 V (+ 10 %) 3 AC				
- Shielded	m	300	300	300
- Unshielded	m	450	450	450
<b>Dimensions</b>				
• Width	mm	300	300	300
• Height	mm	285	285	365
• Depth	mm	257	277	277
<b>Possible as base component</b>		no	no	no
<b>Degree of protection</b>		IP00	IP00	IP00
<b>Weight, approx.</b>	kg	66	73	100
Suitable for PM240 Power Module	Type	6SL3224-0XE41-3UA0	6SL3224-0XE41-6UA0	6SL3224-0XE42-0UA0
Suitable for PM250 Power Module	Type	–	–	–
Rated power of the Power Module	kW (hp)	160 (250)	200 (300)	250 (400)
Rated current $I_{\text{rated}}$ of the Power Module	A	302	370	477
Frame size		FSGX	FSGX	FSGX

**Overview**

Example: Sine-wave filter for PM240 Power Modules frame size FSGX

A sine-wave filter limits the rate of rise of voltage and the capacitive charging/discharging currents that usually occur with inverter operation. An output reactor is not required. Sine-wave filters are only provided for the PM240 and PM250 Power Modules. PM260 Power Modules already have an integrated sine-wave filter and an additional sine-wave filter is not required.

The sine-wave filter at the inverter output supplies almost perfect sinusoidal voltages at the motor so that standard motors can be used without special cables. Standard cables can be used. The maximum permissible motor feeder length is 300 m. The maximum output frequency is 150 Hz at 380 V to 480 V.

When using sine-wave filters, the following should be observed:

- Operation with pulse frequencies from 4 kHz to 8 kHz (sine-wave filter from 160 kW, only for 4 kHz) permissible
- It must be ensured that the automatic pulse frequency reduction functions are also deactivated
- A derating of 5 % must be observed when selecting a suitable inverter
- The output frequency is limited to 150 Hz
- Operation and commissioning may only be performed with the motor connected as the sine-wave filter is not no-load proof

**Selection and ordering data**

Rated power SINAMICS G120 PM240 Power Module				Sine-wave filter
kW	hp	Type 6SL3224-...	Frame size	Order No.
<b>380 ... 480 V 3 AC</b>				
0.37	0.50	OBE13-7UA0	FSA	<span style="color: orange;">new</span> <b>6SL3202-0AE20-3SA0</b>
0.55	0.75	OBE15-5UA0	FSA	
0.75	1.0	OBE17-5UA0	FSA	
1.1	1.5	OBE21-1UA0	FSA	<span style="color: orange;">new</span> <b>6SL3202-0AE20-6SA0</b>
1.5	2.0	OBE21-5UA0	FSA	
2.2	3.0	OBE22-2 . A0	FSB	<span style="color: orange;">new</span> <b>6SL3202-0AE21-1SA0</b>
3.0	4.0	OBE23-0 . A0	FSB	
4.0	5.0	OBE24-0 . A0	FSB	<span style="color: orange;">new</span> <b>6SL3202-0AE21-4SA0</b>
7.5	10	OBE25-5 . A0	FSC	<span style="color: orange;">new</span> <b>6SL3202-0AE22-0SA0</b>
11.0	15	OBE27-5 . A0	FSC	<span style="color: orange;">new</span> <b>6SL3202-0AE23-3SA0</b>
15.0	20	OBE31-1 . A0	FSC	
18.5	25	OBE31-5 . A0	FSD	<span style="color: orange;">new</span> <b>6SL3202-0AE24-6SA0</b>
22	30	OBE31-8 . A0	FSD	
30	40	OBE32-2 . A0	FSD	<span style="color: orange;">new</span> <b>6SL3202-0AE26-2SA0</b>
37	50	OBE33-0 . A0	FSE	<span style="color: orange;">new</span> <b>6SL3202-0AE28-8SA0</b>
45	60	OBE33-7 . A0	FSE	
55	75	OBE34-5 . A0	FSF	<span style="color: orange;">new</span> <b>6SL3202-0AE31-5SA0</b>
75	100	OBE35-5 . A0	FSF	
90	125	OBE37-5 . A0	FSF	<span style="color: orange;">new</span> <b>6SL3202-0AE31-8SA0</b>
110	150	OBE38-8UA0	FSF	<span style="color: orange;">new</span> <b>6SL3000-2CE32-3AA0</b>
132	200	OBE41-1UA0	FSF	
160	250	OXE41-3UA0	FSGX	<span style="color: orange;">new</span> <b>6SL3000-2CE32-8AA0</b>
200	300	OXE41-6UA0	FSGX	<span style="color: orange;">new</span> <b>6SL3000-2CE33-3AA0</b>
250	400	OXE42-0UA0	FSGX	<span style="color: orange;">new</span> <b>6SL3000-2CE34-1AA0</b>

Rated power SINAMICS G120 PM250 Power Module				Sine-wave filter
kW	hp	Type 6SL3225-...	Frame size	Order No.
<b>380 ... 480 V 3 AC</b>				
7.5	10	OBE25-5AA0	FSC	<span style="color: orange;">new</span> <b>6SL3202-0AE22-0SA0</b>
11.0	15	OBE27-5AA0	FSC	<span style="color: orange;">new</span> <b>6SL3202-0AE23-3SA0</b>
15.0	20	OBE31-1AA0	FSC	
18.5	25	OBE31-5 . A0	FSD	<span style="color: orange;">new</span> <b>6SL3202-0AE24-6SA0</b>
22	30	OBE31-8 . A0	FSD	
30	40	OBE32-2 . A0	FSD	<span style="color: orange;">new</span> <b>6SL3202-0AE26-2SA0</b>
37	50	OBE33-0 . A0	FSE	<span style="color: orange;">new</span> <b>6SL3202-0AE28-8SA0</b>
45	60	OBE33-7 . A0	FSE	
55	75	OBE34-5 . A0	FSF	<span style="color: orange;">new</span> <b>6SL3202-0AE31-5SA0</b>
75	100	OBE35-5 . A0	FSF	
90	125	OBE37-5 . A0	FSF	<span style="color: orange;">new</span> <b>6SL3202-0AE31-8SA0</b>

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Load-side power components**

**Sine-wave filters**

## Integration

*Sine-wave filters which are optionally available depending on the Power Module used*

	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
<b>PM240 Power Module with integrated brake chopper</b>							
Available frame sizes	✓	✓	✓	✓	✓	✓	✓
<b>Load-side power components</b>							
Sine-wave filter	U	U	U	S	S	S	S
<b>PM250 Power Module with line-commutated energy recovery</b>							
Available frame sizes	-	-	✓	✓	✓	✓	-
<b>Load-side power components</b>							
Sine-wave filter	-	-	U	S	S	S	-
<b>PM260 Power Module with line-commutated energy recovery and integrated sine-wave filter</b>							
Available frame sizes	-	-	-	✓	-	✓	-
<b>Load-side power components</b>							
Sine-wave filter	-	-	-		-		-

U = Base component

S = Lateral mounting

I = Integrated

- = Not possible

**Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Sine-wave filter (for pulse frequencies 4 kHz ... 8 kHz)			
		6SL3202-0AE20-3SA0		6SL3202-0AE20-6SA0	
<b>Rated current</b>	A	3.5	3.5	3.5	6.0
<b>Power loss</b>	kW	0.005	0.005	0.005	0.005
<b>Connection to the Power Module</b>		Cable	Cable	Cable	Cable
• Conductor cross-section	mm <sup>2</sup>	6	6	6	6
• Length, approx.	m	0.5	0.5	0.5	0.5
<b>Motor connection</b>		Screw terminals	Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	6	6	6	6
<b>PE connection</b>		M5 screw studs	M5 screw studs	M5 screw studs	M5 screw studs
<b>Cable length, max.</b>					
between sine-wave filter and motor					
• 380 ... 480 V 3 AC ±10 %					
- Shielded	m	200	200	200	200
- Unshielded	m	300	300	300	300
<b>Dimensions</b>					
• Width	mm	75.5	75.5	75.5	75.5
• Height	mm	200	200	200	200
• Depth	mm	110	110	110	110
<b>Possible as base component</b>		yes	yes	yes	yes
<b>Degree of protection</b>		IP20	IP20	IP20	IP20
<b>Weight, approx.</b>	kg	2.6	2.6	2.6	3.0
Suitable for PM240 Power Module	Type	6SL3224-0BE13-7UA0	6SL3224-0BE15-5UA0	6SL3224-0BE17-5UA0	6SL3224-0BE21-1UA0
Rated power of the Power Module	kW (hp)	0.37 (0.5)	0.55 (0.75)	0.75 (1.0)	1.1 (1.5)
Rated current $I_{\text{rated}}$ of the Power Module	A	1.3	1.7	2.2	3.1
Frame size		FSA	FSA	FSA	FSA

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Load-side power components****Sine-wave filters****Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Sine-wave filter (for pulse frequencies 4 kHz ... 8 kHz)				
		6SL3202-0AE21-1SA0	6SL3202-0AE21-4SA0	6SL3202-0AE22-0SA0	6SL3202-0AE23-3SA0	
<b>Rated current</b>	A	9.0	9.0	14.0	20.0	33.0
<b>Power loss</b>	kW	0.02	0.02	0.02	0.06	0.06
<b>Connection to the Power Module</b>		Cable	Cable	Cable	Cable	Cable
• Conductor cross-section	mm <sup>2</sup>	6	6	6	10	10
• Length, approx.	m	0.5	0.5	0.5	0.5	0.5
<b>Motor connection</b>		Screw terminals	Screw terminals	Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	6	6	6	10	10
<b>PE connection</b>		M5 screw studs	M5 screw studs	M5 screw studs	M5 screw studs	M5 screw studs
<b>Cable length, max.</b>						
between sine-wave filter and motor						
• 380 ... 480 V 3 AC ±10 %						
- Shielded	m	200	200	200	200	200
- Unshielded	m	300	300	300	300	300
<b>Dimensions</b>						
• Width	mm	153	153	153	189	189
• Height	mm	270	270	270	336	336
• Depth	mm	100	100	100	140	140
<b>Possible as base component</b>		yes	yes	yes	yes	yes
<b>Degree of protection</b>		IP20	IP20	IP20	IP20	IP20
<b>Weight, approx.</b>	kg	6	6	10	12	23
Suitable for PM240 Power Module	Type	6SL3224-0BE22-2UA0 6SL3224-0BE22-2AA0	6SL3224-0BE23-0UA0 6SL3224-0BE23-0AA0	6SL3224-0BE24-0UA0 6SL3224-0BE24-0AA0	6SL3224-0BE25-5UA0 6SL3224-0BE25-5AA0	6SL3224-0BE27-5UA0 6SL3224-0BE27-5AA0
Suitable for PM250 Power Module	Type	–	–	–	6SL3225-0BE25-5AA0	6SL3225-0BE27-5AA0
Rated power of the Power Module	kW (hp)	2.2 (3)	3 (4)	4 (5)	7.5 (10)	11 (15)
Rated current $I_{\text{rated}}$ of the Power Module	A	5.9	7.7	10.2	18	25
Frame size		FSB	FSB	FSB	FSC	FSC

**Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Sine-wave filter (for pulse frequencies 4 kHz ... 8 kHz)			
		6SL3202-0AE24-6SA0		6SL3202-0AE26-2SA0	6SL3202-0AE28-8SA0
<b>Rated current</b>	A	47	47	61.8	92
<b>Power loss</b>	kW	0.2	0.2	0.2	0.17
<b>Connection to the Power Module</b>		Screw terminals	Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	50	50	50	95
<b>Motor connection</b>		Screw terminals	Screw terminals	Screw terminals	Screw terminals
• Conductor cross-section	mm <sup>2</sup>	50	50	50	95
<b>PE connection</b>		M6 screw	M6 screw	M6 screw	M8 screw
<b>Cable length, max.</b>					
between sine-wave filter and motor					
• 380 ... 480 V 3 AC ±10 %					
- Shielded	m	200	200	200	200
- Unshielded	m	300	300	300	300
<b>Dimensions</b>					
• Width	mm	250	250	250	275
• Height	mm	315	315	305	368
• Depth	mm	262	262	262	275
<b>Possible as base component</b>		no	no	no	no
<b>Degree of protection</b>		IP00	IP00	IP00	IP00
<b>Weight, approx.</b>	kg	24.0	24.0	34.0	45.0
Suitable for PM240 Power Module	Type	6SL3224-0BE31-5UA0 6SL3224-0BE31-5AA0	6SL3224-0BE31-8UA0 6SL3224-0BE31-8AA0	6SL3224-0BE32-2UA0 6SL3224-0BE32-2AA0	6SL3224-0BE33-0UA0 6SL3224-0BE33-0AA0
Suitable for PM250 Power Module	Type	6SL3225-0BE31-5 . A0	6SL3225-0BE31-8 . A0	6SL3225-0BE32-2 . A0	6SL3225-0BE33-0 . A0
Rated power of the Power Module	kW (hp)	18.5 (25)	22 (30)	30 (40)	37 (50)
Rated current $I_{rated}$ of the Power Module	A	38	45	60	75
Frame size		FSD	FSD	FSD	FSE

**SINAMICS G120**

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

Load-side power components

Sine-wave filters

**Technical specifications**

Line supply voltage 380 ... 480 V 3 AC		Sine-wave filter (for pulse frequencies 4 kHz ... 8 kHz, from 160 kW only 4 kHz)			
6SL3202-0AE31-5SA0				6SL3202-0AE31-8SA0	6SL3000-2CE32-3AA0
<b>Rated current</b>	A	150	150	182	225
<b>Power loss</b>	kW	0.47	0.25	0.47	0.6
<b>Connection to the Power Module</b>		Screw terminals	Screw terminals	Screw terminals	1 × hole for M10
• Conductor cross-section	mm <sup>2</sup>	150	150	150	1 × hole for M10
<b>Motor connection</b>		Screw terminals	Screw terminals	Screw terminals	1 × hole for M10
• Conductor cross-section	mm <sup>2</sup>	150	150	150	1 × hole for M10
<b>PE connection</b>		M8 screw	M6 screw	M8 screw	1 × hole for M10
<b>Cable length, max.</b>					
between sine-wave filter and motor					
• 380 ... 480 V 3 AC ±10 %					
- Shielded	m	200	200	200	300
- Unshielded	m	300	300	300	450
<b>Dimensions</b>					
• Width	mm	350	350	350	620
• Height	mm	440	440	468	300
• Depth	mm	305	305	305	320
<b>Possible as base component</b>		no	no	no	no
<b>Degree of protection</b>		IP00	IP00	IP00	IP00
<b>Weight, approx.</b>	kg	63.0	63.0	80.0	124
Suitable for PM240 Power Module	Type	6SL3224-0BE34-5UA0 6SL3224-0BE34-5AA0	6SL3224-0BE35-5UA0 6SL3224-0BE35-5AA0	6SL3224-0BE37-5UA0 6SL3224-0BE37-5AA0	6SL3224-0BE38-8UA0 6SL3224-0BE41-1UA0
Suitable for PM250 Power Module	Type	6SL3225-0BE34-5 . A0	6SL3225-0BE35-5 . A0	6SL3225-0BE37-5 . A0	–
Rated power of the Power Module	kW (hp)	55 (75)	75 (100)	90 (125)	110 (150)
Rated current $I_{rated}$ of the Power Module	A	110	145	178	205
Frame size		FSF	FSF	FSF	FSF

**Technical specifications**

<b>Line supply voltage</b> 380 ... 480 V 3 AC	<b>Sine-wave filter</b> (for pulse frequencies 4 kHz ... 8 kHz, from 160 kW only 4 kHz)		
	<b>6SL3000-2CE32-8AA0</b>	<b>6SL3000-2CE33-3AA0</b>	<b>6SL3000-2CE34-1AA0</b>
<b>Rated current</b> A	276	333	408
<b>Power loss</b> kW	0.69	0.53	0.7
<b>Connection to the Power Module</b>	1 × hole for M10	1 × hole for M10	1 × hole for M10
<b>Motor connection</b>	1 × hole for M10	1 × hole for M10	1 × hole for M10
<b>PE connection</b>	1 × hole for M10	1 × hole for M10	1 × hole for M10
<b>Cable length, max.</b> between sine-wave filter and motor			
• 380 ... 480 V 3 AC ±10 %			
- Shielded m	300	300	300
- Unshielded m	450	450	450
<b>Dimensions</b>			
• Width mm	620	620	620
• Height mm	300	370	370
• Depth mm	320	360	360
<b>Possible as base component</b>	no	no	no
<b>Degree of protection</b>	IP00	IP00	IP00
<b>Weight, approx.</b> kg	127	136	198
Suitable for PM240 Power Module	Type	6SL3224-0XE41-3UA0	6SL3224-0XE41-6UA0
Suitable for PM250 Power Module	Type	–	–
Rated power of the Power Module	kW (hp)	160 (250)	200 (300)
Rated current $I_{\text{rated}}$ of the Power Module	A	302	370
Frame size	FSGX	FSGX	FSGX

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

Supplementary system components  
Intelligent Operator Panel IOP

## Overview

### Intelligent Operator Panel IOP



The Intelligent Operator Panel IOP is an extremely user-friendly and powerful Operator Panel for the SINAMICS G120, SINAMICS G120D standard drives and SIMATIC ET 200 frequency converters.

The IOP supports both entry-level personnel and drive experts. Thanks to the large plain text display, the menu prompting and the Application Wizards, it is easy to commission standard drives. A drive can be essentially commissioned without having to use a printed parameter list as the parameters are displayed in plain text and due to the explanatory help texts and the parameter filtering function.

Application Wizards interactively guide you when commissioning important applications such as conveyor technology, pumps, fans and compressors. There are quick commissioning wizards for general commissioning.

The drives are manually and simply controlled using directly assigned buttons and the navigation wheel. The IOP has a dedicated switchover button to switch over from the automatic to the manual mode.

The frequency inverter can be diagnosed in a user-friendly fashion using the plain text display of faults and alarms. Help texts can be obtained by pressing the INFO button.

Up to two process values can either be graphically or numerically visualized on the status screen/status display. Process values can also be displayed in technological units.

IOP supports series commissioning of identical drives. For this purpose, a parameter list can be copied from a frequency inverter into the IOP and when required, downloaded into other drive units of the same type.

The IOP includes the following language packages: English, French, German, Italian and Spanish.

The IOP can be installed in control cabinet doors using the optionally available door mounting kit.

### Updating the IOP

The IOP can be updated and expanded using the integrated USB interface. Data to support future drive systems can be transferred from the PC to the IOP via drag & drop. Further, the USB interface allows user languages and wizards that become available in the future to be subsequently downloaded and the firmware to be updated for the IOP. The IOP is supplied with power via the USB interface during an update.

### IOP Handheld



A handheld version of the IOP can be ordered for mobile use. In addition to the IOP, this includes a housing with rechargeable batteries, charging unit and RS232 interface cable. The charging unit is supplied with connector adapters for Europe, the US and UK. When the batteries are fully charged, the operating time is up to 8 hours.

A PC Inverter Connection Kit 6SL3255-0AA00-2AA1 is required to connect the IOP to the CU240S and CU240E Control Units.

To connect the IOP Handheld to SINAMICS G110D and SINAMICS G120D, the RS232 interface cable with optical interface is additionally required.

## Benefits

- Simple commissioning of standard applications using wizards, it is not necessary to know the parameter structure
- Diagnostics using plain text display; can be used locally on-site without documentation
- Direct manual operation of the drive – you can toggle between the automatic and manual modes
- Status display with freely selectable units; display of real physical values
- Intuitive, navigation using a wheel – just like in everyday applications
- Graphic display for e.g. status values in bar-type diagrams such as e.g. pressure, flow
- Quickly and simply mounted in the door – mechanically and electrically
- Simple local commissioning on-site using the handheld version
- Commissioning without documentation using the integrated help function
- Series commissioning using the clone function (parameter set data is saved for fast replacement)
- User-defined parameter list with a reduced number of self-selected parameters (to generate your own commissioning screens)
- 5 integrated languages
- Simple update of languages, wizards and firmware updates via USB

**Selection and ordering data**

Designation	Order No.
<b>Intelligent Operator Panel IOP</b>	<b>new 6SL3255-0AA00-4JA0</b>
<b>IOP Handheld</b>	<b>new 6SL3255-0AA00-4HA0</b>

For use with SINAMICS G120, SINAMICS G110D, SINAMICS G120D, SIMATIC ET 200S FC or SIMATIC ET 200pro FC

Included in the scope of delivery:

- IOP
- Handheld housing
- Rechargeable batteries (4 x AA)
- Charging unit (international)
- RS232 connecting cable (3 m long, can only be used for SINAMICS G120 and SIMATIC ET 200S FC)
- USB cable (1 m long)

**Accessories**

Designation	Order No.
<b>IOP Door Mounting Kit</b>	<b>new 6SL3256-0AP00-0JA0</b>
IP54 degree of protection for mounting the IOP in control cabinet doors with sheet steel thicknesses of 1 ... 3 mm	
Included in the scope of delivery:	
<ul style="list-style-type: none"> <li>• Seal</li> <li>• Mounting material</li> <li>• Connecting cable (5 m long)</li> </ul>	
<b>RS232 interface cable</b>	<b>3RK1922-2BP00</b>
With optical interface to connect the SINAMICS G110D, SINAMICS G120D or SIMATIC ET 200pro FC inverters to the IOP Handheld (2.5 m long)	

**Integration**Using the IOP with the frequency inverters

IOP	SINAMICS G120 with CU230P-2 Control Unit	SINAMICS G120 with CU240E or CU240S Control Unit	SINAMICS G110D and SINAMICS G120D
Plugging the IOP onto the inverter (power supply from the Control Unit)	✓	—	—
IOP door mounting with door mounting kit (power supply from the Control Unit)	✓	—	—
Mobile use of the IOP Handheld (supplied from rechargeable batteries)	✓	✓ PC Inverter Connection Kit required, 6SL3255-0AA00-2AA1	✓ RS232 interface cable with optical interface required, 3RK1922-2BP00

Mounting the IOP on a CU230P-2 Control Unit

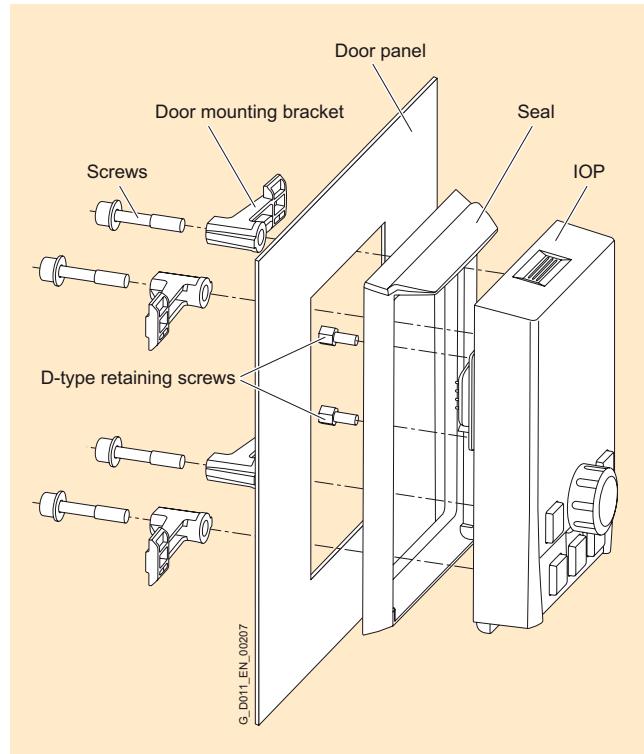
The IOP can be directly plugged onto the CU230P-2 Control Unit.



CU230P-2 Control Unit with plugged on IOP

Mounting the IOP in a door

Using the optionally available door mounting kit, the IOP can be simply mounted in a control cabinet door with just a few manual operations (presently only available in conjunction with the SINAMICS G120 and CU230P-2 Control Unit). Degree of protection IP54/UL Type 12 is achieved when mounting in a door.



# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Supplementary system components**  
**Basic Operator Panel BOP**

## Overview



The Basic Operator Panel BOP can be used to commission drives, monitor drives in operation and input individual parameter settings.

Values and units are displayed on a 5-digit display.

One BOP can be used for several inverters. It is plugged directly onto the CU240 Control Unit.

The BOP provides a function to quickly copy parameters. A parameter set of an inverter can be saved in the BOP and then downloaded to another inverter.

**Note:** The BOP is not suitable for the CU230P-2 Control Unit. The Intelligent Operator Panel IOP is available for this purpose.

## Selection and ordering data

Order No.

**Basic Operator Panel BOP**  
(not for Control Unit CU230P-2)

**6SL3255-0AA00-4BA1**

## Integration



Example: CU240E Control Unit with mounted Basic Operator Panel BOP

**Overview**

The parameter settings for an inverter can be stored on the MMC memory card. When service is required, e.g. after the inverter has been replaced and the data have been downloaded from the memory card the drive system is immediately ready for use again.

- Parameter settings can be written from the MMC memory card to the inverter or saved from the inverter to the MMC memory card.
- Up to 100 parameter sets can be stored.
- Supports series commissioning without the use of additional commissioning tools (e.g. BOP and STARTER).
- Commissioning with the MMC memory card is defined by the user:
  - Parameter p8458 = 0 → parameter set 0 is never automatically downloaded from the MMC ("never")
  - Parameter p8458 = 1 → parameter set 0 is downloaded once after PowerOn ("once")
  - Parameter p8458 = 2 → parameter set 0 is always downloaded after PowerOn ("always")

**Note:**

The MMC memory card is not required for operation and does not have to remain inserted.

**Note:**

The CU240E Control Unit does not have a slot for the MMC memory card.

**Integration**

Example: Inserting the MMC memory card into a CU240 Control Unit



Example: CU240 Control Unit with inserted MMC memory card

**Selection and ordering data**

	Order No.
<b>MMC memory card</b> (not for the CU240E Control Unit)	<b>6SL3254-0AM00-0AA0</b>

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## Supplementary system components CM240NE chemical industry module

### Applications

Inverters for 400 V, 500 V and 690 V are required in the chemical industry that meet the special demands and requirements of this industry sector. The essential requirements and demands of the chemical industry are fulfilled using the SINAMICS G120 series of inverters supplemented by the CM240NE chemical industry module (with ATEX-certified PTC evaluation and a NAMUR terminal strip).



CM240NE chemical industry module

### Selection and ordering data

	Order No.
<b>CM240NE chemical industry module</b>	<b>new 6SL3255-0BT01-0PA0</b>

### Accessories

	Order No.
<b>Supplementary kit for rail mounting</b> comprising	<b>6SL3260-4TA00-1AA6</b>

- Adapter for rail mounting (acc. to DIN 50022, 35 × 15 mm)
- Long cable harness

### Design

- Compact, modular inverter
- Isolated analog inputs and outputs in the chemical industry module (1 setpoint / 2 measured values)
- Isolated digital inputs and outputs in the Control Unit
- Protective separation of the motor sensor cable with respect to the enclosure and other connections using reinforced insulation of the creepage and clearances (rated impulse voltage 12 kV) acc. to EN 60664 1
- Certified power disconnection (94/9/EC, ATEX) of the inverter without main contactor
- Forced inverter inhibit (EMERGENCY STOP function via STO)
- Terminal strip acc. to NE37, if fulfilled

- Sine-wave filter integrated in the PM260 Power Modules (500 V to 690 V)
- A line reactor is not required for the PM260 and PM250 Power Modules
- PM250 and PM260 Power Modules are capable of energy recovery
- A series of inverters for the complete voltage and power range
- The integrated or external sine-wave filter permits unshielded motor cables up to 300 m; shielded motor cables are possible up to 200 m (carefully observe the max. length of the temperature sensor cable!)
- An extremely compact overall drive system can be achieved when using a PM260 Power Module, frame size FSD or FSF (the line reactor and sine-wave filter are not required, the chemical industry module is directly snapped onto the Power Module).



CM240NE chemical industry module without cover

The CM240NE chemical industry module has the following interfaces:

Designation	Description
PROFIBUS	9-pin, Sub-D connector or socket to connect PROFIBUS
X11 and X12	Parallel connection of the CM240NE chemical industry module with the Control Unit
X2	Terminal strip in accordance with NAMUR recommendation NE37 (2.5 mm <sup>2</sup> screw terminals) <ul style="list-style-type: none"> <li>• Digital inputs and outputs</li> <li>• Analog inputs and outputs</li> </ul>
X3	Terminal strip in accordance with NAMUR recommendation NE37 (2.5 mm <sup>2</sup> screw terminals) to connect the motor temperature sensor

### Function

- Thermal motor protection (TMP) using the PTC thermistor integrated in the motor (incl. protective separation up to 690 V line supplies)
- The analog inputs and outputs are electrically isolated (MW1 to 3)
- Provision of NAMUR terminal strip (-X2; -X3)

**Integration**

A chemical industry inverter comprises a SINAMICS G120 inverter (Power Module and Control Unit) and the CM240NE chemical industry module.

The CU240S DP-F is suitable as Control Unit. This is a Control Unit with integrated safety-oriented functions and PROFIBUS-DP interface.

The following Power Module versions are used:

- PM240 Power Module with DC braking function and brake chopper, 400 V line supply voltage
- PM250 Power Module with energy recovery capability, 400 V line supply voltage
- PM260 Power Module with energy recovery capability, 500 V to 690 V line supply voltage

Depending on the power unit, additional components may be necessary to complete the system.

**Additional information**

A script file to parameterize the interconnections in line with the NAMUR assignment is available as download to commission the system using the STARTER commissioning tool.

German:

<http://support.automation.siemens.com/WW/view/de/30814192>

English:

<http://support.automation.siemens.com/WW/view/en/30814192>



Chemical industry inverter comprising PM240 Power Module, CU240S DP-F Control Unit with BOP and CM240NE chemical industry module

# SINAMICS G120

## Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

### Supplementary system components PC Inverter Connection Kit -2

#### Overview

For controlling and commissioning an inverter directly from a PC, if the STARTER commissioning tool has been installed on the PC. With these, the inverter can be

- parameterized (commissioning, optimization)
- monitored (diagnostics)
- controlled (master control via the STARTER commissioning tool for test purposes).

A USB cable (3 m) and the STARTER commissioning tool<sup>1)</sup> are included as scope of delivery on a DVD.

#### Selection and ordering data

	Order No.
<b>PC Inverter Connection Kit -2 for CU230P-2 Control Units</b>	<b>new 6SL3255-0AA00-2CA0</b>

Including USB cable (3 m) and STARTER commissioning tool<sup>1)</sup> on DVD

### Supplementary system components PC Inverter Connection Kit

#### Overview



Example: PC Connection Kit for CU240 Control Units

For controlling and commissioning an inverter directly from a PC, if the STARTER commissioning tool has been installed on the PC. With these, the inverter can be

- parameterized (commissioning, optimization)
- monitored (diagnostics)
- controlled (master control via the STARTER commissioning tool for test purposes).

This is an isolated RS232 adapter board for a reliable point-to-point connection to a PC with a serial RS232 interface. A USB/RS232 adapter can be used as an alternative (e.g. type 12.02.1086R supplied by Roline).

The scope of delivery includes a 9-pin Sub-D connector, an RS232 standard cable (3 m) and the STARTER commissioning tool<sup>1)</sup> on DVD.

#### Selection and ordering data

	Order No.
<b>PC Inverter Connection Kit</b>	<b>6SL3255-0AA00-2AA1</b>

Including a 9-pin Sub-D connector, an RS232 standard cable (3 m) and the STARTER commissioning tool<sup>1)</sup> on DVD

<sup>1)</sup> The STARTER commissioning tool is also available in the Internet under <http://support.automation.siemens.com/WW/view/en/10804985/133100>

## Overview



The Brake Relay allows the Power Module to be connected to an electromechanical motor brake, thereby allowing the motor brake to be driven directly by the Control Unit.

## Selection and ordering data

	Order No.
<b>Brake Relay</b> Including cable harness for connection to the Power Module	<b>6SL3252-0BB00-0AA0</b>

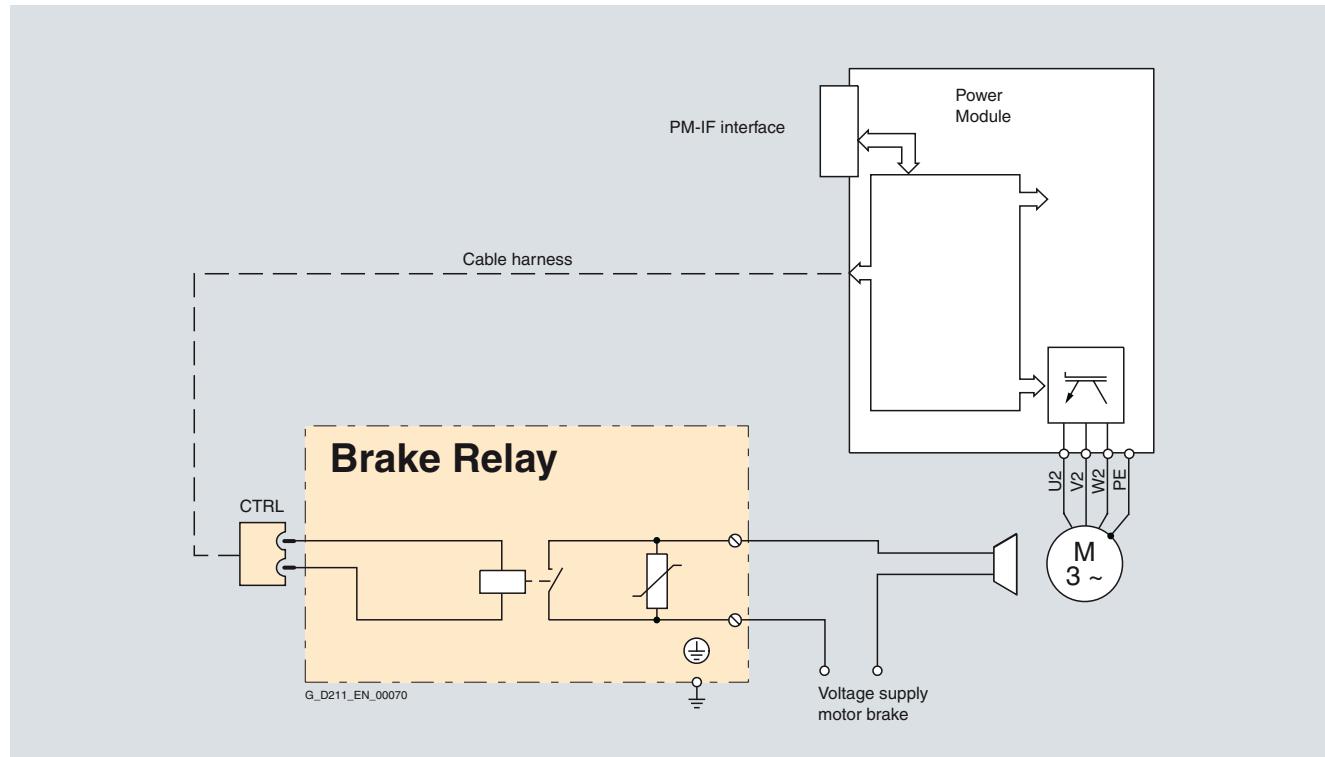
## Integration

The Brake Relay has the following interfaces:

- A switch contact (NO contact) to control the motor brake solenoid
- A connection for the cable harness (CTRL) for connection to the Power Module

The Brake Relay can be installed on the shield bonding plate near the power terminals of the Power Module.

The supplied Brake Relay includes the cable harness for connection with the Power Module.



Connection example of a Brake Relay

## Technical specifications

Brake Relay	
<b>Max. switching capability of the NO contact</b>	440 V AC / 3.5 A 30 V DC / 12 A
<b>Max. conductor cross-section</b>	2.5 mm <sup>2</sup>
<b>Degree of protection</b>	IP20
<b>Dimensions</b>	
• Width	68 mm
• Height	63 mm
• Depth	33 mm
<b>Weight, approx.</b>	0.17 kg

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## Supplementary system components Safe Brake Relay

### Overview



The Safe Brake Relay allows the Power Module to be safely connected to an electromechanical motor brake, allowing the brake to be directly and safely controlled by the Control Unit in accordance with EN 954-1 Safety Category 3 and IEC 61508 SIL 2.

### Selection and ordering data

Order No.

**Safe Brake Relay**

**6SL3252-0BB01-0AA0**

Including cable harness for connection to the Power Module

### Integration

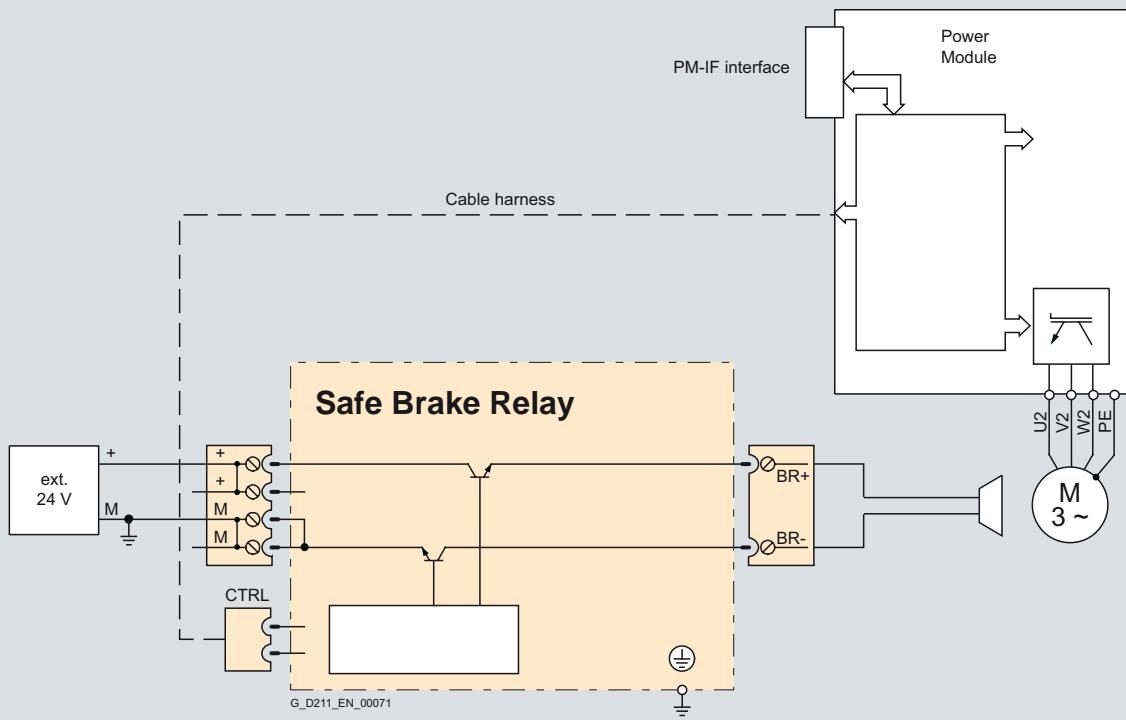
The Safe Brake Relay has the following interfaces:

- A two-channel transistor output stage to control the motor brake solenoid
- A connection for a 24 V DC power supply
- A connection for the cable harness (CTRL) for connection to the Power Module

The Safe Brake Relay can be mounted on the shield bonding plate near the power terminals of the Power Module.

The supplied Safe Brake Relay includes the cable harness for connection with the Power Module.

The 24 V DC solenoid of the motor brake is directly connected to the Safe Brake Relay. External surge suppressors are not required.



Connection example of a Safe Brake Relay

### Technical specifications

<b>Safe Brake Relay</b>	
<b>Supply voltage</b>	20.4 ... 28.8 V DC Recommended rated value of the 24 V DC supply voltage (to equalize and compensate for the voltage drop along the feeder cable to the 24 V DC solenoid of the motor brake)
<b>Max. current requirement of motor brake</b>	2 A
<b>Current requirement at 24 V DC, max.</b>	0.005 A + the current requirement of motor brake

<b>Safe Brake Relay</b>	
<b>Max. conductor cross-section</b>	2.5 mm <sup>2</sup>
<b>Degree of protection</b>	IP20
<b>Dimensions</b>	<ul style="list-style-type: none"> <li>Width: 68 mm</li> <li>Height: 63 mm</li> <li>Depth: 33 mm</li> </ul>
<b>Weight, approx.</b>	0.17 kg

## Supplementary system components

### Adapter for mounting on DIN rails

#### Overview

The adapter for DIN rail mounting can be used to mount inverters, frame sizes FSA and FSB on DIN mounting rails (2 units with a center-to-center distance of 100 mm).

Furthermore, the motor cable shield connection and other cable shields required for mounting inverters on DIN rails comply with the same standards for emissions and conducted emissions as if the inverter were directly installed in a control cabinet.

The adapter for inverter frame size FSA can be used to mount converters singly or with matching line filter.

The adapter for inverter frame size FSB can be used to mount inverters with or without an integrated line filter.

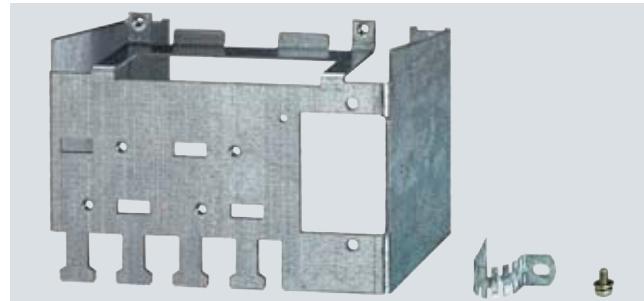
#### Selection and ordering data

Adapter for mounting on DIN rails	Order No.
• for Power Module frame size FSA	<b>6SL3262-1BA00-0BA0</b>
• for Power Module frame size FSB	<b>6SL3262-1BB00-0BA0</b>

## Supplementary system components

### Shield Connection Kit

#### Overview



Example of Shield Connection Kit for Power Module frame size FSB

#### The Shield Connection Kit

- makes it easier to connect the shields of supply and control cables
- provides mechanical strain relief
- ensures optimum EMC performance
- is used to attach the Brake Relay and Safe Brake Relay

#### The Shield Connection Kit includes

- a shield bonding plate for the required Power Module
- a shield bonding plate for a CU240 Control Unit
- connection elements and clamps for mounting
- mounting device for Brake Relay or Safe Brake Relay – frame sizes FSB to FSF

#### Selection and ordering data

Shield Connection Kit	Order No.
• for PM240/PM250 Power Modules	
- Frame size FSA	<b>6SL3262-1AA00-0BA0</b>
- Frame size FSB	<b>6SL3262-1AB00-0DA0</b>
- Frame size FSC	<b>6SL3262-1AC00-0DA0</b>
- Frame sizes FSD and FSE	<b>6SL3262-1AD00-0DA0</b>
- Frame size FSF	<b>6SL3262-1AF00-0DA0</b>
• for PM260 Power Modules	
- Frame size FSD	<b>6SL3262-1FD00-0CA0</b>
- Frame size FSF	<b>6SL3262-1FF00-0CA0</b>

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

**Supplementary system components**  
Shield Connection Kit 1 for CU230P-2

**Supplementary system components**  
Shield Connection Kit for CU240S Control Units

## Overview

The Shield Connection Kit 1 for CU230P-2 Control Units offers for all signal and communication cables

- Optimum shield connection
- Strain relief

It contains the following:

- A matching shield bonding plate
- All of the necessary connecting and retaining elements for mounting

The Shield Connection Kit 1 is suitable for the following SINAMICS G120 Control Units:

- CU230P-2 HVAC
- CU230P-2 DP
- CU230P-2 CAN

## Selection and ordering data

	Order No.
<b>Shield Connection Kit 1</b> for CU230P-2 Control Units	<b>new 6SL3264-1EA00-0FA0</b>

## Overview

The Shield Connection Kit for CU240S Control Units offers for all signal and communication cables

- Optimum shield connection
- Strain relief

It contains the following:

- A matching shield bonding plate
- All of the necessary connecting and retaining elements for mounting

The Shield Connection Kit is suitable for the following SINAMICS G120 Control Units:

- CU240S
- CU240S DP
- CU240S DP-F
- CU240S PN
- CU240S PN-F

## Selection and ordering data

	Order No.
<b>Shield Connection Kit</b> For CU240S Control Units	<b>new 6SL3264-1EA00-0EA0</b>

**Spare parts****CU240 Spare Parts Kit****Spare parts****Spare door for PM240 frame size FSGX****Overview**

The CU240 Spare Parts Kit includes:

- A replacement cover to cover the terminals
- A matching shield bar for the CU240E Control Unit, incl. screws
- A replacement connector for the CU240S Control Unit
- A protective element for the MMC card slot
- Screws to attach the shield bonding plate of the CU240S Control Unit

The CU240 Spare Parts Kit is suitable for the following SINAMICS G120 Control Units:

- CU240E
- CU240S
- CU240S DP
- CU240S DP-F
- CU240S PN
- CU240S PN-F

**Selection and ordering data**

Order No.

**CU240 Spare Parts Kit****new 6SL3200-0SK00-0AA0**

For CU240E and CU240S Control Units

**Overview**

Complete replacement door for the PM240 Power Module frame size FSGX

**Selection and ordering data**

Order No.

**Replacement door****new 6SL3200-0SM10-0AA0**for PM240 Power Module  
frame size FSGX

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## Spare parts

### Terminal Cover Kit for frame sizes FSD and FSE

#### Overview

The Terminal Cover Kit includes a replacement cover for the connecting terminals.

The Terminal Cover Kit is suitable for the following SINAMICS G120 Power Modules:

- PM240 frame sizes FSD and FSE
- PM250 frame sizes FSD and FSE

#### Selection and ordering data

	Order No.
<b>Terminal Cover Kit</b> for frame sizes FSD and FSE	<b>new 6SL3200-0SM11-0AA0</b>

## Spare parts

### Terminal Cover Kit for frame size FSF

#### Overview

The Terminal Cover Kit includes a replacement cover for the connecting terminals.

The Terminal Cover Kit is suitable for the following SINAMICS G120 Power Modules:

- PM240 frame size FSF
- PM250 frame size FSF
- PM260 frame size FSF

#### Selection and ordering data

	Order No.
<b>Terminal Cover Kit</b> for frame size FSF	<b>new 6SL3200-0SM12-0AA0</b>

**Overview**

Replacement connector for the input and output sides.

The replacement connector is suitable for the following SINAMICS G120 PM260 Power Modules frame size FSD.

**Selection and ordering data**

	Order No.
<b>Replacement connector</b> for PM260 Power Modules frame size FSD	<b>new 6SL3200-0ST04-0AA1</b>

# SINAMICS G120

Standard inverters 0.37 kW to 250 kW (0.5 hp to 400 hp)

## Spare parts Replacement fan

### Overview

The Power Module fans are designed for extra long service life. Replacement fans can be ordered for special applications.

### Selection and ordering data

Rated power kW	hp	Type 6SL3224-...	SINAMICS G120 PM240 Power Module	<b>Replacement fan</b>
Frame size and number of fans	Order No.			
<b>380 ... 480 V 3 AC</b>				
0.37	0.50	0BE13-7UA0	FSA, 1 fan	<b>6SL3200-0SF01-0AA0</b> (includes 1 replacement fan)
0.55	0.75	0BE15-5UA0		
0.75	1.0	0BE17-5UA0		
1.1	1.5	0BE21-1UA0		
1.5	2	0BE21-5UA0		
2.2	3	0BE22-2 . A0	FSB, 2 fans <sup>1)</sup>	<b>6SL3200-0SF03-0AA0</b> (includes 1 replacement fan)
3.0	4	0BE23-0 . A0		
4.0	5	0BE24-0 . A0		
7.5	10	0BE25-5 . A0	FSC, 2 fans <sup>1)</sup>	<b>6SL3200-0SF04-0AA0</b> (includes 2 replacement fans)
11.0	15	0BE27-5 . A0		
15.0	20	0BE31-1 . A0		
18.5	25	0BE31-5 . A0	FSD, 2 fans	<b>6SL3200-0SF05-0AA0</b> (includes 2 replacement fans)
22	30	0BE31-8 . A0		
30	40	0BE32-2 . A0		<b>6SL3200-0SF06-0AA0</b> (includes 2 replacement fans)
37	50	0BE33-0 . A0	FSE, 2 fans	<b>6SL3200-0SF07-0AA0</b> (includes 2 replacement fans)
45	60	0BE33-7 . A0		<b>6SL3200-0SF08-0AA0</b> (includes 2 replacement fans)
55	75	0BE34-5 . A0	FSF, 2 fans	<b>6SL3200-0SF09-0AA0</b> (includes 2 replacement fans)
75	100	0BE35-5 . A0		
90	125	0BE37-5 . A0		<b>6SL3200-0SF10-0AA0</b> (includes 2 replacement fans)
110	150	0BE38-8UA0		<b>6SL3200-0SF11-0AA0</b> (includes 2 replacement fans)
132	200	0BE41-1UA0		
160	250	0XE41-3UA0	FSGX, 2 fans	<b>6SL3362-0AG00-0AA1</b> (includes 2 replacement fans)
200	300	0XE41-6UA0		
250	400	0XE42-0UA0		

Rated power kW	hp	Type 6SL3225-...	SINAMICS G120 PM250 Power Module	<b>Replacement fan</b>
Frame size and number of fans	Order No.			
<b>380 ... 480 V 3 AC</b>				
7.5	10	0BE25-5AA0	FSC, 2 fans <sup>1)</sup>	<b>6SL3200-0SF03-0AA0</b> (includes 1 replacement fan)
11.0	15	0BE27-5AA0		
15.0	20	0BE31-1AA0		
18.5	25	0BE31-5 . A0	FSD, 2 fans	<b>6SL3200-0SF04-0AA0</b> (includes 2 replacement fans)
22	30	0BE31-8 . A0		
30	40	0BE32-2 . A0		<b>6SL3200-0SF05-0AA0</b> (includes 2 replacement fans)
37	50	0BE33-0 . A0	FSE, 2 fans	<b>6SL3200-0SF06-0AA0</b> (includes 2 replacement fans)
45	60	0BE33-7 . A0		<b>6SL3200-0SF07-0AA0</b> (includes 2 replacement fans)
55	75	0BE34-5 . A0	FSF, 2 fans	<b>6SL3200-0SF08-0AA0</b> (includes 2 replacement fans)
75	100	0BE35-5 . A0		
90	125	0BE37-5 . A0		<b>6SL3200-0SF09-0AA0</b> (includes 2 replacement fans)
<b>660 ... 690 V 3 AC</b>				
11.0	15	0BH27-5 . A1	FSD, 2 fans	<b>6SL3200-0SF11-0AA0</b> (includes 2 replacement fans)
15.0	20	0BH31-1 . A1		
18.5	25	0BH31-5 . A1		
30	40	0BH32-2 . A1	FSF, 2 fans	<b>6SL3200-0SF07-0AA0</b> (includes 2 replacement fans)
37	50	0BH33-0 . A1		
55	75	0BH33-7 . A1		

<sup>1)</sup> Recommended: Even if only one fan on the Power Module is defective, it is advisable to replace both. In this case, the order quantity must be doubled.

## **ANEXO 5**

## **SWITCH**

# SIEMENS

## SIMATIC NET

**S7-1200  
Compact Switch Module  
CSM 1277**

**Operating Instructions**

Introduction

**1**

Network topologies

**2**

Product characteristics

**3**

Mounting

**4**

Approvals and markings

**5**

References

**6**

Graphics

**7**

## Legal information

### Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

#### **! DANGER**

indicates that death or severe personal injury **will** result if proper precautions are not taken.

#### **! WARNING**

indicates that death or severe personal injury **may** result if proper precautions are not taken.

#### **! CAUTION**

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

#### **CAUTION**

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

#### **NOTICE**

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

### Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

### Proper use of Siemens products

Note the following:

#### **! WARNING**

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be adhered to. The information in the relevant documentation must be observed.

### Trademarks

All names identified by ® are registered trademarks of the Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

### Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

# Table of contents

<b>1</b>	<b>Introduction.....</b>	<b>5</b>
1.1	Preface.....	5
1.2	Introduction .....	7
<b>2</b>	<b>Network topologies .....</b>	<b>9</b>
2.1	Network topologies .....	9
<b>3</b>	<b>Product characteristics .....</b>	<b>11</b>
3.1	Components of the product.....	11
3.2	Unpacking and checking.....	11
3.3	CSM 1277 product characteristics.....	12
3.4	TP ports.....	13
3.5	Displays.....	15
3.6	Technical specifications .....	16
<b>4</b>	<b>Mounting.....</b>	<b>19</b>
4.1	Installation .....	19
4.2	Fixing onto standard mounting rails.....	20
4.3	Power supply.....	22
4.4	Grounding .....	23
4.5	Twisted pair cable .....	23
4.6	Fitting the IE FC RJ-45 Plug 180 .....	24
4.7	Possible sources of problems and how to deal with them.....	25
<b>5</b>	<b>Approvals and markings .....</b>	<b>27</b>
5.1	Notes on the CE Mark.....	27
<b>6</b>	<b>References .....</b>	<b>29</b>
6.1	References.....	29
6.2	Internet .....	29
<b>7</b>	<b>Graphics .....</b>	<b>31</b>
7.1	Dimension drawings.....	31
	<b>Glossary .....</b>	<b>33</b>
	<b>Index.....</b>	<b>35</b>

*Table of contents*

---

# Introduction

## 1.1 Preface

### Overview

This section provides you with an overview of the functions of the unmanaged compact switch module CSM 1277.

### Purpose of the Commissioning Manual

This commissioning manual supports you when commissioning networks with the compact switch module CSM 1277.

### Validity of this Commissioning Manual

This commissioning manual is valid for the following device:

CSM 1277  
6GK7277-1AA10-0AA0

### Further documentation

The "SIMATIC NET Industrial Ethernet Twisted Pair and Fiber Optic Networks" manual contains additional information on other SIMATIC NET products that you can operate along with the CSM 1277 switch in an Industrial Ethernet network.

### Finding information

To help you to find the information you require more quickly, the manual includes not only the table of contents but also the following sections in the Appendix:

- Index
- Glossary

### Audience

This commissioning manual is intended for personnel involved in the commissioning of networks with the CSM 1277 compact switch module.

## **Standards and approvals**

The CSM 1277 compact switch module meets the requirements for the CE, UL, C-Tick, FM and ATEX marks. You will find detailed information in the section "Approvals and Markings" in this commissioning manual in the "Approvals" table.

---

### **Note**

The specified approvals apply only when the corresponding mark is printed on the product.

---

## 1.2      **Introduction**

### **What is possible?**

The CSM 1277 device allows the cost-effective installation of Industrial Ethernet bus or star structures with switching functionality.

---

#### **Note**

It is not possible to use the CSM 1277 switch in a redundant ring because it does not support redundancy.

---

#### **Note**

If the CSM 1277 switch is supplied over long 24 V power supply lines or networks, measures are necessary to prevent interference by strong electromagnetic pulses on the supply lines. These can result, for example, due to lightning or switching of large inductive loads.

One of the tests used to attest the immunity of the switch to electromagnetic interference was the "surge immunity test" according to EN61000-4-5. This test requires overvoltage protection for the power supply lines. A suitable device is, for example, the Dehn Blitzductor VT AD 24 V type no. 918 402 or comparable protective element.

Manufacturer:

DEHN+SÖHNE GmbH+Co.KG Hans Dehn Str.1 Postfach 1640 D-92306 Neumarkt,  
Germany

---



#### **WARNING**

When used under hazardous conditions (zone 2), the CSM 1277 switch must be installed in an enclosure.

To comply with ATEX 95 (EN 60079-15), this enclosure must be at least IP54 in compliance with EN 60529.

**WARNING – EXPLOSION HAZARD: DO NOT DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.**



# Network topologies

## 2.1 Network topologies

Switching technology allows extensive networks to be set up with numerous nodes and simplifies network expansion.

### Which topologies can be implemented?

Linear (bus) and star topologies can be implemented with the compact switch module CSM 1277.

---

#### Note

Make sure that the maximum permitted cable lengths for the relevant devices are not exceeded. You will find the permitted cable lengths in the technical specifications.

---

### Bus topology

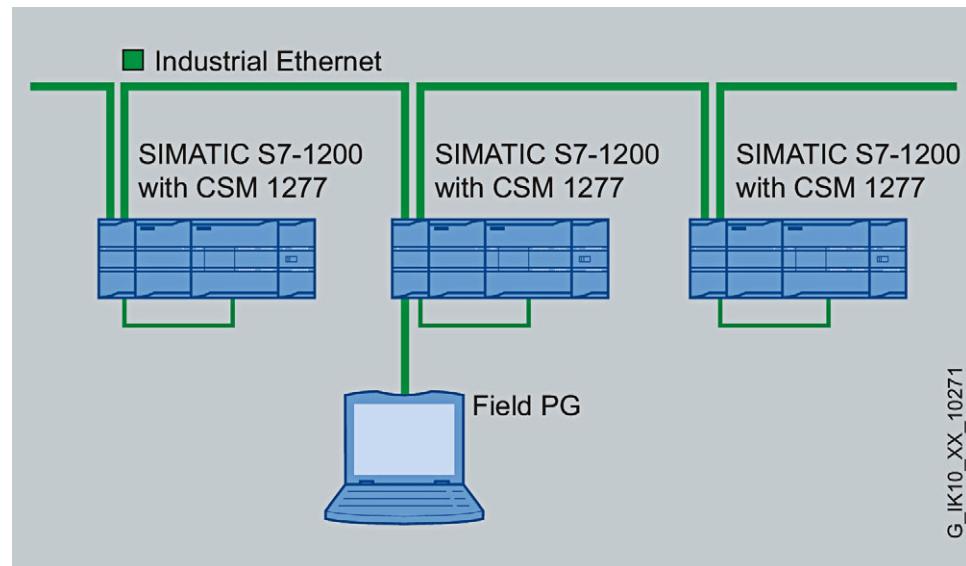


Figure 2-1 Bus topology with the CSM 1277

### Star topology

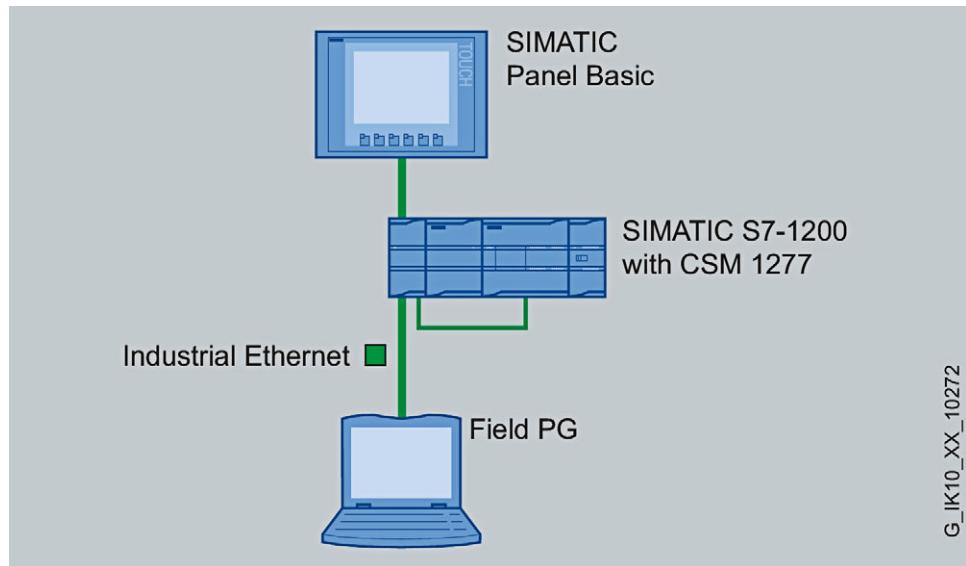


Figure 2-2 Star topology. Example with the CSM 1277

## Product characteristics

### 3.1 Components of the product

The CSM 1277 compact switch module ships with the following:

- 3-pin terminal block (power supply)
- Operating Instructions (on the CD)
- CD

### 3.2 Unpacking and checking

#### Unpacking, checking

1. Make sure that the package is complete.
2. Check all the parts for transport damage.



#### WARNING

Do not use any parts that show evidence of damage!

## *Product characteristics*

### *3.3 CSM 1277 product characteristics*

## **3.3 CSM 1277 product characteristics**

### **Possible attachments**

The CSM 1277 has four RJ-45 jacks for the connection of end devices or other network segments.



Figure 3-1 Compact Switch Module CSM 1277

## 3.4 TP ports

### Connector pinout

On the CSM 1277, the TP ports are implemented as RJ-45 sockets with MDI-X assignment (Medium Dependent Interface—Autocrossover) of a network component.



Figure 3-2 RJ-45 jacks

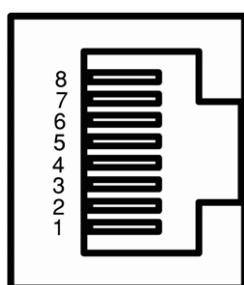


Figure 3-3 RJ-45 jack

Table 3- 1 Pin assignment of the RJ-45 jack

Pin number	Assignment
Pin 8	n. c.
Pin 7	n. c.
Pin 6	TD-
Pin 5	n. c.
Pin 4	n. c.
Pin 3	TD+
Pin 2	RD-
Pin 1	RD+

**NOTICE**

TP cords or TP-XP cords with a maximum length of 10 m can be connected to the RJ-45 TP port.

With the IE FC cables and IE FC RJ-45 plug 180, an overall cable length of up to 100 m is permitted between two devices depending on the cable type.

## **Autonegotiation**

Autonegotiation means the automatic detection of the functionality of the port at the opposite end. Using autonegotiation, network components or end devices can detect the functionality available at the port of a partner device allowing automatic configuration of different types of device. With autonegotiation, two components connected to an Ethernet segment can exchange parameters and set themselves to match the supported communication functionality.

---

**Note**

Devices not supporting autonegotiation must be set to 100 Mbps/ half duplex or 10 Mbps half duplex.

---

---

**Note**

The CSM 1277 is a plug-and-play device that does not require settings to be made for commissioning.

---

## **Auto polarity exchange**

If the pair of receiving cables are incorrectly connected (RD+ and RD- swapped over), the polarity is adapted automatically.

## **MDI /MDIX autocrossover function**

The advantage of the MDI /MDIX autocrossover function is that straight-through cables can be used throughout and crossover Ethernet cables are unnecessary. This prevents malfunctions resulting from mismatching send and receive wires. This makes installation much easier for the user.

## **Insulation between the ports**

There are two port groups:

Group1: P1 and P2  
Group2: P3 and P4

Between ports of different port groups, an insulation voltage of 1.5 kV is adhered to (corresponds to IEEE802.3 Section 33.4.1.1, Environment B). For example between P1 and P4.

Between ports of the same group, the requirements for Environment A are met. For example between P1 and P2.

#### NOTICE

Please note that the direct connection of two ports on the switch or accidental connection over several switches causes an illegal loop. Such a loop can lead to network overload and network failures.

## 3.5 Displays

### Displays of the CSM 1277

#### Power indicator 'DIAG' (green LED)

The status of the power supply is indicated by a green LED:

Status	Meaning
LED lit green	Power supply is connected
LED not lit	Power supply is not connected or the applied voltage is too low. Refer to the Note in Section 4.7

#### Port status indicators 'P1' to 'P4' (green LEDs)

The status of the ports is indicated by four green LEDs. These are below the top panel. See also Figure 4-4

Status	Meaning
Port 1 through 4 LED lit	Existing connection via port to Industrial Ethernet (LINK status)
Port 1 through 4 LED flashing	Port is sending / receiving via Industrial Ethernet
Ports 1 through 4 LEDs flashing / in sequence	Test phase during power on

## *Product characteristics*

### *3.6 Technical specifications*

## **3.6      Technical specifications**

### **Technical specifications of the CSM 1277**

<b>Connectors</b>	
Attachment of end devices or network components over twisted pair	4 x RJ-45 sockets with MDI-X pinning 10/100 Mbps (half/ full duplex), floating
Connector for power supply	3-pin plug-in terminal block
<b>Electrical data</b>	
Power supply	Power supply 24 V DC (limit: 19.2 to 28.8 V DC) safety extra-low voltage (SELV) Functional ground
Power loss at 24 V DC	1.6 W
Current consumption at rated voltage	70 mA
Oversupply protection at input	PTC resettable fuse (0.5 A / 60 V)
<b>Permitted cable lengths</b>	
Connection over Industrial Ethernet FC TP cables 0 – 100 m	Industrial Ethernet FC TP standard cable with IE FC RJ-45 plug 180 or over Industrial Ethernet FC outlet RJ-45 with 0 - 90 m Industrial Ethernet FC TP standard cable + 10 m TP cord
0 – 85 m	Industrial Ethernet FC TP marine/trailing cable with IE FC RJ-45 plug 180 or 0 - 75 m Industrial Ethernet FC TP marine/trailing cable + 10 m TP cord
<b>Learnable MAC addresses / Aging Time</b>	
Learnable MAC addresses	2048
Aging time	280 seconds

<b>Permitted ambient conditions</b>	
Operating temperature	0°C through +60°C
Storage/transport temperature	-40°C through +70°C
Relative humidity in operation	< 95% (no condensation)
Operating altitude	2000 m at max 56 °C ambient temperature 3000 m at max. 50 °C ambient temperature
Immunity	EN 61000-6-2
Emission	EN 61000-6-4
Degree of protection	IP20
<b>MTBF</b>	
MTBF	273 years

<b>Permitted ambient conditions</b>	
<b>Construction</b>	
Dimensions (W x H x D) in mm	45 x 100 x 76
Weight in g	150
Installation options	35 mm DIN rail (DIN EN 60715 TH35)

<b>Order numbers</b>	
CSM 1277	6GK7277-1AA10-0AA0
"Industrial Ethernet TP and Fiber Optic Networks" manual	6GK1970-1BA10-0AA0
TP Cord RJ-45/RJ-45, 0.5 m	6XV1870-3QE50
TP Cord RJ-45/RJ-45, 1 m	6XV1870-3QH10
TP Cord RJ-45/RJ-45, 2 m	6XV1870-3QH20
TP Cord RJ-45/RJ-45, 6 m	6XV1870-3QH60
TP Cord RJ-45/RJ-45, 10 m	6XV1870-3QN10
IE FC Stripping Tool	6GK1901-1GA00
IE FC blade cassettes	6GK1901-1GB00
IE FC TP standard cable	6XV1840 2AH10
IE FC TP trailing cable	6XV1840-3AH10
IE FC TP marine cable	6XV1840-4AH10
IE FC RJ-45 Plug 180 pack of 1	6GK1 901-1BB10-2AA0
IE FC RJ-45 Plug 180 pack of 10	6GK1 901-1BB10-2AB0
IE FC RJ-45 Plug 180 pack of 50	6GK1 901-1BB10-2AE0

### Note

The number of connected switches influences the frame delay.

When a frame passes through the CSM 1277, it is delayed by the store and forward function of the switch

- with a 64 byte frame length by approx. 8 µs (at 100 Mbps)
- with a 1500 byte frame length by approx. 125 µs (at 100 Mbps)

This means that the more CSM 1277 switches that a frame passes through, the higher the frame delay will be.

*Product characteristics*

---

*3.6 Technical specifications*

# Mounting

## 4.1 Installation

### Type of mounting

The CSM 1277 compact switch module is intended for mounting on a 35 mm DIN rail. Wall mounting is possible (see S7-1200 System Manual).

---

#### Note

When installing and operating the device, keep to the installation instructions and safety-related notices as described here and in the manual SIMATIC NET Industrial Ethernet Twisted Pair and Fiber Optic Networks /1/.

---

---

#### Note

Provide suitable shade to protect the device against direct sunlight. This avoids unwanted warming of the device and prevents premature aging of the device and cabling.

---



#### WARNING

If temperatures in excess of 70 °C occur on the cable or at the cable feed-in point, or the temperature at the branching point of the cables exceeds 80 °C, special measures need to be taken. If the equipment is operated at an ambient temperature of 50°C - 60°C, use cables with a permitted ambient temperature of at least 80°C.



#### WARNING

Protective measures must be taken to avoid the rated voltage of the equipment being exceeded by more than 40% by transient overvoltages. This is the case if the equipment is supplied exclusively by SELV circuits.



#### WARNING

If the CSM 1277 is operated in an ambient temperature of more than 55 °C, the temperature of the device housing may be higher than 70 °C.

The subject unit must be located in a Restricted Access Location where access can only be gained by SERVICE PERSONNEL or by USERS who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken when operated in an air ambient in excess of 55 °C.

## *Mounting*

### *4.2 Fixing onto standard mounting rails*

## **4.2 Fixing onto standard mounting rails**

### **Installation on a 35 mm DIN rail**

---

#### **Note**

The CSM 1277 does not have a feedthrough for the backplane bus. It must therefore be mounted either at the start or end of the S7-1200 station!

---

1. Place the upper guide at the top of the CSM housing in the 35 mm DIN rail (DIN EN 60715 TH35 ).
2. Push in the lower part of the CSM 1277 onto the rail until it locks in place.

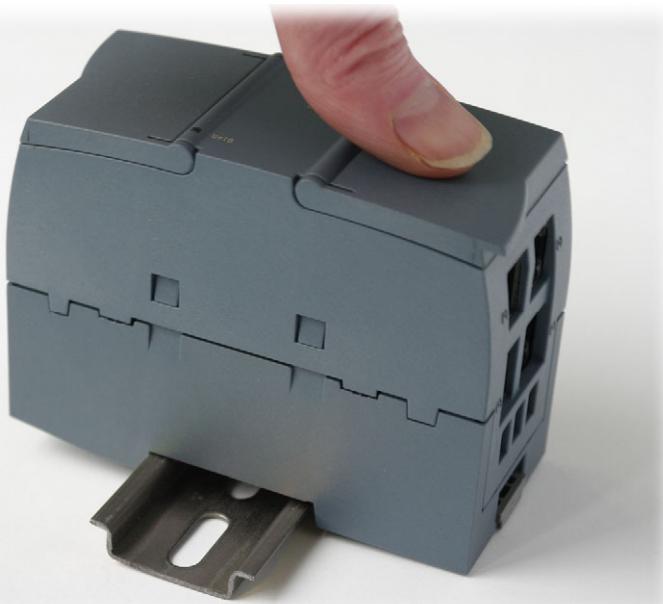


Figure 4-1 Mounting the CSM 1277 on a DIN rail

3. Fit the connectors for the power supply. See Figure 4-5
4. Insert the terminal block into the sockets on the device. See Figure 4-4

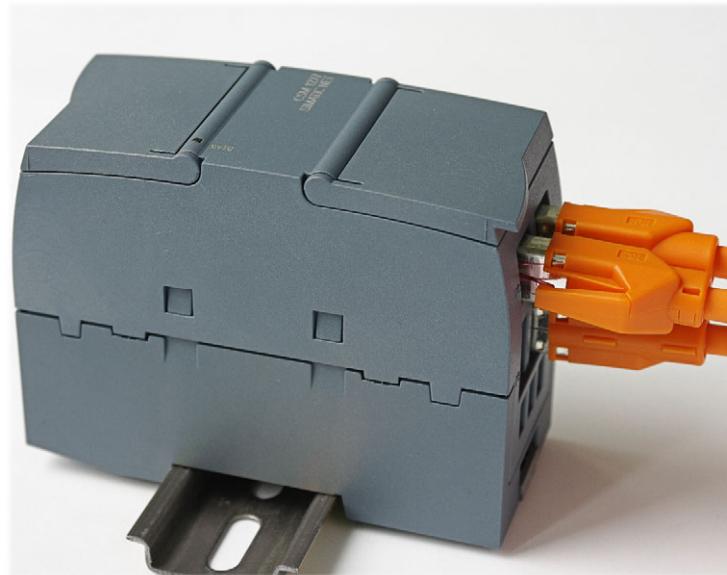


Figure 4-2 CSM 1277 mounted on a DIN rail

## Uninstalling

To remove a CSM 1277 compact switch module from the DIN rail:

1. First disconnect all connected cables.
2. Using a screwdriver, lever out the catch on the bottom of the device approximately 5 mm while pulling the device away from the rail at the same time.

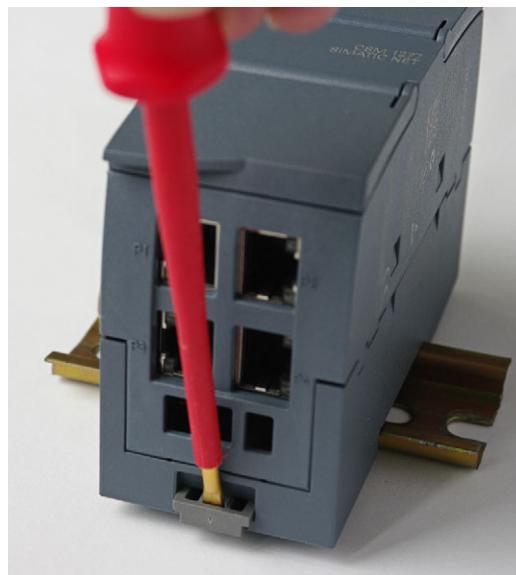


Figure 4-3 Removing the CSM 1277 from the rail

## *Mounting*

### *4.3 Power supply*

## **4.3 Power supply**

### **Power supply**

The power supply is connected using a 3-pin plug-in terminal block. The functional ground can be connected to the grounded DIN rail. It does not need to be connected for problem-free operation. The power supply is non-floating.



Figure 4-4 Connecting the power supply



Figure 4-5 Pin assignment of the terminal block

Table 4- 1 Pin assignment for the power supply

Pin number	Assignment
Pin 1	L+ (24 V DC)
Pin 2	M (chassis ground)
Pin 3	Functional ground

**NOTICE**

The previous device CSM 1277 with order number 6GK7277-1AA00-0AA0 had a different pin assignment of the terminal block. Pin 1: Functional grounding, Pin 2: Protective earth, Pin 3: L+.

The supply input of the CSM is protected against polarity reversal. A reverse polarity of the supply voltage does not cause any damage but will not result in any function either.

**⚠ WARNING**

The device is designed for operation with safety extra-low voltage. This means that only safety extra-low voltages (SELV) complying with IEC 60950-1/EN60950/VDE0805 can be connected to the power supply terminals.

The power supply unit for the device power supply must meet NEC Class 2, as described by the National Electrical Code(r) (ANSI/NFPA 70).

The power of all connected power supply units must total the equivalent of a power source with limited power (LPS limited power source).

Never connect the device to AC voltage.

Never operate the device with DC voltage higher than 28.8 V DC.

## 4.4 Grounding

### 35 mm DIN rail

A functional grounding can be established by connecting a cable from terminal 3 to the DIN rail, , for example. Such a cable should be kept as short as possible. Grounding is, however, not necessary for interference-free operation.

## 4.5 Twisted pair cable

### Recommendation

- Cable quality at least CAT 5
- Standard cables and IE FC RJ-45 Plug 180 connectors that can be assembled in the field for connection of the S7-1200 station to the LAN, for example over greater distances.
- Preassembled cables such as TP Cord RJ-45 0.5 m for connecting the CSM 1277 to the CPU etc.

## *Mounting*

### *4.6 Fitting the IE FC RJ-45 Plug 180*

## **4.6 Fitting the IE FC RJ-45 Plug 180**

### **IE FC RJ-45 Plug 180**

The rugged node connectors with PROFINET-compliant plug-in connectors are designed for industry and provide sure contact.

### **Assembly of the IE FC RJ-45 Plug 180 on an IE FC standard cable**

For information on assembling an IE FC RJ-45 Plug 180 on a SIMATIC NET Industrial Ethernet FastConnect cable, please refer to the instructions supplied with the IE FC RJ-45 Plug.

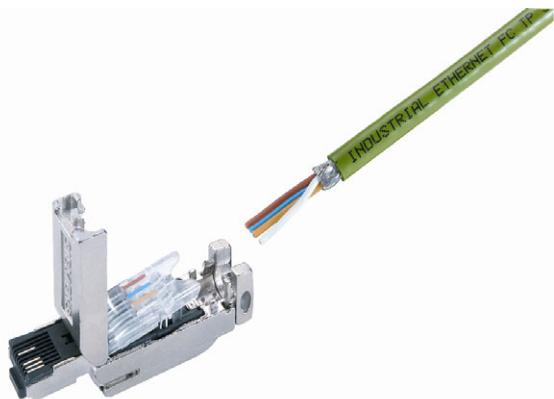


Figure 4-6 IE FC RJ-45 Plug 180

### **Inserting the IE FC RJ-45 Plug 180**

Insert the IE FC RJ-45 Plug 180 into the twisted pair port of the CSM 1277 until it locks in place.

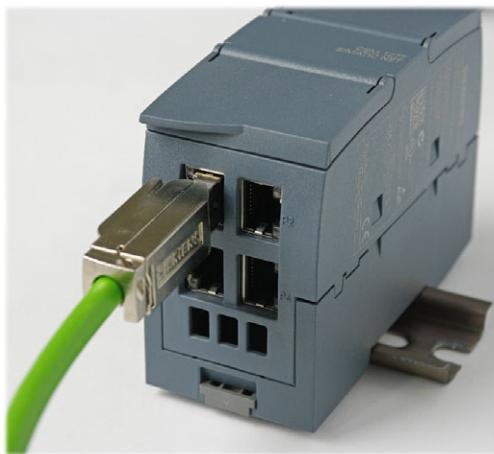


Figure 4-7 Inserting the IE FC RJ-45 Plug 180

### Removing the IE FC RJ-45 Plug 180

Press the release button of the IE FC RJ-45 Plug 180 and pull it out of the twisted pair port of the CSM 1277.

## 4.7 Possible sources of problems and how to deal with them

### Fuses

---

#### Note

The CSM 1277 compact switch module has a resettable fuse / PTC. If the fuse triggers (all LEDs are off despite correctly applied power supply), the device should be disconnected from the power supply for approximately 30 minutes before turning it on again.

---

### LED display when voltage is too low

If the power supply is too low, then the internal power supply will switch off causing the DIAG-LED and all port LEDs to go off. The functionality of the CSM 1277 is no longer available. A supply voltage of at least 19.2 V is necessary for correct operation.

### LED display in case of reverse polarity of the power supply

The CSM 1277 is equipped with reverse polarity protection. A reverse polarity of the supply voltage does not cause any damage but will not result in any function either. The DIAG-LED and all port LEDs are off.

### Device defective

If a fault develops, please send the device to your SIEMENS service center for repair. Repairs on-site are not possible.

## *Mounting*

---

### *4.7 Possible sources of problems and how to deal with them*

# 5

## Approvals and markings

### 5.1 Notes on the CE Mark

#### Product name

Compact switch module		
SIMATIC NET	CSM 1277	6GK7277-1AA10-0AA0

#### EMC directive

89/336/EEC "Electromagnetic Compatibility"

#### Area of application

The product is designed for use in an industrial environment:

Area of application	Requirements	
	RF interference level	Immunity
Industrial area	EN 61000-6-4: 2007	EN 61000-6-2: 2005

#### Installation guidelines

The product meets the requirements if you keep to the installation instructions and safety-related notices as described here and in the manual "SIMATIC NET Industrial Ethernet Twisted Pair and Fiber Optic Networks" /1/ when installing and operating the device.

#### Conformity certificates

The EC Declaration of Conformity is available for the responsible authorities according to the above-mentioned EC Directive at the following address:

Siemens Aktiengesellschaft  
Industry Sector Industry Automation Division  
Industrielle Kommunikation (I IA SC IC)  
Postfach 4848  
D-90026 Nürnberg

#### Notes for the manufacturers of machines

This product is not a machine in the sense of the EC Machinery Directive. There is therefore no declaration of conformity relating to the EC Machinery Directive 98/37/EEC for this product.

## *Approvals and markings*

### *5.1 Notes on the CE Mark*

If the product is part of the equipment of a machine, it must be included in the procedure for obtaining the declaration of conformity by the manufacturer of the machine.

## **Certifications and approvals**

c-UL-us	UL 508 CSA C22.2 No. 142
FM <sup>1</sup>	FM 3611 CL.1, Div.2 GP. A.B.C.D T.. CL.1, Zone 2, GP. IIC, T.. Ta:..
C-TICK	AS/NZS 2064 (Class A)
CE	EN 61000-6-4, EN 61000-6-2
ATEX Zone 2 <sup>1</sup>	EN60079-15:2005 EN60079-0:2006 II 3 G Ex nA II T.. KEMA 08 ATEX 0003 X

<sup>1</sup>For the temperature code "T.." or the maximum ambient temperature "Ta:..", refer to the type plate.



**WARNING**

Explosion hazard!

Replacing components will impair the suitability for class I, category 2.

# 6

## References

### 6.1 References

#### Sources of information and other documentation

1. SIMATIC NET Industrial Twisted Pair and Fiber-Optic Networks,  
Order numbers:  
6GK1970-1BA10-0AA0 German  
6GK1970-1BA10-0AA1 English  
6GK1970-1BA10-0AA2 French  
6GK1970-1BA10-0AA4 Italian
2. PROFINET Cabling and Interconnection Technology Guideline  
Can be ordered from the PROFIBUS User Organization (PNO)

### 6.2 Internet

#### Further information on the Internet

You will find additional information on SIMATIC NET products in the Internet at  
[http://www.automation.siemens.com/net/index\\_00.htm](http://www.automation.siemens.com/net/index_00.htm)

*References*

---

*6.2 Internet*

# Graphics

## 7.1 Dimension drawings

### Dimension drawing

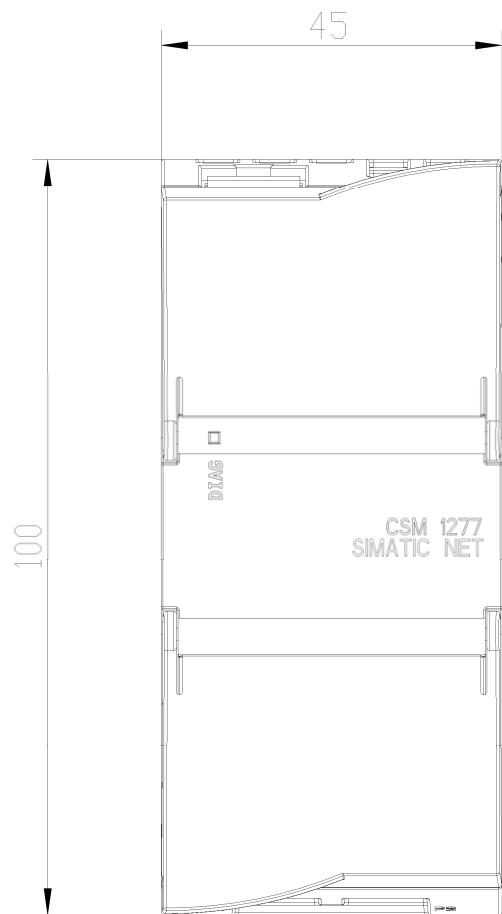


Figure 7-1 Dimension drawing, view from above

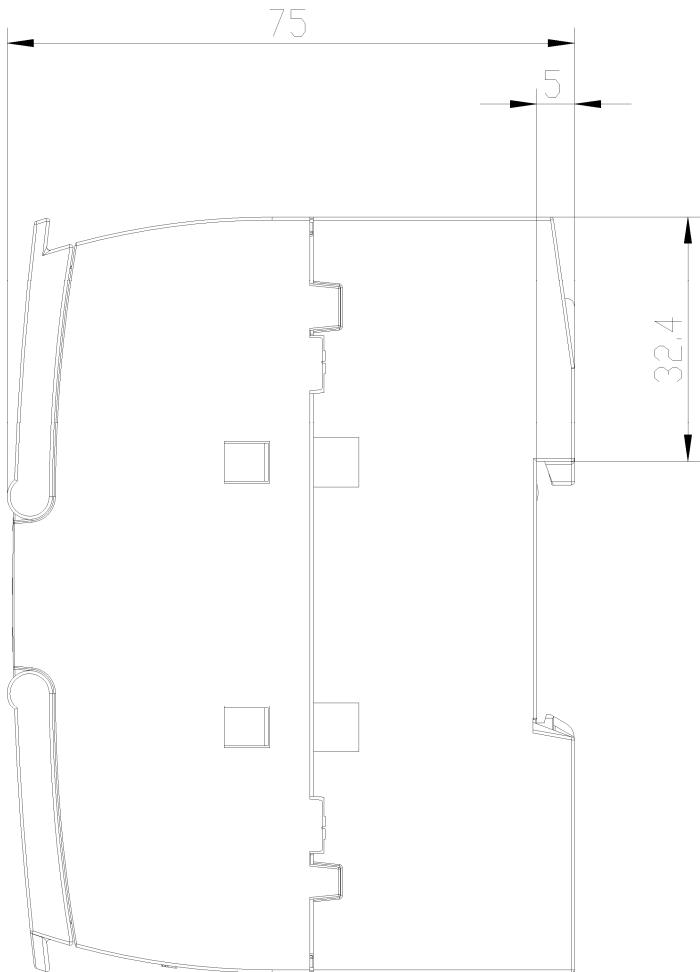


Figure 7-2 Dimension drawing, view from side

# Glossary

## Aging time

The aging time is the time after which a learned MAC address is discarded if a CSM 1277 has not received frames with this sender address during this time.

## Autocrossover

Technique with which a TP port is automatically switched over between MDI and MDI-X assignment to make a connection independent of the port assignment of the device being attached. This means that crossover cables are not required. The autocrossover function can only be used when the port is set to autonegotiation mode.

## Autonegotiation

Procedure standardized by IEEE 802.3 in which the transmission parameters (for example 10/100 Mbps, full/half duplex) are negotiated automatically between the devices.

## CRC

Cyclic Redundancy Check. A checksum used in transmission protocols to detect errors in frames.

## Multicast

A frame with a multicast address is received by all nodes prepared to receive this address.

## Segment

In the Ethernet bus system, transceivers connected together over the bus cable along with the nodes connected over patch cables form a segment. Several such segments can be connected via repeaters. When using twisted pair and fiber-optic cables, each subsection forms a segment.

## Store and forward

An entire frame is received, its validity checked (checksum, length etc.) and then buffered. Invalid frames are discarded, in other words, a frame is forwarded only when it is error-free.

## TP

Twisted Pair

**TP port**

Port with a TP connector (RJ-45 jack)

# Index

Star topology, 9, 10

## A

ATEX, 6, 28  
ATEX 95, 7  
Autonegotiation, 14

## C

CE mark, 28  
Certifications and approvals, 6, 28  
Conformity certificates, 27  
Connecting up  
    High temperatures, 19  
Connector pinout  
    TP port, 13  
C-Tick mark, 6, 28

## D

defective, 25  
Display, 15, 25

## E

Error  
    LED display in case of reverse polarity, 25  
    LED display when voltage is too low, 25

## F

FM approval, 6, 28

## I

Internet, 29

## M

MDI /MDIX autocrossover function, 14

## N

Network topology, 9

## P

Possible attachments, 12

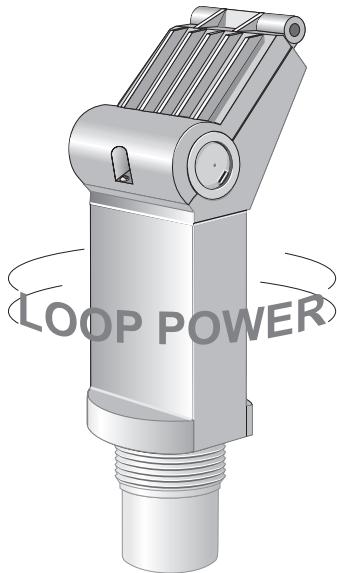
## R

Reduced voltage, 25  
Reverse polarity, 25

## U

UL approval, 6, 28

**ANEXO 6**  
**SENSOR DE NIVEL**



English  
Deutsch  
Español  
Français

# the probe

## LEVEL MONITOR

**MILLTRONICS**

## Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

## Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

**Warning:** This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

**Note:** Always use product in accordance with specifications.

## Copyright Siemens Milltronics Process Instruments Inc. 2003. All Rights Reserved

## Disclaimer of Liability

This document is available in bound version and in electronic version. We encourage users to purchase authorized bound manuals, or to view electronic versions as designed and authored by Siemens Milltronics Process Instruments Inc. Siemens Milltronics Process Instruments Inc. will not be responsible for the contents of partial or whole reproductions of either bound or electronic versions.

While we have verified the contents of this manual for agreement with the instrumentation described, variations remain possible. Thus we cannot guarantee full agreement. The contents of this manual are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

Technical data subject to change.

MILLTRONICS® is a registered trademark of Siemens Milltronics Process Instruments Inc.

**Contact SMPI Technical Publications at the following address:**

Technical Publications  
Siemens Milltronics Process Instruments Inc.  
1954 Technology Drive, P.O. Box 4225  
Peterborough, Ontario, Canada, K9J 7B1  
Email: [techpubs@siemens-milltronics.com](mailto:techpubs@siemens-milltronics.com)

For the library of SMPI instruction manuals, visit our Web site: [www.siemens-milltronics.com](http://www.siemens-milltronics.com)

# Introduction

**Note:** The Probe is to be used only in the manner outlined in this instruction manual.

The Probe is an ultrasonic level monitor combining sensor and electronics in a single package. It is designed to measure liquid levels in open or closed vessels. The process part (sensor) is Kynar Flex® or Tefzel®<sup>1</sup>, allowing The Probe to be used in a wide variety of industries, especially food and chemical.

The sensor houses the ultrasonic transducer and temperature sensing element. The Probe emits a series of ultrasonic pulses from the transducer. Each pulse is reflected as an echo from the material and sensed by the transducer. The echo is processed by The Probe using Milltronics' proven 'Sonic Intelligence' techniques. Filtering is applied to help discriminate between the true echo from the material, and false echoes from acoustical and electrical noises and agitator blades in motion. The time for the pulse to travel to the material and back is temperature compensated and then converted into distance for display, mA output.

## Installation

### Environmental

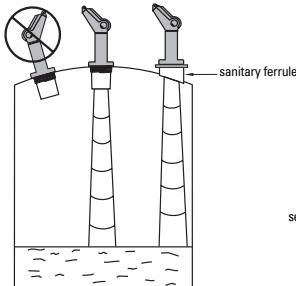
The Probe should be mounted in an area that is within the temperature range specified and that is suitable to the housing rating and materials of construction. The front lid should be accessible to allow programming, wiring and display viewing.

It is advisable to keep The Probe away from high voltage or current runs, contactors and SCR control drives.

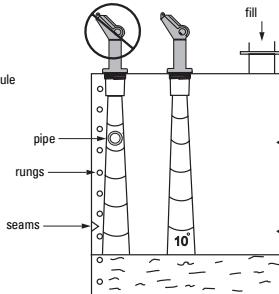


### Location

Locate the Probe so that it will have a clear sound path perpendicular to the liquid surface.



The Probe's sound path should not intersect the fill path, rough walls, seams, rungs, etc.



1. Kynar Flex® is a registered trademark of ELF Atochem.  
Tefzel® is a registered trademark of DuPont.

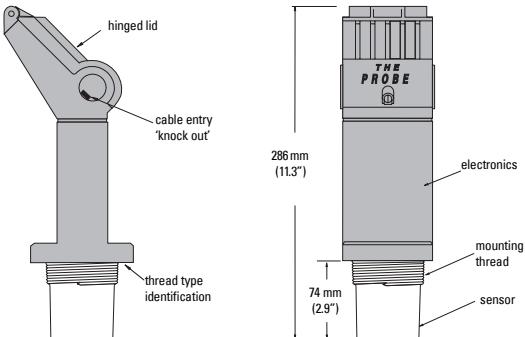
## Mounting

**Note:** Mount the Probe so that the face of the sensor is at least 25 cm above the highest anticipated level.

### Threaded

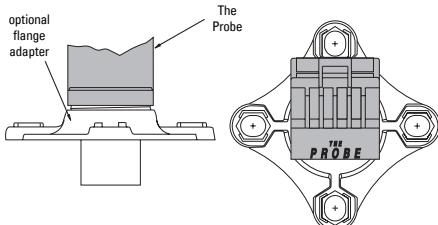
The Probe is available in three thread types: 2" NPT, 2" BSP or PF2.

**Note:** Before inserting The Probe into its mounting hole, ensure that the threads are of the same type to avoid damaging The Probe threads.



### Flange Adapter (optional)

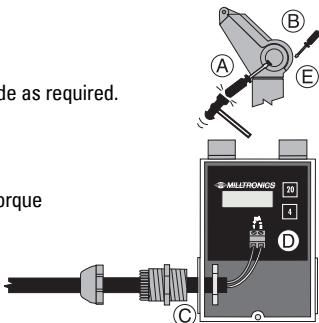
The Probe can be fitted with the optional 75 mm (3") flange adapter for mating to 3" ANSI, DIN 65PN10 and JIS 10K3B flanges.



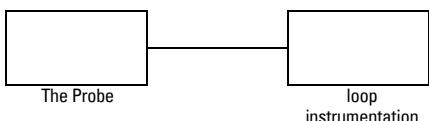
### Interconnection

#### Cable Entry

- A. With lid closed, remove cable entry 'knock out' on either side as required.
- B. Open lid by loosening the lid screw.
- C. Run cable to The Probe.
- D. Connect loop wiring.
- E. Close lid. Tighten screw to 1.1 to 1.7 N·m (10 to 15 in-lb) of torque



### System Diagram



# Intrinsically Safe Model

## FM / SAA (reference drawing 1-8600016Z-DX-A)

Under the entity evaluation concept, The Probe has the following characteristics :

Vmax = 30 V dc

I<sub>max</sub> = 200 mA dc

C<sub>i</sub> = 0

L<sub>i</sub> = 0

### Definition :

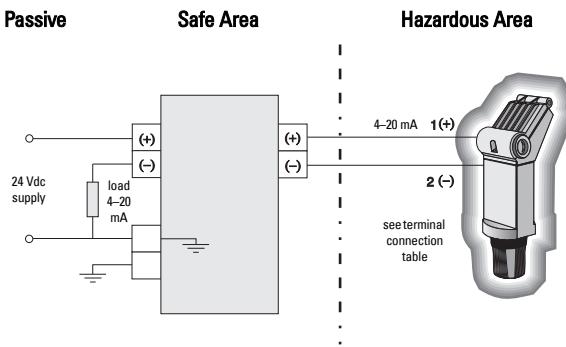
The Entity Concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination. The criteria for interconnection is that the voltage and current which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal or greater than the voltage (V<sub>oc</sub> or V<sub>t</sub>) and current (I<sub>sc</sub> or I<sub>t</sub>) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (C<sub>i</sub>) and Inductance (L<sub>i</sub>) of the intrinsically safe apparatus, including interconnecting wiring, must be equal to or less than the capacitance and inductance which can be safely connected to associated apparatus.

## FM / SAA / CSA (reference drawing 1-8600016Z-DX-A)

Approved dust tight and water tight conduit seals are required for Class II, Div. 1, Gr. E, F, G, and outdoor Type 4X / NEMA 4X / IP65 locations.

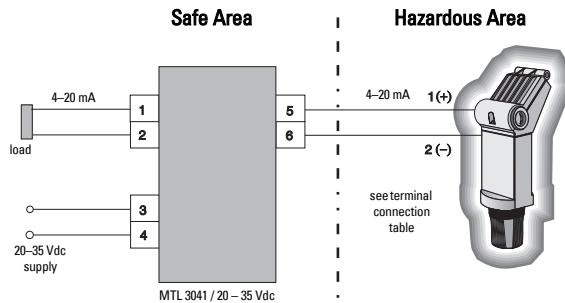
The maximum voltage of the non-intrinsically safe apparatus must not exceed 250 V rms.

Use only intrinsically safe barriers as listed.

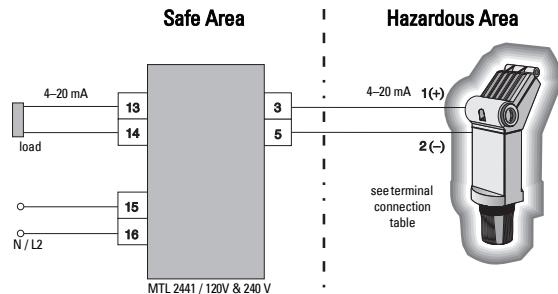


Make	Part no.	Terminal Barrier	Connection The probe
MTL	787s+	3 4	1 2
MTL	706+	4 3	1 2
STAHL	9002 / 13- 280-110-00	3 4	1 2
STAHL	9001 / 51- 280-110-14	3 4	2

## DC Repeater



## AC Repeater

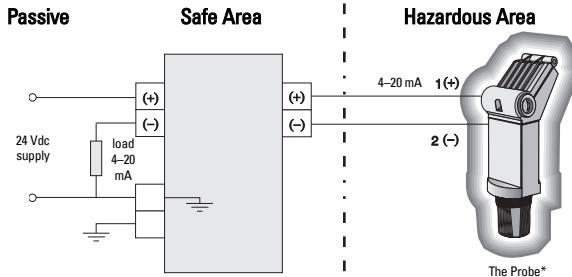


**Note:** Power supply input is reverse polarity protected.

## Baseefa / Cenelec

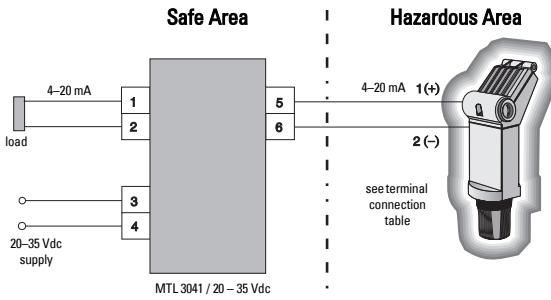
System Approval 95C2033 (reference drawing 1-8600018Z-DX-A)

Approval compliance requires the use of one of the following barriers or equivalent (see EU Equivalency).

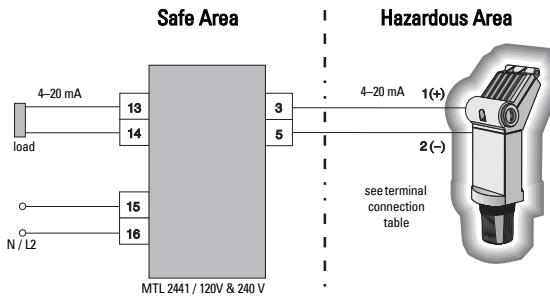


Make	Part No. (certification)	Terminal Barrier	Connection The Probe
MTL	787S+ (EX832452)	3 4	1 2
MTL	706+ (EX87B2428)	4 3	1 2
STAHL	9002 / 13- 280-110-00 (EX-91.C.2045X)	3 4	1 2
STAHL	9001 / 51- 280-110-14 (EX-91.C.2046X)	3 4	1 2

## DC Repeater



## AC Repeater



\* EExia IIC, Tamb = 60 °C, Ex 95C2032

## EU Equivalency

Any single channel shunt zener diode safety barrier, certified by an EU approved certification body to [ EEx ia ] IIC, its output voltage (Vz) not exceeding 28 V and its output current (I out) limited by load resistance (R); such that I out max = Vz / R , does not exceed 110 mA.

### Notes:

- The electrical circuit in the hazardous area must be capable of withstanding an ac test voltage of 500 V rms to earth or frame of the apparatus for one minute.
- The capacitance and inductance of the hazardous area cable must not exceed the specified values.

Group	Capacitance $\mu\text{F}$	Inductance mH
II C	0.07	3
II B	0.39	12

- The installation must comply with national requirements, e.g. in the U.K. BS 5345 : part 4 : 1977.
- System to be marked with a durable label affixed adjacent to 'The Probe' marking to include "BASEEFA system no. EX 95C2033".
- The safe area is unspecified except that it must not be supplied from nor contain under normal or abnormal conditions, a source of potential with respect to earth in excess of 250 V rms or 250 V dc.

## General Guidelines for the Intrinsically Safe Probe covered by EC-Type Examination Certificate BAS99ATEX1300

1. The apparatus may be used with flammable gases and vapours with Apparatus Group IIC and with temperature class T4.
2. The equipment is certified for use in an ambient range of  $-40^{\circ}\text{C}$  to  $60^{\circ}\text{C}$ .
3. The equipment has not been assessed as a safety related device as referred to by EC Directive 94/9/EC Annex II, clause 1.5.
4. Installation and inspection of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice (EN 60079-14 and EN60079-17 within Europe).
5. Repair of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice (e.g. EN 60079-19 within Europe).
6. Components to be incorporated into or used as replacements in the equipment shall be fitted by suitably trained personnel in accordance with the manufacturer's documentation.
7. The certification of this equipment relies upon the following materials used in its construction:  
BF Goodrich PVC GEON, 85856 (enclosure and lid material)  
Dupont Tefzel, 210 (transducer)  
Elf Atochem Kynar Flex, 2820 (alternative transducer)  
Master Bond Polysulphide, EP21LPT encapsulant (transducer)  
Emmerson and Cummings Styccast, 2075 encapsulant (electronics)

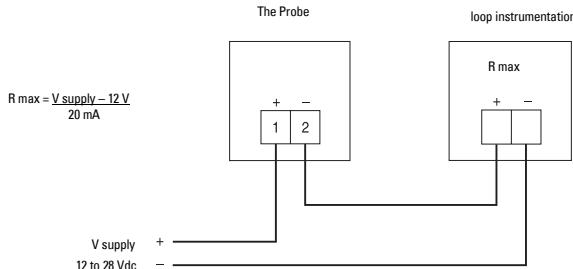
If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

Aggressive substances: e.g. solvents that may affect polymeric materials

Suitable precautions: e.g. regular checks as part of routine inspections or establishing from the materials data sheet that it is resistant to certain chemicals.

PVC GEON 85856 is a registered trademark of BF Goodrich  
Tefzel 210 is a registered trademark of Dupont  
Kynar Flex 2820 is a registered trademark of Elf Atochem  
Polysulphide EP21LPT is a registered trademark of Master Bond  
Stycast 2075 is a registered trademark of Emmerson and Cummings

## Non Intrinsically Safe

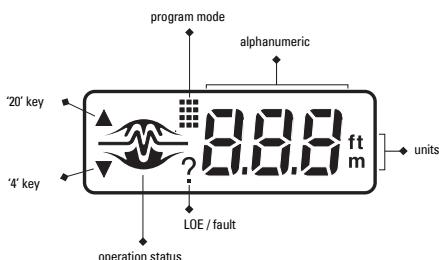


**Note:** Power supply is reverse polarity protected.

# Operation

## Start Up

- With The Probe correctly installed (or aimed at a wall 0.25 to 5 m away), apply power.
- The Probe starts up displaying the following:



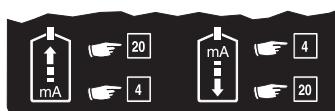
- It then defaults to the Run mode, which is the measurement reading of the distance from the transducer face to the material level in the units indicated:
- If the default display differs from that shown, refer to Operation Status on page 8.



## Calibration

The calibration of the mA output may be done such that its span will be either proportional or inversely proportional to the material level.

**Note:** The 4 and 20 mA levels may be calibrated in any order.



proportional span	inversely proportional span
high level = 20mA	high level = 4 mA
low level = 4 mA	low level = 20mA

### Calibration: Reference Method

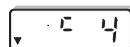
- Adjust the material level (or target) to the desired distance from the sensor face.
- Press the “4” or “20” key (as appropriate) to view the stored distance associated with that mA output value.
- Press the key a second time to set the new distance reference.
- After viewing or calibrating, Probe operation automatically reverts to the Run mode (6 sec). The calibration value is referenced from the face of The Probe sensor, in the units displayed.

### 4 mA calibration

Press “4”



Press “4” again

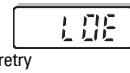


4 mA calibration



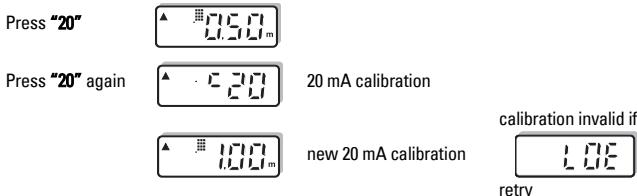
new 4mA calibration

calibration invalid if



retry

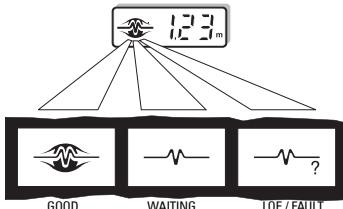
## 20 mA calibration



**Note:** Calibration bypasses the measurement response rate.

## Operation Status

The graphic portion of the display gives the user a visual indication of The Probe's operating status. Viewing the graphic can assist the user in properly locating and installing The Probe to achieve optimum performance.



The logo will change from full to partial to indicate operation status. After the 'Waiting' period, the '?' icon will appear for an 'LOE / FAULT' indication. When a valid echo is again received, a 'Good' indication will resume. Refer to Troubleshooting on page 12.

## Adjustments

There are several operating adjustments that can be made to The Probe.

To access the operating adjustments, simultaneously press the "4" and "20" keys until the desired adjustment is obtained. A viewing sequence of the stored value is automatically initiated. During this time the value can be changed by pressing either the "4" or "20" key. After viewing or changing, operation automatically reverts to the Run mode (6 sec).

	4 mA calibration, scrolling		fail-safe
	20 mA calibration, scrolling		fail-safe timer
	blanking		units
	speed of response		

## Calibration, Scrolling Method

The 4 and 20 mA calibration values can be selected where reference levels, either from the material in the vessel or from a target, cannot be provided. This method can also be used to trim the output levels obtained by the Reference Method (see page 7).

To change the stored calibration value, obtain the 'c 4' or 'c 20' display. The calibration value may be increased by pressing the "20" key or decreased by pressing the "4" key. When the display has scrolled to the desired value, stop pressing the key. The display automatically reverts to the Run mode (6 sec).

## 4 mA calibration



4 mA calibration initiated

view stored 4 mA calibration value i.e. 4.50 m

press "20" to increase to new calibration value i.e. 4.60 m

new calibration value

## 20 mA calibration



20 mA calibration initiated

view stored 20 mA calibration value i.e. 0.50 m

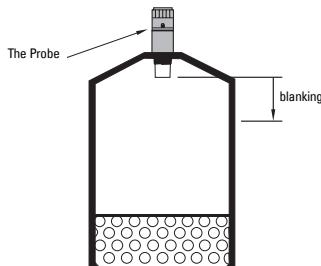
press "4" to decrease to new calibration value i.e. 0.45 m

new calibration value

**Note:** For faster scrolling, hold the key depressed during the calibration adjustment and release when desired value is obtained.

## Blanking

Blanking is used to ignore the zone in front of the transducer where false echoes are at a level that interfere with the processing of the true echo. It is measured outward from the sensor face. The minimum recommended blanking value is 0.25 m (0.82 ft) but can be increased in order to extend the blanking.



- To change the stored blanking value, obtain the 'bL' display.
- Press the "20" key to increase or the "4" key to decrease the blanking value.
- When the display has scrolled to the desired value, stop pressing the key. The display automatically returns to the Run mode (6 sec).



3 sec blanking

stored blanking value i.e. 0.25 m

press "20" to increase blanking i.e. 0.36 m

press "4" to decrease to desired blanking value i.e. 0.35 m

6 sec new blanking value

**Note:** For faster scrolling, hold the key depressed during the blanking adjustment and release when desired value is obtained.

# Speed of Response

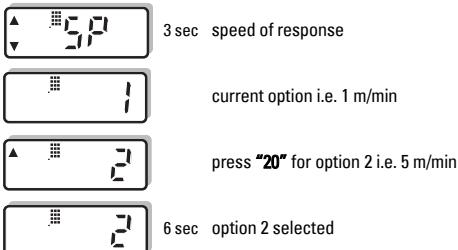
The speed of response adjustment allows the user to collectively set a number of operating parameters.

- measurement response: is the limit to which The Probe will be able to keep up with rates of change. If The Probe measurement cannot keep up with the rate of level change, set the adjustment from '1' to '2'. If The Probe still cannot keep up with the rate of level change, set the adjustment option to '3'. Avoid choosing an option that is too fast for your application.
- agitator discrimination: discriminates between agitator blades in motion, and the material (target) surface.
- filter: discriminates between false echoes from acoustical and electrical noise and the material (target) surface.
- fail-safe timer: establishes the 'Waiting' period from the time a loss of echo or operating fault condition starts until the fail-safe default is effected. Adjusting the speed of response will set the fail-safe timer to the default values in the chart. If a different response is required, adjust the 'FST' option (see page 11).

SP	measurement response	agitator discrimination	filter	fail-safe timer
1*	1 m/min (3.3 ft/min)	on	on	10 min
2	5 m/min (16.4 ft/min)	on	on	3 min
3	immediate	off	off	3 min
4	0.03 m/min (0.1 ft/min)	on	on	10 min

\* = factory setting

- To change the speed of response, obtain the 'SP' display.
- Scroll forward through the options (1-2-3) by pressing the "20" key. Scroll backward through the options (3-2-1) by pressing the "4" key.
- When the desired option is displayed, stop pressing the key. The display will automatically return to the Run mode (6 sec).



## Fail-Safe

In the event a loss of echo or fault condition exceeds the 'Waiting' period (see Speed of Response above or Fail-safe Timer on page 11), the '?' icon appears and one of the following fail-safe defaults is immediately effected.

FLS	default	mA <sup>p</sup>	mA <sup>i</sup>	reading
1	full	22	4	hold
2	empty	4	22	hold
3*	hold	hold	hold	hold

p = proportional span

\* = factory default

- To change the fail-safe default obtain the 'FLS' display.
- Scroll forward through the options (1-2-3) by pressing the "20" key. Scroll backward through the options (3-2-1) by pressing the "4" key.

- When the desired option is displayed, stop pressing the key. The display will automatically return to the Run mode (6 sec).



3 sec fail-safe



current option i.e. full



Press "20" for option 2 i.e. empty



6 sec option 2 selected

## Fail-Safe Timer

The fail-safe timer allows the user to vary the 'waiting' period from the time a loss of echo or operating fault condition begins, until the fail-safe default is effected. The 'waiting' period is adjustable from 1 to 15 minutes, in 1 minute increments.

The fail-safe timer value will default to settings determined by the speed of response (see page 10). If a different value is desired, the fail-safe timer should be adjusted *after* the speed of response is set.

- To change the fail-safe timer, obtain the 'FST' display.
- Increase the 'waiting' period by pressing the "20" key, and decrease it by pressing the "4" key, stopping when the desired value is displayed.
- The display automatically reverts to the Run mode (6 sec).

## Units

The units of the measurement reading can be selected as follows:

1 = metres, m (factory setting)

2 = feet, ft

The selected units are also applicable to the 'Blanking' adjustment.

- To change the units obtain the 'Un' display.
- Scroll forward through the options (1 - 2) by pressing the "20" key. Scroll backward through the options (2 - 1) by pressing the "4" key.
- When the desired option is displayed, stop pressing the key. The display will automatically return to the Run mode (6 sec).



3 sec units



current option i.e. m



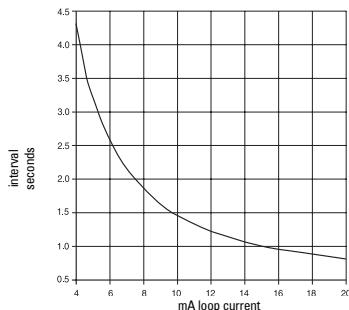
Press "20" for option 2 i.e. ft



6 sec option 2 selected

# Supplement

## Measurement Interval



## Troubleshooting



The echo is not reliable and The Probe is waiting for a valid echo before updating the measurement.

Probable causes are:

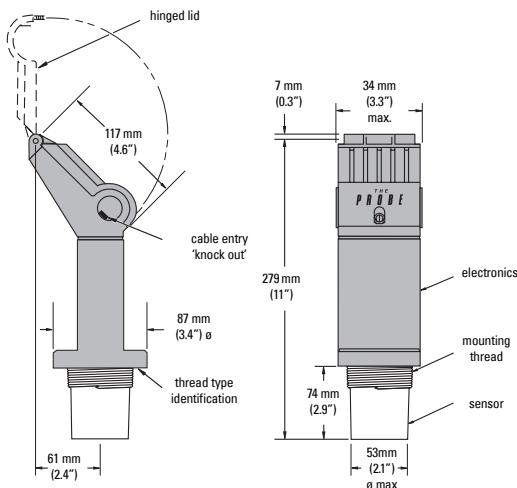
- material or object in contact with sensor face
- The Probe is too close to the fill point
- The Probe is not perpendicular to the liquid surface
- change in level too fast
- measurement out of range
- foam on liquid surface
- high level of vibration in the mounting structure
- level inside the blanking zone



The 'Waiting' period has expired. Investigate the probable causes listed above.

Refer to Speed of Response on page 10 or Fail-safe Timer on page 11 for duration of 'Waiting' periods.

## Dimension Details



# Patents

## Instrument Housing Design:

- Canada: 70345
- U.S.A.: 07/858/707
- Germany: M92022723
- U.K.: 2021748
- France: 921873
- Japan: 966217

## Electronics / Sensor:

- U.S.A.: 5,267,219
- 5,339,292
- U.K.: 2,260,059
- patent applications in U.K., Canada, Europe, Africa, Australia

# Specifications

---

## Power:

- 12 to 28 V dc,(at Probe), 0.1 A surge
- loop current 4 to 20 mA max

## Environmental:

- location: indoor / outdoor
- altitude: 2000 m max.
- ambient temperature continuous: -40 to 60°C (-40 to 140°F)  
-20°C (-5°F) if metal mounting
- relative humidity: suitable for outdoor (Type 4X / NEMA 4X / IP65 enclosure)
- installation category: II
- pollution degree: 4

## Range:

- 0.25 to 5 m ( 0.8 to 16.4 ft ) (liquids only)

## Beam Angle:

- 10° at -3 dB boundary

## Memory:

- non-volatile EEPROM, no battery required

## Programming:

- 2 tactile keys

## Temperature Compensation:

- built-in to compensate over the operating range.

## Display:

- liquid crystal
- three 9 mm (0.35") digits for reading of distance between sensor face and material
- multisegment graphic for operation status

## mA Output

- range: 4 – 20 mA
- span: proportional or inversely proportional
- accuracy: 0.25% of full scale
- resolution: 3 mm (0.125")
- loading: 600 ohms max loop load at 24 V dc supply
- cable: Belden 8760, shielded, twisted pair, 28 AWG (0.75 mm<sup>2</sup>) or equivalent

**Construction:**

- combined sensor and electronics package
- sensor housing: material: Tefzel®
  - mounting:
    - threaded: 2" NPT, 2" BSP PF2
    - optional: flange adapter
- electronics material: PVC
- housing: access: hinged lid
  - 22 mm (0.87") dia. 'knock out' for conduit entrance, 2 places
  - 2 screw terminal block for 2.5 mm<sup>2</sup>
  - (14 ga) solid wire / 1.5 mm<sup>2</sup> (16 ga) stranded wire max

**Enclosure Rating:**

- Type 4X/ NEMA 4X / IP65

**Weight:**

- 1.5 Kg (3.3 lb)

**Approvals:**

- CE, EMC performance available on request.
- intrinsically safe CSA, FM, intrinsically safe for Class I & II, Div. 1,  
GR. A, B, C, D, E, F, G hazardous location  
SAA, Exia IIC T6 IP65, Class I Zone 0  
BASEEFA / CENELEC, EExia IIC T4, Tamb = 60°C Ex 95C2032  
ATEX II 1 G, BAS99ATEX1300

# Einleitung

**Hinweis:** Der Probe darf nur gemäß den Anweisungen in dieser Betriebsanleitung verwendet werden.

Der Probe ist ein kompaktes Ultraschall-Füllstandmessgerät, das einen Sensor und eine Auswerteelektronik umfasst. Er wurde speziell für die Messung von Flüssigkeiten in offenen und geschlossenen Behältern entwickelt. Der Sensorteil besteht aus Kynar Flex® oder Tefzel®<sup>1</sup> für den Einsatz in verschiedensten Industriebereichen, speziell in den Bereichen Chemie und Nahrungsmittel.

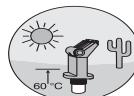
Im Gehäuse ist der Ultraschallsensor und der Temperaturfühler untergebracht. Der Probe sendet Ultraschallimpulse aus, die vom zu messenden Material reflektiert werden. Die Echos werden vom Sensor erfasst und mit der bewährten 'Sonic Intelligence' von Milltronics ausgewertet. Filter ermöglichen die Unterscheidung von Störenchos, die durch akustisches oder elektrisches Rauschen und Rührwerke entstehen, vom Nutzecho des Materials. Die Impulslaufzeit zum Material und zurück ist temperaturkompensiert. Sie wird für die Werte von Anzeige und mA Ausgang in einen Abstandswert umgewandelt.

## Installation

### Umgebung

Die Temperaturen am Einbauort dürfen die maximal zulässigen Temperaturwerte nicht überschreiten. Die Umgebung muss für die Gehäuseschutzart und den Werkstoff geeignet sein. Der Probe ist so zu montieren, dass der elektrische Anschluss, die Kalibrierung und das Ablesen der Messwerte auf der Anzeige problemlos möglich sind.

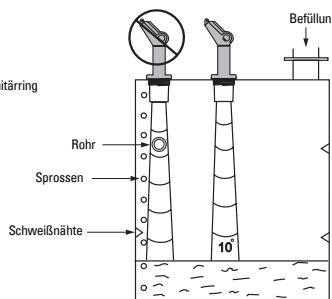
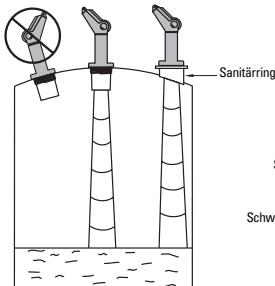
Vermeiden Sie die Installation in der Nähe von Hochspannungs-, Motorleitungen, Schaltschützen oder Frequenzumrichtern.



### Standort

Der Schall muss ungehindert und im rechten Winkel zum Flüssigkeitsspiegel gelangen können.

Zu störenden Einbauten (Leitern, Rohren, Verstrebungen oder Schweißnähten) ist Abstand zu halten.



1. Kynar Flex® ist ein eingetragenes Warenzeichen von ELF Atochem.  
Tefzel® ist ein eingetragenes Warenzeichen von DuPont.

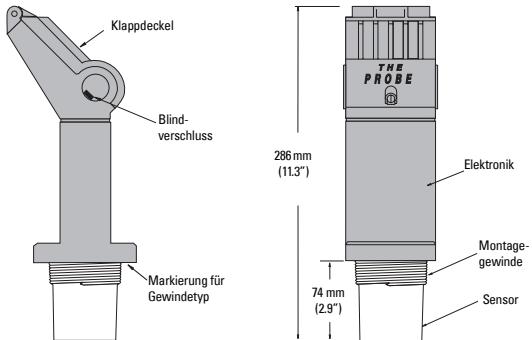
# Montage

**Hinweis:** Beim Einbau des Probe müssen zwischen Sensorunterkante und maximal zu erwartendem Füllstand mind. 25 cm Abstand gewährleistet sein.

## Gewinde

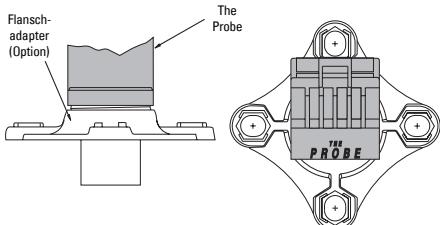
Der Probe ist in 3 Gewindeausführungen erhältlich:  
2" NPT, 2" BSP oder PF2.

**Hinweis:** Um eine Beschädigung des Probe-Gewindes zu vermeiden, ist vor Einschrauben des Probe das Montagegewinde zu überprüfen, damit es sich um denselben Gewindetyp handelt.



## Flanschadapter (optional)

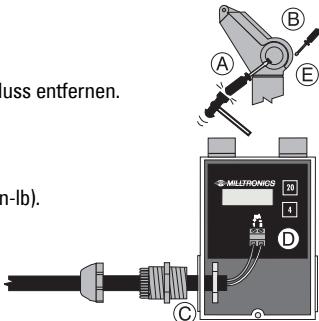
Optional ist die Lieferung eines 75 mm (3") Flanschadapters für 3" ANSI, DIN 65PN10 und JIS 10K3B Flansche möglich.



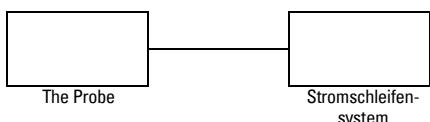
## Anschluss

### Kableinführung

- A. Bei geschlossenem Deckel den vorgesehenen Blindverschluss entfernen.
- B. Schraube lösen und Deckel öffnen.
- C. Kabel einführen.
- D. Kabel für die Schleife anschließen.
- E. Deckel schließen. Max. Drehkraft 1,1 bis 1,7 N·m (10 bis 15 in-lb).



## Systemdiagramm



# Eigensichere Ausführung

## FM / SAA (Bezugszeichnung 1-8600016Z-DX-A)

Im Rahmen des gesamtheitlichen Bewertungskonzepts weist der Probe folgende Merkmale auf:

V<sub>max</sub> = 30 V dc

I<sub>max</sub> = 200 mA dc

C<sub>i</sub> = 0

L<sub>i</sub> = 0

### Definition:

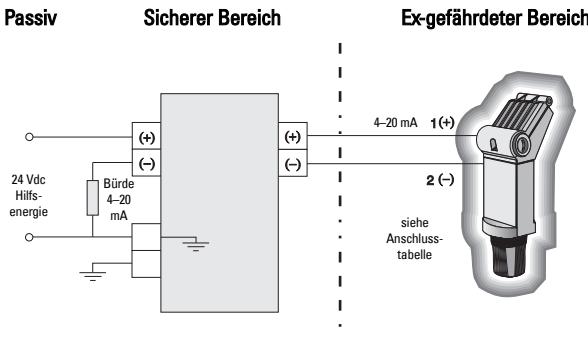
Das Gesamtheitskonzept (Entity Concept) ermöglicht den Anschluss eigensicherer Geräte an zugehörige Geräte, die nicht speziell in diesem Zusammenhang geprüft wurden. Als Anschlusskriterium gilt, dass Spannung und Strom, die eigensichere Geräte ohne Verlust ihrer Eigensicherheit aufnehmen können, größer oder gleich den Spannungs- (V<sub>oc</sub> oder V<sub>t</sub>) und Stromwerten (I<sub>oc</sub> oder I<sub>t</sub>) sein müssen, die vom zugeordneten Gerät geliefert werden können. Dabei müssen Fehler und anwendbare Faktoren berücksichtigt werden. Weiterhin muss die maximale ungeschützte Kapazität (C<sub>i</sub>) und Induktivität (L<sub>i</sub>) des eigensicheren Geräts einschließlich der Verbindungskabel kleiner oder gleich der Kapazität oder Induktivität sein, welche gefahrlos an das zugeordnete Gerät angeschlossen werden kann.

## FM / SAA / CSA (Bezugszeichnung 1-8600016Z-DX-A)

Für Standorte Klasse II, Div. 1, Gr. E, F, G und im Außenbereich Typ 4X / NEMA 4X / IP65 sind zugelassene staub- und wasserdichte Leitungsverschlüsse erforderlich.

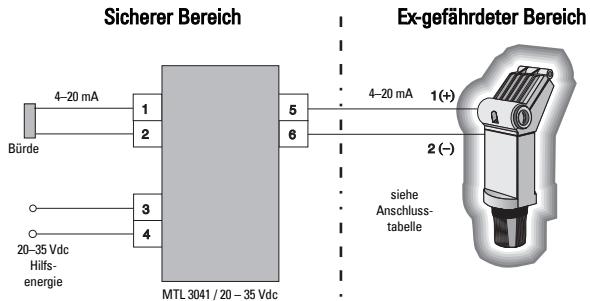
Die maximale Spannung eines nicht eigensicheren Betriebsmittels darf 250 V rms nicht überschreiten.

Verwenden Sie ausschließlich eigensichere Zenerbarrieren gemäß nachstehender Liste.



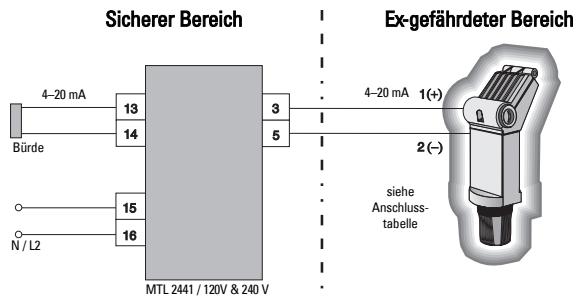
Hersteller	Artikelnr.	Klemme Barriere	Anschluss The Probe
MTL	787s+	3 4	1 2
MTL	706+	4 3	1 2
STAHL	9002 / 13- 280-110-00	3 4	1 2
STAHL	9001 / 51- 280-110-14	3 4	2

# DC Verstärker



Deutsch

# AC Verstärker

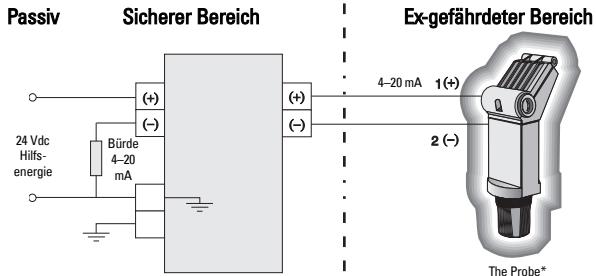


**Hinweis:** Der Spannungseingang ist verpolungsgeschützt.

# Baseefa / Cenelec

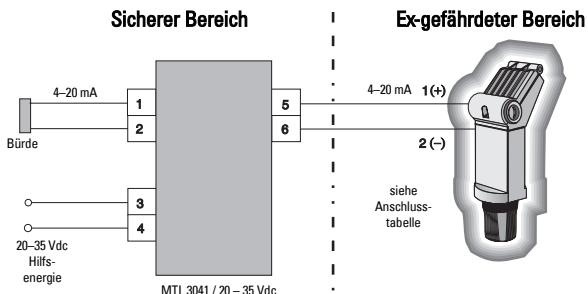
Systemzulassung 95C2033 (Bezugszeichnung 1-8600018Z-DX-A)

Um der Zulassung zu entsprechen, muss eine der folgenden Barrieren oder eine entsprechende Ausführung (siehe EU Äquivalenz) verwendet werden.

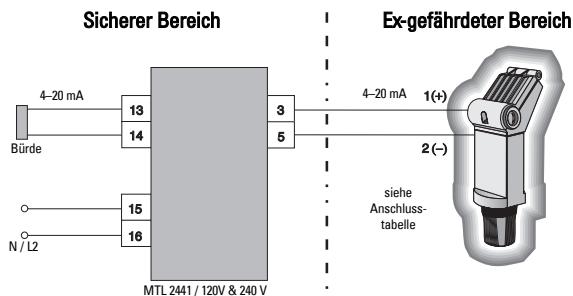


Produkt	Artikelnr. (Zertifizierung)	Klemme Barriere	Anschluss The Probe
MTL	787s+ (EX832452)	3 4	1 2
MTL	706+ (EX87B2428)	4 3	1 2
STAHL	9002 / 13- 280-110-00 (EX-91.C.2045X)	3 4	1 2
STAHL	9001 / 51- 280-110-14 (EX-91.C.2046X)	3 4	1 2

## DC Verstärker



## AC Verstärker



\* EExia IIC, Tamb = 60 °C, Ex 95C2032

## EU Äquivalenz

Jede verwendete Zenerbarriere muss durch eine von der EU zugelassenen Zertifizierungsstelle für [EEx ia] IIC zugelassen sein. Die Ausgangsspannung (Vz) darf 28 V nicht überschreiten und der Ausgangsstrom (I out) ist durch den Widerstand (R) begrenzt, so dass  $I_{out\ max} = V_z / R$  den Wert 110 mA nicht übersteigt.

### Hinweise:

- Die elektrischen Anlagen im EX-gefährdeten Bereich müssen einer Prüfspannung von 500 V Wechselstrom (effektiver Mittelwert) an der Erde oder am Gehäuse des Geräts eine Minute lang standhalten können.
- Die Kapazität und Induktivität des Ex-gefährdeten Bereichs darf die angegebenen Werte nicht überschreiten.

Gruppe	Kapazität $\mu\text{F}$	Induktivität $\text{mH}$
II C	0.07	3
II B	0.39	12

- Die Installation muss den jeweils geltenden nationalen Bestimmungen entsprechen; Bsp. für Großbritannien BS 5345 : Teil 4 : 1977.
- Das System ist neben der Aufschrift 'The Probe' mit einem dauerhaften Aufkleber mit der Aufschrift "BASEEFA System Nr. EX 95C2032" zu versehen.
- Der sichere Bereich ist nicht spezifiziert. Er darf jedoch bei normalen oder außergewöhnlichen Bedingungen nicht von einer Potentialquelle versorgt werden, die 250 V (effektiver Mittelwert) oder 250 V DC übersteigt, und auch keine solche Quelle enthalten.

# Allgemeine Richtlinien für den eigensicheren Probe entsprechend EC-Typprüfungszertifikat BAS99ATEX1300

- Deutsch
- Das Betriebsmittel ist für einen Einsatz bei brennbaren Gasen und Dämpfen mit Betriebsmitteln der Gruppe IIC und mit der Temperaturklasse T4 zugelassen.
  - Der zugelassene Umgebungstemperaturbereich beträgt  $-40^{\circ}\text{C}$  bis  $60^{\circ}\text{C}$ .
  - Das Betriebsmittel wurde nicht als Sicherheitsgerät im Sinne der EG Richtlinie 94/9/EG Anhang II, Klausel 1.5 eingestuft.
  - Die Installation und Prüfung des Betriebsmittels darf nur durch entsprechend geschultes Personal und unter Beachtung der einschlägigen Bestimmungen (EN 60079-14 und EN 60079-17 in Europa) durchgeführt werden.
  - Die Reparatur des Betriebsmittels darf nur durch entsprechend geschultes Personal und unter Beachtung der einschlägigen Bestimmungen (Bsp. EN 60079-19 in Europa) durchgeführt werden.
  - Ins Betriebsmittel einzufügende oder als Ersatzteil zu verwendende Komponenten müssen durch entsprechend geschultes Personal und unter Beachtung der Herstellerdokumentation eingefügt werden.
  - Die Betriebsmittel-Zulassung richtet sich nach folgenden, verwendeten Werkstoffen:  
BF Goodrich PVC GEON, 85856 (Material für Gehäuse und Deckel)  
Dupont Tefzel, 210 (Sensor)  
Elf Atochem Kynar Flex, 2820 (wahlweise für den Sensor)  
Master Bond Polysulphid, EP21LPT Vergussmaterial (Sensor)  
Emmerson and Cummings Stycast, 2075 Vergussmaterial (Elektronik)

Besteht die Wahrscheinlichkeit, dass das Betriebsmittel mit aggressiven Substanzen in Kontakt kommt, so unterliegt es der Verantwortung des Benutzers geeignete Vorkehrungen zu treffen, um eine Beeinträchtigung des Betriebsmittels zu verhindern und die Schutzart zu gewährleisten.

Aggressive Substanzen: z.B. Lösungsmittel, die Polymere beeinträchtigen können

Geeignete Vorkehrungen: z. B. regelmäßige Kontrollen im Rahmen von Routineprüfungen oder Bestimmung anhand des Datenblatts des Materials, dass es gegen bestimmte Chemikalien beständig ist.

PVC GEON 85856 ist eine Marke von BF Goodrich

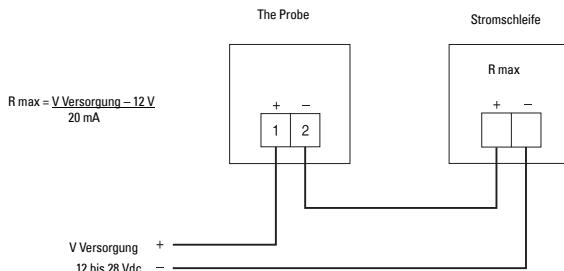
Tefzel 210 ist eine Marke von Dupont

Kynar Flex 2820 ist eine Marke von Elf Atochem

Polysulphid EP21LPT ist eine Marke von Master Bond

Stycast 2075 ist eine Marke von Emmerson and Cummings

## Nicht Eigensicher

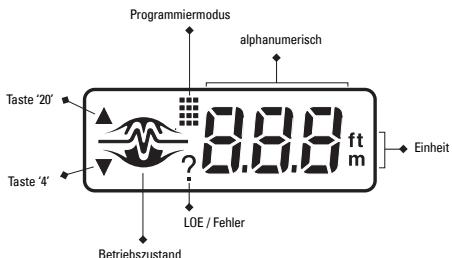


**Hinweis:** Der Spannungseingang ist verpolungsgeschützt.

# Betrieb

## Inbetriebnahme

- Nach korrekter Installation des Probe (oder Ausrichtung auf eine Wand in 0,25 bis 5 m Abstand) wird die Versorgungsspannung zugeschaltet.
- Bei Inbetriebnahme des Probe erscheint folgende Anzeige:



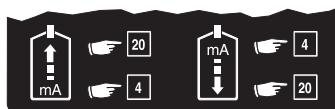
- Daraufhin wird automatisch der Run Modus gestartet. Angezeigt wird der Abstand von der Sensorsendefläche zum zu messenden Füllstand in der angegebenen Einheit:
- Falls eine andere Anzeige erscheint, schlagen Sie unter Betriebszustand auf Seite 8 nach.



## Kalibrierung

Der mA Ausgang kann proportional oder umgekehrt proportional zum Füllstand oder Abstand angegeben werden.

**Hinweis:** Die Werte für 4 und 20 mA können in beliebiger Reihenfolge kalibriert werden.



proportionale Mess-Spanne	umgekehrt proportionale Mess-Spanne
Max. Füllstand = 20 mA	Max. Füllstand = 4 mA
Min. Füllstand = 4 mA	Min. Füllstand = 20 mA

### Kalibrierung: Referenzmethode

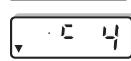
- Bringen Sie den Füllstand im Behälter auf den gewünschten Abstand von der Sensorsendefläche.
- Drücken Sie je nach Bedarf die Taste **"4"** oder **"20"**. Der diesem mA Ausgangswert entsprechende Wert wird angezeigt.
- Drücken Sie die Taste erneut, um den neuen Abstandsbezugspunkt einzustellen.
- Nach der Anzeige oder Kalibrierung kehrt der Probe automatisch in den Run Modus zurück (6 Sek.).
- Der kalibrierte Wert bezieht sich auf die Sendefläche des Probe in der angezeigten Maßeinheit.

### 4 mA Abgleich

Taste **"4"**



Taste **"4"** erneut drücken

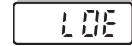


4 mA Abgleich



neuer 4 mA Abgleich

Abgleich ungültig, bei



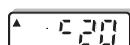
wiederholen

## 20 mA Abgleich

Taste "20"



Taste "20" erneut drücken

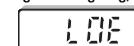


20 mA Abgleich



neuer 20 mA Abgleich

Abgleich ungültig, bei

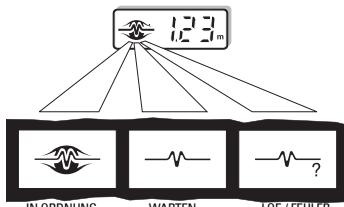


wiederholen

**Hinweis:** Bei der Kalibrierung wird die Reaktionszeit der Messung umgangen.

## Betriebszustand

Über die graphische Anzeige erhält der Benutzer eine optische Information über den Betriebszustand des Gerätes. Sie kann ihm bei der Ausrichtung und korrekten Installation des Probe helfen, um eine optimale Betriebsleistung zu erreichen.



Je nach Betriebszustand wird das Logo vollständig oder teilweise angezeigt. Zur Anzeige eines Echoverlusts (LOE) / Fehlers erscheint nach einer Wartezeit das Fragezeichen "?" neben dem Logo. Sobald wieder ein gültiges Echo empfangen wird, erscheint das Logo 'In Ordnung'. Siehe Abschnitt Fehlersuche, Seite 12.

## Einstellungen

Der Probe erlaubt verschiedene Parametereinstellungen.

Zum Zugriff auf die Programmierung werden die Tasten "4" und "20" gleichzeitig gedrückt, bis der gewünschte Parameter erreicht ist. Der gespeicherte Wert wird automatisch angezeigt. Während dieser Zeit kann der Wert mit der Taste "4" oder "20" verändert werden. Nach der Anzeige oder Änderung wird automatisch wieder der Run Modus gestartet (6 Sek.).



4 mA Abgleich, Durchlauf



Failsafe



20 mA Abgleich, Durchlauf



Failsafe Zeit



Nahbereichsausblendung



Einheit



Reaktionszeit

## Kalibrierung, Schnelldurchlauf (Scroll)

Eine direkte Eingabe der 4 und 20 mA Abgleichswerte ist möglich, wenn kein Referenzfüllstand vom zu messenden Material oder von einem Ziel geliefert werden kann. Diese Methode erlaubt auch einen Feinabgleich der mit der Referenzmethode erhaltenen Werte (siehe Seite 7).

Um die programmierten Werte zu ändern, ist die Anzeige 'c 4' oder 'c 20' aufzurufen. Der Wert kann mit der Taste "20" erhöht und mit der Taste "4" verringert werden. Drücken Sie die entsprechende Taste solange, bis der gewünschte Wert erreicht ist. Die Anzeige kehrt automatisch wieder in den Run Modus zurück (6 Sek.).

## 4 mA Abgleich



Start der 4 mA Kalibrierung

Anzeige des gespeicherten Werts, Bsp. 4,50 m

Taste "20" drücken, um den Wert zu erhöhen, Bsp. 4,60 m

Neuer Kalibrierungswert

## 20 mA Abgleich



Start der 20 mA Kalibrierung

Anzeige des gespeicherten Werts,  
Bsp. 0,50 m

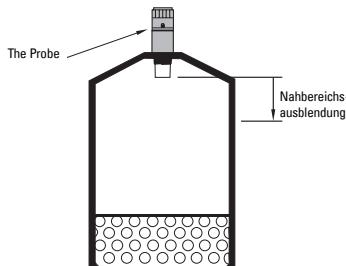
Taste "4" um den Wert zu verringern,  
Bsp. 0,45 m

Neuer Kalibrierungswert

**Hinweis:** Der Durchlauf der angezeigten Werte kann beschleunigt werden, indem Sie die jeweilige Taste gedrückt halten, bis der gewünschte Wert erreicht ist.

## Nahbereichsausblendung

Mit der Nahbereichsausblendung kann ein Bereich ignoriert werden, in dem Störechos die Auswertung des Nutzechos behindern. Dieser Bereich wird von der Sensorsondefläche aus gemessen. Es wird empfohlen, die Ausblendung auf mindestens 0,25 m (0,82 ft) einzustellen. Bei Bedarf kann dieser Wert erhöht werden.



- Um den programmierten Ausblendungswert zu ändern, ist die Anzeige 'bl' aufzurufen.
- Der Wert kann mit der Taste "20" erhöht und mit der Taste "4" verringert werden.
- Drücken Sie die entsprechende Taste solange, bis der gewünschte Wert erreicht ist. Die Anzeige kehrt automatisch wieder in den Run Modus zurück (6 Sek.).



3 Sek. Ausblendung

Gespeicherter Ausblendungswert,  
Bsp. 0,25 m

Taste "20" zur Erhöhung der Ausblendung,  
Bsp. 0,36 m

Taste "4" zur Verringerung der  
Ausblendung, Bsp. 0,35 m

6 Sek. Neuer Ausblendungswert

**Hinweis:** Der Durchlauf der angezeigten Werte kann beschleunigt werden, indem Sie die jeweilige Taste gedrückt halten, bis der gewünschte Wert erreicht ist.

# Reaktionszeit

Mit der Einstellung der Reaktionszeit kann der Benutzer mehrere Parameter gleichzeitig programmieren.

Messwertreaktion:	Maximale Geschwindigkeit, mit der der Probe auf Füllstandsänderungen reagiert. Wenn der Probe nicht schnell genug auf Füllstandsänderungen reagiert, stellen Sie den Wert von '1' auf '2'. Ist dieser Wert immer noch nicht ausreichend, so kann die Option '3' gewählt werden. Es sollte jedoch vermieden werden, einen für die Applikation zu hohen Wert zu programmieren.
Rührwerksausblendung:	Unterscheidung zwischen der Schaufelbewegung eines Rührwerks und der Oberfläche des zu messenden Materials.
Filter:	Unterscheidung zwischen Störechos akustischer und elektrischer Störsignale und Nutzechos des zu messenden Materials.
Failsafe Zeit:	Einstellung der 'Wartezeit' ab Echoverlust oder Eintritt einer Fehlerbedingung bis zum Start der Failsafe Funktion. Durch Änderung der Reaktionszeit wird die Failsafe Zeit auf die vorgegebenen Werte (siehe Tabelle) eingestellt. Ist eine andere Reaktion erforderlich, so ist die Option 'FSt' (siehe Seite 8) einzustellen.

SP	Messwertreaktion	Rührwerksausblendung	Filter	Failsafe Zeit
1*	1 m/min (3.3 ft/min)	ein	ein	10 min
2	5 m/min (16.4 ft/min)	ein	ein	3 min
3	sofort	aus	aus	3 min
4	0.03 m/min (0.1 ft/min)	ein	ein	10 min

\* = Werkseinstellung

- Um die Reaktionszeit zu ändern, ist die 'SP' Anzeige aufzurufen.
- Mit der Taste "20" können die Optionen (1-2-3) durchlaufen werden. Um die Optionen rückwärts zu durchlaufen (3-2-1), wird die Taste "4" gedrückt.
- Drücken Sie die jeweilige Taste solange, bis die gewünschte Option erscheint. Die Anzeige kehrt automatisch wieder in den Run Modus zurück (6 Sek.).



3 Sek. Reaktionszeit



Aktuelle Option, Bsp. 1 m/min



Taste "20" für Option 2, Bsp. 5 m/min



6 Sek. Option 2 gewählt

## Failsafe

Falls ein Echoverlust oder eine Fehlerbedingung die 'Wartezeit' überschreitet (siehe Reaktionszeit oben oder Failsafe Zeit weiter unten), erscheint das Fragezeichen ` ? ' in der Anzeige und eine der folgenden Failsafe Funktionen wird sofort ausgeführt.

FLS	Vorgabewert	mAP	mA <sup>i</sup>	Anzeige
1	voll	22	4	Halten
2	leer	4	22	Halten
3*	Halten	Halten	Halten	Halten

p = proportionale Mess-Spanne i = umgekehrt proportionale Mess-Spanne \* = Werkseinstellung

- Um die Failsafe-Funktion zu ändern, ist die 'FLS' Anzeige aufzurufen.
- Mit der Taste "20" können die Optionen (1-2-3) durchlaufen werden. Um die Optionen rückwärts zu durchlaufen (3-2-1), wird die Taste "4" gedrückt.

- Drücken Sie die jeweilige Taste solange, bis die gewünschte Option erscheint. Die Anzeige kehrt automatisch wieder in den Run Modus zurück (6 Sek.).



3 Sek. Failsafe



Aktuelle Option, Bsp. voll



Taste "20" für Option 2, Bsp. leer



6 Sek. Option 2 gewählt

## Failsafe Zeit

Diese Funktion ermöglicht dem Bediener, die 'Wartezeit' vom Echoverlust oder Betriebsfehler bis zum Start des Failsafebetriebs einzustellen. Der gültige Bereich für diese Zeitspanne beträgt 1 bis 15 Minuten, in Schritten von jeweils einer Minute.

Die Failsafe Zeit nimmt automatisch den Wert an, der durch die Messwertreaktion (siehe Seite 10) vorgegeben ist. Ist ein anderer Wert gewünscht, so muss die Failsafe Zeit *nach* dem Einstellen der Messwertreaktion korrigiert werden.

- Um die Failsafe Zeit zu ändern, ist die 'FSt' Anzeige aufzurufen.
- Der Wert kann mit der Taste "20" erhöht und mit der Taste "4" verringert werden. Drücken Sie die entsprechende Taste solange, bis der gewünschte Wert erreicht ist.
- Die Anzeige kehrt automatisch in den Run Modus zurück (6 Sek.).

## Einheiten

Die Messwerte können in folgenden Einheiten angezeigt werden:

1 = Meter, m (Werkseinstellung)

2 = Feet, ft

Die gewählte Einheit gilt auch für die Einstellung der 'Nahbereichsausblendung'.

- Um die Einheit zu ändern, ist die 'Un' Anzeige aufzurufen.
- Mit der Taste "20" können die Optionen (1 - 2) durchlaufen werden. Um die Optionen rückwärts zu durchlaufen (2 - 1), wird die Taste "4" gedrückt.
- Drücken Sie die jeweilige Taste solange, bis die gewünschte Option erscheint. Die Anzeige kehrt automatisch wieder in den Run Modus zurück (6 Sek.).



3 Sek. Einheit



Aktuelle Option, Bsp. m



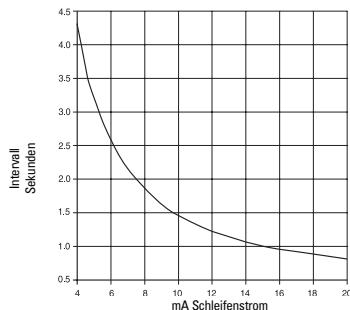
Taste "20" für Option 2 Bsp. ft



6 Sek. Option 2 gewählt

# Anhang

## Messintervall



## Fehlersuche



Das Echo ist nicht zuverlässig. Der Probe wartet auf ein auswertbares Echo, bevor der Messwert aktualisiert wird.

Mögliche Ursachen:

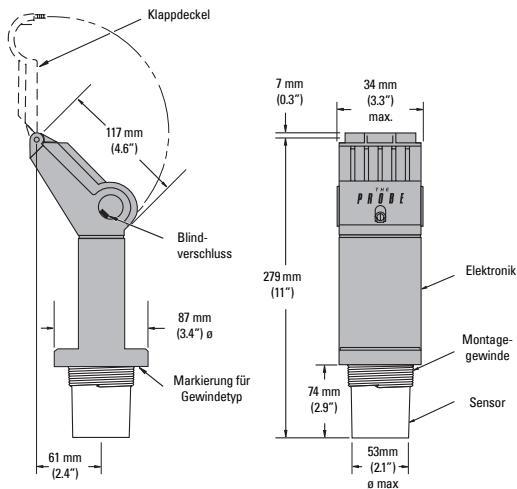
- Material (oder Zielobjekt) hat Kontakt zum Sensor
- Der Probe ist zu nahe an der Befüllung angebracht
- Der Probe steht nicht senkrecht zur Flüssigkeitsoberfläche
- Füllstand ändert sich zu schnell
- Messwert außerhalb des Messbereichs
- Schaumbildung auf der Flüssigkeitsoberfläche
- Starke Vibrationen in der Montagestruktur
- Füllstand innerhalb der Nahbereichsausblendung



Die 'Wartezeit' ist abgelaufen. Prüfen Sie die oben aufgeführten Fehlerursachen

Angaben zur Dauer der Wartezeit finden Sie im Abschnitt Reaktionszeit, Seite 10 oder Failsafe Zeit, Seite 11.

## Abmessungen



# Patente

## Gehäusedesign:

- Kanada: 70345
- U.S.A.: 07/858/707
- Deutschland: M92022723
- U.K.: 2021748
- Frankreich: 921873
- Japan: 966217

## Elektronik / Sensor:

- U.S.A.: 5,267,219
- U.K.: 5,339,292
- 2,260,059
- Patentierte Applikationen in U.K., Kanada, Europa, Afrika, Australien

# Technische Daten

---

## Hilfsenergie:

- 12 bis 28 V dc (am Probe), max. 0,1 A
- Schleifenstrom max. 4 bis 20 mA

## Umgebung:

- Montage: innen / im Freien
- Höhe: max. 2000 m
- Umgebungs- kontinuierlich: -40 bis 60°C (-40 bis 140°F)  
temperatur: -20°C (-5°F) bei Montage auf Metallteilen
- rel. Feuchtigkeit: für Montage im Freien geeignet (Gehäuse Typ 4X / NEMA 4X / IP65)
- Installationskategorie: II
- Verschmutzungsgrad: 4

## Messbereich:

- 0,25 bis 5 m (0,8 bis 16,4 ft) (nur Flüssigkeiten)

## Schallkegel:

- 10° bei -3 dB

## Speicher:

- EEPROM, nicht-flüchtig, keine Batterie erforderlich

## Programmierung:

- 2 Drucktasten

## Temperaturkompensation:

- integriert, für automatische Laufzeitkorrektur im Messbereich

## Anzeige:

- LCD (Flüssigkristall)
- drei Stellen, Höhe 9 mm (0,35") zur Anzeige des Abstands zwischen Sensorunterkante und zu messendem Material
- grafische Anzeige mit mehreren Feldern für Betriebszustand

**mA Ausgang:**

- Bereich: 4 – 20 mA
- Mess-Spanne: proportional oder umgekehrt proportional
- Genauigkeit: 0,25% vom Messbereich
- Auflösung: 3 mm (0,25")
- Bürde: max. 600 Ohm bei 24 V dc
- Kabel: Belden 8760, geschirmt, verdrilltes Paar, 28AWG (0,75 mm<sup>2</sup>) oder entsprechende Größe

**Bauart:**

- Kompaktgerät (Sensor und Elektronik integriert)
- Sensorgehäuse: Material: Kynar Flex® oder Tefzel®
  - Montage:
    - Gewinde: 2" NPT, 2" BSP PF2
    - Option: Flanschadapter
- Elektronik: Material: PVC
- Gehäuse: Öffnung: Klappdeckel
  - 2 Kabeleinführungen (Blindverschluss) 22 mm (0,87") Durchmesser
  - 2 Klemmen für max. 2,5 mm<sup>2</sup> (14 ga) Massivleiter / max. 1,5 mm<sup>2</sup> (16 ga) Litze

**Gehäuseschutzart:**

- Typ 4X/ NEMA 4X / IP65

**Gewicht:**

- 1,5 Kg (3,3 lb)

**Zulassungen:**

- CE, EMV Bescheinigung auf Anfrage erhältlich.
- Eigensicherheit CSA, FM, eigensicher für Klasse I & II, Div. 1,  
GR. A, B, C, D, E, F, G Ex-gefährdeter Bereich  
SAA, Exia IIC T6 IP65, Klasse I Zone 0  
BASEEFA / CENELEC, EExia IIC T4, Tamb = 60°C Ex 95C2032  
ATEX II 1 G, BAS99ATEX1300

# Introducción

**Nota:** The Probe debe ser utilizado únicamente de la manera que se especifica en este manual.

The Probe es un transmisor de nivel ultrasónico que combina un sensor y una parte electrónica en un cuerpo único. Está diseñado para medir niveles de líquidos en depósitos abiertos o cerrados. El sensor se fabrica en Kynar Flex® o Tefzel®<sup>1</sup> lo que lo hace adecuado para una amplia variedad de industrias. La versión sanitaria puede desarmarse y limpiarse muy fácilmente, y ha sido diseñada especialmente para las industrias alimentarias, de bebidas y productos farmacéuticos.

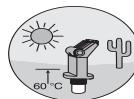
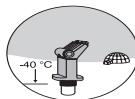
El sensor alberga el transductor ultrasónico y el sensor de temperatura. The Probe emite una serie de impulsos ultrasónicos del transductor. Cada impulso es reflejado como un eco del material y percibido por el transductor. El eco es procesado por The Probe mediante las reconocidas técnicas 'Sonic Intelligence' de Milltronics. Un filtro discrimina entre el eco verdadero del material (o medio a medir) y los ecos falsos provenientes de ruidos acústicos o eléctricos y aspas / paletas de agitadores en movimiento. El tiempo de ida y vuelta de cada impulso hacia y desde el medio es compensado en temperatura y se convierte en distancia su visualización, en salida de mA y en actuación de relé.

## Instalación

### Condiciones ambientales

The Probe debe montarse en un área que no sobrepase los límites de temperatura especificados y que sea adecuada a las especificaciones del encapsulado y de los materiales que lo componen.

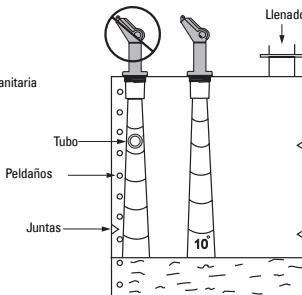
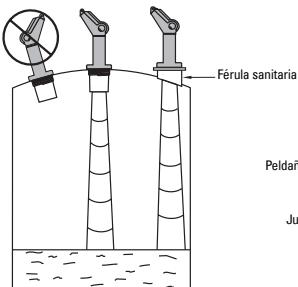
Deberá dejarse libre la tapa frontal para permitir la calibración, el cableado y la visualización. Se recomienda mantener The Probe lejos de los circuitos de alta tensión o corriente, contactores y SCRs.



### Ubicación

Instalar The Probe de forma que pueda emitir un impulso ultrasónico claro y perpendicular a la superficie del líquido.

El haz de sonido no deberá interferir en vías de llenado, irregularidades de las paredes, juntas, peldaños, ...



1. Kynar Flex® es una marca registrada de ELF Atochem.  
Tefzel® es una marca registrada de DuPont.

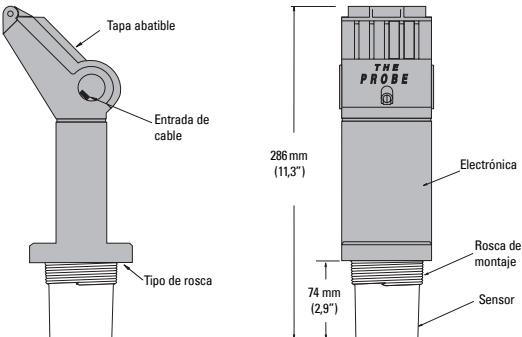
# Montaje

**Nota:** Montar The Probe de forma que la cara del transductor esté por lo menos 25 cm por encima del máximo nivel posible.

## Con rosca

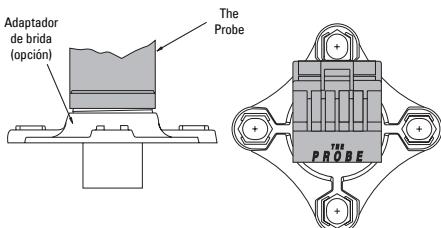
The Probe está disponible con tres tipos de rosca: 2" NPT, 2" BSP ó PF2..

**Nota:** Antes de instalar The Probe, asegurarse de que la rosca sea del mismo tipo que la del aparato para que ésta no sufra daños.



## Adaptadores de brida (opción)

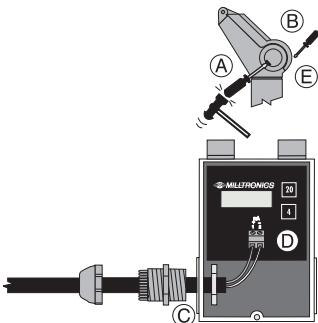
The Probe puede montarse con el adaptador opcional 75 mm (3") en bridás 3" ANSI, DIN 65PN10 y JIS 10K3B.



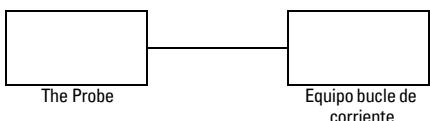
## Conexiones

### Entrada de cable

- A. Con la tapa cerrada, se extrae el tope de la entrada de cable situado en el lado deseado.
- B. Se abre la tapa aflojando su tornillo.
- C. Se conecta el cable a The Probe.
- D. Se conecta el lazo de corriente.
- E. Se cierra la tapa. Apriete máximo de los tornillos:  
1,1 a 1,7 N·m (10 a 15 in-lb).



## Diagrama del sistema



# Modelo con certificación de seguridad intrínseca

## FM / SAA (diagrama de referencia 1-8600016Z-DX-A)

En conformidad con el concepto de evaluación de entidad, The Probe tiene las siguientes especificaciones:

Vmáx = 30 V DC

Imáx = 200 mA DC

Ci = 0

Li = 0

### Definición:

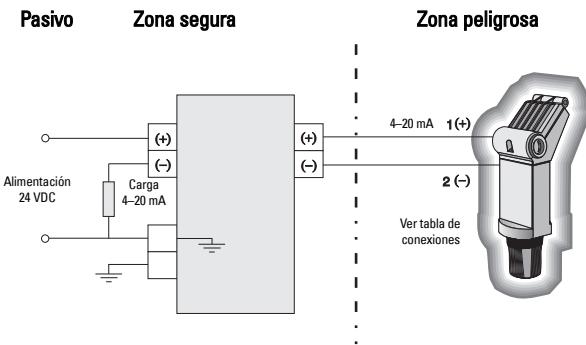
Con el Concepto de Entidad se admite la conexión de aparatos de tipo seguridad intrínseca con otros aparatos, sin examen previo del tipo de conexión. La conexión sólo es posible si la tensión y la intensidad recibidas por el sistema de seguridad intrínseca (SI aún en presencia de fallo) son superiores o equivalentes a la tensión ( $V_{oc}$  o  $V_t$ ) y a la intensidad ( $I_{sc}$  o  $I_t$ ) proporcionadas por el aparato relacionado (fallos y otros factores aplicables considerados). Además, la capacitancia ( $C_i$ ) y la inductancia ( $L_i$ ) máximas, no protegidas, del sistema de seguridad intrínseca (y el cable de conexión) deben ser inferiores o equivalentes a las capacidades e inductancias que se conectarán sin riesgo al aparato relacionado.

## FM / SAA / CSA (diagrama de referencia 1-8600016Z-DX-A)

Utilizar conductos aptos, estancos al polvo y al agua para aplicaciones en zona Clase II, Div. 1, Gr. E, F, G, y para uso en exterior (aplicaciones Tipo 4X / NEMA 4X / IP65).

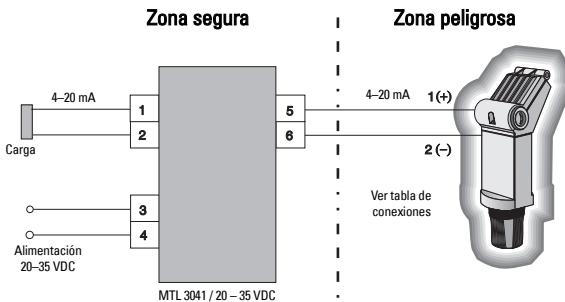
La máxima tensión de aparatos convencionales (sin seguridad intrínseca) es 250 V rms.

Recomendamos utilizar sólo barreras de seguridad intrínseca.

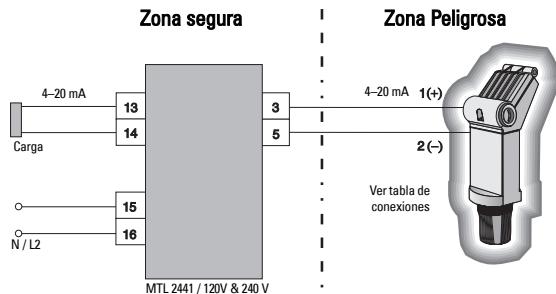


Fabricante	Número de pedido	Regleta Barrera	Conexión The Probe
MTL	787s+	3 4	1 2
MTL	706+	4 3	1 2
STAHL	9002 / 13- 280-110-00	3 4	1 2
STAHL	9001 / 51- 280-110-14	3 4	2

## Repetidor DC



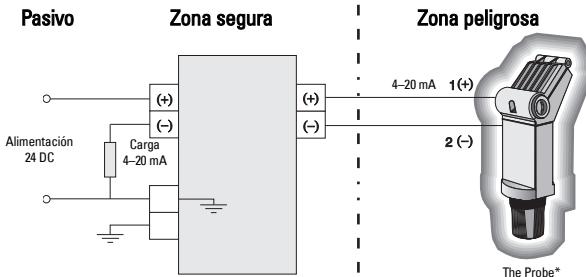
## Repetidor AC



**Nota:** Protección del suministro eléctrico (alimentación) contra polaridad invertida.

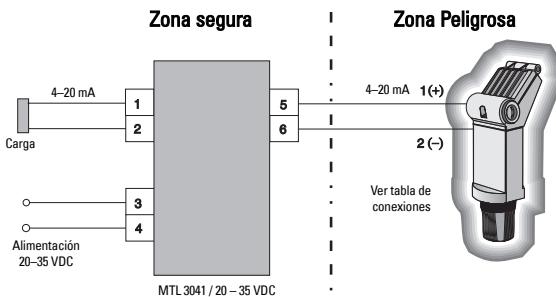
## Baseefa / Cenelec

Aprobación sistema 95C2033 (diagrama de referencia 1-8600018Z-DX-A). Para cumplir con la aprobación utilizar las barreras indicadas, o modelos equivalentes (véase Equivalencia UE).

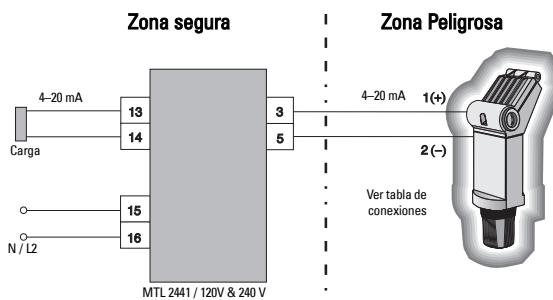


Fabricante	Número de pedido (certificado)	Regleta Barrera	Conexión The Probe
MTL	787s+ (EX832452)	3 4	1 2
MTL	706+ (EX87B2428)	4 3	1 2
STAHL	9002 / 13-280-110-00 (EX-91.C.2045X)	3 4	1 2
STAHL	9001 / 51-280-110-14 (EX-91.C.2046X)	3 4	1 2

## Repetidor DC



## Repetidor AC



\* EExia IIC, Tamb = 60 °C, Ex 95C2032

## Equivalencia UE

Se puede utilizar cualquier canal de barrera de seguridad diodo shunt zener o canal simple, certificado por una oficina de certificación aprobada por la UE, en conformidad con [ EEx ia ] IIC. La tensión de salida (Vz) no deberá exceder 28 V, con corriente de salida (I out) limitada por la resistencia de carga (R); de forma que I out max = Vz / R no exceda 110 mA.

### Notas:

- El circuito electrónico en la zona peligrosa deberá soportar alimentaciones (CA) de hasta 500 V rms (tierra o masa) del aparato, durante al menos un minuto.
- La capacitancia / inductancia del lazo en la zona peligrosa no deberá exceder los valores indicados a continuación.

Grupo	Capacitancia $\mu\text{F}$	Inductancia mH
II C	0.07	3
II B	0.39	12

- El usuario debe asegurar que la instalación se efectua en conformidad con la reglamentación nacional en vigor (ej.: BS 5345 : part 4 : 1977 en el Reino Unido).
- El sistema deberá estar provisto del marcado "BASEEFA sistema n° EX 95C2033", fijado en el aparato, cerca del label The Probe.
- La zona de seguridad no deberá contener, o ser alimentada por una fuente de potencial superior (de 250 V rms ó 250 V DC) respecto a la tierra (bajo condiciones de operación normales o anormales).

## Directrices generales relativas al sistema The Probe, modelo seguridad intrínseca, conforme con el certificado Tipo CE BAS99ATEX1300

1. El aparato puede ser utilizado en zonas con gases y vapores inflamables, con aparatos del Grupo IIC y clase de temperatura T4.
2. El sistema puede soportar temperaturas ambientes de -40°C a +60°C.
3. El aparato no se ha analizado como sistema de protección, como se indica en la Directiva 94/9/CE Anexo II, cláusula 1,5.
4. La instalación e inspección de este aparato deberá realizarse por personal cualificado en conformidad con los códigos de práctica aplicables (EN 60079-14 y EN60079-17 en Europa).
5. La reparación de este aparato deberá realizarse por personal cualificado en conformidad con los códigos de práctica aplicables (EN 60079-19 en Europa, por ejemplo).
6. Los componentes incorporados y/o utilizados para reemplazar piezas o componentes del sistema deberán ser instalados por personal cualificado, teniendo en cuenta las recomendaciones indicadas en la documentación proporcionada por el fabricante.
7. La certificación otorgada a este aparato se basa en la utilización de los siguientes materiales para su construcción:  
BF Goodrich PVC GEON, 85856 (material de la caja y de la tapa)  
Dupont Tefzel, 210 (transductor)  
Elf Atochem Kynar Flex, 2820 (transductor, material opcional)  
Master Bond Polysulphide, EP21LPT encapsulante (transductor)  
Emmerson and Cummings Styccast, 2075 encapsulante (electrónica)

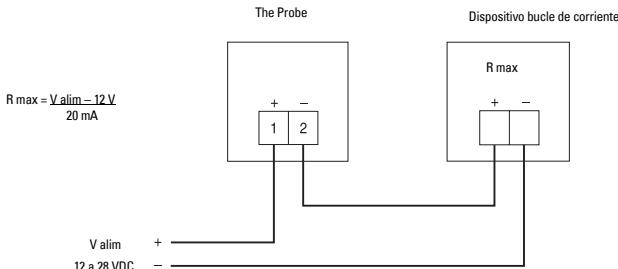
El usuario es responsable de tomar las precauciones necesarias para evitar el daño del aparato y garantizar el nivel de protección obtenido, si existe la posibilidad de que esté en contacto con productos agresivos.

Ejemplo de productos agresivos: solventes que pueden dañar los polímeros.

Ejemplo de las precauciones adecuadas: inspecciones periódicas o confirmación de la resistencia de los materiales a ciertas substancias químicas (ver las especificaciones del producto).

PVC GEON 85856 es una marca registrada de BF Goodrich  
Tefzel 210 es una marca registrada de Dupont  
Kynar Flex 2820 es una marca registrada de Elf Atochem  
Polysulphide EP21LPT es una marca registrada de Master Bond  
Stycast 2075 es una marca registrada de Emmerson and Cummings

## Versión estándar

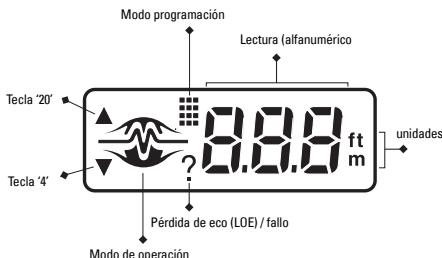


**Nota:** Protección del suministro eléctrico contra polaridad invertida.

# Operación

## Puesta en marcha

- Con The Probe instalado correctamente (o dirigido hacia una pared a una distancia de 0,25 a 5 m), conectar la alimentación eléctrica del aparato.
- El display / indicador de The Probe mostrará inicialmente...



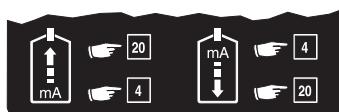
- El sistema vuelve al modo Run. Se visualiza la lectura de la distancia desde la cara del transductor hasta el nivel del material, en las unidades indicadas...
- Si la visualización por defecto es diferente del valor indicado, ver la sección Estado de funcionamiento, página 8.



## Calibración

La calibración de la salida mA puede efectuarse de forma que la distancia total (span) sea proporcional o inversamente proporcional al nivel de material.

**Nota:** Los valores 4 y 20 mA pueden calibrarse en cualquier orden.



proporcional	inversamente proporcional
nivel alto = 20mA	nivel alto = 4 mA
nivel bajo = 4 mA	nivel bajo = 20mA

### Calibración: método de referencia

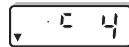
- Comprobar que el material en el depósito (o el medio a medir) se encuentra a la distancia correspondiente al valor deseado (desde la cara del transductor).
- Pulsar la tecla "4" ó "20" correspondiente. Se visualizará la lectura de la medición correspondiente a la salida mA.
- Se puede efectuar la calibración de la distancia pulsando de nuevo la tecla correspondiente.
- Después de la visualización o calibración, The Probe vuelve automáticamente al modo Run (6 segundos). El valor de calibración se calcula desde la cara del transductor, en las unidades visualizadas.

### Calibración 4 mA

Pulsar "4"



Volver a pulsar "4"

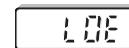


Calibración 4 mA



Nueva calibración 4mA

Calibración no válida si:



... repetir por favor

## Calibración 20 mA

Pulsar "20"

▲ **0.50** m

Volver a pulsar "20"

▲ **0.20** m

Calibración 20 mA

▲ **1.00** m

Nueva calibración 20 mA

Calibración no válida si:

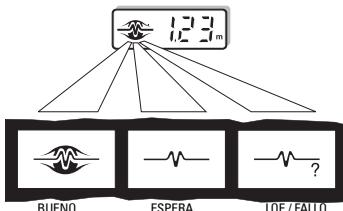
**L0E**

...repetir por favor

**Nota:** Al efectuar la calibración el aparato no procesa el tiempo de respuesta a la medición.

## Estado de operación

La instrucción gráfica del display proporciona al usuario una indicación visual del estado de funcionamiento de The Probe. Esta instrucción gráfica ayudará el usuario a ubicar e instalar correctamente el aparato para conseguir un rendimiento óptimo.



El logo cambiará de completo a parcial para indicar el estado de operación. Después de la secuencia de 'Espera' el usuario visualiza el símbolo `?` para una indicación de 'LOE / FALLO'. Cuando se recibe el eco válido, el usuario visualiza 'Bueno'. Véase Solución de fallos, página 12.

## Ajustes

Se pueden efectuar varios ajustes para conseguir un nivel de operación óptimo de The Probe.

Pulsar simultáneamente las teclas "4" y "20" hasta visualizar el ajuste deseado. Se visualiza automáticamente el valor almacenado. El usuario puede modificar este valor pulsando la tecla "4" ó "20". Despues de la visualización / modificación, el display / indicador vuelve automáticamente al modo Run (6 segundos).

▲ **4**

Desplazamiento 4 mA

▲ **F15**

Autoprotección

▲ **20**

Desplazamiento 20 mA

▲ **F5L**

Temporizador de autoprotección

▲ **b1**

Zona muerta

▲ **U1**

Unidades

▲ **50**

Tiempo de respuesta de la medida

## Método de calibración secuencial

Podrán seleccionarse los valores 4 y 20 mA cuando no se disponga de los niveles de referencia del material del depósito o del medio a medir. Esta secuencia también podrá utilizarse para el ajuste fino de los niveles de salida obtenidos con el método de referencia (ver la página 7).

Para cambiar el valor de calibración, visualizar `c 4` o `c 20`. El valor de calibración puede incrementarse pulsando "20" o decrementarse pulsando "4". Soltar la tecla al visualizar el valor deseado. Volverá a visualizarse automáticamente el modo Run (después de 6 segundos).

## Calibración 4 mA



Calibración 4 mA iniciada



Visualizar el valor de calibración de 4 mA almacenado. Ejemplo: 4.50 m



Pulsar "20" para incrementar hasta el nuevo valor de calibración.  
Ejemplo: 4.60 m



Nuevo valor de calibración

## Calibración 20 mA



Calibración 20 mA iniciada



Visualizar el valor de calibración de 20 mA almacenado. Ejemplo: 0.50 m



Pulsar "4" para decrementar hasta el nuevo valor de calibración. Ejemplo: 0.45 m

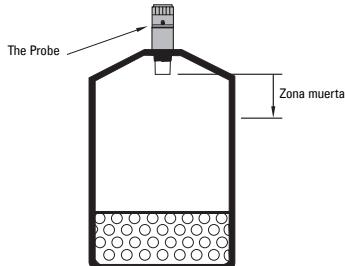
**Nota:** Para una secuencia más rápida, mantener pulsada la tecla durante el ajuste y soltarla al obtener el valor deseado.



Nuevo valor de calibración

## Zona muerta

La zona muerta se utiliza para ignorar la zona frente al transductor en la que los falsos ecos tienen un nivel que interfiere en el proceso del eco verdadero del material. Se mide partiendo de la cara del transductor, en metros. En fábrica se introduce el valor de zona muerta de 0,25 m (0,82 pies) que puede incrementarse en caso necesario.



- Para cambiar el valor de la zona muerta, visualizar `bL`.
- El valor de la zona muerta puede incrementarse pulsando "20" o decrementarse pulsando "4".
- Al visualizar el valor deseado, detener la secuencia soltando la tecla. Volverá a visualizarse automáticamente el modo Run (6 segundos).



3 seg. Zona muerta



Zona muerta- valor almacenado.  
Ejemplo: 0.25 m



Pulsar "20" para incrementar la zona muerta. Ejemplo: 0.36 m



Pulsar "4" para decrementar la zona muerta. Ejemplo: 0.35 m



6 seg. Zona muerta seleccionada

**Nota:** Para una secuencia más rápida, mantener pulsada la tecla durante el ajuste de la zona muerta y soltarla cuando se obtenga el valor deseado.

# Tiempo de respuesta de la medida

El tiempo de respuesta permite al usuario ajustar algunos de los parámetros de operación.

Tiempo de respuesta:	Límite de capacidad de adaptación de The Probe a los cambios de nivel de material. Si éste valor no se adapta a los cambios de nivel de material, cambiar el ajuste de '1' a '2'. Si The Probe sigue sin responder al cambio de nivel, seleccionar la opción '3'. Se recomienda no seleccionar una opción que sea demasiado rápida para la aplicación.
Discriminación agitador:	Proporciona la discriminación entre las palas del agitador (activas) y la superficie del material.
Filtro:	Proporciona la discriminación entre los ecos falsos producidos por los ruidos eléctricos y la superficie del material (o blanco).
Temporizador de la autoprotección:	Define el período de 'Espera' desde la pérdida de eco o la condición de fallo de funcionamiento hasta la atribución del estado de autoprotección. Al ajustar el tiempo de respuesta se obtiene el valor del temporizador indicado a continuación. Para cambiar el tiempo de respuesta, ajustar la opción 'FSt' (ver la página 11).

SP	Respuesta a la medición	Discriminación agitador	Filtro	Temporizador autoprotección
1*	1 m/min (3.3 pies/min)	on	on	10 minutos
2	5 m/min (16.4 pies/min)	on	on	3 minutos
3	inmediata	off	off	3 minutos
4	0.03 m/min (0.1 pies/min)	on	on	10 minutos

\* = valor de fábrica

Para cambiar la velocidad de respuesta a la medición, visualizar 'SP'.

- Visualizar las opciones (1-2-3) - incrementar pulsando la tecla "20". Visualizar las opciones (3-2-1) decrementar pulsando la tecla "4".
- Al visualizar la opción deseada, detener la secuencia soltando la tecla. El display / indicador vuelve automáticamente al modo Run (6 segundos).



3 seg. Tiempo de respuesta de la medida



Opción actual, ejemplo: 1 m/min



Pulsar "20" para la opción 2, ejemplo: 5 m/min



6 seg. Opción 2 seleccionada

## Autoprotección

Si la pérdida de eco o la condición de fallo excede el periodo de 'Espera' (véase Tiempo de respuesta o Autoprotección, página 10) se visualiza el símbolo '?' y se activa uno de los estados de autoprotección indicados a continuación.

Autoprotección	fallo	mAp	mAi	lectura
1	lleno	22	4	mantenido
2	vacío	4	22	mantenido
3*	mantenido	mantenido	mantenido	mantenido

p = span proporcional

i = span inversamente proporcional

\* = valor de fábrica

- Para ajustar la autoprotección, visualizar 'FLS' en el indicador.
- Visualizar las opciones (1-2-3) incrementando con la tecla "20". Visualizar las opciones (3-2-1) decrementando con la tecla "4".

- Al visualizar el valor deseado, soltar la tecla. El display / indicador vuelve automáticamente al modo Run (6 segundos).



3 seg. Autoprotección



Opción seleccionada, ejemplo: lleno



Pulsar "20", opción 2., ejemplo: vacío



6 seg. Opción 2 seleccionada

## Temporizador de autoprotección

Al ajustar el temporizador de autoprotección el usuario puede cambiar el periodo de 'Espera' desde la pérdida de eco o la condición de fallo de funcionamiento hasta la atribución del estado de autoprotección (valor definido). El usuario puede ajustar el periodo de 'Espera' de 1 a 15 minutos, con incrementos de 1 minuto.

El tiempo definido para la respuesta a la medición define el valor de referencia del temporizador de autoprotección (ver la página 10). Para cambiar el valor de autoprotección, modificar la respuesta a la medición (o la capacidad de adaptación) *después* de modificar el temporizador.

- Para cambiar el temporizador de autoprotección, visualizar 'FSt'.
- Incrementar pulsando la tecla "20" y decrementar pulsando la tecla "4".  
Detener la secuencia soltando la tecla.
- El indicador vuelve automáticamente al modo Run (6 segundos).

## Unidades

El usuario puede seleccionar las unidades de medición como sigue:

1 = metros, m (unidad programada en fábrica)

2 = pies, ft

Las unidades seleccionadas también se utilizan para el ajuste de la 'Zona muerta'.

- Para cambiar de unidad, visualizar 'Un'.
- Visualizar las opciones ( 1 - 2 ) pulsando la tecla "20". Visualizar las opciones ( 2 - 1 ) pulsando la tecla "4".
- Al visualizar la opción deseada, soltar la tecla. El display / indicador vuelve automáticamente al modo Run (6 segundos).



3 seg. Unidades



Opción actual, ejemplo: m

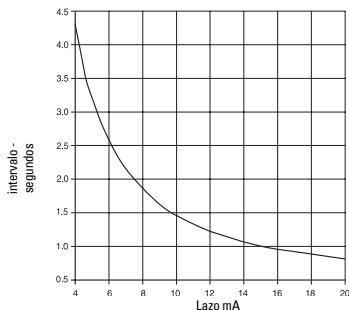


Pulsar "20", opción 2. Ejemplo: ft



6 seg. Opción 2 seleccionada

## Intervalo de medición



## Solución de fallos



El eco no es fiable. The Probe espera un eco válido antes de actualizar la medición.

Causas probables:

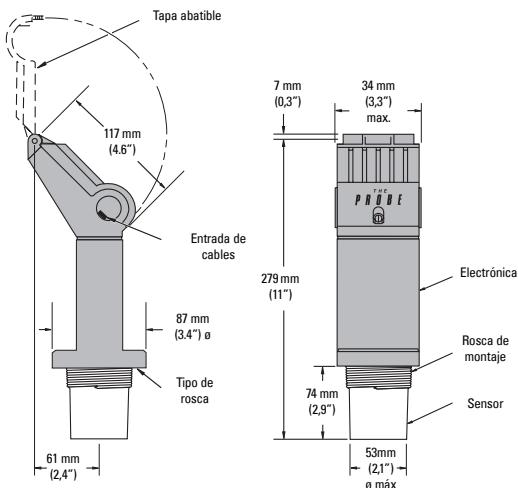
- Material u objeto en contacto con la cara del transductor
- The Probe está demasiado cerca del punto de llenado
- The Probe no se halla perpendicular a la superficie del líquido
- Cambio de nivel demasiado rápido
- Medición fuera del rango
- Espuma en la superficie del líquido
- Alto nivel de vibraciones en la estructura de montaje
- Nivel en la zona muerta



El estado de 'Espera' ha terminado. Investigar las posibles causas anteriores.

Ver Tiempo de respuesta de la medida, página 10 o Temporizador de autoprotección, página 11, para más detalles sobre los tiempos de 'Espera'.

## Dimensiones



# Patentes

## Concepción del encapsulado:

- Canadá: 70345
- E.E.U.: 07/858/707
- Alemania: M92022723
- Reino-Unido: 2021748
- Francia: 921873
- Japón: 966217

## Electrónica / Sensor:

- EE.UU.: 5,267,219
- EE.UU.: 5,339,292
- Reino-Unido: 2,260,059
- Patentes pendientes: Reino Unido, Canadá, Europa, África, Australia

# Especificaciones

---

## Alimentación eléctrica:

- 12 a 28 V DC (The Probe), máximo 0,1 A
- Corriente de bucle máximo 4 a 20 mA

## Condiciones ambientales:

- Ubicación: interior / exterior
- Altitud: máx. 2000 m
- Temperatura continua: -40 a +60°C (-40 a +140°F)  
ambiente: -20°C (-5°F) con montaje metálico
- Humedad relativa: apto para aplicaciones en exterior (caja Tipo 4X / NEMA 4X / IP65)
- Categoría de instalación: II
- Nivel de polución: 4

## Alcance:

- 0,25 a 5 m (0,8 a 16,4 pies) (líquidos únicamente)

## Ángulo de emisión:

- 10° a -3 dB

## Memoria:

- EEPROM no volátil, sin baterías

## Programación:

- 2 teclas

## Compensación de temperatura:

- Incorporada en el instrumento para todo el rango de operación

## Display / indicador:

- Cristal líquido
- Tres dígitos de 9 mm (0,35") para lectura de la distancia, en metros, entre la cara del transductor y el material
- Indicación gráfica del estado de operación

## **Salida analógica**

- Rango: 4 – 20 mA
- Span / alcance: proporcional o inversamente proporcional
- Precisión: 0,25% del rango
- Resolución: 3 mm (0,125")
- Carga: máx. 600 ohmios, suministro eléctrico 24 V DC
- Cable: Belden 8760 a 2 hilos, trenzado, apantallado 28 AWG (0,75 mm<sup>2</sup>) o equivalente

## **Construcción:**

- Sensor y electrónica en un cuerpo único
- Sensor: material: Kynar Flex® ó Tefzel® montaje:
  - rosca: 2" NPT, 2" BSP PF2
  - adaptador para brida (opción)
- Electrónica: material: PVC
- Caja: entrada de cables:tapa abatible
  - 2 orificios de diámetro 22 mm (0,87") para cables
  - regleta de terminales de 2 tornillos para cable único 2,5 mm<sup>2</sup> (14 ga) / cable trenzado máximo 1,5 mm<sup>2</sup> (16 ga)

## **Grado de protección de la caja:**

- Tipo 4X / NEMA 4X / IP65

## **Peso:**

- 1,5 Kg (3,3 lb)

## **Aprobaciones:**

- CE. Certificado relativo a CEM disponible bajo demanda.
- Seguridad intrínseca CSA, FM, seguridad intrínseca para Clase I & II, Div. 1,  
GR. A, B, C, D, E, F, G zona peligrosa  
SAA, Exia IIC T6 IP65, Clase I, Zona 0  
BASEEFA / CENELEC, EExia IIC T4, Tamb = 60°C Ex 95C2032  
ATEX II 1 G, BAS99ATEX1300

# Introduction

**Note :** Le Probe doit être utilisé suivant les instructions fournies dans ce manuel.

L'unité de mesure de niveau Probe intègre l'électronique et le capteur dans un seul et unique boîtier. Cette unité est destinée à la mesure de liquides, dans toutes cuves ou réservoirs fermés. Le capteur est fabriqué en Kynar Flex® ou Tefzel®<sup>1</sup> permettant l'utilisation du Probe dans une large gamme d'applications industrielles, spécialement les industries chimiques et agro-alimentaires.

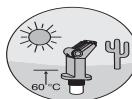
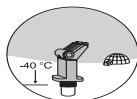
Le capteur abrite le transducteur ultrasonique et la sonde de compensation de température. L'unité Probe émet une série d'impulsions ultrasoniques via le transducteur. Chaque impulsion est réfléchie sur la surface du produit, et reçue à nouveau par le transducteur sous forme d'écho. Chaque écho est analysé par Le Probe. Cette unité intègre les techniques brevetées Sonic Intelligence Milltronics, pour l'extraction d'écho. Un filtre permet de différencier l'écho réel de ceux générés par des bruits électriques et acoustiques, et les pales d'agitateur en mouvement. Le temps de transit de chaque impulsion, entre l'émission et la réception par le capteur, est compensé en température puis converti en une mesure de distance pour l'afficheur et la sortie analogique.

## Installation

### Caractéristiques environnementales

Le Probe doit être installé dans une zone compatible avec la plage de température de fonctionnement, le degré de protection, et les matériaux de construction. Le couvercle doit être accessible pour la programmation, les raccordements et la visualisation des données.

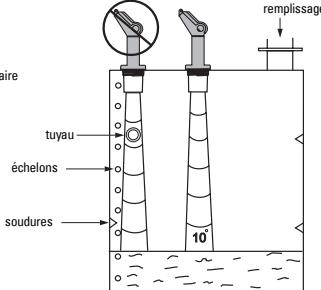
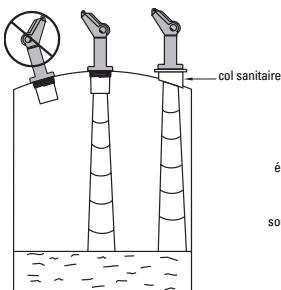
Il est préférable d'utiliser Le Probe loin de toute source haute tension ou haute intensité, contacteurs et systèmes à thyristors.



### Installation

Installer Le Probe de sorte que l'émission ultrasonique soit perpendiculaire à la surface du liquide.

L'axe de transmission ne doit rencontrer aucune interférence telle soudure, échelon, tuyaux, ...



<sup>1</sup>. Kynar Flex® est une marque déposée de ELF Atochem.  
Tefzel® est une marque déposée de DuPont.

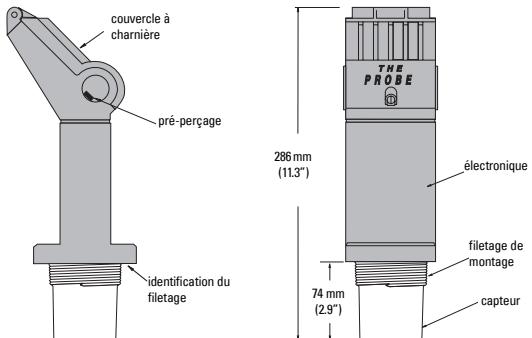
# Montage

**Note :** Le Probe doit être installé de telle sorte que la face émettrice du capteur soit située au moins 25 cm au dessus du niveau attendu le plus haut.

## Raccord fileté

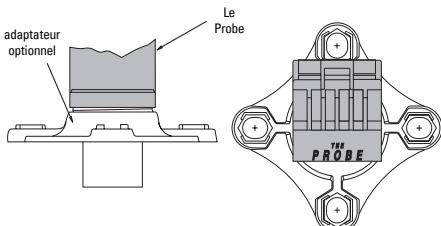
L'unité est disponible en trois versions de filetage : 2" NPT, 2" BSP ou PF2.

**Note :** Afin d'éviter d'endommager Le Probe lors de l'installation, vérifier que le filetage prévu pour sa fixation soit correct.



## Adaptateur pour bride (en option)

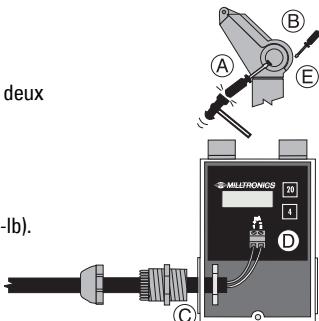
Le Probe peut être équipé d'un adaptateur 75 mm (3") (option) pour montage sur brides 3" ANSI, DIN 65PN10 et JIS 10K3B.



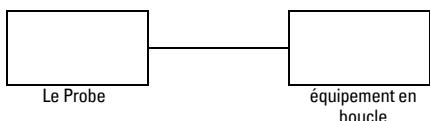
## Connexions

### Entrée de câble

- A. S'assurer que le couvercle soit fermé, puis appuyer sur les deux pré-perçages pour les retirer.
- B. Déserrer la vis de fixation et ouvrir le couvercle.
- C. Installer le câble de liaison à l'intérieur de l'unité Probe.
- D. Connecter la boucle.
- E. Fermer le couvercle et serrer la vis (1.1 à 1.7 N·m (10 à 15 in-lb)).



## Synoptique



# Connexions sécurité intrinsèque

## FM / SAA (schéma de référence 1-8600016Z-DX-A)

Suivant le concept d'évaluation d'entité, Le Probe a les caractéristiques suivantes :

Vmax = 30 V cc

I<sub>max</sub> = 200 mA cc

C<sub>i</sub> = 0

L<sub>i</sub> = 0

### Définition :

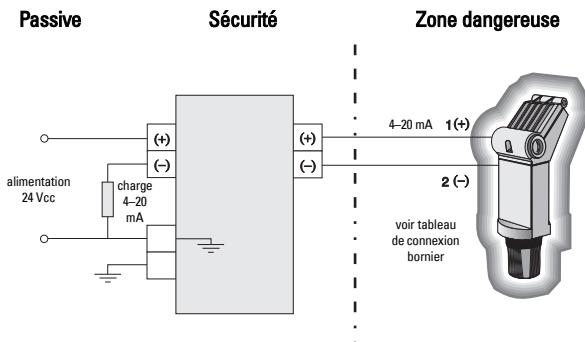
Le Concept d'Entité autorise l'interconnexion de tout appareil à sécurité intrinsèque avec tout appareil associé non spécifiquement éprouvé pour une telle association. Le critère d'interconnexion implique que la tension et l'intensité pouvant être reçues par l'appareil à sécurité intrinsèque, qui reste sécurité intrinsèque en cas de défaut, doivent être supérieures ou égales à la tension (V<sub>oc</sub> ou V<sub>t</sub>) et à l'intensité (I<sub>sc</sub> ou I<sub>t</sub>) pouvant être délivrées par l'appareil associé, considérant défauts et facteurs applicables. De plus, la capacitance (C<sub>i</sub>) et l'inductance (L<sub>i</sub>) maximales non protégées de l'appareil à sécurité intrinsèque, incluant le câble d'interconnexion doivent être inférieures ou égales aux capacités et inductances pouvant être connectées sans risque à l'appareil associé.

## FM / SAA / CSA (schéma de référence 1-8600016Z-DX-A)

Les conduits doivent être étanches à la poussière et à l'eau pour les applications en zone Classe II, Div. 1, Gr. E, F, G, et les applications extérieures Type 4X / NEMA 4X / IP65.

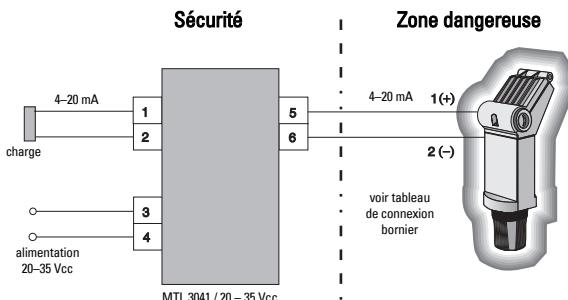
La tension maximale de l'unité non sécurité intrinsèque ne doit pas excéder 250 V rms.

Utiliser uniquement les types de barrière sécurité intrinsèque indiquées.

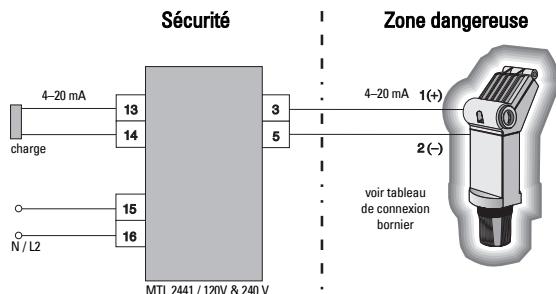


Fabricant	Réf. produit	Barrière Bornier	Connexion Le Probe
MTL	787s+	3 4	1 2
MTL	706+	4 3	1 2
STAHL	9002 / 13- 280-110-00	3 4	1 2
STAHL	9001 / 51- 280-110-14	3 4	2

## Répéiteur CC



## Répéiteur CA

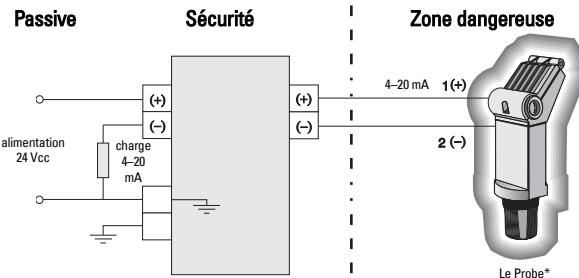


**Note :** L'entrée alimentation est protégée contre une polarité inverse.

## Baseefa / Cenelec

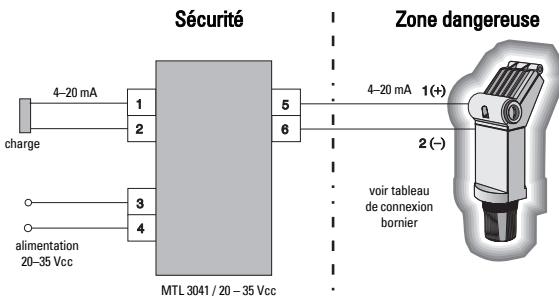
Homologation système 95C2033 (schéma de référence 1-8600018Z-DX-A)

Utiliser une des barrières suivantes (ou toute autre barrière équivalente) pour assurer la conformité aux homologations (se reporter aux Equivalences UE).

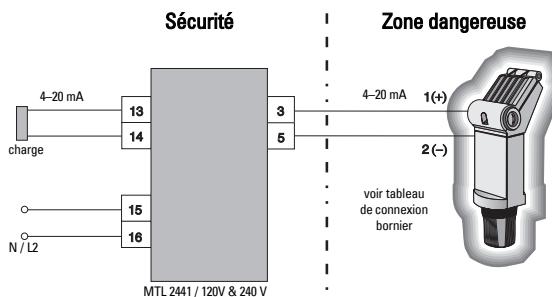


Fabricant	Réf. Produit (certification)	Barrière bornier	Connexion Le Probe
MTL	787s+ (EX832452)	3 4	1 2
MTL	706+ (EX87B2428)	4 3	1 2
STAHL	9002 / 13-280-110-00 (EX-91.C.2045X)	3 4	1 2
STAHL	9001 / 51-280-110-14 (EX-91.C.2046X)	3 4	1 2

## Répéiteur CC



## Répéiteur CA



\* EExia IIC, Tamb = 60 °C, Ex 95C2032

## Équivalence UE

Toute barrière Zener à voie unique, certifiée par un organisme homologué UE, en conformité avec [EEx ia] IIC, doit délivrer une tension de sortie (Vz) inférieure à 28 V et un courant de sortie (I out) limité par la résistance de la charge (R), afin que I out max = Vz / R n'excède pas 110 mA.

### Notes :

- Le circuit électrique dans la zone dangereuse doit pouvoir supporter une alimentation CA de 500 rms (terre ou masse) de l'appareil pendant au moins une minute.
- La capacitance et l'inductance de la liaison en zone dangereuse ne doivent pas dépasser les valeurs spécifiées.

Groupe	Capacitance µF	Inductance mH
II C	0.07	3
II B	0.39	12

- L'installation doit être conforme à la réglementation nationale en vigueur (ex. Royaume Uni : BS 5345 : section 4 : 1977).
- Le système doit être identifié avec une étiquette positionnée à côté du label 'Le Probe', portant la mention "BASEEFA system no. EX 95C2033".
- La zone de sécurité ne doit pas contenir, ou être alimentée par, une source de potentiel 250 V rms ou 250 V cc supérieure par rapport à la terre, que ce soit en conditions normales ou anormales.

# Consignes générales applicables aux système Probe Sécurité Intrinsèque, attestation d'examen CE de Type CE BAS99ATEX1300

1. Le système peut être utilisé en présence de gaz et de vapeurs enflammables, avec des appareils du Groupe IIC, et classification de température T4.
2. Le système peut être utilisé dans une plage de température ambiante de -40°C à +60°C.
3. Conformément à la directive CE 94/9/CE Annexe II, clause 1.5 cet appareil n'est pas considéré un dispositif de sécurité.
4. L'installation et la vérification de ce système doivent être effectuées par un personnel qualifié, en accord avec le code de bonne pratique (EN 60079-14 et EN60079-17 pour l'Europe).
5. Toute réparation du matériel devra être effectuée par un personnel qualifié en accord avec le code de bonne pratique (exemple : EN 60079-19 pour Europe).
6. Les composants intégrables dans le système ou utilisables en tant que pièces de rechange doivent être installés par un personnel qualifié en accord avec la documentation fournie par le fabricant.
7. Le respect des exigences de la certification de cet appareil est assuré par la conformité des matériaux utilisés pour la conception et la construction :  
BF Goodrich PVC GEON, 85856 (boîtier et couvercle)  
Dupont Tefzel, 210 (capteur)  
Elf Atochem Kynar Flex, 2820 (capteur)  
Master Bond Polysulphide EP21LPT, encapsulage (capteur)  
Emmerson and Cummings Styccast, 2075, encapsulage (électronique)

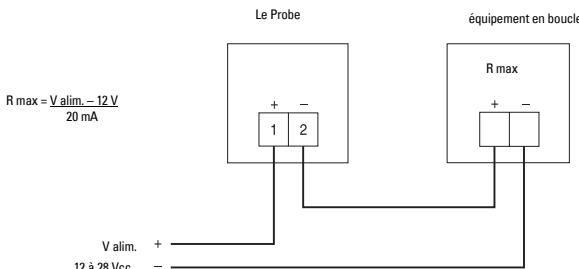
Lorsque le système peut entrer en contact avec des substances agressives, il incombe à l'utilisateur de prendre les mesures adéquates pour empêcher la détérioration du système et garantir l'indice de protection.

Exemple de substances agressives : solvants pouvant affecter des matériaux polymérisés

Exemples de mesures de précaution : vérifications régulières dans le cadre d'inspections régulières ou confirmation de la résistance du matériau à certains substances chimiques sur la base des spécifications fournies.

PVC GEON 85856 est une marque déposée de BF Goodrich  
Tefzel 210 est une marque déposée de Dupont  
Kynar Flex 2820 est une marque déposée de Elf Atochem  
Polysulphid EP21LPT est une marque déposée de Master Bond  
Stycast 2075 est une marque déposée de Emmerson and Cummings

## Version standard

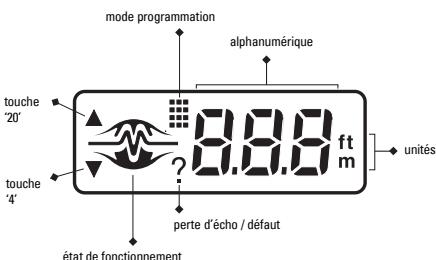


Note : L'entrée alimentation est protégée contre une polarité inverse.

# Fonctionnement

## Mise en service

- Le Probe étant correctement installé (ou orienté vers un mur à une distance de 0.25 à 5 m), effectuer sa mise sous tension.
- L'afficheur du Probe indique initialement ...



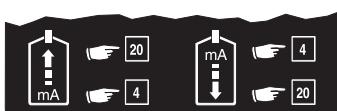
- Le Probe entre en mode Run automatiquement, en affichant la distance, en unité indiquée, entre la face émettrice du capteur et le niveau du produit ...
- Si l'affichage diffère de celui indiqué à droite, se référer à la section Etats de fonctionnement, page 8.



## Etalonnage

L'étalonnage de la sortie analogique peut être réalisé de telle sorte qu'elle soit proportionnelle ou inversement proportionnelle au niveau mesuré.

**Note :** L'étalonnage des niveaux 4 et 20 mA n'est pas soumis à un ordre particulier.



proportionnelle	inversement proportionnelle
niveau haut = 20 mA	niveau haut = 4 mA
niveau bas = 4 mA	niveau bas = 20 mA

### Etalonnage : Méthode de référence

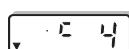
- S'assurer que la distance entre la face émettrice du capteur et le matériau mesuré (ou la cible) correspond à la nouvelle valeur souhaitée.
- Presser la touche "4" ou "20" (tel que nécessaire) pour visualiser la distance enregistrée, associée à la sortie analogique.
- Pour effectuer l'étalonnage de la distance, presser la touche une deuxième fois.
- Une fois la visualisation ou l'étalonnage effectués, Le Probe commute automatiquement en mode Run (après 6 secondes). La valeur d'étalonnage est référencée à la face émettrice du capteur, en unité sélectionnée.

### Etalonnage 4 mA

Presser "4"



Presser "4" à nouveau

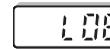


Etalonnage 4 mA



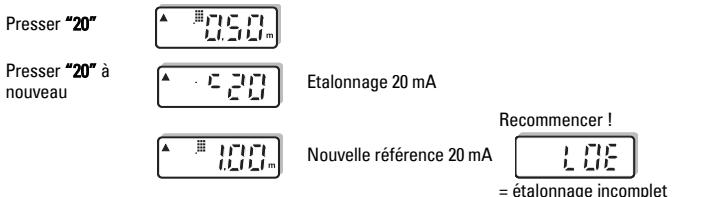
Nouvelle référence 4 mA

Recommencer !



= étalonnage incomplet

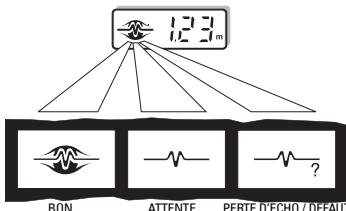
## Etalonnage 20 mA



Note : L'étalonnage peut être effectué sans tenir compte du temps de réponse de la mesure.

## Etats de fonctionnement

La zone graphique de l'afficheur permet de visualiser les états de fonctionnement de l'unité Probe. Cette visualisation graphique peut aider l'utilisateur à correctement positionner et installer l'unité pour obtenir des performances maximales.



Les états de fonctionnement sont visualisés par l'affichage complet ou non du logo. Après un état 'Attente', le symbole '?' apparaît, pour indiquer un état 'PERTE D'ECHO / DEFAUT'. L'affichage de 'BON' indique qu'un écho valide a été reçu. Pour plus de détails se référer à Dépistage des Défauts, page 12.

## Réglages

Plusieurs réglages sont possibles pour optimiser le fonctionnement de l'unité Probe.

Presser les touches "4" et "20" jusqu'à obtenir le réglage souhaité. La valeur programmée est automatiquement affichée. Pendant ce temps, la valeur peut être modifiée en pressant la touche "4" ou "20". Une fois la valeur visualisée ou modifiée, l'unité revient automatiquement en mode Run (6 secondes).

	Visualisation, étalonnage 4 mA		Sécurité-défaut
	Visualisation, étalonnage 20 mA		Temporisation sécurité-défaut
	Zone morte		Unités
	Temps de réponse		

## Etalonnage, méthode pas à pas

Cette fonction permet l'étalonnage des sorties 4 et 20 mA lorsque le matériau dans la cuve, ou une cible n'est pas disponible. Cette méthode peut également être utilisée pour ajuster les valeurs programmées via la méthode Référence (se référer à la page 7).

Pour modifier les valeurs d'étalonnage programmées, visualiser 'c 4' ou 'c 20'. Pour augmenter la valeur d'étalonnage, presser "20". Pour diminuer la valeur, presser "4". Lorsque la valeur souhaitée est obtenue, cesser de presser les touches. L'afficheur revient automatiquement au mode Run (6 secondes).

## Etalonnage 4 mA



Etalonnage 4 mA initialisé



Visualisation de la distance programmée pour la sortie 4 mA. Exemple : 4.50 m



Presser "20" pour incrémenter jusqu'à 4.60 m par exemple



Nouvelle valeur

## Etalonnage 20 mA



Etalonnage 20 mA initialisé



Visualisation de la distance programmée pour la sortie 20 mA. Exemple : 0.50 m



Presser "4" pour décrementer jusqu'à 0.45 m par exemple

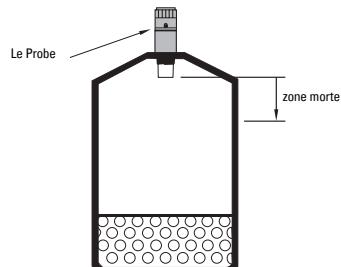


Nouvelle valeur

**Note :** Pour une visualisation plus rapide des valeurs, maintenir la touche pressée pendant le réglage de la valeur, et relâcher lorsque la valeur souhaitée apparaît.

## Zone Morte

La zone morte est utilisée pour masquer la zone sous le capteur où les échos parasites sont à des niveaux pouvant interférer avec le traitement de l'écho vrai. La zone morte est mesurée vers l'extérieur à partir de la face du capteur. Le Probe est livré avec une zone morte programmée de 0.25 m (0.82 pieds) minimum. Cette valeur peut être augmentée pour répondre aux besoins de l'application.



- Pour modifier la zone morte programmée, visualiser 'bL'.
- Presser la touche "20" pour augmenter la valeur de la zone morte et "4" pour la diminuer.
- Une fois la valeur souhaitée affichée, cesser de presser la touche. L'affichage revient automatiquement au mode Run (6 secondes).



3 sec Zone morte

Valeur programmée de la zone morte, exemple : 0.25 m



Presser "20" pour augmenter la zone morte, exemple : 0.36 m



Presser "4" pour diminuer la zone morte, exemple : 0.35 m



6 sec Valeur zone morte sélectionnée

**Note :** Pour un étalonnage plus rapide, maintenir la touche pressée pendant le réglage de la zone morte, et relâcher une fois la valeur souhaitée obtenue.

# Temps de réponse

Le réglage du temps de réponse permet à l'utilisateur de régler plusieurs paramètres de fonctionnement simultanément.

Réponse de mesure :	Correspond à la capacité de l'unité Probe à s'adapter aux vitesses de variation de niveau du matériau mesuré. Si Le Probe ne peut pas s'adapter aux vitesses de variation de niveau, modifier le réglage de '1' à '2'. Si cette condition persiste, sélectionner l'option de réglage '3'. Eviter de sélectionner une option qui soit trop rapide pour l'application en cours.
Discrimination d'écho :	Permet de discriminer entre les échos produits par les pales d'agitateur et la surface du matériau.
Filtre :	Permet de discriminer entre les échos parasites produits par les bruits acoustiques ou électriques et la surface du matériau (cible).
Temporisation sécurité-défaut :	Etablit la période 'Attente' dès le début de la perte d'écho ou du défaut de fonctionnement jusqu'à l'attribution de l'état sécurité-défaut. Le réglage du temps de réponse définit les valeurs par défaut (se référer au tableau ci-dessous) pour la temporisation sécurité-défaut. Lorsqu'une valeur différente est souhaitée, régler l'option 'FS1' (se référer à la page 11).

SP	Réponse mesure	Discrimination d'agitateur	Filtre	Temporisation S-D
1*	1 m/min (3.3 pieds/min)	on	on	10 min
2	5 m/min (16.4 pieds/min)	on	on	3 min
3	immédiat	off	off	3 min
4	0.03 m/min (0.1 pieds/min)	on	on	10 min

\* = réglage usine

- Pour modifier le temps de réponse, visualiser 'SP'.
- Presser la touche "20" pour visualiser les options (1-2-3). Presser la touche "4" pour visualiser les options (3-2-1).
- Une fois l'option souhaitée affichée, cesser de presser la touche. L'afficheur revient automatiquement en mode Run (6 secondes).



3 sec Temps de réponse



Option courante, exemple : 1 m/min



Presser "20" pour obtenir l'option 2, exemple : 5 m/min



6 sec Option 2 sélectionnée

## Sécurité-défaut

Lorsque la condition de perte d'écho ou défaut excède la période 'Attente' (voir Temps de réponse, ci-dessus ou Temporisation sécurité-défaut, page 11) le symbole ' ? ' est affiché et une des valeurs de défaut suivantes est attribuée automatiquement.

FLS	Défaut	mAp	mAi	Lecture
1	plein	22	4	maintien
2	vide	4	22	maintien
3*	maintien	maintien	maintien	maintien

p = plage proportionnelle i = plage inversement proportionnelle \* = valeur par défaut (réglage en usine)

- Pour modifier la valeur par défaut, visualiser 'FLS'.
- Presser la touche "20" pour visualiser les options (1-2-3). Presser la touche "4" pour revenir aux options (3-2-1).

- Cesser de presser la touche dès que l'option souhaitée est affichée. L'affichage revient automatiquement en mode Run (6 secondes).



3 sec Sécurité-défaut



Option sélectionnée, exemple : plein



Presser "20" pour l'option 2,  
exemple : vide



6 sec Option 2 sélectionnée

## Temporisation sécurité-défaut

La temporisation sécurité-défaut permet à l'utilisateur de modifier la période 'Attente' dès le début de la perte d'écho ou du défaut de fonctionnement jusqu'à l'attribution de l'état sécurité-défaut. Cette période d'attente peut être réglée de 1 à 15 minutes, avec un pas d'incrémentation de 1 minute.

La valeur de défaut de la temporisation est déterminée par le temps de réponse (se référer à la page 10). Lorsqu'une valeur différente est souhaitée, régler la temporisation S-D *après* avoir modifié le temps de réponse.

- Pour modifier la temporisation sécurité-défaut, visualiser 'FST'.
- La valeur de la temporisation peut être augmentée avec la touche "20" et diminuée en pressant "4". Cesser de presser la touche dès que la valeur souhaitée est affichée.
- L'affichage revient automatiquement au mode Run (6 secondes).

## Unités

La lecture de la mesure peut être réglée pour un affichage en :

1 = mètres, m (réglage en usine)

2 = pieds, ft

L'unité de mesure sélectionnée peut également être utilisée pour le réglage 'Zone morte'.

- Pour modifier l'unité de mesure visualiser 'Un'.
- Presser la touche "20" pour avancer et visualiser les options (1 - 2). Presser la touche "4" pour visualiser les options (2 - 1).
- Lorsque la valeur souhaitée est affichée, cesser de presser les touches. L'afficheur reviendra automatiquement au mode Run (6 secondes).



3 sec Unités



Option courante, exemple : m

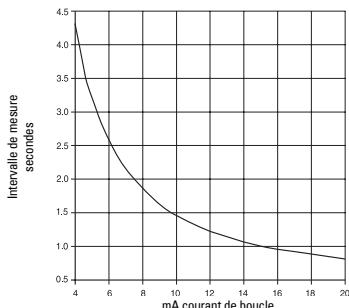


Presser "20" pour option 2,  
exemple : pieds



6 sec Option 2 sélectionnée

## Intervalle de mesure



## Dépistage des défauts



L'écho reçu n'est pas fiable. Le Probe attend de recevoir un écho valide avant de rafraîchir la mesure.

Les causes probables sont :

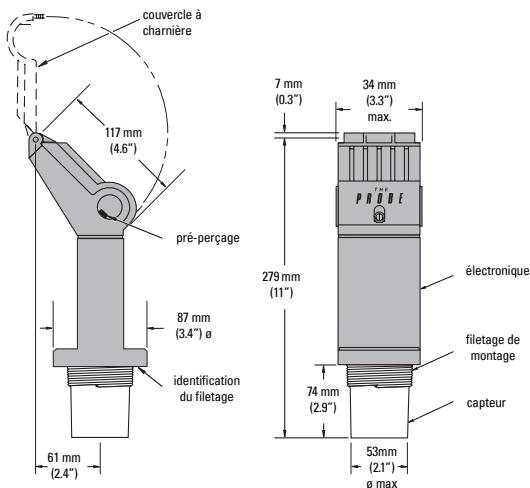
- Matériau ou cible en contact avec la face émettrice du capteur
- Le Probe est trop proche du point de remplissage
- Le Probe n'est pas perpendiculaire à la surface liquide
- Variation du niveau trop rapide
- Mesure en dehors de la plage
- Présence de mousse à la surface du liquide
- Vibrations importantes de la structure de montage
- Niveau produit dans la zone morte



L'état 'Attente' est terminé. Rechercher la cause probable dans la liste ci-dessus.

Se référer à la section Réglages / Temps de réponse, page 10 ou Temporisation Sécurité-défaut, page 11 pour la durée des périodes 'Attente'.

## Dimensions



# Brevets

## Conception du boîtier :

- Canada : 70345
- U.S.A. : 07/858/707
- Allemagne : M92022723
- Royaume-Uni : 2021748
- France : 921873
- Japon : 966217

## Électronique / Capteur :

- U.S.A. : 5,267,219
- 5,339,292
- Royaume-Uni : 2,260,059
- Brevets enregistrés : Royaume-Uni, Canada, Europe, Afrique, Australie

# Caractéristiques Techniques

---

## Alimentation :

- 12 à 28 V cc (Probe), 0.1 A maximum
- courant de boucle 4 à 20 mA maximum

## Caractéristiques environnementales :

- montage : en intérieur / extérieur
- altitude : 2000 m maximum
- température continue: -40 à +60°C (-40 à +140°F)  
ambiante : -20°C (-5°F) pour montage métallique
- humidité relative : adapté à une utilisation en extérieur (boîtier IP65 / Type 4X / NEMA 4X)
- catégorie d'installation : II
- degré de pollution : 4

## Plage de mesure :

- 0.25 à 5 m (0.8 à 16.4 pieds) (applications liquides uniquement)

## Angle d'émission :

- 10° à -3 dB

## Mémoire :

- EEPROM, non volatile, sans pile

## Programmation :

- via 2 touches

## Compensation de température :

- sonde interne, pour compensation sur la plage de température de fonctionnement

## Afficheur :

- cristaux liquides
- 3 chiffres, hauteur 9 mm (0.35") pour lecture, en mètres, de la distance capteur / produit mesuré
- graphique multi-segments, pour les états de fonctionnement

## Sortie analogique :

- plage : 4 – 20 mA
- étendue : proportionnelle ou inversement proportionnelle
- précision : 0.25% de la pleine échelle
- résolution : 3 mm (0.25")
- charge : 600 ohms maximum sous alimentation 24 V cc
- câble : Belden 8760, blindé, paire torsadée, Jauge 28 AWG (0.75 mm<sup>2</sup>) ou équivalent

## **Construction :**

- monobloc, incluant le capteur et l'électronique
- corps du capteur: matériau : Tefzel® ou Kynar Flex®
  - montage :
    - fileté : 2" NPT, 2" BSP PF2
    - option : adaptateur pour montage bride
- électronique : matériau : PVC
- boîtier : accès: couvercle à charnière
  - 2 pré-perçages, diamètre 22 mm (0.87") pour presse étoupes
  - bornier 6 vis pour câble 2.5 mm<sup>2</sup> (Jauge 14) fil unique 1.5 mm<sup>2</sup> (Jauge 16 ga), fil toronné

## **Degré de protection (boîtier) :**

- Type 4X/ NEMA 4X / IP65

## **Poids :**

- 1.5 Kg (3.3 lb)

## **Homologations :**

- CE. Rapport de performance CEM disponible sur demande
- sécurité intrinsèque CSA, FM, sécurité intrinsèque pour zones dangereuses Class I & II, Div. 1, GR. A, B, C, D, E, F, G  
SAA, Exia IIC T6 IP65, Classe I Zone 0  
BASEEFA / CENELEC, EExia IIC T4, Tamb = 60°C Ex 95C2032  
ATEX II 1 G, BAS99ATEX1300

**ANEXO 7**  
**VALVULA SOLENOIDE**



- 01 **Fiable:** Puede soportar constantemente una presión de hasta 220 PSI
- 02 **Durable:** Fabricado con nailon relleno de vidrio que produce una construcción extremadamente sólida
- 03 **Control de Caudal:** Permite el ajuste del caudal y la presión para cada zona

## ICV VÁLVULA

### *La Mejor Electroválvula para Sistemas Comerciales de Alta Presión*

Para crear una válvula de plástico que pueda funcionar convenientemente a 15 bar, Hunter solo confía en materiales probados tanto por el paso del tiempo como por el contratista. Creado para tratar con la amplia variedad de condiciones que presentarán las distintas instalaciones, la válvula ICV incluye, como funciones estándares, un diafragma EPDM de tela reforzado, un asiento E.P.D.M. y un control de caudal. Puede soportar sistemáticamente presiones de hasta 15 bar y a la vez resistir el martilleo constante que producirán dichas presiones. Además, es excepcionalmente fácil de utilizar, con cintas de sujeción para la tapa que pueden aflojarse y apretarse mediante una variedad de herramientas comunes. También está disponible una opción de Filter Sentry™ para aplicaciones que impliquen agua sucia. El sistema Filter Sentry™ mantiene la válvula libre de los residuos presentes en aguas recicladas o estanques.

# ICV VÁLVULA CARACTERÍSTICAS Y ESPECIFICACIONES

## Características

- Aplicación: Comercial/municipal
- Conexión de: 1" (25 mm), 1½" (40 mm), 2" (50 mm), 3" (80 mm) BSP
- La purga manual interna y externa permite una activación rápida y sencilla a "nivel de la válvula"
- La fabricación en nylon reforzado con vidrio permite la mayor presión
- Diseño de junta de diafragma con doble reborde para un rendimiento superior sin pérdidas
- El diafragma EPDM de tela reforzada y el asiento EPDM aseguran un funcionamiento superior en cualquier situación
- Los solenoides tipo "latch" DC admiten los programadores Hunter con pilas
- Los tornillos cautivos de la tapa permiten un mantenimiento de la válvula sin problemas
- La posibilidad de caudal bajo permite utilizar los productos de microriego Hunter
- Solenoide encapsulado de 24 V CA con émbolo cautivo para un mantenimiento sin problemas
- Temperatura: 66 °C
- Período de garantía: 5 años

## Especificaciones de Funcionamiento

- Caudal:
  - ICV-101G: 0.06 to 9 m<sup>3</sup>/hr; 0.4 to 150 l/min
  - ICV-151G: 17 to 31 m<sup>3</sup>/hr; 75 to 510 l/min
  - ICV-201G: 9 to 34 m<sup>3</sup>/hr; 150 to 560 l/min
  - ICV-301: 34 to 68 m<sup>3</sup>/hr; 560 to 1,135 l/min
- Intervalo de presión recomendado: de 1,5 a 15,0 bar; de 150 a 1.500 kPa

## Especificaciones del Solenoide

- Solenoide de 24 VAC:
  - 350 mA en arranque, 190mA en mantenimiento, 60 HZ
  - 370 mA en arranque, 210mA en mantenimiento, 50 HZ

## Modelos

### ICV-101G

**Conexión:** 1" BSP

Altura: 14 cm  
Anchura: 12 cm  
Profundidad: 10 cm



### ICV-151G

**Conexión:** 1½" BSP

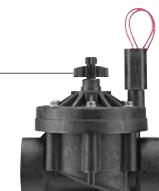
Altura: 18 cm  
Anchura: 17,5 cm  
Profundidad: 14 cm



### ICV-201G

**Conexión:** 2" BSP

Altura: 18 cm  
Anchura: 17,5 cm  
Profundidad: 14 cm



### ICV-301

**Conexión:** 3" BSP

Altura: 27 cm  
Anchura: 23,5 cm  
Profundidad: 19 cm



## ICV – ESPECIFICACIONES: ORDEN 1 + 2 + 3 + 4

1	Modelo	2	Entrada/ Salida	3	Opciones (Instalado De Fábrica)	4	Opciones (Instalado Por El Usuario)
	<b>ICV-101G</b> = Válvula en línea de 1" BSP (25 mm)		B = Roscada BSP	<b>(en blanco)</b> = Sin opción		<b>(en blanco)</b> = Sin opción	
	<b>ICV-151G</b> = Válvula en línea de 1½" BSP (40 mm)			<b>FS</b> = Filtro Sentry		<b>R</b> = Maneta de identificación de agua reciclada	
	<b>ICV-201G</b> = Válvula en línea de 2" BSP (50 mm)			<b>DC</b> = Solenoide tipo "latch" DC		<b>CC</b> = Tapa de conductos del solenoide	
	<b>ICV-301</b> = Válvula en línea/ángulo de 3" BSP (80 mm)					<b>DC</b> = Solenoide tipo "latch" DC	
						<b>AS-ADJ</b> = Regulador de presión ajustable Accu-Sync	
						<b>AS-xx*</b> = Accu-Sync Regulador de presión	
						<b>xx*</b> Indicar el modelo de Accu-Sync elegido: <b>20</b> = 1.4 bar, <b>30</b> = 2.1 bar, <b>40</b> = 2.8 bar, <b>50</b> = 3.5 bar, <b>70</b> = 4.8 bar	

**Website** [hunterindustries.com](http://hunterindustries.com) | **Asistencia Técnica** [SoporteTecnico@hunterindustries.com](mailto:SoporteTecnico@hunterindustries.com)

Lo que nos motiva es contribuir al éxito de nuestros clientes. Aunque nuestra pasión por la innovación y la ingeniería está presente en todo lo que hacemos, es el compromiso que hemos contraído de ofrecerle una asistencia excepcional lo que nos hace albergar la esperanza de que siga formando parte de la familia de clientes de Hunter en los próximos años.

  
Gregory R. Hunter, President of Hunter Industries

**ANEXO 8**  
**MODULO DE COMUNICACION**

## SIMATIC NET

### S7-1200 - Telecontrol CP 1242-7

#### Operating Instructions

#### Preface

Application and properties

1

Configuration examples

2

LEDs and connectors

3

Installation, connecting up,  
commissioning

4

Notes on configuration and  
operation

5

Configuration and  
programming

6

Service and maintenance

7

Technical specifications

8

Dimension drawings

A

Approvals

B

Accessories

C

References

D

## Legal information

### Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

#### DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

#### WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

#### CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

#### NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

### Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

### Proper use of Siemens products

Note the following:

#### WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

### Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

### Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

# Preface

## Validity of this manual

This document contains information on the following product:

CP 1242-7

Order number 6GK7 242-7KX30-0XE0

Hardware product version 1

Firmware version V1.3

The device is the communications processor for data transmission using GPRS for the SIMATIC S7-1200. The CP was developed for use in industrial environments.



Figure 1      CP 1242-7

At the top right behind the hinged cover of the module housing, you will see the hardware product version printed as a placeholder "X" (for example X 2 3 4). In this case, "X" would be the placeholder for hardware product version 1.

## Product name

In this document, the term "CP" is also used instead of the full product name "CP 1242-7".

## Purpose of the manual

This manual describes the properties of this module and supports you when installing and commissioning the device.

The necessary configuration steps are described in the form of an overview.

You will also find instructions for operation and information about the diagnostics options of the device.

## New in this issue

- Sending diagnostics SMS messages
- Optimization of several functions with the firmware version named above.

You will find information on these functions and the firmware for downloading on the Internet on the pages of Siemens Industrial Automation Customer Support at the following address:

45605894 (<http://support.automation.siemens.com/WW/view/en/45605894>)

- Editorial revision

## Replaced documentation

This manual replaces the manual release 03/2012.

## Current manual release on the Internet

You will also find the current version of this manual on the Internet pages of Siemens Automation Customer Support under the following entry ID:

61029644 (<http://support.automation.siemens.com/WW/view/en/61029644>)

## Required experience

To install, commission and operate the CP, you require experience in the following areas:

- Automation engineering
- Setting up the SIMATIC S7-1200
- SIMATIC STEP 7 Basic / Professional V11
- Data transmission using GPRS and the Internet

## Sources of information and other documentation

You will find an overview of further reading and references in the Appendix of this manual.

## License conditions

---

### Note

#### Open source software

Read the license conditions for open source software carefully before using the product. The acceptance of the disclaimers of liability and warranty it contains is a clear precondition of the use of open source software.

You will find license conditions in the document "DOC\_OSS-S7-CM-CP\_74.pdf" on the supplied data medium with the product documentation.

---

## Security messages

---

### Note

For its automation and drives product portfolio, Siemens provides IT security mechanisms to support secure operation of the plant/machine. Our products are continuously being further developed also taking into account the aspect of IT security. We therefore recommend that you regularly check for updates of our products and that you only use the latest versions. You will find information in:

(<http://support.automation.siemens.com/WW/lisapi.dll?func=cslib.csinfo2&aktprim=99&lang=en>)

Here, you can register for a product-specific newsletter.

For the secure operation of a plant/machine, it is also necessary to integrate the automation components in a full IT security concept for the entire plant/machine that represents the state of the art in IT technology. You will find information on this in:

(<http://www.siemens.com/industrialsecurity>)

Products from other manufacturers that are being used must also be taken into account.

---

## SIMATIC NET glossary

Explanations of the specialist terms used in this documentation can be found in the SIMATIC NET glossary.

You will find the SIMATIC NET glossary here:

- SIMATIC NET Manual Collection

The DVD ships with certain SIMATIC NET products.

- On the Internet under the following entry ID:

50305045 (<http://support.automation.siemens.com/WW/view/en/50305045>)

## Service & Support

In addition to the product documentation, the comprehensive online information platform of Siemens Automation Customer Support supports at any time and at any location in the world. You will find the Service & Support pages on the Internet at the following address: (<http://support.automation.siemens.com/WW/lisapi.dll?func=cslib.csinfo2&aktprim=99&lang=en>)

Apart from news, you will also find the following information there:

- Product information, Product Support, Applications & Tools
- Technical Forum
- Technical Support - Ask the Siemens experts
- Our service offer:
  - Technical Consulting, Engineering support
  - Field Service
  - Spare parts and repairs
  - Maintenance, optimization, modernization and more

You will find contact data on the Internet at the following address:  
(<http://www.automation.siemens.com/partner/guiwelcome.asp?lang=en>)

## SITRAIN - Siemens training for automation and industrial solutions

With over 300 different courses, SITRAIN covers the entire Siemens product and system spectrum in the field of automation and drive technology. Apart from the classic range of courses, we also offer training tailored for individual needs and a combination of different teaching media and sequences, for example self-learning programs on CD-ROM or on the Internet.

You will find detailed information on the training curriculum and how to contact our customer consultants at the following Internet address:

([www.siemens.com/sitrain](http://www.siemens.com/sitrain))

# Table of contents

<b>Preface .....</b>	<b>3</b>
<b>1 Application and properties .....</b>	<b>9</b>
1.1 Connecting the S7-1200 to a GSM network .....	9
1.2 Applications .....	10
1.3 Other properties of the CP .....	11
1.4 Performance data .....	11
1.5 Requirements for operation .....	13
<b>2 Configuration examples .....</b>	<b>15</b>
<b>3 LEDs and connectors .....</b>	<b>21</b>
3.1 Opening the housing .....	21
3.2 LEDs .....	22
3.3 Electrical connections .....	25
<b>4 Installation, connecting up, commissioning .....</b>	<b>27</b>
4.1 Important notes on using the device .....	27
4.2 Installing and commissioning the CP .....	29
4.3 Pin assignment of the socket for the external power supply .....	34
<b>5 Notes on configuration and operation .....</b>	<b>35</b>
5.1 Modes and communications partners of the CP 1242-7 .....	35
5.2 Connection modes and connection establishment .....	36
5.3 The wake-up SMS .....	38
5.4 Calling a TeleService connection .....	40
5.5 Connection monitoring, data buffering, acknowledgement .....	41
5.5.1 Redial delay (STEP 7) .....	41
5.5.2 Connection monitoring time .....	42
5.5.3 Frame buffer and acknowledgement .....	42
5.6 Data management in the process image .....	43
5.7 Data transfer between communications partners .....	44
5.7.1 Sending from station to station .....	44
5.7.2 The S7-1200 sends data to the master station (TC_SEND) .....	44
5.7.3 Master station reads data from the S7-1200 (read) .....	46
5.7.4 Master station sends data to the S7-1200 (write, TC_RECV) .....	47
5.8 Main and substitute telecontrol server .....	47
5.9 Reading out time by CPU .....	48

<b>6</b>	<b>Configuration and programming .....</b>	<b>49</b>
6.1	Configuration in STEP 7.....	49
6.2	Information required for configuration .....	49
6.3	Using and creating the telecontrol instructions .....	52
6.4	Programming the telecontrol instructions.....	53
6.4.1	TC_CON: Establish connection via the GSM network.....	53
6.4.2	TC_DISCON: Terminate connection via the GSM network .....	56
6.4.3	TC_SEND: Send data via the GSM network.....	59
6.4.4	TC_RECV: Receive data via the GSM network .....	63
6.4.5	TC_CONFIG: Transferring configuration data to CP .....	66
6.4.6	Other error messages .....	69
6.4.7	TCON_...: SDTs for the telecontrol connection establishment .....	69
6.4.8	IF_CONF: SDT for telecontrol configuration data .....	74
<b>7</b>	<b>Service and maintenance .....</b>	<b>83</b>
7.1	Diagnostics.....	83
7.2	Downloading firmware.....	84
7.3	Module replacement.....	85
<b>8</b>	<b>Technical specifications .....</b>	<b>87</b>
<b>A</b>	<b>Dimension drawings .....</b>	<b>89</b>
<b>B</b>	<b>Approvals.....</b>	<b>91</b>
B.1	Certification .....	91
B.2	Standards and test specifications .....	94
<b>C</b>	<b>Accessories .....</b>	<b>97</b>
C.1	Antennas .....	97
C.2	TS Gateway .....	99
<b>D</b>	<b>References .....</b>	<b>103</b>
	Glossary .....	105
	Index.....	109

# Application and properties

## 1.1 Connecting the S7-1200 to a GSM network

### IP-based WAN communication via GPRS

Using the CP 1242-7 communications processor, the S7-1200 SIMATIC controller can be connected to GSM networks. The CP 1242-7 allows WAN communication from remote stations with a master station, communication between stations via a master station (inter-station communication) and direct communication between stations.

The CP 1242-7 supports the following services for communication via the GSM network:

- GPRS (General Packet Radio Service)

The packet-oriented service for data transmission "GPRS" is handled via the GSM network.

- SMS (Short Message Service)

The CP 1242-7 can receive and send SMS messages. The communications partner can be a mobile phone or an S7-1200.

The CP 1242-7 is suitable for use in industry worldwide and supports the following frequency bands:

- 850 MHz
- 900 MHz
- 1 800 MHz
- 1 900 MHz

In countries in which the CP is approved, you will find this on the Internet on the pages of Siemens Automation Customer Support under the following entry ID:

45605894 (<http://support.automation.siemens.com/WW/view/en/45605894>)

On the Internet page, select the "Entry list" tab and the "Certificates" entry type.

---

#### Note

#### No CDMA mode

The CP is not suitable for GSM networks in which the code multiplex method "Code Division Multiple Access" (CDMA) is used.

---

## **1.2 Applications**

The CP 1242-7 is intended for use in an industrial environment. The following applications are supported by the CP:

### **Telecontrol applications**

- Sending messages by SMS

The function is not dependent on the operating mode of the CP.

Via the CP 1242-7, the CPU of a remote S7-1200 station can receive SMS messages from the GSM network or send messages by SMS to a configured mobile phone or an S7-1200.

- Communication with a control center

The CP is configured in "Telecontrol" mode.

Remote S7-1200 stations communicate via the GSM network and the Internet with a telecontrol server in the master station. The telecontrol server communicates with a higher-level control system using the integrated OPC server function.

- Communication between S7-1200 stations via a GSM network

Depending on the GSM service being used and the mode of the CP, the communication between remote stations with a CP 1242-7 will be handled in different ways:

- Inter-station communication via a master station ("Telecontrol" mode)

In this configuration, connections between S7-1200 stations and the telecontrol server are established in the master station. The telecontrol server forwards the messages between the stations.

- Direct communication between stations ("GPRS direkt" mode)

The CP requires a fixed IP address to be assigned by the GSM network provider.

### **TeleService via GPRS**

A TeleService connection can be established between an engineering station with STEP 7 installed on it and a remote S7-1200 station via the GSM network.

You can use the TeleService connection for the following purposes:

- Downloading project or program data from the STEP 7 project to the station
- Querying diagnostics data on the station

With TeleService via GPRS, a switching station is required between the remote station and engineering Station. This switching station can be a telecontrol server or, if there is no telecontrol server in the configuration, a TeleService gateway. You will find detailed information about both systems in the documentation , see References.

Other connections are not interrupted by a TeleService connection. You will find examples of the structure in the section Configuration examples (Page 15).

## **1.3      Other properties of the CP**

### **Other services and functions of the CP 1242-7**

- Time-of-day synchronization of the CP via the Internet

You can set the time on the CP as follows:

- In "Telecontrol" mode, the time of day is transferred by the telecontrol server. The CP uses this to set its time.

This time-of-day is adopted in the frames sent by the CP.

- In "GPRS direct" mode, the CP can request the time using NTP.

Make sure that your network provider supports NTP.

The NTP server and the time zone are specified during configuration.

The time of day of the CP can be read out by the CPU, see the section *Reading out time by CPU* (Page 48).

- Buffering frames on the telecontrol server

- Increased availability thanks to the option of connecting to a substitute telecontrol server

- Optimized data volume (temporary connection)

As an alternative to a permanent connection to the telecontrol server, the CP can be configured in STEP 7 with a temporary connection to the telecontrol server. In this case, a connection to the telecontrol server is established only when required.

- Logging of a variety of data and its transfer to the telecontrol server, for example:

- Data volumes transferred
- ID of the wireless cell in the area of the station
- GSM signal strength
- Communication status

etc.

## **1.4      Performance data**

### **Types of connection establishment**

The number of connections depends on the type of connection establishment:

- Active connection establishment

The connection establishment is initiated by the local CPU.

- Passive connection establishment

The connection establishment is initiated by the communications partner.

### Number of simultaneous connections in "Telecontrol" mode

- 1 reserved connection to the telecontrol server, for example for TeleService
- When connection establishment is active also:
- Max. 5 telecontrol connections (TCON\_WDC)
  - Max. 5 UDP connections (send only)

### Number of simultaneous connections in "GPRS direct" mode

A total of maximum 4 connections

Of which:

- Max. 1 connection to an NTP server
- Max. 1 TeleService connection
- Max. 4 productive connections

With active connection establishment:

- Max. 4 ISO-on-TCP connections or
- Max. 4 UDP connections (send only) or
- A combination of the connection types listed above

With passive connection establishment: Only ISO-on-TCP connections

---

#### Note

##### Port 30000 for ISO-ON-TCP

For ISO-ON-TCP, the CP does not use port number 102 but port 30000.

---

### User data

User data per send call with the various connection types:

- For telecontrol connections: Max. 2048 bytes
- For ISO-ON-TCP connections: Max. 2048 bytes
- For UDP connections: Max. 1472 bytes
- For SMS: Max. 160 bytes

### Frame buffer

Data buffering in "telecontrol" mode if the connection to the telecontrol server is interrupted:

- With send jobs with up to 1254 bytes of user data:  
Maximum 2000 frames
- With send jobs with 1255 to 2048 bytes of user data:  
Maximum 1000 frames

## 1.5 Requirements for operation

### Hardware requirements

Apart from the CP 1242-7 in the remote S7-1200, the following hardware is also required:

- A CPU with firmware version as of V2.0
- An external antenna for the CP 1242-7, see Accessories (Page 97)
- In the "Telecontrol" mode of the CP 1242-7, a PC with Internet access is required for the central telecontrol server.
- If you intend to use TeleService via GPRS, a TeleService gateway with Internet access is required for configurations without a telecontrol server. This is a PC on which the "TS Gateway" software is installed, see Accessories (Page 97).

### Configuration software

- Configuration tool

To configure the module, the following configuration tool is required:

STEP 7 Basic V11.0 SP2 Update 2

For STEP 7, you also require support package "HSP CP1242-7" version 1.1.

Install the support package in STEP 7 using the menu command "Options" > "Support packages". You can install the support package from your local file system if it is already stored there or from the Internet pages of Siemens Automation Customer Support. You will find the support package at one of the following addresses:

- 45605894 (<http://support.automation.siemens.com/WW/view/en/45605894>)
- 28919804 (<http://support.automation.siemens.com/WW/view/en/28919804>)

On the Internet page, select the "Entry list" tab and the "Download" entry type.

A description of installing support packages is available in the help system of STEP 7 under the search term "Support packages".

### Program blocks (instructions)

For productive communication, the telecontrol instructions are required.

For TeleService, the telecontrol instructions are not necessary.

The telecontrol instructions execute on the CPU. They are made available with the "HSP CP1242-7" support package in STEP 7. For a description of the instructions, refer to the section Configuration and programming (Page 49).

### Software for communication with a telecontrol server

The CP is configured in "Telecontrol" mode.

- The telecontrol server requires the "TELECONTROL SERVER BASIC" software.

For the documentation, see /2/ (Page 104) in the References.

## **Software for TeleService functions**

- STEP 7 including the support package "HSP CP1242-7"  
For the current version, see above in the section "Configuration software".
- For the switching station:
  - For configuration with telecontrol server:  
The "TELECONTROL SERVER BASIC" software
  - For configuration without telecontrol server  
The "TS Gateway" softwareThe software and the manual describing it are on the DVD that ships with the CP. For the documentation, see /3/ (Page 104) in the References.

## **Requirements for using GSM services**

- A contract with a suitable GSM network provider
  - The contract must allow the transfer of data using GPRS.
  - The contract must allow the assignment of public IP addresses.
  - If there is to be direct communication between GPRS stations ("GPRS direct" mode), the GSM network provider must assign fixed IP addresses to the CP 1242-7 and forward the frames to the destination subscribers.
- The SIM card belonging to the contract  
The SIM card is inserted in the CP 1242-7.
- Local availability of a GSM network capable of GPRS in the range of the station

# Configuration examples

Below, you will find configuration examples for stations with a CP 1242-7.

## Sending messages by SMS

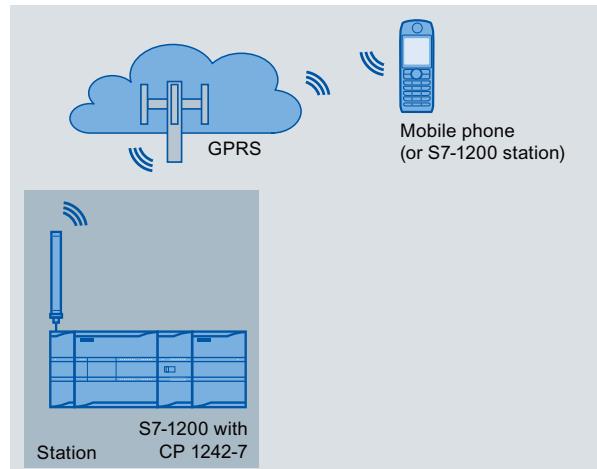


Figure 2-1 Sending messages by SMS from an S7-1200 station

A SIMATIC S7-1200 with a CP 1242-7 can send messages by SMS to a mobile phone or a configured S7-1200 station.

The function can also be used to send diagnostics SMS messages to an authorized mobile phone. You will find details in the section Diagnostics (Page 83).

## Telecontrol by a control center

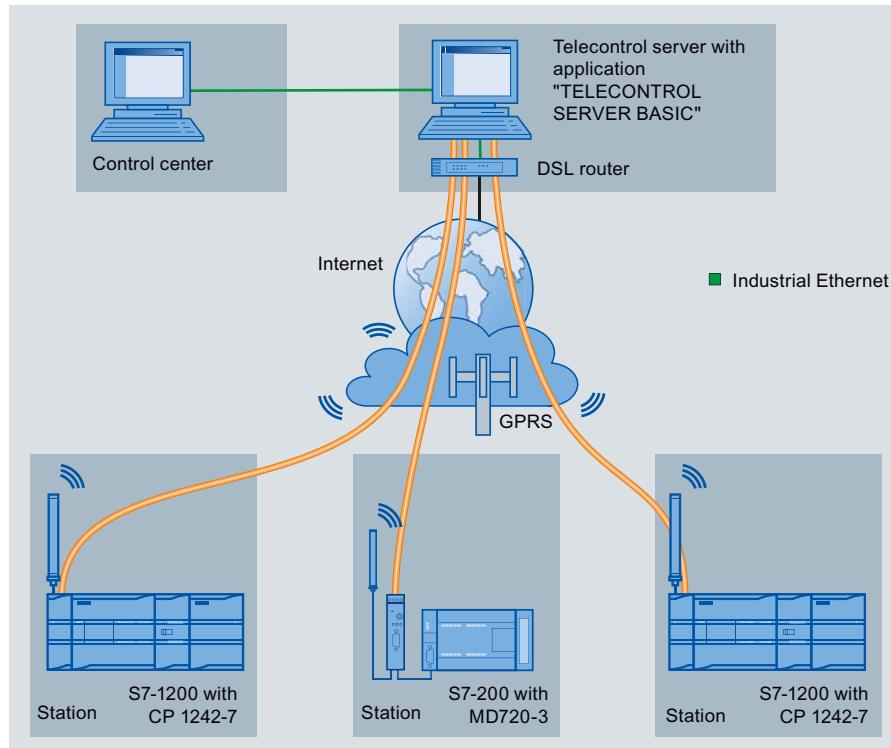


Figure 2-2 Communication between S7-1200 stations and a control center

In telecontrol applications, SIMATIC S7-1200 stations with a CP 1242-7 communicate with a control center via the GSM network and the Internet. The "TELECONTROL SERVER BASIC" (TCSB) application is installed on the telecontrol server in the master station. This results in the following use cases:

- Telecontrol communication between station and control center

In this use case, data from the field is sent by the stations to the telecontrol server in the master station via the GSM network and Internet. The telecontrol server is used to monitor remote stations.

- Communication between a station and a control room with OPC client

As in the first case, the stations communicate with the telecontrol server. Using its integrated OPC server, the telecontrol server exchanges data with the OPC client of the control room.

The OPC client and telecontrol server can be located on a single computer, for example when TCSB is installed on a control center computer with WinCC.

- Inter-station communication via a control center

Inter-station communication is possible with S7 stations equipped with a CP 1242-7.

To allow inter-station communication, the telecontrol server forwards the messages of the sending station to the receiving station.

## Direct communication between stations

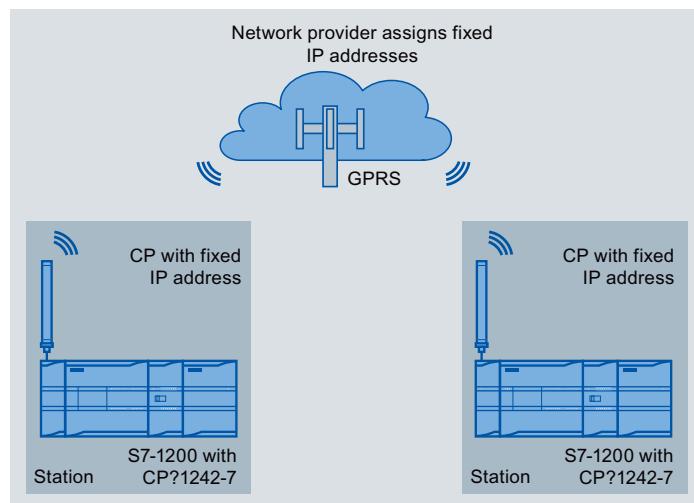


Figure 2-3 Direct communication between two S7-1200 stations

In this configuration, two SIMATIC S7-1200 stations communicate directly with each other using the CP 1242-7 via the GSM network. Each CP 1242-7 has a fixed IP address. The relevant service of the GSM network provider must allow this.

## TeleService via GPRS

In TeleService via GPRS, an engineering station on which STEP 7 is installed communicates via the GSM network and the Internet with the CP 1242-7 in the S7-1200.

Since a firewall is normally closed for connection requests from the outside, a switching station between the remote station and the engineering station is required. This switching station can be a telecontrol server or, if there is no telecontrol server in the configuration, a TeleService gateway.

## TeleService with telecontrol server

The connection runs via the telecontrol server.

- The engineering station and telecontrol server are connected via the Intranet (LAN) or Internet.
- The telecontrol server and remote station are connected via the Internet and via the GSM network.

The engineering station and telecontrol server can also be the same computer; in other words, STEP 7 and TCSB are installed on the same computer.

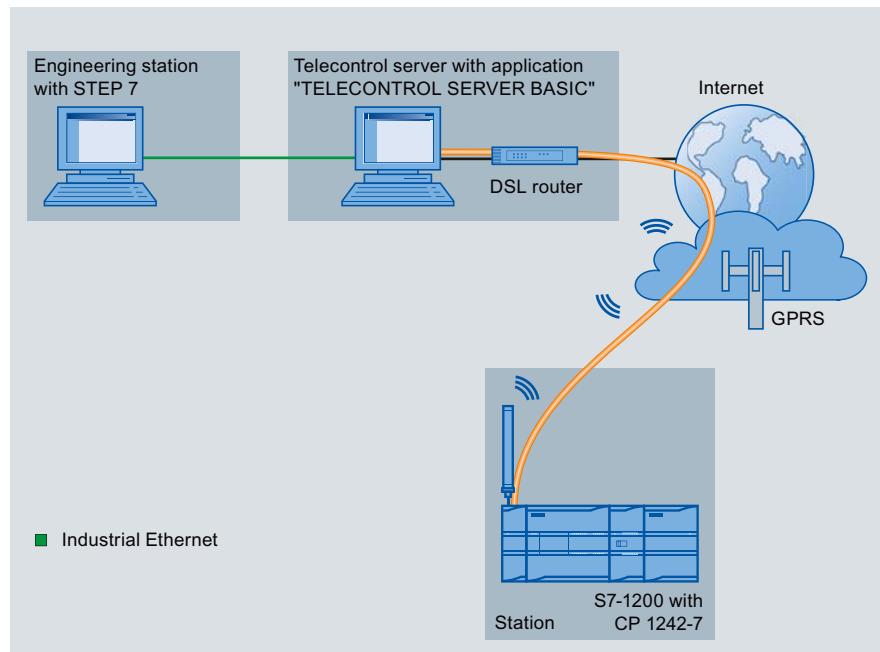


Figure 2-4 TeleService via GPRS in a configuration with telecontrol server

## TeleService without a telecontrol server

The connection runs via the TeleService gateway.

The connection between the engineering station and the TeleService gateway can be local via a LAN or via the Internet.

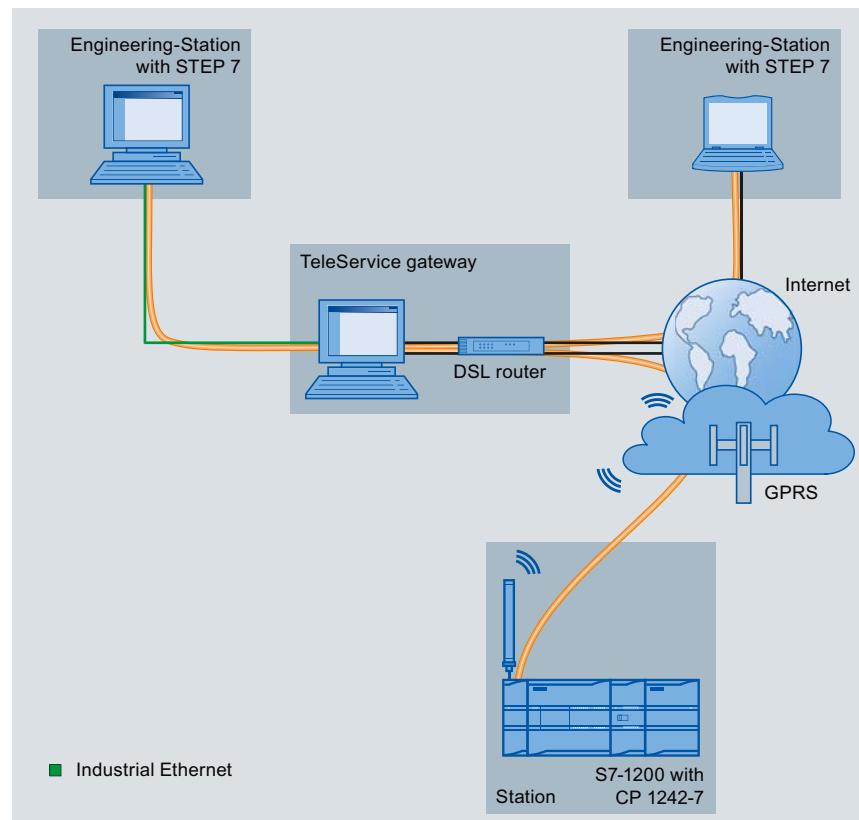


Figure 2-5    TeleService via GPRS in a configuration with TeleService gateway



## LEDs and connectors

### 3.1 Opening the housing

#### Location of the display elements and the electrical connectors

The LEDs for the detailed display of the module statuses are located behind the upper cover of the module housing.

The socket for the power supply is located on the top of the module.

The connector for the external antenna is located on the bottom of the module.

#### Opening the housing

Open the upper or lower cover of the housing by pulling it down or up as shown in the illustration. The covers extend beyond the housing to give you a grip.

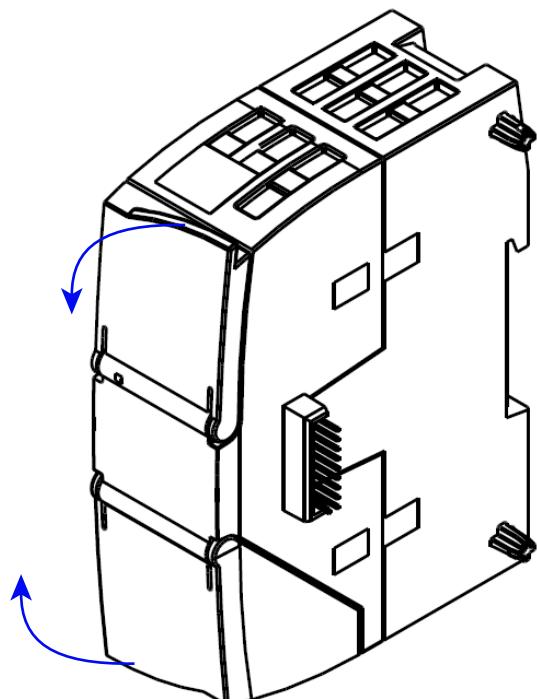


Figure 3-1 Opening the housing

## 3.2 LEDs

### LEDs of the module

The module has various LEDs for displaying the status:

- LED on the front panel

The "DIAG" LED that is always visible shows the basic statuses of the module.

- LEDs below the upper cover of the housing

The LEDs below the upper cover provide more detailed information on the module status.

Table 3- 1 LED on the front panel

LED / colors	Name	Meaning
 red/green	DIAG	Basic status of the module

Table 3- 2 LEDs below the upper cover of the housing

LED / colors	Name	Meaning
 red/green	Network	Status of the network connection
 green	Connect	Number of connections to the telecontrol server
 yellow / green	Signal quality	Signal quality of the GSM network
 green	TeleService	Status of the TeleService connection

---

#### Note

##### LED colors when the module starts up

When the module starts up, all its LEDs are lit for a short time. Multicolored LEDs display a color mixture. At this point in time, the color of the LEDs is not clear.

---

## Display of the operating and communication status

The LED symbols in the following tables have the following significance:

Table 3- 3 Meaning of the LED symbols

					-
					Not relevant

The LEDs indicate the operating and communications status of the module according to the following scheme:

Table 3- 4 Display of the basic statuses of the module

DIAG (red / green)	-	Network (red / green)	Connect (green)	Signal quality (yellow / green)	TeleService (green)	Meaning
		-	-	-	-	Power OFF
		-	-	-	-	RUN without errors, Telecontrol or TeleService is running
		-	-	-	-	Startup (STOP → RUN) and other statuses, refer to the next table.
		-	-	-	-	Error

## LEDs and connectors

### 3.2 LEDs

Table 3- 5 Display schemes for detailed module statuses

DIAG (red / green)	-	Network (red / green)	Connect (green)	Signal quality (yellow / green)	TeleService (green)	Meaning
-		○	-	-	-	No connection to the GPRS service in the GSM network
 green		 green	-	-	-	Connection exists to the GPRS service in the GSM network
 green		 green	○	-	○	Waiting for PIN (SIM card OK)
 red		 red	○	-	○	SIM card defective
 red		 red	○	-	○	Wrong PIN
 red		○	○	○	○	Internal error: Station must be restarted.
 green		-	○	-	○	<ul style="list-style-type: none"> <li>• No connection to the telecontrol server or</li> <li>• No configuration available</li> </ul>
 green		 green	 green	-	-	Connection to the telecontrol server established
 green		 green	 green	-	-	Data transfer
-		-	-	 green	-	Good GSM network (-73 ... > -53 dBm)
-		-	-	 yellow	-	Medium strength GSM network (-89 ... -75 dBm)
-		-	-	 yellow	-	Weak GSM network (-109 ... -91 dBm)
-		-	-	○	-	No GSM network (< -111 dBm)
-		-	-	-	○	Currently no TeleService session
 green		 green	-	-	 green	TeleService session running <sup>1</sup>
 green		-	-	-	 green	Attempted login to TeleService session

<sup>1</sup> When a TeleServiceconnection is being established, the LED is lit for at least 10 minutes.

### 3.3 Electrical connections

#### Power supply

The 3-pin socket for the external 24 V DC power supply is located on the top of the module. The matching plug ships with the product.

You will find the pin assignment of the socket in section Pin assignment of the socket for the external power supply (Page 34).

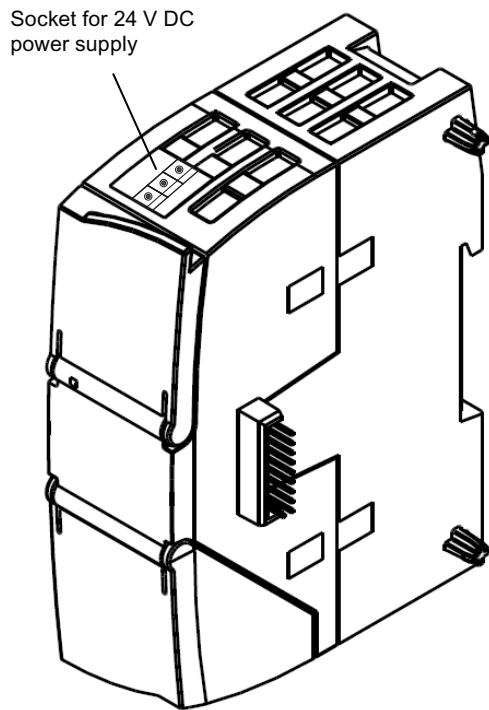


Figure 3-2    Socket for the 24 V DC power supply

#### Wireless interface for the GSM network

An extra antenna is required for GPRS communication in the GSM network. This is connected via the SMA socket of the CP. The SMA socket is located behind the lower front cover of the CP.

You will find a suitable antenna for indoor and outdoor use in the section Accessories (Page 97).

#### More detailed information on the electrical connections

For technical information on the electrical connections, refer to the section Technical specifications (Page 87).



# 4

## Installation, connecting up, commissioning

### 4.1 Important notes on using the device

#### Safety notices on the use of the device

The following safety notices must be adhered to when setting up and operating the device and during all work relating to it such as installation, connecting up, replacing devices or opening the device.

#### General notices



##### **Safety extra low voltage**

The equipment is designed for operation with Safety Extra-Low Voltage (SELV) by a Limited Power Source (LPS). (This does not apply to 100 V to 240 V devices.)

This means that only SELV / LPS complying with IEC 60950-1 / EN 60950-1 / VDE 0805-1 must be connected to the power supply terminals. The power supply unit for the equipment power supply must comply with NEC Class 2, as described by the National Electrical Code (r) (ANSI / NFPA 70).

**There is an additional requirement if devices are operated with a redundant power supply:**

If the equipment is connected to a redundant power supply (two separate power supplies), both must meet these requirements.



##### **Opening the device**

**DO NOT OPEN WHEN ENERGIZED.**

#### General notices on use in hazardous areas



##### **Risk of explosion when connecting or disconnecting the device**

**EXPLOSION HAZARD**

**DO NOT CONNECT OR DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.**

**4.1 Important notes on using the device**



**Replacing components**

**EXPLOSION HAZARD**

SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2 OR ZONE 2.



**Requirements for the cabinet/enclosure**

When used in hazardous environments corresponding to Class I, Division 2 or Class I, Zone 2, the device must be installed in a cabinet or a suitable enclosure.

**General notices on use in hazardous areas according to ATEX**



**Requirements for the cabinet/enclosure**

To comply with EU Directive 94/9 (ATEX95), this enclosure must meet the requirements of at least IP54 in compliance with EN 60529.



**Suitable cables for temperatures in excess of 70 °C**

If the cable or conduit entry point exceeds 70 °C or the branching point of conductors exceeds 80 °C, special precautions must be taken. If the device is operated at ambient temperatures > 50 °C, the permitted temperature range of the selected cable must be suitable for the temperatures actually measured.



**Protection against transient voltage surges**

Provisions shall be made to prevent the rated voltage from being exceeded by transient voltage surges of more than 40%. This criterion is fulfilled, if supplies are derived from SELV (Safety Extra-Low Voltage) only.

## Overvoltage protection

### NOTICE

#### Protection of the external 24 VDC power supply

If power is supplied to the module over longer 24 V power cables or networks, the coupling in of strong electromagnetic pulses onto the power supply cables is possible. This can be caused, for example by lightning strikes or switching of higher loads.

The connector of the external 24 VDC power supply is not protected from strong electromagnetic pulses. To protect it, an external overvoltage protection module is necessary. A suitable device is, for example, the Dehn Blitzductor BVT AD 24V type no. 918 402 or comparable protective element.

Manufacturer:

DEHN + SÖHNE GmbH + Co. KG, Hans-Dehn-Str. 1, PO box 1640, D-92306 Neumarkt

## 4.2      **Installing and commissioning the CP**

### Prior to installation and commissioning

### ⚠ WARNING

#### Read the system manual "S7-1200 Programmable Controller"

Prior to installation, connecting up and commissioning, read the relevant sections in the system manual "S7-1200 Programmable Controller", refer to the documentation in the Appendix.

When installing and connecting up, keep to the procedures described in the system manual "S7-1200 Programmable Controller".

### Configuration

One requirement for the commissioning of the CP is the completeness of the STEP 7 project data (see below). You should also read the section "Configuration and programming (Page 49)".

### Inserting the SIM card

---

#### Note

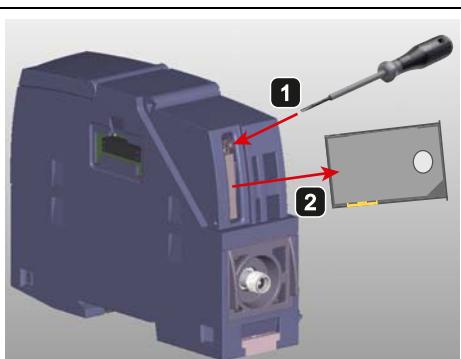
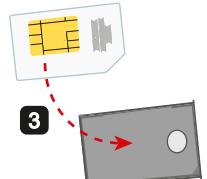
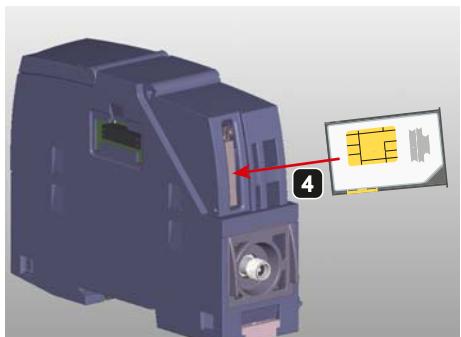
#### Inserting and removing the SIM card

Do not insert or remove the SIM card while the CP is operating.

---

Prior to installation, insert the SIM card in the CP.

## 4.2 Installing and commissioning the CP

Step	Execution	Notes and explanations
1	Turn off the power supply to the station.	
2	Release the slide for the SIM card on the bottom of the CP by gently pressing the release pin.	
3	Remove the slide from the housing.	
4	Insert the SIM card in the slide as illustrated.	
5	Push the slide back into the housing, where it locks gently in place.	
6	Turn on the power supply to the station.	

### Dimensions for installation

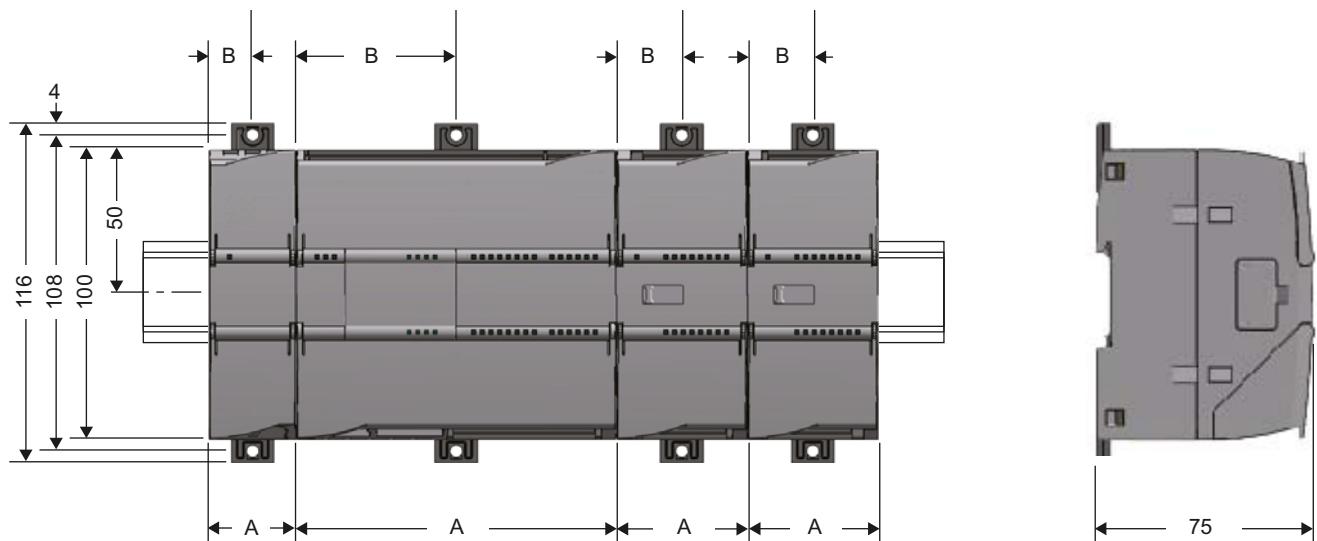


Figure 4-1 Dimensions for installation of the S7-1200

Table 4- 1 Dimensions for installation (mm)

<b>S7-1200 devices</b>		<b>Width A</b>	<b>Width B *</b>
CPU	CPU 1211C, CPU 1212C	90 mm	45 mm
	CPU 1214C	110 mm	55 mm
Signal modules	8 or 16 digital I/Os 2, 4 or 8 analog I/Os Thermocouple, 4 or 8 I/Os RTD, 4 I/Os	45 mm	22.5 mm
	16 analog I/Os RTD, 8 I/Os	70 mm	35 mm
Communications interfaces	CM 1241 RS-232 and CM 1241 RS-485	30 mm	15 mm
	CM 1243-5 (PROFIBUS master) CM 1242-5 (PROFIBUS slave)	30 mm	15 mm
	CP 1242-7 (GPRS CP)	30 mm	15 mm

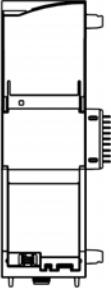
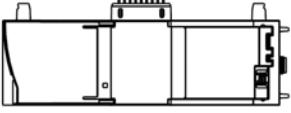
\* Width B: The distance between the edge of the housing and the center of the hole in the DIN rail mounting clip

### DIN rail mounting clips

All CPUs, SMs, CMs and CPs can be installed on the DIN rail in the cabinet. Use the pull-out DIN rail mounting clips to secure the device to the rail. These mounting clips also lock into place when they are extended to allow the device to be installed in a switching panel. The inner dimension of the hole for the DIN rail mounting clips is 4.3 mm.

## **Procedure for installation and commissioning**

<b>NOTICE</b>
<b>Installation location</b>
The module must be installed so that its upper and lower ventilation slits are not covered, allowing adequate ventilation. Above and below the device, there must be a clearance of 25 mm to allow air to circulate and prevent overheating.
Remember that the permitted temperature ranges depend on the position of the installed device.

<b>Device position / permitted temperature range</b>	<b>Installation location</b>
Horizontal installation of the rack: 0 °C to 55 °C	
Vertical installation of the rack: 0 °C to 45 °C	

---

### **Note**

#### **Connection with power off**

Only wire up the S7-1200 with the power turned off.

#### **Power supply from the power outputs of the CPU**

The power supply of the CP must be supplied via the power outputs of the CPU.

Keep within the maximum load of the power outputs of the CPU.

You will find data relating to the current consumption and power loss of the CP in the section Technical specifications (Page 87).

#### **Turning off the station when plugging/pulling the CP**

Do not only turn off the power supply to the CP. Always turn off the power supply for the entire station.

---

Table 4- 2 Procedure for installation and connecting up

Step	Execution	Notes and explanations
1	Mount the CP on the DIN rail and connect it to the module to its right.	Use a 35 mm DIN rail. The slots to the left of the CPU are permitted.
2	Secure the DIN rail.	
3	Secure the power supply wires to the power output of the CPU.	
4	Secure the wires of the power supply to the plug supplied with the CM and insert the plug in the socket on the top of the CM.	The pinning is shown beside the socket on the top of the housing. You will also find this in the section Pin assignment of the socket for the external power supply (Page 34).
5	Connect the antenna to the SMA socket of the CP.	Lower surface of the CP
	<b>Notice</b>	
	<ul style="list-style-type: none"> <li>• Protect the antenna connector using suitable overvoltage protection equipment if the antenna cable is longer than 30 m.</li> <li>• Protect the antenna connector with suitable lightning protection if you install the antenna outdoors.</li> </ul>	
6	Turn on the power supply.	
7	Close the front covers of the module and keep them closed during operation.	
8	The remaining steps in commissioning involve downloading the STEP 7 project data.	<p>The STEP 7 project data of the CP is transferred when you load to the station. To load the station, connect the engineering station on which the project data is located to the Ethernet interface of the CPU.</p> <p>You will find more detailed information on loading in the following sections of the STEP 7 online help:</p> <ul style="list-style-type: none"> <li>• "Loading project data"</li> <li>• "Using online and diagnostics functions"</li> </ul>

#### 4.3 Pin assignment of the socket for the external power supply

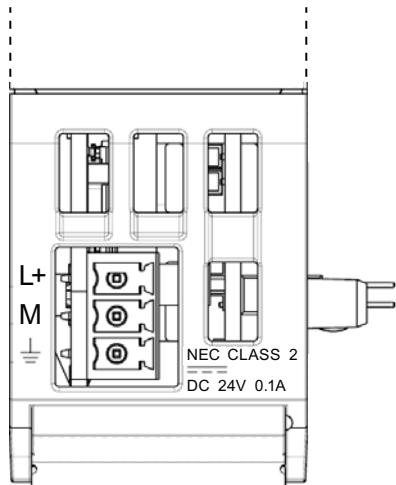


Figure 4-2    Socket for the external 24 VDC power supply (view from above)

Table 4- 3    Pin assignment of the socket for the external power supply

Pin	Labeling	Function
1	L+	+ 24 VDC
2	M	Ground reference for + 24 VDC
3	$\underline{\underline{=}}$	Ground connector

# Notes on configuration and operation

## CAUTION

### Minimum clearance to the device

The device may only be operated when the distance between the device (or antenna) and user is at least 20 cm.

## NOTICE

### Closing the front panels

To ensure interference-free operation, keep the front panels of the module closed during operation.

## 5.1 Modes and communications partners of the CP 1242-7

### Modes and communications partners of the CP

For communication with the CP 1242-7 via GPRS, the CP is set to one of the following modes:

- Telecontrol

This CP mode allows the GPRS station to exchange data with a telecontrol server.

The telecontrol server is a PC with the "TELECONTROL SERVER BASIC" application that is connected to the Internet. It is generally located in the master station and is used for monitoring and control of the remote GPRS stations.

Possible communications partners of the GPRS station with a CP 1242-7 in "Telecontrol" mode are:

- A telecontrol server
- A central control system (via the OPC interface of the telecontrol server)
- An engineering station (for TeleService)
- Up to 5000 GPRS stations with a CP 1242-7 logged on with the telecontrol server

You will find detailed information about the "TELECONTROL SERVER BASIC" application in /2/ (Page 104), see References in the Appendix.

## 5.2 Connection modes and connection establishment

- GPRS direct

This mode of the CP is used for direct communication between remote stations via the GSM network. No telecontrol server is necessary.

To allow network nodes in public wireless networks to be directly accessible, these need to be addressed using a fixed address. Here, SIM cards with a fixed IP address are used that allow the stations to address each other directly.

The possible communications services and security functions (for example VPN) depend on what is offered by the network provider.

Possible communications partners of the GPRS station with a CP 1242-7 in "GPRS direct" mode are:

- A subscriber that can be reached by the CP via an IP address (for example S7-1200 with CP 1242-7)
- An engineering station (for TeleService)

## 5.2 Connection modes and connection establishment

---

### Note

#### Connection interrupted by GSM network provider

When using the GPRS service, remember that existing connections can be interrupted by GSM network providers for maintenance purposes.

---

### Connection modes

- "GPRS direct" mode

There are no different connection modes in the "GPRS direct" mode.

- "Telecontrol" mode

The CP can be configured for the following connection modes.

- "Permanent" connection mode

There is a permanent TCP connection to the telecontrol server. Following connection establishment, there is a permanent TCP connection to the telecontrol server even if data is not transferred permanently.

- "Temporary" connection mode

A connection is only established to the telecontrol server when required.

If a TCP connection is established, process data is sent as soon as the telecontrol instructions are called on the CPU.

## Connection establishment

A connection is always established by the CP. If a connection established by the CP is interrupted, the CP automatically attempts to re-establish the connection.

### Triggering connection establishment for permanent stations ("Telecontrol" mode)

In the "Telecontrol" mode, the permanent connection to the telecontrol server is established when the station starts up. If the connection is interrupted, the CP attempts to re-establish the connection at 15 minute intervals. Connection establishment to the main or substitute server can, however, also be initiated by a wake-up SMS (see below).

---

#### Note

##### Cyclic data exchange with the telecontrol server

The special settings for cyclic data exchange initiated by a telecontrol server are described in the section [The S7-1200 sends data to the master station \(TC\\_SEND\) \(Page 44\)](#).

---

### Triggering connection establishment for temporary stations ("Telecontrol" mode)

With "temporary" stations, connection establishment can be triggered by the following events:

- Event on the local CPU that needs to be evaluated by the program.

These can, for example, be events that lead to a one-time connection establishment (for example alarms or commands of an operator) or the elapsing of a time interval that leads to cyclic connection establishment (for example once daily for data transfer).

- Request by a communications partner (OPC client or S7 station)

A wake-up call or a wake-up SMS message from the communications partner causes a connection establishment.

- Request for TeleService by an engineering station

The request switched by the telecontrol server or TeleService gateway does not need to be evaluated in the program.

- Wake-up SMS of the telecontrol server

The wake-up SMS can be triggered spontaneously on the telecontrol server. It is also possible to configure cyclic sending on the telecontrol server.

- Telephone wake-up call

The wake-up call can be sent from a telephone that has a phone number authorized in the STEP 7 project. The telephone must support the CLIP function (transfer of its own call number).

The connection establishment with the (main) telecontrol server is triggered.

### 5.3 The wake-up SMS

- Telephone wake-up SMS

The wake-up SMS can be sent from a telephone that has a phone number authorized in the STEP 7 project. The telephone must support the CLIP function (transfer of its own call number) and the sending of SMS messages.

The connection establishment with the telecontrol server specified in the SMS is triggered.

#### Triggering connection establishment in "GPRS direct" mode

In "GPRS direct" mode, a connection establishment is triggered by the following events:

- Event on the local CPU that is evaluated by the program.
- Request for TeleService by an engineering station

The wake-up frame (SMS) from the TeleService gateway does not need to be evaluated in the program.

## 5.3 The wake-up SMS

#### Right to wake-up by "authorized phone numbers"

The CP only accepts an SMS if the sending communication partner is authorized based on its phone number. These numbers are configured for the CP in STEP 7 in the "authorized phone numbers" list.

#### "Authorized phone numbers" in the STEP 7 project

- A phone number entered here gives the sender who transfers this phone number the right to trigger connection establishment.
- If only an asterisk (\*) is entered in the list, the CP accepts SMS messages from all senders.
- An asterisk (\*) after a phone number body authorizes connection establishment for all nodes connected to the body (extension numbers).

Example: +49123456\* authorizes +49123456101, +49123456102, +49123456207 etc.

---

#### Note

#### No wake-up without an authorized phone number

If the "Authorized phone numbers" list is empty, the CP cannot be woken up for connection establishment.

---

## Wake-up call and wake-up SMS

The CP is woken by its communications partner using a wake-up call or a wake-up SMS and requested to establish the connection to the partner.

Depending on the connection type and the connection partner, the following text must be transferred in the wake-up SMS:

- For telecontrol connections:

- Text for the wake-up SMS message for establishing a connection to the telecontrol server:  
TELECONTROL

- Text for the wake-up SMS message for establishing a connection to the main telecontrol server:  
TELECONTROL MAIN

- Text for the wake-up SMS message for establishing a connection to the substitute telecontrol server:  
TELECONTROL BACKUP

The configuration of the telecontrol server for the CP 1242-7 is set in STEP 7 in "Telecontrol interface > Operating mode > main or substitute telecontrol server".

---

### Note

#### Wake-up with a mobile phone

- One of the texts listed above can be used in a wake-up SMS message.
  - With a wake-up call, the station always connects to the main telecontrol server.
- 

- For TeleService connections:

- Text for the wake-up SMS message for establishing a connection to the first configured TeleService server:  
TELESERVICE

or

TELESERVICE 1

- Text for the wake-up SMS message for establishing a connection to the second configured TeleService server:  
TELESERVICE 2

For TeleService, no extra wake-up SMS needs to be sent since the connection establishment is initiated by the engineering station.

The phone number of the TeleService must also be configured in the STEP 7 project for the CP in the "Authorized phone numbers" list.

The configuration of the TeleService server for the CP 1242-7 is set in STEP 7 in "Telecontrol interface > TeleService settings".

## 5.4 Calling a TeleService connection

### Requirement for the engineering station

The STEP 7 project with the CP 1242-7 is stored on the engineering station.

### Requirement for switching the connection

The request for connection establishment is triggered by the engineering station. To switch the connection to the remote station, a telecontrol server or a TeleService gateway is required. See also section Requirements for operation (Page 13).

### Procedure for connection establishment for TeleService

---

#### Note

#### No TeleService connection establishment using "Online" > "Go online"

If you attempt to establish a TeleService connection by selecting the CPU and then selecting the menu or shortcut menu command "Online" > "Connect online", STEP 7 will automatically attempt to connect via Ethernet. Reason: In STEP 7, the last connection path used to download the project data is stored.

#### TeleService only from one single STEP 7 project

You can only operate TeleService on an engineering Station from within a single STEP 7 project. TeleService from more than one STEP 7 project at any one time is not possible.

---

Follow the steps below to establish a TeleService connection to the remote station via GPRS from the engineering station:

1. Select the CPU of the remote station in the STEP 7 project.
2. Select the "Online" > "Online & Diagnostics" menu.  
The "Online access" dialog opens.
3. Choose the entry "TeleService via GPRS" in the "Type of interface" drop-down list.
4. Choose the entry "GPRS TeleService board" in the "PG/PC interface" drop-down list.
5. Click on the  icon next to the "PG/PC interface" drop-down list.  
The "Establish remote connection" dialog box opens.
6. Make the necessary entries in this dialog.

You will find information on the necessary entries in the tooltips of the STEP 7 online help.

## Working with TeleService

---

### Note

#### Loading only in offline mode

Loading software and blocks with TeleService via GPRS by calling the function "Load to device" only works when no TeleService connection is established.

#### Canceling a TeleService connection when calling online dialogs

An existing TeleService connection is canceled when you attempt to access an additional station or a node.

When there is an existing TeleService connection, do not select any of the menu commands "Go online", "Online & Diagnostics", "Load to device", "Extended download to device" or "Accessible nodes".

---

## Terminating a TeleService connection

On completion of the TeleService session, terminate the TeleService connection again using the "Go offline" button. The connection is terminated after approximately 5 minutes.

## 5.5 Connection monitoring, data buffering, acknowledgement

### 5.5.1 Redial delay (STEP 7)

#### "Redial delay" parameter ("Telecontrol" mode)

In "Telecontrol" mode, the redial delay is the waiting time between the connection establishment attempts of the CP if the telecontrol server cannot be reached. It is configured in STEP 7, parameter group "Operating mode" of the CP.

A basic value is configured for the waiting time before the next connection establishment attempt. After every 3 redial attempts, the basic value is doubled up to a maximum of 900 s. Range of values: 10 to 600 s.

Example: The basic value 20 results in the following intervals for connection establishment attempts:

- three times 20 s
- three times 40 s
- three times 80 s
- etc. up to max. 900 s

If a substitute telecontrol server is configured, the 4th time the CP attempts to connect to the substitute server, in this example therefore after the following time:

---

## 5.5 Connection monitoring, data buffering, acknowledgement

- three times 20 s redial delay +
- three times the connection monitoring time configured for the CP  
(time until the arrival of the TCP acknowledgement from the communications partner)

---

### Note

Depending on your contract, costs may result from each connection establishment attempt.

---

## 5.5.2 Connection monitoring time

### "Connection monitoring time" parameter

The connection monitoring time is the monitoring time for the connection to the communications partner. The connection monitoring time is configured in the STEP 7 "Keepalive timeout" parameter group of the CP. Range of values: 0...600 s. The response differs depending on the mode of the CP:

- **"Telecontrol" mode**

In the "Telecontrol" mode, the connection monitoring time is the time until the acknowledgement is received from the partner after sending a frame.

If the configured time is exceeded, the frame is buffered if the Telecontrol server is the recipient (RemoteWdcAddress = 0).

If 0 is entered, the default value 10 s will be used.

Note: The time until the arrival of the acknowledgement depends largely on the GSM network being used.

- **"GPRS direct" mode**

In the "GPRS direct" mode (TCON\_IP RFC), the reachability of the partner is checked if the configured time elapses.

If the partner cannot be reached STATUS has the value 80F5<sub>h</sub>.

If you enter 0, the function is disabled.

If a connection is disrupted ERROR = 1 is set by TC\_SEND and STATUS has the value 80F5<sub>h</sub>.

## 5.5.3 Frame buffer and acknowledgement

### Data buffering when there is a connection abort ("Telecontrol")

If the connection to the telecontrol server is interrupted or if the connection monitoring time is exceeded, the send frames are stored with a time stamp in the frame buffer of the CP.

The next time a connection is established to the telecontrol server, the buffered frames are sent to the relevant destination subscribers.

The frame buffer is a ring buffer; if the buffer capacity is exceeded the oldest frames are discarded without any warning.

The maximum number of buffered frames can be found in the section Performance data (Page 11).

### **Monitoring and acknowledgement of send frames**

The receipt of a frame is monitored and acknowledged in different ways. The mechanisms differ depending on the recipients as follows:

- **Recipient: Telecontrol server**

After processing the send job, DONE is set to 1 in the "TC\_SEND" instruction.

If there is a connection abort or the send monitoring time is exceeded, the frame is buffered and sent to the telecontrol server when the connection is re-established.

Receipt is acknowledged by a frame from the telecontrol server.

- **Recipient: CP 1242-7 - "Telecontrol" mode**

The frame is forwarded by the telecontrol server to the destination CP.

Receipt is acknowledged by a frame from the destination CP. DONE is only set to 1 in the "TC\_SEND" instruction after receiving the acknowledgement.

If there is a connection abort or the send monitoring time is exceeded, TC\_SEND outputs to the ERROR and STATUS condition codes. The sending of the frame is not automatically repeated.

- **Recipient: CP 1242-7 - "GPRS direct" mode**

The transfer of the frame with the TC\_SEND instruction to the CP firmware is monitored and acknowledged by TCP mechanisms and DONE is set to 1 in the "TC\_SEND" instruction.

## **5.6 Data management in the process image**

### **Data storage in the process image of the CP**

---

**Note**

The process image on the CP is only created for communication with the OPC server of the telecontrol server ("RemoteWdcAddress" in "TCON\_WDC" = 0).

The data that the CP receives via GPRS and forwards to the CPU and the process data that the CP receives from the CPU to forward via GPRS is stored as an image on the CP:

## 5.7 Data transfer between communications partners

- **Send process image**
  - Data that the "TC\_SEND" instruction in the program of the S7-1200 CPU transfers to the CP to send via GPRS for a read job.
  - Data called up by a read job of the telecontrol server.
- **Receive process image**
  - Data that the "TC\_RECV" instruction in the program of the S7-1200 CPU receives from the CP for a receive job.
  - Data that the CP receives via GPRS and forwards to the "TC\_RECV" instruction for a write job of the telecontrol server.

## 5.7 Data transfer between communications partners

### 5.7.1 Sending from station to station

#### Sending to an S7 station with CP 1242-7

After transferring data from the CPU (TC\_SEND) to the send process image of the CP, the CP sends the data immediately to the remote communications partner via GPRS. This applies to the S7 stations:

- S7 stations that can be reached via the telecontrol server.
  - CP in "Telecontrol" mode
- S7 stations that can be reached directly.
  - CP in "GPRS direct" mode

### 5.7.2 The S7-1200 sends data to the master station (TC\_SEND)

#### Requirements

- The OPC server has been started on the telecontrol server (an OPC client has connected to the telecontrol server).
- The TC\_CON instruction was started successfully.

## Sequence

The sequence and time of sending the data to the telecontrol server via GPRS depend on the setting of the "RemoteWdcAddress" parameter (access ID) of the TCON\_WDC data block:

- RemoteWdcAddress = DW#16#0: immediate transfer
- RemoteWdcAddress = DW#16#FEEDDADA: no immediate or cyclic transfer

The DW#16#FEEDDADA setting is only used to update the process image on the CP.

If the CP is required to receive additional data written by the OPC server, a second connection must be established with RemoteWdcAddress = DW#16#0.

These two transfer options can also be used on the CP at the same time. To achieve this, two different TC\_CON instructions must be called.

### Immediate transfer

"RemoteWdcAddress" = DW#16#0

1. TC\_SEND sends data to the CP.
2. The CP compares the data received from TC\_SEND with the existing send process image.
  - If the process image does not yet exist or the data received from TC\_SEND is larger than the existing image, the new data is stored in the image and the size of the image is automatically increased.
  - If the data received from TC\_SEND does not differ from the existing image, the call is ended and step 3 is omitted.
  - If the existing image is larger than the data received from TC\_SEND, only the first data received from TC\_SEND is stored in the image.
3. Transfer of the entire process image to the telecontrol server via GPRS.

---

#### Note

##### Send cycle time

If you send frames directly to the Telecontrol server ("Telecontrol" mode), make sure that the send cycle time is  $\geq 1$  second.

---

### No immediate transfer

"RemoteWdcAddress" = DW#16#FEEDDADA

1. TC\_SEND sends data to the CP.
2. The CP does not compare the new process data with the previous image, but writes the new data to its process image.
3. Only when the telecontrol server sends a request to the CP, for example after a request by an OPC client, does the CP send the requested part of the data from the image to the telecontrol server.

## 5.7 Data transfer between communications partners

This option is particularly suitable for cyclic data exchange initiated by a request from the telecontrol server ("cyclic communication") to supply data archives with data at fixed intervals.

### 5.7.3 Master station reads data from the S7-1200 (read)

#### Requirements

- The OPC server has been started on the telecontrol server (an OPC client has connected to the telecontrol server).
- The TC\_SEND instruction was called at least once in the CPU of the station.

This creates the send process image on the CP.

---

#### Note

##### Item name of the OPC client

The process image on the CP is created as a data block. The read access of an OPC client to the process image must be transferred by the DB1 item to the CP.

---

#### Sequence

1. With the DB1, DBx,y item, the OPC server sends a read job for "x" bytes starting at offset "y" to the CP.
2. The CP checks whether "x" bytes starting at offset "y" exist in the process image.
3. Reaction of the CP:
  - If "x" bytes starting at offset "y" exist in the image, the data ("x" bytes) is sent to the telecontrol server.
  - If the image is smaller than  $x + y$  bytes, the read job is acknowledged negatively.  
The OPC client receives an error message from the OPC server of the telecontrol server.

## **5.7.4 Master station sends data to the S7-1200 (write, TC\_RECV)**

### **Sequence**

1. The telecontrol server writes "x" bytes starting at offset "y" in a write job to the CP.
2. The CP saves the data at position "y" in the receive process image.
  - If the receive process image does not yet exist on the CP or is smaller than  $x + y$  bytes, the data is saved as a new image. Data areas without value are filled with the value 0.
  - If the data area of the write job is smaller than the image, the image is not reduced in size.
3. The CP always transfers the entire image to TC\_RECV.

Note: Remember this when specifying the size of the "LEN" parameter of TC\_RECV.

## **5.8 Main and substitute telecontrol server**

### **Telecontrol server: Main and substitute server**

If TCSB is installed as the main and substitute server, two parallel systems are installed by TCSB and these are independent of each other. Both systems have their own database and the complete communications functions of TCSB. The two TCSB systems do not monitor each other.

### **Configuration of the main and substitute server**

Make sure that the configuration data on the two systems are consistent with each other. You can achieve this by entering all the configuration data twice manually or after configuring the main system, by copying the database of the main system to the substitute system using operating system tools. Follow the steps outlined below:

1. Copy the database file from the following directory of the main system:  
Programdata > Siemens > Automation > TCS Basic > Data > "SmSc.sqlite"
2. Insert the database file at the same location in the file system of the substitute system.  
The existing "SmSc.sqlite" file on the substitute system is overwritten.
3. If necessary, adapt the addressing of the database server in the configuration of the substitute server under "Settings" if CMT and the database in the main system are installed on different computers.

Copying ensures the consistency of the configuration data. Since the system parameters of the main and substitute system can be configured in the CMT, following copying no editing of the system parameters of the substitute system is necessary.

### **Interaction between the main and substitute server**

In a normal situation, the stations are connected to the main telecontrol server. If the main server cannot be reached, the connection of the remote S7-1200 with the CP 1242-7 fails over from the main to the substitute server.

### **Switchover between the main and substitute server by the CP 1242-7**

When establishing the GPRS connection to the telecontrol server, the CP automatically switches over to the substitute server after the 4th dialing attempt if the main server cannot be reached.

If the substitute server cannot be reached either, the 4th time the CP once again tries to connect to the main server.

The intervals of the redial attempts are controlled by the "Redial delay" parameter.

You will find an example in the section Redial delay (STEP 7) (Page 41).

## **5.9      Reading out time by CPU**

### **Requirement**

Before the CPU can read out the correct time-of-day from the CP, the time-of-day of the CP needs to be set. The options for time-of-day synchronization of the CP via the Internet can be found in the section Other properties of the CP (Page 11).

### **Reading out time by the CPU with RDREC**

You can read out the CP time of day with the RDREC "read data record" instruction. To do this, create a block of the type RDREC.

The parameters of the RDREC need to have the following settings:

- **ID**  
As the logical address, enter the hardware identifier of the CP 1242-7.
- **MLEN**  
Enter a length of 12 bytes.
- **INDEX**  
For the index, enter the data record with the number 160.
- **RECORD**  
Specify a structure of the data type DTL as the target area.

# 6

## Configuration and programming

### 6.1 Configuration in STEP 7

#### Configuration in STEP 7

You configure the modules, networks and connections in SIMATIC STEP 7. You will find the required version in the section Requirements for operation (Page 13).

You can configure a maximum of three CMs/CPs per station. If you insert several modules of the type CP 1242-7 in an S7-1200, you can, for example, establish redundant communications paths.

When you load the station, the configuration data of the CP is stored on the CPU.

#### How to configure in STEP 7

Follow the steps below when configuring:

1. Create a STEP 7 project.
2. Insert the required SIMATIC stations.
3. Insert the CPs in the relevant stations.
4. Configure the inserted CPs.

No Ethernet network needs to be created for the GPRS communication of the CP 1242-7.

A telecontrol server or a TeleService- gateway cannot be configured in STEP 7.

5. Save the project.

You will find more detailed information on configuring the CP in the help system of STEP 7.

### 6.2 Information required for configuration

To configure and commission the CP and the connected telecontrol system, the following information is required:

#### General information

The following information is required for the STEP 7 configuration of the CP 1242-7:

- Own phone number of the CP (required for TeleService)
- Authorized phone numbers

Phone numbers of the subscribers that are allowed to send a wake-up call, a wake-up SMS or a data SMS to the CP.

- APN  
Name of the GPRS access point (APN) of the GSM network provider
- APN user name  
User name for the GPRS access point of the GSM network provider
- APN password  
Password for the GPRS access point of the GSM network provider
- Subscriber number of the SMS center
- PIN of the SIM card

---

**Note**

**Configured PIN and PIN on the SIM card must match.**

If you enter the PIN of the SIM card of the CP 1242-7 incorrectly during STEP 7 configuration and download the station, the CP stores the wrong PIN. An incorrectly entered PIN is transferred by the CP only once so that the SIM card is not locked.

If you change the PIN of the SIM card externally to the incorrectly configured PIN (new PIN of the SIM card = incorrectly entered PIN in STEP 7), the CP rejects this PIN again without checking it.

**Solution after entering an incorrect PIN:**

To avoid the PIN being rejected by the CP again, use a PIN that is different from the incorrectly entered PIN. Procedure:

- If the PIN of the SIM card was not changed:
  - Configure the PIN in STEP 7 with the PIN of the SIM card.
  - Reload the station.
- If the original PIN of the SIM card was changed externally to the PIN that was previously incorrectly entered in STEP 7:
  - Change the PIN of the SIM card externally to a new PIN that has not yet been incorrectly configured in STEP 7.
  - Change the configured PIN in STEP 7 to the newly assigned PIN of the SIM card.
  - Reload the station.

## **Information required in "Telecontrol" mode**

The following information is required for the STEP 7 configuration of the CP 1242-7:

- Address of the telecontrol server
  - IP address
  - or
  - Name of the telecontrol server that can be resolved by DNS
  - Port number
- The relevant station type-dependent number of the listener port is configured in the telecontrol instructions.
- If you install a substitute telecontrol server: Address and port of the substitute telecontrol server
- DNS server address(es)
  - You require the DNS server address if you address the telecontrol server using a name that can be resolved by DNS.
    - If you do not specify an address, the DNS server address is obtained automatically from the network provider (recommended procedure).
    - If you want to use a different DNS server, enter its address.

## **Information for TeleService**

The following information is required for the STEP 7 configuration of the CP 1242-7:

- TeleService user name
  - To authenticate the user with the CP
    - Configuration of the CP in STEP 7. You can configure up to 10 TeleService users.
    - Entry at the engineering station
- TeleService password
  - To authenticate the user with the CP
    - Configuration of the CP in STEP 7
    - Entry at the engineering station
- Server password
  - To authenticate the CP with the telecontrol server
    - Configuration of the telecontrol server
    - Entry at the engineering station
  - If no server password is configured on the telecontrol server, no server password needs to be entered when establishing the TeleService connection.
- Phone number of the SIM card of the CP

### **CP parameter for configuring the telecontrol server**

The following parameters from the STEP 7 configuration of the CP 1242-7 are also required for the configuration of the telecontrol server:

- Address and port of the telecontrol server
- Project number
- Station number
- Slot of the CP
- Telecontrol password
- Authorized phone numbers
- Connection mode (permanent/temporary)

## **6.3 Using and creating the telecontrol instructions**

### **Using the instructions for GPRS communication**

The telecontrol instructions are necessary whenever data of the station needs to be sent to a communications partner.

If you only want to use the TeleService function, no telecontrol instructions are necessary.

### **Installing the telecontrol instructions and creating the SDTs**

You need to install the telecontrol instructions "TC\_..." in a new library in STEP 7 after installing the support package "HSP CP1242-7" (file name: <TC\_LIB.al11>).

You create the corresponding system data types (SDTs) "TCON\_xxx" and "IF\_CONF" as a data block. The procedure is described in the sections for the two SDTs.

### **Connection establishment with the "TC\_CON" instruction**

Connections are established via GPRS using the "TC\_CON" instruction. Note that a separate "TC\_CON" instruction must be called for each connection.

Once a connection is established, data can then be received with the "TC\_RECV" instruction and/or sent with the "TC\_SEND" instruction.

A separate connection must be established for each communications partner even if identical blocks of data are being sent.

After a successful transfer of the data, a connection can be terminated. A connection is also terminated by calling "TC\_DISCON".

Note the maximum number of parallel connections in the section Performance data (Page 11).

---

**Note**

**Connection abort**

If an existing connection is aborted by the communications partner or due to disturbances on the network, the connection must also be terminated by calling "TC\_DISCON". Make sure that you take this into account in your programming.

---

## **Application example for the "TC\_CONFIG" instruction**

With the "TC\_CONFIG" instruction, you cannot permanently overwrite the configuration data of the CP 1242-7. This can have practical applications if you want to activate a TeleService partner temporarily by setting an input and this partner is disabled in the default configuration.

# **6.4 Programming the telecontrol instructions**

## **6.4.1 TC\_CON: Establish connection via the GSM network**

### **Meaning**

The TC\_CON instruction allows an S7-1200 with a CP 1242-7 to establish a connection of the following types:

- ISO-ON-TCP
  - Connection partner is a CP 1242-7.  
ISO-ON-TCP connections are used only in "GPRS direct" mode.
- UDP
  - Any connection partner is possible.
- SMS
  - The connection partner is an SMS client.
- Telecontrol connection
  - The connection partner is either a telecontrol server or another station that can be reached via the telecontrol server.

A TC\_CON establishes exactly one connection. Depending on the mode of the CP 1242-7 and the protocol you are using, a maximum of 3 to 5 simultaneous connections with unique IDs (see below) are supported per CP. You will find the maximum number of simultaneous connections in the performance data of the CP.

The CONNECT parameter uses a data block (DB) with the structure of a system data type (SDT) for the connection description.

#### 6.4 Programming the telecontrol instructions

The required connection type is defined using a connection-specific SDT "TCON\_..." (see below). For each of the connection types listed above, one of the following SDTs must be assigned:

- TCON\_IP RFC for ISO-ON-TCP connections
- TCON\_IP\_V4 for UDP connections
- TCON\_PHONE for SMS connections
- TCON\_WDC for telecontrol connections

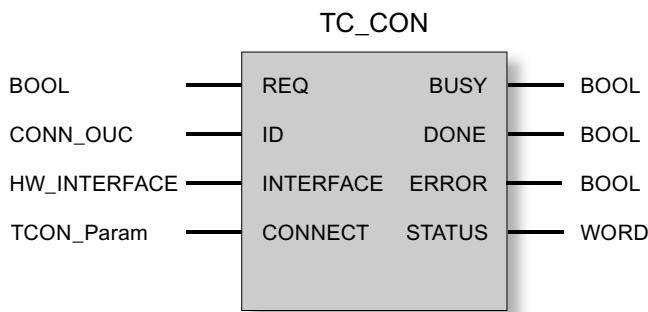
The "ActiveEstablished" parameter of these SDTs also specifies whether or not connection establishment is active or passive.

For parameter settings for these SDTs, see TCON\_...: SDTs for the telecontrol connection establishment (Page 69).

The ID parameter references the GPRS connection. The ID is assigned and must be unique within the CPU.

The INTERFACE parameter references the GPRS interface of the required local CP. This must be taken from STEP 7.

#### Call interface in FBD representation



#### Explanation of the formal parameters

The following table explains all the formal parameters for the TC\_CON instruction.

Parameter	Declaration	Data type	Possible values	Description
REQ	INPUT	BOOL	0, 1	The instruction is started and the status codes initialized on a rising edge. Updating of the DONE, ERROR and STATUS status codes when there is no positive edge.
ID	INPUT	CONN_OUC (WORD)	1...07FF <sub>h</sub>	Reference to the relevant connection. The ID is assigned. The value of ID is also required by the system data type (SDT) of the CONNECT parameter.

Parameter	Declaration	Data type	Possible values	Description
INTERFACE	INPUT	HW_INTERFACE (WORD)		Reference to the interface of the local CP 1242-7 (see STEP 7 > CP configuration > Telecontrol interface > "Hardware identifier")
CONNECT	INOUT	TCON_Param	See also "TCON_...: SDTs for telecontrol connection establishment"  The SDTs of the type TCON_IP RFC, TCON_IP_V4, TCON_PHONE or TCON_WDC specify the structure of the data block suitable for the relevant connection.	Reference to a data block for connection establishment.  In the SDTs, note the parameter "ActiveEstablished" (active / passive connection establishment).
ENO	OUTPUT	BOOL	0: Error 1: Error-free	Enable output If there is a runtime error with the instruction, ENO = 0 is set.
BUSY	OUTPUT	BOOL	0: Execution of the instruction not yet started, completed or aborted 1: The instruction is executing	Display of the processing status of the instruction
DONE	OUTPUT	BOOL	0: - 1: The instruction executed successfully	This parameter indicates whether or not the job was completed without errors. For the meaning in conjunction with the parameters ERROR and STATUS, refer to Codes of the instruction.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code For the meaning in conjunction with the parameters DONE and STATUS, refer to Codes of the instruction.
STATUS	OUTPUT	WORD		Status code For the meaning in conjunction with the parameters DONE and ERROR, refer to Codes of the instruction.

### The codes BUSY, DONE and ERROR

The codes of DONE and ERROR are relevant only when BUSY = 0.

BUSY	DONE	ERROR	Meaning
0	0	0	No job being executed

You will find all other code combinations of DONE and ERROR in the following table.

When called, the instruction remains in the BUSY = 1 state for several seconds. In the following situations, the BUSY state = 1 can last for a longer time:

- On active ISO-on-TCP connections if the partner cannot be reached.
- On passive connections when no frame is received.

## The codes DONE, ERROR and STATUS

The following table shows the condition codes formed based on DONE, ERROR and STATUS that must be evaluated by the user program.

DONE	ERROR	STATUS	Meaning
1	0	0000 <sub>H</sub>	Job executed without errors
0	0	7000 <sub>H</sub>	No job processing active (first instruction call)
0	0	7001 <sub>H</sub>	Job processing started (first instruction call)
0	0	7002 <sub>H</sub>	Job processing already active (renewed instruction call when BUSY = 1)
0	1	8086 <sub>H</sub>	Illegal value for ID
0	1	8087 <sub>H</sub>	Maximum number of connections reached, no further connection possible
0	1	80E3 <sub>H</sub>	The ID is already being used by another connection.
0	1	80E6 <sub>H</sub>	No query in progress (instruction call not started)
0	1	80E8 <sub>H</sub>	Remote partner cannot be reached. Check the connection parameters. In the "GPRS direct" mode, the message is output if the partner is reachable but does not react to the connection request.
0	1	80EB <sub>H</sub>	Request temporarily denied (TC_CON has already been called with the same destination address.)
0	1	80EC <sub>H</sub>	Opening the Listener Port failed: Check the connection parameters.
0	1	80F2 <sub>H</sub>	The CP is in the wrong mode: <ul style="list-style-type: none"><li>• Telecontrol connections are permitted only in "Telecontrol" mode.</li><li>• ISO-ON-TCP connections are permitted only in "GPRS direct" mode.</li></ul>
0	1	80F3 <sub>H</sub>	No free connection endpoint for sending data: <ul style="list-style-type: none"><li>• Use less connections or</li><li>• Use less passive connections or</li><li>• Turn off NTP.</li></ul> Remember the maximum number of simultaneous connections of the CP 1242-7.
0	1	80F4 <sub>H</sub>	Connection endpoint cannot be generated: Repeat the call. If necessary, check the connection parameters.
0	1	80F6 <sub>H</sub>	Format error of a parameter in the called data block (wrong length, wrong format or invalid value) Check the configuration of the "TC_CON..." SDT.

### 6.4.2 TC\_DISCON: Terminate connection via the GSM network

#### Meaning

The TC\_DISCON instruction on an S7-1200 with CP 1242-7 terminates an ISO-ON-TCP, UDP, SMS or telecontrol connection that was established with the TC\_CON instruction.

You will find detailed information on the connection types in the description of the TC\_CON instruction.

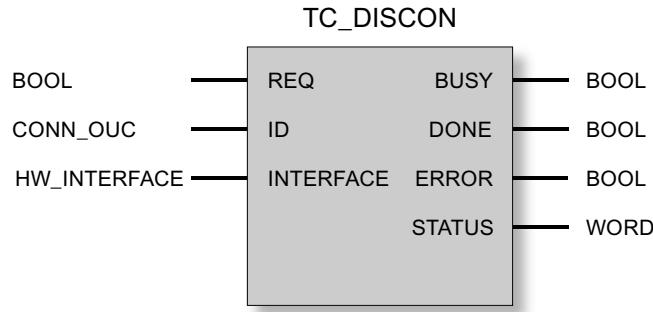
TC\_DISCON terminates the connection to the telecontrol server only logically. If you want the connection to the telecontrol server to be terminated physically, configure the connection as a "Temporary connection" in the "telecontrol server" parameter group in STEP 7.

At the TCP/IP level, the connection is retained. Temporary stations terminate the connection automatically after sending the data.

The ID parameter references the GPRS connection. The ID must be unique within the CPU and the same as the ID used with TC\_CON.

The INTERFACE parameter references the GPRS interface of the required local CP. The value must be the same as that used by TC\_CON for INTERFACE.

### Call interface in FBD representation



### Explanation of the formal parameters

The following table explains all the formal parameters for the TC\_DISCON instruction

Parameter	Declaration	Data type	Possible values	Description
REQ	INPUT	BOOL	0, 1	The instruction is started and the status codes initialized on a rising edge. Updating of the DONE, ERROR and STATUS status codes when there is no positive edge.
ID	INPUT	CONN_OUC (WORD)	1...07FF <sub>h</sub>	Reference to the relevant connection
INTERFACE	INPUT	HW_INTERFACE (WORD)		Reference to the interface of the local CP 1242-7 (see STEP 7 > CP configuration > Telecontrol interface > "Hardware identifier")
ENO	OUTPUT	BOOL	0: Error 1: Error-free	Enable output If there is a runtime error with the instruction, ENO = 0 is set.
BUSY	OUTPUT	BOOL	0: Execution of the instruction not yet started, completed or aborted 1: The instruction is executing	Display of the processing status of the instruction

#### 6.4 Programming the telecontrol instructions

Parameter	Declaration	Data type	Possible values	Description
DONE	OUTPUT	BOOL	0: - 1: The instruction executed successfully	This parameter indicates whether or not the job was completed without errors. For the meaning in conjunction with the parameters ERROR and STATUS, refer to Codes of the instruction.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code For the meaning in conjunction with the parameters DONE and STATUS, refer to Codes of the instruction.
STATUS	OUTPUT	WORD		Status code For the meaning in conjunction with the parameters DONE and ERROR, refer to Codes of the instruction.

#### The codes BUSY, DONE and ERROR

The codes of DONE and ERROR are relevant only when BUSY = 0.

BUSY	DONE	ERROR	Meaning
0	0	0	The instruction has not yet been called.

You will find all other code combinations of DONE and ERROR in the following table.

---

#### Note

When called, the instruction remains in the BUSY = 1 state for several seconds.

---

#### The codes DONE, ERROR and STATUS

The following table shows the condition codes formed based on DONE, ERROR and STATUS that must be evaluated by the user program.

DONE	ERROR	STATUS	Meaning
1	0	0000 <sub>H</sub>	Job executed without errors
0	0	7000 <sub>H</sub>	No job processing active (first instruction call)
0	0	7001 <sub>H</sub>	Job processing started (first instruction call)
0	0	7002 <sub>H</sub>	Job processing already active (renewed instruction call when BUSY = 1)
0	1	8086 <sub>H</sub>	Illegal value for ID
0	1	80E4 <sub>H</sub>	Unknown ID: No connection with this ID has been established by TC_CON.
0	1	80E6 <sub>H</sub>	No query in progress (instruction call not started)

DONE	ERROR	STATUS	Meaning
0	1	80F5H	Invalid connection endpoint: <ul style="list-style-type: none"><li>• Connection establishment by TC_CON failed or</li><li>• Connection terminated by remote partner.</li></ul>
0	1	80F6H	Format error of a parameter in the called data block (wrong length, wrong format or invalid value) Check the configuration of the "TC_CON..." SDT.

#### 6.4.3 TC\_SEND: Send data via the GSM network

##### Meaning

The TC\_SEND instruction allows the sending of data via programmed connections of the following types:

- ISO-ON-TCP connections
- UDP connections
- SMS connections

The sending of SMS messages is supported only if this was set up in the STEP 7 configuration of the CP.

- Telecontrol connections

---

##### Note

###### Sending SMS messages to multiple recipients

If you want to send an identical SMS message to several recipients, you need to establish a connection to each recipient.

---

You will find more detailed information on the connection types in the description of the TC\_CON instruction.

The ID parameter references the GPRS connection. The value of ID must correspond to the value used for ID by TC\_CON.

The INTERFACE parameter references the GPRS interface of the required local CP. The value must be the same as that used by TC\_CON for INTERFACE.

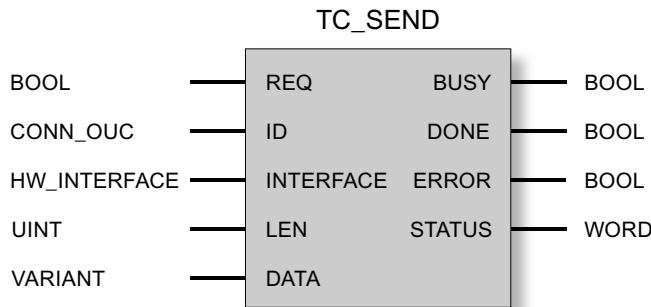
The amount of data to be sent is specified with the LEN parameter.

The size of the data area specified in DATA must be at least as large as the number of bytes configured for LEN. Permitted data types in the data area specified in DATA are all except BOOL and ARRAY of BOOL.

The destination address (connection partner) for the data to be sent is configured in the TC\_CON instruction.

#### 6.4 Programming the telecontrol instructions

##### Call interface in FBD representation



##### Explanation of the formal parameters

The following table explains all the formal parameters for the TC\_SEND instruction.

Parameter	Declaration	Data type	Possible values	Description
REQ	INPUT	BOOL	0, 1	The instruction is started and the status codes initialized on a rising edge. Updating of the DONE, ERROR and STATUS status codes when there is no positive edge.
ID	INPUT	CONN_OUC (WORD)	1...07FF <sub>h</sub>	Reference to the relevant connection
INTERFACE	INPUT	HW_INTERFACE (WORD)		Reference to the interface of the local CP 1242-7 (see STEP 7 > CP configuration > Telecontrol interface > "Hardware identifier")
LEN	INPUT	UINT	1...2048	Number of bytes of data to be sent, maximum 2048. The value should match the size of the range of DATA.
DATA	INOUT	VARIANT		Address reference to the send data area of the CPU *
ENO	OUTPUT	BOOL	0: Error 1: Error-free	Enable output If there is a runtime error with the instruction, ENO = 0 is set.
BUSY	OUTPUT	BOOL	0: Execution of the instruction not yet started, completed or aborted 1: The instruction is executing	Display of the processing status of the instruction
DONE	OUTPUT	BOOL	0: - 1: The instruction executed successfully	This parameter indicates whether or not the job was completed without errors. ** For the meaning in conjunction with the parameters ERROR and STATUS, refer to Codes of the instruction.

Parameter	Declaration	Data type	Possible values	Description
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code For the meaning in conjunction with the parameters DONE and STATUS, refer to Codes of the instruction.
STATUS	OUTPUT	WORD		Status code For the meaning in conjunction with the parameters DONE and ERROR, refer to Codes of the instruction.

\* For special features of the DATA parameter for SMS texts, refer to the next section.

\*\* After sending a frame, TC\_SEND sets DONE = 1. Note the following response:

The loss of an ISO-on-TCP connection is only recognized by the sender after 1 to 2 minutes. The transferred data may be lost although TC\_SEND has set DONE = 1 at the sender.

If an ISO-on-TCP connection is aborted after receiving a frame before TC\_RECV was started, the transferred data may be lost even if TC\_SEND sets DONE = 1 at the sender.

### Configuring SMS texts with the DATA parameter

The instruction sends the data referenced by the pointer of the type VARIANT of the DATA parameter as an SMS text.

If an operand of the data type STRING is referenced by DATA for SMS texts, the first two bytes are transferred with length information of the string.

One option for the correct text representation of SMS messages to be sent is to convert the text string into an Array of BYTE or Array of CHAR using the conversion function Strg\_TO\_Chars. Strg\_TO\_Chars at the EN parameter is linked to the output parameter ENO by TC\_SEND.

For SMS texts, the CP does not support all special characters, for example umlauts (ü, ä etc.). The specification GSM 03.38 applies. There may be additional restrictions imposed by the GSM network provider.

### The codes BUSY, DONE and ERROR

The codes of DONE and ERROR are relevant only when BUSY = 0.

BUSY	DONE	ERROR	Meaning
0	0	0	No job being executed

You will find all other code combinations of DONE and ERROR in the following table.

## The codes DONE, ERROR and STATUS

The following table shows the condition codes formed based on DONE, ERROR and STATUS that must be evaluated by the user program.

DONE	ERROR	STATUS *	Meaning
1	0	0000 <sub>H</sub>	Job executed without errors
0	0	7000 <sub>H</sub>	No job processing active (first instruction call)
0	0	7001 <sub>H</sub>	Job processing started (first instruction call)
0	0	7002 <sub>H</sub>	Job processing already active (renewed instruction call when BUSY = 1)
0	1	8086 <sub>H</sub>	Illegal value for ID
0	1	80E0 <sub>H</sub>	<ul style="list-style-type: none"> <li>• The length information under LEN is greater than the range of data to be transferred under DATA.</li> <li>or</li> <li>• Internal error</li> </ul> <p>If you send frames directly to the Telecontrol server ("Telecontrol" mode), make sure that the send cycle time is <math>\geq</math> 1 second.</p>
0	1	80E1 <sub>H</sub>	<p>Timeout:</p> <ul style="list-style-type: none"> <li>• Increase the value of the "Connection monitoring time" in the configuration of the CP 1242-7 or</li> <li>• Check the connection partner.</li> </ul>
0	1	80E4 <sub>H</sub>	Unknown ID: First call TC_CON.
0	1	80E6 <sub>H</sub>	No query in progress (instruction call not started)
0	1	80E7 <sub>H</sub>	Data to be sent not completely transferred: Repeat the job.
0	1	80E8 <sub>H</sub>	Remote partner cannot be reached. Check the connection parameters. In the "GPRS direct" mode, the message is output if the partner is reachable but does not react to the connection request.
0	1	80E9 <sub>H</sub>	Connection establishment by remote partner: Check the connection partner. If necessary, terminate the connection with TC_DISCON and establish it again with TC_CON.
0	1	80EA <sub>H</sub>	Error message from remote partner: <ul style="list-style-type: none"> <li>• Check the connection partner. Enable the "TC_RECV" instruction on the communications partner.</li> <li>• If necessary, terminate the connection with TC_DISCON and establish it again with TC_CON.</li> </ul>
0	1	80EF <sub>H</sub>	SMS could not be sent: <ul style="list-style-type: none"> <li>• Check whether the destination address (telephone number of the destination subscriber) exists.</li> <li>• Check whether the inserted SIM card allows sending of SMS.</li> <li>• Make sure that when the data block TCON_PHONE was created, the "Standard" option was selected for block access.</li> </ul>

DONE	ERROR	STATUS *	Meaning
0	1	80F1H	Sending of SMS messages is not enabled in the STEP 7 configuration of the CP: Enable the "Allow SMS" option in the configuration of the CP.
0	1	80F4H	Connection endpoint cannot be generated: Check the connection partner.
0	1	80F5H	Invalid connection endpoint: <ul style="list-style-type: none"><li>• Connection establishment by TC_CON failed. or</li><li>• Connection terminated by remote partner: First call TC_DISCON.</li></ul>
0	1	80F6H	Format error of a parameter in the called data block (wrong length, wrong format or invalid value) Check the configuration of the "TC_CON..." SDT.

\* Other statuses that are not listed here can be found in the status codes of the "RDREC" and "WRREC" instructions in the two middle status bytes (STATUS[2], STATUS[3]).

#### 6.4.4 TC\_RECV: Receive data via the GSM network

##### Meaning

The TC\_RECV instruction allows the reception of data via programmed connections of the following types:

- ISO-ON-TCP connections
- SMS connections

To receive SMS messages, the phone number of the sender must be configured in the STEP 7 configuration of the receiving CP (authorized phone numbers). The sender must support the CLIP function.

The phone number of the connection partner must be entered in the "TCON\_PHONE" SDT.

Wake-up SMS messages are filtered out.

- Telecontrol connections

---

##### Note

###### Receiving SMS messages from different senders

If you want to receive SMS messages from different senders, you have two alternatives:

- You configure several connections (TC\_CON, TC\_RECV, TC\_DISCON).  
or
  - You may only enter no telephone number for only one configured connection in the required data block "TCON\_PHONE" in the "PhoneNumber" parameter. When receiving messages, this is then interpreted as a placeholder for all authorized connection partners.
-

#### 6.4 Programming the telecontrol instructions

You will find more detailed information on the connection types in the description of the TC\_CON instruction.

The ID parameter references the GPRS connection. The value of ID must correspond to the value used for ID by TC\_CON.

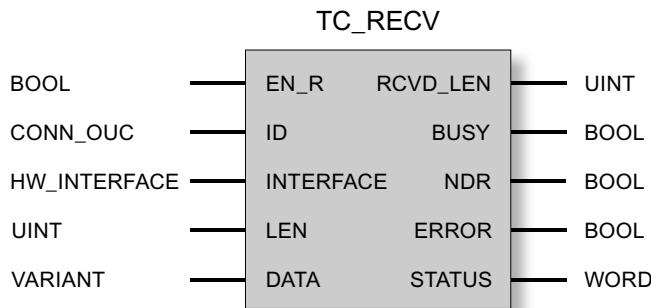
The INTERFACE parameter references the GPRS interface of the required local CP. The value must be the same as that used by TC\_CON for INTERFACE.

The maximum amount of data to be received is specified with the LEN parameter.

The size of the data area specified in DATA must be at least as large as the number of bytes configured for LEN. Permitted data types in the data area specified in DATA are all except BOOL and ARRAY of BOOL. The received data is interpreted as if the sending partner had used the same data types.

The DB (system data type) used for the connection description of TC\_RECV must differ from a DB used for TC\_SEND.

#### Call interface in FBD representation



#### Explanation of the formal parameters

The following table explains all the formal parameters for the TC\_RECV instruction

Parameter	Declaration	Data type	Possible values	Description
EN_R	INPUT	BOOL	0: Data reception locked 1: Data reception enabled	Enables / locks the reception of data. After setting 1 to 0, the program block receives data again.
ID	INPUT	CONN_OUC (WORD)	1...07FF <sub>h</sub>	Reference to the relevant connection
INTERFACE	INPUT	HW_INTERFACE (WORD)		Reference to the interface of the local CP 1242-7 (see STEP 7 > CP configuration > Telecontrol interface > "Hardware identifier")
LEN	INPUT	UINT	1...2048	(minimum) number of bytes of data to be received, maximum 2048
DATA	INOUT	VARIANT		Address reference to the receive data area of the CPU *

Parameter	Declaration	Data type	Possible values	Description
ENO	OUTPUT	BOOL	0: Error 1: Error-free	Enable output If there is a runtime error with the instruction, ENO = 0 is set.
RCVD_LEN	OUTPUT	UINT		Number of bytes of received data
BUSY	OUTPUT	BOOL	0: Execution of the instruction not yet started, completed or aborted 1: The instruction is executing	Display of the processing status of the instruction
DONE	OUTPUT	BOOL	0: - 1: The instruction executed successfully	This parameter indicates whether or not the job was completed without errors. For the meaning in conjunction with the parameters ERROR and STATUS, refer to Codes of the instruction.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code For the meaning in conjunction with the parameters DONE and STATUS, refer to Codes of the instruction.
STATUS	OUTPUT	WORD		Status code For the meaning in conjunction with the parameters DONE and ERROR, refer to Codes of the instruction.

\* For special features of the DATA parameter for SMS texts, refer to the next section.

### Configuring SMS texts with the DATA parameter

The instruction references the received SMS text with the pointer of the type VARIANT of the DATA parameter to the data area of the CPU.

If DATA references an operand of the data type STRING for the SMS text, the first two bytes of the SMS text will be interpreted as length information of the data type STRING and not as SMS text.

One option for the correct text representation of SMS messages to be received is to convert an Array of BYTE or Array of CHAR to a text string using the conversion function Chars\_TO\_Strg. Chars\_TO\_Strg at the EN parameter is linked to the output parameter ENO of TC\_RECV.

For SMS texts, the CP does not support all special characters, for example umlauts (ü, ä etc.). The specification GSM 03.38 applies. There may be additional restrictions imposed by the GSM network provider.

### The codes BUSY, DONE and ERROR

The codes of DONE and ERROR are relevant only when BUSY = 0.

BUSY	DONE	ERROR	Meaning
0	0	0	No job being executed

You will find all other code combinations of DONE and ERROR in the following table.

## The codes DONE, ERROR and STATUS

The following table shows the condition codes formed based on DONE, ERROR and STATUS that must be evaluated by the user program.

DONE	ERROR	STATUS	Meaning
1	0	0000 <sub>H</sub>	Job executed without errors
0	0	7000 <sub>H</sub>	No job processing active (first instruction call)
0	0	7001 <sub>H</sub>	Job processing started (first instruction call)
0	0	7002 <sub>H</sub>	Job processing already active (renewed instruction call when BUSY = 1)
0	1	80A3 <sub>H</sub>	<ul style="list-style-type: none"> <li>• An attempt is being made to establish the connection.</li> <li>• An attempt is being made to terminate a non-existent connection.</li> </ul>
0	1	80E0 <sub>H</sub>	<ul style="list-style-type: none"> <li>• The size of the data received for the range specified by DATA is greater than the length information in LEN.</li> <li>or</li> <li>• Internal error</li> </ul>
0	1	8086 <sub>H</sub>	Illegal value for ID
0	1	80E4 <sub>H</sub>	Unknown ID: First call TC_CON.
0	1	80E6 <sub>H</sub>	No query in progress (instruction call not started)
0	1	80F5 <sub>H</sub>	Invalid connection endpoint: <ul style="list-style-type: none"> <li>• Connection establishment by TC_CON failed.</li> <li>or</li> <li>• Connection terminated by remote partner: First call TC_DISCON.</li> </ul>
0	1	80F6 <sub>H</sub>	Format error of a parameter in the called data block (wrong length, wrong format or invalid value) Check the configuration of the "TC_CON..." SDT.

\* Other statuses that are not listed here can be found in the status codes of the "RDREC" and "WRREC" instructions in the two middle status bytes (STATUS[2], STATUS[3]).

### 6.4.5 TC\_CONFIG: Transferring configuration data to CP

#### Meaning

With the TC\_CONFIG instruction, parameters of a the CP 1242-7 configured in STEP 7 can be modified. The configured values are not overwritten retentively. The overwritten values remain valid until TC\_CONFIG is called again or until the station starts up again (cold restart after cycling power).

If the STEP 7 configuration data of the CP needs to be changed permanently, the instruction needs to be called again each time the station restarts (cold restart) or a modified project must be downloaded to the station.

The CONFIG parameter points to the memory area with the configuration data. The configuration data is stored in a data block (DB). The structure of the DB is specified by the system data type (SDT) IF\_CONF.

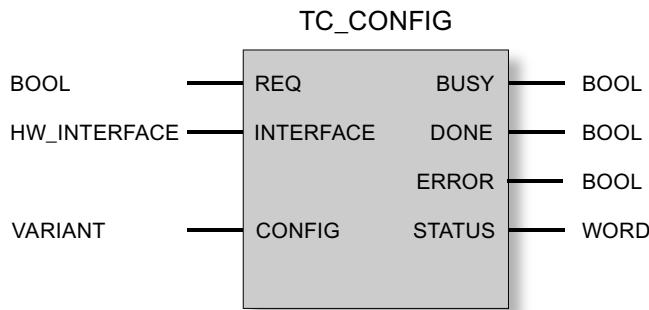
The configuration data to be modified on the CP is put together as necessary in blocks in IF\_CONF "IF\_CONF\_..." for the individual parameters.

Parameters that are not intended to change as a result of the instruction are not entered in IF\_CONF. They retain the value configured in STEP 7.

For detailed information on settings for IF\_CONF, refer to the section IF\_CONF: SDT for telecontrol configuration data (Page 74).

The INTERFACE parameter references the GPRS interface of the required local CP.

### Call interface in FBD representation



### Explanation of the formal parameters

The following table explains all the formal parameters for the TC\_CONFIG instruction

Parameter	Declaration	Data type	Possible values	Description
REQ	INPUT	BOOL	0, 1	The instruction is started and the status codes initialized on a rising edge. Updating of the DONE, ERROR and STATUS status codes when there is no positive edge.
INTERFACE	INPUT	HW_INTERFACE (WORD)		Reference to the interface of the local CP 1242-7
CONFIG	INOUT	VARIANT	See also "IF_CONF: SDT for telecontrol configuration data"	Reference to the memory area with the collected configuration data to be modified
ENO	OUTPUT	BOOL	0: Error 1: Error-free	Enable output If there is a runtime error with the instruction, ENO = 0 is set.
BUSY	OUTPUT	BOOL	0: Execution of the instruction not yet started, completed or aborted 1: The instruction is executing	Display of the processing status of the instruction

#### 6.4 Programming the telecontrol instructions

Parameter	Declaration	Data type	Possible values	Description
DONE	OUTPUT	BOOL	0: - 1: The instruction executed successfully	This parameter indicates whether or not the job was completed without errors. For the meaning in conjunction with the parameters ERROR and STATUS, refer to Codes of the instruction.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code For the meaning in conjunction with the parameters DONE and STATUS, refer to Codes of the instruction.
STATUS	OUTPUT	WORD		Status code For the meaning in conjunction with the parameters DONE and ERROR, refer to Codes of the instruction.

#### The codes BUSY, DONE and ERROR

The codes of DONE and ERROR are relevant only when BUSY = 0.

BUSY	DONE	ERROR	Meaning
0	0	0	No job being executed

You will find all other code combinations of DONE and ERROR in the following table.

#### The codes DONE, ERROR and STATUS

The following table shows the condition codes formed based on DONE, ERROR and STATUS that must be evaluated by the user program.

DONE	ERROR	STATUS	Meaning
1	0	0000 <sub>H</sub>	Job executed without errors
0	0	7000 <sub>H</sub>	No job processing active (first instruction call)
0	0	7001 <sub>H</sub>	Job processing started (first instruction call)
0	0	7002 <sub>H</sub>	Job processing already active (renewed instruction call when BUSY = 1)
0	1	80E6 <sub>H</sub>	No query in progress (instruction call not started)
0	1	80EB <sub>H</sub>	Query temporarily rejected (the CP is currently being configured by STEP 7).
0	1	80F6 <sub>H</sub>	Format error of a parameter in the called data block (wrong length, wrong format or invalid value) Check the "IF_CONF" SDT.
0	1	80F7 <sub>H</sub>	Wrong ID in the parameter fields of the configuration data: Check the "IF_CONF" SDT.

## 6.4.6 Other error messages

### Other error messages

The following error messages are used for diagnostics purposes. You can obtain more information from the Siemens hotline.

DONE	ERROR	STATUS	Meaning
0	1	80E0H	Internal error You should also note the possible meaning with the TC_SEND and TC_RECV instructions.

## 6.4.7 TCON\_...: SDTs for the telecontrol connection establishment

### System data types TCON\_... for the TC\_CON instruction

To configure a telecontrol connection using the TC\_CON instruction, the CONNECT parameter of the instruction is used for the connection description.

The connection description is specified by the structure of the system data type (SDT). The structure of the relevant SDT contains the parameters necessary to establish the connection with the remote communications partner.

For different connection types that depend on the remote communications partner, the following SDTs are used:

- TCON\_IP RFC for ISO-on-TCP connections to IPv4 stations with CP 1242-7
- TCON\_IP\_V4 for UDP connections to IPv4 stations (sending only)
- TCON\_PHONE for connections to SMS clients
- TCON\_WDC for connections to telecontrol servers or stations that can be reached via the telecontrol server.

The parameter assignment of the connection description is made in a data block of the same type as the SDT.

### Creating a DB of the type TCON\_...

You will need to type in the data types of the relevant DBs with the keyboard. They are not displayed in the selection list. The data types are not case-sensitive.

To create a TCON\_... DB, follow the steps outlined below:

#### 6.4 Programming the telecontrol instructions

1. Create a data block of the type "global DB" with block access "Standard".
2. Create an SDT in the table of the parameter configuration of the DB by assigning the name and typing in the required type (for example "TCON\_IP\_RFC") in the cell of the data type.

The SDT and its parameters are created (see below).

3. Configure the parameters that are described below for each SDT type.

Reserved bits are not displayed.

#### System data type TCON\_IP\_RFC for connections to IPv4 stations

This connection type is supported only on ISO-on-TCP connections to communications partners with a fixed IP address. The CP must be configured for the "GPRS direct" mode.

Table 6- 1 Parameters of TCON\_IP\_RFC

Byte	Parameter	Data type	Initial value	Description
0 ... 1	InterfaceID	HW_ANY		Reference to the interface of the local CP 1242-7 (see STEP 7 > CP configuration > Telecontrol interface > "Hardware identifier")
2 ... 3	ID	CONN_OUC	1...07FF <sub>h</sub>	Reference to the GPRS connection. The ID is assigned and must be unique within the CPU. Here, the same value as that of the ID parameter of the TC_CON instruction must be used.
4	ConnectionType	BYTE	W#16#0C	Protocol variant 12 (C <sub>h</sub> ): ISO-on-TCP connection
5	ActiveEstablished	BOOL		Identifier for the type of connection establishment: <ul style="list-style-type: none"><li>• 0: Passive connection establishment</li><li>• 1: Active connection establishment</li></ul>
6 ... 7	-	-	-	- reserved -
8 ... 11	RemoteAddress	IP_V4		IP address of the connection partner
	ADDR	Array [1...4] of Byte		IP address of the relevant connection partner
12 ... 13	RemoteTSelector	TSelector		Remote T selector
	TSelLen	UINT		Length of the remote T selector "RemoteTSelector"
14 ... 45	TSel	Array [1...32] of Byte	any	Remote transport selector of the connection <ul style="list-style-type: none"><li>• When "ActiveEstablished" = 1: With active connection establishment, the T selector of the local partner must be the same as the T selector of the connection partner (passive connection establishment on the remote partner).</li><li>• When "ActiveEstablished" = 0 correspondingly (passive connection establishment local, active connection establishment remote)</li></ul>

Byte	Parameter	Data type	Initial value	Description
46 ... 47	LocalTSelector	TSelector		Local T selector
	TSelLen	UINT		Length of the local T selector "LOCAL_TSel"
48 ... 79	TSel	Array [1...32] of Byte	any	<p>Local transport selector of the connection</p> <ul style="list-style-type: none"> <li>When "ActiveEstablished" = 1: With active connection establishment, the T selector of the local partner must be the same as the T selector of the connection partner (passive connection establishment on the remote partner).</li> <li>When "ActiveEstablished" = 0 correspondingly (passive connection establishment local, active connection establishment remote)</li> </ul>

### System data type TCON\_IP\_V4 for connections to IPv4 stations

This connection type is supported only for sending on UDP connections to communications partners with a fixed IP address.

To receive, ActiveEstablished = 0 must be set.

Table 6- 2 Parameters of TCON\_IP\_V4

Byte	Parameter	Data type	Initial value	Description
0 ... 1	InterfaceID	HW_ANY		Reference to the interface of the local CP 1242-7 (see STEP 7 > CP configuration > Telecontrol interface > "Hardware identifier")
2 ... 3	ID	CONN_OUC	1...07FF <sub>h</sub>	<p>Reference to the GPRS connection. The ID is assigned and must be unique within the CPU. Here, the same value as that of the ID parameter of the TC_CON instruction must be used.</p>
4	ConnectionType	BYTE	W#16#0B	Protocol variant 11 (B <sub>h</sub> ): UDP connection
5	ActiveEstablished	BOOL		<p>Identifier for the type of connection establishment:</p> <ul style="list-style-type: none"> <li>0: Passive connection establishment Setting for sending and receiving data.</li> <li>1: Active connection establishment Setting for sending data only.</li> </ul>
6 ... 7	-	-	-	- reserved -
8 ... 11	RemoteAddress	IP_V4		IP address of the connection partner
	ADDR	Array [1...4] of Byte		IP address of the relevant connection partner
12 ... 13	RemotePort	UINT	1...65535	IP port of the connection partner Not relevant if ActiveEstablished = 0
14 ... 15	LocalPort	UINT	1...65535	Local IP port ("0" is not permitted) Not relevant if ActiveEstablished = 1

## System data type TCON\_PHONE for SMS connections

---

### Note

#### Authorized phone numbers

The CP only accepts an SMS if the sending communication partner is authorized based on its phone number. These numbers are configured for the CP in STEP 7 in the "authorized phone numbers" list.

#### SMS text

- Programmed SMS texts for SMS messages to be sent are accessed using the DATA parameter of the TC\_SEND instruction.
  - The text of a received SMS message is assigned to the address area of the CPU by the DATA parameter of the TC\_RECV instruction.
- 

Table 6- 3 Parameters of TCON\_PHONE

Byte	Parameter	Data type	Initial value	Description
0 ... 1	InterfaceID	HW_ANY		Reference to the interface of the local CP 1242-7 (see STEP 7 > CP configuration > Telecontrol interface > "Hardware identifier")
2 ... 3	ID	CONN_OUC	1...07FF <sub>h</sub>	Reference to the GPRS connection. The ID is assigned and must be unique within the CPU. Here, the same value as that of the ID parameter of the TC_CON instruction must be used.
4	ConnectionType	BYTE	W#16#0E	Protocol variant 14 (E <sub>h</sub> ): SMS connection
5	ActiveEstablished	BOOL		Identifier for the type of connection establishment (not relevant for the CP 1242-7): <ul style="list-style-type: none"> <li>0: Passive connection establishment (not relevant here)</li> <li>1: Active connection establishment</li> </ul>
6...7	-	-	-	- reserviert -
8 ... 31	PhoneNumber	STRING[22]		Call number of the connection partner Permitted values: Plus character (+) and numbers Note the exact notation of the international dialing code of the relevant phone number assigned by the network provider ("+" character or zeros). Without an entry for the PhoneNumber parameter, no connection partner is specified and SMS messages can be received from all authorized connection partners. Note the following during startup: Without an entry, TC_RECV first delivers the oldest received SMS message.

### System data type TCON\_WDC for connections to telecontrol servers or remote stations

You can configure the connection to the telecontrol server assigned to the S7-1200 or to a remote station that can be reached via the telecontrol server with TCON\_WDC. The address data of the telecontrol server assigned to the CP can be found in STEP 7 in the "Telecontrol interface > Mode" tab of the CP. The telecontrol server or a remote station is addressed using the host name or the IP address.

The "RemoteWdcAddress" parameter of TCON\_WDC specifies the Access ID of the connection partner.

Table 6- 4 Parameters of TCON\_WDC

Byte	Parameter	Data type	Initial value	Description
0 ... 1	InterfaceID	HW_ANY		Reference to the interface of the local CP 1242-7 (see STEP 7 > CP configuration > Telecontrol interface > "Hardware identifier")
2 ... 3	ID	CONN_OUC	1...07FF <sub>h</sub>	Reference to the GPRS connection. The ID is assigned and must be unique within the CPU. Here, the same value as that of the ID parameter of the TC_CON instruction must be used.
4	ConnectionType	BYTE	W#16#0F	Protocol variant 15 (F <sub>h</sub> ): Telecontrol connection using an IP address
5	ActiveEstablished	BOOL		Identifier for the type of connection establishment: <ul style="list-style-type: none"><li>• 0: Passive connection establishment</li><li>• 1: Active connection establishment</li></ul>
6 ... 7	-	-	-	- reserved -
8 ... 11	RemoteWdcAddress	DWORD		<p>Specifies the Access ID (hex). The access ID depends on the connection partner.</p> <ul style="list-style-type: none"> <li>• Connection to a remote CP: The access ID is made up of the following:           <ul style="list-style-type: none"> <li>– STEP 7 project number</li> <li>– Station number</li> <li>– Slot</li> </ul>           If the remote station has more than one GPRS-CP and you do not want to specify the path, the last byte for the slot must be set to 0.         </li> <li>• Connection to the telecontrol server: Access ID = 0</li> <li>• To only write to the process image of the CP: Access ID = DW#16#FEEDDADA</li> </ul>

#### **6.4.8 IF\_CONF: SDT for telecontrol configuration data**

##### **Structure of the system data type IF\_CONF for the TC\_CONFIG instruction**

The CONFIG parameter of the TC\_CONFIG instruction references the memory area with the configuration data of the CP 1242-7 to be modified. The configuration data stored in a data block is described as a structure of the system data type (SDT) IF\_CONF.

IF\_CONF is made up of a header followed by fields that correspond to the parameters or parameter areas of the CP in the device properties of the STEP 7 project.

The CP configuration data to be modified is collected together as IF\_CONF fields.

Parameters that will not be modified are ignored in the IF\_CONF structure and remain as they were configured in the STEP 7 project.

##### **Creating the DB and the IF\_CONF structures**

You can create the parameters of the CP within the IF\_CONF DB in one or more structures each with one or more fields.

You will need to type in the data types of the fields using the keyboard. They are not displayed in the selection list. The data types are not case-sensitive.

Follow the steps below to create IF\_CONF:

1. Create a data block of the type "global DB" with block access "Standard".
2. Create a structure (data type "Struct") in the table of the parameter configuration of the DB.

You can specify any name.

3. Under this structure add a header by assigning the name of the header and typing it in in the cell of the data type "IF\_CONF\_Header".

The header of the structure and its three parameters (see below) is created.

4. Create a field for the first parameter to be changed by typing in the required data type (for example "IF\_CONF\_APN") in the cell of the data type.
5. Repeat the last step for all parameters you want to change on the CP using the TC\_CONFIG instruction.
6. Finally, update the number of fields in the header in the "subfieldCnt" parameter.

##### **Header of IF\_CONF**

Table 6- 5 IF\_CONF\_Header

Byte	Parameter	Data type	Initial value	Description
0 ... 1	fieldType	UINT		Field type: Must always be 0.
2 ... 3	fieldId	UINT		Field ID: Must always be 0.
4 ... 5	subfieldCnt	UINT		Total number of fields contained in the structure

## General parameters of the parameter fields

Each field has the following general parameters:

- Id

This parameter identifies the field and must not be modified.

- Length

This parameter indicates the length of the field. The value serves as information.

Fields with strings and / or arrays have a variable length. Due to hidden bytes, the actual length of fields can be greater than the sum of the displayed parameters.

- Mode

The following values are permitted to these parameters:

Table 6- 6 Values of "Mode"

Value	Meaning
1	Permanent validity of the configuration data Not relevant for the CP 1242-7
2	Temporary validity of the configuration data, including deleting of existing permanent configuration data The permanent configuration data is replaced by the parameter fields of IF_CONF.

## Field for the parameter area "GPRS access"

Table 6- 7 IF\_CONF\_APN

Parameter	Data type	Initial value	Description
Id	UINT	4	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 174
Mode	UINT		Validity (1: permanent, 2: temporary)
AccesspointGPRS	STRING [98]		APN: Name of the access point of the GSM network provider to the Internet
AccesspointUser	STRING [42]		APN user name
AccesspointPassword	STRING [22]		APN password

## Field for the parameter area "CP identification"

Table 6- 8 IF\_CONF\_Login

Parameter	Data type	Initial value	Description
Id	UINT	5	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 54
Mode	UINT		Validity (1: permanent, 2: temporary)

## *Configuration and programming*

### *6.4 Programming the telecontrol instructions*

Parameter	Data type	Initial value	Description
ModemName	STRING [22]		Access ID The value cannot be set.
ModemPassword	STRING [22]		Telecontrol password (max. 20 characters)

#### **Field for the parameter area "Telecontrol server access"**

This field is only used when the telecontrol server is addressed with a name that can be resolved by DNS. If the telecontrol server is addressed with its IP address, the "IF\_CONF\_TCS\_IP\_V4" field is used.

In STEP 7, the corresponding data is located in the "Mode" parameter area.

If there is more than one telecontrol server, use the field once per server.

Table 6- 9 IF\_CONF\_TCS\_Name

Parameter	Data type	Initial value	Description
Id	UINT	6	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 266
Mode	UINT		Validity (1: permanent, 2: temporary)
TcsName	-	-	- reserved -
	STRING [254]		Name of the telecontrol server that can be resolved by DNS
RemotePort	UINT		Port of the telecontrol server
Rank	UINT		Priority of the server [1, 2] 1 = main telecontrol server, 2 = substitute telecontrol server

#### **Field for the parameter area "Telecontrol server access"**

This field is only used when the telecontrol server is addressed by its IP address. If the telecontrol server is addressed by its DNS name, the "IF\_CONF\_TCS\_Name" field is used.

In STEP 7, the corresponding data is located in the "Mode" parameter area.

If there is more than one telecontrol server, use the field once per server.

Table 6- 10 IF\_CONF\_TCS\_IP\_v4

Parameter	Data type	Initial value	Description
Id	UINT	7	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 14
Mode	UINT		Validity (1: permanent, 2: temporary)
RemoteAddress	IP_V4		IP address of the telecontrol server
RemotePort	UINT		Port of the telecontrol server
Rank	UINT		Priority of the server [1, 2] 1 = main telecontrol server, 2 = substitute telecontrol server

### Field for the "Mode" parameter area

In STEP 7, the corresponding data is located in the parameter areas "Mode" and Modem settings".

Table 6- 11 IF\_CONF\_GPRS\_Mode

Parameter	Data type	Initial value	Description
Id	UINT	8	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 10
Mode	UINT		Validity (1: permanent, 2: temporary)
GPRSmode	UINT		Mode of the CP: • 0 = Telecontrol • 1 = GPRS direct
TemporaryStation	BOOL		Bit 0: Temporary connection If this option is selected, the CP only establishes a temporary connection to send data. Once the frames have been transferred, the CP terminates the connection again. • 1: activated (temporary connection) • 0: deactivated (permanent connection)
SMS_Enabled	BOOL		Bit 1: Allow SMS Selecting the option allows the S7 station to send SMS messages. • 1: activated (SMS allowed) • 0: deactivated (no SMS)

### Field for the "SMSC" parameter

In STEP 7, the corresponding data is located in the parameter area "Modem settings".

Table 6- 12 IF\_CONF\_SMS\_Provider

Parameter	Data type	Initial value	Description
Id	UINT	10	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 28
Mode	UINT		Validity (1: permanent, 2: temporary)
SMSProvider	STRING [20]		Node number of the SMS center (SMSC) of the GSM network provider with which the contract was signed for this station.

## *Configuration and programming*

### *6.4 Programming the telecontrol instructions*

#### **Field for the "PIN" parameter**

In STEP 7, the corresponding data is located in the parameter area "Modem settings".

Table 6- 13 IF\_CONF\_PIN

Parameter	Data type	Initial value	Description
Id	UINT	11	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 16
Mode	UINT		Validity (1: permanent, 2: temporary)
Pin	STRING [8]		PIN of the SIM card inserted in the SIM card The parameter is not relevant if the PIN was correctly configured. If the PIN was incorrectly configured, the correct PIN can be entered.

#### **Field for monitoring times**

In STEP 7, the corresponding data is located in the parameter areas "Keepalive timeout" and "Operating mode".

Table 6- 14 IF\_CONF\_TC\_Timeouts

Parameter	Data type	Initial value	Description
Id	UINT	12	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 12
Mode	UINT		Validity (1: permanent, 2: temporary)
KeepAliveTimeout	-	-	- Reserved - (cannot be set)
SendTimeout	UINT		Connection monitoring time: Monitoring time of the connection to the communications partner (seconds) Relevant in the "Telecontrol" and "GPRS direct" modes
RedialTimeout	UINT		Dialing repetition delay: Basic value for the wait time until the next attempt to establish a connection following an unsuccessful connection establishment. After every 3 attempts, the basic value is doubled up to a maximum of 900 s. Range of values: 10 to 600 s. If a substitute telecontrol server is configured, the CP attempts to connect to it at the 4th dialin attempt. Example: Basic value 20 results in the following dialing intervals: three times 20 s, three times 40 s, three times 80 s etc. up to a maximum of 900 s. Not relevant for SMS connections

### Field for the "Wake up right" parameter area

Table 6- 15 IF\_CONF\_WakeupList

Parameter	Data type	Initial value	Description
Id	UINT	13	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 246
Mode	UINT		Validity (1: permanent, 2: temporary)
WakeupPhone [1...10]	ARRAY [1...10] of STRING [22]		Phone number subscriber authorized to wake up The asterisk (*) at the end of a call number is used a placeholder for direct dialing numbers.

### Field for the "Preferred GSM networks" parameter area

Table 6- 16 IF\_CONF\_PrefProvider

Parameter	Data type	Initial value	Description
Id	UINT	14	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 46
Mode	UINT		Validity (1: permanent, 2: temporary)
Provider [1...5]	ARRAY [1...5] of STRING [6]		Alternative GSM networks with priority 1 to 5 into which the CP dials. Up to 5 networks can be configured. No. 1 with highest priority, no. 5 with lowest priority. Entry of the Public Land Mobile Network (PLMN) of the network provider consisting of Mobile Country Code (MCC) and Mobile Network Code (MNC). Example (test network of Siemens AG): 26276

### Field for the "DNS configuration" parameter area

Table 6- 17 IF\_CONF\_DNS

Parameter	Data type	Initial value	Description
Id	UINT	16	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 14
Mode	UINT		Validity (1: permanent, 2: temporary)
DNS_IP [1]	IP_V4		IP address of the 1st domain name system server
DNS_IP [2]	IP_V4		IP address of the 2nd domain name system server

#### 6.4 Programming the telecontrol instructions

#### Field for the "Time-of-day synchronization" parameter area

Table 6- 18 IF\_CONF\_NTP

Parameter	Data type	Initial value	Description
Id	UINT	17	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 24
Mode	UINT		Validity (1: permanent, 2: temporary)
NTP_IP [1]	ARRAY [1...4] of IP_V4		IP address of NTP server 1
...	...		(IP address of NTP server 2...3)
NTP_IP [4]	ARRAY [1...4] of IP_V4		IP address of NTP server 4

#### Block for activating / deactivating TeleService users

SDT for activating or deactivating TeleService users already configured in the STEP 7 project of the CP. In STEP 7, the corresponding data can be found in the parameter area "TeleService settings" > "TeleService user management".

Table 6- 19 IF\_CONF\_GPRS\_UserList

Parameter	Data type	Initial value	Description
Id	UINT	19	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 506
Mode	UINT		Validity (1: permanent, 2: temporary)
GPRS_User [1...10]	ARRAY [1...10] of GPRS_User		TeleService user no. 1 to max. no. 10

The array is formed from the parameter records for the TeleService users ("GPRS\_User" [1...n]).

Table 6- 20 GPRS\_User [n] (parameter for TeleService user)

Parameter	Data type	Initial value	Description
UserName [n]	STRING [22]		TeleService user name
Password [n]	STRING [22]		- The string must be empty! -
Diag_Allowed [n]	BOOL		- Reserved - (cannot be set)
Teleserv_Allowed [n]	BOOL		Activation of the TeleService user <ul style="list-style-type: none"> <li>• 0 = user is deactivated</li> <li>• 1 = user is activated</li> </ul>
FW_Load_Allowed [n]	BOOL		- Reserved - (cannot be set)

### Field for setting the parameters for TeleService access (DNS name of the server)

Access data of the TeleService server (switching station).

In STEP 7, the corresponding data is located in the parameter area "TeleService settings".

If there is more than one TeleService server, use the field once per server.

Table 6- 21 IF\_CONF\_TS\_Name

Parameter	Data type	Initial value	Description
Id	UINT	20	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 266
Mode	UINT		Validity (1: permanent, 2: temporary)
ts_name	String [254]		Name of the TeleService server that can be resolved by DNS
RemotePort	UINT		Port of the engineering station
Rank	UINT		Priority of the server [1] or [2] 1 = server 1, 2 = server 2

### Field for setting the parameters for TeleService access (IP address of the server)

Access data of the TeleService server (switching station).

In STEP 7, the corresponding data is located in the parameter area "TeleService settings".

If there is more than one TeleService server, use the field once per server.

Table 6- 22 IF\_CONF\_TS\_IF\_V4

Parameter	Data type	Initial value	Description
Id	UINT	21	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 14
Mode	UINT		Validity (1: permanent, 2: temporary)
RemoteAddress	IP_V4		IP address of the TeleService server
RemotePort	UINT		Port of the TeleService server
Rank	UINT		Priority of the server [1] or [2] 1 = server 1, 2 = server 2



# Service and maintenance

## 7.1 Diagnostics

The following diagnostics options are available:

### LEDs of the module

For information on the LED displays, refer to the section LEDs (Page 22).

### STEP 7: The "Diagnostics" tab in the Inspector window

Here, you can obtain the following information on the selected module:

- Entries in the diagnostics buffer of the CPU
- Information on the online status of the module

### STEP 7: Diagnostics functions in the "Online > Online and diagnostics" menu

Here, you can obtain static information on the selected module:

- General information on the module
- Diagnostics status
- Information on the Telecontrol interface:
  - Network
  - Ethernet port
  - Statistics

You can obtain further information on the diagnostics functions of STEP 7 in the STEP 7 online help.

### Diagnostics SMS message

The CP sends a diagnostics SMS message to a telephone with an authorized call number if it receives an SMS message with the following text from this telephone:

CPDIAG

The diagnostics SMS message that is then sent contains the following data of the S7 station:

- Firmware version of the CP 1242-7
- Mode of the CPU (RUN / STOP)
- Status of the GPRS connection

## 7.2 Downloading firmware

- Date and time of the last dial-in to the GSM network

The data is specified in the ISO 8601 format ("Attach: YYYY-MM-DD hh:mm:ss").

If the time-of-day of the CP has not been synchronized at the time of the dial-in, the time of the measurement since the beginning of the default time-of-day of the CP (01.01.2009) is transferred.

If the last attempted dial-in to the GSM network was not successful, "Attach: -" is sent.

- Name of the current GSM network
- IP address of the CP
- Signal strength of the GSM network
  - weak: poor signal quality (-109 ... -91 dBm)
  - medium: medium signal quality (-89 ... -75 dBm)
  - good: good signal quality (-73 ... -53 dBm)
  - no signal: signal too weak to be received
- Received Signal Strength Indication (RSSI) - received field strength at the station [0 ... 31]
- Status of the connection to the telecontrol server or substitute server (only in "Telecontrol" mode)

If the data to be sent exceeds the default size of an SMS message, several SMS messages are sent.

## 7.2 Downloading firmware

### New firmware versions

If a new firmware version is available for the module, you will find this on the Ethernet pages of the Siemens Automation Customer Support under the following ID:

45605894 (<http://support.automation.siemens.com/WW/view/en/45605894>)

On the Internet page, select the "Entry list" tab and the "Download" entry type. You will find the firmware file and a description of the procedure there.

You can recognize that firmware is being loaded by the flashing LEDs of the CP, see section LEDs (Page 22).

## 7.3      **Module replacement**

### **Module replacement**

The STEP 7 project data of the CP is stored on the local CPU. If there is a fault on the device, this allows simple replacement of this communications module without needing to load the project data to the station again.

When the station starts up again, the new CP reads the project data from the CPU.

If you replace a module, remember to take the SIM card from the old module and insert it in the new CP.



#### **WARNING**

##### **Read the system manual "S7-1200 Programmable Controller"**

Prior to installation, connecting up and commissioning, read the relevant sections in the system manual "S7-1200 Programmable Controller" (refer to the documentation in the Appendix).

When installing and connecting up, keep to the procedures described in the system manual "S7-1200 Programmable Controller".

Make sure that the power supply is turned off when installing/uninstalling the devices.



# Technical specifications

Table 8- 1 Technical specifications of the CP 1242-7

<b>Technical specifications</b>		
Order number		6GK7 242-7KX30-0XE0
<b>Wireless interface</b>		
Antenna connector	Amount	1
	Design	SMA socket
	Nominal impedance	50 ohms
Frequency bands	GPRS	850, 900, 1800, 1900 MHz
Maximum transmit power	GSM 850, class 4	+33 dBm ±2dBm
	GSM 900, class 4	+33 dBm ±2dBm
	GSM 1800, class 1	+30 dBm ±2dBm
	GSM 1900, class 1	+30 dBm ±2dBm
GPRS	Properties	Multislot class 10 device class B coding scheme 1 to 4 (GMSK)
SMS	Properties	Mode outgoing: MO service: point-to-point
<b>Electrical data</b>		
External power supply	Power supply	24 VDC
	Permitted range	19.2 ... 28.8 V
	Design	Connector with terminal block, 3 terminals
	Cable cross-section	
	• Minimum	• 0.14 mm <sup>2</sup> (AWG 25)
	• Maximum	• 1.5 mm <sup>2</sup> (AWG 15)
	Max- tightening torque of the screw terminals	0.45 Nm (4 lb-in)
	Electrical isolation:	
	Power supply unit to internal circuit	710 VDC for 1 minute
Current consumption (typical)	From 24 VDC	100 mA
	From the S7-1200 backplane bus	0 mA
Effective power loss (typical)	From 24 VDC	2.4 W
	From the S7-1200 backplane bus	0 W

---

**Technical specifications**

---

**Permitted ambient conditions**

---

Ambient temperature	During operation with the rack installed horizontally	0 °C to +55 °C
	During operation with the rack installed vertically	0 °C to +45 °C
	During storage	-40 °C to +70 °C
	During transportation	-40 °C to +70 °C
Relative humidity	During operation	≤ 95 % at 25 °C, no condensation
<b>Design, dimensions and weight</b>		
Module format	Compact module for S7-1200, single width	
Degree of protection	IP20	
Weight		
• Net weight	• 133 g	
• Weight including packaging	• 170 g	
Dimensions (W x H x D)	30 x 100 x 75 mm	
Installation options	Standard DIN rail Switch panel	

You will find additional functions and performance data in the section Application and properties (Page 9).

# A

## Dimension drawings

---

### Note

All dimensions in the drawings are in millimeters.

---

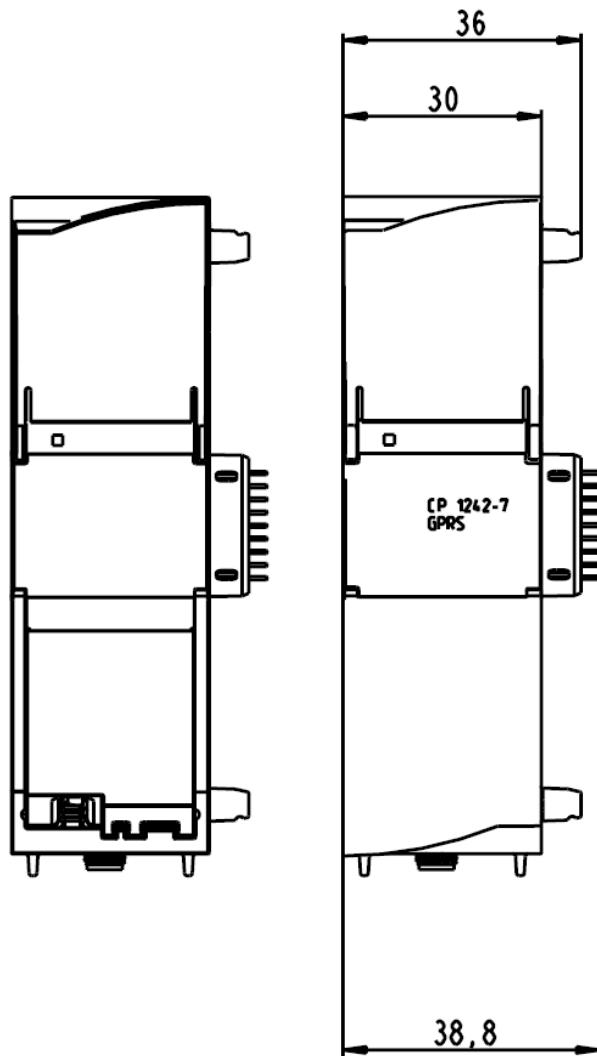


Figure A-1 CP 1242-7 - front view

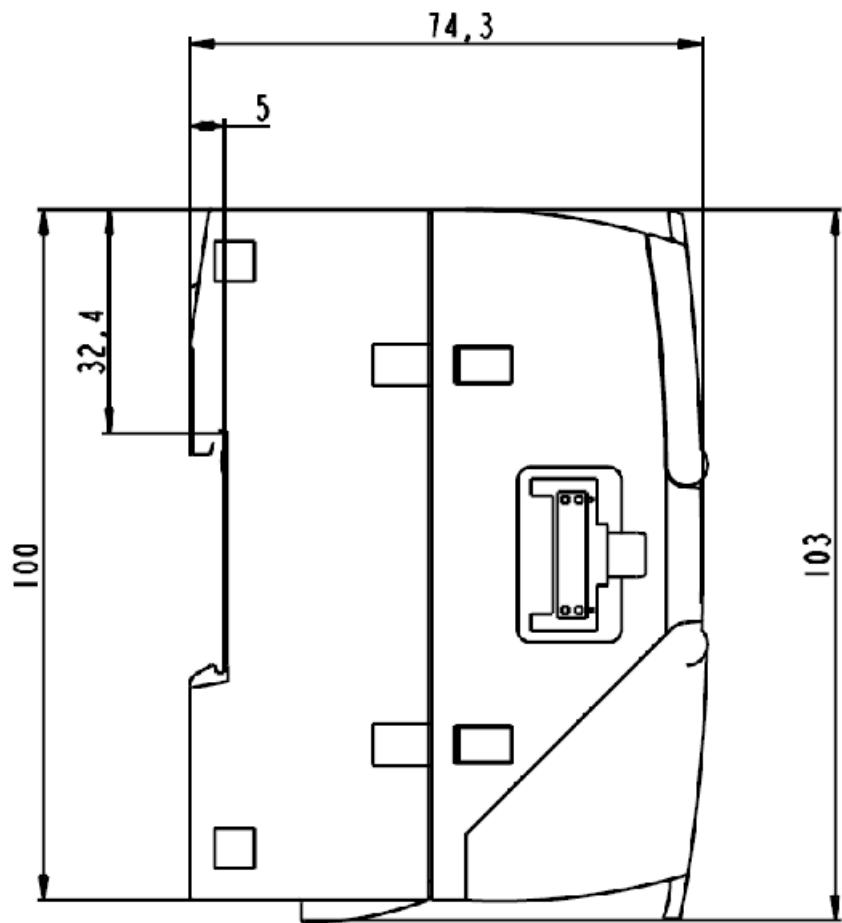


Figure A-2 CP 1242-7 - side view left

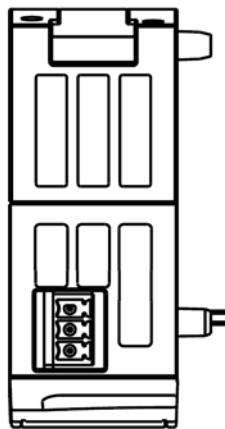


Figure A-3 CP 1242-7 - view from above

# Approvals

## B.1 Certification

### Approvals issued

---

#### Note

##### Issued approvals on the type plate of the device

The specified approvals apply only when the corresponding mark is printed on the product. You can check which of the following approvals have been granted for your product by the markings on the type plate.

---

### National approvals

You will find an overview of the country-specific wireless approvals of SIMATIC NET devices with GSM or UMTS services on the Internet pages of Siemens Automation Customer Support. You will find the link to the document on the following page:

ik-Info ([www.siemens.com/simatic-net/ik-info](http://www.siemens.com/simatic-net/ik-info))

### Other approvals

SIMATIC NET products are regularly submitted to the relevant authorities and approval centers for approvals relating to specific markets and applications.

If you require a list of the current approvals for individual devices, consult your Siemens contact or check the Internet pages of Siemens Automation Customer Support:

45605894 (<http://support.automation.siemens.com/WW/view/en/45605894>)

Under this entry, go to the relevant product and select the following settings: "Entry list" tab > entry type "Certificates".

### Approvals for SIMATIC NET products

You will find an overview of the approvals for SIMATIC NET products including approvals for shipbuilding on the Internet pages of Siemens Automation Customer Support under the following entry ID:

57337426 (<http://support.automation.siemens.com/WW/view/en/57337426>)

## *Approvals*

### *B.1 Certification*

#### **Overview of approvals and standards**

The CP 1242-7 has the following approvals and meets the following standards:

- cULus LISTED IND. CONT. EQ. for HAZ.LOC.
- FM: No. 3600 and 3611
- ATEX: KEMA 10 ATEX 0166X
- EU directives and standards
  - EU Directive 2004/108/EEC "Electromagnetic Compatibility" (EMC Directive)
  - EU Directive 2002/95/EC (RoHS)
  - EC Directive 1999/5/EC (R&TTE)
  - Electromagnetic compatibility (EMC) according to the following standards:  
EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6,  
EN 61000-4-11, EN 61000-6-4
  - Use in industrial environments according to EN 61000-6-4:2007 and  
EN 61000-6-2:2005
- C-TICK

#### **EC declaration of conformity**



The CP meets the requirements and safety objectives of the following EU directives and it complies with the harmonized European standards (EN) for programmable logic controllers which are published in the official documentation of the European Union.

- EU directive 2006/95/EEC "Electrical Equipment Designed for Use within Certain Voltage Limits" (Low Voltage Equipment Directive)
- EN 60950-1 Information Technology Equipment - Safety
- EU Directive 2004/108/EEC "Electromagnetic Compatibility" (EMC Directive)
  - Emission  
EN 61000-6-4:2007: Industrial area
  - Immunity  
EN 61000-6-2:2005: Industrial area
- EU directive 94/9/EC "Equipment and protective systems intended for use in potentially explosive atmospheres" (ATEX Explosion Protection Directive)
  - EN 60079-15:2005: Type of protection 'n':
- Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE)

The EC Declaration of Conformity is available for all responsible authorities at:

Siemens Aktiengesellschaft  
Industry Automation  
Industrielle Kommunikation SIMATIC NET  
Postfach 4848  
D-90327 Nürnberg  
Germany

You will find the EC Declaration of Conformity for this product on the Internet at the following address:

10805878 (<http://support.automation.siemens.com/WW/view/en/10805878>) → Tab "Entry List"

Filter settings:

Entry type: "Certificates"

Certificate Type: "Declaration of Conformity"

Search items(s): <name of the module>

### cULus approval



Underwriters Laboratories Inc. meets

- Underwriters Laboratories, Inc.: UL 508 Listed (industrial control devices)
- Canadian Standards Association: CSA C22.2 Number 142 (process control equipment)

### FM certification



Factory Mutual Research (FM):

Approval Standard Class number 3600 and 3611

Approved for use in:

Class I, Division 2, Group A, B, C, D, Temperature Class T4A, Ta = 55 °C

Class I, Zone 2, Group IIC, Temperature Class T4, Ta = 55 °C

### ATEX approval

ATEX approval: II 3 G Ex nA II T4

Test number: KEMA 10 ATEX 0166X



EN 60079-0:2006: Potentially explosive atmosphere - general requirements

EN 60079-15:2005: Electrical apparatus for explosive gas atmospheres; type of protection 'n'

Over and above this, the following conditions must be met for the safe deployment of the CP:

## Approvals

### B.2 Standards and test specifications

- Install the modules in a suitable enclosure with degree of protection of at least IP54 to EN 60529 and take into account the environmental conditions for operation of the devices.
- If the rated temperatures of 70°C at the cable entry or 80°C at the branching point of the wires are exceeded, the permitted temperature range of the selected cable must be suitable for the actual measured temperatures.
- Measures must be taken to prevent the rated voltage being exceeded by more than 40% due to transient disturbances.

### C-Tick approval



The CP meets the requirements of the AS/NZS 2064 standards (Class A)

## B.2 Standards and test specifications

The device meets the following standards and test specifications. The test criteria for the device are based on these standards and test specifications.

### Industrial environments

The CP was developed for use in industrial environments.

Application	Requirements for emissions	Requirements for immunity
Industry	EN 61000-6-4:2007	EN 61000-6-2:2005

### Electromagnetic compatibility (EMC)

The electromagnetic compatibility (EMC) of an electrical device is its capability of functioning as intended in an electromagnetic environment without emitting electromagnetic interference that could impair the operation of other electrical devices in the vicinity.

Electromagnetic compatibility - immunity	
EN 61000-4-2 Electrostatic discharge	<ul style="list-style-type: none"><li>• 8 kV air discharge on all surfaces</li><li>• 4 kV contact discharge with free conductive surfaces</li></ul>
EN 61000-4-3 Radiated electromagnetic field	<ul style="list-style-type: none"><li>• 300 MHz to 2 GHz, 10 V/m, 80 % AM at 1 kHz</li><li>• 2.0 to 2.7 GHz, 3 V/m, 80 % AM at 1 kHz</li></ul>
EN 61000-4-4 Fast transient bursts	<ul style="list-style-type: none"><li>• 2 kV, 5 kHz with coupling network to AC and DC system voltage</li><li>• 2 kV, 5 kHz with coupling terminal to inputs/outputs</li></ul>
EN 61000-4-5 Surge immunity (power supply)	DC systems - 2 kV common mode, 1 kV push-pull For DC systems (DC power supplies), external protection is necessary.

<b>Electromagnetic compatibility - immunity</b>	
EN 61000-4-6 Conducted disturbances	150 kHz to 80 MHz, 10 V RMS, 80 % AM at 1 kHz
EN 61000-4-11 Voltage dips	DC systems 0 % for 1 cycle, 40 % for 12 cycles and 70 % for 30 cycles at 60 Hz

<b>Electromagnetic compatibility - emission</b>	
Conducted emissions	EN 61000-6-4, Class A
Emitted radiation	EN 61000-6-4, Class A

## Environmental conditions

<b>Environmental conditions - transportation and storage</b>	
EN 60068-2-2, Test Bb, dry heat and EN 60068-2-1 Test Ab, cold	-40°C to +70°C
EN 60068-2-30, Test Db, damp heat	25°C to 55°C, 95% humidity
EN 60068-2-14, Test Na, temperature shock	-40°C to +70°C, dwell time 3 hours, 2 cycles
EN 24180-2 Free fall	0.3 m in dispatch packaging
Atmospheric pressure	1 080 to 660 hPa (corresponding to an altitude of -1 000 to 3 500 m)

<b>Environmental conditions - operation</b>	
Ambient temperatures / air humidity (inlet air 25 mm below device)	0 °C to 55 °C for horizontal installation of the rack 0 °C to 45 °C for vertical installation of the rack 95% relative humidity, non-condensing
Atmospheric pressure	1080 to 795 hPa (corresponding to an altitude of -1000 to 2000 m)
EN 60068-2-14, Test Nb, temperature change	5°C to 55°C, 3°C/minute
EN 60068-2-27 Mechanical shock	15 g, 11 ms pulse, 3 positive and 3 negative shocks in each of the 3 axes (half sine)
EN 60068-2-6 Sinusoidal vibration	DIN rail mount: 7 mm from 5 to 8.51 Hz, 10 m/s <sup>2</sup> from 8.51 to 150 Hz, 1 octave/minute

<b>High voltage isolation test</b>	
Circuit with 24 V/5 V rated voltage	520 VDC (type test of optical electrical isolation limits)

## Protection class

- Protection class III according to EN 60950-1 (protective conductor not required)

## *Approvals*

### *B.2 Standards and test specifications*

#### **Degree of protection**

- Mechanical protection to EN 60529: IP20

Protects against finger contact with high voltage as tested by standard probe. External protection required for dust, dirt, water and foreign objects of < 12.5 mm in diameter.

#### **Rated voltage**

<b>Rated voltage</b>	<b>Tolerance</b>
24 VDC	19.2 to 28.8 VDC

# C

## Accessories

### C.1 Antennas

#### GSM/GPRS antennas

The following antennas are available for use in GSM/GPRS networks and can be installed both indoors and outdoors. The antennas must be ordered separately.

##### Antenna ANT794-4MR



Figure C-1 Antenna ANT794-4MR

Short name	Order no.	Explanation
ANT794-4MR	6NH9 860-1AA00	Quabnd antenna (900, 1800/1900 MHz, UMTS); weatherproof for indoor and outdoor areas; 5 m connecting cable connected permanently to the antenna; SMA connector, including installation bracket, screws, wall plugs

You will find detailed information in the device manual. You will find this on the Internet on the pages of Siemens Industrial Automation Customer Support under the following entry ID:

23119005 (<http://support.automation.siemens.com/WW/view/en/23119005>)

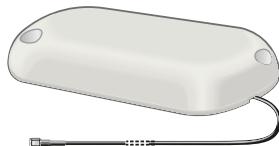
**Flat antenna ANT794-3M**

Figure C-2 Flat antenna ANT794-3M

Short name	Order no.	Explanation
ANT794-3M	6NH9 870-1AA00	Flat antenna (900, 1800/1900 MHz); weatherproof for indoor and outdoor areas; 1.2 m connecting cable connected permanently to the antenna; SMA connector, including adhesive pad, screws mounting possible

You will find detailed information in the device manual. You will find this on the Internet on the pages of Siemens Industrial Automation Customer Support under the following entry ID:  
48729835 (<http://support.automation.siemens.com/WW/view/en/48729835>)

**Technical specifications of the ANT794-4MR GSM/GPRS antenna**

<b>ANT794-4MR</b>	
Order number	6NH9860-1AA00
Mobile wireless networks	GSM/GPRS
Frequency ranges	<ul style="list-style-type: none"> <li>• 824 to 960 MHz (GSM 850, 900)</li> <li>• 1 710 to 1 880 MHz (GSM 1 800)</li> <li>• 1 900 to 2 200 MHz (GSM / UMTS)</li> </ul>
Characteristics	Omnidirectional
Antenna gain	0 dB
Impedance	50 ohms
Standing wave ratio (SWR)	< 2,0
Max. power	20 W
Polarity	Linear vertical
Connector	SMA
Length of antenna cable	5 m
External material	Hard PVC, UV-resistant
Degree of protection	IP65
Permitted ambient conditions	<ul style="list-style-type: none"> <li>• Operating temperature -40 °C to +70 °C</li> <li>• Transport/storage temperature -40 °C to +70 °C</li> <li>• Relative humidity 100 %</li> </ul>
External material	Hard PVC, UV-resistant

<b>ANT794-4MR</b>	
Construction	Antenna with fixed HF cable and SMA male connector
Dimensions (D x H) in mm	25 x 193
Weight	
• Antenna incl. cable	• 310 g
• Fittings	• 54 g
Installation	With supplied bracket

### Technical specifications of the flat antenna ANT794-3M

Order number	6NH9870-1AA00
Mobile wireless networks	<b>GSM 900</b> <b>GSM 1800/1900</b>
Frequency ranges	890 - 960 MHz 1710 - 1990 MHz
Standing wave ratio (VSWR)	≤ 2:1 ≤ 1,5:1
Return loss (Tx)	≈ 10 dB ≈ 14 dB
Antenna gain	0 dB
Impedance	50 ohms
Max. power	10 W
Antenna cable	HF cable RG 174 (fixed) with SMA male connector
Cable length	1.2 m
Degree of protection	IP64
Permitted temperature range	-40°C to +75°C
Flammability	UL 94 V2
External material	ABS Polylac PA-765, light gray (RAL 7035)
Dimensions (W x L x H) in mm	70.5 x 146.5 x 20.5
Weight	130 g

## C.2 TS Gateway

### Use of TS Gateway

TS Gateway is an application used for TeleService connections via GPRS with remote SIMATIC stations of the type S7-1200.

### What is a TeleService gateway?

A TeleService gateway is a PC on which the "TS Gateway" software is installed.

The TeleService gateway is not configured in STEP 7.

### What functions does the TeleService gateway provide?

The TeleService gateway has the following functions:

- Switching station

The TeleService gateway is a PC in the network that serves as the intermediary between the engineering station and remote S7 station.

Since a firewall is normally closed for connection requests from the outside, a switching station between the remote station and the engineering station is required. This switching station can be a telecontrol server or, if there is no telecontrol server in the configuration, a TeleService gateway. The switching station directs the messages via a tunnel through the firewall. This allows access by the engineering station connected to a LAN to the S7-1200 via a router and via the APN of the network provider.

- Configuration of the SMS gateway provider

With the help of TS Gateway, SMS gateway providers are configured that are necessary for the sending of wake-up SMS messages to the remote S7 stations.

### Configuration with TeleService gateway

A TeleService gateway is intended for the following telecontrol systems in which TeleService is used with GPRS:

- Configurations without a telecontrol server

In configurations without a telecontrol server, a TeleService gateway is required for TeleService via GPRS.

- Configurations with telecontrol server

In configurations in which a second path needs to be established for TeleService via GPRS alongside the telecontrol server, a TeleService gateway can be used.

This can, for example, be the case when certain people, groups or companies should not operate TeleService via the telecontrol server or when access to the stations for TeleService needs to be set up independent of the telecontrol server.

### Range of performance of a TS Gateway

- Number of simultaneous TeleService connections: 1

---

#### Note

#### TS Gateway only for TeleService

TS Gateway is used only for the "TeleService" function via GPRS. No connections to the remote stations can be monitored and no process data can be transferred.

---

## Main and substitute TeleService gateway

If the requirements for availability are higher, you can install TS Gateway as the main or substitute gateway. If the connection via the main system cannot be established, you can establish the TeleService connection via the substitute system. In terms of the range of functions, both systems are identical and do not monitor each other.

## Requirements for TeleService with the TeleService gateway

The following requirements must be met for TeleService via a TeleService gateway:

- Engineering station connected to a LAN or with Internet access

The engineering Station on which TeleService will be operated via GPRS requires STEP 7, version V11.0 SP1 or higher. For STEP 7 V11.0 SP1, support package "CP 1242-7" (HSP0003001) is also required.

TeleService is started in the STEP 7 project that contains the remote station with the CP 1242-7.

- SIMATIC S7-1200
  - CPU with firmware version as of V2.0
  - Communications processor CP 1242-7
- PC for the TeleService gateway with:
  - DVD drive
  - Connection to LAN or Internet access for connecting to the engineering station
  - Internet access for connecting to the remote S7 station
  - Installation of the "TS Gateway" application

The software ships with the CP 1242-7 (see product DVD).



# References

D

## Where to find Siemens documentation

- You will find the order numbers for the Siemens products of relevance here in the following catalogs:
  - SIMATIC NET Industrial Communication / Industrial Identification, catalog IK PI
  - SIMATIC Products for Totally Integrated Automation and Micro Automation, catalog ST 70
- You can request the catalogs and additional information from your Siemens representative.
- You will find SIMATIC NET manuals on the Internet pages of Siemens Automation Customer Support: Link to Customer Support (<http://support.automation.siemens.com/WW/view/en>)  
Enter the entry ID of the relevant manual as the search item. The ID is listed below some of the reference entries in brackets.  
As an alternative, you will find the SIMATIC NET documentation on the pages of Product Support:  
10805878 (<http://support.automation.siemens.com/WW/view/en/10805878>)  
Go to the required product group and make the following settings:  
"Entry list" tab, Entry type "Manuals / Operating Instructions"  
You will find the documentation for the SIMATIC NET products relevant here on the data medium that ships with some products:
  - Product CD / product DVD or
  - SIMATIC NET Manual Collection

/1/

SIMATIC  
S7-1200 Programmable Controller  
System Manual  
Siemens AG  
order number: 6ES7298-8FA30-8BH0  
Entry ID: 36932465 (<http://support.automation.siemens.com/WW/view/en/36932465>)

/2/

SIMATIC NET  
TELECONTROL SERVER BASIC  
Operating Instructions  
Siemens AG  
Entry ID: 42674775 (<http://support.automation.siemens.com/WW/view/en/42674775>)

/3/

SIMATIC NET  
TS Gateway  
Operating Instructions  
Siemens AG  
Entry ID: 48548898 (<http://support.automation.siemens.com/WW/view/en/48548898>)

# Glossary

## CM

Communications module

Module for communications tasks that is used in an automation system as an interface expansion of the CPU. Same interface types of a CPU and a CM are functionally identical.

## CMT

Configuration and Monitoring Tool

Program user interface of TELECONTROL SERVER BASIC. Used for configuration of the telecontrol server and monitoring of the connections to the remote stations.

## CP

Communications processor

Module for expanded communications tasks that provides the CPU with additional interface types or communications options.

## Direct communication

With direct communication, the S7 stations communicate directly with each other without the frames needing to be forwarded by a master station or station.

Compare "inter-station communication"

Context: Telecontrol / SINAUT

## GPRS

General Packet Radio Service

Packet-oriented service for IP-based data transmission in GSM networks. GPRS data packets can also be transferred via the Internet. The data is transmitted using the Internet protocols TCP/IP or UDP/IP.

## GPRS direct (mode)

Mode of the CP 1242-7 for direct communication between remote S7 stations via the GSM network. This mode is selected when it is known that the communications partner can be reached using a fixed IP address. This is made possible by the services of the network provider. No telecontrol server is necessary.

## GPRS station

Remote S7 station with a GPRS-compliant communications module

### **Inter-station communication**

With inter-station communication, S7 stations communicate with each other by having an intermediary forward the frames to the relevant destination node.

Compare "direct communication"

Context: Telecontrol / SINAUT

### **MCC - Mobile Country Code**

→ *PLMN*

### **MNC - Mobile Network Code**

→ *PLMN*

### **PLMN**

Public Land Mobile Network

Worldwide unique identifier of mobile wireless networks. The PLMN is made up of the three-digit Mobile Country Code (MCC) and the two-or three-digit Mobile Network Code (MNC) of the network provider.

### **TCSB**

→ *TELECONTROL SERVER BASIC*

### **Telecontrol server**

PC for monitoring and control of remote S7 stations linked via a public GSM network for GPRS communication. The telecontrol server is normally a centrally deployed PC with a connection to the Internet on which the "TELECONTROL SERVER BASIC" application is installed. The telecontrol server is not configured in STEP 7.

### **TELECONTROL SERVER BASIC**

Software for GPRS communication between remote stations and the central telecontrol server. Via the integrated OPC server of TCSB, data can be exchanged with the OPC client of a central control system. TCSB allows TeleService from S7-1200 stations with a CP 1242-7 via GPRS. Communication can be handled via public networks such as GSM networks or via the Internet without requiring addressing of the remote S7 stations using fixed IP addresses.

### **Telecontrol(mode)**

Mode of the CP 1242-7 for GPRS communication between a remote S7 station and the following partners:

- Communication with a telecontrol server
- Communication with other remote GPRS stations (inter-station communication)  
In communication with other remote GPRS stations, the frames are sent via the telecontrol server.

**TeleService gateway**

PC in the network as intermediary between the engineering station and remote S7-1200 with CP 1242-7. The "TS Gateway" software is installed on the PC. TS Gateway is used only for the "TeleService" function via GPRS. No process data can be transferred with TS Gateway. The TeleService gateway is not configured in STEP 7.

**TeleService server**

Switching station for data transmission between the engineering station and remote S7 station. This can be a telecontrol server or a TeleService gateway.

**TS Gateway**

Application on a TeleService gateway

## *Glossary*

---

# Index

## A

Access ID, 45  
Acknowledgment of frames, 43  
ATEX, 28  
Authorized phone numbers, 38

## C

CDMA, 9  
Connection abort, 42, 53  
Connection establishment active/passive, 11  
Connection interrupted, 36  
Connection modes, 36  
Connection resources, 11  
Contact, 6  
Cyclic communication, 46  
Cyclic data exchange, 46

## D

Data buffering, 12, 42  
Degree of protection, 96  
Dimensions, 31  
Direct communication, 9  
DNS server, 51

## E

Electromagnetic compatibility (EMC), 94  
EMC, 94  
Environmental conditions, 94, 95  
Establishing TeleService connection, 40

## F

Firmware version, 3  
Frame buffer, 12, 42

## G

Glossary, 5  
GPRS direct (mode), 36

## H

Hardware identifier, 55, 57, 60, 64, 70, 71, 72, 73  
Hardware product version, 3  
Hazardous area, 27

## I

Image on the CP, 43  
Inserting/removing a SIM card, 29  
Instructions, 13  
Inter-station communication, 9  
Item name (read job), 46

## L

Load to device, 41

## M

Main gateway, 101

## N

NTP, 11

## O

OPC client:Item name, 46  
OPC, configuration, 16  
Operating states, 23

## P

Passwords, 51  
Permanent connection, 36  
Permanent station, 36  
Phone number of the CP (SIM card), 49  
PIN  
    Configuration, 50  
    Incorrect entry, 50  
Process image, 43  
Program blocks, 13  
Protection class, 95

## R

Rated voltage, 96  
Reading out the time, 48  
Receiving SMS messages, 63  
RemoteWdcAddress, 45  
Replacing a module, 85  
Right to wake up, 38

## S

Safety notices, 27  
Sending SMS messages, 59  
Server password, 51  
SIMATIC NET glossary, 5  
SMS gateway, 39  
SMS text, 61, 65, 72  
STEP 7 version, 13  
Substitute gateway, 101  
Support, 6  
Support package (HSP), 13, 101

## T

TC\_CONFIG:Application example, 53  
Telecontrol (mode), 35  
Telecontrol connection, 12  
Telecontrol server, 35  
TELECONTROL SERVER BASIC, 35  
TeleService, 49  
TeleService gateway, documentation, 14  
TeleService via GPRS, 10  
Temporary connection, 11, 36  
Temporary station, 36  
Time synchronization, 11  
Training, 6  
TS Gateway, 101  
TS gateway, documentation, 14

## W

Wake-up SMS, 39

**ANEXO 9**  
**MODULO ANALOGICO**

SIMATIC S7-1200, ENTRADA ANALOG. SM 1231, 8 AI, +/-10V, +/-5V, +/-2.5V, O 0-20MA/4-20 MA, 12 BIT + SIGNO O (13BIT ADC)



### Tensión de alimentación

Valor nominal (DC)

- 24 V DC

Si

### Intensidad de entrada

Consumo, típ.

45 mA

de bus de fondo 5 V DC, típ.

90 mA

### Pérdidas

Pérdidas, típ.

1,5 W

### Entradas analógicas

Nº de entradas analógicas

8; Entradas diferenciales tipo corriente o tensión

Tensión de entrada admisible para entrada de intensidad (límite de destrucción), máx.

± 35 V

Tensión de entrada admisible para entrada de tensión (límite de destrucción), máx.

35 V

Intensidad de entrada admisible para entrada de intensidad (límite de destrucción). máx

40 mA

Intensidad de entrada admisible para entrada de corriente (límite de destrucción). máx

40 mA

Tiempo de ciclo (todos los canales), máx.	625 µs
Rangos de entrada	
• Tensión	Si; ±10 V, ±5 V, ±2,5 V
• Intensidad	Si; 4 a 20 mA, 0 a 20 mA
• Termopar	No
• Termorresistencias	No
• Resistencia	Si
Rangos de entrada (valores nominales), tensiones	
• -10 V a +10 V	Si
• Resistencia de entrada (-10 V a +10 V)	≥ 9 MΩ
• -2,5 V a +2,5 V	Si
• Resistencia de entrada (-2,5 V a +2,5 V)	≥ 9 MΩ
• -5 V a +5 V	Si
• Resistencia de entrada (-5 V a +5 V)	≥ 9 MΩ
Rangos de entrada (valores nominales), intensidades	
• 0 a 20 mA	Si
• Resistencia de entrada (0 a 20 mA)	280 Ω
Termopar (TC)	
Compensación de temperatura	
— parametrizable	No
Formación de valores analógicos	
Tiempo de integración y conversión/resolución por canal	
• Resolución con rango de rebase (bits incl. signo), máx.	12 bit; + signo
• Tiempo de integración parametrizable	Si
• Supresión de perturbaciones de tensión para frecuencia perturbadora f1 en Hz	40 dB, DC a 60 V para frecuencia de perturbación 50/60 Hz
Filtrado de valores medidos	
• parametrizable	Si
• Nivel: ninguno	Si
• Nivel: débil	Si
• Nivel: medio	Si
• Nivel: intenso	Si
Error/precisiones	
Error de temperatura (referido al rango de entrada), (+/-)	25 °C ±0,1 %, a 55 °C ±0,2 % todo el rango de medida
Límite de error básico (límite de error práctico a 25 °C)	
• Tensión, referida al rango de entrada, (+/-)	0,1 %
• Intensidad, referida al rango de entrada, (+/-)	0,1 %
Supresión de tensiones perturbadoras para (f1 +/- 1%), f1 = frecuencia perturbadora	
• Tensión en modo común, máx.	12 V

Alarms/diagnósticos/información de estado	
<b>Alarms</b>	
• Alarms	Si
• Alarma de diagnóstico	Si
<b>Avisos de diagnósticos</b>	
• Funciones de diagnóstico	Si
• Vigilancia de la tensión de alimentación	Si
• Rotura de hilo	Si
<b>LED señalizador de diagnóstico</b>	
• para el estado de las entradas	Si
• para mantenimiento	Si
Grado de protección y clase de protección	
<b>Grado de protección según EN 60529</b>	
• IP20	Si
Normas, homologaciones, certificados	
Marcado CE	Si
Homologación CSA	Si
Homologación FM	Si
RCM (anterior C-TICK)	Si
<b>Homologaciones navales</b>	
• Homologaciones navales	Si
<b>Clase de seguridad máx. alcanzable operando en modo de seguridad</b>	
• SIL según IEC 61508	sin
Condiciones ambientales	
<b>Caída libre</b>	
• Altura de caída, máx.	0,3 m; Cinco veces, en embalaje de envío
<b>Temperatura ambiente en servicio</b>	
• Rango de temperatura permitido	-20 °C a +60 °C con montaje horizontal; -20 °C a 50 °C con montaje vertical; 95 % de humedad del aire, sin condensación
• mín.	-20 °C
• máx.	60 °C
<b>Temperatura ambiente en almacenaje/transporte</b>	
• mín.	-40 °C
• máx.	70 °C
<b>Presión atmosférica según IEC 60068-2-13</b>	
• En servicio mín.	795 hPa
• En servicio máx.	1 080 hPa
• Almacenamiento/transporte, mín.	660 hPa
• Almacenamiento/transporte, máx.	1 080 hPa
<b>Humedad relativa del aire</b>	
• Rango admisible (sin condensación) a 25 °C	95 %

<b>Condiciones ambientales aumentadas</b>	
<b>Concentraciones de sustancias contaminantes</b>	
— SO2 con HR < 60% sin condensación	SO2: < 0,5 ppm; H2S: < 0,1 ppm; HR < 60% sin condensación
<b>Sistema de conexión</b>	
Conector frontal requerido	Sí
<b>Elementos mecánicos/material</b>	
Material de la caja (en el frente)	
• Plástico	Si
<b>Dimensiones</b>	
Ancho	45 mm
Alto	100 mm
Profundidad	75 mm
<b>Pesos</b>	
Peso, aprox.	180 g
<b>Última modificación:</b>	
15.10.2015	