SINAMICS S120
High-performance chassis unit drives
SINAMICS S120 high-performance drives
Chassis format

**Universal**
- Various closed-loop control types
- Extensive range of functions
- Supports a multitude of motor types
- Supports a wide range of encoders
- Covers a wide range of power ratings

**Flexible and scalable**

**Open communications**
- PROFIBUS, PROFINET, EtherNet/IP™, CANopen, Modbus, USS

**Ease of use, intuitive**
- Engineering, installation, commissioning, diagnostics and troubleshooting
System components

**Incoming Service**
- 3AC

**Line Connection**
- Line reactors
- Line filters

**Line Modules**
- Basic Line Modules
- Smart Line Modules
- Active Line Modules

**Control Components**
- Control Unit
- Option Boards
- Sensor Modules
- Terminal Modules
- Operator Panel

**Motor Modules**
- 380 – 480 V
- 660 – 690 V
- Chassis, Booksize

**SINAMICS S120 Chassis and System Components**
- Braking Modules
- Braking Resistors
- Motor reactors
- dv/dt filters
- Sinusoidal filters

**SINAMICS S120CM Cabinet Modules**

**Motors**
- Permanent-magnet
- Induction
  - Standard/trans-standard
  - Servo
## Technical specs overview

### Power and control

<table>
<thead>
<tr>
<th>Line voltage $V_{\text{line}}$ / Power Ratings</th>
<th>Single-Axis</th>
<th>Multi-Axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1AC 200 – 240 V</td>
<td>AC / AC</td>
<td>DC / AC</td>
</tr>
<tr>
<td>3AC 380 – 480 V</td>
<td>150 – 340 HP (110 – 250 kW)</td>
<td>150 – 1,000 HP (110 – 800 kW)</td>
</tr>
<tr>
<td>3AC 500 – 690 V</td>
<td>—</td>
<td>100 – 1,600 HP (75 – 1,200 kW)</td>
</tr>
<tr>
<td>Power Infeed</td>
<td>Non-regulated</td>
<td>Optional, non-regulated or regulated</td>
</tr>
<tr>
<td>Regenerative Feedback</td>
<td>No</td>
<td>Yes, for regulated infeed</td>
</tr>
<tr>
<td>Line Frequency</td>
<td>47 ... 63 Hz</td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>$0 – V_{\text{Line}}$</td>
<td></td>
</tr>
<tr>
<td>Control Principle</td>
<td>V/Hz Control</td>
<td>Yes</td>
</tr>
<tr>
<td>Vector Control</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Servo Control</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pulse Frequency</td>
<td>2 kHz</td>
<td>2 kHz</td>
</tr>
<tr>
<td>Output Frequency</td>
<td>V/Hz Control</td>
<td></td>
</tr>
<tr>
<td>Vector Control</td>
<td>0 – 200 Hz</td>
<td>0 – 160 Hz</td>
</tr>
<tr>
<td>Servo Control</td>
<td>0 – 650 Hz</td>
<td>0 – 650 Hz</td>
</tr>
</tbody>
</table>
### Infeed and motor modules

**Overview / rated output**

<table>
<thead>
<tr>
<th>Chassis</th>
<th>Power</th>
<th>Voltage</th>
<th>Power</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>270 – 950 HP</td>
<td>3AC 380 – 480V</td>
<td>335 – 1070 HP</td>
<td>3AC 400V</td>
</tr>
<tr>
<td></td>
<td>(200 – 710 kW)</td>
<td></td>
<td>(250 – 800 kW)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>335 – 1490 HP</td>
<td></td>
<td>600 – 1877 HP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(250 – 1110 kW)</td>
<td></td>
<td>(450 – 1400 kW)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>335 – 500 – 690V</td>
<td></td>
<td>750 – 1877 HP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(560 – 1400 kW)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100 – 1609 HP</td>
<td>3AC 690V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(75 – 1200 kW)</td>
<td></td>
</tr>
</tbody>
</table>

**Infeed Modules – AC / DC**

- **Basic Line**
  - Power: 270 – 950 HP (200 – 710 kW)
  - Voltage: 3AC 380 – 480V

**Motor Modules – DC / AC**

- **Smart Line**
  - Power: 335 – 1070 HP (250 – 800 kW)

- **Active Line**
  - Power: 175 – 1207 HP (132 – 900 kW)

- **Single**
  - Power: 150 – 1070 HP (110 – 800 kW)
  - Voltage: 3AC 400V
  - Voltage: 3AC 690V
Basic line module
Rugged 1Q infeed

Extremely compact and favorably priced
• Non-regulated infeed unit using thyristors
• Generally used to supply DC busbar drives without regenerative feedback into the line
• Integrated, rugged pre-charging circuit
• Integrated protective functions
• Integrated EMC filter for the second environment

AC Connection
DC Connection
Line Thyristors and thyristor gating
Powerblock
DC link capacitors
Mounting Slot for CU320-2 Control Unit

Pre-charging circuit
RFI suppression filter
Fan
FanFuses

Line current

Line current

V_{DC \text{ link}} = 1.35 \times V_{\text{line supply}}
Smart line module
Rugged infeed / regenerative feedback

Compact and favorably-priced regenerative solution
• 4Q infeed avoiding inverter commutation faults by using IBGTs
  • During line faults, fuses no longer blown
  • Autotransformer is no longer required
• Integrated EMC filter for the second environment

Main components include
• IGBT modules
• DC link capacitors
• Line voltage sensing
• RFI suppression filter
• EN 61800-3 category C3

Line current

\[ V_{DC\ link} = 1.35 \times V_{line\ supply} \]
Active line module
AFE infeed / regenerative feedback unit

**Highest dynamic performance**
Regulated infeed/regenerative feedback unit utilizing IGBT technology
Sinusoidal line supply currents
Higher degree of operational reliability when connected to weak line supplies
• Line-friendly

Main components include
• IGBT modules
• DC link capacitors
• DC fuses

Line Connection Module

Line current

optional (for breakers, fuses, radio interference suppression filter, etc.)

V_{DC \text{ link}} = 1.35 \times V_{\text{line supply}}
Active line module
Coupled with active interface module (AIM)

High-performance infeed / regenerative feedback

Line-side system components for active line modules
• Provides regulated, stable DC link voltage — de-couples the drive from the effects of the line voltage — improves smooth running operation / torque quality

Innovated clean power filter ensures almost sinusoidal line currents

Extremely compact design
Many common parts are shared with the motor module
• Same spare parts

Available as chassis unit over the complete power range

Main components include
• Clean power filter
• RFI suppression filter — EN 61800-3 category C3
• Pre-charging circuit for ALM with contactor, bypass contactor (only for AIM Frame FI and GI)
• Line voltage sensing module VSM
• Step-up reactor
• EMC filter for the 2nd environment (EN 61800-3, Category C3)
• Fan
Motor modules
Chassis format

**Rugged – compact – quiet**

Extremely compact design

Low-noise drive unit fan (sound pressure level 67 – 73 dB(A))

Highly effective drive unit protection (thermal model)

Main components include

- DC fuses
- DC link capacitors
- IGBT modules

![Diagram of motor modules with DC/AC converter and line supply diagram]

\[ V = 0 - V_{\text{line supply}} \]
\[ f = 0 - 300 \text{ Hz} \]
Motor module / active line module
Components

Frame sizes FX and GX

- DC Connection
- Chopper Mounting Location
- DC Busbars
- DC Fuses
- Powerblock(s) with IGBTs, DC link capacitors
- Current Transformer (CT)
- Slot for CU320-2 Control Unit
- Output Busbars
- Fan
- Motor Connection

Frame sizes HX and JX
Line-side system components

**Line reactor**
- 2% uk for basic line modules
- 4% uk for smart line modules (being prepared)
- Current smoothing
- Lower harmonics fed back into the line supply

**Line filter**
- To comply with EMC limit values when operated on the public line supply
- Category C2 according to EN 61 800-3
- Not required when connected to industrial line supplies
DC link components

**Braking modules / braking resistors**

- Braking devices for occasional regenerative operation
- Braking modules are installed in the drive converter
  - No additional space required
- Rugged autonomous control
  - Permanently set switch-in threshold
Motor-side system components

**Motor reactor**
- Required for all cable length
  - Shielded: > 1000 ft. (300 m)
  - Unshielded: > 1500 ft. (450 m)
- Reduces the capacitive re-charging currents
- In conjunction with the cable capacitance, reduces the voltage rate-of-rise $dv/dt$

**$dv/dt$ filter**
- Limits the voltage rate-of-rise $dv/dt$ to values $< 500$ V/$\mu$s
- For motors without special insulation, this limits the conductor – conductor voltage to permissible values
- Allows motors that have been designed for direct online duty and third-party motors to be fed from the drive converter

**Sinusoidal filter**
- Ensures almost sinusoidal voltage at the motor (distortion factor $< 5\%$)
- Reduces the additional motor noises that are dependent on the pulse frequency
- Allows motors with poor insulating systems to be fed from the drive converter
Control unit
CU320-2 DP / PN

Closed-loop
• Vector and closed-loop torque control with and without encoder
• V/Hz control with various characteristics
• Automatic restart
• Flying restart
• Motor identification routine, optimization
• Vdc max controller
• Kinetic buffering

Setpoint channel
• 15 fixed setpoints, motorized potentiometer and jog setpoint, PROFIBUS and analog I/O
• Suppression (skip) frequency bandwidth, limits
• User-friendly ramp-function generator

Protection functions
• Motor short-circuit protection, ground fault, stalled motor (locked rotor),
• Thermal overload – motor and drive inverter
Control unit
CU320-2 DP / PN, cont’d

- 4 DRIVE-CLiQ ports for communications with the drive’s components
- 12 digital inputs 8 bi-directional DI/DO (of which, 4 fast DI)
- 24V DC electronics power supply
- PROFIBUS port (CU320-2 DP)
- LED status display
- Expansion slot, such as for CBE20 Communications Board Ethernet
- PROFINET IO
- EtherNet/IP™
- SINAMICS Link
- Ethernet TCP/IP
- Ethernet programming port for connection of PC with STARTER
- Coding switches for PROFIBUS
Control types

**Open-loop V / Hz**
- For basic, non-regulated induction motor applications
- e.g. group drives

**Closed-loop vector**
- For applications with the highest speed and torque accuracy over a wide control range

**Closed-loop servo**
- SINAMICS S120 chassis from V2.3
- For applications with high-dynamic performance drives and controlled motion control
Operator panels

Basic Operator Panel – BOP20
- Snaps onto CU320-2 Control Unit
- Allows you to
  - Acknowledge faults
  - Set parameters
  - Read diagnostic information, such as alarm and fault messages
- Features a backlit two-line display area and 6 keys
- Integrated plug connector on the back provides the power and communications

Advanced Operator Panel AOP30
- Graphics-capable LCD display
- Menu-prompted
- Plain-text display in several languages
- Extensive help functions
- Can be mounted in cabinet door
Peripheral components

Terminal and communication boards

Terminal board TB30
- Fast digital – I/O: 4 DI, 4 DO
- 2 AI, 2 AO, e.g. for analog setpoint interface

Communication boards
- CBE20:
  - PROFINET IO
  - Ethernet TCP/IP
  - EtherNet/IP™
- CBC10
- CANopen

Terminal module TM31
To connect drive-related peripherals to a CU320 via DRIVE-CLiQ
- 8 digital inputs, 4 bi-directional digital inputs / digital outputs
  - 2 analog inputs, 2 analog outputs
  - 2 relay outputs with changeover contact
  - 1 temperature sensor input (KTY/PTC)
  - IP20 degree of protection
  - May be mounted on DIN mounting rails
Peripheral components
Sensor modules

**SMC10** connects
- Resolver (2-pole and multi-pole)
- Encoder including motor temperature sensor (KTY 84) via sub-D connector
- Max. encoder cable length
  - 2-pole resolver – 425 ft. (130 m)
  - Multi-pole resolver – 165 ft. (50 m)
- Motor module via DRIVE-CLiQ

**SMC20** connects
- sin/cos 1Vpp incremental encoder or EnDat absolute value encoder
- Encoder connection including motor temperature sensor (KTY 84) via sub-D connector
- Max. encoder cable length 325 ft. (100 m)
- Motor module via DRIVE-CLiQ

**SMC30** connects
- TTL encoder / HTL encoder
- Encoder incl. motor temperature encoder (KTY 84) via sub-D connector or terminals
- Max. encoder cable length 100 m
  (for HTL encoders, up to 300 m)
- Motor module via DRIVE-CLiQ

**Voltage Sensing Modules** (VSM) for
- Voltage sensing
- Line supply and motor
- Required for active line modules
  (part of AIM)
- Active line modules via DRIVE-CLiQ
- Voltage sensing for the synchronizing function
## Safety Integrated Functions

<table>
<thead>
<tr>
<th>Control Unit</th>
<th>Chassis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Safety Functions</strong></td>
<td>• CU320-2</td>
</tr>
</tbody>
</table>
| **Extended Safety Functions** (requires license) | • Safe Torque Off (STO)  
• Safe Stop 1 (SS1)  
• Safe Brake Control (SBC)  
  – with Safe Brake Adapter (SBA) |
| **Encoderless** | • Safely-Limited Speed (SLS)  
• Safe Direction (SDI)  
• Safe Speed Monitor (SSM) |
| **With Encoder** | • Safely-Limited Speed (SLS)  
• Safe Direction (SDI)  
• Safe Speed Monitor (SSM)  
• Safe Brake Test (SBT) |
| **Encoder Type** | • Sin/cos encoder  
• Absolute encoder EnDat 2.1  
• HTL/TTL |
| **Activation** | • PROFIsafe  
• F-DI / F-DO |

* Encoderless Safety functions must not be used for applications with drawing loads (e.g. hoist, winder)
Liquid-cooled version

Features

Design has an optimized footprint with excellent power per unit volume and weight
• Up to a 60% smaller footprint when compared to air-cooled drive

Cooling circuit cools all of the main components such as power semiconductors, DC link capacitors, symmetrizing resistors

Compatible with all components, functions and tools of the SINAMICS family

Power rating can be increased by parallel configuration up to 7,500 HP (5,700 kW)

Drinking water quality is used – chemically neutral with pollutants removed
• Derating is not required when using anti-freeze

Only a low flow rate is required

Standard pressure drop of 0.7 bar

Automatic protective functions

Galvanized busbars

Extremely low noise with < 56 dB(A)
Liquid-cooled version
AIM / ALM

For harsh environments: independent of the ambient air
High degrees of protection can be simply implemented
Low noise, light, compact and low maintenance
Lower energy consumption as there are no fans for the power section required
Climate control is not required, or can be significantly reduced
Additional cost saving potential by recovering heat
Active Interface Module permits a completely liquid-cooled solution
  • Almost all of the thermal energy is dissipated to the cooling liquid rather than the environment
Three cooling circuit types

Open

Cooling liquid from rivers, lakes or the public water supply

- The cooling medium flows through the SINAMICS drive units, through the components required for heat dissipation as well as third-party components
- The quality and temperature of the cooling liquid cannot be guaranteed and damage may result

Closed

Cooling medium only flows in the SINAMICS units and in the components required to dissipate heat and if required, in a motor

- In enclosed systems (closed-loop) it is possible to easily guarantee a consistent quality as a result of the secondary circuit

Semi-open

Oxygen can enter the cooling medium

<table>
<thead>
<tr>
<th>SINAMICS S120 Liquid-Cooled Units</th>
<th>Power Modules: Frame Sizes FL, GL Motor Modules: Frame Size GXL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Line Module: Frame Sizes FBL, GBL Motor Modules: Frame Sizes HXL, JXL</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heatsink Material</th>
<th>Aluminum</th>
<th>Stainless Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Cooling Circuit</td>
<td>Recommended</td>
<td>Recommended</td>
</tr>
<tr>
<td>Open Cooling Circuit</td>
<td>Not Permissible</td>
<td>Permissible</td>
</tr>
<tr>
<td>Semi-Open Cooling Circuit</td>
<td>Permissible only with inhibitors and anti-freeze</td>
<td>Permissible</td>
</tr>
<tr>
<td>Inhibitors Required</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>