ANILAM

Inverter Systems and Motors

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This warranty applies to all products when used in a normal industrial environment. Any unauthorized tampering, misuse or neglect will make this warranty null and void.

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The information in this manual has been thoroughly reviewed and is believed to be accurate. ANILAM reserves the right to make changes to improve reliability, function, or design without notice. ANILAM assumes no liability arising out of the application or use of the product described herein.

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Section 1 - Introduction

This manual was written for machine tool manufacturers. It contains information required to install and connect ANILAM SA Series inverter systems and motors on ANILAM 6000M-3X and 6000M-4X Computer Numerical Controls (CNCs).

System Overview

The following sections describe components and motors required for a complete drive system. For more information on CNCs, refer to the *Mounting & Electrical Installation of CNC Chassis for 6000M*, P/N 70000485.

Product Designations

Refer to **Table 1-1**.

Table 1-1, Product Designations

Model Number	Component
SA 200 series SA 300 series SA 400 series	Compact inverter for up to 4 axes and spindle (external Pulse With Modulation [PWM] interfaces). An additional PM 107 power module can be connected.
BR 18	Braking resistor without fan
BR 10F, BR 18F	Braking resistor with fan
BR 9	BR 9 braking resistor module for the modular amplifier system with regenerative power supply
PS 130	Non-regenerative power module of the modular amplifier system
PS 122, PS 144	Energy-recovery power modules of the modular amplifier system
CR 135, CR 170, CR 180	Commutating reactors for the PS 122 and PS 144 energy-recovery power supply modules
LF 135A, LF 180A	Line filter for the PS 122 and PS 144 energy-recovery power modules
PM 107	Power module for the inverter system
PM 1*xx*	Power module for the modular amplifier system for one axis or spindle
PM 2*xx*	Power module for the modular amplifier system for two axes or spindle
AM	Axis (synchronous) motor
SM	Spindle (asynchronous) motor

Components

ANILAM SA Series inverter drive system includes the following components:

- BR 18 or BR 18F braking resistor (as necessary)
- P/N 34000250, 34000251, or 3400252 ferrite toroidal core
- PM 107 power module (optional)
- Ribbon cables for PWM signals and supply voltage (and optional unit bus)
- Covers for the ribbon cables

SA Series Inverters

The following ANILAM SA inverters have a sliding switch on the front of the unit. This feature enables you to use the spindle unit as an axis. Refer to **Table 1-2**.

NOTE: SA 301E and SA 411E do not have a sliding switch.

Table 1-2, SA Series Inverters

Model Number	Load
SA 301A	Continuous load on axes: 3 x 7.5 A Continuous load on spindle: 20 A
SA 311A	Continuous load on axes: 3 x 7.5 A; 1 x 15 A Continuous load on spindle: 20 A
SA 411A	Continuous load on axes: 3 x 7.5 A; 1 x 15 A Continuous load on spindle: 20 A
SA 201A	Continuous load on axes: 2 x 7.5 A Continuous load on spindle: 31 A
SA 301C	Continuous load on axes: 3 x 7.5 A Continuous load on spindle: 31 A
SA 411C	Continuous load on axes: 3 x 7.5 A; 1 x 23 A Continuous load on spindle: 31 A
SA 301E	Continuous load on axes: 3 x 6.0 A Continuous load on spindle: 24 A
SA 411E	Continuous load on axes: 3 x 6.0 A; 1 x 9.0 A Continuous load on spindle: 24 A

IMPORTANT: Phoenix connectors X344, X392, and X393 on the bottom of the inverter are reserved for future applications. Do not use them.

Motors

For performance specifications, model numbers, and dimensional drawings, refer to "Section 7 - Available Motors and Accessories."

Section 2 - Technical Specifications and Power Requirements

Inverter

Refer to **Table 2-1**.

Table 2-1, Inverter Technical Specifications & Power Requirements

Parameter	SA 301A (non-regenerative)		SA 311A (non-regenerative)		
	3 axes	Spindle/Axis	2 axes	1 axis	Spindle/Axis
ANILAM P/N	34000300		34000301		
Power Supply	400 VAC ± 10 % 50 Hz to 60 Hz				
DC-link Voltage	565 VDC (at 400 V power supply)				
DC-link Power					
Rated power	15 kW		15 kW		
Peak power**1	23 kW		23 kW		
Peak power**2	40 kW		40 kW		
Power Loss	Approx. 475 W		Approx. 525 W		
Continuous load at a PWM frequency of:					
3333 Hz	9.0 A	24.5 A/18.4 A	9.0 A	18.4 A	24.5 A/18.4 A
4000 Hz	8.3 A	22.5 A/16.9 A	8.3 A	16.9 A	22.5 A/16.9 A
5000 Hz	7.5 A	20.0 A/15.0 A	7.5 A	15.0 A	20.0 A/15.0 A
6666 Hz	6.4 A	17.0 A/12.8 A	6.4 A	12.8 A	17.0 A/12.8 A
8000 Hz	5.3 A	14.5 A/10.9 A	5.3 A	10.9 A	14.5 A/10.9 A
10000 Hz	4.5 A	12.0 A/9.0 A	4.5 A	9.0 A	12.0 A/9.0 A
Short-time load**3 at a PWM frequency of:					
3333 Hz	15.0 A	30.0 A	15.0 A	30.0 A	30.0 A
4000 Hz	15.0 A	30.0 A	15.0 A	30.0 A	30.0 A
5000 Hz	15.0 A	30.0 A	15.0 A	30.0 A	30.0 A
6666 Hz	12.8 A	25.5 A	12.8 A	25.5 A	25.5 A
8000 Hz	10.6 A	21.8 A	10.6 A	21.8 A	21.8 A
10000 Hz	9.0 A	18.0 A	9.0 A	18.0 A	18.0 A
Continuous power of the integral breaking resistor	1 kW		1 kW		
Peak power of the integral braking resistor**4	23 kW		23 kW		
Load capacity +5 V	8.5 A		8.5 A		
Degree of Protection	IP 20		IP 20		
Weight	44 lb. (≅ 20 kg)		44 lb. (≅ 20 kg)		

(Continued…)

**1 40% cyclic duration factor for duration of 10 minutes (S6-40%)

**2 0.2 s cyclic duration factor for duration of 5 s

**3 40% cyclic duration factor for duration of 10 minutes (S6-40%) or for 0.2 s at standstill

**4 0.4% cyclic duration factor for duration of 120 s

Table 2-1, Inverter Technical Specifications & Power Requirements (Continued)

Parameter	SA 411A (non-regenerative)			SA 201A (non-regenerative)	
	3 axes	1 axis	Spindle/Axis	2 axes	1 axis
ANILAM P/N	34000302			34000303	
Power Supply	400 VAC ± 10 % 50 Hz to 60 Hz				
DC-link Voltage	565 VDC (at 400 V power supply)				
DC-link Power					
Rated power	15 kW			22 kW	
Peak power**1	23 kW			30 kW	
Peak power**2	40 kW			45 kW	
Power Loss	Approx. 595 W			Approx. 520 W	
Continuous load at a PWM frequency of:					
3333 Hz	9.0 A	18.4 A	24.5 A/18.4 A	9.0 A	38.0 A/28.2 A
4000 Hz	8.3 A	16.9 A	22.5 A/16.9 A	8.3 A	35.0 A/26.0 A
5000 Hz	7.5 A	15.0 A	20.0 A/15.0 A	7.5 A	31.0 A/23.0 A
6666 Hz	6.4 A	12.8 A	17.0 A/12.8 A	6.4 A	26.0 A/19.3 A
8000 Hz	5.3 A	10.9 A	14.5 A/10.9 A	5.3 A	22.5 A/16.7 A
10000 Hz	4.5 A	9.0 A	12.0 A/9.0 A	4.5 A	19.0 A/14.1 A
Short-time load**3 at a PWM frequency of:					
3333 Hz	15.0 A	30.0 A	30.0 A	15.0 A	46.0 A
4000 Hz	15.0 A	30.0 A	30.0 A	15.0 A	46.0 A
5000 Hz	15.0 A	30.0 A	30.0 A	15.0 A	46.0 A
6666 Hz	12.8 A	25.6 A	25.5 A	12.8 A	38.6 A
8000 Hz	10.6 A	21.8 A	21.8 A	10.6 A	33.4 A
10000 Hz	9.0 A	18.0 A	18.0 A	9.0 A	28.2 A
Load capacity +5 V	8.5 A			8.5 A	
Degree of Protection	IP 20			IP 20	
Weight	50.6 lb. (≅ 23 kg)			50.6 lb. (≅ 23 kg)	

(Continued…)

**1 40% cyclic duration factor for duration of 10 minutes (S6-40%)

**2 0.2 s cyclic duration factor for duration of 5 s

**3 40% cyclic duration factor for duration of 10 minutes (S6-40%) or for 0.2 s at standstill

Table 2-1, Inverter Technical Specifications & Power Requirements (Continued)

Parameter	**SA 301C (non-regenerative)**		**SA 411C (non-regenerative)**		
	2 axes	**Spindle/Axis**	**3 axes**	**1 axis**	**Spindle/Axis**
ANILAM P/N	34000305		34000306		
Power Supply	400 VAC ± 10 % 50 Hz to 60 Hz				
DC-link Voltage	565 VDC (at 400 V power supply)				
DC-link Power					
Rated power	22 kW		22 kW		
Peak power**1	30 kW		30 kW		
Peak power**2	45 kW		45 kW		
Power Loss	Approx. 520 W		Approx. 770 W		
Continuous load at a PWM frequency of:					
3333 Hz	9.0 A	38.0 A/28.2 A	9.0 A	28.2 A	38.0 A/28.2 A
4000 Hz	8.3 A	35.0 A/26.0 A	8.3 A	26.0 A	35.0 A/26.0 A
5000 Hz	7.5 A	31.0 A/23.0 A	7.5 A	23.0 A	31.0 A/23.0 A
6666 Hz	6.4 A	26.0 A/19.3 A	6.4 A	19.3 A	26.0 A/19.3 A
8000 Hz	5.3 A	22.5 A/16.7 A	5.3 A	16.7 A	22.5 A/16.7 A
10000 Hz	4.5 A	19.0 A/14.1 A	4.5 A	14.1 A	19.0 A/14.1 A
Short-time load**3 at a PWM frequency of:					
3333 Hz	15.0 A	46.0 A	15.0 A	46.0 A	46.0 A
4000 Hz	15.0 A	46.0 A	15.0 A	46.0 A	46.0 A
5000 Hz	15.0 A	46.0 A	15.0 A	46.0 A	46.0 A
6666 Hz	12.8 A	38.6 A	12.8 A	38.6 A	38.6 A
8000 Hz	10.6 A	33.4 A	10.6 A	33.4 A	33.4 A
10000 Hz	9.0 A	28.2 A	9.0 A	28.2 A	28.2 A
Load capacity +5 V	8.5 A		8.5 A		
Degree of Protection	IP 20		IP 20		
Weight	50.6 lb. (≅ 23 kg)		50.6 lb. (≅ 23 kg)		

(Continued…)

**1 40% cyclic duration factor for duration of 10 minutes (S6-40%)

**2 0.2 s cyclic duration factor for duration of 5 s

**3 40% cyclic duration factor for duration of 10 minutes (S6-40%) or for 0.2 s at standstill

Table 2-1, Inverter Technical Specifications & Power Requirements (Continued)

Parameter	**SA 301E / SA 411E (non-regenerative)**		
ANILAM P/N	34000307 / 34000308		
Power Supply	3 x 480 V 60 Hz / 3 x 400 V 50 Hz		
DC-link Voltage	679 V / 565 V		
DC-link Power Rated power Peak power (S6-40%) Peak power (<0.2 s)	 10 kW 15 kW 20 kW		
Power Loss	420 W		
Continuous load at a PWM frequency of:	**SA 301E / SA 411E 3 axes**	**SA 411E 1 axis**	**SA 301E / SA 411E Spindle**
3333 Hz	**6.0 A**	**9.0 A**	**24.0 A**
4000 Hz	5.5 A	8.25 A	22 A
5000 Hz	5 A	7.5 A	20 A
6666 Hz	4.2 A	6.3 A	16.8 A
8000 Hz	3.65 A	5.5 A	14.6 A
10000 Hz	3 A	4.6 A	12.2 A
Short-time load (S6-40%) at a PWM frequency of:	**SA 301E / SA 411E 3 axes**	**SA 411E 1 axis**	**SA 301E / SA 411E Spindle**
3333 Hz	**12.0 A**	**18.0 A**	**36.0 A**
4000 Hz	11 A	16.5 A	33 A
5000 Hz	10 A	15 A	30 A
6666 Hz	8.4 A	12.6 A	25.2 A
8000 Hz	7.3 A	11 A	21.9 A
10000 Hz	6.1 A	9.2 A	18.3 A
Load capacity +5 V for supplying the MC 4xx over X69	10 A		
Integrated braking resistor	1 kW continuous power 27 kW peak power		
Degree of Protection	IP 20		
Weight	44.1 lb. (≅ 20 kg)		

The SA 301E and SA 411E are non-regenerative compact inverters for up to 4 axes (SA 411E), for up to 3 axes (SA 301E) and spindle.

A braking resistor is integrated.

Toroidal Cores

To suppress occurrence of line interference, toroidal cores must be mounted in the motor leads, in the voltage supply lead, and in the lead to the braking resistor (only SA 301A, SA 311A, and SA 411A). Refer to **Table 2-2**, to determine the proper core.

Table 2-2, Connections for Toroidal Cores

Terminal on Inverter	Toroidal Core
Power Supply (X31)	∅ 87 mm (≅3.43 inch) (34000250)
Braking Resistor (X89)**1	∅ 42 mm (≅1.65 inch) (34000251)
Axis 1 to 3 (X81 to X83)	∅ 42 mm (≅1.65 inch) (34000251)
Axis 4 (X84)	∅ 59 mm (≅2.32 inch) (34000252)
Spindle (X80)	∅ 59 mm (≅2.32 inch) (34000252)

**1 Only for SA 301A, SA 311A, and SA 411A

Ribbon Cables and Covers (Only for SA *xxxx*)

50-Line Ribbon Cable (Power Supply to CNC Chassis)

The 50-line ribbon cable connects the SA series inverter to the CNC Chassis and supplies voltage to the CNC Chassis. It is supplied with SA xxxx (length 300 mm (≅11.8 inch), P/N 325 816-01).

20-Line Ribbon Cable (PWM Signals)

The 20-line ribbon cable connects the power module outputs of the CNC chassis to the power module connections on the inverter. One 20-line ribbon cable is required for each axis/ spindle. The 20-line ribbon cables for the connections on the inverter are supplied with the SA xxxx (length 200 mm (≅7.9 inch), P/N 250 479-08; length 400 mm (≅15.8 inch), P/N 250 479-10). If you are using an additional PM 107 power module, an additional 20-line ribbon cable is required. Refer to **Table 2-3**.

Table 2-3, 20-Line Ribbon Cable Specifications

PWM Connection on the PM 107 Power Module	Length of 20-Line Ribbon Cable	P/N
X111, X112	100 mm (≅4 inch)	34000263

40-Line Ribbon Cable (unit bus)

The 40-line ribbon cable serves as the unit bus. It is required if an additional PM 107 power module is being operated with the inverter. Refer to **Table 2-4**.

Table 2-4, 40-Line Ribbon Cable Specifications

Unit Bus Connection	Length of 40-Line Ribbon Cable	P/N
X79	50 mm (≅2 inch)	34000264

Ribbon Cable Covers

The ribbon cables must be covered to protect them from electrical interference. One cover is supplied with the OEM CNC, one cover is supplied with the inverter (197.5 mm, P/N 34000274).

The plastic lateral termination cap is P/N 34000278.

If you are using an additional PM 107 power supply, the cover for this module must be ordered separately. Refer to **Table 2-5**.

Table 2-5, Ribbon Cable Cover - Specifications

Additional Power Module	Length of Cover	P/N
PM 107	50 mm (≅2 inch)	34000265

Modular Amplifier

The following topics are described in this section:

Components of the Modular Amplifier

For operation of the modular ANILAM **non-regenerative** amplifiers, the following components are required:

- PS 130 power supply unit
- PM 1xx power modules, depending on version
- PW 210 (or PW 110, PW 120) braking resistor
- Ribbon cables for Pulse Width Modulation (PWM) signals, unit bus, and power supply
- Covers for the ribbon cables

For operation of the modular ANILAM **regenerative** amplifiers, the following components are required:

- PS 122 or PS 145 power supply unit
- CR 135 or CR 170 commutating reactor
- Line filter
- If required, BR 9 braking resistor module
- PM 1xx power modules, depending on version
- Ribbon cables for PWM signals, unit bus, and power supply
- Covers for the ribbon cables

PS 122, PS 130, PS 145 Power Supply Unit

The PS 1*xx* power supply units supply the DC-link voltage as well as the power for the electronics to the CNC Chassis and power modules.

During braking, the motors feed energy into the DC-link. This energy is converted into heat by the PS 130 through the BR 18 (or BR 10F or BR 18F) braking resistor, or returned to the power line through the PS 122 or PS 145. The PS 122 and PS 145 can be driven only with commutating reactor and line filter.

Refer to **Table 2-6**.

Table 2-6, Power Supply Technical Specifications and Power Requirements

Parameter	PS 122 (regenerative)	PS 130 (non-regenerative)	PS 145 (regenerative)
ANILAM P/N	34000340	34000343	34000346
Description	Amplifier, Power Supply, 22/30kW	Amplifier, Power Supply, 30/40kW	Amplifier, Power Supply, 45/65kW
Power Supply	400 VAC ± 10 % 50 Hz to 60 Hz		
DC-link Power			
Rated Power	22 kW	30 kW	45 kW
Peak Power **1	30 kW	40 kW	65 kW
Peak Power **2	40 kW	50 kW	80 kW
Power Loss	≅ 300 W	≅ 140 W	≅ 570 W
DC-link Voltage	650 VDC	565 VDC (with 400 V power voltage)	650 VDC
Current Consumption **3			
15V	270 mA	240 mA	380 mA
24 V	310 mA	410 mA	310 mA
Load Capacity +5 V	8.5 A		
Degree of Protection	IP 20		
Weight	27 lb. (≅ 12.0 kg)	22 (≅ 9.8 kg)	44 lb. (≅ 20.0 kg)

**1 40% cyclic duration factor for duration of 10 minutes (S6-40%)
**2 0.2 s cyclic duration factor for duration of 5 s
**3 After making your selection, check the current consumption of the 15V and 24V supply of the entire modular amplifier system.

PM 1*xx*, PM 2*xx* Power Modules

The power modules differ in the number of axes and the permissible maximum currents. They can be combined at random. The PWM signals are transferred from the CNC Chassis via external 20-line ribbon cables. Refer to **Table 2-7**.

Table 2-7, Power Module Technical Specifications

Specifications	PM 107	PM 115A		PM 123A	
	Axis	Axis	Spindle	Axis	Spindle
ANILAM P/N	34000320	34000321		34000322	
Continuous load at a PWM frequency of:					
3333 Hz	9.0 A	18.40 A	24.5 A	28.2 A	38.0 A
4000 Hz	8.3 A	16.9 A	22.5 A	26.0 A	35.0 A
5000 Hz	7.5 A	15.0 A	20.0 A	23.0 A	31.0 A
6666 Hz	6.4 A	12.8 A	17.0 A	19.3 A	26.0 A
8000 Hz	5.3 A	10.9 A	14.5 A	16.7 A	22.5 A
10000 Hz	4.5 A	9.0 A	12.0 A	14.1 A	19.0 A
Short-time load**1 at a PWM frequency of:					
3333 Hz	15.0 A	30.0 A		46.0 A	
4000 Hz	15.0 A	30.0 A		46.0 A	
5000 Hz	15.0 A	30.0 A		46.0 A	
6666 Hz	12.8 A	25.6 A		38.6 A	
8000 Hz	10.6 A	21.8 A		33.4 A	
10000 Hz	9.0 A	18.0 A		28.2 A	
Power loss	≅ 60 W	≅ 120 W	≅ 160 W	≅ 180 W	≅ 270 W
Current consumption**2					
15 v	120 mA	150 mA		170 mA	
24 V	60 mA	170 mA		170 mA	
Degree of protection	IP 20				
Weight	12 lb. (≅ 5.5 kg)	12 lb. (≅ 5.5 kg)		20 lb. (≅ 9 kg)	

(Continued…)

**1 40% cyclic duration factor for duration of 10 minutes (S6-40%) or for 0.2 s at standstill

**2 After making your selection, check the current consumption of the 15V and 24V supply of the entire modular amplifier system.

Table 2-7, Power Module Technical Specifications (Continued)

Specifications	PM 132A		PM 148A		PM 170A	
	Axis	Spindle	Axis	Spindle	Axis	Spindle
ANILAM P/N	34000323		34000324		34000325	
Continuous load at a PWM frequency of:						
3333 Hz	39.00 A	61.0 A	58.6 A	91.5 A	91.5 A	91.5 A
4000 Hz	36.2 A	56.5 A	54.4 A	85.0 A	85.0 A	85.0 A
5000 Hz	32.0 A	50.0 A	48.0 A	75.0 A	75.0 A	75.0 A
6666 Hz	26.9 A	42.0 A	40.3 A	63.0 A	63.0 A	63.0 A
8000 Hz	23.0 A	36.0 A	34.6 A	54.0 A	54.0 A	54.0 A
10000 Hz	19.5 A	30.5 A	29.4 A	46.0 A	46.0 A	46.0 A
Short-time load**1 at a PWM frequency of:						
3333 Hz	30.0 A		96.0 A		140.0 A	
4000 Hz	30.0 A		96.0 A		140.0 A	
5000 Hz	30.0 A		96.0 A		140.0 A	
6666 Hz	25.6 A		80.6 A		117.6 A	
8000 Hz	21.8 A		69.2 A		100.8 A	
10000 Hz	18.0 A		58.8 A		85.4 A	
Power loss	≅ 280 W	≅ 430 W	≅ 420 W	≅ 650 W	≅ 610 W	≅ 870 W
Current consumption**2						
15 v	170 mA		250 mA		270 mA	
24 V	250 mA		420 mA		460 mA	
Degree of protection	IP 20		IP 20		IP 20	
Weight	20 lb. (≅ 9 kg)		26.5 lb. (≅ 12.0 kg)		41.9 lb. (≅ 19.0 kg)	

(Continued…)

**1 40% cyclic duration factor for duration of 10 minutes (S6-40%) or for 0.2 s at standstill

**2 After making your selection, check the current consumption of the 15V and 24V supply of the entire modular amplifier system.

Table 2-7, Power Module Technical Specifications (Continued)

Specifications	**PM 207**	**PM 215A**[**1]		**PM 223A**[**1]	
	Axis	**Axis**	**Spindle**	**Axis**	**Spindle**
ANILAM P/N	34000327	34000328		34000329	
Continuous load at a PWM frequency of:					
3333 Hz	9.0 A	18.40 A	24.5 A	28.2 A	38.0 A
4000 Hz	8.3 A	16.9 A	22.5 A	26.0 A	35.0 A
5000 Hz	7.5 A	15.0 A	20.0 A	23.0 A	31.0 A
6666 Hz	6.4 A	12.8 A	17.0 A	19.3 A	26.0 A
8000 Hz	5.3 A	10.9 A	14.5 A	16.7 A	22.5 A
10000 Hz	4.5 A	9.0 A	12.0 A	14.1 A	19.0 A
Short-time load[**2] at a PWM frequency of:					
3333 Hz	15.0 A	30.0 A		46.0 A	
4000 Hz	15.0 A	30.0 A		46.0 A	
5000 Hz	15.0 A	30.0 A		46.0 A	
6666 Hz	12.8 A	25.6 A		38.6 A	
8000 Hz	10.6 A	21.8 A		33.4 A	
10000 Hz	9.0 A	18.0 A		28.2 A	
Power loss	≅ 140 W	2 axes: ≅ 240 W 1 axis, 1 spindle: ≅ 280 W		2 axes: ≅ 360 W 1 axis, 1 spindle: ≅ 450 W	
Current consumption[**3]					
15 v	200 mA	250 mA		290 mA	
24 V	110 mA	170 mA		220 mA	
Degree of protection	IP 20				
Weight	12 lb. (≅ 5.5 kg)	12 lb. (≅ 5.5 kg)		20 lb. (≅ 9 kg)	

**1 For this power module on the lower PWM connection can be used to control the spindle

**2 40% cyclic duration factor for duration of 10 minutes (S6-40%) or for 0.2 s at standstill

**3 After making your selection, check the current consumption of the 15V and 24V supply of the entire modular amplifier system.

Current Consumption of the Entire Inverter System

The current consumption by the power modules from the 15V and 24V supply unit strongly depends on their performance. If several high-performance power modules are used, the maximum permissible current for the supply unit can be exceeded. Therefore, the current consumption must be of controlled separately for the 15V and 24V supply units. The intrinsic needs of the supply unit must also be taken into account. The consumption of the individual components is listed in the specifications table.

The following limit values apply:

- 15V supply unit: Maximum 1.5 A
- 24V supply unit: Maximum 2.0 A

If the total current consumption exceeds **one** limit value, contact ANILAM.

For example, refer to **Table 2-8**.

Table 2-8, Total Current Consumption Example

Device	15 V Power Supply	24 V Power Supply
PS 145	0.38 A	0.31 A
PM 148A	0.25 A	0.42 A
PM 215A	0.25 A	0.17 A
PM 207	0.20 A	0.21 A
PM 107	0.12 A	0.06 A
Total	1.20 A	1.17 A

Ribbon Cables and Covers

50-Line Ribbon Cable (Power Supply to CNC Chassis)

The 50-line ribbon cable connects the PS 1*xx* with the CNC Chassis and serves as voltage supply. This cable is only required once. Refer the **Table 2-9**.

Table 2-9, 50-Line Ribbon Cable P/N List

Ribbon Cable Length	P/N
300 mm (≅18.81 inches)	34000260
400 mm (≅15.74 inches)	34000280
500 mm (≅19.69 inches)	34000281
600 mm**1 (≅23.62 inches)	34000282

**1 With lengths of 600 mm (23.62 inches) and longer, the ribbon cable is led doubled to the CNC Chassis to increase the line cross section.

To select the 50-line ribbon cable length:

1. Add the widths of all modules (including BR 9) between PS 1*xx* and CNC Chassis.
2. Select the next-length cable length, unless there is an exact match.

20-Line Ribbon Cable (PWM signals)

The 20-line ribbon cable connects the PWM outputs of the CNC Chassis with the corresponding PM 1*xx* power modules. One 20-line ribbon cable is required for each axis or spindle. Refer the **Table 2-10**.

Table 2-10, 20-Line Ribbon Cable P/N List

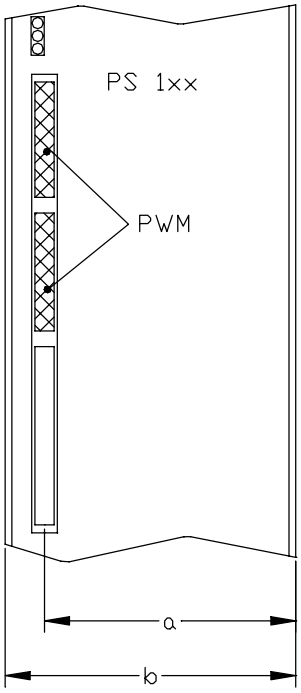
Ribbon Cable Length	P/N
100 mm (≅3.94 inches)	34000263
200 mm (≅7.87 inches)	34000261
300 mm (≅18.81 inches)	34000262
400 mm (≅15.74 inches)	34000270
500 mm (≅19.69 inches)	34000271
600 mm (≅23.62 inches)	34000272

To select the 20-line ribbon cable length:

1. See **Table 2-11** for distance *a* (See **Figure 2-1**) of the PWM input on the power module.
2. Add the widths *b* of all modules (including BR 9) between the corresponding power module and the CNC Chassis.
3. Select the next-length cable length, unless there is an exact match.

Table 2-11, 20-Line Ribbon Cable Distance Guide

Power Module	Distance *a*	Module Width *b*
PM 107, PM 207	Approx. 40 mm	50 mm
PM 1156A, PM 215A	Approx. 85 mm	100 mm
PM 123A, PM 132A, PM 148A, PM 223A	Approx. 90 mm	100 mm
PM 170A	Approx. 140 mm	150 mm



ModuleWidth

Figure 2-1, Module Width Measures

40-Line Ribbon Cable (Unit Bus)

The 40-line ribbon cable connects the PS 1*xx* power supplies with all of the PM 1*xx* and PM 2*xx* power modules (and the PR 9 braking resistor module, if present), making the unit bus. This cable is only required once. Refer to **Table 2-12**.

Table 2-12, 40-Line Ribbon Cable (Unit Bus) P/N List

Ribbon Cable Length	P/N
300 mm (≅18.81 inches)	34000275
400 mm (≅15.74 inches)	34000276
500 mm (≅19.69 inches)	34000277

To select the 40-line ribbon cable length:

1. Add the widths of all modules (including BR 9) between PS 1*xx* and CNC Chassis.
2. Select the next-length cable length, unless there is an exact match.

Ribbon Cable Covers

The ribbon cables must be covered to protect against interference.

The cover for the CNC Chassis is supplied with the CNC Chassis.

If further power modules and the BR 9 braking resistor module are used, the corresponding covers must be ordered separately. Refer to **Table 2-13**.

Table 2-13, Ribbon Cable Covers P/N List

Width of the Cover	P/N
50 mm (≅1.97 inches)	34000265
100 mm (≅3.84 inches)	34000266
150 mm (≅5.90inches)	34000267
500 mm (≅7.87 inches)	34000268

To select the ribbon cable covers:

1. Add the widths of all modules (including BR 9) between PS 1*xx* and CNC Chassis.
2. Select the appropriate cover from the table in order to cover the remaining width.

Axis-Enabling Module

If no axis-enabling module is used, all axis power modules are switched off simultaneously via X72 of the PS 1*xx* power supply. The axis-enabling module makes it possible to switch off power modules group by group.

The module—instead of mounting pins for the covers—is screwed into the front panel of a power module.

The axis-enabling signal is transmitted via a line in the unit bus from power module to power module. This line is interrupted through the axis-enabling module so that all the power modules connected to the axis-enabling module are switched off. All other power modules are switched off via X72 of the PS 1*xx*.

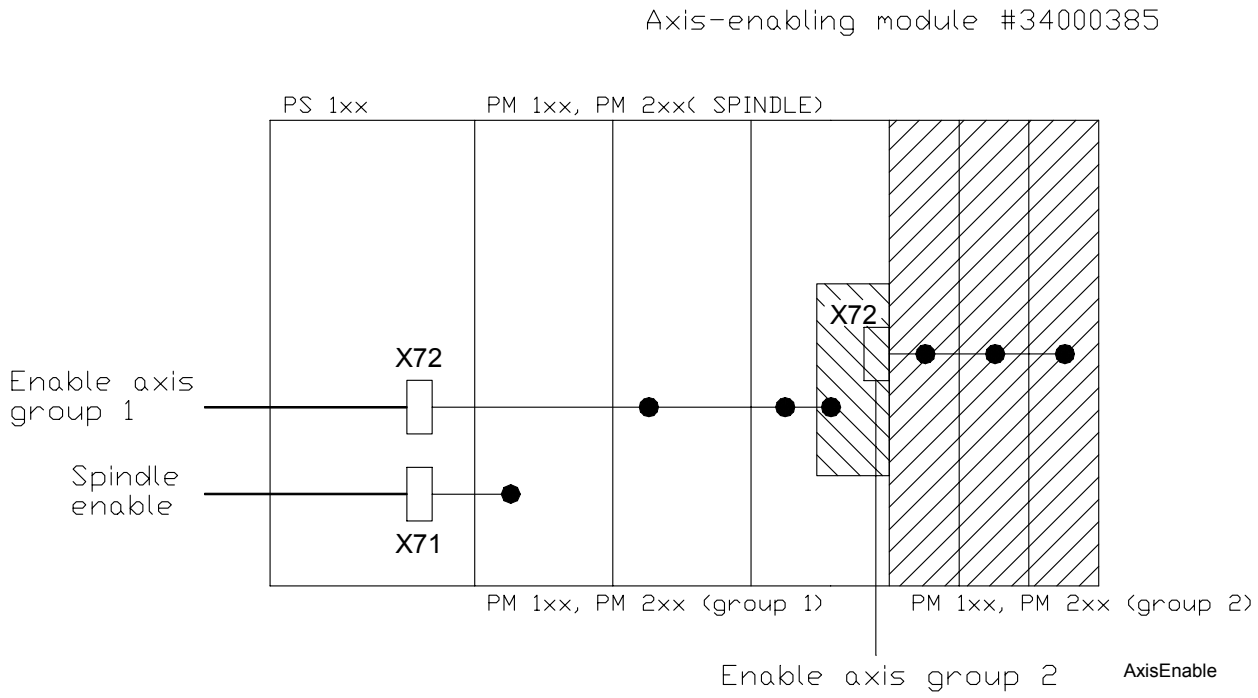


Figure 2-2, Axis-Enabling Module

The unit bus requires a 40-line ribbon cable with connects the PS 1*xx* power supply unit, the axis-enabling module, and the power module to switched off via PS 1xx.

A further 40-line ribbon cable connects the axis-enabling module with the power modules, which are to be switched off via the axis-enabling module.

The width of the covers required for the ribbon cables for the modular amplifier system is reduced by the width of the axis-enabling module (50 mm). Suitable covers are included with the modular amplifier system.

Accessories for Inverters and Modular Amplifiers

The following topics are described in this section:

Braking Resistors

During braking, the braking resistors convert the energy fed back to the DC-link into heat. The BR 10F and BR 18F have a cooling fan; the BR 18 cools through heat radiation only.

Either one BR 18, BR 10F or BR 18F, or two BR 18s in parallel can be connected to a SA series compact inverter and a PM 107 power module.

For PS 122 and PS 145 in the energy-recovery inverter, the braking energy of the motors is normally returned to the line power. If in an exceptional case the line power is interrupted, the braking energy cannot be returned. This can lead to an excessive DC-link voltage that might switch off the inverter and let the motors coast without control. To prevent damage to the machine and workpiece resulting from uncontrolled machine movement, the axis motors must be equipped with brakes, or the energy must be dissipated with the BR 9 braking resistor module.

For PS 130, the BR 10F braking resistor is used.

BR 18 Braking Resistor

For BR 18, refer to **Table 2-14**.

Table 2-14, BR 18 Braking Resistor Technical Specifications

Specifications	BR 18
ANILAM P/N	34000450
Continuous Power	2 kW (4 kW)**1
Peak Power**2	27 kW (54 kW)**1
Resistance	18 Ω
Degree of Protection	IP 20
Weight	12.1 lb. (5.5 kg)

**1 When two BR 18 units are connected in parallel
**2 2 % cyclic duration factor for duration of 120 s

BR 10F and BR 18F Braking Resistor

For BR 10F and BR 18F, refer to **Table 2-15**.

Table 2-15, BR 10F and BR 18F Braking Resistor Technical Specifications

Specifications	BR 10F	BR 18F
ANILAM P/N	34000452	34000451
Continuous Power	2 kW	4 kW
Peak Power**1	27 kW	49 kW
Power Consumption by the Fan	2.5 W	2.4 W
Resistance	10 Ω	18 Ω
Degree of Protection	IP 20	IP 20
Weight	13.2 lb (6 kg)	50.6 lb (11 kg)

**1 BR 10F: 1.5 % cyclic duration factor for duration of 120 s
BR 18F: 2 % cyclic duration factor for duration of 120 s

WARNING: The surface of the braking resistor can exceed temperatures of up to > 150 ºC (302 ºF).

BR 9 Braking Resistor

In the energy-recovery inverter, the braking energy of the motors is normally returned to the line power. If in an exceptional case the line power is interrupted, the braking energy cannot be returned. This can lead to an excessive DC-link voltage that might switch off the inverter and let the motors coast without control. To prevent damage to the machine and workpiece resulting from uncontrolled machine movement, the axis motors must be equipped with brakes, or the energy must be dissipated with the BR 9 braking resistor module.

Refer to **Table 2-16**.

Table 2-16, BR 9 Braking Resistor Technical Specifications

Specifications	BR 9
ANILAM P/N	34000453
Power	60 kW (for 2 s)
Resistance	9 Ω
Degree of Protection	IP 20
Weight	15.5 lb (7 kg)

CR 1xx Commutating Reactor and Line Filter

The PS 122 and PS 145 power recovery modules must be connected to the main power line via the CR 170 commutating reactor and the line filter. This is necessary for keeping the main line free of disruptive higher harmonics. Refer to **Table 2-17** and **Table 2-18**.

Table 2-17, CR 1xx - Commutating Reactor Technical Specifications

Specifications	CR 135	CR 170	CR 180
ANILAM P/N	34000355	34000355	34000357
Rated voltage	3 x 400 V		
Rated frequency	50 Hz/60 Hz		
Rated current	3 x 35 A	3 x 70 A	3 x 80 A
Power loss	≅ 200 W	≅ 340 W	≅ 350 W
Degree of protection	IP 00		
Weight	24.2 lb (≅ 11 kg)	48.5 lb (≅ 22 kg)	51 lb (≅ 23 kg)

Refer to **Table 2-18**.

Table 2-18, Line Filter Technical Specifications

Parameter	LF 135A	LF 180A
ANILAM P/N	34000359	34000358
Suitable for	PS 122	PS 145
Rated voltage	3 x 400 V	
Rated frequency	50 Hz/60 Hz	
Rated current	3 x 35 A	3 x 80 A
Degree of protection	IP 20	
Weight	11 lb. (5 kg)	22 lb. (10 kg)

VPM 363 – Voltage Protection Module

When operating synchronous motors in a field weakening range (for example, as main spindle drives), the voltage can increase at the motor power connections if the power supply is interrupted. This increased voltage can damage the inverters. The voltage protection module is installed between the motor and the inverters, an in case of an error, it short circuits the motor phases. The released braking energy is converted into heat.

Refer to **Table 2-19**.

Table 2-19, VPM 363 – Technical Specifications

Specifications	VPM 363
ANILAM P/N	34000387
Maximum phase current	3 x 63 A
Maximum braking time at maximum phase current	10 s
Minimum duration between braking procedures	5 min
Degree of protection	IP 20
Weight	4.6 lb (≅ 5 kg)

WARNING: The maximum cable length between the VPM 363 and the inverter is 2 m. (6.56 ft.)

Section 3 - Selecting Motors and Inverters

Selecting an Axis Motor

To select the appropriate axis motor and inverter for your needs, you will need to do some calculations. Refer to Table 3-1, Calculation Data for Selecting Axis Motors and Inverters.

- ❑ **Calculate the static moment from the sum of:**
  - Frictional moment (with horizontal axes)
  - Moment for overcoming the force of gravity (for vertical axis)
  - Machining moment
- ❑ **Calculate the desired speed of the motor:**
- ❑ **Select the motor that meets the following requirements:**
  - Stall torque of the motor ≥ static moment
  - Rated speed of the motor ≥ desired speed
- ❑ **Select the inverter that meets the following requirement:**
  - Rated current of the inverter ≥ continuous stall current of the motor
- ❑ **Calculate the external moment of inertia:**
  - Moment of inertia of the table
  - Moment of inertia of the ballscrew
  - Moment of inertia of the gearwheel on the ballscrew
  - Moment of inertia of the gearwheel on the motor
- ❑ **Calculate the total moment of inertia from the following variables:**
  - External moment of inertia
  - Moment of inertia of the motor
- ❑ **Check the ratio of external moment of inertia to the moment of inertia of the motor.**
- ❑ **Calculate the acceleration moment.**
- ❑ **Compare the acceleration moment with the following variables:**
  - Maximum moment of the inverter
  - Maximum moment of the motor
- ❑ **Calculate the effective moment at a given load cycle.**
- ❑ **Compare the effective moment at a given load cycle with the rated torque of the motor.**

Table 3-1, Calculation Data for Selecting Axis Motors and Inverters

Parameter	Formula	Variables
Frictional moment M_{frict}	$M_{\text{frict}} = \frac{m \cdot g \cdot \mu \cdot h \cdot \cos \alpha}{2 \cdot \pi \cdot i \cdot \eta}$	m: Mass [kg] g: Acceleration of gravity [m/s2] μ: Coefficient of friction [-] h: Ballscrew pitch [m] α: Axis angle [°] (0°=horizontal axis) i: Gear ratio [-] (n_{motor} /$n_{ballscrew}$) η: Efficiency [-]
Moment of overcoming the force of gravity Mwz	$Mwz = \frac{m \cdot g \cdot h \cdot \sin \alpha}{2 \cdot \pi \cdot i \cdot \eta}$	m: Mass [kg] g: Acceleration of gravity [m/s2] h: Ballscrew pitch [m] α: Axis angle [°] (90°=vertical axis) i: Gear ratio [-] (n_{motor} /$n_{ballscrew}$) η: Efficiency [-]
Machining moment M_{mach}	$M_{mach} = \frac{F_{mach} \cdot h}{2 \cdot \pi \cdot i \cdot \eta}$	F_{mach}: Machining force [N] h: Ballscrew pitch [m] i: Gear ratio [-] (n_{motor} /$n_{ballscrew}$) η: Efficiency [-]
Static moment M_{Stat}	$M_{Stat} = M_{frict} + M_{wz} + M_{mach}$	M_{frict}: Frictional moment [Nm] M_{wz}: Moment for overcoming the force of gravity [Nm] M_{mach}: Machining moment [Nm]
Rated motor speed η_{Noml}	$n_{Noml} = \frac{v_{\max} \cdot i}{h}$	V_{max}: Rapid traverse [m/min] i: Gear ratio [-] (n_{motor} /$n_{ballscrew}$) h: Ballscrew pitch [m]
Motor selection	$M_{0Motor} \geq M_{Stat}$ $n_{NMotor} \geq n_{Noml}$	M_{0Motor}: Stall torque of the motor M_{Stat}: Static moment n_{NMotor}: Rated speed of the motor n_{Noml}: Desired speed of the motor
Modular Amplifier: Selection of the power module Compact Inverter: Selection of the axis unit	$I_{NInverter} \geq I_{0Motor}$	$I_{NInverter}$: Rated current of the inverter I_{0Motor}: Stall current of the motor

(Continued…)

Table 3-1, Calculation Data for Selecting Axis Motors and Inverters (Continued)

Parameter	Formula	Variables
Moment of inertia of the table J_T	$J_T = m \cdot \left(\frac{h}{2 \cdot \pi} \right)^2$	m: Table mass [kg] h: Ballscrew pitch [m]
Moment of inertia of the ballscrew J_S	$J_S = \frac{d_S{}^4 \cdot \pi \cdot l \cdot p}{32}$	d_S: Diameter of the ballscrew [m] l: Length of the ballscrew [m] ρ: Density of the ballscrew material [kg/m^3]
Moment of inertia of the gearwheel on the ballscrew J_{GS}	$J_{GS} = \frac{d_{GS}{}^4 \cdot \pi \cdot l \cdot p}{32}$	d_{GS}: Diameter of the gearwheel on the ballscrew [m] l: Length of the gearwheel on the spindle [m] ρ: Density of the gearwheel material [kg/m^3]
Moment of inertia of the gearwheel on the motor J_{GM}	$J_{GM} = \frac{d_{GM}{}^4 \cdot \pi \cdot l \cdot p}{32}$	d_{GM}: Diameter of the gearwheel on the ballscrew [m] l: Length of the gearwheel on the spindle [m] ρ: Density of the gearwheel material [kg/m^3]
External moment of inertia J_{ext}	$J_{ext} = \frac{J_T + J_S + J_{GS}}{i^2} + J_{GM}$	J_T: Moment of inertia of the table [kgm^2] J_S: Moment of inertia of the ballscrew [kgm^2] J_{GS}: Moment of inertia of the gearwheel on the ballscrew [kgm^2] i: Gear ratio (n_{motor} /$n_{ballscrew}$) J_{GM}: Moment of inertia of the gearwheel on the motor [kgm^2]
Total moment of inertia of the machine slide with motor J_{total}	$J_{total} = \frac{J_T + J_S + J_{GS}}{i^2} + J_{GM} + J_M$	J_T: Moment of inertia of the table [kgm^2] J_S: Moment of inertia of the ballscrew [kgm^2] J_{GS}: Moment of inertia of the gearwheel on the ballscrew [kgm^2] i: Gear ratio (n_{motor} /$n_{ballscrew}$) J_{GM}: Moment of inertia of the gearwheel on the motor [kgm^2] J_M: Moment of inertia of the motor [kgm^2]

(Continued…)

Table 3-1, Calculation Data for Selecting Axis Motors and Inverters (Continued)

Parameter	Formula	Variables
Ratio of external moment of inertia to the moment of inertia of the motor	$0.5 \geq \frac{J_{ext}}{J_M} \geq 2$	J_M: Moment of inertia of the motor [kgm^2] This ratio ensures a stable control response.
Acceleration moment M_{accl}	$M_{acc} = \frac{J_{total} \cdot 2 \cdot \pi \cdot n_M}{60 \cdot \eta \cdot t_{acc}}$	J_{total}: Total moment of inertia [kgm^2] n_M: Desired speed of the motor [min^{-1}] η: Efficiency of the motor [-] t_{acc}: Desired acceleration time [s]
Maximum moment of the motor M_{Mmax}	M_{Mmax} from data sheet, or: $M_{M\,max} = 3 \cdot M_0$	M_0: Stall torque of the motor [Nm]
Maximum moment of the inverter M_{Umax}	$M_{Umax} = \frac{M_{M\,max}}{I_{M\,max}} \cdot I_{U\,max}$ – or – $M_{Umax} = 0.8 \cdot \frac{M_{MN}}{I_{MN}} \cdot I_{U\,max}$	M_{Mmax}: Maximum moment of the motors [Nm] I_{Mmax}: Maximum current of the motor [A] I_{Umax}: Maximum current of the inverter [A] M_{MN}: Rated torque of the motor [Nm] I_{MN}: Rated current of the motor [A]
Comparison of the acceleration moment with the maximum moment of the motor and inverter	$M_{Mmax} > M_{acc}$ $M_{Umax} > M_{acc}$	M_{Mmax}: Maximum moment of the motors [Nm] M_{acc}: Acceleration moment [Nm] M_{Umax}: Maximum moment of the inverter [Nm]
Weighting factors	$K_{mach} = \frac{t_{mach}}{t_{total}}$ $K_{pos} = \frac{t_{pos}}{t_{total}}$ $K_{acc} = \frac{t_{acc}}{t_{total}}$ **NOTE:** $K_{mach} + K_{pos} + K_{acc} = 1$	t_{mach}: Machining time t_{total}: Total running time t_{Pos}: Time for positioning operations t_{acc}: Time for acceleration All times must be given in the same unit of measure!

(Continued…)

Table 3-1, Calculation Data for Selecting Axis Motors and Inverters (Continued)

Parameter	Formula	Variables
Effective moment at a given load cycle		M_{Stat}: Static moment [Nm] K_{mach}: Weighting factor for machining operations [-] M_{frict}: Frictional moment [Nm] M_{wz}: Moment for overcoming the force of gravity [Nm] K_{Pos}: Weighting factor for positioning operations [-] M_{acc}: Acceleration moment [Nm] K_{acc}: Weighting factor for acceleration operations [-]
$M_{eff} = \sqrt{(M_{Stat})^2 \cdot Kmach + (M_{frict} + M_{wz})^2 \cdot K_{pos} + (M_{frict} + M_{wz} + M_{acc})^2 \cdot K_{acc}}$		
Comparison of the effective moment at a given load cycle with the rated motor torque.	$M_{MN} \geq M_{eff}$	M_{MN}: Rated torque of the motor (Nm) M_{eff}: Effective moment at a given load cycle (Nm)

Selecting a Spindle Motor

Select a spindle motor based on torque and speed requirements.

Selecting an Inverter

Modular Amplifier

The power modules were already selected together with the axis motors. The power supply unit must still be selected.

- Calculation of the DC-link power
- Selecting the power supply unit

Compact Inverter

The number of axes required and the current requirements determine which inverter is appropriate. It has not yet been determined whether the DC-link power of the inverter is sufficient. Refer to **Table 3-2**.

Table 3-2, Calculation Data for Selecting Inverters

Parameter	Formula	Variable
DC-link power P_{DC}	$P_{DC} = \frac{P_{NScr}}{\eta_{Scr}} + \frac{\Sigma P_{NAx}}{\eta_{Ax}} \cdot F_{Mratio}$	P_{NScr}: Power rating of the spindle motor [W] η_{Scr}: Efficiency of the spindle motor [-] Σ_{PNAx} : Sum of the power ratings of the feed motors [W] η_{Ax}: Efficiency of the feed motors [-] F_{Mratio}: Ratio of mean power to rated power of the feed motors.
Selection of power supply unit or examination of the inverter	$P_{DC} \leq P_{NU}$	P_{DC}: DC-link power [W] P_{NU}: Rated power of the power supply unit or the compact inverter [W]

Selection of the Braking Resistor

To select the appropriate braking resistor for your system, you will need to do some calculations. Refer to **Table 3-3**.

- Calculation of braking power
- Calculation of braking power with a specified alternation of load
- Calculation of braking energy
- Selection of the braking resistor according to:
  - Peak performance of the braking resistor
  - Reliable mean value of the braking power
  - Maximum braking energy of the braking resistor

Table 3-3, Calculation Data for Selecting Braking Resistor

Parameter	Formula	Variable
Braking power P_{Br}	$P_{Br} = \frac{2 * \pi * M_{Br} * n_{\max}}{60}$	M_{Br}: Braking moment [N_M] n_{max}: Maximum speed at which braking occurs [rpm]
Braking energy E_{Br}	$E_{Br} = 2 * J * \pi^2 * \left[\left(\frac{n_2}{60} \right)^2 - \left(\frac{n_1}{60} \right)^2 \right]$	J: Moment of inertia, including the motor [kgm^2] n_2: Desired speed of the brakes [rpm] n_1: Desired speed after braking [rpm]
Mean value of the braking power with a specified alternation of load P_M	$P_M = P_{Br} * \frac{t_1}{T}$	P_{Br}: Braking power [W] t_1: Load time [s] T: Cycle duration [s]
Selection of braking resistor	$P_{BR} \le P_{\max}$ $P_M \le P_{Mzul}$ $E_{Br} \le E_{\max}$	P_{Br}: Braking power [W] P_{max}: Peak performance of the braking resistor [W] P_{Mzul}: Permissible mean value of the braking performance according to the diagram as a function of E_{Br} [W] (see example on page 3-11) E_{max}: Maximum braking energy of the braking resistor [W_S]

Mean Value of Braking Performance Example

Example of a braking system with load time t_1 and cycle duration T. See **Figure 3-1**.

P_M is the mean value of the braking performance in this load alternation.

Since $E = P * t$, the enclosed areas must be of equal size:

$$P_M = P_{\max} * \frac{t_1}{T}$$

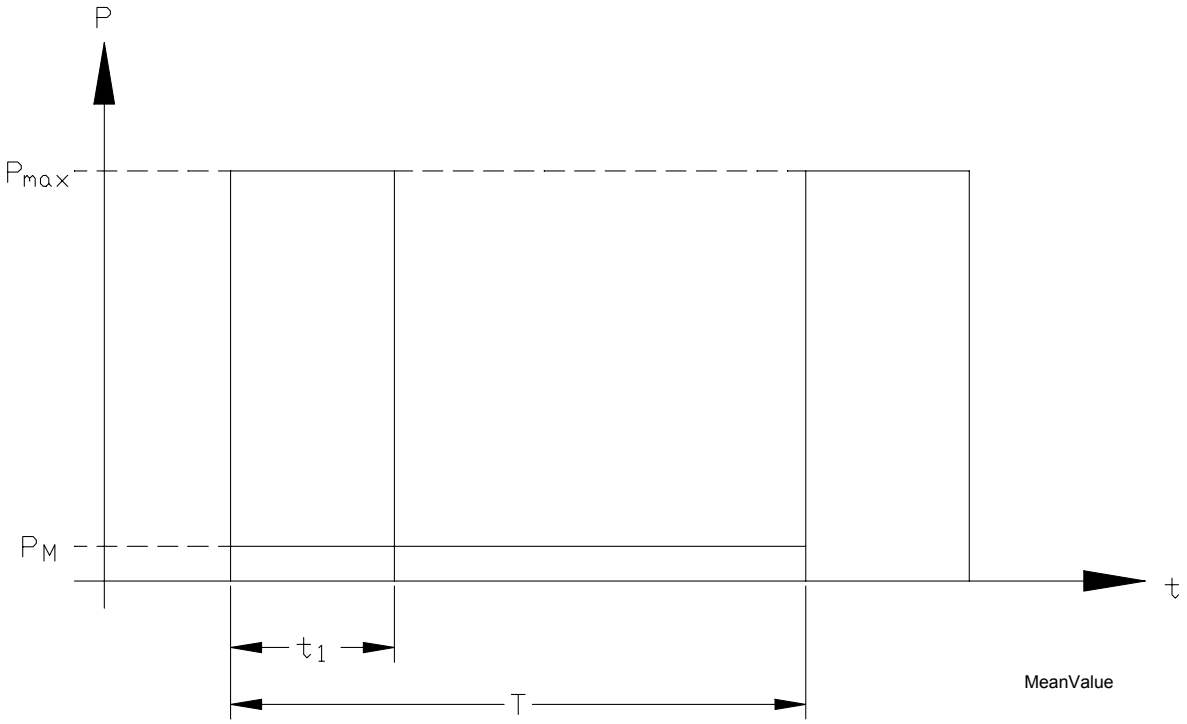


Figure 3-1, Mean Value of Braking Performance Example

BR 18 Braking Resistor Example

Permissible mean value of the braking performance P_{Mzul} as a function of the braking energy E. Refer to **Table 3-4** and **Figure 3-2**.

Table 3-4, BR 18 - Data for Mean Value Braking Performance

t_1	T	Pmax	Emax
0.37 s	5 s	27 kW	10 kWs
0.7 s	10 s	27 kW	18.9 kWs
1.1 s	20 s	27 kW	29.7 kWs
1.5 s	50 s	27 kW	40.5 kWs
2.4 s	120 s	27 kW	65 kWs

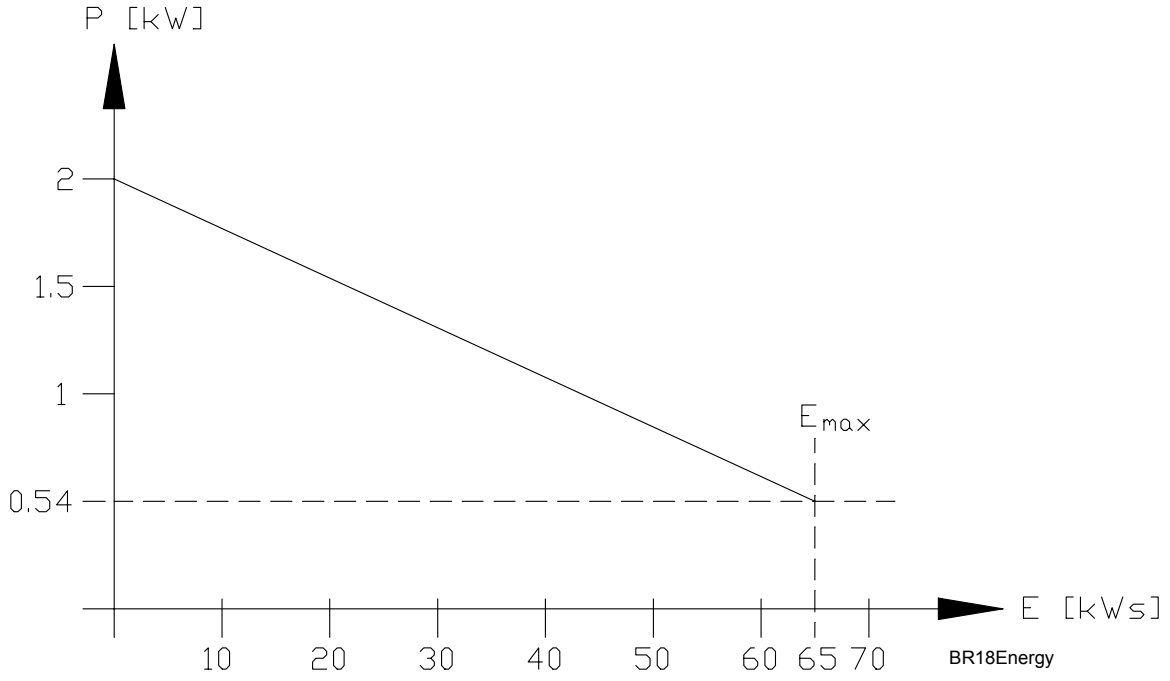


Figure 3-2, BR 18 - Braking Performance Function of Braking Energy

BR 10F Braking Resistor Example

Permissible mean value of the braking performance P_{Mzul} as a function of the braking energy E. Refer to **Table 3-5** and **Figure 3-3**.

Table 3-5, BR 10F - Data for Mean Value Braking Performance

t_1	T	P_{max}	E_{max}
0.37 s	5 s	27 kW	10 kWs
0.6 s	10 s	27 kW	16.2 kWs
0.9 s	20 s	27 kW	24.3 kWs
1.3 s	50 s	27 kW	35.1 kWs
1.8 s	120 s	27 kW	50 kWs

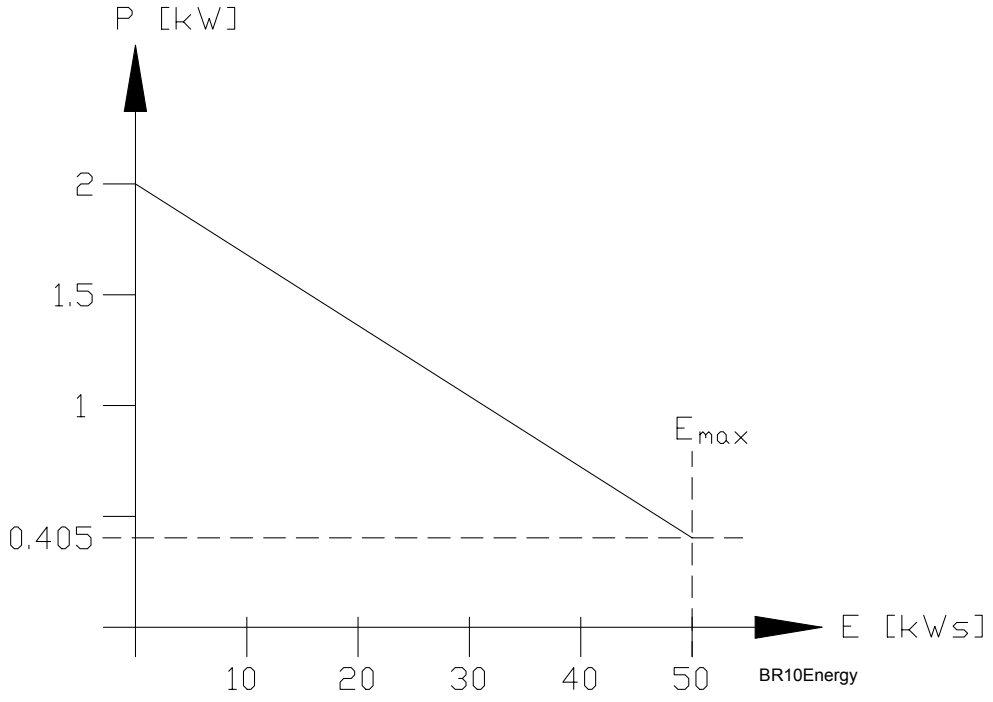


Figure 3-3, BR 10F - Braking Performance Function of Braking Energy

BR 18F Braking Resistor Example

Permissible mean value of the braking performance P_{Mzul} as a function of the braking energy E. Refer to **Table 3-6** and **Figure 3-4**.

Table 3-6, BR 18F - Data for Mean Value Braking Performance

t_1	T	P_{max}	E_{max}
0.37 s	5 s	49 kW	18 kWs
0.7 s	10 s	49 kW	34.3 kWs
1.1 s	20 s	49 kW	53.9 kWs
1.5 s	50 s	49 kW	73.5 kWs
2.4 s	120 s	49 kW	120 kWs

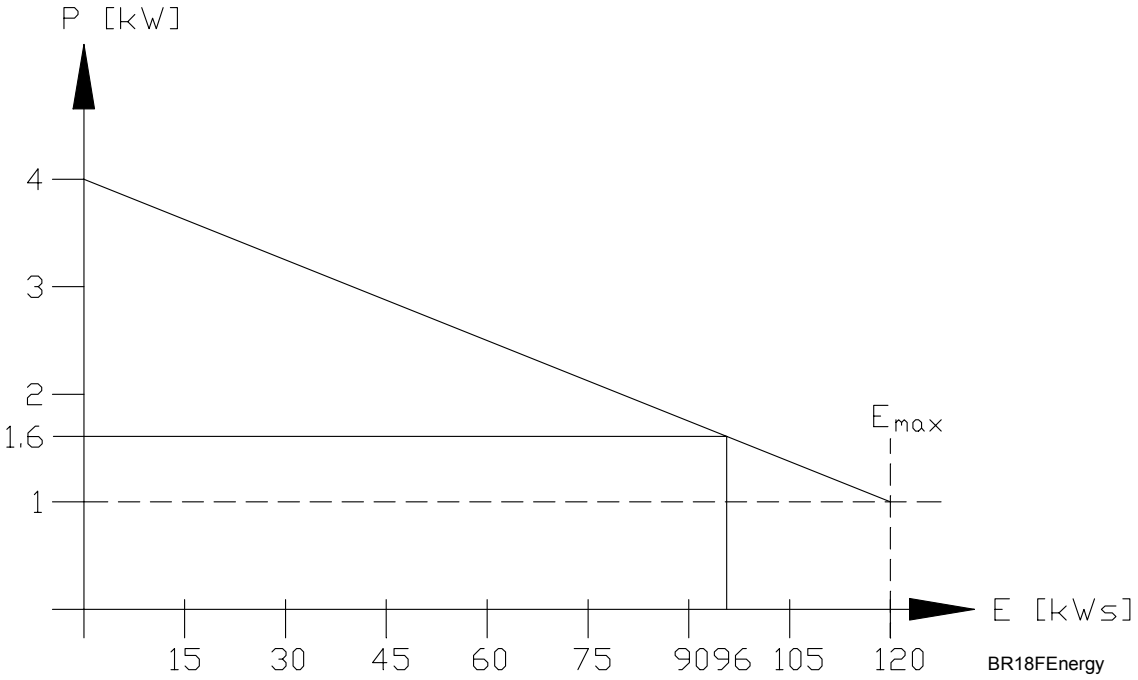


Figure 3-4, BR 18F - Braking Performance Function of Braking Energy

Example:

With the calculated braking energy E_{Br} = 96 kWs, the permissible mean value of the braking performance P_{Mzul} = 1.6 kW, meaning $P_M \leq 1.6$ kW.

Section 4 - Mounting and Operating Conditions

General Information

WARNING:	**Before mounting the inverter and making electrical connections, consider local regulations concerning power installation, interference and noise immunity, environmental conditions, and mounting attitude of the unit (thermal considerations, accessibility, safety, and so forth).**

Intended Area of Application

WARNING:	**Availability of this product is limited according to IEC 61800-3. This product can cause radio interferences in residential areas. This would require the operator to ensure appropriate measures are taken.**

Degree of Protection (IP Code)

The IP Code number indicates the amount of protection afforded by the housing against penetration of solid foreign bodies and/or water. The first digit of this two-digit number indicates the degree of protection afforded by the housing against penetration of solid foreign bodies. The second number indicates the degree of protection against water. For example, an IP code of 20 refers to a chassis that protects against (2) particles ≥ 12.5 mm (0.48 in), and provides no protection (0) from water intrusion. Refer to **Table 4-1** and Table 4-2, Inverter Component IP Ratings.

Table 4-1, IP Code Explanation

First Number	Protection against penetration of solid foreign bodies	Second Number	Protection against penetration of water with disruptive effect
0	No protection	0	No protection
1	≥ 50 mm (2 in)	1	Perpendicular droplets
2	≥ 12.5 mm (0.48 in)	2	Droplets at 15° angle
3	≥ 2.5 mm (0.09 in)	3	Spraying water
4	≥ 1 mm (0.04 in)	4	Splashing water
5	Dust protected	5	Flowing water
6	Dustproof	6	Heavily flowing water
		7	Temporary submersion
		8	Continuous submersion

Table 4-2, Inverter Component IP Ratings

Component	IP Rating
SA Series inverter	IP 20
PS amplifier power supply	IP 20
PM amplifier power modules	IP 20
BR Series braking resistors	IP 20
CR commutating reactors	IP 20
LF line filter	IP 20
SM Series spindle motors	IP 54
AM Series axis motors	IP 65 (shaft bore: IP 64)

Electromagnetic Compatibility

The SA Series inverters conform to requirements for Class A devices, per EN 55022. They are designed to be operated in industrially zoned areas. Protect your equipment from interference by observing the following rules and recommendations:

Noise Interference

Noise is mainly produced by capacitive and inductive coupling from electrical conductors or from device inputs/outputs such as:

- Strong magnetic fields from transformers or electric motors
- Relays, contactors and solenoid valves
- High-frequency equipment, pulse equipment, and stray magnetic fields from switch-mode power supplies
- Power lines and leads to the above equipment

Protective Measures

- Ensure a minimum distance of 20 cm (8 in) from the CNC chassis and its leads to interfering equipment.
- Ensure a minimum distance of 10 cm (4 in) from the CNC chassis and its leads to cables that carry interfering signals. For cables in metallic ducting, adequate decoupling can be achieved via a grounded separation shield.
- Provide shielding per IEC 742 and EN 50178.
- Provide potential compensating lines ∅ 6 mm^2 /10 mm^2 (AWG 10/8).
- Use genuine ANILAM cables, connectors and couplings.
- Keep the shield of the line for the holding brake as close as possible (< 30 mm or 1.2”) to ground. For best results, use a metal clamp to fasten the shield to the sheet metal housing of the electrical cabinet.

- **Only with SA Series inverters:** Mount toroidal cores in the motor leads (X80 to X84) and in the voltage supply lead (X31) to suppress interference (system disturbance) in accordance with EN 55011 / 55022 class A.
- **Only with modular amplifiers:** Use covers for the ribbon cables connecting modules.

DANGER: The leakage current (current at the equipment-grounding conductor) is sometimes higher than 3.5 mA. The equipment-grounding conductor must therefore have a diameter of at least 10 mm^2 (AWG 8) according to EN 50178.

NOTE: When using PS 122 or PS 145 regenerative power supply units, you **must** use the ANILAM CR 1xx commutating reactors, as well as the LF 180 or LF 180A line filters.

High-frequency disturbances in the line power may occur with other commutating reactors or line filters.

Using the Three-phase Current Capacitor

In order to avoid disturbances in the line power even though ANILAM commutating reactors and line filters are being used, ANILAM recommends using the three-phase current capacitor 3 x 24.1 µF/525V (P/N 34000386). For overall dimensions, see Figure 6-22, Three-Phase Current Capacitor, Dimensions. Refer to **Figure 4-1**.

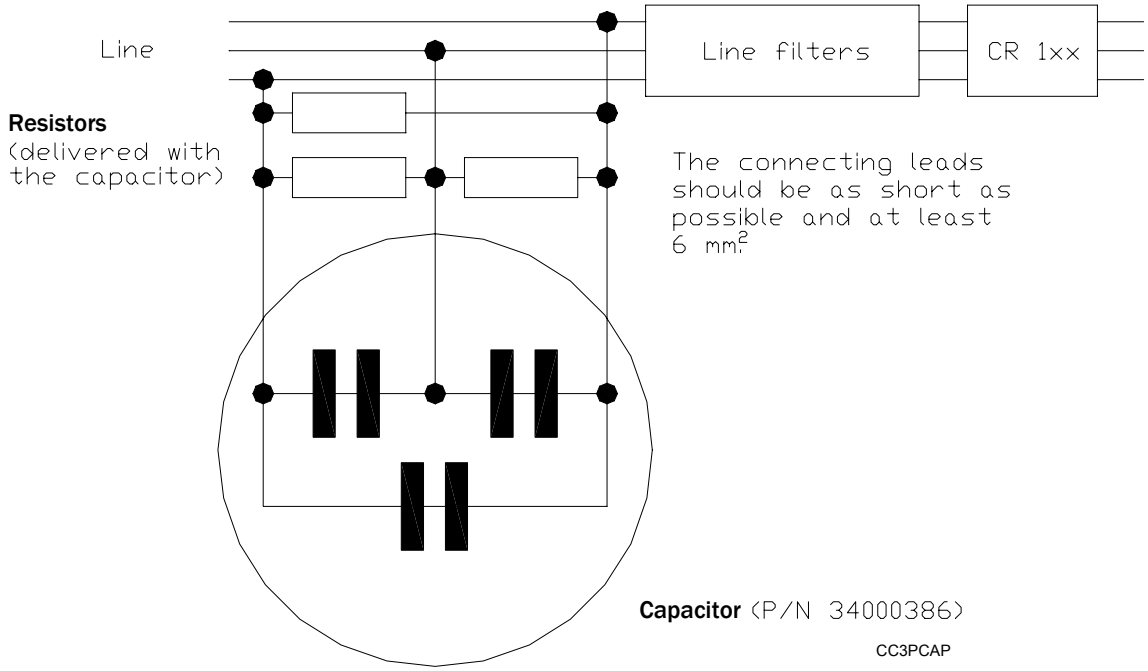


Figure 4-1, CC 3P CAP - Switching On the Three-phase Current Capacitor

Stability Requirements of the Power Supply

Refer to **Table 4-3**.

Table 4-3, Power Supply Stability Requirement

Regenerative Power Supply Unit	Minimum Short-Circuit Current	Minimum Short-Circuit Power
PS 122	$I_{SC} = 50 * I_N = 1600$ A	$S_K = 1.10$ MVA
PS 145	$I_{SC} = 50 * I_N = 3300$ A	$S_K = 2.15$ MVA

Fault-Current Circuit Breaker

Power supply companies require fault-current circuit breakers for TT and IT networks. A type B fault-current circuit breaker (trigger threshold 300 mA) with frequency weighting is to be used. These are available up to the rated current $I_N = 63$A. This is enough for the compact inverters and modular amplifiers with PS 122 and PS 130 power supply units. If the PS 145 power supply unit is used at full capacity, the 63 A of the fault-current circuit breaker is exceeded (65A); in this case, an isolation transformer must be used.

For TN networks, ANILAM recommends connecting the inverter/amplifier without the fault-current circuit breaker. Ensure that the grounding conductor has a large enough cross section. Refer to **Table 4-4**.

Table 4-4, Power Supply Isolation Transformer

Power Supply Unit	Rated Power Output of the Isolation Transformer	Short-Circuit Voltage
PS 145	$S_N \geq 58.3$ kVA	$U_K \leq 3$ %

NOTE: Type A and type AC fault-current circuit breakers may not be used.

Line Voltage

In case no line power with 400 VAC ± 10 % is available, an auto transformaer may be used for adjusting the line voltage. See **Table 4-5**.

Table 4-5, Autotransformer Power Output

Device	Rated Power Output of the Autotransformer
SA 301A, SA 311A, SA 411A	$S_N \geq 19.5$ kVA
SA 201A, SA 301C, SA 411C	$S_N \geq 28.5$ kVA
PS 122	$S_N \geq 28.5$ kVA
PS 130	$S_N \geq 44$ kVA
PS 145	$S_N \geq 58.3$ kVA

Cross Sections of the Power Cables

IEC 204-1 is valid for the dimensions of leads and cables.

A permissible current load value I_Z is assigned to each cable cross section. This value must be corrected with two factors:

- Correction factor C_1 for increased ambient air temperature
  - C1 = 0.91 for +45 °C (113 °F)
  - C1 = 0.81 for +50 °C (122 °F)
  - C1 = 0.71 for +55 °C (133 °F)
- Correction factor C_2 = 1.13 for insulation material with increased operating temperature.

The following tables are valid for:

- An ambient air temperature of +40° C (104 °F)
- An operational temperature of +90 °C (194 °F) (only H07 V2-K and Lapp Ölflex-Servo-FD 795 P single conductors)
- Installation type B1
  Conductor in the installation armor and installation channels to be opened.
- Installation type B2
  Cables and leads in the installation armor and installation channels to be opened.
- Installation type B3
  Cables and leads on walls and on open cable racks.

Refer to **Table 4-6** and **Table 4-7**. ::

Table 4-6, Cable Cross Section Current Load Specifications Installation Type B1

Cable Cross Section	Permissible Current Load with Installation Type B1		Permissible Current Load with Installation Type B2
	Single Conductor Standard PVC	Single Conductor H07 V2-K	Cable Lapp Ölfex-Servo-FD 795 P
1.0 mm^2 (AWG 18)	10.4 A	11.7 A	10.8 A
1.5 mm^2 (AWG 16)	13.5 A	15.2 A	13.8 A
2.5 mm^2 (AWG 14)	18.3 A	20.6 A	18.6 A
4.0 mm^2 (AWG 12)	25.0 A	28.2 A	26.0 A
6.0 mm^2 (AWG 10)	32.0 A	36.1 A	32.8 A
10.0 mm^2 (AWG 8)	44.0 A	49.7 A	45.2 A
16.0 mm^2 (AWG 6)	60.0 A	67.8 A	59.9 A
25.0 mm^2 (AWG 4)	77.0 A	87.0 A	75.7 A
35.0 mm^2 (AWG 2)	97.0 A	109.6 A	93.8 A

Table 4-7, Cable Cross Section Current Load Specifications Installation Type C and E

Cable Cross Section	Permissible Current Load with Installation Type C and E		
	Single Conductor Standard PVC	Single Conductor H07 V2-K	Cable Lapp Ölfex-Servo-FD 795 P
35.0 mm^2 (AWG 2)	104.0 A	117.5 A	117.5 A
50.0 mm^2 (AWG 1)	123.0 A	139.0 A	139.0 A
70.0 mm^2 (AWG 2/0)	155.0 A	175.1 A	175.1 A
95.0 mm^2 (AWG 3/0)	192.0 A	217.0 A	217.0 A
120.0 mm^2 (AWG 4/0)	221.0 A	249.7 A	249.7 A

Cable bundling is not taken into account in the tables. Consult IEC 204-1.

Example:

H07 V2-K single conductor with a cross section of 16 mm^2 and installation type B_2 at an ambient temperature of + 50 °C (122 °F):

Permissible current load at 40 °C (according to table): 67.8 A
Correction factor for ambient temperature of + 50 °C: 0.82

Permissible current load (+ 50 °C) = (C1) x (permissible current load [+40 °C])

Permissible current load (+ 50 °C) = (0.82) x (67.8 A) = 55.6 A

Leakage Current from the Inverter Housing to the Grounding Connection

ANILAM inverters are electronic equipment with a leakage current greater than 3.5 mA (from the housing to the ground). Therefore, a sticker with the following warning is on all inverter components. See **Figure 4-2**.

Ableitstrom> 3,5 mA
Potentialausgleich anschließen!

Leakage current > 3.5 mA
Connect potential equalization!

Figure 4-2, Leakage Current Warning Label

Since humans must not be subjected to leakage currents greater than 3.5 mA, the following must be ensured according to EN 50 178 (protective low voltage):

- Power connection with clamping:
  The cable for the grounding connection must have a line cross-section greater than half that of a line conductor, but at least (≥) ∅ 10 mm².

- Power connection with connector:
  A second grounding conductor with a line cross section greater than half that of a line conductor, but a t least (≥) ∅ 10 mm², along with the grounding conductor of the connector, must be firmly grounded.

In both cases, a clamped grounding connection must also be installed.

If more than one piece of equipment is connected to the same grounding connection, the leakage currents add up. Therefore the installer must ensure that the grounding connection is of sufficient low-impedance.

NOTE: ANILAM recommends placing a sign on the outside of the electrical cabinet with a warning and a connection recommendation for the grounding conductor.

Environmental Conditions

Heating and Cooling

WARNING:	**Ambient operating temperature for the SA Series inverter is 0 °C to 45 °C (32 °F to 113 °F). Operation at temperatures outside these parameters could result in damage to the machine.**

Ensure adequate cooling as follows:

- Provide sufficient space for air circulation.
- Install a fan to extract warm air. Do not allow pre-warmed air to be blown into the unit. The warmed air should flow over surfaces such as sheet metal, which enable heat dissipation.
- Where the chassis is a closed steel housing without assisted cooling, the formula for heat conduction is 3 W/m^2 of surface per °C air temperature difference between inside and outside.
- Use a heat exchanger with separate internal and external circulation.
- Do not blow external air through the control cabinet to replace the internal air. Fine dust or vapors could damage electronic assemblies. If no other method of cooling is possible, ensure that the fan draws warm air out of the electrical cabinet and pulls in air that is adequately filtered. Service the filter regularly.

Air Humidity

Permissible air humidity:

- Maximum 75 % in continuous operation
- Maximum 95% for not more than 30 days a year (randomly distributed)

NOTE:	To avoid condensation on the circuit boards, leave units powered on in humid environments.

Mechanical Vibration

Permissible vibration: ± 0.075 mm, 10 to 41 Hz
5 m/s^2, 41 Hz to 500 Hz

Permissible shock: 50 m/c^2, 11 ms

Contamination

ENJ 50 178 permits contamination level 2. If this standard cannot be adhered to, be sure to use a heat exchanger in order to avoid failures. For reasons of operating safety, ANILAM in principle recommends installing the modules with a separate internal and external cooling circuit.

ANILAM cannot assume responsibility for inverter failures caused by impermissible contamination.

WARNING:

A conducting layer might form on the live components of the inverter from the following:

- **Deposition of dust from the ambient air**
- **Chemical particles contained in the air**
- **Formation of dew after the machine has been switched off**

This conducting layer may cause flashovers of DC-link voltage that might damage the unit.

The so-called "protection by electrical separation" of:

- **Line voltage**
- **DC-link voltages**
- **"Exposed" voltages,**

which are required for safety reasons, are not guaranteed any longer.

Installation Considerations

WARNING:	**When mounting the braking resistors and inverter, observe proper minimum clearance, space requirements, and length of connecting cable.**

Minimum Clearances for BR 10F and BR 18F Braking Resistors

WARNING:	**Because of their high heat generation, these braking resistors must be mounted outside the CNC cabinet in a vertical position (with the fan at the bottom). Position braking resistors in a way that prevents mechanical damage from splashing water (coolant) and injury due to accidental human contact with hot surfaces.**

Refer to **Figure 4-3**.

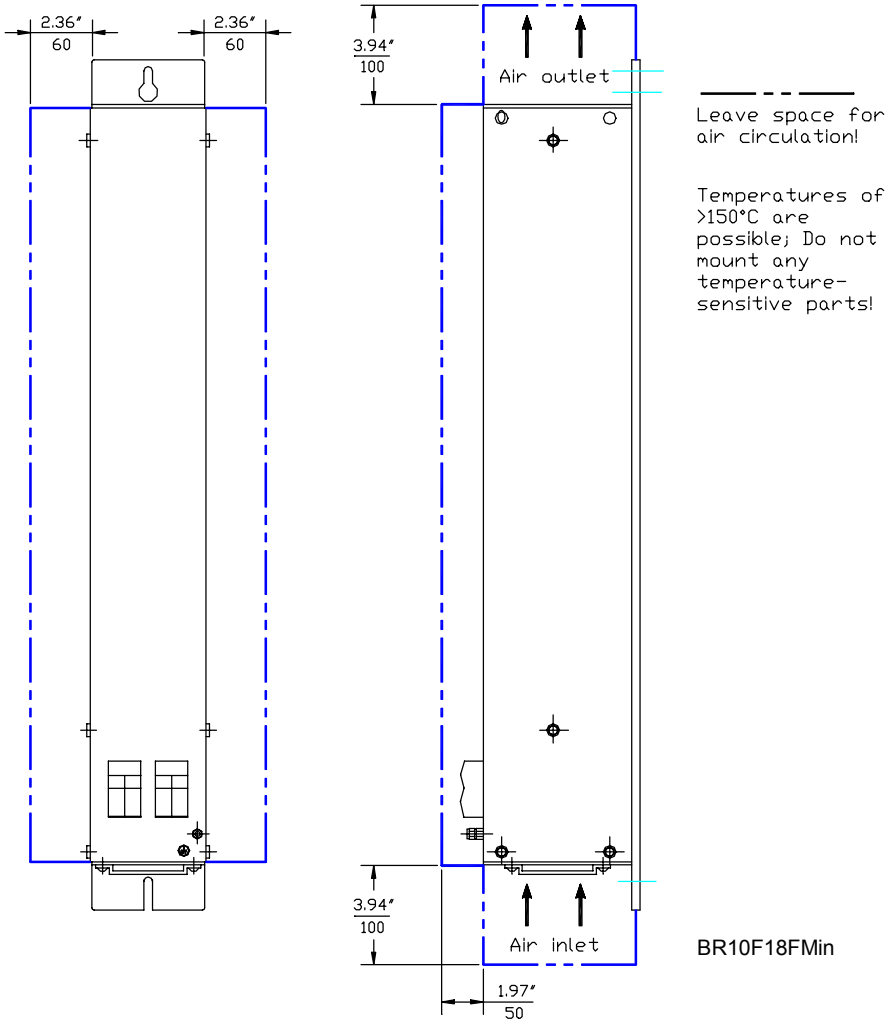


Figure 4-3, BR 10F and BR 18F - Minimum Clearance Positioning

Installation Positioning for BR 18 Braking Resistor

WARNING:	**Because of their high heat generation, the BR 18 braking resistor must be mounted outside the CNC cabinet, either vertically (connections at bottom) or horizontally (connections at rear).**

Refer to **Figure 4-4**.

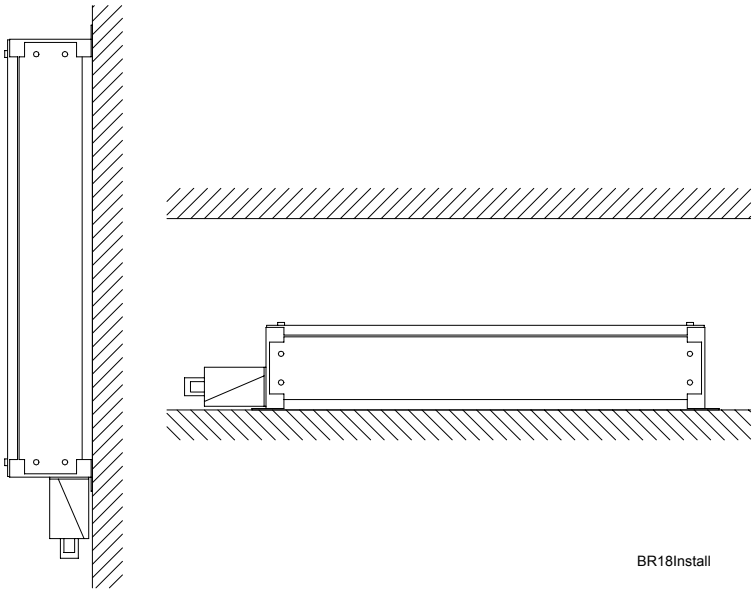


Figure 4-4, BR 18 - Installation Positioning

The braking resistor may not be positioned so that the connections face upwards, since the heat produced rises. Refer to **Figure 4-5**.

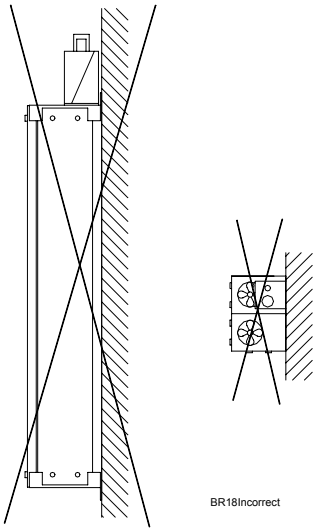


Figure 4-5, BR 18 - Incorrect Installation Positioning

Minimum Clearances for BR 18 Braking Resistor

WARNING:	**Because of their high heat generation, the BR 18 braking resistor must be mounted outside the CNC cabinet, either vertically (connections at bottom) or horizontally (connections at rear).**

Refer to **Figure 4-6**.

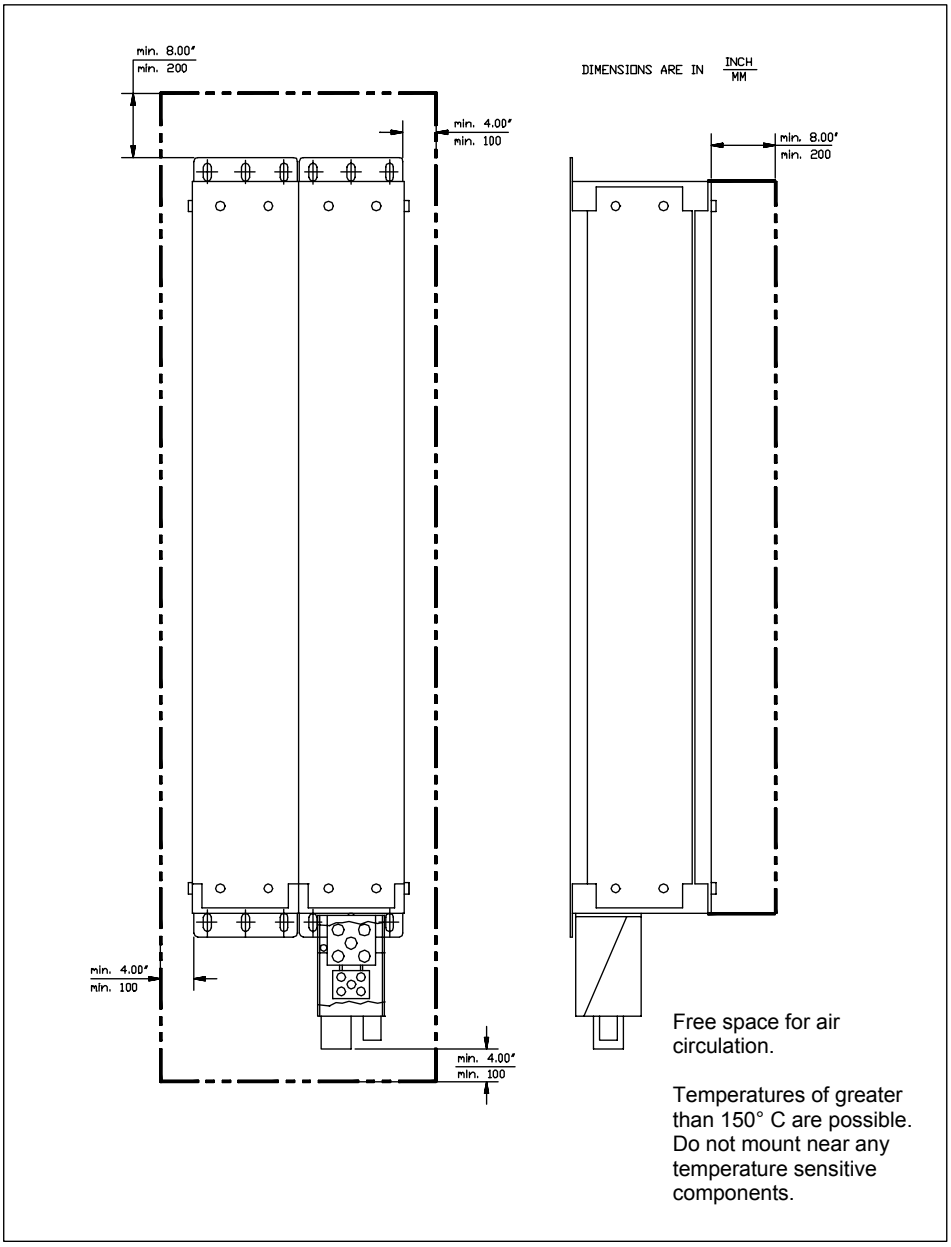


Figure 4-6, BR 18 - Minimum Clearances Positioning

Minimum Clearances for the SA Series Inverter

Refer to **Figure 4-7**.

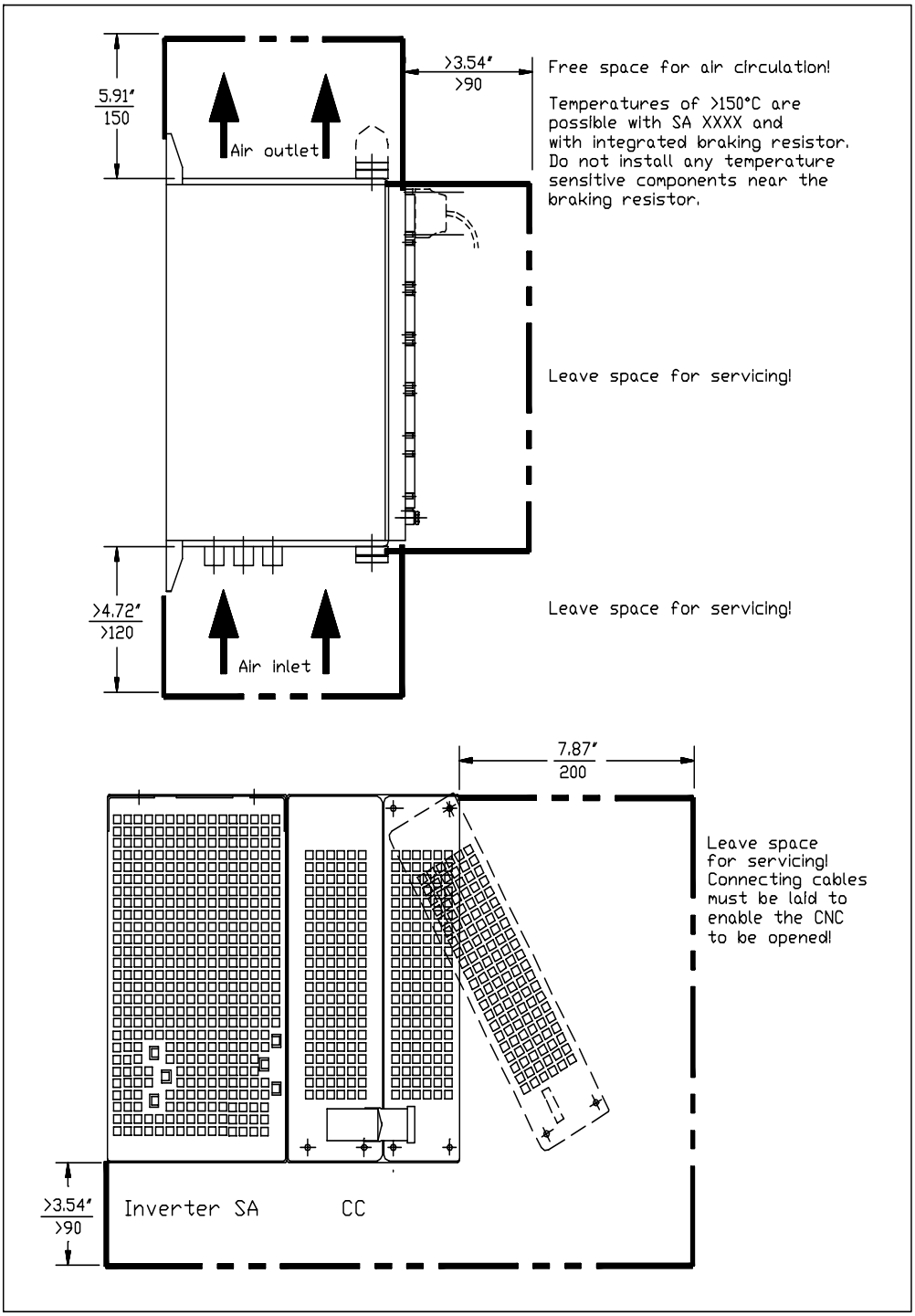


Figure 4-7, SA Series Inverter - Minimum Clearances Positioning

Section 5 - Installing Inverter Systems

Connection Overview

Refer to **Figure 5-1**.

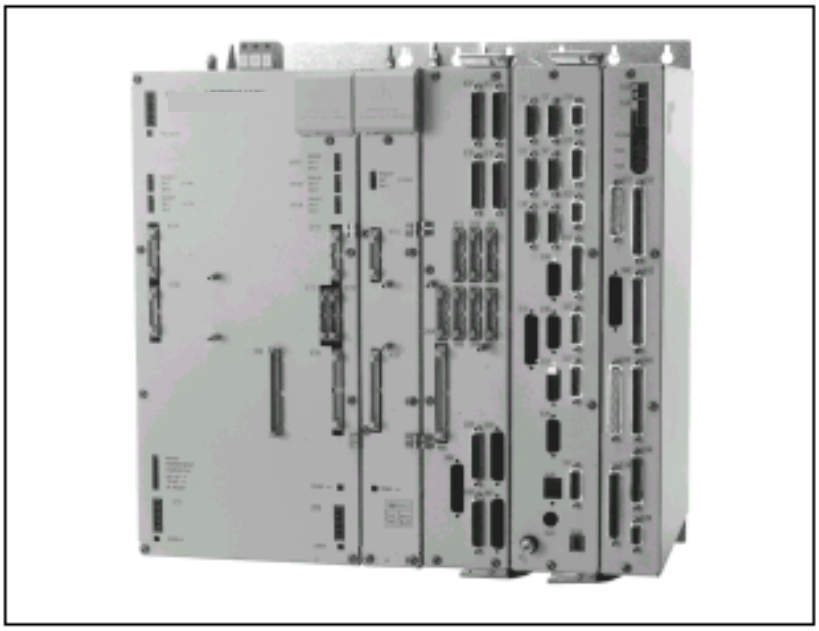


Figure 5-1, Series 6000 CNC, SA Series Compact Inverter and PM 107 Power Module

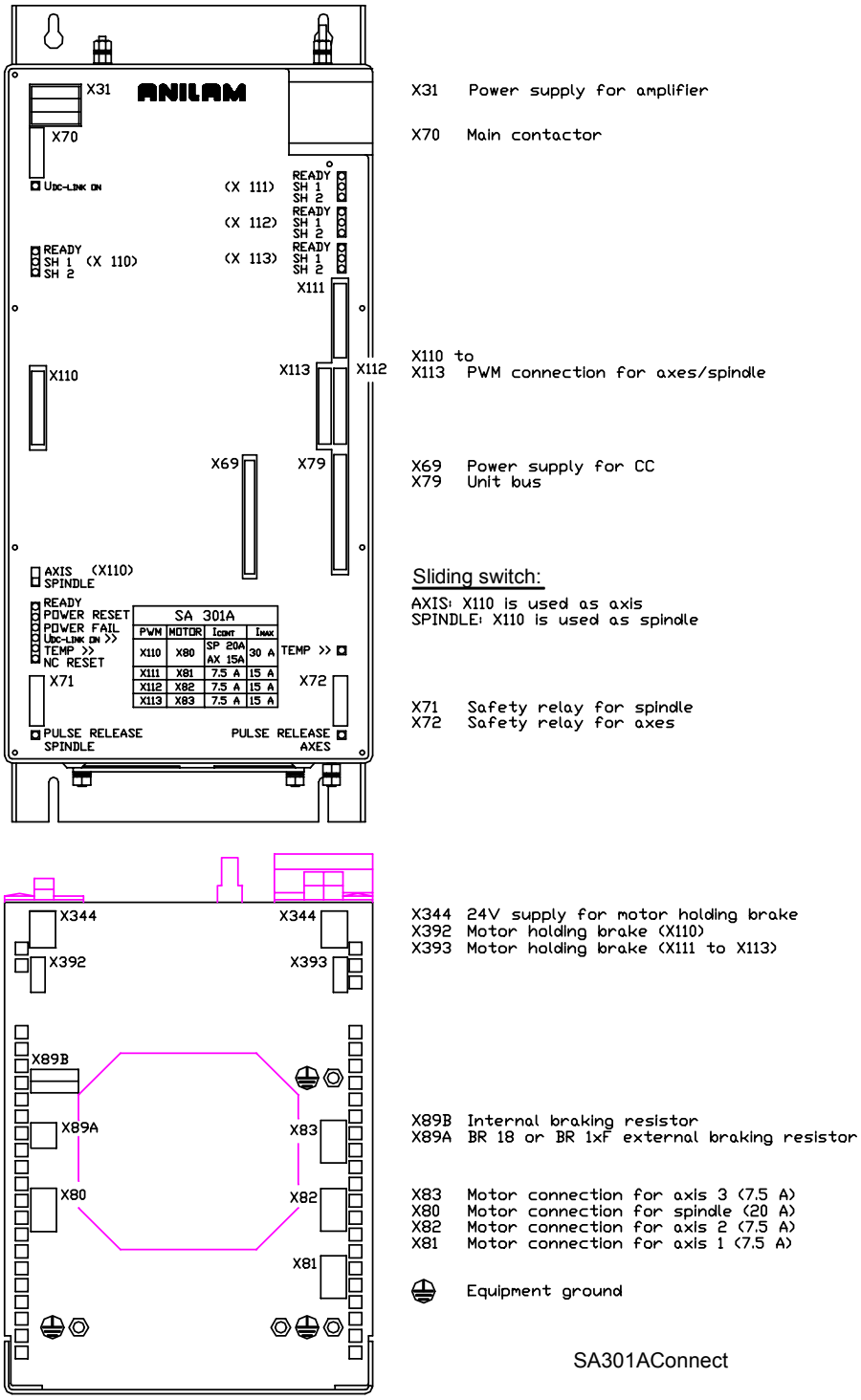
DANGER:	**Do not connect or disconnect any elements while the unit is powered up.**

The following components and connections are illustrated:

- SA 301A
- SA 311A
- SA 411A
- SA 201A
- SA 301C
- SA 411C
- Description of LEDs on the Inverters
- SA 311E/SA 411E
- Description of LEDs on the SA 311E/SA 411E Inverters
- BR 9 Braking Resistor Module
- BR 18 Braking Resistor
- BR 10F and BR 18F Braking Resistors

SA 301A

Refer to **Figure 5-2**.



X31 Power supply for amplifier

X70 Main contactor

X110 to
X113 PWM connection for axes/spindle

X69 Power supply for CC
X79 Unit bus

Sliding switch:

AXIS: X110 is used as axis
SPINDLE: X110 is used as spindle

X71 Safety relay for spindle
X72 Safety relay for axes

X344 24V supply for motor holding brake
X392 Motor holding brake (X110)
X393 Motor holding brake (X111 to X113)

X89B Internal braking resistor
X89A BR 18 or BR 1xF external braking resistor

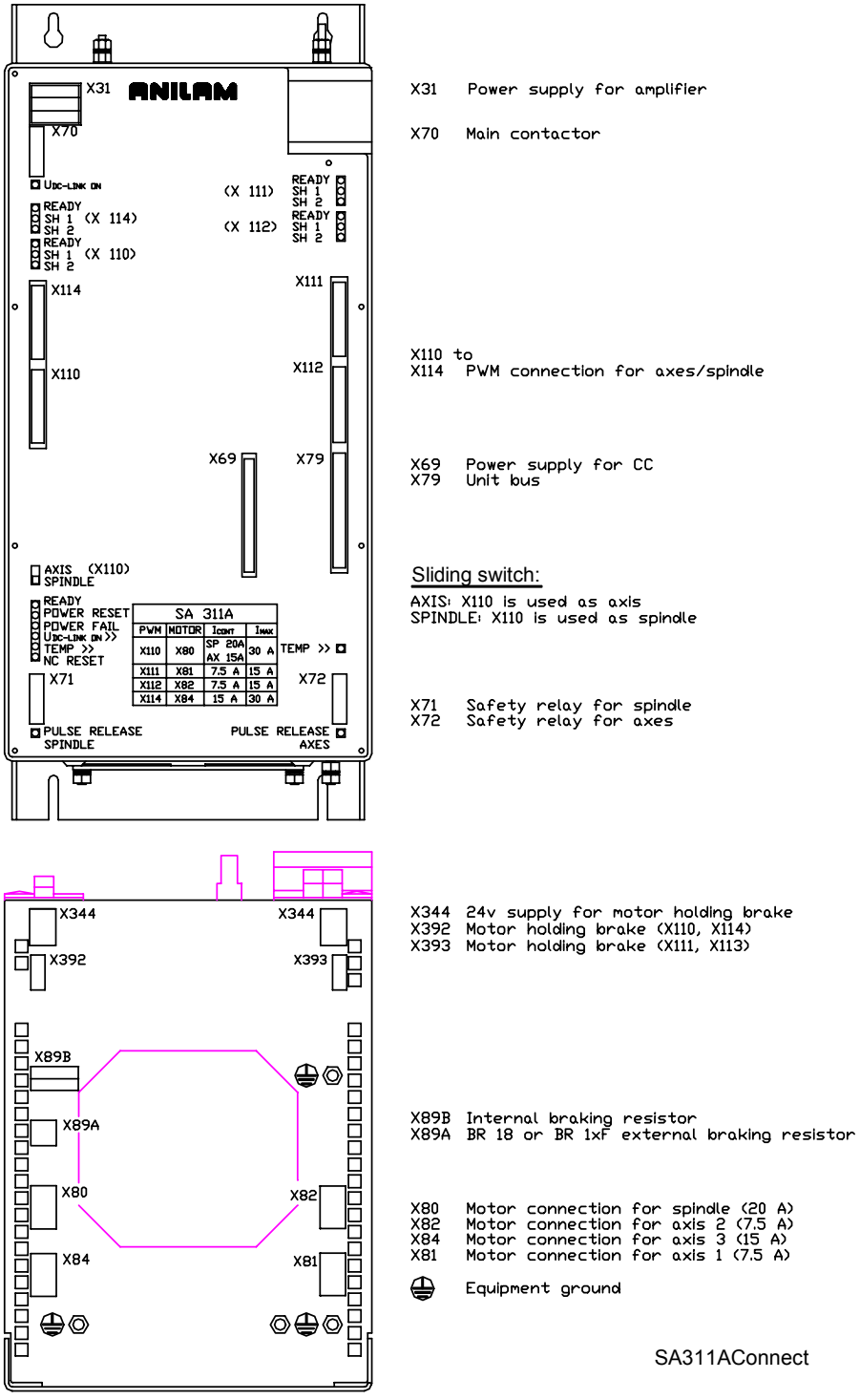
X83 Motor connection for axis 3 (7.5 A)
X80 Motor connection for spindle (20 A)
X82 Motor connection for axis 2 (7.5 A)
X81 Motor connection for axis 1 (7.5 A)

Equipment ground

Figure 5-2, SA 301A

SA 311A

Refer to **Figure 5-3**.



X31 Power supply for amplifier

X70 Main contactor

X110 to
X114 PWM connection for axes/spindle

X69 Power supply for CC
X79 Unit bus

Sliding switch:

AXIS: X110 is used as axis
SPINDLE: X110 is used as spindle

X71 Safety relay for spindle
X72 Safety relay for axes

X344 24v supply for motor holding brake
X392 Motor holding brake (X110, X114)
X393 Motor holding brake (X111, X113)

X89B Internal braking resistor
X89A BR 18 or BR 1xF external braking resistor

X80 Motor connection for spindle (20 A)
X82 Motor connection for axis 2 (7.5 A)
X84 Motor connection for axis 3 (15 A)
X81 Motor connection for axis 1 (7.5 A)

Equipment ground

SA311AConnect

Figure 5-3, SA 311A

SA 411A

Refer to **Figure 5-4**.

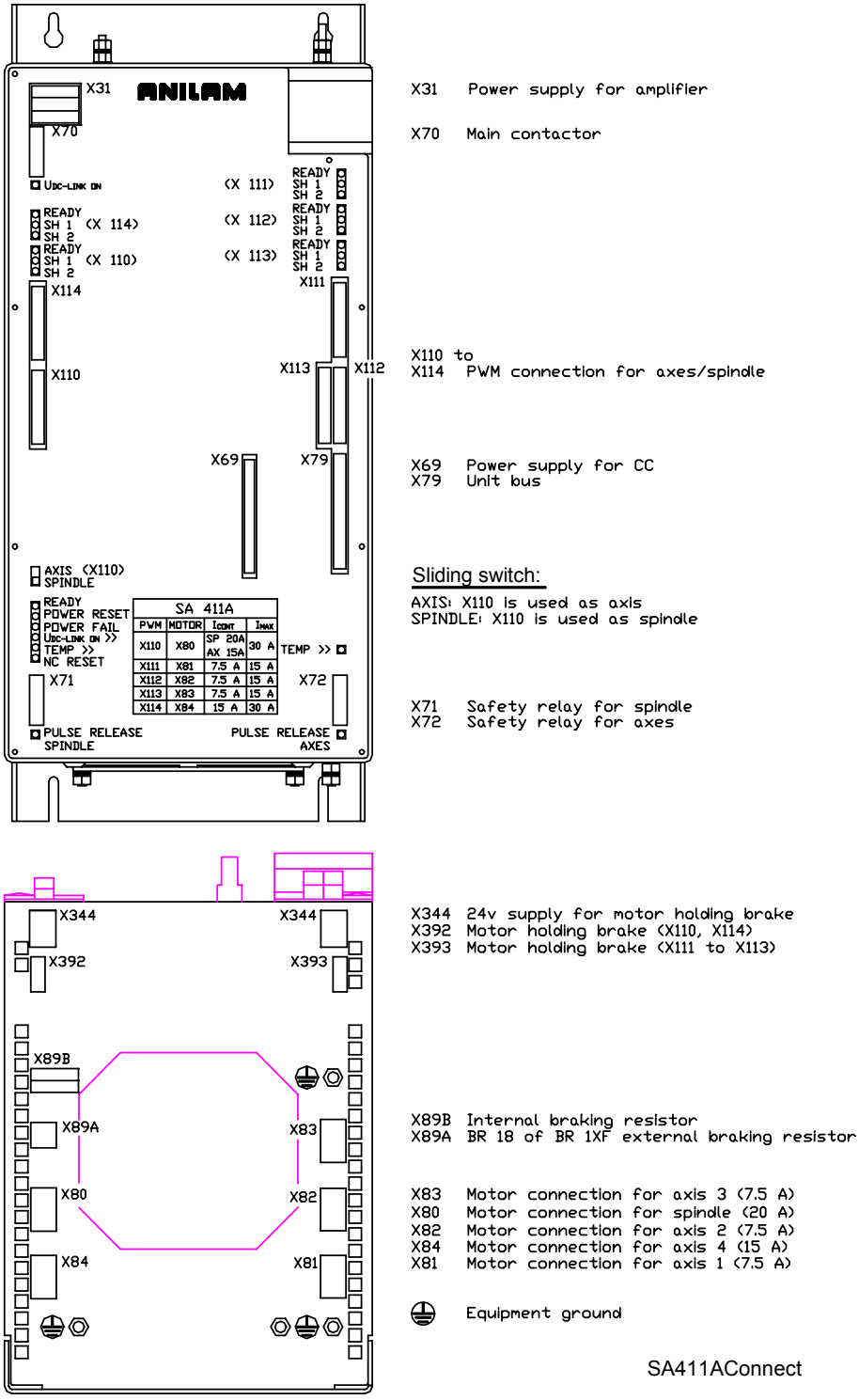
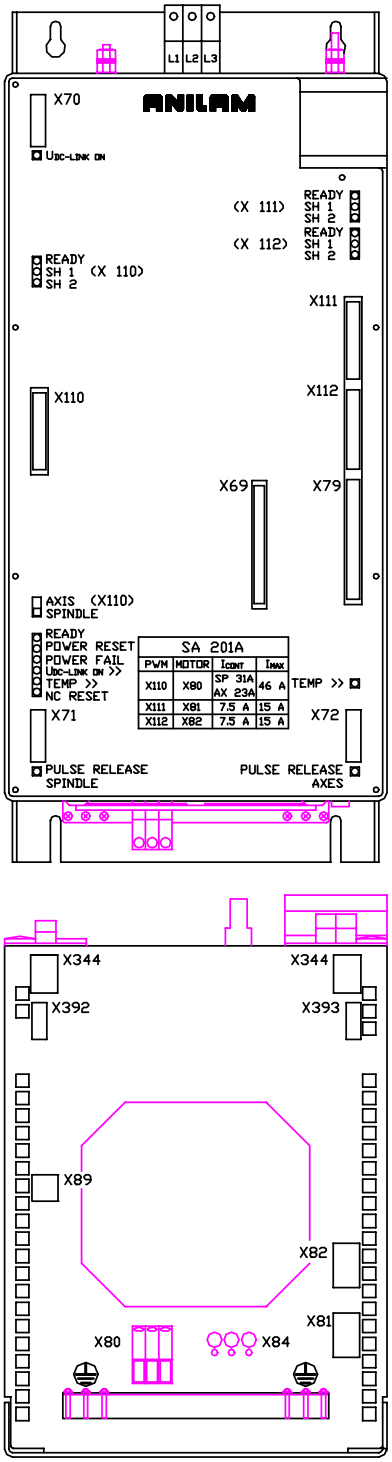


Figure 5-4, SA 411A

SA 201A

Refer to **Figure 5-5**.



X31 Power supply for amplifier

X70 Main contactor

X110 to
X112 PWM connection for axes/spindle

X69 Power supply for CC
X79 Unit bus

Sliding switch:

AXIS: X110 is used as axis
SPINDLE: X110 is used as spindle

X71 Safety relay for spindle
X72 Safety relay for axes

X344 24V supply for motor holding brake
X392 Motor holding brake (X110)
X393 Motor holding brake (X111, X112)

X89 Braking resistor

X82 Motor connection for axis 2 (7.5 A)

X81 Motor connection for axis 1 (7.5 A)
X80 Motor connection for spindle (31 A)

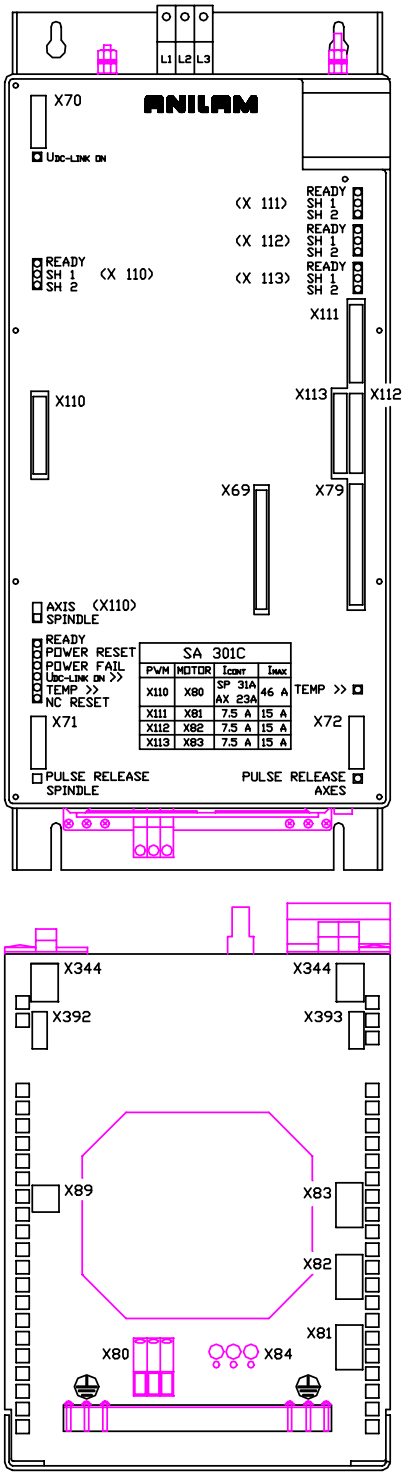
Equipment ground

SA201AConnect

Figure 5-5, SA 201A

SA 301C

Refer to **Figure 5-6**.



X31 Power supply for amplifier

X70 Main contactor

X110 to
X114 PWM connection for axes/spindle

X69 Power supply for CC
X79 Unit bus

Sliding switch:

AXIS: X110 is used as axis
SPINDLE: X110 is used as spindle

X71 Safety relay for spindle
X72 Safety relay for axes

X344 24V supply for holding brake
X392 Motor holding brake (X110)
X393 Motor holding brake (X111 or X113)

X89 Braking resistor
X83 Motor connection for axis 3 (7.5 A)

X82 Motor connection for axis 2 (7.5 A)

X81 Motor connection for axis 1 (7.5 A)
X80 Motor connection for spindle (31 A)

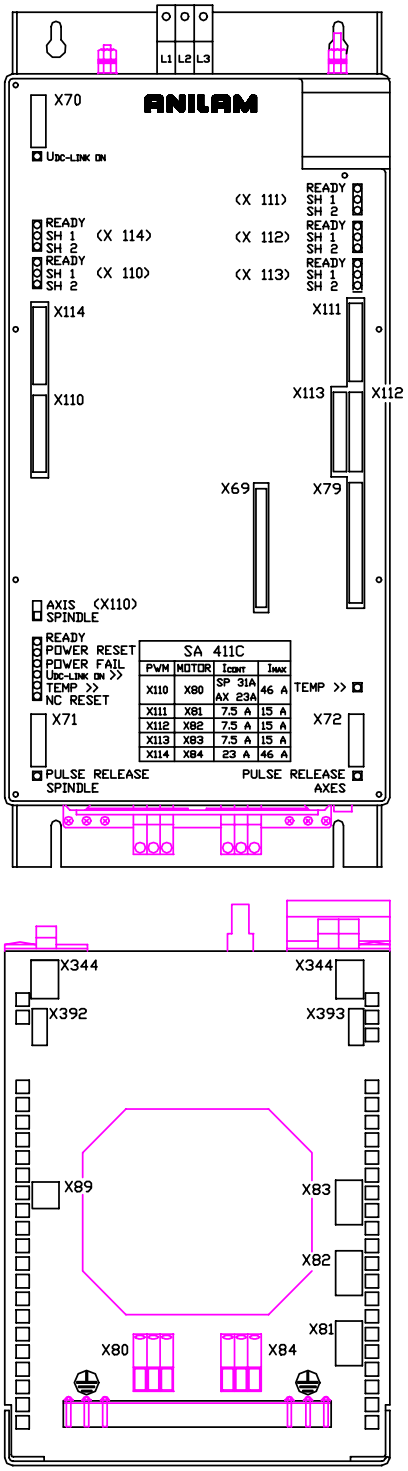
Equipment ground

SA301CConnect

Figure 5-6, SA 301C

SA 411C

Refer to **Figure 5-7**.



X31 Power supply for amplifier

X70 Main contactor

X110 to
X114 PWM connection for axes/spindle

X69 Power supply for CC
X79 Unit bus

Sliding switch:

AXIS: X110 is used as axis
SPINDLE: X110 is used as spindle

X71 Safety relay for spindle
X72 Safety relay for axes

X344 Reserved (do not use)
X392 Reserved (do not use)
X393 Reserved (do not use)

X89 Braking resistor
X83 Motor connection for axis 3 (7.5 A)
X82 Motor connection for axis 2 (7.5 A)
X81 Motor connection for axis 1 (7.5 A)
X80 Motor connection for spindle (31 A)
X84 Motor connection for axis 4 (23 A)

Equipment ground

SA411CConnect

Figure 5-7, SA 411C

Description of LEDs on the Inverters

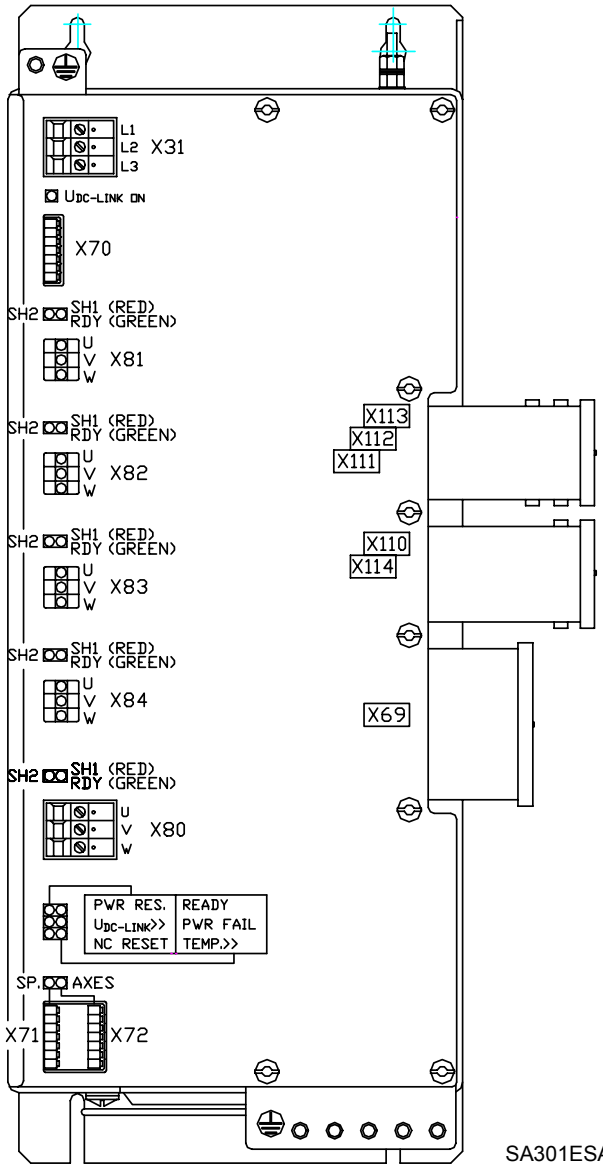
Light Emitting Diodes (LEDs) on the front panel of the inverter indicate functional control, with the following meaning. Refer to **Table 5-1**.

Table 5-1, LED Designations for Inverters

LED	Indicator	Signal Direction	Signal
$U_{DC\ LINK\ ON}$	Main contactor on	—	—
READY	Inverter ready	SA → CNC	RDY
POWER RESET	Reset signal from SA to CNC	SA → CNC	$\overline{\text{RES.PS}}$
POWER FAIL	U_Z too low, U_Z < 410 V (for example, caused by the failure of a phase under load, power < 290 V)	SA → CNC	$\overline{\text{PF.PS}}$
$U_{DC\ LINK}$ >>	U_z too high. (> approximately 800 V); power modules are switched off.	SA → CNC	$\overline{\text{ERR.UZ.GR}}$
TEMP >> (left)	Temperature of heat sink too high for axis 4 and spindle (>100 °C (212 °F))	SA → CNC	$\overline{\text{ERR}}$
TEMP >> (right)	Temperature of heat sink too high for axis 1 to axis 3 (>100 °C (212 °F))	SA → CNC	$\overline{\text{ERR}}$
NC RESET	Reset signal from the CNC to the SA	CNC → SA	$\overline{\text{RES.LE}}$
SPINDLE	Safety relay for spindle on	—	—
AXES	Safety relay for axes on	—	—
X11 × READY	Inverter ready	SA → CNC	RDY
X11 × SH1	Flashing DSP error, PLC error with Emergency Stop, CNC hardware, or software error	CNC → SA	$\overline{\text{SH1B}}$
X11 × SH2	No drive enabled (for example, by the PLC, active via external signal or SH1)	CNC → SA	$\overline{\text{SH2}}$

SA 301E/SA 411E

Refer to **Figure 5-8**.



X31 Power supply for amplifier

X70 Main contactor

X81 Motor connection for axis 1 (X111)
(6 A with 3.3 kHz PWM frequency)

X82 Motor connection for axis 2 (X112)
(6 A with 3.3 kHz PWM frequency)

X83 Motor connection for axis 3 (X113)
(6 A with 3.3 kHz PWM frequency)

X84 Motor connection for axis 4 (X114)
(9 A with 3.3 kHz PWM frequency)
(only SA 411E)

X80 Motor connection for spindle (X110)
(6 A with 3.3 kHz PWM frequency)

X69 Supply bus

X71 Safety relay for spindle
X72 Safety relay for axes

On bottom:
X394 24V input for motor brake output
X345 24V breake output

Equipment ground

SA301ESA411EConnect

Figure 5-8, SA 301E/SA 411E

Description of LEDs on the SA 301E/SA 411E Inverters

LEDs on the front panel of the inverter indicate functional control, with the following meaning. Refer to **Table 5-2**.

Table 5-2, LED Designations for SA 301E/SA 401E Inverters

LED	Indicator	Signal Direction	Signal
$U_{DC\ LINK\ ON}$	Main contactor on	—	—
$U_{DC\ LINK}$ >>	U_Z too high. (> approximately 800 V); power modules are switched off.	SA → CNC	$\overline{\text{ERR.UZ.GR}}$
TEMP >>	Temperature of heat sink too high (>100 °C (212 °F))	SA → CNC	$\overline{\text{ERR.TEMP}}$
PWR FAIL (Power Fail)	U_Z too low, U_Z < 410 V (for example, caused by the failure of a phase under load, power < 290 V)	SA → CNC	$\overline{\text{PF.PS}}$
PWR RES (Power Reset)	Reset signal from SA to CNC	SA → CNC	$\overline{\text{RES.PS}}$
SP (Spindle)	Safety relay for spindle on	—	—
AXES	Safety relay for axes on	—	—
SH1	Flashing DSP error, PLC error with Emergency Stop, CNC hardware, or software error	CNC → SA	$\overline{\text{SH1}}$
SH2	No drive enabled (for example, by the PLC, active via external signal or SH1)	CNC → SA	$\overline{\text{SH2}}$
RDY (Ready)	Inverter ready	SA → CNC	RDY

BR 9 Braking Resistor Module

Refer to **Figure 5-9**.

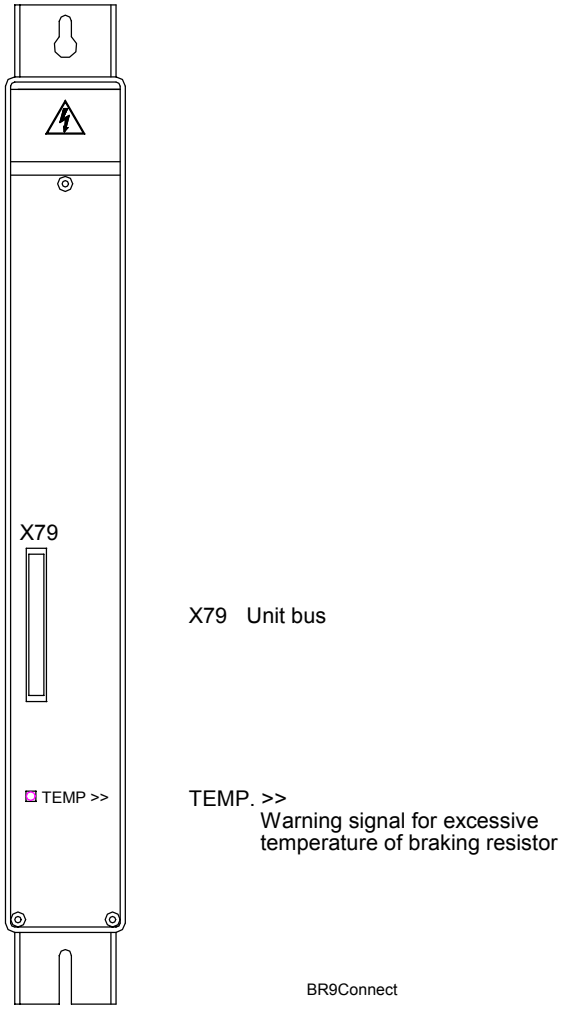
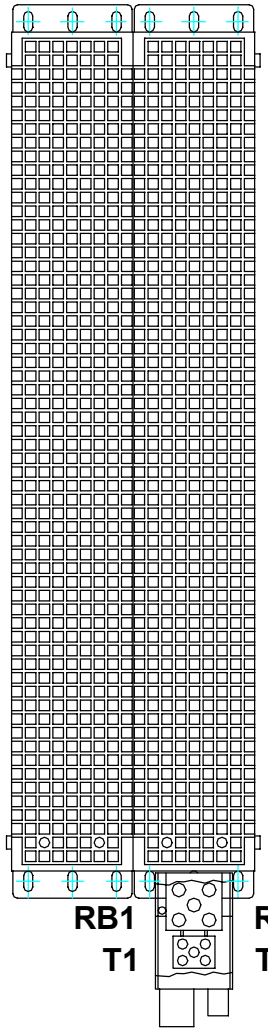


Figure 5-9, BR 9 Braking Resistor

BR 18 Braking Resistor

Refer to **Figure 5-10**.



RB1, RB2 - Compact Inverter SA *XXXX*

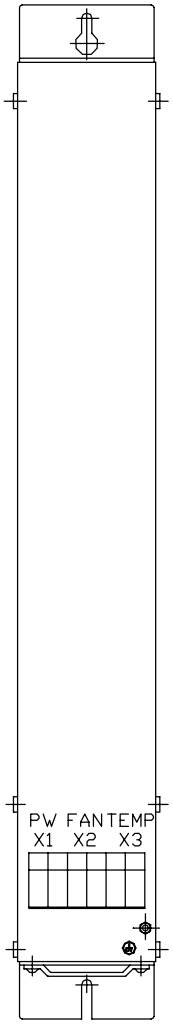
T1, T2 - Temperature switch

BR18Connect

Figure 5-10, BR 18 Connections

BR 10F and BR 18F Braking Resistors

Refer to **Figure 5-11**.



X1 Compact inverter SA XXXX
X2 Supply voltage for the fan of the braking resistor
X3 Temperature switch

BR10F18FConnect

Figure 5-11, BR 10F and BR 18F Braking Resistors

Mounting and Connecting the Inverter

Arranging the Components

The SA Series inverter can be used only with the ANILAM 6300M and 6400M CNCs. Always place the inverter to the left of the CNC. Refer to **Figure 5-12**.

An additional PM 107 power module can be connected to the SA inverter. Always place the power module between the CNC and the inverter.

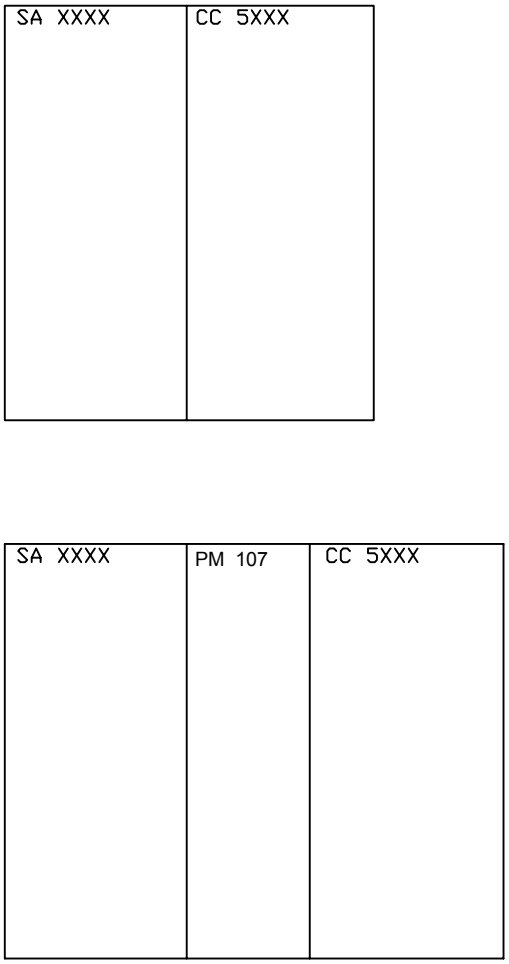


Figure 5-12, Configuration of Inverter, CNC, and Power Supply

Connecting the Components

Connect the inverter to the CNC with ribbon cables, which are connected via plug-in PCBs at the CNC end. A 50-line ribbon cable connects the CNC to the SA 1xxA, SA 2xxA inverter and supplies the power to the control.

The 20-line ribbon cables connect the CNC to the SA 1xxA, SA 2xxA inverter and supply the PWM signals to the axes and spindle.

U_Z dc-link power is supplied to the additional PM 107 power module from the SA 1xxA, SA 2xxA compact inverter via a conductor bar, which is screwed to the power module and compact inverter. A second power conductor establishes the ground connections between the SA 1xxA, SA 2xxA compact inverter and PM 107 power module. The power bars are supplied as accessories with the power module.

A 40-line ribbon cable connects the SA 1xxA, SA 2xxA inverter with the power module, forming the unit bus.

Module Covers

Ribbon cables must be covered to protect from interference.

The covers for the CNC and the SA Series inverters are included with each as accessories.

The cover for the optional PM 107 power module must be ordered separately. Refer to Figure 5-13, Mounting the SA Series Inverter.

Mounting the Inverter

Refer to **Figure 5-13**.

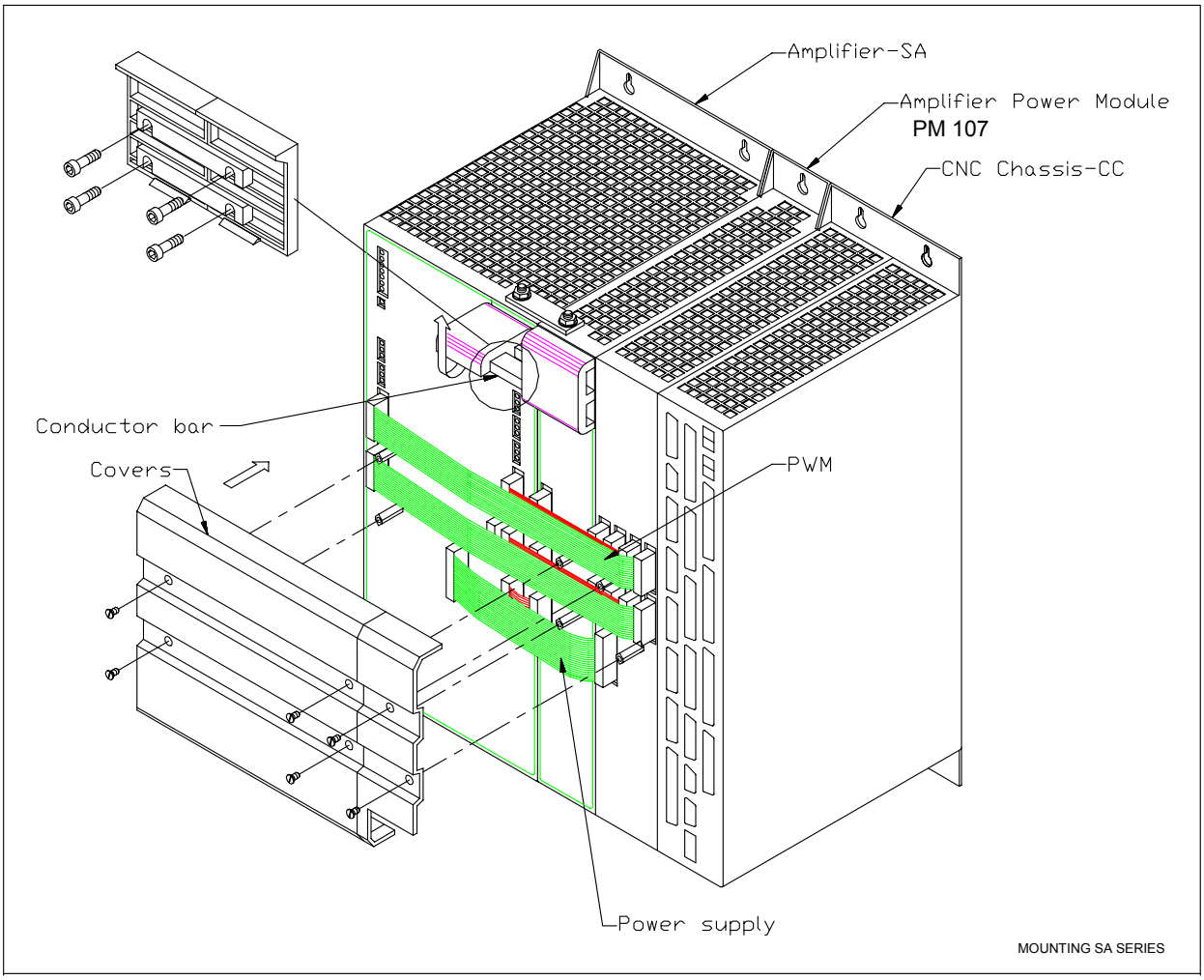


Figure 5-13, Mounting the SA Series Inverter

Warning: All electrical screw connections must be tightened after installation is complete (tightening torque 3.5 Nm [30.8 in-lb]).

Installing the Toroidal Cores

To suppress interference, install toroidal cores in the motor leads (X80 to X84) and in the voltage supply lead (X31). Refer to **Figure 5-14**.

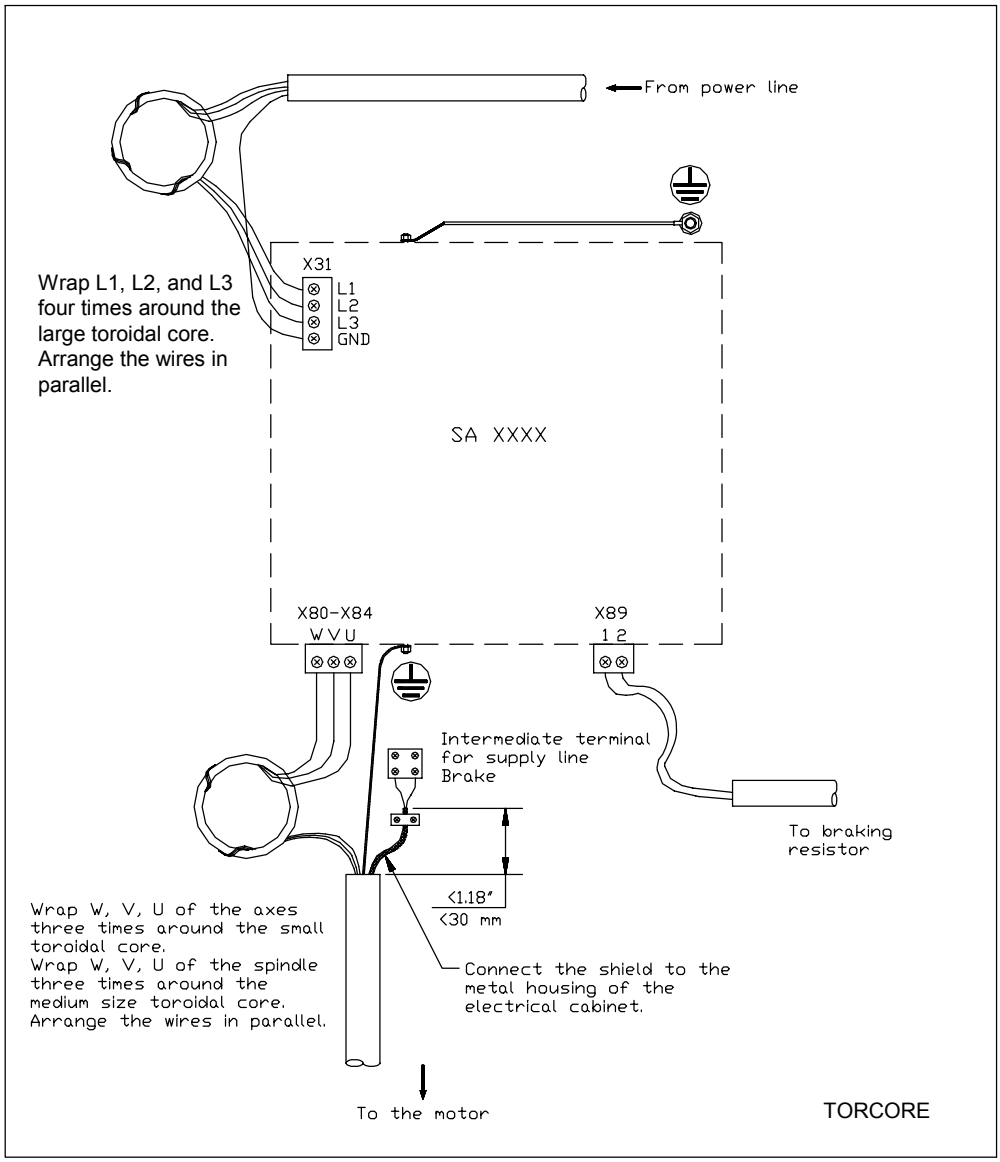


Figure 5-14, Toroidal Core Configuration

Inverter Connections

DANGER:	**Handling components could result in electric shock. Only ANILAM service engineers are authorized to open inverters. Do not connect or disconnect components while the system is powered up.**

Supply Voltages

X31 Supply Voltages for U_z

Given a power supply of 400 V, the inverter voltage U_z is 565 VDC. Refer to **Table 5-3** and Table 5-4, X31 Supply Voltage Connections for SA 301E/SA 411E Inverters.

Table 5-3, X31 Supply Voltage Connections

Connecting Terminals X31	SA 301A, SA 311A, SA 411A	SA 201A, SA 301C, SA 411C
L1	400 Vac ± 10% 50 Hz to 60 Hz	400 Vac ± 10% 50 Hz to 60 Hz
L2		
L3		
	Cable: Wire cross section: 6 mm^2 (AWG 10) Line fuse: 30 A (gRL) Grounding connection: ≥ 10 mm^2 (AWG 8)	Cable: Wire cross section: 10 mm^2 (AWG 8) Line fuse: 50 A (gRL) Grounding connection: ≥ 10 mm^2 (AWG 8)

NOTE:	EN 50 178 requires a non-detachable connection to the power supply line. If the power supply is other than 400 V, an autotransformer is required. At a minimum, it must comply with the connection specifications of the inverter.

X31 Supply Voltages for Uz for SA 301E/SA 411E inverters

Given a power supply of 400 V, the inverter voltage U_Z is 565 VDC. Refer to **Table 5-4** for SA 301E/ SA 411E inverters.

Table 5-4, X31 Supply Voltage Connections for SA 301E/SA 411E Inverters

Connecting Terminals X31	SA 301E	SA 411E
L1	400 Vac ± 10% 50 Hz	480 Vac ± 10% 60 Hz (American mains power)
L2		
L3		
	Cable: Wire cross section: 4 mm^2 (AWG 12) Line fuse: 25 A (gRL) Grounding connection: ≥ 10 mm^2 (AWG 8)	

NOTE: EN 50 178 requires a non-detachable connection to the power supply line.

To suppress occurrence of interference, toroidal cores must be mounted in the voltage supply lead (X31).

Wrap L1, L2, and L3 three times around the large toroidal core (see Figure 5-14, Toroidal Core Configuration).

Motor Connections

X80 Spindle Motor, X81 Axis Motor 1, X82 Axis Motor 2, X83 Axis Motor 3, and X84 Axis Motor 4

Refer to **Table 5-5** and **Table 5-6**.

Table 5-5, Motor Connection Pinout

Terminals	Assignment
U	Motor connection U
V	Motor connection V
W	Motor connection W

NOTE: To suppress occurrence of interference, toroidal cores must be mounted in the motor leads (X80 to X84).

Wrap L1, L2, and L3 three times around the large toroidal core (see Figure 5-14, Toroidal Core Configuration).

Table 5-6, PWM Inputs

Motor Connection	PWM Input
X80 Wire cross section: < 4 mm^2 (AWG 12)	X110
X81 Wire cross section: < 1.5 mm^2 (AWG 16)	X111
X82 Wire cross section: < 1.5 mm^2 (AWG 16)	X112
X83 Wire cross section: < 1.5 mm^2 (AWG 16)	X113
X84 Wire cross section: < 1.5 mm^2 (AWG 16)	X114 (only SA 411E)

For more information on motors, refer to "Section 7 - Available Motors and Accessories."

Connection of the Motor Holding Brakes

X344 24V Supply for Motor Holding Brake

Refer to **Table 5-7**.

Table 5-7, X344 - 24V Supply for Motor Holding Brake Pinout

Connecting Terminals X344	Assignment
1	+ 24 V
2	0 V

X345 24V Supply for Motor Holding Brake

For SA 301E/SA 411E inverters, refer to **Table 5-8**.

Table 5-8, X345 - 24V Supply for Motor Holding Brake Pinout

Connecting Terminals X345	Assignment
1	+ 24 V
2	0 V

X392 Motor Holding Brake

Refer to **Table 5-9**.

Table 5-9, X392 - Motor Holding Brake Pinout

Connecting Terminals X392	Assignment
1	Holding brake (X110)
2	0 V (X110)
3	Holding brake (X114)
4	0 V (X114)

X393 Motor Holding Brake

Refer to **Table 5-10**.

Table 5-10, X393 - Motor Holding Brake Pinout

Connecting Terminals X393	Assignment
1	Holding brake (X111)
2	0 V (X111)
3	Holding brake (X112)
4	0 V (X112)
5	Holding brake (X113)
6	0 V

X394 Motor Holding Brake

For SA 301E/SA 411E, refer to **Table 5-11**.

Table 5-11, X394 - Motor Holding Brake Pinout

Connecting Terminals X394	Assignment
1	Holding brake for motor connected to X81
2	0 V for brake for motor connected to X81
3	Holding brake for motor connected to X82
4	0 V for brake for motor connected to X82
5	Holding brake for motor connected to X83
6	0 V for brake for motor connected to X83
7	Holding brake for motor connected to X84
8	0 V for brake for motor connected to X84

The current load capacity per brake output is 1.5 A.

The total current for all 4 channels is maximum 4 A.

No brake output is provided for the spindle (motor connection X80).

Main Contactor and Safety Relay

Refer to **Table 5-12**. For information on wiring and function, refer to the Basic Circuit diagram in your CNC installation manual.

Table 5-12, X70 Main Contactor, X71 Safety Relay Spindle, and X72 Safety Relay Axes Connections

Connecting Terminals X70 to X72	Assignment
1	+24 V output (maximum 250 mA)
2	0 V
3	+24 V input for U_Z ON, Axis ON, Spindle ON
4	Do not assign
5	Do not assign
6**1	Normally closed contact (OE1, OE1A, or OE1S)
7**1	Normally closed contact (OE2, OE2A, or OE2S)

**1 Maximum 125 V

Warning: A recovery diode is required in the proximity of inductive loads (for example, relay or contactor coils).

PWM Connection to the CNC

Refer to **Table 5-13** for the exposed ribbon cable X110 to X114.

Table 5-13, X110–X114 PWM Connection to the CNC

20-Pin Ribbon Connector	Assignment
1a	PWM U1
1b	0 V U1
2a	PWM U2
2b	0 V U2
3a	PWM U3
3b	0 V U3
4a	$\overline{SH2}$
4b	0 V ($\overline{SH2}$)
5a	$\overline{SH1}$
5b	0 V ($\overline{SH1}$)
6a	+ $I_{Actl\ 1}$
6b	- $I_{Actl\ 1}$
7a	0 V (analog)
7b	+ $I_{Actl\ 2}$
8a	- $I_{Actl\ 2}$
8b	0 V (analog)
9a	Do not assign
9b	$\overline{BRK}$
10a	$\overline{ERR}$
10b	RDY

NOTE: The interface conforms to requirements per EN 50 178 for low voltage electrical separation.

CNC Power Supply and Control Signals

Refer to **Table 5-14** for the exposed ribbon cable X69.

Table 5-14, X69 - CNC Supply Voltage and Control Signals Pinout

50-Pin Ribbon Connector	Assignment	50-Pin Ribbon Connector	Assignment
1a to 5b	+ 5 V	16b	GND
6a to 7b	+ 12 V	17a	RDY.PS
8a	+ 5 V (low voltage separation)	17b	GND
8b	0 V (low voltage separation)	18a	$\overline{\text{ERR.ILEAK}}$
9a	+ 15 V	18b	GND
9b	- 15 V	19a	Do not assign
10a	UZAN	19b	GND
10b	0 V	20a	Do not assign
11a	IZAN	20b	GND
11b	0 V	21a	Do not assign (SA XXXX: 0V)
12a	$\overline{\text{RES.PS}}$	21b	GND
12b	0 V	22a	Do not assign (SA XXXX: 0V)
13a	$\overline{\text{PF.PS}}$	22b	GND
13b	GND	23a	Reserved (SDA)
14a	$\overline{\text{ERR.UZ.GR}}$	23b	GND
14b	GND	24a	Reserved (SCL)
15a	$\overline{\text{ERR.IZ.GR}}$	24b	GND
15b	GND	25a	$\overline{\text{RES.CNC}}$
16a	$\overline{\text{ERR.TEMP}}$	25b	GND

NOTE: This interface meets requirements per EN 50 178 for low voltage electrical separation.

Unit Bus

The unit bus connects the compact inverter and the PM 107 power module. If you are not using a PM 107, you do not need to connect the unit bus. Refer to **Table 5-15**.

Table 5-15, Unit Bus Connection Pinout

40-Conductor Ribbon Connector	Assignment
1a to 3b	0 V **1
4a	+ 24 V **1
4b	+ 24 V **1
5a	+ 15 V **1
5b	+ 24 V **1
6a	+ 15 V **1
6b	+ 15 V **1
7a to 8b	Do not assign
9a	Reserved (SDA)
9b	Do not assign
10a	Reserved (SCL)
10b	$\overline{\text{ERR.TEMP}}$
11a	$\overline{\text{PF.PS}}$
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PWR.OFF}}$
13b	0 V
14a	5 V FS (spindle enable)
14b	0 V
15a	5 V FA (axis enable)
15b to 16b	0 V
17a and 17b	- 15 V
18a and 18b	+ 15 V
19a to 20b	+ 5 V

**1 These voltages must not be linked with other voltages (insulation limitation).

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation (except for 1a to 6b).

BR 18 and BR xxF Braking Resistors for SA xxxx Compact Inverters

An external braking resistors must be connected to the SA 201A, SA 301C, and SA 411C inverters. These inverters are not equipped with internal braking resistors.

An external braking resistors can also be connected to the SA 301A, SA 311A, and SA 411A inverters instead of internal braking resistance. This could become necessary if the internal resistor fails to fully absorb all of the excess braking energy, or if the braking resistor needs to be mounted outside the CNC cabinet.

Either one BR 10F, one BR 18F, one BR 18, or two BR 18 in parallel can be connected to a SA series inverter.

The braking resistor is switched on when the inverter voltage U_Z exceeds 700 V. It is switched off as soon as the voltage falls below 670 V.

NOTE: If no braking resistor is connected, the inverter voltage U_Z can increase and at U_Z > 760 V, all power stages are switched off, and the LED for $U_{DC\text{-}LINK}$ >> lights up.

Cross Section

Refer to **Table 5-16**.

Table 5-16, Cross-Sections for Connection to Braking Resistors

Braking Resistor	Cross Section for Connection
1 x BR 18	1.5 mm^2 (AWG 16)
1 x BR 10F	1.5 mm^2 (AWG 16)
1 x BR 18F	4 mm^2 (AWG 12)
2 x BR 18F in parallel	4 mm^2 (AWG 12)

X89 - Braking Resistor Connection

Refer to **Table 5-17**, Table 5-18, External Braking Resistor Connections, and Table 5-19, SA 201 A, SA 301C, and SA 411C Inverters Connections.

Table 5-17, Internal Braking Resistor Connections

Connecting Terminal X89A on SA 301A, SA 311A, and SA 411A	Assignment	Connecting Terminal X89B on SA 301A, SA 311A, and SA 411A	Assignment
1	Do not assign	1	Jumper
2	Do not assign	2	

Table 5-18, External Braking Resistor Connections

Connecting Terminal X89B on SA 301A, SA 311A, and SA 411A	Assign-ment	Connecting Terminal X89A on SA 301A, SA 311A, and SA 411A	Assignment	BR 18	BR 10F, BR 18F Connecting Terminal X1
1	Do not assign	1	$+U_z$	RB 1	1
2	Do not assign	2	Switch against $-U_z$	RB 2	2

WARNING: Do not operate an internal and external braking resistor in parallel.

Table 5-19, SA 201 A, SA 301C, and SA 411C Inverters Connections

Connecting Terminal X89 on SA 201A, SA 301C, and SA 411C	Assignment	BR 18	BR 10F, BR 18F Connecting Terminal X1
1	$+U_z$	RB 1	1
2	Switch against $-U_z$	RB 2	2

Temperature Switch on BR 18, BR 10F, and BR 18F Braking Resistor

The temperature switch is a normally closed contact. It is set to protect the braking resistor from damage. Maximum load is 250 V, 5 A. The switch can be connected to a PLC input on the CNC, and can be evaluated via the PLC. Refer to **Table 5-20** and **Table 5-21**.

Table 5-20, BR 18 Temperature Switch Pinout

Connecting Terminal on the BR 18	Assignment
T1	1
T2	2

Table 5-21, BR 10F, BR 18F Temperature Switch Pinout

Connecting Terminal X3 on the BR 10F, BR 18F	Assignment
1	1
2	2

X2 Fan for the BR 10F and BR 18F External Braking Resistors

Refer to **Table 5-22**.

Table 5-22, BR 10 and BR 18F – X2 Fan Connections Pinout

Connecting Terminal X2	Assignment
+	+ 24 V (PLC)
-	0 V

BR 9 Braking Resistor Module Connections

The BR 9 braking resistor module must be used when axis motors with brakes are used. In the event of power failure, it dissipates the energy returned by the motors to the DC-link. The BR 9 is switched on when the inverter voltage U_Z exceeds 740 V and is switched off again as soon as it falls below 720V. The X79 cable provides the data communication to the BR 9.

DANGER: Handling components could result in electric shock. Only ANILAM service engineers are authorized to open breaking resistors. Do not engage or disengage any terminals while the system is powered up.

X79 Unit Bus

Table 5-23, BR 9 - X79 Unit Bus Connection Pinout

40-line Ribbon Connector	Assignment
1a to 3b	0 V **1
4a	+ 24 V **1
4b	+ 24 V **1
5a	+ 15 V **1
5b	+ 24 V **1
6a	+ 15 V **1
6b	+ 15 V **1
7a to 8b	Do not assign
9a	Reserved (SDA)
9b	Do not assign
10a	Reserved (SCL)
10b	$\overline{\text{ERR.TEMP}}$
11a	$\overline{\text{PF.PS}}$
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PWR.OFF}}$
13b	0 V
14a	5 V FS (spindle enable)
14b	0 V
15a	5 V FA (axis enable)
15b to 16b	0 V
17a and 17b	- 15 V
18a and 18b	+ 15 V
19a to 20b	+ 5 V

**1 These voltages must not be linked with other voltages (insulation limitation).

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation (except for 1a to 6b).

Physical Dimensions

SA Series Inverter

Refer to **Figure 5-15**.

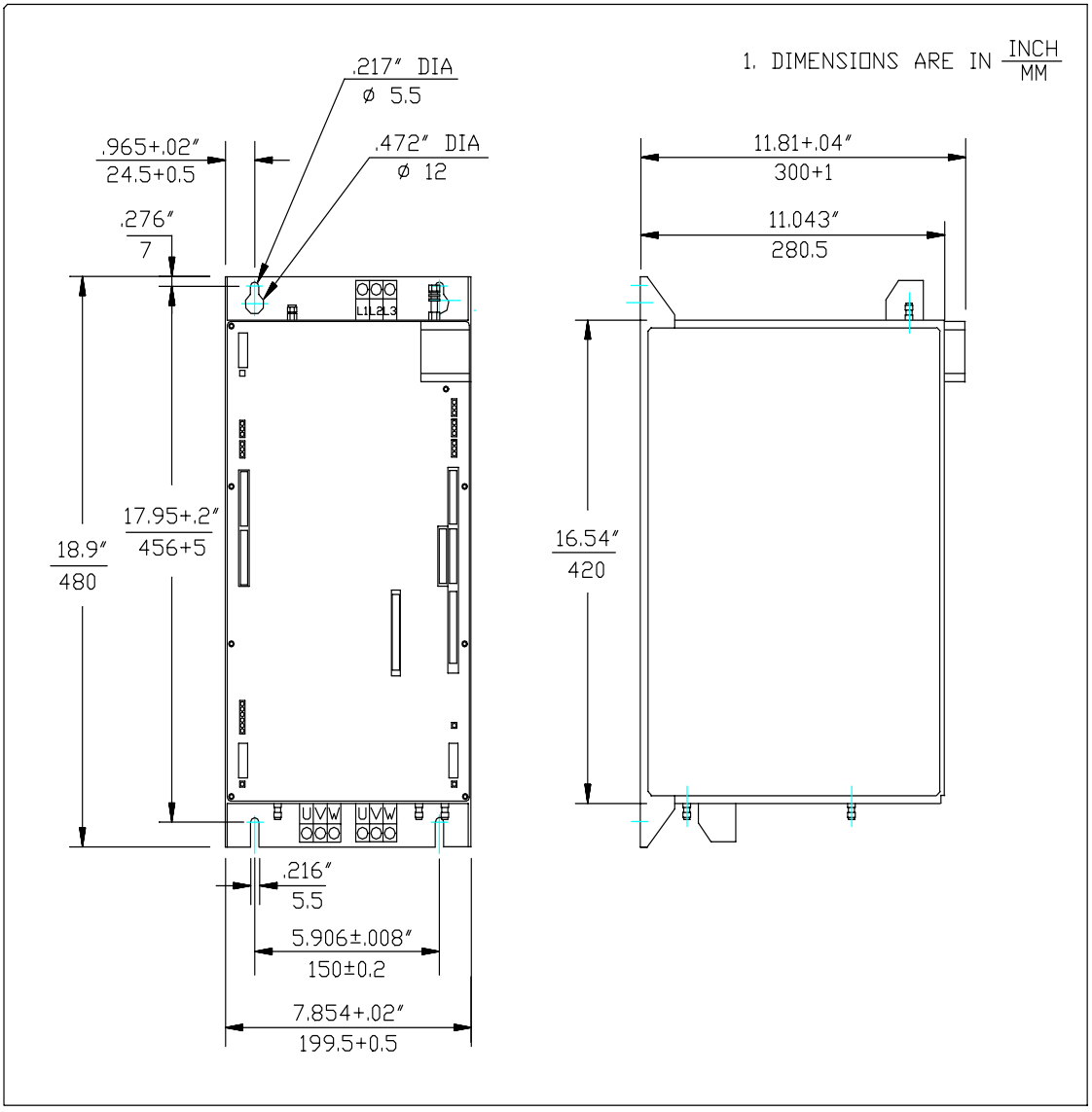


Figure 5-15, SA Series Inverter Dimensions

SA 301E/SA 411E Inverters

For SA 301E/SA 411E inverters, refer to **Figure 5-16**.

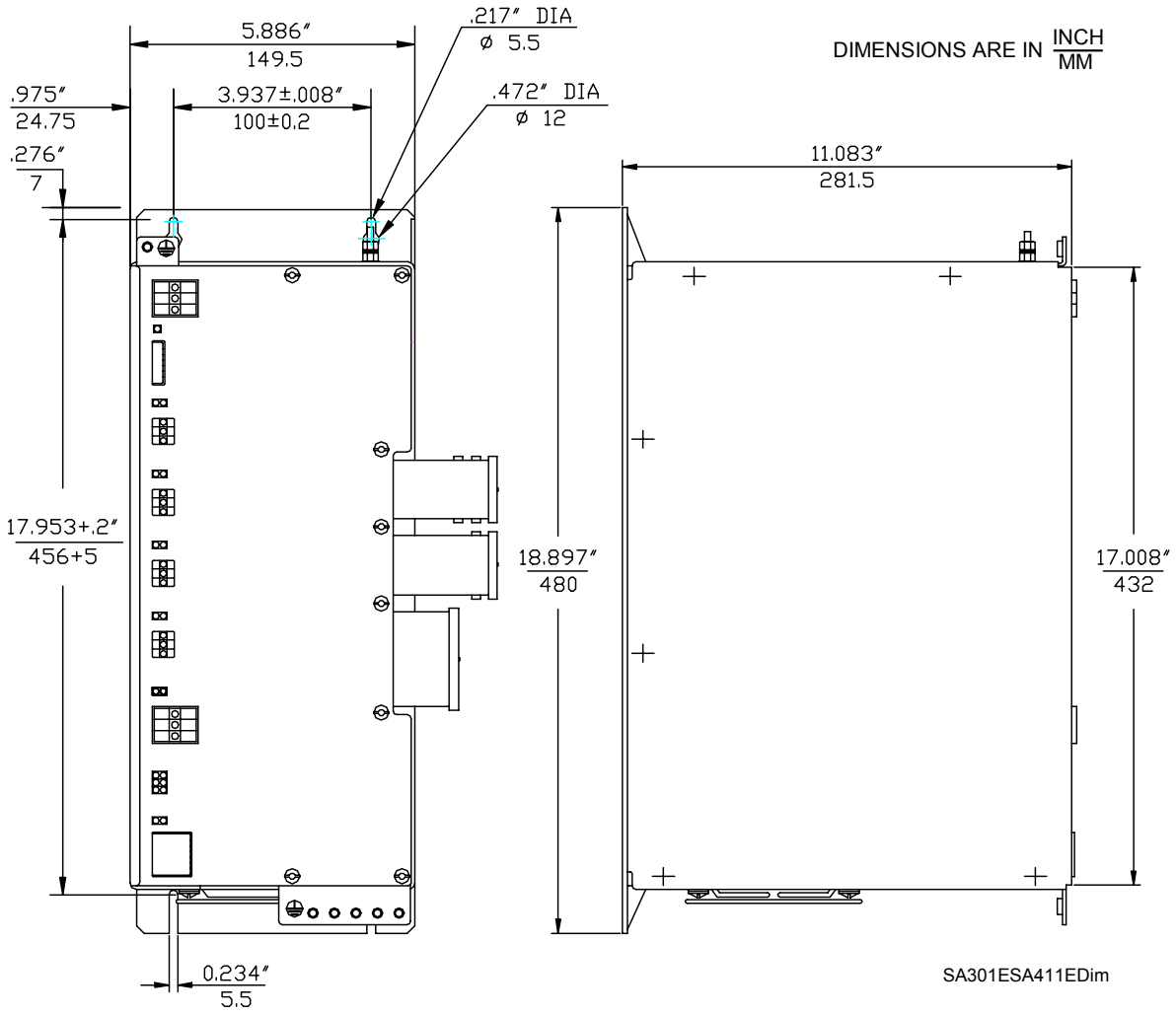


Figure 5-16, SA 301E/SA 411E Inverters Dimensions

PM 107 Power Supply

Refer to **Figure 5-17**.

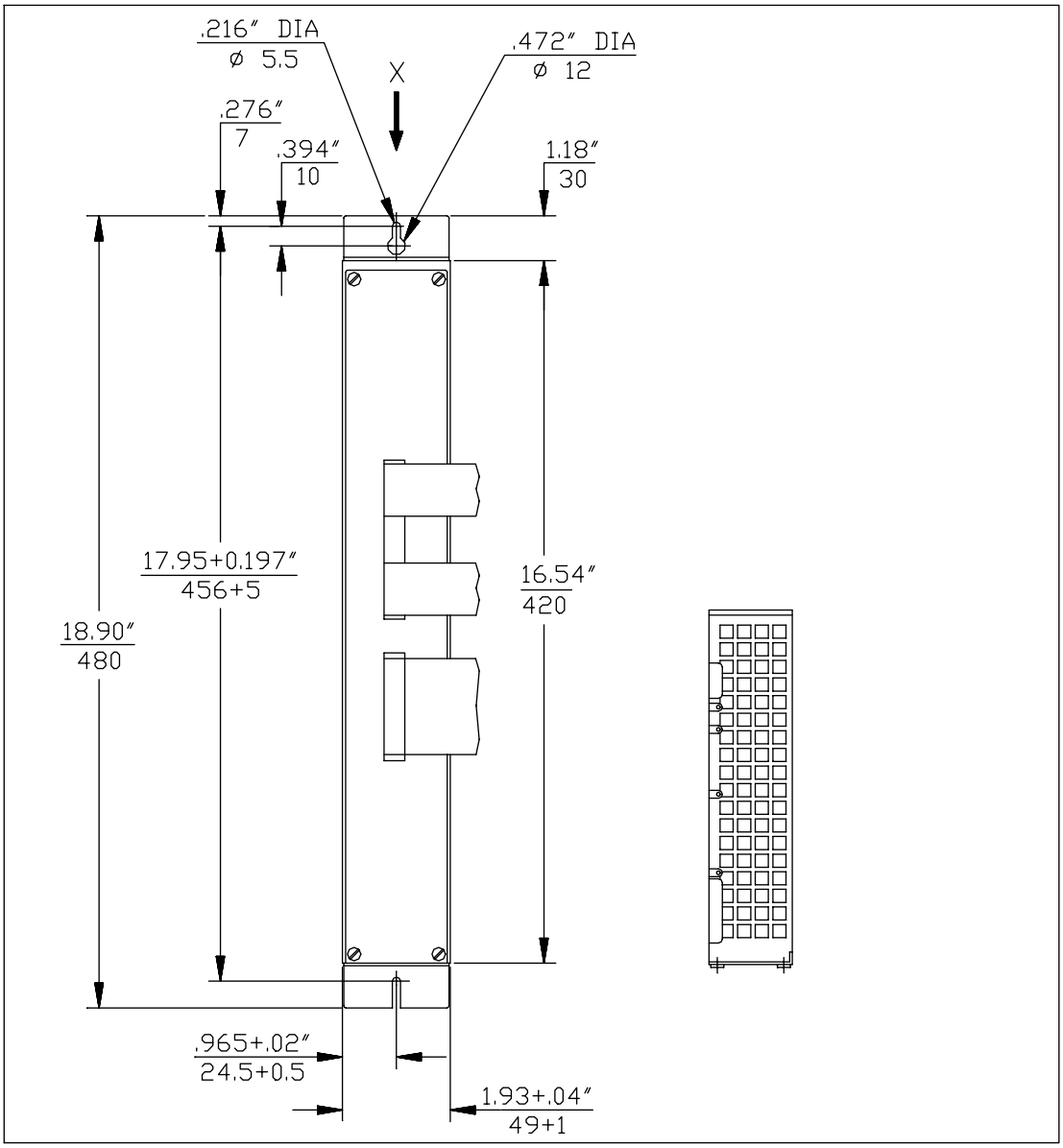


Figure 5-17, PM 107 Power Supply Dimensions

Braking Resistors

Refer to **Figure 5-18**, Figure 5-19, BR 10F and BR 18F Dimensions, and Table 5-24, Braking Resistors with Fans.

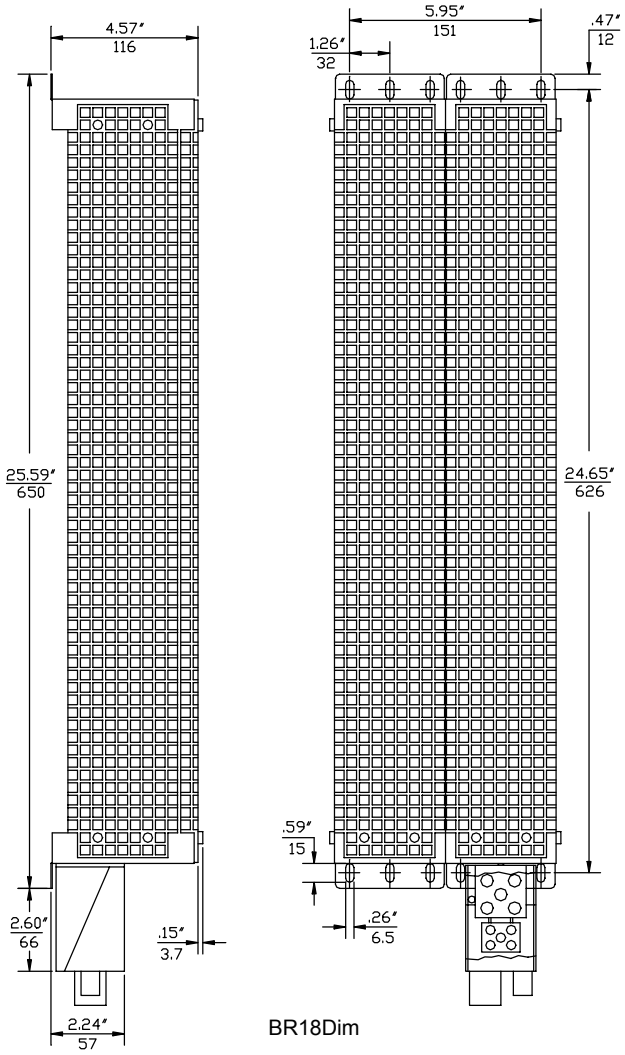


Figure 5-18, BR 18 Dimensions

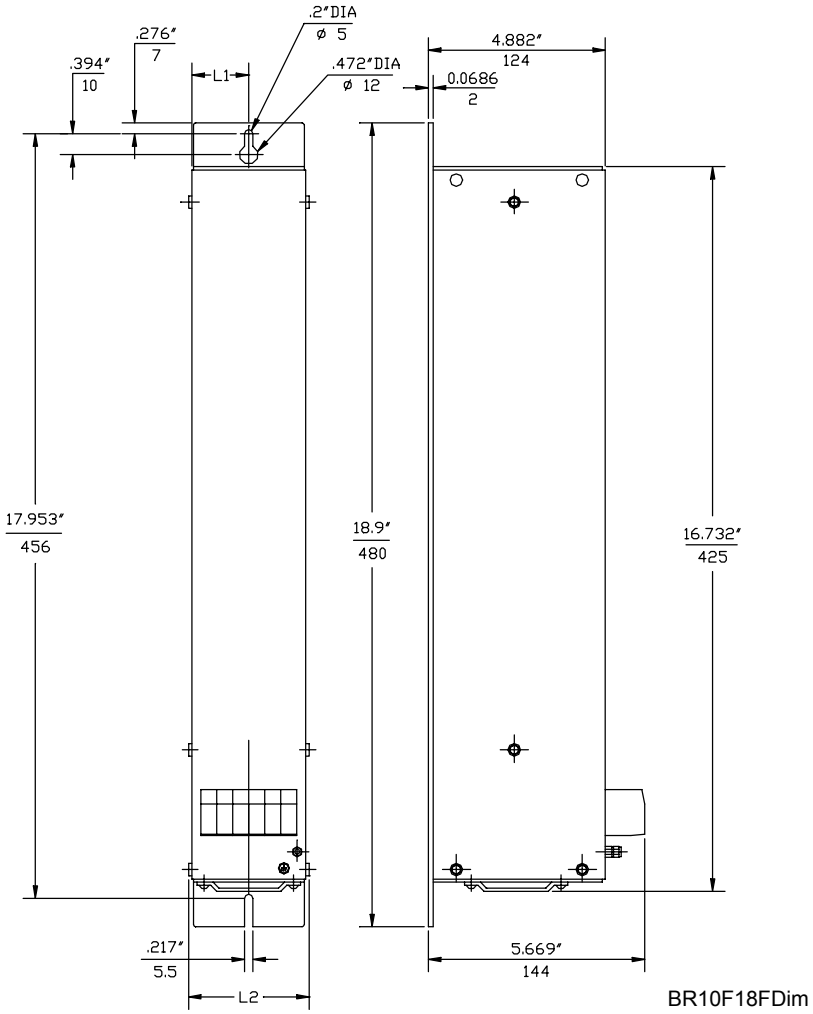


Figure 5-19, BR 10F and BR 18F Dimensions

Table 5-24, Braking Resistors with Fans

Value	BR 18F	BR 10F
L1	38.5 mm (1.516 in)	62.5 mm (2.461 in)
L2	77 mm (3.031 in)	125 mm (4.921 in)

CR 135 Commutating Reactor

Refer to **Figure 5-20**.

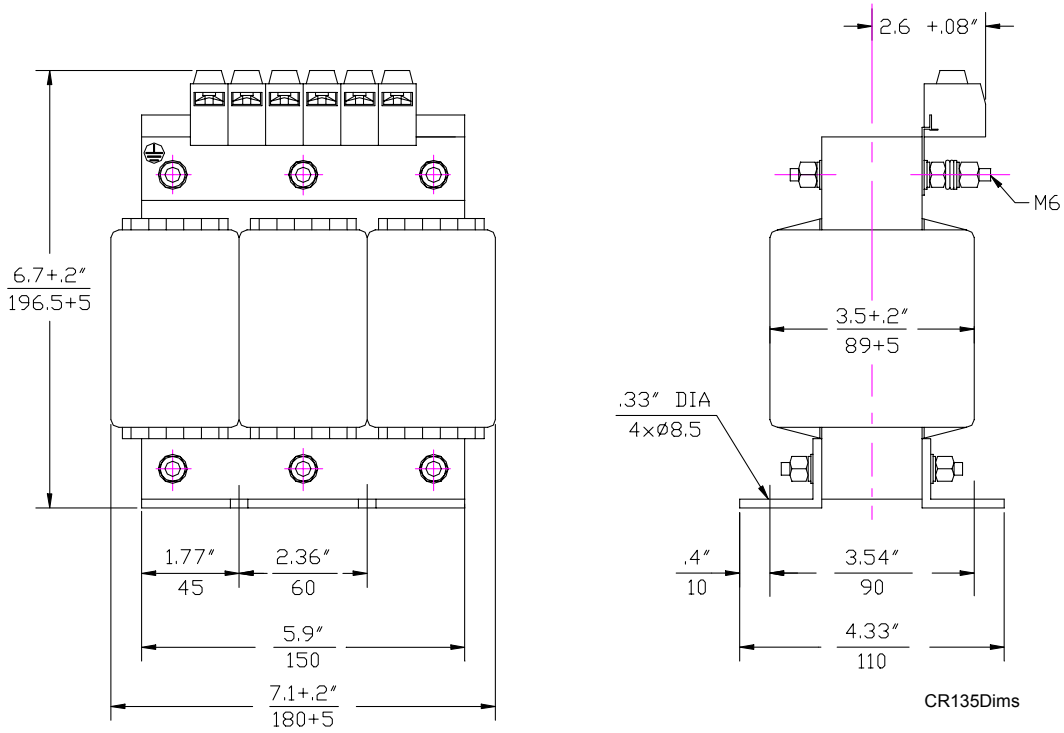


Figure 5-20, CR 135 Dimensions

Section 6 - Installing Modular Amplifiers

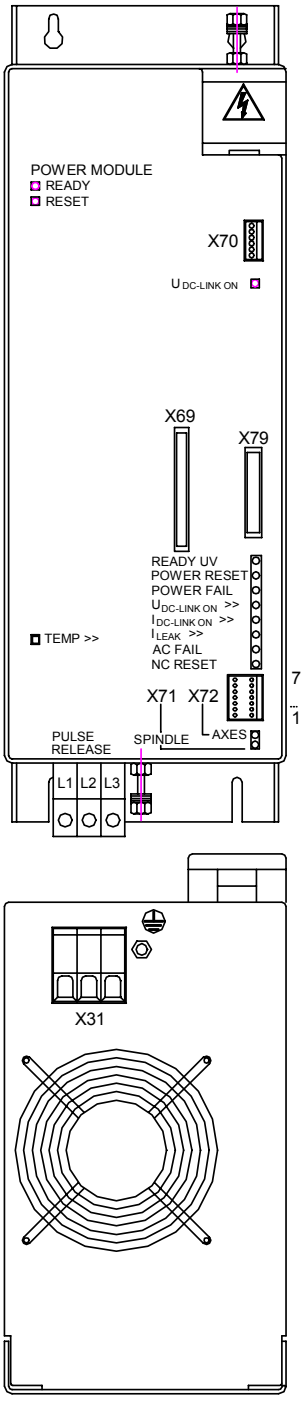
Connection Overview

The following components and connections are illustrated:

PS 122 Power Supply Unit

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-1**.



X70 Main contactor

X69 Power supply for CNC chassis (in double for lenghts over 1.65 ft)
X79 Unit bus

X71 Safety relay for spindle (pulse disable for spindle)
X72 Safety relay for axes (pulse disable for all axis)

X31 Supply voltage for inverter (3 x 400V ±10%)
Equipment ground

Figure 6-1, PS 122 Power Supply Unit, Connections

Description of LEDs on PS 122

Refer to **Table 6-1**.

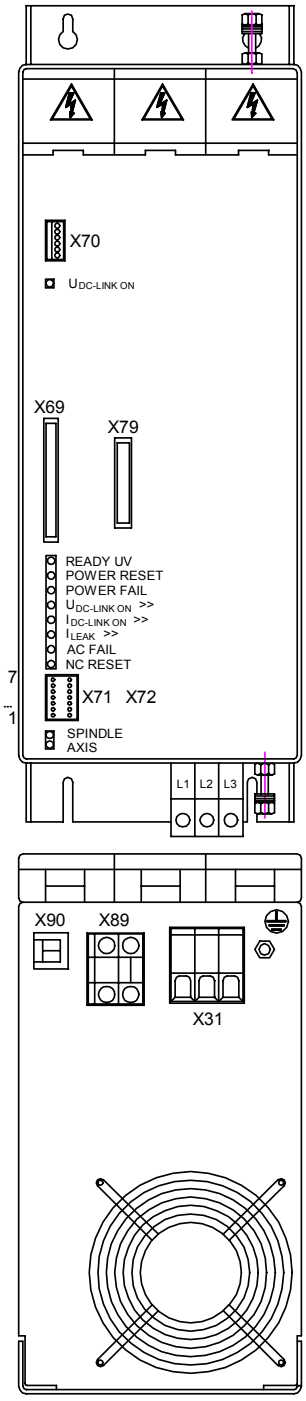
Table 6-1, PS 122 - LEDs Description

LED	Meaning	Signal Direction	Signal
$U_{DC\ LINK\ ON}$	Main contactor on	–	–
READY	End stage ready (only for service purposes)	–	–
RESET	Reset for end stage (only for service purposes)	–	–
READY UV	Supply unit ready	PS > CNC Chassis	RDY.PS
POWER RESET	Reset signal from the PS 122 to CNC Chassis	PS > CNC Chassis	$\overline{\text{RES.PS}}$
POWER FAIL	U_Z too low, U_Z < 410 A (e.g. line power < 290V)	PS > CNC Chassis	$\overline{\text{PF.PS}}$
$U_{DC\ LINK}$ >>	U_Z too high (>approx. 800 V); Power modules are switched off	PS > CNC Chassis	$\overline{\text{ERR.UZ.GR}}$
$I_{DC\ LINK}$ >>	I_Z > 52 A, Warning signal to control at 58 A	PS > CNC Chassis	$\overline{\text{ERR.IZ.GR}}$
I_{LEAK}	Error current (e.g. through short to earth; warning signal to control)	PS > CNC Chassis	$\overline{\text{ERR.ILEAK}}$
AC FAIL	Phase missing	PS > CNC Chassis	$\overline{\text{PF.PS.AC}}$
NC RESET	Reset signal from the CNC Chassis to the PS 122	CNC Chassis > PS	$\overline{\text{RES.LE}}$
TEMP >>	Temperature of heat sink too high (>95 °C [203 °F])	PS > CNC Chassis	$\overline{\text{ERR.TEMP}}$
SPINDLE	Safety relay for spindle on	–	–
AXES	Safety relay for axes on	–	–

PS 130 Power Supply Unit

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-2**.



X70 Main contactor

X69 Power supply for CNC chassis (in double for lenghts over 1.65 ft)

X79 Unit bus

X71 Safety relay for spindle (pulse disable for spindle)

X72 Safety relay for axes (pulse disable for all axis)

X31 Supply voltage for inverter (3 x 400V ±10%)

X89 Breaking resistor

X90 24 V output

Equipment ground

Figure 6-2, PS 130 Power Supply Unit, Connections

Description of LEDs on PS 130

Refer to **Table 6-2**.

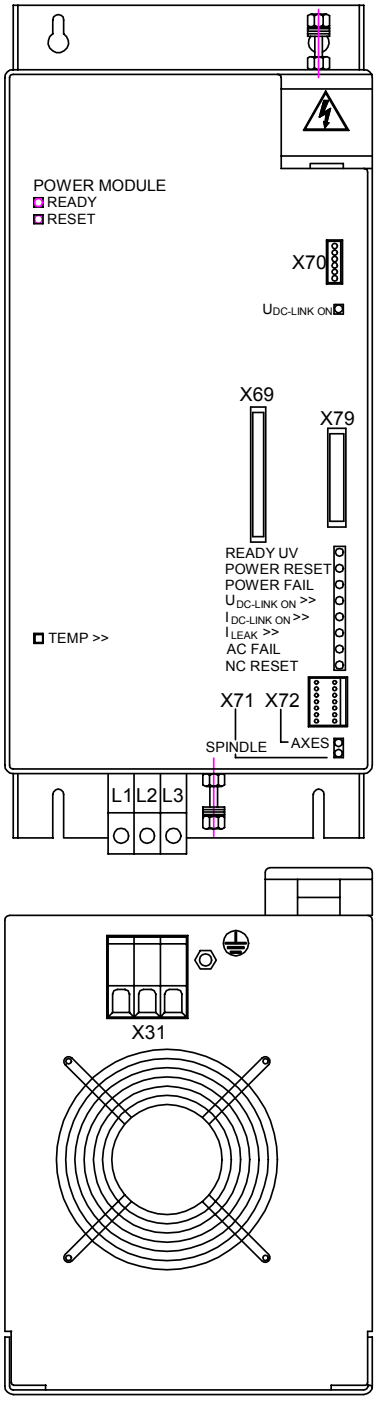
Table 6-2, PS 130 - LEDs Description

LED	Meaning	Signal Direction	Signal
$U_{DC\ LINK\ ON}$	Main contactor on	–	–
READY	Supply unit ready	–	RDY.PS
POWER RESET	Reset signal from the PS 130 to CNC Chassis	PS > CNC Chassis	$\overline{\text{RES.PS}}$
POWER FAIL	U_Z too low, U_Z < 410 A (e.g. line power < 290V)	PS > CNC Chassis	$\overline{\text{PF.PS}}$
$U_{DC\ LINK}$ >>	U_Z too high (>approx. 760 V); Power modules are switched off	PS > CNC Chassis	$\overline{\text{ERR.UZ.GR}}$
$I_{DC\ LINK}$ >>	I_Z > 75 A, Warning signal to control at 88 A	PS > CNC Chassis	$\overline{\text{ERR.IZ.GR}}$
I_{LEAK}	Error current (e.g. through short to earth; warning signal to control)	PS > CNC Chassis	$\overline{\text{ERR.ILEAK}}$
TEMP >>	Temperature of heat sink too high (>95 °C [203 °F])	PS > CNC Chassis	$\overline{\text{ERR.TEMP}}$
NC RESET	Reset signal from the CNC Chassis to the PS 130	CNC Chassis > PS	$\overline{\text{RES.LE}}$
SPINDLE	Safety relay for spindle on	–	–
AXES	Safety relay for axes on	–	–

PS 145 Power Supply Unit

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-3**.



X70 Main contactor

X69 Power supply for CNC chassis (in double for lenghts over 1.65 ft)

X79 Unit bus

X71 Safety relay for spindle (pulse disable for spindle)

X72 Safety relay for axes (pulse disable for all axis)

X31 Supply voltage for inverter (3 x 400V ±10%)

⏚ Equipment ground

Figure 6-3, PS 145 Power Supply Unit, Connections

Description of LEDs on PS 145

Refer to **Table 6-3**.

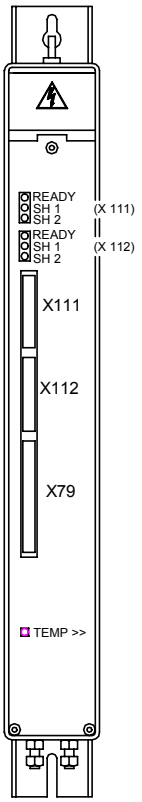
Table 6-3, PS 145 - LEDs Description

LED	Meaning	Signal Direction	Signal
$U_{DC\ LINK\ ON}$	Main contactor on	–	–
READY	End stage ready (only for service purposes)	–	–
RESET	Reset for end stage (only for service purposes)	–	–
READY UV	Supply unit ready	PS > CNC Chassis	RDY.PS
POWER RESET	Reset signal from the PS 145 to CNC Chassis	PS > CNC Chassis	$\overline{\text{RES.PS}}$
POWER FAIL	U_Z too low, U_Z < 410 A (e.g. line power < 290V)	PS > CNC Chassis	$\overline{\text{PF.PS}}$
$U_{DC\ LINK}$ >>	U_Z too high (>approx. 800 V); Power modules are switched off	PS > CNC Chassis	$\overline{\text{ERR.UZ.GR}}$
$I_{DC\ LINK}$ >>	I_Z > 103 A, Warning signal to control at 116 A	PS > CNC Chassis	$\overline{\text{ERR.IZ.GR}}$
I_{LEAK}	Error current (e.g. through short to earth; warning signal to control)	PS > CNC Chassis	$\overline{\text{EFF.ILEAK}}$
AC FAIL	Phase missing	PS > CNC Chassis	$\overline{\text{PF.PS.AC}}$
NC RESET	Reset signal from the CNC Chassis to the PS 145	CNC Chassis > PS	$\overline{\text{RES.LE}}$
TEMP >>	Temperature of heat sink too high (>95 °C [203 °F])	PS > CNC Chassis	$\overline{\text{ERR.TEMP}}$
SPINDLE	Safety relay for spindle on	–	–
AXES	Safety relay for axes on	–	–

PM 107, PM 207 Power Module

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-4**.



X111 PWM, axis 1

X112 PWM, axis 2
(with PM 107 one-axis module only X111 available)

X79 Unit bus

X344 24-V supply for motor holding brake

X392 Motor holding brake

X82 Motor connection for axis 2 (7.5 A)
not on the PM 107

Equipment ground

X81 Motor connection for axis 1 (X111)

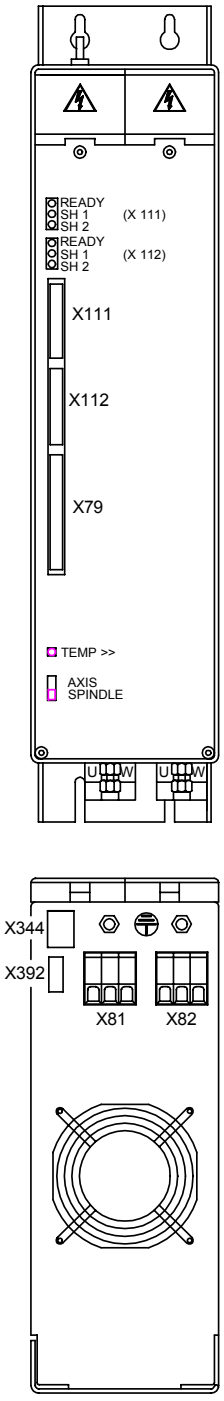
PM1x7

Figure 6-4, PM 107, PM 207 Power Module, Connections

PM 115A, PM 123A, PM 215A, and PM 223A Power Module

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-5**.



X111 (X112) PWM, axis 1

X112 PWM, axis 2/spindle
(PM 123A; PM 115A: X112 can be connected above or) below. Internally both of these inputs are switched in parallel).

X79 Unit bus

Sliding switch:

PM 123A, PM 115A: AXIS: axis module
SPINDLE: spindle module

PM 223A: AXIS: X112 = axis
SPINDLE: X112 = spindle
The upper PWM input (X111) is always an axis.

X344 24-V supply for motor holding brake

X392 Motor holding brake

X82 Motor connection for axis 2 / spindle (X112)

X81 Motor connection for axis 1 (X111)
not on the PM 123A and PM 115A

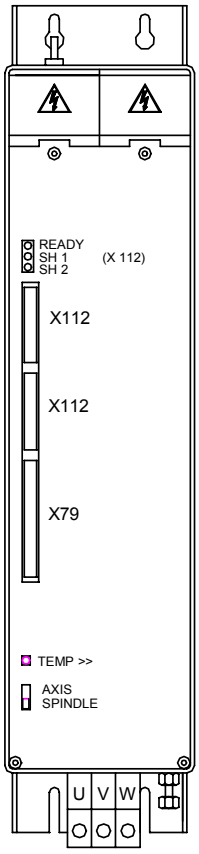
⏚ Equipment ground

Figure 6-5, PM 115A, PM 123A, PM 215A, and PM 223A Power Module, Connections

PM 132A and PM 148A Power Module

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

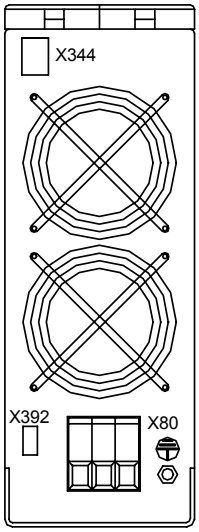
See **Figure 6-6**.



X112 PWM, axis / spindle
(PM 107; PM123A; PM 132A; PM 148A; PM 170A: X112 can be connected above or below. Internally both of these inputs are switched in parallel.).

X79 Unit bus

Sliding switch:
PM 107; PM 123A, PM 132A; PM 148A; PM 170A: AXIS: axis module
SPINDLE: spindle module



X344 24-V supply for motor holding brake

X392 Motor holding brake

X80 Motor connection for axis / spindle (X112)

Equipment ground

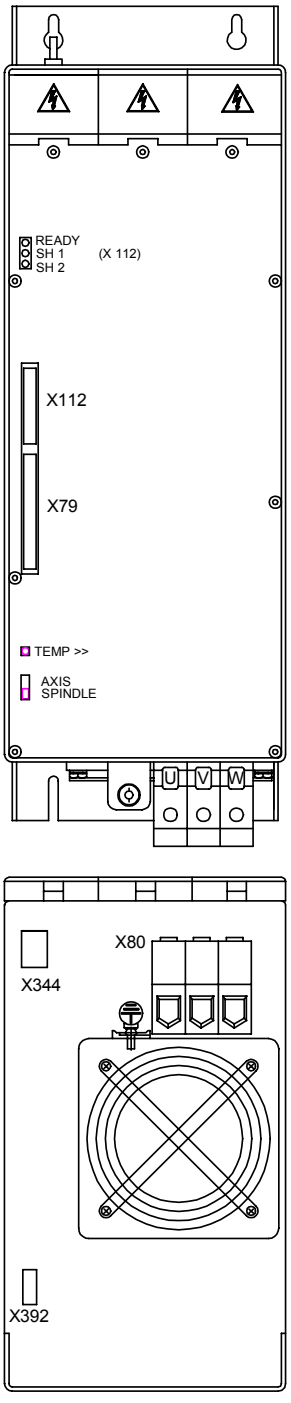
PM132A148A

Figure 6-6, PM 132A and PM 148A Power Module, Connections

PM 170A Power Module

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-7**.



X112 PWM, axis / spindle

X79 Unit bus

Sliding switch:
PM 107; PM 123A; PM 132A; PM 148A; PM 170A:
AXIS: axis module
SPINDLE: spindle module

X344 24-V supply for motor holding brake

X80 Motor connection for axis / spindle

Equipment ground

X392 Motor holding brake

Figure 6-7, PM 170A Power Module, Connections

Description of LEDs on PM Power Modules

For PM power modules description of the LEDs refer to **Table 6-4**.

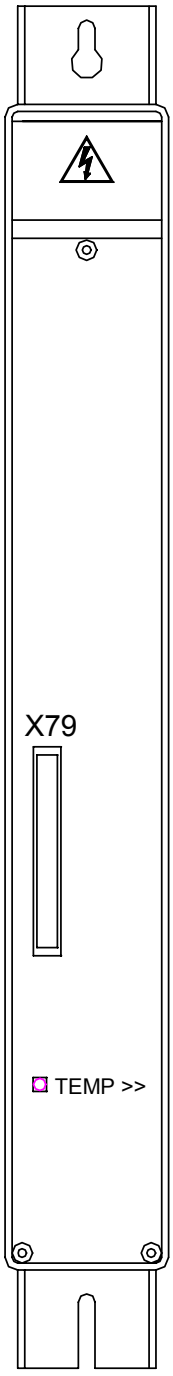
Table 6-4, PM Power Modules - LEDs Description

LED	Meaning	Signal Direction	Signal
READY	Power module is ready	PM > CNC Chassis	RDY
SH 1	Flashing DSP error, PLC error with Emergency Stop, CNC Chassis hardware or software error	CNC Chassis > PM	$\overline{SH1}$
SH 2	No drive available (e.g. by the PLC, active via external signal or SH1)	CNC Chassis > PM	$\overline{SH2}$
TEMP >>	Warning signal for transistor temperature too high	PM > CNC Chassis	$\overline{ERR}$

BR 9 Braking Resistor

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-8**.



X79 Unit bus

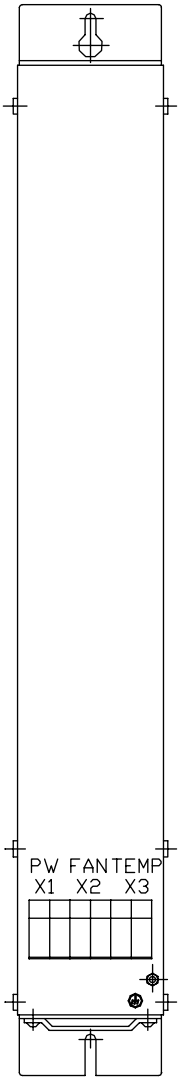
TEMP. >>
Warning signal for excessive temperature of braking resistor

Figure 6-8, BR 9 Connections

BR 10F and BR 18F Braking Resistor

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-9**.



X1 PS 130 power supply module
X2 Supply voltage for the fan of the braking resistor
X3 Temperature switch

BR10F18FConnect

Figure 6-9, BR 10F and BR 18F Connections

BR 18 Braking Resistor Module

DANGER: Do not engage or disengage any connecting elements while the unit is under power!

See **Figure 6-10**.

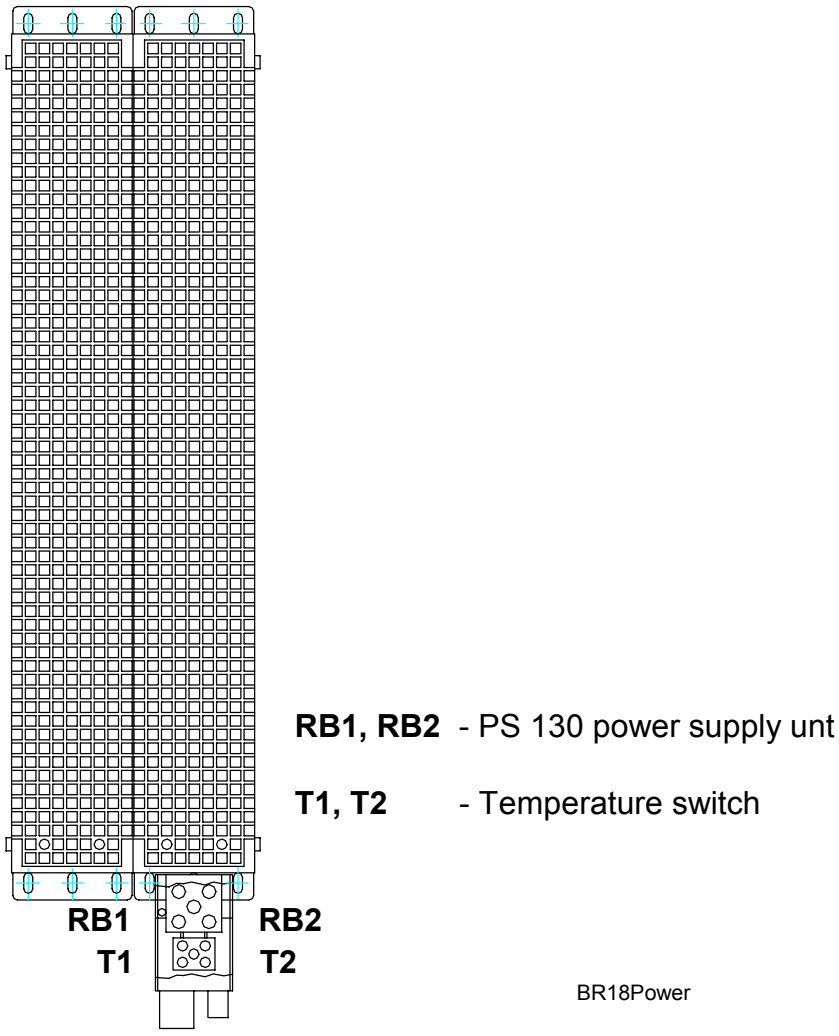


Figure 6-10, BR 18 Braking Resistor Module, Connections

Mounting and Connection of the Modular Amplifier System

The power modules are arranged between the PS 1*xx* power supply unit and the logic unit. The power module for the spindle is placed next to the PS 1*xx* power supply unit, and the power modules for the axes are then place in order of decreasing rated current.

If the BR 9 braking resistor module is used together with the PS 122 and PS 145 energy-recovery power modules, the braking resistor is arranged between the weakest power module and the CNC Chassis.

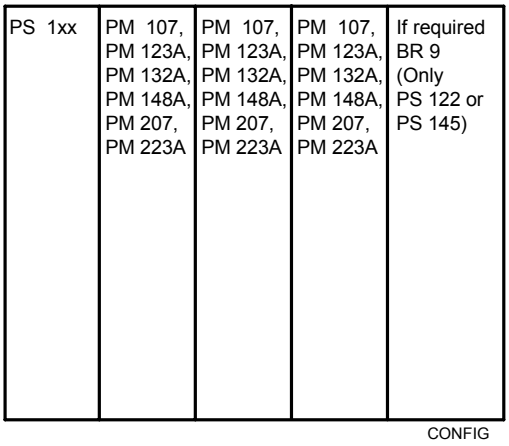


Figure 6-11, Configuration of Amplifier, CNC, and Power Supply

Connecting the Modules

The DC-link power supply UZ is supplied to the amplifier modules for the PS 1xx power supply unit via power bars (screwed into each module, and if required, the BR 9 braking resistor.

A further power conductor establishes the ground connection between the individual modules.

Three power bars are included as accessories with the power modules (two for the DC-link, one of for ground.)

The 50-line ribbon cable connects the CNC Chassis with the PS 1*xx* and supplies the power to the CNC Chassis.

The 40-line ribbon cable connects the PS 1xx with the power modules (PM 107, PM 123A, PM 132A, PM 148A, PM 207, or PM 223A) and, if required, the BR 9, forming the unit base.

The 20-line ribbon cables connect the CNC Chassis and the power modules, and supply the PWM signals of the axes and the spindle.

Module Covers

The ribbon cables must be covered to protect against interference.

A cover is supplied as an accessory with the PS 1*xx* (P/N 12324567), which protects the following modules:

- PS 1xx
- PM 170A or
- One power module (PM 107, PM 123A, PM 132A, PM 148A, PM 207, or PM 223A) (100 mm width), and
  One power module (PM 107, PM 123A, PM 132A, PM 148A, PM 207, or PM 223A) (50 mm width)

The cover for the CNC Chassis is supplied with the CNC Chassis.

If further power modules are used, the corresponding covers must be ordered separately.

Mounting the Modular Amplifier System

Refer to **Figure 6-12**.

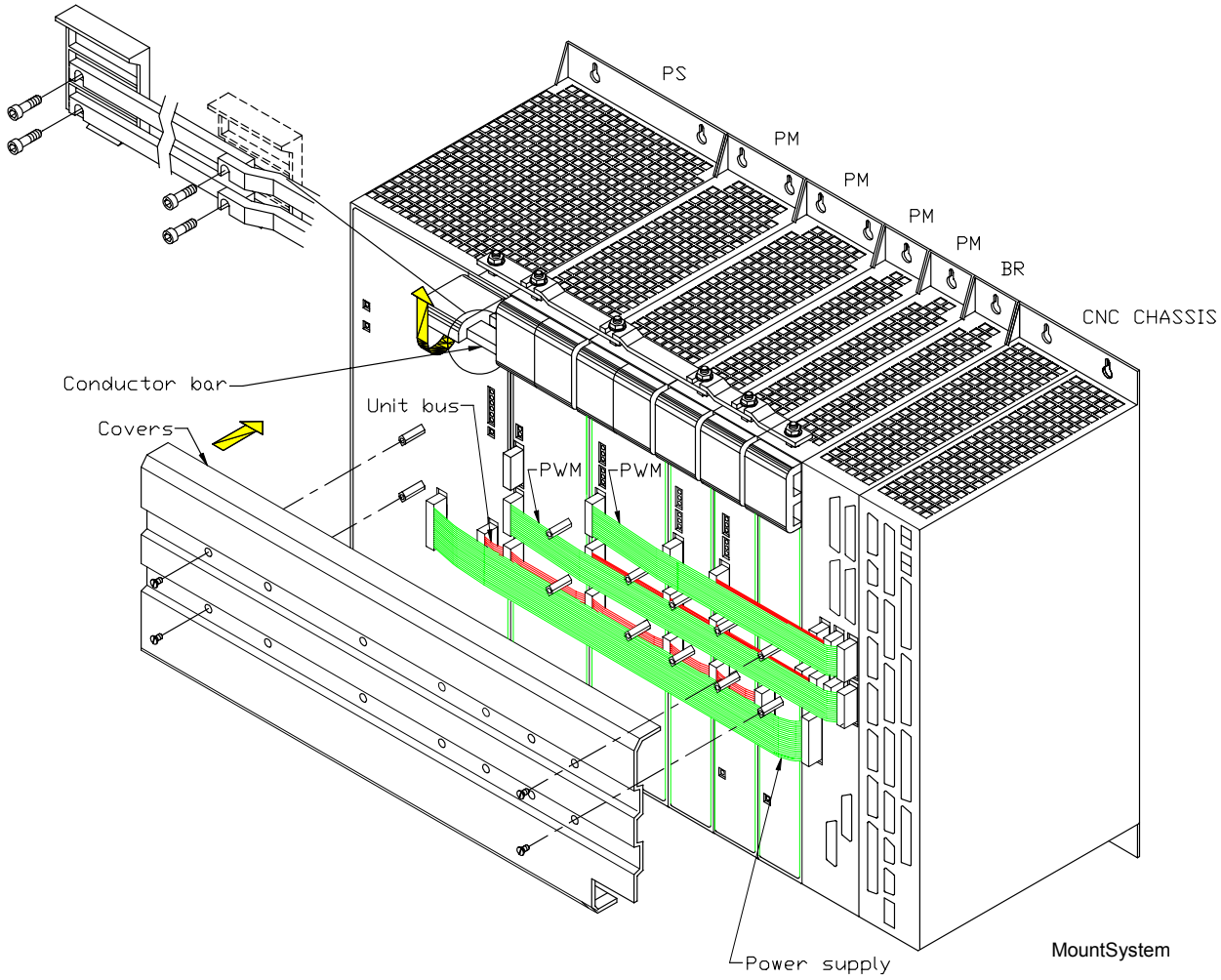


Figure 6-12, Mounting the Modular Amplifier System

WARNING: All electrical screw connections must be tightened after installation is complete (tightening torque 3.5 Nm).

Connecting the Motors

The shield of the lines for the holding brake is to be kept as close as possible (< 1.18 in. [30 mm]) to ground. The best solution is to fasten the shield with a metal clamp directly onto the sheet metal housing of the electrical cabinet.

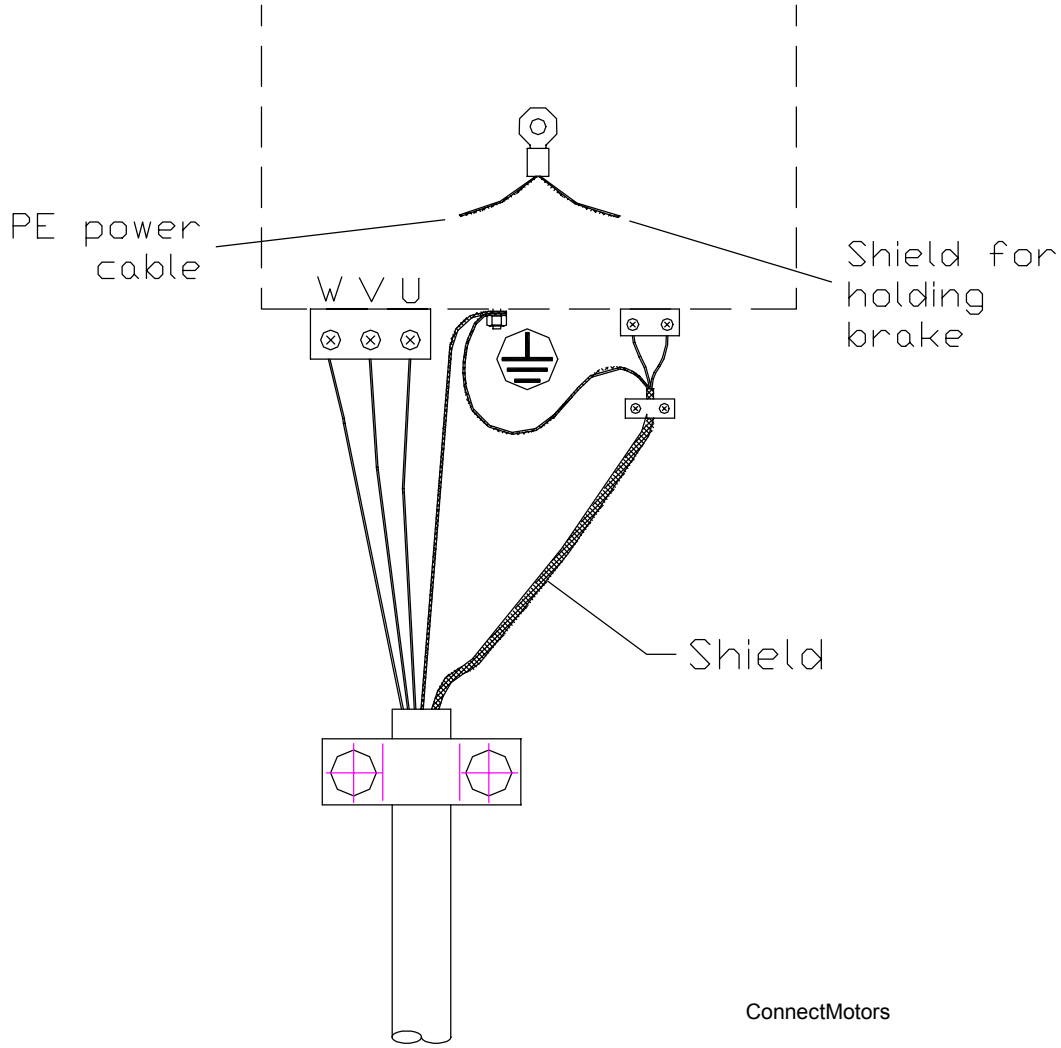


Figure 6-13, Connecting the Motors

Connections on the PS 130 Power Supply Units

DANGER: Danger of electrical shock!

Only ANILAM service engineers must open the PS 130 power supply unit.

Do not engage or disengage any terminals while they are under power.

PS 130 - X31 Supply Voltage for U_Z

The inverter voltage U_Z is 400 VDC; the modular amplifier voltage U_Z is 565 VDC. Refer to **Table 6-5**.

Table 6-5, PS 130 - X31 Supply Voltage Pinout

Terminals	Assignment PS 130
L1	400 VAC ± 10%
L2	50 Hz to 60 Hz
L3	
	Cable: Wire cross section 16 mm^2 (AWG 6) Line fuse: 63 A (gRL) Grounding terminal: ≥ 10 mm^2 (AWG 8)

NOTE: EN 50 178 requires a non-detachable connection to the line power supply.

NOTE: If the power supply is other than 400 V, an autotransformer is required. It must comply at least with the connection specifications of the subsequent power supply unit.

PS 130 - Main Contactor and Safety Relay

PS 130 - X70 Main Contactor

Refer to **Table 6-6**.

Table 6-6, PS 130 – X70 Main Contactor Pinout

Connection Terminal X70	Assignment
1	+24 V output (maximum 250 mA)
2	0 V
3	+24 V input for U_Z ON
4	Do not assign
5	Do not assign
6**[1]	Normally closed contact (OE1)
7**[1]	Normally closed contact (OE2)

**[1] Maximum 125 V

Warning: A recovery diode is required in the proximity of the inductive loads, (for example, relay or contactor coils).

PS 130 - X71 Safety Relay Spindle, X72 Safety Relay Axes

Refer to **Table 6-7**.

Table 6-7, PS 130 - X71 Safety Relay Spindle, X72 Safety Relay Axes Pinout

Terminals X71 and X72	Assignment
1	+24 V output (maximum 250 mA)
2	0 V
3	+24 V input for Axis ON, Spindle ON
4	Do not assign
5	Do not assign
6**[1]	Normally closed contact (OE1A or OE1S)
7**[1]	Normally closed contact (OE2A or OES2)

**[1] Maximum 125 V

Warning: A recovery diode is required in the proximity of the inductive loads, (for example, relay or contactor coils).

PS 130 - CNC Power Supply and Control Signals

With lengths of 25.62 inches (600 mm) and longer, the 50-line ribbon cable for the CNC power supply and control signals is led doubled to the CNC Chassis to increase the wire cross section. Refer to **Table 6-8**.

Table 6-8, PS 130 - X69 CNC Supply Voltage and Control Signals Pinout

50-line Ribbon Connector	Assignment
1a to 5b	+5 V
6a to 7b	+12 V
8a	+5 V (low-voltage separation)
8b	0 V (low-voltage separation)
9a	+15 V
9b	–15 V
10a	UZAN
10b	0 V
11a	IZAN
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PF.PS}}$
13b	GND
14a	$\overline{\text{ERR.UZ.GR}}$
14b	GND
15a	$\overline{\text{ERR.IZ.GR}}$
15b	GND
16a	$\overline{\text{ERR.TEMP}}$

50-line Ribbon Connector	Assignment
16b	GND
17a	RDY.PS
17b	GND
18a	$\overline{\text{ERR.ILEAK}}$
18b	GND
19a	Do not assign
19b	GND
20a	Do not assign
20b	GND
21a	0 V
21b	GND
22a	0 V
22b	GND
23a	Reserved (SDA)
23b	GND
24a	Reserved (SCL)
24b	GND
25a	$\overline{\text{RES.LE}}$
25b	GND

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation.

PS 130 - Unit Bus

Refer to **Table 6-9**.

Table 6-9, PS 130 - X79 Unit Bus Pinout

40-line Ribbon Connector	Assignment
1a to 3b	0 V **[1]
4a	+24 V **[1]
4b	+24 V **[1]
5a	+15 V **[1]
5b	+24 V **[1]
6a	+15 V **[1]
6b	+15 V **[1]
7a to 8b	Do not assign
9a	Reserved (SDA)
9b	Do not assign
10a	Reserved (SCL)
10b	$\overline{\text{ERR.TEMP}}$
11a	$\overline{\text{PF.PS}}$
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PWR.OFF}}$
13b	0 V
14a	5 V FS (spindle enable)
14b	0 V
15a	5 V FA (axes enable)
15b to 16b	0 V
17a and 17b	–15 V
18a and 18b	+15 V
19a to 20b	+5 V

**1 These voltages may not be linked with other voltages (insulation limitation).

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation (except for 1a to 6b).

BR 10F, BR 18, and BR 18F Braking Resistors on the PS 130 Power Supply Unit

A BR 10F, BR 18, BR 18F, or two BR 18 braking resistors in parallel must be connected with the PS 130 power supply unit.

The braking resistor is switched on when the modular amplifier voltage U_Z exceeds 700 V and is switched off again as soon as it falls below 670 V.

NOTE: If no braking resistor is connected, the modular amplifier voltage U_Z can increase and at U_Z > 800 V all power stages will be switched off (LED for $U_{DC\text{-}LINK}$ >> lights up)!

PS 130 - Cross Section

The following cross section is required for connecting the braking resistor. Refer to **Table 6-10**.

Table 6-10, PS 130 - Braking Resistors Cross Section

Braking Resistor	Cross Section
BR 18	1.5 mm^2 (AWG 16)
2 x BR 18 in parallel	4.0 mm^2 (AWG 12)
BR 10F	1.5 mm^2 (AWG 16)
BR 18F	4.0 mm^2 (AWG 12)

PS 130 - X89 Terminal for Braking Resistors

For BR 18, refer to **Table 6-11**.

Table 6-11, PS 130 - BR 18, X89 Terminal Connection

Connecting Terminal X89	Assignment	BR 18 Braking Resistor
1	$+U_Z$	RB1
2	Switch against $–U_Z$	RB2

For BR 10F and BR 18F, refer to **Table 6-12**.

Table 6-12, PS 130 - BR 10F and BR 18F, X89 Terminal Connection

Connecting Terminal X89	Assignment	BR 10F and BR 18F Braking Resistor, Connecting Terminal X1
1	$+U_Z$	1
2	Switch against $–U_Z$	2

PS 130 - BR 18, Temperature Switch

The temperature switch is a normally closed contact and is set to protect the braking resistor from being damaged. It can have maximum load: 250V, 5 A. The switch can be connected to a PLC input on the CNC Chassis and evaluated via the PLC. Refer to **Table 6-13**.

Table 6-13, PS 130 - BR 18, Temperature Switch Pinout

BR 18 Connecting Terminal	Assignment
T1	1
T2	2

PS 130 - BR 10F and BR 18F, X2 Fan

Refer to **Table 6-14** for the external braking resistors: BR 10F and BR 18F.

Table 6-14, PS 130 - BR 10F and BR 18F, X2 Fan

Connecting Terminal X2	Assignment
+	+24 V (PLC)
–	0 V

PS 122 and PS 145 – Connections to Energy-Recovery Power Supply Unit

DANGER: Danger of electrical shock!

Only ANILAM service engineers must open the PS 122 and PS 145 power supply unit.

Do not engage or disengage any terminals while they are under power.

PS 122 and PS 145 – Power Supply

NOTE: EN 50 178 requires a non-detachable connection to the line power supply.

NOTE: If the power supply is other than 400 V, an autotransformer is required. It must comply at least with the connection specifications of the subsequent power supply unit.

PS 122 and PS 145 - X31 Supply Voltage for U_Z

The inverter voltage U_Z is 650 VDC. The PS 122 and PS 140 energy-recovery modules must be connected to the main power via the CR 135, CR 170, and CR 180 commutating reactor and the line filter. This is necessary for keeping the main line free of disruptive higher harmonics. Refer to **Table 6-15**.

Table 6-15, PS 122 and PS 145 - X31 Supply Voltage for U_Z Pinout

Power Voltage		**Line Filter (LF xxxA) Power**	**Device**		**CR 135 CR 170 CR 180**			**PS 122, PS 145 X31**
L1	—	L1	L1'	—	1U1	1U2	—	L1
L2	—	L2	L2'	—	1V1	1V2	—	L2
L3	—	L3	L3'	—	1W1	1W2	—	L3
PE	—	PE		—	⏚		—	
400 VAC ± 10 % 50 Hz to 60 Hz	**PS 122:** Cables or single wires: Wire cross section 16 mm^2 (AWG 6) Line fuse: 35 A (gRL) Grounding terminal: ≥ 10 mm^2 (AWG 8) **PS 145:** Cables or single wires: Wire cross section 25 mm^2 (AWG 4) Line fuse: 80 A (gRL) Grounding terminal: ≥ 16 mm^2 (AWG 6)							

NOTE: The cables between the power supply and the line filter as well as between the commutating reactor and the line filter must be as short as possible (< 1.2 feet [0.4 m])!

PS 122 and PS 145 - Main Contactor and Safety Relay

PS 122 and PS 145 - X70 Main Contactor

Refer to **Table 6-17**.

Table 6-16, PS 122 and PS 145 - X31 Supply Voltage Pinout

Connection to Terminal X70	Assignment
1	+24 V output (maximum 250 mA)
2	0 V
3	+24 V input for U_Z ON
4	Do not assign
5	Do not assign
6**[1]	Normally closed contact (OE1)
7**[1]	Normally closed contact (OE2)

**[1] Maximum 125 V

Warning: A recovery diode is required in the proximity of the inductive loads, (for example, relay or contactor coils).

PS 122 and PS 145 - X71 Safety Relay Spindle, X72 Safety Relay Axes

Refer to **Table 6-17**.

Table 6-17, PS 122 and PS 145 - X71 Safety Relay Spindle, X72 Safety Relay Axes Pinout

Terminals X71 and X72	Assignment
1	+24 V output (maximum 250 mA)
2	0 V
3	+24 V input for Axis ON, Spindle ON
4	Do not assign
5	Do not assign
6**[1]	Normally closed contact (OE1A or OE1S)
7**[1]	Normally closed contact (OE2A or OE2S)

**[1] Maximum 125 V

Warning: A recovery diode is required in the proximity of the inductive loads, (for example, relay or contactor coils).

PS 122 and PS 145 – X90 24-V Output

Refer to **Table 6-18**.

Table 6-18, PS 122 and PS 145 – X90 24-V Output Pinout

Connection to Terminal X90	Assignment
+	+24 V (maximum 250 mA)
–	0 V

PS 122 and PS 145 - CNC Power Supply and Control Signals

Refer to **Table 6-19**.

Table 6-19, PS 122 and PS 145 - X69 CNC Supply Voltage and Control Signals Pinout

50-line Ribbon Connector	Assignment
1a to 5b	+5 V
6a to 7b	+12 V
8a	+5 V (low-voltage separation)
8b	0 V (low-voltage separation)
9a	+15 V
9b	–15 V
10a	UZAN
10b	0 V
11a	IZAN
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PF.PS.ZK}}$
13b	GND
14a	$\overline{\text{ERR.UZ.GR}}$
14b	GND
15a	$\overline{\text{ERR.IZ.GR}}$
15b	GND
16a	$\overline{\text{ERR.TEMP}}$

50-line Ribbon Connector	Assignment
16b	GND
17a	RDY.PS
17b	GND
18a	$\overline{\text{ERR.ILEAK}}$
18b	GND
19a	$\overline{\text{PF.PS.AC}}$
19b	GND
20a	Do not assign
20b	GND
21a	Do not assign
21b	GND
22a	Do not assign
22b	GND
23a	Reserved (SDA)
23b	GND
24a	Reserved (SCL)
24b	GND
25a	$\overline{\text{RES.LE}}$
25b	GND

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation.

PS 122 and PS 145 – X 79 Unit Bus

Refer to **Table 6-20**.

Table 6-20, PS 122 and PS 145 - X79 Unit Bus Pinout

40-line Ribbon Connector	Assignment
1a to 3b	0 V **[1]
4a	+24 V **[1]
4b	+24 V **[1]
5a	+15 V **[1]
5b	+24 V **[1]
6a	+15 V **[1]
6b	+15 V **[1]
7a to 8b	Do not assign
9a	Reserved (SDA)
9b	Do not assign
10a	Reserved (SCL)
10b	$\overline{\text{ERR.TEMP}}$
11a	$\overline{\text{PF.PS}}$
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PWR.OFF}}$
13b	0 V
14a	5 V FS (spindle enable)
14b	0 V
15a	5 V FA (axes enable)
15b to 16b	0 V
17a and 17b	–15 V
18a and 18b	+15 V
19a to 20b	+5 V

**1 These voltages may not be linked with other voltages (insulation limitation).

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation (except for 1a to 6b).

Connections with BR 9 Braking Resistor Module

The BR 9 braking resistor module must be used when axis motors with brakes are used. In the event of power failure, it dissipates the energy returned by the motors to the DC-link. The BR 9 is switched on when the inverter voltage U_Z exceeds 740 V and is switched off again as soon as it falls below 720 V. Refer to **Table 6-21**.

DANGER: Danger of electrical shock!

Only ANILAM service engineers must open the PS 130 power supply unit.

Do not engage or disengage any terminals while they are under power.

Table 6-21, BR 9 - X79 Unit Bus Pinout

40-line Ribbon Connector	Assignment
1a to 3b	0 V **[1]
4a	+24 V **[1]
4b	+24 V **[1]
5a	+15 V **[1]
5b	+24 V **[1]
6a	+15 V **[1]
6b	+15 V **[1]
7a to 8b	Do not assign
9a	Reserved (SDA)
9b	Do not assign
10a	Reserved (SCL)
10b	$\overline{\text{ERR.TEMP}}$
11a	$\overline{\text{PF.PS}}$
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PWR.OFF}}$
13b	0 V
14a	5 V FS (spindle enable)
14b	0 V
15a	5 V FA (axes enable)
15b to 16b	0 V
17a and 17b	–15 V
18a and 18b	+15 V
19a to 20b	+5 V

**1 These voltages may not be linked with other voltages (insulation limitation).

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation (except for 1a to 6b).

Connections on the PM 1xx and PM 2xx Power Module

DANGER: Danger of electrical shock!

Only ANILAM service engineers must open the PM 1xx and PM 2xx power supply unit.

Do not engage or disengage any terminals while they are under power.

PM 1xx and PM 2xx - PWM connection to the CNC Chassis

For PM 107, PM 123A, PM 132A, PM 148A, PM 207, and PM 223A power modules PWM connection (X111, X112) to the CNC Chassis refer to **Table 6-22**.

Table 6-22, X111, X112 PWM connection to the CNC Chassis Pinout

Ribbon Connector 20-pin	Assignment
1a	PWM U1
!	0 V U1
2a	PWM U2
2b	0 V U2
3a	PWM U3
3b	0 V U3
4a	$\overline{SH2}$
4b	0 V ($\overline{SH2}$)
5a	$\overline{SH1}$
5b	0 V ($\overline{SH1}$)
6a	$+I_{actl}$ 1
6b	$-I_{actl}$ 1
7a	0 V (analog)
7b	$+I_{actl}$ 2
8a	$-I_{actl}$ 2
8b	0 V (analog)
9a	Do not assign
9b	$\overline{BRK}$
10a	$\overline{ERR}$
10b	RDY

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation.

PM 1xx and PM 2xx – X79 Unit Bus

For PM 107, PM 123A, PM 132A, PM 148A, PM 207, and PM 223A power modules X79 unit bus connections pinout refer to **Table 6-23**.

Table 6-23, PM 1xx and PM 2xx - X79 Unit Bus Pinout

40-line Ribbon Connector	Assignment	
1a to 3b	0 V **[1]	**1 These voltages may not be linked with other voltages (insulation limitation).
4a	+24 V **[1]	
4b	+24 V **[1]	
5a	+15 V **[1]	
5b	+24 V **[1]	
6a	+15 V **[1]	
6b	+15 V **[1]	
7a to 8b	Do not assign	
9a	Reserved (SDA)	
9b	Do not assign	
10a	Reserved (SCL)	
10b	$\overline{\text{ERR.TEMP}}$	
11a	$\overline{\text{PF.PS}}$	
11b	0 V	
12a	$\overline{\text{RES.PS}}$	
12b	0 V	
13a	$\overline{\text{PWR.OFF}}$	
13b	0 V	
14a	5 V FS (spindle enable)	
14b	0 V	
15a	5 V FA (axes enable)	
15b to 16b	0 V	
17a and 17b	–15 V	
18a and 18b	+15 V	
19a to 20b	+5 V	

NOTE: The interface complies with the requirements of EN 50 178 for low voltage electrical separation (except for 1a to 6b).

PM 1xx and PM 2xx – Motor Connections

For PM 107, PM 123A, PM 132A, PM 148A, PM 207, and PM 223A power modules X81 and X82 motor connections pinout refer to **Table 6-24**.

Table 6-24, PM 1xx and PM 2xx – X81, X82 Axis/Spindle Motor Connections Pinout

Terminals X81, X82	Assignment
U	Motor connection U
V	Motor connection V
W	Motor connection W

For information on synchronous (axis) motors, asynchronous (spindle) motors, and power cables, refer to “Section 7, Available Motors and Accessories.”

PM 1xx and PM 2xx – Connection of the Motor Holding Brakes

PM 1xx and PM 2xx – X344 24-V Supply for Motor Holding Brake

For PM 107, PM 123A, PM 132A, PM 148A, PM 207, and PM 223A power modules X344 24-V supply for the motor holding brake pinout refer to **Table 6-25**.

Table 6-25, PM 1xx and PM 2xx – X344 24-V Supply for Motor Holding Brake Pinout

Connecting Terminal X344	Assignment
1	+24 V
2	0 V

PM 1xx and PM 2xx – X392 Motor Holding Brake

For PM 107, PM 123A, PM 132A, PM 148A, PM 207, and PM 223A power modules X392 connection of the motor holding brake pinout refer to **Table 6-26** (2-pin pinout) and/or **Table 6-27** (4-pin pinout).

Table 6-26, PM 1xx and PM 2xx – X392 Motor Holding Brake 2-Pin Pinout

Connecting Terminal X392	Assignment
1	Holding brake
2	0 V

Table 6-27, PM 1xx and PM 2xx – X392 Motor Holding Brake 4-Pin Pinout

Connecting Terminal X392	Assignment
1	Holding brake (X112)
2	0 V (X112)
3	Holding brake (X111)
4	0 V (X111)

Physical Dimensions

The following components dimensions are illustrated:

- PS 122 Power Supply Unit
- PS 130 Power Supply Unit
- PS 145 Power Supply Unit
- CR 135, Commutating Reactor
- CR 170, CR 180 Commutating Reactors
- LF 135A Line Filter
- LF 180A Line Filter
- BR 18 Braking Resistor
- BR 10F and BR 18F Braking Resistor
- BR 9 Braking Resistor Module
- Three-Phase Current Capacitor
- PM 107, PM 207 Power Modules
- PM 115A, PM 123A, PM 132A, PM 148A, PM 215A, and PM 223A Power Modules

PS 122 Power Supply Unit

Refer to **Figure 6-14**.

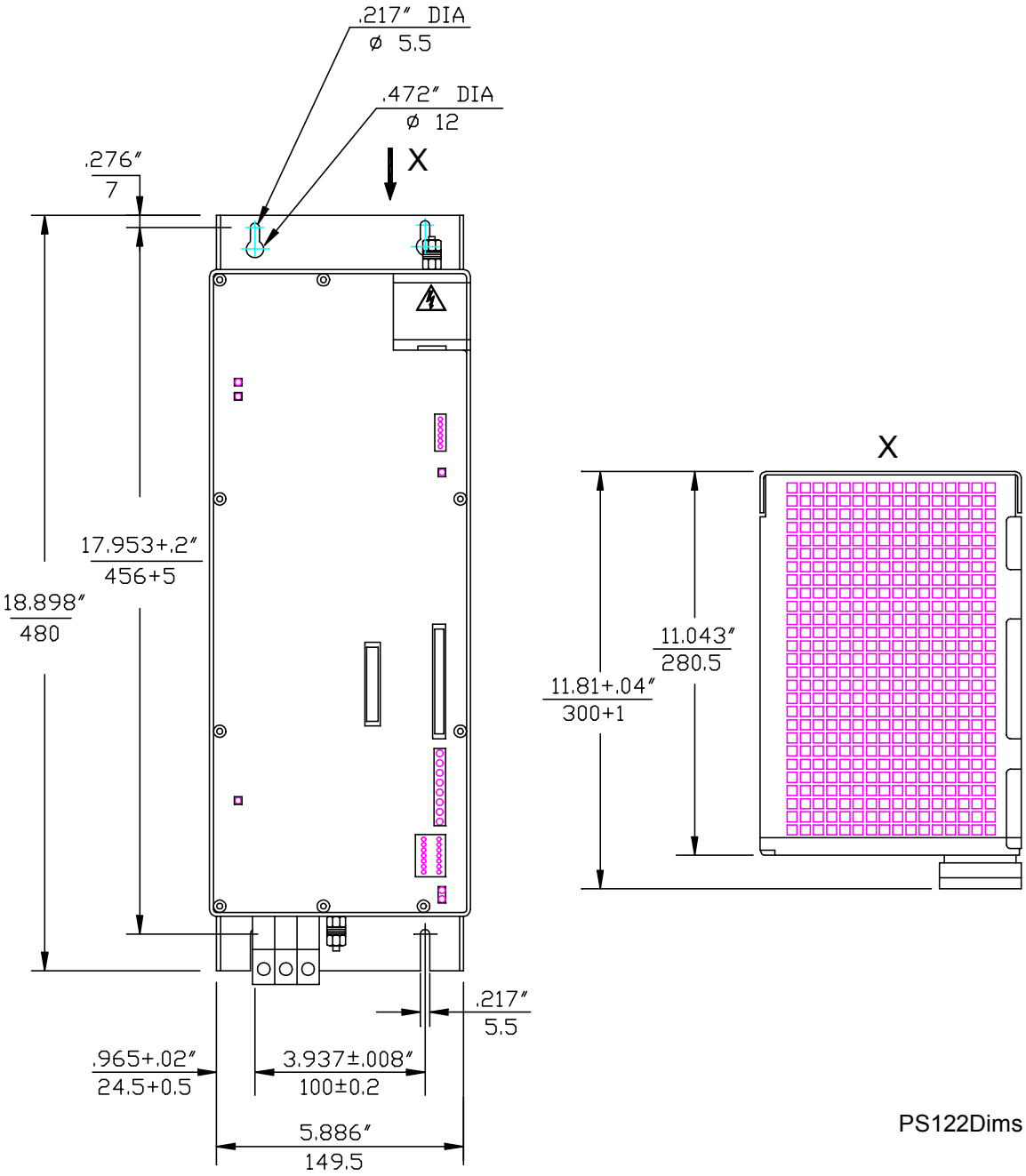


Figure 6-14, PS 122 Power Supply Unit, Dimensions

PS 130 Power Supply Unit

Refer to **Figure 6-15**.

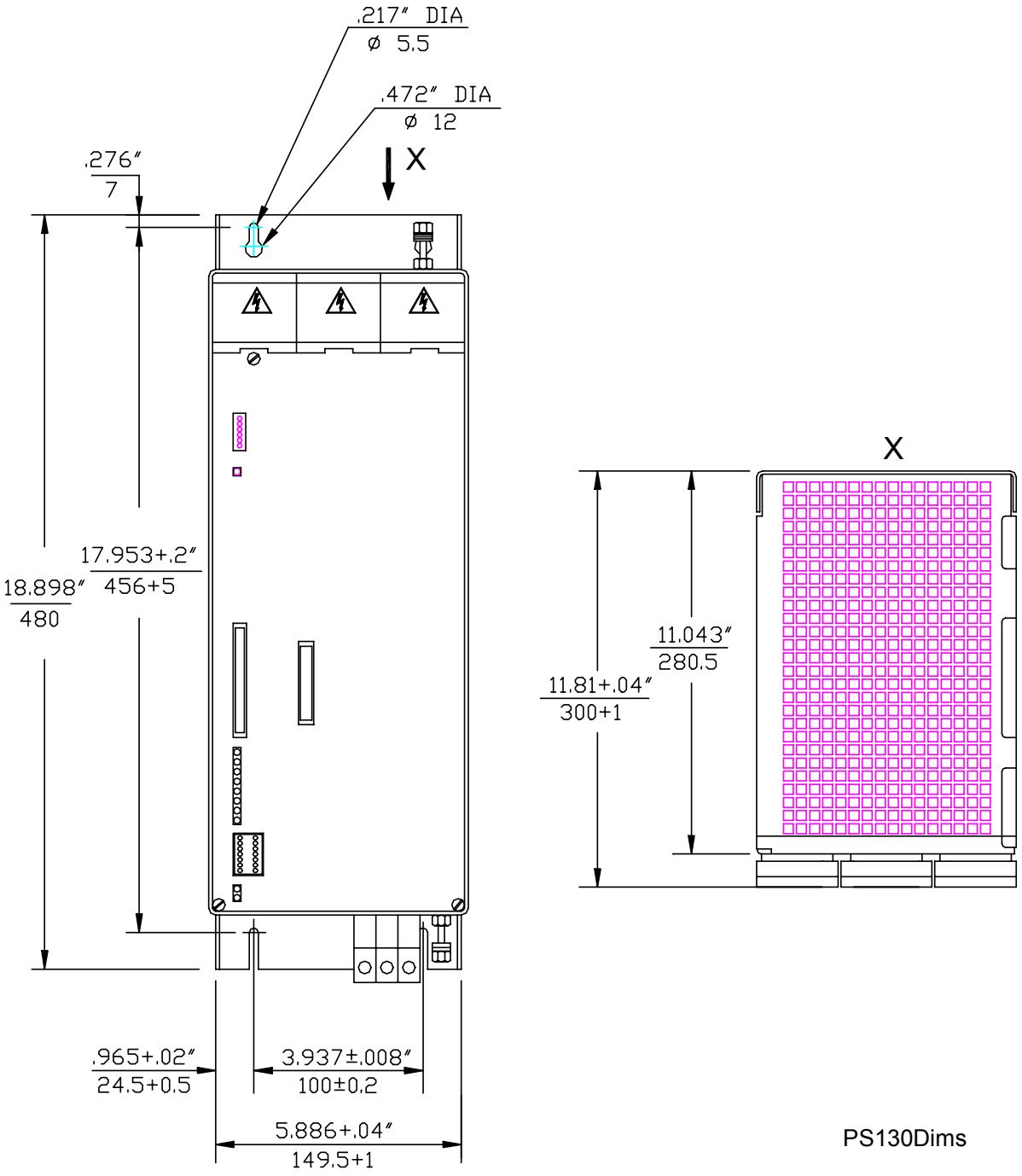


Figure 6-15, PS 130 Power Supply Unit, Dimensions

PS 145 Power Supply Unit

Refer to **Figure 6-16**.

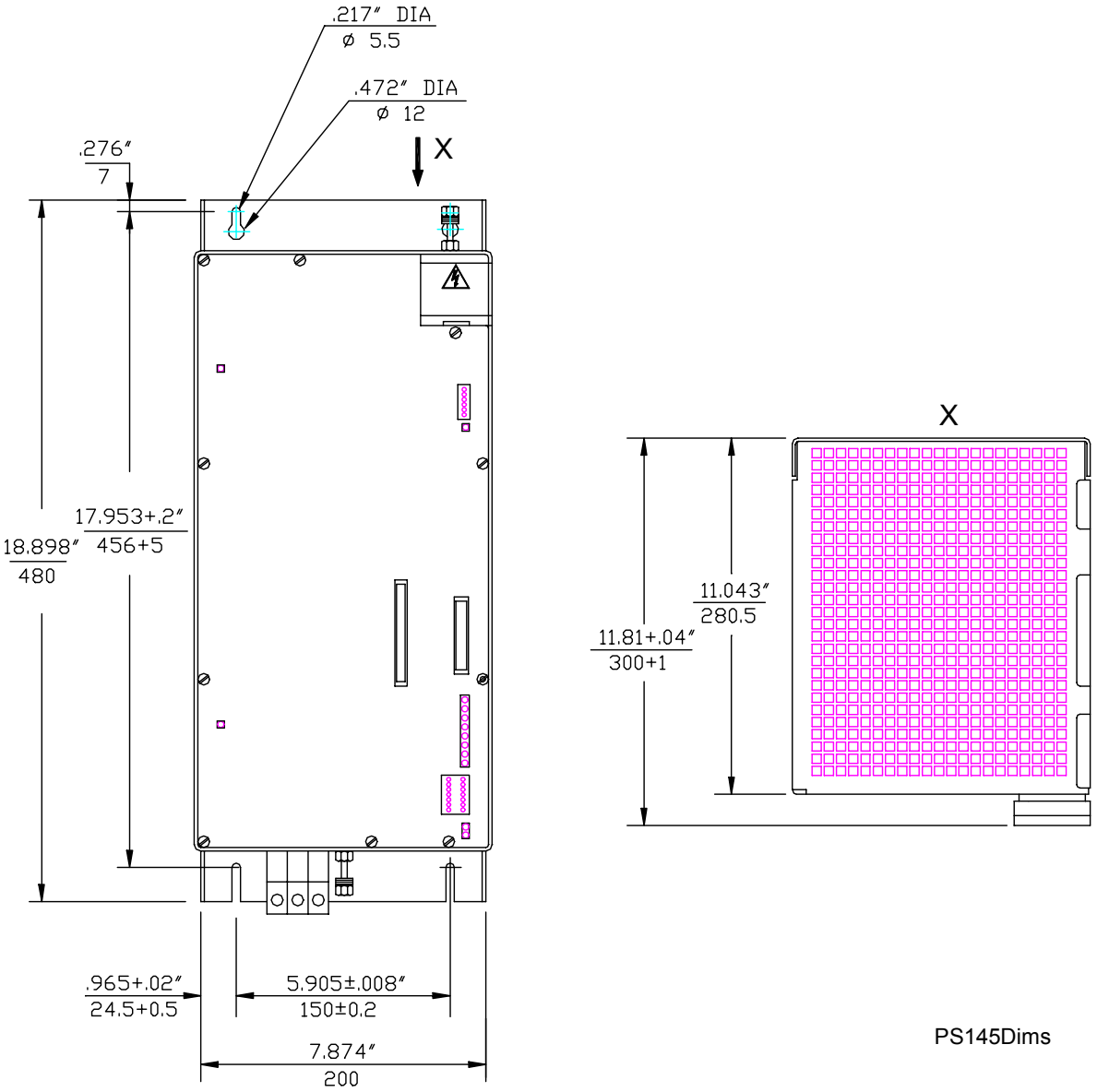


Figure 6-16, PS 145 Power Supply Unit, Dimensions

CR 135 Commutating Reactor

Refer to **Figure 6-17**.

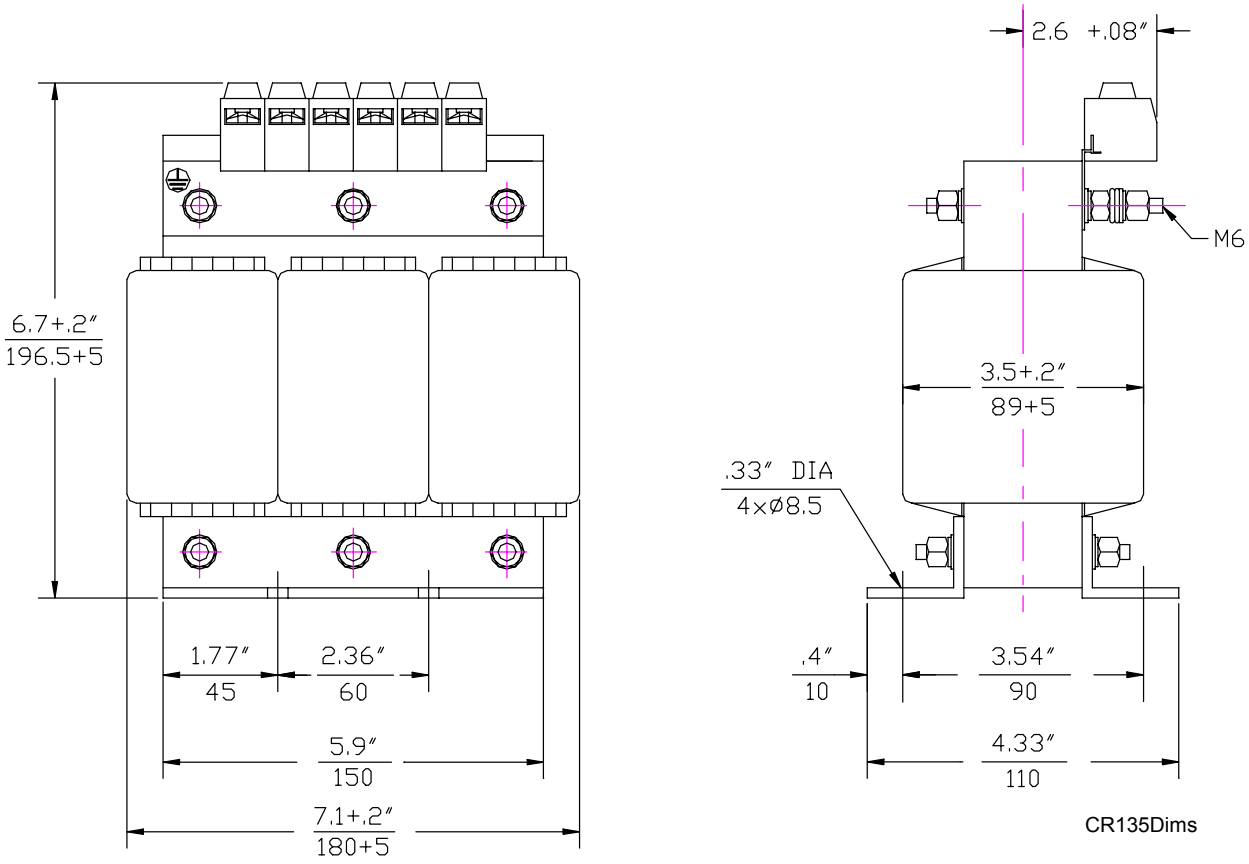


Figure 6-17, CR 135 Commutating Reactor, Dimensions

CR 170, CR 180 Commutating Reactor

Refer to **Figure 6-18** and **Table 6-28**.

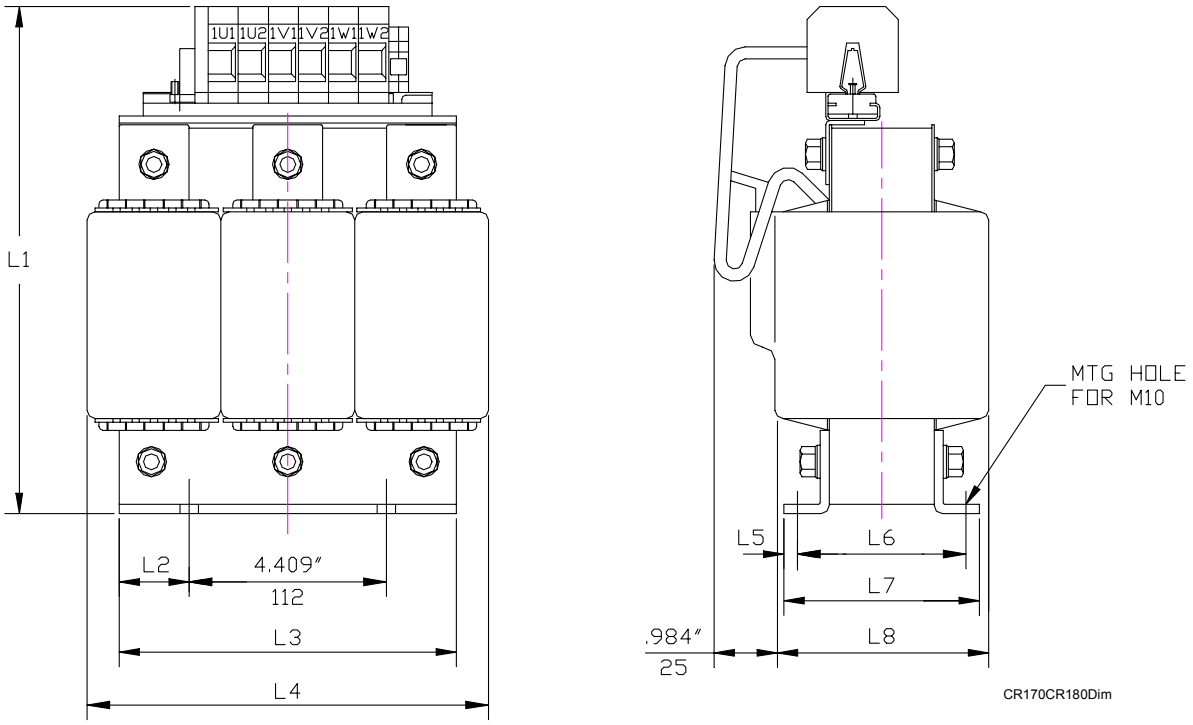


Figure 6-18, CR 170, CR 180 Commutating Reactor, Dimensions

Table 6-28, CR 170, CR 180 Commutating Reactor, Dimensions

Value	CR 170	CR 180
L1	10.748” 273 mm	11.299” 287 mm
L2	1.535” 39 mm	1.732” 44 mm
L3	7.480” 190 mm	7.874” 200 mm
L4	9.448” 240 mm	9.842” 250 mm
L5	0.393” 10 mm	0.433” 11 mm
L6	3.740” 95 mm	4.055” 103 mm
L7	4.527” 115 mm	4.921” 125 mm
L8	4.527” 115 mm	5.118” 130 mm

LF 135A Line Filter

Refer to **Figure 6-19**.

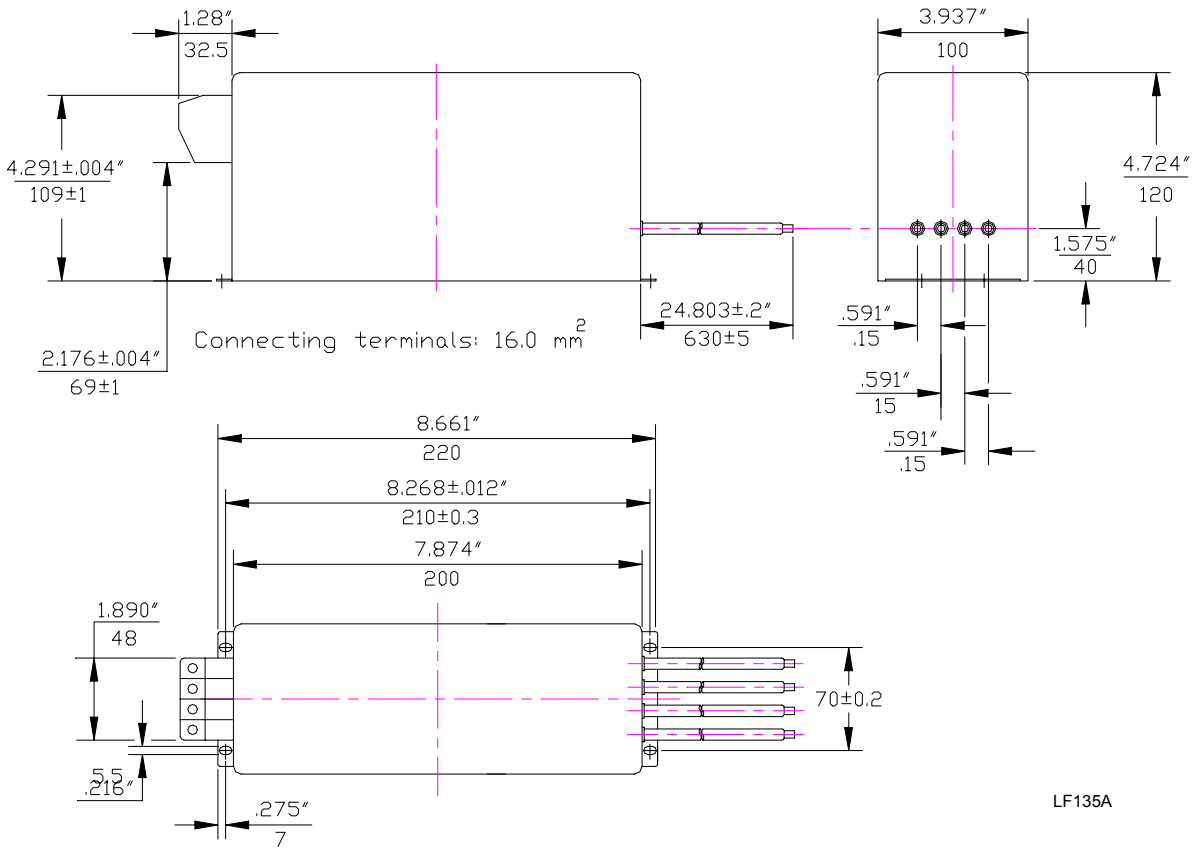


Figure 6-19, LF 135A Line Filter, Dimensions

LF 180A Line Filter

Refer to **Figure 6-20**.

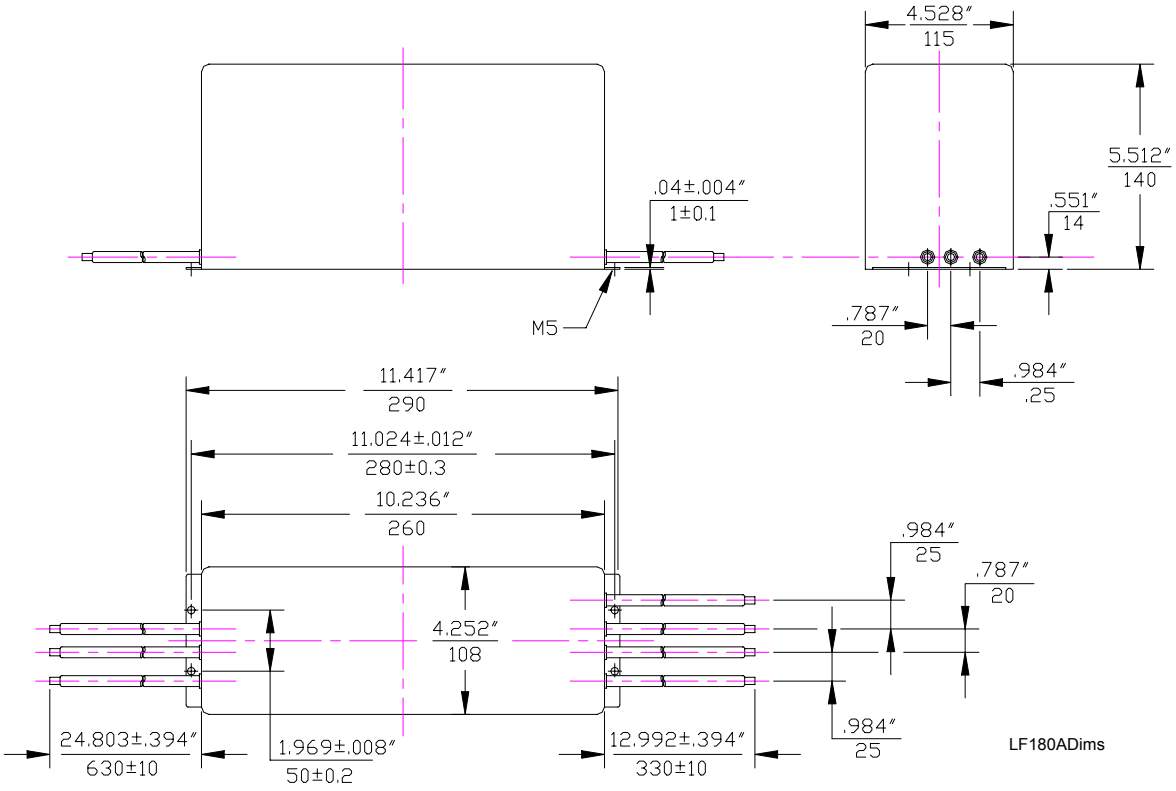


Figure 6-20, LF 180A Line Filter, Dimensions

BR 18 Braking Resistor

Refer to Figure 5-16, BR 18 Dimensions.

BR 10F and BR 18F Braking Resistor

Refer to Figure 5-17, BR 10F and BR 18F Dimensions.

BR 9 Braking Resistor

Refer to **Figure 6-21**.

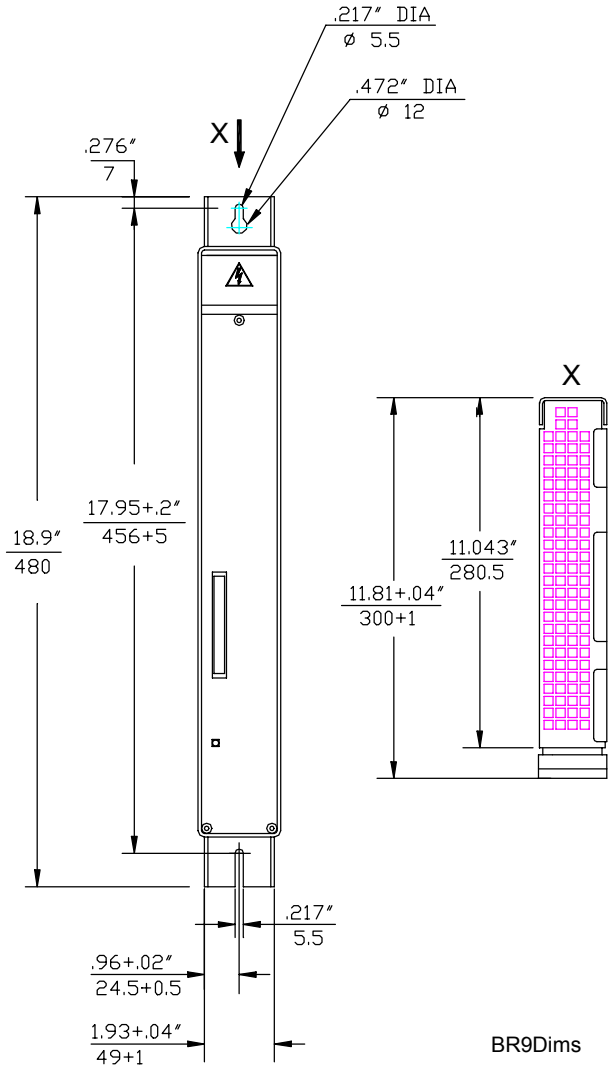
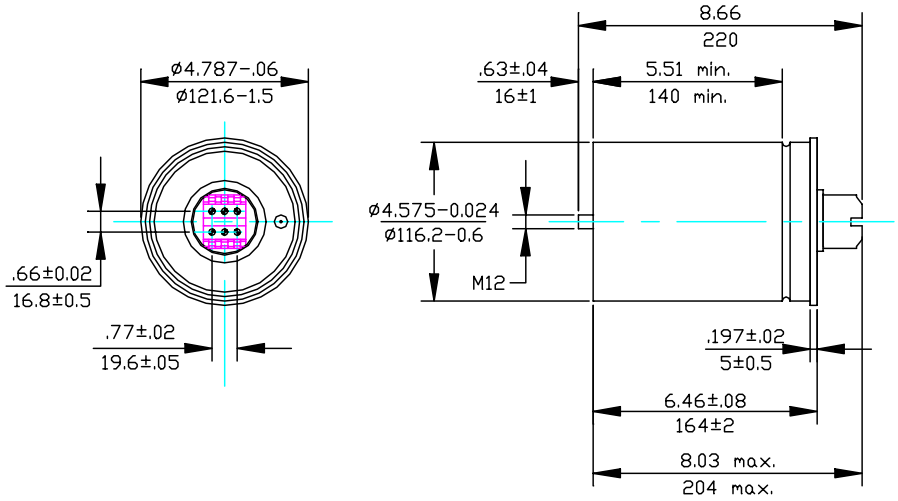


Figure 6-21, BR 9 Dimensions

Three-Phase Current Capacitor

Refer to **Figure 6-22**.



CC3PCAPDims

Figure 6-22, Three-Phase Current Capacitor, Dimensions

PM 107, PM 207 Power Module

Refer to **Figure 6-23**.

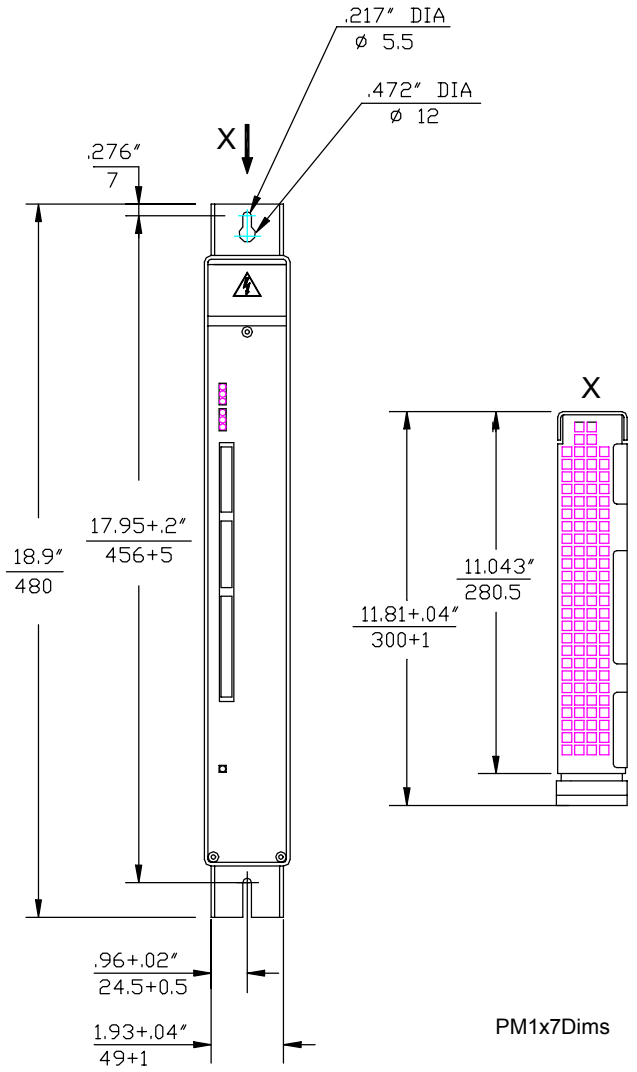


Figure 6-23, PM 107, PM 207 Power Module, Dimensions

PM 115A, PM 123A, PM 132A, PM 148A, PM 215A, and PM 223A Power Modules

Refer to **Figure 6-24**.

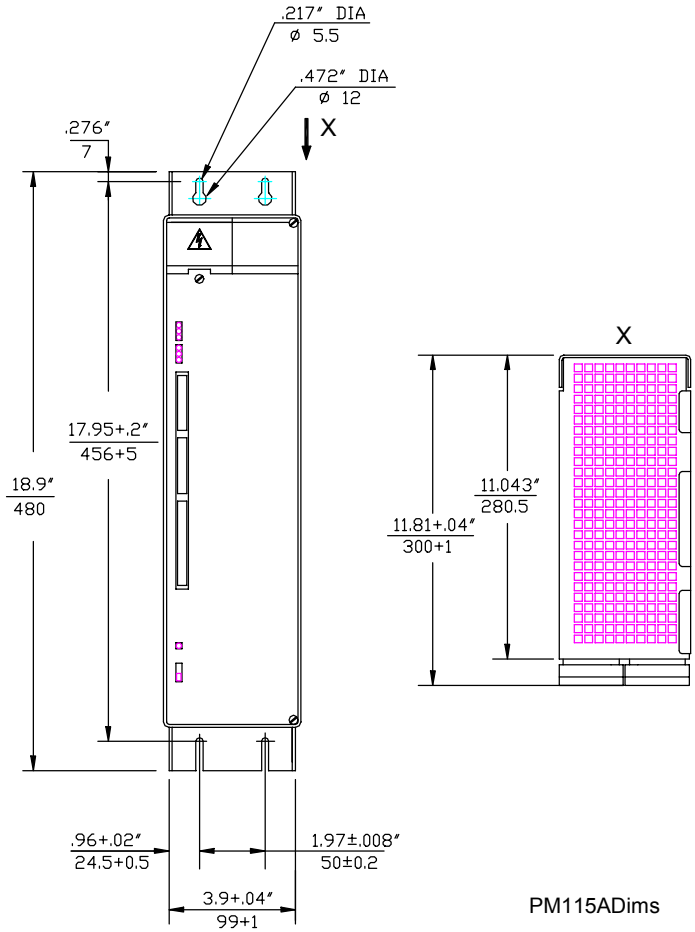
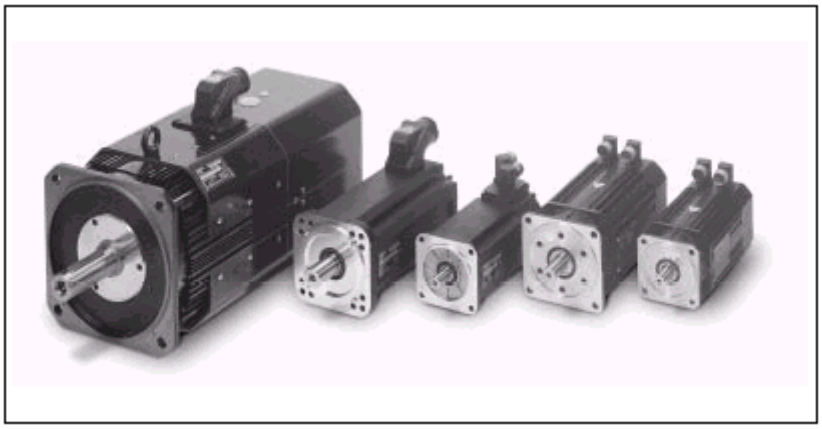


Figure 6-24, PM 115A, PM 123A, PM 132A, PM 148A, PM 215A, and PM 223A Power Module, Dimensions

Section 7 - Available Motors and Accessories

Available Motors



Spindle Motors

Refer to **Table 7-1** for spindle (asynchronous) motors.

Table 7-1, Spindle Motor Specifications

Model Number (features)	Rated Power	Rated Speed	P/N
SM 055A	5.5 kW	1500 rpm	34100600
SM 075A	7.5 kW	1500 rpm	34100605
SM 100A	10.0 kW	1500 rpm	34100610
SM 120A	12.0 kW	1500 rpm	34100615
SM 055C (with standard bearing & with key)	5.5 kW	1500 rpm	34100625
SM 055D (with spindle bearing & with key)	5.5 kW	1500 rpm	34100626
SM 055E (with standard bearing & without key)	5.5 kW	1500 rpm	34100627
SM 055F (with spindle bearing & without key)	5.5 kW	1500 rpm	34100628
SM 075C (with standard bearing & with key)	7.5 kW	1500 rpm	34100630
SM 075D (with spindle bearing & with key)	7.5 kW	1500 rpm	34100631
SM 075E (with standard bearing & without key)	7.5 kW	1500 rpm	34100632
SM 075F (with spindle bearing & without key)	7.5 kW	1500 rpm	34100633

(Continued…)

Table 7-1, Spindle Motor Specifications (Continued)

Model Number (features)	Rated Power	Rated Speed	P/N
SM 100C (with standard bearing & with key)	10.5 kW	1500 rpm	34100635
SM 100D (with spindle bearing & with key)	10.5 kW	1500 rpm	34100636
SM 100E (with standard bearing & without key)	10.5 kW	1500 rpm	34100637
SM 100F (with spindle bearing & without key)	10.5 kW	1500 rpm	34100638
SM 120C (with standard bearing & with key)	12.0 kW	750 rpm	34100640
SM 120D (with spindle bearing & with key)	12.0 kW	750 rpm	34100641
SM 120E (with standard bearing & without key)	12.0 kW	750 rpm	34100642
SM 120F (with spindle bearing & without key)	12.0 kW	750 rpm	34100643
SM 150C (with standard bearing & with key)	12.0 kW	750 rpm	34100645
SM 150D (with spindle bearing & with key)	12.0 kW	750 rpm	34100646
SM 150E (with standard bearing & without key)	12.0 kW	750 rpm	34100647
SM 150F (with spindle bearing & without key)	12.0 kW	750 rpm	34100648
SM 200C (with standard bearing & with key)	20.0 kW	1500 rpm	34100650
SM 200D (with spindle bearing & with key)	20.0 kW	1500 rpm	34100651
SM 200E (with standard bearing & without key)	20.0 kW	1500 rpm	34100652
SM 200F (with spindle bearing & without key)	20.0 kW	1500 rpm	34100653
SM 240C (with standard bearing & with key)	24.0 kW	1500 rpm	34100655
SM 240D (with spindle bearing & with key)	24.0 kW	1500 rpm	34100656
SM 240E (with standard bearing & without key)	24.0 kW	1500 rpm	34100657
SM 240F (with spindle bearing & without key)	24.0 kW	1500 rpm	34100658

Axis Motors

Axis motors (synchronous motors) fulfill all requirements of a Numerical Control (NC) machine tool. Some special characteristics include:

- An excellent running smoothness
- An appropriate mass moment of inertia
- A very good ration of the rated torque to the stall torque
- A low torque ripple

Refer to **Table 7-2**. The B in the model number indicates that the motor has a brake.

Table 7-2, Axis Motor Specifications

Model Number	Stall Torque (100 K)	Rated Speed	P/N
AM 820A	3.0 Nm	3000 rpm	34100400
AM 820AB	3.0 Nm	3000 rpm	34100401
AM 960A	5.2 Nm	4500 rpm	34100200
AM 960AB	5.2 Nm	4500 rpm	34100201
AM 1150A	9.0 Nm	3000 rpm	34100310
AM 1150AB	9.0 Nm	3000 rpm	34100311
AM 1160A	5.2 Nm	3000 rpm	34100210
AM 1160AB	5.2 Nm	3000 rpm	34100211
AM 1160C	7.2 Nm	3000 rpm	34100220
AM 1160CB	7.2 Nm	3000 rpm	34100221
AM 1160E	10.0 Nm	3000 rpm	34100230
AM 1160EB	10.0 Nm	3000 rpm	34100231
AM 1400A	13.0 Nm	3000 rpm	34100430
AM 1400AB	13.0 Nm	3000 rpm	34100431
AM 1400C	13.0 Nm	2000 rpm	34100420
AM 1400CB	13.0 Nm	2000 rpm	34100421
AM 1550C	13.0 Nm	3000 rpm	34100250
AM 1550CB	13.0 Nm	3000 rpm	34100251
AM 1550E	21.6 Nm	3000 rpm	34100260
AM 1550EB	21.6 Nm	3000 rpm	34100261
AM 1550G	26.1 Nm	3000 rpm	34100270
AM 1550GB	26.1 Nm	3000 rpm	34100271

Cables and Connectors

DANGER: Ensure appropriate strain relief on all lines. Never work on the unit while it is powered up. Ensure that the motor is properly grounded. Ensure that the toroidal cores are mounted correctly. For cable lengths longer than 15 m (49.2 ft) between motor and inverter, additional noise suppression measures could be necessary.

Power Cables for Axis Motors

All connections are to the SA Series compact inverter. Refer to **Table 7-3**.

Table 7-3, Available Power Cables for Axis Motors

Motors	Cable P/N	Axes Requiring Cables
AM 960 Series, AM 1160 Series	342001XX**1	Axes 1 to 4
AM 820 Series, AM 1150 Series, AM 1400 Series	342003XX**1	Axes 1 to 4
AM 1550 Series	342002XX**1	Axes 1 to 4

**1 Sold as cable assemblies (that is, with connector) in 5-foot increments, where: XX = the length in feet.

Power Cables for Spindle Motors

Refer to **Table 7-4**.

Table 7-4, Available Power Cables for Spindle Motors

Motors	Cable P/N	Axes Requiring Cables	Fan Cable P/N
SM 055A	34201305**2	Spindle	34201311**2
SM 055C–F	34201305**2	Spindle	34201311**2
SM 075A	34201305**2	Spindle	34201311**2
SM 075C–F	34201305**2	Spindle	34201311**2
SM 100A	34201306**2	Spindle	34201311**2
SM 100C–F	34201306**2	Spindle	34201311**2
SM 120A	34201306**2	Spindle	34201311**2
SM 120C–F	34201306**2	Spindle	34201311**2
SM 150C–F	34201307**2	Spindle	34201311**2
SM 200C–F	34201307**2	Spindle	34201311**2
SM 240C–F	34201308**2	Spindle	34201311**2

**2 Sold by the foot.

Miscellaneous Cables and Connectors

Refer to **Table 7-5**.

NOTE: The last two digits of the cable P/N (XX) indicate the length of the cable. For example, 34300010 indicates a 10-foot cable.

Table 7-5, Miscellaneous Cables and Connectors Specifications

Cable Designation	Lengths (Ft)	P/N
CNC to LCD	05, 10, 15, 20, 25…. 65, 70, 75	343000XX
CNC key input, CNC I/O	05, 10, 15, 20, 25…. 65, 70, 75	343001XX
CNC, MPG, PM300	15, 20, 30, 45, 60	343003XX
CNC, MPG, PM500	05, 10, 15, 20, 25, 30, 35, 45, 60, 75	343004XX
CNC, MPG, PM310	05, 15, 20, 30, 45, 50, 60	343005XX
CNC I/O Module	02, 03, 06, 09, 15, 20, 25	343006XX
CNC I/O	03, 10, 15, 20, 30, 45, 60	343007XX
CNC to floppy PWR/SIG	03 05, 10, 15, 20, 25	343002XX

Maximum Bend Radii of Power Cables with UL Certification

Refer to **Table 7-6**.

Table 7-6, Maximum Bend Radii of Cables

Cross Section		Maximum Bend Radius**1
Metric	**AWG**	
4 x 1.5 mm^2 + (2 x 1 mm^2)	4 x 16 + 2 x 18	≥ 65 mm
4 x 2.5 mm^2 + (2 x 1 mm^2)	4 x 14 + 2 x 18	≥ 65 mm
4 x 4 mm^2 + (2 x 1 mm^2)	4 x 12 + 2 x 18	≥ 75 mm
4 x 6 mm^2 + (2 x 1 mm^2)	4 x 10 + 2 x 18	≥ 85 mm
4 x 10 mm^2 + (2 x 1 mm^2)	4 x 8 + 2 x 18	≥ 105 mm
4 x 2.5 mm^2	4 x 14	≥ 60 mm
4 x 4 mm^2	4 x 12	≥ 70 mm
4 x 6 mm^2	4 x 10	≥ 75 mm
4 x 10 mm^2	4 x 8	≥ 100 mm
4 x 16 mm^2	4 x 6	≥ 135 mm
4 x 25 mm^2	4 x 4	≥ 150 mm
4 x 35 mm^2	4 x 2	≥ 175 mm

**1 Frequent flexing

Required Power Modules and Compact Inverters

Axis Motors

Refer to **Table 7-7**.

Table 7-7, Required Power Modules and Compact Inverters

Motor	Power Module		Compact Inverters
	1-axis	2-axis	
AM 820 Series, AM 1140 Series (n_N = 2000 rpm), AM 1150 Series, AM 1160 Series	PM 107	PM 207	Axis 1 to 4
AM 1400 Series (n_N = 3000 rpm) **AM 1550C, AM 1550CB, AM 1550E, AM 1550EB**	PM 115A	PM 215A	Axis 4
AM 1550G, AM 1550GB	PM 123A	PM 223A	Axis 4 (only SA 411C, RA 411C)

Spindle Motors

Refer to **Table 7-8**.

Table 7-8, Required Power Modules and Compact Inverters

Motor	Power Module		Compact Inverters
	1-axis	2-axis	
SM 055A	PM 115A	PM 215A	Spindle
SM 055C, SM 055D, SM 055E, SM 055F SM 075A, SM 075C, SM 075D, SM 075E, SM 075F SM 120A	PM 123A	PM 223A	Spindle
SM 100A, SM 100C, SM 100D, SM 100E, SM 100F SM 120C, SM 120D, SM 120E, SM 120F	PM 123A	PM 223A	Spindle (only SA 301C, SA 411C, RA 301C, RA 411C)
SM 150C, SM 150D, SM 150E, SM 150F	PM 132A	–	Spindle (only RA 301C, RA 411C)
SM 200C, SM 200D, SM 200E, SM 200F	PM 132A	–	–
SM 240C, SM 240D, SM 240E, SM 240F	PM 148A	–	–

Maximum Torque of a Drive

If the power module is not powerful enough, the maximum torque of the motor cannot be reached because the required current is being limited by the power module. The maximum torque M_{max} achievable by the drive can be calculated.

Axis Motors:

$$M_{\max} = \frac{M_{Nmot}}{I_{Nmot}} * I_{Ndrv}$$

Spindle Motors:

$$M_{\max} = \frac{60 * P_{\max}}{2 * \pi * n}$$

$$P_{\max} = P_{Nmot} * \frac{I_{q\max}}{I_{qN}}$$

$$I_{q\max} = \sqrt{I_{\max}{}^2 - I_{0mot}{}^2}$$

$$I_{qN} = \sqrt{I_{Ndrv}{}^2 - I_{0mot}{}^2}$$

M_{Nmot}: Rated torque of the motor in Nm

I_{Nmot}: Rated current of the motor in A

I_{Ndrv}: Rated current of the power module in A

n: Motor speed in rpm

P_{Nmot}: Power rating of the motor in W

I_{max}: Lesser value between the maximum current of the motor and the maximum current of the power module in A

I_{0mot}: No-load current of the motor

Safety and Labeling Information

Safety Precautions and Warranty Regulations

Please observe the following precautions to prevent personal injury and damage to equipment. Damage caused by failure to observe safety precautions cannot be covered under the manufacturer's warranty.

DANGER:	**During operation, several of the motor parts could be live or moving. Do not open the CNC cabinet, or make/break connections while the unit is powered up. Only trained personnel can repair or service the motor. Enclose the motor as shown in dimensional drawings throughout this section. Ensure that the motor is properly grounded. Do not connect inverter motors directly to three-phase line power. This could ruin the motor! Inverters must be operated via an electronic power converter.** **If your motor is equipped with a feather key at the shaft end, you must secure the key with a collar before you start the motor for the first time. This prevents the key from backing out. Refer to detailed safety and maintenance information in the operating instructions included with each motor.**

WARNING:	**Motor surface temperatures could exceed 100 °C (212 °F). When connecting the fan, ensure that the direction of rotation is correct. The arrow symbol on the fan housing indicates the correct turning direction.** **The optional standstill brake is designed only for a limited number of emergency stops. After mounting the motor, you must verify the brake function. On motors with plug-in connections and built-in brakes, a varistor is required for wiring the brake when commissioning the motor. See "Connecting the Holding Brake" for Motors.**

Motor Nameplate Conventions

Axis Motors

Refer to **Figure 7-1**.

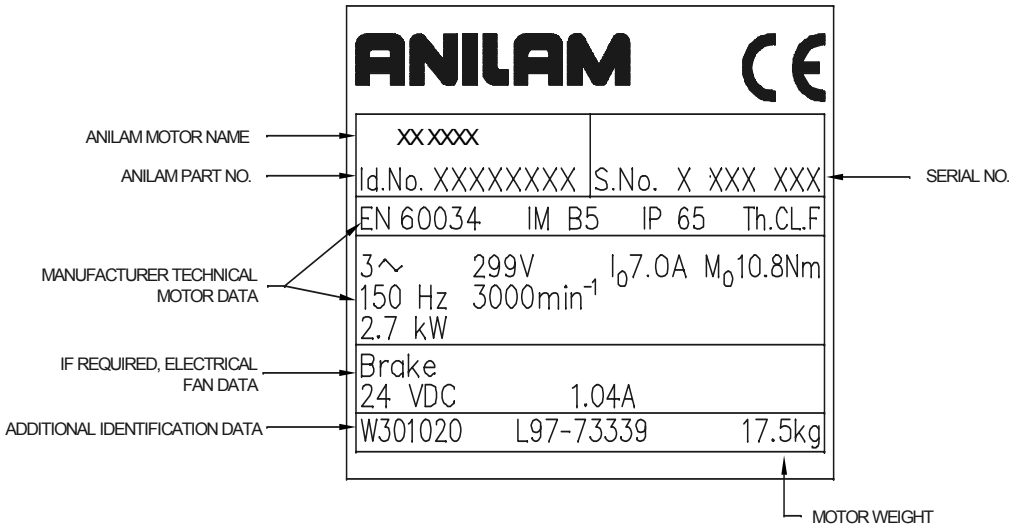


Figure 7-1, Axis Motor Nameplate

Spindle Motors

Refer to **Figure 7-2**.

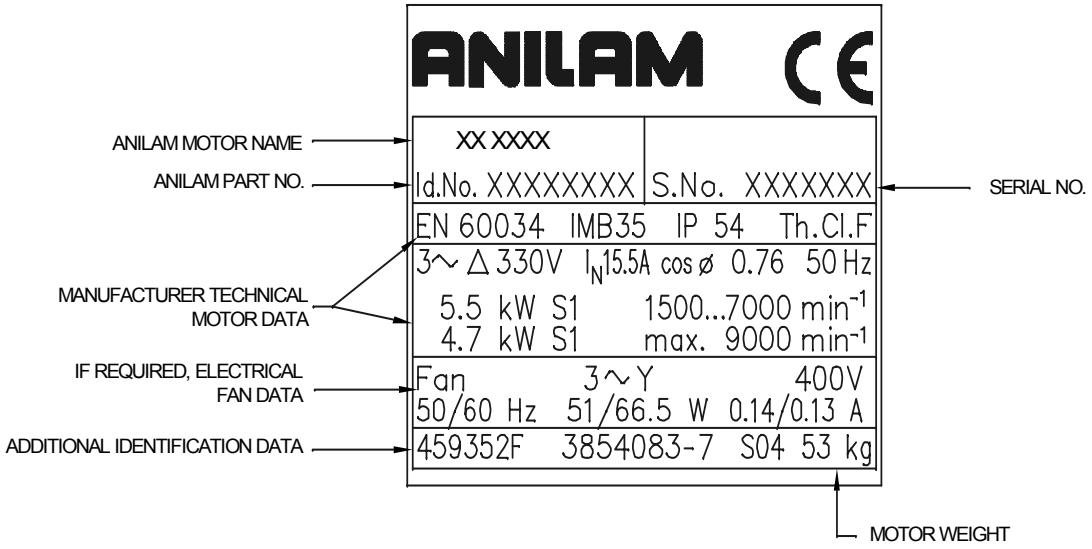


Figure 7-2, Spindle Motor Nameplate

DC-Link Voltages for ANILAM Motors

The ANILAM inverter systems supply different DC-link voltages:

- SA Series non-regeneration compact inverters: 565 V
- Modular amplifiers with PS 130: 565 V
- Modular amplifiers with PS 122, PS 145: 650 V

Axis Motors

The characteristic curves for the ANILAM axis motors were determined with a DC-link voltage of 565 V. Refer to **Figure 7-3**.

If an axis motor is operated at a different DC-link voltage, the voltage limit curve must be displaced in parallel. Calculate the displacement as follows:

$$\Delta n = n_{old} \cdot \frac{U_{Znew}}{U_{Zold}} - n_{old}$$

For example:

$$U_{Zold} = 565\ V, \quad U_{Znew} = 650\ V, \quad n_{old} = 3300\ rpm, \Delta n = ?, \quad n_{new} = ?$$

$$\Delta n = 3300\ rpm \cdot \frac{650\ V}{560\ V} - 330\ rpm = 497\ rpm$$

$$n_{new} = n_{old} + \Delta n = 3300\ rpm + 497\ rpm = 3797\ rpm$$

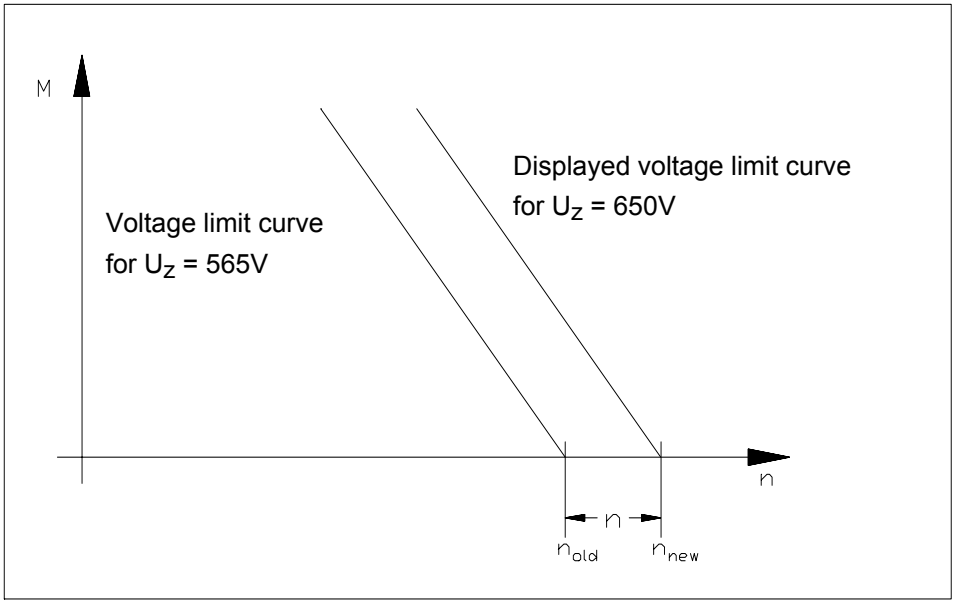


Figure 7-3, Characteristic Curves for Axis Motors

Spindle Motors

The characteristic curves for ANILAM spindle motors were determined with a DC-link voltage of 565 V. If a motor is operated at a different DC-link voltage, the characteristic curve must be adjusted. If the power characteristic lies above the breakdown torque speed, you must multiply it by the factor k.

$$P_{new} = P_{old} \cdot k$$

Given:

$$k = \frac{(U_{Znew})^2}{(U_{Zold})^2}$$

The torque characteristic above the breakdown torque speed must be re-calculated as follows:

$$M_{new} = \frac{P_{new} \cdot 60}{2 \cdot \pi \cdot n}$$

For example, with the SM 120A:

$P_{old} = 10.5\ \text{kW}$ where $n = 7000$ rpm with 565 V.

P_{new} with $n = 7000$ rpm with 650 V *?*

M_{new} with $n = 7000$ rpm with 650 V *?*

$$k = \frac{(650\ \text{V})^2}{(565\ \text{V})^2} = 1.32$$

$$P_{new} = 10.5\ \text{kW} \cdot 1.32 = 13.9\ \text{kW}$$

$$M_{new} = \frac{13900\ \text{W} \cdot 60}{2 \cdot \pi \cdot 7000\ \text{rpm}} = 19\ \text{Nm}$$

Connecting Speed (Rotary) Encoders to the Motors

All ANILAM motors are equipped with speed (rotary) encoders. The encoder signals and signals from the temperature sensors are transmitted via a 17-pin (male) flange socket. Refer to **Table 7-9**.

NOTE: Cables for encoder-to-motor connection are available in lengths of 10, 15, 20, 25, 30, 35, 40, and 45 ft.

Table 7-9, Speed (Rotary) Encoder Flange Socket – Pinout

Motor		**Cable for Speed Encoder P/N 342000XX**		
Pin	**Assignment**	**17-Pin Female Connector**	**Color(s)**	**25-Pin Male D-Sub Connector**
1	A+	1	Green / Black	3
2	A-	2	Yellow / Black	4
3	R+	3	Red	17
4	D-	4	Pink	22
5	C+	5	Green	19
6	C-	6	Brown	20
7	0 V	7	White / Green	2
8	Temperature +	8	Yellow	13
9	Temperature -	9	Violet	25
10	5 V	10	Brown / Green	1
11	B+	11	Blue / Black	6
12	B-	12	Red / Black	7
13	R-	13	Black	18
14	D+	14	Gray	21
15	0 V Sensor	15	White	16
16	5 V Sensor	16	Blue	14
17	Internal Shield	17	Internal Shield	8
Housing	External Shield	Housing	External Shield	Housing
			Free	5, 9, 10, 11, 12, 15, 23, 24

NOTE: This interface meets requirements per EN 50 178 for low voltage electrical separation.

Power Connection for Motors

AM 960, AM 1160, AM 1550 Series Axis Motors, Power Connection

> **NOTE:** The shielded line for the holding brake included in the power cable must have intermediate terminals. Keep the shield as near to ground as possible.
>
> Cables for axis motor connection are available in lengths of 10, 15, 20, 25, 30, 35, 40, and 45 ft.

The power connection for these axis motors is made via a 6-pin flange socket. Refer to **Table 7-10**.

Table 7-10, AM 960, AM 1160, AM 1550 Series Axis Motor Connection - Pinout

6-Pin Male Flange Socket	Assignment	6-Pin Female Connector	Cable P/Ns 342001XX	3-Pin Inverter Terminal
1	U	1	Black 1	U
2	V	2	Black 2	V
Ground	PE		Green / Yellow	
4	+24 V (brake)	4	Black 6	Intermediate Terminals
5	0 V (brake)	5	Black 5	Intermediate Terminals
6	W	6	Black 3	W

AM 820, AM 1150, 1400 Series Axis Motors, Power Connection

The power connection for these axis motors is made via a 9-pin male flange socket. Refer to **Table 7-11**.

Table 7-11, AM 820, AM 1150, AM 1400 Series Axis Motor Connection - Pinout

9-Pin Male Flange Socket	Assignment	6-Pin Female Connector	Cable P/Ns 342003XX	3-Pin Inverter Terminal
A	U	A	Black 1	U
B	V	B	Black 2	V
C	W	C	Black 3	W
D	PE	Ground	Green / Yellow	
F	+24 V (brake)	F	Black 6	Intermediate Terminals
G	0 V (brake)	G	Black 5	Intermediate Terminals
E, H, L	Do not assign	E, H, L	Do not assign	Do not assign

SM 055A, SM 075A, SM 100A, SM 055C–F, SM 075C–F, SM 100C-F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F Spindle Motors, Power Connection

The power connection for these spindle motors is made via a terminal box. The power cables are sold per foot. Refer to **Table 7-12** and **Table 7-13**. Refer to Figure 7-4, Terminal Box with Connections for SM 055A, SM 075A, SM 100A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F.

Table 7-12, SM 055, SM 075, SM 100, SM 120, SM 150, SM 200, and SM 240 Spindle Motor Power Cable P/Ns

Spindle Motor	Cable P/N
SM 055A	34201305
SM 075A	34201305
SM 100A	34201306
SM 120	34201306
SM 150	34201307
SM 200	34201307
SM 240	34201308

Table 7-13, SM 055A, SM 075A, SM 100A, SM 055C–F, SM 075C–F, SM 100C-F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F Spindle Motor Power Connection – Pinout

11-Pin Male Flange Socket	Assignment	11-Pin Female Connector	Cable P/N (See Table 7-12)	3-Pin Inverter Terminal
A	U	A	Black 1	U
B	V	B	Black 2	V
C	W	C	Black 3	W
D	PE	D	Green / Yellow	Ground
E to L	Do not assign			

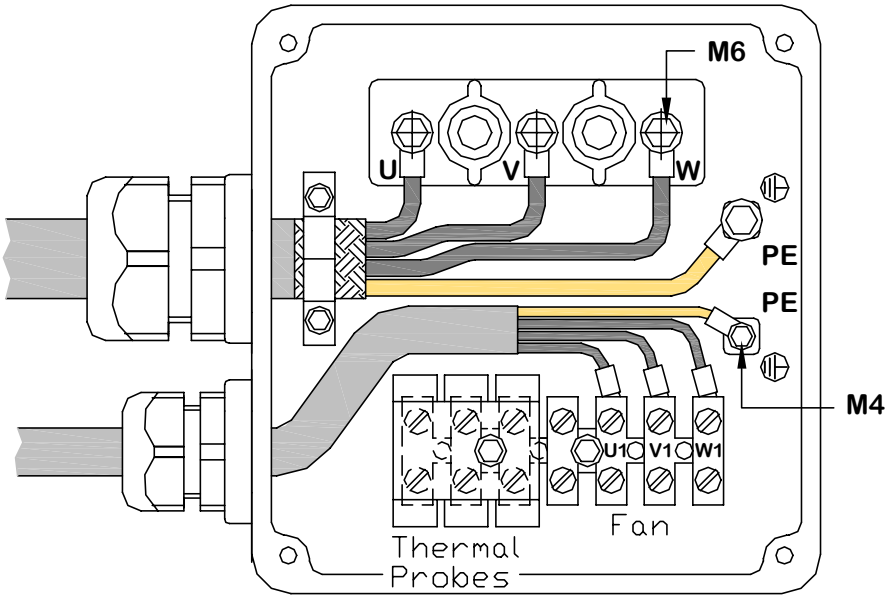


Figure 7-4, Terminal Box with Connections for SM 055A, SM 075A, SM 100A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F

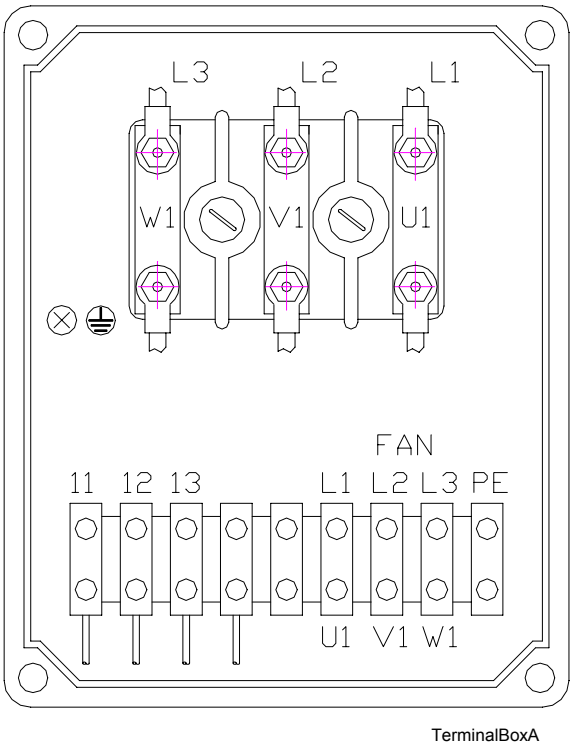


Figure 7-5, Terminal Box with Connections for SM 120A

SM 120A Spindle Motor, Power Connection

The power connection for this spindle motor is made via an 11-pin male flange socket. Refer to Figure 7-5, Terminal Box with Connections for SM 120A. Refer to **Table 7-14** for the Pinout.

NOTE: Cables for spindle motor connection are available in XX lengths of 10, 15, 20, 25, 30, 35, 40, and 45 ft. See **Table 7-14**.

Table 7-14, SM 120A Spindle Motor Power Connection - Pinout

11-Pin Male Flange Socket	Assignment	11-Pin Female Connector	Cable P/N 342010XX	3-Pin Inverter Terminal
A	U	A	Black 1	U
B	V	B	Black 2	V
C	W	C	Black 3	W
D	PE	D	Green / Yellow	Ground
E to L	Do not assign			

Connecting the Holding Brake

Each ANILAM axis motor can be equipped with an optional holding brake. This permanent-magnet single-disk brake operates on direct current and holds the motor at a standstill without backlash. The brake is connected to the power source via the power connection.

NOTE: The brake is a holding brake; not a service brake. When connecting the brake, consider electrical noise immunity. The brake is engaged when it is not powered up. The voltage required to release the brake is 24 V (± 10 %).

WARNING: Holding brakes are permanent-magnet brakes. Ensure that the polarity of the DC voltage is correct. Otherwise, the brake will not be released.

The shield of the lines for the holding brake is to be kept as close as possible (< 1.18 in [30 mm]) to ground. The best solution is to fasten the shield with a metal clamp directly onto the sheet metal housing of the electrical cabinet. Refer to **Figure 7-6**.

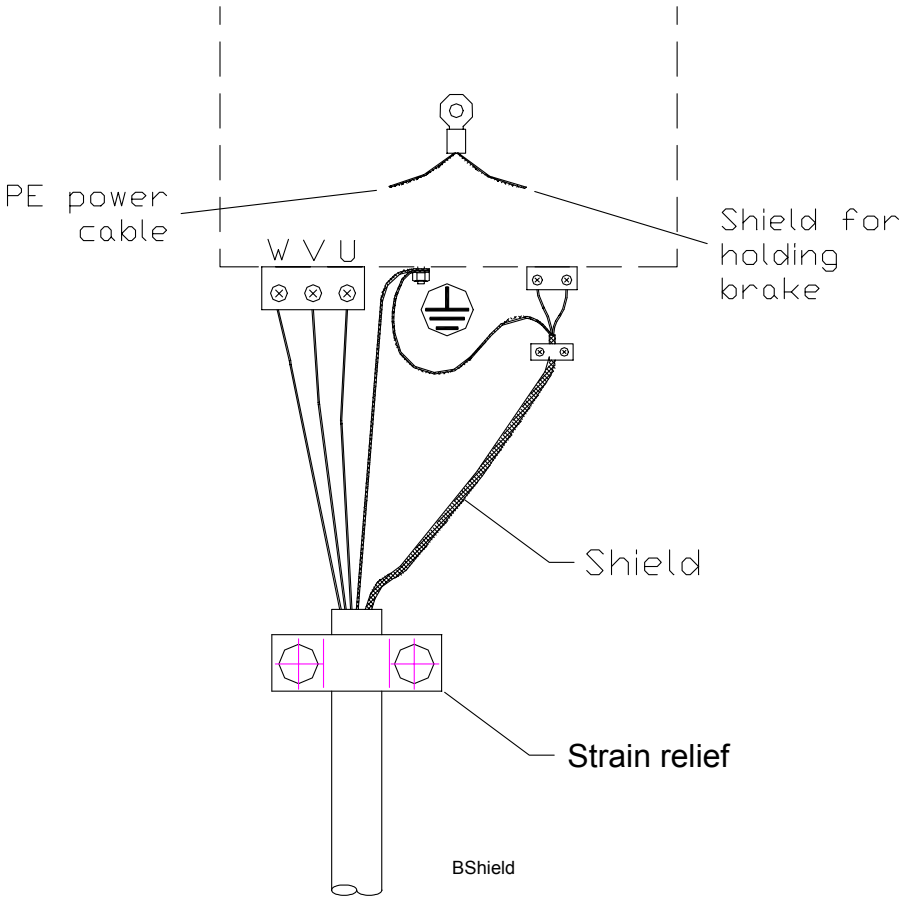


Figure 7-6, Shield for Holding Brake Installation

Due to the inductance of the holding brake, a voltage peak could exceed 1000 V when the exciting current is switched off.

A protective circuit is not necessary if the holding brakes are controlled via the inverters, since the internal electronic switches limit the voltage.

To avoid the voltage peak that occurs when controlling the holding brakes by relay, use a protective circuit with an R varistor, recommended type Q69-X3022. The following circuitry is suggested for the protective circuit of the brake. See **Figure 7-7**.

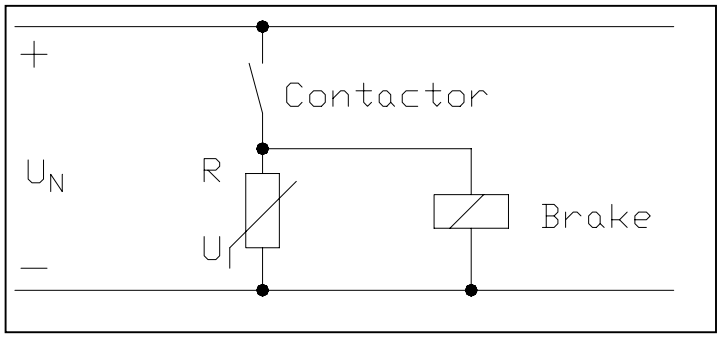


Figure 7-7, Protective Circuit for Holding Brake

NOTE:	After installing the motor, you must verify the trouble-free functioning of the brake.

Connecting the Fan to the Spindle Motor

Axial fans are standard equipment on ANILAM spindle motors. All fan cables are sold per foot.

> **NOTE:** To ensure that the blades will turn in the proper direction, refer to the direction arrow on the fan housing.

The electrical connecting values for the fan are listed in the technical data of Table 7-4, Available Power Cables for Spindle Motors.

The fan can be supplied only via a line with a cross section of 0.75 mm^2 (18 AWG).

SM 055A, SM 075A, SM 100A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F Spindle Motor Fan

On the SM 055A, SM 075A, SM 100A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F motors, the fan is connected via the terminal box of the power connection. This connector is supplied as a motor accessory. Refer to **Table 7-15** and Figure 7-4, Terminal Box with Connections for SM 055A, SM 075A, SM 100A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F.

Table 7-15, SM 055A, SM 075A, SM 100A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F Spindle Motor Fan - Pinout

Terminal Row for Fan	Assignment	Fan Cable P/N 34201311
U1	U	Black 1
V1	V	Black 2
W1	W	Black 3
Ground	PE	Green/Yellow

SM 120A Spindle Motor Fan

On the SM 120A motors, the fan is connected via a STAK3 Hirschmann connector on the B-side of the motor. The connector is supplied with the motor. Refer to **Table 7-16** and Figure 7-5, Terminal Box with Connections for SM 120A.

Table 7-16, SM 120A Spindle Motor Fan - Pinout

Connector (Female) 6-pin	Assignment	Fan Cable P/N 34201310
1	U	Black 1
2	V	Black 2
3	W	Black 3
Ground	PE	Green/Yellow

Mechanical Data

Mounting Flange and Design

Each ANILAM motor is equipped with mounting flange. Refer to **Figure 7-8**.

A flange-mounted motor lessens power loss. If the motor is mounted so that it is thermally insulated, i.e., heat cannot be dissipated through the flange, reduce motor torque by ≈5 % to15 % to avoid overheating the motor.

All operating specifications in this section assume a maximum ambient temperature of +40 °C (104 °F).

If you are using a self-cooling motor, ensure adequate heat dissipation. If the space in which the motor is mounted is too narrow, heat dissipation could be impeded.

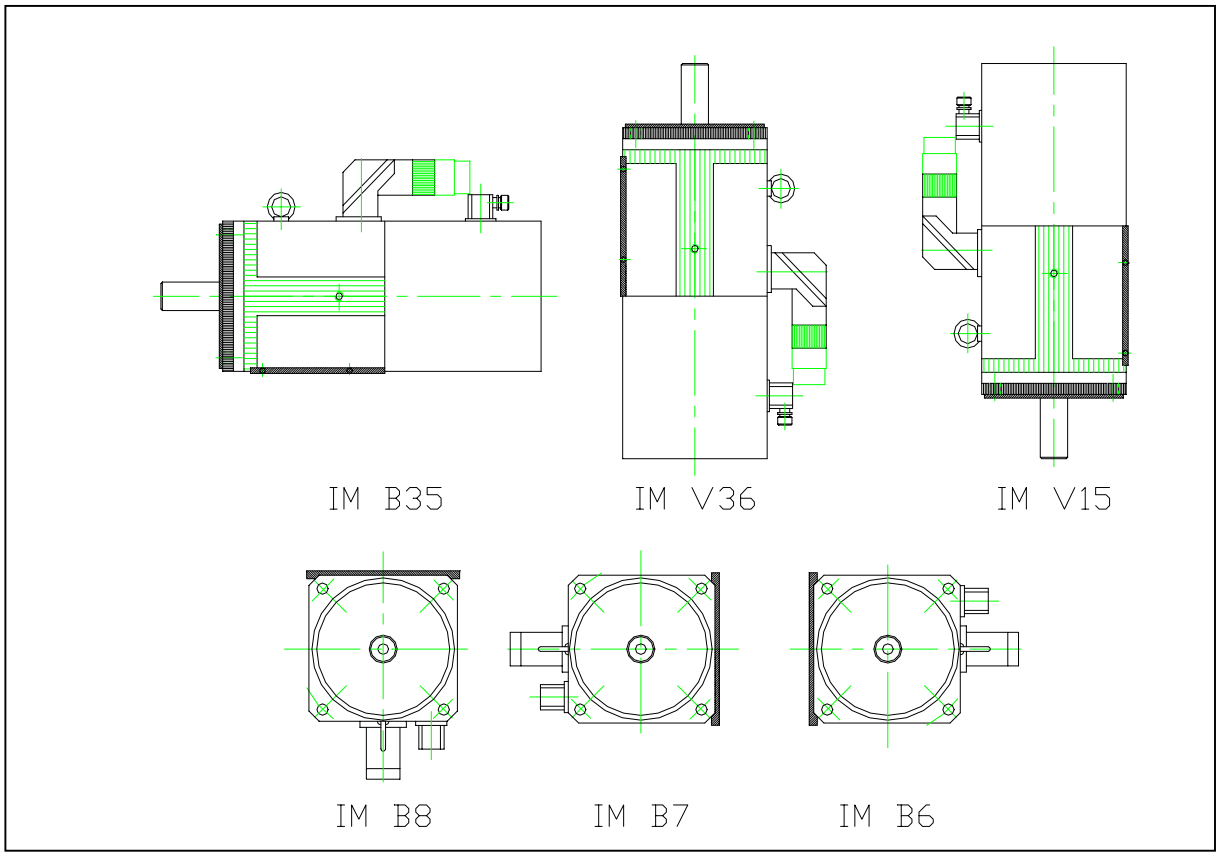


Figure 7-8, Design B35 - Mounting Flange Configurations

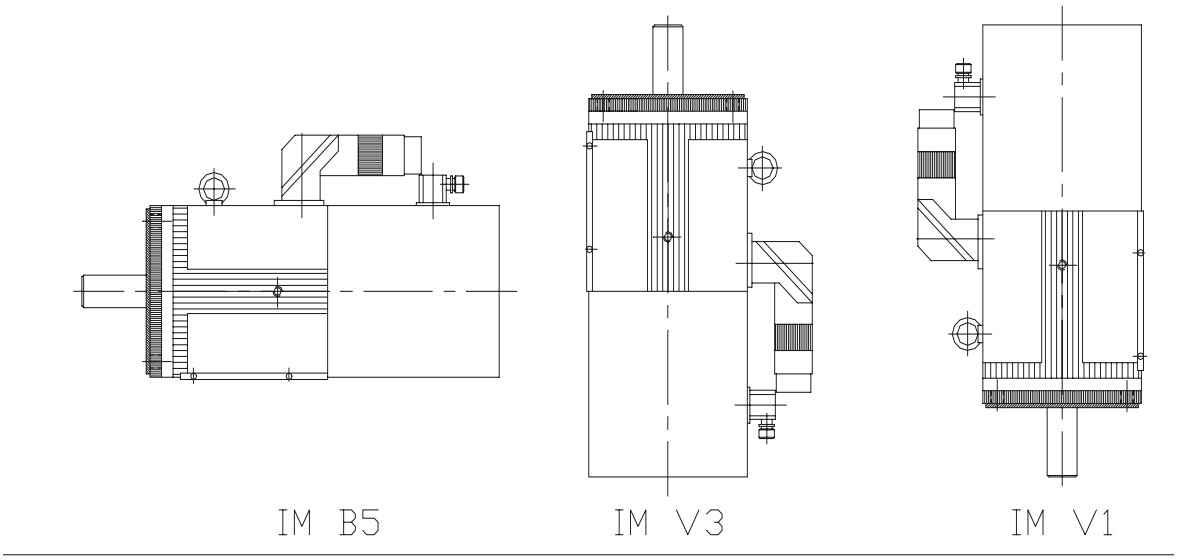


Figure 7-9, Design B5 – Securing the Motor

Securing the Motor

Per EN 24017 or DIN 912, ANILAM recommends the following screws to secure motors. Refer to **Figure 7-9** and **Table 7-17**.

Table 7-17, Recommended Motor Screws

Motor(s)	To Secure Flange	To Secure Block
AM 820 Series	M10	–
AM 960 Series	M6	–
AM 1150 Series	M10	–
AM 1160 Series	M8	–
AM 1400 Series	M10	–
AM 1550 Series	M10	–
SM 055A, SM 075A, SM 100A, SM 055C, SM 055D, SM 055E, SM 055F SM 075C, SM 075D, SM 075E, SM 055F SM 100C, SM 100D, SM 100E, SM 100F	ISO 4017 – M10 x 30	ISO 4017 – M10 x 30
SM 120A	M16	–

Shaft End

ANILAM motors have cylindrical shafts, per ISO-R775 and IEC 72 requirements.

Exceptions: AM 820A, AM 820AB, AM 1150A, AM 1150AB see dimension drawings.

Vibration Severity Grade

The shaft of the motor has a vibration severity grade of S according to EN 60034. The motors of the SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F comply with grade SR. These motors can be high precision balanced externally.

Center Holes

Some ANILAM motors have one center hole in the drive shaft. For dimensions, refer to **Table 7-18**.

Table 7-18, Motor Central Bore Specifications

Motor(s)	Central Bore Hole
AM 820 Series	ISO 866 BS 5 M5 x 12.5
AM 960 Series	ISO 866 BS 5 M6 x 15
AM 1150 Series	ISO 866 BS 5 M6 x 16
AM 1160 Series	ISO 866 BS 5 M8 x 20
AM 1400 Series	ISO 866 BS 5 M8 x 19
AM 1550 Series	ISO 866 BS 5 M12 x 30
SM 055A, SM 075A, SM 100A	DIN 332 – DR M12 x 28
SM 120A	DIN 332 – DR M16 x 36

Feather Keys

Feather keys are standard equipment on all ANILAM spindle (asynchronous) motors. The feather key prevents rotational motion around the shaft while permitting lengthwise motion. Axis motors are not supplied with feather keys. Motors are available with or without feather keys, upon request. Refer to **Table 7-19** and **Figure 7-10**.

Table 7-19, Feather Key Specifications

Motor(s)	Key	Slot Dimensions		
		L	B	T
SM 055A, SM 075A, SM 100A **SM 055C, SM 055D, SM 055E, SM 055F, SM 075C, SM 075D, SM 075E, SM 075F SM 100C, SM 100D SM 100E, SM 100F**	DIN 6885 – E 10 × 8 × 70 mm (0.39 × 0.31 × 2.75 in.) DIN 6885 Sheet 1 AS 10 x 8 x 70	70 mm (2.75 in.)	10 mm (0.39 in.)	8 mm (0.31 in.)
SM 120A	DIN 6885 – A 12 × 8 × 80 mm (0.47 × 0.31 × 3.15 in.)	80 mm (3.15 in.)	12 mm (0.47 in.)	8 mm (0.31 in.)
SM 120C, SM 120D SM 120E, SM 120F	DIN 6885 Sheet 1 AS 12 x 8 x 90 (0.47 x 0.31 x 3.54 in.)	90 mm (3.54 in.)	12 mm (0.47 in.)	8 mm (0.31 in.)
SM 150C, SM 150D SM 150E, SM 150F				
SM 200C, SM 200D SM 200E, SM 200F				
SM 240C, SM 240D SM 240E, SM 240F				

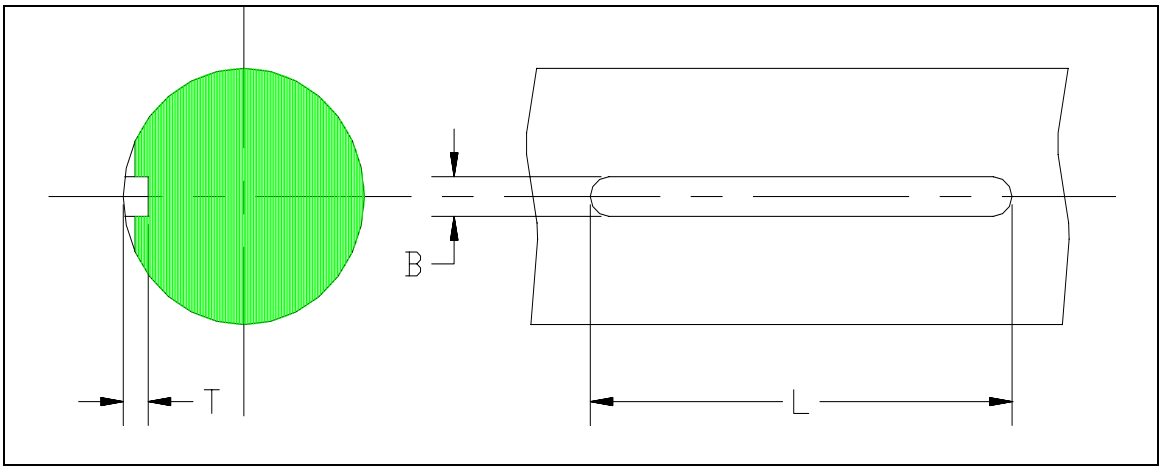


Figure 7-10, Feather Key Configuration

Rotatable Flange Sockets

The flange sockets in some ANILAM motors are rotatable within certain limits.

Spindle Motors

For SM 055A, SM 075A, and SM 100A refer to **Figure 7-11**.

For SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, and SM 240C–F, refer to **Figure 7-12**.

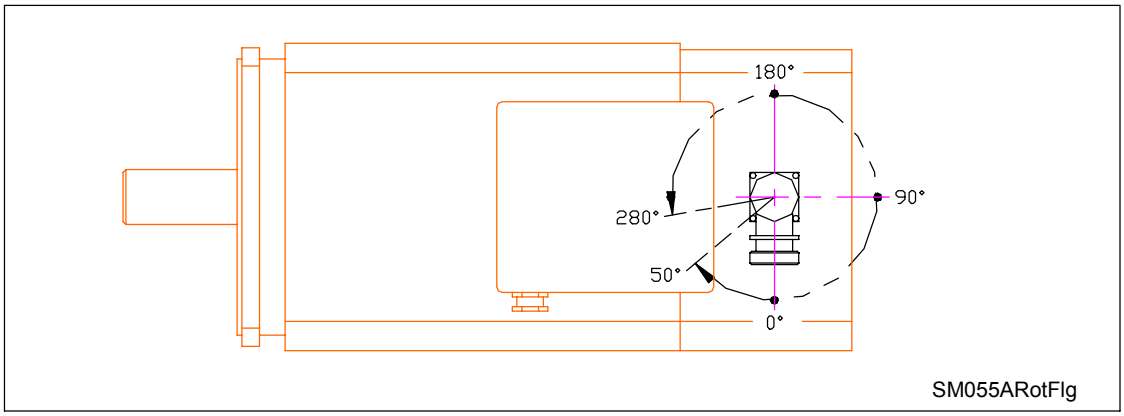


Figure 7-11, SM 055A, SM 075A, and SM 100A Rotatable Flange Socket

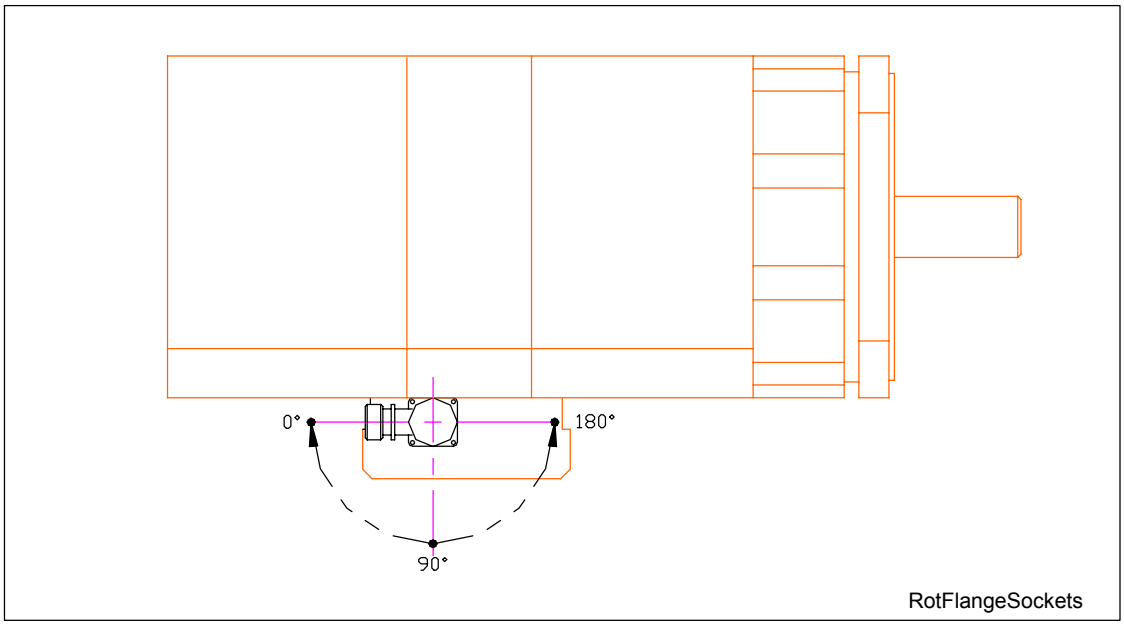


Figure 7-12, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F - Rotatable Flange Socket

Axis Motors

For AM 960 Series, AM 1160 Series (starting in mid-2002) refer to **Figure 7-13**.

For AM 960 Series and AM 1160 Series (until mid-2002) refer to **Figure 7-14**.

For AM 1550 Series (starting in mid-2002) refer to Figure 7-15, AM 1550 Series (starting in mid-2002) Rotatable Flange Socket.

For AM 1550 Series (until mid-2002) refer to Figure 7-16, AM 1550 Series (until mid-2002) Rotatable Flange Socket.

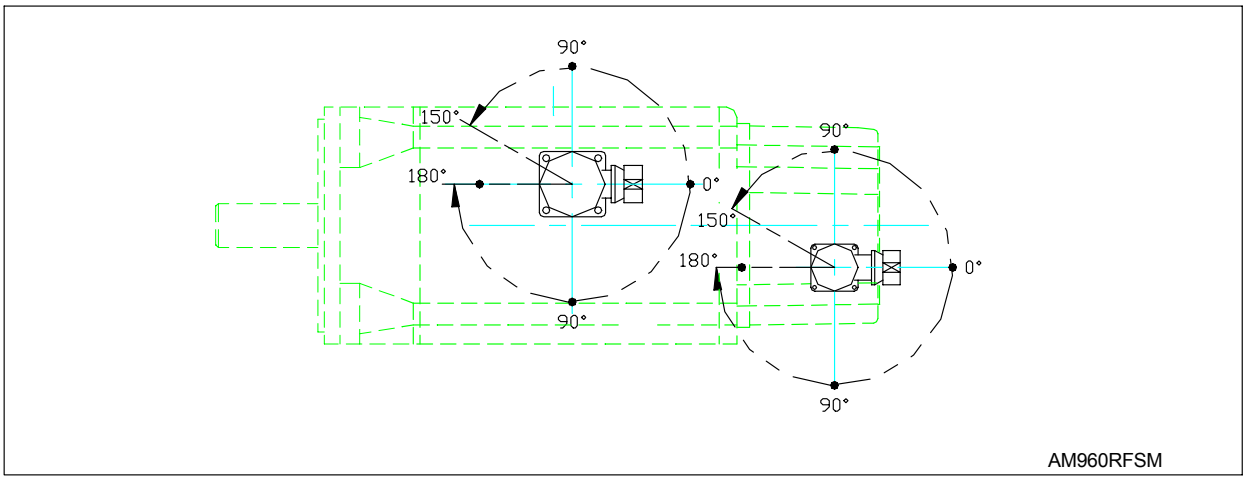


Figure 7-13, AM 960, AM 1160 Series (starting in mid-2002) Rotatable Flange Socket

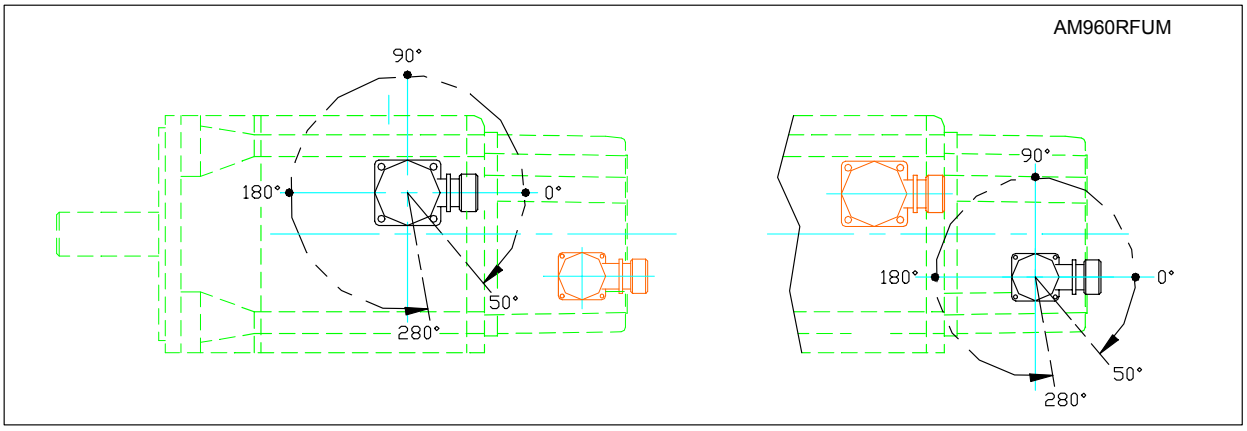


Figure 7-14, AM 960, AM 1160 Series (until mid-2002) Rotatable Flange Socket

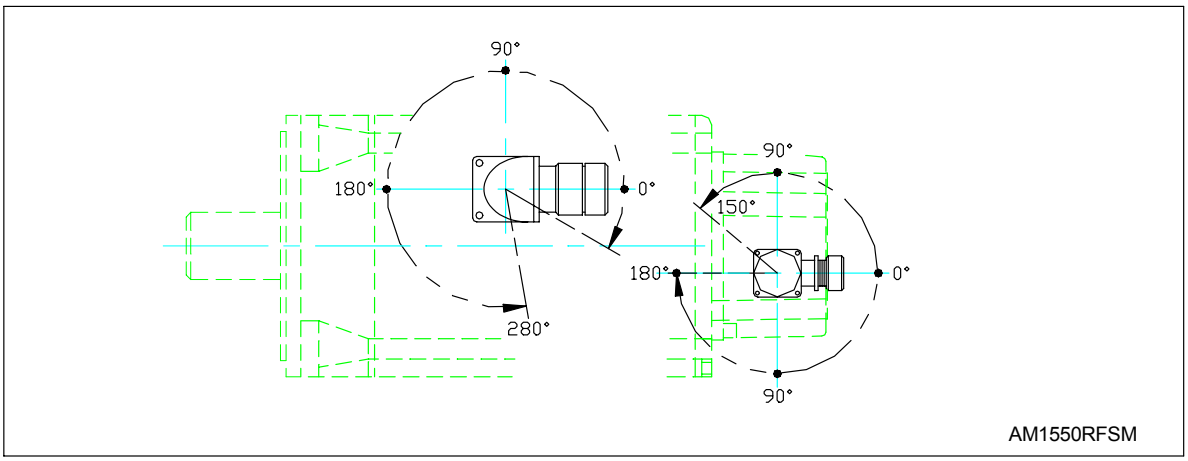


Figure 7-15, AM 1550 Series (starting in mid-2002) Rotatable Flange Socket

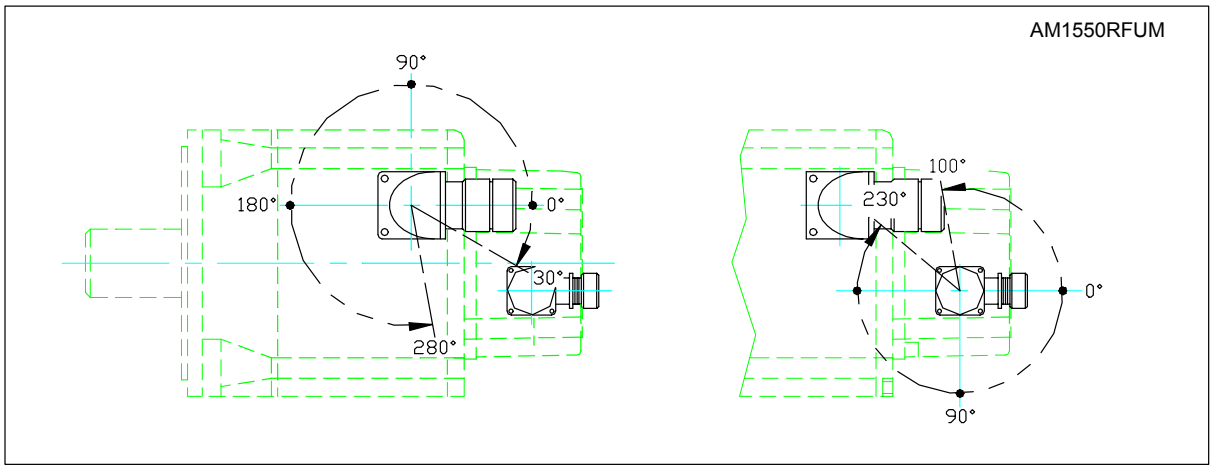


Figure 7-16, AM 1550 Series (until mid-2002) Rotatable Flange Socket

Axis Motors – AM Series

ANILAM axis motors offer the following features:

- Sine commutation
- Rotary encoder for speed measurement.
- Self-cooling
- IM B5 design (for securing by flange) according to EN 60 034-7 (See Figure 7-9, Design B5 – Securing the Motor).
- Protection class IP 65 according to EN 60 529 (shaft exit IP 64)
- Shaft end:
  - Cylindrical as per DIN 748 and IEC 72
  - Without feather key (with feather key by request)
  - With centering hole as per ISO 866 BS 5 and thread
- AM 960 Series, AM 1160 Series, AM 1550 Series: Flange dimensions according to DIN 42 948 and IEC 72
- Maintenance-free bearings
- Natural cooling
- KTY 84-130 resistor probe to monitor temperature in the stator winding
- Thermal class F insulation
- Optional: Integrated preloaded holding brake

NOTE: In the performance diagrams that follow, characteristic curves are shown as broken lines. Each diagram shows characteristic curves as determined on a test stand for one motor, mounted without thermal insulation. All dimensions are shown in inch and millimeter.

Axis Motors General Technical Information

The specifications and the characteristic curves apply to motors mounted without thermal insulation. The temperature of the winding may differ from the maximum permissible ambient temperature of 40°C by a maximum of 100K. If the motor is mounted so that it is thermally insulated, it is necessary to reduce the motor torque in order to avoid thermal overloading o the motor.

Axis Motors Mechanical Life

The service life of the bearings depends on the shaft load and the mean rotational speed (see "Permissible Forces on the Motor Shaft").

AM 820 Series - Axis Motor Specifications

Refer to **Table 7-20**, Figure 7-17, AM 820 Series - Speed-Torque Characteristics Graph, and Figure 7-28, AM 820A and AM 820AB - Dimensional Drawing.

Table 7-20, AM 820 Series - Specifications

	AM 820A (Without Brake)	AM 820AB (With Brake)
P/N	34100400	34100401
Rated Voltage U_N	244 V	
Rated Power Output P_N	0.8 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) [**1] **M_N**	2.5 Nm	
Rated Current (100 K) [**1] **I_N**	2.8 A	
Stall Torque (100 K) [**1] **M_O**	3.0 Nm	
Stall Current (100 K) [**1] **I_O**	3.3 A	
Maximum Current (for ≤ 200 ms) **Imax**	13.5 A	
Maximum Torque (for ≤ 200 ms) **M_{max}**	11.3 Nm	
Pole Pairs PZ	3	
Weight m	9.70 lb 4.40 kg	10.25 lb 4.65 kg
Rotor Inertia J	1.70 kgcm^2	1.86 kgcm^2
Rated Voltage for Brake U_{Br}	–	24 VDC
Rated Current for Brake I_{Br}	–	0.4 A
Holding Torque for Brake M_{Br}	–	2.2 Nm

(100K) [**1] 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 820 Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-17**.

Characteristic curve according to specifications

Measured characteristic curve of one motor

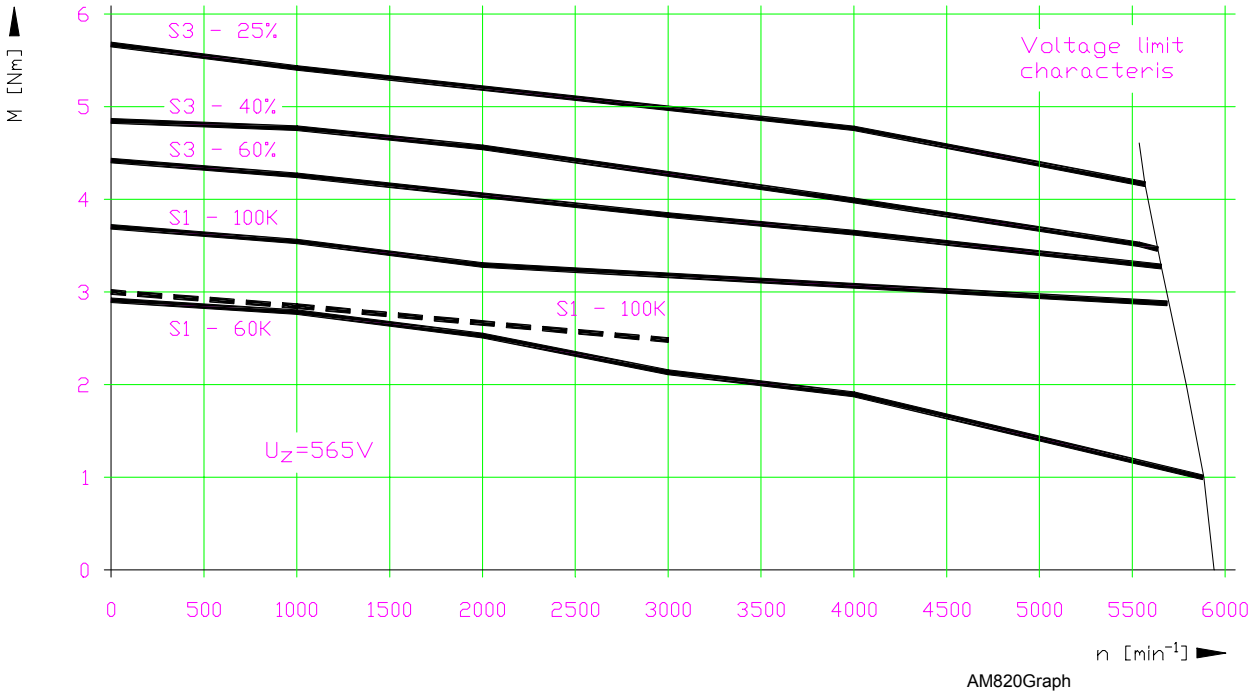


Figure 7-17, AM 820 Series - Speed-Torque Characteristics Graph

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 960A Series - Axis Motor Specifications

Refer to **Table 7-21**, Figure 7-18, AM 960A Series - Speed-Torque Characteristics Graph, and Figure 7-29, AM 960A and AM 960AB - Dimensional Drawing.

Table 7-21, AM 960A Series - Specifications

	AM 960A (Without Brake)	AM 960AB (With Brake)
P/N	34100200	34100201
Rated Voltage U_N	288 V	
Rated Power Output P_N	1.4 kW	
Rated Speed n_N	4500 rpm	
Rated Torque (100 K) **1 M_N	3.0 Nm (4.1 Nm with 3000 rpm)	
Rated Current (100 K) **1 I_N	3.3 A	
Stall Torque (100 K) **1 M_O	5.2 Nm	
Stall Current (100 K) **1 I_O	5.2 A	
Maximum Current (for ≤ 200 ms) I_{max}	25.4 A	
Maximum Torque (for ≤ 200 ms) M_{max}	22.0 Nm	
Pole Pairs PZ	3	
Winding Resistance (in one phase)	1.20 Ω	
Winding Inductance (in one phase)	3.20 mH	
Weight m	15.87 lb 7.20 kg	17.86 lb 8.10 kg
Rotor Inertia J	6.30 kgcm^2	6.60 kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		0.5 A
Holding Torque for Brake M_{Br}		5.0 Nm

(100K) **1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 960A Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-18**.

Characteristic curve according to specifications

Measured characteristic curve of one motor

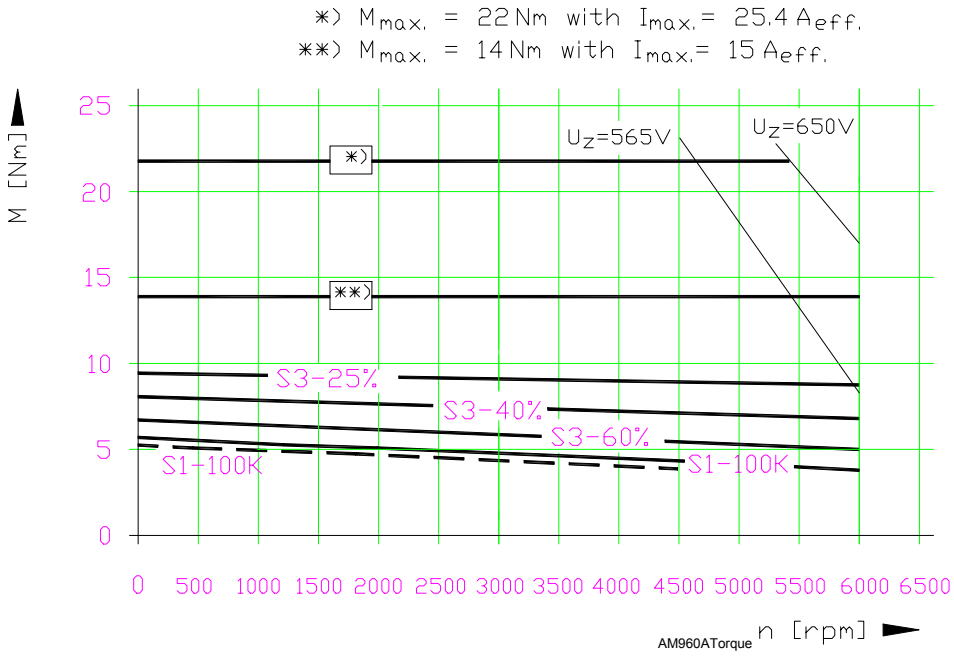


Figure 7-18, AM 960A Series - Speed-Torque Characteristics Graph

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1150A Series - Axis Motor Specifications

Refer to **Table 7-22**, Figure 7-19, AM 1150 Series - Speed-Torque Characteristics Graph, and Figure 7-31, AM 1150 Series - Dimensional Drawing.

Table 7-22, AM 1150A Series - Specifications

	AM 1150A (Without Brake)	AM 1150AB (With Brake)
P/N	34100410	34100411
Rated Voltage U_N	323 V	
Rated Power Output P_N	1.7 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) **1 M_N	5.5 Nm	
Rated Current (100 K) **1 I_N	4.4 A	
Stall Torque (100 K) **1 M_O	9.0 Nm	
Stall Current (100 K) **1 I_O	7.2 A	
Maximum Current (for ≤ 200 ms) **I_{max}**	29.0 A	
Maximum Torque (for ≤ 200 ms) **M_{max}**	32.0 Nm	
Pole Pairs PZ	4	
Weight m	19.40 lb 8.80 kg	22.22 lb 9.17 kg
Rotor Inertia J	8.70 kgcm^2	9.08 kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		0.6 A
Holding Torque for Brake M_{Br}		6.5 Nm

(100K) **1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1150 Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-19**.

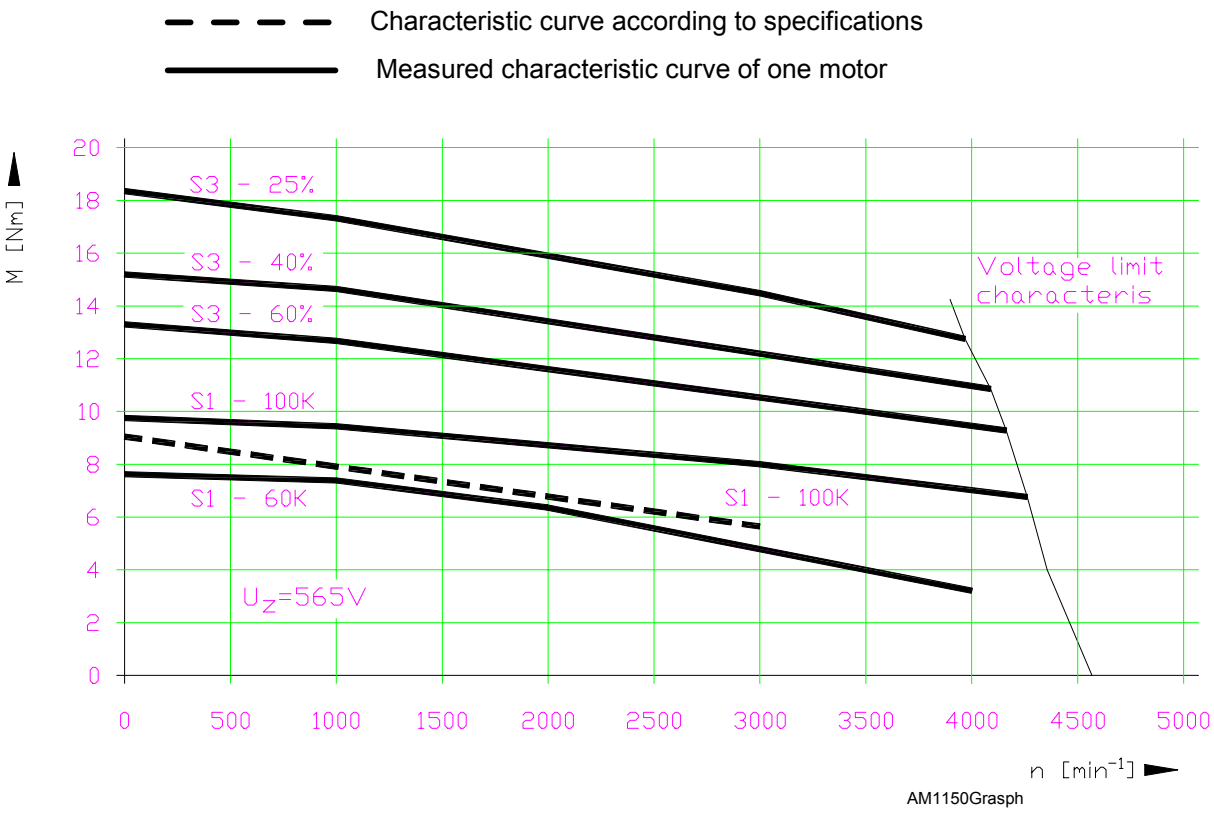


Figure 7-19, AM 1150 Series - Speed-Torque Characteristics Graph

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1160A Series - Axis Motor Specifications

Refer to **Table 7-23**, Figure 7-20, AM 1160A Series - Speed-Torque Characteristics Graph, and Figure 7-32, AM 1160 Series - Dimensional Drawing.

Table 7-23, AM 1160A Series - Specifications

	AM 1160A (Without Brake)	AM 1160AB (With Brake)
P/N	34100210	34100211
Rated Voltage U_N	305 V	
Rated Power Output P_N	1.45 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) **) **M_N**	4.6 Nm	
Rated Current (100 K) **) **I_N**	3.3 A	
Stall Torque (100 K) **) **M_O**	5.2 Nm	
Stall Current (100 K) **) **I_O**	3.4 A	
Maximum Current (for ≤ 200 ms) **I_{max}**	12.7 A	
Maximum Torque (for ≤ 200 ms) **M_{max}**	16.0 Nm	
Pole Pairs PZ	3	
Winding Resistance (in one phase)	3.80 Ω	
Winding Inductance (in one phase)	13.50 mH	
Weight m	15.21 lb 6.90 kg	17.12 lb 7.80 kg
Rotor Inertia J	7.50 kgcm^2	7.90 kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		0.6 A
Holding Torque for Brake M_{Br}		13.5 Nm

(100K) **) 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1160A Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-20**.

Characteristic curve according to specifications

Measured characteristic curve of one motor

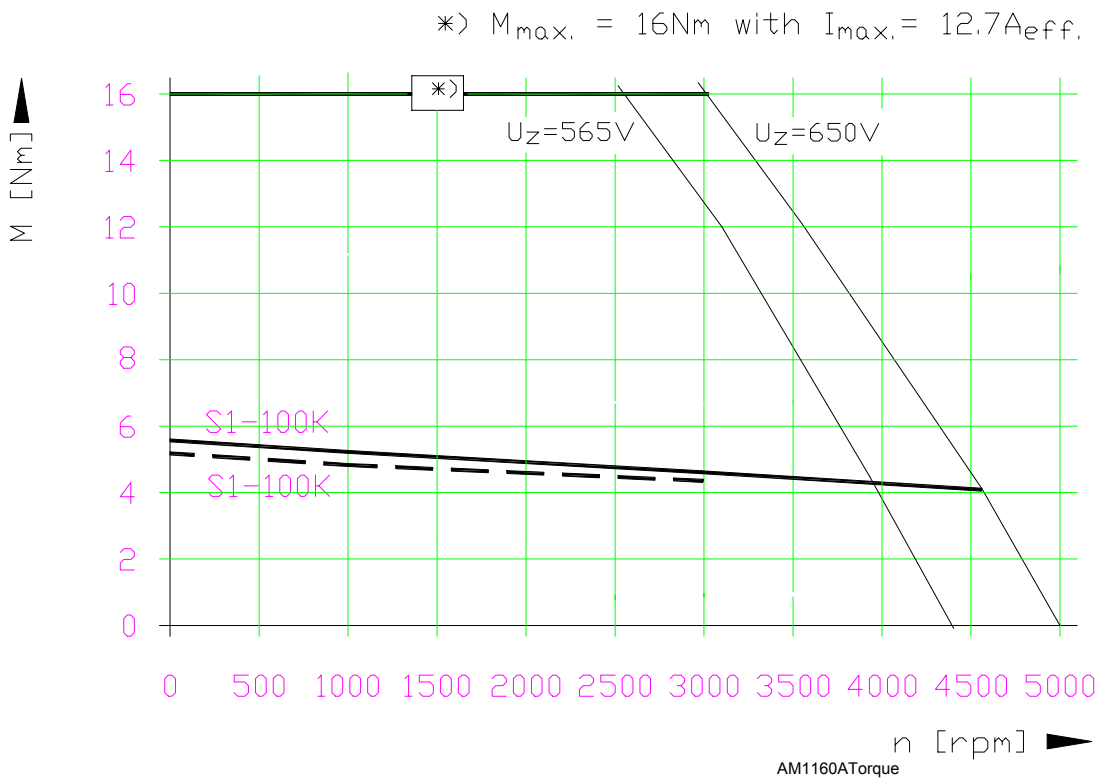


Figure 7-20, AM 1160A Series - Speed-Torque Characteristics Graph

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1160C Series - Axis Motor Specifications

Refer to **Table 7-24**, Figure 7-21, AM 1160C Series - Speed-Torque Characteristics Graph, and Figure 7-32, AM 1160 Series - Dimensional Drawing.

Table 7-24, AM 1160C Series - Specifications

	AM 1160C (Without Brake)	AM 1160CB (With Brake)
P/N	34100220	34100221
Rated Power U_N	296 V	
Rated Power Output P_N	1.85 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) **1 M_N	5.9 Nm	
Rated Current (100 K) **1 I_N	4.1 A	
Stall Torque (100 K) **1 M_O	7.2 Nm	
Stall Current (100 K) **1 I_O	4.8	
Maximum Current (for ≤ 200 ms) I_{max}	19.0 A	
Maximum Torque (for ≤ 200 ms) M_{max}	25.0 Nm	
Pole Pairs PZ	3	
Winding Resistance (in one phase)	2.05 Ω	
Winding Inductance (in one phase)	8.50 mH	
Weight m	18.96 lb 8.60 kg	20.94 lb 9.50 kg
Rotor Inertia J	9.90 kgcm^2	10.30kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		0.6 A
Holding Torque for Brake M_{Br}		13.5 Nm

(100K) **1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1160C Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-21**.

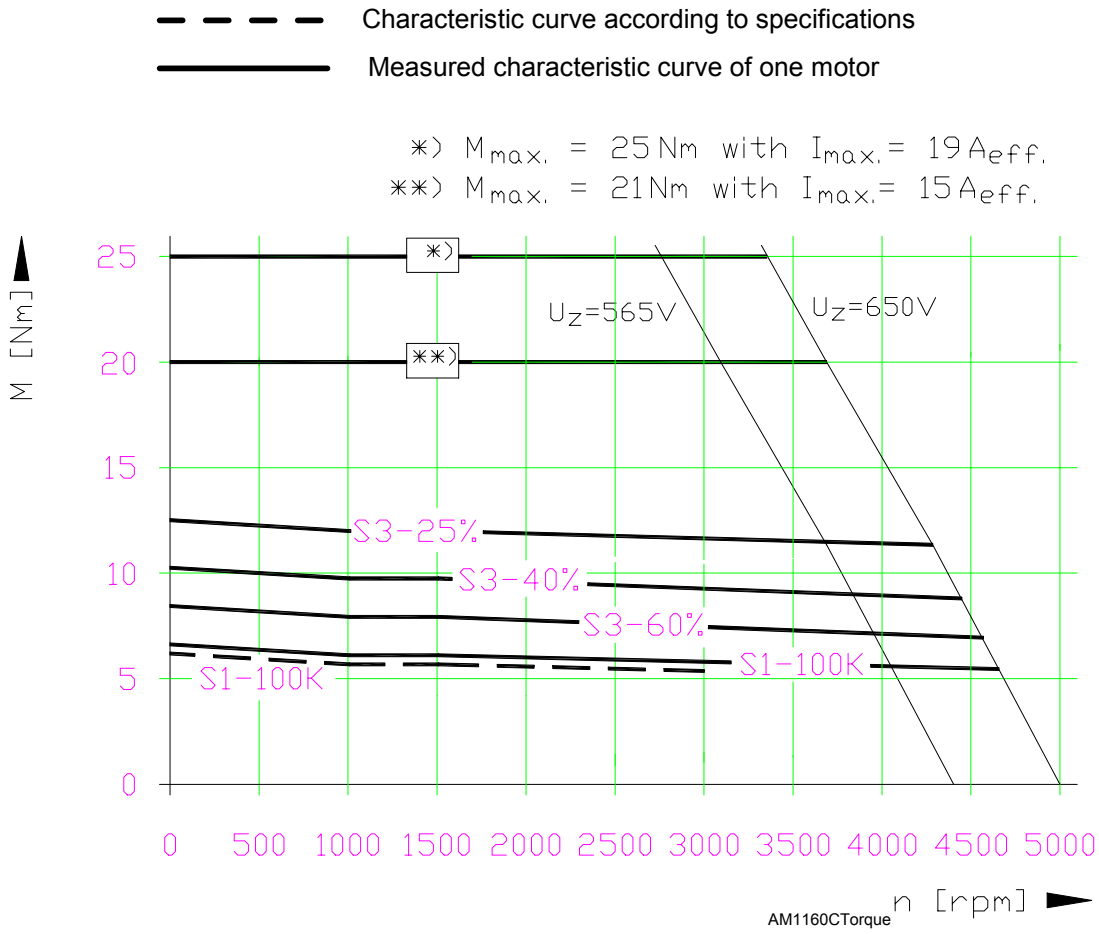


Figure 7-21, AM 1160C Series - Speed-Torque Characteristics Graph

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1160E Series - Axis Motor Specifications

Refer to **Table 7-25**, Figure 7-22, AM 1160E Series - Speed-Torque Characteristics Graph, and Figure 7-32, AM 1160 Series - Dimensional Drawing.

Table 7-25, AM 1160E Series - Specifications

	AM 1160E (Without Brake)	AM 1160EB (With Brake)
P/N	34100230	34100231
Rated Voltage U_N	287 V	
Rated Power Output P_N	2.42 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) **1 M_N	7.7 Nm	
Rated Current (100 K) **1 I_N	5.35 A	
Stall Torque (100 K) **1 M_O	10.0 Nm	
Stall Current (100 K) **1 I_O	6.8	
Maximum Current (for ≤ 200 ms) I_{max}	32.6 A	
Maximum Torque (for ≤ 200 ms) M_{max}	41.0 Nm	
Pole Pairs PZ	3	
Winding Resistance (in one phase)	0.85 Ω	
Winding Inductance (in one phase)	4.75 mH	
Weight m	26.45 lb 12.0 kg	28.44 lb 12.90 kg
Rotor Inertia J	15.00 kgcm^2	15.40kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		0.6 A
Holding Torque for Brake M_{Br}		13.5 Nm

(100K) **1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1160E Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-22**.

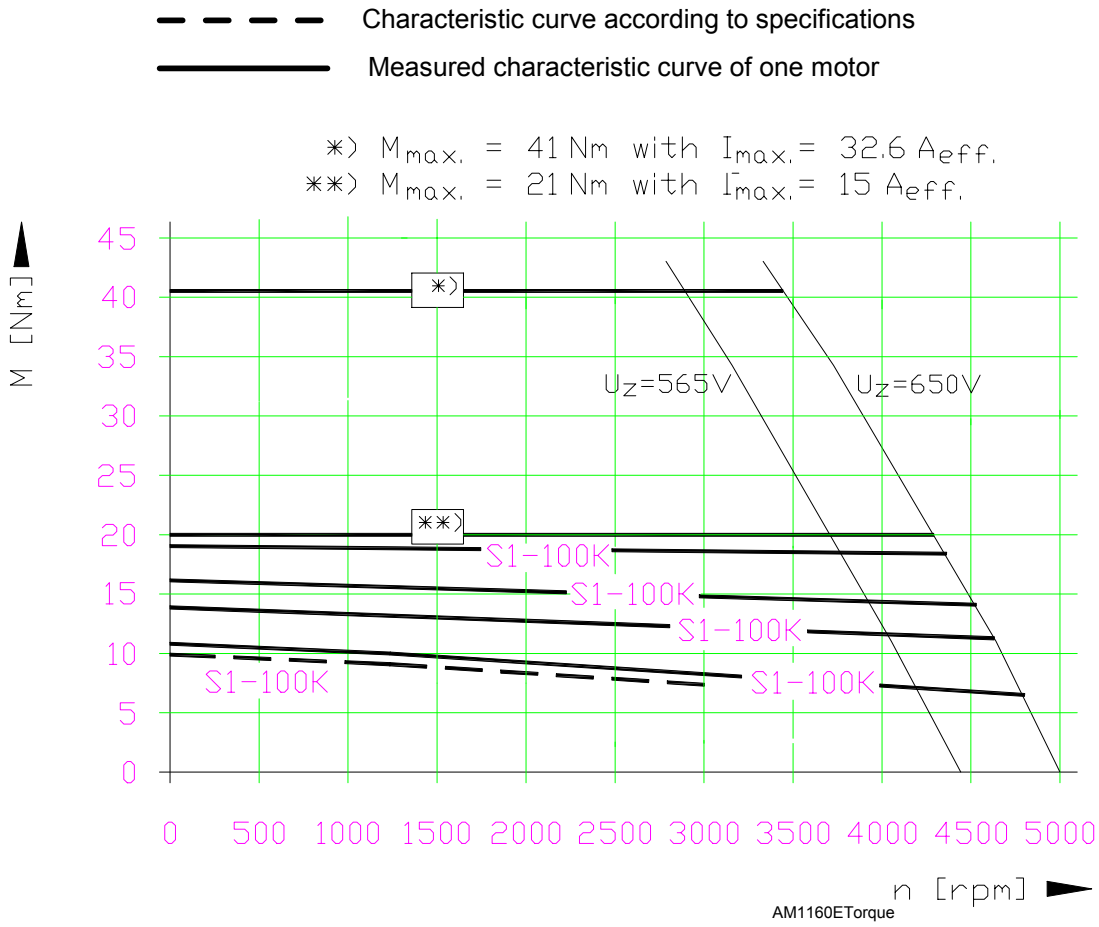


Figure 7-22, AM 1160E Series - Speed-Torque Characteristics Graph

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1400A Series - Axis Motor Specifications (n_N=3000 rpm)

Refer to **Table 7-26**, Figure 7-23, AM 1400A Series - Speed-Torque Characteristics Graph (nN=3000 rpm), and Figure 7-33, AM 1400 Series - Dimensional Drawing.

Table 7-26, AM 1400A Series - Specifications (n_N=3000 rpm)

	AM 1400A (Without Brake)	AM 1400AB (With Brake)
P/N	34100430	34100431
Rated Voltage U_N	330 V	
Rated Power Output P_N	2.7 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) **1 M_N	8.5 Nm	
Rated Current (100 K) **1 I_N	6.6 A	
Stall Torque (100 K) **1 M_O	13.0 Nm	
Stall Current (100 K) **1 I_O	10.1 A	
Maximum Current (for ≤ 200 ms) I_{max}	42.0 A	
Maximum Torque (for ≤ 200 ms) M_{max}	43.5 Nm	
Pole Pairs PZ	4	
Weight m	30.86 lb 14.0 kg	32.19 lb 14.6 kg
Rotor Inertia J	43.00 kgcm^2	43.60 kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		0.7 A
Holding Torque for Brake M_{Br}		11.0 Nm

(100K) **1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1400A Series - Speed-Torque Characteristics Graph (n_N=3000 rpm)

Refer to **Figure 7-23**.

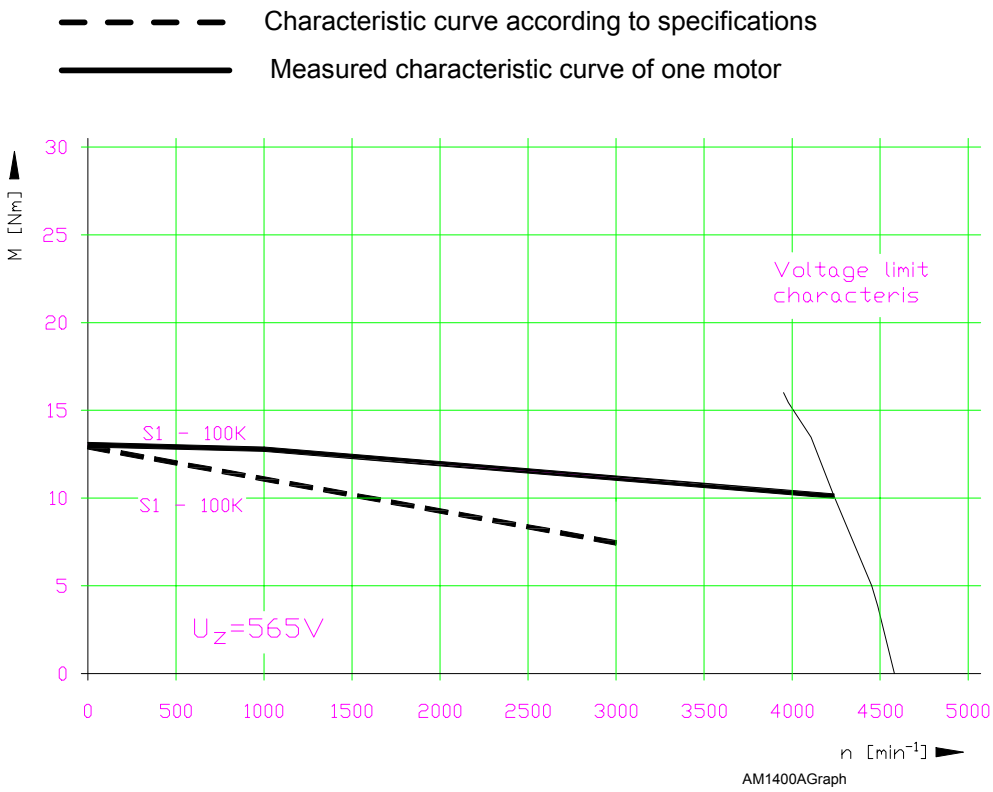


Figure 7-23, AM 1400A Series - Speed-Torque Characteristics Graph (n_N=3000 rpm)

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1400C Series - Axis Motor Specifications (n_N=2000 rpm)

Refer to **Table 7-27**, Figure 7-24, AM 1400C - Speed-Torque Characteristics Graph (nN=2000 rpm), and Figure 7-33, AM 1400 Series - Dimensional Drawing.

Table 7-27, AM 1400C Series - Specifications (n_N=2000 rpm)

	AM 1400C (Without Brake)	AM 1400CB (With Brake)
P/N	34100420	34100421
Rated Voltage U_N	305 V	
Rated Power Output P_N	2.3 kW	
Rated Speed n_N	2000 rpm	
Rated Torque (100 K) **1 M_N	11.0 Nm	
Rated Current (100 K) **1 I_N	6.0 A	
Stall Torque (100 K) **1 M_O	13.0 Nm	
Stall Current (100 K) **1 I_O	7.2 A	
Maximum Current (for ≤ 200 ms) **I_{max}**	30.0 A	
Maximum Torque (for ≤ 200 ms) **M_{max}**	43.5 Nm	
Pole Pairs PZ	4	
Weight m	30.86 lb 14.00 kg	32.19 lb 14.60 kg
Rotor Inertia J	43.00 kgcm^2	43.60 kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		0.7 A
Holding Torque for Brake M_{Br}		11.0 Nm

(100K) **1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1400C Series - Speed-Torque Characteristics Graph (n_N=2000 rpm)

Refer to **Figure 7-24**.

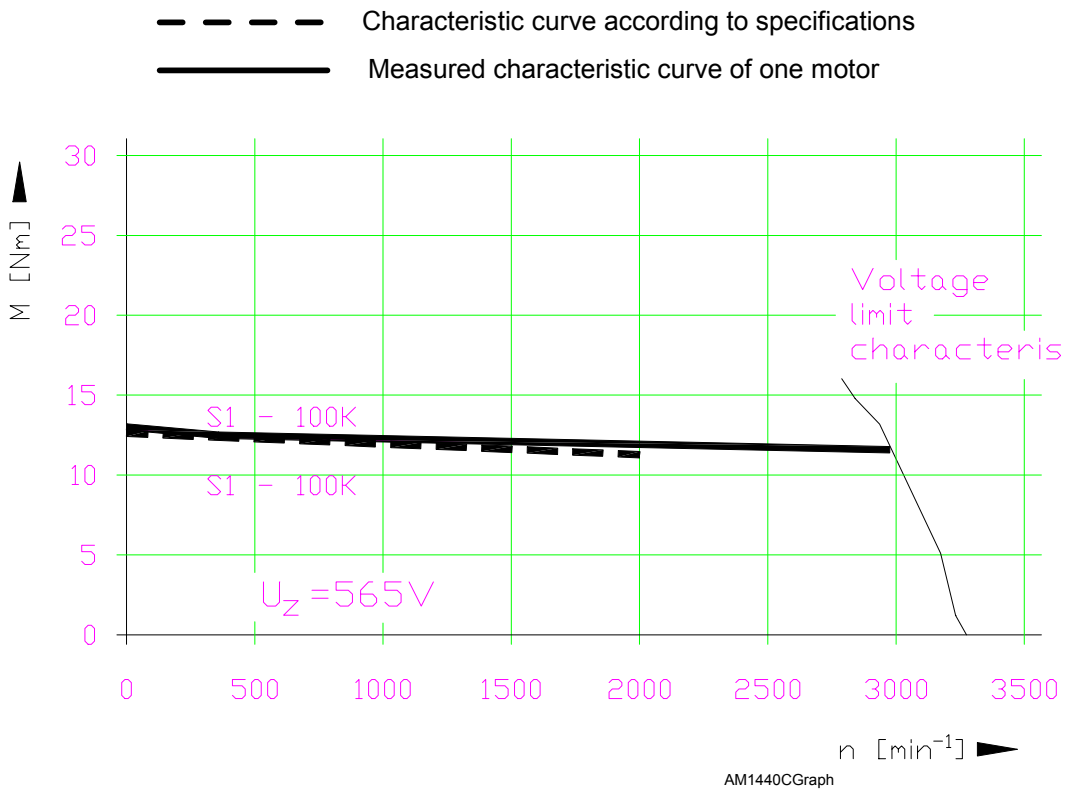


Figure 7-24, AM 1400C Series - Speed-Torque Characteristics Graph (n_N=2000 rpm)

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1550C Series - Axis Motor Specifications

Refer to **Table 7-28**, Figure 7-25, AM 1550C Series - Speed-Torque Characteristics Graph, and Figure 7-34, AM 1550 Series - Dimensional Drawing.

Table 7-28, AM 1550C Series - Specifications

	AM 1550C (Without Brake)	AM 1550CB (With Brake)
P/N	34100250	34100251
Rated Voltage U_n	295 V	
Rated Power Output P_n	2.9 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) ** 1 **M_n**	9.2 Nm	
Rated Current (100 K) ** 1 **I_N**	6.9 A	
Stall Torque (100 K) ** 1 **MI_O**	13.0 Nm	
Stall Current (100 K) ** 1 **I_O**	9.1 A	
Maximum Current (for ≤ 200 ms) **I_{max}**	29.7 A	
Maximum Torque (for ≤ 200 ms) **M_{max}**	39 Nm	
Pole Pairs PZ	4	
Winding Resistance (in one phase)	0.67 Ω	
Winding Inductance (in one phase)	5.40 mH	
Weight m	33.07 lb 15.0 kg	38.36 lb 17.40 kg
Rotor Inertia J	33 $kgcm^2$	35 $kgcm^2$
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		1.1 A
Holding Torque for Brake M_{Br}		40.0 Nm

(100K) ** 1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1550C Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-25** (n_N = 3000 rpm).

Characteristic curve according to specifications

Measured characteristic curve of one motor

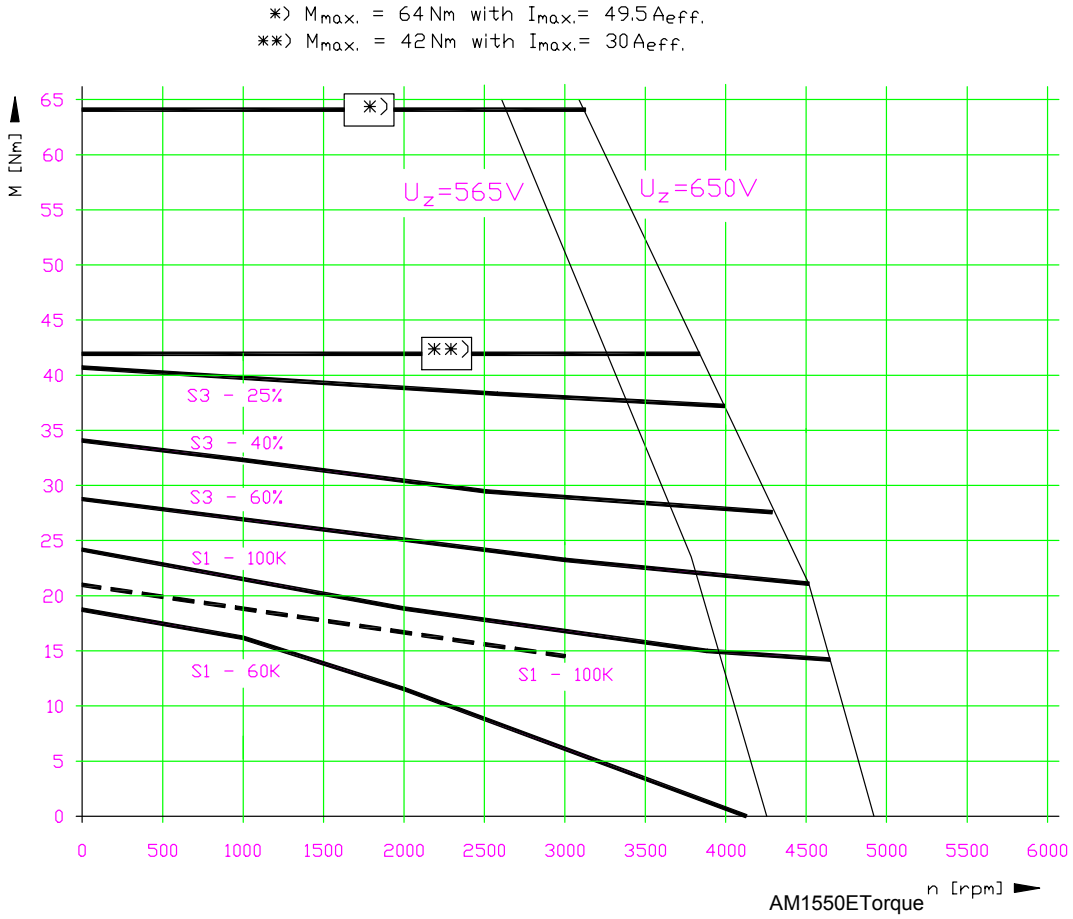


Figure 7-25, AM 1550C Series - Speed-Torque Characteristics Graph

NOTE: In the performance diagram, the characteristic curves are shown as broken lines.

The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1550E Series - Axis Motor Specifications

Refer to **Table 7-29**, Figure 7-26, AM 1550E Series - Speed-Torque Characteristics Graph, and Figure 7-34, AM 1550 Series - Dimensional Drawing.

Table 7-29, AM 1550E and AM 1550EB - Specifications

	AM 1550E (Without Brake)	AM 1550EB (With Brake)
P/N	34100260	34100261
Rated Voltage U_N	291 V	
Rated Power Output P_N	4.6 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) **1 M_N**	14.8 Nm	
Rated Current (100 K) **1 I_N**	10.6 A	
Stall Torque (100 K) **1 M_O**	21.6 Nm	
Stall Current (100 K) **1 I_O**	14.6 A	
Maximum Current (for ≤ 200 ms) **I_{max}**	49.5 A	
Maximum Torque (for ≤ 200 ms) **M_{max}**	64 Nm	
Pole Pairs PZ	4	
Winding Resistance (in one phase)	0.32 Ω	
Winding Inductance (in one phase)	3.10 mH	
Weight m	44.09 lb 20.0 kg	49.38 lb 22.4 kg
Rotor Inertia J	54.00 kgcm^2	56.00 kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		1.1 A
Holding Torque for Brake M_{Br}		40.0 Nm

(100K) **1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1550E Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-26**.

Characteristic curve according to specifications

Measured characteristic curve of one motor

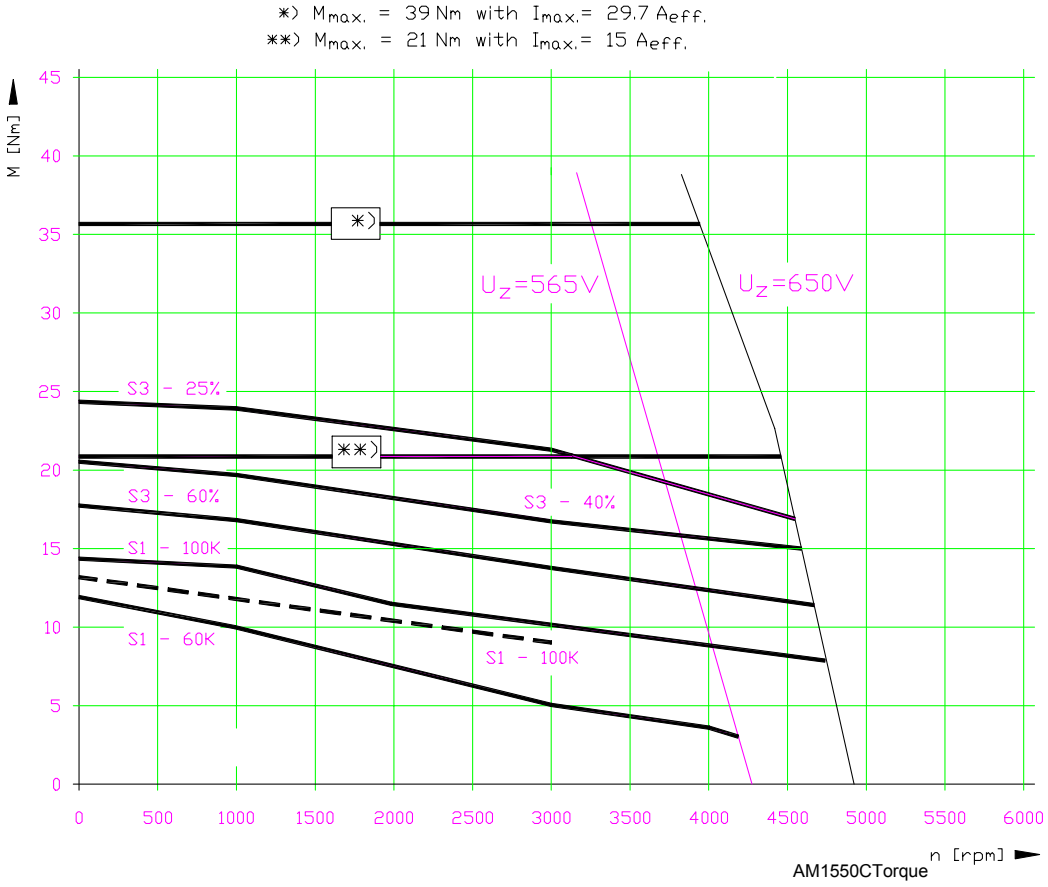


Figure 7-26, AM 1550E Series - Speed-Torque Characteristics Graph

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

AM 1550G Series - Axis Motor Specifications

Refer to **Table 7-30**, Figure 7-27, AM 1550G Series - Speed-Torque Characteristics Graph, and Figure 7-34, AM 1550 Series - Dimensional Drawing.

Table 7-30, AM 1550G Series - Specifications

	AM 1550G (Without brake)	AM 1550GB (With brake)
P/N	34100270	34100271
Rated Voltage U_N	287 V	
Rated Power Output P_N	5.2 kW	
Rated Speed n_N	3000 rpm	
Rated Torque (100 K) **1 M_N**	16.7 Nm	
Rated Current (100 K) **1 I_N**	12.0 A	
Stall Torque (100 K) **1 M_O**	26.1 Nm	
Stall Current (100 K) **1 I_O**	18.0 A	
Maximum Current (for ≤ 200 ms) **I_{max}**	68.6 A	
Maximum Torque (for ≤ 200 ms) **M_{max}**	90 Nm	
Pole Pairs PZ	4	
Winding Resistance (in one phase)	0.23 Ω	
Winding Inductance (in one phase)	2.25 mH	
Weight m	55.11 lb 25.0 kg	60.04 lb 27.4 kg
Rotor Inertia J	75 kgcm^2	77 kgcm^2
Rated Voltage for Brake U_{Br}		24 VDC
Rated Current for Brake I_{Br}		1.1 A
Holding Torque for Brake M_{Br}		40.0 Nm

(100K) **1 100 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

AM 1550G Series - Speed-Torque Characteristics Graph

Refer to **Figure 7-27**.

Characteristic curve according to specifications

Measured characteristic curve of one motor

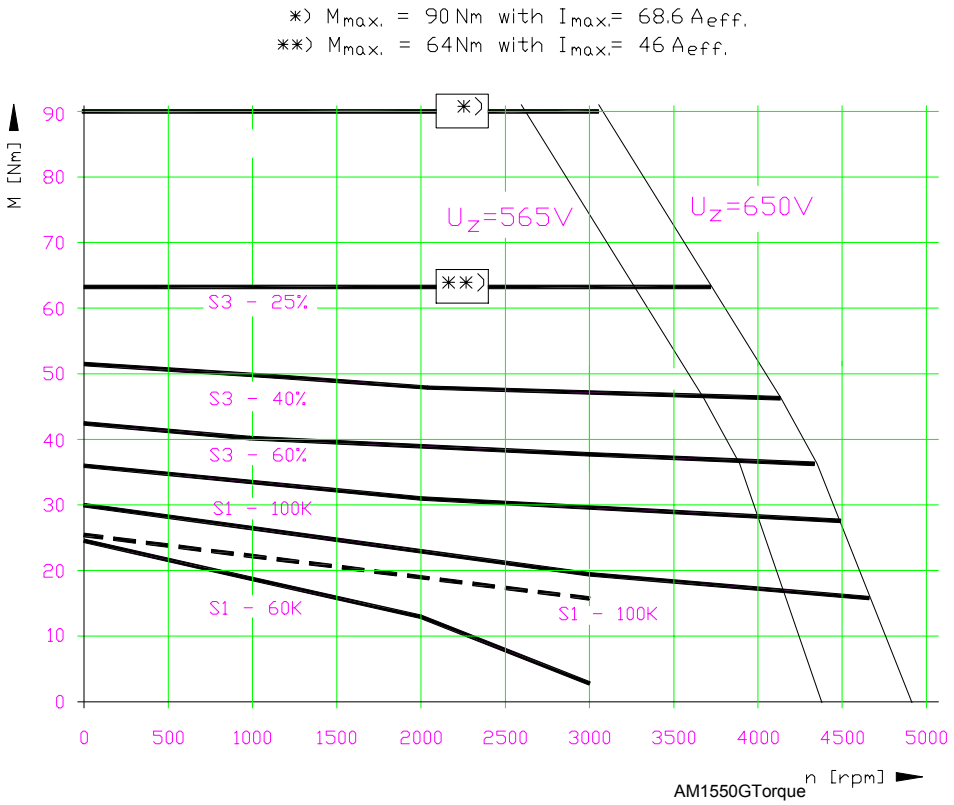


Figure 7-27, AM 1550G Series - Speed-Torque Characteristics Graph

NOTE:	In the performance diagram, the characteristic curves are shown as broken lines. The diagram shows the characteristic curves as determined on a test stand for one motor mounted without thermal insulation.

Axis Motors Dimension Drawings

The dimensional drawings for the following Axis Motors are illustrated:

- AM 820 Series – AM 820A and AM 820AB
- AM 960 Series – AM 960A and AM 960AB
- AM 960 Series – Connector illustrations
- AM 1150 Series – AM 1150A and AM 1150AB
- AM 1160 Series – AM 1160A and AM 1160AB, AM 1160C and AM 1160CB, AM 1160E and AM 1160EB
- AM 1160 Series – Connector illustrations
- AM 1400 Series – AM 1400A and AM 1400AB, AM 1400C and AM 1400CB
- AM 1400 Series – Connector illustrations
- AM 1550 Series – AM 1550C and AM 1550CB, AM 1550E and AM 1550EB, AM 1550G and AM 1550GB
- AM 1550 Series – Connector illustrations

AM 820 Series - Dimensional Drawing

Refer to **Figure 7-28**.

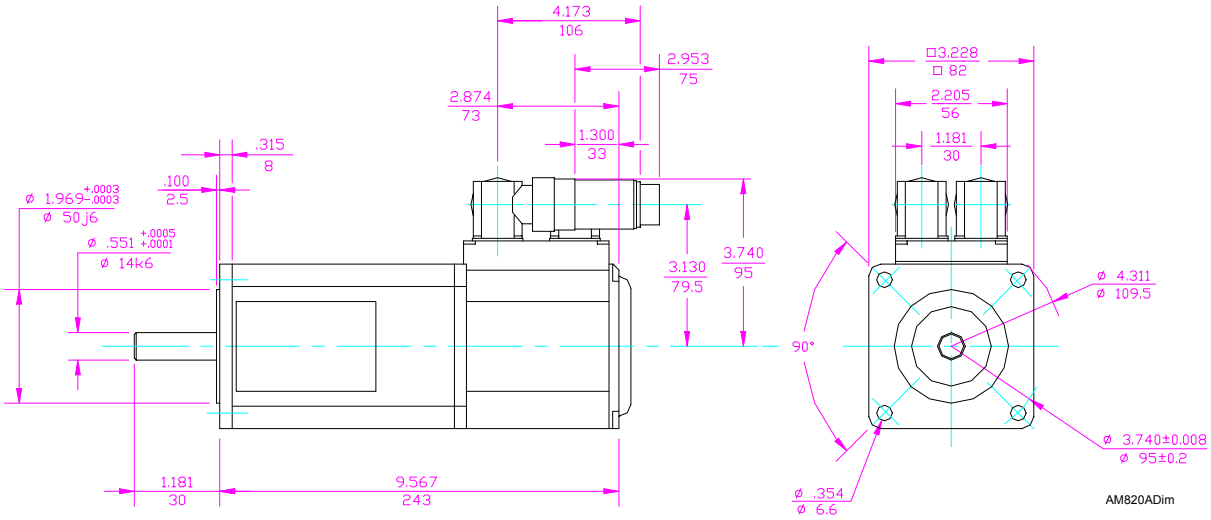


Figure 7-28, AM 820A and AM 820AB - Dimensional Drawing

AM 960 Series - Dimensional Drawing

Refer to **Figure 7-29**, **Table 7-31**, and **Figure 7-30**.

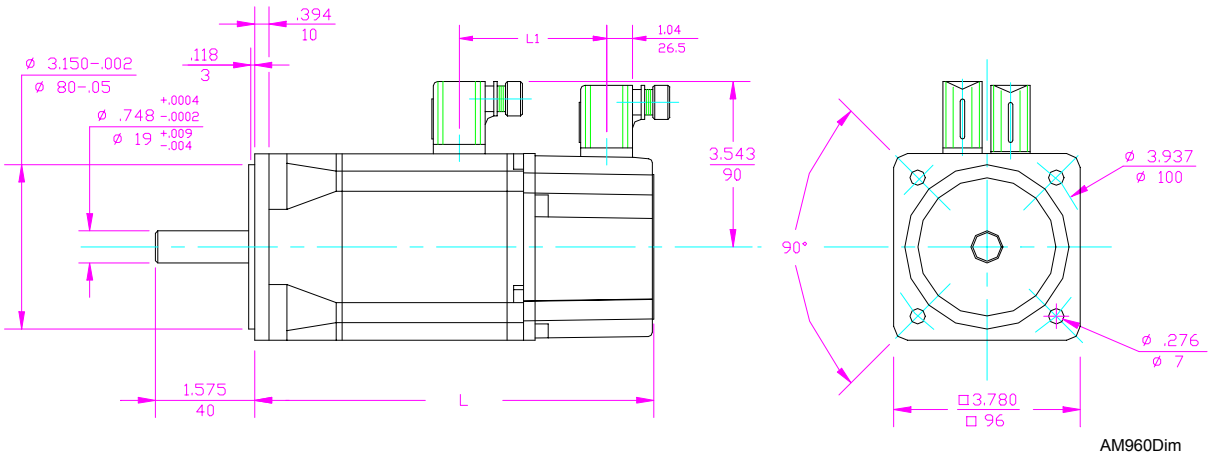


Figure 7-29, AM 960A and AM 960AB - Dimensional Drawing

Table 7-31, AM 960 Series - Motor Dimensions

Motor	L	L1
AM 960A (without brake)	10.55 in 268 mm	2.76 in 70 mm
AM 960AB (with brake)	12.13 in 308 mm	4.25 in 108 mm

AM 960 Series - Connector Illustrations

Refer to **Figure 7-30**. Refer to Table 7-6, Maximum Bend Radii of Cables.

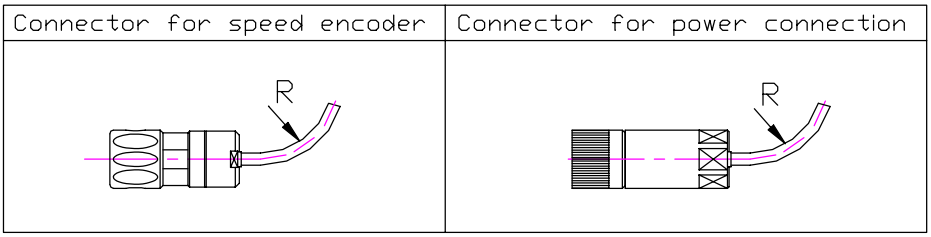


Figure 7-30, AM 960 Series, AM 1160 Series, AM 1400 Series - Connector Illustrations

AM 1150 Series - Dimensional Drawing

Refer to **Figure 7-31**.

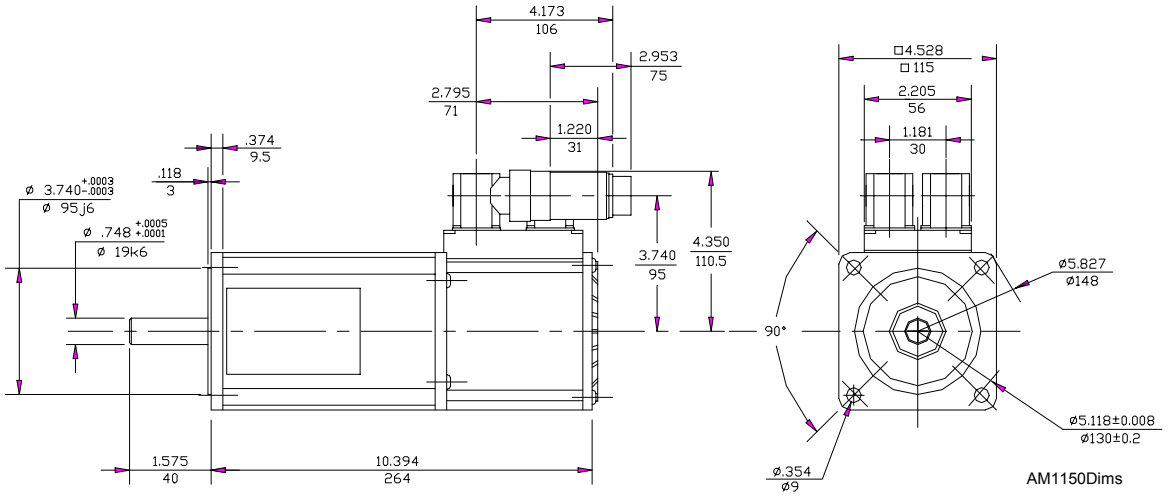


Figure 7-31, AM 1150 Series - Dimensional Drawing

AM 1160 Series - Dimensional Drawing

Refer to **Figure 7-32** and **Table 7-32**.

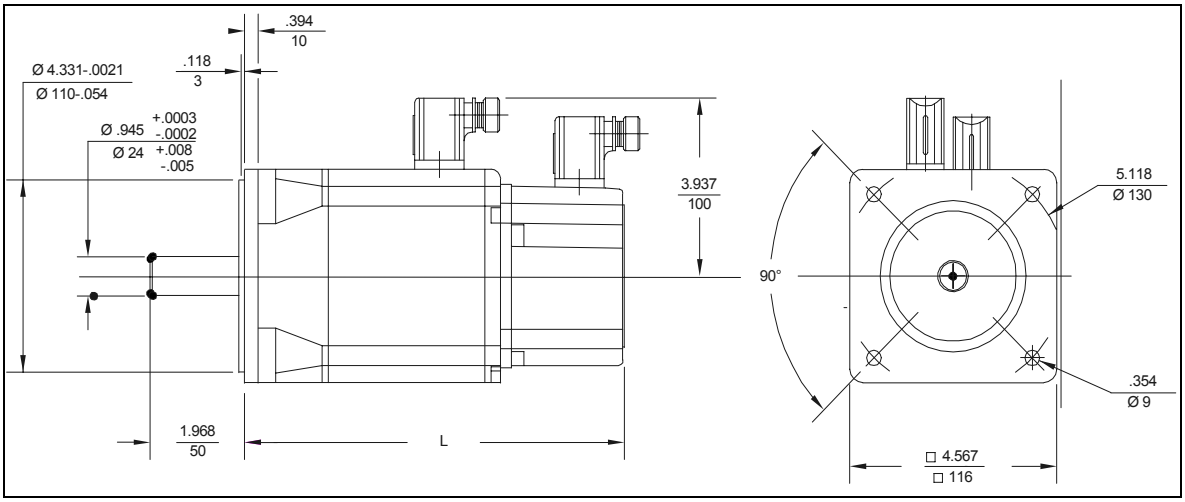


Figure 7-32, AM 1160 Series - Dimensional Drawing

Table 7-32, AM 1160 Series - Motor Dimensions

Motor	L
AM 1160A (without brake)	8.70 in 221 mm
AM 1160AB (with brake)	10.11 in 257 mm
AM 1160C (without brake)	9.72 in 246 mm
AM 1160CB (with brake)	11.10 in 282 mm
AM 1160E (without brake)	11.65 in 296 mm
AM 1160EB (with brake)	3.07 in 332 mm

AM 1160 Series - Connector Illustrations

Refer to Figure 7-30, AM 960 Series, AM 1160 Series, AM 1400 Series - Connector Illustrations.

AM 1400 Series - Dimensional Drawing

Refer to **Figure 7-33**.

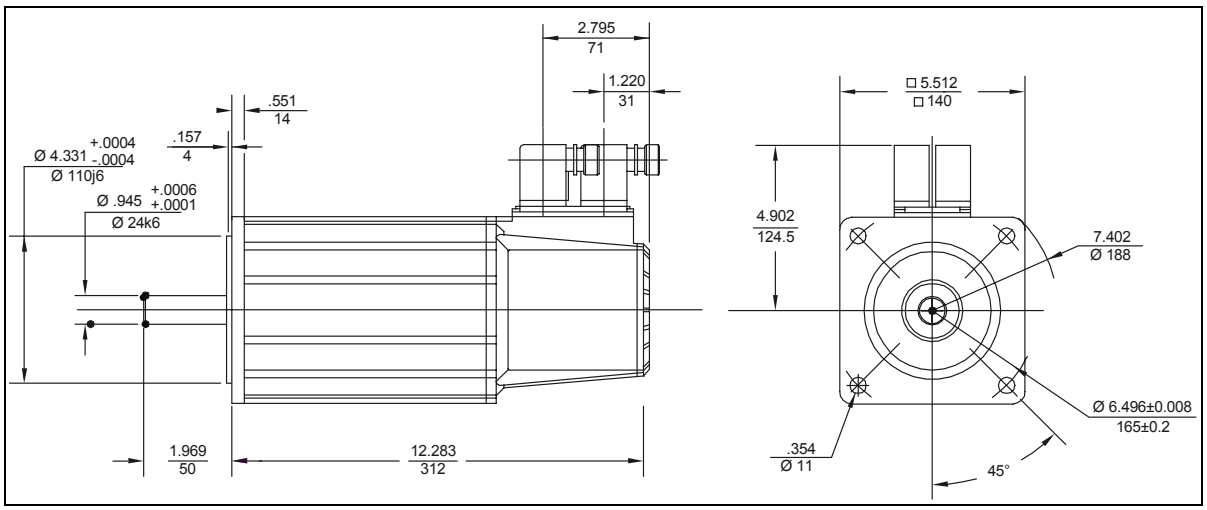


Figure 7-33, AM 1400 Series - Dimensional Drawing

AM 1400 Series - Connector Illustrations

Refer to Figure 7-30, AM 960 Series, AM 1160 Series, AM 1400 Series - Connector Illustrations.

AM 1550 Series - Dimensional Drawing

Refer to **Figure 7-34** and **Table 7-33**.

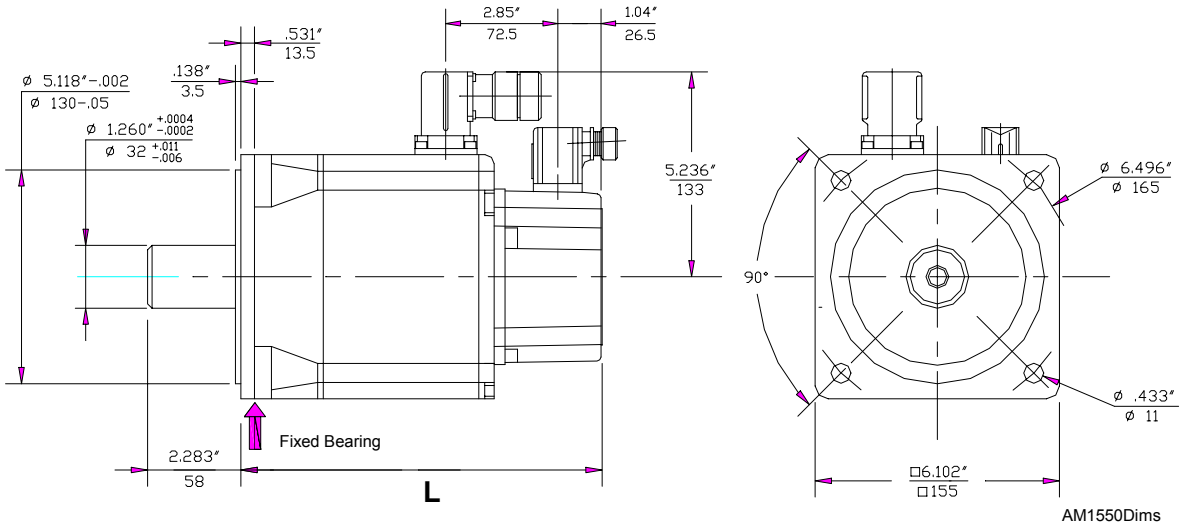


Figure 7-34, AM 1550 Series - Dimensional Drawing

Table 7-33, AM 1550 Series - Motor Dimensions

Motor	L
AM 1550C (without brake)	10.20 in 259 mm
AM 1550CB (with brake)	11.93 in 303 mm
AM 1550E (without brake)	11.93 in 303 mm
AM 1550EB (with brake)	13.66 in 347 mm
AM 1550G (without brake)	13.66 in 347 mm
AM 1550GB (with brake)	15.19 in 386 mm

AM 1550 Series - Connector Illustrations

Refer to **Figure 7-35**. Refer to Table 7-6, Maximum Bend Radii of Cables.

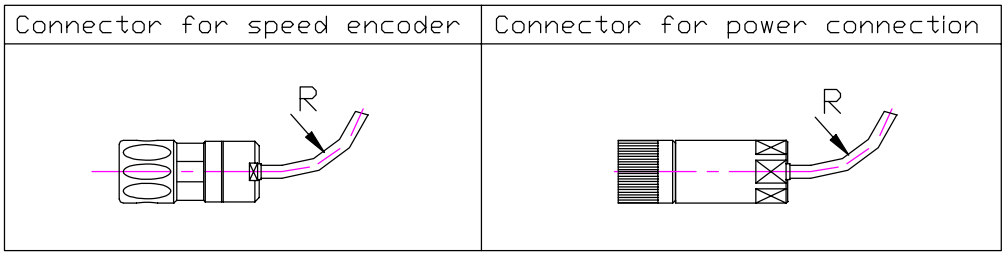


Figure 7-35, AM 1550 Series - Connector Illustrations

Spindle Motors - SM Series

In general, the spindle (asynchronous) motor designation is of the form SM pppf where: SM = Spindle Motor – ppp = rated power in kW, and f = family. The C and D family of motors are the latest motors available. The C version features a standard bearing that allows operation up to 9,000 rpm. The D version features a spindle bearing which allows higher radial forces and operation up to 12,000 rpm. The C and D motors also feature a stronger fan for better cooling and better balancing. The E and F family are the same as the C and D but without a key.

Spindle motors offer the following features:

- Rotary encoder for speed measurement
- Precision balancing – spindle (asynchronous) motor can be balanced at any time
- Separate cooling via integrated fan
- IM B5 design, per EN 60 034-7 requirements (for securing by flange/base)
- Protection class IP 54, per EN 60 529 requirements
- Cylindrical shaft end per DIN 748 with feather key and threaded central bore hole per ISO 866 BS5 requirements
- Flange dimensions per DIN 42 948 and IEC 72 requirements
- Maintenance-free bearings
- Separate cooling through integral fan
- Resistor probe to monitor temperature in the stator winding
- Thermal Class F
- Vibration severity grade S for A and B family; SR for C, D, E, F, G, and H family
- Feather-key balanced

Spindle Motors General Technical Information

The specifications and the characteristic curves apply to motors mounted without thermal insulation. The temperature of the winding may differ from the maximum permissible ambient temperature of 40°C by a maximum of 1005. If the motor is mounted so that it is thermally insulated, it is necessary to reduce the motor torque in order to avoid thermal overloading o the motor.

Spindle Motors Mechanical Life

The service life of the bearings depends on the shaft load and the mean rotational speed (see “Permissible Forces on the Motor Shaft”).

Shaft Bearing

The spindle (asynchronous) motor are equipped with maintenance-free bearings. The shaft bearing is optionally available as either standard bearing or as spindle bearing. The version with spindle bearing can withstand greater lateral forces and allows higher spindle speeds:

- Standard bearing: maximum 8000/9000 rpm
- Spindle bearing: maximum 10000/12000 rpm

Motors with spindle bearing have slightly larger overall length.

Shaft End

The spindle (asynchronous) motors have a cylindrical shaft end as per DIN 748 with a centering hold as per DIN 332-DR.

Spindle (asynchronous) motors with standard bearing are supplied with keyway and feather key as per DIN 6885 Sheet 1 and are balanced. They are also available with smooth shaft upon request.

Feather key (see Table 7-19, Feather Key Specifications):

SM 075C–F: AS 10 x 8 x 70

SM 200C–F: AS 12 x 8 x 90

The standard version of the spindle (asynchronous) motors with spindle bearing has a smooth shaft (without keyway and feather key). Upon request, it is available with keyway and feather key as per DIN 6885 Sheet 1.

SM 055A, SM 075A, and SM 100A - Specifications

Refer to **Table 7-34**.

Table 7-34, SM 055A, SM 075A, and SM 100A - Specifications

	SM 055A	SM 075A	SM 100A
P/N	34100600	34100605	34100610
Fan	+**1	+	+
Brake	–**2	–	–
Rated Voltage U_N	330 V		
Rated Power Output P_N	5.5 kW	7.5 kW	10.0 kW
Rated Speed n_N	1500 rpm		
Rated Torque M_N	35.0 Nm	48.0 Nm	63.5 Nm
Rated Current I_N	15.5 A	21 A	26 A
Operation Ratio n	0.83		0.82
Maximum Speed n_{max}	9000 rpm		
Pole Pairs PZ	2		
Weight m	116.84 lb 53.00 kg	141.09 lb 64.00 kg	160.93 lb 73.00 kg
Rotor Inertia J	184.00 $kgcm^2$	242.00 $kgcm^2$	291.00 $kgcm^2$

Fan

Rated Voltage U_L	3 x 400 V	
Rated Current I_L	0.14 A	0.17 A
Frequency f_L	50 Hz / 60 Hz	

+**1 + Available
–**2 – Not Available

SM 055A - Power and Torque Characteristics

Refer to **Table 7-35**, **Figure 7-36**, and **Figure 7-37**.

Table 7-35, SM 055A - Power and Torque Characteristics Table

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	5.5 kW	35 Nm	15.5 A
	7000 rpm	5.5 kW	7.5 Nm	–
	9000 rpm	4.7 kW	5.0 Nm	–
S6–60%	1500 rpm	7.2 kW	45.8 Nm	18.5 A
	6000 rpm	7.2 kW	11.5 Nm	–
	9000 rpm	4.7 kW	5.0 Nm	–
S6–40%	1500 rpm	8.8 kW	56 Nm	22.0 A
	4300 rpm	8.8 kW	19.5 Nm	–
	9000 rpm	4.7 kW	5.0 Nm	–

SM 055A - Power Characteristics Graph

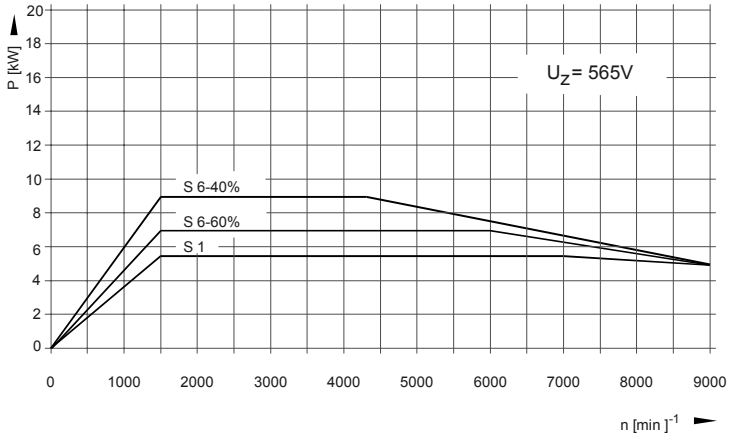


Figure 7-36, SM 055A - Power Characteristics Graph

SM 055A - Torque Characteristics Graph

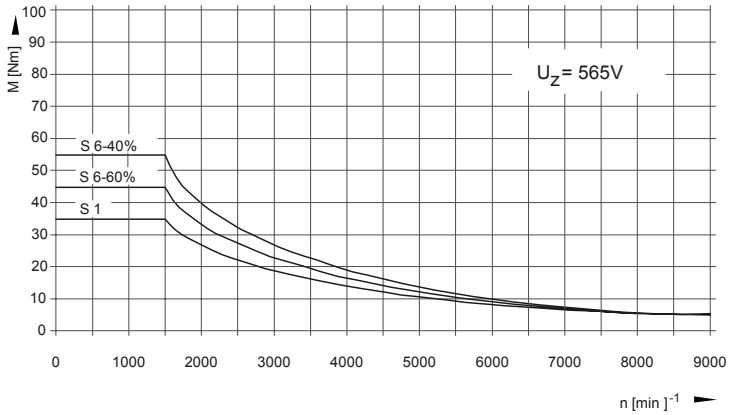


Figure 7-37, SM 055A Torque Characteristics

SM 075A - Power and Torque Characteristics

Refer to **Table 7-36**, **Figure 7-38**, and **Figure 7-39**.

Table 7-36, SM 075A - Power and Torque Characteristics Table

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	7.5 kW	48 Nm	21.0 A
	7000 rpm	7.5 kW	10.2 Nm	–
	9000 rpm	6.5 kW	6.9 Nm	–
S6–60%	1500 rpm	9.8 kW	62.4 Nm	24.5 A
	5800 rpm	9.8 kW	16.5 Nm	–
	9000 rpm	6.5 kW	6.9 Nm	–
S6–40%	1500 rpm	12 kW	76.4 Nm	30.0 A
	4300 rpm	12 kW	28.6 Nm	–
	9000 rpm	6.5 kW	6.9 Nm	–

SM 075A - Power Characteristics Graph

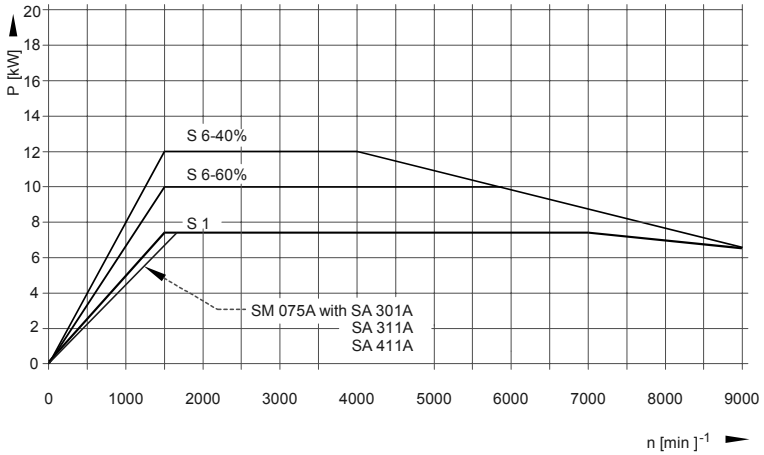


Figure 7-38, SM 075A Power Characteristics Graph

SM 075A - Torque Characteristics Graph

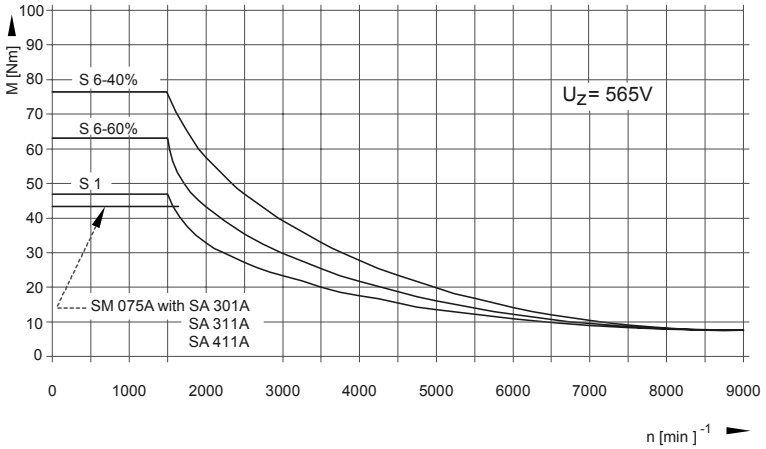


Figure 7-39, SM 075A Torque Characteristics Graph

SM 100A - Power and Torque Characteristics

Refer to **Table 7-37**, **Figure 7-40**, and **Figure 7-41**.

Table 7-37, SM 100A - Power and Torque Characteristics Table

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	10 kW	63.5 Nm	26 A
	7400 rpm	10 kW	13.6 Nm	–
	9000 rpm	7.8 kW	8.3 Nm	–
S6–60%	1500 rpm	13 kW	82.8 Nm	32 A
	5200 rpm	13 kW	22.6 Nm	–
	9000 rpm	7.8 kW	8.3 Nm	–
S6–40%	1500 rpm	82.8 kW	101.9 Nm	38 A
	3000 rpm	22.6 kW	50.9 Nm	–
	9000 rpm	8.3 kW	8.3 Nm	–

SM 100A - Power Characteristics Graph

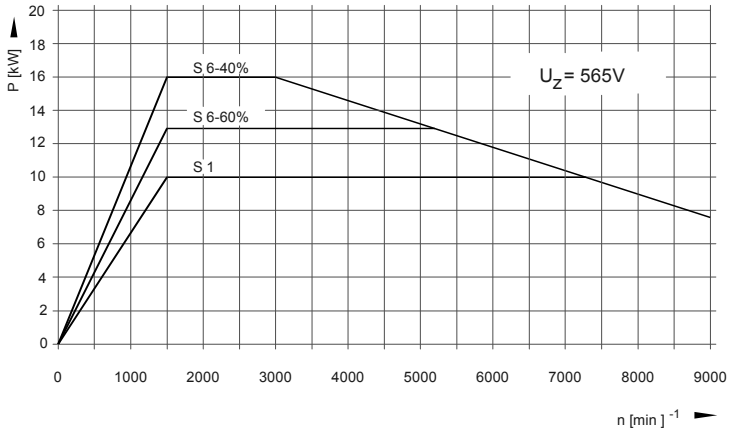


Figure 7-40, SM 100A Power Characteristics Graph

SM 100A - Torque Characteristics Graph

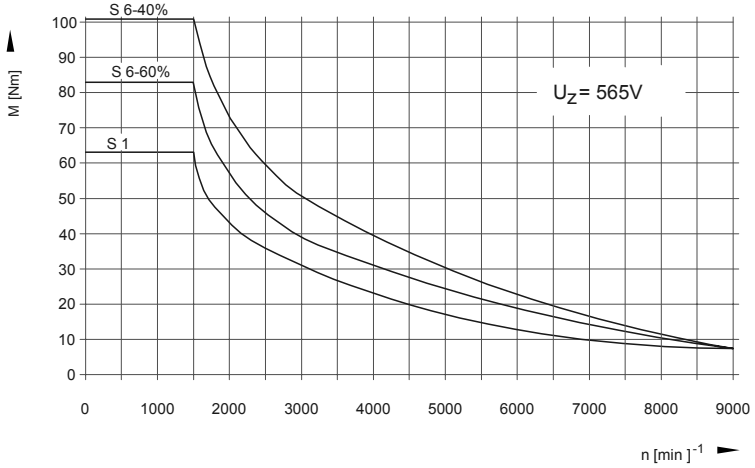


Figure 7-41, SM 100A Torque Characteristics Graph

SM 120A - Specifications

Refer to **Table 7-38** and "SM 120A – Power and Torque Characteristics."

Table 7-38, SM 120A - Specifications

	SM 120A
P/N	34100615
Fan	+**1
Brake	–**2
Rated Voltage U_N	328 V
Rated Power Output P_N	12 kW
Rated Speed n_N	1500 rpm
Rated Torque M_N	76 Nm
Rated Current I_N	27.8 A
Operation Ratio η	0.85 A
Maximum Speed n_{max}	7500 rpm
Pole Pairs PZ	2
Weight m	198.41 lb 90.00 kg
Rotor Inertia J	540.00 kgcm^2

Fan

Rated Voltage U_L	3 x 400 V
Rated Current I_L	0.2 A
Frequency f_L	50 Hz / 60 Hz

+**1 + Available
–**2 – Not Available

SM 120A - Power and Torque Characteristics

Refer to **Table 7-39**, **Figure 7-42**, and **Figure 7-43**.

Table 7-39, SM 120A - Power and Torque Characteristics Table

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	12 kW	76 Nm	27.8 A
	6000 rpm	12 kW	21 Nm	–
	7500 rpm	12 kW	18 Nm	–
S6–60%	1500 rpm	15 kW	98 Nm	34.0 A
	5200 rpm	15 kW	28 Nm	–
	7500 rpm	13 kW	24 Nm	–
S6–40%	1500 rpm	18 kW	117 Nm	40.0 A
	3300 rpm	18 kW	34 Nm	–
	7500 rpm	13 kW	36 Nm	–

SM 120A - Power Characteristics Graph

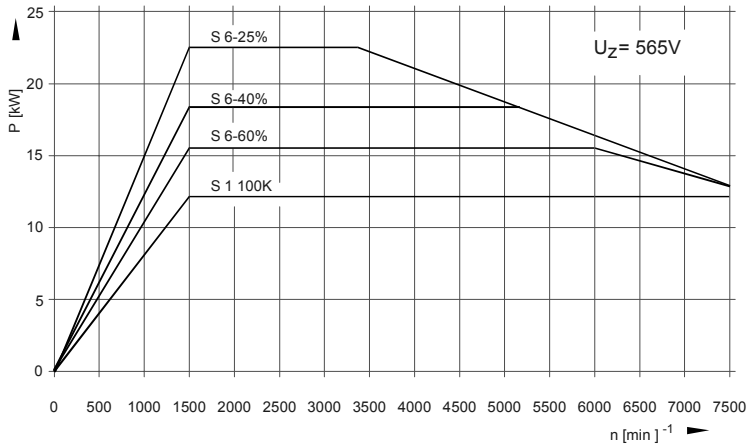


Figure 7-42, SM 120A - Power Characteristics Graph

SM 120A - Torque Characteristics Graph

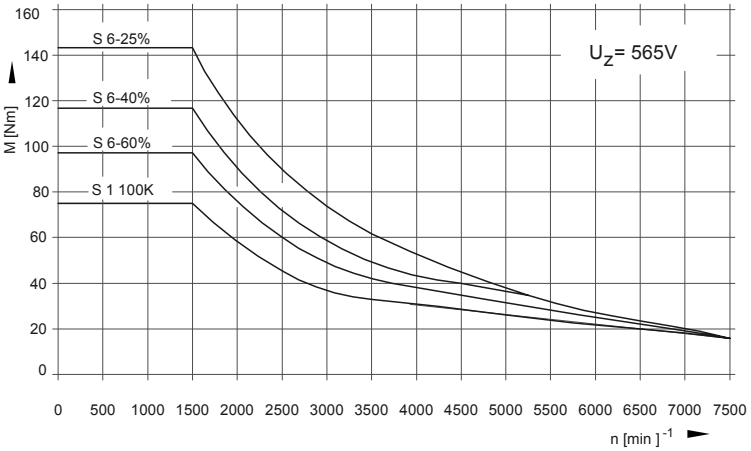


Figure 7-43, SM 120A - Torque Characteristics Graph

SM 055C–F, SM 075C–F, SM 100C–F Specifications Summary

Refer to **Table 7-40**.

Table 7-40, SM 055C–F, SM 075C–F, SM 100C–F – Specifications Summary

	SM 055C,D,E,F	SM 075C,D,E,F	SM 100C,D,E,F
Reference for details	Table 7-41	Table 7-43	Table 7-45
Fan	+**1	+	+
Holding Brake	–**2	–	–
Rated Voltage U_N	250 V	305 V	330 V
Rated power output P_N	5.5 kW	7.5 kW	10.0 kW
Rated speed n_N	1500 rpm		
Rated torque M_N	35.0 Nm	47.8 Nm	63.7 Nm
Rated current I_N	18.0 A	20.1 A	25 A
Efficiency n	0.85		
Maximum Speed n_{max} with standard bearing with spindle bearing	 9,000 rpm 12,000 rpm		
Maximum Current I_{max} at 9,000 rpm at 12,000 rpm	 33 A 33 A	 36 A 36 A	 44 A 44 A
Pole Pairs PZ	2		
Weight m	112.4 lb 51 kg	149.9 lb 68 kg	182.9 lb 83 kg
Rotor Inertia J	245 kgcm^2	353 kgcm^2	405 kgcm^2

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.31 A
Frequency f_L	50 Hz/60 Hz

+**1 + Available
–**2 – Not Available

SM 055C–F - Specifications

Refer to **Table 7-41** and "SM 055C–F - Power and Torque Characteristics."

Table 7-41, SM 055C–F - Specifications

	With Key	SM 055C	SM 055D
	Without Key	SM 055E	SM 055F
P/N	With Key	With standard bearing 34100625	With spindle bearing 34100626
P/N	Without Key	With standard bearing 34100627	With spindle bearing 34100628
Rated Voltage U_N		250 V	
Rated Power Output P_N		5.5 kW	
Rated Speed n_N		1500 rpm	
Rated Torque M_N		35.0 Nm	
Rated Current I_N		18.0 A	
Efficiency n		0.85	
Maximum Speed n_{max}		9000 rpm	12000 rpm
Maximum Current I_{max}	at 9,000 rpm at 12,000 rpm	33 A 33 A	
Pole Pairs PZ		2	
Weight m		112.4 lb 51 kg	
Rotor Inertia J		245 kgcm^2	

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.31 A
Frequency f_L	50 Hz/60 Hz

Accessories

Power Cable without Connector	Up to 24.7 A P/N 34201301
Cable for Fan without Connector	P/N 34201310
Encoder Cable Complete with Connectors	P/N 342000xx

SM 055C–F - Power and Torque Characteristics

Refer to **Table 7-42**, **Figure 7-44**, and **Figure 7-45**.

Table 7-42, SM 055C–F - Power and Torque Characteristics

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	5.5 kW	35.0 Nm	18.0 A
	6000 rpm	5.5 kW	8.8 Nm	–
	12000 rpm	5.5 kW	4.4 Nm	–
S6–60%	1500 rpm	7.0 kW	44.7 Nm	22.0 A
	6000 rpm	7.0 kW	11.2 Nm	–
	12000 rpm	7.0 kW	5.6 Nm	–
S6–40%	1500 rpm	7.9 kW	50.4 Nm	24.0 A
	6000 rpm	7.9 kW	12.6 Nm	–
	12000 rpm	7.9 kW	6.3 Nm	–
S6–25%	1500 rpm	9.5 kW	60.7 Nm	31.0 A
	6000 rpm	9.5 kW	15.2 Nm	–
	12000 rpm	9.5 kW	7.6 Nm	–

SM 055C–F - Power Characteristics Graph

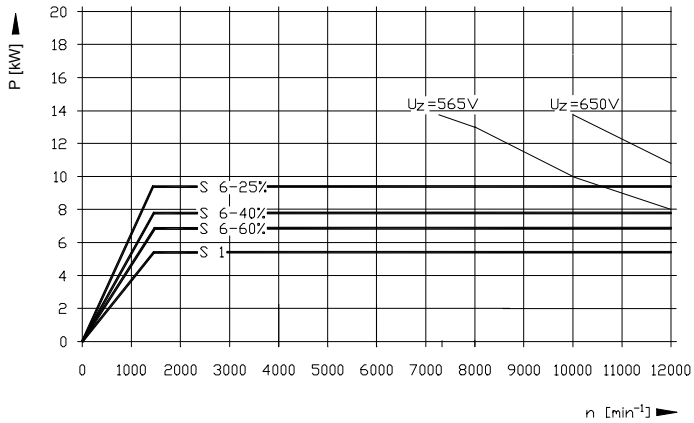


Figure 7-44, SM 055C–F - Power Characteristics Graph

SM 055C–F - Torque Characteristics Graph

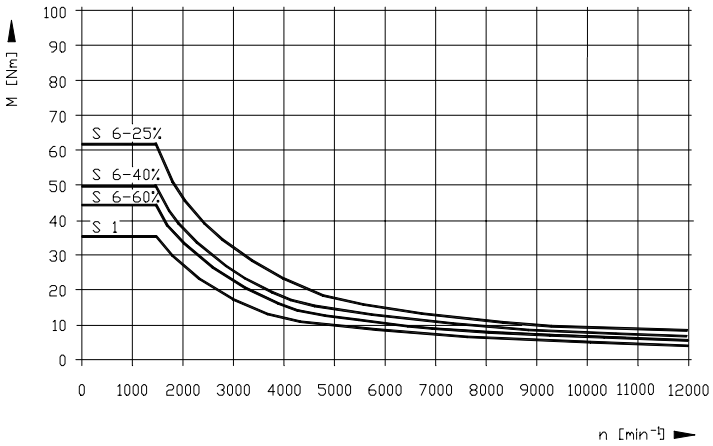


Figure 7-45, SM 055C–F - Torque Characteristics

SM 075C–F - Specifications

Refer to **Table 7-43** and "SM 075C–F - Power and Torque Characteristics."

Table 7-43, SM 075C–F - Specifications

	With Key	SM 075C	SM 075D
	Without Key	SM 075E	SM 075F
P/N	**With Key**	With standard bearing 34100630	With spindle bearing 34100631
P/N	**Without Key**	With standard bearing 34100632	With spindle bearing 34100633
Rated Voltage U_N		305 V	
Rated Power Output P_N		7.5 kW	
Rated Speed n_N		1500 rpm	
Rated Torque M_N		47.8 Nm	
Rated Current I_N		20.1 A	
Efficiency n		0.85	
Maximum Speed n_{max}		9000 rpm	1200 rpm
Maximum Current I_{max}	at 9,000 rpm at 12,000 rpm	36 A 36 A	
Pole Pairs PZ		2	
Weight m		149.9 lb 68 kg	
Rotor Inertia J		353 kgcm^2	

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.31 A
Frequency f_L	50 Hz/60 Hz

Accessories

Power Cable without Connector	Up to 24.7 A P/N 34201301
Cable for Fan Without Connector	P/N 34201310
Encoder Cable Complete with Connectors	P/N 342000xx

SM 075C–F - Power and Torque Characteristics

Refer to **Table 7-44**, **Figure 7-46**, and **Figure 7-47**.

Table 7-44, SM 075C–F - Power and Torque Characteristics

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	7.5 kW	57.8 Nm	20.1 A
	6000 rpm	7.5 kW	12.0 Nm	–
	12000 rpm	7.5 kW	6.0 Nm	–
S6–60%	1500 rpm	9.8 kW	62.6 Nm	24.0 A
	10700 rpm	9.8 kW	23.4 Nm	–
	12000 rpm	8.5 kW	6.8 Nm	–
S6–40%	1500 rpm	11.5 kW	73.4 Nm	27.0 A
	9000 rpm	11.5 kW	27.5 Nm	–
	12000 rpm	8.5 kW	6.8 Nm	–
S6–25%	1500 rpm	13.0 kW	83.0 Nm	31.0 A
	7500 rpm	13.0 kW	16.6 Nm	–
	12000 rpm	8.5 kW	6.8 Nm	–

SM 075C–F - Power Characteristics Graph

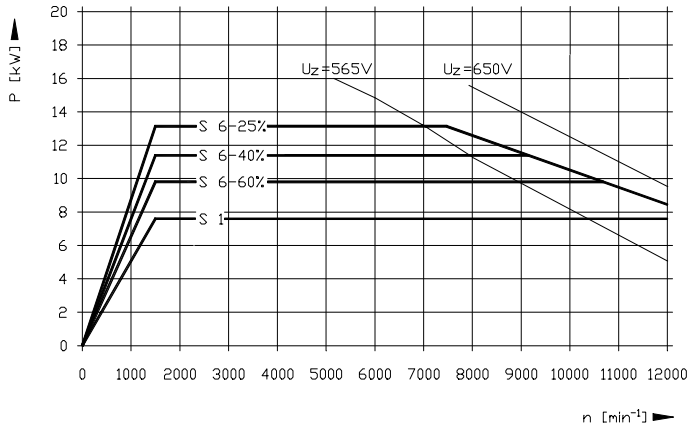


Figure 7-46, SM 075C–F - Power Characteristics Graph

SM 075C–F - Torque Characteristics Graph

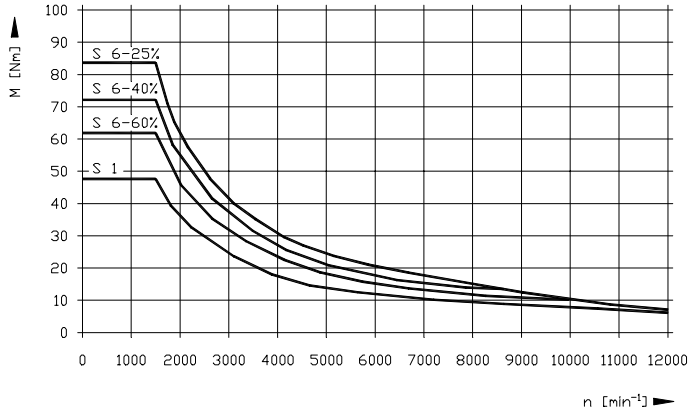


Figure 7-47, SM 075C–F - Torque Characteristics Graph

SM 100C–F - Specifications

Refer to **Table 7-45** and "SM 100C–F - Power and Torque Characteristics."

Table 7-45, SM 100C–F - Specifications

	With Key	SM 100C	SM 100D
	Without Key	SM 100E	SM 100F
P/N	With Key	With standard bearing 34100635	With spindle bearing 34100636
P/N	Without Key	With standard bearing 34100637	With spindle bearing 34100638
Rated Voltage U_N		330 V	
Rated Power Output P_N		10.0 kW	
Rated Speed n_N		1500 rpm	
Rated Torque M_N		63.7 Nm	
Rated Current I_N		25 A	
Efficiency η		0.85	
Maximum Speed n_{max}		9000 rpm	12000 rpm
Maximum Current I_{max}	at 9,000 rpm at 12,000 rpm	44 A 44 A	
Pole Pairs PZ		2	
Weight m		182.9 lb 83 kg	
Rotor Inertia J		405 kgcm^2	

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.31 A
Frequency f_L	50 Hz/60 Hz

Accessories

Power Cable without Connector	Up to 29.8 A P/N 34201302
Cable for Fan Without Connector	P/N 34201310
Encoder Cable Complete with Connectors	P/N 342000xx

SM 100C–F - Power and Torque Characteristics

Refer to **Table 7-46**, **Figure 7-48**, and **Figure 7-49**.

Table 7-46, SM 100C–F - Power and Torque Characteristics

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	10.0 kW	63.7 Nm	25.0 A
	11000 rpm	10.0 kW	23.9 Nm	–
	12000 rpm	8.0 kW	6.4 Nm	–
S6–60%	1500 rpm	12.5 kW	79.8 Nm	29.0 A
	9800 rpm	12.5 kW	12.2 Nm	–
	12000 rpm	8.0 kW	6.4 Nm	–
S6–40%	1500 rpm	14.0 kW	89.4 Nm	32.0 A
	9000 rpm	14.0 kW	19.1 Nm	–
	12000 rpm	8.0 kW	6.4 Nm	–
S6–25%	1500 rpm	17.0 kW	108.6 Nm	37.0 A
	7500 rpm	17.0 kW	21.7 Nm	–
	12000 rpm	8.0 kW	6.4 Nm	–

SM 100C–F - Power Characteristics Graph

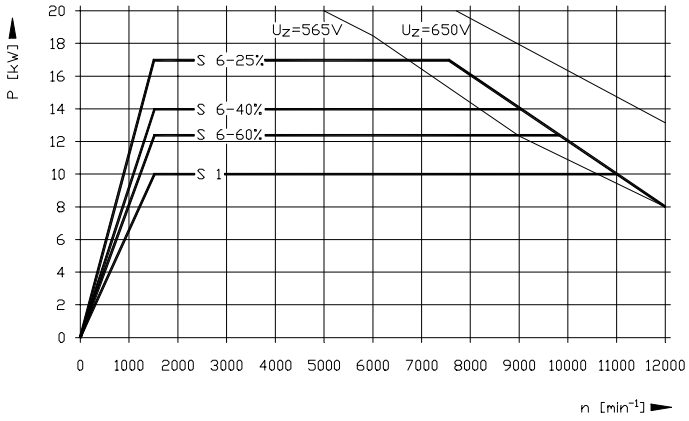


Figure 7-48, SM 100C–F - Power Characteristics Graph

SM 100C–F - Torque Characteristics Graph

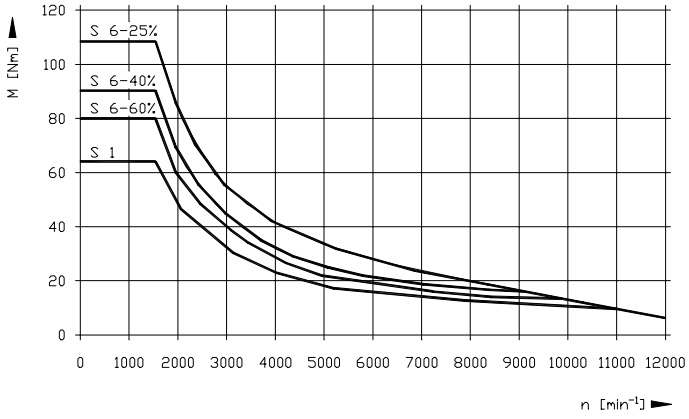


Figure 7-49, SM 100C–F - Torque Characteristics Graph

SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F Specifications Summary

Refer to **Table 7-47**.

Table 7-47, SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F – Specifications Summary

	SM 120C–F	SM 150C–F	SM 200C–F	SM 240C–F
Reference for details	Table 7-48	Table 7-50	Table 7-52	Table 7-54
Fan	+**1	+	+	+
Holding Brake	–**2	–	–	–
Rated Voltage U_N	335 V	348 V	331 V	318 V
Rated power output P_N	12 kW	15 kW	20 kW	24 kW
Rated speed n_N	750 rpm	1500 rpm		
Rated torque M_N (105 K) **3	152.8 Nm	95.5 Nm	127.3 Nm	152.8 Nm
Rated current I_N (105 K) **3	29.0 A	35.0 A	46.0 A	58.0
Efficiency n	0.85			
Maximum Speed n_{max} with standard bearing with spindle bearing	 8,000 rpm 10,000 rpm			
Maximum Current I_{max}	62 A	70 A	96 A	116 A
Pole Pairs PZ	2			
Weight m	348.3 lb 158 kg	246.8 lb 112 kg	297.6 lb 135 kg	348.3 lb 158 kg
Rotor Inertia J	1100 kgcm^2	700 kgcm^2	920 kgcm^2	1100 kgcm^2
Protection	IP 54			

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.25 A
Frequency f_L	50 Hz/60 Hz

+**1 + Available
–**2 – Not Available

(105K)**3 105 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

SM 120C–F - Specifications

Refer to **Table 7-48** and "SM 120C–F - Power and Torque Characteristics."

Table 7-48, SM 120C–F - Specifications

	With Key	SM 120C	SM 120D
	Without Key	SM 120E	SM 120F
P/N	**With Key**	With standard bearing 34100640	With spindle bearing 34100641
P/N	**Without Key**	With standard bearing 34100642	With spindle bearing 34100643
Rated Voltage U_N		335 V	
Rated Power Output P_N		12 kW	
Rated Speed n_N		750 rpm	
Rated Torque M_N (105 K) **1		152.8 Nm	
Rated Current I_N (105 K) **1		29.0 A	
Efficiency n		0.85	
Maximum Speed n_{max}		8000 rpm	10000 rpm
Maximum Current I_{max}		62 A	
Pole Pairs PZ		2	
Weight m		348.3 lb 158 kg	
Rotor Inertia J		1100 kgcm^2	
Protection		IP 54	

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.25 A
Frequency f_L	50 Hz/60 Hz

Accessories

Power Cable without Connector	Up to 24.7 A P/N 34201301
Cable for Fan without Connector	P/N 34201310
Encoder Cable Complete with Connectors	P/N 342000xx

(105K) **1 105 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

SM 120C–F - Power and Torque Characteristics

Refer to **Table 7-49**, **Figure 7-50**, and **Figure 7-51**.

Table 7-49, SM 120C–F - Power and Torque Characteristics

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	750 rpm	12.0 kW	152.8 Nm	29.0 A
	5000 rpm	12.0 kW	22.9 Nm	–
	10000 rpm	4.0 kW	3.8 Nm	–
S6-60%	750 rpm	17.5 kW	222.8 Nm	38.1 A
	3000 rpm	17.5 kW	55.7 Nm	–
	6000 rpm	11.3 kW	18.0 Nm	–
S6-40%	750 rpm	22.0 kW	280.1 Nm	46.4 A
	2500 rpm	22.0 kW	84.0 Nm	–
	3500 rpm	19.0 kW	51.8 Nm	–

SM 120C–F - Power Characteristics Graph

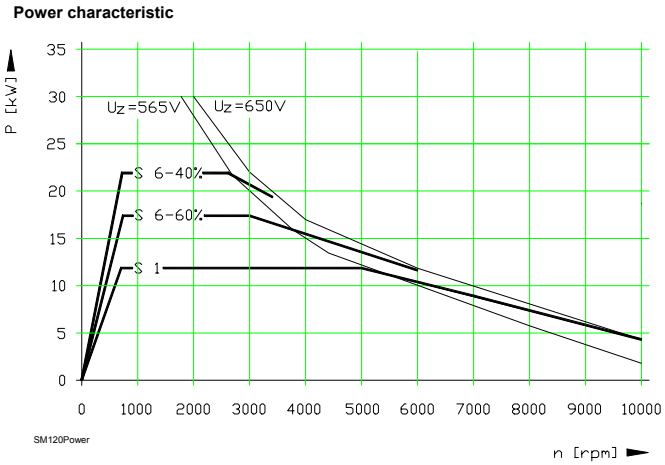


Figure 7-50, SM 120C–F - Power Characteristics Graph

SM 120C–F - Torque Characteristics Graph

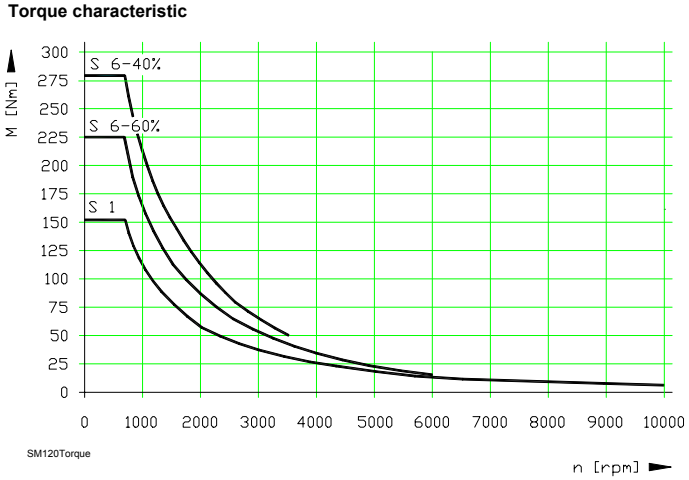


Figure 7-51, SM 120C–F - Torque Characteristics Graph

SM 150C–F - Specifications

Refer to **Table 7-50** and "SM 150C–F - Power and Torque Characteristics."

Table 7-50, SM 150C–F - Specifications

	With Key	SM 150C	SM 150D
	Without Key	**SM 150E**	**SM 150F**
P/N	**With Key**	With standard bearing 34100645	With spindle bearing 34100646
P/N	**Without Key**	With standard bearing 34100647	With spindle bearing 34100648
Rated Voltage U_N		348 V	
Rated Power Output P_N		15 kW	
Rated Speed n_N		1500 rpm	
Rated Torque M_N (105 K) **1		95.5 Nm	
Rated Current I_N (105 K) **1		35.0 A	
Efficiency n		0.85	
Maximum Speed n_{max}		8000 rpm	10000 rpm
Maximum Current I_{max}		70 A	
Pole Pairs PZ		2	
Weight m		246.9 lb 112 kg	
Rotor Inertia J		700 kgcm^2	
Protection		IP 54	

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.25 A
Frequency f_L	50 Hz/60 Hz

Accessories

Power Cable without Connector	Up to 24.7 A P/N 34201301
Cable for Fan without Connector	P/N 34201310
Encoder Cable Complete with Connectors	P/N 342000xx

(105K) **1 105 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

SM 150C–F - Power and Torque Characteristics

Refer to **Table 7-51**, **Figure 7-52**, and **Figure 7-53**.

Table 7-51, SM 150C–F - Power and Torque Characteristics

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	15.0 kW	95.5 Nm	35.0 A
	6500 rpm	15.0 kW	22.0 Nm	–
	10000 rpm	10.0 kW	9.5 Nm	–
S6-60%	1500 rpm	20.0 kW	127.3 Nm	43.3 A
	5000 rpm	20.0 kW	38.2 Nm	–
	9000 rpm	13.5 kW	14.3 Nm	–
S6-40%	1500 rpm	25.0 kW	159.2 Nm	52.3 A
	4500 rpm	25.0 kW	53.1 Nm	–
	8000 rpm	16.8 kW	20.1 Nm	–
S6-25%	1500 rpm	32.0 kW	203.7 Nm	65.0 A
	4000 rpm	32.0 kW	76.4 Nm	–
	6000 rpm	23.7 kW	37.7 Nm	–

SM 150C–F - Power Characteristics Graph

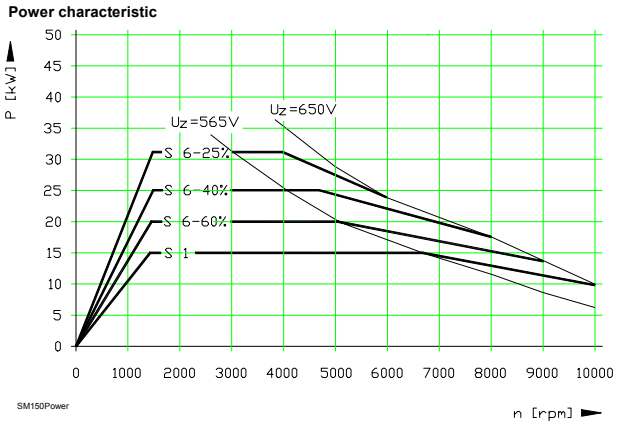


Figure 7-52, SM 150C–F - Power Characteristics Graph

SM 150C–F - Torque Characteristics Graph

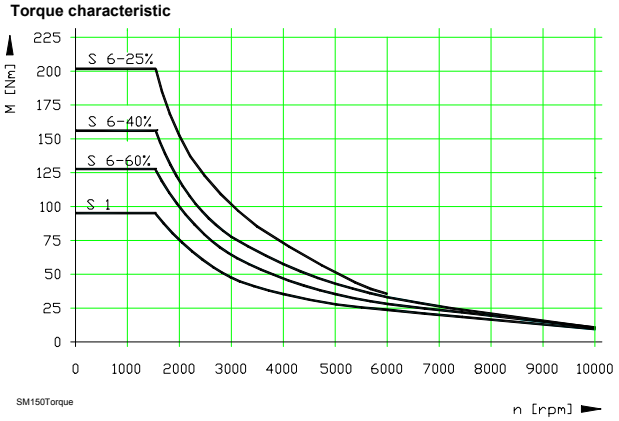


Figure 7-53, SM 150C–F - Torque Characteristics Graph

SM 200C–F - Specifications

Refer to **Table 7-52** and "SM 200C–F - Power and Torque Characteristics."

Table 7-52, SM 200C–F - Specifications

	With Key	SM 200C	SM 200D
	Without Key	**SM 200E**	**SM 200F**
P/N	**With Key**	With standard bearing 34100650	With spindle bearing 34100651
P/N	**Without Key**	With standard bearing 34100652	With spindle bearing 34100653
Rated Voltage U_N		331 V	
Rated Power Output P_N		20 kW	
Rated Speed n_N		1500 rpm	
Rated Torque M_N (105 K) **1		127.3 Nm	
Rated Current I_N (105 K) **1		46.0 A	
Efficiency n		0.85	
Maximum Speed n_{max}		8000 rpm	10000 rpm
Maximum Current I_{max}		96 A	
Pole Pairs PZ		2	
Weight m		297.6 lb 135 kg	
Rotor Inertia J		920 kgcm^2	
Protection		IP 54	

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.25 A
Frequency f_L	50 Hz/60 Hz

Accessories

Power Cable without Connector	Up to 24.7 A P/N 34201301
Cable for Fan without Connector	P/N 34201310
Encoder Cable Complete with Connectors	P/N 342000xx

(105K) **1 105 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

SM 200C–F - Power and Torque Characteristics

Refer to **Table 7-34**, **Figure 7-54**, and **Figure 7-55**.

Table 7-53, SM 200C–F - Power and Torque Characteristics

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	20.0 kW	127.3 Nm	46.0 A
	6500 rpm	20.0 kW	29.4 Nm	–
	10000 rpm	13.0 kW	12.4 Nm	–
S6-60%	1500 rpm	25.0 kW	159.2 Nm	56.0 A
	6000 rpm	25.0 kW	39.4 Nm	–
	10000 rpm	16.0 kW	15.3 Nm	–
S6-40%	1500 rpm	30.0 kW	191.0 Nm	65.0 A
	5500 rpm	30.0 kW	52.1 Nm	–
	10000 rpm	17.5 kW	16.7 Nm	–
S6-25%	1500 rpm	37.0 kW	235.5 Nm	79.0 A
	5000 rpm	37.0 kW	70.7 Nm	–
	8000 rpm	24.0 kW	28.6 Nm	–

SM 200C–F - Power Characteristics Graph

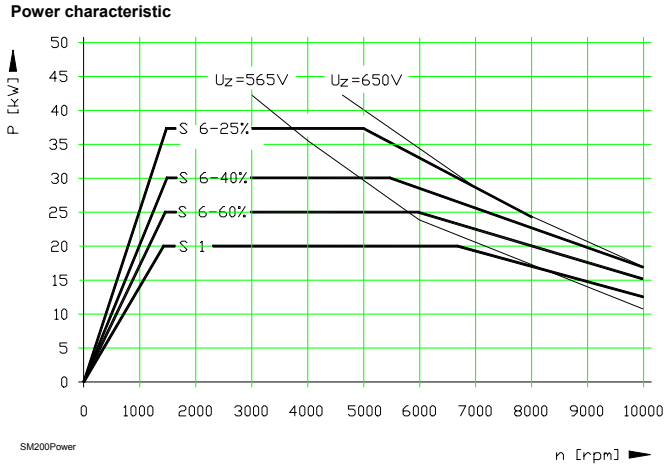


Figure 7-54, SM 200C–F - Power Characteristics Graph

SM 200C–F - Torque Characteristics Graph

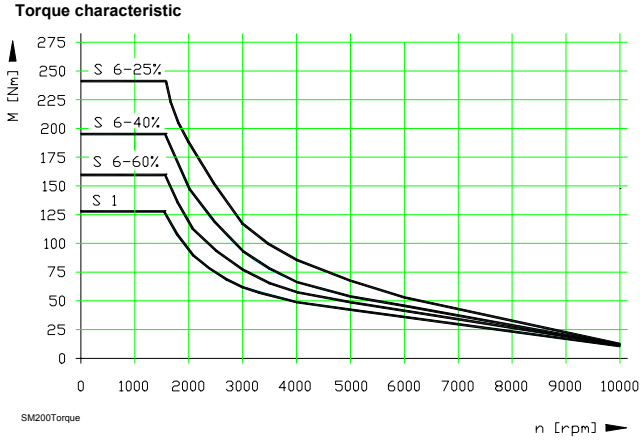


Figure 7-55, SM 200C–F - Torque Characteristics Graph

SM 240C–F - Specifications

Refer to **Table 7-54** and "SM 240C–F - Power and Torque Characteristics."

Table 7-54, SM 240C–F - Specifications

	With Key	SM 240C	SM 240D
	Without Key	SM 240E	SM 240F
P/N	**With Key**	With standard bearing 34100655	With spindle bearing 34100656
P/N	**Without Key**	With standard bearing 34100657	With spindle bearing 34100658
Rated Voltage U_N		318 V	
Rated Power Output P_N		24 kW	
Rated Speed n_N		1500 rpm	
Rated Torque M_N (105 K) **1		152.8 Nm	
Rated Current I_N (105 K) **1		58.0 A	
Efficiency n		0.85	
Maximum Speed n_{max}		8000 rpm	10000 rpm
Maximum Current I_{max}		116 A	
Pole Pairs PZ		2	
Weight m		348.3 lb 158 kg	
Rotor Inertia J		1100 kgcm^2	
Protection		IP 54	

Fan

Rated Voltage for Fan U_L	3 x 400 V
Rated Current for Fan I_L	0.25 A
Frequency f_L	50 Hz/60 Hz

Accessories

Power Cable without Connector	Up to 24.7 A P/N 34201301
Cable for Fan without Connector	P/N 34201310
Encoder Cable Complete with Connectors	P/N 342000xx

(105K) **1 105 K is the temperature difference in Kelvin's between the ambient temperature and the motor temperature.

SM 240C–F - Power and Torque Characteristics

Refer to **Table 7-55**, **Figure 7-56**, and **Figure 7-57**.

Table 7-55, SM 240C–F - Power and Torque Characteristics

Duty Cycle	Speed n	Power P	Torque M	Current I
S1	1500 rpm	24.0 kW	152.8 Nm	58.0 A
	7400 rpm	24.0 kW	31.0 Nm	–
	10000 rpm	18.0 kW	17.2 Nm	–
S6–60%	1500 rpm	30.0 kW	191.0 Nm	67.2 A
	7000 rpm	30.0 kW	40.9 Nm	–
	10000 rpm	22.5 kW	21.5 Nm	–
S6–40%	1500 rpm	38.0 kW	241.9 Nm	81.8 A
	5500 rpm	38.0 kW	66.0 Nm	–
	10000 rpm	26.0 kW	24.8 Nm	–
S6–25%	1500 rpm	48.0 kW	305.6 Nm	100.6 A
	4500 rpm	48.0 kW	101.9 Nm	–
	7000 rpm	41.0 kW	55.9 Nm	–

SM 240C–F - Power Characteristics Graph

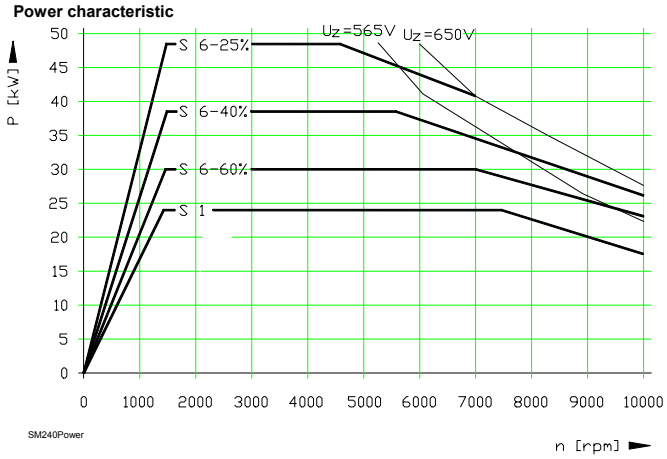


Figure 7-56, SM 240C–F - Power Characteristics Graph

SM 240C–F - Torque Characteristics Graph

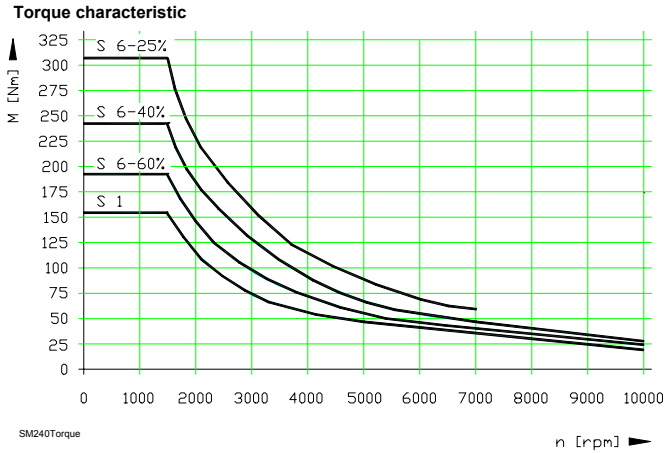


Figure 7-57, SM 240C–F - Torque Characteristics Graph

Spindle Motors Dimension Drawings

The dimensional drawings for the following Spindle Motors and Connectors are illustrated:

- SM 055A, SM 075A, SM 100A - Dimensional Drawing
- SM 055A, SM 075A, SM 100A, SM 055C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F - Connector for Speed (Rotary) Encoder
- SM 120A - Dimensional Drawing
- SM 120A - Connector for Power Connection
- SM 055C–F, SM 075C–F, SM 100C–F - Dimensional Drawing
- SM 120C–F, SM 240C–F - Dimensional Drawing
- SM 150C–F - Dimensional Drawing
- SM 200C–F - Dimensional Drawing

SM 055A, SM 075A, SM 100A - Dimensional Drawing

Refer to **Figure 7-58**, **Table 7-56**, Figure 7-11, SM 055A, SM 075A, SM 100A - Rotatable Flange Socket, and Figure 7-59, SM 055A, SM 075A, SM 100A, SM 120A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240 C–F - Connector for Speed (Rotary) Encoder.

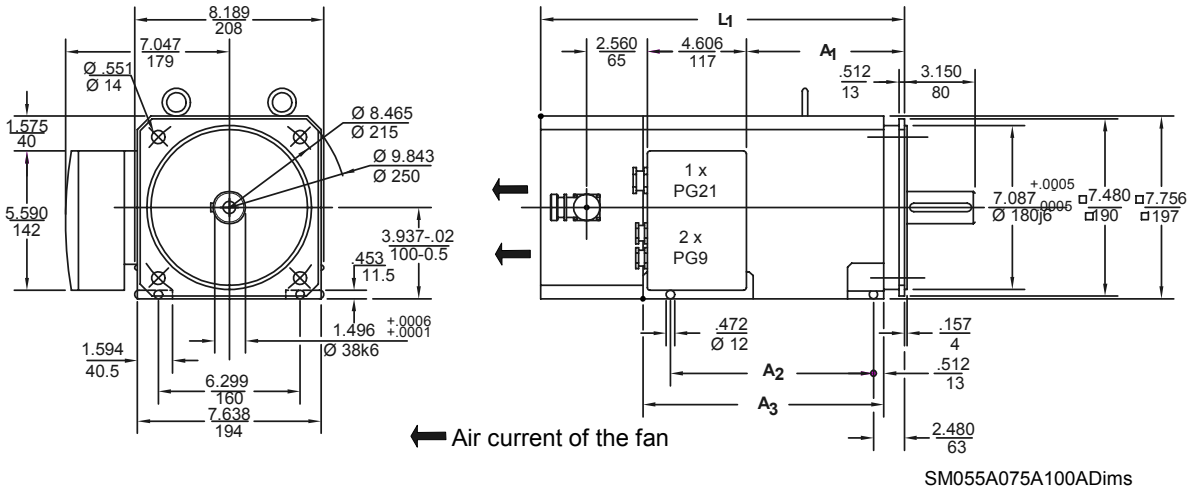


Figure 7-58, SM 055A, SM 075A, SM 100A - Dimensional Drawing

Table 7-56, SM 055A, SM 075A, SM 100A - Motor Dimensions

Motor	L_1	A_1	A_2	A_3
SM 055A	20.866 in 530 mm	8.465 in 215 mm	9.055 in 230 mm	11.457 in 291 mm
SM 075A	23.425 in 595 mm	11.024 in 280 mm	11.624 in 295 mm	14.016 in 356 mm
SM 100A	25.984 in 660 mm	13.189 in 335 mm	13.780 in 350 mm	16.181 in 411 mm

SM 055A, SM 075A, SM 100A, SM 120A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F - Connector for Speed (Rotary) Encoder

Refer to **Figure 7-59**. Refer to Table 7-6, Maximum Bend Radii of Cables.

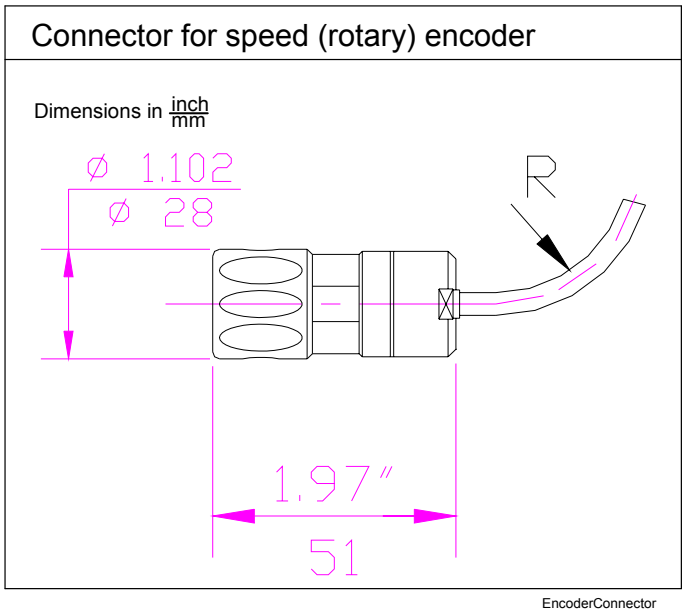


Figure 7-59, SM 055A, SM 075A, SM 100A, SM 120A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240 C–F - Connector for Speed (Rotary) Encoder

SM 120A - Dimensional Drawing

Refer to **Figure 7-60** and **Figure 7-61**.

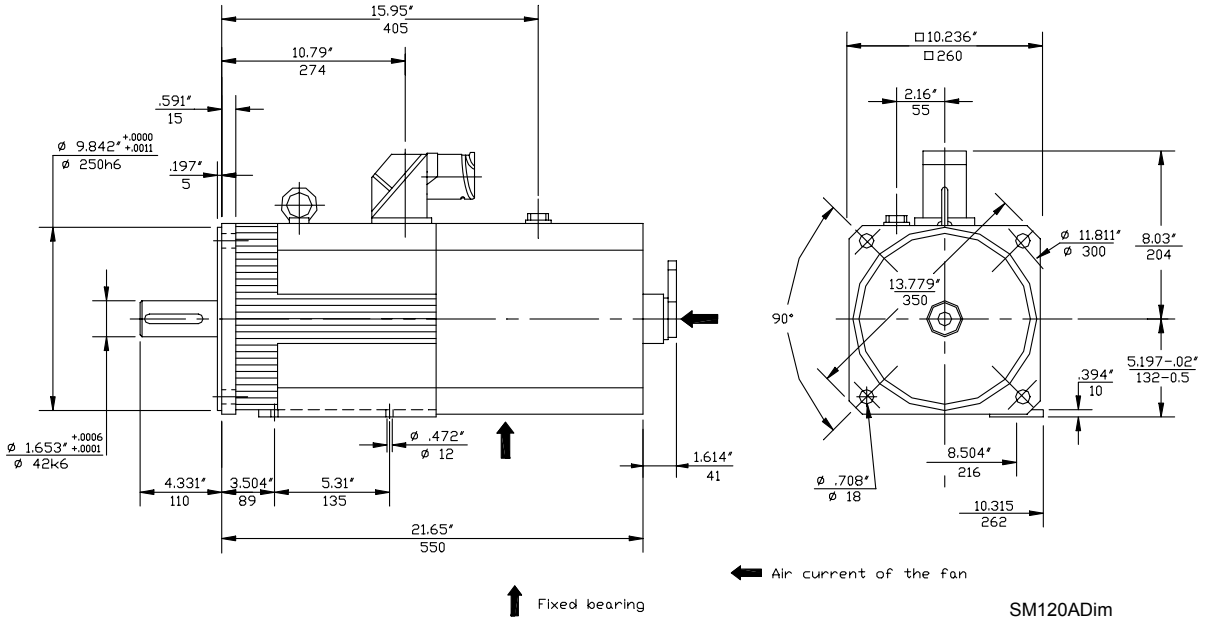


Figure 7-60, SM 120A - Dimensional Drawing

SM 120A - Connector for Power Connection

Refer to **Figure 7-61**. Refer to Table 7-6, Maximum Bend Radii of Cables.

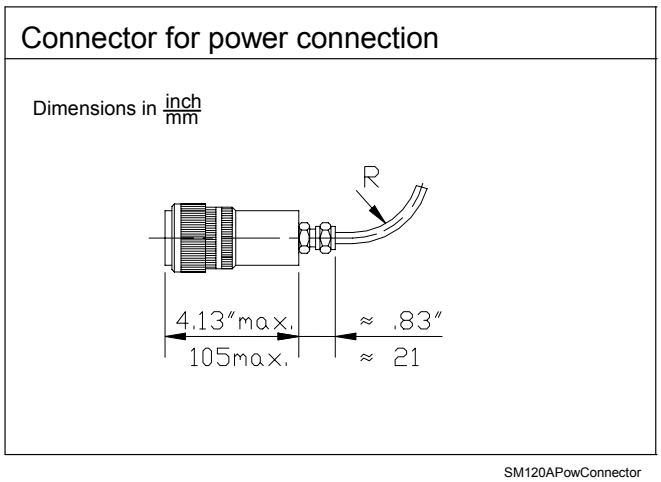


Figure 7-61, SM 120A - Connector for Power Connection

SM 055C–F, SM 075C–F, SM 100C–F - Dimensional Drawing

Refer to **Figure 7-62**, Table 7-57, SM 055C–F, SM 075C–F, SM 100C–F - Motor Dimensions, Figure 7-12, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F - Rotatable Flange Socket, and Figure 7-59, SM 055A, SM 075A, SM 100A, SM 120A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240 C–F - Connector for Speed (Rotary) Encoder.

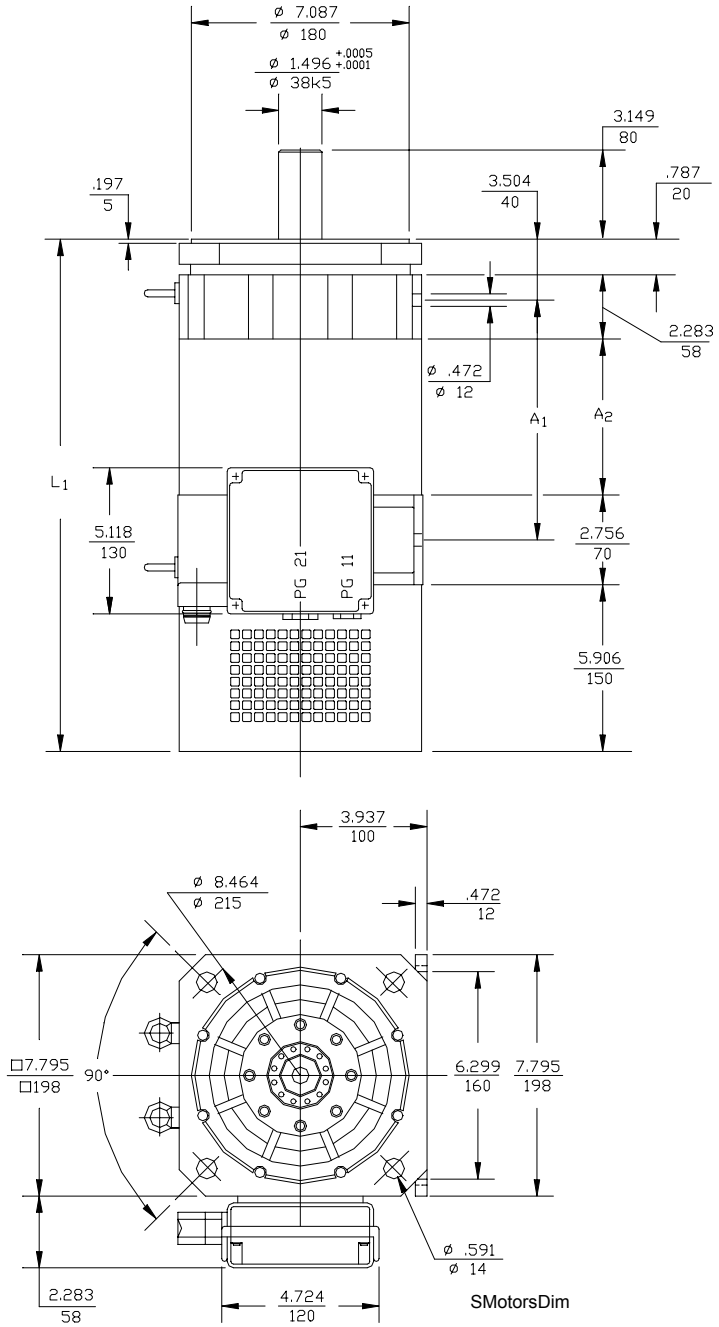


Figure 7-62, SM 055C–F, SM 075C–F, SM 100C–F - Dimensional Drawing

Table 7-57, SM 055C–F, SM 075C–F, SM 100C–F - Motor Dimensions

Motor	Length L_1	Distance A_1	Distance A_2
SM 055C, SM 055E	17.24 438 mm	8.38 213 mm	5.51 140 mm
SM 055D, SM 055F	17.95 456 mm	8.38 213 mm	5.51 140 mm
SM 075C, SM 075E	20.19 513 mm	11.34 288 mm	8.46 215 mm
SM 075D, SM 075F	20.90 531mm	11.34 288 mm	8.46 215 mm
SM 100C, SM 100E	22.95 583 mm	14.09 358 mm	11.22 285 mm
SM 100D, SM 100F	23.66 601 mm	14.09 358 mm	11.22 285 mm

SM 120C–F, SM 240C–F - Dimensional Drawing

Refer to **Figure 7-63**, Figure 7-12, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F - Rotatable Flange Socket, and Figure 7-59, SM 055A, SM 075A, SM 100A, SM 120A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240 C–F - Connector for Speed (Rotary) Encoder.

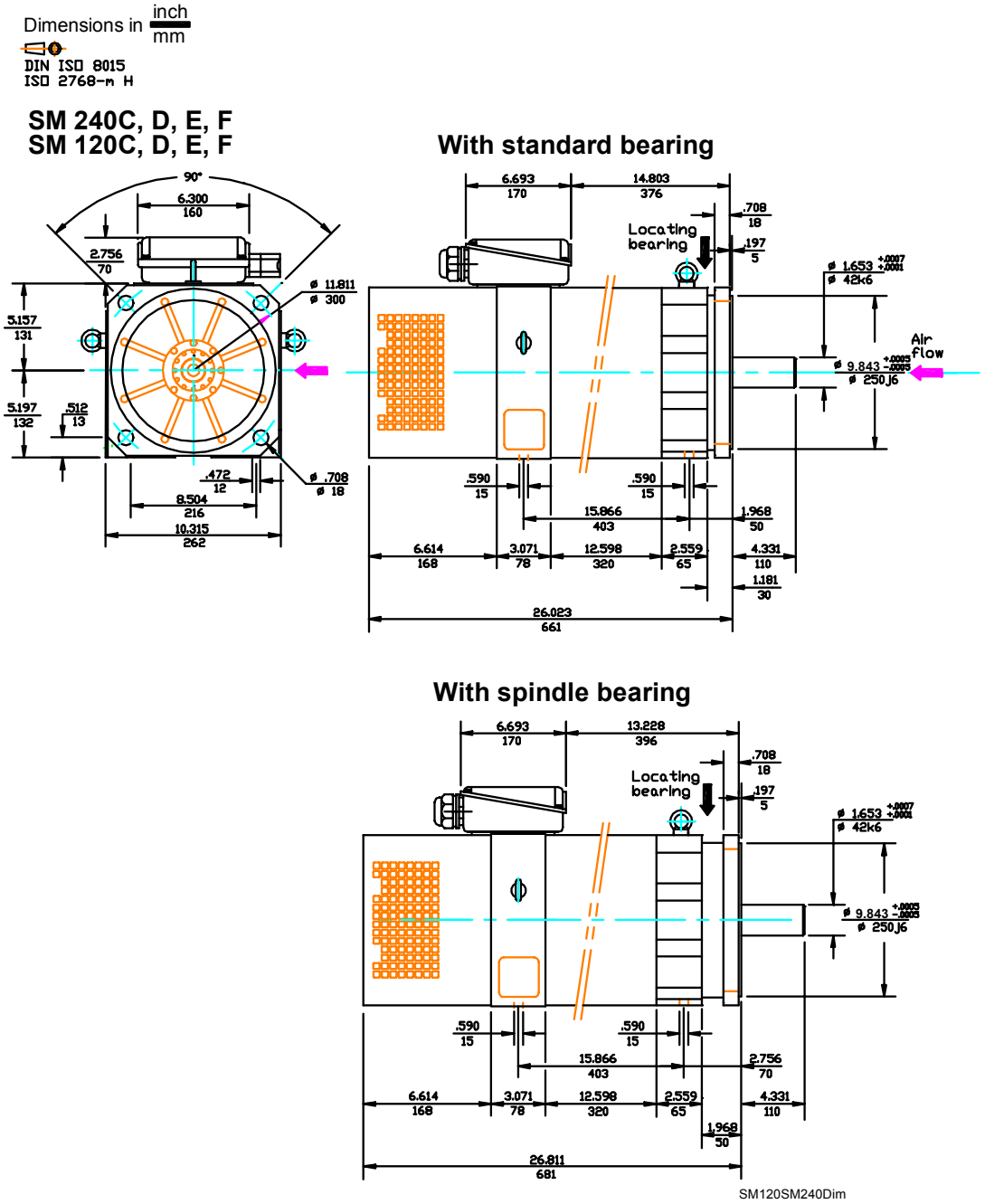


Figure 7-63, SM 120C–F, SM 240C–F - Dimensional Drawing

SM 150C–F - Dimensional Drawing

Refer to **Figure 7-64**, Figure 7-12, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F - Rotatable Flange Socket, and Figure 7-59, SM 055A, SM 075A, SM 100A, SM 120A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240 C–F - Connector for Speed (Rotary) Encoder.

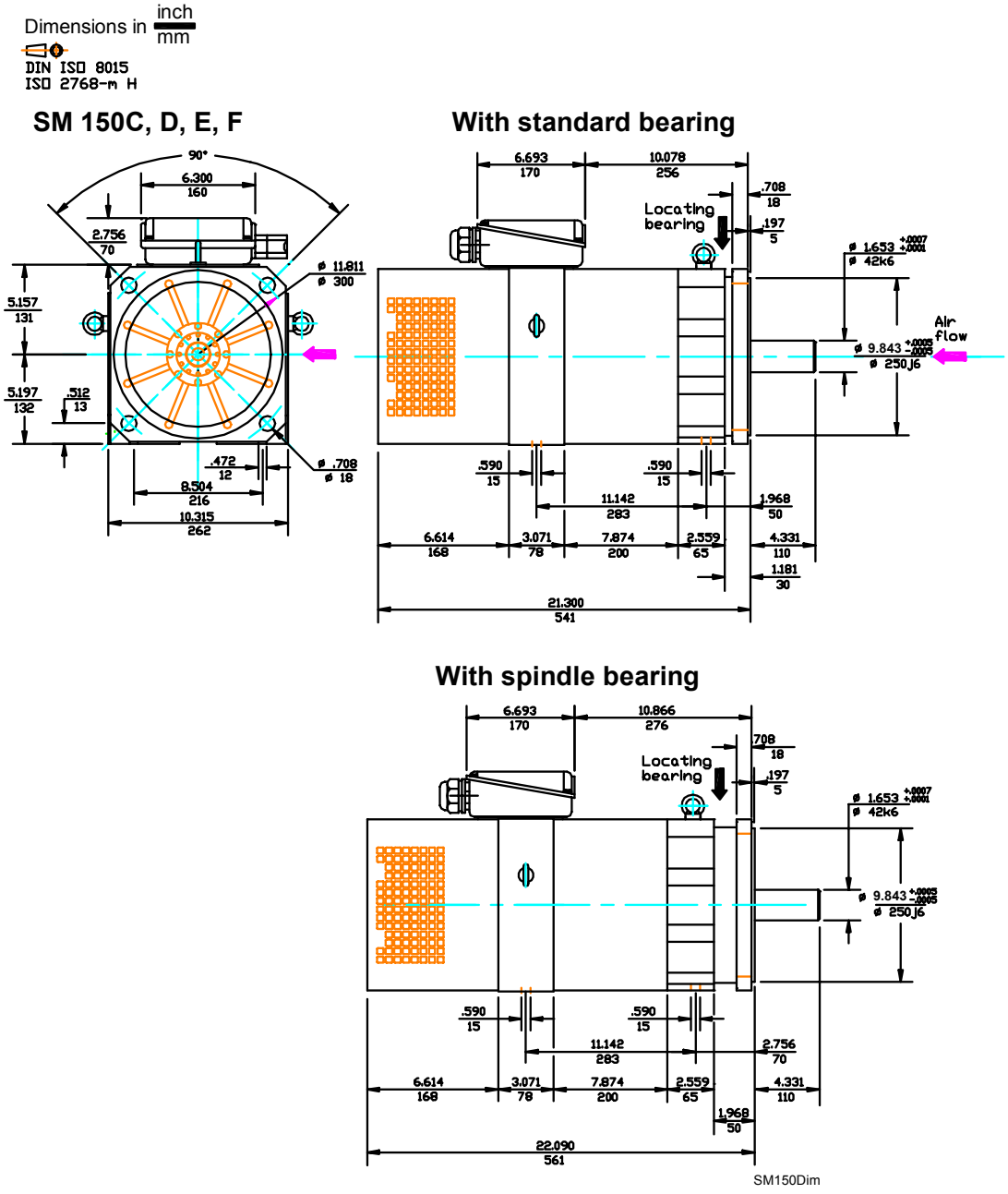


Figure 7-64, SM 150C–F - Dimensional Drawing

SM 200C–F - Dimensional Drawing

Refer to **Figure 7-65**, Figure 7-12, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240C–F - Rotatable Flange Socket, and Figure 7-59, SM 055A, SM 075A, SM 100A, SM 120A, SM 055C–F, SM 075C–F, SM 100C–F, SM 120C–F, SM 150C–F, SM 200C–F, SM 240 C–F - Connector for Speed (Rotary) Encoder.

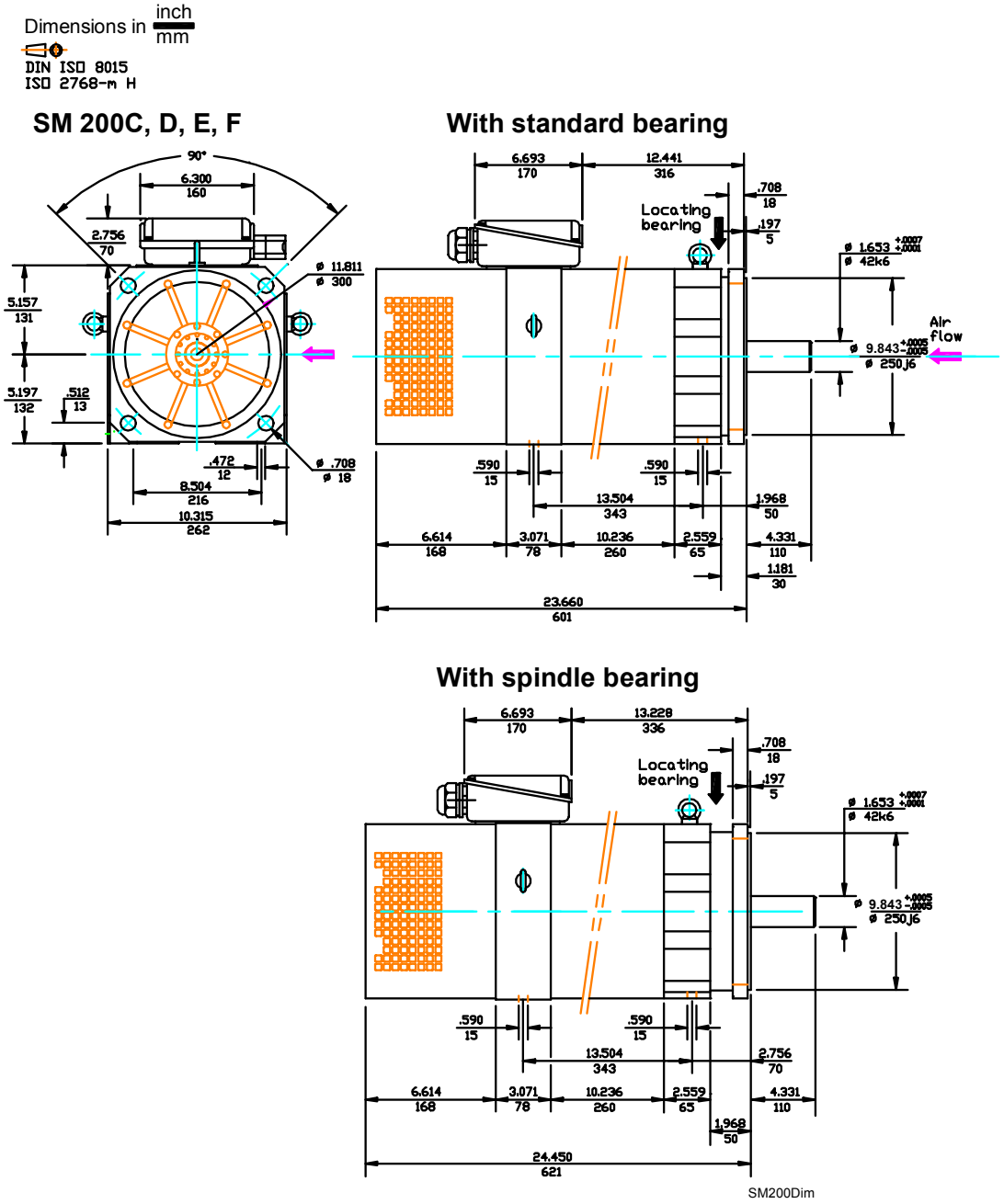


Figure 7-65, SM 200C–F - Dimensional Drawing

Permissible Forces on the Motor Shaft

Point of Radial Force

AM Series Motors and SM Series Spindle Motors

Refer to **Figure 7-66**.

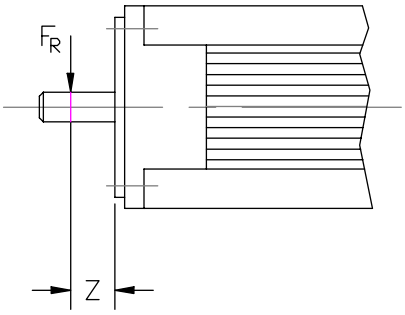


Figure 7-66, AM Series, SM Series - Points of Radial Force

AM 960A, AM 960AB Axis Motors - Permissible Forces

AM 960A, AM 960AB Axis Motors - Axial Force F_A on a Bearing

Refer to **Figure 7-67** for the maximum permissible axial force for a bearing with a rated service life of 30,000 hours.

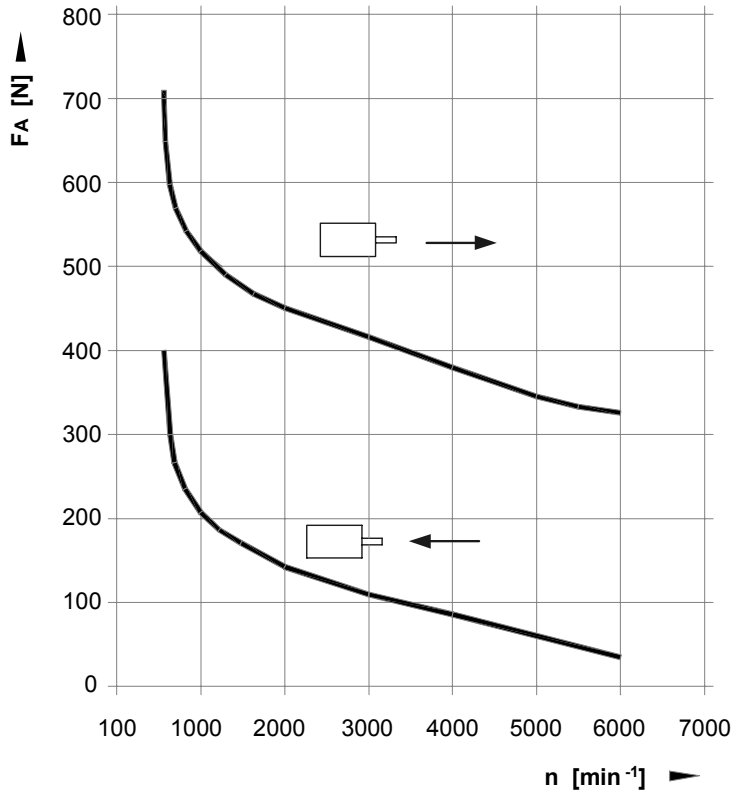


Figure 7-67, AM 960A, AM 960AB - Maximum Permissible Axial Force (F_A)

AM 960A, AM 960AB Axis Motors - Radial Force F_R on a Bearing

Refer to **Figure 7-68** for the maximum permissible radial force F_{Rmax} for a bearing with a rated service life of 30,000 hours, depending on the point of radial force and the average speed.

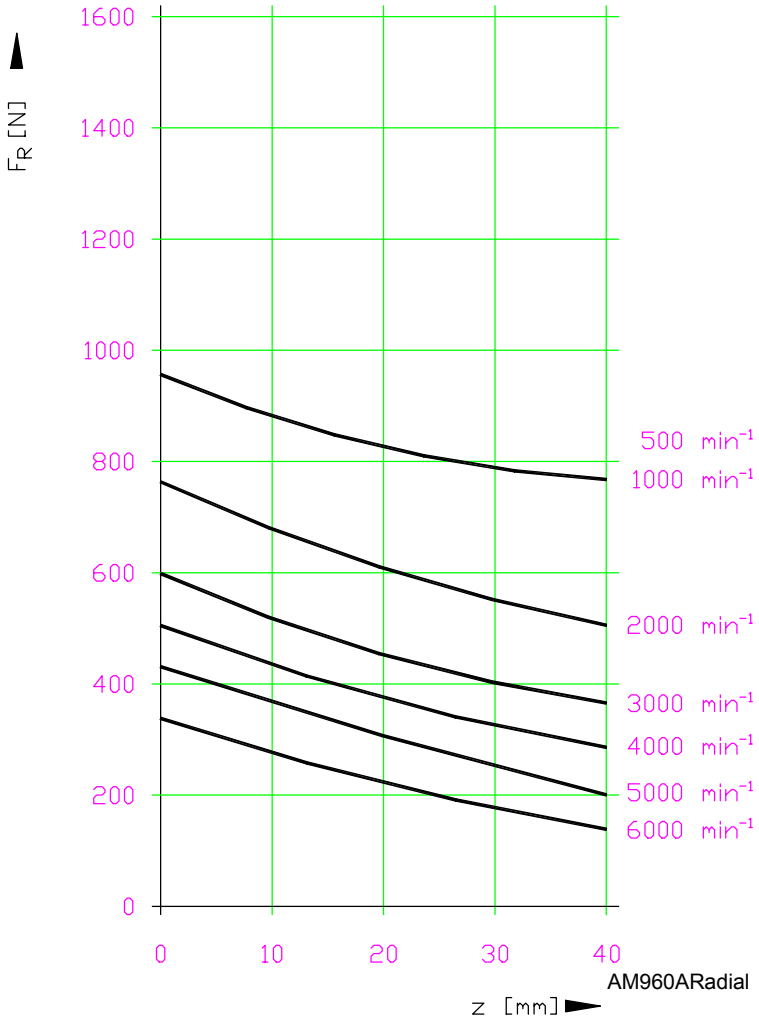


Figure 7-68, AM 960A, AM 960AB - Maximum Permissible Radial Force (F_{Rmax})

Combined Load on AM 1160 Series and AM 1550 Series

Determine the combined load that results from axial and radial forces on the AM 1160 and AM 1550 Series motor shafts as follows:

- Use the first diagram to determine the maximum permissible radial force F_R over the distance z and average speed (for example, refer to Figure 7-69, AM 1160 Series - Maximum Permissible Radial Force (FR)).
- Use the first diagram to determine the equivalent axial force F_{A2} over the applied axial force F_A (for example, refer to Figure 7-70, AM 1160 Series - Maximum Permissible Axial Force (FA2)). The applied axial force F_A shall not exceed 1000 N.
- Calculate the combined load F_{com} from the permissible radial force F_R and the equivalent axial force F_{A2}:

$$F_{com} = (0.56 \times F_R) + F_{A2}$$

The following requirements must be met in order to achieve a bearing service life of 30,000 hours:

- The applied axial force F_A must not exceed 1000 N.
- The applied radial force F_R must not exceed the permissible radial force from the illustration.
- The combined load F_{com} must not exceed the permissible radial force F_R for the first diagram (for example, refer to Figure 7-69, AM 1160 Series - Maximum Permissible Radial Force (FR)).

For the AM 1160 Series, to calculate the combined load F_{com} refer to:

- Figure 7-69, AM 1160 Series - Maximum Permissible Radial Force (FR)
- Figure 7-70, AM 1160 Series - Maximum Permissible Axial Force (FA2)

For the AM 1550 Series, to calculate the combined load F_{com} refer to:

- Figure 7-71, AM 1550 Series - Maximum Permissible Radial Force on the Motor Shaft (F_R)
- Figure 7-72, AM 1550 Series - Maximum Permissible Axial Force on the Motor Shaft (F_{A2})

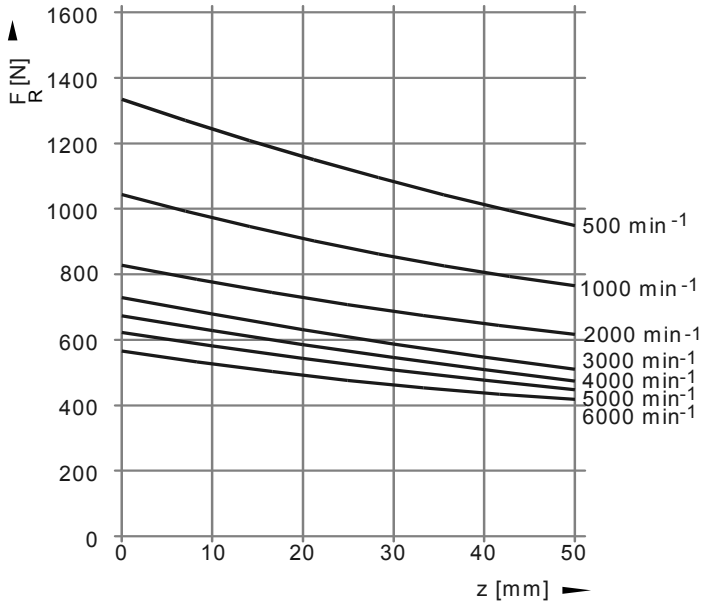


Figure 7-69, AM 1160 Series - Maximum Permissible Radial Force (F_R)

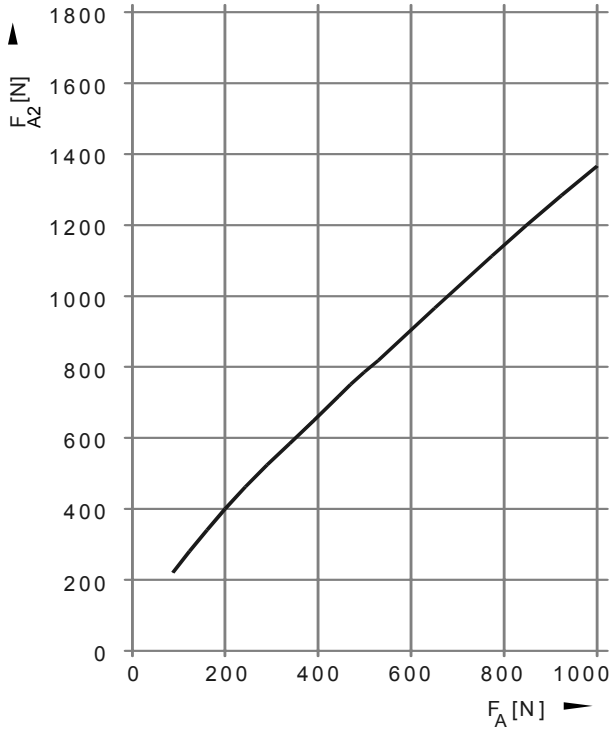


Figure 7-70, AM 1160 Series - Maximum Permissible Axial Force (F_{A2})

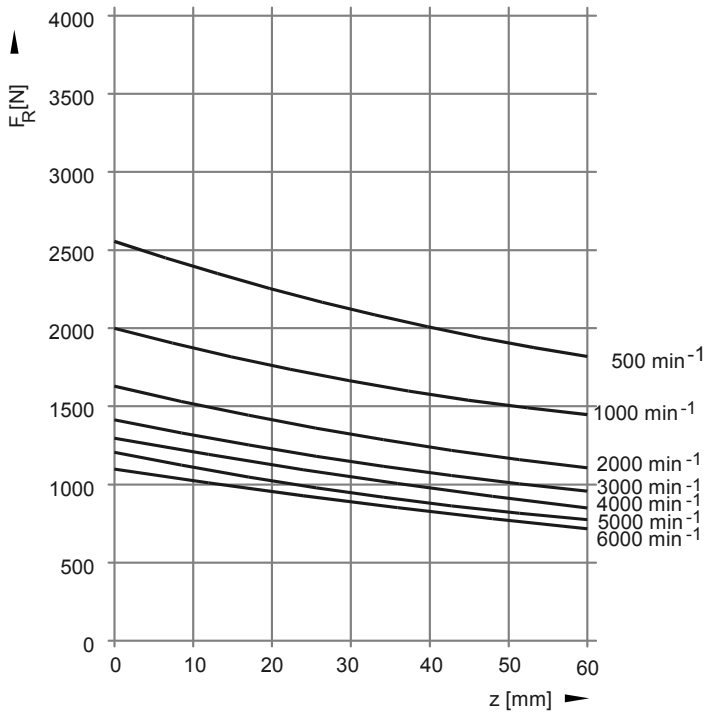


Figure 7-71, AM 1550 Series - Permissible Radial Force on the Motor Shaft (F_R)

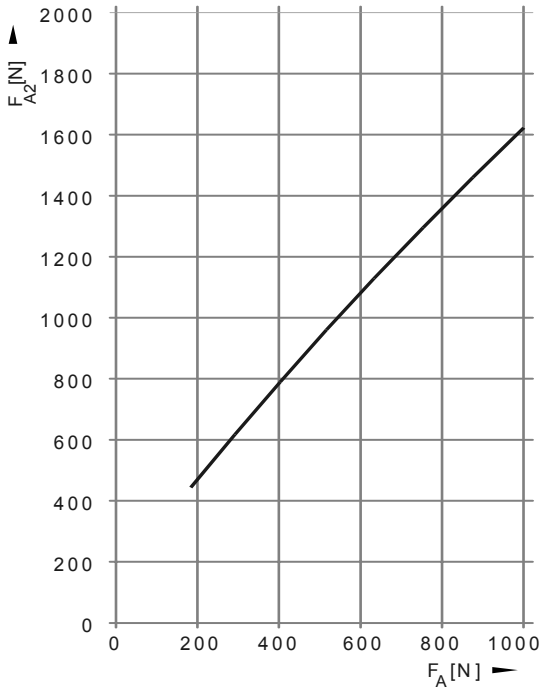


Figure 7-72, AM 1550 Series - Permissible Axial Force on the Motor Shaft (F_{A2})

AM 820, AM 1150, AM 1400 Series - Permissible Forces

The values given for permissible axial and radial forces are valid for a bearing life of 30,000 hours.

Axial Force F_A

To calculate the Axial Force F_A, use formula:

$F_{Amax} = x \cdot F_{Rmax}$

Refer to **Table 7-58** for the appropriate factor x.

Table 7-58, Axial Force Factors for AM 820, AM 1150, AM 1400 Series

Axis Motor	Factor x
AM 820A, AM 820AB	0.45
AM 1150A, AM 1150AB	0.55
AM 1400A, AM 1400AB, AM 1400C, AM 1400CB	0.34

Radial Force F_R

The following graphs show the maximum permissible radial forces F_{Rmax} depending on the point of the radial force and the average speed.

For AM 820 Series, refer to **Figure 7-73**.

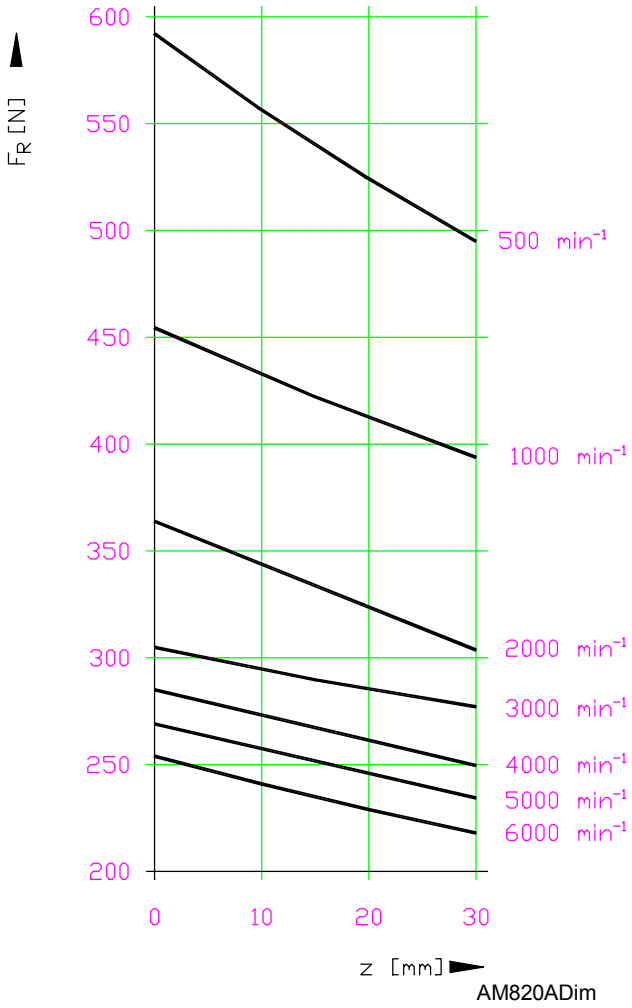


Figure 7-73, AM 820 Series - Permissible Radial Force on the Motor Shaft (F_R)

For AM 1150 Series, refer to **Figure 7-74**.

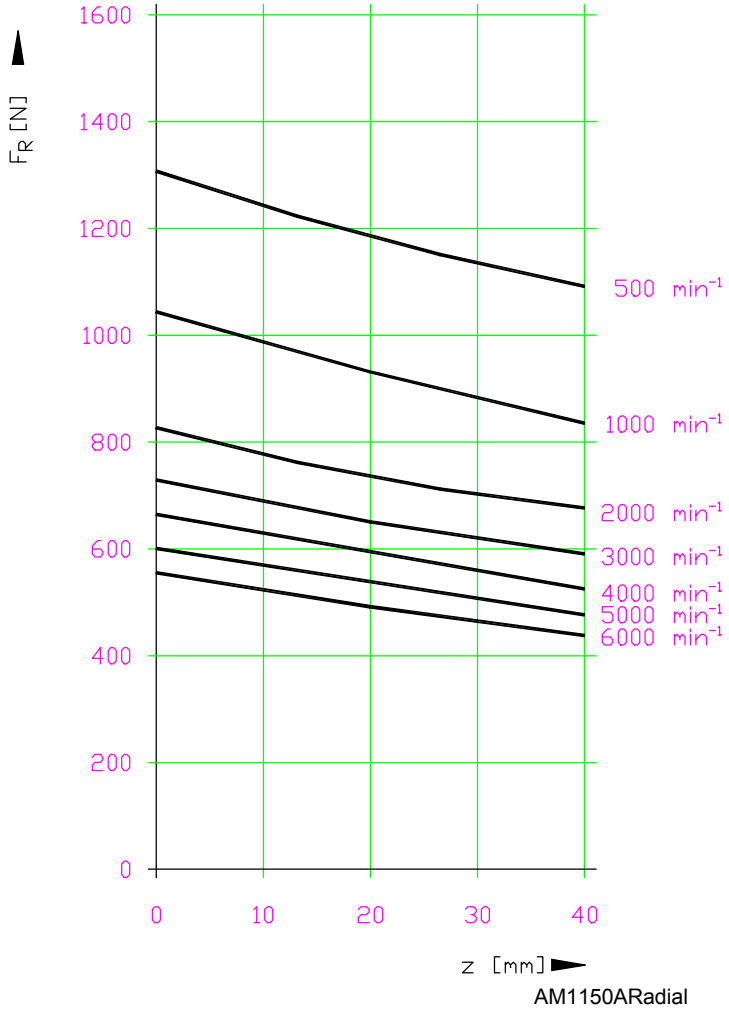


Figure 7-74, AM 1150 Series - Permissible Radial Force on the Motor Shaft (F_R)

For AM 1400 Series, refer to **Figure 7-75**.

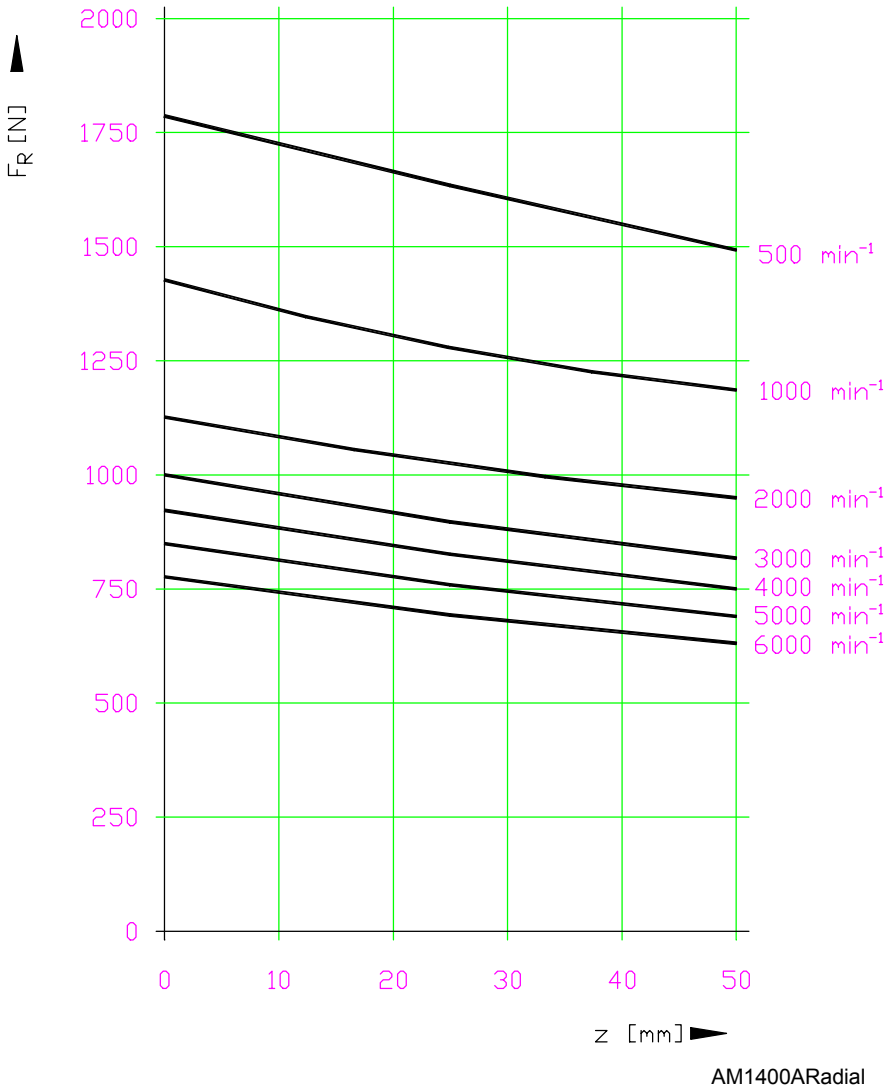


Figure 7-75, AM 1400 Series - Permissible Radial Force on the Motor Shaft (F_R)

SM 055A, SM 075A, and SM 100A Spindle Motors - Permissible Forces

Axial Force F_A

Refer to **Figure 7-76**. This figure shows the maximum permissible axial force, F_A, with horizontal mounting and a bearing service life of 20,000 hours. Specifications for axial load with vertical mounting are available from ANILAM upon request.

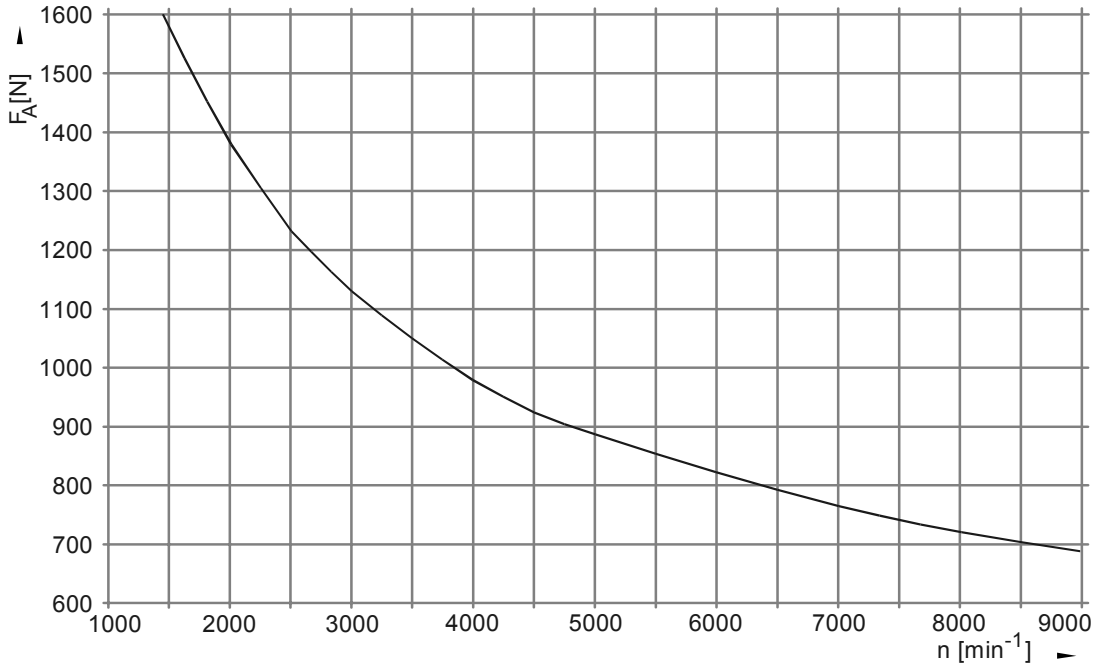


Figure 7-76, SM 055A, SM 075A, and SM 100A - Permissible Axial Force on the Motor Shaft

Radial Force F_R

Refer to **Figure 7-77**. The following diagram shows the maximum permissable radial force F_R at *z* =30 mm for a bearing service life of 20,000 hours.

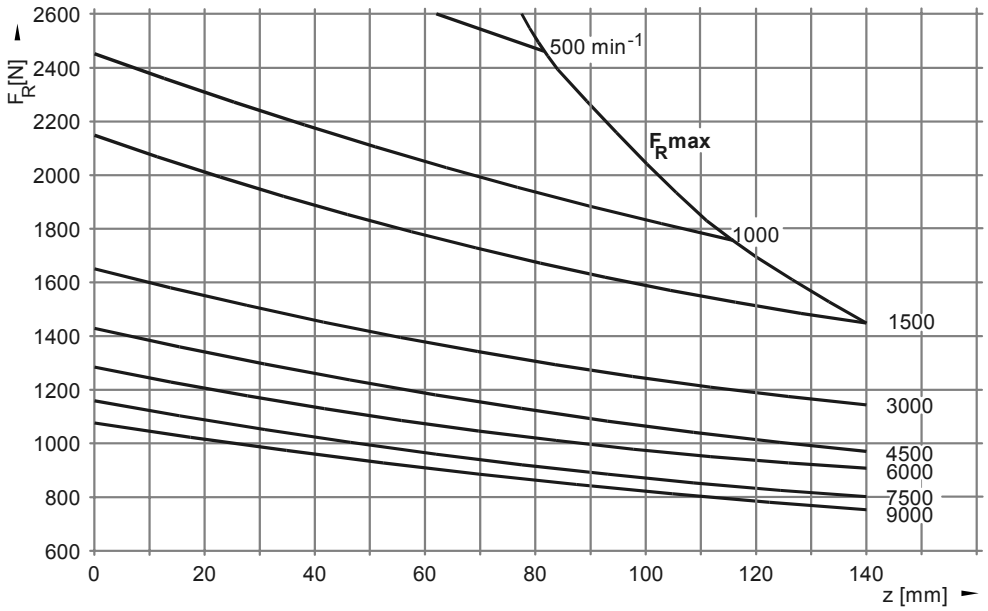


Figure 7-77, SM 055A, SM 075A, and SM 100A - Permissible Radial Force on the Motor Shaft

SM 120A - Permissible Forces

The values given for permissible axial and radial force are valid for a bearing life of 20,000 hours.

Axial Force F_A

SM 120A, maximum permissible axial force: F_A = 50 N

Radial Force F_R

Refer to **Figure 7-78**. The following diagram shows the maximum permissable radial force F_{Rmax} depending on the point of radial force and average speed.

1 = load limit for drive shaft with feather key

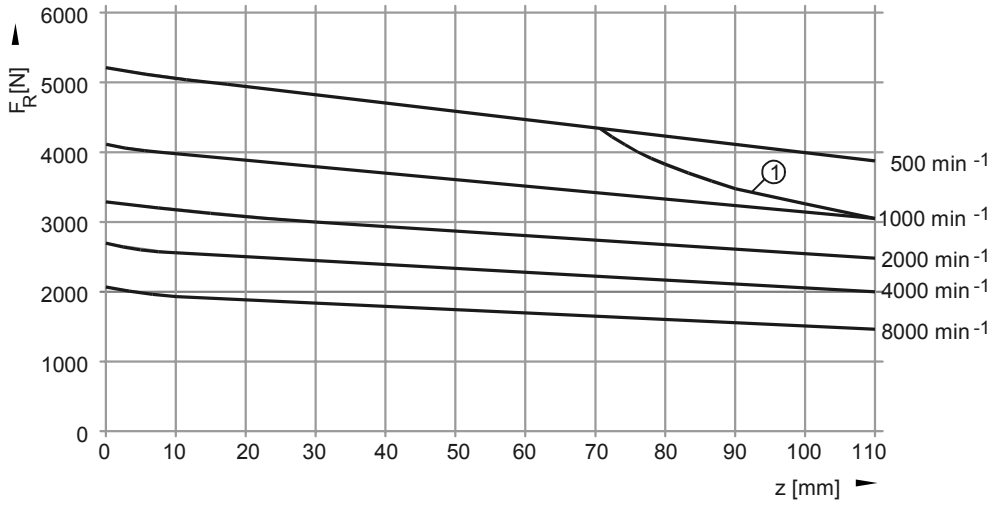


Figure 7-78, SM 120A - Permissible Radial Force on the Motor Shaft

SM 055C–F, SM 075C–F, SM 100C–F - Permissible Forces

The values given for permissible axial and radial force F_A and the radial force F_R for a bearing life of 10,000 hours. This also applies to the grease service life.

Axial Force F_A

For SM 055C, SM 055E, SM 075C, SM 075E, SM 100C, SM 100E – with standard bearing, refer to **Figure 7-79**.

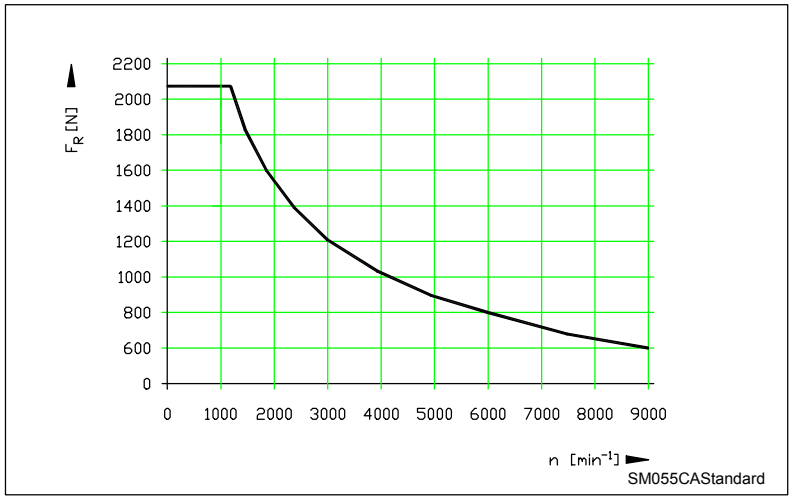


Figure 7-79, SM 055C, SM 055E, SM 075C, SM 075E, SM 100C, SM 100E - with Standard Bearing -Permissible Axial Force on the Motor Shaft

For SM 055D, SM 055F, SM 075D, SM 075F, SM 100D, SM 100F – with spindle bearing, refer to **Figure 7-80**.

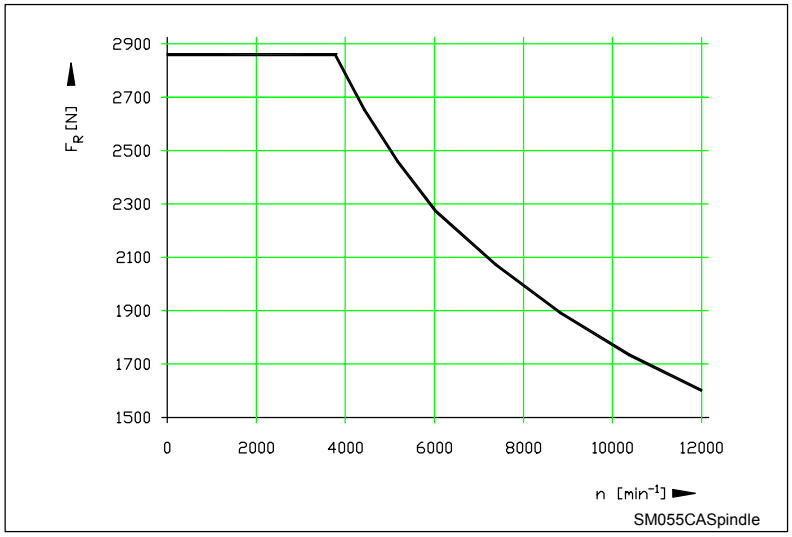


Figure 7-80, SM 055D, SM 055F, SM 075D, SM 075F, SM 100D, SM 100F - with Spindle Bearing - Permissible Axial Force on the Motor Shaft

Radial Force F_R

For SM 055C, SM 055E, SM 075C, SM 075E, SM 100C, SM 100E – with standard bearing, refer to **Figure 7-81**.

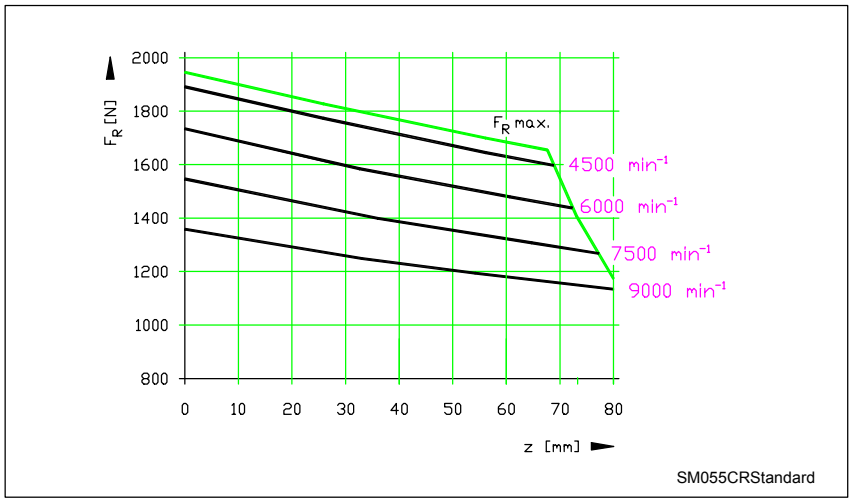


Figure 7-81, SM 055C, SM 055E, SM 075C, SM 075E, SM 100C, SM 100E - with Standard Bearing - Permissible Radial Force on the Motor Shaft

For SM 055D, SM 055F, SM 075D, SM 075F, SM 100D, SM 100F – with spindle bearing, refer to **Figure 7-82**.

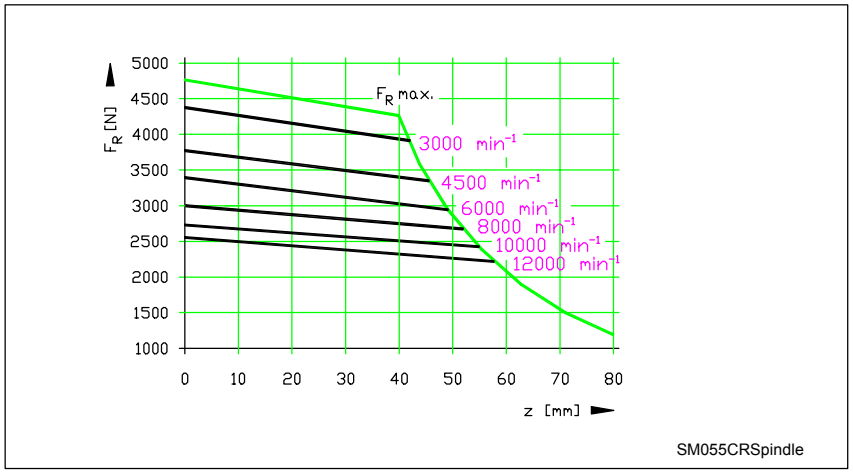


Figure 7-82, SM 055C, SM 055D, SM 075C, SM 075D, SM 100C, SM 100D - with Spindle Bearing - Permissible Radial Force on the Motor Shaft

Input Values for the Current Controller

The following input values for the current controller are initial values, and must adjusted from case to case.

Axis Motors

Refer to **Table 7-59**.

Table 7-59, Axis Motors Input Values for the Current Controller

Motor	Analog Current Controller: Amplification	Analog Current Controller: Amplification at Maximum Speed	Digital Current Controller: P factor	Digital Current Controller: I factor
AM 820A, AM 820AB	45,000	0	—	—
AM 1150A, AM 1150AB	45,000	0	—	—
AM 1400A, AM 1400AB (n_N = 3000 rpm)	55,000	0	—	—
AM 1400C, AM 1400CB (n_N = 2000 rpm)	70,000	0	—	—
AM 960A, AM 960AB	50,000	0		
AM 1160A, AM 1160AB	150,000	0		
AM 1160C, AM 1160CB	100,000	0		
AM 1160E, AM 1160DB	50,000	0	20,000	30,000
AM 1550C, AM 1550CB	50,000	0	15,000	25,000
AM 1550E, AM 1550EB	30,000	0	8,000	5,000
AM 1550G, AM 1550GB	30,000	0	8,000	10,000

Spindle Motors

Refer to **Table 7-60**.

Table 7-60, Spindle Motors Input Values for the Current Controller

Motor	Analog Current Controller: Amplification	Analog Current Controller: Amplification at Maximum Speed	Digital Current Controller: P factor	Digital Current Controller: I factor
SM 055A	15,000 to 20.000	45,000 to 60,000	—	—
SM 075A	10,000	50,000 to 70,000	—	—
SM 100A	10,000	30,000 to 45,000	—	—
SM 120A	25,000	50,000	—	—
SM 055C–F			6,000	9,000
SM 075C–F			6,000	7,000
SM 100C–F			4,000	5,000

B

C

D

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