

Intelligent Drive Systems, Worldwide Services



SK 700E

F 3070 GB



Universal application

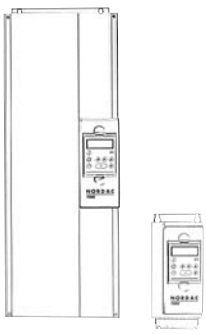
Modular High-Performance Inverter NORDAC SK 700E

The NORDAC SK 700E frequency inverter is designed for the power range between 1.5 kW and 160 kW. The system works with sensorless current vector regulation (ISD). The typical overload capacity is 150% for 60 s or 200% for 3.5 s. As standard, the devices are equipped with a brake chopper and line filter (for limit curve A according to EN 55011, up to 22 kW). The combination of a powerful control module and comprehensive protection and monitoring systems for the controller and the motor ensure great system reliability.



The open, modular concept of the NORDAC series enables the use of SK 700E inverters in a wide range of applications. Via internal modules for I/O and field bus connection, and by means of external plug-in technology units, the units can be individually configured and extended according to requirements. In combination with an incremental and/or absolute encoder, high-precision process applications can also be achieved. If necessary, the inverter can even handle positioning tasks, which can be performed without PLC control.





Flexible through modular design

Technology boxes for inverter operation

For parameterisation and control, technology boxes ensure optimum flexibility: According to the complexity of the application and the required degree of comfort, parameter orientated operation (ControlBox), instruction-free commissioning (ParameterBox) or potentiometer operation (PotentiometerBox) are possible.



ParameterBox

- Instruction-free commissioning
- Plain text display
- Stores 5 data sets
- Control of the frequency inverter
- Display of operating data



ControlBox

- 4-digit, 7-segment display
- Stores 1 data set
- Rapid and direct parameterisation
- Display of operating data



PotentiometerBox

- Direct on/off switching and setting of specified values (e.g. motor speed)
- Simple operation without access to parameters

Technology unit for communication

By means of external plug-in technology units, SK 700E inverters can be adapted to the requirements of specific applications. Optional modules are available to suit all common field buses, so that the inverters can be smoothly integrated into existing automation architectures.



RS 232

- Control, parameterisation and diagnosis of the frequency inverter
- Connecting plug: SUB-D 9-pin
- Baud rate: 38,400 Bit/s
- Internal power supply



Profibus

- Control, parameterisation and diagnosis of the frequency inverter.
- Connecting plug: SUB-D 9-pin
- Baud rate: 1.5 MBit/s
- Internal power supply

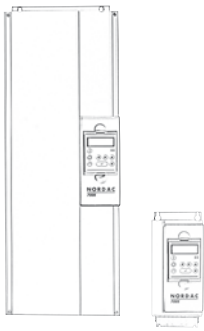


Profibus 24V

As for Profibus, but:

- Baud rate: 12 MBit/s, externally adjustable
- External, 24V power supply, 2-pin screw terminal
- Adjustable Bus address





CANBus

- Control, parameterisation and diagnosis of the frequency inverter
- Connecting plug: SUB-D 9-pin
- Baud rate: 500 KBit/s
- Internal power supply
- Dip switch for the terminating resistor



CANopen

- Control, parameterisation and diagnosis of the frequency inverter.
- Connecting plug: SUB-D 9-pin
- Baud rate: 1 MBit/s, externally adjustable
- External power supply via SUB-D plug
- Bus address can be externally set
- Dip switch for the terminating resistor
- Status LEDs: DR, DE



DeviceNet

- Control, parameterisation and diagnosis of the frequency inverter
- Plug-in 5-pin connecting terminal
- Baud rate: 500 MBit/s, externally adjustable
- External 24V power supply via connecting terminals
- Bus address can be externally set
- Status LEDs: MS, NS, DS, DE



InterBus

- Control, parameterisation and diagnosis of the frequency inverter.
- Connecting plug: SUB-D 9-pin IN and OUT
- Baud rate: 500 KBit/s (optional 2MBit/s)
- External 24V supply, 2-pin plug-in terminal
- PPO-Type can be adjusted externally
- Status LEDs: UL, RC, BA, RD, TA



AS interface

- Control, parameterisation and diagnosis of the frequency inverter.
- Plug-in 5-pin connecting terminals (PWR, AUX) and 8-pin (I/O)
- Slave profile 7.4 with cyclic 4 bit I/O data, string transfer
- Max. 31 frequency inverters (Standard Slave Technology), Cycle time $\leq 5\text{ms}$
- External 24V power supply
- 4x Dig In, 2x Dig Out to terminals (sensors/actuators)
- Status LEDs: Device S/E, AS-Int, PWR/FLT, Digital I/O IN 1-4 / Out1-2, AS-I I/O In1-4 / Out1-4

Customer interfaces

I/O Modules

Customer interfaces for the I/O and the field bus connection are also available for configuring the inverters. The optional plug-in modules, whose slots are located inside the frequency inverter, offer graduated I/O functionalities: One customer interface per device may be used.



SK CU1-BSC

Basic I/O

- 1x multi-function relay
- 3x Digital input
- 1x Analog input 0...10V

Standard I/O

- 2x multi-function relay
- 4x Digital input
- 1x Analog input (0...10V, 0/4...20mA)
- 1x Analog output 0...10V
- 1x RS 485



SK CU1-STD

Multi I/O

- 2x multi-function relay
- 6x Digital input
- 2x Analog input (-10...+10V, 0/4...20mA)
- 2x Analog output (0...10V, or 0/4...20mA)



SK CU1-MLT

BUS Modules

Profibus, CANbus and USS interfaces can be supplied as field bus expansions.



SK CU1-PBR

Profibus

- 1x multi-function relay
- 1x Digital input
- 1x Profibus to terminal
- Baud rate 1.5 Mbit/s

CANbus

- 1x multi-function relay
- 5x Digital input
- 2x RJ45 for data cable
- 1x Dip for terminal resistor



SK CU1-CAN-RJ



SK CU1-USS

USS

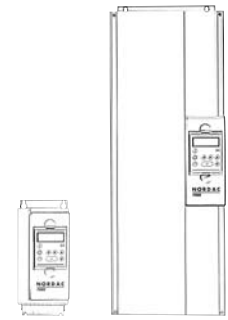
- 1x multi-function relay
- 1x Digital input
- 1x Data cable to terminal



DRIVESYSTEMS



Special extensions



Incremental encoder input

A further option is the encoder card, which allows the direct connection of encoders - therefore SK 700E inverters can be used for applications which require high-precision control of speed and torque (e.g. lifting gear applications, torque to zero speed).



SK XU1-ENC

Encoder

- 1x Digital input
- 1x TTL incremental encoder input

Positioning control

In order to implement simple but precise positioning control with a frequency inverter, the SK 700E provides the optional extension POSICON. Due to the simple principle of this positioning, the corresponding applications can be implemented by anyone. With this, there is no need for servo-solutions if the dynamics and precision of the asynchronous motor are sufficient.

A relative (e.g. pulse operation, rotating platform) or absolute regulation of position (finite axis, linear movement axes) can be carried out. The module contains one input each for an incremental encoder (TTL) and an absolute encoder (SSI interface). The switching of movement and positioning signals is carried out optionally by means of binary (terminals) via the bus system.

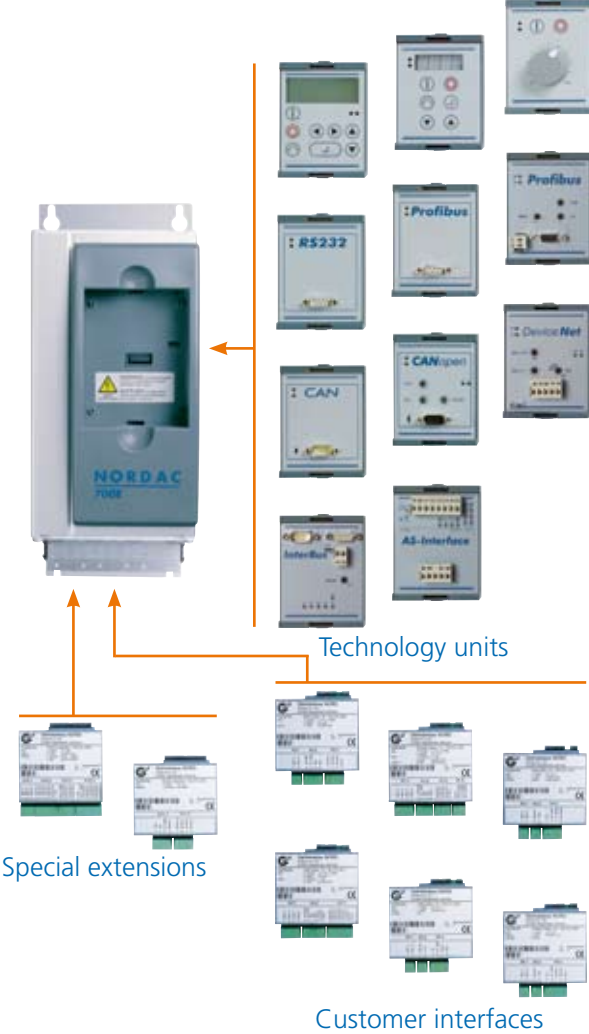
Posicon

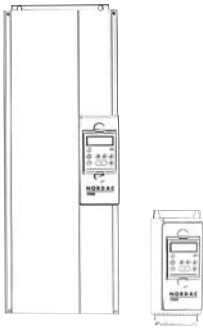
- 1x multi-function relay
- 6x Digital input
- 1x Absolute encoder SSI
- 1x TTL incremental encoder input



SK XU1-POS

System Overview

 The diagram illustrates the NORDAC SK 700E drive system. On the left is the main drive unit. To its right are several technology units including: a digital display unit, a Profibus unit, a CANopen unit, a DeviceNet unit, an RS232 unit, a CAN unit, an AS-Interface unit, and a chopper unit. Below these are special extensions and customer interfaces. Arrows indicate the connection of these units to the main drive.					
Device series SK 700E	Sensorless current vector control (ISD control)	Brake control, electro-mechanical holding brake	Brake chopper (brake resistance)	Flying start	
size 1 - 4 1.5 - 22 KW	✓	✓	✓	✓	
size 5 - 7 30 - 160 KW	✓	✓	✓	✓	



Online switchable parameter sets	✓	✓
All normal drive functions	✓	✓
Process controller / PID controller	✓	✓
Comprehensive parameter structure	✓	✓
Simple to operate	✓	✓
All common BUS Systems	✓	✓
RS 232 diagnosis interface on board	○	✓
Line filter Class A,	✓	○
Incremental encoder input Absolute encoder input	○	○
POSICON (position control, relative and absolute position control and synchronous operation)	○	○

✓ Standard
○ optional

General Data SK 700E

Function	Specification
Output frequency	0,0 ... 400.0 Hz
Pulse frequency	1.5 to 7.5kW: 3,0 ... 20.0kHz (Standard = 6kHz = Nominal power 100% ED) 11 to 37kW: 3,0 ... 16.0kHz (Standard = 6kHz = Nominal power 100% ED) 45 to 110kW: 3,0 ... 8.0kHz (Standard = 4.0kHz = Nominal power 100% ED) 132kW/160kW: 4.0kHz
Typical overload capacity	1.5...22kW: 150% for 60s, 200% for 3.5s 30...132kW: 150% for 60s (Pulse switch-off P537) SK 700E-163-340-O-VT: max. 125% for 60s (> 5Hz) max. 80...125% for 60s (0...5Hz)
Protective measures against	excess temperature of the frequency inverter, overvoltage, undervoltage, short circuit, earth fault, overload, idling
Regulation and control	Sensorless current vector control (ISD control) field-orientated control Linear v./f. characteristic curve
Motor temperature monitoring:	I ² t- Motor (UL/cUL approved), PTC / Bi-metal switch (optional, not UL/cUL)
Ramp times	0 ... 320s
Efficiency of inverter	Approx. 95%
Ambient temperature	0°C ... +50°C (S3 - 75% ED, 15 min.), 0°C ... +40°C (S1 - 100% ED) > 22kW: only 0°C ... +40°C (S1 - 100% ED) for UL/cUL approval 0°C ...+40°C generally applies
Storage and transport temperature	-20°C ... 70°C / +70°C, max. 85% humidity without condensation.
Protection class	IP20
Electrical isolation	Control terminals (digital and analog inputs)
Max. installation altitude above sea level	up to 1000m: No power derating 1000...4000m: 1%/ 100m power reduction (up to 2,000m overvoltage category 3) 2000...4000m: Only overvoltage category 2 is maintained, external overvoltage protection at the mains input is necessary
Waiting time between two mains switching cycles	60 sec for all devices in normal operating cycle



NORD CON

NORD CON is the free operating software for controlling, parameterisation and diagnosis of all NORD frequency inverters.

Control

The connected frequency inverter can be manually operated by means of a software window with all the operating elements of a ControlBox. An enable signal with specification of setpoint values can be given. The parameter settings can be adjusted and read parameters (information and error messages) can be viewed. With this, the user has a support aid for each start-up.

Parameterisation

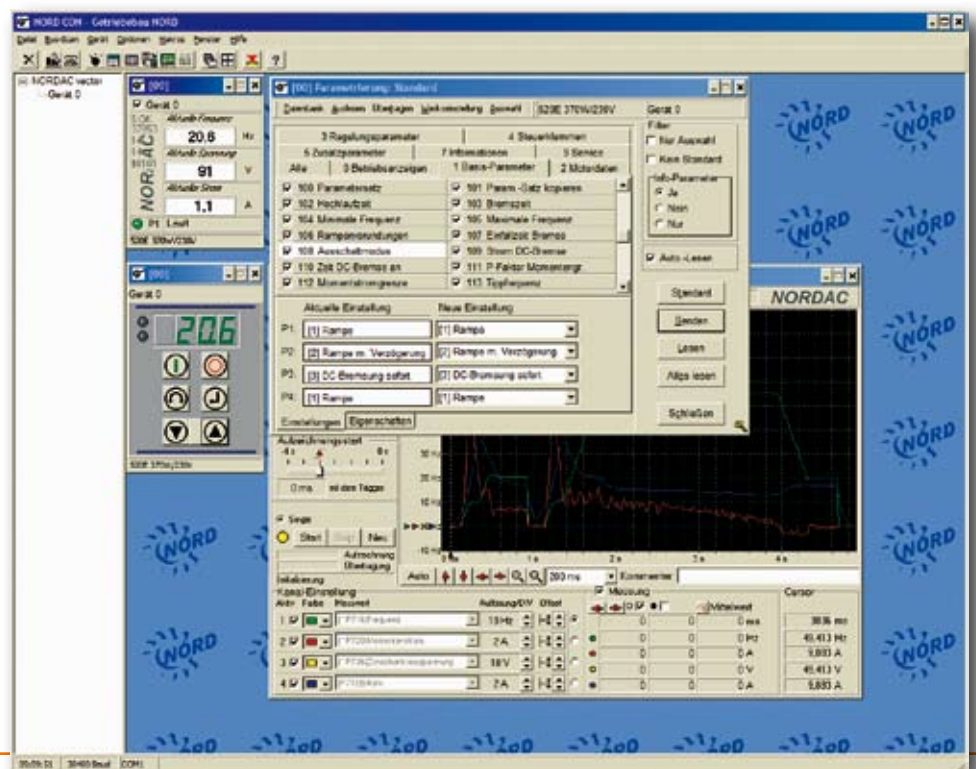
By means of a convenient overview the user can view and adjust each available parameter. By means of an appropriate printing option, parameter lists are generated in printed form either completely or with amended values. The completed data sets can be stored on a laptop/PC and archived for future use.

Diagnosis

As well as the display of all information parameters, the oscilloscope function can be a useful diagnosis instrument. Up to 4 selectable values (e.g. current, frequency) can be recorded as a line graph over a period of up to 2 hours. Automatic scaling can be selected and enables simple handling for rapid results. With this, the various applications, e.g. brake drives can be quickly and simply optimised by anyone.

The free NORD CON software can be obtained:

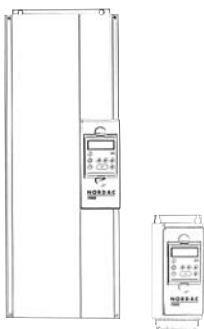
- on the home page www.nord.com
- on the documentation CD EPD (Electronic Product Documentation)



Overview SK 700E

Inverter type SK 700E...	Material number	Mains voltage	Nominal motor output 400 V [kW]
...151-340-A	278 100 150	3 ~ 380...480V, -20%/+10%, 47...63Hz	1,5
...221-340-A	278 100 220		2,2
...301-340-A	278 100 300		3,0
...401-340-A	278 100 400		4,0
...551-340-A	278 100 550		5,5
...751-340-A	278 100 750		7,5
...112-340-A	278 101 100		11
...152-340-A	278 101 500		15
...182-340-A	278 101 850		18,5
...222-340-A	278 102 200		22
...302-340-O	278 103 000		30
...372-340-O	278 103 700		37
...452-340-O	278 104 500		45
...552-340-O	278 105 500		55
...752-340-O	278 107 500		75
...902-340-O	278 109 001		90
...113-340-O	278 111 000		110
...133-340-O	278 113 200		132
...163-340-O-VT	278 116 000		160





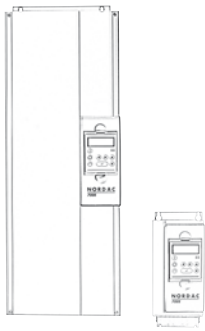
Nominal motor output 480 V [hp]	Nominal output current* rms [A]	Typical input current rms [A]	Dimensions L x B x D [mm]
2	3,6	6	size1: 281 x 123 x 219
3	5,2	8	
4	6,9	11	
5	9,0	13	
7,5	11,5	17	size2: 331 x 123 x 219
10	15,5	21	
15	23	30	size3: 386 x 123 x 219
20	30	40	
25	35	50	size4: 431 x 201 x 268
30	45	60	
40	57	70	size5: 599 x 263 x 263
50	68	88	
60	81	105	
75	103	125	
100	133	172	size6: 736 x 263 x 336
125	158	200	
150	193	240	size7: 1207 x 354 x 263
175	230	280	
200	280	340	

*Overload capacity: 1,5 ... 22 kW: 200% for 3.5s, 150% for 60s
 30 ... 132 kW: 150% for 60s
 160 kW: 125% for 60s

Technology units

	Technology units	Option Type	Material number
Operation		ParameterBox SK TU1-PAR	278 200 100
		ControlBox SK TU1-CTR	278 200 090
		PotentiometerBox SK TU1-POT	278 200 110
Communication		RS 232 SK TU1-RS2	278 200 080
		Profibus module SK TU1-PBR	278 200 060
		Profibus module SK TU1-PBR-24V	278 200 160
		CANbus module SK TU1-CAN	278 200 070
		CANopen SK TU1-CAO	278 200 075
		DeviceNET SK TU1-DEV	278 200 085
		InterBus SK TU1-IBS	278 200 065
		AS interface SK TU1-AS1	278 200 170



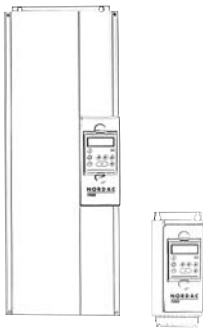


Description	Data
Operating window with clear text display for text-controlled commissioning, parameterisation and control of the frequency inverter. Clip-on option.	6 languages Stores 5 data sets Help text
As ParameterBox, but with simplified display. Clip-on option	4-digit, 7-segment LED display Stores 1 data set
For controlling the drive directly on the frequency inverter. Clip-on option	Potentiometer 0 to 100% Button On/OFF/Reverse
All common bus systems for control, parameterisation and diagnosis of the frequency inverter via a communication system. Clip-on option.	Baud rate: up to 38 400 Bit/s Connector: SUB-D 9-pin
	Baud rate: up to 1.5 MBit/s Connector: SUB-D 9-pin
	Baud rate: up to 12 MBit/s Connector: SUB-D 9-pin +24V DC
	Baud rate: 500 KBit/s Connector: SUB-D 9-pin
	Baud rate: up to 1 MBit/s Connector: SUB-D 9-pin
	Baud rate: up to 500 kBit/s 5-pin screw connector
	Baud rate: 500 kBit/s (optional 2MBit/s) Connector: 2x SUB-D 9-pin
	4 sensors / 2 actuators 5 and 8 pole terminal

Customer interfaces and special expansions

	Interfaces	Option Type	Material number
Customer interfaces		Basic I/O SK CU1-BSC	278 200 000
		Standard I/O SK CU1-STD	278 200 020
		Multi I/O SK CU1-MLT	278 200 010
		Multi I/O 20mA SK CU1-MLT-20mA	278 200 015
		Profibus SK CU1-PBR	278 200 030
		CANBus I/O SK CU1-CAN-RJ	278 200 052
		USS SK CU1-USS	278 200 040
Special extensions		PosiCon SK XU1-POS	278 200 130
		Encoder SK XU1-ENC	278 200 120





Description	Data
Simplest customer interface for optimum adaptation to the application.	1 x multi-function relay 3 x digital input 1 x analog input, 0...10V
Extended functionality of the control signals, including USS bus interface.	2 x multi-function relays 4 x digital input 1 x analog input, 0...10V, 0/4...20mA 1 x analog output, 0...10V 1 x RS 485
Highest functionality with digital and analog signal processing. Analog voltage output.	2 x multi-function relays 6 x digital inputs 2 x analog inputs, -10...+10 V, 0/4...20mA 2 x analog output, 0...10V
Highest functionality with digital and analog signal processing. Analog current output.	2 x multi-function relays 6 x digital inputs 2 x analog inputs, -10...+10 V, 0/4...20mA 2 x analog outputs, 0/4...0.20mA
This option enables control of the NORDAC SK 700E via the Profibus DP serial port.	1 x multi-function relay 1 x digital input 1 x Profibus
This interface enables the control of the NORDAC SK 700E via the serial CAN port.	1 x multi-function relay 5 x digital inputs 2 x RJ45 CANbus connectors
This interface enables the control of the NORDAC SK 700E via the USS protocol.	1 x multi-function relay 1 x digital input 1 x data cable to terminal
Positions controlled by orientation or speed are travelled to an held by means of calculation of optimum path. Detection of the actual value is by means of incremental and/or absolute value encoders.	up to 252 positions 2 x multi-function relays 6 x digital inputs 1 x absolute encoder input, SSI 1 x incremental encoder input, TTL
For high precision speed regulation from standstill up to double the rated speed.	up to 250kHz 1 x digital input 1 x incremental encoder input, TTL

Line filter

Footprint line filter

Inverter type SK 700E	Line filter, type IP20	Material number	without additional line filter
1.5...4.0 kW	SK LF1-460/14-F	278 271 014	Class 2 (A)
5.5...7.5 kW	SK LF1-460/24-F	278 271 024	Class 2 (A)
11...15 kW	SK LF1-460/45-F	278 271 045	Class 2 (A)
18...22 kW	SK LF1-460/66-F	278 271 066	Class 2 (A)

Chassis line filter

Inverter type SK 700E	Line filter, type IP20	Material number	without additional line filter
1,5...2.2 kW	HLD 110-500/8	278 272 008	Class 2 (A)
3.0...5.5 kW	HLD 110-500/16	278 272 016	Class 2 (A)
7.5...11 kW	HLD 110-500/30	278 272 030	Class 2 (A)
15 kW	HLD 110-500/42	278 272 042	Class 2 (A)
18.5 kW	HLD 110-500/55	278 272 055	Class 2 (A)
22...30 kW	HLD 110-500/75	278 272 075	Class 2 (A) / Class 1 (-)
37 kW	HLD 110-500/100	278 272 100	Class 1 (-)
45...55 kW	HLD 110-500/130	278 272 130	Class 1 (-)
75 kW	HLD 110-500/180	278 272 180	Class 1 (-)
90...110 kW	HLD 110-500/250	278 272 250	Class 1 (-)
132 kW	HFD 103-500/300	276 983 997	Class 1 (-)
160 kW	HFD 103-500/400	278 272 400	Class 1 (-)





Footprint line filter



Chassis line filter

with additional line filter	L in mm	B in mm	D in mm
Class 3 (B)	281	121	48
Class 3 (B)	331	121	58
Class 3 (B)	386	165	73
Class 3 (B)	431	201	83

with additional line filter	L in mm	B in mm	D in mm
Class 3 (B)	190	45	75
Class 3 (B)	250	45	75
Class 3 (B)	270	55	95
Class 3 (B)	310	55	95
Class 3 (B)	250	85	95
Class 3 (B) / Class 2 (A)	270	85	135
Class 2 (A)	270	95	150
Class 2 (A)	270	95	150
Class 2 (A)	380	130	181
Class 2 (A)	450	155	220
Class 2 (A)	564	300	160
Class 2 (A)	564	300	160

Class 1 (-) : General, for industrial environments

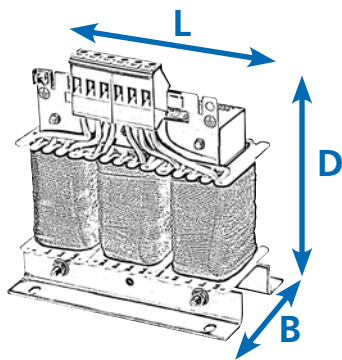
Class 2 (A) : Interference suppressed, for industrial environments

Class 3 (B) : Interference suppressed for domestic, commercial and light industry environments

Input chokes

Inverter type SK 700E	Choke type IP 00	Material number	Continuous current
1,5 ... 2.2 kW	SK CI1-460/6-C	276 995 004	6A
3,0 ... 4.0 kW	SK CI1-460/11-C	276 995 010	11 A
5,5 ... 7.5 kW	SK CI1-460/20-C	276 995 020	20 A
11 ... 18.5 kW	SK CI1-460/40-C	276 995 040	40 A
22 ... 30 kW	SK CI1-460/70-C	276 995 070	70 A
37 ... 45 kW	SK CI1-460/100-C	276 995 100	100 A
55 ... 75 kW	SK CI1-460/160-C	276 995 160	160 A
90 ... 132 kW	SK CI1-460/280-C	276 995 280	280 A
160 kW	SK CI1-460/350-C	276 995 350	350 A





Inductance	L in mm	B in mm	D in mm
3 x 4.88 mH	125	95	140
3 x 2.93mH	155	95	160
3 x 1.47 mH	185	102	201
3 x 0.73 mH	190	122	201
3 x 0.47 mH	230	125	260
3 x 0.29 mH	240	148	230
3 x 0.18 mH	352	140	268
3 x 0.10 mH	352	169	268
3 x 0.084 mH	352	169	268

General information

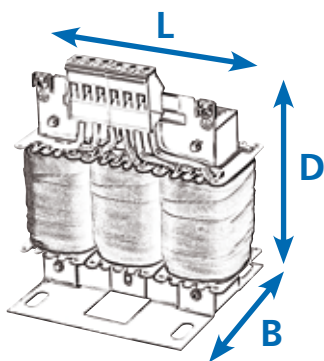
Due to the environment of the inverter, in case of fluctuations in mains voltage it may be necessary to connect an input choke to the frequency inverter. In addition, their use significantly decreases mains feedback and reduces harmonic content to a minimum.

It is recommended that an input choke is always used for frequency inverters with a power of more than 45KW. This also positively influences the device safety and EMC behaviour. All chokes have an IP00 protection rating.

Output chokes

Inverter type SK 700E	Choke type IP 00	Material number	Continuous current
1.5 kW	SK CO1-460/4-C	276996004	4 A
2,2 ... 4.0 kW	SK CO1-460/9-C	276996009	9 A
5,5 ... 7.5 kW	SK CO1-460/17-C	276996017	17 A
11 ... 15 kW	SK CO1-460/33-C	276996033	33 A
18,5 ... 30 kW	SK CO1-460/60-C	276996060	60 A
37 ... 45 kW	SK CO1-460/90-C	276996090	90 A
55 ... 90 kW	SK CO1-460/170-C	276996170	170 A
110 / 132 kW	SK CO1-460/240-C	276996240	240 A
160 kW	SK CO1-460/330-C	276996330	330 A





Inductance	L in mm	B in mm	D in mm
3 x 3.5 mH	120	104	140
3 x 2.5 mH	155	110	160
3 x 1.2 mH	185	102	201
3 x 0.6 mH	185	122	201
3 x 0.33 mH	230	125	260
3 x 0.22 mH	352	144	320
3 x 0.13 mH	412	200	320
3 x 0.07 mH	412	225	320
3 x 0.03 mH	352	181	268

General information

Large motor cable lengths (cable capacity) often require the use of additional output chokes on the frequency inverter output.

This has a positive effect on device protection and the EMC properties.

The output chokes specified in the tables are rated for a frequency inverter pulse frequency of 3 to 6 kHz and an output frequency of 0 to 120 Hz. All chokes have an IP00 protection rating.

Braking resistors

Footprint resistors

Inverter type SK 700E	Resistor type	Material number	Resistance
1,5 ... 2.2 kW	SK BR1-200/300-F	278281030	200 Ω
3,0 ... 4.0 kW	SK BR1-100/400-F	278281040	100 Ω
5,5 ... 7.5 kW	SK BR1-60/600-F	278281060	60 Ω

Chassis resistors

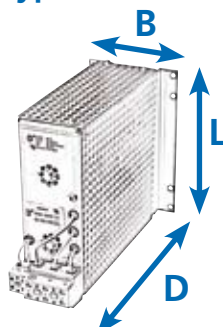
Inverter type SK 700E		Resistor type	Material number	Resistance
Type 1	1,5 ... 2.2 kW	SK BR2-200/300-C	278282030	200 Ω
	3,0 ... 4.0 kW	SK BR2-100/400-C	278282040	100 Ω
Type 2	5,5 ... 7.5 kW	SK BR2-60/600-C	278282060	60 Ω
	11 ... 15 kW	SK BR2-30/1500-C	278282150	30 Ω
	18,5 ... 22 kW	SK BR2-22/2200-C	278282220	22 Ω
	30 ... 45 kW	SK BR2-12/4000-C	278282400	12 Ω
	45 ... 55 kW	SK BR2-8/6000-C	278282600	8 Ω
	75 ... 90 kW	SK BR2-6/7500-C	278282750	6 Ω
	110 ... 160 kW	SK BR2-3/7500-C	278282753	3 Ω



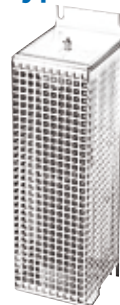
Footprint resistor



Type 1



Type 2



Chassis resistors

Continuous rating	Pulse power approx. *)	L in mm	B in mm	D in mm
300 W	3.0 kW	281	121	48
400 W	4.0 kW	281	121	48
600 W	7.0 kW	331	121	48

Continuous rating	Pulse power approx. *)	L in mm	B in mm	D in mm
300 W	2.4 kW	170	100	240
400 W	4.8 kW	170	100	240
600 W	8.2 kW	350	92	120
1500 W	16 kW	560	185	120
2200 W	22 kW	460	270	120
4000 W	41 kW	560	270	240
6000 W	61 kW	470	600	300
7500 W	82 kW	570	600	300
7500 W	164 kW	570	600	300

*) permitted, depending on application, max. 5% ED / 120s (700VDC)

Footprint resistors

This braking resistor can be mounted flat or vertically, next to the frequency inverter (IP20). This reduces space requirements. Three sizes for frequency inverter powers of up to 7.5 kW are available. The specified resistance values are electrically adapted to standard applications.

Chassis resistors

These braking resistors are for universal use. The resistor elements are integrated into a housing grating and must be connected to the particular frequency inverter via a separate connecting cable. For this, a shielded cable should be used, which is as short as possible. These resistors must be protected from heavy soiling and moisture. (Protection type IP20)

