SK CU5-MLT

Part number: 275 298 200

Optional modules – Functional extensions incl. functional safety
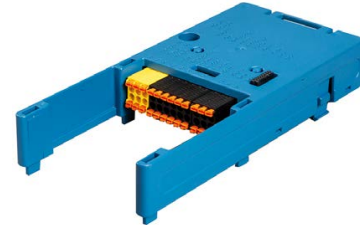
The customer unit SK CU5-MLT described below may only be installed and commissioned by qualified electricians. A qualified electrician is a person who, because of their technical training and experience, has sufficient knowledge with regard to

- Switching on, switching off, disconnection, earthing and labelling of electric circuits and devices,
- Correct maintenance and use of protective devices according to specified safety standards.

⚠ DANGER

Danger of electric shock

The frequency inverter has a hazardous voltage for up to 5 minutes after it has been switched off.

- Only carry out work when the frequency inverter has been disconnected and at least 5 minutes have elapsed since the mains was switched off!


NOTICE

Validity of document

This document is only valid in combination with the operating instructions BU 0600 for the NORDAC *PRO* frequency inverter SK 500P and the supplementary instructions BU 0610 POSICON positioning control as well as BU 0630 functional safety (📖 "Further documentation and software (www.nord.com)"). Only these documents contain all of the information that is required for safe commissioning of the modules and the frequency inverter.

Scope of delivery

1 x	Customer unit	SK CU5-MLT
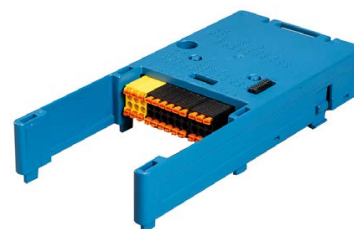
Field of use

Plug-in customer unit for functional extension of a NORDAC *PRO* series frequency inverter of device types SK 530P and SK 550P. This module can be mounted on the front side of the frequency inverter. An encoder interface for connection of different encoder systems as well as 4 digital IOs are available. A plug-in 2-channel connection is available on the module for functional safety requirements.

The module ensures safe shut-down methods for Safe Pulse Block and Safety Digital Input to execute the STO and SS1-t stop functions.

Technical Data

Module

Temperature range	-10°C … +50°C		Vibration resistance	3M4
Temperature class	Class 3k3		Firmware version	V1.0 R1
Protection class	IP20		Hardware version	AA
Max. installation altitude above sea level	≤ 2000 m		Dimensions [mm] H x W x D	145 x 65 x 23

Digital inputs

Quantity	4
Work area	Low level: 0 V … 5 V, High level: 14 V … 30 V
Specific data	R_i = ~3 kΩ, Input capacitance: 10 nF, Response time 1 ms … 2 ms, Inputs according to EN 61131-2

Digital outputs

Quantity	4
Supply voltage	24 VDC ± 25%
Output current	20 mA
Short circuit current limit	150 mA
Work area	Low level = 0 V, High level = 24 V; max. 200 mA
Specific data	R_i = 8 kΩ, Input capacitance: 10 nF, Response time 10 ms, Outputs according to EN 61131-2

"Safe Pulse Block" and "Safety Digital Input"

	Safe Pulse Block	Safety Digital Input
Input voltage	+24 V ±25% (18 V … 30 V)	+24 V -37.5% +25% (15 V … 30 V)
Operation with OSSD	-20% … +25% (19.2 V … 30 V)	+24 V -37.5% +25% (15 V … 30 V)
High level (VT+)	≥ 18 V	≥ 15 V
Low level (VT-)	≤ 3 V	≤ 3 V
Current consumption (average value)	VIS1: ≤ 28 mA VIS2: ≤ 140 mA Depending on the input voltage and application class (frequency inverter type and pulse frequency) 📖 Supplementary instructions BU 0630 "Further documentation and software (www.nord.com)"	≤ 10 mA
Peak current (peak, when switching on or on the OSSD)	VIS1_24V: ≤ 70 mA VIS2_24V: ≤ 700 mA	≤ 25 mA
Input resistance	–	Low level: 10 kΩ High level: 3 kΩ … 5 kΩ
Input capacitance	VIS1_24V: approx. 5 µF VIS2_24V: approx. 30 µF (downstream of inverse polarity protection)	approx. 10 nF
Cable length	≤ 100 m (shielded for compliance with EMC requirements) 📖 Supplementary instructions BU 0630 "Further documentation and software (www.nord.com)"	
Cable capacitance	≤ 20 nF per connected frequency inverter (≤ 4 nF * t_{OSSD}/ 0.1 ms (for t_{OSSD} ≤ 500 µs))	
Requirements for OSSDs		
Test pulse width	200 µs ≤ t_{OSSD} ≤ 500 µs 📖 Supplementary instructions BU 0630 "Further documentation and software (www.nord.com)"	
Duty (High level)	≥ 90%	
Time between double pulses	≥ 2* t_{OSSD} (note the duty factor)	
Switch-on delay (time between input change from Low to High level and the time at which enabling of the frequency inverter is possible.)	≤ 25 ms	≤ 15 ms
Response time (time between input change from High to Low level and triggering of the safety sub-function.)	≤ 140 ms	≤ 10 ms
Cycle time (time between two identical flanks at the input)	≥ 1 s	
Fault response time (The time between detection of a fault and triggering of the fault response function.)		≤ 35 ms
Fault response function		Inverter shut-down (behaviour as for STO)
Priority	Highest	Low
Source of failure rates	SN 29500 at ambient temperature: 40°C (S1 operation) or 50°C (S3 operation with ED = 70%) Special device SK 5x0P-751-340-S3: 40°C (S3 operation with ED = 70%) or 50°C (S3 operation with ED = 50%)	
Conformant object	Type B	
Hardware error tolerance	HFT 0	
Proportion of safe failures	SFF = 100%	SFF = 97.89 %

	Safe Pulse Block	Safety Digital Input
Probability of a hazardous failure per hour	PFH = 0	PFH = 11.33 FIT
Mean time until hazardous failure	$MTTF_d$ = "High" (> 100 years)	
Diagnostic coverage level	cannot be determined (PFH = 0)	DC = 92.85% ("average")
Safety integrity level (as per IEC 61508:2010 + IEC 61800-5-2:2016)	SIL 3	SIL 2
Category (as per EN ISO 13849-1:2016)	Category 4	Category 2
Performance level (as per EN ISO 13849-1:2016)	PL e	PL d
Proof test interval	TM = 20 years (duration of use, "Mission time")	

Installation

Installation of the SK CU5-MLT must be carried out as follows:

1. Switch off the mains voltage and observe the waiting period.
2. Push the control terminal cover down and remove it.
3. Remove the blank cover by activating the release mechanism at the lower edge and removing it with an upward rotating movement.
4. Break out the internal jumper of the STO contact with the aid of a small screwdriver or small needle-nose pliers. Otherwise the customer unit cannot be installed.

Screwdriver max. 2.5 mm

Needle-nosed pliers

STO contact jumper

Frequency inverter without STO contact jumper

5. Hook the customer unit onto the upper edge and press in lightly until it engages. Take care that the connector strip makes proper contact.
6. Install the control terminals and blank cover.

Remove the control terminals and blank cover.

Remove the STO contact jumper.

Install the SK CU5-MLT customer unit.

Install the control terminals and blank cover.

ⓘ Information

Once the jumper of the STO contact has been removed, the frequency inverter cannot be operated with functional safety without the customer unit SK CU5-MLT.

Wiring guidelines

If flexible cables (multiple strand or fine-wire) are used for connections on the terminal block X20, wire end sleeves must be used. In addition, the wiring guidelines in the SK 500 frequency inverter manual BU 0600 and the supplementary instructions BU 630 📖 "Further documentation and software (www.nord.com)"apply.

For the connections on terminal block X21 and X22, the wiring guidelines of the supplementary instructions BU 0610 must also be observed 📖 "Further documentation and software (www.nord.com)".

Electrical connection
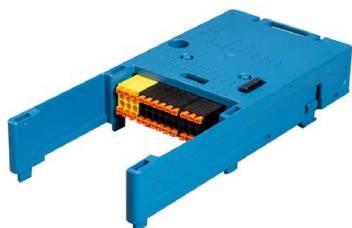
X20: Functional safety: STO, SS1-t

X21: Universal encoder interface (SIN/COS, Hiperface, EnDat 2.1, SSI, BISS)

X22: Digital inputs and outputs

The electrical connection of the functional safety is established at the customer unit SK CU5-MLT via connection terminals on the terminal block X20.

The appropriate contacts must be used depending on the functional safety function in use.

Terminal block X20	Designation	No.	Description
Top view	VIS2_24V	92	24 V STO input 2 (SI2)
	VIS12_0V	93	Reference potential for STO inputs (SI1/2)
	VISD_24V	94	Safety Digital Input
Bottom view	VIS12_0V	93	Reference potential for STO inputs(SI1/2)
	VIS1_24V	91	24 V STO input 1 (SI1)
	VISD_0V	95	Reference potential for the Safety Digital Input

Terminals: Push-in, wire stripping length 10 mm

Cross section: 0.2 mm²… 1.5 mm², AWG 24 … 16, rigid

0.25 mm²… 1.5 mm², AWG 24 … 16, flexible with wire end sleeve

Cross section [mm²]	Wire end sleeve length without insulating collar according to DIN 46228-1 [mm]	Wire end sleeve length with insulating collar according to DIN 46228-4 [mm]
0.25	5 … 7	8 … 10
0.34	7	8 … 10
0.50	8 … 10	8 … 10
0.75	8 … 10	8 … 10
1.00	8 … 10	-
1.50	10	-

Two wires with the same cross section are not possible.

ⓘ Information

All information on electrical connections can be found in the SK 500P frequency inverter manual BU 0600 as well as in the supplementary instructions BU 0630 📖 "Further documentation and software (www.nord.com)".

Electrical connection of the travel measurement systems is made via connection terminals on the universal encoder interface on the terminal block X21.

The appropriate contacts must be used depending on the travel measurement system which is used.

Terminal block X21	Designation	No.	Description
	CLK+	63	CLK signal for BISS-/SSI-/EnDat encoder
	CLK-	64	CLK signal for BISS-/SSI-/EnDat encoder
	DAT+/RS485+	65	Data signal DAT+ for BISS-/SSI-/EnDat encoder, RS485+ Hiperface
	DAT-/ RS485-	66	Data signal DAT- for BISS-/SSI-/EnDat encoder, RS485- Hiperface
	A+/ SIN+	57	Track A+ incremental encoder SIN+ from Hiperface or SIN/COS encoder
	A-/ SIN-	58	Track A- incremental encoder SIN- from Hiperface or SIN/COS encoder
	B+/ COS+	59	Track B+ incremental encoder COS+ from Hiperface or SIN/COS encoder
	B-/ COS-	60	Track B- incremental encoder COS- from Hiperface or SIN/COS encoder
	Z+	61	Zero track Z+ incremental encoder
	Z-	62	Zero track Z- incremental encoder
	VO_12V	49	Encoder supply max. 80 mA
	VO_0V	40	Reference potential for encoder

Further connection terminals are available for 4 selectable digital inputs and outputs (I/Os) on the terminal block X22.

Terminal block X22	Designation	No.	Description
	VO_24V	43	Initiator supply (maximum 200 mA)
	VO_0V	40	Reference potential for I/Os
	DIO1	30	Digital input 7 or digital output 3
	DIO2	31	Digital input 8 or digital output 4
	DIO3	32	Digital input 9 or digital output 5
	DIO4	33	Digital input 10 or digital output 6

ⓘ Information

All information on electrical connections can be found in the SK 500P frequency inverter manual BU 0600 as well as in the supplementary instructions BU 0610 📖 "Further documentation and software (www.nord.com)".

EMC-compliant shield connection

If shielded connection cables are used, the encoder cable shielding and the terminal connection cables must always be connected on both sides. The connection can be made as follows:

- Shielding on the rear wall of the control cabinet
- Use of EMC kits

Depending on size and type or configuration level of the frequency inverter, two different optional EMC kits of type SK HE5-EMC-…can be used for connection. The EMC kits are divided into three different categories and depend on size.

SK 550P without blank covers	SK 550P with mounted SK CU5-MLT	SK HE5-EMC-MS-HS12 SK HE5-EMC-CS-HS23	Detailed view of mounted EMC kits
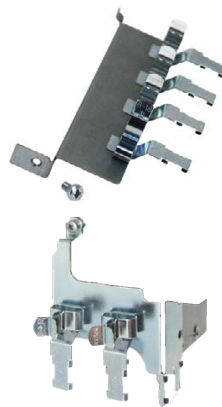
ⓘ Information

The EMC kits used for connection to the customer unit (SK HE5-EMC-CS-…) can only be mounted and used in conjunction with those for motor connection (SK HE5-EMC-MS-…). Detailed information can be found in the technical information on EMC kits 📖 "Further documentation and software (www.nord.com)".

Colour and contact assignment for encoders

TTL incremental encoder

Function	Wire colours	TTL	
Voltage supply 10 V… 30 V	Brown / green	**X21: 49**	24V
Reference potential GND 0 V	White / green	**X21: 40**	GND/0V
Track A	Brown	**X21: 57**	ENC A+
Track A inverse	Green	**X21: 58**	ENC A-
Track B	Grey	**X22: 59**	ENC B+
Track B inverse	Pink	**X21: 60**	ENC B-
Track 0	Red	**X21: 61**	DI5/Z+
Cable shield	Connect to a large area of the frequency inverter housing or shielding terminal on the EMC kit		

Sin-/Cos encoders

Function	Wire colours	Sin-/Cos	
Voltage supply 10 V… 30 V	Brown	**X21: 49**	VO_12V
Reference potential GND 0 V	White	**X21: 40**	VO_0V
Track A	Green	**X21: 57**	A+/SIN+
Track A inverse	Yellow	**X21: 58**	A-/SIN-
Track B	Grey	**X21: 59**	B+/COS+
Track B inverse	Pink	**X21: 60**	B-/COS-
Track 0	Red	**X21: 61**	Z+/RES+
Track 0 inverse	Black	**X21: 62**	Z-/RES-
Cable shield	Connect to a large area of the frequency inverter housing or shielding terminal on the EMC kit		

EnDat 2.1 encoders

Function	Wire colours [1]	EnDat 2.1	
Voltage supply 3.6 V … 14 V [2]	Brown / green	**X21: 49**	VO_12V
Sensor U_B	Blue	**X21: 49**	VO_12V
Reference potential GND 0 V	White / green	**X21: 40**	VO_0V
Sensor 0 V	White	**X21: 40**	VO_0V
Track A [3]	Green / black	**X21: 57**	A+/SIN+
Track A inverse [3]	Yellow / black	**X21: 58**	A-/SIN-
Track B [3]	Blue / black	**X21: 59**	B+/COS+
Track B inverse [3]	Red / black	**X21: 60**	B-/COS-
Cycle +	Violet	**X21: 63**	CLK+
Cycle -	Yellow	**X21: 64**	CLK-
Data + (RS485)	Grey	**X21: 65**	DAT+/RS485+
Data - (RS485)	Pink	**X21: 66**	DAT-/RS485-
Cable shield	Connect to a large area of the frequency inverter housing or shielding terminal on the EMC kit		

[1] Colour example depending on manufacturer. Other colours are possible.

[2] Voltage range depending on the type of encoder.

[3] Optionally available depending on the type of encoder.

Hiperface encoders

Function	Wire colours	Hiperface	
Voltage supply 7 V… 12 V	Red	**X21: 49**	VO_12V
Reference potential GND 0 V	Blue	**X21: 40**	VO_0V
+ SIN	White	**X21: 57**	A+/SIN+
REFSIN	Brown	**X21: 58**	A-/SIN-
+ COS	Pink	**X21: 59**	B+/COS+
REFCOS	Black	**X21: 60**	B-/COS-
Data + (RS485)	Grey or yellow	**X21: 65**	DAT+/RS485+
Data - (RS485)	Green or violet	**X21: 66**	DAT-/RS485-
Cable shield	Connect to a large area of the frequency inverter housing or shielding terminal on the EMC kit		

SSI encoders

Function	Wire colours [1]	SSI	
Voltage supply 10 V … 30 V	Brown	**X21: 49**	VO_12V
Sensor U_B	Red	**X21: 49**	VO_12V
Reference potential GND 0 V	White	**X21: 40**	VO_0V
Sensor 0 V	Blue	**X21: 40**	VO_0V
Cycle +	Green	**X21: 63**	CLK+
Cycle -	Yellow	**X21: 64**	CLK-
Data + (RS485)	Grey	**X21: 65**	DAT+/RS485+
Data - (RS485)	Pink	**X21: 66**	DAT-/RS485-
Cable shield	Connect to a large area of the frequency inverter housing or shielding bracket		

[1] Colour example depending on manufacturer. Other colours are possible.

BISS encoders

Function	Wire colours [1]	BiSS	
Voltage supply 10 V … 30 V	Brown	**X21: 49**	VO_12V
Reference potential GND 0 V	White	**X21: 40**	VO_0V
Track A [2]	Black	**X21: 57**	A+/SIN+
Track A inverse [2]	Violet	**X21: 58**	A-/SIN-
Track B [2]	Grey / pink	**X21: 59**	B+/COS+
Track B inverse [2]	Red / blue	**X21: 60**	B-/COS-
Cycle +	Green	**X21: 63**	CLK+
Cycle -	Yellow	**X21: 64**	CLK-
Data + (RS485)	Grey	**X21: 65**	DAT+/RS485+
Data - (RS485)	Pink	**X21: 66**	DAT-/RS485-
Cable shield	Connect to a large area of the frequency inverter housing or shielding bracket		

[1] Colour example depending on manufacturer. Other colours are possible.

[2] Optionally available depending on the type of encoder.

Commissioning of functional safety

ℹ Information

All information on the commissioning of the device, operating status messages or error messages related to the customer unit or the functional safety function can be found in the SK 500P frequency inverter manual BU 0600 as well as in the supplementary instructions BU 0630 📖 "Further documentation and software (www.nord.com)".

Commissioning of travel measurement system (encoder)

1. Connect encoder
2. Commission the encoder by changing the parameters. For this, make the necessary settings for each axis in the relevant parameter set.

	Step	Incremental	Universal		
		TTL	SIN/COS	BISS/ SSI	Endat 2.1/ Hiperface
1	Contact assignment	P420 [-05] DIN5 TTL Zero track	–	–	–
2	Selection of the travel measurement system	P604			
3	Resolution	P301 [-01]	P301 [-03]	P605 [-03, -04]	
4	Position detection Linear/ Modulo	P619 [-01]	P619 [-03]	P621 [-02]	
5	Additional settings	–	–	P617, (P622)	–
6	Speed ratio				
	Ratio	P607 [-01]	P607 [-03]	P607 [-05]	
	Reduction ratio	P608 [-01]	P608 [-03]	P608 [-05]	
8	Check the direction of rotation, resolution and ratio	P660 [-01], P583	P660 [-03], P583	P660 [-05], P583	
8	Setpoint processing (source and type)	P610			
9	Overflow point (only for modulo)	P620 [-01]	P620 [-03]	–	–
10	Reference the encoder	📖 BU 0610 supplementary instructions POSICON			
11	Define the offset	P609 [-01]	P609 [-03]	P609 [-05]	
12	Define the limits	P612/ P615/ P616			
13	Define the target position	P613			
14	Define the reference point run	P623/ P624			
15	Monitoring etc.	P625, P626, P630 et seq.			

ℹ Information

All information on the commissioning of the device, operating status messages or error messages related to the customer unit or the travel measurement system can be found in the SK 500P frequency inverter manual BU 0600 as well as in the supplementary instructions BU 0610 📖 "Further documentation and software (www.nord.com)".

Parameter overview

Only the parameters specific to **functional safety** and to the **encoder interface** as well as display and setting options are listed below.

Operating displays

P000 (parameter number)	Operating para. disp (parameter name)	S [1]	P [2]
P001	Select of disp.value		
P003	Supervisor-Code		

[1] S corresponds to supervisor password   [2] P is depending on parameter set

Control parameters

P301	Incremental encoder		

Control terminals

P400	Analog input func.		P
P418	Analog output func.		P
P420	Digital inputs		
P423	Safety SS1 max. time		
P424	Safe Dig.input	S	P
P426	Quick stop time		P
P428	Automatic starting	S	
P434	Digital out function		P
P480	Funct. BusIO In Bits	S	
P481	Funct-BusIO Out Bits	S	
P497	Safety password	S	
P498	Change safety passw.	S	
P499	Safety CRC		

Additional parameters

P502	Value Masterfunction	S	P
P503	Leading func. output	S	
P506	Automatic acknowled.	S	
P543	Bus actual value	S	P
P546	Func. bus-setpoint	S	P
P559	DC Run-on time	S	P
P583	Motor phase sequence	S	P

Positioning

P600	Position Control		S	P
P601	Actual position			
P602	Act. Ref. Pos.			
P603	Curr. position diff.		S	
P604	Encoder type		S	P
P605	Abs. Encoder res.		S	
P607	Ratio		S	
P608	Reduction Ratio		S	
P609	Offset Position		S	
P610	Setpoint Mode		S	
P611	P Pos. Control		S	P
P612	Pos. Window		S	P
P613	Position		S	P *
P615	Max. Position		S	P
P616	Min. Position		S	P
P617	Type SSI encoder		S	
P619	Incremental mode		S	
P620	Absolute encoder		S	
P621	Modus abs. encoder		S	
P622	Shift SSI Position		S	
P623	Homing type		S	P
P624	Homing freq		S	P
P625	Hysteresis relais		S	P
P626	Relais Position		S	P
P630	Position slip error		S	P
P631	Slip error 2.encoder		S	P
P632	Slip error source		S	P
P633	Slip error delay		S	P
P640	Unit of pos. value		S	
P650	Status universal enc		S	
P651	SinCos voltage		S	
P660	Position encoder		S	

Information

P700	Actual operating status			
P701	Last fault			

ⓘ **Information**

All information on parametrisation can be found in the SK 500P frequency inverter manual BU 0600 as well as in the supplementary instructions BU 0610 and BU 0630 📖 "Further documentation and software (www.nord.com)".

Error messages

Error messages that occur in connection with the customer unit are displayed in the frequency inverter's error memory in parameter **P700/P701**.

> ### ⓘ Information
>
> Error messages of the optional modules can be found in the SK 500 frequency inverter manual BU 0600 and the supplementary instructions BU 0630 📖 "Further documentation and software (www.nord.com)".

> ### ⓘ Information
>
> Error messages of the optional modules related to the POSICON positioning control or the travel measurement system (encoder) can be found in the supplementary instructions BU 0610 on the SK 500P frequency inverter 📖"Further documentation and software (www.nord.com)".

Further documentation and software (www.nord.com)

Software	Description
NORDCON	Parametrisation and diagnostic software

Software	Description
NORDCON APP	Parametrisation and diagnostic software for mobile terminal devices

Document	Description
BU 0000	Description of NORDCON software
BU 0040	Parameter box manual
BU 0600	Manual for frequency inverter NORDAC *PRO* SK 5xxP
BU 0610	Supplementary instructions for frequency inverter NORDAC *PRO* SK 5xxP POSICON positioning control

Document	Description
BU 0630	Supplementary instructions for frequency inverter NORDAC *PRO* SK 5xxP Functional safety
BU 0960	Manual NORDAC *ACCESS BT* SK TIE5-BT-STICK for NORDCON *APP*
S9090	NORDAC *ACCESS BT* and NORDCON *APP* QUICK START
in preparation	Technical information NORDAC *PRO* EMC kits for SK 5xxP frequency inverter

Flyer	Description
E3000	NORDAC Electronic drive technology