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SK TU4-IOE-M12

Part Number 275 281 206

IO Extension

Only qualified electricians are allowed to install and commission the module described below. An electrician is a person who, because of their technical training and experience, has sufficient knowledge with regard to

- Switching on, switching off, isolating, earthing and marking power circuits and devices,
- Proper maintenance and use of protective devices in accordance with defined safety standards.

⚠ **DANGER**	**Danger of electric shock**

The frequency inverter carries hazardous voltage for up to 5 minutes after being switched off.

- Work must not be carried out unless the frequency inverter has been disconnected from the voltage and at least 5 minutes has elapsed since the mains was switched off!

NOTICE	**Validity of document**

This document is only valid in conjunction with the operating instructions of the respective frequency inverter (📖 See overview at end of document). Safe commissioning of this module and the frequency inverter depends on the availability of this information.

Scope of supply

1 x	Module	SK TU4-IOE-M12
4 x	Hexagon socket	M4 x 40 mm
1 x	System bus cable set	grey / black
1 x	24 VDC cable set	brown / blue
1 x	PE cable	green / yellow
Required accessories:		
1 x	Bus connection unit TI 275280000	SK TI4-TU-BUS (Part No. 275 280 000)

Field of use

External IO extension for mounting on, or in the immediate vicinity of a decentralised frequency inverter (**SK 1x0E** / **SK 2xxE**). This can be connected to the frequency inverter via the system bus. Four digital inputs, 2 digital outputs, 2 analog inputs and 1 analog output are available.

Technical Data

Temperature range	-25 °C … 50 °C
Temperature class	Class 3K3
Protection class	IP55

Vibration resistance	3M7
Firmware version	V1.3 R0
Dimensions [mm]*	HxWxD 95 x 136 x 99**

* Module mounted on the BUS connection unit

** 108 mm with cover caps on the M12 connection

Name	Terminal	Data
Module power supply (load capacity)	15+11	24 VDC ± 20 %, reverse polarity protected (≤ 3 A)
Power consumption of module	15+11	140 mA
Digital input - operating range	19/20/25/26	Low: 0 V … 5 V, High: 15 V … 30 V
Digital input - specific information	19/20/25/26	R_i = 8,1 kΩ, input capacitance: 10 nF Scan rate 1 ms, reaction time 1 ms
Digital output - 24 VDC power supply	35+31	≤ 1000 mA (input)
Digital output - operating range	33/34	Low = 0 V, High = 24 V; max. 500 mA
Analog input - reference voltage	1	10 VDC ±0,1 V, ≤ 20 mA (output)
Analog input - differential input version	3+5; 4+6	Resolution: 12 Bit, accuracy: 0.1 V, Load resistance 250 Ω (Connection via DIP switch when configuration as a current input.)
Analogue input - load capacity	3+5; 4+6	≤ 10 mA (mode: 0/2 … 10 V) ≤ 20 mA (mode: 0/4 … 20 mA)
Analog output - load capacity	9	≥ 1 kΩ (Mode: 0/2 … 10 V) ≤ 250 Ω (Mode: 0/4 … 20 mA)
Analog output - specific information	9	Resolution: 10 Bit, accuracy: 0.25 V

Installation

The bus interface must be attached to a suitable connection unit (SK TI4-TU…) and connected using the 4 provided M4 x 40 mm hexagon socket collar screws. Installation details can be found in the data sheet for the relevant connection units.

Connections

Connection of the signal and control cables is made via the connection unit SK TI4-TU-BUS.

Terminals	Double-sprung terminal bar	2 x 18 contacts
Cable cross section	AWG 14-26	rigid: 0,14 … 2,5 mm flexible: 0.14 … 1.5 mm with wire end sleeves
PE connection	Via housing	
RJ12	RJ45 - socket	Interface for connecting a parameterisation tool

| Potential	Contact	Designation	Description
Analog IOs	1	VO 10V	10 V Reference voltage
	2	VO 10V	10 V Reference voltage
	3	AIN1+	Analog input 1, positive
	4	AIN2+	Analog input 2, positive
	5	AIN1-	Analog input 1, negative
	6	AIN2-	Analog input 2, negative
	7	AGND/0V	Analog Ground (internally connected to terminal 40)*
	8	AGND/0V	Analog Ground (internally connected to terminal 40)*
	9	AOUT	Analog output
	10	PE	PE
System bus level and digital inputs	11	VI 24V	Supply voltage (+24 V - in)
	12	VI 24V	Supply voltage (+24 V - in)
	13	VI 24V	Supply voltage (+24 V - in)
	14	SYS +	System bus data cable +
	15	GND/0V	Reference potential (0 V / GND)
	16	SYS -	System bus data cable -
	17	GND/0V	Reference potential (0 V / GND)
	18	GND/0V	Reference potential (0 V / GND)
	19	DIN1	Digital input 1
	20	DIN3	Digital input 3
	21	GND/0V	Reference potential (0 V / GND)
	22	GND/0V	Reference potential (0 V / GND)
	23	VI 24V	Supply voltage (+24 V - in)
	24	VI 24V	Supply voltage (+24 V - in)
	25	DIN2	Digital input 2
	26	DIN4	Digital input 4
	27	GND/0V	Reference potential (0 V / GND)
	28	GND/0V	Reference potential (0 V / GND)
	29	VI 24V	Supply voltage (+24 V - in)
	30	VI 24V	Supply voltage (+24 V - in)
Digital outputs	31	VI 24V2	Supply voltage (+24 V - in) for digital outputs
	32	GND2/0V2	Reference potential (0 V / GND) of digital outputs
	33	DOUT1	Digital output 1
	34	DOUT2	Digital output 2
	35	GND2/0V2	Reference potential (0 V / GND) of digital outputs
	36	GND2/0V2	Reference potential (0 V / GND) of digital outputs
Diagnostic socket	RJ12 - 1	RS485_A	Data cable RS485
	RJ12 - 2	RS485_B	Data cable RS485
	RJ12 - 3	GND	Reference potential (GND)
	RJ12 - 4	RS232_TxD	Data cable RS232
	RJ12 - 5	RS232_RxD	Data cable RS232
	RJ12 - 6	24 V	Supply voltage (+24 V)

* AGND/0V is internally connected to the reference voltage of the module GND/0V via a special component. In order to prevent damage to the module or faults in the analog signals, the two contacts must not be bridged

Potential level

1 =   Analog IOs

2 =   System bus + DIN

3 =   DOUT

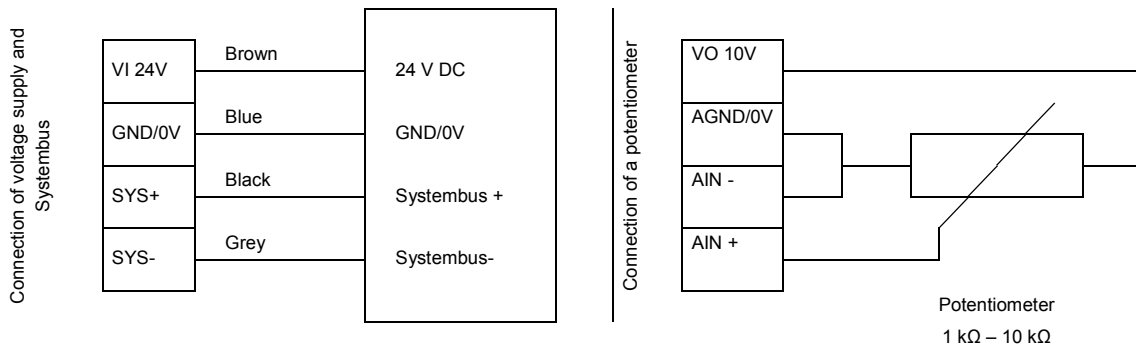**4 =**   Diagnosis

Details of M12 connections
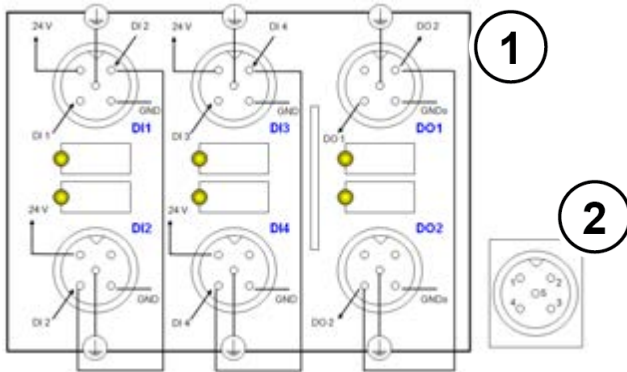
1 = Wiring with M12 plug connectors
2 = Details of pin numbering

The special wiring of the M12 round plug connector enables connection of both single and double sensors, which are equipped with normal M12 system connectors in the standard sensor/actuator configuration.

With the use of M12 round plug connectors, the terminal bar connectors for the digital inputs (connection unit of the option) must not be used.

The LEDs between the plug connectors indicate the switching status of the IOs *(top, from left to right DIN1, DIN3, DOUT1 / bottom, from left to right DIN2, DIN4, DOUT2)*.

Connection examples

Connection of voltage supply and Systembus		
VI 24V	Brown	24 V DC
GND/0V	Blue	GND/0V
SYS+	Black	Systembus +
SYS-	Grey	Systembus-

Connection of a potentiometer	
VO 10V	
AGND/0V	
AIN -	
AIN +	

Potentiometer
1 kΩ – 10 kΩ

Configuration

Configuration of the module is mainly performed via the DIP switches. The DIP switches are read after a "power on" of the module. A change to the DIP switch during operation has no effect.

The system bus must be terminated at both of its physical ends (if necessary set the "System bus termination resistor" DIP switch).

| ⓘ | **Note** | **Broadcast mode** |

In "Broadcast mode, which is activated via the parameter **(P162)**, the module can access up to 4 inverters in parallel. Therefore the frequency inverters jointly access the I/Os and evaluate the input signals according to their own parameterisation. Output signals from the frequency inverters which are sent to the common IO module are linked by a logical "OR" within the module. i.e. a digital output is set as soon as one of the four frequency inverters addresses it. In addition, the highest analog value is provided via the analog output of the IO extension.

DIP switches

Function	DIP-Switch Meaning (DIP-No.)	DIP-Switch Combinations			Assignment Signal
		BIT2	BIT1	BIT0	
System bus termination resistor	S-Bus Term. *(01)*			0 1	not set setting
Addressing system bus	S-Bus Adr. Bit 0 *(02)* S-Bus Adr. Bit 1 *(03)*		0 0 1 1	0 1 0 1	Adr. 20 (for FI 0 Adr. 32)* Adr. 21 (for FI 1 Adr. 34)* Adr. 22 (for FI 2 Adr. 36)* Adr. 23 (for FI 3 Adr. 38)*
Analog input AIN1	Ain1 Mode Bit 0 *(04)* Ain1 Mode Bit 1 *(05)* Ain1 Mode Bit 2 *(06)*	0 0 0 1 1	0 0 1 0 0	0 1 0 0 1	0 … 10 V 2 … 10 V -10 … 10 V 0 … 20 mA 4 … 20 mA
Analog input AIN2	Ain2 Mode Bit 0 *(07)* Ain2 Mode Bit 1 *(08)* Ain2 Mode Bit 2 *(09)*	0 0 0 1 1	0 0 1 0 0	0 1 0 0 1	0 … 10 V 2 … 10 V -10 … 10 V 0 … 20 mA 4 … 20 mA
Analog output AOUT	Aout Mode Bit 0 *(10)* Aout Mode Bit 1 *(11)*		0 0 1 1	0 1 0 1	0 … 10 V 2 … 10 V 0 … 20 mA 4 … 20 mA
Mode Second - IOE	2nd IOE Mode *(12)*			0 1	First SK-…-IOE on FI Second SK-…-IOE on FI
* With DIP12 = ON: Address 10 … 13 instead of 20 … 23					

LED Displays

DS (**D**evice **S**tate)	DE (**D**evice **E**rror)	Meaning Long flashing = 0.5 s on / 1 s off Short flashing = 0.25 s on / 1 s off
OFF	OFF	Technology unit not ready, no control voltage
ON	OFF	Technology unit ready, no error, at least one frequency inverter is communicating via the system bus
ON	Short flashing	Technology unit ready, however • One or more of the connected frequency inverters is in fault status
Long flashing	OFF	Technology unit ready and at least one further participant is connected to the system bus, but • No frequency inverter on the system bus (or connection interrupted) • Address error for one or more system bus participants
Long flashing	Short flashing Flash interval **1** x - 1s pause	System bus is in status "Bus Warning" • Communication on system bus interrupted or • No other participant present on the system bus
Long flashing	Short flashing Flash interval **2** x - 1s pause	• System bus is in status "Bus off" or • The system bus 24V power supply was interrupted during operation
Long flashing	Short flashing Flash interval **3** x - 1s pause	• No system bus 24V power supply (system bus is in status "Bus off")
Long flashing	Short flashing Flash interval **4** x - 1s pause	Module error • EEPROM error
Long flashing	Short flashing Flash interval **5** x - 1s pause	Module error • AOUT error (analog output) • DIP switch configuration error
OFF	Short flashing Flash interval **1…7** - 1s pause	System error, internal program sequence interrupted • EMC interference (observe wiring guidelines!) • Module faulty

IO channel	Display	Meaning
DI 1	ON	High potential DIN1
DI 2	ON	High potential DIN2
DI 3	ON	High potential DIN3
DI 4	ON	High potential DIN4

IO channel	Display	Meaning
DO 1	ON	High potential DOUT1
DO 2	ON	High potential DOUT2

DI 3/4, DO 1/2   **Available according to the type of IO module**

Error messages

Error messages for the module - the present or archived messages for the last error - can be read out via the module parameter (P170).

Error	Meaning	Comments
1000	EEPROM error	EMC fault, module defective
1030	System bus OFF	No 24 V supply to bus, connections not correct
2000	DIP switch changed	DIP switch configuration changed during operation
2001	DIP switch configuration incorrect	Invalid DIP switch settings
2010	Error at analog output	Overload, reference voltage, short-circuit, calibration error
2020	Inverter does not support the module	Incorrect inverter type connected

Parameterisation

<u>Inverter:</u> In order to establish communication between the inverter and the IOE module, the following inverter parameters must be changed.

Parameter	Meaning	Comments	
(P514)	Bus speed	5 (= 250 kBaud)	
(P515 [-01])	Bus address	FI 1 = 32	FI 2 = 34
		FI 3 = 36	FI 4 = 38
(P480 [-01 …])	DIN function of the device	Possible settings according to (P420)	
(P481 [-05 …])	DOUT function of the device	Possible settings according to (P434)	
(P400 [-03 …])	AIN function of the device	Possible settings according to (P400)	
(P418 [-01 …])	AUT function of the device	Possible settings according to (P418)	

<u>IO extension:</u> The module provides a selection of parameters for setting or displaying special operating values. The parameters can be changed with the aid of the NORD CON-software or with a ParameterBox. Communication is only possible via an SK 54xE, SK 2xxE or SK 1x0E which is connected to the module.

Parameter	Meaning	Comments
(P150)	Set relays	Set DOUT directly or control via BUS
(P152)	Factory setting	Reset the module parameters, calibrate AOUT
(P153 [-01 …])	Minimum system bus cycle	Reduction of bus load due to the module
(P160 [-01 …])	Set analog output	Set AOUT directly or control via BUS
(P161 [-01 …])	Filter time	Debounce or round input signals
(P162)	Send broadcast	Activate Broadcast mode (control of several inverters by this module)
(P163 [-01 …])	Invert analog output	Invert analog signal
(P170 [-01 …])	Present errors	Display of module errors
(P171 [-01 …])	Software version	Firmware version / Revision
(P172)	Configuration	Module type
(P173)	Module status	Status of system bus or connected FI
(P174)	Status of digital inputs	Display of DIN switching status
(P175)	Relay status	Display of DOUT switching status
(P176 [-01 …])	Actual voltage	Voltage level of analog signals

Further documentation and software (**www.nord.com**)

Software	Name		Software	Name
NORD CON	Parameterisation and diagnostic software			

Document	Name		Document	Name
BU 0000	Description of NORD CON software		BU 0200	Frequency inverter manual SK 2xxE
BU 0040	ParameterBox manual		BU 0505	Frequency inverter manual SK 54xE
BU 0180	Frequency inverter manual SK 180E, SK 190E		TI 275280000	Bus – connection unit SK TIE4-TU-BUS

Description of parameters

P150	Set relays			
Setting range	0 … 4		Other applicable parameter(s) **P480**	
Factory setting	{ 0 }			
Scope of Application	**SK CU4**-**IOE2, SK TU4**-**IOE, SK EBIOE**-**2**			
Description	Sets the switching states of the digital outputs			
Setting values	Value		Meaning	

0	Via bus	Control of all digital outputs via the system bus; the functions are defined in the frequency inverter (**P480**).
1	Outputs OFF	All digital outputs are Off (Low = 0 V).
2	Output 1 on (DO1):	The digital output DO1 is set to "High" (active); digital output DO2 remains switched off.
3	Output 2 ON (DO2)	The digital output DO2 is set to "High" (active); digital output DO1 remains switched off.
4	Outputs 1 and 2 ON	All digital outputs are on (High)

P152	Factory setting	
Setting range	0 … 2	
Factory setting	{ 0 }	
Description	Resets the module parameters to the factory settings.	
Note	On completion of this process the parameter display changes back to the value "0"	
Setting values	Value	Meaning

0	No change	This function is not implemented.
1	Load factory setting	All parameters are reset to the factory settings.
2	Calibration AOut	The accuracy of the analog output can be improved with a correction line, however, this is not activated as standard. If factory settings (**P152**={ 1 }) are loaded, the correction values are retained. A calibration is carried out if (**P152)** is set to { 2 }, i.e. the line is re-recorded and stored in the EEPROM.

P153	Minimum system bus cycle		
Setting range	5 … 250 ms		
Arrays	[-01] = TxSDO Inhibit Time	[-02] = TxPDO Inhibit time	
Factory setting	{ [-01] = 10 }	{ [-02] = 5 }	
Description	Adjusts the cycle time for transmission of SDOs (Service Data Objects) and PDOs (Process Data Object) on the system bus.		
Note	Increasing the cycle time reduces the bus load		

P160	Set analog output				
Setting range	-0,1 … 10,0 V				
Arrays	[-01] = Analog output 1		[-02] = Analog output 2		
Factory setting	{ [-01] = -0.1 }		{ [-02] = -0.1 }		
Description	Sets the signal to a defined value, independent of the system bus.				
Note	If the analog output is configured as an output for current values, the factor 2 must be considered.				
	The setting 0 V corresponds in this case to a current value of 0 mA (0 × 2 = 0).				
	The setting 10 V corresponds in this case to a current value of 20 mA (10 × 2 = 20).				
	The arrays are only functional if the corresponding IOs are present in the module.				
Setting values	Value		Meaning		
	-0.1		The value is set via Bus		
	0.0	… 10.0	The value is set manually		

P161	Filter time				
Setting range	0 … 400 ms				
Arrays	[-01] = Analog input 1		[-02] = Analog input 2		
	[-03] = Analog output 1		[-04] = Digital input 1		
	[-05] = Digital input 2		[-06] = Digital input 3		
	[-07] = Digital input 4		[-08] = Digital output 1		
	[-09] = Digital output 2		[-10] = Analog output 2		
Factory setting	{ [-01], [-02] = 100 }	{ [-04] … [-07] = 2 }		{ [-03], [-08] … [-10] = 0 }	
Description	The analog and digital inputs are read cyclically every 250 µs, which results in an input uncertainty of 0.25ms. In order to eliminate bounce and smooth the input signals, the information which is read in is passed through a filter routine. The filter time can be parametrised.				
	For example, if a filter time of 1 ms is parametrised for a digital input, the input signal is delayed by approx. 1...1.25ms.				
	The parameterisation of the filter time for the analog outputs is used to round off signal jumps.				
Note	The arrays are only functional if the corresponding IOs are present in the module.				

P162	Send broadcast				
Setting range	0 … 1				
Factory setting	{ 0 }				
Description	Activates the broadcast mode.				
	In broadcast mode, up to four frequency inverters can access the module simultaneously.				
Note	In broadcast mode, the addressing of the module (DIP switches) is no longer taken into account.				
	The received data are linked in the I/O module using OR logic. If several frequency inverters are linked to the digital outputs of the module, the relevant output is set to "High" as soon as it is accessed by a frequency inverter. The analog outputs behave in a similar manner. Here, the highest value has priority.				
Setting values	0 = Off		1 = On (broadcast mode active)		

P163	**AOut Inverse**		
Setting range	0 … 1		
Arrays	[-01] = Analog output 1		[-02] = Analog output 2
Factory setting	{ 0 }		
Description	Inverts the signal at the analog output.		
Note	The arrays are only functional if the corresponding IOs are present in the module.		
Setting values	0 = Off		1 = On (inversion active)

P170	**Actual error**	
Display range	0.0 … 564.0	
Arrays	[-01] = Actual error	Active error message (not acknowledged)
	[-02] = Last fault	Displays the last error message from the error memory
Description	Displays an error message.	
Note	SK CSX-3… The display is encoded	
	SK PAR-3… The display is in plain text	
Display values	📖 Section "Error messages"	

P171	**Software version**	
Display range	0.0 … 9999.0	
Arrays	[-01] = Software version	Version number (e.g.: V1.0)
	[-02] = Software revision	Revision number (e.g.: R1)
	[-03] = Special version	Special version of the hardware/software (e.g: 0.0). The value "0" stands for "Standard Version".
Description	Displays the software version (firmware version) of the module	

P172	**Configuration**	
Display range	0 … 8	
Description	Displays the configuration / version of the device	
Display values	Value	Meaning

Value		Meaning
0	CU4 (internal)	Module type: SK CU4-…
1	TU4 (external)	Module type: SK TU4-…
2	TU1-3 (Techn. Unit)	Module type: SK TU1- / TU2- / TU3- …
3	TU1-3 (Techn. Unit)+DIP	Module type: SK TU1- / TU2- / TU3- … with DIP-switches
4	EBIOE-2	Module type: SK EBIOE-2
5	TU4 Safe	Module type: SK TU4-… / "Safe" version
6	TU3 Safe	Module type: SK TU3-… / "Safe" version
7	CU4IOE-2	Module type: SK CU4-IOE2-…

P173 — Option status

Display range	0000 … FFFF (hex)
Description	Displays the status of the connected devices and the system bus
Note	SK CSX-3… The display is in hexadecimal format
	SK PAR-3… The display is in binary format

Value (Bit)		Meaning			
0	… 5	Not used			
6	BUS WARNING	System bus is in status "BUS WARNING"			
7	BUS OFF	System bus is in status "BUS OFF"			
8	FI 1 (Low – Bit)	FI 1 status (low Bit)	**Bit High**	**Bit Low**	**Meaning**
9	FI 1 (High – Bit)	FI 1 status (High Bit)	0	0	FI is offline
10	… 11	FI 2 status	0	1	FI is not recognised
12	… 13	FI 3 status	1	0	FI is online
14	… 15	FI 4 status	1	1	FI lost

* FI is switched off

P174 — Status of digital in.

Display range	0000 … 1111 (bin)
Description	Actual image of the switching states of the digital inputs.
Note	SK CSX-3… The display is in hexadecimal format
	SK PAR-3… The display is in binary format

Value (Bit)		Meaning
0	Digital input 1	Digital input 1 of the module
1	Digital input 2	Digital input 2 of the module
2	Digital input 3	Digital input 3 of the module
3	Digital input 4	Digital input 4 of the module

P175 — State of relays

Display range	00 … 11 (bin)
Description	Actual image of the switching states of the digital outputs.
Note	SK CSX-3… The display is in hexadecimal format
	SK PAR-3… The display is in binary format

Value (Bit)		Meaning
0	Relay 1	Digital output 1 of the module
1	Relay 2	Digital output 2 of the module

P176 — Current voltage

Display range	-10,0 … 10,0 V		
Arrays	[-01] = Analog input 1	[-02] =	Analog input 2
	[-03] = Analog output 1	[-04] =	Analog output 2
Description	Shows the measured voltage.		