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Safety Controller HSC-A100-ENC Specification

Symbol	Amended Reason			Pages	Date	Amended by	Number
Approved by	Checked by	Drawn by	Designed by	Title	Safety controller HSC-A100-ENC Specification		
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1. Description

- Open programmable and configurable FSoE master unit for operation on EtherCAT networks.
- Interface for up to 6 safe scanner units
- 4 Encoder interface for up to 4 axis
- 16 Safe digital inputs
- 10 Safe digital outputs
- 2 Configurable pulse outputs or safe digital outputs
- 2 Relay outputs
- Safety controller up to PL e acc. to EN ISO 13849-1 or SIL3 acc. to IEC 61508
- cULus approval

1-1. Characteristic of the module

- Safe logic processing of input, output, status and activation signals
- Easy and transparent programming and parametrization via HSC Project designer
- Scanner master functions, activation of monitoring areas and computing of monitoring result status
- Complete set of Drive monitoring
- Deterministic data communication and processing for safe position and speed functions via distributed sensor / multiple axes
- Special AGV functions
- Storage of safe parameters in the base module
- Status LEDs for IO
- Multifunction button (Quit, Start, Reset) front side
- Integrated Communication interface:
 - >EtherCAT interface and FSoE Main Instance stack for safe connectivity to higher levels of control
 - >or Modbus TCP/IP

2. Safety related characteristic data

Performance Level	PLe	EN ISO13849-1
PFH / architecture	PFH=2.08*10 ⁻⁸	
Safety Integrity Level	one channel mode	Cat3(EN13849-1)
		SIL2(IEC61508)
	two channel mode	Cat4(EN13849-1)
		SIL3(IEC61508)
Proof test interval	20 years	max. operation period

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3.Specification

Item	Specification		
GENERAL DATA	Max. no. of expansion modules		2x Axis or 4x IO
	Interface for expansion modules		2x RJ-45(Ethernet)
	Number of safe digital inputs		16
	Number of safe digital outputs	pp-switching *	6+2**+4
		pn-switching *	2
	Number of relay outputs		2
	Number of analog inputs		2
	Number of pulse outputs (clock outputs)		2
	Number of scanner connections (data interface)		6
	Number of encoder interface		4(8x 6pins)
	Type of connection		Plug-in terminals with spring connection
ELECTRICAL DATA	Supply voltage (tolerance)		24 VDC; 2A (-35%, +30%)
	Fuse	Scanner power supply +24V	min. 32 VDC; max. 2A
		I/O power Supply +24V	min. 32 VDC; max. 10A
	Max. Power consumption (logic)		4.7W
	Rated data digital inputs		24VDC ; 20mA Typ2(IEC61131-2)
	Rated data digital outputs		24VDC ; 0.5A
	Rated data digital outputs	pn-switching	24VDC ; 2A
		pp-switching	24VDC ; 2A
		pulse outputs	24VDC ; 250mA
	Rated data relay outputs		240VAC ; 24VDC ; 2A
Rated data analog inputs		-10..+10V, 4..20mA	
ENVIRONMENTAL DATA	Temperature(operation)		-25°C...+55°C
	Temperature (storage and transport)		-25°C...+70°C
	Class of protection		IP20 connectors IP00 EN 60529
	Climatic category		3K24(DIN EN60721-3-3)
	Pollution class		2(EN60664-1)
	EMC		DIN EN61800-3,DIN EN61800-5-1 DIN EN62061,DIN EN62477-1 DIN EN55011

*pn/pp are configurable via HSC Project designer

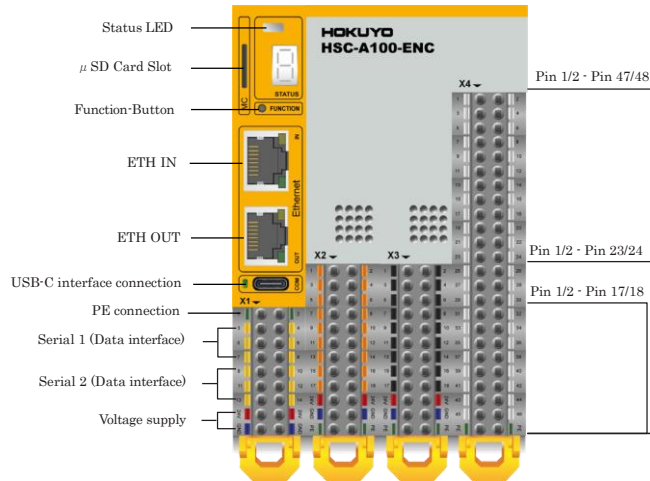
**configurable 2 pulse outputs or 2 pp-switching

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Item	Specification	
ENVIRONMENTAL DATA	Shock	15g/11ms, 10G/16ms and 5G/11ms in all three axes
	Vibration/shock resistance	conforms to EN 60068-2-6 EN 60068-2-27, IEC 60068-2-64
	Max. appl. height	≤2000m
MECHANICAL DATA	Dimension (HxDxW)	124mm×95mm×76mm
	Weight	413g
	Mounting	to snap on top-hat rail
	Min. terminal cross-section /AWG	0.2mm ² / 24
	Max. terminal cross-section /AWG	1.5mm ² / 16

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4. Device interfaces



Interface	Description of interface
X1 / Serial 1, Serial 2	Data Interface
X2 / I0.0-I0.15	Voltage supply and I/O interfaces
X3 / QX0.0-QX0.7, Q0.8-Q0.11Q0.1x Rx, P1-P2	I/O Interface
X4 / ENC _x , Analog_IN _x	Encoder interface
ETH OUT / ETH IN	Fieldbus interfaces
USB-C	Data interface
μSD Card Slot	Data interface

4.1 DATA INTERFACE, VOLTAGE SUPPLY & I/O INTERFACE

Pin assignment

X1				X2			
Pin	1-PE	2-PE	Protective earth	Pin	1-NC	2-NC	Safe digital inputs
	3-RS-485_1+	4- RS-485_1-	Serial interface 1		3-I0.0	4-I0.8	
	5-RS-485_1+	6- RS-485_1-			5-I0.1	6-I0.9	
	7-RS-485_1+	8- RS-485_1-			7-I0.2	8-I0.10	
	9-RS-485_2+	10-RS-485_2-	Serial interface 2		9-I0.3	10-I0.11	
	11-RS-485_2+	12-RS-485_2-			11-I0.4	12-I0.12	
	13-RS-485_2+	14-RS-485_2-			13-I0.5	14-I0.13	
	15-VCC_IN	16-VCC_OUT	Voltage supply scanner +24V ^{※1}		15-I0.6	16-I0.14	Voltage supply device+24VDC ^{※2}
	17-GND	18-GND	Voltage supply 0 VDC ^{※1}		17-I0.7	18-I0.15	
				19-VCC_IN	20-VCC_IN	Voltage supply device+24VDC ^{※2}	
				21-GND	22-GND	Voltage supply device ^{※2}	
				23-PE	24-PE	Protective earth	

※1 : Pin X1_15-16(17-18) is a power supply port to the scanner that runs internally. Connect Pin 15(17) to external power supply. It is possible to supply the power to the scanner from pin 16(18).

※2 : X2_19-20 (21-22) pins are internally conducting

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I/O INTERFACE AND VOLTAGE SUPPLY

X3				
Pin	1-Q0.0	Safe digital outputs	2-P1 / Q0.6_P	Non-safe pulse output / Safe digital output
	3-Q0.1		4-P2 / Q0.7_P	Non-safe pulse output / Safe digital output
	5-Q0.2		6-Q0.8_PP/Q0.8_P	Safe output pn ⁻ / pp switching 00
	7-Q0.3		8-Q0.9_PP/Q0.9_N	Safe output pn ⁻ / pp switching 01
	9-Q0.4		10-Q0.10_PP/Q0.10_P	Safe output pn ⁻ / pp switching 02
	11-Q0.5		12-Q0.11_PP/Q0.11_N	Safe output pn ⁻ / pp switching 03
	13-Q0.12_R1.1	Relay output 1	14-Q0.12_R1.2	Relay output 1
	15-NC	No function	16-NC	No function
	17-Q0.14_R2.1	Relay output 2	18-Q0.14_R2.2	Relay output 2
	19-VCC_IN	I/O +24VDC※3	20-VCC_IN	I/O +24VDC※3
	21-GND	I/O 0VDC※3	22-GND	I/O 0VDC※3
	23-PE	Protective earth	24-PE	Protective earth

※3 : 19-20(21-22) pins are internally conducting

ENCODER INTERFACES

X4				
Encoder1	Pin	1-ENC1_Data+ NCA+	2-ENC1_Data- NCA-	TTL/HTL, SinCos Resolver
		3-ENC1_CLK+ NCB+	4-ENC1_CLK- NCB-	
		5-ENC1_Z+	6-ENC1_Z-	
		7-ENC1_U_Out+	8-ENC1_U_Out-	
		9-ENC1_U_In+	10-ENC1_U_In-	
		11-NC	12-NC	
Encoder 2	Pin	13-ENC2_Data+	14-ENC2_Data-	TTL/HTL, SinCos Resolver, Analog
		15-ENC2_CLK+	16-ENC2_CLK-	
		17-ENC2_Z+	18-ENC2_Z-	
		19-EUT2_U_Out+	20-ENC2_U_Out-	
		21-ENC2_U_In+	22-ENC2_U_In-	
		23-Analog_IN1+	24-Analog_IN1-	
Encoder 3	Pin	25-Analog_IN2+	26-Analog_IN2-	TTL/HTL, SSI Analog
		27-ENC3_Data+	28-ENC3_Data-	
		29-ENC3_CLK+	30-ENC3_CLK-	
		31-ENC3_Z+	32-ENC3_Z-	
		33-EUT3_U_Out+	34-ENC3_U_Out-	
		35-ENC3_U_IN+ / Analog_IN3+	36-ENC3_U_In- / Analog_IN3-	

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X4				
Encoder4	Pin	37-ENC4_Data+	38-ENC4_Data-	SSI,Analog
		39-ENC4_CLK+	40-ENC4_CLK-	
		41-ENC4_Z+	42-ENC4_Z-	
		43-EUT4_U_Out+	44-ENC4_U_Out-	
		45-ENC4_U_In+ / Analog_IN4+	46-ENC4_U_In- / Analog_IN4-	
		47-PE	48-PE	

4.2 Encoder types and their combinations, diagnostics characteristic data

Encoder combinations			
Type	Single Encoder	Dual Encoder	
Encoder Interface	1,2	3	4
Safe data	Safe speed	Safe position, safe speed	
Encoder type	Resolver	SSI, INC/HTL	SSI
	TTL/HTL		Analog
	SinCos	-	
	Analog	Analog	-

4.3 Encoder diagnoses

Encoder type	Interface X4			
	TTL/HTL	SinCos	SSI	Analog
Supply Voltage Monitoring	✓	✓	✓	✓
Plausibility Test Position Signal MPUA/MPUB	✓	✓	✓	✓
Plausibility Test Speed Signal MPUA/MPUB	✓	✓	✓	✓
Comparison of the Encoder Raw Values MPUA/MPUB	-	-	-	✓
Encoder Diagnostic According to Corresponding Safety Manual	-	-	-	-
Difference Level Monitoring	✓	-	-	-
Monitoring of the Permitted Quadrants	-	✓	-	-
Monitoring of the Counter Signal Separated for Track A/B	✓	-	-	-
SIN/COS Plausibility Monitoring	-	✓	-	-
Input Signal Level Monitoring	-	✓	-	✓
Clock-Frequency Monitoring	-	-	✓	-

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Encoder1	Encoder2	Safe Direction	Safe Speed	Safe Absolute Position	Fault Exclusion※	DC[%]		
						Single-Channel Subsystem	Dual-Channel Subsystem	dynamic Subsystem non-dynamic
NC	NC	-	-	-	-	-	-	-
Resolver	none	✓	✓	-	-	99	99	90-95
TTL/HTL		✓	✓	-	-	90	99	80-90
SinCos		✓	✓	-	-	99	99	90-95
Analog	Analog	-	-	✓	-	90-95	90-95	90-95
SSI	Resolver	✓	✓	✓	-	-	99	90-95
	TTL/HTL	✓	✓	✓	-	-	99	90-95
	SSI	✓	✓	✓	-	-	99	90-95

4.4 Encoder specifications

Incremental encoder-HTL

Signal level	24V / 0V
Physical Layer	PUSH/PULL
Measuring signal A/B	Track with 90 degree phase difference
Type of connection	Plug-in terminals with spring connection
Max. counting pulse frequency (X4/ENC1-ENC3)	200 kHz
Phase detection	30°(Max. allowed deviation from the rated value)

Incremental encoder -TTL

Signal level	5V/0V
Physical Layer	RS-422 compatible
Measuring signal A/B	Track with 90 degree phase difference
Type of connection	Plug-in terminals with spring connection
Max. counting pulse frequency (X4/ENC1-ENC3)	500 kHz
Phase detection	30°(Max. allowed deviation from the rated value)

Sin/Cos

Physical Layer	+/-0.5V _{SS}
Signal level tolerance	0.7...1.4V _{SS}
Measuring signal A/B	Track with 90 degree phase difference
Type of connection	Plug-in terminals

Standard Mode

Max. frequency of input clock pulses(X4/ENC1,ENC2)	500 kHz
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High Resolution Mode (optional)

Max. frequency of input clock pulses (X4)	15 kHz
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SSI encoder

Data interface	Serial Synchronous Interface (SSI) with variable data length of 12 – 28 Bit
Data format	Binary or Gray code
Physical Layer	RS-422 compatible
Type of connection	Plug-in terminals
Master Operation Mode	
Clock rate (X4/ENC3,ENC4)	Variable: 125, 250, 500, 1000, 2000 kHz

Resolver

Mode	Main and Sub
Signal level	8..20V _{SS}
Source frequency master	8kHz
Source frequency slave	4..12kHz
Standard mode	yes
Maximum frequency / poles (X4/ ENC1, ENC2)	500 kHz / 4

Analog encoder(X4/ENC2,ENC3)


Mode	Main
Data interface	Analog input with data length of 9 Bit resolution
Data format	N.a
Physical Layer	-10..+10V,4..20mA



5. Other interfaces

FIELDBUS INTERFACES

Pin assignment ETH IN / ETH OUT , ethernet-based interface

EtherCAT interface(RJ45)				
Pin	Name	Description	Color	IN/OUT
1	TX+	Transmit Data +	white-orange	
2	TX-	Transmit Data -	orange	
3	RX+	Receive Data +	white-green	
4	NC	Not used	blue	
5	NC	Not used	white-blue	
6	RX-	Receive Data -	green	
7	NC	Not used	white-brown	
8	NC	Not used	brown	

ETHERNET INTERFACE

The Ethernet based one is for fieldbus communication whereby the HSC-A100-ENC acts as a safe slave on the following fieldbus standards:

- EtherCAT with FSoE

Designation	Type	Description
Technology	Ethernet	Ethernet Port for Fieldbus communication, Selection by parameter
Protocol	EtherCAT	EtherCAT Slave protocol with mandatory CoE, EoE
Safe protocol	FSoE	EtherCAT safe slave data protocol
Functional data	18 / 34Byte	18 Byte functional inputs / 34 Byte functional outputs
DC Mode	Free sync and DC sync	Synchronization with top-level control
Min. cycle time	4ms	-

- or Modbus TCP/IP

Designation	Type	Description
Technology	Ethernet	Ethernet Port for Fieldbus communication, Selection by parameter
Protocol	TCP/IP	Modbus Port 502
Functional data	18 / 34Byte	18 Byte functional inputs / 34 Byte functional outputs
Min. cycle	4ms	

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DATA INTERFACES

Serial (Scanner) interface


The serial interface is exclusively reserved for communication with the Hokuyo-Type scanners by use of the proprietary Hokuyo protocol UAM-05LP. The HSC-A100-ENC is MainDevice and can communicate with 3 SubDevice per interface. There are two serial interfaces on the HSC-A100-ENC, the MainDevice is instantiated twice, therefore up to 6 scanners can be connected on one HSC-A100-ENC.

Designation	Type	Description
Technology	Serial RS 485	Type and physical standard
Protocol	Hokuyo	Hokuyo protocol for MainDevice / SubDevice communication, standard data if any
Safe Protocol	Hokuyo UAM-05LP	Hokuyo protocol for safe MainDevice / SubDevice communication
Safe data	Master to Slave	8 Byte process data + 9 Byte Overhead
	Slave to Master	13 Byte process data + 9 Byte Overhead
Timing	As defined in UAM-05LP	Synchronization by master telegram with slots for return data of the slaves
Min. cycle Time	30ms	-

- Scanners 1...3 are connected to X1 (Serial Interface 1)
- Scanners 4...6 are connected to X1 (Serial Interface 2)

USB-C interface

A USB-C connection is available to connect an engineering PC directly to the device for tooling purposes.

Pin assignment USB-C interface					
Pin	Name	Pin	Name	Description	USB-C
A1	GND	B1	GND	Ground	
A2	TX1+	B2	TX2+	Not connected	
A3	TX1-	B3	TX2-	Not connected	
A4	V _{BUS}	B4	V _{BUS}	Voltage supply	
A5	CC1	B5	CC2	Not connected	
A6	D+	B6	D+	USB data +	
A7	D-	B7	D-	USB data -	
A8	NC	B8	NC	Not connected	
A9	V _{BUS}	B9	V _{BUS}	Voltage supply	
A10	RX2-	B10	RX1-	Not connected	
A11	RX2+	B11	RX1+	Not connected	
A12	GND	B12	GND	GND	

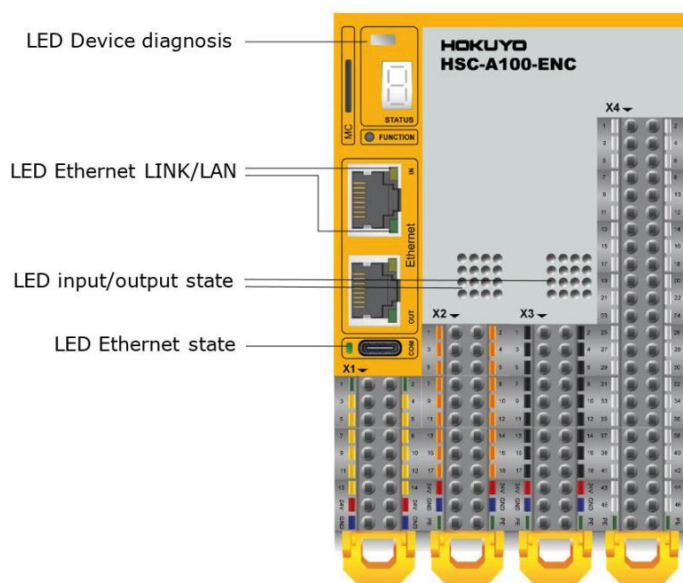
uSD-Card Slot

The μ SD card slot is used to exchange devices without a technical PC and enables the backup / recovery of software on the devices.

Designation	Type	Description
Tooling connection	Micro SD card connector	Backup / recovery of FW, parameterization and PLC code (esp. for device exchange)

HMI

The following table gives an overview of the LEDs



Overview	Parameter	Description
LED Device diagnosis	Multicolor	Green / orange / red to show device status
LED Ethernet state	Green/red	1 LED
LED Ethernet LINK/LAN	Green & yellow	2 per Ethernet, following conventions
LED I/O state	Green	1 per I/O
LED voltage supply	Green/red	1 on 24V / GND supply
Function button	1 push button	Button for interaction with device on front panel
Display	-	1x 7-segment display

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LED assignment

Input		Output		LED display X2, X3
LED	Name	LED	Name	
1	I0.0	1	Q0.0	
2	I0.1	2	Q0.1	
3	I0.2	3	Q0.2	
4	I0.3	4	Q0.3	
5	I0.4	5	Q0.4	
6	I0.5	6	Q0.5	
7	I0.6	7	Q0.6	
8	I0.7	8	Q0.7	
9	I0.8	9	Q0.8_PP/_P	
10	I0.9	10	Q0.9_PP/_N	
11	I0.10	11	Q0.10_PP/_P	
12	I0.11	12	Q0.11_PP/_N	
13	I0.12	13	Q0.12_R1(Relay1)	
14	I0.13	14	Q0.14_R2(Relay2)	
15	I0.14	15	-	
16	I0.15	16	Voltage supply I/O	

