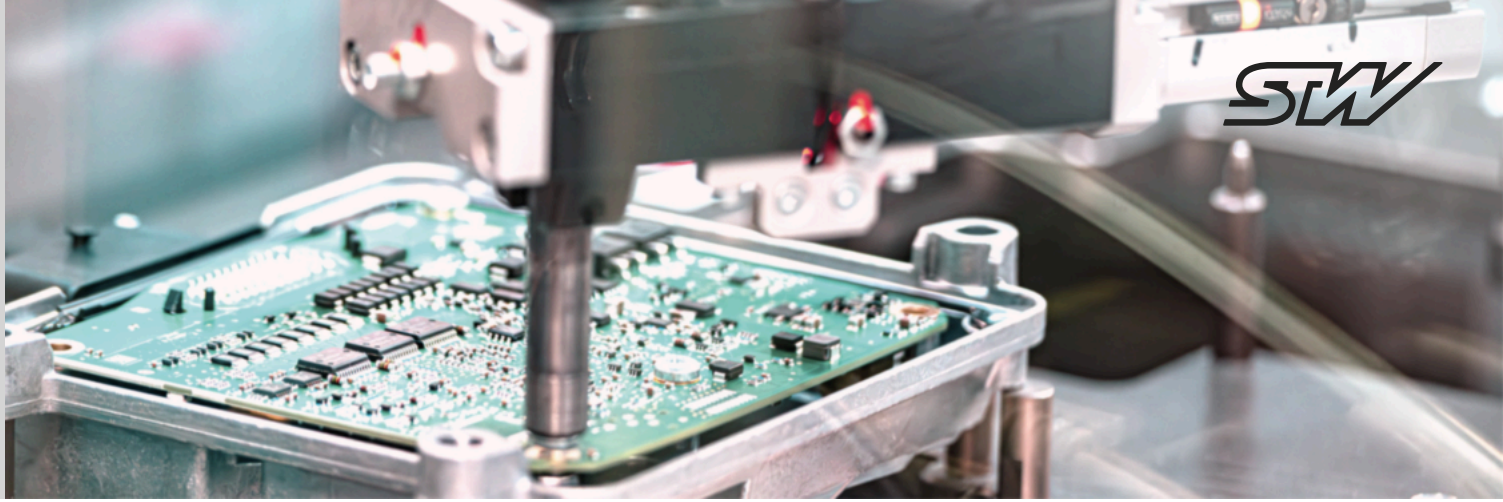




ESX.4cm-ag

ESX control units

KEY FEATURES

- Control specially designed for use in harsh mobile applications
- Flexible programming in C, MATLAB Simulink or Neuron Power Engineer (IEC 61131-3, formerly logi.CAD 3) SF)
- Suitable for safety-related applications up to SIL 2 according to IEC 61508:2010 SF), PL d according to EN ISO 13849-1:2015 SF), AgPL d Cat 2. according to DIN EN ISO 25119 SF) or ASIL B according to ISO 26262 SF)
- Prepared for the Cyber Resilience Act (CRA)

TECHNICAL DATA

- Aurix TC399 Multicore 32 bit, 300 MHz
- Internal: 6.5 MB RAM, 16 MB Flash
- External: optional data flash and F-RAM options
- 256 kB F-RAM
- 4 CAN (CAN FD SF)) interfaces, 1 RS232 or LIN
- 1 100/1000BASE-T1, 2 100BASE-T1 and 1 100BASE-TX Ethernet interfaces
- 34 inputs
- 25 outputs
- 4 sensor supplies

ACCESSORIES

- Integrated into STW's openSYDE software platform
- openSYDE CANopen handler
- Component deployment for C, MATLAB Simulink, and Neuron Power Engineer (IEC 61131-3, formerly logi.CAD 3)
- ISOBUS library
- Mating plugs, development cables, and starter kit
- Debug device of the controller
- Debugger
- Compiler

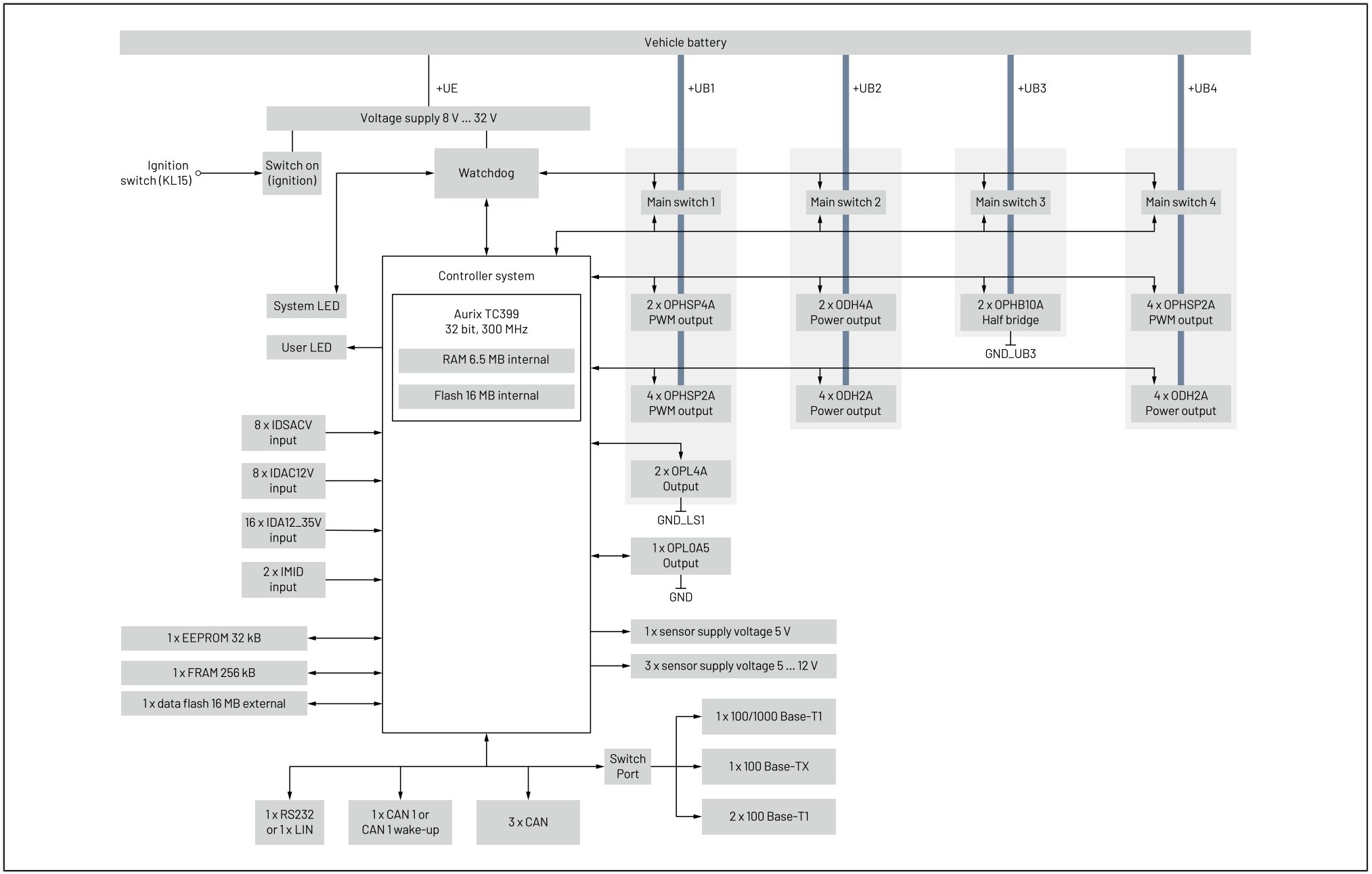
Sensor-Technik Wiedemann GmbH

Am Bärenwald 6
87600 Kaufbeuren
Germany
+49 8341 9505-0
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www.stw-mm.com

SF) Scheduled feature

Subject to change without notice

BLOCK DIAGRAM



The block diagram represents the maximum possible configuration of the controller. The components available on the controller depend on the variant.

Variants

Variant features of the ESX.4cm-ag

Feature		Variant 1	Variant 2	Variant 3	Variant 4
Processor and memory	32 bit Infineon Aurix TC399 multicore CPU, @ 300 MHz	✓	✓	✓	✓
	6.5 MB internal RAM	✓	✓	✓	✓
	16 MB internal Flash	✓	✓	✓	✓
	16 MB external data Flash	✓	✓	✓	✓
	256 kB F-RAM	✓	✓	✓	✓
Communication interface	CAN, from 100 kbit/s to 1 Mbit/s	4	2 (CAN bus 1 and 2)	2 (CAN bus 1 and 2)	3
	RS232 or LIN	1 x RS232	1 x RS232	-	1 x RS232
	100/1000BASE-T1 Ethernet (M12 2pol. - SPE)	1	1	-	-
	100BASE-TX Ethernet (M12 4pol.)	1	1	-	-
	100BASE-T1 Ethernet (via vehicle connector)	2	-	-	-
Inputs	IDSACV	8	8	-	8
	IDA12_35V	16	10	10	16
	IDAC12V	8	-	-	8
	Module identifier (IMID)	2	2	2	2
Outputs	Digital/PWM high side output OPHSP4A	2	2	-	2
	Digital/PWM high side output OPHSP2A	8	4	4	8
	Digital output ODH4A	2	2	-	2
	Digital output ODH2A	8	8	4	8
	PWM half bridge output OPHB10A	2	2	2	2

Variants

Variant features of the ESX.4cm-ag

Feature		Variant 1	Variant 2	Variant 3	Variant 4
	Digital/PWM low side output OPL4A	2	2	-	2
	Digital/PWM low side output OPL0A5	1	-	-	1
	Sensor supply voltage 5 ... 12 V	3	2	1	3
	Sensor supply voltage 5 V	1	-	-	1

TECHNICAL DATA

Processor and memory

Type	Properties	Features
Aurix TC399	32 bit, multicore processor, @ 300 MHz	• External system supervisor with programmable watchdog • 12 bit A/D converter for analog signal processing
Flash	16 MB	15.5 MB available for customer application
Data Flash	16 MB	
RAM	6.5 MB	On-chip RAM This memory serves as system memory for BIOS stack and data. In addition roughly 80 % can be used for the customer application.
FRAM	256 kB	Available for customer application. FRAM data retention: • 11 years at 105 °C • 121 years at 85 °C Typical endurance according to manufacturer: 10^{13} read/write cycles at 125 °C

Communication interfaces

Type	Maximum quantity	Configuration
CAN	4	CAN 2.0B, baud rate from 100 kbit/s to 1 Mbit/s (CAN FD SF))
Ethernet	1	100/1000BASE-T1 Link Type A (100 Mbit/s/1 Gbit/s Single Pair Ethernet)
	2	100BASE-T1 (100 Mbit/s Single Pair Ethernet)
	1	100BASE-TX (100 Mbit/s Ethernet)
RS232	1	Baud rate up to 115 kBit/s
LIN (optional)	1	In accordance to LIN specification 2.2A

SF) Scheduled feature

• LIN and RS232 share the same connector pins, i.e. either RS232 or LIN is available, but not both.

TECHNICAL DATA

Inputs

Type	Maximum quantity	Possible configuration	Measurement
Multifunctional input 12 V and 35 V IDA12_35V	16	Analog voltage range (programmable)	0 ... 35 V 0 ... 12 V
		Programmable pull-up resistor	1.1 kΩ to +8.5 V
		Programmable pull-down resistor	1 kΩ to GND
		NAMUR sensor	NAMUR sensor compatible
		Digital	Active-high/Active-low
		Frequency	0.6 Hz ... 20 kHz
		Incremental encoder interface	Change of position or angular change
Digital analog input IDSACV	8	Analog voltage range (programmable)	0 ... 35 V 0 ... 12 V 0 ... 5 V
		Analog current	0 ... 24 mA
		Programmable pull-up resistor	1.1 kΩ to +8.5 V 10 kΩ to +5 V
		Programmable pull-down resistor	1 kΩ to GND
		NAMUR sensor	NAMUR sensor compatible
		Digital (voltage mode)	Active high Achtive low
		Frequency	0.6 Hz ... 20 kHz
		SENT	Full SENT interface at voltage measuring range 0 ... 5 V

TECHNICAL DATA

Inputs

Type	Maximum quantity	Possible configuration	Measurement
Digital analog input 0 ... 12 V IDAC12V	8	Analog voltage	0 ... 12 V
		Analog current	0 ... 24 mA
		Programmable pull-up resistor	1.1 kΩ to +8.5 V
		Programmable pull-down resistor	1 kΩ to GND
		NAMUR sensor	NAMUR sensor compatible
		Digital (voltage mode)	Active high Achtive low
		Frequency	0.6 Hz ... 20 kHz
		Incremental encoder interface	Change of position or angular change

Outputs

Type	Maximum quantity	Possible configuration	Range	Characteristics	Feature
Digital/PWM high side output OPHSP2A	8	PWM	0 ... 2.5 A	0 ... 100 % duty cycle resolution < 0.1 % PWM frequency 5 ... 1000 Hz	• high side switch • precise current measurement, accuracy is ±2.3 % ±70 mA • supports current control mode • digital feedback, open load detection in OFF state • automated shutdown on overcurrent > 4.6 A ±0.9 A • combine several outputs for parallel operation
		Digital	-	ON/OFF	

TECHNICAL DATA

Outputs

Type	Maximum quantity	Possible configuration	Range	Characteristics	Feature
Digital/PWM high side output OPHSP4A	2	PWM	0 ... 4 A	0 ... 100 % duty cycle resolution < 0.1 % PWM frequency 5 ... 1000 Hz	• high side switch • precise current measurement, accuracy is ±2.3 % ±140 mA • supports current control mode • digital feedback, open load detection in OFF state • automated shutdown on overcurrent > 7.5 A ±1.5 A • combine several outputs for parallel operation
		Digital	-	ON/OFF	
Digital output ODH2A	8	PWM	0 ... 2.5 A	0 ... 100 % duty cycle resolution < 0.1 % PWM frequency 5 ... 1000 Hz	• high side switch • optimized for digital operation mode (ON/OFF) • current feedback,measurement accuracy is ±25.0 % (gain) ±100 mA (offset) • output voltage feedback, voltage measurement with ±3 % (gain) ±0.15 V (offset) • automated shutdown on overcurrent > 3.6 A ±0.9 A • combine several outputs for parallel operation up to 15 A
		Digital	-	ON/OFF	
Digital output ODH4A	2	PWM	0 ... 4 A	0 ... 100 % duty cycle resolution < 0.1 % PWM frequency 5 ... 1000 Hz	• high side switch • optimized for digital operation mode (ON/OFF) • current feedback, measurement accuracy is ±25.0 % (gain) ±100 mA (offset) • output voltage feedback, voltage measurement with ±3 % (gain) ±0.15 V (offset) • automated shutdown on overcurrent 6 A ±1.5 A • combine several outputs for parallel operation up to 12 A
		Digital	-	ON/OFF	

TECHNICAL DATA

Outputs

Type	Maximum quantity	Possible configuration	Range	Characteristics	Feature
Digital/PWM low side output OPL4A	2	PWM	0 ... 4 A	0 ... 100 % duty cycle resolution < 0.1 % PWM frequency 5 ... 1000 Hz	• low side switch • precise current measurement, accuracy is ±2.3 % ±120 mA • supports current control mode • digital feedback, open load detection in OFF state • automated shutdown on overcurrent > 7.5 A ±0.9 A • output voltage feedback, accuracy is ±4.5 % ±200 mV
		Digital	-	ON/OFF	
Digital/PWM half-bridge output OPHB10A	2	PWM	0 ... 10 A	0 ... 100 % duty cycle resolution < 0.1 % PWM frequency 5 ... 1000 Hz	• push-pull output • current measurement ±2.3 % ±400 mA • supports current control mode • digital feedback • output voltage feedback, accuracy is 3 % ±150 mV • automated shutdown on overcurrent > 32 A ±15 A • automated shutdown on overtemperature • two half-bridge outputs might be combined as full-bridge
Digital low side output OPL0A5	1	PWM	0 ... 0.5 A	0 ... 100 % duty cycle resolution < 0.1 % PWM frequency 5 ... 1000 Hz	• low side switch • output voltage feedback, accuracy is ±4 % ±200 mV
		Digital	-	ON/OFF	
Main Switch	4		8 ... 32 V DC	ON/OFF	• high-side switch • switches the output groups +UB1 to +UB4 • Current up to 12 A

TECHNICAL DATA

Outputs

Type	Maximum quantity	Possible configuration	Range	Characteristics	Feature
Sensor supply voltage 5 V	1	-	5 V	ON/OFF Accuracy voltage output is +2 ... -2.5% Accuracy voltage readback is ±2.5% ±50 mV	Maximum output current 250 mA
Sensor supply voltage 5 ... 12 V	3	Voltage	5 ... 12 V	Accuracy voltage output is ±0.9% ±50 mV This is valid under the following conditions: • Capacitive load ≤470 µF • Settling time 100 ms Accuracy voltage readback: ±0.9% ±50 mV	Maximal output current I_{MAX} = 250 mA programmable output needs derating for output voltages U_{EXT} < 10 V: $I_{MAX} = 0.875 / (13.5 - U_{EXT})$ A

TECHNICAL DATA

Mechanical data

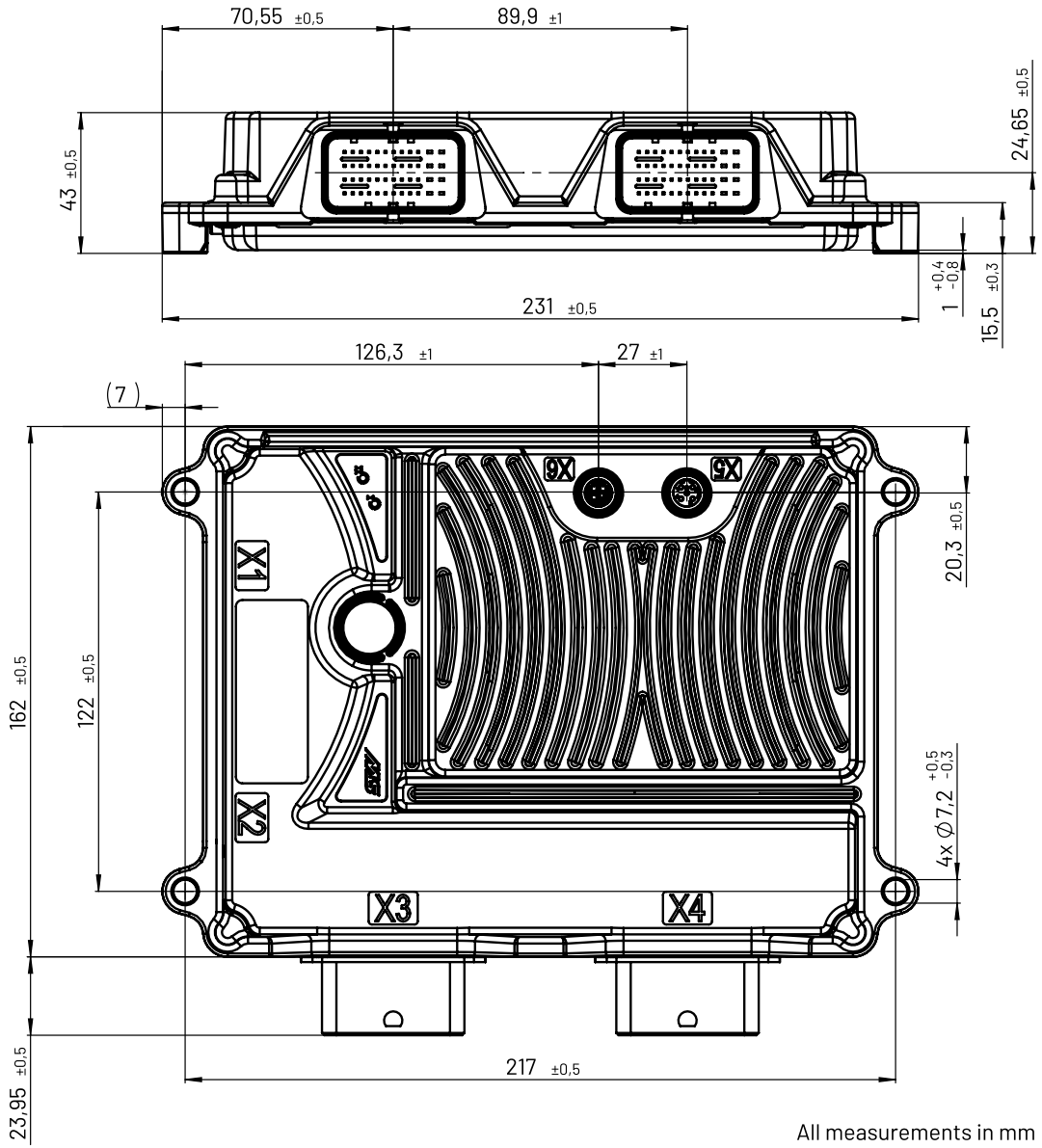
Component	Description	Value
Connectors	—	2 x Molex CMC 48 pin
		Ethernet, M12 connector: 1x 100/1000BASE-T1: 2 pins, IEC63171-5 1x 100BASE-TX: 4 pins, D-type
Indicators	2 LED, dual color (red/green or mixed colors)	System LED and User LED
Housing	Die-cast aluminum	GORE-TEX™-breathing filter for pressure equalization
Degree of protection	Variant without M12 Ethernet connector	IP6K6, IPX7, IPX9K
	Variant with M12 Ethernet connector	IP6K5, IPX7
Dimensions	—	231 mm x 162 mm x 43 mm
Operating temperature, housing temperature	—	-40 ... +85 °C (-40 ... +185 °F)
Operating altitude	—	-400 ... +4000 m

TECHNICAL DATA

Power supply

Component	Description	Range	
		Minimum Value	**Maximum Value**
DC voltage supply	Voltage at +UE ECU supply and +UB power supply	8 V DC	32 V DC
Current consumption	Power supply +UB1 fully loaded 12 A	-	48 A, short-term
	Power supply +UB2 fully loaded 12 A		
	Power supply +UB3 fully loaded 12 A		
	Power supply +UB4 fully loaded 12 A		
	2 x low side output OPL4A	-	8 A, fully loaded
Standby	Sum of input currents at +UE and +UB (U_{KL15} = 0 V, ignition off) Without external load		< 1 mA (max. 28 V)
ECU active	+UE supply current (U_{KL15} > $U_{KL15HIGH}$, no external load)		≈ 500mA at +UE = 12 V ≈ 300mA at +UE = 28 V

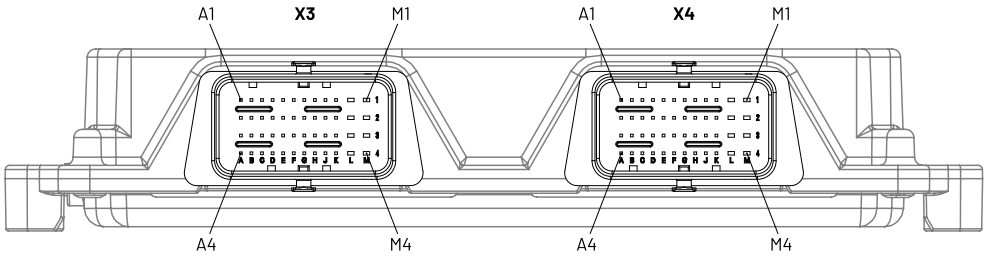
TECHNICAL DRAWING



All measurements in mm

PIN ASSIGNMENT (Not all pins are available in every variant. An overview of the available options for each variant can be found on the Variants page.)

Pin assigment main connector X3 and X4



Pin assigment main connector X3 and X4

Pin	Signal name	Description
X3.A1	LIN1 / RS232_RXD	LIN Bus / RS232 (Rx)
X3.A2	SUP_U_LIN1/ RS232_TXD	LIN 12 V power supply / RS232 (Tx)
X3.A3	–	n.c
X3.A4	–	n.c
X3.B1	CAN1_H	CAN bus 1 high
X3.B2	CAN2_H	CAN bus 2 high
X3.B3	ETH1_P3_BRR-	ETH1_P3 BRR-
X3.B4	ETH1_P4_BRR-	ETH1_P4 BRR-
X3.C1	CAN1_L	CAN bus 1 low
X3.C2	CAN2_L	CAN bus 2 low
X3.C3	ETH1_P3_BRR+	ETH1_P3 BRR+
X3.C4	ETH1_P4_BRR+	ETH1_P4 BRR+
X3.D1	IDSACV_1	Analog / Digital input IDSACV_01
X3.D2	IDSACV_2	Analog / Digital input IDSACV_02
X3.D3	–	n.c
X3.D4	–	n.c
X3.E1	IDA12_35V_1	Analog / Digital input IDA12_35V_01
X3.E2	IDA12_35V_2	Analog / Digital input IDA12_35V_02
X3.E3	IDA12_35V_5	Analog / Digital input IDA12_35V_05
X3.E4	IDA12_35V_6	Analog / Digital input IDA12_35V_06

PIN ASSIGNMENT (Not all pins are available in every variant. An overview of the available options for each variant can be found on the Variants page.)

Pin assigment main connector X3 and X4

Pin	Signal name	Description
X3.F1	IDAC12V_1	Analog / Digital input IDAC12V_01
X3.F2	IDAC12V_2	Analog / Digital input IDAC12V_02
X3.F3	UEXT5-12V_1	Sensor Supply 5-12V
X3.F4	AGND	Analog GND
X3.G1	IDA12_35V_3	Analog / Digital input IDA12_35V_03
X3.G2	IDA12_35V_4	Analog / Digital input IDA12_35V_04
X3.G3	IDA12_35V_7	Analog / Digital input IDA12_35V_07
X3.G4	IDA12_35V_8	Analog / Digital input IDA12_35V_08
X3.H1	IDSACV_3	Analog / Digital input IDSACV_03
X3.H2	IDSACV_4	Analog / Digital input IDSACV_04
X3.H3	UEXT5V_1	Sensor Supply 5V
X3.H4	AGND	Analog GND
X3.J1	IDAC12V_3	Analog / Digital input IDAC12V_03
X3.J2	IDAC12V_4	Analog / Digital input IDAC12V_04
X3.J3	KL15	Ingnition (KL15)
X3.J4	OPL0A5	Digital-/ PWM-Output OPL0A5
X3.K1	OPHSP2A_1	Digital-/ PWM-Output OP2A_01
X3.K2	OPHSP2A_2	Digital-/ PWM-Output OP2A_02
X3.K3	OPHSP2A_3	Digital-/ PWM-Output OP2A_03
X3.K4	OPHSP2A_4	Digital-/ PWM-Output OP2A_04

Pin assigment main connector X3 and X4

Pin	Signal name	Description
X3.L1	UB_1	Power Supply for power group UB_1 (OPHSP2A_1..4, OPHSP4A_1..2)
X3.L2	OPL4A_1	Digital-/PWM-Output OPL4A_01
X3.L3	OPHSP4A_1	Digital-/ PWM-Output OP4A_01
X3.L4	UE	ECU power supply
X3.M1	GND_LS1	GND_LS1: Ground pin for the low side outputs
X3.M2	OPL4A_2	Digital-/PWM-Output OPL4A_02
X3.M3	OPHSP4A_2	Digital-/ PWM-Output OP4A_02
X3.M4	GND	Common ECU GND

PIN ASSIGNMENT (Not all pins are available in every variant. An overview of the available options for each variant can be found on the Variants page.)

Pin assigment main connector X3 and X4

Pin	Signal name	Description
X4.A1	CAN3_H	CAN bus 3 high
X4.A2	CAN3_L	CAN bus 3 low
X4.A3	CAN4_H	CAN bus 4 high
X4.A4	CAN4_L	CAN bus 4 low
X4.B1	IDSACV_5	Analog / Digital input IDSACV_05
X4.B2	IDSACV_6	Analog / Digital input IDSACV_06
X4.B3	UEXT5-12V_2	Sensor Supply 5-12V
X4.B4	AGND	Analog GND
X4.C1	IDAC12V_5	Analog / Digital input IDAC12V_05
X4.C2	IDAC12V_6	Analog / Digital input IDAC12V_06
X4.C3	IMID_1	Ident Input IMID_1
X4.C4	AGND	Analog GND
X4.D1	IDSACV_7	Analog / Digital input IDSACV_07
X4.D2	IDSACV_8	Analog / Digital input IDSACV_08
X4.D3	UEXT5-12V_3	Sensor Supply 5-12V
X4.D4	AGND	Analog GND
X4.E1	IDA12_35V_9	Analog / Digital input IDA12_35V_09
X4.E2	IDA12_35V_10	Analog / Digital input IDA12_35V_10
X4.E3	IDA12_35V_13	Analog / Digital input IDA12_35V_13
X4.E4	IDA12_35V_14	Analog / Digital input IDA12_35V_14

Pin assigment main connector X3 and X4

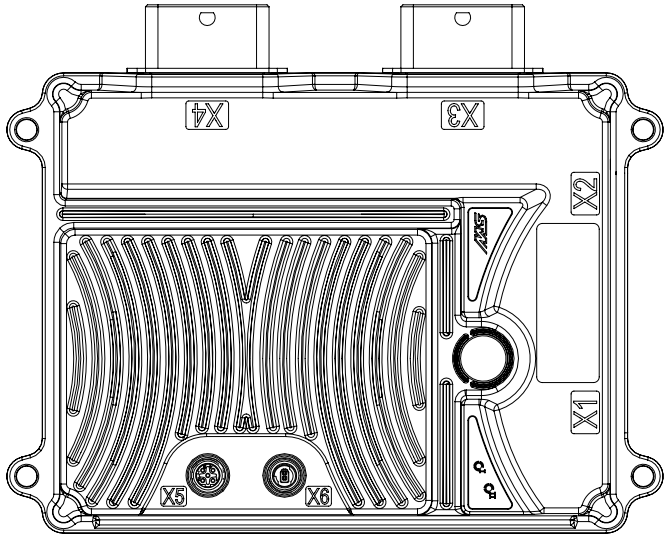
Pin	Signal name	Description
X4.F1	IDAC12V_7	Analog / Digital input IDAC12V_07
X4.F2	IDAC12V_8	Analog / Digital input IDAC12V_08
X4.F3	IMID_2	Ident Input IMID_2
X4.F4	AGND	Analog GND
X4.G1	IDA12_35V_11	Analog / Digital input IDA12_35V_11
X4.G2	IDA12_35V_12	Analog / Digital input IDA12_35V_12
X4.G3	IDA12_35V_15	Analog / Digital input IDA12_35V_15
X4.G4	IDA12_35V_16	Analog / Digital input IDA12_35V_16
X4.H1	ODH2A_1	Digital-Output ODH2A_1
X4.H2	ODH2A_2	Digital-Output ODH2A_2
X4.H3	ODH2A_3	Digital-Output ODH2A_3
X4.H4	ODH2A_4	Digital-Output ODH2A_4
X4.J1	OPHSP2A_5	Digital-/ PWM-Output OP2A_05
X4.J2	OPHSP2A_6	Digital-/ PWM-Output OP2A_06
X4.J3	OPHSP2A_7	Digital-/ PWM-Output OP2A_07
X4.J4	OPHSP2A_8	Digital-/ PWM-Output OP2A_08
X4.K1	ODH2A_5	Digital-Output ODH2A_5
X4.K2	ODH2A_6	Digital-Output ODH2A_6
X4.K3	ODH2A_7	Digital-Output ODH2A_7
X4.K4	ODH2A_8	Digital-Output ODH2A_8

PIN ASSIGNMENT (Not all pins are available in every variant. An overview of the available options for each variant can be found on the Variants page.)

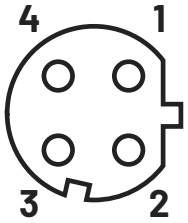
Pin assigment main connector X3 and X4

Pin	Signal name	Description
X4.L1	UB_4	Power Supply for power group UB_4 (OPHSP2A_5..8, ODH2A_5..8)
X4.L2	UB_2	Power Supply for power group UB_2 (ODH2A_1..4, ODH4A_1..2)
X4.L3	OPHB10A_1	Digital-/PWM-Halfbridge Output OPHB10A_01
X4.L4	ODH4A_1	Digital-Output ODH4A_01
X4.M1	GND_UB3	GND_UB3: Ground pin for the half-bridge outputs
X4.M2	UB_3	Power Supply for power group UB_3 (OPHB10A_1..2)
X4.M3	OPHB10A_2	Digital-/PWM-Halfbridge Output OPHB10A_02
X4.M4	ODH4A_2	Digital-Output ODH4A_02

Connectors X5 and X6:

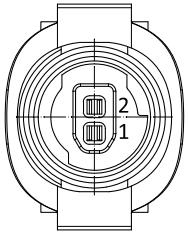


Pin Assignment M12, D-coded Connector X5:



Pin	Signal name	Description
X5.1	ETH1_P1_TX+	Ethernet 1, port 1, 100BASE-TX
X5.2	ETH1_P1_RX+	
X5.3	ETH1_P1_TX-	
X5.4	ETH1_P1_RX-	

Pin Assignment M12-SPE Connectors X6:



Pin	Signal name	Description
X6.1	ETH1_P2_BRR+	Ethernet 1, port 2, 100/1000BASE-T1
X6.2	ETH1_P2_BRR-	

QUALIFICATION

Compliance Information

Standard	Description		Parameter
ISO/IEC 17050-1 REGULATION (EC) No 765/2008	CE	Conformity	
EN ISO 13849-1:2015	Safety of machinery		PL d / Cat. 2 SF)
IEC 61508:2010	Functional safety		SIL 2 SF)
EN ISO 25119:2023	Safety of Tractors and machinery for agriculture and forestry		AgPL d SF)
ISO 11783-2:2019	CAN ISOBUS conformity		AEF hardware conformance test SF)
KBA (Kraftfahrt-Bundesamt)	E1	Certification This approved device can be used on any vehicle type with the following restrictions: All vehicle types with a 12 V respectively 24 V - electrical wiring and battery(-) at the body	According UN ECE Regulation No. 10
2011/65/EU 2015/863/EU	RoHS	Restriction of Hazardous Substances	
2006/42/EC	Machinery directive		

SF) Scheduled feature