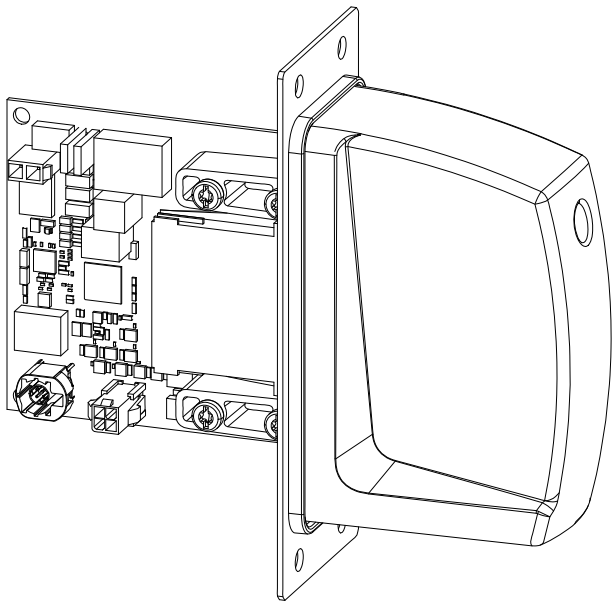
Operating Instructions

RI FB/i CRC 1.0
RI MOD/i CC Modbus TCP-2P



EN-US | Operating instructions

42,0426,0453,EA 001-13112023

Table of contents

General

Safety

⚠ WARNING!

Danger from incorrect operation and work that is not carried out properly.
This can result in serious personal injury and damage to property.
- ▶ All the work and functions described in this document must only be carried out by technically trained and qualified personnel.
- ▶ Read and understand this document in full.
- ▶ Read and understand all safety rules and user documentation for this equipment and all system components.

⚠ WARNING!

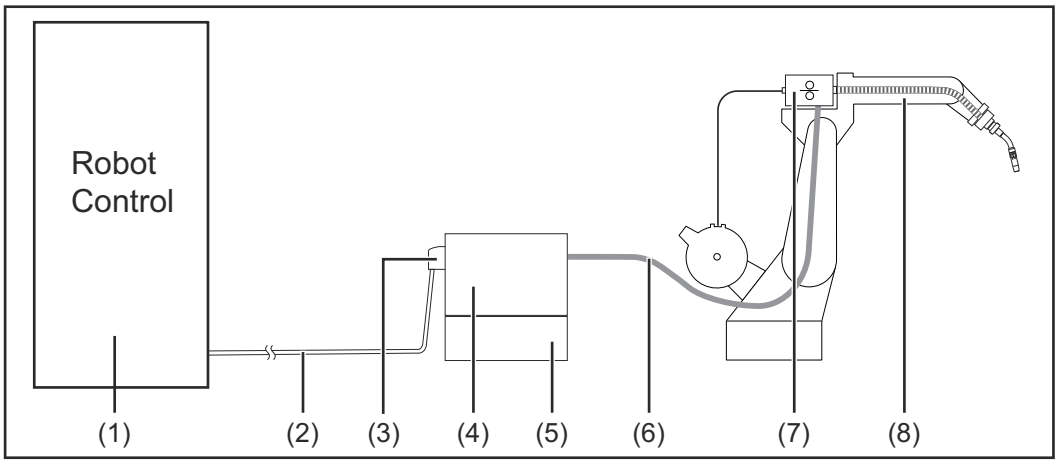
Danger from electrical current.
This can result in serious personal injury and damage to property.
- ▶ Before starting work, switch off all the devices and components involved and disconnect them from the grid.
- ▶ Secure all devices and components involved so they cannot be switched back on.

⚠ WARNING!

Danger from unplanned signal transmission.
This can result in serious personal injury and damage to property.
- ▶ Do not transfer safety signals via the interface.

Device Concept

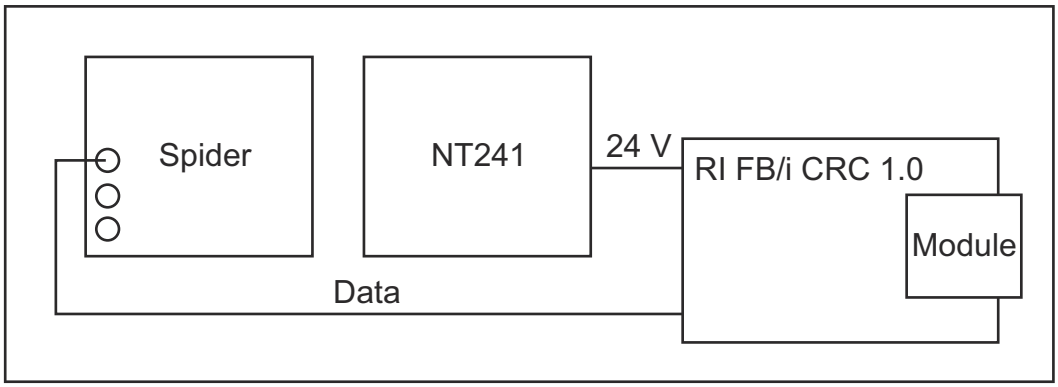
The robot interface serves as an interface between the power source and standardized bus modules supporting a wide range of communication protocols. Fronius may factory-fit the robot interface in the power source but it can also be retrofitted by appropriately trained and qualified personnel.



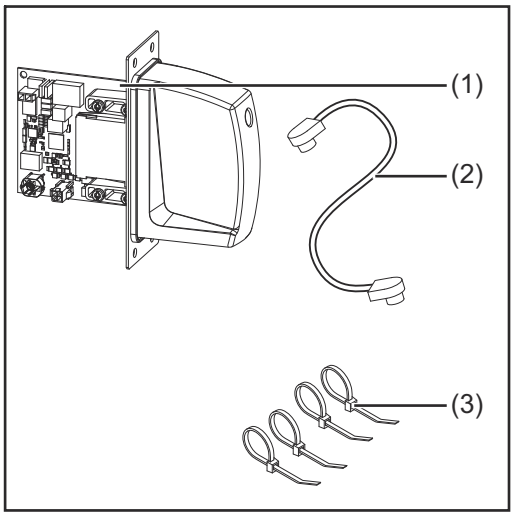
(1)	**Robot control system**
(2)	**SpeedNet data cable**
(3)	**Robot interface**

(4)	**Power source**
(5)	**Cooling unit**
(6)	**Interconnecting hosepack**
(7)	**Wirefeeder**
(8)	**Robot**

Block diagram



Scope of supply



(1)	**RI FB/i CRC 1.0**
(2)	**Data cable 4-pin**
(3)	**Cable ties**
(4)	**This document (not pictured)**

Required Tools and Materials

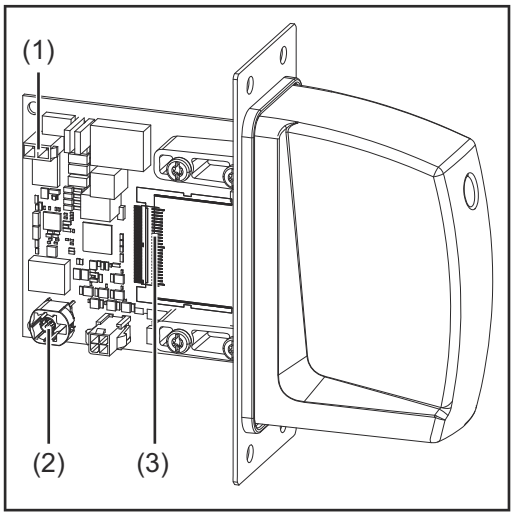
- Screwdriver TX8
- Screwdriver TX20
- Screwdriver TX25
- Diagonal cutting pliers

Installation Requirements

The robot interface may only be installed in the designated opening on the rear of the power source.

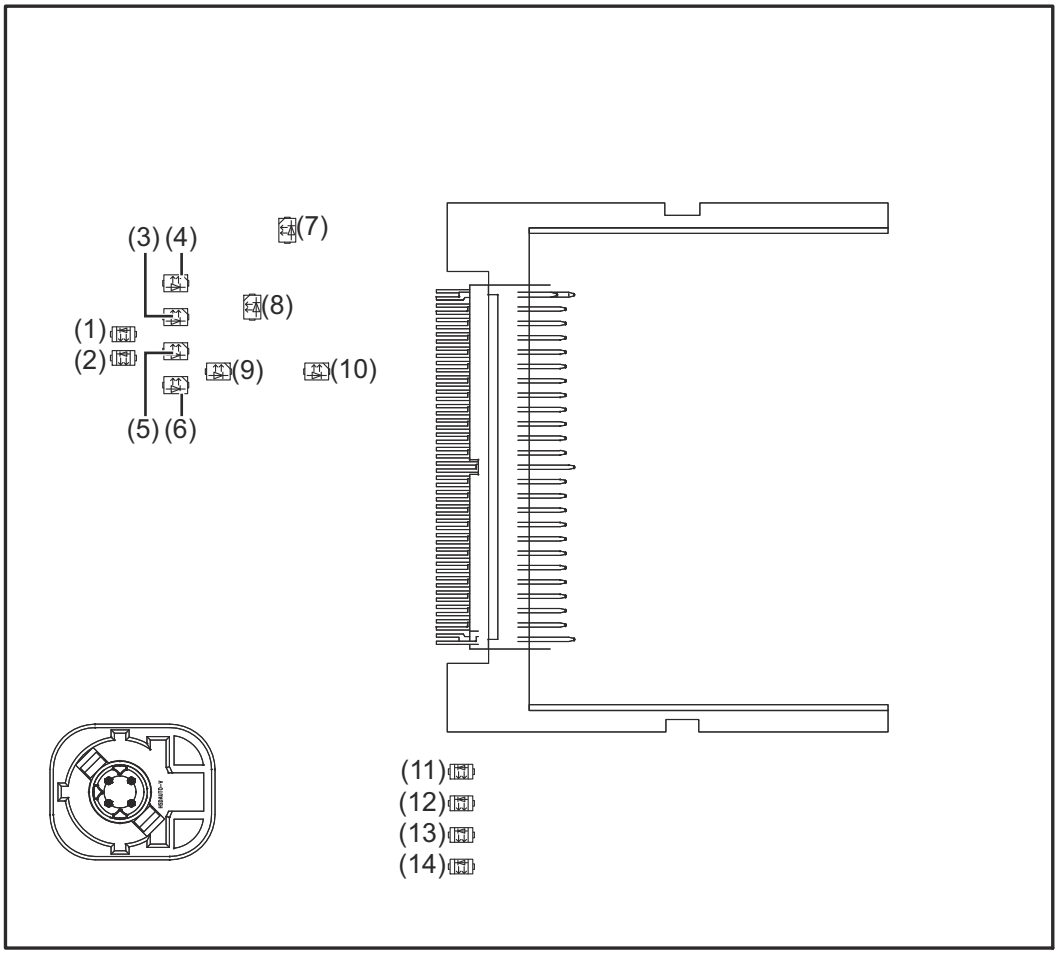
Connections and Indicators

Connections on the Robot Interface



(1)	**Power supply connection 2-pin**
(2)	**SpeedNet data cableconnection 4-pin**
(3)	**Bus module connection**

LEDs on Robot Interface PCB



(1)	ETH1 LED	Green	For diagnosing the network connection. For details, see section below titled "LEDs for Network Connection Diagnosis"
(2)	ETH2 LED	Orange	

(3)	LED 3	Green	No function
(4)	LED 4	Green	
(5)	LED 5	Green	- Flashes at 4 Hz = No SpeedNet connection - Flashes at 20 Hz = Establishing SpeedNet connection - Flashes at 1 Hz = SpeedNet connection established
(6)	LED 6	Red	Lights up when an internal error occurs. Remedy: Restart the robot interface. If this does not resolve the issue, inform the service team.
(7)	+3V3 LED	Green	For diagnosing the power supply. For details, see section below titled "LEDs for Power Supply Diagnosis"
(8)	+24V LED	Green	
(9)	DIG OUT 2 LED	Green	Digital output 2. LED lights up when active
(10)	DIG OUT 1 LED	Green	Digital output 1. LED lights up when active
(11)	LED 11	Green	No function
(12)	LED 12	Green	
(13)	LED 13	Green	
(14)	LED 14	Green	

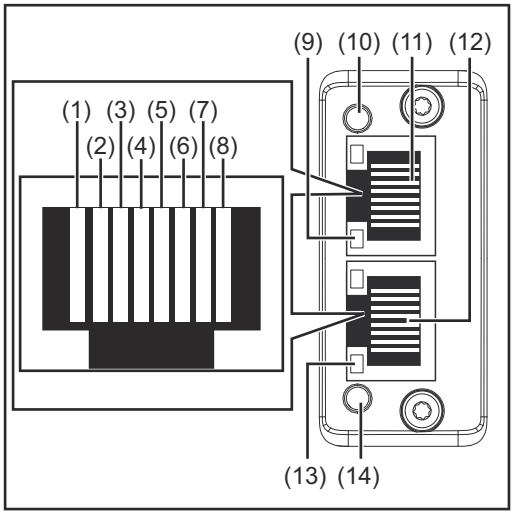
LEDs for Power Supply Diagnosis

LED	Indicator	Meaning	Cause
+24V	Off	No supply voltage available for interface	- Robot interface power supply not established - Power supply cable faulty
	Lights up	24 VDC supply voltage present on robot interface	
+3V3	Off	No operating voltage present on robot interface	- 24 VDC supply voltage not present - Robot interface power supply unit is faulty
	Lights up	3 VDC operating voltage present on robot interface	

LEDs for Network Connection Diagnosis

LED	Indicator	Meaning	Cause
ETH1	Off	No network connection	- No network connection established for interface - Network cable faulty
	Lights up	Network connection established	
	Flashes	Data transfer in progress	
ETH2	Off	Transmission speed 10 Mbit/s	
	Lights up	Transmission speed 100 Mbit/s	

Connections and indicators on RJ 45 module



(1)	TX+
(2)	TX-
(3)	RX+
(6)	RX-
(4)	Not normally used; to ensure signal completeness, these pins must be interconnected and, after passing through a filter circuit, must terminate at the ground conductor (PE).
(5)	
(7)	
(8)	
(9)	Link/Activity LED 2
(10)	Module status LED

(11)	RJ-45 Ethernet connection 2
(12)	RJ-45 Ethernet connection 1
(13)	Link/Activity LED 1
(14)	Network status LED

Network Status LED:	
Status	**Meaning**
Off	No IP address or exception state
Lights up green	At least one Modbus message received
Flashes green	Waiting for first Modbus message
Lights up red	IP address conflict, serious error
Flashes red	Connection timeout. No Modbus message was received within the period defined for the "Process active timeout"

Module Status LED:	
Status	**Meaning**
Off	No supply voltage
Lights up green	Normal operation
Lights up red	Major error (exception state, serious fault, etc.)
Flashes red	Minor error
Alternates between red and green	Firmware update in progress

Link/Activity LED:	
Status	**Meaning**
Off	No connection, no activity
Lights up green	Connection established (100 Mbit/s)
Flickers green	Activity (100 Mbit/s)
Lights up yellow	Connection established (10 Mbit/s)
Flickers yellow	Activity (10 Mbit/s)

Technical data

Environmental Conditions

⚠ CAUTION!

A risk is posed by prohibited environmental conditions.
This can result in severe damage to equipment.
▶ Only store and operate the device under the following environmental conditions.

Temperature range of ambient air: - During operation: -10 °C to +40 °C (14 °F to 104 °F) - During transport and storage: -20 °C to +55 °C (-4 °F to 131 °F)
Relative humidity: - Up to 50% at 40 °C (104 °F) - Up to 90% at 20 °C (68 °F)
Ambient air: free of dust, acids, corrosive gases or substances, etc.
Altitude above sea level: up to 2000 m (6500 ft).

Robot Interface Technical Data

Power supply	Internal (24 V)
Degree of protection	IP 23

Data Transfer Properties

RJ-45 Connection
Transmission technology: Ethernet
Medium (4 x 2 twisted-pair copper cable): Category 5 (100 Mbit/s) or higher
Transmission speed: 10 Mbit/s or 100 Mbit/s
Bus connection: Ethernet RJ-45

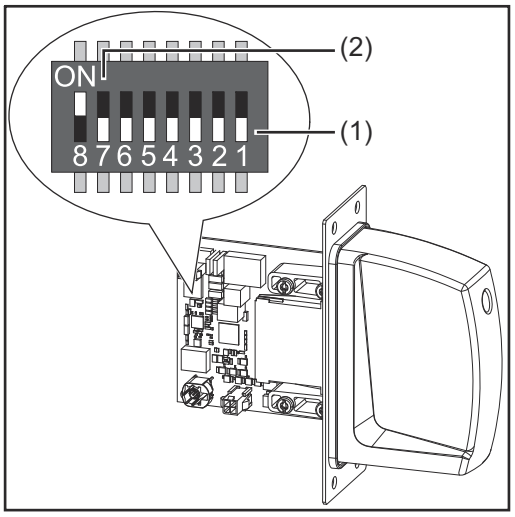
Configuration parameters

In some robot control systems, it may be necessary to state the configuration parameters described here so that the bus module can communicate with the robot.	
Parameter	**Value**
Vendor Name	Fronius International GmbH
Product Code	0304_{hex} (772_{dec})
Major / Minor Revision	V1.00

In some robot control systems, it may be necessary to state the configuration parameters described here so that the bus module can communicate with the robot.	
Parameter	**Value**
Vendor URL	www.fronius.com
Product Name	fronius-fb-crc-1-0-modbus-tcp
Model Name	Fronius Modbus TCP
User Application Name	Fronius welding controller for the TPS/i series with CRC 1.0

Configuration of robot interface

General



The DIP switch on the robot interface is used to configure:
- The process image (standard image, retrofit image)
- The IP address

Default setting for process image:
Positions 7 and 8 of DIP switch set to OFF (1) = standard image = Weldcom V2.0

Default setting for IP address = 192.168.255.210:
- Positions 6, 5, 3, and 1 of DIP switch set to OFF (1)
- Positions 2 and 4 of DIP switch set to ON (2)

Setting the process image

Dip switch								
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Configuration**
OFF	OFF	-	-	-	-	-	-	Standard image (CRC 1.0)
OFF	ON	-	-	-	-	-	-	Not used
ON	OFF	-	-	-	-	-	-	Not used
ON	ON	-	-	-	-	-	-	Not used

The process image defines the volume of data transferred and the system compatibility.

Configuring the Robot Interface

1 Set the DIP switch in accordance with the desired configuration

NOTE!

Risk due to invalid DIP switch settings.
This may result in malfunctions.
- ▶ Whenever changes are made to the DIP switch settings, the interface must be restarted. This is the only way for the changes to take effect.
- ▶ Restart the interface = interrupting and restoring the power supply or executing the relevant function on the website of the power source (SmartManager).

Installing the Robot Interface

Safety

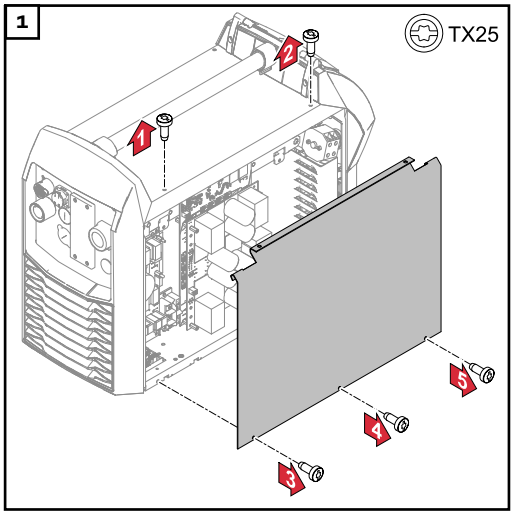
⚠ WARNING!

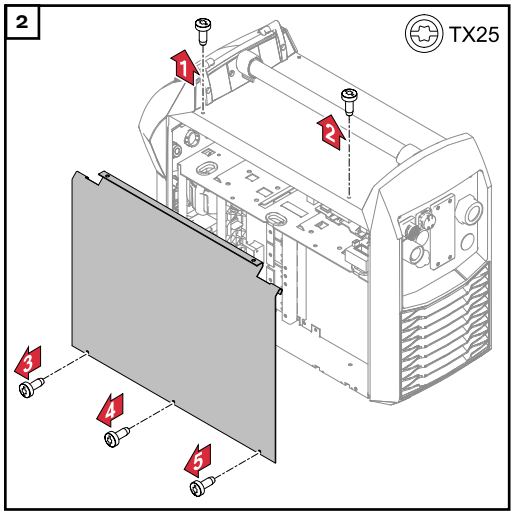
Electrical current hazard.
This can result in serious injuries or death.
- ▶ Before starting work, switch off all the devices and components involved and disconnect them from the grid.
- ▶ Secure all the devices and components involved to prevent unintentional re-starting.
- ▶ After opening the device, use a suitable measuring instrument to check that electrically charged components (such as capacitors) have been discharged.

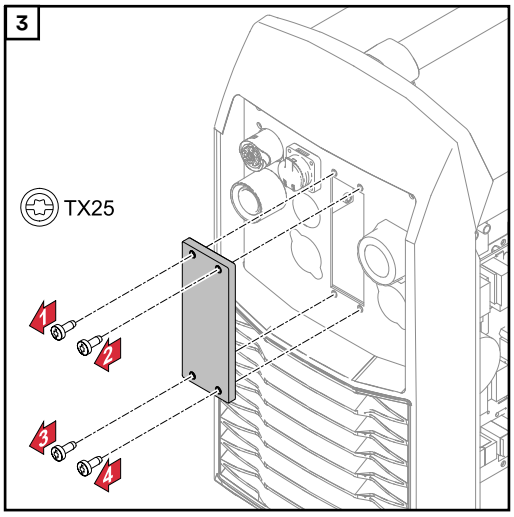
⚠ WARNING!

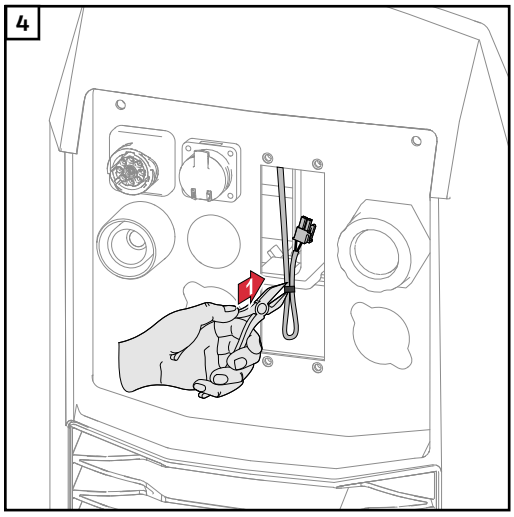
Electrical current hazard caused by an inadequate ground conductor connection.
This can result in severe personal injury and damage to property.
- ▶ Always use the original housing screws in the original quantity.

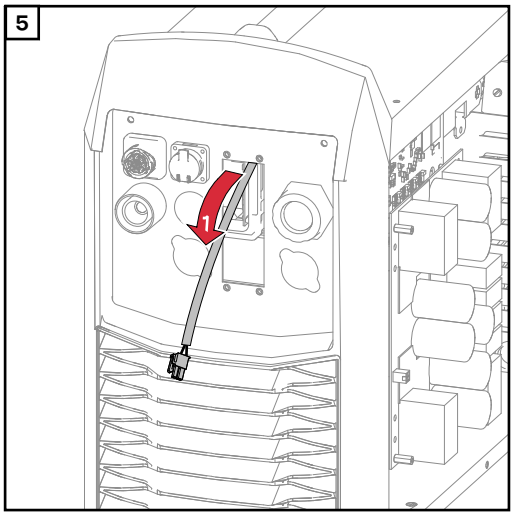
Preparation



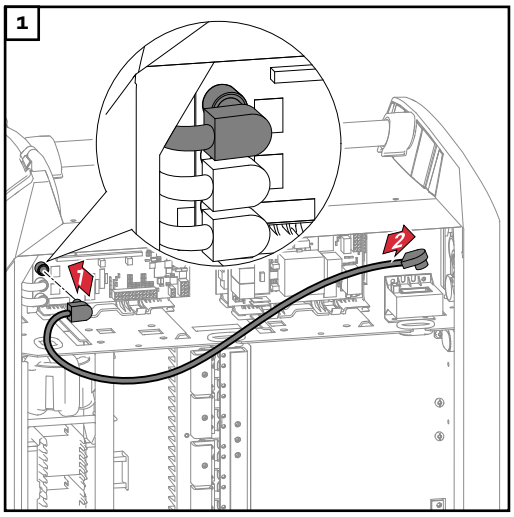


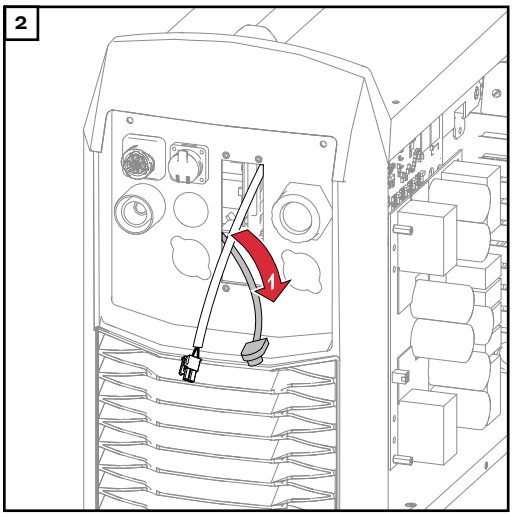


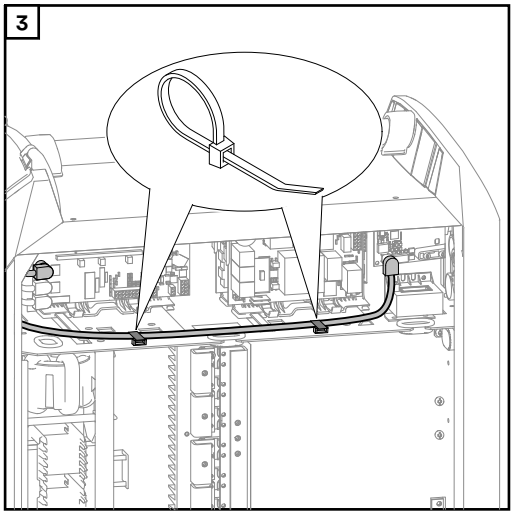




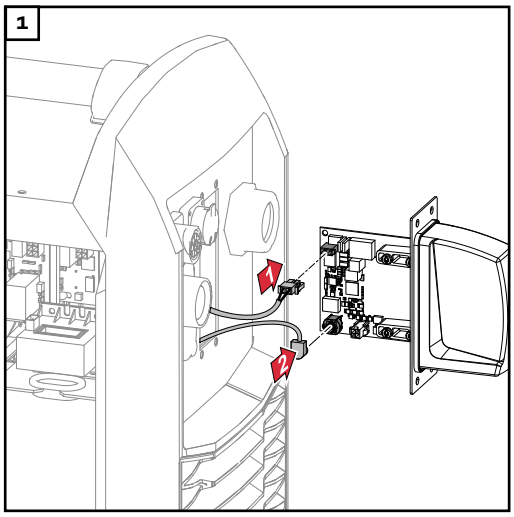
Routing the Data Cable

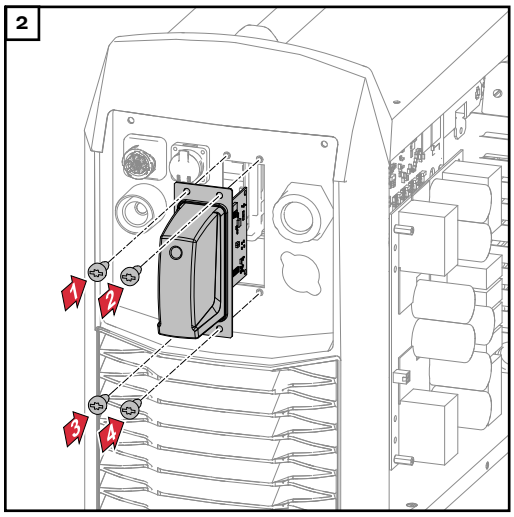




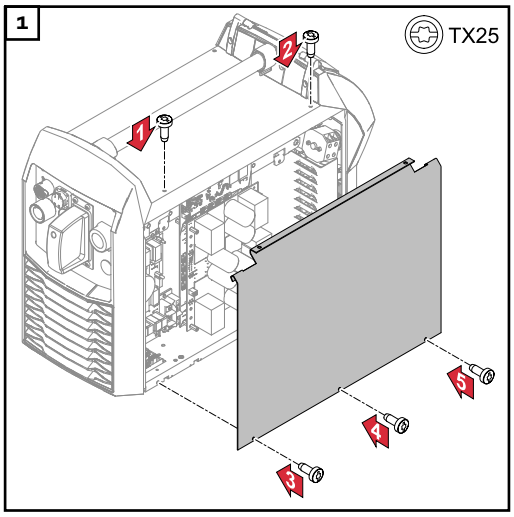


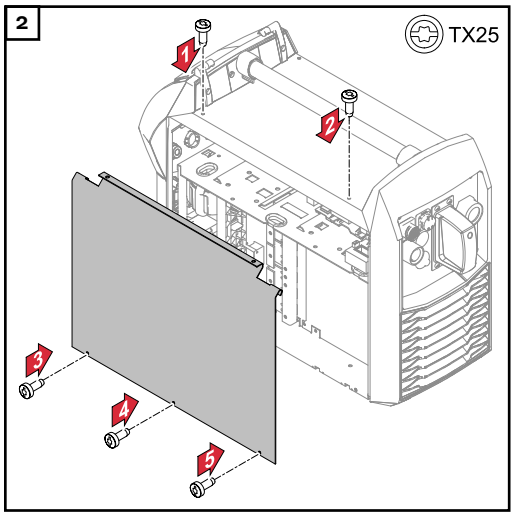
Installing the Robot Interface





Final Tasks





Installing the Bus Module

Safety

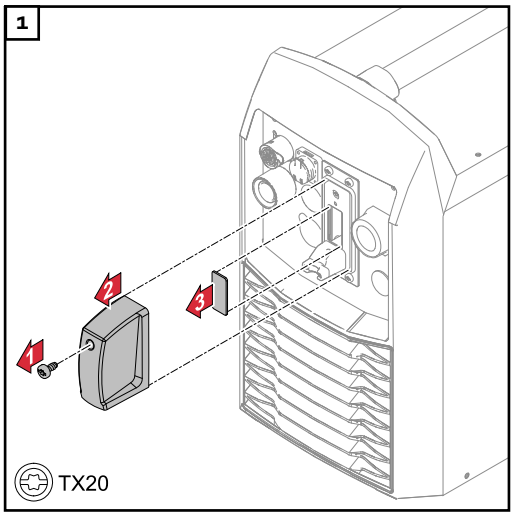
⚠ WARNING!

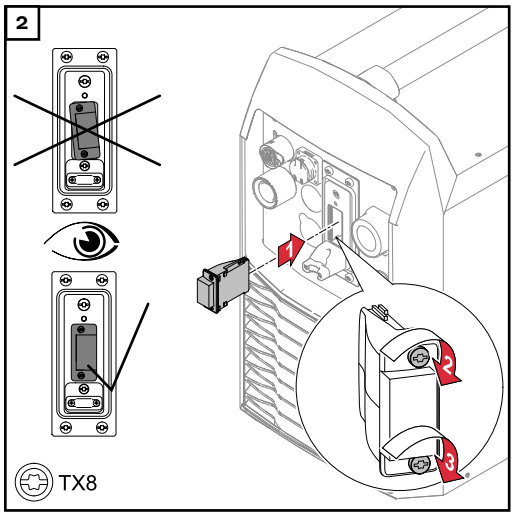
Danger from electrical current.
Serious injuries or death may result.
- ▶ Before starting work, switch off all devices and components involved, and disconnect them from the grid.
- ▶ Secure all devices and components involved so that they cannot be switched back on.

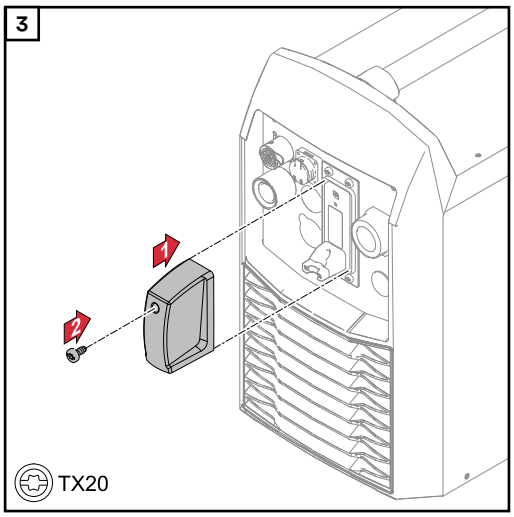
⚠ WARNING!

Danger from electrical current due to inadequate ground conductor connection.
Serious personal injury and property damage may result.
- ▶ Always use the original housing screws in the quantity initially supplied.

Installing the Bus Module







Input and output signals

Data types

The following data types are used:
- **UINT16** (Unsigned Integer)
  Whole number in the range from 0 to 65535
- **SINT16** (Signed Integer)
  Whole number in the range from -32768 to 32767

Conversion examples:
- for a positive value (SINT16)
  e.g. desired wire speed x factor
  12.3 m/min x 100 = 1230_{dec} = $04CE_{hex}$

- for a negative value (SINT16)
  e.g. arc correction x factor
  -6.4 x 10 = -64_{dec} = $FFC0_{hex}$

Input signals

From robot to power source
Applicable to firmware V4.1.0 and higher

HEX address	Signal		Data type Activity	Unit/range	Factor
F000	Control Flag Group 1				
	Bits 0 to 7	Process active timeout	Byte	ms	10
	Bits 8 to 15	Reserved			

HEX address	Signal		Data type Activity	Unit/range	Factor
F001	Control Flag Group 2				
	Bit 0	Welding start	Rising Edge		
	Bit 1	Robot ready	High		
	Bit 2	Source error reset	High		
	Bit 3	Gas on	Rising Edge		
	Bit 4	Wire inching	Rising Edge		
	Bit 5	Wire retract	Rising Edge		
	Bit 6	Torch blow out	Rising Edge		
	Bit 7	Welding simulation	High		
	Bit 8	Touch sensing	Rising Edge		
	Bit 9	Booster manual	High		
	Bit 10	SFI ON	High		
	Bit 11	Synchro pulse on	High		
	Bit 12	WireBrake	High		
	Bit 13	Torch XChange	High		
	Bit 14	Teach mode	High		
	Bit 15	Reserved			
F002	Control Flag Group 3				
	Bit 0	Process line selection Bit 0	High	See **Value range Process line selection** on page **21**	
	Bit 1	Process line selection Bit 1	High		
	Bit 2	TWIN mode Bit 0	High	See **Value Range for TWIN Mode** on page **21**	
	Bit 3	TWIN mode Bit 1	High		
	Bits 4 to 10	Reserved			
	Bit 11	Wire sense start	Rising Edge		
	Bit 12	Wire sense break	Rising Edge		
	Bits 13 to 15	Reserved			

HEX address	Signal		Data type Activity	Unit/range	Factor
F003	Control Flag Group 4				
	Bit 0	Documentation mode	High	See **Value Range for Documentation mode** on page **21**	
	Bits 1 to 4	Reserved			
	Bit 5	Motor type Bit 0	High	See **Value range for Motor Type** on page **22**	
	Bit 6	Motor type Bit 1	High		
	Bit 7	Motor type Bit 2	High		
	Bits 8 to 15	Reserved			
F004	Control Flag Group 5				
	Bits 0 to 15	Reserved			
F005	Control Flag Group 6				
	Bits 0 to 15	Reserved			
F006	Control Flag Group 7				
	Bits 0 to 9	Reserved			
	Bit 10	Enable Start-End-Parameter	High		
	Bit 11	Enable components setup	High		
	Bit 12	Enable Unit / Standard	High		
	Bits 13 to 15	Reserved			
F007	Control Flag Group 8				
	Bit 0	ExtInput1 => OPT_Output 1	High		
	Bit 1	ExtInput2 => OPT_Output 2	High		
	Bit 2	ExtInput3 => OPT_Output 3	High		
	Bit 3	ExtInput4 => OPT_Output 4	High		
	Bit 4	ExtInput5 => OPT_Output 5	High		
	Bit 5	ExtInput6 => OPT_Output 6	High		
	Bit 6	ExtInput7 => OPT_Output 7	High		
	Bit 7	ExtInput8 => OPT_Output 8	High		
	Bits 8 to 15	Reserved			

HEX address	Signal		Data type Activity	Unit/range	Factor
F008	Working mode				
	Bit 0	Working Mode Bit 0		See **Value range for Working mode** on page **21**	
	Bit 1	Working Mode Bit 1			
	Bit 2	Working Mode Bit 2			
	Bit 3	Working Mode Bit 3			
	Bit 4	Working Mode Bit 4			
	Bits 5 to 13	Reserved			
	Bit 14	Command value selection Bit 0	High	See **Value Range for Command value selection** on page **21**	
	Bit 15	Reserved			
F009	Bits 0 to 15	Job number	UINT16	0 to 1000	
F00A	Bits 0 to 15	Characteristic number (xml-file)	UINT16	0 to 65,535	
F00B	Bits 0 to 15	Feeder command value	SINT16	-327.68 to 327.67 m/min	100
F00C	Bits 0 to 15	Arc length correction	SINT16	-10 to +10	10
F00D	Bit 0-15	Pulse/Dynamic correction	SINT16	-10 to +10	10
F00E	Bits 0 to 15	Wire retract	SINT16	0 to +10	10
F00F	Bits 0 to 15	Welding speed	UINT16	0 to 65,535 (0 to 6553.5 m/min)	10
F010	Bit 0-15	Penetration stabilizer	SINT16	0 to +10	10
F011	Bit 0-15	Arc length stabilizer	UINT16	0 to +10	10
F012-F019	Bit 0-15	Reserved			
F01A	Bits 0 to 15	Wire forward / backward length	UINT16	OFF/1 to 65,535 mm	1
F01B	Bits 0 to 15	Wire sense edge detection	UINT16	OFF/0.5 to 20.0 mm	10
F01C	Bit 0-15	Reserved			
F01D	Bit 0-15	Seam number	UINT16	0 to 65,535	1
F01E-F031	Bit 0-15	Reserved			

Value range Process line selection

Bit 1	Bit 0	Description
0	0	Process line 1 (default)
0	1	Process line 2
1	0	Process line 3
1	1	Reserved

Value range for process line selection

Value Range for TWIN Mode

Bit 1	Bit 0	Description
0	0	TWIN Single mode
0	1	TWIN Lead mode
1	0	TWIN Trail mode
1	1	Reserved

Value range for TWIN mode

Value Range for Documentation mode

Bit 0	Description
0	Seam number of power source (internal)
1	Seam number of robot

Value range for documentation mode

Value range for Working mode

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	0	0	0	0	Internal welding parameter selection
0	0	0	0	1	Special 2-step mode characteristics
0	0	0	1	0	Job mode
0	1	0	0	0	2-step mode characteristics
0	1	0	0	1	2-Step manual mode
1	0	0	0	1	Stop cooling pump

Value range for operating mode

Value Range for Command value selection

Bit 14	Description
0	Wirefeeder set value
1	Welding current set value

Value range for set value

Value range for Motor Type

Bit 2	Bit 1	Bit 0	Description
0	0	0	Fronius wirefeeder
0	0	1	M500
0	1	0	P-600Z
0	1	1	Reserved
1	0	0	Reserved
1	0	1	Reserved
1	1	0	Reserved
1	1	1	Reserved

Output signals

From power source to robot
Applicable to firmware V4.1.0 and higher

HEX address	Signal		Data type Activity	Unit/range	Factor
F100	Status Flag Group 1				
	Bits 0 to 7	Reserved			
F101	Status Flag Group 2				
	Bit 0	Heartbeat Powersource	Tppgle	0.5 Hz	
	Bit 1	Power source ready	High		
	Bit 2	Arc stable / Touch signal	High		
	Bit 3	Current flow signal	High		
	Bit 4	Main current signal	High		
	Bit 5	Collision protection	Low	Low = Collision	
	Bits 6 to 7	Reserved			
	Bit 8	Touch signal	High		
	Bit 9	Torchbody connected	High		
	Bit 10	Command value out of range	High		
	Bit 11	Correction out of range	High		
	Bit 12	Process active	High		
	Bit 13	Robot Motion Release	High		
	Bit 14	Wire stick workpiece	High		
	Bit 15	Reserved			

HEX address	Signal		Data type Activity	Unit/range	Factor
F102	Status Flag Group 3				
	Bit 0	Welding Mode Bit 0	High	See **Tab.: Value range for welding process** on page **25**	
	Bit 1	Welding Mode Bit 1	High		
	Bit 2	Welding Mode Bit 2	High		
	Bit 3	Welding Mode Bit 3	High		
	Bit 4	Welding Mode Bit 4	High		
	Bits 5 to 7	Reserved			
	Bit 8	Parameter selection internally	High		
	Bit 9	Characteristic number valid	High		
	Bit 10	Reserved			
	Bit 11	Process run	High		
	Bits 12 to 13	Reserved			
	Bit 14	Process image Bit 0	High	See **Tab.: Value range for process image** on page **25**	
	Bit 15	Process image Bit 1	High		
F103	Status Flag Group 4				
	Bit 0	Penetration stabilizier	High		
	Bit 1	Arclength stabilizier	High		
	Bits 2 to 4	Reserved			
	Bit 5	Motor type Bit 0	High	See **Value range for Motor Type** on page **22**	
	Bit 6	Motor type Bit 1	High		
	Bit 7	Motor type Bit 2	High		
	Bits 8 to 13	Reserved			
	Bit 14	Short circuit contact tip	High		
	Bit 15	Gas nozzle touched	High		
F104	Status Flag Group 5				
	Bit 0	Sensor status 1	High	See **Assignment of Sensor Statuses 1–4** on page **25**	
	Bit 1	Sensor status 2	High		
	Bit 2	Sensor status 3	High		
	Bit 4	Sensor status 4	High		
	Bits 4 to 10	Reserved			
	Bit 11	Safety status Bit 0	High	See **Value range Safety status** on page **26**	
	Bit 12	Safety status Bit 1	High		
	Bit 13	Reserved			
	Bit 14	Notification	High		
	Bit 15	System not ready	High		

HEX address	Signal		Data type Activity	Unit/range	Factor
F105	Status Flag Group 6				
	Bit 0	Limit Signal	High		
	Bits 1 to 8	Reserved			
	Bit 9	TWIN synchronization active	High		
	Bit 10	Main supply status	High		
	Bit 11	Standby active	High		
	Bit 12	Active process line bit 0	High	See **Value range Process line selection** on page **21**	
	Bit 13	Active process line bit 1	High		
	Bit 14	Warning	High		
	Bit 15	Reserved			
F106	Status Flag Group 7				
	Bits 0 to 15	Reserved			
F107	Status Flag Group 8				
	Bit 0	ExtOutput1 <= OPT_Input1	High		
	Bit 1	ExtOutput2 <= OPT_Input2	High		
	Bit 2	ExtOutput3 <= OPT_Input3	High		
	Bit 3	ExtOutput4 <= OPT_Input4	High		
	Bit 4	ExtOutput5 <= OPT_Input5	High		
	Bit 5	ExtOutput6 <= OPT_Input6	High		
	Bit 6	ExtOutput7 <= OPT_Input7	High		
	Bit 7	ExtOutput8 <= OPT_Input8	High		
	Bits 8 to 15	Reserved			
F108	Bit 0-15	Main error number	UINT16	0 to 65,535	
F109	Bit 0-15	Warning number	UINT16	0 to 65,535	1
F10A	Bit 0-15	Welding voltage actual value	UINT16	0.0 to 327.67 volts	100
F10B	Bit 0-15	Welding current actual value	UINT16	0.0 to 3276.7 amperes	10
F10C	Bit 0-15	Motor current actual value M1	SINT16	-327.68 to 327.67 amperes	100
F10D	Bit 0-15	Motor current actual value M2	SINT16	-327.68 to 327.67 amperes	100
F10E	Bit 0-15	Motor current actual value M3	SINT16	-327.68 to 327.67 amperes	100
F10F	Bits 0 to 15	Reserved			
F110	Bit 0-15	Wire speed actual value	SINT16	-327.68 to 327.67 m/min	100
F111	Bit 0-15	Seam tracking actual value	UINT16	0 to 6.5535	10,000

HEX address	Signal		Data type Activity	Unit/range	Factor
F112	Bits 0 to 15	Real energy actual value	UINT16	0 to 6553.5 kilo-joules	10
F113	Bits 0 to 15	Wire position	SINT16	-327.68 to 327.67 mm	100
F114-F11F	Bit 0-15	Reserved			
F120	Bit 0-15	External feeder command	SINT16	-327.68 to 327.67 m/min	100
F121	Bit 0-15	External feeder slope value	UINT16	0 to 6553.5 m/min/sec	10
F122-F126	Bit 0-15	Reserved			

Value range for welding process and process image

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	0	0	0	0	Internal mode selection
0	0	0	0	1	MIG/MAG pulsed synergic
0	0	0	1	0	MIG/MAG standard synergic
0	0	0	1	1	MIG/MAG PMC
0	0	1	0	0	MIG/MAG LSC
0	0	1	0	1	MIG/MAG standard manual
0	0	1	1	0	Electrode
0	0	1	1	1	TIG
0	1	0	0	0	CMT

Value range for welding process

Bit 15	Bit 14	Description
0	0	Standard image (CRC 1.0)

Value range for process image

Assignment of Sensor Statuses 1–4

Signal	Description
Sensor status 1	OPT/i WF R wire end (4,100,869)
Sensor status 2	OPT/i WF R wire drum (4,100,879)
Sensor status 3	OPT/i WF R ring sensor (4,100,878)
Sensor status 4	Wire buffer set CMT TPS/i (4,001,763)

Value range Safety status

Bit 1	Bit 0	Description
0	0	Reserve
0	1	Hold
1	0	Stop
1	1	Not installed / active

TAG table

- To read the following TAGs, use the mode function 03dec (03hex) - see section **03_{dec} (03_{hex}) Read Holding Register** from page **32**
- To edit the following TAGs, use the mode function 06dec (06hex) - see section **06_{dec} (06_{hex}) Write Single Register** from page **33**

HEX address	Signal	Access	Type	Range	Unit	Step size
D000 / E064	Gas preflow [Gpr]	Reading & writing	FLOAT	0.0 to 9.9	s	0.1
D001 / E065	Gas postflow [Gpo]	Reading & writing	FLOAT	0.0 to 9.9	s	0.1
D002 / E0A3	Inching speed [Fdi]	Reading & writing	FLOAT	0.5 to vD-max	m/min	0.1
D003 / E032	SynchroPulse DeltaWireFeed	Reading & writing	FLOAT	0.1 to 6.0	m/min	10
D004 / E031	SynchroPulse Frequency	Reading & writing	FLOAT	0.5 to 10.0	Hz	10
D005 / E033	SynchroPulse DutyCycle	Reading & writing	FLOAT	10 to 90	%	1
D006 / E034	SynchroPulse ArcLength Correction High	Reading & writing	FLOAT	-10.0 to 10.0		10
D007 / E035	SynchroPulse ArcLength Correction Low	Reading & writing	FLOAT	-10.0 to 10.0		10
D008 / E06A	Starting current [I-S]	Reading & writing	FLOAT	0.0 to 200.0	%	1
D009 / E011	Start Arclength Correc-tion	Reading & writing	FLOAT	-10.0 to 10.0		0.1
D00A / E056	Starting Current Time [t-S]	Reading & writing	FLOAT	0.0 to 10.0	s	0.1
D00B / E06B	Slope 1	Reading & writing	FLOAT	0.0 to 9.9	s	0.1
D00C / E06C	Slope 2	Reading & writing	FLOAT	0.0 to 9.9	s	0.1

HEX address	Signal	Access	Type	Range	Unit	Step size
D00D / E06D	End current [I-E]	Reading & writing	FLOAT	0.0 to 200.0	%	1
D00E / E012	End arc length correction	Reading & writing	FLOAT	-10.0 to 10.0		0.1
D00F / E057	End Current Time [t-e]	Reading & writing	FLOAT	0.0 to 10.0	s	0.1
D010 / E02E	SFI HotStart	Reading & writing	FLOAT	0.01 to 2.00	s	0.01
D011 / E0BF	Ignition time out	Reading & writing	FLOAT	5 to 100	mm	1
D012 / E09E	Cooling unit mode	Reading & writing	FLOAT	See table **Cooling unit mode** on page **28**		
D013	Cooler filter time	Reading & writing	FLOAT	5 to 25	s	5
D014	Cooler flow warning level	Reading & writing	FLOAT	0.75 to 0.95	l/min	0.01
D015	Touch sensitivity	Reading & writing	FLOAT	0 to 10		1
D016 / E06F	Language	Reading & writing	FLOAT	See table **Language** on page **28**		
D017	Units	Reading & writing	FLOAT	See table **Unit** on page **29**		
D018	Welding standard	Reading & writing	FLOAT	See table **Welding standard** on page **29**		
D100 / F10B	Error number	Reading	FLOAT	0 to 65,535		1
D101 / E062	Min. feeder value	Reading	FLOAT	0.0 to 100.0	m/min	0.1
D102 / E063	Max. feeder value	Reading	FLOAT	0.0 to 100.0	m/min	0.1
D103 / E0A6	Hourmeter Current flow	Reading	FLOAT	0.0 to 1,000,000	h	0.1
D104 / E0A7	Hourmeter Power on	Reading	FLOAT	0.0 to 1,000,000	h	0.1
D105 / E0AA	Power value	Reading	FLOAT	0.1 to 1,000,000	kW	0.1
D106 / E0AB	Real energy value	Reading	FLOAT	0.1 to 1,000,000	kJ	0.1
D107 / E0BB	Coolertemperature	Reading	FLOAT	-100 to 200	°C	0.1
D108 / E0BC	Coolerflow	Reading	FLOAT	-100 bis 100	l/min	0.01

Cooling unit mode

Value	Description
20e34	Eco
13e34	Auto
11e34	On
12e34	Off

Language

Value	Description
8e34	English
9e34	German
58e34	Japanese
10e34	Chinese
23e34	Spanish
24e34	French
25e34	Czech
26e34	Hungarian
27e34	Italian
28e34	Norwegian
29e34	Polish
30e34	Portuguese
31e34	Slovak
32e34	Turkish
33e34	Russian
34e34	Swedish
35e34	Estonian
36e34	Finnish
39e34	Lithuanian
40e34	Latvian
41e34	Dutch
42e34	Slovenian
43e34	Romanian
44e34	Croatian
59e34	Ukrainian
61e34	Korean
66e34	Icelandic
67e34	Vietnamese
70e34	Thai
71e34	Indonesian
75e34	Serbian

Value	Description
76e34	Hindi
130e34	Tamil
151e34	Danish
156e34	Bulgarian

Unit

Value	Description
37e34	Metrisch
38e34	Imperial

Welding standard

Value	Description
49e34	AWS
57e34	CEN

Modbus – General Information

Protocol Description

The MODBUS ADU is constructed by the client that initiates the MODBUS transaction. The function tells the server which action is to be performed. The MODBUS application protocol defines the format of a client-initiated request.

The function code field of a MODBUS data unit is coded in one byte. Valid codes are in the range of 1 ... 255 decimal (the range 128-255 is reserved for exception responses). When the server receives a message from a client, the function code field tells the server which action to perform.

If several actions are to be performed, subfunction codes are added to some function codes. When messages are sent to servers by a client, the data field in the message contains additional information that the server uses to perform the action defined by the function code. This can include elements such as discrete addresses, register addresses, the quantity to be handled, or the number of actual data bytes contained within the field.

With certain types of request, there might not be a data field (length: zero). In this case, the server does not require any additional information because the action is specified by the function code alone.

If a MODBUS ADU is correctly received without any errors occurring in connection with the requested MODBUS function, the requested data will be included in the data field when a server responds to a client. If an error does occur in connection with the requested MODBUS function, the field will contain an exception code that the server application can use to determine what action to perform next.

For instance, a client can read the ON/OFF statuses of a group of discrete inputs or outputs, or it can read/write the data contents of a group of registers.

When sending a response to the client, the server uses the function code field either to indicate that the response is normal (free of errors) or that an error has occurred (this kind of response is called an "exception response"). In the case of a normal response, the server simply echoes the original function code.

Data Coding

For addresses and data elements, MODBUS uses a big-endian format. When a number larger than a single byte is transmitted, this means that the most significant byte is sent first.

Register Size	Value
16 bits, 1234_{hex}	12_{hex} is sent as the first byte and then 34_{hex}

Application Data Unit (ADU)

This section describes the encapsulation method used for a MODBUS request or response when it is transmitted over a MODBUS TCP network.

MPAP header	Function code	Data

Description of MPAP header:	
Transaction Identifier Used to allocate the transaction. The MODBUS server copies the Transaction Identifier of the request into the response.	
Transaction Identifier This is used for transaction pairing. The MODBUS server copies the transaction identifier from the request into the response.	
Length:	2 bytes
Description:	For identifying a MODBUS request/response transaction
Client:	Initialized by the client
Server:	Copied back by the server from the request received
Protocol Identifier This is used for multiplexing within the system. The MODBUS protocol is identified by the value 0.	
Length:	2 bytes
Description:	0 = Modbus protocol
Client:	Initialized by the client
Server:	Copied back by the server from the request received
Length This field is used to specify the number of bytes in the field to follow, including the unit identifier, function code, and data field.	
Length:	2 bytes
Description:	Number of bytes to follow
Client:	Initialized by the client
Server:	-
Unit Identifier This field is used for routing within the system. It is usually used for communication with a serially connected MODBUS- or MODBUS+ slave where communication takes place via a gateway between an Ethernet network and a serial MODBUS line. The field value is set in the request by the MODBUS client and must be replicated exactly in the response from the server.	
Length:	1 byte
Description:	For identifying a remote slave that is connected via a serial line or other type of bus.
Client:	Initialized by the client

All MODBUS/TCP ADUs are sent via TCP on registered port 502.

Modbus Functions

03_{dec} (03_{hex}) Read Holding Register

This code is used to read the contents of a contiguous block of holding registers in a remote device. The request PDU determines the starting register address and the number of registers.
The registers are addressed in the PDU starting at zero. This means registers numbered 1-16 will be addressed using 0-15.

The register data in the response message is packed as two bytes per register, with the binary contents precisely aligned/justified within each byte. Within the individual registers, the first byte contains the high-order bits and the second byte the low-order bits.

Request		
Function code	1 byte	03_{hex}
Start address	2 bytes	0000_{hex} to $FFFF_{hex}$
Number of registers	2 bytes	1 to 125 ($7D_{hex}$)

Response		
Function code	1 byte	03_{hex}
Number of bytes	2 bytes	2 x N*
Register value	N* x 2 bytes	-
N* = Number of registers		

Errors		
Error code	1 byte	83_{hex}
Exception code	1 byte	01 or 02 or 03 or 04

Example
Example of a read request for register F009 (job number).

Request		**Response**	
Field name	**Hex**	**Field name**	**Hex**
Transaction Identifier Hi	00	Transaction Identifier Hi	00
Transaction Identifier Lo	01	Transaction Identifier Lo	01
Protocol Identifier Hi	00	Protocol Identifier Hi	00
Protocol Identifier Lo	00	Protocol Identifier Lo	00
Length Hi	00	Length Hi	00
Length Lo	06	Length Lo	05
Unit Identifier	00	Unit Identifier	00
Function code	03	Function code	03
Starting Address Hi	F0	Byte Count	02
Starting Address Lo	F9	Register value Hi (108)	02
No. of Registers Hi	00	Register value Lo (108)	37

Example Example of a read request for register F009 (job number).			
Request		**Response**	
Field name	**Hex**	**Field name**	**Hex**
No. of Registers Lo	01		

The contents of register F009 (job number) are displayed in the form of the two-byte values 237_{hex} or 567_{dec}.

06_{dec} (06_{hex}) Write Single Register

This function code is used to write a single holding register in a remote device. The request PDU specifies the address of the register to be written. Registers are addressed starting at zero. This means that the register that has been numbered as 1 will be addressed using 0.
The normal response is an echo of the request, which is returned after the register contents are written.

Request		
Function code	1 byte	06_{hex}
Register address	2 bytes	0000_{hex} to $FFFF_{hex}$
Register value	2 bytes	0000_{hex} or $FFFF_{hex}$

Response		
Function code	1 byte	06_{hex}
Register address	2 bytes	0000_{hex} to $FFFF_{hex}$
Register value	2 bytes	0000_{hex} or $FFFF_{hex}$

Errors		
Error code	1 byte	86_{hex}
Exception code	1 byte	01 or 02 or 03 or 04

Example Example request for writing the value 237_{hex} (567_{dec}) to register F009 (job number).			
Request		**Response**	
Field name	**Hex**	**Field name**	**Hex**
Transaction Identifier Hi	00	Transaction Identifier Hi	00
Transaction Identifier Lo	01	Transaction Identifier Lo	01
Protocol Identifier Hi	00	Protocol Identifier Hi	00
Protocol Identifier Lo	00	Protocol Identifier Lo	00
Length Hi	00	Length Hi	00
Length Lo	06	Length Lo	06
Unit Identifier	00	Unit Identifier	00
Function code	06	Function code	06
Register Address Hi	F0	Register Address Hi	F0

Example **Example request for writing the value 237_{hex} (567_{dec}) to register F009 (job number).**			
Request		**Response**	
Field name	**Hex**	**Field name**	**Hex**
Register Address Lo	09	Register Address Lo	09
Register Value Hi	02	Register Value Hi	02
Register Value Lo	37	Register Value Lo	37

16_{dec} (10_{hex}) Write Multiple Register

This function code is used to write a block of contiguous registers in a remote device. The requested written values are specified in the request data field. Data is packed as two bytes per register. The normal response returns the function code, the starting address, and the number of registers written.

Request		
Function code	1 byte	10_{hex}
Starting address	2 bytes	0000_{hex} to $FFFF_{hex}$
Number of registers	2 bytes	0001_{hex} or 0078_{hex}
Number of bytes	1 byte	2 x N*
Register values	N* x 2 bytes	Value
N* = number of registers to be written		

Response		
Function code	1 byte	10_{hex}
Starting address	2 bytes	0000_{hex} to $FFFF_{hex}$
Number of registers	2 bytes	1 to 123 ($7B_{hex}$)

Errors		
Error code	1 byte	90_{hex}
Exception code	1 byte	01 or 02 or 03 or 04

Example **Example request for writing two registers ($F00B_{hex}$ – $F00C_{hex}$).**			
Request		**Response**	
Field name	**Hex**	**Field name**	**Hex**
Transaction Identifier Hi	00	Transaction Identifier Hi	00
Transaction Identifier Lo	01	Transaction Identifier Lo	01
Protocol Identifier Hi	00	Protocol Identifier Hi	00
Protocol Identifier Lo	00	Protocol Identifier Lo	00
Length Hi	00	Length Hi	00
Length Lo	11	Length Lo	11

Example **Example request for writing two registers ($F00B_{hex}$ – $F00C_{hex}$).**			
Request		**Response**	
Field name	**Hex**	**Field name**	**Hex**
Unit Identifier	00	Unit Identifier	00
Function code	10	Function code	10
Starting Address Hi	F0	Starting Address Hi	F0
Starting Address Lo	0B	Starting Address Lo	0B
Quantity of Registers Hi	00	Quantity of Registers Hi	00
Quantity of Registers Lo	02	Quantity of Registers Lo	02
Byte Count	04		
Register Value Hi	04		
Register Value Lo	CE		
Register Value Hi	FF		
Register Value Lo	C0		

23_{dec} (17_{hex}) Read/Write Multiple Register

This function code performs a combination of one read operation and one write operation in a single MODBUS transaction. The write operation is performed before the read operation.
Holding registers are addressed starting at zero. This means that holding registers 1-16 will be addressed in the PDU using 0-15.

The request PDU specifies:
- The starting address and number of holding registers to be read
- The starting address, number of holding registers, and data for the write operation.

The byte count field specifies the number of bytes to follow in the write data field.

The normal response contains the data from the group of registers read. The byte count field specifies the number of bytes to follow in the read data field.

Request		
Function code	1 byte	17_{hex}
Read starting address	2 bytes	0000_{hex} to $FFFF_{hex}$
Number of registers to read	2 bytes	0001_{hex} to approx. 0076_{hex}
Write starting address	2 bytes	0000_{hex} to $FFFF_{hex}$
Number of registers to write	2 bytes	0001_{hex} to approx. 0076_{hex}
Write number of bytes	1 byte	2 x N*
Write register values	N* x 2 bytes	

Request
N* = number of registers to be written

Response		
Function code	1 byte	17_{hex}
Number of bytes	1 byte	2 x N*
Write register values	N* x 2 bytes	
N* = number of registers to be read		

Errors		
Error code	1 byte	97_{hex}
Exception code	1 byte	01 or 02 or 03 or 04

Example Example request for reading 2 registers and writing 2 registers.			
Request		**Response**	
Field name	**Hex**	**Field name**	**Hex**
Transaction Identifier Hi	00	Transaction Identifier Hi	00
Transaction Identifier Lo	01	Transaction Identifier Lo	01
Protocol Identifier Hi	00	Protocol Identifier Hi	00
Protocol Identifier Lo	00	Protocol Identifier Lo	00
Length Hi	00	Length Hi	00
Length Lo	11	Length Lo	7
Unit Identifier	00	Unit Identifier	00
Function code	17	Function code	17
Read Starting Address Hi	F1	Byte Count	2
Read Starting Address Lo	0A	Read Registers Value Hi	04
Quantity to Read Hi	00	Read Registers Value Lo	08
Quantity to Read Lo	2	Read Registers Value Hi	0A
Write Starting Address Hi	F0	Read Registers Value Lo	C8
Write Starting Address Lo	0B		
Quantity to Write Hi	00		
Quantity to Write Lo	04		
Write Byte Count	2		
Write Registers Value Hi	04		
Write Registers Value Lo	CE		
Write Registers Value Hi	FF		
Write Registers Value Lo	C0		
Transaction Identifier Hi	00		

103_{dec} (67_{hex}) Read Holding Register Float

This function is used to read the contents of a contiguous block of registers in the TAG tables contained in this document. The register uses floating-point format (32 bits). The request PDU determines the starting register address and the number of registers.
The registers are addressed in the PDU starting at zero. This means registers numbered 1-16 will be addressed using 0-15.

The register data in the response message is packed as two bytes per register, with the binary contents precisely aligned/justified within each byte. Within the individual registers, the first byte contains the high-order bits and the second byte the low-order bits.

Requirement		
Function code	1 byte	xx_{hex}
Starting address	2 bytes	$xxxx_{hex}$ to $xxxx_{hex}$
Number of registers	2 bytes	1 to 125 ($7D_{hex}$)

Response		
Function code	1 byte	03_{hex}
Number of bytes	2 bytes	2 x N*
Register value	N* x 2 bytes	-
N* = number of registers		

Error		
Error code	1 bytes	83_{hex}
Exception code	1 byte	01 or 02 or 03 or 04

Example
Example read request for register $E064_{hex}$ (gas pre-flow):

Requirement		**Response**	
Field Name	**Hex**	**Field Name**	**Hex**
Transaction Identifier Hi	00	Transaction Identifier Hi	00
Transaction Identifier Lo	01	Transaction Identifier Lo	01
Protocol Identifier Hi	00	Protocol Identifier Hi	00
Protocol Identifier Lo	00	Protocol Identifier Lo	00
Length Hi	00	Length Hi	00
Length Lo	06	Length Lo	05
Unit Identifier	00	Unit Identifier	00
Function code	67	Function code	67
Starting Address Hi	E0	Byte Count	02
Starting Address Lo	64	Register Value High Hi	3F
No. of Registers Hi	00	Register Value High Lo	C0
No. of Registers Lo	01	Register Value Low Hi	00
		Register Value Low Lo	00

The contents of register $E064_{hex}$ (gas pre-flow) are displayed in the form of the two-byte values 3FC00000 or 1.5_{dec}.

104_{dec} (68_{hex}) Write Single Register Float

This function is used to edit registers in the TAG tables contained in this document. The register uses floating-point format (32 bits). The request PDU specifies the address of the register to be written. Registers are addressed starting at zero. This means that the register that has been numbered as 1 will be addressed using 0.
The normal response is an echo of the request, which is returned after the register contents are written.

Requirement		
Function code	1 byte	68_{hex}
Register address	2 bytes	$E000_{hex}$ to $Exxx_{hex}$
Register value	2 bytes	0000_{hex} or $FFFFFFFF_{hex}$

Response		
Function code	1 byte	68_{hex}
Register address	2 bytes	$E000_{hex}$ to $Exxx_{hex}$
Register value	2 bytes	0000_{hex} or $FFFFFFFF_{hex}$

Error		
Error code	1 bytes	$E8_{hex}$
Exception code	1 byte	01 or 02 or 03

Example
Example request for writing the value $3FC00000_{hex}$ (1.5_{dec}) to register $E064_{hex}$ (gas pre-flow):

Requirement		**Response**	
Field Name	**Hex**	**Field Name**	**Hex**
Transaction Identifier Hi	00	Transaction Identifier Hi	00
Transaction Identifier Lo	01	Transaction Identifier Lo	01
Protocol Identifier Hi	00	Protocol Identifier Hi	00
Protocol Identifier Lo	00	Protocol Identifier Lo	00
Length Hi	00	Length Hi	00
Length Lo	08	Length Lo	08
Unit Identifier	00	Unit Identifier	00
Function code	68	Function code	68
Register Address Hi	E0	Register Address Hi	E0
Register Address Lo	64	Register Address Lo	64
Register Value High Hi	3F	Register Value Hi	45
Register Value High Lo	C0	Register Value Lo	09
Register Value Low Hi	00	Register Value Hi	80

Example **Example request for writing the value $3FC00000_{hex}$ (1.5_{dec}) to register $E064_{hex}$ (gas pre-flow):**			
Requirement		**Response**	
Field Name	**Hex**	**Field Name**	**Hex**
Register Value Low Lo	00	Register Value Lo	00

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