Operating Instructions

CFG/i RI FB PRO AllSeas 1.0

EN-US | Operating instructions

42,0426,0543,EA 001-16072024

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Safety

Safety

⚠ WARNING!

Incorrect operation and incorrectly performed work can cause serious injury and property damage.

- ▶ All the work and functions described in this document must only be carried out by trained and qualified personnel.
- ▶ All work and functions described in this document must only be performed once you have read and understood this document in full.
- ▶ Do not perform the work and functions described in this document until you have thoroughly read and understood all the documents for the system components, especially the safety rules.

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

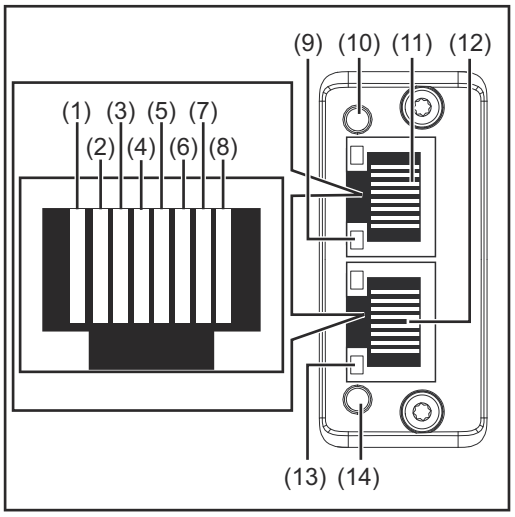
In some robot control systems, it may be necessary to state the configuration parameters described here so that the bus module can communicate with the robot.

Parameter	Value
Vendor name	Fronius International GmbH
Product code	0304_{hex} (772_{dec})
Major/minor revision	V1.00
Vendor URL	www.fronius.com

Parameter	Value
Product name	fronius-fb-pro-modbus-2p
Model name	Fronius FB PRO/i Modbus -TCP-2-Port
User application name	Fronius welding controller for the series TPS/i with Modbus-TCP-2-Port

Connections and Indicators

Connections and indicators on the 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)	Connection/Activity 2 LED
(10)	Module status LED

(11)	RJ 45 Ethernet connection 2
(12)	RJ 45 Ethernet connection 1
(13)	Connection/Activity 1 LED
(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

Connection/Activity LED:	
Status	**Meaning**
Off	No connection, no activity

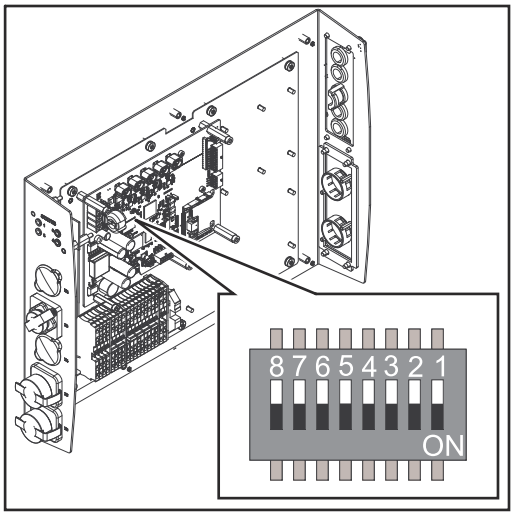
Connection/Activity LED:	
Status	**Meaning**
Lights up green	Connection established (100 Mbit/s)
Flickers green	Activity (100 Mbit/s)
Lights up yellow	Connection established (10 Mbit/s)
Flickers yellow	Activity (10 Mbit/s)

Setting the Bus Module IP Address

Overview

The IP address of the bus module can be set using the dip switch in the interface or on the website of the welding machine.

Setting the IP address on the dip switch



Set the IP address of the bus module in the interface within the range 192.168.0.xx (xx = dip switch setting = 1 to 63).

All positions are set to the OFF position at the factory. In this case, the IP address must be set on the website of the welding machine

The IP address is set using DIP switch positions 1 to 6. The configuration is carried out in binary format. This results in a configuration range of 1 to 63 in decimal format.

Example:

Dip switch								IP address
8	7	6	5	4	3	2	1	
-	-	OFF	OFF	OFF	OFF	OFF	ON	1
-	-	OFF	OFF	OFF	OFF	ON	OFF	2
-	-	OFF	OFF	OFF	OFF	ON	ON	3
-	-	ON	ON	ON	ON	ON	OFF	62
-	-	ON	ON	ON	ON	ON	ON	63

Setting the IP address on the SmartManager

Note down the IP address of the welding machine being used:

1. On the welding machine control panel, select "Defaults"
2. On the welding machine control panel, select "System"
3. On the welding machine control panel, select "Information"
4. Note down the displayed IP address

Access website of the welding machine in the internet browser:

5. Connect the computer to the network of the welding machine
6. Enter the IP address of the welding machine in the search bar of the internet browser and confirm
7. Enter the standard user name (admin) and password (admin)
   - The website of the welding machine is displayed

Set the bus module IP address:

8. On the website of the welding machine, select the "RI FB PRO/i" tab

9 Enter the desired IP address for the interface under "Module configuration"

10 Select "Set configuration"

11 Select "Restart module"

- The set IP address is applied

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

Input signals

From robot to welding machine
Applicable to firmware V2.0.0 and higher

Unless indicated otherwise, the signals apply both to the MIG/MAG and TIG welding processes and to ConstantWire.

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F000	0	0-7	Process active timeout	UINT8	0-255	10
	1	8-15	Reserved			

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F001	2	0	Welding start	Rising edge		
		1	Robot ready	High		
		2	Error quit	Rising edge		
		3	Gas on	Rising edge		
		4	Wire forward	Rising edge		
		5	Wire backward	Rising edge		
		6	Torch blow out	Rising edge		
		7	Welding simulation	High		
	3	8	Touch sensing	Rising edge		
		9	Booster manual	High		
		10	*For the MIG/MAG welding process:* SFI on			
			For the TIG welding process: CAP shaping	High		
			For the ConstantWire welding process: Reserved			
		11	*For the MIG/MAG welding process:* Synchro pulse on	High		
			For the TIG welding process: TAC on	High		
			For the ConstantWire welding process: Synchro pulse on	High		
		12	*For the MIG/MAG welding process:* Wire brake	High		
			For the TIG welding process: Reserved			
			For the ConstantWire welding process: Wire brake	High		
		13	Torchbody Xchange	High		
		14	Teach mode	High		
		15	Reserved			

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F002	4	0	Process line Bit 0	High		
		1	Process line Bit 1	High		
		2	*For the MIG/MAG welding process:* TWIN mode Bit 0	High		
			For the TIG welding process: Reserved			
			For the ConstantWire welding process: TWIN mode Bit 0	High		
		3	*For the MIG/MAG welding process:* TWIN mode Bit 1	High		
			For the TIG welding process: Reserved			
			For the ConstantWire welding process: TWIN mode Bit 1	High		
		4-7	Reserved			
	5	8	Reserved			
		9	Reserved			
		10	Reserved			
		11	Wire sense start	Rising edge		
		12	Wire sense break	Rising edge		
		13-15	Reserved			
F003	6	0	Documentation mode	High		
		1-7	Reserved			
	7	8-15	Reserved			
F004	8	0-7	Reserved			
	9	8-15	Reserved			
F005	10	0-7	Reserved			
	11	8-15	Reserved			

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F006	12	0	Enable resistance overwrite	Rising edge		
		1	Set resistance value	Rising edge		
		2	Enable inductance overwrite	Rising edge		
		3	Set inductance value	Rising edge		
		4-7	Reserved			
	13	8-15	Reserved			
F007	14	0	ExtInput1 => OPT_Output 1	High		
		1	ExtInput2 => OPT_Output 2	High		
		2	ExtInput3 => OPT_Output 3	High		
		3	ExtInput4 => OPT_Output 4	High		
		4	ExtInput5 => OPT_Output 5	High		
		5	ExtInput6 => OPT_Output 6	High		
		6	ExtInput7 => OPT_Output 7	High		
		7	ExtInput8 => OPT_Output 8	High		
	15	8-15	Reserved			
F008	16	0	Working Mode Bit 0	High		
		1	Working Mode Bit 1	High		
		2	Working Mode Bit 2	High		
		3	Working Mode Bit 3	High		
		4	Working Mode Bit 4	High		
		5-7	Reserved			
	17	8-13	Reserved			
		14	Command value selection Bit 0	High		
		15	Reserved			
F009	18-19	0-15	Job number	UINT16	0 to 1000	1
F00A	20-21	0-15	Characteristic number	UINT16	0 to 65,535	1
F00B	22-23	0-15	*For the MIG/MAG welding process:* Wire feed speed command value	SINT16	-327.68 to 327.67 [m/min]	100
			For the TIG welding process: Main current	SINT16	0 to 6553.5 [A]	10
			For the ConstantWire welding process: Wire feed speed command value	SINT16	-327.68 to 327.67 [m/min]	100

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F00C	24-25	0-15	*For the MIG/MAG welding process:* Arc length correction	SINT16	-10 to +10	10
			For the TIG welding process: Feeder command value	SINT16	-327.68 to 327.67 [m/min]	100
			For the ConstantWire welding process: Current	UINT16	0 to 6553.5 [A]	10
F00D	26-27	0-15	*For the MIG/MAG welding process:* Pulse/Dynamic correction	SINT16	-10 to +10	10
			For the TIG welding process: Wire correction	SINT16	-10 to +10	10
			For the ConstantWire welding process: Reserved			
F00E	28-29	0-15	*For the MIG/MAG welding process:* Wire retract correction		0 to +10	10
			For the TIG welding process: Wire retract end	UINT16	OFF, 1 to 50 [mm]	1
			For the ConstantWire welding process: Wire retract correction			
F00F	30-31	0-15	Welding speed	UINT16	0 to 1000 [cm/min]	10
F010	32-33	0-15	Penetration stabilizer	UINT16	0 to 1000 [cm/min]	10
F011	34-35	0-15	Arc length stabilizer	SINT16	0 to +5	10
F012	36-37	0-15	*For the MIG/MAG welding process:* Reserved			
			For the TIG welding process: Wire positioning start	UINT16	OFF, 1 to 50 [mm]	1
			For the ConstantWire welding process: Reserved			
F013	38-39	0-15	Reserved			
F014	40-41	0-15	Reserved			
F015	42-43	0-15	Reserved			
F016	44-45	0-15	Reserved			
F017	46-47	0-15	Reserved			
F018	48-49	0-15	Reserved			
F019	50-51	0-15	Reserved			

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F01A	52-53	0-15	Wire forward/backward length	UINT16	OFF (0) / 1 to 1000 [cm]	1
F01B	54-55	0-15	Wire sense edge detection	UINT16	OFF (0) / 0.5 to 20.0 [mm]	10
F01C	56-57	0-15	Reserved			
F01D	58-59	0-15	Seam number	UINT16	0 to 65,535	1
F01E	60-61	0-15	Resistance overwrite	UINT16	0 to +400 [mOhm]	10
F01F	62-63	0-15	Inductance overwrite	UINT16	0 to +25 [µH]	10
F020	64-65	0-15	Reserved			
F021	66-67	0-15	Reserved			
F022	68-69	0-15	Reserved			
F023	70-71	0-15	Reserved			
F024	72-73	0-15	Reserved			
F025	74-75	0-15	Reserved			
F026	76-77	0-15	Reserved			
F027	78-79	0-15	Reserved			
F028	80-81	0-15	Reserved			
F029	82-83	0-15	Reserved			
F02A	84-85	0-15	Reserved			
F02B	86-87	0-15	Reserved			
F02C	88-89	0-15	Reserved			
F02D	90-91	0-15	Reserved			
F02E	92-93	0-15	Reserved			
F02F	94-95	0-15	Reserved			
F030	96-97	0-15	Reserved			
F031	98-99	0-15	Reserved			

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	MIG/MAG Standard Manual, 2-step
1	0	0	0	0	Quiet mode

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
1	0	0	0	1	Stop coolant pump
1	1	0	0	0	R/L measurement
1	1	0	0	1	R/L alignment

Value range for operating mode

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 welding machine (internal)
1	Seam number of robot (Word 19)

Value range for documentation mode

Output signals

Output signals

From welding machine to robot
Applicable to firmware V2.0.0 and higher

Unless indicated otherwise, the signals apply both to the MIG/MAG and TIG welding processes and to ConstantWire.

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F100	0	0-7	Reserved			
	1	8-15	Reserved			
F101	2	0	Heartbeat power source	High		
		1	Power source ready	High		
		2	Arc stable/Touch signal	High		
		3	Current flow signal	High		
		4	Main current signal	High		
		5	Collision box active	High		
		6	Reserved			
		7	Reserved			
	3	8	Touch signal	High		
		9	Torchbody gripped	High		
		10	Command value out of range	High		
		11	Correction out of range	High		
		12	Process active	High		
		13	Robot motion release	High		
		14	Wire stick workpiece	High		
		15	*For the MIG/MAG welding process:* Reserved			
			For the TIG welding process: Electrode overloaded	High		
			For the ConstantWire welding process: Reserved			

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F102	4	0	Welding process Bit 0	High		
		1	Welding process Bit 1	High		
		2	Welding process Bit 2	High		
		3	Welding process Bit 3	High		
		4	Welding process Bit 4	High		
		5-7	Reserved			
	5	8	Parameter selection internal	High		
		9	Characteristic number valid	High		
		10-15	Reserved			
F103	6	0-7	Reserved			
	7	8-13	Reserved			
		14	Short circiut contact tip	High		
		15	Gas nozzle touched	High		
F104	8	0	Sensor status 1	High		
		1	Sensor status 2	High		
		2	Sensor status 3	High		
		3	Sensor status 4	High		
		4-7	Reserved			
	9	8	Function status Bit 0	High		
		9	Function status Bit 1	High		
		10	Reserved			
		11	Safety status Bit 0	High		
		12	Safety status Bit 1	High		
		13	Reserved			
		14	Notification	High		
		15	System not ready	High		

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F105	10	0	Limit signal	High		
		1-7	Reserved			
	11	8	Reserved			
		9	*For the MIG/MAG welding process:* Twin synchronization active	High		
			For the TIG welding process: Reserved			
			For the ConstantWire welding process: Twin synchronisation active	High		
		10	Main supply status	High		
		11	Standby active	High		
		12	Active processline Bit 0	High		
		13	Active processline Bit 1	High		
		14	Warning	High		
		15	Reserved			
F106	12	0-7	Reserved			
	13	8-15	Reserved			
F107	14	0	Ext. output 1 => OPT_input 1	High		
		1	Ext. output 2 => OPT_input 2	High		
		2	Ext. output 3 => OPT_input 3	High		
		3	Ext. output 4 => OPT_input 4	High		
		4	Ext. output 5 => OPT_input 5	High		
		5	Ext. output 6 => OPT_input 6	High		
		6	Ext. output 7 => OPT_input 7	High		
		7	Ext. output 8 => OPT_input 8	High		
	15	8-15	Reserved			
F108	16-17	0-15	Error number	UINT16	0 to 65,535	1
F109	18-19	0-15	Warning number	UINT16	0 to 65,535	1
F10A	20-21	0-15	Welding voltage	UINT16	0 to 327.67 [V]	100
F10B	22-23	0-15	Welding current	UINT16	0 to 3276.7 [A]	10
F10C	24-25	0-15	Motor current M1	SINT16	-327.68 to 327.67 [A]	100
F10D	26-27	0-15	Motor current M2	SINT16	-327.68 to 327.67 [A]	100

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F10E	28-29	0-15	Motor current M3	SINT16	-327.68 to 327.67 [A]	100
F10F	30-31	0-15	Reserved			
F110	32-33	0-15	Wire feed speed	SINT16	-327.68 to 327.67 [m/min]	100
F111	34-35	0-15	Actual real value seam tracking	UINT16	0 to 6.5535	10,000
F112	36-37	0-15	Real power value	UINT16	0 to 6553.5 [kJ]	10
F113	38-39	0-15	Wire position	SINT16	-327.68 to 327.67 [mm]	100
F114	40-41	0-15	Resistance	UINT16	0 to +400 [mOhm]	10
F115	42-43	0-15	Inductance	UINT16	0 to +25 [µH]	10
F116	44-45	0-15	Reserved			
F117	46-47	0-15	Reserved			
F118	48-49	0-15	Reserved			
F119	50-51	0-15	Reserved			
F11A	52-53	0-15	Reserved			
F11B	54-55	0-15	Reserved			
F11C	56-57	0-15	Reserved			
F11D	58-59	0-15	Reserved			
F11E	60-61	0-15	Reserved			
F11F	62-63	0-15	Reserved			
F120	64-65	0-15	Reserved			
F121	66-67	0-15	Reserved			
F122	68-69	0-15	Reserved			
F123	70-71	0-15	Reserved			
F124	72-73	0-15	Reserved			
F125	74-75	0-15	Reserved			
F126	76-77	0-15	Reserved			
F127	78-79	0-15	Reserved			
F128	80-81	0-15	Reserved			
F129	82-83	0-15	Reserved			
F12A	84-85	0-15	Reserved			
F12B	86-87	0-15	Reserved			
F12C	88-89	0-15	Reserved			

Address	Byte	Bit	Signal	Data type/ activity	Range [unit]	Factor
F12D	90-91	0-15	Reserved			
F12E	92-93	0-15	Reserved			
F12F	94-95	0-15	Reserved			
F130	96-97	0-15	Reserved			
F131	98-99	0-15	Reserved			

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)

Assignment of sensor statuses

Value range for Function status

Bit 1	Bit 0	Description
0	0	Inactive
0	1	Idle
1	0	Finished
1	1	Error

Value range for function status

Value range for Process Bit

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	0	0	0	0	No internal parameter selection or process
0	0	0	0	1	MIG/MAG pulse 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
0	1	0	0	1	ConstantWire
0	1	0	1	0	ColdWire

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	1	0	1	1	DynamicWire

Value range for process bit

Value range for waveform positive and waveform negative

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	0	0	0	1	Hard rectangle waveform
0	0	0	1	0	Soft rectangle waveform
0	0	0	1	1	Triangle waveform
0	0	1	0	0	Sine waveform

Value range for positive waveform and negative waveform

Value range Safety status

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

Value range Safety status

TAG description

TAG table

Address	Signal	Access	Data type/activity	Range [unit]	Factor
A000	Current 1	write	SINT16	-3276.8 to 3276.7 [A]	10
A001	Current 2	write	SINT16	-3276.8 to 3276.7 [A]	10
A002	Current 3	write	SINT16	-3276.8 to 3276.7 [A]	10
A003	Current 4	write	SINT16	-3276.8 to 3276.7 [A]	10
A004	Current 5	write	SINT16	-3276.8 to 3276.7 [A]	10
A005	Current 6	write	SINT16	-3276.8 to 3276.7 [A]	10
A006	Current 7	write	SINT16	-3276.8 to 3276.7 [A]	10
A007	Current 8	write	SINT16	-3276.8 to 3276.7 [A]	10
A008	Voltage 1	write	SINT16	-327.68 to 327.67 [V]	100
A009	Voltage 2	write	SINT16	-327.68 to 327.67 [V]	100
A00A	Frequency 1	write	UINT16	1 to 6553.5 [Hz]	10
A00B	Wire feed 1	write	SINT16	-327.68 to 327.67 [m/min]	100
A00C	Wire feed 2	write	SINT16	-327.68 to 327.67 [m/min]	100
A00D	Wire feed 3	write	SINT16	-327.68 to 327.67 [m/min]	100
A00E	Wire feed 4	write	SINT16	-327.68 to 327.67 [m/min]	100
A00F	Wire feed 5	write	SINT16	-327.68 to 327.67 [m/min]	100
A010	Wire feed 6	write	SINT16	-327.68 to 327.67 [m/min]	100
A011	Time 1	write	UINT16	0 to 65535 [x 25 µs]	1
A012	Time 2	write	UINT16	0 to 65535 [x 25 µs]	1
A013	Time 3	write	UINT16	0 to 65535 [x 25 µs]	1
A014	Time 4	write	UINT16	0 to 65535 [x 25 µs]	1
A015	Time 5	write	UINT16	0 to 65535 [x 25 µs]	1
A016	Time 6	write	UINT16	0 to 65535 [x 25 µs]	1
A017	Time 7	write	UINT16	0 to 65535 [x 25 µs]	1
A018	Time 8	write	UINT16	0 to 65535 [x 25 µs]	1
A019	Time 9	write	UINT16	0 to 65535 [x 25 µs]	1
A01A	Time 10	write	UINT16	0 to 65535 [x 25 µs]	1
A01B	Factor unsigned 1	write	UINT16	0 to 65.535 [%]	1000
A01C	Factor unsigned 2	write	UINT16	0 to 65.535 [%]	1000
A01D	Factor unsigned 3	write	UINT16	0 to 65.535 [%]	1000

Address	Signal	Access	Data type/activity	Range [unit]	Factor
A01E	Factor unsigned 4	write	UINT16	0 to 65.535 [%]	1000
A01F	Factor unsigned 5	write	UINT16	0 to 65.535 [%]	1000
A020	Factor unsigned 6	write	UINT16	0 to 65.535 [%]	1000
A021	Factor unsigned 7	write	UINT16	0 to 65.535 [%]	1000
A022	Tau 1	write	UINT16	0 to 65535 [x 25 µs]	1
A023	Tau 2	write	UINT16	0 to 65535 [x 25 µs]	1
A024	Tau 3	write	UINT16	0 to 65535 [x 25 µs]	1
A025	Tau 4	write	UINT16	0 to 65535 [x 25 µs]	1
A026	Tau 5	write	UINT16	0 to 65535 [x 25 µs]	1
A027	Current slope 1	write	UINT16	0 to 65535 [A/ms]	1
A028	Current slope 2	write	UINT16	0 to 65535 [A/ms]	1
A029	Current slope 3	write	UINT16	0 to 65535 [A/ms]	1
A02A	Current slope 4	write	UINT16	0 to 65535 [A/ms]	1
A02B	Current slope 5	write	UINT16	0 to 65535 [A/ms]	1
A02C	Current slope 6	write	UINT16	0 to 65535 [A/ms]	1
A02D	Current slope 7	write	UINT16	0 to 65535 [A/ms]	1
A02E	MIG-45-1	write	UINT16	0 to 65535 [N]	1
A02F	MIG-45-2	write	UINT16	0 to 65535 [N]	1
A030	MIG-45-3	write	UINT16	0 to 65535 [N]	1
A031	Number unsigned 1	write	UINT16		1
A032	Number unsigned 2	write	UINT16		1
A033	Number unsigned 3	write	UINT16		1
A034	Number unsigned 4	write	UINT16		1
A035	Resistance 1	write	UINT16	0 to 65,535 [mOhm]	1000
A036	Resistance 2	write	UINT16	0 to 65,535 [mOhm]	1000
A037	Resistance 3	write	UINT16	0 to 65,535 [mOhm]	1000
A038	Resistance 4	write	UINT16	0 to 65,535 [mOhm]	1000
A039	Length 1	write	SINT16	-327.68 to 327.67 [mm]	1000
A03A	Length 2	write	SINT16	-327.68 to 327.67 [mm]	1000
A03B	Factor signed 1	write	SINT16	-327.68 to 327.67 [%]	1000
A03C	Factor signed 2	write	SINT16	-327.68 to 327.67 [%]	1000
A100	Gas preflow [1)]	write	UINT16	0 to 9.9 [s]	10
A101	Gas postflow [1)]	write	UINT16	0 to 9.9 [s]	10
A102	Inching speed [1)]	write	UINT16	0.5 to vDmax [m/min]	10

Address	Signal	Access	Data type/activity	Range [unit]	Factor
A103	Starting current [2)]	write	UINT16	0 to 200 [%]	1
A104	Starting current time [2)]	write	UINT16	0.01 to 30 [s]	100
A105	Slope 1 [2)]	write	UINT16	0.01 to 30 [s]	100
A106	Slope 2 [2)]	write	UINT16	0.01 to 30 [s]	100
A107	End current [2)]	write	UINT16	0 to 200 [%]	1
A108	End current time [2)]	write	UINT16	0.01 to 30 [s]	100
A109	Pulse frequency [2)]	write	UINT16	0.1 to 1999.9 [Hz]	10
A10A	Gas preflow [2)]	write	UINT16	0 to 9.9 [s]	10
A10B	Gas postflow [2)]	write	SINT16	0 to 9.9 AUTO [s]	10
A10C	Inching speed [2)]	write	UINT16	0.5 to vDmax [m/min]	10
A10D	Wire start delay [2)]	write	UINT16	0.1 to 9.9 [s]	10
A10E	Wire end delay [2)]	write	UINT16	0.1 to 9.9 [s]	10
A10F	Needle diameter [2)]	write	UINT16	1 to 6.4 [mm]	10
A110	AC frequency [2)]	write	UINT16	40 to 250 [%]	1
A111	AC balance [2)]	write	UINT16	15 to 50 [%]	1
A112	Waveform positive [2)]	write	UINT16		1
A113	Waveform negative [2)]	write	UINT16		1
A114	Apply characteristic parameters [1)]	write	UINT16	0 to 1000	1

[1)] *Description MIG/MAG:* MIG/MAG pulse synergic, MIG/MAG standard synergic, MIG/MAG standard manual, MIG/MAG PMC, MIG/MAG, LSC

[2)] *Description WIG:* TIG cold wire, TIG hot wire

Controlling the tags

The tag values in registers 0xA000 to 0xA03C override the welding machine parameters. If a variable value is not to override the welding machine parameters, one of the following two values must be written to the register:

- 32768 (0x8000) for signed values, e.g., current 1
- 65535 (0xFFFF) for unsigned values, e.g., time 1

In order to activate the variable values, the register 0xA114 (apply characteristic parameters) must be increased. This register is a counter with a value range of 1 to 1000. This means that a value of 1 must be written after the value 1000.

Activating variable value:

1 Write a parameter register.
Unused parameters are written to 32768 or 65535. If the parameter is never written, it is considered unused.

2 Increase the register 0xA114.
First write 1, then increase to 1000 and then again to 1.

The tag values in registers 0xA100-0xA113 take effect immediately when they are written.

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		

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