

# The Modbus to Foundation Fieldbus gateway, the T710 Reference Manual



White Series ©Fieldbus International AS



#### TABLE OF CONTENTS

ABOUT THIS	DOCUMENT	2
SUMMARY	3	
1.	INTRODUCTION	4
1.1.	Functional Description	4
1.2.	Mechanical Dimensions	6
2.	INSTALLATION	7
2.1.	Electrical Connections	7
2.2.	Slide switches and DIP switch	8
2.2.1.	Modbus termination	8
2.2.2.	FF termination	8
2.2.3.	DIP switches	8
2.2.4.	Programming utility	8
2.3.	Power, Termination and Diagnostic LEDs	9
3.	OPERATION PRINCIPLE	
3.1.	Connecting Modbus devices	. 10
3.1.	Setting up the Modbus	. 11
3.2.	Channel communication services	
3.2.1.	Set-up of PV	. 13
3.2.2.	Diagnosis	. 15
3.2.3.	Transparent Read/Write services.	. 16
3.2.4.	Configuration windows in the NI configurator	. 17
3.2.5.	Write protection of Modbus set-up	. 20
4.	TECHNICAL SPECIFICATIONS	. 21
5.	OPERATIONAL BEHAVIOR	. 22
5.1.	RUN-TIME	
5.2.	Modbus	. 22



## About this document

The Reference Manual gives an overview of the capabilities and the use of the T710 DIN rail mounted generic Foundation Fieldbus gateway. Furthermore it explains how to configure the device.

The following abbreviations are used in this document:

FF	Foundation Fieldbus
PV	Primary Variable, dynamic variable in the transmitter
AI FB	Analog Input Function Block, measurement application object.
RB	Resource Block, device application object
TB	Transducer Block, Modbus application object
DD	Device Description, Electronic description of device application capability.
NI	National Instrument



## Summary

The T710 capabilities can be summarized as follows:

- Interfaces up to four Modbus RTU devices to Foundation Fieldbus (FF)
- Supports Diagnostics Flags according to NAMUR NE107
- Supports transparent Read/Write services for configuration of Modbus devices
- Set-up services of T710 through the FF interface.
- Powered from 18V 30 V instrument power
- The bus load is 13,8 mA

The instrument interface:

Protocol:

- Modbus RTU
- Physical interfaces:
  - RS 485



## **1. INTRODUCTION**

## **1.1.** Functional Description

The T710 is an FF compliant DIN rail mountable gateway for connecting Modbus RTU instruments (Modbus slaves) to FF.



## Figure 1. the T710

Up to four Modbus instruments can be connected through one T710 module.

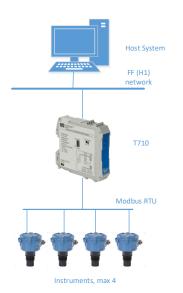


Figure 2. T710 used in an FF application

White Series



T710 has communication routines for communicating with a Modbus instrument (Modbus slave). Applying the T710 enables an existing Modbus instrument to become an FF compliant device.

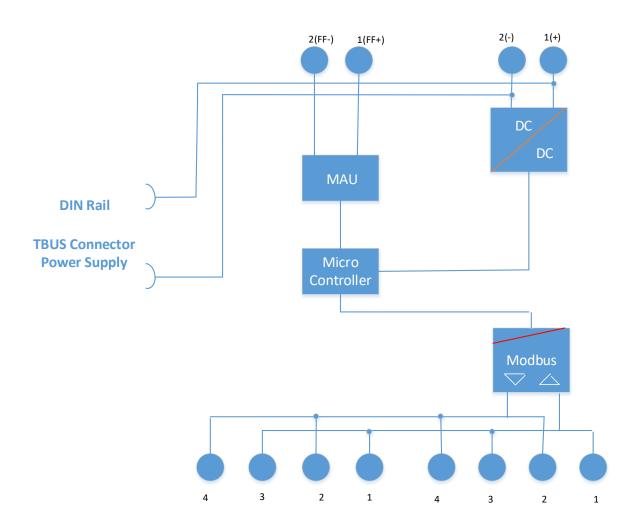


Figure 3 Functional Diagram



# **1.2.** Mechanical Dimensions

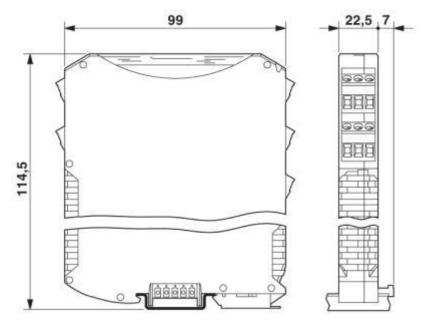


Figure 4 – ME MAX Dimensions



## 2. INSTALLATION

The T710 is designed for being mounted in a cabinet on a DIN rail.

## **2.1. Electrical Connections**

The T710 contains 4 pluggable screw terminals.

The T710 shall use the connector pinout as shown in Table 1

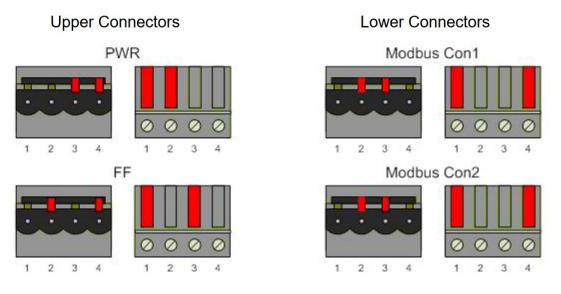
Table 1 Connector Arrangement Table

Connector	Pin	Comment		
Top connectors				
	1	Positive supply to FGW		
PWR	2	Negative supply to FGW		
PWK	3	No Connection		
	4	No Connection		
	1	FF +		
FF	2	FF -		
ГГ	3	No Connection		
	4	No Connection		
Bottom connectors				
	1	MODBUS Device 1 – Signal A		
Modbus Con1	2	MODBUS Device 1 – Signal B		
Modbus Coll1	3	MODBUS Device 2 – Signal A		
	4	MODBUS Device 2 – Signal B		
	1	MODBUS Device 3 – Signal A		
Modbus Con2	2	MODBUS Device 3 – Signal B		
Modbus Coll2	3	MODBUS Device 4 – Signal A		
	4	MODBUS Device 4 – Signal B		
Other				
DIN clip	-	PE connection for EMC, see Figure 5		
TBUSPositive supply to T710 (pin 1 is		Positive supply to T710 (pin 1 is at top of the TBUS		
	1	connector		
	2	Negative supply to T710		



Figure 5 The TBUS connector





#### Figure 6 Connector Keying

## 2.2. Slide switches and DIP switch

#### 2.2.1. Modbus termination

The RS485 Modbus line may be terminated in the T710. Whether to terminate is selected by a slide switch as indicated in Figure 5. There is one terminator serving all the four Modbus instruments. Internally they are connected together. The terminator terminates all four instruments.

#### 2.2.2. FF termination

The Fieldbus lines may be terminated in the T710. Whether to terminate is selected by a slide switch as indicated in Figure 5.

#### 2.2.3. DIP switches

One DIP switch is used for Simulation Mode, ON/OFF. The other switches are not in use.

#### 2.2.4. Programming utility

Behind the panel on top of the device, there is an USB connector, see Figure 7, for software download.





Figure 7 Front and Side Label mounted on T710, showing the functions

## 2.3. Power, Termination and Diagnostic LEDs

There are five LEDs on the front. One for Power ON, One for Modbus Termination ON/OFF, one for FF Termination ON/OFF, one for the Modbus communication and one for the FF communication. The communication LEDs are bicolor. One color is blinking on request telegrams and the other on responding telegrams. A slow blink in one of the Modbus LED indicates that there is no Modbus communication. The blinking frequency is determined by the configured time-out time on Modbus

Page 9



## **3. OPERATION PRINCIPLE**

## **3.1.** Connecting Modbus devices

The T710 is a protocol converter, to allow legacy Modbus devices to communicate on an FF network.

Four channels are supported. The source of each channel is defined by a Modbus Device Address. Up to four Modbus devices may be connected. This implies four different Modbus addresses. The instruments are electrically interconnected.

The channels may be assigned to the same Modbus address. This will allow more information to be interchanged with one Modbus instrument.

NOTE: Set-up can only be performed when the Channels are in Out of Service mode.

Each Channel supports three types of traffic, transfer of measurements (PV), transfer of status/diagnostic information and Modbus instrument read/write services. The principle diagram for the communication is shown in Figure 6.

The PV, the status information and the configuration data can be located anywhere within the Modbus Register map. In order for the T710 to find the data, it must be configured. The configuration is done through the FF interface.

The FF read and write services are used to set-up the Modbus channels. These services should be writable for the OEM user and Read-only for the end-user.

The device parameters are organized in a Block structure consisting of a Resource Block (RB), Function Blocks (FBs) and a Transducer Block (TB). There are standard parameters defined for all these three Block categories.

The RB is used to describe the device's identity in the field, such as name, manufacturer, and serial number. There are no input or output parameters in the RB. T710 supports one RB.

The TB contains the setup parameters required to establish the Modbus communication for each channel. T710 supports one TB.

The Modbus communication is configured independently for each channel. The setup is performed using read and write services, by reading and writing to indexes in the TBs. Fint is providing a DD package that allows the configuration to be done from a DD based Host, like an NI Configurator.



## **3.1. Setting up the Modbus**

The Modbus setup is generic for the four channels. The parameters for set-up is located in the RB.

Modbus baud rate	9 600, 19 200, 38 400, 57 600, 115 200
	kbit/s
# stop bits	1 or 2 (1 is default)
Modbus Parity	0 = Odd parity
	1= Even parity
	2= No parity (default)
CRC byte order	0 = Normal byte order (default)
	1 = Reverse byte order
Modbus Timeout	In ms (100ms default)

## Table 2 The Modbus setup parameters



.

## **3.2.** Channel communication services

For each of the four channels there is a set-up record.

The Modbus address is configured per channel. This implies that the PVs may reside in four different instruments (four different Modbus addresses). They may also be located in the same instrument.

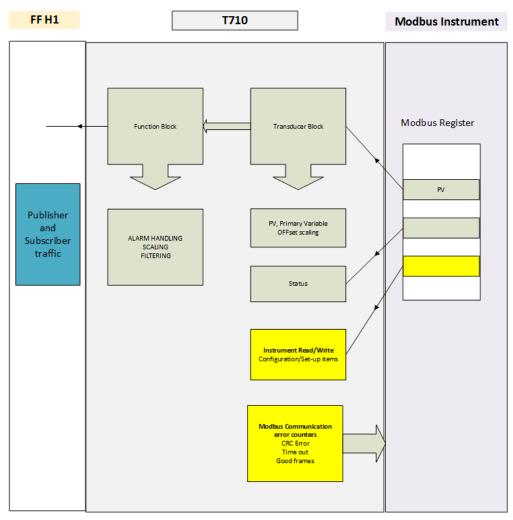
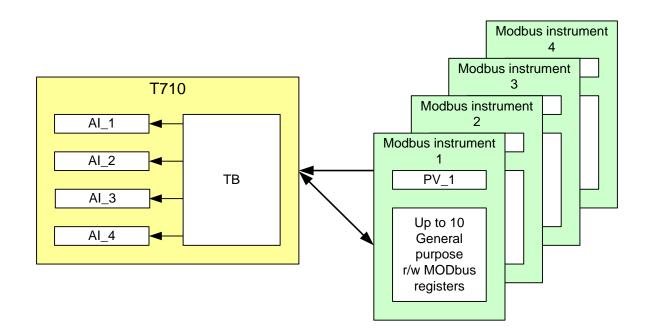


Figure 8 Channel communication services



## **3.2.1.** Set-up of PV

The T710 can support up to 4 channels.



#### Figure 9 Four channels

Each channel supports one PV (Primary Variable). The PV is processed through an Analog Input Function Block (AI FB).

The PV is read from a Holding or Read register in the Modbus instrument. The register address and the Function code to be used shall be set-up by the user. It is possible to enter the Register address or the address that is sent on the bus. Hence if it is entered 30001, the address sent on the bus is 0 or if the entered value is 40001, the value in the data frame sent on the bus is 0. However, it will also be possible to enter 0 and the value sent on the bus will be 0.

The T710 supports a variety of data types and related byte ordering. The variable needs to be converted into the IEEE 785 float format in order to be processed through an AI FB. The data type parameter allows the user to select the right data type and byte ordering.

The PV type defines the data type and the byte ordering of the dynamic variable stored in the Modbus device. T710 needs this information in order to convert the variable to an IEEE format float used by Foundation Fieldbus. The PV may be defined as float, integer or unsigned integer in the Modbus instrument. T710 assumes that there are two bytes per register, so a float will be located in two adjacent registers. An integer will be located in one register.

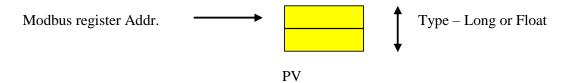
The byte ordering is defined in the type. The byte is numbered so the Most Significant byte has the higher number.



Data Type Modbus	Byte order	PV Type code
Float	4321	0 (normal)
Float	2143	1
Float	3412	2
Float	1234	3
Short Integer	21	4 (normal)
Short Integer	12	5
Unsigned short	21	6 (normal)
Unsigned short	12	7
Long Integer	4321	8 (normal)
Long Integer	2143	9
Long Integer	3412	10
Long Integer	1234	11
Long unsigned	4321	12 (normal)
Long unsigned	2143	13
Long unsigned	3412	14
Long unsigned	1234	15

### Table 3. Byte order for PV

If the PV is stored as a float or long in the Modbus device, T710 assumes that two consecutive registers are used. The Register address pointer in T710 will point to the lower address.



#### Figure 10 Storage when the PV is a float or Long

The scaling factors allow offset and gain to be adjusted before the variables are processed further.

If an Integer value is stored in a fixed format with one decimal, the scaling factor (gain) must be specified to "0.1" to allow T710 to interpret the value correctly.

The PV unit shall be specified by the user. There is no unit conversion in the T710 module. The PV unit is just for information purposes, but it is important that they are the same as the units in the AI\_i, i=1,2,3,4, blocks XD\_SCALE parameter, else it will be a block configuration error in the AI-i, i=1,2,3,4, block.

T710 adds a status byte to the PV. The status provides quality information about the measurement.



Page 15

## 3.2.2. Diagnosis

For each channel the user can fetch four flags from the Modbus device. The flag must be located in one Modbus register which is denoted the Status register.

The operation on the Status register is defined by its Modbus register address and Function Code. Status register can either be Read or Holding registers. The four flags to be used in the register are selected using a Status Mask. The status mask is configured by the user.

Set-up is only allowed when the channel is in Out of Service mode.

The four selected flags are transferred to the NAMUR NE107 structure in the same order as stored in the status register. Do as follows,

- 1) Set-up the communication for reading a Status register from the Modbus instrument. It is possible to read one register from each instrument connected. The set-up is by Modbus Register address, Byte order and Function Code.
- 2) Select up to four bit-flags from the Status. This is done by using the Mask. The selected four bits will then be available for the Field Diagnostic structure. Regardless of their placement in the Status register, the bits will be renumbered 1-4 but with the same priority as in the Status register.
- 3) These bits can now be mapped into the Field Diagnostic structure. There is one structure for each of the four NAMUR flags, The NAMUR flag MAP parameter determines which bit-flag shall be mapped to each NAMUR flag. The NAMUR flag MASK determines if some of the bits shall not contribute anyway.
- 4) The Priority parameter must be set in order for the setting to be taken into consideration.

The Modbus communication is supervised. If the communication on one channel is unstable, a warning flag is set, if it stops working, an error flag is set. This is mapped to the Field Diagnostics in the same manner as described above.

If the Modbus registers are erroneously set, Modbus device is returning Error Codes and the Configuration Error Flag is set.

The NAMUR NE107 Diagnosis structure contains:

- Modbus Device Status Flags
- Modbus Device Communication Errors
- Modbus Device Communication Warning
- Modbus Device Configuration Error.

Map and mask parameters determine how these flags shall be NAMUR flags, Fault, Function Check Maintenance required and Out of spec.



### **3.2.3.** Transparent Read/Write services.

For each channel there is a block of up to ten consecutive Modbus Read/Write Holding registers, MODBUS\_RW\_REGS\_x. They can be reached from the FF control system. This block of up to ten registers is characterized with a start address (The lower address of the block) and number of registers. They start at Modbus register MODBUS\_RW\_REGS\_START\_ADDRESS. MODBUS\_RW\_REGS\_NUM\_OF defines how many of the ten registers that is used. It is possible to swap the byte ordering of the registers if required by writing 0 (byte order 1-0, default) or 1 (byte order 0-1) to the parameter MODBUS\_RW\_REGS\_BYTE\_ORDER.

The content of these registers will be written to the Modbus device when the user is writing to the corresponding indexes of the T710.

Read back of Modbus rw registers:

The Modbus rw registers are read back at request the from the Host:

In each MODBUS\_RW\_REGS\_x record, x=1,2,3 or 4, there is one subindex (1) UP\_DATE\_RW\_REGS which function as follows:

i.) To trigger a read back of a rw-register a value of 1 (enumerated as Update\_RW\_regs) is written into the MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS.

ii.) As long as a new register value is NOT ready, T710 sets the value of 2 (enumerated as Update in progress) MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS.

iii). When the value of the MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS is set to 3 (Enumerated as Updated RW regs ready) the updated values of MODBUS\_RW\_REGS\_x can be read by the Host.

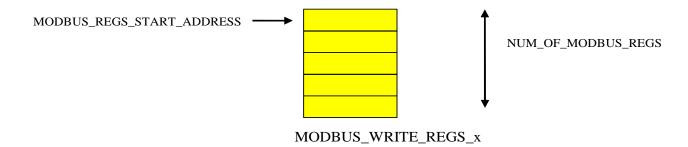
iv). At start-up all configured rw-registers are read out from each Modbus slave.

v) A Host is only allowed to write the values 0 and 1 to the MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS. In fact it must terminate the read sequense of rw-registers by writing a 0 (No update) to MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS after the updated rw-registers has been read out. Or in the unlikely event that the MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS is stuck at the value 2.

vi). Writing to a Modbus rw-register or to MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS is only allowed when the transducer block is in OoS mode.

vii). When the transducer block mode is changed from Auto to OoS all the configured rw-registers are re-read. This will be indicated by the value 3(Updated RW regs ready) in the MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS parameter. This parameter can be left in this state after the transducer block is changed to Auto, but it is not recommended. After a mode change to OoS the MODBUS\_RW\_REGS\_x.UPDATE\_RW\_REGS\_x.UPDATE\_RW\_REGS always goes through the sequence 0 (3) -> 1 -> 2 -> 3 (data ready)





### Figure 11 Read/Write registers

## 3.2.4. Configuration windows in the NI configurator

How they appear under configuration is shown below.



FINT-T710 : FFM_TB (TB)			
Apply Values	66 53   54 55 46   55 55	0	
		V	
	<u>.</u>		
OOS Auto			
Process   I/O Config   Alarms   D	iagnostics Trends Others		
Parameter	Value	Type & Exte	Help
PV_1     Fvalue     BSTATUS	<b>p</b> 0	•	Primary value 1 A numerical quantity entered by a user or calculated
- QUALITY - SUBSTATUS - LIMITS	Bad OutOfService NotLimited	enu enu enu	QUALITY SUBSTATUS LIMITS
• PV_UNIT_1		enu	Primary_value_unit_1
⊞ ● PV_2			Primary value 2
• PV_UNIT_2		enu	Primary_value_unit_2
			Primary value 3
• PV_UNIT_3		enu	Primary_value_unit_3
⊞● PV_4			Primary value 4
PV_UNIT_4		enu	Primary_value_unit_4
MODBUS_STATUS_REG_1	麺 0×0000	enu	Modbus status register device 1
MODBUS_STATUS_REG_2	த 0x0000	enu	Modbus status register device 2
MODBUS_STATUS_REG_3	麵 0x0000	enu	Modbus status register device 3
MODBUS_STATUS_REG_4	麵 0x0000	enu	Modbus status register device 4
MODBUS_RW_REGS_1     UPDATE_RW_REGS	No update 🗸	enu	Modbus setup registers for Modbus device 1 Modbus writable register 1
-REGISTER_1	No update	u16	Modbus writable register 1
-REGISTER_2 -REGISTER_3	Update RW regs	u16 u16	Modbus writable register 2 Modbus writable register 3
	Update in progress Updated RW regs ready	016	Modbus writable register 4
-REGISTER_5	U	016	Modbus writable register 5
-REGISTER_6	0	016	Modbus writable register 6
-REGISTER_7	0	016	Modbus writable register 7
-REGISTER_8	0	016	Modbus writable register 8
-REGISTER_9	0	016	Modbus writable register 9
REGISTER_10	0	<b>016</b>	Modbus writable register 10
■ MODBUS_RW_REGS_2		_	Modbus setup registers for Modbus device 2
-UPDATE_RW_REGS	No update	enu	Modbus writable register 2
-REGISTER_1	0	e16	Modbus writable register 1
-REGISTER_2	0	e16	Modbus writable register 2
-REGISTER_3	0	<b>016</b>	Modbus writable register 3
-REGISTER_4	0	e16	Modbus writable register 4
-REGISTER_5	0	u16	Modbus writable register 5
-REGISTER_6	0	u16	Modbus writable register 6
-REGISTER_7	0	u16	Modbus writable register 7
-REGISTER_8	0	u16	Modbus writable register 8
-REGISTER_9	0	u16	Modbus writable register 9
-REGISTER_10	0	<b>a16</b>	Modbus writable register 10
<			······································
Write Cł	nanges		Read All

Figure 12 Transducer Block with R/W registers – ten per channel

The picture is a NI configurator picture of the Transducer Block parameters. There is one dynamic variable (PRIMARY\_VALUE) per channel. The MODBUS\_SETUP contains the communication settings for the Modbus. Each channel is set-up individually and the related configuration parameters are in MODBUS\_REG\_SETUP\_x. The communication statistics per channel is shown in MODBUS\_STATISTICS\_x.



The picture below shows the MODBUS\_COM\_SETUP parameters and the set-up parameters for each channel, MODBUS\_REG\_SETUP\_x. The variables can be located in four different Modbus devices; hence the Modbus device address is part of the set-up for each channel.

- STATUS_REG_FUNCTION_CODE       Function code 3       Image: Control of the status register         - MODBUS_RW_REGS_START_ADDRESS 1       Image: Control of the status register       Numbers of consecutive Modbus setup registers         - MODBUS_RW_REGS_NUM_OF       1       Image: Control of the status register         - MODBUS_RW_REGS_START_ADDRESS       Image: Control of the status register       Numbers of consecutive Modbus setup registers         - MODBUS_ADDRESS       0       Image: Control of the status register       Modbus register setup for Modbus device 2         - MODBUS_ADDRESS       0       Image: Control of the status register       Modbus register setup for Modbus device 2         - MODBUS_ADDRESS       0       Image: Control of the status register       Modbus register address         - PV_REG_FUNCTION_CODE       PV Read Function code 4       Image: Control of the dynamic variable registers         - PV_SCALING_FACTOR       0       Image: Control of the status register       PV Of set         - STATUS_REG_ADDRESS       65535       Image: Control of the status register       Image: Control of the status register         - MODBUS_RW_REGS_START_ADDRESS       0       Image: Control of the status register       PV Of set         - STATUS_REG_ADDRESS       65535       Image: Control of the status register       Image: Control of the status register         - MODBUS_RW_REGS_START_ADDRESS	FINT-T710 : FFM_TB (TB)			
Private Update         2 (sec)         3           Process         Volta         Type & Extension         Help           Process         Volta         Type & Extension         H				
Dot       Add         Process   V/O Config   Alarms   Dispositics   Trends   Offers           Process   V/O Config   Alarms   Disposition   Process   Offers           Process   V/O Config   Process   Offers   Offers           Process   V/O Config   Process   Offers   Offers           Process   V/O Config   Process   Offers   Offers	- ( )			
Process (U Cooling) Alarma (Diagnostic) Tradis Others         Type & Extensions         Help           Process (U Cooling) Alarma (Diagnostic) Tradis Others         Type & Extensions         Help           PhoDBUS, WHTE, PROTECTION HUMAN (Diagnostic) Tradis Status (Diagnostic) Procession Procession Status (Diagnostic) Procession Procession Status (Diagnostic) Procession Processint Procession Procesing Processint Procession Procesion Pr	Periodic Updates 2 (sec)			
Parsmeter Parsmeter Value Value Type & Extensions Help Modbus Varte: PAPTECTION Modbus Contractions etcu Modbus Varte: PAPTECTION Modbus Contractions etcu Parsword code to protect the Modbus Engineers Modbus Varte: PAPTECTION Modbus Contractions etcu Parsword code to protect the Modbus Engineers Modbus Varte: PAPTECTION Modbus Contractions etcu Password code to protect the Modbus Engineers Modbus Varte: PAPTECTION Modbus Contractions etcu Password code to protect the Modbus Engineers Modbus Varte: PAPTECTION Modbus Contractions etcu Password code to protect the Modbus Engineers Modbus Varte: PAPTECTION Modbus Contractions etcu Password code to protect the Modbus Engineers Modbus Contractions etcu Password code to protect the Modbus Engineers Modbus Contractions etcu Password code to protect the Modbus Engineers Modbus Engineers Modbus Contractions etcu Password code to protect the Modbus Engineers Modbus Engineers Modbus Contractions etcu Password code to protect the Modbus Engineers Modbus Engineers Modbus Engineers Modbus Contractions Password code to protect the Modbus Engineers Modbus Engineers Password code to protect the Modbus Engineers Modbus Engineers Modbus Engineers Password code to protect the Modbus Engineers Modbus Engineers Modbus Engineers Modbus Engineers Password code to protect the Modbus Engineers Modbus Eng	DOS Auto			
MODBUS_WHITE_PROTECTION     MODBUS_WHITE_PROTECT_STATUS     MODBUS_VENTE_PROTECT_STATUS     MODBUS_VENTE_PROTECT_STATUS     MODBUS_VENTE_PROTECT_STATUS     MODBUS_DECS_VENTE_PROTECT_STATUS	Process   I/O Config   Alarms   Diagnostics   Tre	nds Others		
HobBULS, WATE_FORDET_STATUS         0x0000         ■         Check Multiprotection level which is enabled to Modulus communication           HobBULS, CRU, PASSWORD         0         ■         Personal code to protect the Modulus Communication Serup           HobBULS, CRU, SETUP         ■         ■         Personal code to protect the Modulus Registers setup           HAUDBARAE         1000 ms         ■         Modulus Section         Personal code to protect the Registers           HAUDBARAE         1000 ms         ■         Modulus Section         Modulus Section           HAUDBARAE         1000 ms         ■         Modulus Section         Modulus Section           - VTMEOUT         100 ms         ■         Modulus Section         Modulus Section           - SETUP_TIMEOUT         100 ms         ■         Modulus Section         Modulus Section           - PARTY         None         ■         Person         Modulus CRC Dysee         Modulus CRC Dysee           MODBUS_ADDRESS         0         ■         Person         Modulus CRC Dysee         Modulus CRC Dysee           MODBUS_ADDRESS         0         ■         Person Caster Dysee         Modulus CRC Dysee         Primacy variable Modulus creaters           MODBUS_ADDRESS         0         ■         Primacy Variable Modulus CRC Dysee	Parameter	Value	Type & Extensions	Help
- BAUDRATE       19200 Bend       Immitted in Module Bendrele         - POLLING, TIME       0 ms       Immitted in microsolution         - STOP_BTS       1       Immitted in microsolution         - BAUDRATE       0 ms       Immitted in microsolution         - STOP_BTS       1       Immitted in microsolution         - DV_TIMEOUT       100 ms       Immitted in microsolution         - BAUDRATE       0 ms       Immitted in microsolution         - PAUDRATE       100 ms       Immitted in microsolution         - PAUDRATE       Normal       Immitted in microsolution         - PAUDRATE       Normal       Immitted in microsolution         - MOBBUS_ADDRESS       6535       Immitted in microsolution         - PV_TRE_ADDRESS       6555       Immitted in microsolution         - PV_TRE_ADDRESS       6553       Immitted in microsolution         - STATUS_REG_ADDRESS       6553 </td <td>-MODBUS_WRITE_PROTECT_STATUS -MODBUS_COM_PASSWORD -MODBUS_REG_SETUP_PASSWORD</td> <td>0 0</td> <td>035</td> <td>Shows which protection level which is enabled for Modbus communication Password code to protect the Modbus Communication setup Password code to protect the Modbus Register setup</td>	-MODBUS_WRITE_PROTECT_STATUS -MODBUS_COM_PASSWORD -MODBUS_REG_SETUP_PASSWORD	0 0	035	Shows which protection level which is enabled for Modbus communication Password code to protect the Modbus Communication setup Password code to protect the Modbus Register setup
<ul> <li>MODBUS_REG_SETUP_1</li> <li>MODBUS_ADDRESS</li> <li>D</li> <li>MODBUS_ADDRESS</li> <li>PV_REG_ADDRESS</li> <li>PV_REG_FUNCTION_CODE</li> <li>PV Read Function code 4</li> <li>Modbus register setup for Modbus device 1</li> <li>Modbus function code for the dynamic variable registers</li> <li>PV_PC_RED_FUNCTION_CODE</li> <li>PV Read FUNCTION_CODE</li> <li>PV Read FUNCTION_CODE</li> <li>PV READERS</li> <li>S5535</li> <li>S10</li> <li>Status register address</li> <li>MODBUS_RW_REGS_NUM_OF</li> <li>MODBUS_RW_REGS_NUM_OF</li> <li>MODBUS_RW_REGS_STAT_ADDRESS</li> <li>Byle order1-0</li> <li>Gives the choice of the Modbus device 2</li> <li>Modbus register setup for Modbus device 2</li> <li>Modbus ADDRESS</li> <li>MODBUS_RW_REGS_STAT_ADDRESS</li> <li>Status register address</li> <li>PV_REG_ADDRESS</li> <li>Gives the choice of the Modbus registers byte ordering</li> <li>Modbus register setup for Modbus device 2</li> <li>Modbus Instrument address</li> <li>PV_REG_ADDRESS</li> <li>Gives the choice of the Modbus Revice 2</li> <li>Modbus function code 4</li> <li>Modbus function code 4 Modbus Modbus registers address</li> <li>PV_REG_ADDRESS</li> <li>Gives the choice of the Modbus Revice 2</li> <li>Modbus function code 4</li> <li>Modbus function code 4</li> <li>PV_REG_ADDRESS</li> <li>Gis</li></ul>	-BAUDRATE -POLLING_TIME -MEASURED_POLLING_TIME -STOP_BITS -DV_TIMEOUT -SETUP_TIMEOUT -PARITY -CRC_ORDER	1000 ms 0 ms 1 100 ms 100 ms None Normal	076 078 070 070 070 070 070	Modbus Baudrate 1ms resolution Modbus Number of stop bits Modbus imeout for Dynamic variables (1ms resolution) Modbus timeout for setup data (1ms resolution) Parity Swaps the Modbus CRC bytes
MODBUS_ADDRESS       0       Image: Control of the status register address         -PV_REG_ADDRESS       65535       Image: Control of the status register address         -PV_REG_FUNCTION_CODE       PV Read Function code 4       Image: Control of the status register address         -PV_TYPE_BYTEORDER       Float(2 two bytes registers). Byte order 3-2-1-0       Image: Control of the status register address         -PV_SCALING_FACTOR       0       Image: Control of the status register address         -STATUS_REG_ADDRESS       65535       Image: Control of the status register to include in the NE-107 diagnos         -STATUS_REG_ADDRESS       65535       Image: Control of the status register to include in the NE-107 diagnos         -STATUS_REG_FUNCTION_CODE       Function code 3       Image: Control of the status register to include in the NE-107 diagnos         -STATUS_REG_FUNCTION_CODE       Function code 3       Image: Control of the status register to include in the NE-107 diagnos         -MODBUS_RW_REGS_NUM_OF       2       Image: Control of the status register status registers         -MODBUS_RW_REGS_SETUP_3       -       Modbus informent address         -MODBUS_REG_SETUP_3       -       Modbus informent address         -PV_REG_FUNCTION_CODE       PV Read Function code 4       Image: Control of the dynamic variable registers         -PV_REG_FUNCTION_CODE       PV Read Function code 4       Modbus ins	HODBUS_ADDRESS -PV_REG_FUNCTION_CODE -PV_TYPE_BYTEORDER -PV_SCALING_FACTOR -PV_OFFSET -STATUS_REG_ADDRESS -STATUS_REG_MASK -STATUS_REG_FUNCTION_CODE -MODBUS_RW_REGS_START_ADDRESS -MODBUS_RW_REGS_NUM_OF	65535 PV Read Function code 4 Float(2 two bytes registers). Byte order 3-2-1-0 0 65535 0x0000 Function code 3 1		Modbus instrument address Primary variable Modbus register address Modbus function code for the dynamic variable registers Gives the choice of data type and byte ordering Scaling factor PV Offset Status register address Select xx number of bits in the status register to include in the NE-107 diagnostic Modbus function code for the status registers The statt address for the Modbus RVV registers Numbers of consecutive Modbus setup registers
HODBUS_ADDRESS         0         Image: Modbus instrument address           -PV_REG_FUNCTION_CODE         65535         Image: Modbus function code for the dynamic variable register address           -PV_REG_FUNCTION_CODE         PV Read Function code 4         Image: Modbus function code for the dynamic variable registers           -PV_TYPE_BYTEORDER         Float(2 two bytes registers). Byte order 3-2-1-0         Image: Gives the choice of data type and byte ordering           -PV_SELING_FACTOR         0         Scaling factor           -PV_OFFSET         0         PV Offset           -STATUS_REG_ADDRESS         65535         Image: Status register address           -STATUS_REG_MASK         0000         Selet xn number of bits in the status register to include in the NE-107 diagnost	HODBUS_ADDRESS PV_REG_FUNCTION_CODE PV_TYPE_BEG_FUNCTION_CODE PV_TYPE_BYTEORDER PV_SCALING_FACTOR PV_OFFSET STATUS_REG_ADDRESS STATUS_REG_ADDRESS STATUS_REG_FUNCTION_CODE -MODBUS_RW_REGS_NUM_OF	65535 PV Read Function code 4 Float(2 two bytes registers), Byte order 3-2-1-0 0 65535 0x0000 Function code 3 2 2		Modbus instrument address Primary variable Modbus register address Modbus function code for the dynamic variable registers Gives the choice of data type and byte ordering Scaling factor PV Offset Status register address Select xx number of bits in the status register to include in the NE-107 diagnostic Modbus function code for the status registers The start address for the Modbus RW registers Numbers of consecutive Modbus setup registers
· · · · · · · · · · · · · · · · · · ·	- MODBUS_ADDRESS - PV_REG_FUNCTION_CODE - PV_REG_FUNCTION_CODE - PV_TYPE_BUTEORDER - PV_SCALING_FACTOR - PV_OFFSET - STATUS_REG_ADDRESS - STATUS_REG_MASK	65535 PV Read Function code 4 Float(2 two bytes registers), Byte order 3-2-1-0 0 0 65535 0x0000	016 600 67 67 67 676 800	Modbus instrument address Primary variable Modbus register address Modbus function code for the dynamic variable registers Gives the choice of data type and byte ordering Scaling factor PV Offset Status register address Select xx number of bits in the status register to include in the NE-107 diagnosti
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#### Figure 13 Modbus set-up and configuration of the four channels



## 3.2.5. Write protection of Modbus set-up

T710 has three levels of write protection of the Modbus registers. Each level has its individual passcode according to the table below:

Parameter(s)	Passcode	Description
MODBUS_COM_SETUP	1014	Protection of the Modbus Communication
		setup
MODBUS_REG_SETUP_i,i=1,2,3,4	2037	Protection of the Modbus register setup
MODBUS_RW_REGS_i, i=1,2,3,4	4084	Protection of the Modbus read/write
		registers

#### Table 4 Write protect Pass codes

Each protection level is implemented as a toggle function: Entering the correct passcode turns the protection ON if OFF, and vice versa.

The enabled protection level is stored in EEProm and thus remembered through power cycling. When a correct passcode is entered the Protection status is shown in the Modbus write protection status parameter. (See below).

The passcode is set to zero by the device immediately after it is entered so that it not viewable if you re-open the Transducer Block

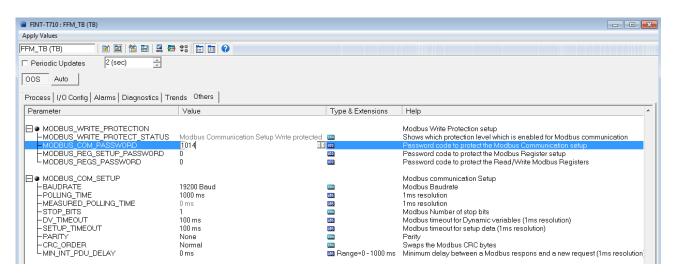


Figure 14 Pass codes



## 4. TECHNICAL SPECIFICATIONS

Mechanical:	
Size	114,5 * 99 mm
Mounting	DIN rail
Module width	23,2 mm
Weight	126 gram
Housing	Plastic Polyamid, IP-20 protection
DIP Switch	Simulation on/off
Slide Switch	FF Terminator
Slide Switch	Modbus Terminator

#### **Electrical:**

Supply voltage	1830 VDC
Supply current	34 mA MAX
FF input voltage	932 VDC
Current draw	13,8 mA

#### **Environmental:**

Operating temperature range	-40 °C to + 85 °C
Shock	IEC 600068-2-27
Vibration resistance	IEC 600068-2-6

#### **Protocols and Ports:**

Number of FF ports	1
Number of Modbus ports	4
FF protocol	H1, Slave
Modbus protocol	Modbus RTU, Master
Modbus serial standard	RS-485



## 5. **OPERATIONAL BEHAVIOR**

## 5.1. RUN-TIME

The T710 controls the reading of variables from the Modbus instruments. The PV and the Modbus data string will be read periodically if their register address is different from 0xFFFF.

If the instrument module has failed to respond to ten requests for data, it is defined as failing. This is flagged in the status for PV and will show "Status bad. Device failure"

When a variable (PV) is read on Modbus, it will be stored in the related Transducer Block and calculated through the Analog Function Block connected to this Transducer Block

## 5.2. Modbus

The Modbus RTU protocol is used. There is no length field in the frame. The frame is supposed to be transmitted without gaps between bytes. The frame is by definition completed when there has been silence for 3.5 characters.

If an instrument does not respond within the specified time-out time, the T710 Modbus protocol will time out and continue with other requests.

Function Code 3 (Read Holding registers) or Function Code 4 (Read Input registers) is used to read the dynamic variables.

The Function code is selected in the set-up and is selected individually per variable.

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