Operating the

IO113

via
Modbus

Edition 1.7, January 2015

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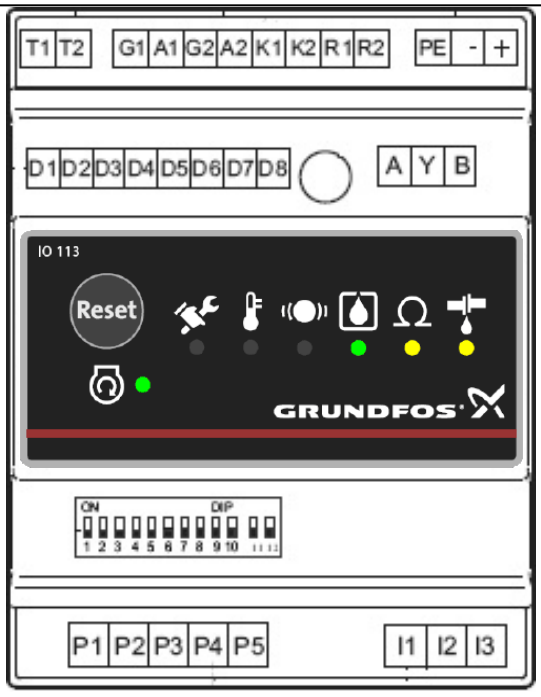


This document is mainly intended for development engineers integrating Modbus based Grundfos motors/pumps in automation systems using a direct access to Modbus.

It specifies all data items from the Functional Profile of the device with a description of how to use and interpret them. This makes the application programmer able to operate and configure the IO113 for different applications and to utilize its functionality to its full extend.

Using the information in this document for implementation of direct Modbus access presuppose a knowledge of the Modbus communications protocol.

This document can be freely distributed.

Date	Initials	Changes	Version
OCT/2012	BAL	Released document	1.6
JAN/2015	CHU/UFG	Updated document for 1. Naming of Modbus and GENIbus 2. Correction of content of DIP switches setting 3. Remove the content of mixer 4. Add version history	1.7

Version History

1. Introduction

This document describes the functional profile on Modbus for the Grundfos IO113 Module. The IO113 Module is working as a slave unit on Modbus. In order to communicate with the IO113 Module, it must be configured via DIP switch setting (DIP switch 9 = on) to enable the Modbus protocol (see also page 11).

	Modbus
Protocol	Modbus RTU
Addressing the unit	Address range: 32 – 231 Factory default address: 231 Unit Address by Geni or Modbus **Note: There is 31 offset if address the unit by PC tool WU if the version is older than TC06.00.06.** **For example: the real address is 40 if you choose unit number 9 in PC tool WU.**
Adressing a data item	As Modbus protocol describes – start address and number of data items to be read.
Data Format	Baudrate: 19200 Databit: 8 Parity: Even Stopbit: 1
Scaling	No scaling information. Please refer to data item overview, section 11

Table 1:When a data item is referred to in the text or in a table, it will often be done like this:

`r_insulate` (reg 1996)

`r_insulate` is the identifier for the data item. *(1996)* means register 1996 in decimal number for Modbus access.

SUPPORTED MODBUS FUNCTIONS

- (0x03) Read holding register
- (0x06) Write single registers
- (0x10) Write multiple registers
- (0x08) Diagnostics (only sub-function code 0x00)

DATA NOT AVAILABLE

16 bit data item values of '0x00FF' must be interpreted as "NA" (data not available) for Modbus, if not other is defined.

CHANGING OF SETTINGS

Whenever a setting in the IO113 module is changed via a command or a configuration parameter, the setting will take effect instantaneously, meaning that there is no need to power the IO113 module off and on again.

Notice! The only exception to this general rule are the boot commands **USER_BOOT** and **FACT_BOOT**, which both requires a subsequent RESET command or that the device is powered off and on for the boot action to take place.

Notice! Because almost all the configuration parameters reside in the SM113 power line sensor module (fig. 1) writing to configurable parameters is forwarded by IO113 over power line. This limits the maximum number of configuration parameters, which can be written from Modbus in the same telegram to only two.

MODBUS MAXIMUM TELEGRAM LENGTH

The IO113 Module cannot buffer telegrams longer than **80** bytes. So, for Modbus access, telegrams are not allowed to exceed a complete length of 80 bytes neither for Data Requests nor for Data Replies. Only **4** registers can be written per telegram.

2. Addressing

The unit address can be configured via dip switches as below.

Address	ON DIP 1 2 3 4 5 6 7 8 9 10 11 12	Description
40		IO 113 address1
41		IO 113 address 2
42		IO 113 address 3
43		IO 113 address 4
44		IO 113 address 5
45		IO 113 address 6
Address set by bus		Unique address for IO 113 set in the control system via bus. Default address: 231.

And it can be configured by bus also. An address between 32 and 231 can be selected by addressing **`unit_addr (reg 2050)`**. The factory default unit address is **231**.

3. Device Identification

The data items **`unit_family` (reg 2019)**, **`unit_type` (reg 2020)** and **`unit_version` (reg 2021)** can be used to identify different *GENIbus* units [reference to GENI description]. The IO113 module will reply with the values below:

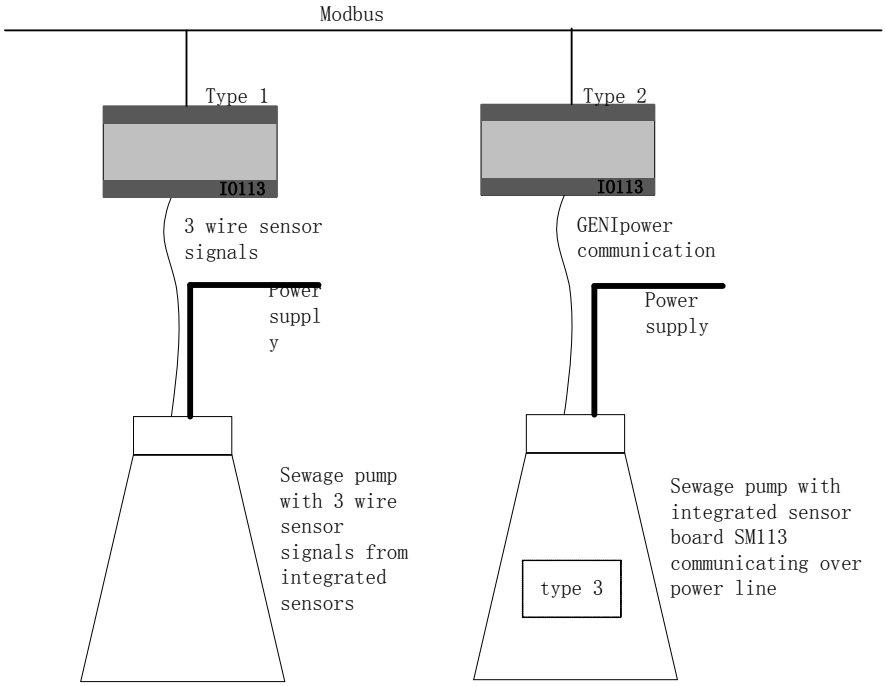
`unit_family` = 22
`unit_type` See table below
`unit_version = 0`

Device selection		Device name	SM 113	`unit_type` (reg 2020)	Description
DIP1	DIP2				
OFF	OFF	Pump, PC	X	4	SM 113 sensor board integrated (reserved)
ON	OFF	Pump, PA		5	Sensors connected directly to IO 113
OFF	ON	Pump, PB	X	6	SM 113 sensor board integrated
ON	ON	Pump, PD		7	Sensors connected directly to IO 113

Table 2: *IO113 identification.*

4. IO113 in a System

Figure 1: *Illustration of IO113 together with pumps.*



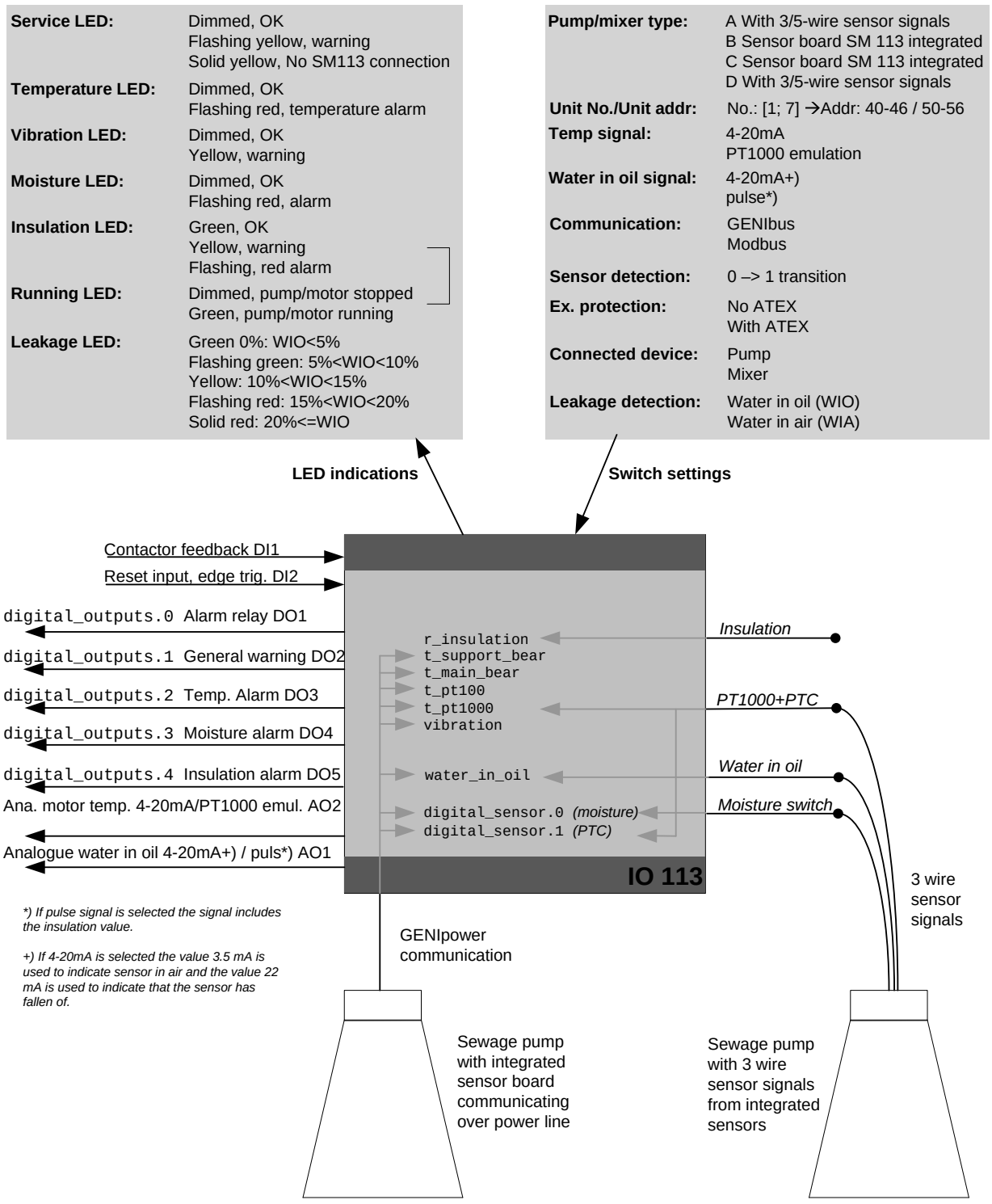


Figure 2: *Illustration of IO113 input/output signals.*

5. Terminal description

External connections (I/O)	
Name	**Description**
T1, T2	Terminal for alarm relay (DO1)
G1, A1	Analogue output 1 (AO1) of Water in oil SW7 Off: Pulse output SW7 On: 4-20mA
G2, A2	Analogue output 2 (AO2) of Stator winding temperature SW6 Off: PT1000 emulated output SW6 On: 4-20mA
K1, K2	Contactor feedback (DI1), short circuited when pump is running
R1, R2	Reset input (DI2), short-circuited to reset alarms
PE, +, -	Supply voltage: 24V +/- 10%, AC or DC
A, Y, B	RS485
I1, I2, I3	Terminals for measurement of stator insulation when motor is off. Measurement voltage is 10 Vdc
P1	Terminal for sensors in the pump
P2	Terminal for 15V supply voltage for sensors in the pump
P3	Terminal for sensors in the pump
P4	Terminal for 15V supply voltage for sensors in the pump or for power line communication with SM 113
P5	Terminal for sensors in the pump or for power line communication with SM 113
D1, D2	Digital alarm output (DO3) in case of high stator temperature
D3, D4	Digital alarm output (DO4) in case of moisture in motor
D5, D6	Digital alarm output (DO5) in case of insulation fault in motor
D7, D8	Digital warning output (DO2) in case of: Connection to SM113 (Code 10) Setup conflict (Code 25) Stator insulation warning (Code 20)

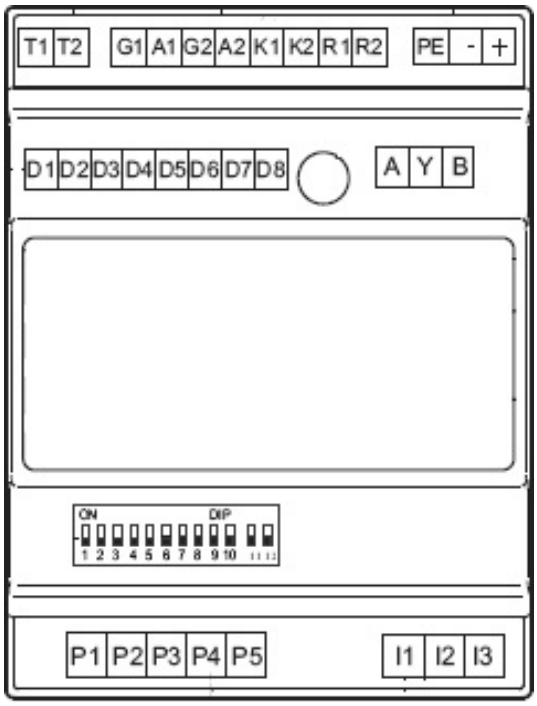


Table 5.1: *External connections*

DIP switch settings	
Name	**Description**
SW1 **SW2**	Pump variant selection: 00: Type A 01: Type B 10: Type C 11: Type D
SW3 **SW4** **SW5**	Select the SM113 address. The maximum address is 6, the default no is 1.
SW6	The slave SM113 detects sensor status and communicates with IO113 to be set address
SW7	Selects signal type of AO2 for stator winding temperature: 0: 4-20mA 1: PT1000 emulated output
SW8	Selects signal type of AO1 for Water in oil: 0: 4-20mA 1: Pulse output
SW9	Selects fieldbus protocol for RS485 (A, Y, B) terminals: 0: GENIbus 1: Modbus
SW10	Explosion protection (ATEX area): 0: No ATEX 1: ATEX
SW11 / **SW12**	Product type: 00: Pump with WIO sensor 01: Reserved for further configuration (No WIO or WIA sensor) 10: Pump with WIA sensor 11: Reserved for further configuration (No WIO or WIA sensor)

Table 5.2: *DIP switch settings.*

6. Supervised values and related limits and signals

Measurement	Identifier	A/D	Alarm/Warning limit	Measurement source			Event code	Signal fault code	Related digital output	Related front plate LEDs
				3 wire signals	PL signals	IO113 meas.				
Temperature in support bearing (PT100)	t_support_bear	A	t_support_bear_alarm t_support_bear_warn		X		A/W: 145	W: 179	dig_outputs.0: Alarm relay**) dig_outputs.2: Temp. alarm**) dig_outputs.1: General warning	**Temp. LED:** front_leds1.2: Dimmed, temp. OK Flash service led, pump temp, warn Red flashing, Pump temp. alarm**)
Temperature in main bearing (PT100)	t_main_bear	A	t_main_bear_alarm t_main_bear_warn		X		A/W: 146	W: 180		
PT100 motor stator temperature	t_pt100	A	t_pt100_alarm t_pt100_warn		X		A/W: 64		dig_outputs.1: General warning	- **Service LED:** front_leds1.0-1: Flash service led, pump temp, warning Red flashing, Pump temp. alarm
PT1000 motor stator temperature	t_pt1000	A	t_pt1000_alarm t_pt1000_warn	X	X					
Insulation resistance	r_insulate	A	r_insulate_alarm r_insulate_warn			X	A/W: 20	-	dig_outputs.0: Alarm relay dig_outputs.1: General warning dig_outputs.4: Insulation alarm	**Insulation. LED:** front_leds1.5-6: Green, insulation OK Yellow, insulation warning Red flashing, insulation alarm
Water in oil	water_in_oil	A	water_in_oil_alarm water_in_oil_warn	X	X		A/W: 11	W: 170	dig_outputs.0: Alarm relay*) dig_outputs.1: General warning	**Leakage LED:** front_leds2.0-2: Green, leakage<0% Flashing green, 5%<leakage<10% Yellow, 10%<leakage<15% Flashing red, 15%<leakage<20% Red, leakage>20% Flashing yellow: Signal fault*) **)
Power Line Communication		A	pl_com_limit			X	A/W: 10	-	dig_outputs.0: Alarm relay*) dig_outputs.1: General warning dig_outputs.2: Temp. alarm*)	**Service LED:** front_leds1.0-1: Yellow, comm.. alarm +)
Vibration	vibration	A	vibration_alarm vibration_warn		X		A/W: 24	-	-	**Vibration LED:** front_leds1.3: Dimmed, vibration OK Yellow, vibration warning
Time for service	t_run_trip_cnt	A	t_run_trip_cnt_warn			X	W: 12	-	dig_outputs.1: General warning	**Service LED:** front_leds1.0-1: Flashing yellow, service warning
Moisture switch bottom	digital_sensor.0	D	-	X	X		A: 22	-	dig_outputs.0: Alarm relay dig_outputs.3: Moisture alarm	**Moisture LED:** front_leds1.4: Dimmed, moisture OK Flashing red, moisture alarm
Thermal switch (PTC)	digital_sensor.1	D	-	X	X		A: 69	A: 181	dig_outputs.0: Alarm relay dig_outputs.2: Temp. alarm	**Temp. LED:** front_leds1.2: Dimmed, temp. OK Red flashing, Pump temp. alarm
Water in air (WIA)	water_in_air	D	-	X	X		W: 11	W: 170	dig_outputs.1: General warning	**Leakage LED:** See above
EEPROM status in Sensor Board	-	D	-		X		W: 85	-	dig_outputs.1: General warning	**Service LED:** front_leds1.0-1: Flashing yellow, service warning
EEPROM status in IO113	-	D	-			X	W: 83	-		
Setup conflict	-	D	-		X	X	A/W: 25	-		

*) If "sensor placed in air" fault.
**) Only if Ex (Explosion protected) is enabled.
***) If the SM113 is of type without PTC and IO113 has been setup to SM113 with sensor board, this gives a setup conflict alarm (security risc). If the SM113 is of type with PTC and IO113 has been setup to SM113 without PTC this gives a setup conflict warning (no security risc).
+) Only if Ex (Explotion protected) is enabled or connected pumptype is C (SM113 with PTC).

Table 3: *An overview of supervised values/conditions with related limits and alarm codes. IO113 builds a functional profile using measurements from different sources as shown.*

The alarm code status (**alarm_code**), the warning code status (**warning_code**), the alarm/warning bits (**alarms** / **warnings#**) and the digital outputs **(dig_out**) always reflect the actual status of the alarm/warning condition.

alarms (reg 2012) Individual alarms recording

Bit No.	Description
0:	Moisture switch activated (code 22)
1:	Thermal switch (PTC) activated (code 69)
2:	Thermal switch (PTC) signal fault (code 181)
3:	PT100 motor stator temperature high (code 64)
4:	PT1000 motor stator temperature value high (code 64)
5:	Power line communication error rate high (code 10)
6:	Setup conflict (code 25)
7:	-
8:	Motor support bearing temperature value high (code 145)
9:	Motor main bearing temperature value high (code 146)
10:	Motor support bearing temperature sensor signal fault (179)
11:	Motor main bearing temperature sensor signal fault (180)
12:	Insulation resistance value low (code 20)
13:	Leakage (Water in oil value /water in air)high (code 11)
14:	Leakage (Water in oil) Water in oil sensor signal fault (code 170)
15:	Vibration value high (code 24)

warnings1 (reg 2013) Individual warnings recording

Bit No.	Description
0:	-
1:	-
2:	-
3:	PT100 motor stator temperature high (code 64)
4:	PT1000 motor stator temperature high (code 64)
5:	Power line communication error rate high (code 10)
6:	Setup conflict (code 25)
7:	-
8:	Motor support bearing temperature value high (code 145)
9:	Motor main bearing temperature value high (code 146)
10:	Motor support bearing temperature sensor signal fault (179)
11:	Motor main bearing temperature sensor signal fault (180)
12:	Insulation resistance value low (code 20)
13:	Leakage (Water in oil value high / Water in air) (code 11)
14:	Leakage (Water in oil) sensor signal fault (code 170)
15:	Vibration value high (code 24)

warnings2 (reg 2014) Individual warnings recording, byte 3

Bit No.	Description
0:	IO113 EEPROM parameter verification error (code 83)
1:	Sensor board EEPROM parameter verification error (code 85)
2:	Time for service
7-2:	-

alarms_enable (reg 2059) Individual enable/disable of alarms

Bit No.	Description
0:	Moisture switch activated (code 22)
1:	Thermal switch (PTC) activated (code 69)
2:	Thermal switch (PTC) signal fault (code 181)
3:	PT100 motor stator temperature high (code 64)
4:	PT1000 motor stator temperature value high (code 64)
5:	Power line communication error rate high (code 10)
6:	Setup conflict (code 25)
7:	-
8:	Motor support bearing temperature value high (code 145)
9:	Motor main bearing temperature value high (code 146)
10:	Motor support bearing temperature sensor signal fault (179)
11:	Motor main bearing temperature sensor signal fault (180)
12:	Insulation resistance value low (code 20)
13:	Leakage (Water in oil value high / Water in air) (code 11)
14:	Water in oil sensor signal fault (code 170)
15:	Vibration value high (code 24)

warnings1_enable (reg 2060) Individual enable/disable of warnings

Bit No.	Description
0:	-
1:	-
2:	-
3:	PT100 motor stator temperature high (code 64)
4:	PT1000 motor stator temperature high (code 64)
5:	Power line communication error rate high (code 10)
6:	Setup conflict (code 25)
7:	-
8:	Motor support bearing temperature value high (code 145)
9:	Motor main bearing temperature value high (code 146)
10:	Motor support bearing temperature sensor signal fault (179)
11:	Motor main bearing temperature sensor signal fault (180)
12:	Insulation resistance value low (code 20)
13:	Leakage (Water in oil) sensor signal fault (code 11)
14:	Water in oil sensor signal fault (code 170)
15:	Vibration value high (code 24)

warnings2_enable (reg 2061) Individual warnings enable/disable, byte 3

Bit No.	Description
0:	IO113 EEPROM parameter verification error (code 83)
1:	Sensor board EEPROM parameter verification error (code 85)
2:	Time for service
7-3:	-

sensors_present (reg 2015) Result of sensor signal auto learning or presetting, byte 1
Shows whether a given sensor signal is present or not.

Bit No.	Description
0:	Moisture switch present
1:	Thermal switch (PTC) present
2:	-
3:	PT100 motor stator temperature sensor present
4:	PT1000 motor stator temperature sensor present
5:	Power line communication error rate calculation present
7-6:	-
8:	Motor support bearing temperature sensor present
9:	Motor main bearing temperature sensor present
10:	-
11:	-
12:	Insulation resistance sensor present
13:	Leakage (Water in oil / Water in air) sensor present
14:	-
15:	Vibration sensor present

Error code	Alarm/warning event	alarms	warnings1	warnings2	alarms_enable	warnings1_enable	warnings2_enable	sensors_present	Related dig_output bit signals		Related *LED* bit signals	
									Alarm	Warning	Alarm	Warning
22	Moisture switch activated	b0	-		b0	-		b0	0: Alarm relay 3: Moist. alarm	-	Red flashing moisture LED	-
69	Thermal switch (PTC) activated	b1	-		b1	-		b1	0: Alarm relay 2: Temp. alarm	-	Red flashing temp. LED	-
181	Thermal switch (PTC) signal fault	b2	-		b2	-		-	0: Alarm relay 2: Temp. alarm	-		-
64	PT100 motor stator temperature value high	b3	b3		b3	b3		b3				
64	PT1000 motor stator temperature value high	b4	b4		b4	b4		b4				
10	Power line communication fault	b5	b5		b5	b5		b5	0: Alarm relay***)	1: General warning	**) Yellow Service LED	Yellow Service LED
25	Setup conflict	b6	b6		b6	b6		b6	0: Alarm relay***)	1: General warning	Red/flashing leakage LED	All LED flashing
-	-	-	-		-	-						
145	Motor support bearing temperature value high +)	b8	b8		b8	b8		b8	0: Alarm relay**)	1: General warning	Red flashing pump temp LED***	
146	Motor main bearing temp. value high +)	b9	b9		b9	b9		b9	2: Temp. alarm**)			
179	Motor support bearing temp. sensor signal fault +)	b10	-		b10	-		-	0: Alarm relay**)			
180	Motor main bearing temp. sensor signal fault +)	b11	-		b11	-		-	0: Alarm relay**)			
20	Insulation resistance value low	b12	b12		b12	b12		b12	0: Alarm relay 4: Insul. alarm	1: General warning	Red flashing insulation LED	Yellow insulation LED
11	Leakage (Water in oil value high /Water in air or sensor placed in air	b13	b13		b13	b13		b13	0: Alarm relay*)		Red/flashing leakage LED*)	Yellow leakage LED
170	Leakage (Water in oil) sensor signal fault+)	b14	b14		b14	b14		-	0: Alarm relay**)			Yellow flashing leakage LED
24	Vibration value high	b15	b15		b15	b15		b15	-	-	Yellow vibration led	Yellow vibration led
83	IO113 EEPROM param. verification error			b0			b0		-	1: General warning	-	Yellow flashing Service LED
85	Sensor board EEPROM param. ver. error			b1			b1					
12	Time for service			b2			b2					

*) If "sensor placed in air" fault.
**) Only if Ex (Explosion protected) is enabled.
***) Only pump type C.
+) The enable bit for the related warning/alarm event will automatically be set if Ex (Explosion protected) is enabled

Table 4: *An overview of possible alarm/warning events and their relation to event codes and to bit registration.*

Fault	Standard		ATEX/IECEx protection activated	
	Warning	Alarm	Warning	Alarm
Stator winding temperature too high	•	•	•	•
Moisture in top cover		•		•
Moisture in stator housing		•		•
Moisture in bottom of motor		•		•
Water in air		•		•
Missing signal from water-in-air sensor		•		•
Water in oil exceeds limit	•		•	
Missing signal from water-in-oil sensor	•			•
Insulation resistance too low	•	•	•	•
Configuration conflict	•	•	•	•
Main bearing temperature too high*	•		•	•
Support bearing temperature too high*	•		•	•
Missing signal from bearing sensor*	•			•
Communication fault*	•			•
Time for service	•		•	
Internal fault	•		•	
Vibrations exceed limit	•	•	•	•

Table 5: *An overview of alarms and warnings in stand mode and ATEX/IECE mode.*

If there is a pending error (**supervise_mode_status (reg 2009)** not equal 0), the error code (table 4, left column) describing the type of error can be read in **alarm_code (reg 2010)** or **warning_code (reg 2011)** .

7. Mode Control and Mode Status

`command_mode_status` (reg 2008) Status of commanded modes.

Bit No.	Description
0:	*Operation Mode* *)
	0: Start
	1: Stop
1:	*Test Mode*
	0: Use
	1: Test (internal use)
2:	*Automatic sensor learning*
	0: Learning unarmed
	1: Learning armed **)
	(Command **`ARM_LEARNING`**)
7-3:	Not used

*) Set by contactor feedback or by bus command

**) Automatic sensor detection enabled. Must be followed by command RESET

`supervise_mode_status` (reg 2009) Status of supervision

Bit No.	Description
1-0:	*Supervise Mode*
	00: Normal
	01: Pump in warning mode
	10: Pump in alarm mode
2:	*Acknowledge status*
	0: No unacknowledged (pending) alarm
	1: Unacknowledged (pending) alarm
	(Cleared with **`RESET_ALARM`** or pushing the [Reset] button)
7-3:	Not used

8. Digital input/output

`dip_switch` (reg 2016) Hardware DIP switch 1-12 used for various setup

Bit No. Description

0: SW6: Transition 0->1 is required to execute ARM_LEARNING command

1: SW10: *Explosion protection*
- 0: No
- 1: Yes

3-2: SW12/SW11: *Product type*
- 00: Pump with WIO sensor
- 10: Reserved for further configuration (No WIO or WIA sensor)
- 01: Pump with WIA sensor
- 11: Reserved for further configuration (No WIO or WIA sensor)

4-7: Reserved

9-8: SW2, SW1: *pump variant*
- 00: C: With SM 113 sensor board (reserved)
- 01: A: Without SM113, sensors are connected to IO113
- 10: B: With SM 113 sensor board
- 11: D: Without SM113, Only WIO and WIA sensors are connected to IO113

12-10: SW3, SW4, SW5: Define the IO113 address
- 000: Address switch disabled. **`unit_addr`** programmed via Modbus.
- 001 **`unit_addr`** = 40
- 010 **`unit_addr`** = 41
- **:** -
- 110 **`unit_addr`** = 45

13: SW7: *Analogue motor temperature output signal selection*
- 0: Motor temperature is a 4-20mA signal
- 1: Motor temperature is a PT1000 emulated signal

14: SW8: *Analogue water in oil output signal selection*
- 0: Water in oil is a 4-20mA signal (3.5mA: sensor in air; 22mA: sensor has fallen off)
- 1: Water in oil is a puls signal (also containing the insul. value and WIO signal fault)

15: SW9: *Communications interface*
- 0: GENIbus
- 1: Modbus

`dig_outputs` (reg 2017) Status of digital outputs and output relays

Bit No. Description

0: Alarm relay :
- Motor support bearing temp. high**)
- Motor main bearing temperature high**)
- Motor support bearing temp. signal fault**)
- Motor main bearing temp. signal fault**)
- Insulation resistance low
- Leakage (WIO high / WIO sensor in air)**)
- Leakage (Water in oil) sensor signal fault**)
- Moisture switch activated
- Thermal switch (PTC) activated
- Thermal switch (PTC) signal fault
- Power line communication error
- Setup conflict alarm **)

1: General warning:
- Motor support bearing temp. high**)
- Motor main bearing temperature high**)
- Motor support bearing temp. signal fault**)
- Motor main bearing temp. signal fault**)
- Insulation resistance low
- Leakage (Water in oil value high)

Leakage (Water in oil) sensor signal fault
Power line communication error
IO113 EEPROM param. ver. error
SM113 EEPROM param. ver. error
Time for service
Setup conflict

2: Temperature high alarm
3: Moisture high alarm
4: Insulation low alarm

**) Only if Ex (Explosion protected) is enabled. If Ex is disabled only warning will set the output
*) If "sensor placed in air" fault

`dig_inputs` (reg 2018) Status of digital inputs.

0: *Contactor feedback*
0: Motor switched out (stopped)
1: Motor switched in (started)

1: *Reset button*
0: Disabled (locked)
1: Enabled

2: *Alarm reset*
0: Alarm reset not active
1: Alarm reset active

9. Front plate diode indications

Figure 9.1: *IO113 front plate image.*

`front_leds1` (reg2069) Status of front plate LED's part 1

Bit No.	Description
1-0:	*Service LED*
	00: Dimmed, condition sound
	01: Flashing yellow, service warning (Code 12) or setup conflict (Code 25)
	10: Solid yellow, no connection to SM 113 (Code 10)
	11: -
2:	*Temperature LED*
	0: Dimmed, condition sound
	1: Flashing (1 Hz) red, over-temperature alarm (Code 64, 145, 146)
3:	*Vibration LED*
	0: Dimmed, condition sound
	1: Solid yellow, vibration warning (Code 24)
4:	*Moisture LED*
	0: Dimmed, condition sound
	1: Flashing (1 Hz) red, moisture alarm (Code 22)
6-5:	*Insulation LED*
	00: Solid green, condition sound
	01: Solid yellow, insulation warning (Code 20)
	10: Flashing (1 Hz) red, insulation alarm (Code 20)
	11: -
7:	Running LED
	0: Dimmed, pump is stopped
	1: Solid green, pump is running

`front_leds2` (reg2070) Status of front plate LED's part 2

Bit No.	Description
2-0:	*Leakage LED*
	000: Solid green, leakage< 5%, condition sound
	001: Flashing green, 5%<leakage < 10%,
	010: Solid yellow, 10%<leakage < 15%, leakage warning (Code 11)
	011: Flashing (1 Hz) red, 15%<leakage < 20%, leakage alarm (Code 11)
	100: Solid red, leakage >20%, leakage alarm (Code 11)
	101: Flashing (1 Hz) yellow, leakage signal fault
7-3:	-

Notice that alarms and warnings from PT100/PT1000 are not indicated with LEDs and does not trigger the alarm relay. PT temperature alarms/warnings can only be read via modbus. This gives the system integrator the option to program his own temperature limits in a system controller (PLC, PC).

10. Value resetting

Value resetting the IO113 means to clear counters and logged values and return settings to predefined (factory) values. The IO113 has three commands for this each operating on different data items (see Table 6).

	Command **RESET_HIST**	Command **USER_BOOT**	Command **FACT_BOOT**
Action	• Resets trip counters: **t_run_trip_cnt_hi/lo** **start_trip_cnt_hi/lo** • Resets "service" peak logs **r_insulate_peak_serv** **vibration_peak_serv** **water_in_oil_peak_serv** **aux_sensor_peak_serv** **t_supp_bear_peak_serv** **t_main_bear_peak_serv** **t_pt100_peak_serv** **t_pt1000_peak_serv** • Resets "service" alarm counters overtemp_serv_cnt_hi/lo	• Resets Power on counter and Running time counter*) **t_run_hi/lo** **t_on_hi/lo** **start_cnt_hi/lo** • Resets trip counters **t_run_trip_cnt_hi/lo** **start_trip_cnt_hi/lo** • Resets peak logs **r_insulate_peak** **vibration_peak** **water_in_oil_peak** **aux_sensor_peak** **t_supp_bear_peak** **t_main_bear_peak** **t_pt100_peak** **t_pt1000_peak**	• Resets the same values as USER_BOOT • Returns all configuration parameters to their factory default.

*) Cleared in the IO113 but not in the sensor board

Table 6: *Value resetting the IO113.*

11. References

Reference	Document Title	Document File
/1/	IO113 Installation and operating instructions	Booklet
/2/	GENIbus Protocol Specification	genispec.pdf
/3/	Operating the IO113 via GENIbus or G100	IO113.pdf
/4/	SM113 Installation and operating instructions	Booklet

Table 7*: Suggested reading*

12. Telegram examples

Request data:
In this example the support bearing temperature is requested. The reply answers with temperature measured to 95 °C.

Request	Data
Address	231 [0xE7]
Function code	3 [0x03]
Reg. byte hi	7 [0x07]
Reg. byte lo	200 [0xC8]
No. of reg. hi	0 [0x00]
No. of reg. lo	1 [0x01]
Crc lo	*) 18 [0x12]
Crc hi	*) 134 [0x86]

*) Calculated by software

Answer	Data
Address	231 [0xE7]
Function code	3 [0x03]
Data byte count	2 [0x02]
Hi data value	0 [0x00]
Lo data value	95 [0x5f]
Crc lo	*) 170 [0xAA]
Crc hi	*) 241 [0xF1]

Execute command:
In this example a START command is sent.

Request	Data
Address	231 [0xE7]
Function code	16 [0x10]
Reg. byte hi	7 [0x07]
Reg. byte lo	245 [0xF5]
No. of reg. hi	0 [0x00]
No. of reg. lo	1 [0x01]
Data byte count	2 [0x02]
Hi data value	**) 1 [0x01]
Lo data value	**) 1 [0x01]
Crc lo	*) 230 [0xE6]
Crc hi	*) 1 [0x01]

*) Calculated by software
**) Must differ from 00

Answer	Data
Address	231 [0xE7]
Function code	16 [0x10]
Reg. byte hi	7 [0x07]
Reg. byte lo	[0xF5]
No. of reg. hi	0 [0x00]
No. of reg. lo	1 [0x01]
Crc lo	*) 6 [0x06]
Crc hi	*) 241 [0xF1]

Perform configuration
In this example the support bearing temperature alarm limit is set to 140 °C.

Request	Data
Address	231 [0xE7]
Function code	16 [0x10]
Reg. byte hi	7 [0x07]
Reg. byte lo	249 [0xF9]
No. of reg. hi	0 [0x00]
No. of reg. lo	1 [0x01]
Data byte count	2 [0x02]
Hi conf. value	0 [0x00]
Lo conf value	140 [0x8C]
Crc lo	*) 39 [0x27]
Crc hi	*) 56 [0x38]

*) Calculated by software

Answer	Data
Address	231 [0xE7]
Function code	3 [0x10]
Reg. byte hi	7 [0x07]
Reg. byte lo	249 [0xF9]
No. of reg. hi	0 [0x00]
No. of reg. lo	1 [0x01]
Crc lo	*) 198 [0xC6]
Crc hi	*) 138 [0x8A]

13. Data Item Overview

Explanation to used abbreviations for scaling:

<unit>: The data item has this unit as its fixed scaling. All data items use extended precision scaling.
unsca.: The data item is unscaled (e.g. a number, a counter, etc.).
bits: The data item is bit interpreted. The bit interpretation is explained in the text chapters.

Identifier	Modbus		R/W	Description
	Register	Scaling		
t_support_bear*)	1992	1 °C	R	Temperature in support bearing (PT100)
t_main_bear*)	1993	1 °C	R	Temperature in main bearing (PT100)
t_pt100	1994	1 °C	R	Motor stator temperature (PT100)
t_pt1000	1995	1 °C	R	Motor stator temperature (PT1000)
r_insulate*)	1996	100 kΩ	R	Insulation resistance
vibration*)	1997	20 mm/s /254	R	Vibration in x direction
water_in_oil	1998	0.1 %	R	Water in oil
aux_sensor	1999	unscaled	R	Auxiliary sensor at SM113
t_support_bear_peak*)	2000	1 °C	R	Temp. in support bear. (PT100) peak value
t_main_bear_peak*)	2001	1 °C	R	Temp. in main bear. (PT100) peak value
t_pt100_peak	2002	1 °C	R	Motor stator temp. (PT100) peak value
t_pt1000_peak	2003	1 °C	R	Motor stator temp. (PT1000) peak value
r_insulate_peak*)	2004	100 kΩ	R	Insulation resistance peak value
vibration_peak*)	2005	20 mm/s /254	R	Vibration peak value in x direction
water_in_oil_peak	2006	0.1 %	R	Water in oil peak value
aux_sensor_peak	2007	unscaled	R	Peak value from auxiliary sensor at SM113
command_mode_status	2008	bits	R	Status of commanded modes
supervise_mode_status	2009	bits	R	Status of supervision
alarm_code	2010	unsca.	R	Alarm code, see table
warning_code	2011	unsca.	R	Warning code, see table
alarms	2012	bits	R	Alarm bits
warnings1	2013	bits	R	Warning bits byte 1
warnings2	2014	bits	R	Warning bits byte 2
sensors_present	2015	bits	R	Result of sensor learning/preset
dip_switch	2016	bits	R	Dip switch for functional setup
dig_outputs	2017	bits	R	Status of alarm and warning relay
dig_inputs	2018	bits	R	Status of digital inputs
unit_family	2019	unsca.	R	Unit family code
unit_type	2020	unsca.	R	Unit type code
unit_version	2021	unsca.	R	Unit version code
t_run_hi t_run_lo	2022 2023	1 min	R	Running time counter.
t_on_hi t_on_lo	2024 2025	1 min	R	Power on time counters
t_run_trip_cnt_hi t_run_trip_cnt_lo	2026 2027	1 min	R	Running time trip counter. Cleared with **RESET_HIST**
start_cnt_hi start_cnt_lo	2028 2029	unscaled	R	No. of starts counter.
start_trip_cnt_hi start_trip_cnt_lo	2030 2031	unscaled	R	No. of starts trip counter. Cleared with **RESET_HIST**
RESET	2032	-	W	Hardware resets the MPC Module
RESET_ALARM	2033	-	W	Resets pending alarms and attempts restart
FACT_BOOT	2034	-	W	Self configuration of fact. EEPROM area
USER_BOOT	2035	-	W	Self configuration of user EEPROM area
STOP	2036	-	W	Records the pump as stopped
START	2037	-	W	Records the pump as started
RESET_HIST	2038	-	W	Resets historical values
Reserved	2039	-	W	-
ARM_LEARNING	2040	-	W	Arm the automatic sensor learning
t_support_bear_alarm*)	2041	1 °C	R/W	Temperature in support bearing alarm limit Factory: 140
t_support_bear_warn*)	2042	1 °C	R/W	Temp. in support bearing warning limit Factory: 120
t_main_bear_alarm*)	2043	1 °C	R/W	Temperature in main bearing alarm limit Factory: 140
t_main_bear_warn*)	2044	1 °C	R/W	Temperature in main bearing alarm limit Factory: 120
t_pt1000_alarm	2045	1 °C	R/W	Temperature in stator alarm limit Factory: 150 °C
t_pt1000_warn	2046	1 °C	R/W	Temperature in stator alarm limit Factory: 130 °C
t_pt100_alarm	2047	1 °C	R/W	Extra temperature alarm limit Factory: 150 °C
t_pt100_warn	2048	1 °C	R/W	Extra temperature alarm limit Factory: 130 °C
t_run_trip_cnt_warn	2049	100 h	R/W	Running time trip counter warning limit Factory: 255
unit_addr	2050	unsca.	R/W	Unit address Factory: 231
vibration_alarm*)	2051	20 mm/s /254	R/W	Vibration alarm limit Factory: 255
vibration_warn*)	2052	20 mm/s /254	R/W	Vibration warning limit Factory: 255

water_in_oil_warn	2053	0.1 %	R/W	Water in oil warning limit Factory: 195
wio_meas_delay	2054	1 s	R/W	Water in oil measurement delay Factory: 20 s
wio_meas_filter	2055	unsca	R/W	Water in oil measurement filter Factory: 120
wio_output_offset	2056			Analog output offset: Factory: 0
alarms_enable	2059	bits	R/W	Individual enable/disable of alarms Factory: b 0x01 xxxx –1x0 0111 ¤)
warnings1_enable	2060	bits	R/W	Individual enable/disable of warnings Factory: b 0111 xxxx –1x0 0--- ¤)
warnings2_enable	2061	bits	R/W	Individual enable/disable of warnings Factory: b ---- ---- ---- -011 ¤)
sensors_present_set*)	2062	bits	W	Presetting of installed sensors

r_insulate_peak_serv*)	2063	100 kΩ	R	Insulation resist. peak value since service
speed	2064	1 rpm	R	Pump speed
vibration_peak_serv	2065	20 mm/s /254	R	Vibration peak value since last service. Cleared with **RESET_HIST**
water_in_oil_peak_serv	2066	0.1 %	R	Water in oil peak value since last service. Cleared with **RESET_HIST**
water_in_air	2067	bool	R	Water in air detection
aux_sensor_peak_serv	2068	unsca	R	Peak value from SM113 auxiliary sensor. since last service.Cleared by **RESET_HIST**
front_leds1	2069	Bits	R	Status of the front plate diodes, part 1
front_leds2	2070	bits	R	Status of the front plate diodes, part 2
digital_sensors	2071	Bits	R	Status of digital sensors
vib_meas_delay	2072	1s	R/W	Vibration measurement delay. Factory: 20
vibmeas_filter	2073	unsca	R/W	Vibration measurement filter Factory: 0

*) Unit type 2 (power line communication) only
+) Notice that this configuration parameter cannot be written
¤) 0: Disabled
1: Enabled
x: Forced setup via Ex enable/disable
-: No alarm/warning support

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