

Operating the

IO111

via **Modbus**

Edition 1.5, February 2008

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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 IO111 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.

1. Introduction

This document describes the functional profile on Modbus for the Grundfos IO111 Module. The IO111 Module is working as a slave unit on Modbus. In order to communicate with the IO111 Module, it must be configured via DIP switch setting (DIP switch 8 = 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 DIP switch: DIP switch + 39
Addressing 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 IO111 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 IO111 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 SM111 power line sensor module (fig. 1) writing to configurable parameters is forwarded by IO111 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 IO111 Module cannot buffer telegrams longer than 70 bytes. So, for Modbus access, telegrams are not allowed to exceed a complete length of 70 bytes neither for Data Requests nor for Data Replies. Only 4 registers can be written per telegram.

2. Addressing

The Modbus Unit Address can be selected by means of DIP switch 3-5 in the range of 40 - 46:

dip_switch (reg 2016)	Hardware DIP switch used for Modbus address
<u>Bit No.</u>	<u>Description</u>
1-0:	see later
4-2:	Unit No. (Unit Address=Unit No.+39) (DIP 3-5)
15-5:	see later

If a Unit no. different from 0 is selected, the equivalent Unit address (Unit no. + 39) will be stored in data item **unit_addr (reg 2050)**, which is the effective bus address.

If Unit no. 0 is selected, the unit address can be configured via Modbus in the range of 32 – 231 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 IO111 module will reply with the values below:

	unit_family (reg 2019)	unit_type (reg 2020)	unit_version (reg 2021)
IO111 with 3 wire sensor	22	1	0
IO111 with power line sensors	22	2	0
SE Power line sensor, SM111	22	3	0

Table 2: IO111 identification.

4. IO111 in a System

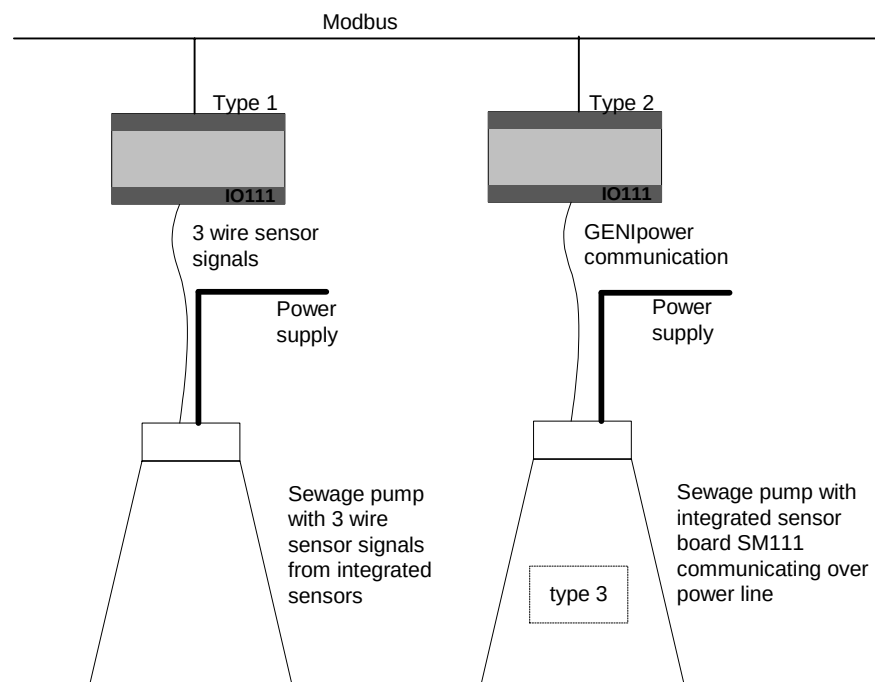


Figure 1: Illustration of IO111 together with pumps.

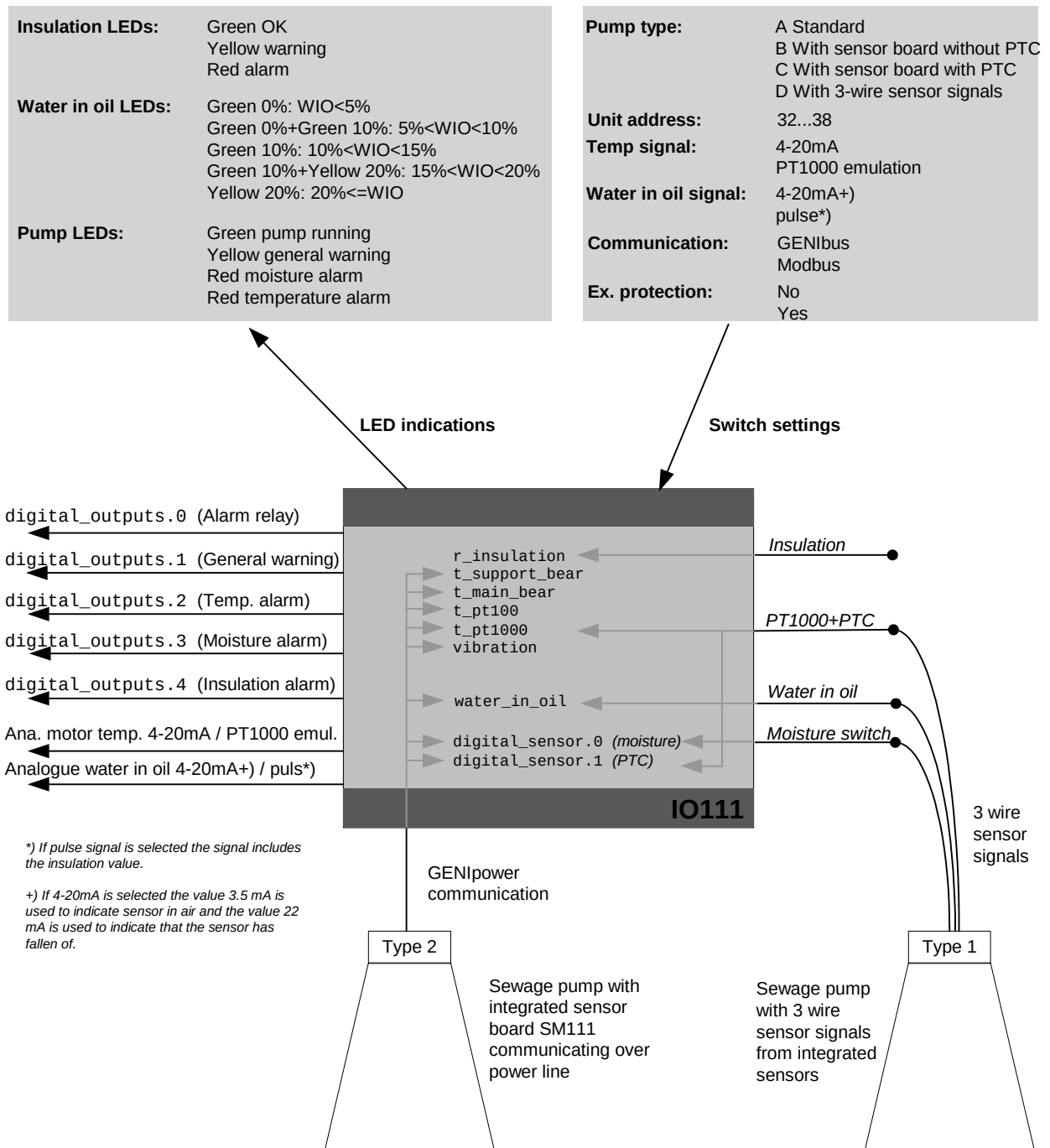


Figure 2: Illustration of IO111 input/output signals.

5. 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	IO111 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	pump_leds: Red pump temp. alarm**) Yellow pump warn.
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			
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_leds: Green insulation OK Yellow insulation warn. Red 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	water_in_oil_leds: 2 green water in oil Yellow water in oil warning All flashing if 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*)	pump_leds: Red pump temp. alarm*) Yellow pump warn.
Vibration	vibration	A	vibration_alarm vibration_warn		X		A/W: 24	-	-	-
Time for service	t_run_trip_cnt	A	t_run_trip_cnt_warn			X	W: 12	-	dig_outputs.1: General warning	pump_leds: Yellow pump warn.
Moisture switch bottom	digital_sensor.0	D	-	X	X		A: 22	-	dig_outputs.0: Alarm relay dig_outputs.3: Moisture alarm	pump_leds: Red pump 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	pump_leds: Red pump temp. alarm.
EEPROM status in Sensor Board	-	D	-		X		W: 85	-	dig_outputs.1: General warning	pump_leds: Yellow pump warn.
EEPROM status in IO111	-	D	-			X	W: 83	-		
Setup conflict	-	D	-		X	X	A/W: 25	-	dig_outputs.0: Alarm relay dig_outputs.1: General warning	pump_leds: Red pump moist/temp. flash***) Yellow pump warn. flash

*) If "sensor placed in air" fault.

**) Only if Ex (Explosion protected) is enabled.

***) If the SM111 is of type without PTC and IO111 has been setup to SM111 with sensor board, this gives a setup conflict alarm (security risc). If the SM111 is of type with PTC and IO111 has been setup to SM111 without PTC this gives a setup conflict warning (no security risc).

+) Only if Ex (Explosion protected) is enabled or connected pumtype is C (SM111 with PTC).

Table 3: An overview of supervised values/conditions with related limits and alarm codes. IO111 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: Water in oil value high (code 11)
- 14: 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: -
- 11: -
- 12: Insulation resistance value low (code 20)
- 13: Water in oil value high (code 11)
- 14: 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: IO111 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

<u>Bit No.</u>	<u>Description</u>
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:	Water in oil value high (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

<u>Bit No.</u>	<u>Description</u>
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:	Water in oil value high (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

<u>Bit No.</u>	<u>Description</u>
0:	IO111 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.

<u>Bit No.</u>	<u>Description</u>
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:	Water in oil 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 pump moisture LED	-
69	Thermal switch (PTC) activated	b1	-		b1	-		b1	0: Alarm relay 2: Temp. alarm	-	Red pump temp LED	-
181	Thermal switch (PTC) signal fault	b2	-		b2	-		-	0: Alarm relay 2: Temp. alarm	-	Red pump temp LED	-
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	Red pump temp LED ^{***}	Yellow pump warn. LED
25	Setup conflict	b6	b6		b6	b6		b6	0: Alarm relay ^{***}	1: General warning	Moist./temp. LED flashing	Yellow pump warn. LED flashing
-	-	-	-		-	-		-				
145	Motor support bearing temperature value high ^{†)}	b8	b8		b8	b8		b8	0: Alarm relay ^{**}	1: General warning	Red pump temp LED ^{**}	Yellow pump warn. 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 ^{**}	1: General warning		Yellow pump warn. LED
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 insulation low LED	Yellow insulation warn. LED
11	Water in oil value high or sensor placed in air	b13	b13		b13	b13		b13	0: Alarm relay ^{†)}		All WIO LEDs flashing ^{†)}	Yellow WIO warn. LED
170	Water in oil sensor signal fault ^{†)}	b14	b14		b14	b14		-	0: Alarm relay ^{**}		All WIO LEDs flashing ^{**}	Yellow WIO warn LED flashing
24	Vibration value high	b15	b15		b15	b15		b15	-	-	-	-
83	IO111 EEPROM param. verification error			b0				b0	-	1: General warning	-	Yellow pump warn. 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.

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)**.

6. Mode Control and Mode Status

command_mode_status (reg 2008)	Status of commanded modes.	
	<u>Bit No.</u>	<u>Description</u>
	0:	<i>Operation Mode</i> *)
		0: Start
		1: Stop
	1:	<i>Test Mode</i>
		0: Use
		1: Test (internal use)
	2:	<i>Automatic sensor learning</i>
		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	
	<u>Bit No.</u>	<u>Description</u>
	1-0:	<i>Supervise Mode</i>
		00: Normal
		01: Pump in warning mode
		10: Pump in alarm mode
	2:	<i>Acknowledge status</i>
		0: No unacknowledged (pending) alarm
		1: Unacknowledged (pending) alarm
		(Cleared with RESET_ALARM or pushing the [Reset] button)
	7-3:	Not used

7. Digital input/output

dip_switch (reg 2016)	Hardware DIP switch 1-10 used for various setup	
	<u>Bit No.</u>	<u>Description</u>
	1-0:	<i>Connected pump type</i>
	00:	C, Pump with sensor board with PTC (unit type 2)
	01:	B, Pump with sensor board without PTC (unit type 2)
	10:	A, Pump with 3/5 wire sensor signals (unit type 1)
	11:	D, Pump with 3/5 wire sensor signals, separate sensors (unit type 1).
	4-2:	<i>Unit address selection</i>
	000:	Address switch disabled.
		unit_addr programmed via Modbus.
	001	unit_addr = 40
	010	unit_addr = 41
	:	-
	111	unit_addr = 46
	5:	<i>Analogue motor temperature output signal selection</i>
	0:	Motor temperature is a 4-20mA signal
	1:	Motor temperature is a PT1000 emulated signal
	6:	<i>Analogue water in oil output signal selection</i>
	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)
	7:	<i>Communications interface</i>
	0:	GENIbus
	1:	Modbus
	8:	Transition 0->1 is required to execute ARM_LEARNING command
	9:	<i>Explosion protection</i>
	0:	No
	1:	Yes
	10-15:	-
dig_outputs (reg 2017)	Status of digital outputs and output relays	
	<u>Bit No.</u>	<u>Description</u>
	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
		Water in oil value high (WIO sensor in air) ^{*)}
		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
		Water in oil value high ^{*)}
		Water in oil sensor signal fault
		Power line communication error
		IO111 EEPROM param. ver. error
		SM111 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

8. Value resetting

Value resetting the IO111 means to clear counters and logged values and return settings to predefined (factory) values. The IO111 has three commands for this each operating on different data items (see Table 5).

	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 peak logs r_insulate_peak vibration_peak water_in_oil_peak t_pt100_peak t_pt1000_peak aux_sensor_peak	- 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 t_pt100_peak t_pt1000_peak	Returns all configuration parameters to their factory default.

*) Cleared in the IO111 but not in the sensor board

Table 5: Value resetting the IO111.

9. References

Reference	Document Title	Document File
/1/	IO111 Installation and operating instructions	Booklet
/2/	GENIbus Protocol Specification	genispec.pdf
/3/	Operating the IO111 via GENIbus or G100	io111.pdf
/4/	SM111 Installation and operating instructions	Booklet

Table 6: Suggested reading

10. 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]

11. 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	GENIbus		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 SM111
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 SM111
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	2022	1 min	R	Running time counter.
t_on_hi	2023			
t_on_lo	2024	1 min	R	Power on time counters
t_run_trip_cnt_hi	2025			
t_run_trip_cnt_lo	2026	1 min	R	Running time trip counter. Cleared with RESET_HIST
start_cnt_hi	2027			
start_cnt_lo	2028			
start_trip_cnt_hi	2029	unscaled	R	No. of starts counter.
start_trip_cnt_lo	2030	unscaled	R	No. of starts trip counter. Cleared with RESET_HIST
	2031			

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

*) 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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