Operating the

UPE Circulator Pump

via
GENIbus or G100

Edition 2.6, May 2002

Contents

This document is mainly intended for development engineers integrating GENIbus based Grundfos motors/pumps in automation systems using a direct access to GENIbus or access via the gateway G100.

It contains a selected subset of 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 motors/pumps for different applications and to utilize their functionality to its full extend.

Using the information in this document for implementation of direct GENIbus access presuppose a knowledge of the GENIbus communications protocol as described in the *GENIbus Protocol Specification.*

Using the information for implementation of communication with GENIbus devices via G100 presuppose a knowledge of how to access data in G100 from the main network in question. Documents for each of the main network connections are included on the G100 Support Files CD ROM.

This document can be freely distributed.

1. Introduction

This manual is supposed to document the Functional Profile for the Grundfos UPE circulator pumps.

All Data Items are the same, are named by the same identifier and have the same access right (read/write) both for communication directly with GENIbus or communication via G100. However, there are some small differences in the way data is represented and accessed, which influences the description in this manual. These differences are important to notice, and so they are summerized here:

	GENIbus directly	via G100
Protocol	The GENIbus Protocol (GENIpro) See /1/	G100 Basic: G100 protocol. See /4/ G100 R/M/P: G100 protocol. See /4/ Satt Control Comli. See /6/ MODbus. See /7/ G100 Profibus: See /8/ G100 Interbus: See /9/
Data format	Date Items are 8 bit. 16 bit data is split into two 8 bit Data Items with suffix _hi, _lo	Subindex <252: Data Items are 16 bit Subindex>=240: Data Items are 32 bit
Addressing the unit	Unit Address = No.(given with R100) + 0x1F Example: Give the device No. 4 with R100, then its GENIbus address will be 0x04+0x1F = 0x23	Index = No.(given with R100) + 0x211F Example: Give the device No. 4 with R100, then its G100 index will be 0x04+0x211F = 0x2123
Data Item addressing	Is done with a Class No. [2;5] and an ID code [0; 255]	Is done with a subindex [0; 255]
Scaling	Scaling information like range and unit is requested separately for each Data Item with an INFO operation. Some Data Items have a predefined scaling. In these cases it will be mentioned in the tables.	Scaling is predefined and mentioned in the tables

Table 1: *Summarizing the differences in accessing GENIbus data directly or via the gateway G100*

When a Data Item is referred to in the text or in a table, it will often be done like this:

`ref_rem` (5, 1 / 107)

`ref_rem` is the identifier for the Data Item. *(5, 1 / 107)* means Class 5, ID code No. 1 for GENIbus access and subindex 107 for G100 access.

Data Item values of '0xFF' must be interpreted as "data not available" for GENIbus (however, for a low order data item to a 16 bit value '0xFF' is a legal value). For G100 the value '0xFFFF' and '0xFFFFFFFF' has this meaning for a 16bit or a 32bit data item respectively.

NOTICE!
The UPE pump cannot buffer telegrams longer than 70 byte. So, for GENIbus access, telegrams are not allowed to exceed a complete length of 70 byte neither for Data Requests nor for Data Replies.

2. Addressing

Any *GENIbus* unit can be addressed by sending a Telegram to its Unit Address. The Unit Address can be configured from the bus by writing to the Data Item:

`unit_addr` **(4, 46 / 47)**

From the factory the address have been pre-set to some standard value (=231). The Unit Address for each motor/pump on the bus system must have been written with a unique value for the network communication to work. This can be done via the bus if the units are connected one at a time and then programmed or it can be done with R100 which is the must obvious and easy way.

If communicating directly over GENIbus, the Broadcast Address (=255) can also be used to get in contact with a unit. Caution must be exercised when requesting data via broadcast addressing. If more than one unit is connected several simultaneous replies might result.

3. Device Identification

The Data Items `unit_family` (2, 148 / 40) `unit_type` (2, 149 / 41) and `unit_version` (2, 150 / 42) can be used to identify different *GENIbus* units. All UPE pumps will reply with:

- `unit_family` = 1
- `unit_type` = [1; 8]
- High order nibble of `unit_version`=[1, 2]

The `unit_type` is the type of the Electronics Control. It can be attached to different pump types, as seen in the table below.

UPE Electronics Control Type (`unit_type`)	UPE Pump Type	Data Sheet Maximum head	Data Sheet Maximum flow	Data Sheet Maximum power
1. CS3000 (Out of production since 1997)	UPE50-120	11.7 m	33 m^3/h	1000 W
	UPE65-120	11.7 m	54 m^3/h	1400 W
	UPE80-120	11.7 m	78 m^3/h	2000 W
	UPE100-60	6.5 m	100 m^3/h	1500 W
2. CS2000	UPE32-120	12.0 m	17 m^3/h	400 W
	UPE40-120	11.5 m	24 m^3/h	500 W
	UPE50-60	6.1 m	35 m^3/h	450 W
	UPE65-60	6.4 m	38 m^3/h	550 W
3. CS1000	UPE25-80	7.8 m	12.5 m^3/h	250 W
	UPE32-80	7.8 m	12.5 m^3/h	250 W
	UPE40-80	7.8 m	12.5 m^3/h	250 W
4. CS100	UPE25-60	5.8 m	4.2 m^3/h	100 W
	UPE32-60	5.8 m	4.2 m^3/h	100 W
5. CS3000 mrk III	UPE 50-120	9.0 m	34 m^3/h	900 W
	UPE 65-120	10 m	51 m^3/h	1200 W
	UPE 80-120	10.5 m	75 m^3/h	1500 W
	UPE100-60	5.6 m	102 m^3/h	1300 W
	UPED50-120	9.0 m	53 m^3/h	1600 W
	UPED65-120	10.5 m	85 m^3/h	2400 W
	UPED80-120	11.5 m	127 m^3/h	3200 W
	UPED100-60	5.9 m	141 m^3/h	2300 W
6. CS2000 mrk III	UPE32-120	9.5 m	15 m^3/h	400 W
	UPE40-120	9.0 m	20 m^3/h	500 W
	UPE50-60	6.0 m	29 m^3/h	450 W
	UPE65-60	5.5 m	40 m^3/h	550 W
	UPED32-120	9.5 m	24 m^3/h	800 W
	UPED40-120	9.5 m	35 m^3/h	1050 W
	UPED50-60	6.0 m	43 m^3/h	850 W
	UPED65-60	5.5 m	62 m^3/h	1100 W
7. CS2600 (Magna)	UPE32-120	12.0 m	20 m^3/h	340 W
	UPE40-120	12.0 m	23 m^3/h	430 W
	UPE50-60	6.0 m	36 m^3/h	330 W
	UPE65-60	6.0 m	36 m^3/h	420 W
	UPED32-120*)	12.0 m	20 m^3/h	340 W
	UPED40-120*)	12.0 m	23 m^3/h	430 W
	UPED50-60*)	6.0 m	36 m^3/h	330 W
	UPED65-60*)	6.0 m	36 m^3/h	420 W
8. CS300	UPE25-40	3.8 m	3.2 m^3/h	60 W
	UPE32-40	3.8 m	3.2 m^3/h	60 W

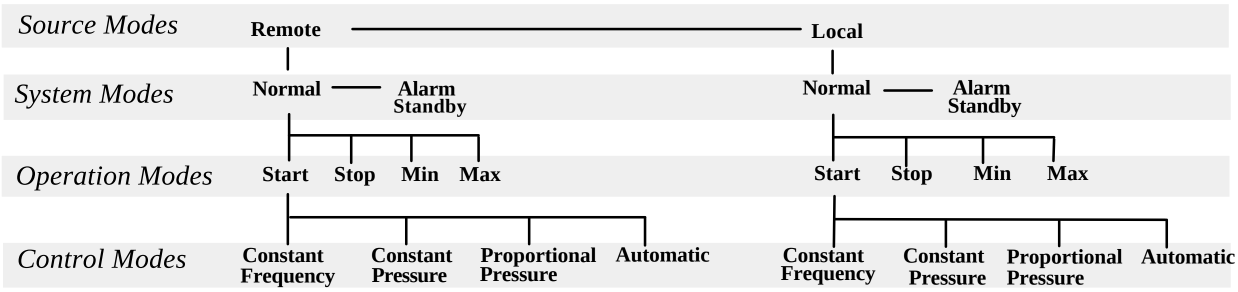
*) *Only one of the pump heads can be operating at a time.*

Table 2: *UPE survey.*

4. Mode Control and Setup Status

A UPE pump have the mode scheme shown below. By the use of the Commands, which are also shown below, a UPE pump can be brought to operate as required. To react to Commands from the bus the UPE pump must first be brought into Remote Mode by use of the REMOTE Command. Except for REF_UP and REF_DOWN this is the only Command from the bus it will react to when in Local Mode.

As long as the pump is regularly addressed from the bus it remains in Remote Mode. If it is not addressed for 6 s (For Unit Type 5, 6 and 7 it is 35 s) it automatically switches back into Local Mode.



Command	Class, ID / Subindex	Action
RESET	3, 1 / 75	• The UPE will be hardware reset
RESET_ALARM	3, 2 / 76	• Deletes all alarm backup bytes. • Turns RED LED off and GREEN LED on (or blinking if the pump is stopped). • If the pump is in **Alarm Standby** it will be brought into **Normal**. • The `act_mode3`, *bits 0-3* are updated accordingly.
REMOTE	3, 7 / 79	• Switch to **Remote Mode** • Updates the `act_mode3`, *bit 4* accordingly
LOCAL	3, 8 / 80	• Switch to **Local Mode** • Updates the `act_mode3`, *bit 4* accordingly
START	3, 6 / 78	• Starts the pump (*Operation Mode* **Start**) • Updates the `act_mode1`, *bits 0-2* accordingly
STOP	3, 5 / 77	• Stops the pump (*Operation Mode* **Stop**) • Updates the `act_mode1`, *bits 0-2* accordingly
MIN	3, 25 / 88	• Pump operating on the selected minimum curve (*Operation Mode* **Min**) • Updates the `act_mode1`, *bits 0-2* accordingly
MAX	3, 26 / 89	• Pump operating on its maximum curve (*Operation Mode* **Max**) • Updates the `act_mode1`, *bits 0-2* accordingly
CONST_FREQ	3, 22 / 85	• Sets the pump in *Control Mode* **Constant Frequency** (Const. Curve). `ref_rem` is used as contr. signal (embedded control loop is opened). • Updates the `act_mode1`, *bit 3-5* accordingly
CONST_PRESS	3, 24 / 87	• Sets the pump in *Control Mode* **Constant Pressure.** *ref_rem* is used directly as the pressure/head reference to the embedded control loop (but discreatizised in `h_ref_step` steps). • Updates the `act_mode1`, *bit 3-5* accordingly.
PROP_PRESS	3, 23 / 86	• Sets the pump in *Control Mode* **Proportional Pressure**. `ref_rem` is used directly as the pressure/head reference to the embedded control loop (but discreatizised in `h_ref_step` steps). • Updates the `act_mode1`, *bit 3-5* accordingly
LOCK_KEYS	3, 30 / 90	• Locks the +/- buttons on the pump
UNLOCK_KEYS	3, 31 / 91	• Unlocks the +/- buttons on the pump
REF_UP*)	3, 33 / 93	• If pump is in **Local Mode** this command steps the **Local Mode** reference (setpoint) up to next pump curve (like pressing the plus button)
REF_DOWN*)	3, 34 / 94	• If pump is in **Local Mode** this command steps the **Local Mode** reference (setpoint) down to next pump curve (like pressing the minus button)
AUTOMATIC+)	3, 52 / 103	• Sets the pump in *Control Mode* **Automatic**. • Updates the `act_mode1`, *bit 3-5* accordingly
NIGHT_REDUCT_E+)	3, 66 / -	• Enables **Night Reduction** • Updates the `act_mode1`, *bit 6* accordingly

NIGHT_REDUCT_D[+)]	3, 67 / -	• Disables **Night Reduction** • Updates the `act_mode1`, *bit 6* accordingly

*) Only Unit Type 5, 6 and 7 fulfil this
+) Only Unit Type 7 fulfil this.

***Table 2:** Commands.*

Below is the Data Items holding information about which actual mode the UPE pump is in. `loc_setup1` and `rem_setup1` are bitwise interpreted as `act_mode1`. They reflect the setup from local sources (*GENIlink* and push buttons on pump) and the remote source *GENIbus* respectively. By the use of the REMOTE Command, `act_mode1` becomes equal to `rem_setup1` and the pump operates accordingly. In the same way the LOCAL Command makes `act_mode1` equal to `loc_setup1`.

`act_mode1` (2, 81 / 18)

Actual mode status No. 1.

Bit no	Description
2 - 0	*Operation Modes (User Modes)*: 000: Start 001: Stop 010: Min 011: Max
5 - 3	*Control Modes*: 000: Constant Pressure 001: Proportional Pressure 010: Constant Frequency 101: Automatic Setpoint (only unit type 7)
6	*Night reduction:* 0: Disabled 1: Enabled (only unit type 7)

`act_mode2` (2, 82 / 19)

Actual mode status No. 2.

Bit no	Description	
0	*Temperature Influence*	
	0: Disabled	1: Enabled
5	*Buttons on Pump*	
	0: Enabled (Unlocked)	1: Disabled (Locked)
7 - 6	*Minimum Curves*: 00: Minimum curve 1 selected 01: Minimum curve 2 selected	

`act_mode3` (2, 83 / 20)

Actual mode status No. 3. This byte is not influenced by the setup status. It contains information about modes for which no setup exists. Typically these modes are generated by the system itself (except REMOTE/LOCAL).

Bit No.	Description	
2-0	*System Modes:* 000: Normal 011: Survive 100: Alarm standby	
3	*Pending Alarm*	
	0: No alarm	1: Alarm
4	*Source Mode*	
	0: Remote	1: Local

`loc_setup1` (2, 85 / 21) Bitwise interpreted as *act_mode1* and reflecting the setup from *local* sources (*GENIlink* and push buttons on pump).

`rem_setup1` (2, 87 / 22) Bitwise interpreted as *act_mode1* and reflecting the setup from *remote* (*GENIbus*).

The local Operation Mode and Control Mode can only be changed from a local source (*GENIlink* or push buttons). Notice, that Local Mode can be considered as a kind of "default mode" which a bus operated pump will enter in case that bus communication breaks down.

The Data Item `twin_pump_mode` distinguishes between single pump or a twin pump mode. This is only relevant for Unit Type 5 and 6 twin pumps. When operating these UPED's via GENIbus you must bring them into Single Pump Mode (with R100) and handle them as single pumps to avoid handling a multi master network.

`twin_pump_mode` (2, 166 / -) Twin Pump Mode, UPED's only

Value	Description
0	Operating as Single Pump
1	Operating as Twin Pump Slave
2	Operating as Twin Pump Master, Spare Mode
3	Operating as Twin Pump Master, Synchronous Mode
4	Operating as Twin Pump Master, Alternating Mode

5. Alarm Status

The UPE pumps record alarm events in the Alarm Status Bits shown below. These events all result in the UPE entering the Alarm Standby Mode. In this mode the green diode at the pump is switched OFF and the red diode is switched ON. An automatic restart will occur if the cause of the alarm disappears. The Alarm Status Bits will then be cleared and the green diode will be switched ON again.
Notice! There are an exception to the behaviour described above. Faults that are not fatal for the pump will make the pump continue operation with the red diode on and the belonging Alarm Status Bit set.

Alarms preventing the UPE pump from starting			
`start_alarm1` (2, 64 / -), `start_alarm1_bak` (2, 73 / 56)			
bit No.	bit name	Low level description	High level description
0:	V_DC_MAX_ST_err	DC link voltage too high	Voltage high
1:	V_DC_MIN_ST_err	DC link voltage too low	Voltage low
2:	V_SUPP_MAX_ST_err	Internal supply voltage too high	Fault in electronics
3:	V_SUPP_MIN_ST_err	Internal supply voltage too low	Fault in electronics
4:	T_M_ST_err	Motor temperature too high	Pump temperature high
5:	T_E_ST_err	Electronics temperature too high	Pump temperature high
6:	T_W_ST_err	Water temperature too high	Water temperature high
7:	HW_ST_err	Hardware fault	Fault in electronics
`start_alarm2` (2, 65 / -), `start_alarm2_bak` (2, 74 / 57)			
bit No.	bit name	Low level description	High level description
0:	V_RIP_ST_err	DC link ripple curr. too high	Missing phase
1:	V_LINE_MAX_ST_err	Line voltage too high	Voltage high
2:	V_LINE_MIN_ST_err	Line voltage too low	Voltage low
3:	SW_ST_err	Software verification error	Fault in electronics
4:	I_LEAK_err	Leakage current too high	Leakage current
Alarms effecting a Quick Shut Down of the power electronics, pump stops			
`qsd_alarm1` (2, 66 / -), `qsd_alarm1_bak` (2, 75 / 58)			
bit No.	bit name	Low level description	High level description
0:	V_DC_MAX_QSD_err	DC link voltage too high	Voltage high
1:	V_DC_MIN_QSD_err	DC link voltage too low	Voltage low
2:	V_SUPP_MAX_QSD_err	Internal supply voltage too high	Fault in electronics
3:	V_SUPP_MAX_QSD_err	Internal supply voltage too low	Fault in electronics
4:	I_FAULT_QSD_err	Current too high	Overcurrent/Blocked pump
5:	FAULT_err	Hardware fault signal	Fault in electronics
6:	HSD_err	Hardware fault	Fault in electronics
Alarms effecting a stop of the pump			
`stop_alarm1` (2, 68 / -), `stop_alarm1_bak` (2, 77 / 60)			
bit No.	bit name	Low level description	High level description
0:	V_RIP_STOP_err	DC link ripple current too high	Missing phase
1:	BLOCKED_err	pump/motor blocked	Overcurrent/Blocked pump
2:	I_DC_STOP_err	DC link current too high	Overcurrent/Blocked pump
3:	I_MO_STOP_err	Motor current too high	Overcurrent/Blocked pump
4:	T_M_STOP_err	Motor temperature too high	Pump temperature high
5:	T_E_STOP_err	Electronics temperature too high	Pump temperature high
6:	T_W_STOP_err	Water temperature too high	Water temperature high
7:	MPF_STOP_err	Motor Protection Func. active	Overcurrent/Blocked pump
`stop_alarm2` (2, 69 / -), `stop_alarm2_bak` (2, 78 / 61)			
bit No.	bit name	Low level description	High level description
0:	FB_SIG_STOP_err	Feed back signal error	Sensor fault
1:	REF_SIG_STOP_err	Reference signal error	Setpoint signal fault
2:	-	-	-
3:	I_FAULT_STOP_err	Current too high	Overcurrent/Blocked pump
4:	INT_COM_STOP_err	Internal communication error	Fault in electronics
5:	RPM_MEAS_STOP_err	rpm measurement error	Fault in electronics
6:	SLIP_STOP_err	Motor slip too high	Overcurrent/Blocked pump

stop_alarm3 (2, 93 / -), stop_alarm3_bak (2, 96 / 64)			
bit No.	bit name	Low level description	High level description
2:	DRY_RUN_err	Too low current consumption	Dry running
3:	EE_STOP_err	Check sum error in EEPROM	Fault in electronics
Alarms effecting a survive action of the pump			
surv_alarm1 (2, 70 / -), surv_alarm1_bak (2, 79 / 62)			
bit No.	bit name	Low level description	High level description
0:	HW_SURV_err	Hardware survive error	Fault in electronics
surv_alarm2 (2, 71 / -), surv_alarm2_bak (2, 80 / 63)			
bit No.	bit name	Low level description	High level description
3:	FB_SIG_SURV_err	Feedback signal from sensor	pressure sensor error
5:	RPM_MEAS_SURV_err	Signal from rpm sensor	Fault in electronics
6:	TWIN_COMM_err	Twin pump bus connection error	Twin pump bus connection error
Indication only alarms			
ind_alarm (2, 72 / -), ind_alarm_bak (2, 46 / -)			
bit No.	bit name	Low level description	High level description
0:	EE_CHK_err	Check sum error in EEPROM	Fault in electronics
1:	EE_ACC_err	Access error in EEPROM	Fault in electronics
2:	PANEL_err	Bar graph hardware error	Fault in electronics

Table 3: *Alarm Status Bits*

Backup (bak) versions of the Alarm Status Bits will not be cleared automatically but will accumulate occurred alarms. The command RESET_ALARM is necessary to clear backed up alarms and to switch OFF the red diode.
(Notice that Unit Type 7 constitute an exception to this behaviour. When an automatic restart has successfully occurred the pump automatically acknowledges the alarm which means that backed up alarms are cleared and the red diode is switched OFF.)

`act_mode3` bits 0-2 (see paragraph 3) holds the information about the pump being in Alarm Standby or not. `act_mode3` bit 3 holds the information about the presence of unacknowledged alarms. This bit is set whenever the red LED is ON.

A secondary system for recording alarm events in the form of *codes* exist in the UPE unit_type 5, 6 and 7. The Data Items to use are listed and explained below. The interpretation of the codes are according to Table 4.

`alarm_code` (2, 158 / 66):
All alarms which cause the red LED to be ON are shown in `alarm_code`. This Data Item will be cleared when the pump makes an auto restart, or is forced to restart by the command RESET_ALARM. All faults leading to Alarm Standby or a survive action with both the red and the green diode on are recorded in `alarm_code`

`alarm_code_disp` (2, 155 / -):
A filtered version of `alarm_code` used to give a high level alarm interpretation. This will typically be the code for the Alarm Group (see page 6)..

`alarm_log#` (2, 159..163 / 67..71):
The Alarm Log contains the code for the 5 last occurred alarms. The *Unacknowledged Alarm* bit (act_mode3.3) tells if an unacknowledged alarm is pending. The cause for it can be found in `alarm_log1` which always contains the latest alarm. When a new alarm event occurs, it is added to the Alarm Log and the existing ones are pushed to the next position.

Code	Alarm Group	Alarm Cause
2		Missing Phase
32	Overvoltage	Overvoltage
40	Undervoltage	Undervoltage
48	Overload	Overload
49		Overcurrent (i_line, i_dc, i_mo)
51		Blocked motor/pump
56	Underload	Underload

57		Dry Running
58		Low Flow
64	Overtemperature	Overtemperature
65		Motor Temperature (t_m)
66		Control Electronics Temperature (t_e)
67		Power Converter Temperature (t_m)
68		External Temperature / Water Temperature (t_w)
72	Hardware Fault type 1	Hardware Fault type 1
73		Hardware Shut Down (HSD)
74		Internal Supply Voltage too high
75		Internal Supply Voltage too low
76		Internal Communication failure
77		Twin Pump Communication failure
152		Add On Module Communication Fault
80	Hardware Fault type 2	Hardware Fault type 2
83		FE Parameter Area Verification error (EEPROM)
85		BE Parameter Area Verification error (EEPROM)
88	Sensor Fault	Sensor Fault
89		(Feedback) Sensor 1 signal fault
90		RPM Sensor signal fault
91		Temperature Sensor signal fault
92		(Feedback) Sensor calibration fault

Table 4: *Numbering system used for* `alarm_code`

The status of the pump diodes (LED's) can be requested via the Data Item `led_contr` defined below:

`led_contr` **(2, 47 / 32)**

Controls indication LED's

Bit no	Description
1-0:	00: LED 1 (green) off
	01: LED 1 (green) on
	10: LED 1 (green) blinking
	11: -
3-2	00: LED 2 (red) off
	01: LED 2 (red) on
	10: LED 2 (red) blinking
	11: -

Green LED	Red LED	Cause	Alarm Relay*)
OFF	OFF	Power off or fault in mains connection	-
ON	OFF	System Mode Normal, Operation Mode Start	-
Flash	OFF	System Mode Normal, Operation Mode Stop	-
ON	ON	System Mode Normal and Operation Mode Start but 1) Unacknowledged alarm pending or 2) Survive alarm, e.g. pressure sensor fault	Active
Flash	ON	System Mode Normal and Operation Mode Stop but 1) Unacknowledged alarm pending or 2) Survive alarm, e.g. pressure sensor fault	Active
OFF	ON	System Mode Alarm Standby	Active

*) For small UPE's (unit type 3, 4 and 8) this is an add on module.

Table 5: *Interpretation of LED's and status of the Alarm Relay. Notice, that the relay status follows the ON condition of the red LED. Using 'NC' terminal at the relay means that active equals an open relay. Using 'NO' terminal means that active equals a closed relay.*

6. Physical values

In the table below the relevant physical values which a UPE pump can supply are listed.

Data Item	GENIbus		G100		Description
	Class, ID	scaling	subindex	scaling	
t_2hour_hi	2, 24	INFO	253	2h	Two hour operating time counter
t_2hour_lo	2, 25	low order			
t_e*)	2, 28	INFO	30	0.1 ºC	Electronics temperature
t_m	2, 29	INFO	31	0.1 ºC	Frequency converter module temperature.
t_w*)	2, 58	INFO	33	0.1 ºC	Water temperature
i_mo	2, 30	INFO	2	0.1 A	Motor current (not available for all types).
f_act	2, 32	INFO	251	1Hz / 1%	Control/Driving signal for pump
p	2, 34	INFO	5	1 W	Power
speed	2, 35	INFO	252	1 rpm	Speed
h	2, 37	INFO	7	0.1 m	Head feedback
q	2, 39	INFO	8	0.1 m^3/h	Flow measurement
p_max	2, 41	INFO	36	1 W	Maximum power.
q_max	2, 43	INFO	38	0.1 m^3/h	Maximum flow
h_max	2, 44	INFO	39	0.1 m	Maximum head
energy_hi	2, 152	INFO	254	1 kWh	Energy consumption
energy_lo	2, 153	low order			

*) Not all UPE types can supply these. Be sure to handle the value 255 (data not available) correctly.

***Table 6:** Physical values*

7. Control loop values

When the pump is in Remote Mode it can be controlled by the reference value `ref_rem` (5, 1 / 107). When the pump is in Local Mode, the local reference variable `ref_loc` (2, 40 / 9) is used, but may be attenuated by the external analogue input variable `ref_att_loc` (2, 61 / 16), which is an option on some UPE types. The figure shows how the resulting reference variable `sys_ref` is generated.

In Control Mode Constant Frequency this reference is applied directly as the frequency control signal `f_act` (2, 32 / 4) to the pump. In other words, setting the pump in Remote Mode and Constant Frequency Mode means that the pump frequency can be directly controlled from `ref_rem`. Management Systems where the pressure control takes place in the host must follow this procedure.

`ref_rem` can always be considered as an unscaled Data Item: [0; 254] corresponds to [0; 100%]. Notice! `ref_rem` cannot be read back from the pump - the value is so to speak "consumed". Attempts to do so will return the value 255, "data not available".

In Constant Pressure Mode (Command CONST_PRESS) the internal control loop in the pump is active and H'_{ref} is used as the reference. In Proportional Pressure Mode (Command PROP_PRESS) a flow proportional influence is applied to H'_{ref} before entering the pressure control loop. This gives the resulting proportional pressure control curves.

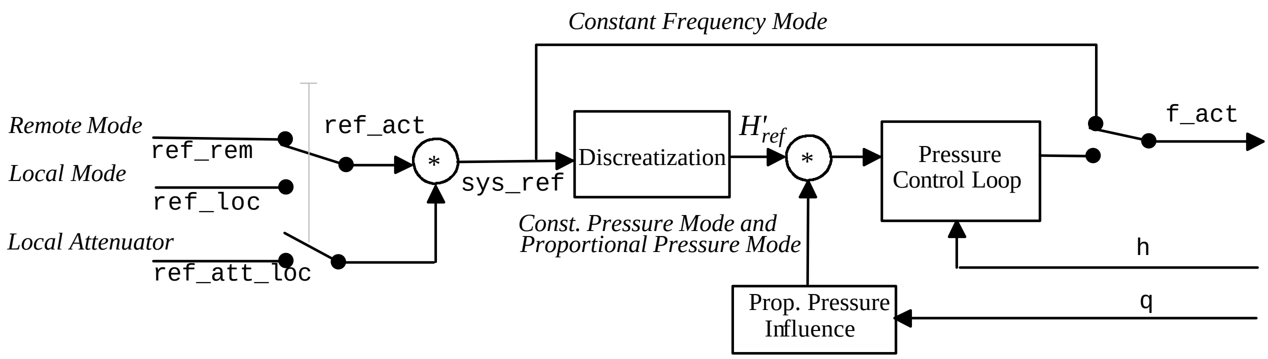


Figure 1: *Control loop model*.

When using one of the closed loop Control Modes `ref_rem` is discretizised in a number of steps (unit type 4 an 8 has 7 steps, unit type 1, 2, 3, 5 and 6 has 19 steps, unit type 7 has 10 or 5 steps). You can always read the number of steps for a given unit in the data item `ref_steps` (4, 87 / 116. The discrete steps are mapped into reference values, represented by H'_{ref}, evenly distributed between `h_const_ref_min` and `h_const_ref_max` (In Proportional Pressure Mode `h_prop_ref_min` and `h_prop_ref_max`). This is shown in figure 2. In the figure is also shown how `ref_rem` in Constant Frequency Mode is mapped directly and without discretization into `f_act` from the minimum curve to 100%. Notice that H'_{ref} is an internal value not represented by any requestable Data Item.

How the UPE Data Items are used for open and closed loop control will be illustrated by the example in chapter 10.

As described earlier, the pump will enter Local Mode in case it is not addressed for 6 s (for Unit Type 5, 6 and 7 it is 35 s). In this mode `ref_loc` will be the active reference value (and Operation Mode and Control Mode will be according to `loc_setup1`, see chap.. 3). In contrary to the local Operation Mode and Control Mode the local reference can be changed from the bus by writing the curve No. to `ref_ir`.

Data Item	GENIbus		G100		R/W	Description
	Class, ID	Scaling	sub index	Scaling		
`ref_rem`	5, 1	100%/254 1)	107	100%/254 1)	W	Remote (*GENIbus)* reference
`ref_ir`	5, 2	1-19, 1-10, 1-7 or 1-5 2)	110	1-19, 1-10, 1-7 or 1-5 2)	W	*GENIlink* (R100) reference
`ref_loc`	2, 40	as `h` or 100%/254 3)	9	0.1m or 0.1 % 8)	R	Local reference
`ref_act`	2, 48	as `h` or 100%/254 4)	10	0.1m or 0.1 % 9)	R	Actual reference
`ref_att_loc`	2, 61	100%/254 5)	16	0.1 % 10)	R	Attenuator signal (local analog)
`sys_ref`	2, 62	as `h` or 100%/254 4)	17	0.1m or 0.1 % 9)	R	System control loop reference
`f_act`	2, 32	INFO 6)	251	0.1 %	R	Driving signal
`curve_no_ref`	2, 97	1-10, 1-19 or 1-7 7)	27	1-10, 1-19 or 1-7 7)	R	Curve No. reference
`h_const_ref_min`	4, 83	as `h`	112	0.1 m	R	Const. Press. Mode min. reference
`h_const_ref_max`	4, 84	as `h`	113	0.1 m	R	Const. Press. Mode max. reference
`h_prop_ref_min`	4, 85	as `h`	114	0.1 m	R	Prop. Press. Mode min.reference
`h_prop_ref_max`	4, 86	as `h`	115	0.1 m	R	Prop. Press. Mode max. reference
`ref_steps`	4, 87	unscaled	116	unscaled	R	No. of discrete reference steps

1) Values 0-254 correspond to 0-100%
2) The data item only use a curve number as its legal value. Use `ref_steps` to see what the maximum number of curves is.
3) This data item use 0-254 to represent 0-100%. An exception is unit type 2 where the data item is scaled as h.
4) The data item is scaled as h for unit type 5, 6 and 7. Unit type 2 uses 0-254 to represent 0-100%. Not implemented in unit type 3, 4 and 8.
5) This data item use 0-254 to represent 0-100%. Not implemented in unit type 3, 4 and 8.
6) The data item is scaled in Hz (use INFO). Can also be used as a relative measure because values 0-254 always represent 0-100%
7) The data item only uses the discrete curve numbers. Use `ref_steps` to see what the maximum curve number is.
8) Unit type 2 is scaled in 0.1m. All others are scaled in 1%
9) The data item is scaled in 0.1m for unit type 5, 6 and 7. It is scaled in 1% for unit type 2 and not implemented in unit type 3, 4 and 8.
10) Not implemented in unit type 3, 4 and 8.

Table 7: *Data Items for open/closed loop control. Please notice that the four Data Items which are shown shaded, differs in implementation and scaling between the various UPE unit types. On GENIbus,use the reply to the INFO operation to decide how to process them.*

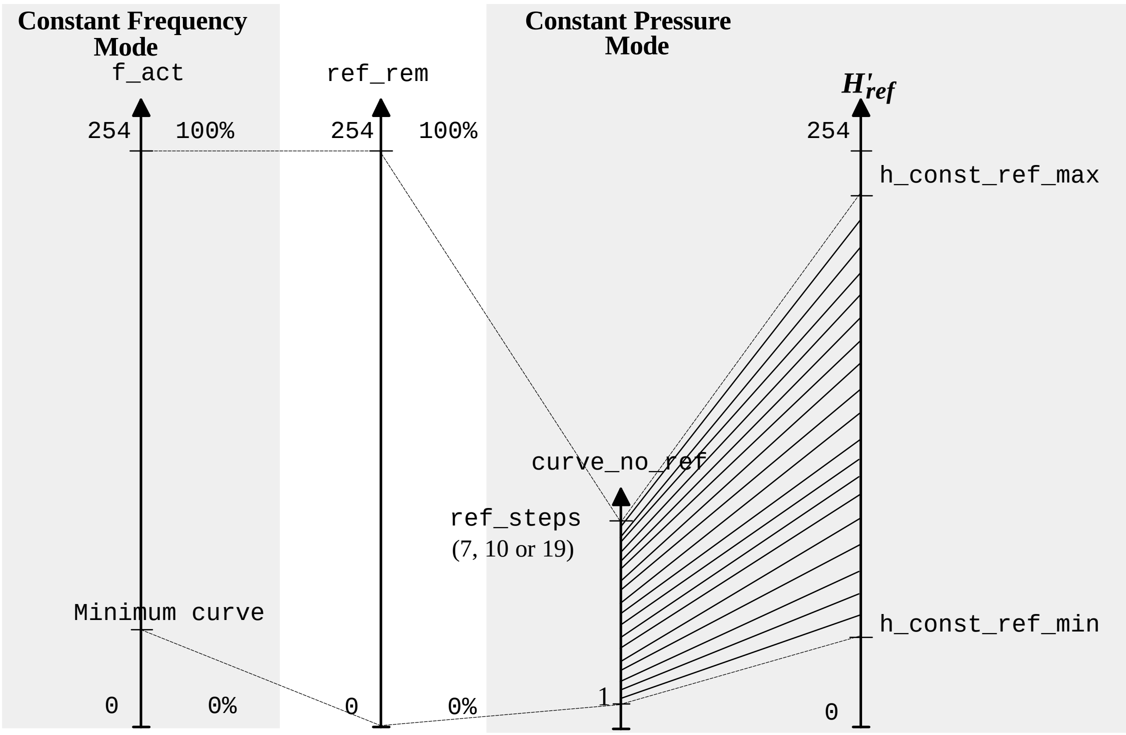


Figure 2: *Reference mapping in Constant Frequency Mode (open loop) and Constant Pressure Mode (closed loop). In Proportional Pressure Mode is h_const_ref_min replaced by h_prop_ref_min and h_const_ref_max is replaced by h_prop_ref_max.*

8. Considerations about Control Sources

While the bus Commands are ignored (except REMOTE) in Local Mode the Operation Mode Commands STOP and MAX from local sources are always active in Remote Mode. They are however prioritized according to the table below. This means e. g., if the pump is in Remote Mode and stopped from bus, it can be brought to the Operation Mode Max via buttons or *GENIlink* (R100). As seen in the table the external signals STOP and START (=not STOP) is also active in REMOTE. This means, that a pump in Remote Mode can be brought to Operation Mode Stop by the external signal STOP.

	Local Control Sources		Remote Control Sources	
Priority	**Buttons**	***GENIlink***	**External**	***GENIbus***
1	STOP	STOP		
2	MAX	MAX		
3			STOP	STOP
4			MAX	MAX
5	MIN	MIN	MIN	MIN
6	START	START		START

Disabled in Local Mode

Disabled in Remote Mode

Table 8: *Command source priorities*

As seen from the scheme, the pump does not react to external signals MAX and MIN when in Remote Mode. If these signals should lead to any action it is the responsibility of the Management System to implement this. The information about active external signals and which control source is currently controlling the active Operation Mode can be requested from the below Data Items.

`extern_inputs` (2, 89 / 23)

The logical value of all the external control signals.

Bit no	Description	
4	0: STOP inactive	1: STOP active
5	0: MIN inactive	1: MIN active
6	0: MAX inactive	1: MAX active

`contr_source` (2, 90 / 24)

Registration of the control source currently active.

Bit no	Description		
3-0	priority of active command from active source (values from 1 to 6, low value is high priority)		
4-7	active source:	0001:	Buttons
		0010:	*GENIbus*
		0011:	*GENIlink*
		0100:	External control

It is <u>not</u> possible to change the local Operation Mode or Control Mode from the bus. The local setpoint (reference curve) however can be changed by writing to the same reference value as R100 uses. Put the pump in Local Mode by the use of the LOCAL Command, next write the setpoint (curve number 1-19, 1-10 or 1-7) to the Data Item `ref_ir` (5, 2 / 108). Alternatively use the REF_UP or REF_DOWN command to step the local reference curve up or down when the pump is in Local Mode.

9. Control of UPE from a Managment System (SCADA)

When controlling the pump via GENIbus the Managment System need to get scaling information from the pump(s) once when the Managment System software is initializing. A telegram requesting INFO from the scaleable data items is used (e. g. figure 6).

A *GENIbus* System of UPE pumps can be supervised and controlled by using a frequent request (once per 1-5 sec) of Data Items which reflect the status of the pump. The telegram in figure 5 is an example.

Control or operator actions to take care of by the management system for each individual pump is

Mode Handling

If Source Mode is incorrect, correct it with REMOTE/LOCAL Commands
If Operation Mode is incorrect, correct it with STOP/START/MIN/MAX Commands
If Control Mode is incorrect, correct it with CONST_FREQ / CONST_PRESS / PROP_PRESS / AUTOMATIC Commands.

Pressure Control

Loop closed in Management System, UPE in Constant Frequency Control Mode
Feed pressure setpoint and measured value `h` to controller algoritm. Send new control signal value to `ref_rem`

Loop closed in UPE, UPE in Constant/Proportional Pressure Control Mode
Send pressure setpoint to `ref_rem`

Handling of Operator Inputs

The management system software defines which mode changes should be possible from the operators interface (e.g. keyboard). The inputs are processed and will result in telegrams (like figure 7) which write data to the UPEE.

Handling of alarms

The management system records alarms when they occur and maybe it logs them with a time stamp. The system should also provide a user with the possibility of resetting the alarm.

Pump Configuration

The management system gives the possibility to change user related pump settings by writing to the most important configuration parameters. A telegram like figure 8 can be used.

10. An Application Example: A Complete UPE Control Panel

Below is an example of a control panel for operation and monitoring of a UPE pump that can be realised by using bus communication either directly with GENIbus or via G100. Such a panel can be designed in many other ways than shown here. It can also be simpler with less data and functionality or it can be more advanced utilising more of the data items from the functional profile. In the following it will be explained how the displayed functionality is implemented by reading and writing the related data items. The operations on the data items are identical whether the GENIbus protocol is used or the communication takes place via G100. The telegram format is however different in the two cases. The telegram examples given will be for the GENIbus protocol only.

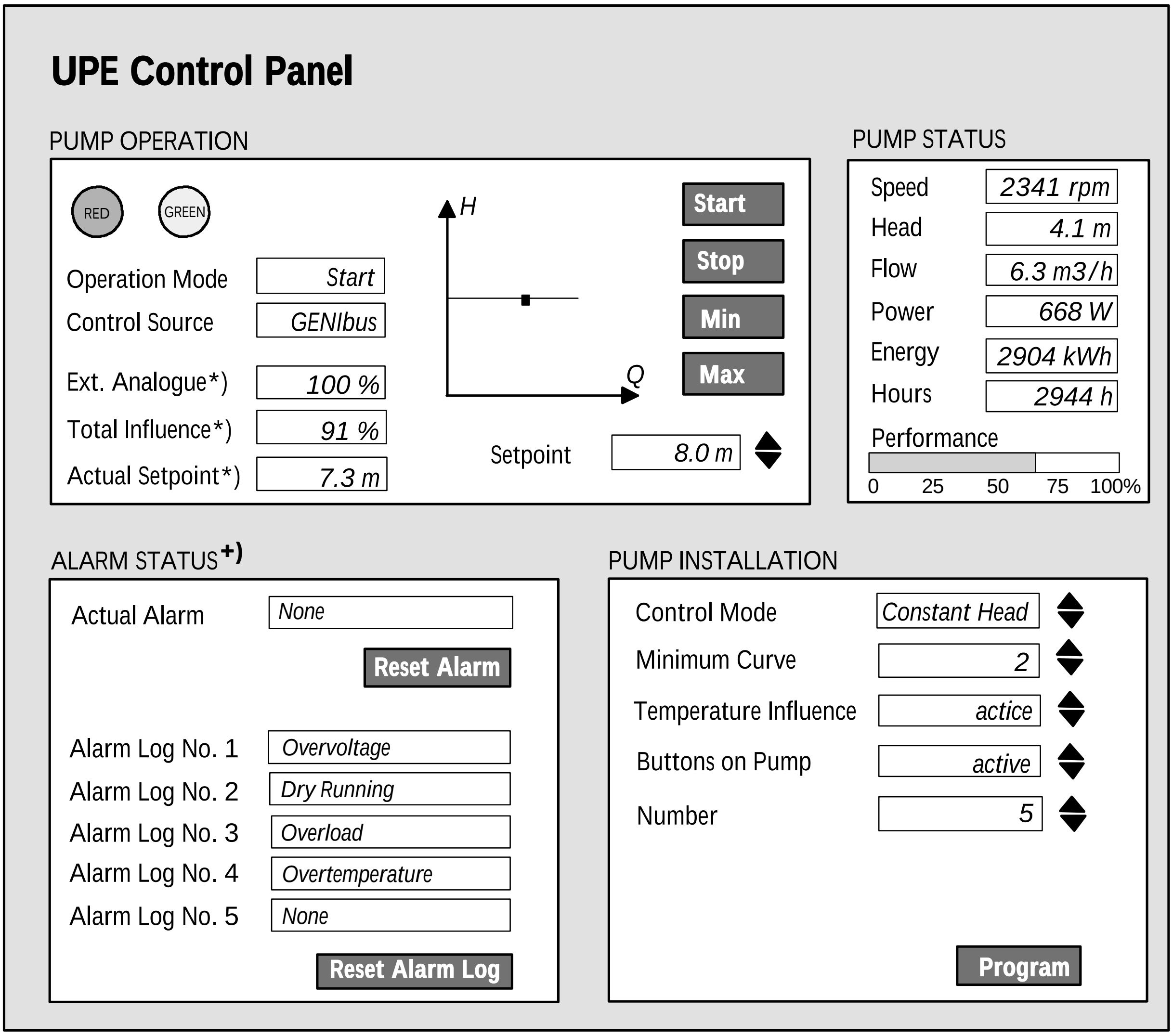


***Figure 4**: UPE control panel example.*

**) The data items which supplies these data are <u>not</u> available for UPE unit type 1, 2, 3, 4 and 8*

+) The data items which supplies these data (table 4) are <u>not</u> available for UPE unit type 1, 2, 3, 4, 6 and 8. Instead alarm status bits from table 3, which are available for all types, can be used for the actual alarm.

10.1 The Pump Operation Window

Reading data:

- The status of the red and green diode can be read directly from **`led_contr`**
- The Operation Mode can be read directly from **`act_mode1`**
- The Control Source can be read directly from **`contr_source`**

- The External Analogue Input can be read directly from **`ref_att_loc`**
- The Total Setpoint Influence (from water temperature, flow proportionality and External Analogue Input together) can be read directly from **`ref_inf`**.
- The actual setpoint is read from **`sys_ref`** (exclude this for UPE's of unit type 1, 2, 3, 4 and 8 where the Data Item is not scaled in m)
- The setpoint value in control mode Constant Head or Proportional Head can only take a number of discrete steps (the total number can be read from **`ref_steps`** and the actual number from **`curve_no_ref)`**. Calculation of the setpoint can be done from the following formula:

  Control Mode Constant Head:
  H_{set} = (curve_no_ref / ref_steps) * (h_const_ref_max - h_const_ref_min) + h_const_ref_min

  The head values are all scaled like **h** so for GENIbus you multiply the resulting value with UNIT(**h**)*RANGE(**h**) to get H_{set} in meters and for G100 you multiply by the **h** scaling.

  Control Mode Proportional Head: The head values are all scaled like **h**.
  H_{set} = (curve_no_ref / ref_steps) * (h_prop_ref_max - h_prop_ref_min) + h_prop_ref_min

  The head values are all scaled like **h** so for GENIbus you multiply the resulting value with UNIT(**h**)*RANGE(**h**) to get H_{set} in meters and for G100 you multiply by the **h** scaling.

  Control Mode Constant Frequency: the frequency setpoint can be changed without discretisation.
  F_{set} = 100% * (f_act/254)
- The (Q,H) diagram can be made from the reading of **h** and **q**. The axis can be scaled according to **h_max** and **q_max**

Writing Data:

- The change of setpoint is done by writing to **`ref_rem`** .

When stepping up and down you actually step between curve numbers. You display the setpoint in [m] by using the H_{set} (or F_{set} formula) and you write the following value to the pump:

`ref_rem` = (254 * `curve_no_ref` - 127) / `ref_steps`

- The Operation mode is changed by clicking the command buttons (Start, Stop, Min, Max). Each of them launches the belonging command.

10.2 The Pump Status Window

Reading data:

- speed, head, flow, power, energy and hours, can be requested from the data items **`speed`**, **`h`**, **`q`**, **`p`**, **`energy`** and **`t_2hour`**
- The relative pump performance in % (here shown as a bar graph) can be requested from **`f_act`**

10.3 The Alarm Status Window

Reading data:

- The actual alarm can be requested from **`alarm_code`**
  The logged alarms can be requested from the data items **`alarm_log_1`**, **`alarm_log_2`**, **`alarm_log_3`**, **`alarm_log_4`**, **`alarm_log_5`**

NOTICE! only UPE `unit_type` 5, 6 and 7 support the alarm log data items mentioned here. A general operator interface have to use the data items from table 3 and abstain from showing an alarm log.

Writing data:

- Reset the alarm and make the pump attempt a restart with the command RESET_ALARM
- Clear the alarm log with the command RESET_ALARM_LOG

10.4 The Pump Installation Window

Reading data:

- Status of the Control Mode is read from **act_mode1**
- Status of the Minimum Curve, the Temperature Influence and of the buttons on the pump is read from **act_mode2**
- Status of the pump number is read from **unit_addr** - 31

Writing Data:

- Control mode is changed with the commands CONST_FREQ, CONST_PRESS and PROP_PRESS
- The Minimum Curve is changed by writing to **min_curve_no**, value range is [0; 1]
- Enabling and disabling of the Temperature Influence is done with the commands INFLUENCE_E, INFLUENCE_D
- Enabling and disabling of the buttons on the pump is done with LOCK_KEYS, UNLOCK_KEYS
- The pump number is changed by writing to the data item **unit_addr** = Pump No. + 31

10.5 Telegrams

All the examples assumes a master with GENIbus address 0x04 and a UPE pump with GENIbus address 0x20 (corresponding to No. 1 given with the remote controller R100).

Data Request

Start Delimiter	0x27
Length	0x1F
Destination Address	0x20
Source Address	0x04
Class 2: Measured Data	0x02
OS=0 (GET), Length=27	0x1B
act_mode1 = ID 81	0x51
act_mode2 = ID 82	0x52
act_mode3 = ID 83	0x53
led_contr = ID 47	0x2F
ref_act = ID 48	0x30
ref_inf = ID 49	0x31
ref_att_loc = ID 61	0x3D
sys_ref = ID 62	0x3E
h = ID 37	0x25
q = ID 39	0x27
h_max = ID 44	0x2C
q_max = ID 43	0x2B
2hour_hi = ID 24	0x18
2hour_lo = ID 25	0x19
contr_source = ID 90	0x5A
ref_steps = ID 87	0x57
p = ID 34	0x22
energy_hi = ID 152	0x98
energy_lo = ID 153	0x99
speed = ID 35	0x23
curve_no_ref = ID 97	0x61
alarm_code = ID 158	0x9E
alarm_log1 = ID 159	0x9F
alarm_log2 = ID 160	0xA0
alarm_log3 = ID 161	0xA1
alarm_log4 = ID 162	0xA2
alarm_log5 = ID 163	0xA3
CRC high	0x4B
CRC low	0x8D

Data Reply

Start Delimiter	0x24
Length	0x1F
Destination Address	0x04
Source Address	0x20
Class 2: Measured Data	0x02
Ack.=0 (OK), Length=27	0x1B
value example of act_mode1	0x10
value example of act_mode2	0x00
value example of act_mode3	0x00
value example of led_contr	0x01
value example of ref_act	0xA5
value example of ref_inf	0xFE
value example of ref_att_loc	0xFE
value example of sys_ref	0x94
value example of h	0x7B
value example of q	0x23
value example of h_max	0xCD
value example of q_max	0xB4
value example of 2hour_hi	0x0B
value example of 2hour_lo	0x80
value example of contr_source	0x22
value example of ref_steps	0x13
value example of p	0xE9
value example of energy_cons_hi	0x0C
value example of energy_cons_lo	0xE7
value example of speed	0xA5
value example of curve_no_ref	0x0E
value example of alarm_code	0x00
value example of alarm_log1	0x20
value example of alarm_log2	0x39
value example of alarm_log3	0x30
value example of alarm_log4	0x40
value example of alarm_log5	0x00
CRC high	0x19
CRC low	0x6D

Figure 5: *Telegram used to request all status values needed by the control panel. This telegram should be repeated cyclically to keep the status information updated.*

Data Request

Start Delimiter	0x27
Length	0x09
Destination Address	0x20
Source Address	0x04
Class 2: Measured Data	0x02
OS=3 (INFO), Length=5	0xC5
`h` = ID 37	0x25
`q` = ID 39	0x27
`p` = ID 34	0x22
`speed` = ID 35	0x23
`energy_hi` = ID 152	0x98
CRC high	0xFA
CRC low	0xA9

Data Reply

Start Delimiter	0x24
Length	0x18
Destination Address	0x04
Source Address	0x20
Class 2: Measured Data	0x02
Ack.=0 (OK), Length=20	0x14
`h` INFO Head	0x82
`h` UNIT	0x19
`h` ZERO	0x00
`h` RANGE	0x0C
`q` INFO Head	0x82
`q` UNIT	0x17
`q` ZERO	0x00
`q` RANGE	0x20
`p` INFO Head	0x82
`p` UNIT	0x09
`p` ZERO	0x00
`p` RANGE	0x28
`speed` INFO Head	0x82
`speed` UNIT	0x13
`speed` ZERO	0x00
`speed` RANGE	0x24
`energy_hi` INFO Head	0x82
`energy_hi` UNIT	0x2F
`energy_hi` ZERO	0x00
`energy_hi` RANGE	0xFE
CRC high	0xD9
CRC low	0xBF

Figure 6: *Telegram sent once to request all necessary scaling information for the status values in the control panel. A priori knowledge that h and h_max, q and q_max are scaled identically is used to minimise the size of the telegram.*

Data Request

Start Delimiter	0x27
Length	0x09
Destination Address	0x20
Source Address	0x04
Class 3: Commands	0x03
OS=2 (SET), Length=1	0x81
`START` = ID 6	0x06
Class 5: Reference Values	0x05
OS=2 (SET), Length=2	0x82
`ref_rem` = ID 1	0x01
`ref_rem` value example 65%	0xA5
CRC high	0x28
CRC low	0xDF

Data Reply

Start Delimiter	0x24
Length	0x06
Destination Address	0x04
Source Address	0x20
Class 3: Commands	0x03
Ack.=0 (OK), Length=0	0x00
Class 5: Reference Values	0x05
Ack.=0 (OK), Length=0	0x00
CRC high	0xC5
CRC low	0x28

Figure 7: *Telegram used to send a command and to write a new frequency reference (setpoint). This could also have been done in two seperate telegrams.*

Data Request

Start Delimiter	0x27
Length	0x0D
Destination Address	0x20
Source Address	0x04
Class 3: Commands	0x03
OS=2 (SET), Length=3	0x83
`CONST_PRESS` = ID 6	0x06
`INFLUENCE_E` = ID 28	0x1C
`UNLOCK_KEYS` = ID 31	0x1F
Class 4: Configuration Parameters	0x04
OS=2 (SET), Length=4	0x84
`min_curve_no` = ID 74	0x01
value example = 1 (min curve 2)	0x01
`unit_addr` = ID 46	0x2E
value example = 36 (No. 5)	0x24
CRC high	0x50
CRC low	0x62

Data Reply

Start Delimiter	0x24
Length	0x06
Destination Address	0x04
Source Address	0x20
Class 3: Commands	0x03
Ack.=0 (OK), Length=0	0x00
Class 4: Configuration Parameters	0x04
Ack.=0 (OK), Length=0	0x00
CRC high	0xF6
CRC low	0x19

Figure 8: *Telegram used to give the pump the setting (configuration) shown in the control panel. This could also have been done in two seperate telegrams.*

10.6 G100 Telegram Examples

Block Read Request

Position	Value [Hex]	Description
STX	2	Start delimiter
TGM_LENGTH_HI	0	Total telegram length
TGM_LENGTH_LO	16	
COM_REF	0	G100 broadcast address
INVOKE_ID	0	don't care
SERVICE	E	Read multiple objects
PRIMITIVE	0	Request
OBJ_LENGTH_HI	0	Length of object field
OBJ_LENGTH_LO	A	
NO_OF_INDICES	3	Total No. of indices
INDEX_HI	21	Unit address 0x20
INDEX_LO	20	(No. 1)
SUB_INDEX	5	**p** (power)
INDEX_HI	21	Unit address 0x20
INDEX_LO	20	(No. 1)
SUB_INDEX	7	**q** (flow)
INDEX_HI	21	Unit address 0x20
INDEX_LO	20	(No. 1)
SUB_INDEX	8	**h** (head)
ETX	3	End delimiter
CHK_SUM_HI	1B	XOR check sum
CHK_SUM_LO	AA	always AA

Block Read Reply

Position	Value [Hex]	Description
STX	2	Start delimiter
TGM_LENGTH_HI	0	Total telegram length
TGM_LENGTH_LO	1B	
COM_REF	0	G100 broadcast address
INVOKE_ID	0	don't care
SERVICE	E	Read multiple objects
PRIMITIVE	1	Reply
OBJ_LENGTH_HI	0	Length of object field
OBJ_LENGTH_LO	F	
RESULT	0	0=OK; FF=error
ERROR_CLASS	0	
ERROR_CODE	0	
ADD_CODE_HI	0	Not used, always 0
ADD_CODE_LO	0	
LENGTH	9	Length of all objects
OBJ_1_LENGTH	2	Length of object 1 data
OBJ_1_DATA	A4	Value example of **p**
	36	(power) in W
OBJ_2_LENGTH	2	Length of object 2 data
OBJ_2_DATA	12	Value example of **q**
	EF	(flow) in 0.1 m^3/h
OBJ_2_LENGTH	2	Length of object 2 data
OBJ_2_DATA	50	Value example of **h**
	0B	(head) in 0.1 m
ETX	3	End delimiter
CHK_SUM_HI	25	XOR check sum
CHK_SUM_LO	AA	always AA

Figure 9: *G100 Protocol telegram used to request 3 data items from a UPE pump having GENIbus address 0x20 (corresponding to No. 1 given with R100).*

Write Request

Position	Value [Hex]	Description
STX	2	Start delimiter
TGM_LENGTH_HI	0	Total telegram length
TGM_LENGTH_LO	11	
COM_REF	0	G100 broadcast address
INVOKE_ID	0	don't care
SERVICE	3	Write object
PRIMITIVE	0	Request
OBJ_LENGTH_HI	0	Length of object field
OBJ_LENGTH_LO	5	
INDEX_HI	21	Unit address 0x20 (No. 1)
INDEX_LO	20	
SUB_INDEX	4E	**START** command
LENGTH	1	Length of object data
OBJECT_DATA	0	the value of a command is don't care
ETX	3	End delimiter
CHK_SUM_HI	58	XOR check sum
CHK_SUM_LO	AA	always AA

Write Reply

Position	Value [Hex]	Description
STX	2	Start delimiter
TGM_LENGTH_HI	0	Total telegram length
TGM_LENGTH_LO	11	
COM_REF	0	G100 broadcast address
INVOKE_ID	0	don't care
SERVICE	3	Write object
PRIMITIVE	1	Reply
OBJ_LENGTH_HI	0	Length of object field
OBJ_LENGTH_LO	5	
RESULT	0	0=OK; FF=error
ERROR_CLASS	0	
ERROR_CODE	0	
ADD_CODE_HI	0	Not used, always 0
ADD_CODE_LO	0	
ETX	3	End delimiter
CHK_SUM_HI	17	XOR check sum
CHK_SUM_LO	AA	always AA

Figure 10: *G100 Protocol telegram used to send a command to a UPE pump having GENIbus address 0x20 (corresponding to No. 1 given with R100). Remember to use the REMOTE command first to put the pump in Remote Mode.*

10.7 Using the G100 telegram examples for Profibus

The telegrams in figure 9 - 10 are for the G100 protocol. With the following small modifications the same telegrams can be used as (embedded) Profibus telegrams, see also /8/:

STX	is substituted with COUNT
TGM_LENGTH_HI / TGM_LENGTH_LO	is removed
COM_REF	is a don't care value
ETX	is removed
CHK_SUM_HI / CHK_SUM_LO	Added sum of the complete telegram (except the sum itself) (In the software profibusV04.bin the use of checksum for Profibus DP communication is optional in the request telegram)

11. Application Example: Simple UPE Operation

It is assumed that four requirements to the UPE operation from bus has to be fulfilled.

Requiremt #1: The pump should operate according to its local setting (R100 or +/- buttons)

Let the pump operate in Local Mode (default when powered on). In this way it will keep operating with its local value of setpoint, Operation Mode and Control Mode.

Requiremt #2: All relevant data like flow, pressure, speed, etc. should be shown on a screen

You can read all the Data Items you want and show them on an operator screen or display. Let chapter 10 be an inspiration to you.

Requiremt #3: It must be possible to change the Operation Mode from the bus

When you want to change the Operation Mode via the bus, you send the REMOTE command followed by the Operation Mode command (STOP, MAX, MIN) you want. Remember that, as long as the pump is in Remote Mode it has to be polled at least every 6'th second not to fall back into Local Mode.

When you again want the pump to operate according to the local settings you just send the LOCAL command.

Requiremt #4:The Local setpoint should be modifiable from the bus

By writing the wanted curve No. to **`ref_ir`** (5, 2 / 108) you can change the local setpoint in a total of **`ref_steps`** (4, 87 / 116) discrete steps.

12. References

Reference	Document Title	Document File
/1/	GENIbus Protocol Specification	genispec.pdf
/2/	GENIbus Managment Master Driver (DLL) for W95/NT/W2000	man_mast.pdf
/3/	G100 Data Access and Data Organisation	g100data.pdf*)
/4/	G100 Protocol Specification	g100prot.pdf*)
/5/	G100 Object Reference Specification	objref..pdf*)
/6/	Accessing G100 via the Satt Control Comli Protocol	comli.pdf*)
/7/	Accessing G100 via MODbus	modbus.pdf*)
/8/	Accessing G100 via Profibus-DP	profibus.pdf*)

*) Included on the G100 Support Files CD ROM

13. Data Item overview

Explanation to used abbreviations:

INFO: Using INFO operation at GENIbus will return scaling information UNIT, RANGE, ZERO
unsca.: The Data Item is unscaled (e.g. a number, a counter, etc.)
lo: At GENIbus this is the low order byte to a 16 bit value. Scaling follows high order
bits: The Data Item is bit interpreted. The bit interpretation explained in the text chapters
<unit>: The Data Item has this unit (with a possible prefix and factor) as its fixed scaling

Identifier	GENIbus		G100		R/W	Description
	Class, ID	Scaling	Sub-index	Scaling		
t_2hour_hi	2, 24	INFO	253	2 h	R	Two hour counter high/low order byte
t_2hour_lo	2, 25	lo				
i_dc	2, 26	INFO	1	0.1 A	R	Frequency converter DC link current
v_dc	2, 27	INFO	29	0.1 V	R	Frequency converter DC link voltage
t_e	2, 28	INFO	30	0.1 C	R	Temperature in control electronics
t_m	2, 29	INFO	31	0.1 C	R	Temp. in motor or in frequency converter module
i_mo	2, 30	INFO	2	0.1 A	R	Motor current
i_line	2, 31	INFO	3	0.1 A	R	Mains supply current
f_act	2, 32	100% / 254	251	0.1 %	R	Actual control signal (freq. or voltage) applied to pump
p	2, 34	INFO	5	1 W	R	Power consumption
speed	2, 35	INFO	252	1 rpm	R	Pump speed
h	2, 37	INFO	7	0.1 m	R	Actual pump head
q	2, 39	INFO	8	0.1 m^3/h	R	Actual pump flow
ref_loc	2, 40	INFO	9	0.1 m / 0.1 %	R	Local reference setting
p_max	2, 41	INFO	36	1 W	R	Maximum power consumption
q_kn1	2, 42	INFO	37	0.1 m^3/h	R	Minimum possible flow at maximum power consum.
q_max	2, 43	INFO	38	0.1 m^3/h	R	Maximum possible flow at maximum power consum.
h_max	2, 44	INFO	39	0.1 m	R	Maximum pump head (closed valve)
ind_alarm_bak	2, 46	bits	-	-	R	Back up byte to indication alarm
led_contr	2, 47	bits	32	-	R	Status of green and red indication diodes
ref_act	2, 48	INFO	10	0.1 m / 0.1 %	R	Actual reference
ref_inf	2, 49	100% / 254	11	1 %	R	Reference influence
t_w	2, 58	INFO	33	0.1 C	R	Water temperature
ref_att_loc	2, 61	100%/ 254	16	0.1 %	R	Local reference attenuator input
sys_ref	2, 62	INFO	17	0.1 m / 0.1 %	R	Selected system control loop reference
start_alarm1	2, 64	bits	-	-	R	Start Alarm No. 1 . See text
start_alarm2	2, 65	bits	-	-	R	Start Alarm No. 2 . See text
qsd_alarm1	2, 66	bits	-	-	R	Quick Shot Down Alarm No. 1 . See text
qsd_alarm2	2, 67	bits	-	-	R	Quick Shot Down Alarm No. 2 . See text
stop_alarm1	2, 68	bits	-	-	R	Stop Alarm No. 1. See text
stop_alarm2	2, 69	bits	-	-	R	Stop Alarm No. 2. See text
surv_alarm1	2, 70	bits	-	-	R	Survive Alarm No.1. See text
surv_alarm2	2, 71	bits	-	-	R	Survive Alarm No.2. See text
ind_alarm	2, 72	bits	-	-	R	Indication Alarm. See text
start_alarm1_bak	2, 73	bits	56	bits	R	Start Alarm No. 1 backup. See text
start_alarm2_bak	2, 74	bits	57	bits	R	Start Alarm No. 2 backup. See text
qsd_alarm1_bak	2, 75	bits	58	bits	R	Quick Shot Down Alarm No. 1 backup. See text
qsd_alarm2_bak	2, 76	bits	59	bits	R	Quick Shot Down Alarm No. 2 backup. See text
stop_alarm1_bak	2, 77	bits	60	bits	R	Stop Alarm No. 1 backup. See text
stop_alarm2_bak	2, 78	bits	61	bits	R	Stop Alarm No. 2 backup. See text
surv_alarm1_bak	2, 79	bits	62	bits	R	Survive Alarm No.1 backup. See text
surv_alarm2_bak	2, 80	bits	63	bits	R	Survive Alarm No.2 backup. See text
act_mode1	2, 81	bits	18	bits	R	Actual Mode Status No. 1. See text
act_mode2	2, 82	bits	19	bits	R	Actual Mode Status No. 2. See text
act_mode3	2, 83	bits	20	bits	R	Actual Mode Status No. 3. See text
loc_setup1	2, 85	bits	21	bits	R	Local setup. See text
rem_setup1	2, 87	bits	22	bits	R	Remote setup. See text
extern_inputs	2, 89	bits	23	bits	R	Logical value of all external control inputs. See text
contr_source	2, 90	bits	24	bits	R	Currently active contr. source and priority. See text
stop_alarm3	2, 93	bits	-	-	R	Stop Alarm No. 3. See text
stop_alarm3_bak	2, 96	bits	64	bits	R	Stop Alarm No. 3 backup. See text
curve_no_ref	2, 97	unsca	27	unsca	R	Selected curve No. (LED bar indicator No.)
contr_ref	2, 147	unsca	-	-	R	Control loop reference
unit_family	2, 148	unsca	40	unsca	R	Unit family code
unit_type	2, 149	unsca	41	unsca	R	Unit type code
unit_version	2, 150	unsca	42	unsca	R	Unit version code
energy_hi	2, 152	INFO	254	1 kWh	R	Accumulated electric energy consumption
energy_lo	2, 153	lo				
alarm_code_disp	2, 155	bits	-	-	R	Interpreted (filtered) version of alarm_code
alarm_code	2, 158	bits	66	bits	R	Actual alarm
alarm_log_1	2, 159	bits	67	bits	R	Logged alarm code No. 1
alarm_log_2	2, 160	bits	68	bits	R	Logged alarm code No. 2
alarm_log_3	2, 161	bits	69	bits	R	Logged alarm code No. 3
alarm_log_4	2, 162	bits	70	bits	R	Logged alarm code No. 4
alarm_log_5	2, 163	bits	71	bits	R	Logged alarm code No. 5
twin_pump_mode	2, 166	bits	-	-	-	Twin Pump Mode, UPED's only. See text
RESET	3, 1	-	75	-	W	Hardware resets the pump
RESET_ALARM	3, 2	-	76	-	W	Resets pending alarm and attempts a restart
USER_BOOT	3, 4	-	-	-	W	Returns to factory setting. Pump must be stopped
STOP	3, 5	-	77	-	W	Stops the pump (*Operation Mode* **Stop**)
START	3, 6	-	78	-	W	Starts the pump (*Operation Mode* **Start**)
REMOTE	3, 7	-	79	-	W	Switch to **Remote Mode**
LOCAL	3, 8	-	80	-	W	Switch to **Local Mode**
RUN	3, 9	-	-	-	W	**Run Mode**, only for factory use
PROGRAM	3, 10	-	-	-	W	**Programming Mode**, only for factory use

CONST_FREQ	3, 22	-	85	-	W	Sets the pump in Control Mode **Const. Frequency**
PROP_PRESS	3, 23	-	86	-	W	Sets the pump in Control Mode **Proportional Press**.
CONST_PRESS	3, 24	-	87	-	W	Sets the pump in Control Mode **Constant Pressure**
MIN	3, 25	-	88	-	W	Pump running on min. curve (*Operation Mode* **Min**)
MAX	3, 26	-	89	-	W	Pump running on max. curve (*Oper. Mode* **Max**)
INFLUENCE_E	3, 28	-	-	-	W	Enables temperature influence
INFLUENCE_D	3, 29	-	-	-	W	Enables temperature influence
LOCK_KEYS	3, 30	-	90	-	W	Keys Setting is Locked (buttons at pump disabled)
UNLOCK_KEYS	3, 31	-	91	-	W	Keys Setting is Unlocked (buttons at pump enabled)
REF_UP	3, 33	-	93	-	W	Increases setpoint one step, like pressing + button
REF_DOWN	3, 34	-	94	-	W	Decreases setpoint one step, like pressing - button
RESET_HIST	3, 36	-	95	-	W	Resets kWh- and h-counter. Pump must be stopped
RESET_ALARM_LOG	3, 51	-	102	-	W	Resets the alarm log
AUTOMATIC	3, 52	-	103	-	W	Sets the pump in Control Mode **Automatic**
TWIN_MODE_SPARE	3, 58	-	104	-	W	Twin Pump Mode **Spare**
TWIN_MODE_ALT	3, 59	-	105	-	W	Twin Pump Mode **Alternating**
TWIN_MODE_SYNC	3, 60	-	106	-	W	Twin Pump Mode **Syncrouneous**
NIGHT_REDUCT_E[+)]	3, 66	-	-	-	W	Enables **Night Reduction**
NIGHT_REDUCT_D[+)]	3, 67	-	-	-	W	Disables **Night Reduction**
unit_addr	4, 46	unsca	47	unsca	R/W	GENIbus/GENIlink unit address
group_addr	4, 47	unsca	48	unsca	R/W	GENIbus group address
min_curve_no	4, 74	unsca.	-	-	R/W	Minimum curve No.
h_const_ref_min	4, 83	INFO	112	0.1 m	R/W	Constant Pressure Mode minimum reference
h_const_ref_max	4, 84	INFO	113	0.1 m	R/W	Constant Pressure Mode maximum reference
h_prop_ref_min	4, 85	INFO	114	0.1 m	R/W	Proportional Pressure Mode minimum reference
h_prop_ref_max	4, 86	INFO	115	0.1 m	R/W	Proportional Pressure Mode maximum reference
ref_steps	4, 87	unsca	116	unscale.	R/W	No. of discrete reference steps
ref_rem	5, 1	100%/ 254	107	100 % / 254	W	GENIbus setpoint (Remote reference)
ref_ir	5, 2	1-19, 1-10 or 1-7	108	1-19, 1-10 or 1-7	W	GENIlink setpoint (curve No.)
ref_att_rem	5,19	100%/ 254	111	100%/ 254	W	Remote reference attenuation
product_name	7, 1	-	-	-	R	e.g. CS2600
software_name1	7, 3	-	-	-	R	e.g. CS2600 Front End
compile_date1	7, 4	-	-	-	R	e.g. Feb 14 00
protocol_code	7, 5	-	-	-	R	e.g. GENIpro v2.00 SB
Developers	7, 7	-	-	-	R	e.g. JRL NJS
rtos_code	7, 12	-	-	-	R	e.g. RTOS v0.97