USER'S MANUAL

NEG Pump Controller Ver. 1.1 and Ver 1.1 Procom

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1. GENERAL INFORMATION

1.1. Symbols Used in This Manual



IMPORTANT INFORMATION !
Calls attention to an important operating procedure, practice, condition, or the like.



WARNING !
Denotes a hazard to personnel. A failure to observe the instruction could result in injury or death.



CAUTION !
Denotes a hazard to equipment. A failure to observe the instruction could result in damage to the equipment and process.

1.2. Scope of This Manual

This manual provides information about the installation, operation and maintenance for the NEG Pump Controller Ver. 1.1. and NEG Pump Controller Ver. 1.1. PROCOM. This instrument must be used as specified in this manual.



Before installing, connecting or using the instrument, you are advised to read the following manual carefully. SAES GETTERS cannot accept any responsibility in the event of damage to person or property that are the result of mishandling, improper or incorrect use that is not consistent with the purpose for which the instrument was designed.

2. INTRODUCTION

2.1. General Description

The NEG Pump Controller V1.1 is an electronic unit specifically designed to control the heating and in particular the activation process of all Getter pumps equipped with a thermocouple of the GP (GP100, GP200[1], GP500[1]) and CapaciTorr (CapaciTorr-B 1300-2 and CapaciTorr-D 2000) families. In addition, it can also be used as a power supply to heat and activate the pumps not equipped with a thermocouple, such as the GP 50, CapaciTorr D 400-2 and CapaciTorr B 200. It can also be used to control the activation process of pumps of the InsiTorr family.

2.2. Electronic Circuit Features.

Substantially, the NEG Pump Controller V1.1 is an 1100 W switching power supply, with an adjustable voltage output from 0 to 110V. The instrument has two modes of operation: in the first mode (Thermoregulation OFF), the unit behaves as a variable voltage (0-110 V) power supply. By manually adjusting the voltage delivered to the pump with the 10-turn potentiometer, it is possible to reach the desired temperature for a specific pump. In the case of pump models not equipped with a thermocouple, it is necessary to refer to the voltage temperature charts (in the pump manual) for proper setting of the potentiometer. In the second mode (Thermoregulation ON), the unit uses a thermoregulator to control the power delivered to the pump and reach the set temperature. Also in this case it is advisable to use the adjustable potentiometer to set the voltage output to a value compatible with pump model being powered.

[1] For these models, only the pumps equipped with St 707 cartridges can be activated with the NEG Pump Controller V1.1.

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The unit is capable of diagnosing the following malfunctions:

1. Thermocouple problems: open-circuit or reversed-polarity.
2. Internal over-temperature in power section.

and the following alarms:

1. Temperature exceeding the alarm set point (programmed by user).
2. External interlock alarm (alarm condition generated by the user's vacuum system).

The unit has a START/RESET button and a STOP button.
If an alarm condition occurs, an audible BUZZER is energized, the corresponding LED comes on and the power section is put in the STOP condition. A green LED indicates the normal operation condition.
Fig 1 shows a block schematic of the instrument and its typical application.

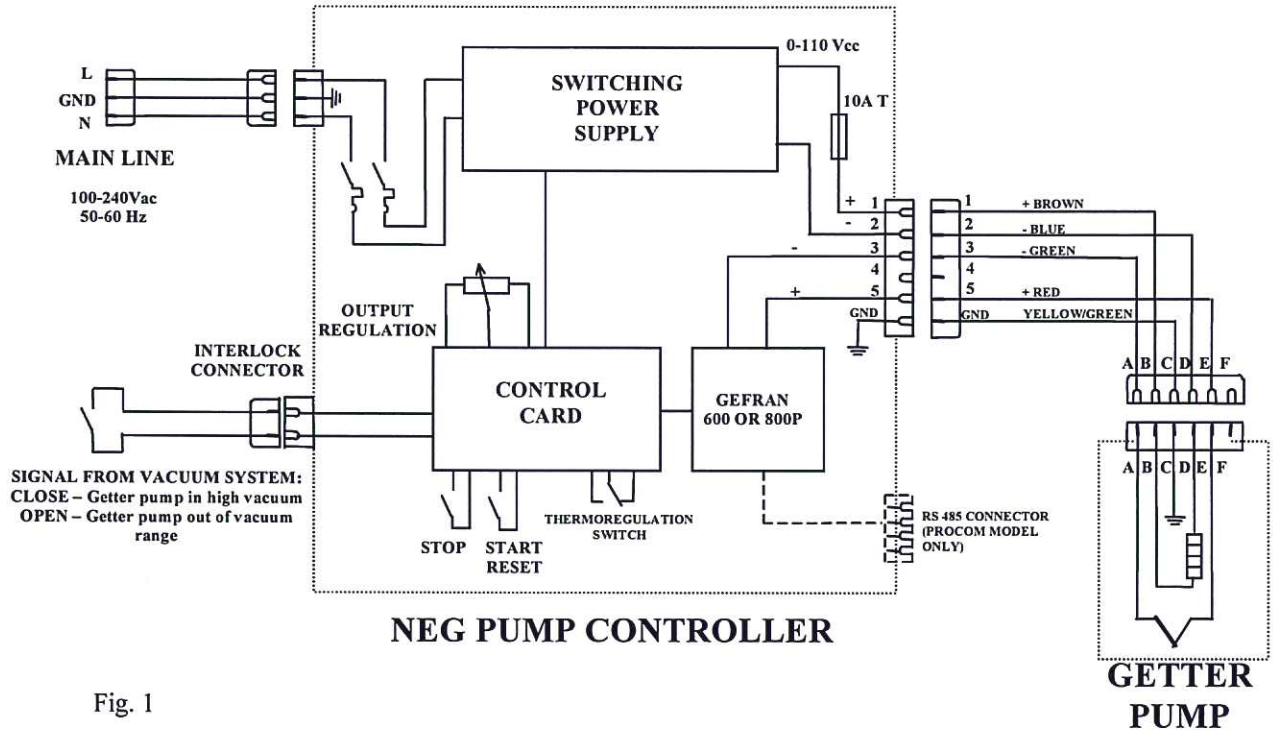


Fig. 1

The NEG Pump Controller V1.1 converts the (100 – 240 VAC, 50/60 Hz) line voltage to DC voltage using a variable switching power supply. An electronic card controls all the switching power supply functions. When the thermoregulation ON function is selected a thermoregulator reads getter pump temperature and controls the amount of power delivered by the NEG Pump Controller. The NEG Pump Controller Ver. 1.1 PROCOM uses a thermoregulator-programmer for temperature control so it is possible to heat the getter pump following a specific heating profile or heating cycle. The PROCOM model can be also controlled using the thermoregulator serial interface (RS 485 MODBUS).

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3. INSTALLATION

3.1. Operating Environment



The instrument cannot be used in zones that are potentially flammable or explosive.



Use instruments within environment specification only!
Improper use could damage electronic circuit.

- protection degree ..... IP 20
- ambient operating temperature ..... 0°C - +40°C
- max. humidity without condensation 85%
- working environment ..... indoor use

The unit may be installed on the floor, on a laboratory bench or mounted in a rack.
Place the instrument away from any heat sources. A gap of at least 5 cm must be left between the sides of the unit and adjacent walls to ensure sufficient air flow to the cooling fan. If the NEG Pump Controller is installed inside a cabinet, the latter must be provided with vents capable of ensuring adequate air exchange between the inside and the outside.

3.2. On-Desk Installation

Install the adhesive feet delivered with the unit.
Be sure to place instrument on a stable and clean surface.

3.3. Rack Mounting

Insert the instrument in the appropriate space (19" rack, 3U).
Fix the front panel of unit on the rack columns with four M6 screws.

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3.4. Electrical Connection

Before connecting the unit to the electricity supply, make sure that supply voltage is within the range specified in section 6: ELECTRICAL SPECIFICATIONS

The connections for the pump, the input line, the interlock and the external interface are on the rear panel of the instrument.



Fig. 2

1	GROUND SCREW	A 4 mm^2 section ground wire must be connected.
2	MAINS 16A IEC PLUG	The AC line-voltage connection requires the IEC 16A cable included with the instrument
3	OUTPUT CONNECTOR	The Getter pump is connected to the output of NEG Pump Controller V1.1 with dedicated cable: See APPENDIX B
4	INTERFACE D TYPE CONNECTOR	Serial RS485 thermoregulator interface (PROCOM model only).
5	INTERLOCK INPUT CONNECTOR	If the contacts of the connector are open, the output power supply is stopped. Usually it is connected to a N.O. contact that is closed when getter pump is in high vacuum.
6	10A-T OUTPUT FUSE	Protection for the getter pumps cables and connectors.

The ground wire must be connected to the unit before connecting the power cord and must remain connected while the power cord is connected.

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4. OPERATION

4.1. Front Panel Commands

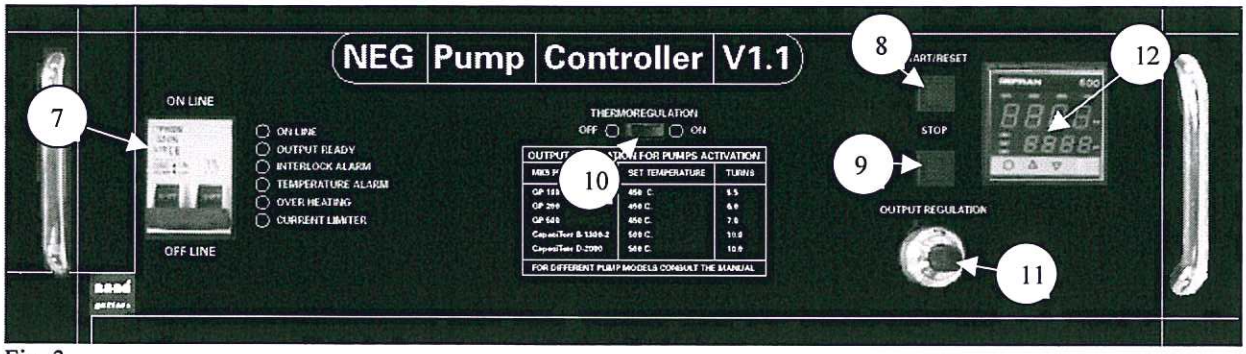


Fig. 3

7	POWER SWITCH/BREAKER	ON-OFF switch, circuit breaker.
8	START/RESET BUTTON	Starts and restarts the power unit and/or resets alarms.
9	STOP BUTTON	Stops the power unit.
10	THERMOREGULATION ON/OFF SWITCH	Enables/disables thermoregulator control of the power unit.
11	OUTPUT REGULATION	Regulation of the output voltage both with Thermoregulation OFF and with Thermoregulation ON.
12	THERMOREGULATOR	Allows thermoregulation of the getter pump in Thermoregulation ON mode. Displays the pump temperature in Thermoregulation OFF and ON modes (if the pump is equipped with a thermocouple)

4.2. Front Panel Signals

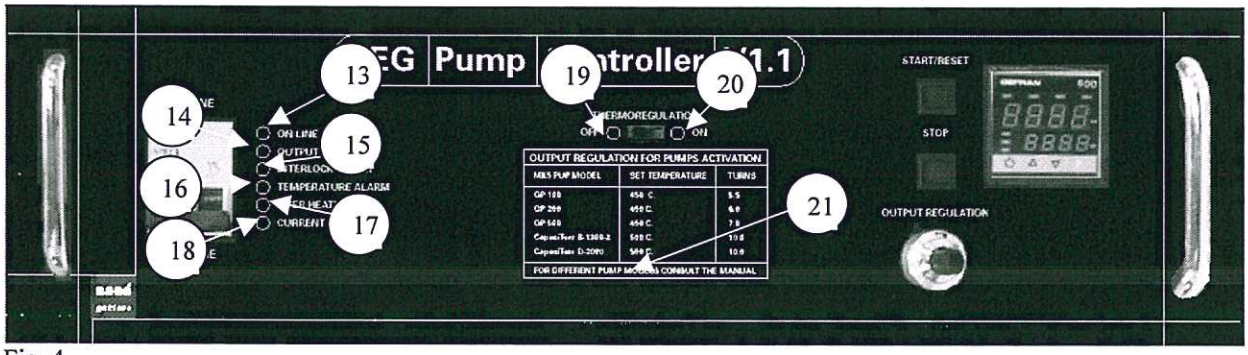


Fig. 4

13	ON LINE GREEN LED	Mains power-on indicator.
14	OUTPUT READY GREEN LED	Power unit ready indicator.
15	INTERLOCK ALARM RED LED	Signals an alarm generated by external INTERLOCK.
16	TEMPERATURE ALARM RED LED	Alarm indicator for temperature exceeding the programmed threshold.
17	OVERHEATING RED LED	Alarm indicator for over temperature condition inside the unit.
18	CURRENT LIMITER GREEN LED	Signals that the 10 A current limiter is in operation.
19	THERMOREGULATION OFF GREEN LED	Thermoregulation OFF indicator.
20	THERMOREGULATION ON GREEN LED	Thermoregulation ON indicator.
21	INTERMITTENT BUZZER	Audible warning signaling the presence of one or more alarm conditions

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4.3. Modes of Operation

NEG Pump Controller V1.1 can be used in two modes of operation.

- Thermoregulation OFF (for getter pumps without a thermocouple or for getter pumps with thermocouple but if thermoregulation is not requested)
- Thermoregulation ON (for getter pumps equipped with thermocouple).

The mode of operation can be selected using the switch (10) located in the center of the front panel.



Before beginning to heat a getter pump with NEG Pump Controller be sure that the pump is in high vacuum level. If heated in air the getter pump could burn!



Improper activation parameters could damage getter pump!
Before beginning to heat getter pump, read carefully appendix A of this manual to choose the correct activation parameter.

4.3.1. Thermoregulation OFF

In this operating mode, the power necessary to heat the pump is controlled by setting the NEG Pump Controller output power manually: this is possible using the 10-turn potentiometer (11). The getter pump activation voltages (potentiometer settings) are indicated in appendix A of this manual. Be aware that the temperature reached by the pump can vary ± 10 % with respect to the target value. This is because the heat dissipation characteristics of the vacuum chamber in which the pump is installed may differ from those of the chamber used to determine the reference parameters.

To activate a pump proceed as follows:

1. Connect the NEG Pump Controller V1.1 to the mains and to the pump to be heated by means of the proper cable.
2. Set the Main Power Switch/Breaker (7) to the ON LINE position.
    - The thermoregulator display (12) blinks for 3-4 seconds then displays an error message[2] if a thermocouple is not connected.
    - The ON LINE LED (13) lights up.
3. Select the OFF position of the THERMOREGULATION switch (10) (using a screwdriver to set the switch).
    - THERMOREGULATION OFF LED (19) lights up
4. Turn the OUTPUT REGULATION potentiometer (11) until it indicates the number of turns required for activation of the getter pump that you are using. (see appendix A of this manual).
5. Press the START/ RESET button (8).
    - After 5 seconds, the OUTPUT READY LED (14) lights up and the unit starts to deliver the power necessary to reach the temperature set point. The thermoregulator display (12) goes blank for 5 seconds then blinks for 5 seconds.
6. After one hour, press the STOP button (9) to stop the activation The user can set longer or shorter activation times, as required. It is possible to reset the OUTPUT REGULATION potentiometer in order to set different output voltage values to reach different temperatures. If a thermocouple is not available, it is necessary to refer to the temperature voltage chart included in the pump manual.

Over heating alarm in thermoregulation OFF mode

This alarm is triggered when the internal temperature of the unit reaches critical levels, hazardous to the unit itself.
The actions that follow are:

- Power output is disabled (OUTPUT READY LED (14) off).
- OVER HEATING LED lights up (17).
- Warning buzzer is energized (21).

To recover from this condition, let the unit cool down and then press the START/RESET (8) button.

[2] See paragraph 3 of the attached GEFRAN 600 User Manual, FACEPLATE DESCRIPTION section. of the attached GEFRAN 800P User Manual, FACEPLATE DESCRIPTION section.

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Interlock alarm in thermoregulation OFF mode

The interlock is disabled when there is a closed contact on the output terminal. If the contact is opened by an alarm coming from the vacuum system, the interlock alarm is triggered.
The actions that follow are:

- Power output is disabled (OUTPUT READY LED (14) off).
- INTERLOCK ALARM LED lights up (15).
- Warning buzzer is energized (21).

To recover from this condition, correct the open contact condition and then press the START/RESET (8) button.



If vacuum was lost, the getter pump must be inspected for damage. If heated in air the getter pump can burn!

4.3.2. Thermoregulation ON

In this operating mode, the temperature set point for pump activation is set on a thermoregulator that controls the NEG Pump Controller V1.1 output power using a PID algorithm. The maximum amount of available energy to heat the pump is set using the 10-turn potentiometer (11). The getter pump activation parameters are in appendix A of this manual.

Activation of a pump for the first time

Perform the following operations:

1. Connect the NEG Pump Controller V1.1 to line voltage (100-240 VAC, 50/60 Hz) and to the pump to be heated by means of the proper cable.
2. Set the POWER SWITCH/BREAKER (7) to the ON LINE position.
   - The thermoregulator display (12) blinks for 5 seconds then displays the actual pump temperature.
   - The ON LINE LED (13) lights up.
3. Select the ON position of the THERMOREGULATION switch (10) (using a screwdriver to set the switch).
   - THERMOREGULATION ON LED (20) lights up
4. Turn the OUTPUT REGULATION potentiometer (11) until it indicates the number of turns required for the activation of the getter pump that you are using. (see appendix A of this manual).
5. Set the thermoregulator parameters (12) (temperature and alarm 1 set points) for the getter pump that you are using (see appendix A, chapter 4.3.3 or chapter 4.3.4 for PROCOM model).
6. Enable the thermoregulator Self-tuning feature[3] (see chapter 4.3.3 or chapter 4.3.4 for PROCOM model).
7. Press the START/ RESET button (8).
   - After 5 seconds the OUTPUT READY led (14) lights up and the unit starts to deliver the power necessary to reach the temperature set point.
   - The thermoregulator display (12) goes blank for 5 seconds, then blinks for 3-4 seconds and then displays the pump temperature.
   - If the self-tuning feature has been enabled, the temperature display of thermoregulator blinks while tuning the PID parameters.
   - After the PID parameters have been set up, the thermoregulator pump temperature display stops blinking.
8. After the activation temperature has been reached and maintained for 45 minutes, press the STOP button (9) to stop the activation process. The user can set longer or shorter activation times, as required.

[3] Use the Self-tuning feature every time the NEG Pump Controller V1.1 is used to heat/activate a new pump model for the first time, or if the same pump model is used in a system with substantially different heat dissipation characteristics.

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Subsequent activations (set-up unchanged)

In this case the PID parameters of the thermoregulator have been already determined during the first activation process and they are stored in the thermoregulator memory. There is no need to enable the Self-tuning feature and no need to change the PID parameters. The activation procedure can be performed as follows:

1. Connect the NEG Pump Controller V1.1 to line voltage (100-240 VAC, 50/60 Hz) and to the pump to be heated by means of the proper cable.
2. Set the POWER SWITCH/BREAKER (7) to the ON LINE position.
   - The thermoregulator display (12) blinks for 3-4 seconds then displays the actual pump temperature.
   - The ON LINE LED (13) lights up.
   - THERMOREGULATION ON LED (20) lights up
3. Press the START/ RESET button (8).
   - After 5 seconds the OUTPUT READY LED (14) lights up and the unit starts to deliver the power necessary to reach the temperature set point.
   - The thermoregulator display (12) goes blank for 5 seconds then blinks for 3-4 seconds and then displays the pump temperature.
4. After the activation temperature has been reached and maintained for 45 minutes, press the STOP button (9) to stop the activation process. The user can set longer or shorter activation times, as required.

Temperature alarm in thermoregulation ON mode

The alarm is triggered when the pump temperature exceeds the value programmed in ALARM 1
The actions that follow are:

- The power output is disabled (OUTPUT READY LED (14) off).
- The TEMPERATURE ALARM LED (16) lights up.
- The warning buzzer is energized (21).

To recover from this condition, let the unit cool down and press the START/RESET button (8).

Overheating alarm in thermoregulation ON mode

This alarm is triggered when the internal temperature of the unit reaches critical levels, hazardous to the unit itself.
The actions that follow are:

- The power output is disabled (OUTPUT READY LED (14) off).
- The OVER HEATING LED (17) lights up.
- The warning buzzer is energized (21).

To recover from this condition, let the unit cool down and then press the START/RESET button (8).

Interlock alarm in thermoregulation ON mode

The interlock is disabled when there is a closed contact on the output terminal. If this contact is opened by an alarm coming from the vacuum system, the interlock alarm is triggered.
The actions that follow are:

- The power output is disabled (OUTPUT READY LED (14) off)
- The INTERLOCK ALARM LED (15) lights up.
- The warning buzzer is energized (21).

To recover from this condition, correct the open contact condition and then press the START/RESET button.



If vacuum was lost, the getter pump must be inspected for damage. If heated in air the getter pump can burn!

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4.3.3. Gefran 600 Thermoregulator Setup (standard model)

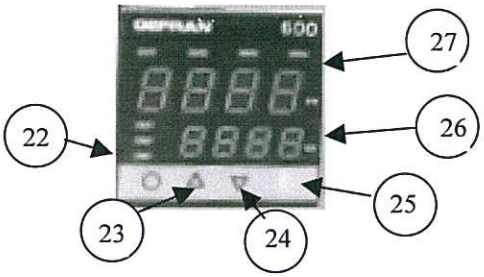


Fig. 5

To program the thermoregulator, proceed as follows:

1) **Temperature set-up**
   The temperature can be set when the display (27) shows the measured temperature and the display (26) shows the set point; if the thermoregulator is in another menu, press the Function key (25) repeatedly until this condition is obtained.
   To set the temperature set point, press the Up (23) or Down (24) arrow keys.
   The set point value is shown on the display (26).

2) **Alarm 1 set-up**
   Press the Function key (25) repeatedly until the display (27) shows the "**_AL.1**" message.
   To set the alarm 1 set point press the Up (23) or Down (24) arrow keys.
   The alarm 1 set point value is shown on display (26).
   Press the Function key (25) to store the new alarm value.

3) **Enabling self tuning**
   Press the Function key (25) and keep pressed until the display (27) shows the "**CFG**" message, than release.
   Press Function key again (25) until the display (27) will show "**S._tu**" message.
   Set the "**2**" value on display (26) pressing the Up (23) or Down (23) arrow keys.
   Press the Function key (25) until the display (27) shows the measured temperature and the display (26) shows the set point, than release. Now that self-tuning is enabled, when a getter pump activation is started, the thermoregulator will calculate the PID parameters. During the self-tuning procedure the led "**L3**" (22) blinks.

Self-tuning helps users to find the best PID parameters for getter pump heating. It calculates the Proportional band, Integral time and Derivative time delivering power to the getter pump and measuring the temperature reached and the response time of system. The self-tuning feature must be executed before activating a getter pump for the first time. Once the PID parameters have been stored, they are saved in the thermoregulator memory for future use.

For more information on the thermoregulator, read the attached GEFRAN 600 User's Manual.

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4.3.4. Gefran 800P Thermoregulator Set-Up (PROCOM model)

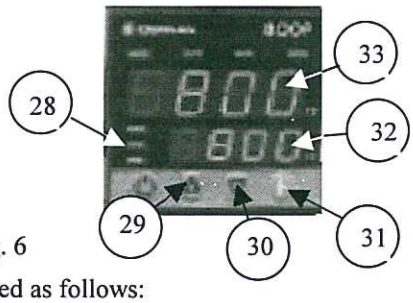


Fig. 6

To program the thermoregulator, proceed as follows:

1) **Temperature set-up**
   The temperature can be set when the display (33) shows the measured temperature and the display (32) shows the set point; if the thermoregulator is in another menu, press the Function key (31) repeatedly until this condition is obtained.
   To set the temperature set point, press the Up (29) or Down (30) arrow keys.
   The set point value is shown on the display (32)
   Press the Function key (31) to store the new set point value.
2) **Alarm 1 set-up**
   Press the Function key (31) repeatedly until the display (33) shows the "**_AL.1**" message.
   To set the alarm 1 set point press the Up (29) or Down (30) arrow keys.
   The alarm 1 set point value is shown on display (32).
   Press the Function key (31) to store the new set point value.
3) **Enabling self tuning**
   Press the Function key (31) and keep pressed until the display (33) shows the "**CFG**" message.
   Press Function key again (31) until the display (33) will show "**S._tun**" message.
   Set the "**002**" value on display (32) pressing the Up (29) or Down (30) arrow keys.
   Press the Function key (31) until the display (33) shows the measured temperature and the display (32) shows the set point. Now that self-tuning is enabled, when a getter pump activation is started, the thermoregulator will calculate the PID parameters. During the self-tuning procedure the led "**AUX**" (28) blinks.

Self-tuning helps users to find the best PID parameters for getter pump heating. It calculates the Proportional band, Integral time and Derivative time delivering power to the getter pump, measuring the temperature reached and response time of the system. The self-tuning feature must be executed before activating a getter pump for the first time. Once the PID parameters have been stored, they are saved in the thermoregulator memory for future use.

For more information on the thermoregulator and to learn programming features, read the attached GEFRAN 800P User's Manual.

5. FACTORY CONFIGURATION OF THE UNIT

The units are normally shipped with the following configuration:

THERMOREGULATION	**ON**
SET POINT	**000**
ALARM 1	**999**
OUTPUT REGULATION	**0.0**

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5.1. GEFRAN 600 Default Configuration

CFG		InP		Out		Hrd	
S.tu	2	SP.r	0	A1.r	0	HD.1	0
h.Pb	10.0	TyP	2	A1.t	0	CTR	6
h_It	0.00	FLt	0.0	RL.1	2	AL.N	1
h_dt	0.00	Fld	0.0	RL.2	0	BUT	1
h.P.H	100.0	dP.s	0	Ct.2	1	DSP	0
h.P.L	0.0	Lo.S	0	REL	0	_LD.1.	1
rSt	0	Hi_S	1000			LD.2	0
P.rS	0	oFS	0			LD.3	20
A.rS	0	Lo.L	0				
FFd	0	Hi.L	1000				
Hy.1	-1						
FA.P	0.0						
G.SP	0.0						
				Prot			
				Prot	128		

In addition to this manual, the GEFRAN 600 manual is also supplied with the standard controller.

5.2. GEFRAN 800P Default Configuration

CFG		InP		Out		Hrd	
S.tun	2	SP.ty	0	AL.1.r	0	SP.Pt	1
h_Pb	10.0	tyPE	2	AL.2.r	0	SP.Pr	1
h_It	0.00	FiLt	1.0	AL.3.r	0	hrd.1	8
h_dt	0.00	Fild	0.0	AL.1.t	0	hrd.2	7
h.P.H.I	100.0	dP_S	0	AL.2.t	0	CtrL	6
h.P.L.o	0.0	Lo_S	0	AL.3.t	0	_S.S.t.	7
_rSt	0	Hi_S	1000	RL.o.1	0	__r.t.	7
P.rSt	0	oFSt	0	RL.o.2	2	SEnS	0
A.rSt	0	Lo_L	0	RL.o.3	3	AL.nr	1
_FFd	0	Hi_L	1000	RL.o.4	3	butt	10
SoFt	0			_Ct.1	0.2	d.i.F.1.	0
HyS.1	-1			_Ct.2	0	d.i.F.2.	0
HyS.2	0			_Ct.3	0	diSP	0
HyS.3	0			_Ct.4	0	Led.1	1
FAC.P	0			_rEL.	0	Led.2	19
Ser				Prot		Led.3	31
CodE	0			Prot	0		
Ser.P	1						
Baud	4						
_Par	0						

In addition to this manual, the GEFRAN 800P manual is also supplied with the PROCOM controller.

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6. ELECTRICAL SPECIFICATIONS

6.1. .. Line Voltage

- SUPPLY VOLTAGE..... 110 - 240Vac -15%, +25%.
- FREQUENCY ..... 50/60Hz.
- MAINS CORD CONNECTOR ..... IEC Type 16A 250V
- OVER VOLTAGE CLASS ..... CAT II.

6.2. .. Line Protection Required

- SUPPLY PROTECTION..... 16A fuse or circuit breaker.
- DIFFERENTIALS SWITCH..... 30 mA.
- ISOLATION TYPE..... class I

6.3. .. Output

- OUTPUT VOLTAGE..... 0-110Vdc ±6%
- MAX. CURRENT ..... 10 A.
- MAXIMUM POWER..... 1100W.

6.4. .. Instrument Protection

- AUTOMATIC BREAKER LINE..... 16A - C
- OUTPUT FUSE..... 10A - T.
- OVERLOAD PROTECTION..... electronic control.
- HIGH TEMPERATURE PROTECTION ..... electronic control.

6.5. .. Temperature Measurement Precision.

- TYPE K THERMOCOUPLE..... ±1 °C
- COMPENSATED CABLE AND CONNECTORS..... ±2 °C
- THERMOREGULATOR ..... 3 DIGIT

7.....CLEANING

The unit may be cleaned using a cloth moistened with alcohol or liquid detergent. The use of SOLVENTS stronger then alcohol is not permitted. Avoid spraying or spilling any type of liquid directly onto the unit.

8.....DIMENSIONS AND WEIGHT

- Dimension..... 19" rack, 3U, depth: 401mm
- Weight ..... 10 kg.

9.....HANDLING

Manual lifting and handling of the unit is permitted.

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10. TROUBLESHOOTING

FAULT DESCRIPTION	FAULT CAUSE / POSSIBLE CORRECTIVE MEASURE
INTERLOCK ALARM LED (15) lights up	Check that interlock connector (5) or the cable is connected.
TEMPERATURE ALARM LED.(16) lights up	The temperature of the getter pump is above the alarm 1 set point of thermoregulator. Check the temperature set point, the PID parameters and the potentiometer setting.
OVER HEATING LED (17) lights up	Internal over temperature in the power section. The instrument needs better cooling, check the cooling fans
CURRENT LIMITER LED (18) lights up	Short circuit on the output or wrong activation parameters set. Check the cable, the Getter pump and the connector (3) integrity or check parameter set.
POWER SWITCH/ BREAKER is ON LINE (7) position, ON LINE LED (13) and OUTPUT READY LED (14) are light but the getter pump does not heat up.	Check the temperature set-point on the thermoregulator, potentiometer (11) setting or 10A-T OUTPUT FUSE
POWER SWITCH/ BREAKER is ON LINE (7) position but ON LINE LED (13) and thermoregulator display does not light.	No line voltage to the instrument or instrument failure. Check the power cord and plug (2) and the line voltage or call SAES for service.

In case of fault different from the above mentioned, call SAES for hint or service.

DISTRIBUTOR AND TECHNICAL SERVICE:

SAES Getters S.p.A., Viale Italia, 77,20020 Lainate (MI) Italy
Telephone (2) 93178 1 Telefax (2) 93178320 - (2) 93178460

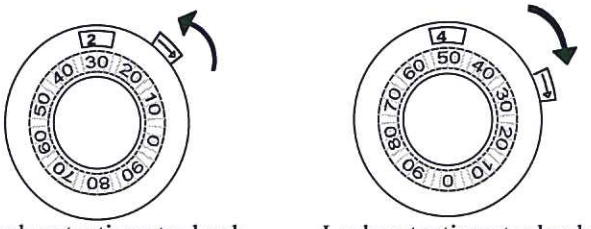
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11. APPENDIX A Activation Parameters

All the activation parameters listed below are for pumps without jackets.

To avoid damage to the pump heater a predetermined voltage limit has to be set before initiating the activation process. These limits are dependent on the pump type and activation temperature. The voltage limit must be set by using the potentiometer on the front panel of the unit. Each turn of the potentiometer knob corresponds to 11 Vdc output to the pump (e.g. 2.2 turns x 11V=24.2Vdc)

To avoid undesired potentiometer knob rotation after setting, lock potentiometer knob, as shown below.



Unlock potentiometer knob Lock potentiometer knob

Fig 7

For getter pumps equipped with a thermocouple (GP100, GP200, GP500, CapaciTorr-B 1300, CapaciTorr-D 2000), which are powered in the Thermoregulation ON mode, setting of the temperature Set Point, Alarm 1 set-point and PID parameters are required:

- The temperature set point usually coincides with the Activation temperature. Other temperatures can be set
- The Alarm 1 set point is a value 10-15% above than the Temperature Set Point.
- The PID parameters strongly depend on the geometrical configuration of a vacuum chamber in which the pump is installed, and they can be easy calculated by the thermoregulator self-tuning function.

The self-tuning feature is required to set thermoregulator PID parameters to activate a getter pump the first time. Once the PID parameters have been set, they are saved in the thermoregulator memory for future use.

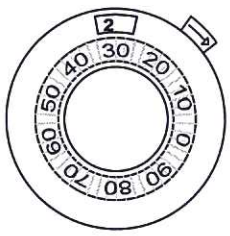
GP50 2F series

This pump can be activated only in Thermoregulation OFF mode.
Characteristic parameters:

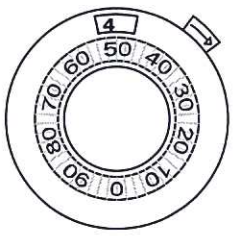
GP 50 2F	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST707	450	25	3	75
	ST101	700	49	4.6	225

Thermoregulation OFF

Activation temperature:
ST707 450°C
Potentiometer setting:
2.30



Activation temperature:
ST101 700°C
Potentiometer setting:
4.50



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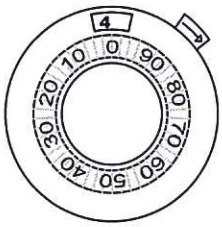
GP100 MK4 and MK5 series

Characteristic parameters:

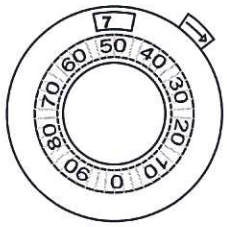
GP 100 MK4 GP 100 MK5	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST707	450	42.8	3.2	137
	ST101	700	80.8	5.18	418

Thermoregulation OFF

Activation temperature:
ST707 450°C
Potentiometer setting:
4.00

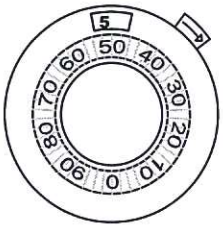


Activation temperature:
ST101 700°C
Potentiometer setting:
7.50

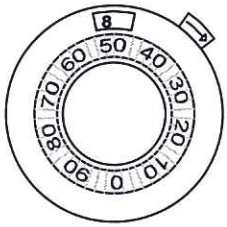


Thermoregulation ON

Activation temperature:
ST707 450°C
Potentiometer setting:
5.50



Activation temperature:
ST101 700°C
Potentiometer setting:
8.50



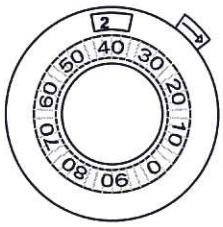
GP200 MK4 series

Characteristic parameters:

GP 200 MK4	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST707	450	25	7	175

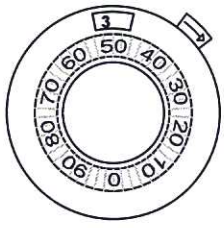
Thermoregulation OFF

Activation temperature:
ST707 450°C
Potentiometer setting:
2.40



Thermoregulation ON

Activation temperature:
ST707 450°C
Potentiometer setting:
3.50



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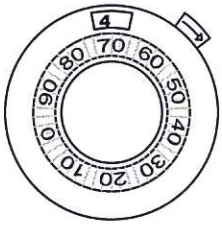
GP200 MK5 series

Characteristic parameters:

GP 200 MK5	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST707	450	52	3.8	198

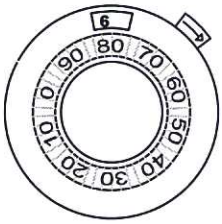
Thermoregulation OFF

Activation temperature:
ST707 450°C
Potentiometer setting:
4.7



Thermoregulation ON

Activation temperature:
ST707 450°C
Potentiometer setting:
6.80



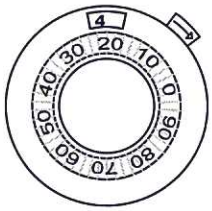
GP500 MK4 series

Characteristic parameters:

GP 500 MK4	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST707	450	46	9.9	455

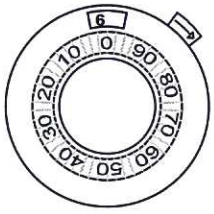
Thermoregulation OFF

Activation temperature:
ST707 450°C
Potentiometer setting:
4.20



Thermoregulation ON

Activation temperature:
ST707 450°C
Potentiometer setting:
6.00



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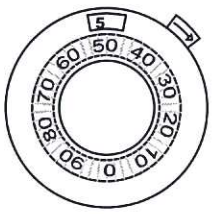
GP500 MK5 series

Characteristic parameters:

GP 500 MK5	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST707	450	61	9.4	574

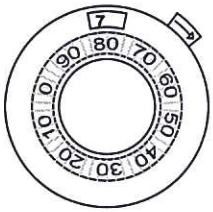
Thermoregulation OFF

Activation temperature:
ST707 450°C
Potentiometer setting:
5.50



Thermoregulation ON

Activation temperature:
ST707 450°C
Potentiometer setting:
7.80



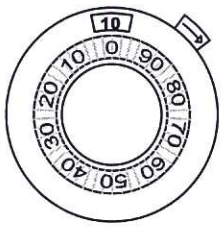
CapaciTorr B 1300-2 MK4 and MK5 series

Characteristic parameters:

CapaciTorr-B 1300-2	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST185	500	110	4.45	490

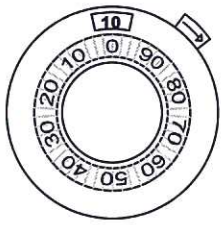
Thermoregulation OFF

Activation temperature:
ST185 500°C
Potentiometer setting:
10.0



Thermoregulation ON

Activation temperature:
ST185 500°C
Potentiometer setting:
10.0



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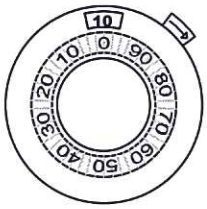
CapaciTorr D 2000 MK4 and MK5 series

Characteristic parameters:

CapaciTorr-D 2000	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST172	450	110	4.55	500

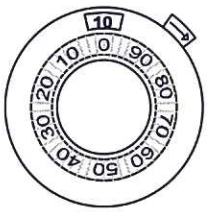
Thermoregulation OFF

Activation temperature:
ST172 450°C
Potentiometer setting:
10.0



Thermoregulation ON

Activation temperature:
ST172 450°C
Potentiometer setting:
10.0



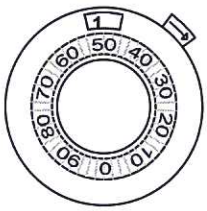
CapaciTorr D 400 and CapaciTorr D 400-2

Characteristic parameters:

CapaciTorr-D 400	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST172	450	16,5	5.5	91

Thermoregulation OFF

Activation temperature:
ST172 450°C
Potentiometer setting:
1.5



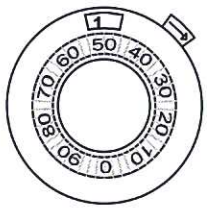
CapaciTorr B 200

Characteristic parameters:

CapaciTorr-B 200	Getter material	Activation temperature (°C)	Voltage (V)	Current (A)	Power (W)
	ST185	500	16,5	5.5	91

Thermoregulation OFF

Activation temperature:
ST185 500°C
Potentiometer setting:
1.5



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12. APPENDIX B Supply cables

GP100 MK4, GP200 MK4, GP500 MK4, CapaciTorr-B 1300-2, CapaciTorr-D 2000.

For these pumps which are equipped with a dedicated electrical connector, use output supply shown in fig. 7.

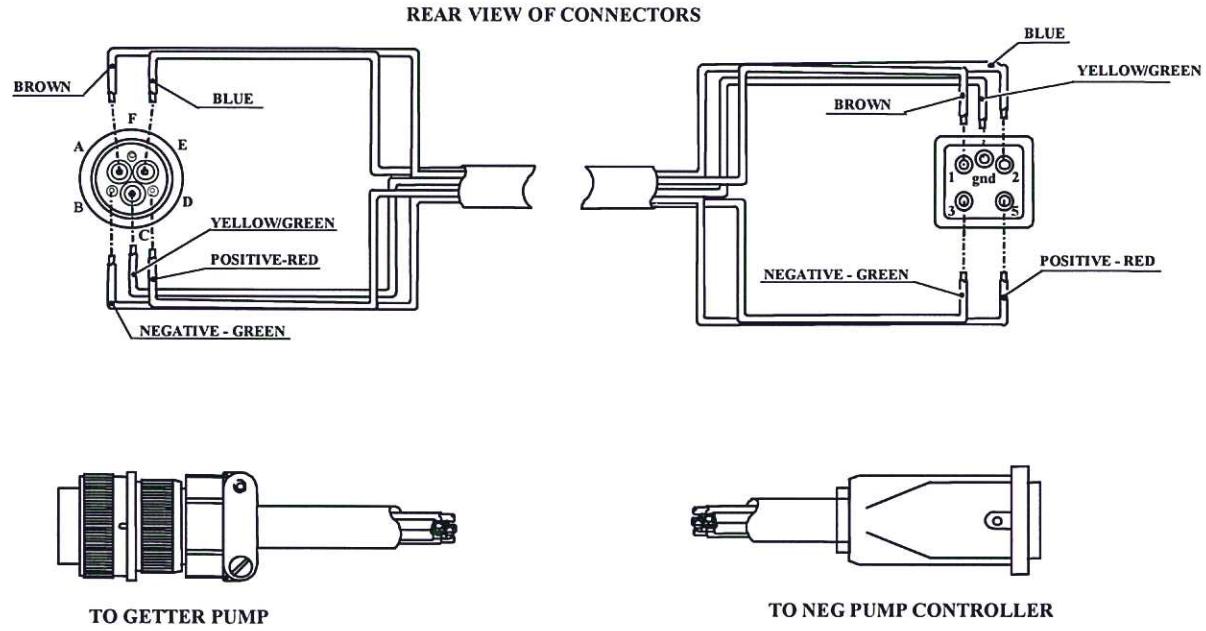


Fig. 7

GP 50

For the GP 50 pump and pumps not equipped with an electrical connector (i.e. InsiTorr type pumps), use the output supply cable supply shown in fig. 8.

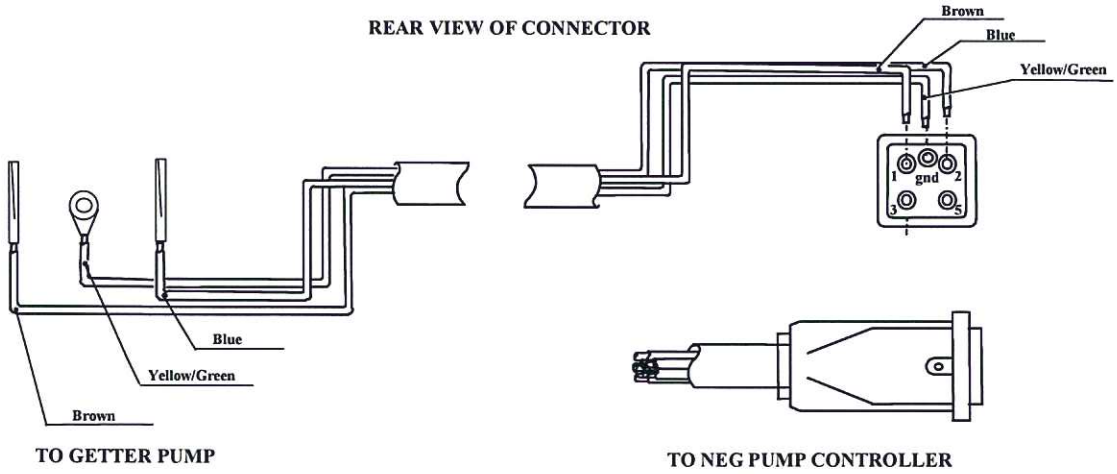


Fig. 8

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GP100 MK5, GP200 MK5, GP500 MK5, CapaciTorr B 1300-2 MK5, CapaciTorr D 2000 MK5.

For these pumps which are equipped with a dedicated electrical connector, use the output supply cable shown in fig. 9

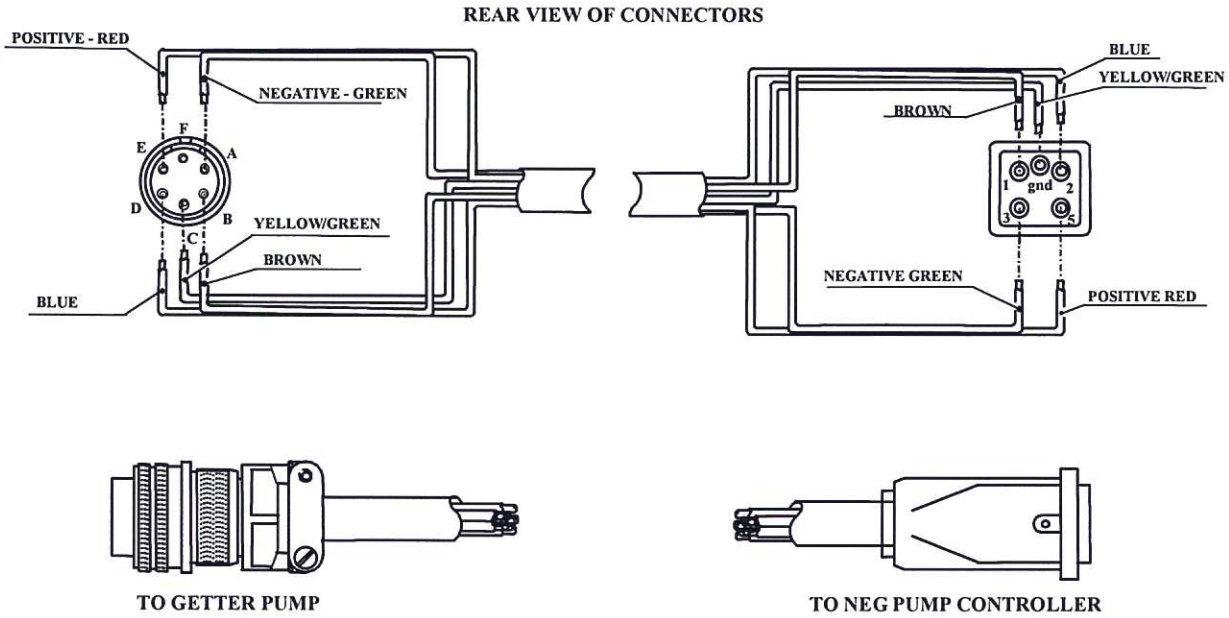


Fig. 9

CapaciTorr D400-2, CapaciTorr B200.

For these pumps which are equipped with a dedicated electrical connector, use the output supply cable shown in fig. 10.

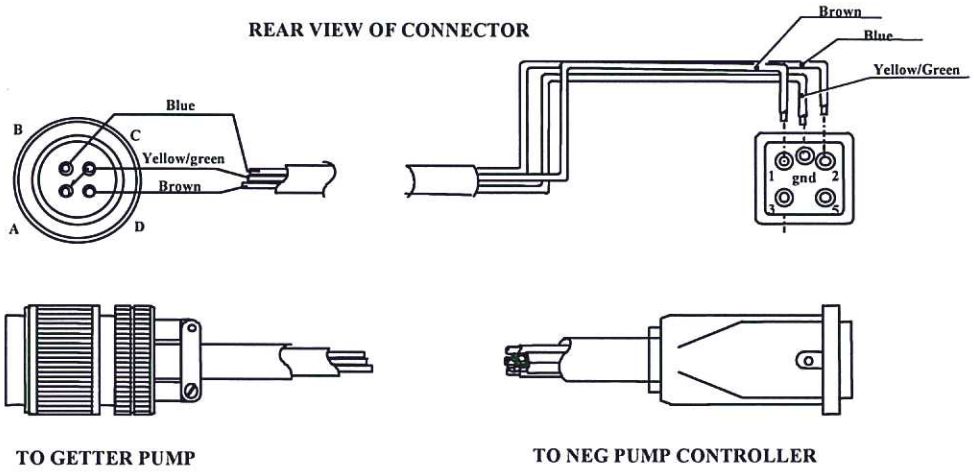


Fig. 10

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13. APPENDIX C PROCOM unit connection

For NEG Pump Controller V1.1 PROCOM equipped with GEFRAN 800P thermoregulator, an interfaces connector is available: the in field connection is shown in fig. 11

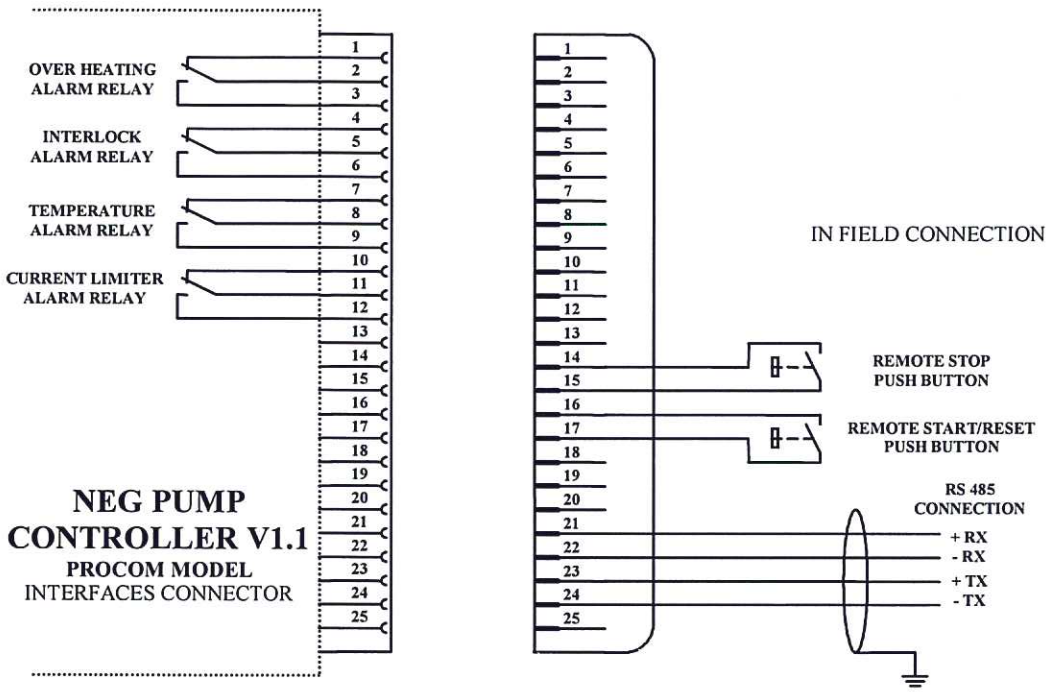


Fig. 11

The GEFRAN 800P thermoregulator has a RS485 serial interface with Modbus protocol: this feature allows communication of the thermoregulator parameter, setpoint and temperature values towards a remote PC.
To establish a communication towards a PC, it is necessary to install a proper RS485 interface inside.
The master PC must be equipped with a SCADA software with Modbus communication protocol option.
In the RS485 Serial Standard, a higher immunity from disturbances is reached and wider distances can be covered.
Selectable transmission speeds are: 1200, 2400, 4800 and 9600 bauds.

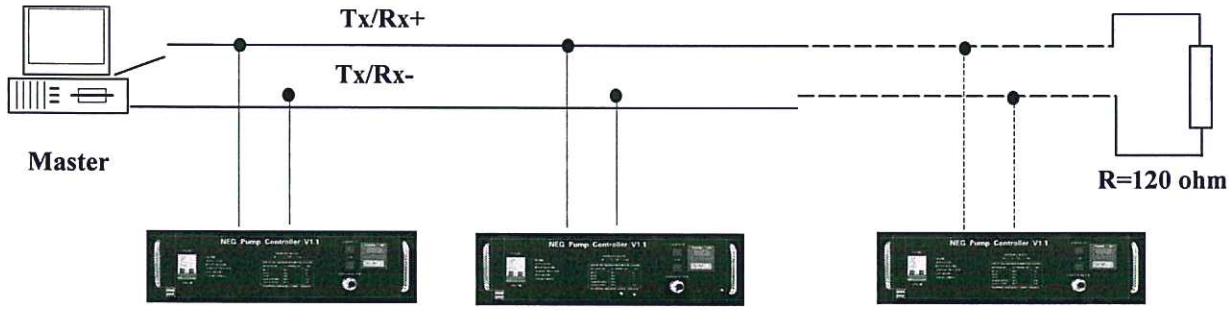


Fig. 12

The two-wire EIA RS485 standard features provided for half-duplex protocol can be considered valid :

- max. 10Mbps data rate within 12m
- distances up to 1.2 km with 100Kb/sec speed
- max. 32 instruments connected in parallel.
- Line terminals with two 120ohm resistances at the edges
- Differential transmission with low electromagnetic emission

Modbus is a standard protocol adopted by many manufacturers, which allows many different instruments to be interchangeable by the serial programming point of view. The communication network is composed by a Master and by a max. of 255 Slaves on the same line.
The Master only is enabled to initialize the communications, which can be: query/response, where one only slave answers the master, or no response, where all present slaves are addressed.
A communication is composed by a frame (information unit) of single query and by a frame of single response or by a single broadcast frame.
In the digital communication loop, the user can change only some parameters: interface (two or four wire RS485), baude rate (1200, 2400, 4800 or 9600 baudes) or parity..
In the Modbus protocol, each communication is considered finished when there are no communications on line for a time (called "time out") equal to 3.5 times the time taken for a character transmission.

When some information has to be sent on the data line, the message has to be contained in an "envelope". The envelope comes out through a "port" and it is transported on the line to the specified address. In the examined case, the Modbus defines the "envelope" as a message frame or as a byte structured sequence.

The information included in the message is:

Message Size

- Slave address
- Function
- Data
- A test word (CRC) to check the presence of any aventual error.(Error Check).

Range	Byte
Slave address	1
Function	1
Data	n
Error check (CRC-16)	2

When a slave receives a message, the instrument returns a data frame of the same structure, but containing the requested information.

List of implemented controls:

01, 02	n Bit Reading
03, 04	n Word Reading (memory location)
05	Bit Writing
06	Word Writing (memory location)
15	N Bit Writing
16	N Word Writing(memory location)

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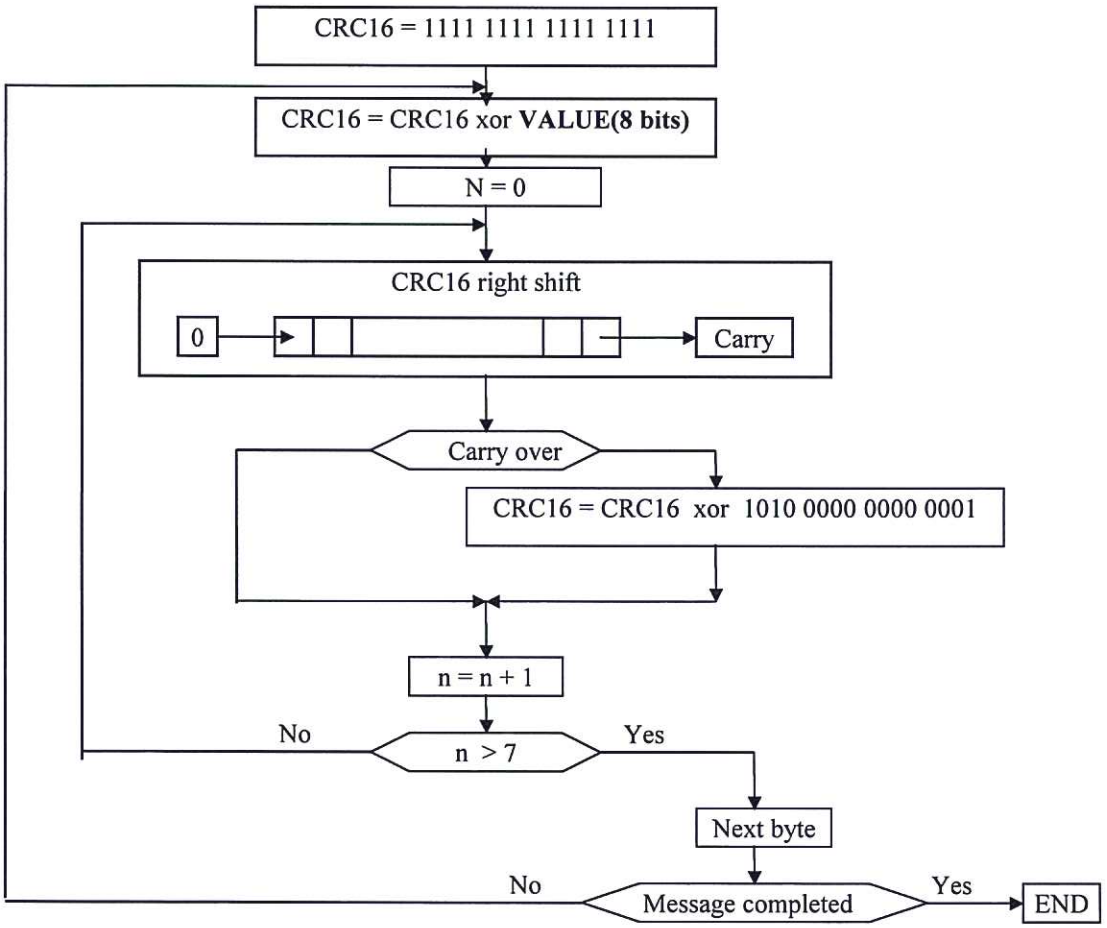
Transmission Mode:

The transmission mode is the structure of the single information unit in a message. Between the two available Modbus standard modes (ASCII e RTU), Gefran has adopted the RTU one (Remote Terminal Unit), which foresees data binary codification. An error check is also available by means of CRC (Cyclic Redundancy Check)

Error Checking:

Generally, because of the electric noise, digital transmissions can contain errors. Two protection mechanisms are available to find and control error situations: the parity control which verifies each byte consistence and the CRC.
Through the CRC Error Check, frame incongruity situations are identified, in this case the sent message is insubstantial and the receiving unit ignores it.
CRC Calculation: Data bits are considered as a continuous binary number, which most significant part (MSB) is transmitted as first. The message is first multiplied by x^{16} (that is shifted rights 16 times), then divided by $x^{16} + x^{15} + x^2 + 1$ expressed as binary number, that is 11000000000000101. The whole quotient is ignored and the remainder at 16 bit forms CRC. When the receiving unit will divide CRC by $x^{16} + x^{15} + x^2 + 1$ polynomial, it will have to obtain zero remainder with no errors.

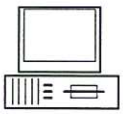
The following flow chart shows how to organize a 16 bit CRC calculation algorythm:



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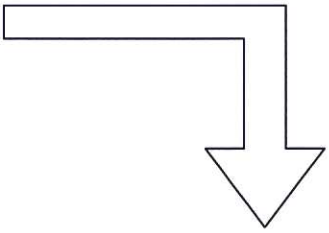
Reading Operations

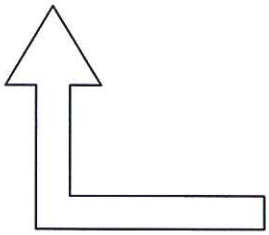
N bit reading



Master

Range	Byte
Slave address (1-255)	1
Function code (1-2)	1
Bit starting address (MSB)	1
Bit starting address (LSB)	1
Number of bits (MSB)	1
Number of bits (LSB)	1
Error check (CRC-16)	2



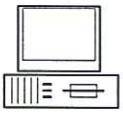


Range	Byte
Slave address (1-255)	1
Function code (1-2)	1
Byte count (n)	1
Data (LSb), ...	n
Error check (CRC-16)	2



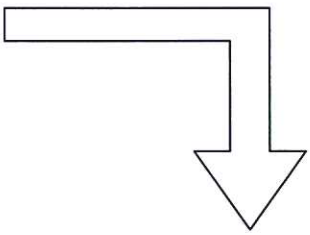
Slave

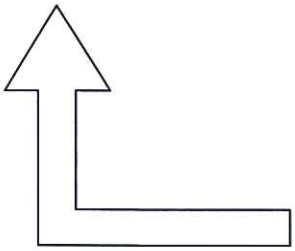
N word reading



Master

Range	Byte
Slave address (1-255)	1
Function code (3-4)	1
Word starting address (MSB)	1
Word starting address (LSB)	1
Number of words (MSB)	1
Number of words (LSB)	1
Error check (CRC-16)	2





Range	Byte
Slave address (1-255)	1
Function code (3-4)	1
Byte count (n)	1
Data (Word MSB)	n
Data (Word LSB)	
Error check (CRC-16)	2

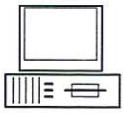


Slave

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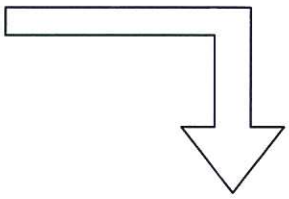
Writing Operations

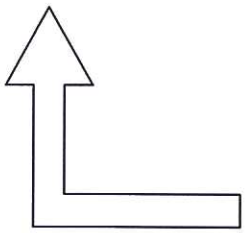
Bit writing



Master

Range	Byte
Slave address (1-255)	1
Function code (5)	1
Bit address (MSB)	1
Bit address (LSB)	1
Data (00 = OFF, 255 = ON)	1
Data (00)	1
Error check (CRC-16)	2





Range	Byte
Slave address (1-255)	1
Function code (5)	1
Bit address (MSB)	1
Bit address (LSB)	1
Data	1
Data (00)	1
Error check (CRC-16)	2



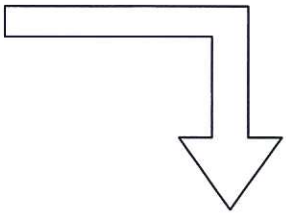
Slave

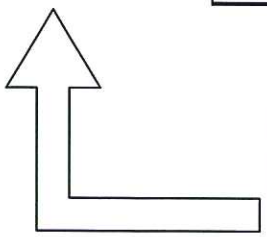
N bit writing



Master

Range	Byte
Slave address (1-255)	1
Function code (15)	1
Bit starting address (MSB)	1
Bit starting address (LSB)	1
Number of bits (MSB)	1
Number of bits (LSB)	1
Byte counter (n)	1
Data (LSb), ...	n
Error check (CRC-16)	2



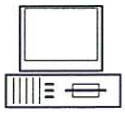


Range	Byte
Slave address (1-255)	1
Function code (15)	1
Bit starting address (MSB)	1
Bit starting address (LSB)	1
Number of bits (MSB)	1
Number of bits (LSB)	1
Error check (CRC-16)	2



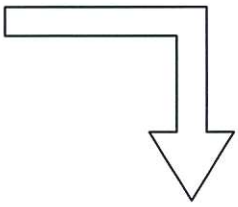
Slave

Word writing



Master

Range	Byte
Slave address (1-255)	1
Function code (6)	1
Word address (MSB)	1
Word address (LSB)	1
Data (Word MSB)	1
Data (Word LSB)	1
Error check (CRC-16)	2

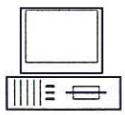




Slave

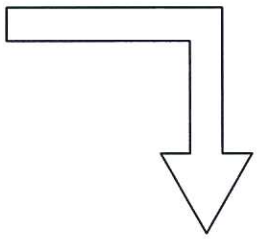
Range	Byte
Slave address (1-255)	1
Function code (6)	1
Word address (MSB)	1
Word address (LSB)	1
Data (Word MSB)	1
Data (Word LSB)	1
Error check (CRC-16)	2

N Word writing



Master

Range	Byte
Slave address (1-255)	1
Function code (16)	1
Word starting address (MSB)	1
Word starting address (LSB)	1
Number of words (MSB)	1
Number of words (LSB)	1
Byte counter (n)	1
Data (Word MSB)	n
Data (Word LSB)	
Error check (CRC-16)	2





Slave

Range	Byte
Slave address (1-255)	1
Function code (16)	1
Word starting address (MSB)	1
Word starting address (LSB)	1
Number of words (MSB)	1
Number of words (LSB)	1
Error check (CRC-16)	2

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Mains Gefran 800P MODBUS registers:

Software V2.41

Addr.	Item	Description	R/W	Min	Max	Dp	Def.	Meas. Unit
0	P.V.	Process variable	R	LO_S	HI_S	dP_S	-	P.s
1	S.P.	Active Set Point	R/W (1)	Lo_L	HI_L	dP_S	-	P.s
2	-	Control Output	R/W (2)	-100.0	100.0	1		%
-								
4	-	Deviation (S.P. – P.V.)	R			dP_S	-	
5	HPb_	Heating proportional band	R/W	0.0	999.9	1	10.0	%
7	HIt_	Heating integr. Time	R/W	0.00	99.99	2	4.00	min
8	Hdt_	Heating Derivat.time	R/W	0.00	99.99	2	1.00	min
12	-	Alarm 1 (if relative)	R/W	Lo_L -999	HI_L 999	dP_S	500	P.s
13	-	Alarm 2 (if relative)	R/W	Lo_L -999	HI_L 999	dP_S	600	P.s
16	-	Local Set point	R/W	Lo_L	HI_L	dP_S	400	P.s
-								

(1) They can be written in local mode and stop programmer
(2) They can be written in manual mode only

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