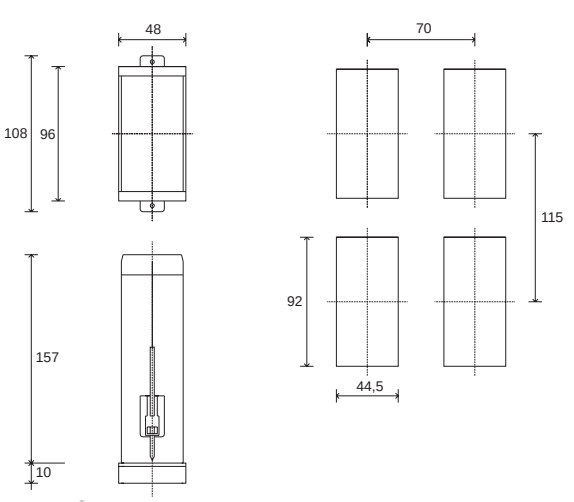
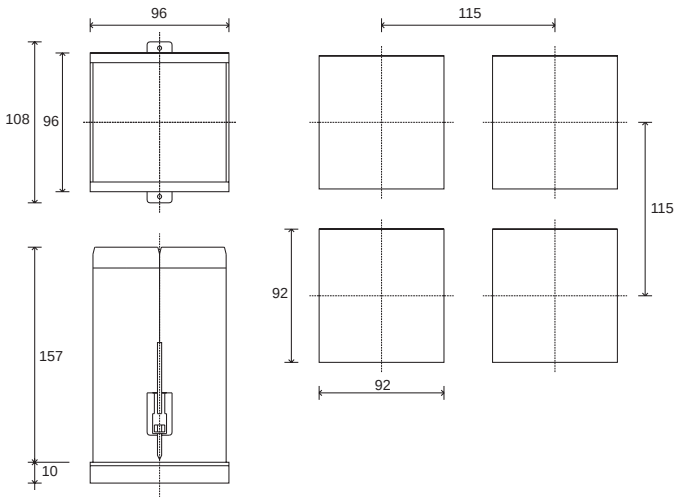
1 • INSTALLATION

• Dimensions and cut-out





Fastening single instrument

Panel mounting.
Front panel dimensions:
3500 - 48x96mm1.89”x3.78”(1/8 DIN) Depth: 159mm /6.26”
Cut-out dimensions:
45(+0.6/-0)x92(+0.8/-0)mm/1.77”(+0.02/ -0)x3.62”(+0.03/-0).
Front panel dimensions:
4500 - 96x96mm 3.78”x3.78”(1/4 DIN) Depth: 159mm /6.26”
Cut-out dimensions:
92(+0.8/-0)x92(+0.8/-0)mm/3.62”(+0.03/ -0)x3.62”(+0.3/-0).
To fasten the instrument, insert the two blocks into the seats on top and bottom side of the box and lock with the screws. To mount two or more instruments side by side, use the locking blocks and respect the following cut-out dimensions:

3500
Side by side
Base (48 x n) -3, (1.89”x n) -0.11” Height 92(+0.8/ -0) /3.62”(+0.3/ -0)
4500
Side by side
Base (96 x n) -4, (3.78”x n) -0.15” Height 92(+0.8/ -0) /3.62”(+0.3/ -0)
where “n” is the number of instruments
On request, we can supply blocks to group the instrument boxes side by side or stacked.

For correct and safe installation, follow the instructions and observe the warnings contained in this manual.

2 • TECHNICAL DATA

INPUTS
Precision 0.1% f.s. ± 1 digit
Sampling time: 120msec
TC- Thermocouple
J (Fe-CuNi) 0...1000°C / 32...1832°F
K (NiCr-Ni) 0...1300°C / 32...2372°F
R (Pt13Rh-Pt) 0...1750°C / 32...3182°F
S (Pt10Rh-Pt) 0...1750°C / 32...3182°F
T (Cu-CuNi) -100...400°C / -148...752°F
B (Pt30Rh-Pt6Rh) (*) 50...1800°C / 122...3272°F
E (NiCr-CuNi) -100...750°C / -148...1382°F
N (NiCr-Si-NiSi) 0...1300°C / 32...2372°F
Ni-Ni18Mo (Ni-Ni18Mo) 0...1100°C/ 32...2012°F
(*) for type **B** thermocouple, the precision class applies for temperature values > 500°C.
RTD 2/3 wires
Pt100 -200...600°C / -328...1112°F
DC - Linear
0...50mV, 10...50mV for signals 0...10V, 0...20mA, 4...20mA use external shunts. 32-section custom linearization available.

Auxiliary input
Isolation 1500V
For remote setpoint: 0...10V - Ri > 100KΩ; 0...20mA - Ri = 50W; 4...20mA - Ri = 50Ω
For potentiometer: 0...1V - Ri > 10MΩ (potentiometer with value from 100W to 20KΩ)
For current transformer: 0...5Aac, 50/60Hz - Ri = 20mΩ
Digital
Isolation 1500V. 3 control inputs with: Start (IN1), Stop (IN2), Reset (IN3) functions - NPN 12V/3.5mA/ - PNP 24V/6mA (12V/2mA)
8 programmable inputs: NPN 12V-5mA / PNP 24V - 4mA PNP 12V-2.5mA

OUTPUTS
Functions programmable and settable from faceplate keys:
Main heat / Main cool / Repeat: setpoint for programmer and process variable, remote setpoint (secondary input), controller setpoint, deviation (set-value), deviation (value-set) / Alarm 1 and 2 / Open/Close for motorized valve
Continuous
Isolation 1500V; 0...10V max 20mA; 0...20, 4...20mA max load 500Ω
Resolution 4000 points, max. refresh time 80msec.
Relay
Contact 5A/250Vac (with resistive load). Spark suppression on NO contacts.
Logic
Isolated in voltage for control of solid state relay (SSR).
23Vdc, Rout = 470W (20mA, max.12V).
MD81
Interface for expansion outputs. Functions attributed to each module are programmable and settable from faceplate: 8 programmer event outputs (1...8) / 8 programmer event outputs (9...16) / 8 intercept outputs (alarm 3...10)
Digital
Isolation 1500V.
8 programmer outputs configurable by jumpers: SOURCE 12V (40Ma max total)
Short-circuit protection; SINK 3...30V external (max 33V), 50mA for each output.
Output impedance 100 Ω. Maximum inverse voltage: -50V
SERIAL LINE
Optoisolated 4 wires; Passive Current Loop (1200 baud) or RS422/485, RS232 (1200/2400/4800/9600 baud).
Protocol: GEFRAN CENCAL or MODBUS
POWER SUPPLY
100...240Vac/dc ± 10%, 50/60Hz
12VA max (3500), 15VA max. (4500)
Protected by internal fuse not serviceable by user.

2 • TECHNICAL DATA

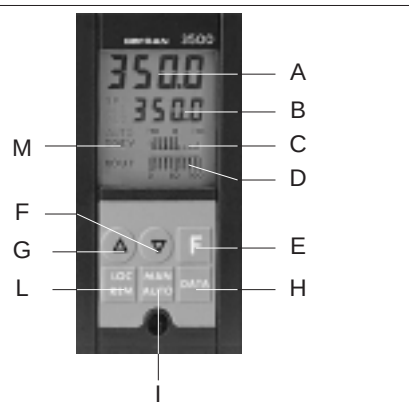
AMBIENT CONDITIONS
Working temperature: 0...50°C
Storage temperature: -20...70°C
Humidity: 20...85% relative humidity, non-condensing

CONTROLLER
On/Off, P, PD, PI, PID control with settable and independent parameters for two heat and cool control actions.
Main settable parameters:
Cooling setpoint relative to heating setpoint ±25% f.s.
Manual reset or deviation correction factor ±999 scale points
Main input offset ±999 scale points
Secondary input offset ±999 scale points
Digital filter on main variable value 0.1...20.0 sec
Reset power for heating (0...100%) or cooling (0...-100%)
Antireset or integral action limitation band 0...9999 scale points
Feed Forward range: ±100%
For every heating and cooling action, you can set:
Proportional band 0.0...999.9% f.s.
Integral time 0.00...9.99 min
Derivative time 0.00...9.99 min
Max. power limit 0...100%
Main support and control functions:
Soft-start: gradual supply of main output power when instrument is turned on (0.0...100.0 min)
Self-Tuning: Auto-Tuning
LBA: loop-break alarm with setting of time (0.0...20.0 min) and power (0.0...100.0%) (time = 0 disables action)
H: Holdback or max. tolerance band alarm for control around setpoint 1...9999 scale points (= 0 disables action)
HB: Heat Break or load interrupt alarm referred to ammeter input

PROGRAMMER
Accuracy of time base: better than ±4 sec every 10 hours (<0.01% of hold time or ramp time of program step). The programmer function lets you run a program as a group of segments or steps, each consisting of a ramp and a hold. 100 steps are available for a maximum of 50 programs.
Each step is composed of the following data:
Setpoint
Programmable ramp time (99 days 23 hours 59 min. 59 sec.) or ramp programmable in 0 scale points 999.9 min.
Hold time of programmable setpoint in days/hrs/min/sec.
Tolerance band (H alarm) settable directly in 0...999 scale points.
Number of PID parameters set (one of ten preset) (= 0 to keep previous sets).
Code for combination of digital outputs 1..8
Code for combination of digital outputs 9..16
Code for combination of 8 inputs to test ON.
Code for combination of 8 inputs to test OFF.

ALARMS
2 + 8 intercepts settable in absolute value, deviation, symmetrical deviation compared to setpoint with high or low function.
Faceplate keys can be used to configure LBA, HB and H alarm states.
Programmable setting and hysteresis limits. Non-repetitive response time less than 80 msec max.
WEIGHT 600g (3500) - 850g (4500)

3 • DESCRIPTION OF FACEPLATE



A Display
4-digit display (-1999/9999). Value of variable. Positive (-Hl-) or negative (-LO-) off-scale signal. Indication of broken sensor (Sbr), incorrect connection (Err), mathematical processing error. Configuration and calibration messages. Signal flashes when self-tuning is active.

B Display
4-digit display (-1999/9999). Value of local setpoint or auxiliary input.
Value of alarm limits AL1 and AL2. Percentage value of main output or valve position in manual mode. Parameters and configuration and calibration codes.

C Deviation bargraph
Deviation between controlled variable and setpoint expressed as percentage of full scale, with segment size equal to 2% of full scale in a range equal to 10% of such size, with indication of when such limit is exceeded, and other indications for no deviation, <-10% and >+10% (flashing). Indication flashes when auto-tuning is active.
Percentage value of main output or valve position. Percentage value of input of remote setpoint. Bargraph flashes when Soft-start is active or in power limitation state due to LBA alarm.

M Signals
SP, SPR indication of setpoint type displayed.
AL1, AL2 indication of alarm limits.
COOL indication of active cooling.
MAN, AUTO indication of manual or automatic work mode.
Indication SP flashes to show programmer activity, with display of local setpoint.
Indication REM, AL1 and AL2, flash to signal, respectively, selection of remote setpoint or relative alarm states without display of the relative variable.

CONTROLS

E "FUNCTION" Button
Under normal operating conditions, accesses the following functions: local setpoint (SP), auxiliary input (SPR), alarm 1 (AL1) and alarm 2 (Al 2), to read and/or change values. If the button is not pushed to confirm a change, the change will be saved automatically after about 10 seconds, and the display will return to the setpoint value in automatic mode or to the main input value in manual mode. Key F also accesses various configuration and calibration phases, and confirms set data so you can go to the next data item. It also lets you interrupt programmer configuration (DAt1, Dat2).

F/G Raise and Lower Buttons
These keys raise or lower the data value.
In manual mode, they raise or lower the value of the main output shown as a percentage on display B. The raising (lowering) speed is proportional to the time the key is pushed. When the maximum (minimum) of the setting range is reached, the function stops with the key pushed.

H Data Button
Under normal operating conditions, accesses the setting of some control parameters. If the button is not pushed to confirm a change, the change will be saved automatically after about 10 seconds, and the display will return to the setpoint value in automatic mode or to the main input value in manual mode. Key D also accesses various programmer configuration phases, and confirms set data so you can go to the next data item.
It also accesses the output from the 'CFG' and 'CAL' menu. Simultaneous pressing of the "Man" and "Data" keys causes switching between programmer (Start) and wait (Stop) modes. The programmer can be reset by simultaneously pressing the "Loc/Rem" and "Data" keys.

I Manual/Automatic Button
Switches from Manual (indication MAN) to Automatic (indication AUTO) mode and vice versa. Switching from MAN to AUTO is "Bumpless" to avoid breaks in control. The button can be activated or deactivated by setting the protection level. In MAN, the main output value can be forced from the faceplate keys. Simultaneous pressing of the "Man" and "Data" keys causes switching between programmer (Start) and wait (Stop) modes.

L Local/Remote Button
Lets you choose between local and remote setpoint according to the protection level set. The button can be activated or deactivated by setting the protection level. In local, with programmer inactive, the setpoint can be changed by means of the "Raise" and "Lower" keys." The remote setpoint chosen has priority over the local one, even if a program is running. The programmer can be reset by simultaneously pressing the "Loc/Rem" and "Data" keys.

4 • ELECTRICAL CONNECTIONS

Always check the configuration code before turning on the instrument.
Instrument 3500 (48x96) is composed of two basic cards and has 22 screw attachments.
Instrument 4500 (96x96) is composed of a minimum of two basic cards up to a maximum of four, and has 44 screw attachments 22(A) + 22(B).
The following terminal numbers refer to the 4500; for 3500 connections, there is correspondence between the following terminals:
1A-11A and 12B-22B with terminals 1-11 and 12-22; terminals 12A-13A refer to the 4500 only.

Main inputs
Inputs from CT and in DC are attached to terminals 1A(+) and 2A(-).
For RTDs with 4 wires, a pair is connected to terminals 3A and 4A, the other to terminals 1A and 2A;
for RTDs with 3 wires, the single wire is connected to terminal 1A, one of the remaining wires goes to terminal 2A and the other to terminal 3A;
for RTDs with 2 wires, connect the two wires to terminals 1A and 2A; connect terminal 2A to terminal 3A.

Auxiliary input from potentiometer (4500 only)
The input can be used with retroaction function on the controller for motorized valves.
The input from potentiometer (>= 100 Ohm) is at terminal 12A (cursor), the max. end has to be connected to terminal 13A (+ power = 1V) and the min. end to terminal 7A (-)

Auxiliary input from current transformer (4500 only)
If the instrument accepts this input, it is attached to terminals 12A and 13A. Display of load value is enabled during.
The CT input is alternate to the potentiometer input signal.

Auxiliary input from linear signals: 0-1V, 0-10V, 0-20mA, 4-20mA (4500 only)
The linear input is connected to terminals 12A (+) and 7A (-).

Isolated logic inputs
The input function is: IN1 (6A) = Start IN2 (5A) = Stop IN3 (4A) = Reset
The common reference is terminal 7A. The Reset function is also accessed by simultaneously activating inputs IN1 and IN2 (Start and Stop).

8 logic inputs for programmer (4500 only)
At terminals 21A, 20A, 19A, 18A, 17A, 16A, 15A, 14A for inputs 1-8 respectively. All inputs refer to terminal 22A.

Digital communication
Configure the interface type with jumpers (see hardware configuration).
- Interface type C.L.: the reception diode is available to terminals 9A (+Rx) and 8A (-Rx); the transmission transistor to terminals 11 A(+Tx) and 10A(-Tx). Resistance in series to the diode is 1 KΩ, in series to the transistor collector 100Ω.
For the series connection, resistance in series to the diode is reduced to 100Ω.
- Interface type RS485 4 wires (RS422 compatible): reception line available to terminals 9A (+Rx) and 8A (-Rx), transmission line to terminals 11A (+Tx) and 10A (-Tx).
- Interface type RS232: reception line available to terminal 9A (+Rx) and transmission to terminal 11 A (+Tx), common reference is terminal 8A (-Rx) and 10A (-Tx) to be connected to one another

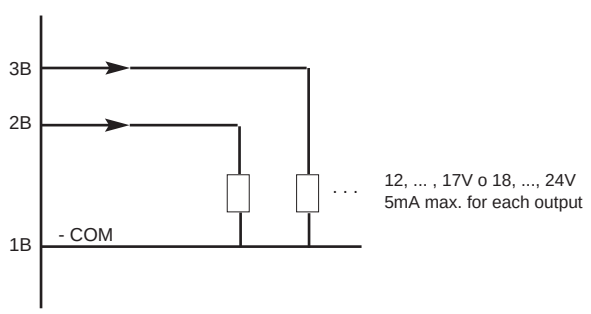
Control outputs 1, 2, 3 and 4
1 to terminals 15B and 16B, **2** to terminals 17B and 18B, **3** to terminals 19B and 20B, **4** to terminals 21 B and 22B.
Type of available outputs:
- relay outputs with contact capacity 5A / 220Vac
- isolated logic outputs type D2 PNP 24V/20mA max
- isolated continuous outputs 0-10V or 0-20mA or 4-20mA
- outputs for MD8-1 expansion module, Clock and Date with negative reference (GND) to terminal 14B.
Logic and isolated continuous outputs are protected against short circuit of load.

Control output 5 (4500 only)
At terminals 10B and 11B as relay output or non-isolated output type D2 NPN 24V/20Ma.

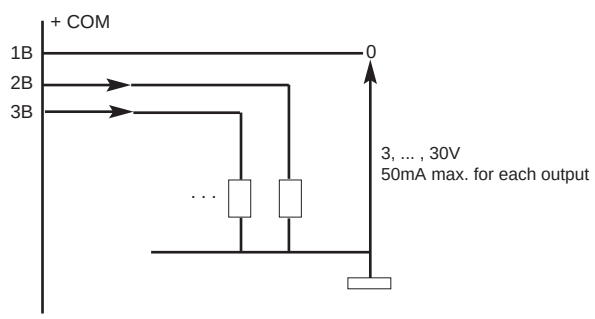
Transmitter power output
Isolated output 24V/ 30mA (protected against short circuit of load): available as alternative to any control output on terminals 15B(+), 16B(-) or 17B(+),18B(-) or 19B(+), 20B(-) or 21B(+), 22B(-).

8 logic outputs for (4500 only)
At terminals 2B, 3B, 4B, 5B, 6B, 7B, 8B, 9B for outputs 1-8 respectively. All refer to terminal 1 B, negative for source outputs with internal power supply, positive for sink outputs with external power supply. Examples of logic output connections:

Source output with internal power supply

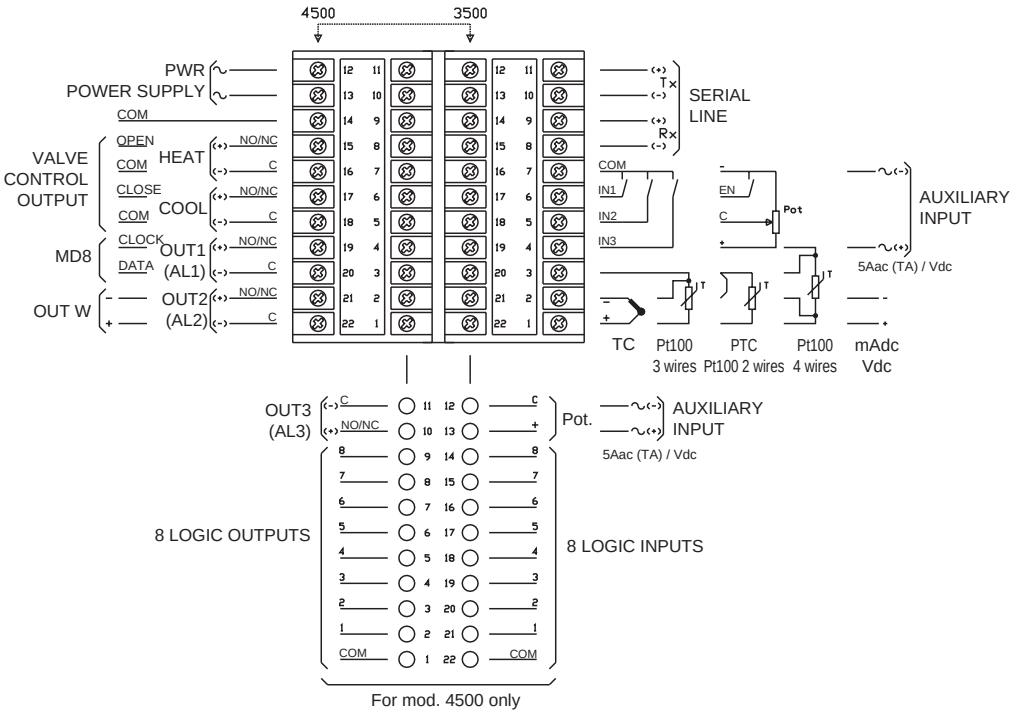


Sink output with external power supply

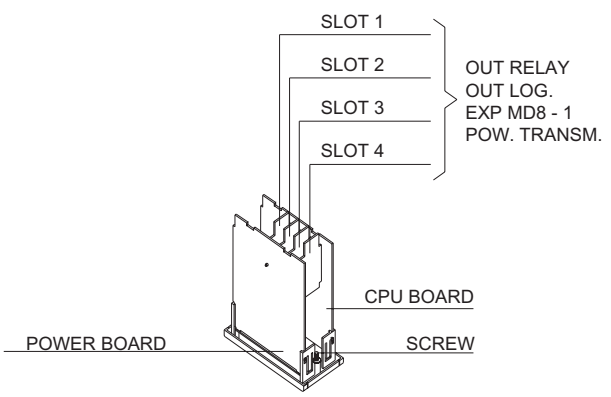


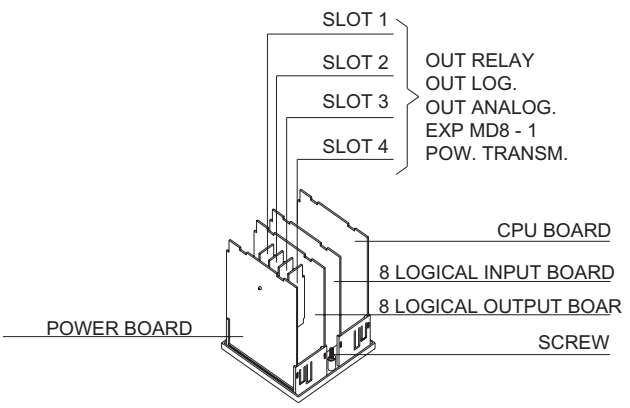
Instrument power supply
Power supply 1 0-30Vac/Vdc or 90+260Vac is applied to terminals 12B and 13B.

4 • ELECTRICAL CONNECTIONS



5 • HARDWARE CONFIGURATION



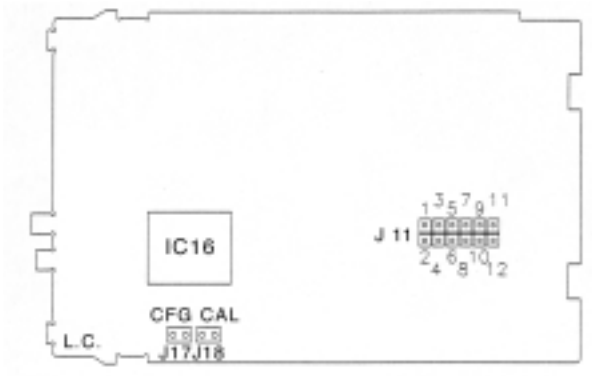


HOW TO CONFIGURE

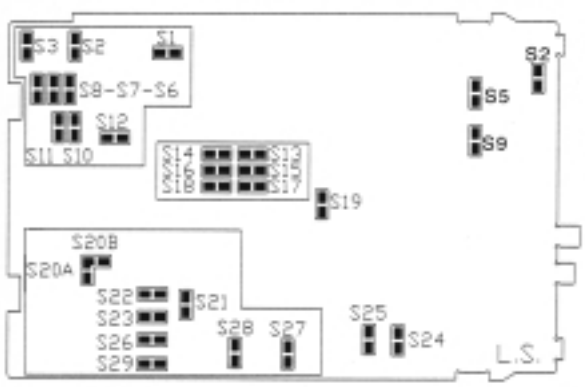
To configure the instrument, you first have to configure the hardware based on the type of inputs and outputs you want; then configure the software.
The 3500/4500 has a configurable structure of cars that are freely assignable to software functions. For standard applications, we offer preconfigurations corresponding to the connection diagrams shown.
If you have to change the configuration, remove the electronic part from its seat by unscrewing the front screw until the part is released, then remove the part by hand.
Access to programming of configuration and calibration depends on the position of jumpers J17 and J13 on the CPU card:
Jumper J17(CFG) ON = enable configuration
Jumper J18(CAL) ON = enable calibration
A CPU card configuration is assigned to each version by execution of sealed jumpers and the J11 jumper group as described below (see figure of CPU components side).
The following terminal numbers refer to the 4500; for 3500 connections, there is correspondence between the following terminals:
terminals 1A - 11A and 12B - 22B with terminals 1-11 and 12-22; terminals 12A - 22A and 1B - 11B refer to the 4500 only.

5 • HARDWARE CONFIGURATION

CPU CARD Components Side



CPU CARD Solder Side



The following have to be configured for all versions:
- CPU card for inputs and any serial interface (table D);
- cards for control outputs 1, 2, 3, 4;
- control output 5 for selection of NO/NC relay contact (4500 only);
- 8 logic inputs card (tables E, F) (4500 only);
- 8 logic outputs card (table G) (4500 only).

HOW TO CONFIGURE THE MAIN INPUT

The instrument is supplied in standard version, with ability to configure the sensor type only from the faceplate keys by setting the “tYPE” parameter, accessible in configuration CFG2.
Inputs from thermocouple, resistance thermometer (2 or 3 wires), linear inputs 0-50mV and 10-50mV are standard.
Configuration for 4-wire RTD (TYPE=11) requires a specific hardware setting with jumpers (see table A).
For inputs 0-10V, 2-10V, 0-20mA, 4-20mA, you can keep the configuration as for 0-50mV or 10-50mV by means of external shunts (or dividers).
Order codes:
- 10V/50mV adapter module; input impedance ≥1MΩ: 960000000010
- 20mA/50mV adapter module; input impedance ≥ 5Ω:960000000020

Table A
Configuration by type of sensor input (see figure of CPU solder side): (remember to set the relative “tyPE” code in configuration CFG2)

Sensor Type	S21	S22	S20A	S20B
TC	X			X
RTD 2/3 wires	X			X
RTD 4 wires (*)		X	X	
Linear 0-50mV	X			X
10-50mV	X			X

(*) as alternative to digital input 3 (RESET)

HOW TO CONFIGURE THE AUXILIARY INPUT

On the 4500, the auxiliary input is used to acquire the current value from the CT, or the potentiometer position for valve control, or the remote setpoint. The auxiliary input is enabled by means of jumper 7-9 on J11 (see table B).
When it is configured for the input from the CT, it has to be connected with terminals 12A and 13A
When configured for the Potentiometer input, this has to be connected to the power supply with terminals 13A(+) and 7A(-), the cursor with terminal 12A. When configured for the linear input used for remote setpoint, this has to be connected with terminals 12A(+) and 7A(-).

Table B
Configuration by instrument version (numbers refer to jumper J11 group - see figure of CPU components side)

Selection of auxiliary input	J11 (see CPU card components side)
CT or Potentiometer	7 - 9
0 - 1V	7 - 9
0 - 10V	7 - 9, 1 - 2
0-20mA/4-20mA	7 - 9, 1 - 3

See table F regarding configuration of 8 logic inputs card Jumper J23 to select between CT or Potentiometer and Linear.

HOW TO CONFIGURE LOGIC INPUTS
Table C
Input IN1 is always present.

Selection of auxiliary input	J11 (see CPU card components side)
IN2	11 - 12
IN3 (*)	5 - 6

(*) Input not available with main input from 4-wire RTD

CONFIGURATION BY TYPE OF ISOLATED LOGIC INPUTS
IN1, IN2 and IN3 (see figure of CPU solder side)
Table C1

INPUT	Input Type: - switch 3.5A - relays - open collector NPN (12V / 3.5mA)			Input Type: - Open collector PNP (24V / 6mA) (12V / 1.8mA)		
	S14	S16	S18	S13	S15	S17
IN1	X			X		
IN2		X			X	
IN3			X			X

HOW TO CONFIGURE THE SERIAL INTERFACE

May be configured according to most common standards (table D); instruments normally have the configuration for parallel serial current-loop

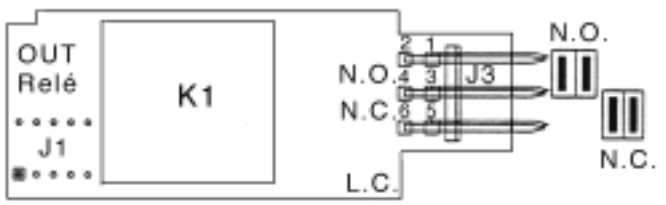
Table D
Configuration by type of serial interface, see figure of CPU solder side.

Serial Type	Reception						Transmission		
	S8	S7	S6	S10	S11	S12	S1	S2	S3
RS232			X	X		X	X	X	
RS422			X	X		X	X	X	
RS485			X	X		X	X	X	
Parallel CL		X			X				X
Series CL	X				X				X

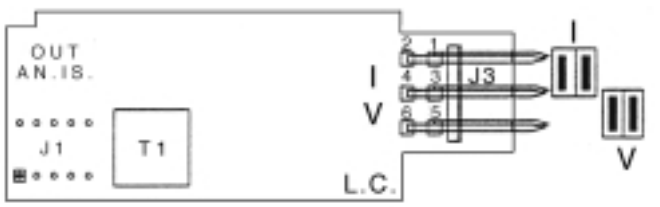
5 • HARDWARE CONFIGURATION

CONTROL OUTPUTS

Relay output card
Insertable in any position, manages output based on configuration (CFG3). In standard version, proposed in position 1 and 2 for heat/cool control outputs, in position 3 and 4 for alarm 1 and alarm 2 outputs (see electrical connection). Indication of jumpers for connection of NO/NC contact:
- NC contact: jumpers J3 on NC
- NO contact: jumpers J3 on NO



Continuous output card isolated in voltage/current
Insertable in any position, manages output based on configuration (CFG3). In standard version, proposed in position 1 and 2 for heat/cool control outputs, in position 4 for repeat output as alternative to alarm 2 (see electrical connection).
Indication for configuration of output for voltage or current:
- voltage output (V): jumper J3 on V



- current output (I): jumper J3 on I

Logic voltage output card
Insertable in any position, manages output based on configuration (CFG3). In standard version, proposed in position 1 and 2 for heat/cool control outputs, in position 3 and 4 for alarm 1 and alarm 2 outputs (see electrical connection).

Card for connection of MD8-1 expansion
Insertable in any position, manages output based on configuration (CFG3). In standard version, proposed in position 3 as alternative to alarm 1 (see electrical connection of MD8-1 expansion).

Transmitter power card
Insertable in any position, supplies isolated 24Vdc/30mA non-stabilized power.

HOW TO CONFIGURE EVENT LOGIC OUTPUTS (4500 only)

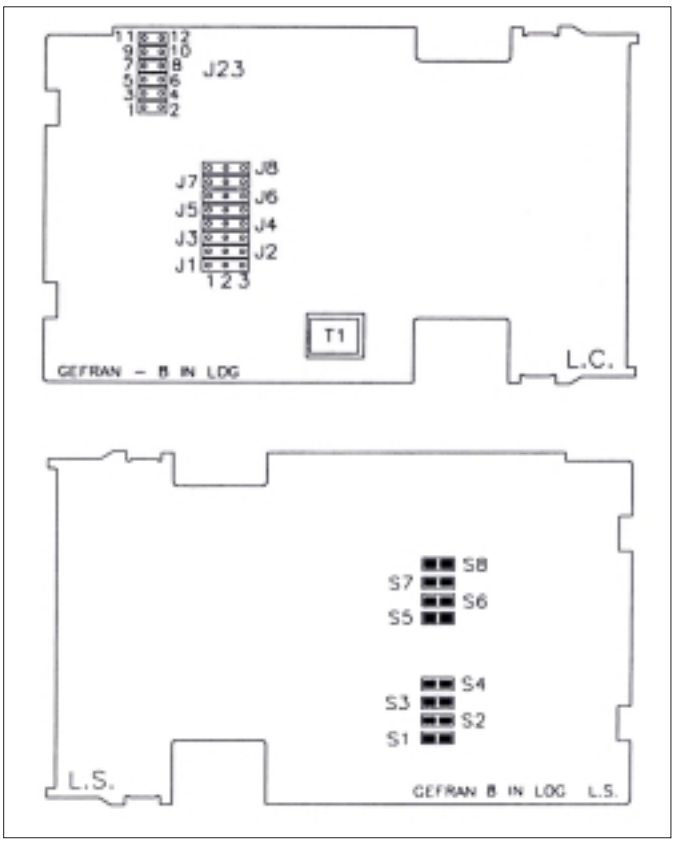
Table E
Configuration by type of 8 logic outputs

Output type	position of jumper J23 J1, J2, J3, J4, J5, J6, J7, J8
NPN - switch - relay - open collector (12V / 5mA)	2 - 3
PNP (24V / 4mA) (*)	1 - 2

(*) for PNP inputs (12V/2.5mA) solder jumpers S1, S2, S3, S4, S5, S6, S7, S8 on the appropriate side.

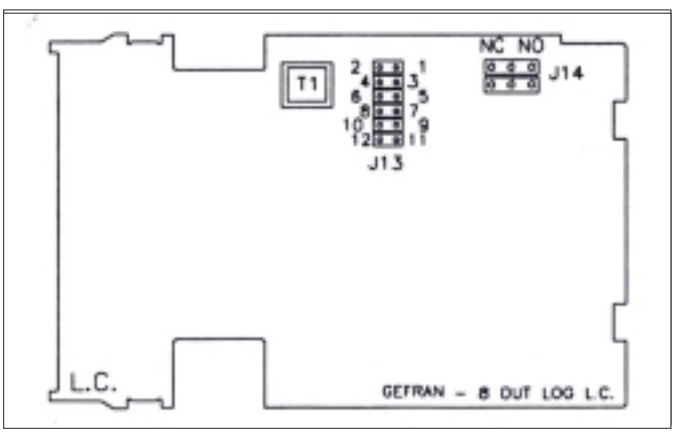
Table F
Configuration by stage of input from CT or Potentiometer and linear

Version	position of jumper J23
TA	1-2, 9-10, 5-6, 7-8, 11-12
Potentiometer 0-1V, 0-10V, 0-20mA, 4-20mA	3-5, 2-4, 6-8, 10-12, 9-11



8 isolated logic inputs card

HOW TO CONFIGURE EVENT LOGIC OUTPUTS (4500 only)



8 isolated logic outputs card
Table G
Configuration by type of 8 logic outputs

Output type	position of jumper J13		
Internal power supply (source)			
18...24V /40mA max. total on 8 outputs	1-2	5-6	9-10
12…17V /40mA max. total on 8 outputs	1-2	5-6	7-8
External power supply (sink)			
3...30V/50mA for each output	3-4	7-8	11-12

HOW TO CONFIGURE CONTROL OUTPUT 5 (4500 only)

Jumper indication to connect NO/NC relay contact:
- NC contact: jumpers J14 on NC
- Contact NO: jumpers J14 on NO

6 • SOFTWARE CONFIGURATION

In normal operation, display A shows the variable measured in input.
Values are set with the raise/lower buttons.
Key F lets you select and display (display B) the following values in rotation:
- SPR auxiliary input
- SP setpoint
- AL1 alarm 1
- AL2 alarm 2 with signal (display M).

In manual mode you add a phase with % indication of POWER in output.
After setting , push button F to confirm the data and update the next item; return to normal operation is timed: display of variable with setpoint.
Press key F for a few seconds to access the controller configuration phases.
Press key D for a few seconds to access the settings needed for the programmer.

SETTING CONTROL PARAMETERS
Key D lets you select and display the following control parameters in rotation (indication on display A, value on display B):

HPb- / proportional band in heating (0.0% - 999.9%) (heating hysteresis for ON/OFF)

CPb- / proportional band in cooling (0.0% - 999.9%) (cooling hysteresis for ON/OFF)

rSt_ / manual reset (±99 scale points) or corrective deviation factor added algebraically to setpoint value

P.rSt / reset power for heating (0/ +100%) or for cooling (-100.0%-0) (2)

S.tun / self-tuning code (0-15) to enable self-tuning, auto-tuning, soft-start.
The self-tuning phase starts when the instrument is turned on, or by pressing keys F + raise + lower; it turns off automatically after correct execution.
One-shot autotuning (codes 8-15) turns off automatically after execution; it can be reactivated simply by incrementing the code by 1.
Auto-tuning (codes 1-3-5-7) is permanently on; it is deactivated simply by decrementing the code. Calculated control parameters are replaced by programmed parameters.

Cod	AUTO permanent	SELF	SOFT	Cod	AUTO on-shot	SELF	SOFT
0	NO	NO	NO	8	WAIT	NO	NO
1	YES	NO	NO	9	GO	NO	NO
2	NO	YES	NO	10	WAIT	YES	NO
3	YES	YES	NO	11	GO	YES	NO
4	NO	NO	YES	12	WAIT	NO	YES
5	YES	NO	YES	13	GO	NO	YES
6	NO	YES	YES	14	WAIT	YES	YES
7	YES	YES	YES	15	GO	YES	YES

ArSt / integral action or anti-reset band, under SP for Heat and over SP for Cool (0 - 9999 scale points, 0 = action disabled) (integral power is not updated externally)

FFd- / feed forward (±100%), power to be added to P.I.D., proportionality factor on percentage value of setpoint in range of variability (power of FFW = FFd_* SP%; 0 = action disabled)

PrOG / work program number setpoint programmer mode: 1-50 (accessible only if SP.Pr <> 0, i.e., if instrument is defined as programmer)

When setting is finished, press button D to confirm the data and go to the next item. In all cases, return to normal operation is timed or by pushing button F.

CONFIGURATION PROCEDURE
In normal operation, press button F to display data:

_**no**_ with indication of instrument code no. in serial line,

UPdt with indication of software version implemented.
Release button F to return to normal operation.
To access the configuration phase, press button F until the message CFG appears on display A.
There are four configuration levels:

CFG_ 0: return to normal operation
CFG_ 1: configuration of control parameters and alarm functions
CFG_ 2: first level configuration for hardware
CFG_ 3: second level configuration for hardware
CFG_ 4: linearization setting for custom sensor.

Select with the raise/lower keys and confirm with key F.
Use key F to confirm every data item set during various configuration phases.
Return to normal operation by pressing the “Data” key.

CONFIGURATION CFG1:

To access this configuration, parameter Prot (CFG2) must be 0.

_**no**_ / instrument code number (0 - 9999)

Hit- / integral time in heating (0.00 - 99.99 min)

Hdt- / derivative time in heating (0.00 - 99.99 min)

Cit- / integral time in cooling (0.00 - 99.99 min)

Cdt- / derivative time in cooling (0.00 - 99.99 min)

SOFt / softstart time (0.0 - 100.0 min).

HPHI / max. heating power limit (0.0 - 100.0%)

CPHI / max. cooling power limit (0.0 - 100.0%)

CSPO / cooling setpoint relative to heating setpoint
(± 25.0% scale range).

HyS1 / hysteresis for AL1 (± 999 scale points). A negative (positive) number indicates a hysteresis band positioned below (above) the alarm limit and is characteristic of a direct (reverse) alarm.

HyS2 / hysteresis for AL2 (± 999 scale points).). A negative (positive) number indicates a hysteresis band positioned below (above) the alarm limit and is characteristic of a direct (reverse) alarm.

Continue setting the limits and hystereses for alarms 3, 4, 5, 6, 7, 8, 9, 0, only if management of the MD8-1 expansion unit is enabled in CFG2 as alarm outputs:

AL3 / alarm limit in scale range if absolute, -1999/+f.s. if deviation

HYS3 / hysteresis for AL3 (± 999 scale points).
....
AL0 / alarm limit in scale range if absolute, -1999/+f.s. if deviation

HYS0 / hysteresis for alarm 3 : AL3 (± 999 scale points).

Return to CFG_ 0.

6 • SOFTWARE CONFIGURATIONE

CONFIGURATION CFG2:

To access this configuration, jumper J17 (CFG) must be in ON position.

Prot / Protection level; password to configurations, calibrations and enabling of A/M, L/R keys according to table:

	Display only	Display and Change
0		SP / Alarm / Data / CFG1 **(*)**
1		SP / Alarm
2	Alarm	SP
3	SP / Alarm	

+4	to lock MAN/AUTO key
+8	to lock LOC/REM key
+16	to lock Programmer data (dAt1, dAt2)

(*) jumper J17 = ON enables CFG2, 3, 4
jumper J18 + ON enables CAL

rEG.t / type of controller

Type of controller
The 3500 can be type V0 only, because it has no potentiometer inputs.

0	normal
1	with heating valve without potentiometer V0 (or floating)
2	with heating valve with indication by potentiometer V1
3	with heating valve with reaction by potentiometer V2
4	normal
5	with cooling valve without potentiometer V0 (or floating)
6	with cooling valve with indication by potentiometer V1
7	with cooling valve with reaction by potentiometer V2

-At- / actuator stroke time (only on valve controller) (0.0 - 20.0 min). Actuator stroke time is the time the valve takes to go from completely open to completely closed.

t_LO / minimum pulse time for actuator stroke time (only on valve controller) in range 0.0 -100.0 % of actuator stroke time; minimum pulse time is necessary to avoid excessive valve activity.

-db- / band of symmetrical inactivity around setpoint (only on valve controller) (0-1000 scale points)

tyPE / type of sensor or linear input.

F				
0=J	(Fe-CuNi, type TC)	max.range	0-1000C	(32/1832F)
1=K	(NiCr-Ni, type TC)	max.range	0-1300C	(32/2372F)
2=R	(Pt13Rh-Pt, type TC)	max.range	0-1750C	(32/3182F)
3=S	(Pt10Rh-Pt, type TC)	max.range	0-1750C	(32/3182F)
4=T	(Cu-CuNi, type TC)	max.range	-100-400C	(-148/752F)
5=B	(Pt30Rh-Pt6Rh,type TC)	max.range	50-1800C	(122/3272F)
6=E	(NiCr-CuNi, type TC)	max.range	-100-750C	(-148/1382F)
7=N	(Nicrosil-Nisil, type TC)	max.range	0/1300C	(32/2372F)
8=Ni-Ni18Mo	(Ni-Ni18Mo, type TC)	max.range	0/1100C	(32/2012F)
10=Pt100	(type RTD 3wires)	max.range	-200-600C	(-328/1112F)
11=Pt100	(type RTD 4 wires)	max.range	-200-600C	(-328/1112F)

+ 16	for thermocouples or temperature thermometers on which you want to see the temperature in °F, add 16 to the code.

12=0-50mV	(linear type)	max.range	-1999/9999
13=0-10V	(linear type)	max.range	-1999/9999
14=0/20mA	(linear type)	max.range	-1999/9999
15=0-50mV	(custom 32 segment type)	max.range	-1999/9999
28=10-50mV	(linear type)	max.range	-1999/9999
29=2-10V	(linear type)	max.range	-1999/9999
30=4/20mA	(linear type)	max.range	-1999/9999
31=10-50mV	(custom 32 segment type)	max.range	-1999/9999

Input 0/10V or 0/20mA or 2/10V or 4/20mA by means of divider or external shunts

Measurement with type B thermocouple input conforms to precision class 0.1% for temperatures exceeding 500°C.

dP_S / position of decimal point (0 - 3), (0 or 1 for TC and RTD sensors; only 0 for type R, S, B TC sensors).

LO_S / minimum scale limit (-1999/9999), for TC and RTD sensors, value is limited by max range of selected scale.

HI_S / maximum scale limit (-1999/9999), for TC and RTD sensors, value is limited by max range of selected scale.

OFSt / offset of input (±999 scale points)

SPr.t/ type of auxiliary input (for 4500 only):

Code		
0	0 -1V o Potentiometer	Type aux. input
1	0 -10V	
2	0 -20mA	
3	4 -20mA	
4	0 -1V	Type of auxiliary input as SPR relative to local set
5	0 -10V	
6	0 -20mA	
7	4 -20mA	
8	TA 0 - 5A	For ammeter input

dPSP / decimal point position for aux. input scale (0-3)

LOSP / minimum scale for auxiliary input (required only for normal controller or for V0 valves) setting within limits of input scale.

HISP / maximum scale for auxiliary input (required only for normal controller or for V0 valves) setting within limits of input scale.

OFSP / offset of auxiliary input (±999 scale points)

_LO_ / lower setting limit of setpoint (*), setting within limits of input scale.

_HI_ / upper setting limit of setpoint (*), setting within limits of input scale.

(*) L0_ and _HI are also the limits for the repeat output for the input and setpoint.

SP.Pr / selection of programmer type:

Value	Instrument function
0	Non programmer with IN1, IN2, IN3 inputs in logic NPN
1	Single programmer with NPN inputs (^)
2	Multiple programmer with NPN inputs (^) (*)
3	
4	Non programmer with IN1, IN2, IN3 inputs in logic NPN
5	Single programmer with NPN inputs (^)
6	Multiple programmer with NPN inputs (^) (*)

(*) With remote selection of program 1, ..., 16 by means of binary combination of first 4 logic inputs (4500 only)
(^) The programmer function is not enabled if the instrument lacks buffer RAM.

bArG / selection of variable indicated on % bargraph (see faceplate C/D)
0: power % with indication of heat/cool
1: valve input position
2: open valve (0...+10%) – close valve (0...-10%) control

bAud / baud rate for serial communication
0: 1200 baud for interface type CL, RS232, RS485
1: 2400 baud for interface type RS232, RS485
2: 4800 baud for interface type RS232, RS485
3: 9600 baud for interface type RS232, RS485

FLt_ / acts as digital filter on variable 0 for filter excluded, range 0.1 - 20.0 sec

E8_ / enables management of expansion unit for alarms 3-10:
0: MD8-1 expansion disabled **1**: MD8-1 expansion enabled

L.b.A.t./ wait for tripping of LBA alarm (0.0...20.0 min); if 0.0, alarm disabled.

L.b.A.P./ limit of power supplied in LBA alarm state (0.0...100.0%); reset is automatic following a logical variation of indication, but may be performed by simultaneously pressing "Data" and "F" keys.

AL1.t/ alarm 1 function according to table:
(see also: function notes)

Note	Code	Alarm Function
-	0	Direct absolute
-	1	Reverse absolute
-	2	Direct deviation
-	3	Reverse deviation
-	4	Direct symmetrical deviation
-	5	Reverse symmetrical deviation
*	6	Direct HB (Heat Break)
*	7	Reverse HB (Heat Break)
-	8	Direct LBA (Loop Break Alarm)
-	9	Reverse LBA (Loop Break Alarm)
-	10	Direct H (Holdback)
-	11	Reverse H (Holdback)
-	12	Direct program end
-	13	Reverse program end
♣	14	Direct absolute
♣	15	Reverse absolute
♣	16	Direct deviation
♣	17	Reverse deviation
♣	18	Direct symmetrical deviation
♣	19	Reverse symmetrical deviation
♥	20	Direct absolute
♥	21	Reverse absolute
♥	22	Direct deviation to remote set
♥	23	Reverse deviation to remote set
♥	24	Direct symmetrical deviation to remote set
♥	25	Reverse symmetrical deviation to remote set
	+32	For deactivation at power-up (option valid for alarms with code 0,...5 and 14,...25).

* Function allowed only if slot 1 has a relay or logic output card with Heat or Cool function.
♣ Referred to auxiliary input
♥ Referred to setpoint

AL2t / alarm 2 function according to table: as per alarm 1
Continue setting of function type of alarms 3,4,5,6,7,8,9,0 only if management of MD8-1 expansion unit as alarm outputs is enabled on CFG2.

AL3t / alarm 3 function according to table: as per alarm 1.

AL0t / alarm 10 function according to table: as per alarm 1.

Return to CFG_0

CONFIGURATION CFG3

To access this configuration, jumper J17 (CFG) must be in ON position.
This configuration phase regards the instrument's hardware structure. You can insert four output cards on the basic power card (see control outputs). The four output cards must be assigned a logic function.

SLOt / select control output (1...5)
control output 1 connected through terminals 15B, 16B (slot 1)
control output 2 connected through terminals 17B, 18B (slot 2)
control output 3 connected through terminals 19B, 20B (slot 3)
control output 4 connected through terminals 21B, 22B (slot 4)
control output 5 connected through terminals 10B, 11B (4500 only)

Based on the type of card inserted in the selected slot (1...4), the configuration is proposed in relation to the type of output:

a) if isolated analog output (0.3% f.s):

An.O.x/ attribution of reference signal:
(slot number 1-4 is shown in x)

0	Main Heat output
1	Main Cool output
2	Repeat setpoint (of programmer) output
3	Repeat input output
4	Repeat SPR output
5	Repeat setpoint (of controller) output
6	Deviation output (setpoint - input)
7	Deviation output (input - setpoint)
+8	If 2/10V or 4/20mA
+16	Reverse output

L.OUx/ correction of minimum (-200/+1000 converter points) with immediate action on output to check voltage or current value (output assumes minimum value, slot number 1-4 is shown in x).

H.OUx/ correction of maximum (-1000/+ 200 converter points) with immediate action on output to check voltage or current value (output assumes maximum value, slot number 1-4 is shown in x).

b) if isolated logic output:
LOOx / attribution of reference signal: (slot number 1…4 is shown in x)
0 Main Heat output
1 Main Cool output
2 alarm 1 output
3 alarm 2 output
4 valve open output
5 valve close output

Ct_x / cycle time for main output (0 - 200 sec)
0 = ON/OFF type Heat/Cool control
(slot number 1…4 is shown in x)

c) if relay output:
rL.O.x / attribution of reference signal:
(slot number 1…4 is shown in x)
0 Main Heat output
1 Main Cool output
2 alarm 1 output
3 alarm 2 output
4 valve open output
5 valve close output
6 repetition of programmer event 1 output
7 repetition of programmer event 2 output
8 repetition of programmer event 3 output
9 repetition of programmer event 4 output

Ct_x / cycle time for main output (0 - 200 sec)
0 = ON/OFF type Heat/Cool control
(slot number 1…4 is shown in x)
Note: Set powers below 3.2% to 0 and powers above 96.8% to 100.

d) if output for MD8-1 expansion interface:
E8_x / attribution of reference
(slot number 1…4 is shown in x)
0 excluded
1 event 1-8 outputs slaved to programmer
2 alarms (Alarm 3-10)
3 event 9-16 outputs slaved to programmer

e) if output for transmitter power supply
E8_x (slot number 1…4 is shown in x)
In absence of card, indication **E8_x** is shown.

Return to CFG_ 0.

CONFIGURATION CFG4:

(setting of custom scale)
To access the configuration, jumper J17 (CFG) must be in ON position.

_Pn.t / step number (0-32) of sector for linearization of custom sensor.

St.xx / engineering value corresponding to step xx (xx= _Pnt set)
Press key F:
if xx <32, you return to _Pnt function with increment of the step
if xx = 32 you return to CFG_0.

6 • SOFTWARE CONFIGURATION

SETTING THE PROGRAMMER

(only for instruments configured as programmer at item SP_Pr= 1 or 2 (NPN); [SP_Pr = 5 or 6 (PNP) of CFG2]
To access configuration, press button D until message _**dAt 0** appears on the display.
There are two configuration levels:
0 - dAt0: return to normal operation
1 - dAt1: set programs
2 - dAt2: set control parameters
Select with the raise/lower keys and confirm with key D.
Use key D to confirm each data item set during the various configuration steps.
To access the configuration, parameter Prot (CFG2) must be <16.

CONFIGURATION DAt1: Setting programs.

There are two separate phases:
description of program and insertion of individual steps.

PrG.n / program number 1 – 50, set n=0 to display program in execution: step no., setpoint, current times:

CS.tP/ current step
(•)
-tH- / step time days.hrs (max. 9999 23hh referred to entire step).
For steps with longer duration, display B shows 99.23 flashing.
(•)
-tL- / step time in mm.ss. (referred to entire step)
(•)
LOOP / number of cycles to run
(•)
If n <> 0, proceed with:

F.St_ / number of first step 0 – 99

L.St / number of last step 0 – 99

- for instrument 3500S / 4500S

F.St_ / number of first step 0 – 14

L.St / number of last step 0 – 14

PrG.t / program restart after a power down
(when Start command is given)
0 - start of setpoint prior to power down, start program
1 - start from input value at power down, start program
2 - start from setpoint prior to power down, wait for reset to start program
3 - start from program stop conditions

LOOP/ number of program cycles
(0-200; 0 = perpetual loop)

Setting of single step: .

StP.n / step no. 0-99 (=xx) **for instrument 3500S / 4500S**: 0-14 (=xx)

SPxx / setpoint of step xx, range in scale limits (*)

G.rxx/ setpoint variation gradient, 0...200 digit min (*) (**)

rHxx / ramp time days.hrs (max 99.23 days.hours) (*) (**)

rLxx / ramp time mm.ss (max 59.59 minutes.seconds) (*) (**)

SHxx / hold time on setpoint days.hrs (max 99.23)

SLxx / hold time on setpoint mm.ss (max 59.59)

(•) all of these parameters can be changed with the programmer stopped (stop, non-verified conditions on 8 inputs); with this data displayed, the power bargraph represents the binary value of the 8 logic inputs (from d0 to d7, left to right).

(*) - xx shows the step number being set

(**) the two settings (ramp or time) are alternative:
- set the ramp when you want to set a constant setpoint gradient; gradient is defined as variation in one minute; a gradient other than zero inhibits reading of range time
- set ramp time when you want to set the time between the initial setpoint and the one to be reached.

Hbxx/ symmetrical tolerance band relative to setpoint (hold-back band) and referred to main or auxiliary input as per table
(1..1000 scale points)

HBxx	Value	Enable H alarm referred to input main auxiliary (2)	Enable H Alarm referred to input
	-1000...-1 (1)	NO	YES
	0	NO	NO
	1000...1	YES	NO

(1): the attributed numerical value is always considered as absolute value. This value constitutes the symmetrical band relative to the setpoint and referred to the main input (for values between 1000…1) or auxiliary (for values between -1000….-1)

(2): function is active if alarm 3 is used with code 18 or 19. In this case, the symmetrical band relative to the setpoint refers to the auxiliary input and is set in configuration **1** (**CFG1**) at item AL3, accessible after setting item **E8_=1** in configuration **CFG2**.

(3): OR of alarms

When the variable is not within these limits, the programmer time base stops and waits for it to return within limits. (*)

dSxx/ control parameters attribution (0 - 9)
0 = retention of previous parameters (*)

oAxx / outputs 1-8: output (0 - 255) code combination (*) (***)

obxx / **obxx**/ outputs 9-16: output (0 - 255) code combination (*) (***)

ISxx / inputs 1-8: input (0-255) code combination; must be verified ACTIVE before starting the step, otherwise the program stops and waits (*) (***)

Irxx / inputs 1-8: input (0-255) code combination; must be verified NOT ACTIVE before starting the step, otherwise the program stops and waits (*) (***)

By pressing key F (if set step number xx = last step of LSt_ program) you return to phase PrGn n, with n raised for setting of the next program. Otherwise, xx is raised and you return to phase StPnxx for programming of the next step.

CONFIGURATION DAt2: Setting control parameters

dS.n_/ number of control parameters group 1 - 9 (=x)

HPbx / proportional band in heating (0.0°/0 - 999 9%) (#)

Hltx / integral time in heating (0.00 - 99 99 min) (#)

Hdtx / derivative time in heating (0.00 - 99 99 min) (#)

CPbx / proportional band in cooling (0.0% - 999.9%) (#)

Cltx / integral time in cooling (0.00% - 99 99 min) (#)

Cdtx / derivative time in cooling (0.00% - 99 99 min) (#)

The group number is then raised up to value 9;
beyond this value it returns to dAt_0.

(*) - xx shows the step number being set.

(**) the two settings (ramp or time) are alternative:
- set the ramp when you want to set a constant setpoint gradient; gradient is defined as variation in one minute; a gradient other than zero inhibits reading of range time
- set ramp time when you want to set the time between the initial setpoint and the one to be reached.

(***) - with this data displayed, the power bargraph represents the binary value of the requested combination (from d0 to d7, left to right). This combination can be changed (in addition to the normal digital way) with a procedure, initialized by pressing key F, that shows (on the deviation bargraph) a cursor, moveable cyclically toward the right by pressing key F, that enables selection/unselection, respectively, by using the “Raise” and “Lower” keys, of the corresponding bit.

(#) x shows the parameters group number being set.

7 - CALIBRATION

CALIBRATION PROCEDURE

The 3500/4500 instruments are supplied already calibrated. Therefore, perform the procedure only when necessary.
In normal operating conditions, press button F until CAL_ 0 appears on display (A) (there must also be enabling by means of jumper J18 [CAL]). Set the software password to access the calibration phase in question:

8 calibration of input based on type of sensor specified in Type (in CFG2) (*)
9 calibration of auxiliary input (SPR or CT or Potentiometer) based on type of sensor specified in SPrt (in CFG2) (*)

The following codes allow calibration independent of the type of sensor configured:

0..7,20 !not significant
10 ! calibration inputs from CT
11 ! calibration inputs from RTD 3 wires (%)
12 ! calibration linear inputs 0/50mV or 10/50mV (*)
13 ! calibration linear inputs 0/10V or 2/10V (*)
14 ! calibration linear inputs 0/20mA or 4/20mA (*)
15 ! calibration inputs from custom sensor

16 ! calibration SPR linear inputs 0/1V, pot. or CT
17 ! calibration SPR linear inputs 0/10V
18 ! calibration SPR linear inputs 0/20mA or 4/20mA (*)

19 ! recall factory calibration

Note: none of these calibrations modify the type of sensor configured.

(%) Calibration of sensor Pt100 RTD 4 wires is performed only by setting code CAL 8 on the correctly configured instrument (TyPE = 11 in CFG 2; see table A)

(*) Calibration of sensors 10/50mV, 2/10V, 4/20mA is performed with minimum at 0mV, 0V, 0mA respectively.

CALIBRATION TYPE 10

C_50 / apply a 50mV signal at input terminal 1A(+) terminal 2A(-). Press key F to confirm.

C_t.A(25) / set the room temperature (25°C = room temperature default value). Press key F to confirm return to CAL_ 0.

CALIBRATION TYPE 11 (%)

C.18.5/ insert a resistance of 18.49 Ohms (in configuration for RTD 2 or 3 or 4 wires) between the inputs for RTD. Press key F to confirm.

C.313 / insert a resistance of 313.59 Ohms (in configuration for RTD 2 or 3 or 4 wires) between the inputs for RTD. Press key F to confirm return to CAL_ 0.

CALIBRATION TYPE 12, 13, 14, 15

S_LO / apply the signal corresponding to scale minimum to input terminal 1A(+) and terminal 2A(-). Press key F to confirm.

S_HI / apply the signal corresponding to scale maximum to input faston 1A(+) and faston 2A(-). Press key F to confirm return to CAL_ 0.

CALIBRATION TYPE 16,17, 18

NOTE:
If the instrument is configured as controller of valves V1 or V2, the “Raise” and “Lower” keys generate a command to open or close the valve, respectively.

SPLO / apply the signal corresponding to scale minimum to the auxiliary input. Press key F to confirm.

SPHI / apply the signal corresponding to scale maximum to the auxiliary input. Press key F to confirm return to CAL_0.

8 - FUNCTION NOTES

Alarms
Alarms can be absolute, direct (maximum) or reverse (minimum), relative to remote setpoint, symmetrical deviation, referred to the main input, secondary input and setpoint.
With deviation alarms, limits have values in the range -1999 and + f.s. The value set is algebraically added to the deviation variable (the deviation alarm limit may extend below the minimum and above the maximum of the set scale).

code 0: Direct absolute alarm referred to main input: set limit is compared to input value (ex: alarm state: main input = 450, alarm limit 400).

code 1: Reverse absolute alarm referred to main input: set limit is compared to input value (ex: alarm state: main input = 400 alarm limit 450).

code 2: Direct alarm relative to setpoint referred to main input: set limit and setpoint value are compared to value of main input (ex: alarm state main input = 500. alarm limit = 50 setpoint = 400)

code 3: Reverse alarm relative to setpoint referred to main input: set limit and setpoint value are compared to value of main input (ex: alarm state main input = 400 alarm limit = 50 setpoint = 400)

code 4: Direct symmetrical deviation alarm to setpoint referred to main input: set limit and setpoint value are compared to value of main input (ex: alarm state main input = 500 alarm limit = ±50 setpoint = 400)

code 5: Reverse symmetrical deviation alarm to setpoint referred to main input: set limit and setpoint value are compared to value of main input (ex: alarm state main input = 400 alarm limit = ±50 setpoint = 400)

code 14: Direct absolute alarm referred to auxiliary input: set limit is compared to value of auxiliary input (ex: alarm state: auxiliary input = 450 alarm limit 400).

code 15: Reverse absolute alarm referred to auxiliary input: set limit is compared to value of auxiliary input (ex: alarm state: auxiliary input = 450 alarm limit 450).

code 16: Direct alarm relative to setpoint referred to auxiliary input: set limit and setpoint value are compared to value of auxiliary input (ex. alarm state: auxiliary input = 500 alarm limit = 50. setpoint = 400)

code 17: Reverse alarm relative to setpoint referred to auxiliary input: set limit and setpoint value are compared to value of auxiliary input (ex. alarm state: auxiliary input = 400 alarm limit = 50. setpoint = 400).

code 18: Direct symmetrical deviation alarm to setpoint referred to auxiliary input: set limit and setpoint value are compared to value of auxiliary input (ex: alarm state auxiliary input = 500. alarm limit = ±50 setpoint = 400)

code 19: Reverse symmetrical deviation alarm to setpoint referred to auxiliary input: set limit and setpoint value are compared to value of auxiliary input (ex: alarm state auxiliary input = 400. alarm limit = ± 50 setpoint = 400)

code 20: Direct absolute alarm referred to setpoint: set limit is compared to setpoint value (ex. alarm state setpoint = 450 alarm limit 400).

code 21: Reverse absolute alarm referred to setpoint: set limit is compared to setpoint value (ex. alarm state: setpoint = 400 alarm limit 450).

code 22: Direct alarm relative to remote setpoint referred to setpoint: set limit and remote setpoint value are compared to value of setpoint (ex. alarm state: setpoint = 500 alarm limit 50 remote setpoint = 400).

code 23: Reverse alarm relative to remote setpoint referred to setpoint: set limit and remote setpoint value are compared to value of setpoint (ex. alarm state: setpoint = 400 alarm limit 50. remote setpoint = 400).

code 24: Direct symmetrical deviation alarm to remote setpoint referred to setpoint: set limit and remote setpoint value are compared to value of setpoint (ex. alarm state: setpoint = 500 alarm limit ± 50, remote setpoint = 400) .

code 25: Reverse symmetrical deviation alarm al setpoint remote referred al setpoint: to remote setpoint referred to setpoint: set limit and remote setpoint value are compared to value of setpoint (ex. alarm state: setpoint = 400 alarm limit :1 50 remote setpoint = 400).

8 - FUNCTION NOTES

- LBA Function

This alarm identifies interruption of the control loop due short circuit of the sensor, reversed sensor, or load break.
It is always active, and generates an alarm if the variable does not increase its value in heating (does not decrease in cooling) under maximum power supplied for set time **LbAt.**
If the value of the variable is beyond the proportional band, power is limited to set value **LbAP**.
The active alarm state is signaled by flashing of the bargraph that displays the power percentage.
A relay can be assigned to the alarm by means of the configuration code.
The alarm state resets if the temperature rises in heating (lowers in cooling) or by simultaneously pressing the “Data” and “F” keys.

- HB Alarm

This type of alarm depends on use of the current transformer (C.T.) input. It signals changes in load input by indicating the percentage of current in amperometric input (max. 5A).
It is enabled by means of configuration code. In this case, the alarm tripping value is expressed as a percentage (0-100%).
The percentage of current can be displayed on bargraph if the controller type (rEG.t in CFG2) = 2, 3, 6, 7.

- H Alarm

This type of alarm depends on the setting of the H (hold) band. When the controlled variable leaves the symmetrical H band compared to the setpoint, the programmer time base stops and alarm H activates.

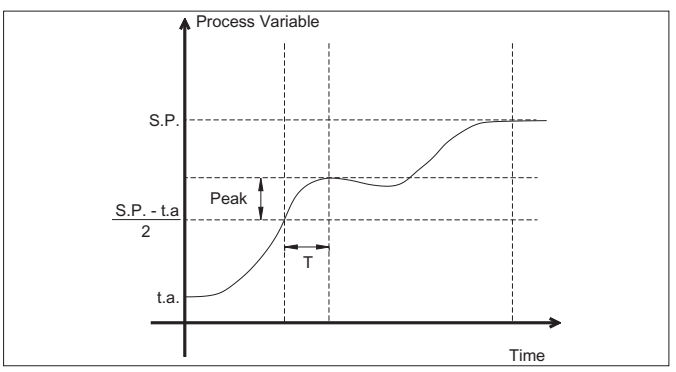
Notes on control actions

Proportional Action:
action in which contribution to output is proportional to deviation at input (deviation = difference between controlled variable and setpoint).
Derivative Action: action whose contribution to output is proportional to speed of variation of controlled variable.
Integral action: action whose contribution to output is proportional to integral of deviation time.

Influence on Proportional, Derivative, Integral actions on response of controlled process:
- An increase in Proportional Band reduces oscillations but increases deviation.
- Reduction of the Proportional Band reduces deviation, but excessively low values may make the system unstable.
- Increasing Derivative Action, corresponding to an increase in Derivative Time, prevents oscillations up to a critical value, beyond which deviation increases and provokes extended oscillations.
- Increasing Integral Action, corresponding to a reduction in Integral Time, tends to cancel deviation under standard conditions.
For high Integral Time values (weak Integral Action), persistent deviation is possible under standard conditions.

Notes on Self-tuning

The function works for single output systems (heating or cooling).
The self-tuning action calculates optimum control parameter values during process startup.
The variable (for example, temperature) must be that assumed at zero power (room temperature).
The controller supplies maximum power until an intermediate value



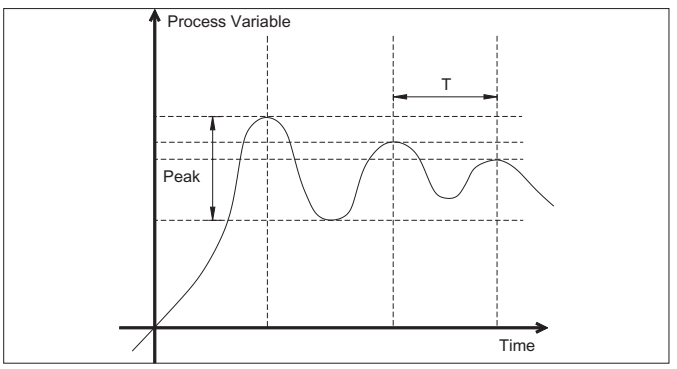
between starting value and setpoint is reached, after which it zeros power.
PID parameters are calculated by measuring overshoot and the time needed to reach peak. When calculations are finished, the system disables automatically and the control proceeds until the setpoint is reached.

Notes on Auto-tuning

PID parameters cannot be set if the self-tuning function is enabled.
The function can be one of two types: permanent or one-shot.
The first continuously measures system oscillations to find the optimum PID values to reduce such oscillations.
It does not engage if the oscillations drop below 0.5% of the proportional band.
It is interrupted if the setpoint is changed, and is automatically resumed when the setpoint stabilizes.
The calculated parameters are not stored.
If the unit is switched off, the controller reverts to the values set before self-tuning was enabled.
One-shot self-tuning is useful for calculating values around a setpoint. It produces a variation of 10% of current power at the output and examines the effect of the overshoot over time. These parameters are stored and replace those previously set. After this disturbance, the controller resumes control at the setpoint using the new parameters.

MANUAL TUNING TECHNIQUES

A) Enter the setpoint at its working value.
B) Set the proportional band at a value of 0 1% (with cycle time zero to have an on-off type control with relay output).



C) Switch to automatic and observe the behavior of the variable.
It will be similar to that in the figure::

D) The PID parameters are calculated s follows: Proportional band

$$P.B. = \frac{\text{Peak}}{(V\,max - V\,min)} \times 100$$

(V max - V min) is the scale range.
Integral time: It = 1.5 x T
Derivative time: dt = It/4

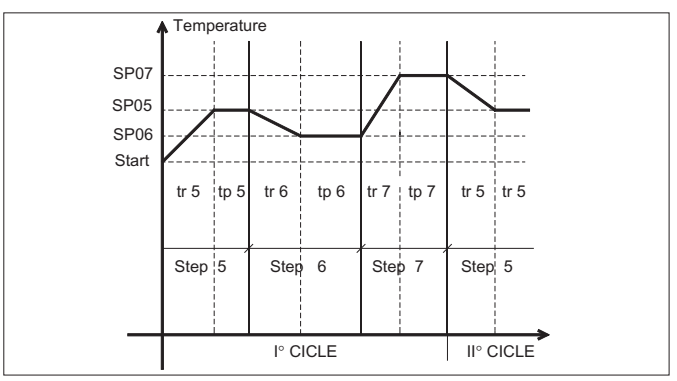
E) Switch the unit to manual, set the calculated parameters. Return to PID action by setting the appropriate relay output cycle time, and switch back to Automatic.

F) If possible, to optimize parameters, change the setpoint and check temporary response. If an oscillation persists, increase the proportional band. If the response is too slow, reduce it.

Programmer

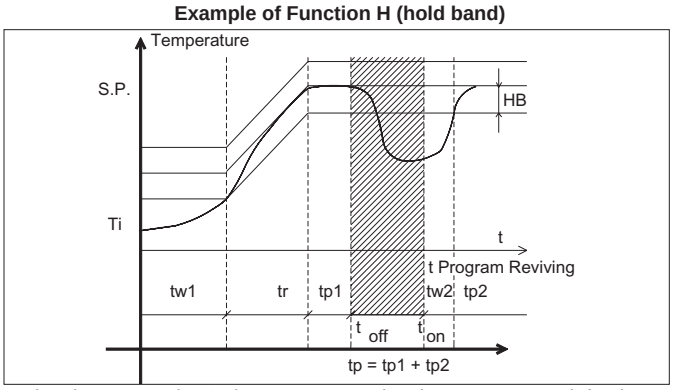
The 3500/4500 combines the function of a controller with that of a single-loop programmer.
The programmer function lets you run a program as a set of segments or steps, each consisting of a ramp and a hold.

Example of Program



8 - FUNCTION NOTES

Example of Function H (hold band)



During time tw1 and tw2, the programmer time base stops to wait for the temperature to return within band H (hold band).

Each step is composed of the following data:
- (**SPxx**) a setpoint value;
- (**rHxx,rLxx**) ramp time (0 to 99 days, 23h, 59'59'') or (Grxx) gradient (0 to 200 scale points per minute); set a time that allows a more or less rapid variation based on the starting value and the setpoint to be reached. Set a gradient that allows a variable ramp time based on the starting value and the setpoint to be reached.

- (**SHxx,SLxx**) a hold time (from 0 to 99 days, 23h, 59', 59")

- (**Hbxx**) A symmetrical tolerance band relative to the setpoint refers to the main input or to the auxiliary input according to the table on page 27.

- (**dSxx**) a set of PID control parameters defined in the context of nine programmable (1-9, 0 for no attributed parameter, see configuration dAt2).

- (**oAxx**) outputs 1-8: output code combination (0-255)

- (**obxx**) outputs 9-16: output code combination (0-255)

- (**ISxx**) inputs active (ON) for clearance to run

- (**Irxx**) inputs inactive (OFF) for clearance to run

100 program steps are available for a maximum of 50 programs. Examples of organization:
1 program of 100 steps, / 5 programs of 20 steps,
10 programs of 10 steps, / etc..

For instrument 3500S/4500S
15 program steps are available. Examples of organization: 1 program of 15 steps, 5 programs of 3 steps, etc.

USING THE PROGRAMMER:

Program selection:
- from faceplate keys by setting parameter ProG in Data function
- remote (only for 4500 programs 1-16) with first 4 logic inputs, that acquire this function only if enabled with parameter:
SP.Pr=2 (NPN) or SP.Pr=6 (PNP) in configuration CFG2
- remote from serial line

Program control:
- **Start** from digital input (IN1) on faceplate with MAN/AUTO and DATA keys simultaneously pressed / from serial line by typing value 48 (30 Hex) at address 10 (0 AHex)
- **Stop** from digital input (IN2) on faceplate with MAN/AUTO and DATA keys simultaneously pressed / from serial line by typing value 24 (18 Hex) at address 10 (0 AHex)
- **Reset** from digital input (IN3) / from digital inputs start (IN1) and stop (IN2) activated simultaneously / from faceplate with LOC/REM and DATA keys simultaneously pressed / from serial line by typing value 128 (80 Hex) at address 10 (0 Ahex)
Data for the program being run can be displayed by selecting:
Prg.n = 0 in DAt1.

Stop program:
- remote with STOP (IN2) input
- remote from serial line by typing value 48 (30Hex) at address 10 (0 AHex)
- from faceplate with keys MAN/AUTO and DATA pressed simultaneously
- variation of local setpoint, occurring during a program suspension phase, causes restart of the step currently being run, with conservation of the set gradient or with set ramp time.

Start program:
- at power-on with START (IN1) input (see setting of SP.Pr mode)
- from faceplate with keys MAN/AUTO and DATA pressed simultaneously.

Stop and restart program:
- remote with START (IN1) and STOP (IN2) inputs
- from faceplate with keys MAN/AUTO and DATA pressed simultaneously.
- if the instrument is turned off and then on, execution of the program can continue or start again from the first step (see PrGt parameter in configuration DAt 1 to define restart conditions).

PROGRAMMING FROM PC

All configuration and calibration procedures can be run with an industrial personal computer (Gefran industrial terminals or IBM*-compatibile PC) and appropriate management software.

** IBM is a registered trademark of International Business Machines.*

ORDER CODES

MODEL	
3500/3500S	
Power supply 100…240 Vac	
Serial communication:	
Current Loop	351
RS422/485	352
RS232C	353
4500/4500S	
Power supply 100…240 Vac	
Serial communication:	
Current Loop	451
RS422/485	452
RS232C	453

VERSION	
COMPLETE 100 steps available	C
SIMPLIFIED 15 steps available	S

INPUT	
TC/RTD 2-3 wires linear 0…50mV	A*
RTD 4 wires	B
0...10V	C
0...20mA, 4...20mA	D

AUXILIARY INPUTS (4500 only)	
None	0
0...1V	1
0...10V	2
0...20mA, 4...20mA	3
Potentiometer	4
Current transformer CT	5*

DIGITAL INPUTS (4500 only)	
None	0
NPN 12V	1*
PNP 12V	2
PNP 24V	3

(*) Standard model

DIGITAL OUTPUTS (4500 only)	
0	None
1	Source 12V
2	Source 24V
3*	3…30V Sink

Digital outputs include output OUT3 (relay type)

OUTPUT 4	
0	None
R*	Relay
D	Solid State
V	Continuous 0...10V
I	Continuous 0...20, 4...20mA
M	Expansion MD81
T	Transmitter powers supply

OUTPUT 3	
0	None
R*	Relay
D	Solid State
V	Continuous 0...10V
I	Continuous 0...20, 4...20mA
M	Expansion MD81
T	Transmitter powers supply

OUTPUT 2	
0	None
R*	Relay
D	Solid State
V	Continuous 0...10V
I	Continuous 0...20, 4...20mA
M	Expansion MD81
T	Transmitter powers supply

OUTPUT 1	
0	Nessuna
R*	Relè
D	Statica
V	Continuous 0...10V
I	Continuous 0...20, 4...20mA
T	Transmitter powers supply

Please, contact GEFRAN sales people for the codes availability.

• WARNINGS

WARNING: this symbol indicates danger.
It is placed near the power supply circuit and near high-voltage relay contacts.

Read the following warnings before installing, connecting or using the device:
• follow instructions precisely when connecting the device.
• always use cables that are suitable for the voltage and current levels indicated in the technical specifications.
• the device has no ON/OFF switch: it switches on immediately when power is turned on. For safety reasons, devices permanently connected to the power supply require a two-phase disconnecting switch with proper marking. Such switch must be located near the device and must be easily reachable by the user. A single switch can control several units.
• if the device is connected to electrically NON-ISOLATED equipment (e.g. thermocouples), a grounding wire must be applied to assure that this connection is not made directly through the machine structure.
• if the device is used in applications where there is risk of injury to persons and/or damage to machines or materials, it MUST be used with auxiliary alarm units. You should be able to check the correct operation of such units during normal operation of the device.
• before using the device, the user must check that all device parameters are correctly set in order to avoid injury to persons and/or damage to property.
• the device must NOT be used in inflammable or explosive environments. It may be connected to units operating in such environments only by means of suitable interfaces in conformity to local safety regulations.
• the device contains components that are sensitive to static electrical discharges. Therefore, take appropriate precautions when handling electronic circuit boards in order to prevent permanent damage to these components.
Installation: installation category II, pollution level 2, double isolation
• power supply lines must be separated from device input and output lines; always check that the supply voltage matches the voltage indicated on the device label.
• install the instrumentation separately from the relays and power switching devices
• do not install high-power remote switches, contactors, relays, thyristor power units (particularly if “phase angle” type), motors, etc... in the same cabinet.
• avoid dust, humidity, corrosive gases and heat sources.
• do not close the ventilation holes; working temperature must be in the range of 0...50°C.
If the device has faston terminals, they must be protected and isolated; if the device has screw terminals, wires should be attached at least in pairs.
• *Power*: supplied from a disconnecting switch with fuse for the device section; path of wires from switch to devices should be as straight as possible; the same supply should not be used to power relays, contactors, solenoid valves, etc.; if the voltage waveform is strongly distorted by thyristor switching units or by electric motors, it is recommended that an isolation transformer be used only for the devices, connecting the screen to ground; it is important for the electrical system to have a good ground connection; voltage between neutral and ground must not exceed 1V and resistance must be less than 6Ohm; if the supply voltage is highly variable, use a voltage stabilizer for the device; use line filters in the vicinity of high frequency generators or arc welders; power supply lines must be separated from device input and output lines; always check that the supply voltage matches the voltage indicated on the device label.
• *Input and output connections*: external connected circuits must have double insulation; to connect analog inputs (TC, RTD) you have to: physically separate input wiring from power supply wiring, from output wiring, and from power connections; use twisted and screened cables, with screen connected to ground at only one point; to connect adjustment and alarm outputs (contactors, solenoid valves, motors, fans, etc.), install RC groups (resistor and capacitor in series) in parallel with inductive loads that work in AC *(Note: all capacitors must conform to VDE standards (class x2) and support at least 220 VAC. Resistors must be at least 2W)*; fit a 1N4007 diode in parallel with the coil of inductive loads that operate in DC.
GEFRAN spa will not be held liable for any injury to persons and/or damage to property deriving from tampering, from any incorrect or erroneous use, or from any use not conforming to the device specifications.