Multiloop controller R1/R2-120TC

User's guide

(This user guide is valid for R1-120TC (non isolated channels model) and R2-120TC (isolated channels model). Wiring and user operation remain the same.)

Multiloop controller R1/R2-120TC
User's guide
Version: 11 Febbraio 2005

Sielco Elettronica

Via Edison 209 SETTIMO MILANESE (Milano)

Web-Site WWW:SIELCOELETTRONICA.COM

Index

1 - Installation

1.1 - Packaging check

Before starting installation, it is necessary to check that the packaging contents is in compliance with your order. In the packaging there must be:

- # 1 R1-120TC series controller
- # 1 instruction manual
- # 1 F1-10 operator panel with connection cable (option)

The R1-120TC has the following features:

- 24 Vdc power supply
- 6 thermocouple inputs with the following features:
  - sensor type : J, K, N, R, S, T
  - resolution: 16 bit
  - precision: ±0,05 % full scale
- 2 digital inputs with the following features:
  - optoisolated with positive common 24Vcc
  - state 0: 0 ÷ 5 Vdc
  - state 1: 7 ÷ 36 Vdc
- 12 digital outputs with the following features:
  - optically isolated PNP transistor (24V)

Check that the model module code is in compliance with the ordered code.

Verify that the user's guide edition correspond to the purchase year.

R1-120TC controllers are covered by 1 year of warranty except for damages caused by tampering or wrong wiring.

The label on the controllers backside certificates the purchase date.

1.2 - Dimensions

R1-120TC controller dimensions are shown in figure 1.1.

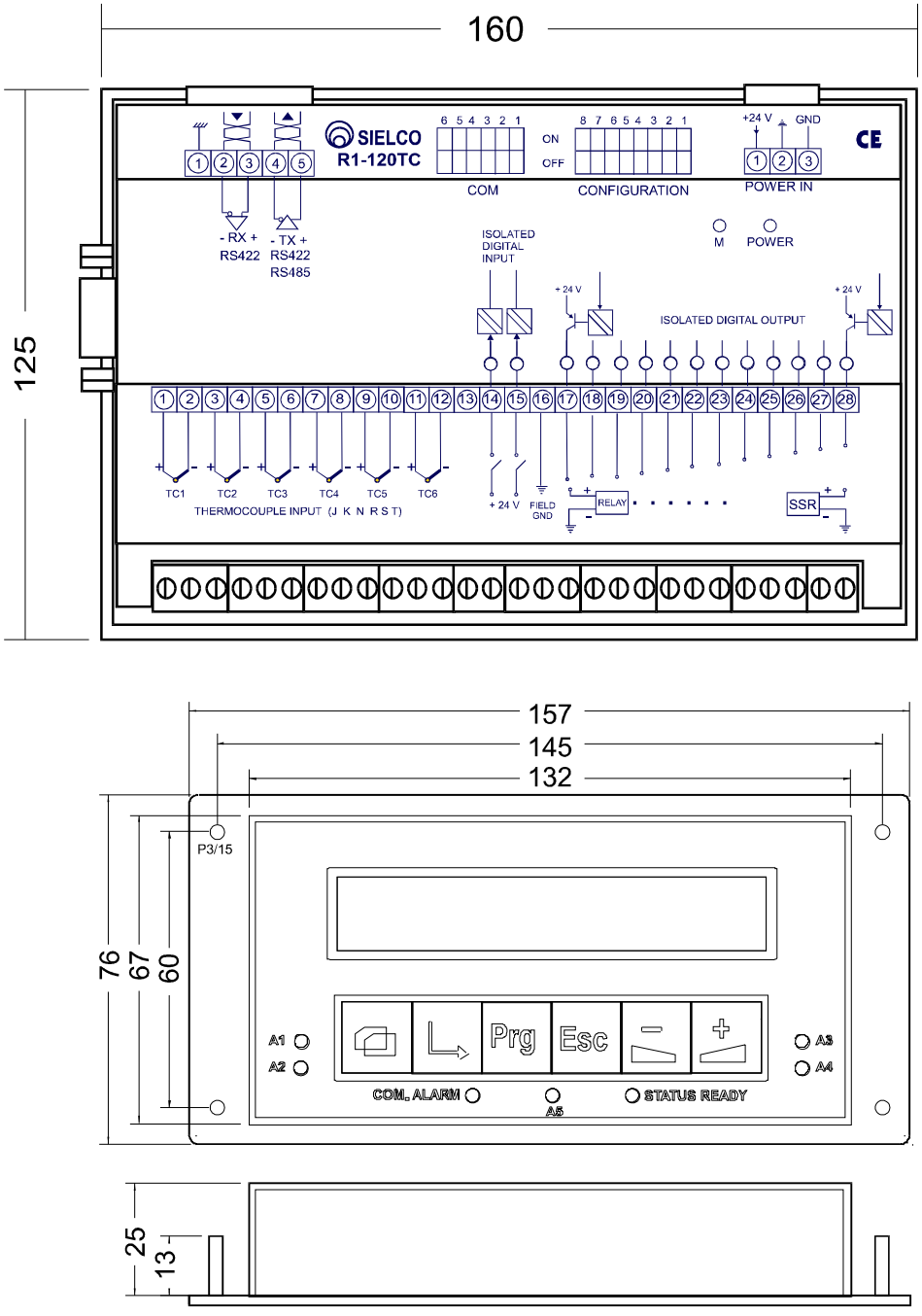

Figure 1.1 - R1-120TC controller and F1-10 panel dimensions.

1.3 - Fixing method

All R1-120TC series products are provided by a plastic support for fixing on normalized DIN EN rail and by a shielding serigraphed cover.

On the cover there are schematic mounting indications; in grey areas are shown the interface circuits that are inside the module, in yellow areas common use sensors and actuators to be connected externally.

The cover serigraph provides, obviously, only a general wiring diagram and cannot show every possible connection cases; for this reason it is necessary, before starting R1-120TC installation, to read carefully this manual.

Do not use excessive pressure on the cover, mounting or dismounting the module on the rail.

Remember to mount or dismount module with supply voltage switched off or not connected.

F1-10 console is provided in option for panel mounting. Panel hole dimensions are shown in figure 1.2.

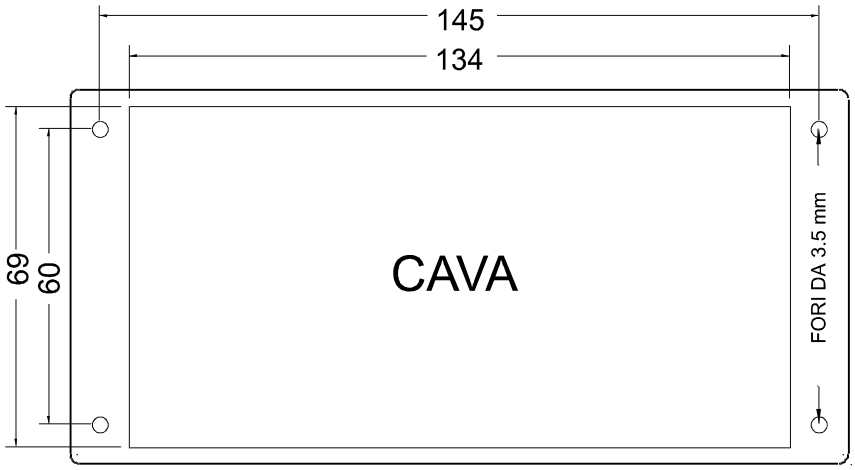

Figure 1.2 - F1-10 console hole dimensions.

1.4 - Electric wiring

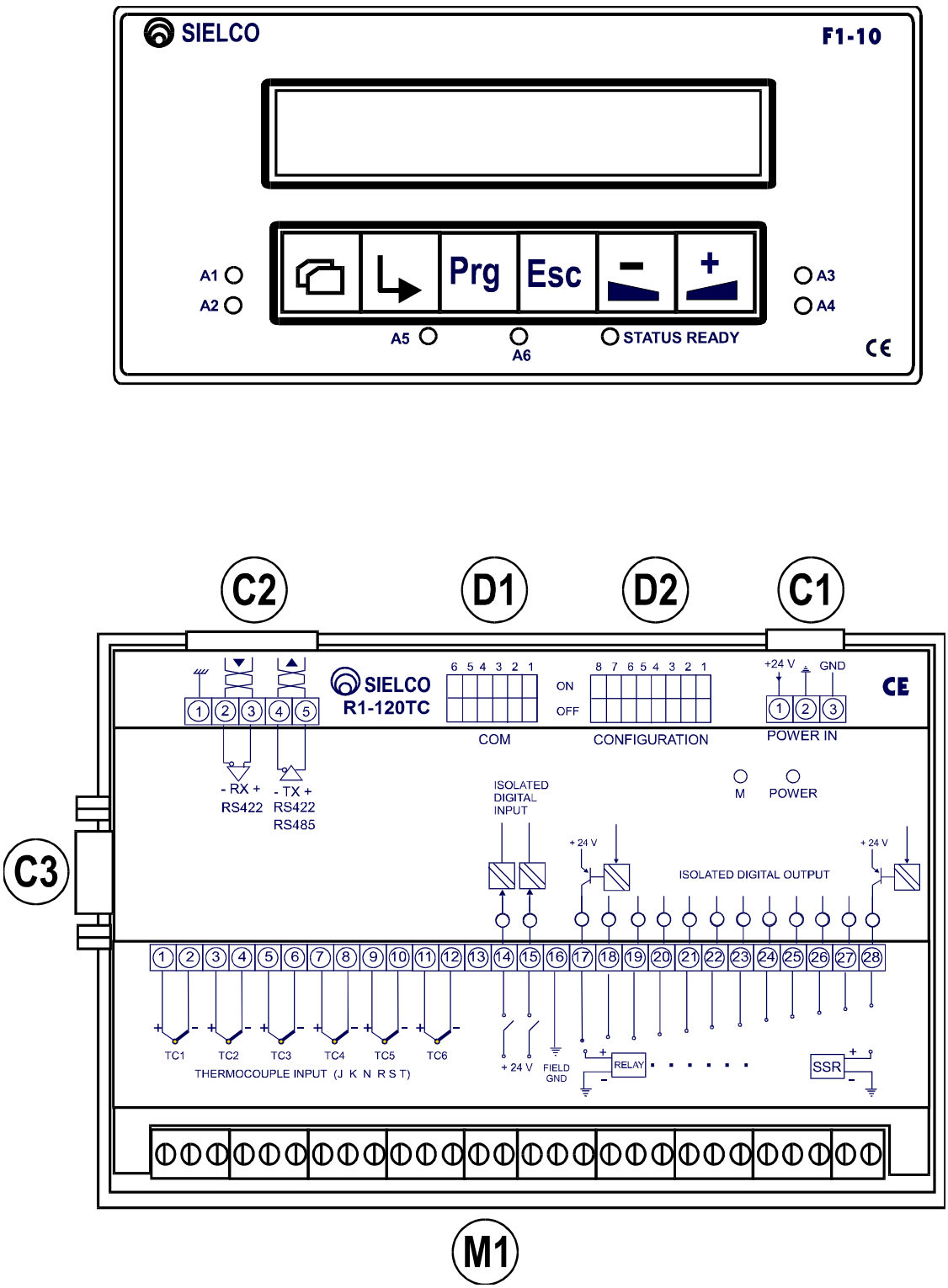

Figure 1.3 - R1-120TC and F1-10 scheme.

	Description	Paragraph
[M1]	Inputs (screws from 1 to 15) and outputs screws	1.4.2
	(screws from 17 to 28)	1.4.4
[C1]	24 Vdc supply connector	1.4.1
[C2]	Communication serial channel connector	1.4.6
[C3]	F1-10 panel connector	1.4.6
[D1]	RS422/RS485 dipswitch	1.4.5
[D2]	Protocol and address dipswitch	1.4.8
Power	Supply led	1.4.1
Led M	Autotest led	
Led TX	Transmitted data led	
Led RX	Received data led	
Led 14-15	Digital inputs status	1.4.3
Led 17-28	Digital outputs status	1.4.4

[M1] – Inputs and outputs screws

	THERMOCOUPLE INPUT
1	Channel 1 positive
2	Channel 1 negative
3	Channel 2 positive
4	Channel 2 negative
5	Channel 3 positive
6	Channel 3 negative
7	Channel 4 positive
8	Channel 4 negative
9	Channel 5 positive
10	Channel 5 negative
11	Channel 6 positive
12	Channel 6 negative

	DIGITAL INPUT
14	Digital input 1
15	Digital input 2

	FIELD GROUND
16	field ground

	DIGITAL OUTPUT
17	Digital output 1
18	Digital output 2
19	Digital output 3
20	Digital output 4
21	Digital output 5
22	Digital output 6
23	Digital output 7
24	Digital output 8
25	Digital output 9
26	Digital output 10
27	Digital output 11
28	Digital output 12

Screw #13 contains the cold junction sensor (Pt100).

[C1] - 24 Vdc supply connector

	POWER
1	+24 Vdc
2	FIELD GND
3	MECH. GND

[C2] - Communication serial channel connector

	RS422		RS485
1	SERIAL GND	**1**	SERIAL GND
2	RX–	**2**	N.C.
3	RX+	**3**	N.C.
4	TX–	**4**	TX–/RX–
5	TX+	**5**	TX+/RX+

R1-120TC controllers can be connected to an F1-10 user interface providing (see figure 3):

7 Signalling led:
- **A1** - Channel 1 configurable alarm
- **A2** - Channel 2 configurable alarm
- **A3** - Channel 3 configurable alarm
- **A4** - Channel 4 configurable alarm
- **A5** - Channel 5 configurable alarm
- **A6** - Channel 6 configurable alarm
- **STATUS READY** - Device status ready led

1 2x24 characters display with led backlight

6 Mechanical control keys
- **Page**
- **Enter**
- **Prog**
- **Esc**
- **Inc**
- **Dec**

1.4.1 - Power supply

The controller needs a 24 Vdc (9V < Vdc < 36V) supply by [C1] connector and absorb a maximum current Icc=170 mA at 24 Vdc except any load connected to the output (max 100mA for output).

1.4.2 - Analog inputs

R1-120TC controller provides 6 inputs for thermocouples or 0-50mV low voltage signals (M1 screws). If you are using thermocouples, connect only J, K, N, R, S, T type sensors in compliance with IEC 584 standard. The controller make automatically the cold junction compensation. Connect “positive” and “negative” sensors wires respectively to “positive” and “negative” module screws (respectively #1 and #2 for first input) see figure 1.2.

1.4.3 - Command digital inputs

R1-120TC controllers are equipped with 2 digital inputs with negative common. Input state is ON for voltage between 7 and 36 Vdc; OFF for voltage between 0 and 5 Vdc.

1.4.4 - Alarm and control outputs

R1-120TC controller provides 12 digital outputs. Logic outputs are “open collector” with 24 Vdc PNP transistor, suppression diode and restored fuse (output Imax for channel is 100 mA), see figure 1.4.

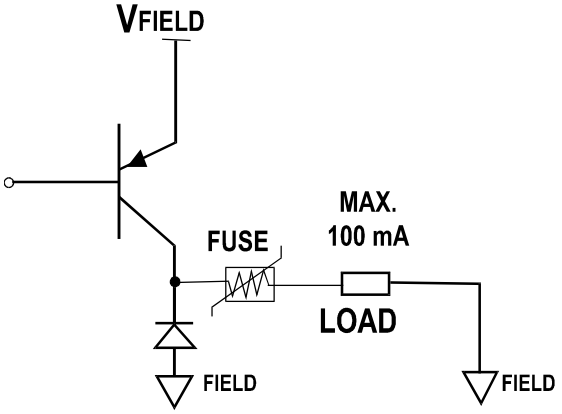

Figure 1.4 - Logical output.

These outputs can be used to command standard or solid state relays (SSR).

In case of static relay connection, verify that the internal solid state relay resistance limits the current to the above value.

In case of standard relay connection, verify that the output current is enough to excite the coil.

Using relay to drive inductive load. It can be a good thing to connect a protection filter in parallel as shown in table 1.1. For filters use film capacitors.

LOAD (mA)	C (µF)	Vmax (V)	R (Ω)	P (W)
< 40	0,047	400	100	0,5
< 150	0,1	400	22	2
< 500	0,33	400	47	2
> 500	1	400	---	---

Table 1.1 - Inductive loads filters.

Connect “positive” wiring coming from actuator to M1 screws from #17 to #28.

Connect “negative” wiring coming from actuator to M1 screws from #16 (FIELD GND).

1.4.5 - Serial link

R1-120TC controller can be connected:

- to a remote PC or to a master unit for supervision and configuration using RS422 or RS485 serial link;
- to programming and supervision console F-10 by [C3] connector.

SUPERVISOR CONNECTION

To connect to R1-120TC controllers, it is necessary to use a RS422/485 serial interface that usually are not standard equipment in personal computers. Sielco produce C1-25 model, a RS232 to RS422/RS485 serial interface converter with triple optical isolation; see table 1.2 for details.

C1-25 CONVERTER

DB 9 PIN

RS232	*#*
n.c.	1
RXD	2
n.c.	3
TXD	4
GND	5
n.c.	6
RTS	7
n.c.	8
n.c.	9

CONNECTOR 7 PIN

#	*RS422*	*RS485*
1	GND	GND
2	RX-	n.c.
3	RX+	n.c.
4	TX-	TX-/RX-
5	TX+	TX+/RX+
6	0 V	0 V
7	+24 V	+24 V

Table 1.2 - C1-25 converter input/output signals.

This converter can be connected to PC serial port (COM) and to R1-120TC by [C2] connector as shown in table 1.3.

	C1-25		***R1-120TC***		
#	**RS-422**		**RS-422**	**#**	
1	GND	⟷	SERIAL GND	1	C2
2	RX–	⟷	TX–	4	C2
3	RX+	⟷	TX+	5	C2
4	TX–	⟷	RX–	2	C2
5	TX+	⟷	RX+	3	C2
6	0 V				
7	+24 V				

	C1-25		***R1-120TC***		
#	**RS-485**		**RS-485**	**#**	
1	GND	⟷	SERIAL GND	1	C2
2	n.c.		n.c.	2	C2
3	n.c.		n.c.	3	C2
4	TX–/RX–	⟷	TX–/RX–	4	C2
5	TX+/RX+	⟷	TX+/RX+	5	C2
6	0 V				
7	+24 V				

Table 1.3 - C1-25 - R1-120TC wiring (RS422/RS485).

In case of alternative products choice, it is better to choose optically isolated products with galvanically isolated grounds.

R1-120TC controller serial link must be set to RS422 or to RS485 mode using [D1] dipswitch (see table 1.4).

RS422

	6	**5**	**4**	**3**	**2**	**1**
ON		■				
OFF	■		■	■	■	■

RS485

	6	**5**	**4**	**3**	**2**	**1**
ON	■					
OFF		■	■	■	■	■

Table 1.4 - Serial mode (RS422/RS485) configuration using [D1] dipswitch.

WARNING! Configurations in which both selectors #5 and #6 are simultaneously ON or OFF, are not permitted. Selector from #1 to #4 are reserved and they must be kept in OFF position.

F1-10 PROGRAMMING AND SUPERVISION OPERATOR PANEL

It is possible to connect R1-120TC controller to the local operator panel F1-10 by [C3] connector, to provide a complete programming and supervision.

1.4.6 - Earth wiring and shielding

EARTH WIRING

It is suggested to make the following earth:

- device mechanical ground (connector [C1] pin #3) goes directly to earth;
- the power supply negative signal (connector [C1] pin #2) must be connected to a local earth;
- in case of long or disturbed serial lines, connect serial ground (connector [C2] pin #1) to earth by a 100 Ω resistance.

It is important that device grounds are connected to earth independently; it is also important to avoid to share the same wire path with power devices such as inverter, drives etc.

INPUTS SHIELDING

Temperature reading is based on low intensity signal detection (TC, 0-50mV).

To improve the sensors reading particularly in environment noise affected by power devices (motor driver, power contact, etc.), follow these shielding rules:

- use shielded and twisted cables for sensors connection;
- keep connection cables as short as possible;
- it is a good thing to avoid to share the same wire path with power devices as inverter, drives etc.;
- connect all sensor cable metal shields to the controller negative screw leaving them non connected by the sensor side (parasite currents on the shields can induce disturbances that can affect sensor reading);
- connect all sensor cable metal shields to connector C1 pin #3.

SERIAL CHANNEL SHIELDING

Use shielded cable with one (RS-485) or two (RS-422) twisted pair in compliance with EIA RS-422 or EIA RS-485; using the shield for ground.

Recommended cable:	Belden 9841 (RS-485), 9842 (RS-422)
Maximum signal loss:	6 dB
Maximum line capacitance:	100 nf
Maximum line length:	1200 m
Line impedance:	between 100 Ω and 120 Ω

1.4.7 - Communication protocol

Software communication protocol is realised according to ModBus ASCII or RTU standard: protocol selection is made by #7 selector of [D2] dipswitch (ON=RTU, OFF=ASCII).

ASCII protocol features

Baud rate	9600 / 19200
Data bits	7
Parity bit	even
Stop bit	1

RTU protocol features

Baud rate	9600 / 19200
Data bits	8
Parity bit	none
Stop bit	1

The baudrate selection is made by #8 selector of [D2] dipswitch (ON=19200, OFF=9600).

1.4.8 - Device identification

Up to 63 R1-120TC controllers can be connected to same master unit. Modules identification is made through binary notation, using the [D2] dipswitch.

			ADDRESS					
	8	7	6	5	4	3	2	1
	BAUD	*PROT.*	2^5	2^4	2^3	2^2	2^1	2^0
ON	19200	RTU						
OFF	9600	ASCII						

Table 1.5 - R1-120TC controller address configuration using [D2] dipswitch.

2 - Operation

2.1 - Introduction

The multiloop controller R1-120TC can handle up to six independent PID control loops with thermocouple inputs.

Two digital inputs are also available to remotely control some functions commons to all the loops:

- input number one activates the regulation process on all the loops (§2.5);
- input number two selects the second set-point on all the loops (§2.4).

2.2 - Input configuration

Input configuration allows independent settings for each loop of parameters for temperature reading ,like sensor type, reading options and offset application.

- Sensor type and reading options
  sensor type:
    - bit 0,1,2: (none, linear, TcJ, TcK, TcN, TcR, TcS, TcT)
  reading options:
    - bit 6: filter on temperature reading
    - bit 7: temperature rounding

- Temperature offset (xx.x °C)

When the sensor type is set to “none”, the temperature will be forced to 0°C.

The offset allows to translate the read temperature to a desired level. The offset (in °C) is applied only to thermocouple sensors.

The reading filter is necessary only in case of noisy environment; with the filter the instantaneous values are substituted by a recursive average values calculated on least eight samples.

The rounding option allows to filter temperature variations inside 1°C range.

2.3 - Regulating outputs configuration

In output configuration you can define, for each of six pairs of digital outputs (one pair per loop), the following parameters:

- Outputs type (primary and secondary), value in hex
  - x0 = primary On/Off
  - x1 = primary pulse width modulation (SSR)
  - 22 = primary incremental (the secondary is forced to incremental type)
  - 0x = secondary alarm
  - 1x = secondary On/Off
  - 22 = secondary incremental (forced by primary output)

- On/Off output cycle (xxx sec) for primary and secondary
- SSR minimum value (xxx %) primary only
- SSR maximum value (xxx %) primary only
- SSR slope (xxx.x %/sec) primary only
- Valve runtime (xxx sec) primary, secondary
- Valve extratime (xxx sec) primary, secondary
- Valve dead band (xxx sec) primary, secondary

When the output is configured in On/Off mode, the output turn off only at the minimum value (0%) and turn on only at the maximum value (100%); in PWM mode, the period is 1 second.

The minimum and maximum values are used in PWM mode only and set the limits of regulating output power; the slope parameter allows to set the maximum speed of variation (in %/sec) of the regulation output power.

2.4 - Set-point configuration

Set-point configuration allows independent settings for each loop of the following parameters:

- Set-point type and options
  set-point type:
    - bit 0,1,2: (programmed value, loop 1 temperature, ..., ..., loop 6)
  options:
    - bit 6: soft-start option

- bit 7: holdback option

- Final set-point 1 (xxxx.x °C)
- Final set-point 2 (xxxx.x °C)

- Increment/decrement set-point step (xxx.x °C)
- Set-point increment cycle (xxx sec)
- Set-point decrement cycle (xxx sec)

The parameter “set-point type” allows to use as regulation set-point the value written in the gates “Final set-point” (type = 0) or to use as set point the temperature of one of the six loops (type = 1..6).

With the “soft start” option active, after a power fail or after a process deactivation, the set-point is set to the value of the current loop temperature.

With the “holdback” option active, in case of low or high temperature alarm, set-point variations are not allowed until the alarm condition becomes inactive.

The set-points values 1 or 2 are selected according to the state of the second digital input (input not active = set-point 1, input active = set-point 2).

The current set-point trends towards the final set point with a slope which depends on parameters set-point step and set-point increment and decrement cycles. Combining these values you can obtain the desired rising and falling slopes.

2.5 - Control configuration

PID control parameters can be set independently for each loop, these are:

- Regulation type, regulation mode and start order
  start order (Oa):
  - bit 0,1,2: (0 = excluded, 1..6)
  regulation mode:
  - bit 3,4: (0 = disabled, 1 = manual, 2 = automatic, 3 = autotuning)
  regulation type:
  - bit 6,7: (0 = none, 1 = hot, 2 = cold, 3 = hot/cold)

- PID control cycle (xxx sec)
- Proportional band (xxx.x °C)
- Dead band (xx.x °C)
- Integral action time (xxxx sec)
- Derivative action time (xxxx sec)
- Lower band of integral action (xxx.x °C)

- Upper band of integral action (xxx.x °C)

- Cold proportional band (xxx.x °C)
- Hot / Cold dead band (+/-xx.x °C)

Operating mode also depends to the state of the first digital input:

- digital input 1 not active disables the regulation process of all loops, turn off all the digital outputs and initialize to 0 the value of the start-up step.

The dead band parameter disable the PID control when the difference from the set-point and the real temperature is lower than the dead band value.

Lower and upper integral band values are usually set equal to the proportional band value; they can be modified to reduce a possible overshoot in case of set-point change.

The Hot / Cold dead band defines the band between the end of the heat control and the beginning of the cool control; if the dead band has a negative value, there is a band where heat and cool control outputs are active at the same time.

When setting regulation mode to “disable”, the regulation process is disabled; in “manual mode”, the value of output power is controlled by the operator; in “autotuning” mode, the temperature oscillates around the set-point value and, at the end of the procedure, the PID parameters are automatically calculated and updated, and the regulation mode switch to “automatic”.

The controller can perform only one autotuning procedure at the same time. If the operator set to autotuning mode more than one loop at the same time, the last setting is not applied and the operating mode of this loop is forced to “disabled”. The operating mode of the first loop that was set to autotuning is maintained. When this loop terminates an autotuning procedure, the operator can proceed to autotune another loop.

The PID algorithm set the correct output power on a primary and a secondary regulation outputs.

2.6 - Alarm configuration

Alarm configuration allows setting alarm conditions independently for each loop; the alarm conditions depends on the following alarm thresholds:

- relative low temperature (xxxx.x °C)
- relative high temperature (xxxx.x °C)
- minimum temperature (xxxx.x °C)
- maximum temperature (xxxx.x °C)

The relative alarm condition goes on if the difference between the loop temperature and the set-point exceeds the relative low or high thresholds; the absolute alarm condition goes on if the loop temperature exceeds the minimum or the maximum thresholds.

Alarm conditions resulting from comparison with alarm thresholds, are available in the alarm status read-only gate. Alarm conditions can be used to generate a specific alarm at the secondary output of the loop, through the following parameters:

- Alarm mask
    - bit 0: sensor break
    - bit 1: low alarm
    - bit 2: high alarm
    - bit 3: minimum alarm
    - bit 4: maximum alarm
    - bit 5: -----
    - bit 6: -----
    - bit 7: -----

- Time for alarm activation, ON filter (xxx sec)

The filter time can be used to avoid alarm generation when conditions are fulfilled for a short time.

2.7 - Start-up sequence programming

Programming the start-up sequence of heating allows a reduction of peak energy requirement during the start-up phase.

It can be convenient to start with heating zones which takes more time to reach the final temperature; by this way it is possible to reduce the total energy consumption and to avoid current peaks.

With the parameter “start-up sequence number” called “Oa”, it is possible to assign to each loop a sequential number which specify the start-up order; to program the start-up sequence it is necessary to set, for each loop, the parameter Oa and the minimum temperature alarm threshold; if Oa is set to zero, the start-up procedure for the loop is bypassed and the regulation process starts immediately.

The start-up sequence is controlled by the index “start-up step” (Pa), which varies from 1 (start of sequence) to 6 (end of sequence). When the logic input 1 is turned off, Pa is initialized to the value 0.

When Pa=1, all loops whit Oa=1 start heating; when these loops reaches a temperature greater than their respective minimum temperature alarm threshold, the index Pa automatically increases by one; at this point all loops with Oa=2 start heating, and the procedure goes on until Pa reaches the final value Pa=6.

2.8 - Supervision

For each loop the following read gates are available, in addition to read/write gates used for the configuration:

- Actual temperature in tenth of degrees (xxxx.x °C)
- Effective set-point temperature in tenth of degrees (xxxx.x °C)
- Value of primary regulation output (xxx.x %)
- Value of secondary regulation output (xxx.x %)

- Actual operating mode
  - 0 = disabled
  - 1 = manual
  - 2 = automatic
  - 3 = autotuning

- Alarm status
  - bit 0: sensor break
  - bit 1: low temperature
  - bit 2: high temperature
  - bit 3: minimum temperature
  - bit 4: maximum temperature
  - bit 5: -----
  - bit 6: -----
  - bit 7: -----

It is also available the actual start-up step (Pa), common of all loops.

2.9 - Self test led

The self test led gives a synthetic indication about the operation of the controller; there are three possibilities:

- the led is always on or off: this indicates that the CPU is not working, it can depend on a power loss or a fault;

- the led turn on and off constantly: this indicates that the initialization procedure is running, this procedure starts after a reset and it takes about

10 seconds. When the initialization procedure is running the serial communication and the regulation process are disabled;

- the led executes three fast pulses followed by a long pause: this indicates a normal running state.

3 - User interface

3.1 - Introduction

The configuration, programming and supervision of the controller can be done with one of these procedures:

- with the local operator panel F1-10, connected directly to the controller with a dedicated cable; the dialog procedures are explained in paragraph 2 of this chapter.

- with a personal computer: connected to many controllers with a RS485 bus and Modbus protocol; the list of available gates is indicated in Appendix A of this chapter.

3.2 - Operator panel F1-10

The operator panel F1-10 has a 2 lines by 24 characters each (liquid crystal display), a 6 keys keyboard and 6 led.

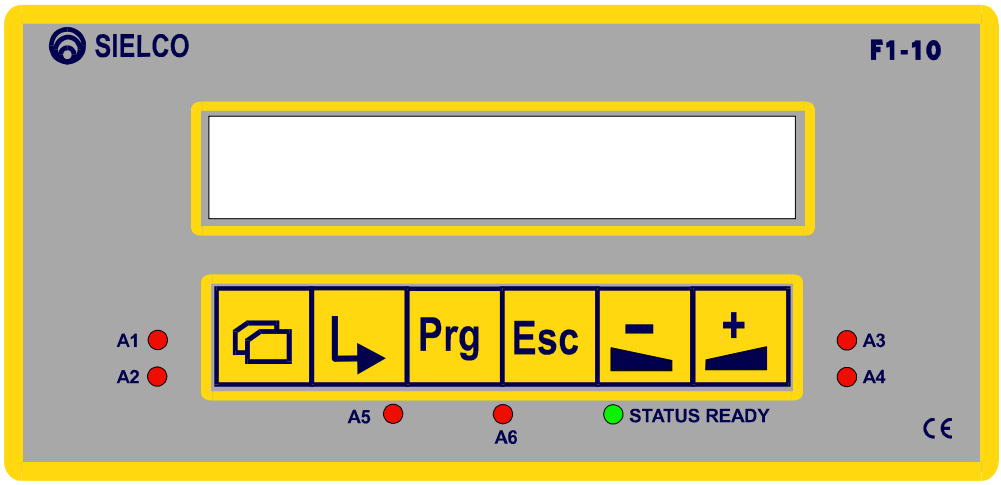

Figure 3.5 - Operator panel F1-10.

When connected to a controller, the operator panel will show various menus that allows configuration, programming and supervision of the controller.

In the default page the six thermocouples temperatures are visualized.

The structure of other pages is made by a fixed title in the first row and a rotating items in the second row.

In the following pages the meaning of the various menus is explained. Is also explained how to insert or modify a value and, for numeric parameters, the minimum and maximum values allowed are displayed in the right side of the tables in the form [min..max].

3.2.1 - Keyboard

When not indicated otherwise, pushing a key yields the following operations:

Key	Description	Operation
	*SELECT*	Rotate the various items of the menu.
	*ENTER*	Enter in the next menu level (if present)
	*PROGRAM*	Confirm the data modifications
	*ESCAPE*	Cancel a data modification or escape to previous menu level (if present)

	*DEC*	Decrement selected data
	*INC*	Increment selected data

3.2.2 - Front led

The led on F1-10 panel are used in association with a digital output alarms.

3.2.3 - Default page

The default page, or main page, is the first page displayed when the controller is turned on. The six thermocouples temperatures are displayed in Celsius.

+nnnn.n	+nnnn.n	+nnnn.n	Loop1	Loop2 Loop3
+nnnn.n	+nnnn.n	+nnnn.n	Loop4	Loop5 Loop6

With the enter key  you go to the main menu.

3.2.4 - Main menu

From the main menu you can go to the supervision menu, the programming menu, the configuration menu and the diagnostic menu.

With the selection key  you can rotate the various menu items and with the enter key  you go to the next menu level.

* MAIN MENU *	
- Supervision	
- Programming	
- Configuration	
- Diagnostics	
- Language	[Italiano, English]

The last row allow to select the language.

With  and  data can be modified, with  new data can be confirmed.

3.2.5 - Supervision

The supervision page summarize the actual status of each loop.

[N] AL:----- PV:+nnnn.n	[abmnr]
[sss] P:nnn.n SV:+nnnn.n	

The data displayed are:

AL:	actual alarms:
[a]	high
[b]	low
[m]	maximum
[n]	minimum
[r]	sensor break
PV:	actual temperature (°C)
sss	actual loop status:
[dis]	disabled
[man]	manual
[aut]	automatic
[tun]	autotuning
P:	primary output power (%)
SV:	actual set-point temperature (°C)

Use the selection key  to switch to the next loop, use the escape key  to come back to previous menu.

3.2.6 - Programming

In the programming pages you can set the operating mode and the set-points of each loop.

Choose the desired loop, then go to parameter settings.

PROGRAMMING LOOP N	[1..6]
Status :ssssss	[disable, manual, auto, tuning]
Set Point 1 [°C]:+nnnn.n	[-100..+2000]
Set Point 2 [°C]:+nnnn.n	[-100..+2000]
Primary out [%]: nnn.n	[0.0..100.0]

When the status is set to “disable”, the primary regulation output is forced to off state. For the secondary output: if configured as “on/off” type, is forced to off state, if configured as “alarm” type, it will maintain the status imposed by the alarms conditions.

When the status is set to “manual”, the operator can change the value of primary output power. If the output is configured as “on/off” type, only the values 0%

and 100% are effective. Intermediate values are effective when the output is configured as “SSR” type.

3.2.7 - Configuration

The controller configuration has two sections: loop configuration and outputs configuration.

* CONFIGURATION MENU *
- Loop Configuration
- Output Configuration

Loop configuration

CONFIGURATION LOOP N	[1..6]
- Input	
- Set point	
- Control	
- Alarms	

For each loop is necessary to set the parameters required for configuring input, set-points, regulation and alarms.

INPUT CONFIGUR. LOOP N		[1..6]
Sensor type	: ssssssss	[none, 50mV, TC J,K,N,R,S,T]
Read filter	: SSS	[YES/NO]
Rounding	: SSS	[YES/NO]
Offset [°C]	: +nn.n	[-99.9..+99.9]

In the input configuration pages you can set the parameters required to read a temperature with a thermocouple sensor.

When the sensor type is set to “none”, the temperature will be forced to 0°C.

The reading filter is necessary only in case of noisy environment; with the filter the instantaneous values are substituted by a moving average values calculated on least eight samples.

The “Rounding” option allow to filter temperature variations below 1°C.

The “Offset” parameter allow to translate the read temperature to a desired level.

SETPOINT CONFIG. LOOP N	[1..6]
Soft Start : SSS	[YES/NO]
Holdback : SSS	[YES/NO]
Setpoint type : ssssss	[progr., temp 1..temp 6]
i/d step [°C]: nnn.n	[0.1..400.0]
Incr. cycle [s]: nnn	[1..240]
Decr. cycle [s]: nnn	[1..240]

For the set-point type, the values allowed are:

progr.	the programmed value, set-point 1 or 2 according to the status of the second digital input
temp N	the set-point is the temperature of the loop N

CONTROL CONFIG. LOOP N	[1..6]
Control tipe :sssssss	[none, hot, cold, hot/col]
PID cycle [s]: nnn	[1..240]
Prop. band [°C]: nnn.n	[0.1..400.0]
Dead band [°C]: nn.n	[0.0..40.0]
Integral T. [s]: nnnn	[0..4000]
Derivative T.[s]: nnnn	[0..4000]
Int.- band [°C]: nnn.n	[0.0..400.0]
Int.+ band [°C]: nnn.n	[0.0..400.0]
Cold band [°C]: nnn.n	[0.1..400.0]
Dead h/c b. [%]: +nn.n	[-50.0..+50.0]
Start order : n	[0..6]

Control type

When the control type is set to “none”, the primary regulation output is forced to off state. For the secondary output: if configured as “on/off” type, is forced to off state, if configured as “alarm” type, it will maintain the status imposed by the alarms conditions.

When the control type is set to “hot” or “cold” , the regulation output is a primary output only.

When the control type is set to “hot/cold”, the hot regulation output is a primary output and the cold regulation output is a secondary output (if properly configured as “on/off” type).

Start order

The controller can perform a start-up sequence of the six loops. To include a loop in this sequence, set the value to 1..6; to exclude a loop, set the value to 0.

ALARM CONFIG. LOOP N	[1..6]
Low temp [°C]: nnnn.n	[0.0..2000.0]
High temp [°C]: nnnn.n	[0.0..2000.0]
Minimum temp[°C]:+nnnn.n	[-100.0..+2000.0]
Maximum temp[°C]:+nnnn.n	[-100.0..+2000.0]
ON filter [s]: nnn	[0..240]
Break sensor : SSS	[YES/NO]
Low alarm : SSS	[YES/NO]
High alarm : SSS	[YES/NO]
Minimum alarm : SSS	[YES/NO]
Maximum alarm : SSS	[YES/NO]

To define the alarms mask set to “yes” or “no” the various items. The secondary output (if properly configured as “alarm” type) will turn on if at least one item is set to “yes”. In the supervision page the alarm situation is visualized in any case.

The “ON filter” parameter allow to avoid short alarm situations. The filter time apply only to alarm ON condition. The alarm conditions must remain constantly active for the time indicated to turn on the alarm output. To turn on immediately the alarm output set this parameter to 0 seconds. The alarm output turn off immediately after all the alarm conditions being inactive. No alarm retention is performed by the device.

Output Configuration

Each loop uses two digital outputs to regulate or to indicate alarms. Each loop has a primary output used for regulation only and a secondary output used for regulation (hot/cold mode or motorized valve) or for alarm purposes. The following table summarizes the links between loops and outputs.

LOOP	1st	2nd	3rd	4th	5th	6th
PRIMARY OUTPUT (regulation)	1	3	5	7	9	11
SECONDARY OUTPUT (alarm / regulation)	2	4	6	8	10	12

Digital output configuration requires, for each loop, a separate configuration of the primary and secondary output

CONF. PRIMARY OUT LOOP N	[1..6]
Output type : ssssss	[on/off, SSR, increm]
Cycle (on/off)[s]: nnn	[1..240]
Minimum (SSR)[%]: nnn	[0..100]
Maximum (SSR)[%]: nnn	[0..100]
Slope (SSR)[%/s]: nnn.n	[0.1..100.0]
Run time (inc)[s]: nnn	[1..240]
Extra time (inc)[s]: nnn	[1..240]
Dead band (inc)[s]: nnn	[0..100]

CONF. SECOND. OUT LOOP N	[1..6]
Output type : ssssss	[alarm, on/off] - [increm]
Cycle (on/off)[s]: nnn	[1..240]

Primary regulation output

The primary regulation output can be configured as “on/off” type (regulation with mechanical relays), or as “SSR” type (regulation with solid state relays) or as “incremental” type (regulation with motorized valves).

When the output is configured as “on/off” type, the parameter “cycle” is the minimum interval time between variation of the output states.

When the output is configured as “SSR” type, the parameters “minimum” and “maximum” are the lowest and highest value that the output can reach. The parameter “slope” allow to select the speed of a set-point variation (in percent per second, in both increasing and decreasing direction).

When the output is configured as “incremental” type, is necessary to set the run time of the valve (that’s the time needed by the valve to be completely open or closed). The “extra time” indicates the supplementary time to continue opening or closing the valve even if the completely open or close position has been reached. This allows the controller to be assured that the position of the valve is correct, because there is no feedback of real position of the valve. The parameter “dead band” allows to avoid a valve movement shorter than indicated.

Secondary regulation output

When the output is configured as “alarm”, it turn on or off according to alarm conditions specified in the loop configuration. If the output is configured as “on/off” (in the case of hot/cold regulation, as the cold output), the parameter “cycle” is the minimum interval time between variation of the output status.

The secondary output configuration is strictly dependent to primary output configuration. If the primary output is configured as “incremental” type,

automatically the secondary output will be forced to the same type, because the control of a motorized valve requires two outputs (one for open and one for close). In this case, in the secondary output type configuration menu, the “increm” value will be displayed, but the operator cannot change it. The only way to change this value is to set the type of the primary output to a value other than “increm”.

3.2.8 - Diagnostics

Diagnostic pages are useful during controller installation and to verify the correct working.

In the diagnostic menu you can display the pages related to digital inputs/outputs, serial communication and analog inputs.

```
    * DIAGNOSTICS *
- Digital I/O
- Communication
- Analog inputs
```

In the digital input diagnostic you can see their actual status.
In the digital output diagnostic you can see and modify their actual status

```
  * I/O DIAGNOSTICS *
IN:XX   OUT:XXXXXXXXXXXX [0,1]
```

In the communication diagnostic page you can see the values set by the microswitch on the board: device address, baud rate and Modbus protocol type.

```
 * COMM. DIAGNOSTICS *
Device address   :    nn [1..63] from switch
Baud Rate        : sssss [9600/19200] from switch
Protocol         : sssss [ASCII/RTU] from switch
```

In the analog input diagnostics some values are displayed. Three binary numbers: the slope A/D converter offset (Off), the voltage sample (Vsa) and the resistive sample (Rsa). It is also displayed the cold junction temperature (in °C) of thermocouples (Jct).

* ANALOG INPUTS DIAGN. *
[Off]: nnnn [Vsa]:nnnnn
[Rsa]:nnnnn [Jct]:+nn.n

3.3 - Personal computer supervision

Any commercial scada software with Modbus driver can be used for the controller management. The user can configure the devices, download and upload recipes, do real-time supervision, historical trends analysis and alarm management. All the data are stored in data bases that can be accessed by most common windows application such as Excel™, Access™. An integrated development environment make available a large set of instruments to quickly build multilanguage applications.

A - Gates list

A.1 - Numeric gates list (holding registers)

ADDRESS	DESCRIPTION	UNIT	BYTE	MIN	MAX	FORMAT	READ ONLY
000	Device - Identification “R1”		2	0	0	SS	•
001	Device - Identification “120”	#	2	0	0	nnn	•
002	Device - firmware version	#	2	0	65535	nnn.nn	•
005	Reset counter	#	1	0	255	nnn	
006	Loop 1 – Sensor type and read options	bit	1	0	199	bbxxxbbb	
007	Loop 2 – Sensor type and read options	bit	1	0	199	bbxxxbbb	
008	Loop 3 – Sensor type and read options	bit	1	0	199	bbxxxbbb	
009	Loop 4 – Sensor type and read options	bit	1	0	199	bbxxxbbb	
010	Loop 5 – Sensor type and read options	bit	1	0	199	bbxxxbbb	
011	Loop 6 – Sensor type and read options	bit	1	0	199	bbxxxbbb	
012	Loop 1 – Temperature offset	℃	2	-999	+999	±nn.n	
013	Loop 2 – Temperature offset	℃	2	-999	+999	±nn.n	
014	Loop 3 – Temperature offset	℃	2	-999	+999	±nn.n	
015	Loop 4 – Temperature offset	℃	2	-999	+999	±nn.n	
016	Loop 5 – Temperature offset	℃	2	-999	+999	±nn.n	
017	Loop 6 – Temperature offset	℃	2	-999	+999	±nn.n	
018	Ramp offset binary	#	2	0	65535	nnnnn	•
019	Voltage sample binary	#	2	0	65535	nnnnn	•
020	PT100 sample binary	#	2	0	65535	nnnnn	•

021	Cold junction temperature	℃	2	0	+1000	+nnn.n	•
022	Loop 1 - Temperature	℃	2	-1000	+30000	±nnnn.n	•
023	Loop 2 - Temperature	℃	2	-1000	+30000	±nnnn.n	•
024	Loop 3 - Temperature	℃	2	-1000	+30000	±nnnn.n	•
025	Loop 4 - Temperature	℃	2	-1000	+30000	±nnnn.n	•
026	Loop 5 - Temperature	℃	2	-1000	+30000	±nnnn.n	•
027	Loop 6 - Temperature	℃	2	-1000	+30000	±nnnn.n	•
028	Menu language	#	1	0	1	n	
029	Output 1 & 2 – Type	bit	1	0	34	xxbbxxbb	
030	Output 3 & 4 – Type	bit	1	0	34	xxbbxxbb	
031	Output 5 & 6 – Type	bit	1	0	34	xxbbxxbb	
032	Output 7 & 8 – Type	bit	1	0	34	xxbbxxbb	
033	Output 9 & 10 – Type	bit	1	0	34	xxbbxxbb	
034	Output 11 & 12 – Type	bit	1	0	34	xxbbxxbb	
035	Output 1 – On/Off Cycle time	sec	1	1	240	nnn	
036	Output 2 – On/Off Cycle time	sec	1	1	240	nnn	
037	Output 3 – On/Off Cycle time	sec	1	1	240	nnn	
038	Output 4 – On/Off Cycle time	sec	1	1	240	nnn	
039	Output 5 – On/Off Cycle time	sec	1	1	240	nnn	
040	Output 6 – On/Off Cycle time	sec	1	1	240	nnn	
041	Output 7 – On/Off Cycle time	sec	1	1	240	nnn	
042	Output 8 – On/Off Cycle time	sec	1	1	240	nnn	
043	Output 9 – On/Off Cycle time	sec	1	1	240	nnn	
044	Output 10 – On/Off Cycle time	sec	1	1	240	nnn	
045	Output 11 – On/Off Cycle time	sec	1	1	240	nnn	
046	Output 12 – On/Off Cycle time	sec	1	1	240	nnn	
047	Output 1 – SSR Minimum value	%	1	0	100	nnn	
048	Output 3 – SSR Minimum value	%	1	0	100	nnn	
049	Output 5 – SSR Minimum value	%	1	0	100	nnn	
050	Output 7 – SSR Minimum value	%	1	0	100	nnn	
051	Output 9 – SSR Minimum value	%	1	0	100	nnn	
052	Output 11 – SSR Minimum value	%	1	0	100	nnn	
053	Output 1 – SSR Maximum value	%	1	0	100	nnn	
054	Output 3 – SSR Maximum value	%	1	0	100	nnn	
055	Output 5 – SSR Maximum value	%	1	0	100	nnn	
056	Output 7 – SSR Maximum value	%	1	0	100	nnn	
057	Output 9 – SSR Maximum value	%	1	0	100	nnn	
058	Output 11 – SSR Maximum value	%	1	0	100	nnn	
059	Output 1 – SSR Ramp	%/s	2	1	1000	nnn.n	
060	Output 3 – SSR Ramp	%/s	2	1	1000	nnn.n	
061	Output 5 – SSR Ramp	%/s	2	1	1000	nnn.n	
062	Output 7 – SSR Ramp	%/s	2	1	1000	nnn.n	
063	Output 9 – SSR Ramp	%/s	2	1	1000	nnn.n	
064	Output 11 – SSR Ramp	%/s	2	1	1000	nnn.n	
065	Output 1 – Manual value	%	2	0	1000	nnn.n	

066	Output 3 – Manual value	%	2	0	1000	nnn.n	
067	Output 5 – Manual value	%	2	0	1000	nnn.n	
068	Output 7 – Manual value	%	2	0	1000	nnn.n	
069	Output 9 – Manual value	%	2	0	1000	nnn.n	
070	Output 11 – Manual value	%	2	0	1000	nnn.n	
071	Output 1 & 2 – Valve Runtime	sec	1	1	240	nnn	
072	Output 3 & 4 – Valve Runtime	sec	1	1	240	nnn	
073	Output 5 & 6 – Valve Runtime	sec	1	1	240	nnn	
074	Output 7 & 8 – Valve Runtime	sec	1	1	240	nnn	
075	Output 9 & 10 – Valve Runtime	sec	1	1	240	nnn	
076	Output 11 & 12 – Valve Runtime	sec	1	1	240	nnn	
077	Output 1 & 2 – Valve Extratime	sec	1	1	240	nnn	
078	Output 3 & 4 – Valve Extratime	sec	1	1	240	nnn	
079	Output 5 & 6 – Valve Extratime	sec	1	1	240	nnn	
080	Output 7 & 8 – Valve Extratime	sec	1	1	240	nnn	
081	Output 9 & 10 – Valve Extratime	sec	1	1	240	nnn	
082	Output 11 & 12 – Valve Extratime	sec	1	1	240	nnn	
083	Output 1 & 2 – Valve Dead band	sec	1	1	100	nnn	
084	Output 3 & 4 – Valve Dead band	sec	1	1	100	nnn	
085	Output 5 & 6 – Valve Dead band	sec	1	1	100	nnn	
086	Output 7 & 8 – Valve Dead band	sec	1	1	100	nnn	
087	Output 9 & 10 – Valve Dead band	sec	1	1	100	nnn	
088	Output 11 & 12 – Valve Dead band	sec	1	1	100	nnn	
089	Loop 1 – Set-point type and options	bit	1	0	199	bbxxxbbb	
090	Loop 2 – Set-point type and options	bit	1	0	199	bbxxxbbb	
091	Loop 3 – Set-point type and options	bit	1	0	199	bbxxxbbb	
092	Loop 4 – Set-point type and options	bit	1	0	199	bbxxxbbb	
093	Loop 5 – Set-point type and options	bit	1	0	199	bbxxxbbb	
094	Loop 6 – Set-point type and options	bit	1	0	199	bbxxxbbb	
095	Loop 1 – Final set-point 1	℃	2	-1000	+20000	±nnnn.n	
096	Loop 2 – Final set-point 1	℃	2	-1000	+20000	±nnnn.n	
097	Loop 3 – Final set-point 1	℃	2	-1000	+20000	±nnnn.n	
098	Loop 4 – Final set-point 1	℃	2	-1000	+20000	±nnnn.n	
099	Loop 5 – Final set-point 1	℃	2	-1000	+20000	±nnnn.n	
100	Loop 6 – Final set-point 1	℃	2	-1000	+20000	±nnnn.n	
101	Loop 1 – Final set-point 2	℃	2	-1000	+20000	±nnnn.n	
102	Loop 2 – Final set-point 2	℃	2	-1000	+20000	±nnnn.n	
103	Loop 3 – Final set-point 2	℃	2	-1000	+20000	±nnnn.n	
104	Loop 4 – Final set-point 2	℃	2	-1000	+20000	±nnnn.n	
105	Loop 5 – Final set-point 2	℃	2	-1000	+20000	±nnnn.n	
106	Loop 6 – Final set-point 2	℃	2	-1000	+20000	±nnnn.n	
107	Loop 1 – Set-point step	℃	2	1	4000	nnn.n	
108	Loop 2 – Set-point step	℃	2	1	4000	nnn.n	
109	Loop 3 – Set-point step	℃	2	1	4000	nnn.n	
110	Loop 4 – Set-point step	℃	2	1	4000	nnn.n	
111	Loop 5 – Set-point step	℃	2	1	4000	nnn.n	

112	Loop 6 – Set-point step	℃	2	1	4000	nnn.n	
113	Loop 1 – Set-point increment cycle	sec	1	1	240	nnn	
114	Loop 2 – Set-point increment cycle	sec	1	1	240	nnn	
115	Loop 3 – Set-point increment cycle	sec	1	1	240	nnn	
116	Loop 4 – Set-point increment cycle	sec	1	1	240	nnn	
117	Loop 5 – Set-point increment cycle	sec	1	1	240	nnn	
118	Loop 6 – Set-point increment cycle	sec	1	1	240	nnn	
119	Loop 1 – Set-point decrement cycle	sec	1	1	240	nnn	
120	Loop 2 – Set-point decrement cycle	sec	1	1	240	nnn	
121	Loop 3 – Set-point decrement cycle	sec	1	1	240	nnn	
122	Loop 4 – Set-point decrement cycle	sec	1	1	240	nnn	
123	Loop 5 – Set-point decrement cycle	sec	1	1	240	nnn	
124	Loop 6 – Set-point decrement cycle	sec	1	1	240	nnn	
125	Loop 1 – Regulation options	bit	1	0	223	bbxbbbbb	
126	Loop 2 – Regulation options	bit	1	0	223	bbxbbbbb	
127	Loop 3 – Regulation options	bit	1	0	223	bbxbbbbb	
128	Loop 4 – Regulation options	bit	1	0	223	bbxbbbbb	
129	Loop 5 – Regulation options	bit	1	0	223	bbxbbbbb	
130	Loop 6 – Regulation options	bit	1	0	223	bbxbbbbb	
131	Loop 1 – PID regulation cycle	sec	1	1	240	nnn	
132	Loop 2 – PID regulation cycle	sec	1	1	240	nnn	
133	Loop 3 – PID regulation cycle	sec	1	1	240	nnn	
134	Loop 4 – PID regulation cycle	sec	1	1	240	nnn	
135	Loop 5 – PID regulation cycle	sec	1	1	240	nnn	
136	Loop 6 – PID regulation cycle	sec	1	1	240	nnn	
137	Loop 1 – Proportional band	℃	2	1	4000	nnn.n	
138	Loop 2 – Proportional band	℃	2	1	4000	nnn.n	
139	Loop 3 – Proportional band	℃	2	1	4000	nnn.n	
140	Loop 4 – Proportional band	℃	2	1	4000	nnn.n	
141	Loop 5 – Proportional band	℃	2	1	4000	nnn.n	
142	Loop 6 – Proportional band	℃	2	1	4000	nnn.n	
143	Loop 1 – Dead band	℃	2	0	400	nn.n	
144	Loop 2 – Dead band	℃	2	0	400	nn.n	
145	Loop 3 – Dead band	℃	2	0	400	nn.n	
146	Loop 4 – Dead band	℃	2	0	400	nn.n	
147	Loop 5 – Dead band	℃	2	0	400	nn.n	
148	Loop 6 – Dead band	℃	2	0	400	nn.n	
149	Loop 1 – Integral time	sec	2	0	4000	nnnn	
150	Loop 2 – Integral time	sec	2	0	4000	nnnn	
151	Loop 3 – Integral time	sec	2	0	4000	nnnn	
152	Loop 4 – Integral time	sec	2	0	4000	nnnn	
153	Loop 5 – Integral time	sec	2	0	4000	nnnn	
154	Loop 6 – Integral time	sec	2	0	4000	nnnn	
155	Loop 1 – Derivative time	sec	2	0	4000	nnnn	
156	Loop 2 – Derivative time	sec	2	0	4000	nnnn	
157	Loop 3 – Derivative time	sec	2	0	4000	nnnn	

158	Loop 4 – Derivative time	sec	2	0	4000	nnnn	
159	Loop 5 – Derivative time	sec	2	0	4000	nnnn	
160	Loop 6 – Derivative time	sec	2	0	4000	nnnn	
161	Loop 1 – Lower integral band	℃	2	0	4000	nnn.n	
162	Loop 2 – Lower integral band	℃	2	0	4000	nnn.n	
163	Loop 3 – Lower integral band	℃	2	0	4000	nnn.n	
164	Loop 4 – Lower integral band	℃	2	0	4000	nnn.n	
165	Loop 5 – Lower integral band	℃	2	0	4000	nnn.n	
166	Loop 6 – Lower integral band	℃	2	0	4000	nnn.n	
167	Loop 1 – Upper integral band	℃	2	0	4000	nnn.n	
168	Loop 2 – Upper integral band	℃	2	0	4000	nnn.n	
169	Loop 3 – Upper integral band	℃	2	0	4000	nnn.n	
170	Loop 4 – Upper integral band	℃	2	0	4000	nnn.n	
171	Loop 5 – Upper integral band	℃	2	0	4000	nnn.n	
172	Loop 6 – Upper integral band	℃	2	0	4000	nnn.n	
173	Loop 1 – Cold proportional band	℃	2	1	4000	nnn.n	
174	Loop 2 – Cold proportional band	℃	2	1	4000	nnn.n	
175	Loop 3 – Cold proportional band	℃	2	1	4000	nnn.n	
176	Loop 4 – Cold proportional band	℃	2	1	4000	nnn.n	
177	Loop 5 – Cold proportional band	℃	2	1	4000	nnn.n	
178	Loop 6 – Cold proportional band	℃	2	1	4000	nnn.n	
179	Loop 1 – Cold dead band	%	2	-500	500	±nn.n	
180	Loop 2 – Cold dead band	%	2	-500	500	±nn.n	
181	Loop 3 – Cold dead band	%	2	-500	500	±nn.n	
182	Loop 4 – Cold dead band	%	2	-500	500	±nn.n	
183	Loop 5 – Cold dead band	%	2	-500	500	±nn.n	
184	Loop 6 – Cold dead band	%	2	-500	500	±nn.n	
185	Loop 1 – Alarm Low level	℃	2	0	20000	nnnn.n	
186	Loop 2 – Alarm Low level	℃	2	0	20000	nnnn.n	
187	Loop 3 – Alarm Low level	℃	2	0	20000	nnnn.n	
188	Loop 4 – Alarm Low level	℃	2	0	20000	nnnn.n	
189	Loop 5 – Alarm Low level	℃	2	0	20000	nnnn.n	
190	Loop 6 – Alarm Low level	℃	2	0	20000	nnnn.n	
191	Loop 1 – Alarm High level	℃	2	0	20000	nnnn.n	
192	Loop 2 – Alarm High level	℃	2	0	20000	nnnn.n	
193	Loop 3 – Alarm High level	℃	2	0	20000	nnnn.n	
194	Loop 4 – Alarm High level	℃	2	0	20000	nnnn.n	
195	Loop 5 – Alarm High level	℃	2	0	20000	nnnn.n	
196	Loop 6 – Alarm High level	℃	2	0	20000	nnnn.n	
197	Loop 1 – Alarm Minimum level	℃	2	-1000	+20000	±nnnn.n	
198	Loop 2 – Alarm Minimum level	℃	2	-1000	+20000	±nnnn.n	
199	Loop 3 – Alarm Minimum level	℃	2	-1000	+20000	±nnnn.n	
200	Loop 4 – Alarm Minimum level	℃	2	-1000	+20000	±nnnn.n	
201	Loop 5 – Alarm Minimum level	℃	2	-1000	+20000	±nnnn.n	
202	Loop 6 – Alarm Minimum level	℃	2	-1000	+20000	±nnnn.n	

203	Loop 1 – Alarm Maximum level	℃	2	-1000	+20000	±nnnn.n	
204	Loop 2 – Alarm Maximum level	℃	2	-1000	+20000	±nnnn.n	
205	Loop 3 – Alarm Maximum level	℃	2	-1000	+20000	±nnnn.n	
206	Loop 4 – Alarm Maximum level	℃	2	-1000	+20000	±nnnn.n	
207	Loop 5 – Alarm Maximum level	℃	2	-1000	+20000	±nnnn.n	
208	Loop 6 – Alarm Maximum level	℃	2	-1000	+20000	±nnnn.n	
209	Loop 1 – Alarm mask	bit	1	0	31	xxxbbbbb	
210	Loop 2 – Alarm mask	bit	1	0	31	xxxbbbbb	
211	Loop 3 – Alarm mask	bit	1	0	31	xxxbbbbb	
212	Loop 4 – Alarm mask	bit	1	0	31	xxxbbbbb	
213	Loop 5 – Alarm mask	bit	1	0	31	xxxbbbbb	
214	Loop 6 – Alarm mask	bit	1	0	31	xxxbbbbb	
215	Loop 1 – Alarm filter ON	sec	1	0	240	nnn	
216	Loop 2 – Alarm filter ON	sec	1	0	240	nnn	
217	Loop 3 – Alarm filter ON	sec	1	0	240	nnn	
218	Loop 4 – Alarm filter ON	sec	1	0	240	nnn	
219	Loop 5 – Alarm filter ON	sec	1	0	240	nnn	
220	Loop 6 – Alarm filter ON	sec	1	0	240	nnn	
221	Loop 1 – Primary Output Value	%	2	0	1000	nnn.n	•
222	Loop 1 – Secondary Output Value	%	2	0	1000	nnn.n	•
223	Loop 1 – Actual Set-point	℃	2	-1000	+20000	±nnnn.n	•
224	Loop 1 – Alarms	bit	1	0	31	xxxbbbbb	•
225	Loop 1 – Status	#	1	0	3	n	•
226	Loop 2 – Primary Output Value	%	2	0	1000	nnn.n	•
227	Loop 2 – Secondary Output Value	%	2	0	1000	nnn.n	•
228	Loop 2 – Actual Set-point	℃	2	-1000	+20000	±nnnn.n	•
229	Loop 2 – Alarms	bit	1	0	31	xxxbbbbb	•
230	Loop 2 – Status	#	1	0	3	n	•
231	Loop 3 – Primary Output Value	%	2	0	1000	nnn.n	•
232	Loop 3 – Secondary Output Value	%	2	0	1000	nnn.n	•
233	Loop 3 – Actual Set-point	℃	2	-1000	+20000	±nnnn.n	•
234	Loop 3 – Alarms	bit	1	0	31	xxxbbbbb	•
235	Loop 3 – Status	#	1	0	3	n	•
236	Loop 4 – Primary Output Value	%	2	0	1000	nnn.n	•
237	Loop 4 – Secondary Output Value	%	2	0	1000	nnn.n	•
238	Loop 4 – Actual Set-point	℃	2	-1000	+20000	±nnnn.n	•
239	Loop 4 – Alarms	bit	1	0	31	xxxbbbbb	•
240	Loop 4 – Status	#	1	0	3	n	•
241	Loop 5 – Primary Output Value	%	2	0	1000	nnn.n	•
242	Loop 5 – Secondary Output Value	%	2	0	1000	nnn.n	•
243	Loop 5 – Actual Set-point	℃	2	-1000	+20000	±nnnn.n	•
244	Loop 5 – Alarms	bit	1	0	31	xxxbbbbb	•
245	Loop 5 – Status	#	1	0	3	n	•
246	Loop 6 – Primary Output Value	%	2	0	1000	nnn.n	•
247	Loop 6 – Secondary Output Value	%	2	0	1000	nnn.n	•

248	Loop 6 – Actual Set-point	℃	2	-1000	+20000	±nnnn.n	•
249	Loop 6 – Alarms	bit	1	0	31	xxxbbbbb	•
250	Loop 6 – Status	#	1	0	3	n	•
251	Digital inputs status	#	1	0	3	n	•
252	Digital outputs status	#	2	0	4095	nnnn	
253	Tuning phase	#	1	0	6	n	•
254	Tuning set-point	℃	2	-1000	+20000	±nnnn.n	•
255	Tuning timer 1	sec	2	0	65535	nnnnn	•
256	Tuning timer 2	sec	2	0	65535	nnnnn	•
257	Tuning low temperature	℃	2	-1000	+20000	±nnnn.n	•
258	Tuning high temperature	℃	2	-1000	+20000	±nnnn.n	•
259	Current start step	#	1	0	6	n	•

A.2 - Digital gates list (coils)

ADDRESS	DESCRIPTION	READ ONLY
000	Digital Input 1	•
001	Digital Input 2	•
002	Digital Output 1	
003	Digital Output 2	
004	Digital Output 3	
005	Digital Output 4	
006	Digital Output 5	
007	Digital Output 6	
008	Digital Output 7	
009	Digital Output 8	
010	Digital Output 9	
011	Digital Output 10	
012	Digital Output 11	
013	Digital Output 12	