Multiloop controller R1-120A-I

User's guide

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User's guide
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Figures and tables index

1 - Installation

1.1 - Packaging check

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

- n° 1 R1-120A-I controller
- n° 1 instruction manual
- n° 1 F1-10 operator panel with connection cable (if optionally ordered)

The R1-120A-I has the following features:

- 24Vdc power supply
- 6 analog inputs with the following features:
  - 0..20 mA analog input with current terminating resistor of 246Ω.
  - resolution: 16 bit
  - precision: 0. 05% of full scale
- 2 digital inputs with the following features:
  - optoisolated with positive common 24Vdc
  - state 0: 0 ÷ 5Vdc
  - state 1: 7 ÷ 36Vdc
- 12 digital outputs with the following features:
  - optically isolated PNP transistor (24V)

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

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

R1-120A-I 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

R1-120A-I controller dimensions are shown in figure 1.1.

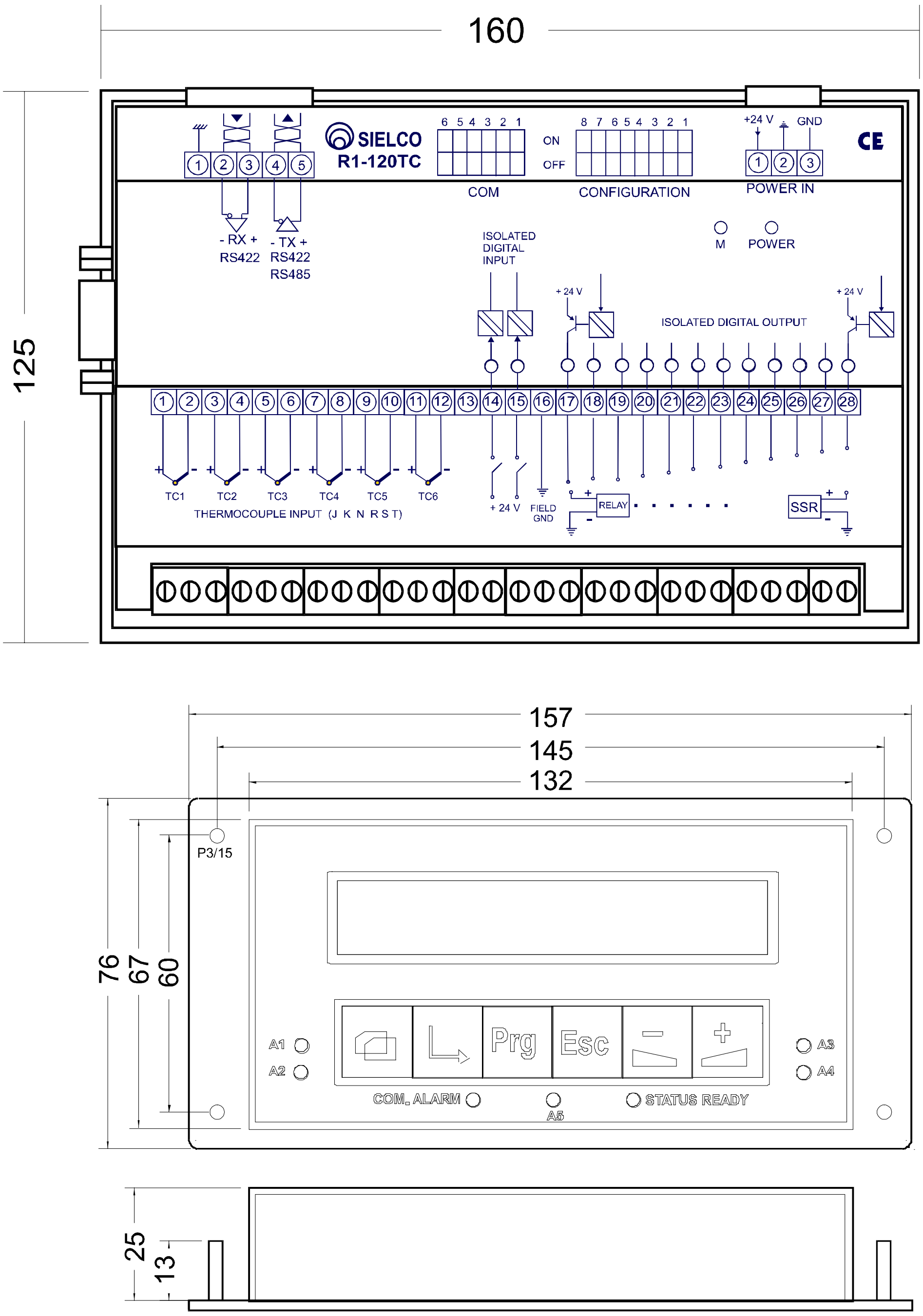


Figure 1.1 - R1-120A-I controller and F1-10 panel dimensions.

1.3 - Fixing method

All R1-120A-I 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 the interface circuits that are inside the module are shown, in yellow areas common use sensors and actuators to be connected externally.

Verify that the lower square on the left side of the cover is blackened, indicating the analog input series models.

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

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.

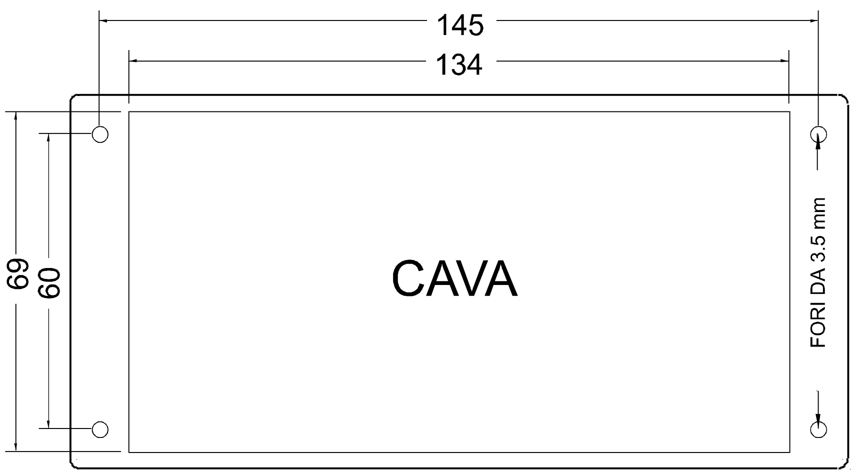


Figure 1.2 - F1-10 console hole dimensions.

1.4 - Electric wiring

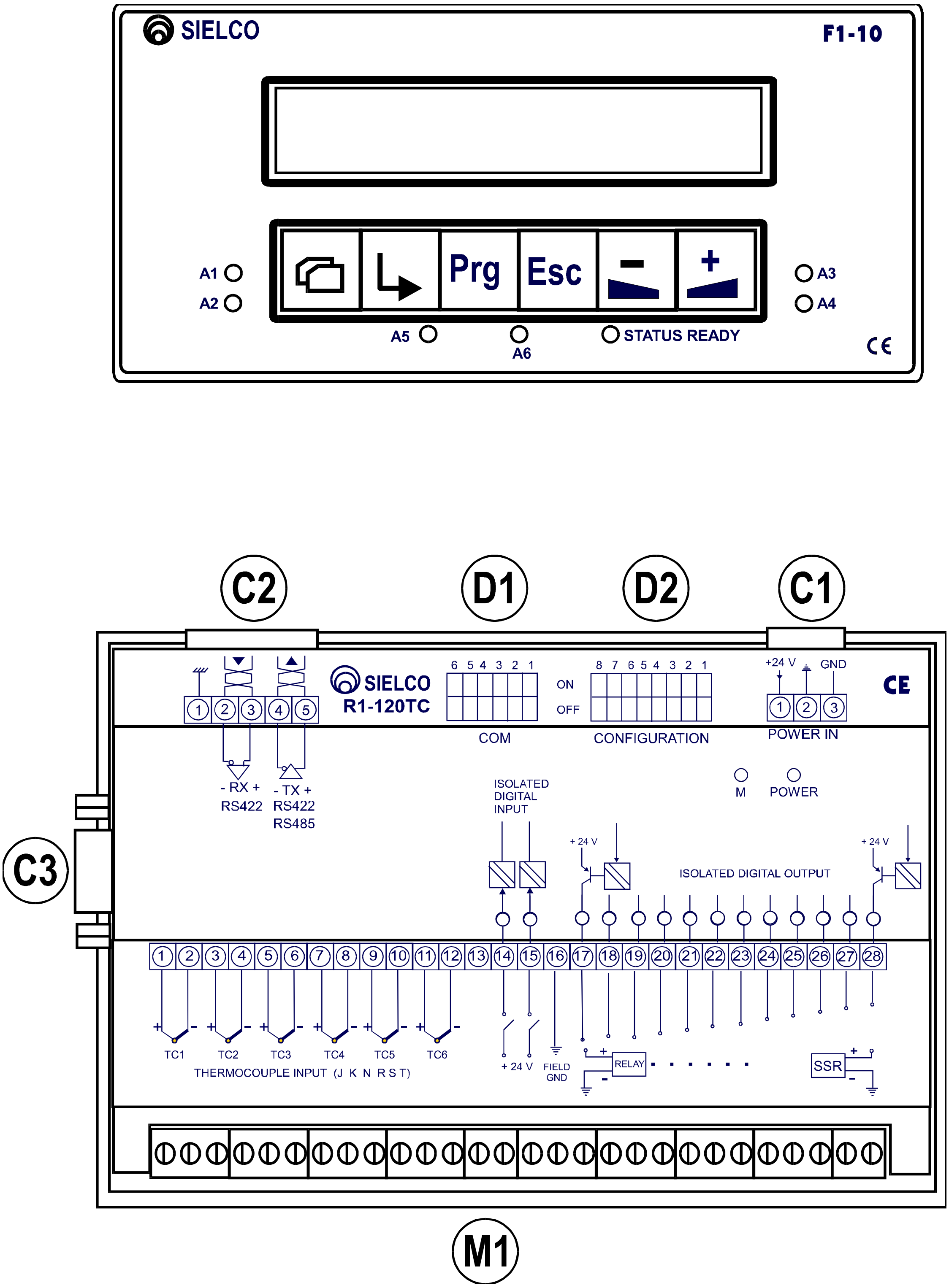


Figure 1.3 - R1-120A-I and F1-10 scheme.

	Description	Paragraph
[M1]	Inputs (screws from 1 to 15) and outputs screws (screws from 17 to 28)	1.4.2 1.4.4
[C1]	24Vdc 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

	Analog inputs
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

[C1] - 24Vdc supply connector

	POWER
1	+24Vdc
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+

R1-120A-I 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 24Vdc (9V < Vdc < 36V) supply by [C1] connector and absorb a maximum current Icc=170mA at 24Vdc except any load connected to the output (max 100mA for output).

1.4.2 - Analog inputs

R1-120A-I controller provides 6 inputs for 0..20mA signals (M1 screws). Connect “positive” and “negative” sensors wires respectively to “positive” and “negative” module screws (respectively n° 1 and n° 2 for first input, see figure 1.2).

1.4.3 - Command digital inputs

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

1.4.4 - Alarm and control outputs

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

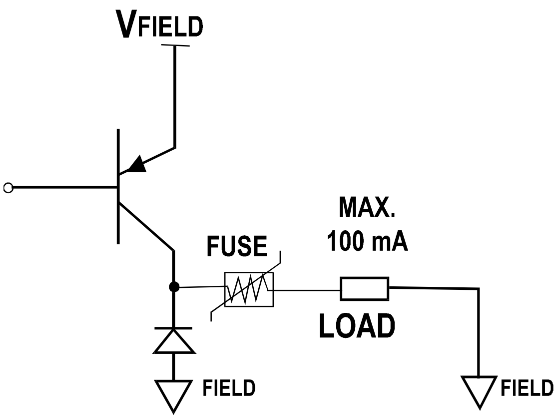


Figure 1.4 - Logical output.

These outputs can be used to control 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, use 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 n° 17 to n° 28.

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

1.4.5 - Serial link

R1-120A-I 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 R1-120A-I controllers, it is necessary to use a RS422/485 serial interface that is not usually included in the standard equipment of personal computers. Sielco produces 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	+24V	+24V

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

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

C1-25 #	**RS-422**		***R1-120A-I*** **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	0V				
7	+24V				

C1-25 #	**RS-485**		***R1-120A-I*** **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	0V				
7	+24V				

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

If alternative devices are chosen, it is better to use optically isolated products with galvanically isolated grounds.

R1-120A-I 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 n° 5 and n° 6 are simultaneously ON or OFF are not allowed. Selector from n° 1 to n° 4 are reserved and they must be kept in OFF position.

F1-10 PROGRAMMING AND SUPERVISION OPERATOR PANEL

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

1.4.6 - Earth wiring and shielding

EARTH WIRING

The observation of the following points to make earth connections is suggested:

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

To improve the sensors reading, particularly in environment affected by the noise of 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 n° 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; use the shield for ground.

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

1.4.7 - Communication protocol

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

<u>ASCII protocol features</u>

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

<u>RTU protocol features</u>

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

The baud rate selection is made by n° 8 selector of [D2] dipswitch (ON=19200, OFF=9600).

1.4.8 - Device identification

Up to 63 R1-120A-I 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 - R1-120A-I controller address configuration using [D2] dipswitch.

2 - Operation

2.1 - Introduction

The multiloop controller R1-120A-I can handle up to six independent PID control loops with analog input from 0 to 20mA.

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

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

2.2 - Input configuration

Input configuration allows independent settings, for each loop, of parameters regarding the input.

- Sensor type, reading and visualization options
  sensor type:
    - bit 0,1: (none, 0..5V, 0..20mA)
  digits number for visualization in engineered units:
    - bit 4,5: (0, 1, 2, 3)
  reading options:

bit 6: read filter on analog input

- Linearization value at zero scale
- Linearization value at full scale

When the sensor type is set to “none” the readed value will be forced to 0.

Digits number settings allow to read on the F1-10 front panel the engineered values according to desired linearization scale. The digits number affects only the visualization on the front panel F1-10. The modbus gates are without digits.

A linearization procedure will be applied to measured value in volts to obtain an equivalent engineered value according to the linearization parameters. As an example: visualization with one digit, an humidity sensor with voltage output (0V = 0%Rh, 4V = 100%Rh) connected to analog input. We want to read 0.0 when the Rh is 0% and 100.0 when the Rh is 100%. The linearization parameters are: value at zero scale = 0.0, value at full scale = 125.0

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

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)
  - x3 = primary analog
  - 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 s)	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 s)	primary, secondary
- Valve extratime (xxx s)	primary, secondary
- Valve dead band (xxx s)	primary, secondary

When the output is configured in On/Off mode, the output turns off only at the minimum value (0%) and turns on only at the maximum value (100%); in PWM mode, the period is 1 second; in analog mode the output is still in PWM mode, but the period is 250ms, so you can connect the Sielco C1-10 (PWM to analog module, 0..10V or 4..20mA output).

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.

The valve runtime is the time needed by the valve to completely open or close. The valve extratime is the supplementary time the output tries to open (close) the valve when the valve is already opened (closed).

The valve deadband specifies the minimum time, calculated by the PID, necessary to move the valve. This parameter is useful to avoid continuous and shorts movements of the valve.

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 value, ..., ..., loop 6)
  - options:
    - bit 6: soft-start option
    - bit 7: holdback option

- Final set-point 1 in engineered units
- Final set-point 2 in engineered units

- Increment/decrement set-point step in engineered units
- Set-point increment cycle (xxx s)
- Set-point decrement cycle (xxx s)

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 engineered values 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 value.

With the “holdback” option active, in case of low or high value 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 set-point step, 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, and they are:

- Regulation type, regulation mode and starting sequence
  - starting sequence (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 s)
- Proportional band in engineered units
- Dead band in engineered units
- Integral action time (xxxx s)
- Derivative action time (xxxx s)
- Lower band of integral action in engineered units
- Upper band of integral action in engineered units

- Cold proportional band in engineered units
- Hot / Cold dead band in engineered units

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

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

The dead band parameter disables the PID control when the difference from the set-point and the real value 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 engineered value 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 switches to “automatic”.

The controller can perform only one autotuning procedure at the same time. If the operator sets 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 sets 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 depend on the following alarm thresholds:

- relative low value in engineered units
- relative high value in engineered units
- minimum value in engineered units
- maximum value in engineered units

The relative alarm condition goes on if the difference between the loop variable value and the set-point exceeds the relative low or high thresholds; the absolute alarm condition goes on if the loop variable value 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 s)

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 heating zones which take more time to reach the final value; 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 specifies the start-up order; to program the start-up sequence it is necessary to set, for each loop, the parameter Oa and the minimum value 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 reach a value greater than their respective minimum value 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 value in engineered units
- Effective set-points in engineered units
- 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 alarm
  - bit 1: low value alarm
  - bit 2: high value alarm
  - bit 3: minimum value alarm
  - bit 4: maximum value alarm
  - bit 5: -----
  - bit 6: -----
  - bit 7: -----

It is also available the actual start-up step (Pa), common for every loop.

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 turns 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 R1-120A-I 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 liquid crystal display with 2 rows and 24 columns, a 6 key- keyboard and 6 led.

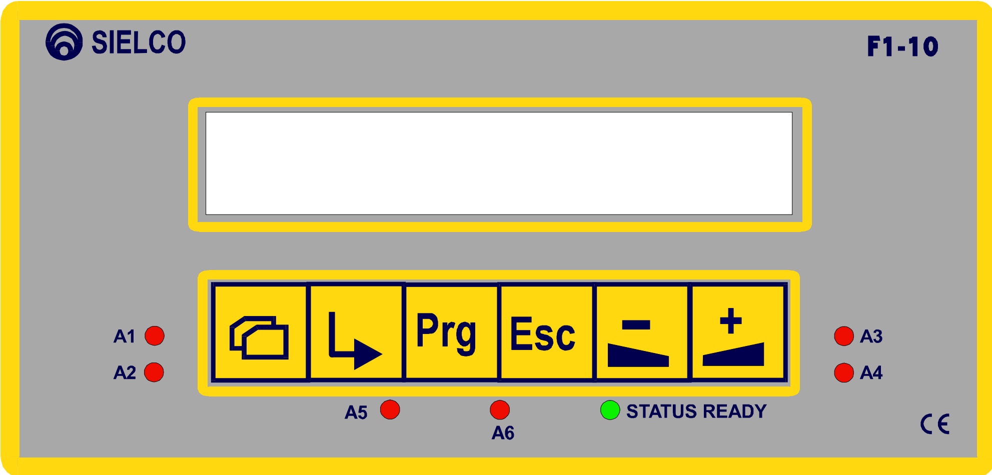


Figure 3.5 - Operator panel F1-10.

When connected to a R1-120A-I controller, the operator panel will show various menus that allows configuration, programming and supervision of the controller.

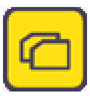
In the default page the value of the 6 analog input channels are displayed .

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

In the following pages the meaning of the various menus is explained. It is also explained how to insert or modify a value. 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

Esc	*ESCAPE*	Cancel a data modification or escape to the previous menu level (if present)
–	*DEC*	Decrement selected data
+	*INC*	Increment selected data

3.2.2 - Front led

The leds on F1-10 panel are used in association with 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 6 analog input values are displayed in the engineered unit selected in programming procedure.

+nnnnn	+nnnnn	+nnnnn	Loop1	Loop2	Loop3
+nnnnn	+nnnnn	+nnnnn	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 allows to select the language.

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

3.2.5 - Supervision

The supervision page summarizes the actual status of each loop.

```
[N]  AL:----- PV: +nnnnn [abmnr]
[sss] P:nnn.n SP: +nnnnn
```

The data displayed are:

AL:	actual alarms:
[a]	high
[b]	low
[m]	maximum
[n]	minimum
[r]	sensor break
PV:	Actual input values in engineered units
sss	actual loop status:
[dis]	disabled
[man]	manual
[aut]	automatic
[tun]	autotuning
P:	primary output power (%)
SP:	actual set-point in engineered units

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 :sssssss	[disable, manual, auto, tuning]
Set Point 1 : +nnnnn	[-30000..+30000]
Set Point 2 : +nnnnn	[-30000..+30000]
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 to configure input, set-points, regulation and alarms.

INPUT CONFIGUR. LOOP N	[1..6]
Sensor type : ssssss	[none, 0-5V, 0-20mA]
Read filter : SSS	[YES/NO]
Digits : sssss	[x x.x x.xx x.xxx]
Value at zero : +nnnnn	[-30000..+30000]
Value at full : +nnnnn	[-30000..+30000]

In the input configuration pages you can set the parameters required to read analog inputs.

When the sensor type is set to "none", the read value will be forced to 0.

The number of digits specifies the position of the decimal point in the displayed values in F1-10.

It is necessary to specify the linearization parameters. The value at zero scale must be lower than the value at full scale.

A filter has been implemented on the base of the last 8 samples read.

SETPOINT CONFIG. LOOP N	[1..6]
Soft Start : SSS	[YES/NO]
Holdback : SSS	[YES/NO]
Setpoint type : ssssss	[progr., input1..input6]
i/d step : nnnn	[1..4000]
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, so set-point 1 or 2 according to the status of the second digital input
input N	the set-point is the value of the loop N

CONTROL CONFIG. LOOP N	[1..6]
Control type :sssssss	[none, hot, cold, hot/col]
PID cycle [s]: nnn	[1..240]
Proport. band : nnnn	[1..4000]
Dead band : nnn	[0..400]
Integral T. [s]: nnnn	[0..4000]
Derivative T.[s]: nnnn	[0..4000]
Int.- band : nnnn	[0..4000]
Int.+ band : nnnn	[0..4000]
Cold band : nnnn	[1..4000]
Dead h/c b. [%]: +nn.n	[-50.0..+50.0]
Start order : n	[0..6]

<u>Control type</u>

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).

<u>Starting sequence</u>

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 threshold :	nnnnn	[0..30000]
High threshold :	nnnnn	[0..30000]
Minimum thresh :	+nnnnn	[-30000..+30000]
Maximum thresh :	+nnnnn	[-30000..+30000]
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 allows to avoid short alarm situations. The filter time applies only to alarm ON conditions. 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 turns off immediately after all the alarm conditions are 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 Output type : ssssss	[1..6] [on/off, SSR, increm, analog]
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 Output type : ssssss	[1..6] [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) or as “ analog “ when an analog output is required (using a C1-10 as adaptor for 0..10V output or 4..20mA output).

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

The secondary output configuration is strictly dependent on the 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 the opening and one for the closure). 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:XXXXXXXXXXX  [0,1]
```

In the communication diagnostic page you can see the values set by the dipswitch 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) and the voltage sample (Vsa)

* ANALOG INPUTS DIAGN. *
[Off]: nnnn [Vsa]:nnnnn

3.3 - Personal computer supervision

WINLOG W/A, a SCADA software suggested in option with the controller, makes available to the user a Windows™ based operator interface. 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 application such as Excel™ and Access™. An integrated development environment makes available a large set of instruments to build multilanguage applications quickly.

To use WINLOG W/A software, please refer to the specific user manual. The communication protocol used is Modbus RTU or Modbus ASCII. The list of available gates is indicated in Appendix A.

A - Gates list

A.1 - Numeric gates list (holding registers)

Warning

When you find µA in the 'Unit' column of the following table, it implies that the quantity under control is the input current signal of the device. If you choose another quantity, the measure must be changed consequently.

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	nnnnn	•
005	Reset counter		1	0	255	nnn	
006	Loop 1 – Sensor type and read options	bit	1	0	199	xbbbxxbb	
007	Loop 2 – Sensor type and read options	bit	1	0	199	xbbbxxbb	
008	Loop 3 – Sensor type and read options	bit	1	0	199	xbbbxxbb	
009	Loop 4 – Sensor type and read options	bit	1	0	199	xbbbxxbb	
010	Loop 5 – Sensor type and read options	bit	1	0	199	xbbbxxbb	
011	Loop 6 – Sensor type and read options	bit	1	0	199	xbbbxxbb	

012	Loop 1 – Value	µA	2	-30000	+30000	±nnnnn	•
013	Loop 2 – Value	µA	2	-30000	+30000	±nnnnn	•
014	Loop 3 – Value	µA	2	-30000	+30000	±nnnnn	•
015	Loop 4 – Value	µA	2	-30000	+30000	±nnnnn	•
016	Loop 5 – Value	µA	2	-30000	+30000	±nnnnn	•
017	Loop 6 – Value	µA	2	-30000	+30000	±nnnnn	•
018	Ramp offset binary		2	0	65535	nnnnn	•
019	Voltage sample binary		2	0	65535	nnnnn	•
020	Voltage sample binary		2	0	65535	nnnnn	•
021	Voltage sample binary		2	0	65535	nnnnn	•
022	Loop 1 - Value	µA	2	-30000	+30000	±nnnnn	•
023	Loop 2 - Value	µA	2	-30000	+30000	±nnnnn	•
024	Loop 3 - Value	µA	2	-30000	+30000	±nnnnn	•
025	Loop 4 - Value	µA	2	-30000	+30000	±nnnnn	•
026	Loop 5 - Value	µA	2	-30000	+30000	±nnnnn	•
027	Loop 6 - Value	µA	2	-30000	+30000	±nnnnn	•
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	s	1	1	240	nnn	
036	Output 2 – On/Off Cycle time	s	1	1	240	nnn	
037	Output 3 – On/Off Cycle time	s	1	1	240	nnn	
038	Output 4 – On/Off Cycle time	s	1	1	240	nnn	
039	Output 5 – On/Off Cycle time	s	1	1	240	nnn	
040	Output 6 – On/Off Cycle time	s	1	1	240	nnn	
041	Output 7 – On/Off Cycle time	s	1	1	240	nnn	
042	Output 8 – On/Off Cycle time	s	1	1	240	nnn	
043	Output 9 – On/Off Cycle time	s	1	1	240	nnn	
044	Output 10 – On/Off Cycle time	s	1	1	240	nnn	
045	Output 11 – On/Off Cycle time	s	1	1	240	nnn	
046	Output 12 – On/Off Cycle time	s	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	0.001/s	2	1	1000	nnnn	
060	Output 3 – SSR Ramp	0.001/s	2	1	1000	nnnn	
061	Output 5 – SSR Ramp	0.001/s	2	1	1000	nnnn	
062	Output 7 – SSR Ramp	0.001/s	2	1	1000	nnnn	
063	Output 9 – SSR Ramp	0.001/s	2	1	1000	nnnn	
064	Output 11 – SSR Ramp	0.001/s	2	1	1000	nnnn	
065	Output 1 – Manual value	0.001	2	0	1000	nnnn	
066	Output 3 – Manual value	0.001	2	0	1000	nnnn	
067	Output 5 – Manual value	0.001	2	0	1000	nnnn	
068	Output 7 – Manual value	0.001	2	0	1000	nnnn	
069	Output 9 – Manual value	0.001	2	0	1000	nnnn	
070	Output 11 – Manual value	0.001	2	0	1000	nnnn	
071	Output 1 & 2 – Valve Runtime	s	1	1	240	nnn	
072	Output 3 & 4 – Valve Runtime	s	1	1	240	nnn	
073	Output 5 & 6 – Valve Runtime	s	1	1	240	nnn	
074	Output 7 & 8 – Valve Runtime	s	1	1	240	nnn	
075	Output 9 & 10 – Valve Runtime	s	1	1	240	nnn	
076	Output 11 & 12 – Valve Runtime	s	1	1	240	nnn	
077	Output 1 & 2 – Valve Extratime	s	1	1	240	nnn	
078	Output 3 & 4 – Valve Extratime	s	1	1	240	nnn	
079	Output 5 & 6 – Valve Extratime	s	1	1	240	nnn	
080	Output 7 & 8 – Valve Extratime	s	1	1	240	nnn	
081	Output 9 & 10 – Valve Extratime	s	1	1	240	nnn	
082	Output 11 & 12 – Valve Extratime	s	1	1	240	nnn	
083	Output 1 & 2 – Valve Dead band	s	1	1	100	nnn	
084	Output 3 & 4 – Valve Dead band	s	1	1	100	nnn	
085	Output 5 & 6 – Valve Dead band	s	1	1	100	nnn	
086	Output 7 & 8 – Valve Dead band	s	1	1	100	nnn	
087	Output 9 & 10 – Valve Dead band	s	1	1	100	nnn	
088	Output 11 & 12 – Valve Dead band	s	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	µA	2	-30000	+30000	±nnnnn	
096	Loop 2 – Final set-point 1	µA	2	-30000	+30000	±nnnnn	
097	Loop 3 – Final set-point 1	µA	2	-30000	+30000	±nnnnn	
098	Loop 4 – Final set-point 1	µA	2	-30000	+30000	±nnnnn	
099	Loop 5 – Final set-point 1	µA	2	-30000	+30000	±nnnnn	
100	Loop 6 – Final set-point 1	µA	2	-30000	+30000	±nnnnn	
101	Loop 1 – Final set-point 2	µA	2	-30000	+30000	±nnnnn	

102	Loop 2 – Final set-point 2	µA	2	-30000	+30000	±nnnnn	
103	Loop 3 – Final set-point 2	µA	2	-30000	+30000	±nnnnn	
104	Loop 4 – Final set-point 2	µA	2	-30000	+30000	±nnnnn	
105	Loop 5 – Final set-point 2	µA	2	-30000	+30000	±nnnnn	
106	Loop 6 – Final set-point 2	µA	2	-30000	+30000	±nnnnn	
107	Loop 1 – Set-point step		2	1	4000	nnnn	
108	Loop 2 – Set-point step		2	1	4000	nnnn	
109	Loop 3 – Set-point step		2	1	4000	nnnn	
110	Loop 4 – Set-point step		2	1	4000	nnnn	
111	Loop 5 – Set-point step		2	1	4000	nnnn	
112	Loop 6 – Set-point step		2	1	4000	nnnn	
113	Loop 1 – Set-point increment cycle	s	1	1	240	nnn	
114	Loop 2 – Set-point increment cycle	s	1	1	240	nnn	
115	Loop 3 – Set-point increment cycle	s	1	1	240	nnn	
116	Loop 4 – Set-point increment cycle	s	1	1	240	nnn	
117	Loop 5 – Set-point increment cycle	s	1	1	240	nnn	
118	Loop 6 – Set-point increment cycle	s	1	1	240	nnn	
119	Loop 1 – Set-point decrement cycle	s	1	1	240	nnn	
120	Loop 2 – Set-point decrement cycle	s	1	1	240	nnn	
121	Loop 3 – Set-point decrement cycle	s	1	1	240	nnn	
122	Loop 4 – Set-point decrement cycle	s	1	1	240	nnn	
123	Loop 5 – Set-point decrement cycle	s	1	1	240	nnn	
124	Loop 6 – Set-point decrement cycle	s	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	s	1	1	240	nnn	
132	Loop 2 – PID regulation cycle	s	1	1	240	nnn	
133	Loop 3 – PID regulation cycle	s	1	1	240	nnn	
134	Loop 4 – PID regulation cycle	s	1	1	240	nnn	
135	Loop 5 – PID regulation cycle	s	1	1	240	nnn	
136	Loop 6 – PID regulation cycle	s	1	1	240	nnn	
137	Loop 1 – Proportional band		2	1	4000	nnnn	
138	Loop 2 – Proportional band		2	1	4000	nnnn	
139	Loop 3 – Proportional band		2	1	4000	nnnn	
140	Loop 4 – Proportional band		2	1	4000	nnnn	
141	Loop 5 – Proportional band		2	1	4000	nnnn	
142	Loop 6 – Proportional band		2	1	4000	nnnn	
143	Loop 1 – Dead band		2	0	400	nnn	
144	Loop 2 – Dead band		2	0	400	nnn	
145	Loop 3 – Dead band		2	0	400	nnn	
146	Loop 4 – Dead band		2	0	400	nnn	
147	Loop 5 – Dead band		2	0	400	nnn	

148	Loop 6 – Dead band		2	0	400	nnn	
149	Loop 1 – Integral time	s	2	0	4000	nnnn	
150	Loop 2 – Integral time	s	2	0	4000	nnnn	
151	Loop 3 – Integral time	s	2	0	4000	nnnn	
152	Loop 4 – Integral time	s	2	0	4000	nnnn	
153	Loop 5 – Integral time	s	2	0	4000	nnnn	
154	Loop 6 – Integral time	s	2	0	4000	nnnn	
155	Loop 1 – Derivative time	s	2	0	4000	nnnn	
156	Loop 2 – Derivative time	s	2	0	4000	nnnn	
157	Loop 3 – Derivative time	s	2	0	4000	nnnn	
158	Loop 4 – Derivative time	s	2	0	4000	nnnn	
159	Loop 5 – Derivative time	s	2	0	4000	nnnn	
160	Loop 6 – Derivative time	s	2	0	4000	nnnn	
161	Loop 1 – Lower integral band		2	0	4000	nnnn	
162	Loop 2 – Lower integral band		2	0	4000	nnnn	
163	Loop 3 – Lower integral band		2	0	4000	nnnn	
164	Loop 4 – Lower integral band		2	0	4000	nnnn	
165	Loop 5 – Lower integral band		2	0	4000	nnnn	
166	Loop 6 – Lower integral band		2	0	4000	nnnn	
167	Loop 1 – Upper integral band		2	0	4000	nnnn	
168	Loop 2 – Upper integral band		2	0	4000	nnnn	
169	Loop 3 – Upper integral band		2	0	4000	nnnn	
170	Loop 4 – Upper integral band		2	0	4000	nnnn	
171	Loop 5 – Upper integral band		2	0	4000	nnnn	
172	Loop 6 – Upper integral band		2	0	4000	nnnn	
173	Loop 1 – Cold proportional band		2	1	4000	nnnn	
174	Loop 2 – Cold proportional band		2	1	4000	nnnn	
175	Loop 3 – Cold proportional band		2	1	4000	nnnn	
176	Loop 4 – Cold proportional band		2	1	4000	nnnn	
177	Loop 5 – Cold proportional band		2	1	4000	nnnn	
178	Loop 6 – Cold proportional band		2	1	4000	nnnn	
179	Loop 1 – Cold dead band	0.001	2	-500	500	±nnn	
180	Loop 2 – Cold dead band	0.001	2	-500	500	±nnn	
181	Loop 3 – Cold dead band	0.001	2	-500	500	±nnn	
182	Loop 4 – Cold dead band	0.001	2	-500	500	±nnn	
183	Loop 5 – Cold dead band	0.001	2	-500	500	±nnn	
184	Loop 6 – Cold dead band	0.001	2	-500	500	±nnn	
185	Loop 1 – Alarm Low level	µA	2	0	30000	nnnnn	
186	Loop 2 – Alarm Low level	µA	2	0	30000	nnnnn	
187	Loop 3 – Alarm Low level	µA	2	0	30000	nnnnn	
188	Loop 4 – Alarm Low level	µA	2	0	30000	nnnnn	
189	Loop 5 – Alarm Low level	µA	2	0	30000	nnnnn	
190	Loop 6 – Alarm Low level	µA	2	0	30000	nnnnn	
191	Loop 1 – Alarm High level	µA	2	0	30000	nnnnn	
192	Loop 2 – Alarm High level	µA	2	0	30000	nnnnn	

193	Loop 3 – Alarm High level	µA	2	0	30000	nnnnn	
194	Loop 4 – Alarm High level	µA	2	0	30000	nnnnn	
195	Loop 5 – Alarm High level	µA	2	0	30000	nnnnn	
196	Loop 6 – Alarm High level	µA	2	0	30000	nnnnn	
197	Loop 1 – Alarm Minimum level	µA	2	-30000	+30000	±nnnnn	
198	Loop 2 – Alarm Minimum level	µA	2	-30000	+30000	±nnnnn	
199	Loop 3 – Alarm Minimum level	µA	2	-30000	+30000	±nnnnn	
200	Loop 4 – Alarm Minimum level	µA	2	-30000	+30000	±nnnnn	
201	Loop 5 – Alarm Minimum level	µA	2	-30000	+30000	±nnnnn	
202	Loop 6 – Alarm Minimum level	µA	2	-30000	+30000	±nnnnn	
203	Loop 1 – Alarm Maximum level	µA	2	-30000	+30000	±nnnnn	
204	Loop 2 – Alarm Maximum level	µA	2	-30000	+30000	±nnnnn	
205	Loop 3 – Alarm Maximum level	µA	2	-30000	+30000	±nnnnn	
206	Loop 4 – Alarm Maximum level	µA	2	-30000	+30000	±nnnnn	
207	Loop 5 – Alarm Maximum level	µA	2	-30000	+30000	±nnnnn	
208	Loop 6 – Alarm Maximum level	µA	2	-30000	+30000	±nnnnn	
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	s	1	0	240	nnn	
216	Loop 2 – Alarm filter ON	s	1	0	240	nnn	
217	Loop 3 – Alarm filter ON	s	1	0	240	nnn	
218	Loop 4 – Alarm filter ON	s	1	0	240	nnn	
219	Loop 5 – Alarm filter ON	s	1	0	240	nnn	
220	Loop 6 – Alarm filter ON	s	1	0	240	nnn	
221	Loop 1 – Primary Output Value	0.001	2	0	1000	nnnn	•
222	Loop 1 – Secondary Output Value	0.001	2	0	1000	nnnn	•
223	Loop 1 – Actual Set-point	µA	2	-30000	+30000	±nnnnn	•
224	Loop 1 – Alarms	bit	1	0	31	xxxbbbbb	•
225	Loop 1 – Status		1	0	3	n	•
226	Loop 2 – Primary Output Value	0.001	2	0	1000	nnnn	•
227	Loop 2 – Secondary Output Value	0.001	2	0	1000	nnnn	•
228	Loop 2 – Actual Set-point	µA	2	-30000	+30000	±nnnnn	•
229	Loop 2 – Alarms	bit	1	0	31	xxxbbbbb	•
230	Loop 2 – Status		1	0	3	n	•
231	Loop 3 – Primary Output Value	0.001	2	0	1000	nnnn	•
232	Loop 3 – Secondary Output Value	0.001	2	0	1000	nnnn	•
233	Loop 3 – Actual Set-point	µA	2	-30000	+30000	±nnnnn	•
234	Loop 3 – Alarms	bit	1	0	31	xxxbbbbb	•
235	Loop 3 – Status		1	0	3	n	•
236	Loop 4 – Primary Output Value	0.001	2	0	1000	nnnn	•
237	Loop 4 – Secondary Output Value	0.001	2	0	1000	nnnn	•

238	Loop 4 – Actual Set-point	µA	2	-30000	+30000	±nnnnn	•
239	Loop 4 – Alarms	bit	1	0	31	xxxbbbbb	•
240	Loop 4 – Status		1	0	3	n	•
241	Loop 5 – Primary Output Value	0.001	2	0	1000	nnnn	•
242	Loop 5 – Secondary Output Value	0.001	2	0	1000	nnnn	•
243	Loop 5 – Actual Set-point	µA	2	-30000	+30000	±nnnnn	•
244	Loop 5 – Alarms	bit	1	0	31	xxxbbbbb	•
245	Loop 5 – Status		1	0	3	n	•
246	Loop 6 – Primary Output Value	0.001	2	0	1000	nnnn	•
247	Loop 6 – Secondary Output Value	0.001	2	0	1000	nnnn	•
248	Loop 6 – Actual Set-point	µA	2	-30000	+30000	±nnnnn	•
249	Loop 6 – Alarms	bit	1	0	31	xxxbbbbb	•
250	Loop 6 – Status		1	0	3	n	•
251	Digital inputs status	bit	1	0	3	n	•
252	Digital outputs status	bit	2	0	4095	nnnn	
253	Tuning phase		1	0	6	n	•
254	Tuning set-point	µA	2	-30000	+30000	±nnnnn	•
255	Tuning timer 1	s	2	0	65535	nnnnn	•
256	Tuning timer 2	s	2	0	65535	nnnnn	•
257	Tuning low value	µA	2	-30000	+30000	±	•
258	Tuning high value	µA	2	-30000	+30000	±	•
259	Current start step		1	0	6	n	•
260	Linearization value at 0V channel 1	µA	2	-30000	30000	±nnnnn	
261	Linearization value at 0V channel 2	µA	2	-30000	30000	±nnnnn	
262	Linearization value at 0V channel 3	µA	2	-30000	30000	±nnnnn	
263	Linearization value at 0V channel 4	µA	2	-30000	30000	±nnnnn	
264	Linearization value at 0V channel 5	µA	2	-30000	30000	±nnnnn	
265	Linearization value at 0V channel 6	µA	2	-30000	30000	±nnnnn	
266	Linearization value at 5V channel 1	µA	2	-30000	30000	±nnnnn	
267	Linearization value at 5V channel 2	µA	2	-30000	30000	±nnnnn	
268	Linearization value at 5V channel 3	µA	2	-30000	30000	±nnnnn	
269	Linearization value at 5V channel 4	µA	2	-30000	30000	±nnnnn	
270	Linearization value at 5V channel 5	µA	2	-30000	30000	±nnnnn	
271	Linearization value at 5V channel 6	µA	2	-30000	30000	±nnnnn	

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	