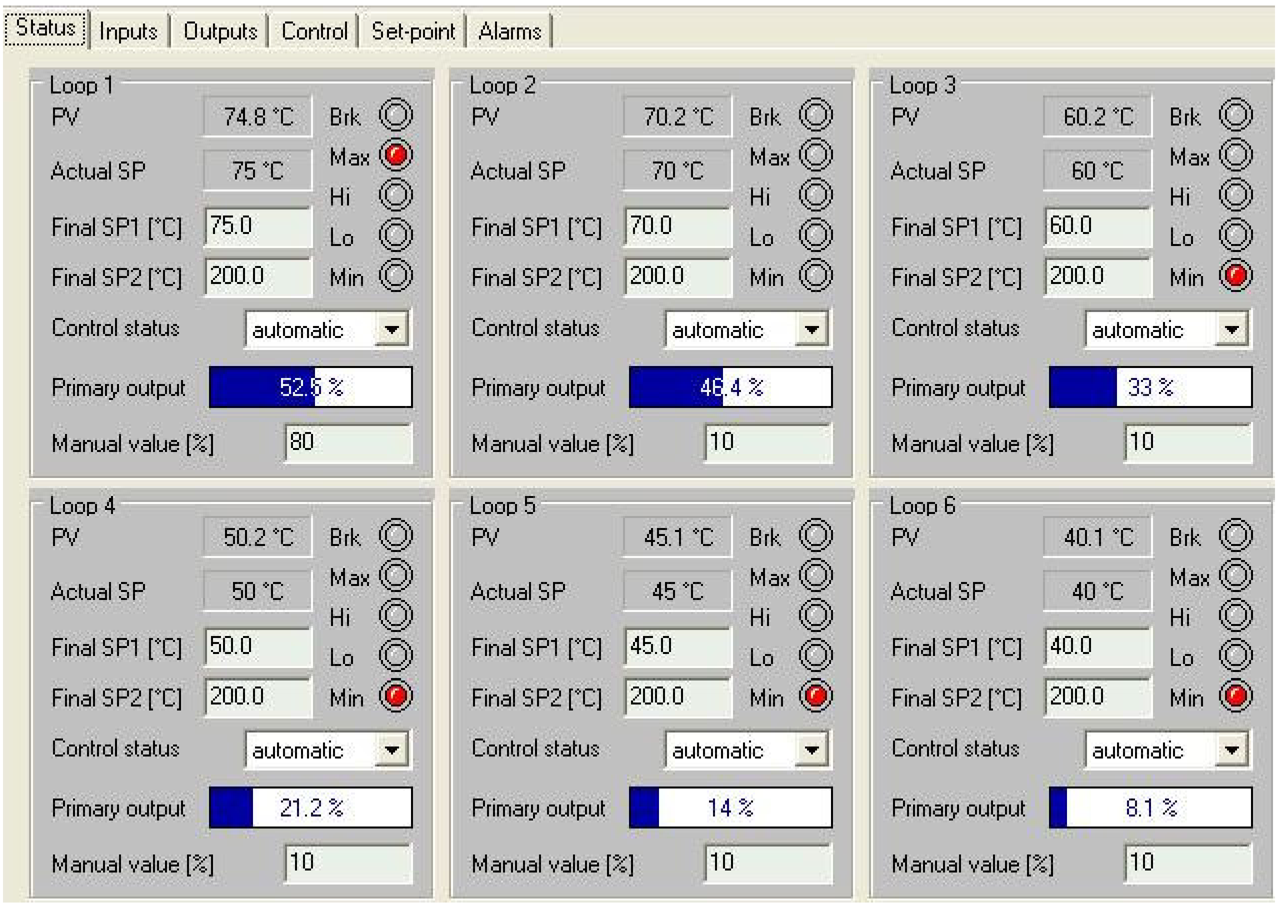
Simple user guide of R1/2 - 120TC

Connect the device R1/2 –120TC through a serial interface (eventually by mean of an RS232-RS485 converter) to the PC Host.
The device will be visible in the COM port selected.

(see the Device Log Manual in this site at http://www.sielcoelettronica.com/multiloop-temperature-controllers.html)

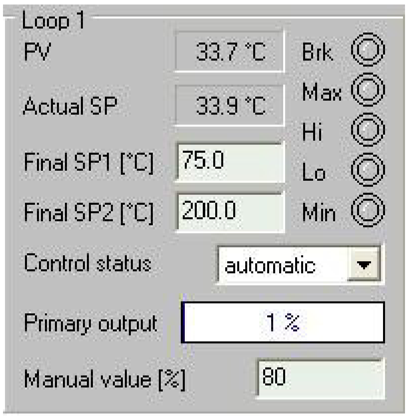
Launch the project manager program to configure the communication parameters according the device selected : Modbus type (RTU or ASCHI) , n° of COM port , Baud rate , N° of unit (ID) = 1
Launch the run time program when you have connected the device.
As below reported the variables will appear in the windows.
For simplicity only one loop will be concerned here . The same programming procedures can be applied for all the loops.
Following configuration steps must be followed in sequence:

1) STATUS 2) INPUTS 3) OUTPUTS 4) SET POINT 5) CONTROL 6) ALARM



1) STATUS Configuration

In this menu set point values can be set and the status of the loop can be monitored.



PV
Process variable , usually temperature measure in °C degrees

Actual SET point
PID algorithm is based on this reference This is a transient value that points toward the final SET point according with a ramp programmed in the SET point menu. This variable is calculated and displayed by the system. The operator cannot change it, but can see how the actual reference set point is moving on. It's useful in the cases that a very slow ramp are activated , to see immediately how much is the distance between the final set point.

Final SP1
It's the SET point programmed by the operator in °C units and tenth of °C . This reference is enabled when digital input n 1 has been left open .

Final SP2
A Second set point can be set by the operator (as SP1). The choice between the 2 is determined by voltage on input n° 2 (with 24 Volt is enabled the SP2) Switching between the 2 set points can be controlled by an external signal (es. a PLC action).

BRK
A led lighting indicates a broken (open junction) sensor .

Primary output
This value in % is the power that the PID process calculates and outputs to load , in the template is visible also as bar graph . Depends on the output actuators if this power is really active or not. , they must be SSR or analog type . In the case of rele' type actuators the real power to load will be necessary to 0 or 100% .

Min
the led lights when temperature reading is under the absolute value set in the Alarm mask.

MAX
This led lights when the temp reading is over the absolute value set in the alarm mask

Hi
This led lights when the positive difference between reading and actual set point exceeds the value set in the Mask menu'.

Lo
The led lights when temp reading is under the actual set point by a difference greater than the value set in the mask menù

Manual value
If the state is in manual position , the output to the power can be set by the operator . This state is useful in governing the process manually , (ex. for valuating the rise and fall times of the process) . In this condition the alarms are operative

Control Status

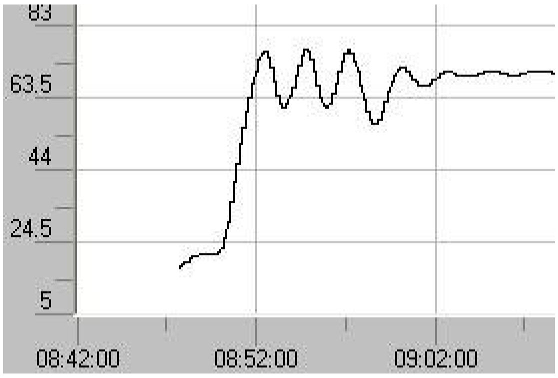
It defines 4 possible state for each loop

1) Disabled
2) Manual
3) Automatic
4) Autotuning

When a loop is disabled all the outputs (even the alarm outputs if previously enabled) are set to 0 automatically.
(Security state for the actuators)

In the Manual state the loop is open . The outputs assume the state according the manual power set . The operator can control the outputs In this configuration the alarm outputs are enabled..

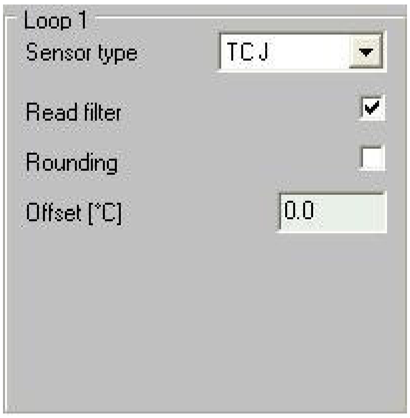
.In Automatic position , the outputs are controlled by the system according to the PID parameters and the value of PV .All the alarms are active . It's important to note that the system begins this action when and if the digital input n° 1 is on at 24 V dc.



Autotuning cycle

The tuning state is a transient state that can be enabled only one loop at a time . The system controls the controlling outputs forcing them over and under the set point and calculating the PID parameters At the end of the procedure the loop change in automatic state, the parameters calculated are visible on the controlling menu. During the autotuning cycle the ramps controlling actual set point are ignored.

2) **Input Configuration**



Sensor Type

This parameter is set by the operator according the type of input . Possible choices are:

1) 50 mv
2) TCJ
3) TCK
4) TCN
5) TCR
6) TCS
7) TCT

Once set the parameter is recorded permanently in eeprom of the device.

Read Filter

If this filter is enabled an 8 samples depth dynamic media is performed . This technique makes longer the reading of the variable , but is advised in strongly electrically disturbed environments.

Rounding

If enabled the readings are rounded to the decimal point .
Es.
1,6 = 2
1,4 = 1

Offset (°C)

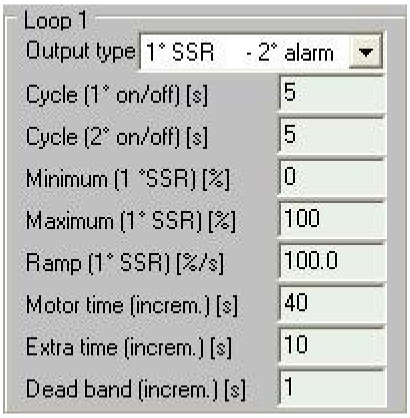
In the case of thermocouple inputs the readings are offset . Algebraic sum is performed with variable reading .The offset is very useful when the hot point of the process is hardly reachable physically by the sensor. By this mean also sensor errors reading can be compensated.

3) Control Configuaration

There are 3 main type of outputs used as actuators for controlling the process

1) ON-OFF Outputs
2) SSR – Analog outputs
3) Motor control outputs

In the case 1) only simple actions can be done : all ON or all OFF . PID algorithms are not substantially used because its use is limited by the type of actuators. Analog outputs require additional hardware devices to convert pwm in analog form (4-20 ma or 0-10 V.), The PID process the SSR outputs and the Analog outputs in the same way. Third type require start stop motorized valves as actuators. The valve does not change its position when outputs are deactivated.



Ramp

This parameter can be used in case of SSR outputs or Analog outputs . This limit the percentage of power that can be output to the load avoiding for ex. possible damage to the heaters .

Dead Band (increm.)

Inside this time interval , the PID action on actuators is stopped , the valve remain in the previous position.

This prevents frequent actions on actuators due to very low adjustment

Otput type

1ON/OFF-2 Alarm
1SSR – 2 Alarm
1 ON/OFF – 2 ON/OFF
1 SSR – 2 ON/OFF
1 INCR-2 INCR
1Analog – 2 Alarm
1 Analog – 2 ON/OFF

A proper set of the outputs must consider the type of control selected in the control menù :For ex. An hot-cold controlling action , use both the 2 physical units as controlling . The loop cannot have a free output for alarm in this case . The alarms detected by the system will still be visible at supervisor level .

In the case of output configured as motor valve control , the ,if the loop is disabled , the valve position does not change.

Cycle (1° on-off)

IN the case of an ON-OFF output (Relè) ,the action must be lowered by the Cycle time set. This is a protection action toward the actuators . This action is valid also in case of alarm outputs . If outputs are SSR , the base time is 1 sec. In this case these parameters are meaning less.

Cycle 2

The same meaning of the cycle 1 for the secondary output

Motor time

A time parameter that identify the time from moving the valve from a total open valve position to the total closed valve. The PID algorithm during the closed loop action, calculate the corrective time actions proportionally

Extra time

The system applies this time for computing the fixed reference synchronization points corresponding to the all open and all closed valve positions. No potentiometer feedback from the valve are necessary to determine the valve position.

MInimum

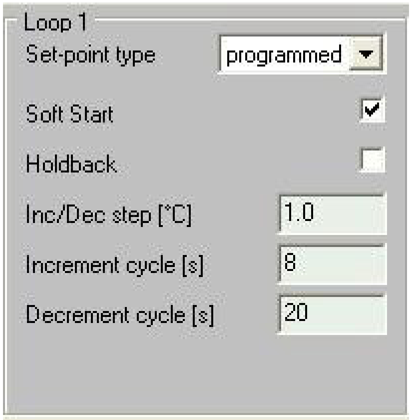
With this parameter the operator can fix a minimum amount of power to be delivered to the load in the case of SSR outputs . Independently on the PID algorithms , the operator can assure a minimum power to the heater when the loop is in automatic state

Maximum

Conversely to the minimum this parameter can limit the power delivered to the load o . It can avoid eventual damage to some type of heaters , that cannot tolerate the maximum power to be delivered..

4) Set Point configuration

In this menu the operator can fix the transient behaviour of the actual set point.
This transient govern the process during heating and cooling phases. It's of primary importance to control the process.



Set-point type

The value of the final set point iis set in the Status menu, here it's possible to choose the linear trend of the actual set point (programmed) or the process van be governed by a set point that is the input temp. from another channel.

Soft start

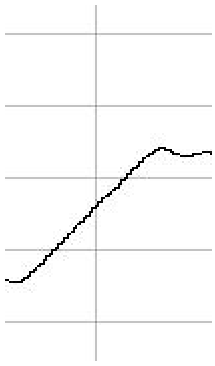
Enabling this parameter , will force the system (in automatic state) to start after an interruption imposing an actual set point to assume the value of the temp. read from that channel. This avoids over shoots in temp trend.

Hold back

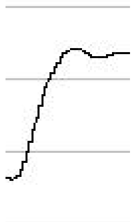
This important parameter is used to slow thermal response in presence of alarms. When high temp is alarm is enabled , in presence of an alarm the set point is hold to the last value calculated .
The ramp is frozen until alarm conditions disappear . The Hold back has an effect on the rising and falling times of the set point. See the graphic .It's a good rule to keep the process in hold back., if you want to control the rising and falling times of the heaters.

Ex of a heating ramp with a set point 1 °C /cycle and an increment of 5 sec./ cycle

A) Hold back enabled with 2 °C Ho and LO alarm set..



B) with Hold back disabled

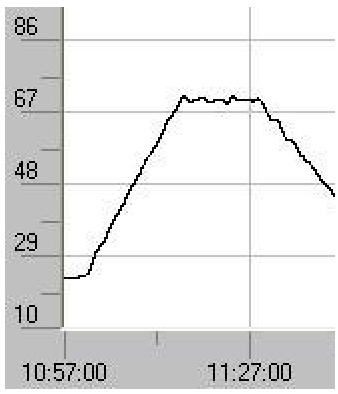


IND /Dec Step

This value fix the amount of °C that increment or decrement the actual set point at each cycle

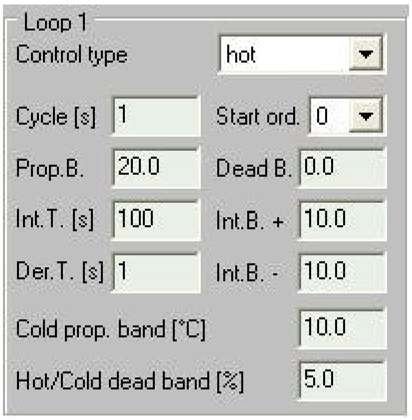
Increment Cycle –Decrement Cycle

These 2 parameters define the time after witch the actual set point is forced to move . The programmed ramps facilitates thermal cycles . See fig.



3) **Control configuration**

Some basic rules are described for determining the value of PID parameters. A first approach can be done using autotuning algorithms , and then proceeding with successive adjustements. Wrong values of these parameters can bring the process out of control.



Control Type

1) NO-ONE
2) Hot
3) Cold
4) Hot / Cold

It's important to remember that in a hot control the primary output when set on will heat the material , while in a cold configuration the same output will cool the material. For ex. If heaters are erroneously programmed in cold configuration , the heaters will run away out of control.

Cycle

Scheduling time of the control process Normally set to 1 sec. for thermal processes (this is even the lowest possible value) An higher values can be used when thermal variations are extremely slow.

Prop.Band

This fundamental parameter is set in °C and must and is active under and over the set point. Inside this band at every cycle the pid algorithm calculates the correct output to the actuators on the basis of the distance between the PV and the actual set point.. In the case of ON-OFF outputs , the proportional band becomes an hysteresis band and the relè actuators are switched when ouput power reach the 0 and 100 % points. In this case the PB must not be unnecessarily wide to avoid fluctuations of the temperature but not so narrow to involve too many frequent dangerous switching actions.

Int. T

Integral time in second. After this time the action is equivalent of the proportional band action provided the error detected does not change during this time.

Therefore the action is progressively enforced (integral action). The contribute is fundamental .The proportional term alone cannot be sufficient to bring the temp. at the set point value, especially in the presence of a wide proportional band. A temp offset would not be eliminable The integral action growing its contribute during time , corrects this error and bring the temperature variable at the set point programmed.

A greater T int will low the contribute of the integral action. A good choice is to set a value grater than 100. A 0 value disable integral action.

Der. T

The derivative action is a critical parameter , because its influence is proportional to the derivative of the PV. His action can be strong even in proximity of the set point In thermal process is a good rule to limit this action and put this parameter = 1. The greater the value of the parameter , the grater the action it produces. A 0 value disable the function.

B int+ B int –

Normally these bands are set to a value equal the proportional band . Some times they can be restricted to a lower value where the integral contribute is more efficient.

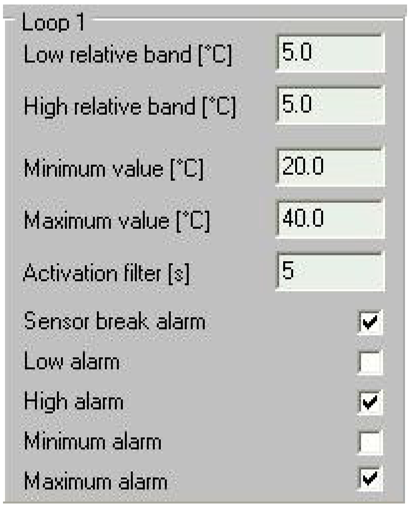
Cold prop. Band.

This band is active over the set point in case of cold type controlling

Hot –Cold dead band

The dead band is useful to inhibit the action in set point proximity. The value can have a negative sign , that makes a double concurrently action possible on the actuators.

5) Alarm Configuration



Low relative band
The system goes into alarm condition , when the temperature rises over the set point by a difference greater than the value parameter set.

High relative band

The system goes into alarm condition , when the temperature falls under the set point by a difference greater than the value parameter set

Maximum Value
The system goes into alarm condition when the temperature rises over the maximum absolute value set .

Minimum Value
The system goes into alarm condition when the temperature falls under the minimum absolute value set .

Activation Filter
Durinfr this time , even if the alarm conditions are present, no alarm is activated by the system.

Sensor break alarm
Physical alarms can be enabled or disabled in correspondence. For each channel the alarm is the second output , that for this purpose must be configured as “ Alarm “.

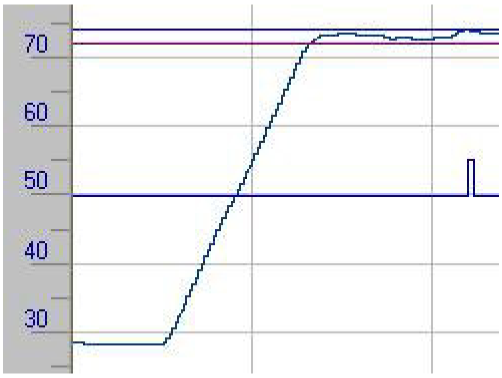
Low alarm
Output alarms can be enabled or disabled . If enabled , Physical output is activated in correspondence of relative band condition alarm

High Alarm
Output alarms can be enabled or disabled . If enabled Physical output is activated in correspondence of high relative band condition alarm

Minimum Alarm
Output alarms can be enabled or disabled . If enabled Physical output is activated in correspondence of maximum value alarm condition

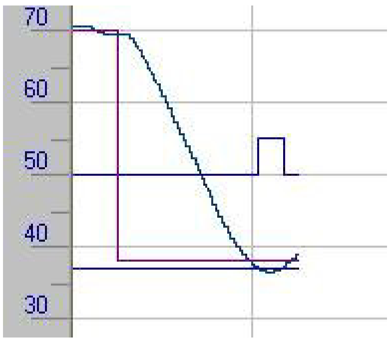
Maximum Alarm
Output alarms can be enabled or disabled . If enabled , Physical output is activated in correspondence minimum value alarm condition.

Recording the alarms



Using this program transient alarms can be seen in graphic form. The output alarm can be seen as a modbus variable and traced in graphic form. To enable this function enter in " Graphics " in device log program run time.

1) In the example , a max alarm is set at 74°C , and the set Point at 72 °C.. Relative alarms don't activate outputs , but are used to produce linear variations on ramps.
An eventual timing filter programmed can inhibit the output



2) In the cooling controlled action of the second example, the final set point is set at 38 °C and a down ramp is activated with a minimum alarm set at 37 °C .
An eventual timing filter programmed can inhibit the output