7. Operating mode

7.1 Slave proportional mode

7.1.1 Applications

Control from external controller or manually controlled potentiometer.

7.1.2 Operation

Three-phase output voltage varies in proportion to the prevalent input. The minimum speed limits, **Lo/L.o.** are active. and maximum, **hi/h.i.**, with forcing at 0% and relative hysteresis (**So/S.o.** + **io/i.o.**). Regulation jumps (**Jh1** + **JL1** and **Jh2** + **JL2**) are enabled, used to avoid particularly noisy zones.

7.1.3 Slave regulation on OUT output for power Slave

*menu **conF** > parameter **C7**=0*

The **OUT** analog output is set to control one or more external power slave units. It increases or decreases in direct proportion to the **Co** parameter (regulation control value).

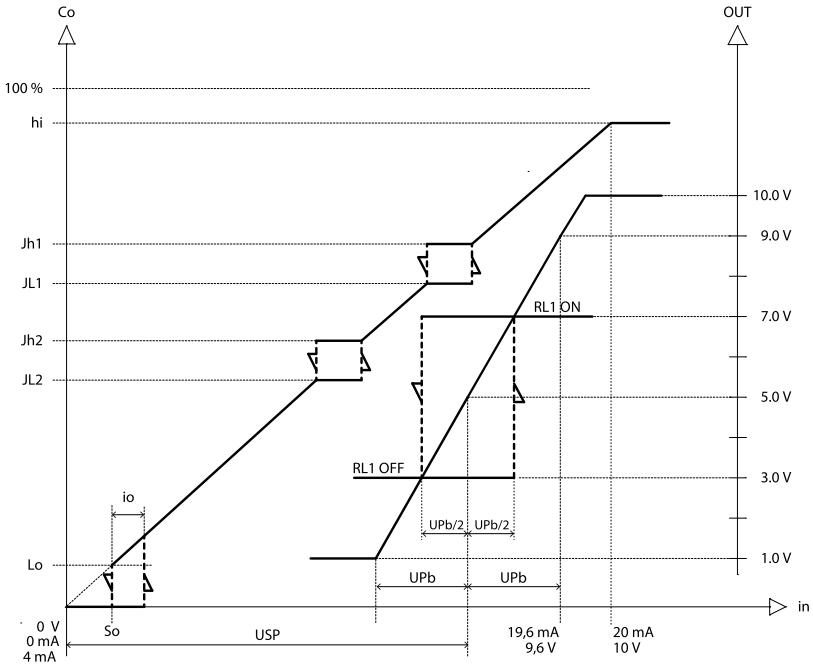
7.1.4 Slave regulation on OUT output for spray and relay control

*menu **conF** > parameter **C6**=3, parameter **C7**= 1 (default)*

The controller enables a second work zone with independent setpoint **USP** and **UPb** proportional band. The work zone uses the same IN input signal and overlaps the fan work zone.

The **OUT** analog output is set to control water spray units (**C7**=1). It increases or decreases in direct proportion to the **Co** parameter (regulation control value).

The RL1 relay is configured for the On/Off control of a water spray unit (**C6**=3): it is On when input **IN** is greater than **USP** + **UPb**/2, it is Off when input IN is lower than **USP** - **UPb**/2.



Operating example

Following is an example of spray unit control via relay.

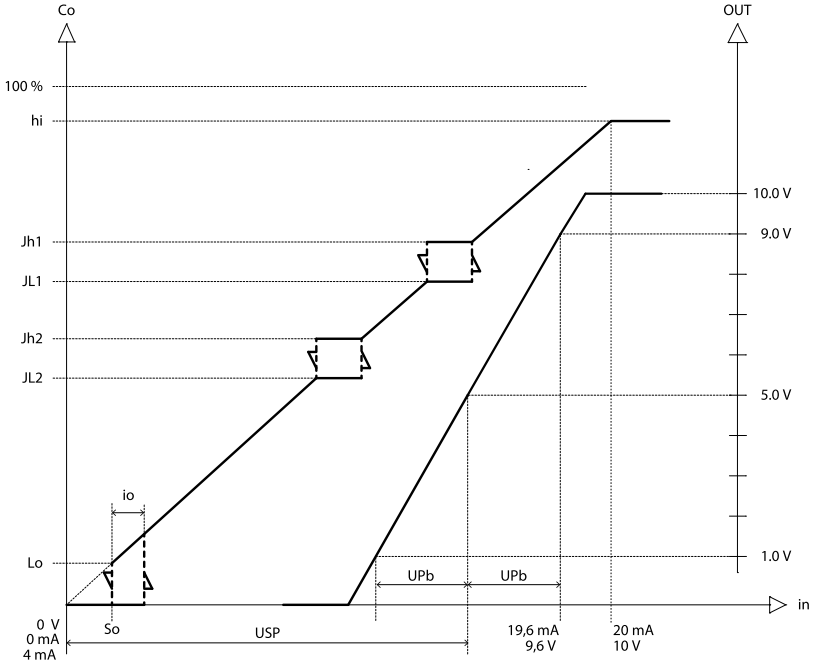
Configuration	Setpoint	Proportional band	Effect on relay
rS-020	**USP** = 15 mA	**UPb** = 4.2 mA	Relay On with **IN1** or **IN2** = 15+4.2/2 = 17.1 mA Relay Off with **IN1** or **IN2** = 15-4.2/2 = 12.9 mA
rS-420	**USP** = 15 mA	**UPb** = 4.2 mA	Relay On with **IN1** or **IN2** = 15+4.2/2 = 17.1 mA Relay Off with **IN1** or **IN2** = 15-4.2/2 = 12.9 mA
rS-010	**USP** = 7.5 V	**UPb** = 2.1 V	Relay On with **IN1** or **IN2** = 7.5+2.1/2 = 8.55 mA Relay Off with **IN1** or **IN2** = 7.5-2.1/2 = 6.45 V

7.1.5 Slave regulation on OUT output to directly control a motorized valve actuator

*menu **conF** > parameter **C7**=2*

The controller enables a second work zone with independent setpoint **USP** and **UPb** proportional band. The work zone uses the same IN input signal and overlaps the fan work zone.

The **OUT** analog output is set to control an auxiliary motorized system (**C7**=2). It increases or decreases in direct proportion to the **Co** parameter (regulation control value).

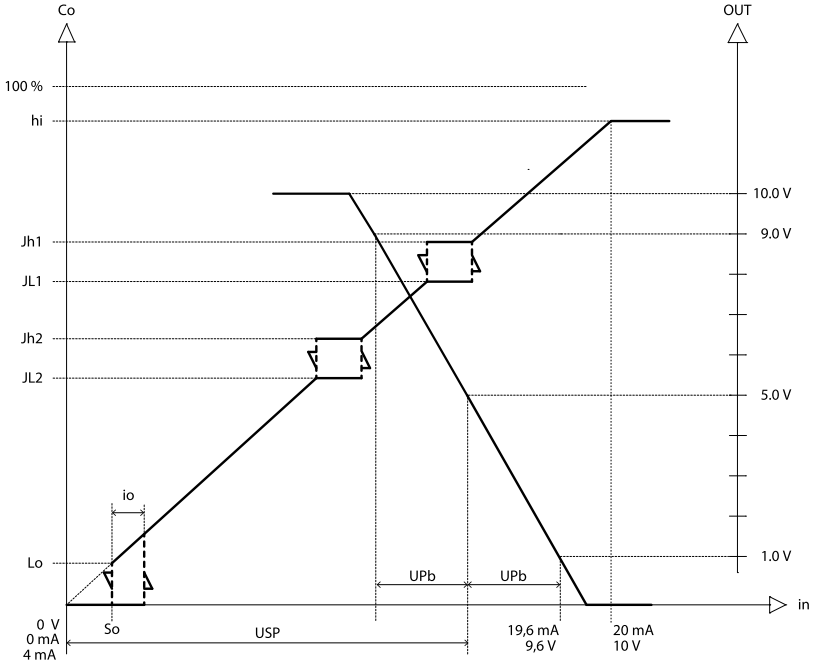


7.1.6 Slave regulation on OUT output to reversely control a motorized valve actuator

*menu **conF** > parameter **C7**=3*

The controller enables a second work zone with independent setpoint **USP** and **UPb** proportional band. The work zone uses the same IN input signal and overlaps the fan work zone.

The **OUT** analog output is set to control an auxiliary motorized system (**C7**=3). It increases or decreases in inverse proportion to the **Co** parameter (regulation control value).



7.2 Master proportional mode

7.2.1 Applications

Signals from temperature sensors or transducers.

7.2.2 Operation

The three-phase output voltage varies to keep the magnitude measured by the prevalent input transducer within the proportional band (higher or lower in value).

The controller manages fans with its setpoint (**S1** or **S2**) and reference proportional band (**Pb1** or **Pb2**). The minimum (**Lo/L.o.**) and maximum (**hi/h.i.**) speed limits are enabled, with forcing and relevant hysteresis at 0% (**So/S.o.** + **io/i.o.**) and 100% (**Sh/S.h.** + **ih/i.h.**). Regulation jumps (**Jh1** + **JL1** and **Jh2** + **JL2**) are enabled, used to avoid particularly noisy zones.

7.2.3 Master regulation on OUT output for power Slave

*menu **conF** > parameter **C7**=0*

The **OUT** analog output is set to control one or more external power slave units. It increases or decreases in direct proportion to the **Co** parameter (regulation control value).

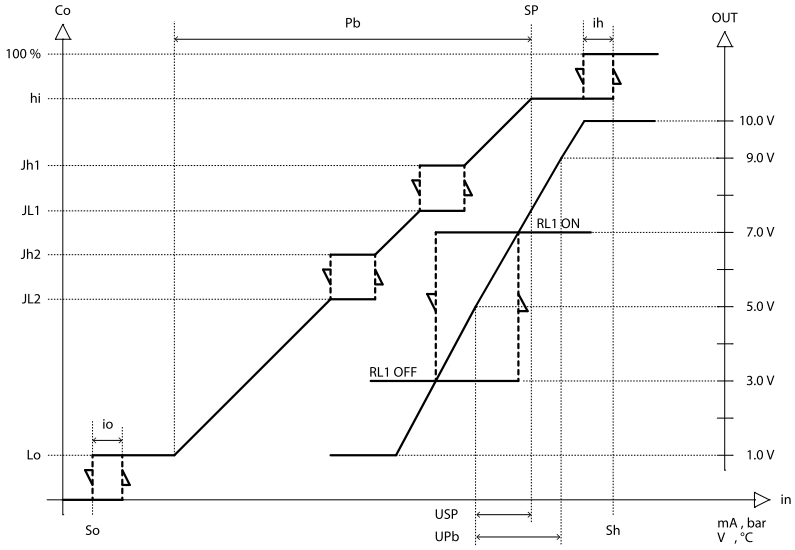
7.2.4 Master regulation on OUT output for spray and relay control for spray

*menu **conF** > parameter **C6**=3, **C7**= 1 (default)*

The controller enables a second work zone with independent setpoint **S1-USP** or **S2-USP** and **UPb** proportional band. The work zone uses the same **IN** input signal and overlaps the fan work zone.

The **OUT** analog output is set to control water spray units (**C7**=1). It increases or decreases in direct proportion to the **Co** parameter (regulation control value).

Relay RL1 is set to On/Off control a water spray unit (**C6**=3): it is On when input **IN** is higher than **S1**+**USP**+**UPb**/2 (or **S2**+**USP**+**UPb**/2), it is Off when input **IN** is lower than **S1**+**USP**-**UPb**/2 (or **S2**+**USP**-**UPb**/2)



Operating example

Following is an example of spray unit control via relay.

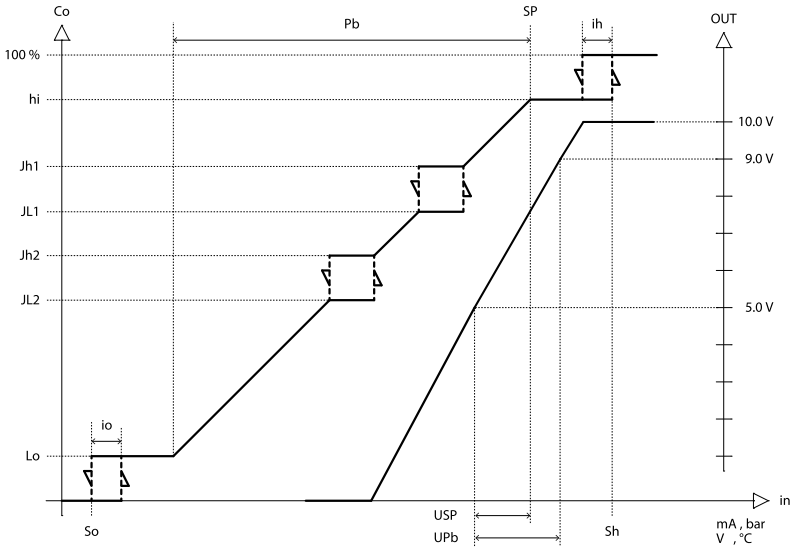
Selected setpoint	Setpoint	Proportional band	Effect on relay
S1 = 45.0 °C	**USP** = - 1,0 °C	**UPb** = 4,0 °C	Relay On with **IN1** or **IN2** = 46.0 °C Relay Off with **IN1** or **IN2** = 42.0 °C
S2 = 50.0 °C	**U.S.P.** = 3,0 °C	**U.P.b.** = 3,0 °C	Relay On with **IN1** or **IN2** = 54.5 °C Relay Off with **IN1** or **IN2** = 51.5 °C

7.2.5 Master regulation on OUT output to directly control a motorized valve actuator

*menu **conF** > parameter **C7**=**2***

The controller enables a second work zone with independent setpoint **S1-USP** or **S2-USP** and **UPb** proportional band. The work zone uses the same **IN** input signal and overlaps the fan work zone.

The **OUT** analog output is set to control an auxiliary motorized system (**C7**=2). It increases and decreases in direct proportion to the **IN** input signal.

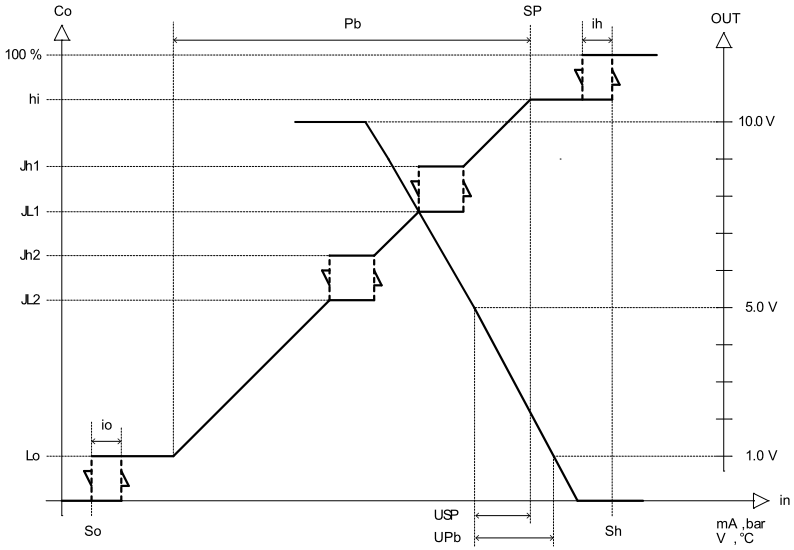


7.2.6 Master regulation on OUT output to reversely control a motorized valve actuator

*menu **conF** > parameter **C7**=**3***

The controller enables a second work zone with independent setpoint **S1-USP** or **S2-USP** and **UPb** proportional band. The work zone uses the same IN input signal and overlaps the fan work zone.

The **OUT** analog output is set to control an auxiliary motorized system (**C7**=3). It increases and decreases in inverse proportion to the **IN** input signal.



7.3 Master PID mode

7.3.1 Applications

Signals from temperature sensors or transducers.

7.3.2 Operation

The three-phase output voltage varies to keep the prevalent input at the setpoint value. On the other hand, the analog output uses the same **IN** input but with a specific setpoint and proportional band.

***Note**: for correct PID regulation operations, accurately set the specific parameters*

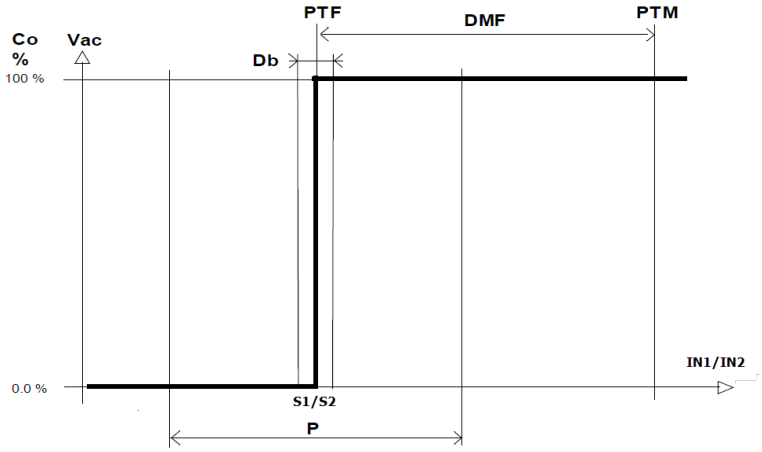
At full potential, meaning once the settlement transitions are depleted and far from the minimum and maximum limits (**Lo/L.o.**) and maximum limits (**hi/h.i.**), the PID controller maintains the set setpoint value of the magnitude measured by the prevalent transducer (**IN1** or **IN2**) at the setpoint (**S1** or **S2**). Fan control (**Co**) can have a free value that ranges from 0% to 100%, according to that required to keep the set work point.

During transitions, if the prevalent input value (**IN1** or **IN2**) moves around the setpoint (**S1** or **S2**),, but remains within the proportional band (**P**), fan control (**Co**) varies from 0% to 100% to return the input value (**IN1** or **IN2**) to the set setpoint (**S1** or **S2**).

If, instead, the prevalent input value (**IN1** or **IN2**) exits the proportional band (**P**), fan control gradually moves to 0%, or 100%, according to that needed.

A dead band zone (**Db**) can be enabled around the setpoint by setting DIP switch 2 On. This balances the small regulation system variations.

The minimum (**Lo/L.o.**) and maximum (**hi/h.i.**) speed limits are enabled, with forcing and relevant hysteresis at 0% (**So/S.o.** + **io/i.o.**) and 100% (**Sh/S.h.** + **ih/i.h.**). Regulation jumps (**Jh1** + **JL1** and **Jh2** + **JL2**) are enabled, used to avoid particularly noisy zones.



Key

Variable	Description
PTF	Minimum working temperature or pressure restricted by system conditions. Set the setpoint to the same value as PTF to obtain greater compressor energy savings
PTM	Maximum working temperature or pressure restricted by system conditions.
DMF	Temperature or pressure difference (PTM-PTF). Movement of the input from PTF to PTM occurs due to an increase in ambient temperature.
Db	*with DIP switch SW1 switch 2 = On* Dead band around the setpoint **(S1 or S2)**, equals +/- 2.5% of the proportional band (**P**). Freezes the fan control value if the prevalent input value **IN1** o **IN2** is within it.

7.3.3 Master PID regulation on OUT output for power Slave

*menu **conF** > parameter **C7**=**0***

The **OUT** analog output is set to control one or more external power slave units. It increases or decreases in direct proportion to the **Co** parameter (regulation control value).

7.3.4 Master PID regulation on OUT output for spray and relay control for spray

*menu **conF** > parameter **C6**=**3**, **C7**= **1** (default)*

The controller enables a second work zone with independent setpoint **S1-USP** or **S2-USP** and **UPb** proportional band. The work zone uses the same **IN** input signal and overlaps the fan work zone. The **OUT** analog output is set to control water spray units (**C7**=1). It increases and decreases in direct proportion to the **IN** input signal.

Relay RL1 is set to On/Off control a water spray unit (**C6**=3): it is On when input **IN** is higher than **S1**+**USP**+**UPb**/2 (or **S2**+**USP**+**UPb**), it is Off when input **IN** is lower than **S1**+**USP**-**UPb**/2 (or **S2**+**USP**-**UPb)**. See diagram "Master regulation on OUT output for spray and relay control for spray" on page 37.

7.3.5 Master regulation on OUT output to directly control a motorized valve actuator

*menu **conF** > parameter **C7**=**2***

The controller enables a second work zone with independent setpoint **S1-USP** or **S2-USP** and **UPb** proportional band. The work zone uses the same **IN** input signal and overlaps the fan work zone. The **OUT** analog output is set to control an auxiliary motorized system (**C7**=2). It increases and decreases in direct proportion to the **IN** input signal. See diagram "Master regulation on OUT output to directly control a motorized valve actuator" on page 37.

7.3.6 Master regulation on OUT output to reversely control a motorized valve actuator

*menu **conF** > parameter **C7**=**3***

The controller enables a second work zone with independent setpoint **S1-USP** or **S2-USP** and **UPb** proportional band. The work zone uses the same **IN** input signal and overlaps the fan work zone. The **OUT** analog output is set to control an auxiliary motorized system (**C7**=3). It increases and decreases in inverse proportion to the **IN** input signal. See diagram "Master regulation on OUT output to reversely control a motorized valve actuator" on page 38.

7.4 Defrost and snow-free operation

***Note**: function available only in Master mode.*

7.4.1 Applications

To defrost the unit for heat pump applications or remove snow if the fans are installed outdoors.

7.4.2 Operation

It applies a constant voltage to the motor that keeps the fan blades rotating at constant speed. The circulating current heats the motor. The amount of voltage is set using the parameter **iCE**.

With **iCE** = 0, no voltage is dispensed.

With **icE** greater than 0, motor heating can be activated via the On/Off input **S1**, for example, by means of an antifreeze thermostat connected to the input **S1** terminals 1 and 2.

With **iCE** greater than 0, the voltage distribution to the motor can be activated with the start/stop contact, based on the settings of switch 4 of DIP switch SW1. See "DIP switch SW1" on page 14.

Function will automatically activate in the case of a closed contact, provided there is no regulation at device output.

***Note**: if **icE**= 0 (default) input **S1** is used to select the Direct/Reverse mode. The reverse mode (output voltage decreases as the input increases) is used to run the controller in heat pump mode.*

7.5 Overload protection function (optional)

***NOTICE**: this function cannot be added after the device is purchased.*

7.5.1 Operation

The device reads the value of the effective output current (Ampere RMS) and compares it to two current values: the maximum working current and the maximum pickup current.

The maximum working current is 1.2 times the rated current (In*1.2). When exceeded, the maximum time within which the overcurrent value (I-In) can be distributed is calculated. The higher the overcurrent, the shorter the distribution, and vice versa. The period is the result of an algorithm that takes into account the size of the controller. The relation between the overcurrent (I-In) and time is quadratic.

The maximum pickup current is 2 times the rated current (In*2). When exceeded, a fixed 5.0 s timer starts.

7.5.2 Controller behavior

When the distributed current...	Then...
is lower than the maximum working current (In*1.2)	distribution is not limited in time. Normal messages (parameter table, etc.) appear on the display.
is higher than the maximum working current (In*1.2)	The real-time distributed current blinks on the display. When the distributed current is kept above the maximum current beyond the calculated maximum time, the device alarm triggers and "ERR it" ("i.t" = thermal current) appears on the display. When the distributed current drops below the maximum current before the maximum time expires then the calculated time is deducted from the accumulated value until it returns to zero.
Greater than the maximum pickup current (In*2.0)	The real-time distributed current blinks on the display. Distribution continues for up to 5 seconds. When the distributed current is above the threshold for more than 5 seconds, the device alarm triggers and the following message is displayed: "ERR. i.P" ("i.P" = pickup current). When the distributed current drops below the threshold before 5 seconds, the residual time is reset.

7.5.3 Examples

The following table gives an indicative duration of the distribution time in seconds from the moment the distributed current (I) exceeds the rated current (In), depending on the I/In ratio:

I / In	Seconds	Description
1.3	120	I = In * 1,3: distribution for 120 seconds
1.4	67.5	I = In * 1,4: distribution for 67 seconds
1.5	43.2	I = In * 1,5: distribution for 43 seconds
1.6	30	I = In * 1,6: distribution for 30 seconds
1.7	22.4	I = In * 1,7: distribution for 22.4 seconds
1.8	16.9	I = In * 1,8: distribution for 16.9 seconds
1.9	13.3	I = In * 1,9: distribution for 13.3 seconds
2.0	10.8	I = In * 2,0: distribution for 10.8 seconds