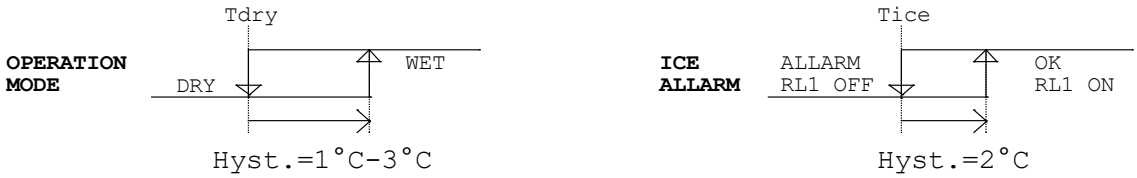
5. Operating Mode

From version 2.0 of the EPS firmware, the temperature and pressure values can be viewed with Imperial units of measure (°F e psi). Therefore, where the text indicates the unit of measure available in °C, it is considered to be °F, and where bar is indicated, it is considered to be psi. For the conversion values, use the following formulas: °F = 32 + (°C x 9/5), psi = bar x 14.5.

5.1. Start conditions

The EPS works if the following preliminary conditions are met, listed in descending order of priority.
The quantities referred to below, and the methods for their reading, are described in chapter 6.

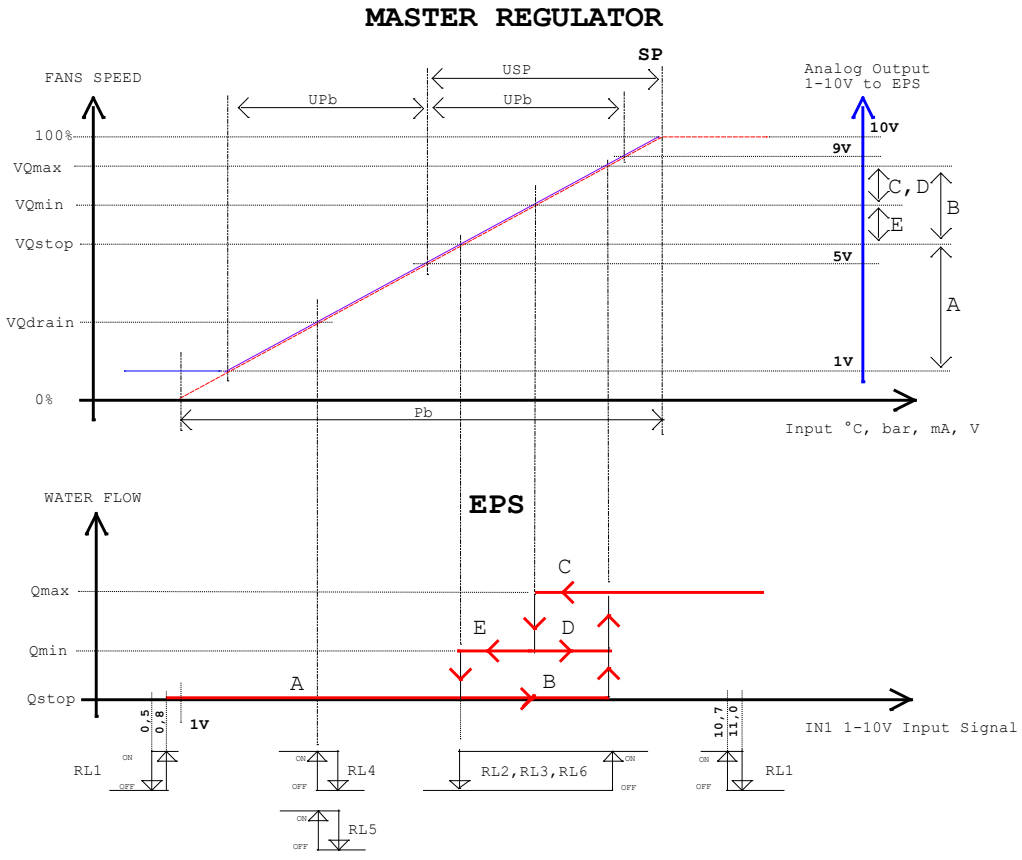
1. **Start / Stop command (S2)**: this is a contact connected between terminals 5 and 6 of terminal board M2 (see paragraph 3.3.2 and paragraph 4.4)
2. If the status is **STOP:** EPS is not running, the "**--- Stop ---**" message appears on the first row of the display
3. If it is in the **START** state: EPS is enabled to run, one of the messages described in para 4.2 appears on the first row of the display.
4. **External temperature (Ta)** measured by the NTC probe connected to input IN2 (see paragraph 3.3.1).
   - If **Ta < TDry**: EPS is not running, and the "**--- Dry---**" message appears on the first row of the display
   - If **Ta > TDry+Hyst** and **Ta > Ice +2 °C (35,6 °F)**, EPS is enabled, the "**-Wet Ready-**" or "**-Wet Work-**" message appears on the first row of the display according to the conditions described below**.**



If both of the previous conditions are met, EPS behavior depends on the 1-10 Vdc command value received at the **IN** input (see para. 3.3.1) proportional to the fan speed control, coming from the controller that controls the fans.

5.2. Water supply in "Energy & Water Saving" mode

Control that minimizes both energy and water consumption; it compares the 1-10 Vdc analog signal at IN1 input with **VQmax**, **VQmin, VQstop**, **VQdrain** thresholds and controls the modulating and solenoid valves as per the following graph.



The fan speed moves freely from 0 to 100%, and consequently the 1-10V signal at input IN1

Water is supplied to the A.P.s as follows, see chart above:

- **A.** Fan speed starts at zero, if fan speed remains under **VQmax**, no supply to A.P.s.
- **B.** Fan speed increases and exceeds **VQmax** switching to “C”.
- **C.** A.P.s are powered with value **Qmax**, fan speed adjusts to the new condition, minimizing energy consumption. If the speed decreases, the quantity supplied remains **Qmax** until it drops below **VQmin**; switching to “D” or “E”, the A.P.s are supplied with the **Qmin** value minimizing water consumption.
- **D.** If the speed increases, the quantity supplied remains **Qmin** until it exceeds **VQmax**, switching to “C” and the cycle repeats.
- **E.** If the speed decreases again, the quantity supplied remains **Qmin** until it drops below **VQstop**; there is a switch to “A” or "B" and the cycle repeats**.**

B->A If the fan speed drops and remains under the **VQdrain** threshold, the "DDrain system inactivity time = Drain Wait Time” starts, default value 120 minutes. When it expires, the water contained in the system is drained.

A->B If the fan speed rises above the **VQdrain** threshold and the time has not expired, the timer is canceled along with the drain.

IN1 (Vdc)	Display			RL1	RL2	RL3	RL4	RL5	RL6
	Status Message (*)	SP (l/m)	Qdx Qsx (l/m)	Alarm	EPS On	Water Supply	Drain	Drain Aux	Pump
IN1 < 0.4V	IN1 Command Under	0	0	-	-	-	-	-	-
0.5 V < IN1 < VQmax	Wet Ready	0	0	ON	-	-	-	-	-
VQmax < IN1	Wet Work	Qmax	Qmax	ON	ON	ON	-	-	ON
11.0 V < IN1	IN1 Command Over	Qmax	Qmax	-	ON	ON	-	-	ON
VQmax < IN1	Wet Work	Qmax	Qmax	ON	ON	ON	-	-	ON
VQmin<IN1<VQmax	Wet Work	Qmax	Qmax	ON	ON	ON	-	-	ON
VQstop<IN1<VQmin	Wet Work	Qmin	Qmin	ON	ON	ON	-	-	ON
IN1< VQstop	Wet Ready	0	0	ON	-	-	-	-	-
0.5V <IN1< VQdrain	Aut. Drainage (**)	0	0	ON	-	-	ON	ON	-
0.5V <IN1< VQdrain	Wet Ready	0	0	ON	-	-	-	-	-
IN1 < 0.5V	IN1 Command Under	0	0	-	-	-	-	-	-

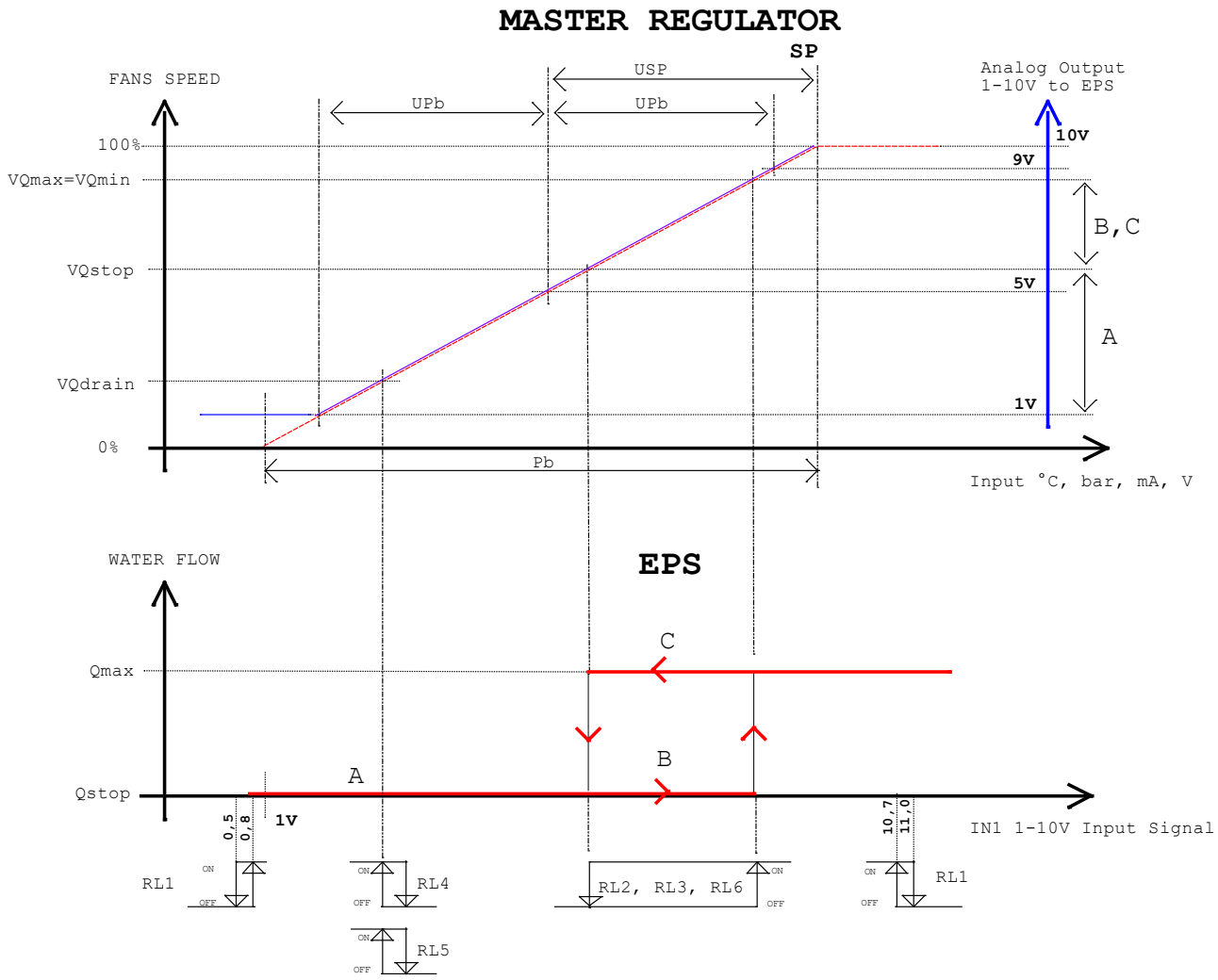
- = OFF

(*) If the flow rate of the water supplied is stably insufficient or excessive: QA and/or QB < -25% QR > +25% QR: the “**W. Flow Error**” alarm message appears on the first row of the display (for alarms see Chapter 8).

(**) Timed drain command; if **VQdrain< IN1** before the end of the drain time, the operation is canceled and the timer is reset.

5.3. Water supply in "Energy Saving" mode

Function that minimizes fan energy consumption; this compares the 1-10 Vdc analog signal at the IN1 input with the **VQmax**, **VQstop**, **VQdrain** thresholds and controls the modulating and solenoid valves as per the following graph
It is activated by setting **VQmin = VQmax**



The fan speed moves freely from 0 to 100%, and consequently the 1-10V signal at input IN1
Water is supplied to the A.P.s as follows, see chart above:

- **A.** Fan speed starts at zero, if fan speed remains under **VQmax**, no supply to A.P.s.
- **B.** Fan speed increases and exceeds **VQmax** switching to “C”.
- **C.** A.P.s are supplied with value **Qmax**, fan speed adjusts to the new condition, minimizing energy consumption. If the speed decreases, the quantity supplied remains **Qmax** until the speed drops below **VQstop**; there is a switch to “A” or “B” and the cycle repeats.

B->A If fan speed drops and remains under threshold **VQdrain** the "DDrain system inactivity time = Drain Wait Time " starts, default value 120 min. When it expires, the water contained in the system is drained.
A->B If fan speed rises over the **VQdrain** threshold and the time has not expired, the timer is canceled along with the drain

IN1 (Vdc)	Display			RL1	RL2	RL3	RL4	RL5	RL6
	Status Message (*)	SP (l/m)	Qdx Qsx (l/m)	Alarm	EPS On	Water Supply	Drain	Drain Aux	Pump
IN1 < 0.4V	IN1 Command Under	0	0	-	-	-	-	-	-
0.4 V < IN1 < VQmax	Wet Ready	0	0	ON	-	-	-	-	-
VQmax < IN1	Wet Work	Qmax	Qmax	ON	ON	ON	-	-	ON
11.0 < IN1	IN1 Command Over	Qmax	Qmax	-	ON	ON	-	-	ON
VQmax < IN1	Wet Work	Qmax	Qmax	ON	ON	ON	-	-	ON
VQstop<IN1<VQmax	Wet Work	Qmax	Qmax	ON	ON	ON	-	-	ON
IN1< VQstop	Wet Ready	0	0	ON	-	-	-	-	-
0.4V <IN1< VQdrain	Aut. Drainage (**)	0	0	ON	-	-	ON	ON	-
0.4V <IN1< VQdrain	Wet Ready	0	0	ON	-	-	-	-	-
IN1 < 0.5V	IN1 Command Under	0	0	-	-	-	-	-	-

- = OFF

(*) If the flow rate of the water supplied is stably insufficient or excessive: QA and/or QB < -25% QR > +25% QR the "**W. Flow Error**" alarm message appears on the first row of the display (for alarms see Chapter 8).

(**) Timed drain command; if **VQdrain < IN1** before the end of the drain time, the operation is canceled and the timer is reset.

5.4. Drive Master Device Settings

The EPS must be driven by one of the following devices suitable for controlling fans: ECM for fans with EC motor (driven both in ModBus and in 0-10V), RGM to drive three-phase AC motors with phase cut and DSV to drive three-phase AC stepper motors.

ECM

Use the OUT1 analog output (M2, terminals 1 and 2) 0-10V command signal for the fans.
The output can be modified with parameter **C7** (default "output SLAVE 0-10V"), see paragraph 10.2.3 on page 82 of the ECM manual.
Use the OUT2 analog output (M2, terminals 3 and 4) 1-10V command signal for the Water Spray unit.
The output can be modified with parameter C8 (default "output SPRAY 1-10V"), see paragraph 10.2.3 on page 82 of the ECM manual.
For the connections, see paragraph 6.6 on page 34 of the ECM manual.
Set the values of the USP and UPb parameters on the ECM according to the following table, depending on the input configuration used, see paragraph 10.1 on page 71 of the ECM manual.

ECP

Use the OUT analog output (M1, terminals 9 and 10) 1-10V command signal for the Water Spray unit.
The output can be modified with parameter **C7** (default=1)**,** see paragraph 8.9 on page 54 of the manual.
For the connections, see paragraph 6.5 on page 27 of the manual.
Set the values of the USP and UPb parameters on the RGM according to the following table, depending on the input configuration used, see paragraph 8.2 on page 36 of the manual.

RGM

Use the OUT analog output (M1, terminals 9 and 10) 1-10V command signal for the Water Spray unit.
The output can be modified with parameter **C7** (default=1)**,** see paragraph 8.9 on page 62 of the manual.
For the connections, see paragraph 6.5 on page 28 of the manual.
Set the values of the USP and UPb parameters on the RGM according to the following table, depending on the input configuration used, see paragraph 8.2 on page 44 of the manual.

DSV

Use the OUT2 analog output (M2, terminals 3 and 4) 1-10V command signal for the Water Spray unit.
The output can be modified using the C8 parameter (default "output SPRAY 1-10V"), see paragraph 10.2.3 on page 83 of the DSV manual.
For the connections, see paragraph 6.6 on page 34 of the DSV manual.
Set the values of the USP and UPb parameters on the DSV according to the following table, depending on the input configuration used, see paragraph 10.1 on page 71 of the DSV manual.

Config.	Default		ECM, DSV, RGM		U.M.
	SP	Pb	USP	UPb	
rtE-01	45/113	7.5/45.5	-3.75/22.25	3/37.4	°C/°F
rtE-02	45/113	7.5/45.5	-3.75/22.25	3/37.4	°C/°F
rPr420	14	2.6	-1.3	1.04	mA
rPr015	10.6/153.7	2.4/34.8	-1.2/17.4	0.96/13.9	bar/psi
rPr025	17/246.5	3.5/50.7	-1.75/-25.4	1.4/20.3	bar/psi
rPr030	17/246.5	3.5/50.7	-1.75/-25.4	1.4/20.3	bar/psi
rPr045	25/362.5	5.2/75.4	-2.6/-37.7	2.08/30.16	bar/psi

Config.	Default		ECM, DSV, RGM		U.M.
	SP	Pb	USP	UPb	
rUu-05	2.9	0.8	-0.4	0.32	Vdc
rPu030	17/246.5	3.5/50.7	-1.75/-25.4	1.4/20.3	Bar/psi
rUu010	6	1.6	-0.8	0.64	Vdc
rS020	-	20	10	8	mA
rS420	-	16	8	6.4	mA
rS010	-	10	5	4	Vdc

If the Pb values used on the master controller differ from the default values, the valuesto be set on the master controller for **USP** and **UPb** are given by the following formulas:

$$USP = - Pb/2$$

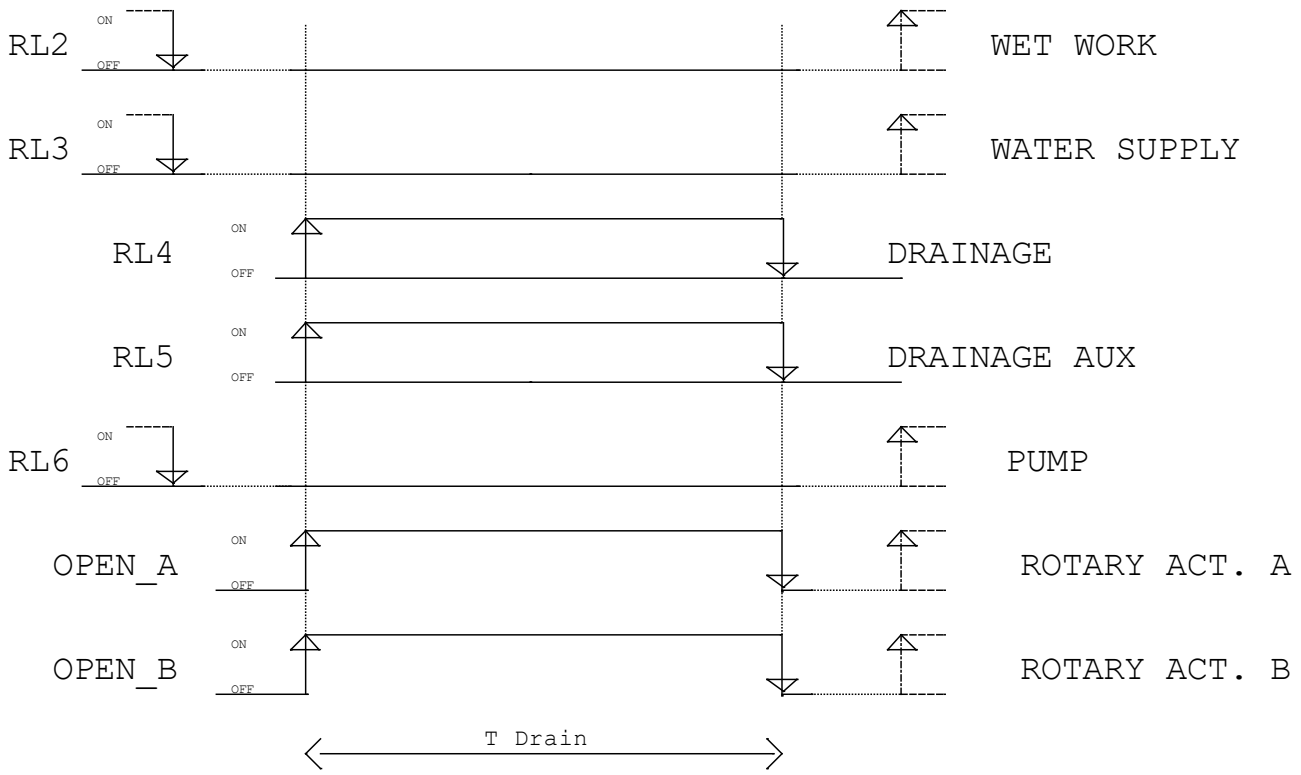
$$UPb = (Pb * 0,8) / 2$$

5.5. System Water Drain (drainage)

The device is designed for the following ramp and entire system drain methods.

N.B. In the "**Ice Temperature**" state, it is not possible to manually activate the "**Man. Drainage" (**water drain) and **Purging** (P.A. Washing**).**
In the "**Wet Work**" state (water dispensing), it is not possible to manually activate the "**Man. Drainage" (**water drain) to avoid waste.
In the state "**Man. Drain"** or **"Auto Drain**" (water drain), the **"STOP"** command (input **S2**) DOES NOT interrupt any operations running.

The drain cycle is as follows:



The duration is set by parameter **"T DRain = Drain ON Time"**. After this time interval, the EPS returns to the previous operating state.

5.5.1. Manual system drain ("Man. Drainage")

Fully drains water contained in the system, it is activated alternatively with one of the following methods:

1. Press and hold down the "+" and "**-**" keys simultaneously for at least two seconds (see paragraph 4.1)
2. Press the SB2 button on the board for at least two seconds (see paragraph 1.4.1, item 12)
3. Activate the remote control (S7) connected to M2 terminals 1 and 2 (see paragraph 3.3.2).

5.5.2. Auto drain: automatic system drain ("Aut. Drainage")

There are three automatic activation modes to run the "Drainage" cycle.

- When the fan speed drops steadily and remains below the threshold **VQdrain**, the "D Drain system inactivity timer = Drain Wait Time" activates; default value 120 minutes. When it expires, the water contained in the system is drained.
- With the frequency selected by the operator, using the **"Drain Rate"** and **"Drain Start"** parameters, see Chapter 6

5.6 Adiabatic Panel Purging

Allows the adiabatic panels (A.P.) to be purged, activating the water flow to the A.P. at the "**Qpurge**" flow rate for the "**Tpurge**" time. Activate the remote control (S8) connected to M2 terminals 3 and 4 (see paragraph 3.3.2).