USER'S MANUAL

Rev. 06/2022

REVO RT

MULTIZONE TEMPERATURE CONTROLLER

from 35A to 90A

002

M-RT-35-90

CD Automation S.r.l.
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Declaration of conformity

Declaration of conformity-Dichiarazione di Conformità CE

PRODUCT MANUFACTURER/ PRODUTTORE:

CD Automation S.R.L.
Controllers, Drives & Automation

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Declare that the product / Dichiara che il prodotto:

REVO RT 35A-50A-75A-90A

PRODUCT DESCRIPTION: Electric power control
SCOPE OF APPLICATION: Thermal control process
DESCRIZIONE DEL PRODOTTO: Unità di controllo potenza elettrica
UTILIZZO: Controllo processi termici

FULFILS THE REQUIREMENTS OF THE STANDARD:

Electrical safety Standard	EN60947-1: 2007 + A1 2011, A2 2014 EN60947-4-3: 2014
Generic Emission standard	EN60947-4-3: 2014 Group 1 Class A emissions
Generic Immunity standard	EN60947-4-3: 2014 Industrial Immunity

SODDISFA I REQUISITI DELLA NORMA:

Specifica di sicurezza	EN60947-1: 2007 + A1 2011, A2 2014 EN60947-4-3: 2014
Specifica sulle emissioni	EN60947-4-3: 2014 gruppo 1 emissioni classe A
Specifica sulle Immunità	EN60947-4-3: 2014 Immunità industriale

CDAutomation declares that the products above mentioned are conforming to the directive
CDAutomation dichiara che i prodotti sopra menzionati sono conformi alla direttiva
Alla direttiva Bassa Tensione (low Voltage) EMC directive updated 2014/30/EU,
Low Voltage Directive updated 2014/35/EU

Issued on: 20/03/2017
Data di emissione: 20/03/2017

Amministratore Unico e
Legale Rappresentante
Simone Brizzi

Declaration of conformity

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UK CA

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Data di emissione: 07/03/2022

Amministratore Unico e
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Important warnings for safety

This chapter contains important information for the safety. The not observance of these instructions may result in serious personal injury or death and can cause serious damages to the Thyristor unit and to the components system included.
The installation should be performed by qualified persons.
In the manual are used symbols to give more evidence at the notes of safety and operativity for the attention for the user:

	This icon is present in all the operational procedures where the Improper operation may result in serious personal injury or death by Electrical Shock Hazard Symbol (a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING safety statement.
	Warning or Hazard that needs further explanation than the label on unit can provide. Consult User's Guide for further information.
	Unit is compliant with European Union directives. See Declaration of Conformity for further details on Directives and Standards used for Compliance.
	If available, unit is a Listed device per Underwriters Laboratories. It has been investigated to ANSI/UL® 508 standards for Industrial Control Switches and equivalent to CSA C22.2 #14. For more detail search for File E231578 on www.ul.com
	ESD Sensitive product, use proper grounding and handling techniques when installing or servicing product.
	Do not throw in trash, use proper recycling techniques or consult manufacturer for proper disposal.

A **"NOTE"** marks a short message to alert you to an important detail.

A **"CAUTION"** safety alert appears with information that is important for protecting your equipment and performance. Be especially careful to read and follow all cautions that apply to your application.

A **"WARNING"** safety alert appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.

Safety notes

WARNING! To avoid damage to property and equipment, injury and loss of life, adhere to applicable electrical codes and standard wiring practices when installing and operating this product. Failure to do so could result in damage, injury and death.

AVERTISSEMENT! Pour éviter d'endommager la propriété et l'équipement, les blessures et la perte de vie, respecter les codes électriques en vigueur et les pratiques de câblage standard au moment de l'installation et de l'utilisation de ce produit. Dans le cas contraire, cela peut entraîner la mort, des blessures graves ou des dommages.

WARNING! All service including inspection, installation, wiring, maintenance, troubleshooting, fuse or other user serviceable component replacement must be performed only by properly qualified personnel. Service personnel must read this manual before proceeding with work. While service is being performed unqualified personnel should not work on the unit or be allowed in the immediate vicinity.

AVERTISSEMENT! Tous les services, y compris l'inspection, l'installation, le câblage, l'entretien, le dépannage, le remplacement de fusibles ou d'autres composants pouvant être réparés par l'utilisateur, doivent être effectués uniquement par un personnel diment qualifié. Le personnel de service doit lire ce manuel avant d'effectuer tout travail. Pendant que l'entretien est exécuté, tout personnel non qualifié ne doit effectuer de travail sur l'appareil ni se trouver a proximité.

WARNING! When in use the power controller is connected to dangerous voltages. Do not remove the protective covers without first disconnecting and preventing power from being restored while servicing the unit.

AVERTISSEMENT! Au moment de l'utilisation, le régulateur de puissance est connecté a des tensions dangereuses. Ne retirer aucun couvercle de protection sans d'abord débrancher l'appareil et ainsi empêcher l'alimentation d'être rétablie pendant l'entretien.

WARNING! Do not use in aerospace or nuclear applications.

AVERTISSEMENT! Ne pas utiliser pour les applications aérospatiales ou nucléaires.

WARNING! The units are not developed to manage capacitive loads.

AVERTISSEMENT! Les unités ne sont pas développées pour la conduite de charges capacitives.

WARNING! The power controller's protection rating is IP20 with all covers installed and closed. It must be installed in an enclosure that provides all the necessary additional protections appropriate for the environment and application.

AVERTISSEMENT! L'indice de protection du régulateur de puissance est de IP20 lorsque les couvercles sont installés et fermés. L'appareil doit être installé dans une enceinte qui assure toute la protection supplémentaire nécessaire pour l'environnement et l'application.

WARNING! Ground the power controller via the provided protective earth grounding terminal. Verify ground is within impedance specifications. This should be verified periodically.

AVERTISSEMENT! Mise a la terre du régulateur de puissance par le biais de la borne de prise de terre de protection fournie. Vérifier que la prise de terre est conforme aux spécifications de l'impédance. Cela doit être vérifié périodiquement.

WARNING! Electric Shock Hazard: when the power controller has been energized, after shutting off the power, wait at least one minute for internal capacitors to discharge before commencing work that brings you in to contact with power connections or internal components.

AVERTISSEMENT! Risque de décharges électriques: lorsque le régulateur de puissance est mis sous tension, après avoir été éteint, attendre au moins une minute pour que les condensateurs internes se déchargent avant de commencer tout travail incluant le contact avec les connexions électriques ou les composants internes.

WARNING! The installation must be protected by electromagnetic circuit breakers or by fuses. The semiconductor fuses located inside the power controller are classified for UL as supplementary protection for semiconductor devices. They are not approved for branch circuit protection.

AVERTISSEMENT! L'installation doit être protégée par des disjoncteurs électromagnétiques ou des fusibles. Les fusibles pour semi-conducteurs situés a l'intérieur du régulateur de puissance sont classés UL comme protection supplémentaire pour les dispositifs pour semi-conducteurs. Ils ne sont pas approuvés pour la protection des circuits de dérivation.

WARNING! When making live voltage or current measurements, use proper personal protective equipment for the voltages and arc-flash potentials involved.

AVERTISSEMENT! Au moment de relever des mesures de tension ou de courant en direct, utiliser un équipement de protection individuelle approprié pour les tensions et les potentiels d'arc électrique concernés.

WARNING! Verify the voltage and current ratings of the power controller are correct for the application.

AVERTISSEMENT! Vérifier que les valeurs de tension et de courant du régulateur de puissance sont correctes pour l'application.

CAUTION: To avoid compromising the insulation, do not bend wire or other components beyond their bend radius specifications.

ATTENTION: Pour éviter de compromettre l'isolation, ne pas plier le fil ou tout autre composant au-delà de ses spécifications en matière de rayon de courbure.

CAUTION: Protect the power controller from high temperature, humidity and vibrations.

ATTENTION: Protéger le régulateur de puissance contre les températures élevées, l'humidité et les vibrations.

CAUTION: The power controller warranty is void if the tested and approved fuses are not used.

ATTENTION: La garantie du régulateur de puissance est nulle si aucun fusible testé et approuvé n'est utilisé.

CAUTION: Only trained and authorized personnel should access and handle the internal electronics and they must follow proper electro-static prevention procedures.

ATTENTION: Seul le personnel formé et autorisé peut accéder aux composants électroniques internes et les gérer, et il doit se conformer a des procédures de prévention électrostatique appropriées.

CAUTION: Install an appropriately sized RC filter across contactor coils, relays and other inductive loads.

ATTENTION: Installer un filtre RC de dimensions appropriées sur les bobines du contacteur, les relais et autres charges par induction.

CAUTION: The thyristor units here described have been designed for use with sinusoidal networks with nominal frequency 50-60 Hz. Any application with NON-SINUSOIDAL, distorted or disturbed networks could compromise the correct operation of the unit.

ATTENTION: Les unités de thyristors décrites ici ont été conçues pour être utilisées avec des réseaux sinusoïdaux d'une fréquence nominale de 50 à 60 Hz. Toute application utilisant des réseaux NON SINUSOÏDAUX, déformés ou perturbés peut compromettre le bon fonctionnement de l'appareil.

NOTE: Provide a local disconnect to isolate the power controller for servicing.

REMARQUE: Fournir une déconnexion locale afin d'isoler le régulateur de puissance pour l'entretien.

NOTE: The nominal current is specified for ambient temperatures at or below 40˚ C. Ensure the application design allows for adequate cooling of each power controller. The power controller must be mounted vertically. The cooling design must prevent air heated by one power controller from causing power controllers mounted above to exceed the ambient operating temperature limit. When power controllers are mounted side by side allow a minimum spacing of 15mm between them.

REMARQUE: Le courant nominal est précisé pour des températures ambiantes égales ou inférieures a 40˚C. S'assurer que la conception de l'application permette le refroidissement adéquat de chaque régulateur de puissance. Le régulateur de puissance doit être monté verticalement. La conception de refroidissement doit empêcher l'air chauffé par le régulateur de puissance de dépasser la limite de température de fonctionnement ambiante de la part des régulateurs de puissance montés au-dessus. Lorsque les régulateurs de puissance sont montés côte a côte, il faut conserver un espacement minimal de 15 mm entre les deux.

NOTE: Use only copper cables and wires rated for use at 90˚C or greater.

REMARQUE: N'utiliser que des cables et des fils en cuivre pour l'utilisation a 90˚C ou plus.

Maintenance

In order to have a corrected cooling, the user must clean the heat-sink and the protective grill of the fans. The frequency of this servicing depends on environmental pollution.
Also check periodically if the screw for the power cables and safety earth are tightened correctly
(See Connection Diagram)

Warranty condition

Producer gives a 12 months warranty to its products.

The warranty is limited to repairing and parts substitution in our factory and does exclude products not properly used and fuses.

Warranty does not include products with serial numbers deleted. The faulty product should be shipped to Producer at customer's cost and our Service will evaluate if product is under warranty terms.

Substituted parts remain of Producer property.

CE

CD Automation srl assumes no liability for any damage to persons or property deriving from tampering, from incorrect or improper use, or from any use not conforming to the characteristics of the controller and to the instructions in this User Manual.

Return Material Authorization (RMA)

Customers wishing to return any items, whether they are incorrectly supplied, faulty or damaged in transit, must first complete a Return Material Authorisation (RMA) form to obtain an RMA number from the Service Department.
A full repair service is available for customers. Prior to submitting the RMA form and returning products, customers are recommended to contact the technical support team to determine whether the issue can be resolved with telephone support.

How the RMA service works

The RMA form and details are available on our web sites:

https://www.cdautomation.com/returns-material-authorisation/

When completing the RMA form, please be as specific as possible about the problem, including any pertinent application details. The more information given, the more quickly and more thoroughly the problem can be solved. The minimum information required is:

1. The Full Model Number
2. Quantity of units being returned
3. The units Serial Number(s)
4. A description of the problem ("faulty" or "unknown" is not sufficient)

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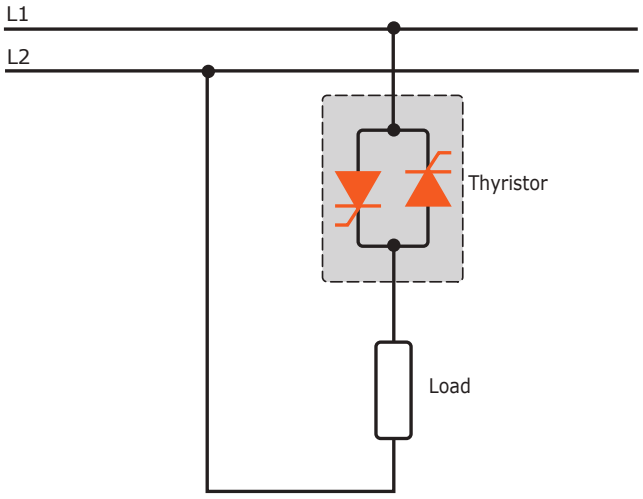
1 Introduction

A thyristor unit is semiconductor device which acts as a switch formed by two thyristors in antiparallel.
To switch on the alternating current the input signal will be on and the thyristor will switch off at first Zero Crossing voltage with no input signal.
The benefits of thyristor units compared with elettromechanical contactors are numerouses: no moving parts, no maintenance and capacity to switch very fast. Thyristors are the only solution to control transformers and special loads that change resistance with temperature and with age.



1.1 Overview

Current transformer and user interface
- Saves installation time and eases setup and commissioning
- Delivers a user-friendly, intuitive interface

Industry-leading design and serviceability
- Offers a robust SCR design to meet a rugged industrial environment's high quality and reliability needs
- Provides quick and easy access to maintain and service fuses and individual legs in minimal time
- Enables fast troubleshooting by providing helpful thermal system diagnostics.

Comprehensive power controller range
- Provides wide range of options from simple single phase to complex three-phase loads to 600V

100kA short circuit current rating (SCCR) (Not reviewed by UL®)
- Enables greater protection in the event of a short circuit

c-UL® 508 Listed - PRELIMINARY, to be tested
- Shortens project schedules, agency testing and expenses

Control modes: contactor, voltage, current or power
- Satisfies a wide range of demanding thermal applications

Load firing mode: burst fire
- Handles a wide range of load types including nichrome, medium and long waveform infrared lamps, moly, transformers, silicon carbide, UV lamps and tungsten
- Protects and extends the life of connected loads

Wide range of communication protocols
- Enable factory and process automation with connectivity to process and equipment data via Modbus® RTU. Modbus® TCP, Profibus, Profinet (available with external master communication module)

Open heater and shorted SCR indication
- Minimizes production downtime with easy to understand, intelligent, troubleshooting diagnostics

Integrated USB and user interface for configuration
- Easily and safely program configuration settings as the user interface can be powered through USB connection
- Eliminates need to work in a high voltage hazard environment. High voltage to the power controller and system panel can be shut off and locked out for safety while configuring controller.

2 Configurator Software

Thyristor configurator software is free and is possible download it from our site.
If the Order Code is in line with requirement, then unit has been already configured in Factory and it's ready to use.
You need the software only to modify the ordered configuration. Anyway we suggest to check the unit on the machine with the "Test unit" section.
For install the software, launch the program and follow the instructions on the screen.
Run the software configurator and set the correct serial port number by menu setting-serial com – port number.

Software Configurator download link:
https://www.cdautomation.com/download/cd-automation/software/ThyristorConfigurator_ver6.exe

Micro USB

To connect the unit at the PC, it's necessary to use the micro USB 2.0 Modbus RTU cable.
USB connection need a driver to work properly, you can find it from our site.

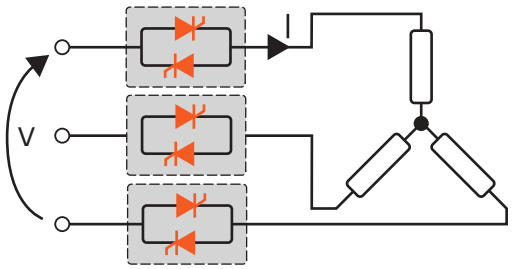
However the configuration software installer will install as default the correct driver.

3 Basic Connections and sizing

Star wiring with resistive load (control on three phases)

$$I = \frac{P}{1{,}73V}$$

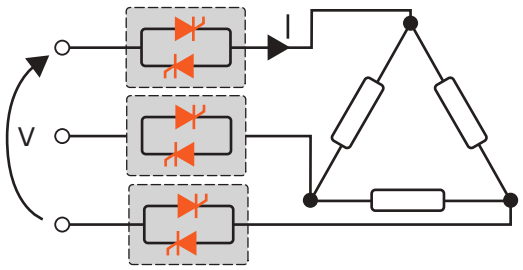
V = Nominal voltage of the load
I = Nominal current of the load
P = Nominal power of the load



Delta wiring with resistive load (control on three phases)

$$I = \frac{P}{1{,}73V}$$

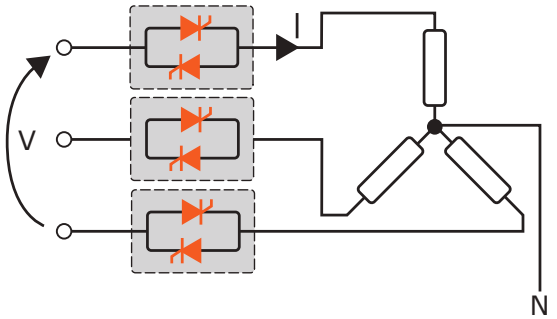
V = Nominal voltage of the load
I = Nominal current of the load
P = Nominal power of the load



Star + Neutral wiring

$$I = \frac{P}{1{,}73V}$$

V = Nominal voltage of the load
I = Nominal current of the load
P = Nominal power of the load



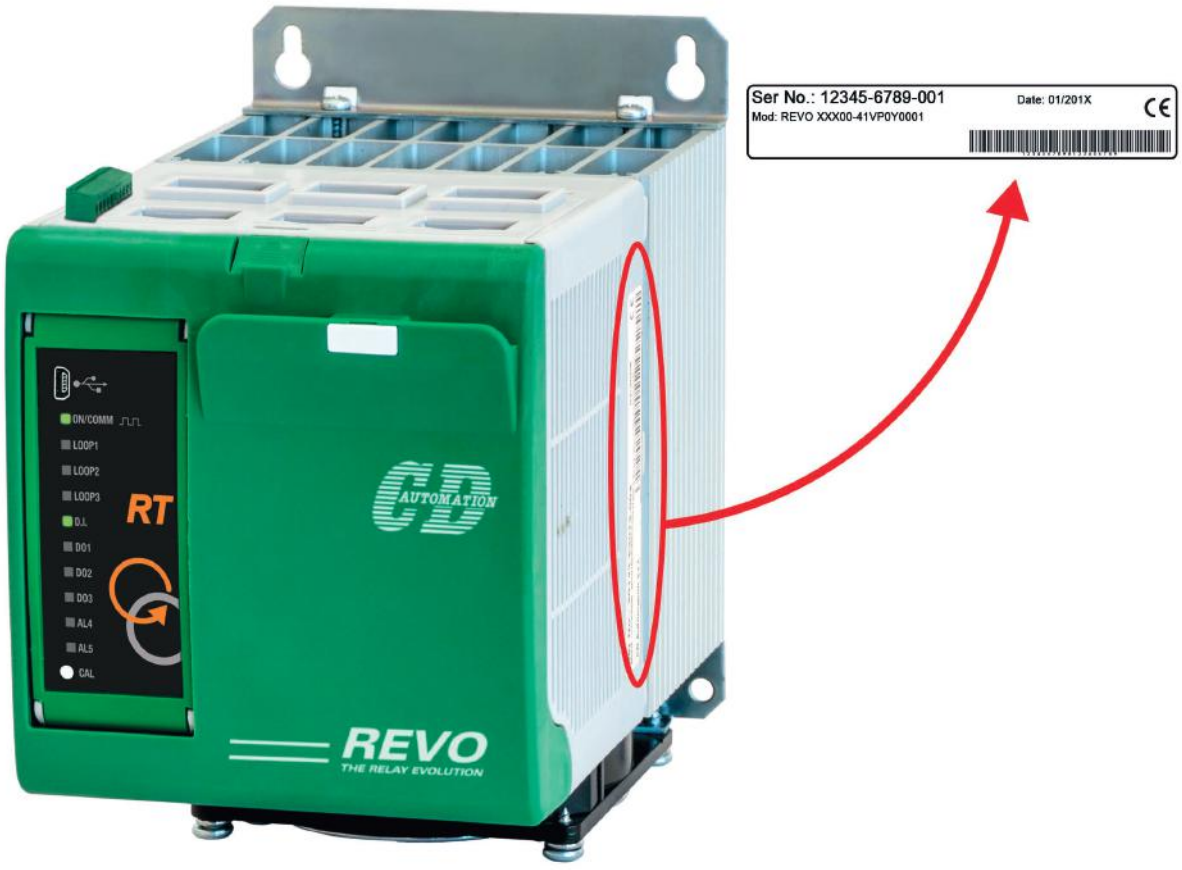
4 Identification and Order Code

4.1 Identification of the unit

Caution: Before to install, make sure that the Thyristor unit have not damages. If the product has a fault, please contact the dealer from which you purchased the product.

The identification label give all the information regarding the factory settings of the Thyristor unit, this label is on the unit, like represented in figure.

Verify that the product is the same thing as ordered.



4.2 Order Code

REVO RT 2 Loop (+ 1 measure)

	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16
ORDER CODE	R	T	2	_	_	_	-	-	-	-	-	-	-	-	-	-	-

N° ZONES X CURRENT RATING	4	5	6
description	code		
2 Zones 35 A each + 1 Measure	0	3	5
2 Zones 50 A each + 1 Measure	0	5	0
2 Zones 75 A each + 1 Measure	0	7	5
2 Zones 90 A each + 1 Measure	0	9	0

MAX VOLTAGE	7
description	code
480V	4
600V	6

AUXILIARY VOLTAGE	8
description	code
24Vdc	4

INPUT	9
description	code
N° 3 configurable input as Tc, J, K, S or Analog 4:20mA o 0:10V	0

FIRING	10
description	code
Zero Crossing	Z

CONTROL MODE	11
description	code
N° 2 Loop Heating and Cooling or Heating Only to be configured by the customer	0

FUSES & OPTION	12
description	code
Fixed Fuse - No Option	F
Fixed Fuse - Heater Break Alarm	H

FAN VOLTAGE	13
description	code
24Vdc Fan standard	3

APPROVALS	14
description	code
CE EMC For European Market	0

MANUAL	15
description	code
None	0
Italian	1
English	2
German	3
French	4

VERSION	16
description	code
Version 1	1

REVO RT 3 Loop

	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16
ORDER CODE	R	T	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

N° ZONES X CURRENT RATING	4	5	6
description	code		
3 Zones 35 A each	0	3	5
3 Zones 50 A each	0	5	0
3 Zones 75 A each	0	7	5
3 Zones 90 A each	0	9	0

MAX VOLTAGE	7
description	code
480V	4
600V	6

AUXILIARY VOLTAGE	8
description	code
24Vdc	4

INPUT	9
description	code
N° 3 configurable input as Tc, J, K, S or Analog 4:20mA o 0:10V	0

FIRING	10
description	code
Zero Crossing	Z

CONTROL MODE	11
description	code
N° 3 Loop Heating and Cooling or Heating Only to be configured by the customer	0

FUSES & OPTION	12
description	code
Fixed Fuse - No Option	F
Fixed Fuse - Heater Break Alarm	H

FAN VOLTAGE	13
description	code
24Vdc Fan standard	3

APPROVALS	14
description	code
CE EMC For European Market	0

MANUAL	15
description	code
None	0
Italian	1
English	2
German	3
French	4

VERSION	16
description	code
Version 1	1

5 Technical Specifications

5.1 General features

Cover and Socket material:	Polymeric V2
Utilization Category:	AC-51 AC-55b AC-56A
IP Code:	20
Method of Connecting:	Load in Delta, Load in Star
Auxiliary voltage:	24Vdc 1A
Relay output for Heater Break Alarm (only with HB option)	0.5A a 24Vac/dc

5.2 Input and Output features (power device)

Current	Nominal Voltage range (Ue)	Repetitive peak reverse voltage (Uimp)		Latching current	Max peak one cycle	Leakage current	FUSE I2T value Suggested A2s (at500V)	Frequency range	Power loss Thyristor + Fuse	Isolation Voltage (Ui)
(A)	(V)	(480V)	(600V)	(mAeff)	(10 msec.) (A)	(mAeff)	tp= 10msec	(Hz)	I =Inom (W)	(Vac)
30	24÷600	1600	600	520	15	546	47÷70	36	3000	3000
50	24÷600	1600	600	1500	15	1750	47÷70	54	3000	3000
75	24÷600	1600	600	1900	15	4305	47÷70	102	3000	3000
90	24÷600	1600	600	1900	15	4305	47÷70	145	3000	3000

5.3 Input features (electronic control board)

configurable via software

Input n°: 3

Resolution 16Bit

Thermocouple

Type: K, S, R, J, T, E, N, B with automatic joint compensation

Tolerance +/- 0,2% FS

Cold junction accuracy +/- 0,1 °C/°C

V/mA

Type: 0-1V, 0-5V, 0-10V, 0-20mA, 4-20mA, 0-60mV

Impedence: 0-10 V: > 110 KΩ
0-20 mA: < 5 Ω
0-60 mV: > 1 MΩ

5.4 Output features (electronic control board)

Relay

Function: Cooling, temperature alarms, system alarms, system signals

DO 1,2,3: 230Vac / 1A resistive load

AL4: 230Vac / 1A resistive load

AL5: 24V / 1A

5.5 Software features

Regulation algorithm	ON-OFF with hysteresis. P, PI, PID, PD at proportional time
Proportional band	0 - 9999°C o °F
Integral time	0,0 - 999,9 sec (0 excludes)
Derivative time	0,0 - 999,9 sec (0 excludes)
Regulator functions	Selectable manual or automatic alarm tuning, command and alarm set protection.

5.6 Environmental installation conditions

Ambient temperature	0-40°C (32-104°F) at nominal current. Over 40°C-104°F use the derating curve (max 50°C).
Storage temperature	-25°C to 70°C -13°F to 158°F
Installation place	Don't install at direct sun light, where there are conductive dust, corrosive gas, vibration or water and also in salty environmental.
Altitude	Up to 1000 meter over sea level. For higher altitude reduce the nominal current of 2% for each 100m over 1000m
Humidity	From 5 to 95% without condense and ice
Pollution Level	Up to 2nd Level ref. IEC 60947-1 6.1.3.2

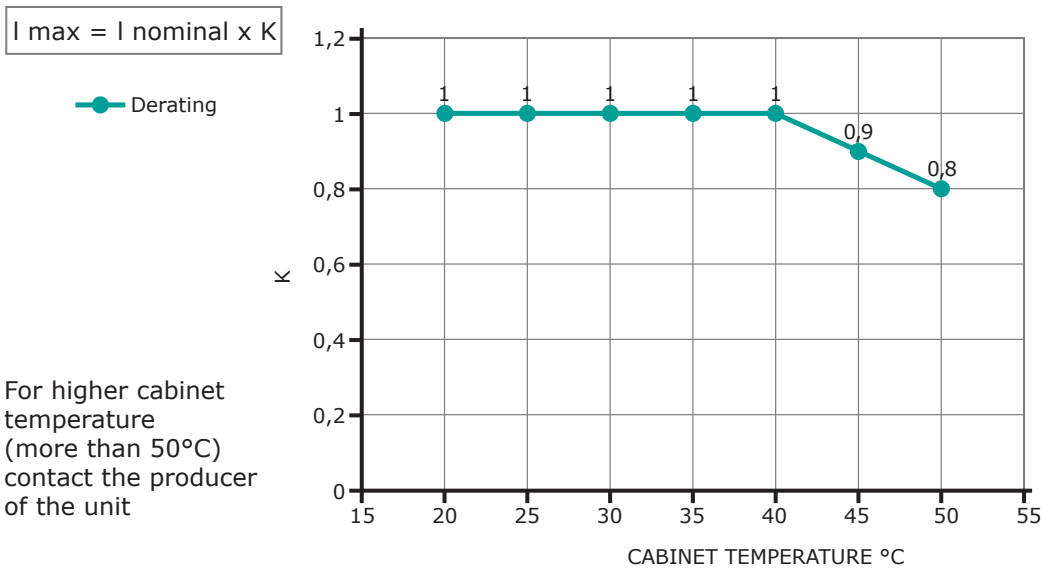
5.7 Fan Specification

Supply: 24 Vdc Power 7W (1 fan)

5.8 Derating Curve

The nominal current of the units in specification are referred to continuous service at 40°C ambient temperature. For higher temperature multiply the nominal current times derating coefficient K below represented:

I max = I nominal x K



For higher cabinet temperature (more than 50°C) contact the producer of the unit

5.9 Calculating flow capacity of the fan

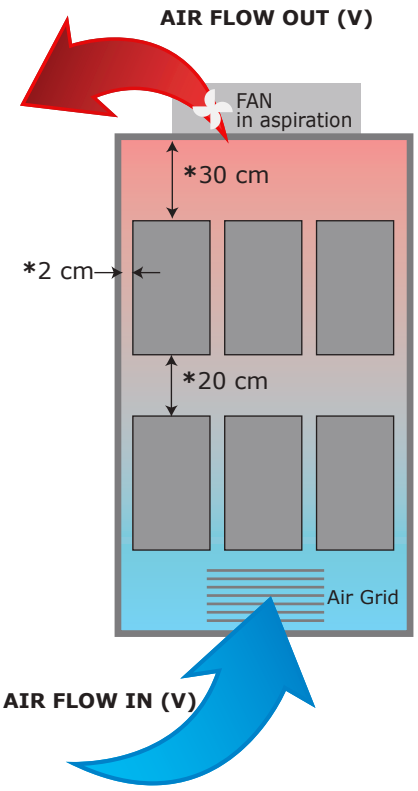
All the thyristor units when are in conduction produces power loss that is dissipated inside cubicle in terms of heating. Due to this fact the internal temperature of cubicle is higher than ambient temperature. To be cooled the thyristor need of fresh air cooling and to do it is normally used a fan mounted on the front door or on the roof of the cabinet.
Procedure to size **Fan air mass flow (V)**: *see power loss for each thyristor and fuse mounted indicated in the manual related to the current (Output feature and Internal fuse Chapter).*

$V = f * \frac{Qv}{tc-ta}$	**Qv** = total power losses (w) (thyristor + fuse power loss) **ta** = ambient temperature (°C) **tc** = cabinet temperature (°C) **V** = fan air mass flow (m3/h) **f** = altitude coefficient (see table on right)	**Altitude** 0:100 meters f = 3.1 m3k/Wh 100:250 meters f = 3.2 m3k/Wh 250:500 meters f = 3.3 m3k/Wh 500:750 meters f = 3.4 m3k/Wh

The formulas used are for information only and is not a substitute for a proper thermal rating done by a qualified person.

6 Installation

Before to install, make sure that the Thyristor unit have not damages. If the product has a fault, please contact the dealer from which you purchased the product. Verify that the product is the same thing as ordered.
The Thyristor unit must be always mounted in vertical position to improve air cooling on heat-sink.
Maintain the minimum distances (*) in vertical and in horizontal as represented, *this area must be free from obstacle* (wire, copper bar, plastic channel).
When more unit has mounted inside the cabinet maintain the air circulation like represented in figure without obstacle for the air flow. Is necessary to install a fan to have better air circulation as calculated previously.

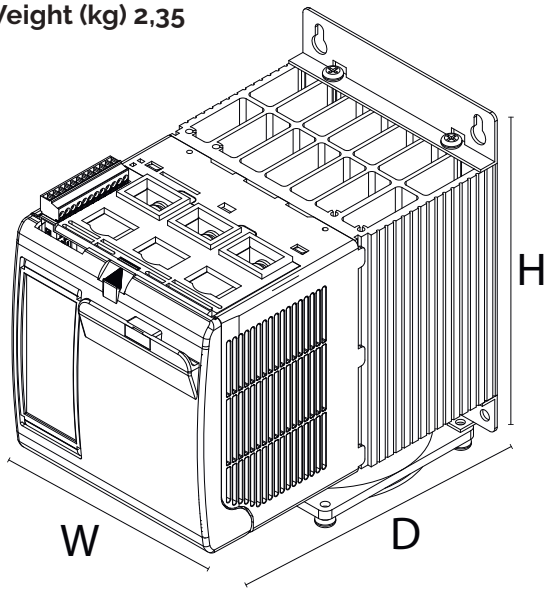


The V Air flow must be equal or more than the value calculated.

If the cabinet fan mounted by the customer have an air flow lower than the correct value the warranty will decay.

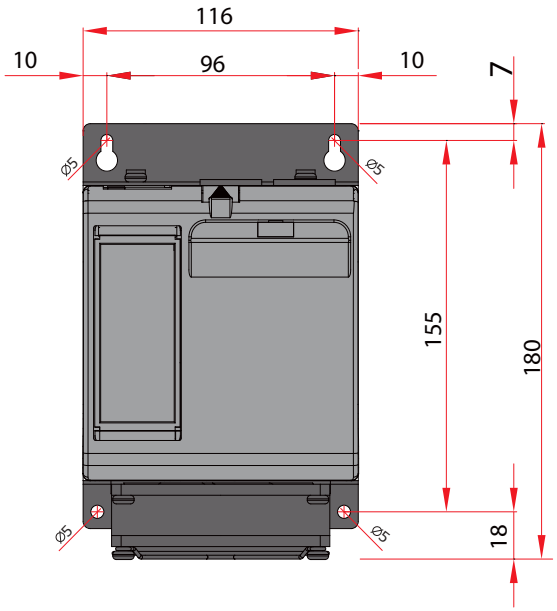
6.1 Dimensions and weight

Size SR25
W (mm) 116 - H (mm) 180 - D (mm) 183
Weight (kg) 2,35



6.2 Fixing holes

Size SR25



7 Wiring instructions

The Thyristor unit could be susceptible to interferences lost by near equipments or by the power supply, for this reason in accord to the fundamental practices rules is opportune take some precautions:

- The coil contactor, the relays and other inductive loads must be equipped with opportune RC filter.
- Use shielded bipolar cables for all the input and output signals.
- The signal cables must not be near and parallel to the power cables.
- Local regulations regarding electrical installation should be rigidly observed.

Use 90°C copper (CU) conductor only, wire ranges (AWG), wire terminal type (ZMVV), terminal tightening torque in the table below.

Power cable torque (suggested):

Type	Connector Type	Torque Lb-in (N-m)	Wire Range mm^2 (AWG)	MAX Current Terminals	Wire Terminals UL Listed (ZMVV)
035 050 075 090	Screw M6	44.2 (5.0)	18 (5) 25 (3)	90A	Fork/Spade Terminal Copper Tube Crimp.Lug

Cable dimensions of the Command Terminals	0.5 mm^2 (AWG 18)
Cable dimensions of the Earth (suggested)	6 mm^2 (AWG 10)

Warning: Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.

REVO RT 2 Loop REVO RT 1 Loop 2PH	
Terminal	**Description**
L1	Line Input Phase 1
L2	Line Input Phase 2
T1	Load Output Phase 1
T3	Load Output Phase 2

REVO RT 3 Loop REVO RT 1 Loop 3PH	
Terminal	**Description**
L1	Line Input Phase 1
L2	Line Input Phase 2
L3	Line Input Phase 3
T1	Load Output Phase 1
T2	Load Output Phase 2
T3	Load Output Phase 3

7.1 Command Terminals

Warning: Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.

7.1.1 Terminal block M1

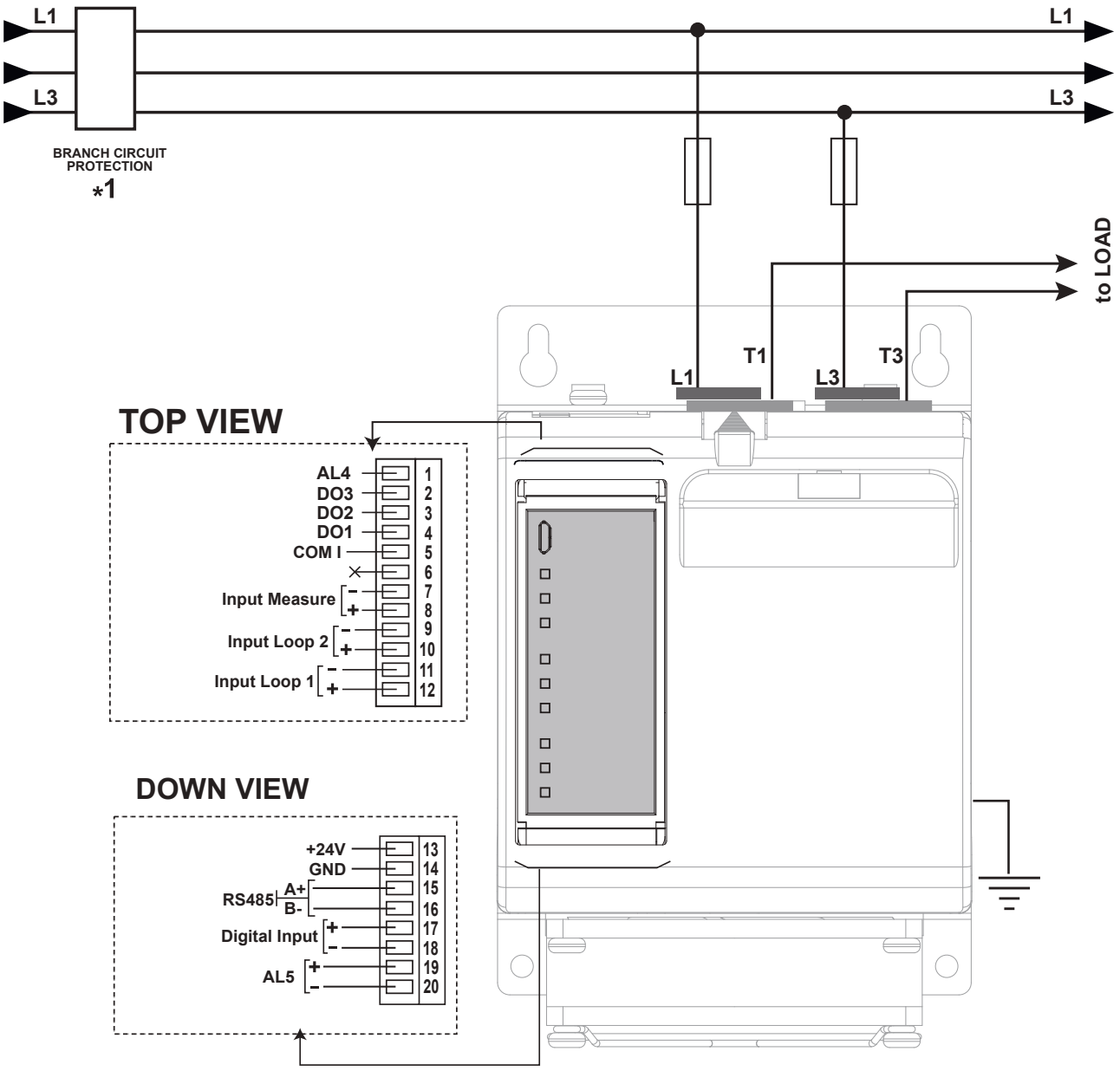
Terminal	Description	
	REVO RT 3 Loop	REVO RT 2 loop
1	Al 4	
2	Digital output 3	
3	Digital output 2	
4	Digital output 1	
5	COM I - Common Digital Input	
6	not used	
7	- Input 3: Misure 1	- Input 3: Loop 3
8	+ Input 3: Misure 1	+ Input 3: Loop 3
9	- Input 2: Loop 2	- Input 2: Loop 2
10	+ Input 2: Loop 2	+ Input 2: Loop 2
11	- Input 1: Loop 1	- Input 1: Loop 1
12	+ Input 1: Loop 1	+ Input 1: Loop 1

7.1.3 Terminal block M2

Terminal	Description
13	Auxiliary + 24Vdc Input power supply
14	Auxiliary - 24Vdc Input power supply
15	RS485 A+
16	RS485 B-
17	+ Digital Input
18	- Digital input
19	Al 5 +
20	Al 5 -

7.2 REVO RT 2 Loop Schematic

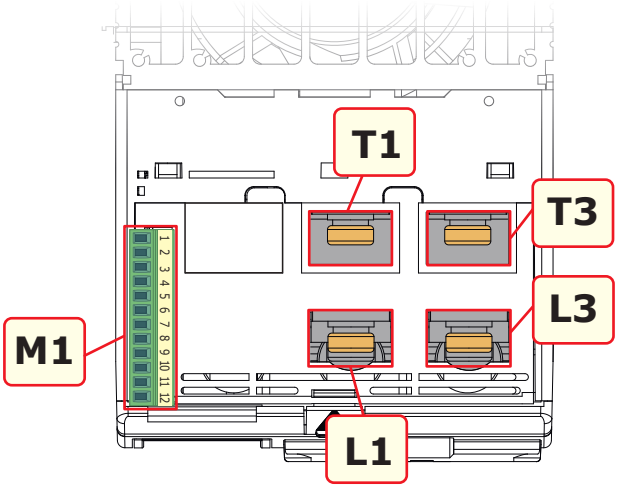
Warning: Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.



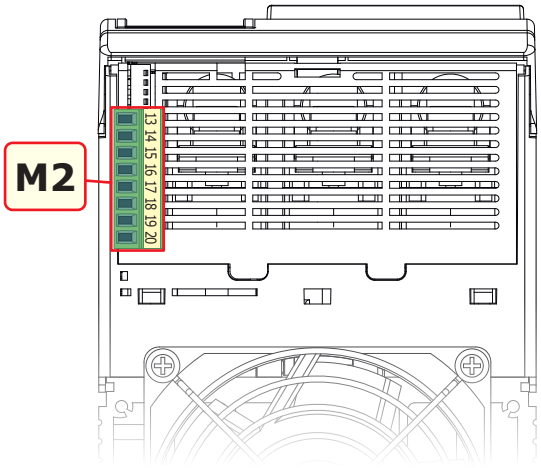
NOTE:

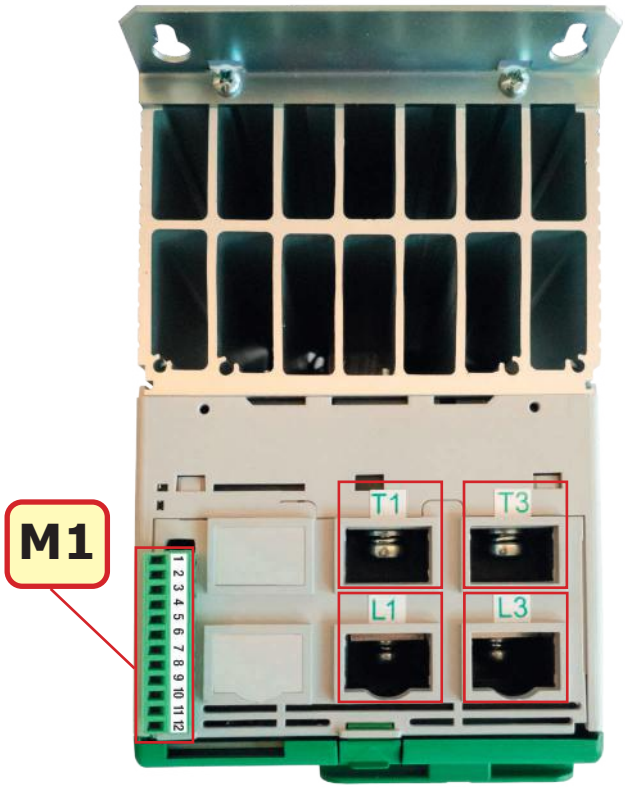
***1** The user installation must be protecting by electromagnetic circuit breaker or by fuse isolator. The Fuse must be branch circuit protection.

TOP VIEW



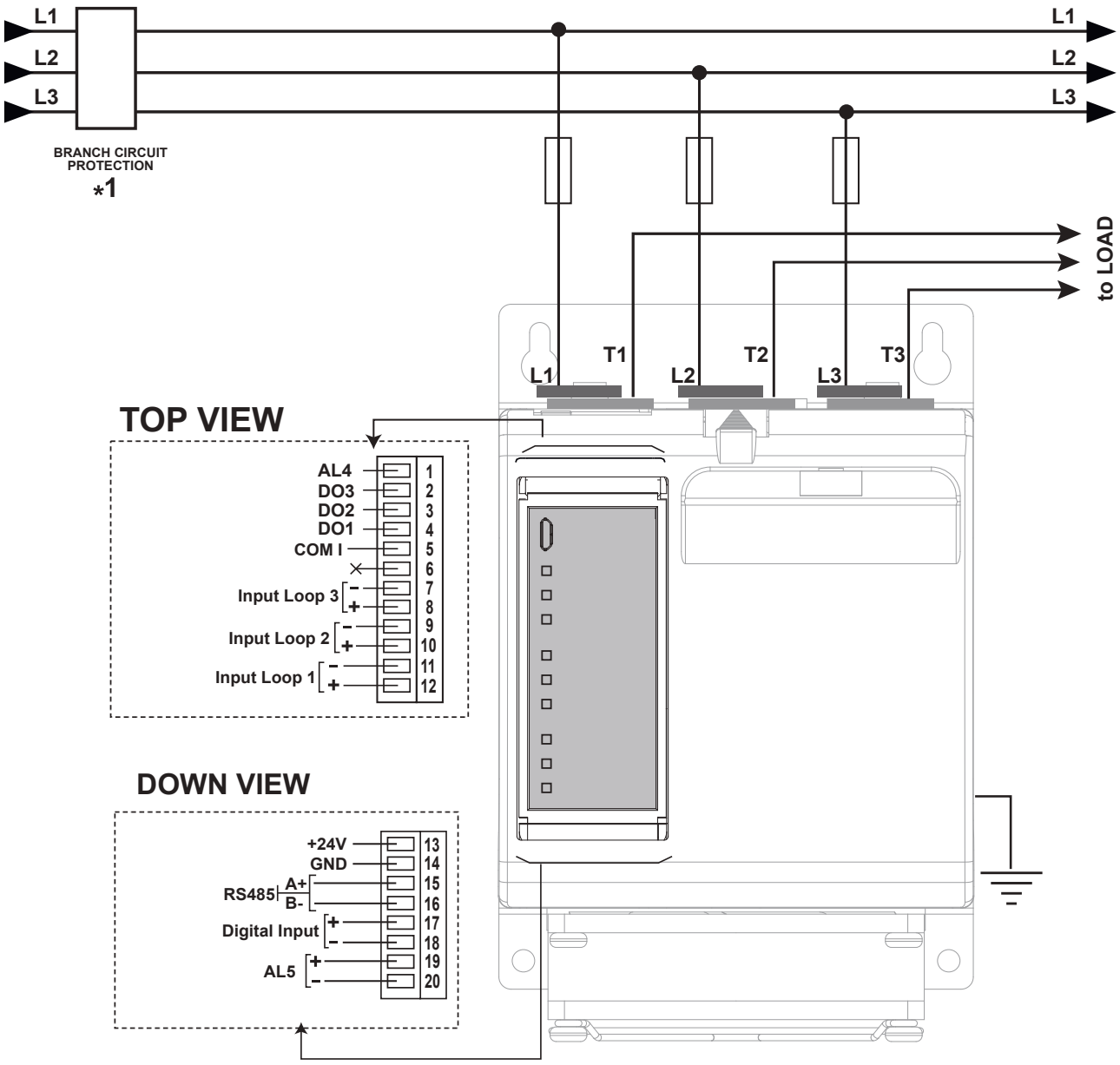
DOWN VIEW





7.3 REVO RT 3 Loop Schematic

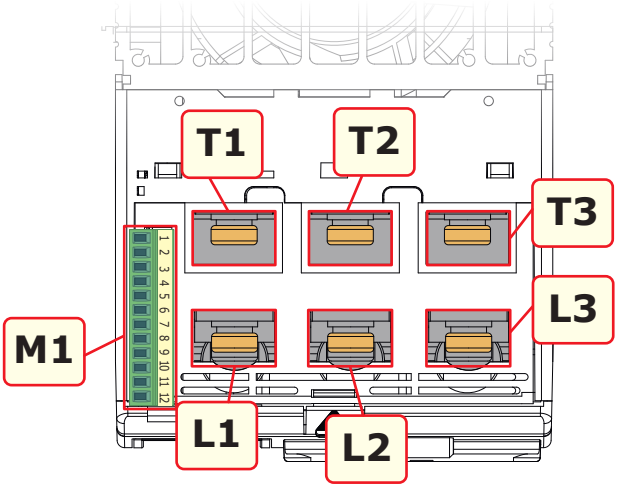
Warning: Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.



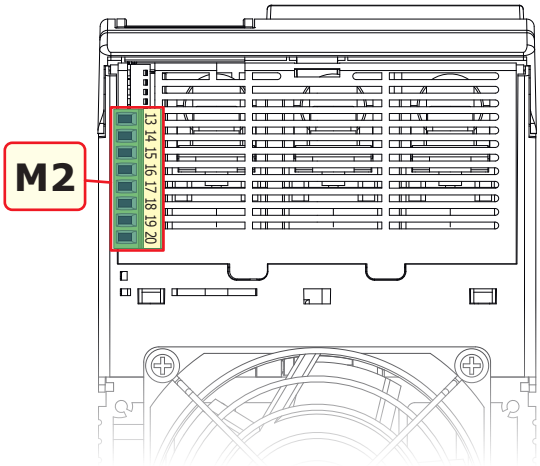
NOTE:

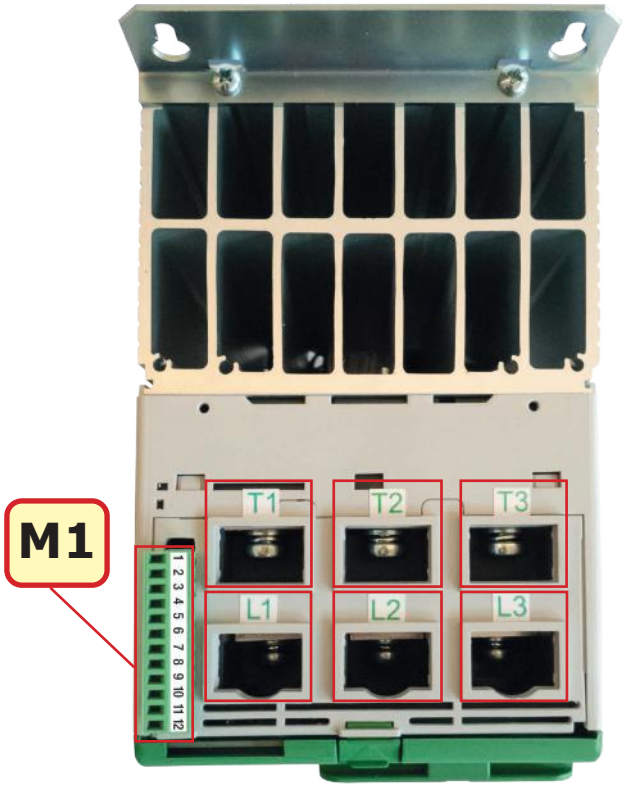
***1** The user installation must be protecting by electromagnetic circuit breaker or by fuse isolator. The Fuse must be branch circuit protection.

TOP VIEW

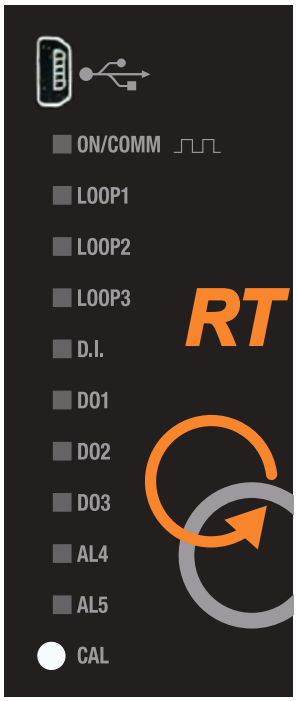


DOWN VIEW





8 Control Panel



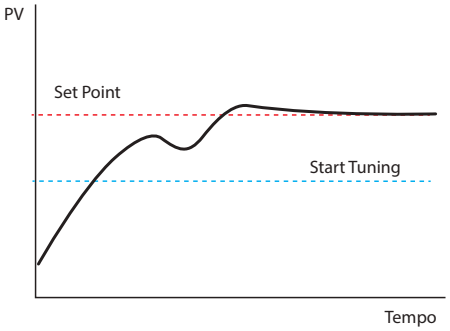
		LED	
ON/COMM	On/Communication	Solid Green	Lit up
		Red flashing	In Communication
Loop 1	Thermocouple canal 1	Solid Red	Thermocouple error Canal 1
		Off	OK
Loop2	Thermocouple canal 2	Solid Red	Thermocouple error Canal 2
		Off	OK
Loop3	Thermocouple canal 3	Solid Red	Thermocouple error Canal 3
		Off	OK
D.I.	Digital Input	Solid Green	ON
		Off	
DO1	Relay status 1	Solid Red	Relay error 1
		Off	
DO2	Relay status 2	Solid Red	Relay error 2
		Off	
DO3	Relay status 3	Solid Red	Relay error 3
		Off	
AL4	Relay status 4	Solid Red	Relay error 4
		Off	
AL5	Relay status 5	Solid Red	Relay error 5
		Off	
CAL	Current calibration		

9 Automatic tune

Automatic tuning procedure allows a precise regulation without detailed knowledge of PID regulation algorithm.
There are different types of tuning depending on your needs:
- Pre Tunn
- Self Tunn
- Tuning Once

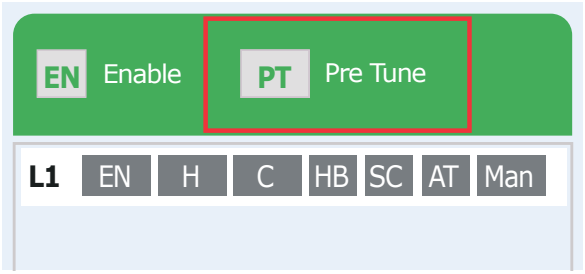
9.1 Pre Tune

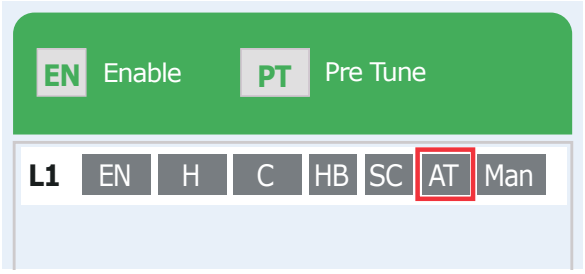
With the Pre Tune function, the instrument generates an oscillation in order to be able to calculate the inertia and response of the system. Based on the data collected, the instrument calculates the optimal PID parameters for stable regulation.
NOTE: For better precision in the calculation of the PID parameters, it is advisable to start the manual tuning procedure when the process deviates by at least 10% from the full scale.



The Pre Tune function is enabled for each Loop, with the "Tune" parameter, or via serial line by setting "2" on the parameters:
- P85 Add 2085 for Loop 1,
- P111 Add 2111 for Loop 2,
- P137 Add 2137 for Loop 3,

If the function is enabled, the Pre Tune button in the Test section of the configurator will also be enabled.





To execute the Pre Tune function, press the key PT Pre Tune o by serial write the value "1" on parameters with modbus address:
- 1216 (for Loop1)
- 1217 (for Loop2)
- 1218 (for Loop3)

Once the function is completed, the parameter will be reset to 0 automatically.

On the configurator, during the Pre Tune operation, the "AT" LED on the configurator will be on.

Once the function to stop the tuning has been activated, manually write "0" on the modbus word of the respective command words

The starting threshold of the tuning calculation is given by the formula

Tune treshold = Set Point - "Set Deviation Tune (P86 Add 2086)"

Example: If set point is 100.0°C and parameter P86 is 20.0°C the starting threshold for calculating the PID parameters is (100.0 - 20.0) = 80.0°C.

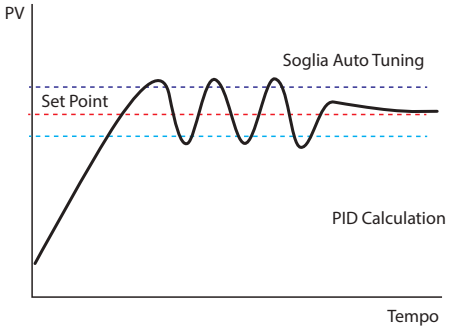
9.2 Tuning once

Autotuning procedure is executed only once at next REVO RT restart. If for any reason the procedure doesn't work, it will be be executed at next restart.
The Tuning Once function is enabled for each Loop, with the "Tune" parameter in the configurator for each Loop, or via serial port by setting "3" on the parameters: :

- P85 Add 2085 for Loop 1,
- P111 Add 2111 for Loop 2,
- P137 Add 2137 for Loop 3.

9.3 Self tuning

The Adaptive Tuning function is used to automatically optimize the PID when environmental conditions change.



The Self Tune function is enabled for each Loop with the "Tune" parameter in the configurator for each Loop, o via serial by setting "1" on the following parameters:

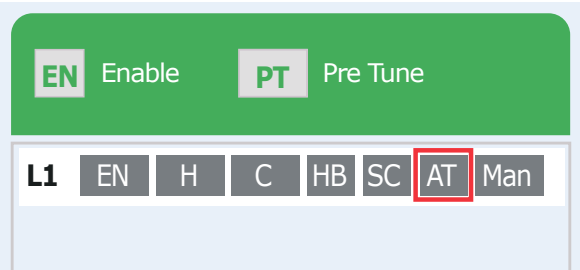
- P85 Add 2085 for Loop 1
- P111 Add 2111 for Loop 2
- P137 Add 2137 for Loop 3

the controller analyzes the process oscillations and optimizes the PID parameters to obtain a stable process, if the regulation oscillates outside a threshold established by the parameters:

- P101 = threshold value for Loop 1
- P127 = threshold value for Loop 2
- P153 = threshold value for Loop 3

When in operation, the values at the Modbus address are as follows:

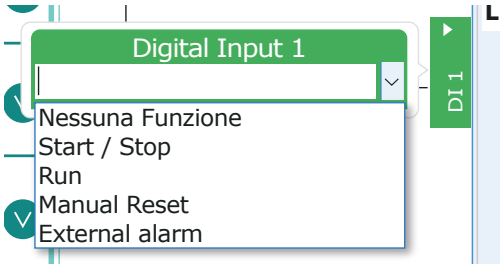
- 1216 = value 1 for Loop 1
- 1217 = value 1 for Loop 2
- 1218 = value 1 for Loop 3



On the configurator, during the Pre Tune operation, the "AT" LED on the configurator will be on.

9.4 Digital input functions

It is possible to associate functions to a digital input by setting the "DI function" parameter in the test page of the configurator, or via serial with the parameter P233 Add 2233.



Available functions are:

0 =	**Nessuna funzione**	No associated functions.
1 =	**Start / Stop**	Start / Stop of the controller by digital input with impulse command.
2 =	**Run**	If the input is active, the regulation is enabled. NOTE: With the regulator in STOP the alarms remain active.
3 =	**Manual Reset**	Resets the alarms if manual reset is set.
4 =	**Allarme Esterno**	With the digital input active, the regulator goes on STOP and the alarms will be disabled. The controller does not return to START automatically: for this operation the user's intervention is required.

NOTE: the status of the digital input is always visible on parameter Add 1010 or in the status table on parameter Add 1016 even if assigned "No Function".

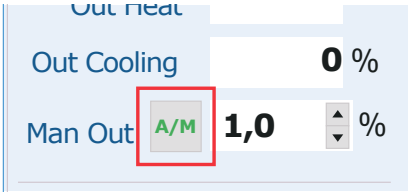
9.5 Automatic / Manual regulation for % output control

This function allows to switch from automatic functioning to manual command of the output percentage.

The Automatic/Manual selection is given by the parameters:
- 1219 = value 0: Manual / value 1: Automatic for Loop 1
- 1220 = value 0: Manual / value 1: Automatic for Loop 2
- 1221 = value 0: Manual / value 1: Automatic for Loop 3

or from table Add 1215:
- Bit 0 = Manual / Automatic for Loop 1
- Bit 1 = Manual / Automatic for Loop 2
- Bit 2 = Manual / Automatic for Loop 3

Or by the configurator with the "A/M" key



The value can be set in: **0 ÷ 100** / **0.0 ÷ 100.0** / **0.00 ÷ 100.00** if the regulation is only Heating, in: **-100 ÷ 100** / **-100.0 ÷ 100.0** / **-100.00 ÷ 100.00** if the regulation is Heating/Cooling, on parameters:
- 1230, 1229, 1228 for Loop 1
- 1239, 1238, 1237 for Loop 2
- 1248, 1247, 1246 for Loop 3

Or via the configurator only in the format: **0.0 ÷ 100.0** / **0.00 ÷ 100.00**

9.6 Double Action operation (heating-cooling)

REVO RT is suitable for systems requiring heating only or a combined heating-cooling action.

The Heating/Cooling action is obtained through the following steps:

1 configuring the main control as Heating with the parameter "Action Type (**Tipo Azione**)" = "Heating" on parameters:

- P47 Add 2047 = Heating (Value "0") for Loop 1
- P61 Add 2061 = Heating (Value "0") for Loop 2
- P75 Add 2075 = Heating (Value "0") for Loop 3

2 connecting at least one of the 5 Relay Digital Outputs (DO1, DO2,...DO5), to cooling funtion by the following parameters:

- P219 Add 2219
- P221 Add 2021
- P223 Add 2223
- P225 Add 2025
- P227 Add 2027

3 raising the configuration bits on each output

- Bit 0 = Cooling Loop 1
- Bit 1 = Cooling Loop 2
- Bit 2 = Cooling Loop 3

PID regulation works in this way:

Parameter "**Proportional band** (**Banda Proporzionale**)" → *Heating* Proportional band
Parameter "**Integral Time** (**Tempo Integrale**)" → Integral time of *heating and cooling*
Parameter "**Derivative Time** (**Tempo Derivativo**)" → Derivative time of *heating and cooling*
Parameter "**Heating time Cycle** (**Tempo Ciclo Riscaldamento**)" → *Heating* Time Cycle
Parameter "**Cooling PB Multiplier** (**Moltiplicatore PB Freddo**)" → *Cooling* Proportional band

Consequently the **Cooling Proportional band** is determined by:
"**Proportional band**" x "**Cooling PB Multiplier**", while **Integral Time** and **Derivative Time** they are the same for both actions.

The two bands can overlap or space each other with the parameter "**Dead Band** (**Banda Morta**)": see Parameters P97, P123, P149 in **Chapter 11 "Parameter List"**.
For systems where the heating and the cooling output must never be active at the same time, the "dead band" parameter will be configured with a value <0, vice versa if an overlap of the 2 bands is required, the "Dead Band" parameter will be configured with a value >0.

9.7 Soft-Start Function

To safeguard the life of the heating elements that require preheating, the REVO RT has the Soft start function, available in 2 modes:

- Gradient
- Percentual

Both modes perform a preheating, avoiding potentially harmful thermal shocks to the heating elements. During the activation of Soft Start function the parameter 1216 goes to value "5"

Gradient:

When the regulator is turned on or enabled via digital input or via serial command, the Set Point is reached by following the rising gradient set on the "Gradient Soft-start" parameter:

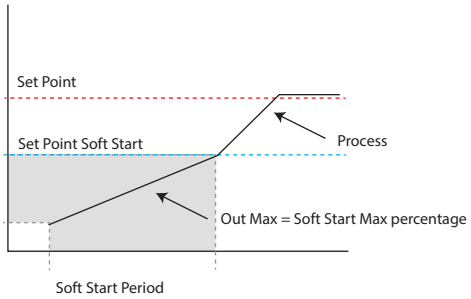
- P241 Add 2241 = in Unit/hour (°C/h) for Loop 1
- P251 Add 2251 = in Unit/hour (°C/h) for Loop 2
- P261 Add 2261 = in Unit/hour (°C/h) for Loop 3

until the temperature set in the "Soft-Start Threshold" parameter is reached

- P243 Add 2243 = Set Point Soft start for Loop 1
- P253 Add 2253 = Set Point Soft start for Loop 2
- P263 Add 2263 = Set Point Soft start for Loop 3

or when the time set in the "Soft-Start Time" parameter has elapsed.

- P244 Add 2244 = Soft start time (hh.mm) for Loop 1
- P254 Add 2254 = Soft start time (hh.mm) for Loop 2
- P264 Add 2264 = Soft start time (hh.mm) for Loop 3



Percentual:

When the regulator is turned on or enabled, the output goes to the power set in the parameter "Soft-Start Percentage"

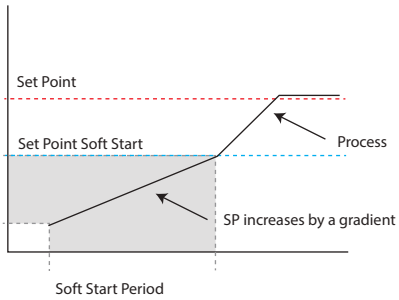
- P242 Add 2242 = Output Soft Start percentage (0 ÷ 100%) for Loop 1
- P252 Add 2252 = Output Soft Start percentage (0 ÷ 100%) for Loop 2
- P262 Add 2262 = Output Soft Start percentage (0 ÷ 100%) for Loop 3

until the temperature set in the parameter "Soft-Start Threshold" is reached,

- P243 Add 2243 = Set Point Soft start for Loop 1
- P253 Add 2253 = Set Point Soft start for Loop 2
- P263 Add 2263 = Set Point Soft start for Loop 3

or when the time set in the parameter "Soft-Start Time" has elapsed (Par 244, 254, 264).

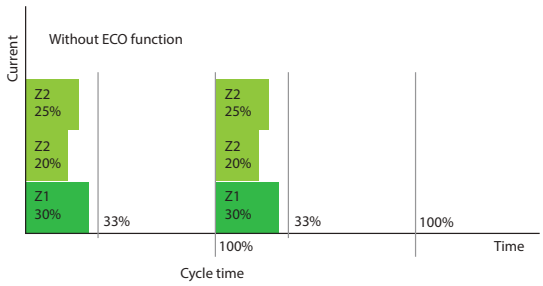
- P244 Add 2244 = Soft start time (hh.mm) for Loop 1
- P254 Add 2254 = Soft start time (hh.mm) for Loop 2
- P264 Add 2264 = Soft start time (hh.mm) for Loop 3

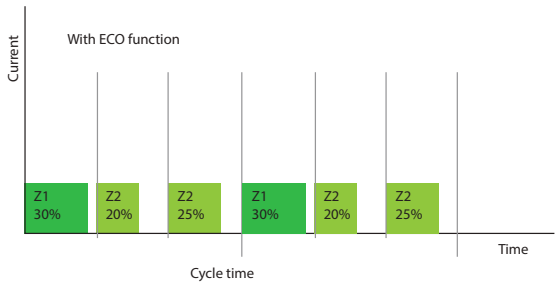


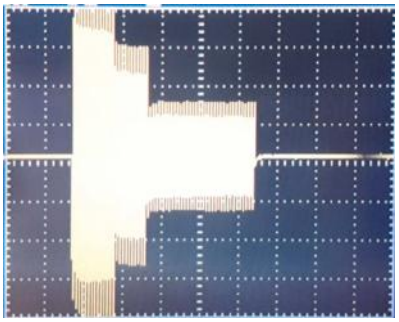
NOTE: If the Sof-Start function is active the automatic/manual Tuning function cannot be activated.

9.8 ECO Function

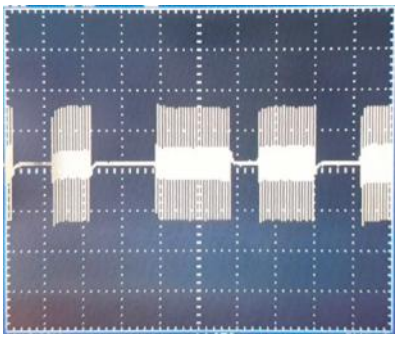
In order to limit the overlap of the switching on of the 3 zones, the ECO function has been introduced.
The ECO function delays the switching on of the second output compared to the first, and of the third output compared to the second, but always remaining within the operating cycle time
In this way, if during the temperature control, the power of the 3 zones does not exceed 33% of use, when the ECO function is activated, the shifting of the ignitions avoids the overlapping of the three ignitions, limiting the current peaks.
If, on the other hand, the 33% threshold is exceeded, the power demand is added to the next zone, but in a much less burdensome way.
By avoiding overlaps, consumption is optimized.







Example of 3 zones in modulation at different control rates, you can see that the signals add up.



By activating the ECO function, the ignitions are distributed over the available cycle time avoiding overlaps and therefore current peaks.

See parameter P53 on **chapter 11 "Configuration parameter list"**

9.9 DO Function selection

Digital relay outputs are multifunctional outputs, which can be associated with the functions of:

- Cooling for Loop 1,2 and 3
- Alarms 1,2,3,4
- Heater Break
- Watch Dog on RS485
- Error on an input
- Replication of DI status
- RUN status for Loop 1,2 and 3
- Remote command 1 and 2

The various functions can also be combined with each other to have different functions on a single output. See parameters P219, P221, P223, P225, P227 on **chapter 11 "Configuration parameter list"**.

Es: The status of 2 alarms + the status of the sensors + the status of the Heater Break can be associated on one output.

9.10 Customizable reading area

There is an area of 30 parameters, where you can configure the sequence of the parameters you want to read. By configuring this area it is possible to put in order the information most frequently read, facilitating the reading by a communication Master and using a single multiple reading command.

Parameter	Description	R/W
2501	N° of parameter to visualize in the parameter Add 1401	R/W
2502	N° of parameter to visualize in the parameter Add 1402	R/W
...	...	...
...	...	...
2530	N° of parameter to visualize in the parameter Add 1430	R/W
2531	N° of parameter to visualize in the parameter Add 1431	R/W

The values will be read on parameters:

Parameter	Description	R/W
1401	Value of parameter contained in parameter Add 2501	R
1402	Value of parameter contained in parameter Add 2502	R
...	...	...
...	...	...
1430	Value of parameter contained in parameter Add 2530	R
1431	Value of parameter contained in parameter Add 2531	R

10 Configuration parameter list

10.1 Analog Input

P1 – Input Type Loop 1 (Address ModBus 2001)
P15 - Input Type Loop 2 (Address ModBus 2015)
P29 - Input Type Loop 3 (Address ModBus 2029)

Analog input configuration / AI1 sensor selection

1	Tc-K	-260° C ÷ 1360° C (**Default**)
2	Tc-S	-40° C ÷ 1760° C
3	Tc-R	-40° C ÷ 1760° C
4	Tc-J	-200° C ÷ 1200° C
5	Tc-T	-260° C ÷ 400° C
6	Tc-E	-260° C ÷ 980° C
7	Tc-N	-260° C ÷ 1280° C
8	Tc-B	100° C ÷ 1820° C
9	0-1	0 ÷ 1 V
10	0-5	0 ÷ 5 V
11	0-10	0 ÷ 10 V
12	0-20	0 ÷ 20 mA
13	4-20	4 ÷ 20 mA
14	0-60	0 ÷ 60 mV

P2 - Lower limit Loop 1 (Address ModBus 2002)
P16 - Lower limit Loop 2 (Address ModBus 2016)
P30 - Lower limit Loop 3 (Address ModBus 2030)

Lower limit of the analog input

Example: with 4 ÷ 20 mA input this parameter assumes the value associated with 4 mA.
-32767 ÷ +32767 [digit]
Default: 0

P3 - Upper limit Loop 1 (Address ModBus 2003)
P17 - Upper limit Loop 2 (Address ModBus 2017)
P31 - Upper limit Loop 3(Address ModBus 2031)

Upper limit of the analog input

Example: with 4 ÷ 20 mA input this parameter assumes the value associated with 4 mA.
-32767 ÷ +32767 [digit]
Default: 1000

P4 - Over Limits Loop 1 (Address ModBus 2004)
P18 - Over Limits Loop 2 (Address ModBus 2018)
P32 - Over Limits Loop 3 (Address ModBus 2032)

When set as a linear input, it allows the process to exceed its limits (Par. P2 and P3)

0	Disabled (**Default**)
1	Enabled

P5 - Offset input Loop 1 (Address ModBus 2005)
P19 - Offset input Loop 2 (Address ModBus 2019)
P33 - Offset input Loop 3 (Address ModBus 2033)

Value in algebraic sum to the displayed process

-10000 ÷ +10000 [digit] (degrees.tenths for temperature sensors).
Default: 0

P6 - Multiplier Loop 1 (Address ModBus 2006)
P20 - Multiplier Loop 2 (Address ModBus 2020)
P34 - Multiplier Loop 3 (Address ModBus 2034)

Displayed process multiplier value expressed as a percentage of full scale

Example: to correct a display with a scale from 0 ÷ 1000 ° C that displays 0 ÷ 1010 ° C, set the parameter to -1.0%,
1000 * (-1%) = -10 → 1010 + 10 = 1000
-1000 (-100.0%) ÷ 1000 (+100.0%),
Default: 0.0%.

P7 - Filter Loop 1 (Address ModBus 2007)
P21 - Filter Loop 2 (Address ModBus 2021)
P35 - Filter Loop 3 (Address ModBus 2035)

Filter used to increase the stability of the reading

Increasing the value slows down the speed of the control loop
1 ÷ 15.
Default: 10

P8 - Unit of measurement for all Loops (Address ModBus 2008)

0 °C - Celsius Degrees (**Default**)
1 °F - Fahrenheit Degrees
2 K - Kelvin

P9 - Conversion rate for all Loops (Address ModBus 2009)

Sampling frequency of the input.
Increasing the conversion speed decreases the reading stability.
(example: for fast variables such as pressure, it is advisable to increase the sampling rate).

0 4.17 Hz (Minimum conversion speed)
1 6.25 Hz
2 8.33 Hz
3 10.0 Hz
4 12.5 Hz
5 16.7 Hz (Default) Ideal for noise filtering 50 / 60 Hz
6 19.6 Hz
7 33.2 Hz
8 39.0 Hz
9 50.0 Hz
10 62.0 Hz
11 123 Hz
12 242 Hz
13 470 Hz (maximum conversion speed)

P14 - Decimal point Loop 1 (Address ModBus 2014)
P28 - Decimal point Loop 2 (Address ModBus 2028)
P42 - Decimal point Loop 3 (Address ModBus 2042)

Number of decimal places; read-only value. The value depends on the selected input type

10.2 SSR control outputs

P43 - Command Output Loop 1 (Address ModBus 2043)

Enables control output 1 related to Loop 1

0	Disabled	Output disabled
1	Enabled	Output Enabled (**Default**)
2	3.PHA	Output enabled in three-phase mode (Loop 2 and Loop 3 will no longer be active, while the three SSRs will be switched on in parallel with output 1)

P57 - Command Output Loop 2 (Address ModBus 2057)
P71 - Command Output Loop 3 (Address ModBus 2071)

Enables control output 1 related to Loop 1

0	Disabled	Output disabled
1	Enabled	Output Enabled (**Default**)

P44 - Initial state Loop 1 (Address ModBus 2044)
P58 - Initial state Loop 2 (Address ModBus 2058)
P72 - Initial state Loop 3 (Address ModBus 2072)

Select the initial state of the adjustment zone 1 after switching on

0	Start	Zone enabled (**Default**)
1	Stop	Zone disabled
2	Last state	Start / Stop status prior to shutdown

P45 - Input selection Loop 1 (Address ModBus 2045)
P59 - Input selection Loop 2 (Address ModBus 2059)
P73 - Input selection Loop 3 (Address ModBus 2073)

Select the input connected to the regulation loop

0 Input 1 (**Default**)
1 Input 2
2 Input 3

P46 - Setpoint connected to Loop 1 (Address ModBus 2046)
P60 - Setpoint connected Loop 2 (Address ModBus 2060)
P74 - Setpoint connected Loop 3 (Address ModBus 2074)

Selects the reference setpoint for the control loop

0 Setpoint 1 (**Default**)
1 Setpoint 2
2 Setpoint 3

P47 - Control Action Type Loop 1 (Address ModBus 2047)
P61 - Control Action Type Loop 2 (Address ModBus 2061)
P75 - Control Action Type Loop 3 (Address ModBus 2075)

Type of action for controlling the output of the regulation loop

0	Heating	Reverse action (**Default**)
1	Cooling	Direct action

P48 - Hysteresis Loop 1 (Address ModBus 2048)
P62 - Hysteresis Loop 2 (Address ModBus 2062)
P76 - Hysteresis Loop 3 (Address ModBus 2076)

Hysteresis value for control, when process control is ON/OFF type

-10000 ÷ +10000 [digit] with analog input
-1000.0 ÷ +1000.0 ° with thermocouple
Default: 0.2.

P49 - Percentage of exit with error input Loop 1 (Address ModBus 2049)
P63 - Percentage of exit with error input Loop 2 (Address ModBus 2063)
P77 - Percentage of exit with error input Loop 3 (Address ModBus 2077)

Fixed output percentage in case of input sensor error

If configured in Heating/Cooling, the negative value indicates the percentage of the cooling output.
-100% ÷ +100% Percentage of control output.
Default: 0%.

P50 - Input error control type Loop 1 (Address ModBus 2050)
P64 - Input error control type Loop 2 (Address ModBus 2064)
P78 - Input error control type Loop 3 (Address ModBus 2078)

Selects the operating mode of the error control function
When active it forces the output to the value contained in parameter 49

0 Error generated by loop 1 probe failure (**Default**)
1 Error generated by breakage of any probe

P51 - Percentage of output when in Stop Loop 1 (Address ModBus 2051)
P65 - Percentage of output when in Stop Loop 2 (Address ModBus 2065)
P79 - Percentage of output when in Stop Loop 3 (Address ModBus 2079)

Fixed percentage of control output with controller in STOP mode

If configured in Heating/Cooling, the negative value indicates the percentage of the cooling output.
-100% ÷ +100% Percentage of control output.
Default: 0%.

P52 - Enabling storage Manual status Loop 1 (Address ModBus 2052)
P66 - Enabling storage Manual status Loop 2 (Address ModBus 2066)
P80 - Enabling storage Manual status Loop 3 (Address ModBus 2080)

If enabled, on switching on the regulator will return to the automatic or manual mode prior to switching off, also maintaining any output percentage.
If in automatic operation, in the event of a probe breakage, the regulator will switch to manual mode, maintaining the value of the output percentage generated by the PID immediately before the breakage.

0 Disabled (**Default**)
1 Enabled

P53 - Eco Mode function enabled for all Loops (Address ModBus 2053)

Function can only be enabled in single-phase mode (see Par P43)
It manages the active zones using the cycle time of loop 1 at all times, staggering the activation of loop 2 and 3 outputs by 1/3 of the cycle time. By doing so, as long as the output percentage remains below 33.3% the outputs will not overlap.

0 Disabled (**Default**)
1 Enabled

10.3 Autotuning and PID

P85 - Tune Loop 1 (Address ModBus 2085)
P111 - Tune Loop 2 (Address ModBus 2111)
P137 - Tune Loop 3 (Address ModBus 2137)

Active Tuning type

0	Disabled	(**Default**)
1	Self	PID with continuous parameter calculation
2	Tune	PID with parameter calculation on command
3	Pre Tune	PID with calculation of parameters at power-on once only
	Pre Tune Once	

P86 - Setpoint deviation for Pretune activation Loop 1 (Address ModBus 2086)
P112 - Setpoint deviation for Pretune activation Loop 2 (Address ModBus 2112)
P138 - Setpoint deviation for Pretune activation Loop 3 (Address ModBus 2138)

Threshold for starting the oscillation necessary for calculating PID parameters with the Pretune function

0-10000 [digit]
0.0-1000.0° with thermocouple.
Default: 30.0.

P87 - Proportional band Loop 1 (Address ModBus 2087)
P113 - Proportional band Loop 2 (Address ModBus 2113)
P139 - Proportional band Loop 3 (Address ModBus 2139)

Proportional band for PID process control (process inertia)

If Proportional band = 0 and Integral Time = 0, the regulation becomes type ON / OFF
1 ÷ 10000 [digit]
0.1 ÷ 1000.0° with thermocouple.
Default: 0

P88 - Integral time Loop 1 (Address ModBus 2088)
P114 - Integral time Loop 2 (Address ModBus 2114)
P140 - Integral time Loop 3 (Address ModBus 2140)

Integral time for PID process control (duration of process inertia)

0.0 ÷ 2000.0 sec. (0.0 = disabled),
Default: 0.0

P89 - Derivative time Loop 1 (Address ModBus 2089)
P115 - Derivative time Loop 2 (Address ModBus 2115)
P141 - Derivative time Loop 3 (Address ModBus 2141)

Derivative time for PID process control (usually ¼ of the integral time)

0.0 ÷ 1000.0 sec. (0.0 = disabled),
Default: 0

P90 - Inactivity band Loop 1 (Address ModBus 2090)
P116 - Inactivity band Loop 2 (Address ModBus 2116)
P142 - Inactivity band Loop 3 (Address ModBus 2142)

Band around the SP within which the output percentage does not vary

Function mainly used when controlling valves to avoid continuous variations that are not useful for regulation
0 ÷ 10000 [digit]
0.0 ÷ 1000.0° with thermocouple.
Default: 0

P91 - Centred proportional band Loop 1 (Address ModBus 2091)
P117 - Centred proportional band Loop 2 (Address ModBus 2117)
P143 - Centred proportional band Loop 3 (Address ModBus 2143)

Defines whether the proportional band must be centred on the setpoint
In double loop operation (hot/cold) it is always disabled (not centred).

0	Disabled	Band below (heating) or above (cooling) (**Default**)
1	Enabled	Centred band

P92 - Auto power off above a threshold Loop 1 (Address ModBus 2092)
P118 - Auto power off above a threshold Loop 2 (Address ModBus 2118)
P144 - Auto power off above a threshold Loop 3 (Address ModBus 2144)

In PID operation it enables the SCR control output to be switched off when a certain threshold is exceeded (setpoint + P93)

0	Disabled (**Default**)
1	Enabled

P93 - Auto power off over a threshold Loop 1 (Address ModBus 2093)
P119 - Auto power off over a threshold Loop 2 (Address ModBus 2119)
P145 - Auto power off over a threshold Loop 2 (Address ModBus 2145)

Sets the deviation from the setpoint, for the calculation of the intervention threshold of the "Auto power off" function beyond the threshold

-10000 ÷ +10000 [digit]
-1000.0 ÷ 1000.0 ° with thermocouple.
Default: 0

P94 - Cycle time Loop 1 (Address ModBus 2094)
P120 - Cycle time Loop 2 (Address ModBus 2120)
P146 - Cycle time Loop 3 (Address ModBus 2146)

Cycle time used in modulation with PID control

When connected to a contactor the value is typically between 15 and 30s.
When connected to a SSR with SSR input the value is typically between 1 and 2s.
1-300 sec
Default: 2 sec

P95 - Cooling type Loop 1 (Address ModBus 2095)
P121 - Cooling type Loop 2 (Address ModBus 2121)
P147 - Cooling type Loop 3 (Address ModBus 2147)

This defines the type of cooling used for control in hot/cold PID mode.
NOTE: Enable the cold output in the "DOx relay function" parameter".

0 Air (**Default**)
1 Oil
2 Water

P96 - Cooling proportional band multiplier Loop 1 (Address ModBus 2096)
P122 - Cooling proportional band multiplier Loop 2 (Address ModBus 2122)
P148 - Cooling proportional band multiplier Loop 3 (Address ModBus 2148)

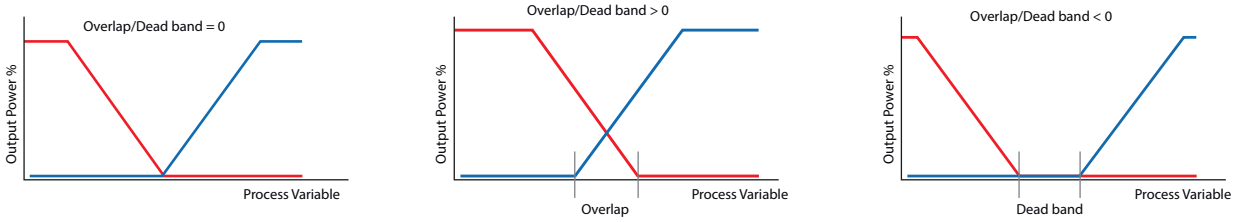
When the process is configured as heating/cooling PID, the proportional band for the cold action is given by the value of the parameter "Proportional band 1" multiplied by this value

1.00 ÷ 5.00
Default: 1.00

P97 - Overlap / Dead Band Loop 1 (Address ModBus 2097)
P123 - Overlap / Dead Band Loop 2 (Address ModBus 2123)
P149 - Overlap / Dead Band Loop 3 (Address ModBus 2149)

When the process is configured as a hot / cold PID, the Overlap / Deadband function, defines whether the heating action and the cooling action can overlap or must have a dead band between the two actions.

-20.0% ÷ 50.0%
Negative: Dead Band
Positive: Overlap
Default: 0.0%



P98 - Cooling cycle time Loop 1 (Address ModBus 2098)
P124 - Cooling cycle time Loop 2 (Address ModBus 2124)
P150 - Cooling cycle time Loop 3 (Address ModBus 2150)

Cycle time for cold output when set in heating/cooling PID mode

1 ÷ 300 sec
Default: 10 sec

P99 - Low output percentage limit Loop 1 (Address ModBus 2099)
P125 - Low output percentage limit Loop 2 (Address ModBus 2125)
P151 - Low output percentage limit Loop 3 (Address ModBus 2151)

Minimum value of power output percentage

0% ÷ 100%
Default: 0%

P100 - Maximum output percentage limit Loop 1 (Address ModBus 2100)
P126 - Maximum output percentage limit Loop 2 (Address ModBus 2126)
P152 - Maximum output percentage limit Loop 3 (Address ModBus 2152)

Maximum value of power output percentage

0% ÷ 100%
Default: 100%

P101 - Maximum deviation for SelfTune activation Loop 1 (Address ModBus 2101)
P127 - Maximum deviation for SelfTune activation Loop 2 (Address ModBus 2127)
P153 - Maximum deviation for SelfTune activation Loop 3 (Address ModBus 2153)

When the automatic PID calculation is active (Self Tune), this parameter sets the maximum process-setpoint deviation beyond which the automatic tune recalculates the PID parameters.

8 ÷ 10000 [digit]
0,8 ÷ 1000.0° with thermocouple.
Default: 2.0

P102 - Minimum proportional band Loop 1 (Address ModBus 2102)
P128 - Minimum proportional band Loop 2 (Address ModBus 2128)
P154 - Minimum proportional band Loop 3 (Address ModBus 2154)

Minimum proportional band value for automatic PID calculation (Pretune)

0 ÷ 10000 [digit]
0,0 ÷ 1000,0° with thermocouple
Default: 3.0

P103 - Maximum proportional band Loop 1 (Address ModBus 2103)
P129 - Maximum proportional band Loop 2 (Address ModBus 2129)
P155 - Maximum proportional band Loop 3 (Address ModBus 2155)

Maximum proportional band value for automatic PID calculation (Pretune)

0 ÷ 10000 [digit]
0,0 ÷ 1000,0° with thermocouple
Default: 100.0

P104 - Minimum Integral Time Loop 1 (Address ModBus 2104)
P130 - Minimum Integral Time Loop 2 (Address ModBus 2129)
P156 - Minimum Integral Time Loop 3 (Address ModBus 2156)

Minimum integral time value for automatic PID calculation (Pretune)

0.0 ÷ 1000.0 sec
Default: 30.0 sec

P105 - Overshoot function level Loop 1 (Address ModBus 2105)
P131 - Overshoot function level Loop 2 (Address ModBus 2131)
P157 - Overshoot function level Loop 3 (Address ModBus 2157)

The level of the overshoot function prevents overshoot when the setpoint is reached or changed.
If the overshoot is set too low, the overshoot may not be fully absorbed, while too high a value may cause the process to reach the setpoint more slowly.

0 Disabled
1 ÷ 10 [Lev.1 ÷ Lev.10]
Default: Lev.5

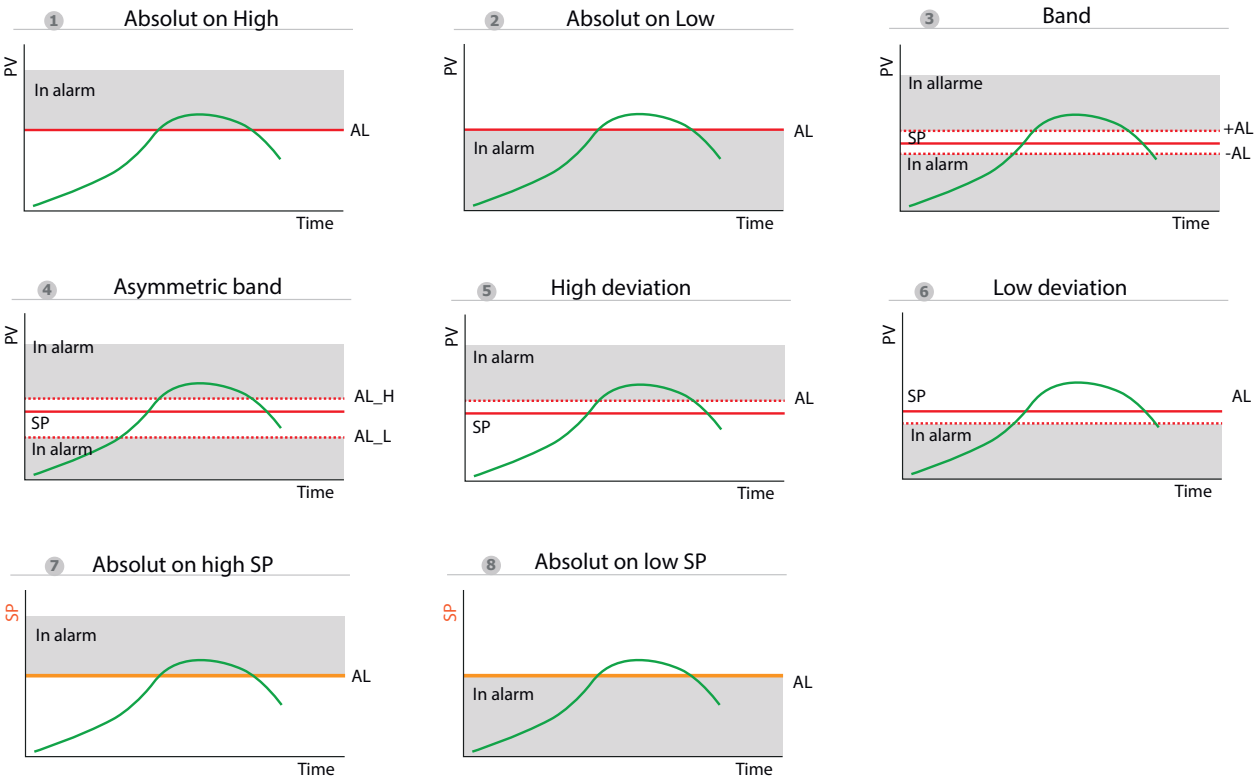
10.4 Alarms

P163 - Alarm 1 function (Address ModBus 2163)
P177 - Alarm 2 function (Address ModBus 2177)
P191 - Alarm 3 function (Address ModBus 2191)
P177 - Alarm 4 function (Address ModBus 2177)

NOTE: Alarm 4 is the AND condition of the 3 zones with the alarm configured
Example: If Alarm 4 is configured as "Absolute Low", if all three variables are lower than the Alarm 4 threshold, then the alarm is activated.

PV = Process variable
SP = Regulation SetPoint
AL = Alarm Threshold
AL_L = Alarm threshold low for asymmetrical alarm
AL_H = Alarm threshold high for asymmetrical alarm
Select Alarm Type 1.

0 Disabled (**Default**)
1 Absolute of high. Absolute referred to PV, active when PV exceeds threshold
2 Absolute of low. Absolute referred to PV, active when PV below threshold
3 Band alarm (SP ± alarm setpoint)
4 Asymmetrical band Alarm (SP + AL_H and SP - AL_L)
5 High deviation. Deviation alarm, active when PV exceeds SP + AL
6 Low deviation. Deviation alarm, active when PV goes below SP - AL
7 Absolute on high of SP. Absolute on SP, active when SP higher than threshold
8 Absolute of low SP. Absolute referred to SP, active when SP lower than threshold



P164 - Input selection Alarm 1 (Address ModBus 2164)
P178 - Input selection Alarm 2 (Address ModBus 2178)
P192 - Input selection Alarm 3 (Address ModBus 2192)

Selects the input connected to the alarm

0 Input 1. (**Default** for Alarm1)
1 Input 2. (**Default** for Alarm2)
2 Input 3. (**Default** for Alarm3)

Alarm 4, Alarm 5 not available

P165 - Reference SP selection for Alarm 1 (Address ModBus 2165)
P179 - Reference SP selection for Alarm 2 (Address ModBus 2179)
P193 - Reference SP selection for Alarm 3 (Address ModBus 2193)

Select reference Loop

0 SP 1. (**Default** for Alarm1)
1 SP 2. (**Default** for Alarm2)
2 SP 3. (**Default** for Alarm3)

Alarm 4 not available

P166 - Alarm 1 State Output (Address ModBus 2166)
P180 - Alarm 2 State Output (Address ModBus 2180)
P194 - Alarm 3 State Output (Address ModBus 2194)
P208 - Alarm 4 State Output (Address ModBus 2208)

Alarm 1 output contact type and intervention type

0 (N.O. Start) normally open, operational from start (**Default**)
1 (N.C. Start) normally closed, operational from start
2 (N.O. Threshold) operational when the alarm is reached
3 (N.C. Threshold) operational when the alarm is reached
4 (N.C. Threshold Variation) inhibited after command set change
5 (N.C. Threshold Variation) inhibited after command set change

P167 - Hysteresis Alarm 1 (Address ModBus 2167)
P181 - Hysteresis Alarm 2 (Address ModBus 2181)
P195 - Hysteresis Alarm 2 (Address ModBus 2195)
P209 - Hysteresis Alarm 4 (Address ModBus 2209)

Hysteresis alarme

-10000 ÷ +10000 [digit] (degrees.tenths for temperature sensors).
Default: 0.5.

P168 - Reset Alarm 1 (Address ModBus 2168)
P182 - Reset Alarm 2 (Address ModBus 2182)
P196 - Reset Alarm 3 (Address ModBus 2196)
P210 - Reset Alarm 4 (Address ModBus 2210)

Alarm contact reset type

0 Automatic reset (**Default**)
1 Manual reset (manual reset form keyboard or digital input)
2 Manual reset stored (maintains the output status even after any power failure)
3 Automatic reset with time activation. The alarm remains active for the time set in the "Alarm delay" parameter P171, P185, P199, P213, even if the conditions that generated it are no longer present. The alarm conditions must be cleared before it can be triggered again.

P169 - Alarm 1 State Error (Address ModBus 2169)
P183 - Alarm 2 State Error (Address ModBus 2183)
P197 - Alarm 3 State Error (Address ModBus 2197)
P211 - Alarm 4 State Error (Address ModBus 2211)

Alarm output status in case of error

0 Open contact (**Default**)
1 Closed contact

P170 - Alarm 1 State Stop (Address ModBus 2170)
P184 - Alarm 2 State Stop (Address ModBus 2184)
P198 - Alarm 3 State Stop (Address ModBus 2198)
P212 - Alarm 4 State Stop (Address ModBus 2212)

Alarm output status with controller in STOP mode

0	open	Open contact (**Default**)
1	close	Closed contact

P171 – Alarm 1 delay (Address ModBus 2171)
P185 – Alarm 2 delay (Address ModBus 2185)
P199 – Alarm 3 delay (Address ModBus 2199)
P213 – Alarm 4 delay (Address ModBus 2213)

Alarm delay

-60:00 ÷ 60:00 mm:ss
Default: 00:00.
Negative value: delay in exiting the alarm state.
Positive value: delay when entering the alarm state.

10.5 Digital Relay Outputs

P219 - Relay function 1 DO1 (Address ModBus 2219)
P221 - Relay function 2 DO2 (Address ModBus 2221)
P223 - Relay function 3 DO3 (Address ModBus 2223)
P225 - Relay function 4 DO4 (Address ModBus 2225)
P227 - Relay function 5 DO5 (Address ModBus 2227)

Various functions can be combined with the relay outputs by raising or lowering the relevant bit.
If I enable 2 functions, I will obtain the result of OR logic
Example: if bit 3 (Alarm1) and bit 4 (Alarm2) on DO1 are raised, this output will be active if Alarm1 or Alarm2 is active.
Functions associated with the output relay (DO):

Bit	Function
0	Cooling Loop 1
1	Cooling Loop 2
2	Cooling Loop 3
3	Alarm 1
4	Alarm 2
5	Alarm 3
6	Alarm 4
7	Heater Break
8	RS485 Watch dog
9	Probe error
10	Status DI 1
11	RUN Loop 1
12	RUN Loop 2
13	RUN Loop 3
14	Remote 1
15	Remote 2

Default: 0

P220 - Alarm contact type DO1 (Address ModBus 2220)
P222 - Alarm contact type DO2 (Address ModBus 2222)
P224 - Alarm contact type DO3 (Address ModBus 2224)
P226 - Alarm contact type DO4 (Address ModBus 2226)
P228 - Alarm contact type DO5 (Address ModBus 2228)

Alarm output contact 5 and trip type

0	n.o.	(N.O.) Normally open (**Default**)
1	n.c.	(N.C.) Normally closed

10.6 Digital input

P233 – Digital input 1 Function (Address ModBus 2233)

0 Disabled
1 Start / Stop (with impulse)
2 Run (if closed in run)
3 Manual reset alarm
4 External alarm.

The controller goes into STOP and the alarms are disabled.
The controller does not automatically return to START: user intervention is required for this operation.

P234 - Digital Input 1 contact (Address ModBus 2234)

Defines the break contact of digital input 1

0 Normally open (**Default**)
1 Normally closed

10.7 Soft Start

P240 - Soft-Start type Loop 1 (Address ModBus 2240)
P250 - Soft-Start type Loop 2 (Address ModBus 2250)
P260 - Soft-Start type Loop 3 (Address ModBus 2260)

Enables and selects the type of soft-start 1

0	Disab.	Disabled (**Default**)
1	Grad.	Gradient
2	Perc.	Percentage

P241 - Gradient Soft-Start Loop 1 (Address ModBus 2241)
P251 - Gradient Soft-Start Loop 2 (Address ModBus 2251)
P261 - Gradient Soft-Start Loop 3 (Address ModBus 2261)

Up/down gradient for soft-start

0 ÷ 20000 Digit/hour (degrees.tenth/hour if temperature).
Default: 100.0

P242 - Soft-Start 1 percentage (Address ModBus 2242)
P252 - Soft-Start 2 percentage (Address ModBus 2252)
P262 - Soft-Start 3 percentage (Address ModBus 2262)

Percentage of output during soft-start function 1

0 ÷ 100%.
Default: 50%

P243 - Soft-Start threshold Loop 1 (Address ModBus 2243)
P253 - Soft-Start threshold Loop 2 (Address ModBus 2253)
P263 - Soft-Start threshold Loop 3 (Address ModBus 2263)

Threshold below which the percentage soft-start function is activated, on power-up

-30000 ÷ 30000 [digit] (degrees.tenth/hour if temperature)
Default: 1000

P244 - Soft-Start time Loop 1 (Address ModBus 2244)
P254 - Soft-Start time Loop 2 (Address ModBus 2254)
P264 - Soft-Start time Loop 3 (Address ModBus 2264)

Maximum duration of soft-start 1: If the process does not reach the threshold entered in Par. "Soft-Start Threshold" (P243-P253-P263) within the set time, the controller starts to adjust to the setpoint.

00:00 Disabled
00:01-24:00 hh:mm
Default: 00:15

10.8 Current Transformer Input

P270 - Current transformer function Loop 1 (Address ModBus 2270)
P280 - Current transformer function Loop 2 (Address ModBus 2280)
P290 - Current transformer function Loop 3 (Address ModBus 2290)

Enables CT input 1 and selects the mains frequency

0 Disabled (**Default**)
1 50 Hz
2 60 Hz

P273 - Nominal load current Loop 1 (Address ModBus 2273)
P283 - Nominal load current Loop 2 (Address ModBus 2283)
P293 - Nominal load current Loop 3 (Address ModBus 2293)

Nominal value of the connected load. Setting 0.0 disables the H.B. alarm.

0.0 Disabled alarm (**Default**)
0.0-200.0 Ampere.

P274 - Heater Break sensitivity Loop 1 (Address ModBus 2274)
P284 - Heater Break sensitivity Loop 2 (Address ModBus 2284)
P294 - Heater Break sensitivity Loop 3 (Address ModBus 2294)

Percentage of reduction of the measured current, below which the H.B. error is generated.

0-80% (**Default**: 20%)

P275 - Overcurrent Loop 1 (Address ModBus 2275)
P285 - Overcurrent Loop 2 (Address ModBus 2285)
P295 - Overcurrent Loop 3 (Address ModBus 2295)

Overcurrent alarm trip threshold for CT 1

0.0 Disabled alarm (**Default**)
0.1-200.0 Ampere

P276 - Intervention delay Heater Break Loop 1 (Address ModBus 2276)
P286 - Intervention delay Heater Break Loop 2 (Address ModBus 2286)
P296 - Intervention delay Heater Break Loop 3 (Address ModBus 2296)

Intervention Delay time for Heater Break Alarm

00:00-60:00 mm:ss
Default: 01:00

10.9 Serial RS485 MODBUS RTU

P300 - Slave Address (Address ModBus 2300)

Selects the slave address for serial communication

1 ÷ 254.
Default: 247

P301 - Baud Rate (Address ModBus 2301)

Selects the baud rate for serial communication

0 1200 bit/s
1 2400 bit/s
2 4800 bit/s
3 9600 bit/s
4 19200 bit/s (**Default**)
5 28800 bit/s
6 38400 bit/s
7 57600 bit/s
8 115200 bit/s

P302 - Serial Port Parameters (Address ModBus 2302)

Selects the format for Modbus RTU serial communication

0 8 bit, no parity, 1 stop bit (**Default**)
1 8 bit, even parity, 1 stop bit
2 8 bit, odd parity, 1 stop bit
3 8 bit, no parity, 2 stop bit
4 8 bit, even parity, 2 stop bit
5 8 bit, odd parity, 2 stop bit

P303 - Serial Delay (Address ModBus 2303)

Select serial delay

0 ÷ 100 ms.
Default: 5 ms.

P304 - RS458 MODBUS RTU WatchDog (Address ModBus 2304)

Selects the WatchDog time. If there is no serial communication within the set time, the controller switches off the control output

0 Disabled offline (**Default**)
0.1-600.0 tenths of a second.

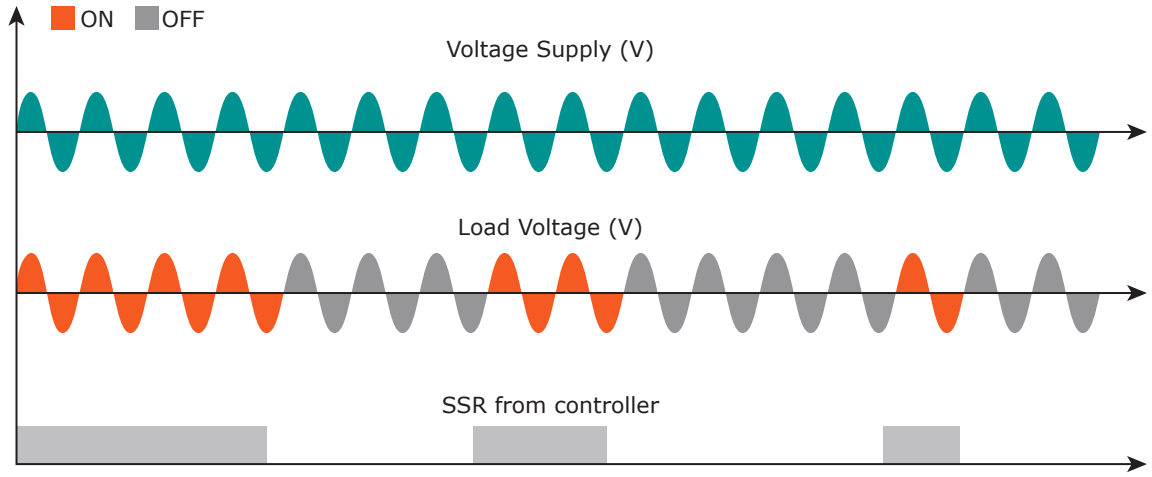
11 Firing type

Choose a correct firing type allows to optimize the thyristor unit for the installed load.
The firing type has already configured in line with customer requirements that are defined in the Order Code.
The Order Code is written on the identification label.
However, if you wish to change the firing type you can use the software configurator or the Control Panel.

Caution: this procedure must be performed only by qualified persons.

11.1 Zero Crossing

L'accensione ZC è usata con un'uscita logica dal regolatore di temperatura ed il thyristor opera come un contattore.
Il tempo di ciclo è stabilito dal regolatore di temperatura. L'accensione ZC minimizza le interferenze elettro-magnetiche perché il thyristor cambia di stato quando la tensione passa per lo zero.



12 Control Mode (feed-back)

The Control Mode (feed-back) type has already configured in line with customer requirements that are defined in the Order Code. The Order Code is written on the identification label.
However, if you wish to change the Control Mode (feed-back) type you can use the software configurator or the Control Panel.

Caution: this procedure must be performed only by qualified persons.

The Control Mode (feed-back) type is defined by the parameter Control Mode (feed-back) in setup menu.
If the configurable digital input has set like feed-back Selection, it's possible to change the select feed-back with the Voltage feed-back (V) simply activating the input.
It's possible to have:

V2 = Square Voltage feed-back.

The input signal is proportional to the output square voltage. This means that input signal becomes a power demand. The power remains constant if the load impedance doesn't change.

V = Voltage feed-back.

The input signal is proportional to the output voltage. This means that input signal becomes a voltage demand. This control mode compensates the voltage fluctuation of the incoming line supply.

I = Current feed-back.

The input signal is proportional to the current output. This means that input signal becomes a current demand. This control mode maintain the current also if the load impedance changes.

P(VxI) = Power feed-back.

The input signal is proportional to the power output. This means that input signal becomes a power demand. The power remains constant also if voltage and load impedance change. This control mode is used with silicon carbide elements that change its resistive value with temperature and with age. In addition it compensates the voltage fluctuation of the incoming line supply.

I2 = Square Current feed-back.

The input signal is proportional to the output square current. This kind of feed-back is suggested for cold resistance applications.

None = No feed-back Open Loop. The input is proportional to the firing angle (α).

External = External feed-back (0÷10V, 4÷20mA, 0÷20mA).

The input signal is proportional to an external signal. This means that input signal becomes a demand to maintain this signal always constant. This control mode is used for example with galvanic systems, where it's necessary to control the current value through the electrodes.

13 Electronic board

13.1 Supply the electronic board

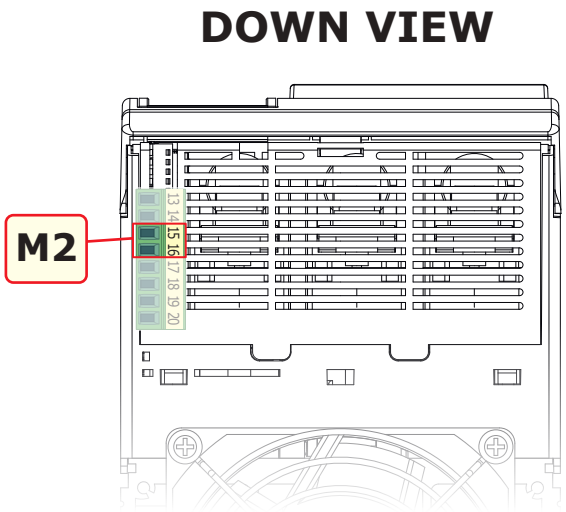
The thyristor unit, to work, requires a voltage supply for the electronic board of 24Vdc 1A on terminal M2 (13+; 14-).

Warning: Before connecting or disconnecting the unit check that power and control cables are isolated from voltage sources.

14 RS485 Serial port

Terminal M3	Description
15	RS485 A+
16	RS485 B-

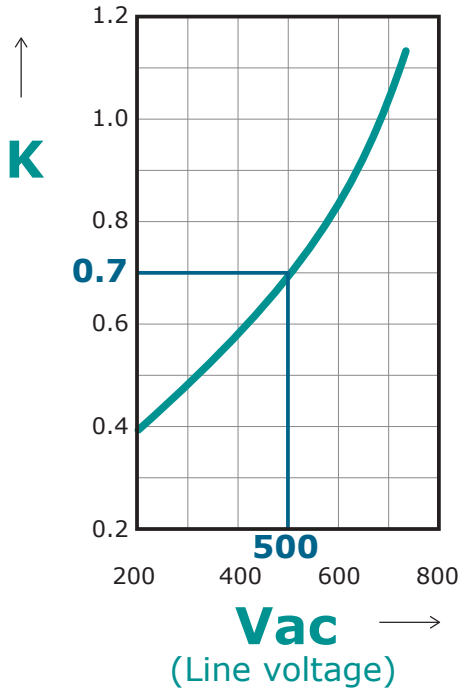
The serial communication port RS485 is available on the Command Terminals.
On this port may be done a network up to 127 units.



15 Internal fuses

The thyristor unit have internal fuse extrarapid at low I^2t for the thyristor protection of against the short-circuits. The Fuses must have I2T 20% less than thyristor's I^2t. The warranty of thyristor is null if no proper fuses are used.

Tipo	Codice fusibile ricambio	Corrente (A_{RMS})	Vac	Fusibile I^2t suggerito A2s (a 500V)*	Fusibile I^2t suggerito A2s (a 690V)	Quantità per ogni fase
035	FU5007306.50	50	690	546	780	1
050	FU5007306.80	80	690	1750	2500	1
075	FU5007306.100	100	690	2170	3100	1
090	FU5007306.100	100	690	2170	3100	1

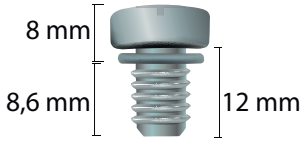


*I^2t are multiplied for K value in function of Vac, at 500V K is equal to 0,7 (es:3100 X 0,7 = 2170).
At 690Vac K is equal to 1.

Fuses replacement:

Open the cover and remove the screws, then replace it with the correct fuse, use the screws with a proper suggested torque indicated below.
Use correct screws M6 x 12 mm.

N° 2 M6x12mm for each fuse



Type	Screw	Torque Lb-in (N-m)
30A-90A	M6	44.2 (5.0)

Caution: High speed fuses are used only for the thyristor protection and can not be used to protect the installation.

Caution: The warranty of thyristor is null if no proper fuses are used. See tab.

Warning: When powered, the thyristor unit is subject to dangerous voltages; disconnect from the power supply before opening the fuse box and touching electrical equipments.

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