

TECSYSTEM S.r.l.®

# INSTRUCTION MANUAL

## NT538 V4-R1.4

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**NT538 V4-R1.4 protection relays**

**INNOVATIONS INTRODUCED WITH THE NT538**

1. New hardware and software for a further improvement of immunity to disturbances.
2. Reading rate increasing, indispensable for applications where fast temperature variations must be monitored.
3. Intelligent control of alarm detecting relays which is able to exclude possible overtemperatures caused by an external disturbance without causing working problems or manual reset conditions.
4. Detecting of possible corruption of data stored in the memory (Ech) and default value reset for security.
5. Storage in T.Max mode of possible alarms occurred from last reset and recording of possible sensor failures.
6. Error detecting in case of wrong programming with specific indication of the wrong value couple.
7. Possibility to return to previous programming step for a faster value modification.
8. Safer programming block which can be activated just through the closing of an inner jumper.
9. SCAN display mode to see, in sequence, the temperature and the state of the alarms for all channels
10. 8 channels with two programmable thresholds in an independent way.
11. Fan contact to check a cooling system.
12. More compact sizes compared with T538 version1
13. Options with serial output to control the expansion module such as:
  - a) EXT 4.20-8: module with 4-20 mA outputs for each channel
  - b) EXT RL-8: module with 2 relays (alarm and trip) for each channel
  - c) EXT RS485 Modbus: module for connection on a Modbus network
14. Possibility to connect many expansion module on serial output in order to have many expanding options simultaneously

**TECSYSTEM S.r.l®**

**1) TECHNICAL SPECIFICATIONS**

<p><b>POWER SUPPLY</b></p> <ul style="list-style-type: none"> <li>• Rated values 24-240 Vac-dc</li> <li>• Highest tolerable values 20-270 Vac -dc</li> <li>• Vdc with reversable polarity Vdc</li> </ul>	<p><b>COMMUNICATION</b></p> <ul style="list-style-type: none"> <li>• option</li> </ul>
<p><b>INPUTS</b></p> <ul style="list-style-type: none"> <li>• 8 inputs RTD Pt100—3 wires</li> <li>• Removable rear terminals</li> <li>• Input channels protected against electro-magnetic noises and spikes</li> <li>• Sensor length cable compensation up to 500 m (1mm<sup>2</sup>)</li> </ul>	<p><b>OUTPUTS</b></p> <ul style="list-style-type: none"> <li>• 2 alarm relays (ALARM-TRIP)</li> <li>• 1 alarm relay for fan control (FAN)</li> <li>• 1 alarm for sensor fault or working anomaly (FAULT)</li> <li>• Outputs contacts capacity: 5A -250V ac res.</li> </ul>
<p><b>TESTS AND PERFORMANCES</b></p> <ul style="list-style-type: none"> <li>• Assembling in accordance with CE rules</li> <li>• Protection against electrical noises CEI-EN50081-2/50082-2</li> <li>• Dielectric strength 2500 Vac for 1 minute from relays to sensors, relays to power supply, power supply to sensors</li> <li>• Accuracy <math>\pm 1\%</math> full scale value <math>\pm 1</math> digit</li> <li>• Ambient operating temperature from <math>-20^{\circ}\text{C}</math> to <math>+60^{\circ}\text{C}</math></li> <li>• Humidity 90% no-condensing</li> <li>• ABS self-extinguishing housing NORYL 94VO</li> <li>• Frontal in polycarbonate IP65</li> <li>• Absorption 3VA</li> <li>• Data storage 10 years minimum</li> <li>• Digital linearity of sensor signal</li> <li>• Self-diagnosis circuit</li> <li>• Option protection treatment of electronic part</li> </ul>	<p><b>DISPLAYING AND DATA MANAGEMENT</b></p> <ul style="list-style-type: none"> <li>• 1 display 13mm high with 3 digit for displaying temperatures and messages</li> <li>• 8 leds to show selected channel</li> <li>• 4 leds to display the state of the alarms for selected channel</li> <li>• Temperature monitoring from <math>0^{\circ}\text{C}</math> to <math>240^{\circ}\text{C}</math></li> <li>• 2 alarm thresholds (alarm/trip) for each channel</li> <li>• 2 ON-OFF thresholds for fan control</li> <li>• Sensors diagnostic (Fcc-Foc)</li> <li>• Data storage diagnostic (Ech)</li> <li>• Programming access through front key</li> <li>• Automatic output from programming cycle after 1 minute of no-operation</li> <li>• Wrong programming automatic display</li> <li>• Possibility of setting automatic channels scanning hottest channel manual scanning</li> <li>• Maximum recorded temperatures alarm storage and sensor fault.</li> <li>• Frontal alarm reset push button</li> </ul>
<p><b>DIMENSIONS</b></p> <ul style="list-style-type: none"> <li>• 96x96mm-DIN43700—depth140mm (terminal box included)</li> <li>• Panel cut-out 92x92mm</li> </ul>	

**2) MOUNTING**

Make a hole in the panel sheet with dimensions 92x92 mm.  
Firmly tighten the device with the enclosed fixing blocks.

**3) POWER SUPPLY**

NT538 control device has an UNIVERSAL supply, i.e. it can be indifferently fed from 24 to 240 Vac-dc, regardless of polarities in Vdc.

This peculiarity is obtained using a new -concept and new -designed tested feeder, which relieves the technician of each concern for the correct supply Vac or Vdc.

To terminal 41 must always be connected the ground.

When the control device is directly fed from secondary winding of the transformer to be protected, it can be damaged by high-intensity overvoltages.

These problems occur if the main switch is connected without load.

Above mentioned problems are much more evident when the voltage is 220 Vac is directly taken from the transformer secondary bars and there is a fixed capacitor battery to phase the transformer itself.

*To protect the control device from line overvoltages, we suggest to use the electronic discharger PT73-220, designed by TECSYSTEM S.r.l. for this specific purpose.*

*As alternative we suggest to use supply voltages from 24 Vac or, much better, 24*

**4) ELECTRICAL CONNECTIONS FOR ALARMS AND FAN**

Carry out the electrical connections on the removable rear terminals, after having removed them from the device.

ALARM and TRIP relays switch only when the set temperature limits are reached.

FAULT relay (Fault) switches when the meter is fed, while gets de-energised when a fault occurs to Pt100 sensors, data memory fault (Ech) or when supply voltage is lacking.

FAN contact can be used to check the cooling fans or it can be inserted in a transformer room conditioning circuit.

**5) TEMPERATURE SENSOR CONNECTION**

Each Pt100 temperature sensor Pt100 has 4 pin cable wire and two red wires (CEI 75 3 standard).

Fig. 1 shows the position inside the terminal box of monitoring unit connection cables.

Each channel can be independently programmed with two alarm thresholds (alarm and trip).

#### 6) MEASURING SIGNAL TRANSFER

All the measuring signal transfer cables for Pt100 must absolutely:

- be separated from the power ones
- be made with shielded cable and twisted conductors
- have at least 0,5 mm<sup>2</sup> section
- be twisted if there is no shield
- be firmly fixed inside the terminal boxes
- have tinned or silvered conductors

*TECSYSTEM S.r.l. has designed an own special cable to transfer the measuring signals, according to CEI standards, with all the protection requirements provided for : mod. CT-ES*

All "NT" series control devices have the sensor signal linearization, with a maximum error of 1% of full scale value.

#### 7) TEMPERATURE SENSOR DIAGNOSTIC

In case of breaking of a temperature sensor mounted on the machine to be protected, **FAULT** relay immediately switches with the relevant indication of defective sensor on the corresponding channel.

- **Fcc** for short-circuited sensor.
- **Foc** for interrupted sensor

To eliminate the message and reset Fault switching, it is necessary to verify Pt100 connections and, in case, replace the defective sensor.

#### 8) PROGRAMMED DATA DIAGNOSTIC

In case of breaking of the internal storage or corruption of programmed data, just after switching on, it appears **Ech** indication with the relevant reporting of the Fault contact.

In this case, for safety reasons, the default parameters: Alarm Ch1-2-3= 90°C, Trip Ch1-2-3= 119°C, Ch4= Yes, Alarm Ch4= 120°C, Trip Ch4= 140°C, Ch-Fan= 1-2-3, Fan-on= 70°, Fan-off= 60°, HFN= 000 are automatically loaded.

Eliminate **Ech** indication by pressing **RESET** button programming to insert desired values.

Finally turn off and turn on again the unit to verify the correct memory working; in case it is damaged and **Ech** still appears, please return the monitoring unit to Tecsystem for repair.

#### 9) TEMPERATURE DIAGNOSTIC

If one of the temperature sensor detects a temperature higher than 1°C compared to set value as alarm limit, after approximately 5 seconds **ALARM** relay switches together with turning on of channel reference LED **ALARM (CHn)**.

When the release temperature limit is passed, **TRIP** relay switches together with turning on of channel reference LED **TRIP (CHn)**.

As soon as taken temperature returns to equal or lower values than set limit for **ALARM** and **TRIP** relays switching, they de-energise with consequent turning off of relevant LED's.

**10) COOLING FAN CONTROL**

NT538 monitoring unit, if opportunely programmed, can control ON-OFF of transformer fans, according to set temperatures.  
Fans on machine are driven using the temperatures taken from enabled channels.

**11) FAN TEST**

It is possible, through programming (hFn), to lay down that fans are activated for 5 minutes each "xxx" hours, regardless of column or room temperature values (ex.: with hfn=001 fans are activated for 5 minutes each hour).  
This function has the aim to periodically verify the working of the fans and their control apparatus during long idle periods.  
Loading 000 value, this function is inhibited.

**12) DISPLAY MODE**

Pressing MODE key, display mode is loaded:

- **SCAN:** control device displays in scansion all activated channels (each 2 seconds)
- **AUTO:** control device automatically displays the hottest channel
- **MAN:** channel temperature manual reading of channel through cursor keys
- **T.MAX:** monitoring unit displays the highest temperature reached by the sensors and possible alarm or fault situations occurred after last reset.  
Select channels with ▲ and ▼, delete values with RESET.

**13) WORKING PROGRAM CONTROL**

To check the programmed temperature values, shortly press PRG key. VIS indication appears for 2 seconds, confirming entering in program vision mode.  
By repeatedly pressing PRG key, all the previously loaded values are rolled in sequence.  
After 1 minute of keyboard no-operation, display-programming procedure will be automatically left.  
To end display, press ENT key.

**14) LAMP TEST**

We suggest to regularly carry out monitoring unit LED test.  
For this operation, shortly press TEST key. All displays turn on for 2 seconds.

*If one of the LED's should not work, we kindly ask you to return the monitoring unit to TECSYSTEM (Led RS is not available on monitoring units without optional module)*

**15) ALARM RELAY TEST**

This function allows to carry out a test on relays working without having to use further devices.

To start test procedure you have to keep pressed TEST key for about 5 seconds; TST indication appears for 2 seconds, confirming entering in Relays Test mode.

Blinking led shows the relay to test; using the cursors you can select the desired one.

Press SET and RESET keys to energise and de-energise the relay to test; display will show ON-OFF.

After 1 minute keyboard no-operation, RELAYS TEST procedure will be automatically left.

To end RELAYS TEST procedure, press TEST key.

**16) ALARM RELAY EXCLUSION**

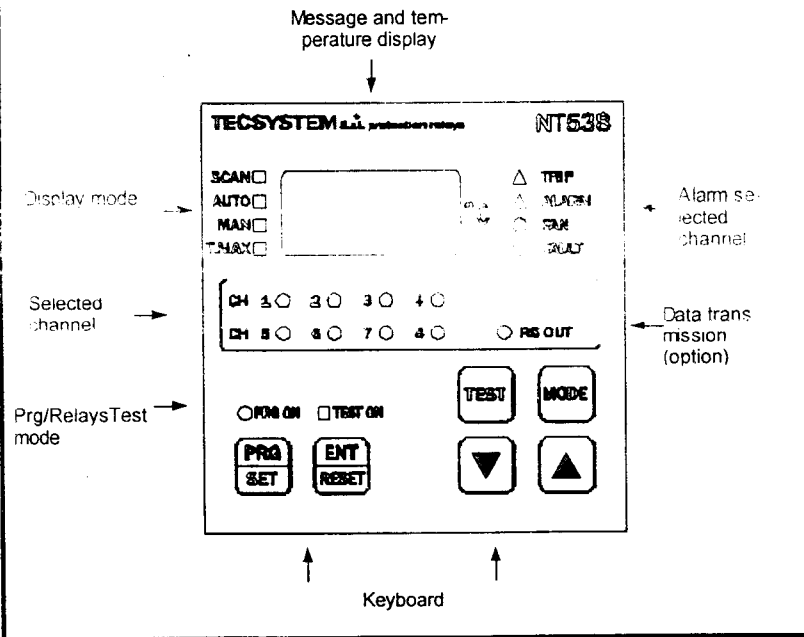
If you want to exclude the ALARM signal press RESET key: relay de-energises itself and LED ALARM, which was fixed, will start to blink.

Exclusion system is automatically disconnected when the temperature goes under the ALARM threshold.

**17) IMPORTANT NOTICE**

Before carrying out the insulation test on the switchboard where the monitoring unit is mounted, you have to disconnect it from the mains in order to avoid serious damages.

**18) FRONT PANEL**












NT538 V4-R1.4 protection relays

**19) PROGRAMMING**

**NOTE: LED PRG-ON OFF: PROGRAM DISPLAY.**

**LED PRG-ON ON: PROGRAM MODIFICATION**

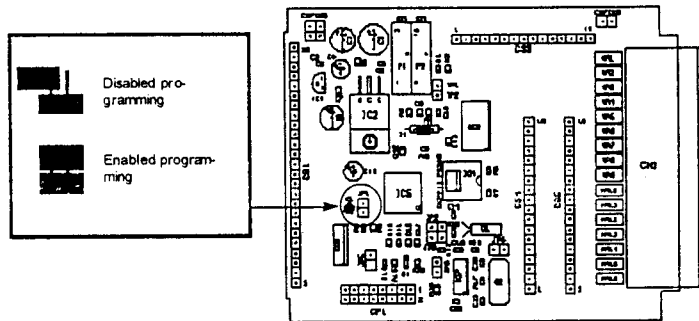
N°	PRESS	EFFECT	NOTES
1	PRG/SET	Keep pressed PRG key until PRG-ON led turns on. After PRG indication, it appears NCH indication (number of channels)	If NOP appears please see "Programming block" paragraph
2		Load number of desired channels	Refer to channel leds (from 1 to 8)
3	PRG/SET	It appears ALARM threshold for CH 1	
4		Load desired threshold	
5	PRG/SET	It appears TRIP threshold for CH 1	
Follow the same procedure for the number of channels chosen at step 2			
6	PRG/SET	Fan led blinks	
7		Set: YES or NO	NO: disabled fan YES: enabled fan
8	PRG/SET	Display shows ON	FAN turning on
9	PRG/SET	It appears ON threshold for FAN	
10		Load desired threshold	
11	PRG/SET	Display shows OFF	FAN turning off
12	PRG/SET	It appears OFF threshold for FAN	
13		Load desired threshold	
14	PRG/SET	Display shows HFN	Fan cyclic test for 5 minutes each "n" hours
15		Load desired number of hours	000= disabled function
16	PRG/SET	Display shows n.o./n.c and Alarm led blinks	Alarm relay working logic
17		Set n.o. or n.c.	n.o., normally open n.c., normally closed
18	PRG/SET	Display shows n.o./n.c and Trip led blinks	Trip relay working logic
19		Set n.o. or n.c.	n.o., normally open n.c., normally closed
20	PRG/SET	Display shows FCD <> "threshold"	Fault for fast temperature increase (°C/sec)
21		Load desired threshold (see page 10)	From "no" up to 30 °C/sec (no disabled function)
22	PRG/SET	Display shows END	Programming end
23	ENT	Loaded data storage and programming exit	Err(2): wrong programming for values indicated by leds
24	PRG/SET	Return to step 1	

- 1) It is possible to return to previous step by pressing MODE key.
- 2) if pressing ENT it appears "ERR", it means that one of the following mistakes has been made: ALARM ≥ TRIP or FAN-OFF ≥ FAN-ON.  
Press PRG to return to step 1 and correct the data.
- 3) After 1 minute of keyboard no-operation, programming is left without data storage.



**20) PROGRAMMING RE-ENABLING IN CASE OF BLOCK (Prg no)**

If pressing PRG to enter programming (step 1) "NOP" indication appears, it means that programming access jumper inside the unit has been removed and therefore this function is blocked. To reset programming access, mount the jumper as shown in the figure below.



**21) WARRANTY**

"NT" series monitoring units are covered by a 12-month warranty starting from the delivery date on the device itself.

This Guarantee is valid if device should be damaged by causes which can be attributed to TECSYSTEM S.r.l., such are manufacturing defects or improper calibration.

The warranty is not valid if the monitoring unit would be tampered or if it would be damaged by supply voltages beyond the highest working limits (20+270 Vac-dc). The warranty is not valid if the device would be burnt out by too many transient voltage peaks. In this case TECSYSTEM S.r.l. do not answer for damages caused by faulty or defective monitoring units. All the deliveries (go and back) as well as the repair and servicing costs for the device will be at Customer's expenses, reckoned according to AN-IMA Col. C rates.

In case of contest may only be instituted the Milan court.  
The warranty is always FREE OUR DOMICILE in CORSICO.

**22) EXTENSION CABLE FOR Pt100 TECHNICAL SPECIFICATIONS**

- Cable 20xAWG 20/19 cu/stg
- Section 0.55 mm<sup>2</sup>
- Insulation PVC105 flame-retardant
- Standards CEI 20.35 IEC 332.1
- Max working temperature : 105°C
- Structure: 4 terns composed of three numbered wires (1-1-1.....4-4-4)
- Twisted and coloured wires Red-Red-White
- Shield in cu/stg
- Sheath in flame-retardant PVC
- External Diameter 9,0 mm
- Standard packaging in skein of 100 m

FAULT DIAGNOSTIC	CAUSES AND REMEDIES
Monitoring unit doesn't turn on, even if there is power supply and the terminals are fed.	Connector not well placed inside its seat. Connection cables are not tightened in the terminal. Burnt out feeder. <i>Take out and give supply again.</i>
One of 8 channels is in FAULT for FOC/FCC	1)Check Pt100 sensor connections: possible defective sensor. <i>Replace the damaged sensor.</i> 2)Number of channels programming different to number of sensors connected. <i>Repeat programming.</i>
When turning on, indication "ECH" appears.	A strong disturbance damaged the stored data. Please refer to paragraph 8. If this problem should persist, please contact <i>TECSYSTEM S.r.l. Technical Department.</i>
All the sensors are in FCC.	Wrong sensor connections. Terminal box connected inside out. <i>Check connections and terminal box.</i>
Temperature indicated by one or more channel is wrong.	Contact <i>TECSYSTEM S.r.l. Technical Department.</i>
Sudden trip of main switch. Temperature is on standard levels. Just a channel caused the trip.	Verify through T.MAX function possible defective sensors. <i>Replace the sensor. Check the measuring signal terminal boxes.</i>

**23) NOTES ON FCD FUNCTION**

NT device series have an innovatory control function combined with the Pt100 probes dynamic state.

If a thermometric probe should by chance break down, the defect is highlighted with a fast increase of its own resistance and therefore of the temperature recorded by the monitoring device. It's obvious that this increase is not directly resulting from the power increase of the machine to be protected, whether it is a motor or a dry or encapsulated transformer. Therefore it is necessary to know the state of the probe and send a Fault signal instead of an Alarm signal or worse still, a Trip signal.

In case of temperature control on electrical motors, the fast rise in temperature could be caused by the working with a stalled rotor and not by a defective probe. In this case Fault relay, once energised, indicates that the temperature condition for motor working.

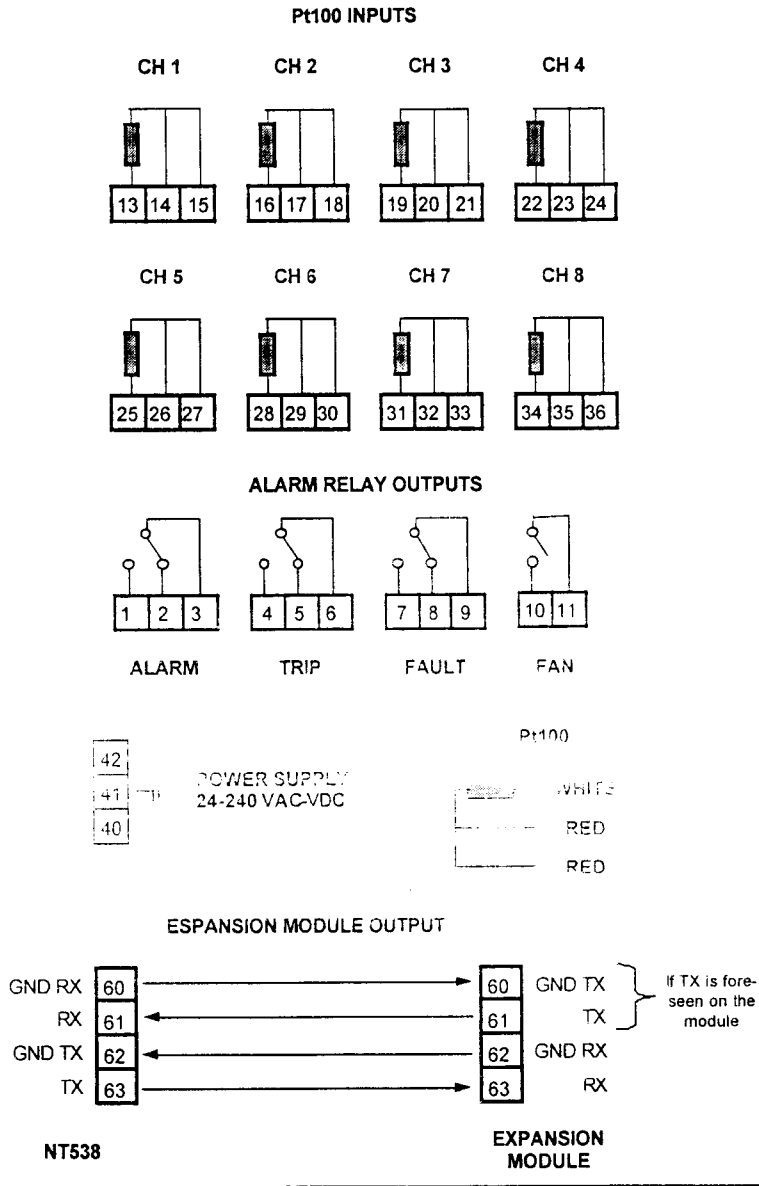
Activating FCD function it is possible to have on contacts 7/8-9 a Fault signal when temperature recorded by a Pt100 rises with a speed higher than "n" °C/sec (loadable from 1 to 25).

According to the loaded value you can have a different sensitivity, which can be useful for different applications

- from 1 to 10: high sensitivity, for instance useful to immediately detect stalled of a motor rotor.
- From 10 to 20: average sensitivity, useful to get information relevant to possible noises which affect probe reading, connection problems or defective probes.
- From 20 to 30: low sensitivity, useful for applications where a higher sensitivity could cause a fault for unwanted FCD's
- With "no" FCD function is disabled.

When a channel is in Fault for FCD, relevant Alarm and Trip signalings are inhibited in order to report just the anomaly for the too fast rise in temperature.  
Press Reset to cancel FCD signalling for all the channels and to reset relays fault.

**FIG.1** NT538 ELECTRICAL CONNECTIONS



**TEST DECLARATION FOR NT538**

This device has passed a test at the origin, according to the following procedure:

N°	Description
1	Mounting card check
2	Input working check
3	Relay contacts and output check
4	Push-button working check
5	Check lamp
6	Calibration at 0 and 200°C
7	Software working check
8	Burn-in min. 24h

checked by date .....