

TECSYSTEM S.r.l®

INSTRUCTION MANUAL

NT935 4-20mA ANALOG INSIDE



RoHS
COMPLIANT
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NT935 4-20mA ANALOG INSIDE

INNOVATIONS INTRODUCED WITH THE NT935

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 a 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 sensors 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. SCAN display mode to see, in sequence, the temperature and the state of the alarms for all channels.
9. Wider temperature reading range: from 0 to 240°C

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1) TECHNICAL SPECIFICATIONS

POWER SUPPLY

- Rated values 24-240 Vac-dc
- Highest tolerable values 20-270 Vac-dc
- Vdc with reversible polarities

INPUTS

- 3 or 4 inputs RTD Pt100 -3 wires
- Removable rear terminals
- Input channels protected against electro-magnetic noises and spikes
- Sensor length cable compensation up to 500 m (1mm²)

OUTPUTS

- 2 alarm relays (ALARM-TRIP)
- 1 alarm relay for fan control (FAN)
- 1 alarm for sensor fault or working anomaly (FAULT)
- Output contacts capacity: 5A-250 Vac res.
- 1 output 4.20 mA (0-240°C standard)

TESTS AND PERFORMANCES

- Assembling in accordance with CE rules
- Protection against electrical noises CEI -EN50081-2/50082-2
- Dielectric strength 2500 Vac for 1 minute from relays to sensors, relays to power supply, power supply to sensors
- Accuracy $\pm 1\%$ full scale value ± 1 digit
- Ambient operating temperature from -20 °C to +60°C
- Humidity 90% no-condensing housing NORYL 94V0
- Frontal in polycarbonate IP65
- Absorption 3VA
- Data storage 10 years minimum
- Digital linearity of sensor signal
- Self-diagnostic circuit
- **Option** protection treatment of electronic part
- Vibration test IEC 68-2-6
Amplitude ± 1 mm from 2Hz to 13.2Hz
Acceleration $\pm 0.7G$ from 13.2Hz to 100Hz.
- (*) Seismic test according to IEEE 344-1.987

*Cross reference T154 for constructive analogy.

DISPLAYING AND DATA MANAGEMENT

- 1 display 13 mm high with 3 digit for displaying temperatures and messages
- 4 leds to show selected channel
- 4 leds to display the state of the alarms for selected channel
- Temperature monitoring from 0°C to 240°C
- 2 alarm thresholds for channels 1-2-3
- 2 alarm thresholds for channel 4
- 2 ON-OFF thresholds for fan control
- Sensors diagnostic (Fcc-Foc)
- Data storage diagnostic (Ech)
- Programming access through front key
- Automatic output from programming cycle after 1 minute of no-operation
- Wrong programming automatic display
- Possibility of setting automatic channels scanning, hottest channel, manual scanning
- Maximum reached temperatures, alarm storage and sensor fault.
- Frontal alarm reset push button

DIMENSIONS

- 100 x 100 mm-DIN43700– depth 140 mm (terminal box included)
- Panel cut-out 92 x 92 mm

2) MOUNTING

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

3) POWER SUPPLY

NT935 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 Vdc.*

In case of unit replacement, to grant the correct and safe operating, you must replace the sensors, relays, and power supply connecting terminals with the new terminals provided with the unit: this only if the terminal blocks are of different brand.

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 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 has a white wire and two red wires (CEI 75.8 standards).

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

Channel CH2 must always be referred to transformer central column.

Channel CH4 must be referred either to the transformer core or to Pt100 sensor for room in case you want to control the temperature of transformer room using NT935 monitoring unit.

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 mm² 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= NO, Ch-Fan= 1-2-3, Fan-on= 70°, Fan-off= 60°, HF_n= 000 are automatically reloaded.

Eliminate **Ech** indication by pressing RESET and run 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** (CH_n).

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

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

NT935 monitoring unit, if opportunely programmed, can control ON-OFF of transformer fans, according to set temperatures.

Fans on machine can be driven in two different ways:

- Using the temperatures taken by the sensors on three columns
CHF 1.2.3
(ex. ON at 80°C - OFF at 70°C)
- Through an extra sensor (**CH4/YES**) for the room temperature inside the transformer box.
CHF 4
(ex. ON at 40°C - OFF at 30°C)

11) FAN TEST

It is possible, through programming (**HF_n**), to lay down that fans are activated for 5 minutes each "xxx" hours, regardless of column or room temperature values (ex.: with HF_n=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 scanning all activated channels (each 2 seconds)
- **AUTO**: control device automatically displays the hottest channel
- **MAN**: channel temperature manual reading 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 ▲▼, 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 programming, press ENT key.

14) LAMP TEST

We suggest to regularly carry out control device 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)

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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

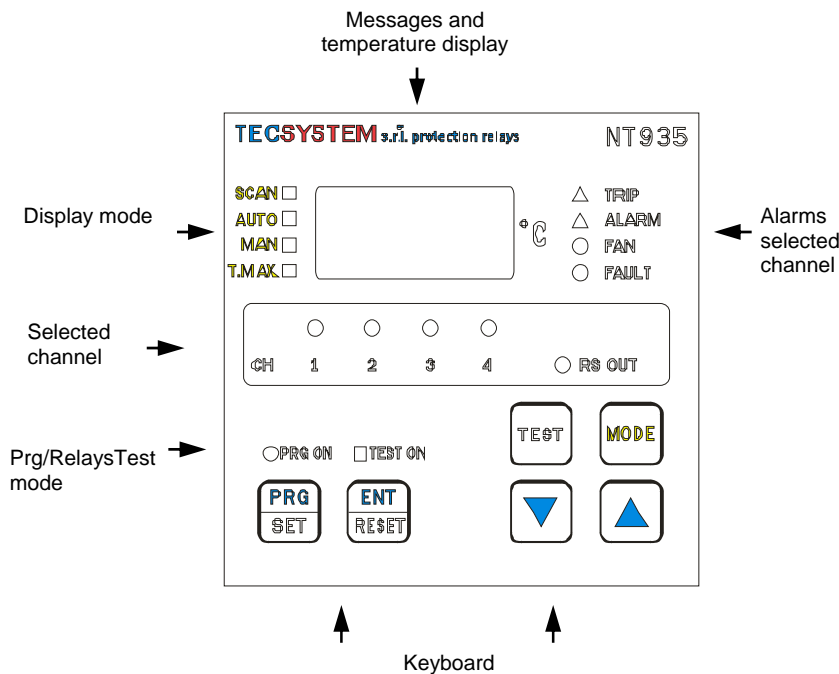
If you want to exclude the ALARM signal press RESET key: relay de-energises itself and LED ALARM, which was fixed, will start to blink.

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






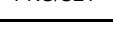

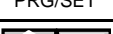
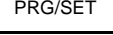
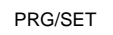


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19) PROGRAMMING

NOTE: LED PRG-ON ON: PROGRAM MODIFICATION

LED PRG-ON OFF: PROGRAM DISPLAY.

| N° | PRESS | EFFECT | NOTES |
|----|---|---|--|
| 1 | PRG/SET | Keep pressed PRG key until PRG-ON led turns on. After PRG indication, it appears ALARM threshold for CH 1-2-3 | If NOP appears please see "Programming block" paragraph |
| 2 |  | Load desired threshold | |
| 3 | PRG/SET | It appears TRIP threshold for CH 1-2-3 | |
| 4 |  | Load desired threshold | |
| 5 | PRG/SET | led CH 4 blinks | Enabling CH 4 |
| 6 |  | Load YES or NO | with YES CH 4 is connected with NO CH 4 is disconnected |
| 7 | PRG/SET | It appears ALARM threshold for CH 4 | if CH 4=NO goes to point 11 |
| 8 |  | Load desired threshold | |
| 9 | PRG/SET | Appear TRIP threshold for CH 4 | |
| 10 |  | Load desired threshold | |
| 11 | PRG/SET | led Fan blinks and channel leds to which fan is referred turn on | |
| 12 |  | Select NO, CH 1-2-3 or CH 4 (if CH 4 YES) | NO: disabled fan, Goes to point 20 |
| 13 | PRG/SET | Display shows ON | FAN turning on |
| 14 | PRG/SET | It appears ON threshold for FAN | |
| 15 |  | Load desired threshold | |
| 16 | PRG/SET | Display shows OFF | FAN turning off |
| 17 | PRG/SET | It appears OFF threshold for FAN | |
| 18 |  | Load desired threshold | |
| 19 | PRG/SET | Display shows HF _n | Fan cyclic test for 5 minutes each "n" hours |
| 20 |  | Load desired number of hours | 000= disabled function |
| 21 | PRG/SET | Display shows FCD <-> "threshold" | Fault for fast temperature increase (°C/sec) |
| 22 |  | Load desired threshold (see page10) | From "no" up to 30 °C/sec (no: disabled function) |
| 23 | PRG/SET | Display shows END | Programming end |
| 24 | ENT | Loaded data storage and programming exit | Err: wrong programming for values indicated by leds (note 2) |
| 25 | 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) RULES FOR WARRANTY

The Product purchased is covered by manufacturer's warranty or the seller's terms and conditions set forth in the "General Conditions of Sale Tecsystem srl", available at www.tecsystem.it and / or purchase agreement.

The warranty is considered valid only when the product will be damaged by causes attributable to TECSYSTEM srl, such as manufacturing or components defects.

The warranty is invalid if the Product proves tampered / modified, incorrectly connected, because voltages outside the limits, non-compliance with the technical data for use and assembly, as described in this instruction manual.

Any action about warranty is always at our factory in Corsico-MI, Italy as stated by the "General Conditions of Sale Tecsystem srl".



RAEE: This SYMBOL, shown on the unit, indicates that the waste must be subject to "separate collection". The end-user must send the unit to the "waste collection centers", or return the unit to the dealer against the purchase of a new equivalent device.

21) EXTENSION CABLE FOR Pt100 TECHNICAL SPECIFICATIONS

Cable 20 x AWG 20/19 Cu/Sn

Section 0,55 mm²

Insulation PVC105 flame-retardant

Standards CEI 20.35 IEC 332.1

Max. working temperature : 90°C

Structure: 4 terns composed of three twisted and coloured wires

Shield in Cu/Sn

Sheath in flame-retardant PVC

External Diameter 9,0 mm

Standard packaging in skein of 100 m

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| 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> |
| CH4 is in FAULT FOC (only 3 sensors Pt100 are connected) | Wrong programming of the monitoring unit with CH4/no. <i>Repeat programming.</i> |
| One of three/four channels is in FAULT for FOC/FCC | Check Pt100 sensor connections. Possible defective sensor. <i>Replace the damaged sensor.</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> |

22) 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, makes clear this anomalous 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 30).

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 signalling 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.

23) INTRODUCTION TO 420 INSIDE INTERNAL MODULE

420 INSIDE internal module allows to take in output 1 4-20 mA current signal referred to selected channel on the unit.

The current loop is self supplied and optoinsulated.

24) WORKING NOTES

Serial communication between temperature monitoring unit and module 420 INSIDE is active only when NT935 or NT538 are in temperature control working mode in one of the provided modes (Scan, Auto, Man and T.Max).

When other functions such as programming, programming display and relay test are activated, the communication with 420 INSIDE is temporarily deactivated.

25) 4.20 mA OUTPUT CONNECTION

To 4.20 mA output can be connected a read-out or data capture device.
The admitted load impedance for each output goes **from 0 to 500 ohm**.

4-20 mA signal is referred to 0-240°C range with accuracy of 1% with respect to full scale value.

It is possible to ask for a special calibration with reference to a range 0-200°C.

The 420 INSIDE allows to withdraw in exit a signal in current 4-20 mA referred to the channel selected on the unit (see paragraph 12)

For 0-240 range, the relation current/temperature is the following:

$$I_{out} = (T/15)+4 \quad (T= \text{temperature in } ^\circ\text{C})$$

Example:

$$\text{If } T=100^\circ\text{C} \quad I_{out} = 100/15+4 = 10,67 \text{ mA } (\pm 0.2 \text{ mA})$$

For 0-150 range, the relation is: $I_{out} = (T/9.375)+4$ (T= temperature in °C)

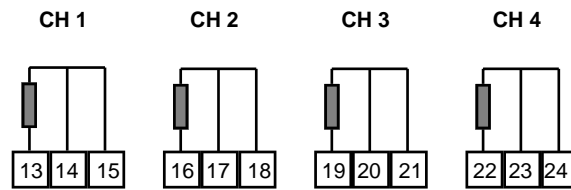
For 0-200 range, the relation is: $I_{out} = (T/12.5)+4$ (T= temperature in °C)

For -40 +200 range, the relation is: $I_{out} = (T/15)+6.7$ (T= temperature in °C)

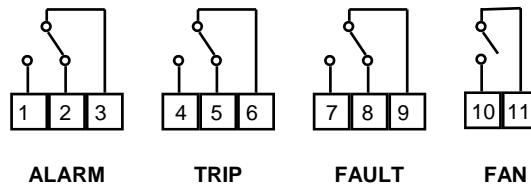
FIG.1

NT935 ELECTRICAL CONNECTIONS

Pt100 INPUTS



ALARM RELAY OUTPUTS





POWER SUPPLY
24-240 VAC-VDC

Pt100



OUTPUT 4.20 mA NT935



Note: In the version "420 Inside", FAN2 output is not available.

NOTES: