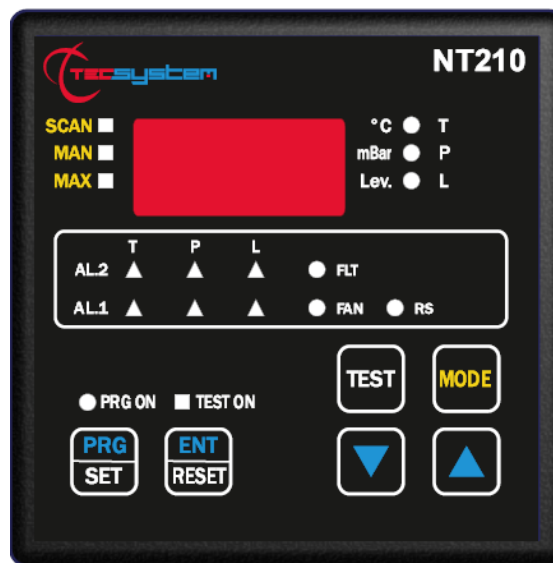# INSTRUCTION MANUAL

NT210 K
TPL503

1MN0079 REV. 0

operates with ISO9001:2008 certified quality system

TECSYSTEM S.r.l.
20094 Corsico (MI)
Tel.: +39-024581861
Fax: +39-0248600783

http: //www.tecsystem.it

R. 1.2 22/04/15

"Translations of the original instructions"

INTRODUCTION

First of all we wish to thank you for choosing to use a **TECSYSTEM** product and recommend you read this instruction manual carefully: You will understand the use of the equipment and therefore be able to take advantage of all its functions.

ATTENTION! THIS MANUAL IS VALID AND COMPLETE FOR THE NT210 K VERSION COMBINED WITH THE TRANSPARENT TPL503 SENSOR.

CONTENTS

SAFETY REQUIREMENTS

ATTENTION:

Read the manual carefully before starting to use the control unit. Keep the instructions for future reference.

Do not open the device, touching any internal components can cause electric shock. Contact with 110-240 Volts can be fatal. To reduce the risk of electric shock, do not dismantle the back of the device for any reason. Moreover its opening would void the warranty. B**efore connecting the device to the power supply, make sure that all the connections are correct.** Always disconnect the unit from the supply before any cabling modification.

Any intervention on the equipment must be entrusted to a qualified repair engineer

Failure to comply with these instructions can cause damages, fires or electric shock, and possible serious injuries!

POWER SUPPLY

The NT210 K series has UNIVERSAL power supply, i.e. it can be supplied by 24 to 240 Vac-Vdc, irrespectively of polarity in Vdc.
Before using it, make sure the power cable is not damaged, kinked or pinched. Do not tamper with the power cable. Never disconnect the unit by pulling the cable, avoid touching the pins. Do not carry out any connecting/disconnecting with wet hands. To disconnect the device, do not use objects such as levers. Immediately disconnect the device if you smell burning or see any smoke: contact technical service.

LIQUIDS

Do not expose the equipment to splashes or drops, do not position it in places with humidity exceeding 90% and never touch with wet or humid hands during storms. If any liquid penetrates the control unit, disconnect it immediately and contact technical service.

CLEANING

Disconnect the power cable before cleaning the control unit, use a dry cloth to dust it, without any solvent or detergents, and compressed air.

OBJECTS

Never insert any objects into the cracks of the control unit. If this happens, disconnect the control unit and contact an engineer.

USE RESERVED TO QUALIFIED PERSONNEL

The purchased goods are a sophisticated electronic device that is totally unsuitable to be used by non-qualified personnel. Any intervention must be carried out by a specialist engineer.

ACCESSORIES

The use of non-original accessories or spare parts might damage the unit and endanger users' safety. In the event of faults, contact technical service.

LOCATION

Install the control unit indoors, in a place protected from water splashes and sun rays. Do not place near heat sources exceeding the parameters stated in this manual. Position on a stable surface, far from any possible vibrations. Position the unit as far as possible from any intense magnetic fields.

REPAIRS

Do not open the control unit. For any fault, always use qualified personnel. The opening of the control unit and/or the removal of the series identifying label entails the automatic forfeiture of the warranty. The Warranty seal is applied to all devices, any attempt to open the unit would break the seal and cause the consequent automatic forfeiture of the warranty.

TECHNICAL INFORMATION

Mail: ufficiotecnico@tecsystem.it — tel: 02/4581861

ACCESSORIES

The following objects are present inside the box:

Control unit

Instruction manual CD

2 blocks for panel mounting
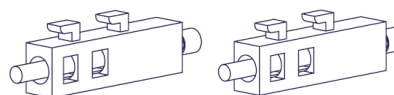
1 supply terminal 3 poles pitch 5
Code: 2PL0367

1 relay terminal 11 poles pitch 5
Code: 2PL0359
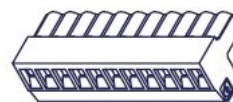
1 RS485 terminal 3 poles pitch 3.81
Code: 2PL0366

1 TPL503 sensor Tecsybus terminal 4 poles pitch 3.81
Code: 2PL0368

1MN0030 REV. 1

ATTENTION: always install the device using the terminals included in the pack. The use of terminals other than those included with the control unit might cause malfunctions.

TECHNICAL SPECIFICATIONS	NT210 K
POWER SUPPLY	
Supply rated values	24-240 Vac-Vdc (50/60Hz)
Supply min/max values	20-270 Vac-Vdc (50/60Hz)
Vdc with reversible polarities	●
INPUTS	
Digital input for the connection with the TPL503 sensor	●
OUTPUTS	
2 alarm relays (ALARM AND TRIP) **SPDT**	●
1 fault sensor or operating failure (FAULT) relay **SPDT**	●
Output relay with 5A-250Vca-res COSΦ=1 contacts.	●
Ventilation management relay **SPST**	FAN
Power-link output (9Vdc 100 mA max.) to feed the TPL503 sensor.	●
COMMUNICATION	
RS485 Modbus RTU serial output	●
DIMENSIONS	
100x100 mm– din43700-depth 131mm (terminal block included)	Hole 92 x 92 mm
TEST AND PERFORMANCE	
Construction in compliance with CE regulations	●
Protection from electrical interference EN 61000-4-4	●
Dielectric strength 1500 Vac for 1 minute between relays and supply, relays and power-link, relays and RS485 input, power-link and supply, RS485 input and supply.	●
Ambient operating temperature from –20°C to +60°C	●
Humidity 90% non-condensing	●
Housing NORYL 94 _V0	●
Absorption 5VA	●
Data storage: 10 years minimum	●
Polycarbonate IP65 front	●
Electronic protection only on customer's request	Option
DISPLAY AND DATA MANAGEMENT	
1 x 13 mm display with 3 digits to display T-P-L values and messages	●
3 LEDs to show the displayed oil temperature (°C), pressure (mbar) and level.	●
6 LEDs to show the T-P-L alarm status	●

TECHNICAL SPECIFICATIONS	NT210 K
1 LED to show the correct connection of RS485 with TPL503	●
Temperature control: from 0°C to + 120°C	●
Oil pressure control: from -400 to 500 mbar (DEP indication for negative value)	●
Level control in 3 modes (FULL - ALARM - TRIP).	●
2 alarm thresholds (AL.1/AL.2) for temperature, pressure and level.	●
1 threshold for the quick increase of the programmable pressure (FPS)	●
1 threshold for the quick increase of the programmable pressure (FCD)	●
2 thresholds for ventilation ON-OFF control, controlled by the oil temperature	●
Incorrect programming warning	●
Selection of the data display mode between automatic and manual scan and memory.	●
Maximum temperature and pressure memory recorded since the last reset	●
Front alarm reset button	●
Sensor fault diagnostics (FLT)	●

TPL503 TECHNICAL SPECIFICATIONS	TPL503
POWER SUPPLY	
Direct connection to the Power-link source of the NT210 K control unit.	9VDC 100mA max
MEASURED QUANTITIES	
Oil temperature: from –20 to +120°C	●
Resolution: ±1°C	●
Accuracy: ±1% full scale value	●
Oil pressure: from -400 to 500 mbar	●
Resolution: ±10 mBar ±10 digit	●
Accuracy: ±2% full scale value	●
Level in 3 modes (FULL - ALARM - TRIP).	●
TEST AND PERFORMANCE	
T.P.L. parameter management in compliance with the IEC EN 20216-3/A standard	●
Protection from electro-magnetic interference IEC EN 61000-4-4	●
Dielectric strength 2500 Vac for 1 minute	●
Operating temperature of the electronic part: -20°C to + 85°C	●
Self-diagnosis circuit of the T-P-L sensors.	●
Maximum cable length: 100 m (4 wires AWG22/24, shielded, impedance 120 ohm)	●
Pressure sensor resistant to the corrosion of mineral oil.	●

TPL503 SENSOR INSTALLATION PROCEDURE

INTRODUCTION

The TPL503 sensor is fitted on the transformer cover in oil sealed box with integral filling.

The installation method is described below just for information purposes; the installer is fully responsible for the installation.

INSTALLATION PRECAUTIONS

The transformer must be disconnected.
The transformer dielectric fluid must be at ambient temperature (about 20°C).
The level of dielectric fluid must be slightly below the transformer cover.
The hole the TPL503 must be fitted on must be open.
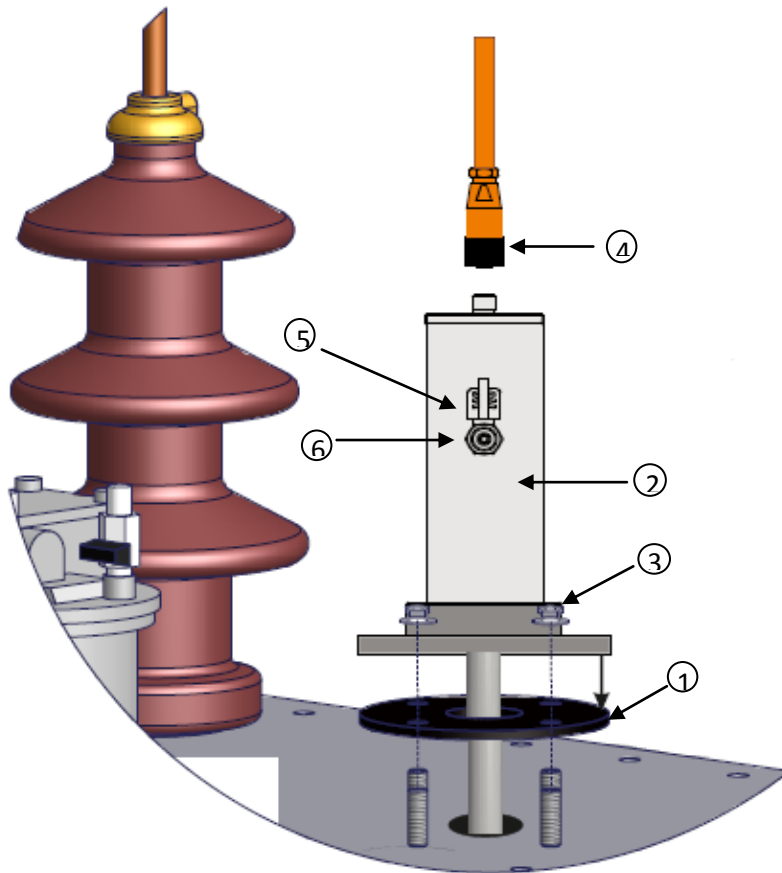The area the sensor is to be fixed to must be free from welding or painting residue and perfectly clean.

NECESSARY TOOLS

A 13x13mm spanner
A 5mm Allen wrench (inbus)

1MN0073 REV. 2

1)	Cork- rubber gasket	4)	Data and supply cable
2)	TPL503 sensor	5)	Air release tap
3)	Flange fixing bolts and washers	6)	Air release tap plug

STEP BY STEP DESCRIPTION pictures on page 8.

NOTE: the temperature of the oil during installation must be about 20°C.

1) Insert the cork rubber (1) into the appropriate hole in the transformer cover, following the suitably sized hole centering on the transformer fixing pins.

2) Insert the TPL503 sensor (2) immediately over the seal.

3) Insert the 4 washers (3) with the knurled part facing downwards.

4) Insert the bolts (3) onto the fixing pins and screw them in, use the 13x13 spanner, tighten but without straining (strength recommended 3 m.Kg).

5) Check that the air release tap (5) is OFF.

6) Remove the plug on the air release tap (6), use the 5mm Allen wrench (tighten but without straining).

7) Remove the protection cap on the data / supply connector.

8) Connect the data / supply cable (4), tighten the connector manually, TPL503 connection on page 15.

9) Finish filling the transformer.

10) Open the release tap (6), position ON, until the oil shows no air bubbles (sensor air bleeding), turn the tap to the OFF position. Repeat the operation until all the air is released.

Attention: bleeding must be carried out taking into consideration the transformer operating conditions, with the transformer switched off and a temperature of about 20°C; the installer or maintenance engineer takes full responsibility for this operation.

ON

OFF

11) Insert the tap plug (6) and screw fully in, using the 5mm Allen wrench.

12) Zero the pressure sensor, see page 16.

13) With the transformer switched off, check the values displayed by the control

unit: Temperature (ambient) - Pressure (000) - Level (full)

NOTES ON THE ASSEMBLY

The installation of the sensor must be carried out by a specialized engineer following the above procedure carefully.

For the system to work correctly, the oil level must be in line with the release tap (6). The end of the stem (temperature measurement) is placed 10cm below the transformer cover.

Before starting the transformer, always check the bolts are tightened and bleed the air. The bolts loosening or the presence of air in the system might cause malfunctioning.

The presence of air bubbles might affect the level reading, therefore it is necessary to check there is no air in the system.

Filling or topping up the oil must be done with the transformer switched off and cold (ambient temperature about 20°C).

FRONT PANEL

NT210

1MN0079 REV. 0
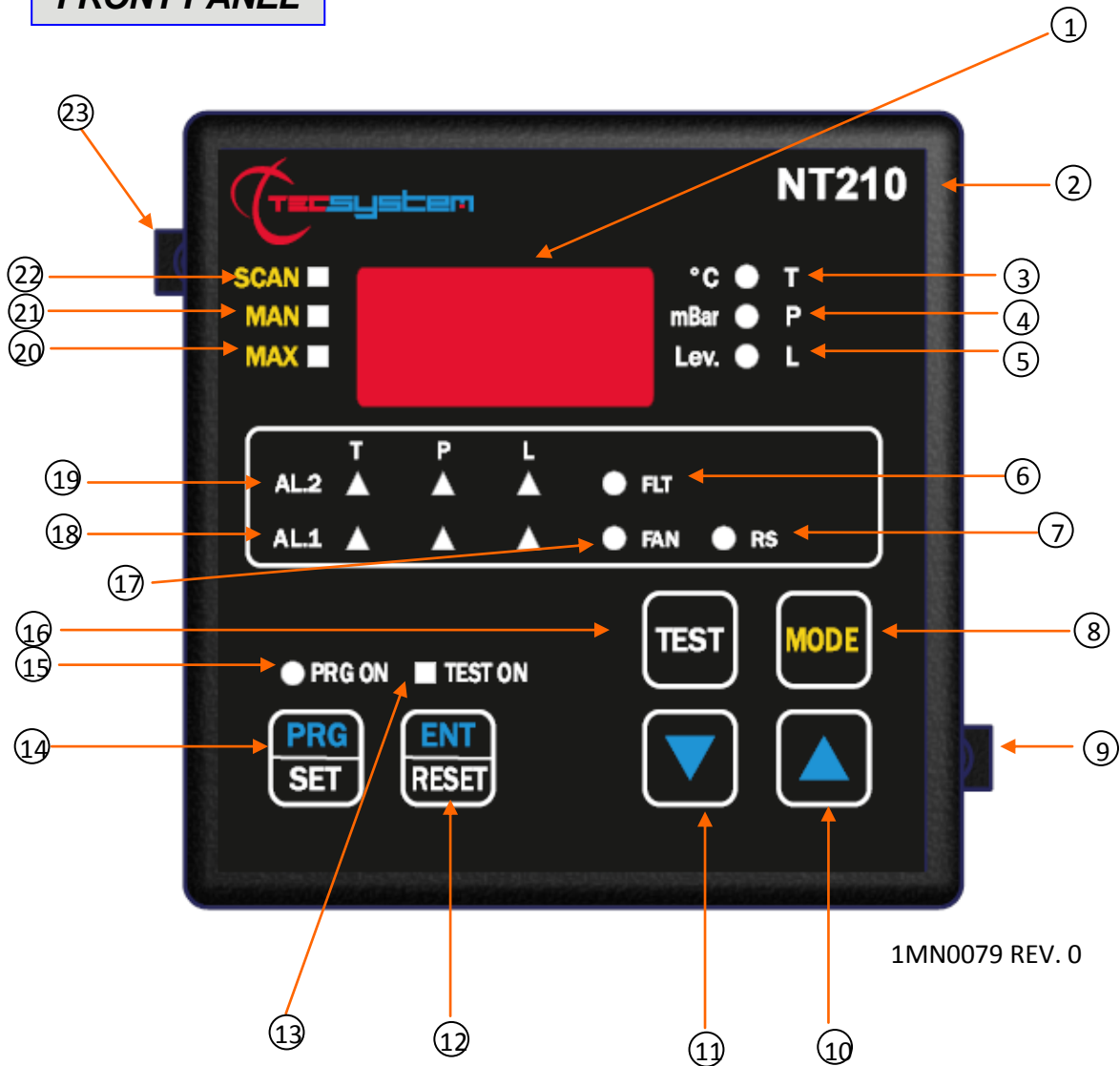
1)	3-digit display	13)	Relay ON test (yellow) LED
2)	Control unit series	14)	Programming button
3)	Temperature display (green) LED	15)	PRG ON (yellow) LED
4)	Pressure display (green) LED	16)	LED/relay test button
5)	Level display (green) LED	17)	FAN warning (green) LED
6)	FAULT warning (red) LED	18)	T-P-L alarm activation AL1 (red) LED
7)	RS communication (TPL503) (green) LED	19)	T-P-L alarm activation AL2 (red) LED
8)	Scanning mode selection button	20)	T-max mode selection (red) LED
9)	Fixing block	21)	Man mode selection (yellow) LED
10)	UP button	22)	Scan mode selection (yellow) LED
11)	DOWN button	23)	Fixing block
12)	Enter/Reset button		

DISPLAY

Pressing the MODE button, the display viewing modes are set:

- *SCAN*: the unit displays the T-P-L values scanned (every 2 seconds)
- *MAN*: manual reading of the T-P-L values using the up/down buttons
- *T.MAX*: the unit displays the maximum temperature and pressure values reached, the minimum level recorded and the possible alarms or faults that have occurred after the last reset.
  Select the channels with ▲▼, zero the values with RESET.

CHECKING THE WORK PROGRAM

To check the set protection levels, press the PRG button briefly.

Vis appears for 2 seconds, confirming you have entered viewing mode.

By pressing the PRG button repeatedly, all the previously set values are scrolled through in sequence.

After 1 minute's keyboard inactivity, the programming viewing procedure is automatically abandoned.

To end viewing, press the ENT button.

LED TEST

If one of the LEDS does not work, please return the control unit to TECSYSTEM for repair.

We recommend the unit LEDs are tested regularly.

For this operation press the TEST button briefly, all the displays light up for 2 seconds.

ALARM RELAY TEST

This function allows carrying out a test of the relay operation without having to use supplementary equipment.

To start the test procedure, keep the TEST button pressed for about 5 seconds: TST is displayed for 2 seconds, confirming you have entered the Relay Test mode.

The flashing LED shows the relay to be tested, select the desired LED with the sliders.

Press the SET and RESET buttons to energise and de-energise the relay to be tested, ON-OFF appears on

the display. After 1 minute's keyboard inactivity, the RELAY TEST procedure is automatically abandoned. To

end the RELAY TEST procedure, press the TEST button.

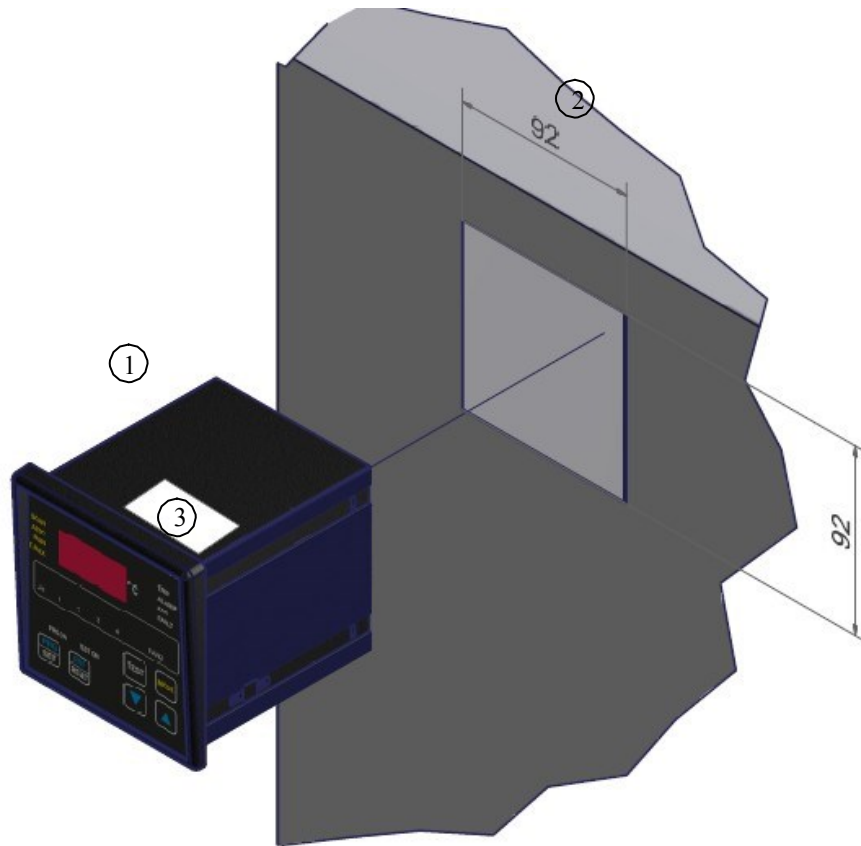### AL1 ALARM RELAY SILENCING

If you wish to silence the ALARM, press the RESET button: the relay is de-energised and the AL1 LED, that was ON, starts flashing.

Silencing is automatically disabled when the temperature goes below the alarm threshold.

MOUNTING

Drill a 92 x 92 mm hole in the panel sheet.

1MN0007 REV. 0

1)	Control unit	2)	Panel hole dimensions (+0.8mm tolerance)
3)	Identification label		

Fix the unit securely with the blocks supplied.
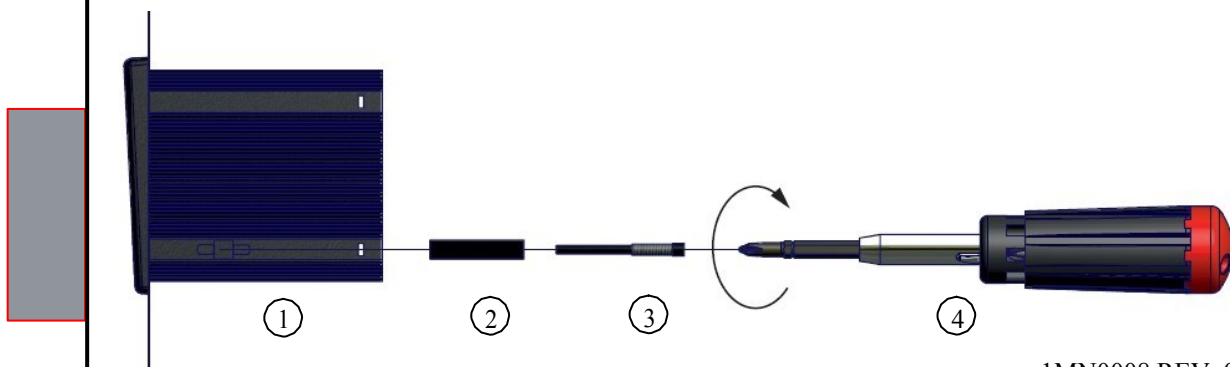
1MN0008 REV. 0

1)	Control unit	3)	Fixing screw
2)	Fixing block	4)	Crosshead screwdriver #1X100mm

NT210 K

ELECTRICAL CONNECTIONS

NT210 K
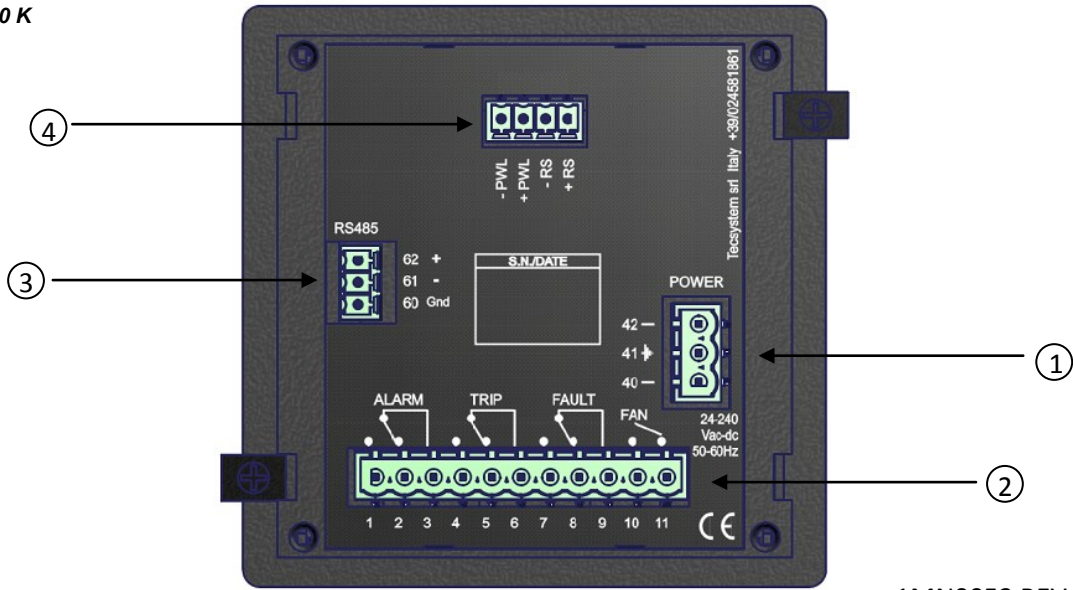
1MN0053 REV. 0

1)	Power supply (24-240 Vac-dc 50/60Hz)	3)	RS485 Output
2)	Relays (ALARM-TRIP-FAULT-FAN)	4)	TPL503 sensor connection

NOTE: Carry out the electrical connections on the removable terminal blocks only after disconnecting them from the unit.

SENSOR CONNECTION
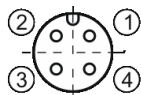
Connector

Connector connection colours:

1.   + RS white
2.   + PWL brown
3.   - PWL black
4.   - RS Blue

RELAY CONNECTION EXAMPLE

Output relay with 5A-250Vac-res COSΦ=1 contacts

Note: with the power to the unit ON, the FAULT relay switches, contacts 8-9 open (NO) and 7-9 closed (NC), read paragraph *ALARMS AND* **VENTILATION page 14**

FAULT 8-9 NC: ALARM FAULT OR POWER OFF

FAULT 7-9: NC POWER ON

POWER SUPPLY

The NT210 K control unit has UNIVERSAL power supply, i.e. it can be supplied by 24 to 240 Vac-Vdc, (50/60 Hz) irrespectively of polarity in Vdc (terminals 40-42).

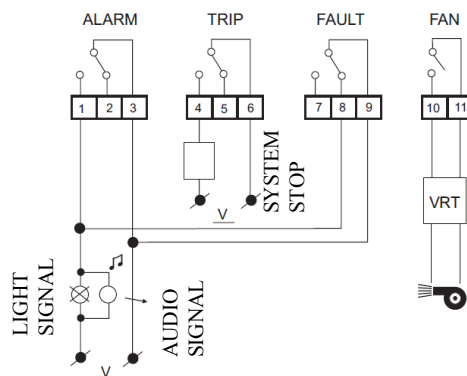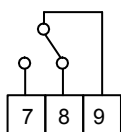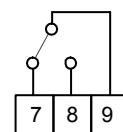This is obtained thanks to the use of a tested power supply unit, newly designed and manufactured, that frees installers from worrying about the correct Vac and Vdc supply.

Earth must always be connected to terminal 41.

When the unit is supplied directly by the secondary of the transformer to be protected, it can be burnt out by strong overvoltages.

This happens if the main switch is closed and the transformer has no load (blank test). The above is much more obvious when the voltage of 220 Vac is taken directly from the bars of the transformer secondary and there is a fixed bank of capacitors to correct the power factor of the transformer itself.

> *To protect the control unit from line overvoltages, we recommend using the electronic PT-73-220 surge limiter, designed by TECSYSTEM S.r.l. specifically for this purpose.*
> *Alternatively we recommend 24 Vac or, even better, 24 Vdc supply voltages are adopted.*

If an existing control unit must be replaced with a new one, to guarantee its correct and safe operation, the sensor/relay/supply connecting terminals <u>must</u> be replaced with the new terminals supplied.

⚠ **IMPORTANT WARNING**

Before carrying out the insulation test of the electrical panel the control unit is installed on, disconnect it from the power supply to prevent it from being seriously damaged.

ALARMS AND VENTILATION

When the control unit is in one of the modes mentioned below, it does not monitor the temperature and the relays are all blocked.

- Vis. programming display
- PRG Programming.
- Relay test.

The ALARM and TRIP relays switch only when the set temperature, pressure and level thresholds are exceeded.

The FAULT relay switches when the unit is powered, contacts 7-9 closed (NC) and 8-9 open (NO), and holds till one of the following events takes place:

- Data storage fault (Ech message).
- TPL503 sensor fault:

  1. ER0 -> communication error between TPL503 and NT210 K
  2. ER1 -> faulty TPL503 internal temperature sensor
  3. ER2 -> TPL503 electronic card temperature > than 85°C
  4. ER3 -> TPL503 electronic card temperature < than -20°C
  5. FLT T -> faulty oil temperature sensor
  6. FLT P -> faulty pressure sensor
  7. FCD -> quick increase in oil temperature (exceeding x °C/sec)
  8. FPS -> quick increase in oil pressure (exceeding x mbar/sec)

- Insufficient supply voltage.
- During the power on reset after programming (PRG) of the control unit (local or via Modbus).

NOTE: do not connect the FAULT relay to the transformer tripping circuit to avoid unwanted system interruptions.

The FAN contact can be used to control the cooling fans or it can be inserted into the air conditioning system of the room where the transformer is located.

NOTE: always disconnect the unit before performing any electrical connections.

COOLING FAN CONTROL

The NT210 K unit can control the cooling system of the oil temperature of the operating machine (i.e. ON at 80°C - OFF at 70°C).

FAN TEST

By programming (**HFn**), it is possible to have the fans operating 5 minutes every "*xxx*" hours, regardless of the column or ambient temperature values (i.e.: with HFn=001 the fans are activated for 5 minutes every hour).

This function aims at verifying the operation of the fans and their control apparatus periodically in periods when they would not be used for a long time.

Setting **000** as a value inhibits the function.

TPL503 CONNECTIONS

The TPL503210 is fitted with an M12 IEC 947-5-2 connector that must be connected to the control unit with the cable supplied, electrical connections are shown on page 13.

The signals present are power (POWER LINK) and data output (RS485). Note: All the

cables transferring signals must:

- be separated from the power cables
- be shielded cables with twisted conductors
- have at least 0.5 mm² section
- be twisted if there is no shield
- be firmly fixed inside the terminal boxes

PROGRAMMED DATA DIAGNOSTICS

In case of failure of the internal memory or alteration of the programmed data, at start-up **Ech** is displayed with the relative warning of the Fault contact.

In this case, for safety reasons, the default parameters are loaded automatically (see the programming table on pages 17 and 18 according to the model purchased).

Eliminate the **Ech** message by pressing RESET and enter the desired values.

Finally switch the unit off and back on to check the memory works correctly, if it is damaged **Ech** will be displayed again (send the control unit to TECSYSTEM srl for repair).

TEMPERATURE MEASUREMENT (T)

The reading of the temperature takes place using an RTD Pt100 sensor placed at the end of the stem.

When the temperature exceeds the set pre-alarm threshold by 1°C (AL.1) the ALARM relay switches and the ALARM LED comes ON while T. is displayed.

When the temperature exceeds the set alarm threshold by 1°C (AL.2) the TRIP relay switches and the TRIP LED comes ON while T. is displayed.

As soon as the temperature goes back to values equal to or lower than the threshold set for the **ALARM** and **TRIP** relays to switch, these relays deenergise and the relative LEDs switch off.

If the FCD function is activated and the set temperature increase speed is exceeded, the FAULT relay switches and FCD is displayed on the screen.

With FCD the ALARM and TRIP functions are inhibited. Press

RESET to cancel FCD.

PRESSURE MEASUREMENT (P)

The pressure reading is made by a sensor placed under the head, through the specially provided opening.
The reading range of the sensor is -400 to + 500 mbar, the display negative values is made by indication DEP and the relative value of depression.
Setting for ALARM and TRIP contains just the positive value 0 to + 500 mbar.

When the pressure exceeds the set pre-alarm threshold (AL.1) by 10mbar the ALARM relay (AL1) switches, the ALARM LED (AL1) comes on and P. is displayed. When the temperature exceeds the set pre-alarm threshold (AL2) by 10 mbar, the TRIP(AL2) relay switches, the TRIP LED comes on and P. is displayed.

As soon as the pressure goes back to values equal to or lower than the threshold set for the **ALARM** and **TRIP** relays to switch, these relays deenergise and the relative LEDs switch off.

If the FPS function is activated and the set pressure increase speed is exceeded, the FAULT relay switches and FPS is displayed on the screen. In this case the ALARM and TRIP functions are always active.

PRESSURE SENSOR ZEROING

To benefit from the precision offered by the electronic pressure sensor, we recommend the scale value is zeroed before starting the transformer that must be cold and stable at ambient temperature (±20°C):

1) Press the MODE button and go to MAX mode
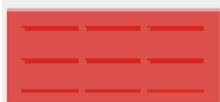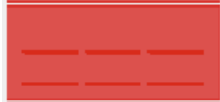2) Press MODE again without releasing it for 6 seconds until the control unit is reset.

This operation will allow compensating for any reading tolerances due to differences in altitude or transformer filling pressure.

For the system to be operating correctly the transformer must be cold.

LEVEL MEASUREMENT (L)

The level sensor measures quantity of oil into the sensor TPL503 case; the reading is expressed in three different modes:

When the level reaches 0 (L2 threshold activated), alarm AL2 is triggered due to the minimum level being exceeded and the TRIP relay switches.

Level value	Display	Gas formation / loss
FULL (3)		0 cm³/90 cm³
ALARM /AL1 (2)		100 cm³/180 cm³
TRIP /AL2 (1)		190 cm³ and more

By enabling the Alarm function or AL1 (YES), see programming on page 17, the alarm relay is triggered when the level reaches the loss value of 100 cm³, with NO the function is disabled.

By enabling the Trip function or AL2 (YES), see programming on page 17, the trip relay is triggered when the level reaches the loss value of 190 cm³, with NO the function is disabled.

The TPL503 must be installed so that the base end position corresponds to the minimum level below the transformer cover, below which the warning must be triggered and the transformer tripped.

 IMPORTANT WARNING

The stated oil volume/level values refer to the use of mineral oils with the following density: 888 Kg/m³ at the temperature of 15°C (mineral oil general specifications).

The presence of air bubbles inside the transformer is identified as formation of gas which can cause a decrease in the level indication and the activation of the Alarm and Trip signals.

PROGRAMMING

NT210 K

STEP	PRESS	EFFECT	PRESS	NOTES
1	● PRG ON PRG SET	Keep the PRG button pressed till the PRG-ON LED lights up. After PRG the temperature ALARM (AL1) threshold is displayed		
2		Set the desired threshold	▼ ▲	Default 80°C
3	PRG SET	The temperature TRIP (AL2) threshold is displayed.		
4		Set the desired threshold	▼ ▲	Default 90°C
5	PRG SET	The pressure ALARM (AL1) threshold is displayed		
6		Set the desired threshold	▼ ▲	Default 100mbar
7	PRG SET	The pressure TRIP (AL2) threshold is displayed.		
8		Set the desired threshold	▼ ▲	Default 200mbar
9	PRG SET	The level/gas ALARM (AL1) threshold is displayed		
10		Select YES or NO	▼ ▲	Default NO
11	PRG SET	The level/gas ALARM (AL2) threshold is displayed		
12		Select YES or NO	▼ ▲	Default YES
13	PRG SET	The Fan LED flashes and Yes/No is displayed		
14		Select YES or NO	▼ ▲	Default YES
15	PRG SET	ON is displayed		
16	PRG SET	The ON threshold of the FANS is displayed		Default 70°C
17		Set the desired threshold	▼ ▲	
18	PRG SET	OFF is displayed		

19	PRG SET	The OFF threshold of the FANS is displayed		Default 60°C
20		Set the desired threshold	▼ ▲	
21	PRG SET	HFN is displayed		Cyclical test of the fans for 5 minutes every "n" hours
22	PRG SET	Display 000		Default 000= function disabled
23		Set the desired number of hours	▼ ▲	Default 000
24	PRG SET	FCD <> "datum" is displayed		Fault due to quick temperature increase (°C/sec) Default NO
25		Set the desired value (see page 19)	▼ ▲	Default no "function excluded"
26	PRG SET	FPS <> "datum" is displayed		Fault due to quick pressure increase (mbar/sec) Default NO
27		Set the desired value (see page 19)	▼ ▲	Default no "function excluded"
28	PRG SET	ADR <> "datum" is displayed		Modbus address Default 001
29		Set the desired address	▼ ▲	From 1 to 255
30	PRG SET	BDR <> "datum" is displayed		Modbus transmission speed Default 9.6 Kb/s
31		Set the desired speed	▼ ▲	From 2.4 Kb/s to 38.4 Kb/s
32	PRG SET	PAR <> "datum" is displayed		Parity bit selection Default NO
33		Set the desired speed	▼ ▲	None (No), Even (EVE), Odd (ODD)
34	PRG SET	END is displayed		End of programming
35	ENT RESET	Storing the settings and exiting programming		Err: incorrect programming of the LED values (note 2)
36	PRG SET	Return to step 1		

1) *It is possible to go back to the previous step by pressing the MODE button.*
2) *If, when pressing ENT, "Err" is displayed, it means that one of the following errors have been made:*
   ALARM ≥ TRIP or FAN-OFF ≥ FAN-ON. Press PRG to go back to step 1 and correct the data.
3) *After 1 minute's keyboard inactivity programming is abandoned without saving the data.*
4) *At the end of programming the FAULT relay is disabled till the control unit is restarted.*
5) *During programming the control unit does not control/protect the monitored machine.*

⚠️ *ATTENTION:*

We recommend you check the control unit before starting the device.

The default parameters set by TECSYSTEM might not suit your requirements.

Programming the device is the end user's responsibility: the set alarm thresholds and the enabled functions described in this manual must be checked (by a specialized technician) referring them to the application and system characteristics on which the control unit is installed.

NOTES ON THE FCD FUNCTION

The NT series equipment boasts an innovative control function combined with the dynamic status of the Pt100 sensor inside the TPL503.

Activating FCD, the control unit analyses the increase in temperature ΔT (*) recorded in a second (**°C/sec**).

Enabling the function, the user can select the value (ΔT) from a minimum of 1°C/sec (2°F) to a maximum of 30°C/ sec. (54°F). If the value sensed is higher than the value set by the user, the control unit inhibits the possible activation of the ALARM and TRIP alarms and switches the FAULT relay (7-8-9), displaying the message **"Fcd fault".**

Example: if we set the function to 5°C, FAULT for FCD will switch only if the control unit senses an increase in ΔT of over 5°C in a second on the monitored system.

Setting "no" disables the FCD function.

When a channel is in FAULT for FCD, the Alarm and Trip warnings are inhibited; therefore only the quick temperature increase is highlighted.

Press Reset to delete the FCD warnings on all channels and reset the FAULT relay.

Possible FCD applications

Identification of a possible induced disturbance on the sensor line

If the installation instructions are not complied with (see TPL503 connections on page 15), any disturbance on the Pt100 sensor line may cause false readings or anomalous alarms.

Setting the FCD function in a temperature range of between 1°C and 10°C (5°C recommended), the effects caused by false readings can be suppressed and the alarm relay activation can be prevented, as shown above.

Corrective actions: check the installation of the sensor extension cable is in line with the instructions given in the paragraph on the TPL503 connections on page 15.

Identification of a sensor fault or faulty connection

In case of a faulty connection or sensor fault, a quick positive or negative variation in temperature might occur, leading to the system tripping or the alarms of the monitored system to be triggered.

In this specific case we recommend the FCD function to be set in a temperature range of between 10°C and 20°C.

(*) The ΔT value shows the temperature range for each second.

NOTES ON THE FPS FUNCTION

Activating the FPS function it is possible to monitor quick increases in pressure.

If the pressure exceeds the set value in a second, the FAULT relay switches and FPS is displayed on the pressure channel.

This increase can be set in steps of 10 mbar up to a maximum of 200 mbar.

Sensitivity is controlled by the value set, setting "no" disables the FPS function. Excessively low values might cause warnings too often, while excessively high values would do the opposite.

In case of FPS, the relative Alarm and Trip thresholds are always monitored. Press Reset to delete the FPS warnings and reset the FAULT relay.

NT210 K

MODBUS RS485 OUTPUT OPTION

INTRODUCTION TO THE MODBUS INSIDE MODULE

The MODBUS INSIDE expansion module is embedded in the control unit and allows transferring data on an RS485 network with MODBUS RTU protocol.

OPERATING NOTES

For the module to work correctly, the set-up parameters of the RS485 network must be set: address, baud rate, parity bits.

See programming steps 28 to 33 as shown in the table on page 18.

The serial communication of the temperature control unit is active only when the NT210 K is in temperature control mode in one of the modes provided (Scan, Man and T.Max).

When other functions such as programming, programming display and relay test are activated, the ModBus communication is temporarily disabled.

DATA TRANSMISSION ON MODBUS NETWORK

The MODBUS INSIDE internal module allows connecting the NT210 K control unit to an RS485 network with ModBus RTU protocol. In order to read/write data remotely, read the paragraph notes for remote programming on page 21. Note: the module is always in slave mode.

The NT210 K control unit communicates with the network only when it is in temperature reading mode, while it is inactive when it is in the following modes: display, programming and relay test.

RS485 ELECTRICAL CONNECTIONS

As to the signal cable to use in order to guarantee correct network operation, follow standard EIA RS485 that recommends the use of a 24AWG pair.
The pair that connects all the units in RS485 might require a 120 ohm terminating resistor on the last unit of the series. Connect the pair taking polarities into account and lay the network avoiding to create tight bends or ring windings so as not to change the line impedance. Place always the cable away from the power cable.
If necessary, the terminal for the GND earth connection is available.

DATA FRAME

The frame in asynchronous transmission consists of: 1 start bit, 8 data bits, 1 parity bit (even or odd if parity has been set) and 1 stop bit.
The allowed Baud rates are: 2400, 4800, 9600, 19200, 38400.
Where unspecified, the length of the words (DATA) is 16 bits.

DATA PACKET

A complete sequence of request/answer consists of the following: Master request:

SLAVE ADDRESS   - 1 byte
FUNCTION CODE   - 1 byte
DATA   - variable, depends on the function code
CRC   - 2 bytes

Slave request:

SLAVE ADDRESS   - 1 byte
FUNCTION CODE   - 1 byte
DATA   - variable, depends on the function code
CRC   - 2 bytes

FUNCTION CODE

The ModBus module supports the following function codes:

3(10):   - holding register reading

16(10):   - multiple register writing

If ModBus receives a message and the presence of a CRC error is confirmed, no answer is given.

CODE 3(10).

Request:
Slave address, code 3(10), Starting address HI, Starting address LO, Number of Point HI, Number of Point LO, Crc LO, Crc HI.

Answer:
Slave address, code 3(10), Byte count, Data HI, Data LO......., Crc LO, Crc HI.

CODE 16(10).

Request:
Slave address, code 16(10), Starting address HI, Starting address LO, Number of Point HI, Number of Point LO, Byte count, Data HI, Data LO......., Crc LO, Crc HI.

Answer:
Slave address, code 16(10), Starting address HI, Starting address LO, Number of Register HI, Number of register LO, Crc LO, Crc HI.

The writable registers contain the following data: Alarm, Trip, Fan-on, Fan-off.
So the possible starting addresses are: **00-17** for alarm and fan, **00-25** for the Trip thresholds. The Number of Point LO parameter can be set only to 8.

If a writing request is sent to an address other than the above, ModBus shall answer with an error code 02 (incorrect data address).

If a writing request is sent for more than 8 registers (Number of point LO), ModBus will not be able to accept the request and will not answer, so the request will time out.

NOTES FOR REMOTE PROGRAMMING

If an NT210 K needs to be programmed, it is necessary to remember that the Temperature, Pressure and Level alarm settings must be modified selecting 8 registers at a time (registers 00-17, 00-18 .... 00-24).

The same must be remembered for the Trip thresholds (registers 00-25, 00-26 .... 00-32) and for each quantity measured (Temperature, Pressure, Level).

Note: the Alarm level thresholds must be programmed in the register number 20 selecting 2 for active the function. The Trip level thresholds must be programmed in the register number 28 selecting 1 for active the function.

Also in the remote programming stage via ModBus it is necessary to consider that the Alarm thresholds must be lower than the Trip thresholds and that the Fan-on thresholds must be higher than the Fan-off thresholds.

If an attempt is made to set these thresholds incorrectly, the NT210 K control unit will not set and store the data, so the data of the previous programming will not be changed.
Before restarting ERR is displayed.

After sending a writing request the control unit will take about 1" to store the data in eeprom; while storing the ModBus module will not be able to process any other requests.
If the programming request is successful, the control unit resets automatically and loads the new values. Before restarting PRG is displayed.

ERROR CODES (exception code)

If the request is incorrect, ModBus will answer with modified codes and codified errors as follows:

1.   Unsupported function code
2.   Incorrect data address
3.   Incorrect data (i.e. length)

POLLING FREQUENCY

The maximum time to answer a call never exceeds a second, so we recommend shorter polling frequencies are not adopted.

MODBUS MAPPING TABLE

Address HI (10)	Address LO (10)	Data HI	Data LO	Primary tables	Notes
00	01	00	Oil temperature	Holding register	Temperature Range -40+120° DATA LO -50$_{(10)}$
00	02	00	Oil pressure HI	Holding register	mbar see note page 22.
00	03	00	Oil pressure LO	Holding register	mbar see note page 22.
00	04	00	Oil level	Holding register	1-2-3, see level indication page 16.
00	05	00	TPL503 sensor temperature	Holding register	Temperature Range -40+120° DATA LO -50$_{(10)}$
00	06	00	Not used	Holding register	
00	07	00	Oil pressure	Holding register	mbar/10 see note page 22.
00	08	00	Not used	Holding register	

NOTE: The pressure is readable in the form of mB of 0 to 500 bytes of HI (register 2) and LO byte (register 3).
Or it is available in the form of mBar / 10 (single byte register 7).

The sign is present in bit 6 of the flag FLG_GEN register 49 (HI + sign pressure, LO sign - and then depression).

Address HI (10)	Address LO (10)	Data HI	Data LO	Primary tables	Notes
00	09	00	Oil temperature status	Holding register	See note 1 on page 27
00	10	00	Oil pressure status HI	Holding register	
00	11	00	Oil level status	Holding register	
00	12	00	Not used	Holding register	
00	13	00	Not used	Holding register	
00	14	00	Not used	Holding register	
00	15	00	Not used	Holding register	
00	16	00	Not used	Holding register	
00	17	00	Oil Temperature Set Alarm	Holding register	°C
00	18	00	Oil Pressure HI Set Alarm	Holding register	mbar
00	19	00	Oil Pressure LO Set Alarm	Holding register	mbar
00	20	00	Oil Level Set Alarm	Holding register	2 = enabled 0 = disabled
00	21	00	Fan On	Holding register	°C
00	22	00	Fan Off	Holding register	°C
00	23	00	Oil Pressure Alarm	Holding register	mbar/10
00	24	00	Not used	Holding register	

Address HI (10)	Address LO (10)	Data HI	Data LO	Primary tables	Notes
00	25	00	Oil Temperature Trip	Holding register	°C
00	26	00	Oil pressure Trip HI	Holding register	mbar
00	27	00	Oil pressure Trip LO	Holding register	mbar
00	28	00	Oil level Trip	Holding register	1 = enabled 0 = disabled
00	29	00	Oil pressure Trip	Holding register	mbar/10
00	30	00	Not used	Holding register	
00	31	00	Not used	Holding register	
00	32	00	Not used	Holding register	
00	33	00	Hfn	Holding register	See page 15
00	34	00	Fcd	Holding register	See page 19
00	35	00	Fps	Holding register	See page 19
00	36	00	Not used	Holding register	
00	37	00	Not used	Holding register	
00	38	00	Not used	Holding register	
00	39	00	Not used	Holding register	
00	40	00	Not used	Holding register	

NOTE : AL1 = ALARM, AL2 = TRIP.

Address HI (10)	Address LO (10)	Data HI	Data LO	Primary tables	Notes
00	41	00	Oil T.max	Holding register	Temperature Range -40+120° DATA LO -50(10)
00	42	00	P.max HI	Holding register	mbar
00	43	00	P.max LO	Holding register	mbar
00	44	00	Oil minimum level	Holding register	1-2-3, see level indication page 16.
00	45	00	Oil Temperature alarm history	Holding register	See note 2 on page 28.
00	46	00	Oil Pressure alarm history	Holding register	
00	47	00	Oil Level alarm history	Holding register	
00	48	00	Not used	Holding register	
00	49	00	FLG_GEN	Holding register	See note 3 on page 28.
00	50	00	FLG_GEN2	Holding register	
00	51	00	Not used	Holding register	
00	52	00	Not used	Holding register	
00	53	00	Not used	Holding register	
00	54	00	Not used	Holding register	
00	55	00	Not used	Holding register	
00	56	00	Not used	Holding register	

Address HI (10)	Address LO (10)	Data HI	Data LO	Primary tables	Notes
00	57	00	Not used	Holding register	
00	58	00	Not used	Holding register	
00	59	00	Not used	Holding register	
00	60	00	Not used	Holding register	
00	61	00	Not used	Holding register	
00	62	00	Not used	Holding register	
00	63	00	Not used	Holding register	
00	64	00	Not used	Holding register	
00	65	00	Not used	Holding register	
00	66	00	Not used	Holding register	
00	67	00	Not used	Holding register	
00	68	00	Not used	Holding register	
00	69	00	Not used	Holding register	

Address HI (10)	Address LO (10)	Data HI	Data LO	Primary tables	Notes
00	70	00	Not used	Holding register	
00	71	00	Not used	Holding register	
00	72	00	Not used	Holding register	
00	73	00	Not used	Holding register	
00	74	00	Not used	Holding register	
00	75	00	Not used	Holding register	
00	76	00	Not used	Holding register	
00	77	00	Not used	Holding register	
00	78	00	Not used	Holding register	
00	79	00	Not used	Holding register	
00	80	00	Not used	Holding register	

NOTE 1: STATUS REGISTER

The status register contains information on the status of the alarms of the channel it refers to. Each bit represents a flag that is active only when its value is 1.

OIL TEMPERATURE STATUS							
B7	B6	B5	B4	B3	B2	B1	B0
TRIP	ALARM	FREE	FAN	FREE	FREE	FCD	FREE

OIL PRESSURE STATUS							
B7	B6	B5	B4	B3	B2	B1	B0
TRIP	ALARM	FREE	FREE	FREE	FREE	FPS	FREE

OIL LEVEL STATUS							
B7	B6	B5	B4	B3	B2	B1	B0
TRIP	ALARM	FREE	FREE	FREE	FREE	FREE	FREE

TPL503 210 TEMPERATURE STATUS							
B7	B6	B5	B4	B3	B2	B1	B0
FREE	ER3	ER2	FLT-P	ER1	FREE	FREE	FLT-T

NOTE 2: ALARM HISTORY REGISTER

The status register contains information on the storage of the alarms of the channel it refers to.

Each bit represents a flag that is active only when its value is 1.

OIL TEMPERATURE ALARM MEMORY							
B7	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
TRIP	ALARM	FREE	FAN	FREE	FREE	FREE	FREE

OIL PRESSURE ALARM MEMORY							
B7	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
TRIP	ALARM	FREE	FREE	FREE	FREE	FREE	FREE

OIL LEVEL ALARM MEMORY							
B7	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
TRIP	ALARM	FREE	FREE	FREE	FREE	FREE	FREE

NOTE 3: GENERAL FLAG REGISTER

The general function register contains information on the enabling of general functions

FLG_GEN: GENERAL FLAGS							
B7	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
FREE	PRES/DEP	FREE	SYSTEM FLAG	ECH EE- PROM ERR	FAN TEST IN PROGRESS	ALARM1 RESET	SYSTEM FLAG

FLG_GEN2: GENERAL FLAGS							
B7	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
FREE	SYSTEM FLAG	SYSTEM FLAG	SYSTEM FLAG	ErO TPL503 timeout	SYSTEM FLAG	SYSTEM FLAG	SYSTEM FLAG

NOTE: The pressure is readable in the form of mB of 0 to 500 bytes of HI (register 2) and LO byte (register 3).
Or it is available in the form of mBar / 10 (single byte register 7).

The sign is present in bit 6 of the flag FLG_GEN register 49 (HI + sign pressure, LO sign - and then depression).

NOTE 4: TPL503 STATUS FLAG

Each bit represents a flag that is active only when its value is 1.

When the flag is active it means the sensor, even if powered, is not working because no circulating current is sensed (presence of no-load voltage). The sensor is very likely faulty or incorrectly connected.

CRC CALCULATION

This protocol includes 2 CRC-16 bytes in each transmission. The characteristic polynomial (11000000000000101B) is used for the calculation and the result is "hung" at the end of the packet. The polynomial is used in reverse order with the most significant bit suppressed because useless for the purpose of the calculation.

PARAMETER DESCRIPTION

A - 16bit AL
register - A low
part AH - A high
part i,j - METERS
(+) - EXCLUSIVE OR
Di - Datum of the «i»th frame of the packet
N - number of bytes in the packet excluding the 2 of
the CRC G - Polynomial: 1010-0000-0000-0001
shr - shift to the right

ALGORHITHM

1)   0xFFFF -> A
2)   0 -> i
3)   0 -> j
4)   Di (+) AL -> AL
5)   j +1 -> j
6)   shr A
7)   if carry then G (+) A -> A
8)   if NOT j=8 then go to 5
9)   i +1 -> i
10) if NOT i = N then go to 3
11) A -> in CRC (the result is in order L,H)

WARRANTY REGULATIONS

The purchased product is covered by manufacturer's or seller's warranty as per the "Tecsystem s.r.l.'s General Conditions of Sale" available at www.tecsystem.it and/or the purchase agreement drawn up.

Said Warranty is valid only when the Product fails due to reasons attributable to TECSYSTEM srl, such as manufacturing faults or faulty components.

The Warranty is invalid when the product is tampered with / modified, connected incorrectly, causing voltages outside the permitted limits, non-compliant with the use and installation technical specifications, as described in this instruction manual.
The Warranty is always ex our Corsico works, as stated in the "General Conditions of Sale".

TROUBLESHOOTING	CAUSES AND *SOLUTIONS*
The control unit does not switch on and the supply to terminals 40-42 is correct.	Check that: the connector is correctly inserted into its housing, the wires are tightened, there is no evidence of burning on the connectors. Disconnect the power supply, carry out the above and reconnect.
On startup "ECH" is displayed	Strong disturbance has damaged the data in the memory. See the paragraph Programmed data diagnostics on page 15.
The display shows ER0	Check the connecting cable between the TPL503 sensor and the NT210 K control unit: the connector must be fully pushed in, the wires must be tightened.
The main switch has been tripped unexpectedly.	Check the T.P.L. values recorded in MAX, check the oil level in the transformer.
FCD or FPS warning.	See the FCD or FPS function on page 19.
Contact *TECSYSTEM Technical Department if the problem persists.*	

EQUIPMENT DISPOSAL

European directives 2012/19/EC (WEEE) and 2011/65/EC (RoHS) have been approved to reduce electrical and electronic waste and promote the recycling and reuse of the materials and components of this equipment, cutting down on the disposal of the residues and harmful components of electrical and electronic materials

All the electrical and electronic equipment supplied after 13 August 2005 is marked with this symbol, pursuant to the European directive 2002/96/EEC on electrical and electronic waste (WEEE). Any electrical or electronic equipment marked with this symbol must be disposed of separately from normal domestic waste.

Returning used electrical devices: contact TECSYSTEM or the TECSYSTEM agent for information on the correct disposal of the devices.

TECSYSTEM is aware of the impact its products have on the environment and asks its customers active support in the correct and environmentally-friendly disposal of its devices.

USEFUL CONTACTS

TECHNICAL INFORMATION: ufficiotecnico@tecsystem.it

COMMERCIAL INFORMATION: info@tecsystem.it