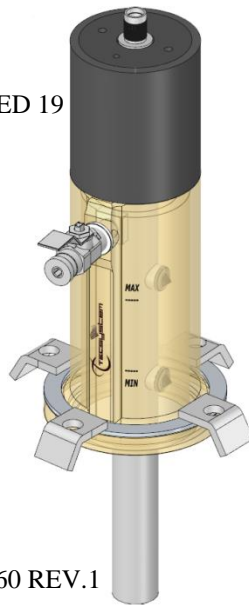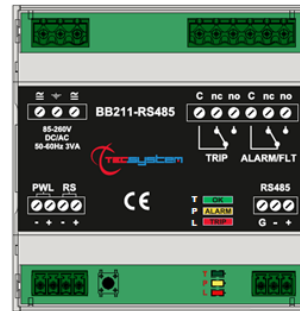INSTRUCTION MANUAL

BB211+TPL503

TPL503 ED 19

1MN0160 REV.1

1MN0149 REV.0

operates with ISO9001 certified quality system

http://www.tecsystem.it

R. 1.7 05/12/23

ENGLISH

"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 BB211 RS485 AND BB211 RS232 CONTROL UNITS + TPL503 (ED19)

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 voltage exceeding 50 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.

Before 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 work 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 BB211 control unit can be supplied by 85 to 260 Vdc-Vac, irrespectively of polarity in Vdc.
Before using it, make sure the power cable is not damaged, knotted 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. 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 work must be carried out by a specialist engineer.

ACCESSORIES
The use of non-original accessories or spare parts can 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

TECHNICAL SPECIFICATIONS TPL503	TPL503
POWER SUPPLY	
Direct connection with the Power-link source of the BB211 control unit	9VDC 100mA max
MEASURED VALUES	
Oil temperature: from –40 to +120°C	•
Temperature resolution: 1°C	•
Temperature precision: ±1% v.f.s ± 1 digit	•
Relative oil pressure: from –400 to 500 mbar	•
Pressure resolution: 10 mbar	•
Pressure precision: ±2% v.f.s ± 10 digit	•
Level in 3 modes (FULL - ALARM - TRIP)	•
TESTS AND PERFORMANCE	
Dielectric strength test 2500 Vac for 1 minute	•
IP rating TPL503	IP67
Sensor head in 50μ anodized aluminum	•
Operating temperature of the electronic part as EN 60076-11	•
Oil leakage test 100KPa at 90°C for 30min.	•
Pressure test 250KPa at 115°C for 2min.	•
TPL connection cable	40mt max

ATTENTION: The TPL503 version ED19 is supplied with: fixing brackets in AISI 316 stainless steel, air bleeding tap in AISI 316 stainless steel, AISI 316 stainless steel base disk

TPL503 MOUNTING

INTRODUCTION

The TPL503 sensor has to be installed on the top cover of the oil transformers with hermetic tank and integral filling.

The installation method described below is just an indication: the installer is wholly responsible for the installation.

At the end of the stem there is the oil temperature sensor.
Inside the head of the TPL503 is located the sensor for reading the absolute pressure inside the transformer (**PAT**).
The BB211 measures ambient pressure (**PAMB**) and obtains the relative pressure value inside the transformer (**PRT**) according to the following report: **PRT = PAT - PAMB**
PAT = absolute transformer pressure
PAMB = ambient pressure

INSTALLATION PRECAUTIONS

The BB211 has not be installed inside a tin container that could be pressurized or depressed.
The transformer must be switched off.
The transformer dielectric must be at ambient temperature (about 20°C).
The level of the dielectric must be slightly below the transformer lid.
The hole of the TPL503 must be open.
The sensor fixing area must be: flat, free from welding or painting residues and perfectly clean.
In order to avoid malfunctions of the pressure sensor, never over turn the TPL503 sensor upside down. The eventual oil inlet, with overturn sensor, could cause reading anomalies.

TPL503

1

2

NECESSARY TOOLS

1) A 13mm spanner.
2) A 14mm spanner.
3) 4/5mm Allen key

3

TPL503 KIT COMPONENTS

1) M12 connector + sensor cable
2) TPL503 sensor
3) O-ring head sensor
4) PPSU transparent base
5) O-ring base Viton
6) 4 x base fixing brackets

4

FIXING COMPONENTS

1) 4 x bracket washers stainless 316
2) 4 x base fixing bolts stainless 316

NOTE: the bolts and washers used to fix the sensor are not supplied by Tecsystem and must therefore be purchased separately.

5

6

1MN0160 REV.1

BB211+TPL503

TPL503 DIMENSIONS

1MN0160 REV.1

Length		Size (mm)
A	Length	312
B	TPL stem	100
C	Stem diameter	22
D	Fixing base	85
E	TPL base connection	58.5

FIXING NOTES:

Do not carry out operations with hot oil. Secure the transformer before working on the machine.

The installation of the sensor must be carried out by a qualified engineer and follow faithfully the assembly procedure explained on page 8.

For the system to work properly, the oil level must be in line with the bleeding valve.

The end of the stem (temperature measurement) is 10 cm below the transformer; always comply with the safety distance from the transformer live parts.

The hole to insert the TPL base into must have a diameter of 60mm (±0.5mm).

The fixing pins must be 4 (spread at 90°) or 3 (spread at 120°), screw pin M8 diameter position pins 98mm.

Always check the bolts and bleeding valve are tightened properly before starting the transformer.

If the bolts are not tightened or there is air in the system, this might cause malfunction.

The presence of air bubbles may lead to alterations in the reading of the level or pressure, it is therefore appropriate there are none.

Filling or topping up the oil must be carried out with the transformer OFF and cold (ambient temperature 20°C).

TPL503 FITTING NUMBERING

1) Hole Ø 60mm (±0.5mm).

2) M8 transformer fixing pins H = 27mm

3) TPL503 O-ring base

4) 4 x bolts, 4 x fixing washers and 4 x fixing brackets

5) Fixing TPL base

6) Air bleeding valve

7) O-ring sensor head

8) TPL503

9) M12 connector + sensor connecting cable

1MN0160 REV.1
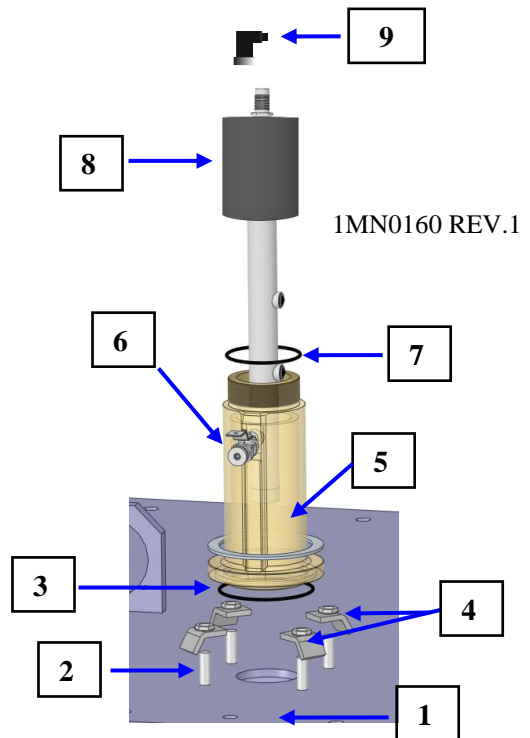
ASSEMBLY PROCEDURE

1) Insert the O-ring base gasket (3) and fit the TPL base (5) onto the appropriate hole on the transformer cover (1).

2) Insert the brackets (2) onto the transformer fastening pins (1).

3) Insert the 4 washers (4) onto the transformer fastening pins (1).

4) Insert the 4 bolts (4) onto the fastening pins and screw them in, using the 13x13 spanner, tighten firmly but smoothly (tightening force 6 N.m).

5) Check that the air bleeding valve (6) is in the closed position.

6) Complete filling the transformer, 4 cm below the air bleeding valve (6).
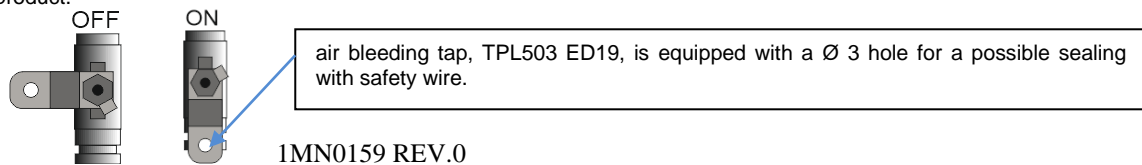
7) Position the O-ring head gasket (7) onto the base, screw the TPL503 sensor (8) in as far as it will go (tightening force 10 N.m).

8) Remove the protection cover on the connector (9).

9) Connect the sensor cable M12 connector (9), manually tighten the connector (TPL503 connection page 16).

10) Open the bleeding valve (6), to level the oil with the valve (sensor air bleed), close the valve (tightening force 1.5 N.m).

NOTE: carry out the bleeding operation using the 14mm spanner and a 4/5mm allen key, in order to keep the bleed valve firm.

Attention: bleeding must be done taking into consideration the transformer operating conditions, with the transformer switched off and a temperature of about 20°C. The installer or maintenance engineer is fully responsible for this operation.

NOTE: the sensor and the TPL base must be cleaned using only with a dry cloth.

The TPL503 version ED19 is supplied with AISI 316 ON / OFF stainless steel air bleeding tap. When filling is complete, always, checking that the tap is in the OFF position. It is also advisable to apply the closing cap supplied with the product.

air bleeding tap, TPL503 ED19, is equipped with a Ø 3 hole for a possible sealing with safety wire.

1MN0159 REV.0

The **MAX** and **MIN** indications, shown on the TPL body, can be used, when topping up the transformer to adjust the oil level: between the value of Alarm (pre-alarm) and the maximum level (in line with the tap of purge).

1MN0160 REV.1
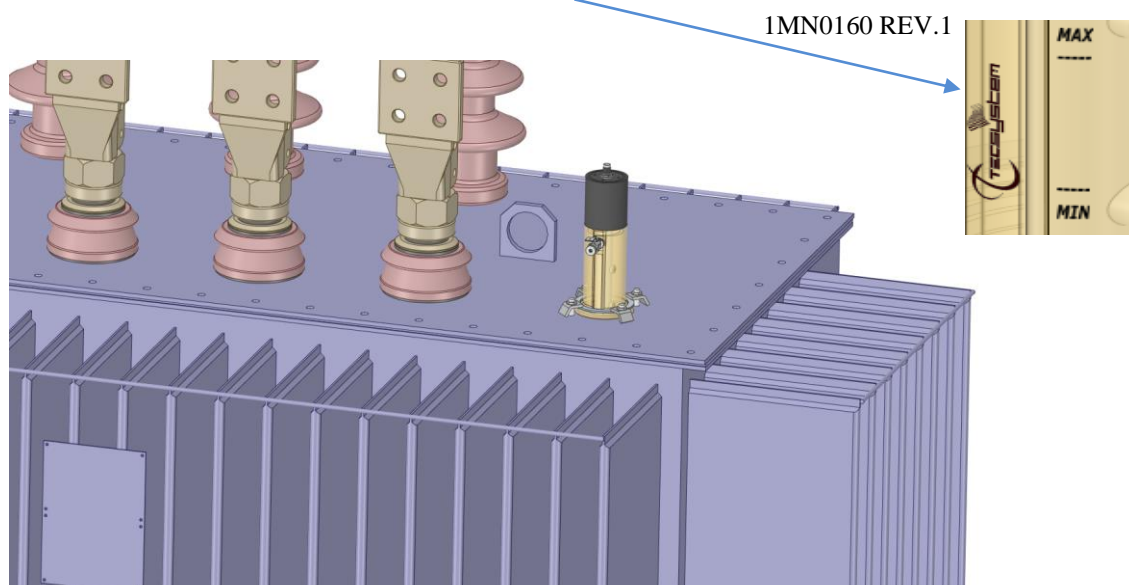
TECHNICAL SPECIFICATIONS BB211	BB211 RS485	BB211 RS232
POWER SUPPLY		
Power supply values	85-260 Vdc-Vac 50/60Hz (*)	85-260 Vdc-Vac 50/60Hz (*)
Vdc with reversible polarities	●	●
INPUTS		
Digital input for the connection with the TPL503 sensor	●	●
Connections to removable terminals	●	●
Input protected against electromagnetic interference	●	●
Compensation of cable maximum length	40m	40m
OUTPUTS		
1 alarm relay (ALARM / FAULT) SPDT	●	●
1 alarm relay (TRIP) SPDT	●	●
Output relays with COM-NC-NO	●	●
RTU Modbus RS485 output (**)	●	NO
RTU Modbus RS232 output	NO	●
DIMENSIONS		
88X93X62mm	DIN rail	DIN rail
TESTS AND PERFORMANCE		
Construction in compliance with CE regulations	●	●
Protection from electrical interference EN 61000-4-4	●	●
Dielectric strength 1500 Vac for a min. between: signal TPL and relays, relays and power supply, power supply and signal TPL	●	●

(*) Available on request in the BB211 RS485 or RS232 version with 24Vdc power supply.
(**) Ethernet output available via CONV. ETH

TECHNICAL SPECIFICATIONS BB211	BB211 RS485	BB211 RS232
Working temperature from -20°C to + 60°C	●	●
Humidity 90% non-condensing	●	●
IP20 protection	●	●
Blend PC/ABS UL 94V0 self-extinguishing housing	●	●
Demand 3VA	●	●
Self-diagnostic circuit	●	●
Protection treatment of the electronic part	Option	Option
DATA DISPLAY AND MANAGEMENT		
3 LEDs to display the status of the alarms (TEMPERATURE-PRESSURE-LEVEL)	●	●
Remote programming T.P.L parameter	●	●
Incorrect programming warning	●	●
Reset programming default key	●	●
T.P.L sensor diagnostics	●	●
Data memory diagnostics	●	●
T.P.L communication diagnostics	●	●
Memory of the maximum values reached parameters T.P.	●	●
T.P.L parameter alarm activation memory	●	●

BB211 ACCESSORIES

The following objects are present inside the box:

Control unit

Quick start guide and QR code
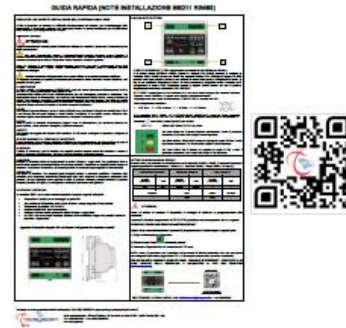
1 supply terminal 3 poles pitch 5
  Code: 2PL0367 - Screw tightening torque 0.5Nm

1 relay terminal 6 poles pitch 5
  Code: 2PL0372 - Screw tightening torque 0.5Nm

1 TPL connection terminal 4 poles pitch 3.81
  Code: 2PL0368 - Screw tightening torque 0.25Nm

1 RS485 / RS232 terminal 3 poles pitch 3.81
  Code: 2PL0366 - Screw tightening torque 0.25Nm

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.

BB211 MOUNTING

Secure the device to the DIN track and make the connections to the removable terminals.
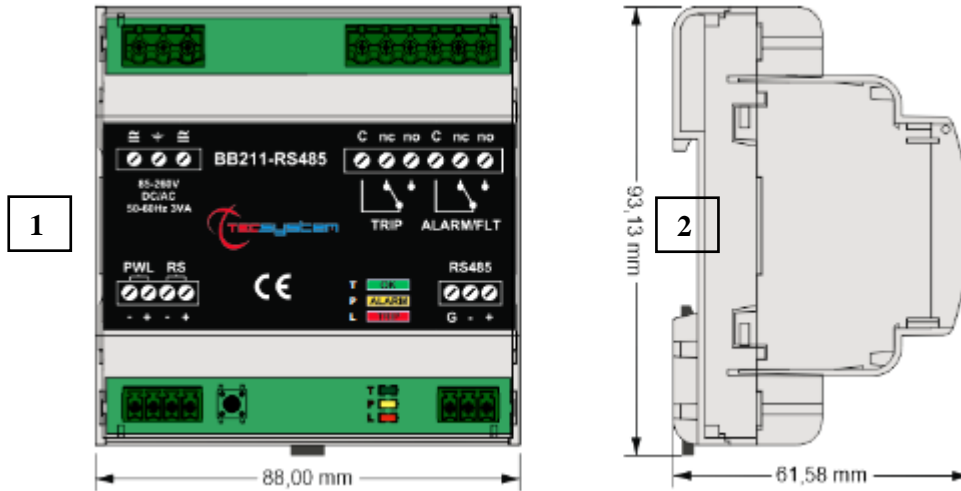
1MN0149 REV. 0

NOTE: the BB211 has not be installed inside a tin container that could be pressurized or depressed.

1)	BB211 control unit	2)	DIN track fixing

ELECTRICAL CONNECTIONS BB211 RS485
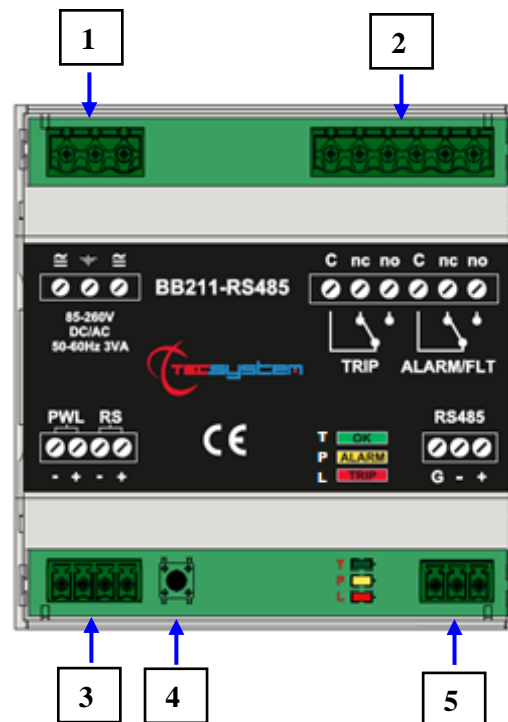
1MN0149 REV. 0

1)	Supply 85-260Vdc-ac 50/60Hz	4)	Reset key
2)	Relays (ALARM/FAULT-TRIP)	5)	RTU Modbus RS485 output
3)	Power Link RS TPL503		

ELECTRICAL CONNECTIONS BB211 RS232
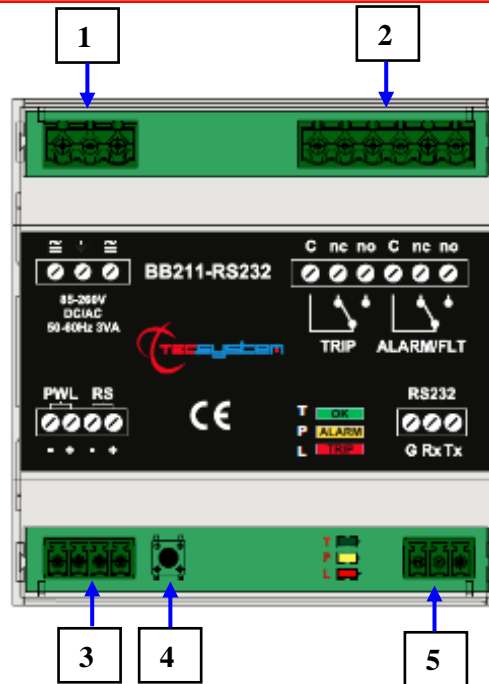
1MN0149 REV. 0

1)	Supply 85-260Vdc-ac 50/60Hz	4)	Reset key
2)	Relays (ALARM/FAULT-TRIP)	5)	RTU Modbus RS232 output
3)	Power Link RS TPL503		

Note: The picture shows the relay contacts in the following conditions: non-alarm of the TRIP relay and alarm of the ALARM/FAULT relay. The ALARM/FAULT relay switches: contacts C-NO closed and C-NC open after the device is switched on and stays switched until an ALARM and/or FAULT signal, see paragraphs: T-P-L ALARMS, ALARM/FAULT RELAY, TRIP RELAY page 14-15.

RELAY CONNECTION EXAMPLE

SYSTEM STOP

ALARM CONDITION AUDIBLE AND VISUAL WARNING

M12 connector connection:
1. + PWL Brown
2. + RS White
3. - RS Blue
4. - PWL Black

TPL503 CONNECTION

BB211 connector connection:
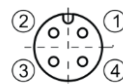
1. - PWL Black
2. + PWL Brown
3. - RS Blue
4. + RS White

Box connector 3.81
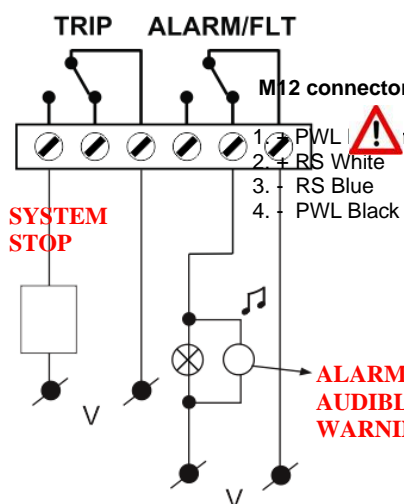
Note: Read note at the paragraph on the TPL503 connection on page 16 carefully, before connecting the TPL sensor to the control unit.

Connector M12

RELAYS SWITCHING CAPACITY

High-capacity(-EU)

The BB211 device has 3 LEDs: T= Temperature, P= Pressure, L= Level to show the alarms.
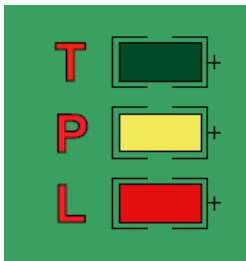
Green LED shows the system is working correctly, the monitored parameter is below the set Alarm threshold.

Yellow LED shows the Alarm threshold has been exceeded, the monitored parameter is above the set Alarm threshold.

Red LED shows the Trip threshold has been exceeded, the monitored parameter is above the set Trip threshold.
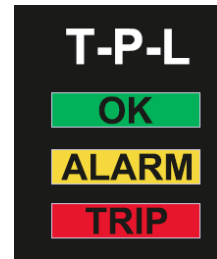
Let's now see some practical **examples** of how BB211 signals the alarm activation:

Programming T-P-L alarms:

> Temperature = ALARM 70°C / TRIP 90°C
> Pressure = ALARM 100mbar / TRIP 200mbar
> Level = ALARM 2 / TRIP 1

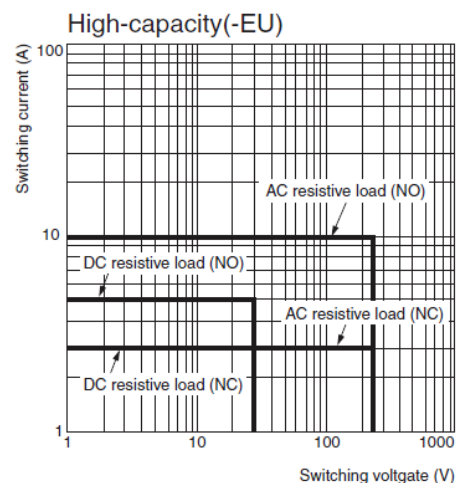| all LEDs green	temperature LED yellow	temperature LED red
System monitored OK	Alarm temperature above 70°C	Trip temperature above 90°C

all LEDs green	pressure LED yellow	pressure LED red
System monitored OK	Alarm pressure above 100mbar	Trip pressure above 200mbar

all LEDs green	level LED yellow	level LED red
System monitored OK	Level 2 Alarm	Level 1 Trip

NOTE: LED OFF T.P.L. parameter disabled

T-P-L ALARMS

The alarm parameters must be configured by remote programming, see procedure on page 17.

Temperature

The alarms of the temperature parameter can be programmed with a range between 1°C and 120°C with 1°C steps. Programming the values must always comply with the ALARM < TRIP rule.

When the temperature sensor detects a temperature 1°C higher than the value set as the alarm limit, the ALARM relay switches (yellow led ALARM lighting, reference led T).

When the trip temperature limit is exceeded, the TRIP relay switches (red led TRIP lighting, reference led T).

As soon as the temperature detected returns to values equal to or lower than the limit set for the ALARM and TRIP relays to switch, these relays de-energise (all LEDs green).

Pressure

The alarms regarding the pressure parameter can be set with a range between 10mbar and 500mbar with 10mbar steps. Values must always be set in compliance with the ALARM < TRIP rule.

When detected pressure exceeds the value set as the alarm limit by 10mbar, the ALARM relay switches (yellow led ALARM lighting, reference led P).

When the trip pressure limit is exceeded, the TRIP relay switches (red led TRIP lighting, reference led P).

As soon as the pressure detected returns to values equal to or lower than the limit set for the ALARM and TRIP relays to switch, these relays de-energise (all LEDs green).

Level

The level parameter has fixed programming divided into three indications 3-2-1(0)

3= Full: oil volume loss less than 85cm³.

2= Alarm: oil volume loss greater than 85cm³ is detected, the ALARM relay switches (yellow led ALARM lighting, reference led L).

1= Trip: oil volume loss greater than 170cm³ is detected, the TRIP relay switches (red led TRIP lighting, reference led L).

As soon as the level detected returns to values equal to or lower than the limit set for the ALARM and TRIP relays to switch, these relays de-energise (all LEDs green).

IMPORTANT WARNING

The stated oil volume/level values refer to the use of mineral oils with a density of: 888 Kg/m³ at the temperature of 15°C (mineral oil general specifications).
The presence of air bubbles inside the transformer is identified as the formation of gas, which can determine a decrease in the level measurement and the activation of both Alarm and Trip signals.

ALARM / FAULT RELAY

The ALARM/FAULT relay is programmed in active failsafe mode and switches: contacts C-NO closed and C-NC open when the device switches on and stays switched until an ALARM and/or FAULT signal.

Alarm signal

When the detected T.P.L values exceed the threshold set as the alarm limit, the ALARM relay switches (yellow led ALARM lighting of reference).

Fault signal

A fault is signalled when one of the following events takes place:

> CPU ERROR signal (see paragraph on page 20)
> TPL sensor diagnostics (see paragraph on page 21)
> Low device voltage
> During the "power on reset" after programming (PRG)

NOTE: In order to prevent unwanted system downtime, do not connect the ALARM/FAULT relay to the transformer trip circuit.

TRIP RELAY

The TRIP relay, contacts C-NO open and C-NC closed, switches when the detected T.P.L values exceed the preset threshold as a trip limit.

ALARM/FAULT CONTACT OPERATION

ALARM/FLT

no nc C
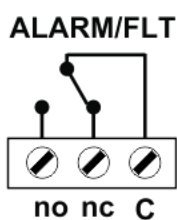
ALARM FAULT OR POWER OFF

ALARM/FLT

no nc C
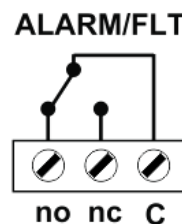
POWER ON OR NO ALARM - NO FAULT

POWER SUPPLY

The BB211 control unit can be supplied by 85 to 260 Vdc-Vac, 50/60Hz irrespectively of polarity in Vdc (terminals ~).

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.

The ground cable must always be connected to terminal ⏚.

To protect the control unit from line overvoltages, we suggest using the PT-73-220 electronic discharger, designed by TECSYSTEM S.r.l. for this specific purpose. As an alternative we suggest using 110 Vac or, even better, 110 Vdc supply voltages.

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

TPL503 CONNECTION NOTES

The TPL503 is provided with an M12 connector that must be connected to the control unit with the appropriate cable; electrical connections are shown on page 13.

The signals present are power (POWER LINK) and data output (RS) signals.

Note: All cables carrying signals must absolutely:

- be separated from the power cables
- be made with screened, twisted-wire cables
- have a section of at least 0.25mm²
- be twisted if there is no screen
- be secured to the terminal blocks
- have tinned or silver conductors

⚠ **ATTENTION:** *The use of cables not complying with the above might cause reading anomalies. It is very important to remember that any disturbance on the signal lines may cause anomalie.*

FIRST STARTUP

Before starting the BB211 device, check that:

- All the connections to the BB211 device are correct.

- The TPL503 sensor has been fitted in compliance with the instructions given in the TPL503 assembly paragraph on page 8.

To allow the communication with the RS232 and/or RS485 device, on first startup it is necessary to set the following communication parameters: Address (1) - Baud rate (19200) - Parity (EVEN) - Bit stop (1).

Immediately after starting the transformer, check the color of the BB211 unit T-P-L leds.

The color of the LEDs of: Temperature - Pressure - Level must be green.

The data transmitted via Modbus has to be:

Temperature (ambient / 20 ° C) - Pressure (000 / 010mbar) - Level (3 FULL).
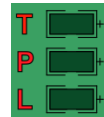
If the control unit shows the LEVEL ALARM / TRIP alarms are activated, it may be necessary to top up the oil.

If one or more LEDs are flashing, check the CPU error or sensor diagnostics signals, on page 20-21.

PROGRAMMING

Programming the BB211 device can be done via remote writing, the registers that can be written are shown in the MODBUS MAPPING TABLE as: W or RW (**write or read/write)**, see table on page 23.

NOTE: To allow the communication with the device, on first startup it is necessary to set the following communication parameters: Address (1) - Baud rate (19200) - Parity (EVEN) - Bit stop (1).

Registers must be written using *FUNCTION CODE*

$16_{(10)}$:   - register multiple writing

The writable registers with monitored parameter thresholds are:

Register	Parameter	Programmable values	Default
22	TEMPERATURE ALARM	From 1°C to 120°C	70°C
23	TEMPERATURE TRIP	From 2°C to 120°C	90°C
26	PRESSURE ALARM	From 10mBar to 500mBar	100mBar
27	PRESSURE TRIP	From 20mBar to 500mBar	200mBar

Rules for correct programming of the T.P.L parameters

- For the Temperature and Pressure parameters always set ALARM < TRIP

The writable registers to modify the communication settings are:

Register	Parameter	Programmable values	Default
14	Address	1-255	1
15	Baud rate	0=2400 1=4800 2=9600 3=19200 4=38400	(3)19200
16	Parity	0=No+1 stop 1=Even 2=Odd 3=No+2 stop	(1) Even, 1 Stop

The writable registers to enable the monitored parameters are:

Register	Parameter	Programmable values		Default	
		BIT 1	BIT 0	BIT	BIT0
36	TEMPERATURE	ALARM	TEMPERATURE	1	1
37	PRESSURE	ALARM	PRESSURE	1	1
38	LEVEL	ALARM	LEVEL	1	1

Registers 36-37-38 allow enabling the monitored parameters, that is they allow the operator to activate and de-activate the T.P.L parameters BIT 0: 0=disabled 1= enabled or the BIT1 alarm warning: 0= disabled 1= enabled.

NOTE: If you decide to disable a parameter, the control unit will not activate the TRIP and ALARM indications for the disabled parameter. The disabled T.P.L LED will be off and the reading indication in the register will be 00 or a value not to be taken into consideration. If, on the other hand, only the ALARM indication is disabled, the TRIP warning will still be active. Enabling / Disabling Parameters T.P.L is an user's responsibility.

SETTING

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	--	--	--	--	Alarm enabled	CAN_enabled

PROGRAMMING NOTES

- During programming the control unit does not control/protect the monitored machine.

- At the end of programming the control unit is restarted and the FAULT relay is disabled until the unit is fully restarted.

- At the end of the Write command, data compatibility is checked:

  in case of incompatibility, the answer is an "exception" and the data packet is refused in full. The code of the first wrong datum can be requested reading the register "**Received datum error**" written according to the "wrong data codes" table (NB: this code is lost during RESET, that is new starting or data writing in E2PROM);
  if the data are correct, they are transferred into the non-volatile memory (E2PROM), historical data are cancelled and, then, a system RESET is forced.

  If the WRITE command entails only writing "COMMANDS", it will be performed autonomously and without a RESET, that is without affecting the control unit data.

- If a programming error is found, the device will highlight the error, the "wrong data codes" Table follows (value in binary):

Code 00	No error		Code 10	ERR. Modbus address	
Code 01	Temperature	Trip ≤ Alarm	Code 11	ERR. Modbus baud rate	
Code 02	Pressure	Trip ≤ Alarm	Code 12	ERR. Modbus parity	

  The error code is written in register 7 **Received datum error**, the programming of the device is not processed.

- If writing information is sent towards a READ-only register, the data will be binned without affecting the message received.

To avoid long times both receiving and transmitting, a data limit equal to "43 Registers" is placed.

NOTE: EVERY TIME THE CONTROL UNIT IS PROGRAMMED WITH DATA SAVING CONFIRMATION, THE VALUES STORED IN T-MAX ARE RESET TO THE TIME OF SAVING.

DEFAULT PARAMETER PROGRAMMING RESET

If it is necessary to reset the default programming parameters, follow the following instructions:

1) Power off the device BB211.

2) Press the reset key ![reset key] without releasing it

3) Power on the device BB211, keeping press the Reset key, until the TPL LEDs are red.

NOTE: before resetting the default parameters, check that: this operation does not involve activating the T.P.L alarms and stopping the monitored machine.

⚠ *IMPORTANT WARNING*

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

MEASURED VALUES

The values measured by the TPL503 sensor are written into the registers:

Temperature, register 20: data HI sign / data LO value read by the TPL range from -40°C to 120°C.

Temperature-Max, from the last reset, register 21: data HI sign / data LO value read by the TPL range from 0°C to 120°C.

TPL electronic temperature, register 30: data HI sign / data LO value read by the TPL range from -20°C to 85°C.

TPL electronic temperature-max, register 31: data HI sign / data LO value read by the TPL range from 0°C to 85°C.

Address LO (10)	Data HI	Data LO	Note 1 (Range)	Note 2	R: read W: write RW: read/write
20	2'compl. sign	2'compl. temperature	-40 ÷ 120°C		R
21	2'compl. sign	2'compl. max temperature	0 ÷ 120°C		R
30	2'compl. sign	2'compl. TPL electronic temp.	-20 ÷ 85°C		R
31	2'compl. sign	2'compl. Temp. Max PCB_TPL	0 ÷ 85°C		R

Pressure, register 24: data HI sign / data LO value read by the TPL range from -400mbar to 500 mbar.

Pressure-Max from the last reset, register 25: data HI sign / data LO value read by the TPL range from 0mbar to 500 mbar.

BB211 ambient pressure, register 28: data HI sign / data LO value read by the BB211.

Address LO (10)	Data HI	Data LO	Note 1 (Range)	Note 2	R: read W: write RW: read/write
24	2'compl. sign	2'compl. relative pressure	-400 ÷ 500 mBar/10		R
25	2'compl. sign	2'compl. relative max pressure	0 ÷ 500 mBar/10		R
28	2'compl. sign	2'compl. ambient pressure (absolute value)	≥ 600 mBar/10		R

Level, register 29 data LO indication 3 =OK; 2 = Alarm; 1 = Trip

Address LO (10)	Data HI	Data LO	Note 1 (Range)	Note 2	R: read W: write RW: read/write
29	00	level	3=OK; 2=Alarm 0/1 = Trip (*)	(*) 0 = sensor fault	R

CPU COMMANDS

The command function is in register 8, of the modbus mapping, table and allows performing the following operations remotely:

1. CPU ERROR reset (BIT 2)
2. Reset of historical data T-MAX (BIT1)

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	--	--	--	Reset CPU_Error Reg.	Reset historical data	--

CPU SETTING

Register 10 of the modbus mapping table allows the remote enablement of: the failsafe function on the TRIP - ALARM/FAULT relays, by modifying the COM-NC-NO contacts position, and disabling the Alarm function on the T-P-L parameters of the ALARM / FAULT relay.

Default:
The ALARM T-P-L function (ALARM / FAULT relay) enabled BIT 5 = 0 (1 = disabled - 0 = enabled).

The ALARM/FAULT failsafe active relay BIT 0 = 1 (0 = disabled - 1 = enabled).

The TRIP failsafe non active relay BIT 1 = 0 (0 = disabled - 1 = enabled).

NOTE: The modification of the 0/1 condition on register 10 can involve alarm activation or the tripping of the monitored machine.

CPU SETTING

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	No relay for Alarm	--	--	--	Failsafe trip	Failsafe Fault Alarm

RELAY STATUS (coil energizing status)

Register 12 of the modbus mapping table, allows the remote monitoring of the energising status of the coils for the TRIP and ALARM/FAULT relays.

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	--	--	--	--	TRIP relay 1=ON	Relay Fault Alarm 1=ON

ALARM STATUS AND HISTORY

Registers 40-41-42 contain the data HI alarm history from the last reset, and the data LO alarm status of the monitored parameters, BIT 6 = TRIP - BIT 5 =ALARM – BIT 4= FAULT.
FAULT indication see page 21 *TPL503 SENSOR DIAGNOSTICS.*

Address LO (10)	Data HI	Data LO	Note 1	Note 2	R: read W: write RW: read/write
40	Temperature History	Temperature Status	See status notes		R
41	Pressure History	Pressure Status	See status notes		R
42	Level History	Level Status	See status notes		R

HISTORY

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	TRIP	ALARM	**FAULT**	--	--	--	--

STATUS

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	*TRIP*	*ALARM*	*FAULT*	--	--	--	--

CPU ERROR DIAGNOSTICS

The CPU ERROR diagnostics is shown in register 11 of the modbus mapping table.

CPU ERROR

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	--	--	--	TPL not connected	TPL Rx error	E2P Error

A CPU error is signalled when one of the following events takes place:

➢ TPL sensor disconnected: all the TPL LEDs are red and flashing quickly, check the connection between the sensor and the BB211, device connections on page 13.

➢ TPL sensor RX error, the control unit does not communicate correctly with the TPL sensor, check:
  • The connection between the sensor and the BB211
  • The position of the cable connecting the BB211 and the sensor

  NOTE: any noise on the sensor line can cause incorrect readings or communication problems between the devices. Data transmission is not guaranteed.

➢ E2P Error: if the internal memory is broken or the programmed data are altere. In this case all the LEDS flash quickly and their colour depends on their status (OK, alarm or trip). In this case, the default parameters are loaded automatically for safety reasons.

The FAULT relay switches highlighting one of the conditions: TPL disconnected and E2P error. The indication E2P error can be resetted by pressing the reset key or from the register 8 (commands).

TPL503 SENSOR DIAGNOSTICS

The TPL sensor diagnostics is shown: in the parameter status registers 40-41-42 for the monitored parameters and in register 13 TPL ERROR for the electronic board.

Temperature sensor

In case of failure or out scale reading the FAULT relay opens immediately with the relative warning of faulty temperature sensor (status register 40).

Red **T**emperature LED (flashing slowly).

Note: exceeding the minimum/maximum full scale value can also be caused by interferences on the sensor lines; in this case we recommend that you check the cable between the control unit and the TPL, see notes on the TPL connections on page 16.

Pressure sensor

In case of failure or out scale reading the FAULT relay opens immediately with the relative warning of faulty pressure sensor (status register 41).

Red **P**ressure LED flashing (flashing slowly).

Level sensor

Level sensor diagnostics is activated when: the trip level sensor is dry while the alarm one is wet. This is an anomalous situation and in this case the device gives priority to the machine protection, enabling the TRIP relay to switch. The relative indication of faulty level sensor is shown in register 42 (register 29 datum = 0 TRIP for FAULT).

Red **L**evel LED (fixed on).

Check the level of the oil in the monitored machine.

If the level of the monitored machine is suitable for operation, it is possible to disable monitoring the level parameter, see parameter programming on page 17. This action must take into consideration the operation of the monitored machine, the installer or maintenance engineer is fully responsible for this operation.

Electronic board temperature

In order to monitor the temperature of the electronic board, the sensor is fitted with an internal Pt100 highlighting the T-plate-Low board temperature below -50°C and T-plate-High board temperature above 125°C; T-plate-OK shows the board is working correctly.

TPL STATUS

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	T_plate_Low	T_plate_High	Err_press	T_plate_KO	--	--	FCC+FOC

The FAULT relay switches highlighting one of the above conditions, with the exception electronic board temperature fault.

OUTPUT RS485 MODBUS RTU

INTRODUCTION TO THE MODBUS INSIDE MODULE

The Modbus output is built into the control unit and allows transferring the data on an RS485 line with MODBUS RTU protocol, 32 devices maximum.

OPERATING NOTES

For the module to work correctly, it is necessary to set the network set-up parameters: address, baud rate, parity bit. The serial communication of the control unit is active only when the BB211 is in reading mode.
When the unit is in: starting, programming or reset mode operation the ModBus communication is temporarily deactivated.

DATA TRANSMISSION ON MODBUS NETWORK

The internal module allows connecting the BB211 to a serial network with Modbus RTU protocol in order to read the data shown in the MODBUS table on page 23 and write those in the notes for remote programming; the module is always in slave mode.

ELECTRICAL CONNECTIONS

As far as the signal cable to be used in order to ensure the correct network operation is concerned, we recommend you follow the provisions of the EIA RS485 standard which suggests using a 24AWG twisted pair.
The twisted pair that connects units in RS485 might need a 120 ohm end resistor on the last unit of the series.
Connect the + / - twisted pair paying attention to polarities and lay the network avoiding to make sharp bends or ring windings in order not to modify line impedance. If necessary, the terminal for the GND ground connection is also available.
Always position the RS485 twisted pair far from power cables.

OUTPUT RS485 MODBUS RTU

INTRODUCTION TO THE MODBUS INSIDE MODULE

The Modbus output is built into the control unit and allows transferring the data on an RS232 line directly connected to the PC, with MODBUS RTU protocol.

OPERATING NOTES

For the module to work correctly, it is necessary to set the network set-up parameters: address, baud rate, bit number and parity bit. The serial communication of the control unit is active only when the BB211 is in reading mode. In order to guarantee correct communication with the device, do not exceed 19200 baud rate and the maximum communication distance of 5m.
When the unit is in: starting, programming or reset mode operation the ModBus communication is temporarily deactivated.

DATA TRANSMISSION

The internal module allows connecting the BB211 to a PC, via RS232 serial line, with Modbus RTU protocol in order to read the data shown in the MODBUS table on page 23 and write those in the notes for remote programming; the module is always in slave mode.

ELECTRICAL CONNECTIONS

As far as the signal cable to be used in order to ensure the correct network operation is concerned, we recommend you follow the provisions of the EIA RS232 regulation.
The RS232 connection with DB9 connector must be done taking into account: RX -pin 2; TX - pin 3 and GND-pin5. Lay the cable with no sharp bends or ring windings, always position the RS232 cable far from any power cables; we recommend you use a twisted and screened cable.

DATA FRAME

The frame in asynchronous transmission consists of: 1 bit start, 8 bits data, 1 bit parity (even or odd, if parity has been set) and 1 bit stop.
With NO parity it is possible to select N-1 (1 bit stop) or N-2 (2 bits stop).
The following Baud rates are allowed: 2400, 4800, 9600, 19200 and 38400.
The length of the words (DATA) is 16 bits where not specified.

FUNCTION CODE

The Modbus module supports the following function codes:

$3_{(10)}$:   - holding register reading

$16_{(10)}$:   - register multiple writing

If Modbus receives a message and a CRC error is spotted, 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.

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 answer:

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

ERROR CODES (exception codes)

In case of an incorrect request, Modbus will answer with modified codes and errors codified as follows:

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

POLLING

We recommend you use polling frequencies higher than or equal to 1 second.
More frequent polling can overload the system, without any added benefit. In RS485 lines with multiple devices polled in sequence, it might be useful to insert a delay between polls with regard to: the number of devices connected, the speed of communication and number of registers read.

MODBUS MAPPING TABLE

To avoid long times both receiving and transmitting, a data limit equal to "43 Registers" is placed.

HEADER (information and commands):

Address LO (10)	Data HI	Data LO	R: read W: write RW: read/write
1	Model – MSD (ASCII)	Model - 2nd Digit (ASCII)	R
2	Model - 3rd Digit (ASCII)	Model – LSD (ASCII)	R
3	Vers. Fw – MSD (ASCII)	Vers. Fw - 2nd Digit (ASCII)	R
4	Vers. Fw - 3rd Digit (ASCII)	Vers. Fw – LSD (ASCII)	R
5	00	00	R
6	00	00	R
7	00	Wrong datum received	R-see table
8	00	Commands	W-see table

SYSTEM: Setting and Status

Address LO (10)	Data HI	Data LO	Note 1	Note 2	R: read W: write RW: read/write
10	00	CPU Setting	see notes		RW
11	00	CPU Error	see notes		R
12	00	Relays Status	see notes		R
13	00	TPL error	see notes		R
14	00	Address	Modbus address	1÷255	RW
15	00	Bdr	Modbus baud rate	0=2400 1=4800 2=9600 3=19200 4=38400	RW
16	00	Parity	Modbus parity bit	0=No+1stop 1=Even 2=Odd 3=No+2stop	RW

TPL settable data and measurement values:

Address LO (10)	Data HI	Data LO	Note 1 (Range)	Note 2	R: read W: write RW: read/write
20	2'compl. sign	2'compl. temperature	-40 ÷ 120°C		R
21	2'compl. sign	2'compl. max temperature	0 ÷ 120°C		R
22	2'compl. sign	2'compl. temperature alarm set point	1 ÷ 120 °C		RW
23	2'compl. sign	2'compl. temperature trip set point	2 ÷ 120 °C		RW
24	2'compl. sign	2'compl. relative pressure	-400 ÷ 500 mBar/10		R
25	2'compl. sign	2'compl. relative max pressure	0 ÷ 500 mBar/10		R
26	2'compl. sign	2'compl. relative pressure alarm set point	1 ÷ 500 mBar/10		RW
27	2'compl. sign	2'compl. relative pressure trip set point	2 ÷ 500 mBar/10		RW
28	2'compl. sign	2'compl. ambient pressure (absolute value)	≥ 600 mBar/10		R
29	00	level	3=OK; 2=Alarm 0/ 1 = Trip	(*) 0 = Sensor fault	R
30	2'compl. sign	2'compl. TPL electronic temp.	-20 ÷ 85°C		R
31	2'compl. sign	2'compl. Temp. Max PCB_TPL	0 ÷ 85°C		R

TPL PARAMETERS: Setting

Address LO (10)	Data HI	Data LO	Note 1	Note 2	R: read W: write RW: read/write
36	00	Temperature Setting	See setting notes		RW
37	00	Setting pressure	See setting notes		RW
38	00	Setting level	See setting notes		RW
39	00	00	--		R

TPL PARAMETERS: Status

Address LO (10)	Data HI	Data LO	Note 1	Note 2	R: read W: write RW: read/write
40	Temperature History	Temperature Status	See status notes		R
41	Pressure History	Pressure Status	See status notes		R
42	Level History	Level Status	See status notes		R
43	00	00	--		R

BB211+TPL503

NOTES:

COMMANDS (Write)

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	No relay for Alarm	--	--	Reset CPU_Error Reg.	Reset historical data	--

SETTING

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	--	--	--	--	Alarm enabled	CAN_enabled

STATUS

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	TRIP	ALARM	FAULT	--	--	--	--

CHn STORY

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	TRIP	ALARM	FAULT	--	--	--	--

RELAY STATUS (coil energizing status)

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	--	--	--	--	TRIP relay 1=ON	Relay Fault Alarm 1=ON

CPU SETTING

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	--	--	--	--	Failsafe trip	Failsafe Fault Alarm

CPU ERROR

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	--	--	--	--	TPL not connected	TPL Rx error	E2P Error

TPL ERROR

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
--	T_plate_Low	T_plate_High	Err_press	T_plate_KO	--	--	FCC+FOC

WARRANTY CONDITIONS

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

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

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

The warranty is always ex Corsico as stated in the "General Conditions of Sale".

TROUBLESHOOTING	CAUSES AND *SOLUTIONS*
The control unit does not switch on and the power supply at terminals ~ ~ is correct.	Check that: the connector is fully into its seat, the connecting wires are tightened and there are no burn marks on the connectors. Switch the power off, do as stated before and switch back on.
All TPL LEDs are red and flashing	Check the connection between the TPL503 sensor and the BB211, device connections on page 13.
All TPL LEDs are flashing	Turn the power off for 1 minute and then turn back on, if the LEDs are still flashing, contact Tecsystem Technical Service.
The control unit shows the level ALARM, yellow L LED, has been activated.	The oil may need to be topped up. With the transformer switched off, temperature at 20°C, check the oil level and top up as required.
The control unit shows the pressure ALARM, yellow P LED, has been activated.	The oil may need to be drained. With the transformer switched off, temperature at 20°C, check if there is air inside the TPL503, open and close the bleeding valve to expel the air.
If the problem continues, contact *TECSYSTEM Technical Department.*	

EQUIPMENT DISPOSAL

European directive 2012/19/EU (WEEE) has been approved to reduce electrical and electronic waste and promote the recycling and reuse of the materials and components of said 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 European directive 2012/19/EU 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 your 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

SALES INFO: info@tecsystem.it