Installation and User Manual
version 1.00

TLE
ANALOG WEIGHT TRANSMITTER
4÷20 mA, 0÷20 mA, 0÷10 V, 0÷5 V, -10÷10 V, -5÷5 V
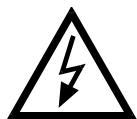
$C \epsilon$ **2004/108/EC**

EN55022   EN61000-6-2   EN61000-6-4

SYSTEM IDENTIFICATION

KEY TO SYMBOLS

Below are the symbols used in the manual to draw the reader's attention:

Warning! Risk of electrocution.

Warning! This operation must be performed by skilled workers.

Read the following indications carefully.

Further information.

GUARANTEE
24 months from the delivery document date. The guarantee covers only defected parts and includes the replacement parts and labour. All shipping and packing costs are paid by the customer. It is possible to have the repair in guarantee on condition that the returned product has not been transformed, damaged or repaired without authorization. No guarantee is applicable on returned products without the original label and/or serial number. No guarantee against misuse.
Batteries: Laumas provides 1 year guarantee from the date of delivery note, against material defects or battery manufacturing faults.

Disposal of Waste Equipment by Users in Private Households in the European Union

This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. It is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help preserve natural resources and protect human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local waste disposal Authority or the equipment retailer.

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USER WARNINGS

RECOMMENDATIONS FOR THE PROPER USE OF WEIGHING INSTRUMENT
- Keep away from heat sources and direct sunlight
- Repair the instrument from rain
- Do not wash with water jets
- Do not dip in water
- Do not spill liquid on the instrument
- Do not use solvents to clean the instrument
- Do not install in areas subject to explosion hazard

RECOMMENDATIONS FOR CORRECT INSTALLATION OF WEIGHING INSTRUMENTS

The terminals indicated on the instrument's wiring diagram to be connected to earth must have the same potential as the weighed structure (same earthing pit or earthing system). If you are unable to ensure this condition, connect with an earthing wire the terminals of the instrument (including the terminal 0 VDC) to the weighed structure.

The cell cable must be individually led to its panel input and not share a conduit with other cables; connect it directly to the instrument terminal strip without breaking its route with support terminal strips.

Use "RC" filters on the instrument-driven solenoid valve and remote control switch coils.

Avoid inverters in the instrument panel; if inevitable, use special filters for the inverters and separate them with sheet metal partitions.

The panel installer must provide electric protections for the instruments (fuses, door lock switch etc.).

It is advisable to leave the equipment always switched on to prevent the formation of condensation.

MAXIMUM CABLE LENGTHS
- RS485: 1000 metres with AWG24, shielded and twisted cables
- Analog current output: up to 500 metres with 0.5 mm^2 cable
- Analog current output: up to 300 metres with 0.5 mm^2 cable

RECOMMENDATIONS FOR CORRECT INSTALLATION OF THE LOAD CELLS

INSTALLING LOAD CELLS: The load cells must be placed on rigid, stable in-line structures; it is important to use the mounting modules for load cells to compensate for misalignment of the support surfaces.

PROTECTION OF THE CELL CABLE: Use water-proof sheaths and joints in order to protect the cables of the cells.

MECHANICAL RESTRAINTS (pipes, etc.): When pipes are present, we recommend the use of hoses and flexible couplings with open mouthpieces with rubber protection; in case of hard pipes, place the pipe support or anchor bracket as far as possible from the weighed structure (at a distance at least 40 times the diameter of the pipe).
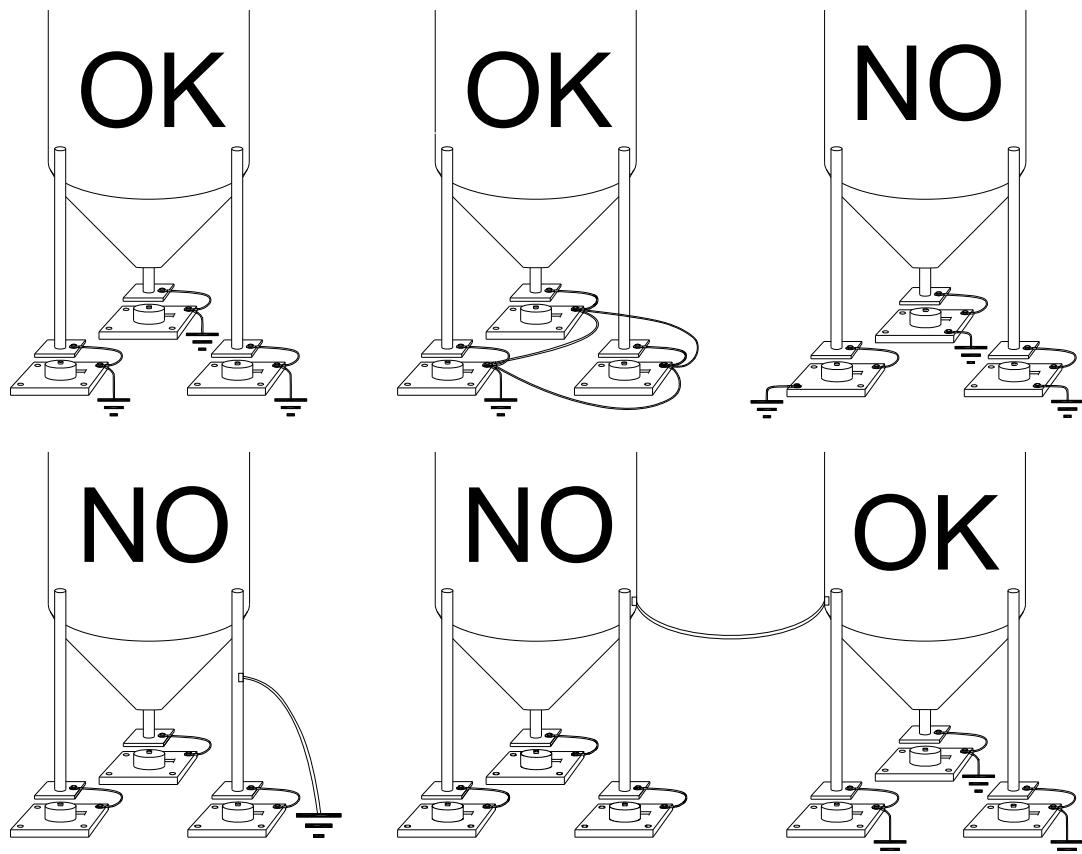
CONNECTING SEVERAL CELLS IN PARALLEL: Connect several cells in parallel by using - if necessary - a watertight junction box with terminal box. The cell connection extension cables must be shielded, led individually into their piping or conduit and laid as far as possible from the power cables (in case of 4-wire connections, use cables with 4 x 1 sq.mm minimum cross-section).

WELDING: Avoid welding with the load cells already installed. If this cannot be avoided, place the welder ground clamp close to the required welding point to prevent sending current through the load cell body.

WINDY CONDITIONS - KNOCKS - VIBRATIONS: The use of weigh modules is strongly recommended for all load cells to compensate for misalignment of the support surfaces. The system designer must ensure that the plant is protected against lateral shifting and tipping relating to: shocks and vibration; windy conditions; seismic conditions in the installation setting; stability of the support structure.

EARTHING THE WEIGHED STRUCTURE: By means of a copper wire with suitable cross-section, connect the cell upper support plate with the lower support plate, then connect all the lower plates to a single earthing system. Electrostatic charges accumulated because of the product rubbing against the pipes and the weighed container walls are discharged to the ground without going through or damaging the load cells. Failure to implement a proper earthing system might not affect the operation of the weighing system; this, however, does not rule out the possibility that the cells and connected instrument may become damaged in the future. It is forbidden to ensure earthing system continuity by using metal parts contained in the weighed structure.

FAILURE TO FOLLOW THE INSTALLATION RECOMMENDATIONS WILL BE CONSIDERED
A MISUSE OF THE EQUIPMENT

LOAD CELL TESTING

Load cell resistance measurement (use a digital multimeter):

- Disconnect the load cells from the instrument and check that there is no moisture in the cell junction box caused by condensation or water infiltration. If so, drain the system or replace it if necessary.
- The value between the positive signal wire and the negative signal wire must be equal or similar to the one indicated in the load cell data sheet (output resistance).
- The value between the positive excitation wire and the negative excitation wire must be equal or similar to the one indicated in the load cell data sheet (input resistance).
- The insulation value between the shield and any other cell wire and between any other cell wire and the body of the load cell must be higher than 20 Mohm (mega ohm).

Load cell voltage measurement (use a digital multimeter):

- Take out the load cell to be tested from underneath the container, or alternatively, lift the container support.
- Make sure that the excitation of two wires of the load cell connected to the instrument (or amplifier) is 5 Vdc +/- 3%.
- Measure the response signal between the positive and the negative signal wires by directly connecting them to the tester, and make sure that it is comprised between 0 and 0.5 mV (thousandths of a Volt).
- Apply load to the cell and make sure that there is a signal increment.

IF ONE OF THE ABOVE CONDITIONS IS NOT MET, PLEASE CONTACT THE TECHNICAL ASSISTANCE SERVICE.

MAIN SPECIFICATIONS OF THE INSTRUMENT

- Analog/serial weight transmitter suitable for assembly on back panel fitted Omega/DIN rail. Dimensions: 90x93x65 mm.
- Current or voltage 16 bit analog output.
- RS485 serial output with Modbus RTU or continuous transmission protocol.
- Zero and full scale setting.
- Simultaneous display of the load cell reading in mV and of the analog output reading.
- Operating mode selection via 3-position selector switch, DIP switches, knob control and 2 line, 8 column alphanumeric display.

TECHNICAL SPECIFICATIONS
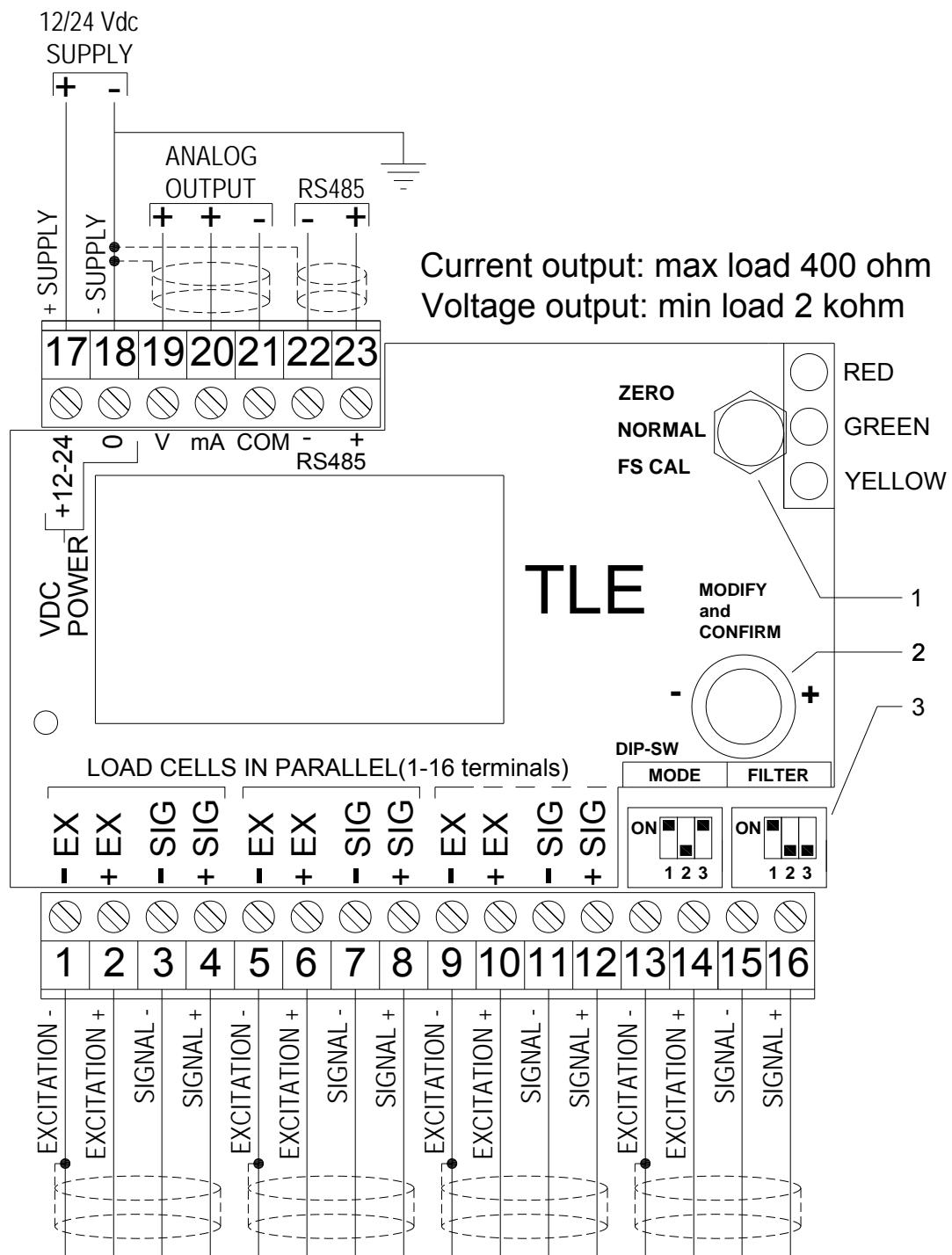
POWER SUPPLY and CONSUMPTION	12/24 VDC ±10%; 5 W
NO. OF LOAD CELLS IN PARALLEL and SUPPLY	max 8 (350 ohm); 5 VDC/120 mA
LINEARITY / ANALOG OUTPUT LINEARITY	< 0.01% F.S.; < 0.01% F.S.
THERMAL DRIFT / ANALOG OUTPUT THERMAL DRIFT	< 0.0005% F.S./°C; < 0.003% F.S./°C
A/D CONVERTER	24 bit (16000000 points)
RS485 MAX DIVISIONS	±200000 (±10 mV with sens. 2 mV/V) ±300000 (±15 mV with sens. 3 mV/V)
MEASUREMENT RANGE	±39 mV
MAX SENSITIVITY OF USABLE LOAD CELLS	±7 mV/V
MAX CONVERSIONS PER SECOND	300 conversions/second
DIGITAL FILTER / READINGS PER SECOND	0.003÷4 sec / 10÷300 Hz
SERIAL PORTS	RS485
BAUD RATE	2400, 4800, 9600, 19200, 38400, 115200
ANALOG OUTPUT 16 bit = 65535 divisions	CURRENT (max 400 ohm) 0÷20 mA; 4÷20 mA VOLTAGE (min 2 kohm) 0÷10 V; 0÷5 V; -10÷10 V; -5÷5 V
HUMIDITY (non-condensing)	85%
STORAGE TEMPERATURE	-30°C +80°C
OPERATING TEMPERATURE	-20°C +60°C

ELECTRICAL CONNECTIONS

BASIC INFORMATION

- It is recommended that the power supply negative pole be grounded.
- It is possible to supply up to eight 350 ohm load cells or sixteen 700 ohm load cells.
- Connect terminal "0 VDC" to the RS485 port common of the connected instruments in the event that these receive alternating current input or that they have an optoisolated RS485 port.

WIRING DIAGRAM

Current output: max load 400 ohm
Voltage output: min load 2 kohm
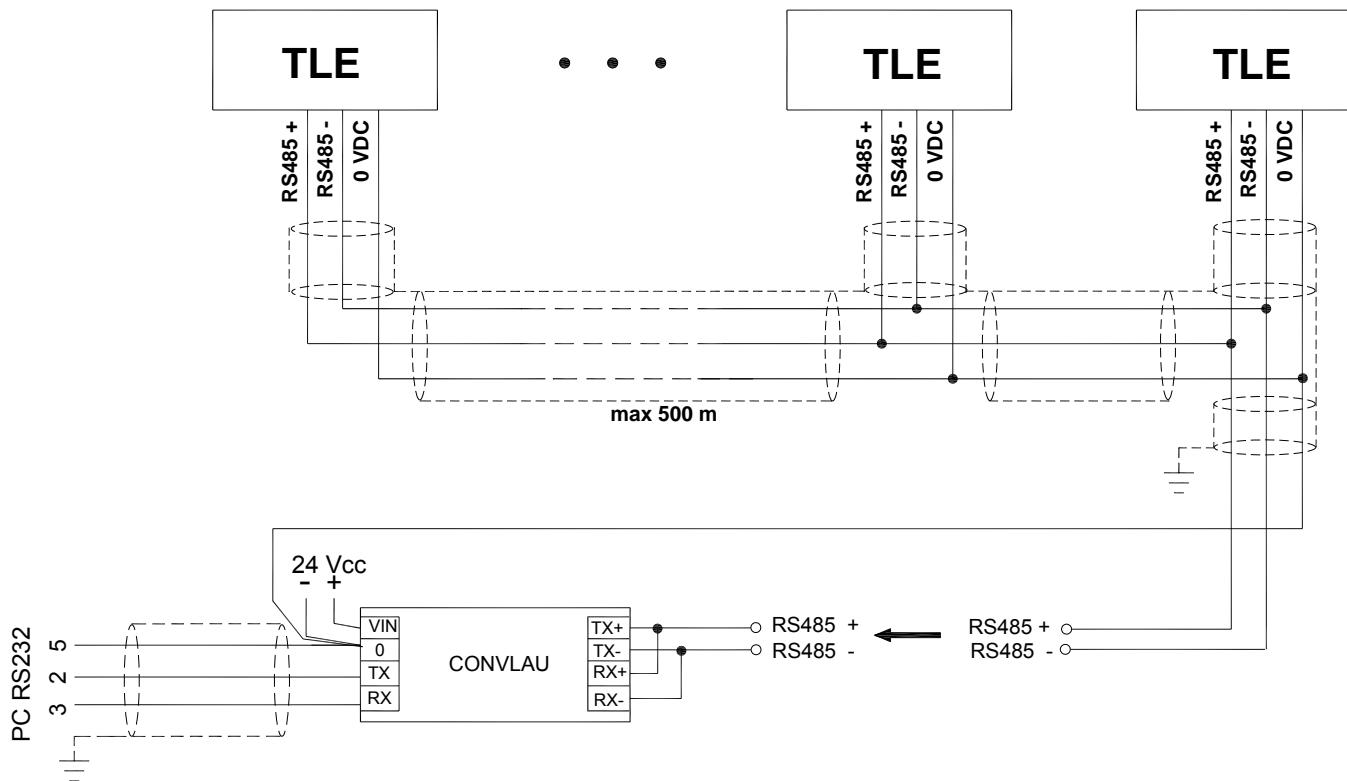
1: Selector switch   2: Knob control   3: DIP switch

RS485 SERIAL CONNECTION

☝ If the RS485 network is longer than 100 metres or baud rates higher than 9600 are used, connect two 120 ohm terminating resistors between the '+' and '−' terminal strip ends of the instruments furthest away. Should there be different instruments or converters, refer to the specific manuals to determine whether it is necessary to connect the above-mentioned resistors.

ANALOG OUTPUT TYPE SELECTION

Set the indicated DIP switch with MODE.

DIP SWITCH			OPERATION MODE
1	2	3	
OFF	OFF	OFF	0÷5 V
OFF	OFF	ON	0÷10 V
OFF	ON	OFF	-5÷5 V
OFF	ON	ON	-10÷10 V
ON	OFF	ON	4÷20 mA (default)
ON	ON	OFF	0÷20 mA

By default, the instrument is calibrated to convert the load cell 0÷10 mV to the selected analog output value.

☝ By modifying the type of analog output, calibration will be brought back to default values.

INSTRUMENT COMMISSIONING

Power on the transmitter and wait 5 minutes until all the components have reached a stable temperature. Check that the display shows the mV value of the load cells and that when loading the load cells there is an increase in this value. If this does not happen, check the connections and correct positioning of the load cells.

TARE WEIGHT ZERO SETTING

Set the three-way selector switch to ZERO, the red LED lights up.

If the display reads **BLOCK**, zero setting is not enabled.

The display shows the load cell reading in mV and the flashing zero value of the selected analog output (0 V, 0 mA or 4 mA); adjust the analog output value by working the knob control; hold the knob control down until the display reads **ZERO**; release the knob control and set the selector switch back to NORMAL.
Zero setting can also be obtained by referring to the values read by devices connected to the instrument, such as the PC or PLC.

REAL CALIBRATION (WITH SAMPLE WEIGHT)

Before carrying out the instrument real calibration, the type of analog output must be selected and the tare weight zero setting must be performed.

Load onto the weighing system a sample weight, which must be at least 50% of the full scale value. Set the three-way selector switch to FS CAL, the yellow LED lights up.

If the display reads **BLOCK**, calibration is not enabled.

The display shows the load cell reading in mV and the corresponding flashing value of the analog output; adjust the analog output value by working the knob control; hold the knob control down until the display reads **FS CAL**; release the knob control and set the selector switch back to NORMAL.
Calibration can also be obtained by referring to the values read by devices connected to the instrument, such as the PC or PLC.

Example:
The weighing system uses four 1000 kg cells, the 4÷20mA analog output has been selected and you wish to have 20 mA at 2000 kg. Check that the system is not loaded; perform the tare weight zero setting and load a sample weight of 1000 kg onto the system (equal to 50% of the required full scale value); move the selector switch to FS CAL and set the analog output value to 12 mA by working the knob control (range: 20 – 4 = 16 mA; ½ of the range: 16 / 2 = 8 mA; ½ of full scale: 8 + 4 = 12 mA); hold down the knob control until the display reads **FS CAL**; release the knob control and set the selector switch back to NORMAL.

THEORETICAL CALIBRATION

With this type of calibration it is possible to set the analog output value corresponding to a given value in mV read by the cell.

Theoretical calibration may be carried out <u>with or without</u> load cells connected to the instrument. The analog output is zero (4 mA for the 4÷20 mA output case) when the value read by the cell is 0 mV.

- Hold down the control knob, set the selector switch to FS CAL within four seconds (yellow LED lighting up) and release the control knob:
  - The display will show **5.000mV** flashing on the first line.
  - Adjust the value by working the control knob.
  - Hold down the control knob for at least three seconds.
- On releasing the control knob, line two on the display will start flashing:
  - Adjust the analog output value by working the control knob.
  - Hold down the control knob for at least three seconds.
- On releasing the knob control the first display line begins to flash again: confirm the settings by adjusting the selector switch to NORMAL, or change the values again by repeating the above described procedure steps.
- Ensure that the weighing system is not loaded and perform the tare weight zero setting.

Example:

The weighing system uses four 1000 kg cells with 2 mV/V sensitivity, the 4÷20mA analog output has been selected and you wish to have 20 mA at 2000 kg. Considering that the instrument provides 5 Vdc supply for the load cells, the cell full scale value is equal to 2 mV/V x 5 V = 10 mV. Additionally, 2000 kg is equal to 50% of the system full scale (4 x 1000 kg = 4000 kg), therefore, the values to enter are 50% of 10 mV = 5 mV and 20 mA.

FILTER ON THE WEIGHT

The instrument has a digital filter to reduce the effects of weight oscillation. Set the DIP switch indicated by FILTER.

For an increased effect (weight more stable) increase the value of the response time.

DIP SWITCH			Response time [ms]	Display and serial port refresh frequency [Hz]
1	**2**	**3**		
OFF	OFF	OFF	3	300
OFF	OFF	ON	150	100
OFF	ON	OFF	260	50
OFF	ON	ON	425	25
ON	OFF	OFF	850	12.5 (default)
ON	OFF	ON	1700	12.5
ON	ON	OFF	2500	12.5
ON	ON	ON	4000	10

RS485 SERIAL CONNECTION

The instrument transmits via RS485 serial port, according to a continuous one way protocol or a querying protocol (MODBUS RTU), the division value comprised between 0 and 200000 for load cell signal values comprised between 0 and 10 mV.
For protocol setting, see section **RESERVED FOR INSTALLER.**

CONTINUOUS ONE WAY TRANSMISSION PROTOCOL

The instrument transmits the number of divisions according to a continuous protocol via the following string:

xxxxxxCRLF

where: **xxxxxx** = 6 division characters (48÷57 ASCII).
CR = 1 carriage return character (13 ASCII).
LF = 1 new line character (10 ASCII).

MODBUS-RTU PROTOCOL

The MODBUS-RTU protocol enables to manage the reading and writing of the registers listed here below according to the specifications contained in the reference document for this standard **Modicon PI-MBUS-300.**

If preceded by 0x, the numerical data listed below are expressed in the hexadecimal notation format.

MODBUS-RTU DATA FORMAT

Data received and transmitted via the MODBUS-RTU protocol have the following format:
- 1 start bit;
- 8 data bits, *least significant bit* sent first;
- Parity: none;
- 1 stop bit.

Of the controls available in the MODBUS-RTU protocol, only the READ HOLDING REGISTER control may be used **(code 0x03)**.

The interrogation frequency is linked with the preset communication rate (the instrument will stand by for at least 3 bytes before beginning to calculate a possible response).

QUERY

Address	Function	Register 1 address	No. of registers	2 bytes
A	0x03	0x0000	0x0002	CRC

Tot. bytes = 8

CORRECT QUERY RESPONSE

Address	Function	No. of bytes	Register 1	Register 2	2 bytes
A	0x03	0x04	0x0064	0x00C8	CRC

Tot. bytes = 3+2*No. of registers+2

where:　No. of registers = number of Modbus registers to be read, starting from register 1 address;
　　　　No. of bytes = number of following data bytes;

In the event of a string received correctly but not executable, the slave responds with an EXCEPTIONAL RESPONSE. The "FUNCTION" field is transmitted with the msb at 1.

EXCEPTIONAL RESPONSE

Address	Function	Code	2 bytes
A	Funct + 0x80		CRC

CODE	DESCRIPTION
1	ILLEGAL FUNCTION (Function not valid or not supported)
2	ILLEGAL DATA ADDRESS (The specified data address is not available)
3	ILLEGAL DATA VALUE (The data received have no valid value)

The communication strings are controlled by CRC (Cyclical Redundancy Check).
In case of a communication error the slave will not respond with any string. The master must allow for a time-out before response reception and if no response is received, it infers that a communication error has occurred.

REGISTERS AND VALUES

The instrument ModBus registers may only be read.
H - L: high half and low half - respectively, making up the DOUBLE WORD value.

REGISTER	DESCRIPTION
40007	STATUS REGISTER
40008	H divisions
40009	L divisions

STATUS REGISTER (40007)

Bit 0	Cell Error (ERCEL)	**Bit 1**	AD Converter Malfunction (ER AD)
Bit 2	Off scale analog output (ER OL)	**Bit 3**	
Bit 7	Division negative sign	**Bit 7**	
Bit 11	Weight stability	**Bit 12**	

H&L DIVISIONS (40008-40009)

For more information see section **SERIAL COMMUNICATION RS485**.

For additional examples regarding the generation of correct control characters (CRC16) refer to the manual **Modicon PI-MBUS-30**.

ALARMS

ERCEL: the load cell is not connected or is connected in an incorrect manner; the load cell signal exceeds 39 mV; the analog output generates the lowest possible value.

ER AD: the conversion electronics is malfunctioning, the analog output generates the lowest possible value; check load cell connections, if necessary contact technical assistance.

ER OL: the calculated analog signal is outside the allowed generating range:

ANALOG OUTPUT VALUE UNDER ALARM CONDITIONS

ANALOG OUTPUT TYPE	Minimum	Maximum
0÷10 V	-1.000	11.000
0÷5 V	-1.000	5.500
-10÷10 V	-11.000	11.000
-5÷5 V	-5.500	5.500
0÷20 mA	0.000	24.000
4÷20 mA	0.000	24.000

RESERVED FOR THE INSTALLER

RESTORING FACTORY VALUES

Turn off the instrument and set the selector switch to ZERO; while holding down the control knob, turn the instrument back on until the following is displayed:

CANC
NO

Release the control knob and set the selector switch to NORMAL; rotate the control knob to display **YES**; confirm by pressing the control knob, the instrument restart and all the parameters will be restored to factory values.

CALIBRATION AND RS485 PORT SETTING ACCESS LIMITATION

Turn on the instrument and set the selector switch to NORMAL; hold down the control knob for five seconds until the following is displayed:

Block
No

By working the control knob it is possible to select:
- **No**: access allowed;
- **Yes**: access denied for unauthorised staff; if the selector switch is set to ZERO or FS CAL the display will read **BLOCK**.

Confirm by holding down the control knob for at least three seconds, release it to shift to the next parameter. The display will show the address set for the RS485 serial connection protocol:

Address
0

By working the control knob it is possible to select:
- **0**: continuous division transmission according to a frequency proportional to the set baud rate (30 Hz to 300 Hz with baud rate equal to 38400 bps);
- **1÷99**: querying Modbus RTU slave protocol.

Confirm by holding down the control knob for at least three seconds, release it to shift to the next parameter. The display will show the rate setting for RS485 serial connection:

Baud
9600

By working the control knob the transmission rate can be adjusted (2400, 4800, 9600, 19200, 38400, 115200. Default: 9600 bps).

Confirm by holding down the control knob for at least three seconds, release it to quit the settings menu and return to normal instrument operation.

DECLARATION OF CONFORMITY $C\epsilon$

EC-Konformitätserklärung   EC-Declaration of Conformity
EC- Déclaration de conformité   EC-Declaración de Conformidad
EC-Dichiarazione di conformità   EC-Conformiteitverklaring
EC- Declaração de conformidade   EC- Prohlášení o shode
EC-Deklaracja zgodności   EC-Заявление о соответствии

I	Dichiarazione di conformità	Dichiariamo che il prodotto al quale la presente dichiarazione si riferisce è conforme alle norme di seguito citate.
GB	Declaration of conformity	We hereby declare that the product to which this declaration refers conforms with the following standards.
E	Declaración de conformidad	Manifestamos en la presente que el producto al que se refiere esta declaración está de acuerdo con las siguientes normas
D	Konformitäts-erklärung	Wir erklären hiermit, dass das Produkt, auf das sich diese Erklärung bezieht, mit den nachstehenden Normen übereinstimmt.
F	Déclaration de conformité	Nous déclarons avec cela responsabilité que le produit, auquel se rapporte la présente déclaration, est conforme aux normes citées ci-après.
CZ	Prohlášení o shode	Tímto prohlašujeme, že výrobek, kterého se toto prohlášení týká, je v souladu s níže uvedenými normami.
NL	Conformiteit-verklaring	Wij verklaren hiermede dat het product, waarop deze verklaring betrekking heeft, met de hierna vermelde normen overeenstemt.
P	Declaração de conformidade	Declaramos por meio da presente que o produto no qual se refere esta declaração, corresponde às normas seguintes.
PL	Deklaracja zgodności	Niniejszym oświadczamy, że produkt, którego niniejsze oświadczenie dotyczy, jest zgodny z poniższymi normami.
RUS	Заявление о соответствии	Мы заявляем, что продукт, к которому относится данная декларация, соответствует перечисленным ниже нормам.

Models: TLE

Mark Applied	EU Directive	Standards
$C\epsilon$	**2006/95/EC** Low Voltage Directive	*Not Applicable (N/A)*
$C\epsilon$	**2004/108/EC** EMC Directive	EN 55022 EN 61000-6-2 EN 61000-6-4 EN 61000-4-2/3/4/5/6
$C\epsilon$ **M** (only if "M" mark is applied)	**2009/23/EC** NAWI Directive	EN 45501:1992 OIML R76-1:2006

Montechiarugolo (PR), 08/05/2013

LAUMAS Elettronica s.r.l.
M. Consonni (*RCQ*)