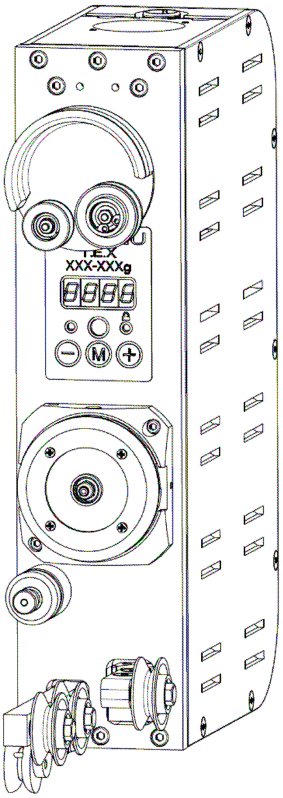
VISHNU

WIRE TENSIONER SERIES

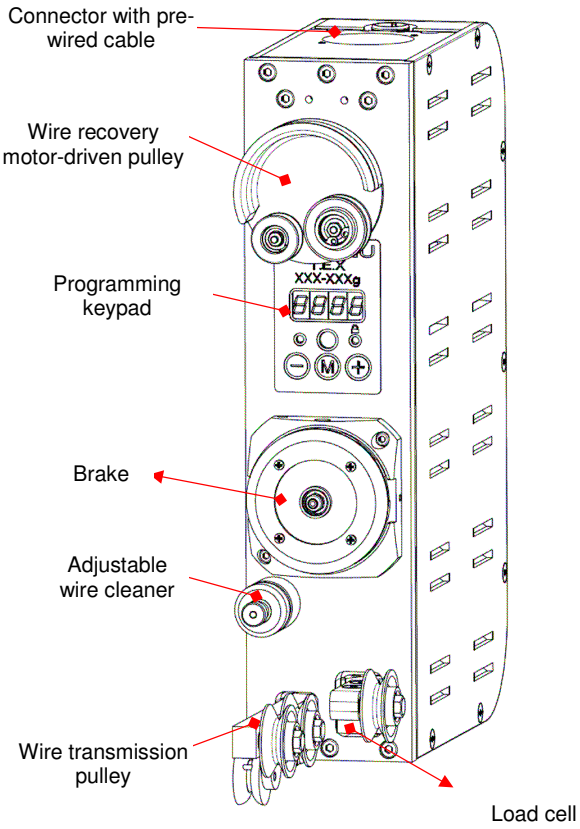
TYPE T.E.3 and T.E.4

PROGRAMMABLE CLOSED - LOOP ELECTRONIC WIRE TENSIONER



Description
The electronic wire tensioner type **T.E.** is a programmable device which can be used in winding machines in order to ensure a constant wire tension (in grams) during the winding phase.

Characteristics
- Microcontroller-based function control
- Closed-loop grammage control through a load cell
- Setting keypad and display
- Wire recovery by means of an electric-motor-driven pulley
- Pre-wired connector
- Control weight by analog input
- Control weight by IR remote control
- Control weight by RS-485 serial bus



Performance
The wire running or peripheral speed can be calculated through the following formula:

V = **D** x **Vm** x **3,14** / **60.000** [m/s]

where:
D is the coil max. winding diameter (mm);
Vm is the spindle rotational speed (rpm);

If the **"V"** speed exceeds 25 m/s, the spindle rotational speed will have to be decreased.
NB: the **"V"** speed depends on the diameter of the wire used.

Tension range

T.E.3 [125 - 600] g (wire from **0,13** to **0,31 mm**);
T.E.4 [275 - 2500] g (wire from **0,21** to **0,65 mm**);

Note: if parameter b8 = typ1, tension range (only by analog input) is limited to following values:

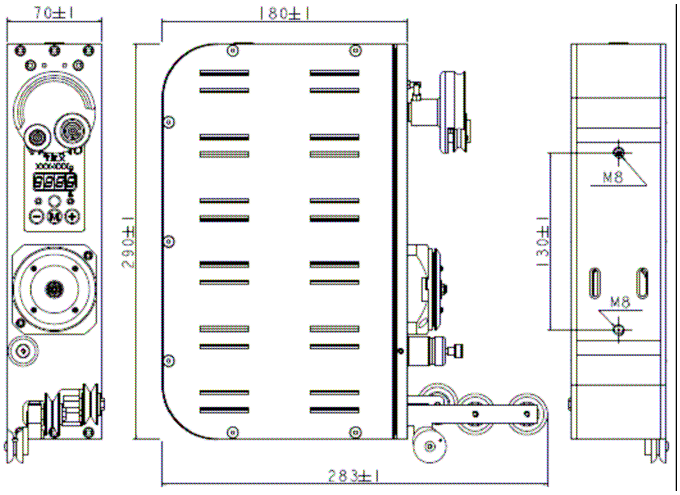
T.E.3 : 500 g

T.E.4 : 2000 g

Max linear speed 25 m/s

Resolution +/- 1 g

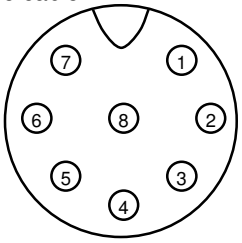
Dimensions



Mechanical fixing
Two M8 threaded holes are available on the wire tensioner back for its mechanical fixing.
Important: use screws with an appropriate length to enter 8mm min. and 12mm max. into the wire tensioner.

Installation
The wire tensioner is supplied in a single package with a pre-wired cable.

Electrical wiring
Power **(24V DC)** is supplied through the connector placed on the top of the wire tensioner by means of the appropriate cable supplied with the wire tensioner itself.
The maximum power consumption is 1.5A dc
Use suitable cables and power supply unit according to the number of wire tensioners installed.
The following figure shows the wiring diagrams of the connector and the cable.

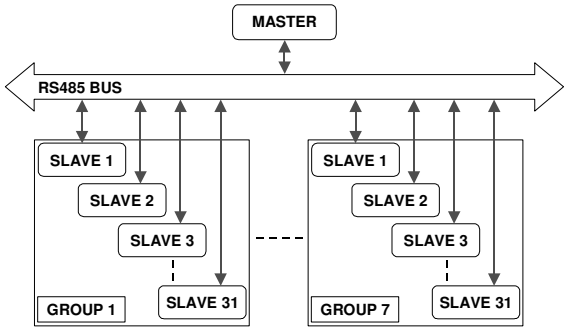


Flying female connector
(soldering opposite side view)

Wire colour	Wire section	Function	Ref. no.
Red	0.50 mm^2	+24VDC power supply	1
Black	0.50 mm^2	GND power supply	2
Red	0.22 mm^2	Not connected	3
White	0.22 mm^2	Wire breaking output (+24VDC)	4
Brown	0.22 mm^2	RS485-A connection	5
Green	0.22 mm^2	RS485-B connection	6
Yellow	0.22 mm^2	GND analog input	7
Grey	0.22 mm^2	0-10VDC analog input	8

Pin 4 of the connector **(white wire)** is given an output signal **(+24VDC)** when the wire tensioner is in wire breaking condition. The wire breaking signal cannot be used to directly drive loads such as relays, lamps, etc.; in these applications use a suitable external device (optional supplied separately).
Pin 7 **(Analog GND – yellow wire)** and pin 8 **(Analog IN 0-10V – grey wire)** of the connector can be supplied with a voltage signal by an external unit to set up the working grammage instead of using the front keypad or RS-485.

Communication with RS-485 BUS
Through an appropriate communication protocol it is possible to manage most of the wire tensioner parameters in read-and-write mode by means of external devices.



Analog input
If the wire tensioner is suitably configured, this input can be given a voltage signal by an external unit in order to set up the working grammage instead of using the front keypad (or 485 serial communication):
0 Volts = 0 grams
10 Volts = max. grammage.

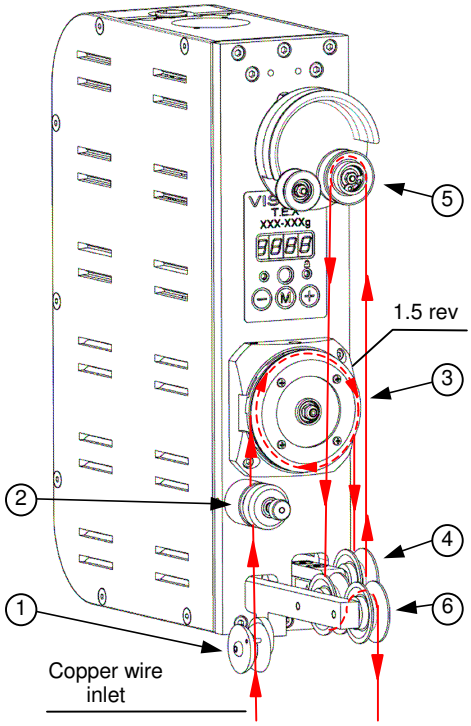
Directions for the installer

- Respect national and european standards related to electrical safety (EN60335-1/prEN50165).
- Before starting the device check cables and wirings carefully.
- Before starting the system, check the cables carefully: wrong wiring can damage the device and compromise the plant safety.
- After turning the system on, wait a few seconds till the initialization procedure is completed.
- Connect and disconnect the control system only after cutting off the power supply.
- Avoid exposing the wire tensioner to dripping water.
- Do not place control signal cables close to power cables.

Installation in the machine

Important:
Wire tensioners should be installed so as to create a right angle with the spindles.
Make sure that the wire tensioner support frame is solid enough.
Make sure that from the wire tensioners to the wire guide tubes the wire is straight enough and that its transmission is direct and not deviated by any other elements.
In case of thin wires, it is important to avoid as far as possible any wire deviation between the coil and the wire tensioner, as each deviation causes a grammage increase that the wire tensioner could not be able to compensate.
For a good operation we recommend using the appropriate wire cleaner on the coil.

Use and programming (Wire path)



1. Insert the wire into the transmission inlet pulley
2. Open the felts and put the wire between them
3. Let the wire make 1.5 revolutions on the brake pulley
4. Insert the wire into the load cell pulley
5. Rotate the wire recovery pulley,(with the pulley turned right) insert the wire into the pulley
6. Insert the wire into the pulley on the bottom; now the wire can be inserted into the machine

Initial start-up

After being supplied, the device remains in an initialization state, during which the display shows the last four digits of the product code, alternated with software revision index.
During this phase (about 6 seconds) it is appropriated to avoid any winding step.

Multifunction keypad

Start-up

- Without wire or with broken wire

The upper pulley makes a complete anticlockwise rotation, and soon after the **Er.01** message appears on the display signalling the wire breaking status.
Once the wire has been restored, press the **"M"** key to exit the wire breaking status and re-enable the wire breaking upper pulley motor.

- With wire

The wire tensioner starts operating and prepares to display the average value of the measured grammage (parameter **"A1"**).
The **"M"** key has a double function:

a) shifting from the type of parameter to the parameter value; releasing the key restores the initial display;

b) resetting the **"Er.01"** condition (wire breaking) and restoring the system operation.

The **"-"** and **"+"** keys have the function of changing a set up parameter. They also give the possibility of selecting additional parameters.
The **"Red LED"** lights up when the correct password is entered and indicates that parameters type **"b"** (usually protected) can be modified.
The **"Green LED"** is available for searching any particular function.

Parameters

The following table shows the available parameters and their function.

Parameter	Function	Operation
A0	Set up grammage display / Grammage setting	Reading / Writing
A1	Average grammage measure display	Reading
A2	Brake current (mA)	Reading
A3	Recovery motor position	Reading
A4	Recovery motor parameter	Reading
A5	Load cell offset	Reading
A6	Recovery motor position sensor offset	Reading
A7	Hours-life counter	Reading
b0	Password to access "b" parameters	Writing
b1	New password insertion	Writing
b2	Proportional PID parameter	Reading / Writing
b3	Integral PID parameter	Reading / Writing
b4	Default display	Reading / Writing
b5	Grammage setting source	Reading / Writing
b6	Factory-set data recovery	Writing
b7	Calibration	Writing
b8	Grammage range by analogic control mode	Reading / Writing
b9	Maximum brake current (mA)	Reading / Writing
C0 [T.E.4 only]	Minimum current parameter (recovery)	Reading / Writing
C1 [T.E.4 only]	Minimum current parameter (winding)	Reading / Writing
C2 [T.E.4 only]	Nominal Diamater (mm)	Reading / Writing

C3 [T.E.4 only]	Correction factor tension weight	Reading / Writing

Attention:

- The parameters on a grey background are factory-set for the correct operation of the wire tensioner and should not be modified, as this may lead to operation failures.
- Pressing the **"M"** key while parameter **"b7"** is displayed causes a calibration loss leading to operation failures in the wire tensioner, which will therefore need to be recalibrated.

A0 Grammage setting display; if the wire tensioner is set up to be operated through the keypad (see parameter **"b5"**), the **"-"** and **"+"** keys will enable to adjust the requested grammage value.

A1 Average grammage measure display.

A2 Instantaneous brake current (mA).

A3 Detected recovery motor position display.
Pressing **"M"** enables to display the detected position of the motor controlling the upper wire recovery pulley.
A normal detected value is around 300 (if b8=typ2), or 600 (if b8=typ1), both with the pulley completely rotated clockwise and with the pulley completely rotated anticlockwise (wire breaking position). Different detected values indicate that the pulley is not correctly aligned with the internal position sensor, and this may compromise the correct operation of the wire tensioner.

A4 This parameter indicates the current supplied to the motor recovery.

A5 Parameter indicating the load cell calibration offset.

A6 Parameter indicating the motor recovery calibration offset.

A7 Parameter indicating hours-life counter of the tensioner.

b0 Password insertion for the protection removal of **"b"** parameters.
This operation enables to release protected parameters.
When using this function for the first time, press the **"M"** key and then select parameter **"b0"**. Then press the **"M"** key 4 times: 4 zeros will appear on the display representing the factory-set password. If you wish to change it, select parameter **"b1"**.

b1 New password insertion.
After selecting parameter **"b1"**, press the **"M"** key and enter the requested 4 digits through the **"+"** and **"-"** keys.

b2 Proportional gain (**"n"** numerator **"d"** denominator) in the closed-loop grammage control:

"default 3n2d" (**"n"** numerator **"d"** denominator) for T.E.3

"default 1n2d" (**"n"** numerator **"d"** denominator) for T.E.4

It is expressed as a fractional value (numerator and denominator) and represents the system quickness of reaction to variations.
An elevated proportional term is desirable for a prompt response of the system and an low steady-state error.
However, a strongly proportional regulation may cause oscillations around the set point and excessive overshoots.
To eliminate any steady-state error (the difference between the required weight and the result obtained), act on the integral parameter "b3" increasing its value.
In case of wire breaking due to very high accelerations in the winding phase, the factory-set value will have to be increased. The higher this ratio value, the quicker the system will react to variations, till becoming instable in some cases (in this event decrease "b2" value).

b3 Integral action (**"n"** numerator **"d"** denominator) in the closed-loop grammage control.

"default 1n4d" (**"n"** numerator **"d"** denominator) for T.E.3

"default 1n3d" (**"n"** numerator **"d"** denominator) for T.E.4

It is expressed as a fractional value (numerator and denominator) and allows to cancel any steady-state error
However, too high values of this term may introduce elevated oscillations of grammage.

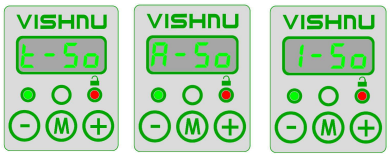
b4 Enables to choose the parameter to be displayed at start-up or after the system restoration following any wire breaking.

b4=0 -> Parameter A0
b4=1 -> Parameter A1
b4=2 -> Parameter A2
b4=3 -> Parameter A3
b4=4 -> Parameter A4
b4=5 -> Parameter A5
b4=6 -> Parameter A6

b5 Enables to select the grammage value setting source.
Three wire tensioner management methods are available:

t-So = setting through the keypad
A-SO = setting through analog input (0 - 10V dc)
I-SO = setting through RS485 serial line

To select the requested setting method press **"M"** and then choose one of the 3 functions through the **"+"** and **"-"** keys.



Address display (RS485)

By selecting the remote source (I-So) through the "M" key, it is possible to change the device address. In particular, the group address (initially blinking) can take values between 01 and 07, which are then confirmed by pressing the "M" key. After confirming the group address, the node address starts blinking, which can be changed between 01 and 31; pressing the "M" key enables to confirm the node address change.
Default address:
- Group address: 01
- Node address: 01

b6 Factory-set data recovery.
By entering this parameter and pressing **"M"**, factory-set parameters can be restored; the abbreviation **"rec."** appears on the display. Press again "M" to confirm and exit the procedure.
This function, which should be used only if it is absolutely necessary, enables to restore initial factory-set conditions.

b7 Calibration.
To carry out a correct calibration of the tensioner, see the related procedure in chapter "Calibration".

b8 This parameter enables to choose, through the **"+"** and **"-"** keys , between the following options ("**M**" key to confirm):

- "**typ2**": default option. Enables to use the analog input up to the maximum allowed weight value (600g for TE3, 2500g for T.E.4).
- "**typ1**": Enables to use the analog input up to the weight value of 500g for TE3 and 2000g for T.E.4). **Select this option only if the tensioner is in a battery where 500g or 2000g type are installed.**

Note: changing the weight by keyboard, IR remote control and RS-485 does not involve the setting of the parameter.

b9 This parameter represents the maximum current (mA) that can be supplied to the brake. Default value is 120, and maximum value is 254.

Parameter to be changed only in case of real need, because the tensioner is equipped with an integrated closed-loop controller that allows to calibrate accurately the desired weight. Values that are too low or too high may cause malfunctions of the tensioner.

C0 acts on the minimum current supplied to the recovery motor during recovery phases. Default value is 100, and maximum value is 254. Parameter to be changed only in case of real need. Values that are too low or too high may cause malfunctions of the tensioner.

C1 acts on the minimum current supplied to the recovery motor during winding phases. Default value is 0, and maximum value is 254. Parameter to be changed only in case of real need. Values that are too low or too high may cause malfunctions of the tensioner.

C2 nominal diamater of the wire (mm). Default value is 0.20 and maximum value is 0.70.

C3 correction factor (percent) of the tension weight; default 100%, min = 50%, max = 150%

Practical examples of grammage setting

- Press **"M"**: **"A1"** will appear on the display
- Press **"-"** to go to **"A0"**, then press **"M"** to display the corresponding value
- Change the value through **"-"** and **"+"**
- Leave the set up value displayed or
  - Press **"M"** (**"A0"** will appear on the display)
  - Press **"+"** to go to **"A1"**, then press **"M"** to display the corresponding value.

Practical examples of proportional gain adjustment (parameter b2)

In the following tests, in very high acceleration conditions, the system proportional gain had to be changed in comparison with the default value **(3n2d)**, to avoid any wire breaking at winding start-up.

Wire tensioner **T.E.3**
Wire 0.15

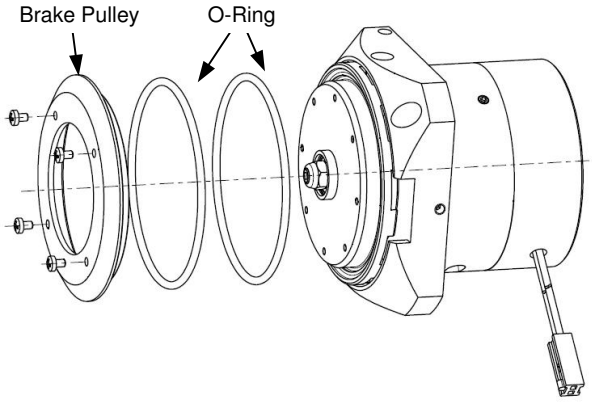
Acceleration ..... 1 sec. for 10000 rpm
Winding speed ..... 8000 - 10000 rpm
The gain had to be changed to ..... **(2n1d)**

Acceleration ..... 1 sec. for 15000 rpm
Winding speed ..... 8000 - 10000 rpm
The gain had to be changed to ..... **(4n1d)**

Maintenance

Since the **T.E.X** series wire tensioner is a sophisticated measuring device, some ordinary maintenance interventions are necessary.

Brake O-ring replacement

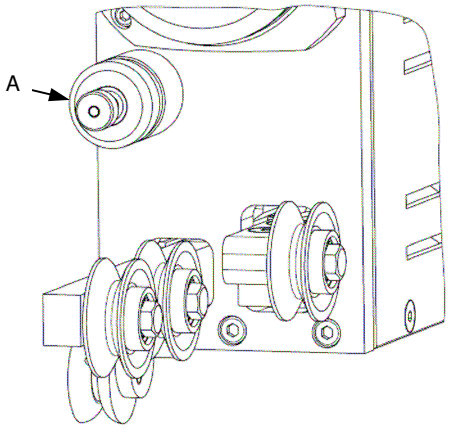


– Loosen the four screws placed on the brake pulley.
– Remove the pulley and the worn out O-rings.
– Clean the pulleys using an appropriate solution.
– Replace the O-rings with original ones.
– Reassemble the brake pulley and tighten the four screws.

Wire cleaning felts

– Check the wear level of the two felts periodically.
– Adjust the friction force (according to the diameter of the wire used) through knob A.

Important: felts clean off the paraffin wax covering the wire; if they do not work properly, paraffin wax will settle on the O-rings and make the wire slip on the brake.



Calibration

The measuring and feedback system is a delicate tool which should not suffer any shock or collision.

To carry out a correct calibration of the load cell and the recovery motor position, proceed as follows:

- go to parameter **"b7"** (**"b7"** should appear on the display);
- completely remove the wire from the wire tensioner (keep the wire tensioner in vertical position);
- rotate the recovery pulley and keep it positioned in such a way that the stop pin is vertical and turned downwards (towards the display);
- press **"M"** to start the calibration;
- a horizontal moving dash will appear on the display for a few seconds; once it disappears the wire tensioner will be calibrated.

Attention:
This operation should be carried out accurately, otherwise the system may not operate correctly.

Wire transmission pulleys

Check the good operation of the transmission pulleys periodically. If they do not rotate freely and/or are noisy, they **must** necessarily be replaced, as they may compromise the correct operation of the whole wire tensioner.

ATTENTION --> Company VISHNU S.r.l. takes no responsibility for any damage resulting from Customer tampering with the device.

VISHNU S.r.l.
Via dell'Industria, 4
37049 Villa Bartolomea (VR)
Tel. +39 0442 659283 - Telefax +39 0442 658637
http://www.vishnu.it - E-mail : info@vishnu.it

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