THE TENSION CONTROL SPECIALISTS

INSTRUCTION MANUAL

EtherCAT® Tension Amplifier
Model TA500-ECAT

DOC 801-2586

Dover Flexo Electronics
307 Pickering Road
Rochester, NH 03867- 4630
U.S.A.

FOR ASSISTANCE:

TECHNICAL SERVICE - Installations, Start-Up, Troubleshooting, Repairs, Field Service or Returns. **Call (603) 332-6150 and ask for Technical Support or email us at: techsupport@dfe.com**

CUSTOMER SERVICE - Replacement Parts, Individual Products, Questions about Orders, Manuals. **Call (603) 332-6150 and ask for Customer Service or email us at: customerservice@dfe.com**

SALES - Product Information, System Application Questions or Placing Orders, **Please e-mail us at: sales@dfe.com or call (603) 332-6150 and ask for Sales.**

Telephone: (603) 332-6150 Fax: (603) 332-3758

E-mail: info@dfe.com Internet: www.dfe.com

SAFETY

This label indicates: “Read The Manual”

Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your TA500-ECAT Tension Amplifier. If you have any questions concerning the operation of your device or the information in this manual, please contact us.

Email: techsupport@dfe.com
Telephone: (603) 332-6150

- **Observe all warning labels.**
- **Never remove warning labels.**

WARNING: If this equipment is not connected or operated in the manner specified, the operating safety of this unit or of connected equipment cannot be guaranteed.

WARNING: When working with TA500-ECAT follow the instructions below and read the manual carefully to protect yourself from injury and the TA500-ECAT from damage.

WARNING: Do not open the housing.

WARNING: Protect the TA500-ECAT from shocks and vibrations.

WARNING: The TA500-ECAT may become warm during normal use. Always allow adequate ventilation around the TA500-ECAT and use care when handling.

WARNING: Do not operate the TA500-ECAT adjacent to heat sources and do not expose it to unnecessary thermal radiation. Ensure an ambient temperature as specified in the technical data.

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DOCUMENT CONVENTIONS

NOTICE **NOTES -** Highlight important concepts, decisions you must make, or the implications of those decisions.

CAUTIONS - Tell you when equipment may be damaged if the procedure is not followed properly.

WARNINGS - Tell you when people may be injured, or equipment may be damaged if the procedure is not followed properly.

Numbered lists indicate tasks that should be carried out in sequence:

1. First do this
2. Then do this

Bulleted lists are used for:

- Tasks that can be carried out in any order
- Itemized information

1 GENERAL DESCRIPTION

TA500-ECAT is a Tension Amplifier with Quik-Cal™ push-button zero and calibration. In addition, this tension amplifier provides a tension transducer interface with an EtherCAT® connection. It can be used with any DFE tension transducer (load cell) to monitor tension in any zone on web or filament processing machinery. This device accepts commands and allows tension monitoring over an Ethernet connection using the EtherCAT® protocol.

Legacy push button calibration is supported to allow fast commissioning. With this method machine builders will find the TA500-ECAT very familiar to existing DFE tension amplifiers. Once calibrated, the amplifier will provide a simultaneous tension signal out in the format of 0-10V and 4-20mA. Optionally an EtherCAT® connection can be established and the tension data will be available through the EtherCAT® connection. For the more advanced users, commands such as calibration, push-button lockout and additional diagnostics are available to facilitate sophisticated machine integration for next generation tension control or monitoring tasks.

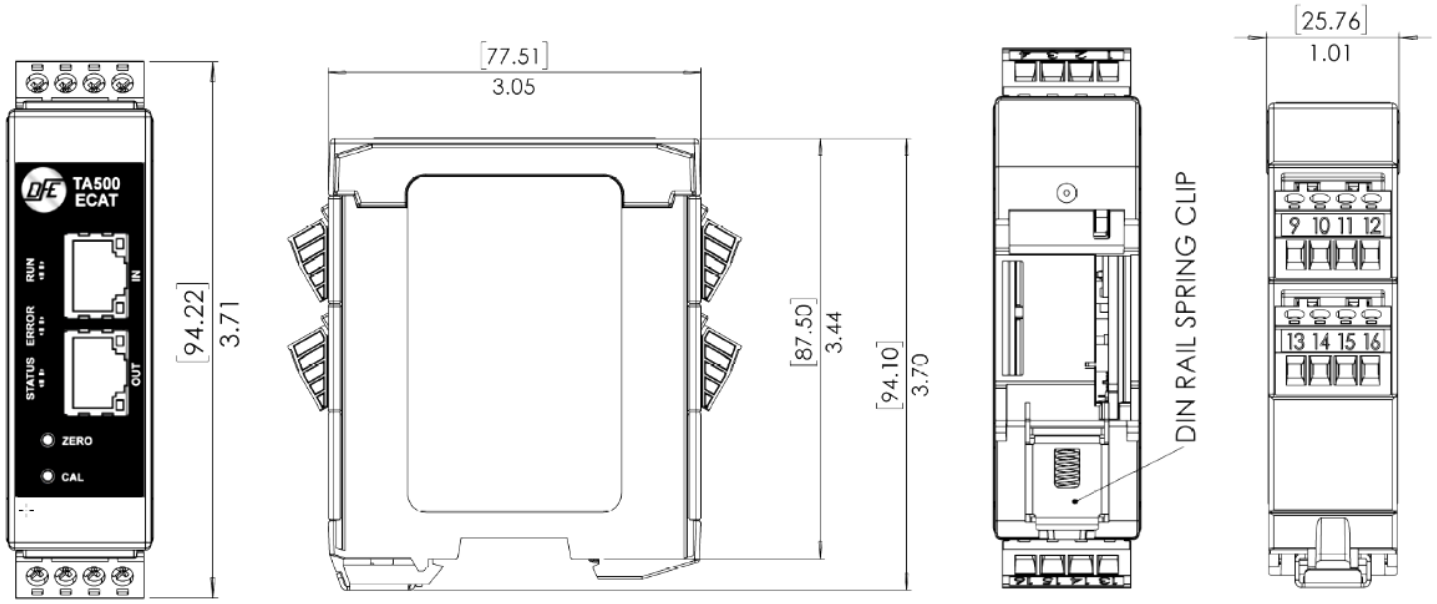
1.1 FEATURES

- Quik-Cal™ push-button zero and calibration eliminates pot adjustments to make calibrating simple and fast.
- 10% or 25% Calibration Ratio: Full scale output when tension is at 10 or 4 times the calibration weight.
- DIN Rail Clip compatible with 35mm DIN rail.
- Dual Tension Outputs: Simultaneous 0-10 VDC and 4-20 mA proportionate outputs for connection to a PLC, drive, display meter or data logging device.
- Tension data provided over EtherCAT® connection.
- Calibration / Button lockout commands via EtherCAT® connection.
- Web interface for configuration and calibration options / functions.
- Integral two port Ethernet switch simplifies network cabling.
- Integration and remote troubleshooting capability reduce total system and support costs.

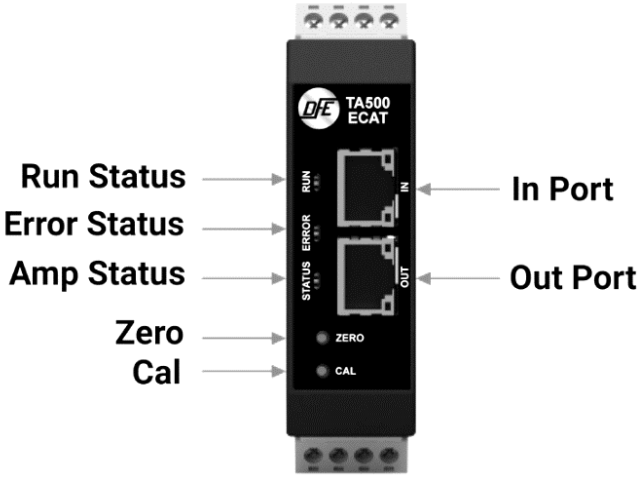
1.2 SPECIFICATIONS

Power Input: Voltage: 24 VDC +/- 10%, Current: 0.15 Amps DC typical, internal fusing PTC resettable
Temperature Range: 0°C to 40°C
Network Interface: 10/100baseT. Supports EtherCAT®
Network Connectors: Shielded RJ45
Status LEDs: 3 Bicolored LEDs - See Status LEDs section
Tension Amplifier Accuracy: +/- 1/2% drift at ambient maximum
Tension Outputs: Output 1: 0-10 VDC isolated from 24 VDC input GND
Output 2: 4-20 mA isolated from 24 VDC input GND
Calibration Range: Up to 50:1
Host Processor: 32 Bit
Resolutions: ADC – 24 Bit (16 Bit effective), DAC - 4,096 (12 Bit)
Weight: .25 lbs (114g)
Physical Dimensions: 3.71" (94.22mm) x 1.01" (25.76mm) x 3.70" (94.10mm)
Certifications: CE

1.3 DIMENSIONS



1.4 HARDWARE IDENTIFICATION



1.5 STATUS LEDs

Amplifier Status Information is useful for determining the condition of the tension amplifier and its network and module operational state. Three bi-colored LEDs located on the front of the TA500-ECAT provided this information.

1.5.1 Amplifier Status LED

The Amplifier Status LED is a bi-color red/green LED. The state of the LED depends on the state of the amplifier module. Wiring faults and/or overload conditions of transducer loadcells are indicated and can be decoded using the table below. During normal operation, the status LED is showing a solid steady green. The amplifier status information is also available of the data interface.

STATUS LED STATE	DEFINITION
Off	Power off.
Steady Green	Normal operation.
Green, 1 Flash	Device not calibrated.
Green, 2 Flash	Over Range Condition: Once calibrated the TA500-ECAT will indicate an over range or under range condition by setting the error code to 'Outside Cal Range'. The error is active once -20% or 120% tension is exceeded - Action Required: To clear this error the tension must be brought back into range, or a new calibration will need to be performed to do so.
Red, 3 Flash	Wiring Error: Will alert until the load cells are wired correctly - Action Required: Check wiring and retry. Check for loose wires at the terminal blocks, check for shorts, and be sure the load cells are connected. If the transducers need trouble shooting – contact tech support for assistance. Overload Condition (LT Transducer): Will intermittently alert if overload is reached - Action Required: Check that the tension range does not exceed the transducer load rating. Reduce wrap angle to reduce effective net force exerted on load cell.
Red, 4 Flash	Excitation Failure or Wiring Error - Action Required: Check for shorts in the transducer / load cell wiring. If the transducers need trouble shooting – contact tech support for assistance.
Red, 5 Flash	Internal Failure - Action Required: Contact DFE for replacement.

1.5.2 RUN LED

The LED signals the status of the slave in the EtherCAT® network:

RUN LED STATE	DEFINITION
Off	Init.
Blinking	Pre-operational.
Single Flash	Safe-operational.
Flashes	Initialization or bootstrap*.
On	Operational.

*The TA500 does not support Bootstrap Operations.

1.5.3 ERROR LED

Error code

NS LED STATE	DEFINITION
Off	No error.
Blinking	Invalid configuration.
Single Flash	Unsolicited state change.
Double Flash	Application watchdog timeout.
Flickering	Booting error.
On	PDI watchdog timeout.

Link Activity (L/A) LEDs

A green LED labelled is located next to each EtherCAT® socket. The LED indicates the communication state of the respective socket:

L/A STATUS LED	DEFINITION
Off	No connection to the connected EtherCAT® device.
Lit	LINK: Connection to the connected EtherCAT® device.
Single Flash	ACT: Communication with the connected EtherCAT® device.

2 INSTALLATION & MOUNTING

The unit is DIN rail mountable, compatible with 35mm DIN rails. To install snap on to DIN rail. To remove from the DIN rail, use a screwdriver and release the clamp at bottom of the unit as shown below.

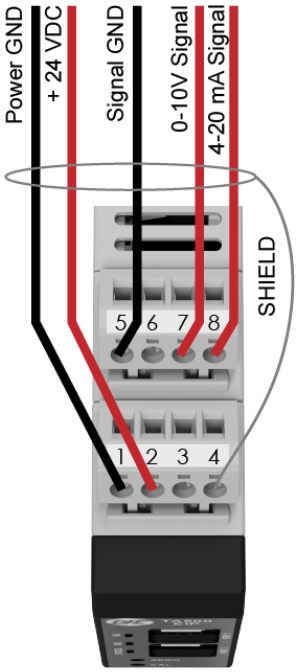
TA500 devices shall be mounted vertically. Zero-stacking is allowed when operating at or below the maximum temperature specification (104°F / 40°C). Care should be taken to observe the ambient temperature and minimize exposure to adjacent sources of thermal radiation. Operating in excess temperatures may cause performance issues.

3 STANDARD ELECTRICAL CONNECTIONS

CAUTION – Use care when wiring as incorrect wiring can cause damage to the unit.

3.1 POWER INPUT CONNECTIONS

- Pin 1: Power GND
- Pin 2: +24 VDC
- Pin 3: No connect
- Pin 4: Shield (Tied to Functional Earth Ground Connection)



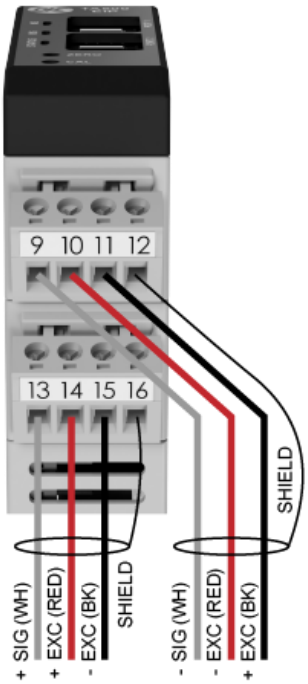
3.2 SIGNAL OUTPUT CONNECTIONS 0-10V, 4-20MA

- Pin 5: Signal GND
- Pin 6: No connect
- Pin 7: Output 1 - V OUT 0-10 V
- Pin 8: Output 2 - I OUT 4-20 mA

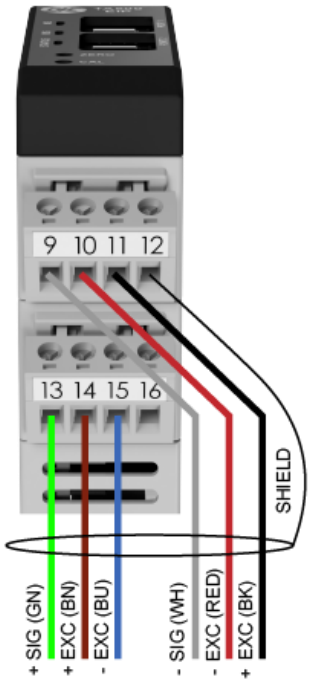
3.3 TRANSDUCER LOAD CELL CONNECTIONS

- Pin 9: - SIGNAL
- Pin 10: - EXCITATION
- Pin 11: + EXCITATION
- Pin 12: Shield (Tied to Functional Earth Ground Connection)
- Pin 13: + SIGNAL
- Pin 14: + EXCITATION
- Pin 15: - EXCITATION
- Pin 16: Shield (Tied to Functional Earth Ground Connection)

Transducer Connections
MODEL C, F

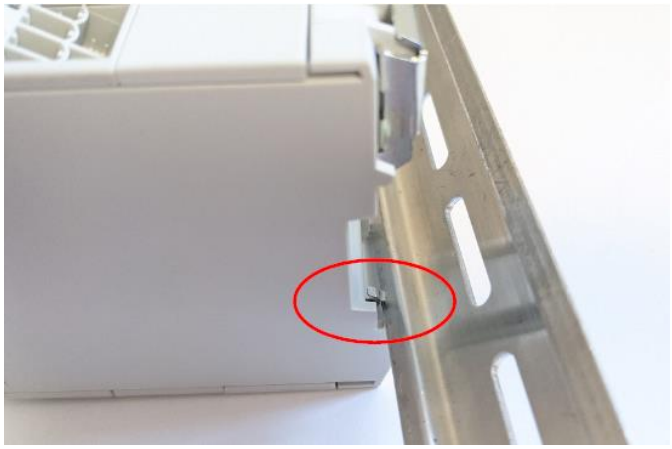


Transducer Connections
TR / NW / RFA / LT / VNW



NOTICE *TA500-ECAT meets the European Union's Low Voltage Directive and EMC Directive only when installation is done correctly. To meet the EMC Directive, a proper transducer installation, including shielded cables must be used.*

Functional Earth Connection A functional earth connection is provided to make contact with the DIN rail. Functional earth is a current path of low impedance between current circuits and earth, which is used to maximize interference immunity.



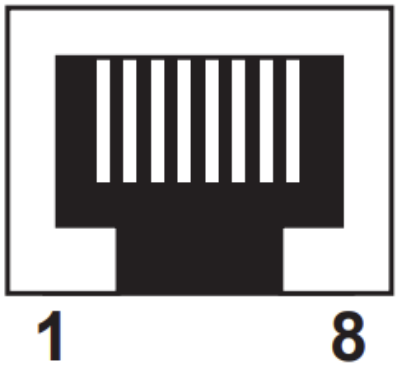
NOTICE *Connect the mounting rail to functional earth potential. Please note that the impedance of the connecting cable has to be kept low.*

3.4 ETHERNET PORT CONNECTIONS

IN & OUT Ethernet Interface RJ45 connectors Details:

The Ethernet interface capability is 10/100Mbit, full or half duplex operation. Ethernet cord set is recommended to be CAT-5 cable, shielded (STP). The pinout connection is standard and is provided below for reference.

Pin no	Description
4,5,7,8	Connected to chassis ground over serial RC circuit
6	RD-
3	RD+
2	TD-
1	TD+
Housing	Cable Shield



4 CALIBRATION

A calibration process must be performed before your amplifier is ready to indicate tension.
The following should already be completed prior to calibration.

- Attach power connection to the unit
- Attached the Transducer Load cell connections
- Attached the analog signal output connection if used
- Attached the ethernet data connection if used
- Power the unit
- Status indication of the unit should indicate no status errors, however it may indicate that the device is not calibrated or is in an overloaded condition if the device was previously calibrated – see status LEDs

NOTICE *The TA500-ECAT can be used as an amplifier with or without an EtherCAT® connection established.*

There are two methods to calibrate the TA500-ECAT

- Traditional Push Button Calibration
- Calibration through the EtherCAT® interface

NOTICE *All calibration methods require zeroing the amplifier with no weight or load on the transducer load cells. Once zeroed, a calibration weight or load can be applied equal to 10% or 25% of the full range desired.*

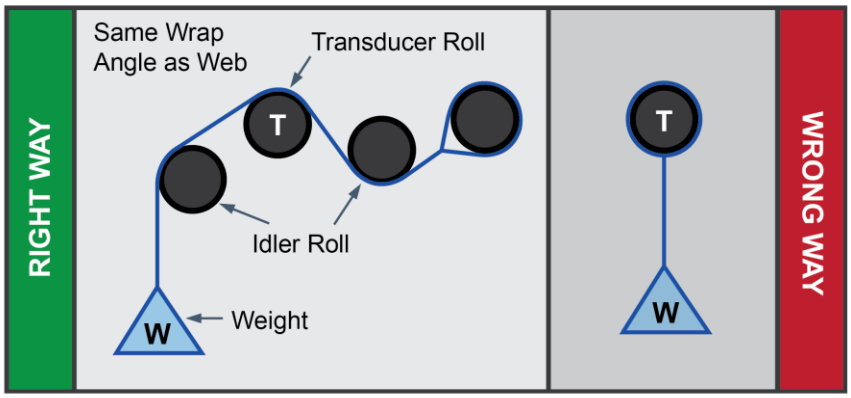
Traditional Push Button Calibration

This calibration process is easy and produces a unitless proportional 2-point calibration. An appropriate calibration weight will need to be selected. The weight determines the value of web tension that will be produced at full output of the TA500-ECAT. The TA500-ECAT allows calibration to be performed with 10% or 25% of the full range desired.

For example: A 15 lb weight will result in a scaled range of 0-150 lbs of tension if a 10% calibration is performed. Analog output values of tension are always unitless and proportional to tension.

1. **ZERO:** Ensure nothing is hanging on or pressing on the transducer roll (including the calibration rope). Press the ZERO pushbutton on the unit front panel for at least 1 second. The unit will automatically adjust and store the tension-zero value one second after the button is pressed. The unit will rapidly flash the green status LED to indicate the zero has been stored. Release the button. The Output1 will read 0 VDC and Output2 will read 4 mA.

2. **CALIBRATE:** Hang weight as indicated below. Wait for the weight to stop swinging.



To calibrate at 10%: Push and Hold the Cal Button (About 1 Second) until confirmation blinks, then release the button. The output will read 10% of full scale after calibration.

To calibrate at 25%: Push and Hold Cal Button (About 5 Seconds) until you see two sets of confirmation blinks. Then release the button. The output will read 25% of full scale after calibration. (If no confirmation blink occurs, inadequate calibration weight may have been used)

After calibration: Remove the weight and observe the output. It should read 0 VDC or 4 mA with nothing touching the tension sensing roller.

NOTICE *Once calibrated, tension data is also available over the network connection, however it should be noted that the calibration performed can be considered unitless and range-less unless the value in the CalRange Register and the CalUnits register at calibration was valid. In this case the TENSION_P may be the most desirable tension register. See Accessing Tension Data for more information.*

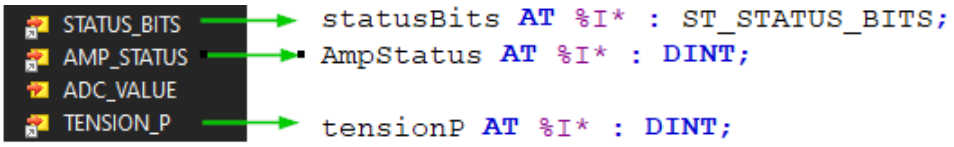
4.1 CALIBRATION USING THE ETHERCAT® INTERFACE

4.1.1 In program Calibration

Using TwinCAT® 3, be sure that you have a valid ESI file installed for the TA500-ECAT and that you have added the TA500-ECAT to you connected devices. See the section on ESI installation for more information.

When the module is properly installed, transmit and receive PDO will be available to map to local variables. In this example we will map the following:

INPUTS:



OUTPUT:

Once mapped in the TwinCAT® 3 environment we have easy access to the TA500 registers. For calibration we will send the command instruction values to the mapped TA500cmd register and we can use the statusBits.cmd Processed bit to identify when the command is complete as the TA500cmd should be cleared or set to zero when no command is requested.

Below is a simple logical example of an approach issuing commands necessary for calibration of the TA500 from within a program. This can be useful if the designer wants to implement calibration or commissioning process from within a program to enable a calibration method that doesn't involve locating the physical zero and calibration buttons of the amplifier.

```
IF ZeroAmp = TRUE THEN
    TA500cmd := 1;
END_IF

IF CalAmp10Percent = TRUE THEN
    TA500cmd := 2;
END_IF

IF statusBits.cmdProcessed = 1 THEN
    TA500cmd := 0;
    CalAmp10Percent := 0;
    ZeroAmp := 0;
END_IF
```

```
AmpOk TRUE := statusBits.ampOk TRUE;
TensionPercent 10 := (DINT_TO_REAL(tensionP 100 ) / 10.0);
eAmpStatusText AmplfierOk := DINT_TO_UINT(AmpStatus 0 );
eCmdResponseText ReadyForCo := DINT_TO_UINT(CmdResponse 0 );
```

When properly calibrated the tension value is available in the TENSION_P register with a signed value represented with one decimal place. Divide the value by 10 to get the percentage.

The calibration process is identical to previously discussed calibration methods. Where, as always, the amplifier should be zeroed with no weight hanging on the load cells and calibrated with a weight equal to 10% or 25% of the full range weight.

It may be desirable to add units or range information to the calibration. If so, these registers must be set accordingly **before** a calibration command is completed. The registers which must be set are **CAL_UNITS** and **CAL_RANGE.** See the Receive PDO section for more details and information regarding unit and range value definitions.

Error checking can also be useful when constructing a calibration process via the EtherCAT® Interface. The process should check for a valid calibration by checking the **COMMAND_RESP** register after the command is sent. If the **COMMAND_RESP** indicates an error, this is usually due to insufficient calibration weight applied or the zero command was performed with the calibration weight applied. This register will hold its value until the COMMAND register is set to zero.

5 ESTABLISHING COMMUNICATIONS

5.1 ESI FILE

The ESI (EtherCAT® Slave Information) file is provided by Dover Flexo Electronics. Many EtherCAT® platforms support the use of ESI files to simplify the addition and configuration of devices. At a minimum, an ESI file conveys the identity information required for a network tool to recognize the device. Using the ESI file simplifies configuration and setup.

NOTICE *This section covers the installation and use of the ESI file TwinCAT® 3. Other systems will follow a similar pattern. Consult your controller's documentation if you need additional information.*

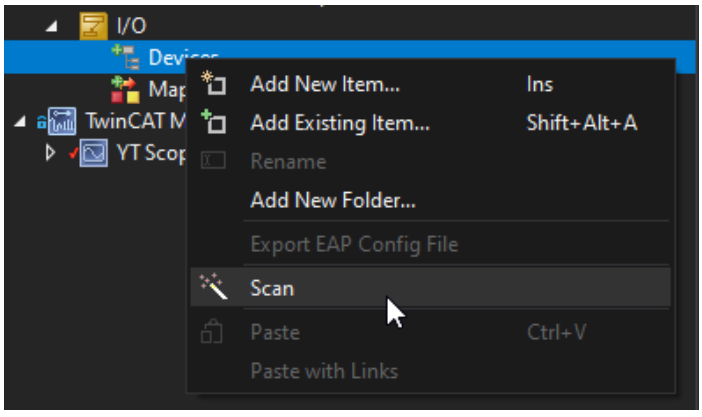
NOTICE *All Dover Flexo Electronics' ESI files are located on our website.*

5.2 INSTALLING THE ESI FILE AND ESTABILING A CONNECTION

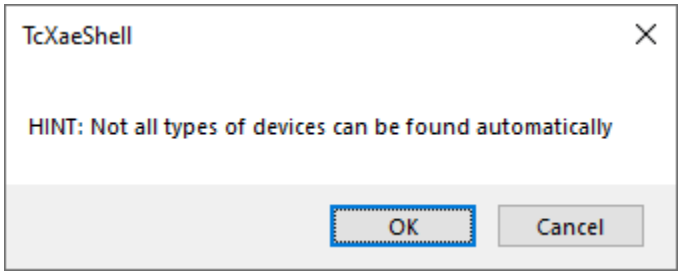
TwinCAT® 3 EtherCAT® Master requires the device description files of all EtherCAT® devices for configuration in online and offline mode. The ESI for the TA500 must be installed. This process is known as "Updating the ESI device description" for more information refer to the Beckhoff website.

The process is as follows:

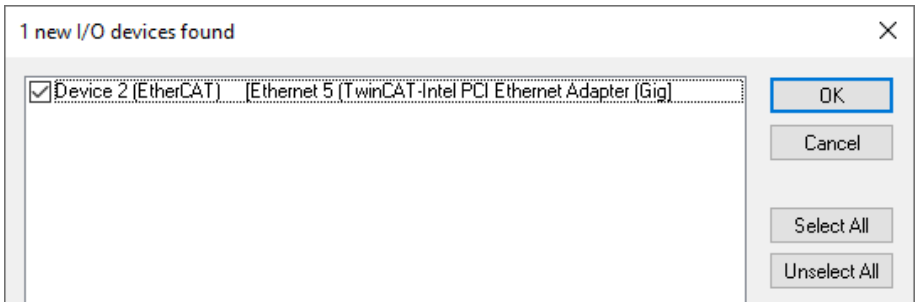
1. Download the ESI file from DFE.
2. Make sure TwinCAT® 3 is not running
3. Copy the ESI to the location of TwinCAT 3 installation directory:
   Typically: C:\TwinCAT\3.1\Config\Io\EtherCAT
4. Start TwinCAT® 3 and
5. Go to IO -> Devices, select Scan

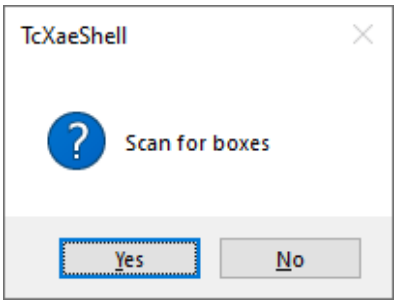


6. The tool will provide a hint that not all device types can be found automatically. Select 'OK'

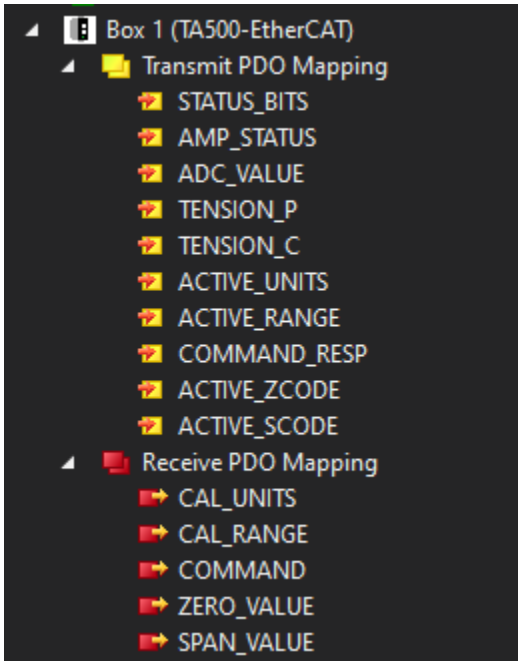


7. Choose Adapter and Select ‘Yes’ to scan for boxes.





8. The TA500 should be identified in the scan as shown:



5.3 TENSION DATA AND STATUS

After the module is added transmit PDOs carry the calibrated tension value if the unit is calibrated and other status information of the device. If calibration of the unit is required see the section Calibration. Tension data is signed 32–bit integer value. The transmit PDO descriptions are as follows:

5.3.1 Transmit PDO: Process Data Objects received from the TA500

STATUS_BITS

	STATUS_BITS																
31-16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED	AMP_OK	CMD PROCESSED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	HEARTBEAT	RESERVED	RESERVED	RESERVED	RESERVED	Zerored At Unit	Calibrated At Unit	Amp Locked

Status BIT	Name	Definition
0	Amplifier locked	No Button access is allowed for zero or calibration.
1	Calibrated at unit	Indicates that the last valid calibration was performed using the buttons.
2	Zeroed at unit	Indicates that the last zero operation was performed using the buttons.
3-6	RESRVED	Always Zero.
7	Heartbeat Bit	Bit toggles every 0.5 seconds approx.
8-13	RESRVED	Always Zero.
14	Command Processed	Bit set High after a command is processed, can be used in ladder logic to reset the command register to zero (no command).
15	AMP OK	SUMMARY Bit indicating no error status.
16-31	RESRVED	Always Zero.

AMP_STATUS

Status	Definition
0x00000000	Amplifier OK – Normal Operation.
0x00000001	Internal Failure.
0x00000002	No cailbration.
0x00000003	Out of Range – Amplifier is calibrated but is experiencing an overload or underload condition.
0x00000004	A wiring error is detected – in rare occurnences this error could be caused by an extreme overload conditions on load cells.
0x00000005	An error is detected with the excitation of the load cells – usually this means a short circuit is present externally to the amplifier.

ADC_VALUE – Raw value of input signal from load cells. Useful for troubleshooting or by advanced users.

TENSION_P – Tension value in percent of total calibrated range. Format: 1 decimal.

> **NOTICE** *If the calibration was performed using the zero and calibration button on the TA500 then the calibration performed can be considered unitless and range-less unless the value in the CalRange Register and the CalUnits register at calibration was valid.*

TENSION_C – Tension value in the configured unit with 2 decimals.

> **NOTICE** *The configured unit and range must be set prior to calibration and cannot be set after. The calibration process will store the units and range only at the time of calibration.*

ACTIVE_UNITS – This is the units value stored with the calibration.

ACTIVE_RANGE – This is the range value stored with the calibration. For instance, if this value is 9, then the range specified in calibration is 100. See CAL_RANGE in the Output Tags section for the lookup table.

COMMAND_RESP – This value is valid after a command has been issued to the TA500. The value should remain until the “no command” value is sent.

Value	Definition
0	Ready for Command.
1	Zero Completed OK.
2	Calibration 10% Completed OK.
3	Calibration 25% Completed OK.
4	Error – Usually due to insufficient calibration weight.

ACTIVE_ZCODE – Internal ADC value latched when the zero operation was completed. These are for advanced users.

ACTIVE_SCODE – Internal ADC value latched when the calibration operation was completed. These are for advanced users.

5.3.2 Receive PDO: Process Data Objects sent to the TA500

CAL_UNITS – If desired the unit type can be stored with the calibration. The data in this tag must be valid when sending the calibration command for the unit to be stored.

Value	Definition
0	"lb" Pounds
1	"oz" Ounces
2	"g" Grams
3	"kg" Kilograms
4	"N" Newtons

CAL_RANGE – The calibration range can be stored with the calibration. This data in this tag must be valid when sending the calibration command for the unit to be stored.

Value	Definition
0	1
1	5
2	10
3	15
4	20
5	25
6	35
7	50
8	75
9	100
10	125
11	150
12	200
13	250
14	300
15	400
16	500
17	750
18	1000
19	1250
20	1500
21	2000
22	2500
23	3000
24	4000
25	5000

COMMAND – Commands can be used to Zero and Calibrate the amplifier as well as lockout the front buttons to prevent user interference with a pre-existing calibration. These commands are detailed in the section Sending Commands

ZERO_VALUE – For advanced users only

SPAN_VALUE – For advanced users only

6 SENDING COMMANDS

Commands are primarily used for calibration of the TA500 via the EtherCAT® interface. If the push button method is used for calibration, users can disregard this section of the manual if they are not interested in additional features.

Utilizing calibration commands via the EtherCAT® interface can enable machine builders to create a more robust and efficient machine commissioning routines for their customers or builders without the need to physically locate the amplifier and push buttons as was done for legacy calibration techniques. Below is a list of the available commands and their definitions:

VALUE	COMMAND	DEFINITION
0	No Command	No command requested, idle.
1	Zero Amplifier	Command the TA500 to establish a zero-point, part of the calibration process. This command is always used before a Calibrate 10% or 25% command.
2	Calibrate 10%*	Calibrate the amplifier using a calibration weight equal to 10% of the full range.
3	Calibrate 25%*	Calibrate the amplifier using a calibration weight equal to 25% of the full range.
4	Lock Amplifier	When the amplifier is locked it prevents button operation at the unit, such as zero, calibrate, or reset.
5	Unlock Amplifier	When the amplifier is unlocked, buttons at the unit function as described in the manual. (DEFAULT)
6	Reset Calibration	Forces the Amplifier to an uncalibrated state.
7	Set Gain	Gain can be set manually for advanced users.

Transducers (load cells) should be loaded with appropriate calibration weight before this command is sent

Command values 1,2 and 3 are used to establish a two-point calibration in the amplifier. During the calibration process the gain is automatically calculated in the amplifier. The Calibration using the EtherCAT® Interface section defines how to use calibration commands in more detail.

NOTICE *All Commands are processed only on a command transition. The command register should be set to zero when no command is requested and after a command is processed. Users may find the bit 'Command Processed' useful when developing command logic. See the Transmit PDO Status Bit section for the bit location.*

6.1 CHECKING ACTIVE CONNECTIONS

The TA500-ECAT indicates active connections using the status LEDs at the front of the device. When an established connection is active the Network status LED will be solid green. For more information see the ERROR LED section **Network Status (NS) LED**.

TERMS AND CONDITIONS OF SALE AND SHIPMENT

See www.dfe.com/terms-and-conditions/ for current Terms and Conditions.

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