

## T3 Series



General Purpose IO for Integrators

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## T3 SERIES

The T3 Series are general purpose input/output modules for building integrators. Available in several input/output configurations, the T3 Series modules provide convenient termination for field devices and interfacing to your HVAC, lighting, temperature sensors, and other typical building automation applications. Each of the analog inputs can be jumper configured for signals of either 0-5V, 0-20mA, or dry contact. The outputs are available in dry contacts 1amp/output, 0-10V analog, and PNP sinking. The modules are slave devices that can be easily controlled via the RS485 serial interface using the industry standard Modbus Protocol.

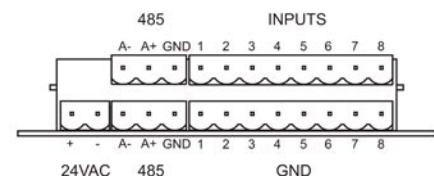
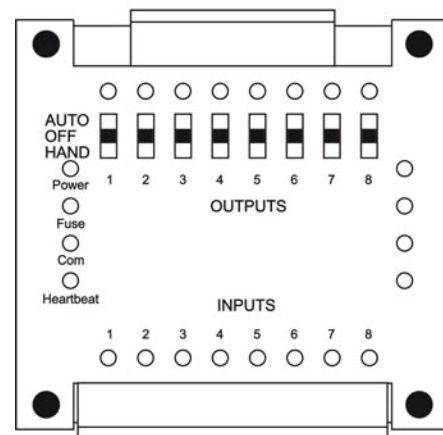
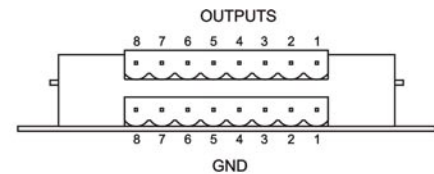


### Highlights:

- Surge-protected analog inputs with 10-bit resolution.
- Outputs can individually be switched to ON, OFF, AUTO.
- High impact plastic enclosure provides durability in commercial environments.
- Standard modbus protocol allows for up to 254 unique devices on one RS485 network.

### Technical Data

Types:	
<b>T3-8IO-A</b> .....	8 analog outputs @0-10VDC 200mA total, 8 analog inputs @0-5V, 0-20mA, dry
<b>T3-8IO-D</b> .....	8 dry-contact relay outputs x 1amps @120V, 8 analog inputs @0-5V, 0-20mA, dry
<b>T3-32I</b> .....	32 analog inputs @0-5V, 0-20mA, dry
<b>T3-8I16O</b> .....	16 PNP Sinking outputs @12V 200mA total, 8 analog inputs @0-5V, 0-20mA, dry
Temperature range .....	10-50°C (50-99°F)
Supply voltage .....	24VAC ±20%, 50-60Hz
Power consumption .....	100mA at 12VDC
Relay contacts rating .....	max 1A
Ambient temperature:	
Operation.....	10-50°C (50-99°F)
Storage.....	2-50°C (35-120°F)
Ambient humidity.....	10-90 %Rh
Material, enclosure.....	Flame proof plastic
Enclosure rating.....	IP31
Temperature sensor.....	10K thermistor ±0.5°C
Colour.....	White/Off-white
Weight .....	280g



## Standard Operation

### Inputs

Each input of a T3 module can be jumper-configured in 1 of 3 ways:

- 0-5V signal
- 0-20mA signal
- Dry contact, thermistor

The value of each input is stored as a 10-bit number in the respective modbus register. The registers addresses are as follows:

T3 Model	Number of Inputs	Register Addresses
T3-8IO-A	8	108-115
T3-8IO-D	8	108-115
T3-32I	32	100-131
T3-8I16O	8	108-115

Table 1: Input Register Addresses

A 5V, or 20mA, would give a reading of 1024. Each input has a corresponding LED which will light up if the value of the input is greater than 512. For more info on reading the input registers, see the section on Serial Communications.

### Outputs

The state of each output is determined by its corresponding switch position. The switches have 3 states – ‘hand’, ‘off’, and ‘auto’. When switched to ‘hand’, the corresponding output will be switched on - 10V for analog, contacts closed for relay, or 0V for sinking outputs. When switched to ‘off’, the output will be set to 0V for analog, open contact for relay, or open circuit for sinking outputs. When switched to ‘auto’, Analog outputs will be set to the level stored in the corresponding MODBUS output registers. For Digital or Sinking outputs, a register value 0 is de-activate and register value 1000 is activate.

The output registers are as follows:

T3 Model	Number of Outputs	Register Addresses
T3-8IO-A	8	100-107
T3-8IO-D	8	100-107
T3-32I	0	--
T3-8-16	16	100-107 & 116-123

Table 2: Output Register Addresses

These registers can be changed using the RS485 serial interface. For analog outputs, a 0 corresponds to 0V. Likewise, a 1024 corresponds to 10V. For relay or sinking outputs, the output will be activated by any number greater than 512. The output registers are stored in RAM, thus the contents of each register will be lost upon power-off. Each output has a corresponding LED which will light up if the value of the output is greater than 512 (5V). For more info on writing the output registers, see the section on Serial Communications.

### Analog Output Calibration

The T3-8IO-A has an output calibration feature that allows for an adjustment of +/- 1.28V. Calibration is controlled via the calibration register located at register address 13. By default, this is 128, which corresponds to 0V calibration. A value of 0 would give a -1.28V offset. A value of 255 would give a +1.28V offset. *It is recommended that the calibration be determined while the output is set to 5V.* The calibration value is located in flash memory and will be restored upon power-up.

### Bandrate

All T3-modules have adjustable Baudrates set by MODBUS register 15. By default baud is set to 19.2kbps

Value 1 will set the baud to 19200 bps.

Value 0 will set the baud to 9600 bps.

## Master Timer Clock Function for Tstats in a Network

The T3-8IO can act as a master timeclock for the tstat network to set a series of tstats to occupied and unoccupied mode. The system works by connecting an ordinary mechanical timeclock or a separate controller to input#1 of the network controller. Whenever the timeclock contact opens or closes, a message is sent from the network controller out to the tstats to go into occupied and unoccupied mode.

- Opening the contact connected to input #1 of the T3-8IO signals an occupied event, the network controller will send an occupied command to each tstat in the network. This command is sent only once to each tstat so that the user in the room can change the fan speed manually.
- Closing the contact on input #1 will signal an unoccupied event, all thermostats in the network are set to unoccupied mode. This command is sent to each tstat only once so that the local user has manual override control.

The T3-8IO network controller will maintain a list of all tstats that are successfully commanded for each timeclock event so that each timeclock event is transmitted to each tstat one time. In this way, the users in the rooms will have local control between timeclock events. If a tstat happens to be offline, the T3-8IO will repeat the event command until the tstat comes back online and a response is received. The T3-8IO polls each tstat and waits approximately 1 second for a response, starting from address #1 and on up to #254. Below is a typical wiring diagram for a Master timeclock and several tstats connected on the RS485 network.

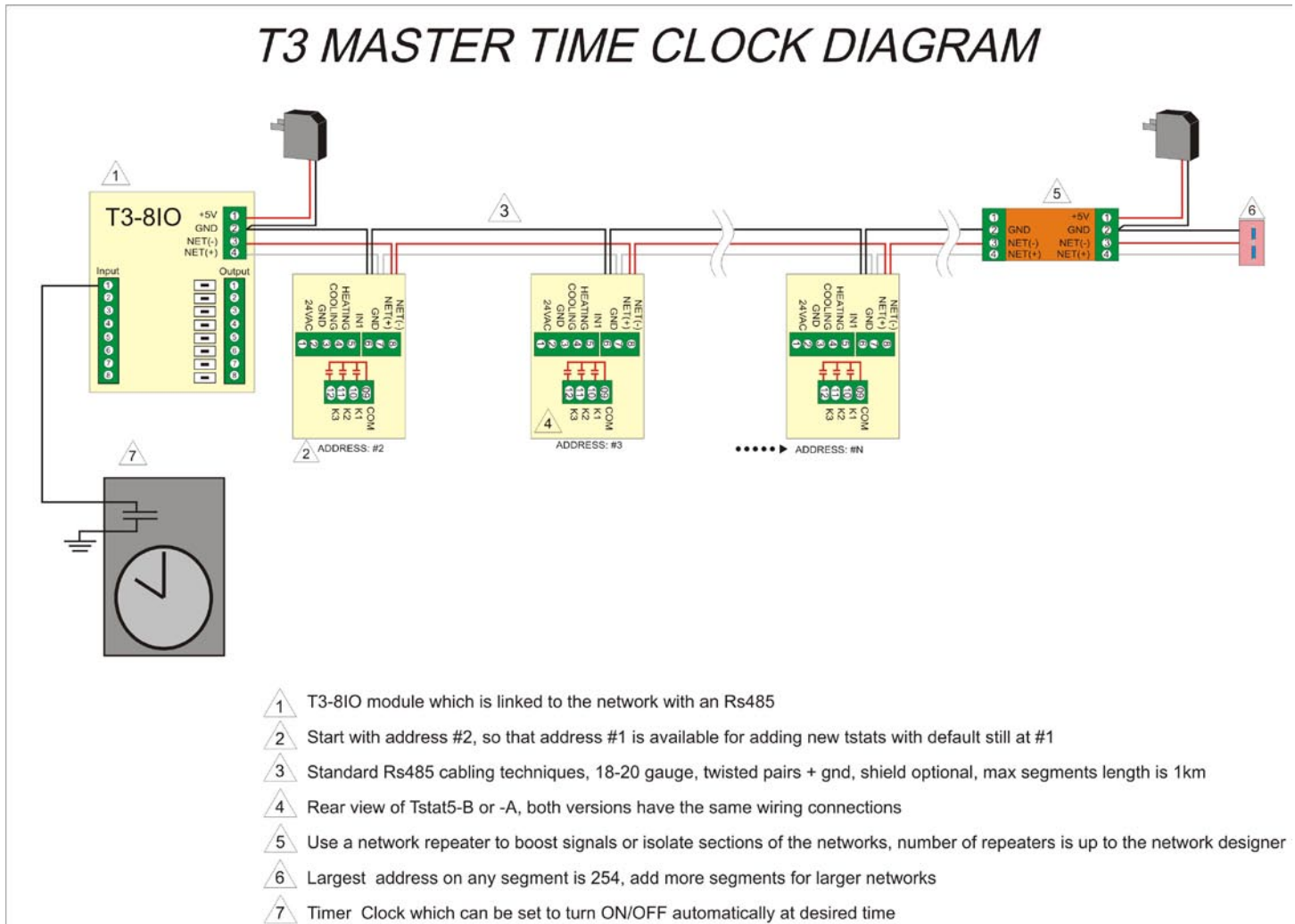


Fig. 1: T3 Master Time Clock Diagram

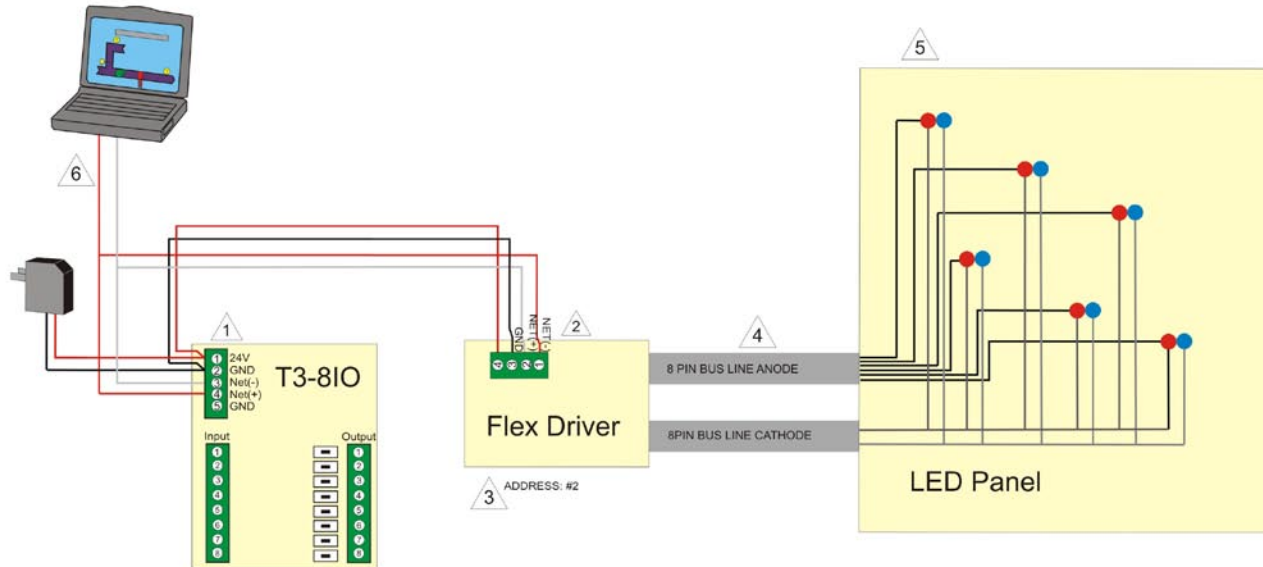
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## Master for FlexDriver LED in a Network

The T3-8IO can act as a master for the FlexDriver as well. Given the FlexDriver is only a Slave, the multi-purpose T3-8IO is used at a medium to talk to the FlexDriver device. □

### *FLEX DRIVER NETWORK WIRING DIAGRAM*

*RS485 cabling details*



- 1 T3-8IO module which is linked to the network with an Rs485
- 2 Flex Driver module which takes in information through the Rs485 line (modbus protocol) and controls LEDs accordingly
- 3 Start with address #2, so that address #1 is available for adding new tstats with default still at #1
- 4 FlexDriver 8 pins bus lines anode and cathode
- 5 LED panel
- 6 Data streaming from the computer on the Rs485 line (modbus protocol)

Fig. 2: Flex Driver Network Wiring Diagram

Date: November 5, 2004

## Accessing T3 Series Registers Via Serial Communications

The T3 modules have a built-in serial interface for communication over an RS485 network. Communication is currently implemented using Modbus Protocol. However, future versions of the T3 modules will work with both BACnet and TCP/IP Protocols. For detailed information on Modbus Protocol, see the chapter entitled Modbus Serial Communications.

### Connecting the T3 module to a computer

The T3 modules connect to a computer serially via the RS485 interface. An RS232 to RS485 converter is required in order to communicate with a standard PC. Figure 14 shows how the T3 module should be connected to the serial port of a PC.

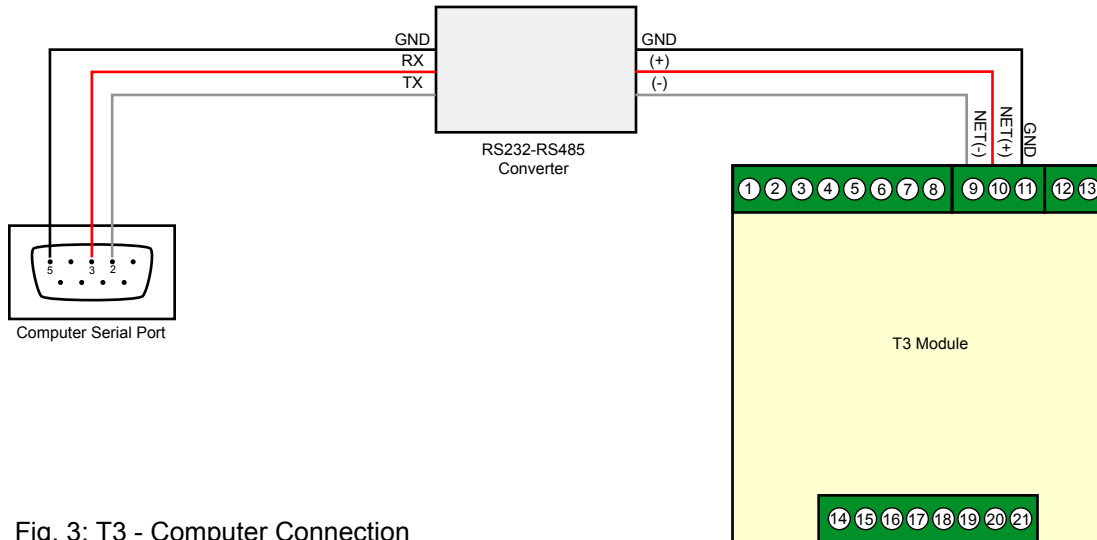


Fig. 3: T3 - Computer Connection

### List of registers in the T3-8IO-x

Note: When using the Modbus Poll software, addressing should be set to "Protocol Addresses (Base 0)" under the "Display" menu.

Address	Bytes	Register and Description
0 to 3	4	Serial Number, 4 byte value
4	1	EEPROM hardware Version Number
5	1	Firmware Version Number
6	1	ADDRESS, Modbus device address
7	1	Product Model
8	1	Hardware Revision
9	1	PIC Version Number
13	1	Calibration register – used to calibrate the outputs.
15	1	Baudrate setting: 0 will set 9600bps, 1 will set 19200bps
100	2	Output 1 Register
101	2	Output 2 Register
102	2	Output 3 Register
103	2	Output 4 Register
104	2	Output 5 Register
105	2	Output 6 Register
106	2	Output 7 Register
107	2	Output 8 Register
108	2	Input 1 Register
109	2	Input 2 Register
110	2	Input 3 Register
111	2	Input 4 Register
112	2	Input 5 Register
113	2	Input 6 Register
114	2	Input 7 Register
115	2	Input 8 Register
116	2	Switch Bank 1 Register
117	2	Switch Bank 2 Register

## Additional Registers for T3-8IO module with high input detect

Note: When using the Modbus Poll software, addressing should be set to "Protocol Addresses (Base 0)" under the "Display" menu.

Address	Bytes	Register and Description
118-119	4	Channel 1, Pulse count HI and LO word respectively
120-121	4	Channel 2, Pulse count HI and LO word respectively
122-123	4	Channel 3, Pulse count HI and LO word respectively
124-125	4	Channel 4, Pulse count HI and LO word respectively
126-127	4	Channel 5, Pulse count HI and LO word respectively
128-129	4	Channel 6, Pulse count HI and LO word respectively
130-131	4	Channel 7, Pulse count HI and LO word respectively
132-133	4	Channel 8, Pulse count HI and LO word respectively
		Clearing Pulse Number Registers: Writing to their respective Year registers (134 for ch1,139 for ch2,144 for ch3...) will clear the above pulse numbers
134-138	5	Date stamp of Channel 1: Year, Month, Day, Hour, Minute respectively.
139-143	5	Date stamp of Channel 2: Year, Month, Day, Hour, Minute respectively.
144-148	5	Date stamp of Channel 3: Year, Month, Day, Hour, Minute respectively.
149-153	5	Date stamp of Channel 4: Year, Month, Day, Hour, Minute respectively.
154-158	5	Date stamp of Channel 5: Year, Month, Day, Hour, Minute respectively.
159-163	5	Date stamp of Channel 6: Year, Month, Day, Hour, Minute respectively.
164-168	5	Date stamp of Channel 7: Year, Month, Day, Hour, Minute respectively.
169-173	5	Date stamp of Channel 8: Year, Month, Day, Hour, Minute respectively.

Example: register 118 reads 5 (hex 05)  
 register 119 reads 138 (hex 8A)  
 The Pulse Count for Channel1 is then 1418 pulse (hex 058A)

Writing to register 134 will clear registers 118 and 119. Subsequent registers 135 to 138 are optional memory to store date and time at which Pulse Counts have been cleared.

## List of registers in the T3-32I

Note: When using the Modbus Poll software, addressing should be set to "Protocol Addresses (Base 0)" under the "Display" menu.

Address	Bytes	Register and Description
0 to 3	4	Serial Number, 4 byte value
4	1	EEPROM hardware Version Number
5	1	Firmware Version Number
6	1	ADDRESS, Modbus device address
7	1	Product Model
8	1	Hardware Revision
9	1	PIC Version Number
13	1	Calibration register – used to calibrate the outputs
15	1	Baudrate setting: 0 will set 9600bps, 1 will set 19200bps
100	2	Input 1 Register
101	2	Input 2 Register
102	2	Input 3 Register
103	2	Input 4 Register
104	2	Input 5 Register
105	2	Input 6 Register
106	2	Input 7 Register
107	2	Input 8 Register
108	2	Input 9 Register
109	2	Input 10 Register
110	2	Input 11 Register
111	2	Input 12 Register
112	2	Input 13 Register
113	2	Input 14 Register
114	2	Input 15 Register
115	2	Input 16 Register
116	2	Input 17 Register
117	2	Input 18 Register
118	2	Input 19 Register
119	2	Input 20 Register
120	2	Input 21 Register
121	2	Input 22 Register
122	2	Input 23 Register
123	2	Input 24 Register
124	2	Input 25 Register
125	2	Input 26 Register
126	2	Input 27 Register
127	2	Input 28 Register
128	2	Input 29 Register
129	2	Input 30 Register
130	2	Input 31 Register
131	2	Input 32 Register



## List of registers in the T3-8-16

Note: When using the Modbus Poll software, addressing should be set to "Protocol Addresses (Base 0)" under the "Display" menu.

Address	Bytes	Register and Description
0 to 3	4	Serial Number, 4 byte value
4	1	EEPROM hardware Version Number
5	1	Firmware Version Number
6	1	ADDRESS, Modbus device address
7	1	Product Model
8	1	Hardware Revision
9	1	PIC Version Number
13	1	Calibration register – used to calibrate the outputs
15	1	Baudrate setting: 0 will set 9600bps, 1 will set 19200bps
100	2	Output 1 Register
101	2	Output 2 Register
102	2	Output 3 Register
103	2	Output 4 Register
104	2	Output 5 Register
105	2	Output 6 Register
106	2	Output 7 Register
107	2	Output 8 Register
108	2	Input 1 Register
109	2	Input 2 Register
110	2	Input 3 Register
111	2	Input 4 Register
112	2	Input 5 Register
113	2	Input 6 Register
114	2	Input 7 Register
115	2	Input 8 Register
117	2	Output 9 Register
118	2	Output 10 Register
119	2	Output 11 Register
120	2	Output 12 Register
121	2	Output 13 Register
122	2	Output 14 Register
123	2	Output 15 Register
124	2	Output 16 Register
125	2	Switch Bank 1 Register
126	2	Switch Bank 2 Register

For example, if we would like to read the input 2 register at module node address #1,

Slave Address	Function	Starting Address Hi	Starting Address Lo	No. of Points Hi	No. of Points Lo	CRC Hi Byte	CRC Lo Byte
1	3	0	109	0	1	xx	xx

Or we read 8 values after input 2 in module 1,

Slave Address	Function	Starting Address Hi	Starting Address Lo	No. of Points Hi	No. of Points Lo	CRC Hi Byte	CRC Hi Byte
1	3	0	109	0	8	xx	xx

Or we write 600 to output 4 in module 1,

Slave Address	Function	Starting Address Hi	Starting Address Lo	No. of Points Hi	No. of Points Lo	CRC Hi Byte	CRC Lo Byte
1	6	0	103	0	600	xx	xx

More details can be found in Modbus Serial Communication Section below

### Note about registers when updating the firmware

There are two registers that will tell the CPU information about the model and hardware of the T3 module. NOTE: after updating the firmware you MUST setup these registers first or the module may not function properly.

Product Model is register address 7. The corresponding values are as follows:

- T3-8IO-A = 20
- T3-8IO-D = 21
- T3-32I = 22
- T3-8-16 = 23

Hardware revision is register address 8. The hardware revision can be found by removing the front cover of the module. It is written in white silkscreen on the edge of the board.

**Revision history:**

## Hardware Updates:

## Hardware Rev03

- First model of the T3-8IO module

## Hardware Rev05

- Driver Chip installed to add capability of using heavier Relay Switches
- Driver Chip ensured better control on Relay Switches during start-up
- Added 5V Voltage Regulator to have a more accurate and stable reference voltage
- Moved current-limiting resistors on input lines, which caused faulty readings for inputs below 0.2V
- Used smaller packet resistors to facilitate board layout

## Hardware Rev06

- Corrected the Driver Chip footprint to facilitate board layout

## Hardware Rev07

- Corrected the packet resistors footprint to facilitate board layout
- Firmware updates: reading of PIC chip protocol modified to an Interrupt, increased successful readings
- Firmware updates: this then allowed filtering code to be added in the PIC chip routines
- Firmware updates: starting condition for the PIC communication routine made more robust
- Firmware updates: added networking features such as scan and plug-and-play
- Firmware updates: added register to change baudrate. Look at T3 modbus registers

## Hardware Rev08

- Added High Speed input detection circuit
- Firmware updates: automatic PIC detect

## Firmware Updates:

## Firmware Version 1-0

- Released version of T3-Modules

## Firmware Version 1-1

- PIC code protocol is now done as interrupt
- Filtering of inputs is now done in PIC chip, making GOAL MCU free to perform other task
- SCAN and PLUG-N-PLAY features added

## Firmware Version 1-5

- Added Com Baudrate select between 9600 and 19200, register 15
- Communication response time improved, improved network health

## Firmware Version 1-7

- Implemented improved memory management algorithm
- Added High-Speed Input option for each Input

## Firmware Version 1-8

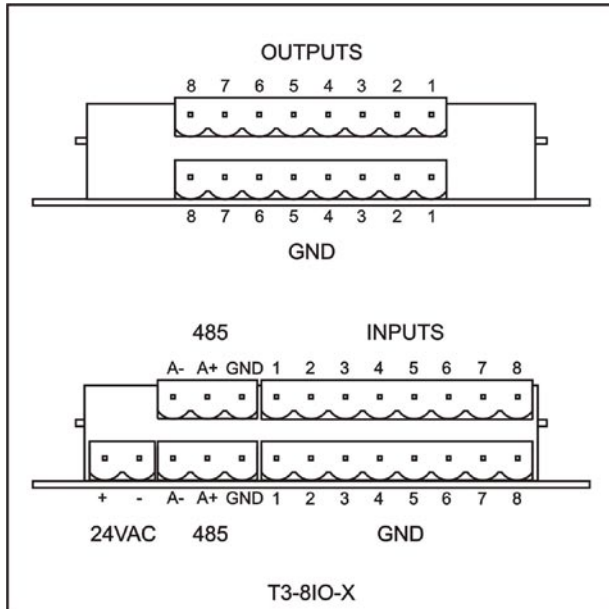
- Implemented automatic PIC detection

## Firmware Version 1-9

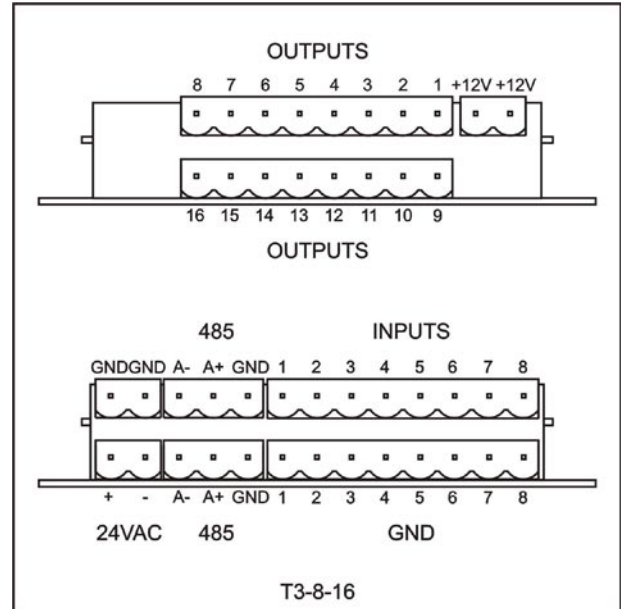
- Changed input reading filtering

## Installation

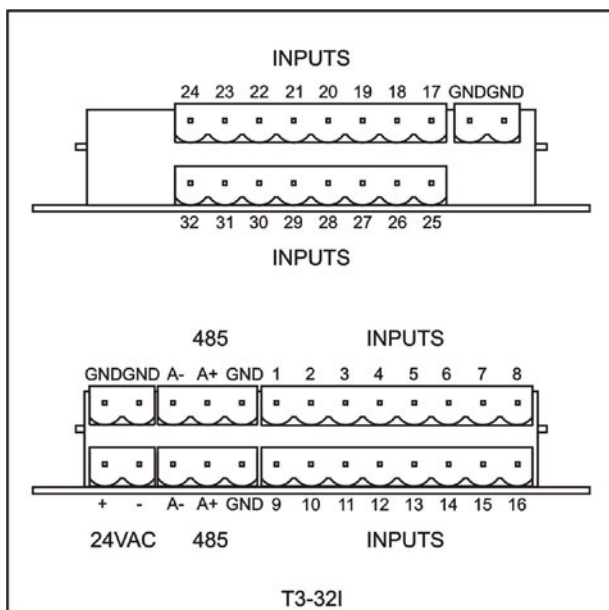
**Terminal Block Connections (T3-8IO-X)**



**Terminal Block Connections (T3-8-16)**



**Terminal Block Connections (T3-32I)**



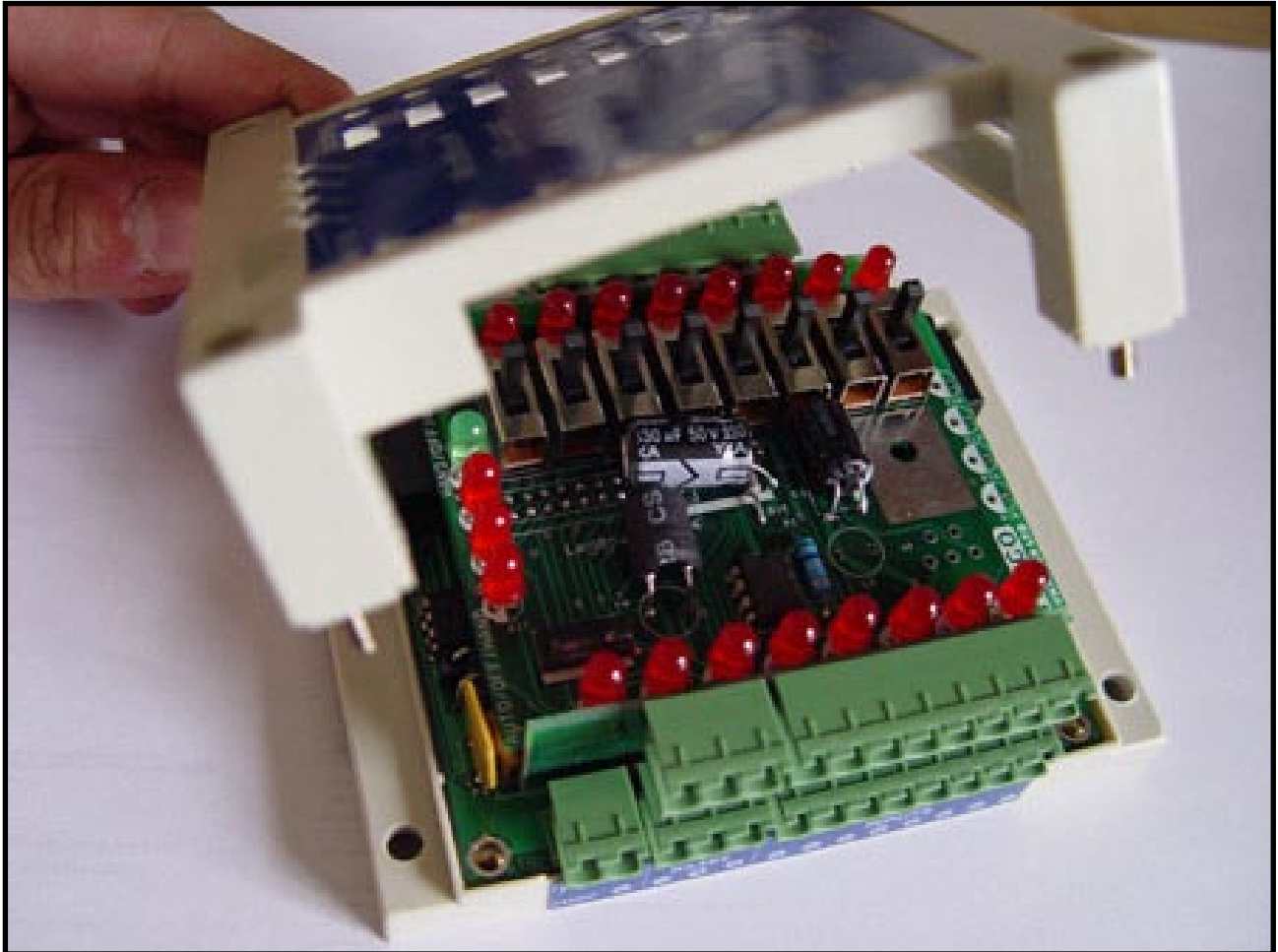
## Mounting

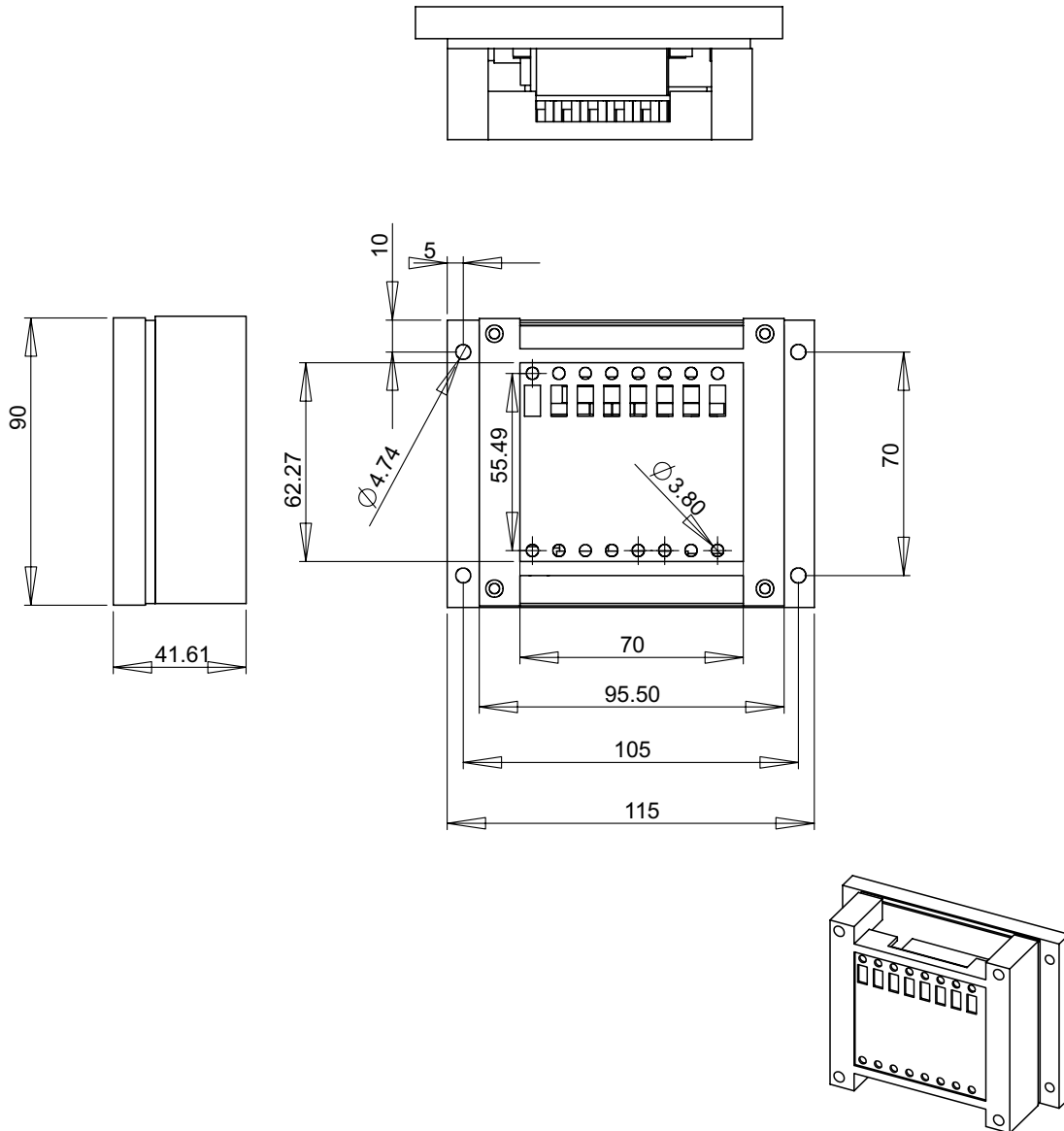
External wiring is connected to a terminal block on the circuit board.

The enclosure comprises a base section and a cover. The base section can be mounted directly on a wall or on a wall box.

## Length of cables

Max 200m area 0.5mm<sup>2</sup>





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		MATERIAL							
		FINISH							
	NEXT ASSY	USED ON							
	APPLICATION	DO NOT SCALE DRAWING							
					COMMENTS:				
							SIZE DWG. NO. REV.		
							<b>A</b> Assem2		
							SCALE:1:5 WEIGHT: SHEET 1 OF 1		