



ETN-32

ETN slave remote module
16 digital inputs and 16 transistor digital outputs

ETN-16/DI

ETN slave remote module
16 digital inputs

ETN-16/DOP

ETN slave remote module
16 PNP transistor digital outputs

ETN-16/DON

ETN slave remote module
16 NPN transistor digital outputs

USER'S MANUAL

MAN-E-ETN-32 - REV. 2 – 22 December 2009

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2. GENERAL DESCRIPTION

2.1. Introduction

The ETN-32/x and ETN-16/x boards are member of the product family designed by Tecnint HTE to be used in industrial automation and control system field.

These products have been planned as remote modules which communicate with a network master through an appropriate I/O remoting system called ETN.

The ETN system ETN is a powerful and professional distributed system specifically designed for industrial automation and for control and data acquisition systems. For further details about the ETN system, please refer to Tecnint HTE technical literature "*The ETN system*".

In particular, the ETN-32 has the following functions.

- **INPUTS**
16 optoisolated digital inputs

- **OUTPUTS**
16 transistor digital outputs

For the ETN-16/DI board, module with 16 optoinsulated digital inputs, sections referring to the digital outputs description cannot be applied, as well as sections referring to digital inputs cannot be applied for the ETN-16/DOP and ETN-16/DON boards, module with 16 optoinsulated digital outputs.

2.2. Specifications

Specifications of the ETN-32 module are listed on Table 1.

CHARACTERISTICS	SPECIFICATIONS
Power-supply	24 V DC \pm 25% -160 mA Max. (I_{typ} =100mA @ 24V with input and output disabled)
ETN serial bus	Optoisolated 16-bit slave
Baud rate	3 Mbit/sec 1.5 Mbit/sec. 750 Kbit/sec. 375 Kbit/sec. 187 Kbit/sec. 93.75 Kbit/sec. 46.875 Kbit/sec.
Address selection	selectable from 1 to 255 through rotary switch
Identification type	6 Hex
Input insulation	1000 Vdc
Digital inputs	<ul style="list-style-type: none"> • 16 optoisolated inputs with 24V common or GND and status LED on each input • $I_{IN} \leq 7$ mA @ 24V • OFF status: $V_{IN} < 8V$, $I_{IN} < 50\mu A$ • ON status: $V_{IN} > 10V$, $I_{IN} > 1mA$ • 2mS filter
Digital outputs	<ul style="list-style-type: none"> • 16 channels with 24V transistor output; $V_{MAX} \leq 30V$ • Max 500mA voltage per channel • Watch-dog circuit for output safety • Status Led on each output • ETN-32/P version with outputs protected against short-circuit and overtemperature and failure alert through LED
Watch-dog	<ul style="list-style-type: none"> • Intervention in case of loss of ETN communication • Configurable intervention time: 100, 200, 400, 600, 1600 mS o disabled
LEDs	<ul style="list-style-type: none"> • ERROR: red; inactive ETN communication • POWER: red; board powered • IN 1÷16: red input status • OUT 1÷16: red; output status • DIAG: red; output diagnostics (ETN-32/P only)
Board protection	630 mA fuse, anti-reverse circuit
Work temperature	From 0 to +60°C
Storage temperature	From -25 to +85°C
Relative humidity	From 10 to 90% without condensation
Sizes	160 x 115 mm

Table 1: ETN-32 board specifications

Note: for the ETN/16DI version the digital output section cannot be applied for the ETN/16DOP and ETN-16/DON versions the digital input section cannot be applied

2.3. Layout

The following figure 2.1 shows the ETN-32 component location.

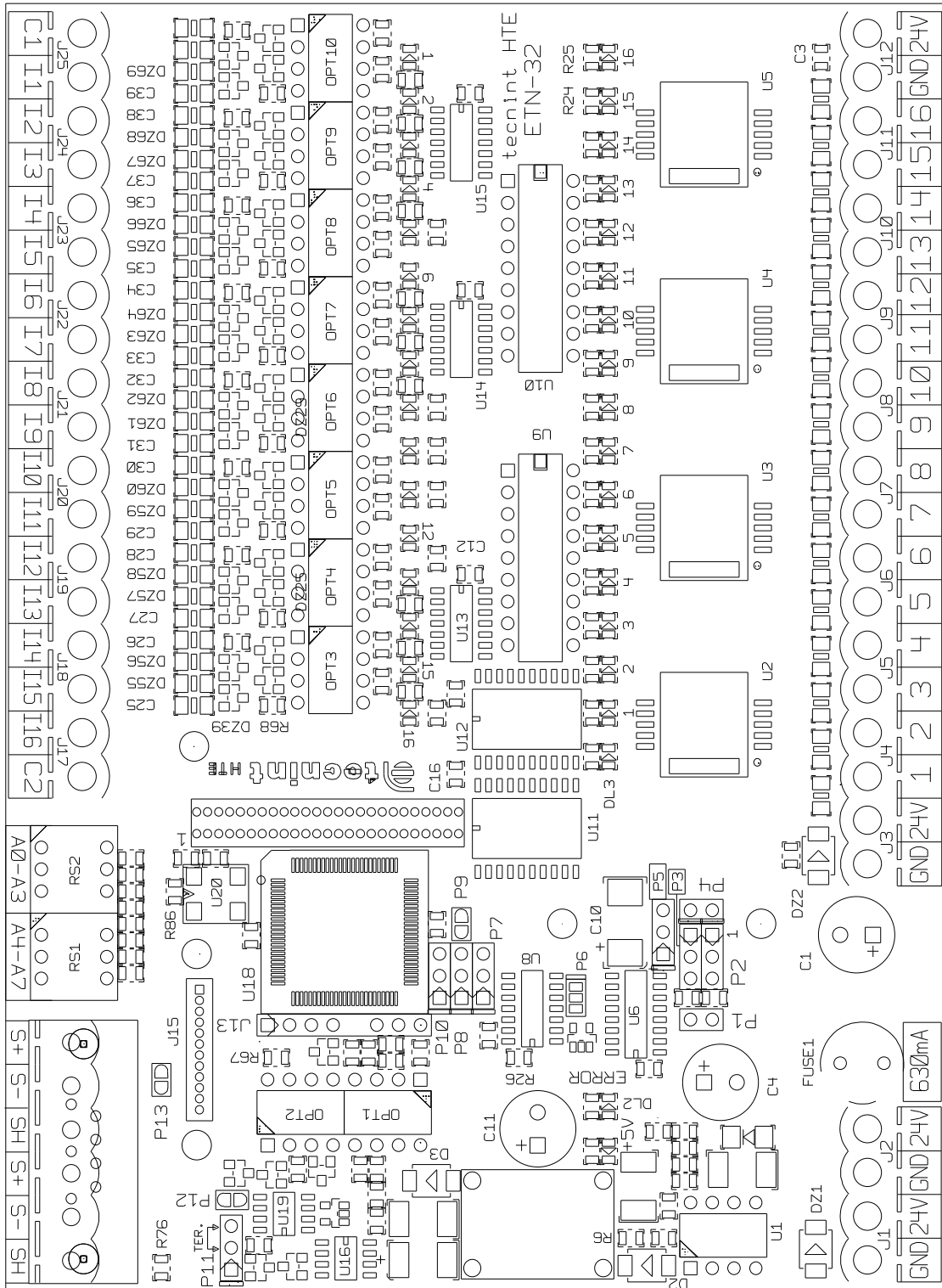


Figure 2-1 : ETN-32 module layout

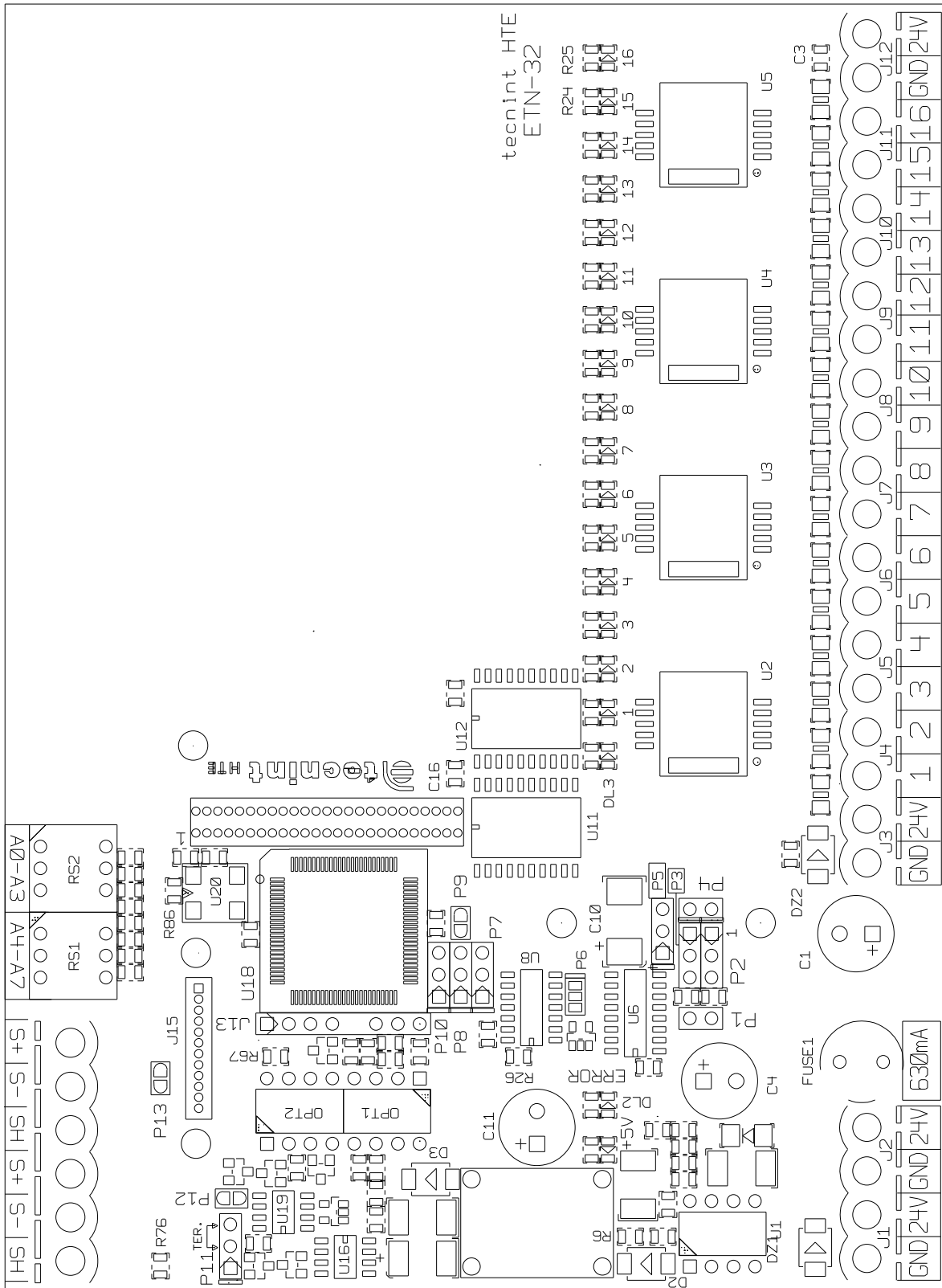


Figure 2-2: ETN-16/DOP module layout

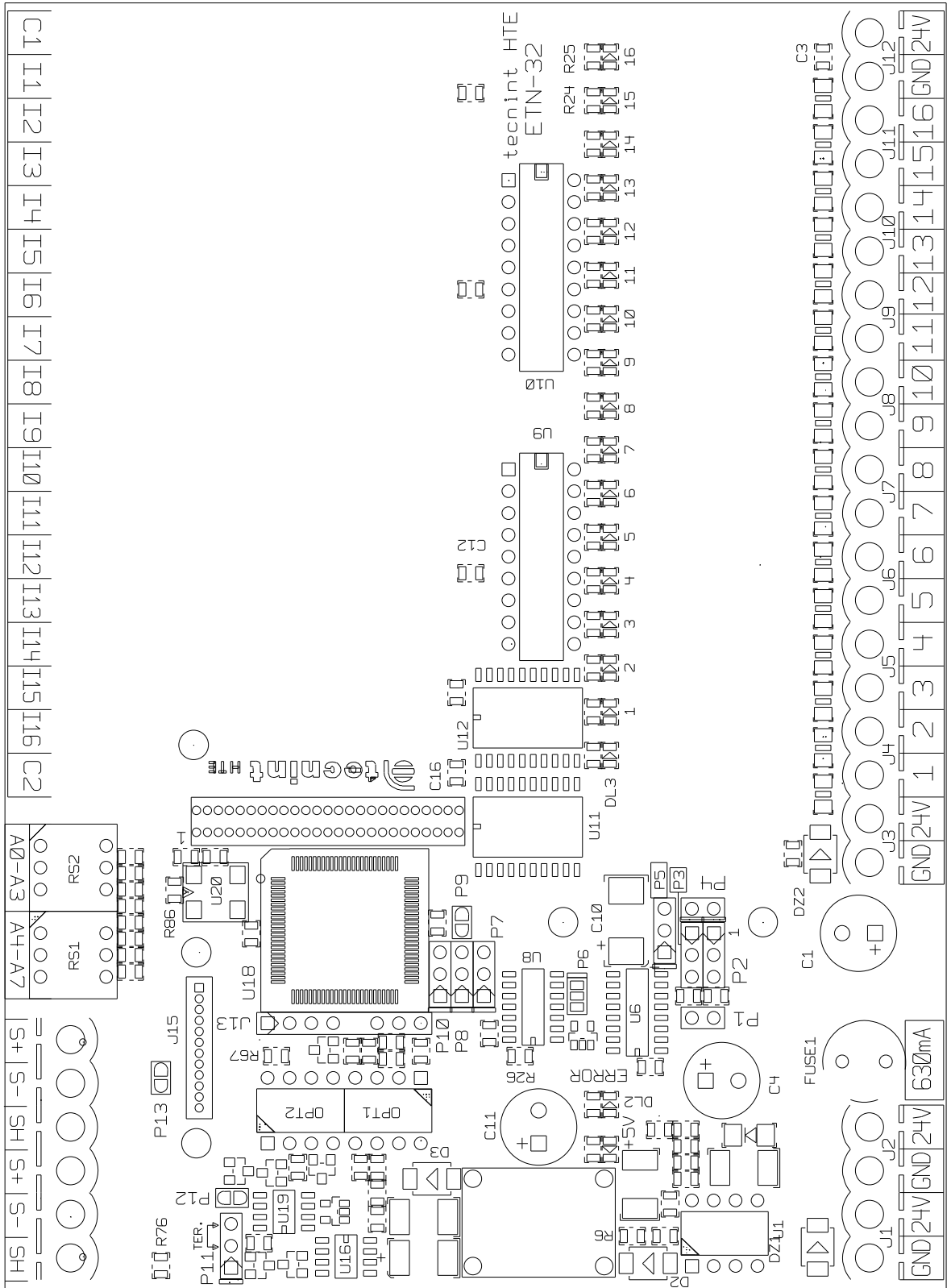


Figura 2-3: ETN-16/DON module layout

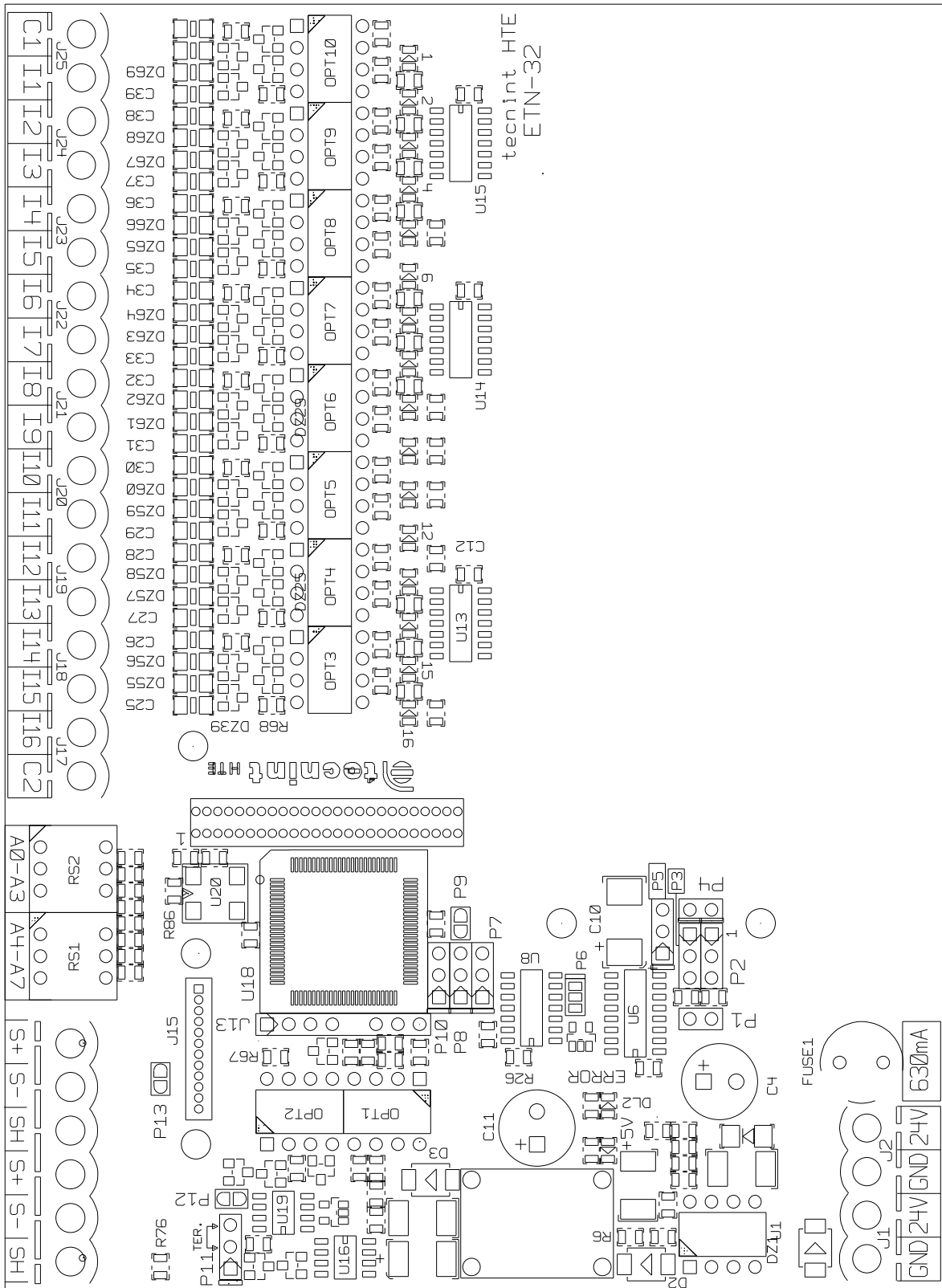


Figure 2-4: ETN-16/DI module Layout

2.4. Order information

For eventual orders of the above-mentioned boards, please refer to the codes listed in the following table:

Order Code	Description
ETN-32/N	16 DI, 16 NPN transistor outputs
ETN-32/P	16 DI, 16 PNP transistor outputs
ETN-16/DI	16 optoinsulated digital inputs
ETN-16/DOP	16 optoinsulated transistor outputs, PNP
ETN-16/DON	16 optoinsulated transistor outputs, NPN

Table 2: Order information

3. TECHNICAL DESCRIPTION

3.1. Introduction

This chapter gives the information necessary for configuration of the ETN-32 board according to your specific applications and needs:

- block diagram;
- interface with the ETN serial bus;
- LEDs;
- description of jumpers;
- assignment of signals on interface board;
- meaning of data received and transmitted to the Master;
- ETN-32 board timing.

3.2. Block diagram

Figure 3.1 shows the simplified block diagram of ETN-32 board .

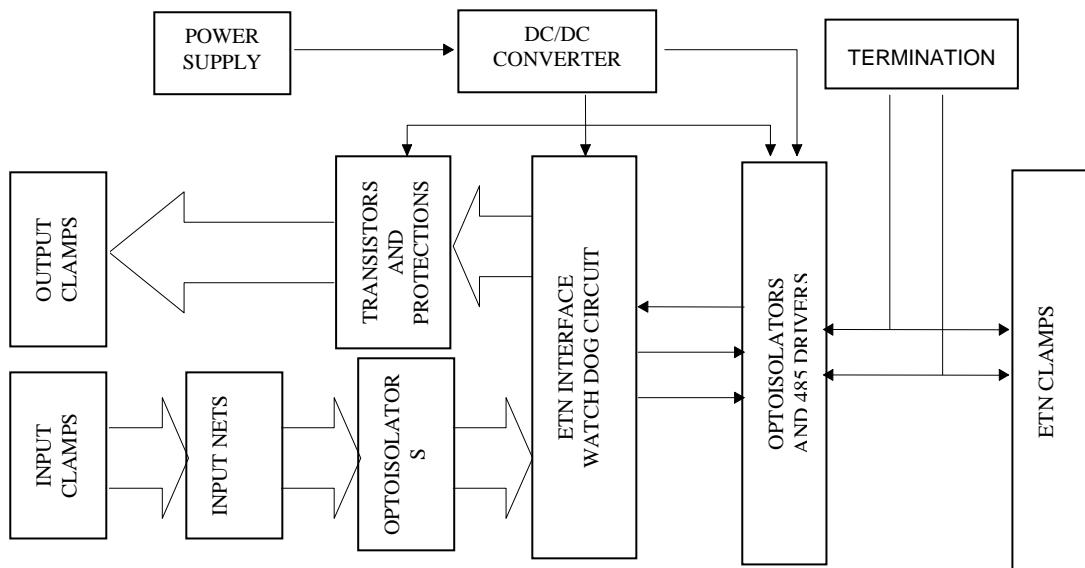


Figure 3-1 : Block diagram

3.3. Interface with ETN bus

The module interface which allows to link with the ETN network has the following characteristics:

- it is implemented through an RS-485 driver;

- the power-supply and the signals are galvanically isolated from the other parts of the module;
- it is protected against eventual network over-voltages;
- eventual no power-supply on the ETN-32 module does not involve any noise or failure on the ETN network;
- the transmission speed is configurable up to 3 Mbit/s; it is possible to have a special 6/12 Mbit/s version.

3.4. LEDs

On the ETN-32 module there are 16 LEDs which allow to monitor the status of each input and other 16 relative to the status of each output. In particular, for the inputs, a LED ON means that its input is ON (switch closed, cfr. figg. 4.1 and §4.4), whereas for the outputs a LED ON means that its transistor is conducting (current circulating in the load). Moreover, for the ETN-32/P version a diagnostic Led ON means that there are short-circuits on the outputs.

On the ETN-16/DI there are just 16 LEDs for the digital inputs, and on the ETN-16/DOP there are 16 LEDs for the digital outputs and the diagnostic LED .

On the ETN-32, , ETN-16/DI and ETN-16/DOP module there are two other red LEDs with the following meaning:

DL1 : POWER board powered ;

DL2 : ERROR inactive communication with the ETN Master, safety outputs.

The ERROR LED shows the status of the Watch-dog circuit, which disables all outputs (no circulating voltage in the load) if the data received from the ETN-32 module are not continuously update by the ETN Master within the trigger time selected on the module. (not applicable for the ETN-16/DI version).

Normal working condition (board powered, communicating with the ETN Master) foresees that the POWER LED is ON and the ERROR LED is OFF.

3.5. Signals assignment on the board.

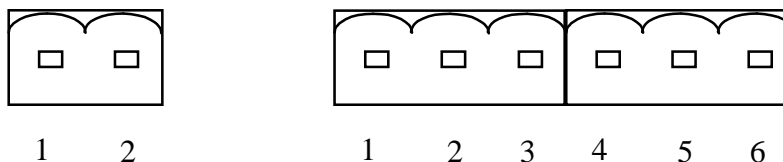
Table of Connectors	
Connectors	Description
J14 and J15	Reserved to the manufacturer
J16	ETN interface
J17 ÷ J25	Digital inputs
J3 ÷ J12	Digital outputs
J1 e J2	Module power-supply

Table 3: Table of Connectors

The following table 4 shows the meaning of each clamp present on the ETN-32¹; from figure 3.2 it is possible to locate the position of each clamp on the board.

CONN.	PIN	SERIG.	MEANING	CONN.	PIN	SERIG.	MEANING
J1	1	GND	GND	J25	1	C1	COMMON INPUT 1÷8
J1	2	24V	24V Power-supply.	J25	2	I1	INPUT 1
J2	1	GND	GND	J24	1	I2	INPUT 2
J2	2	24V	24V Power-supply	J24	2	I3	INPUT 3
J3	1	GND	GND	J23	1	I4	INPUT 4
J3	2	24V	Output power-supply	J23	2	I5	INPUT 5
J4	1	1	OUTPUT 1	J22	1	I6	INPUT 6
J4	2	2	OUTPUT 2	J22	2	I7	INPUT 7
J5	1	3	OUTPUT 3	J21	1	I8	INPUT 8
J5	2	4	OUTPUT 4	J21	2	I9	INPUT 9
J6	1	5	OUTPUT 5	J20	1	I10	INPUT 10
J6	2	6	OUTPUT 6	J20	2	I11	INPUT 11
J7	1	7	OUTPUT 7	J19	1	I12	INPUT 12
J7	2	8	OUTPUT 8	J19	2	I13	INPUT 13
J8	1	9	OUTPUT 9	J18	1	I14	INPUT 14
J8	2	10	OUTPUT 10	J18	2	I15	INPUT 15
J9	1	11	OUTPUT 11	J17	1	I16	INPUT 16
J9	2	12	OUTPUT 12	J17	2	C2	COMMON INPUT 9÷16
J10	1	13	OUTPUT 13	J16	1	S+	ETN S+
J10	2	14	OUTPUT 14	J16	2	S-	ETN S-
J11	1	15	OUTPUT 15	J16	3	SH	ETN SH
J11	2	16	OUTPUT 16	J16	4	S+	ETN S+
J12	1	GND	GND	J16	5	S-	ETN S-
J12	2	24V	Output power-supply	J16	6	SH	ETN SH

Table 4: Meaning of ETN-32 connectors



Note: Pins 1, 2 and 3 of J16 are respectively connected with pins 4, 5 and 6 on the printed circuit.

¹ For the ETN-16/DI version description for J3+J12 is not applicable; For the ETN-16/DOP and ETN-16/DON versions description for J17+J25 is not applicable

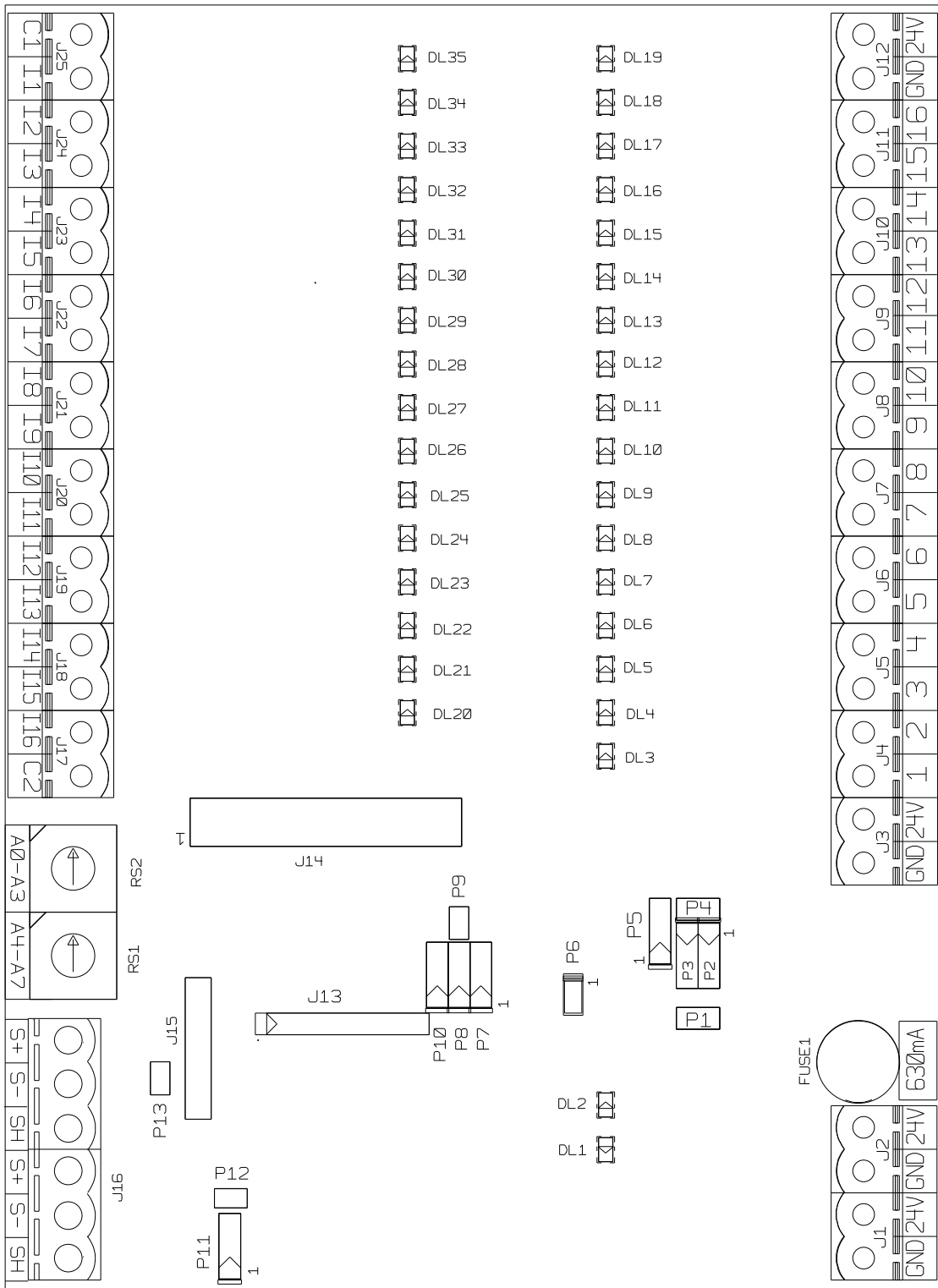


Figure 3-2 : Position of connectors and jumpers

Note:

ETN-16/DI version doesn't mount LEDs DL3÷DL19 and connectors J3÷J12.

ETN-16DOP and ETN-16/DON versions doesn't mount LEDs DL20÷DL35 and connectors J17÷J25.

3.6. Description of jumpers

Table 5 identifies the jumpers present on the ETN-32, ETN-16/DI and ETN-16/DOP modules. Figure 3.2 show their position on the board.

Table of Jumpers	
Jumpers	Function
P11	Termination Resistor
P12, P13, P5, P6, P9	Reserved to the manufacturer
P7, P8, P10	ETN speed selection
P1, P2, P3, P4	Watchdog circuit configuration

Table 5: Table of Jumpers

3.7. Meaning of data received and transmitted to the Master

Communication between the Master module and the ETN-32 is made through a hardware implemented transaction protocol. As transaction we mean the whole message request and its consequent answer. The request message is sent by the Master; answer of the ETN-32 arrives immediately after the request. The ETN-32 is Slave type, therefore it does not act by itself, but it only executes the commands received from the Master. For more details about the ETN protocol, please refer to “*The ETN system*” technical literature.

On table 7 you can find the format of a transaction record between a Master module and a generic Slave module.

BYTE	MEANING
0	ETN slave module address transmitted
1	ETN slave module type code transmitted
2	Information bits transmitted (24÷31)
3	Information bits transmitted (16÷23)
4	Information bits transmitted (8÷15)
5	Information bits transmitted (0÷7)
6	Type of transaction (16 bit = 01)
7	Not used
8	ETN slave module address received
9	ETN slave module type code received
10	Information bits received (24÷31)
11	Information bits received (16÷23)
12	Information bits received (8÷15)
13	Information bits received (0÷7)
14	Master module address (00)
15	Error flag (0=OK, FF=error)

Table 6: Structure of a transaction record.

For the ETN-32 and ETN-16/DOP modules the information bits transmitted by the Master are data bits concerning the status assumed by the outputs. In particular a bit at logic status 1 means that its relative output will be active (current circulating in the load). For the ETN-16/DI version data transmitted by the Master have no effect on the module.

For the ETN-32 and ETN-16/DI modules bits received from the Master refer to the inputs state: if a bit is at logic status 0 it means that its relative input is ON.

For the ETN-16/DOP and ETN-16/DON versions data received from the Master reflect the digital outputs state: each bit reflects how the module is managing the relative output.

The code type that characterizes the ETN-32 module and the ETN-16/DOP and ET-16/DON module is 6 hex and the relative transactions must be 16-bit information ones.

The code type that characterizes the ETN-16/DI module is 5 hex

Considering the communication protocol characteristics, it is not recommended to connect on the same ETN network Slave modules with 16-bit and 32-bit transaction having the same address .

3.7.1. Module bits and inputs /outputs correspondence

Following table shows the correspondence between bits received/transmitted from the Master module and the ETN-32. inputs/outputs.

As already specified, for the ETN-16/DI version data transmitted from the Master don't have any effect on the module, whereas for the ETN-16/DOP and ETN-16/DON versions data received by the Master reflect the digital outputs state: each bit reflects how the module is managing the relative outputs (data transmitted and received are the same).

RX MASTER			TX MASTER		
BYTE	BIT	INPUTS	BYTE	BIT	OUTPUT
13	0	1	5	0	1
	1	2		1	2
	2	3		2	3
	3	4		3	4
	4	5		4	5
	5	6		5	6
	6	7		6	7
	7	8		7	8
12	8	9	4	8	9
	9	10		9	10
	10	11		10	11
	11	12		11	12
	12	13		12	13
	13	14		13	14
	14	15		14	15
	5	16		15	16

Table 7: ETN-32 bit-I/O correspondence.

3.8. ETN-32 module timing

Whichever Master module is able, through the ETN network, to update the status of the 16 outputs of an ETN-32 module and to acquire the status of the 16 inputs at a speed which depends on the transmission frequency selected for the network. A transaction updates the whole 16 outputs and acquires the whole 16 inputs simultaneously.

The relative cases are listed on table 8.

In case of ETN-16/DI, data transmitted from the Master ETN won't have any effect on the module as it doesn't have any outputs, whereas in case of ETN-16/DOP or ETN-16/DON data sent to the Master ETN will always have logic value =1 .

Transactions/s	ETN Bus Frequency
20000	3 Mbit/s
10000	1.5 Mbit/s
5000	750 Kbit/s
2500	375 Kbit/s
1250	187.5 Kbit/s
625	93.75 Kbit/s

Table 8: ETN-32 Master/Slave Transactions

4. USE OF BOARD

If the board package is damaged, please be sure that the carrier is present during unpacking and inspection of the content.

Open the package and check that the printed circuit, the connectors and the module components are not damaged. We recommend to keep the module package for eventual future transports.

4.1. Instructions for installation

The module components are sensitive to electrostatic charges. We recommend to put the board on an antistatic surface during the configuration operations.

All Tecnint HTE products are tested before being shipped to our customers. We recommend the user not to modify the board hardware before checking its correct working. To ensure the complete module functionality we suggest you to act as follows:

1. Configure the jumpers as shown on chapter 4.3 keeping in mind that the termination resistors must be put at the ends of the transmission line. Furthermore, configure the transmission speed of the ETN-32 Slave module and of the Master module in order that they are equal and suitable for the cable length.
2. Through a proper bipolar shielded cable connect the Master module with the various Slave modules and configure their ETN address. The Slave modules are identified, besides the address, by a Type code (which cannot be modified). Modules with the same address, but of different type are considered by the ETN Master as different modules.
3. Now it is possible to power-up the system. The power order can be whichever. As concerns the description of the initialization procedure which allows the ETN bus to operate, please refer to the manual of the Master in use.

4.2. Jumper configuration

In the next paragraphs are described the meanings of the various jumpers present on the ETN-32, ETN-16/DI, ETN-16/DOP and ETN-16/DON modules. Please see figure 3.2 for their location on the board and section 4.7 for the manufacturer configuration.

4.2.1. ETN address selection

RS1 and RS2 rotary switches allow to select the module address.

Each rotary switch allows to configure four of the eight address bits, thus having 255 different matches (from 1 to 255). Address 0 is not a valid ETN address.

Figure 3.2 allows to locate the RS1 and RS2 rotary switches on the ETN-32, ETN-16/DI, ETN-16/DOP and ETN-16/DON modules.

Rotary switch	Function
RS1	Address Bit A4÷A7
RS2	Address Bit A0÷A3

Table 9: ETN address selection

4.2.2. ETN speed

Through P10, P8 and P7 jumpers you select the transmission speed of the serial channel and the consequent maximum ETN bus cable length according to the diagram shown on the following tables.

Maximum cable length function speed	
Speed	Length
3 Mbit/s	100 m
1.5 Mbit/s	200 m
750 Kbit/s	400 m
375 Kbit/s	800 m
187.5 Kbit/s	1600 m
93.75 Kbit/s	3200 m
46.875 Kbit/s	6400 m

Table 10: Table of Speed-Length correspondence

ETN speed selection			
Speed	P10	P8	P7
3 Mbit/s	1 -- 2 3	1 -- 2 3	1 2 -- 3
1.5 Mbit/s	1 -- 2 3	1 2 -- 3	1 -- 2 3
750 Kbit/s	1 -- 2 3	1 2 -- 3	1 2 -- 3
375 Kbit/s	1 2 – 3	1 -- 2 3	1 -- 2 3
187.5 Kbit/s	1 2 – 3	1 -- 2 3	1 2 -- 3
93.75 Kbit/s	1 2 – 3	1 2 -- 3	1 -- 2 3
46.875 Kbit/s	1 2 – 3	1 2 -- 3	1 2 -- 3

Table 11: ETN speed selection jumpers

4.2.3. Termination resistor

Through P11 jumper it is possible to insert the termination resistor in the ETN serial bus.

P11	Termination Resistor
1 – 2 3	Resistor OUT
1 2 – 3	Resistor IN

Table 12: P11 Jumper – Termination Resistor

The value of the termination resistor is equal to 120 Ω and it is generally inserted in the Master and in the last ETN network Slave.

4.3. Watch-dog time modify

You can see P1-P2-P3-P4 jumpers on Figure 3.2. By these jumpers it is possible to configure the intervention time of the Watchdog circuit. All possible configurations are listed in the following table, and are grouped in two possible situations: watchdog circuit disabled, watchdog circuit enabled with intervention time selectable as per the table.

P1	P2	P3	P4	WDOG INTERVENTION TIME (ms)
Open	Uninfluent	Uninfluent	Uninfluent	Watchdog disabled
Closed	Open	Open	Open	1600
Closed	2-3	2-3	Closed	600
Closed	2-3	Open	Closed	400
Closed	Open	2-3	Closed	200
Closed	1-2	Open	Open	100

Table 13: Configuration of Watchdog circuit jumpers

4.4. Signal connection with input connectors

(Not applicable to the ETN-16/DOP and ETN-16/DON module)

Figures 4.1 and 4.2 show the two possible modes of connection with the ETN-32 and ETN-16/DI input clamps. The switching threshold is about 9V, the current absorbed by each input is 7 mA @ 24V and the maximum voltage is 30V. The OFF current is equal to 50µA. It is possible to use both the configurations on the same ETN-32 since the input channels are divided in two independent groups: for the group of channels 1÷8 the common is marked by C1 on serigraphy (pin1, J25), whereas for the group of channels 9÷16 the common is marked by C2 on serigraphy (pin2, J17)

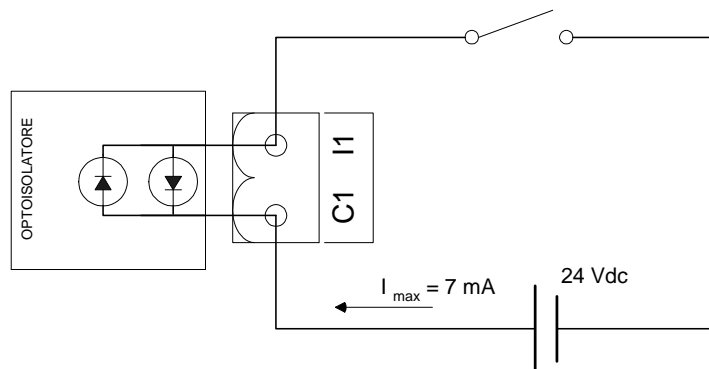


Figura 4-1: Connection diagram for 0V active inputs

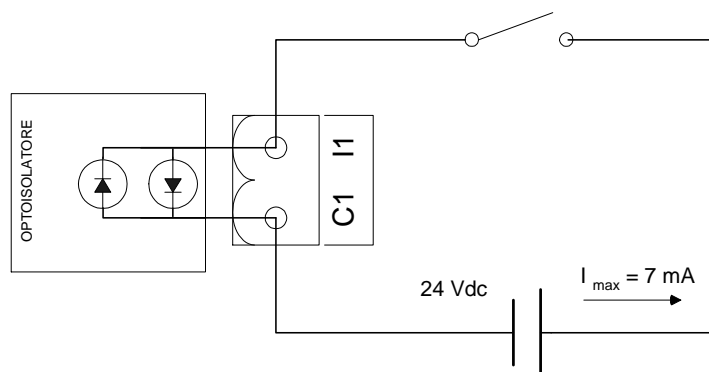


Figura 4-2: Connection diagram for 24V active inputs

4.5. Load connection with ETN-32/P digital outputs

(Not applicable to the ETN-16/DI module)

On the next figure you can see an example of connection of a generic load with the digital output clamps of the ETN-32/P and ETN-16/DOP modules.

The load can be inductive or resistive.

The fall of maximum voltage on output transistors is 200mV, 500mA.

Each output is protected against overloads. Furthermore, there is a diagnostic LED ON in case of short-circuit. The digital output section must be powered with $24V \pm 25\%$ through J3 and J12 jumpers.

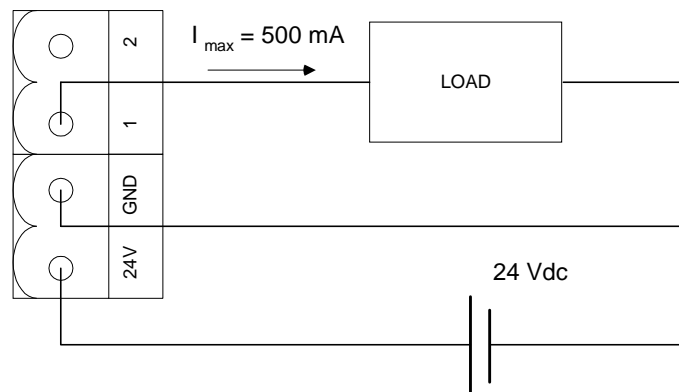


Figure 4-3: Connection diagram of digital outputs for ETN-32/P

4.6. Load connection with ETN-32/N digital outputs

(Not applicable to the ETN-16/DI and ETN-16/DOP modules)

On next figure you can see an example of connection of a generic load with digital output clamps of the ETN-32/N and ETN-16/DON modules.

The load can be inductive or resistive.

The fall of maximum voltage on output transistors is 1.6V, 500mA.

The digital output section must be powered with $24V \pm 25\%$ through J3 and J12 jumpers.

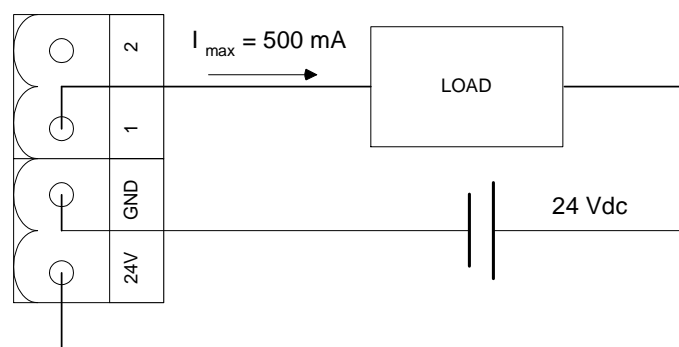


Figure 4-4: Connection diagram of digital outputs for ETN-32/N and ETN-16/DON

4.7. Manufacturer configuration

Each ETN-32, ETN-16/DI, ETN-16/DOP and ETN-16/DON module produced by Tecnint HTE is supplied with the following configuration:

- 1,5 Mbit/s ETN speed;
- Address equal to 1;
- Termination resistor not IN;
- Watch-dog circuit operation time equal to 100mS.

5. BOARD CONFIGURATION

5.1. Board installation

Before connecting the board, please be sure that the board has not been damaged during transport.

5.2. Hardware preparation

To configure the ETN-32, you have to carry out the operations described on chapter 4.3.

5.3. Connection and power-up

After configuring the module, you can connect it with the signals coming from field and you can power it up.

Figure 5.1 shows how to connect the ETN modules.

For further details on the system configuration please refer to the manual of the Master module in use.

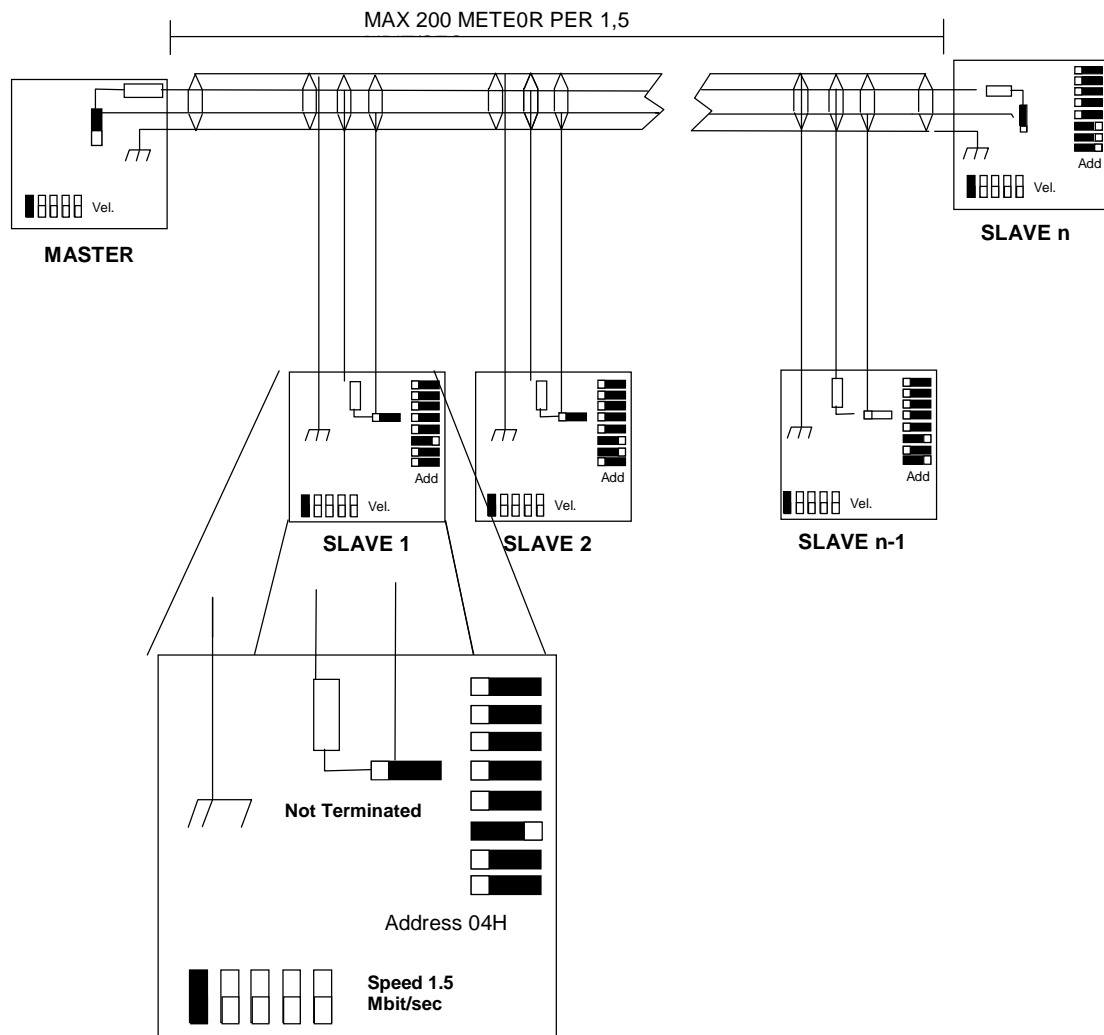
5.4. Software and “Type”code

Since on the module it is not installed a microcontroller, it doesn't need any type of programming. Management of the module is made by the ETN Master. It is very important to remember that each module is identified by an address (1÷255) and by a code which is referred to the type (6 hex for the ETN-32 , ETN-16/DOP and ETN-16/DON, 5 hex for the ETN-16/DI) .

Here-below you can find an example of transaction record initialization on an ETN-32 applied to a generic Master module:

Byte Meaning	Value
Receiver address	01
Slave module type	06
Datum HH transmitted	00
Datum HL transmitted	00
Value of outputs 8÷15	AA
Value of outputs 0÷7	AA
Type of transmission	01
Not used	00
Receiver address received by the Master	01
Slave module type received by the Master	06
Datum HH received	00
Datum HL received	00
Status of inputs 8÷15	00
Status of inputs 0÷7	00
Master address received	00
Error flag	00

Table 14: Example of a transaction record



- DO NOT MAKE BRANCHES OVER 1 METER LENGTH
- CONFIGURE THE TRANSMISSION SPEED IN THE SAME WAY ON ALL THE MODULES
- CONFIGURE THE MODULES SLAVE TYPE SO THAT EVERYONE HAS IT'S OWN ADDRESS
- CONFIGURE THE MODULES AT THE CABLE ENDS WITH THE TERMINATION RESISTOR INSERTED AND ALL THE OTHER WITH THE RESISTOR UNINSERTED
- CONNECT 32 MODULES MAX ON THE SAME BRANCH WITHOUT REPEATER
- USE BIPOLAR SHIELDED CABLE

Figure 5-1: ETN module connection diagram

6. APPENDIX

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