



# GaIA Gateway for Industrial Automation

## HARDWARE MANUAL

MANUAL: GaIA204 HW EN

PRELIMINARY

## DISCLAIMER

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| 1.22 | BC     | Encoder connections corrected (base and expansion board)                                                   | 21/09/2018 |
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Note:

# 1 Introduction

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This section introduces the main features of GaIA product as part of an industrial automation system.



## 1.1 Symbols

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Symbols used in this manual:



**Danger  
Warning  
Caution**

Used when user life or health could be exposed to a potential danger or when a potential damage to devices or materials are possible.



**Attention**

Special instruction for a safe and efficient installation and use.



**Information**

Used to highlight important additional information.



**EMC Warning**

An essential element to fulfill limits specified by EMC guidelines is to be compliant with EMC installation rules.

## 1.2 GaIA - Description

---

GaIA system has been designed to accomplish two main functions:

- Communication protocol converter/adapter (gateway)
- Programmable I/O device

The *communication protocol converter/adapter* function allows to handle and interface different fieldbuses, such as:

- CANopen
- DeviceNet
- Modbus RTU
- Modbus/TCP
- Profibus
- Profinet
- Ethernet PowerLink
- EtherCAT

The *programmable I/O device* function allows user to write automation procedures to be executed by the GaIA device.

Such automation procedures can interface both digital and analog I/Os available on the GaIA device.

Both functions could coexist on the same device, allowing user a whole range of possibilities to automate an industrial process.

GaIA device is designed to guarantee enforceability of EN61800-3 and EN60204-1 rules: to satisfy such rules user must guarantee connections characteristics compliant with EMC immunity and emission, such as ground connection, correct installation and a power supply filter.

## 1.3 GaIA - Hardware

Following image shows the GaIA system block diagram; non numbered blocks are always present, while other blocks, defined by a block number, are optional and define the overall system version.



This manual holds information about installation, start-up and service of a GaIA device. Please note that some function could be missing, depending on the GaIA device version.

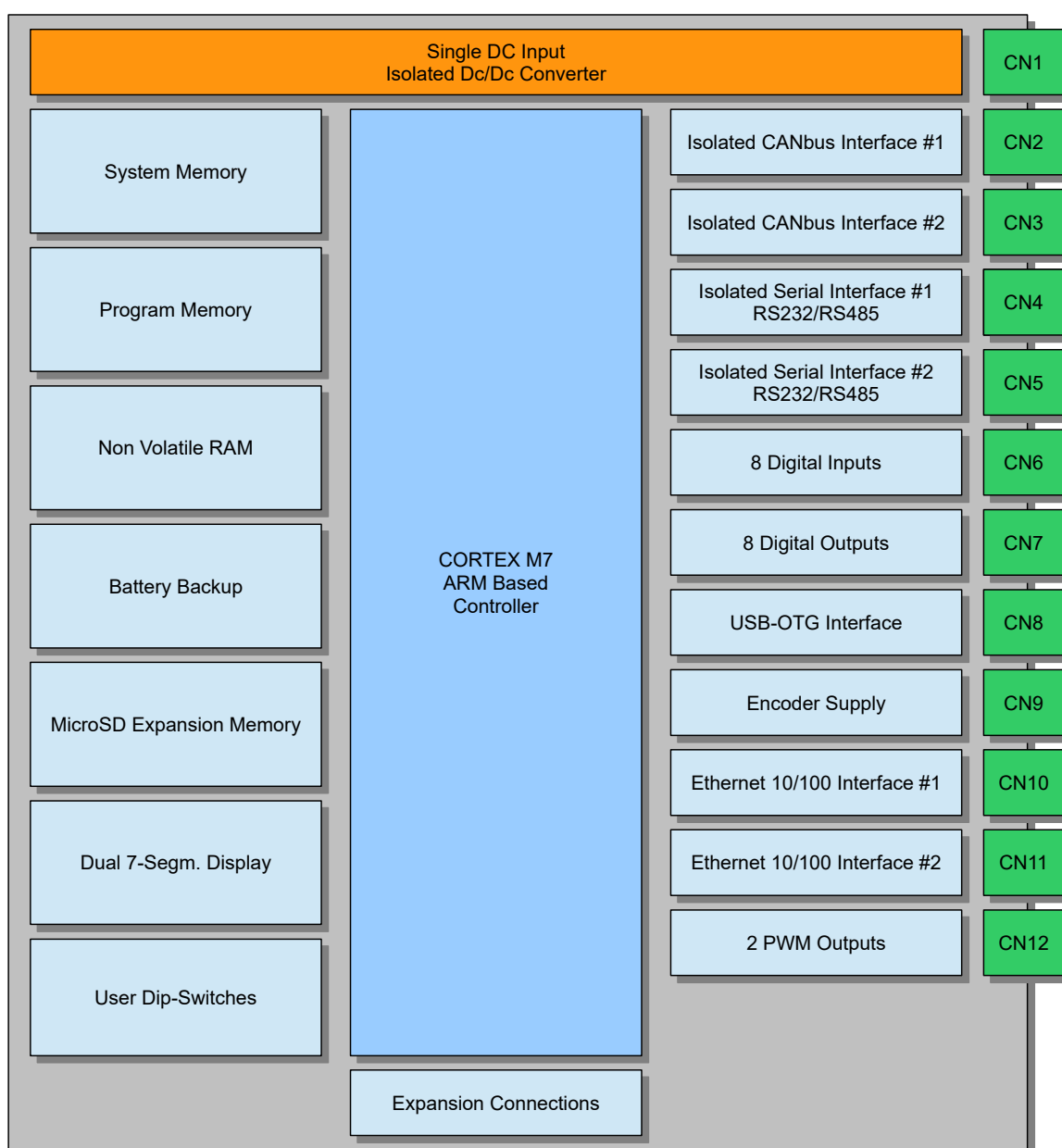


Figure 2: GaIA device hardware block diagram

## 1.4 Operating limits, risks and warnings

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A safe and effective installation is possible only when done in accordance with IEC 1000, EN 60204-1, EN 61800-3 standards, and the safety law in the end user installation field.



- Installation of a GaIA device must comply with information reported in this manual.
- TECNOLOGIX is not responsible for damages and injuries caused by an improper use or by a not compliant use of a GaIA device.
- GaIA device is intended for installation in an electrical panel; it is user responsibility to guarantee GaIA device appropriate operating conditions.
- This manual intended audience is GaIA device installer personnel; it is not intended to be support documentation for GaIA device end users.



When performing isolation test on a system including a GaIA device, please be sure to do not exceed GaIA device maximum isolation voltages.



GaIA device could cause environmental damages if not disposed properly.

## 1.5 Limited Warranty

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TECNOLOGIX s.r.l., ("TECNOLOGIX") warrants the buyer ("Buyer") of a TECNOLOGIX GaIA (the "Product") as follows: when properly used and installed, the Product will be free from defects in material and workmanship, and will conform to buyer specifications for the Warranty Period of 1 year. The Warranty commences on the manufacturing date printed on the Product label.

In no case TECNOLOGIX will be responsible, during the Warranty Period, of a Product not properly stored, installed, used or serviced. In no case TECNOLOGIX will be responsible, during the Warranty Period, of a Product modified, setup or serviced without written authorization by others.

TECNOLOGIX responsibility is limited to service (or replacement) of any manufactured Product, in whole or in part, that will result defective due to materials or workmanship, according to TECNOLOGIX warranty conditions.

The content of this manual is updated to its printing date. TECNOLOGIX reserves the right to modify or change its Product to improve their performances without any notice or change to this manual.

TECNOLOGIX does not recommend usage of its Products in safety critical or life support application or in any case in which a fault can could threaten life of safety of people or things; if Buyer will use TECNOLOGIX Products in this kind of application he will be the sole responsible of such use. In such case TECNOLOGIX will reserve the right to ask the Buyer for compensation of all caused damages, material and immaterial.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its Products, and any use of TECNOLOGIX Products in its applications, notwithstanding any applications-related information or support that may be provided by TECNOLOGIX. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TECNOLOGIX and its representatives against any damages arising out of the use of any TECNOLOGIX Products in safety-critical applications.



## 2 EC conformity declaration

---

TECNOLOGIX S.R.L. hereby declares that the product:

Model: GaIA  
with article numbers: GaIA204-H7-E1  
GaIA204-H7-E2

fulfils the requirements of the standards:

EN 61000-6-4:2007 +A1:2013

- Emission standard for-industrial environments

EN 55022:2014 Class A

EN 61000-6-2:2006

- Immunity for industrial environments

EN 55024 Class A:2013 +A1 2015

according to the following test report:

Politecnico di Torino  
Sede di Alessandria - LIE  
TR 01-25 LIE 12/02/2025

The product thus complies with the EC  
directive:

2014/30/UE

This declaration applies to all devices that bear the CE symbol and loses its validity if modifications are carried out on the product.

Milano, 14 February 2025

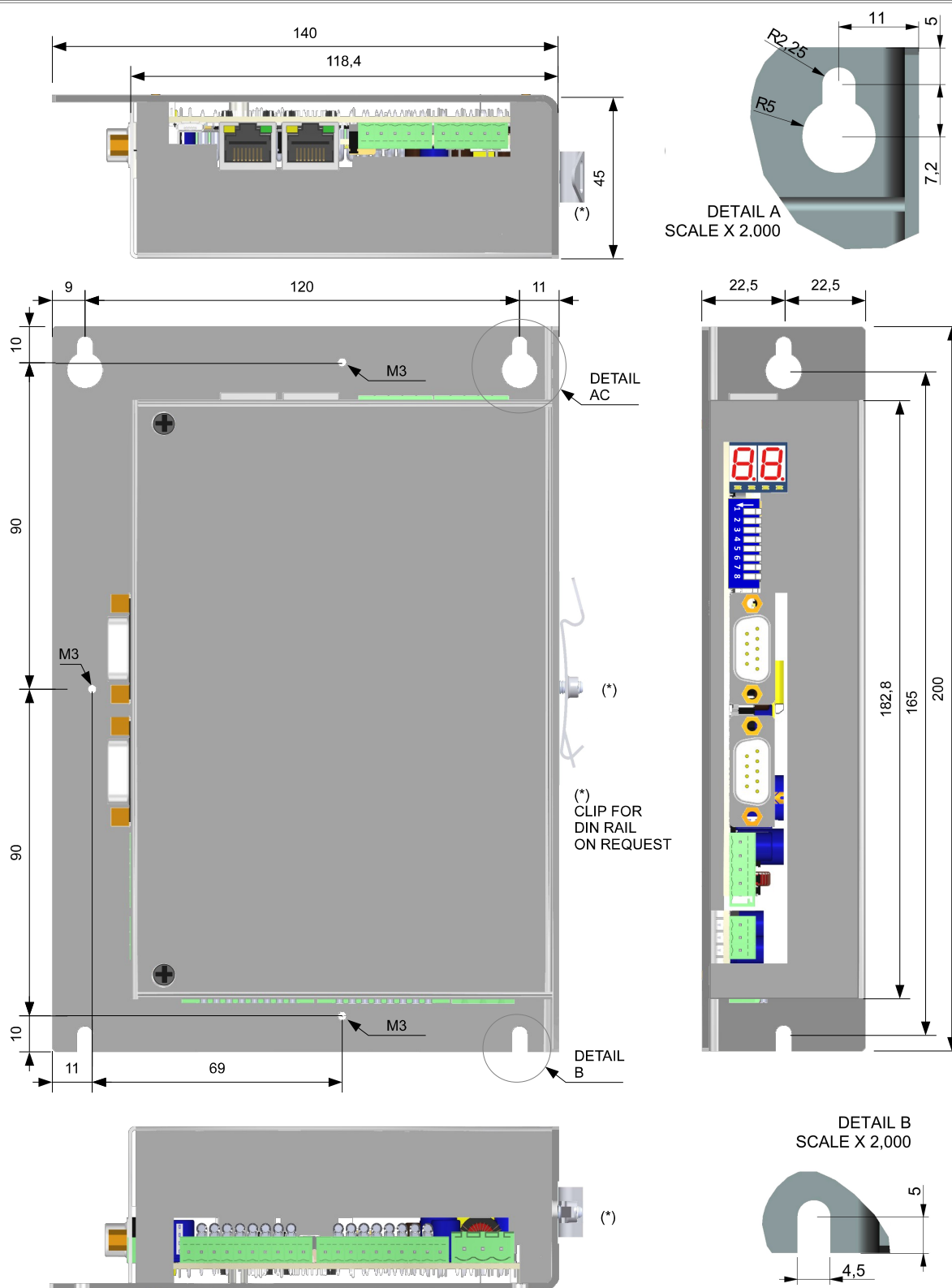
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## 3 Specifications

### 3.1 Mechanical specifications (units: mm)



|                     |                                                                                        |
|---------------------|----------------------------------------------------------------------------------------|
| Physical dimensions | 200(H) x 45(W) x 140(D) mm                                                             |
| Weight              | 380g (w/o metal box)<br>480g (w/ metal box)<br>800g (w/ metal box and expansion board) |

GaIA device can be installed in 3 different ways:

- a) Narrow side wall mount;
- b) Wide side wall mount;
- c) DIN "U" guide mount (back clip on request)



To install the device, please use:

- #2 or #4 MA4 screws and washers for type a) or type b) mount
- No screws are needed for type c) mount

## 3.2 Environmental specifications

|                             |                                                                                                                                                                                             |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power supply voltage        | 24Vdc ( $\pm 20\%$ )                                                                                                                                                                        |
| Power supply max current    | 800mA                                                                                                                                                                                       |
| Protection class            | IP20                                                                                                                                                                                        |
| Storage temperature range   | From $-25^{\circ}\text{C}$ to $+55^{\circ}\text{C}$                                                                                                                                         |
| Operating temperature range | From $+5^{\circ}\text{C}$ to $+50^{\circ}\text{C}$                                                                                                                                          |
| Humidity                    | From 5% to 85% non condensing                                                                                                                                                               |
| Max work altitude           | <ul style="list-style-type: none"> <li>• 0 to 2000 m s.l. No derating</li> <li>• &gt; 2000 m s.l. Reduction of working temperature by <math>0.5^{\circ}\text{C}</math> per 100 m</li> </ul> |

### 3.3 Technical specifications

---

- RISC 32 bit 480MHz STM32H743ZI microcontroller, w/ 2MB internal flash memory, 1MB internal RAM
- Serial E2PROM
- 2 isolated 1MBit/s CAN interfaces
- 2 isolated, half/full duplex independent serial RS232 or RS232/RS485 interfaces
- 8 isolated PNP inputs, 5V or 24V 500 Hz; even inputs could be driven by an incremental quadrature encoder with frequency up to 1 Mhz.
- 8 isolated, short circuit protected outputs, 24V 500 Hz
- 8 dip switches handled by software
- 2 7-segment display handled by software
- 1 Ethernet interface with optional integrated 2 ports switch
- 1 USB OTG interface
- 2 PWM Outputs
- 1 SD-Card solid state disk
- 1 Battery backup circuitry

## 3.4 Electrical specifications



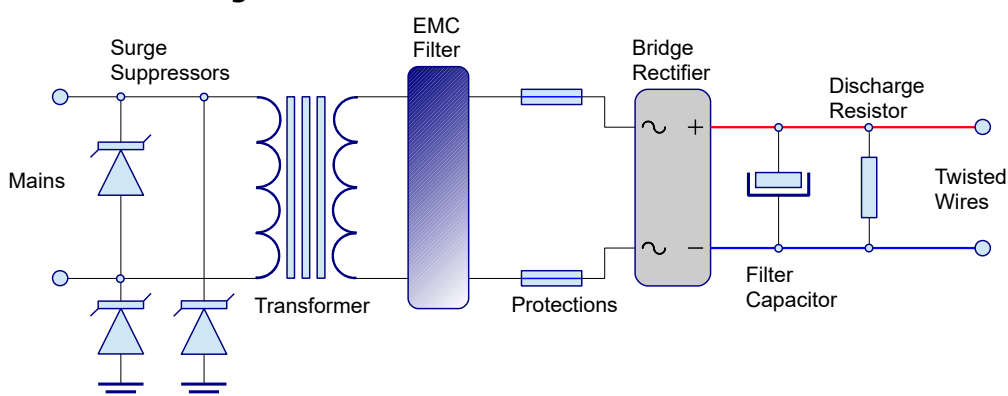
*Electrical tolerance specifications satisfy EN 60204 standards, if not stated elsewhere.*

***Some product features depend upon product version.***

|                          |                      |
|--------------------------|----------------------|
| Power supply voltage     | 24Vdc ( $\pm 20\%$ ) |
| Power supply max current | 800mA                |

### 3.4.1 Power supply

Connection diagram



Power supply characteristics depend upon loads connected to DC line. Approx. characteristics can be obtained by following procedure:

- Overall power consumption  $P_{tot}$  (Watt):  

$$P_{tot} = \sum PL$$
 Where  $PL$  is a connected load power consumption in Watt.
- Transformer power  $P_{Tr}$  (Watt):  

$$P_{Tr} = 2 \cdot P_{tot}$$
- Transformer power  $P_{TrVA}$  (VA):  

$$P_{TrVA} = P_{Tr} / 0.7 \text{ (1 ph.)}$$

$$P_{TrVA} = P_{Tr} / 0.8 \text{ (3 ph.)}$$
- Lets consider a voltage fall equal to 8% of nominal voltage on load connection, then:  

$$P_{TrVA} = V_{dcBUS} \cdot I_{max} \cdot \sqrt{2}$$

|                   |                                                                                                                                                                                                                            |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Surge suppressors | Protect device from mains surge, located on transformer primary circuit.                                                                                                                                                   |
| Transformer       | Transformer primary circuit has to be chosen according to mains characteristics.<br>Voltage peaks on secondary equals to $V_{2-RMS} \cdot \sqrt{2}$<br>where $V_{2-RMS}$ is transformer secondary circuit nominal voltage. |

AC/DC converter (requirements to power a GaIA w/expansion board):

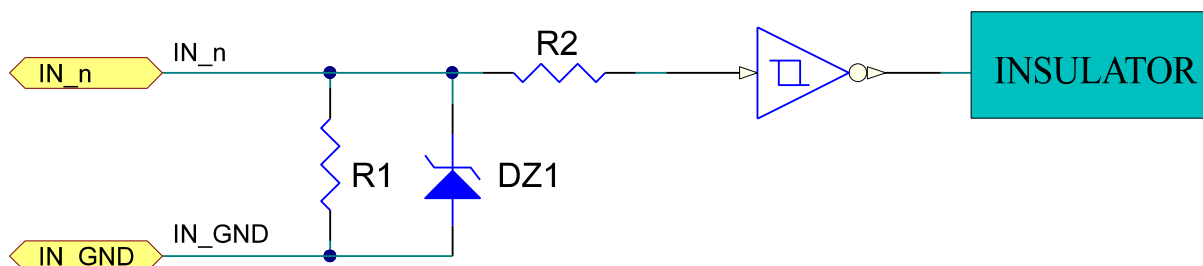
|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rectifiers  | Consider 800mA as maximum nominal current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| C           | 2200uF (85°C) w/ 1ph mains<br>1000uF (85°C) w/ 3ph mains<br>Capacitors working voltage has to be greater than VDC maximum value plus a safety zone, e.g. 35V                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| EMC filter  | It is necessary to be compliant with EMC requirements; an EMC filter is recommended in presence of sensible circuitry powered by AC line.<br><br>When using a commercial part, please consider the overall RMS current of driven load.<br><br>EMC filter should be inserted between mains and transformer in case the transformer is nearby the load; in all other cases the filter should be inserted between transformer and rectifiers, paying attention to keep its connection to the transformer as short as possible.<br><br>Please refer to filter installation instructions for further details. |
| Protections | Please use 1A delayed fuses or an equivalent safety switch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

### 3.4.2 Digital I/O

#### Digital inputs

Opto-isolated, 500 Hz bandwidth, 24Vdc PNP/Push-Pull (5Vdc upon request).

Digital inputs connection schematic



To avoid damages to input circuitry, please do not exceed minimum and maximum ratings reported in the following table:

| Digital inputs electrical specifications |        |                                      |          |                 |          |
|------------------------------------------|--------|--------------------------------------|----------|-----------------|----------|
| Nominal voltage                          | Limits | Logical state 0                      |          | Logical state 1 |          |
|                                          |        | UL<br>V                              | IL<br>mA | UH<br>V         | IH<br>mA |
| 5 Vdc $\pm$ 5%                           | Max.   | 1.5                                  | ND       | 5               | 17       |
|                                          | Min.   | 0                                    | ND       | 2               | 3        |
| 24 Vdc $\pm$ 20%                         | Max.   | ND                                   | ND       | 19.2            | 7        |
|                                          | Min.   | ND                                   | ND       | 28.8            | 12       |
| f <sub>MAX</sub>                         |        | 500 Hz                               |          |                 |          |
| Protections                              |        | Protected against polarity inversion |          |                 |          |

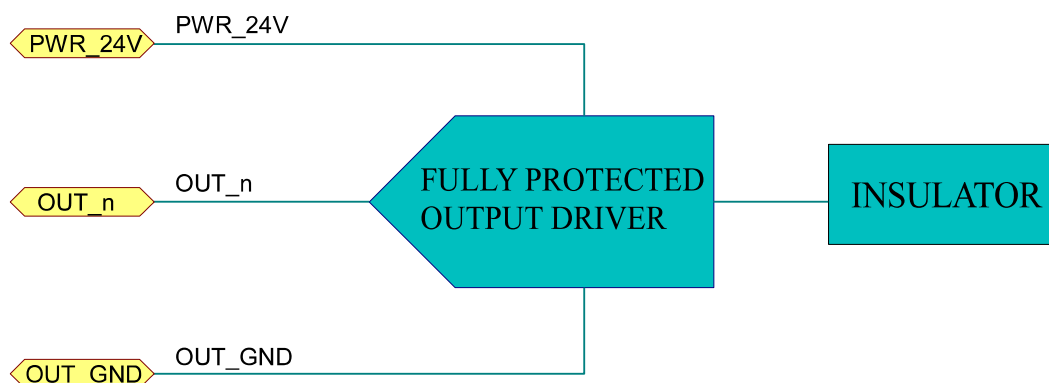


The external device connected to GaIA should have a dedicated power supply.

## Digital outputs

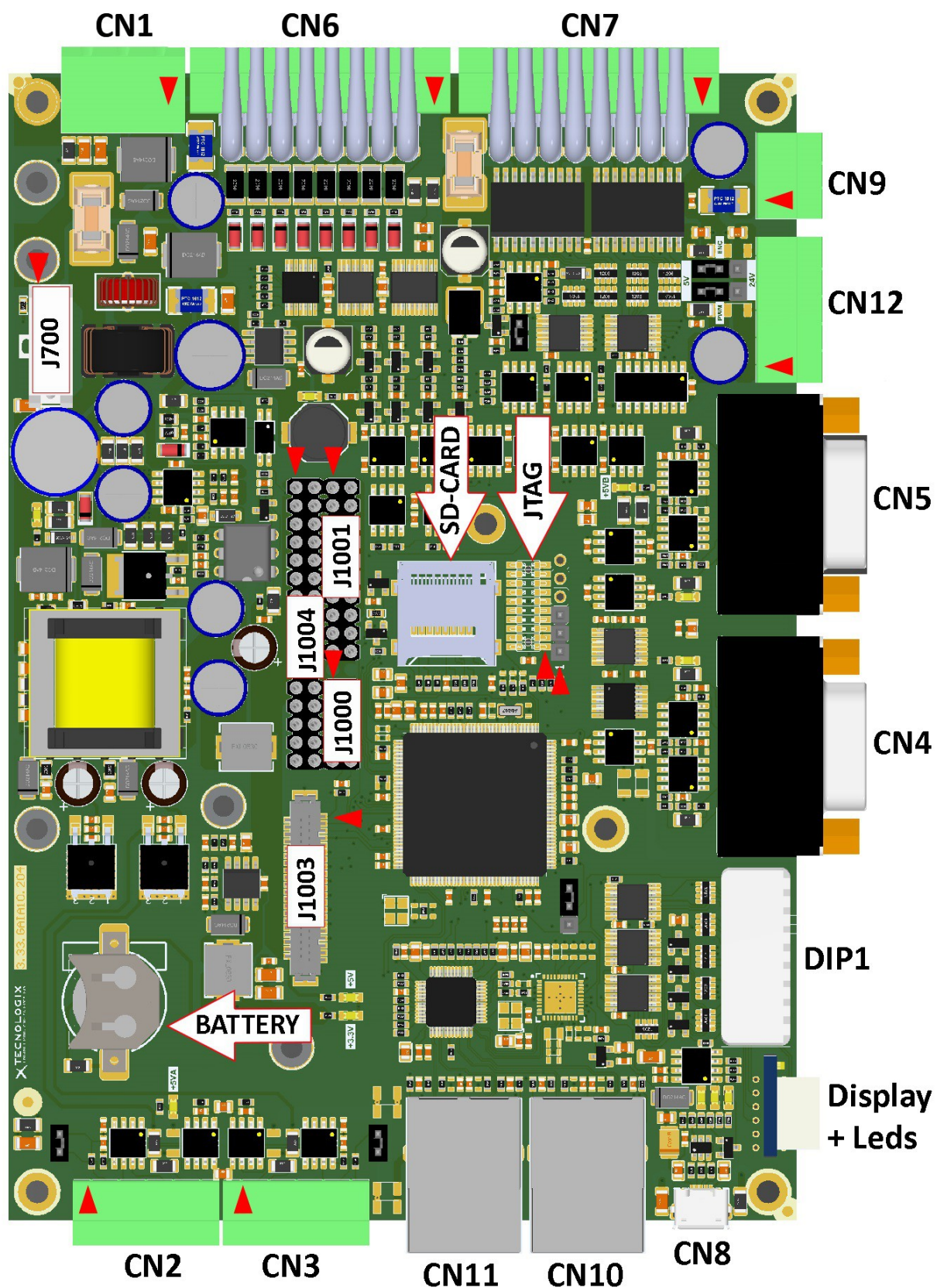
Opto-isolated, 24Vdc PNP, short circuit protected

Digital outputs connection schematic



| Digital outputs electrical specifications   |                       |                                    |
|---------------------------------------------|-----------------------|------------------------------------|
| Nominal current (logic state 1)             | In (A)                | 0.5                                |
| Max current (logic state 1)                 | Max (A)               | 0.7                                |
| Available outputs                           | n.                    | 8                                  |
| Output voltage (logic state 1)              | Max (V)               | 30                                 |
| Drift current (logic state 0)               | Max (A)               | 2                                  |
| Nominal voltage                             | Vnom                  | 24Vdc                              |
| Minimum output voltage                      | Vmin                  | 19Vdc                              |
| Maximum output voltage                      | Vmax                  | 28.8Vdc                            |
| Type                                        | PNP                   | current source                     |
| Maximum output frequency                    | f                     | 500 Hz                             |
| Protection                                  | Short circuit         |                                    |
| Overcurrent/short circuit threshold         | I (over-current)      | > 0.11A min<br>= 0.22A max         |
| Overcurrent/short circuit intervention time | tshort <sub>MAX</sub> | 100μs<br>@Vout = 30Vdc<br>@RL = 0Ω |

## 4 Connectors and wiring



## 4.1 Power supply – CN1

### 4.1.1 Connection to DC power supply (PS)

**Introduction** PS connector allows wiring GaIA device to a DC power supply. Please use a wire with 0.5 mm<sup>2</sup> (or greater) section (#21 AWG) to connect PS terminals; PS terminal wiring should meet industrial cabling standards locally applicable.

**PS V+** Positive power terminal is CN1.1

**PS V-** Return power terminal is CN1.2



#### Attention

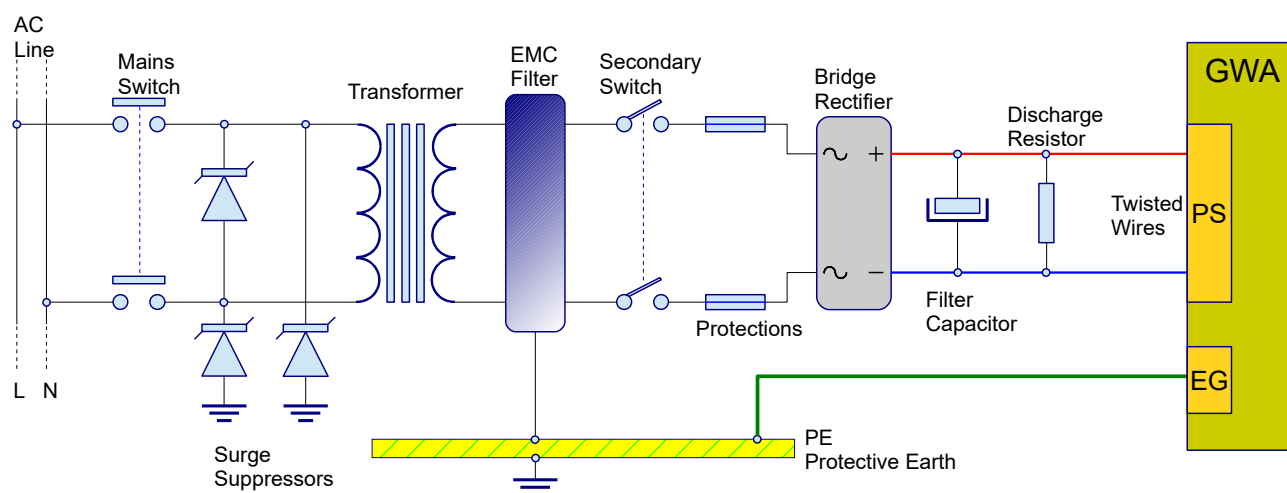
EG and V- terminals are not internally connected; anyway they are dynamically linked by a parallel RC circuit ( $R=1\text{M}\Omega$ ,  $C=2.2\text{nF}$ ).



#### Attention

Please do not solder wire ends and then insert them in the connector; soldering may deteriorate and then cause a loss of electrical connection.

### Connection diagram



### 4.1.2 Connection to protection ground (EG)



Connect EG terminal to the protection ground PE prior any other connection.

#### Cabling requirements

Please use a wire with 0.5 mm<sup>2</sup> (or greater) section (#21 AWG) to connect EG terminal; such wire should have a section equal or greater than power supply wires section. EG terminal wiring should meet industrial cabling standards locally applicable.

**Earth ground** EG terminal is CN1.3

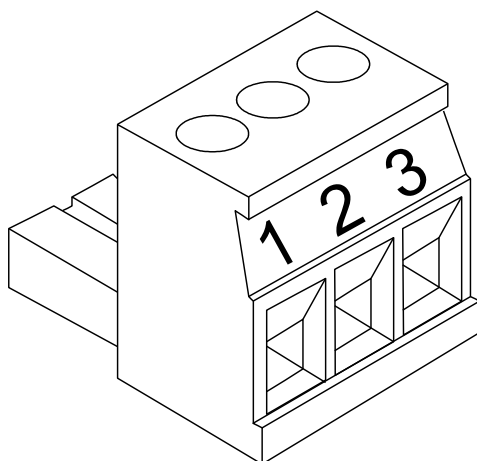
### 4.1.3 DC power supply connector description and pinout

CN1 is a Phoenix 3-pole connector MSTBA 2,5/ 3-G-5,08 – 1757255  
Mating connector is Phoenix MSTB 2,5/ 3-ST-5,08 - 1757022

#### Connections CN1

| Input | Pin   | Description                   |
|-------|-------|-------------------------------|
| V+    | CN1.1 | DC power supply(+)            |
| V-    | CN1.2 | DC power supply reference (-) |
| EARTH | CN1.3 | Earth Ground                  |

#### Pin assignment



## 4.2 CAN/CAN FD bus Interface - CN2 CN3

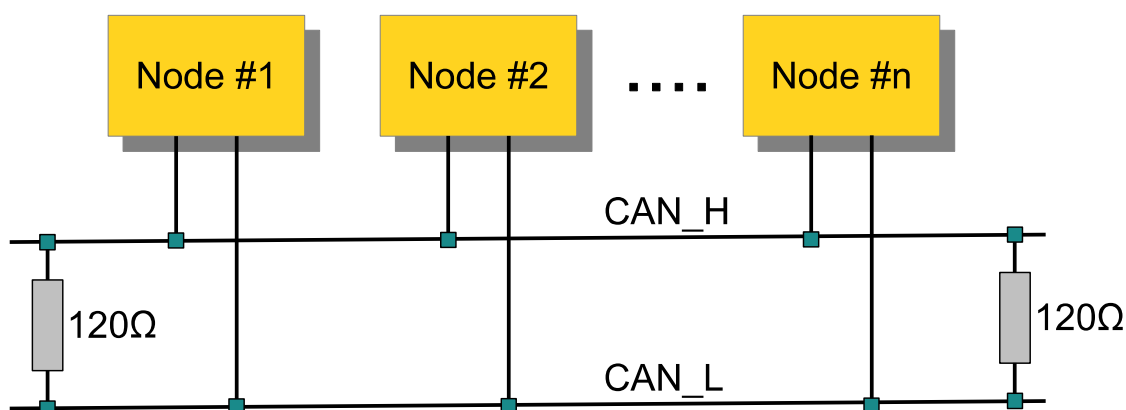
### 4.2.1 Connection to a CAN/CAN FD bus network

**Introduction** GaIA board is equipped with TWO galvanically isolated CAN/CAN FD interfaces. The interfaces are isolated and are powered by an on board isolated DC/DC converter, no external power source is needed.



Please refer to software manual for information related to CAN bus interface operations.

#### CAN bus network connection



**Cabling requirements** CAN cable highly depends on network length, number of nodes in the network, baudrate and other network and environmental factors. Please follow specification document CiA 303-1 for information about cable type, wire section, network topology and cable length.

### 4.2.2 CAN FD Capability

The STM32H743 microcontroller supports two CAN/CAN FD peripherals, GaIA Controller implements the TJA1042 CAN physical layer as defined in ISO 11898-2:2016 and SAE J2284-1 to SAE J2284-5. Maximum speed in CAN-FD Data Phase is 5 Mbit/s.

### 4.2.3 CAN bus Integrated Termination Resistor

CAN bus needs termination resistors at both ends of the cable.

GaIA board features an integrated 120 Ohm termination resistor that can be activated by simply shorting two nearby pins on the CAN connector.

When CAN connector pins 4 and 5 are short-circuited, a 120 Ohm termination resistor is placed between CAN\_H and CAN\_L, simplifying cable wiring.

### 4.2.4 CAN bus connectors description and pinout

CN2 and CN3 are Phoenix 5-pole connectors MC 1,5/5-G-3,5 – 1844249

Mating connector is Phoenix MC 1,5/5-ST-3,5 - 1840395

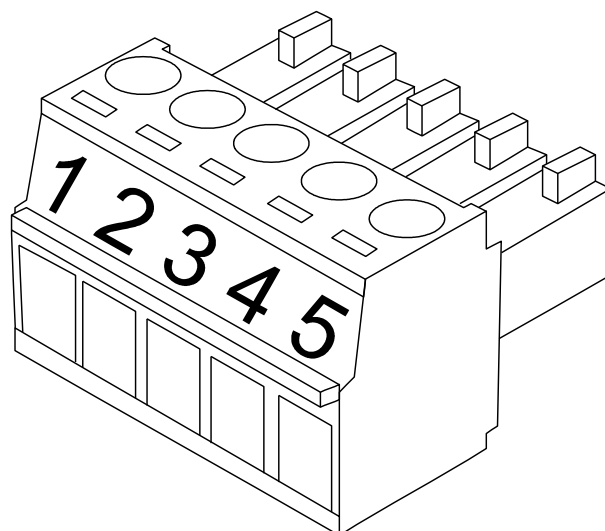
#### Connections CN2 – CAN channel 1

| Signal  | Pin   | Description                                  |
|---------|-------|----------------------------------------------|
| CAN_GND | CN2.1 | CAN Ground (common GROUND for CAN1 and CAN2) |
| CAN1_L  | CN2.2 | CAN_L bus line (dominant low)                |
| EARTH   | CN2.3 | Optional CAN shield                          |
| CAN1_H  | CN2.4 | CAN_H bus line (dominant high)               |
| CAN_TR  | CN2.5 | CAN Terminator Resistor                      |

#### Connections CN3 – CAN channel 2

| Signal  | Pin   | Description                                  |
|---------|-------|----------------------------------------------|
| CAN_GND | CN3.1 | CAN Ground (common GROUND for CAN1 and CAN2) |
| CAN2_L  | CN3.2 | CAN_L bus line (dominant low)                |
| EARTH   | CN3.3 | Optional CAN shield                          |
| CAN2_H  | CN3.4 | CAN_H bus line (dominant high)               |
| CAN2_TR | CN3.5 | CAN Terminator Resistor                      |

#### Pin assignment



## 4.3 RS232/RS485 Serial Interface – CN4 CN5

---

### 4.3.1 Connection to a Serial device

**Introduction** GaIA board is equipped with TWO galvanically isolated RS232/RS485 serial interfaces. RS232 allows a point-to-point link, according to EIA/TIA232E CCIT V.28 standard. RS485 allows a multipoint link, according to RS-485 CCITT V.11 X.27 standard. The interfaces are isolated and powered by an on board isolated DC/DC converter, so no external power source is needed.

### 4.3.2 RS232 Serial Interface

RS232 is a Full Duplex Serial Interface with Tx and Rx pins.

### 4.3.3 RS485 Half Duplex or Full Duplex Serial Interface

RS485 Serial Interface is available with two different assembly options. By default GaIA is factory assembled with a 2Wire Half Duplex interface; optionally, a 4Wire Full Duplex interface can be factory assembled on request. In the default 2Wire HD mode, Dn\_TxD+ and Dn\_TxD- pins are used to both Transmit and Receive serial data.

### 4.3.4 RS485 Integrated Termination Resistor

RS485 Serial Interface needs termination resistors at both ends of the cable. GaIA board features an integrated 120 Ohm termination resistor that can be activated by simply shorting two nearby pins on the DB9 Serial connector. When DB9 connector pins 4 and 9 are short-circuited, a 120 Ohm termination resistor is placed between Dn\_TxD+ and Dn\_TxD-, simplifying cable wiring. Similarly, in 4 Wire FD hardware option, short-circuiting pins 1 and 6, places a 120 Ohm termination resistor between Dn\_RxD+ and Dn\_RxD- signals.



Please refer to software manual for information related to serial interface operations.

**Cabling requirements** Please use a 0.5mm<sup>2</sup> (#20 AWG) or a 0.25mm<sup>2</sup> (#23AWG) twisted pair for RS232/RS485 interface connection

### 4.3.5 RS232/RS485 connectors description and pinout

CN4 and CN5 are standard DB9 9-pole male connectors

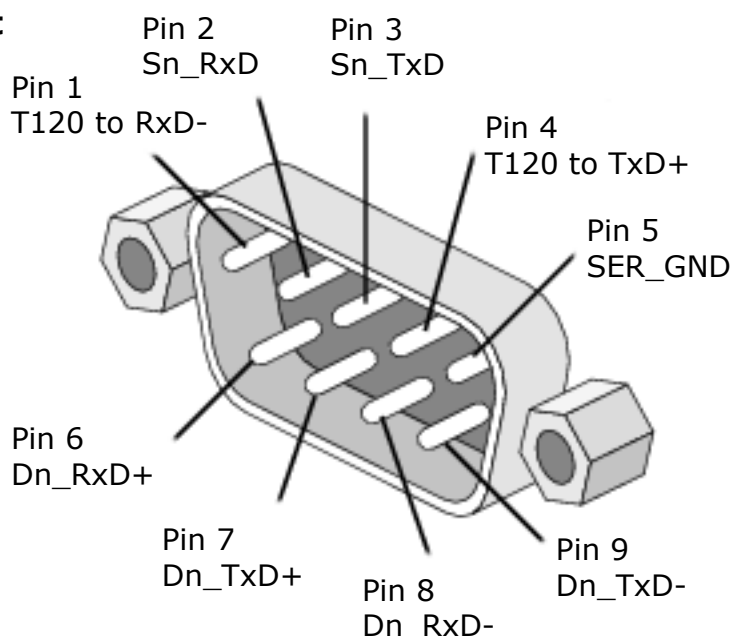
#### Connections CN4 – Serial channel 1

| Signal     | Pin   | Description                                          |
|------------|-------|------------------------------------------------------|
| T120_RxD1- | CN4.1 | T120 to RxD- Termination resistor                    |
| S1_RxD     | CN4.2 | RS232 Ch1 RxD                                        |
| S1_TxD     | CN4.3 | RS232 Ch1 TxD                                        |
| T120_TxD1+ | CN4.4 | T120 to TxD+ Termination Resistor                    |
| SER_GND    | CN4.5 | SER_GND (common GND for SERIAL1 and SERIAL2)         |
| D1_RxD+    | CN4.6 | RS485 Ch1 RxD+ (only available with 4Wire FD option) |
| D1_TxD+    | CN4.7 | RS485 Ch1 TxD+                                       |
| D1_RxD-    | CN4.8 | RS485 Ch1 RxD- (only available with 4Wire FD option) |
| D1_TxD-    | CN4.9 | RS485 Ch1 TxD-                                       |

#### Connections CN5– Serial channel 2

| Signal     | Pin   | Description                                          |
|------------|-------|------------------------------------------------------|
| T120_RxD2- | CN5.1 | T120 to RxD- Termination resistor                    |
| S2_RxD     | CN5.2 | RS232 Ch2 RxD                                        |
| S2_TxD     | CN5.3 | RS232 Ch2 TxD                                        |
| T120_TxD2+ | CN5.4 | T120 to TxD+ Termination Resistor                    |
| SER_GND    | CN5.5 | SER_GND (common GND for SERIAL1 and SERIAL2)         |
| D2_RxD+    | CN5.6 | RS485 Ch2 RxD+ (only available with 4Wire FD option) |
| D2_TxD+    | CN5.7 | RS485 Ch2 TxD+                                       |
| D2_RxD-    | CN5.8 | RS485 Ch2 RxD- (only available with 4Wire FD option) |
| D2_TxD-    | CN5.9 | RS485 Ch2 TxD-                                       |

#### Pin assignment



## 4.4 Ethernet network Interface – CN10 CN11

### 4.4.1 Connection to a network device

**Introduction** GaIA board is equipped with a single Ethernet MAC interface. Ethernet interface allows a network link according to IEEE 802.3 standards.

The Ethernet MAC controller operates at 10 and 100 Mbit/s; GaIA can be connected to physical media by means of a RJ45 100 Base-T standard connector.

Ethernet interface is available in two different versions:

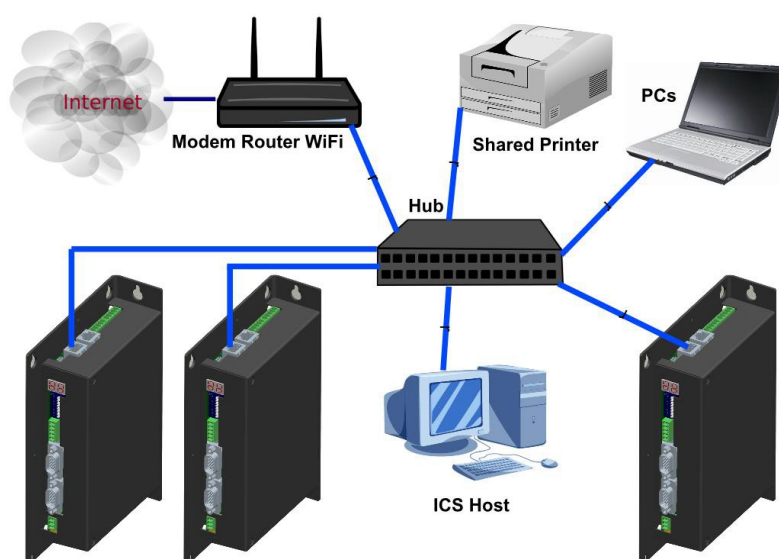
- Single Ethernet PHY TI DP83848, connected to a single RJ45 100 Base-T Ethernet connector (CN10).
- Dual Ethernet PHY Micrel KSZ8863, connected to two RJ45 100 Base-T Ethernet connectors (CN10 and CN11). The dual RJ45 100 Base-T connector option includes an high performance/low latency switch for easy board daisy chaining, conforming to Industrial Ethernet specification requirements.



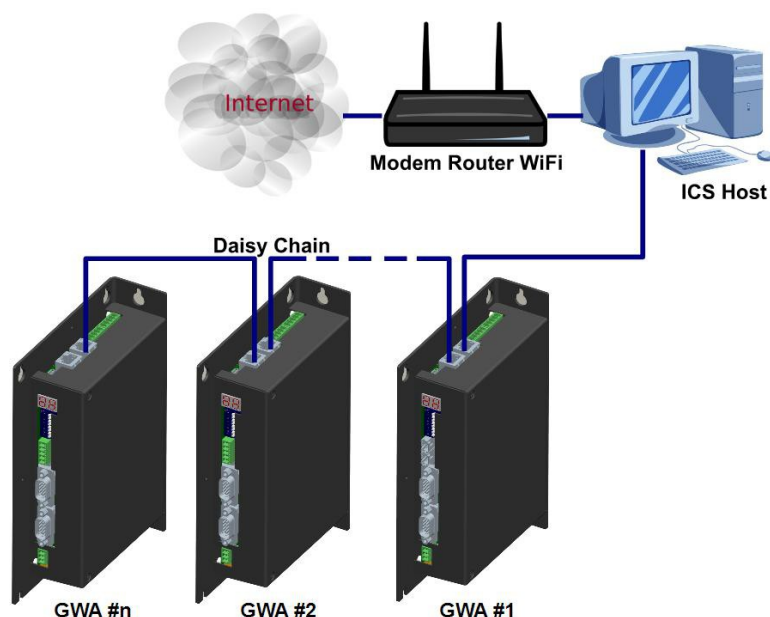
Please refer to software manual for information related to Ethernet interface operations and supported protocols.

**Cabling requirements** Please use a UTP Cat.5 cable for Ethernet interface connection.

### Ethernet network connection – single RJ45 connector



## Ethernet network connection – dual RJ45 connector



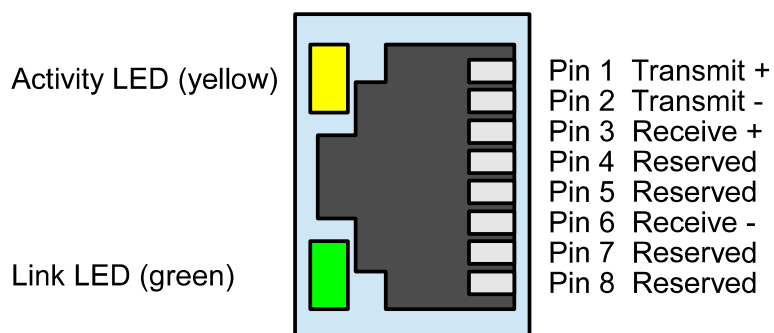
### 4.4.2 Ethernet connectors description and pinout

CN10 and CN11 are standard RJ45 100 Base-T 8 pole female connectors

#### Connections CN10 CN11 – Ethernet interface

| Signal   | Pin    | Description |
|----------|--------|-------------|
| ETH_TxD+ | CN1x.1 | Transmit +  |
| ETH_TxD- | CN1x.2 | Transmit -  |
| ETH_RxD+ | CN1x.3 | Receive +   |
|          | CN1x.4 | N.C.        |
|          | CN1x.5 | N.C.        |
| ETH_RxD- | CN1x.6 | Receive -   |
|          | CN1x.7 | N.C.        |
|          | CN1x.8 | N.C.        |

#### Pin assignment



## 4.5 USB OTG Full Speed Interface - CN8

**Introduction** GaIA board is optionally equipped with a single USB On-The-Go Full Speed (12 Mbit/s) interface, connected to a USB Micro-AB receptacle CN8. USB OTG Interface allows a point-to-point connection with a PC or a peripheral, acting as a dual role USB Host/Device interface, depending on application firmware. GaIA USB interface can be used for firmware reprogramming via STM32 Bootloader.



Please refer to STM32 microcontroller user's manual for information related to firmware reprogramming via USB using the Bootloader protocol.



Please refer to software manual for information related to USB interface operations and supported protocols.

**Cabling requirements** Please use proper USB cable for USB interface connection.

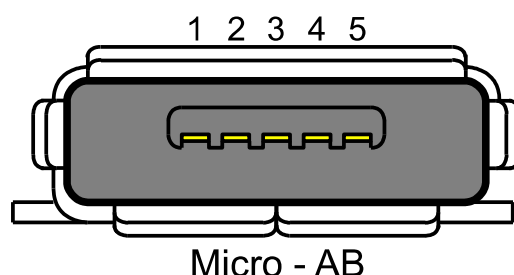
### 4.5.1 USB OTG connector description and pinout

CN8 is a standard USB Micro-AB receptacle connector

#### Connections CN8 – USB OTG interface

| Signal   | Pin   | Description                              |
|----------|-------|------------------------------------------|
| OTG VBUS | CN8.1 | VBUS – Device power out in Host mode     |
| OTG DM   | CN8.2 | OTG DM – Data bus -                      |
| OTG DP   | CN8.3 | OTG DP – Data bus +                      |
| OTG ID   | CN8.4 | OTG ID – ID pin for OTG role arbitration |
| GND      | CN8.5 | GND                                      |

#### Pin assignment



## 4.6 SD-Card socket

---

**Introduction** SD-Card socket holds a Micro-SD card to be used for data storage.



Please refer to software manual for information about SD-Card operations.

## 4.7 DIP-switches - DIP1

---

**Introduction** DIP-switches contacts can be used to perform some user setup, such as:

- CAN bus node id and baudrate setup
- User functions setup

DIP-switches are accessible from front side of the GaIA device.



DIP-switches functions are defined by software, please refer to software manual for information about DIP-switches operations.  
NOTE: DIP-switch 8 could be used for BOOT MODE setup, please see BOOT1 jumper description.

## 4.8 BATTERY socket

---

**Introduction** GaIA is equipped with a socket for a CR1220 3V lithium button cell; the battery is connected to STM32H7 V<sub>BAT</sub> pin and provides backup power to STM32H7 RTC, backup SRAM and backup Registers.



**Attention**

Battery socket must be populated ONLY when battery backup is needed.

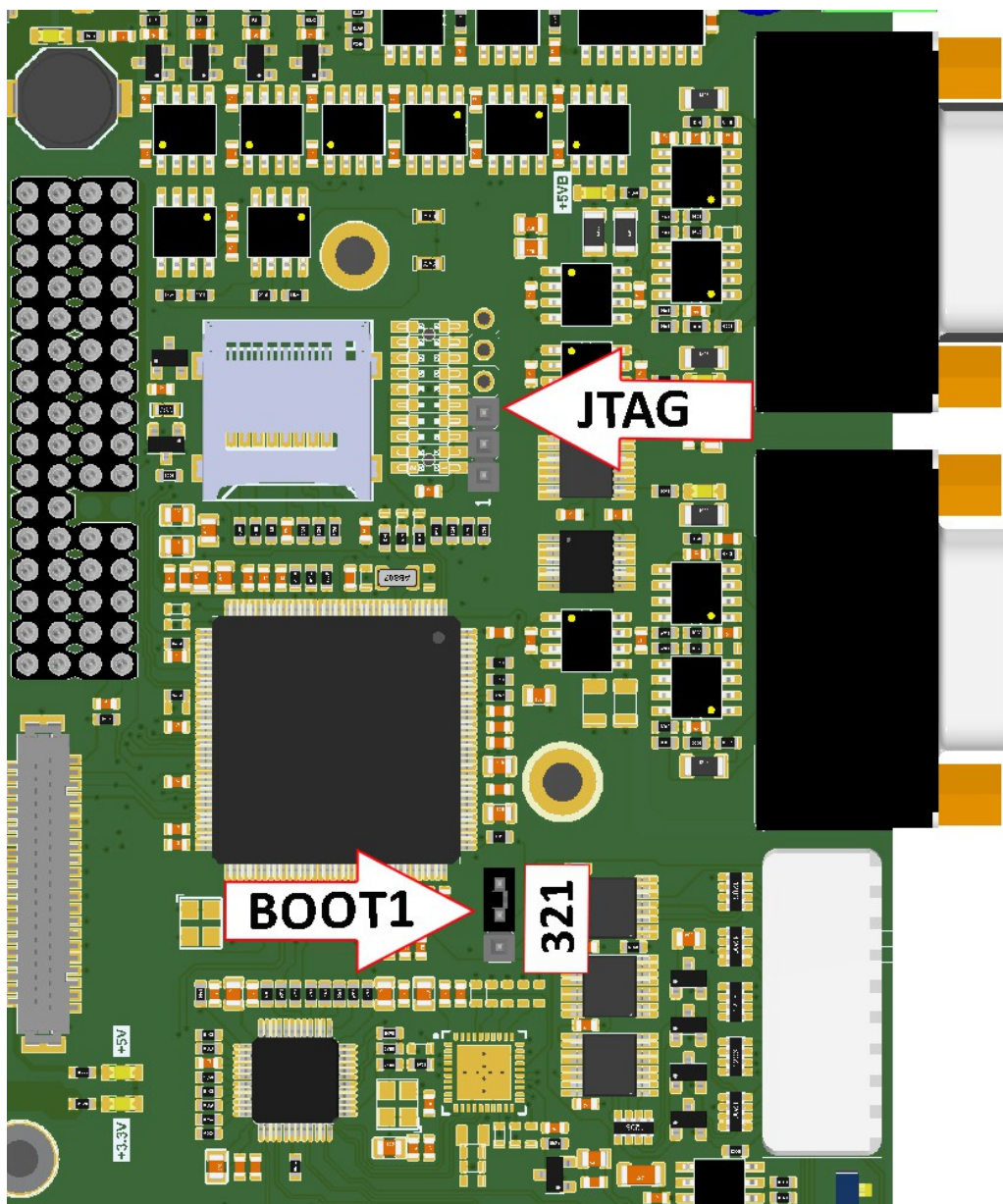
A discharged battery must be removed promptly to prevent acid leaks from damaging the GaIA Controller PCB.

## 4.9 JTAG debug interface – JTAG

**Introduction** GaIA board is equipped with a standard Cortex Debug+ETM Connector (20 pin). The JTAG interface is used for firmware debug and chip programming.

### 4.9.1 JTAG Connector

JTAG Connector is available in TWO different versions: by default, a 6 pin 2.54mm strip connector is provided, compatible with ST-Link pinout. The Arm Standard SAMTEC 20 pin connector is available as an option and can be factory assembled on request.



### 4.9.2 ST-Link JTAG Connector

ST-Link JTAG Connector is the de-facto standard connector featured on STMicroelectronics ST-Link JTAG debug adapter; the 6 pins provide the lowest count interface to effectively debug a Cortex-M processor.

ST-Link JTAG is a standard 2.54mm 6 pin male header connector.

#### Connections ST-Link JTAG

| Signal | Pin    | Description                       |
|--------|--------|-----------------------------------|
| VTref  | JTAG.1 | +3V3 – Target power supply        |
| SWCLK  | JTAG.2 | Serial Wire Clock                 |
| GND    | JTAG.3 | Target ground                     |
| SWDIO  | JTAG.4 | Serial Wire I/O                   |
| RESET  | JTAG.5 | Target Reset                      |
| SWO    | JTAG.6 | Optional Serial Wire Trace Output |

### 4.9.3 Arm Cortex-M 20 pin JTAG Connector

Arm Cortex-M JTAG Connector is the standard connector conceived by Arm to provide all the signals needed to debug a Cortex-M class processor.

The connector is a 20 pin male (2x10) header SAMTEC FTSH-110-01-L-DV-K.

#### Connections Arm Cortex-M 20 pin JTAG

| Signal    | Pin               | Description                                      |
|-----------|-------------------|--------------------------------------------------|
| VTref     | JTAG.1            | +3V3 – Target power supply                       |
| SWDIO/TMS | JTAG.2            | Serial Wire I/O/JTAG TMS                         |
| SWCLK/TCK | JTAG.4            | Serial Wire Clock/JTAG TCK                       |
| SWO/TDO   | JTAG.6            | Serial Wire Trace Output/JTAG TDO                |
| TDI       | JTAG.8            | NOT CONNECTED - JTAG TDI                         |
| RESET     | JTAG.10           | Target Reset                                     |
| TRACECLK  | JTAG.12           | ETM Trace Clock                                  |
| TRACED0   | JTAG.14           | ETM Trace Data0                                  |
| TRACED1   | JTAG.16           | ETM Trace Data1                                  |
| TRACED2   | JTAG.18           | ETM Trace Data2 (hardware configured on request) |
| TRACED3   | JTAG.20           | ETM Trace Data3 (hardware configured on request) |
| KEY       | JTAG.7            | KEY pin (not connected)                          |
| GND       | JTAG.3 to JTAG.19 | Odd Pins are Target ground                       |



Please refer to Arm Cortex-M manuals for information about JTAG debug on Cortex-M microcontrollers.

## 4.10 Digital inputs and Encoder interface - CN6

- Introduction** GaIA board is equipped with an 8 bit Digital Input interface, input signals are opto-isolated, 24Vdc, PNP/Push pull source compatible, available on CN6 connector.  
A status LED for each input, driven by a light pipe immediately over the contact pin, is available as option, on request. The status LED is ON to indicate 24V present on input pin.
- Encoder Interface** An optional encoder interface is connected on CN6 input pins; the encoder interface features four differential high speed inputs, organized as two dual channel quadrature encoder inputs. The encoder interface can accept 5V or 24V encoder signals, differential or single ended. Encoder power supply is provided on CN9 connector.



Please refer to software manual for information about I/O and encoder operations.

- Cabling requirements** Please use shielded cable wires with 1.0 mm<sup>2</sup> (#18AWG) or 0.5 mm<sup>2</sup> (#20AWG) section.

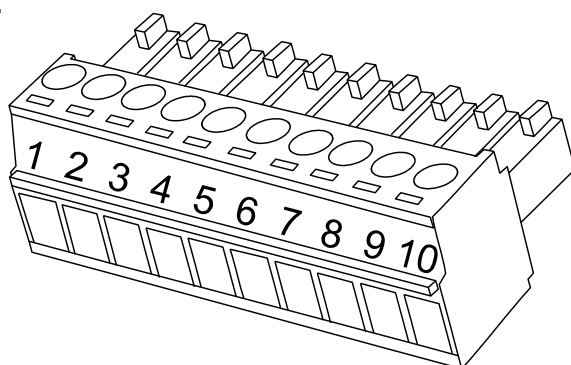
### 4.10.1 Digital Inputs connector description and pinout

CN6 is a Phoenix 10-pole connector MC 1,5/10-G-3,5 – 1844294  
Mating connector is Phoenix MC 1,5/10-ST-3,5 - 1840447

#### Connections CN6 – Inputs

| Signal  | Pin    | Description            |
|---------|--------|------------------------|
| IN_GND  | CN6.1  | Common input GND       |
| IN_0    | CN6.2  | Input 0 – Encoder 2 B- |
| IN_1    | CN6.3  | Input 1 – Encoder 2 B+ |
| IN_2    | CN6.4  | Input 2 – Encoder 2 A- |
| IN_3    | CN6.5  | Input 3 – Encoder 2 A+ |
| IN_4    | CN6.6  | Input 4 – Encoder 1 B- |
| IN_5    | CN6.7  | Input 5 – Encoder 1 B+ |
| IN_6    | CN6.8  | Input 6 – Encoder 1 A- |
| IN_7    | CN6.9  | Input 7 – Encoder 1 A+ |
| PWR_24V | CN6.10 | +24V Output            |

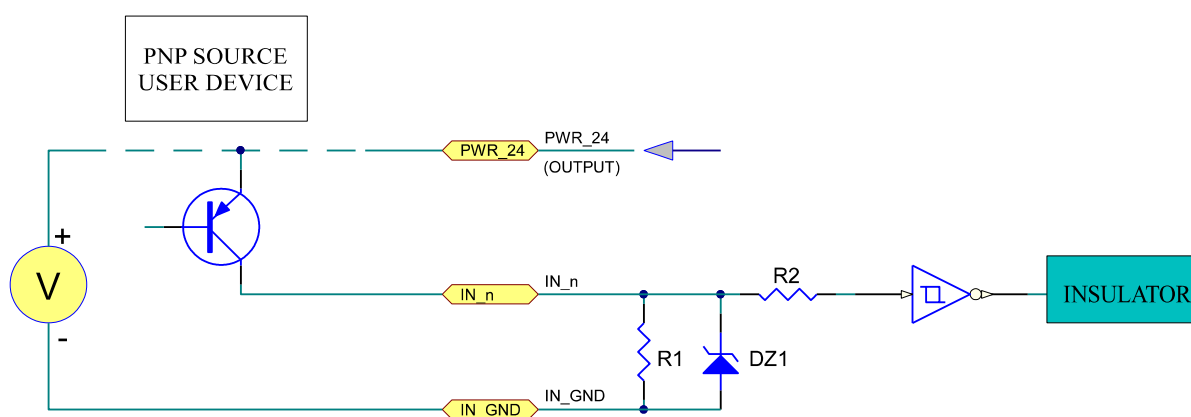
## Pin assignment



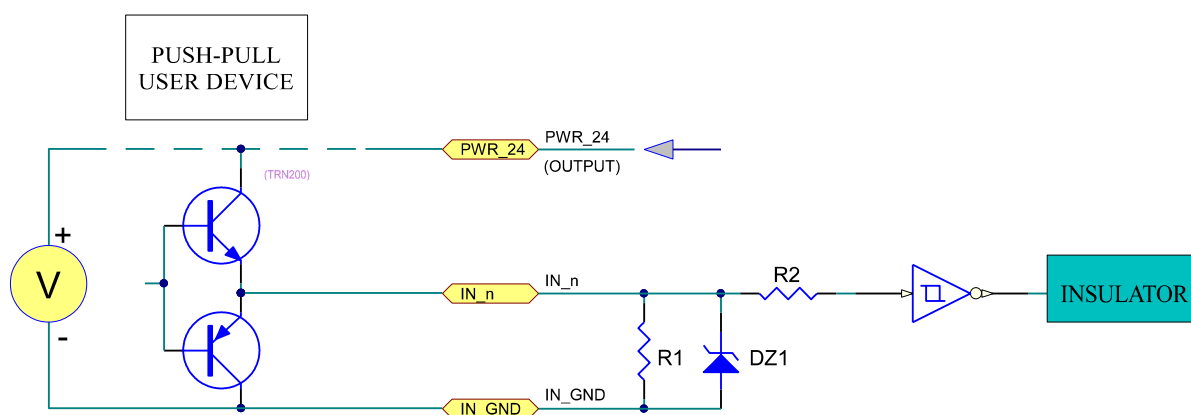
### 4.10.2 Digital inputs electrical connection

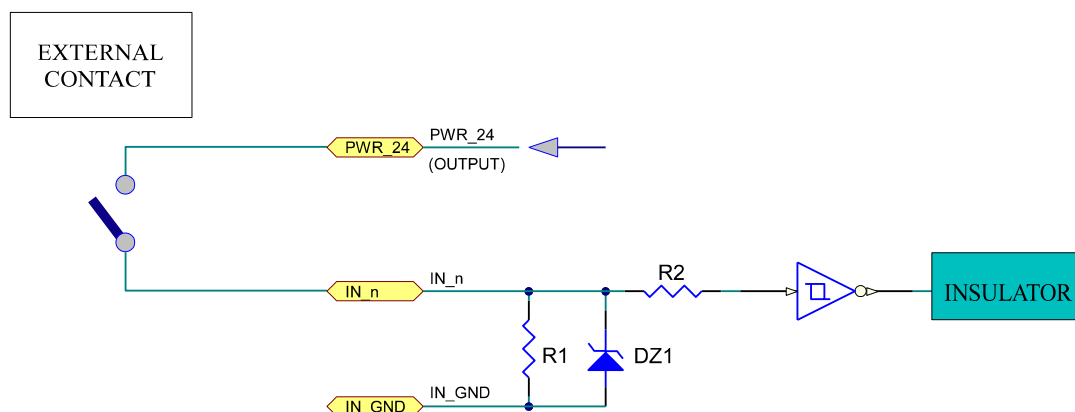
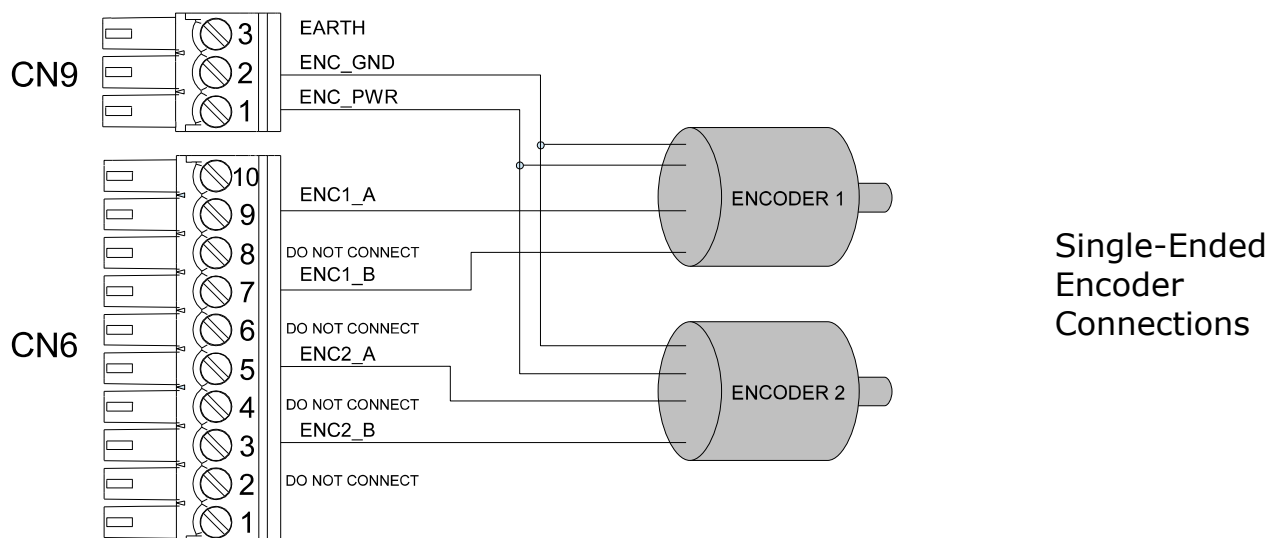
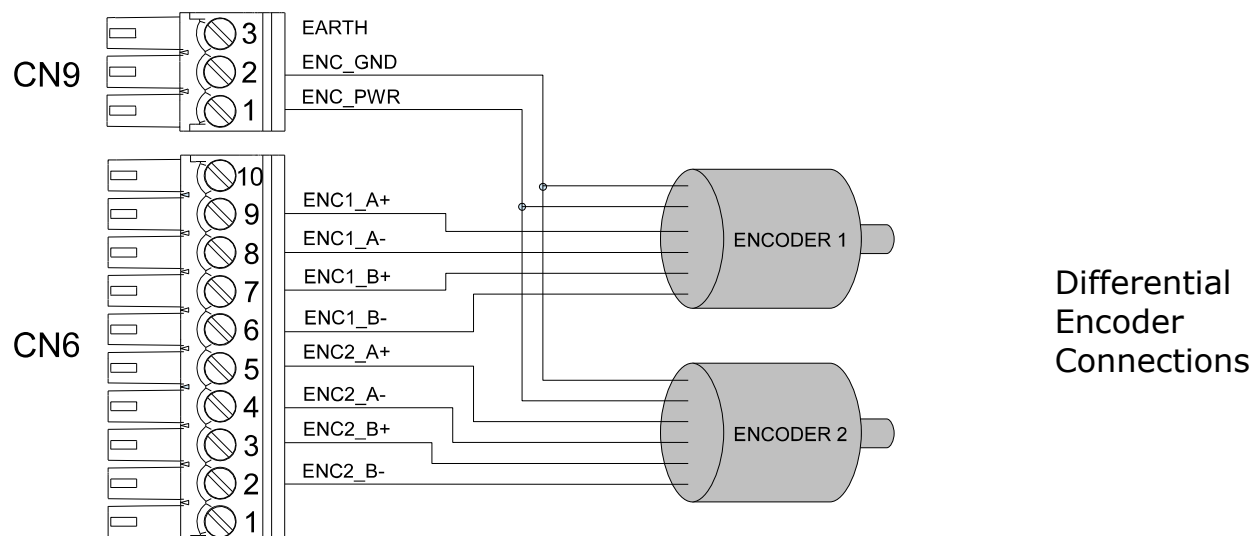
Depending upon external device output type, please adopt the most appropriate electrical connection scheme between those reported hereafter.

#### PNP source



#### Push-Pull source



**Switch source****4.10.3 Single Ended Encoder connection example****4.10.4 Differential Encoder connection example**

## 4.11 Encoder Power supply – CN9

**Introduction** When GaIA is equipped with the optional encoder interface, CN9 connector provides power supply for the encoder. Encoder power supply can be 5V or 24V, depending on hardware settings.

**Cabling requirements** Please use shielded cable wires with 1.0 mm<sup>2</sup> (#18AWG) or 0.5 mm<sup>2</sup> (#20AWG) section.

### 4.11.1 Encoder power connector description and pinout

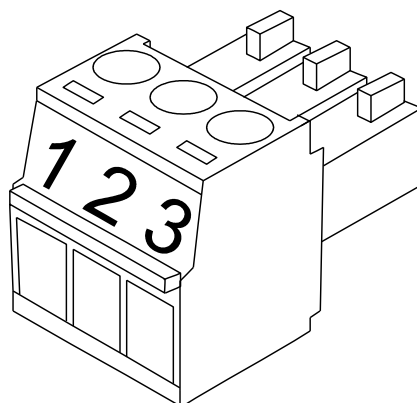
CN9 is a Phoenix 3-pole connector MC 1,5/3-G-3,5 – 1844223

Mating connector is Phoenix MC 1,5/3-ST-3,5 - 1840379

#### Connections CN9 – Outputs

| Signal  | Pin   | Description                         |
|---------|-------|-------------------------------------|
| ENC_PWR | CN9.1 | Encoder power supply(+) (5V or 24V) |
| ENC_GND | CN9.2 | Encoder power supply reference (-)  |
| EARTH   | CN9.3 | Earth Ground                        |

#### Pin assignment



## 4.12 PWM Outputs – CN12

**Introduction** When GaIA is equipped with the optional PWM interface, CN12 connector provides TWO PWM differential outputs. By default, outputs are provided via a standard differential 26LS31 +5V driver. Optionally, a more powerful driver can be factory assembled: AVAGO AEIC-7272-S16, capable of driving up to 80mA peak current per channel; in that case, PWM Output levels can be 5V or 24V, depending on hardware settings.



Please refer to AVAGO AEIC-7272-S16 datasheet for details.

**Cabling requirements** Please use shielded cable twisted pairs with 1.0 mm<sup>2</sup> (#18AWG) or 0.5 mm<sup>2</sup> (#20AWG) section.

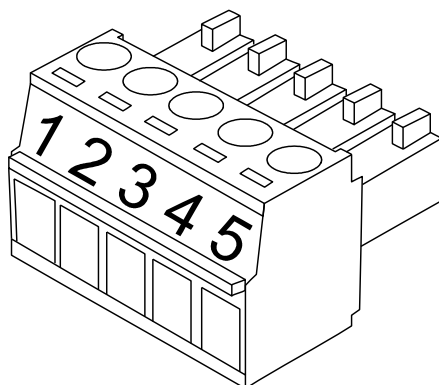
### 4.12.1 PWM Output connector description and pinout

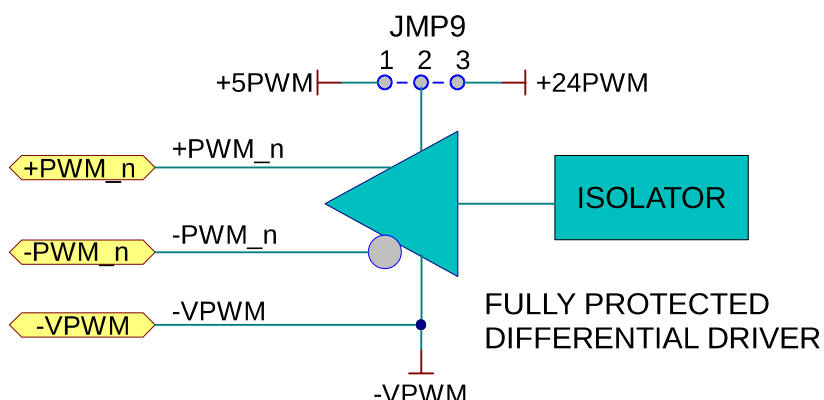
CN12 is a Phoenix 5-pole connector MC 1,5/5-G-3,5 - 1844249  
Mating connector is Phoenix MC 1,5/5-ST-3,5 - 1840395

#### Connections CN12 – Outputs

| Signal    | Pin    | Description                |
|-----------|--------|----------------------------|
| PWM_GND   | CN12.1 | PWM Output reference (GND) |
| PWM_OUT2- | CN12.2 | PWM Output2 -              |
| PWM_OUT2+ | CN12.3 | PWM Output2 +              |
| PWM_OUT1- | CN12.4 | PWM Output1 -              |
| PWM_OUT1+ | CN12.5 | PWM Output1 +              |

#### Pin assignment



**Attention**

+24VPWM can be safely enabled ONLY when the AVAGO driver is installed on GaIA board. Enabling +24VPWM with the standard 26LS31 driver, will cause permanent damage to the driver itself.

| PWM outputs electrical specifications |                                                                                |                       |                  |
|---------------------------------------|--------------------------------------------------------------------------------|-----------------------|------------------|
| <b>Available differential outputs</b> | n.                                                                             | 2                     |                  |
| <b>Output Type</b>                    | Differential Push-pull                                                         |                       |                  |
| <b>Nominal Output voltage</b>         | Vnom                                                                           | 5Vdc                  | @JMP9 closed 1-2 |
|                                       |                                                                                | 24Vdc                 | @JMP9 closed 2-3 |
| <b>Output voltage (logic state 1)</b> | typ. (V)                                                                       | 22.1V typ.            | @JMP9 closed 1-2 |
|                                       |                                                                                | 2.8V typ.             | @JMP9 closed 2-3 |
| <b>Output voltage (logic state 0)</b> | typ. (V)                                                                       | 0.37V typ.            | @JMP9 closed 1-2 |
|                                       |                                                                                | 0.37V typ.            | @JMP9 closed 2-3 |
| <b>Maximum output current peak</b>    | Max mA                                                                         | 80mA<br>Sink / Source |                  |
| <b>Maximum output frequency</b>       | f                                                                              | 800 KHz               |                  |
| <b>Protection</b>                     | against shorts to ground, shorts to Vcc and to other outputs, over-temperature |                       |                  |

## 4.13 Digital outputs - CN7

**Introduction** GaIA board is equipped with an 8 bit Digital Output interface, output signals are opto-isolated, 24Vdc, PNP, available on CN7 connector.

A status LED for each output, driven by a light pipe immediately over the contact pin, is available as option, on request. The status LED is ON to indicate 24V is present on output pin.

The 8 bit Digital output block is protected from short circuit and failure electronically and by a 4A fuse.

**Output Watchdog** An hardware watchdog circuit ensures the reset of outputs if they are not refreshed by firmware for more than 100 ms. A jumper is provided to exclude the watchdog function during the firmware debug phase.



Please refer to software manual for information about I/O operations.

**Cabling requirements** Please use shielded cable wires with 1.0 mm<sup>2</sup> (#18AWG) or 0.5 mm<sup>2</sup> (#20AWG) section.

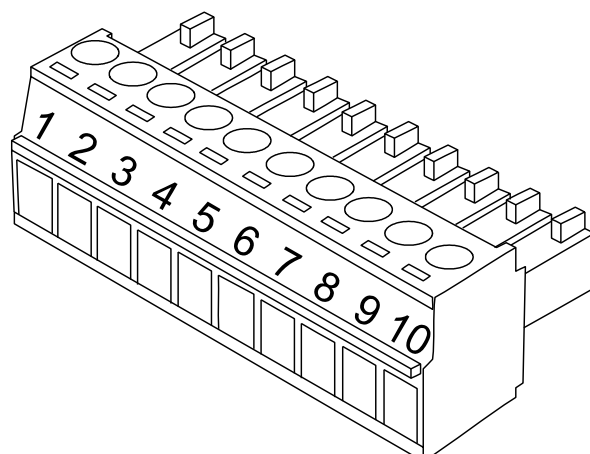
### 4.13.1 Digital outputs connector description and pinout

CN7 is a Phoenix 10-pole connector MC 1,5/10-G-3,5 – 1844294  
Mating connector is Phoenix MC 1,5/10-ST-3,5 - 1840447

#### Connections CN7 – Outputs

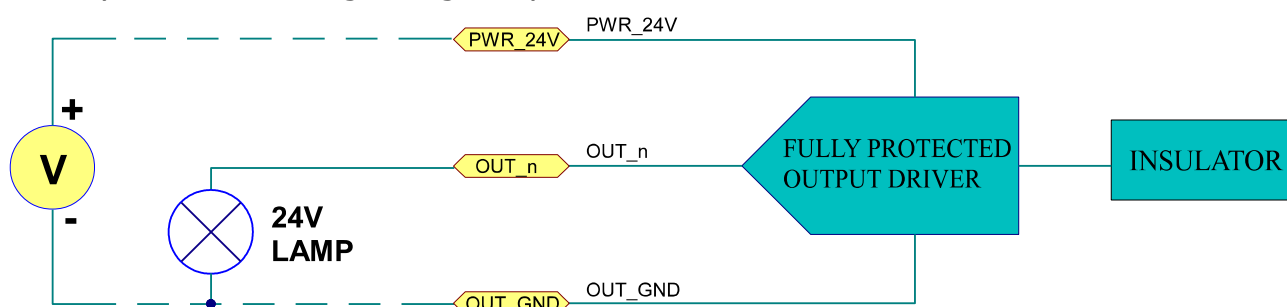
| Signal  | Pin    | Description                               |
|---------|--------|-------------------------------------------|
| OUT_GND | CN7.1  | Common output GND                         |
| OUT_0   | CN7.2  | Output 0                                  |
| OUT_1   | CN7.3  | Output 1                                  |
| OUT_2   | CN7.4  | Output 2                                  |
| OUT_3   | CN7.5  | Output 3                                  |
| OUT_4   | CN7.6  | Output 4                                  |
| OUT_5   | CN7.7  | Output 5                                  |
| OUT_6   | CN7.8  | Output 6                                  |
| OUT_7   | CN7.9  | Output 7                                  |
| PWR_24V | CN7.10 | +24V Input power to Output driver (fused) |

## Pin assignment

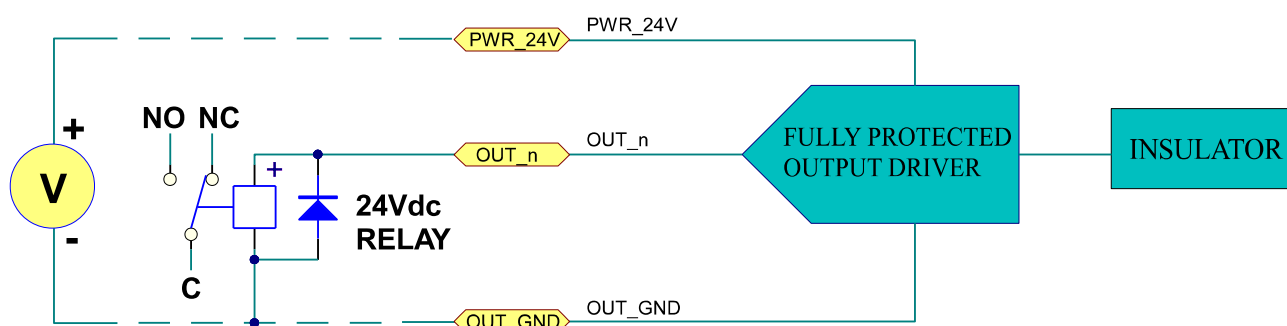


### 4.13.2 Digital outputs electrical connection

Example #1 : 24V signaling lamp



Example #2 : 24V relay





## 5.1 Jumper Description

---

**Introduction** Jumpers are available to configure some hardware options.

### 5.1.1 BOOT – Bootloader jumper

The jumper is connected to STM32 BOOT0 pin to activate the STM32 internal System Memory Bootloader for firmware programming. The jumper can be operated in THREE different ways:

|            |                                                                                                                                                                                    |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OPEN       | NORMAL OPERATION mode                                                                                                                                                              |
| CLOSED 1-2 | BOOT MODE is ACTIVE                                                                                                                                                                |
| CLOSED 2-3 | BOOT MODE depends on DIP1.9 position: <ul style="list-style-type: none"> <li>• DIP1.9 ON           BOOT MODE ACTIVE</li> <li>• DIP1.9 OFF         NORMAL OPERATION mode</li> </ul> |

During reset, STM32 BOOT pin is tied to GND by means of a pull-down resistor. For more information please refer to proper STM32 Microcontroller Reference Manual.

### 5.1.2 JMP5 – Termination resistor on CAN #1

Closing this jumper inserts a 120 Ohm resistor across the CAN #1 differential lines.

### 5.1.3 JMP6 – Termination resistor on CAN #2

Closing this jumper inserts a 120 Ohm resistor across the CAN #1 differential lines.

### 5.1.4 JMP7 – Encoder Power Supply voltage

This jumper is factory set to determine the Encoder Power Supply voltage (5V or 24V) available on connector CN9.

### 5.1.5 JMP8 – Output Hardware Watchdog protection

**This jumper must be left permanently OPEN for safety purposes** on 24V digital outputs. When open, the jumper enables an hardware watchdog functionality which prevents erratic behaviour of digital outputs. Outputs must be periodically refreshed (at least every 100 ms) by CPU; in case of microcontroller failure, the outputs are not refreshed and the hardware circuitry RESETS the outputs to their inactive state.

The jumper is provided to disable the watchdog feature during firmware debug. When jumper JMP8 is CLOSED, the output watchdog circuit is DISABLED.

### 5.1.6 JMP9 – PWM Outputs Voltage Level

The jumper selects the voltage level of Differential PWM Outputs.

The jumper is factory soldered at 5V, it can optionally be set in TWO different ways:

|            |                              |
|------------|------------------------------|
| CLOSED 1-2 | 5V PWM Differential Outputs  |
| CLOSED 2-3 | 24V PWM Differential Outputs |

### GaIA Jumpers - definition

| Name | Description                  |
|------|------------------------------|
| BOOT | STM32 Boot Loader activation |
| JMP5 | CAN #1 Termination resistor  |
| JMP6 | CAN #2 Termination resistor  |
| JMP7 | Encoder Power Supply voltage |
| JMP8 | Output Hardware Watchdog     |
| JMP9 | PWM Outputs Voltage Level    |

## 6 GaIA Installation

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This section describes how to install the GaIA device.  
Main activities are:



- Remove external package and visually inspect the provided device
- Setup and safe use of the controller
- Controller mounting
- Controller connection

### 6.1 Package removal, inspection and storage

---



**Please verify** that controller package contains all ordered parts; the label on the controller metal box should report the serial number, the version, and manufacture date.

**Please inspect** the controller: each problem caused by a not appropriate handling/delivery must be immediately submitted to producer.

**Please store** the controller in a place compliant with specified requirements.

### 6.2 Setup and safe use of the controller

---

#### Guide

GaIA device should be installed only by qualified personnel who are fully familiar with this manual content. Setup instruction should be followed and approved and any doubt about it should be clarified in advance with GaIA device supplier before any use.



*In no case TECNOLOGIX will be chargeable for direct or indirect damages caused by an improper installation, setup, use or unauthorized modification of the GaIA device.*

To avoid personal damages or injury while working with the GaIA device, please:

- do not power on the GaIA device if the shell is not yet connected to PE protection ground (see appropriate connection point on CN1 connector).
- Verify that PE protection ground impedance is compliant with local security laws.
- do not connect anything directly to internal circuitry.
- avoid connecting or disconnecting anything while the GaIA device is powered on.



Please disconnect power before any setup or service operation.

## 6.3 Device fitting

---

**Environment** The environment where the GaIA device will fit should be clean, with no corrosive vapours, gases, or liquid. Please avoid device fitting in places where vapours or humidity should condense.

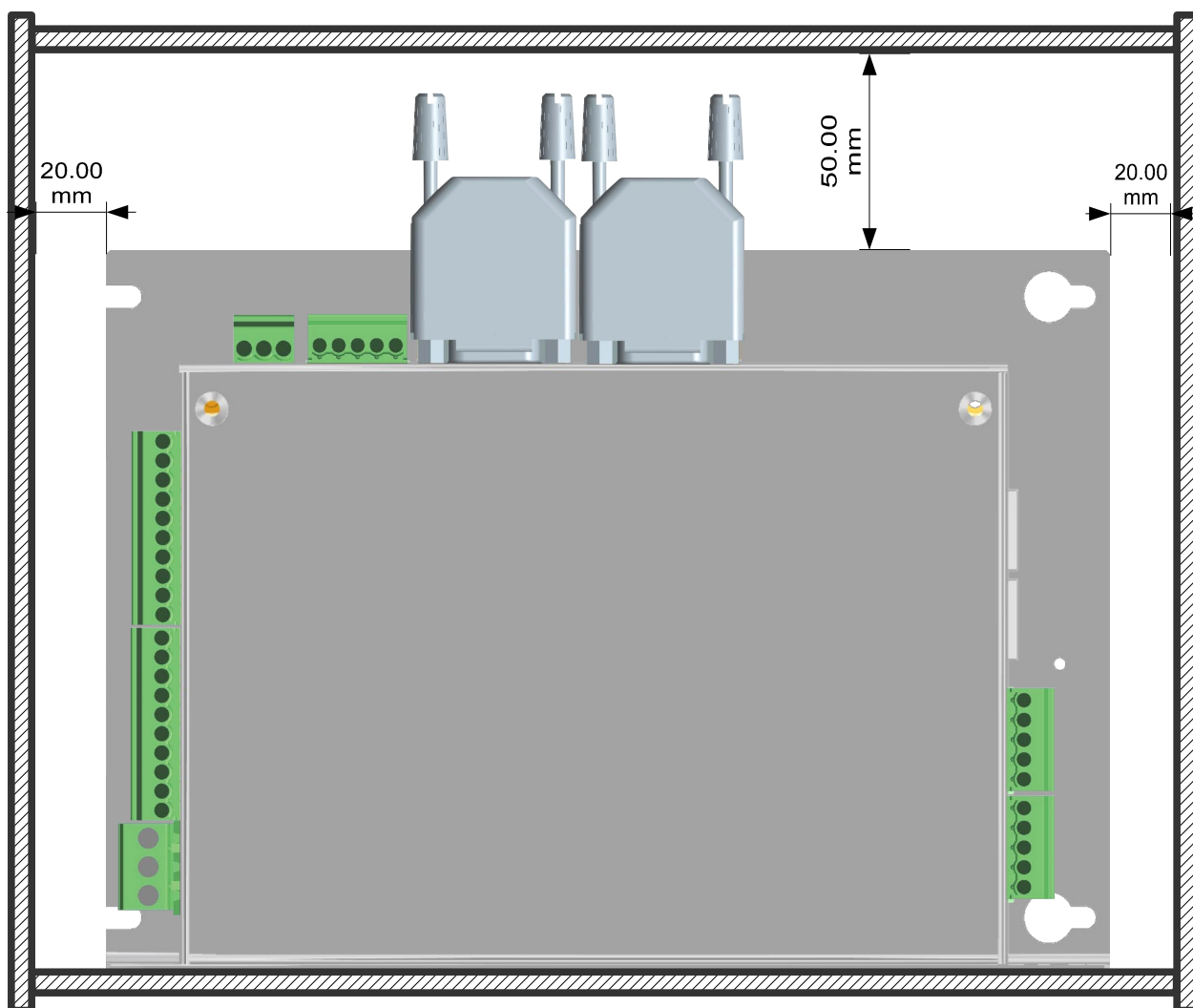
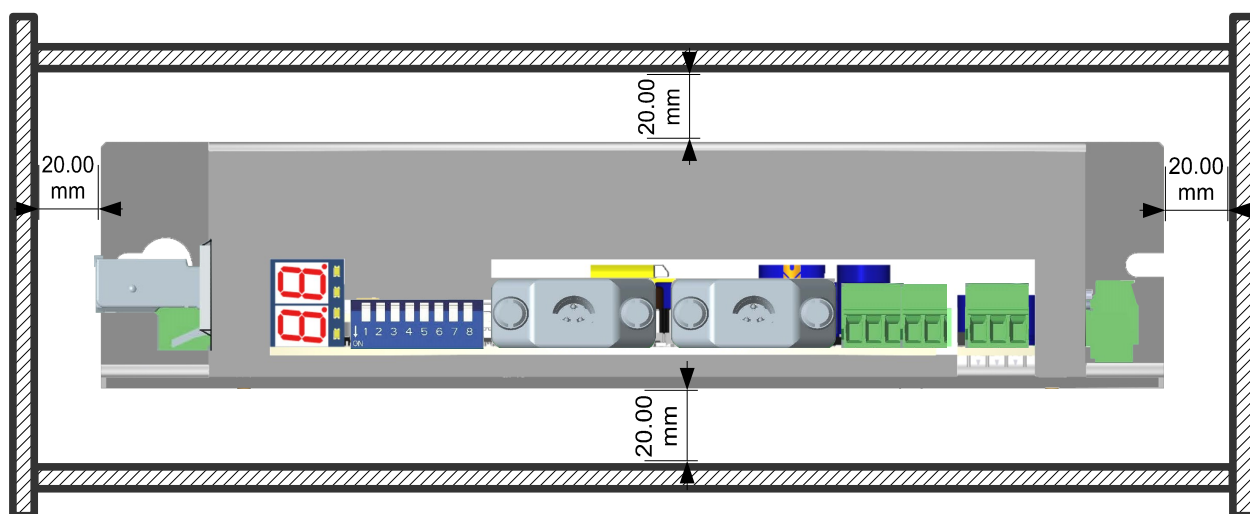


**Please verify** By fitting the GaIA device into a cabinet, please be sure that the air flow or the cooling system should be sufficient to keep GaIA device temperature below its maximum temperature ratings.  
*Current laws on safety must be considered as a design requirement for the device installation.*

**Installation Guide** Device installation should satisfy at least following requirements:

- Keep device vertical
- Avoid excessive vibrations or mechanical shocks
- Leave enough free room to allow air flows on device top and bottom

**Cooling** Device cooling is guaranteed by its metal box surfaces; please optimize thermal flow between those surfaces and the environment so that internal temperature is always kept below its maximum temperature ratings.

**Minimum distances**

## 6.4 GaIA wiring

---

GaIA available connectors and possible wiring:

|             |                                        |
|-------------|----------------------------------------|
| <b>CN1</b>  | DC Input Supply + Protection Ground PE |
| <b>CN2</b>  | CAN #1                                 |
| <b>CN3</b>  | CAN #2 (*)                             |
| <b>CN4</b>  | RS232/485(*) #1                        |
| <b>CN5</b>  | RS232/485(*) #2                        |
| <b>CN6</b>  | Digital Inputs/Encoder(*)              |
| <b>CN7</b>  | Digital Outputs                        |
| <b>CN8</b>  | USB OTG Full Speed (*)                 |
| <b>CN9</b>  | Encoder Power Supply (*)               |
| <b>CN10</b> | Ethernet #1 (*)                        |
| <b>CN11</b> | Ethernet #2 (*)                        |
| <b>CN12</b> | PWM Outputs (*)                        |

(\*) features depending on specific GaIA device version.

### **Wiring is specific for a given application**

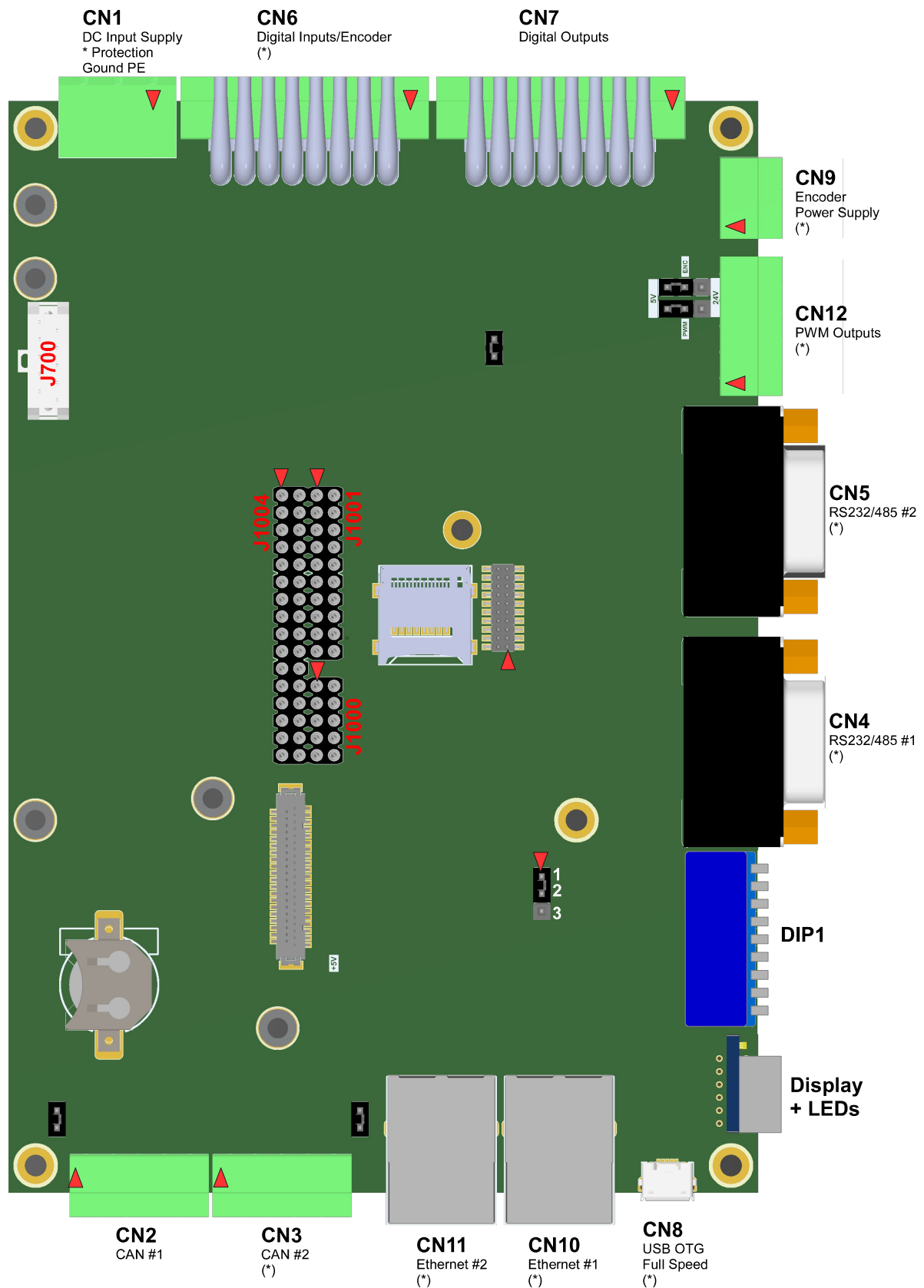


Wiring rules and protection ground connection and shielding techniques should be appropriate for most applications.

A good noise immunity could be obtained by twisting and shielding electric cables.  
Further improvements could be obtained by separating signal and power lines.

*Local laws on electrical safety, special working conditions and specific cabling standards should have precedence on information reported in this manual.*

## Connector location



## 7 GaIA start up

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This section provides information on how to startup GaIA controller.

User should:

- check the installation
- provide GaIA controller maintenance.

### 7.1 Check the installation

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#### **Before starting it up**

- Please check that GaIA device version is the correct/desired one
- Please check that controller setup satisfies software application requirements
- Please check that wiring and mounting have been performed in the correct way

### 7.2 Maintenance

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GaIA device is designed to reduce maintenance operations to the minimum, such as regular removal of dust from heat sinks by mean of filtered, dry and low pressure air flow.

### 7.3 Signals and working conditions

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#### **Signals**

GaIA device current state/operating condition is displayed by means of a 7-segment display.



Please refer to software manual for the meaning of specific application signals.

### 7.4 Troubleshooting

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Please use provided protection state diagram and troubleshooting table to locate the problem and solve it. If correct device operations are not restored, please contact TECNOLOGIX service department.



If not sure about GaIA device operations, prior to replace it please check that installation and provided power supply are those needed for device correct operations.

Attempts to solve a problem by simply replacing the supposed faulty unit are not a good practice in troubleshooting.



When normal operation conditions have been restored, please start up the system (GaIA device and controlled system) in order to avoid dangerous situations.

If the problem cannot be solved, please send an e-mail to TECNOLOGIX technical support, including following information:

- GaIA device version (GaIA-xxxx) and serial number, as printed on the label placed on the metal box
- A full description of the problem, including working conditions in which the problem arose
- Any information about GaIA device setup, i.e. I/O connections, communication interfaces used and related network topology, if any, etc.)
- Nominal and measured power supply voltage and characteristics (i.e. ripple)

Any information about additional devices connected to GaIA (data exchanged, connection diagram, etc.)

### Troubleshooting table

| Simptoms                                          | Consequent action                                                                                                                                                                                            |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No effects are observed on the controller system. | <ul style="list-style-type: none"> <li>• Please check power supply wiring, fuse integrity and, if previous checks are ok, verify that power supply voltage is within allowed range and tolerances</li> </ul> |
| User program does not run                         | <ul style="list-style-type: none"> <li>• Please check wirings and power supplies.</li> <li>• Please check software manual</li> </ul>                                                                         |
| No data exchange on communication lines           | <ul style="list-style-type: none"> <li>• Please check wirings and power supplies.</li> <li>• Please check software manual</li> </ul>                                                                         |
| Digital outputs do not work                       | <ul style="list-style-type: none"> <li>• Please check digital outputs wirings and power supplies</li> <li>• Please check software manual</li> </ul>                                                          |
| Data on digital inputs is not read properly       | <ul style="list-style-type: none"> <li>• Please check digital input wirings, in particular the Vss signal cable</li> <li>• Please check software manual</li> </ul>                                           |

## 7.5 Return Procedure for defective units

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In order to process return deliveries quickly and smoothly, please apply for a RMA number (see also RMA number request) before shipping back.

Please label the outside of the shipping package as well as all shipping documents with the RMA number.

After applying a RMA number, you will automatically receive the delivery note together with the RMA number from TECNOLOGIX.

TECNOLOGIX reserves the right to refuse the reception of deliveries without valid RMA or incomplete shipping documents.

Freight costs will be at the expense of the customer.

### 7.5.1 RMA number request

To apply for a RMA number please use our RMA form on our website:

<http://www.tecnologix.it/rma/>

Please provide a detailed problem description with each serial board to assist the repair staff. ("defective" is not sufficient).

As soon as we verified the data, your RMA number will be generated.

You will receive a return delivery note form by e-mail.

### 7.5.2 Return for repair

- Please send the device together with the return delivery note to the address mentioned above.
- The signed return delivery form including all necessary information must be enclosed with the consignment. Return deliveries without a detailed description of the defect cannot be processed.
- Please label the outside of the shipping package with the RMA number.
- The product to be repaired must be packed correctly according to ESD guidelines. Please use the original packaging if possible.
- All deliveries to TECNOLOGIX have to be paid by the customer. TECNOLOGIX will refuse the reception of unpaid deliveries.

### 7.5.3 Repair costs

- TECNOLOGIX is entitled to reimbursement of costs if you report what you believe to be a defect without being able to prove it to be so.
- TECNOLOGIX will charge the customer for the repair of damages which are caused by the customer through the misuse of the product, even if the product is still under warranty.
- A repair of a minimal value is performed and charged to the customer without a previous cost estimation. If a cost estimation is required in any

case, the customer has to specify this in writing within the RMA form. This can lead to a longer repair time than usually specified by TECNOLOGIX.

- For extensive damages, TECNOLOGIX will automatically send a quote before the repair.

## 8 GaIA versions and specifications

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This section describes characteristics of available GaIA versions.



Information provided in this section supersedes GaIA general specifications previously reported.

### 8.1 Device coding and order information

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DEVICE CODING TABLE

TBD

## 9 GaIA v.2.04 STM32 pin reference

|                |             |                        |        |
|----------------|-------------|------------------------|--------|
| GaIA v.2.04    | CPU         | STM32H743ZI            |        |
|                | Clock       | 50 Mhz                 |        |
|                |             |                        |        |
| Subsystem      | Signal Name | Port                   | Type   |
| USB            |             |                        |        |
|                | USB_PWR     | PG8 (0 = POWER ON)     | OUT PP |
|                | USB_OVRCR   | PF11 (0 = OVERCURRENT) | IN     |
|                | OTG_FS_DP   | PA12                   | SF     |
|                | OTG_FS_DM   | PA11                   | SF     |
|                | OTG_FS_ID   | PA10                   | SF     |
|                | OTG_FS_VBUS | PA9                    | SF     |
| CAN1           |             |                        |        |
|                | CAN1_Tx     | PB9                    | SF     |
|                | CAN1_Rx     | PB8                    | SF     |
| CAN2           |             |                        |        |
|                | CAN2_Tx     | PB13                   | SF     |
|                | CAN2_Rx     | PB12                   | SF     |
| SER1           |             |                        |        |
|                | USART6_Tx   | PC6                    | SF     |
|                | USART6_Rx   | PG9                    | SF     |
|                | SER1_RTS    | PB2 (1 = ENABLE 485)   | OUT PP |
| SER2           |             |                        |        |
|                | USART3_Tx   | PD8                    | SF     |
|                | USART3_Rx   | PD9                    | SF     |
|                | SER2_RTS    | PG6 (1 = ENABLE 485)   | OUT PP |
| SD Card        |             |                        |        |
|                | SD_CMD      | PD2                    | SF     |
|                | SD_CK       | PC12                   | SF     |
|                | SD_DAT0     | PC8                    | SF     |
|                | SD_DAT1     | PC9                    | SF     |
|                | SD_DAT2     | PC10                   | SF     |
|                | SD_DAT3     | PC11                   | SF     |
| Ethernet       |             |                        |        |
|                | Single PHY  | DP83848JSQ @50 Mhz     |        |
|                | Dual PHY    | KSZ8863RLLI @50 Mhz    |        |
|                | RMII_REFCLK | PA1                    | SF     |
|                | RMII_MDC    | PC1                    | SF     |
|                | RMII_MDIO   | PA2                    | SF     |
|                | RMII CRS_DV | PA7                    | SF     |
|                | RMII_TXD0   | PG13                   | SF     |
|                | RMII_TXD1   | PG14                   | SF     |
|                | RMII_RXD0   | PC4                    | SF     |
|                | RMII_RXD1   | PC5                    | SF     |
|                | RMII_TXEN   | PG11                   | SF     |
| Eeprom I2C bus |             |                        |        |
|                | Chip        | 24LC16                 |        |
|                | I2C1_SDA    | PB7                    | I/O OD |
|                | I2C1_SCL    | PB6                    | I/O OD |

|               |                  |                        |            |
|---------------|------------------|------------------------|------------|
| GaIA v.2.04   |                  |                        |            |
| Subsystem     | Signal Name      | Port                   | Type       |
| ENCODER       |                  |                        |            |
|               | ENC1A            | PD12 (TIM4_CH1)        | IN         |
|               | ENC1B            | PD13 (TIM4_CH2)        | IN         |
|               | ENC1C            | PB4 (TIM3_CH1)         | IN         |
|               | ENC1D            | PC7 (TIM3_CH2)         | IN         |
| IOBUS         |                  |                        |            |
|               | BUS_LD           | PG15                   | OUT PP     |
|               | BUS_ID/VERS      | PF10 (SEE VERS. TABLE) | OUT PP     |
|               | BUS_RST/XVERS    | PF9 (SEE VERS. TABLE)  | OUT PP     |
|               | SPI1_MISO        | PA6                    | IN         |
|               | SPI1_MOSI        | PB5                    | OUT PP     |
|               | SPI1_SCK         | PA5                    | OUT PP     |
| SPI2          |                  |                        |            |
|               | SPI2_MISO        | PC2                    | IN         |
|               | SPI2_MOSI        | PC3                    | OUT PP     |
|               | SPI2_SCK         | PB10                   | OUT PP     |
| PWM Output    |                  |                        |            |
|               | PWM1_OUT         | PE5 (TIM9_CH1)         | OUT PP     |
|               | PWM2_OUT         | PE6 (TIM9_CH2)         | OUT PP     |
| OTHER         |                  |                        |            |
|               | XVERSION         | PF9 (SEE VERS. TABLE)  | ANALOG IN  |
|               | VERSION          | PF10 (SEE VERS. TABLE) | ANALOG IN  |
|               | POWERFAIL        | PC13 (0 = 24V OK)      | IN         |
|               | OSC32_IN         | PC14                   | OSC 32 Khz |
|               | OSC32_OUT        | PC15                   | OSC 32 Khz |
|               |                  |                        |            |
| Types Legenda |                  |                        |            |
|               |                  |                        |            |
| IN            | Input            |                        |            |
| ANALOG IN     | Analog Input     |                        |            |
| I/O PP        | I/O Push Pull    |                        |            |
| I/O OD        | I/O Open Drain   |                        |            |
| OUT PP        | Output Push Pull |                        |            |
| SF            | Special Function |                        |            |

| GaIA v.2.04 EXPANSION CONNECTORS |            |           |     |         |           |
|----------------------------------|------------|-----------|-----|---------|-----------|
| J1000                            | EXP SUPPLY |           |     |         |           |
| Pin                              | Signal     | Alt Func  | Pin | Signal  | Alt Func  |
| 1                                | +5V        |           | 2   | +5V     |           |
| 3                                | +3V3       |           | 4   | +3V3    |           |
| 5                                | GND        |           | 6   | GND     |           |
| 7                                | AGND       |           | 8   | AGND    |           |
| 9                                | +A3V3      |           | 10  | +A3V3   |           |
| J1001                            | EXP ANALOG |           |     |         |           |
| Pin                              | Signal     | Alt Func  | Pin | Signal  | Alt Func  |
| 1                                | +5V        |           | 2   | +5V     |           |
| 3                                | +3V3       |           | 4   | +3V3    |           |
| 5                                | GND        |           | 6   | GND     |           |
| 7                                | PF6        |           | 8   | PA0     |           |
| 9                                | PF7        |           | 10  | PA3     |           |
| 11                               | PF8        |           | 12  | PA4     |           |
| 13                               | PF9        | X_VERSION | 14  | PB0     |           |
| 15                               | PC0        |           | 16  | PB1     |           |
| 17                               | AGND       |           | 18  | AGND    |           |
| 19                               | +A3V3      |           | 20  | +A3V3   |           |
| J1004                            | EXP MISC   |           |     |         |           |
| Pin                              | Signal     | Alt Func  | Pin | Signal  | Alt Func  |
| 1                                | PB6        | I2C1_SCL  | 2   | PA8     |           |
| 3                                | PB7        | I2C1_SDA  | 4   | PA15    |           |
| 5                                | PE0        |           | 6   | PB3     |           |
| 7                                | PE1        |           | 8   | PB10    | SPI2_SCK  |
| 9                                | PE5        |           | 10  | PB11    |           |
| 11                               | PE6        |           | 12  | PB14    |           |
| 13                               | PE11       |           | 14  | PB15    |           |
| 15                               | PE12       |           | 16  | PD3     |           |
| 17                               | PE13       |           | 18  | PD10    |           |
| 19                               | PE14       |           | 20  | PD11    |           |
| 21                               | PE15       |           | 22  | PC13    | PFAIL     |
| 23                               | PG7        |           | 24  | PC2     | SPI2_MISO |
| 25                               | PG10       |           | 26  | PC3     | SPI2_MOSI |
| 27                               | PG12       |           | 28  | OSC1_5V |           |
| 29                               | NRESET     |           | 30  | RESET   |           |
| 31                               | GND        |           | 32  | GND     |           |

| GaIA v.2.04 EXPANSION CONNECTORS |        |            |            |     |        |            |            |
|----------------------------------|--------|------------|------------|-----|--------|------------|------------|
| J1003 HIROSE EXT BUS             |        |            |            |     |        |            |            |
| Pin                              | Signal | Alt Func 1 | Alt Func 2 | Pin | Signal | Alt Func 1 | Alt Func 2 |
| 1                                | PA8    | EC_IRQ     | MCO1       | 2   | PE2    | A23        | SPI2_SCK   |
| 3                                | PE11   | EC_SYN0    | TIM1_CH2   | 4   | PE4    | A20        | SPI2_MOSI  |
| 5                                | PE13   | EC_SYN1    | TIM1_CH3   | 6   | PE3    | A19        | SPI2_MISO  |
| 7                                | PE14   | EC_RST     | TIM1_CH4   | 8   | PD7    | CS         | USART2_CK  |
| 9                                | PD6    | BSY        | USART2_RX  | 10  | PD5    | NWE        | USART2_TX  |
| 11                               | PD4    | NOE        | USART2_RTS | 12  | PE10   | D7         | TIM1_CH2N  |
| 13                               | PE9    | D6         | TIM1_CH1   | 14  | PE8    | D5         | TIM1_CH1N  |
| 15                               | PE7    | D4         | TIM1_ETR   | 16  | PD1    | D3         | CAN1_TX    |
| 17                               | PD0    | D2         | CAN1_RX    | 18  | PD15   | D1         | TIM4_CH4   |
| 19                               | PD14   | D0         | TIM4_CH3   | 20  | PG5    | A15        |            |
| 21                               | PG4    | A14        |            | 22  | PG3    | A13        |            |
| 23                               | PG2    | A12        |            | 24  | PG1    | A11        |            |
| 25                               | PG0    | A10        |            | 26  | PF15   | A9         |            |
| 27                               | PF14   | A8         |            | 28  | PF13   | A7         |            |
| 29                               | PF12   | A6         |            | 30  | PF5    | A5         |            |
| 31                               | PF4    | A4         |            | 32  | PF3    | A3         |            |
| 33                               | PF2    | A2         | I2C2_SMBA  | 34  | PF1    | A1         | I2C2_SCL   |
| 35                               | PF0    | A0         | I2C2_SDA   | 36  | +5V    |            |            |
| 37                               | GND    |            |            | 38  | +5V    |            |            |
| 39                               | GND    |            |            | 40  | +5V    |            |            |
| 41                               | GND    |            |            |     |        |            |            |

| GaIA v.2.04 EXPANSION CONNECTORS |        |           |     |        |           |
|----------------------------------|--------|-----------|-----|--------|-----------|
| J700 I/O EXPANSION               |        |           |     |        |           |
| Pin                              | Signal | Alt Func  | Pin | Signal | Alt Func  |
| 1                                | +5VENC |           | 2   | +5VENC |           |
| 3                                | PF10   | BUS_ID    | 4   | PA5    | SPI1_SCK  |
| 5                                | PG15   | BUS_LD    | 6   | PF9    | BUS_RST   |
| 7                                | PA6    | SPI1_MISO | 8   | PB5    | SPI1_MOSI |
| 9                                | GNDENC |           | 10  | GNDENC |           |

| GaIA v.2.04 I2C bus Devices Address |             |
|-------------------------------------|-------------|
|                                     | Bit address |
| Eeprom 24C16                        | 1010xxxR    |