



# Industrial DC/DC CONVERTER MGDI-20 Standard Input : 20W POWER

Industrial Grade ■

## 2:1 Standard Input Single, Bi & Triple Outputs Metallic case - 1.500 VDC Isolation



- Nominal power up to 20 W without derating
- Wide temperature range : -40°C/+ 95°C case
- High efficiency (typ. 83%)
- Soft start
- Galvanic isolation 1.500 VDC
- Integrated LC EMI filter
- Permanent short circuit protection
- No optocoupler for high reliability
- RoHS process

### 1-General

The MGDI-20 series is a complete line of DC/DC power modules designed for use in distributed power architecture and are particularly suitable for mobile or ground fixed applications in transportation, industrial and telecommunication areas. These modules use a high frequency fixed switching technic at 480KHz providing excellent reliability, low noise characteristics and high power density. Standard models are available with standard input voltage range of 4,5-5,5 or 18-36 volts. The series include single, bi and triple output voltage choices of 3,3 , 5, 12, 15 volts.

No external heatsink is required for the MGDI-20 series to supply 20W output power over the full temperature range.

The MGDI-20 series is designed in conformity with safety standards EN60950 and UL1950.

All the modules are designed with LC network filters to minimize reflected input current ripple and output voltage ripple according to EN55022 and FCC Part 15J standard.

The modules include a soft-start, an input undervoltage lock-out, a permanent short circuit protection and an output overvoltage protection to ensure efficient module protections. The soft-start allows current limitation and eliminates inrush current during start-up. The short circuit protection completely protects the modules against short-circuits of any duration by a shut-down and restores to normal when the overload is removed.

The design has been carried out with surface mount components and is manufactured in a fully automated process to guarantee high quality. Each module is tested with a GAIA Converter automated test equipment.

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### 2-Product Selection

Single output model : MGDSI - 20 -  input -  output  
 Bi output model : MGDBI - 20 -  input -  output  
 Triple output model : MGDTI - 20 -  input -  output

| Input Voltage Range |
|---------------------|
| <b>Permanent</b>    |
| C : 4,5-5,5 VDC     |
| I : 18-36 VDC       |

| Output                     |
|----------------------------|
| B : 3.3 VDC                |
| C : 5 VDC or +/-5VDC       |
| E : 12 VDC or +/-12VDC     |
| F : 15 VDC or +/-15VDC     |
| BE : 3,3 VDC and +/-12 VDC |
| BF : 3,3 VDC and +/-15 VDC |
| CE : 5 VDC and +/-12 VDC   |
| CF : 5 VDC and +/-15 VDC   |



## 3- Electrical Specifications

Data are valid at +25°C, unless otherwise specified.

| Parameter                                     | Conditions   | Limit or typical | Units | Single Output MGDSI-20 |         |                    |
|---|--|------------------|-------|------------------------|---------|--------------------|
|   |  |                  |       | 20 - C                 | 20 - I  |                    |
| <b>Input</b>                                  |  |                  |       |                        |         |                    |
| Nominal input voltage                         | Full temperature range                                 | Nominal          | VDC   | 5                      | 24      |                    |
| Permanent input voltage range (Ui)            | Full temperature range                                 | Min. - Max.      | VDC   | 4,5- 5,5               | 18- 36  |                    |
| Undervoltage lock-out (UVLO)                  | turn-on/turn-off threshold                             | Minimum          | VDC   | 4                      | 16      |                    |
|   |  | Maximum          | VDC   | 4,5                    | 17,5    |                    |
| Start up time                                 | Ui nominal   | Maximum          | ms    | 40                     | 40      |                    |
|   | Nominal output<br>Full load : resistive                |                  |       |                        |         |                    |
| Reflected ripple current                      | Ui nominal, full load at switching freq.<br>BW = 20MHz | Typical          | mApp  | 50                     | 50      |                    |
| Input current in short circuit mode (Average) | Ui nominal<br>Short-circuit                            | Maximum          | mA    | 100                    | 60      |                    |
| No load input current                         | Ui nominal<br>No load                                  | Maximum          | mA    | 100                    | 60      |                    |
| <b>Output</b>                                 |  |                  |       |                        |         |                    |
| Output voltage *                              | Full temperature range                                 | Nominal          | VDC   | 3,3                    | 3,3     |                    |
|   | Ui min. to max.  | Nominal          | VDC   | 5                      | 5       |                    |
|   | 75% load   | Nominal          | VDC   | 12                     | 12      |                    |
|   |  | Nominal          | VDC   | 15                     | 15      |                    |
| Set Point accuracy                            | Ambient temperature : +25°C<br>Ui nominal, 75% load    | Maximum          | %     | +/- 2                  | +/- 2   |                    |
| Output power                                  | Full temperature range<br>Ui min. to max.              | Maximum          | W     | 20                     | 20      |                    |
| Output current                                | Full temperature range<br>Ui min. to max.              | Maximum          | A     | 4                      | 4       |                    |
|   |  | Maximum          | A     | 4                      | 4       |                    |
|   |  | Maximum          | A     | 1,6                    | 1,6     |                    |
|   |  | Maximum          | A     | 1,3                    | 1,3     |                    |
| Ripple output voltage **                      | Ui nominal<br>Full load<br>BW = 20MHz                  | Maximum          | mVpp  | 50                     | 50      |                    |
|   |  | Maximum          | mVpp  | 100                    | 100     |                    |
|   |  | Maximum          | mVpp  | 150                    | 150     |                    |
|   |  | Maximum          | mVpp  | 150                    | 150     |                    |
| Line regulation                               | Ui min. to max.<br>Full load                           | Typical          | %     | +/- 1                  | +/- 1   |                    |
| Load regulation ***                           | Ui nominal<br>25% to full load                         | Typical          | %     | +/- 2,5                | +/- 2,5 |                    |
| Efficiency                                    | Ui nominal<br>Full load                                | Typical          | %     | 79                     | 83      |                    |
| Maximum admissible Capacitive load            | Ui nominal<br>Full load<br>Per output                  | Maximum          | µF    | 2.000                  | 2.000   |                    |
|   |  |                  |       |                        |         | 3,3V and 5V output |
|   |  |                  |       |                        |         | 12V and 15V output |
|   |  | Maximum          | µF    | 680                    | 680     |                    |

Note \* : For proper operation the MGDI-20 module requires to install a 22µF chemical or tantalum capacitance across output terminals.

Note \*\*: The ripple output voltage is the periodic AC component imposed on the output voltage, an aperiodic and random component (noise) has also to be considered. This noise can be reduced by adding an external capacitor (typically 10nF/rated voltage depending on isolation requirement) connected between the pin Gin and the pin Gout of the converter. This capacitor should be layed-out as close as possible from the converter.

Note \*\*\* : For load regulation characteristics from 0% to full load, please contact factory.

## 3- Electrical Specifications (continued)

Data are valid at +25°C, unless otherwise specified.

| Parameter   | Conditions  | Limit or typical | Units | Bi Output MGDBI-20 - I |
|---|---|------------------|-------|------------------------|
| <b>Input</b>  |   |                  |       |                        |
| Nominal input voltage   | Full temperature range  | Nominal          | VDC   | 24                     |
| Permanent input voltage range (Ui)                                    | Full temperature range  | Min. - Max.      | VDC   | 18- 36                 |
| Undervoltage lock-out (UVLO)  | turn-on/turn-off threshold  | Minimum          | VDC   | 16                     |
|   |   | Maximum          | VDC   | 17,5                   |
| Start up time   | Ui nominal<br>Nominal output<br>Full load : resistive             | Maximum          | ms    | 40                     |
| Reflected ripple current  | Ui nominal, full load at switching freq.<br>BW = 20MHz            | Typical          | mApp  | 50                     |
| Input current in short circuit mode (Average)                         | Ui nominal<br>Short-circuit                                       | Maximum          | mA    | 60                     |
| No load input current   | Ui nominal<br>No load   | Maximum          | mA    | 60                     |
| <b>Output</b>   |   |                  |       |                        |
| Output voltage *  | Full temperature range<br>Ui min. to max.<br>75% load             | Nominal          | VDC   | +/- 5                  |
|   |   | Nominal          | VDC   | +/- 12                 |
|   |   | Nominal          | VDC   | +/- 15                 |
| Set Point accuracy  | Ambient temperature : +25°c<br>Ui nominal, 75% load               | Maximum          | %     | +/- 2                  |
| Output power  | Full temperature range<br>Ui min. to max.                         | Maximum          | W     | +/- 10                 |
| Output current<br>+/- 5V output<br>+/- 12V output<br>+/- 15V output   | Full temperature range<br>Ui min. to max.                         | Maximum          | A     | +/- 2                  |
|   |   | Maximum          | A     | +/-0, 80               |
|   |   | Maximum          | A     | +/- 0,65               |
| Ripple output voltage **<br>5V output<br>12V output<br>15V output     | Ui nominal<br>Full load<br>BW = 20MHz                             | Maximum          | mVpp  | 50                     |
|   |   | Maximum          | mVpp  | 100                    |
|   |   | Maximum          | mVpp  | 150                    |
|   |   | Maximum          | mVpp  | 150                    |
| Line regulation   | Ui min. to max.<br>Full load                                      | Typical          | %     | +/- 1                  |
| Load regulation ***   | Ui nominal<br>25% to full load                                    | Typical          | %     | +/- 2,5                |
| Cross load output regulation  | Ui nominal<br>+ Vout nominal load<br>- Vout from 25% to full load | Typical          | %     | +/- 0,5                |
| Efficiency  | Ui nominal<br>Full load   | Typical          | %     | 83                     |
| Maximum admissible Capacitive load<br>5V output<br>12V and 15V output | Ui nominal<br>Full load<br>Per output                             | Maximum          | µF    | 1.000                  |
|   |   | Maximum          | µF    | 330                    |
|   |   | Maximum          | µF    | 330                    |

Note \* : For proper operation the MGDI-20 module requires to install a 22µF chemical or tantalum capacitance across output terminals.

Note \*\*: The ripple output voltage is the periodic AC component imposed on the output voltage, an aperiodic and random component (noise) has also to be considered. This noise can be reduced by adding an external capacitor (typically 10nF/rated voltage depending on isolation requirement) connected between the pin Gin and the pin Gout of the converter. This capacitor should be layed-out as close as possible from the converter.

Note \*\*\* : For load regulation characteristics from 0% to full load, please contact factory.

### 3- Electrical Specifications (continued)

Data are valid at +25°C, unless otherwise specified.

| Parameter                                     | Conditions  | Limit or typical         | Units      | Triple Output MGDTI-20 - I |             |
|---|---|--------------------------|------------|----------------------------|-------------|
| <b>Input</b>                                  |   |                          |            |                            |             |
| Nominal input voltage                         | Full temperature range  | Nominal                  | VDC        | 24                         |             |
| Permanent input voltage range (Ui)            | Full temperature range  | Min. - Max.              | VDC        | 18- 36                     |             |
| Undervoltage lock-out (UVLO)                  | turn-on/turn-off threshold  | Minimum                  | VDC        | 16                         |             |
|   |   | Maximum                  | VDC        | 17,5                       |             |
| Start up time                                 | Ui nominal<br>Nominal output<br>Full load : resistive             | Maximum                  | ms         | 40                         |             |
| Reflected ripple current                      | Ui nominal, full load at switching freq.<br>BW = 20MHz            | Typical                  | mApp       | 50                         |             |
| Input current in short circuit mode (Average) | Ui nominal<br>Short-circuit                                       | Maximum                  | mA         | 60                         |             |
| No load input current                         | Ui nominal<br>No load   | Maximum                  | mA         | 60                         |             |
| <b>Output</b>                                 |   |                          |            |                            |             |
| Output voltage *                              | Full temperature range  | Nominal                  | VDC        | 3,3 & +/- 12               |             |
|   | Ui min. to max.   | Nominal                  | VDC        | 3,3 & +/- 15               |             |
|   | 75% load  | Nominal                  | VDC        | 5 & +/- 12                 |             |
|   |   | Nominal                  | VDC        | 5 & +/- 15                 |             |
| Set Point accuracy                            | Ambient temperature : +25°C<br>Ui nominal, 75% load               | Maximum                  | %          | +/- 2                      |             |
| Output power                                  | Full temperature range<br>Ui min. to max.                         | Maximum                  | W          | 10 & 2 x 5                 |             |
| Output current                                | Full temperature range<br>Ui min. to max.                         | 3,3V & +/- 12V output    | Maximum    | A                          | 2 & +/- 0,4 |
|   |   | 3,3V & +/- 15V output    | Maximum    | A                          | 2 & +/- 0,3 |
|   |   | 5V & +/- 12V output      | Maximum    | A                          | 2 & +/- 0,4 |
|   |   | 5V & +/- 15V output      | Maximum    | A                          | 2 & +/- 0,3 |
|   |   | Ripple output voltage ** | Ui nominal | Maximum                    | mVpp        |
| 3,3V and 5V output                            | Full load<br>BW = 20MHz   | Full load                | Maximum    | mVpp                       | 100         |
|   |   | 12V output               | Maximum    | mVpp                       | 150         |
|   |   | 15V output               | Maximum    | mVpp                       | 150         |
| Line regulation                               | Ui min. to max.<br>Full load                                      | Typical                  | %          | +/- 1                      |             |
| Load regulation ***                           | Ui nominal<br>25% to full load                                    | Typical                  | %          | +/- 2,5                    |             |
| Cross load output regulation                  | Ui nominal<br>+ Vout nominal load<br>- Vout from 25% to full load | Typical                  | %          | +/- 0,5                    |             |
| Efficiency                                    | Ui nominal<br>Full load   | Typical                  | %          | 83                         |             |
| Maximum admissible Capacitive load            | Ui nominal<br>Full load<br>Per output                             | Maximum                  | µF         | 3,3V and 5V output         | 1.000       |
|   |   |                          |            | 12V and 15V output         | 100         |

Note \* : For proper operation the MGDI-20 module requires to install a 22µF chemical or tantalum capacitance across output terminals.

Note \*\*: The ripple output voltage is the periodic AC component imposed on the output voltage, an aperiodic and random component (noise) has also to be considered. This noise can be reduced by adding an external capacitor (typically 10nF/rated voltage depending on isolation requirement) connected between the pin Gin and the pin Gout of the converter. This capacitor should be layed-out as close as possible from the converter.

Note \*\*\* : For load regulation characteristics from 0% to full load, please contact factory.

## 4- Switching Frequency

| Parameter           | Conditions  | Limit or typical | Specifications |
|---------------------|---|------------------|----------------|
| Switching frequency | Full temperature range<br>Ui min. to max.<br>No load to full load | Nominal, fixed   | 480 KHz        |

## 5- Isolation

| Parameter  | Conditions       | Limit or typical | Specifications    |
|--|------------------|------------------|-------------------|
| Electric strength test voltage   | Input to output  | Minimum          | 1.500 VDC / 1 min |
| Electric strength test voltage between outputs (for dual and triple outputs) | Output to output | Minimum          | No isolation      |
| Isolation resistance   | 500 VDC          | Minimum          | 100 MOhm          |

## 6- Protection Functions

| Characteristics                       | Protection Device                            | Recovery           | Limit or typical                         | Specifications   |
|---------------------------------------|--|--------------------|--|--|
| Input undervoltage lock-out (UVLO)    | Turn-on, turn-off circuit with no hysteresis | Automatic recovery | Threshold                                | See section 3  |
| Output short circuit protection (SCP) | Hiccup circuitry with auto-recovery          | Automatic recovery | Permanent                                | See section 11   |
| Output overvoltage protection (OVP)   | Zener clamp                                  | /                  | Maximum<br>Maximum<br>Maximum<br>Maximum | For 3.3v : 4v<br>For 5v : 6v<br>For 12v : 14v<br>For 15v : 17v |

## 7- Reliability Data

| Characteristics  | Conditions         | Temperature                  | Specifications             |
|--|--------------------|------------------------------|----------------------------|
| Mean Time Between Failure (MTBF)<br>According to MIL-HDBK-217F | Ground fixed (Gf)  | Case at 40°C<br>Case at 70°C | 750.000 Hrs<br>320.000 Hrs |
|  | Ground mobile (Gm) | Case at 40°C<br>Case at 70°C | 208.000 Hrs<br>85.000 Hrs  |
| Mean Time Between Failure (MTBF)<br>According to IEC-62380-TR  | Telecom switchers  | /                            | Consult factory            |

## 8- Electromagnetic Interference

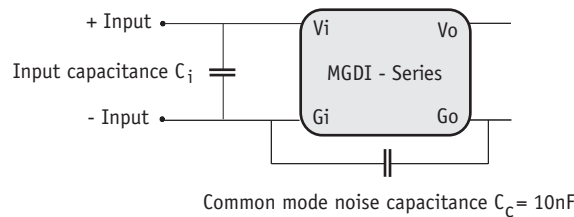
Electromagnetic interference requirements according to EN55022 class A and class B can be easily achieved as indicated in the following table :

| Electromagnetic Interference according to EN55022 |                       |  |  |
|---|-----------------------|--|--|
| Conducted noise emission                          | Configuration         | With common mode capacitor $C_c = 10\text{nF}$ and input capacitor $C_i$ | With common mode capacitor $C_c = 10\text{nF}$ and external filter |
|   | Models                |  |  |
|   | 4,5-5,5V input models | Class A, $C_i = 10\mu\text{F} / 35\text{ V tantalum}$                    | Class B  |
|   | 18-36V input models   | Class A, $C_i = 4.7\mu\text{F} / 50\text{ V tantalum}$                   | Class B  |
| Radiated noise emission                           | Configuration         | With common mode capacitor $C_c = 10\text{ nF}$                          |  |
|   | Models                | Class B  |  |
|   | All models            | Class B  |  |

### 8-1 Module Compliance with EN55022 class A Standard

Electromagnetic interference requirements according to EN55022 class A can be easily achieved by adding an external input capacitance ( $C_i$  Value explained in previous table) and a common mode noise capacitance

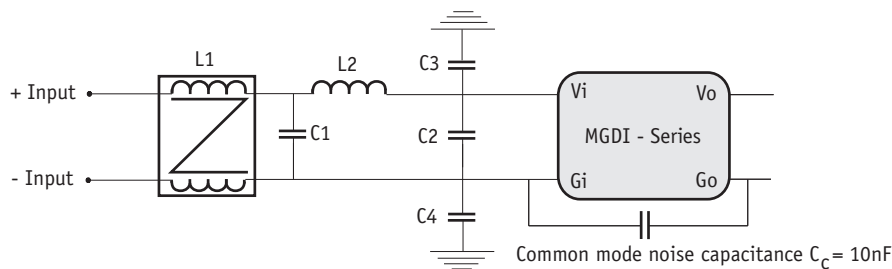
$C_c$  (10 nF/rated voltage depending on isolation requirement) connected between  $G_{in}$  and  $G_{out}$ . This common mode noise capacitance  $C_c$  should be laid-out as close as possible from the DC/DC converter.



### 8-2 Module Compliance with EN 55022 Class B Standard

Electromagnetic interference requirements according to EN55022 class B can be easily achieved by adding an external input filter consisting of 4 capacitances, a common mode choke, and a differential

mode inductance, together with a common mode noise capacitance (10 nF/rated voltage depending on isolation requirement) connected between  $G_{in}$  and  $G_{out}$ . Please consult EN55022 Class B EMI Filter design note for further details.



## 9- Thermal Characteristics

| Characteristics                                  | Conditions   | Limit or typical   | Performances      |
|--|--|--------------------|-------------------|
| Operating ambient temperature range at full load | Ambient temperature *                              | Minimum<br>Maximum | - 40°C<br>+ 71°C  |
| Operating case temperature range at full load    | Case temperature                                   | Minimum<br>Maximum | - 40°C<br>+95°C   |
| Storage temperature range                        | Non functioning                                    | Minimum<br>Maximum | - 40°C<br>+ 105°C |
| Thermal resistance                               | Rth case to ambient in free air natural convection | Typical            | 7°C /W            |

Note \*: The upper temperature range depends on configuration, the user must assure a max. case temperature of + 95°C.

The MGDI-20 series operating **case** temperature must not exceed 95°C. The maximum **ambient** temperature admissible for the DC/DC converter corresponding to the maximum operating case temperature of 95°C depends on the ambient airflow, the mounting/orientation, the cooling features and the power dissipated.

To calculate a maximum admissible ambient temperature the following method can be used. Knowing the maximum case temperature Tcase = 95°C of the module, the power used Pout and the efficiency η :

- determine the power dissipated by the module P<sub>diss</sub> that should be evacuated :

$$P_{diss} = P_{out}(1/\eta - 1)$$

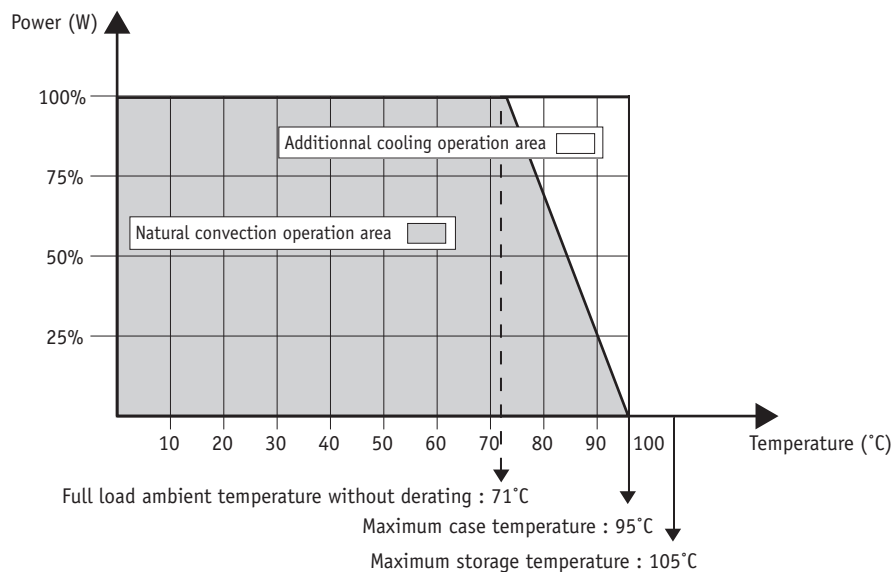
- determine the maximum ambient temperature :

$$T_a = 95^\circ\text{C} - R_{th} \times P_{diss}$$

where **Rth** is the thermal resistance from the case to ambient.

The previous thermal calculation shows two areas of operation :

- a normal operation area in a free natural ambient convection (grey area in this following graph),
- an area with cooling features (air flow or heatsink) ensuring a maximum case temperature below the maximum operating case temperature of 95°C (white area in the following graph).



## 10- Environmental Qualifications

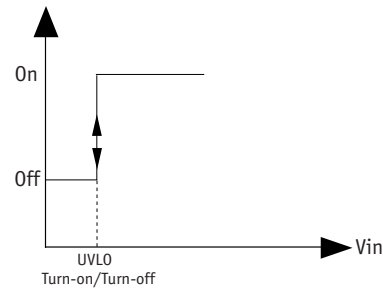
The modules have been subjected to the following environmental qualifications.

| Characteristics                           | Conditions   | Severity   | Test procedure                               |
|---|--|--|--|
| <b>Climatic Qualifications</b>            |  |  |  |
| Life at high temperature                  | Duration<br>Temperature<br>Status of unit  | 1.000 Hrs<br>95°C case<br>unit operating   | IEC 68-2-2                                   |
| Humidity steady                           | Damp heat<br>Temperature<br>Duration<br>Status of unit   | 93 % relative humidity<br>40°C<br>56 days<br>unit not operating  | IEC 68-2-3<br>Test Ca                        |
| Temperature cycling                       | Number of cycles<br>Temperature change<br>Transfert time<br>Steady state time<br>Status of unit                                | 200<br>-40°C / +71°C<br>40 min.<br>20 min.<br>unit not operating   | IEC 68-2-14<br>Test N                        |
| Temperature shock                         | Number of shocks<br>Temperature change<br>Transfert time<br>Steady state time<br>Status of unit                                | 50<br>-40°C / +105°C<br>10 sec.<br>20 min.<br>unit not operating   | IEC 68-2-14<br>Test Na                       |
| <b>Mechanical Qualifications</b>          |  |  |  |
| Vibration (Sinusoidal)                    | Number of cycles<br>Frequency : amplitude<br>Frequency : acceleration<br>Amplitude /acceleration<br>Duration<br>Status of unit | 10 cycles in each axis<br>10 to 60 Hz / 0.7 mm<br>60 to 2000 Hz / 10 g<br>0.7 mm/10 g<br>2h 30 min. per axis<br>unit not operating | IEC 68-2-6<br>Test Fc                        |
| Shock (Half sinus)                        | Number of shocks<br>Peak acceleration<br>Duration<br>Shock form<br>Status of unit  | 3 shocks in each axis<br>100 g<br>6 ms<br>1/2 sinusoidal<br>unit not operating   | IEC 68-2-27<br>Test Ea                       |
| Bump (Half sinus)                         | Number of bumps<br>Peak acceleration<br>Duration<br>Status of unit   | 2000 bumps in each axis<br>25 g<br>6 ms<br>unit not operating  | IEC 68-2-29<br>Test Eb                       |
| <b>Electrical Immunity Qualifications</b> |  |  |  |
| Electrical discharge susceptibility       | Number of discharges<br>Air discharge level<br>Contact discharge level<br>Air discharge level<br>Contact discharge level       | 10 positive & 10 negative discharges<br>4 kV : sanction A<br>2 Kk : sanction A<br>8 Kk : sanction B<br>4 kV : sanction B           | EN55082-2 with :<br>EN61000-4-2<br>IEC 801-2 |
| Electrical field susceptibility           | Antenna position<br>Electromagnetic field<br>Wave form signal<br>Frequency range   | at 1 m<br>10 V/m<br>AM 80%, 1 kHz<br>26 MHz to 1 GHz   | EN55082-2 with :<br>EN61000-4-3<br>IEC801-3  |
| Electrical fast transient susceptibility  | Burst form<br>Wave form signal<br>Impedance<br>Level 1<br>Level 3  | 5/50 ns<br>5 kHz with 15 ms burst duration period 300 ms<br>50 Ohm<br>0,5 kV : sanction A<br>2 kV : sanction B                     | EN55082-2 with :<br>EN61000-4-4<br>IEC801-4  |

## 11- Description of Protections

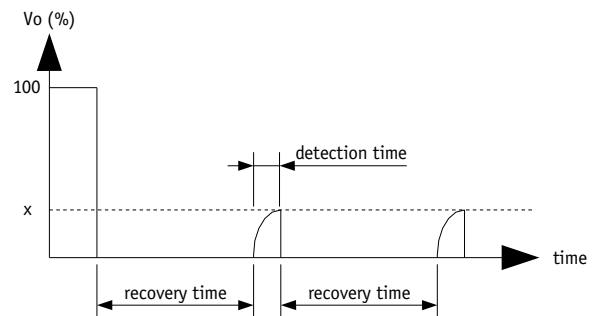
### 11-1 Input Undervoltage Lock-out (UVLO)

The input undervoltage lock-out protection device turns-on and turns-off the output voltage when the input bus voltage reaches the undervoltage lock-out threshold. There is no hysteresis cycle at turn-on and turn-off.



### 11-2 Output Short Circuit Protection (SCP)

The short circuit protection device protects the module against short circuit of any duration and restores the module to normal operation when the short circuit is removed. It operates in «hiccup» mode by testing periodically if an overload is applied (typically every 200ms recovery time). The overload detection threshold is typically 200% of maximum current and typically 300% of maximum current for 'C' input range series with a detection time lower than 5ms.



### 11-3 Output Overvoltage Protection (OVP)

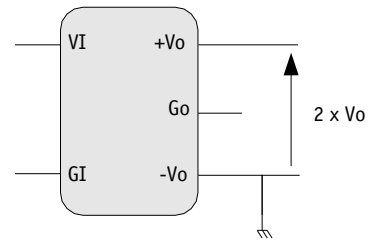
The output overvoltage protection device protects external components against high voltage or possible overvoltages which can be supplied by the module (i.e in case of internal failure). It consists of a zener diode clamping the output voltage; under worst case conditions this zener diode will short-circuit.

The output voltage protection is not designed to withstand externally applied output overvoltages to protect the module itself.

## 12- Application Notes

### 12-1 Connection of Outputs in Series

Any of the bi output converters can be configured to produce an output of 10V (+/-5 output models), 24V (+/-12V output models), or 30V (+/-15V output models) by connecting the load across the output (+) and the output (-) with either output grounded, and leaving the common pin floating.

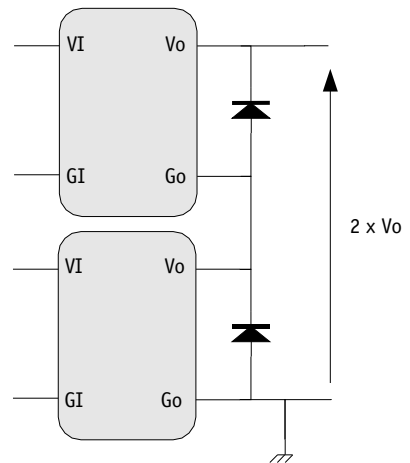


### 12-2 Connection of Modules in Series

The output of single output units can be connected in series without any precautions to provide higher output voltage level.

Nevertheless, GAIA Converter recommends to protect each individual output by a low power shottky diode rated with the maximum current of the converter to avoid reverse polarity at any output.

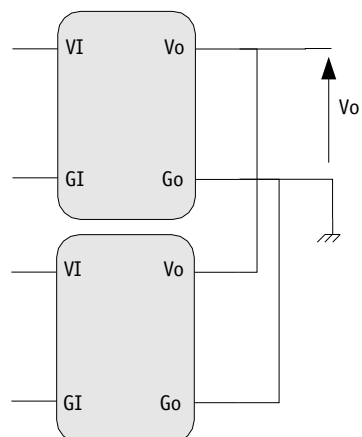
Reverse polarity may occur at start up if the output voltages do not rise at the same time.



### 12-3 Connection of Modules in Parallel

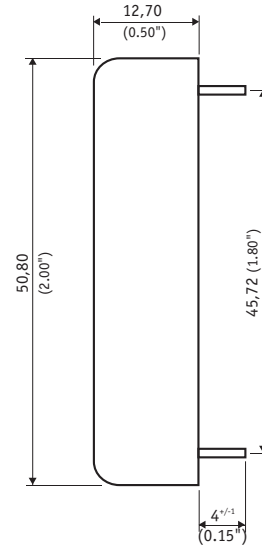
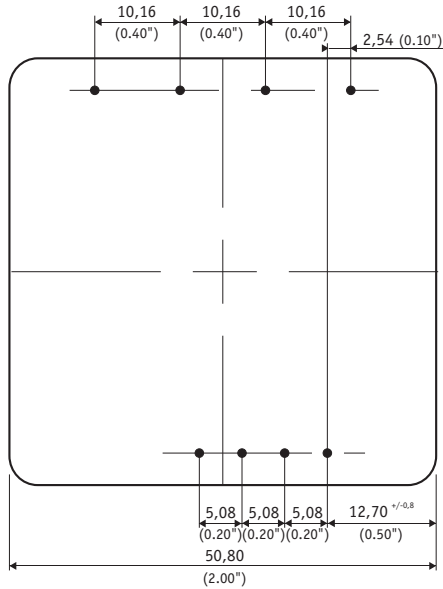
Several converters with equal output voltage can be connected in parallel to increase power. Nevertheless some cares have to be taken in particular as the output voltage of each converter is slightly different, when paralleling, the converter with the highest output voltage will source the most current.

However the GAIA Converter modules are designed with a "soft" output voltage versus current characteristic. This causes the output voltage of each converter to automatically adjust downward as its current increases so each converter very approximately shares the total output current. It is important that each converter has approximately the same impedance between their output and the common load.



## 13- Dimensions

Dimensions are given in mm (inches). Tolerance : +/- 0,2 mm (+/- 0.01 ") unless otherwise indicated.  
Weight : 80 grams (2.8 Ozs) max.



Pin dimensions :  $\varnothing$  0,83 mm (0.033 ")

## 14- Materials

Case : Matallic black painted coating.

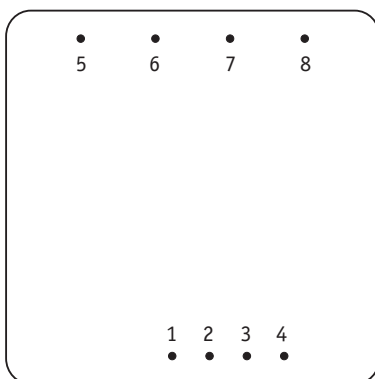
Pins : Plated with pure matte tin over nickel underplate.

## 15- Product Marking

Upper face : Company logo, location of manufacturing.

Side face : Module reference, option, date code : year and week of manufacturing.

## 16- Connections



Bottom view

| Pin | Single         | Bi             | Triple          |
|-----|----------------|----------------|-----------------|
| 1   | + Input (Vi)   | + Input (Vi)   | + Input (Vi)    |
| 2   | - Input (Gi)   | - Input (Gi)   | - Input (Gi)    |
| 3   | Case           | Case           | Case            |
| 4   | Do not connect | Do not connect | Do not connect  |
| 5   | Do not connect | Output + (+Vo) | Output 2+ (+V2) |
| 6   | Output (Vo)    | Common (Go)    | Output 1 (V1)   |
| 7   | Common (Go)    | Output - (-Vo) | Common (Go)     |
| 8   | Do not connect | Do not connect | Output 2- (-V2) |



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