



Hi-Rel DC/DC CONVERTER MGDM-35 : 35W POWER

Hi-Rel
Grade ■■

**4:1 Wide Input
Single, Bi & Triple Outputs
Metallic Case - 1 500 VDC Isolation**

- 28Vdc input compliant with MIL-STD-740A/D/E/F
- Nominal power up to 35 W
- Wide temperature range : -40°C/+105°C case
- High efficiency (typ. 84%)
- Soft start
- Galvanic isolation 1.500 VDC
- Integrated LC input filter
- Permanent short circuit protection
- External synchronisation
- External trim and sense adjustment : +/-5%
- No optocoupler for high reliability
- RoHS or Leaded process option



1-General

The MGDM-35 wide input series is a full family of DC/DC power modules designed for aerospace, military and high-end industrial applications. These modules use a high frequency fixed switching technic at 250KHz providing excellent reliability, low noise characteristics and high power density. Standard models are available with wide input voltage range of 9-36, and 16-75. The serie includes single, bi and triple output voltage choices of 3.3, 5, 12, 15 volts.

No external heatsink is required for the MGDM-35 series to supply 35W output power over the full temperature range. All the modules are designed with LC network filters to minimize reflected input current ripple and output voltage ripple .

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.

4

2-Product Selection

Single output model : MGDS - 35 - - / -
 Bi output model : MGDB - 35 - - / -
 Triple output model : MGDT - 35 - - / -

| Input Voltage Range | |
|---------------------|---------------|
| Permanent | Transient |
| H : 9-36 VDC | 40 VDC/100 ms |
| O : 16-75 VDC | 80 VDC/100 ms |

| 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 |

Options :
 /T : option for -55°C start up operating temperature
 /S : option for screening and serialization

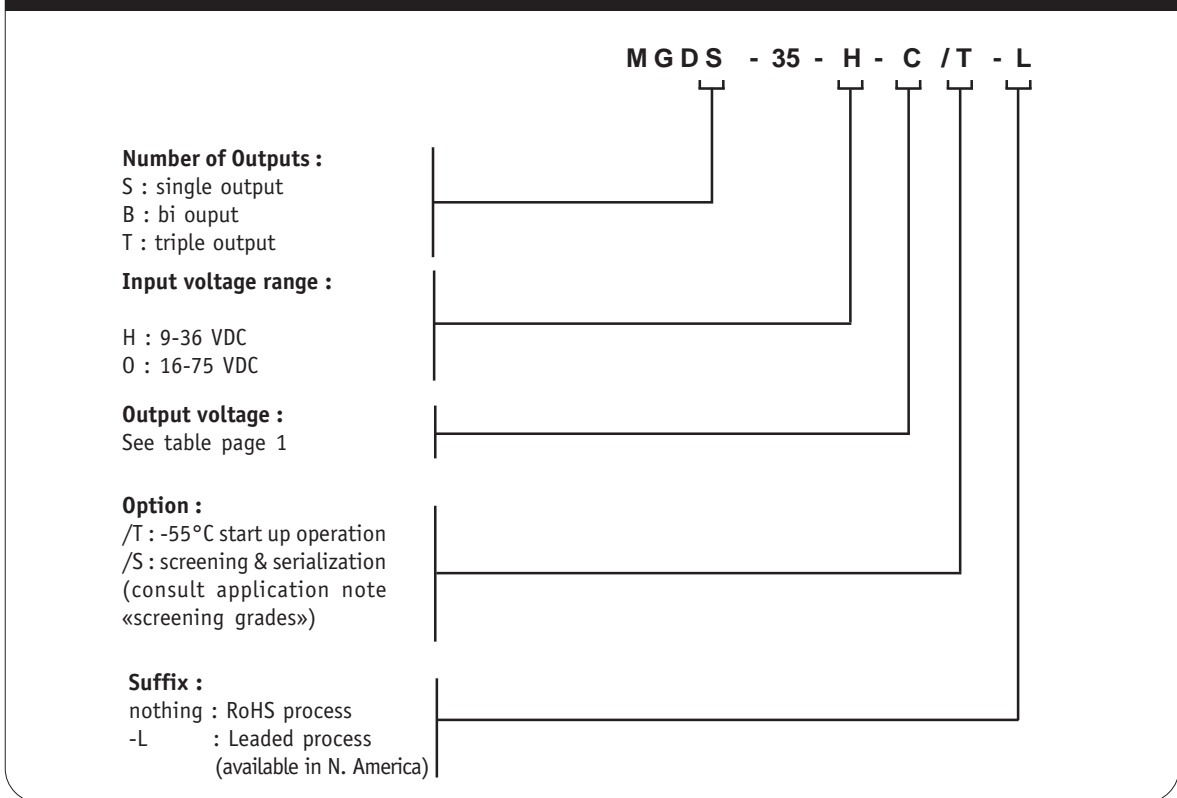
Suffix :
 nothing : RoHS process
 -L : leaded process (available in N. America)

2- Product Selection (continued)

| Input range | Output | Current | Reference | Options | Suffix |
|-------------|--------------------|------------------|--------------|---------|--------|
| 9-36 VDC | 3,3 VDC | 7 A | MGDS-35-H-B | /T, /S | -, -L |
| 9-36 VDC | 5 VDC | 7 A | MGDS-35-H-C | /T, /S | -, -L |
| 9-36 VDC | 12 VDC | 2,9 A | MGDS-35-H-E | /T, /S | -, -L |
| 9-36 VDC | 15 VDC | 2,3 A | MGDS-35-H-F | /T, /S | -, -L |
| 9-36 VDC | +/- 5 VDC | +/- 4 A* | MGDB-35-H-C | /T, /S | -, -L |
| 9-36 VDC | +/- 12 VDC | +/- 1,7 A* | MGDB-35-H-E | /T, /S | -, -L |
| 9-36 VDC | +/- 15 VDC | +/- 1,3 A* | MGDB-35-H-F | /T, /S | -, -L |
| 9-36 VDC | 3,3 & +/- 11,8 VDC | 4 A & +/- 1,1 A* | MGDT-35-H-BE | /T, /S | -, -L |
| 9-36 VDC | 3,3 & +/- 15,2 VDC | 4 A & +/- 0,9 A* | MGDT-35-H-BF | /T, /S | -, -L |
| 9-36 VDC | 5,1 & +/- 11,8 VDC | 4 A & +/- 1,1 A* | MGDT-35-H-CE | /T, /S | -, -L |
| 9-36 VDC | 5,1 & +/- 14,7 VDC | 4 A & +/- 0,9 A* | MGDT-35-H-CF | /T, /S | -, -L |
| 16-75 VDC | 3,3 VDC | 7 A | MGDS-35-O-B | /T, /S | -, -L |
| 16-75 VDC | 5 VDC | 7 A | MGDS-35-O-C | /T, /S | -, -L |
| 16-75 VDC | 12 VDC | 2,9 A | MGDS-35-O-E | /T, /S | -, -L |
| 16-75 VDC | 15 VDC | 2,3 A | MGDS-35-O-F | /T, /S | -, -L |
| 16-75 VDC | +/- 5 VDC | +/- 4 A* | MGDB-35-O-C | /T, /S | -, -L |
| 16-75 VDC | +/- 12 VDC | +/- 1,7 A* | MGDB-35-O-E | /T, /S | -, -L |
| 16-75 VDC | +/- 15 VDC | +/- 1,3 A* | MGDB-35-O-F | /T, /S | -, -L |
| 16-75 VDC | 3,3 & +/- 11,7 VDC | 4 A & +/- 1,1 A* | MGDT-35-O-BE | /T, /S | -, -L |
| 16-75 VDC | 3,3 & +/- 14,7 VDC | 4 A & +/- 0,9 A* | MGDT-35-O-BF | /T, /S | -, -L |
| 16-75 VDC | 5,1 & +/- 11,7 VDC | 4 A & +/- 1,1 A* | MGDT-35-O-CE | /T, /S | -, -L |
| 16-75 VDC | 5,1 & +/- 14,7 VDC | 4 A & +/- 0,9 A* | MGDT-35-O-CF | /T, /S | -, -L |

* Note : Indicated values are maximum current on each output with total power not exceeding 35W.

Converter Selection Chart



3- Electrical Specifications

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

| Parameter | Conditions | Limit or typical | Units | Single Output MGDS-35 | |
|-----------------------------------------------|-------------------------------------------------------------------|------------------|-------|-----------------------|--------|
| | | | | 35 - H | 35 - 0 |
| Input | | | | | |
| Nominal input voltage | Full temperature range | Nominal | VDC | 20 | 28 |
| Permanent input voltage range (Ui) | Full temperature range | Min. - Max. | VDC | 9-36 | 16-75 |
| Transient input voltage | Full load (Consult factory) | Maximum | VDC/S | 40/0,1 | 80/0,1 |
| Undervoltage lock-out (UVLO) | Turn-on voltage | Nominal | VDC | 8,8 | 15,8 |
| | Turn-off voltage | Nominal | VDC | 8 | 14 |
| Start up time | Ui nominal within 3 ms Nominal output Full load : resistive | Maximum | ms | 30 | 30 |
| Reflected ripple current | Ui nominal, full load at switching freq. BW = 20MHz | Maximum | mApp | 600 | 600 |
| Input current in short circuit mode (Average) | Ui nominal Short-circuit | Typical | mA | TBD | TBD |
| No load input power | Ui min. to max. No load or Stanby | Maximum | mW | 300 | 500 |
| Output | | | | | |
| 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 Ui nominal, 75% load | Maximum | % | +/- 2 | +/- 2 |
| Output power | Full temperature range Ui min. to max. | Maximum | W | 35 | 35 |
| Output current | | Maximum | A | 7 | 7 |
| 3,3V output | Full temperature range Ui min. to max. | Maximum | A | 7 | 7 |
| 5V output | | Maximum | A | 2,9 | 2,9 |
| 12V output | | Maximum | A | 2,3 | 2,3 |
| 15V output | | Maximum | A | 2,3 | 2,3 |
| Ripple output voltage * | Ui nominal | Maximum | mVpp | 100 | 100 |
| 3,3V and 5V output | Full load | Maximum | mVpp | 200 | 200 |
| 12V output | Full load BW = 20MHz | Maximum | mVpp | 200 | 200 |
| 15V output | | Maximum | mVpp | 200 | 200 |
| Line regulation | Ui min. to max. 75% load | Maximum | % | +/- 1 | +/- 1 |
| Load regulation ** | Ui nominal 25% to full load | Maximum | % | +/- 2 | +/- 2 |
| Efficiency | Ui nominal Full load | Typical | % | 83 | 84 |
| Maximum admissible Capacitive load | Ui nominal | | | | |
| 3,3V and 5V output | Full load | Maximum | µF | 10 000 | 10 000 |
| 12V and 15V output | Per output | Maximum | µF | 1 000 | 1 000 |

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 MGDB-35 | |
|-----------------------------------------------|------------------------------------------------------------------|------------------|-------|-------------------|---------|
| | | | | 35 - H | 35 - 0 |
| Input | | | | | |
| Nominal input voltage | Full temperature range | Nominal | VDC | 20 | 28 |
| Permanent input voltage range (Ui) | Full temperature range | Min. - Max. | VDC | 9-36 | 16-75 |
| Transient input voltage | Full load (Consult factory) | Maximum | VDC/S | 40/0,1 | 80/0,1 |
| Undervoltage lock-out (UVLO) | Turn-on voltage | Nominal | VDC | 8,8 | 15,8 |
| | Turn-off voltage | Nominal | VDC | 8 | 14 |
| Start up time | Ui nominal Nominal output Full load : resistive | Maximum | ms | 30 | 30 |
| Reflected ripple current | Ui nominal, full load at switching freq. BW = 20MHz | Maximum | mApp | 600 | 600 |
| Input current in short circuit mode (Average) | Ui nominal Short-circuit | Typical | mA | TBD | TBD |
| No load input power | Ui min. to max. No load or Standby | Maximum | mW | 300 | 500 |
| Output | | | | | |
| Output voltage | Full temperature range | Nominal | VDC | +/- 5 | +/- 5 |
| | Ui min. to max. | Nominal | VDC | +/- 12 | +/- 12 |
| | 75% load | Nominal | VDC | +/- 15 | +/- 15 |
| Set Point accuracy | Ambient temperature : +25°C Ui nominal, 75% load | Maximum | % | +/- 2 | +/- 2 |
| Output power * | Full temperature range Ui min. to max. | Maximum | W | +/- 20 | +/- 20 |
| Output current * | Full temperature range Ui min. to max. | Maximum | A | +/- 4 | +/- 4 |
| | | Maximum | A | +/- 1,7 | +/- 1,7 |
| | | Maximum | A | +/- 1,3 | +/- 1,3 |
| Ripple output voltage ** | Ui nominal | Maximum | mVpp | 100 | 100 |
| | 5V output | Maximum | mVpp | 200 | 200 |
| | 12V output | Maximum | mVpp | 200 | 200 |
| | 15V output | Maximum | mVpp | 200 | 200 |
| Line regulation | Ui min. to max. 75% load | Maximum | % | +/- 1 | +/- 1 |
| Load regulation *** | Ui nominal 25% to full load | Maximum | % | +/- 2 | +/- 2 |
| Cross load output regulation | Ui nominal + Vout at 75% load - Vout from 25% to full load | Maximum | % | +/- 0,5 | +/- 0,5 |
| Efficiency | Ui nominal Full load | Typical | % | 84 | 85 |
| Maximum admissible Capacitive load | Ui nominal | Maximum | μF | 1 000 | 1 000 |
| | Full load | | | | |
| 5V output | Per output | Maximum | μF | 1 000 | 1 000 |
| 12V and 15V output | | | | | |

Note * : Maximum power per output with total power not exceeding 35W.

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 | Tri Output MGDT-35 | | |
|-----------------------------------------------|------------------------------------------------------------------|--------------------------|------------|--------------------|----------------|-------------|
| | | | | 35 - H | 35 - O | |
| Input | | | | | | |
| Nominal input voltage | Full temperature range | Nominal | VDC | 20 | 28 | |
| Permanent input voltage range (Ui) | Full temperature range | Min. - Max. | VDC | 9-36 | 16-75 | |
| Transient input voltage | Full load | Maximum | VDC/-S | 40/0,1 | 80/0,1 | |
| Undervoltage lock-out (UVLO) | Turn-on voltage | Nominal | VDC | 8,8 | 15,8 | |
| | Turn-off voltage | Nominal | VDC | 8 | 14 | |
| Start up time | Ui nominal Nominal output Full load : resistive | Maximum | ms | 30 | 30 | |
| Reflected ripple current | Ui nominal, full load at switching freq. BW = 20MHz | Maximum | mApp | 600 | 600 | |
| Input current in short circuit mode (Average) | Ui nominal Short-circuit | Typical | mA | TBD | TBD | |
| No load input power | Ui min. to max. No load or Stanby | Maximum | mW | 300 | 500 | |
| Output | | | | | | |
| Output voltage (1) | Full temperature range | Nominal | VDC | 3,3 & +/-11,8 | 3,3 & +/-11,7 | |
| | Ui min. to max. | Nominal | VDC | 3,3 & +/-15,2 | 3,3 & +/-14,7 | |
| | 75% load | Nominal | VDC | 5,1 & +/- 11,8 | 5,1 & +/- 11,7 | |
| | | Nominal | VDC | 5,1 & +/- 14,7 | 5,1 & +/- 14,7 | |
| Set Point accuracy | Ambient temperature : +25°C Ui nominal, 75% load | Maximum | % | +/- 2 | +/- 2 | |
| Output power * | Full temperature range Ui min. to max. | Maximum | W | 20 & +/- 14 | 20 & +/- 14 | |
| Output current * | Full temperature range Ui min. to max. | 3,3V & +/- 12V output | Maximum | A | 4 & +/- 1,1 | 4 & +/- 1,1 |
| | | 3,3V & +/- 15V output | Maximum | A | 4 & +/- 0,9 | 4 & +/- 0,9 |
| | | 5V & +/- 12V output | Maximum | A | 4 & +/- 1,1 | 4 & +/- 1,1 |
| | | 5V & +/- 15V output | Maximum | A | 4 & +/- 0,9 | 4 & +/- 0,9 |
| | | Ripple output voltage ** | Ui nominal | Maximum | mVpp | 100 |
| 3,3V and 5V output | Full load BW = 20MHz | Full load | Maximum | mVpp | 200 | 200 |
| | | 12V output | Maximum | mVpp | 200 | 200 |
| | | 15V output | Maximum | mVpp | 200 | 200 |
| Line regulation | Ui min. to max. 75% oad | Maximum | % | +/- 1 | +/- 1 | |
| Load regulation *** | Ui nominal 25% to full load | Maximum | % | +/- 2 | +/- 2 | |
| Cross load output regulation | Ui nominal + Vout at 75% load - Vout from 25% to full load | Maximum | % | +/- 0,5 | +/- 0,5 | |
| Efficiency | Ui nominal Full load | Typical | % | 84 | 85 | |
| Maximum admissible Capacitive load | Ui nominal Full load Per output | 3,3V and 5V output | Maximum | µF | 4 700 | 4 700 |
| | | 12V and 15V output | Maximum | µF | 470 | 470 |

Note (1) : The primary voltage should be minimum loaded (consult factory) to be able to get the secondary outputs.

Note * : Maximum power per output with total power not exceeding 35W.

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 Characteristics (continued)

Figure 1 : Typical efficiency versus load at various input

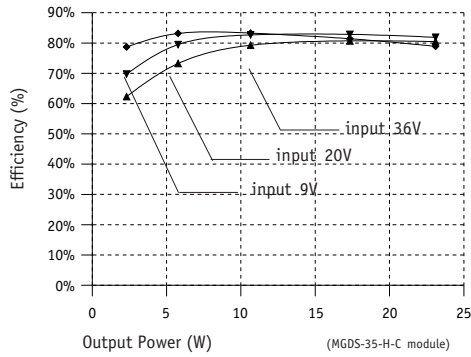


Figure 2 : Typical efficiency versus load at various input

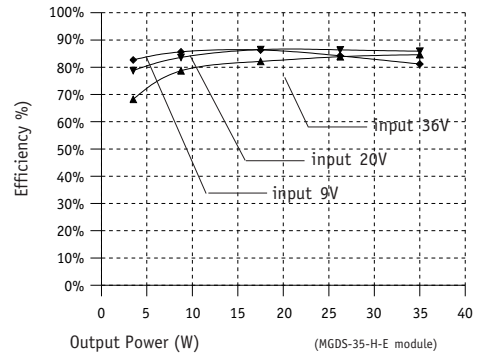


Figure 3 : Typical efficiency versus load at various input

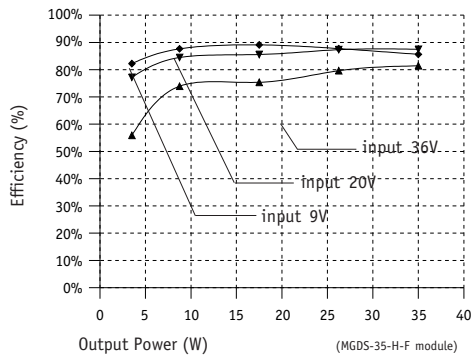


Figure 4 : Typical load regulation characteristics at nominal input

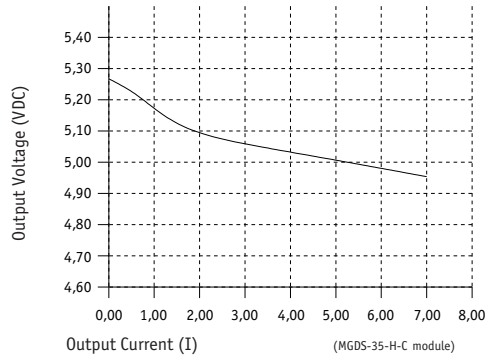


Figure 5 : Typical load regulation characteristics at nominal input

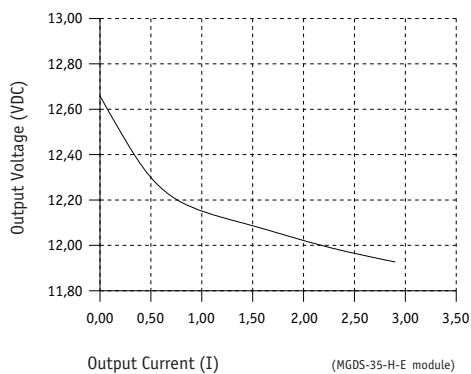
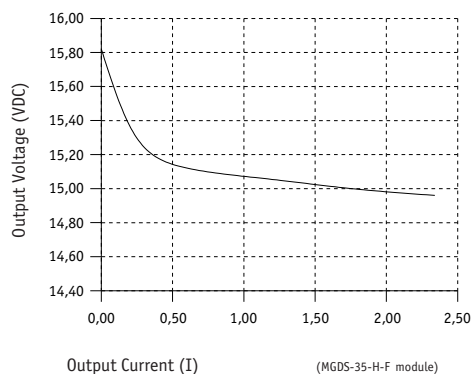


Figure 6 : Typical load regulation characteristics at nominal input



4- Switching Frequency

| Parameter | Conditions | Limit or typical | Specifications |
|---------------------|-------------------------------------------------------------------|------------------|----------------|
| Switching frequency | Full temperature range Ui min. to max. No load to full load | Nominal, fixed | 250 KHz |

5- Isolation

| Parameter | Conditions | Limit or typical | Specifications |
|------------------------------------------------------------------------------|------------------|------------------|-------------------|
| Electric strength test voltage (basic version) | 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 hysteresis cycle | Automatic recovery | Turn-on nominal Turn-off nominal | See section 3 |
| Output short circuit protection (SCP) | Hiccup circuitry with auto-recovery | Automatic recovery | Permanent | See section 11 |
| Output overvoltage protection (OVP) | Overvoltage protection device with clamping | Automatic recovery | Nominal | Between 105% and 110% of output voltage |

7- Reliability Data

| Characteristics | Conditions | Temperature | Specifications |
|----------------------------------------------------------------|----------------------------------|---------------------------------|----------------------------|
| Mean Time Between Failure (MTBF) According to MIL-HDBK-217F | Ground fixed (Gf) | Case at 40°C Case at 85°C | 700 000 Hrs 360 000 Hrs |
| | Airborne, Inhabited, Cargo (AIC) | Case at 40°C Case at 85°C | 390 000 Hrs 150 000 Hrs |
| Mean Time Between Failure (MTBF) According to IEC-62380-TR | Civilian avionics, calculators | Ambient at 55°C 100% time on | 980 000 Hrs |

8- Electromagnetic Interference

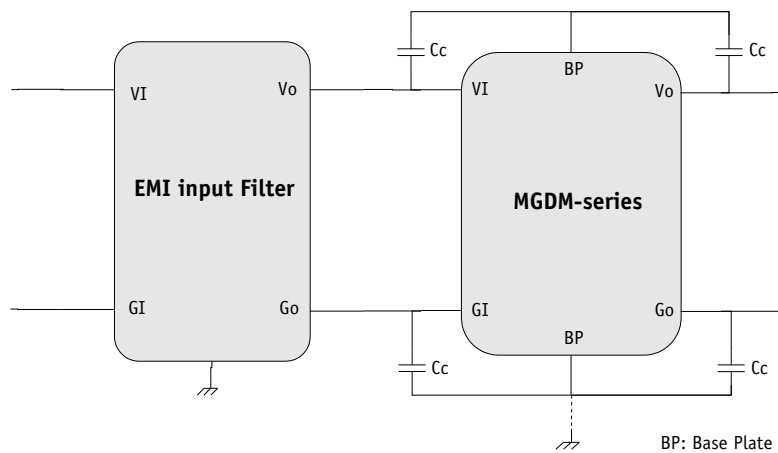
Electromagnetic Interference requirements according to MIL-STD-461C/D/E standards can be easily achieved as indicated in the following section. The following table resumes the different sections covered by these standards.

| Standard Requirements | MIL-STD-461C Standard | MIL-STD-461D/E Standard | Compliance with GAIA Converter Module & common mode capacitance |
|-----------------------------------------------------------------------------|-----------------------|-------------------------|------------------------------------------------------------------------|
| Conducted emission (CE) : Low frequency High frequency | CE 01 CE 03 | CE 101 CE 102 | compliant module stand-alone compliant with additionnal filter |
| Conducted susceptibility (CS) : Low frequency High frequency | CS 01 CS 02 | CS 101 CS114 | compliant with additionnal filter compliant with additionnal filter |
| Radiated emission (RE) : Magnetic field Electrical field | RE 01 RE 02 | RE 101 RE 102 | compliant module stand-alone compliant module stand-alone |
| Radiated susceptibility (RS) : Magnetic field Electrical field | RS 01 RS 03 | RS 101 RS 103 | compliant module stand-alone compliant module stand-alone |

8-1 Module Compliance with MIL-STD-461C/D/E Standards

To meet the latest US military standards MIL-STD-461D/E (and also the MIL-STD-461C) requirements and in particular the conducted noise emission CE102 (and also CE03) requirements, Gaia Converter can propose a stand-alone ready-to-use EMI filter module. This EMI filter module has to be used together with a common mode noise capacitance C_c (10nF/rated voltage depending on isolation requirement) connected between G_{in} and G_{out} .

EMI Filter module reference : FGDS-2A-50V.
Please consult EMI filter datasheet for further details.



9- Thermal Characteristics

| Characteristics | Conditions | Limit or typical | Performances |
|-----------------------------------------------|----------------------------------------------------|--------------------|-------------------|
| Operating ambient temperature range | Ambient temperature * | Minimum Maximum | - 40°C + 85°C |
| Operating case temperature range at full load | Case temperature | Minimum Maximum | - 40°C + 105°C |
| Storage temperature range | Non functioning | Minimum Maximum | - 55°C + 125°C |
| Thermal resistance | Rth case to ambient in free air natural convection | Typical | 6°C /W |

Note * : The upper temperature range depends on configuration, the user must assure a max. case temperature of + 105°C.

The MGDM-35 series operating **case** temperature must not exceed 105°C. The maximum **ambient** temperature admissible for the DC/DC converter corresponding to the maximum operating case temperature of 105°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 = 105°C of the module, the power used Pout and the efficiency η :

- determine the power dissipated by the module P_{diss} that should be evacuated :

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

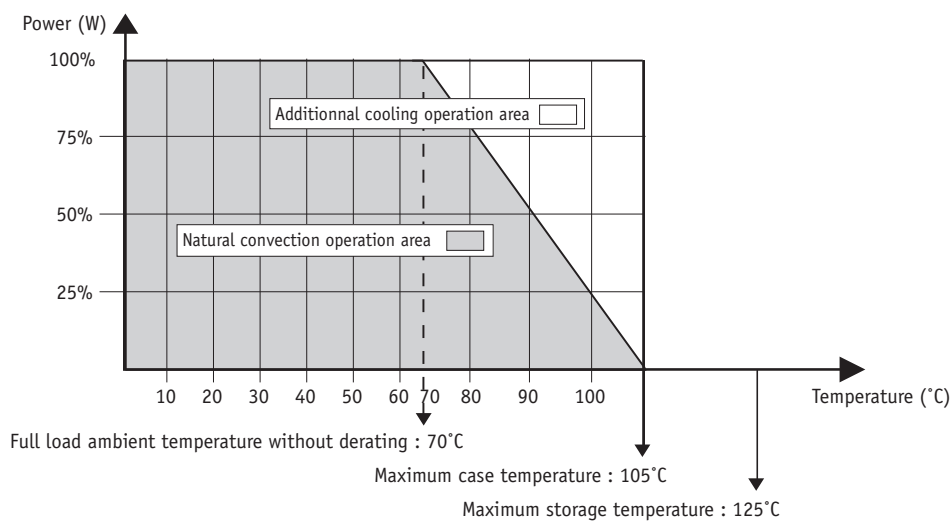
- determine the maximum ambient temperature :

$$T_a = 105^\circ\text{C} - R_{th} \times P_{diss}$$

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 105°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 |
|----------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------------------------|
| Climatic Qualifications | | | |
| Life at high temperature | Duration Temperature / status of unit | Test D : 1 000 Hrs @ 105°C case, unit operating @ 125°C ambient, unit not operating | MIL-STD-202G Method 108A |
| Altitude | Altitude level C Duration Climb up Stabilization Status of unit | 40 000 ft@-55°C 30 min. 1 000 ft/min to 70 000 ft@-55°C, 30 min. unit operating | MIL-STD-810E Method 500.3 |
| Humidity cyclic | Number of cycle Cycle duration Relative humidity variation Temperature variation Status of unit | 10 Cycle I : 24 Hrs 60 % to 88 % 31°C to 41°C unit not operating | MIL-STD-810E Method 507.3 |
| Humidity steady | Damp heat Temperature Duration Status of unit | 93 % relative humidity 40°C 56 days unit not operating | MIL-STD-202G Method 103B |
| Salt atmosphere | Temperature Concentration NaCl Duration Status of unit | 35°C 5 % 48 Hrs unit not operating | MIL-STD-810E Method 509.3 |
| Temperature cycling | Number of cycles Temperature change Transfert time Steady state time Status of unit | 200 -40°C / +85°C 40 min. 20 min. unit operating | MIL-STD-202A Method 102A |
| Temperature shock | Number of shocks Temperature change Transfert time Steady state time Status of unit | 100 -55°C / +105°C 10 sec. 20 min. unit not operating | MIL-STD-202G Method 107G |
| Mechanical Qualifications | | | |
| Vibration (Sinusoidal) | Number of cycles Frequency / amplitude Frequency / acceleration Duration Status of unit | 10 cycles in each axis 10 to 60 Hz / 0.7 mm 60 to 2 000 Hz / 10 g 2h 30 min. per axis unit not operating | MIL-STD-810D Method 514.3 |
| Shock (Half sinus) | Number of shocks Peak acceleration Duration Shock form Status of unit | 3 shocks in each axis 100 g 6 ms 1/2 sinusoidal unit not operating | MIL-STD-810D Method 516.3 |
| Bump (Half sinus) | Number of bumps Peak acceleration Duration Status of unit | 2 000 bumps in each axis 40 g 6 ms unit not operating | MIL-STD-810D Method 516.3 |

11- Description of Protections

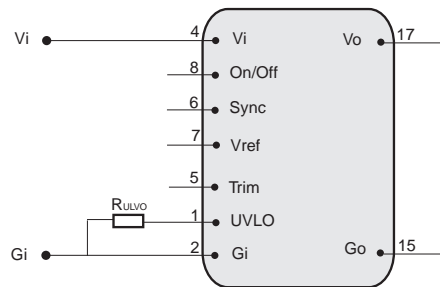
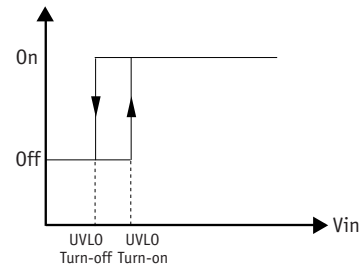
11-1 Input Undervoltage Lock-out (UVLO)

An input undervoltage protection will inhibit the module when input voltage drops below the lock-out turn-off threshold (see section 3 for value) and restores to normal operation automatically when the input voltage rises the lock-out turn-on threshold.

The input undervoltage lock-out threshold (UVLO) can be trimmed by connecting a resistor between UVLO and Gi pins. This resistance can be calculated as follow :

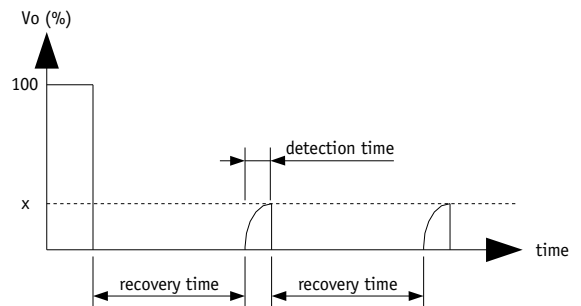
$$R_{UVLO} = \frac{K \times 10^4}{(n - 1)} \quad \text{where } n = \frac{UVLO_{trim}}{UVLO_{threshold}}$$

| | Input H | Input O |
|---|---------|---------|
| K | 0,932 | 1,34 |



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 1s recovery time). The overload detection threshold is typically 200% of maximum current with a detection time lower than 5ms.



11-3 Output Overvoltage Protection (OVP)

Each circuit has an internal overvoltage protection circuit that monitors the voltage across the output power terminals.

It is designed to latch the converter off between 105% and 110% of output voltage.

Once in OVP protection, the module will restart automatically when overvoltage is removed.

12- Description of Functions

12-1 Trim Function

The output voltage V_o may be trimmed in a range of 95%/105% of the nominal output voltage via a single external trimpot or fixed resistor. In case of dual or triple outputs, the trim function is also acting on the secondary outputs.

Trim Up Function

Do not attempt to trim the module higher than 105% of nominal output voltage as the overvoltage protection may occur. Also do not exceed the maximum rated output power when the module is trimmed up.

The trim up resistor must be connected to Vref pin. The trim up resistance must be calculated with the following formula :

$$R_U(k) = 12 \cdot \frac{\frac{V_{Otrim-up}}{2 \cdot V_o} - 1}{1 - \frac{V_{Otrim-up}}{V_o}} - 47$$

Trim Down Function

Do not trim down more than 95% of nominal output voltage. The available output power is reduced by the same percentage that output voltage is trimmed down.

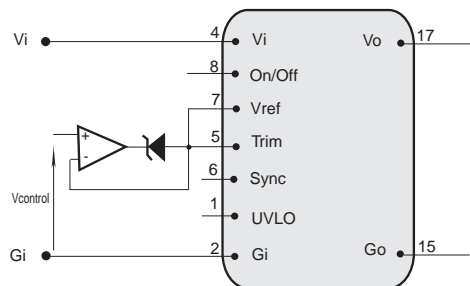
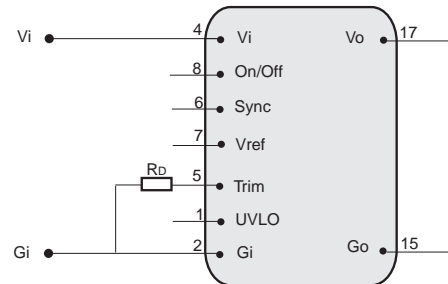
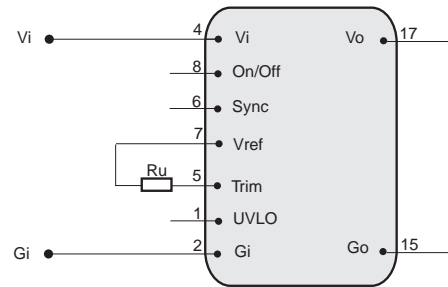
The trim down resistor must be connected to Gi pin. The trim down resistance must be calculated with the following formula :

$$R_D(k) = 12 \cdot \frac{\frac{V_{Otrim-down}}{V_o}}{2 \cdot (1 - \frac{V_{Otrim-down}}{V_o})} - 47$$

Trim via a voltage

The output voltage is given by the following formula :

$$V_o = V_{o_{nom}}(0.0565 V_{control} + 0.887)$$



12- Description of Functions (continued)

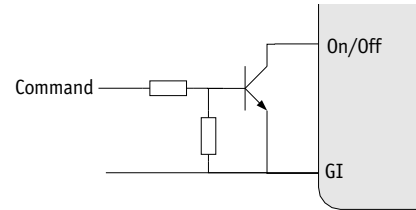
12-2 On/Off Function

The control pin 8 (On/Off) can be used for applications requiring On/Off operation. This may be done with an open collector transistor, a switch, a relay or an optocoupler. Several converters may be disabled with a single switch by connecting all

On/Off pins together.

- The converter is disabled by pulling low the pin 8.
- No connection or high impedance on pin 8 enables the converter.

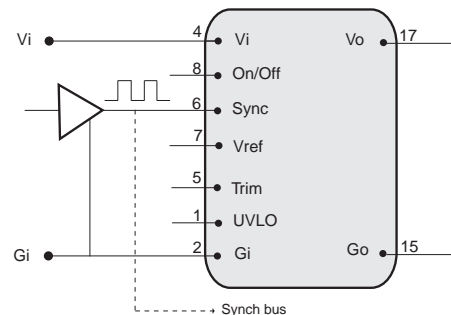
By releasing the On/Off function, the converter will restart within the start up time specifications given in table section 3. For further details please consult "Logic On/Off" application note.



| Parameter | Unit | Min. | Typ. | Max. | Notes, conditions |
|-------------------------------|------|------|------|------|------------------------------------------------|
| On/Off module enable voltage | Vdc | 3 | / | 4 | Open, the switch must not sink more than 100µA |
| On/Off module disable voltage | Vdc | 0 | / | 1.5 | The switch must be able to sink 1mA |
| On/Off module enable delay | ms | / | / | 30 | / |
| On/Off module disable delay | µs | / | / | 100 | Vin nominal at full load |

12-3 Synchronization Function

An external clock with rectangular «Pull Up» signals can be used to lock one or more converters. The external clock signal should have a frequency range from 550KHz to 600KHz, a low level below 0,5V a high level of 4V (+/-0.5V), a rise time of 30 ns max. and a drop time of 100ns max.



12-4 Reference function (Vref)

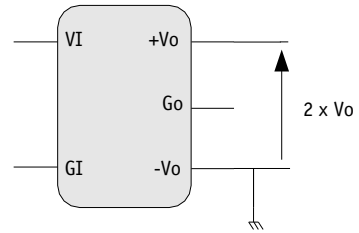
The Vref signal output provides a stable 4V (± 0.1 V) reference signal on Vref pin. It is protected by an internal 10 kohms resistor. This signal may be used also in conjunction with the Trim input pin 5 (primary side).

It is recommended to connect a filter capacitor (10nF) between Vref and Gi, if Vref is used.

13- Application Notes

13-1 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.

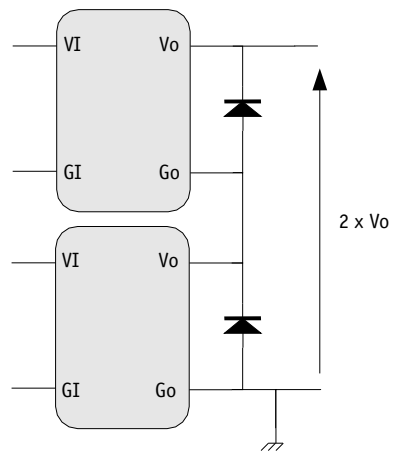


13-2 Connection of Modules in Series

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

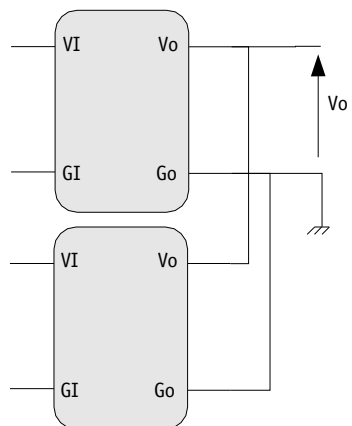
Nevertheless, GAIA Converter recommends to protect each individual output by a low power shottky diode rated with the maximum current of the converter to avoid reverse polarity at any output.

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



13-3 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.



14- PCB Mounting Specifications

The MGDM-35 series has been design for low profile applications.

Two levels of mounting can be designed :

- On-board mounting with 12,5 mm height
- In-board mounting with 10,5 mm height and PCB hole design on the mother board

Onboard Mounting

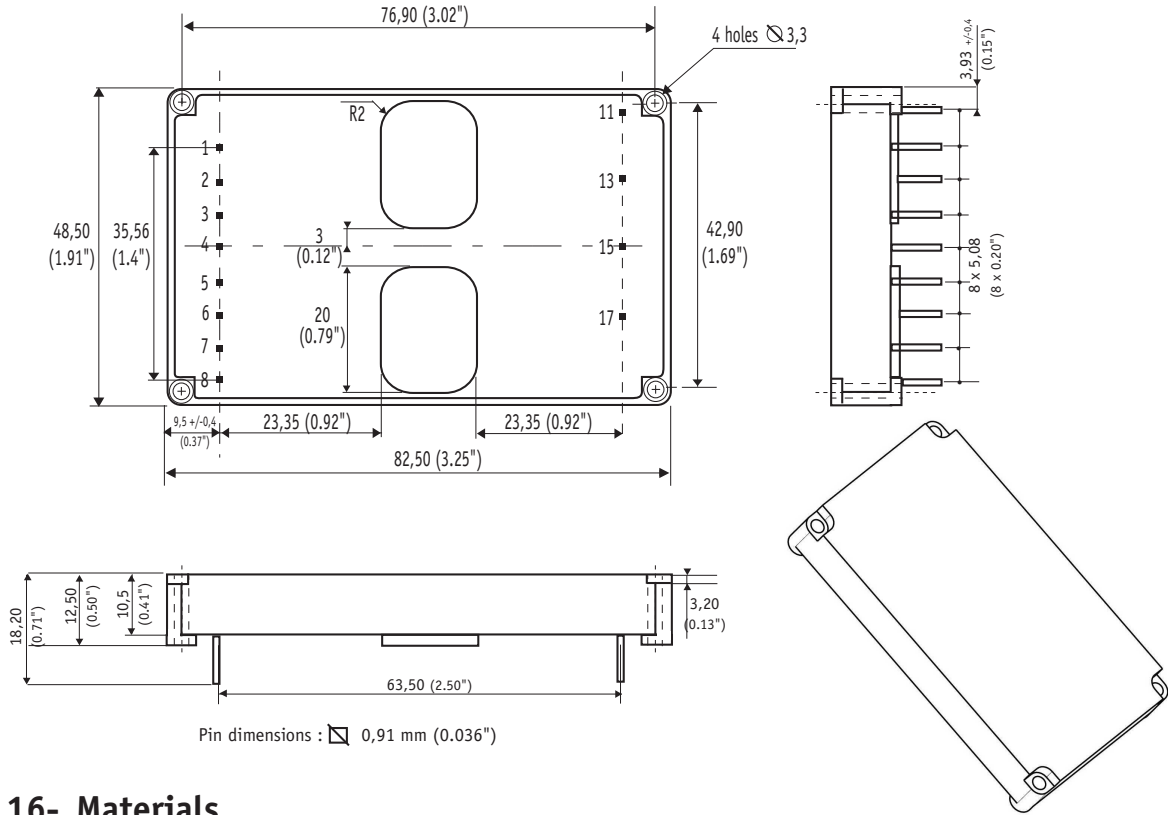


Inboard Mounting



15- Dimensions

Dimension are given in mm (inches). Tolerance : +/- 0,2 mm (+/- 0.01 ") unless otherwise indicated.
Weight : 80 grams (2.80 Ozs) max.



Pin dimensions : 0,91 mm (0.036")

Recommended screw for mounting : M2.5

4

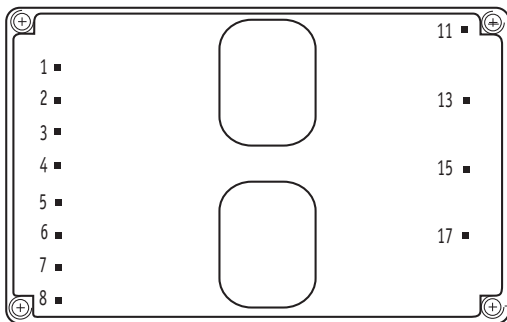
16- Materials

Case : Metallic black anodized coating.
Pins : Plated with pure matte tin over nickel underplate.

17- Product Marking

Upper face : Company logo, location of manufacturing.
Side face : Module reference : MGDx-35-»X»-»Y».
Date code : year and week of manufacturing, suffix, /option.

18- Connections



Bottom view

| Pin | Single | Bi | Triple |
|-----|----------------|----------------|-----------------|
| 1 | UVLO | UVLO | UVLO |
| 2 | - Input (Gi) | - Input (Gi) | - Input (Gi) |
| 3 | Do not connect | Do not connect | Do not connect |
| 4 | + Input (Vi) | + Input (Vi) | + Input (Vi) |
| 5 | Trim | Trim | Trim |
| 6 | Synchro (Sync) | Synchro (Sync) | Synchro (Sync) |
| 7 | Vref | Vref | Vref |
| 8 | On / Off | On / Off | On / Off |
| 11 | Do not connect | Output - (-Vo) | Output 2- (-V2) |
| 13 | Do not connect | Do not connect | Output 2+ (+V2) |
| 15 | Common (Go) | Common (Go) | Common (Go) |
| 17 | Output (Vo) | Output + (+Vo) | Output 1 (V1) |



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