



# Hi-Rel DC/DC CONVERTER MGDM-26 : 25W POWER

Hi-Rel  
Grade ■■

## Single Output Metallic Case - 1 500 VDC Isolation



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- 28Vdc input compliant with MIL-STD-704 D/E
- Nominal power up to 25 W
- Wide temperature range : -40°C/+105°C case
- High efficiency (typ. 83%)
- Soft start
- Galvanic isolation 1.500 VDC
- Synchronizable, load sharing and N+1 redundancy
- Integrated LC EMI filter
- No load to full load operation
- Permanent short circuit protection
- No optocoupler for high reliability
- RoHS or Leaded process option

### 1-General

The MGDM-26 series is a complete line of DC/DC power modules designed for aerospace, military and high-end industrial applications. These modules use a high frequency fixed switching technic at 1MHz providing excellent reliability, low noise characteristics and high power density. Standard models are available with standard input voltage range of 9-36 or 16-40 volts. The series include single output voltage choices of 3,3, 5, 12, 15 volts.

The MGDM-26 series include synchronization and load sharing functions.

The synchronization function allows to synchronize more than one converter to one frequency or an external source frequency. The load sharing allows parallel operation to increase power with a true N+1 redundancy.

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 and a permanent short circuit 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. The modules are potted with a bi-component thermal conductive compound and package in a metallic case to ensure the module's integrity under high environmental conditions.

### 2-Product Selection

Single output model : MGDS - 26 -  -  /  -

Input Voltage Range	
Permanent	Transient
H : 9-36 VDC	40 VDC/100 ms *
J : 16-40 VDC	50 VDC/100 ms *

\* Consult factory

**Options :**

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

Output
B : 3.3 VDC
C : 5 VDC
E : 12 VDC
F : 15 VDC

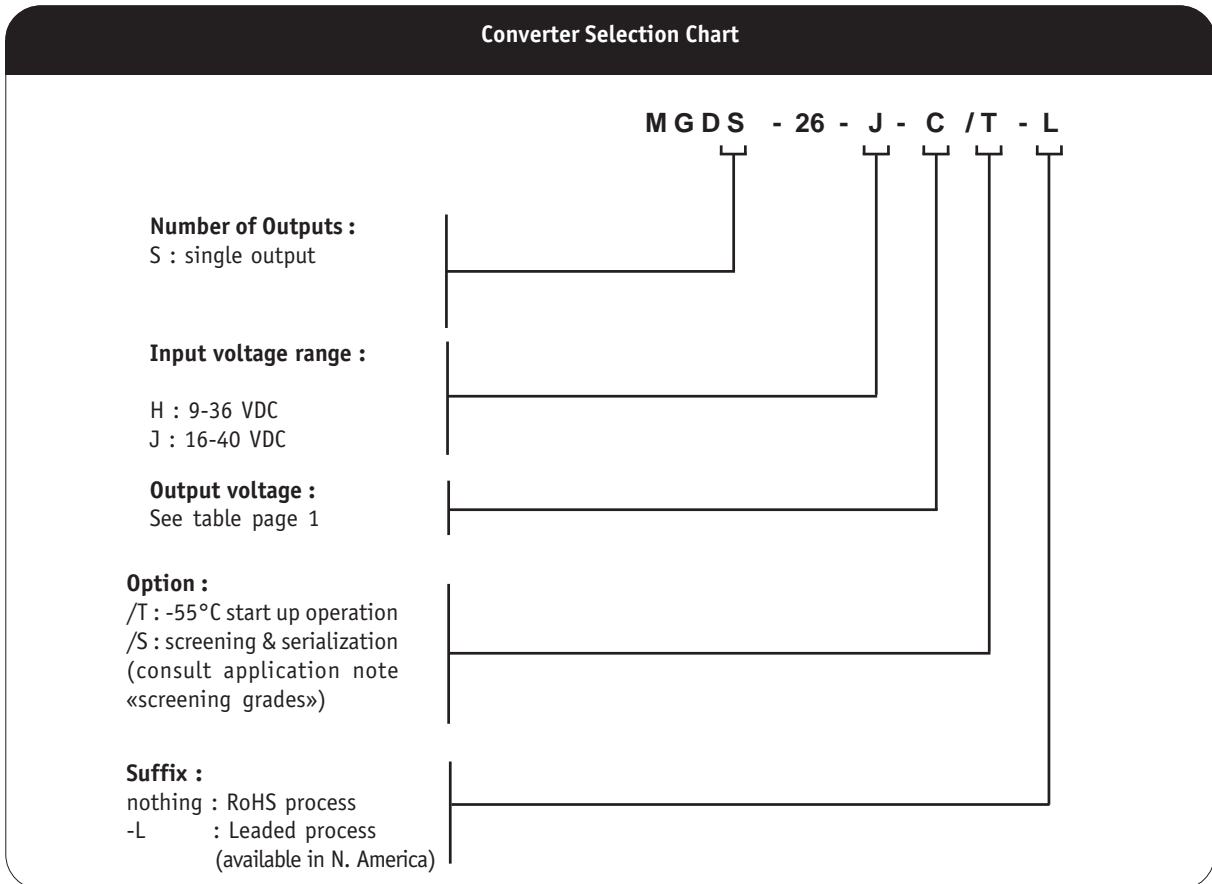
**Suffix :**

- 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	6 A	MGDS-26-H-B	/T, /S	-, -L
9-36 VDC	5 VDC	5 A	MGDS-26-H-C	/T, /S	-, -L
9-36 VDC	12 VDC	2,08 A	MGDS-26-H-E	/T, /S	-, -L
9-36 VDC	15 VDC	1,65 A	MGDS-26-H-F	/T, /S	-, -L
16-40 VDC	3,3 VDC	6 A	MGDS-26-J-B	/T, /S	-, -L
16-40 VDC	5 VDC	5 A	MGDS-26-J-C	/T, /S	-, -L
16-40 VDC	12 VDC	2.08 A	MGDS-26-J-E	/T, /S	-, -L
16-40 VDC	15 VDC	1,65 A	MGDS-26-J-F	/T, /S	-, -L

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### 3- Electrical Specifications

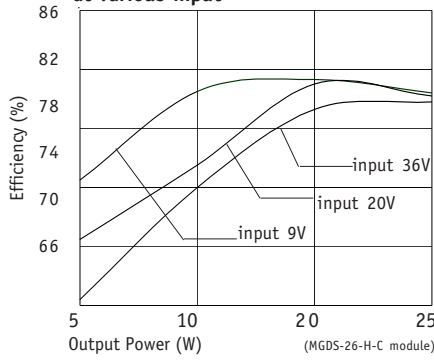
Data are valid at +25°C, unless otherwise specified.

Parameter	Conditions	Limit or typical	Units	Single Output MGDS-26		
				26 - H	26 - J	
<b>Input</b>						
Nominal input voltage	Full temperature range	Nominal	VDC	20	28	
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	9-36	16-40	
Transient input voltage	Full load (Consult factory)	Maximum	VDC/S	40/0,1	50/0,1	
Undervoltage lock-out (UVLO)	Turn-on voltage	Nominal	VDC	8,5	15,5	
	Turn-off voltage	Nominal	VDC	7,5	14,5	
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	50	50	
Input current in short circuit mode (Average)	Ui nominal Short-circuit	Maximum	mA	35	35	
No load input current	Ui nominal No load	Maximum	mA	35	35	
Input current in inhibit mode	Ui nominal Inhibit	Maximum	mA	25	25	
<b>Output</b>						
Output voltage	Full temperature range Ui min. to max. 75% load	Nominal	VDC	3,3	3,3	
		Nominal	VDC	5	5	
		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	25	25	
Output current *	Full temperature range Ui min. to max.	3,3V output	Maximum	A	6	6
		5V output	Maximum	A	5	5
		12V output	Maximum	A	2,1	2,1
		15V output	Maximum	A	1,65	1,65
		Ripple output voltage				
3,3V and 5V output	Ui nominal	Maximum	mVpp	50	50	
12V output	Full load	Maximum	mVpp	50	50	
15V output	BW = 20MHz	Maximum	mVpp	60	60	
Line regulation	Ui min. to max. Full load	Maximum	%	+/- 1	+/- 1	
Load regulation	Ui nominal No load to full load	Maximum	%	+/- 2	+/- 2	
Output Voltage Trim	As function of output voltage	Minimum	%	- 20	- 20	
		Maximum	%	+ 10	+ 10	
Efficiency	Ui nominal Full load	Typical	%	See on page 4		
<b>Maximum admissible Capacity load</b>						
3,3V output 5V output 12V output 15V output	Full input voltage range Full load Per output	Maximum	µF	4 700	4 700	
		Maximum	µF	1 000	1 000	
		Maximum	µF	330	330	
		Maximum	µF	250	250	

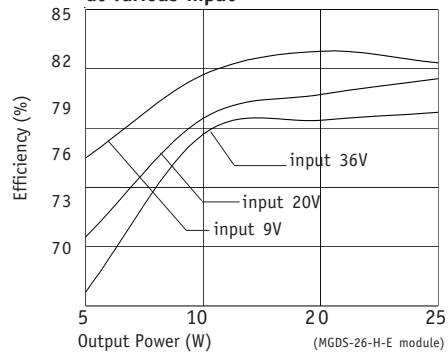
Note \* : For 9-36V input range, the current is derated of 80% at 9V and increases linearly to full current at 12V.

### 3- Electrical Characteristics (continued)

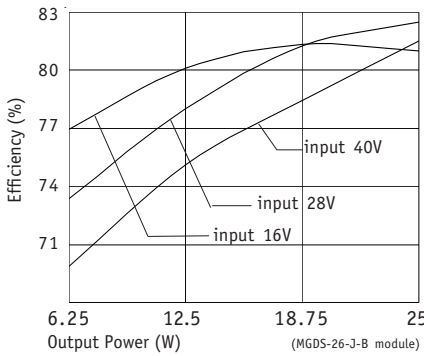
**Figure 1 : Typical efficiency versus load at various input**



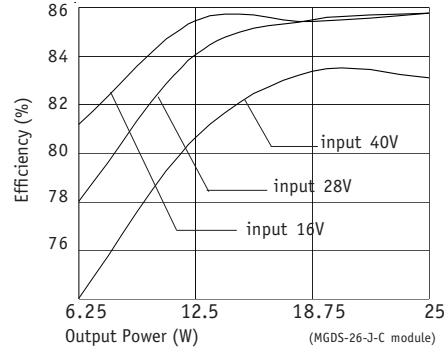
**Figure 2 : Typical efficiency versus load at various input**



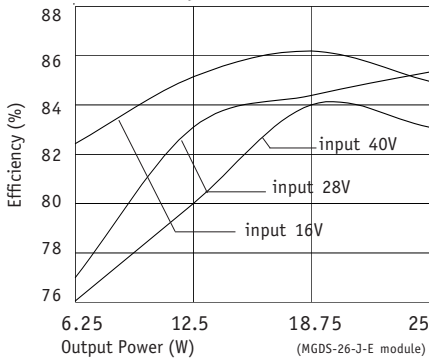
**Figure 3 : Typical efficiency versus load at various input**



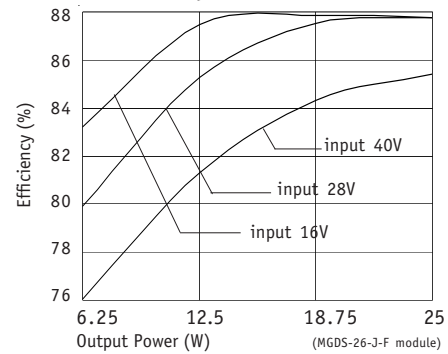
**Figure 4 : Typical efficiency versus load at various input**



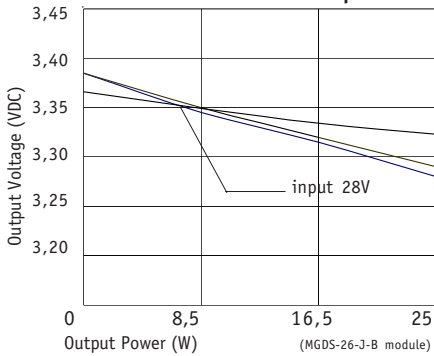
**Figure 5 : Typical efficiency versus load at various input**



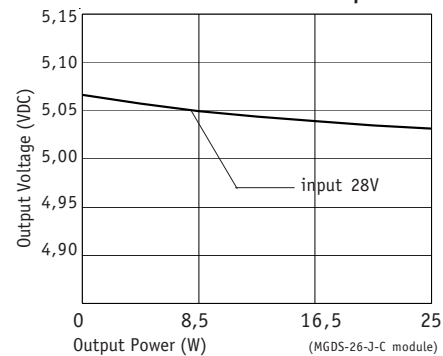
**Figure 6 : Typical efficiency versus load at various input**



**Figure 7 : Typical load regulation characteristics at nominal input**



**Figure 8 : 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	1 MHz

## 5- Isolation

Parameter	Conditions	Limit or typical	Specifications
Electric strength test voltage	Input to output	Minimum	1 500 VDC / 1 min
	Input to case	Minimum	500 VDC / 1 min
	Output to case	Minimum	1 500 VDC / 1 min
Isolation resistance	500 VDC	Minimum	1 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

## 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	750 000 Hrs 300 000 Hrs
	Airborne, Inhabited, Cargo (AIC)	Case at 40°C Case at 85°C	410 000 Hrs 185 000 Hrs
Mean Time Between Failure (MTBF) According to IEC-62380-TR	Civilian avionics, calculator	Ambient at 55°C 100% time on	691 000 Hrs

## 8- Electromagnetic Interference

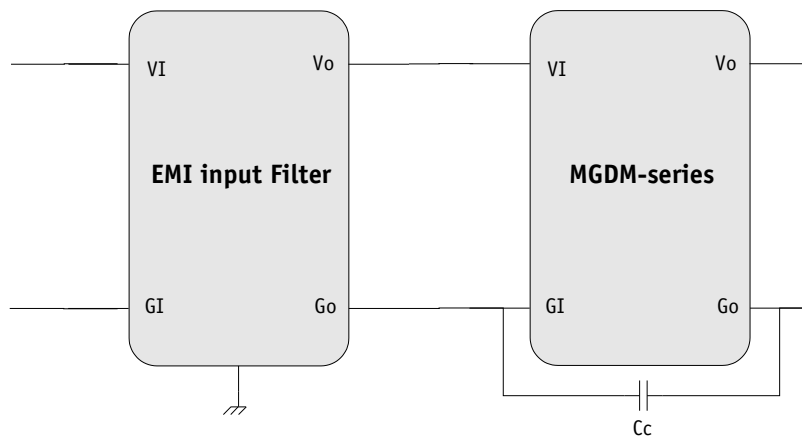
Electromagnetic Interference requirements according to MIL-STD-461C/D/E standards can be easily achieved as indicated in the following section. The following table resumes the different sections covered by these standards.

Standard Requirements	MIL-STD-461C Standard	MIL-STD-461D/E Standard	Compliance with GAIA Converter Module & common mode capacitance
<b>Conducted emission (CE) :</b> Low frequency High frequency	CE 01 CE 03	CE 101 CE 102	compliant module stand-alone compliant with additional filter
<b>Conducted susceptibility (CS) :</b> Low frequency High frequency	CS 01 CS 02	CS 101 CS114	compliant with additional filter compliant with additional filter
<b>Radiated emission (RE) :</b> Magnetic field Electrical field	RE 01 RE 02	RE 101 RE 102	compliant module stand-alone compliant module stand-alone
<b>Radiated susceptibility (RS) :</b> 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 at full load	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	7°C /W

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

The MGDM-26 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<sub>diss</sub> that should be evacuated :

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

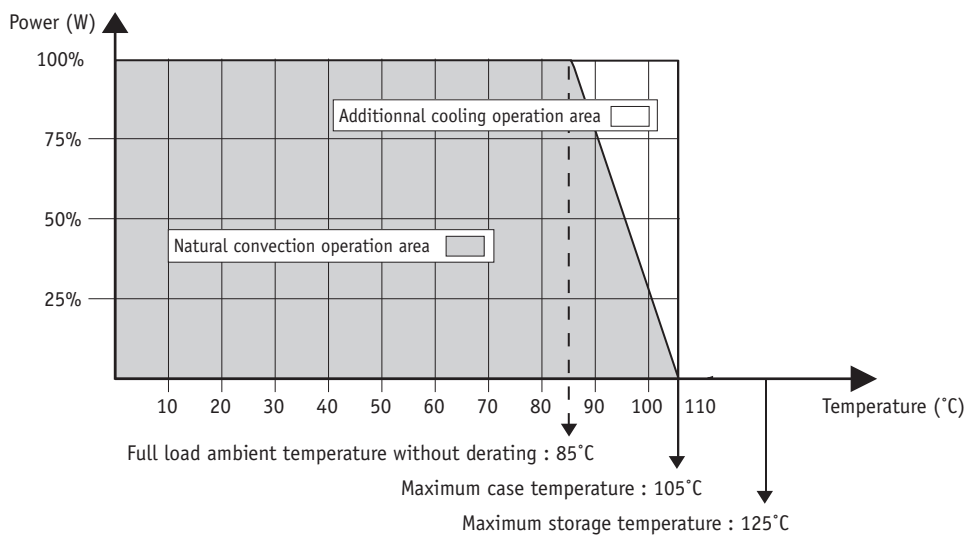
- determine the maximum ambient temperature :

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

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.

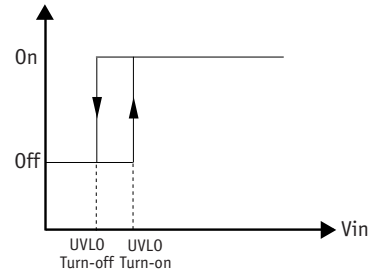
Characteristics	Conditions	Severity	Test procedure
<b>Climatic Qualifications</b>			
Life at high temperature	Duration Temperature / status of unit	Test D : 1 000 Hrs @ 105°C case, unit operating @ 125°C ambient, unit not operating	MIL-STD-202G Method 108A
Altitude	Altitude level C Duration Climb up 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
<b>Mechanical Qualifications</b>			
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

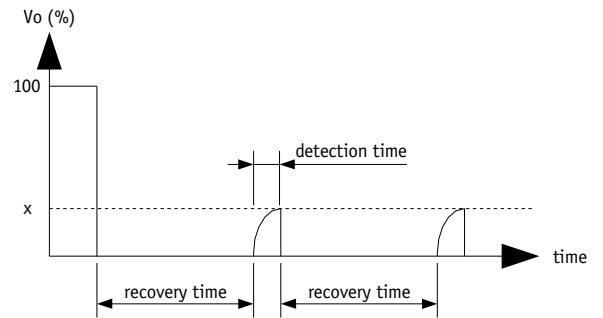
### 11-1 Input Undervoltage Lock-out (UVLO)

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.



### 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.



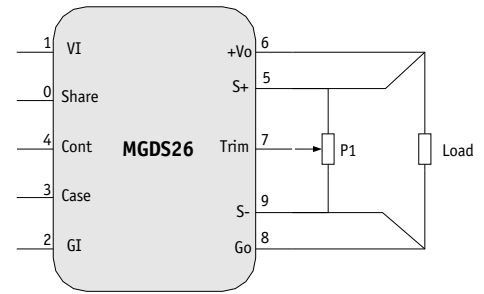
## 12- Description of Functions

### 12-1 Trim Function

The primary output voltage  $V_o$  may be trimmed at  $-20\%/+10\%$  via a single external trimpot or fixed resistor. The trimpot should be connected as shown in figure hereafter. Value of the trim resistance is given in the following table.

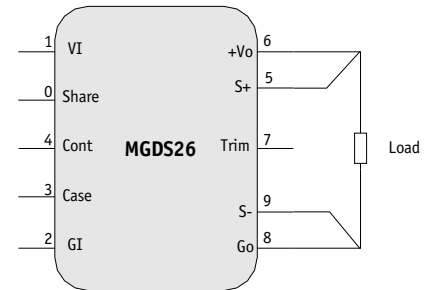
$V_o$	P1 Value
3,3 V	4,7 KOhm
5 V	10 KOhm
12 V	12 KOhm
15 V	22 KOhm

*For other  $V_{o1}$  Output value consult Factory*



### 12-2 Sense Function

If the load is separated from the output by any line length, some of these performance characteristics will be degraded at the load terminals by an amount proportional to the impedance of the load leads. Sense connections enable to compensate the line drop at a maximum of  $\pm 10\%$  of output voltage. Connection is described in figure herein.

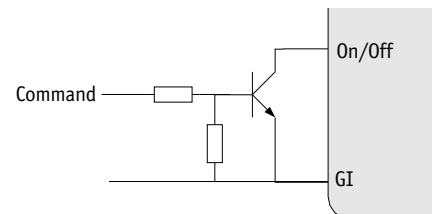


### 12-3 On/Off Function

The control pin 4 (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.

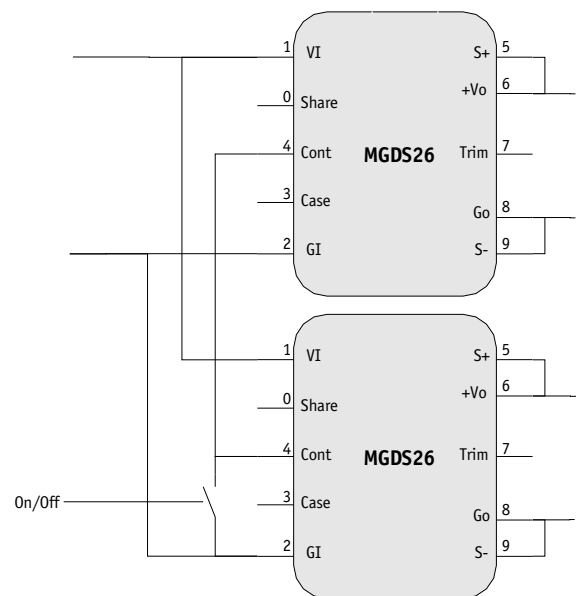
- The converter is disabled by pulling low the pin 4.
- No connection or high impedance on pin 4 enables the converter.

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.



### 12-4 Synchronization Function

The MGDM-26 series provide a bi-directional synchronization function through pin 4 (CONT) to enable automatic synchronization between several converters. The converters lock into the highest switching frequency if more than one converter is used or on an external clock for a frequency in the range between 105% and 115% of the converter's free frequency.



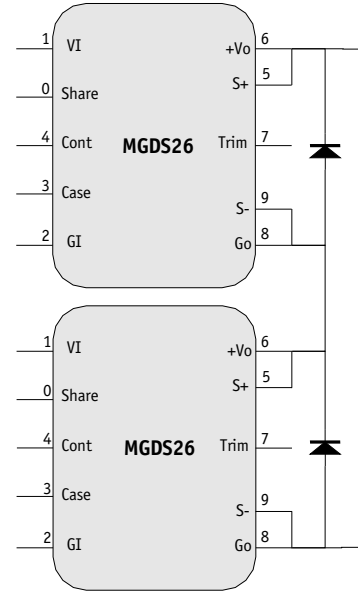
## 13- Application Notes

### 13-1 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.

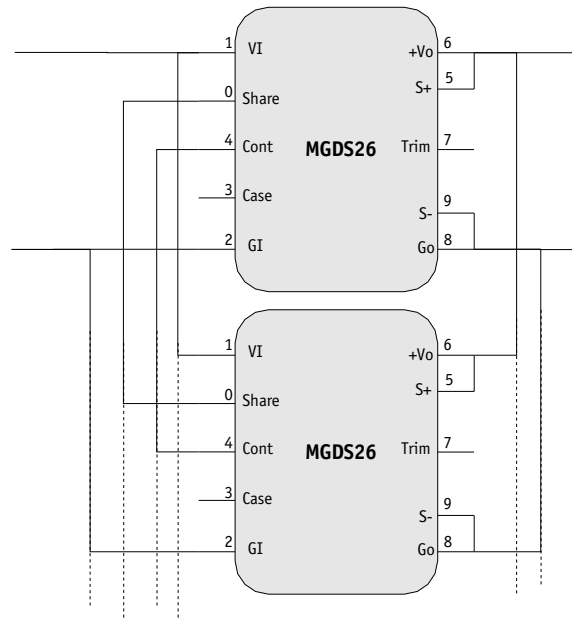
Nevertheless, GAIA Converter recommends to protect each individual output by a low power shottky diode rated with the maximum current of the converter to avoid reverse polarity at any output.

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



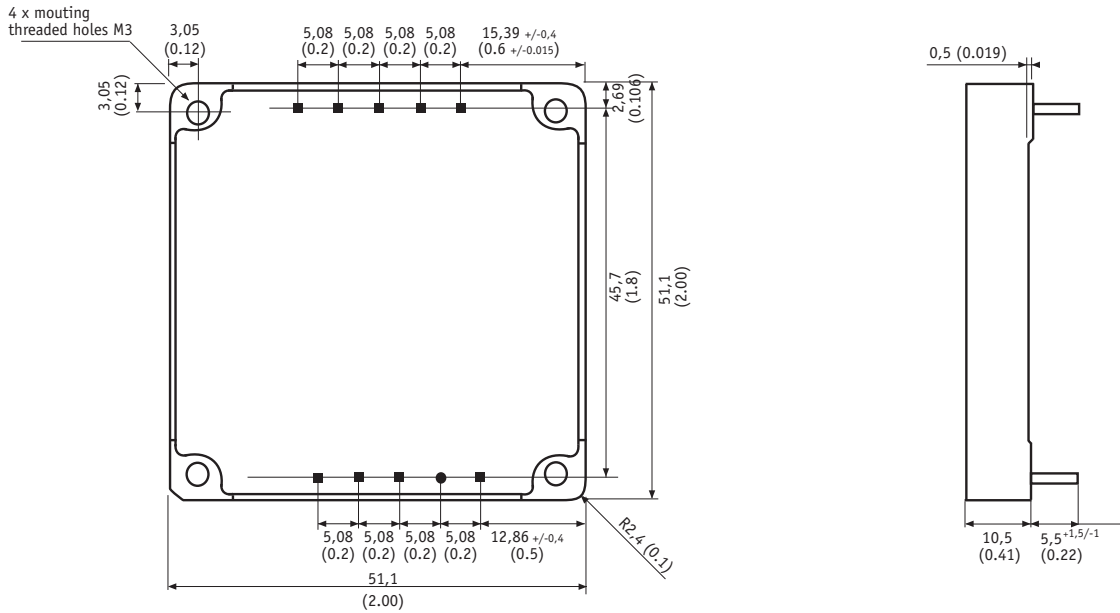
### 13-2 Connection of Modules in Parallel

The MGDM-26 series features parallel (load sharing) operations to increase output power with a true N+1 redundancy. Up to 4 converters can be parallelized through the "SHARE" pins as described in the following schematic



## 14- Dimensions

Dimension are given in mm (inches). Tolerance : +/- 0,2 mm (+/- 0.01 ") unless otherwise indicated.  
Weight : 65 grams (2.3 Ozs) max.



Pin 3 : round pin  $\varnothing$  0,83 mm (0.032") length : 4<sup>+/-1</sup> mm  
All other pins : square pin  $\varnothing$  0,91mm (0.036") length : 5,5<sup>+1,5/-1</sup> mm

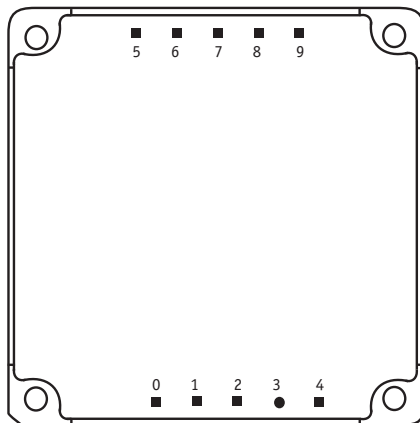
## 15- Materials

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

## 16- Product Marking

Upper face : Company logo, location of manufacturing.  
Side face : Module reference : MGDx-26-»X»-»Y».  
Date code : year and week of manufacturing, suffix, /option.

## 17- Connections



Bottom view

Pin	Single Output
0	Share
1	+ Input (Vi)
2	- Input (Gi)
3	Case
4	Control (Cont)
5	Sense + (S+)
6	+ Output (Vo)
7	Trim (Trim)
8	- Output (Go)
9	Sense - (S-)



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