



Hi-Rel DC/DC CONVERTER MGDM-04 : 4W POWER

Hi-Rel
Grade ■■■

**Single, Bi & Triple Outputs
Metallic Case - 1.500 VDC Isolation**

- 28 Vdc input compliant with MIL-STD-704 D/E
- Low profile : 0,3" (7.5mm)
- Nominal power of 4W without derating
- Wide temperature range : -40°C/+105°C case
- Soft start
- Galvanic isolation 1.500 VDC
- Integrated LC EMI filter
- Permanent short circuit protection
- Standard pin out DIL24 9 pins
- Inhibit function
- No optocoupler for high reliability



1-General

The MGDM-04 series is a full family of high performance and low profile DC/DC power modules designed for aerospace, military and high-end industrial applications. These modules use a high frequency fixed switching technic at 500 KHz providing excellent reliability, low noise characteristics, high power density and a low profile package. Standard models are available with nominal input voltages as 5, 12 or 28 volts in range of 4,5-5,5, 9-36 or 16-40 volts. The series include single, bi and triple output voltage choices of 3.3, 5, 12, 15, +/-5, +/-12 or +/-15 volts. No external heatsink is required for the MGDM-04 series to supply 4W output power over the case temperature range of -40°C up to 105°C. 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, a permanent

short circuit protection and an inhibit function to ensure efficient module protection.

The soft-start allows current limitation and eliminates inrush current during start-up. The short circuit protection completely protects the module against short-circuits of any duration by a shut-down and restores to normal when the overload is removed.

The inhibit function is commanded with a low logic level and disables the module for applications requiring on/off operations. 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 and burned in with a GAIA converter automated test equipment before and after encapsulation. The modules are potted with a bi-component thermal conductive compound and packaged in a metallic case to ensure the module's integrity under high environmental conditions.

4

2-Product Selection

Single output model : MGDS-04- ☐ — ☐ (/T) and/or (/S)
Bi output model : MGDB-04- ☐ — ☐ (/T) and/or (/S)
Triple output model : MGDT-04- ☐ — ☐ (/T) and/or (/S)

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

Input Voltage Range

Permanent	Transient
C : 4,5-5,5 VDC	n/a
H : 9-36 VDC	40 VDC/100 ms*
J : 16-40 VDC	50 VDC/100 ms*

Output

B : 3.3 VDC
C : 5 VDC or +/-5VDC
E : 12 VDC or +/-12VDC
F : 15 VDC or +/-15VDC
CF : 5 VDC and +/-15 VDC

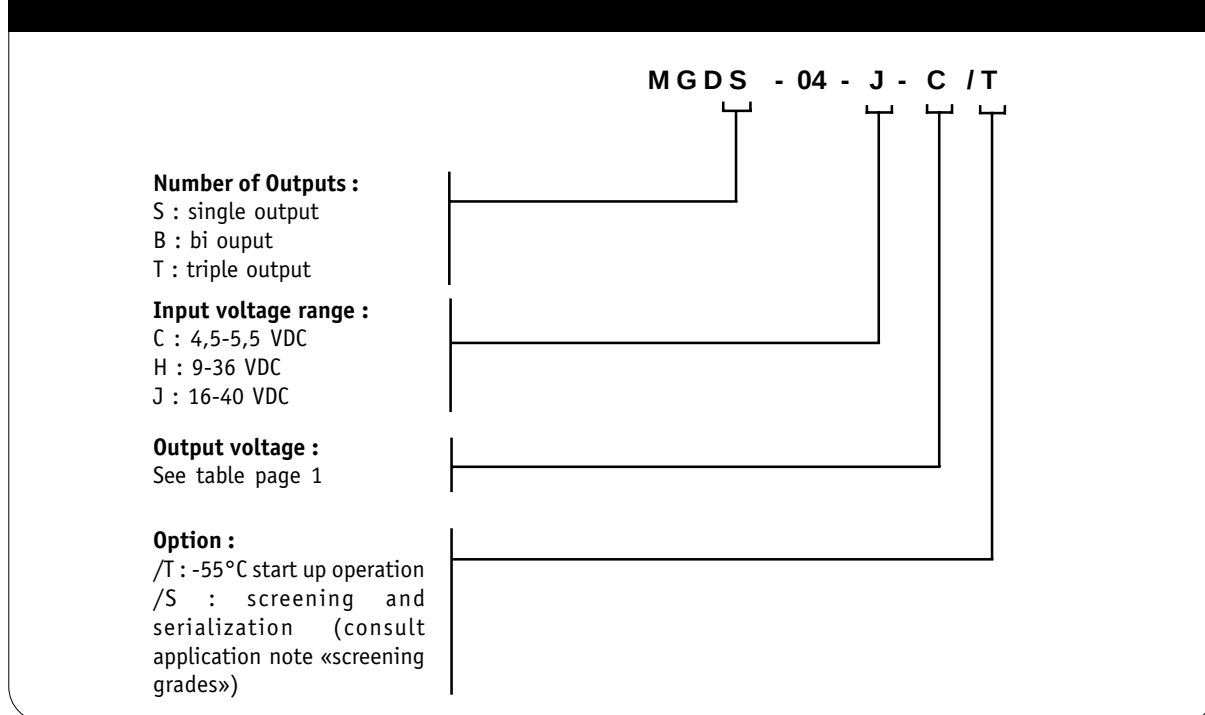
* Consult factory for details

2- Product Selection (continued)

Input range	Output	Current	Reference	Options
4,5-5,5 VDC	3,3 VDC	1A	MGDS-04-C-B	/T, /S
4,5-5,5 VDC	5 VDC	800 mA	MGDS-04-C-C	/T, /S
4,5-5,5 VDC	12 VDC	330 mA	MGDS-04-C-E	/T, /S
4,5-5,5 VDC	15 VDC	260 mA	MGDS-04-C-F	/T, /S
4,5-5,5 VDC	+/- 5 VDC	+/- 400 mA	MGDB-04-C-C	/T, /S
4,5-5,5 VDC	+/- 12 VDC	+/- 165 mA	MGDB-04-C-E	/T, /S
4,5-5,5 VDC	+/- 15 VDC	+/- 130 mA	MGDB-04-C-F	/T, /S
9-36 VDC	3,3 VDC	1A	MGDS-04-H-B	/T, /S
9-36 VDC	5 VDC	800 mA	MGDS-04-H-C	/T, /S
9-36 VDC	12 VDC	330 mA	MGDS-04-H-E	/T, /S
9-36 VDC	15 VDC	260 mA	MGDS-04-H-F	/T, /S
9-36 VDC	+/- 5 VDC	+/- 400 mA	MGDB-04-H-C	/T, /S
9-36 VDC	+/- 12 VDC	+/- 165 mA	MGDB-04-H-E	/T, /S
9-36 VDC	+/- 15 VDC	+/- 130 mA	MGDB-04-H-F	/T, /S
16-40 VDC	3,3 VDC	1A	MGDS-04-J-B	/T, /S
16-40 VDC	5 VDC	800 mA	MGDS-04-J-C	/T, /S
16-40 VDC	12 VDC	330 mA	MGDS-04-J-E	/T, /S
16-40 VDC	15 VDC	260 mA	MGDS-04-J-F	/T, /S
16-40 VDC	+/- 5 VDC	+/- 400 mA	MGDB-04-J-C	/T, /S
16-40 VDC	+/- 12 VDC	+/- 165 mA	MGDB-04-J-E	/T, /S
16-40 VDC	+/- 15 VDC	+/- 130 mA	MGDB-04-J-F	/T, /S
16-40 VDC	5 & +/-15 VDC	500 & +/-50 mA	MGDT-04-J-CF	/T, /S

4

Converter Selection Chart



3- Electrical Specifications

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

Parameter	Conditions	Limit or typical	Units	Single Output MGDS-04		
				04 - C	04 - H	04 - J
Input						
Nominal input voltage	Full temperature range	Nominal	VDC	5	20	28
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	4,5-5,5	9-36	16-40
Transient input voltage	Full load (consult factory)	Maximum	VDC/S	/	40/0,1	50/0,1
Start up input voltage	Full load	Minimum	VDC	4,3	8,5	15,5
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	200	200	200
Reflected ripple current	Ui nominal, full load at switching freq. BW = 20MHz	Maximum	mApp	50	50	30
Input current in short circuit mode (Average)	Ui nominal Short-circuit	Maximum	mA	50	30	30
No load input current	Ui nominal No load	Maximum	mA	50	30	30
Input current in inhibit mode	inhibit	Maximum	mA	5	5	5
Output						
Output voltage	Full temperature range Ui min. to max. 75% load	Nominal	VDC	3,3	3,3	3,3
		Nominal	VDC	5	5	5
		Nominal	VDC	12	12	12
		Nominal	VDC	15	15	15
Set Point accuracy	Ambient temperature : +25°C Ui nominal, 75% load	Maximum	%	+/- 2	+/- 2	+/- 2
Output power	Full temperature range Ui min. to max.	Maximum	W	4	4	4
Output current	Full temperature range Ui min. to max.	Maximum	mA	1.000	1.000	1.000
3,3V output		Maximum	mA	800	800	800
5V output		Maximum	mA	330	330	330
12V output		Maximum	mA	260	260	260
15V output		Maximum	mA	260	260	260
Ripple output voltage *						
3,3V and 5V output	Ui nominal	Maximum	mVpp	40	40	40
12V output	Full load	Maximum	mVpp	50	50	50
15V output	BW = 20MHz	Maximum	mVpp	60	60	60
Line regulation	Ui min. to max. Full load	Maximum	%	+/- 0,5	+/- 0,5	+/- 0,5
Load regulation	Ui nominal 25% to full load	Maximum	%	+/- 2	+/- 2	+/- 2
Efficiency	Ui nominal Full load	Typical	%	see on page 6		
Maximum admissible Capacity load	Ui nominal					
3,3V and 5V output	Full load	Maximum	µF	1.000	1.000	1.000
12V and 15V output	Per output	Maximum	µF	47	47	47

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 capacitance (typically 10nF/rated voltage depending on isolation requirement) connected between the pin Gin and the pin Gout of the converter. This capacitance should be layed-out as close as possible from the converter.

3- Electrical Specifications (continued)

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

Parameter	Conditions	Limit or typical	Units	Bi Output MGDB-04		
				04 - C	04 - H	04 - J
Input						
Nominal input voltage	Full temperature range	Nominal	VDC	5	20	28
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	4,5-5,5	9-36	16-40
Transient input voltage	Full load (consult factory)	Maximum	VDC/S	/	40/0,1	50/0,1
Start up input voltage	Full load	Minimum	VDC	4,3	8,5	15,5
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	200	200	200
Reflected ripple current	Ui nominal, full load at switching freq. BW = 20MHz	Maximum	mApp	50	50	30
Input current in short circuit mode (Average)	Ui nominal Short-circuit	Maximum	mA	50	30	30
No load input current	Ui nominal No load	Maximum	mA	50	30	30
Input current in inhibit mode	inhibit	Maximum	mA	5	5	5
Output						
Output voltage	Full temperature range	Nominal	VDC	+/- 5	+/- 5	+/- 5
	Ui min. to max.	Nominal	VDC	+/- 12	+/- 12	+/- 12
	75% load	Nominal	VDC	+/- 15	+/- 15	+/- 15
Set Point accuracy	Ambient temperature : +25°C Ui nominal, 75% load	Maximum	%	+/- 2	+/- 2	+/- 2
Output power	Full temperature range Ui min. to max.	Maximum	W	+/- 2	+/- 2	+/- 2
Output current	Full temperature range Ui min. to max.	Maximum	mA	+/- 400	+/- 400	+/- 400
+/- 5V output		Maximum	mA	+/- 165	+/- 165	+/- 165
+/- 12V output		Maximum	mA	+/- 130	+/- 130	+/- 130
+/- 15V output						
Ripple output voltage *						
5V output	Ui nominal	Maximum	mVpp	40	40	40
12V output	Full load	Maximum	mVpp	50	50	50
15V output	BW = 20MHz	Maximum	mVpp	60	60	60
Line regulation	Ui min. to max. Full load	Maximum	%	+/- 0,5	+/- 0,5	+/- 0,5
Load regulation	Ui nominal 25% to full load	Maximum	%	+/- 2	+/- 2	+/- 2
Cross load output regulation	Ui nominal + Vout nominal load - Vout from 25% to full load	Maximum	%	+/- 0,5	+/- 0,5	+/- 0,5
Efficiency	Ui nominal Full load	Typical	%	see on page 6		
Maximum admissible Capacity load	Ui nominal					
5V output	Full load	Maximum	μF	470	470	470
12V and 15V output	Per output	Maximum	μF	22	22	22

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 capacitance (typically 10nF/rated voltage depending on isolation requirement) connected between the pin Gin and the pin Gout of the converter. This capacitance should be layed-out as close as possible from the converter.

3- Electrical Specifications (continued)

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

Parameter	Conditions	Limit or typical	Units	Triple Output MGDT-04- J
Input				
Nominal input voltage	Full temperature range	Nominal	VDC	28
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	16-40
Transient input voltage	Full load (consult factory)	Maximum	VDC/S	50/0,1
Start up input voltage	Full load	Minimum	VDC	15,5
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	200
Reflected ripple current	Ui nominal, full load at switching freq. BW = 20MHz	Maximum	mApp	30
Input current in short circuit mode (Average)	Ui nominal Short-circuit	Maximum	mA	30
No load input current	Ui nominal No load	Maximum	mA	30
Input current in inhibit mode	inhibit	Maximum	mA	5
Output				
Output voltage	Full temperature range Ui min. to max. 75% load	Nominal	VDC	5 & +/- 15
Set Point accuracy	Ambient temperature : +25°C Ui nominal, 75% load	Maximum	%	+/- 2
Output power	Full temperature range Ui min. to max.	Maximum	W	2 & +/- 1
Output current 5V & +/- 15V output	Full temperature range Ui min. to max.	Maximum	mA	500 & +/- 50
Ripple output voltage *	Ui nominal			
5V output	Full load	Maximum	mVpp	40
15V output	BW = 20MHz	Maximum	mVpp	60
Line regulation	Ui min. to max. Full load	Maximum	%	+/- 0,5
Load regulation	Ui nominal 25% to full load	Maximum	%	+/- 2
Cross load output regulation	Ui nominal + Vout nominal load - Vout from 25% to full load	Maximum	%	+/- 0,5
Efficiency	Ui nominal Full load	Typical	%	80
Maximum admissible Capacity load	Ui nominal			
5V output	Full load	Maximum	μF	220
15V output	Per output	Maximum	μF	47

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 capacitance (typically 10nF/rated voltage depending on isolation requirement) connected between the pin Gin and the pin Gout of the converter. This capacitance should be layed-out as close as possible from the converter.

3- Electrical Characteristics (continued)

Figure 1 : Typical efficiency versus load at nominal input

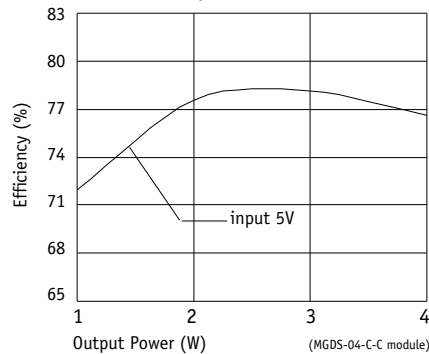


Figure 2 : Typical efficiency versus load at nominal input

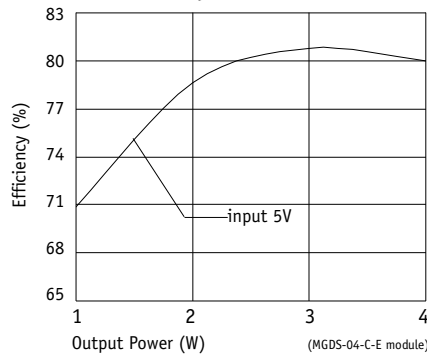


Figure 3 : Typical efficiency versus load at nominal input

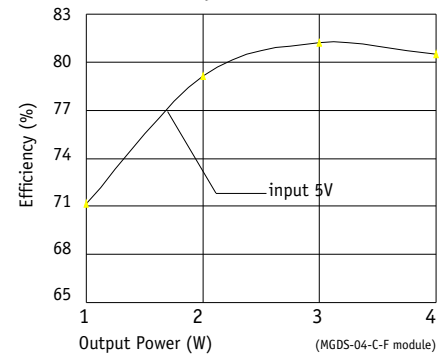


Figure 4 : Typical efficiency versus load at various input

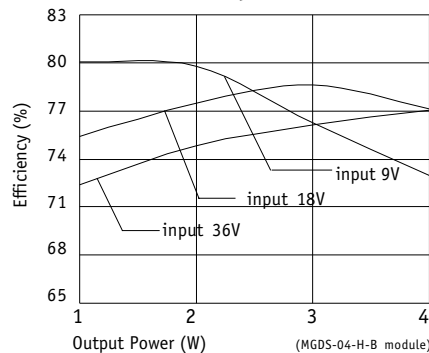


Figure 5 : Typical efficiency versus load at various input

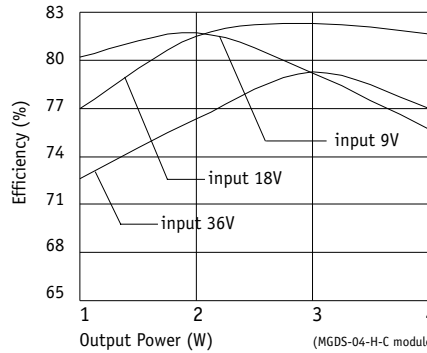


Figure 6 : Typical efficiency versus load at nominal input

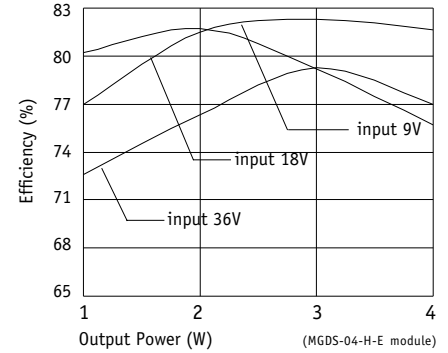


Figure 7 : Typical efficiency versus load at various input

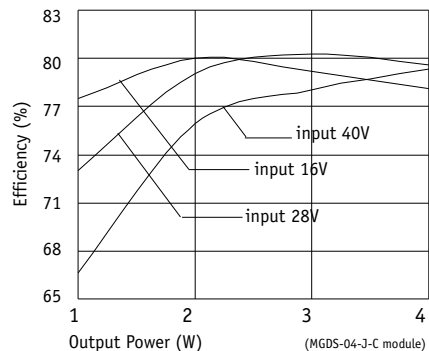


Figure 8 : Typical efficiency versus load at various input

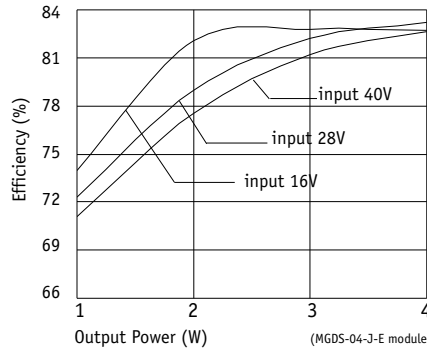


Figure 9 : Typical efficiency versus load at various input

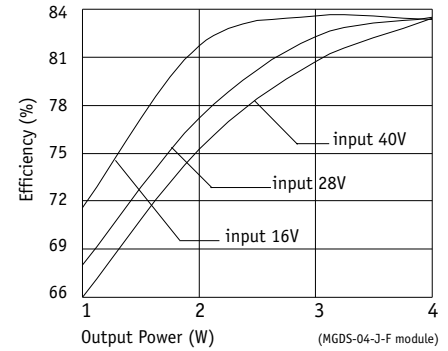


Figure 10 : Typical load regulation characteristics at nominal input

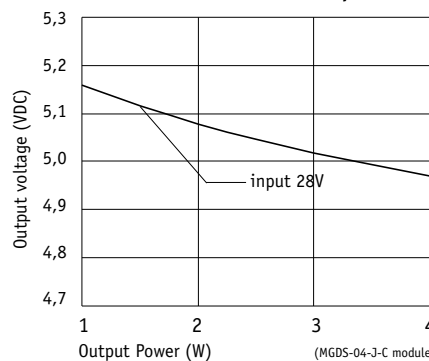


Figure 11 : Typical load regulation characteristics at nominal input

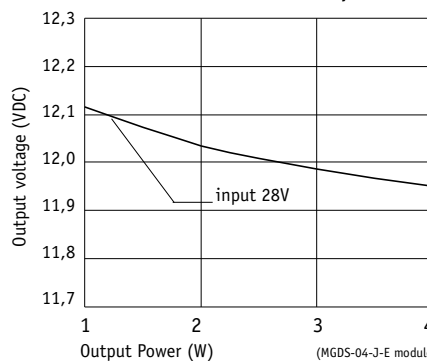
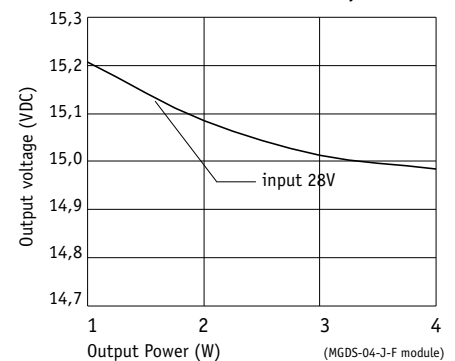


Figure 12 : Typical load regulation characteristics at nominal input



4- Functional Characteristics

Characteristics	Conditions	Limit or typical	Performances
Electric strength test voltage	Input to output	Minimum	1.500 VDC / 1 min
Isolation resistance	500 VDC	Minimum	100 Mohm
Inhibit function	Inhibit	/	See section 7.3
Short circuit protection	Short circuit	/	Permanent
Switching frequency	No load to full load	Nominal	500 KHz single & bi output models 400 KHz triple output models

5- Thermal and Reliability 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	20°C /W
Mean time between failure According to MIL - HDBK - 217F	Ground fixed (Gf) Airborne, Inhabited, Cargo (AIC)	Case at 40°C Case at 85°C Case at 40°C Case at 85°C	1.650.000 Hrs 645.000 Hrs 900.000 Hrs 350.000 Hrs

Note *: The upper temperature range depends on configuration, the user must assure a max. case temperature of + 105°C (See Application Notes : Ambient versus case temperature).

6- Environmental and Electromagnetic Interference Qualification

Characteristics	Conditions	Severity	Test procedure
Altitude	Altitude level C Climb up	40.000 ft, unit functioning 1.000 ft/min to 70.000 ft, unit functioning	MIL - STD - 810D Method 500.2
Humidity	Damp heat Duration	88 % H.R Cycle I : 240 Hrs	MIL - STD - 810D Method 507.2
Salt atmosphere	Duration	48 Hrs	MIL - STD - 810E Method 509.1
Temperature cycling	Number of cycles Temperature change Transfert time / Steady state time	200 -40°C / +85°C 40 min. / 20 min.	MIL - STD - 883C Method 1010
Vibration (Sinusoidal)	Number of cycles Frequency Amplitude/acceleration	10 cycles in each axis 10 to 60 Hz/60 to 2000 Hz 0.7 mm/10 g	MIL - STD - 810D Method 514.3
Shock (Half sinus)	Number of shocks Peak acceleration Duration	3 shocks in each axis 100 g 6 ms	MIL - STD - 810D Method 516.3
Bump (Half sinus)	Number of bumps Peak acceleration Duration	2000 Bumps in each axis 40 g 6 ms	MIL - STD - 810D Method 516.3
Conducted Emission	Module stand alone & common mode capacitance (10nF) With external filter KG9501 Module stand alone	CE01 CE03 CE07	MIL - STD - 461C
Conducted susceptibility	With external filter KG9501 With external filter KG9501	CS01, CS02 CS06 spike #2	MIL - STD - 461C
Radiated emission	Module stand alone & common mode capacitance (10nF)	RE01 RE02	MIL - STD - 461C
Radiated susceptibility	Module stand alone	RS01, RS03	MIL - STD - 461C

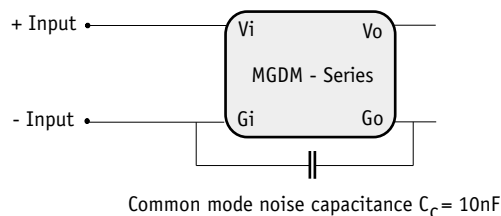
6- Environmental and Electromagnetic Interference Qualification (continued)

Electromagnetic interference requirements according to MIL-STD-461 C and MIL-STD-461 D can be easily achieved as indicated in the following table. Compliance to these requirements apply to J series or H series of DC/DC modules.

	MIL-STD-461 C	Module stand alone with common mode noise capacitance C_c	Module with external filter with common mode noise capacitance C_c
Conducted emission Low frequency 30Hz - 15KHz Narrowband 15KHz - 50 MHz Broadband 15KHz - 50 MHz	CE 01 CE 03 CE 03	CE 01 / /	CE 01 CE 03 CE 03
Conducted susceptibility Band 1.5 Hz - 50 KHz Band 50 KHz - 400 MHz	CS 01 CS 02	/ /	CS 01 CS 02
Radiated emission Band 30Hz - 15Hz Narrowband 14KHz - 1GHz Broadband 14KHz - 1GHz	RE 01 RE 02 RE 02	RE 01 RE 02 RE 02	RE 01 RE 02 RE 02
Radiated susceptibility Band 30 Hz - 50 KHz Band 14 KHz - 10GHz	RS 01 RS 03	RS 01 RS 03	RS 01 RS 03

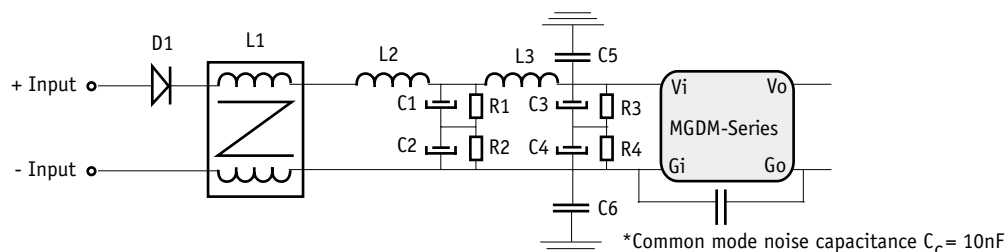
6-1 Basic Configuration : Module Stand Alone with Common Mode Noise Capacitance

A basic configuration with module stand alone and common mode noise capacitance C_c connected between G_{in} and G_{out} will conduct to the results described in the previous table. This common mode noise capacitance C_c (10nF/rated voltage depending on isolation requirement) should be layed-out as close as possible from the DC/DC converter.



6-2 Configuration with Module and Front Filter KG9501

To meet MIL-STD-461 C requirements and in particular CE 03, Gaia Converter recommends the use of front filter KG9501 together with the common mode noise capacitance C_c (10nF/rated voltage depending on isolation requirement) connected between G_{in} and G_{out} . Please consult KG9501 datasheet for further details.



7- Application Notes

7-1 Short Circuit Protection

The short circuit protection device protects the modules against short circuits of any duration and restores the module to normal operation when the short circuit is removed.

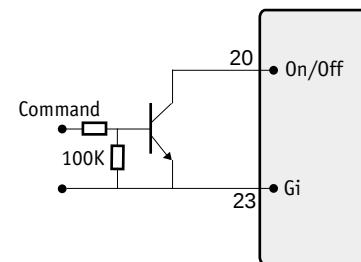
7-2 Custom Output

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.

7-3 On/Off function

The control pin 20 (On/Off) can be used for applications requiring On/Off operation. By using an open collector command with a transistor Q referenced to the common terminal (Gi) :

- A logic pulled low ($<0.2V@1mA$, referenced to Gi) on pin 20 disables the converter
- No connection or high impedance on pin 20 enables the converter.



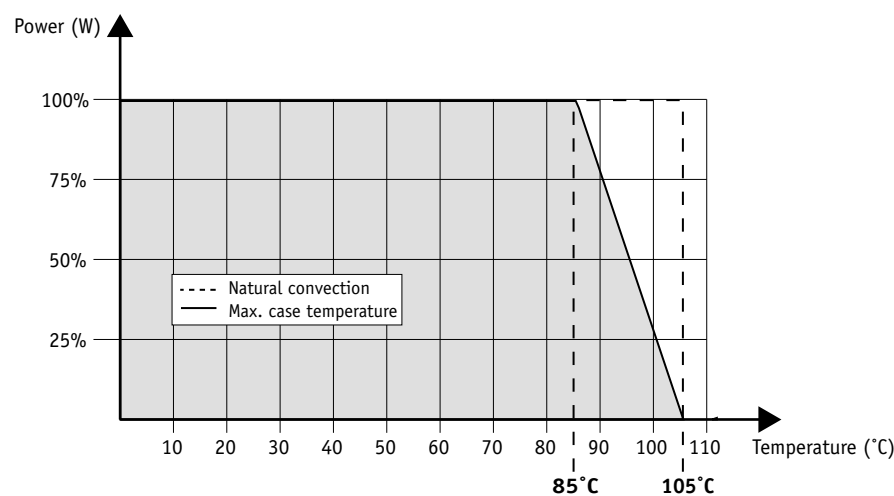
For further details please consult "Logic On/Off" Application Note.

By releasing the On/Off function, the converter will restart within the start-up time specifications given in table page 3.

7-4 Ambient versus Case Temperature

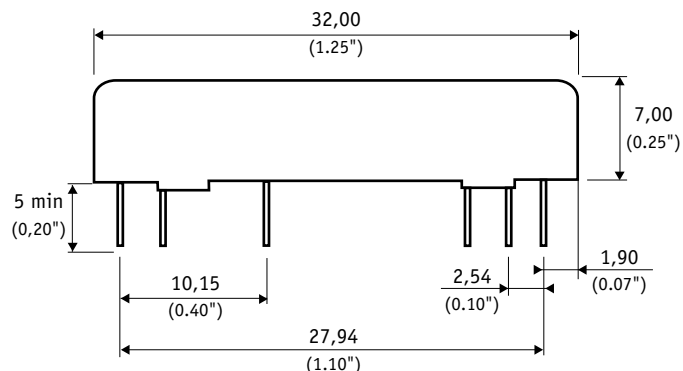
The MGDM-04 series operating **case** temperature at full load must not exceed 105°C. The maximum **ambient** temperature admissible for the DC/DC converter corresponding to the maximum operating case temperature of 105°C depends on the ambient airflow, the mounting/orientation, the cooling features and the power dissipated. 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 at full load (white area in the following graph).

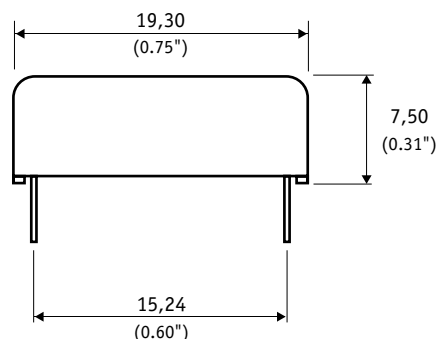


8- Dimensions

Dimension are given in mm (inches). Tolerance : +/- 0,2 mm (+/- 0.01 ") unless otherwise indicated.
Weight : 10 grams (0.3 Ozs) max.



Pin dimensions : Ø 0,53 mm (0.02 ")



Metallic case black anodized coating solder plated pin

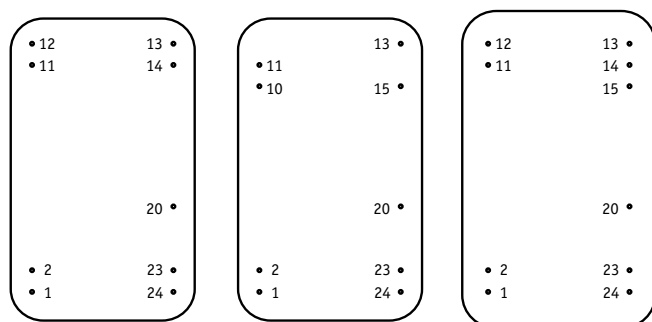
For triple output models outline dimensions are : 35 mm (1.4") x 20 mm (0.8") x 10,50 mm (0.4")

9- Product Marking

Upper face : Company logo, location of manufacturing, module reference.
Side face : Date code : year and week of manufacturing.

4

10- Connections



Single output model

Bi output model

Triple output model

Bottom view

Pin	Single	Bi	Triple
1	+ Input (Vi)	+ Input (Vi)	+ Input (Vi)
2	+ Input (Vi)	+ Input (Vi)	+ Input (Vi)
10	/	Common (Go)	/
11	Common (Go)	Common (Go)	Common (Go)
12	Common (Go)	/	Common (Go)
13	Output (Vo)	Output - (-Vo)	Output 2- (-V2)
14	Output (Vo)	/	Output 1 (V1)
15	/	Output + (+Vo)	Output 2+ (+V2)
20	On/Off	On/Off	On/Off
23	- Input (Gi)	- Input (Gi)	- Input (Gi)
24	- Input (Gi)	- Input (Gi)	- Input (Gi)



For more detailed specifications and applications information, contact :

International Headquarters

Marketing and Sales department

GAIA Converter - France

Address : B.P. 26 - 33186 LE HAILLAN - FRANCE

Tel. : + (33)-5-57-92-12-80

Fax : + (33)-5-57-92-12-89

North American Headquarters

GAIA Converter Canada, Inc

Address : 6611 Thimens

ST-LAURENT, QUEBEC - CANADA H4S 1W2

Tel. : (514)-333-3169

Fax : (514)-333-4519

Represented by :

--