Hi-Rel DC/DC CONVERTER
CGDM TETHYS : 30W POWER

Hi-Rel Grade

Configurable Multiple Outputs
Metallic case - 1 500 VDC Isolation

- 28 Vdc input compliant with MIL-STD-704D/E
- Highly configurable DC/DC converter
- Up to 6 outputs and 3 independant line regulations
- Low profile : 0,33 " (8.5mm)
- Nominal Power of 30 W without derating
- Wide temperature range : -40°C/+105°C case
- Galvanic isolation 1.500 VDC
- Integrated LC EMI filter
- Permanent short circuit protection
- External trim and sense adjustment : +/-5%
- Inhibit function
- RoHS or Leaded process option

1-General

The TETHYS 30W series is a full family of highly configurable DC/DC low profile power module designed for direct implementation on high density printed circuit boards designed for aerospace, military and high-end industrial applications. This module uses a high frequency fixed swiching technic at 480 KHz providing excellent reliability, low noise characteristics and low profile package. This model is available with nominal input voltages as 12 or 28 volts in range of 9-36 or 16-40 volts. The serie includes thousands of output configuration from single, bi up to six possible output voltages in choices of 3,3, 5, 12, 15, 24 volts with trim and sense functions for output voltage adjustment.

No external heatsink is required for the for CGDM series to supply 30W 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 undervoltage lock-out, a permanent short circuit protection an output overvoltage protection and a thermal 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 module against short-circuits of any duration by a shut-down and restores to normal when the overload is removed. The thermal protection is adjusted to 110°C and protects the module against overheat.

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.

2-Product Selection

Multiple output model : CGDM - *input* – *output* – *output* – *output* / *option* – *suffix*

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

* Consult factory

Output
3 : 3.3 VDC
5 : 5 VDC
5B : +/-5VDC
12 : 12 VDC
12B : +/-12VDC
15 : 15 VDC
15B : +/-15VDC
24 : 24 VDC
24B : +/- 24VDC

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)

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For locations, phone, fax, E-Mail see back cover

2- Product Selection (continued)

Single line model : CGDM- □ — ■ — 0 — 0 > 30 W first line output : primary output

Dual line model : CGDM- □ — ■ — 0 — ■ > 20 W first line output : primary output
> 10 W second line output : secondary output

Triple line model : CGDM- □ — ■ — ■ — ■ > 10 W on each line output : primary and secondary outputs

First line output functions :
Trim function at +/- 5%
Sense function at +/- 5%
Tight regulation below 1%
Indefinite short circuit protection

Secondary line output functions :
Independant regulation from primary output
Indefinite short circuit protection

Input Voltage Range

Designation	Permanent
H	9-36 VDC
J	16-40 VDC

Output Voltage

Designation	Output Voltage
3	3.3 VDC
5	5 VDC
5B	+/-5VDC
12	12 VDC
12B	+/-12VDC
15	15 VDC
15B	+/-15VDC
24	24 VDC
24B	+/-24VDC

Converter Selection Chart

CGDM - Q - 5 - 0 - 12B /T - L

Input voltage range :
H : 9-36 VDC
J : 16-40 VDC

Output voltage :
5 : 5 Vdc, 20W First line
12B : +/-12 Vdc, 10W second line
See table page 1 for complete possibilities

Options :
/T : -55°C start up operating temp.
/S : option for screening and serialization
(consult application note «screening grades»).

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

3- Electrical Specifications

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

Parameter	Conditions	Limit or typical	Units	CGDM-H	CGDM-J
Input					
Nominal input voltage	Full temperature range	Nominal	VDC	20	28
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	9-36	16-40
Transient input voltage	Full load (consult factory)	Maximum	VDC/S	40/0,1	50/0,1
Undervoltage lock-out (UVLO)	Threshold	Minimum Maximum	VDC VDC	7 8,5	12 15
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	40	40
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	60	60
No load input current	Ui nominal No load	Maximum	mA	60	60
Primary Output					
Output voltage *	Ui min. to max. 75% load	Nominal	VDC	3,3V , 5V , 12V , 15V or 24V *Consult factory for other outputs*	
Set Point accuracy + Line regulation + Load regulation	Ambient temperature : +25°c Ui min. to max. 25% to full load	Maximum	%	+/- 1	+/- 1
Output power **	Full temperature range Ui min. to max.	Maximum	W	10, 20 or 30 (limited to respectively 2A, 4A or 6A max.)	
Ripple output voltage *** 3,3V and 5V output 12V output 15V and 24V output	Ui nominal Full load BW = 20MHz	Maximum Maximum Maximum	mVpp mVpp mVpp	40 50 60	40 50 60
Trim function	Ui nominal	Maximum Minimum	% %	+ 5 - 5	+ 5 - 5
Sense function	Ui nominal	Maximum Minimum	% %	+ 5 - 5	+ 5 - 5
Secondary Output					
Output voltage *	Ui min. to max. 75% load	Nominal	VDC	3,3V , 5V , 12V , 15V or 24V +/- 5V , +/- 12V , +/- 15V or +/- 24V *Consult factory for other outputs*	
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	10 or 20 (limited to respectively 2A, 4A max)	10 or 20 (limited to respectively 2A, 4A max)
Ripple output voltage *** 3,3V, 5V and +/-5V output 12V and +/-12V output 15V and +/-15V output 24V and +/-24V output	Ui nominal Full load BW = 20MHz	Maximum Maximum Maximum Maximum	mVpp mVpp mVpp mVpp	40 50 60 60	40 50 60 60
Line regulation	Ui min. to max. Full load	Maximum	%	+/- 1	+/- 1
Load regulation ****	Ui nominal 25% to full load	Maximum	%	+/- 2,5	+/- 2,5

*Note * : For proper operation the CGDI module requires to install a 22µF chemical or tantalum capacitance accross output terminals.*
*Note ** : For 9-36V inpt range, the power is derated at 80% at 9V and increases linearly to full power at 12V.*
*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)

Figure 1 : Typical efficiency versus load at nominal input

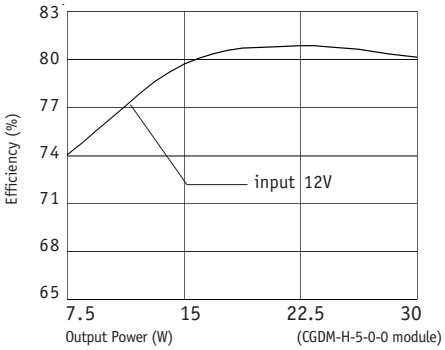


Figure 2 : Typical efficiency versus load at nominal input

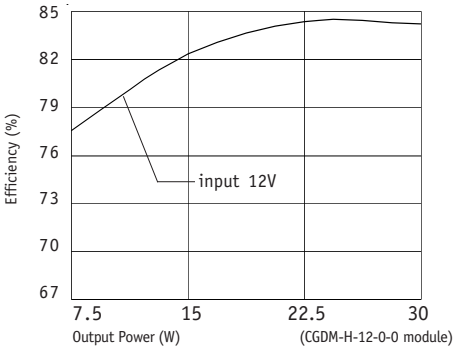


Figure 3 : Typical efficiency versus load at nominal input

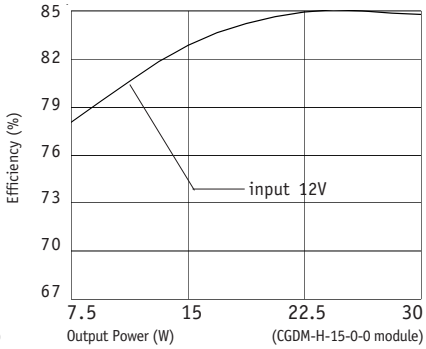


Figure 4 : Typical efficiency versus load at various input

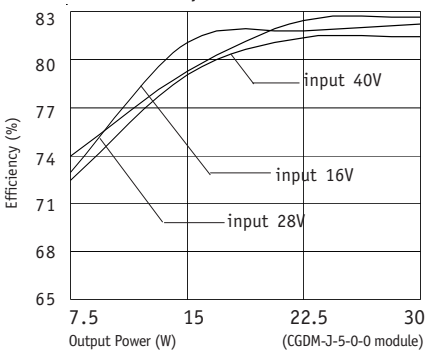


Figure 5 : Typical efficiency versus load at various input

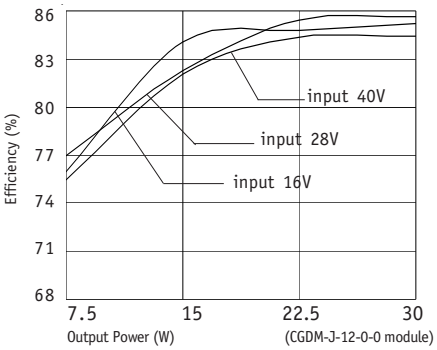


Figure 6 : Typical efficiency versus load at various input

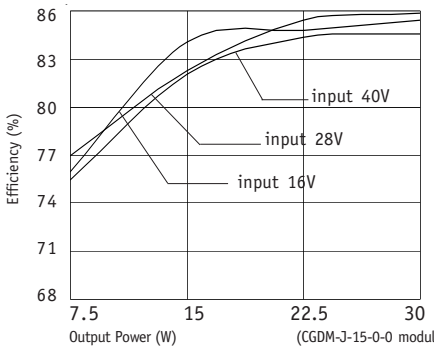


Figure 7 : Typical load regulation characteristics on primary output 5Vdc at nominal input

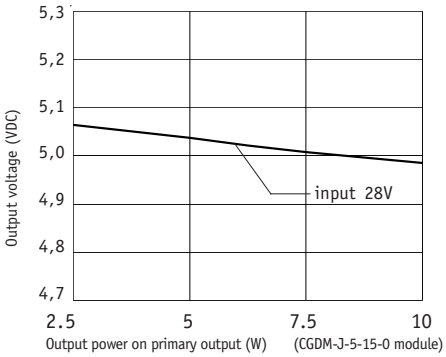


Figure 8 : Typical load regulation characteristics on primary output 12Vdc at nominal input

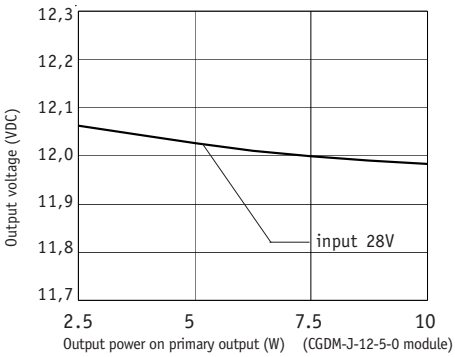


Figure 9 : Typical load regulation characteristics on primary output 15Vdc at nominal input

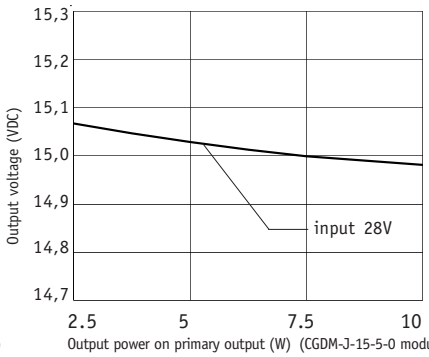


Figure 10 : Typical load regulation characteristics on secondary output 5Vdc at nominal input

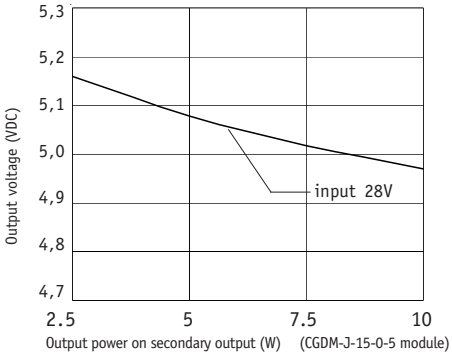


Figure 11 : Typical load regulation characteristics on secondary output 12Vdc at nominal input

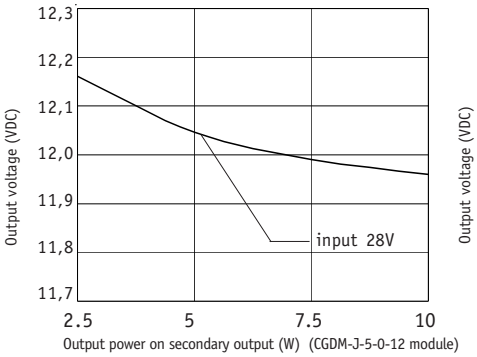
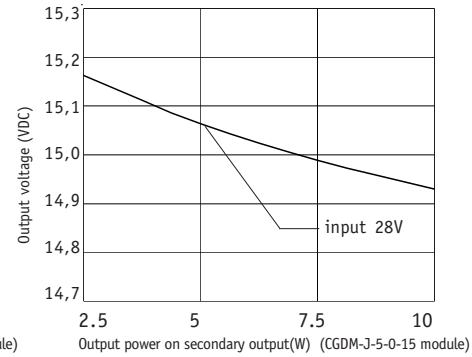


Figure 12 : Typical load regulation characteristics on secondary output 15Vdc at nominal input



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	9-36 VDC input : 480 KHz 16-40 VDC input : 480 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 outputs of the same line of regulation)	Output to output	Minimum	No isolation
Electric strength test voltage between outputs (for outputs of different line of regulation)	Output to output	Minimum	500 VDC/ / 1 min.
Isolation resistance	500 VDC	Minimum	100 MOhm

6- Protection Functions

Characteristics	Protection Device	Recovery	Limit or typical	Specifications
Output short circuit protection (SCP)	Hiccup circuitry with auto-recovery	Automatic recovery	Permanent	See section 11
Output overvoltage protection (OVP)	Zener clamp	/	Maximum Maximum Maximum Maximum	For 3.3v : 4v For 5v : 6v For 12v : 14v For 15v : 17v
Over temperature protection (OTP)	Thermal device with hysteresis cycle	Automatic recovery	Nominal	115°C

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	965 000 Hrs 385 000 Hrs
	Airborne, Inhabited, Cargo (AIC)	Case at 40°C Case at 85°C	260 000 Hrs 115 000 Hrs
Mean Time Between Failure (MTBF) According to IEC-62380-TR	Civilian avionics, calculators	Ambient at 55°C 100% time on	361 000 Hrs

8- Electromagnetic Interference

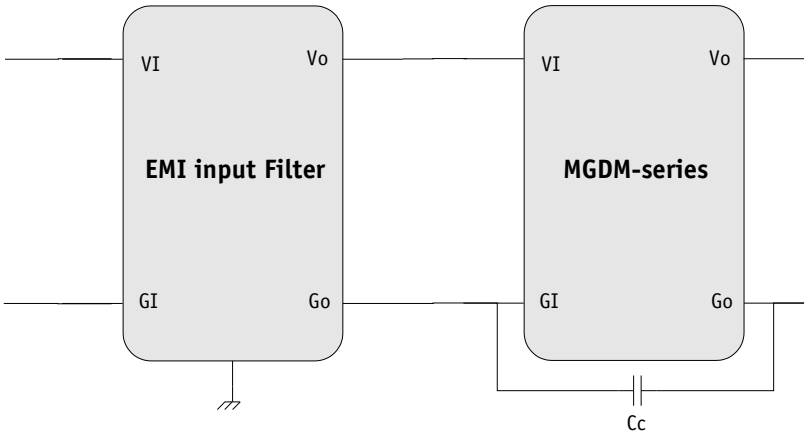
Electromagnetic Interference requirements according to MIL-STD-461C/D/E standards can be easily achieved as indicated in the following section. The following table resumes the different sections covered by these standards.

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

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 functionning	Minimum Maximum	- 55°C + 125°C
Thermal resistance	Rth case to ambient in free air natural convection	Typical	4°C /W

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

The CGDM 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 temparature Tcase = 105°C of the module, the power used Pout and the efficiency η :

- determine the power dissipated by the module Pdiss that should be evacuated :

$$\mathbf{Pdiss = Pout(1/\eta - 1)}$$

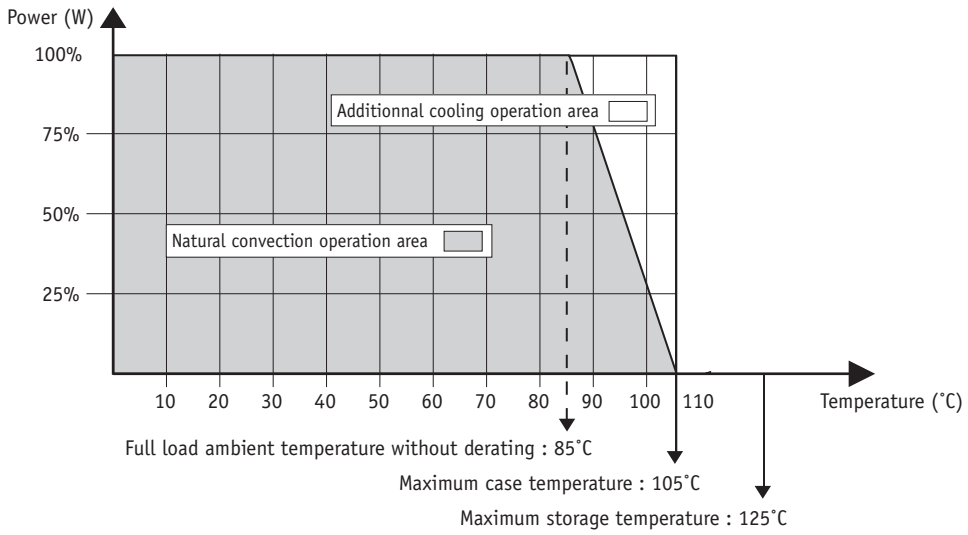
- determine the maximum ambient temperature :

$$\mathbf{Ta = 105°C - Rth \times Pdiss}$$

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

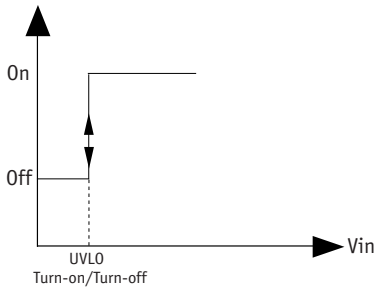
The modules have been subjected to the following environmental qualifications.

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

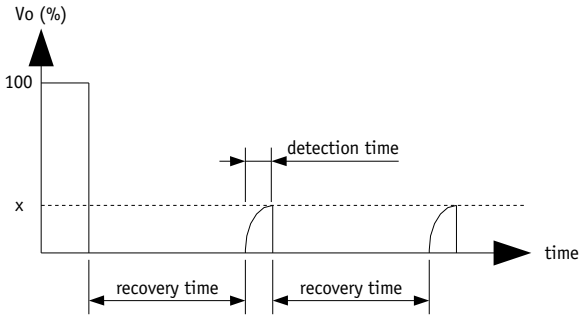
11-1 Input Undervoltage Lock-out (UVLO)

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 with a detection time lower than 5ms.

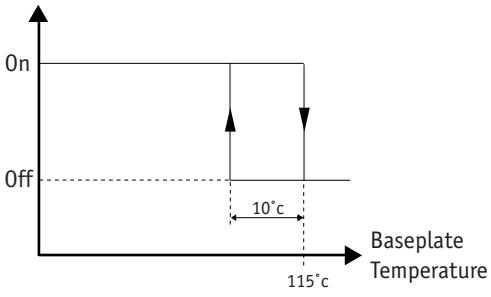


11-3 Output Overvoltage Protection (OVP)

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.

11-4 Over Temperature Protection (OTP)

A thermal protection device adjusted at 115°C (+/-5%) internal temperature with 10°C hysteresis cycle will inhibit the module as long as the overheat is present and restores to normal operation automatically when overheat is removed. The efficiency of the OTP function is warranty with the module mounted on a heatsink.

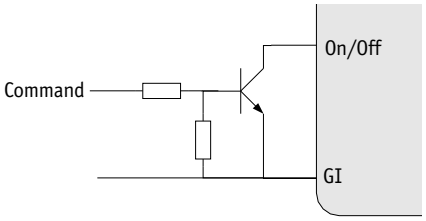


12- Description of Functions

12-1 On/Off Function

The control pin 16 (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 16 disables the converter
- No connection or high impedance on pin 16 enables the converter.

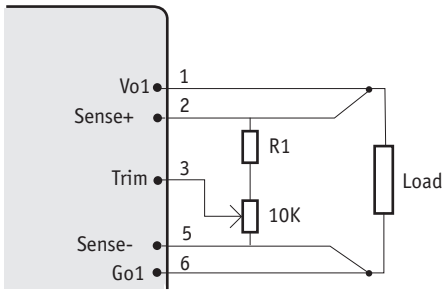


By releasing the On/Off function, the converter will restart within the start-up time specifications given in table page 3. For further details please consult "Logic On/Off" application note.

12-2 Trim Function

The primary output voltage Vo1 may be trimmed at +/-5% 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 :

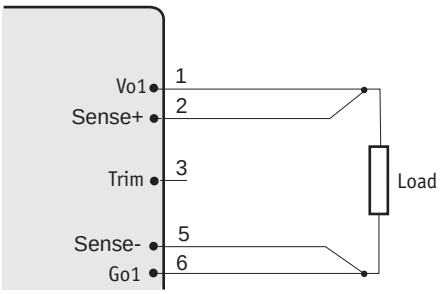
Vo1	R1 Value	Vo1	R1 Value
2,5 V	0 Ohm	12 V	12 KOhm
3,3 V	0 Ohm	15 V	22 KOhm
5 V	0 Ohm	24 V	36 KOhm



12-3 Sense Function

If the load is seperated from the output by any line lenght, some of these performance characteristics will be degraded at the load terminals by an amount proportional to the impedance of the load leads. With the sense function, the voltage at the power supply output shifts by up to the maximum allowed voltage per load line to compensate the voltage drop in the load leads, there by maintaining a constant voltage at the load terminals.

Both Trim and Sense function can be combined but the compensation voltage must not exceed 0.5V max or +/- 5% of the output voltage.



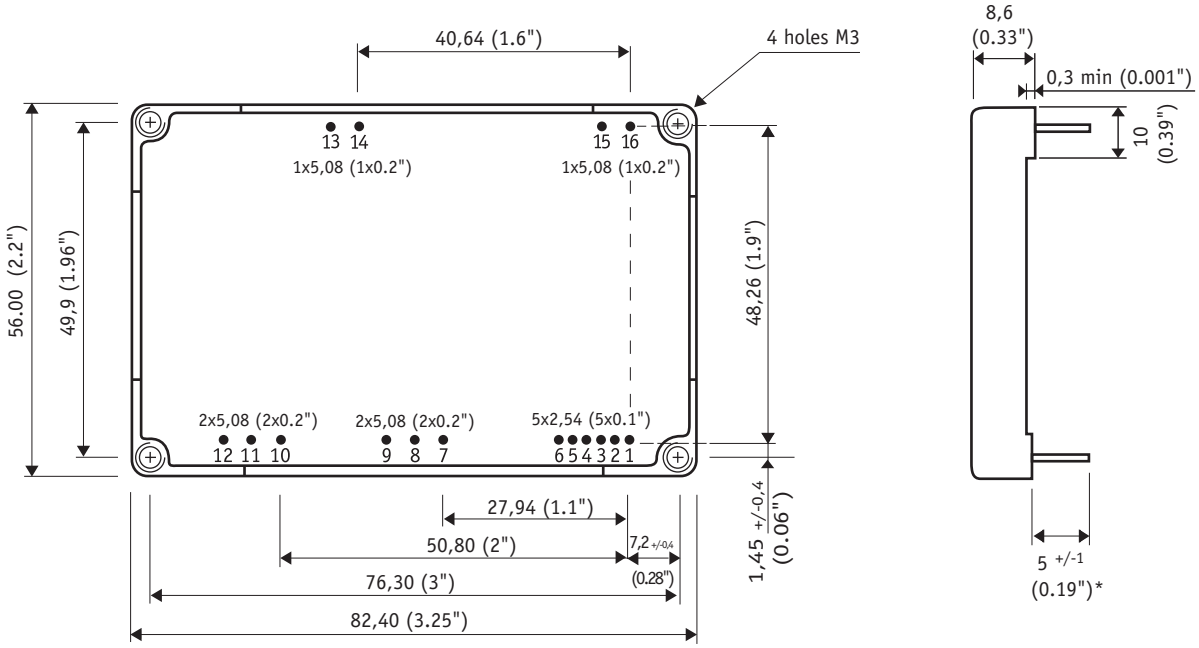
13- Application Notes

13-1 Parallel operations

Tethys series can be used in parallel to increase output power. Up to 3 Tethys can be used to add power up to a maximum of 90W. Contact factory for further details.

14- Dimensions

Dimension are given in mm (inches). Tolerance : +/- 0,2 mm (+/- 0.01 ") unless otherwise indicated.
Weight : 85 grams (2.9 Ozs) max.



15- Materials

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

Pin dimensions : Ø 0,83mm (0.032")
* Except pin 15 : 6 mm (0.23") long

16- Product Marking

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

17- Connections

	Single line	Dual line		Triple line				
	1 Output	2 Outputs		3 Outputs		4 Outputs	5 Outputs	6 Outputs
Pin	CGDM -□-△- 0 - 0	CGDM -□-△- 0 -△	CGDM -□-△-△- 0	CGDM -□-△- 0 -△	CGDM -□-△-△- -△	CGDM -□-△-△-△	CGDM -□-△-△-△	CGDM -□-△-△-△
1	Ouput 1 + (+Vo1)	Output 1 + (+Vo1)	Output 1 + (+Vo1)	Output 1 + (+Vo1)	Output 1 + (+Vo1)	Output 1 + (+Vo1)	Output 1 + (+Vo1)	Output 1 + (+Vo1)
2	Sense +	Sense +	Sense +	Sense +	Sense +	Sense +	Sense +	Do not connect
3	Trim	Trim	Trim	Trim	Trim	Trim	Trim	Do not connect
4	Do not connect	Do not connect	Do not connect	Do not connect	Do not connect	Do not connect	Do not connect	Return 1 (Go1)
5	Sense -	Sense -	Sense -	Sense -	Sense -	Sense -	Sense -	Do not connect
6	Return 1 (Go1)	Return 1 (Go1)	Return 1 (Go1)	Return 1- (Go1)	Return 1 (Go1)	Return 1 (Go1)	Return 1 (Go1)	Output 1 - (-Vo1)
7	Do not connect	Do not connect	Output 2+ (+Vo2)	Do not connect	Output 2 + (+Vo2)	Output 2 + (+Vo2)	Output 2 + (+Vo2)	Output 2 + (+Vo2)
8	Do not connect	Do not connect	Do not connect	Do not connect	Do not connect	Do not connect	Return 2 (Go2)	Return 2 (Go2)
9	Do not connect	Do not connect	Return 2 (Go2)	Do not connect	Return 2 (Go2)	Return 2 (Go2)	Output 2 - (-Vo2)	Output 2 - (-Vo2)
10	Do not connect	Output 2+ (+Vo2)	Do not connect	Output 2+ (+Vo2)	Output 3 + (+Vo3)	Output 3 + (+Vo3)	Output 3 + (+Vo3)	Output 3 + (+Vo3)
11	Do not connect	Do not connect	Do not connect	Return 2 (Go2)	Do not connect	Return 3 (Go3)	Return 3 (Go3)	Return 3 (Go3)
12	Do not connect	Return 2 (Go2)	Do not connect	Output 2- (-Vo2)	Return 3 (Go3)	Output 3 - (-Vo3)	Output 3 - (-Vo3)	Output 3 - (-Vo3)
13	- Input (Gi)	- Input (Gi)	- Input (Gi)	- Input (Gi)	- Input (Gi)	- Input (Gi)	- Input (Gi)	- Input (Gi)
14	+ Input (Vi)	+ Input (Vi)	+ Input (Vi)	+ Input (Vi)	+ Input (Vi)	+ Input (Vi)	+ Input (Vi)	+ Input (Vi)
15	Case	Case	Case	Case	Case	Case	Case	Case
16	On/Off	On/Off	On/Off	On/Off	On/Off	On/Off	On/Off	On/Off

For more detailed specifications and applications information, contact :

International Headquarters
GAÏA Converter - France
ZI de la Morandière
33185 LE HAILLAN - FRANCE
Tel. : + (33)-5-57-92-12-80
Fax : + (33)-5-57-92-12-89

North American Headquarters
GAÏA Converter Canada, Inc
4038 Le Corbusier Blvd
LAVAL, QUEBEC - CANADA H7L 5R2
Tel. : (514)-333-3169
Fax : (514)-333-4519

Represented by :

Printed in France by GAIA Converter FC97-019.01/10 Revision K Graphisme : Philippe Clicq