



Industrial DC/DC CONVERTER

MGDI-150 Wide Input : 150W POWER

Industrial
Grade

5:1 Ultra Wide Input
Single Output
Metallic case - 1.500 VDC Isolation

- Ultra wide input range
- Industry standard half brick package
- Power up to 150 W
- Wide temperature range : -40°C/+ 105° case
- High efficiency (typ. 86%)
- Soft start
- Galvanic isolation 1.500 VDC
- Integrated LC EMI filter
- Synchronizable
- Load sharing, N+1 redundancy
- No load to full load operation
- Fully protected by independant security
 - Overvoltage protection
 - Current limitation & protection
 - Overtemperature protection
- No optocoupler for high reliability

Preliminary



1- General

The MGDI-150 series is a complete line of DC/DC power modules designed for use in distributed power architecture where variable input voltage and transient are prevalent making them ideal particularly for transportation, railways or high-end industrial applications. These modules use a fixed switching technic at 400 KHz providing ultra wide input range, low noise characteristics and high power density. Standard models are available with ultra wide input voltage range of 9-45, 16-80 and 35-155 volts. The series include single output voltage choices of 3,3, 5, 12, 15, 24 volts.

The MGDI-150 series is designed in conformity with safety standards EN60950 and UL1950.

All the modules are designed with LC network filters to minimize reflected input current ripple and output voltage ripple.

The modules include totally independant security functions including temperature protection (OTP), current limitation protection (OCP), output overvoltage protection (OVP), input undervoltage and overvoltage lock-out (UVLO & OVLO). Additionally a soft-start function allows current limitation and eliminates inrush current during start-up.

The design has been carried out with surface mount components, planar transformer 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 harsh environmental conditions.

2- Product Selection

Single output model : MGDSI-150- ☐ - ☐

Permanent Input Voltage Range

Permanent	Transient
H : 9-45 VDC	n/a
O : 16-80 VDC	n/a
Q : 35-155 VDC	n/a

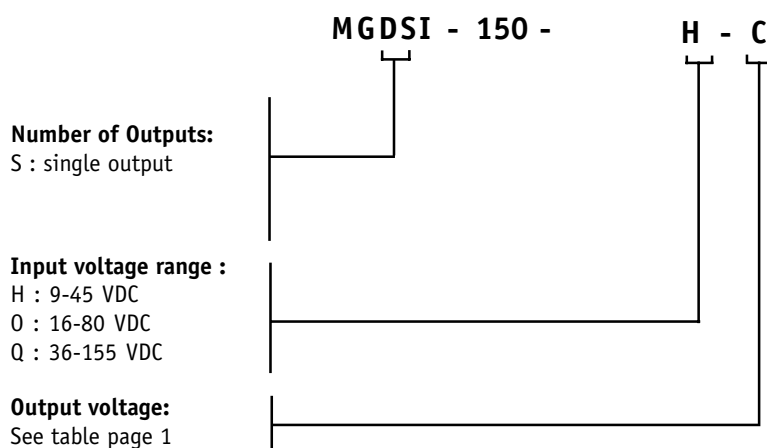
Output

B	: 3,3 VDC
C	: 5 VDC
E	: 12 VDC
F	: 15 VDC
I	: 24 VDC

2- Product Selection (continued)

Input range	Output	Current	Reference	Option
9-45 VDC	3,3 VDC	30 A	MGDSI-150-H-B	
9-45 VDC	5 VDC	30 A	MGDSI-150-H-C	
9-45 VDC	12 VDC	12,5 A	MGDSI-150-H-E	
9-45 VDC	15 VDC	10 A	MGDSI-150-H-F	
9-45 VDC	24 VDC	6,25 A	MGDSI-150-H-I	
16-80 VDC	3,3 VDC	30 A	MGDSI-150-O-B	
16-80 VDC	5 VDC	30 A	MGDSI-150-O-C	
16-80 VDC	12 VDC	12,5 A	MGDSI-150-O-E	
16-80 VDC	15 VDC	10 A	MGDSI-150-O-F	
16-80 VDC	24 VDC	6,25 A	MGDSI-150-O-I	
35-155 VDC	3,3 VDC	30 A	MGDSI-150-Q-B	
35-155 VDC	5 VDC	30 A	MGDSI-150-Q-C	
35-155 VDC	12 VDC	12,5 A	MGDSI-150-Q-E	
35-155 VDC	15 VDC	10 A	MGDSI-150-Q-F	
35-155 VDC	24 VDC	6,25 A	MGDSI-150-Q-I	

Converter Selection Chart



3- Electrical Specifications

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

Models				Single Output MGDI-150		
Parameter	Conditions	Limit or typical	Units	150-H	150-O	150-Q
Input						
Nominal input voltage	Full temperature range	Nominal	VDC	24	28	72
Permanent input voltage range (Ui)	Full temperature range	Min.-Max.	VDC	9-45	16-80	35-155
Extended permanent* input voltage range	Full temperature range	Min.-Max.	VDC	8-45	15-80	35-155
Surge withstand input voltage	Full load (consult factory)	Maximum	VDC/s	N.A	N.A	N.A
Overvoltage lock out (OVLO)	Turn On Turn Off			N.A N.A	N.A N.A	N.A N.A
Undervoltage lock out (UVLO)	Turn on Turn off	Minimum Maximum		N.A N.A	N.A N.A	N.A N.A
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	N.A	N.A	N.A
Reflected ripple current	Ui nominal, full load BW=20MHz	Maximum	mA pp	N.A	N.A	N.A
Input current in short circuit mode (Average)	Ui nominal Short-circuit	Maximum	mA	N.A	N.A	N.A
No load input current	Ui nominal No load	Maximum	mA	N.A	N.A	N.A
Input current in inhibit mode	Ui nominal Inhibit	Maximum	mA	N.A	N.A	N.A
Output						
Output voltage	Ui min. to max.	Nominal	VDC	3.3	3.3	3.3
		Nominal	VDC	5	5	5
		Nominal	VDC	12	12	12
		Nominal	VDC	15	15	15
		Nominal	VDC	24	24	24
Set Point accuracy	Ambient Temperature:+25°C Ui nominal, 75% load	Maximum	%	+/-2	+/-2	+/-2
Output power	At 105°C baseplate Ui min. to max.	Maximum	W	100 to 150	100 to 150	100 to 150
Output current	Full temperature range Ui min. to max.	Maximum	A	30	30	30
		Maximum	A	30	30	30
		Maximum	A	12.5	12.5	12.5
		Maximum	A	10	10	10
		Maximum	A	6.25	6.25	6.25
Ripple output voltage	Ui nominal Full load BW=20MHz	Maximum	mV pp	50	50	50
		Maximum	mV pp	100	100	100
		Maximum	mV pp	150	150	150
Line regulation	Ui min.to max. Full load	Maximum	%	+/-1	+/-1	+/-1
Load regulation	Ui nominal 0% to full load	Maximum	%	+/-1	+/-1	+/-1
Output Voltage Trim	As function of output voltage	Minimum	%	-90	-90	-90
		Maximum	%	+10	+10	+10
Efficiency	Ui nominal Full load	Typical	%	86	86	86
Output Current Limit	Full input voltage range Full load Per output	Maximum	A	N.A	N.A	N.A
		Maximum	A	N.A	N.A	N.A
		Maximum	A	N.A	N.A	N.A
		Maximum	A	N.A	N.A	N.A
		Maximum	A	N.A	N.A	N.A

Note *: Please consult factory for details

4- Functional Characteristics & Protections

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
Current limitation protection (OCP)	Automatic recovery	/	see table section 3
Undervoltage lockout (UVLO)	Automatic recovery	/	see table section 3
Overvoltage lockout (OVLO)	Automatic recovery	/	see table section 3
Overvoltage protection (OVP)	Re-armable	/	see table section 3
Over temperature protection (OTP)	Automatic recovery	Maximum	110°C
Switching frequency	No load to full load	Nominal	400 KHz

5- Thermal and Reliability Characteristics

Characteristics	Conditions	Limit or typical	Performances
Operating ambient temperature range at full load	Ambient temperature *	Minimum Maximum	-40°C see section 7-4
Baseplate temperature	Baseplate temperature	Minimum Maximum	-40°C +105°C
Storage temperature range	Non functioning	Minimum Maximum	-55°C +125°C
Thermal resistance	Baseplate to ambient Rth(b-a)	Typical	N.A
Mean time between failure According to MIL-HDBK-217F	Ground fixed (Gf) Ground mobile (Gm)	Case at 40°C Case at 85°C Case at 40°C Case at 85°C	N.A N.A N.A N.A

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

6- Environmental and Electromagnetic Interference Qualification

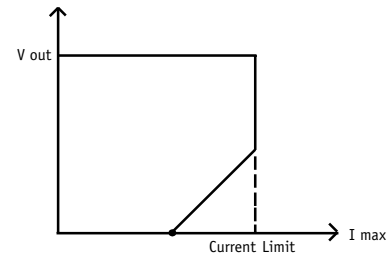
Characteristics	Conditions	Severity	Test procedure
Humidity	Damp heat Temperature	93 %H.R 56 Days 40°C	IEC 68-2-3
Vibration (Sinusoidal)	Number of cycle Frequency Amplitude /acceleration	10 cycles in each axis 10 to 60 Hz/ 60 to 2000 Hz 0.7 mm/10 g	IEC 68-2-6
Shock (Half sinus)	Number of shocks Peak acceleration Duration	3 shocks in each axis 100 g 6 ms	IEC 68-2-27
Bump (Half sinus)	Number of bumps Duration Peak acceleration	2000 Bumps in each axis 6 ms 25 g	IEC 68-2-29
Conducted noise emission	Frequency range 150 KHz to 30 MHz	Class A compliance with external capacitance Class B with external filter KG9502	EN55022 and FCC part 15J
Radiated noise emission	Frequency range 30 MHz to 1.000 MHz	Class A compliance stand alone Class B with common mode capacitance (10nF)	EN55022 and FCC part 15J
Electrical discharge susceptibility	Air discharge level +/-4 KV Contact discharge level +/- 2KV Air discharge level 8 KV Contact discharge level 4 KV	sanction A sanction A sanction B sanction B	EN55082-2 with : EN61000-4-2 IEC 801-2
Electrical field susceptibility	Antenna at 1 m Wave form : AM modulated 80 %, 1KHz Test : 26 KHz to 1 GHz	Value 10V/m	EN55082-2 with : EN61000-4-3 IEC801-3
Electrical fast transient susceptibility	Level 1 : 0.5 KV Level 3 : 2 KV	sanction A sanction B	EN55082-2 with : EN61000-4-4 IEC801-4

7- Application Notes

The MGDI-150 Series include 5 types of protection devices that are powered and controlled on a fully independent side power stage.

7-1 Current Limitation Protection (OCP)

The MGDI-150 series incorporate a foldback current limit and protection circuit. When the output current reaches 110% of its maximum admissible current, the output voltage falls and current falls along the foldback line as described in the figure herein. The module restart automatically to normal operation when overcurrent is removed.



7-2 Output Overvoltage Protection (OVP)

Each circuit has an internal output overvoltage protection circuit that monitors the voltage across the output power terminals. It is designed to latch the converters off at 115% to 135% of rated output voltage. The module needs to be rearmed to restart.

7-3 Overtemperature Protection (OTP)

A thermal protection device adjusted at 115°C 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.

7-4 Undervoltage Lockout (UVLO)

An undervoltage protection will inhibit the module when input voltage falls below a certain threshold (Undervoltage Lockout turn off) and restores to normal operation automatically when undervoltage is removed (Undervoltage Lockout turn on).

7-5 Overvoltage Lockout (UVLO)

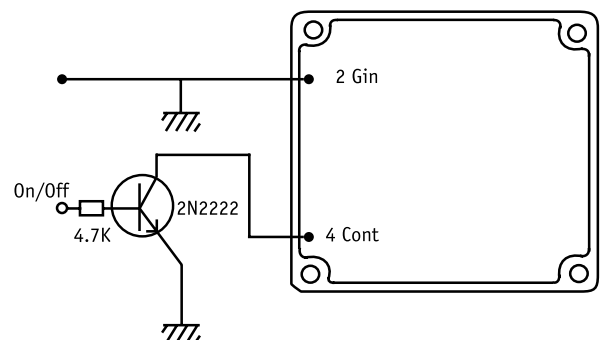
An overvoltage protection will inhibit the module when input voltage reaches a certain threshold (Overvoltage Lockout turn off) and restores to normal operation automatically when overvoltage is removed (Overvoltage Lockout turn on).

7-6 On/Off Function

The control pin 4 (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 4 disables the converter.
- No connection or high impedance on pin 4 enables the converter.

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



7- Application Notes (Continued)

7-7 Trim and Sense Function

7-7-1 Trim Function

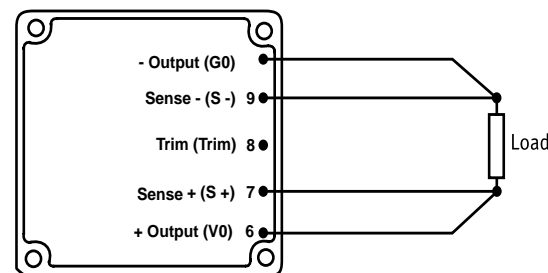
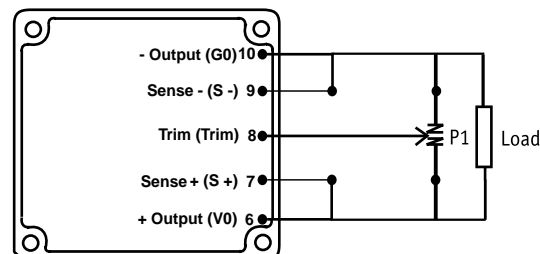
The output voltage V_o may be trimmed in a range of -90%/+10% of the nominal output voltage via a single external trimpot or fixed resistor. Do not attempt to trim the module higher than 110% of nominal output voltage as the overvoltage protection may occur also do not exceed the maximum rated output power when the module is trimmed up. Do not trim down more than -90% of nominal output voltage or 1 Vdc.

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	TBD k Ω
5 V	TBD k Ω
12 V	TBD k Ω
15 V	TBD k Ω
24 V	TBD k Ω

For other V_o 1 Output value consult Factory



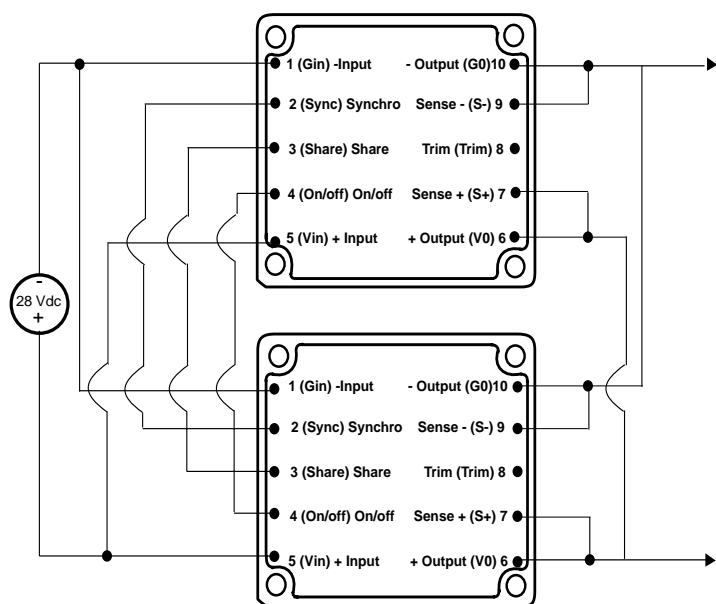
7-7-2 Sense Function

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 +/-10% of output voltage. The overvoltage protection will be activated and module will shut down if remote sense tries to boost output voltage above 110% of nominal output voltage. Connection is described in figure herein.

7-8 Synchronization and Parallel Functions

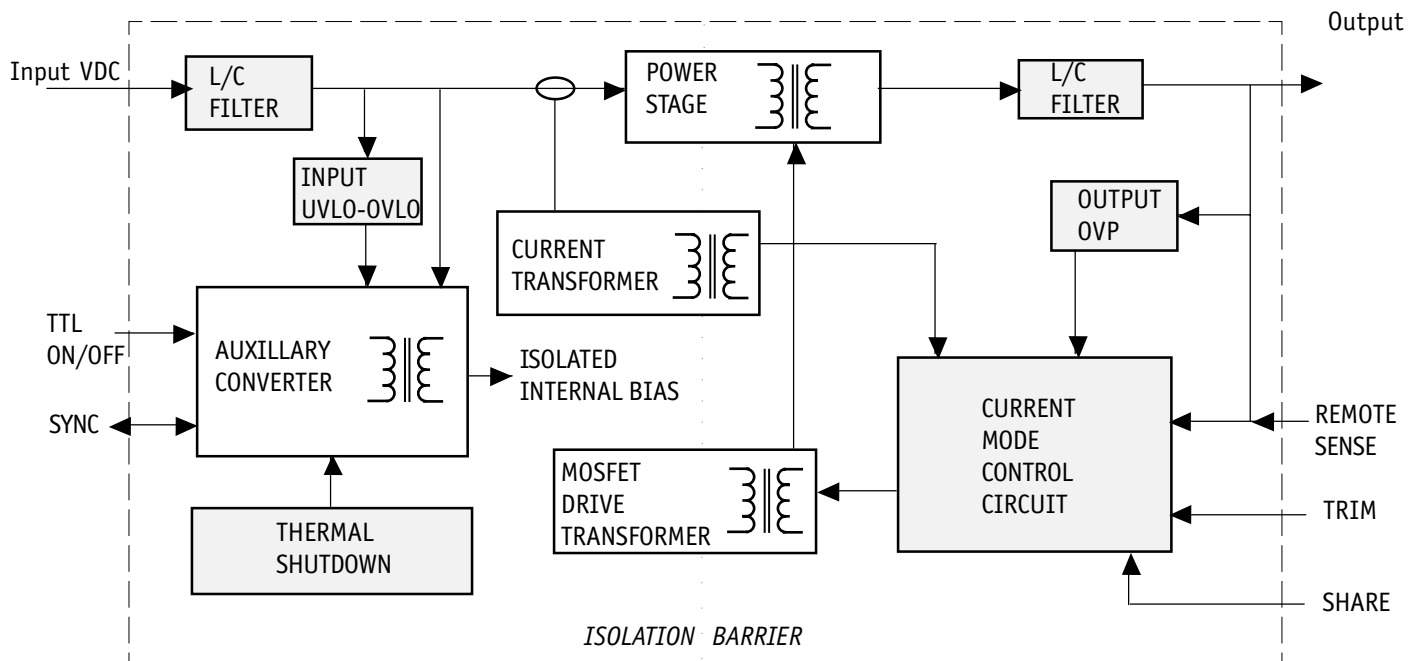
The MGDI-150 series provide synchronization function through pin 2 (Synchro) to enable automatic synchronisation between several converters. The converters lock into the highest switching frequency if more than one converter is used or on an external clock for a frequency in the range between 95% and 105% of the converter's free frequency.

The MGDI-150 series features parallel operations with load sharing to increase output power with a true N+1 redundancy. Up to 10 converters can be parallelized through the Share (Share) pin.



7- Application Notes (Continued)

7-9 Block diagram



7-10 Thermal Consideration

The MGDI-150 series maximum **baseplate** temperature at full load must not exceed 105°C. Heat can be removed from the baseplate via three basic mechanisms :

- Radiation transfert : radiation is counting for less than 5% of total heat transfert in majority of case,
- Conduction transfert : in most applications, heat will be conducted from the baseplate into an attached heatsink or heat conducting member,
- Convection transfert : convecting heat transfer into air refers to still air or forced air cooling.

In majority of the applications, heat will be removed from the baseplate either with :

- heatsink,
- forced air cooling,
- both heatsink and forced air cooling.

To calculate a maximum admissible ambient temperature the following method can be used :

Please consult application note for further details.

«Grafoil» ® is a registered trademark of the Union Carbide Company

Knowing the maximum baseplate temperature $T_{base} = 105^{\circ}\text{C}$ of the module, the power used P_{out} 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
 $T_a = 105^{\circ}\text{C} - R_{th}(b-a) \times P_{diss}$

where **$R_{th}(b-a)$ is the thermal resistance from the baseplate to ambient**. This thermal $R_{th}(b-a)$ resistance is the summ of :

- **the thermal resistance of baseplate to heatsink : $R_{th}(b-h)$** . The interface between baseplate and heatsink can be nothing or integrate a conducting member, a thermal compound, a thermal pad.... The value of $R_{th}(b-h)$ can range from 0.4°C/W for no interface up to 0.1°C/W for a Grafoil interface
- **the thermal resistance of heatsink to ambient air : $R_{th}(h-a)$** , which is depending of air flow in given by heatsink manufacturer.



For more detailed specifications and applications information, contact :

International Headquarters

Marketing and Sales department
GAIA Converter - France
Address : B.P. 14 - MERIGNAC - 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 :