Industrial DC/DC CONVERTER
MGDI-35 Wide Input : 35W POWER

Industrial Grade

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

- Wide input range
- Nominal power up to 35 W
- Wide temperature range : -40°C/+95°C case
- High efficiency (typ. 84%)
- Soft start
- Galvanic isolation 1.500 VDC according to EN 60950
- Integrated LC EMI filter
- Permanent short circuit protection
- External synchronisation
- External trim and sense adjustment
- No optocoupler fo high reliability
- RoHS process

1-General

The MGDI-35 wide input series is a full family 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 high frequency fixed swiching 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, 18-75 and 36-140 volts. The serie includes single, bi and triple output voltage choices of 3.3, 5, 12, 15 volts.
No external heatsink is required for the MGDI-35 series to supply 35W output power over the full temperature range.
The MGDI-35 serie 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 according to EN55022 and FCC Part 15J standard.
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.

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2-Product Selection

Single output model : MGDSI - 35 - *input* – *output* / *option*
Bi output model : MGDBI - 35 - *input* – *output* / *option*
Triple output model : MGDTI - 35 - *input* – *output* / *option*

Input Voltage Range

Permanent	Transient
H : 9-36 VDC	40 VDC/100 ms
O : 18-75 VDC	80 VDC/100 ms
Q : 36-140 VDC**	175 VDC/100 ms

** for 154 Vdc consult factory

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 :
/Y : option for 3 000 VDC isolation

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2- Product Selection (continued)

Input range	Output	Current	Reference	Options
9-36 VDC	3,3 VDC	7 A	MGDSI-35-H-B	/
9-36 VDC	5 VDC	7 A	MGDSI-35-H-C	/
9-36 VDC	12 VDC	2,9 A	MGDSI-35-H-E	/
9-36 VDC	15 VDC	2,3 A	MGDSI-35-H-F	/
9-36 VDC	+/- 5 VDC	+/- 4 A*	MGDBI-35-H-C	/
9-36 VDC	+/- 12 VDC	+/- 1,7 A*	MGDBI-35-H-E	/
9-36 VDC	+/- 15 VDC	+/- 1,3 A*	MGDBI-35-H-F	/
9-36 VDC	5 & +/- 11,8 VDC	4 A & +/- 1,1 A*	MGDTI-35-H-CE	/
9-36 VDC	5,1 & +/- 14,7 VDC	4 A & +/- 0,9 A*	MGDTI-35-H-CF	/
18-75 VDC	3,3 VDC	7 A	MGDSI-35-O-B	/
18-75 VDC	5 VDC	7 A	MGDSI-35-O-C	/
18-75 VDC	12 VDC	2,9 A	MGDSI-35-O-E	/
18-75 VDC	15 VDC	2,3 A	MGDSI-35-O-F	/
18-75 VDC	+/- 5 VDC	+/- 4 A*	MGDBI-35-O-C	/
18-75 VDC	+/- 12 VDC	+/- 1,7 A*	MGDBI-35-O-E	/
18-75 VDC	+/- 15 VDC	+/- 1,3 A*	MGDBI-35-O-F	/
18-75 VDC	5,1 & +/- 11,8 VDC	4 A & +/- 1,1 A*	MGDTI-35-O-CE	/
18-75 VDC	5,1 & +/- 14,7 VDC	4 A & +/- 0,9 A*	MGDTI-35-O-CF	/
36-140 VDC	3,3 VDC	7 A	MGDSI-35-Q-B	/
36-140 VDC	5 VDC	7 A	MGDSI-35-Q-C	/Y
36-140 VDC	12 VDC	2,9 A	MGDSI-35-Q-E	/
36-140 VDC	15 VDC	2,3 A	MGDSI-35-Q-F	/
36-140 VDC	+/- 5 VDC	+/- 4 A*	MGDBI-35-Q-C	/
36-140 VDC	+/- 12 VDC	+/- 1,7 A*	MGDBI-35-Q-E	/Y
36-140 VDC	+/- 15 VDC	+/- 1,3 A*	MGDBI-35-Q-F	/
36-140 VDC	3,3 & +/- 12,15 VDC	4 A & +/- 1,1 A*	MGDTI-35-Q-BE	/
36-140 VDC	5 & +/- 12,25 VDC	4 A & +/- 1,1 A*	MGDTI-35-Q-CE	/
36-140 VDC	5 & +/- 15,4 VDC	4 A & +/- 0,9 A*	MGDTI-35-Q-CF	/

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

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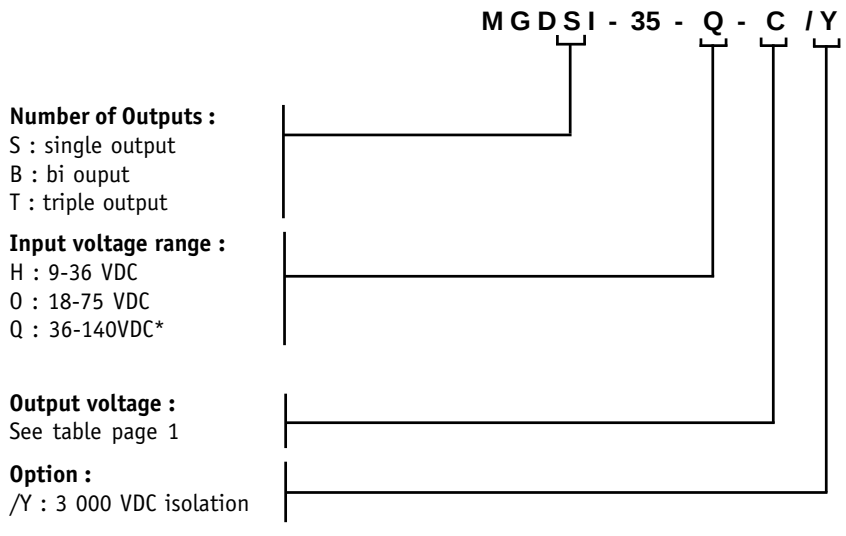
Converter Selection Chart



** for 154 Vdc consult factory*

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3- Electrical Specifications

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

Parameter	Conditions	Limit or typical	Units	Single Output MGDSI-35		
				35 - H	35 - O	35 - Q
Input						
Nominal input voltage	Full temperature range	Nominal	VDC	20	48	72
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	9-36	18-75	36-140
Extended permanent input voltage range	Full temperature range (Consult factory)	Min. - Max.	VDC	/	/	36-154
Transient input voltage	Full load (Consult factory)	Maximum	VDC/S	40/0,1	80/0,1	175/0,1
Undervoltage lock-out (UVLO)	Turn-on voltage Turn-off voltage	Nominal Nominal	VDC VDC	8,8 8	17 16	33 30
Start up time	Ui nominal within 3 ms Nominal output Full load : resistive	Maximum	ms	30	30	30
Reflected ripple current	Ui nominal, full load at switching freq. BW = 20MHz	Maximum	mApp	600	600	600
Input current in short circuit mode (Average)	Ui nominal Short-circuit	Typical	mA	TBD	TBD	TBD
No load input power	Ui min. to max. No load or Stanby	Maximum	mW	300	500	800
Output						
Output voltage	Full temperature range Ui min. to max. 75% load	Nominal Nominal Nominal Nominal	VDC VDC VDC VDC	3,3 5 12 15	3,3 5 12 15	3,3 5 12 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	35	35	35
Output current 3,3V output 5V output 12V output 15V output	Full temperature range Ui min. to max.	Maximum Maximum Maximum Maximum	A A A A	7 7 2,9 2,3	7 7 2,9 2,3	7 7 2,9 2,3
Ripple output voltage * 3,3V and 5V output 12V output 15V output	Ui nominal Full load BW = 20MHz	Maximum Maximum Maximum	mVpp mVpp mVpp	100 200 200	100 200 200	100 200 200
Line regulation	Ui min. to max. 75% load	Maximum	%	+/- 1	+/- 1	+/- 1
Load regulation **	Ui nominal 25% to full load	Maximum	%	+/- 2	+/- 2	+/- 2
Efficiency	Ui nominal Full load	Typical	%	83	84	85
Maximum admissible Capacitive load 3,3V and 5V output 12V and 15V output	Ui nominal Full load Per output	 Maximum Maximum	 µF µF	 10 000 1 000	 10 000 1 000	 10 000 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.*

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3- Electrical Specifications (continued)

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

Parameter	Conditions	Limit or typical	Units	Bi Output MGDBI-35		
				35 - H	35 - O	35 - Q
Input						
Nominal input voltage	Full temperature range	Nominal	VDC	20	48	72
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	9-36	18-75	36-140
Extended permanent input voltage range	Full temperature range (Consult factory)	Min. - Max.	VDC	/	/	36-154
Transient input voltage	Full load (Consult factory)	Maximum	VDC/S	40/0,1	80/0,1	175/0,1
Undervoltage lock-out (UVLO)	Turn-on voltage Turn-off voltage	Nominal Nominal	VDC VDC	8,8 8	17 16	33 30
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	30	30	30
Reflected ripple current	Ui nominal, full load at switching freq. BW = 20MHz	Maximum	mApp	600	600	600
Input current in short circuit mode (Average)	Ui nominal Short-circuit	Typical	mA	TBD	TBD	TBD
No load input power	Ui min. to max. No load or Stanby	Maximum	mW	400	500	800
Output						
Output voltage	Full temperature range Ui min. to max. 75% load	Nominal Nominal Nominal	VDC VDC VDC	+/- 5 +/- 12 +/- 15	+/- 5 +/- 12 +/- 15	+/- 5 +/- 12 +/- 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	+/- 20	+/- 20	+/- 20
Output current * +/- 5V output +/- 12V output +/- 15V output	Full temperature range Ui min. to max.	 Maximum Maximum Maximum	 A A A	 +/- 4 +/- 1,7 +/- 1,3	 +/- 4 +/- 1,7 +/- 1,3	 +/- 4 +/- 1,7 +/- 1,3
Ripple output voltage ** 5V output 12V output 15V output	Ui nominal Full load BW = 20MHz	 Maximum Maximum Maximum	 mVpp mVpp mVpp	 100 200 200	 100 200 200	 100 200 200
Line regulation	Ui min. to max. 75% load	Maximum	%	+/- 1	+/- 1	+/- 1
Load regulation ***	Ui nominal 25% to full load	Maximum	%	+/- 2	+/- 2	+/- 2
Cross load output regulation	Ui nominal + Vout at 75% load - Vout from 25% to full load	Maximum	%	+/- 0,5	+/- 0,5	+/- 0,5
Efficiency	Ui nominal Full load	Typical	%	84	85	85
Maximum admissible Capacitive load 5V output 12V and 15V output	Ui nominal Full load Per output	 Maximum Maximum	 µF µF	 1 000 1 000	 1 000 1 000	 1 000 1 000

*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.*

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3- Electrical Specifications (continued)

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

Parameter	Conditions	Limit or typical	Units	Tri Output MGDTI-35		
				35 - H	35 - O	35 - Q
Input						
Nominal input voltage	Full temperature range	Nominal	VDC	20	48	72
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	9-36	18-75	36-140
Extended permanent input voltage range	Full temperature range (Consult factory)	Min. - Max.	VDC	/	/	36-154
Transient input voltage	Full load	Maximum	VDC/-S	40/0,1	80/0,1	175/0,1
Undervoltage lock-out (UVLO)	Turn-on voltage Turn-off voltage	Nominal Nominal	VDC VDC	8,8 8	17 16	33 30
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	30	30	30
Reflected ripple current	Ui nominal, full load at switching freq. BW = 20MHz	Maximum	mApp	600	600	600
Input current in short circuit mode (Average)	Ui nominal Short-circuit	Typical	mA	TBD	TBD	TBD
No load input power	Ui min. to max. No load or Stanby	Maximum	mW	300	500	800
Output						
Output voltage (1)	Full temperature range Ui min. to max. 75% load	Nominal Nominal Nominal Nominal	VDC VDC VDC VDC	/ / 5 & +/- 11,8 5,1 & +/- 14,7	/ / 5,1 & +/- 11,8 5,1 & +/- 14,7	3,3 & +/-12,15 / 5 & +/- 12,25 5 & +/- 15,4
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	20 & +/- 14	20 & +/- 14	20 & +/- 14
Output current * 3,3V & +/- 12V output 3,3V & +/- 15V output 5V & +/- 12V output 5V & +/- 15V output	Full temperature range Ui min. to max.	Maximum Maximum Maximum Maximum	A A A A	/ / 4 & +/- 1,1 4 & +/- 0,9	/ / 4 & +/- 1,1 4 & +/- 0,9	4 & +/- 1,1 / 4 & +/- 1,1 4 & +/- 0,9
Ripple output voltage ** 3,3V and 5V output 12V output 15V output	Ui nominal Full load BW = 20MHz	Maximum Maximum Maximum	mVpp mVpp mVpp	100 200 200	100 200 200	100 200 200
Line regulation	Ui min. to max. 75% oad	Maximum	%	+/- 1	+/- 1	+/- 1
Load regulation ***	Ui nominal 25% to full load	Maximum	%	+/- 2	+/- 2	+/- 2
Cross load output regulation	Ui nominal + Vout at 75% load - Vout from 25% to full load	Maximum	%	+/- 0,5	+/- 0,5	+/- 0,5
Efficiency	Ui nominal Full load	Typical	%	84	85	85
Maximum admissible Capacitive load 3,3V and 5V output 12V and 15V output	Ui nominal Full load Per output	Maximum Maximum	µF µF	4 700 470	4 700 470	4 700 470

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.*

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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 12
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 70°C	700 000 Hrs 360 000 Hrs
	Ground mobile (Gm)	Case at 40°C Case at 70°C	420 000 Hrs 200 000 Hrs
Mean Time Between Failure (MTBF) According to IEC-62380-TR	Railway, Payphone	Ambient at 25°C 100% time on	340 000 Hrs

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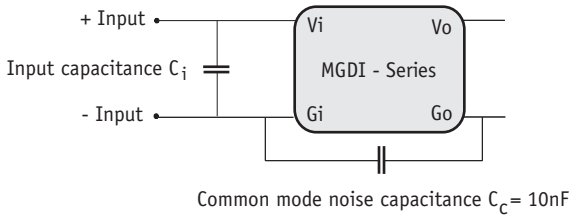
8- Electromagnetic Interference

Electromagnetic interference requirements according to EN55022 class A and class B can be easily achieved as indicated in the following table :

Electromagnetic Interference according to EN55022			
Conducted noise emission	Configuration / Models	With common mode capacitor C_c = 10nF and input capacitor C_i	With common mode capacitor C_c = 10nF and external filter
	9-36V input models	Class A, C_i =4,7µF/ 50 V tantalum	Class B
	18-75V input models	Class A, C_i =4,7µF/ 100 V tantalum	Class B
	36-140V input models	Class A, C_i =47µF / 200 V chemical	/
Radiated noise emission	Configuration / Models	With common mode capacitor C_c = 10 nF	
	All models	Class B	

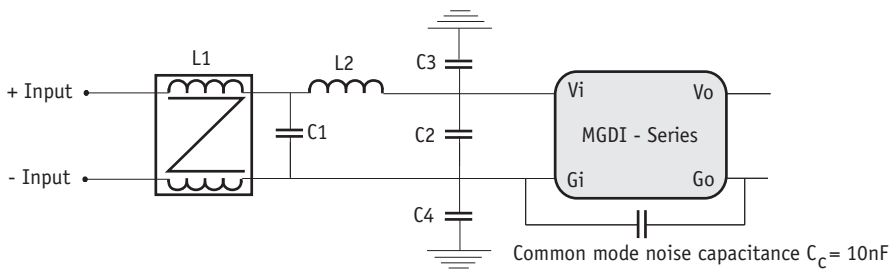
8-1 Module Compliance with EN55022 class A Standard

Electromagnetic interference requirements according to EN55022 class A can be easily achieved by adding an external common mode noise capacitance (C_c = 10nF/rated voltage depending on isolation requirement) and an input capacitance (C_I Value explained in previous table). This common mode noise capacitance C_c should be layed-out as close as possible from the DC/DC converter.



8-2 module Compliance with EN 55022 Class B Standard

Electromagnetic interference requirements according to EN55022 class B can be easily achieved by adding an external input filter consisting of 4 capacitances, a common mode choke, a differential mode inductance and the common mode noise capacitance (C_c = 10nF/rated voltage depending on isolation requirement).
Please consult EN55022 Class B EMI Filter design note for further details.



** Note : Value of common mode noise capacitance depends on isolation requirements (typically 10nF/1500V or 10nF/3000V). In case of dielectric strengh test in AC mode, adapt the capacitance value in order to be compatible with maximum admissible leakage current.*

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9- Surge Susceptibility EN61000-4-5 & EN50155

Surge susceptibility requirements according to EN50155, EN61000-4-5 and electromagnetic interference requirements of EN55022 class A can easily be achieved using either :

- a limitor module LGDS-50 series : ready-to-use single module solution,
- an input limitor filter : schematics of discret components, to sustain the following surge levels :

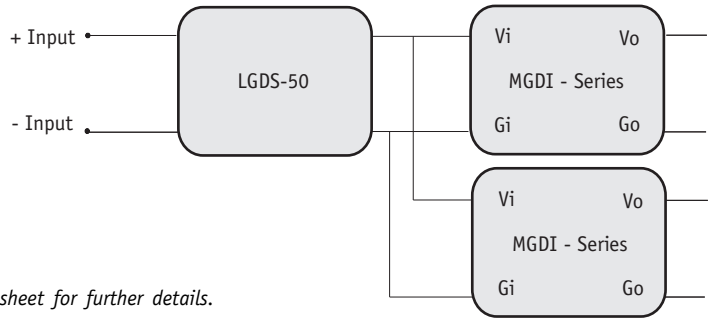
Characteristics	Standards	Levels
Spikes Line to line	EN 61000-4-5	Level 4 with 4 000 V waveform 50 µs, impedance 2 Ohm
	EN 50155	Level 1 800 V waveform 50 µs, impedance 100 and 5 Ohm Level 8 400 V waveform 0.1 µs, impedance 100 Ohm
Spikes Line to earth	EN 61000-4-5	Level 4 with 4 000 V waveform 50 µs, impedance 12 Ohm
	EN 50155	Level 1 800 V waveform 50 µs, impedance 100 and 5 Ohm Level 8 400 V waveform 0.1 µs, impedance 100 Ohm

9-1 Surge Protection with Off-the-Shelf Solution : LGDS-50 Limitor Module

To sustain surge requirements of EN61000-4-5, and EN50155 together with EN55022 class A, GAÏA Converter proposes a ready-to-use single product. Depending on bus input range two references of limitor module are existing with references as follow :

Input types	DC/DC converter family	Limitor module reference
9-36 VDC Input	MGDI-35-H series	LGDS-50-J-K
18-75 VDC Input	MGDI-35-O series	LGDS-50-J-K
36-140 VDC Input	MGDI-35-Q series	LGDS-50-Q-K

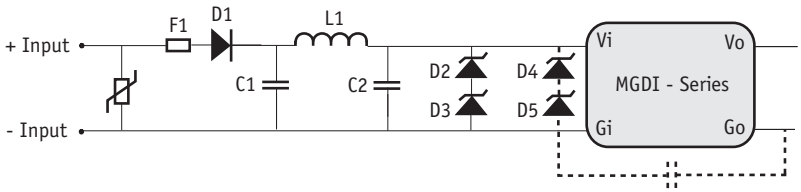
These modules designated LGDS-50 series are designed up to 50W power and will protect MGDI-35 series with 9-36, 18-75 or 36-140 VDC input against surges.
The implantation of LGDS-50 with modules can be undertook as follow :



Please consult LGDS-50 datasheet for further details.

9-2 Surge Protection with Discrete Components

To sustain surge requirements of EN61000-4-5 and EN50155 together with EN55022 class A, GAÏA Converter proposes the following front protection filter.



* Common mode noise capacitance C_C = 10nF

Please consult EN50155 Transient/EMI Filter design note for further details.
** Note : Value of common mode noise capacitance rated voltage depends on isolation requirements.*

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10- Thermal Characteristics

Characteristics	Conditions	Limit or typical	Performances
Operating ambient temperature range	Ambient temperature *	Minimum Maximum	- 40°C + 71°C
Operating case temperature range at full load	Case temperature	Minimum Maximum	- 40°C +95°C
Storage temperature range	Non functionning	Minimum Maximum	- 40°C + 105°C
Thermal resistance	Rth case to ambient in free air natural convection	Typical	7,5°C /W

*Note * : The upper temperature range depends on configuration, the user must assure a max. case temperature of + 95°C.*

The MGDI-35 series operating **case** temperature must not exceed 95°C. The maximum **ambient** temperature admissible for the DC/DC converter corresponding to the maximum operating case temperature of 95°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 = 95°C of the module, the power used Pout and the efficiency η :

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

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

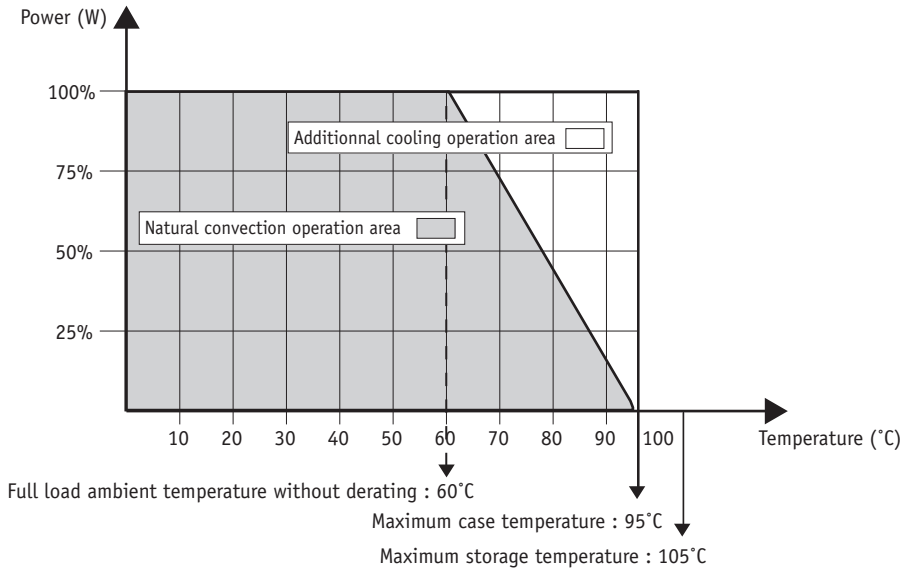
- determine the maximum ambient temperature :

$$\mathbf{Ta = 95°C - Rth \times Pdiss}$$

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 95°C (white area in the following graph).



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11- Environmental Qualifications

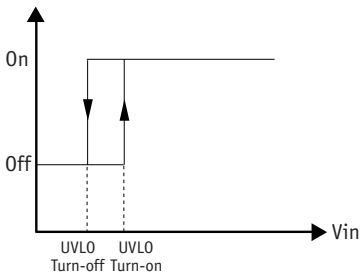
The modules have been subjected to the following environmental qualifications.

Characteristics	Conditions	Severity	Test procedure
Climatic Qualifications			
Life at high temperature	Duration Temperature Status of unit	1 000 Hrs 95°C case unit operating	IEC 68-2-2
Humidity steady	Damp heat Temperature Duration Status of unit	93 % relative humidity 40°C 56 days unit not operating	IEC 68-2-3 Test Ca
Temperature cycling	Number of cycles Temperature change Transfert time Steady state time Status of unit	200 -40°C / +71°C 40 min. 20 min. unit not operating	IEC 68-2-14 Test N
Temperature shock	Number of shocks Temperature change Transfert time Steady state time Status of unit	50 -40°C / +105°C 10 sec. 20 min. unit not operating	IEC 68-2-14 Test Na
Mechanical Qualifications			
Vibration (Sinusoidal)	Number of cycles Frequency : amplitude Frequency : acceleration Amplitude /acceleration Duration Status of unit	10 cycles in each axis 10 to 60 Hz / 0.7 mm 60 to 2000 Hz / 10 g 0.7 mm/10 g 2h 30 min. per axis unit not operating	IEC 68-2-6 Test Fc
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	IEC 68-2-27 Test Ea
Bump (Half sinus)	Number of bumps Peak acceleration Duration Status of unit	2 000 bumps in each axis 25 g 6 ms unit not operating	IEC 68-2-29 Test Eb
Electrical Immunity Qualifications			
Electrical discharge susceptibility	Number of discharges Air discharge level Contact discharge level Air discharge level Contact discharge level	10 positive & 10 negative discharges 4 kV : sanction A 2 Kk : sanction A 8 Kk : sanction B 4 kV : sanction B	EN55082-2 with : EN61000-4-2 IEC 801-2
Electrical field susceptibility	Antenna position Electromagnetic field Wave form signal Frequency range	at 1 m 10 V/m AM 80%, 1 kHz 26 MHz to 1 GHz	EN55082-2 with : EN61000-4-3 IEC801-3
Electrical fast transient susceptibility	Burst form Wave form signal Impedance Level 1 Level 3	5/50 ns 5 kHz with 15 ms burst duration period 300 ms 50 Ohm 0,5 kV : sanction A 2 kV : sanction B	EN55082-2 with : EN61000-4-4 IEC801-4
Surge Susceptibility	Surge form Impedance Level 4	1,2/50 µs 2 Ohm 4 kV : with transient protection or LGDS-50 limitor module (see section surge)	EN61000-4-5 EN50155

12- Description of Protections

12-1 Input Undervoltage Lock-out (UVLO)

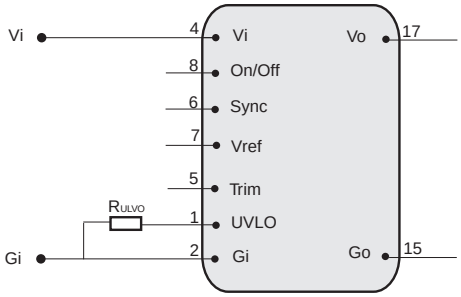
An input undervoltage protection will inhibit the module when input voltage drops below the lock-out turn-off threshold (see section 3 for value) and restores to normal operation automatically when the input voltage rises the lock-out turn-on threshold.



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 folow :

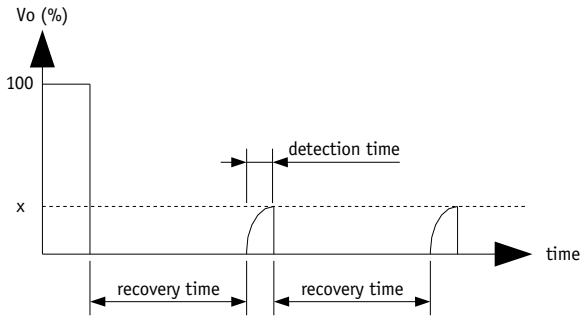
$$R_{UVLO} = \frac{K \times 10^4}{(n - 1)} \qquad \text{where } n = \frac{UVLO_{trim}}{UVLO_{threshold}}$$

	Input H	Input O	Input Q
K	0,932	1,34	1,66



12-2 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.



12-3 Output Overvoltage Protection (OVP)

Each circuit has an internal overvoltage protection circuit that monitors the voltage accross 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.

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13- Description of Functions

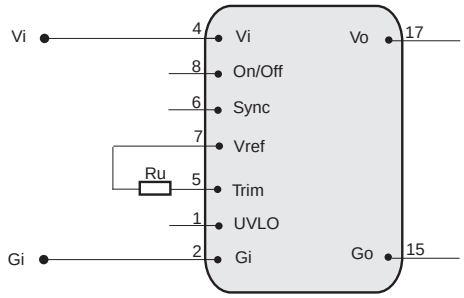
13-1 Trim Function

The output voltage Vo 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 :

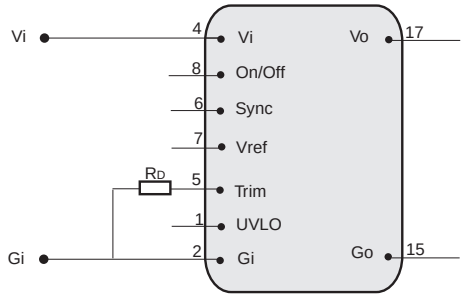
$$R_U(k) = 12 \cdot \frac{\frac{V_{O\,trim-up}}{2 \cdot V_O} - 1}{1 - \frac{V_{O\,trim-up}}{V_O}} - 47$$



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 :

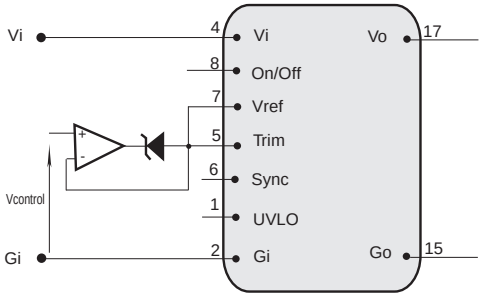
$$R_D(k) = 12 \cdot \frac{\frac{V_{O\,trim-down}}{V_O}}{2 \cdot \left(1 - \frac{V_{O\,trim-down}}{V_O}\right)} - 47$$



Trim via a voltage

The output voltage is given by the following formula :

$$Vo = Vo_{nom}(0.0565\ V_{control} + 0.887)$$



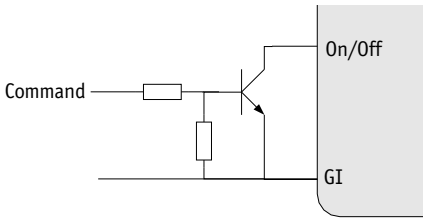
13- Description of Functions (continued)

13-2 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.

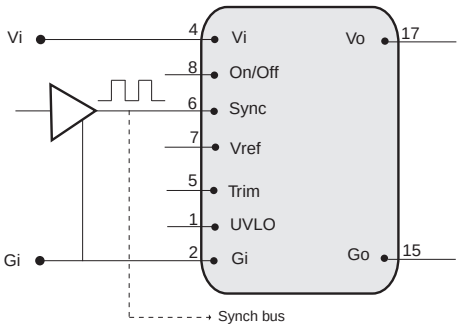
By releasing the On/Off function, the converter will restart within the start up time specifications given in table section 3. For further details please consult "Logic On/Off" application note.



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

13-3 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.



13-4 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.

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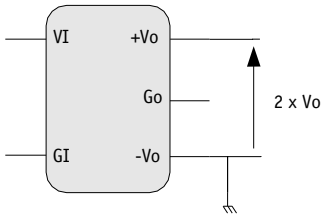
14- Application Notes

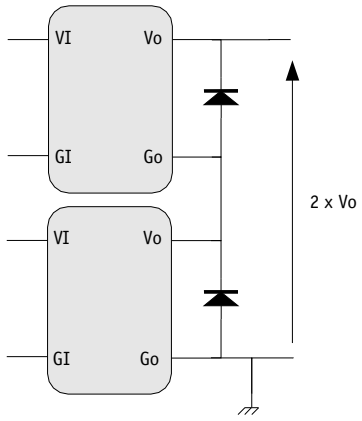
14-1 Connection of Outputs in Series

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.



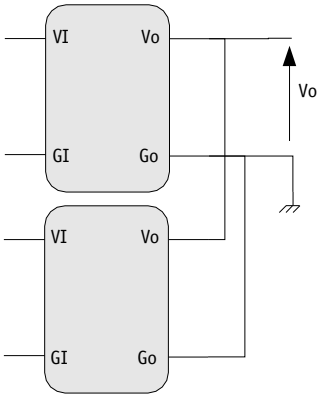
14-2 Connection of Modules in Series

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.



14-3 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.
However the GAIA Converter modules are designed with a "soft" output voltage versus current characteristic. This causes the output voltage of each converter to automatically adjust downward as its current increases so each converter very approximately shares the total output current. It is important that each converter has approximately the same impedance between their output and the common load.



14-4 Safety Consideration

For safety agency approval of the system in which the power module is used, the power module must be installed in compliance with requirements of the UL1950, CSA22.2-950, EN60950 standards : i.e if the output circuit operator accessible, it shall be a SELV circuit.
A SELV (Safety Extra Low Voltage) output for a converter is a secondary circuit that under normal operation or a single fault condition cannot reach hazardous voltage (i.e Voltage above 60 VDC) between any two accessible parts or an accessible part and protective each.
In the event of a single fault condition (insulation or component failure), the voltage in accessible parts of SELV circuits shall not exceed 60 VDC for longer than 0.2 sec. and an absolute limit of 120 VDC SELV circuits must be separated from hazardous voltages (e.g primary circuits) by two levels of protection which may be double or reinforced insulation or basic insulation combined with an earthed conductive barrier.
Generally DC/DC Converters are power by an input bus that comes from a front end which can be an AC/DC powered supply, a transformer, a charger or a battery. It is the sole responsability of the user to ensure compliance of the front-end with the relevant safety requiements.
The following table resumes some possible installation configuration using Gaïa Converter wide input series.

Bus voltage at the input of DC/DC converter	Safety status of the input bus	DC/DC converter requirements	Resulting safety at the DC/DC converter output
Voltage : ≤ 60 VDC	Basic isolation with ELV circuit Basic isolation with earthed SELV circuit	Operationnal insulation Operationnal insulation	Earthed SELV circuit SELV circuit
Hazardous voltage : > 60VDC	Basic isolation with hazardous voltage Double or reinforced insulation with hazadous voltage	Operationnal insulation Operationnal insulation	Earthed SELV circuit Earthed SELV circuit

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15- PCB Mounting Specifications

The MGDI-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 10,7 mm height and PCB hole design on the mother board

On-board Mounting

In-board Mounting

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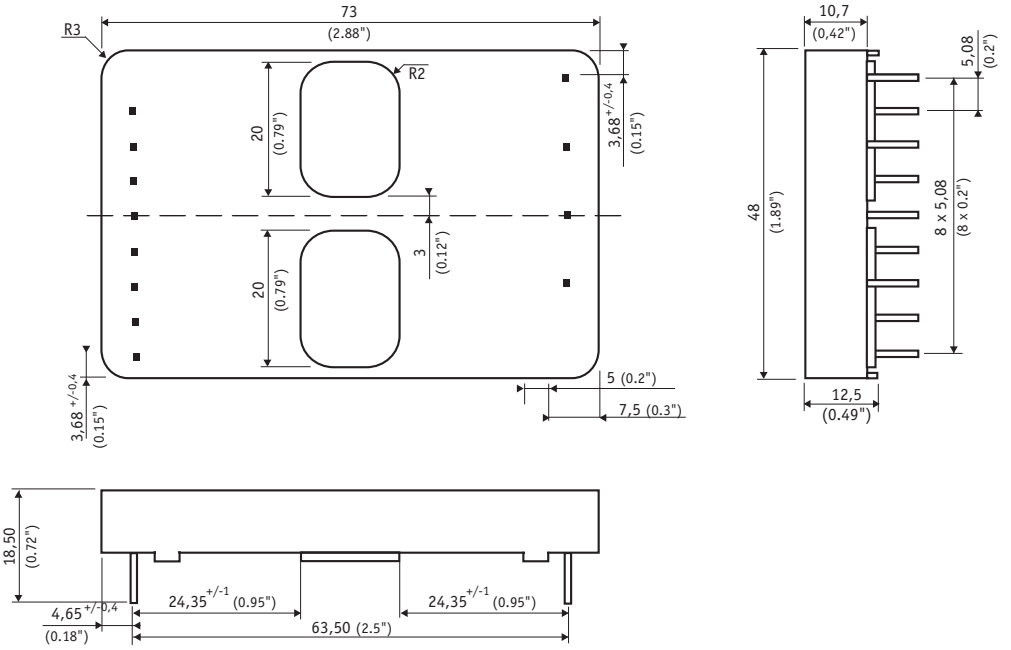
16- Dimensions

Dimension are given in mm (inches). Tolerance : +/- 0,2 mm (+/- 0.01 ") unless otherwise indicated.
Weight : 65 grams (2.30 Ozs) max.



Pin dimensions : ⊠ 0,91 mm (0.036")

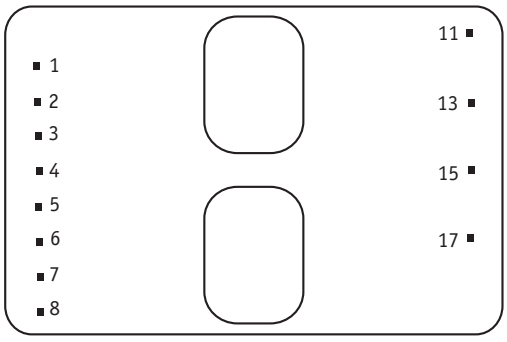
17- Materials

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

18- Product Marking

Upper face : Company logo.
Side face : Module reference, option, date code : year and week of manufacturing.

19- 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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