



Industrial DC/DC CONVERTER MGDI-18 Wide Input : 18W POWER

Industrial
Grade ■

**3:1 & 4:1 Wide Input
Single Output
Metallic Case - 1.500 VDC Isolation**

- Wide input range and high transient compliance
- Ultra compact 18/20W DC/DC converter
- Wide temperature range : -40°C/+91°C
- High efficiency (typ. 85%)
- Soft start
- Permanent short circuit protection
- No optocoupler for high reliability



1- General

The MGDI-18 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 switching technic at 500 KHz providing excellent reliability, low noise characteristics, high power density and low profile package. Standard models are available with wide input voltage range of 4,7-16, 9-36, 16-40 and 36-140 volts, with high transient levels. The series include single output voltage choices of 3,3, 5, 12 or 15 volts. The MGDI-18 series is able to supply up to 18/20W output power.

The MGDI-18 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 according to EN55022 and FCC Part 15J standard. The modules include a soft-start, and a permanent short circuit protection 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 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.

2- Product Selection

Single output model : MGDSI-18- -

Input Voltage Range	
Permanent	Transient
D : 4,7-16 VDC	n/a
H : 9-36 VDC	40 VDC/100 ms
J : 16-40 VDC*	45 VDC/100 ms
Q : 36-140 VDC**	175 VDC/100 ms

* for 45 Vdc consult factory
**for 150 Vdc consult factory

Output
B : 3,3 VDC
C : 5 VDC
E : 12 VDC
F : 15 VDC

2-Product Selection (continued)

Input range	Output	Current	Reference	Option
4,7-16 VDC 4,7-16 VDC 4,7-16 VDC 4,7-16 VDC	3,3 VDC 5 VDC 12 VDC 15 VDC	4A 4A 1,50 A 1,20 A	MGDSI-18-D-B MGDSI-18-D-C MGDSI-18-D-E MGDSI-18-D-F	
9-36 VDC 9-36 VDC 9-36 VDC 9-36 VDC	3,3 VDC 5 VDC 12 VDC 15 VDC	4A 4A 1,50 A 1,20 A	MGDSI-18-H-B MGDSI-18-H-C MGDSI-18-H-E MGDSI-18-H-F	
16-40 VDC 16-40 VDC 16-40 VDC 16-40 VDC	3,3 VDC 5 VDC 12 VDC 15 VDC	4A 4A 1,50 A 1,20 A	MGDSI-18-J-B MGDSI-18-J-C MGDSI-18-J-E MGDSI-18-J-F	
36-140 VDC 36-140 VDC 36-140 VDC 36-140 VDC	3,3 VDC 5 VDC 12 VDC 15 VDC	4A 4A 1,50 A 1,20 A	MGDSI-18-Q-B MGDSI-18-Q-C MGDSI-18-Q-E MGDSI-18-Q-F	

Converter Selection Chart

Number of Outputs :
S : single output

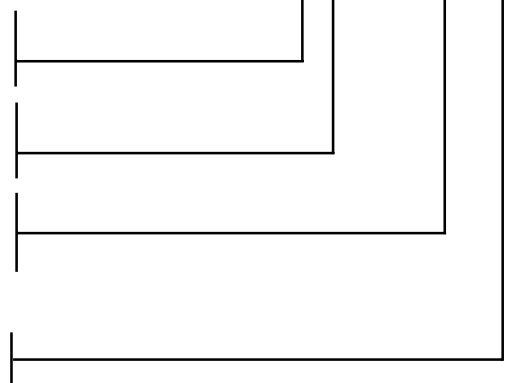
Family :
I : Industrial

Input voltage range :
D : 4.7-16 VDC
H : 9-36 VDC
J : 16-40 VDC*
Q : 36-140 VDC**

* for 45 Vdc consult factory
** for 150 Vdc consult factory

Output voltage :
See table page 1

M G D S I - 18 - Q - C



3- Electrical Specifications

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

Models				Single output MGDSI-18			
Parameter	Conditions	Limit or typical	Units	18-D-	18-H-	18-J-	18-Q-
Input							
Nominal input voltage	Full temperature range	Nominal	VDC	9	20	24	72
Permanent input voltage range (Ui)	Full temperature range	Min.-Max.	VDC	4,7-16	9-36	16-40	36-140
Extended permanent input voltage range	Full temperature range (Consult factory)	Min.-Max.	VDC	/	/	16-45	36-150
Transient input voltage	Full load	Maximum Maximum	VDC/S VDC/S	/	40/0,1 /	45/0,1 /	175/0,1 165/1
Start up input voltage	Full load	Minimum	VDC	4,5	8,5	15,5	33
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	40	40	40	40
Reflected ripple current	Ui nominal, full load BW=20MHz	Maximum	mApp	50	50	50	50
Input current in short circuit mode (Average value)	Ui nominal Short-circuit	Maximum	mA	100	60	60	40
No load input current	Ui nominal No load	Maximum	mA	100	60	60	40
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	3,3 5 12 15
Set point accuracy	Ambient temperature : +25°C Ui nominal 75 % load	Maximum	%	+/-2	+/-2	+/-2	+/-2
Output power	Full temperature range Ui min. to max.	Maximum	W	20	20	20	20
Output current ** 3,3V output 5V output 12V output 15V output	Full temperature range Ui min. to max.	Maximum Maximum Maximum Maximum	mA mA mA mA	4.000 4.000 1.500 1.200	4.000 4.000 1.500 1.200	4.000 4.000 1.500 1.200	4.000 4.000 1.500 1.200
Ripple output voltage *** 2,5V, 3,3V, 5V output 12V output 15V output	Ui nominal Full load BW = 20MHz	Maximum Maximum Maximum	mV pp mV pp mV pp	50 100 150	50 100 150	50 100 150	50 100 150
Line regulation	Ui min. to max. Full load	Maximum	%	+/-1	+/-1	+/-1	+/-1
Load regulation	Ui nominal 25 % to full load	Maximum	%	+/-2,5	+/-2,5	+/-2,5	+/-2,5
Cross load output regulation	Ui nominal + Vout nominal load - Vout from 25 % to full load	Maximum	%	/	/	/	/
Efficiency	Ui nominal Full load	Typical	%	81	82	83	83
Maximum admissible Capacitive load 3.3V, 5V output 12V, 15V output	Ui nominal Full load Per output	Maximum Maximum	μF μF	2.000 680	2.000 680	2.000 680	2.000 680

Note * : For proper operation the MGDI-18 module requires to install a 22μF chemical or tantalum capacitance across output terminals.

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

4- Functional Characteristics

Characteristics	Conditions	Limit or typical	Performances
Electric strength test voltage Basic Version	input to output	Minimum	1.500 VDC / 1 min
/	/	/	/
Isolation resistance	500 VDC	Minimum	100 Mohm
Short circuit protection	Short circuit	Auto restart	Permanent
Switching frequency			
4,7-16, 9-36, 16-40 VDC input	No load to full load	Nominal	480 KHz
36-140 VDC input	No load to full load	Nominal	430 KHz

5- Thermal and Reliability Characteristics

Characteristics	Conditions	Limit or typical	Performances
Operating ambient temperature range	Ambient temperature	Minimum Maximum	-40°C see section 8.3
Operating case temperature range	Case temperature	Minimum Maximum	-40°C see section 8.3
Storage temperature range	Non functioning	Minimum Maximum	-40°C +105°C
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 70°C	950.000 Hrs 380.000 Hrs 240.000 Hrs 105.000 Hrs

* The upper temperature range depends on configuration, the user must assure a max. case of +91°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
Surge Susceptibility	Level 4	with KG9503 transient protection or LGDS-50 limitor module (see section 7)	EN61000-4-5 EN50155

6- Electromagnetic Interference Qualification (continued)

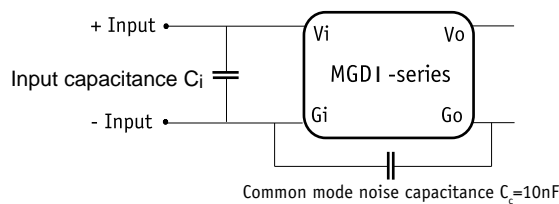
Electromagnetic interference requirements according to EN55022 class A and class B can be easily achieved as indicated in the following table :

Electromagnetic Interference according to EN55022			
Conducted noise emission	Configuration	With common mode capacitor $C_c=10\text{nF}$ and input capacitor C_i	With common mode capacitor $C_c=10\text{nF}$ and external filter
	Models		
	4,7-16 VDC input models	Class A, $C_i=10\text{ }\mu\text{F}/35\text{V}$ tantalum + inductance 4.7 mH	Class B with KG9502
	9-36 VDC input models	Class A, $C_i=4.7\text{ }\mu\text{F}/50\text{V}$ tantalum	Class B with KG9502
	16-40 VDC input models	Class A, $C_i=4.7\text{ }\mu\text{F}/50\text{V}$ tantalum	Class B with KG9502
Radiated noise emission	36-140 VDC input models	Class A, $C_i=47\text{ }\mu\text{F}/200\text{V}$ chemical	/
	Configuration	With common mode capacitor $C_c = 10\text{ nF}$	
	Models		
All models		Class B	

6-1 Basic Configuration : Module Stand Alone with Common Mode Noise Capacitance and Input Capacitance : EN55022 class A

Electromagnetic interference requirements according to EN55022 class A can be easily achieved by adding an external common mode noise capacitance ($C_c = 10\text{nF}$ /rated voltage depending on isolation requirement) and an

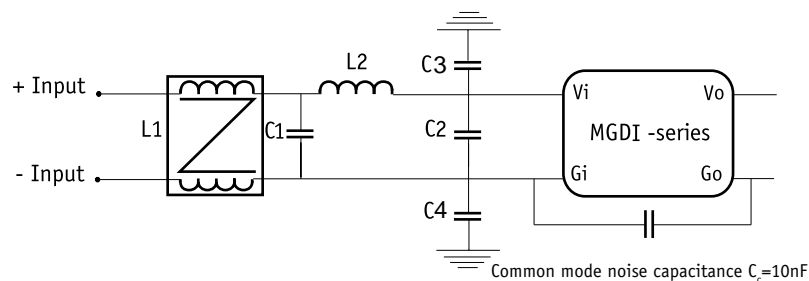
input capacitance (C_i Value explained in previous table). This common mode noise capacitance C_c should be layed-out as close as possible from the DC/DC converter.



6-2 Configuration with Module and Front filter KG9502

Electromagnetic interference requirements according to EN55022 class B can be easily achieved by adding an external input filter KG9502 consisting of 4 capacitances, a common mode choke, a differential mode inductance and the

common mode noise capacitance ($C_c = 10\text{nF}$ /rated voltage depending on isolation requirement). Please consult KG9502 datasheet for further details.



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

7- Surge Susceptibility EN61000-4-5 (IEC801-4-5) and 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 limiter module LGDS-50 series : ready-to-use single module solution,
 - an input limiter component kit KG9503 : schematics of discret components,
- to sustain the following surge levels :

	Standards	Levels
Spikes Line to line	EN 61000-4-5	Level 4 with 4.000 V waveform 50 μ s, impedance 2 Ω .
	EN 50155	1.800 V waveform 50 μ s, impedance 100 Ω and 5 Ω , 8.400 V waveform 0.1 μ s, impedance 100 Ω .
Spikes Line to earth	EN 61000-4-5	Level 4 with 4.000 V waveform 50 μ s, impedance 12 Ω .
	EN 50155	1.800 V waveform 50 μ s, impedance 100 Ω and 5 Ω , 8.400 V waveform 0.1 μ s, impedance 100 Ω .

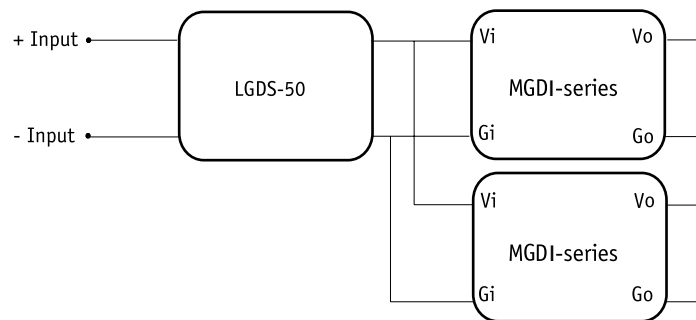
7-1 Surge Protection with Off-the-Shelf Solution : LGDS-50 Limitor Module

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

Input types	DC/DC converter family	Limiter module reference
9-36 VDC Input	MGDI-18-H series	LGDS-50-J-K
16-40 VDC Input	MGDI-18-J series	LGDS-50-J-K
36-140 VDC Input	MGDI-18-Q series	LGDS-50-Q-K

These modules designated LGDS-50 series are designed up to 50W power and will protect MGDI-18 series with 9-36, 16-40 or 36-140 VDC input against surges.

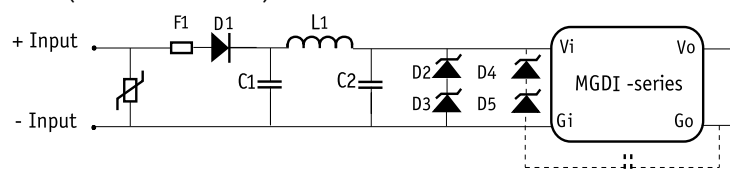
The implantation of LGDS-50 with modules can be undertook as follow :



Please consult LGDS-50 datasheet for further details.

7-2 Surge Protection with Discrete Components : KG9503 Component Kit

To sustain surge requirements of EN61000-4-5 and EN50155 together with EN55022 class A GAIA Converter proposes the following front protection filter. This filter is available as a kit of components (reference : KG9503)



* Common mode noise capacitance $C_c = 10\text{nF}$

Please consult KG9503 datasheet for further details.

* Note : Value of common mode noise capacitance rated voltage depends on isolation requirements.

8- Application Notes

8-1 Isolation

MGDI-18 series come with the following possible isolation:

- Basic version : 1.500 Vdc / 1 min, in metal case

8-2 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

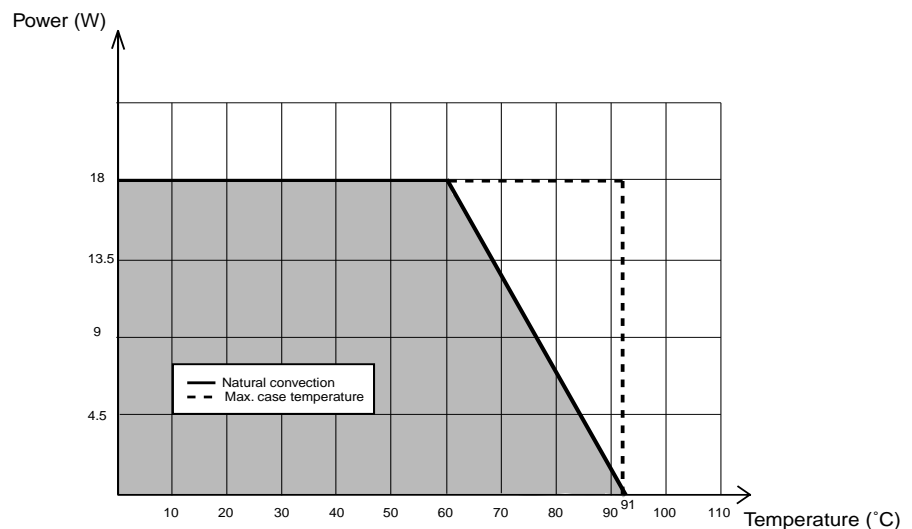
in accessible parts of SELV circuits shall not exceed 60 VDC for longer than 0.2 sec. and an absolute limit of 120 VDC. SELV circuits must be separated from hazardous voltages (e.g primary circuits) by two levels of protection which may be double or reinforced insulation or basic insulation combined with an earthed conductive barrier. Generally DC/DC Converters are powered 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 responsibility of the user to ensure compliance of the front-end with the relevant safety requirements. The following table resumes some possible installation configuration using Gaia Converter MGDI-10 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	Operationnal insulation	Earthed SELV circuit
	Basic isolation with earthed SELV circuit	Operationnal insulation	SELV circuit
Hazardous voltage : > 60 VDC	Basic isolation with hazardous voltage	Operationnal insulation	Earthed SELV circuit
	Double or reinforced insulation with hazardous voltage	Operationnal insulation	Earthed SELV circuit

8-3 Ambient versus Case Temperature

The MGDI-18 series operating **case** temperature at full load must not exceed 91°C. The maximum **ambient** temperature admissible for the DC/DC converter corresponding to the maximum operating case temperature of 91°C depends on the ambient airflow, the unit mounting/orientation, the cooling features and the power dissipated. Thermal calculation shows two areas of operation :

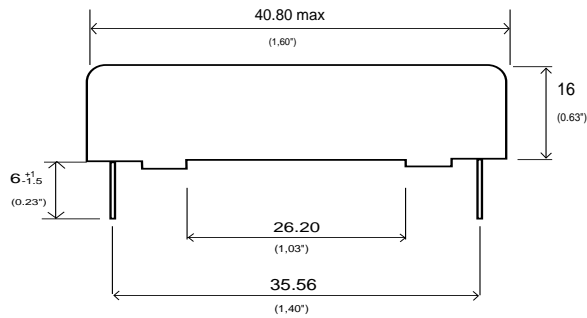
- a normal operation area in a free natural ambient convection (grey area in the following graph)
- an area with cooling features (air flow or heatsink) ensuring a maximum case temperature below 91°C at full load (white area in the following graph).



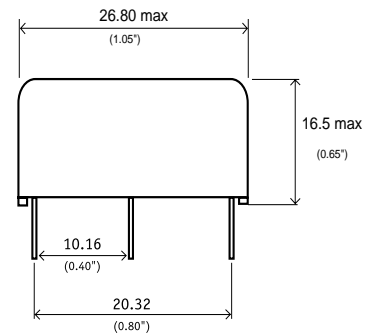
9- Dimensions

Dimensions are given in mm (inches). Tolerance : +/- 0.2 mm (+/- 0.01 ") unless otherwise indicated.
Weight : 35 grams (1.22 Ozs) max.

Basic Version : Metal Case



Pin dimensions : \varnothing 0.83 mm (0.032 ")



Metallic case black anodized coating solder plated pin

10- Product Marking

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

11- Connections



bottom view

Pin	Single
1	+ input (Vi)
2	Do not connect
3	- input (Gi)
4	Output (Vo)
5	No pin
6	Common (Go)



For more detailed specifications and applications information, contact :

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