Hi-Rel DC/DC CONVERTER
MGDM-200 : 200W POWER

Hi-Rel Grade

GAÏA CONVERTER

5:1 Low Input Voltage : 9-45 & 16-80 VDC
Single Output
Metallic case - 1 500 VDC Isolation

- Same surface as 1/2 brick standard form factor
- BaseRail™ & SideRail™ heat dissipation
- Vertical or horizontal mounting
- Ultra wide input range 9-45 Vdc, 16-80 Vdc
- 28Vdc input compliant with MIL-STD-704A/D/F
- Power up to 200 W
- Wide temperature range : -40/+105°C frame
- High efficiency (typ.90%)
- Soft start
- Galvanic isolation 1 500 VDC
- Integrated LC filter
- Synchronizable
- Load sharing, N+1 redundancy
- No load to full load operation
- Fully protected by independant protection
  - Under voltage lock-out
  - Overvoltage protection
  - Output current limitation
  - Over temperature protection
- No optocoupler for high reliability
- RoHS process

1-General

The MGDM-200 low input voltage series is a complete line of high density wide input range DC/DC power modules designed for aerospace, military and high-end industrial applications. These modules use a patented fixed switching topology at 270 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 volts. The series include single output voltage choices of 3,3, 5, 12, 15, 24 volts.

The MGDM-200 low input voltage series include synchronization, load sharing, trim, current trim limitation and sense functions.
The synchronization function allows to synchronize one converter to the other or to an external frequency source. The load sharing allows parallel operation to increase output power with a true N+1 without any additionnal external components.

All modules are designed with LC network filters to minimize reflected input current ripple and output voltage ripple.
The modules have independant protection functions including input undervoltage lock-out, output overvoltage protection, output current limitation, and thermal protection. Additionnally a soft-start function reduces inrush current during start-up.
The thermal design is innovative and use baserail™ and siderail™ concept. The heat is removed through thick copper planes down to the external frame on the top and the side allowing better thermal path.
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 thermally conductive compound to ensure optimum power dissipation under harsh environmental conditions.

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2-Product Selection

Single output model : MGDS - 200 - [input] – [output] / [option] – [suffix]

Input Voltage Range
Permanent
H : 9-45 VDC
O : 16-80 VDC

Output
B : 3.3 VDC
C : 5 VDC
E : 12 VDC
F : 15 VDC
I : 24 VDC

Options :
/2H : option with side pin configuration
/T : option for -55°C start up operating temperature
/S : option for screening and serialization

Suffix :
nothing : RoHS process

2- Product Selection (continued)

Input range	Output	Current	Reference	Options	Suffix
9-45 VDC	3.3 VDC	35 A	MGDS-200-H-B	/T , /S , 2H	/
9-45 VDC	5 VDC	35 A	MGDS-200-H-C	/T , /S , 2H	/
9-45 VDC	12 VDC	16,7 A	MGDS-200-H-E	/T , /S , 2H	/
9-45 VDC	15 VDC	13,4 A	MGDS-200-H-F	/T , /S , 2H	/
9-45 VDC	24 VDC	8,4 A	MGDS-200-H-I	/T , /S , 2H	/
16-80 VDC	3.3 VDC	35 A	MGDS-200-O-B	/T , /S , 2H	/
16-80 VDC	5 VDC	35 A	MGDS-200-O-C	/T , /S , 2H	/
16-80 VDC	12 VDC	16,7 A	MGDS-200-O-E	/T , /S , 2H	/
16-80 VDC	15 VDC	13,4 A	MGDS-200-O-F	/T , /S , 2H	/
16-80 VDC	24 VDC	8,4 A	MGDS-200-O-I	/T , /S , 2H	/

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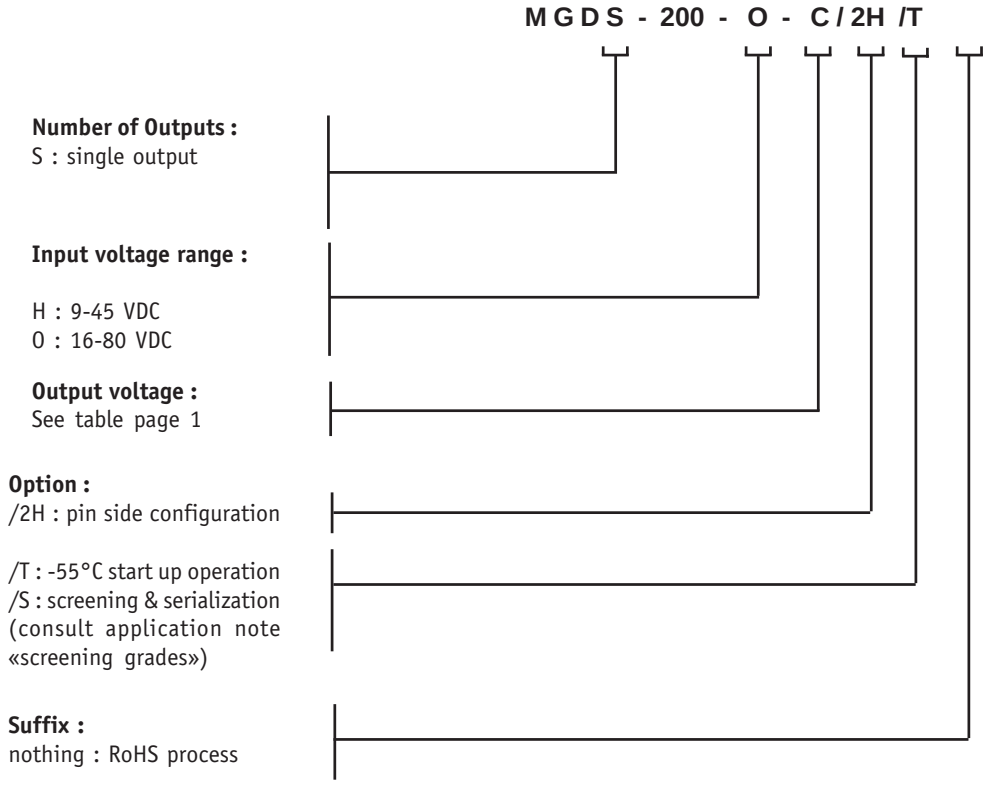
Converter Selection Chart



3- Electrical Specifications

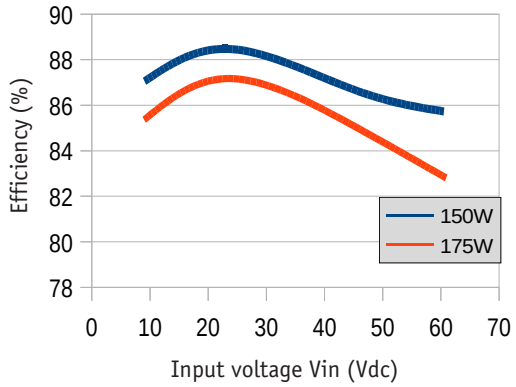
Data are valid at +25°C, unless otherwise specified.

Parameter	Conditions	Limit or typical	Units	Single Output MGDS-200	
				200 - H	200 - 0
Input					
Nominal input voltage	Full temperature range	Nominal	VDC	24	28
Permanent input voltage range (Ui)	Full temperature range	Min. - Max.	VDC	9 - 45	16 - 80
Input absolute surge withstand	Full temperature range	Maximum	VDC/sec.	60/0,5	100/1
Undervoltage lock-out (UVLO)	Turn-on voltage Turn-off voltage	Maximum Maximum	VDC VDC	9 8	16 14
Start up time	Ui nominal Nominal output Full load : resistive	Maximum	ms	30	30
Reflected ripple current	Ui nominal, full load BW = 20MHz	Maximum	App	5	2,5
No load input power	Ui nominal No load	Maximum	W	1,5	1,5
Input power in inhibit mode	Ui nominal Inhibit	Maximum	W	1	1
Output					
Output voltage *	Ui min. to max.	Nominal Nominal Nominal Nominal Nominal	VDC VDC VDC VDC VDC	3,3 5 12 15 24	3,3 5 12 15 24
Set Point accuracy *	Ambient temperature : +25°c Ui nominal, 75% load	Maximum	%	+/- 2	+/- 2
Output power **	At 105°c baseplate Ui min. to max.	Maximum	W	200	200
Output current ** 3,3V output 5V output 12V output 15V output 24V output	 Full temperature range Ui min. to max.	 Maximum Maximum Maximum Maximum Maximum	 A A A A A	 35 35 16,7 13,4 8,4	 35 35 16,7 13,4 8,4
Ripple output voltage *** 3,3V and 5V output 12V output 15V output 24V output	 Ui nominal Full load BW = 20MHz	 Typical Typical Typical Typical	 mVpp mVpp mVpp mVpp	 100 250 450 500	 100 250 450 500
Output regulation * (Line + load + thermal)	Ui min. to max. 0% to full load	Maximum	%	+/- 1	+/- 1
Output Voltage Trim Range	As function of output voltage	Minimum Maximum	% %	10 110	10 110
Efficiency	Ui nominal Full load	Typical	%	88	88

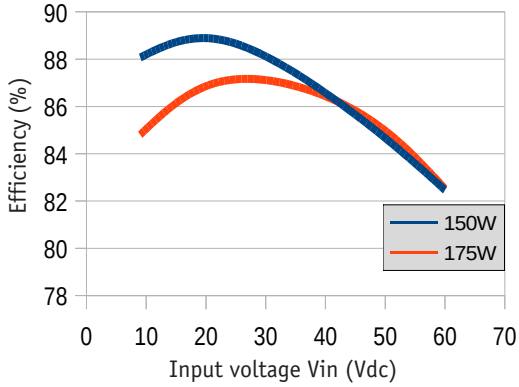
*Note * : These performances are measured with the sense lines connected. For H input series, output regulation is +1/-5% when Vin is below 10V.*
*Note ** : It is recommended to mount the converter on a heatsink for this test, see section 10-3 and 10-9 for further details.*
*Note *** : The output voltage ripple is the periodic AC component superimposed on the output voltage, an aperiodic and random component (noise) has also to be considered. This noise can be reduced by adding 4 external decoupling capacitors connected between inputs and case and between outputs and case. These capacitance should be layed-out as close as possible from the converter. Please refer to page 8 for more details.*
Note 1 : The MGDS-200-H-F has a no load input current of 1,2W max. and 450 mVpp ripple.

3- Electrical Characteristics (continued)

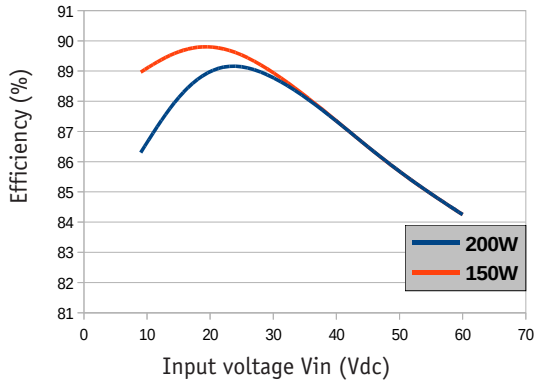
Typical efficiency MGDS-200-H-C at 25°C



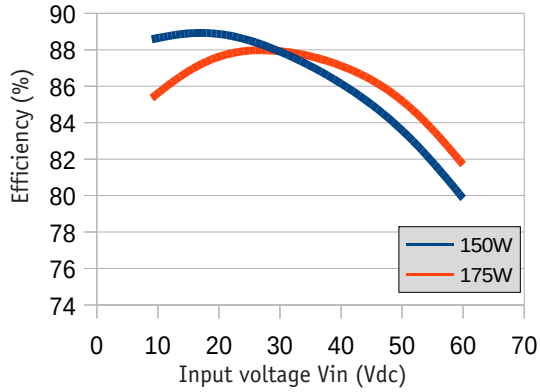
Typical efficiency MGDS-200-H-E at 25°C



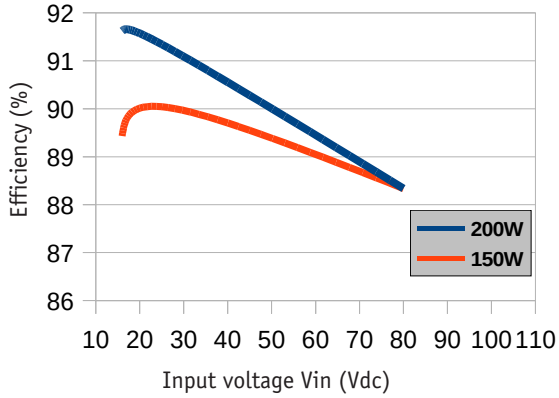
Typical efficiency MGDS-200-H-F at 25°C



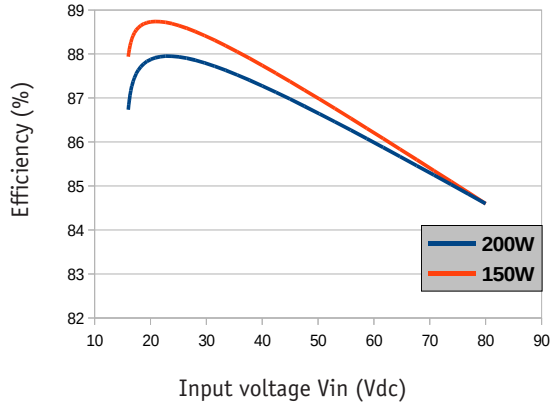
Typical efficiency MGDS-200-H-I at 25°C



Typical efficiency MGDS-200-O-F at 25°C



Typical efficiency MGDS-200-O-I at 25°C



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	270 KHz

5- Isolation

Parameter	Conditions	Limit or typical	Specifications
Electric strength test voltage	Input to output Input to case Output to case	Minimum Minimum Minimum	1 500 VDC / 1 min 1 500 VDC / 1 min 1 500 VDC / 1 min
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 4
Output current limitation (OCP)	Foldback current limitation	Automatic recovery	Maximum	120% of output current
Output short circuit protection (SCP)	Hiccup circuitry with auto-recovery	Automatic recovery	Permanent	See section 11
Output overvoltage protection (OVP)	Overvoltage protection device with latch-up	Automatic recovery	Typical	115% to 130% of output voltage
Over temperature protection (OTP)	Thermostat with hysteresis cycle	Automatic recovery	Maximum	120°C internal

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	575 000 Hrs 155 000 Hrs
	Airborne, Inhabited, Cargo (AIC)	Case at 40°C Case at 85°C	325 000 Hrs 105 000 Hrs
Mean Time Between Failure (MTBF) According to IEC-62380-TR	Civilian avionics, calculators	Ambient at 55°C 100% time on	411 000 Hrs

8- Electromagnetic Interference

Electromagnetic Interference requirements according to MIL-STD-461C/D/E standards can be 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 with additionnal filter
Electrical field	RE 02	RE 102	compliant with additionnal filter
Radiated susceptibility (RS) :			
Magnetic field	RS 01	RS 101	compliant with additionnal filter
Electrical field	RS 03	RS 103	compliant with additionnal filter

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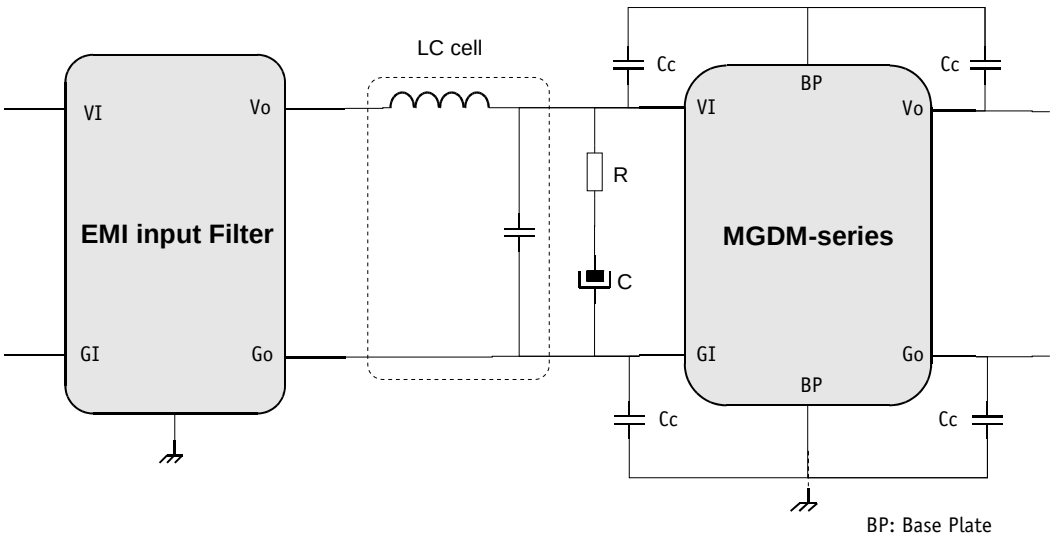
8-1 Module Compliance with MIL-STD-461 Standards

To meet the latest US military standards MIL-STD-461 requirements and in particular the conducted noise emission CE102 and CE03 requirements, Gaïa Converter can propose a stand-alone ready-to-use EMI filter module solution together with a RC cell (see filter module datasheet) and a LC cell (L=1µH, C=10µF min. ceramic capacitor) and 4 external decoupling capacitance Cc (10nF/rated voltage depending on isolation requirement) connected between input and case and output and case.

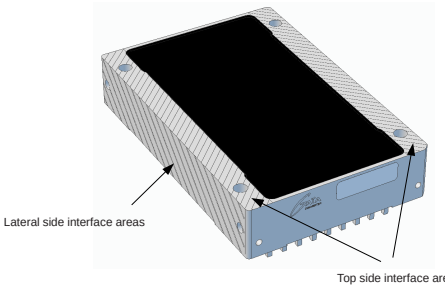
EMI input filter : See detailed configuration as per datasheet FGDS-20A-50V

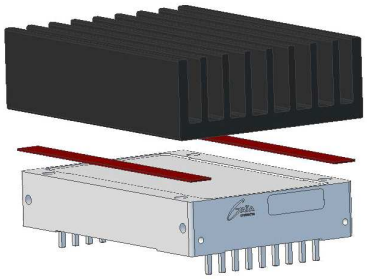


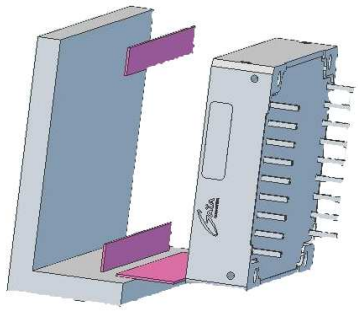
9- Thermal Characteristics

Characteristics	Conditions	Limit or typical	Performances
Operating ambient temperature range at full load	Ambient temperature *	Minimum Maximum	- 40°C see section below
Frame operating temperature	Frame temperature	Minimum Maximum	- 40°C see curve herafter
Storage temperature	Non functionning	Minimum Maximum	- 55°C + 125°C

The MGDM-200 series use an innovative thermal dissipation concept : the baseRail™ and sideRail™ .The entire module is layed-out on a multi-layer printed circuit board that includes multi copper thermal plans. Those ones ensure thermal transfer towards frame rails with pressurized high conductivity thermal drain. The frame rails transfer heat trough the top side rail or lateral side rail of the converter frame. This concept allows a high flexibility of converter mounting either vertically or horizontally.







The following discussion will help designer to determine the thermal characteristics and the operating temperature.
Heat can be removed from the frame via three basic mechanisms :

- Radiation transfert : radiation is counting for less than 5% of total heat transfert in majority of case, for this reason the presence of radient cooling is used as a safety margin and is not considered.
- Conduction transfert : in most of the applications, heat will be conducted from the frame into an attached heat conducting member and heatsink; heat is then conducted thru the interface.
- Convection transfert : convecting heat transfer into air refers to still air or forced air cooling.

In majority of the applications, we will consider that heat will be removed from the frame either with :

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

To calculate the maximum admissible ambient temperature the following method can be used.
Knowing the power used Pout and the efficiency η:

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

Pdiss = Pout(1/η - 1) (A)

- then determine the thermal dissipation :

Tdiss = Rth(b-a) x Pdiss (B)

where **Rth(b-a) is the thermal resistance from the frame to ambient**.

This thermal Rth(b-a) resistance is the summ of :

- **the thermal resistance frame to heatsink (Rth(b-h)).** The interface between baseplate and heatsink can be nothing or a conducting member, a thermal compound, a thermal pad.... The value of Rth(b-h) can range from 0.4°C/W for no interface down to 0.01°C/W for a thermal conductive member interface.
- **the thermal resistance heatsink to ambient air (Rth(h-a))**, which is depending of heatsink models.

The table hereafter gives some example of thermal resistance for different heat transfert configurations.

Heat transfert	Thermal resistance heatsink to air Rth(h-a)		Thermal resistance (@top frame area) frame to heatsink Rth(b-h)		Global resistance
Free air cooling only	Heatsink Fisher SK099 :	3°C/W	Bergquist Silpad2000	0,15°C/W	3,15°C/W
			Kerafol 86/600:	0,09°C/W	3,09°C/W
	Heatsink Fisher SK445 :	2,5°C/W	Bergquist Silpad2000	0,15°C/W	2,65°C/W
			Kerafol 86/600:	0,09°C/W	2,59°C/W

Fisher is a heasink manufacturers. «Silpad» © is a registered trademark of Bergquist.
Note : thermal resistances frame to heatsink with thermal pad are calculated for the MGDM-200 frame contact surface of 9,3 cm2 and pressure of 50 Psi.*

9- Thermal Characteristics (continued)

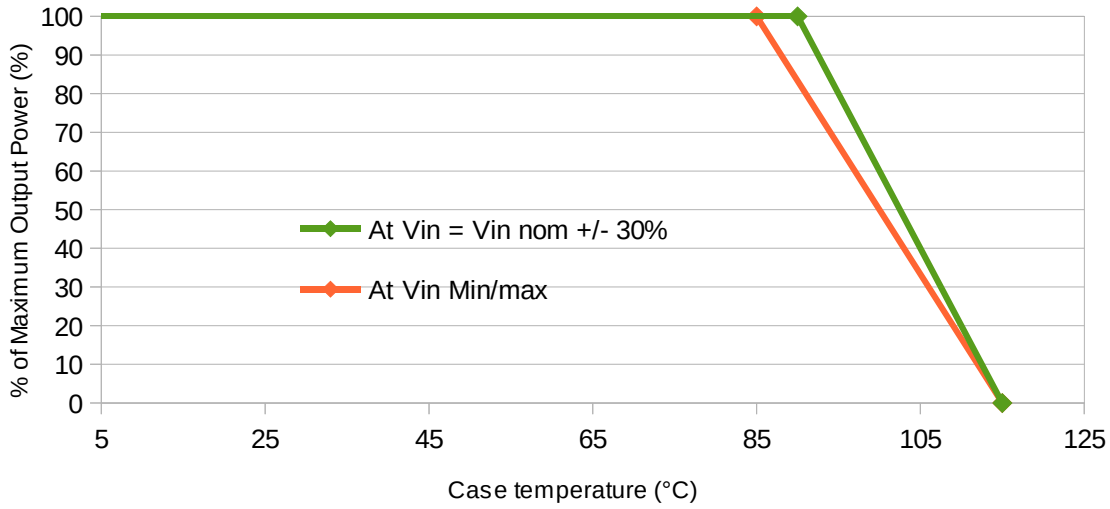
The two formulas (A) and (B) described in previous page :

- **Pdiss = Pout(1/η - 1) (A)**
- **Tdiss = Rth(b-a) x Pdiss (B)**

conduct to determine the maximum ambient temperature admissible as a function of the maximum frame temperature of the module.
Knowing the maximum frame temparature $Tmax_{frame}$ the maximum ambient temperature is given by the following formula :

$Ta = Tmax_{frame}$ - Tdiss (C)

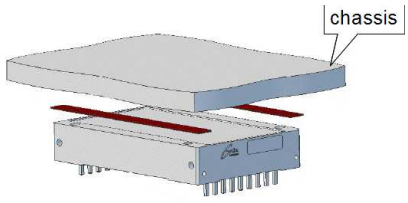
MGDM-200 Series Typical Maximum Frame Temperature Versus % of Maximum Output Power



In case of a chassis or cold plate mounting :

In case of report on a chassis, the max temperature chassis would not overflow is given by the following formula :

$Tchassis = Tmax_{frame} - Rth(i) \times Pdiss$



Where :
Tchassis = Chassis maximum temperature
$Tmax_{frame}$ = Maximum converter frame temperature (see curve above)
Rth(i) = thermal resistance of the thermal interface between frame & chassis in °C/W
Pdiss = module power dissipation

Rth(i) x Pdiss is the temperature dissipated by the module

The table hereafter gives some example of chassis mounting heat transfert configurations.

Heat transfert	Power	Thermal resistance (@top frame area) frame to chassis Rth(b-h)		Max. Chassis Temperature
Chassis Mounting Horizontally	Considering the module at a power used of 200W (efficiency 88%)	Bergquist Silpad2000	0,15°C/W	Tmax chassis = 86°C
		Kerafol 86/600	0,09°C/W	Tmax chassis = 88°C
		Panasonic EYGS091210	0,00027°C/W	Tmax chassis = 90°C
Chassis Mounting Vertically	Considering the module at a power used of 200W (efficiency 88%)	Bergquist Silpad2000	0,15°C/W	Tmax chassis = 86°C
		Kerafol 86/600	0,09°C/W	Tmax chassis = 88°C

«Silpad» © is a registered trademark of Bergquist.
Note : thermal resistances frame with thermal pad are calculated for the MGDM-200 frame contact surface of 9,3 cm2 and pressure of 50 Psi.*

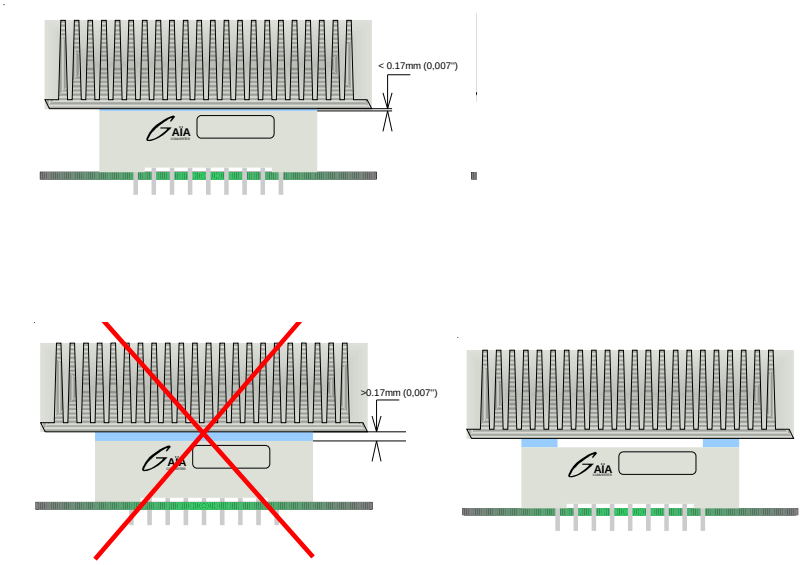
9- Thermal Characteristics (continued) : Heatsink Mounting

To mount properly the module to heatsink, some important recommendations need to be taken into account in order to avoid overstressing conditions that might lead to premature failures.

Heat must be conducted from the frame into an attached heat sink/heat conducting member through either the top side interface areas, or either one or both of the lateral side interface areas.

Thermal compound or a thermal pad should be used to fill surface irregularities of these areas.

If thermal interface material is thin enough (< 0,17mm - 0,007") it can cover the whole module surface, otherwise, it must be placed only on metal parts of case, but not on black area with compound. Any thick thermal interface covering black area might apply dangerous thermo mechanical constraints on the sensitive module's central area.



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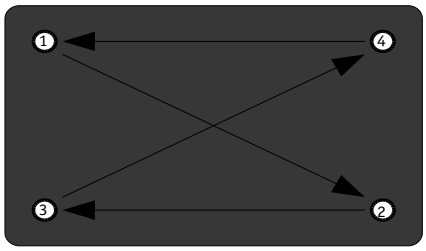
Gaia converter suggests to follow the procedure hereunder for the mechanical assembly procedure in order to avoid any stress on the pins of the converters. It is good practice to be sure to mount the converters first mechanically, then solder the units in place.

1. Choice of the thermal gap pad : its shape must be the same as the module frame contact. The dimensions of the gap pad can be a little larger than the module.

2. Screw the converter to the heatsink and/or to the board. The four screws have to be screwed in a "X" sequence.
• Lightly finger-tighten all screws and run several «X» sequences
before achieving final torque to get homogeneous tightening.
• Torque screws from 0,35 N.m (3 lbs.in) to 0,7 N.m (6 lbs.in).

3. Screw the heatsink to the board.

4. Solder the pins of the converters on the board. This sequence avoids mechanical stresses on the converters that could lead to stress internal components or assemblies and cause their failures.



10- Environmental Qualifications

The modules have been subjected to the following environmental qualifications.

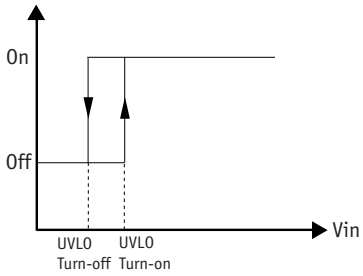
Characteristics	Conditions	Severity	Test procedure
Climatic Qualifications			
Life at high temperature	Duration Temperature / status of unit	Test D : 1 000 Hrs @ 125°C ambient, unit not operating	MIL-STD-202G Method 108A
Altitude	Altitude level C Duration Climb up Stabilization Status of unit	40 000 ft@-55°C 30 min. 1 000 ft/min to 70 000 ft@-55°C, 30 min. unit operating	MIL-STD-810G Method 500.5
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-810G Method 507.5
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-810G Method 509.5
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 / ,.7 mm 60 to 2000 Hz / 10 g 2h 30 min. per axis unit not operating	MIL-STD-810G Method 514.6
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-810G Method 516.6
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-810G Method 516.6

11- Description of Protections

The MGDM-200 low input series include 4 types of protections.

11-1 Input Undervoltage Lockout (UVLO)

An undervoltage protection is implemented to switch off the converter as long as the input voltage has not reached the UVLO turn-on threshold (see section 3 for value) which is the minimum input voltage required to operate without damaging the converter.



11-2 Output Over Current Protection (OCP)

The MGDM-200 series includes an output over current protection that operates with to 2 phases. A transient current limitation (TCL) step that maitains the maximum current to 150% +/- 30% of it's nominal current value Io nom. The maximum phase duration is 30ms.

If the over current condition is still present after 30ms, a second phase called slow current limitation (SCL) limits the output current to 115% + 30%/-0% of nominal output current. This SCL phase brings the converter in fold-back mode described in figure attached. The A area of Vo/Io diagram describes the normal use of converter when current did not reached the limit. The B are of Vo/Io diagram represents a forbidden area when Vo is trimmed.

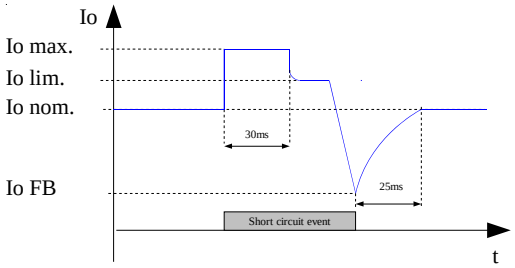


Fig : Short circuit current diagram
Io max = 150% +/- 30% Io nom.
Io lim = 115% + 15%/-5% Io nom.
Io FB = 25% + 10% Io nom.

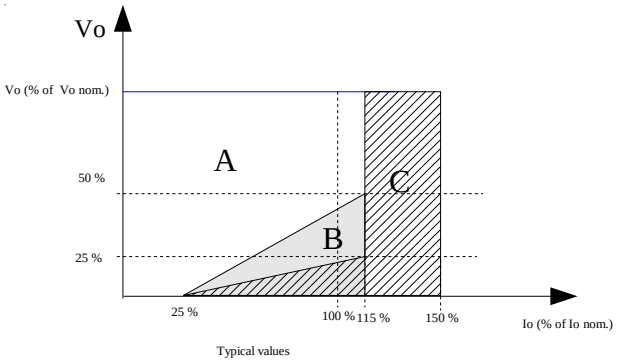


Fig : Current Limitation SCL shows 3 areas
Area A : Permanent not restricted usage
Area B : Permanent forbidden are when Vo is trimmed
Area C : Usage when current spikes duration does not overflow 30msrepresents a forbidden area when Vo is trimmed.

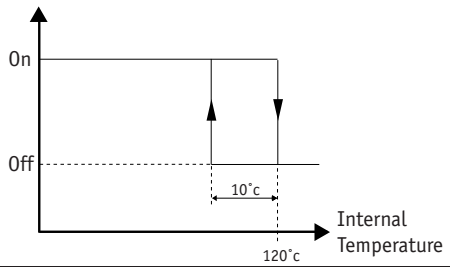
11-3 Output Overvoltage Protection (OVP)

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 at 115% to 130% of nominal output voltage.

Once in OVP protection, the module clamps the output voltage to 130% of it's nominal output voltage.

11-4 Over Temperature Protection (OTP)

A thermal protection device adjusted at 120°C (+/-5%) internal temperature with 10°C hysteresis cycle will inhibit the module as long as the overheat is present and will restore to normal operation automatically once the overheat is removed. The effectiveness of the OTP function is warranty with the module mounted on a heatsink.



12- Description of Functions

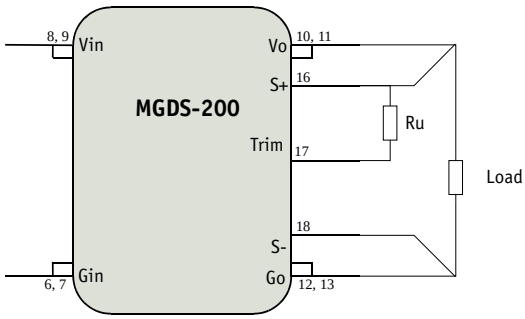
12-1 Trim Function

The output voltage Vo may be trimmed in a range of 10% to 110% of the nominal output voltage via an external trimmer or a fixed resistor.

Trim Up Function

Do not trim the module above 110% of nominal output voltage as the overvoltage protection will trigger.
Also do not exceed the maximum rated output power when the module is trimmed up.
The trim up resistor must be connected to the S+ pin.
The trim up resistor must be calculated with the following formula :

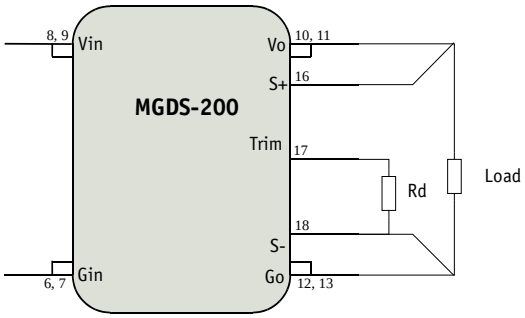
$$Ru = \frac{R1 \cdot (Vo - Vref) \cdot Vo_{nom}}{(Vo - Vo_{nom}) \cdot Vref} - R1 - R2$$



Trim Down Function

Do not trim down below 10% of nominal output voltage or 1 Vdc.
The available output power is reduced by the same percentage that output voltage is trimmed down.
The trim down resistor must be connected to S- pin.
The trim down resistor must be calculated with the following formula :

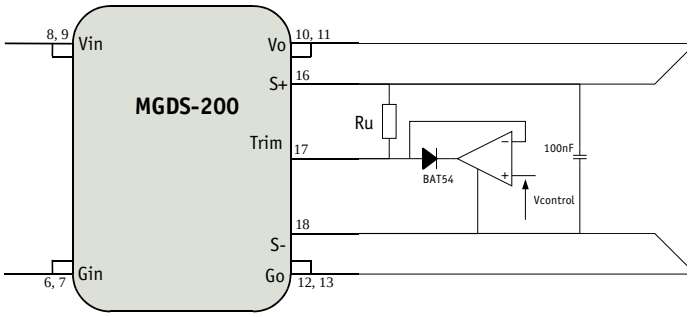
$$Rd = \frac{(R1 + R2) \cdot Vo - (R2 \cdot Vo_{nom})}{Vo_{nom} - Vo}$$



Trim via a voltage

The output voltage is given by the following formula :

$$Vo = (1 + \frac{R1}{R1 + R2} \cdot (\frac{Vcont}{Vref} - 1)) \cdot Vo_{nom}$$



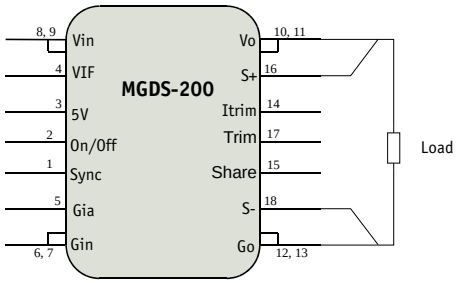
Trim resistor values calculated automatically:
On-line calculators for trim resistor values are available on the Gaia converter website at :
http://www.gaia-converter.com/calculator.

Parameter	Unit	Min.	Typ.	Max.
Trim reference Vref	Vdc	2,45	2,5	2,55
Resistor R1	Ohm	/	3,9K	/
Resistor R2	Ohm	/	270	/

12- Description of Functions (continued)

12-2 Sense Function (Sense)

If the load is separated from the output by any line lenght, some of the 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 the module will limit it's output to 130% of nominal output voltage. Connections are described in figure herein.

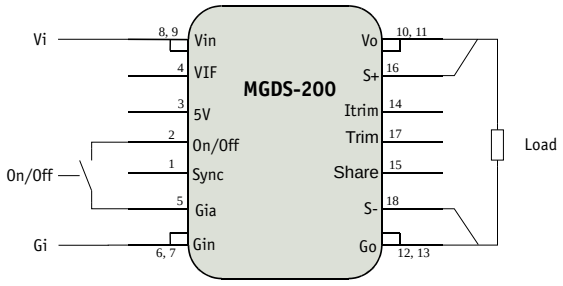


12-3 On/Off Function (On/Off)

The On/Off control pin 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 On/Off pin.
- No connection or high impedance on the On/Off pin 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.

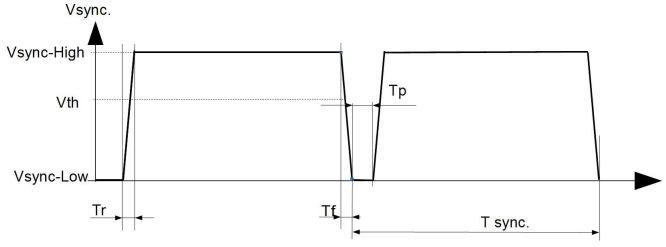


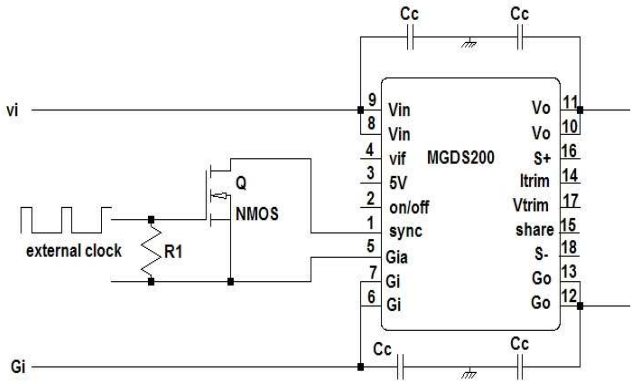
Parameter	Unit	Min.	Typ.	Max.	Notes, conditions
On/Off module enable voltage	Vdc	3.5	/	5	Open, the switch must not sink more than 100µA
On/Off module disable voltage	Vdc	0	/	0,5	The switch must be able to sink 1mA
On/Off alarm level	Vdc	0	/	0,5	OTP, faulty module
On/Off module enable delay	ms	/	/	30	The module restarts with the same delay after alarm mode removed
On/Off module disable delay	µs	/	/	100	Vi nominal, full load

12-4 Synchronization Function (Sync)

The «Sync» pin allows the synchronization of a module to an external frequency source or to another MGDM-200 module. The pin is bidirectionnal and must be driven by an open drain circuitry providing a square wave signal (active on falling edge) with a frequency ranging between 285kHz to 310kHz. The characteristics of the signal are detailed in the table hereunder. Refer to application notes section for further information on multiple modules synchronisation.

(tr, tf < 30ns; 100ns < Tp< 400ns)

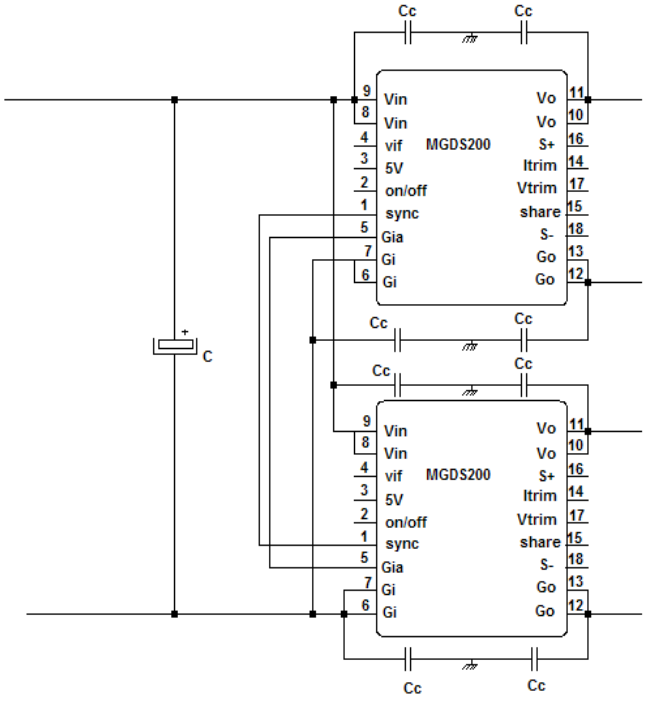




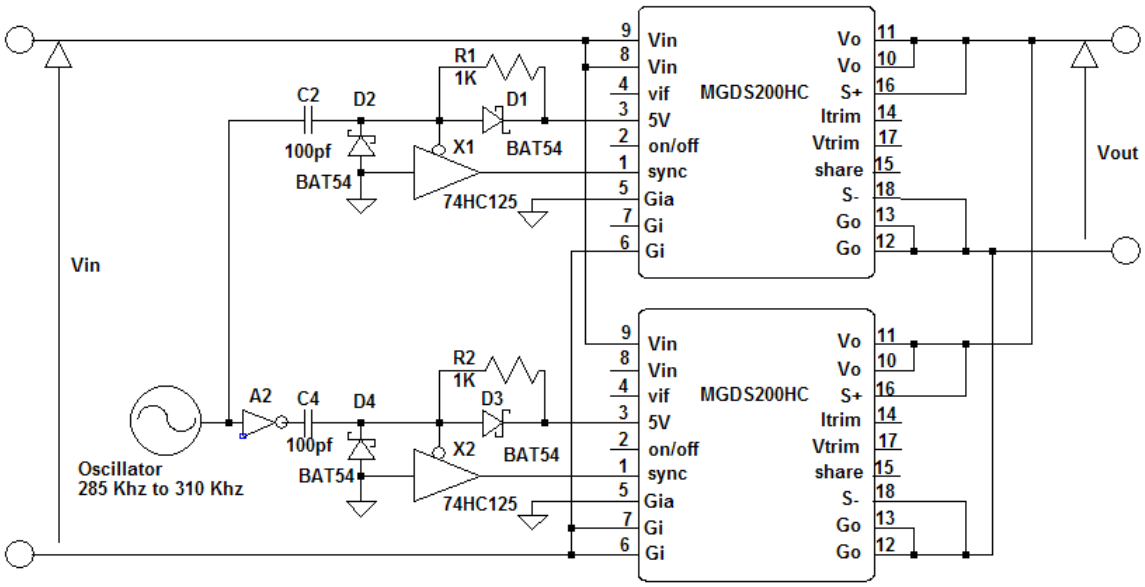
12- Description of Functions (continued)

12-4 Synchronization of Modules (continued)

The MGDM-200 low input series provides a synchronization function through the «Sync» pin to enable automatic synchronisation between several converters.
If several converters are used, they lock themselves at the highest switching frequency.
The synchronization signal «Sync» is internally referenced to «Gia» small signal ground (see page further) .
For this reason the synchronization signal need to be lay-out far from high power lines and coupled to «Gia» line.



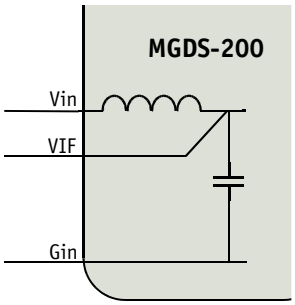
To optimize EMI level, it is possible to synchronize 2 MGDS200 switching frequencies with a 180° phase difference to reduce conducted emission.



12- Description of Functions (continued)

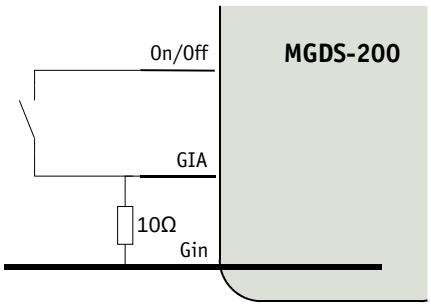
12-5 Input Current Ripple Reduction Function (Vif)

The «Vif» pin is a direct access to the capacitor of the LC input filter and allows to increase the C value to enhance the converter's stability and performance and to reduce the input current ripple for improved EMI performance.
It is recommended to provide for at least 10uF/low ESR ceramic capacitors.
These capacitors should have the proper voltage rating and should be connected between «Vif» and «Gin» as close as possible from the converter, using large copper traces.



12-6 Small Signal Ground (Gia)

The «Gia» pin is connected to the primary small signal ground to provide a clean grounding reference to interface sensitive external circuitry with the converter.
To prevent noise from perturbating the converter, this pin should not be connected to the input power ground Gi. If for design reasons «Gia» and «Gin» have to be connected, it should be done through a 10R resistor. For the same reason, «Gia» should not be connected to any noisy circuits nor be used to carry high currents.



12-7 Small Signal 5Vdc Voltage (5Vdc)

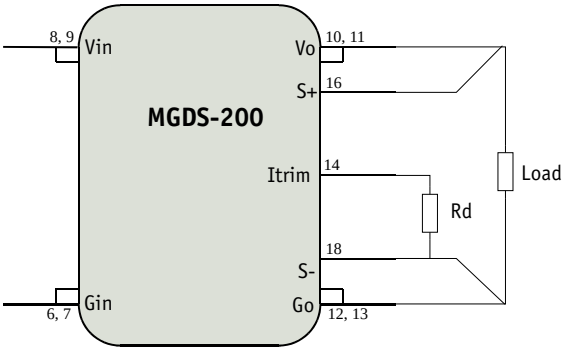
The 5V pin provides a stable voltage referenced to «Gia» that can source up to 5mA to supply external circuitry.
It is recommended to bypass the 5V to «Gia» with a 100nF ceramic capacitor if it is used.

Parameter	Unit	Min.	Typ.	Max.	Notes, conditions
Output voltage	Vdc	4,5	5	5,5	From no load to full load
Output impedance	Ohm	/	47		
Output current	mA	/	/	5	Source

12-8 Output Current Limitation Trim (Itrim)

The ITRIM pin allows to trim down the output current threshold at which the current limitation protection will trigger with a resistor connected between ITRIM and S-.
The pin must not be trimmed up. The formula hereunder allows to determine the resistor value Rd for a given output current threshold.

$$Rd = \frac{39000}{\left(1.15 \cdot \frac{Io_{nom}}{Io_{limit}} - 1\right)}$$



12- Description of Functions (continued)

12-9 Warm-Up Phase / Soft Start

The MGDM-200 series include a soft start device that controls inrush current whatever loading conditions. The MGDS-200 series behave as a current generator when it is loaded with a capacitive load. Thanks to this feature, there are no limitation to the capacitance value of the load but the charging time will increase the total start-up time.

Start-up phase with resistive load:

For resistive or low capacitive loads, the converter starts in less than 25ms, according to diagram showed in figure hereafter.

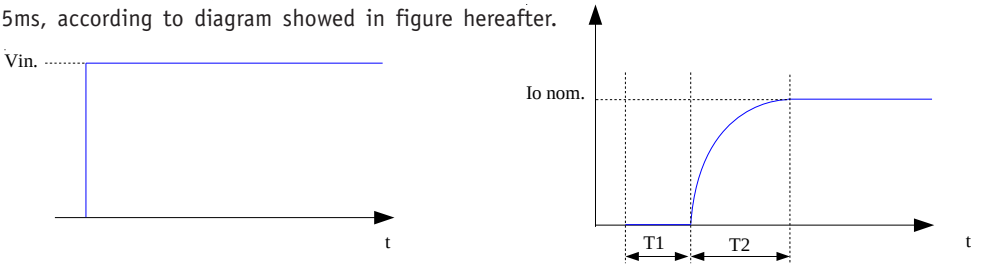


Figure : Typical start-up diagram when MGDS-200 is loaded with a resistive or low capacitive load.
T1 = 10 ms typical T2 = 15 ms typical Starting time =T1 +T2 = 25ms typical

Start-up phase with capacitive loads :

The MGDS-200 series has been designed to support different capacitive loads. In this case, a transient current limitation (TCL) protection circuit operates and limits the output current to a typical value between 120 to 180% of nominal output current. If after 30ms the nominal output voltage is no yet reached, the slow current limitation (SCL) circuit fixes the output current to 115% of nominal output current in order to finalise the capacitance charging until the nominal output voltage is reached.For resistive or low capacitive loads, the converter starts in less than 25ms, according to diagram showed in figure herafter.

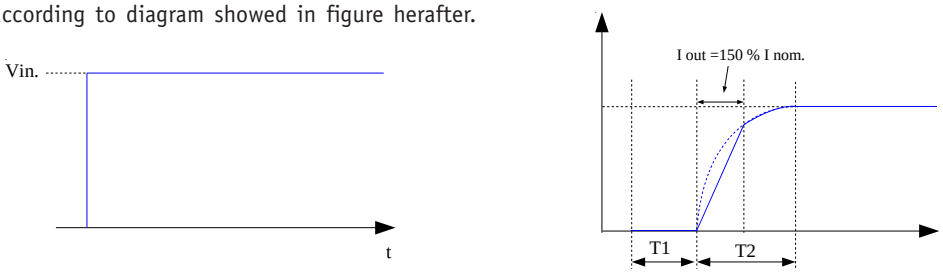


Figure : Typical start-up diagram when MGDS-200 is loaded with a capacitive load that charges in less than 15ms
T1 = 10 ms typical T2 = 15 ms typical Starting time = T1 +T2 = 25ms typical

Start-up phase with large capacitive loads :

For very large capacitive load, when the charging process is not ended within the 30ms, the slow current limitation process fixes the current to 115% of nominal, and finalise the capacitance charging.

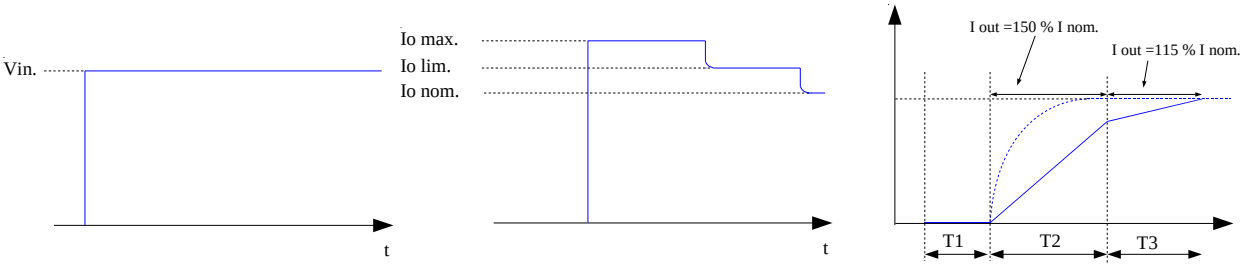
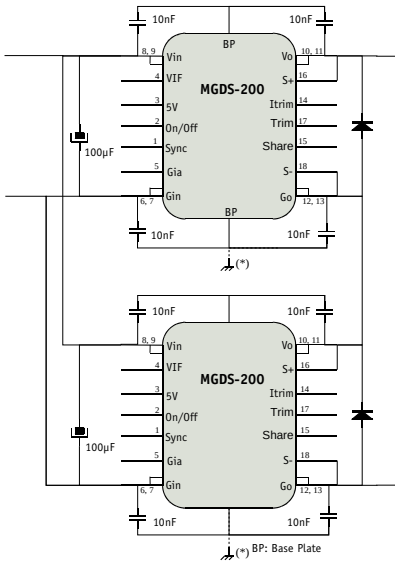


Figure : Typical start-up diagram when MGDS-200 is loaded with a very large capacitive load that charges in more than 30ms
T1 = 10 ms Typical T2 = 30 ms Typical T3 = depends on capacitor Starting time >40ms
Io max = 150% +/- 30% of Io nominal Io lim = 115% + 15%/-5% of Io nominal

13- Application Notes

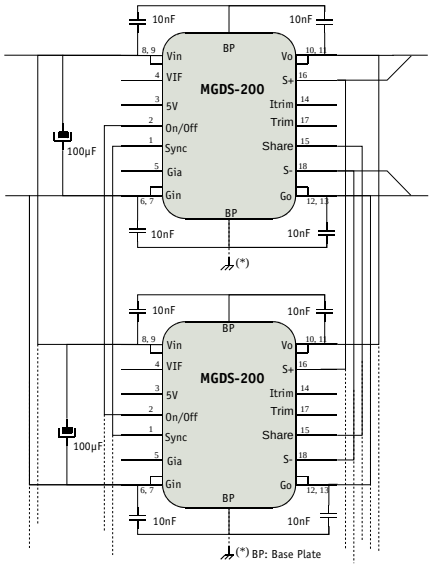
13-1 Connection of Modules in Series

The output of single output units can be connected in series without any precautions to provide higher output voltage level.
GAIA Converter recommends to protect each individual output with a 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 are not synchronous.
Special care must be taken to layout properly low level signals Sync. and On/Off from high current tracks. They must be shielded with GIA signal to avoid any disturbances by noises and crosstalk.



13-2 Connection of Modules in Parallel

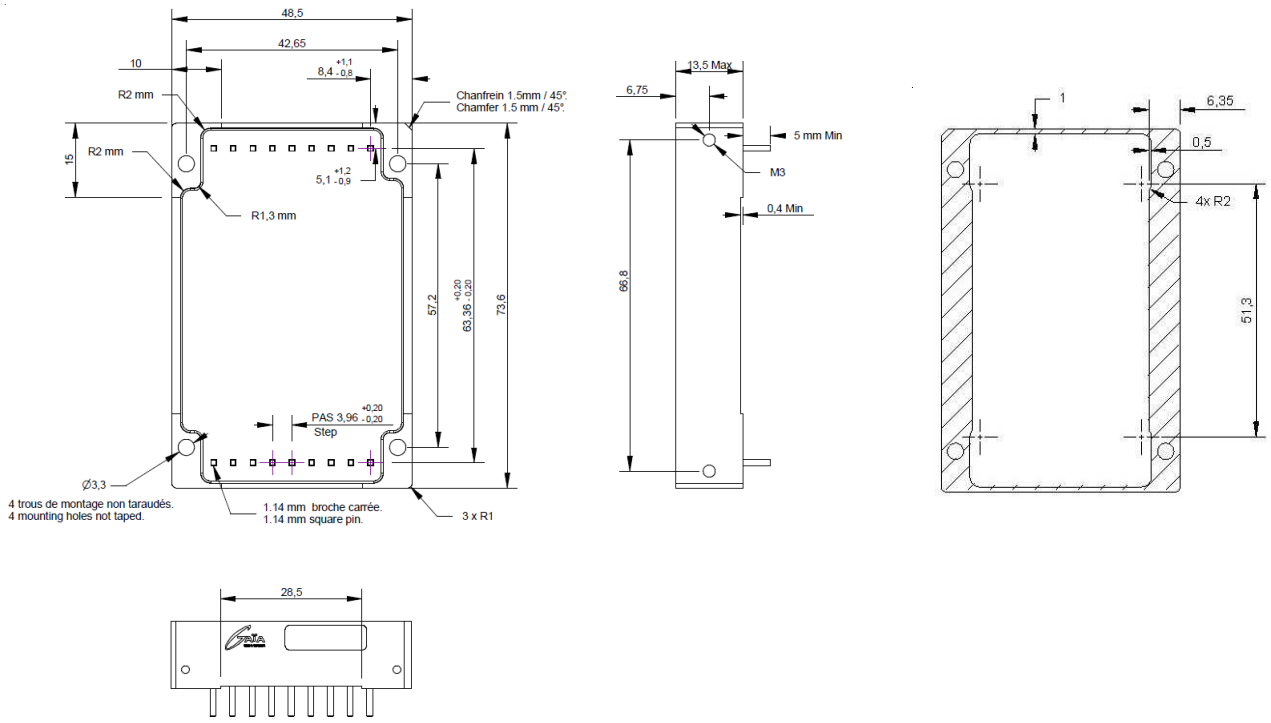
The MGDM-200 low input series features a «parallel operation function» to increase the output power capability of a single unit by connecting the outputs of 2 or more converters in parallel. By connecting the «Share» pin with each other, the units will share the load current equally within a few percent. Up to 5 converters can be parallelized.
The «Share» signal is a DC voltage referenced to «Sense-» which varies between 0Vdc and 5Vdc depending on the output load.
Modules can share the output power even if they are connected to different input buses.
Sense+ and Share tracks must be shielded with Sense- to avoid any disturbances by noise and crosstalk.



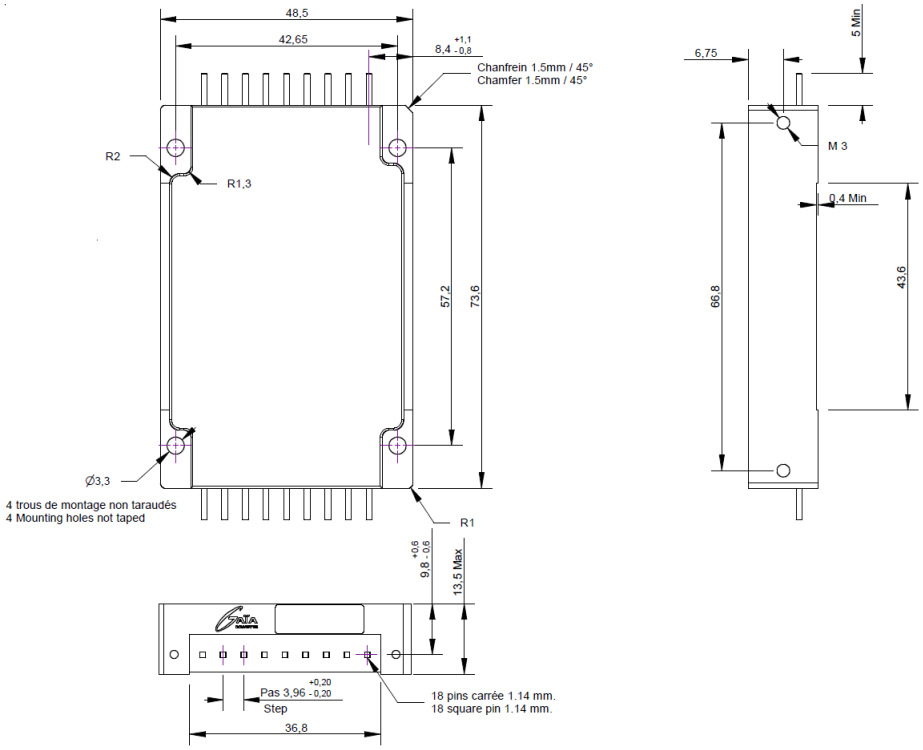
14- Dimensions

Dimensions are given in mm (inches). Tolerance : +/- 0,2 mm (+/- 0.01 ") unless otherwise indicated.
Weight : 105 grams (3.7 Ozs) max.

14-1 Basic Version



14-2 Option /2H with Pin Configuration on Side



4

15- Materials

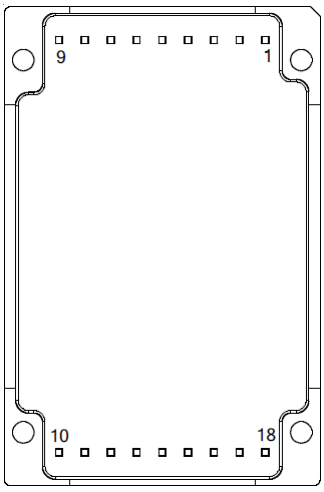
Frame : Aluminium alodined coating.
Pins : Flash gold plating over nickel underplate.

16- Product Marking

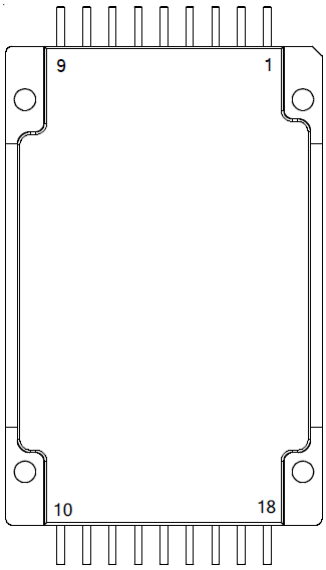
Side face : Company logo.
: Module reference : MGDx-200-»X»-»Y».
Date code : year and week of manufacturing, suffix, /option.

17- Connections and Footprint

Basic Version

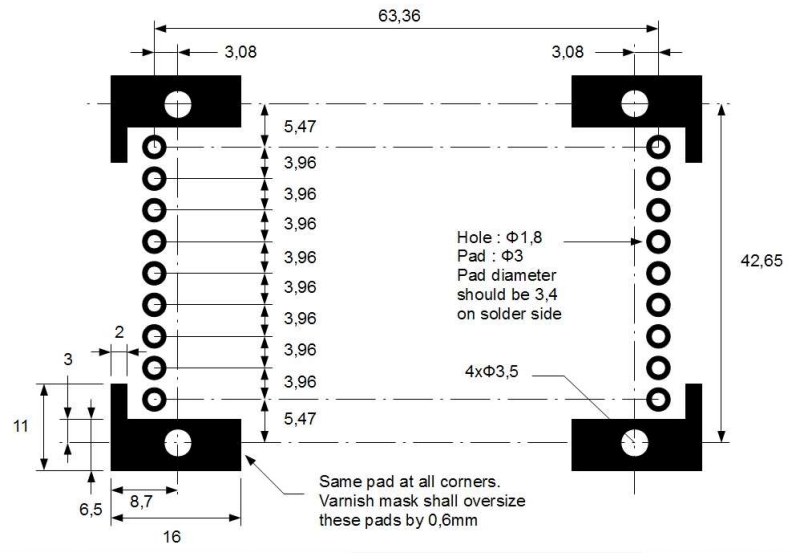


Option /2H Pin on Side



Pin	Single Output
1	Synchro (Sync)
2	On/Off
3	5Vdc
4	VIF
5	GIA
6,7	- Input (Gi)
8,9	+ Input (Vi)
10,11	+ Output (Vo)
12,13	- Output (Go)
14	Itrim
15	Share
16	Sense + (S+)
17	Trim (Trim)
18	Sense - (S-)

Bottom view



4

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