PRELIMINARY

MGDM-201 200W POWER

Hi-Rel Grade

Hi-Rel Smart DC/DC Converter
Single Programmable Output
1500 Vdc isolation

Features

- 9-45 or 16-80Vdc input.
- Power up to 200W
- Efficiency up to 91%
- Galvanic isolation 1500Vdc
- Paralleling function
- Wide output voltage trim
- Output current limit trim
- Synchronization
- No complex logic
- Undervoltage Lock Out
- Over voltage protection
- Output overload protection
- Thermal protection

Standards

- Mil-STD-704
- Mil-STD-1275
- Mil-STD-461
- DO160

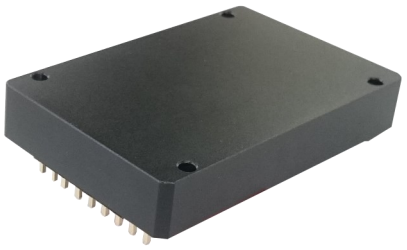
Applications

- Mil-Aero
- Ground-borne
- Naval
- Civilian Avionic
- On-board military Radars
- Navigation Systems
- Surveillance drone
- Redundant P.S.U.
- Flight recorders
- Night vision illuminators
- Intelligent weapons

Product Information

The MGDM-201 series features a range of 200W military grade isolated dc/dc converters with ultra-wide input voltage range of 9 - 45 or 16 - 80 Volts dc. The series includes single output voltage choices of 3.3, 5 12, 15, or 24Vdc. Using fixed switching frequency, the converter is based on a forward topology, and uses magnetic feed-back technology instead of classical opt-coupler for an improved reliability. The converter does not embed complex logic circuitry, and it features multiple functions. The ultra-wide output voltage trim allows users to define the output voltage value with only one low power resistor. To avoid input bus drop, in case of load failure, the Itrim function will limit the output power.

The converter's switching frequency can be slightly shifted to avoid radar bandwidth or simply synchronized to another converter to reduce switching noise. The output current sharing function allows connecting multiple converters in parallel in order to boost output power. The series is equipped with useful protections like soft-start for inrush current limitation, overload and short circuit protection, input under voltage lockout, and over temperature shut-down. The MGDM-201 is especially suitable for demanding applications. It comes in a fully potted metallic case that can operate with temperature ranging from -55 to 105°C.



Selection Guide

Part Number	Permanent Input Voltage (Vdc)	Transient Input Voltage (Vdc/s)	Nominal Output Power (W)	Nominal Output Voltage (Vdc)	Output Voltage Trim Range (Vdc)
MGDS-201-H-B	9-45	60/0.5	115	3.3	3 – 3.63
MGDS-201-H-C	9-45	60/0.5	175	5	3.5-5.5
MGDS-201-H-E	9-45	60/0.5	200	12	5.5-13.2
MGDS-201-H-F	9-45	60/0.5	200	15	8-16.5
MGDS-201-H-I	9-45	60/0.5	200	24	12-26.4
MGDS-201-O-B	16-80	100/1	115	3.3	3 – 3.63
MGDS-201-O-C	16-80	100/1	175	5	3.5-5.5
MGDS-201-O-E	16-80	100/1	200	12	5.5-13.2
MGDS-201-O-F	16-80	100/1	200	15	8-16.5
MGDS-201-O-I	16-80	100/1	200	24	12-26.4
Options :					
/T : option for -55°C case temperature start-up					
/S :option for screening and serialization					

1-ELECTRICAL SPECIFICATIONS

Data are valid at +25°C, unless otherwise specified				Specification	
Parameter	**Conditions**	**Limit**	**Units**	**H input**	**O input**
INPUT					
Nominal Input Voltage	Full temperature range	Nominal	Vdc	24-28	48
Undervoltage lock-out (UVLO)	Turn-on voltage turn-off voltage	Max. Max.	Vdc	9 8	16 14
Start up time	Ui nominal Full load resistive load	Maximum	ms	30	30
Input ripple current	Ui nom. Full load *as % of nominal current	Maximum	%	10	10
No load input Power	Ui nom.	Maximum	W	1,5	1,5
Input power in inhibit mode	Ui nom.	Maximum	W	1	1
OUTPUT					
Output current : B output (3V3) C output (5V) E output (12V) F output (15V) I output (24V)	Ui min. To Ui max Vo nominal	Maximum	A	 35 35 16,7 13,4 8,4	 35 35 16,7 13,4 8,4
Set Point accuracy	Uinom @75% load	Maximum	%	+/- 2	+/- 2
Output regulation (Line+Load+Thermal)	Ui min. to Ui max 0% to full load	Maximum	%	+/- 1	+/- 1
Output ripple voltage B output (3V3) C output (5V) E output (12V) F output (15V) I output (24V)	Ui min. To Ui max	Typical	mVpp	 100 100 250 450 500	 100 100 250 450 500
Output voltage trim Range	As a function of nominal output voltage	Minimum Maximum	% %	10** 110	10** 110
Power efficiency	Uinom @75% load	typical	%	88	88
Maximum capacitive load	Ui nom.	Maximum	µF	>10000	>10000

* with 100µF and 10µF MLCC across input bus ** depending on model

1-ELECTRICAL SPECIFICATIONS

Data are valid at +25°C, unless otherwise specified Parameter	Conditions	Limit	Units	H & O input
Switching frequency	Vi min. to max. 0% to full load	Nominal	Khz	250
Isolation strength	Input/Output Input/Case Output/Case	Minimum Minimum Minimum	Vdc/mn. Vdc/mn. Vdc/mn.	1500/1 1500/1 1500/1
Isolation Resistance	500 Vdc	Minimum	Mohms	500
PROTECTIONS				
Over Current Protection (OCP) **Trigger level :**	As function of nominal output current	Minimum Maximum	%	120 300
Over Current Protection (OCP) **Protection mode**			Hic-up	
Output Over Voltage Protection level (OVP)	As function of nominal output voltage	Typical	%	130
Over Temperature Protection **Level (OTP)**	Thermostat with hysteresis cycle	Maximum	°C	120
On/Off module enable voltage	Ui nom.	Minimum Maximum	Vdc Vdc	3,5 5
On/Off module disable voltage	Ui nom.	Maximum Minimum	Vdc Vdc	0,5 0
Start up time	Ui nom. time to Vout following on/off rilease	Maximum	ms	30
THERMAL				
Case operating temperature	Ui nom. Full Load	Minimum Maximum	°C °C	105 -40
Storage temperature	Not operating	Minimum Maximum	°C °C	125 -55
Case to Air thermal resistance	Ui nom. Full Load	Typical	°C/W	7
RELIABILITY **Mean time between failures (MTBF)**				
According to Mil HDBK 217F	Ground fixed (Gf) 40°C Ground fixed (Gf) 85°C Airborne, Inhabited, Cargo (AIC)) 40°C Airborne, Inhabited, Cargo (AIC) 85°C		Hours	TBD
According to IEC-62380-TR	Civilian avionics, calculators 55°C 100% time on		Hours	TBD

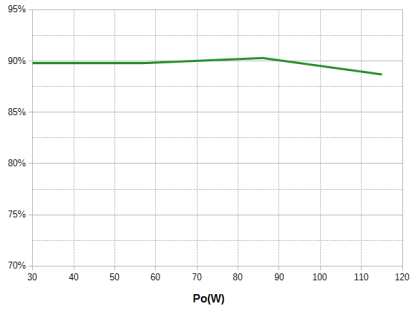
2-ENVIRONEMENTAL

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 Transfer 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 Transfer time Steady state time Status of unit	100 -55°C / +105°C 10 sec. 20 min. unit not operating	MIL-STD-202G Method 107G
Mechanical Qualifications			
Vibration (Sinusoidal)	Number of cycles Frequency / amplitude Frequency / acceleration Duration Status of unit	10 cycles in each axis 10 to 60 Hz / 0.7 mm 60 to 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

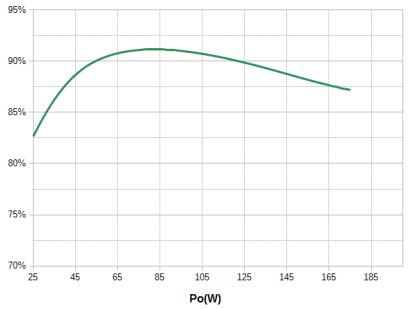
3-PERFORMANCE

Efficiency

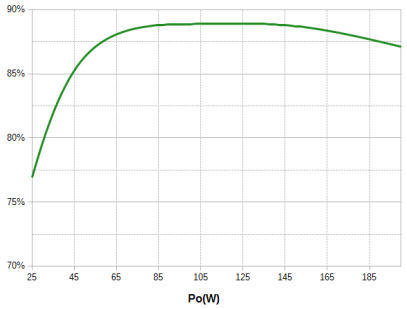
MGM200HB - Typical Efficiency at Vi=28V 25°C



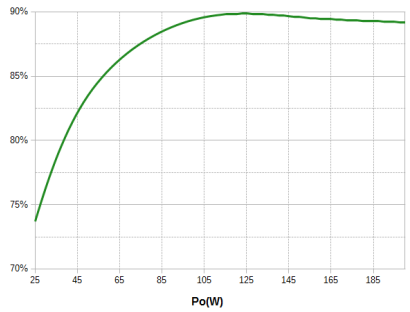
MGM200HC - Typical Efficiency at Vi=28V 25°C



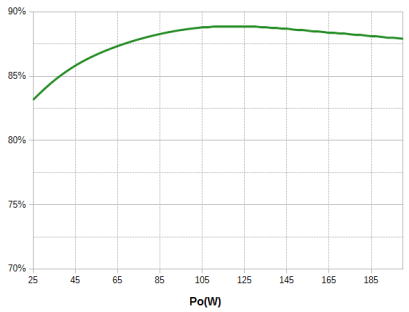
MGM200HE - Typical Efficiency at Vi=28V 25°C



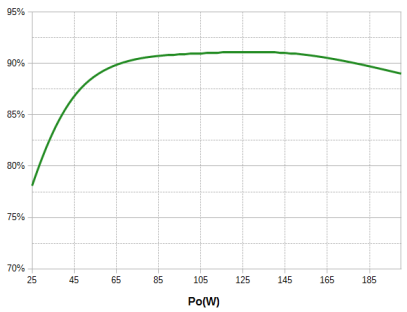
MGM200HF - Typical Efficiency at Vi=28V 25°C



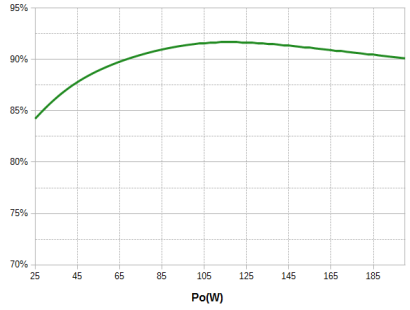
MGM200HI - Typical Efficiency at Vi=28V 25°C



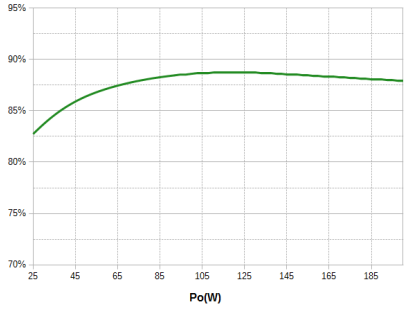
MGM200OF - Typical Efficiency at Vi=28V 25°C



MGM200OE - Typical Efficiency at Vi=28V 25°C



MGM200OF - Typical Efficiency at Vi=28V 25°C

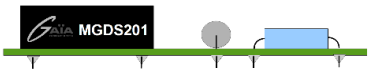


4-APPLICATION NOTE

4.1-THERMAL MANAGEMENT

The converter thermal management can be achieved in 3 different ways:

Free air cooling : the converter thermal resistance (Rth) allows operation without additional cooling device. Warning: this mode of cooling is reserved to very low ambient temperature or very low power conditions.

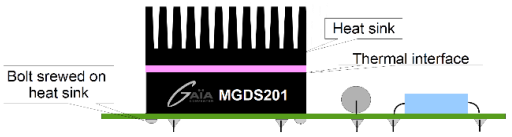


Free ai cooling

Cooling through an heat-sink : the heat-sink is applied to the converter top case through a thermal interface (gap-pad).This allows to reduce the total thermal resistance from case to ambient (Rth), resulting of the combination of case thermal resistance, gap-pad thermal resistance, and heat-sink thermal resistance. The max ambient temperature is given by:

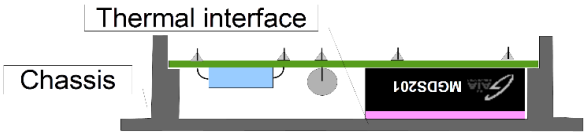
$$Tamb = Tc - Po * \left(\frac{1}{eff} - 1\right) * Rth$$

T_{amb} = max ambient temp.
T_c = max case temp.
eff = efficiency
R_{th} = thermal resistance of assembly case plus heat-sink to ambient



Heat-sink usage

Chassis mount: converter is applied to the chassis surface through a dedicate thermal interface (Gap-pad). The maximum ambient temperature operation will be given by the following formula :

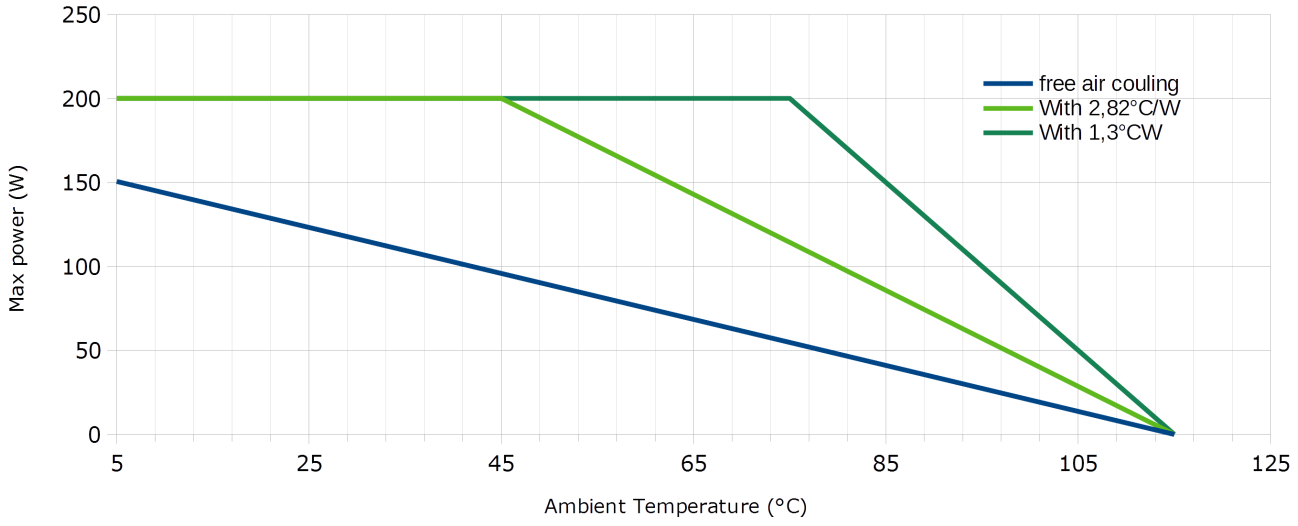


Chassis mount

$$Tamb = Tch - Po * \left(\frac{1}{eff} - 1\right) * Rth$$

T_{amb} = max ambient temp.
T_{ch} = max chassis temp.
eff = efficiency
R_{th} = thermal resistance of assembly case plus gap-pad

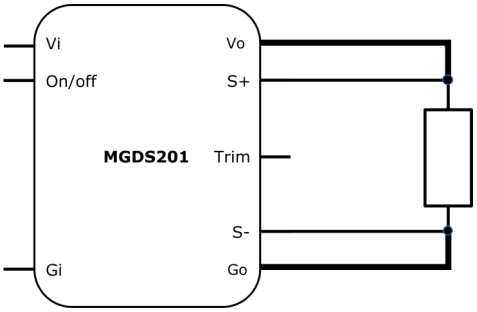
The diagram below shows various ambient temperature derating curves according to final thermal resistances Rth.



4-APPLICATION NOTE

4.2-SENSE FUNCTION

Sense terminals can be connected to the load to compensate any possible output wires losses. Sense terminals can compensate up to 10% output voltage drop. If not used senses should not be connected.

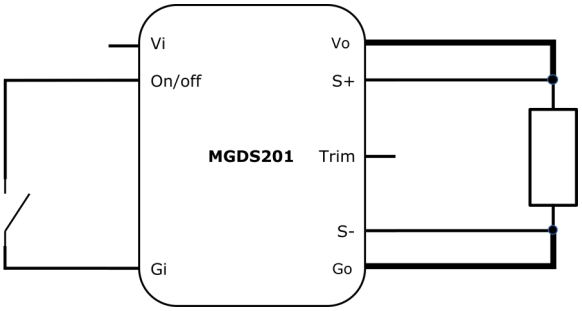


4.3-ON-OFF FUNCTION

The On/Off control pin can be used in applications requiring remote operation control. This may be done with an open collector transistor, a switch, a relay or an optocoupler. Several converters can be disabled with a single switch by connecting all on/off pins together.

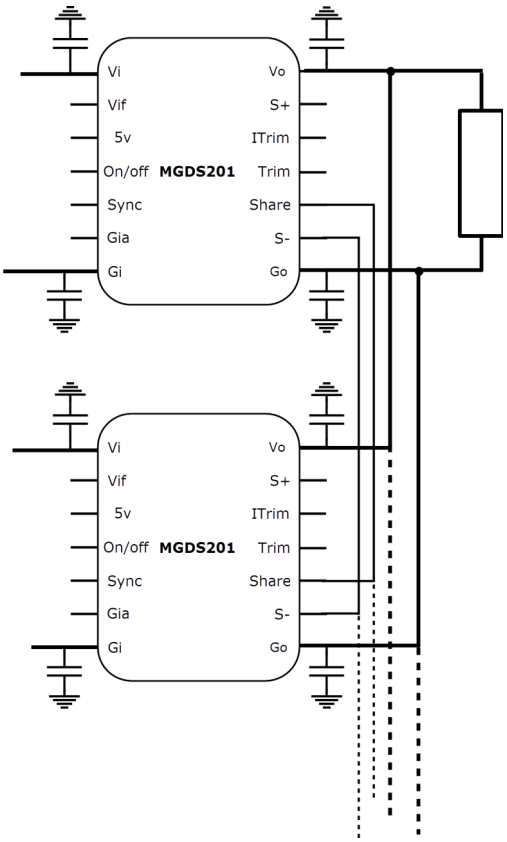
- The converter is disabled by pulling low the On/Off pin.
- No connection or high impedance on the On/Off pin enables the converter.

By releasing the On/Off function, the converter will restart within the start up time specifications given in table section 1. For further details please consult "Logic On/Off" application note.



4.4-LOAD SHARING

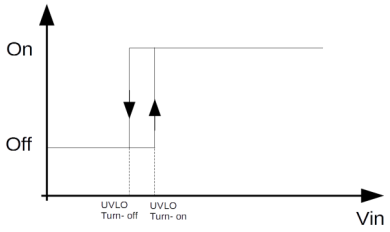
The MGDM-201 series features a «parallel operation function» to increase the output power capability by connecting the outputs of 2 or more converters in parallel. When the «Share» pin of each converter are tied together, the units will share the output load current equally. Up to 5 converters can be paralleled. The «Share» signal is a DC voltage referenced to «Sense-» which varies between 0Vdc and 5Vdc depending on the output load. Converters can share the output power even if they are connected to different input buses. PCB Share tracks must be shielded with Sense- to avoid any disturbances by noise and crosstalk.



4-APPLICATION NOTE

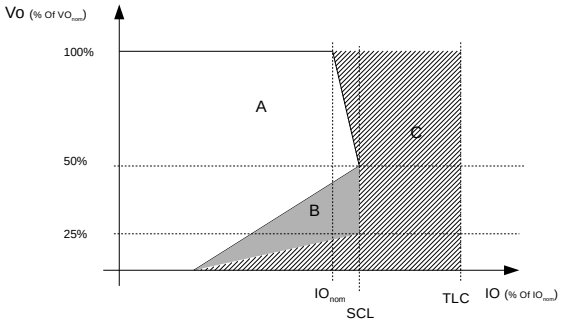
4.5-INPUT UNDERLOCKAGE VOLTAGE (UVLO)

An undervoltage protection is implemented to keep the converter off as long as the input voltage has not reached the UVLO turn-on threshold (see electrical specification for threshold value)



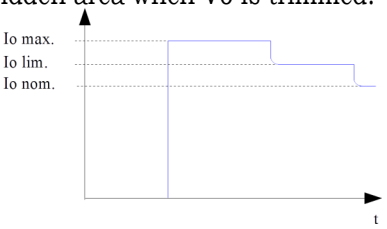
4.6-OUTPUT OVERCURRENT PROTECTION (OCP)

The MGDM-201 series includes an output over current protection that operates with to 2 phases. A transient current limitation (TCL) step that maintains the maximum current to Imax. If the over current condition is still present after TCL duration, a second phase called slow current limitation (SCL) limits the output current to Ilim. 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 has not reached the limit. The B area of Vo/Io diagram represents a forbidden area when Vo is trimmed.



Fold-Back Current limitation :

Area A = Permanent not restricted usage
Area B = Forbidden usage
Area C = Usage less than TCL duration

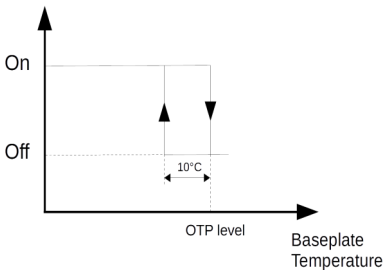


4.7-OUTPUT OVERVOLTAGE PROTECTION (OVP)

Each converter has an internal overvoltage protection circuit that monitors the voltage across the output power terminals. It is designed to limit the output voltage to OVP level, the output voltage recovers when over-voltage reason has disappeared.

4.8-OVER-TEMPERATURE PROTECTION

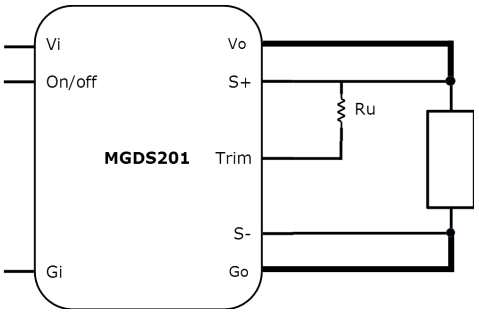
A thermal protection device adjusted at the OTP level (see characteristics) will inhibit the converter as long as the overheat is present and will resume to normal operation automatically once the overheat is removed. The effectiveness of the OTP function is warranty with the module mounted on a heatsink.



4-APPLICATION NOTE

4.9-TRIM FUNCTION

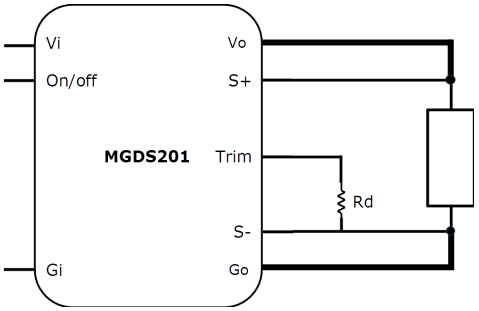
the output voltage Vo may be trimmed in a range of 10% to 110% of the nominal output voltage via an external trimmer or a fixed resistor.



Trim Up Function
Do not trim the converter 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 across the S+ pin and the trim pin. The trim up resistor can be calculated with the following formula :

$$Ru = 3.9 * \frac{(Vo-2.5)*VOnom}{(VO-VOnom\ )*2.5} - 4.17$$

Where:
Ru = trim resistor value in KΩ (value given at +/-7%)
VO = desired output voltage in Volts
VOnom = nominal output Voltage



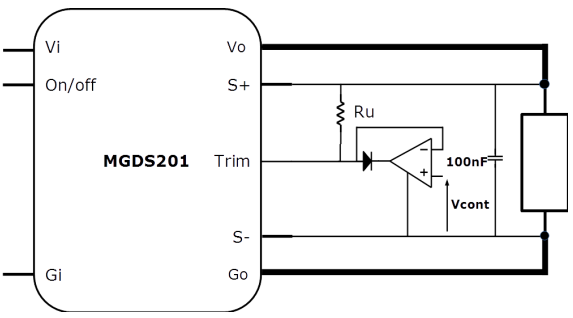
Trim Down Function
The available output power is reduced by the same percentage that output voltage is trimmed down. For this reason, in most of cases trimming down below 50% of VOnom is not valuable. The trim down resistor must be connected across S- pin and trim pin. The trim down resistor must be calculated with the following formula :

$$Rd = \frac{4.17*VO-0.27*VOnom}{VOnom\ -VO}$$

Where:
Rd = trim resistor value in KΩ (value given at +/-7%)
VO = desired output voltage in (Volts)
VOnom = nominal output Voltage

Trim via a voltage
The output voltage is given by the following formula :

$$Vo = \left(1 + \frac{3.9}{4.17} * \left(\left(\frac{Vcont}{2.5}\right) - 1\right)\right) * VOnom$$



Where:
Vcont = control voltage
VO = desired output voltage in (Volts)
VOnom = nominal output Voltage

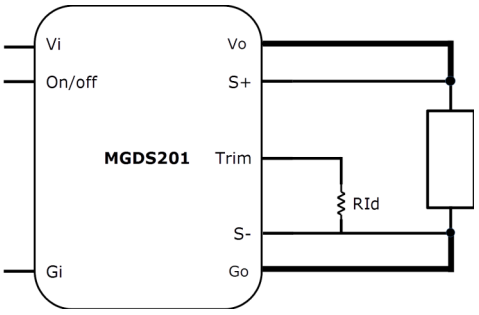
Trim resistor values calculated automatically:
On-line calculators for trim resistor values are available on Gaia converter website
http://www.gaia-converter.com/calculator

4-APPLICATION NOTE

4.10-CURRENT / POWER LIMITATION

The converter includes a function that allows to trim down the Foldback mode current limitation value in order to limit the input power and prevent input drop by overload. The current limit can be trimmed down with a resistor connected between I-TRIM and sense-, or through a voltage. The standard voltage on I-trim is 2.5V, reducing this voltage allow to trim down the permanent current limit. Warning: do not trim up this voltage.
To find the I-trim resistor (Rd) value, uses the following formula:

$$Rd = \frac{39}{1.15 * \left(\frac{Ion}{Iolim}\right) - 1}$$

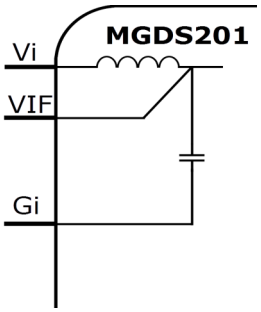


Where :

Rd = Trim resistor in KΩ (+/-10% result)
Inon = nominal output current
Iolim= desired current limit

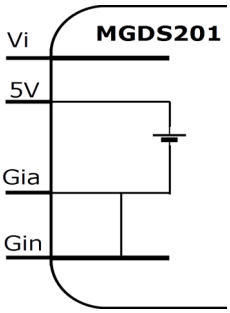
4.11-INPUT CURRENT RIPPLE REDUCTION

The «Vif» pin is a direct access to the capacitor of the internal 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 to the converter, using large copper traces on PCB.



4.12-PRIMARY SIDE AUXILIARY VOLTAGE

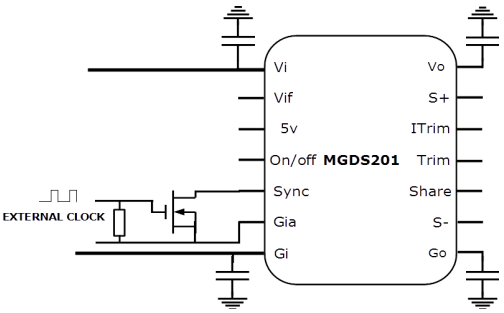
The 5V pin provides a stable voltage referenced to «Gia» that can source up to 5mA to supply external circuitry. It is recommended to bypass the 5V to «Gia» with a 100nF ceramic capacitor if it is used. The Gia pin is a small signal primary side signal return with a low level of switching noise that is electrically connected to Gi. It is intended to be use for all small signal circuit (on/off, sync…)

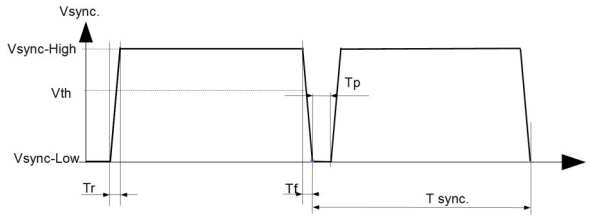


4-APPLICATION NOTE

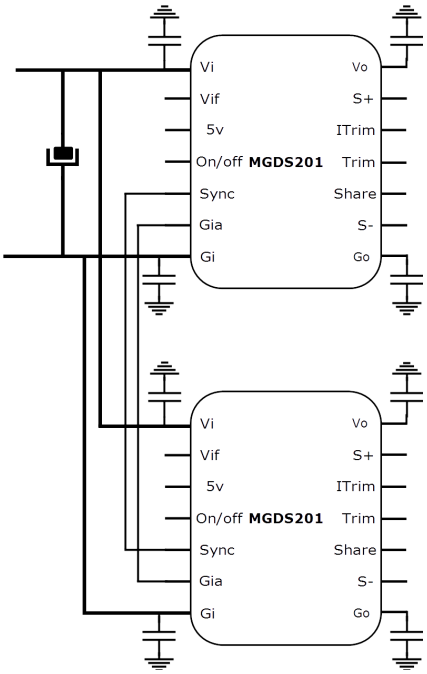
4.13-SYNCHRONIZATION FUNCTION

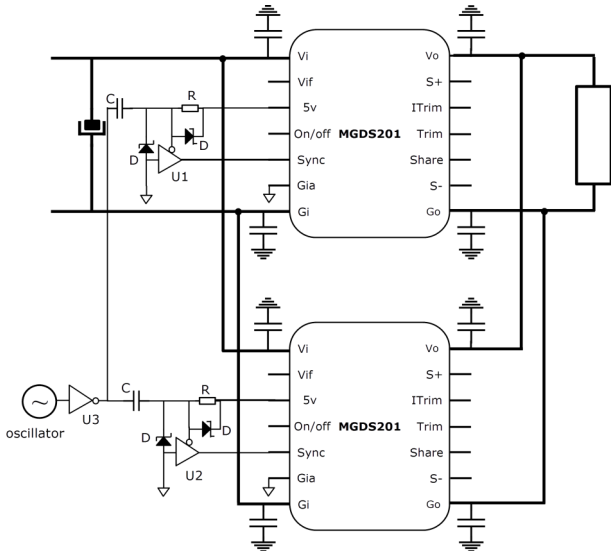
The «Sync» pin allows the synchronization of the converter to an external frequency source or to another MGDM-201 module. The pin is bidirectional and must be driven by an open drain circuitry delivering a square wave signal (active on falling edge) with a frequency ranging between 285kHz to 310kHz. The characteristics of the signal are detailed by the figure hereunder. Refer to application notes section for further information on multiple converters synchronization.
(tr, tf < 30ns; 100ns < Tp< 400ns)





To optimize EMI level, it is possible to synchronize 2 MGDS201 with a 180° phase difference to reduce differential mode conducted emission noise. A schematic diagram of such an Active Noise Reduction (ANR) is show here after.
C=100pF R=1KΩ,D=bat54, U1&U2=74Hc125 U3= 74HC14.

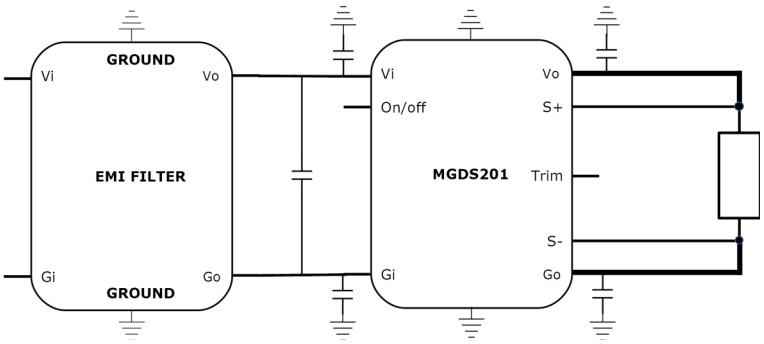




4-APPLICATION NOTE

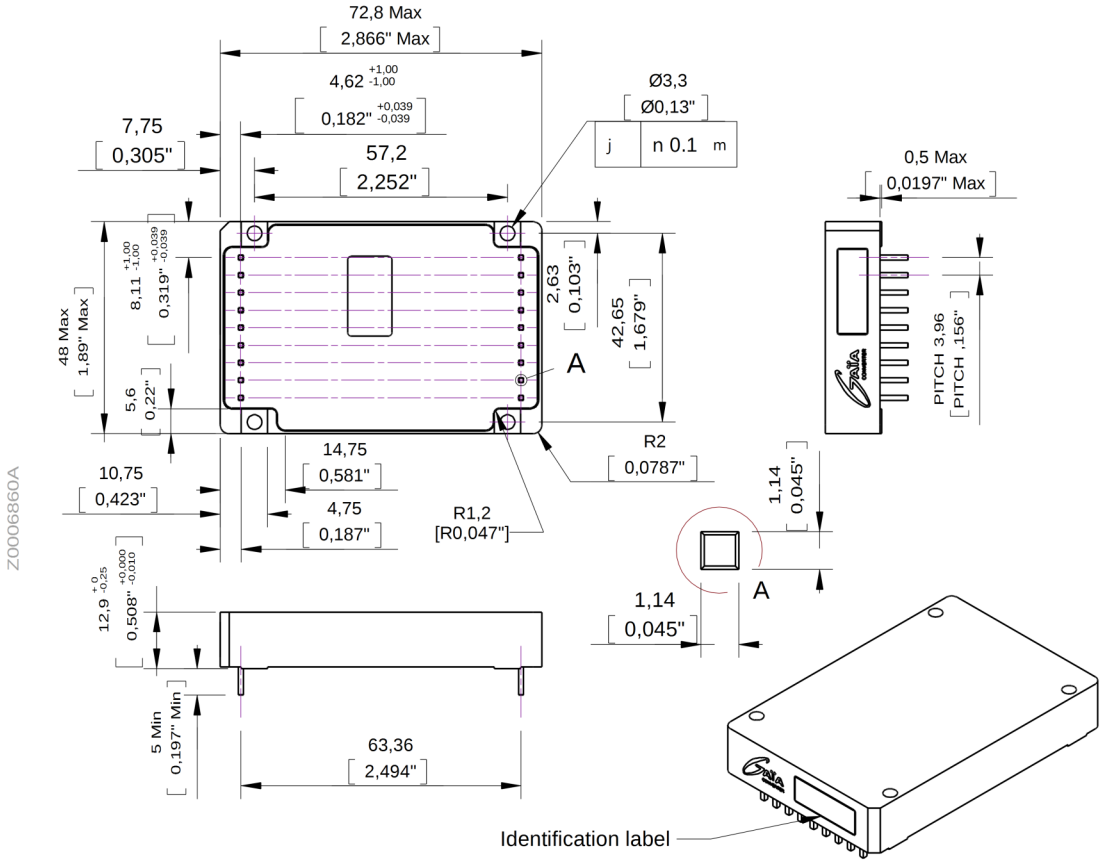
4.13-EMC COMPLIANCE

Depending on the standard reference to comply, the converter will need to be associated to any input filter to mitigate the switching noise. An additional input capacitance may be necessary to avoid impedance mismatch for some case of high output power and low input voltage.



4.14-MECHANICAL DRAWINGS

Dimensions are given in mm [inch].
General tolerance is +/-0.2mm [+/-0.008"] unless otherwise indicated.
All dimensions specified "min" or "max" are not subjected to the general tolerance.

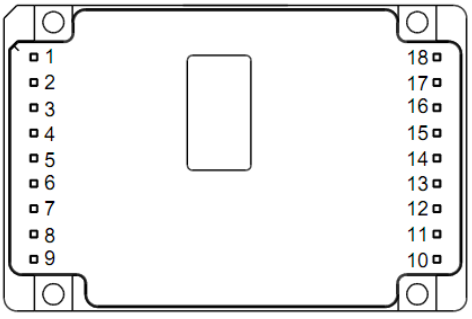


4.15-CONNECTION-PRODUCT MARKING

Pin	Function	Pin	Function
1	Sync	10	VO
2	On/Off	11	VO
3	5 Vdc	12	GO
4	VIF	13	GO
5	GIA	14	ITRIM
6	GI	15	Share
7	GI	16	Sense +
8	VI	17	Trim
9	VI	18	Sense -

Metallic case
Pin plating : gold flash

Side face : Company logo.
: Module reference : MGDx-200-»X»-»Y».
: Date code : year and week of manufacturing, suffix, /option.
Weight : 105 gr 3.7 Oz max.



Bottom view