MGDM-500 500W POWER

Hi-Rel Grade

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

Features

- 9-36 Vdc input.
- Power up to 500W
- Efficiency up to 93%
- Galvanic isolation 1500Vdc
- Output voltage trim
- Synchronization
- No complex logic
- Undervoltage Lock Out
- Over voltage protection
- Output overload protection
- Thermal protection

Standards

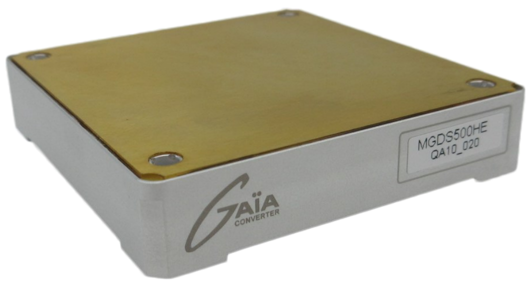
- Mil-STD-704
- Mil-STD-1275
- Mil-STD-461
- DO160

Applications

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

Product Information

The MGDM-500 series features a range of 500W military grade isolated dc/dc converters with wide input voltage range of 9 - 36Volts dc. The series switches at fixed frequency, the converter is based on a forward topology, and uses magnetic feed-back technology instead of classical opto-coupler for an improved reliability. The converter does not embed complex logic circuitry. Based on double interleaved forward topology, the MGDM-500 has outstanding conducted noise performances. The converter features multiple functions. The output voltage trim allows users to slightly change the output voltage value with only one low power resistor. The switching frequency can be slightly shifted to avoid radar bandwidth or simply synchronized to another converter to reduce switching noise. The series is equipped with useful protections like soft-start for inrush current limitation, overload and short circuit protection, and over temperature shut-down. The MGDM-500 is especially suitable for demanding applications. It comes in a fully potted metallic half brick case that can operate with temperature ranging from -40 to 105°C.



Selection Guide

Part Number	Permanent Input Voltage (Vdc)	Transient Input Voltage (Vdc/ms)	Nominal Output Power (W)	Nominal Output Voltage (Vdc)	Output Current (Adc)
MGDS-500-H-E	9-36	40/100	500	12	41.7
MGDS-500-H-F	9-36	40/100	500	15	33.4
MGDS-500-H-I	9-36	40/100	500	24	20.8
MGDS-500-H-J	9-36	40/100	500	28	16.7
MGDS-500-H-P	9-36	40/100	450	48	16.7

Options :

Part Number /T : -55°C

Part Number /S : screening

REDEFINING THE SOURCES OF POWER

Hi-Rel Grade

1-ELECTRICAL SPECIFICATIONS

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

Parameter	Conditions	Limit	Units	H input
Input				
Nominal Input Voltage (Ui)	Full temperature range	Nominal	Vdc	28
Undervoltage lock-out (UVLO)	Turn-on voltage turn-off voltage	Max. Max.	Vdc	10.5 8.5
Start up time	Ui Full load resistive load	Maximum	ms	30
Reflected ripple input current	Ui Full load with input Lc filter	Maximum	% (of input current)	10%
No load input Power	Ui	Maximum	W	22
Input power in inhibit mode	Ui	Maximum	W	0.3
Output				
Set Point accuracy	Ui 75% load	Maximum	%	+/- 2
Output regulation (Line+Load+Thermal)	Vi min. To Vi max 0% to full load	Maximum	%	+/- 0.5
Output ripple voltage E output (12V) F output (15V) I output (24V) J output (28V) P output (48V)	Vi min. To Vi max	Typical	mVpp	220 250 300 300 300
Output voltage trim Range	As function of nominal output voltage	Minimum Maximum	% %	90 110
Power Efficiency	Ui 75% load	Typical	%	92
Maximum capacitive load	Ui	Maximum	µF	>10000

1-ELECTRICAL SPECIFICATIONS

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

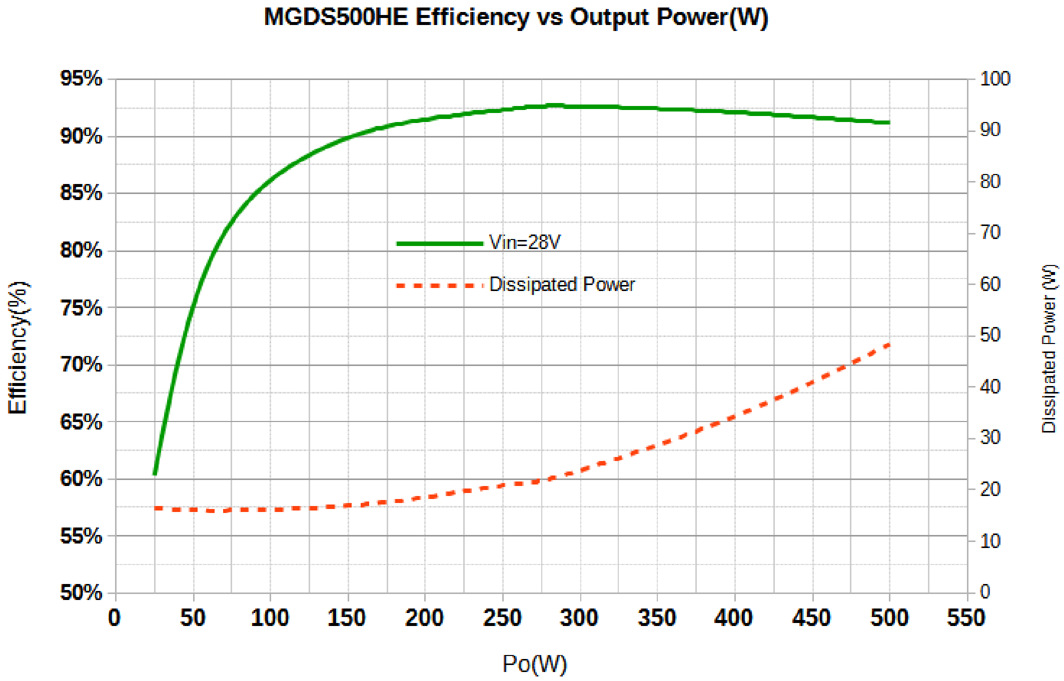
Parameter	Conditions	Limit	Units	H input
Switching frequency	Vi min. to max. 0% to full load	Nominal	Khz	300
External sync. frequency		Min.Max		270-330
External sync. Signal level		Min.Max	V	3.8-5
External sync. Pulse width (TD)		Min.Max	ns	15-150
Isolation strength	Input/Output Input/Case Output/Case	Minimum Minimum Minimum	Vdc/mn. Vdc/mn. Vdc/mn.	1500/1 1500/1 500/1
Isolation Resistance	500 Vdc	Minimum	Mohms	500
PROTECTIONS				
Over Current Protection (OCP) Trigger level :	As function of nominal output current	Minimum Maximum	%	120 TBD
Over Current Protection (OCP) Protection mode			Hiccup	
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 to Air thermal resistance	Ui nom. Full Load	Typical	°C/W	8
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

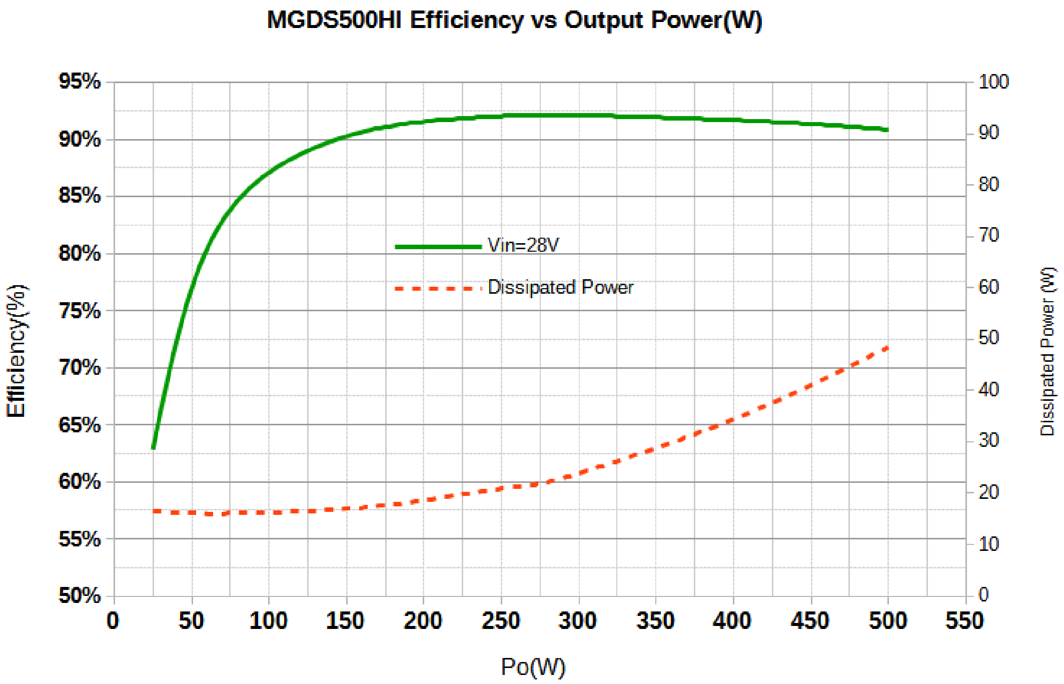
2-ENVIRONEMENTAL

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

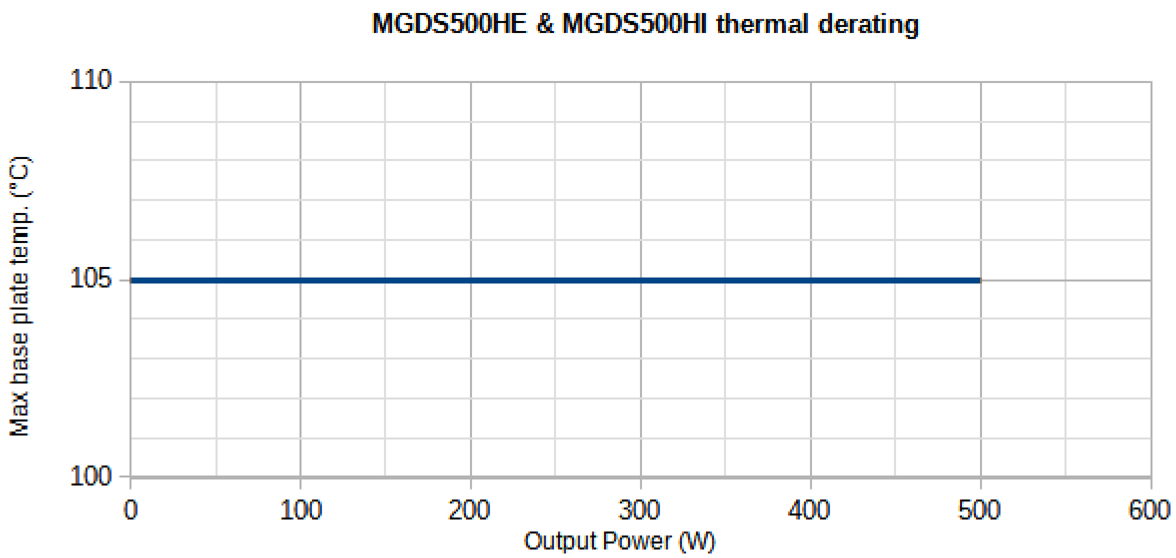
Efficiency





3-PERFORMANCE

Thermal derating

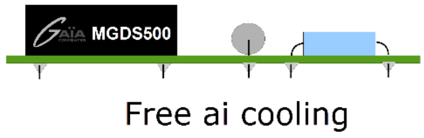


4-APPLICATION NOTE

4.1-THERMAL MANAGEMENT

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

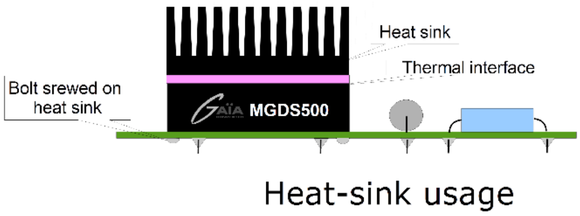
Free air cooling : the converter thermal resistance (Rth) allows operation without additional cooling device. Warning: this mode of cooling is reserved to very low ambient temperature or very low power conditions.



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:

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

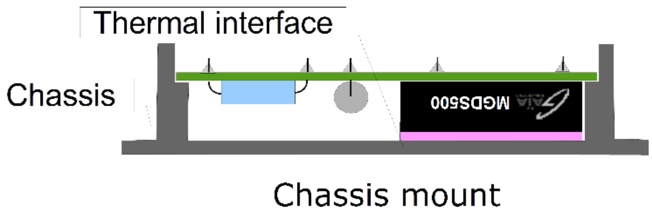
T_{amb} = max ambient temp.
T_c = max case temp.
eff = efficiency
R_{th} = thermal resistance of the assembly: case + thermal pad + heat-sink to ambient



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 :

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

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



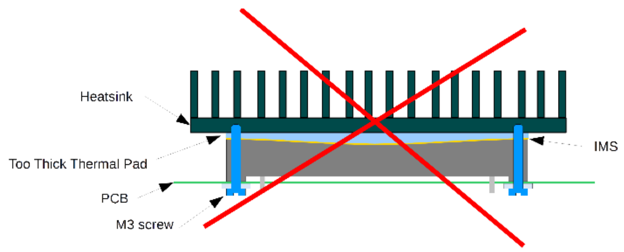
4-APPLICATION NOTE

4.1-THERMAL MANAGEMENT (continued)

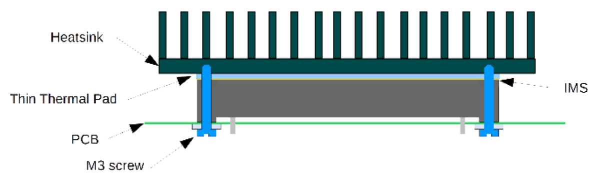
Thermal Pad Usage :

The module case is built with a IMS (isolated metalic substrate) crimped on an aluminum frame that provides case rigidity. The IMS surface is the module base plate that need to be reported to heat sink to achieve proper cooling. If for some reasons like poor module report, the IMS base plate is subject to mechanical overstress, module's electrical characteristics may be definitely affected.

A typical example of damageable report is the use of thick thermal interface with usual screwing torque applied on mounting screws. This combination causes a high pressure on baseplate center due to thermal interface material compression. The final consequence is a slight IMS bending that can conduct for the module to fail high voltage isolation leading to heavy electrical damage on internal circuit.



The good practice is to respect the 4 following recommendations:
do not exceed recommended screwing torque of 0,7 N.m (6 lbs.in)
- prefer thin thermal pad with thickness lower than 0,6 mm (0.023"). GAIA Converter recommends to use thin thermal pads instead of thermal compound like grease.
- take care to reflow module leads only when all assembly operations are completed.
- do not report module on surfaces with poor flatness characteristics. GAIA Converter recommends not to exceed 0,1mm/m for the surface flatness.

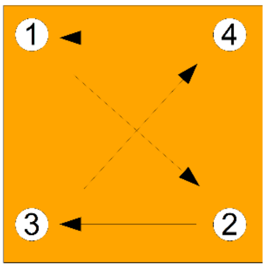


Gaia converter suggests to follow the procedure hereunder for the mechanical assembly procedure in order to avoid any stress on the pins of the converters. It is good practice to be sure to mount the converters first mechanically, then solder the units in place.
1. Choice of the thermal gap pad : its shape must be the same as the module. 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. The screwing sequence need to be performed very slowly to give thermal interface time to change its shape .
• 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.

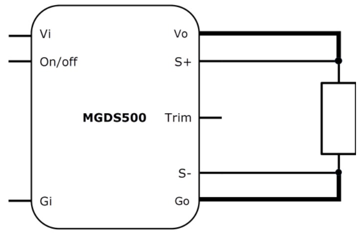


Converter screwing sequence

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.

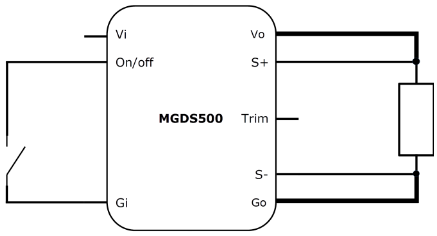


4.3-ON-OFF FUNCTION

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.

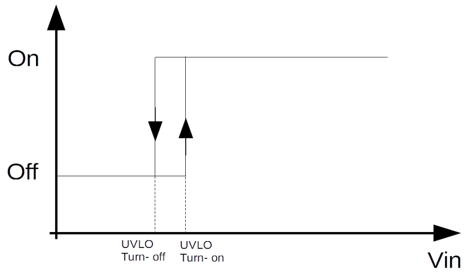
- The converter is disabled by pulling low the On/Off pin.
- No connection or high impedance on the On/Off pin enables the converter.

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.



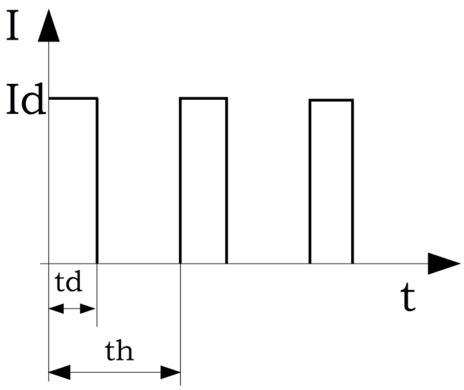
4.4-INPUT UNDERLOCKAGE VOLTAGE (UVLO)

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)



4.5-OUTPUT OVERCURRENT PROTECTION (OCP)

The converter series incorporates an over-current protection circuit. The over-current protection detects short circuit or over current and protects the module according to the hiccup graph opposite. The minimum detection current Id depends on input voltage Vin, temperature, and is given above I Electrical specification paragraph. When OCP is triggered, the converter falls in hiccup mode by testing periodically if the overload is still present. The module restarts automatically to normal operation when over-current cause is removed. Td (detection time) and Th (hiccup period) are depending on Vin and temperature. In hiccup mode the average current is around 25 % of nominal current.



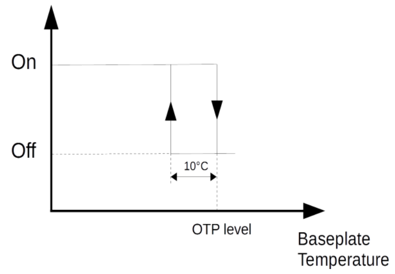
4-APPLICATION NOTE

4.6-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.

4.7-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.



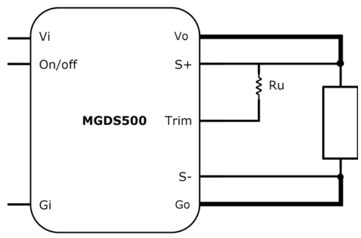
4.8-TRIM FUNCTION

the output voltage Vo may be trimmed in the range define electrical specifications paragraph 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 :

$$Ru = 16.9 * \frac{(Vo-2.5)*VOnom}{(VO-VOnom)*2.5} - 16.9$$

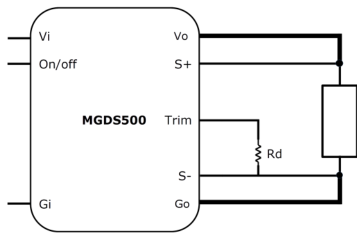
Where:
Ru = trim resistor value in KΩ (value given at +/-7%)
VO = desired output voltage in Volts
VOnom = nominal output Voltage



Trim Down Function
The available output power is reduced by the same percentage that output voltage is trimmed down. The trim down resistor must be connected across S- pin and trim pin. The trim down resistor must be calculated with the following formula:

$$Rd = \frac{16.9*VO-13*VOnom}{VOnom-VO}$$

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

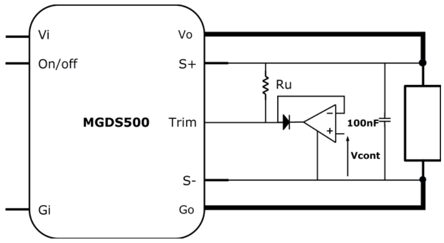


4-APPLICATION NOTE

4.8-TRIM FUNCTION (continued)

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

$$Vo = \left(1 + \frac{3.9}{16.9} * \left(\left(\frac{Vcont}{2.5}\right) - 1\right)\right) * VOnom$$

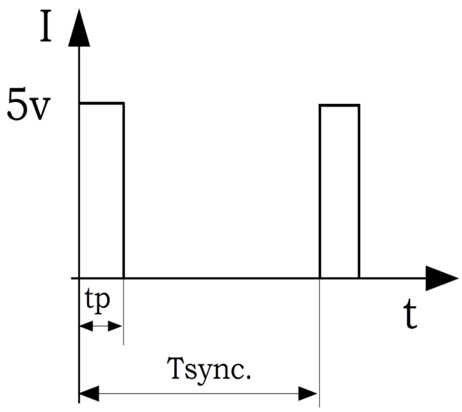


Where:
Vcont = control voltage
VO = desired output voltage in (Volts)
VOnom = nominal output Voltage

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

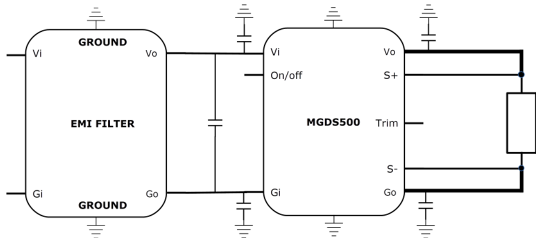
4.9-SYNCHRONIZATION FUNCTION

The «Sync» pin allows the synchronization of the converter to an external frequency source. The pin must be driven by a logic gate output circuitry delivering a square wave signal. The characteristics of the signal are detailed by the figure hereunder. Refer to electrical specification paragraph for further information on synchronization signal characteristics.



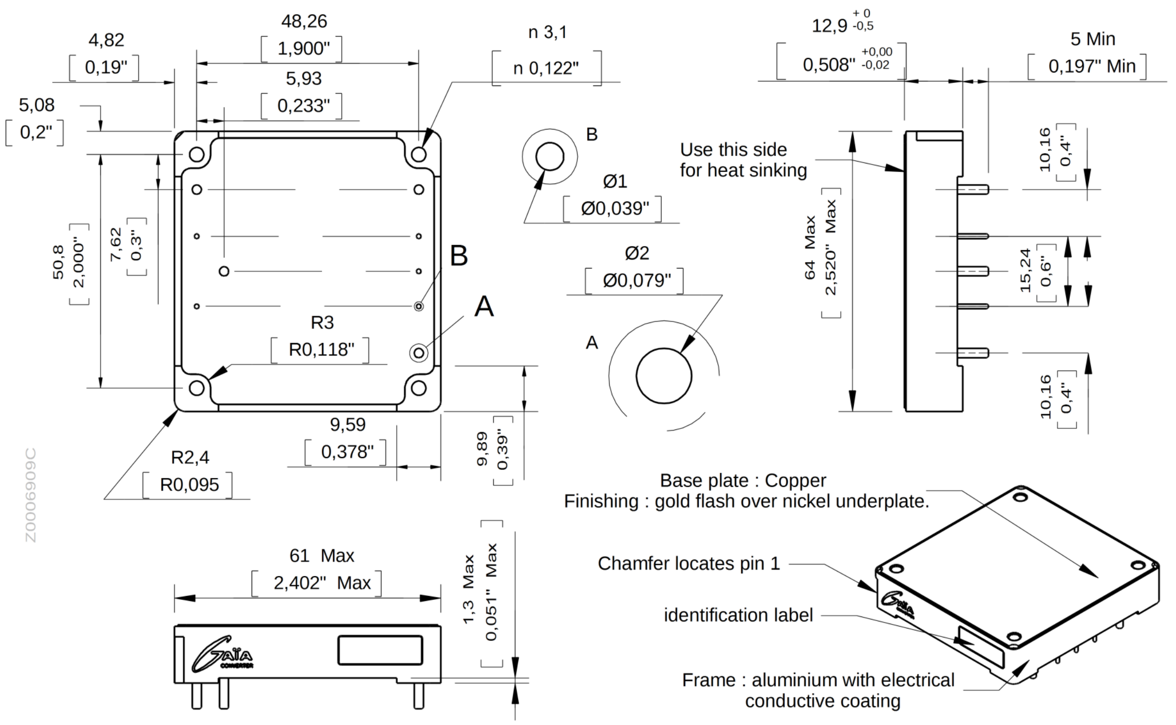
4.10-EMC COMPLIANCE

Depending on the reference of the standard to comply, the converter will need to be associated to any input filter to reduce the switching noise level. An additional input capacitance may be necessary to avoid impedance mismatch for some case of high output power and low input voltage. 4 common mode capacitors connected as close as possible to the pins VO, GO, VI,GI will help reducing common mode noise. The common mode capacitor values are not strictly imposed and 47nF ceramics can be a good starting value.



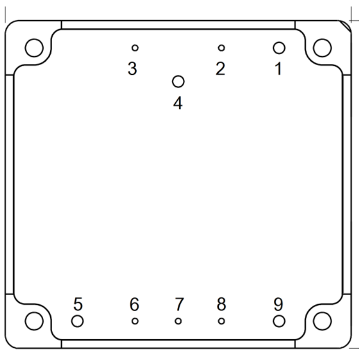
4-APPLICATION NOTE

4.11-MECHANICAL DRAWINGS

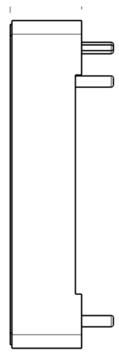


4.12-CONNECTION-PRODUCT MARKING

Product marking
Side face : Company logo.
: Module partnumber
: Date code : year and week of manufacturing, suffix, /option.
Product weight : 142 gr 3oz.

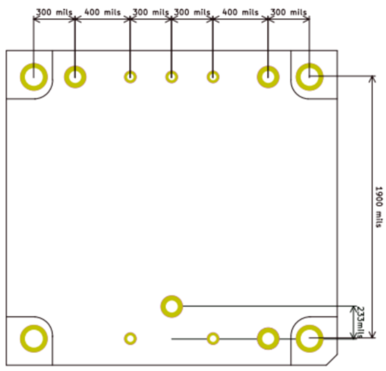


Pin dimensions :
1, 4, 5, 9 : Ø0.079"
2, 3, 6, 7, 8 : Ø0.039"



Metallic case.
Pin plating : Gold flash.

Pin	Désignation
1	- Input (Gi)
2	Synchro
3	On/Off
4	+ Input (Vi)
5	+ Output (Vo)
6	Sense + (S+)
7	Trim
8	Sense - (S-)
9	- Output (Go)



Foot print given as example, pads and holes dimension
to be defined by user