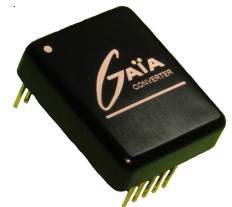




Hi-Rel NON ISOLATED DC CONVERTER MPGS-14A : 14A POWER

Hi-Rel
Grade ■■

8:1 Ultra Wide Input Single Output Metallic Case - Buck Converter



4

- Ultra wide input range 4,75-36 VDC
- Nominal output voltage 3,3V
- Adjustable output voltage from 1,2V to 24V
- Nominal current up to 14 A & power up to 260W
- High efficiency (typ. 97%)
- Programmable output power
- Adjustable Soft start
- Fast output voltage tracking
- External synchronisation
- Paralleling function
- Over current protection
- Over temperature protection
- RoHS process

1-General

The MPGS-14 point of load series designates a family of non isolated buck point of load (PoL) power modules with a permanent ultra wide input voltage range of 4.75 - 36 volts.

The family is designed for use in local voltage conversion and can be used alone or in conjunction with isolated DC/DC converters as part of a highly efficient, distributed power system.

The series is optimized for low voltage point of load applications with adjustable output from 1.2 Vdc to 24 Vdc with high efficiency synchronous rectification and fast transient response.

The modules include an adjustable soft-start, an input undervoltage lock-out, a permanent short circuit and overload protection and a over temperature protection to ensure efficient module protections. The soft-start allows current limitation and eliminates inrush current during start-up. The short circuit protection completely protects the modules against short-circuits of any duration by a shut-down and restores to normal when the overload is removed.

The modules are potted with a bi-component thermal conductive compound to ensure optimum power dissipation under harsh environmental conditions.

2-Product Selection

Single output model : MPGS - 14 - - /

Input Voltage Range

Permanent	Transient
E : 4.75-36 VDC	42 VDC / 0.1 s

Output

B : 3.3 VDC trimmable from 1.2 to 24 Vdc

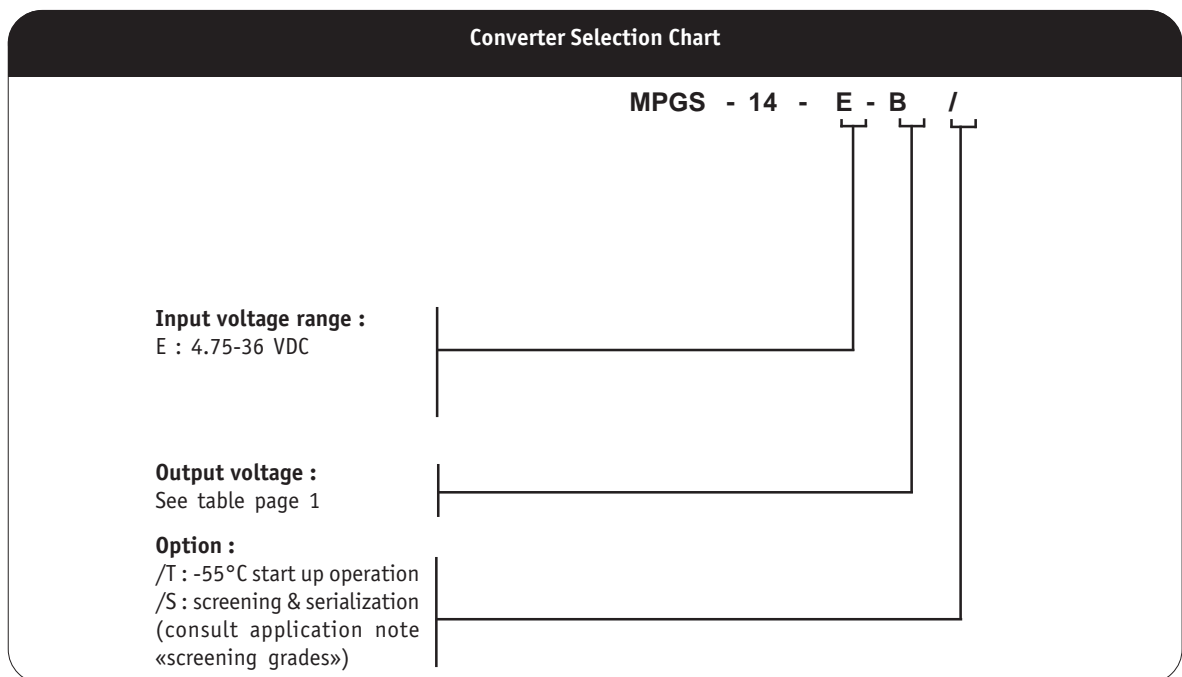
Options :

- /T : option for -55°C start up operating temperature
- /S : option for screening and serialization

2- Product Selection (continued)

Input range	Output	Max Current	Reference	Options
4.75-36 VDC	3,3 VDC	14 A	MPGS-14-E-B	/T, /S

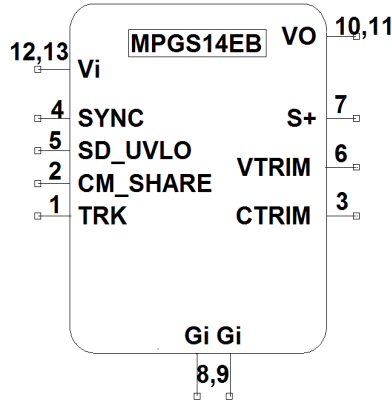
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3- Pin Description

The MPGS-14 series is based on a new generation platform with a new topology allowing ultra wide input range up to 4.75-36 VDC input voltage.

The MPGS-14 series pin description is presented hereafter.



Pin Description :

Pin Number	Pin Name	Pin Mode	Pin Description
1	Tracking (TRK)	I	Tracking function, this pin is used to perform a fast tracking of the output voltage.
2	CM_Share	I/O	CM : current monitoring, this pin provides a voltage image of the output current Share : connected to others MPGD-14-E-B pin 2 allows full current share for parallele operation.
3	Ctrim	I	A resistor connected between this pin and Go pin will allow to change output current limitation value.
4	Sync	I	To change switching frequency.
5	SD_UVLO	I	SD : on/off pin, tied to Go module is disabled UVLO : a resistor connected accross this pin and Vin allows change of the under voltage lock-out value.
6	Vtrim	I	A resistor connected accross this pin and Vin or Vo allows change of output voltage.
7	Sense+	I	Sense pin is used to compensate losses of output connections.
8	Gnd	I/O	Power input and output common connection.
9	Gnd	I/O	Power input and output common connection.
10	Vo	O	Power output positive connection.
11	Vo	O	Power output positive connection.
12	Vin	I	Power input positive connection.
13	Vin	I	Power input positive connection.

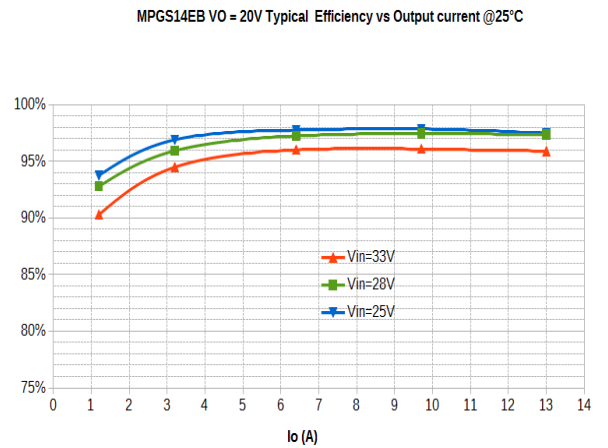
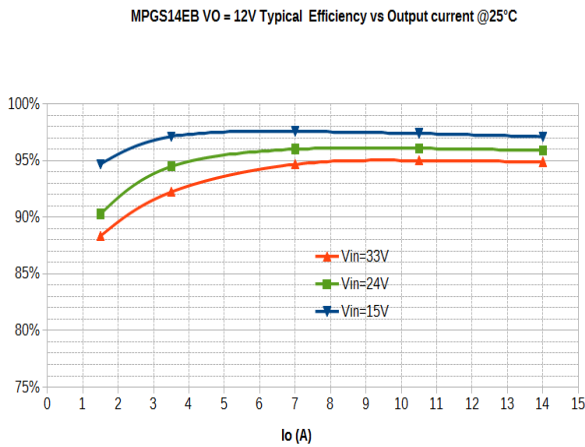
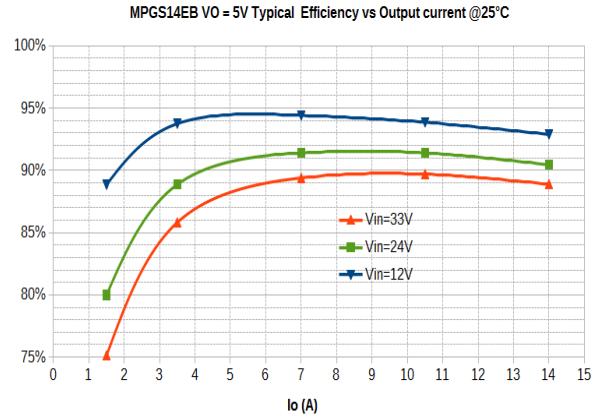
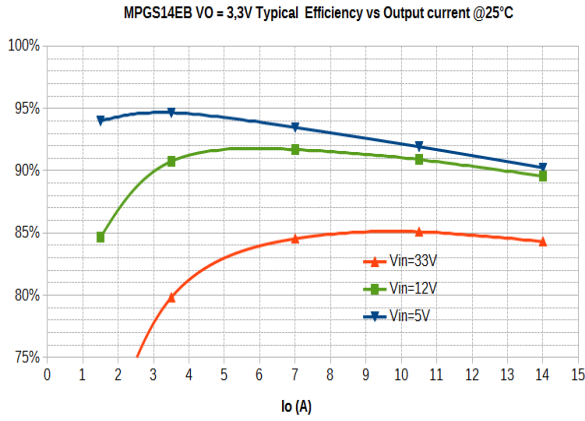
4- Electrical Specifications

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

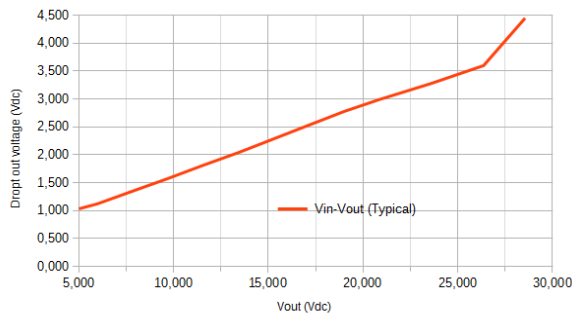
Parameter	Conditions	Limit or typical	Units	Single Output MPGS-14-E-B
Input				
Nominal input voltage	Full temperature range	Nominal	VDC	12
Permanent input voltage range (Ui)	Full temperature range Full load	Min. - Max.	VDC	4.75-36
Extended permanent input voltage range (Ui)	Consult factory Depends on reference	Min. - Max.	VDC	4.5-36
Transient input voltage	Full load	Minimum	VDC/s	42 / 0,1
Absolute max. input voltage	Power off	Maximum	VDC	45
Undervoltage lock-out (UVLO)	Turn-on voltage	Nominal	VDC	4.75
	Hysteresis	Nominal	VDC	0.8
Minimum drop-out voltage	Full load		VDC	see curve page 4
Start up time on power-up	Ui nominal, full load resistive	Maximum	ms	2
Reflected ripple current	Ui nominal, full load at switching freq. BW = 20MHz Vo = 3.3 Vdc	Maximum	% Inom.	TBD
No load input power	Ui nominal No load	Nominal	mA	100
Standby input power	Ui nominal, in inhibit mode	Nominal	mW	3.6
Input power in short circuit	Ui nominal	Nominal	mW	6.4
Output				
Output voltage range	Full temperature range Ui min. to max. and Ui>Vo	Minimum	VDC	1.2
		Maximum	VDC	24
Nominal output voltage	Full temperature range Ui min. to max.	Nominal	VDC	3.3
Set Point accuracy	Ambient temperature : +25°C Ui nominal, 75% load	Maximum	%	+/- 2
Output current / power	Full temperature range Ui min. to max., and Ui>Vo	Maximum	A / W	14 / 16.6
1.2 V output		Maximum	A / W	14 / 21
1.5V output		Maximum	A / W	14 / 25.2
1.8V output		Maximum	A / W	14 / 35
2.5V output		Maximum	A / W	14 / 46.2
3.3V output		Maximum	A / W	14 / 70
5V output		Maximum	A / W	14 / 168
12V output		Maximum	A / W	14 / 210
15V output		Maximum	A / W	13 / 260
20V output		Maximum	A / W	5 / 120
24V output		Maximum	A / W	5 / 120
Ripple output voltage **	Ui nominal Full load BW = 20MHz	Maximum	mVpp	66
3,3V output		Maximum	mVpp	100
>5V output				
Output regulation * (Line + load + thermal)	Ui min. to max. 0% to full load	Maximum	%	+/- 2
Maximum admissible capacitive load	Ui nominal Full load	Maximum	μF	50 000
<15V output		Maximum	μF	3 000
Efficiency	Ui nominal Full load	Typical	%	up to 97

4- Electrical Specifications

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



The MPGS-14 series being a buck DC converter, it shows a LDO characteristic that is depending on output voltage & current values (Iout). The MPGS14EB voltage drop-out (difference between input and output voltage) is given in the curves :



5- Switching Frequency

Characteristics	Conditions	Limit or typical	Specification
Switching frequency	Full temperature range Ui min. to max. No load to full load	Nominal, fixed	330 KHz
Synchronization frequency range	Frequency of external synchronization signal	Minimum Maximum	200 KHz 460 KHz

6- Isolation

Parameter	Conditions	Limit or typical	Specifications
Isolation voltage (Case not connected)	Input to output	/	Non isolated

7- 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 overvoltage protection (OVP)		Automatic recovery		See section 12
Output current limitation protection (OCP) :	For Vo < 20V For Vout > 20V Hiccup detection time TBD	Automatic recovery	Maximum Maximum	16A 5.25A
internal Over temperature protection (OTP)	trigger limit Hysteresis cycle	Automatic recovery	Typical	125°C 10 °C

8- Reliability Data

Characteristics	Conditions	Temperature	Specifications
Mean Time Between Failure (MTBF) According to MIL-HDBK-217F	Ground fixed (Gf)	Case at 40°C Case at 70°C	TBD Hrs TBD Hrs
	Airborne, Inhabited Cargo	Case at 40°C Case at 85°C	TBD Hrs TBD Hrs
Mean Time Between Failure (MTBF) According to IEC-62380-TR	Aircraft Civilian	Ambient at 25°C 100% time on	Consult factory

9- Thermal Characteristics

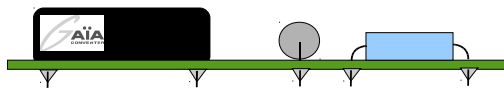
Characteristics	Conditions	Limit or typical	Performances
Operating ambient temperature range	Ambient temperature	Minimum Maximum	- 40°C see below
Operating case temperature range at full load	Case temperature	Minimum Maximum	- 40°C 105°C
Storage temperature range	Non functioning	Minimum Maximum	- 55°C + 125°C
Thermal resistance	Junction to lead Junction to case	Typical Typical	TBD TBD

To calculate the maximum ambient temperature, the converter, will be able to operate, the following parameters are required :

- Tcase = maximum case temperature the converter can operate
- Tmax = maximum ambient temperature the converter can operate in
- Pout= effective output power
- Rth(c) = thermal resistance case to ambient of the converter
- Rth(tot) = thermal resistance of converter and its heatsink (if used)
- Rth(hs) = Thermal resistance of heat sink (if used)
- η = converter efficiency

There are 3 mounting variant possibilities as described below :

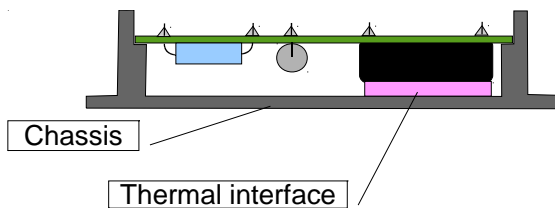
Converter Stand-Alone Mounting



To calculate the maximum ambient temperature the converter can operate, the following formula can be applied :

$$T_{max} = T_{case} - R_{th}(c) \times P_{out}(1/\eta - 1)$$

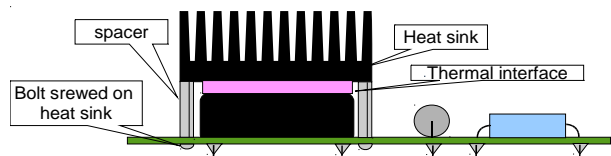
Converter with Chassis Mounting



If the thermal interface resistance can be neglected, the maximum chassis temperature is equal to the maximum converter case temperature.

$$T_{max \text{ chassis}} = T_{max}$$

Converter with Heatsink Mounting



To calculate the maximum ambient temperature the converter can operate, the following formula can be applied :

$$T_{max} = T_{case} - R_{th}(tot) \times P_{out}(1/\eta - 1)$$

The most sensitive parameter in this formula is the Rth(tot) value.

Rth(tot) is depending on the thermal resistance of the converter Rth(c) in the mounting configuration and the thermal resistance of the heatsink Rth(hs).

- The Rth(c) is dependant on ambient temperature, way the converter is tied to the PCB, position, PCB copper track and power plane length.
- Also, in general Rth(c) is decreasing as temperature is increasing.
- Rth(hs) : Rth(hs) value is highly depending on way heatsink is connected to case.

The value of Rth(tot) can be evaluated with the below definition :

$$R_{th}(c) \times R_{th}(hs) / (R_{th}(c) + R_{th}(hs)) < R_{th}(tot) < R_{th}(c)$$

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

Heat transfert	Thermal resistance heatsink to air Rth(h-a)	Conditions	Global resistance
Free air cooling only	Rth(c) : no Heatsink baseplate only	Ambient 60°C, converter on PCB	20 °C/W
	Rth(tot) with heatsink ABL BGA-STD-050	Ambient 60°C, converter on PCB	14°C/W

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 @ 105°C case, unit operating @ 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-810E Method 500.3
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-810E Method 507.3
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-810E Method 509.3
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 / 0.7 mm 60 to 2 000 Hz / 10 g 2h 30 min. per axis unit not operating	MIL-STD-810D Method 514.3
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-810D Method 516.3
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-810D Method 516.3

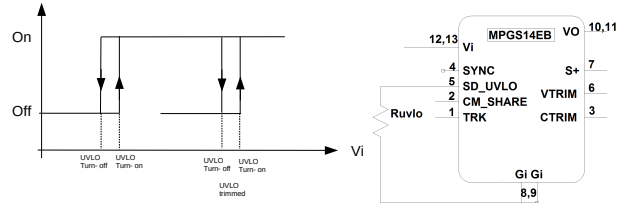
11- Description of Protections

The MPGS-14 series includes the following types of protection devices.

11-1 Input Undervoltage Lockout (UVLO)

An undervoltage protection will inhibit the module when input voltage drops below the lockout turn-off threshold (See characteristic section for value) and restores to normal operation automatically when the input voltage rises the lockout turn-on threshold. The turn on uvlo threshold (Vuvlo) value can be adjusted by changing the Ruvlo resistor value according to the formula below :

$$R_{uvlo} (K\Omega) = \frac{1057}{18 \times V_{uvlo} - 81.25}$$



11-2 Output Over Current Protection (OCP)

The MPGS-14A series embeds an over current protection (OCP) function that operates :

- as a current source when output voltage is trimmed below **Volim**.
- and in a hiccup mode for a Vo higher than **Volim**.

For both modes of OCP, the threshold limits are set to :
 Volim=20 Vdc and IL (16A for Vo<Volim and 5.25 Vo>Volim) by default.

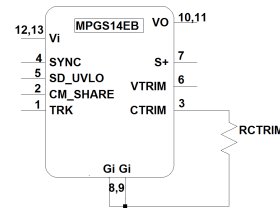
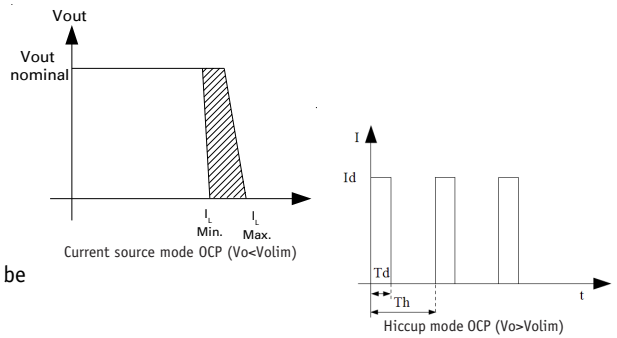
The **IL** level can be reduced using a resistor **RCTRIM** connected between Ctrim pin and Gi. The RCTRIM value can be calculated using the formula below :

$$R_{ctrim} = 56 \times I_L / (280 - 15.6 \times I_L)$$

Rctrim= trimming resistor in kOhm

IL = desired new OCP limitation

Thanks to the Ctrim function it is possible to use the MPGS-14A series as a constant current source to build for example a batteries charger.



11-3 Output Current Monitoring

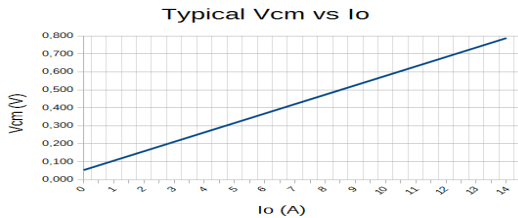
The MPGS-14 series provides on its pin 2 a voltage Vcm which is the image of the output current :

$$V_{cm} = 51.2 \times I_o + 53.57$$

where :

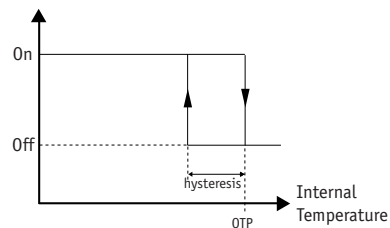
Vcm : image of output current in mV

Io : output current in A



11-4 Over Temperature Protection (OTP)

A thermal protection device will inhibit the module when internal temperature reaches the specified value (see section 7) as long as the overheat is present and restores to normal operation automatically when overheat is removed.



12- Description of Functions (continued)

12-1 Trim (TRIM) Function

The MPGS-14 series embeds a Vtrim function that allows to trim the output voltage using simple resistor tied to Gi or Vo according to trim up or trim down configuration.

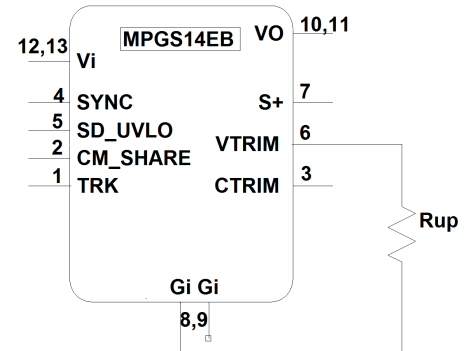
Trim Up Function

The trim up resistance must be calculated with the following formula :

$$R_u = \frac{56824 - V_o * 470}{V_o * 4,7 - 15,52}$$

where :

- Ru is trim resistor value in Ohm
- VO_{nom} is nominal output voltage
- VO is desired trimmed output voltage



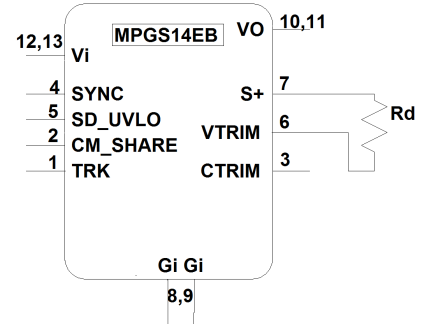
Trim Down Function

The trim down resistance must be calculated with the following formula :

$$R_d = \frac{56824 - V_o * 69560}{V_o * 4,7 - 15,52}$$

where :

- Rd is trim resistor value in KOhm
- VO_{nom} is nominal output voltage
- VO is desired trimmed output voltage



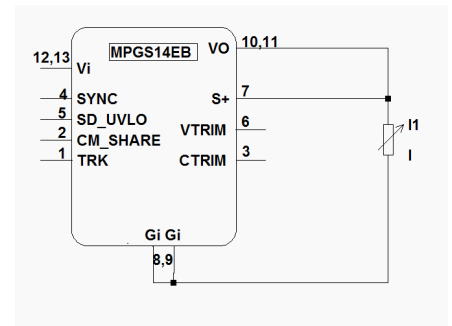
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Output Voltage	1.2 Vdc	2.7 Vdc	4.5 Vdc	5 Vdc	6 Vdc	9 Vdc	19 Vdc	20 Vdc	24 Vdc
Ru (KOhm)	/	/	8.96	6.82	4.26	1.96	0.65	0.6	0.47
Rd (KOhm)	2.7	46.29	/	/	/	/	/	/	/

12-2 Sense (S+) Function

The sense connections enable to compensate the line losses when loads are connected to the converter through long wires. The maximum voltage drop that sense can compensate is 10% of output voltage.

Warning : if the output power line is unconnected while the sense connection remains connected, the DC/DC may be damaged. If there are no losses to compensate, sense can remains unconnected. Connection is described in figure herein.



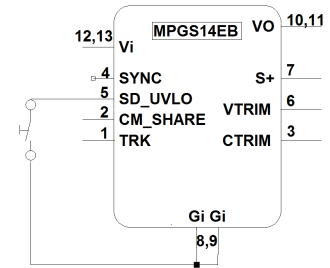
12- Description of Functions (continued)

12-3 On/Off (SD_UVLO) Function

The control pin 5 (SD_UVLO) 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.

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

By releasing the On/Off function, the converter will restart within the start up time specifications given in table section 4

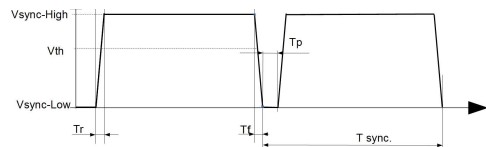
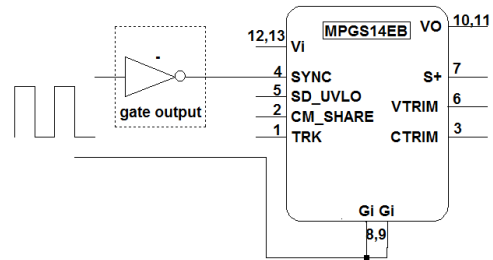


Parameter	Unit	Min.	Typ.	Max.	Notes, conditions
On/Off module enable voltage	Vdc		/	1.25	Open, the switch must not sink more than 50µA
On/Off module disable voltage	Vdc	0	/	0.5	The switch must be able to sink 0,5mA
On/Off module enable delay	ms	/	2	3	The module restarts with the same delay after alarm mode removed
On/Off module disable delay	µs	/	/	100	Vi nominal, full load

12-4 Synchronization (SYNC) Function

The MPGS-14 series provides an external synchronization function through the SYNC-On/Off pin. SYNC-On/Off pin is an input only and is referenced to Gi. Automatic synchronization mode (all Sync pins connected) is not possible.

This pin can be driven directly by using a LV TTL (3,3V) gate. SYNC_On/Off pin is internally pulled up to 3V (logic level 1). It is possible to synchronize the module by using an open collector gate (transistor, optocoupler, ...). Minimum 3,3V LV TTL rise time (tr) and fall time (tf) are 20ns. The module can lock on frequency above or below its free-run frequency $2.52 \mu s < T_{sync} < 3.78 \mu s$ and $0.3 \mu s < T_p < 2.7 \mu s$.



12-5 Tracking (TRK) Function

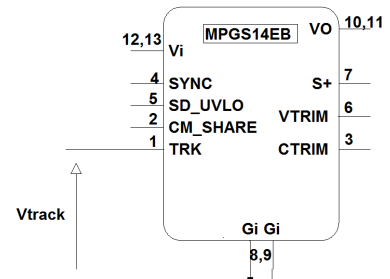
The MPGS-14 series embeds a Tracking function pins that allows a dynamic control of the output voltage. The source for Vtrack can be an operational amplifier, a digital to analogue converter output, or any other controlled voltage source. Tracking function can be implemented for many purposes as soft start time increase *, special output voltage profile achievement, or special waveform copy. The Vtrack transfer function is described below $V_{trk} = 0,8 \times VO / VO_{nom}$

Where :

VO : desired output voltage

VO_{nom} : nominal output voltage (given by trim setting)

* Consult factory for Soft start time increase using Vtrack.

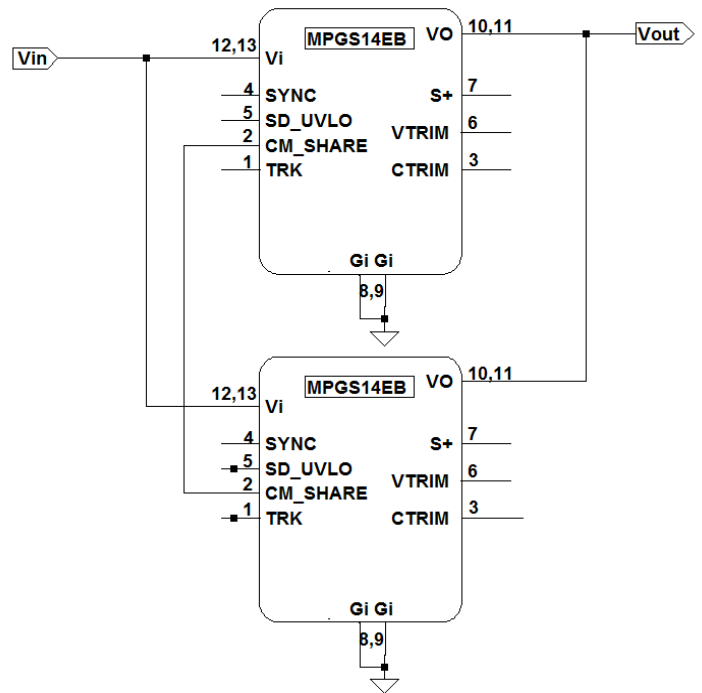


12- Description of Functions (continued)

12-6 Current Sharing (CM_SHARE) Function

The current sharing function allows to connect two or more MPGS-14 series in parallel, with a good current balance between the each modules.

Simply connect Pin2 (Cm-share) of all modules to activate the current sharing function.

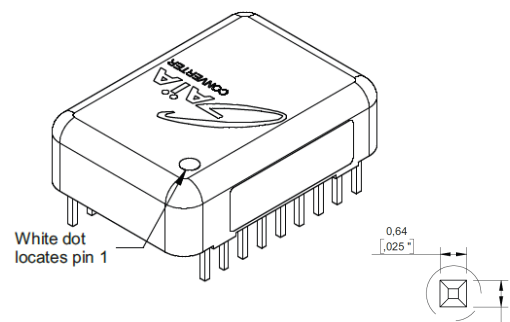
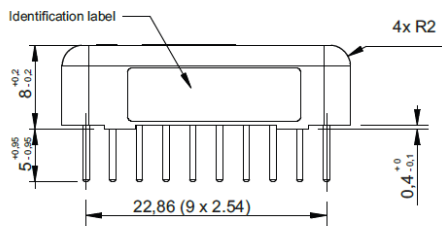
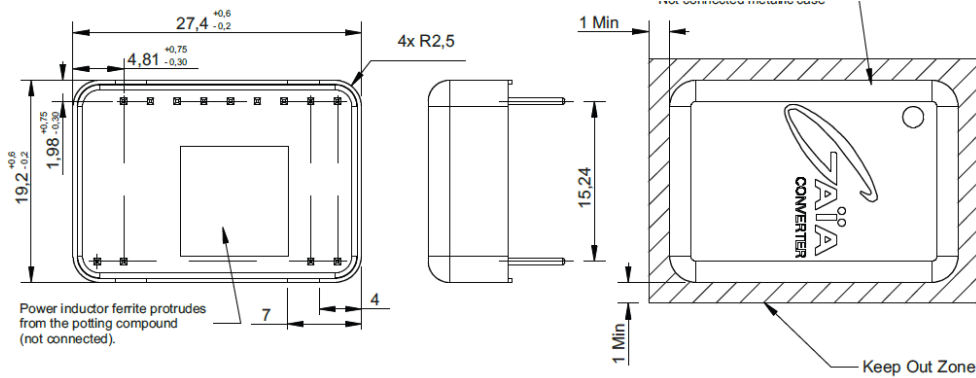


13- Dimensions

Dimension are given in mm. Tolerance : +/- 0,2 mm (+/- 0.01 ") unless otherwise indicated.

All dimensions specified "Min" or "Max" are not subjected to the general tolerance.

Weight : 12 grams (0.4 Ozs) max.



4

14- Materials

Case : Metallic black anodized coating.

Pins : Flash gold plating over nickel underplate.

15- Product Marking

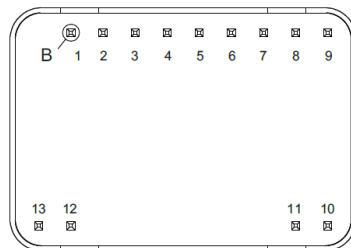
Upper face : Company logo.

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

16- Connections

The MGPS-14 series has been designed for on-board mounting.

it is recommended not to lay-out any component under the module.



Bottom view

Pin	Dual
1	Tracking
2	CM-Share
3	Itrim
4	Synchro
5	SD-UVLO
6	Vtrim
7	Sense (S+)
8,9	Ground (Gnd)
10,11	Output (Vo)
12,13	Input (Vi)



Represented by :

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