DC/DC Input Bus Conditioner
LGDS-600 Series : 600 W Power

Hi-Rel Grade

RoHS

Key features

- Transient suppressor for Avionics/Defense
- DEF-STAN-61.5 issue 6
- VG96916-5
- MIL-STD-704 A/D/E/F, EN2282, AIR2021E
- DO-160 C/D/E/F cat A, B and Z
- MIL-STD-1275 all revisions
- ASP : Abnormal Surge Protection

General characteristics

- Transient suppressor : 60, 80, 100, 202 Vdc
- Power range : from 4 W to 600 W
- Galvanic isolation input/output : non isolated
- Protections : reverse polarity, over temperature
- Additional functions : back-up source control, switching frequency synchronization generator

1 - General

The input bus conditioner LGDS-600 designates a range of 600W military grade front end that enables and eases construction of power architectures.
The LGDS-600 includes:
- A powerful voltage limiter for long lasting surges up to 202 Vdc
- A 100 Vdc reverse polarity protection
- A soft-start function to limit inrush current
- An abnormal surge protection (ASP) to secure applications.

In addition, the LGDS-600 come with:

- A control functions to handle power back-up
- A bi-phase switching frequency generator for synchronization of downstream converters.
- Ultra low series losses

As consequence, the LGDS-600 requires only input EMI filtering to fully comply with most of international input bus standards such as:
- DEF-STAN-61.5 issue 6
- VG96916-5
- MIL-STD-704 (all revisions)
- AECMA EN2282
- GAM-EG13B/AIR2021E
- DO160E cat A, B
- MIL-STD-1275 (all revisions)

The input bus conditioner operates according 3 modes of operation:
- Normal operation: When input bus voltage is within its steady state range, the LGDS-600 acts like a buffer that transmits the input power to the DC/DC architecture with low losses.
- Power fail operation and low transient voltage: The power fail operation occurs when the input bus drops below its low voltage limit. An undervoltage lock-out rise a drive aux signal that can be used to switch converter bus to a back-up power source.
- Transient operation: The LGDS-600 clamps input transient, limiting its output voltage to the maximum value acceptable by downstream DC/DC architecture.

The modules are potted with a bi-component thermal conductive compound and packaged in a metallic case to ensure the module's integrity under severe environmental conditions.

1.1 - Product code construction

Single output model : LGDS - 600 - Input - Output / Options

Input voltage
. P : 9 - 36 Vdc (202 Vdc / 350 ms)
. O : 9 - 36 Vdc (100 Vdc / 50 ms)

Output voltage range
. H : 38 +/- 1 Vdc (Single)

Options
. /T : Screening at start-up -55° C
. /S : Screening and serialization

Consult factory for customized specifications

1.2 Product selection

Order code	Input voltage	Output voltage	Output current
LGDS-600-O-H	9 - 36 Vdc (Max. 100 Vdc / 50 ms)	38 +/- 1 Vdc	
LGDS-600-P-H	9 - 36 Vdc (Max. 202 Vdc / 350 ms)	38 +/- 1 Vdc	

Options :

. /T : Screening at start-up -55° C

. /S : Screening and serialization

2 Modes of operation

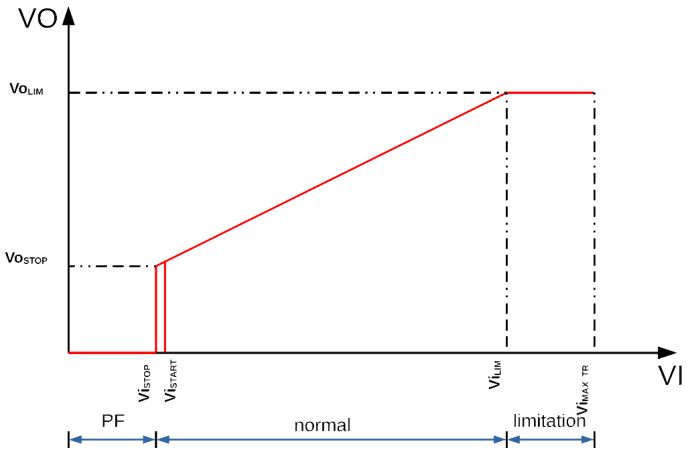
The LGDS-600 operates according to four different modes of operation that are depending on Input voltage values:

Normal operation: When input voltage is above a minimum threshold voltage named ViSTART (for rising input voltage) or ViSTOPS (for falling input voltage), and below a limitation threshold value named ViLIM the output of Limiter input is connected to its output through an unidirectional switch.

Power fail operation: The power fail operation occurs when the input bus drops below ViSTOPS .in this case the switching MOSFET linking Vi to Vo become unbiased, only its natural junction diode links Vi to Vo. In this mode, no current should be drawn on Vi .

Transient operation: when input voltage bus goes above ViLIM, The LGDS-600 clamps the input transient, and limits the output to ViLIM.

On/Off operation: when On/off pin is tied to GND The LGDS-600 output is disconnected from the input. The on/off operation overrides the normal operation and transient operation.
The figure opposite describes these modes of operation : ViSTART : starting voltage at rising- ViSTOPS: stop input voltage at falling, ViLIM : max input voltage in normal operation mode, VimaxTR: max allowed surge voltage, VOLIM : max output voltage VOSTOP: min output voltage.



3 Technical specifications

3.1 Input

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

Parameter	Condition	Limit or typical	Unit	Values by input range P	O
Input voltage range		Min. - Max.	Vdc	9 - 36	9 - 36
Transient input voltage	350 ms	Max.	Vdc	202.0	
	50 ms	Max.	Vdc		100.0
Nominal input voltage	Full temperature range		Vdc	28	28
Permanent input voltage range	With output power derating, Full temperature range	Min.	Vdc	10.2	10.2
		Max.	Vdc	36	36
Reverse Vin - Vout	Not operating		Vdc	-100	-100
Power fail voltage ViSTART	Switch on backup mode	Nominal	Vdc	10.2	10.2
Power fail voltage ViSTOP	Switch on backup mode	Nominal	Vdc	9.2	9.2
Reverse polarity protection (REV.POL)	Full temperature range	Min.	Vdc	-100	-100
Input Voltage Surge	MIL-STD-704 (A to F)				
Start-up time		Max.	ms	12	12
Input to output serie resistance	Normal mode, Ui nominal	Max.	mOhm	6	6

3.2 Output

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

Parameter	Condition	Output type	Output	Limit or typical	Unit	Values
Output voltage	Normal mode, Full temperature range, Full load		H	Typical	Vdc	Ui - losses
		S	H	Max.	Vdc	38 +/- 1
Output current			H	Max.	A	35
Output power			H	Max.	W	600
Power dissipation	28V, Full load, Ui nominal		H	Max.	W	2.5
	16V, Ui nominal, full load		H	Max.	W	7.5
ASP : Abnormal Surge Protection				Typical	Vdc/ms	100/150

3.3 Miscellaneous

Parameter	Condition	Limit or typical	Unit	Values
Synchronization frequency range		Min. - Max.	KHz	600 +/- 80
Synchronization signal level		Min. - Max.	Vdc	3.8 to 5
Isolation strength	Input to output	Min.		No Isolation
	Input to case	Min.	Vdc/mn	500
	Output to case	Min.	Vdc/mn	500
Isolation resistance	500 Vdc	Min.	MOhm	500
Over temperature protection (OTP) +/- 5 °C	Thermostat with hysteresis cycle	Max.	°C	120
OTP Hysteresis		Nominal	°C	10
On/Off module enable voltage	Ui nominal	Min.	Vdc	3.5
		Max.	Vdc	5
On/Off module disable voltage	Ui nominal	Min.	Vdc	0
		Max.	Vdc	0.5
Drive max voltage	Enable	Max.	Vdc	0.5
	Disable, (open drain)	Max.	Vdc	60
Drive sink current	Enable, (open drain)	Max.	mA	10
	Disable, (open drain)	Max.	mA	0.5

3.4 Thermal Characteristics

Parameter	Condition	Limit or typical	Unit	Values
Case to air thermal resistance	Ui nominal, full load	Typical	°C/W	9
Operating case temperature range			°C	-40 to 105
Storage temperature		Typical	°C	-55 to 125

3.5 Reliability Data

Parameter	Condition	Limit or typical	Unit	Values
MTBF MIL-HDBK217 Reliability	Ground benign(Gb), Tcase=40°C	Typical	Hrs	1 300 000
	Ground benign(Gb), Tcase=70°C	Typical	Hrs	579 000

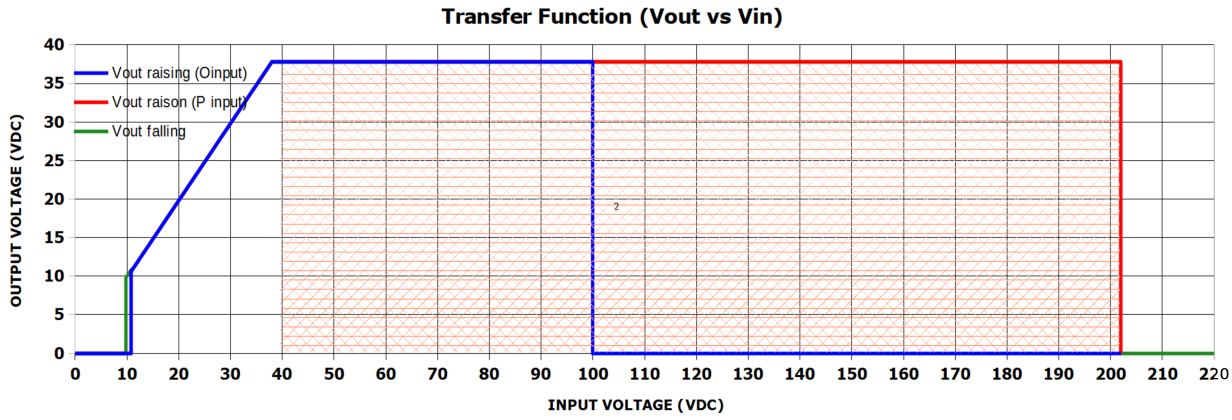
4 Environmental qualifications

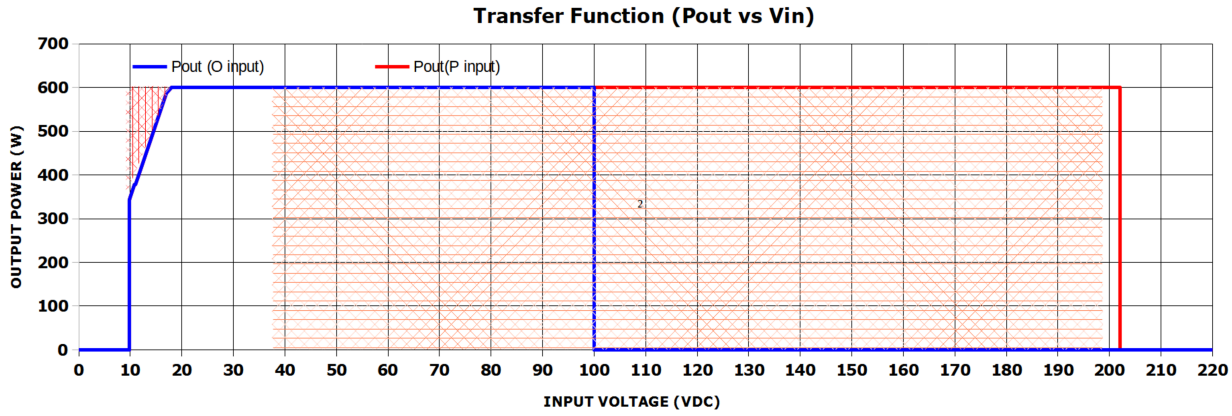
The modules have been subjected to the following environmental qualifications.

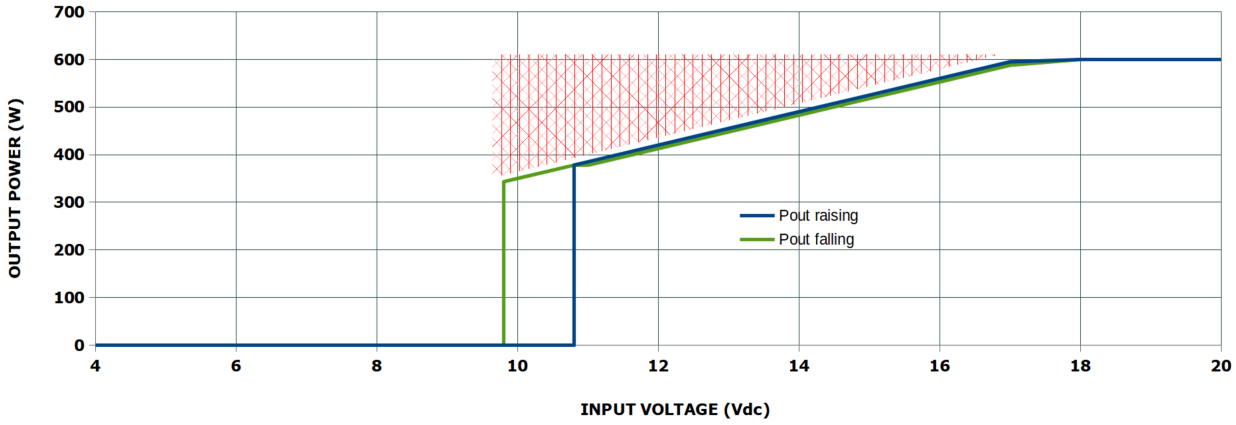
Parameter	Conditions & severity	Test procedure
Life at high temperature	Duration : test D : 1 000 Hrs Temperature / status of unit : @105°C case / unit operating Temperature / status of unit : @125°C case / unit not operating	MIL-STD-202G, Method 108A
Altitude	Altitude, Level C : 40 000 ft @ -55°C Duration : 30 min. Climb up : 1 000 ft/min to 70 000 ft @55°C Stabilization : 30 min Unit operating	MIL-STD-810E, Mehod 500.3
Humidity cyclic	Number of cycles : 10 Cycle duration : cycle I : 24 hrs Relative humidity variation : 60% to 88% Temperature variation : 31°C to 41°C Unit not operating	MIL-STD-810E, Method 507.3
Humidity steady	Damp heat : 93 % relative humidity Temperature : 40°C Duration : 56 days Unit not operating	MIL-STD-202G, Method 103B
Salt atmosphere	Temperature : 35°C Concentration NaCl : 5 % Duration : 48 hrs Unit not operating	MIL-STD-810E, Method 509.3
Temperature cycling	Number of cycles : 200 Temperature change : -40°C / 85°C Transfer time : 40 min Steady state time : 20 min Unit operating	MIL-STD-202A, Method 102A
Temperature shock	Number of shocks : 100 Temperature change : -55°C / 105°C Transfer time : 10 s Steady state time : 20 min Unit not operating	MIL-STD-202G, Method 107G
Vibration (sinusoidal)	Frequency / amplitude : 10 to 60 Hz / 0.7 mm Frequency / acceleration : 60 to 2 000 Hz / 10 g Duration : 2 h 30 min per axis Unit not operating	MIL-STD-810D, Method 514.3
Shock (half sinus)	Number of shocks : 3 shocks in each axis Peak acceleration : 100 g / Duration : 6 ms Shock form : 1/2 sinusoidal Unit not operating	MIL-STD-810D, Method 516.3
Bump (half sinus)	Number of bumps : 2 000 bumps in each axis Peak acceleration : 40 g / Duration : 6 ms Unit not operating	MIL-STD-810D, Method 516.3

5 Performances

5.1 Transfer function







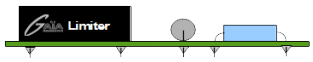
Hash areas show transient mode operation

6 Application notes

6.1 Thermal Management

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

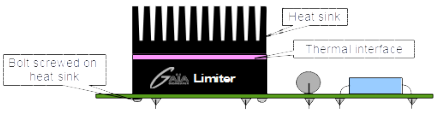
Free air cooling : the converter thermal resistance (Rth) allows operation without additional cooling device.
Warning: this mode of cooling is reserved to very low ambient temperature or very low power conditions.



Free air cooling

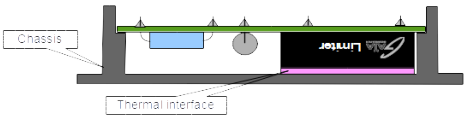
Cooling through an heat-sink : the heat-sink is applied to the converter top case through a thermal interface (gap-pad).This allows to reduce the total thermal resistance from case to ambient (Rth), resulting of the combination of case thermal resistance, gap-pad thermal resistance, and heat-sink thermal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

Tamb = max ambient temp.
Tc = max case temperature
Pd = dissipated power
Rth = thermal resistance of the assembly: case + thermal pad + heat-sink to ambient



Heat-sink usage

Chassis mount : The converter is applied to the chassis surface through a dedicate thermal interface (Gap-pad). The maximum ambient temperature operation is given by the following formula : Tamb = Tc - Pd * Rth



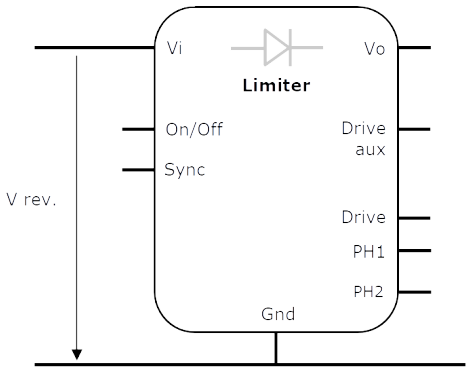
Chassis mount

Tamb = max ambient temp.
Tch = max chassis temperature
Pd = dissipated power .
Rth = thermal resistance of the assembly case + thermal pad

Discussion about Pd :
The dissipated power Pd should be considered for both mode of operation and duration:
Normal operation (steady state) : Pd = losses * (Iout)2
Transient operation (100 ms) : Pd = Pout * (1/eff - 1)
The dissipated power during transient operation is neglectable with respect to thermal dissipation, based on the duration the limiter operates in that mode.

6.2 Reverse polarity protection

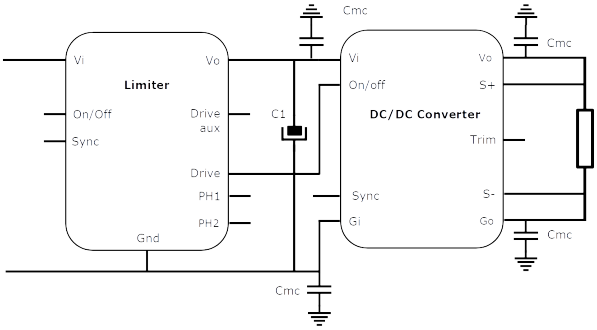
The limiter features a fast reverse polarity protection that prevent downstream converters architecture from damage. The reverse polarity protection is fast enough to handle connection error or negative spikes. The maximum negative coltage across Gin and Vin is given in "Electrical specifications" table.



6.3 Drive function

The limiter features a drive output pin to control down-stream converters start-up. The drive pin signal is provided through an open drain output with no internal pull-up resistor. The drive pin complies all GAIA converter's DC/DC products with regard to the on/off function and must be connected according to the opposite diagram. This application scheme insures 3 major behaviors for proper operation:

- Converters on/off will be released after drive delay to avoid start-up bus overload.
- The limiter's on/off function, when activated, turns off also the downstream converters.
- When Vin is below UVLO and no back-up voltage is present, both the limiter and downstream converters are turned off.

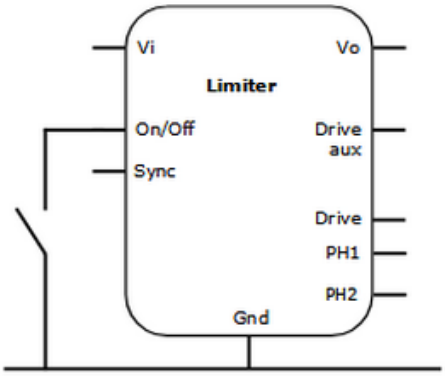


The table below shows possible components part numbers.

Component	Power	Unit	Value
C1	150 W	µF	220
	300 W	µF	470
	600 W	µF	1000

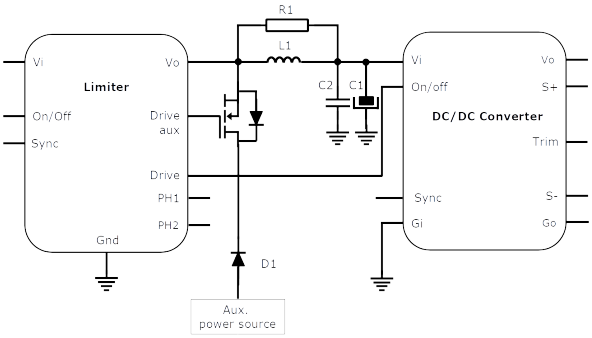
6.4 On/Off function

When the pin On/Off is connected to GND, the Vo output disconnects from the input bus Vin, and the drive pin output falls to 0V, in order to disable the downstream converters architecture. The pin On/Off can be driven by a switch, an opto-couple, an open-drain or open-collector transistor without external pull-up resistor. To operate the limiter the On/Off pin should remain unconnected.



6.5 Hold-Up function

The Drive aux pin allows user to implement a hold-up function by connecting an external power source to the downstream converters architecture input. The application diagram is given opposite. In case of Input bus drop below UVLO, the Drive aux pin will drive the Q1 transistor to switch the external Hold-up power source to the pin Vo of the limiter. The Diode D1 prevent untimely connection of Vo to the hold-up power source during start-up and switch off stage of normal operation of the limiter. The capacitor C1 is a transition capacitor that maintains input power for the duration of switching process. The inductor L1 is intended to limits inrush current into Q1 during switching phase.
The table below shows some possible part number/ value for given components.

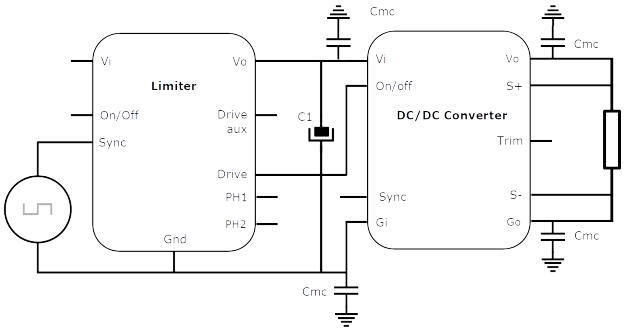


Parameter	Condition	Limit or typical	Unit	Values
C1	150 W		µF	220
	300 W		µF	470
	600 W		µF	1000
Q1	600 W			IPT020N10N3
Resistor R1			mOhm	50/0.5W
C2			µF	

6.6 Synchronization function

The limiter switching frequency can be synchronized to an external source, by connecting this source to the Sync pin. This will enable 2 functions:

- Internal circuits will be synchronized to the sync source to avoid possible beat frequencies or interference.
- The PH2 an PH2 signals will be synchronized to the sync source.

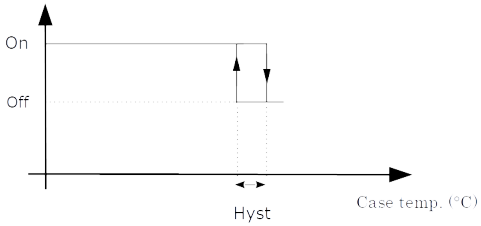


6.7 Synchronization generator

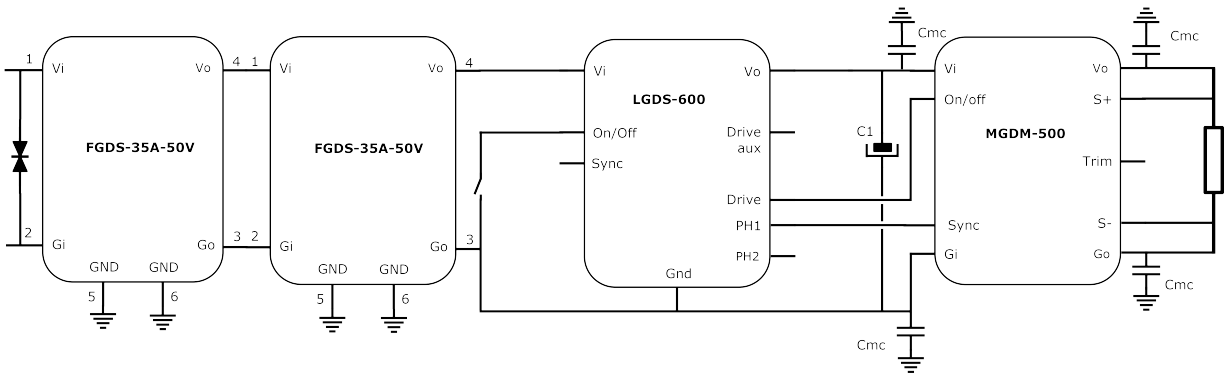
The PH1 an PH2 pins generate square signals 180° phased one to each other that can be used to synchronize 2 downstream DC/DC converters in order to reduce their conducted EMI noise. When used with only one downstream converter, a single PH (PH1 or PH2) can be connected to the sync input of following DC/DC converters. The frequency of PH1 and PH2 signal is half the frequency of internal circuits. The opposites diagrams schematics shows various possible applications.

6.8 Over temperature protection (OTP)

A thermal protection device with a hysteresis will inhibit the converter as long as an overheat is present and resume normal operation automatically when the overheat is removed. The thermal cycle is described into the diagram opposite



6.9 Typical architecture



Possible values of discret components :
C1 : 1000 µF
D1 : TVS for 38Vdc limitation

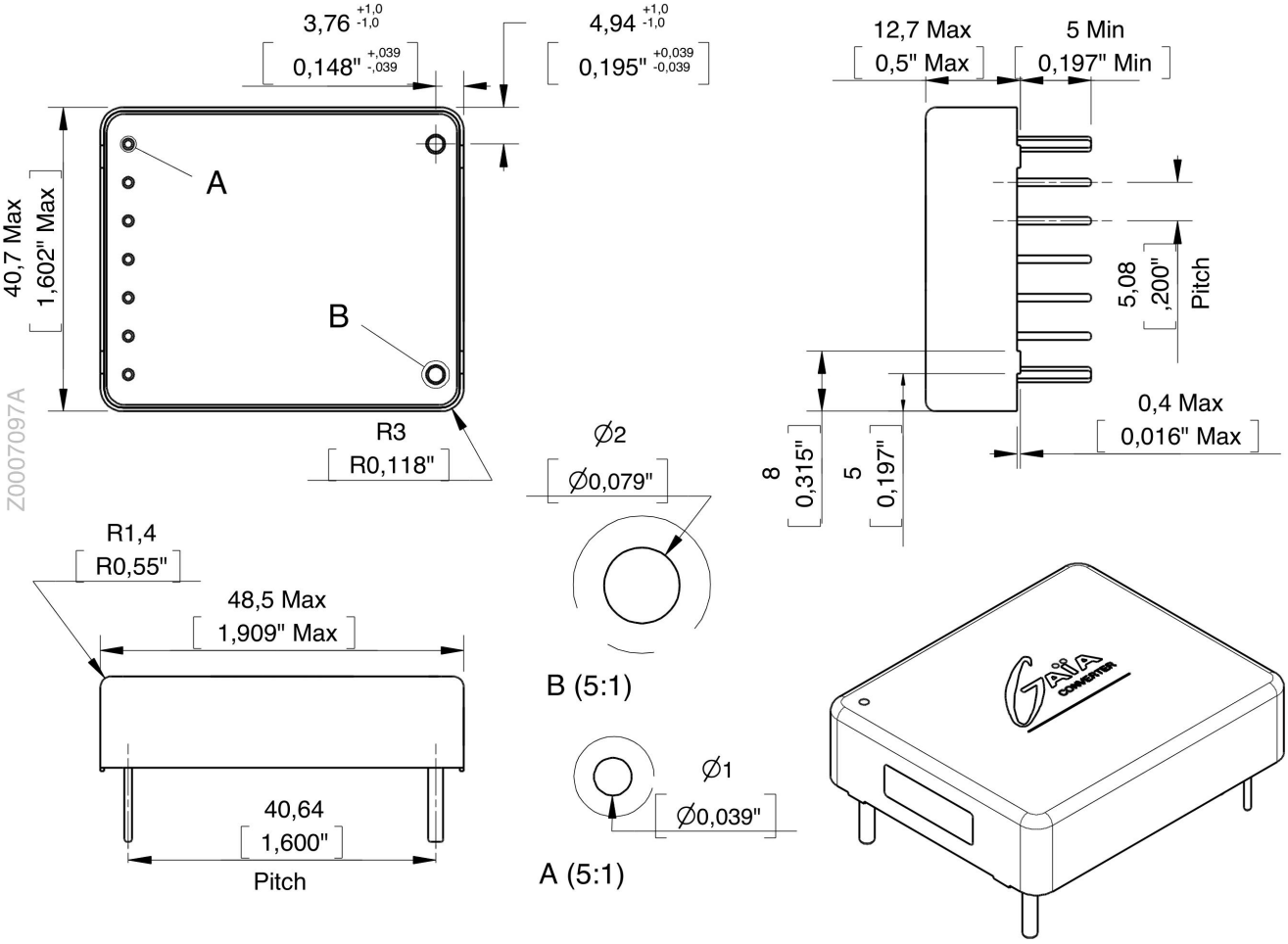
7 Mechanical specifications

7.1 Dimensions

Parameter			Unit	Value
Case dimensions		Max.	mm	48.5 x 40.7 x 12.7
Height		Max.	mm	12.7
Weight	-		Gr	60
	.		Oz	2.1
GAIA Overall package F0001824/BM				2.0-1.6-0.5

DATASHEET

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.



White dot locates pin 2

(1) : GAIA Converter has defined its own dimensional format category : "GAIA Overall package" : The name of the overall package refers to the dimensions of modules, in inches, with a tolerance of +/- 10 % of the stated values.

7.2 Materials

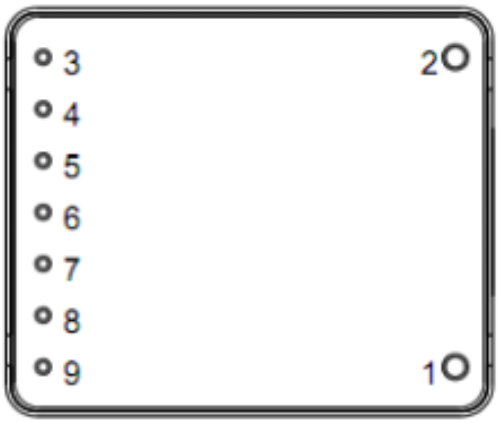
Parameter	Condition	Limit or typical	Values
Case material			Metallic black anodized coating

7.3 Product marking

Side :

- Company logo.
- Module reference
- Date code : year and week of manufacturing, suffix, /option.

7.4 Connections



Pin	Signal
1	Vi
2	Vo
3	Drive Aux
4	On/Off
5	Drive
6	GND
7	Sync
8	PH2
9	PH1

Bottom view

GAÏA
CONVERTER