PSDG-48 48W POWER

24/28Vdc MIL-AERO LOW PROFILE POWER SUPPLY
MIL-STD-1275/MIL-STD-704/DO160 COMPATIBLE
up to 3 outputs (6 voltages)

Features

- 16-60 Vdc input permanent
- 10.7-100 Vdc input transient
- Power up to 48W
- Integrated EMI filter
- Reverse Polarity protection
- Inrush current limiter
- Hold-up function
- Output 3.3 to 96Vdc
- Up to 3 outputs
- Efficiency up to 88%
- Galvanic isolation 1500Vdc
- Output voltage trim
- -55/-40 to 105°C case
- EU RoHs process

Standards

- MIL-STD-704
- MIL-STD-1275
- MIL-STD-461
- DO160
- ABD100

Applications

- Mil -Aero
- Mil-Ground-borne
- Naval
- Civilian Avionic

Product Introduction

The PSDG48 series designates a fully integrated COTS multi-output 48W isolated power supply. These board mount modules comply with 24 & 28VDC input bus standards such as DO-160, MIL-STD-1275 MIL-STD-704 MIL-STD-461 thanks to built-in EMI filters, reverse polarity protection, inrush current limiter, input surge limiter and holdup functions. The internal limiter withstands input bus disturbances from the 12 Vdc level given by MIL-STD-1275 IES initial engagement surge), up to the 100 Vdc overvoltage level. Holdup time of 50ms or more are managed by the internal switching circuits and an additional external capacitor. 3 isolated DC-DC outputs of 20W, 20W and 8 W provide a wide variety of output voltage combination from 3.3V & +-15V for example all the way to 96VDC. Each output can be pre-configured as single ended or symmetrical. The PSDG48 first 2 outputs (20W + 20W) can be used independently, connected in series or can be factory combined into a 40W output. The PSDG48 power supply module can operate with a case temperature of -40 to 105°C without derating. The PSGD48 can be ordered with additional synchronization and individual channel on/offs (/F option), -55°C startup operating temperature (/T option) and/or screening and serialization (/S option). The PSDG48 is particularly suitable for space constrained and other demanding projects in application areas such as compact vehicle or airborne equipment. Ready to use, the PSDG48 is designed to speed up design processes and reduce time-to-market
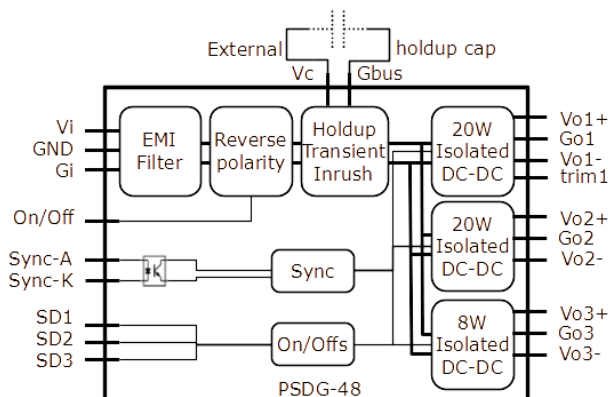
mm: 91.4 x 54.6 x 10.3
In: : 3.6 x 2.15 x 0.4

Part-numbering

PSDG-48-input-output-output- output / OPTIONS

Input value		
Input Code	Permanent	Transient
M	16-60Vdc	10.7-100Vdc

Output values	
Output Code	Output Value
X	No output 3
0	No output 2
3	3.3Vdc
3B	+/-3.3Vdc
5	5Vdc
5B	+/-5Vdc
12	12Vdc
12B	+/-12Vdc
15	15Vdc
15B	15Vdc
24	24Vdc
24B	+/-24Vdc

Options	
/F	swithching frequency synchronization inputs and individual channel ON/OFFs
/T	option for -55°C start up operating temperature
/S	option for screening and serialization

Hi-Rel Grade

Part-numbering and convention

Conventions	Description	Exceptions	Examples
Output voltages in ascending order	First voltage is always the lowest voltage, outputs arranged in ascending order.	If lowest voltage is also only 8W max, use of 3rd channel is authorized.	PSDG-48-M-5-12-15 (5V @ 20w,12V @ 20W, 15V @ 8W) standard part numbering PSDG-48-M-12-15-5 (12V @ 20w,15V @ 20W, 5V @ 8W) lowest power 3rd channel exception
2 outputs variants	Output not populated at all: "X" used only for last 8W output, not available for first or second outputs.		PSDG-48-M-5-12-X (5V @ 20w,12V @ 20W, no third) PSDG-48-M-5-X-12 (5V @ 20w,no second, 12V @ 8W,) NOT AUTHORIZED
	Outputs 1 and 2 can be connected combined (factory) for 40W output, use "0" for channel 2		PSDG-48-M-5-0-15 (5V @ 40w, 15V @ 8W) PSDG-48-M-12-0-3 (12V @ 40w, 3.3V @ 8W) lowest power 3rd channel exception
	Symmetrical outputs never combined: only single ended outputs can be combined for channel 1 & 2.		PSDG-48-M-5-0-15 (5V @ 40w, 15V @ 8W) PSDG-48-M-5B-0-15 (+-5V @ 40w, 15V @ 8W) NOT AUTHORIZED

Typical application examples

| p/n	Description
PSDG-48-M-3-5-12B	3 outputs 3.3V @20w, 5V @20w, +-12V @ 8W , no options
PSDG-48-M-3-12-15B/F	3 outputs 3.3V @20w, 12V @20w, +-15V @ 8W , sync & on/off inputs option
PSDG-48-M-5-0-15B/F	2 outputs 5V @40w, +-15V @ 8W , sync & on/off inputs option
PSDG-48-M-5-15-X	2 outputs 5V @20w, +-15V @ 20W , no third 8W output, no options
PSDG-48-M-3-12B-X/T	2 outputs 3.3V @20w, +-12V @ 20W , -55°C start up operating temperature option
PSDG-48-M-12B-12B-5	3 outputs +-12V @ 20W, +-12V @ 20W, 5V @ 8W , no options, this can also be used to address 48VDC output (40W) by connecting the 2 first outputs in series.
PSDG-48-M-24B-24B-5	3 outputs +-24V @ 20W, +-24V @ 20W, 5V @ 8W , no options, this can also be used to address 96VDC output (40W) by connecting the 2 first outputs in series.
PSDG-48-M-5-12B-24B/F/S	3 outputs 5V @20w, +-12V @ 20W, +-24V @ 8W , sync & on/off inputs option AND screening and serialization

For special applications contact factory

Additional notes :
-Vo1 and Vo2 when set for 20W output have same output performance as MGDD21N(x) DC-DC converter series.
-Vo1 when set for 40W output have same output performance as MGDD40N(x) DC-DC converter series.
-Vo3 when set for 8W output have same output performance as MGDD08N(x) DC-DC converter series.

REDEFINING THE SOURCES OF POWER

1-PRODUCT INTRODUCTION

Pin Functions

Pin	Functions
Power Pins	
VI	Input bus positive lead
GI	Input bus return lead
GND	Chassis ground -Note : GND is not connected to module case
VO1+	Output 1 positive output
GO1	Output 1 return lead
VO1-	Output 1 negative output, only available when a symmetrical output is ordered, not populated for single ended outputs
VO2+	Output 2 positive output
GO2	Output 2 return lead
VO2-	Output 2 negative output, only available when a symmetrical output is ordered, not populated for single ended outputs
VO3+	Output 3 positive output
GO3	Output 3 return lead
VO3-	Output 3 negative output, only available when a symmetrical output is ordered, not populated for single ended outputs
VC	Holdup capacitor positive voltage lead
GBUS	Holdup capacitor negative voltage lead
Signal Pins	
ON/OFF	General On/Off control
TRIM	Output 1 voltage trim input
SYNC A	Switching frequency synchronization input, optocoupled input, input diode anode, only populated with **/F option**
SYNC K	Switching frequency synchronization input, optocoupled input, input diode cathode, only populated with **/F option**
SD1	Input shutdown control for output 1, only populated with **/F option**
SD2	Input shutdown control for output 2, only populated with **/F option**
SD3	Input shutdown control for output 3, only populated with **/F option**
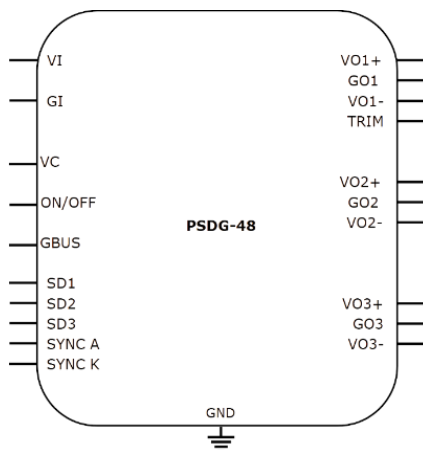
PSDG-48 48W POWER

2-ELECTRICAL SPECIFICATIONS

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

Parameter	Conditions	Limit	Units	M input
INPUT				
Nominal Input Voltage (Ui)	Full temperature range	Nominal	Vdc	28
Input Voltage range	Full Load Full temperature	Permanent Transient	Vdc	16 to 60 10.7 to 100
Maximum reverse input voltage	Full load, full temperature range	Max.	Vdc	-100
Undervoltage lock-out (UVLO)	Turn-on voltage turn-off voltage turn-off voltage turn-off voltage	Max. Max. Nom. Min.	Vdc	12.5 11.2 10.7 10
Start-up time	Ui Full load resistive load	Typical Max.	ms	35 40
No load input Power	Ui	Maximum	W	1.2
Input power in inhibit mode	ON/OFF tied to GBUS	Maximum	W	0.2
Maximum input Current	Ui, steady state Low line transient	Max.	A A/s	3.75 5.5/30
Maximum input ripple Current	Ui Full load resistive load			Mil-Std-461 CE102 compliant DO160
OUTPUT				
Set Point accuracy Refers to datasheets of MGDD-08, MGDD-21, MGDD-40.	Ui 75% load	Typical	%	+/- 2
Output regulation (Line+Load+Thermal) Refers to datasheets of MGDD-08, MGDD-21, MGDD-40.	Vi min. To Vi max 0% to full load	Typical	%	+/- 2
Output ripple voltage Refers to datasheets MGDD-08, MGDD-21, MGDD-40 for specific	3.3Vdc output 5Vdc output 12Vdc output 15Vdc output 24Vdc output	Typical	mVpp mVpp mVpp mVpp mVpp	150 150 240 300 500
Output voltage trim Range Refers to MGDD-21, MGDD-40 datasheets	As function of nominal output voltage **Applicable to output 1 only**	Minimum Maximum	% %	80 110
Power Efficiency	Ui 75% load	Typical	**%**	87

2-ELECTRICAL SPECIFICATIONS

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

Parameter	Conditions	Limit	Units	Values
Maximum capacitive load	40W output 3.3, 5 Vdc 40W output 12 Vdc 40W output 15 Vdc 40W output 24 Vdc 20W output 3.3, 5 Vdc 20W output 12 Vdc 20W output 15 Vdc 20W output 24 Vdc 8W output 3.3, 5 Vdc 8W output 12 Vdc 8W output 15 Vdc 8W output 24 Vdc	**max**	**µF**	2000 1000 200 470 1000 470 330 220 680 330 220 100
Hold-up				
Hold-up capacitor voltage (Vc)	Ui	Max.	Vdc	20
Hold-up capacitor value (max.)	For 50ms to 1s	Max.	µF	400 000
Hold-up capacitor value (min.)	Hold-up not used (**VC unconnected**)	Min.	µF	0
Hold-up capacitor inrush current	Ui	Typical	A	1.1
Hold-up charging time (@48W output)	Hold up cap =18 000µF Hold up cap =70 000µF Hold up cap =360 000µF	Typical	ms ms ms	500 2000 9900
Hold-up time (@48W output)	Hold up cap =18 000µF Hold up cap =70 000µF Hold up cap =360 000µF	Typical	ms ms ms	50 200 1000
Miscellaneous				
Operating case temperature range	No derating over output power.	Min.to Max.	°C	-40 to 105°C
Storage temperature	Not Operating	Min.to Max.	°C	-55 to 125°C
Case to Air thermal Resistance	Without heat-sink	Typical	°C/W	5.5
Switching Frequency (fixed free running)	Full input voltage range	Min.to Max.	kHz	285 +/-5%
Switching Frequency synchronization range (option)	Full input voltage range	Min.to Max.	kHz	300 to 360
synchronization input signal across Sync A, Sync K (option)	Led forward current Led forward voltage	Max Typ.	mA Vdc	10 1.5
Synchronization signal recommended duty-cycle (option)	Full input voltage range	Min.to Max.	%	10 to 35
Sync input isolation to other pins	Sync A/ other, Sync K /other	Typical	Vdc	1500
Isolation strength	Inputs/Outputs Inputs/case or Outputs/ case Output1 / Output2 / Output3	Typical	Vdc	1500 500 500
Isolation Resistance	Pin to Case, Pin to GND	Typical	MΩ	500

REDEFINING THE SOURCES OF POWER

Hi-Rel Grade

2-ELECTRICAL SPECIFICATIONS

Data are valid at +25°C, unless otherwise specified				
Parameter	**Conditions**	**Limit**	**Units**	**Values**
On/Off module disable delay	Ui (without output capacitors)	Max	μs	500
On/Off module enable delay	Ui (without output capacitors)	Max	ms	36
On/Off module enable voltage	Ui	Min.to Max	Vdc	2 to 4.5
On/Off module disable voltage	Ui	Min.to Max	Vdc	0 to 0.5
RELIABILITY				
MTBF MIL-HDBK217	Case at 40°C, Ground fixed (Gf)	Hrs		TBD
	Case at 85°C, Ground fixed (Gf)			TBD
	Case at 40°C, Ground mobile (GM)			TBD
	Case at 85°C, Ground mobile (GM)			TBD

REDEFINING THE SOURCES OF POWER

3-ENVIRONMENTAL

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

REDEFINING THE SOURCES OF POWER

4-PERFORMANCE

Efficiency

PSDG48-M-C-C-C - Typical Efficiency vs Output Power at T=25°C

PSDG48-M-E-E-E - Typical Efficiency vs Output Power at T=25°C

PSDG-48-M-I-I-I -Typical Efficiency vs Output Power at T=25°C

PSDG-48-M-F-F-F - Typical Efficiency vs Output Power at T=25°C
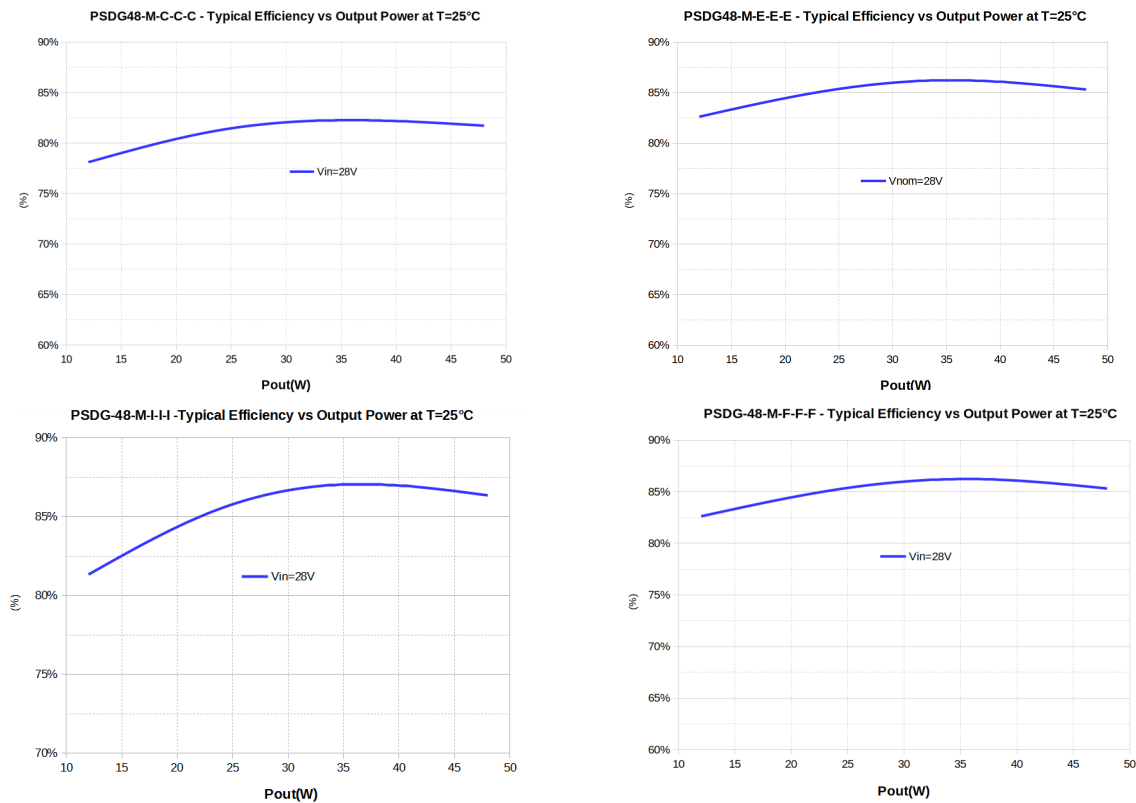
Power derating :

Maximum power rating @ 105°C case.

REDEFINING THE SOURCES OF POWER
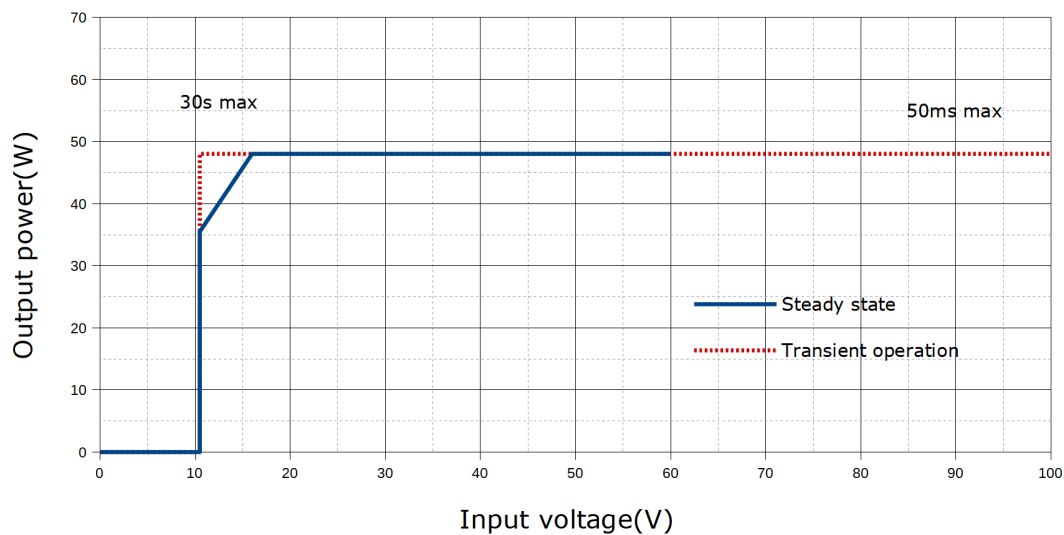
5-APPLICATION NOTE

5.1-THERMAL MANAGEMENT

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

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

In majority of the applications, heat will be removed from the baseplate either with :

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

To calculate a maximum admissible ambient temperature the following method can be used. Knowing the maximum case temperature : **Tcasemax** of the module, the output power, and the whole efficiency of the converter

- determine the power dissipated by the module : **Pdiss** that should be evacuated: **Pdiss = Pout x(1-1/eff)** where Pout is the output power and eff is the whole efficiency
- determine the maximum ambient temperature : **Ta = Tcasemax (°C)- Rth(c-a) x Pdiss** where Rth(b-a) is the thermal resistance from the case to ambient.

Free air cooling

Heat-sink usage

Chassis mount

REDEFINING THE SOURCES OF POWER
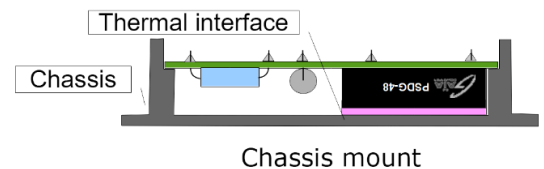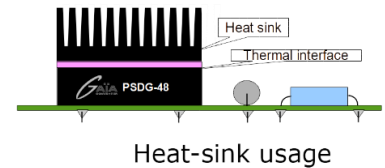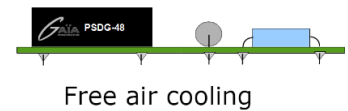
5-APPLICATION NOTE

5.2-ON-OFF FUNCTION

The On/Off pin can be used to control the internal front-end operation, in order to shut down the converters input bus. This allows to reach low consummation disable mode. The disable function can be done with an open collector transistor, a switch, a relay or an opto-coupler. The PSDG-48 is disabled by pulling the On/Off pin low, this way, several PSDG-48 can be disabled with the same signal distributed to all modules.

In option each internal converter can be disabled individually using the pins SD1, SD2 and SD3 in the same way than described above.
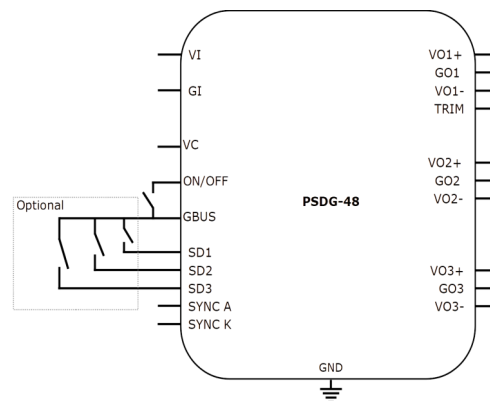
5.3-HOLD-UP FUNCTION

The Hold-up section of the PSDG-48 charges an external bulk capacitor at a voltage Vc depending on the input voltage and limited to 20V. The hold-up mode of operation is described below:

1) During normal operation, the internal circuit maintains the voltage across the hold-up capacitor at a fixed voltage (if specification). During this phase the capacitor is not connected to the output pin of the input bus. The inrush current generated by the hold-up capacitor during its charge is limited by an internal resistor.

2) During input bus interruption, off mode, or when the input voltage drops below the voltage at which the hold-up capacitor is charged, the bulk capacitor is connected to the output pin of the internal bus through a diode.

3) When the input bus recovers above the voltage remaining at the hold-up capacitor, the outputs are supplied again from the input bus and the capacitor recharges.

The hold-up capacitor value **CH (mF)** can be evaluated with the given formula where **P (Watt)** is the output power and **T (ms)** the desired hold-up time.

Thanks to the low hold-up voltage (Vc) limited to 20V, best ratio value/ size capacitors can be used to minimize the hold-ups function size.

The hold-up function is fully linear with no use of switching mode charger for best noise performance.
In case the hold-up function is not used, it is recommended to keep the VC pin unconnected.
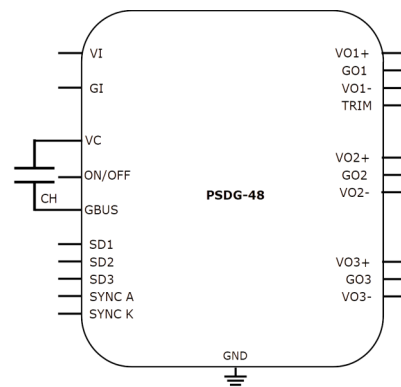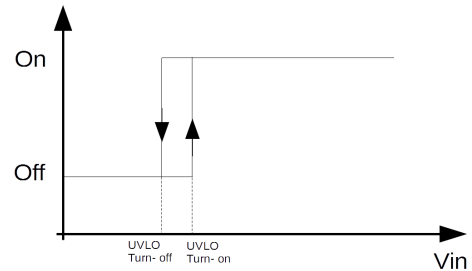
$$CH = \frac{P.T}{135}$$

5-APPLICATION NOTE

5.4-INPUT UNDERVOLTAGE LOCK OUT (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)


5.5-OUTPUT VOLTAGE TRIM

The PSDG-48 Output 1 voltage can be trimmed up and down according to values specified in § electrical specifications. To trim outputs connect Rup as described. To trim down, connect Rd as described. Please refer to MGDD21 series datasheet for Rup(x) or Rd(x) calculation. Only the first channel can be trimmed, see § electrical specifications for channels 2 and 3 specifications.
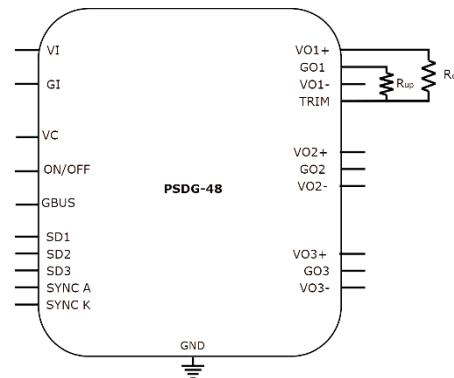
5.6-SYNCHRONIZATION (OPTION)

The PSDG-48 series provides an external synchronization function through the SYNC A/SYNC K pins which allows to synchronize internal switching frequencies to any external source. These pins are input only. These two pins are the anode and cathode of the LED of the internal opto-coupler, providing a full isolation from other pins. The current inside the LED should be limited. The sync signal can be a square signal with duty cycle lower than 50% (see specifications)
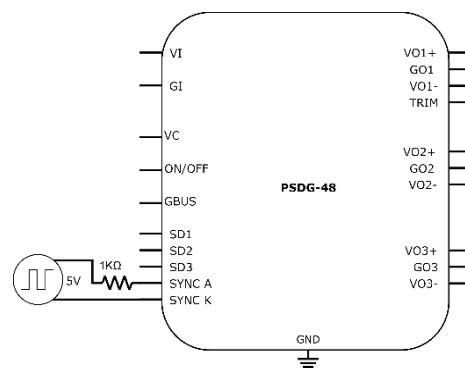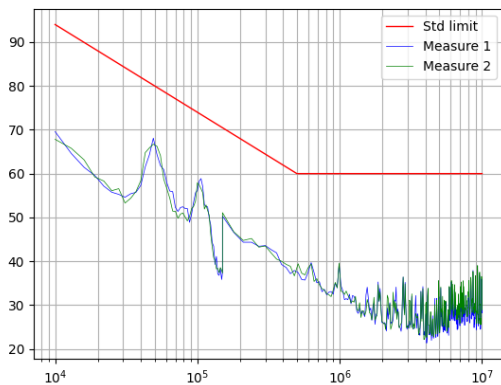
5-APPLICATION NOTE
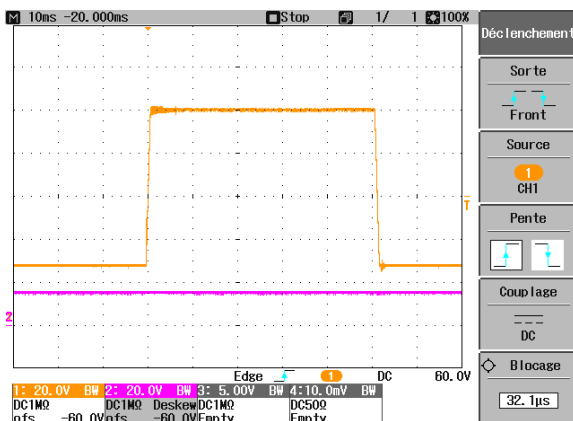
5.7-OVER-CURRENT PROTECTION (OCP)

Please refer to MGDD-40, MGDD-21, MGDD-08 datasheet for over voltage protection specifications

5.8-Mil STD 461 and DO160 CONDUCTED EMI COMPLIANCE
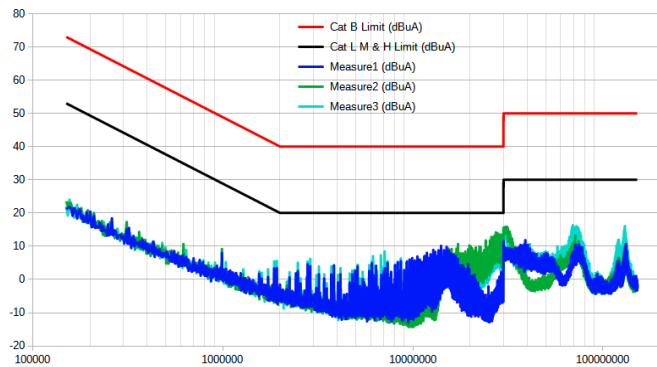
Plots above show the conducted noise typical performance of PSDG-48
Measure 1 = positive lead, Measure 2 = negative lead, Measure 3 = common mode

5.9-1275 SURGE COMPLIANCE

Plots show the Mil-Std 1275 100V/50ms surge compliance of the PSDG-48
Ch1 = input
Ch2 = 15V output (output 3)

REDEFINING THE SOURCES OF POWER

5-APPLICATION NOTE

5.10-Examples of typical applications

All pins in the diagrams below are shown, although some may not be present depending on output configuration and options. TVS are indicative and may be replaced by other models/values depending on the application.

Example of an isolated **dual-output** power supply with 5V **40W** + and 5V **8W** . This power supply complies with Mil-STD-704, Mil-STD-1275, Mil-STD-461 and DO 160 standards, among others
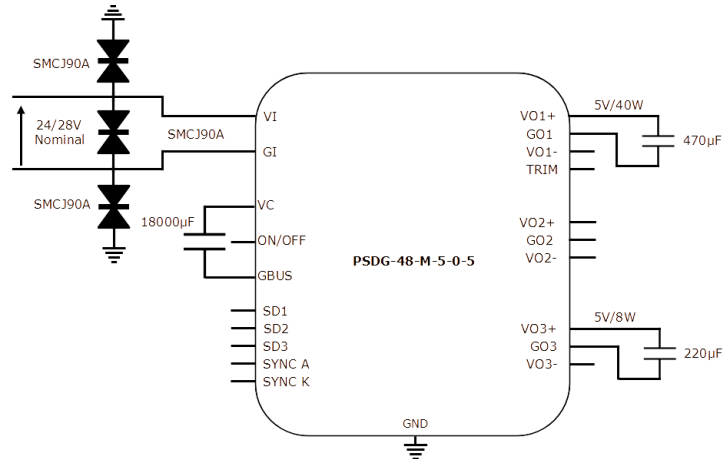
Example of an isolated **triple-output** power supply with 12V **20W,** 12V **20W** and 5V **8W**. This power supply complies with Mil-STD-704, Mil-STD-1275, Mil-STD-461 and DO 160 standards, among others.
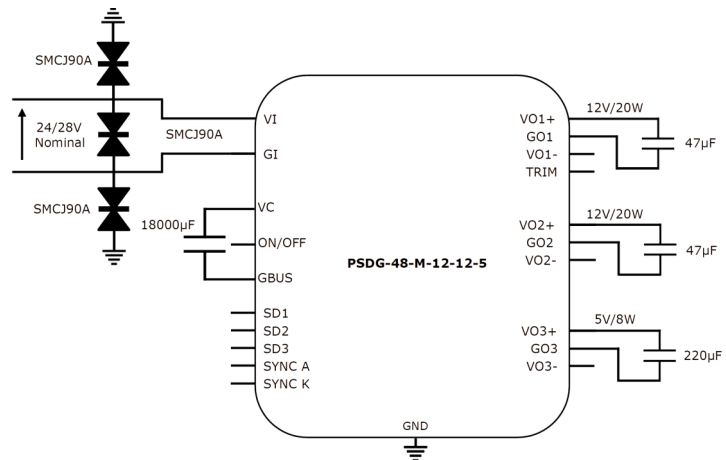

Example of an isolated **triple-output** power supply with **+/-24V 20W, +/-24V 20W** and **5V 8W**. This power supply complies with Mil-STD-704, Mil-STD-1275, Mil-STD-461 and DO 160 standards, among others.
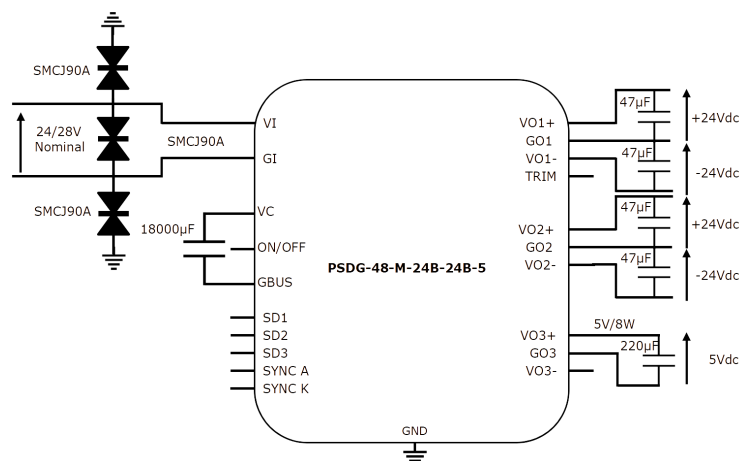
6-MECHANICAL

6.1-MECHANICAL DRAWINGS

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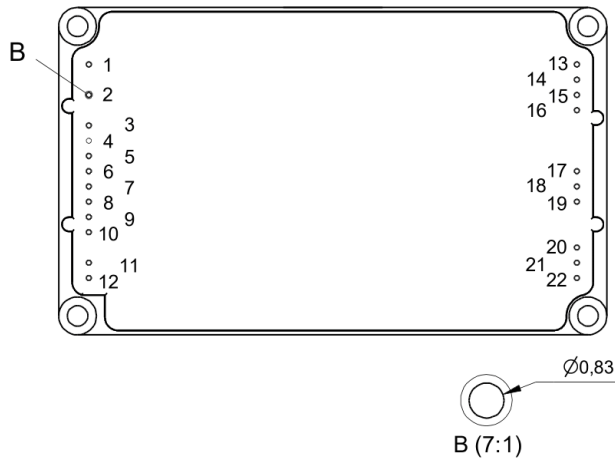All dimensions specified "min" or "max" are not subjected to general tolerance.

Anodization removed on stand off for case electrical connection.

White dot locates pin 1
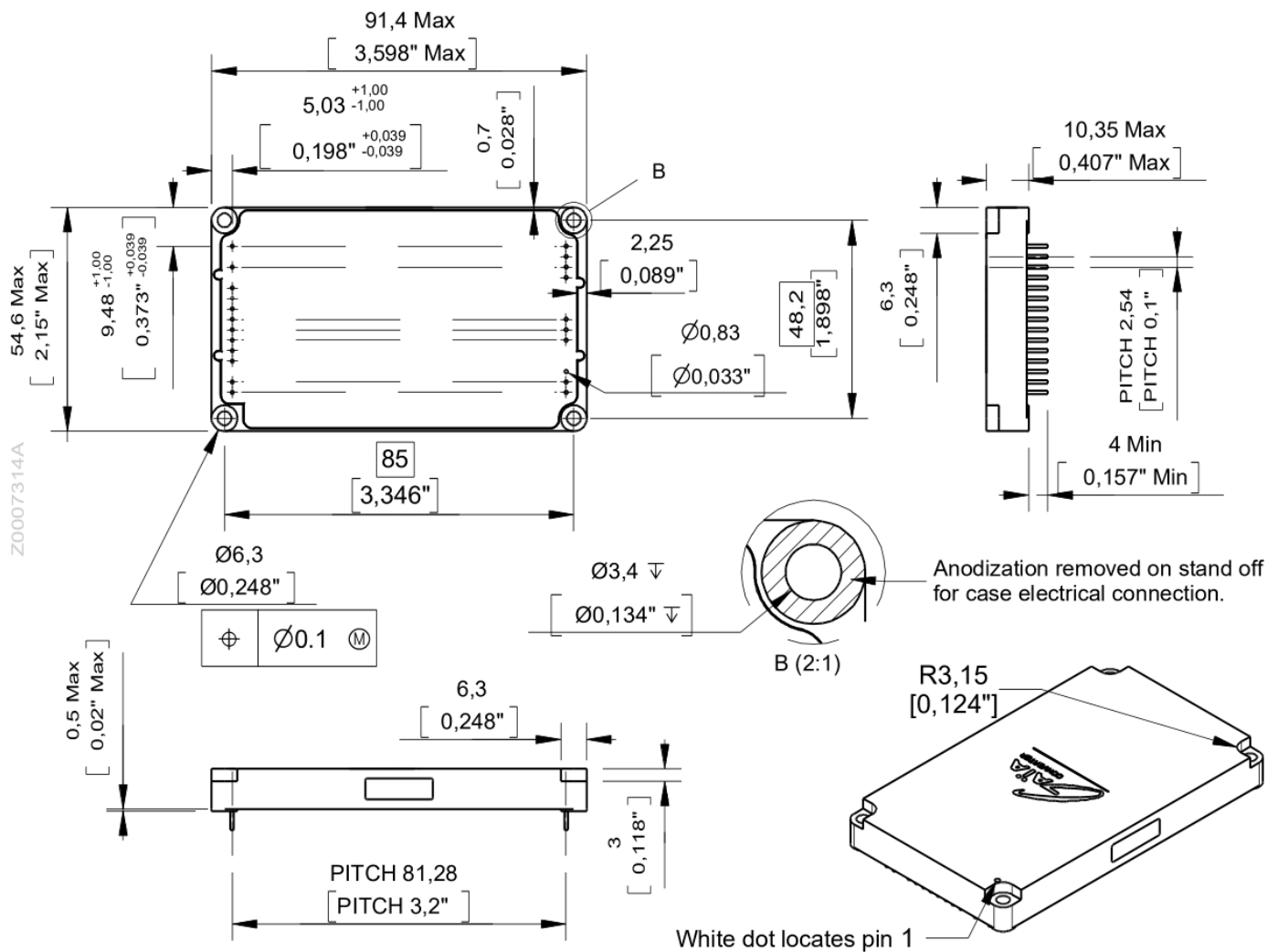
Max product weight	:	130 gr, 4.6 Oz
Case material	:	Metallic aluminium case black anodized coating

REDEFINING THE SOURCES OF POWER

6-APPLICATION NOTE

6.2-CONNECTIONS,

PIN DEFINITION

Pin	Signal	Pin	single ended	+&- symmetrical
1	VI	13	VO1	VO1+
2	GND	14	GO1	GO1
3	GI	15	TRIM	TRIM
4	NO PIN	16	NO PIN	VO1-
5	VC	17	VO2	VO2+
6	GBUS	18	GO2	GO2
7	ON/OFF	19	NO PIN	VO2-
8	SD3	20	VO3	VO3+
9	SD2	21	GO3	GO3
10	SD1	22	NO PIN	VO3-
11	SYNC K			
12	SYNC A			

B (7:1)   Ø0,83

Pin material : Brass
Finishing : Copper flash 0.15µm + Nickel underplate 2µm to 4µm + 100% Electrolytic matte tin

6.3-PRODUCT MARKING

REFERENCE
DATECODE OPTIONS
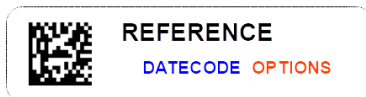
Left side :
: GAIA internal product identification.

Right side
Line 1 : Product identification

REFERENCE: Product identification, according to Commercial reference, without options.
Depending on the dimensions of the product, the printed reference may exlude "-" characters.
Example : Catalog reference SERIES-10-J-C printed SERIES10JC

Line 2 : DateCode and Options
DATECODE: Code format YYXX (YY :Year ; XX : Week)

OPTIONS:
In this order for the marking :
L : if leaded product (RoHs if absent)
P : if prototype
/... : Succession of integrated options, format "/letter", in alphabetical order, where letter is the standard code for the option (/M/T/...).
/XX : derivative product from the standard family

Example of options marking : DATECODELP/M/S/XX

Particular marking for "/S" option :
In this case,
  - The DataMatrix code is not present,
  - The DATECODE is replaced by the SERIAL NUMBER of the product.

REDEFINING THE SOURCES OF POWER