

## 24/28Vdc MIL LOW PROFILE POWER SUPPLY MIL-STD-1275/MIL-STD704 COMPATIBLE Configurable Dual Channel

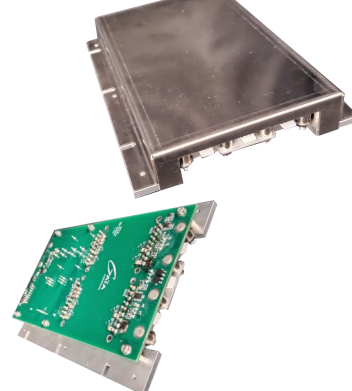
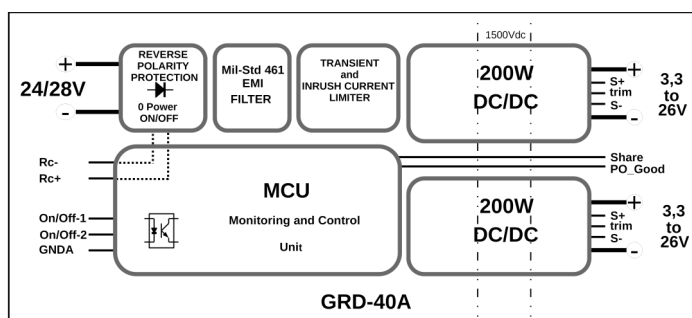
### Features

- 10-45/100 Vdc input.
- Power up to 400W
- Reverse Polarity protection
- Inrush current limiter
- Output 3.3 to 52Vdc
- Dual configurable channel
- Board Parallelizable
- Efficiency up to 88%
- Galvanic isolation 1500Vdc
- Output voltage trim
- -40 to 85°C base-plate
- Thermal protection
- EU RoHs process

### Product Information

The GRD40A designates a complete family of 400W low profile military grade C.O.T.S power supplies. The board includes EMI filters, reverse polarity protection, inrush current limiter and input surge limiter to fully comply with common input bus standards such as MIL-STD-1275 MIL-STD-704 and MIL-STD-461. 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. Several fixed output voltages from 3.3 Vdc to 52 Vdc are available. The outputs channel can be adjusted from 10% to 110% of the nominal value. A sharing function allows multiple boards to be connected in parallel to increase

output power. The power supply can operate with a base temperature from -40 to 85°C. The GRD40A comes with 2 independent and isolated 200W output channels that can be connected in series, in parallel, with a common line, and +/- outputs. The power connections are made by 4mm studs, the monitoring signals are available on standard low power connectors. The 180mm x 140mm x 28mm board can be ordered coated (/V option), or with a metal chassis cover (/C option). The GRD40A is particularly suitable for demanding projects in various application areas such as land vehicles or marine. Ready to use, the GRD40A is designed to speed up design processes and reduce time-to-market.



mm: 190 x 140 x 28  
In : 7.5 x 5.5 x 1.09

### Standards

- MIL-STD-704
- MIL-STD-1275
- MIL-STD-461

### Selection Guide

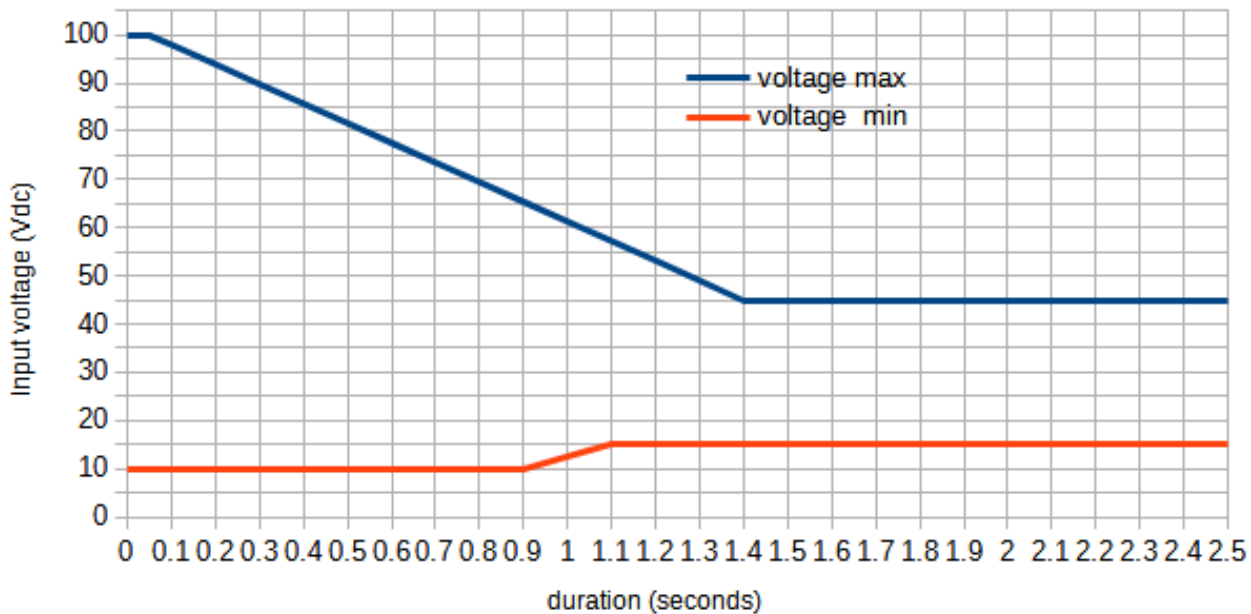
| Part Number   | Nominal Output Voltage (Vdc) | Output Current (Adc) | Output Power (W) | Part Number | Nominal Output Voltage (Vdc) | Output Current (Adc) | Output Power (W) |
|---|------------------------------|----------------------|------------------|-------------|------------------------------|----------------------|------------------|
| GRD40A-H-P  | 48                           | 8.33                 | 400              | GRD40A-H-2E | +/-12                        | +/-16.6              | 200-200          |
| GRD40A-H-J  | 28                           | 13.3                 | 373              | GRD40A-H-2F | +/-15                        | +/-13.3              | 200-200          |
| GRD40A-H-I  | 24                           | 16.7                 | 400              | GRD40A-H-2I | +/-24                        | +/-8.33              | 200-200          |
| GRD40A-H-F  | 15                           | 26.7                 | 400              | GRD40A-H-IC | 24-5                         | 8.33-35              | 200-170          |
| GRD40A-H-E  | 12                           | 33.3                 | 400              | GRD40A-H-IE | 24-12                        | 8.33-16.6            | 200-200          |
| GRD40A-H-C  | 5                            | 70                   | 350              | GRD40A-H-IF | 24-15                        | 8.33-13.3            | 200-200          |
| GRD40A-H-B  | 3.3                          | 70                   | 231              | GRD40A-H-FB | 24-3.3                       | 8.33-35              | 200-115          |
| GRD40A-H-CC   | 5-5                          | 35-35                | 170-170          | GRD40A-H-FC | 15-5                         | 13.3-35              | 200-170          |
| GRD40A-H-EE   | 12-12                        | 16.6-16.6            | 200-200          | GRD40A-H-FE | 15-12                        | 13.3-16.6            | 200-200          |
| GRD40A-H-FF   | 15-15                        | 13.3-13.3            | 200-200          | GRD40A-H-EB | 12-3.3                       | 16.6-35              | 200-115          |
| GRD40A-H-II   | 24-24                        | 8.33-8.33            | 200-200          | GRD40A-H-EC | 12-5                         | 16.6-35              | 200-170          |
| GRD40A-H-2C   | +/-5                         | +/-35                | +/-170           | GRD40A-H-CB | 5-3.3                        | 35-35                | 170-115          |
| Options :<br>/C cover /S screen /T- 55°C /V Coating |                              |                      |                  |             |                              |                      |                  |

### Applications

- Mil-Ground-borne
- Naval

## 1-PRODUCT INTRODUCTION

GRD40A-H Transient operating input voltage



Max non operating input voltage = 202Vdc

## TERMINALS FUNCTION

**Vi:** Positive input power connection.

**Gi:** Return input power connection.

**AGND\_IN:** return for the ON/OFF1, and ON/OFF2 signals.

**ON/OFF1:** Active low internal converter of channel 1 disable command.

**ON/OFF2:** Active low internal converter of channel 2 disable command.

**RC+ & RC- :** Remote control lines. When connected together, these 2 lines disable the complete board that switches to green power mode.

**Vo1, Vo2:** Positive output channel 1 & 2.

**Go1, Go2:** Return output channel 1 & 2.

**S1+, S2+:** Low current channel 1 & 2 positive sense.

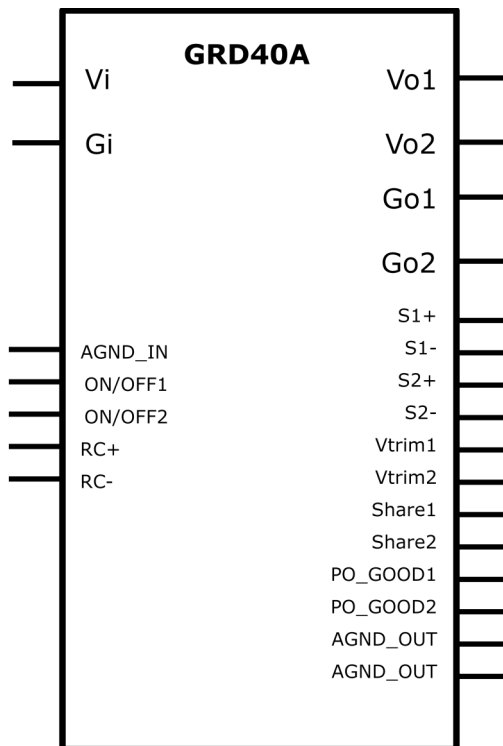
**S1-, S2-:** Low current channel 1 & 2 negative sense.

**Vtrim1, Vtrim2:** Output voltage trim of channel 1 & 2.

**Share1, Share2:** When outputs of GRD40AN are configured in parallel, these pins are internally connected together, and can be used to connect in parallel 2 GRD40AN.

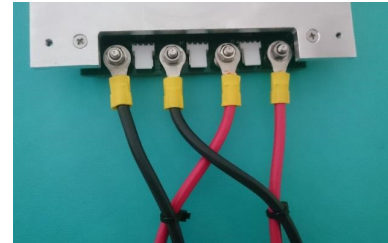
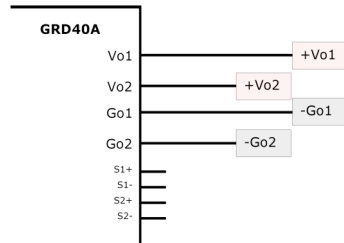
**PO\_GOOD1, PO\_GOOD2:** Power output good, opto-isolated output signal that raises when respectively output voltage of channel 1 and output voltage of channel 2 reaches the expected value.

**Note: in case of 2 different output voltages, the voltage across Vo1/Go1 is the lowest voltage**

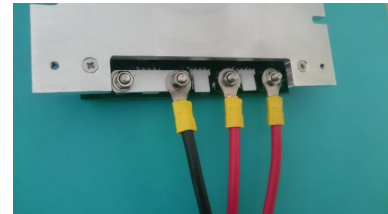
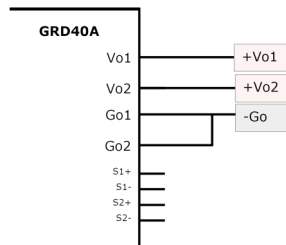


## 1-PRODUCT INTRODUCTION

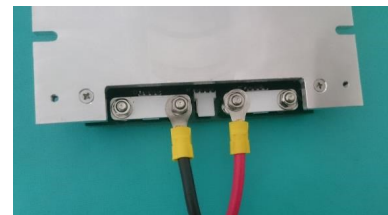
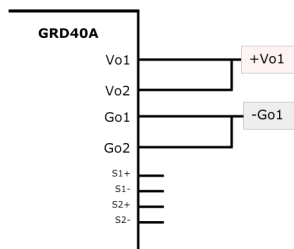
### OUTPUT CONFIGURATION :



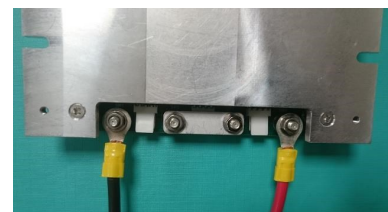
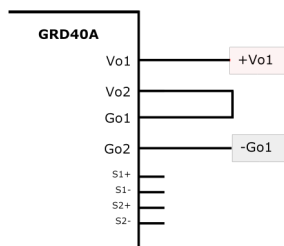
Output configuration **A** :2 isolated channels



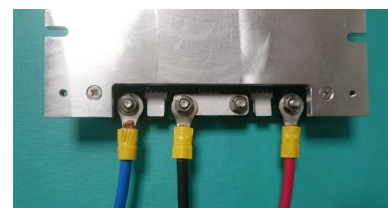
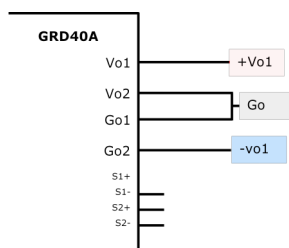
Output configuration **B** :2 independant channels common Go



Output configuration **C**: Parallel connection mode



Output configuration **D** :Series connection mode



Output configuration **E** : Symmetrical mode 2 channels

## 2-ELECTRICAL SPECIFICATIONS

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

| Parameter                           | Conditions                                       | Limit                | Units                          | H input     |
|-------------------------------------|--|----------------------|--------------------------------|-------------|
| <b>INPUT</b>                        |  |                      |                                |             |
| <b>Nominal Input Voltage (Ui)</b>   | Full temperature range                           | Nominal              | Vdc                            | 28          |
| <b>Undervoltage lock-out (UVLO)</b> | Turn-on voltage<br>turn-off voltage<br>Pout 200W | Max.<br>Min.         | Vdc                            | 11.1<br>9.1 |
| <b>Start up time</b>                | Ui Full load<br>resistive load                   | Maximum              | ms                             | 50          |
| <b>No load input Power</b>          | Ui   | Maximum              | W                              | 3.3         |
| <b>Input power in inhibit mode</b>  | Ui   | Maximum              | W                              | 0.2         |
| <b>Maximum input Current</b>        | Full input voltage range                         | Maximum steady state | A                              | 30          |
|                                     |  | Maximum Transient    | A                              | (40)        |
| <b>Maximum input ripple Current</b> | Ui Full load<br>resistive load                   |                      | Mil-Std-461<br>C0102 compliant |             |

### OUTPUT

|  |   |            |      |  |
|--|---|------------|------|--|
| <b>Set Point accuracy</b>  | Ui 75% load   | Maximum    | %    | +/- 2                                  |
| <b>Output regulation</b><br>(Line+Load+Thermal)  | Vi min. To Vi max<br>0% to full load  | Maximum    | %    | +/- 1                                  |
| <b>Output ripple voltage</b><br>B output (5V)<br>C output (5V)<br>E output (24V)<br>F output (12V)<br>I output (24V)<br>P output (12V) | Vi min. To Vi max   | Typical    | mVpp | 100<br>100<br>220<br>250<br>480<br>500 |
| <b>Output voltage trim Range</b>   | As function of nominal<br>output voltage<br><b>Unchanged Max output<br/>current !</b> | Minimum    | %    | 10                                     |
|  |   | Maximum    | %    | 110                                    |
| <b>Power Efficiency</b>  | Ui 75% load   | Typical    | %    | 86                                     |
| <b>Maximum capacitive load</b>   | Ui  | Maximum    | μF   | 5000                                   |
| <b>Switching Frequency</b>   | Full input voltage range*   | Min<br>Max | Khz  | 210<br>280                             |
| <b>Isolation strength</b>  | Input/Output  |            | Vdc  | 1500                                   |
|  | Input/baseplate   |            | Vdc  | 500                                    |
|  | Output/ baseplate   |            | Vdc  | 500                                    |
|  | Output1 / Output2   |            | Vdc  | 100                                    |
| <b>Isolation strength</b>  | Tested at 500Vdc  |            | MΩ   | 500                                    |

\*Main apparent switching frequency tone may be close to 500kHz as result of 250khz internal biphas synchronization

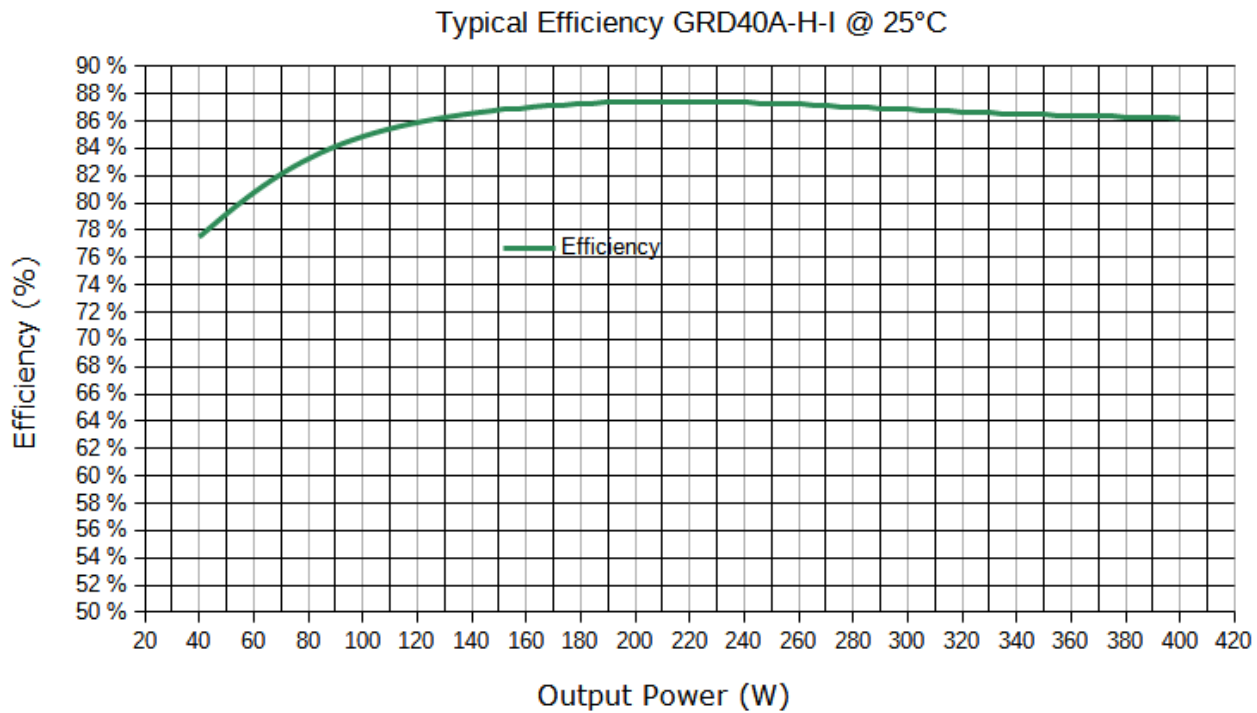
## 2-ELECTRICAL SPECIFICATIONS

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

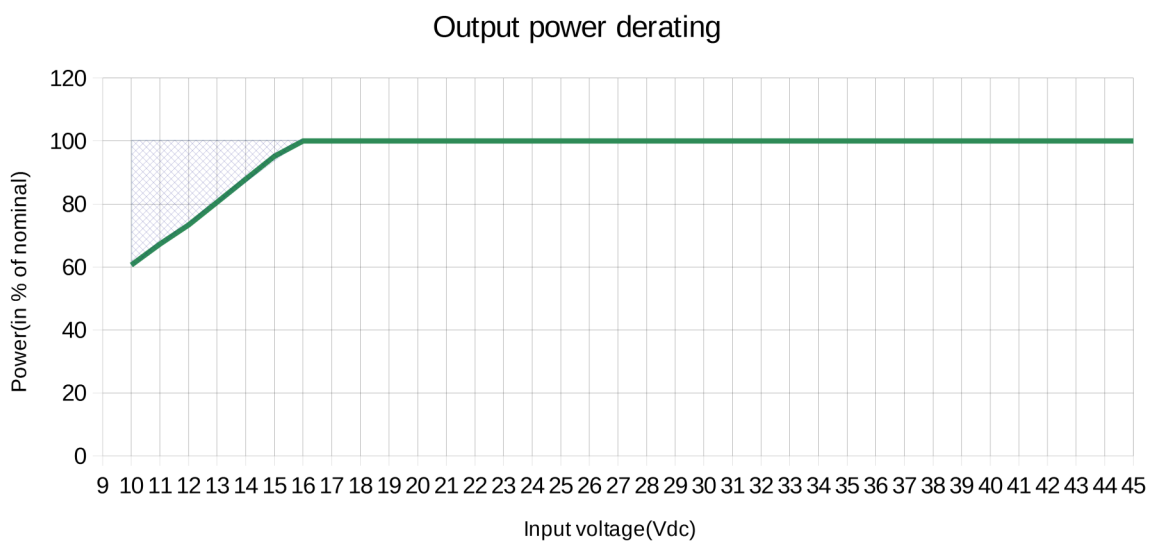
| Parameter   | Conditions  | Limit              | Units       | H input    |
|---|---|--------------------|-------------|------------|
| <b>PROTECTIONS &amp; CONTROLS</b>                                       |   |                    |             |            |
| Refers to MGDM-201 datasheet for complete output protection description |   |                    |             |            |
| Over Current Protection (OCP)<br>Protection mode                        |   |                    | FOLD BACK   |            |
| Over Temperature Protection<br>Converters OTP level                     | Thermostat<br>with hysteresis cycle<br>(Base plate Temperature) | Max./hyst          | °C          | 115/10     |
| <b>CONTROLS and MONITORING</b>  |   |                    |             |            |
| On/Off module enable voltage  | Ui<br>5mA max bias current                                      | Minimum<br>Maximum | Vdc<br>Vdc  | 3,5<br>5.5 |
| On/Off module disable voltage   | Ui  | Maximum<br>Minimum | Vdc<br>Vdc  | 1<br>0     |
| Rc-Rc+ control dry contact impedance                                    | Ui Disable mode   | Maximum            | Ohms        | 100        |
| RC-Rc+ max voltage  | Ui Enable mode  | Maximum            | Vdc         | 15         |
| PI_GOOD max Vce voltage<br>PI_GOOD max sink current (Ic)                | For current < 2.5mA<br>Ic For voltage < 10 Vdc .                | Maximum            | Vdc<br>mAdc | 60<br>15   |
| PO_GOOD(1)(2) trigger level   | Ui<br>As function of output voltage                             | Minimum            | %           | 95%        |
| PO_GOOD max Vce voltage<br>PO_GOOD max sink current (Ic)                | For current < 2.5mA<br>For voltage < 10 Vdc .                   | Maximum            | Vdc<br>mAdc | 60V<br>15  |
| <b>THERMAL</b>  |   |                    |             |            |
| Operating temperature range   | Ui nominal Full power<br>Base Plate temperature                 | Minimum<br>Maximum | °C          | -40<br>85  |
| Base Plate to Air thermal resistance                                    | Ui<br>Full Load   | Typical            | °C/W        | 3          |
| <b>RELIABILITY</b>  |   |                    |             |            |
| Mean time between failures (MTBF)                                       |   |                    |             |            |
| According to Mil HDBK 217F  | Ground fixed (Gf) 40°C<br>Ground fixed (Gf) 85°C                |                    | Hours       | TBD        |

## 3-PERFORMANCE

### Efficiency



### Power derating :



Transient power area is in hatched blue

## 4-APPLICATION NOTE

### 4.1-THERMAL MANAGEMENT

The GRD40A thermal management can be achieved in 2 different ways:

**Air cooling :** Due to its high base-plate to air thermal resistance air cooling (with no heat-sink or cold plate) is possible for GRD40A-N only for low power or short duration operation. The max ambient temperature will be:

$$T_{amb} = BpT - P_o * \left( \frac{1}{eff} - 1 \right) * R_{th}$$

$T_{amb}$  = max ambient temperature.  
 $BpT$  = max base plate temperature.  
 $eff$  = efficiency.  
 $R_{th}$  = baseplate to air thermal resistance.  
 $P_o$  = output power in watts.

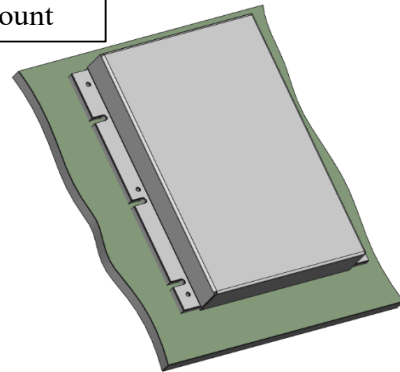
**Cooling through a heat-sink or chassis mount:**

The most common use of GRD40A is application where Board baseplate is screwed down to a heat-sink or the cold plate of a chassis. In this case The max ambient temperature will be:

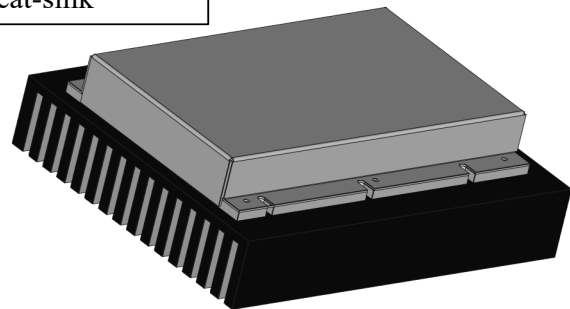
$$T_{amb} = BpT - P_o * \left( \frac{1}{eff} - 1 \right) * R_{th}$$

$T_{amb}$  = max ambient temperature.  
 $BpT$  = max base plate temperature.  
 $eff$  = efficiency.  
 $R_{th}$  = heat-sink or chassis to air thermal Resistance.  
 $P_o$  = output power in watts.

Chassis mount

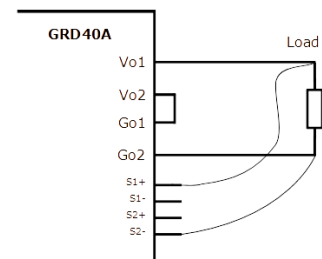
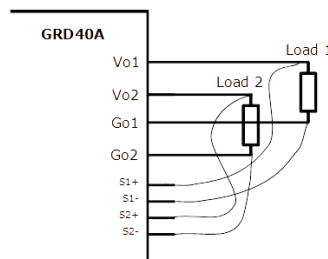


Heat-sink



### 4.2-SENSE FUNCTION

Sense terminals can be connected to the load to compensate for possible output cables losses. Sense terminals can compensate up to 10% output voltage drop. If not used senses should not be connected. When outputs channels are connected in series and sense function is implemented, only Sense1+ and Sense2- must be used.



## 4-APPLICATION NOTE

### 4.3-ON-OFF FUNCTION

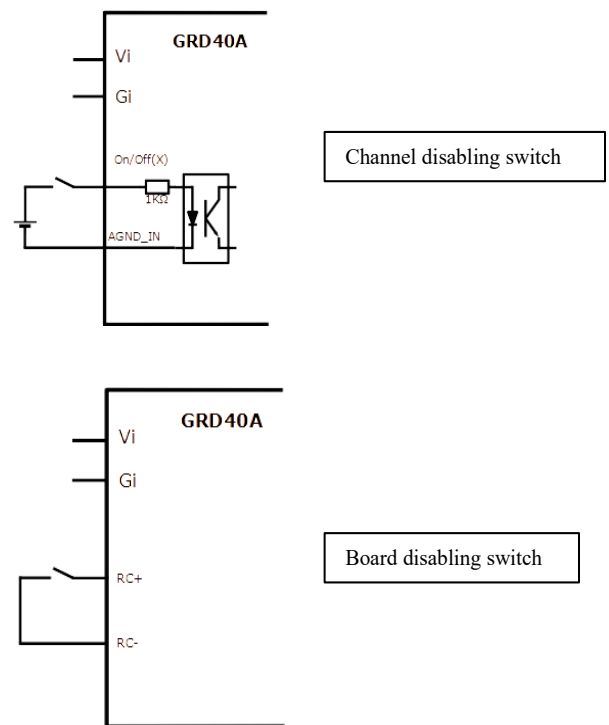
**ON/OFF1 , ON/OFF2 :** Each channel of the board can be disabled individually when output configuration is not “connected in series”. The channel is disabled when voltage is applied between ON/OFF1 or ON/OFF2 and AGND\_IN. See electrical specification for voltage and current values of ON/OFF signal. The channels are enabled with ON/OFF(X) unconnected. These ON/OFF(X) control lines are galvanically isolated, from other parts of the board electrical circuit.

When the outputs are “connected in series” both the ON/OFF(X) signal will disable the 2 channels.

When ON/OFF(X) are active only internal dc/dc converters are disabled, while the front-end of the board is still in operation.

**RC+-RC-:** when RC+ and RC- are connected together, the input stage of the board is no longer biased, and whole consumption is reduced to the minimum value. See electrical specification section for more details.

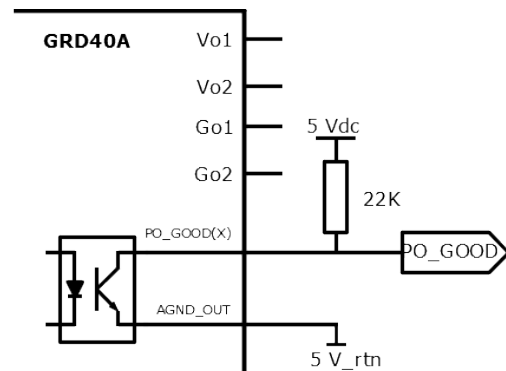
These RC+ and RC- are not galvanically isolated, from other parts of the board electrical circuit, therefore it is recommended to control those pins with a dry contact only.



### 4.4-POWER GOOD SIGNALS

The GRD40A provides user with output power good (PO\_GOOD1 , PO\_GOOD2) signals that are activated when outputs voltage reach their expected values. The signals are provided through transistor of opto-coupler that get saturated when board operate in nominal conditions, and transistor get open when an input or output voltage are not in their nominal values.

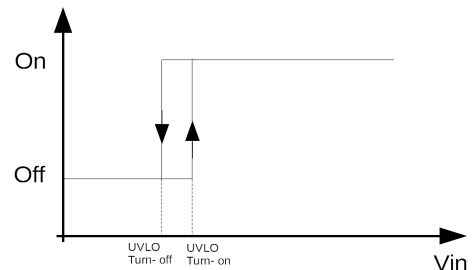
**Warning :** When an output voltage is trimmed, the corresponding PO\_GOOD will have threshold values changed. The opposite diagrams show a suggested circuit to use power good signals in a 0 -5V range.



## 4-APPLICATION NOTE

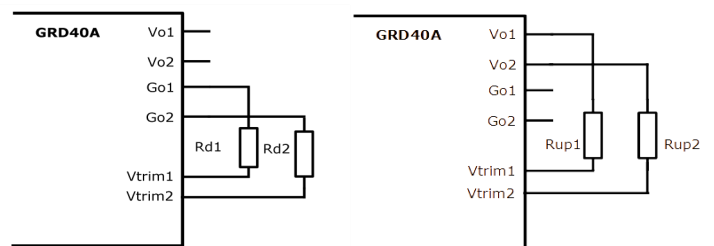
### 4.4-INPUT UNDERVOLTAGE LOCK OUT (UVLO)

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)



### 4.5-OUTPUT VOLTAGE TRIM

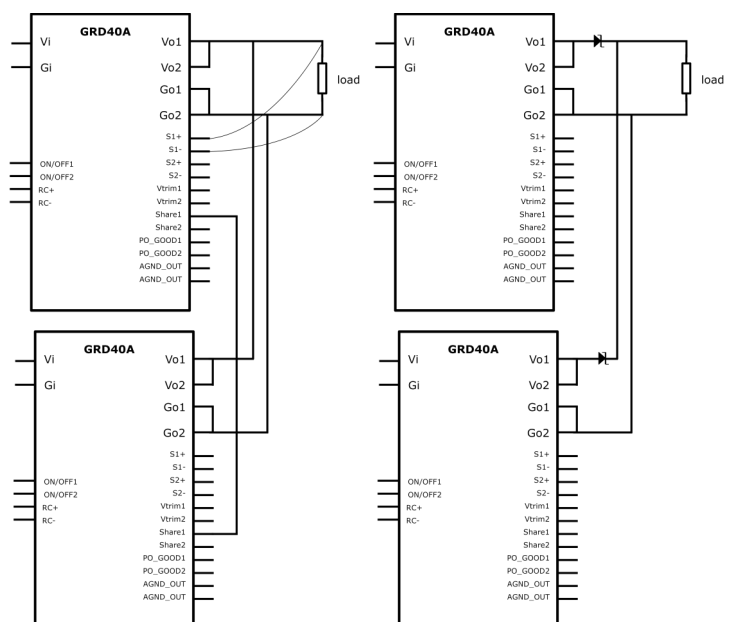
Outputs voltages of GRD40A can be trimmed up and down according to values specified in § electrical specifications. To trim outputs connect  $R_{up}(x)$  as described into opposite diagram. To trim down, connect  $R_{d}(x)$  as described into opposite diagram. Please refer to MGDM-201 datasheet for  $R_{up}(x)$  or  $R_{d}(x)$  calculation. Each channel can have its proper output voltage trimmed independently, but when channels are connected in series, the current into each channel being the same, it will define each channel output power base on channel voltage.



### 4.6-PARALLELING And REDUNDANCY FUNCTION

**Paralleling function:** in order to boost the output power of a power supply, it is possible to connect outputs of several GRD40A in parallel, with current sharing activated. When the 2 channels of a GRD40A are connected in parallel, the Share1 and Share2 signals of this GRD40A are connected together, only one of them need to be used to parallel several GRD40A.

**Redundancy function:** Several GRD40A can be connected to the same load for redundancy purposes. In this case, Oring diodes must be used (their losses can be compensated using trim function) If GRD40A-N are connected in redundancy mode, the shares (x) pins and ON/OFF2 must not be connected.



## 4-APPLICATION NOTE

### 4.7-OUTPUT OVERVOLTAGE PROTECTION (OVP)

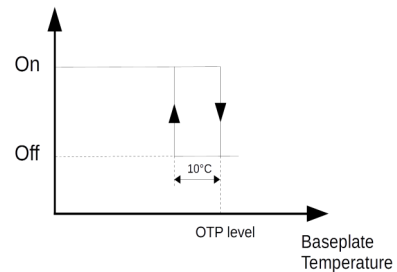
Please refer to MGDM-201 datasheet for over voltage protection

### 4.8-OVER-CURRENT PROTECTION (OCP)

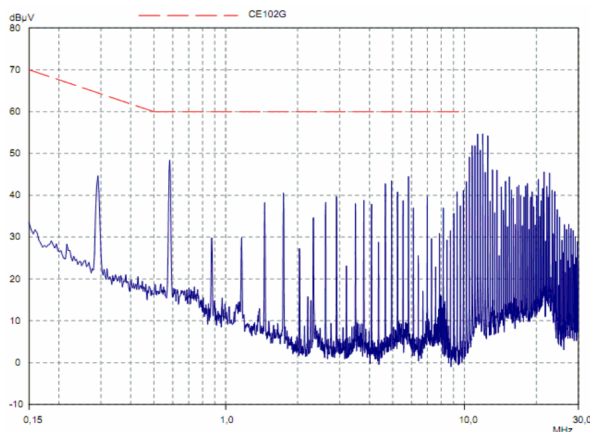
Please refer to MGDM-201 datasheet for over current protection

### 4.9-OVER-TEMPERATURE PROTECTION

A thermal protection device adjusted at the OTP level (see characteristics) will inhibit the board 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 guaranteed only when the board is mounted on a heatsink.

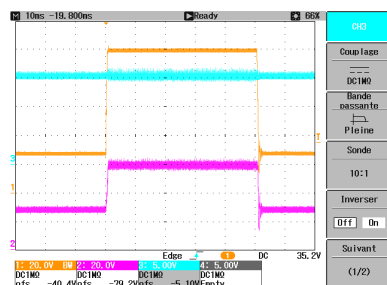


### 4.10-Mil STD 461 CONDUCTED EMI COMPLIANCE



GRD40A-H-I Vin= 28V Pout =400W

### 4.11-1275 SURGE COMPLIANCE



GRD40A-H-F Vin= Ch1, Vout =Ch3

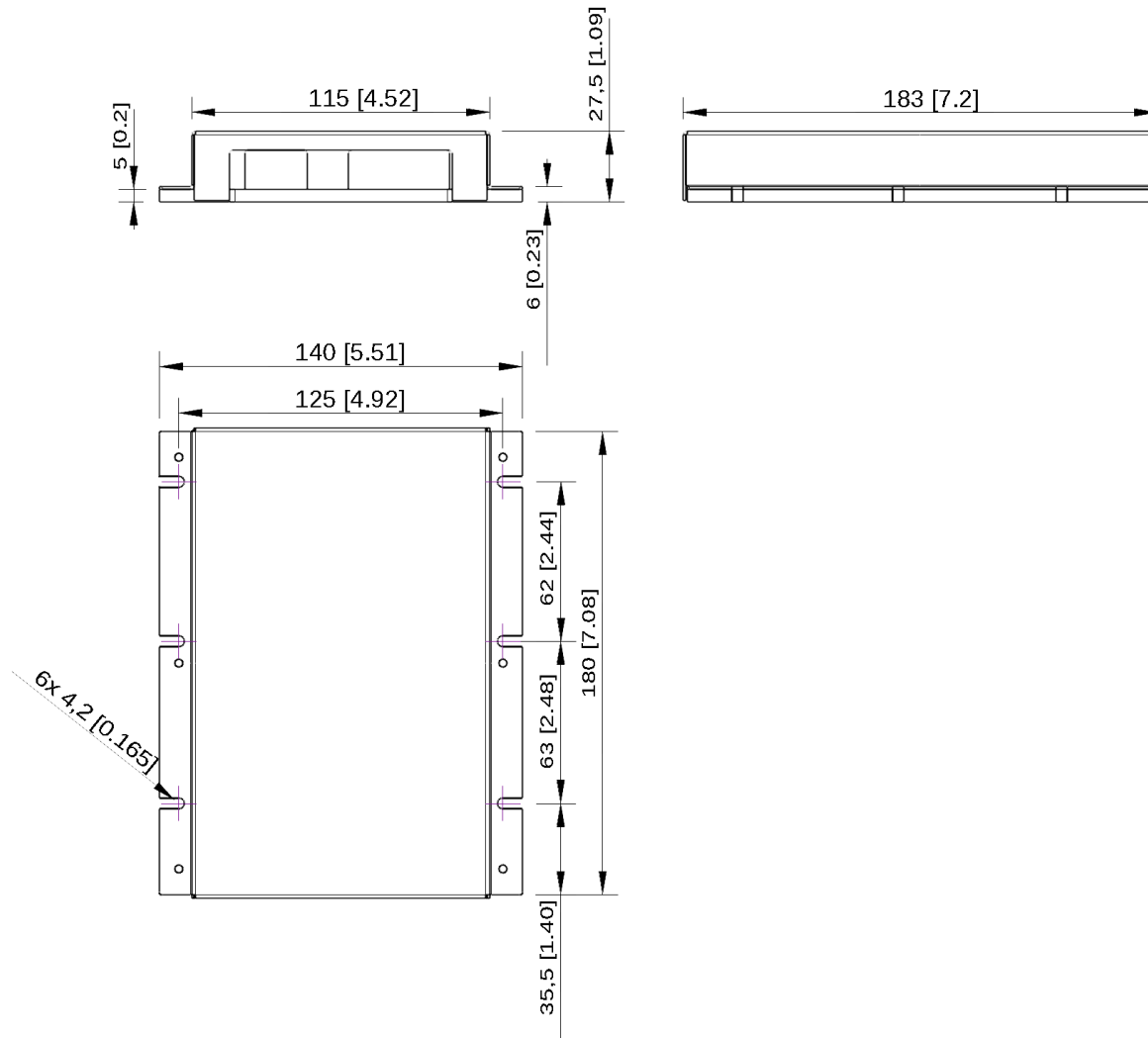
\*Ch2 shows the internal voltage at MGDS-201 input

## 4-APPLICATION NOTE

### 4.12-MECHANICAL DRAWINGS

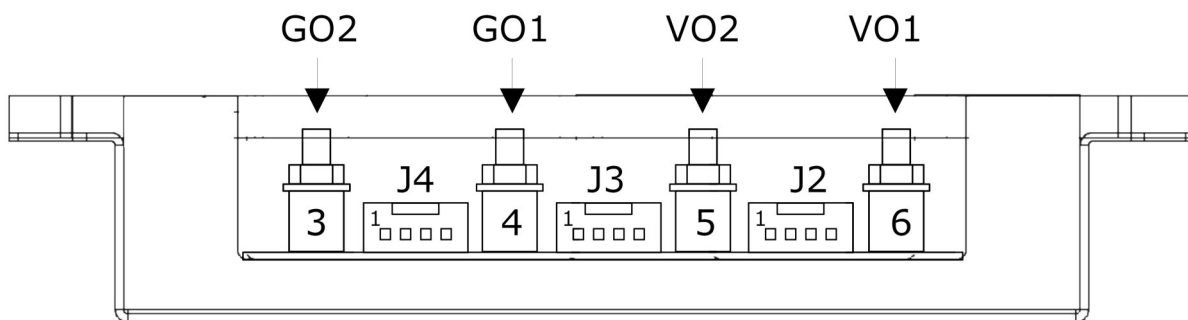
**Material :**  
 baseplate : aluminum  
 Cover : stainless steel SUS 430 with Nickel plating  
 Cover : thickness 1mm

Dimensions in mm [Inches], general tolerance +/- 0.2

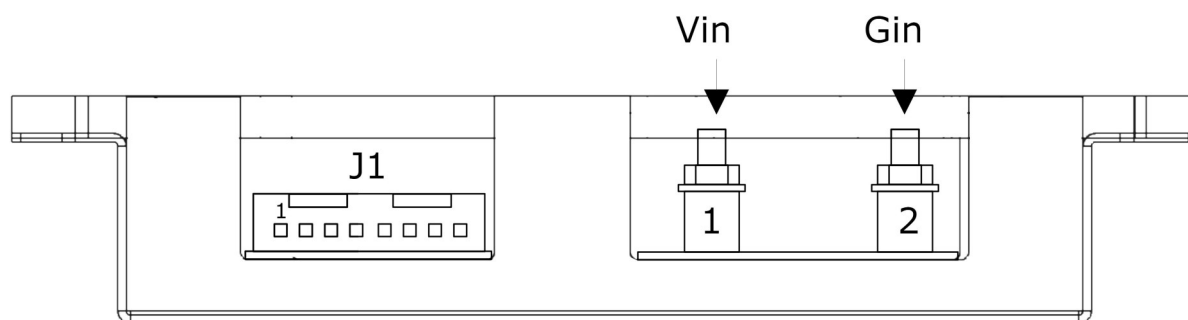


## 4-APPLICATION NOTE

### 4.13-CONNECTIONS, PRODUCT MARKING



Front side input connections



Back side output connections

| Connector      | Pin | Designation    |
|----------------|-----|----------------|
| Stud Connector | 1   | +Input(Vin)    |
| Stud Connector | 2   | -Input(Gin)    |
| Stud Connector | 3   | -Output 2(Go2) |
| Stud Connector | 4   | -Output 1(Go1) |
| Stud Connector | 5   | +Output 2(Vo2) |
| Stud Connector | 6   | +Output 1(Vo1) |

| Connector | Pin | Designation |
|-----------|-----|-------------|
| J1        | 1   | DNC*        |
| J1        | 2   | AGND_IN     |
| J1        | 3   | On/Off1     |
| J1        | 4   | On/Off2     |
| J1        | 5   | DNC*        |
| J1        | 6   | DNC*        |
| J1        | 7   | RC+         |
| J1        | 8   | RC-         |

| Connector | Pin | Designation |
|-----------|-----|-------------|
| J2        | 1   | S1+         |
| J2        | 2   | VTRIM1      |
| J2        | 3   | S1-         |
| J2        | 4   | SHARE1      |

| Connector | Pin | Designation |
|-----------|-----|-------------|
| J4        | 1   | S2+         |
| J4        | 2   | VTRIM2      |
| J4        | 3   | S2-         |
| J4        | 4   | SHARE2      |

| Connector | Pin | Designation |
|-----------|-----|-------------|
| J3        | 1   | AGND_OUT    |
| J3        | 2   | PO_GOOD2    |
| J3        | 3   | AGND_OUT    |
| J3        | 4   | PO_GOOD1    |

\* Do not connect

Stud Connector : M4 (Phos. Bronze) **Max. torque=1 N.m ( 8in.Lbs)**

J1 : Molex KK 22-12-4082 Mating connector : Molex KK 22-01-3087

J2,J3,J4 : Molex KK 22-12-4042 Mating connector : Molex KK 22-01-3047





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