

### Features & Benefits

- -55°C Operating Temperature
- Digital Control
- Isolated Wide Input DC-DC Half Brick
- Up to 250 W Output Power
- 90% Efficiency at Full Load
- Input Under Voltage Lockout
- Output Over Voltage Protection
- Output Current Limit
- Short Circuit Protection
- Thermal Shutdown
- Remote ON/OFF Control
- Output Voltage Remote Sense
- Output Voltage Trim Range +10%, -40%

### Compliance

The converter (with a KRFL filter) is designed to meet:

- MIL-STD-461G
- MIL-STD-810G
- MIL-STD-1275D\*
- MIL-HDBK-704-8\*

\*: details in the Standards Compliance table

### Typical Applications

- Military/Defense Power Systems
- Armored Vehicles
- Land Platforms
- Aerospace Platforms
- Communications and Radar Systems
- Medical Systems

| Product Ratings |          |
|-----------------|----------|
| $V_{IN}$        | 9 – 70 V |
| $V_{OUT}$       | 12 V     |
| $I_{OUT}$       | 21 A     |
| $P_{OUT}$       | 250 W    |

### Product Description

KRBM05-DC28WE-P250-DC12-HB is a 250 W DC/DC converter in half-brick size that operates from a nominal 28 V input and generates 12 V isolated output. The converter is fully protected to operate reliably under all kinds of disturbances. The baseplate is designed and manufactured in-house to provide efficient cooling and safe operation at 100 °C base plate temperature.



**Size:** 61.0 x 58.4 x 13.0 mm  
[2.402" x 2.299" x 0.512"]

**Weight:** 150 ± 5 g

## Electrical Characteristics

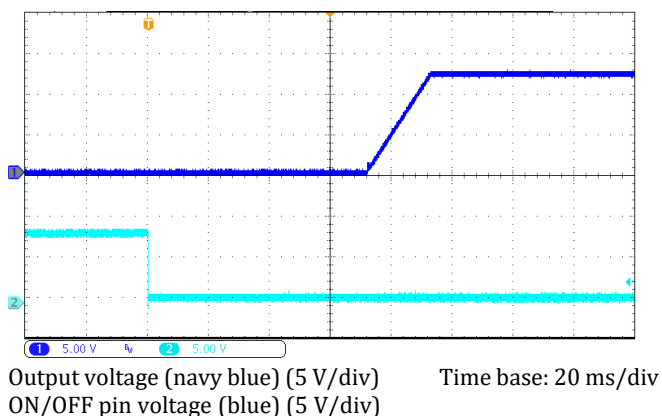
All data are obtained at nominal line and full load unless otherwise specified. (Ta = 25 °C)

| Input Characteristics                  |                                  |     |     |     |      |
|----------------------------------------|----------------------------------|-----|-----|-----|------|
| Parameters                             | Notes & Conditions               | Min | Typ | Max | Unit |
| Non-Operating Input Voltage Range      | Continuous                       | -1  |     | 100 | V    |
| Input Voltage Transient                | 1s transient                     |     |     | 100 | V    |
| Operating Input Voltage Range          |                                  | 9   | 28  | 70  | V    |
| Input Under Voltage Turn-On Threshold  |                                  | 8.8 | 9.2 | 9.6 | V    |
| Input Under Voltage Turn-Off Threshold |                                  | 8.2 | 8.5 | 8.8 | V    |
| No-Load Input Current                  |                                  |     | 340 | 450 | mA   |
| Disabled Input Current                 |                                  |     | 1.3 |     | mA   |
| Input Current Ripple (pk-pk)           |                                  |     | 0.5 | 1   | A    |
| Maximum Input Current                  | At low line and %10 trim up      |     |     | 34  | A    |
| Recommended External Input Capacitance | Typ. ESR 0.3-0.4 Ω; See Figure S |     | 500 |     | μF   |
| Recommended External Input Fuse        | Fast acting                      |     |     | 40  | A    |

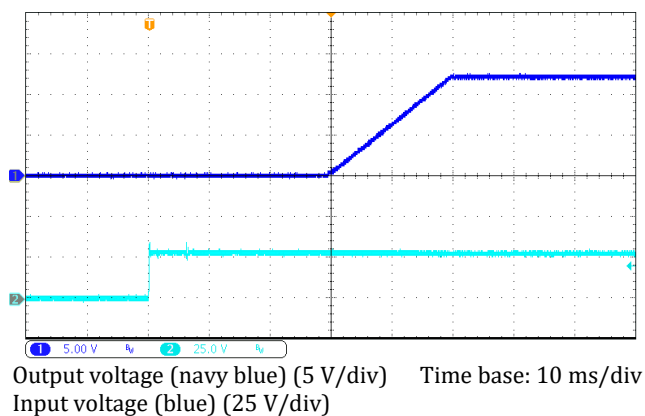
| Output Characteristics                   |                                     |     |       |     |      |
|------------------------------------------|-------------------------------------|-----|-------|-----|------|
| Parameters                               | Notes & Conditions                  | Min | Typ   | Max | Unit |
| Output Voltage                           |                                     |     | 12    |     | V    |
| Output Voltage Set Point                 |                                     |     | ± 1   |     | %    |
| Output Voltage Line Regulation           |                                     |     | ± 0.1 |     | %    |
| Output Voltage Load Regulation           |                                     |     | ± 0.3 |     | %    |
| Output Voltage Ripple and Noise (pk-pk)  | 20 MHz bandwidth                    |     | 80    |     | mV   |
| Operating Output Current Range           |                                     | 0   |       | 21  | A    |
| Output Current Limit                     |                                     | 24  |       |     | A    |
| Output Current Shutdown Limit            |                                     |     | 30    |     | A    |
| Output DC Current-Limit Shutdown Voltage |                                     |     | 6     |     | V    |
| Output Power                             |                                     |     | 250   |     | W    |
| Maximum Output Capacitance               | Nominal output voltage              |     |       | 7   | mF   |
| Input Voltage Transient Response         | 250 V/ms; See Figure B and Figure E |     |       |     |      |
| Step Change                              | 28V to 70V to 28V input voltage     |     | 0.7   |     | V    |
| Settling Time                            | Within 1% output voltage            |     | 1     |     | ms   |
| Load Current Transient Response          | 1 A/μs; See Figure C and Figure F   |     |       |     |      |
| Step Change                              | 50% to 75% to 50% output load       |     | 0.5   |     | V    |
| Settling Time                            | Within 1% output voltage            |     | 2     |     | ms   |
| Output Voltage Trim Range                | Across Sense+ and Sense- Pins       | -40 |       | +10 | %    |
| Recommended External Output Capacitance  | Typ. ESR 0.3-0.4 Ω; See Figure S    |     | 100   |     | μF   |
| Output Over-Voltage Protection           | At nominal output voltage           |     | 14.4  |     | V    |

| General Characteristics                    |                             |     |      |     |                      |
|--------------------------------------------|-----------------------------|-----|------|-----|----------------------|
| Parameters                                 | Notes & Conditions          | Min | Typ  | Max | Unit                 |
| Efficiency                                 | From half load to full load | 87  |      | 90  | %                    |
| Turn-On Transient Time                     | Within 90% output voltage   |     | 50   |     | ms                   |
| Turn-On Transient Output Voltage Overshoot | Maximum output capacitance  |     |      | 1   | %                    |
| Soft-Start Time                            | Within 90% output voltage   |     | 20   |     | ms                   |
| Switching Frequency                        |                             |     | 250  |     | kHz                  |
| Non-Operating ON/OFF Pin Voltage           | Continuous                  | -1  |      | 70  | V                    |
| ON/OFF Control Off-State Voltage           |                             | 0.8 |      |     | V                    |
| ON/OFF Control On-State Voltage            |                             | -1  |      | 0.7 | V                    |
| MTBF                                       | Ground Begin, 30°C Ta       |     | 3214 |     | 10 <sup>3</sup> Hrs. |
|                                            | Ground Fixed, 40°C Ta       |     | 464  |     | 10 <sup>3</sup> Hrs. |
|                                            | Ground Mobile, 45°C Ta      |     | 186  |     | 10 <sup>3</sup> Hrs. |
| Over Temperature Shutdown Trip Point       | Average PCB Temperature     |     | 125  |     | °C                   |
| Over Temperature Shutdown Hysteresis       |                             |     | 15   |     | °C                   |

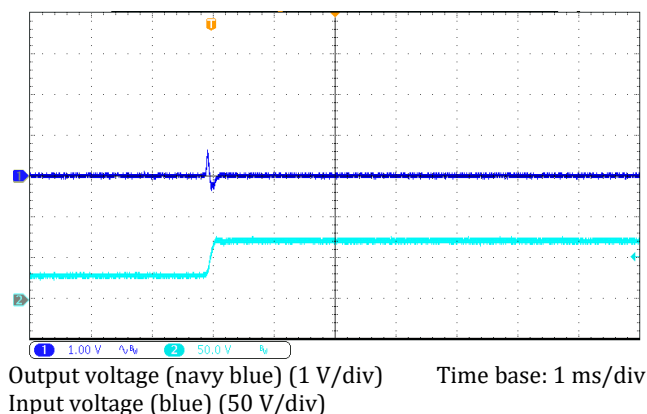
| Standards Compliance         |     |     |      |      |        |
|------------------------------|-----|-----|------|------|--------|
| MIL-STD-1275D                |     |     |      |      |        |
| Parameters                   | Min | Typ | Max  | Unit | Status |
| 5.1.3.1 Steady-State Voltage | 25  | -   | 30   | V    | Passed |
| 5.1.3.2 Ripple               | -   | -   | 2    | V    | Passed |
| 5.1.3.3 Surges               | 28  | -   | 40   | V    | Passed |
| 5.1.4.1 Steady-State Voltage | 23  | -   | 33   | V    | Passed |
| 5.1.4.3 Surges               | 28  | -   | 100  | V    | Passed |
| MIL-HDBK-704-8               |     |     |      |      |        |
| LDC101                       | -   | -   | -    | -    | Passed |
| LDC102                       | 16  | 28  | 40   | V    | Passed |
| LDC105                       | 28  | -   | 100  | V    | Passed |
| LDC201                       | -   | -   | -    | -    | Passed |
| LDC301-704E                  | 20  | -   | 31.5 | V    | Passed |
| LDC302-704E                  | 22  | -   | 50   | V    | Passed |
| LDC401-704E                  | 18  | -   | 29   | V    | Passed |
| LDC501                       | 12  | -   | 29   | V    | Passed |
| LDC601                       | 0   | -   | 28   | V    | Passed |



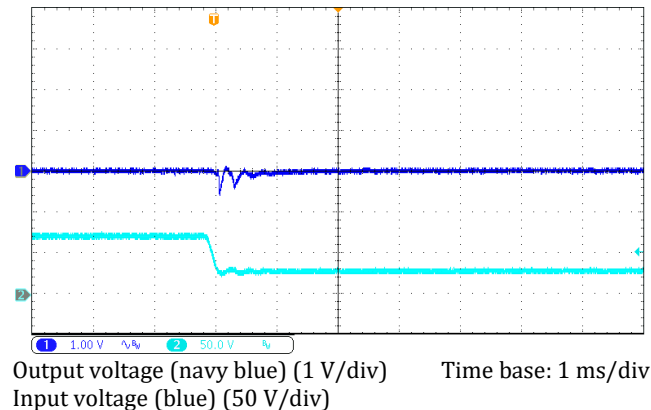
**Figure A.** Startup waveform, input voltage pre-applied at full resistive load with no output capacitor across the load terminals.



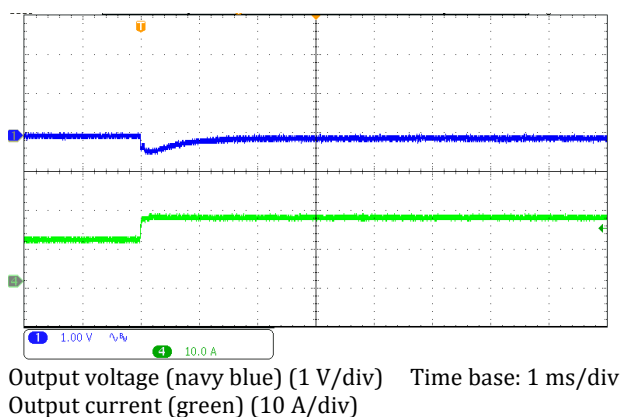
**Figure D.** Turn on transient at full resistive load with no output capacitor across the load terminals.



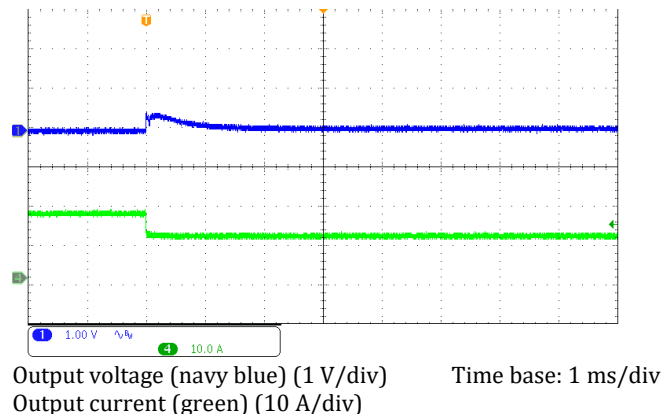
**Figure B.** Input voltage transient response, output voltage (AC Coupled): from 28 V to 70 V with 1  $\mu$ F ceramic and 100  $\mu$ F electrolytic capacitors across the load terminals. Output voltage is AC coupled ( $dV/dt = 250$  V/ms).



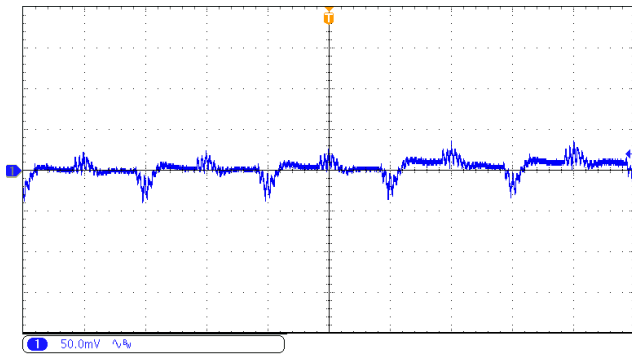
**Figure E.** Input voltage transient response, output voltage (AC Coupled): from 70 V to 28 V with 1  $\mu$ F ceramic and 100  $\mu$ F electrolytic capacitors across the load terminals. Output voltage is AC Coupled ( $dV/dt = 250$  V/ms).



**Figure C.** Load current transient response (AC Coupled): from 50% to 75% with 1  $\mu$ F ceramic and 100  $\mu$ F electrolytic capacitor across the load terminals ( $di/dt = 1$  A/ $\mu$ s).

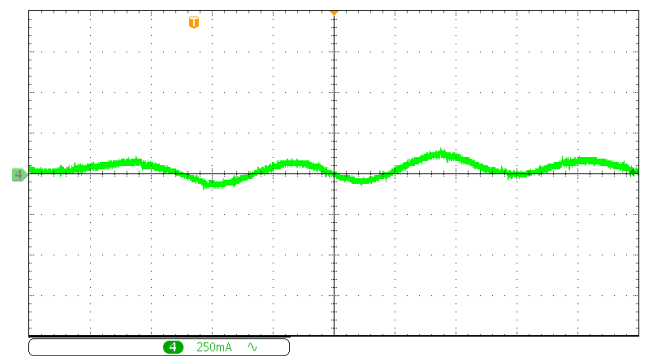


**Figure F.** Load current transient response (AC Coupled): from 75% to 50% load with 1  $\mu$ F ceramic and 100  $\mu$ F electrolytic capacitor across the load terminals ( $di/dt = 1$  A/ $\mu$ s).



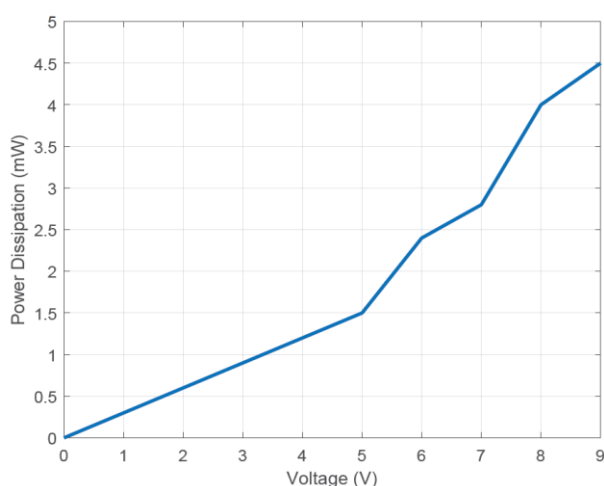
Output voltage ripple (50 mV/div) Time base: 2  $\mu$ s/div

**Figure G.** Output voltage ripple at nominal input voltage and full load current with 1  $\mu$ F ceramic and 100  $\mu$ F electrolytic capacitor across the load terminals. Bandwidth: 20 MHz

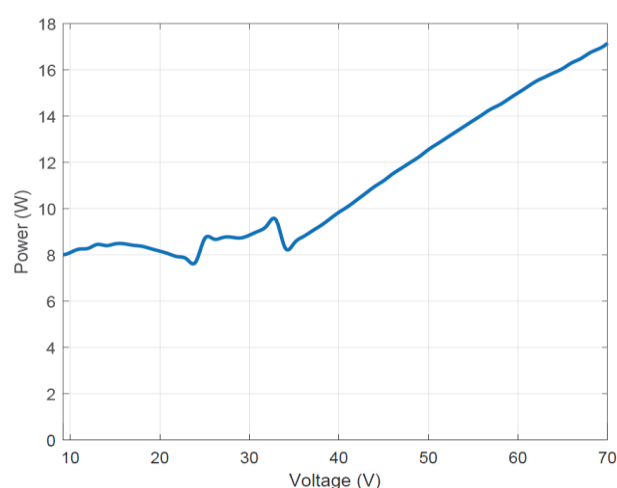


Input current ripple (500 mA/div) Time base: 2  $\mu$ s/div

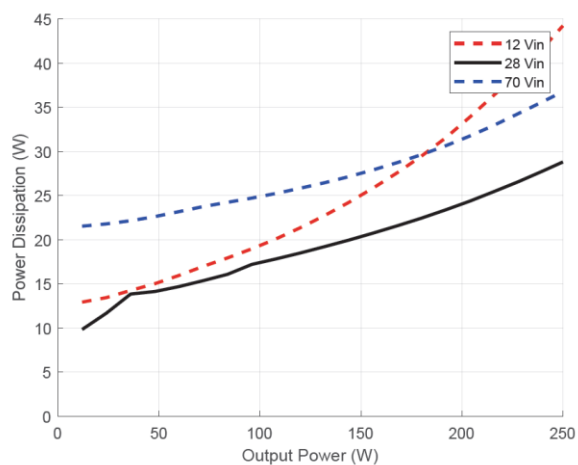
**Figure H.** Input current ripple at nominal input voltage and full load current with 470  $\mu$ F electrolytic capacitor across the input terminals. Bandwidth: 20 MHz



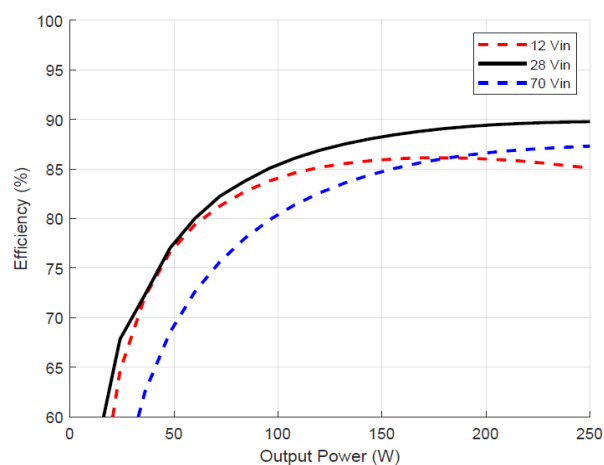
**Figure I.** Disabled power dissipation versus input voltage



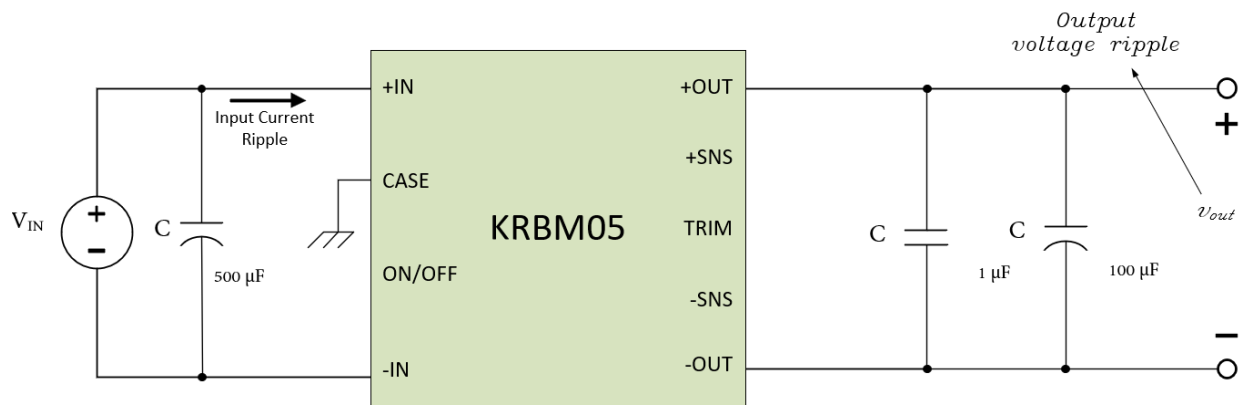
**Figure K.** Enabled power dissipation versus input voltage



**Figure J.** Power dissipation versus output power at minimum, nominal, and maximum input voltage



**Figure L.** Efficiency versus output power at minimum, nominal, and maximum input voltage



**Figure M.** Test set-up showing measurement point for output voltage ripple (**Figure G**).

## Basic Operation and Features

### REMOTE ON/OFF

The ON/OFF input, Pin 2, allows the user to control the ON and OFF states of the module. This input, which is referenced to the return terminal of the input bus (-IN), is held as active high to keep the module in OFF state. If it is pulled down to the return terminal of the input bus (-IN), the converter goes into the ON state. Moreover, the ON/OFF function allows the product to be turned ON/OFF by an external device, like a semiconductor or a mechanical switch.

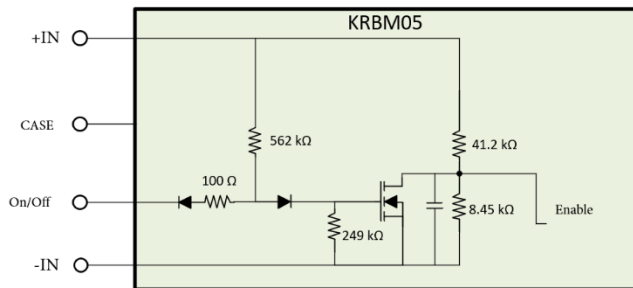


Figure N. Internal ON/OFF circuit

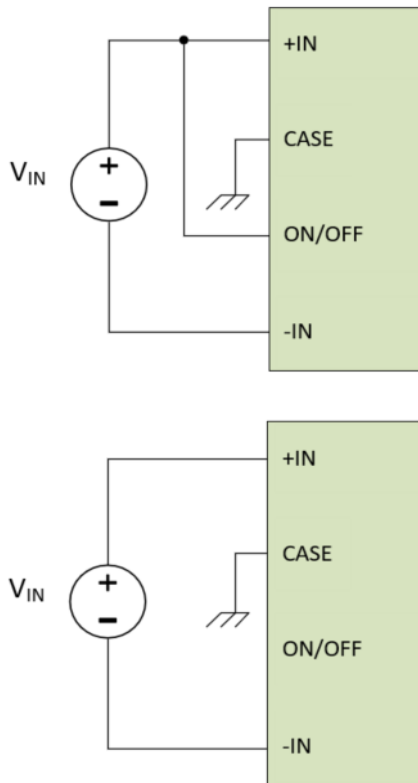


Figure O. Recommended OFF State connections

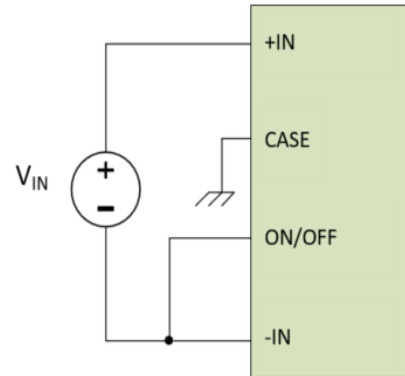


Figure P. Recommended ON state connection

### SENSE

Sense terminals are placed at the load side of the converter module. The sense inputs are used to adjust and fine-tune the output voltage and compensate for any error at the voltage level. If the load is away from the unit, which may require connection over a long pair of cables, connect +SNS and -SNS to the load terminal, respectively, to compensate for the voltage drop across the line.

### OUTPUT VOLTAGE TRIM

The TRIM input feature of the module permits the user to adjust the output voltage across the sense leads up or down according to the trim range. The user should connect a resistor between TRIM and +SNS input to decrease the output voltage.

For a desired decrease of the nominal output voltage, the value of the resistor should be calculated as below.

$$R_{TRIM\_DOWN} = 2.8 \times \frac{(V_{OUTnom} - 2.05 \times V_{OUTdesired})}{(V_{OUTdesired} - V_{OUTnom})} \text{ k}\Omega$$

Output Voltage resulting from inserting a trim-down resistor can be calculated as below.  $R_{TRIM\_DOWN}$  is the trim-down resistor's value in kΩ.

$$V_{generated} = V_{OUTnom} \times \frac{(2.8 + R_{TRIM\_DOWN})}{(5.74 + R_{TRIM\_DOWN})} \text{ V}$$

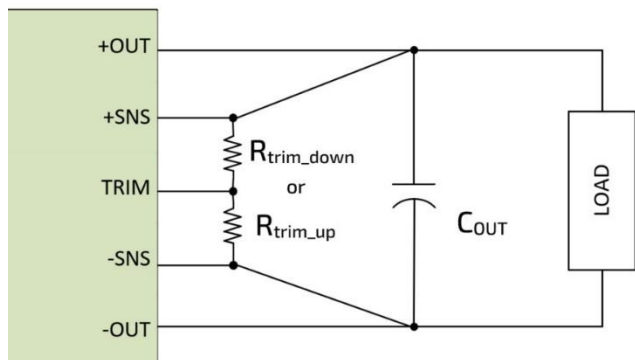
The user should connect a resistor between TRIM and -SNS input to increase the output voltage.

For a desired increase of the nominal output voltage, the value of the resistor should be calculated as below.

$$R_{TRIM\_UP} = \frac{(2.8 \times V_{OUTnom} - 2 \times V_{OUTdesired})}{(V_{OUTdesired} - V_{OUTnom})} \text{ k}\Omega$$

The output voltage resulting from the trim-up resistor can be calculated as below.  $R_{TRIM\_UP}$  is the trim-up resistor's value in kΩ.

$$V_{generated} = V_{OUTnom} \times \frac{(2.8 + R_{TRIM\_UP})}{(2 + R_{TRIM\_UP})} \text{ V}$$



**Figure Q.** Typical trim application circuit

## DROOP CURRENT SHARING

For “droop active” models (part numbers with PR option), output voltage has a 1 V slope from full load to no load. In other words, output voltage of the module is 12.2 V for no load and 11.8 V for full load. This enables safe parallel connection of multiple models.

For the connection diagram, please refer to Figure T. ORing diodes (simple diode or ideal diode) are required for parallel connection.

## PMBUS

PM option field in KOLT Brick Module part numbers indicates I2C capability. I2C digital interface can be used to monitor output parameters.

KRB05 brick module provides a two-wire I2C compatible communication interface that enables host device to monitor device parameters including Output Voltage and Current, Device Temperature and Status.

## I2C PIN DESCRIPTIONS AND RATINGS

| Pin Name        | Absolute Maximum Voltage Ratings |
|-----------------|----------------------------------|
| PMBUS_C2        | 3.6 V                            |
| GND             | 3.6 V                            |
| PMBUS_SDA*      | 3.6 V                            |
| PMBUS_SMBALERT* | 3.6 V                            |
| PMBUS_SCL*      | 3.6 V                            |
| PMBUS_ADDRESS*  | 3.6 V                            |

\*: Internal 10kOhm pull-up resistor to 3.3 V

## I2C SIGNAL SPECIFICATIONS

| Parameter                       | Min  | Typ | Max  | Unit |
|---------------------------------|------|-----|------|------|
| High Level Input Voltage        | 2.64 |     | 3.5  | V    |
| Low Level Input Voltage         | 0    |     | 1    | V    |
| SDA and SCL Bus Capacitive Load |      |     | 400  | pF   |
| Bus Frequency                   |      | 100 |      | kHz  |
| Clock Low Time                  | 4.7  |     |      | μs   |
| Clock High Time                 | 4    |     |      | μs   |
| SDA and SCL Fall Time           |      |     | 300  | ns   |
| SDA and SCL Rise Time           |      |     | 1000 | ns   |
| Data Input Setup Time           | 250  |     |      | ns   |
| Start Condition Setup Time      | 4.7  |     |      | μs   |
| Start Condition Hold Time       | 4.0  |     |      | μs   |
| Stop Condition Setup Time       | 4.0  |     |      | μs   |
| Stop Condition Hold Time        | >0   |     |      | μs   |
| Bus Free Time                   | 4.7  |     |      | μs   |

## I2C READ OPERATION

KRB05 supports 100 kHz bus frequency and always acts as a slave. I2C Master can only read registers of KRB05. Write to registers is not possible. Read register sequence is detailed in Figure R.

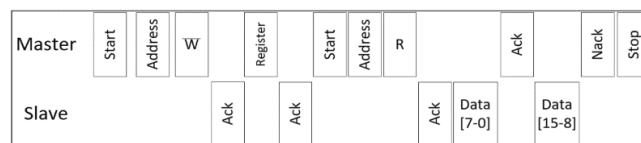


Figure R. Read Register Operation

KRB05 brick modules incorporate internal 10kOhm pull-up resistors to 3.3V on SDA and SCL lines.

Depending on the bus load SDA and SCL lines may require additional pull-up resistors to 2.8 to 3.5V external supply. Absolute maximum capacitive load on SDA and SCL lines are 400pF.

## I2C ID SELECTION

I2C address of device is combination of physical address and Read/Write bit. Default I2C physical address for a KRB05 brick module is 0x2. Alternate physical I2C address of 0x6 is selected when PMBUS\_ADDRESS pin tied to Digital Ground (GND) pin.

| PMBUS_ADDRESS<br>Pin State | I2C Address Byte |       |
|----------------------------|------------------|-------|
|                            | Read             | Write |
| Float                      | 0x3              | 0x2   |
| Tied to GND                | 0x7              | 0x6   |

## I2C REGISTERS

I2C digital interface is used to monitor input, output and status information of converter.

Digital configuration via Write to registers with I2C interface feature for KRB05 brick modules will be implemented in the future.

| Register Address | R/W       | Register Name | Scale Factor | Description                     |
|------------------|-----------|---------------|--------------|---------------------------------|
| 0x79             | Read Only | STS           | -            | Status Register                 |
| 0x8B             | Read Only | VOUT          | 1mV/LSB      | Output Voltage Reading Register |
| 0x8C             | Read Only | IOUT          | 1mA/LSB      | Output Current Reading Register |
| 0x8D             | Read Only | TEMP          | 1 °C/LSB     | Temperature Reading Register    |

### STATUS REGISTER (STS) 0x79

Status Register (0x79) is a 16-bit register containing status information and last logged fault of brick module.

| Status Register (STS) |    |    |     |     |      |     |   |
|-----------------------|----|----|-----|-----|------|-----|---|
| 15                    | 14 | 13 | 12  | 11  | 10   | 9   | 8 |
| Res                   |    |    | LOT | LOC | LREG | Res |   |
| 7                     | 6  | 5  | 4   | 3   | 2    | 1   | 0 |
| Res                   |    |    | OT  | OC  | REG  | Res |   |

Eight least significant bits (LSBs) of STS (0x79) holds status information of the device. If any bit is set to 1, this indicates output is turned off due to fault conditions described in Status Register Fields table.

Eight most significant bits (MSBs) of STS (0x79) holds last fault log since power up. Fault log can only be cleared by powering down the converter or by pulling Remote ON/OFF pin to OFF state.

| Status Register (STS) Fields |       |       |                                                                                                                                                                                       |
|------------------------------|-------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bits                         | Field | Reset | Description                                                                                                                                                                           |
| 0-1                          | Res   | 0     | Reserved                                                                                                                                                                              |
| 2                            | REG   | 0     | Regulation Fault bit<br>1: Output Voltage is lower than "Output DC Current-Limit Shutdown Voltage" or higher than "Output Over Voltage Protection Limit".<br>0: Output Voltage is OK. |
| 3                            | OC    | 0     | Output Over Current Fault bit<br>1: Output Current is higher than "Output Current Shutdown Limit".<br>0: Output Current is in operating limits.                                       |
| 4                            | OT    | 0     | Over Temperature Fault bit<br>1: Temperature is higher than "Over Temperature Shutdown Trip Point".<br>0: Temperature is in operating limits.                                         |
| 5-9                          | Res   | 0     | Reserved                                                                                                                                                                              |
| 10                           | LREG  | 0     | Logged Regulation Fault bit                                                                                                                                                           |
| 11                           | LOC   | 0     | Logged Output Over Current Fault bit                                                                                                                                                  |
| 12                           | LOT   | 0     | Logged Over Temperature Fault bit                                                                                                                                                     |
| 13-15                        | Res   | 0     | Reserved                                                                                                                                                                              |

### OUTPUT VOLTAGE REGISTER (VOUT) 0x8B

Output Voltage Register (0x8B) is a 16-bit register containing unsigned output voltage reading information of brick module. This register has a scale factor of 1 mV/LSB.

| Output Voltage Register (VOUT) |    |    |    |    |    |   |   |
|--------------------------------|----|----|----|----|----|---|---|
| 15                             | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| VOUT [15-8]                    |    |    |    |    |    |   |   |
| 7                              | 6  | 5  | 4  | 3  | 2  | 1 | 0 |
| VOUT [7-0]                     |    |    |    |    |    |   |   |

Lower 8-bit part of VOUT (0x8B) register holds eight least significant bits (LSBs) of output voltage reading.

Upper 8-bit part of VOUT (0x8B) register holds eight most significant bits (MSBs) of output voltage reading.

| Output Voltage Register (VOUT) Fields |       |       |                                                                                                          |
|---------------------------------------|-------|-------|----------------------------------------------------------------------------------------------------------|
| Bits                                  | Field | Reset | Description                                                                                              |
| 0-15                                  | VOUT  | 0     | Output Voltage Reading<br>0 = 0 V<br>1 = 0.001 V<br>.<br>.<br>28000 = 28.0 V<br>.<br>.<br>50000 = 50.0 V |

### OUTPUT CURRENT REGISTER (IOUT) 0x8C

Output Current Register (0x8C) is a 16-bit register containing unsigned output current reading information of brick module. This register has a scale factor of 1 mV/LSB.

| Output Current Register (IOUT) |    |    |    |    |    |   |   |
|--------------------------------|----|----|----|----|----|---|---|
| 15                             | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| IOUT [15-8]                    |    |    |    |    |    |   |   |
| 7                              | 6  | 5  | 4  | 3  | 2  | 1 | 0 |
| IOUT [7-0]                     |    |    |    |    |    |   |   |

Lower 8-bit part of IOUT (0x8C) register holds eight least significant bits (LSBs) of output current reading.

Upper 8-bit part of IOUT (0x8C) register holds eight most significant bits (MSBs) of output current reading.

| Output Current Register (IOUT) Fields |       |       |                                                                                                          |
|---------------------------------------|-------|-------|----------------------------------------------------------------------------------------------------------|
| Bits                                  | Field | Reset | Description                                                                                              |
| 0-15                                  | IOUT  | 0     | Output Current Reading<br>0 = 0 A<br>1 = 0.001 A<br>.<br>.<br>10700 = 10.7 A<br>.<br>.<br>50000 = 50.0 A |

## TEMPERATURE REGISTER (TEMP) 0x8D

Temperature Register (0x8D) is a 16-bit register containing temperature reading information of brick module in twos complement format. This register has a scale factor of 1 °C/LSB

| Temperature Register (TEMP) |    |    |    |    |    |   |   |
|-----------------------------|----|----|----|----|----|---|---|
| 15                          | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| TEMP [15-8]                 |    |    |    |    |    |   |   |
| 7                           | 6  | 5  | 4  | 3  | 2  | 1 | 0 |
| TEMP [7-0]                  |    |    |    |    |    |   |   |

Lower 8-bit part of TEMP (0x8D) register holds eight least significant bits (LSBs) of temperature reading.

Upper 8-bit part of TEMP (0x8D) register holds eight most significant bits (MSBs) of temperature reading.

| Temperature Register (TEMP) Fields |       |       |                                                                                                          |
|------------------------------------|-------|-------|----------------------------------------------------------------------------------------------------------|
| Bits                               | Field | Reset | Description                                                                                              |
| 0-15                               | TEMP  | 0     | Temperature Reading<br>155: 155 °C<br>.<br>.<br>1: 1 °C<br>0: 0 °C<br>65535: -1 °C<br>.<br>65481: -55 °C |

## Protection Features

### Input Under Voltage Lockout

The converter module starts operating when the input voltage is raised above the "Under Voltage Turn-On Threshold." Once turned on, turn off is initiated when the input falls below the "Under Voltage Turn-Off Threshold." The "Module Input Specifications" Table gives the associated limits.

### Output Current Limit

The converter will derate the output voltage if the output current exceeds the "Output Current Limit" value. If the fault condition is resolved, the control output voltage will increase to the nominal value.

### Output Over Voltage Protection

If the output voltage exceeds the "Output Over Voltage-Protection" value the converter outputs are disabled immediately and retries after cooldown period. The "Output Over Voltage Protection Limit" is 120% of Output Voltage. If trim up or down is used protection limit will change according to output voltage setting.

### Output Over Current Protection

If the output current exceeds the "Output Current Shutdown Limit" value the converter outputs are disabled immediately and retries after cooldown period.

### Short Circuit Protection

The short circuit condition is an extreme case of the Output Current Limit condition. When output Voltage drops below "Output DC Current-Limit Shutdown Voltage" limit, the converter outputs are disabled immediately and retries after cooldown period. The "Output DC Current-Limit Shutdown Voltage" is 50% of Output Voltage. If trim up or down is used protection limit will change according to output voltage setting.

### Over Temperature Shutdown

The brick has a thermistor located at the hottest point inside the module. The thermal shutdown circuit is designed to turn the converter off when the temperature at the sensed location goes above the "Over Temperature Shutdown" limit. It locks itself and waits to cool off. The Converter then resumes operation automatically when the temperature of the sensed location falls below the trip point by the amount equal to the "Over Temperature Shutdown Hysteresis."

## Soldering and Cleaning

### Hand Soldering

1. Mounting of brick module should not put mechanical stress on the pins and solder joints. If the brick module will be fixed to an immovable surface, soldering should be done after the brick module is screwed to surface.
2. Tip temperature of soldering iron should not exceed 430 °C. Recommended soldering durations and soldering iron temperature are detailed in table below.

| Pin Type                     | Soldering Duration (range) | Soldering Temperature °C (range) |
|------------------------------|----------------------------|----------------------------------|
| PMBUS                        | 3-5                        | 330-390                          |
| Power                        | 5-8                        | 330-430                          |
| Remote ON/OFF, TRIM, SENSE ± | 4-6                        | 330-410                          |

3. Soldering the brick module longer periods of time and at higher temperatures may result in damage to the brick module.

### Wave Soldering Profile

1. Bottom side preheaters: Zone 1: 180 °C, Zone 2: 150 °C, Zone 3: 360 °C
2. Top side preheaters: Zone 1: 105-115 °C
3. Wave Temperature: 265 °C
4. Wave type: 108 mm standard laminar wave

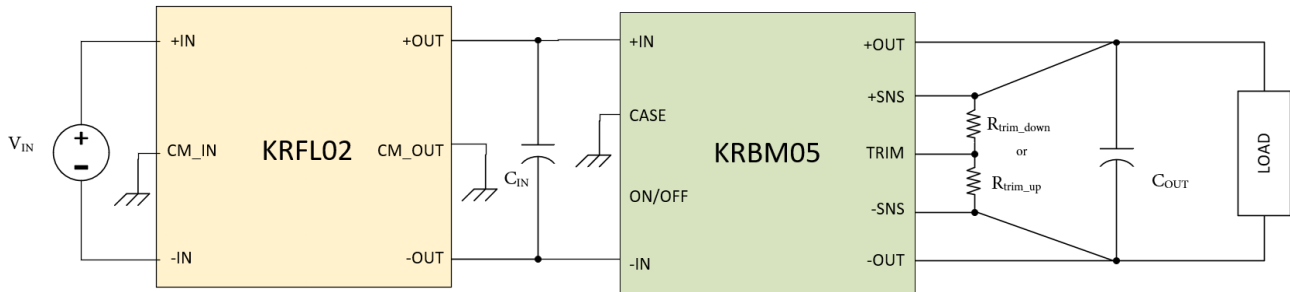
### Cleaning

1. Brick modules are not sealed and exposure to liquid may result in damage to the brick module.
2. If PCB needs to be exposed aqueous wash after soldering, surface mount or through-hole sockets are recommended for mounting the brick modules after cleaning process.

### De-soldering

1. Brick modules should not be re-used after de-soldering. De-soldering may cause mechanical and thermal stresses to damage brick module. KOLT does not guarantee reusability of brick modules after de-soldering

## Application Considerations

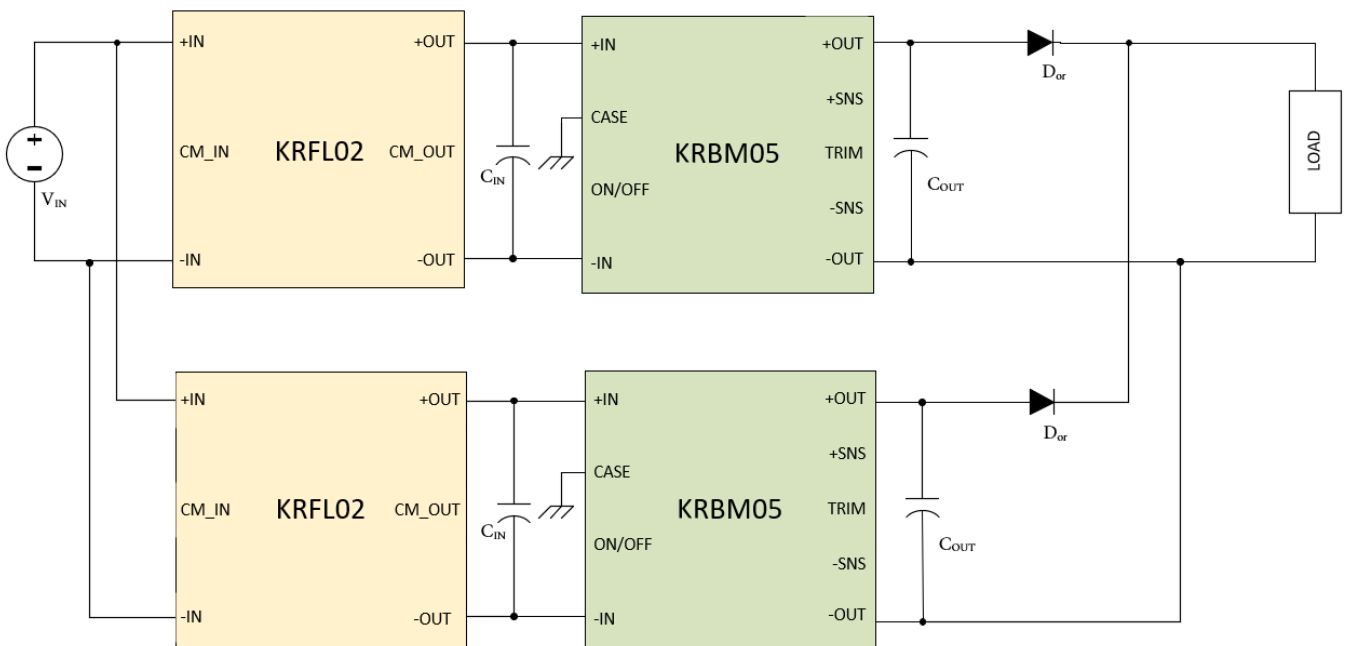


**Figure S.** Typical application

**NOTE:** If the output voltage is to be used in its default state, there is no need to use trim resistors.

**C<sub>IN</sub>:** 5 parallel 160SGV100M18x16.5 (100uF 160V Aluminum- Electrolytic Capacitor)

**C<sub>OUT</sub>:** EEE-FTH101XAP (100uF 50V Aluminum- Electrolytic Capacitor)



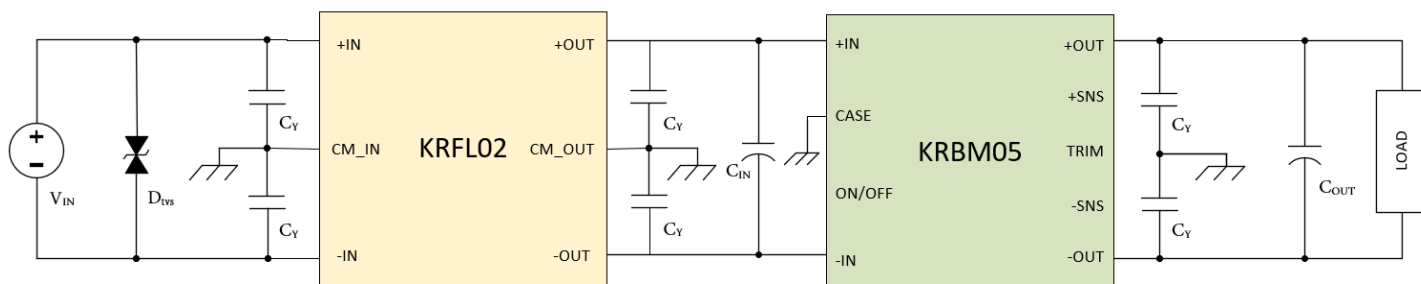
**Figure T.** Recommended application N+1 redundant parallel connection

CM\_IN and CM\_OUT of KRFL02 should be connected to the chassis.

**C<sub>IN</sub>:** 5 parallel 160SGV100M18x16.5 (100uF 160V Aluminum- Electrolytic Capacitor)

**C<sub>OUT</sub>:** EEE-FTH101XAP (100uF 50V Aluminum- Electrolytic Capacitor)

**D<sub>or</sub>:** Can be either an ORing diode or ideal diode driver circuit



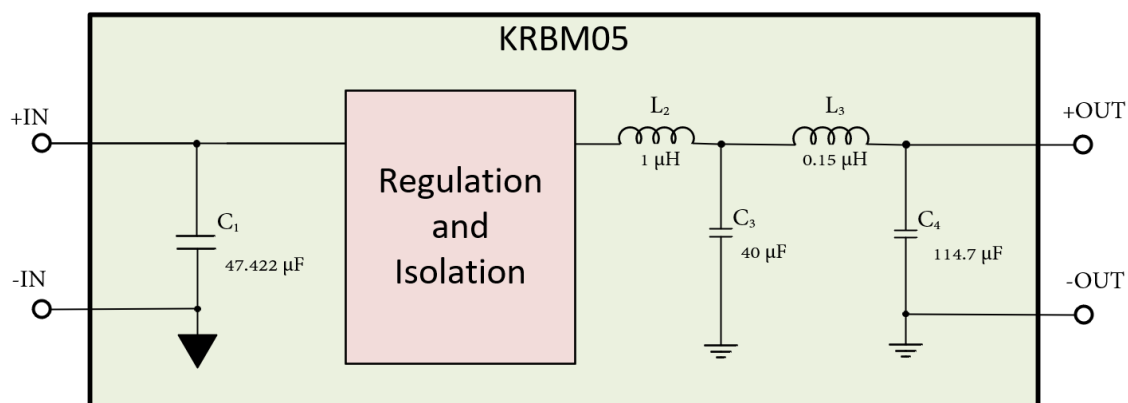
**Figure U.** Recommended Application for better EMI/EMC compliance

**C<sub>Y</sub>:** CHV1206N2K0472KXT (4700 pF 2kV X7R Ceramic Capacitor)

**C<sub>IN</sub>:** : 5 parallel 160SGV100M18x16.5 (100uF 160V Aluminum-Electrolytic Capacitor)

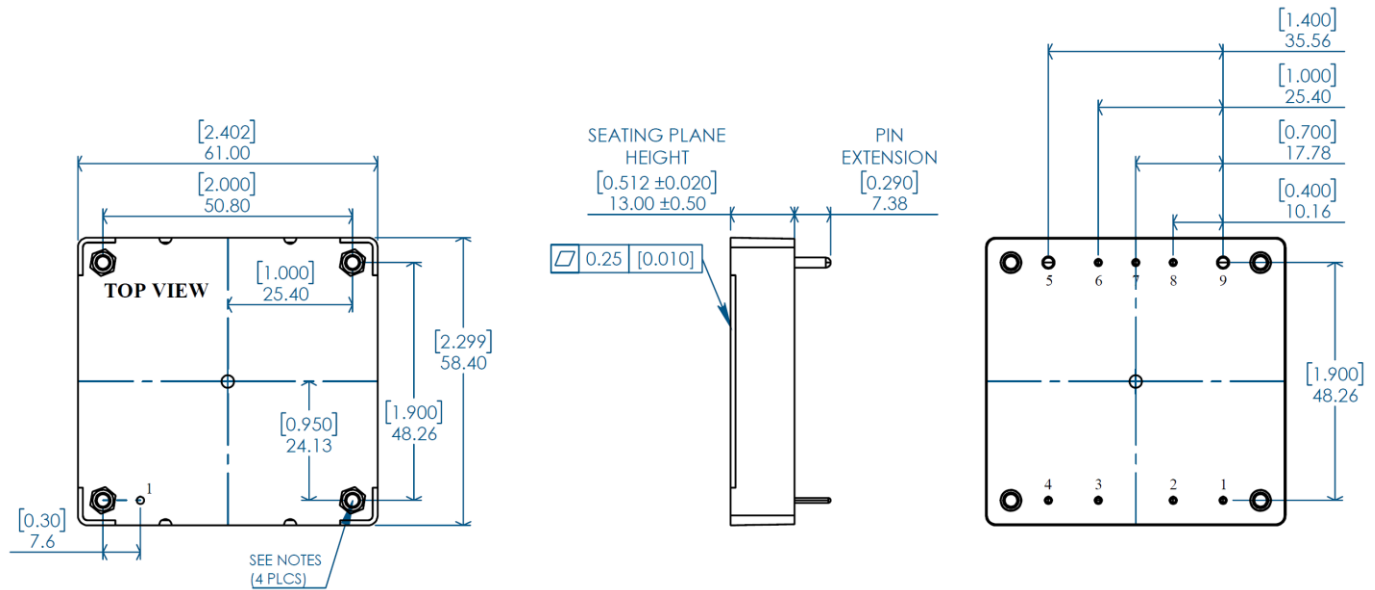
**C<sub>OUT</sub>:** EEE-FTH101XAP (100uF 50V Aluminum-Electrolytic Capacitor)

**D<sub>TVS</sub>:** 5.0SMDJ40CA (Bi-directional 40Vwm TVS Diode)



**Figure V.** Internal input and output filter diagram of KRBM05

### Mechanical Drawing – Threaded



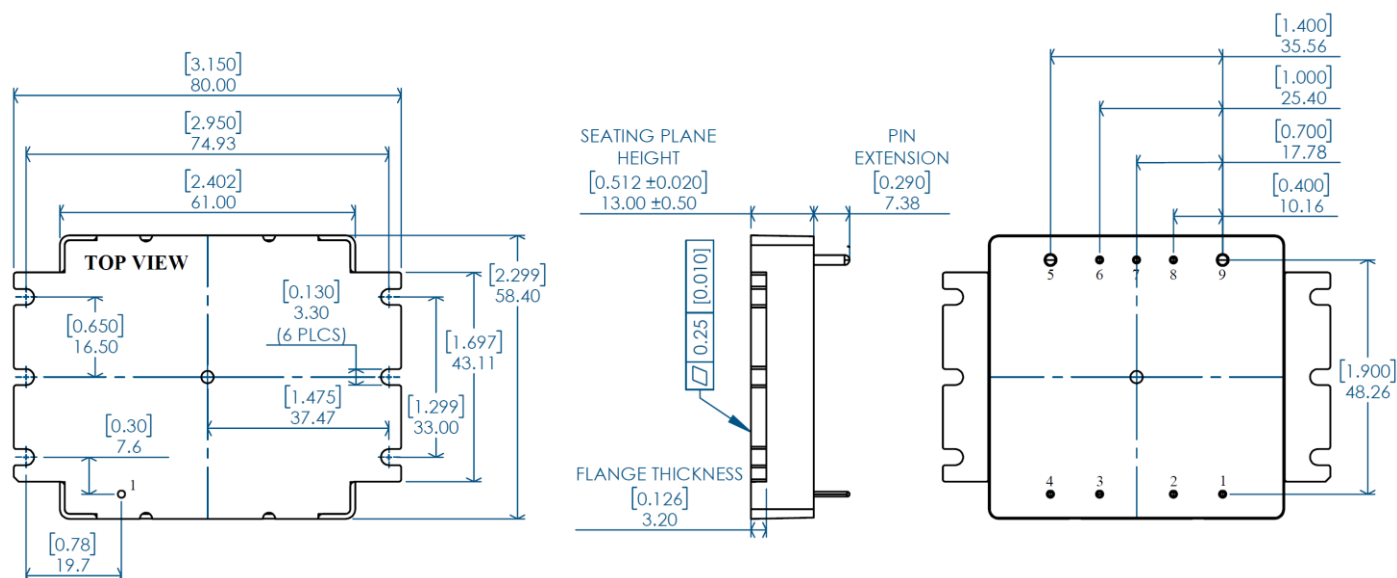
#### NOTES:

- APPLIED TORQUE PER M3 SCREW 0.45Nm (4in-lb) RECOMMENDED [0.56Nm (5in-lb) LIMIT]. M3 SCREW SHOULD NOT EXCEED 6mm (0.236") DEPTH BELOW THE SURFACE OF THE BASEPLATE.
- BASEPLATE FLATNESS TOLERANCE IS 0.25mm (0.010") TIR FOR SURFACE.
- PINS 1-4 AND 6-8 ARE 1.02mm DIA. (0.040") WITH 1.83mm DIA. (0.072") STANDOFFS.
- PINS 5 AND 9 ARE 2.03mm DIA. (0.080") WITH 3.18mm DIA. (0.125") STANDOFFS.
- PINS 1-9
- MATERIAL: BRASS ALLOY
- FINISH: 10μ" GOLD OVER NICKEL
- WEIGHT: 151.4 g (5.34 oz)
- ALL DIMENSIONS IN MILLIMETERS [inches]
- TOLERANCES: X.Xmm ± 0.5mm (X.XXIN ± 0.020)  
X.XXmm ± 0.25mm (X.XXXIN ± 0.010)

| Pin | Name   | Function                         |
|-----|--------|----------------------------------|
| 1   | +IN    | Positive input voltage           |
| 2   | ON/OFF | Remote on/off, referenced to -IN |
| 3   | CASE   | Chassis connection               |
| 4   | -IN    | Input return                     |
| 5   | -OUT   | Output return                    |
| 6   | -SNS   | Negative remote sense            |
| 7   | TRIM   | Output voltage trim              |
| 8   | +SNS   | Positive remote sense            |
| 9   | +OUT   | Positive output voltage          |



### Mechanical Drawing – Flanged



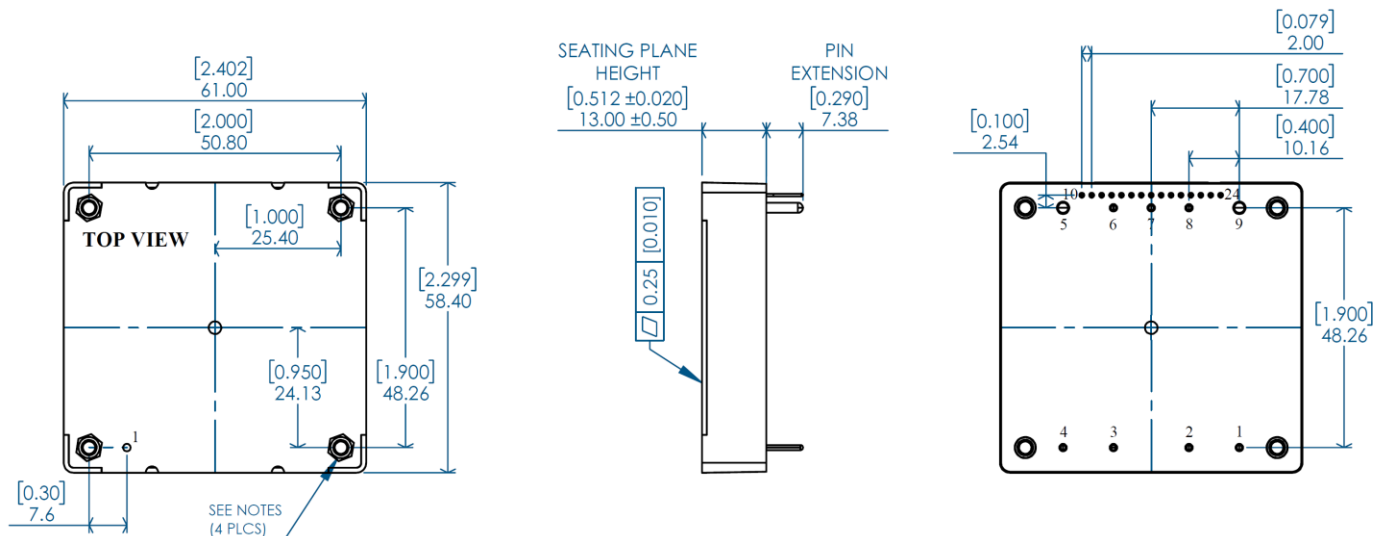
#### NOTES:

- APPLIED TORQUE PER M3 SCREW 0.45Nm (4in-lb) RECOMMENDED [0.56Nm (5in-lb) LIMIT].
- BASEPLATE FLATNESS TOLERANCE IS 0.25mm (0.010") TIR FOR SURFACE.
- PINS 1-4 AND 6-8 ARE 1.02mm DIA. (0.040") WITH 1.83mm DIA. (0.072") STANDOFFS.
- PINS 5 AND 9 ARE 2.03mm DIA. (0.080") WITH 3.18mm DIA. (0.125") STANDOFFS.
- PINS 1-9
- MATERIAL: BRASS ALLOY
- FINISH: 10μ" GOLD OVER NICKEL
- WEIGHT: 165.0 g (5.82 oz)
- ALL DIMENSIONS IN MILLIMETERS [inches]
- TOLERANCES: X.Xmm ± 0.5mm (X.XXIN ± 0.020)
- X.XXmm ± 0.25mm (X.XXXIN ± 0.010)

| Pin | Name   | Function                         |
|-----|--------|----------------------------------|
| 1   | +IN    | Positive input voltage           |
| 2   | ON/OFF | Remote on/off, referenced to -IN |
| 3   | CASE   | Chassis connection               |
| 4   | -IN    | Input return                     |
| 5   | -OUT   | Output return                    |
| 6   | -SNS   | Negative remote sense            |
| 7   | TRIM   | Output voltage trim              |
| 8   | +SNS   | Positive remote sense            |
| 9   | +OUT   | Positive output voltage          |



### Mechanical Drawing – Threaded & PMBUS Capable



#### NOTES:

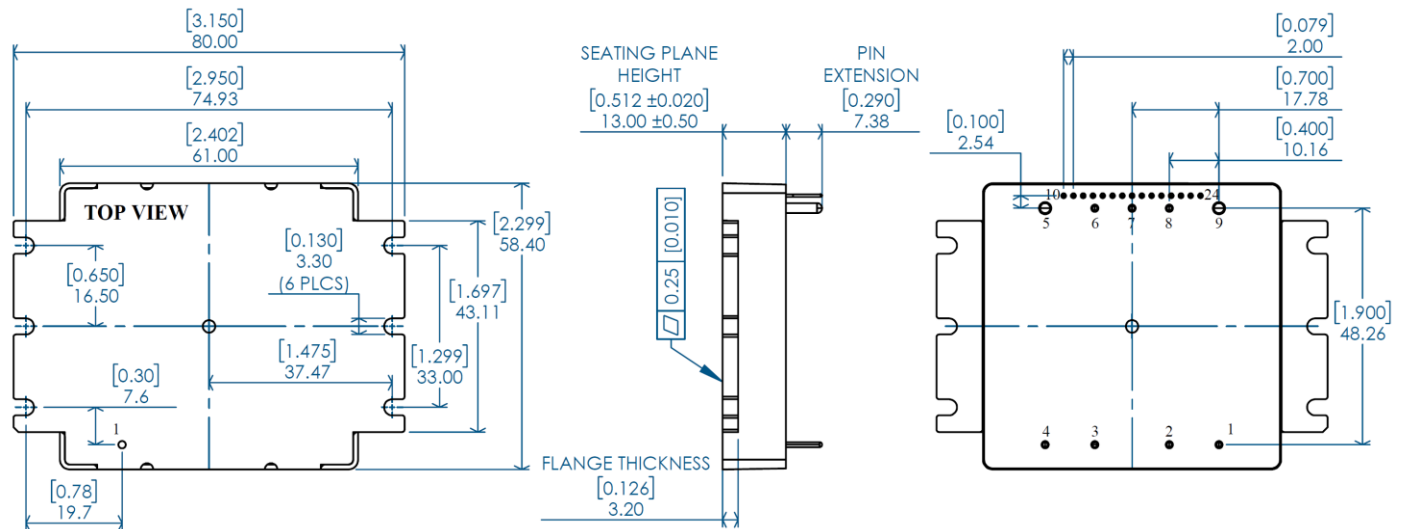
- APPLIED TORQUE PER M3 SCREW 0.45Nm (4in-lb) RECOMMENDED [0.56Nm (5in-lb) LIMIT]. M3 SCREW SHOULD NOT EXCEED 6mm (0.236") DEPTH BELOW THE SURFACE OF THE BASEPLATE.
- BASEPLATE FLATNESS TOLERANCE IS 0.25mm (0.010") TIR FOR SURFACE.
- PINS 1-4 AND 6-8 ARE 1.02mm DIA. (0.040") WITH 1.83mm DIA. (0.072") STANDOFFS.
- PINS 5 AND 9 ARE 2.03mm DIA. (0.080") WITH 3.18mm DIA. (0.125") STANDOFFS.
- PM OPTION PINS 10-24 ARE 0.50mm x 0.50mm SQUARE
- PINS 1-9  
MATERIAL: BRASS ALLOY  
FINISH: 10μ" GOLD OVER NICKEL
- PM OPTION PINS 10-24  
MATERIAL: PHOSPHOR BRONZE  
FINISH: 10μ" GOLD OVER NICKEL
- WEIGHT: 152.25 g (5.37 oz)
- ALL DIMENSIONS IN MILLIMETERS [inches]
- TOLERANCES: X.Xmm ±0.5mm (X.XXIN ±0.020)  
X.XXmm ±0.25mm (X.XXXIN ±0.010)

| Pin | Name           | Function                         |
|-----|----------------|----------------------------------|
| 1   | +IN            | Positive input voltage           |
| 2   | ON/OFF         | Remote on/off, referenced to -IN |
| 3   | CASE           | Chassis connection               |
| 4   | -IN            | Input return                     |
| 5   | -OUT           | Output return                    |
| 6   | -SNS           | Negative remote sense            |
| 7   | TRIM           | Output voltage trim              |
| 8   | +SNS           | Positive remote sense            |
| 9   | +OUT           | Positive output voltage          |
| 10  | SYNCH          | Active Current Synchronization   |
| 11* | DATA-          | RS485 Data-                      |
| 12* | DATA+          | RS485 Data+                      |
| 13* | PMBUS_C2       | I2C Control                      |
| 14* | GND            | Digital Ground                   |
| 15* | PMBUS_SDA      | I2C Data                         |
| 16* | PMBUS_SMBALERT | I2C slave to master alert        |
| 17* | PMBUS_SCL      | I2C Clock                        |
| 18* | PMBUS_ADDRESS  | I2C address selection            |
| 19* | NC             | No-connect                       |
| 20* | NC             | No-connect                       |
| 21* | NC             | No-connect                       |
| 22* | NC             | No-connect                       |
| 23* | NC             | No-connect                       |
| 24* | NC             | No-connect                       |

\*: AVAILABLE ON PMBUS OPTION



### Mechanical Drawing – Flanged & PMBUS Capable



#### NOTES:

- APPLIED TORQUE PER M3 SCREW 0.45Nm (4in-lb) RECOMMENDED [0.56Nm (5in-lb) LIMIT].
- BASEPLATE FLATNESS TOLERANCE IS 0.25mm (0.010") TIR FOR SURFACE.
- PINS 1-4 AND 6-8 ARE 1.02mm DIA. (0.040") WITH 1.83mm DIA. (0.072") STANDOFFS.
- PINS 5 AND 9 ARE 2.03mm DIA. (0.080") WITH 3.18mm DIA. (0.125") STANDOFFS.
- PM OPTION PINS 10-24 ARE 0.50mm x 0.50mm SQUARE
- PINS 1-9
- MATERIAL: BRASS ALLOY
- FINISH: 10μ" GOLD OVER NICKEL
- PM OPTION PINS 10-24
- MATERIAL: PHOSPHOR BRONZE
- FINISH: 10μ" GOLD OVER NICKEL
- WEIGHT: 165.0 g (5.82 oz)
- ALL DIMENSIONS IN MILLIMETERS [inches]
- TOLERANCES: X.Xmm ±0.5mm (X.XXIN ±0.020)  
X.XXmm ±0.25mm (X.XXXIN ±0.010)

| Pin | Name           | Function                         |
|-----|----------------|----------------------------------|
| 1   | +IN            | Positive input voltage           |
| 2   | ON/OFF         | Remote on/off, referenced to -IN |
| 3   | CASE           | Chassis connection               |
| 4   | -IN            | Input return                     |
| 5   | -OUT           | Output return                    |
| 6   | -SNS           | Negative remote sense            |
| 7   | TRIM           | Output voltage trim              |
| 8   | +SNS           | Positive remote sense            |
| 9   | +OUT           | Positive output voltage          |
| 10  | SYNCH          | Active Current Synchronization   |
| 11* | DATA-          | RS485 Data-                      |
| 12* | DATA+          | RS485 Data+                      |
| 13* | PMBUS_C2       | I2C Control                      |
| 14* | GND            | Digital Ground                   |
| 15* | PMBUS_SDA      | I2C Data                         |
| 16* | PMBUS_SMBALERT | I2C slave to master alert        |
| 17* | PMBUS_SCL      | I2C Clock                        |
| 18* | PMBUS_ADDRESS  | I2C address selection            |
| 19* | NC             | No-connect                       |
| 20* | NC             | No-connect                       |
| 21* | NC             | No-connect                       |
| 22* | NC             | No-connect                       |
| 23* | NC             | No-connect                       |
| 24* | NC             | No-connect                       |

\*: AVAILABLE ON PMBUS OPTION



## Part Ordering Information

| Family | Input Voltage      | Power         | Output Voltage | Package          | Option Field                                |
|--------|--------------------|---------------|----------------|------------------|---------------------------------------------|
| KRBM05 | DC28WE<br>9-70 VDC | P250<br>250 W | DC12<br>12 VDC | HB<br>Half Brick | F: Flanged<br>PM: PMBUS<br>PR: Droop Active |

| Ordering Number                     | Baseplate | Communication                                       | Droop   |
|-------------------------------------|-----------|-----------------------------------------------------|---------|
| KRBM05-DC28WE-P250-DC12-HB          | Threaded  | No communication capability, PMBUS pins are absent. | Passive |
| KRBM05-DC28WE-P250-DC12-HB-F        | Flanged   | No communication capability, PMBUS pins are absent. | Passive |
| KRBM05-DC28WE-P250-DC12-HB-PR       | Threaded  | No communication capability, PMBUS pins are absent. | Active  |
| KRBM05-DC28WE-P250-DC12-HB-F-PR     | Flanged   | No communication capability, PMBUS pins are absent. | Active  |
| KRBM05-DC28WE-P250-DC12-HB-PM       | Threaded  | With PMBUS communication capability                 | Passive |
| KRBM05-DC28WE-P250-DC12-HB-F-PM     | Flanged   | With PMBUS communication capability                 | Passive |
| KRBM05-DC28WE-P250-DC12-HB-PM-PR    | Threaded  | With PMBUS communication capability                 | Active  |
| KRBM05-DC28WE-P250-DC12-HB-F-PM -PR | Flanged   | With PMBUS communication capability                 | Active  |

## Revision History

| Document Number | Revision | Date       | Description     | Page Number(s) |
|-----------------|----------|------------|-----------------|----------------|
| 110265          | 01       | 20.03.2025 | Initial Release | -              |

## Contact Us

**KOLT Türkiye**

salesturkiye@koltpower.com

KOLT Muhendislik A.S.

Serhat Mah. 1148. Sok.  
No:1B/1 Yenimahalle, Ankara 06374

Türkiye

[www.kolt.com.tr](http://www.kolt.com.tr)**KOLT Europe**

saleseurope@koltpower.com

KOLT Power Ltd.

Fareham Innovation Centre Merlin House, 4 Meteor way,  
Daedalus Drive, Fareham, Lee-On-Solent PO13 9FU

United Kingdom

[www.koltpower.com](http://www.koltpower.com)

The information provided in this datasheet is believed to be accurate and reliable. However, KOLT assumes no responsibility for any consequences arising from its use, nor for any infringement of patents or other rights of third parties that may result from its use. These products are sold only under KOLT's general terms and conditions of sale, unless otherwise specified in writing. Specifications are subject to change without notice. All rights reserved.