

Features

Regulated Converters

- Reinforced Insulation for 250VAC Working Voltage
- Clearance and Creepage Distance: 8mm
- 5kVAC I/P to O/P 2MOPP Isolation
- 2µA Patient Leakage Current
- Industry Standard Pinout
- 2:1 and 4:1 Wide Input Range

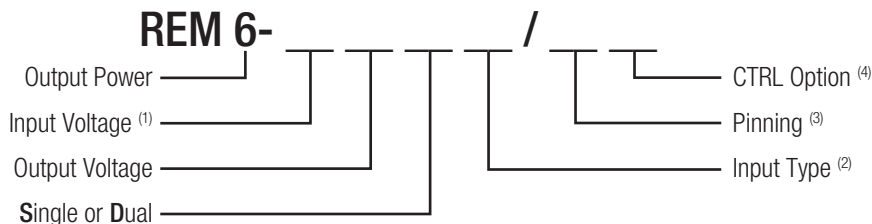
Description

The REM6 series of medical grade regulated DC/DC converters feature reinforced 5kVAC/1 minute isolation with low 2µA leakage and are 60601-1 3rd Ed. certified for 250VAC continuous working. The compact DIP24 package offers tightly regulated single and dual outputs, even under no-load conditions. The outputs are short circuit and overload protected. The converters are available in two different pinning options and optionally with an external control pin for standby consumption as low as 12.5mW. The converters are fully certified to CB, IEC/EN and ANSI/AAMI standards and carry the CE and UL marks.

Selection Guide

| Part Number | Input Voltage Range (VDC) | Output Voltage (VDC) | Output Current (mA) | Efficiency typ. (%) | Max. Capacitive Load (µF) |
|----------------|------------------------------|----------------------|---------------------|---------------------------|---------------------------|
| REM6-xx3.3S/* | 4.5-9 / 9-18 / 18-36 / 36-75 | 3.3 | 1800 | 81.5 / 83.5 / 83 / 82.5 | 2100 |
| REM6-xx05S/* | 4.5-9 / 9-18 / 18-36 / 36-75 | 5 | 1200 | 86 / 86 / 86 / 86.5 | 1500 |
| REM6-xx12S/* | 4.5-9 / 9-18 / 18-36 / 36-75 | 12 | 500 | 86 / 89 / 89 / 88 | 260 |
| REM6-xx15S/* | 4.5-9 / 9-18 / 18-36 / 36-75 | 15 | 400 | 87.5 / 88.5 / 88.5 / 88.5 | 210 |
| REM6-xx24S/* | 4.5-9 / 9-18 / 18-36 / 36-75 | 24 | 250 | 87 / 88.5 / 88.5 / 88 | 75 |
| REM6-xx05D/* | 4.5-9 / 9-18 / 18-36 / 36-75 | ±5 | ±600 | 84 / 85 / 85 / 85 | ±860 |
| REM6-xx12D/* | 4.5-9 / 9-18 / 18-36 / 36-75 | ±12 | ±250 | 86.5 / 89 / 88.5 / 88 | ±150 |
| REM6-xx15D/* | 4.5-9 / 9-18 / 18-36 / 36-75 | ±15 | ±200 | 87.5 / 88 / 88.5 / 87 | ±110 |
| REM6-xx3.3SW/* | 9-36 / 18-75 | 3.3 | 1800 | 83 / 82.5 | 2100 |
| REM6-xx05SW/* | 9-36 / 18-75 | 5 | 1200 | 86 / 86.5 | 1500 |
| REM6-xx12SW/* | 9-36 / 18-75 | 12 | 500 | 89 / 88 | 260 |
| REM6-xx15SW/* | 9-36 / 18-75 | 15 | 400 | 89 / 88.5 | 210 |
| REM6-xx24SW/* | 9-36 / 18-75 | 24 | 250 | 88.5 / 88 | 75 |
| REM6-xx05DW/* | 9-36 / 18-75 | ±5 | ±600 | 85 / 85 | ±860 |
| REM6-xx12DW/* | 9-36 / 18-75 | ±12 | ±250 | 88.5 / 88 | ±150 |
| REM6-xx15DW/* | 9-36 / 18-75 | ±15 | ±200 | 88.5 / 87 | ±110 |

Model Numbering



Notes:

Note1: for 4:1 Input Voltage Type add "W", see Note 2.

| 2:1 | | 4:1 "W" | |
|---------------|--------|--------------|--------|
| xx= 4.5-9 Vin | = "05" | xx= 9-36Vin | = "24" |
| xx= 9-18Vin | = "12" | xx= 18-75Vin | = "48" |
| xx= 18-36Vin | = "24" | | |
| xx= 36-75Vin | = "48" | | |

Note2: Blank for Standard 2:1 Input Voltage Range; „W" suffix for 4:1 Input Voltage Range

Note3: „A" suffix for A pinning; „C" suffix for C pinning, for more details refer to Package Style and Pinning

Note4: „CTRL" suffix for control pin option, for A pinning only, for C pinning not available

Examples:

| | | | | | | |
|--------------------|---|------------|-----------|----------|-------------|---------------------|
| REM6-0512D/A | = | 2:1 Input, | 4.5-9Vin, | ±12Vout, | pinout „A", | without control pin |
| REM6-1215S/C | = | 2:1 Input, | 9-18Vin, | 15Vout, | pinout „C", | without control pin |
| REM6-4815SW/A/CTRL | = | 4:1 Input, | 36-75Vin, | 15Vout, | pinout „A" | with control pin |
| REM6-243.3SW/C | = | 4:1 Input, | 9-36Vin, | 3.3Vout, | pinout „C", | without control pin |

REM6

6 Watt

2:1 & 4:1

DIP24

Single and Dual Output



2MOPP 250VAC



- UL-60950-1 (Pending)
- EN-55011 (Pending)
- EN-55022 (Pending)
- IEC/EN-60950-1 (Pending)
- IEC/EN-60601-1 (Pending)

Specifications (measured at TA= 25°C, nominal input voltage, full load and after warm-up)

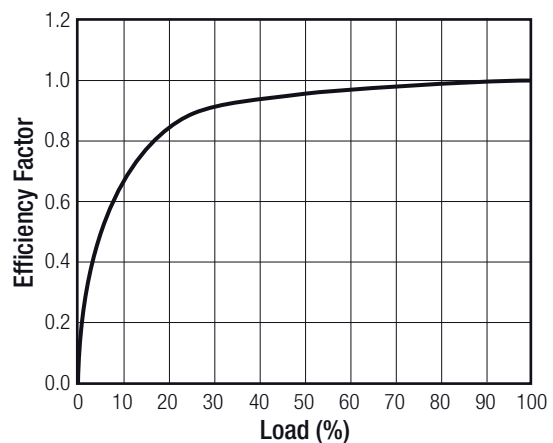
| BASIC CHARACTERISTICS | | | | | |
|---|--|-------------------------------|------------------|---------|--------|
| Parameter | Condition | | Min. | Typ. | Max. |
| Absolute Maximum Input Voltage (3sec max.) | 2:1 | 5Vin nom. | | | 16VDC |
| | | 12Vin nom. | | | 25VDC |
| | 4:1 | 24Vin nom. | | | 50VDC |
| | | 48Vin nom. | | | 100VDC |
| Under Voltage Lockout | 2:1 | 5Vin nom. | 4VDC | | 4.5VDC |
| | | 12Vin nom. | 8VDC | | 9VDC |
| | 4:1 | 24Vin nom. | 16VDC | | 18VDC |
| | | 48Vin nom. | 33VDC | | 36VDC |
| Start-up Time | constant resistive load, Power up or Remote ON/OFF | 24Vin nom. | 8VDC | | 9VDC |
| | | 48Vin nom. | 16VDC | | 18VDC |
| Remote ON/OFF (referenced to -Vin Pin) | DC-DC ON | | Open or 0-1.2VDC | | |
| | DC-DC OFF | | 2.2-12VDC | | |
| Current of CTRL Pin | | | -0.5mA | | 1mA |
| Remote OFF Input Current | | | | 2.5mA | |
| Operating Frequency | | | 225kHz | 250kHz | 275kHz |
| Output Ripple and Noise (20MHz BW limited) | 10µF/25V 7XR MLCC for 3.3, 5Vout 12, 15Vout | | | 30mVp-p | |
| | | 4.7µF/50V X7R MLCC for 24Vout | | 40mVp-p | |
| | | | | 50mVp-p | |

Efficiency

Table1 : Efficiency Crosstable

Graph1 : Efficiency Factor vs. Load

| Efficiency Crosstable (%) @ full load | | | | | | | |
|---------------------------------------|------|---------------|------|------|------|------|------|
| | | Input Voltage | | | | | |
| | | 5 | 12 | 24 | 48 | 24W | 48W |
| Output Voltage | 3.3S | 81.5 | 83.5 | 83 | 82.5 | 83 | 82.5 |
| | 05S | 86 | 86 | 86 | 86.5 | 86 | 86.5 |
| | 12S | 86 | 89 | 89 | 88 | 89 | 88 |
| | 15S | 87.5 | 88.5 | 89 | 88.5 | 89 | 88.5 |
| | 24S | 87 | 88.5 | 88.5 | 88 | 88.5 | 88 |
| | 05D | 84 | 85 | 85 | 85 | 85 | 85 |
| | 12D | 86.5 | 89 | 88.5 | 88 | 88.5 | 88 |
| | 15D | 87.5 | 88 | 88.5 | 87 | 88.5 | 87 |



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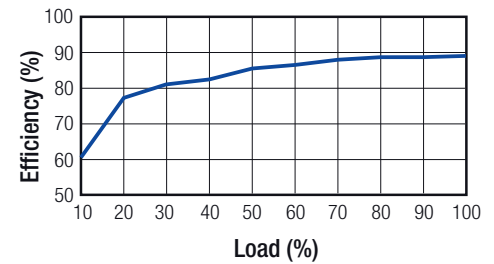
Specifications (measured at T_A= 25°C, nominal input voltage, full load and after warm-up)

Calculation Example:

choose your model:

REM6-1212D

- Efficiency from Table1 (= 89% @ max Load / nom Vin)
- Loading conditions in application (e.g. 50%)
- use Eff factor from Graph1 (= 0.96 @50%)



Calculation:

V_{in} = 12V
 I_{out} = 50%
 Eff_{100%} = 89%
 Eff_{factor50%} = 0.96
 R_{th} = 18°C/W
 T_{CASEmax} = 105°C

$$Eff_{50\%} = Eff_{100\%} * Eff_{factor50\%} = 89 * 0.96 = 85.44\%$$

$$P_{DIS50\%} = P_{in50\%} - P_{out50\%} = \frac{P_{out100\%} * 0.5}{Eff_{50\%}} - (P_{out100\%} * 0.5) = 3.51 - 3 = 0.51W$$

$$T_{OVER} = R_{th} * P_{DIS50\%} = 18 * 0.51 = 9.2°C$$

$$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105 - 9.2 = 95.8°C$$

REGULATIONS

| Parameter | Condition | Type | Value |
|-------------------------|--|----------------|-----------------------|
| Output Voltage Accuracy | | | ±1% |
| Voltage Adjustability | Single | 3.3, 5, 12Vout | ±10% |
| | Dual | 15, 24Vout | ±10% min. / ±20% max. |
| Line Voltage Regulation | LL to HL Single | | ±0.2% |
| | LL to HL Dual | | ±0.5% |
| Load Voltage Regulation | no load to full load Single | | ±0.2% |
| | no load to full load Dual | | ±1% |
| Cross Regulation | asymmetrical load 25% / Full Load only Dual Output | | ±5% |
| Transient Response | 25% load step change | | 250µs |

PROTECTIONS

| Parameter | Condition | Type | Value |
|--------------------------------------|-----------------------------|----------------|---|
| Short Circuit Protection (SCP) | | | continuous, auto-recovery |
| Over Load Protection (OLP) | % of I _{out} rated | | Hiccup mode, 150% typ. |
| Output Over Voltage Protection (OVP) | | Single 3.3Vout | 3.7VDC min. / 5VDC max. |
| | | 5Vout | 5.6VDC / 7VDC max. |
| | | 12Vout | 13.5VDC min. / 16VDC max. |
| | | 15Vout | 18.3VDC min. / 22VDC max. |
| | | 24Vout | 29.1VDC min. / 34.5VDC max. |
| | | Dual 5Vout | 5.6VDC min. / 7VDC max. |
| 12Vout | 13.5VDC min. / 18.2VDC max. | | |
| 15Vout | 17VDC min. / 22VDC max. | | |
| Isolation Voltage (2MOPP insulation) | I/P to O/P working voltage | | 5kVAC / 1 minute 250VAC / continuous |
| Leakage Current | 240VAC, 60Hz | | 2µA |
| Clearance | I/P to O/P | | 8mm |
| Creepage | I/P to O/P | | 8mm |
| Isolation Capacitance | | | 12pF typ. / 17pF max. |

Specifications (measured at $T_A = 25^\circ\text{C}$, nominal input voltage, full load and after warm-up)

| ENVIRONMENTAL | | |
|---|---------------------------------------|--|
| Parameter | Condition | Value |
| Relative Humidity | | 5% to 95% RH |
| Temperature Coefficient | | $\pm 0.02\% / ^\circ\text{C}$ |
| Thermal Impedance | natural convection (20LFM) | $18^\circ\text{C} / \text{W}$ |
| max. Case Temperature Range max. Ambient Temperature Range | | -40°C to $+105^\circ\text{C}$ see calculation example |
| Storage Temperature Range | | -55°C to $+125^\circ\text{C}$ |
| MTBF ($+25^\circ\text{C}$) | according to MIL-HDBK-217F, full load | 4718×10^3 hours |

| SAFETY AND CERTIFICATIONS | | |
|-------------------------------|---|---|
| Agency | Report / File Number | Standard |
| CB | | IEC-60950-1 |
| CB Medical | | IEC-60601-1 |
| UL General Safety | | UL-60950-1 |
| ANSI/AAMI | | ES60601-1 |
| EN General Safety | | EN-60950-1 |
| EN Medical Safety | | EN-60601-1 |
| Certificate Type | Condition | Standard / Criterion |
| ESD | Air $\pm 8\text{kV}$; Contact $\pm 6\text{kV}$ | EN61000-4-2, Criteria A |
| Radiated Immunity | 10V/m | EN61000-4-3, Criteria A |
| Fast Transient ⁽¹⁾ | $\pm 2\text{kV}$ | EN61000-4-4, Criteria A |
| Surge ⁽¹⁾ | $\pm 2\text{kV}$ | EN61000-4-5, Criteria A |
| Conducted Immunity | 10Vr.m.s | EN61000-4-6, Criteria A |
| EMI Standard ⁽²⁾ | | EN55011, Class A, B EN55022, Class A, B FCC Part 18 |
| Thermal Shock | | MIL-STD-810F |
| Vibration | | MIL-STD-810F |

Notes:

Note1: An external input filter capacitor is required if the model has to meet EN61000-4-4 or/and EN61000-4-5.

Recommended components:

| | |
|--------------|--|
| 5Vin | aluminium capacitor (Nippon Chemi-con KY series, $1000\mu\text{F}/25\text{V}$) and a reverse diode (Vishay V10P45) to connect in parallel |
| 12Vin, 24Vin | aluminium capacitor (Nippon Chemi-con KY series, $470\mu\text{F}/50\text{V}$) |
| 48Vin | aluminium capacitor (Nippon Chemi-con KY series, $330\mu\text{F}/100\text{V}$) |

Note2: The REM3 (W) with 4:1 input voltage can meet EMI Class A with no external filter. And Class B only with external components.

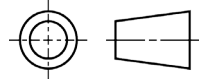
Note3: This Power module is not internally fused. A input line fuse must be always used.

Specifications (measured at $T_A=25^\circ\text{C}$, nominal input voltage, full load and after warm-up)

DIMENSIONS and PHYSICAL CHARACTERISTICS

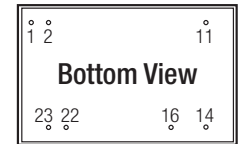
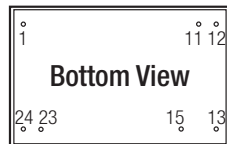
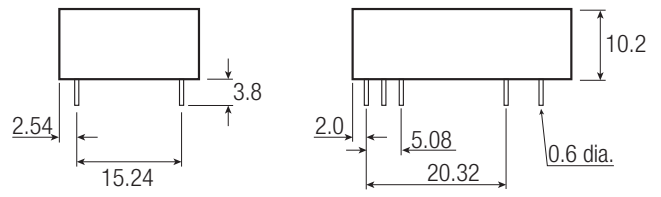
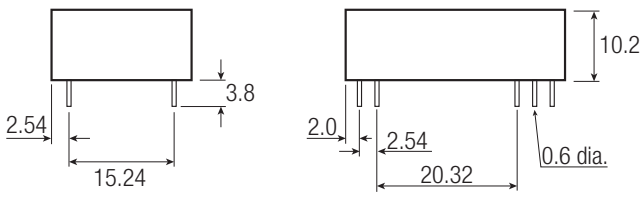
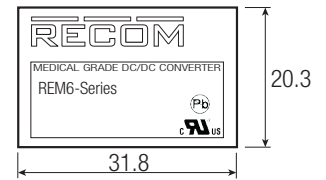
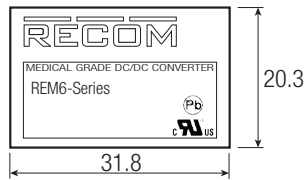
| Parameter | Type | Value |
|------------------------------|--------------|--|
| Material | Case Potting | non-conductive black plastic Silicone (UL94-V0) |
| Package Dimensions (LxWxH) | | 31.80 x 20.30 x 10.20mm |
| Package Weight | | 14g |
| Packaging Dimensions (LxWxH) | Tube | 225 x 21.80 x 16.50mm |
| Packaging Quantity | | 7pcs |

Mechanical Dimensions



“C” Pinning

“A” Pinning (Standard)



Pin Connections

| Pin # | Single | Dual |
|-------|--------|--------|
| 1 | +Vin | +Vin |
| 11 | No Pin | Com |
| 12 | -Vout | No Pin |
| 13 | +Vout | -Vout |
| 15 | No Pin | +Vout |
| 23 | -Vin | -Vin |
| 24 | -Vin | -Vin |

Tolerance: xx.x= ±0.5mm
xx.xx= ±0.25mm

Pin Connections

| Pin # | Single | Dual |
|-------|--------|-------|
| 1 | CTRL* | CTRL* |
| 2 | -Vin | -Vin |
| 11 | No Pin | -Vout |
| 14 | +Vout | +Vout |
| 16 | -Vout | Com |
| 22 | +Vin | +Vin |
| 23 | +Vin | +Vin |

* If don't choose CTRL option, there is no pin on the corresponding pin number

Tolerance: xx.x= ±0.5mm
xx.xx= ±0.25mm

The product information and specifications are subject to change without prior notice. All products are designed for non-safety critical commercial and industrial applications. The buyer agrees to implement safeguards that anticipate the consequences of any failures that might cause harm, loss of life and/or property damage.