

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

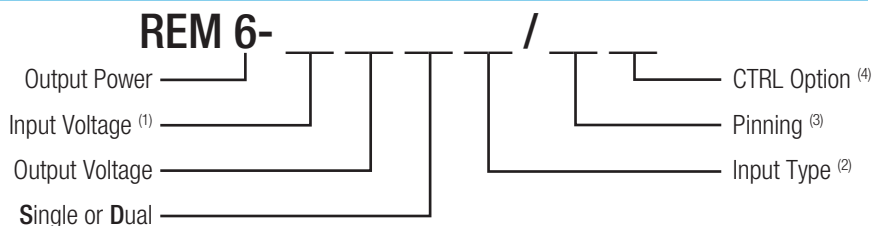
Description

The REM6 series of medical grade regulated DC/DC converters features 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/ (3,4) | 4.5-9 / 9-18 / 18-36 / 36-75 | 3.3 | 1800 | 81.5 / 83.5 / 83 / 82.5 | 2100 |
| REM6-xx05S/ (3,4) | 4.5-9 / 9-18 / 18-36 / 36-75 | 5 | 1200 | 86 / 86 / 86 / 86.5 | 1500 |
| REM6-xx12S/ (3,4) | 4.5-9 / 9-18 / 18-36 / 36-75 | 12 | 500 | 86 / 89 / 89 / 88 | 260 |
| REM6-xx15S/ (3,4) | 4.5-9 / 9-18 / 18-36 / 36-75 | 15 | 400 | 87.5 / 88.5 / 88.5 / 88.5 | 210 |
| REM6-xx24S/ (3,4) | 4.5-9 / 9-18 / 18-36 / 36-75 | 24 | 250 | 87 / 88.5 / 88.5 / 88 | 75 |
| REM6-xx05D/ (3,4) | 4.5-9 / 9-18 / 18-36 / 36-75 | ±5 | ±600 | 84 / 85 / 85 / 85 | ±860 |
| REM6-xx12D/ (3,4) | 4.5-9 / 9-18 / 18-36 / 36-75 | ±12 | ±250 | 86.5 / 89 / 88.5 / 88 | ±150 |
| REM6-xx15D/ (3,4) | 4.5-9 / 9-18 / 18-36 / 36-75 | ±15 | ±200 | 87.5 / 88 / 88.5 / 87 | ±110 |
| REM6-xx3.3SW/ (3,4) | 9-36 / 18-75 | 3.3 | 1800 | 83 / 82.5 | 2100 |
| REM6-xx05SW/ (3,4) | 9-36 / 18-75 | 5 | 1200 | 86 / 86.5 | 1500 |
| REM6-xx12SW/ (3,4) | 9-36 / 18-75 | 12 | 500 | 89 / 88 | 260 |
| REM6-xx15SW/ (3,4) | 9-36 / 18-75 | 15 | 400 | 89 / 88.5 | 210 |
| REM6-xx24SW/ (3,4) | 9-36 / 18-75 | 24 | 250 | 88.5 / 88 | 75 |
| REM6-xx05DW/ (3,4) | 9-36 / 18-75 | ±5 | ±600 | 85 / 85 | ±860 |
| REM6-xx12DW/ (3,4) | 9-36 / 18-75 | ±12 | ±250 | 88.5 / 88 | ±150 |
| REM6-xx15DW/ (3,4) | 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 |

RECOM
DC/DC Converter

REM6

6 Watt

2:1 & 4:1

DIP24

Single and Dual Output



2MOPP
250VAC

IEC-60601-1 Certified
ES-60601-1 Certified
EN-55011 Certified
EN-55022 Certified

Refer to Applications Notes

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

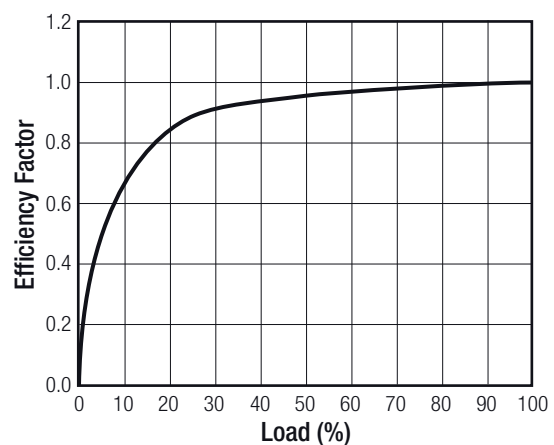
| BASIC CHARACTERISTICS | | | | | |
|---|---|------------|-------------------------------|-------------------------------|--------|
| Parameter | Condition | | Min. | Typ. | Max. |
| Absolute Maximum Input Voltage (3sec max.) | 2:1 | 5Vin nom. | | | 16VDC |
| | | 12Vin nom. | | | 25VDC |
| | 4:1 | 24Vin 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 |
| | 4:1 | 24Vin nom. | 8VDC | | 9VDC |
| | | 48Vin nom. | 16VDC | | 18VDC |
| Start-up Time | constant resistive load, Power up or Remote ON/OFF | | | 30ms | |
| Remote ON/OFF (referenced to -Vin Pin) | DC-DC ON DC-DC OFF | | Open or 0-1.2VDC 2.2-12VDC | | |
| Current of CTRL Pin | | | -0.5mA | | 1mA |
| Remote OFF Input Current | | | | 2.5mA | |
| Operating Frequency Range | | | 225kHz | 250kHz | 275kHz |
| Output Ripple and Noise (20MHz BW limited) | 10 μ F/25V X7R MLCC for 3.3, 5Vout 10 μ F/25V X7R MLCC for 12, 15Vout 4.7 μ F/50V X7R MLCC for 24Vout | | | 30mVp-p 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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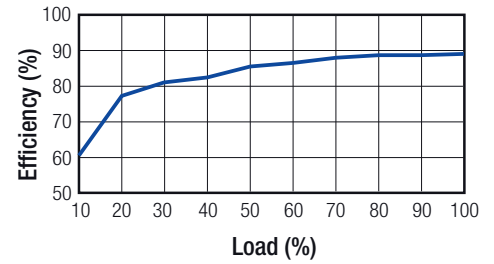
Specifications (measured at T_A= 25°C, nominal input voltage, full load and after warm-up)

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

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

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

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

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

REGULATIONS

| Parameter | Condition | Type | Value |
|-------------------------|--|--------|-------|
| Output Voltage Accuracy | | | ±1% |
| 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 | 3.3V _{out} 3.7VDC min. / 5VDC max. |
| | | 5V _{out} 5.6VDC min. / 7VDC max. | |
| | | 12V _{out} 13.5VDC min. / 16VDC max. | |
| | | 15V _{out} 18.3VDC min. / 22VDC max. | |
| | | 24V _{out} 29.1VDC min. / 34.5VDC max. | |
| | | Dual | 5V _{out} 5.6VDC min. / 7VDC max. |
| 12V _{out} 13.5VDC min. / 18.2VDC max. | | | |
| 15V _{out} 17VDC min. / 22VDC max. | | | |

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

| | | |
|-------------------------------|-------------------------------|---|
| Isolation Voltage | I/P to O/P working voltage | 5kVAC / 1 minute 250VAC / continuous |
| Means of Protection | | 2MOPP |
| Leakage Current | 240VAC, 60Hz | 2µA |
| Medical Device Classification | | Type CF applied device (design to meet) |
| Internal Clearance | I/P to O/P | 8mm |
| Creepage | I/P to O/P | 8mm |
| External Clearance | I/P to O/P, Single Output | >19.72mm |
| | I/P to O/P, Dual Output | >14.64mm |
| Creepage | I/P to O/P, Single Output | >19.72mm |
| | I/P to O/P, Dual Output | >14.64mm |
| Isolation Capacitance | | 12pF typ. / 17pF max. |
| Insulation Grade | | Reinforced Insulation |

Notes:

Note5: This Power module is not internally fused. A input line fuse must be always used.

| Recommended Fuse: | 2:1 Input Voltage | Fuse (slow blow) | 4:1 Input Voltage | Fuse (slow blow) |
|-------------------|-------------------|------------------|-------------------|------------------|
| | 5V | T2.5A | 24V | T1.25A |
| | 12V | T1.25A | 48V | T0.63A |
| | 24V | T0.63A | | |
| | 48V | T0.315A | | |

ENVIRONMENTAL

| Parameter | Condition | Value |
|--------------------------------|---------------------------------------|------------------------------|
| Relative Humidity | | 5% to 95% RH |
| Temperature Coefficient | | ±0.02% / °C |
| Thermal Impedance | natural convection (20LFM) | 18°C / W |
| max. Case Temperature Range | | -40°C to +105°C |
| max. Ambient Temperature Range | | see calculation example |
| MTBF (+25°C) | according to MIL-HDBK-217F, full load | 4718 x 10 ³ hours |

SAFETY AND CERTIFICATIONS

| Certificate Type (Safety) | Report / File Number | Standard |
|---------------------------|-----------------------|--|
| CB Medical Safety | E314885-A6 1409015 | IEC-60601-1 Medical Report + ISO14971 Risk Assessment |
| ANSI/AAMI | E314885-A6 | ES60601-1 |
| CAN/CSA Medical | E314885-A6 | C22.2 No. 60601-1:08 |

| Certificate Type (Others) | Conditions | Standard / Criterion |
|-------------------------------|---|---|
| EMI Standard ⁽⁷⁾ | Conducted Radiated Conducted and Radiated | EN55011 (EN-55022), Class A, B EN55011 (EN-55022), Class A, B FCC18 |
| ESD | Air ±8kV; Contact ±6kV | EN61000-4-2, Criteria A |
| Radiated Immunity | 10V/m | EN61000-4-3, Criteria A |
| Fast Transient ⁽⁶⁾ | ±2kV | EN61000-4-4, Criteria A |
| Surge ⁽⁶⁾ | ±2kV | EN61000-4-5, Criteria A |
| Conducted Immunity | 20Vr.m.s | EN61000-4-6, Criteria A |

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

| | | |
|--------------------------------|-------|-------------------------|
| Power Frequency Magnetic Field | 10A/m | EN61000-4-8, Criteria A |
| Thermal Shock | | MIL-STD-810F |
| Vibration | | MIL-STD-810F |

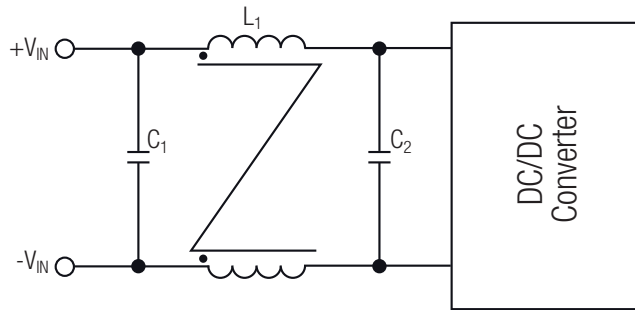
Notes:

Note6: An external input filter capacitor is required if the model has to meet EN61000-4-4 or/and EN61000-4-5.

| | | |
|--------------------------------|--------------|--|
| <u>Recommended components:</u> | 5Vin | aluminium capacitor (Nippon Chemi-con KY series, 1000 μF /25V) and a reverse diode (Vishay V10P45) to connect in parallel |
| | 12Vin, 24Vin | aluminium capacitor (Nippon Chemi-con KY series, 470 μF /50V) |
| | 48Vin | aluminium capacitor (Nippon Chemi-con KY series, 330 μF /100V) |

Note7: The whole REM6 series can meet EMI Class A with no external filter. And Class B only with external components.

EMC Filter Suggestion for Class B



| MODEL | C1 ⁽⁸⁾ | C2 ⁽⁸⁾ | L1 ⁽⁸⁾ |
|--|---------------------------------|--------------------------------|--------------------------------|
| REM6-05xxS_D | 22 μF /16V MLCC | 22 μF /16V MLCC | 33mH WE 744825433 |
| REM6-12xxS_D REM6-24xxS_D REM6-24xxS_D/W | 4.7 μF /50V MLCC | 4.7 μF /50V MLCC | 500 μH WE 744223 |
| REM6-48xxS_D REM6-48xxS_D/W | 2.2 μF /100V MLCC | 1 μF /100V MLCC | 500 μH WE 744223 |

Notes:

Note8: The component values can be adapted according to customers' application.

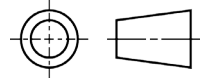
DIMENSION and PHYSICAL CHARACTERISTICS

| Parameter | Type | Value |
|---------------------------|------|------------------------------|
| Case Material | | non-conductive black plastic |
| Potting Material | | silicone (UL94-V0) |
| Package Dimension (LxWxH) | | 31.80 x 20.30 x 10.40mm |
| Package Weight | | 14g |

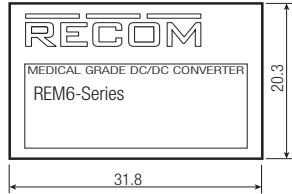
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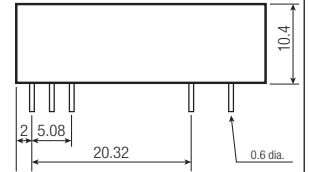
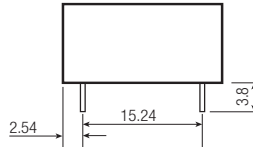
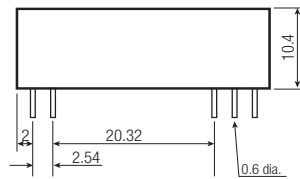
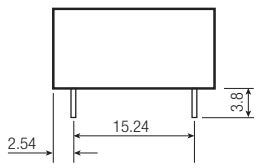
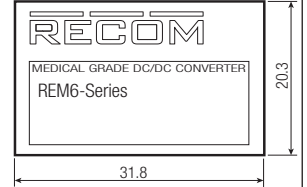
Dimension Drawing (mm)



“C” Pinning

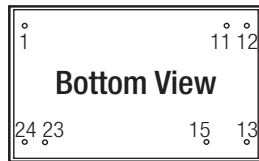


“A” Pinning (Standard)



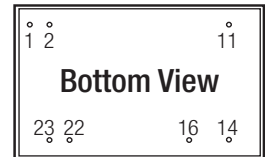
Pin Connections

| 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 |



Pin Connections

| Pin # | Single | Dual |
|-------|--------|-------|
| 1 | CTRL* | CTRL* |
| 2 | -Vin | -Vin |
| 11 | NC | -Vout |
| 14 | +Vout | +Vout |
| 16 | -Vout | Com |
| 22 | +Vin | +Vin |
| 23 | +Vin | +Vin |



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

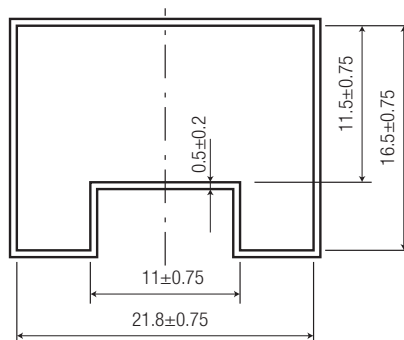
* If don't choose CTRL option, there is no pin on the corresponding pin number

NC= not connected
Tolerance: xx.x= ±0.5mm
xx.xx= ±0.25mm

PACKAGING INFORMATION

| Parameter | Type | Value |
|-----------------------------|------|---------------------|
| Packaging Dimension (LxWxH) | Tube | 255 x 21.8 x 16.5mm |
| Packaging Quantity | | 7pcs |
| Storage Temperature Range | | -55°C to +125°C |

Tube Dimension Drawing (mm)



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