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

RECOM

DC/DC Converter

REM6

6 Watt 2:1 & 4:1 DIP24 Single and Dual Output

5 YEAR warranty

E314885

2MOPP 250VAC

IEC/EN60601-1 Certified
CSA/CAN C22.2 60601-01 Certified
ANSI/AAMI ES60601-1 Certified
EN55011 Certified

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 UL mark.

Selection Guide

Part Number	nom. Input Voltage (1) [VDC]	Output Voltage [VDC]	Output Current [mA]	Efficiency typ. [%]	Max. Capacitive Load [µF]
REM6-xx3.3S/ (3,4)	5 / 12 / 24 / 48	3.3	1800	81.5 / 83.5 / 83 / 82.5	2100
REM6-xx05S/ (3,4)	5 / 12 / 24 / 48	5	1200	86 / 86 / 86 / 86.5	1500
REM6-xx12S/ (3,4)	5 / 12 / 24 / 48	12	500	86 / 89 / 89 / 88	260
REM6-xx15S/ (3,4)	5 / 12 / 24 / 48	15	400	87.5 / 88.5 / 88.5 / 88.5	210
REM6-xx24S/ (3,4)	5 / 12 / 24 / 48	24	250	87 / 88.5 / 88.5 / 88	75
REM6-xxx05D/ (3,4)	5 / 12 / 24 / 48	±5	±600	84 / 85 / 85 / 85	±860
REM6-xx12D/ (3,4)	5 / 12 / 24 / 48	±12	±250	86.5 / 89 / 88.5 / 88	±150
REM6-xx15D/ (3,4)	5 / 12 / 24 / 48	±15	±200	87.5 / 88 / 88.5 / 87	±110
REM6-xx3.3SW/ (3,4)	24 / 48	3.3	1800	83 / 82.5	2100
REM6-xx05SW/ (3,4)	24 / 48	5	1200	86 / 86.5	1500
REM6-xx12SW/ (3,4)	24 / 48	12	500	89 / 88	260
REM6-xx15SW/ (3,4)	24 / 48	15	400	89 / 88.5	210
REM6-xx24SW/ (3,4)	24 / 48	24	250	88.5 / 88	75
REM6-xx05DW/ (3,4)	24 / 48	±5	±600	85 / 85	±860
REM6-xx12DW/ (3,4)	24 / 48	±12	±250	88.5 / 88	±150
REM6-xx15DW/ (3,4)	24 / 48	±15	±200	88.5 / 87	±110

Model Numbering

REM 6- ___ ___ ___ / ___ ___

- Output Power
- Input Voltage (1)
- Output Voltage
- **S**ingle or **D**ual
- CTRL Option (4)
- Pinning (3)
- Input Type (2)

Notes:

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

2:1	nom. Vin	4:1 "W"	nom. Vin
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 aviable

Examples:

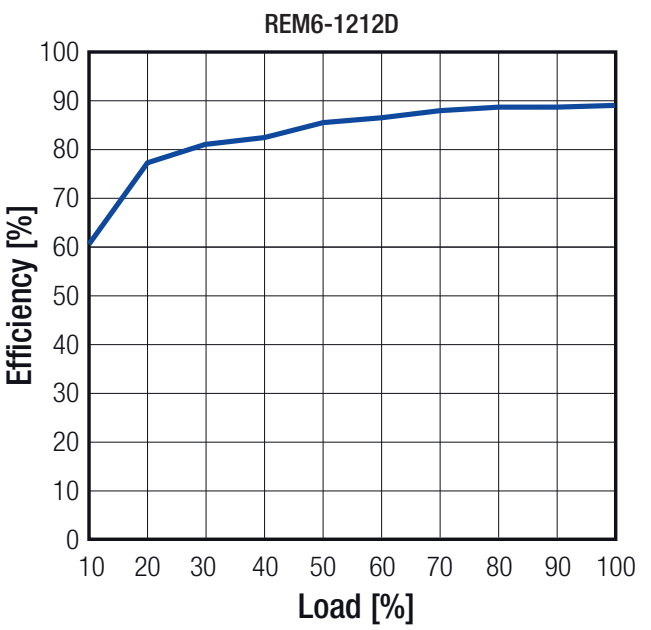
REM6-0512D/A	=	2:1 Input,	4.5-9Vin,	±12Vout,	pinout „A",	without control pin
REM6-1215S/C	=	2:1 Input,	9-18Vin,	15Vout,	pinout „C",	without control pin
REM6-4815SW/A/CTRL	=	4:1 Input,	36-75Vin,	15Vout,	pinout „A"	with control pin
REM6 -243.3SW/C	=	4:1 Input,	9-36Vin,	3.3Vout,	pinout „C",	without control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

Specifications (measured @ 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. 12Vin nom. 24Vin nom. 48Vin nom.			16VDC 25VDC 50VDC 100VDC
	4:1	24Vin nom. 48Vin nom.			50VDC 100VDC
Under Voltage Lockout	2:1	5Vin nom. 12Vin nom. 24Vin nom. 48Vin nom.	4VDC 8VDC 16VDC 33VDC		4.5VDC 9VDC 18VDC 36VDC
	4:1	24Vin nom. 48Vin nom.	8VDC 16VDC		9VDC 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	
Internal Operating Frequency			225kHz	250kHz	275kHz
Output Ripple and Noise (20MHz BW limited)	10µF/25V X7R MLCC for 3.3, 5Vout 10µF/25V X7R MLCC for 12, 15Vout 4.7µF/50V X7R MLCC for 24Vout			30mVp-p 40mVp-p 50mVp-p	

Efficiency vs. Load



REGULATIONS

Parameter	Condition	Type	Value
Output Accuracy			±1%
Line Regulation	low line to high line	Single Dual	±0.2% ±0.5%
Load Regulation	no load to full load	Single Dual	±0.2% ±1%
Cross Regulation	asymmetrical load 25% / Full Load	only Dual Output	±5%
Transient Response	25% load step change		250µs

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

PROTECTIONS

Parameter	Condition	Type	Value
Short Circuit Protection (SCP)			continuous, auto-recovery
Over Load Protection (OLP)	% of Iout rated		Hiccup mode, 150% typ.
Output Over Voltage Protection (OVP)		Single 3.3Vout	3.7VDC min. / 5VDC max.
		Single 5Vout	5.6VDC min. / 7VDC max.
		Single 12Vout	13.5VDC min. / 16VDC max.
		Single 15Vout	18.3VDC min. / 22VDC max.
		Single 24Vout	29.1VDC min. / 34.5VDC max.
		Dual 5Vout	5.6VDC min. / 7VDC max.
		Dual 12Vout	13.5VDC min. / 18.2VDC max.
		Dual 15Vout	17VDC min. / 22VDC max.
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
Internal Creepage	I/P to O/P		8mm
External Clearance and Creepage	I/P to O/P	Single	>19.72mm
		Dual	>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.

Recomended Fuse:

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

4:1 Input Voltage	Fuse (slow blow)
24V	T1.25A
48V	T0.63A

ENVIRONMENTAL

Parameter	Condition	Value
Operating Humidity		5% to 95% RH
Temperature Coefficient		±0.02% / °C
Thermal Impedance	natural convection (20LFM)	18°C / W
Operating Altitude		5000m
Pollution Degree		PD2
Thermal Shock		MIL-STD-810F
Vibration		MIL-STD-810F
MTBF (+25°C)	according to MIL-HDBK-217F, full load	4718 x 10^3 hours
max. Case Temperature Range		-40°C to +105°C
max. Ambient Temperature Range		see calculation example

continued on next page

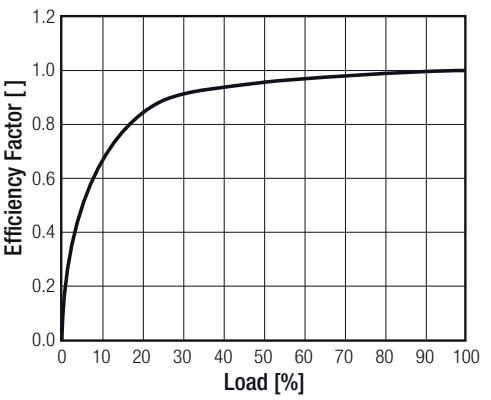
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

Calculation Example:

Table1: Efficiency Crosstable

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

Graph1: Efficiency Factor vs. Load



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:

Vin = 12V
Iout = 50%
$Eff_{100\%}$ = 89%
$Eff_{factor50\%}$ = 0.96
R_{th} = 18°C/W
$T_{CASEmax}$ = 105°C

$Eff_{50\%} = Eff_{100\%} * Eff_{factor50\%} = 89 * 0.960 = \underline{\mathbf{85.44\%}}$

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

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

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

SAFETY AND CERTIFICATIONS

Certificate Type (Safety)	Report / File Number	Standard
Medical Electric Equipment, General Requirements for Safety and Essential Performance	E314885-A6-CB-1	CAN/CSA-C22.2 No. 60601-1:08 ANSI/AAMI ES60601-1:2005
Medical Electric Equipment, General Requirements for Safety and Essential Performance (CB Scheme)	E314885-A6-CB-1	IEC60601-1:2005 + C2:2007 3rd Edition EN60601-1:2006

Certificate Type (Others)	Conditions	Standard / Criterion
Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests		EN60601-1-2:2015
Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement (7)		EN55011:2009 + A1:2010 Class A & B
ESD Electrostatic discharge immunity test	Air ±15kV; Contact ±8kV	EN61000-4-2:2008
Radiated, radio-frequency, electromagnetic field immunity test	10V/m (80-2500MHz) 27V/m (385MHz) 28V/m (450MHz)	EN61000-4-3:2006 + A2:2010
Fast Transient and Burst Immunity (6)	DC Port: ±2kV	EN61000-4-4:2012
Surge Immunity (6)	DC Port: ±2kV	EN61000-4-5:2005
Immunity to conducted disturbances, induced by radio-frequency fields	6Vr.m.s	EN61000-4-6:2013
Power Frequency Magnetic Field	30A/m	EN61000-4-8:2009

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

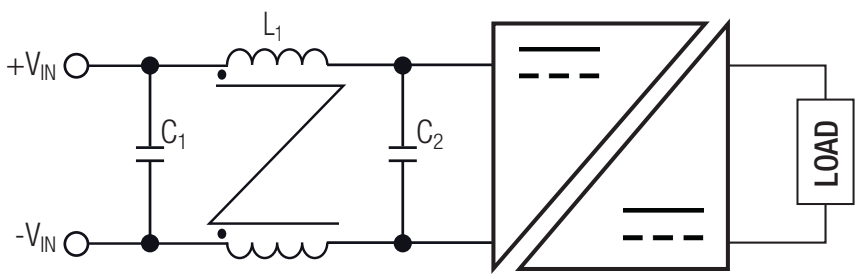
Notes:

Note6: 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, 1000µF/25V) and a reverse diode (Vishay V10P45) to connect in parallel
	12Vin, 24Vin	aluminium capacitor (Nippon Chemi-con KY series, 470µF/50V)
	48Vin	aluminium capacitor (Nippon Chemi-con KY series, 330µF/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 (8)



MODEL	C1 (8)	C2 (8)	L1 (8)
REM6-05xxS_D	22µF/16V MLCC	22µF/16V MLCC	137µH CMC
REM6-12xxS_D REM6-24xxS_D(/W)	4.7µF/50V MLCC	4.7µF/50V MLCC	227µH CMC
REM6-48xxS_D(/W)	2.2µF/100V MLCC	1µF/100V MLCC	419µH CMC

Notes:

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

DIMENSION and PHYSICAL CHARACTERISTICS		
Parameter	**Type**	**Value**
Material	case PCB potting	non-conductive black plastic (UL94-V2) FR4 (UL94-V1) silicone (UL94-V0)
Package Dimension (LxWxH)		31.80 x 20.30 x 10.40mm
Package Weight		14g

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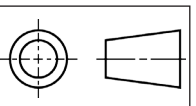
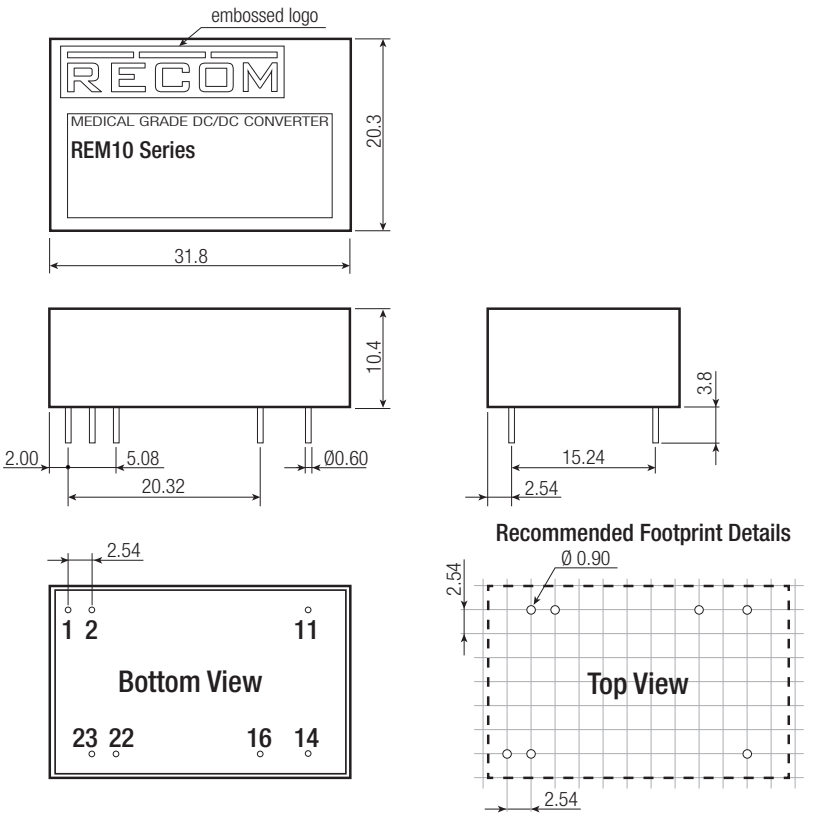
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

Dimension Drawing (mm)



"A" Pinning (Standard)



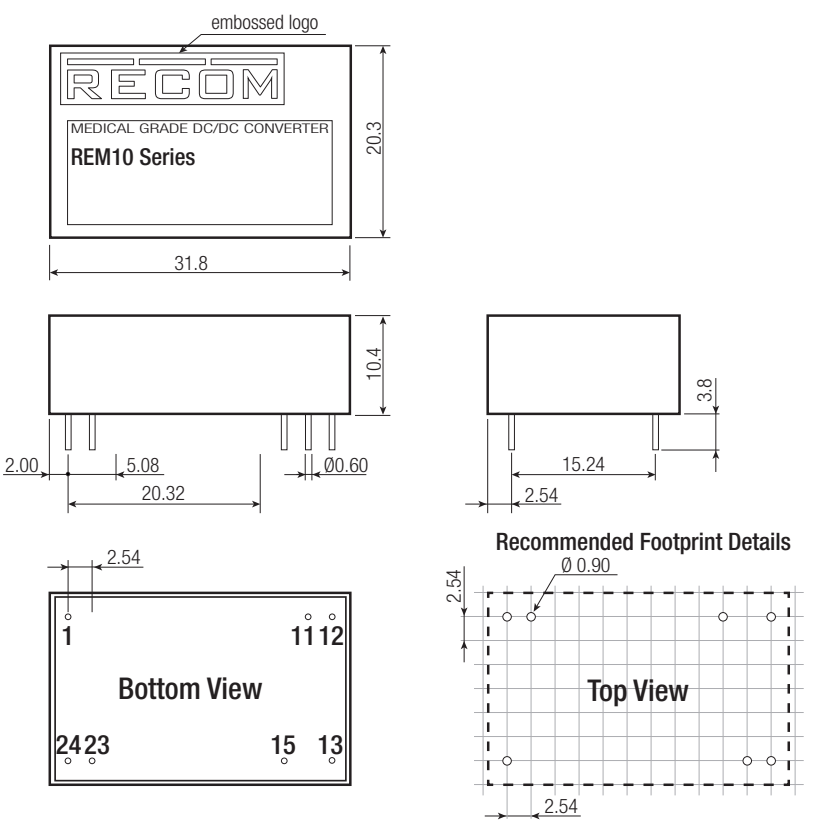
Pin Connections

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

* 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

"C" Pinning



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

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

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
Stoarge Humidity	non-condensing	5% to 95% RH max.

Tube Dimension Drawing (mm)