

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

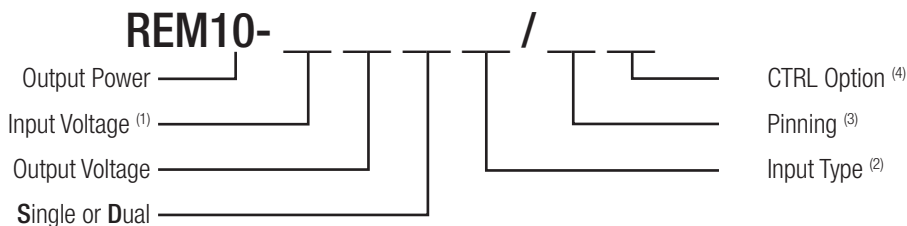
Description

The REM10 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 UL mark.

Selection Guide

Part Number	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [mA]	Efficiency typ. [%]	Max. Capacitive Load [µF]
REM10-xx3.3S/ (3,4)	5 / 12 / 24 / 48	3.3	2500	80 / 83 / 83 / 82.5	3000
REM10-xx05S/ (3,4)	5 / 12 / 24 / 48	5	2000	84 / 85.5 / 86.5 / 86.5	2500
REM10-xx12S/ (3,4)	5 / 12 / 24 / 48	12	830	86.5 / 88 / 89 / 89	430
REM10-xx15S/ (3,4)	5 / 12 / 24 / 48	15	670	87 / 89 / 89 / 89	350
REM10-xx24S/ (3,4)	5 / 12 / 24 / 48	24	416	85.5 / 89 / 89 / 88.	125
REM10-xxx05D/ (3,4)	5 / 12 / 24 / 48	±5	±1000	83 / 84 / 85 / 85	±1440
REM10-xx12D/ (3,4)	5 / 12 / 24 / 48	±12	±416	85.5 / 89 / 89 / 88	±250
REM10-xx15D/ (3,4)	5 / 12 / 24 / 48	±15	±333	86.5 / 88 / 89 / 88	±180
REM10-xx3.3SW/ (3,4)	24 / 48	3.3	2500	83 / 82.5	3000
REM10-xx05SW/ (3,4)	24 / 48	5	2000	86.5 / 86.5	2500
REM10-xx12SW/ (3,4)	24 / 48	12	830	89 / 89	430
REM10-xx15SW/ (3,4)	24 / 48	15	670	89 / 89	350
REM10-xx24SW/ (3,4)	24 / 48	24	416	89 / 88.5	125
REM10-xx05DW/ (3,4)	24 / 48	±5	±1000	85 / 85	±1440
REM10-xx12DW/ (3,4)	24 / 48	±12	±416	89 / 88	±250
REM10-xx15DW/ (3,4)	24 / 48	±15	±333	88 / 88	±180

Model Numbering



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

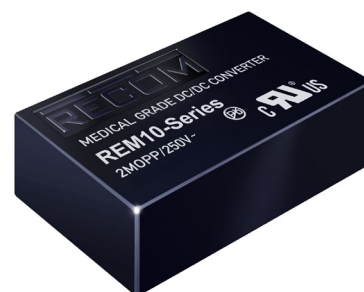
Note4: „CTRL" suffix for control pin option, for A pinning only, for C pinning not aviable

Examples:

REM10-0512D/A	=	2:1 Input, 4.5-9Vin, ±12Vout, pinout „A", without control pin
REM10-1215S/C	=	2:1 Input, 9-18Vin, 15Vout, pinout „C", without control pin
REM10-4815SW/A/CTRL	=	4:1 Input, 36-75Vin, 15Vout, pinout „A" with control pin
REM10-243.3SW/C	=	4:1 Input, 9-36Vin, 3.3Vout, pinout „C", without control pin

REM10

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



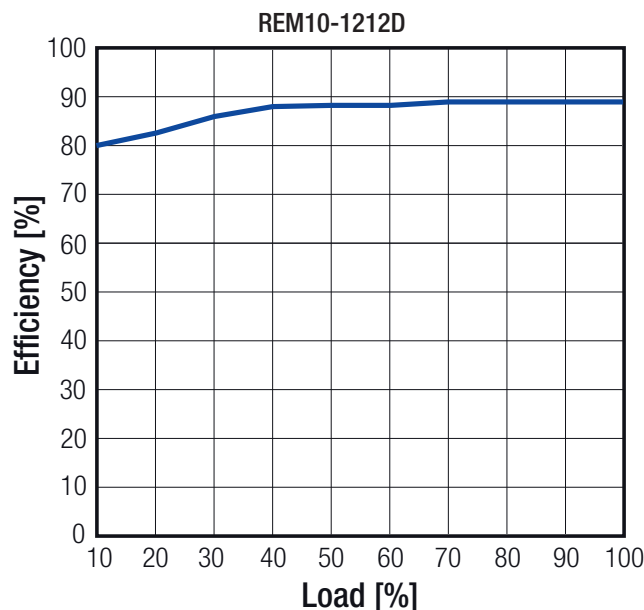
2MOPP
250VAC

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

Specifications (measured @ $t_a = 25^\circ\text{C}$, 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. 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			270kHz	300kHz	330kHz
Output Ripple and Noise (20MHz BW limited)	10μF/25V X7R MLCC for 3.3, 5Vout 10μF/25V X7R MLCC for 12, 15Vout 4.7uF/50V X7R MLCC for 24Vout			30mVp-p 40mVp-p 50mVp-p	

Efficiency vs. Load



REGULATIONS

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

Specifications (measured @ $t_a = 25^\circ\text{C}$, 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)		3.3Vout	3.7VDC min. / 5VDC max.																
		5Vout	5.6VDC min. / 7VDC max.																
		Single 12Vout	13.5VDC min. / 16VDC max.																
		15Vout	18.3VDC min. / 22VDC max.																
		24Vout	29.1VDC min. / 34.5VDC max.																
		5Vout	5.6VDC min. / 7VDC max.																
		Dual 12Vout	13.5VDC min. / 18.2VDC max.																
		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 Creepage	I/P to O/P		8mm																
			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.																			
<u>Recommended Fuse:</u>																			
<table><tr><th>2:1 Input Voltage</th><th>Fuse (slow blow)</th></tr><tr><td>5V</td><td>T5A</td></tr><tr><td>12V</td><td>T2A</td></tr><tr><td>24V</td><td>T1A</td></tr><tr><td>48V</td><td>T0.5A</td></tr></table>		2:1 Input Voltage	Fuse (slow blow)	5V	T5A	12V	T2A	24V	T1A	48V	T0.5A	<table><tr><th>4:1 Input Voltage</th><th>Fuse (slow blow)</th></tr><tr><td>24V</td><td>T2A</td></tr><tr><td>48V</td><td>T1A</td></tr></table>		4:1 Input Voltage	Fuse (slow blow)	24V	T2A	48V	T1A
2:1 Input Voltage	Fuse (slow blow)																		
5V	T5A																		
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4:1 Input Voltage	Fuse (slow blow)																		
24V	T2A																		
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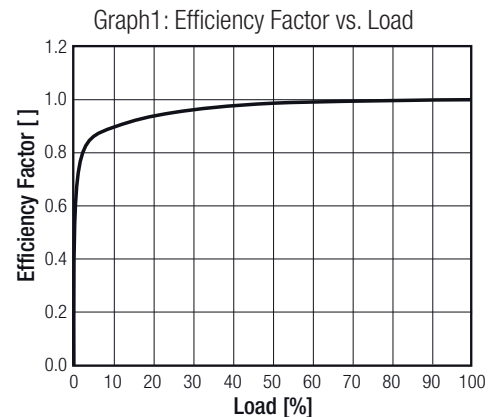
ENVIRONMENTAL		
Parameter	Condition	Value
Operating Humidity		5% to 95% RH
Temperature Coefficient		$\pm 0.02\%$ / $^\circ\text{C}$
Thermal Impedance	natural convection (0.1m/s)	18 $^\circ\text{C}$ / W
Operating Altitude		5000m
Pollution Degree		PD2
Thermal Shock		MIL-STD-810F
Vibration		MIL-STD-810F
MTBF (+25 $^\circ\text{C}$)	according to MIL-HDBK-217F, full load	3849 x 10 ³ hours
max. Case Temperature Range		-40 $^\circ\text{C}$ to +105 $^\circ\text{C}$
max. Ambient Temperature Range		see calculation example
continued on next page		

Specifications (measured @ $t_a = 25^\circ\text{C}$, 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	80	83	83	82.5	83	82.5
	05S	84	85.5	86.5	86.5	86.5	86.5
	12S	86.5	88	89	89	89	89
	15S	87	89	89	89	89	89
	24S	85.5	89	89	88.5	89	88.5
	05D	83	84	85	85	85	85
	12D	85.5	89	89	88	89	88
	15D	86.5	88	88	88	88	88



choose your model:

REM10-1212D

- Efficiency from Table1 (= 89% @ max Load / nom Vin)
- Loading conditions in application (= 50%)
- use Eff factor from Graph1 (= 0.99)

Calculation:

$V_{in} = 12V$
 $I_{out} = 50\%$
 $Eff_{100\%} = 89\%$
 $Eff_{factor50\%} = 0.99$
 $R_{th} = 18^\circ\text{C/W}$
 $T_{CASEmax} = 105^\circ\text{C}$

$$Eff_{50\%} = Eff_{100\%} * Eff_{factor50\%} = 89 * 0.99 = \underline{88.19\%}$$

$$P_{DIS50\%} = P_{in50\%} - P_{out50\%} = \frac{P_{out100\%} * 0.5}{Eff_{50\%}} - (P_{out100\%} * 0.5) = 5.67 - 5 = \underline{0.67W}$$

$$T_{OVER} = R_{th} * P_{DIS50\%} = 18 * 0.67 = \underline{12.1^\circ\text{C}}$$

$$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105 - 12.1 = \underline{92.9^\circ\text{C}}$$

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 $\pm 15\text{kV}$; Contact $\pm 8\text{kV}$	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: $\pm 2\text{kV}$	EN61000-4-4:2012
Surge Immunity ⁽⁶⁾	DC Port: $\pm 2\text{kV}$	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 @ $t_a = 25^\circ\text{C}$, nominal input voltage, full load and after warm-up)

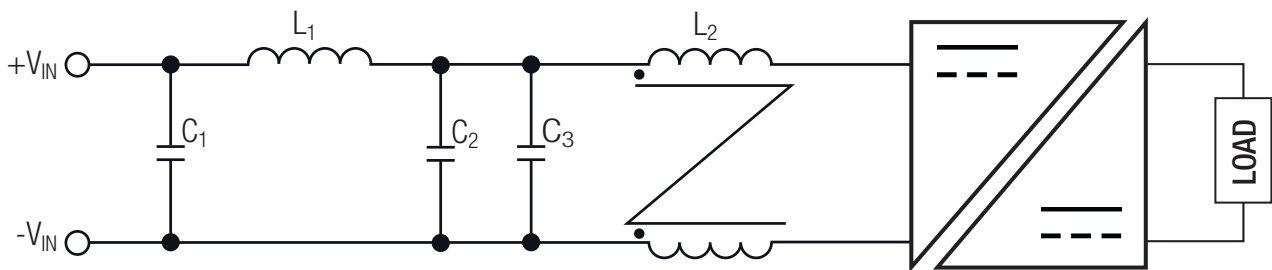
Notes:

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, 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 $\mu\text{F}/100\text{V}$)

Note7: The whole REM10 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⁾	C3 ⁽⁸⁾	L1 ⁽⁸⁾	L2 ⁽⁸⁾
REM10-05xxS_D	N/A	22 $\mu\text{F}/16\text{V}$ MLCC	22 $\mu\text{F}/16\text{V}$ MLCC	3.3 μH ; 3.3A SMD Inductor	52 μH CMC
REM10-12xxS_D REM10-24xxS_D(W)	4.7 $\mu\text{F}/50\text{V}$ MLCC	4.7 $\mu\text{F}/50\text{V}$ MLCC	N/A	10 μH ; 2.3A SMD Inductor	175 μH CMC
REM10-48xxS_D(W)	1 $\mu\text{F}/100\text{V}$ MLCC	4.7 $\mu\text{F}/100\text{V}$ MLCC	N/A	10 μH ; 2.3A SMD Inductor	419 μH CMC

Notes:

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

DIMENSION and PHYSICAL CHARACTERISTICS

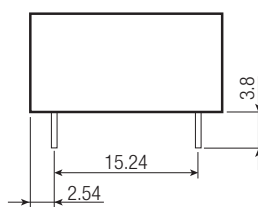
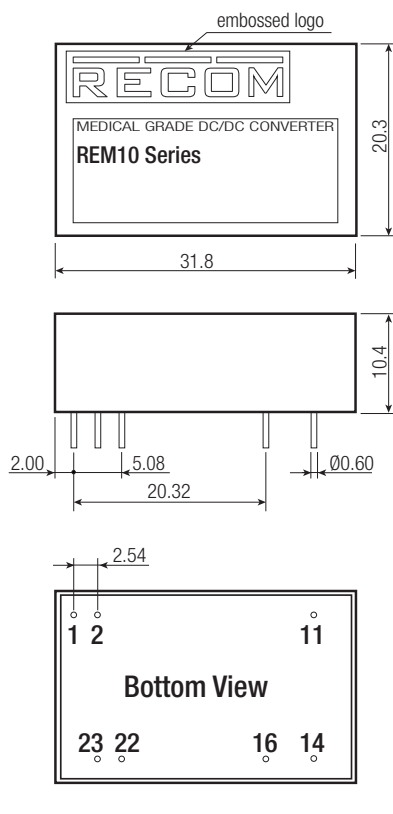
Parameter	Type	Value
Material	case	non-conductive black plastic (UL94-V2)
	PCB	FR4 (UL94-V1)
	potting	silicone (UL94-V0)
Package Dimension (LxWxH)		31.80 x 20.30 x 10.40mm
Package Weight		14g

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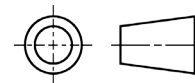
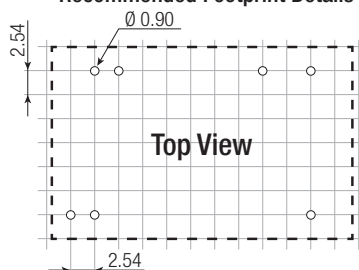
Specifications (measured @ $t_a = 25^\circ\text{C}$, nominal input voltage, full load and after warm-up)

Dimension Drawing (mm)

"A" Pinning (Standard)



Recommended Footprint Details



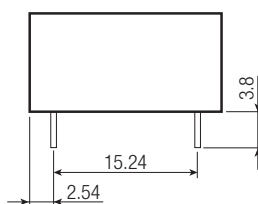
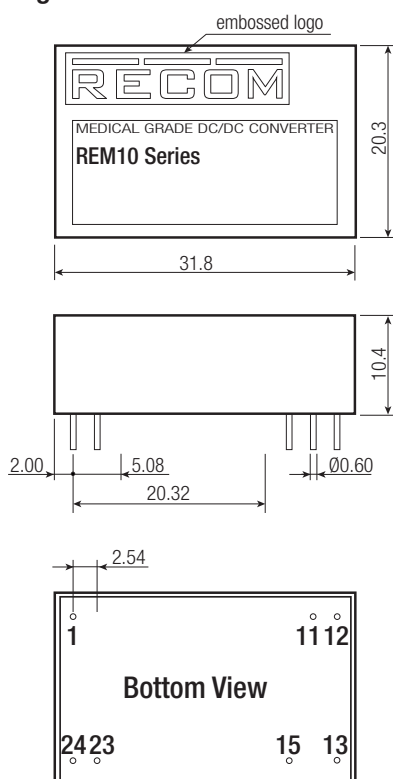
Pin Connections

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

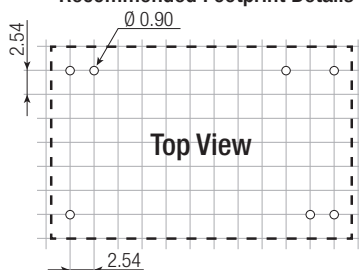
* If don't choose CTRL option, there is no pin on the corresponding pin number

NC= not connected
Tolerance: xx.x= $\pm 0.5\text{mm}$
xx.xx= $\pm 0.25\text{mm}$

"C" Pinning



Recommended Footprint Details

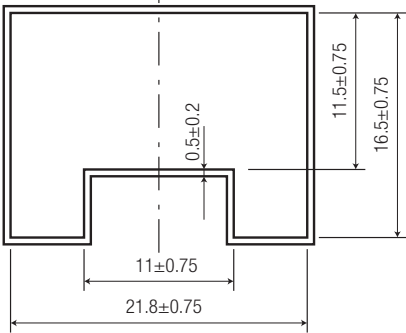


Pin Connections

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= $\pm 0.5\text{mm}$
xx.xx= $\pm 0.25\text{mm}$

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
Storage Humidity	non-condensing	5% to 95% RH max.
Tube Dimension Drawing (mm) 		

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