

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

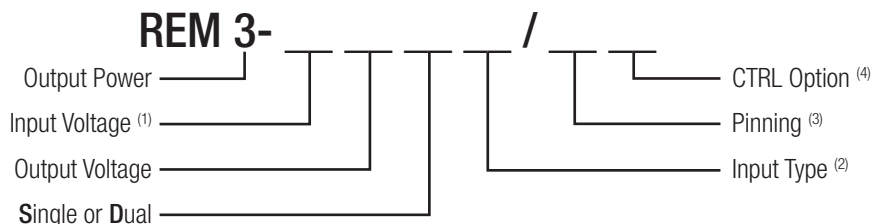
Description

The REM3 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]
REM3-xx3.3S/ ^(3,4)	5 / 12 / 24 / 48	3.3	1000	81 / 82 / 82 / 81	1050
REM3-xx05S/ ^(3,4)	5 / 12 / 24 / 48	5	600	84.5 / 84.5 / 84.5 / 84	780
REM3-xx12S/ ^(3,4)	5 / 12 / 24 / 48	12	250	85.5 / 87 / 87 / 87	130
REM3-xx15S/ ^(3,4)	5 / 12 / 24 / 48	15	200	87.5 / 87 / 87 / 86.5	100
REM3-xx24S/ ^(3,4)	5 / 12 / 24 / 48	24	125	85.5 / 87 / 87 / 86.5	39
REM3-xx05D/ ^(3,4)	5 / 12 / 24 / 48	±5	±300	83 / 83.5 / 83 / 83	±430
REM3-xx12D/ ^(3,4)	5 / 12 / 24 / 48	±12	±125	86 / 87.5 / 86 / 86	±75
REM3-xx15D/ ^(3,4)	5 / 12 / 24 / 48	±15	±100	86 / 86.5 / 86 / 86	±56
REM3-xx3.3SW/ ^(3,4)	24 / 48	3.3	1000	82 / 81	1050
REM3-xx05SW/ ^(3,4)	24 / 48	5	600	84.5 / 84	750
REM3-xx12SW/ ^(3,4)	24 / 48	12	250	87 / 87	130
REM3-xx15SW/ ^(3,4)	24 / 48	15	200	87 / 86.5	100
REM3-xx24SW/ ^(3,4)	24 / 48	24	125	87 / 86.5	39
REM3-xx05DW/ ^(3,4)	24 / 48	±5	±300	83 / 83	±430
REM3-xx12DW/ ^(3,4)	24 / 48	±12	±125	87 / 86	±75
REM3-xx15DW/ ^(3,4)	24 / 48	±15	±100	86 / 86	±56

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:

REM3-0512D/A	=	2:1 Input,	4.5-9Vin,	±12Vout,	pinout „A",	without control pin
REM3-1215S/C	=	2:1 Input,	9-18Vin,	15Vout,	pinout „C",	without control pin
REM3-4815SW/A/CTRL	=	4:1 Input,	36-75Vin,	15Vout,	pinout „A"	with control pin
REM3-243.3SW/C	=	4:1 Input,	9-36Vin,	3.3Vout,	pinout „C",	without control pin

RECOM
DC/DC Converter

REM3

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



2MOPP
250VAC

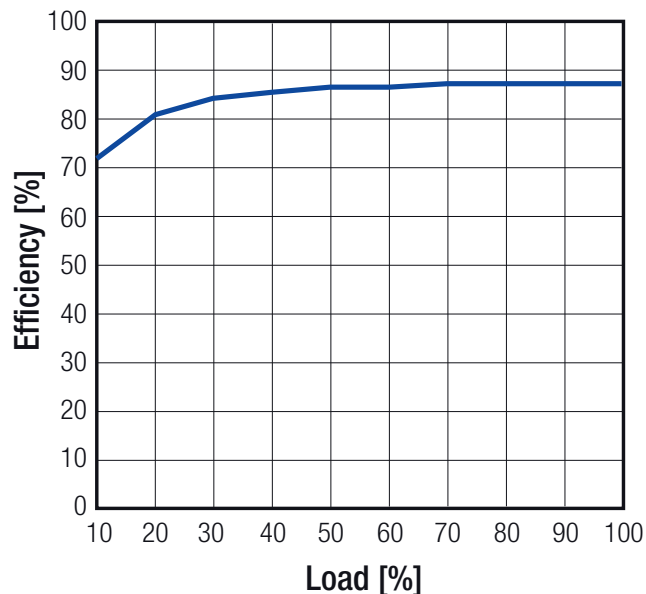
IEC/EN60601-1 Certified
CSA/CAN C22.2 60601-01 Certified
ANSI/AAMI ES60601-1 Certified
EN55011 Certified

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		135kHz	150kHz	165kHz
Output Ripple and Noise (20MHz BW limited)	10 μF /25V X7R MLCC for 3.3, 5Vout 10 μF /25V X7R MLCC for 12, 15Vout 4.7 μF /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 μs

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																	
	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. Recommended Fuse: <table><tr><th>2:1 Input Voltage</th><th>Fuse (slow blow)</th></tr><tr><td>5V</td><td>T1.25A</td></tr><tr><td>12V</td><td>T0.63A</td></tr><tr><td>24V</td><td>T0.315A</td></tr><tr><td>48V</td><td>T0.315A</td></tr></table><table><tr><th>4:1 Input Voltage</th><th>Fuse (slow blow)</th></tr><tr><td>24V</td><td>T0.63A</td></tr><tr><td>48V</td><td>T0.315A</td></tr></table>				2:1 Input Voltage	Fuse (slow blow)	5V	T1.25A	12V	T0.63A	24V	T0.315A	48V	T0.315A	4:1 Input Voltage	Fuse (slow blow)	24V	T0.63A	48V	T0.315A
2:1 Input Voltage	Fuse (slow blow)																		
5V	T1.25A																		
12V	T0.63A																		
24V	T0.315A																		
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4:1 Input Voltage	Fuse (slow blow)																		
24V	T0.63A																		
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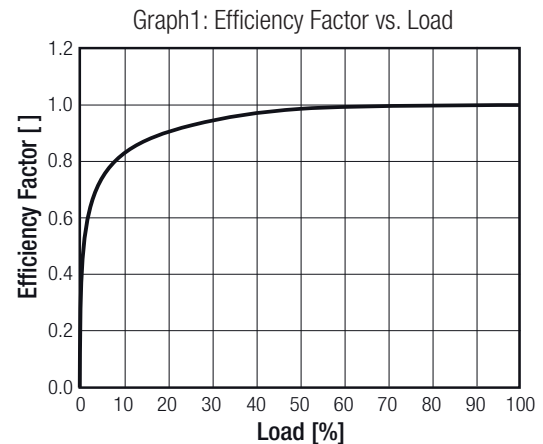
ENVIRONMENTAL		
Parameter	Condition	Value
Operating Humidity		5% to 95% RH
Temperature Coefficient		$\pm 0.02\%$ / $^\circ\text{C}$
Thermal Impedance	natural convection (20LFM)	18 $^\circ\text{C}$ / W
Operating Altitude		5000m
Pollution Degree		PD2
Thermal Shock		MIL-STD-810F
Vibration		MIL-STD-810F
MTBF (+25 $^\circ\text{C}$)	according to MIL-HDBK-217F, full load	6444 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	81	82	82	81	82	81
	05S	84.5	84.5	84.5	84	84.5	84
	12S	85.5	87	87	87	87	87
	15S	87.5	87	87	86.5	87	86.5
	24S	85.5	87	87	86.5	87	86.5
	05D	83	83.5	83	83	83	83
	12D	86	87.5	86	86	87	86
	15D	86	86.5	86	86	86	86



choose your model:

REM3-1212D

- Efficiency from Table1 (= 87.5% @ max Load / nom Vin)
- Loading conditions in application (e.g. 50%)
- use Eff factor from Graph1 (= 0.98 @50%)

Calculation:

$V_{in} = 12V$
 $I_{out} = 50\%$
 $Eff_{100\%} = 87.5\%$
 $Eff_{factor50\%} = 0.98$
 $R_{th} = 18^\circ\text{C/W}$
 $T_{CASEmax} = 105^\circ\text{C}$

$$Eff_{50\%} = Eff_{100\%} * Eff_{factor50\%} = 87.5 * 0.98 = \underline{85.75\%}$$

$$P_{DIS50\%} = P_{in50\%} - P_{out50\%} = \frac{P_{out100\%} * 0.5}{Eff_{50\%}} - (P_{out100\%} * 0.5) = 1.75 - 1.5 = \underline{0.25W}$$

$$T_{OVER} = R_{th} * P_{DIS50\%} = 18 * 0.25 = \underline{4.5^\circ\text{C}}$$

$$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105 - 4.5 = \underline{100.5^\circ\text{C}}$$

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)

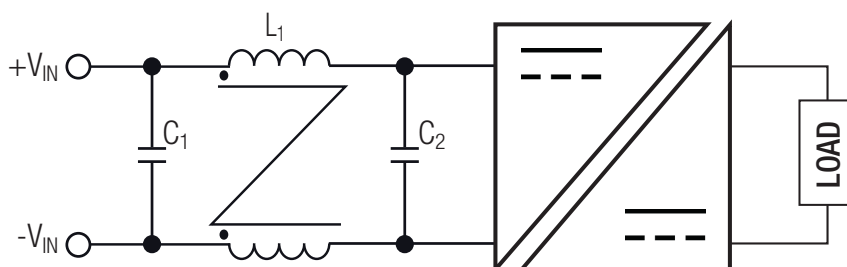
Notes:

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

<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 REM3 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⁾
REM3-05xxS_D	22 μF /16V MLCC	22 μF /16V MLCC	137 μH CMC
REM3-12xxS_D REM3-24xxS_D(W)	4.7 μF /50V MLCC	4.7 μF /50V MLCC	277 μH CMC
REM3-48xxS_D(W)	2.2 μF /100V MLCC	1 μF /100V MLCC	175 μH CMC

Notes:

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

DIMENSION and PHYSICAL CHARACTERISTICS

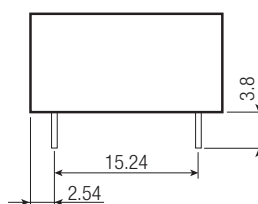
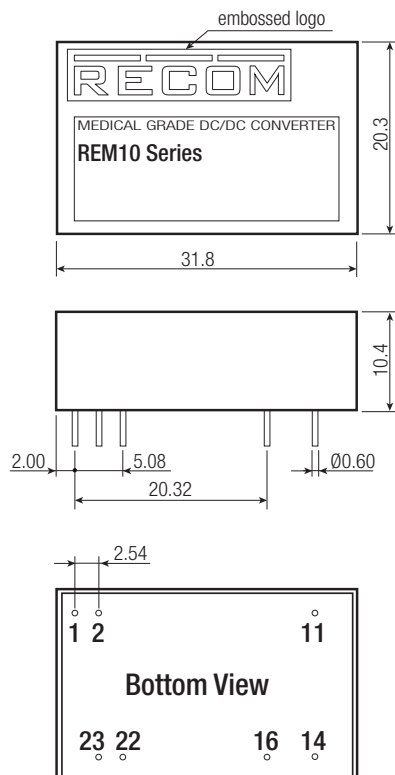
Parameter	Type	Value
Material	Case	non-conductive black plastic (UL94-V2)
	PCB	FR4 (UL94-V1)
	Potting	silicone (UL94-V0)
Package Dimension (LxWxH)		31.80 x 20.30 x 10.40mm
Package Weight		14g

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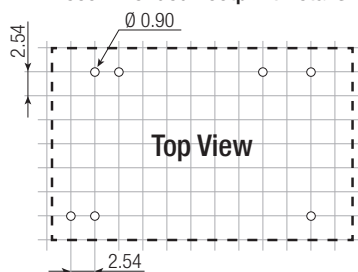
Specifications (measured @ $t_a = 25^\circ\text{C}$, nominal input voltage, full load and after warm-up)

Dimension Drawing (mm)

"A" Pinning (Standard)



Recommended Footprint Details



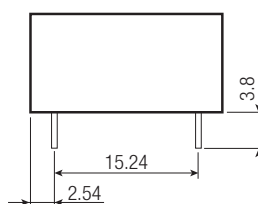
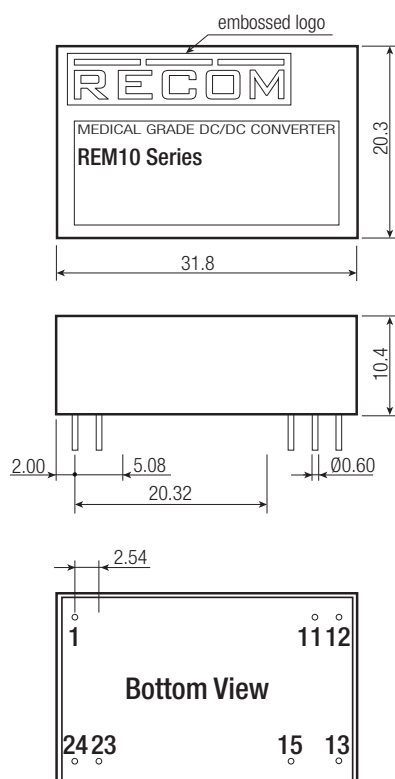
Pin Connections

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

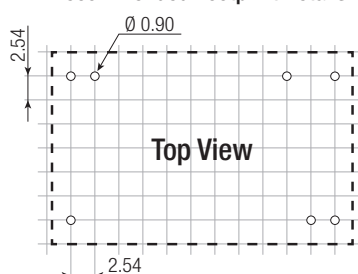
* If don't choose CTRL option, there is no pin on the corresponding pin number

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

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