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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

REM10

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

5 YEAR Warranty

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

E314885

2MOPP 250VAC

Model Numbering

REM10- ____ ____ ____ / ____ ____

- Output Power
- Input Voltage (1)
- Output Voltage
- Single or Dual
- CTRL Option (4)
- Pinning (3)
- Input Type (2)

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

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

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

BASIC CHARACTERISTICS

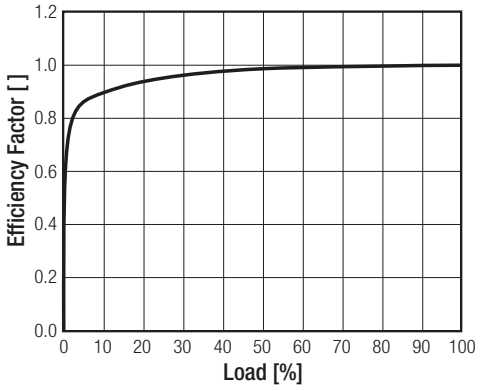
Parameter	Condition		Min.	Typ.	Max.
Absolute Maximum Input Voltage (3sec max.)	2:1	5Vin nom.			16VDC
		12Vin nom.			25VDC
		24Vin nom.			50VDC
		48Vin nom.			100VDC
	4:1	24Vin nom.			50VDC
		48Vin nom.			100VDC
Under Voltage Lockout	2:1	5Vin nom.	4VDC		4.5VDC
		12Vin nom.	8VDC		9VDC
		24Vin nom.	16VDC		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	
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 4.7µF/50V X7R MLCC for 24Vout			30mVp-p 40mVp-p 50mVp-p	

Efficiency

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	855	89	89	88	89	88
	15D	86.5	88	88	88	88	88

Graph1: Efficiency Factor vs. Load

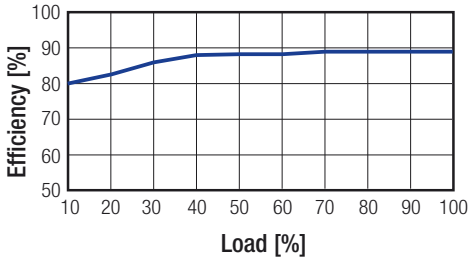


Calculation Example:

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:

Vin = 12V
Iout = 50%
$Eff_{100\%}$ = 89%
$Eff_{factor50\%}$ = 0.99
R_{th} = 18°C/W
$T_{CASEmax}$ = 105°C

$$Eff_{50\%} = Eff_{100\%} * Eff_{factor50\%} = 89 * 0.991 = \underline{\mathbf{88.19\%}}$$

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

$$T_{OVER} = R_{th} * P_{DIS50\%} = 18 * 0.67 = \underline{\mathbf{12.1°C}}$$

$$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105 - 12.1 = \underline{\mathbf{92.9°C}}$$

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

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

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 Single 5Vout Single 12Vout Single 15Vout Single 24Vout	3.7VDC min. / 5VDC max. 5.6VDC min. / 7VDC max. 13.5VDC min. / 16VDC max. 18.3VDC min. / 22VDC max. 29.1VDC min. / 34.5VDC max.
		Dual 5Vout Dual 12Vout Dual 15Vout	5.6VDC min. / 7VDC max. 13.5VDC min. / 18.2VDC max. 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 Dual	>19.72mm >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	T5A
12V	T2A
24V	T1A
48V	T0.5A

4:1 Input Voltage	Fuse (slow blow)
24V	T2A
48V	T1A

ENVIRONMENTAL

Parameter	Condition	Value
Operating Humidity		5% to 95% RH
Temperature Coefficient		±0.02% / °C
Thermal Impedance	natural convection (20LFM)	18°C / W
MTBF (+25°C)	according to MIL-HDBK-217F, full load	3849 x 10^3 hours
max. Case Temperature Range max. Ambient Temperature Range		-40°C to +105°C see calculation example

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

SAFETY AND CERTIFICATIONS

Certificate Type	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 (Environmental)	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
Power Frequency Magnetic Field	10A/m	EN61000-4-8, Criteria A
Thermal Shock		MIL-STD-810F
Vibration		MIL-STD-810F

Notes:

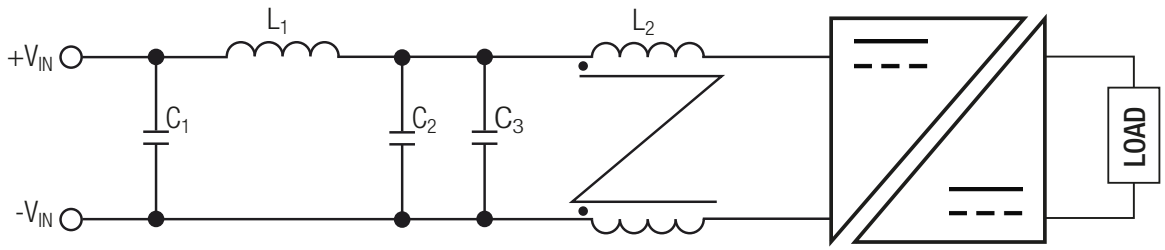
Note6: An external input filter capacitor is required if the model has to meet EN61000-4-4 or/and EN61000-4-5.

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 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	22µF/16V MLCC	22µF/16V MLCC	3.3µH; 3.3A SMD Inductor	52µH CMC
REM10-12xxS_D REM10-24xxS_D REM10-24xxS_D/W	4.7µF/50V MLCC	4.7µF/50V MLCC	N/A	10µH; 2.3A SMD Inductor	175µH CMC
REM10-48xxS_D REM10-48xxS_D/W	1µF/100V MLCC	4.7µF/100V MLCC	N/A	10µH; 2.3A SMD Inductor	419µH CMC

Notes:

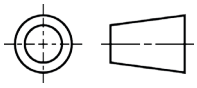
Note8: The component values can be adapted according to customers' applictation.

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

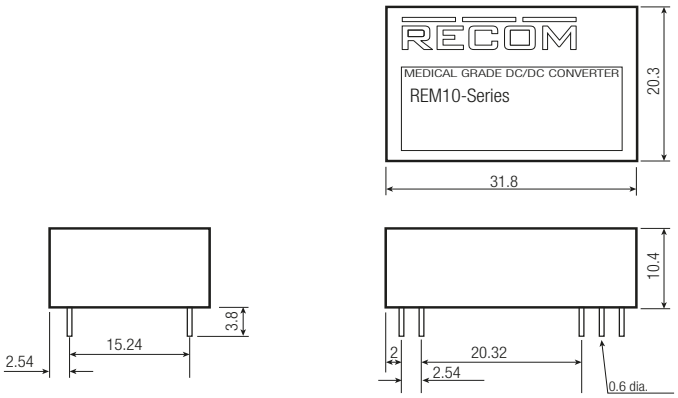
DIMENSION and PHYSICAL CHARACTERISTICS

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

Dimension Drawing (mm)



"C" Pinning

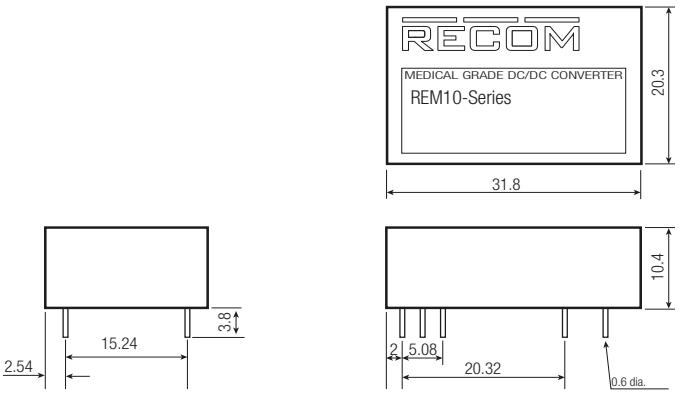


Pin Connections

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

"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

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)