

# 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

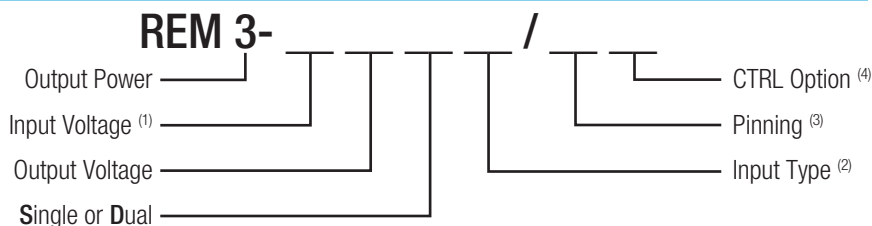
## Description

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 CE and UL marks.

## Selection Guide

Part Number	Input Voltage Range (VDC)	Output Voltage (VDC)	Output Current (mA)	Efficiency typ. (%)	Max. Capacitive Load (µF)
REM3-xx3.3S/ <sup>(3,4)</sup>	4.5-9 / 9-18 / 18-36 / 36-75	3.3	1000	81 / 82 / 82 / 81	1050
REM3-xx05S/ <sup>(3,4)</sup>	4.5-9 / 9-18 / 18-36 / 36-75	5	600	84.5 / 84.5 / 84.5 / 84	780
REM3-xx12S/ <sup>(3,4)</sup>	4.5-9 / 9-18 / 18-36 / 36-75	12	250	85.5 / 87 / 87 / 87	130
REM3-xx15S/ <sup>(3,4)</sup>	4.5-9 / 9-18 / 18-36 / 36-75	15	200	87.5 / 87 / 87 / 86.5	100
REM3-xx24S/ <sup>(3,4)</sup>	4.5-9 / 9-18 / 18-36 / 36-75	24	125	85.5 / 87 / 87 / 86.5	39
REM3-xx05D/ <sup>(3,4)</sup>	4.5-9 / 9-18 / 18-36 / 36-75	±5	±300	83 / 83.5 / 83 / 83	±430
REM3-xx12D/ <sup>(3,4)</sup>	4.5-9 / 9-18 / 18-36 / 36-75	±12	±125	86 / 87.5 / 86 / 86	±75
REM3-xx15D/ <sup>(3,4)</sup>	4.5-9 / 9-18 / 18-36 / 36-75	±15	±100	86 / 86.5 / 86 / 86	±56
REM3-xx3.3SW/ <sup>(3,4)</sup>	9-36 / 18-75	3.3	1000	82 / 81	1050
REM3-xx05SW/ <sup>(3,4)</sup>	9-36 / 18-75	5	600	84.5 / 84	750
REM3-xx12SW/ <sup>(3,4)</sup>	9-36 / 18-75	12	250	87 / 87	130
REM3-xx15SW/ <sup>(3,4)</sup>	9-36 / 18-75	15	200	87 / 86.5	100
REM3-xx24SW/ <sup>(3,4)</sup>	9-36 / 18-75	24	125	87 / 86.5	39
REM3-xx05DW/ <sup>(3,4)</sup>	9-36 / 18-75	±5	±300	83 / 83	±430
REM3-xx12DW/ <sup>(3,4)</sup>	9-36 / 18-75	±12	±125	87 / 86	±75
REM3-xx15DW/ <sup>(3,4)</sup>	9-36 / 18-75	±15	±100	86 / 86	±56

## Model Numbering



### Notes:

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

2:1		4:1 "W"	
xx= 4.5-9Vin	= "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:

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

Refer to Applications Notes

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

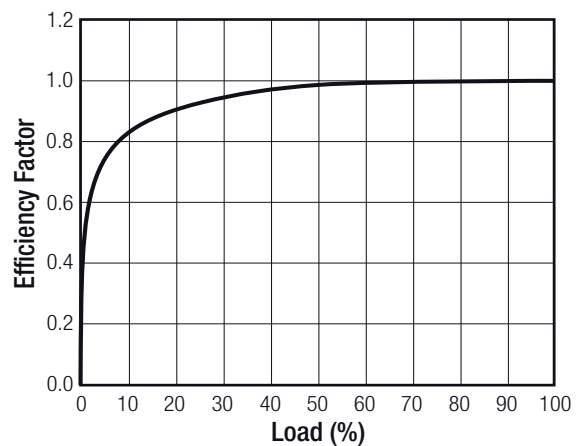
BASIC CHARACTERISTICS					
Parameter	Condition		Min.	Typ.	Max.
Absolute Maximum Input Voltage (3sec max.)	2:1	5Vin nom.			16VDC
		12Vin nom.			25VDC
	4:1	24Vin nom.			50VDC
		48Vin nom.			100VDC
		24Vin nom.			50VDC
		48Vin nom.			100VDC
Under Voltage Lockout	2:1	5Vin nom.	4VDC		4.5VDC
		12Vin nom.	8VDC		9VDC
	4:1	24Vin nom.	16VDC		18VDC
		48Vin nom.	33VDC		36VDC
		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			135kHz	150kHz	165kHz
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

Graph1 : Efficiency Factor vs. Load

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



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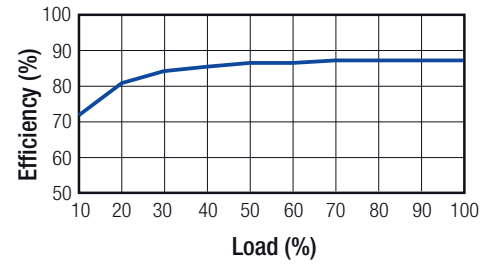
**Specifications** (measured at T<sub>A</sub>= 25°C, nominal input voltage, full load and after warm-up)

**Calculation Example:**

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<sub>in</sub> = 12V  
 I<sub>out</sub> = 50%  
 Eff<sub>100%</sub> = 87.5%  
 Eff<sub>factor50%</sub> = 0.98  
 R<sub>th</sub> = 18°C/W  
 T<sub>CASEmax</sub> = 105°C

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

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

$$T_{OVER} = R_{th} * P_{DIS50\%} = 18 * 0.25 = \mathbf{4.5°C}$$

$$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105 - 4.5 = \mathbf{100.5°C}$$

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 <sub>out</sub> rated			Hiccup mode, 150% typ.
Output Over Voltage Protection (OVP)	Single	3.3V <sub>out</sub>		3.7VDC min. / 5VDC max.
		5V <sub>out</sub>		5.6VDC min. / 7VDC max.
		12V <sub>out</sub>		13.5VDC min. / 16VDC max.
		15V <sub>out</sub>		18.3VDC min. / 22VDC max.
		24V <sub>out</sub>		29.1VDC min. / 34.5VDC max.
	Dual	5V <sub>out</sub>		5.6VDC min. / 7VDC max.
12V <sub>out</sub>			13.5VDC min. / 18.2VDC max.	
15V <sub>out</sub>			17VDC min. / 22VDC max.	

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## Specifications (measured at T<sub>A</sub>= 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	T1.25A	24V	T0.63A
	12V	T0.63A	48V	T0.315A
	24V	T0.315A		
	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	6444 x 10 <sup>3</sup> 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 <sup>(7)</sup>	Conducted Radiated Conducted and Radiated	CISPR 11, EN55011, Class A, B CISPR 11, EN55011, 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 <sup>(6)</sup>	±2kV	EN61000-4-4, Criteria A
Surge <sup>(6)</sup>	±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:**

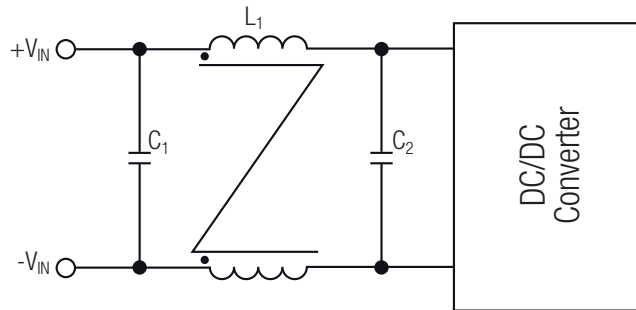
Note6: An external input filter capacitor is required if the model has to meet EN61000-4-4 or/and EN61000-4-5.

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 REM3 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 <sup>(8)</sup>	C2 <sup>(8)</sup>	L1 <sup>(8)</sup>
REM3-05xxS_D	22 $\mu\text{F}/16\text{V}$ MLCC	22 $\mu\text{F}/16\text{V}$ MLCC	33mH WE 744825433
REM3-12xxS_D REM3-24xxS_D REM3-24xxS_D/W	4.7 $\mu\text{F}/50\text{V}$ MLCC	4.7 $\mu\text{F}/50\text{V}$ MLCC	500 $\mu\text{H}$ WE 744223
REM3-48xxS_D REM3-48xxS_D/W	2.2 $\mu\text{F}/100\text{V}$ MLCC	1 $\mu\text{F}/100\text{V}$ MLCC	200 $\mu\text{H}$ WE 744272221

**Notes:**

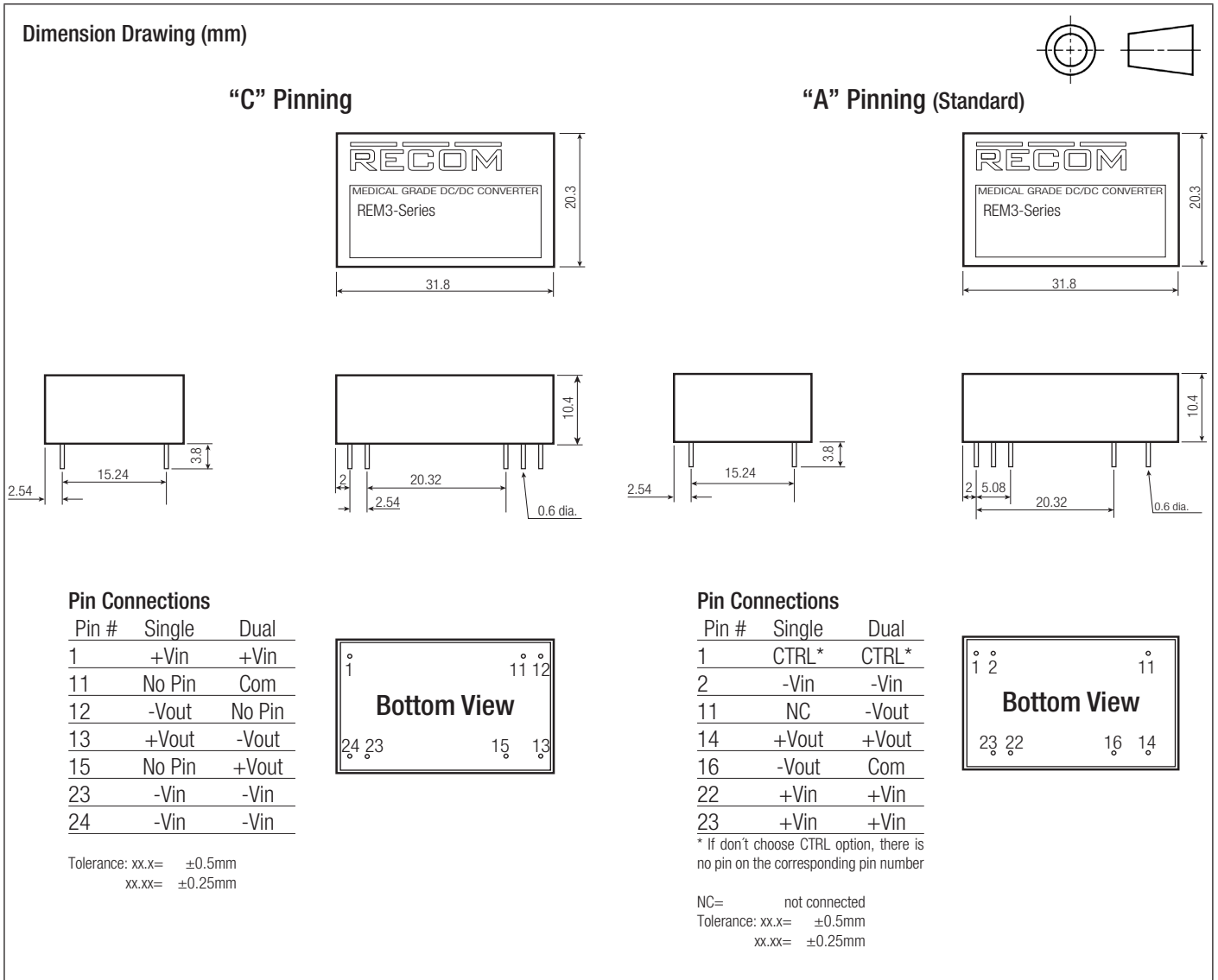
Note8: The component values can be adapted according to customers' application.

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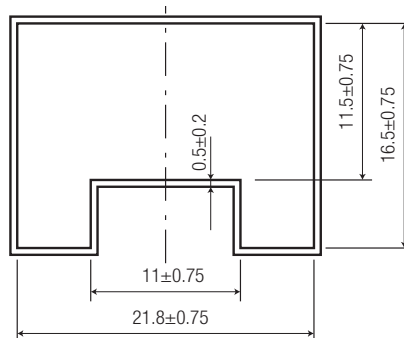
Specifications (measured at  $T_A = 25^\circ\text{C}$ , nominal input voltage, full load and after warm-up)



**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

**Tube Dimension Drawing (mm)**



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