

# Features

- 2MOPP, 250VAC working voltage isolation
- Clearance and creepage distance >8mm
- Up to 10kVDC reinforced insulation
- IEC/EN/UL 60601 certified with CB Report (3rd Ed. Safety, 4th Ed. EMC)
- -40°C to +80°C operation, no derating
- 2:1 wide input range

# Regulated Converter



## REM5E

5 Watt  
2:1 Input  
DIP24  
Single & Dual  
Output



2MOPP  
250VAC



## Description

The REM5E series of medical grade regulated DC/DC converters feature reinforced 250VAC continuous working isolation with >8mm creepage/clearance. The compact DIP24 package offers industry standard pinouts with tightly regulated single/dual outputs and UVLO, SCP, OCP and OVP. The operating ambient temperature range is from -40°C to +80°C without derating. The converters are UL marked and certified to CB, IEC, EN and ANSI/AAMI 60601 3rd. Ed. Safety and 4th Ed. EMC medical standards. The low 1µA leakage current makes them suitable for medical B, BF and CF applications.

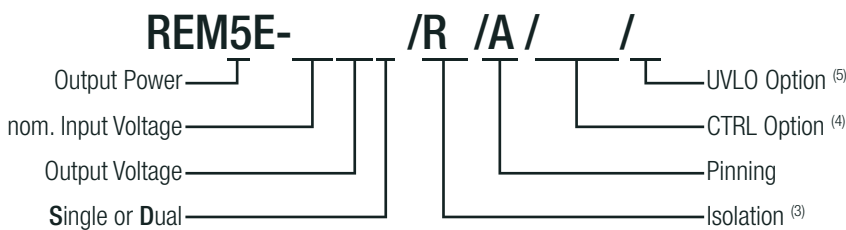
## Selection Guide

Part Number	nom. Input Voltage [VDC]	Output Voltage [VDC]	Output Current [mA]	Efficiency typ. <sup>(1)</sup> [%]	Max. Capacitive Load <sup>(2)</sup> [µF]
REM5E-xx05S/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	5	1000	75 / 80 / 81 / 82	4700
REM5E-xx09S/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	9	556	80 / 81 / 82 / 83	4700
REM5E-xx12S/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	12	417	81 / 82 / 84 / 82	2200
REM5E-xx15S/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	15	333	81 / 83 / 84 / 84	2200
REM5E-xx24S/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	24	208	82 / 83 / 84 / 85	1000
REM5E-xx05D/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	±5	±500	75 / 80 / 81 / 82	±2200
REM5E-xx09D/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	±9	±277	80 / 81 / 82 / 83	±1600
REM5E-xx12D/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	±12	±208	81 / 82 / 83 / 84	±1000
REM5E-xx15D/R <sup>(3)</sup> /A <sup>(4,5)</sup>	5 / 12 / 24 / 48	±15	±166	82 / 82 / 84 / 84	±1000

### Notes:

- Note1: Efficiency is tested at nominal input and full load at +25°C ambient  
 Note2: Max Cap Load is tested at nominal input and full resistive load

## Model Numbering



### Notes:

- Note3: add suffix „/R8“ for 8kVDC or „/R10“ for 10kVDC isolation  
 Note4: add suffix „/CTRL“ for fitted CTRL pin  
 Note5: add suffix „/X1“ for Under Voltage Lockout Option  
 Note6: SMD versions available from Q2/2019

CAN/CSA-C22.2 No. 60601-1:14  
 ANSI/AAMI ES60601-1  
 EN60601-1 pending  
 IEC60601-1 pending  
 IEC60601-1-2 pending  
 EN55032 pending

### Ordering Examples

- REM5E-0505S/R8/A = 5Vin, 5Vout, Single, 8kVDC Isolation and „A“ pinning, DIP24  
 REM5E-1205D/R10/A/CTRL = 12Vin, 5Vout, Dual, 10kVDC Isolation, „A“ pinning, with CTRL pin  
 REM5E-2405S/R8/A/X1 = 24Vin, 5Vout, Single, 8kVDC Isolation, „A“ pinning, DIP24 and with UVLO Option  
 REM5E-2405D/R10/A/CTRL/X1 = 24Vin, 5Vout, Dual, 10kVDC Isolation, „A“ pinning, DIP24, CTRL pin and UVLO Option

**Specifications** (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

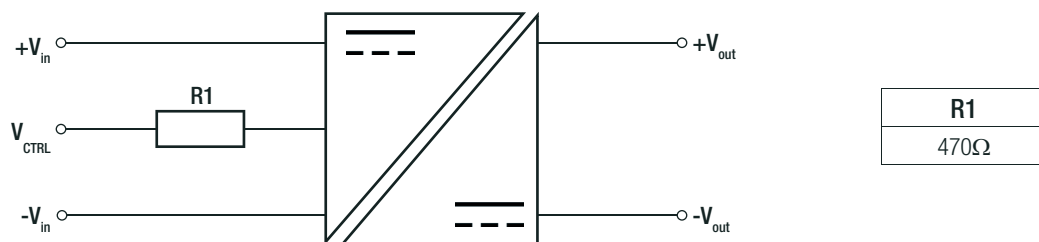
**BASIC CHARACTERISTICS**

Parameter	Condition	Min.	Typ.	Max.
Internal Input Filter				Pi-type
Input Voltage Range	nom. Vin = 5VDC nom. Vin = 12VDC nom. Vin = 24VDC nom. Vin = 48VDC	4.5VDC 9VDC 18VDC 36VDC	5VDC 12VDC 24VDC 48VDC	9VDC 18VDC 36VDC 75VDC
Under Voltage Lockout (UVLO) (X1 version)	nom. Vin= 5VDC		DC-DC ON DC-DC OFF	4.5VDC
	nom. Vin= 12VDC		DC-DC ON DC-DC OFF	3.9VDC
	nom. Vin= 24VDC		DC-DC ON DC-DC OFF	7.9VDC
	nom. Vin= 48VDC		DC-DC ON DC-DC OFF	16.7VDC
Input Current	nom. Vin = 5VDC nom. Vin = 12VDC nom. Vin = 24VDC nom. Vin = 48VDC			1200mA 520mA 250mA 130mA
Quiescent Current	nom. Vin = 5VDC nom. Vin = 12VDC nom. Vin = 24VDC nom. Vin = 48VDC			70mA 30mA 7mA 3.5mA
Minimum Load <sup>(6)</sup>				10%
Start-up time				0.45ms
Rise time				35ms
Hold-up time				0.6ms
ON/OFF CTRL	DC-DC ON DC-DC OFF			Open or 0VDC < V <sub>CTRL</sub> < 1.2VDC Short or 4.8VDC < V <sub>CTRL</sub> < 12VDC
Input Current of CTRL Pin	V <sub>CTRL</sub> = 5VDC			25mA
Standby Current	DC-DC OFF			350µA
Internal Operating Frequency		120kHz		
Output Ripple and Noise <sup>(7)</sup>	20MHz BW			150mVp-p

**Notes:**

Note7: Measurements are made with a 0.1µF MLCC across output. (low ESR)

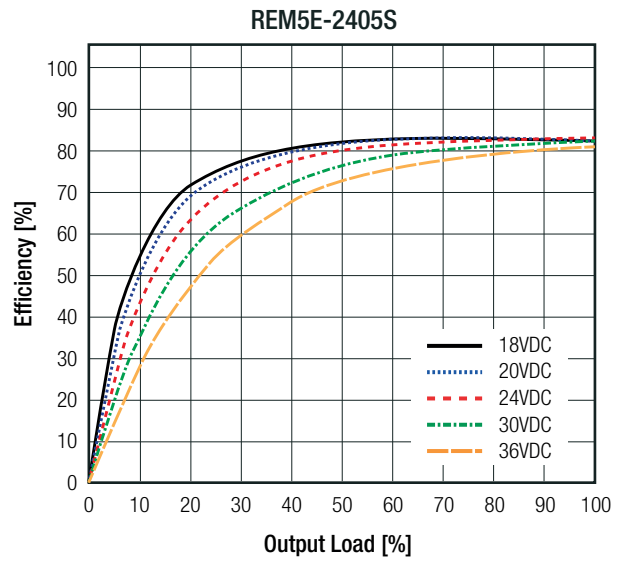
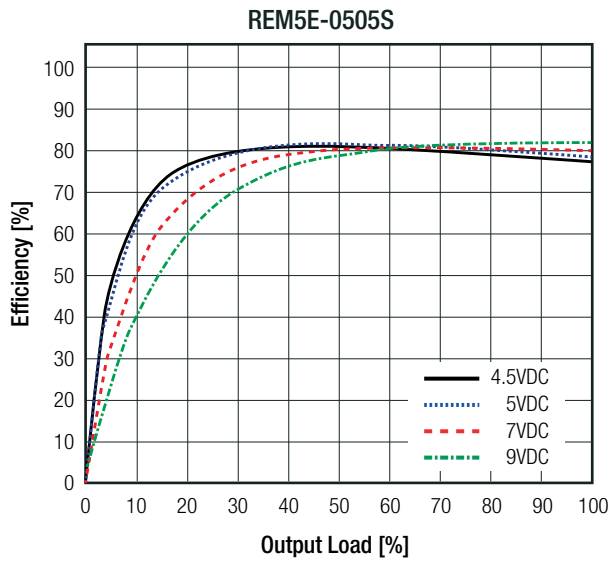
**ON/OFF CTRL Option**



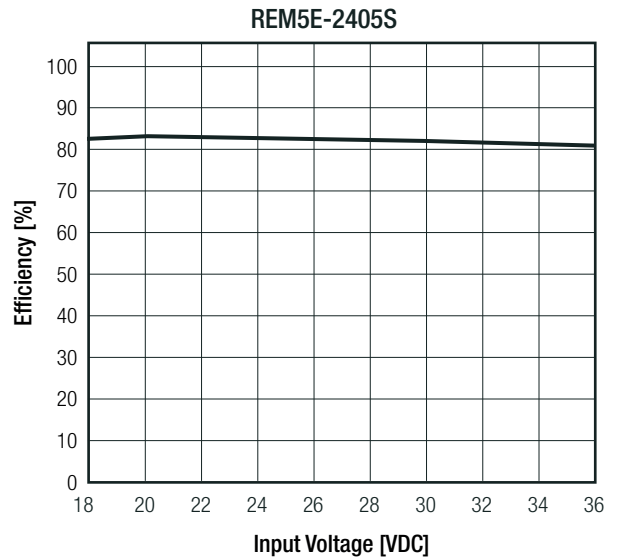
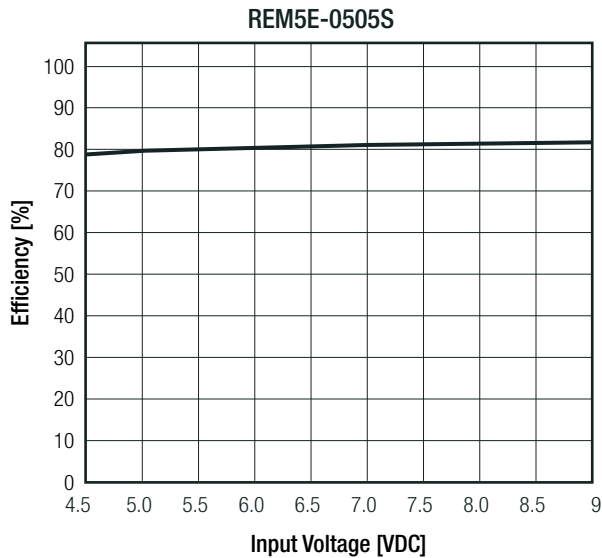
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Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Efficiency vs. Output Load



Efficiency vs. Input Voltage  
(@ full Load)



**REGULATIONS**

Parameter	Condition	Value
Output Accuracy		±1.5% typ.
Line Regulation	low line to high line, full load	±0.3% max.
Load Regulation <sup>(8)</sup>	10% to 100% load	0.5% typ.
Cross Regulation	dual output only	±5.0% max.
Transient Response	25% load step change	5ms

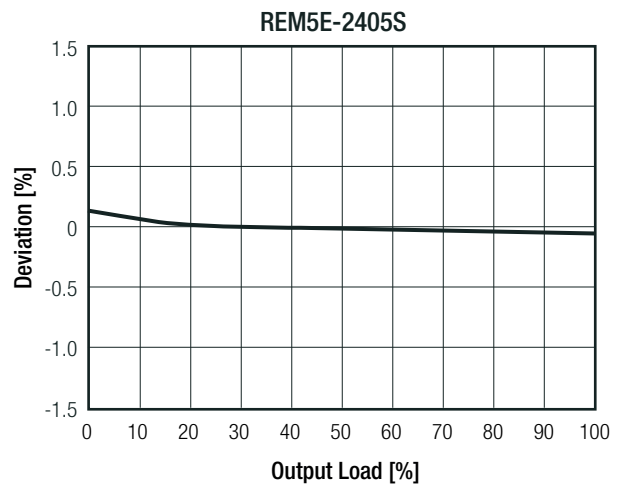
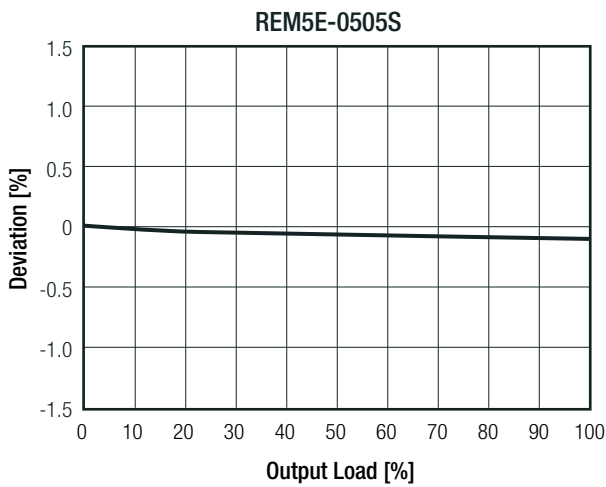
**Notes:**

Note8: Operation below 10% load will not harm the converter, but specifications may not be met

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**Specifications** (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Deviation vs. Load



**PROTECTIONS**

Parameter	Type			Value
Short Circuit Protection (SCP)	below 100mΩ			continuous, hiccup mode automatic recovery
Isolation Voltage <sup>(9)</sup>	"/R8" suffix	I/P to O/P	tested for 1 second rated for 1 minute	8kVDC 4kVAC/60Hz
	"/R10" suffix	I/P to O/P	tested for 1 second rated for 1 minute	10kVDC 5kVAC/60Hz
Isolation Resistance				10GΩ min.
Isolation Capacitance				20pF typ.
Insulation Grade				reinforced
Leakage Current				0.8μA typ. / 1μA max.
Means of Protection	250VAC working voltage			2MOPP
Medical Device Classification				built-in power supply
Internal	clearance/creepage			>8mm
External	clearance/creepage			>8mm

**Notes:**

Note9: For repeat Hi-Pot testing, reduce the time and/or the test voltage

Note10: Refer to local safety regulations if input over-current protection is also required. Recommended fuse: slow blow type

**ENVIRONMENTAL**

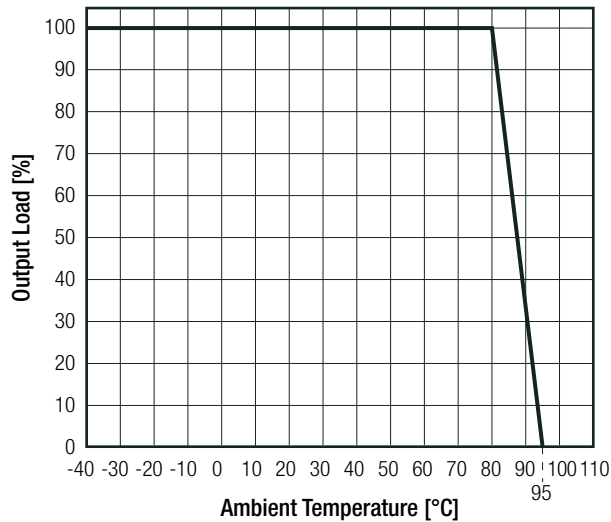
Parameter	Condition		Value
Operating Temperature Range	full load @ natural convection 0.1m/s (see graph)		-40°C to +80°C
Maximum Case Temperature			+105°C
Temperature Coefficient			±0.02%/K typ. / ±0.05%/K max.
Thermal Impedance	0.1m/s, horizontal		20K/W
Operating Altitude			3000m
Operating Humidity	non-condensing		5% - 95% RH max.
Pollution Degree			PD2
MTBF	according to MIL-HDBK-217F, G.B.	+25°C	2400 x 10 <sup>3</sup> hours
		+80°C	510 x 10 <sup>3</sup> hours

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**Specifications** (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

**Derating Graph**

(@ Chamber and natural convection 0.1m/s)

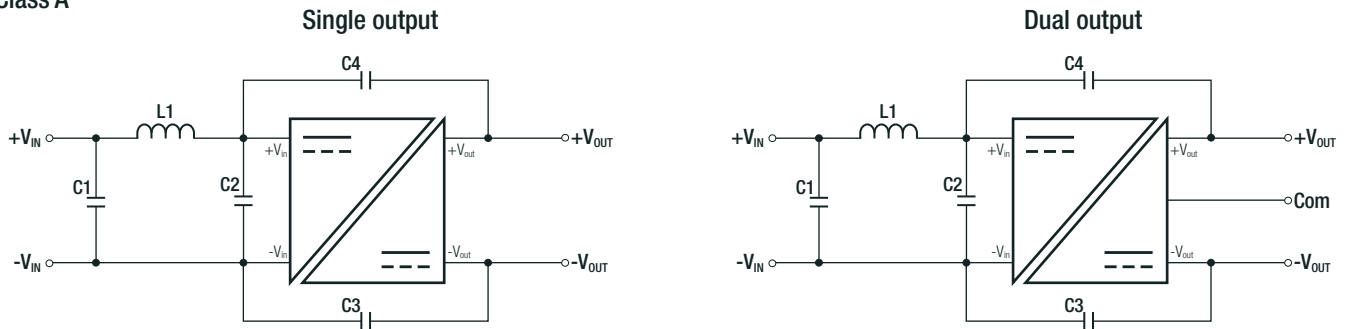


<b>SAFETY AND CERTIFICATIONS</b>		
<b>Certificate Type (Safety)</b>	<b>Report / File Number</b>	<b>Standard</b>
Medical Electric Equipment, General Requirements for Safety and Essential Performance	E314885	CAN/CSA-C22.2 No. 60601-1:14, 3rd Edition: 2014 ANSI/AAMI ES60601-1:2012
Medical Electric Equipment, General Requirements for Safety and Essential Performance	pending	EN60601-1:2006 + A12:2014
Medical Electric Equipment, General Requirements for Safety and Essential Performance (CB Scheme)	pending	IEC60601-1:2005, 3rd Edition + AM1:2012
RoHS 2+		RoHS 2011/65/EU + AM2015/863
<b>EMC Compliance</b>	<b>Condition</b>	<b>Standard / Criterion</b>
Medical electrical equipment Part 1-2: Electromagnetic disturbances – Requirements and tests	pending	IEC60601-1-2
Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	with external filter	EN55032, Class A and B
ESD Electrostatic discharge immunity test	Air ±15kV, Contact ±8kV	EN61000-4-2, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	10V/m	EN61000-4-3, Criteria A
Fast Transient and Burst Immunity	DC Power Port: ±2kV	EN61000-4-4, Criteria A
Surge Immunity	DC Power Port: ±1kV	EN61000-4-5, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	10Vr.m.s	EN61000-4-6, Criteria A
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Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

### EMC Filtering Suggestions according to EN55032

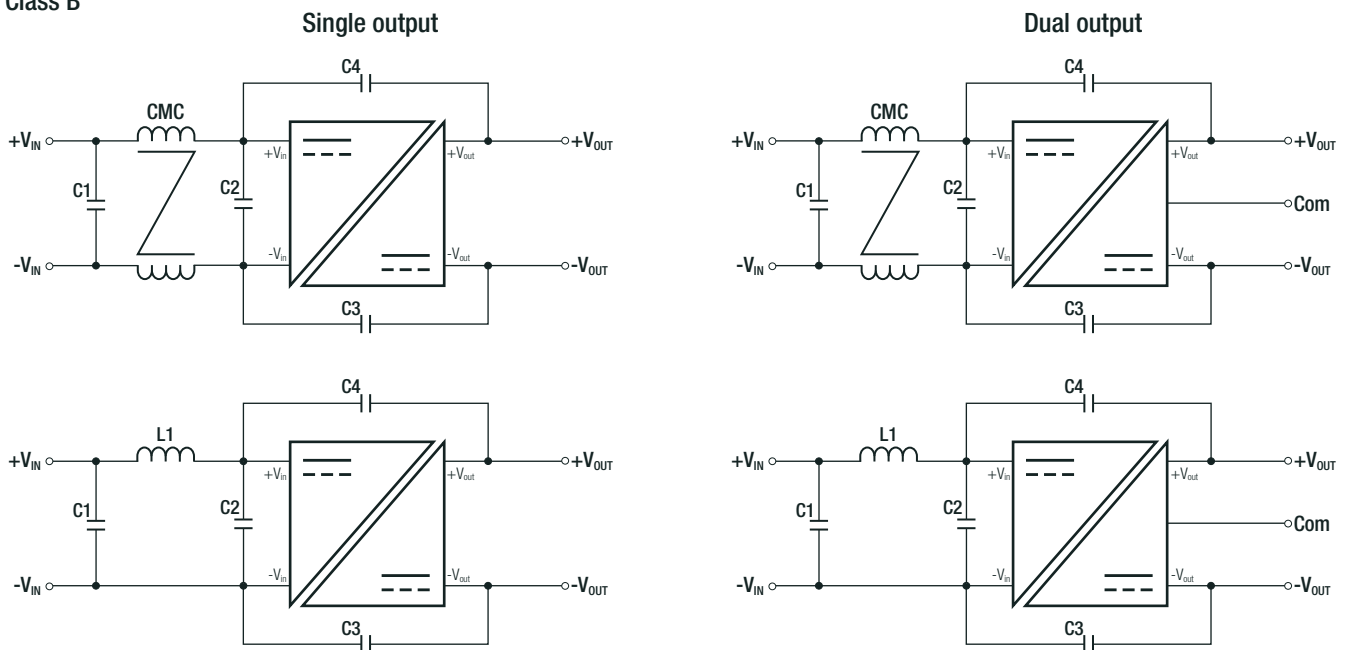
#### Class A



#### Component List Class A

MODEL	C1	C2	C3	C4	L1
REM5E-05xxS/R/A and REM5E-12xxS/R/A	4.7µF/50V	N/A	100pF/12kV	N/A	3.3µH
REM5E-24xxS/R/A and REM5E-48xxS/R/A			150pF/12kV		
REM5E-05xxD/R/A and REM5E-12xxD/R/A	10µF/100V		100pF/12kV	100pF/12kV	
REM5E-24xxD/R/A and REM5E-48xxD/R/A			150pF/12kV	150pF/12kV	

#### Class B



#### Component List Class B

MODEL	C1	C2	C3	C4	L1	CMC
REM5E-05xxS/R/A	4.7µF/50V	N/A	100pF/12kV	N/A	N/A	0.2mH
REM5E-12xxS/R/A		4.7µF/50V	220pF/12kV		50µH	N/A
REM5E-24xxS/R/A	10µF/100V	10µF/100V	220pF/12kV		N/A	1mH
REM5E-48xxS/R/A			330pF/12kV			
REM5E-05xxD/R/A	4.7µF/50V	N/A	100pF/12kV	100pF/12kV	N/A	0.2mH
REM5E-12xxD/R/A		4.7µF/50V	220pF/12kV	220pF/12kV	50µH	N/A
REM5E-24xxD/R/A	10µF/100V	10µF/100V	220pF/12kV	220pF/12kV		
REM5E-48xxD/R/A			330pF/12kV	330pF/12kV	N/A	1mH

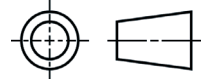
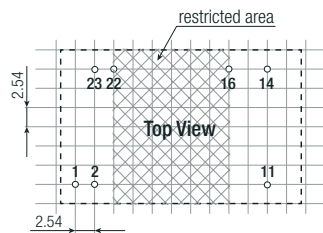
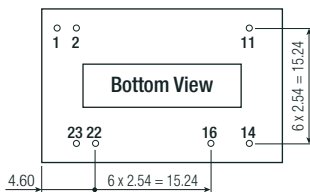
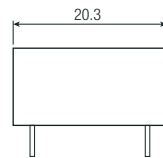
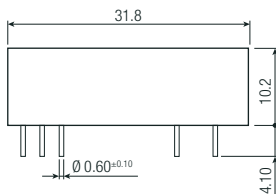
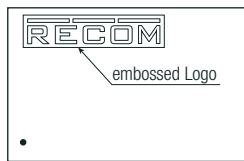
**Specifications** (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

**DIMENSION and PHYSICAL CHARACTERISTICS**

Parameter	Type	Value
Material	baseplate case potting	non-conductive black plastic, (UL94 V-0) non-conductive black plastic, (UL94 V-0) silicone, (UL94 V-0)
Dimension (LxWxH)		31.8 x 20.3 x 10.2mm
Weight		14g typ.

**Dimension Drawing (mm)**

**"A" Pinning**



**Pin Connections**

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

Tolerance:  
XX.X ± 0.5mm  
XX.XX ± 0.25mm

**PACKAGING INFORMATION**

Parameter	Type	Value
Packaging Dimension (LxWxH)	tube	520.0 x 22.7 x 18.3mm
Packaging Quantity	tube	15pcs
Storage Temperature Range		-55°C to +125°C
Storage Humidity		95% RH max.



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Zertifiziert nach ISO 9001:2015

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