Features

Regulated Converter

- 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 +85°C operation, no derating
- 2:1 wide input range

RECOM
DC/DC Converter

REM3.5E

3.5 Watt 2:1 Input DIP24 Single & Dual Output

Description

The REM3.5E 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 +85°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.(1) [%]	Max. Capacitive Load (2) [µF]
REM3.5E-xx05S/R(3)/A (4,5)	5 / 12 / 24 / 48	5	700	76 / 80 / 81 / 82	4700
REM3.5E-xx09S/R(3)/A (4,5)	5 / 12 / 24 / 48	9	388	80 / 81 / 82 / 82	3300
REM3.5E-xx12S/R(3)/A (4,5)	5 / 12 / 24 / 48	12	290	82 / 82 / 83 / 82	2200
REM3.5E-xx15S/R(3)/A (4,5)	5 / 12 / 24 / 48	15	233	83 / 82 / 84 / 83	2200
REM3.5E-xx24S/R(3)/A (4,5)	5 / 12 / 24 / 48	24	145	82 / 82 / 84 / 83	1000
REM3.5E-xx05D/R(3)/A (4,5)	5 / 12 / 24 / 48	±5	±350	76 / 80 / 81 / 82	±2200
REM3.5E-xx09D/R(3)/A (4,5)	5 / 12 / 24 / 48	±9	±194	80 / 81 / 82 / 82	±1600
REM3.5E-xx12D/R(3)/A (4,5)	5 / 12 / 24 / 48	±12	±145	82 / 82 / 83 / 82	±1000
REM3.5E-xx15D/R(3)/A (4,5)	5 / 12 / 24 / 48	±15	±117	83 / 82 / 84 / 83	±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 resisitive load

2MOPP
250VAC

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

Model Numbering

REM3.5E- ___ ___ /R /A / ___ /

- Output Power
- nom. Input Voltage
- Output Voltage
- Single or Dual
- UVLO Option (5)
- CTRL Option (4)
- Pinning
- Isolation (3)

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*

Ordering Examples

REM3.5E-0505S/R8/A	= 5Vin, 5Vout, Single, 8kVDC Isolation and „A“ pinning, DIP24
REM3.5E-1205D/R10/A/ CTRL	= 12Vin, 5Vout, Dual, 10kVDC Isolation, „A“ pinning, with CTRL pin
REM3.5E-2405S/R8/A/X1	= 24Vin, 5Vout, Single, 8kVDC Isolation, „A“ pinning, DIP24 and with UVLO Option
REM3.5E-2405D/R10/A/CTRL/X1	= 24Vin, 5Vout, Dual, 10kVDC Isolation, „A“ pinning, DIP24, CTRL pin and UVLO Option

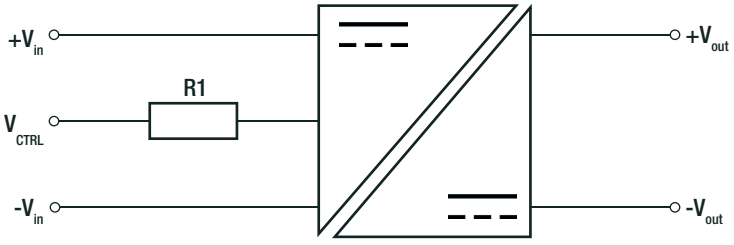
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

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		 3.9VDC	4.5VDC
	nom. Vin= 12VDC	DC-DC ON DC-DC OFF		 7.9VDC	9VDC
	nom. Vin= 24VDC	DC-DC ON DC-DC OFF		 16.7VDC	18VDC
	nom. Vin= 48VDC	DC-DC ON DC-DC OFF		 34.3VDC	36VDC
Input Current	nom. Vin = 5VDC nom. Vin = 12VDC nom. Vin = 24VDC nom. Vin = 48VDC			900mA 360mA 180mA 90mA	
Quiescent Current	nom. Vin = 5VDC nom. Vin = 12VDC nom. Vin = 24VDC nom. Vin = 48VDC				50mA 20mA 5mA 2.5mA
Minimum Load (8)				10%	
Start-up time				0.6ms	
Rise time				0.45ms	
Hold-up time				0.6ms	
ON/OFF CTRL	DC-DC ON DC-DC OFF				Open or 0VDC<V_{CTRL}<1.2VDC Short or 4.8VDC<V_{CTRL}<12VDC
Input Current of CTRL Pin	V_{CTRL}=5VDC			25mA	
Standby Current	DC-DC OFF				350µA
Intvernal Operating Frequency			120kHz		
Output Ripple and Noise (7)	20MHz BW				150mVp-p

Notes:

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

ON/OFF CTRL Option



R1
470Ω

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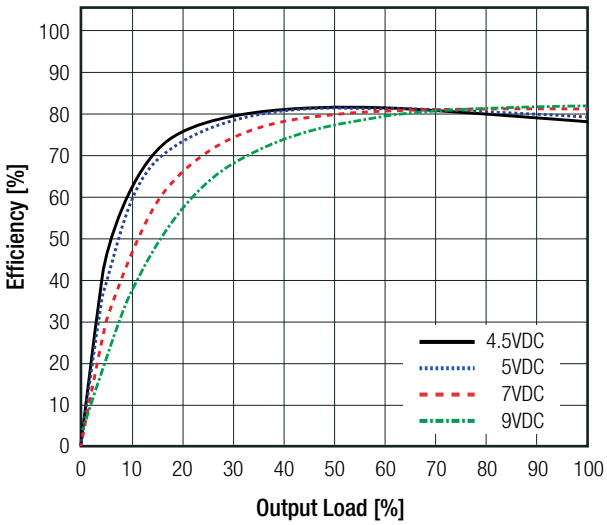
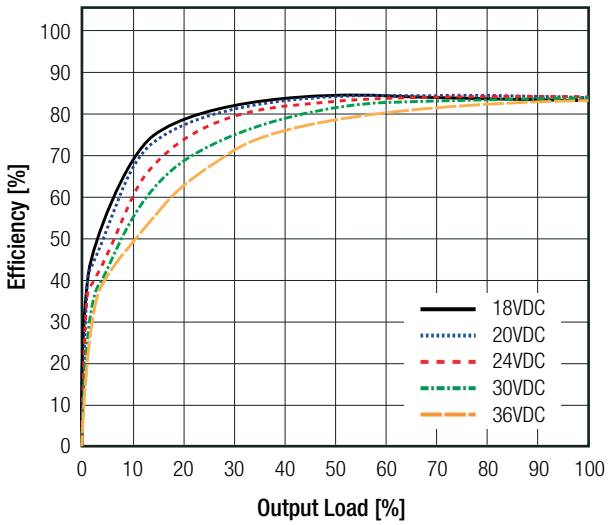
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Efficiency vs. Output Load

REM3.5E-0505S



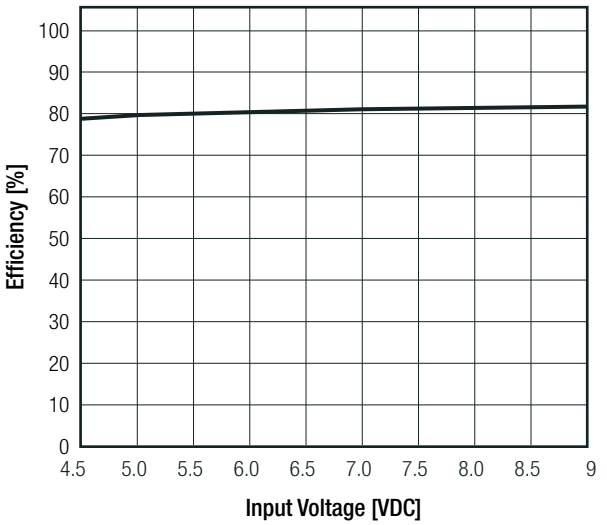
REM3.5E-2405S



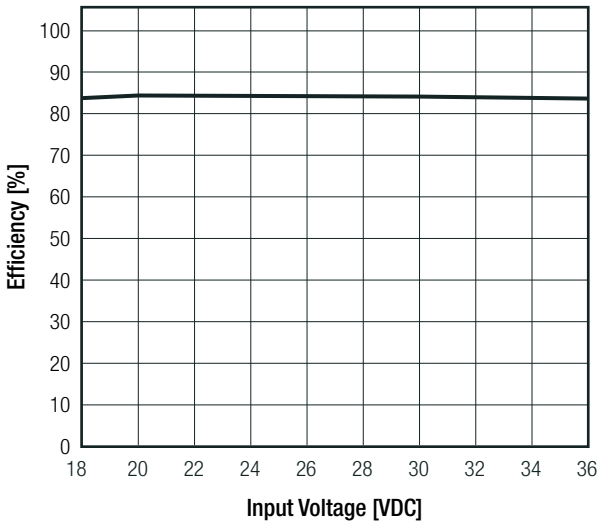
Efficiency vs. Input Voltage

(@ full Load)

REM3.5E-0505S



REM3.5E-2405S



REGULATIONS

Parameter	Condition	Value
Output Accuracy		±1.5% typ.
Line Regulation	low line to high line, full load	±0.3% max.
Load Regulation [8]	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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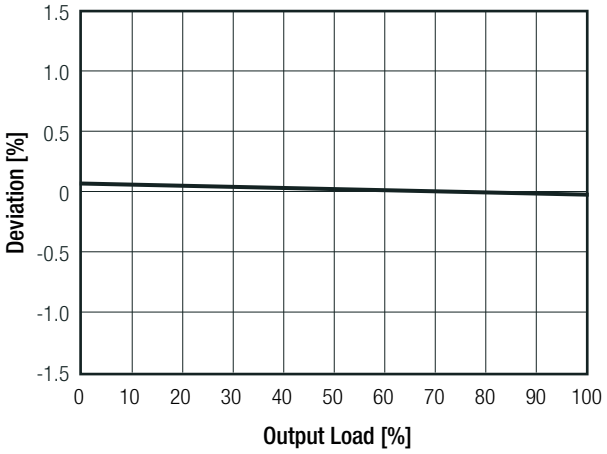
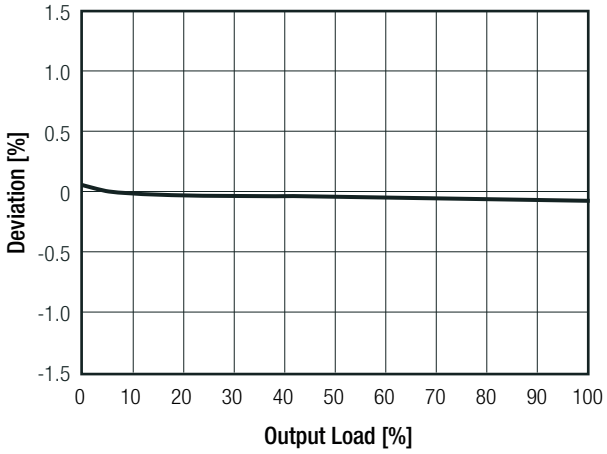
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Deviation vs. Load

REM3.5E-0505S



REM3.5E-2405S



PROTECTIONS

Parameter	Type			Value
Short Circuit Protection (SCP)	below 100mΩ			continuous, hiccup mode, automatic recovery
Isolation Voltage (9)	"/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 +85°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 +85°C	3600 x 10^3 hours 450 x 10^3 hours

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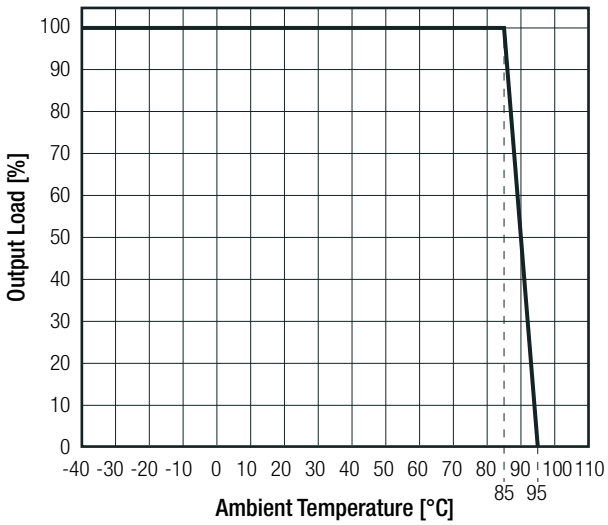
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Derating Graph

(@ Chamber and natural convection 0.1m/s)



SAFETY AND CERTIFICATIONS		
Certificate Type (Safety)	**Report / File Number**	**Standard**
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

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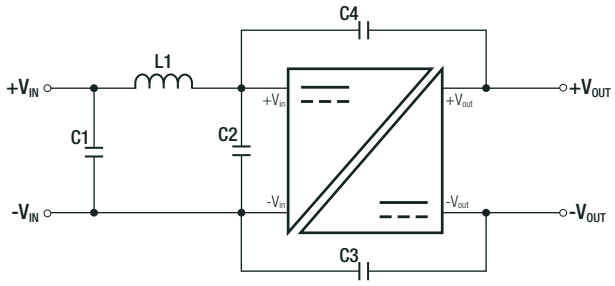
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

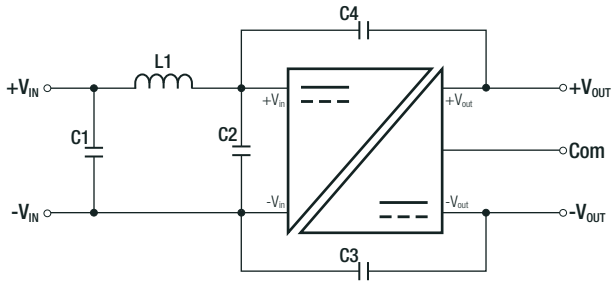
EMC Filtering Suggestions according to EN55032

Class A

Single output



Dual output

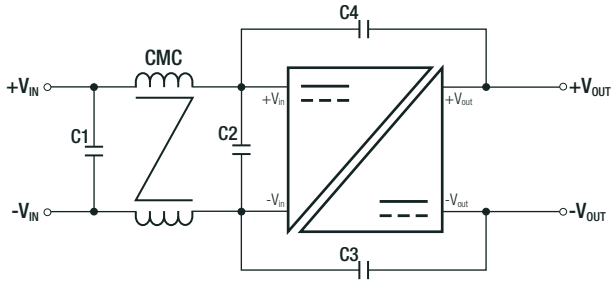


Component List Class A

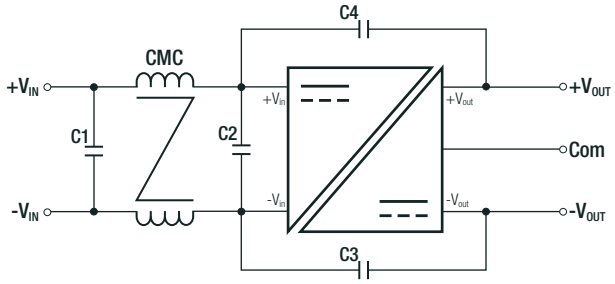
MODEL	C1	C2	C3	C4	L1
REM3.5E-05xxS/R/A and REM3.5E-12xxS/R/A	4.7µF/50V	N/A	100pF/12kV	N/A	3.3µH
REM3.5E-24xxS/R/A and REM3.5E-48xxS/R/A			150pF/12kV		
REM3.5E-05xxD/R/A and REM3.5E-12xxD/R/A	10µF/100V		100pF/12kV	100pF/12kV	
REM3.5E-24xxD/R/A and REM3.5E-48xxD/R/A			150pF/12kV	150pF/12kV	

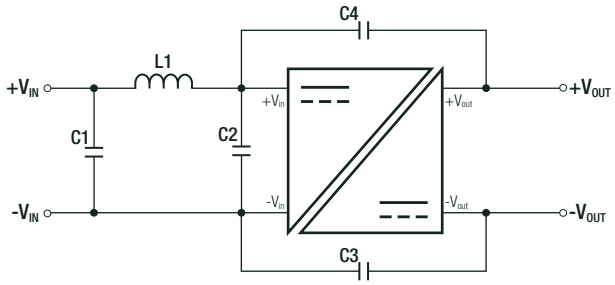
Class B

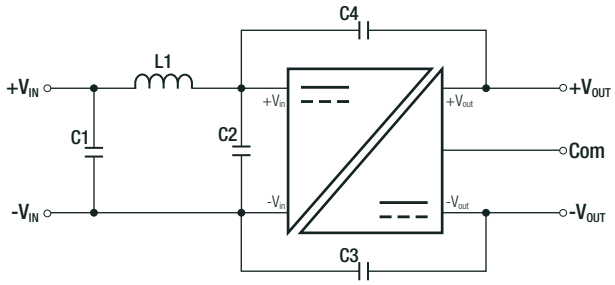
Single output



Dual output







Component List Class B

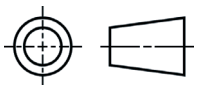
MODEL	C1	C2	C3	C4	L1	CMC
REM3.5E-05xxS/R/A	4.7µF/50V	N/A	100pF/12kV	N/A	N/A	0.2mH
REM3.5E-12xxS/R/A		4.7µF/50V	220pF/12kV		50µH	N/A
REM3.5E-24xxS/R/A	10µF/100V	10µF/100V	220pF/12kV			
REM3.5E-48xxS/R/A			330pF/12kV		N/A	1mH
REM3.5E-05xxD/R/A	4.7µF/50V	N/A	100pF/12kV	100pF/12kV		0.2mH
REM3.5E-12xxD/R/A		4.7µF/50V	220pF/12kV	220pF/12kV	50µH	N/A
REM3.5E-24xxD/R/A	10µF/100V	10µF/100V	220pF/12kV	220pF/12kV		
REM3.5E-48xxD/R/A			330pF/12kV	330pF/12kV	N/A	1mH

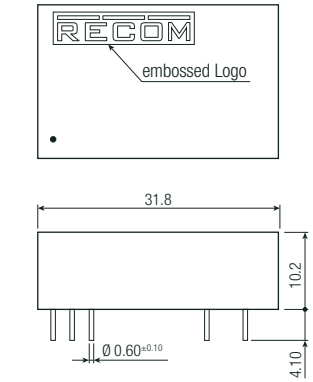
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

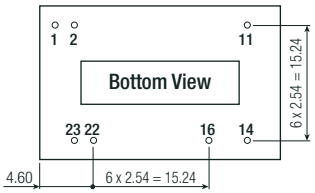
DIMENSION and PHYSICAL CHARACTERISTICS

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.

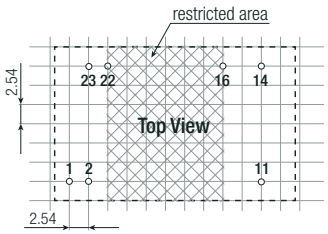
Dimension Drawing (mm)
“A” Pinning







Recommended Footprint Details



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.

CODICO®

CODICO GmbH
Zwingenstraße 6-8, 2380 Perchtoldsdorf, Austria
Telefon: +43 1 86 305-0, Fax: +43 1 86 305-5000
e-mail: office@codico.com, www.codico.com
FN 436940i, Landesgericht Wr. Neustadt

Zertifiziert nach ISO 9001:2015

Features

Regulated Converter

- 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

RECOM
DC/DC Converter

REM5E

5 Watt 2:1 Input DIP24 Single & Dual Output

2MOPP 250VAC

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

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.(1) [%]	Max. Capacitive Load (2) [µF]
REM5E-xx05S/R(3)/A (4,5)	5 / 12 / 24 / 48	5	1000	75 / 80 / 81 / 82	4700
REM5E-xx09S/R(3)/A (4,5)	5 / 12 / 24 / 48	9	556	80 / 81 / 82 / 83	4700
REM5E-xx12S/R(3)/A (4,5)	5 / 12 / 24 / 48	12	417	81 / 82 / 84 / 82	2200
REM5E-xx15S/R(3)/A (4,5)	5 / 12 / 24 / 48	15	333	81 / 83 / 84 / 84	2200
REM5E-xx24S/R(3)/A (4,5)	5 / 12 / 24 / 48	24	208	82 / 83 / 84 / 85	1000
REM5E-xx05D/R(3)/A (4,5)	5 / 12 / 24 / 48	±5	±500	75 / 80 / 81 / 82	±2200
REM5E-xx09D/R(3)/A (4,5)	5 / 12 / 24 / 48	±9	±277	80 / 81 / 82 / 83	±1600
REM5E-xx12D/R(3)/A (4,5)	5 / 12 / 24 / 48	±12	±208	81 / 82 / 83 / 84	±1000
REM5E-xx15D/R(3)/A (4,5)	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 resisitive load

Model Numbering

REM5E- ___ ___ /R /A / ___ /

- Output Power
- nom. Input Voltage
- Output Voltage
- **S**ingle or **D**ual
- Isolation (3)
- Pinning
- CTRL Option (4)
- UVLO Option (5)

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*

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)

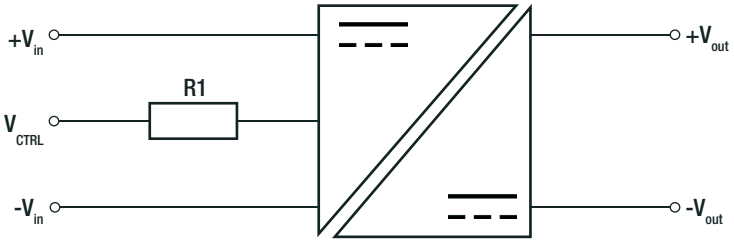
BASIC CHARACTERISTICS

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		 3.9VDC	4.5VDC
	nom. Vin= 12VDC	DC-DC ON DC-DC OFF		 7.9VDC	9VDC
	nom. Vin= 24VDC	DC-DC ON DC-DC OFF		 16.7VDC	18VDC
	nom. Vin= 48VDC	DC-DC ON DC-DC OFF		 34.3VDC	36VDC
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 (8)				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_{CTRL}<1.2VDC Short or 4.8VDC<V_{CTRL}<12VDC
Input Current of CTRL Pin	V_{CTRL}=5VDC			25mA	
Standby Current	DC-DC OFF				350µA
Internal Operating Frequency			120kHz		
Output Ripple and Noise (7)	20MHz BW				150mVp-p

Notes:

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

ON/OFF CTRL Option



R1
470Ω

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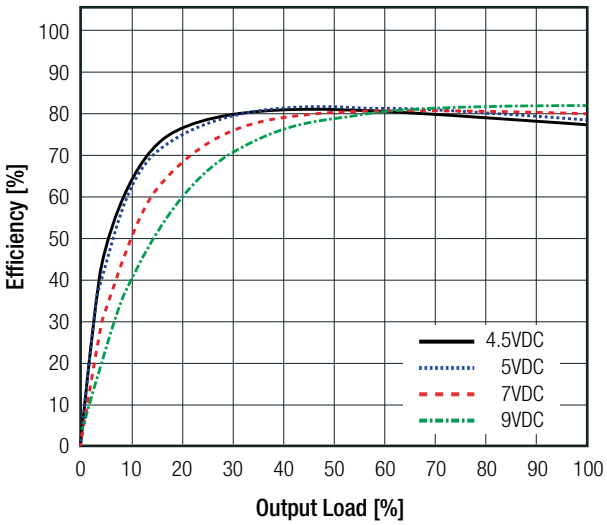
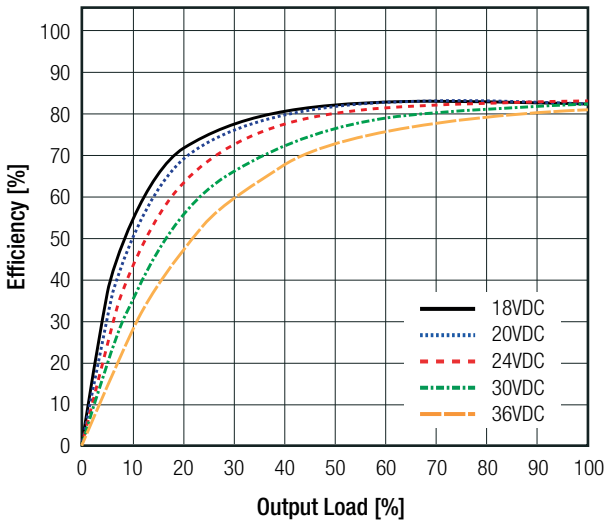
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Efficiency vs. Output Load

REM5E-0505S



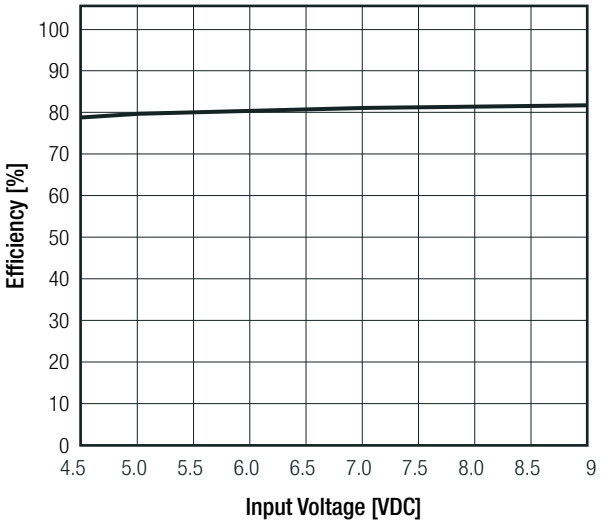
REM5E-2405S



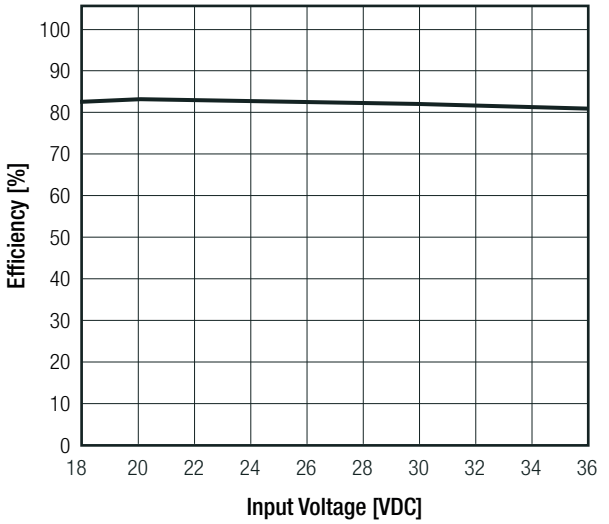
Efficiency vs. Input Voltage

(@ full Load)

REM5E-0505S



REM5E-2405S



REGULATIONS		
Parameter	**Condition**	**Value**
Output Accuracy		±1.5% typ.
Line Regulation	low line to high line, full load	±0.3% max.
Load Regulation [8]	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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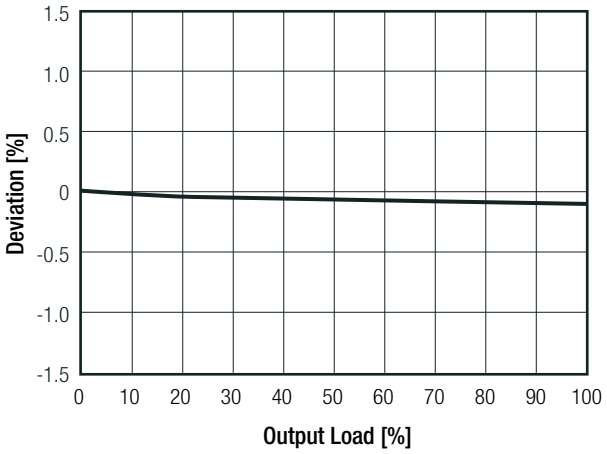
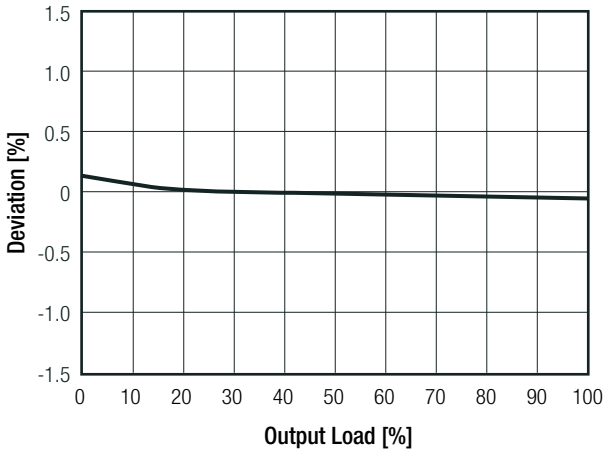
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Deviation vs. Load

REM5E-0505S



REM5E-2405S



PROTECTIONS

Parameter	Type			Value
Short Circuit Protection (SCP)	below 100mΩ			continuous, hiccup mode automatic recovery
Isolation Voltage [9]	"/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 +80°C	2400 x 10^3 hours 510 x 10^3 hours

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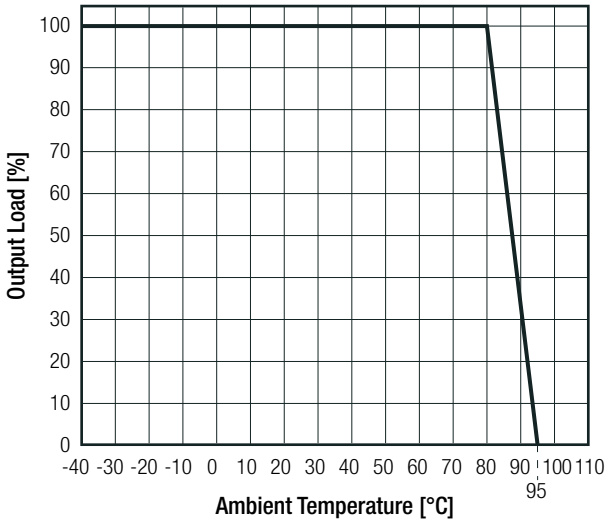
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Derating Graph

(@ Chamber and natural convection 0.1m/s)



SAFETY AND CERTIFICATIONS		
Certificate Type (Safety)	**Report / File Number**	**Standard**
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

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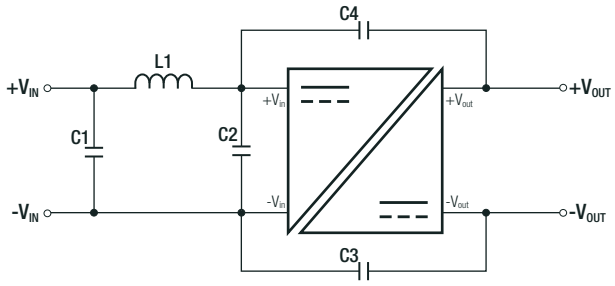
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

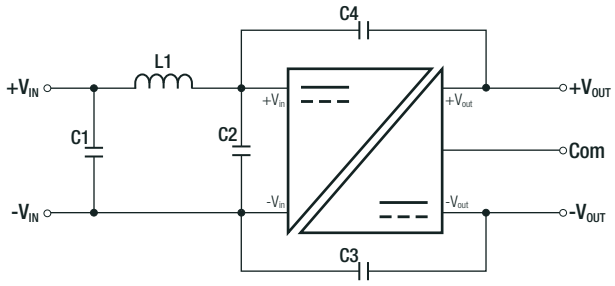
EMC Filtering Suggestions according to EN55032

Class A

Single output



Dual output

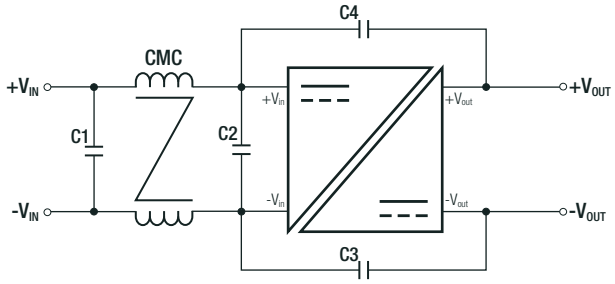


Component List Class A

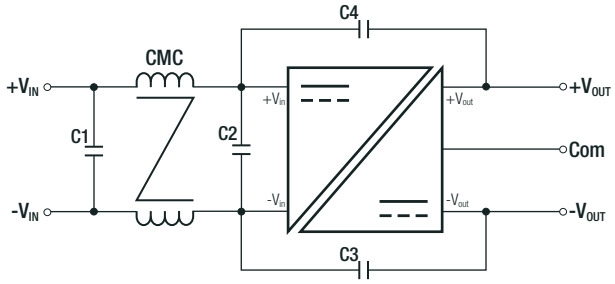
MODEL	C1	C2	C3	C4	L1
REM5E-05xxS/R/A and REM5E-12xxS/R/A	4.7µF/50V	N/A	100pF/12kV	N/A	3.3µH
REM5E-24xxS/R/A and REM5E-48xxS/R/A			150pF/12kV		
REM5E-05xxD/R/A and REM5E-12xxD/R/A	10µF/100V		100pF/12kV	100pF/12kV	
REM5E-24xxD/R/A and REM5E-48xxD/R/A			150pF/12kV	150pF/12kV	

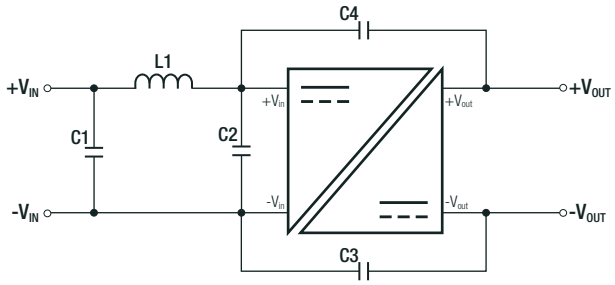
Class B

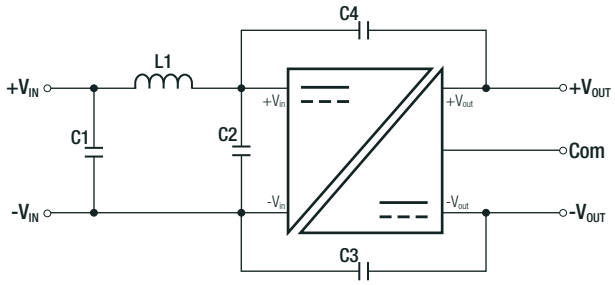
Single output



Dual output







Component List Class B

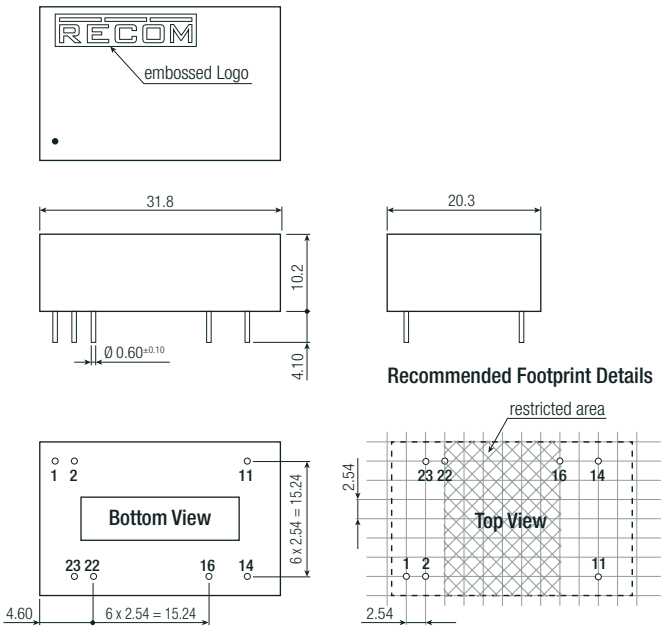
MODEL	C1	C2	C3	C4	L1	CMC
REM5E-05xxS/R/A	4.7µF/50V	N/A	100pF/12kV	N/A	N/A	0.2mH
REM5E-12xxS/R/A		4.7µF/50V	220pF/12kV		50µH	N/A
REM5E-24xxS/R/A	10µF/100V	10µF/100V	220pF/12kV			
REM5E-48xxS/R/A			330pF/12kV		N/A	1mH
REM5E-05xxD/R/A	4.7µF/50V	N/A	100pF/12kV	100pF/12kV		0.2mH
REM5E-12xxD/R/A		4.7µF/50V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

CODICO®

CODICO GmbH
Zwingenstraße 6-8, 2380 Perchtoldsdorf, Austria
Telefon: +43 1 86 305-0, Fax: +43 1 86 305-5000
e-mail: office@codico.com, www.codico.com
FN 436940i, Landesgericht Wr. Neustadt

Zertifiziert nach ISO 9001:2015

Features

Regulated Converter

- 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

REM6

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

5 YEAR Warranty

2MOPP 250VAC

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

Description

The REM6 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]
REM6-xx3.3S/ (3,4)	5 / 12 / 24 / 48	3.3	1800	81.5 / 83.5 / 83 / 82.5	2100
REM6-xx05S/ (3,4)	5 / 12 / 24 / 48	5	1200	86 / 86 / 86 / 86.5	1500
REM6-xx12S/ (3,4)	5 / 12 / 24 / 48	12	500	86 / 89 / 89 / 88	260
REM6-xx15S/ (3,4)	5 / 12 / 24 / 48	15	400	87.5 / 88.5 / 88.5 / 88.5	210
REM6-xx24S/ (3,4)	5 / 12 / 24 / 48	24	250	87 / 88.5 / 88.5 / 88	75
REM6-xxx05D/ (3,4)	5 / 12 / 24 / 48	±5	±600	84 / 85 / 85 / 85	±860
REM6-xx12D/ (3,4)	5 / 12 / 24 / 48	±12	±250	86.5 / 89 / 88.5 / 88	±150
REM6-xx15D/ (3,4)	5 / 12 / 24 / 48	±15	±200	87.5 / 88 / 88.5 / 87	±110
REM6-xx3.3SW/ (3,4)	24 / 48	3.3	1800	83 / 82.5	2100
REM6-xx05SW/ (3,4)	24 / 48	5	1200	86 / 86.5	1500
REM6-xx12SW/ (3,4)	24 / 48	12	500	89 / 88	260
REM6-xx15SW/ (3,4)	24 / 48	15	400	89 / 88.5	210
REM6-xx24SW/ (3,4)	24 / 48	24	250	88.5 / 88	75
REM6-xx05DW/ (3,4)	24 / 48	±5	±600	85 / 85	±860
REM6-xx12DW/ (3,4)	24 / 48	±12	±250	88.5 / 88	±150
REM6-xx15DW/ (3,4)	24 / 48	±15	±200	88.5 / 87	±110

Model Numbering

REM 6- ___ ___ ___ / ___ ___

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

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 available

Examples:

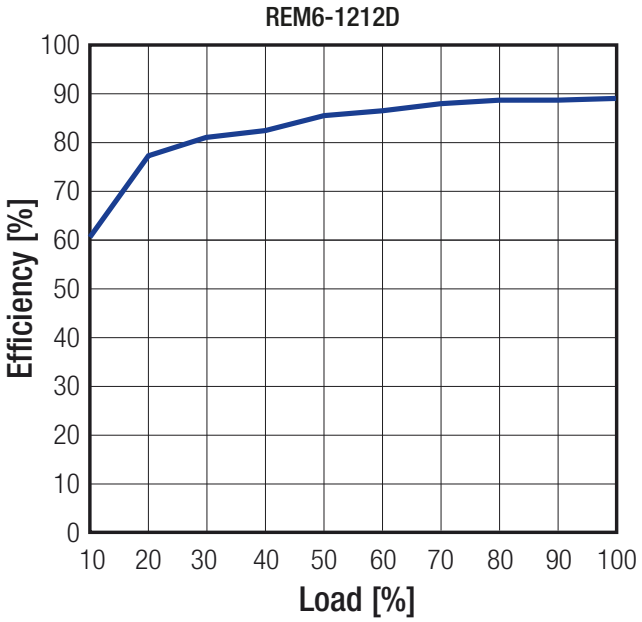
REM6-0512D/A	= 2:1 Input,	4.5-9Vin,	±12Vout,	pinout „A",	without control pin
REM6-1215S/C	= 2:1 Input,	9-18Vin,	15Vout,	pinout „C",	without control pin
REM6-4815SW/A/CTRL	= 4:1 Input,	36-75Vin,	15Vout,	pinout „A"	with control pin
REM6 -243.3SW/C	= 4:1 Input,	9-36Vin,	3.3Vout,	pinout „C",	without control 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. 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			225kHz	250kHz	275kHz
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 vs. Load



REGULATIONS

Parameter	Condition	Type	Value
Output Accuracy			±1.0%
Line Regulation	low line to high line	Single Dual	±0.2% ±0.5%
Load Regulation	no load to full load	Single Dual	0.2% 1.0%
Cross Regulation	asymmetrical load 25% / Full Load	only Dual Output	±5.0%
Transient Response	25% load step change		250µs

Specifications (measured @ Ta= 25°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)		Single 3.3Vout	3.7VDC min. / 5VDC max.
		Single 5Vout	5.6VDC min. / 7VDC max.
		Single 12Vout	13.5VDC min. / 16VDC max.
		Single 15Vout	18.3VDC min. / 22VDC max.
		Single 24Vout	29.1VDC min. / 34.5VDC max.
		Dual 5Vout	5.6VDC min. / 7VDC max.
		Dual 12Vout	13.5VDC min. / 18.2VDC max.
		Dual 15Vout	17VDC min. / 22VDC max.
Isolation Voltage	I/P to O/P working voltage		5kVAC / 1 minute 250VAC / continuous
Isolation Capacitance			12pF typ. / 17pF max.
Leakage Current	240VAC, 60Hz		2µA
Insulation Grade			reinforced
Means of Protection			2MOPP
Medical Device Classification			built-in power supply
Internal Clearance and Creepage	I/P to O/P		≥8mm
External Clearance and Creepage	I/P to O/P	"C" Pinning	>19.72mm
		"A" Pinning	>14.64mm

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	T2.5A
12V	T1.25A
24V	T0.63A
48V	T0.315A

4:1 Input Voltage	Fuse (slow blow)
24V	T1.25A
48V	T0.63A

ENVIRONMENTAL

Parameter	Condition		Value
Maximum Case Temperature Range			-40°C to +105°C
Maximum Ambient Temperature Range			see thermal calculation below
Temperature Coefficient			0.02%/K typ.
Thermal Impedance	natural convection 0.1m/s		18K/W
Operating Altitude			5000m
Operating Humidity	non-condensing		5% - 95% RH max.
Pollution Degree			PD2
MTBF	according to MIL-HDBK-217F, G.B.	+25°C	4718 x 10^3 hours
Thermal Shock			according to MIL-STD-810F standard
Vibration			according to MIL-STD-810F standard

continued on next page

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

Thermal Calculation:

$$\eta_{set} = \eta_{full\ load} \times f_{\eta}$$

$$P_{diss} = \left[\frac{P_{out\ set}}{\eta_{set}} \right] - P_{out\ set}$$

$$T_{over} = R_{th} \times P_{diss}$$

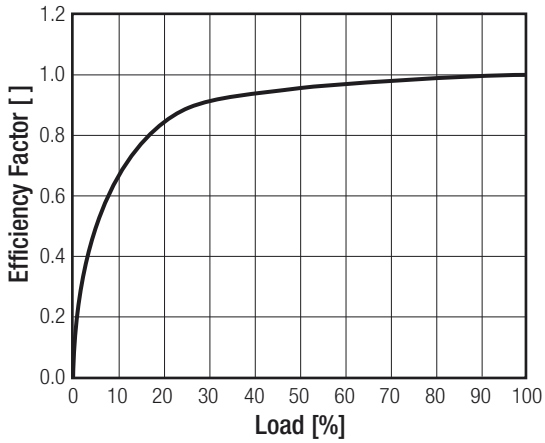
$$T_{amb} = T_{case} - T_{over}$$

T_{case}	= baseplate temperature	[°C]
T_{over}	= temperature losses	[°C]
T_{amb}	= ambient temperature	[°C]
$P_{out\ nom.}$	= nom. output power	[W]
$P_{out\ set}$	= output power set	[W]
P_{diss}	= internal losses	[W]
R_{th}	= thermal impedance	[K/W]
η_{set}	= efficiency set	[%]
$\eta_{full\ load}$	= efficiency @ full load	[%]
f_{η}	= efficiency factor	[ ]

Efficiency Crosstable (%) @ full Load

		Input Voltage					
		5	12	24	48	24W	48W
Output Voltage	3.3S	81.5	83.5	83	82.5	83	82.5
	05S	86	86	86	86.5	86	86.5
	12S	86	89	89	88	89	88
	15S	87.5	88.5	89	88.5	89	88.5
	24S	87	88.5	88.5	88	88.5	88
	05D	84	85	85	85	85	85
	12D	86.5	89	88.5	88	88.5	88
	15D	87.5	88	88.5	87	88.5	87

Efficiency Factor vs. Load



Practical Example:

Take the **REM6-1212D** with 12V Input Voltage, 50% load.
What is the maximum ambient operating temperature?

T_{case}	= 105°C
$P_{out\ nom.}$	= 6W
$P_{out\ set}$	= 6 x 0.5 = 3W
R_{th}	= 18K/W
$\eta_{full\ load}$	= 89% (Crosstable)
f_{η}	= 0.96 (Graph)

η_{set} = 89 x 0.96 **85.44%**

$P_{diss} = \left[\frac{3}{0.854} \right] - 3 =$ **0.51W**

T_{over} = 18 x 0.51 = **+9.2°C**

T_{amb} = 105 - 9.2 = **+95.8°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
EAC	RU-AT.49.09571	TP TC 004/2011 TP TC 004/2011
RoHS2+		RoHS-2011/65/EU + AM-2015/863

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

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 ±15kV; Contact ±8kV	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: ±2kV	EN61000-4-4:2012
Surge Immunity (6)	DC Port: ±2kV	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

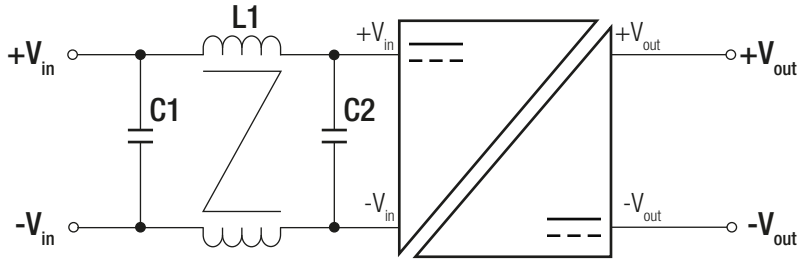
Notes:

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 REM6 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)
REM6-05xxS_D	22µF/16V MLCC	22µF/16V MLCC	137µH CMC
REM6-12xxS_D REM6-24xxS_D(/W)	4.7µF/50V MLCC	4.7µF/50V MLCC	227µH CMC
REM6-48xxS_D(/W)	2.2µF/100V MLCC	1µF/100V MLCC	419µH CMC

Notes:

Note8: The component values can be adapted according to customer´s application

DIMENSION and PHYSICAL CHARACTERISTICS

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

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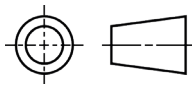
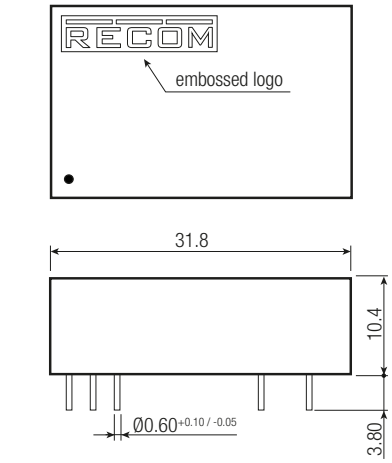
Specifications (measured @ Ta= 25°C, nominal input voltage, full load and after warm-up)

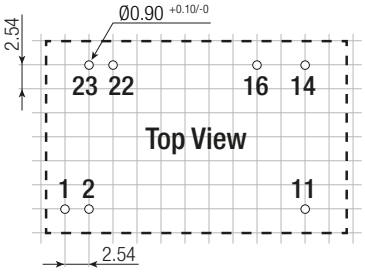
Dimension Drawing (mm)



"A" Pinning (Standard)



Recommended Footprint Details



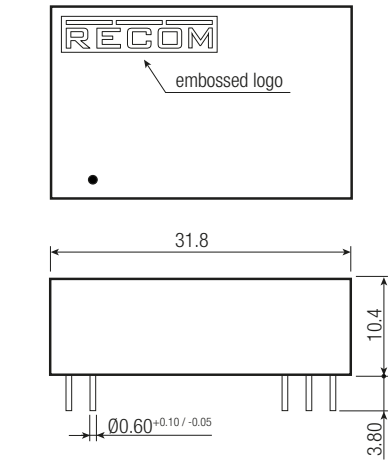
Pin Connections

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

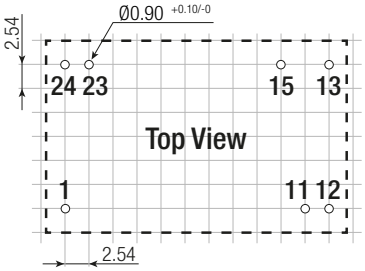
* If don´t choose CTRL option, there is no pin on the corresponding pin number

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

"C" Pinning



Recommended Footprint Details



Pin Connections

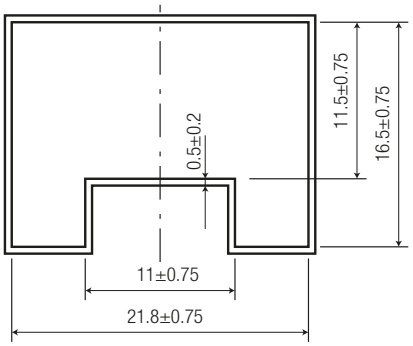
Pin #	Single	Dual
1	+Vin	+Vin
11	No Pin	Com
12	-Vout	No Pin
13	+Vout	-Vout
15	No Pin	+Vout
23	-Vin	-Vin
24	-Vin	-Vin

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
Stoarge Humidity	non-condensing	5% to 95% RH max.

Tube Dimension Drawing (mm)



CODICO®

CODICO GmbH
Zwingenstraße 6-8, 2380 Perchtoldsdorf, Austria
Telefon: +43 1 86 305-0, Fax: +43 1 86 305-5000
e-mail: office@codico.com, www.codico.com
FN 436940i, Landesgericht Wr. Neustadt

Zertifiziert nach ISO 9001:2015