

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 or SMD
Single & Dual
Output



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/SMD 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 complies with medical applied part B, BF and CF limits as defined by IEC60601-1.

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 resistive load

Model Numbering



Notes:

Note3: add suffix „/R8“ for 8kVDC or „/R10“ for 10kVDC isolation (DIP24 only)
 if SMD package is used, always add suffix „/R6“ for 6kVDC isolation
 Note4: add suffix „/CTRL“ for fitted CTRL pin (DIP24 only)
 if SMD package is used do not add suffix „/CTRL“, CTRL pin is always mounted
 Note5: add suffix „/X1“ for Under Voltage Lockout Option

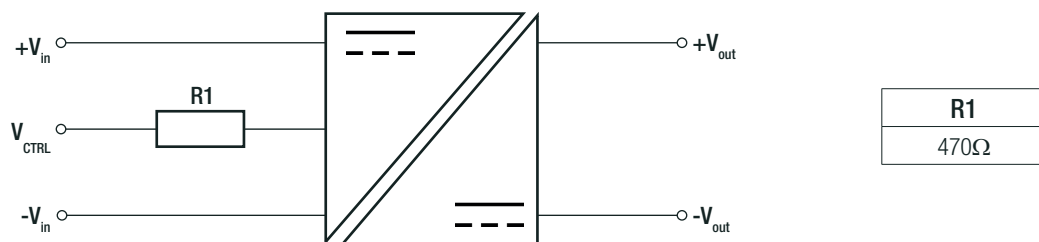
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

| 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 ⁽⁷⁾ | | | | 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 ⁽⁶⁾ | 20MHz BW | | | | 150mVp-p |

Notes:

Note6: Measurements are made with a 0.1µF MLCC across output. (low ESR)

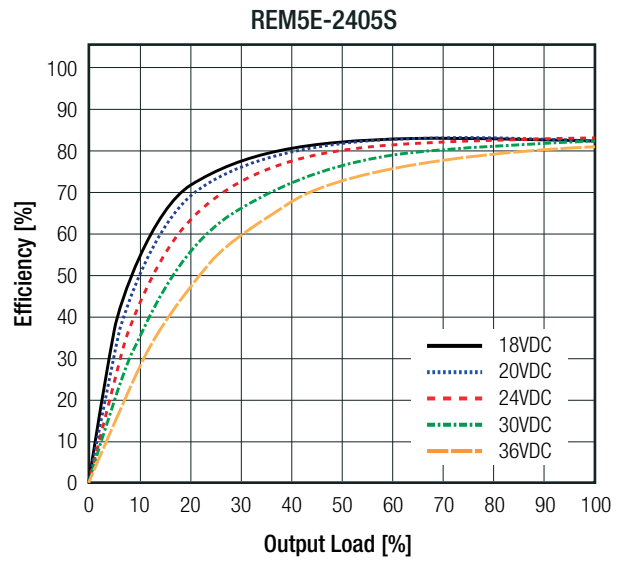
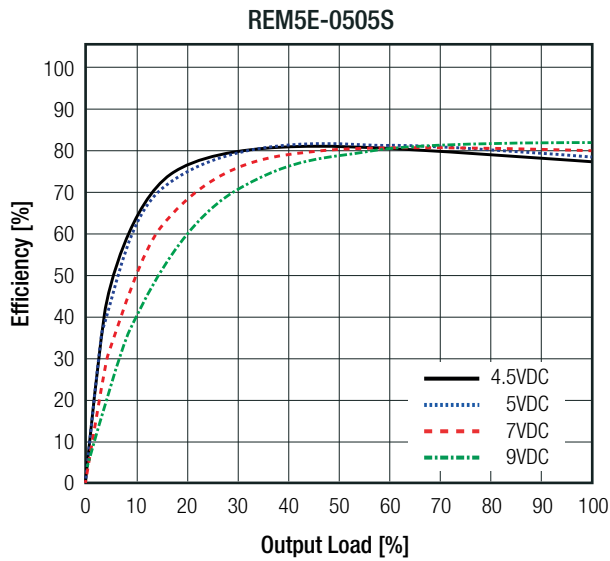
ON/OFF CTRL Option



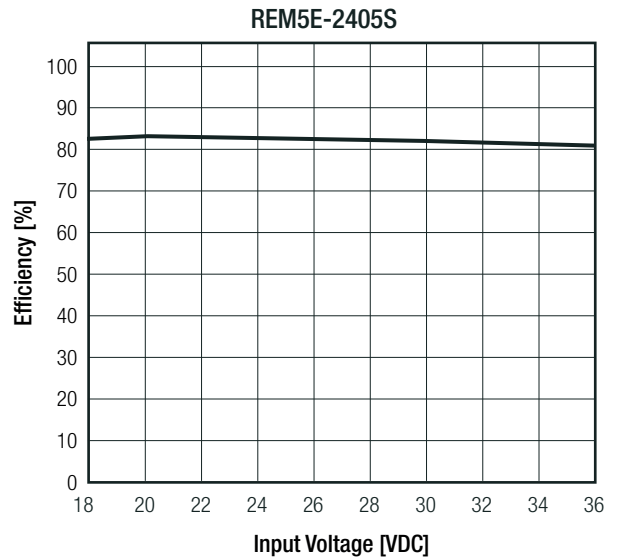
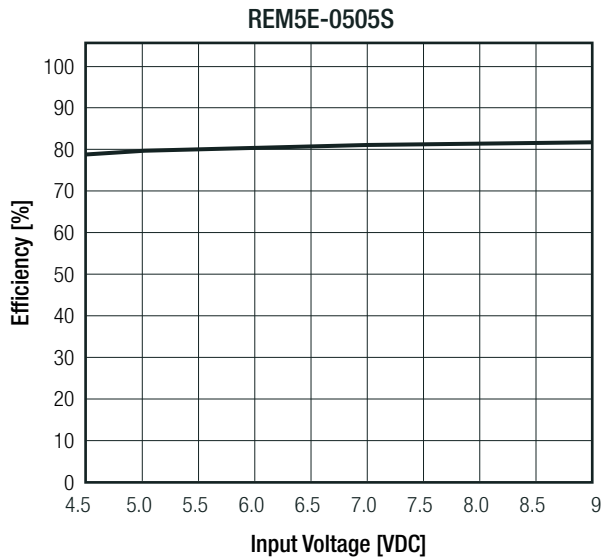
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Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

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 ⁽⁷⁾ | 10% to 100% load | 0.5% typ. |
| Cross Regulation | dual output only | ±5.0% max. |
| Transient Response | 25% load step change | 5ms |

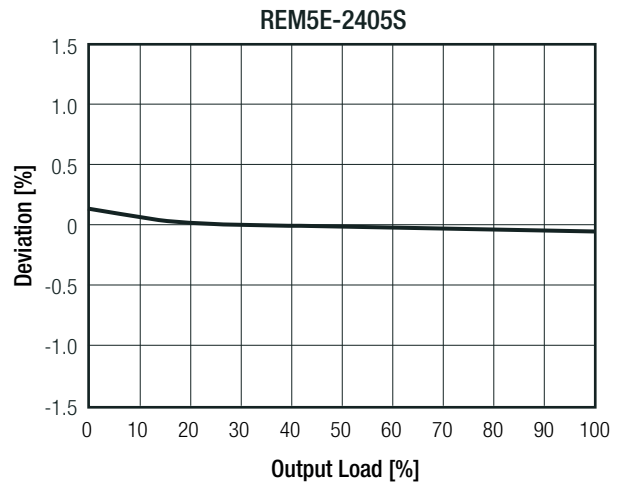
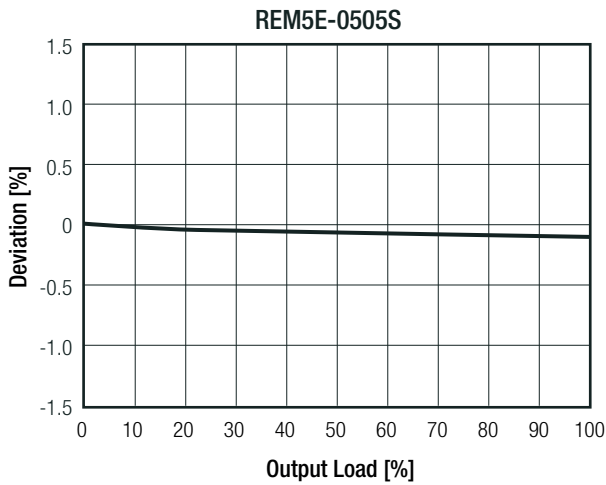
Notes:

Note7: 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 ⁽⁸⁾ | I/P to O/P | DIP24 | "/R8" suffix | tested for 1 second rated for 1 minute |
| | | | "/R10" suffix | tested for 1 second rated for 1 minute |
| | SMD | "/R6" suffix | rated for 1 minute | 8kVDC 4kVAC/60Hz 10kVDC 5kVAC/60Hz 6kVDC |
| 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:

Note8: For repeat Hi-Pot testing, reduce the time and/or the test voltage

Note9: Refer to local safety regulations if input over-current protection is also required. Recommended fuse: slow blow type

ENVIRONMENTAL

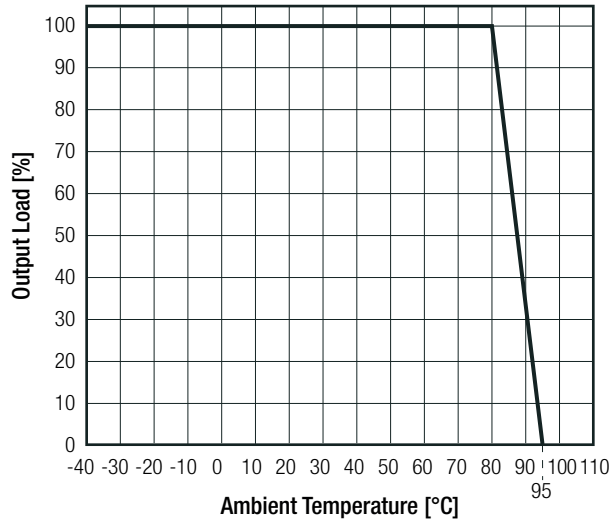
| Parameter | Condition | | Value |
|-----------------------------|---|-------|-------------------------------|
| Operating Temperature Range | full load @ natural convection 0.1m/s (see graph) | | -40°C to +80°C |
| Maximum Case Temperature | | | +105°C |
| Temperature Coefficient | | | ±0.02%/K typ. / ±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 ³ hours |
| | | +80°C | 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)



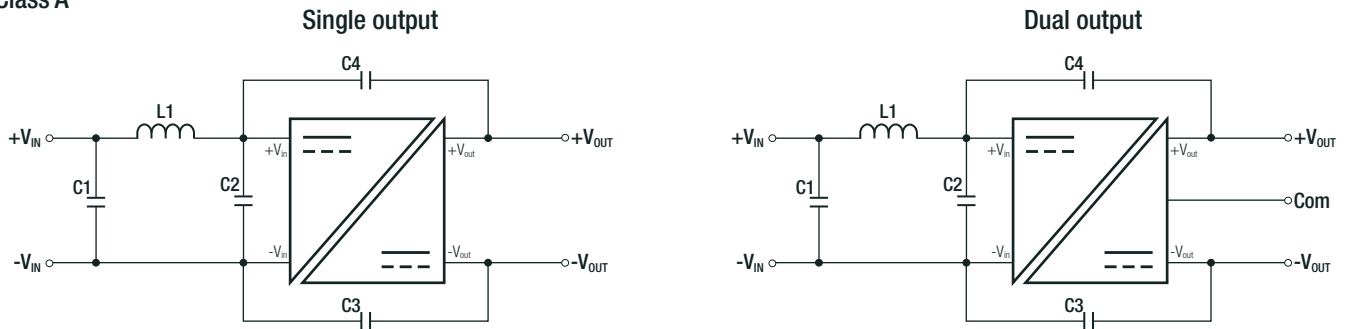
| SAFETY AND CERTIFICATIONS | | |
|--|-----------------------------|---|
| Certificate Type (Safety) | Report / File Number | Standard |
| Medical Electric Equipment, General Requirements for Safety and Essential Performance | E314885 | CAN/CSA-C22.2 No. 60601-1:14, 3rd Edition: 2014 ANSI/AAMI ES60601-1:2012 |
| 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

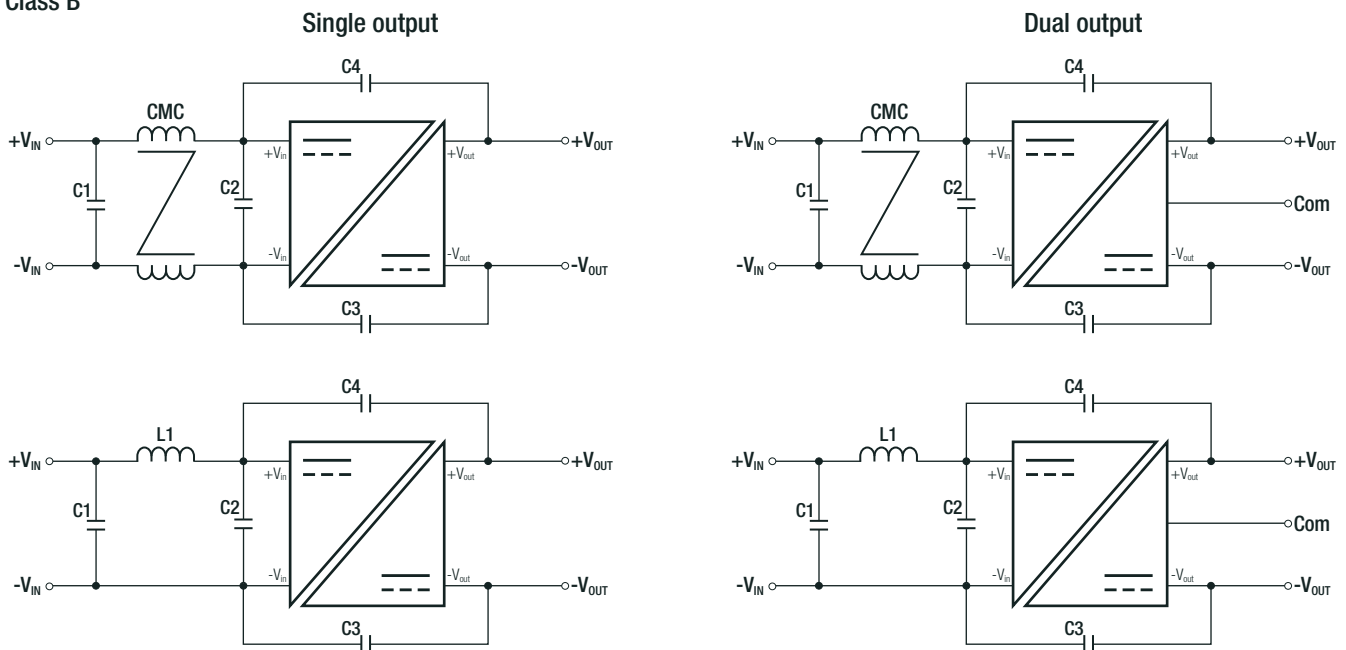
Class A



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 | 50µH | 0.2mH |
| REM5E-12xxD/R/A | | 4.7µF/50V | 220pF/12kV | 220pF/12kV | | |
| REM5E-24xxD/R/A | 10µF/100V | 10µF/100V | 220pF/12kV | 220pF/12kV | N/A | N/A |
| REM5E-48xxD/R/A | | | 330pF/12kV | 330pF/12kV | | |

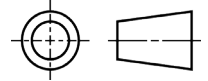
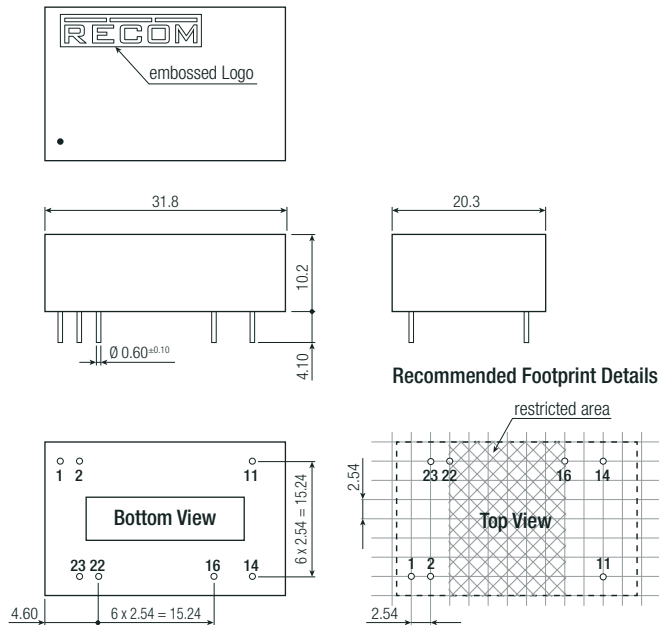
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

DIMENSION and PHYSICAL CHARACTERISTICS

| Parameter | Type | Value |
|-------------------|-----------|--|
| Material | baseplate | non-conductive black plastic, (UL94 V-0) |
| | case | non-conductive black plastic, (UL94 V-0) |
| | potting | silicone, (UL94 V-0) |
| Dimension (LxWxH) | DIP24 | 31.8 x 20.3 x 10.2mm |
| | SMD | 31.8 x 20.3 x 10.9mm |
| Weight | | 14g typ. |

Dimension Drawing (mm)

DIP24

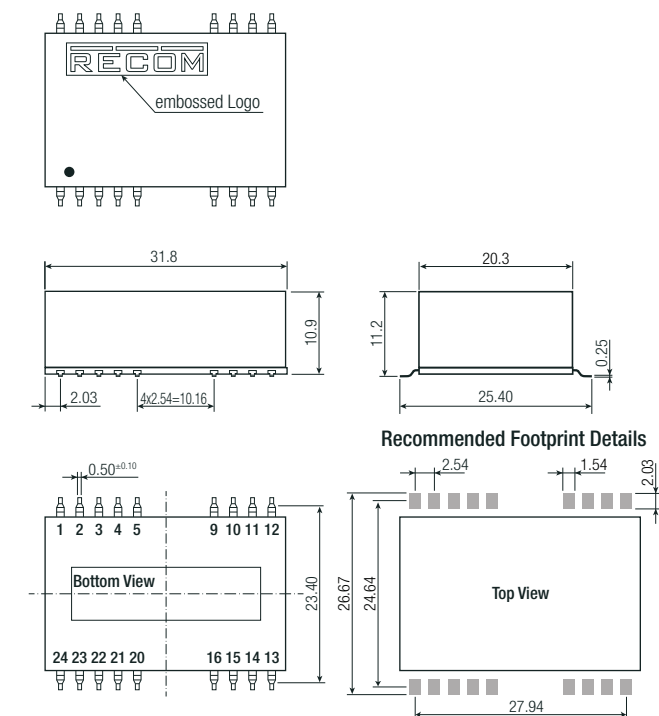


Pin Connections

| 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

SMD



Pin Connections

| Pin # | Single | Dual |
|----------------|--------|-------|
| 1 | CTRL | CTRL |
| 2 | -Vin | -Vin |
| 3, 4, 5, 9, 10 | NC | NC |
| 11 | NC | -Vout |
| 12, 13, 15 | NC | NC |
| 14 | +Vout | +Vout |
| 16 | -Vout | Com |
| 20, 21, 24 | NC | NC |
| 22 | +Vin | +Vin |
| 23 | +Vin | +Vin |

Tolerance:
xx.x ± 0.5mm
xx.xx ± 0.35mm

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

| PACKAGING INFORMATION | | | |
|-----------------------------|------|-------|-----------------------|
| Parameter | Type | | Value |
| Packaging Dimension (LxWxH) | tube | DIP24 | 520.0 x 22.7 x 18.3mm |
| | | SMD | 530.0 x 30.3 x 19.2mm |
| Packaging Quantity | tube | | 15pcs |
| Storage Temperature Range | | | -55°C to +125°C |
| Storage Humidity | | | 95% RH max. |

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