

# 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

## REM3

**3 Watt**  
**2:1 & 4:1**  
**DIP24**  
**Single and Dual Output**



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

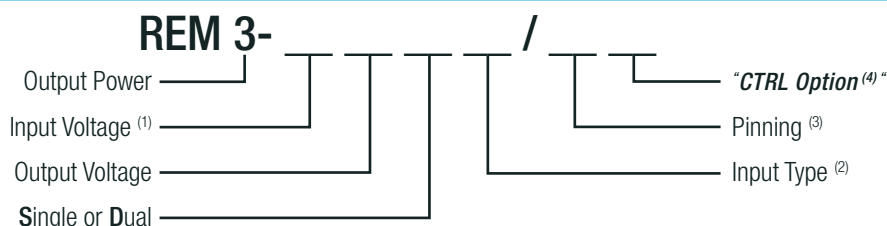
## Description

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 UL mark.

## Selection Guide

| Part Number                    | nom. Input Voltage <sup>(1)</sup> [VDC] | Output Voltage [VDC] | Output Current [mA] | Efficiency typ. [%]     | Max. Capacitive Load [µF] |
|--------------------------------|-----------------------------------------|----------------------|---------------------|-------------------------|---------------------------|
| REM3-xx3.3S/ <sup>(3,4)</sup>  | 5 / 12 / 24 / 48                        | 3.3                  | 1000                | 81 / 82 / 82 / 81       | 1050                      |
| REM3-xx05S/ <sup>(3,4)</sup>   | 5 / 12 / 24 / 48                        | 5                    | 600                 | 84.5 / 84.5 / 84.5 / 84 | 780                       |
| REM3-xx12S/ <sup>(3,4)</sup>   | 5 / 12 / 24 / 48                        | 12                   | 250                 | 85.5 / 87 / 87 / 87     | 130                       |
| REM3-xx15S/ <sup>(3,4)</sup>   | 5 / 12 / 24 / 48                        | 15                   | 200                 | 87.5 / 87 / 87 / 86.5   | 100                       |
| REM3-xx24S/ <sup>(3,4)</sup>   | 5 / 12 / 24 / 48                        | 24                   | 125                 | 85.5 / 87 / 87 / 86.5   | 39                        |
| REM3-xx05D/ <sup>(3,4)</sup>   | 5 / 12 / 24 / 48                        | ±5                   | ±300                | 83 / 83.5 / 83 / 83     | ±430                      |
| REM3-xx12D/ <sup>(3,4)</sup>   | 5 / 12 / 24 / 48                        | ±12                  | ±125                | 86 / 87.5 / 86 / 86     | ±75                       |
| REM3-xx15D/ <sup>(3,4)</sup>   | 5 / 12 / 24 / 48                        | ±15                  | ±100                | 86 / 86.5 / 86 / 86     | ±56                       |
| REM3-xx3.3SW/ <sup>(3,4)</sup> | 24 / 48                                 | 3.3                  | 1000                | 82 / 81                 | 1050                      |
| REM3-xx05SW/ <sup>(3,4)</sup>  | 24 / 48                                 | 5                    | 600                 | 84.5 / 84               | 750                       |
| REM3-xx12SW/ <sup>(3,4)</sup>  | 24 / 48                                 | 12                   | 250                 | 87 / 87                 | 130                       |
| REM3-xx15SW/ <sup>(3,4)</sup>  | 24 / 48                                 | 15                   | 200                 | 87 / 86.5               | 100                       |
| REM3-xx24SW/ <sup>(3,4)</sup>  | 24 / 48                                 | 24                   | 125                 | 87 / 86.5               | 39                        |
| REM3-xx05DW/ <sup>(3,4)</sup>  | 24 / 48                                 | ±5                   | ±300                | 83 / 83                 | ±430                      |
| REM3-xx12DW/ <sup>(3,4)</sup>  | 24 / 48                                 | ±12                  | ±125                | 87 / 86                 | ±75                       |
| REM3-xx15DW/ <sup>(3,4)</sup>  | 24 / 48                                 | ±15                  | ±100                | 86 / 86                 | ±56                       |

## Model Numbering



### 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:

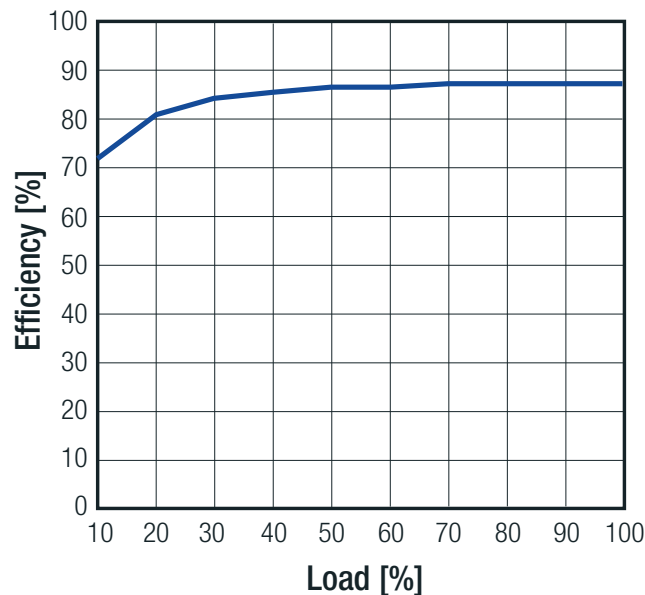
|                    |   |                                                               |
|--------------------|---|---------------------------------------------------------------|
| REM3-0512D/A       | = | 2:1 Input, 4.5-9Vin, ±12Vout, pinout „A", without control pin |
| REM3-1215S/C       | = | 2:1 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  |

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<br>( 3sec max.) | 2:1 input                                                                                             | 5Vin nom.<br>12Vin nom.<br>24Vin nom.<br>48Vin nom. |                                |                               | 16VDC<br>25VDC<br>50VDC<br>100VDC |
|                                                | 4:1 input                                                                                             | 24Vin nom.<br>48Vin nom.                            |                                |                               | 50VDC<br>100VDC                   |
| Under Voltage Lockout                          | 2:1 input                                                                                             | 5Vin nom.<br>12Vin nom.<br>24Vin nom.<br>48Vin nom. | 4VDC<br>8VDC<br>16VDC<br>33VDC |                               | 4.5VDC<br>9VDC<br>18VDC<br>36VDC  |
|                                                | 4:1 input                                                                                             | 24Vin nom.<br>48Vin nom.                            | 8VDC<br>16VDC                  |                               | 9VDC<br>18VDC                     |
| Start-up Time                                  | constant resistive load, Power up or Remote ON/OFF                                                    |                                                     |                                | 30ms                          |                                   |
| Remote ON/OFF<br>(referenced to -Vin Pin)      | DC-DC ON<br>DC-DC OFF                                                                                 |                                                     |                                |                               | Open or 0-1.2VDC<br>2.2-12VDC     |
| Current of CTRL Pin                            |                                                                                                       |                                                     | -0.5mA                         |                               | 1mA                               |
| Remote OFF Input Current                       |                                                                                                       |                                                     |                                | 2.5mA                         |                                   |
| Internal Operating Frequency                   |                                                                                                       |                                                     | 135kHz                         | 150kHz                        | 165kHz                            |
| Output Ripple and Noise<br>(20MHz BW limited)  | 10µF/25V X7R MLCC for 3.3, 5Vout<br>10µF/25V X7R MLCC for 12, 15Vout<br>4.7µF/50V X7R MLCC for 24Vout |                                                     |                                | 30mVp-p<br>40mVp-p<br>50mVp-p |                                   |

#### Efficiency vs. Load



#### REGULATIONS

| Parameter          | Condition                         | Type             | Value          |
|--------------------|-----------------------------------|------------------|----------------|
| Output Accuracy    |                                   |                  | ±1.0%          |
| Line Regulation    | low line to high line             | Single<br>Dual   | ±0.2%<br>±0.5% |
| Load Regulation    | no load to full load              | Single<br>Dual   | 0.2%<br>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) |                               | 3.3Vout       | 3.7VDC min. / 5VDC max.                 |
|                                      |                               | 5Vout         | 5.6VDC min. / 7VDC max.                 |
|                                      |                               | Single 12Vout | 13.5VDC min. / 16VDC max.               |
|                                      |                               | 15Vout        | 18.3VDC min. / 22VDC max.               |
|                                      |                               | 24Vout        | 29.1VDC min. / 34.5VDC max.             |
|                                      |                               | Dual 5Vout    | 5.6VDC min. / 7VDC max.                 |
|                                      |                               | 12Vout        | 13.5VDC min. / 18.2VDC max.             |
|                                      |                               | 15Vout        | 17VDC min. / 22VDC max.                 |
| Isolation Voltage                    | I/P to O/P<br>working voltage |               | 5kVAC / 1 minute<br>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.

#### Recommended Fuse:

| 2:1 Input Voltage | Fuse (slow blow) |
|-------------------|------------------|
| 5V                | T1.25A           |
| 12V               | T0.63A           |
| 24V               | T0.315A          |
| 48V               | T0.315A          |

| 4:1 Input Voltage | Fuse (slow blow) |
|-------------------|------------------|
| 24V               | T0.63A           |
| 48V               | T0.315A          |

#### 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 | 6444 x 10 <sup>3</sup> hours       |
| Thermal Shock                     |                                        | according to MIL-STD-810F standard |
| Vibration                         |                                        | according to MIL-STD-810F standard |

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

### Thermal Calculation

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

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

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

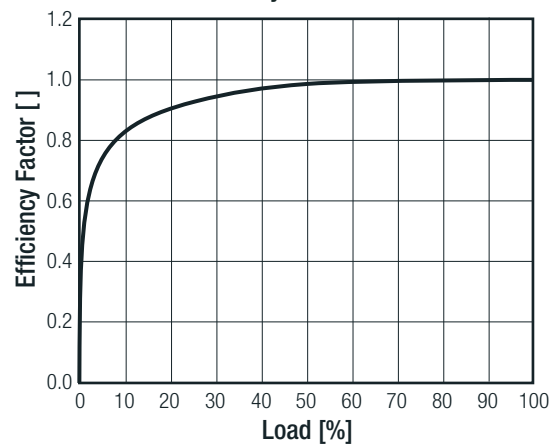
$$T_{\text{amb}} = T_{\text{case}} - T_{\text{over}}$$

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

### 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   |

### Efficiency Factor vs. Load



### Practical Example:

Take the REM3-1212D with 12V Input Voltage, 50% load.  
What is the maximum ambient operating temperature?

|                           |                         |                                                                    |                 |
|---------------------------|-------------------------|--------------------------------------------------------------------|-----------------|
| $T_{\text{case}}$         | = 105°C                 | $\eta_{\text{set}} = 87.5 \times 0.98$                             | <b>85.75%</b>   |
| $P_{\text{out nom.}}$     | = 3W                    | $P_{\text{diss}} = \left[ \frac{1.5}{0.856} \right] - 1.5 = 0.25W$ |                 |
| $P_{\text{out set}}$      | = $3 \times 0.5 = 1.5W$ |                                                                    |                 |
| $R_{\text{th}}$           | = 18K/W                 | $T_{\text{over}} = 18 \times 0.25 =$                               | <b>+4.5°C</b>   |
| $\eta_{\text{full load}}$ | = 87.5% (Crosstable)    | $T_{\text{amb}} = 105 - 4.5 =$                                     |                 |
| $f_{\eta}$                | = 0.98 (Graph)          |                                                                    |                 |
|                           |                         |                                                                    | <b>+100.5°C</b> |

### 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<br>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<br>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 <sup>(7)</sup>                                          |                                                        | 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)<br>27V/m (385MHz)<br>28V/m (450MHz) | EN61000-4-3:2006 + A2:2010         |
| Fast Transient and Burst Immunity <sup>(6)</sup>                                                                                                                                       | DC Port: ±2kV                                          | EN61000-4-4:2012                   |
| Surge Immunity <sup>(6)</sup>                                                                                                                                                          | 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                   |

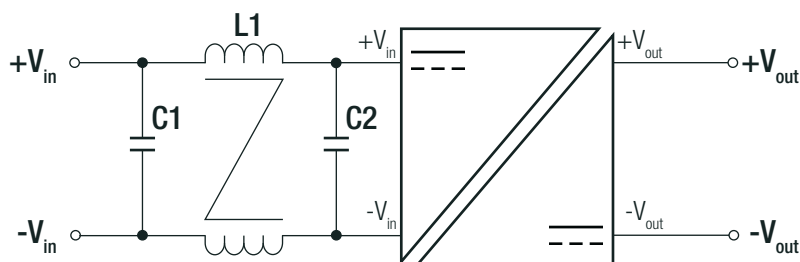
**Notes:**

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

|                                |              |                                                                                                                         |
|--------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------|
| <u>Recommended components:</u> | 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 REM3 series can meet EMI Class A with no external filter. And Class B only with external components

**EMC Filter Suggestion for Class B <sup>(8)</sup>**



| MODEL                           | C1 <sup>(8)</sup> | C2 <sup>(8)</sup> | L1 <sup>(8)</sup> |
|---------------------------------|-------------------|-------------------|-------------------|
| REM3-05xxS_D                    | 22µF/16V MLCC     | 22µF/16V MLCC     | 137µH CMC         |
| REM3-12xxS_D<br>REM3-24xxS_D(W) | 4.7µF/50V MLCC    | 4.7µF/50V MLCC    | 277µH CMC         |
| REM3-48xxS_D(W)                 | 2.2µF/100V MLCC   | 1µF/100V MLCC     | 175µH CMC         |

**Notes:**

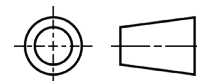
Note8: The component values can be adapted according to customer's application

**DIMENSION and PHYSICAL CHARACTERISTICS**

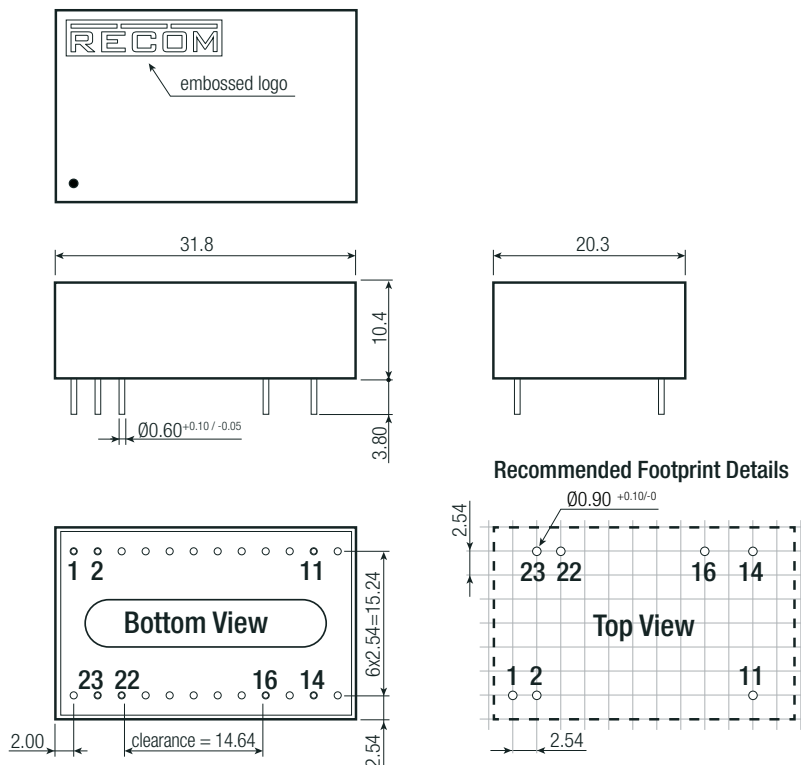
| Parameter         | Type                   | Value                                                                         |
|-------------------|------------------------|-------------------------------------------------------------------------------|
| Material          | case<br>PCB<br>potting |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

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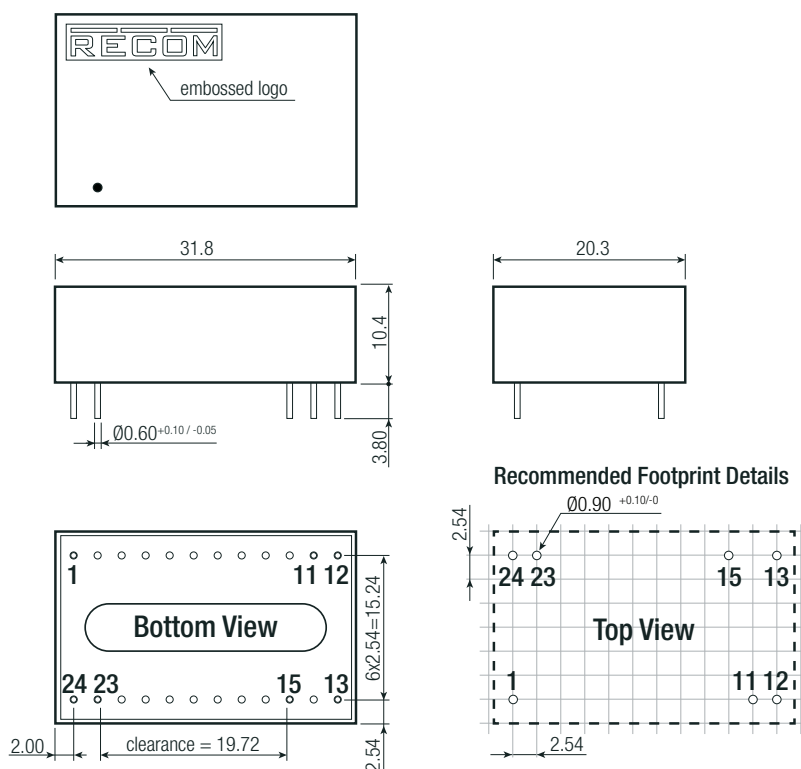
### Dimension Drawing (mm)



### “A” Pinning (Standard)



## “C” Pinning



## 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 the CTRL option is not chosen,  
Pin 1 will be absent

NC= not connected

Tolerance: xx.x=  $\pm 0.5\text{mm}$

 $xx.xx = \pm 0.25\text{mm}$ 

## 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=  $\pm 0.5\text{mm}$

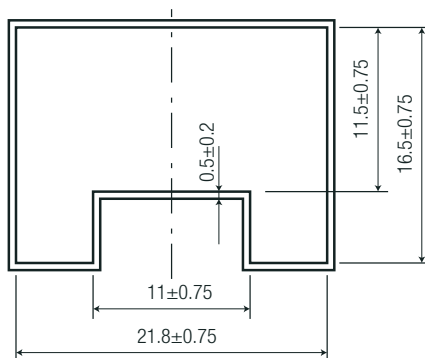
xx.xx= ±0.25mm

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     |
| Storage Humidity            | non-condensing | 5% to 95% RH max.   |

**Tube Dimension Drawing (mm)**



The product information and specifications may be subject to changes even without prior written notice. The product has been designed for various applications; its suitability lies in the responsibility of each customer. The products are not authorized for use in safety-critical applications without RECOM's explicit written consent. A safety-critical application is an application where a failure may reasonably be expected to endanger or cause loss of life, inflict bodily harm or damage property. The applicant shall indemnify and hold harmless RECOM, its affiliated companies and its representatives against any damage claims in connection with the unauthorized use of RECOM products in such safety-critical applications.



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- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
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- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

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