# Features

# Switching Regulator

- Efficiency up to 96%, no need for heatsinks
- Pin-out compatible with LM78XX linears
- Low profile (L*W*H=11.6*8.5*10.4mm)
- Wide input range (5V - 42V)
- Short circuit protection, thermal shutdown
- Low ripple and noise
- IEC/EN60950 certified
- Positive to negative converter

RECOM
DC/DC Converter

# R-78C-1.0

## 1.0 Amp SIP3 Single Output

3 YEAR warranty


IEC60950-1 certified
EN60950-1 certified
EN55032 compliant

## Description

The R-78Cxx-1.0 series switching regulators are ideally suited to replace 1 Amp 78xx linear regulators and are pin compatible. Efficiencies of up to 96% means that very little energy is wasted as heat and the high input voltage is a useful feature.

## Selection Guide

| Part Number | Input Voltage Range [VDC] | Output Voltage [VDC] | Output Current [A] | Efficiency @ min Vin [%] | Efficiency @ max. Vin [%] |
|---|---|---|---|---|---|
| R-78C1.8-1.0 | 5 - 42 | 1.8 | 1.0 | 80 | 71 |
| R-78C3.3-1.0 | 7 - 42 | 3.3 | 1.0 | 89 | 79 |
| R-78C5.0-1.0 | 8 - 42 | 5 | 1.0 | 93 | 85 |
| R-78C9.0-1.0 | 12 - 42 | 9 | 1.0 | 95 | 90 |
| R-78C12-1.0 | 15 - 42 | 12 | 1.0 | 96 | 92 |
| R-78C15-1.0 | 18 - 42 | 15 | 1.0 | 96 | 94 |

## Model Numbering

R-78C__ -1.0

Output Voltage — Output Current

## Specifications (measured at Ta= 25°C, minimum load, otherwise specified)

| BASIC CHARACTERISTICS | | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Condition** | | **Min.** | **Typ.** | **Max.** |
| Input Voltage Range | | | Vout +3V | | 42VDC |
| Output Voltage Range | | | 1.8VDC | | 15VDC |
| Minimum Load (1) | | | 0% | | |
| Quiescent Current | | | | 1mA | |
| Internal Operating Frequency | | | 280kHz | 350kHz | 420kHz |
| Output Ripple and Noise (2) | 20MHz BW | Vin= 24VDC Vout=1.8-15 full load | | 75mVp-p 30mVp-p | 120mVp-p |
| Max. Capacitive Load | with normal start-up time, no external components | with <1 second start-up time + diode protection circuit | | | 470µF 6800µF |

**Notes:**

Note1: No load operation will not damage these devices, however they may not meet all specifications
A minimum load of 10mA is required

Note2: Measurements are made with a 10µF MLCC across output. (low ESR)

| REGULATIONS | | |
|---|---|---|
| **Parameter** | **Condition** | **Value** |
| Output Voltage Accuracy | full load | ±2% typ. / ±3% max. |
| Line Voltage Regulation | max. Vin, full load | ±0.2% typ. |
| Load Voltage Regulation | max. Vin. and 10% to 100% load | ±0.4% typ. |
| Transient Response | 100% <-> 50% load<br>100% <-> 10% load | ±75mV max.<br>±200mV max. |

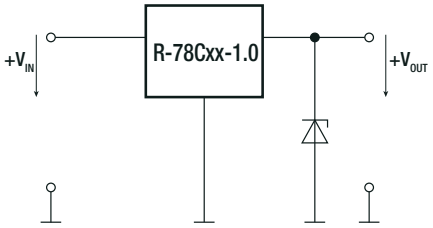
## Specifications (measured at Ta= 25°C, minimum load, otherwise specified)

### PROTECTIONS

| Parameter | Condition | Value |
|---|---|---|
| Short Circuit Protection (SCP) | | continuous, automatic recovery |
| Short Circuit Input Current | nom. Vin = 24VDC | 65mA typ. |

**External Zener Diode Calculation for Output Over Voltage Protection**

Minimum Zener Breakdown Voltage (VZmin) ≥ VOUTnom + 3% Accuracy

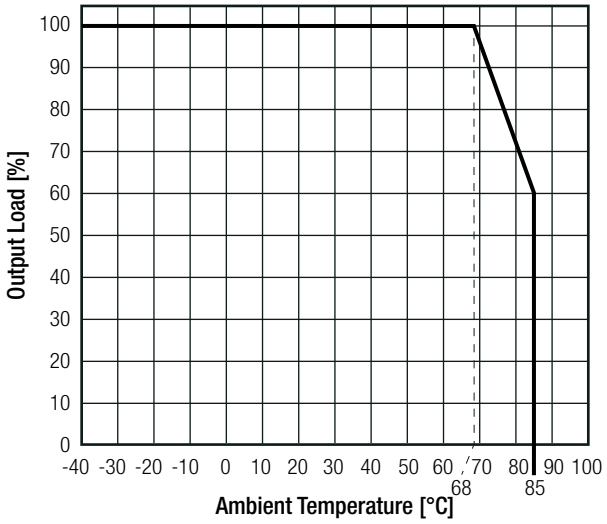



| R-78C Vout | Zener Voltage, Vz (VZmin) | Recommended Zener Diode |
|---|---|---|
| **1.8V** (1.85V max.) | **2.0V** (1.90V) | MMSZ679T1G |
| **3.3V** (3.4V max.) | **3.6V** (3.42V) | MMSZ4685T1G |
| **5V** (5.15V max.) | **5.6V** (5.32V) | MMSZ4690T1G |
| **9V** (9.27V max.) | **10V** (9.50V) | MMSZ4697T1G |
| **12V** (12.36V max.) | **13V** (12.35V) **14V** (13.30V) | MMSZ4700T1G / MMSZ4701T1G |
| **15V** (15.45V max.) | **17V** (16.15V) | MMSZ4704T1G |

### ENVIRONMENTAL

| Parameter | Condition | | Value |
|---|---|---|---|
| Operating Temperature Range | with derating (see graph) | | -40°C to +85°C |
| Max. Case Temperature | | | +100°C |
| Temperature Coefficient | | | 0.015%/°C |
| Case Thermal Impedance | | | 70°C/W max. |
| Operating Altitude | | | 2000m |
| Operating Humidity | non condensing | | 5% - 95% max., RH |
| Pollution Degree | | | PD2 |
| MTBF | MIL-HDBK 217F | +25°C<br>+68°C | 8600 x $10^3$ hours<br>3880 x $10^3$ hours |

**Derating Graph**




### SAFETY AND CERTIFICATIONS

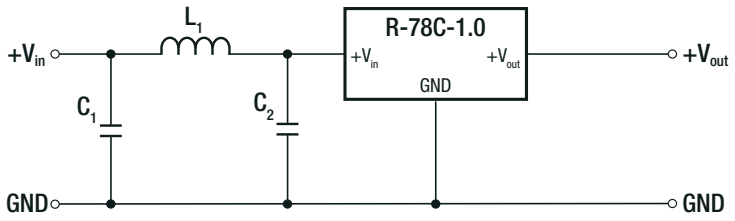
| Certificate Type (Safety) | Report / File Number | Standard |
|---|---|---|
| Information Technology Equipment, General Requirements for Safety | 1603123 | IEC60950-1:2005, 2nd Edition + AM 2:2013<br>EN60950-1:2006 + AM2:2013 |
| RoHS 2+ | | RoHS 2011/65/EU + AM2015/863 |
| EAC | RU-AT.49.09571 | TP TC 004/2011 |

continued on next page

## Specifications (measured at Ta= 25°C, minimum load, otherwise specified)

| EMC Compliance | Condition | Standard / Criterion |
|---|---|---|
| Electromagnetic compatibility of multimedia equipment - Emission requirements | with external filter (see filter suggestion below) | EN55032, Class A and B |

### EMC Filter Suggestion according to EN55032




### Component List Class A

| MODEL | C1 | L1 |
|---|---|---|
| R-78C3.3-1.0 | 10µF 100V MLCC | 5.6µH choke RLS-567 |
| R-78C5.0-1.0 | | |

### Component List Class B

| MODEL | C1 | C2 | L1 |
|---|---|---|---|
| R-78C3.3-1.0 | 10µF 100V MLCC | 10µF 100V MLCC | 12µH choke RLS-126 |
| R-78C5.0-1.0 | | | |

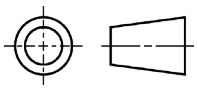
**Notes:**

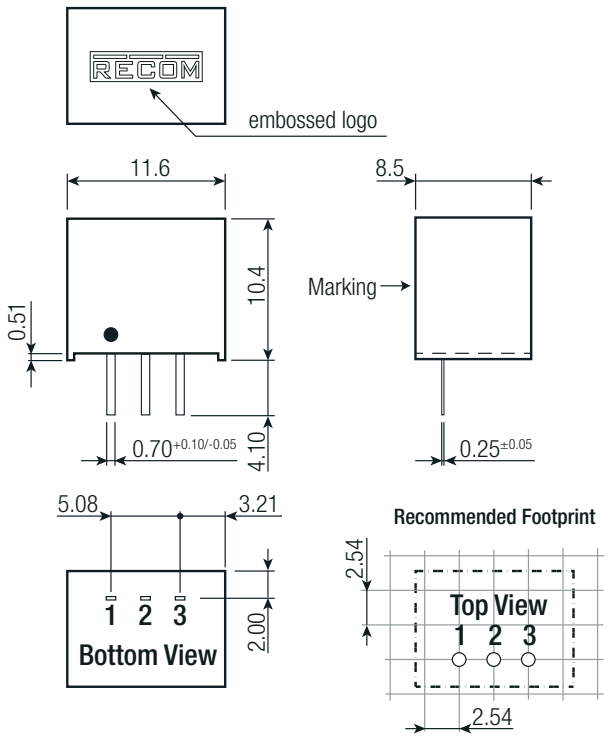
Note3: Filter suggestions are valid for indicated part numbers only. For other part numbers, please contact RECOM tech support for advice

## DIMENSION AND PHYSICAL CHARACTERISTICS

| Parameter | | Value |
|---|---|---|
| Material | case<br>potting | non-conductive black plastic, (UL94 V-0)<br>silicone, (UL94 V-0) |
| Package Dimension (LxWxH) | | 11.6 x 8.5 x 10.4mm |
| Package Weight | | 2g typ. |

### Dimension Drawing (mm)






**Pin Connections**

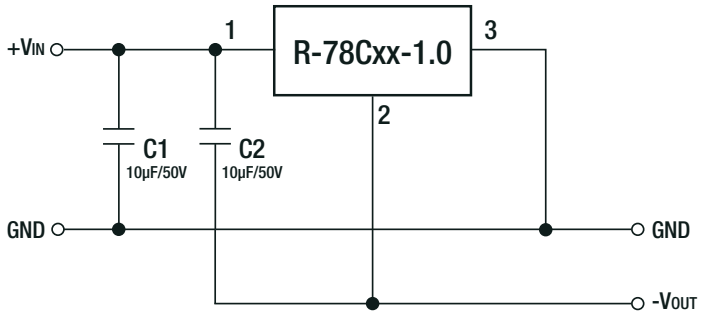
| Pin # | Function |
|---|---|
| 1 | +Vin |
| 2 | GND |
| 3 | +Vout |

Tolerance: xx.x= ±0.50mm
xx.xx= ±0.25mm

## Specifications (measured at Ta= 25°C, minimum load, otherwise specified)

### INSTALLATION AND APPLICATION

#### Positive to Negative Converter




**Pin Connections**

| Pin # | Negative | Positive |
|---|---|---|
| 1 | +Vin | +Vin |
| 2 | -Vout | GND |
| 3 | GND | +Vout |

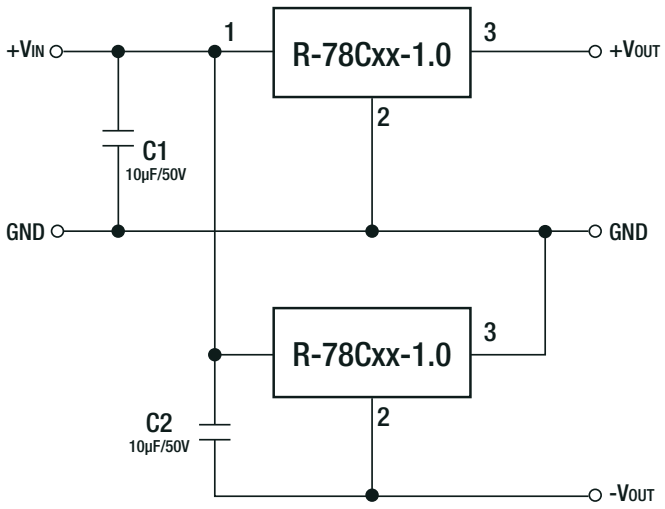
#### Selection Guide - Negative Output

| Part Number | Input Voltage Range (3) [VDC] | Output Voltage [VDC] | Output Current [A] | Efficiency @ min Vin [%] | Efficiency @ max. Vin [%] |
|---|---|---|---|---|---|
| R-78C1.8-1.0 | 5 - 38 | -1.8 | -0.8 | 69 | 70 |
| R-78C3.3-1.0 | 7 - 37 | -3.3 | -0.8 | 77 | 80 |
| R-78C5.0-1.0 | 8 - 35 | -5 | -0.7 | 79 | 83 |
| R-78C9.0-1.0 | 12 - 31 | -9 | -0.6 | 85 | 87 |
| R-78C12-1.0 | 15 - 28 | -12 | -0.5 | 87 | 89 |
| R-78C15-1.0 | 18 - 25 | -15 | -0.5 | 89 | 90 |

**Notes:**

Note4: When using the R-78C as positive-to-negative converter, the input voltage range is limited

#### Dual Output (two Converters) with Negative Output

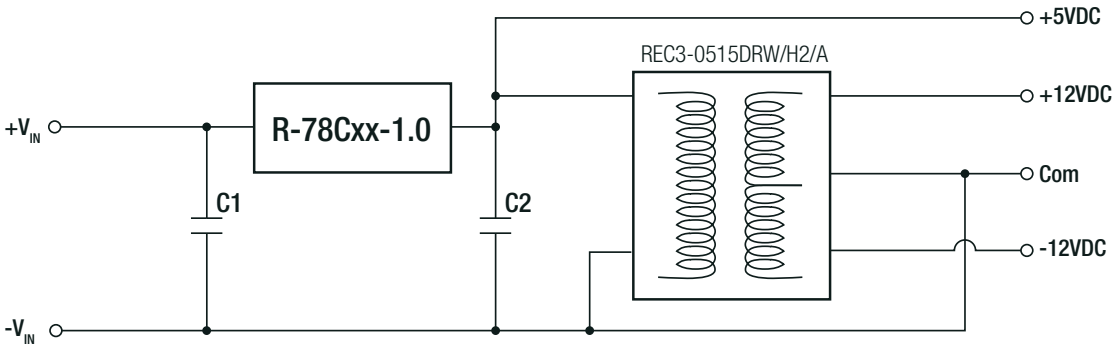



**Notes:**

Note5: When connecting two R-78C together to create a dual output, both connectors must be connected in parallel
Connecting them in series might cause start-up problems of the second R-78C

## Specifications (measured at Ta= 25°C, minimum load, otherwise specified)

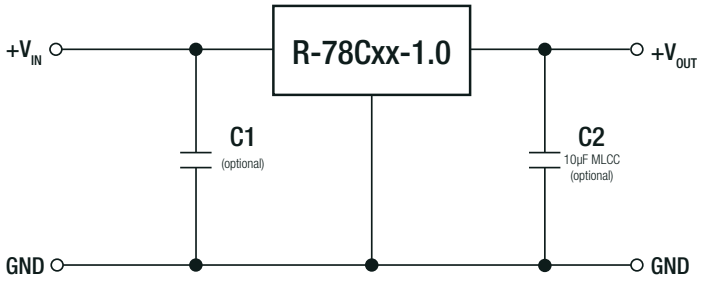
### High Efficiency Regulated Outputs




C1: optional; C2: Required (further decoupling filtering may be neccesary between the two conversters)

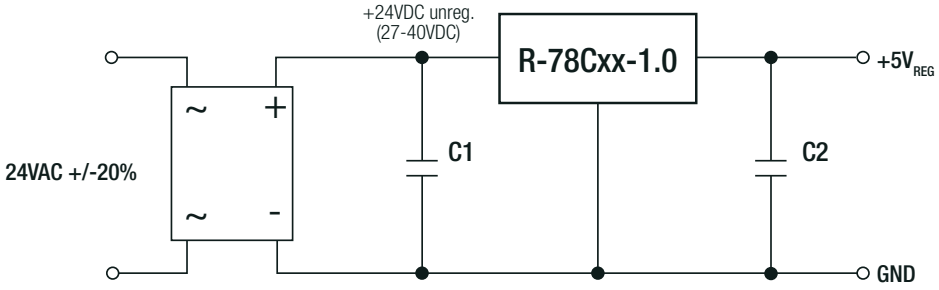
- Triple Outputs
- Wide Input Range 8V to 42V
- High System Efficiency, Suitable for 12V, 24V, 36V Battery Powered Devices

### Standard Application Circuit




To protect the converter during power-up, use soft start power supply.

### Low Voltage AC Input, Regulated DC Output




- Low Voltage AC Input
- Regulated and protected DC Output

| PACKAGING INFORMATION | | |
|---|---|---|
| **Parameter** | **Type** | **Value** |
| Packaging Dimension (LxWxH) | tube | 520 x 18.2 x 11.2mm |
| Packaging Quantity | | 42pcs |
| Storage Temperature Range | | -55°C to +125°C |