

# Features

# Switching Regulator

- Efficiency up to 97%, no heatsinks required
- Pin-out compatible with LM78XX linears
- Low profile (L/W/H=11.5 x 8.5 x 17.5mm)
- Wide input range
- Short circuit protection, thermal shutdown
- Low ripple and noise
- „L“ version with 90° pins

# RECOM

## DC/DC Converter

## R-78B-1.0(L)

1.0 Amp  
SIP3  
Single Output



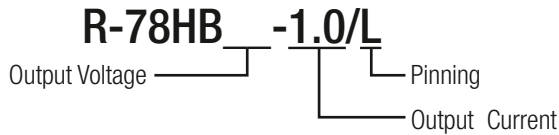
### Description

The R-78Bxx-1.0 series high efficiency switching regulators are ideally suited to replace 78xx linear regulators and are pin compatible. The efficiency of up to 97% means that very little energy is wasted as heat so there is no need for any heat sinks with their additional space and mounting costs. The L-Version with 90° pins allows direct replacement for laid-flat regulators where component height is at a premium. Low ripple and noise figures and a short circuit input current of typically only 10mA round off the specifications of this versatile converter series.

### Selection Guide

Part Number	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [A]	Efficiency	
				@ min Vin [%]	@ max. Vin [%]
R-78B1.5-1.0 <sup>(1)</sup>	4.75 - 26	1.5	1.0	77	71
R-78B1.8-1.0 <sup>(1)</sup>	4.75 - 26	1.8	1.0	80	74
R-78B2.5-1.0 <sup>(1)</sup>	4.75 - 32	2.5	1.0	85	78
R-78B3.3-1.0 <sup>(1)</sup>	4.75 - 32	3.3	1.0	89	83
R-78B5.0-1.0 <sup>(1)</sup>	6.5 - 32	5.0	1.0	93	88
R-78B6.5-1.0 <sup>(1)</sup>	9.0 - 32	6.5	1.0	94	90
R-78B9.0-1.0 <sup>(1)</sup>	12 - 32	9.0	1.0	95	93
R-78B12-1.0 <sup>(1)</sup>	16 - 32	12	1.0	96	95
R-78B15-1.0 <sup>(1)</sup>	20 - 32	15	1.0	97	96

### Model Numbering



#### Notes:

Note1: add suffix "L" for 90° bent pins, e.g. R-78B5.0-1.0L

### Specifications (measured @ Ta= 25°C, 10% minimum load, unless otherwise stated)

BASIC CHARACTERISTICS					
Parameter	Condition		Min.	Typ.	Max.
Absolute Maximum Input Voltage Range	1.5Vout , 1.8Vout 2.5Vout to 15Vout				26VDC 34VDC
Quiescent Current	nom. Vin= 24VDC			5mA	7mA
Internal Power Dissipation	Vout= 1.5VDC				0.65W
Internal Operating Frequency	nom. Vin= 24VDC		280kHz	330kHz	380kHz
Minimum Load <sup>(2)</sup>			0%		
Output Ripple and Noise <sup>(3)</sup>	20MHz BW	1.5Vout to 6.5Vout		15mVp-p	20mVp-p
		9Vout to 15Vout		25mVp-p	35mVp-p
Ref. Back Ripple Current				150mA	200mA-p-p
Absolute Maximum Capacitive Load	1 second start up, no external components				470µF
	<1 second start up + diode protection circuit				6800µF

#### Notes:

Note2: Operation under no load will not harm the converter, but specifications may not be met  
A minimum load of 10mA is recommended

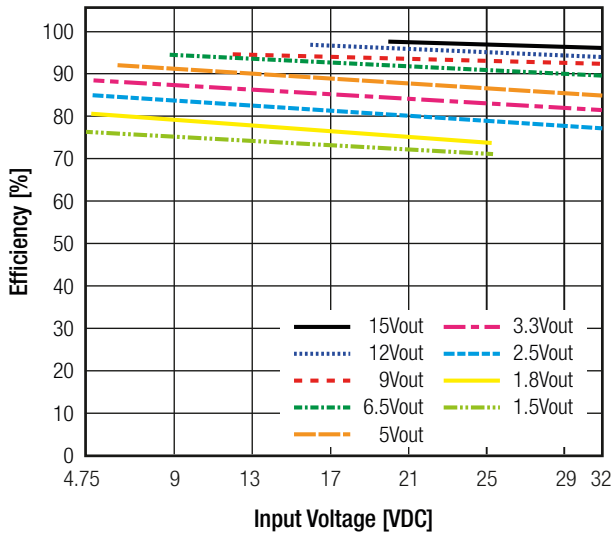
Note3: Output Ripple and Noise is tested from 10% to 100% load

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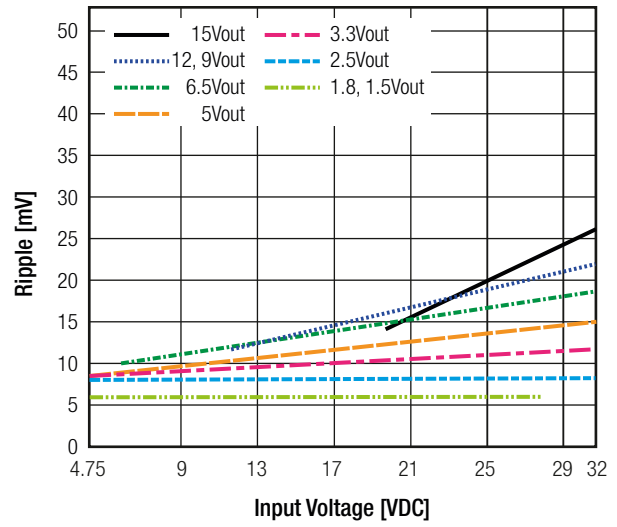
EN55032 compliant  
IEC/EN60950-1 certified

Specifications (measured @ Ta= 25°C, 10% minimum load, unless otherwise stated)

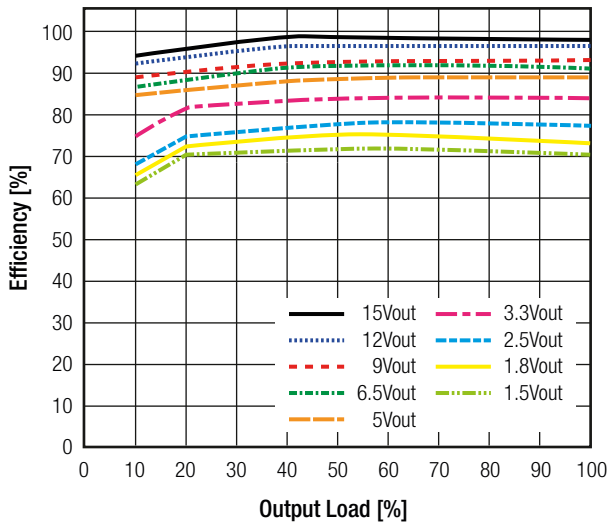
Efficiency vs. Vin (full load)



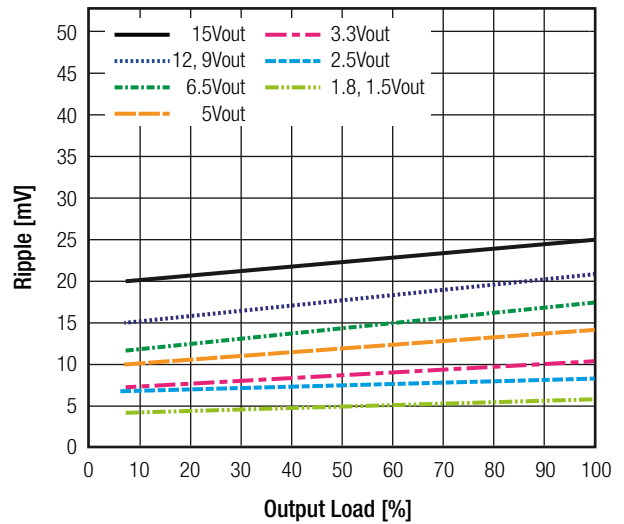
Ripple vs. Vin (full load)



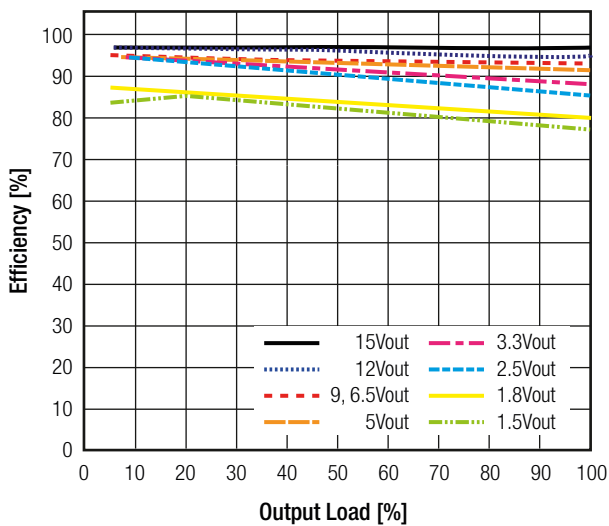
Efficiency vs. Load (max. Vin)



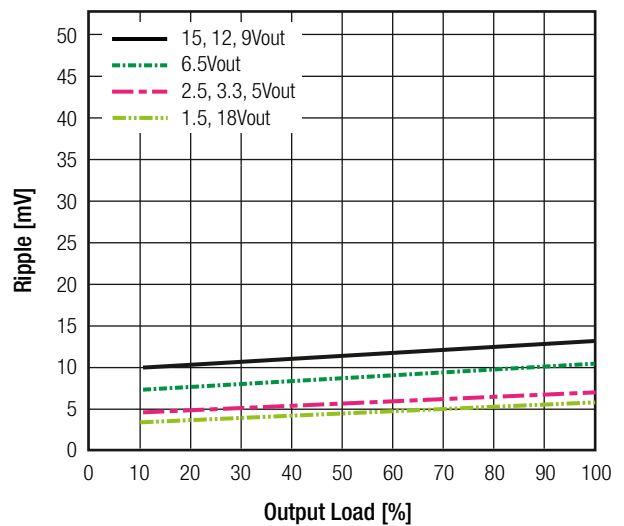
Ripple vs. Load (max. Vin)



Efficiency vs. Load (min. Vin)



Ripple vs. Load (min. Vin)



**Specifications** (measured @ Ta= 25°C, 10% minimum load, unless otherwise stated)

REGULATIONS			
Parameter	Condition		Value
Output Accuracy	100% load		±2.0% typ / ±3.0% max.
Line Regulation	low line to high line, full load	1.5Vout to 6.5Vout	±0.2% typ. / ±0.4% max.
		9Vout to 15Vout	±0.1% typ. / ±0.2% max.
Load Regulation	10% to 100% load	1.5Vout to 6.5Vout	±0.4% typ. / ±0.6% max.
		9Vout to 15Vout	±0.25% typ. / ±0.4% max.
Transient Response	100% <-> 50% load		±100mV typ. / ±150mV max.
	Recovery Time		1.0ms typ. / 1.5ms max.

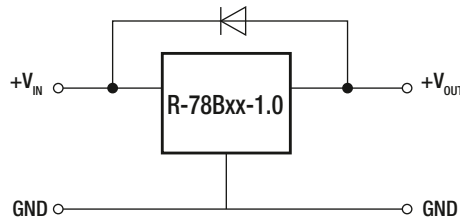
PROTECTIONS			
Parameter	Condition		Value
Short Circuit Protection (SCP)	below 100mΩ		continuous, automatic recovery
Short Circuit Input Current	nom. Vin= 24VDC		60mA max.

**Optional Diode Protection Circuit**

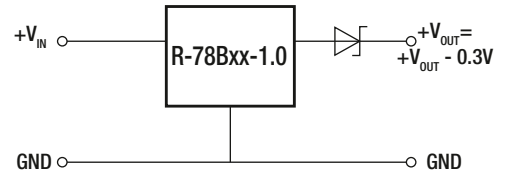
Add a blocking diode to Vout if current can flow backwards into the output, as this can damage the converter when it is powered down.

The diode can either be fitted across the device if the source is low impedance or fitted in series with the output (recommended).

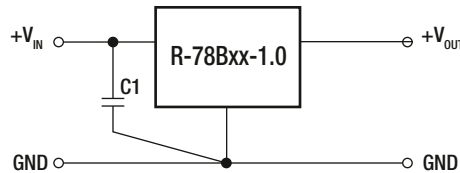
**Optional Protection 1:**



**Optional Protection 2:**



**Protection Circuit**



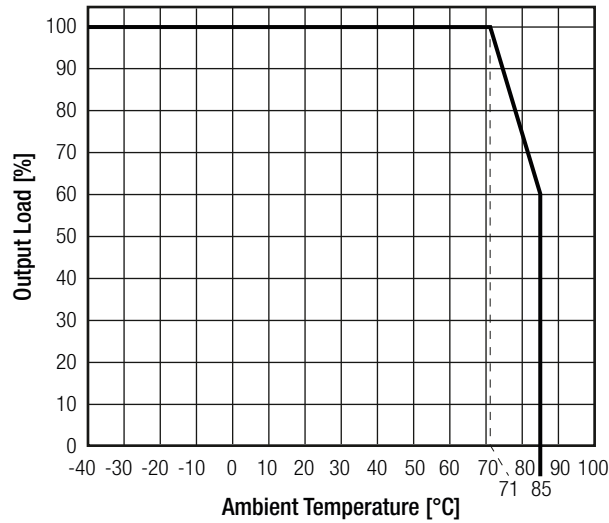
To protect the converter during power-up, use C1=22µF if Vin>30

ENVIRONMENTAL			
Parameter	Condition		Value
Operating Temperature Range	with derating (see graph)		-40°C to +85°C
Maximum Case Temperature			+100°C
Temperature Coefficient			±0.015%/°C
Thermal Impedance	0.1 m/s, vertical		60°C/W
Operating Altitude			2000m
Operating Humidity	non-condensing		95% RH max.
Pollution Degree			PD2
MTBF	according to MIL-HDBK-217F, G.B.	+25°C	8593 x 10 <sup>3</sup> hours

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**Specifications** (measured @ Ta= 25°C, 10% minimum load, unless otherwise stated)

Derating Graph

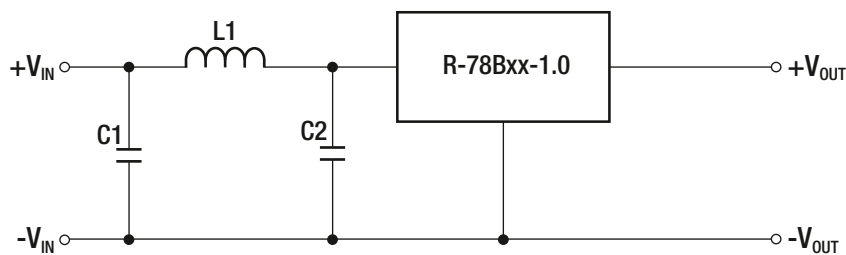


**SAFETY AND CERTIFICATIONS**

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

EMC Compliance	Condition	Standard / Criterion
Electromagnetic compatibility of multimedia equipment - Emission requirements	with external components	EN55032, Class A EN55032, Class B
ESD Electrostatic discharge immunity test	Air ±8kV, Contact ±4kV	EN61000-4-2, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	3V/m	EN61000-4-3, Criteria A

EMC Filter Suggestion according EN55032 Class A and Class B



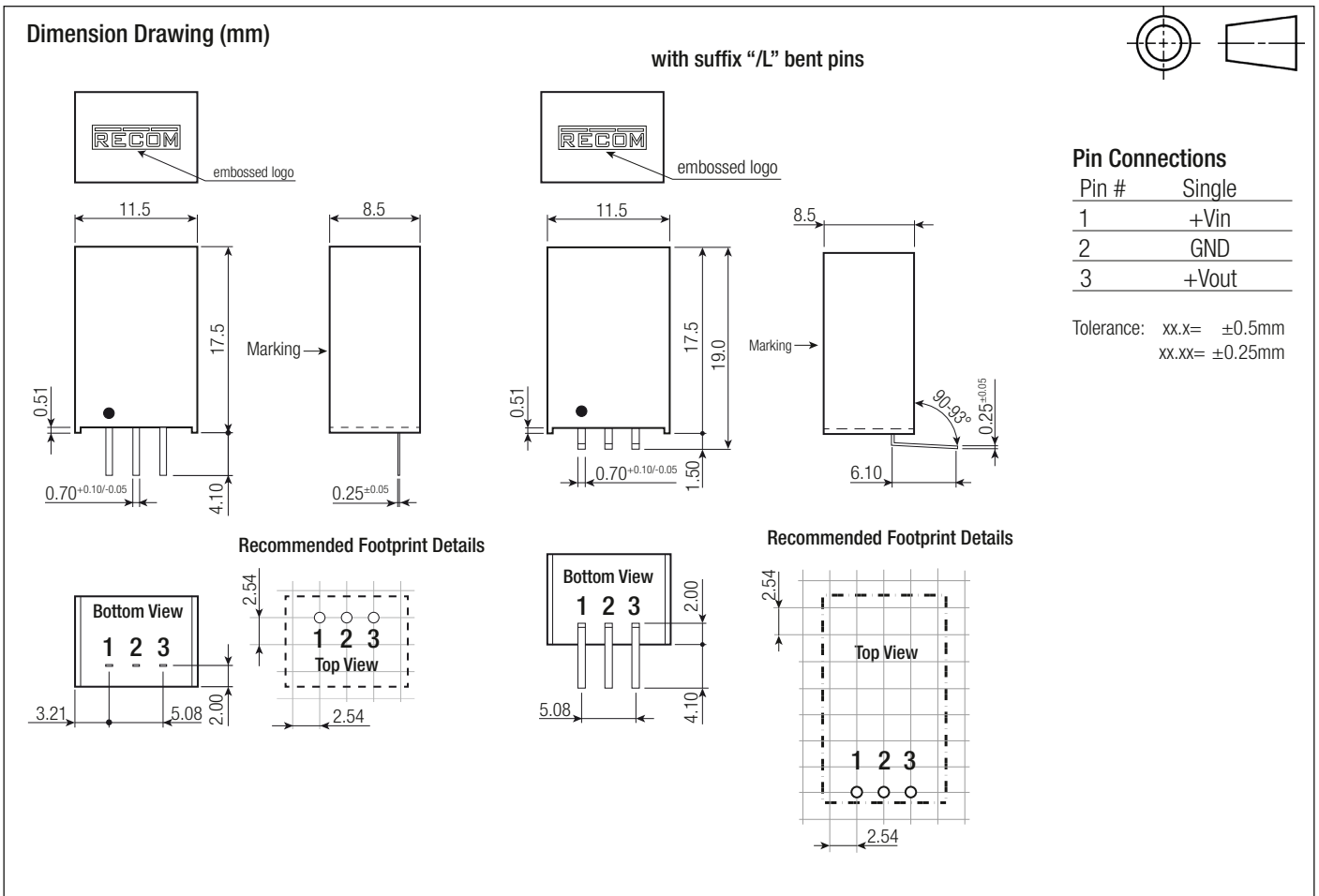
Level	C1	C2	L1
Class A	10µF 100V MLCC	4.7µF 50V MLCC	3.9µH choke
Class B	10µF 100V MLCC	10µF 100V MLCC	12µH choke

**DIMENSION AND PHYSICAL CHARACTERISTICS**

Parameter	Type	Value
Material	case potting	non-conductive black plastic, (UL94 V-0) silicone, (UL94 V-0)
Package Dimension (LxWxH)		11.5 x 8.5 x 17.5mm
Package Weight		4g typ.

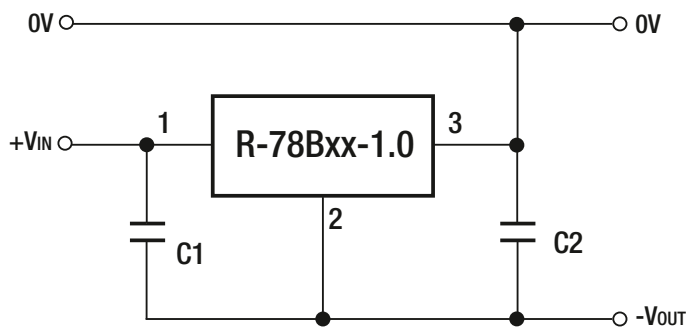
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**Specifications** (measured @ Ta= 25°C, 10% minimum load, unless otherwise stated)



## INSTALLATION AND APPLICATION

### Positive to Negative Converter



C1 and C2 are required and should be fitted close to the converter pins.

Maximum capacitive load including C2 is 220µF

### Pin Connections

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

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**Specifications** (measured @ Ta= 25°C, 10% minimum load, unless otherwise stated)

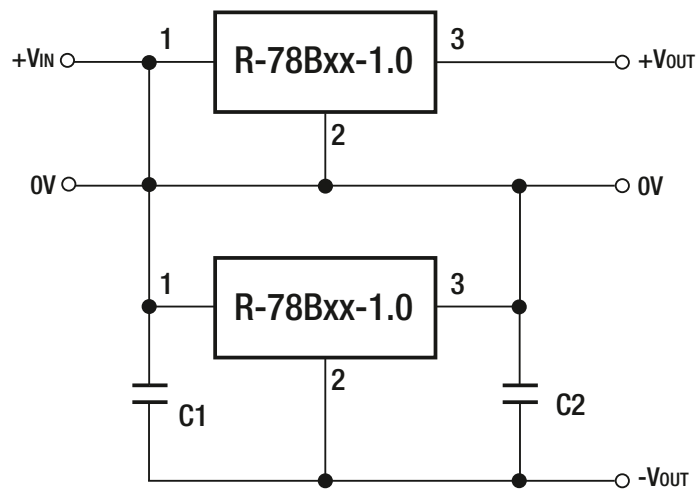
**Selection Guide - Negativ Output**

Part Number	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [A]	Efficiency		External Capacitor	
				@ min Vin [%]	@ max. Vin [%]	C1	C2 <sup>(6)</sup>
R-78B1.5-1.0	4.75 - 28	-1.5	-0.6	70	68	10µF/50V	22µF/6.3V
R-78B1.8-1.0	4.75 - 28	-1.8	-0.6	72	72	10µF/50V	22µF/6.3V
R-78B2.5-1.0	4.75 - 28	-2.5	-0.6	75	77	10µF/50V	22µF/6.3V
R-78B3.3-1.0	4.75 - 28	-3.3	-0.6	77	80	10µF/50V	22µF/6.3V
R-78B5.0-1.0	6.5 - 28	-5.0	-0.6	83	85	10µF/50V	22µF/10V
R-78B6.5-1.0	8.0 - 26	-6.5	-0.4	84	87	10µF/50V	10µF/10V
R-78B9.0-1.0	8.0 - 18	-9.0	-0.4	88	89	10µF/25V	10µF/25V
R-78B12-1.0	8.0 - 18	-12	-0.3	89	90	10µF/25V	10µF/25V
R-78B15-1.0	8.0 - 18	-15	-0.3	89	91	10µF/25V	10µF/25V

**Notes:**

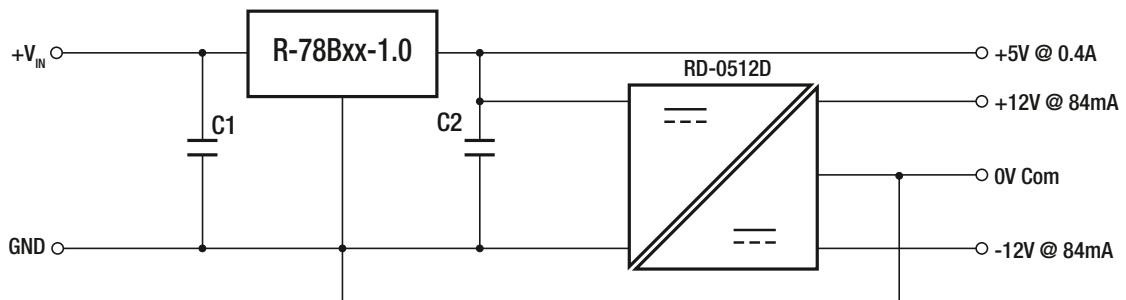
Note6: Maximum Capacitive Load including C2 is 220µF

**Dual Output (two Converters) with Negativ Output**



**Application Examples**

**High Efficiency Multiple Output**



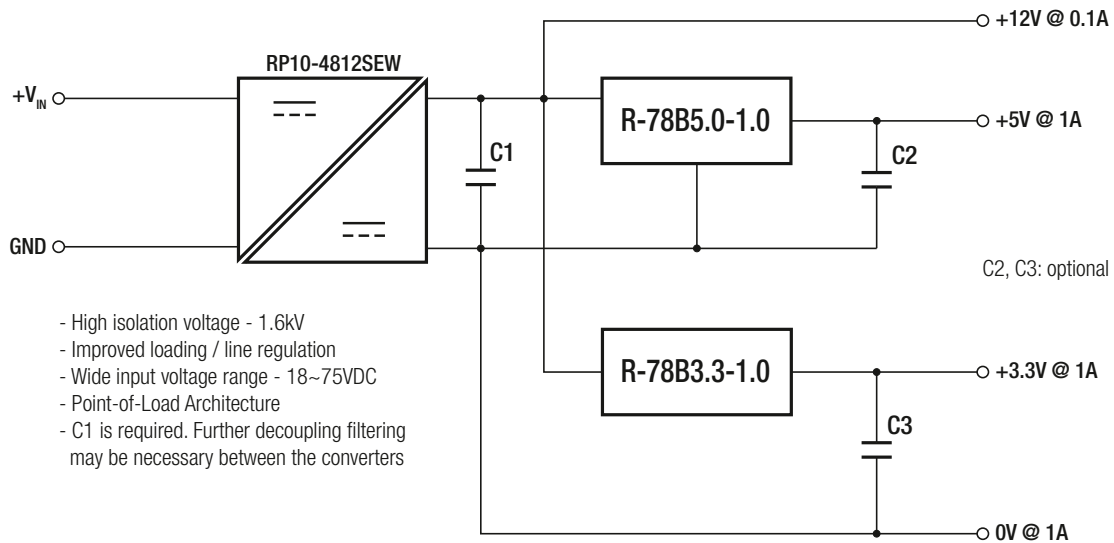
C1 optional;  
C2 required (further decoupling filtering may be necessary between the two converters)

- Wide input range 4.75V to 34V
- ±12V outputs for analogue circuits, e.g. instrumentation amplifier
- +5V output for digital circuits

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**Specifications** (measured @ Ta= 25°C, 10% minimum load, unless otherwise stated)

**Isolated, Wide Input Range, Distributed Power Architecture (Point-of-Load)**



**PACKAGING INFORMATION**

Parameter	Type		Value
	tube	without suffix with suffix "L"	
Packaging Dimension (LxWxH)			520.0 x 25.1 x 10.6mm 520.0 x 26.1 x 15.8mm
Packaging Quantity	tube		42pcs
Storage Temperature Range			-55°C to +125°C
Storage Humidity			95% RH max.

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