Features

Regulated Converters

- 12W in SIP8 package
- 3kVDC isolation
- 4:1 input voltage range
- Operating temperature from -40°C to +75°C with no derating and convection cooling only
- Continuous short circuit protection
- ON/OFF CTRL pin

RECOM
DC/DC Converter

RS12-Z

12 Watt SIP8 Single Output

3 YEAR warranty

Description

The RS12 is an advanced DC/DC converter that uses planar transformer technology to offer a very high power density, 4:1 input voltage, regulated DC output with 3kVDC isolation and a wide operating temperature range of -40°C to +75°C (without derating and with convection cooling only). The SIP8 pinout is backwards compatible with our RS6 (6W) and RS3 (3W) offering the option of 3W, 6W or 12W of output power in the same sized package, the difference being that the RS12 uses a metal case. Additional features such as UVLO, CTRL pin, trimmable outputs and simple EMC filtering round off this versatile DC/DC converter which is also UL/IEC/EN 62368-1 safety certified with CB report.

Selection Guide

Part Number	nom. Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [mA]	Efficiency typ. (1) [%]	max. Capacitive Load (2) [µF]
RS12-243.3SZ	9-36	3.3	2400	85	6000
RS12-2405SZ	9-36	5	2400	88	6000
RS12-2412SZ	9-36	12	1000	88	1000
RS12-2415SZ	9-36	15	800	88	860
RS12-2424SZ	9-36	24	500	89	200
RS12-483.3SZ	18-75	3.3	2400	85	5600
RS12-4805SZ	18-75	5	2400	88	5600
RS12-4812SZ	18-75	12	1000	88	1000
RS12-4815SZ	18-75	15	800	88	860
RS12-4824SZ	18-75	24	500	89	200

Notes:

Note1: Efficiency is tested by nominal input and full load at +25°C ambient

Note2: Max Cap Load is tested by minimum input and constant resistive load

c UL us
E224736

IEC/EN62368-1 certified
UL62368-1 certified
CSA/CAN No. 62368-1 certified
CB Report
EN55032 compliant

Model Numbering

Ordering Examples:

RS12-2405SZ	nom. 24Vin (9-36VDC)	5Vout	Single
RS12-4812SZ	nom. 48Vin (18-75VDC)	12Vout	Single

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

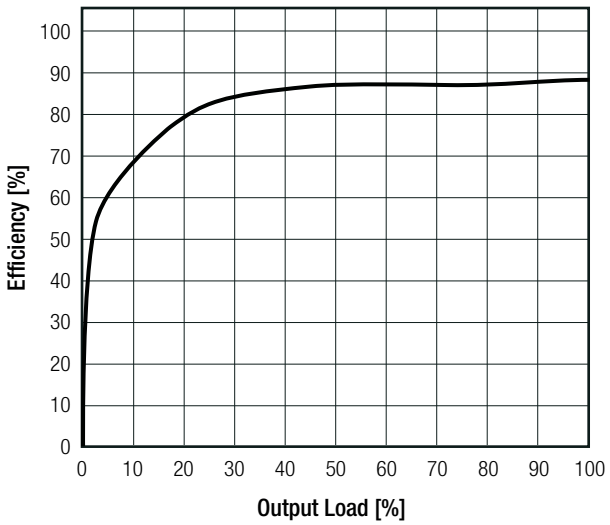
BASIC CHARACTERISTICS					
Parameter	**Condition**		**Min.**	**Typ.**	**Max.**
Input Voltage Range	nom. Vin=	24VDC 48VDC	9VDC 18VDC	24VDC 48VDC	36VDC 75VDC
Input Surge Voltage	100ms max.	nom. Vin= 24VDC 48VDC			50VDC 100VDC
Input Current	nom. Vin=	24VDC 48VDC		580mA 290mA	
Quiescent Current	nom. Vin=	24VDC 48VDC		7mA 5mA	
Under Voltage Lockout	nom. Vin=	24VDC 48VDC		7.5VDC 16VDC	
ON/OFF CTRL	DC-DC ON DC-DC OFF				Open or 3.5VDC ≤ V_{CRTL} ≤ 15VDC Short or 0VDC ≤ V_{CRTL} ≤ 1.2VDC
Input Current of CTRL Pin	DC-DC OFF				1mA
Internal Operating Frequency			470kHz	500kHz	
Output Voltage Trimming	refer to ***"OUTPUT VOLTAGE TRIMMING"***		-10%		+10%
Minimum Load				0%	
Start-up time	power up ON/OFF CTRL			15ms 7ms	
Rise time				5ms	
Output Ripple and Noise (3)	20MHz BW	3.3, 5, 12Vout 15, 24Vout		50mVp-p 75mVp-p	

Notes:

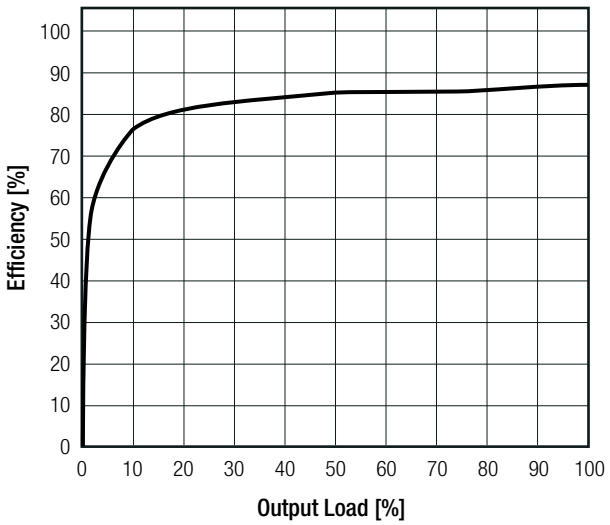
Note3: Measurements are made with a 10µF MLCC across output (low ESR)

Efficiency vs. Load

RS12-2405SZ



RS12-2412SZ



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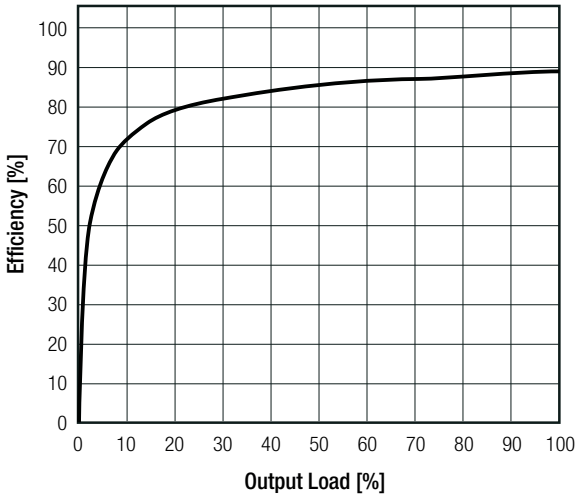
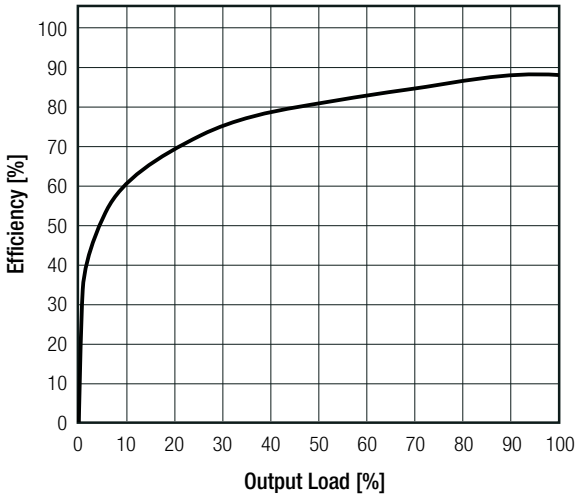
Specifications (measured @ Ta= 25°C, nominal input voltage, full load and after warm up unless otherwise specified)

Efficiency vs. Load

RS12-2424SZ



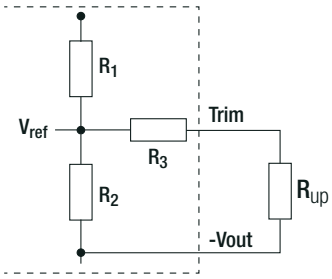
RS12-4824SZ



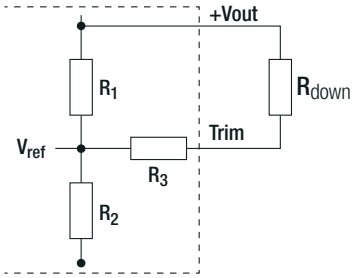
OUTPUT VOLTAGE TRIMMING

It allows the user to increase or decrease the output voltage of the module. This is accomplished by connecting an external resistor between the Trim pin and either the +Vout or -Vout pins. With an external resistor between the -Vout and Trim pin, the output voltage increases. With an external resistor between the Trim and +Vout pin, the output voltage decreases. The values for trim resistors shown in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary.

Trim UP



Trim DOWN



$Vout_{nom}$	= nominal output voltage	[VDC]
$Vout_{set}$	= trimmed output voltage	[VDC]
V_{ref}	= reference voltage	[VDC]
R_{up}	= trim up resistor	[Ω]
R_{down}	= trim down resistor	[Ω]
R_1, R_2, R_3	= internal resistors	[Ω]
k_u	= trim up factor	[ ]
k_d	= trim down factor	[ ]

$Vout_{nom}$	3.3VDC	5VDC	12VDC	15VDC	24VDC
R_1	16.74kΩ	10kΩ	38.1kΩ	50kΩ	86.32kΩ
R_2	10kΩ				
R_3	52.3kΩ	35.7kΩ	48.7kΩ	51kΩ	73.2kΩ
V_{ref}	1.24VDC	2.5VDC			

Calculation:

$$k_u = \left[\frac{V_{ref}}{Vout_{set} - V_{ref}} \right] \times R_1 \qquad R_{up} = \left[\frac{k_u \times R_2}{R_2 - k_u} \right] - R_3$$

$$k_d = \left[\frac{Vout_{set} - V_{ref}}{V_{ref}} \right] \times R_2 \qquad R_{down} = \left[\frac{k_d \times R_1}{R_1 - k_d} \right] - R_3$$

continued on next page

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

Practical Example REC15-0505SZ trim up 10%

$$k_u = \left[\frac{2.5}{5.5 - 2.5} \right] \times 10k = \mathbf{8k33}$$

$$R_{up} = \left[\frac{8k33 \times 10k}{10k - 8k33} \right] - 35k7\Omega = \mathbf{14k2\Omega}$$

R_{up} according to E96 ≈ **14k3Ω**

Practical Example REC15-0505SZ trim down 10%

$$k_d = \left[\frac{4.5 - 2.5}{2.5} \right] \times 10k = \mathbf{8k}$$

$$R_{down} = \left[\frac{8k \times 10k}{10k - 8k} \right] - 35k7 = \mathbf{4k3\Omega}$$

R_{down} according to E96 ≈ **4k32Ω**

Calculated trim table

RS12-xx03.3SZ

$Vout_{set}$ =	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.63	[VDC]
R_{down} (E96) ≈	1M15	357k	196k	127k	86k6	61k9	44k2	31k6	21k5	13k7	[Ω]

$Vout_{set}$ =	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.97	[VDC]
R_{down} (E96) ≈	649k	357k	232k	165k	124k	92k1	71k5	54k9	42k2	31k6	[Ω]

RS12-xx05SZ

$Vout_{set}$ =	5.05	5.10	5.15	5.20	5.25	5.30	5.35	5.4	5.45	5.50	[VDC]
R_{down} (E96) ≈	464k	215k	130k	88k7	64k9	47k5	35k7	26k7	20k	14k3	[Ω]

$Vout_{set}$ =	4.95	4.90	4.85	4.80	4.75	4.70	4.65	4.60	4.55	4.5	[VDC]
R_{down} (E96) ≈	453k	205k	121k	78k7	54k9	37k4	25k5	16k9	9k76	4k32	[Ω]

RS12-xx12SZ

$Vout_{set}$ =	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20	[VDC]
R_{down} (E96) ≈	953k	392k	237k	162k	118k	88k7	68k1	53k6	41k2	32k4	[Ω]

$Vout_{set}$ =	11.88	11.76	11.64	11.52	11.40	11.28	11.16	11.04	10.92	10.8	[VDC]
R_{down} (E96) ≈	2M43	1M27	866k	634k	499k	402k	332k	280k	243k	210k	[Ω]

RS12-xx15SZ

$Vout_{set}$ =	15.15	15.3	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50	[VDC]
R_{down} (E96) ≈	953k	402k	243k	165k	121k	93k1	71k5	56k2	43k2	34k	[Ω]

$Vout_{set}$ =	14.85	14.70	14.55	14.40	14.25	14.10	13.95	13.80	13.65	13.5	[VDC]
R_{down} (E96) ≈	3M48	1M82	1M21	909k	715k	576k	487k	412k	357k	309k	[Ω]

RS12-xx24SZ

$Vout_{set}$ =	24.24	24.48	24.72	24.96	25.2	25.44	25.68	25.92	26.16	26.4	[VDC]
R_{down} (E96) ≈	1M27	487k	287k	196k	143k	107k	84k5	66k5	52k3	42k2	[Ω]

$Vout_{set}$ =	23.76	23.52	23.28	23.04	22.8	22.56	22.32	22.08	21.84	21.6	[VDC]
R_{down} (E96) ≈	5M62	3M16	2M15	1M62	1M3	1M07	909k	768k	665k	590k	[Ω]

REGULATIONS		
Parameter	**Condition**	**Values**
Output Accuracy		±1.0% max.
Line Regulation	low line to high line	±0.5% max.
Load Regulation	0% to 100% load	1.0% max.

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

PROTECTIONS

Parameter	Condition		Value
Short Circuit Protection (SCP)	below 100mΩ		continuous, automatic recovery
Over Load Protection (OLP)			150% typ.
Isolation Voltage (4)	tested for 1 minute	I/P to O/P	3kVDC
		I/P (O/P) to metal case	1.5kVDC
Isolation Capacitance			2200pF typ.
Isolation Resistance			1GΩ min.
Insulation Grade			functional

Notes:

Note4: For repeat Hi-Pot testing, reduce the time and/or the test voltage

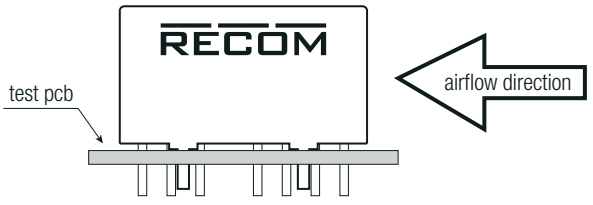
Note5: Refer to local safety regulations if input over-current protection is also required. Recommended fuse: slow blow type

ENVIRONMENTAL

Parameter	Condition		Value
Operating Temperature Range (6)			-40°C to refer to ***"Thermal Calculation"***
Maximum Case Temperature			+105°C
Temperature Coefficient			±0.05%/K
Thermal Impedance (6)	0.25m/s (natural convection) 1m/s 1.5m/s		19.7K/W 14.9K/W 13.1K/W
Operating Altitude	according to 62368-1		5000m
Operating Humidity			5% - 95% RH max.
Pollution Degree			PD2
Vibration			according to MIL-STD-202G
MTBF	according to MIL-HDBK-217F, G.B.	+25°C	1338 x 10³ hours

Notes:

Note6: Test PCB:160x100mm105µm (Eurocard), double layer, vertical mounted + refer to airflow direction below



Thermal Calculation

$T_{case\ max.}$ = case temperature [°C]
T_{over} = temperature losses [K]
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 = efficiency under given operating conditions [%]

$$P_{diss} = \frac{P_{out\ set}}{\eta} - P_{out\ set}$$

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

$$T_{amb} = T_{case\ max.} - T_{over}$$

continued on next page

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

Practical Example:

Take the **RS12-2405SZ** with 24V Input Voltage, 75% load, **1.0m/s airflow.** (6)
What is the maximum operating ambient temperature?

$T_{case\ max.}$ = 105°C
$P_{out\ set}$ = 9W
R_{th} = 14.9K/W (1.0m/s)
η = 87% (Eff. vs Load Graph)

$$P_{diss} = \frac{9}{0.88} - 9 = \mathbf{1.23W}$$

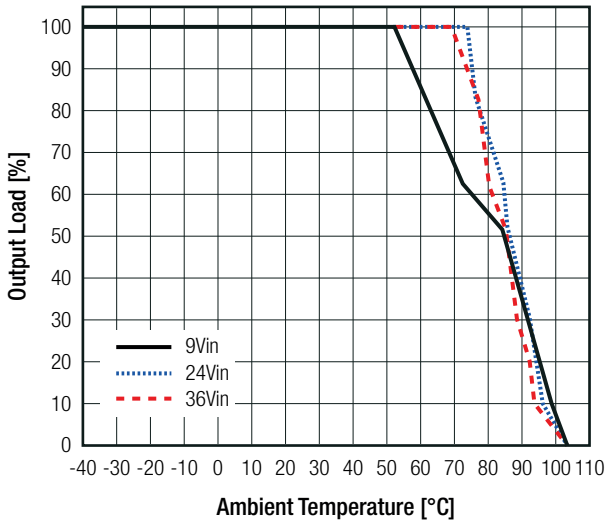
T_{over} = 14.9 x 1.23 = **18.3K**

T_{amb} = 105 - 18.3= **86.7°C**

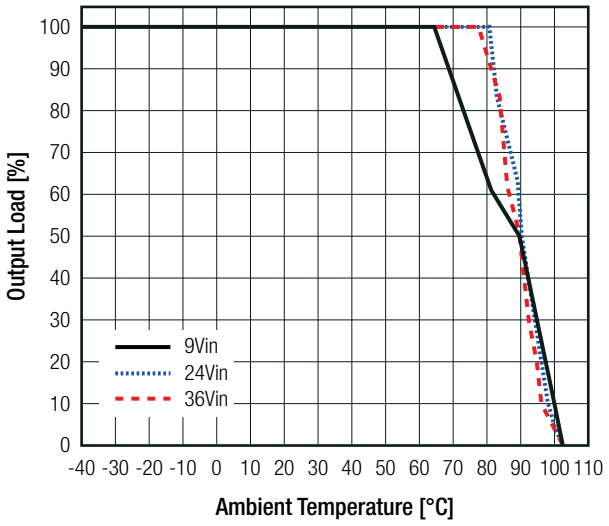
Derating Graph (R12S-2405SZ)

(@ Chamber - tested with double layer PCB: 160x100mm 105µm Eurocard)

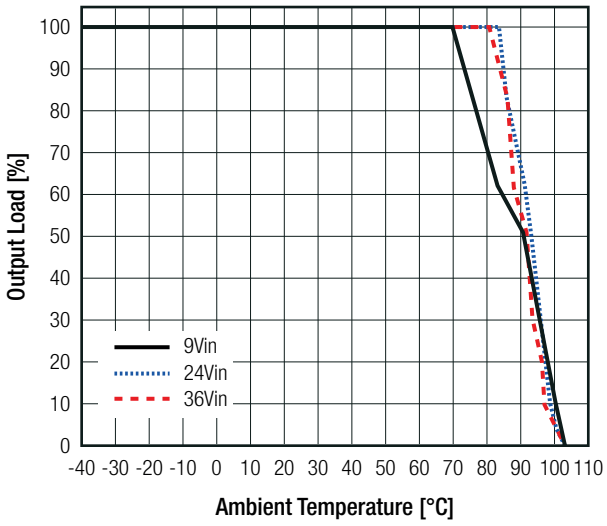
natural convection



1.0m/s



1.5m/s



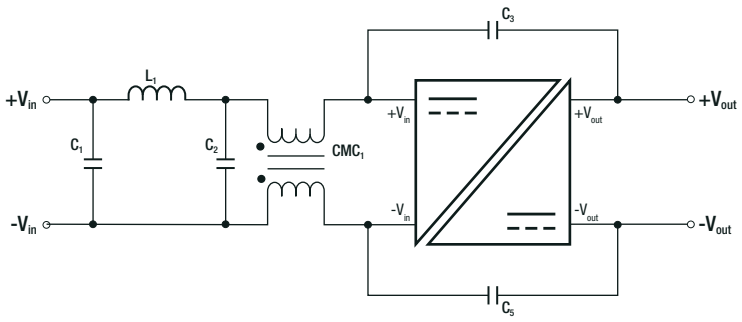
Specifications (measured @ Ta= 25°C, nominal input voltage, full load and after warm up unless otherwise specified)

SAFETY AND CERTIFICATIONS

Certificate Type	Report / File Number	Standard
Audio/video, information and communication technology equipment. Safety requirements (CB)	1912033-3-CB	IEC62368-1:2014 2nd Edition
Audio/video, information and communication technology equipment. Safety requirements		EN62368-1:2014+A11:2017
Audio/video, information and communication technology equipment. Safety requirements	E224736-A6002-UL	UL62368-1, 2nd Edition CAN/CSA-C22.2 No. 62368-1-14
RoHS2+		RoHS-2011/65/EU + AM-2015/863

EMC Compliance	Condition	Standard / Criterion
Electromagnetic compatibility of multimedia equipment - Emission requirements	with external filter (refer to ***"EMC Filtering"***)	EN55032, Class A EN55032, Class B
ESD Electrostatic discharge immunity test	Air ±8kV Contact ±6kV	EN61000-4-2, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	10V/m	EN61000-4-3, Criteria A
Fast Transient and Burst Immunity	±2kV	EN61000-4-4, Criteria A
Surge Immunity	±2kV	EN61000-4-5, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	10V/rms	EN61000-4-6, Criteria A
Power Magnetic Field Immunity	10A/m	EN61000-4-8, Criteria A

EMC Filtering Suggestions according to EN55032 (7)



Component List Class A

MODELS	C_1	L_1	C_2	CMC_1	C_3 & C_4
RS12-2405SZ	N/A	18µH RLS-186	10µF	N/A	1nF
RS12-2412SZ					
RS12-2424SZ					

Component List Class B

MODELS	C_1	L_1	C_2	CMC_1	C_3 & C_4
RS12-2405SZ	10µF	18µH RLS-186	10µF	11µH	2.2nF
RS12-2412SZ					
RS12-2424SZ					

Notes:

Note7: 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	Type	Value
Material	case potting	metal epoxy, (UL94 V-0)
Dimension (LxWxH)		21.8 x 12.1x 9.6mm
Weight		8.5g

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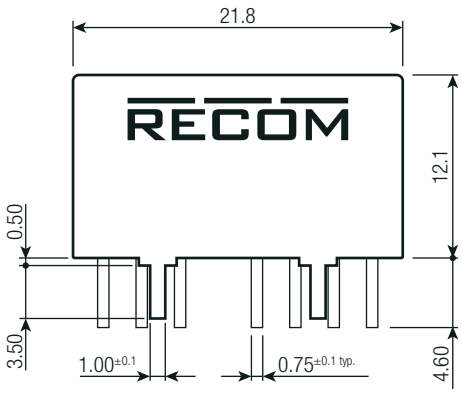
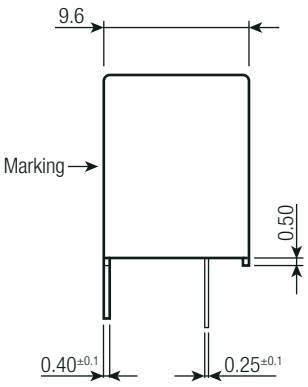
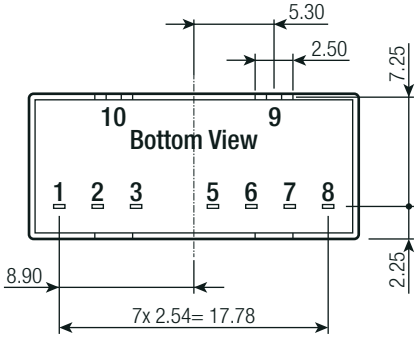
Specifications (measured @ Ta= 25°C, nominal input voltage, full load and after warm up unless otherwise specified)

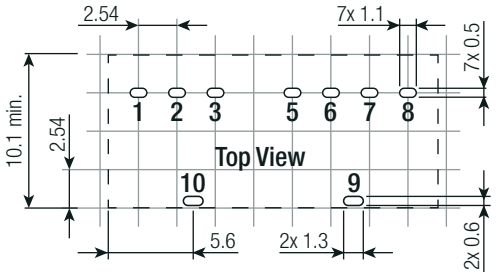
Dimension Drawing (mm)







Recommended Footprint Details



Pin Connections

Pin #	Single
1	-Vin
2	+Vin
3	CTRL
5	Trim
6	+Vout
7	-Vout
8	NC
9,10	case pin (8)

NC= no connection
Tolerance: ±0.5mm

Notes:

Note8: To increase thermal performance, do not use thermal relief vias (around case pins 9,10)

PACKAGING INFORMATION		
Parameter	**Type**	**Value**
Packaging Dimension (LxWxH)	tube	520.0 x 14.6 x 20.0mm
Packaging Quantity		22pcs
Storage Temperature Range		-55°C to +125°C
Storage Humidity	non-condensing	95% RH max.

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