

RPMVH-0.5 Series ◇ Power Module

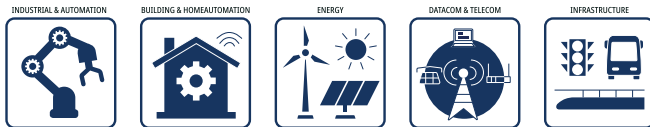
0.5A ◇ Input: 6V-115VDC ◇ LGA

FEATURES

- Wide Vin 6V to 115VDC
- Non isolated power module
- High power density
- Operating temperature -40°C to +100°C at full load
- Efficiency up to 90%, no need for heat-sink
- 6-sided shielding
- Thermally and EMI enhanced 25 pad LGA
- DOSA compatible footprint
- Low profile
- 3 year warranty



Dimensions (LxWxH): 12.19 x 12.19 x 3.75mm (0.48 x 0.48 x 0.15 inch)
1.1g (0.0024 lbs)

APPLICATIONS**SAFETY & EMC****DESCRIPTION**

The RPMVH-0.5 series is a wide input voltage, 0.5A non-isolated switching regulator power module. The module accepts up to 115VDC input and provides a trimmable output from 2.6 up to 28VDC and comes complete with a full set of features including adjustable output, sequencing, on/off control, and power good signals. The ultra-compact module has a profile of only 3.75mm, but with an efficiency of up to 90%, the device can operate at full load in ambient temperatures as high as +100°C and with power derating up to 120°C without forced air cooling. The package is complete with 6-sided shielding for optimal EMC performance and excellent heat management.

SELECTION GUIDE

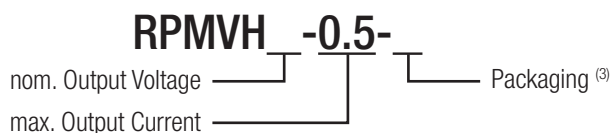
Part Number	Input Voltage Range ⁽¹⁾ [VDC]	Output Voltage [VDC]	Vout Adjust Range [VDC]	Output Current max. [mA]	Efficiency typ. [%]	Max. Capacitive Load ⁽²⁾ [μF]
RPMVH3.3-0.5	6-115	3.3	2.64 - 3.63	500	71	1100
RPMVH5.0-0.5	7.5-115	5	4 - 5.5	500	78	1200
RPMVH12-0.5	14.5-115	12	7.2 - 13.2	500	87	1800
RPMVH24-0.5	28-115	24	15 - 28	500	90	100

Note1: Input voltage must be higher than desired output voltage.

Note2: Max. Cap Load is tested at nominal input and full resistive load

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0.5A ◇ Input: 6V-115VDC ◇ LGA

MODEL NUMBERING

Note3: Add suffix "-R" for tape and reel packaging

Add suffix "-CT" for bag packaging (refer to „Packaging Information“)

BASIC CHARACTERISTICS (measured @ $T_{AMB} = 25^{\circ}\text{C}$, nom. V_{IN} , full load, with input and output capacitors ⁽⁴⁾ and after warm-up unless otherwise stated)

Parameter	Condition		Min.	Typ.	Max.
Input Voltage Range	V _{OUT} = 3.3VDC		6VDC	48VDC	115VDC
	V _{OUT} = 5VDC		7.5VDC		
	V _{OUT} = 12VDC		14.5VDC		
	V _{OUT} = 24VDC		28VDC		
Absolute Maximum Input Voltage					115VDC
Input Current (Range)	nom. V _{IN} = 48VDC	V _{OUT} = 3.3VDC		50mA	
		V _{OUT} = 5VDC		69mA	
		V _{OUT} = 12VDC		150mA	
		V _{OUT} = 24VDC		284mA	
Quiescent current	nom. V _{IN} = 48VDC, V _{CTRL} = 2.5VDC	V _{OUT} = 3.3VDC, 5VDC		65µA	145µA
		V _{OUT} = 12VDC		72µA	150µA
		V _{OUT} = 24VDC		105µA	170µA
Internal Power Dissipation	nom. V _{IN} = 48VDC full load	V _{OUT} = 3.3VDC		0.65W	
		V _{OUT} = 5VDC		0.67W	
		V _{OUT} = 12VDC		0.92W	
		V _{OUT} = 24VDC		1.24W	
Output Current (Range)			0mA		500mA
Output Voltage Trimming ⁽⁶⁾	V _{OUT} = 3.3VDC	refer to „Output Voltage Trimming“	2.64VDC		3.63VDC
	V _{OUT} = 5VDC		4VDC		5.5VDC
	V _{OUT} = 12VDC		7.2VDC		13.2VDC
	V _{OUT} = 24VDC		15VDC		28VDC
Minimum Load			0%		
Start-up Time				3ms	
Rise Time				2.5ms	
ON/OFF CTRL	DC-DC ON		Open or 1.45V< V _{CTRL} <V _{IN}		
	DC-DC OFF		Short or -0.3V< V _{CTRL} <1.44VDC		
Standby Current	DC-DC OFF			60µA	140µA
Internal Operating Frequency	V _{OUT} = 3.3VDC			300kHz	
	V _{OUT} = 5VDC				
	V _{OUT} = 12VDC			400kHz	
	V _{OUT} = 24VDC			800kHz	
Output Ripple and Noise ⁽⁶⁾	20MHz BW	V _{OUT} = 3.3VDC		20mVp-p	100mVp-p
		V _{OUT} = 5VDC		35mVp-p	
		V _{OUT} = 12VDC		40mVp-p	
		V _{OUT} = 24VDC		70mVp-p	

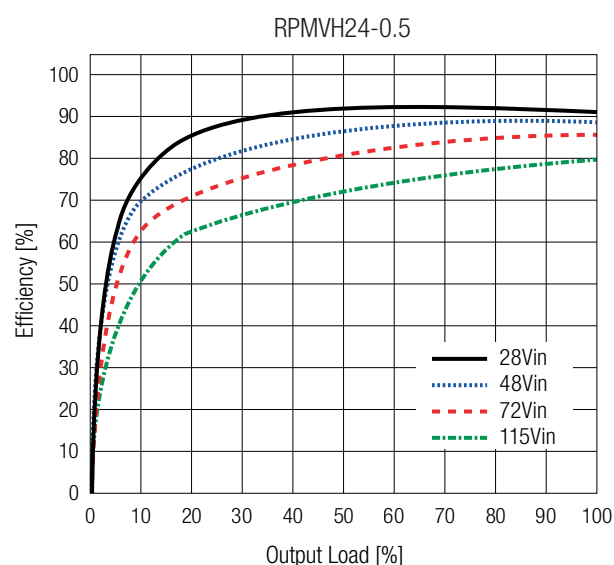
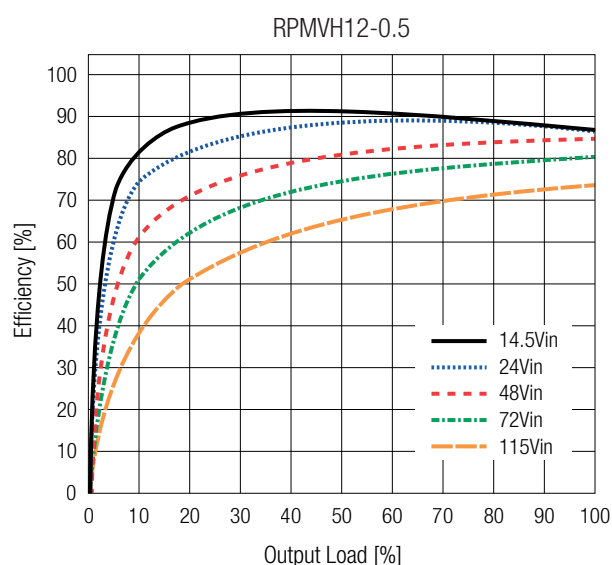
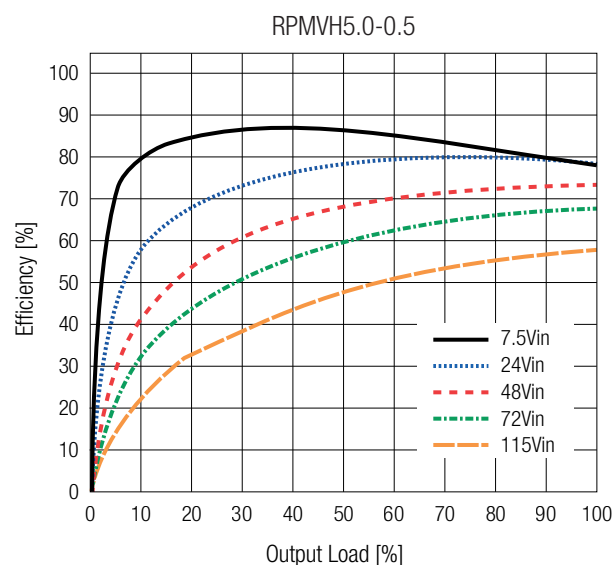
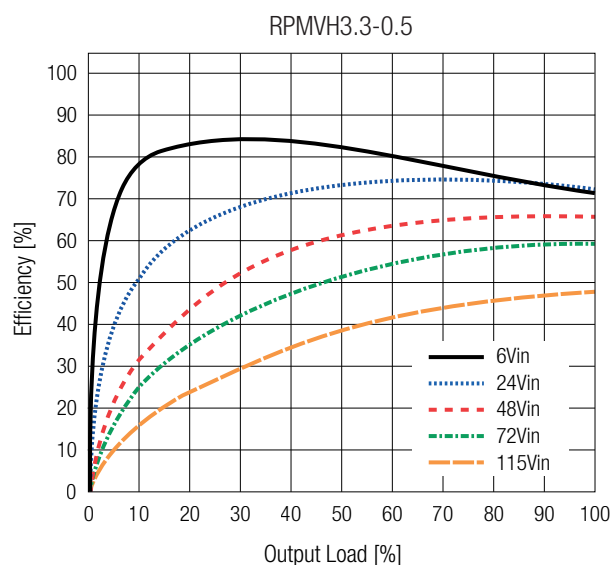
Note4: Refer to „Input and Output Capacitors“

Note5: For more detailed information, please refer to „Output Voltage Trimming“

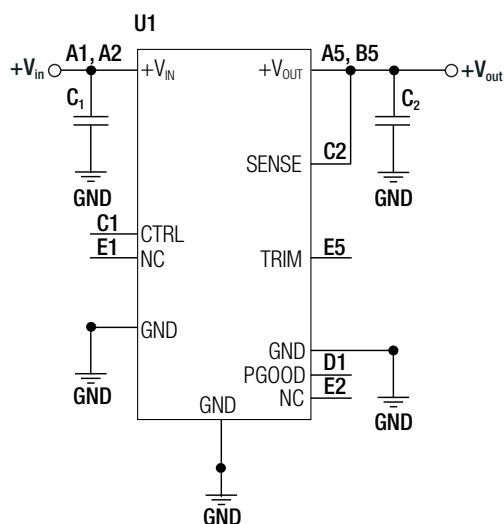
Note6: Measurements for Ripple and Noise are made with a 22 μF MLCC across output (low ESR)

BASIC CHARACTERISTICS (measured @ $T_{AMB} = 25^{\circ}\text{C}$, nom. V_{IN} , full load and after warm-up unless otherwise stated)

Efficiency vs. Output Current



Test Setup



Input and Output Capacitors

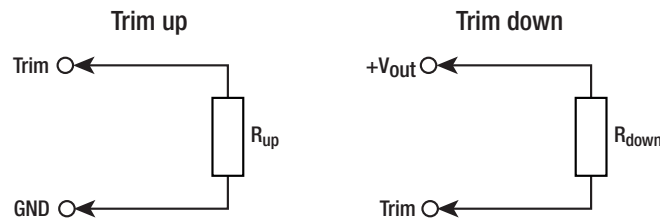
Output Capacitance

V_{out_nom} [VDC]	C_2
3.3	2 x 22 μ F 10V X7R 1206
5	1 x 22 μ F 10V X7R 1206
12	2 x 22 μ F 25V X7R 1210
24	2 x 10 μ F 50V X7R 1210

Note7: The RPMVH requires MLCC input capacitor (C1) of 2.2 μ F 250V X7R 2220 and output capacitors for normal operation (see table).

OUTPUT VOLTAGE TRIMMING

The RPMVH-series offers the feature of trimming the output voltage by using external trim resistors. The values for the trim resistors in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary. Refer to „Selection Guide“.



$V_{out_{nom}}$	= nominal output voltage	[VDC]
$V_{out_{set}}$	= 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]

$V_{out_{nom}}$ [VDC]	R_1 [Ω]	R_2 [Ω]	R_3 [Ω]	V_{ref} [VDC]
3.3	453k	261k	10k	1.2
5		143k		
12		49k9		
24		24k		

Calculation

$$R_{UP} = \frac{[(V_{OUTset} - V_{REF}) \times (R_2 \times R_3)] - [(R_1 \times V_{REF}) \times (R_2 + R_3)]}{V_{REF} \times (R_1 + R_2) - R_2 \times V_{OUTset}} = \Omega$$

$$R_{DOWN} = \frac{(V_{OUTset} - V_{REF}) \times (R_1 \times R_2 + R_2 \times R_3) - V_{REF} \times (R_1 \times R_3)}{V_{REF} \times (R_1 + R_2) - V_{OUTset} \times (R_2)} = \Omega$$

RPMVH3.3-0.5

Trim up

$V_{out_{set}} =$	3.4	3.5	3.63	[VDC]
$R_{up} (E96) \approx$	4M64	2M49	1M54	[Ω]

Trim down

$V_{out_{set}} =$	3.1	3	2.8	2.64	[VDC]
$R_{down} (E96) \approx$	4M64	2M87	1M5	1M	[Ω]

RPMVH5.0-0.5

Trim up

$V_{out_{set}} =$	5.1	5.3	5.5	[VDC]
$R_{up} (E96) \approx$	5M49	1M82	1M07	[Ω]

Trim down

$V_{out_{set}} =$	4.7	4.5	4.3	4	[VDC]
$R_{down} (E96) \approx$	5M23	2M94	2M	1M24	[Ω]

RPMVH12-0.5

Trim up

$V_{out_{set}} =$	12.4	12.6	12.8	13	13.2	[VDC]
$R_{up} (E96) \approx$	1M78	1M07	768k	590k	487k	[Ω]

Trim down

$V_{out_{set}} =$	10	9.6	9	8.5	8	7.7	7.2	[VDC]
$R_{down} (E96) \approx$	1M87	1M5	1M13	909k	750k	665k	549k	[Ω]

RPMVH24-0.5

Trim up

$V_{out_{set}} =$	24.5	25	25.5	26	28	[VDC]
$R_{up} (E96) \approx$	825k	464k	316k	243k	120k	[Ω]

Trim down

$V_{out_{set}} =$	19.5	19.2	18	17.5	17	16.5	16	15.5	15	[VDC]
$R_{down} (E96) \approx$	1M91	1M74	1M3	1M15	1M02	931k	845k	768k	698k	[Ω]

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0.5A ◇ Input: 6V-115VDC ◇ LGA

REGULATIONS

Parameter	Condition		Value
Output Accuracy			±1.5% max.
Line Regulation	low line to high line, full load	$V_{OUT} = 3.3VDC$	±0.7% typ.
		$V_{OUT} = 5VDC$	±1.2% typ.
		$V_{OUT} = 12VDC$	±2% typ.
		$V_{OUT} = 24VDC$	±2.5% typ.
Load Regulation	0% to 100% load	$V_{OUT} = 3.3VDC, 5VDC$	±1.5% typ.
		$V_{OUT} = 12VDC, 24VDC$	±0.5% typ.
Transient Response	$C_{IN} 470\mu F, C_{OUT} 2x1000\mu F$ low ESR (10% to 100% / 100% to 10% load)	$V_{OUT} = 3.3VDC$	40mV/30ms typ.
			40mV/15ms typ.
		$V_{OUT} = 5VDC$	40mV/4ms typ.
			40mV/50µs typ.
		$V_{OUT} = 12VDC$	50mV/1ms typ.
			50mV/200µs typ.
		$V_{OUT} = 24VDC$	40mV/50ms typ.
			60mV/25ms typ.

PROTECTIONS

Parameter	Condition	Value
Short Circuit Protection (SCP)		automatic recovery, hiccup mode
Over Current Protection (OCP)	nom. $V_{IN} = 48VDC$	140%

ENVIRONMENTAL

Parameter	Condition		Value
Operating Temperature Range ⁽⁸⁾	with derating, refer to „Derating Graph“		-40°C to +120°C
Max. Case Temperature	measured on tc point (refer to „Dimension Drawing“)		+105°C
Temperature Coefficient			0.02%/K
Thermal Impedance ⁽⁸⁾	0.1m/s, horizontal (T_{CASE} to T_{AMB})		12.5K/W
Operating Altitude ⁽⁹⁾	with derating @ natural convection 0.1m/s		5000m
Operating Humidity	non-condensing		5% - 95% RH max.
Pollution Degree			PD2
Shock	MIL-STD-810G, Method 516.6, Procedure I	40g, 11ms, saw-tooth, 3 shocks ± per axis 3 axis; unit is operating	
	MIL-STD-810G, Method 516.6, Procedure IV	drop on 50mm plywood on concrete 26 times from 1 meter	
Random Vibration	MIL-STD-810G, Method 514.6, Procedure I, Category 24	Category 24 - Figure 514.6E-1 - power spectral density = 0.04g ² /Hz at 20Hz – 1000Hz; -6dB/octave at 1000Hz – 2000Hz; 60 minutes x 3 axis; unit is operating during tests	
MTBF	according to MIL-HDBK-217F, G.B.	$T_{AMB} = +25^{\circ}C$	1900 x 10 ³ hours
		$T_{AMB} = +85^{\circ}C$	471 x 10 ³ hours

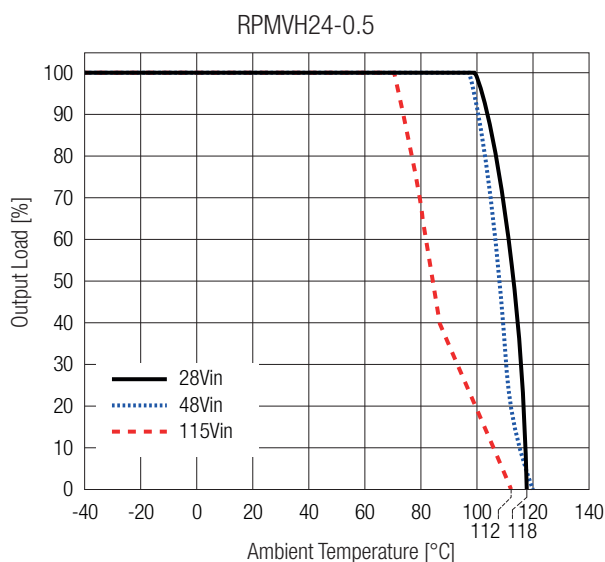
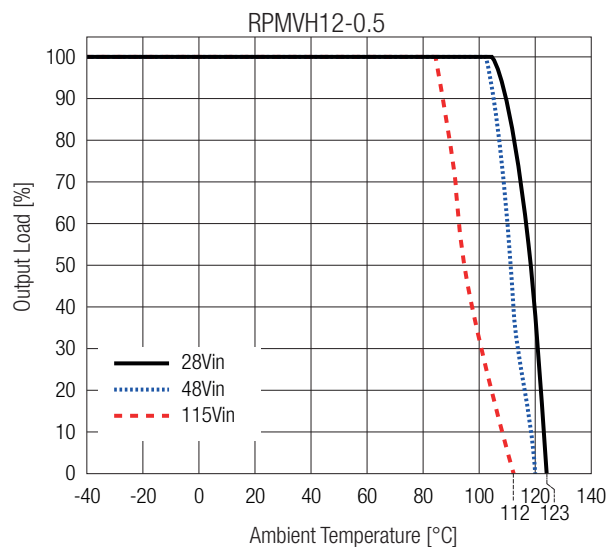
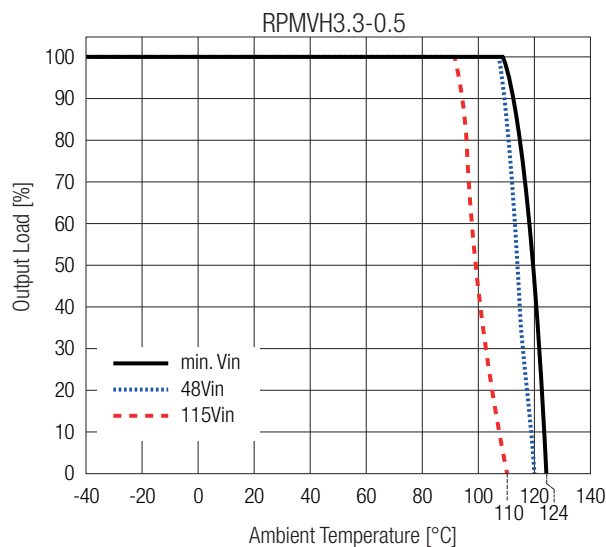
Note8: Tested with an eurocard 160x100mm 70µm copper, 4 layer

Note9: At altitudes above 2000m, derate output power by 5%/1000m

ENVIRONMENTAL

Derating Graph

@ chamber and natural convection 0.1m/s

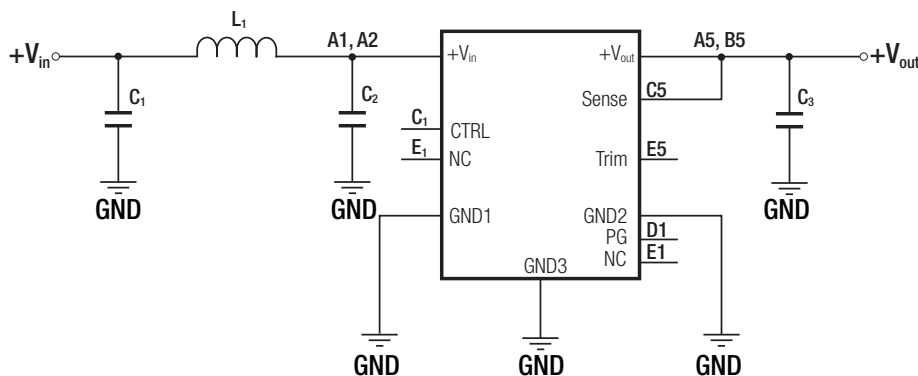


SAFETY AND CERTIFICATIONS

Certificate Type (Safety)	Report Number	Standard
Audio/Video, information and communication technology equipment - Part1: Safety requirements 2nd Edition (LVD)	designed to meet	EN62368-1:2014+A11:2017
RoHS2		RoHS 2011/65/EU + AM2015/863
EMC Compliance	Condition	Standard /Criterion
Electromagnetic Compatibility of Multimedia Equipment - Emission Requirements	with external components	EN55032, Class B

SAFETY AND CERTIFICATIONS

EMC Filtering Suggestions according to EN55032



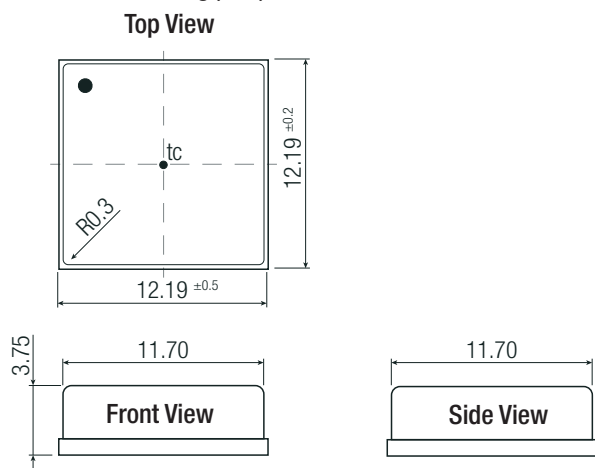
Component List Class B

Model	L1	C1	C2	C3
RPMVH3.3-0.5	RECOM- RLS-126	47 μ F 250V Electrolytic Capacitor	2 x 2.2 μ F 250V X7R	2 x 22 μ F 10V X7R
RPMVH5.0-0.5				1 x 22 μ F 10V X7R
RPMVH12-0.5				2 x 22 μ F 25V X7R
RPMVH24-0.5				2 x 10 μ F 50V X7R

DIMENSION & PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	case	metal
	PCB	FR4, (UL94 V-0)
	solder pads	copper with electrolytic nickel-gold
Dimension (LxWxH)		12.19 x 12.19 x 3.75mm
		0.48 x 0.48 x 0.15 inch
Weight		1.1g typ. 0.0024 lbs

Dimension Drawing (mm)



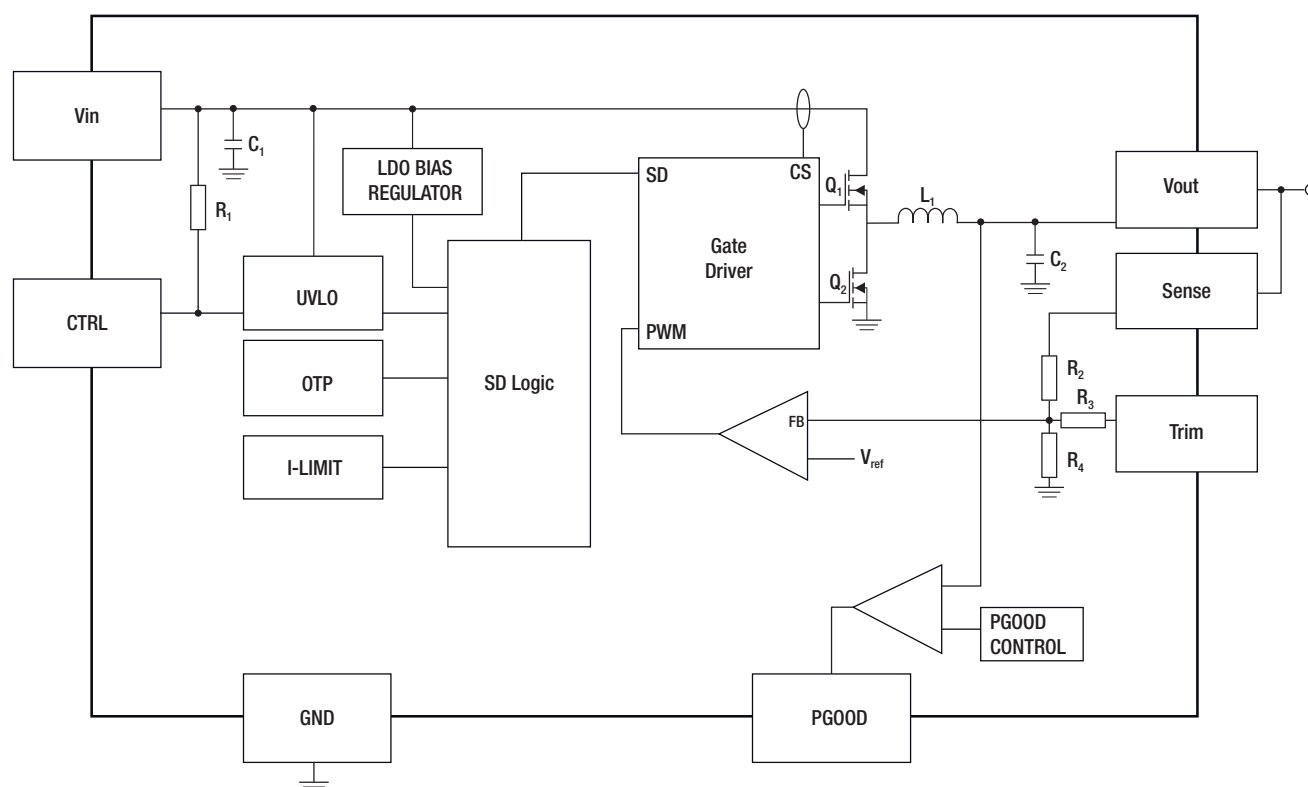
Pinning information

Pad #	Function	Description
A1, A2	Vin	Positive input voltage with respect to GND. Connect to a Vin plane for enhanced thermal performance
C1	CTRL	Active High: pull to GND to disable the device. Pull high or leave open to enable the device
A5, B5	Vout	Positive output voltage. Connect to a Vout plane for enhanced thermal performance
C5	Sense	Connect this pad to the load or directly to Vout. This pad must not be left floating
E5	Trim	Use this pad to set the output voltage (refer to „Output Voltage Trimming“ for different Vout)
E2	NC	Not connected
E1	NC	Not connected
D1	PGood	Output power good. High = Vout at set level, Low = Vout below nominal regulation. It has a high impedance output (100k Ω connected to Vout), no higher than 14V. Left floating if not used
A3, A4, B1, B2, B3, B4, C2, C3, C4, D2, D3, D4, D5, E3, E4	GND	Negative input voltage. Connect to GND plane(s) for enhanced thermal performance

tc = case temperature measuring point

NC = not connected

Tolerances:
x.x = ± 0.5 mm
x.xx = ± 0.25 mm

BLOCKDIAGRAM**Component List**

$V_{out_{nom}}$	C1	R1	L1	C2	R2	R3	R4
3.3VDC	0.5 μ F	1M Ω	47 μ H	10 μ F	453k Ω	10k Ω	261k Ω
5VDC				10 μ F			143k Ω
12VDC			68 μ H	4.7 μ F			49.9k Ω
24VDC				1 μ F			24k Ω

PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	tape and reel	202.0 x 192.0 x 50.0mm
	tube ("CT")	530.0 x 30.3 x 19.2mm
Packaging Quantity	tape and reel	200pcs
	tube ("CT")	30pcs
Tape Width		24mm
Storage Temperature Range		-55°C to +125°C
Storage Humidity	non-condensing	95% RH max.

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