Features

Power Module

- Wide input range (4.7 - 18VDC)
- Low profile 2mm
- Small footprint 3x2.8mm
- Adjustable output 0.8 to 5.4VDC
- Over 100°C ambient temperature at full load
- Integrated solution

RECOM
DC/DC Converter

RPL-3.0A

3 Amp 8-Pin QFN Package

Description

The RPL-3.0A is a buck converter with an integrated inductor in a tiny 3mm x 2.8mm x 2mm thermally-enhanced QFN package. The input range is from 4.7 to 18VDC, allowing 5V and 12V supply rails to be used. The output voltage can be set with two resistors in the range from 0.8V up to 5.4VDC. The output current is up to 3A and is fully protected against continuous short-circuits, output overcurrent, or over-temperature faults. Its high current and small size as well as its high ambient temperature rating make the RPL-3.0A ideal for imaging systems, distributed power architectures, and portable equipment in telecom as well as in industrial applications where both thermal performance and board space are critical.

Selection Guide

Part Number	Input Voltage Range [VDC]	Output Voltage Range [VDC]	Output Current max. [mA]	Efficiency (1) typ. [%]
RPL-3.0A	4.7 - 18	0.8 - 5.4	3000	88

Notes:

Note1: Efficiency tested at V_{IN}= 4.7VDC, full load, and V_{OUT}= 3.3VDC

Model Numbering

RPL-3.0A-___

Output Current ———┘   └——— Packaging (2)

Notes:

Note2: add suffix "-R" for tape and reel packaging

add suffix "-CT" for cut tape packaging (refer to "*PACKAGING INFORMATION*")

Specifications

ABSOLUTE MAX RATINGS (exceeding these ratings may damage the device)

Parameter	Symbol	Min.	Typ.	Max.
Absolute Maximum Voltage	V_{IN} to GND	-0.3VDC		19VDC
	CTRL, SS, PG (3)	-0.3VDC		19.3VDC
	FB, V_{OUT}	-0.3VDC		6VDC
Maximum continuous power losses (4)	T_{AMB} = 25°C			3.33W
Junction Temperature	T_J	-40°C		+125°C
Lead Temperature	10 seconds max			+260°C

Notes:

Note3: For CTRL absolute max ratings, please refer to "*CTRL Operating CONDITIONS*"

Note4: Exceeding maximum allowable power dissipation causes device to enter thermal shutdown which protects device from permanent damage. Refer to "*CHARACTERISTIC CURVES*"

Specifications

OPERATING CONDITIONS (V_{IN}= 12VDC, V_{OUT}= 3.3VDC, I_{OUT}= 3A, unless otherwise noted, typical values are at T_{AMB}= +25°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.
Input Voltage Range	V_{IN}	refer to **"SAFE OPERATING AREA"**	4.7VDC		18VDC
Under Voltage Lockout UVLO		DC-DC ON	4.3VDC	4.5VDC	4.7VDC
		DC-DC OFF	3.9VDC	4.1VDC	4.3VDC
		hysteresis		400mV	
Output Voltage Range	V_{OUT}	refer to **"OUTPUT VOLTAGE SETTING"**	0.8VDC		5.4VDC
Output Current Range	I_{OUT}		0A		3A
Standby current	I_{IN}	V_{CTRL} = low (DC-DC OFF)		2µA	5µA
Quiescent current	I_Q	V_{CTRL} = high (DC-DC ON)	18mA	22mA	27mA
Switching frequency	f_{SW}		1.7MHz	2MHz	2.3MHz
Feedback voltage	V_{FB}		785mV	800mV	815mV
Output load regulation				refer to **"Characteristic Curves"**	
Maximum Duty Cycle			85%		
Minimum On Time				50ns	
Soft Start			External programmable soft-start time limits the inrush current		
Rise time		V_{OUT} from 10% to 90%; C_{SS}= open		370µs	500µs

Typical Application

V_{IN}= 12VDC, V_{OUT}= 3.3VDC, I_{OUT}= 3A, soft start time= 9.64ms
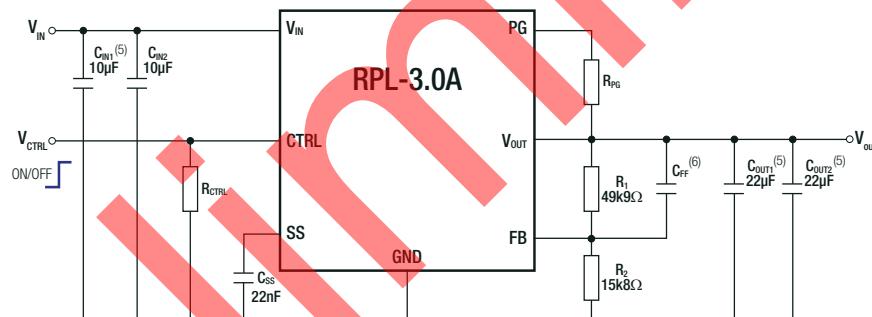
Notes:

Note5: The RPL-3.0A requires a 10µF MLCC input capacitor as close as possible to V_{IN} and GND pin and 2x 22µF output capacitors to handle noise problems.

Note6: Transient load reaction time can be improved by adding a feedforward capacitor, C_{FF} in parallel with R_1 but it is not required for normal operation.

SAFE OPERATING AREA
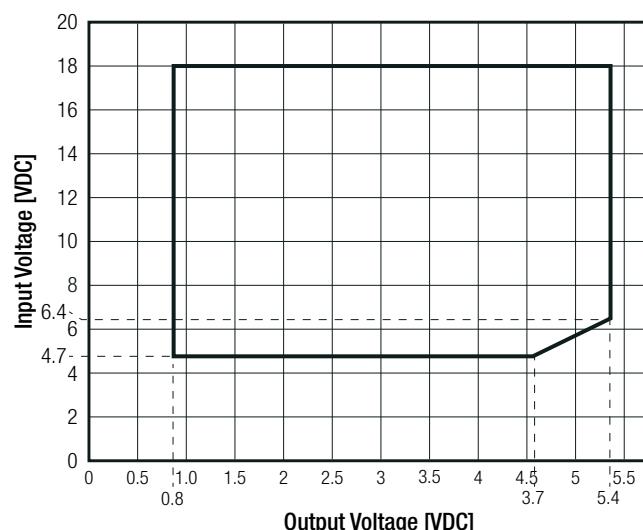
INPUT AND OUTPUT CAPACITOR

Input Capacitor

The RPL-3.0A requires a 10µF MLCC input capacitor for normal operation. To reduce back ripple current increase capacitance to 20µF MLCC.

Output Capacitor

The RPL-3.0A requires MLCC output capacitors for normal operation (see table). Transient load reaction time can be improved by adding a feed-forward capacitor, C_{FF} across R_1, but it is not required for normal operation.

Output capacitance		
V_{OUTset} [VDC]	C_{OUT} min. [µF]	C_{OUT} max. [µF]
0.8 <0.9	2x 22µF	300
0.9 <1.8		400
1.8 <3.3		600
3.3 <5.4		1100

OUTPUT VOLTAGE SETTING

A resistor divider connected to the FB pin (pin 6) sets the output voltage of the RPL-3.0A. The output voltage adjustment range is from 0.8VDC to 5.4VDC. The schematic below shows the feedback resistor connections for setting the output voltage. The recommended value of R_1 is 49k9Ω. Use the equation to calculate the value for R_2. The table below lists the R_2 resistor values according to standard E96 values; therefore, the specified voltage may slightly vary.

Feedback Network

Calculation:

$$R_2 = \frac{0.8V}{(V_{OUTset} - 0.8V)} \times R_1$$
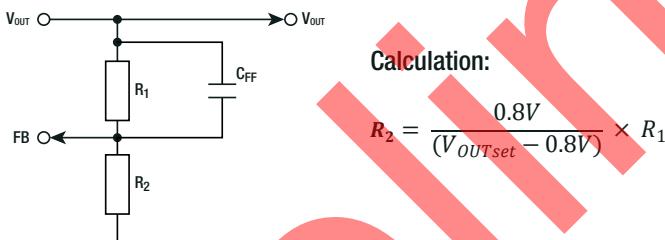
Practical example with V_{OUTset} = 1.8VDC

$$R_2 = \frac{0.8V}{(1.8V - 0.8V)} \times 49.9k\Omega = \mathbf{39.92k\Omega}$$

Table below lists recommended resistor values for common V_{OUT}:

V_{OUTset} [VDC]	R1 [Ω]	R2 [Ω]	C_{FF} [pF]*	C_{OUT} [µF]
1.2	49k9	100k	optional *	2x 22
1.5		57k6		2x 22
1.8		40k2		2x 22
2.5		23k2		2x 22
3.3		15k8		2x 22
5		19k1		2x 22

*to stabilize the system and optimize the load transient response, place a feed-forward capacitor (C_{FF}) in parallel with R1.

SOFT START SETTING

The soft-start time can be programmed via the SS pin by connecting one capacitor between the SS pin and the GND pin. If this pin is floating, soft-start time is start time is approximately 370µs. The typical value of the SS charging current I_{SS} is 1.7µA. To guarantee the programmable soft-start time is not too short when using smaller SS capacitor. Refer to below recommended C_{SS} table:
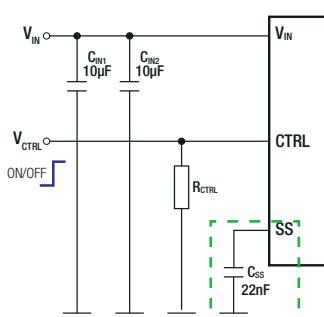
C_{SS} capacitor [nF]	Soft start time from 10% to 90% V_{OUTset} [ms]
open	0.37
3.3	1.36
22	9.64
47	19.5
100	43.1
470	196
1000	482

Specifications

CTRL OPERATING CONDITIONS (V_{IN}= 12VDC, V_{OUT}= 3.3VDC, I_{OUT}= 3A, unless otherwise noted, typical values are at T_{AMB}= +25°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.
CTRL rising threshold	V_{CTRL_RISING}		0.9VDC		
CTRL falling threshold	$V_{CTRL\_FALLING}$				0.3VDC
CTRL pull down resistance		V_{CTRL}= 0.2V	300kΩ	400kΩ	500kΩ

POWER GOOD OPERATING CONDITIONS (V_{IN}= 12VDC, V_{OUT}= 3.3VDC, I_{OUT}= 3A, unless otherwise noted, typical values are at T_{AMB}= +25°C)

Parameter	Condition	Min.	Typ.	Max.
PG thresholds	V_{FB}=rising, PG from low to high	91%	95%	99%

REGULATIONS

Parameter	Condition	Min.	Typ.	Max.
Load Regulation	0-100% load			±1%
Line Regulation	low line to high line, 50% load			±1%
Temperature Regulation	T_{AMB}= -40°C to +85°C, 50% load			±2%

PROTECTION

Parameter	Condition	Value
Short Circuit Protection SCP		hiccup mode
Over Current Protection OCP		3A typ.; 4.5A max.; auto recovery
Thermal Shutdown	junction temperature	150°C typ., auto recovery
	hysteresis	15°C typ.

THERMAL OPERATING CONDITIONS (V_{IN}= 12VDC, V_{OUT}= 3.3VDC, I_{OUT}= 3A, unless otherwise noted, typical values are at T_{AMB}= +25°C)

| Parameter	Symbol	Condition	Min.	Typ.	Max.
Operating Ambient Temperature	T_{AMB}	junction to ambient		refer to *"Thermal Derating"*	
Operating Case Temperature	T_{CASE}				115°C
Operating Junction Temperature	T_J		-40°C		+125°C
Thermal Resistance [7]	R_{thJA}	junction to ambient		30K/W	
	R_{thJC}	junction to case		0.5K/W	

Notes:

Note7: Tested with 80x80mm, double layer PCB (75µm copper) RECOM EVM board.

ENVIRONMENTAL

| Parameter	Condition	Value
ESD	human-body model (HBM), ANSI/ESDA/JEDEC JS-001	±2.5kV
	charged-device model (CDM), JEDEC JESD22-C101	±1kV
MTTF	T_J= 55°C; VCC max; CL= 60%	19680 x 10³ hours

TYPICAL PERFORMANCE CHARACTERISTICS (V_{OUT}= 2.5VDC, T_J= +25°C; tested with RECOM evaluation module: RPL-3.0A-EVM-1)
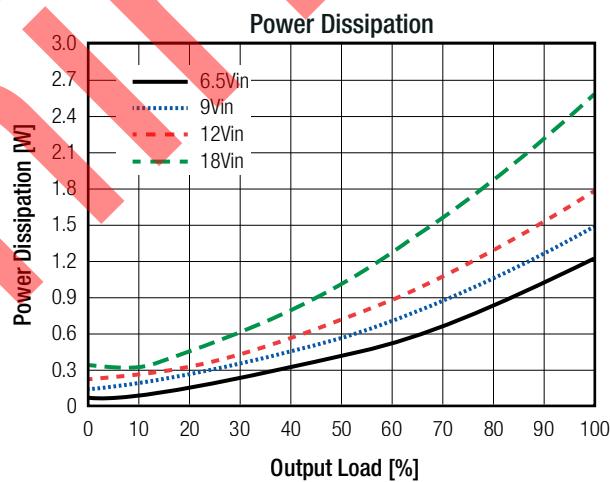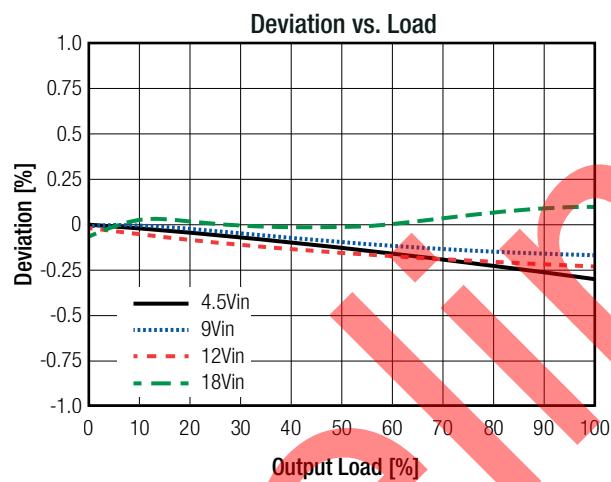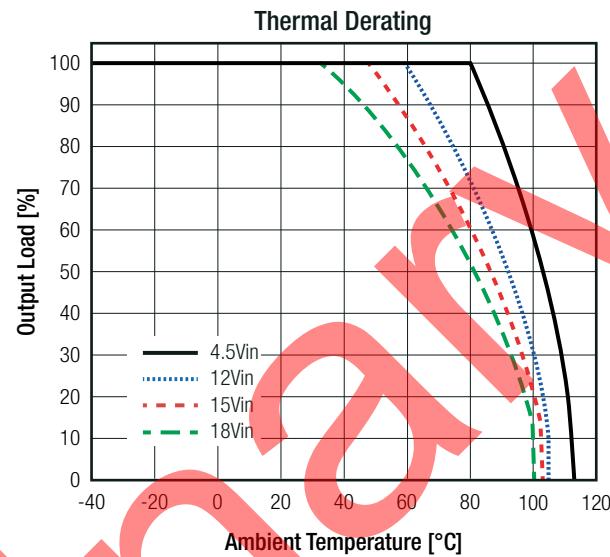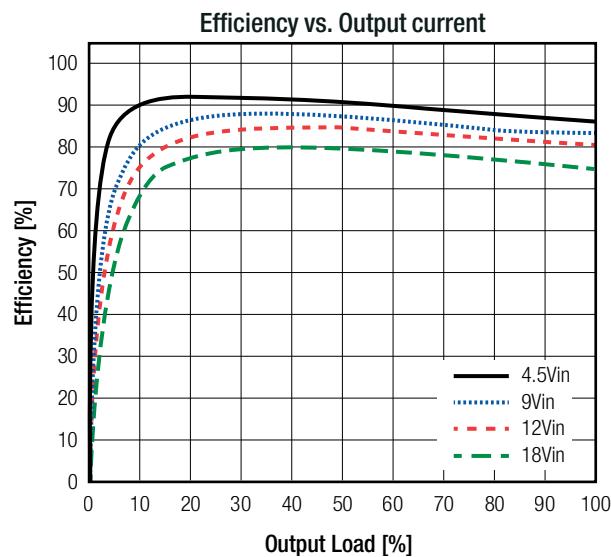
Efficiency vs. Output current

Thermal Derating

Deviation vs. Load

Power Dissipation

TYPICAL PERFORMANCE CHARACTERISTICS (V_{OUT}= 3.3VDC, T_J= +25°C; tested with RECOM evaluation module: RPL-3.0A-EVM-1)

Efficiency vs. Output current

Thermal Derating
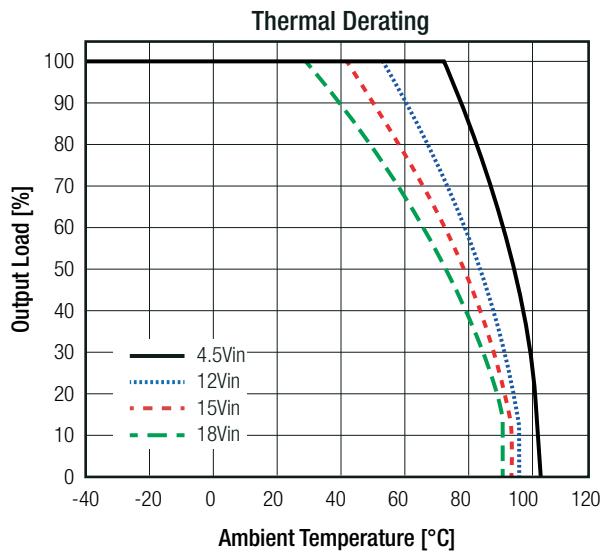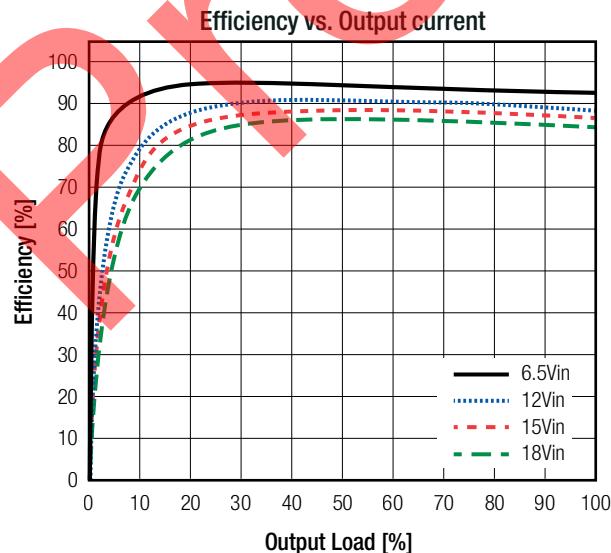
Specifications

TYPICAL PERFORMANCE CHARACTERISTICS (V_OUT= 3.3VDC, T_J= +25°C; tested with RECOM evaluation module: RPL-3.0A-EVM-1)


Deviation vs. Load

Power Dissipation
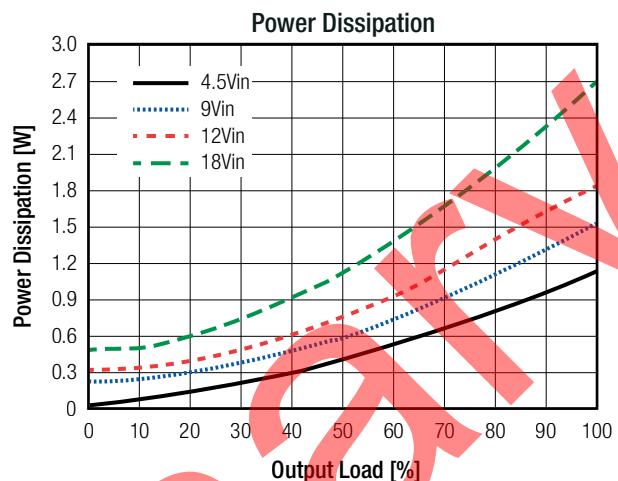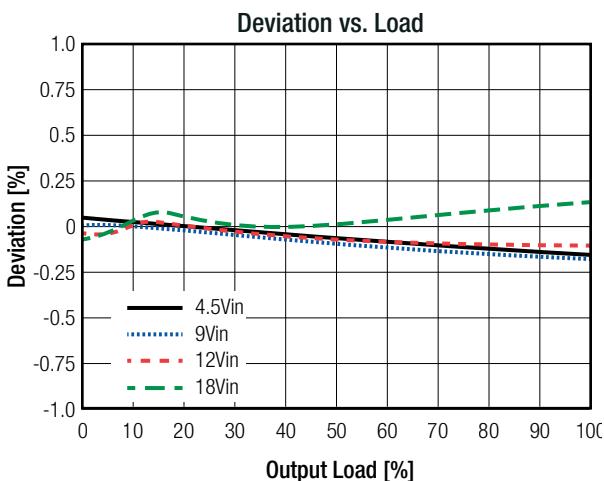
TYPICAL PERFORMANCE CHARACTERISTICS (V_OUT= 5.0VDC, T_J= +25°C; tested with RECOM evaluation module: RPL-3.0A-EVM-1)


Efficiency vs. Output current

Thermal Derating

Deviation vs. Load

Power Dissipation
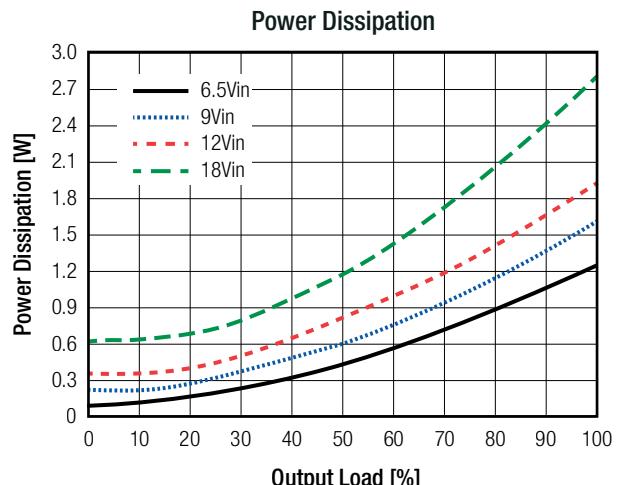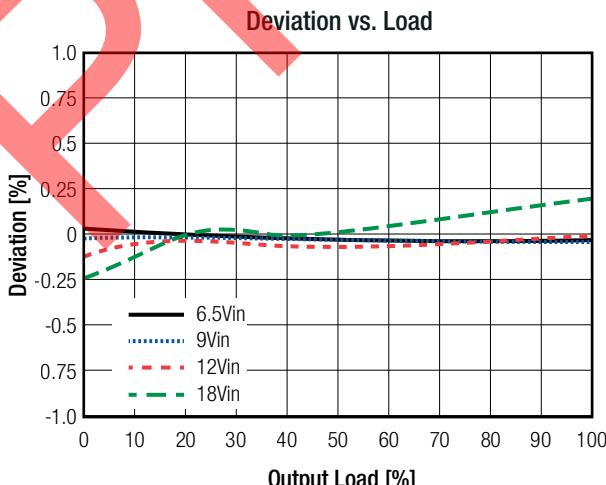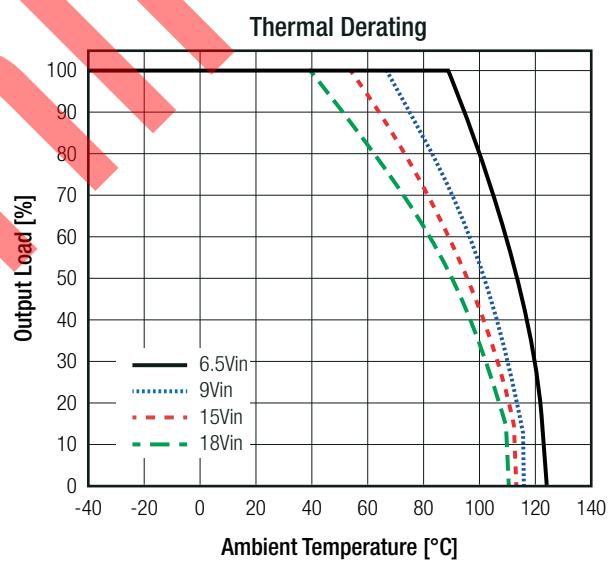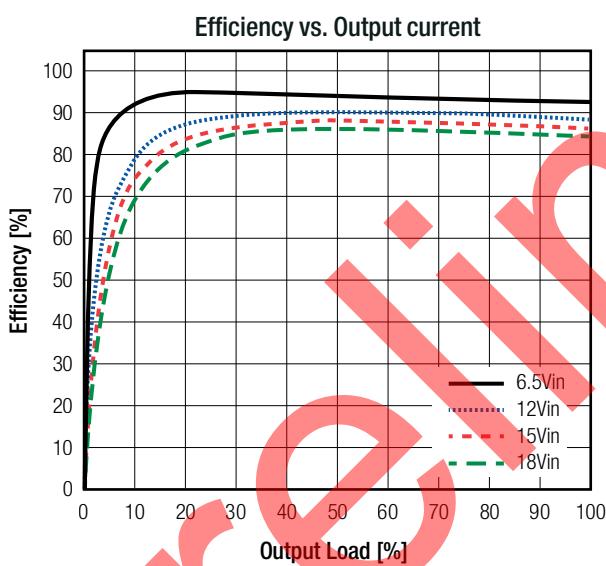
Specifications

SAFETY AND CERTIFICATIONS

Certificate Type (Safety)	Standard
RoHS2	RoHS 2011/65/EU + AM2015/863

DIMENSION AND PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Dimension (LxWxH)		3.0 x 2.8 x 2.0mm
Weight		0.1g typ.

Dimension Drawing (mm)

PIN 1 ID
Index Area
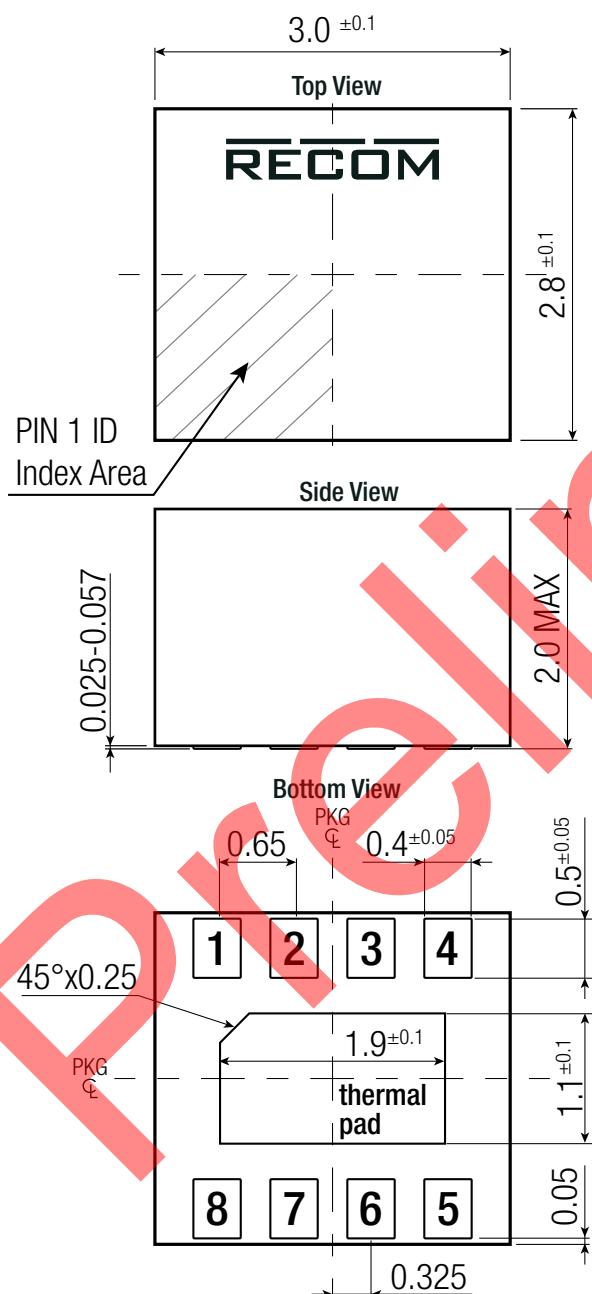
Pad Information

Pad #	Function	Description
1	CTRL	Pull high to turn on. Integrated 400kΩ pull down resistor. This resistor is only active when V_{IN} is available.
2	V_{IN}	Input voltage pin. Decouple to GND with at least a 10µF MLCC
3	GND	GND pin
4, 5	V_{OUT}	Output voltage pin. Decouple this pin to GND pin with 2x 22µF ceramic capacitor
6	FB	Feedback voltage pin. Connect to the center point of output resistor divider to set the output voltage. (refer to *"OUTPUT VOLTAGE SETTING"*
7	PG	Power good pin. Open drain output at PG OK status. Recommended pull-up resistor= 10-100kΩ
8	SS	Soft-start programming pin. Refer to *"SOFT START SETTING"*
thermal pad		This pad must be connected to GND

All dimensions exclude mold flash and metal burr.

Tolerances:
x.x= ±0.1mm
x.xx= ±0.05mm

Recommended Footprint Details (*)
(Top View)
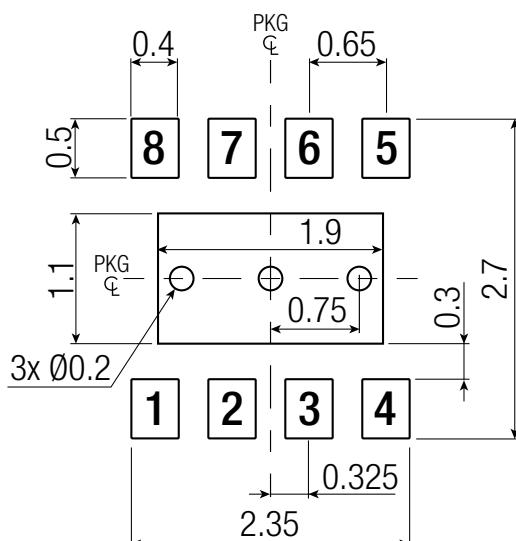
* A large ground plane greatly reduces noise and increases thermal performance.

Specifications

SOLDERING

Profile Feature	PB-Free Assembly
Preheat	
minimum Temperature (TS_min)	150°C
maximum Temperature (TS_max)	200°C
Time (tS)	60s-120s
Liquids	
Temperature (TL)	217°C
Time (tL)	60-150s
Peak Temperature (TP)	255°C
max Ramp Down Rate (from Ts_max to TP)	6°C/s
max Ramp Up Rate	3°C/s
max time from 25°C to Peak Temperature (TP)	8min

1	Pb-Free assembly is recommended according ro JEDEC J-STD020.
2	Ensure that the peak re-flow temperature does not exceed 240°C ±5°C as per JEDEC J-STD020
3	The re-flow time period during peak temperature of 240°C ±5°C should not exceed 30 seconds.
4	Re-flow time above liquids (217°C) should not exceed 150 seconds.
5	For solder paste use a standard SAC Alloy such as SAC 305, type 3 or higher.
6	Other soldering methods (e.g. vapor-phase) are not verified and have to be validated at his own risk.

Solder Pofil
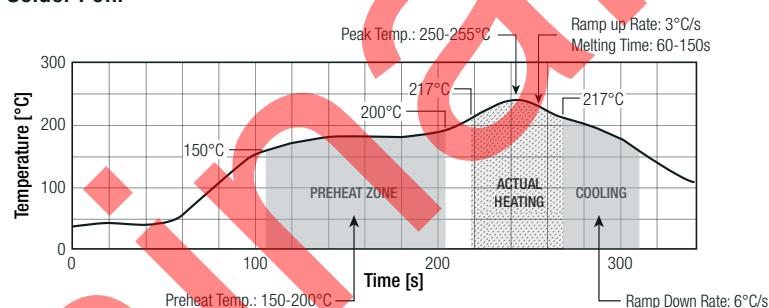
PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	reel 13" (diameter + width)	Ø330.2 + 12.4mm
	tape and reel (carton)	355.0 x 340.0 x 39.0mm
	moisture barrier bag ("-CT")	100.0 x 100.0 x 30.0mm
Packaging Quantity	tape and reel	3000pcs
	moisture barrier bag ("-CT")	50pcs
Tape Width		12mm
Storage Temperature Range		-55°C to +150°C
Moisture Sensitive Level	MSL peak temp. (9)	Level 3, 260°C, 168hrs

Notes:

Note9: The Moisture Sensitivity Level rating is according to the JEDEC industry standard classifications and peak solder temperature