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Technical Data Sheet

RPL-5.0 Series / Power Module

5 Amp / 2.75-17VDC / 24 Pad QFN Package

RECOM DC/DC Converter

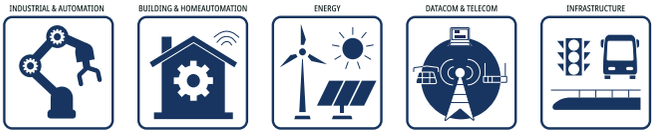
FEATURES

- Buck regulator power module with integrated shielded inductor
- 17V maximum input voltage
- Programmable 0.6 - 12V output voltage
- 5A maximum output current
- SCP, OCP and UVLO protection
- 4mm x 6mm x 1.6mm QFN package
- Flip-Chip technology for improved thermal management
- Efficiency up to 90%
- 3 years warranty



Dimensions (LxWxH): 4.0 x 6.0 x 1.6mm (0.157 x 0.236 x 0.062inch)
0.1g (0.002lbs)

APPLICATIONS



SAFETY & EMC

RoHS² compliant 10 from 10

Reach compliant

DESCRIPTION

RECOM's RPL-5.0 series is a pinnacle in power module technology that sets a new standard for compactness and performance within its portfolio. This state-of-the-art Non-Isolated Step-Down Power Module is meticulously designed to be the smallest and most powerful in its class, embodying innovation and efficiency. The RPL-5.0 series features a cutting-edge buck regulator power module with an integrated shielded inductor. With a maximum input voltage of 17V, it ensures stable and reliable power conversion, catering to a diverse array of point of load applications with precision. This module offers unparalleled flexibility, allowing for programmable output voltages ranging from 0.6V to 12V. This adaptability makes the RPL-5.0 series a versatile solution, seamlessly integrating into a variety of system requirements. Capable of delivering up to 5A maximum output current, this power module is engineered to meet the dynamic needs of contemporary electronics. Safety is ingrained in its design, featuring Short Circuit Protection (SCP), Overcurrent Protection (OCP) and Undervoltage Lockout (UVLO) features to ensure the longevity and safeguarding of connected devices. Packaged in an incredibly compact 3mm x 3mm x 2mm QFN package, the RPL-5.0 series redefines expectations for size in its class, revolutionizing the landscape of power modules. The incorporation of Flip-Chip technology further enhances thermal management, enabling efficient operation even in the most demanding conditions. With an efficiency rating of up to 90%, the RPL-5.0 series not only meets but surpasses industry standards. This remarkable efficiency not only minimizes energy consumption but also mitigates heat generation, contributing to the overall reliability and extended lifespan of the module. The RPL-5.0 series is one of the smallest and most potent Non-Isolated Step-Down Power Module in its class, embodying the perfect blend of compact design, power, and efficiency.

SELECTION GUIDE

Part Number	Input Voltage Range [VDC]	Output Voltage Range [VDC]	Output Current max. [A]	Efficiency (1) typ. [%]
RPL-5.0	2.75 - 17	0.6 - 12	5000	90

Note1: Efficiency is tested at V_{IN}= 5VDC, V_{OUT}= 3.3VDC full load at +25°C ambient

MODEL NUMBERING

RPL-5.0-__

Output Current — Packaging (2)

Note2: Add suffix "-R" for tape and reel packaging
Add suffix "-CT" for bag packaging (refer to **„Packaging Information“**)

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ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Min.	Typ.	Max.
Absolute maximum voltage	V_{IN}		-0.3VDC		20VDC
	V_{SW}		-0.3VDC		V_{IN} +0.7VDC
			-0.3VDC		4VDC
Maximum continuous power losses (3)		T_{AMB} = +25°C			3.816W
Junction Temperature	T_J				+150°C
Lead Temperature					+260°C

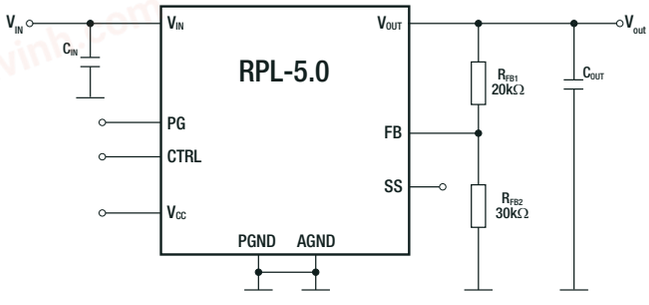
Note3: Exceeding maximum allowable power dissipation causes device to enter thermal shutdown which protects device from permanent damage.

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

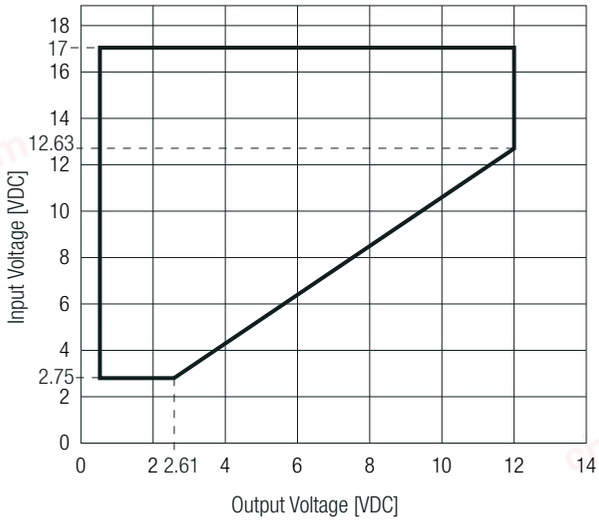
Parameter	Symbol	Condition	Min.	Typ.	Max.
Input voltage range	V_{IN}	refer to **„Safe Operating Area“**	2.75VDC		17VDC
Quiescent current	I_Q	V_{CTRL}= 2VDC, V_{FB}= 0.65VDC		100µA	150µA
Output voltage range	V_{OUT}	refer to **„Safe Operating Area“**	0.6VDC		12VDC
			0.6VDC		V_{IN} x Dmax
Standby current	I_{IN}	V_{CTRL}= 0VDC		2µA	5µA
Feedback voltage	V_{FB}		594mV	600mV	606mV
		T_{AMB}= -40°C to 125°C	591mV	600mV	609mV
Feeback current		V_{FB} = 700mV		10nA	50nA
Valley current limit			6A	7A	
Switching frequency	f_{SW}		0.9kHz	1.2kHz	1.6kHz
Minimum on time				50ns	
Minimum off time				100ns	
Soft start current			4µA	6µA	8µA

Typical Application

V_{IN}= 2.75-17VDC, V_{OUT}= 1VDC, I_{OUT}= 6A



Safe Operating Area



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CTRL OPERATING CONDITIONS (measured @ T_{AMB}= 25°C, V_{IN}= 5VDC, full load and after warm-up unless otherwise stated)

Parameter	Symbol	Condition	Min.	Typ.	Max.
CTRL rising threshold	V_{CTRL_RISING}		1.19VDC	1.23VDC	1.27VDC
CTRL falling threshold	$V_{CTRL_FALLING}$		0.96VDC	1VDC	1.04VDC
CTRL pull-down resistor				1.2MΩ	

POWER GOOD OPERATING CONDITIONS (measured @ T_{AMB}= 25°C, V_{IN}= 5VDC, full load and after warm-up unless otherwise stated)

Parameter	Symbol	Condition	Min.	Typ.	Max.
OV rising threshold	PG_{OVHI}		115% of V_{REF}	120% of V_{REF}	125% of V_{REF}
OV falling threshold	PG_{OVLO}		105% of V_{REF}	110% of V_{REF}	115% of V_{REF}
UV rising threshold	PG_{UVHI}		85% of V_{REF}	90% of V_{REF}	95% of V_{REF}
UV falling threshold	PG_{UVLO}		75% of V_{REF}	80% of V_{REF}	85% of V_{REF}
Delay	PG_{DELAY}	both edges		50µs	
Leakage current	I_{PG_LEAK}	V_{PG}= 5VDC			10µA
Sink current capability	V_{PG_SINK}	$sink_{current}$= 4mA			0.4VDC

VCC CONDITIONS (measured @ T_{AMB}= 25°C, V_{IN}= 5VDC, full load and after warm-up unless otherwise stated)

Parameter	Condition	Min.	Typ.	Max.
Regulator	V_{IN}= 5VDC		3.5VDC	
Load regulation	I_{CC}= 5mA		3%	
UVLO rising threshold		2.4VDC	2.5VDC	2.6VDC
UVLO threshold hysteresis			200mV	

PROTECTIONS (measured @ T_{AMB}= 25°C, V_{IN}= 5VDC, full load and after warm-up unless otherwise stated)

Parameter	Condition		Value
Short Circuit Protection SCP			hiccup, auto recovery
Over Current Protection OCP			hiccup, auto recovery
Thermal shutdown	restart after cooldown	junction temperature	150°C typ.
		hysteresis	20°C typ.

THERMAL OPERATING CONDITIONS (measured @ T_{AMB}= 25°C, V_{IN}= 5VDC, full load and after warm-up unless otherwise stated)

Parameter	Symbol	Condition	Min.	Typ.	Max.
Operating Junction Temperature	T_J	refer to **„Thermal Derating“**	-40°C		+125°C
Thermal Resistance (4)	R_{th_JA}	junction to ambient		32.8K/W	
	R_{th_JC}	junction to case		10.2K/W	

Note4: Test PCB= 6.4 x 6.4cm double sided PCB with 2oz copper, natural convection

ENVIRONMENTAL

Parameter	Condition	Value
Moisture Sensitive Level		Level 3, 245°C, 168hrs

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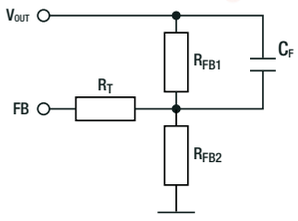
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OUTPUT VOLTAGE SETTING

The external resistor divider sets V_{OUT}. First, choose a value for R_{FB1}. Too small of an R_{FB1} value leads to considerable quiescent current (IQ) loss, while too large an R_{FB1} value makes FB noise sensitive. It is recommended that R_{FB1} be between 2kΩ and 100kΩ. Typically, set the current flowing through R_{FB1} below 250µA to balance system stability and minimize load loss. Then R_{FB1} can be calculated with Equation below. The values for trim resistors shown in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary.

Feedback Network



Calculation:

$$R_{FB1} = \frac{(V_{OUT} - V_{ref})}{V_{ref}} \times R_{FB2}$$

Practical example with V_{OUT}= 1.8VDC

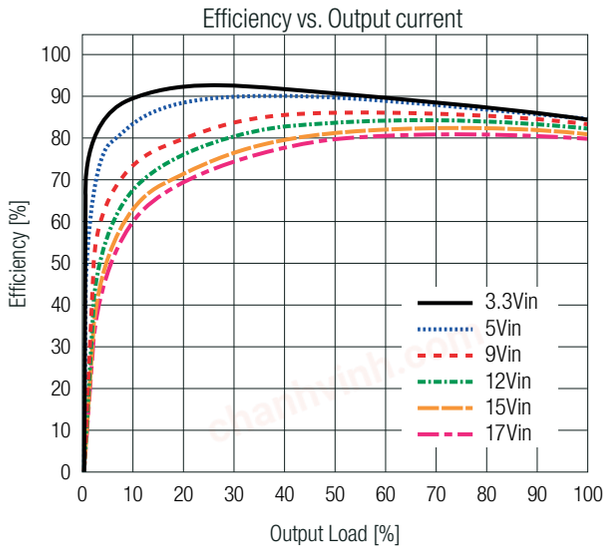
$$R_{FB1} = \frac{(1.8V - 0.6V)}{0.6V} \times 10k\Omega = \mathbf{20k\Omega}$$

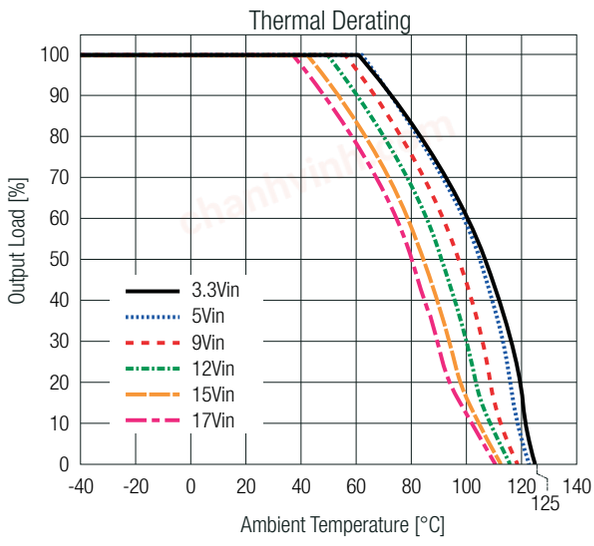
Table below lists recommended resistor values for common V_{OUT}:

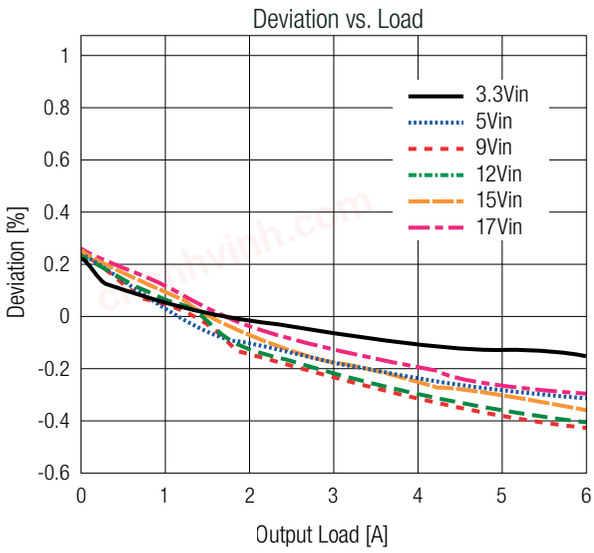
V_{OUT} [VDC]	R_{FB1} [Ω]	R_{FB2} [Ω]	C_F [pF]	R_T [Ω]
1	6k67	10k	39	0
1.2	10k			
1.5	15k			
1.8	20k			
2.5	31k6			
3.3	45k			

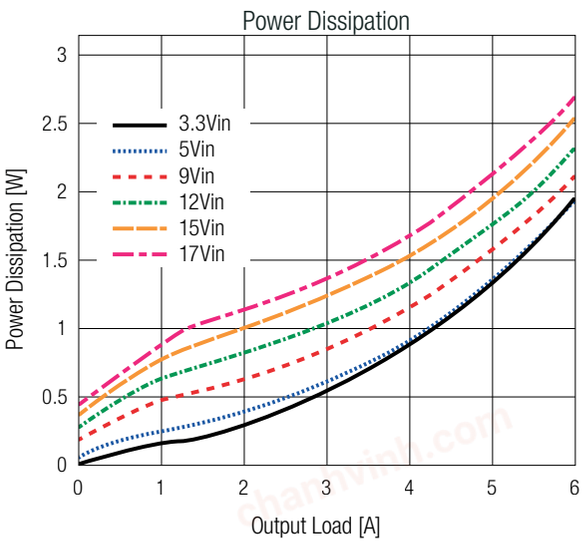
TYPICAL PERFORMANCE CHARACTERISTICS (measured @ T_{AMB}= 25°C, V_{OUT}= 1.8VDC)

1.8Vout









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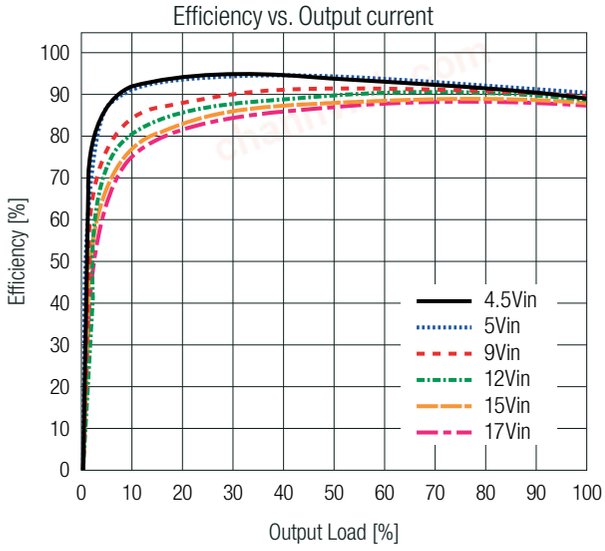
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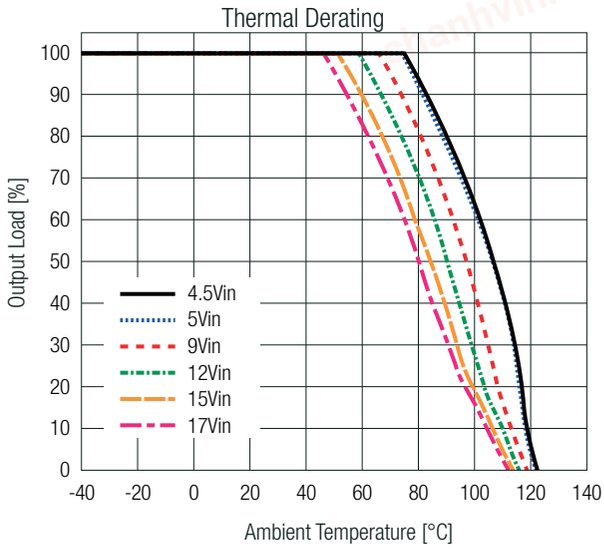
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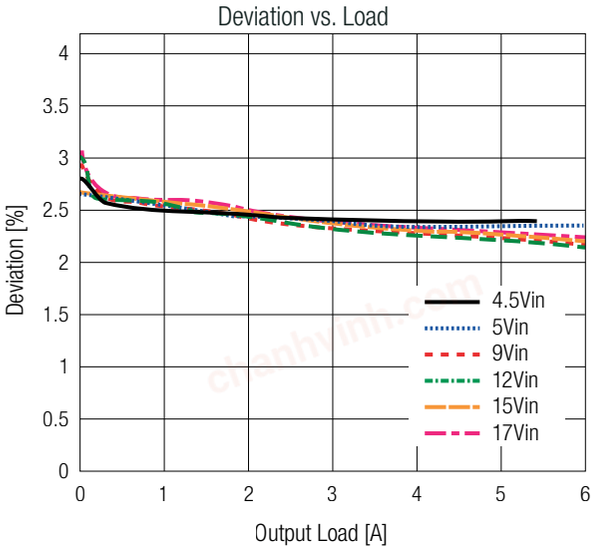
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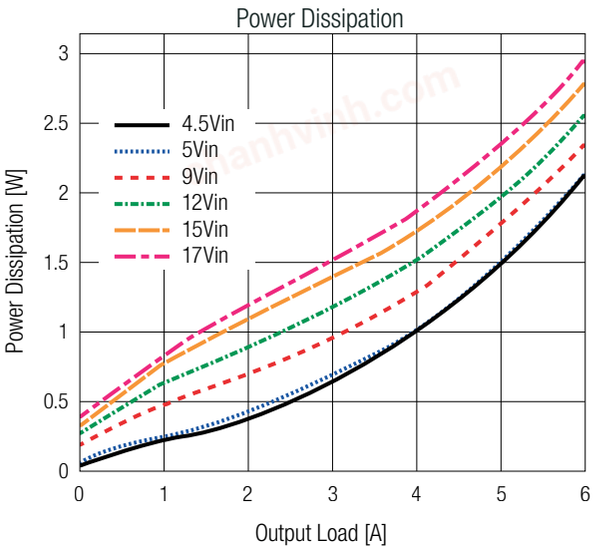
TYPICAL PERFORMANCE CHARACTERISTICS (measured @ T_{AMB}= 25°C, V_{OUT}= 3.3VDC)

3.3Vout









SAFETY & CERTIFICATIONS

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

DIMENSION & PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	case	plastic
Dimension (LxWxH)		4.0 x 6.0 x 1.6mm 0.157 x 0.236 x 0.062inch
Weight		0.1g typ. 0.0002lbs

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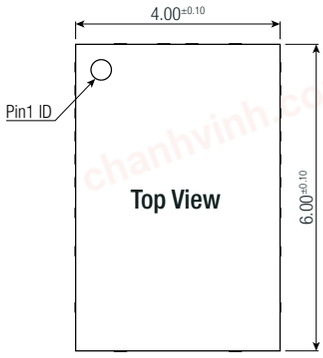
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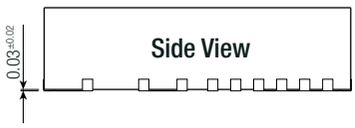
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DIMENSION & PHYSICAL CHARACTERISTICS

Dimension Drawing (mm)

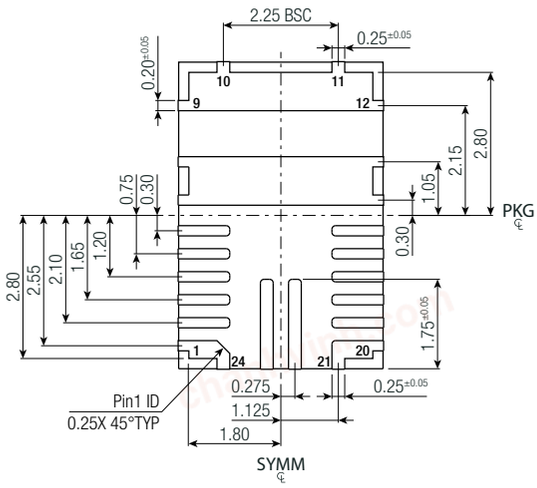


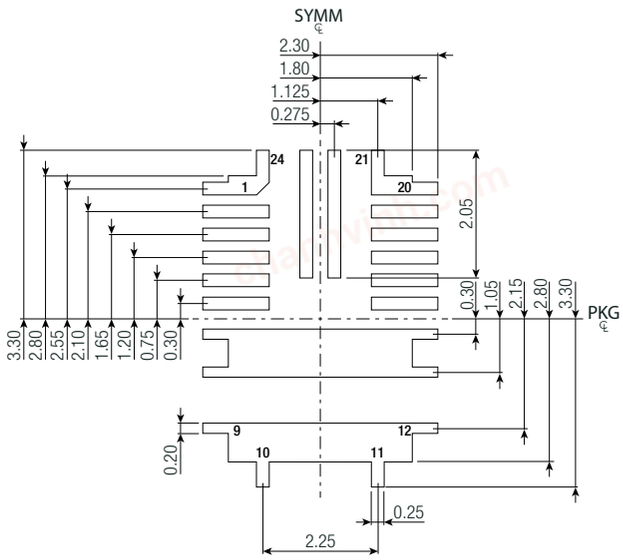




Recommended Footprint Details (Top View)

Bottom View





Pad Information

Pad #	Function	Description
1, 2, 3, 4, 5, 24	PGND	System ground. Reference ground of the regulated output voltage. Connect to input supply return, load return, and input and output capacitors.
6	VCC	Internal bias supply output
7, 8, 13, 14, 23	SW	Switch output
9, 10, 11, 12	V_{OUT}	Output voltage pin. Connect the V_{OUT} pin to the output capacitor (C_{OUT})
15	BST	Bootstrap
16	CTRL	Control Pin. Pull the CTRL pin high to turn the part on; float CTRL to turn it off. CTRL is pulled to AGND via an internal 1.2MΩ pull-down resistor (R_{CTRL_PD})
17	FB	Feedback. To set V_{OUT} connect the FB pin to the tap of an external resistor divider connected between the output and AGND.
18	AGND	Signal Ground. The AGND pin is not connected internally to the system ground. When designing the PCB layout, ensure that AGND is connected to the system ground.
19	SS	Soft Start. Connect a capacitor between the SS pin and AGND to set the soft-start time (t_{ss}) and to avout start-up inrush current. SS has an internal 22nF capacitor (C_{ss}).
20, 21	PG	Power good output.
22	V_{IN}	Input supply voltage. Connect using wide PCB traces. Requires CIN between these pins and PGND close to the pins.

Tolerances:
x.x= ±0.1mm
x.xx= ±0.05mm

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PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	Suffix -R: tape & reel (diameter)	Ø330.2
	tape and reel (carton)	355.6 x 355.6 x 50.8mm
	Suffix -CT: moisture barrier bag	100 x 100 x 30mm
Packaging Quantity	Suffix -R: tape & reel	500pcs
	Suffix -CT: moisture barrier bag	10pcs
Tape Width		12mm
Storage Temperature Range		-65°C to +150°C
Storage Humidity	non-condensing	60% RH max.

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