

3A, 40V, 150KHz Buck DC to DC Converter**Features**

- 3A Constant output Current Capability
- Input Voltage up to 45V
- Output Voltage Accuracy $\pm 1.5\%$
- 4.5V to 40V Input Operating Range
- Fixed Volts: 3.3V/5.0V/12V and Adjustable Versions
- Output Adjustable from 1.23V to 38V
- High efficiency up to 93%
- Fixed 150KHz Switching Frequency
- Maximum Duty Cycle 99%
- Internal Soft-Start
- No external compensation required
- Short circuit protection (SCP)
- Undervoltage protection (UVLO)
- Built-in Over Current Limit (OCP)
- Built-in Over Voltage Protection (OVP)
- Thermal Shutdown (OTP)
- Temperature range from -40°C to +125°C
- Available in SOIC-8(SOP-8) Package.

Applications

- LCD Monitor and LCD TV
- Digital Photo Frame
- Car multimedia power supply
- ADSL Modem
- Telecom / Networking Equipment

General Description

The HCR3321 is a 150 KHz fixed frequency PWM buck (step-down) DC/DC converter, capable of driving a 3A load with high efficiency up to 93%, low ripple and excellent line and load regulation. Requiring a minimum number of external components, the regulator is simple to use and include internal frequency compensation and a fixed-frequency oscillator.

The PWM control circuit is able to adjust the duty ratio linearly from 0 to 99%. An enable function, an over current protection function is built inside. When second current limit function happens, the operation frequency will be reduced from 150KHz to 50KHz. Only four external components are needed to form a complete voltage reduction system, making it easy to use.

The HCR3321 has input overvoltage protection, output short-circuit protection, input undervoltage protection, output overcurrent protection, output overvoltage protection, and thermal shutdown protection, with extremely high reliability.

The HCR3321 is available in a green SOIC-8 (SOP-8) package. Its operating temperature range from -40°C to +125°C



SOIC-8(SOP-8)

Figure 1. Package Type of HCR3321

3A, 40V, 150KHz Buck DC to DC Converter

Pin Configuration

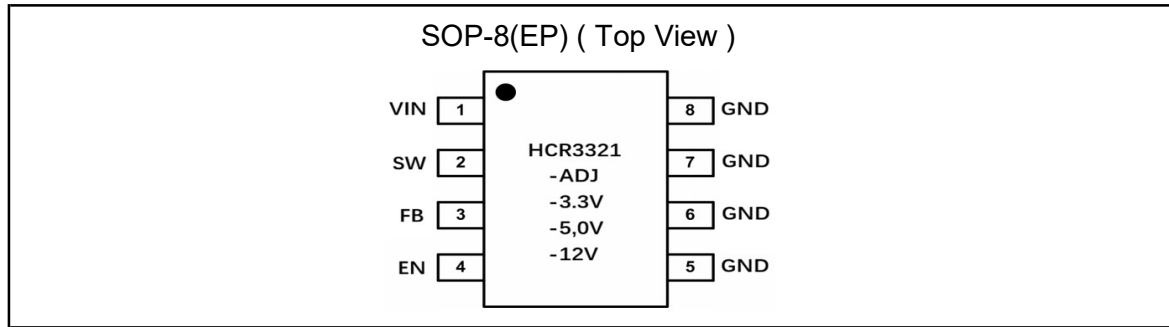
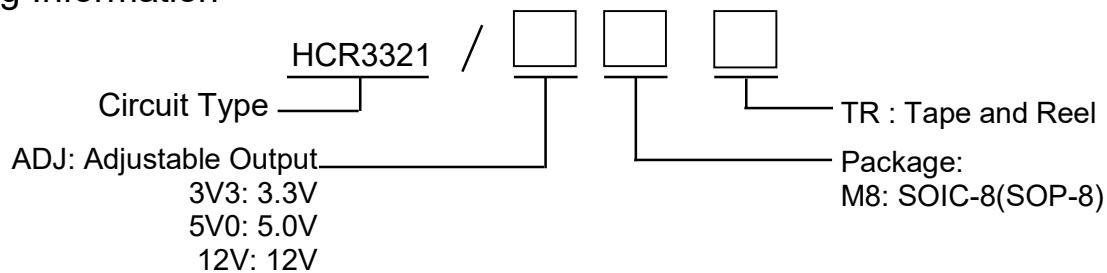


Figure 2. Pin Configuration of HCR3321 (Top View)

Pin Function Table

Pin Number	Pin Name	Function
1	VIN	Supply Voltage Input Pin. The HCR3321 operates from 4.5V to 40V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.
2	SW	Power Switch Output Pin (SW). Output is the switch node that supplies power to the output.
3	FB	Feedback Pin (FB). Through an external resistor divider network, Feedback senses the output voltage and regulates it. The feedback threshold voltage is 1.23V.
4	EN	Enable Pin. Drive EN pin low to turn on the device, drive it high to turn it off. Floating is default low.
5/6/7/8	GND	Ground Pin. Care must be taken in layout. This pin should be placed outside of the Schottky Diode to output capacitor ground path to prevent switching current spikes from inducing voltage noise into HCR3321

Ordering Information



Ordering Code

Part Number	Marking ID ²	Temperature Range	Package	Quantity per Reel
HCR3321/ADJM8TR	HCR3321-ADJxx	-40'C to +125'C	SOIC-8(SOP-8)	4000pcs/TR
HCR3321/3V3M8TR	HCR3321-3V3xx	-40'C to +125'C	SOIC-8(SOP-8)	4000pcs/TR
HCR3321/5V0M8TR	HCR3321-5V0xx	-40'C to +125'C	SOIC-8(SOP-8)	4000pcs/TR
HCR3321/12VM8TR	HCR3321-12Vxx	-40'C to +125'C	SOIC-8(SOP-8)	4000pcs/TR

Note2: the HCR3321-ADJ/3V3/5V0/12V" is product type and the "XX" is date code.

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Function Block

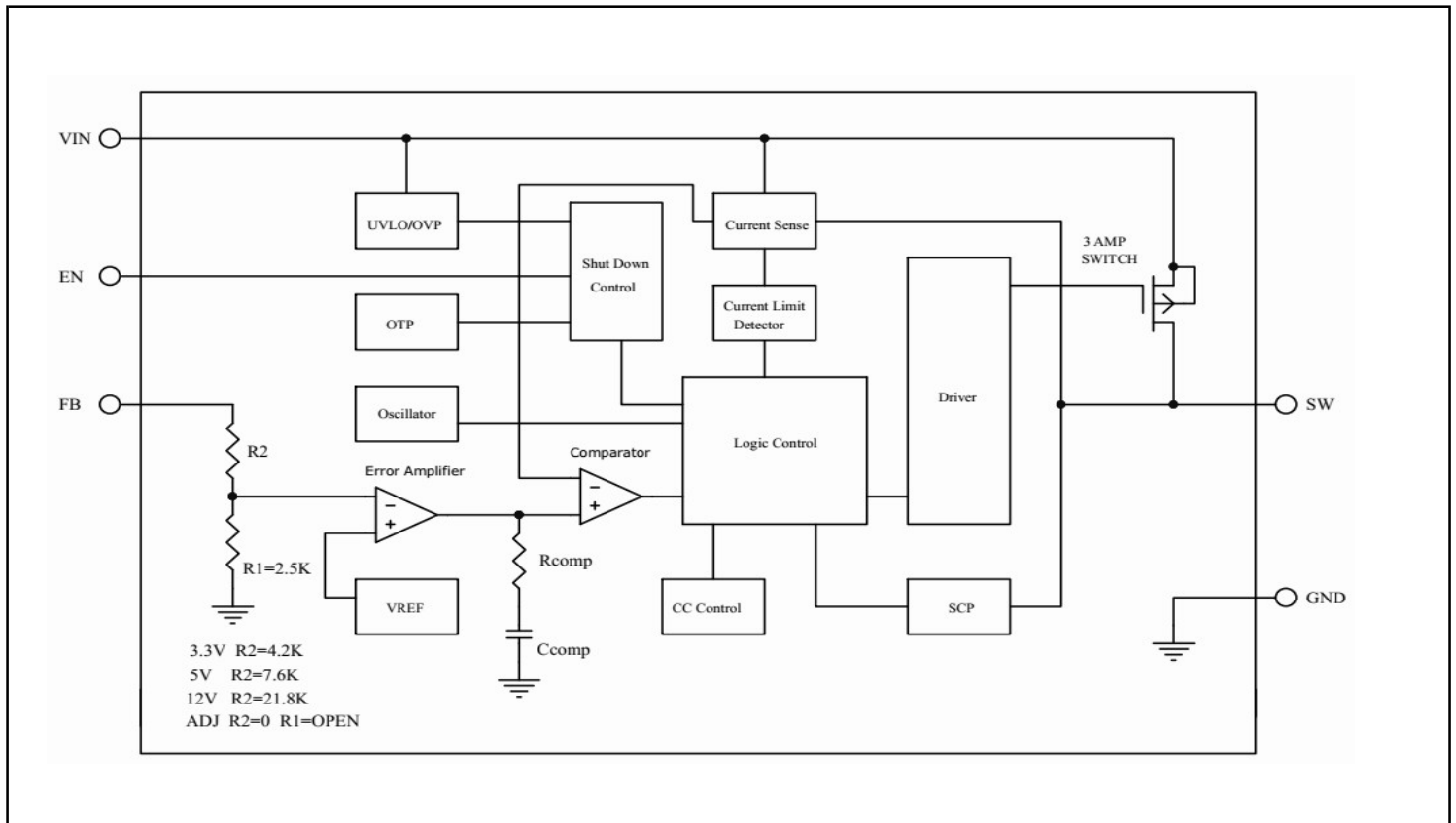


Figure 3. Function Block of HCR3321

Typical Application Circuit

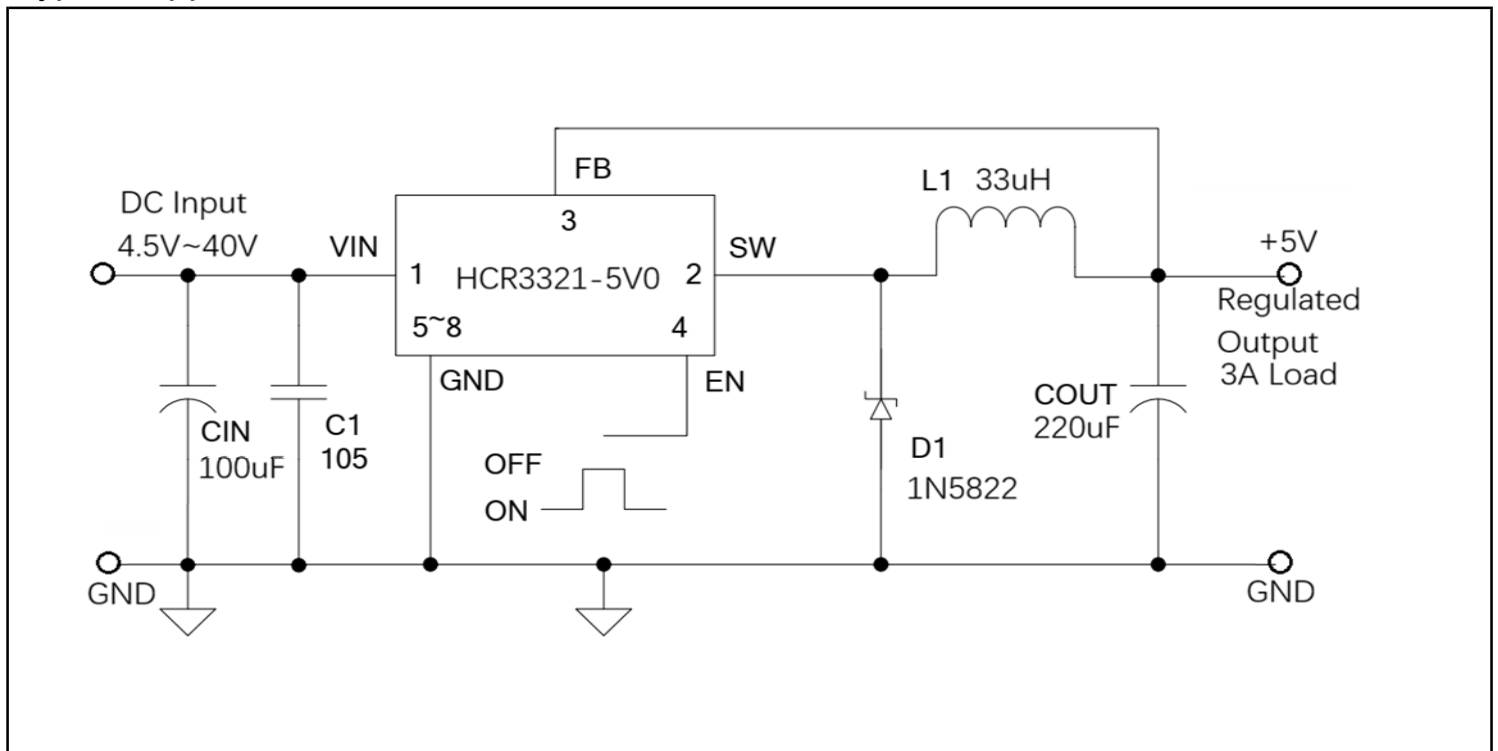


Figure 4. Typical Application Circuit of HCR3321

3A, 40V, 150KHz Buck DC to DC Converter**Absolute Maximum Ratings** Note 1

Parameter	Symbol	Value	Unit
Supply Voltage	V _{IN}	-0.3 to +45	V
Enable Voltage	V _{EN}	-0.3 to +45	V
Feedback Pin Voltage(for the ADJ, 3.3V, 5V)	V _{FB}	-0.3 to +7	V
Feedback Pin Voltage(for the 12V)	V _{FB}	-0.3 to +45	V
output Switch Pin Voltage	V _{SW}	-0.3 to V _{IN}	V
Maximum Power Dissipation	P _D	Internally limited	W
Thermal Resistance (Junction to Ambient, No Heatsink, Free Air)	R _{θJA}	87	'C/W
Thermal Resistance Junction to Case	R _{θJC}	53	'C/W
Storage Temperature Range	T _{STG}	-65 to 150	'C
Operating Junction Temperature	T _J	-40 to 150	'C
Lead Temperature (Soldering, 10s)	T _{LEAD}	280	'C
ESD (HBM)	HBM	2000	V
ESD (MM)	MM	200	V

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device.

This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommend Operating Conditions note2

Parameter	Symbol	Min.	Max.	Unit
Input Voltage	V _{IN}	4.5	40.0	V
Output Adjustable Voltage	V _{OUT}	1.23	38.0	V
Ambient Operting Temp	T _A	-40	+125	'C

Note 1: Stresses beyond those listed under "Absolute maximum Ratings" may damage the device.

2: The device is not guaranteed to function outside the recommended operating conditions.

3A, 40V, 150KHz Buck DC to DC Converter
Electrical Characteristics

The specifications which apply over the full operating temperature range, otherwise specification are VIN=12V, (Ta=25°C; unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Input Operation Voltage	V _{in}		4.5	-	40	V
Vin Under-voltage Lockout Threshold	V _{UVLO}	VIN falling	-	4.5	-	V
Vin Under-voltage Lockout Threshold-Hysteresis	V _{UVLO_HYST}	VIN rising	-	50	-	mV
Vin Over Voltage Protection Threshold	V _{VOP}	VIN rising	-	42	-	V
Vin Overvoltage protection recovery voltage hysteresis	V _{VOP_HYST}	VIN falling	-	100	-	mV
Shutdown Supply Current	I _{SD}	V _{OUT} =0V	-	80	-	uA
Quiescent Supply Current	I _Q		-	1.3	-	mA
Feedback Voltage	V _{FB}		1.216	1.230	1.244	V
Top-side Switch On-Resistance	R _{DS(ON)T}	By Design	-	180	-	mΩ
Top_side Switch On-Resistance Quiescent Current	I _{LEAK_TOP}	VIN=24V, V _{SW} =0V	-	1	-	uA
Output Current Limit	I _{LIMIT}	-	-	3.0	-	A
Oscillator Frequency	F _{SW}		120	150	180	KHz
Short Circuit Oscillator Frequency	F _{SHT}	V _{FB} =0V	-	50	-	KHz
Maximum Duty Cycle	D _{MAX}		-	99	-	%
Minimum On Time	T _{on}		-	500	-	us
EN Input Voltage	V _{EN}	EN High Threshold	1.4	-	-	V
		EN Low Threshold	-	-	0.8	
Thermal Shutdown Temperature	T _{SD}		-	160	-	°C
Thermal Shutdown Hysteresis	T _{SDHYS}		-	40	-	°C

3A, 40V, 150KHz Buck DC to DC Converter
Electrical Characteristics(Con.)

Ta=25°C; unless otherwise specified

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
HCR3321-3V3 Electrical Characteristics						
System Parameters test Circuit Figure 6.						
Output Voltage	V _{OUT}	Vin=12V, Iload=0.5A	3.250	3.3	3.350	V
Output Voltage	V _{OUT}	Vin=12V, Iload=3A	3.200	3.3	3.400	V
Efficiency	η	Vin=12V, Iload=3A	-	82	-	%
HCR3321-5V0 Electrical Characteristics						
System Parameters test Circuit Figure 7.						
Output Voltage	V _{OUT}	Vin=12V, Iload=0.5A	4.925	5.0	5.075	V
Output Voltage	V _{OUT}	Vin=12V, Iload=3A	4.875	5.0	5.125	V
Efficiency	η	Vin=12V, Iload=3A	-	87	-	%
HCR3321-12V Electrical Characteristics						
System Parameters test Circuit Figure 8.						
Output Voltage	V _{OUT}	Vin=24V, Iload=0.5A	11.82	12.0	12.18	V
Output Voltage	V _{OUT}	Vin=24V, Iload=3A	11.77	12.0	12.23	V
Efficiency	η	Vin=24V, Iload=3A	-	93	-	%
HCR3321-ADJ Electrical Characteristics						
System Parameters test Circuit Figure 9.						
Output Voltage	V _{OUT}	Vin=4.5V to 40V, Iload=0.2A to 3A	1.193	1.23	1.267	V
Efficiency	η	Vin=12V, Vout=3V, Iload=3A	-	83	-	%

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Test Circuit note5

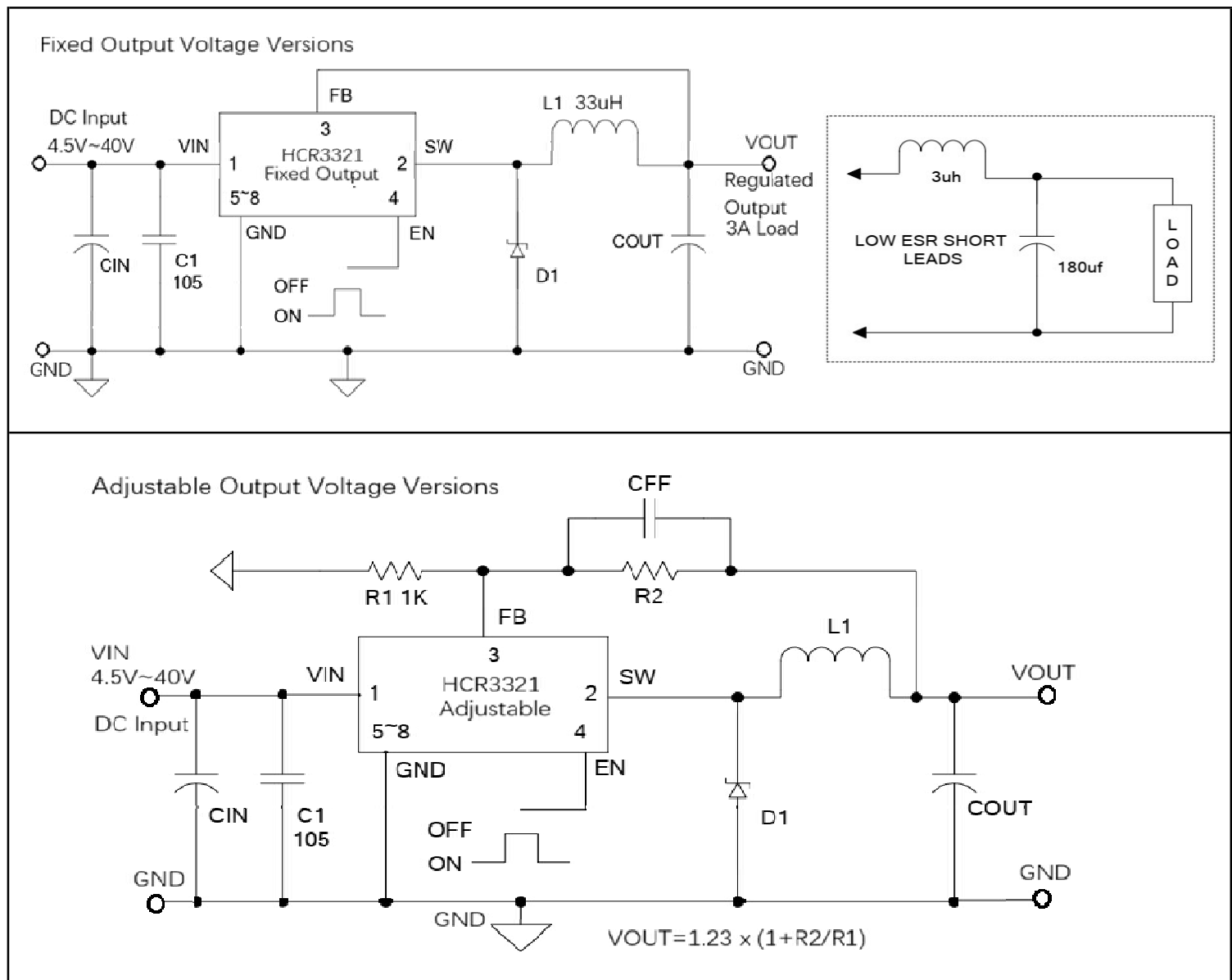


Figure 5. Standard Test Circuits of HCR3321

Note 5. Select R1 to be approximately 1K, use a 1% resistor for best stability.

C1 and CFF are optional; in order to increase stability and reduce the input power line noise, C1 must be placed near to PIN1 and PIN5~8;

For output voltages greater than approximately 10V, an additional capacitor CFF is required. The compensation capacitor is typically between 100 pf and 33 nf, and is wired in parallel with the output voltage setting resistor, R2. It provides additional stability for high output voltage, low input-output voltages, and/or very low ESR output capacitors, such as solid tantalum capacitors.

$CFF = 1 / (31 \times 1000 \times R2)$; This capacitor type can be ceramic, plastic, silver mica, etc. (Because of the unstable characteristics of ceramic capacitors made with Z5U material, they are not recommended.)

3A, 40V, 150KHz Buck DC to DC Converter
HCR3321 Series Buck Regulator Design Procedure (Fixed Output)

Conditions			Inductor	Output Capacitor (COUT)			
			(L1)	Through Hole Electrolytic		Surface Mount Tantalum	
Output Voltage	Load Current	Max Input Voltage	Inductance	Panasonic HFQ Series	Nichicon PL Series	AVX TPS Series	Sprague 595D Series
(V)	(A)	(V)	(uH)	(uF/V)	(uF/V)	(uF/V)	(uF/V)
3.3	3.0	6	22	470 / 25	470 / 35	330 / 6.3	390 / 6.3
		10	33	330 / 35	330 / 35	330 / 6.3	390 / 6.3
		40	47	330 / 35	270 / 50	220 / 10	330 / 10
5.0	3.0	9	22	470 / 25	560 / 35	220 / 10	330 / 10
		20	68	180 / 35	180 / 35	100 / 10	270 / 10
		40	68	180 / 35	180 / 35	100 / 10	270 / 10
12.0	3.0	15	33	330 / 25	330 / 25	100 / 16	180 / 16
		20	68	180 / 25	180 / 25	100 / 16	120 / 20
		40	150	82 / 25	82 / 25	68 / 20	68 / 25

Buck Regulator Design Procedure (Adjustable Output) of HCR3321 Series

Conditions			Inductor	Output Capacitor (COUT)			
	Through Hole Output Electrolytic			Surface Mount Output Capacitor			
Output Voltage	Panasonic HFQ Series	Nichicon PL Series	Feedforward Capacitor	AVX TPS Series	Sprague 595D Series	Feedforward Capacitor	
(V)	(uF/V)	(uF/V)		(uF/V)	(uF/V)		
2	820 / 35	820 / 35	33nF	330 / 6.3	470 / 4	33nF	
4	560 / 35	470 / 35	10nF	330 / 6.3	470 / 6.3	10nF	
6	470 / 25	470 / 35	3.3nF	220 / 10	330 / 10	3.3nF	
9	330 / 25	330 / 25	1.5nF	100 / 16	180 / 16	1.5nF	
12	330 / 25	330 / 25	1nF	100 / 16	180 / 16	1nF	
15	220 / 25	220 / 35	680pF	68 / 20	120 / 20	680pF	
24	220 / 35	150 / 35	560pF	33 / 25	33 / 25	220pF	
28	100 / 50	100 / 50	390pF	10 / 35	15 / 50	220pF	

Schottky Diode Selection Table

Current	Surface Mount	Through Hole	VR (The same as system maximum input voltage)				
			20V	30V	40V	50V	60V
1A		✓	1N5817	1N5818	1N5819		
3A		✓	1N5820	1N5821	1N5822		
		✓	MBR320	MBR330	MBR340	MBR350	MBR360
	✓		SK32	SK33	SK34	SK35	SK36
	✓			30WQ03	30WQ04	30WQ05	
		✓		31DQ03	31DQ04	31DQ05	
		✓	SR302	SR303	SR304	SR305	SR306

3A, 40V, 150KHz Buck DC to DC Converter

Typical System Application for 3.3V Version

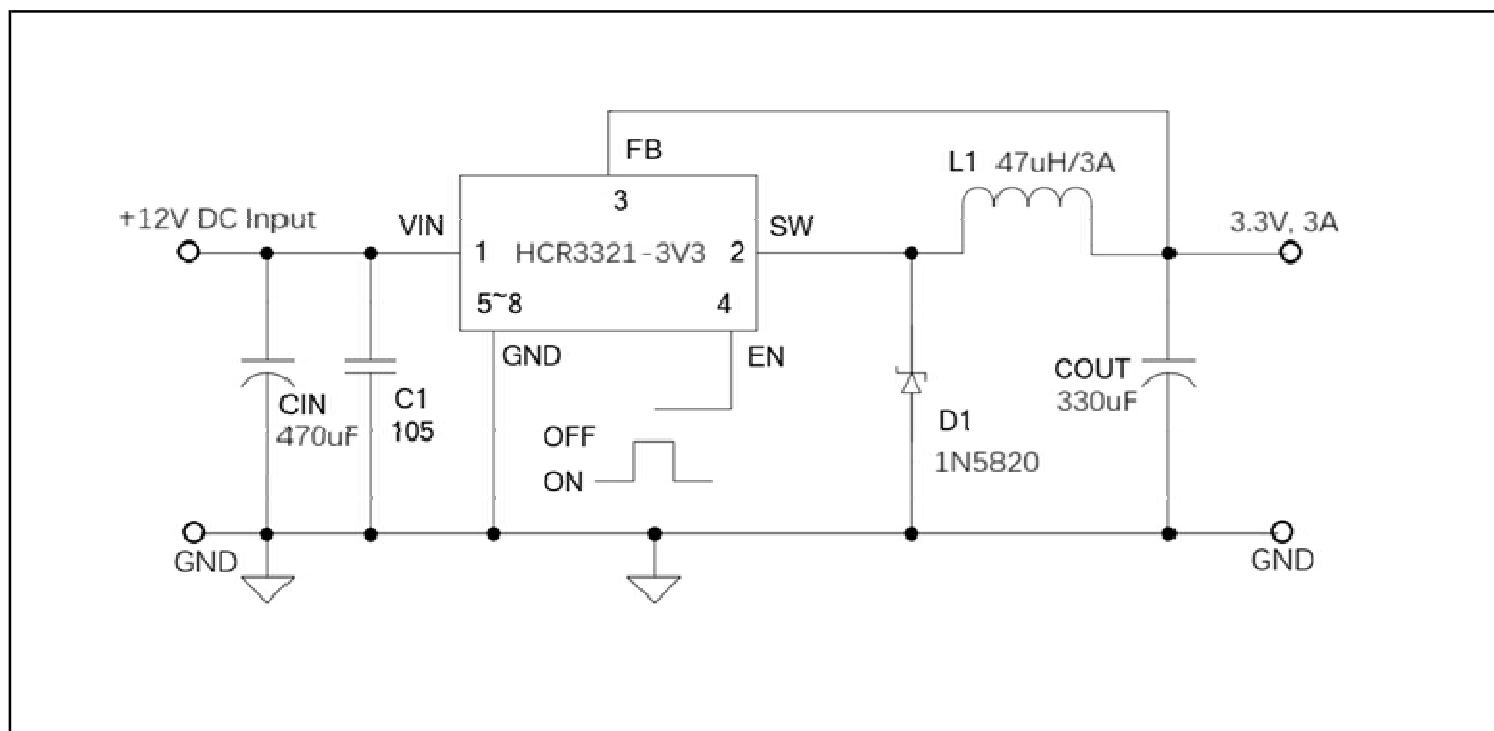


Figure 6. System Parameters Test Circuit for HCR3321-3V3

Typical System Application for 5V Version

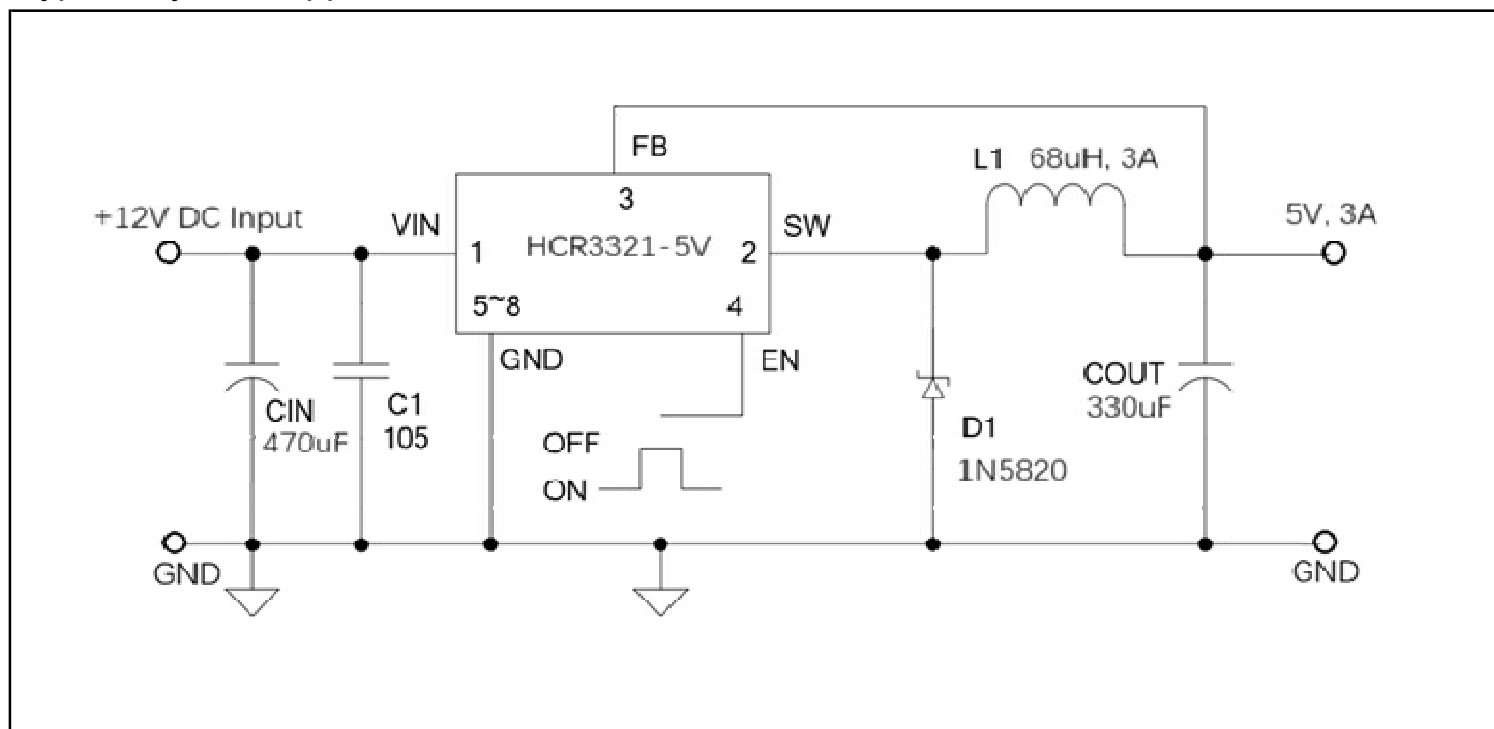


Figure 7. System Parameters Test Circuit for HCR3321-5V0

3A, 40V, 150KHz Buck DC to DC Converter

Typical System Application for 12V Version

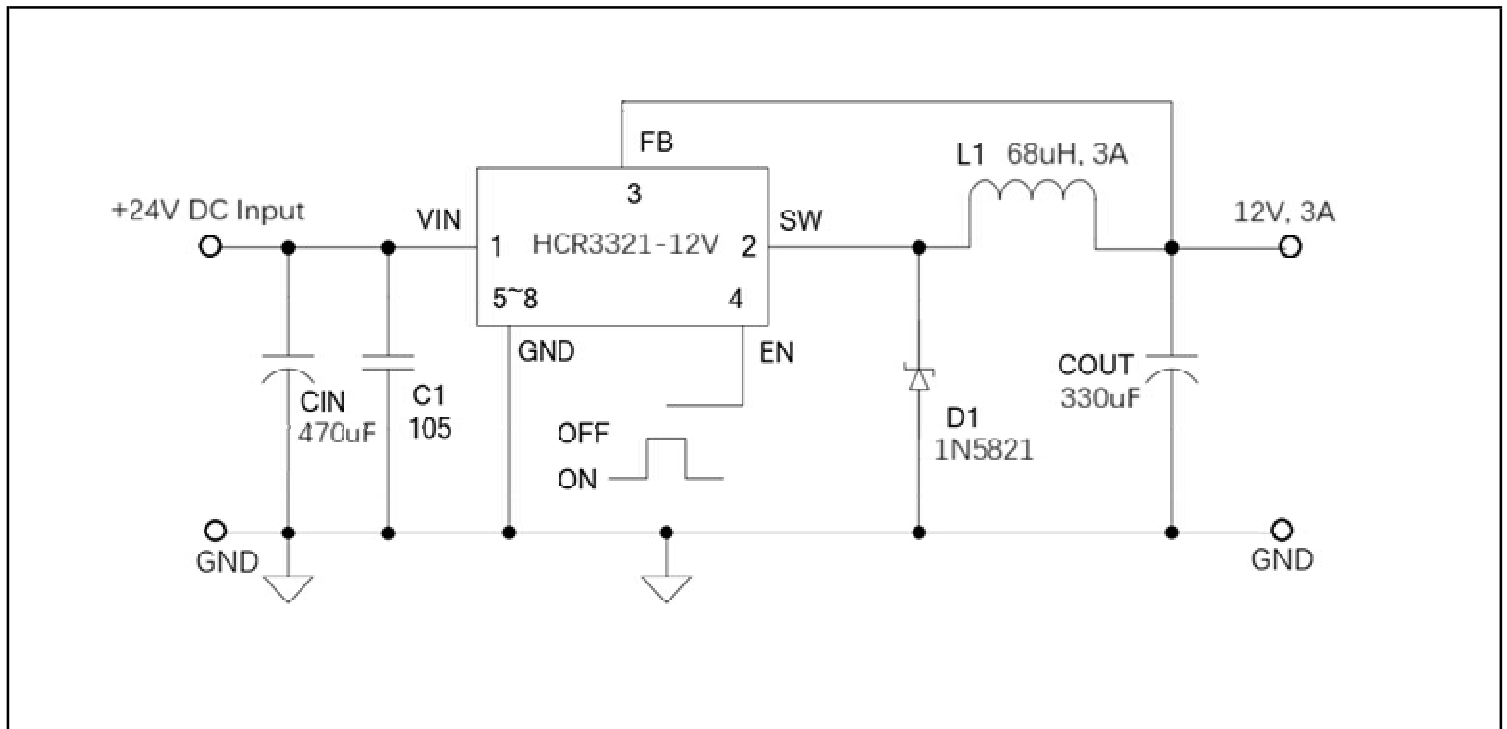


Figure 8. System Parameters Test Circuit for HCR3321-12V

Typical System Application for ADJ Version

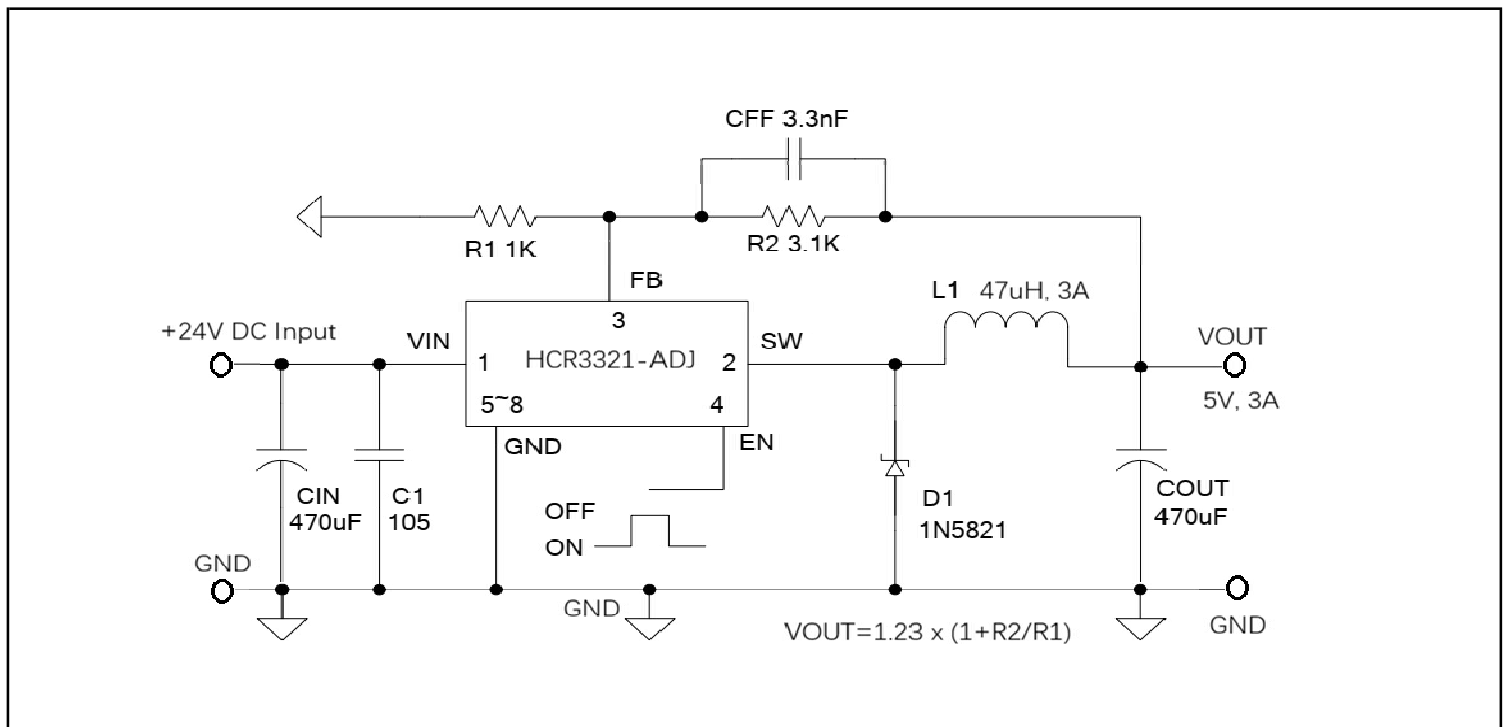
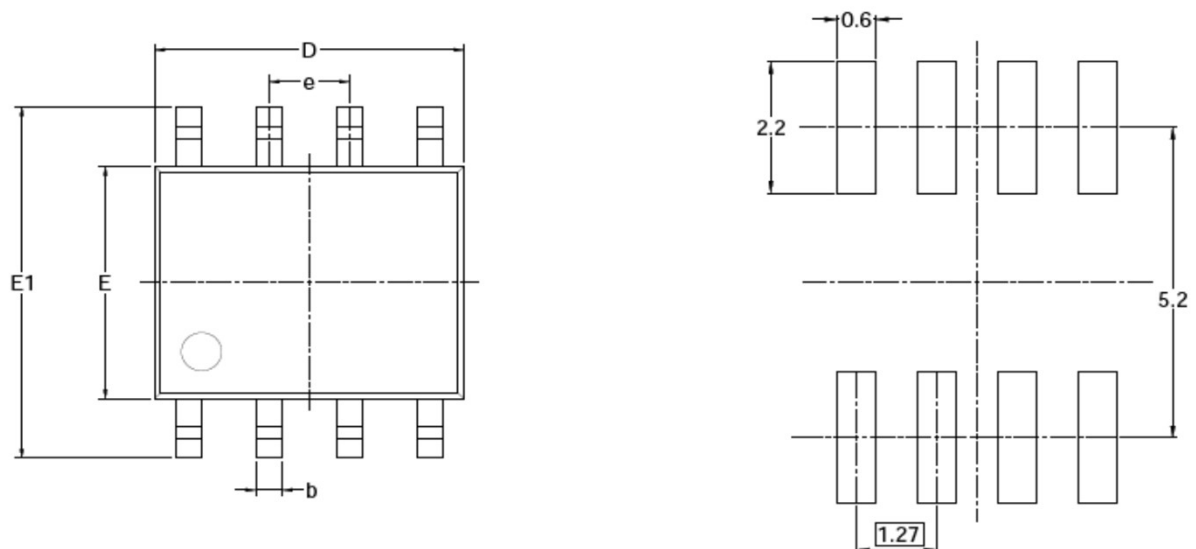
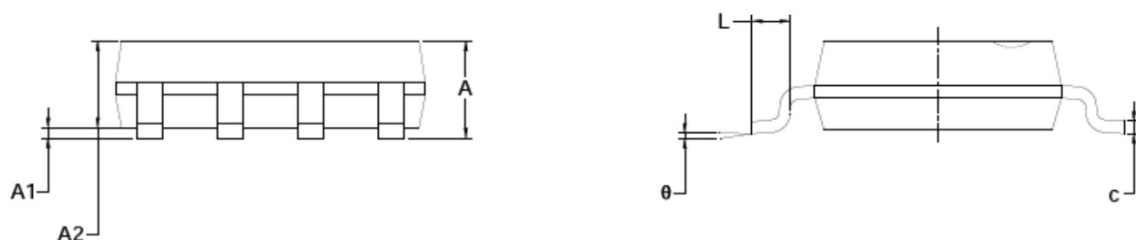


Figure 9. System Parameters Test Circuit for HCR3321-ADJ

3A, 40V, 150KHz Buck DC to DC Converter
Mechanical Dimensions

M8: SOIC-8(SOP-8) Package

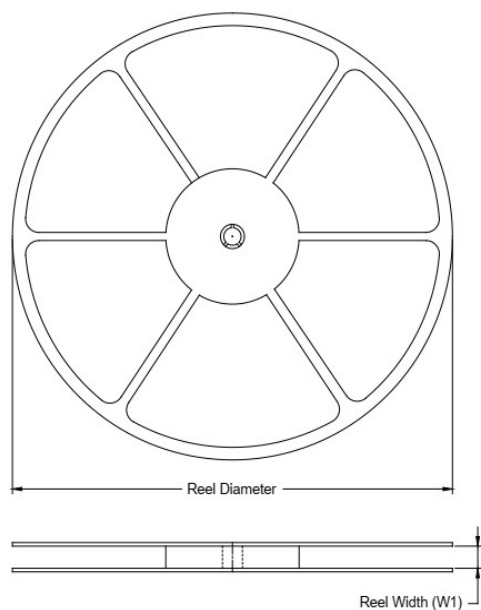
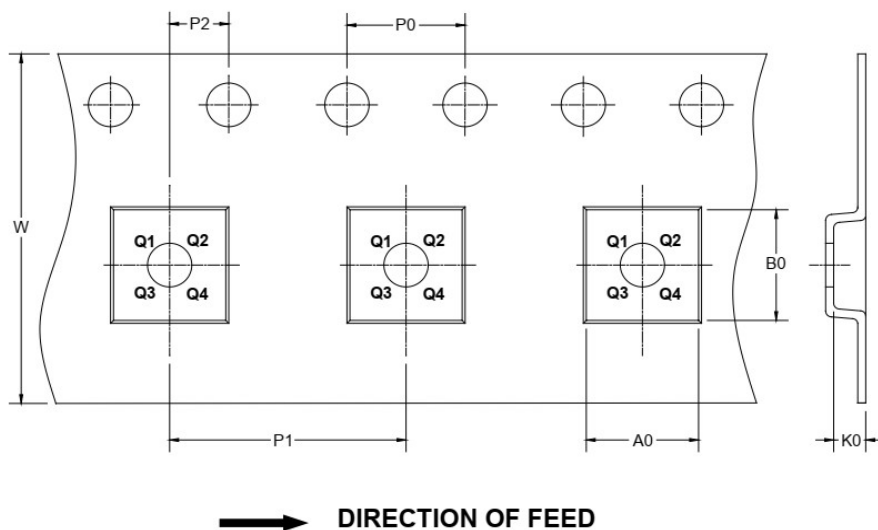
Unit: mm(inch)


RECOMMENDED LAND PATTERN (Unit: mm)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

NOTES:

1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

3A, 40V, 150KHz Buck DC to DC Converter
Tape and Reel Information
REEL DIMENSIONS

TAPE DIMENSIONS


NOTE: The picture is only for reference. Please make the object as the standard.

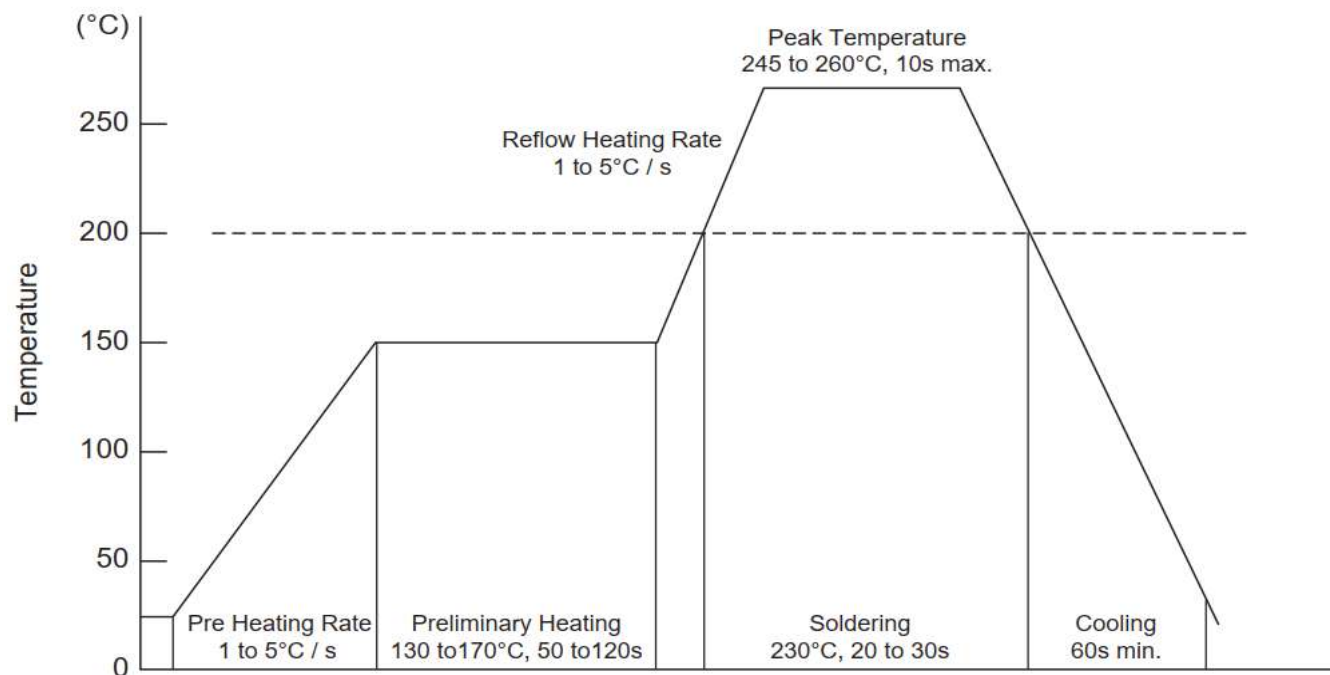
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOIC-8(SOP-8)	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1

3A, 40V, 150KHz Buck DC to DC Converter

Conditins of Soldering and Storage

- * Recommended condition of reflow soldering



Recommended peak temperature is over 245°C, if peak temperature is below 245°C, you may adjust the following parameters:

- * Time length of peak temperature (longer)
 - * Time length of soldering (longer)
 - * Thickness of solder paste (thicker)
- * Conditions of hand soldering
 - * Temperature : 300°C
 - * Time : 3s max
 - * Times : one time
 - * Storage conditions
 - * Temperature
5 to 40°C
 - * Humidity
30 to 80% RH
 - * Recommended period
One year after manufacturing