

5.5V High Efficiency 1MHz, 1.2 μ A IQ Synchronous Step-Up Converter**Features**

- * **Ultra-low IQ: 1.2 μ A**
- * **0.9V Startup**
- * **True Disconnection During Shutdown**
- * **1MHz Fixed Switching Frequency**
- * **Output to Input Reversed Current Protection**
- * **Up to 74% Efficiency at 10 μ A Load**
- * **Up to 95% Efficiency**
- * **Short-circuit Protection**
- * **Available in SOT23-6 and PDFN-2x2-6L Package**
- * **Pb Free, RoHS and REACH Compliant**
- * **Halogen Free and “Green” Device**

Applications

- * **Tablet, MID**
- * **Smart Phone**
- * **Battery Powered Systems**
- * **Low Power Wireless Applications**

General Description

The HCR6602 is a high efficiency synchronous step-up converter with ultra-low quiescent current down to 1.2 μ A. It is capable of delivering up to 5W of power from a low voltage source, i.e, 5V/1A output at 3V input. It also features a true-shutdown function that disconnects the input from output, during shutdown and output short-circuit conditions.

This eliminates the need for an external MOSFET and its control circuitry to disconnect the input from output and provides robust output overload protection.

A switching frequency of 1MHz minimizes solution footprint by allowing the use of tiny and low-profile inductors and ceramic capacitors. An internal synchronous MOSFET provides high efficiency and with a current mode control that is internally compensated, external parts count is reduced to minimum. With the ultra-low IQ feature, HCR6602B is ideal for solution that requires low standby power such as IoT applications.

The HCR6602 is available in Green SOT23-6 and PDFN-2x2-6L Package, It operates over an ambient temperature range of -40°C to +85°C.



PDFN-2x2-6L



SOT23-6

Figure 1. Package Type of HCR6602

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Pin Configuration

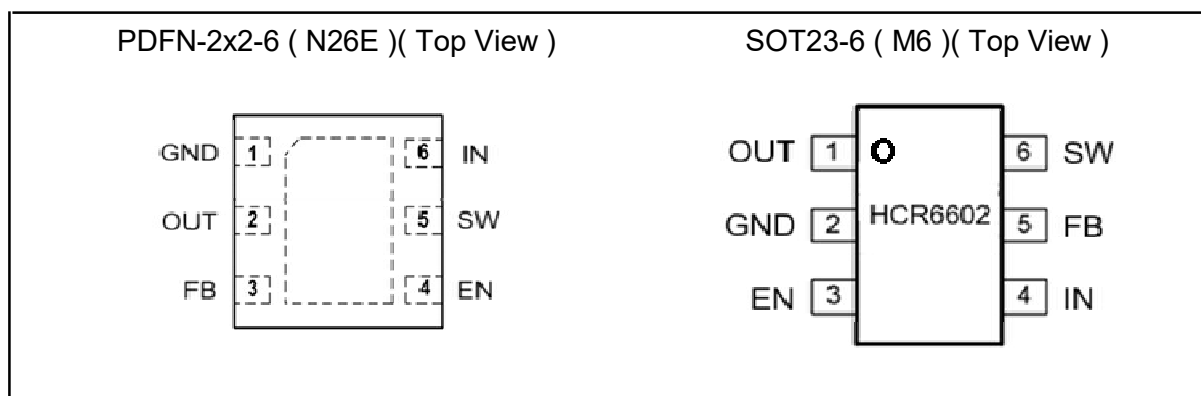
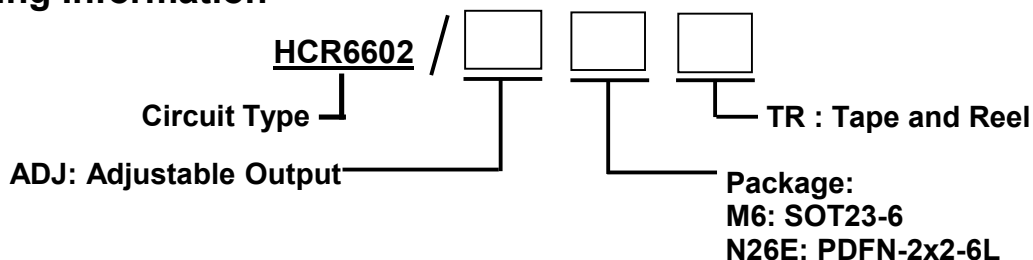


Figure 2. Pin Configuration of HCR6602(Top View)

Pin Function Table

SOT23-6	DFN2x2-6	Name	Description
1	2	OUT	Output Pin. Bypass with a 10μF or larger ceramic capacitor closely between this pin and GND
2	1	GND	Ground Pin
3	4	EN	Enable Pin for the IC. Drive this pin high to enable the part, low to disable.
4	6	IN	Input Supply Voltage pin. Bypass with a 10μF ceramic capacitor to GND.
5	3	FB	Feedback Input. Add an external resistor divider from the OUT to FB and GND to set VOUT for output voltage.
6	5	SW	Switch pin of converter. It is connected to the inductor.

Ordering Information



Ordering Code

Part Number	Marking ID ^[1]	Operating Junction Temperature Range	Package	Quantity per Reel
HCR6602/ADJM6TR	e1YW	-40°C to +85°C	SOT23-6	3000pcs/TR
HCR6602/ADJN26ETR	UqYW	-40°C to +85°C	PDFN-2x2-6L	3000pcs/TR

note [1]. Y=Year code and W=week code

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Absolute Maximum Ratings ^{Note 1}

Parameter		Symbol	Value	Unit
IN Pin Voltage Range		V _{IN}	-0.3 to 6.5	V
OUT Pin Voltage Range		V _{OUT}	-0.3 to 6.5	V
SW Pin Voltage		V _{SW}	-0.3 to 30	V
EN Pin Voltage		V _{EN}	-0.3 to 6.5	V
FB Pin Voltage		V _{FB}	-0.3 to 6.5	V
SW to ground Current		-	Internally Limited	-
Thermal Resistance Junction to Ambient	SOT23-6	R _{θJA}	180	'C/W
	PDFN-2x2-6L		80	'C/W
Thermal Resistance Junction to Case	SOT23-6	R _{θJC}	90	'C/W
	PDFN-2x2-6L		30	'C/W
Junction Temperature		T _J	150	'C
Storage Temperature Range		T _{STG}	-55 to 150	'C
Lead Temperature (Soldering, 10s)		T _{LEAD}	260	'C
Human Body Model		ESD HBM	4000	V
Charged Device Mode		ESD CDM	1000	V

Recommend Operating Conditions ^{note2}

Parameter	Symbol	Min.	Max.	Unit
Reliable Operating Input Voltage Range	V _{IN}	0.75	5.5	V
Operating Temperature Range	T _a	-40	+85	'C
Junction Temperature Range	T _J	-40	+125	'C

Note 1: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability

2: The device is not guaranteed to function outside its operating conditions

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Electrical Characteristics ^{note2}

(VIN=3.6V, VOUT=5V, TA=+25°C, unless otherwise noted.)

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Input Operation Voltage	V _{IN}	After Start-up	0.75	-	5.5	V
Shutdown Supply Current at IN pin	I _{SHDN}	V _{EN} =GND	-	0.32	-	uA
Quiescent Current	I _Q	V _{EN} =V _{IN} , No load, Not switching	-	1.2	2.0	uA
Input Startup Voltage	V _{startup}	I _{OUT} =1mA, Hysteresis=200mV	-	0.9	-	V
Min Output Voltage	V _{out_min}	V _{IN_MIN} =1V, I _{OUT_MAX} =10mA	-	2.0	-	V
Feedback Voltage	V _{FB}		0.98	1.0	1.02	V
Switching Frequency	f		-	1	-	MHz
NMOS Switch On Resistance	R _{NMOS}	I _{SW} =100mA	-	140	-	mΩ
PMOS Switch On Resistance	R _{NMOS}	I _{SW} =100mA	-	120	-	mΩ
SW Leakage Current	I _{QSW}	V _{OUT} =5.2V, EN=GND, V _{SW} =5.2V or V _{SW} =0V	-	-	3	uA
NMOS Switch Current Limit	I _{SW_LMT}	-	-	3.05	-	A
Start-Up Current Limit	I _{ST_LMT}	-	-	1.6	-	A
Short Circuit Hiccup time	t _{ON}	ON	-	2	-	ms
	t _{OFF}	OFF	-	42	-	ms
Maximum Duty Cycle	η	V _{FB} =0V	95	-	-	%
EN "High" Voltage	V _{EN_H}	V _{OUT} =5V	1.2	-	-	V
EN "Low" Voltage	V _{EN_L}	V _{OUT} =5V	-	-	0.4	V
EN Input Current	I _{EN}	V _{EN} =5V or 0V	-1.0	0	1.0	uA
Thermal Shutdown	T _{SHD}	Rising Hysteresis=25°C	-	150	-	°C

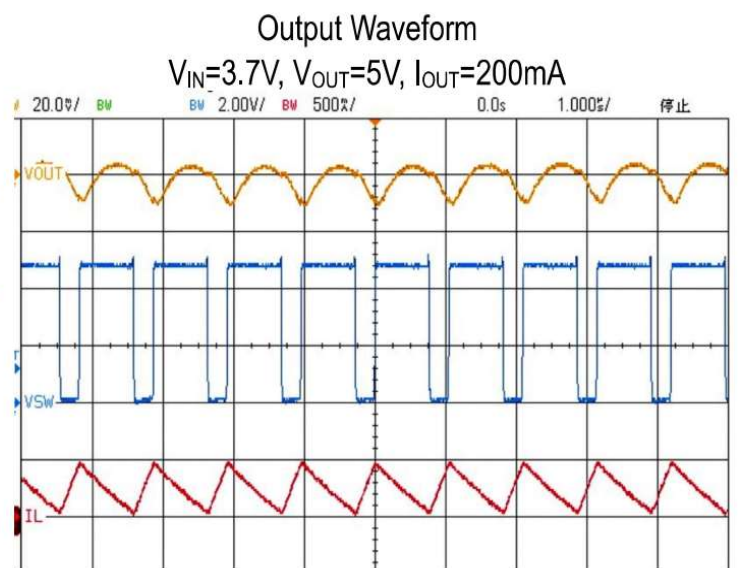
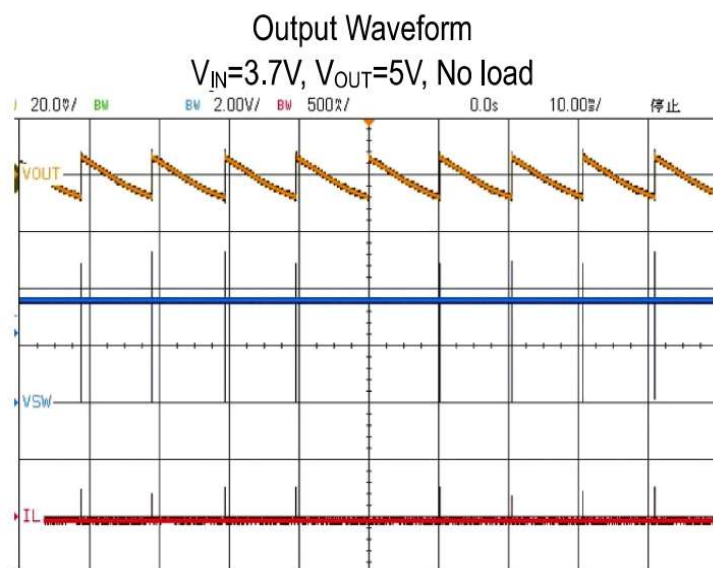
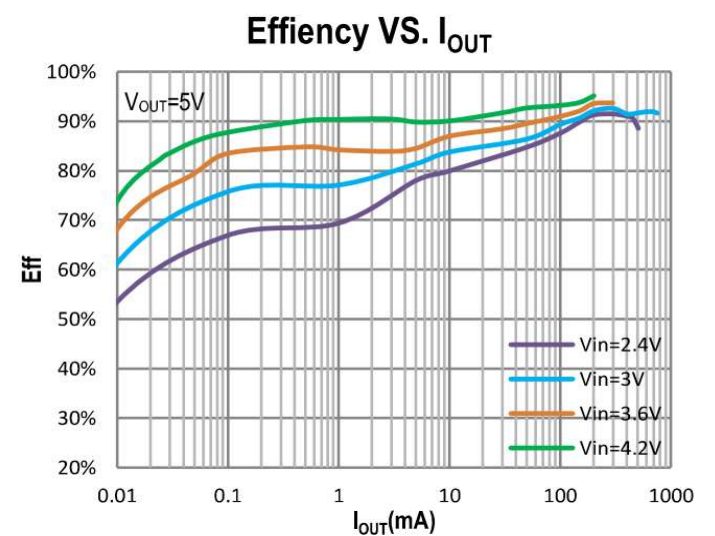
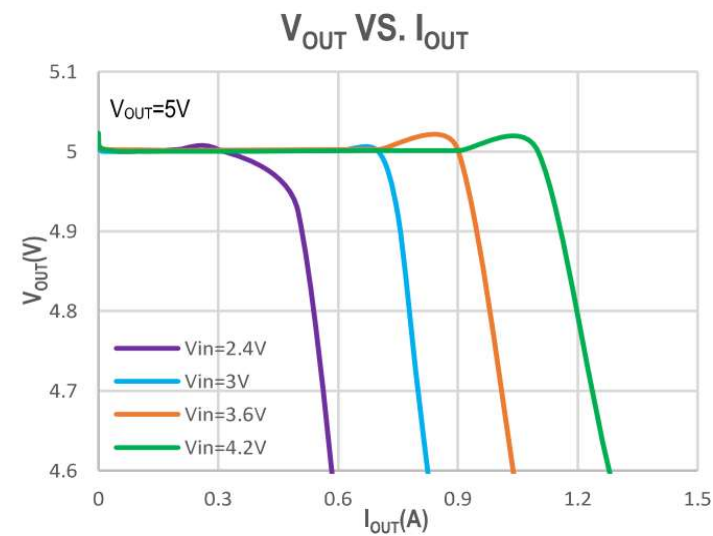
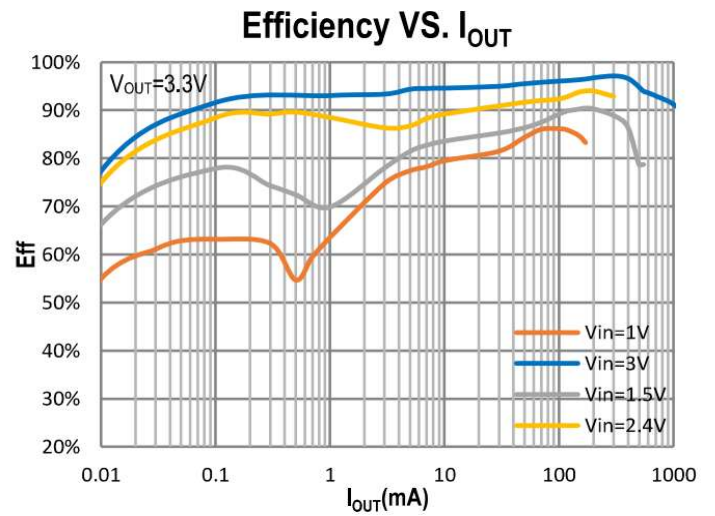
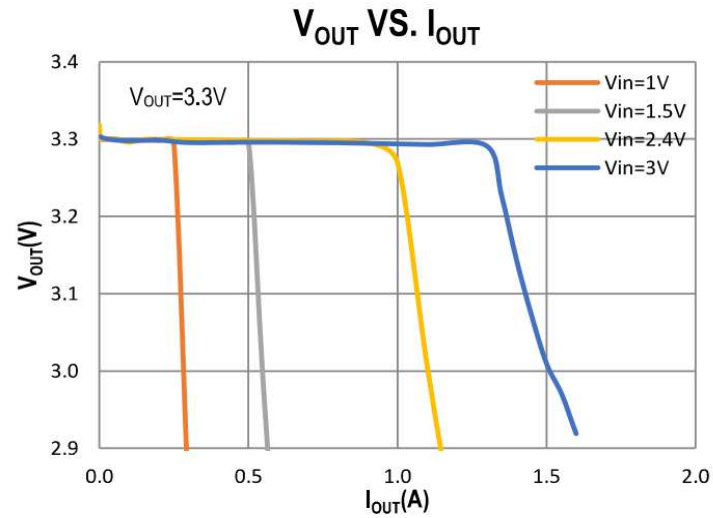
Note 1. Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

2. 100% production test at 25°C. Specifications over the temperature range are guaranteed by design and characterization.

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TYPICAL PERFORMANCE CHARACTERISTICS

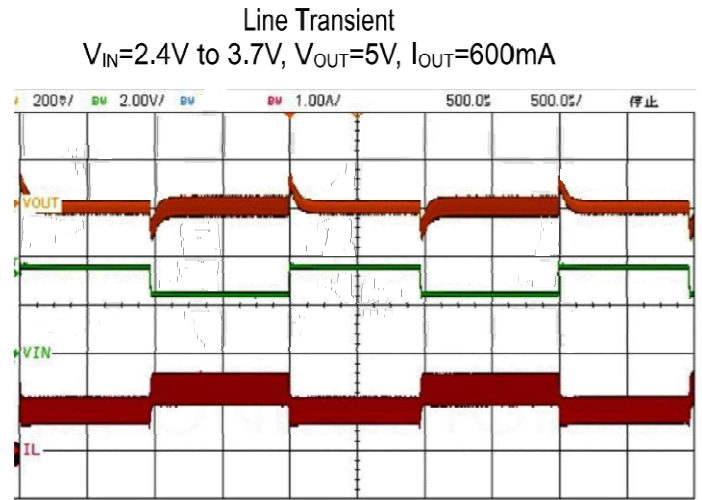
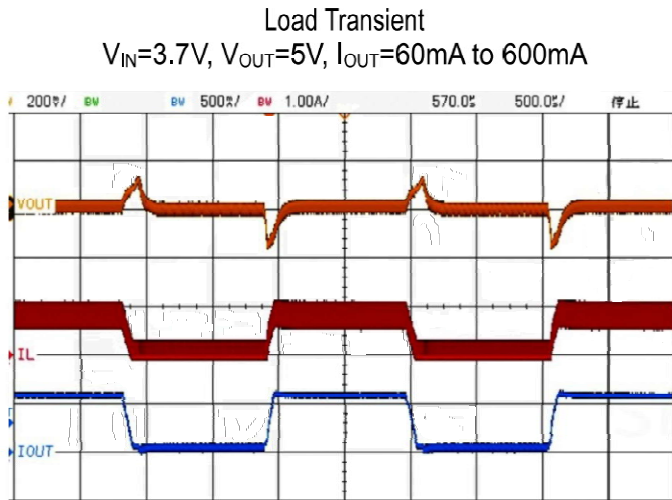
(Typical values are at TA=25°C, unless otherwise noted.)



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TYPICAL PERFORMANCE CHARACTERISTICS(con.)

(Typical values are at TA=25°C, unless otherwise noted.)



Functional Block Diagram

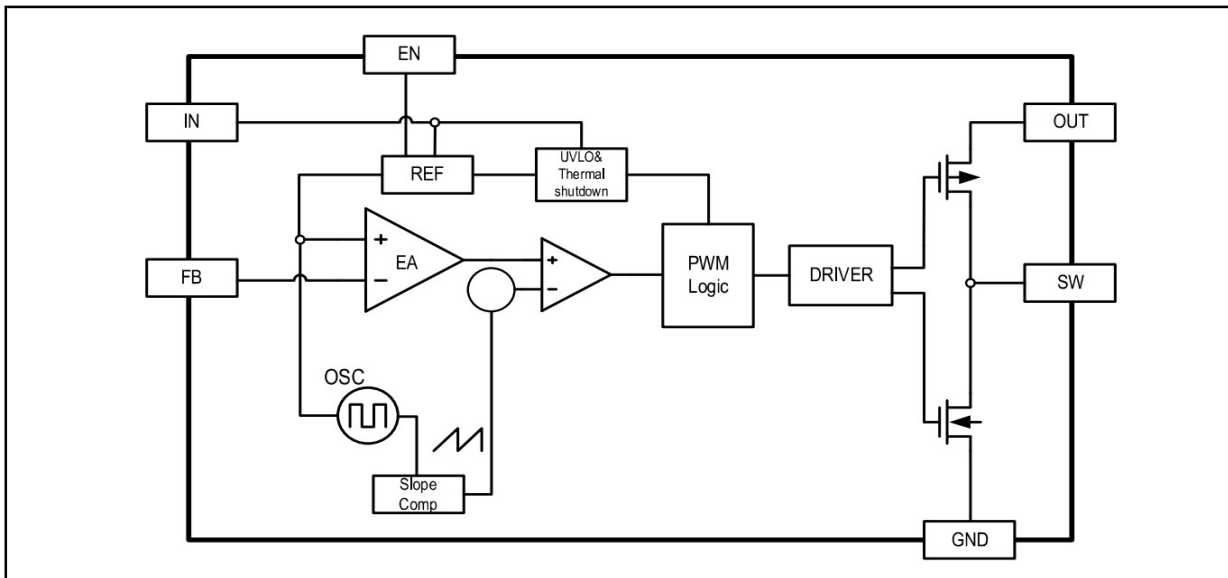


Figure 3. Functional Block Diagram of HCR6602

Typical Application

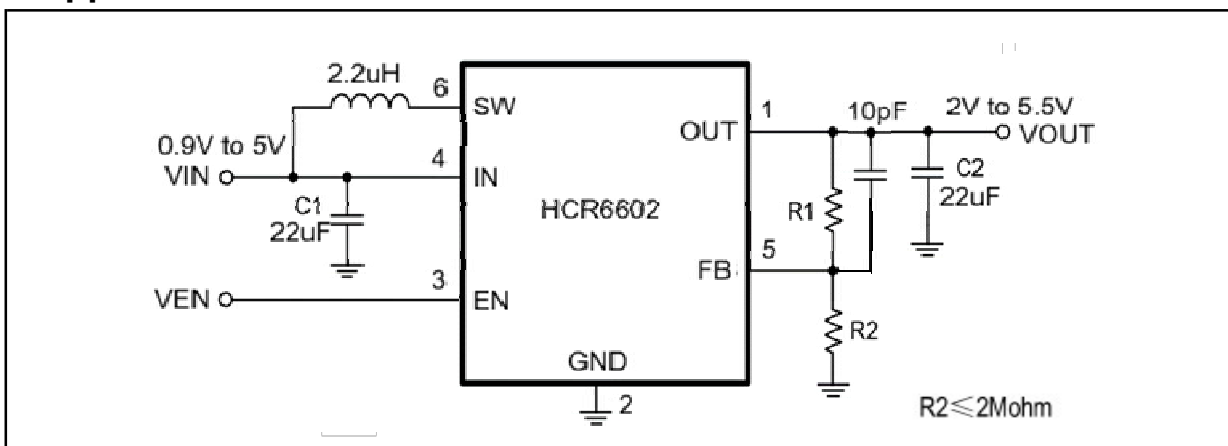


Figure 4. Typical Application Circuit of HCR6602

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APPLICATION INFORMATION

Loop Operation

The HCR6602 is a high efficiency synchronous step-up converter with ultra-low quiescent current down to 1.2μA. It integrates a 140mΩ Low Side Main MOSFET and 120mΩ synchronous MOSFET. It uses a PWM current-mode control scheme. An error amplifier integrates error between the FB signal and the internal reference voltage. The output of the integrator is then compared to the sum of a current-sense signal and the slope compensation ramp. This operation generates a PWM signal that modulates the duty cycle of the power MOSFETs to achieve regulation for output voltage.

The peak current of the NMOS switch is also sensed to limit the maximum current flowing through the switch and the inductor. The typical peak current limit is set to 2.9A. An internal temperature sensor prevents the device from getting overheated in case of excessive power dissipation.

Ultra low current consumption at Light Load Operation.

Traditionally, a fixed constant frequency PWM DC/DC regulator always switches even when the output load is small. When energy is shuffling back and forth through the power MOSFETs, power is lost due to the finite RDSONs of the MOSFETs and parasitic capacitances. At light load, switching loss is prominent and efficiency is therefore very low. HCR6602 employs a proprietary control scheme that improves efficiency in this situation by enabling the device into a power saving mode during light load and the quiescent current can be as low as 1.2μA.

Short-Circuit Protection

Unlike most step-up converters, the HCR6602 allows short circuits on the output. In the event of a short circuit, the device first turns off the NMOS when the sensed current reaches the current limit. When OUT drops below IN, the device then enters a linear charge period with the current limited same as the start-up period. In addition, the thermal shutdown circuits disable switching if the die temperature rises above 150° C.

Adjustable Output Voltage Setting with FB pin

By adding a resistor divider at FB pin, HCR6602 can be set to any voltage level less than 5.5V at output node. The R2 is recommended to be 2MΩ or less, which will add about 0.5uA or more at output. The output voltage is set by following equation:

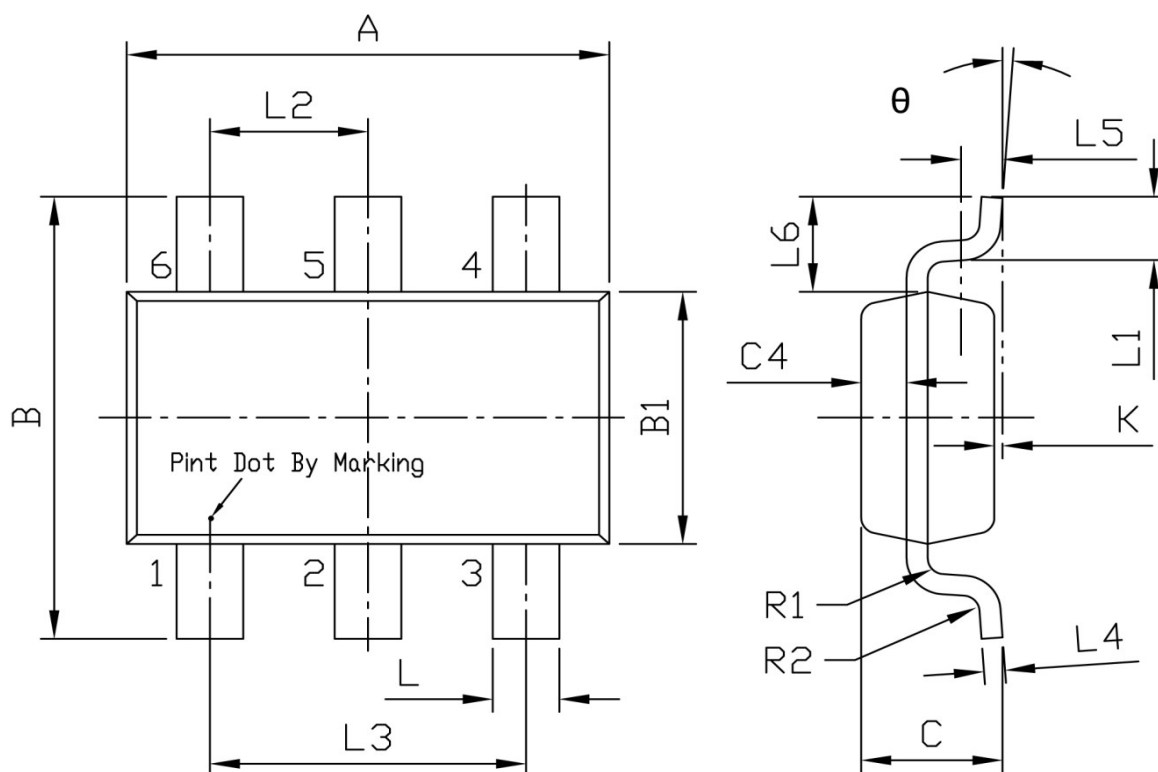
$$V_{OUT} = \frac{R1+R2}{R2} \times 1V$$

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Mechanical Dimensions

PKG: SOT23-6 (M6)

Unit:mm



Unit: mm

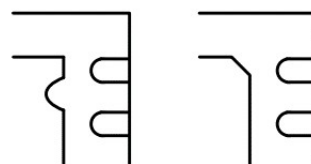
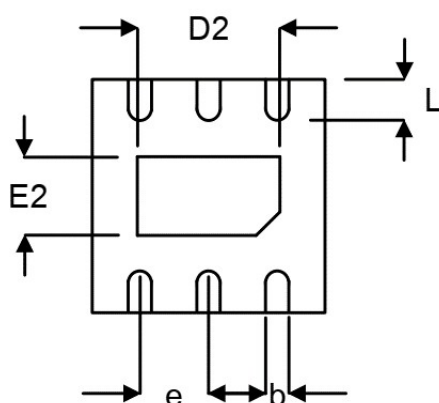
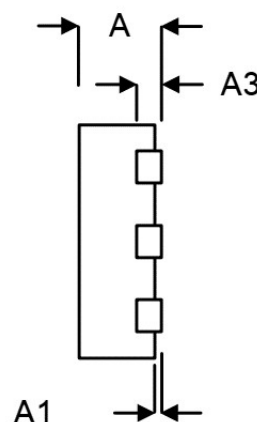
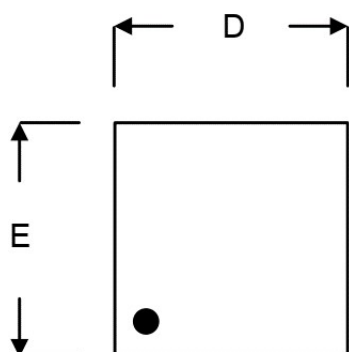
Symbol	Dimensions In Millimeters			Symbol	Dimensions In Millimeters		
	Min	Typ	Max		Min	Typ	Max
A	2.80	2.90	3.00	L3	1.800	1.900	2.000
B	2.60	2.80	3.00	L4	0.077	0.127	0.177
B1	1.50	1.60	1.70	L5	-	0.250	-
C	-	-	1.05	L6	-	0.600	-
C1	0.60	0.80	1.00	θ	0°		0°
C2	0.35	0.40	0.45	θ1	10°	12°	14°
C4	0.223	0.273	0.323	θ2	10°	12°	14°
K	0.000	0.075	0.150	R	-	0.100	-
L	0.325	0.400	0.475	R1	-	0.100	-
L1	0.325	0.450	0.550	R2	-	0.100	-
L2	0.850	0.950	1.050				

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Mechanical Dimensions(con.)

PKG: PDFN-2x2-6L (N26E)

Unit:mm



DETAILA

PIN #1 ID and Tie Bar Mark Options

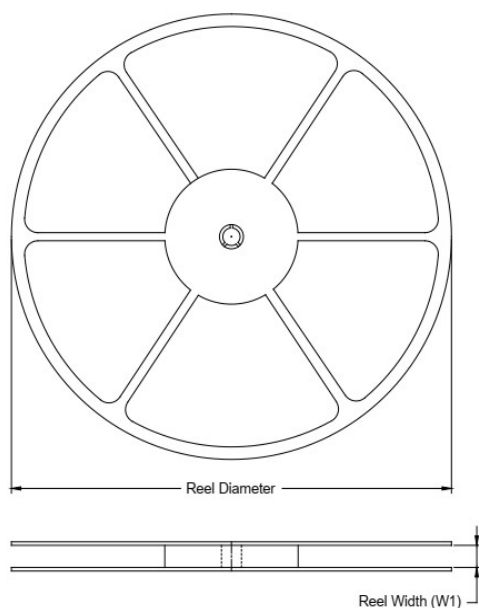
Note : The configuration of the Pin #1 identifier is optional, but must be located within the zone indicated.

Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.175	0.250	0.007	0.010
b	0.200	0.350	0.008	0.014
D	1.950	2.050	0.077	0.081
D2	1.000	1.450	0.039	0.057
E	1.950	2.050	0.077	0.081
E2	0.500	0.850	0.020	0.033
e	0.650		0.026	
L	0.300	0.400	0.012	0.016

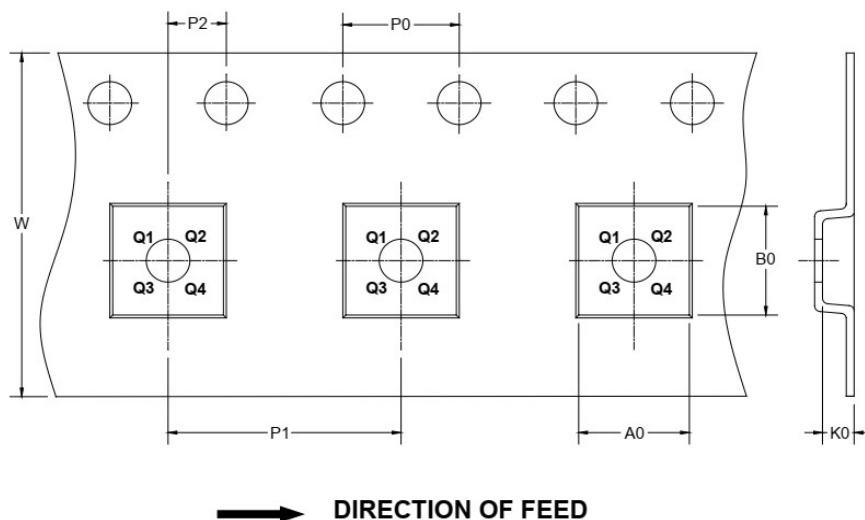
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Tape and Reel Information

REEL DIMENSIONS



TAPE DIMENSIONS



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

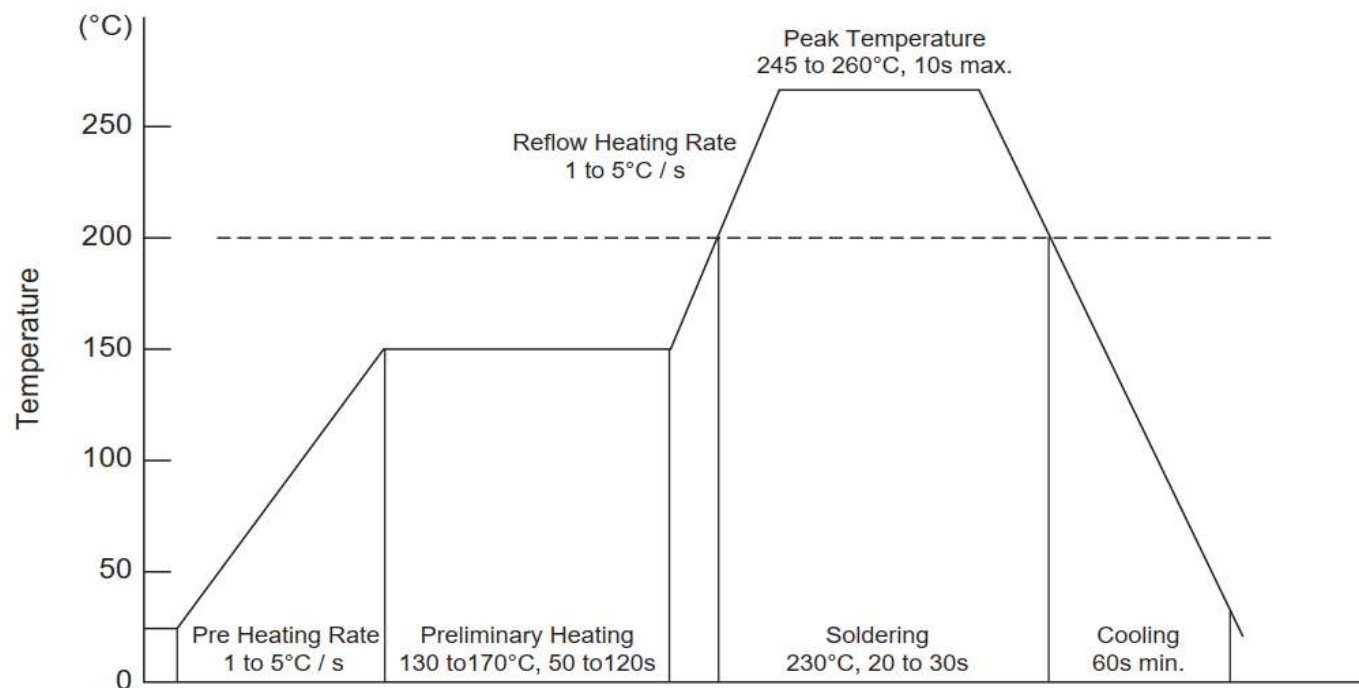
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1	A0	B0	K0	P0	P1	P2	W	Pin1
		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	Quadrant
SOT23-6	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
PDFN-2x2-6L	7"	9.5	2.30	2.30	1.10	4.0	4.0	2.0	8.0	Q1

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Conditions 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