28V High Efficient 1MHz Current Mode Step-Up Converter

Features

* Up to 93% Efficient Boost Converter
* Integrated 80mΩ Power MOSFET
* 2.5V to 7V Input Voltage
* 1MHz Fixed Switching Frequency
* Internal 3A Switch Current Limit
* Adjustable Output Voltage up to 28V
* Internal Compensation
* Automatic Pulse Frequency Modulation Mode at Light Loads
* Available in Green SOT23-6 Package

Applications

* Battery-Powered Equipment
* Set-Top Boxed
* White LED Driver
* DSL and Cable Modems and Routers
* Power Bank

General Description

The HCR6635 is a constant frequency, SOT23-6 current mode step-up converter intended for small, low power applications. The HCR6635 switches at 1MHz and allows the use of tiny, low cost capacitors and inductors 2mm or less in height. Internal soft-start results in small inrush current and extends battery life.

The HCR6635 features automatic shifting to pulse frequency modulation mode at light loads. The HCR6635 includes under-voltage lockout, current limiting, and thermal overload protection to prevent damage in the event of an output overload. The HCR6635 is available in a small SOT23-6 package.

SOT23-6

Figure 1. Package Type of HCR6635

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Pin Configuration

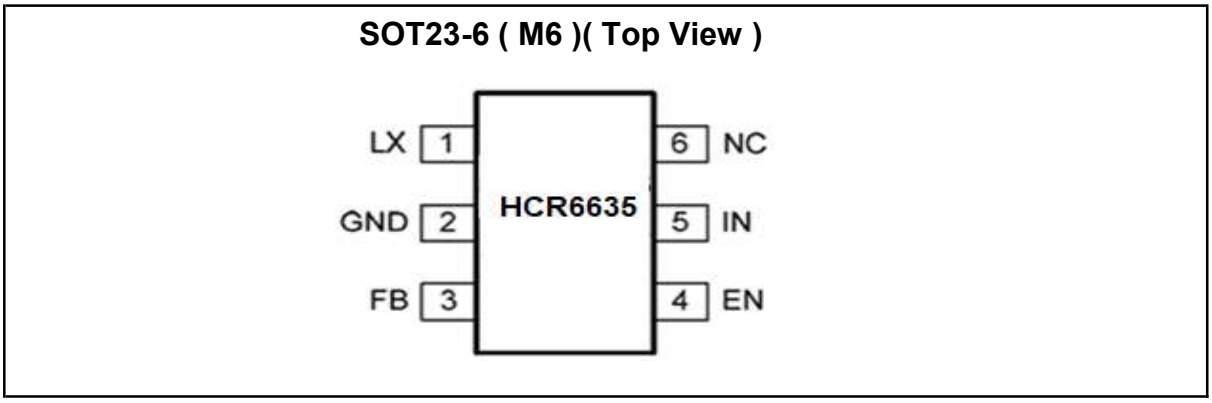
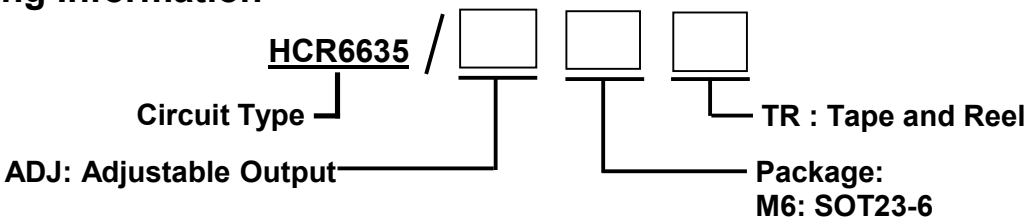


Figure 2. Pin Configuration of HCR6635(Top View)

Pin Function Table

Pin	Pin Name	Function
1	LX	Power Switch Output. LX is the drain of the internal MOSFET switch. Connect the power inductor and output rectifier to LX. LX can swing between GND and 28V.
2	GND	Ground pin
3	FB	Feedback Input. The FB voltage is 0.6V. Connect a resistor divider to FB.
4	EN	Regulator On/off control input. A high input at EN turns on the converter, and a low input turns it off. When not used, connect EN to the input supply for automatic startup.
5	IN	Input Supply Pin. Must be locally bypassed.
6	NC	Not Connection.

Ordering Information



Ordering Code

Part Number	Marking ID noteA	Operating Junction Temperature Range	Package	Quantity per Reel
HCR6635/ADJM6TR	S35BXY	-40'C to +125'C	SOT23-6	3000pcs/TR

note A. X=Year code and Y=week code

Absolute Maximum Ratings Note 1

Parameter	Symbol	Value	Unit
Input Voltage Voltage	V_{IN}	-0.3 to 8	V
LX Voltage	V_{LX}	-0.3 to 30	V
EN Voltage	V_{EN}	-0.3 to 24	V
FB Voltage	V_{FB}	-0.3 to 6	V
Continuous Power Dissipation	P_D	500	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	150	'C/W
Thermal Resistance Junction to Case	$R_{\theta JC}$	68.5	'C/W
Junction Temperature note2	T_J	160	'C
Storage Temperature Range	TSTG	-60 to 150	'C
Lead Temperature (Soldering, 10s)	T_{LEAD}	260	'C
Human Body Model	ESD HBM	2000	V
Machine Mode	ESD MM	200	V

Recommend Operating Conditions note2

Reliable Operating Input Voltage Range	V_{CC}	2.5 to 7	V
Operting Junction Temperature Range	T_J	-40 to +125	'C

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

2: TJ is calculated from the ambient temperature TA and power dissipation PD according to the following formula: TJ = TA + (PD) x (150°C/W).

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Electrical Characteristics note3

(V_{IN}=V_{EN}=5V, Typical values are at TA=+25'C, unless otherwise noted.)

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Operating Input Voltage	V_{IN}	V_{IN} < 0.9V_{OUT}	2.5	-	7	V
Under Voltage Lockout	V_{LKT}		-	2.4	-	V
Under Voltage Lockout Hysteresis	$V_{LKT-Hys}$		-	200	-	mV
Current (Shutdown)	I_{SHDN}	V_{EN}=0V	-	0.1	1.0	uA
Quiescent Current	I_{Q1}	V_{FB}=1.2V, No switch	-	100	350	uA
Switching Frequency	f		-	1	-	MHz
Maximum Duty Cycle	η	V_{FB}=0V	93	-	-	%
EN "High" Voltage	V_{IH}	-	1.5	-	-	V
EN"Low" Voltage	V_{IL}	-	-	-	0.4	V
FB Voltage	V_{FB}		0.588	0.6	0.612	V
FB Input Bias Current	I_{FB}		-50	-10	-	nA
LX On Resistance	R_{LX-RES}	-	-	80	-	mΩ
LX Current Limite	I_{LX}	V_{IN}=5V, Duty cycle=50%	-	3	-	A
LX Leakage	I_{LX-LKG}	V_{LX}=20V	-	-	1	uA
Over Temperature Shutdown	T_{SHD}		-	155	-	'C
Over Temperature Hysteresis	T_{HYS}		-	20	-	'C

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

2. TJ is calculated from the ambient temperature TA and power dissipation PD according to the following TJ=tA+(PD)X(150'C/W)

3. 100% production test at 25°C. Specifications over the temperature range are guaranteed by design and characterization.

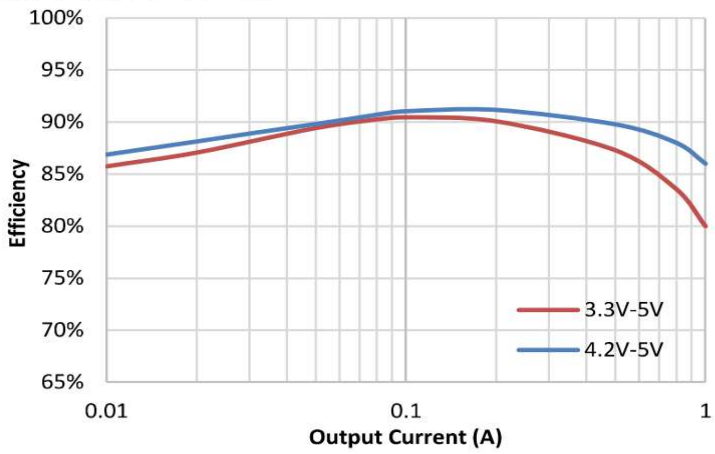
4. Dynamic supply current is higher due to the gate charge being devlivered at the switching frequency

TYPICAL PERFORMANCE CHARACTERISTICS

(VIN=5V, VOUT=12V, CIN=22uF, COUT=22uF, L=10uH, TA=25'C, unless otherwise noted.)

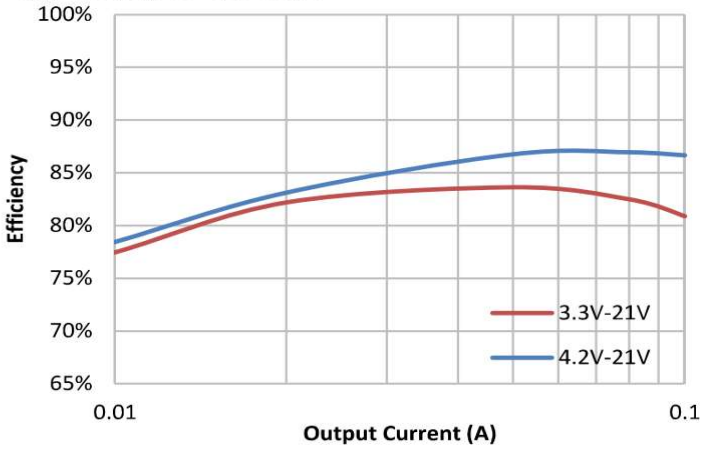
Efficiency

V_{OUT}=5V, T_A=25°C, L=10µH



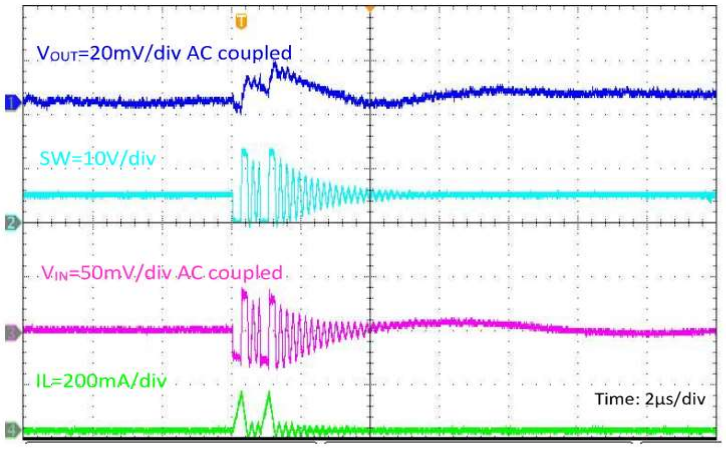
Efficiency

V_{OUT}=21V, T_A=25°C, L=22µH



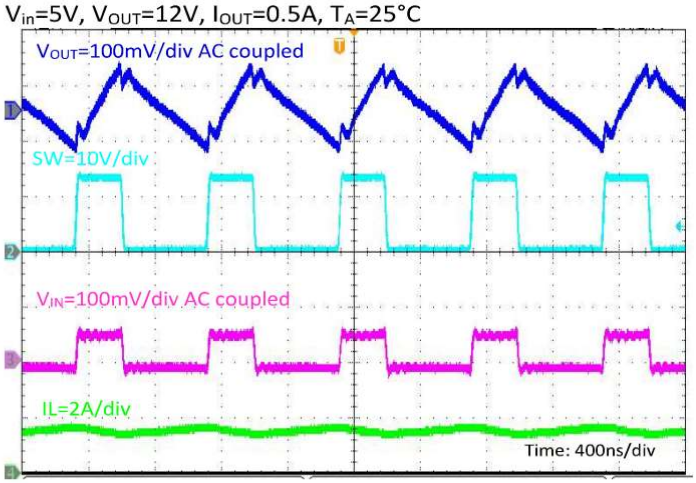
Steady State

V_{in}=5V, V_{OUT}=12V, I_{OUT}=0A, T_A=25°C



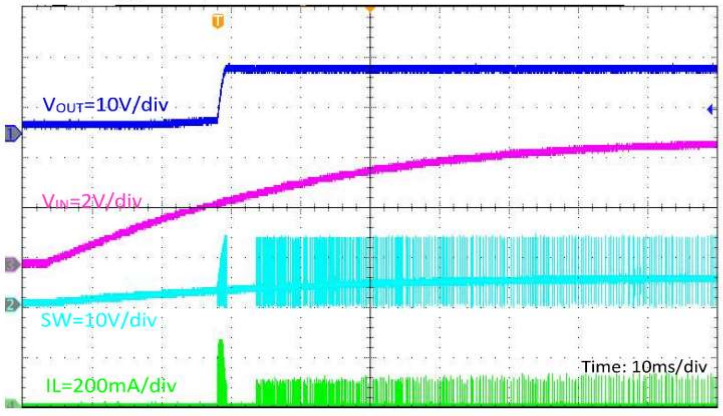
Steady State

V_{in}=5V, V_{OUT}=12V, I_{OUT}=0.5A, T_A=25°C



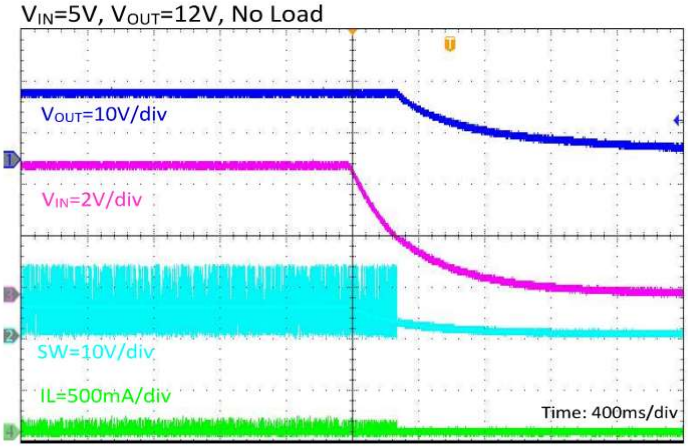
VIN Power On

V_{IN}=5V, V_{OUT}=12V, No load



VIN Power Off

V_{IN}=5V, V_{OUT}=12V, No Load



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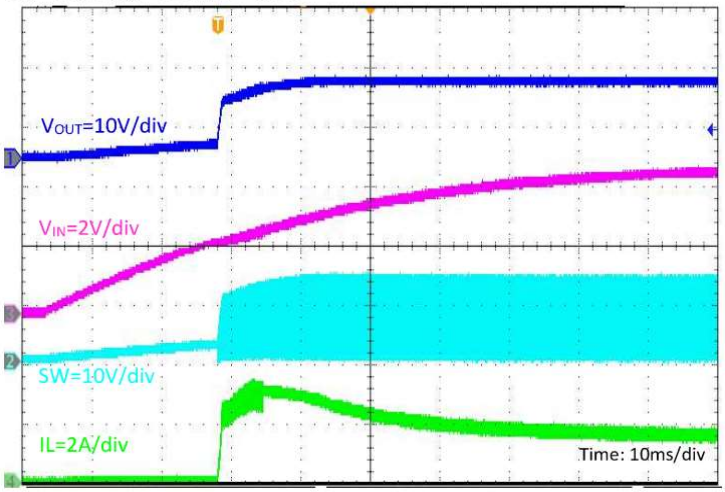
TYPICAL PERFORMANCE CHARACTERISTICS(Con.)

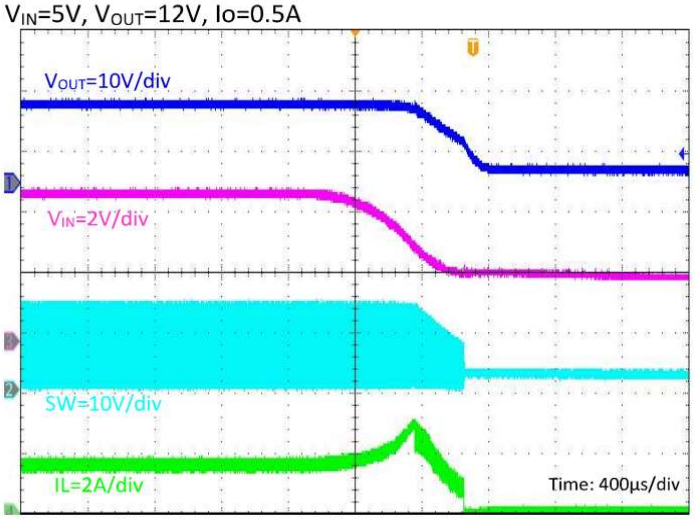
VIN Power On

V_{IN}=5V, V_{OUT}=12V, Io=0.5A



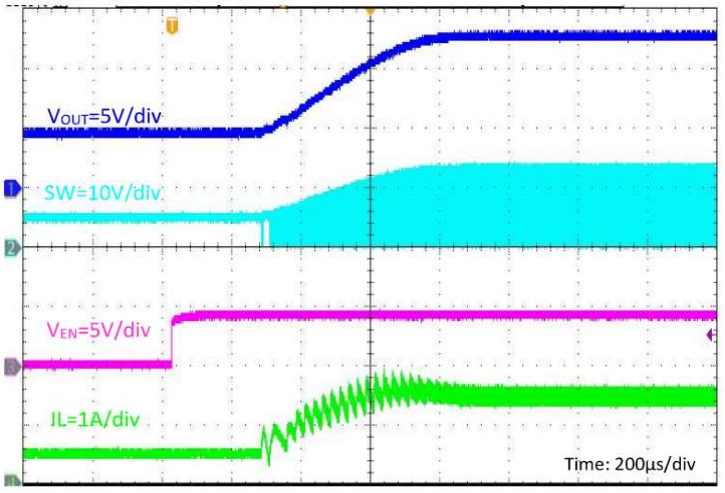
VIN Power Off

V_{IN}=5V, V_{OUT}=12V, Io=0.5A



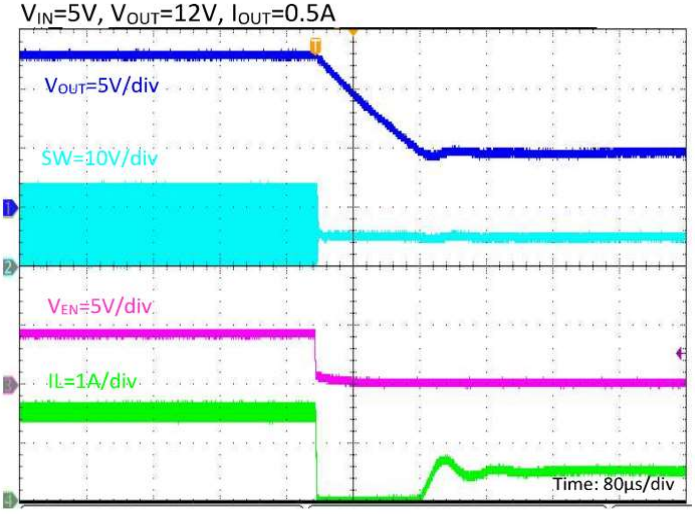
Power On through EN

V_{IN}=5V, V_{OUT}=12V, I_{OUT}=0.5A



Power Off through EN

V_{IN}=5V, V_{OUT}=12V, I_{OUT}=0.5A



Functional Block Diagram

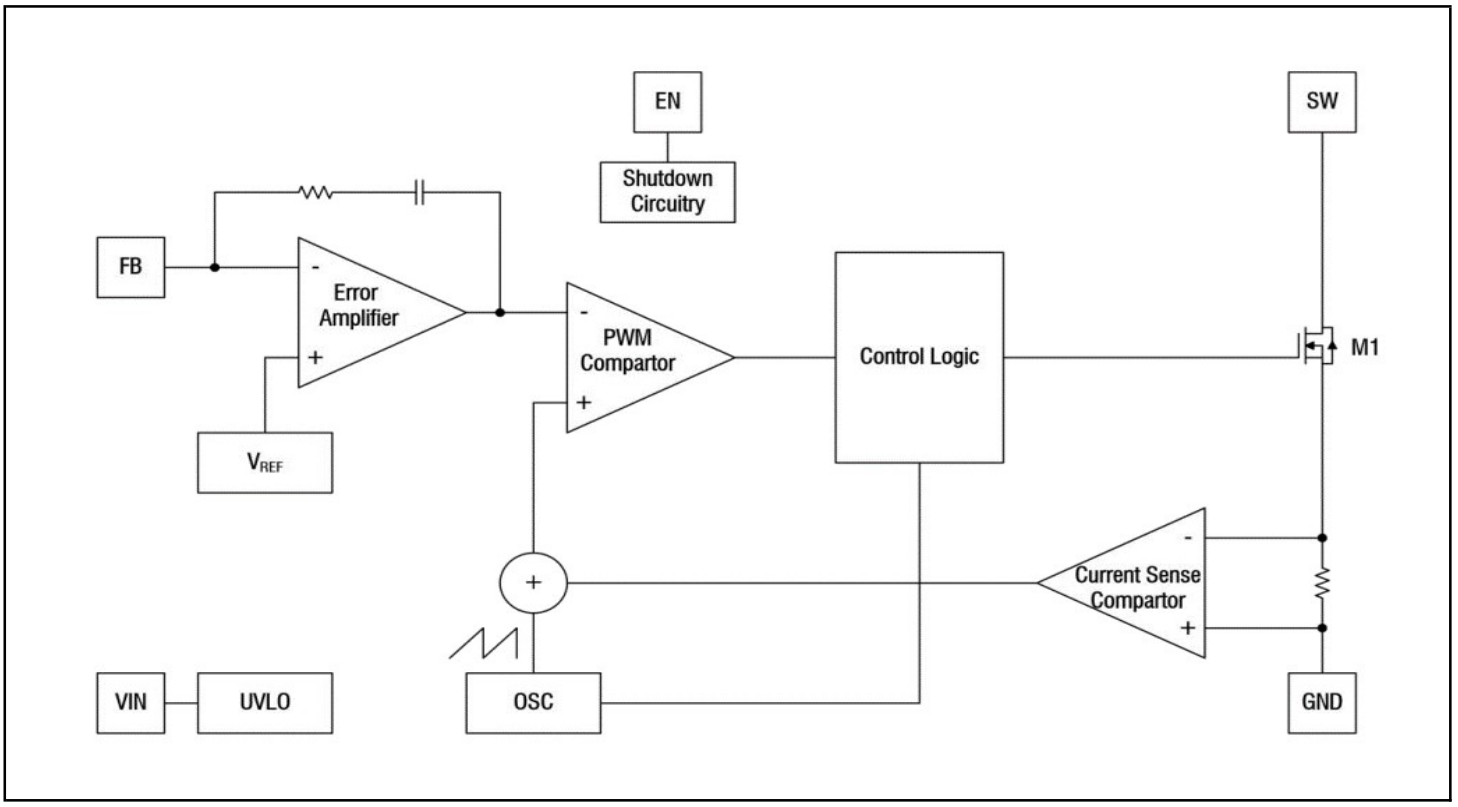


Figure 3. Functional Block Diagram of HCR6635

Typical Application

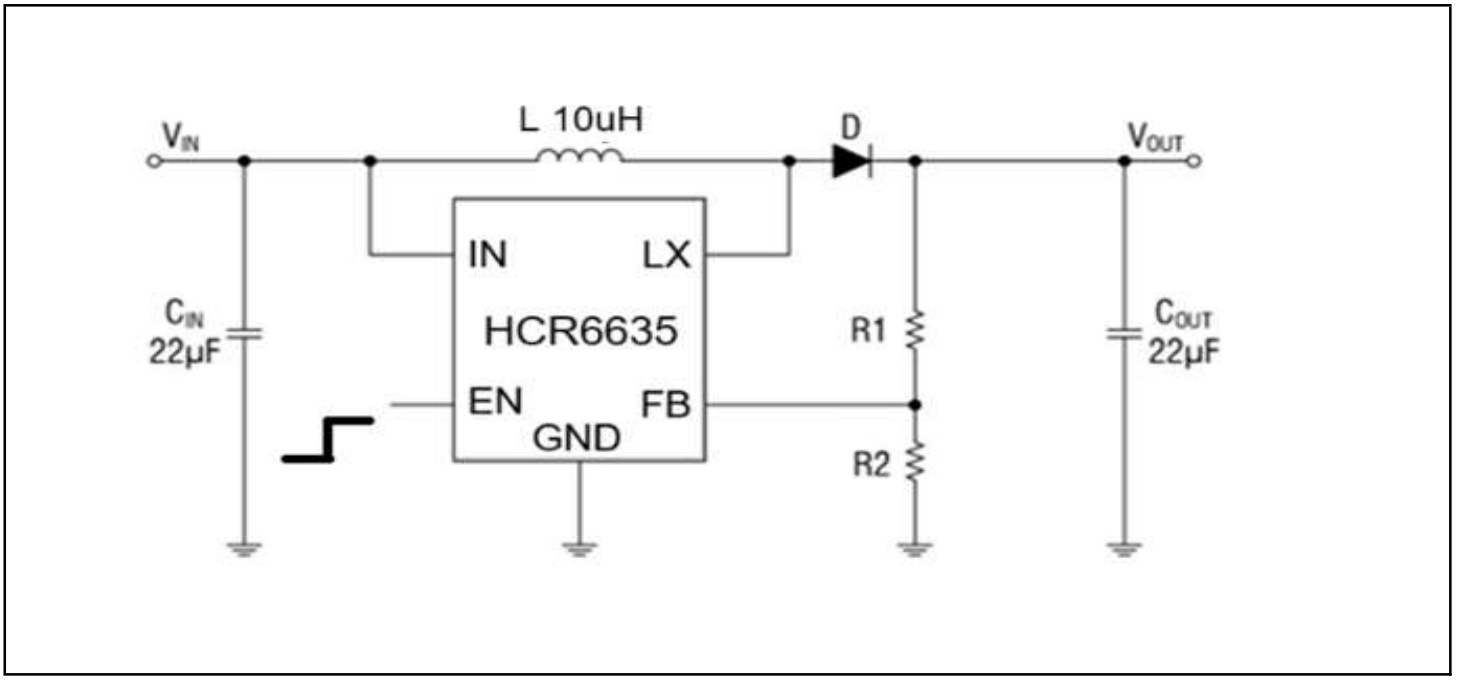


Figure 4. Typical Application Circuit of HCR6635

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Operation

The HCR6635 uses a fixed frequency, peak current mode boost regulator architecture to regulate voltage at the feedback pin. The operation of the HCR6635 can be understood by referring to the block diagram of Figure 3. At the start of each oscillator cycle the MOSFET is turned on through the control circuitry. To prevent sub-harmonic oscillations at duty cycles greater than 50 percent, a stabilizing ramp is added to the output of the current sense amplifier and the result is fed into the negative input of the PWM comparator. When this voltage equals The output voltage of the error amplifier the power MOSFET is turned off. The voltage at the output of the error amplifier is an amplified version of the difference between the 0.6V bandgap reference voltage and the feedback voltage. In this way the peak current level keeps the output in regulation. If the feedback voltage starts to drop, the output of the error amplifier increases. These results in more current to flow through the power MOSFET, thus increasing the power delivered to the output. The HCR6635 has internal soft start to limit the amount of input current at startup and to also limit the amount of overshoot on the output.

Typical Application

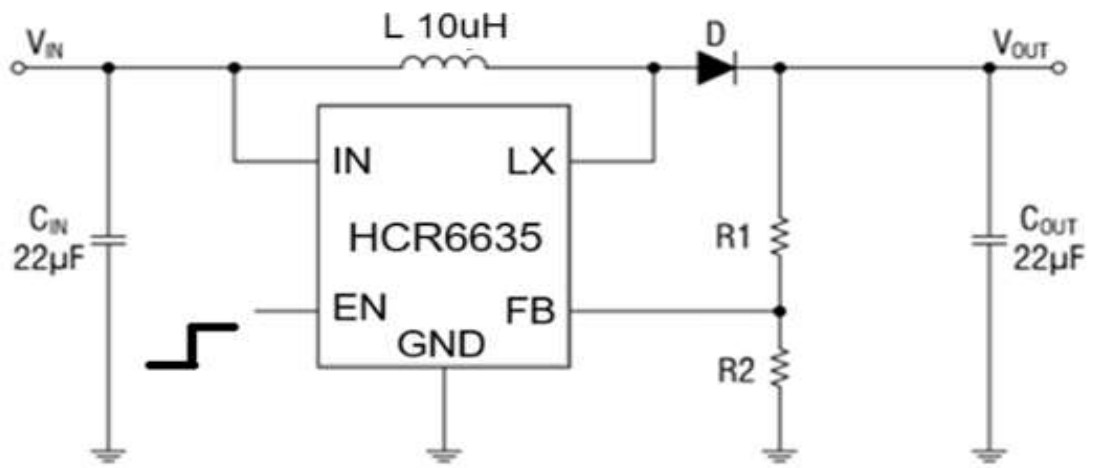

Figure 5. Typical Application Circuit of HCR6635

Application Information

Setting the Output Voltage

The internal reference VREF is 0.6V (Typical). The output voltage is divided by a resistor divider,R1 and R2 to the FB pin. The output voltage is given by

$$V_{OUT}=V_{REF} \times (1+ (R1/R2))$$

Inductor Selection

The recommended values of inductor are 4.7 to 22μH. Small size and better efficiency are the major concerns for portable device, such as HCR6635 used for mobile phone. The inductor should have low core loss at 1MHz and low DCR for better efficiency. To avoid inductor saturation current rating should be considered.

Capacitor Selection

Input and output ceramic capacitors of 22μF are recommended for HCR6635 applications. For better voltage filtering, ceramic capacitors with low ESR are recommended. X5R and X7R types are suitable because of their wider voltage and temperature ranges.

Diode Selection

Schottky diode is a good choice for HCR6635 because of its low forward voltage drop and fast reverses recovery. Using Schottky diode can get better efficiency. The high speed rectification is also a good characteristic of

Diode Selection (con.)

Schottky diode for high switching frequency. Current rating of the diode must meet the root mean square of the peak current and output average current multiplication as following

$$I_D(RMS) \approx \sqrt{I_{OUT} \times I_{PEAK}}$$

The diode' s reverse breakdown voltage should be larger than the output voltage.

Layout Consideration

For best performance of the HCR6635, the following guidelines must be strictly followed.

a>. Input and Output capacitors should be placed close to the IC and connected to ground plane to reduce noise coupling.

b>. The GND should be connected to a strong ground plane for heat sinking and noise protection.

c>. Keep the main current traces as possible as short and wide.

d>. LX node of DC-DC converter is with high frequency voltage swing. It should be kept at a small area.

e>.Place the feedback components as close as possible to the IC and keep away from the noisy devices.

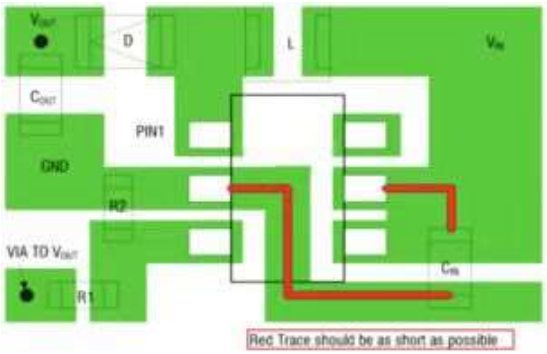

Figure 6. HCR6635 Suggested Layout

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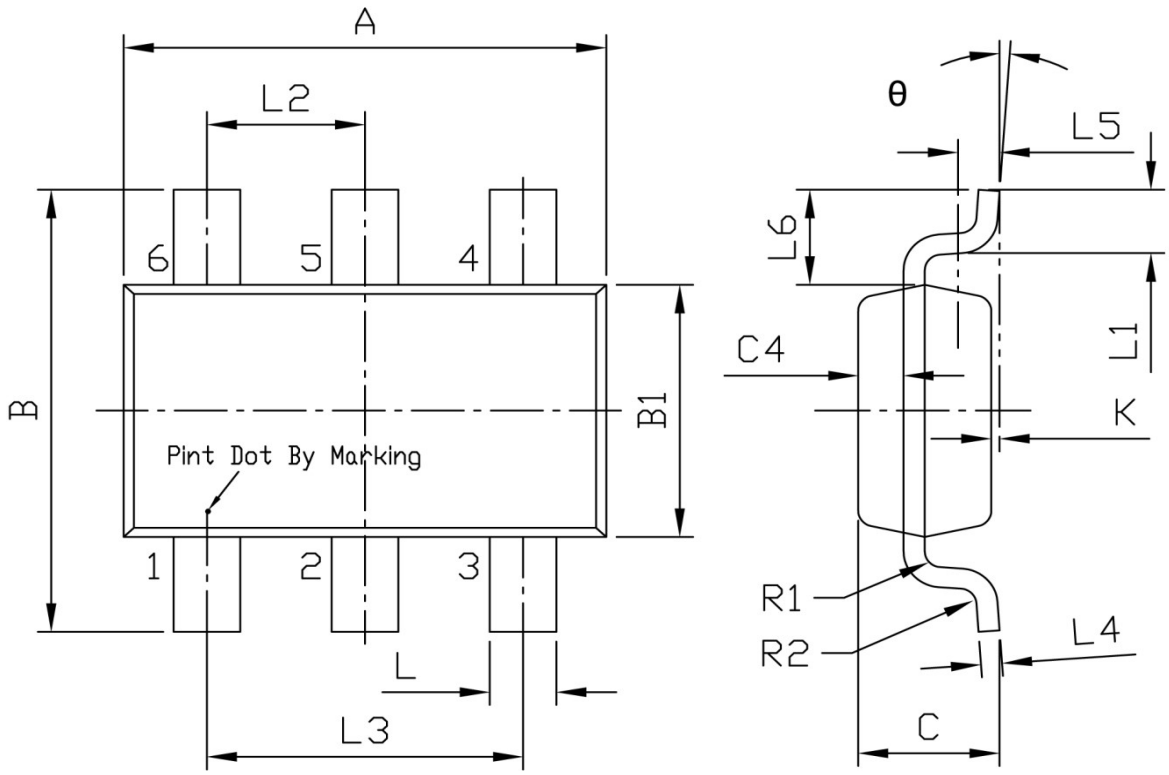
Mechanical Dimensions

PKG: SOT23-6 (M6)

Unit:mm

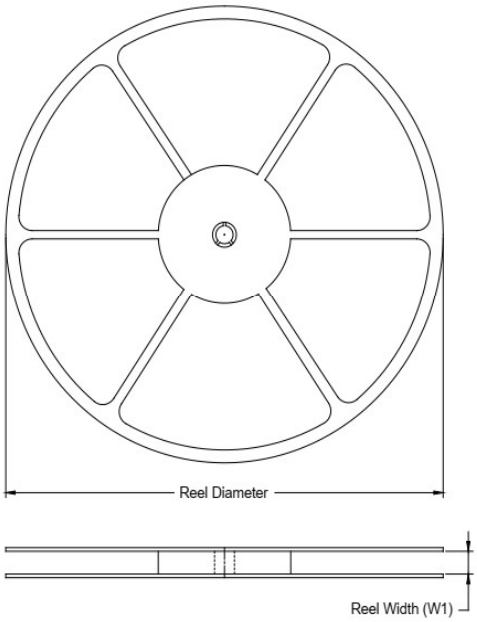


Unit: mm

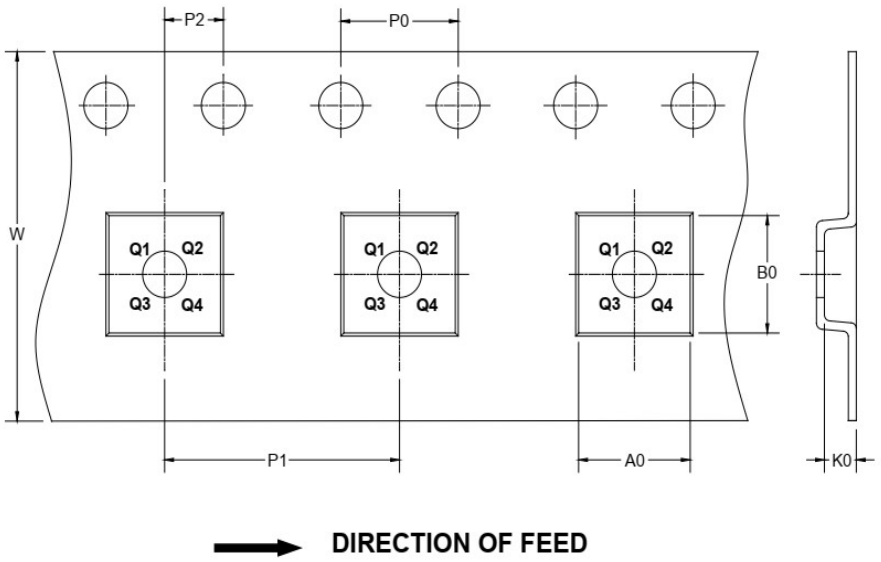
Symbol	Dimensions In Millimeters			Symbol	Dimensions In Millimeters		
	Min	Typ	Max		Min	Typ	Max
A	2.80	2.90	3.00	L3	1.800	1.900	2.000
B	2.60	2.80	3.00	L4	0.077	0.127	0.177
B1	1.50	1.60	1.70	L5	-	0.250	-
C	-	-	1.05	L6	-	0.600	-
C1	0.60	0.80	1.00	θ	0°		0°
C2	0.35	0.40	0.45	θ1	10°	12°	14°
C4	0.223	0.273	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				

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS

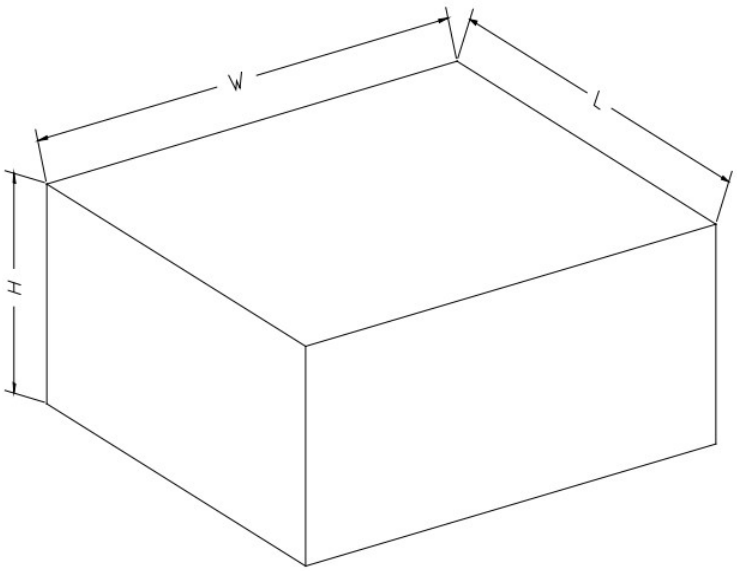


NOTE: The picture is only for reference. Please make the object as the standard.

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
SOT23-6	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3

CARTON BOX DIMENSIONS



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

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7″	442	410	224	18