1.5MHz, 7V, 1.3A with 2uA Ultra Low Iq Synchronous Step-Down Converter

Features

- Input voltage range from 2.6V to 7V
- Up to 1.3A Output Current
- 1.5MHz Switching Frequency
- High Efficiency: Up to 96%
- No Schottky Diode Required
- Low Dropout Operation:100% Duty Cycle
- Ultra-low Quiescent Current: 2uA typical
- PFM Mode for High Efficiency in Light Load
- Slope Compensated Current Mode Control for Excellent Line and Load Transient Response
- Short Circuit Protection
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- <1uA Shutdown Current
- Available in a Green SOT-23-5 package

General Description

The HCR3101A is a constant frequency, current mode step-down converter. The device integrates a main switch and a synchronous rectifier for high efficiency without an external Schottky diode. It is ideal for powering portable equipment that runs from a single cell Lithium-Ion (Li+) battery. The output voltage can be regulated as low as 1.13V. This device offers two operation modes, PWM control and PFM Mode switching control, which allows a high efficiency over the wider range of the load.

The HCR3101A is available in a Green SOT-23-5 package and is available in an adjustable version.

Applications

- Battery-Powered Devices
- IoT Modules
- Wearable Device
- Energy Harvest

SOT-23-5

Figure 1. Package Type of HCR3101A

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Pin Configuration

SOT23-5 (Top View)

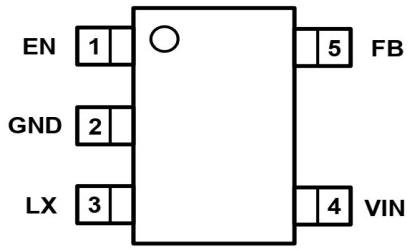
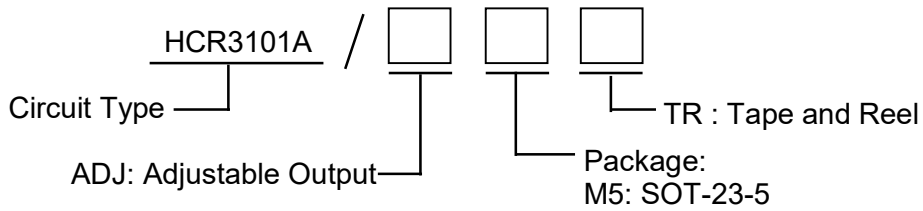


Figure 2. Pin Configuration of HCR3101A (Top View)

Pin Function Table

Pins HCR3101A	Name	Function
1	EN	Chip Enable Pin. Drive EN above 1.5V to turn on the part. Drive EN below 0.3V to turn it off. Do not leave EN floating.
2	GND	Analog ground pin
3	LX	Power Switch Output. It is the switch node connection to Inductor. This pin connects to the drains of the internal P-ch and N-ch MOSFET switches.
4	VIN	Power Supply Input.Must be closely decoupled to GND with a 10μF or greater ceramic capacitor.
5	FB	Output Voltage Feedback Pin. An internal resistive divider divides the output voltage down for comparison to the internal reference voltage

Ordering Information



Ordering Code

Part Number	Marking ID note2	Temperature Range	Package	Quantity per Reel
HCR3101A/ADJM5TR	A01xyz	-40'C to +85'C	SOT-23-5	3000pcs,Tape&Reel

Note 2: "A01" is device code, "x" is Version, and "y"is year code, and "z" is week code

Absolute Maximum Ratings Note 1

Parameter	Symbol	Value	Unit
Input Supply Voltage Range	V_{IN}	-0.3 to +7.0	V
LX Voltage Range	V_{LX}	-0.3 to (V_{IN}+0.3)	V
EN Voltage Range	V_{EN}	-0.3 to (VIN+0.3)	V
FB Voltage Range	V_{FB}	-0.3 to (VIN+0.3)	V
Adjustable Output Voltage Range	V_{OUT}	0.9 to 5.5	V
Power Dissipation	P_D	450	mW
Thermal Resistance Junction to Ambient note3	$R_{\theta JA}$	250	'C/W
Thermal Resistance Junction to Case note3	$R_{\theta JC}$	130	'C/W
Storage Temperature Range	T_{STG}	-65 to 150	'C
Operating Junction Temperature note2	T_J	-40 to +150	'C
Lead Temperature (Soldering, 10s)	T_{LEAD}	300	'C
Human Body Model for all pins	V_{ESD_HBM}	2	KV
Charge Device Model for all pins	V_{ESD_CDM}	200	V

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 (250°C/W)

3. Measured on JESD51-7, 4-layer PCB.

Recommended Operating Conditions

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Input Voltage Range	V_{IN}		2.6	-	7	V
Operating Temperature Range	T_A		-40	-	+85	'C

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Electrical Characteristics note3

(VIN=VEN=5V,TA = 25°C, unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Input Voltage Range	VIN	-	2.6	-	7	V
Input OVP Threshold	VOVP	VIN rising	-	7	-	V
Input OVP Hysteresis	VOVP_HYS	VIN falling	-	0.3	-	V
UVLO Threshold	VUVLO		-	2.37	-	V
UVLO Hysteresis	VUVLO-HYS		-	0.28	-	V
Quiescent Current	IQ	No load, RFB_G=1MΩ	-	2	-	uA
Input Shutdown Current	ISHDN		-	0.1	-	uA
Regulated Feedback Voltage	VFB	TA=25'C	1.107	1.130	1.153	V
Output Voltage Load Regulation	ΔOVLR	TA=25'C	-	0.4	-	%/A
Reference Voltage Line Regulation	ΔRVLR	VIN=2.7V to 5.5V	-	0.1	-	%/V
On Resistance of PMOS	RDS(ON)1	ILX=100mA	-	200	'-	mΩ
On Resistance of NMOS	RDS(ON)2	ILX= -100mA	-	300	-	mΩ
Peak Current Limit in normal operation	IPCT		1.5	1.8	-	A
Peak Current Limit in Hiccp mode	IPCH		1.4	1.6	-	A
Oscillation Frequency	FOSC	VFB=100%xVREF	-	1.5	-	MHz
EN High-Level Input Voltage	VEN-H		1.5	-	-	V
EN Low-Level Input Voltage	VEN-L		-	-	0.4	V
EN Leakage Current	IEN_LC		-	0.1	0.3	uA
LX Leakage Current	ILX_LC	VEN=0V, VIN=VLX=5V	-	0.1	0.5	uA
Thermal Shutdown Threshold note4	TSHDN		-	155	-	'C
Thermal Shutdown Hysteresis	THYTS		-	20	-	'C

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

4. Thermal shutdown threshold and hysteresis are guaranteed by design.

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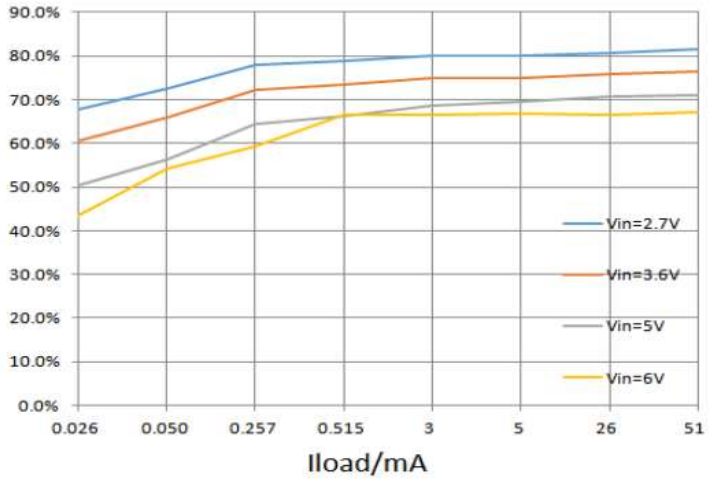
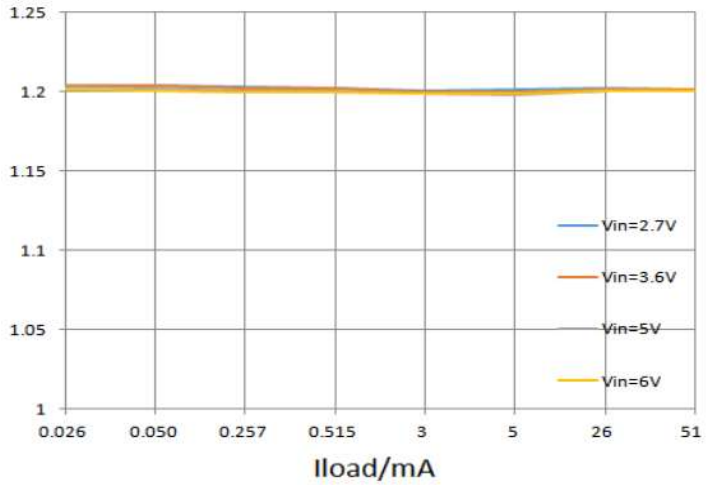
Typical Performance Characterstics

VIN=VEN=5V, VOUT=1.2V

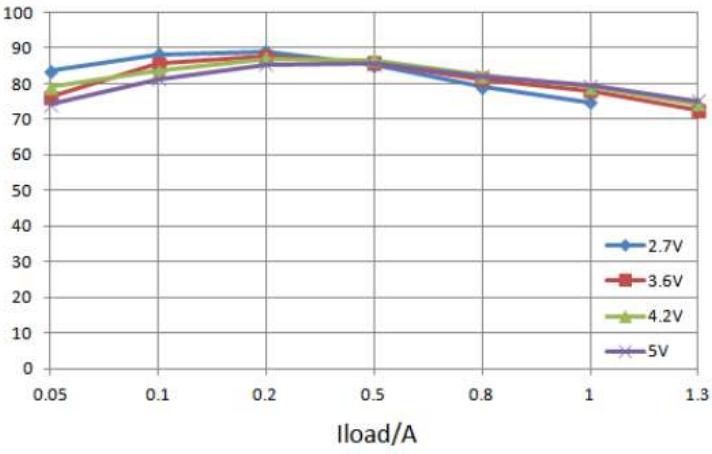
Efficency vs Iload



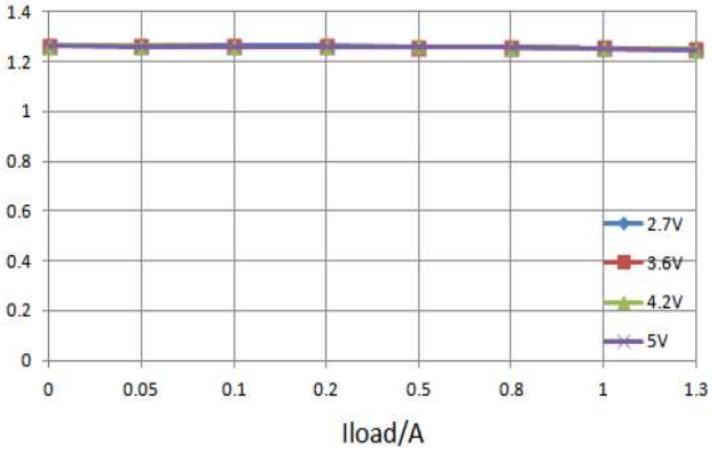
Vout vs Iload



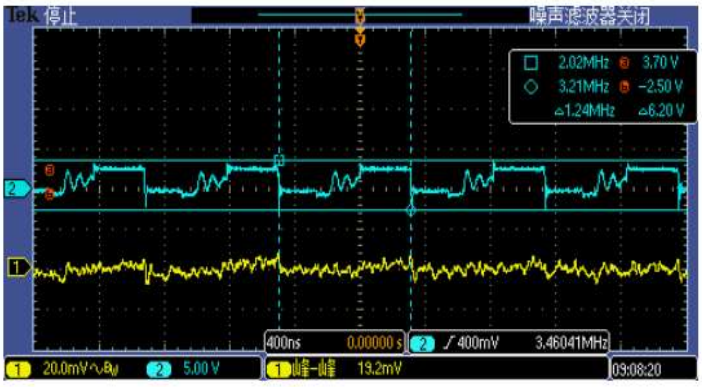
Efficency vs Iload



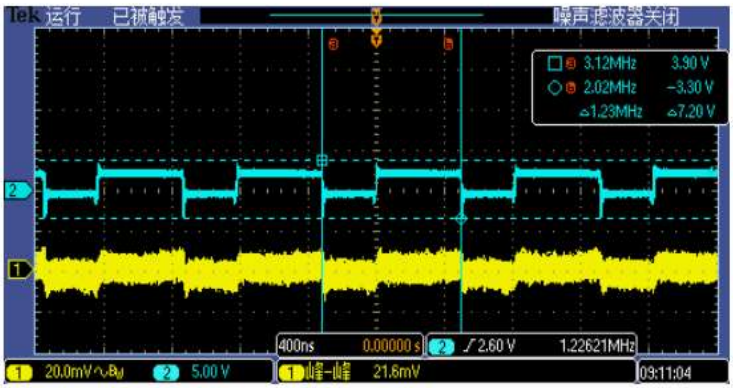
VOUT vs Iload



Vin=2.7V,Load=0.1A



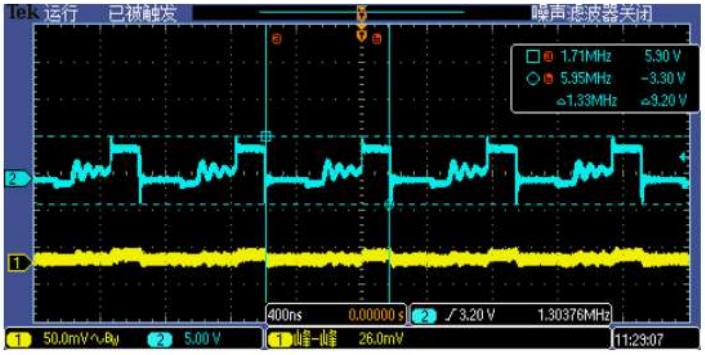
Vin=2.7V,Load=1A



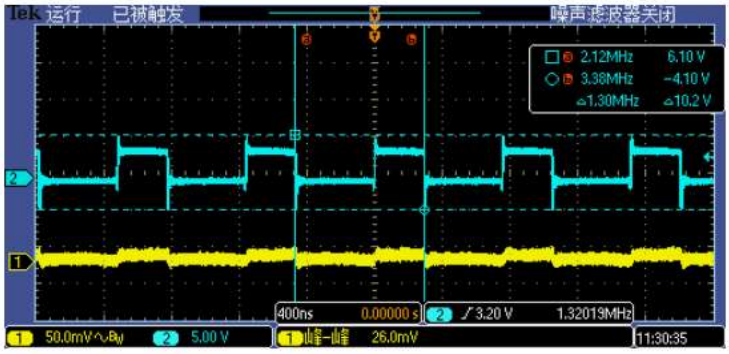
Typical Performance Characterstics(Con.)

VIN=VEN=5V, VOUT=1.2V

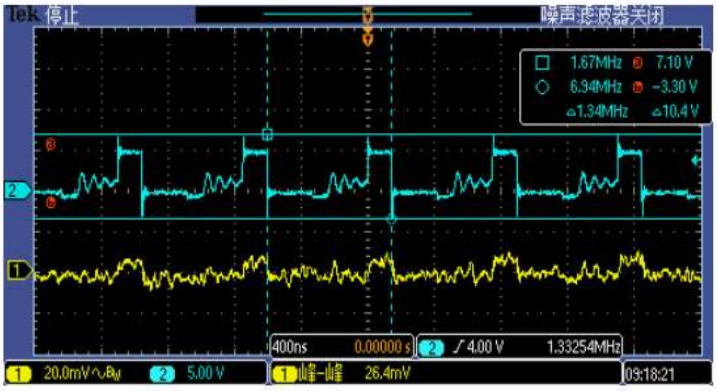
Vin=4.2V,Load=0.1A



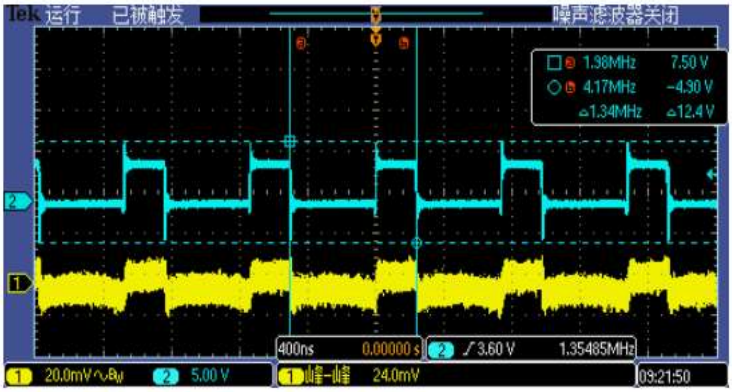
Vin=4.2V,Load=1.3A



Vin=5V,Load=0.1A



Vin=5V,Load=1.3A



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Functional Block Diagram

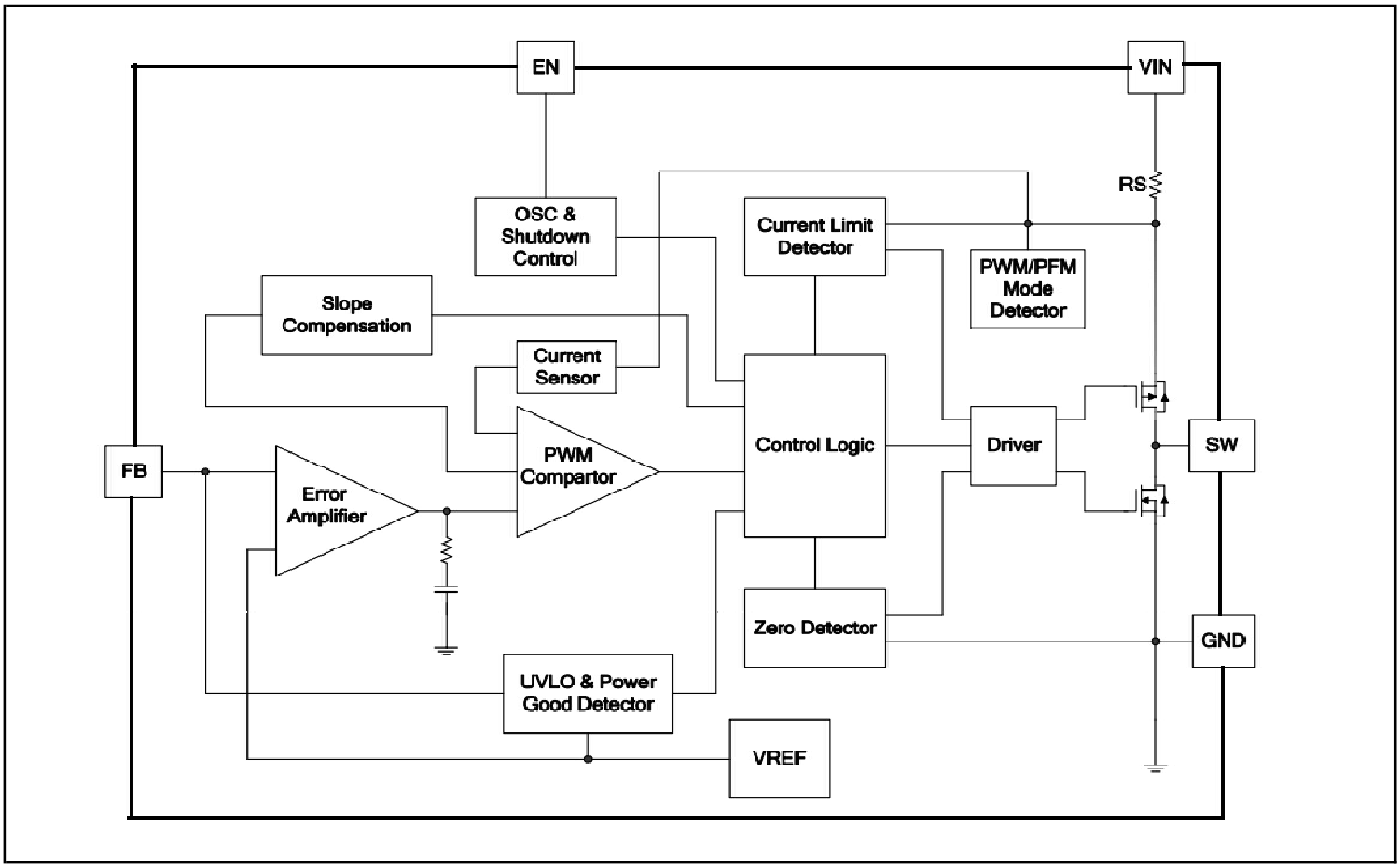


Figure 3. Functional Block Diagram of HCR3101A

Typical Application

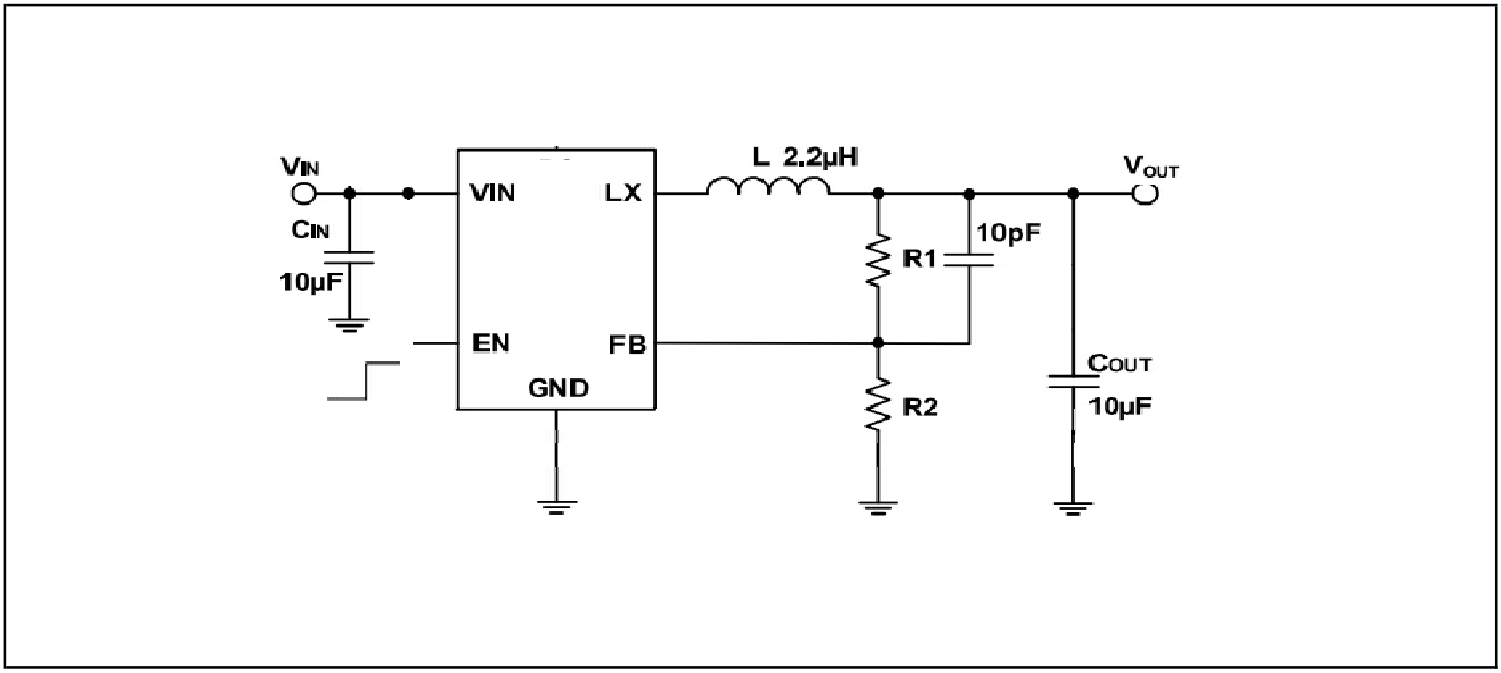


Figure 4. Basic Application Circuit

Function Description

The HCR3101A is a high performance, 1.3A, 1.5MHz monolithic step-down converter. HCR3101A requires only three external power components(CIN, COUT and L), The adjustable version can be programmed with external feedback to any voltage, ranging from 1.13V to the input voltage. At dropout operation, the converter duty cycle increases to 100% and the output voltage tracks the input voltage minus the RDS(ON) drop of the high-side MOSFET.

The internal error amplifier and compensation provides excellent transient response, load, and line regulation. Soft start function prevents input inrush current and output overshoot during start up.

Applications Information

Setting the Output Voltage

The internal reference VREF is 1.13V (Typical). The output voltage is divided by a resistor, R1 and R2 to the FB pin. The output voltage is given by:

VOUT=1.13V x (1+R1/R2)

Inductor Selection

For most designs, the HCR3101A operates with inductors of 1μH to 4.7μH. Low inductance values are physically smaller but require faster switching, which results in some efficiency loss. The inductor value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where ΔIL is inductor Ripple Current. Large value inductors result in lower ripple current and small value inductors result in high ripple current. For optimum voltage-positioning load transients, choose an inductor with DC series resistance in the 50mΩ to 150mΩ range.

Input Capacitor Selection

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency should be less than input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS

Input Capacitor Selection(con.)

current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. A 10uF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering

Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current ratings. The output ripple ΔVOUT is determined by:

$$\Delta V_{OUT} \le \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left(ESR + \frac{1}{8 \times f_{OSC} \times C_{OUT}} \right)$$

A 10μF ceramic can satisfy most applications.

PCB Layout Recommendations

When laying out the printed circuit board, the following checking should be used to ensure proper operation of The HCR3101A Check the following in your layout:

- The power traces, consisting of the GND trace, the SW trace and the VIN trace should be kept short, direct and wide

Applications Information(Con.)

PCB Layout Recommendations(con.)

- Does the (+) plates of CIN connect to VIN as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.
- Keep the switching node, SW, away from the sensitive VOUT node
- Keep the (-) plates of CIN and COUT as close as possible

Suggested Layout

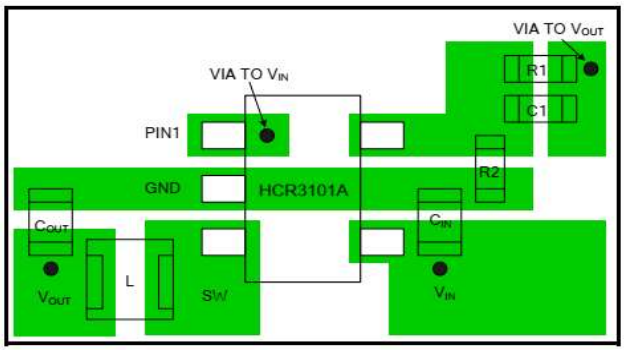
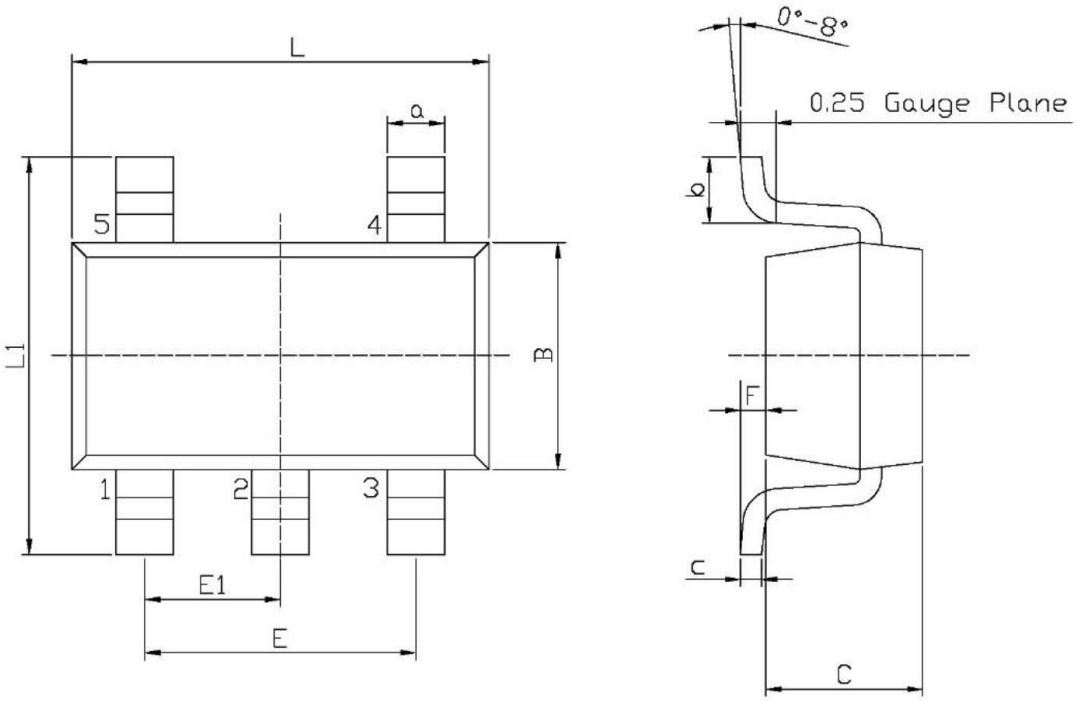


Figure 5. HCR3101A Suggested Layout

Mechanical Dimensions

M5 PKG: SOT-23-5

unit: mm



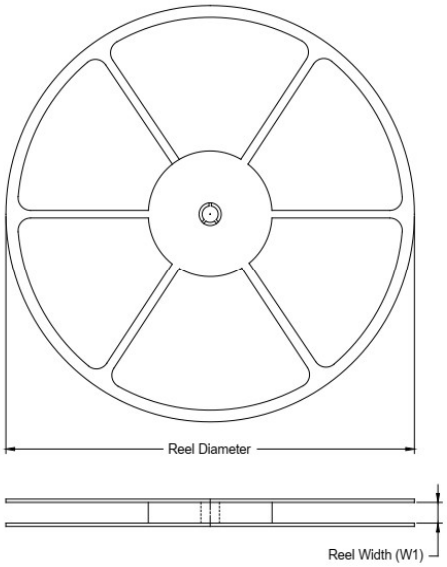
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
L	2.82	3.02	E1	0.85	1.05
B	1.50	1.70	a	0.35	0.50
C	0.90	1.30	c	0.10	0.20
L1	2.60	3.00	b	0.35	0.55
E	1.80	2.00	F	0	0.15

Note:

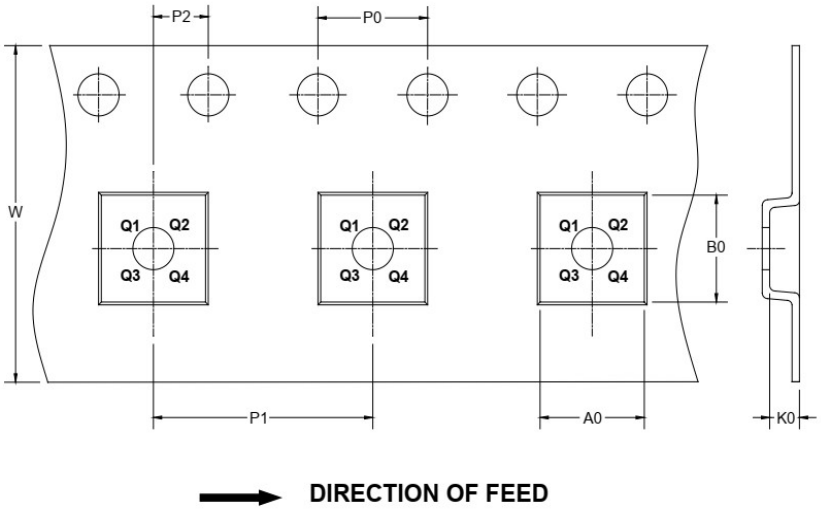
1) All dimensions are in millimeters.
2) Package length does not include mold flash, protrusion or gate burr.
3) Package width does not include interlead flash or protrusion.
4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
5) Pin 1 is lower left pin when reading top mark from left to right.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



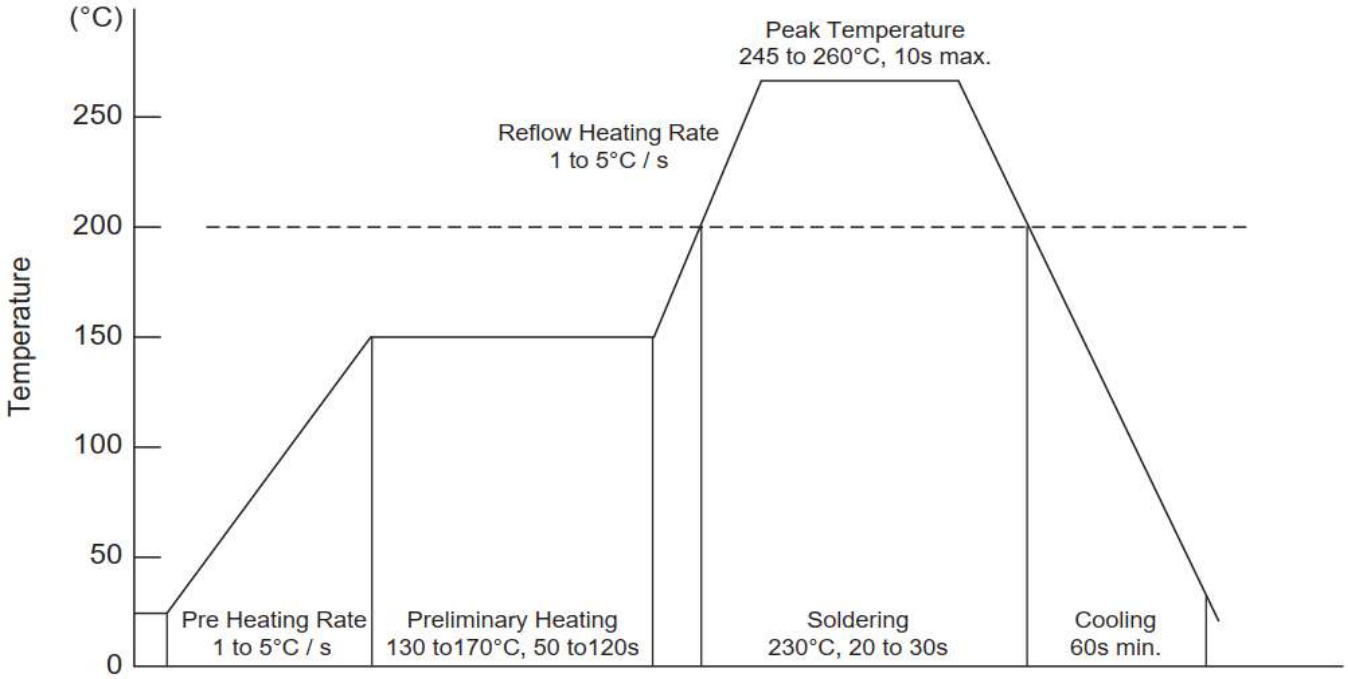
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOT23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3

Conditins of Soldering and Storage

* Recommended condition of



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