2.3MHz, 6V/1A Synchronous Step-Down Converter

Features

- Input voltage range from 2.5V to 6.0V
- Continuous Output Current: 1A
- 2.3MHz Frequency Operation
- High Efficiency: Up to 96%
- Input OVP 6.1V
- No Schottky Diode Required
- Output Voltage as Low as 0.6V
- 100% Duty Cycle in Dropout
- Low Quiescent Current: 40uA
- Slope Compensated Current Mode Control for Excellent Line and Load Transient Response
- Short Circuit Protection
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- Input over voltage protection(OVP)
- <1uA Shutdown Current

General Description

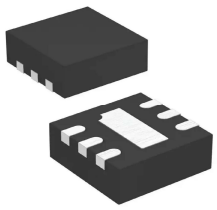
The HCR3110D is a constant frequency,current mode PWM step-down converter. The device integrates a main switch and a synchronous rectifier for high efficiency without an external Schottky diode. It is ideal for powering portable equipment that runs from a single cell Lithium -Ion (Li+) battery. The output voltage can be regulated as low as 0.6V. The HCR3110D can also run at 100% duty cycle for low dropout operation, extending battery life in portable system. This device offers two operation modes, PWM control and PFM Mode switching control, which allowsa high efficiency over the wider range of the load.

Applications

- Cellular and Smart Phones
- Wireless and DSL Modems
- PDA/MID/PAD
- Digital Still and Video Cameras

Pacakage

- DFN-2X2-6



DFN-2X2-6

Figure 1. Package Type of HCR3110D

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Pin Configuration

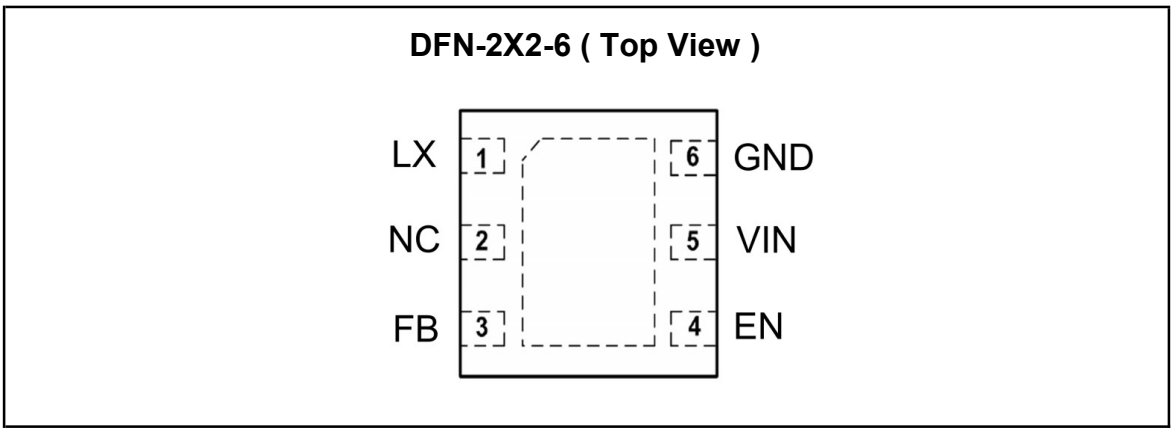
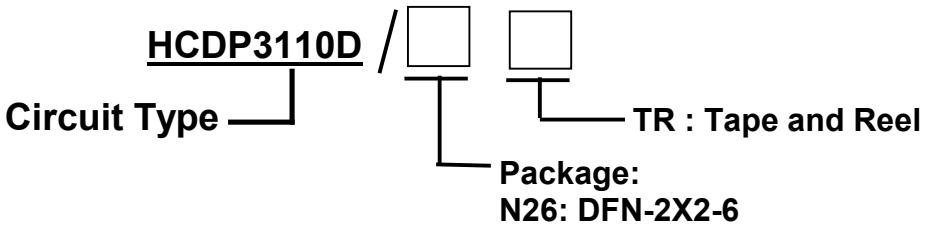


Figure 2. Pin Configuration of HCR3110D (Top View)

Pin Function Table

Pin Number	Pin Name	Function
1	LX	Power Switch Output. It is the switch node connection to Inductor.
2	NC	Not Connected
3	FB	Output Voltage Feedback Pin. An internal resistive divider divides the output voltage down for comparison to the internal reference voltage.
4	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.
5	VIN	Power Supply Input. Must be closely decoupled to GND with a 10μF or greater ceramic capacitor.
6	GND	Ground Pin

Ordering Information



Ordering Code

Part Number	Marking ID note2	Temperature Range	Package	Quantity per Reel
HCR3110D/N26TR	T0AXXX	-40'C to +125'C	DFN-2X2-6	3000pcs/TR

Note 2: The "T0A" is device code and the "XXX" is lot number code.

Absolute Maximum Ratings Note 1

Parameter	Symbol	Value	Unit
Input Supply Voltage Range	V_{IN}	-0.3 to +7	V
LX Voltage Range	V_{LX}	-0.3 to Vin+0.3	V
EN Voltage Range	V_{EN}	-0.3 to Vin+0.6	V
FB Voltage Range	V_{FB}	-0.3 to Vin+0.6	V
Power Dissipation	P_O	600	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	100	'C/W
Thermal Resistance Junction to Case	$R_{\theta JC}$	53.5	'C/W
Storage Temperature Range	T_{STG}	-65 to 150	'C
Operating Junction Temperature	T_J	-40 to +125	'C
Lead Temperature (Soldering, 10s)	T_{LEAD}	260	'C
Human Body Model for all pins	V_{ESD_HBM}	±2000	V
Charge Device Model for all pins	V_{ESD_CDM}	±200	V

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.

Recommended Operating Conditions

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Input Voltage Range	V_{IN}		2.5	-	6.0	V
Operating Junction Temperature Range	T_J		-40	-	125	'C

Electrical Characteristics

(VIN=VEN=3.6V, VOUT=1.8V, TA=25'C, unless otherwise noted.)

Parameter		Symbol	Test Condition	Min	Type	Max	Unit
Input Voltage Range		V_{IN}		2.5	-	6.0	V
Input OVP Threshold		V_{OVP}	V_{IN} rising	-	6	-	V
UVLO Threshold		V_{UVLO}	V_{IN} rising	-	2.5	-	V
UVLO Hysteresis		$V_{UVLO-HYS}$		-	0.3	-	V
Input DC Supply Current	PWM Mode	I_{Q1}	Vout=90%, Iload=0mA	-	140	300	uA
	PFM Mode	I_{Q2}	Vout=105%, Iload=0mA	-	20	35	uA
	Shutdown Mode	I_{SHDN}	VEN=0V, V_{IN}=4.2V	-	0.1	1.0	uA
Regulated Feedback Voltage Accuracy		V_{REF}	T_A=25'C	0.588	0.600	0.612	V
			T_A=0'C<=T_A<=85'C	0.586	0.600	0.613	V
			T_A=-40'C<=T_A<=85'C	0.585	0.600	0.615	V
Reference Voltage Line Regulation		ΔRVLR	V_{IN}=2.5 to 6V	-	0.04	0.4	%/V
Output Voltage Accuracy		-	V_{IN}=2.5 to 6V, I_{OUT}=10mA to 1A	-3	-	+3	%
Output Voltage Line Regulation		ΔOVLR1	V_{IN}=2.5 to 6V	-	0.04	0.4	%/V
Output Voltage Load Regulation		ΔOVLR2	-	-	0.5	-	%/V
On Resistance of PMOS		$R_{DS(ON)1}$	I_{LX}=100mA	-	300	-	mΩ
On Resistance of NMOS		$R_{DS(ON)2}$	I_{LX}=100mA	-	150	-	mΩ
Peak Current Limit		I_{PCT}	V_{IN}=5V, V_{OUT}=1.2V, L=4.7uH/2A	1.2	-	-	A
Oscillation Frequency		F_{OSC}	V_{OUT}=100%	-	2.3	-	MHz
			V_{OUT}=0V	-	500	-	KHz
EN High Level Input Voltage		V_{EN-H}		1.5	-	-	V
EN Low Level Input Voltage		V_{EN-L}		-	-	0.3	V
EN Leakage Current		I_{EN_LC}		-	0.01	1.0	uA
LX Leakage Current		I_{LX_LC}	V_{EN}=0V, V_{IN}=V_{LX}=5V	-	0.01	1.0	uA
Maximum Duty Cycle		η	V_{FB}=0.6V	-	94	-	%
Minimum On-Time		TON		-	60	-	nS
Minimum Off-Time		Toff		-	90	-	nS
Soft Start		Tstart		-	-	1.2	mS
Thermal Shutdown note3		T_{SHDN}		-	150	-	'C
Thermal Hysteresis		T_{HYTS}		-	25	-	'C

Note 3. Thermal shutdown threshold and hysteresis are guaranteed by design.

2.3MHz, 6V/1A Synchronous Step-Down Converter

Functional Description

The HCR3110D is a high performance 1.0A 2.3MHz step-down converter. The HCR3110D requires only three external power components (Cin, Cout and L). The adjustable version can be programmed with external feedback divider to any voltage, ranging from 0.6V to the input voltage.

At dropout condition, the converter duty cycle increases to 100% and the output voltage tracks the input voltage minus the Rdson 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.

Functional Block Diagram

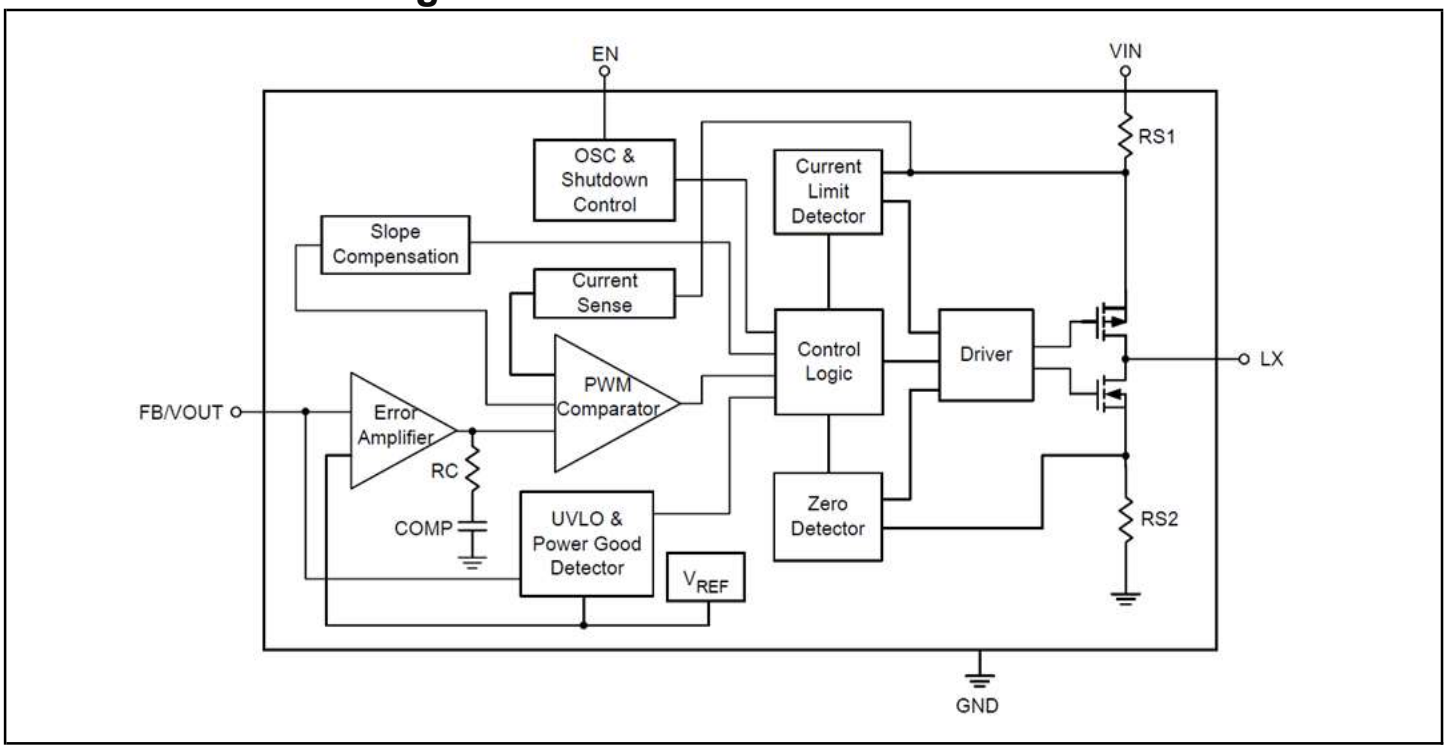
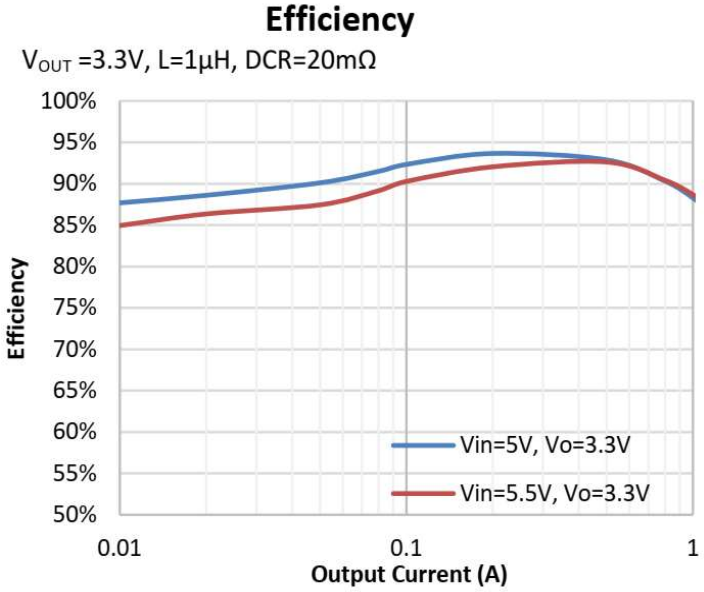
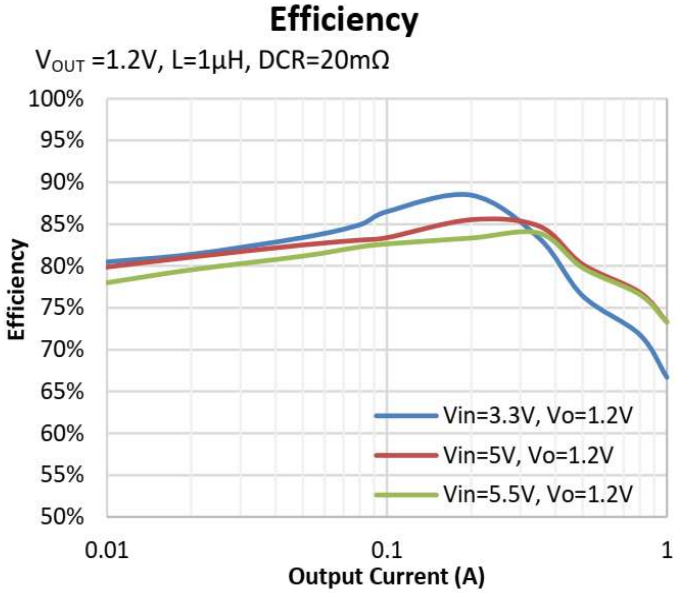


Figure 3. Functional Block Diagram of HCR3110D

Function Test





Typical Application Circuit

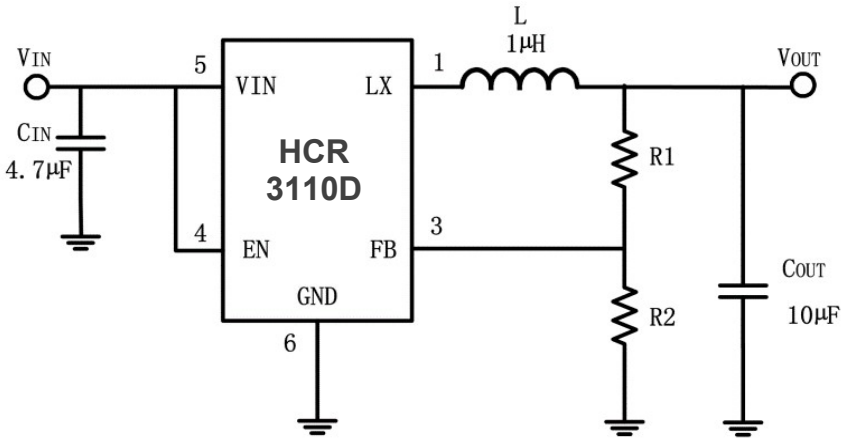


Figure 4. Typical Application Circuit of HCR3110D

APPLICATION INFORMATION

Setting the Output Voltage

Figure 4 shows the basic application circuit for the HCR3110D. The output voltage of HCR3110D can be externally programmed. Resistors R1 and R2 in Figure 4 program the output to regulate at a voltage higher than 0.6V. To limit the bias current required for the external feedback resistor string while maintaining good noise immunity, the minimum suggested value for R2 is 59kΩ. Although a larger value will further reduce quiescent current, it will also increase the impedance of the feedback node, making it more sensitive to external noise and interference. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 0.6 \times (1 + \frac{R_1}{R_2}) \quad R_1 = (V_{OUT} / 0.6 - 1) \times R_2$$

Inductor Selection

For most designs, the HCR3110D operates with inductors of 0.47μH 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 current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. A 4.7μF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

APPLICATION INFORMATION(Con.)

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 VOUT is determined by:

$$\Delta V_{OUT} \le \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left(ESR + \frac{1}{8 \times f_{osc} \times C3} \right)$$

An effective 10μF ceramic can satisfy most applications.

Layout Consideration

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the HCR3110D. Check the following in your layout:

A-1. The power traces, consisting of the GND trace, the LX trace and the VIN trace should be kept short, direct and wide.

A-2. Does the (+) plates of Cin connect to Vin as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.

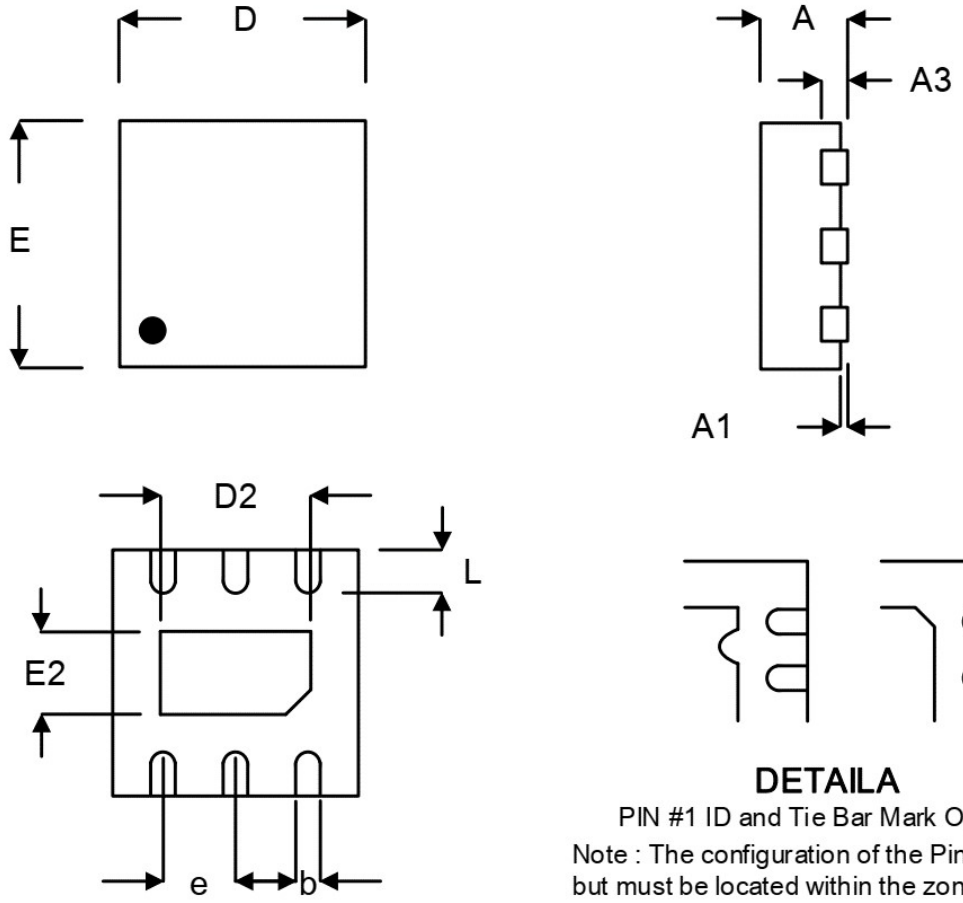
A-3. Keep the switching node, LX, away from the sensitive VOUT node.

A-4. Keep the (-) plates of Cin and Cout as close as possible.

Mechanical Dimensions

N26 PKG: DFN-2X2-6

Unit: mm



DETAILA

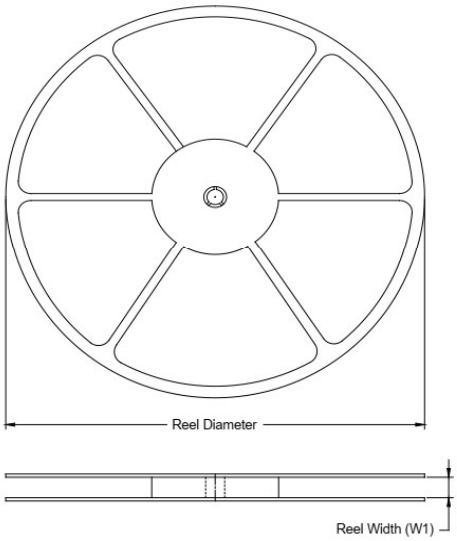
PIN #1 ID and Tie Bar Mark Options

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

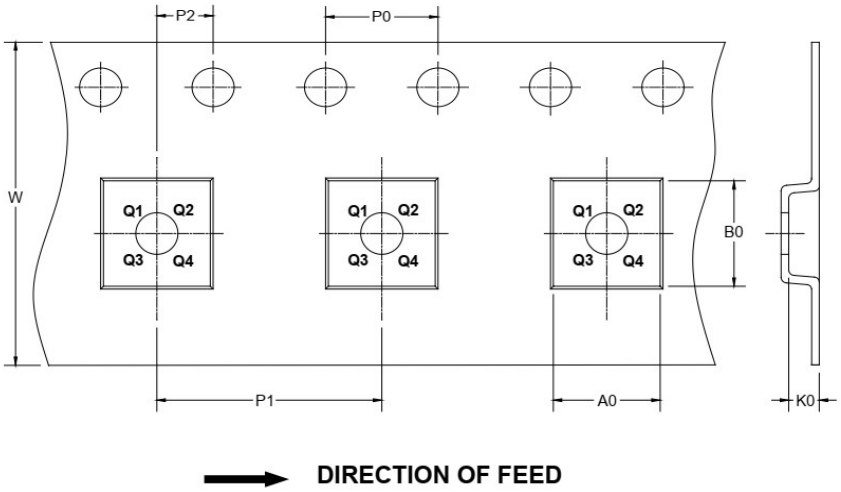
Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.175	0.250	0.007	0.010
b	0.200	0.350	0.008	0.014
D	1.950	2.050	0.077	0.081
D2	1.000	1.450	0.039	0.057
E	1.950	2.050	0.077	0.081
E2	0.500	0.850	0.020	0.033
e	0.650		0.026	
L	0.300	0.400	0.012	0.016

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS

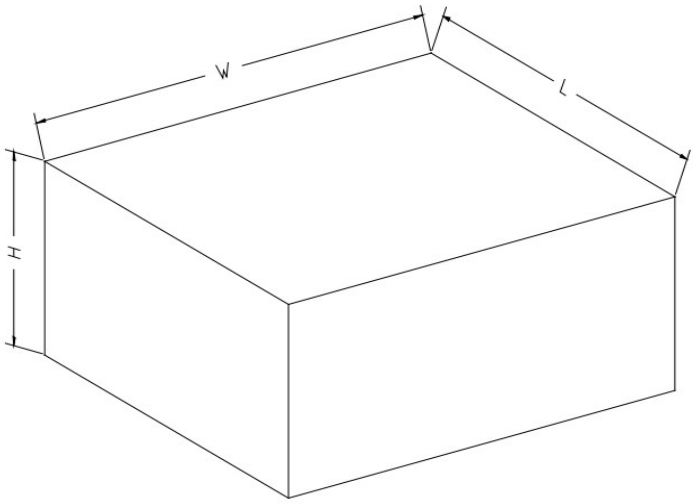


NOTE: The picture is only for reference. Please make the object as the standard.

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
DFN-2×2-6	7″	9.5	2.30	2.30	1.10	4.0	4.0	2.0	8.0	Q1

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″ (Option)	368	227	224	8