VIN 45V异步PWM升压/SPEIC/反激式控制器

VIN 50V Asynchronous PWM BOOST/SPEIC/Flyback Controller

■ FEATURES

- Wide supply voltage operating range: 2.8V-45V
- Programmable switching frequency:100K-1000KHz
- Programmable switching MOSFET over current threshold
- Input under voltage and over temperature protection
- Packages: Pb-free Packages, ESOP8

- 宽输入电源范围2.8V-45V
- 开关频率可调100K-1000KHz
- 开关MOS过流阈值可调
- 欠压保护和过热关断保护
- 无铅封装，ESOP8

■ APPLICATIONS

- Bluetooth/Wi-Fi Speakers
- Chargers
- Power Bank
- Electronic Cigarette
- High-power Emergency Power Supply

- 蓝牙/ Wi-Fi音箱
- 充电
- 移动电源
- 电子烟
- 大功率应急电源

■ DESCRIPTION

The HTN5157 is an asynchronous current mode DCDC boost controller for wide operating voltage (2.8V-50V) applications.

HTN5157 provides built-in gate driver pin for driving external NMOS.

The HTN5157 adjusts the switching frequency through an external resistor connected to the RT pin, with the switching frequency range being 100KHz-1000KHz.

HTN5157 has programmable inductor peak current limit by external resistor from CS to GND.

The HTN5157 adopts peak current mode control and an external compensation network, making the system more stable in a simpler and more flexible way.

HTN5157 can be controlled to be turned on and off through EN.

HTN5157是一颗异步电流模式DCDC升压控制器，支持宽工作电压范围（2.8V-45V）应用。

HTN5157内置栅极驱动器，通过GATE管脚驱动外置NMOS。

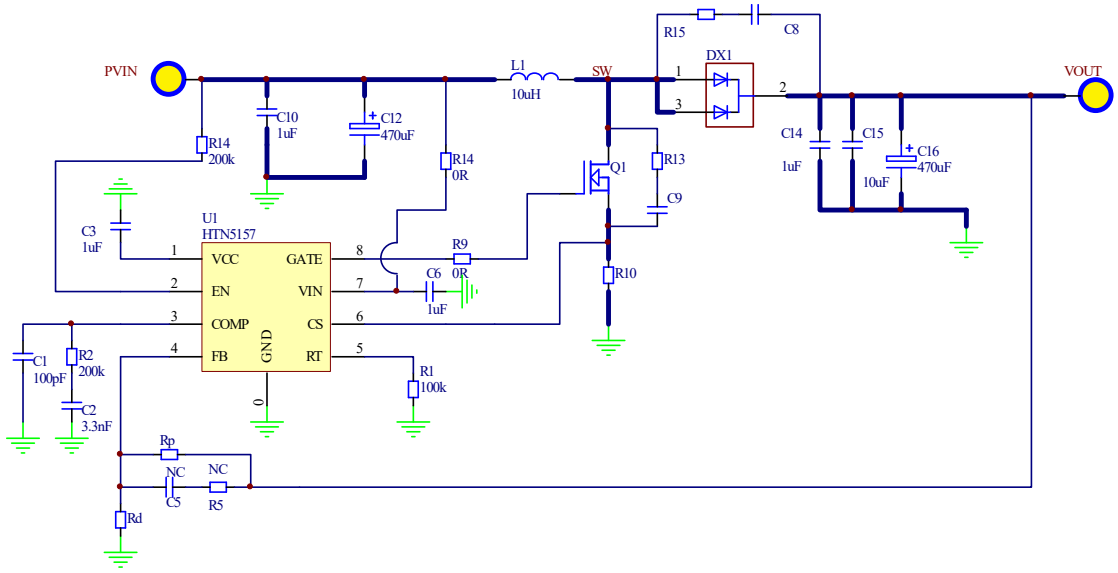
HTN5157通过RT管脚外接电阻调整开关频率，开关频率范围为100KHz-1000KHz。

HTN5157通过CS管脚外接电阻调整电感峰值电流。

HTN5157采用峰值电流模式控制和外置补偿网络，更简单更灵活的使系统稳定。

HTN5157通过EN可以控制开启和关断。

■ TYPICAL APPLICATION



1. EN直接外加电压建议低于5V；外接高压时（如连接至PVIN），需串接R14 (>200k)。

2. Comp典型参数（**R2=200k**, C2=3.3nF, C1=100pF）可适用于大多数应用。但若输出不稳，则需调整。

3. 输出电压由FB端电阻Rp和Rd设置：$VOUT = 1.2 \times \left(1 + \frac{Rp}{Rd}\right)$；**FB端R5, C5可不用。**

4. 开关频率FSW由RT端电阻R1设置：$FSW(kHz) \approx \frac{13465}{R1(kohm)^{0.895}}$，或参看典型图表；RT端悬空，则为固定200kHz。

5. 电感峰值电流$I_{ILIM}(A) = \frac{0.1}{R10(\Omega)}$，**需设置一定的1.5倍以上余量**； Rilim需大尺寸封装，承受功率Po > $\frac{0.01}{R10(\Omega)}$，建议使用1812及以上封装，或多个电阻并联。

6. VIN < 45V应用，使用1uF电容下地；**若单节锂电池输入使用，VIN脚需接升压输出VOUT**。

7. Q1选型，V_{DS} 耐压> 1.5×VOUT。

8. R13, C9; R15, C8 均做预留，用于EMI调试。

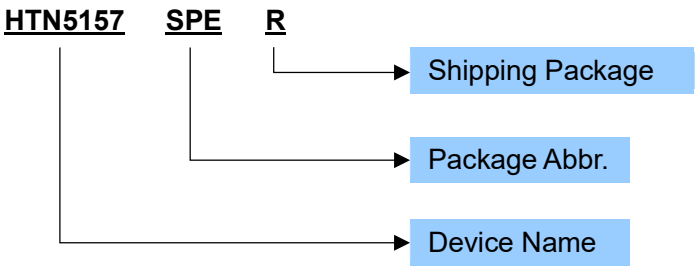
9. L选型，大多数应用可推荐10uH或22uH，额定电流建议大于I_{ILIM}设置值，并留有余量。

10. D选型，反向击穿电压建议> 1.5×VOUT，峰值额定电流大于I_{ILIM}设置值，且平均额定电流大于平均输出电流IOUT。

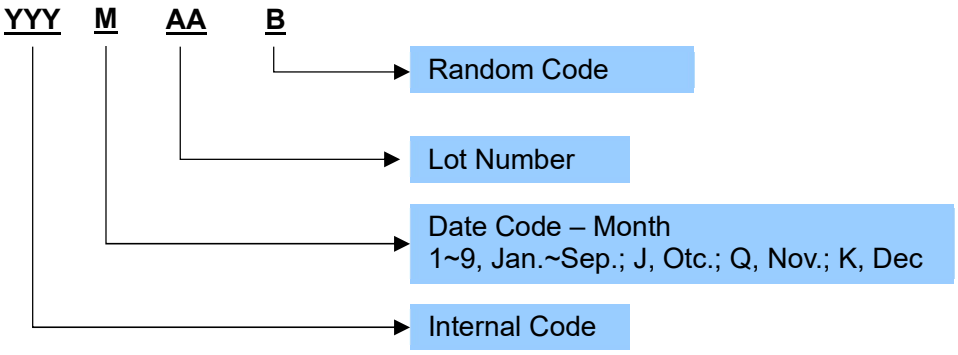
■ ORDERING INFORMATION

Part Number	Package Type	Package Abbr.	Eco Plan	MSL Level	Marking	Shipping Package / MOQ
HTN5157SPER	ESOP8	SPE	RoHS	MSL3	HTN5157 YYYMAAB[1]	Tape and Reel (R) / 2500pcs

Part Number

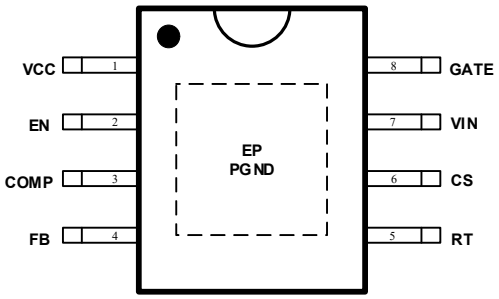


Production Tracking Code



[1] YYYMAAB is production tracking code

■ TERMINAL CONFIGURATION



Top View

■ TERMINAL FUNCTION

Terminal No.	Name	I/O[1]	Description
1	VCC	P	Power Supply for Internal Circuits and Gate Drivers 内部控制电路和栅极驱动器的电源
2	EN	I	Device Enable pin 器件使能引脚
3	COMP	O	Compensation pin 补偿管脚
4	FB	I	Feedback voltage 反馈电压
5	RT	I	Frequency Programming 频率设定
6	CS	I	Mosfet switch current sense MOS管开关电流检测
7	VIN	P	IC power supply 芯片电源
8	GATE	O	Gate Driver Output 栅极驱动输出
EP	PGND	G	IC Ground（Exposed PAD）-Must connect to Ground 芯片地-必须接地

[1] I: Input; O: Output; G: Ground; P: Power; BST: BOOT Strap; OD: Open drain

■ SPECIFICATIONS[1]

● Absolute Maximum Ratings [2]

PARAMETER	Symbol	MIN	TYP	MAX	UNIT
Power supply voltage	VIN	-0.3		50	V
VCC/GATE Voltage	VCC/GATE	-0.3		15	V
Others Pin Voltage		-0.3		6	V
Moisture Sensitivity Level (MSL)			MSL3		
Ambient Operating Temperature	T_A	-25		85	℃
Junction Temperature	T_J	-40		125	℃
Storage Temperature	T_{STG}	-40		125	℃

● Recommended Operating Conditions

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Power supply voltage	VIN		5		40	V
VCC/GATE Voltage	VCC/GATE			8		V
Others Pin Voltage			0		5	V
Operating Temperature Range	T_A	Ambient Temperature	-25		+85	℃

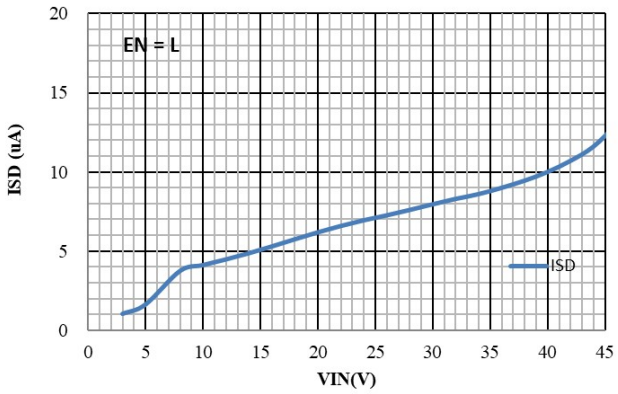
● Electrical Characteristics（VIN= 12V, T_A = +25°C, unless otherwise noted.）

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Start-up Voltage	VIN			2.8		V
Input Supply Voltage	VIN		2.8		40	V
Under Voltage Lockout	V_{UVLO}			2.5		V
UVLO Hysteresis				0.3		V
Average Current	I_{CC}	FB=1.0V, Switching		1		mA
Quiescent Current	I_{CC}	FB=1.3V, No Switching		800		uA
Shutdown Current	Icc	V_{EN}=GND		6		uA
VCC Regulator Voltage	VCC			8		V
Operation Frequency	f_{OSC}	RT=NC		200		KHz
		RT=51KΩ		400		KHz
Maximum Duty Ratio		FB=0V		93		%
Feedback Voltage	V_{FB}	VIN=12V		1.2		V
Enable Voltage	V_{EN}			1.24		V
Shutdown Voltage	V_{EN}			1.12		V
UVEN Hysteresis				120		mV
EXT Pull-UP Resistance	R_{EXTH}	VDS=8V		0.9		Ω
EXT Pull-Down Resistance	R_{EXTL}	VDS=8V		0.9		Ω
Sense Voltage	V_{CS}			100		mV
Thermal Shutdown Threshold	T_{TS}			160		°C
Thermal Shutdown Threshold Hysteresis	T_{TSH}			30		°C

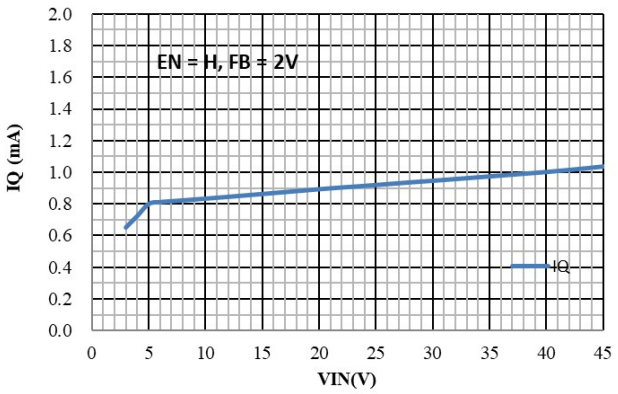
[1] Depending on parts and PCB layout, characteristics may be changed.
[2] Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute–maximum–rated conditions for extended periods may affect device reliability.

■ TYPICAL OPERATING CHARACTERISTICS

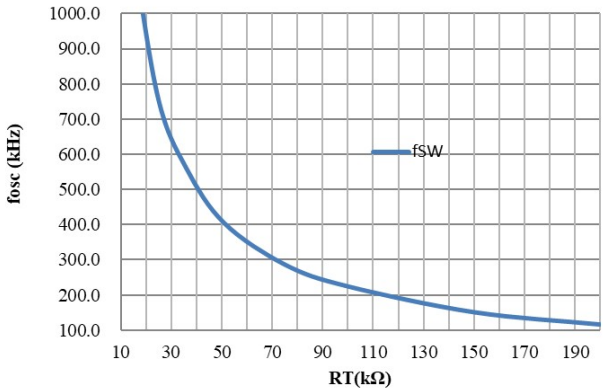
ISD vs VIN



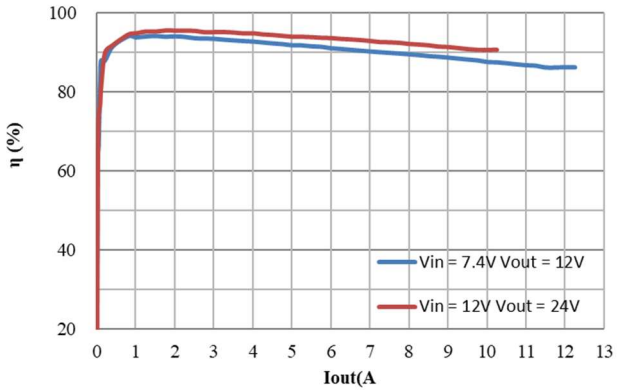
IQ vs VIN



f_{SW} vs RT



Iout vs η



■ APPLICATION INFORMATION

The HTN5157 is current mode boost controller. It operates with pulse width modulation (PWM). The internal resistive divider provides 1.2V reference for the error amplifier. It changes to PFM mode when the output is light load. In PFM mode, it can reduce switching lose to raise efficiency, but the output ripple is bigger.

Oscillator

The oscillator frequency can be set from 100KHz to 1000KHz by external resistance. Acceptable resistance values range from 220KΩ to 17KΩ. The frequency is 200KHz when the resistance is unconnected. The relationship between the timing resistance RT and frequency is shown in Figure1. The oscillator frequency can be calculated using formula below.

$$\mathrm{FSW(kHz)} \approx \frac{13465}{R1(kohm)^{0.895}}$$

Enable Mode / Shutdown Mode

Input voltage connects to EN pin through a resistive divider to set UVLO threshold. HTN5157 is enabled when EN voltage greater than 1.24V. The EN voltage is lower than 1.12V to shutdown it. In shutdown mode, the device goes into low power consumption mode. If the applications don't need to set UVLO, the EN connects to input voltage through resistance 200KΩ, and EN internal clamping circuit limit V_{EN} is under 6V.

Current Sense Control

External switching MOSFET is turned on inductor current flows across the current sense resistor to generate VCS. VCS provides part of current mode control loop. Internal leading-edge blanking is provided to prevent premature turn off the switching MOSFET in each switching cycle.

HTN5157是电流模式升压控制器。它工作模式为脉宽调制（PWM）。内部电阻分压器为误差放大器提供1.2V参考。输出轻载时切换为PFM模式。在PFM模式下，可以减小开关损耗以提高效率，但输出纹波较大。

振荡器

振荡器频率可以通过外部电阻从 100KHz 到 1000KHz 进行设置。可接受的电阻值范围为 220KΩ to 17KΩ。不接电阻时，频率为 200KHz。时序电阻 RT 与频率的关系如图 1 所示。振荡器频率可以用下面的公式计算。

$$\mathrm{FSW(kHz)} \approx \frac{13465}{R1(kohm)^{0.895}}$$

使能关断模式

输入电压通过电阻分压器连接到 EN 引脚，设置 UVLO 阈值。当 EN 电压大于 1.24V 时，HTN5157 使能。EN 电压低于 1.12V 关机。在关断模式下，芯片进入低功耗模式。如果应用不需要设置 UVLO，EN 通过电阻 200KΩ 连接到输入电压，EN 内部箝位电路限制 V_{EN} 在 6V 以下。

电流检测控制

外部开关 MOSFET 打开电感电流流过电流检测电阻以产生 VCS。VCS 提供了一部分电流模式控制回路。内部前缘消隐时间内不触发过流，以防止在每个开关周期边沿误关断开关 MOSFET。

Current Limit Setting Resistor (R_{CS})

R_{CS} is connected between CS pin and ground, its calculation formula is as below. Where 0.085V is minimum threshold voltage of current sense, ILp is peak inductor current, and the factor 1.3 provides a 30% margin for tolerances.

$$Rcs（\Omega）=\frac{0.085V}{ILp(A)\times 1.3}$$

According to following equations calculate the peak inductor current ILp. Where ILavg is the average inductor current, ILpp is the peak-to-peak inductor current, Vout is the output voltage, Iout(max) is the output maximum current, Eff is the efficiency, Fs is the switching frequency, and the L is inductance.

$$ILp=ILavg+\frac{ILpp}{2}$$

$$ILavg=\frac{Vout\times Iout(max)}{Vin\times Eff}$$

$$ILpp=\frac{Vout-Vin}{Fs\times Iout(max)}\times\frac{Eff}{L}\times ILavg$$

Thermal Shutdown Protection

The IC will shut down automatically when the internal junction temperature exceeds +150°C. The device can restart until the junction temperature drops below +120°C approximately.

Inductor Selection

The Inductance value is decided based on different condition. 3.3μH to 47uH inductance value is recommended for general application circuit. There are three important inductor specifications, DC resistance, saturation current and core loss. Low DC resistance has better power efficiency. The inductance is calculated using formula. Where Vout is output voltage, Fs is switching frequency, Iout is output maximum current, Eff is boost efficiency and r is the ratio of the inductor peak-to-peak ripple current to the average DC inductor current at full load current. r is recommended between 0.3 and 0.5.

$$L=(\frac{Vin}{Vout})^2\times\frac{Vout-Vin}{Fs\times Iout(\max)}\times\frac{Eff}{r}$$

限流电阻设置（Rcs）

R_{CS} 连接在 CS 引脚与地之间，其计算公式如下：其中 0.085V 是电流检测的最小阈值电压，ILp 是电感器的峰值电流，因子 1.3 提供了 30%的容差余量。

$$Rcs（\Omega）=\frac{0.085V}{IL\ (A)\times 1.3}$$

根据下式计算电感峰值电流 ILp。其中 ILavg 为电感平均电流，ILpp 为电感峰间电流，Vout 为输出电压，Iout（max）为输出最大电流，Eff 为效率，Fs 为开关频率，L 为电感。

$$ILp=ILavg+\frac{ILpp}{2}$$

$$ILavg=\frac{Vout\times Iout(max)}{Vin\times Eff}$$

$$ILpp=\frac{Vout-Vin}{Fs\times Iout(max)}\times\frac{Eff}{L}\times ILavg$$

热关断保护

当 IC 内部结温超过+160℃时，IC 将自动关闭，直到结温降到+130℃以下，芯片才能重新启动。

电感的选择

电感值是根据不同的条件来确定的。一般应用电路推荐采用 3.3μH～47uH 的电感值。有三个重要的电感规格：直流电阻、饱和电流和铁芯损耗。直流电阻小，功率效率高。电感用公式计算。式中 Vout 为输出电压，Fs 为开关频率，Iout 为输出最大电流，Eff 为升压效率，r 为电感峰峰纹波电流与满载时直流电感平均电流之比。r 建议在 0.3 到 0.5 之间。

$$L=(\frac{Vin}{Vout})^2\times\frac{Vout-Vin}{Fs\times Iout(\max)}\times\frac{Eff}{r}$$

Capacitor Selection

Output capacitor is required to maintain the DC voltage during switching. Low ESR capacitors are preferred to reduce the output voltage ripple. Ceramic capacitor of X5R and X7R are recommended, which have low equivalent series resistance (ESR) and wider operation temperature range.

Diode Selection

Schottky diodes with fast recovery times and low forward voltages are recommended. Ensure the diode average and peak current rating exceed the average output current and peak inductor current. In addition, the diode's reverse breakdown voltage must exceed the output voltage.

Output Voltage Programming

The output voltage is set by a resistive voltage divider from the output voltage to FB. The output voltage is:

$$\text{Vout}=1.2V\times\ （1+\frac{\text{Rp}}{\text{Rd}}）$$

电容的选择

在开关过程中需要输出电容来维持直流电压。低 ESR 电容器是减少输出电压纹波的首选。推荐使用 X5R 和 X7R 陶瓷电容器，它们具有较低的等效串联电阻（ESR）和较宽的工作温度范围。

二极管的选择

建议使用恢复时间快、正向电压低的肖特基二极管。确保二极管的平均和峰值额定电流超过平均输出电流和峰值电感电流。此外，二极管的反向击穿电压必须超过输出电压。

输出电压设定

输出电压由从输出电压到 FB 的电阻分压器设定。输出电压为：

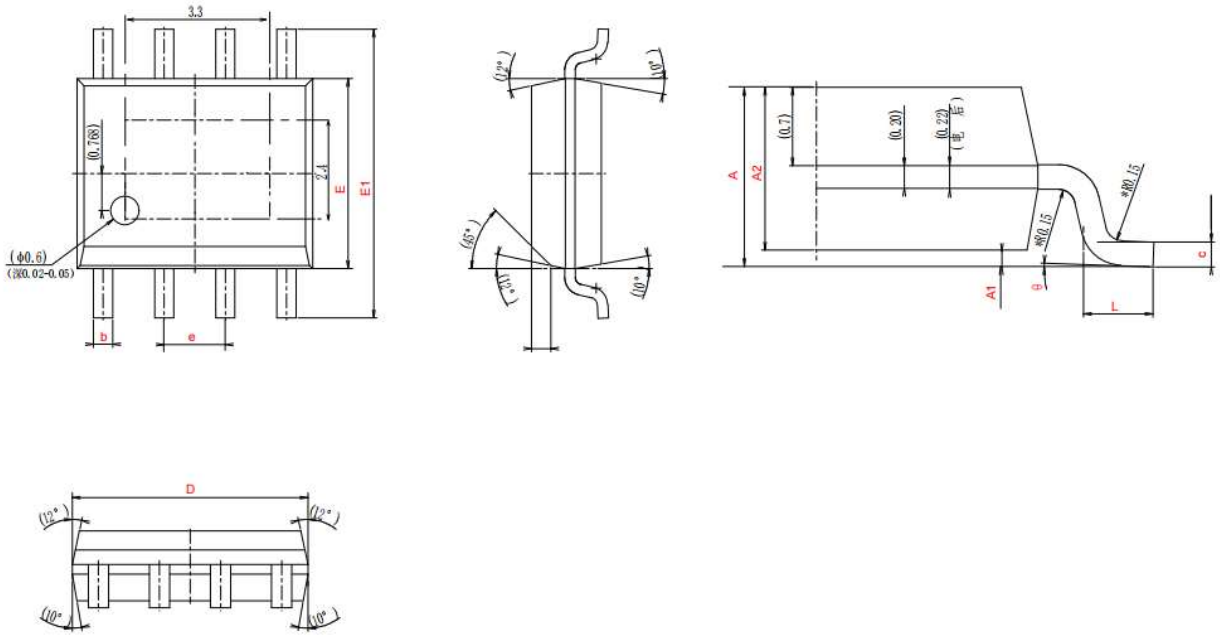
$$\text{Vout}=1.2V\times\ （1+\frac{\text{Rp}}{\text{Rd}}）$$

■ Revision History

Date	Version	Revision Content
2025-6-9	V0.5	Preliminary Version.

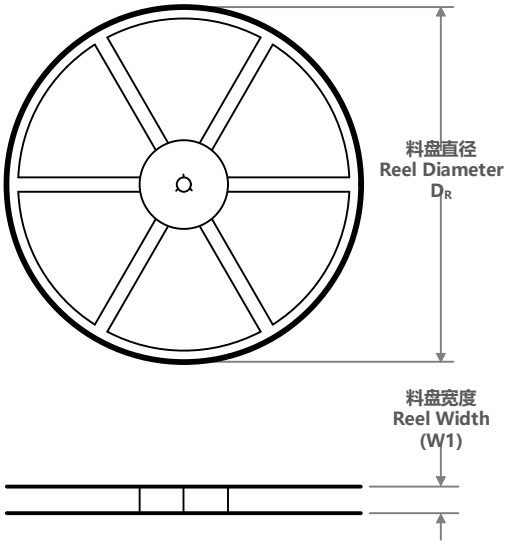
■ PACKAGE OUTLINE

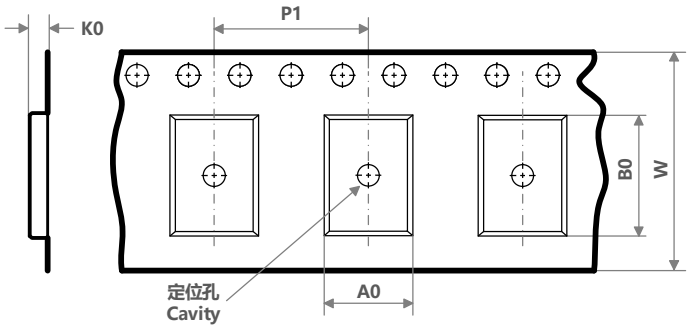
SPE (ESOP8)



Symbol	Dimensions in Millimeters		
	Min.	Standard	Max.
A	1.350	1.500	1.700
A1	0.000		0.150
A2	1.350	1.450	1.550
b	0.360	0.400	0.440
c	0.215	0.220	0.235
D	4.800	4.900	5.000
E	3.840	3.940	4.040
E1	5.900	6.000	6.100
e	1.27BSC		
L	0.400	0.550	0.700
θ	0°		8°

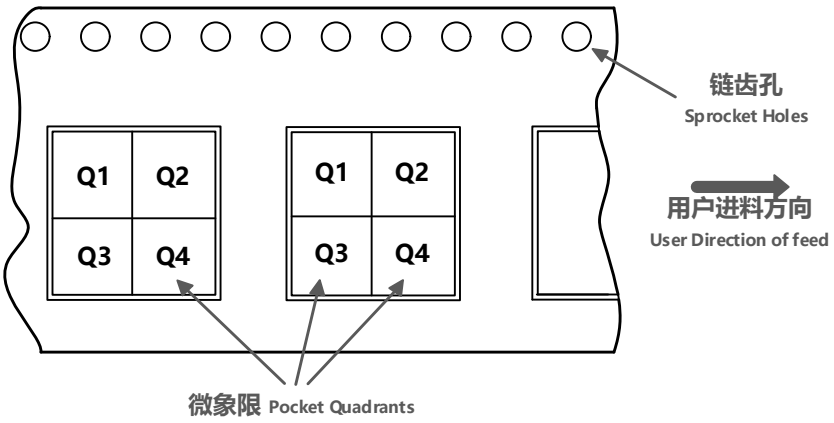
■ TAPE AND REEL INFORMATION





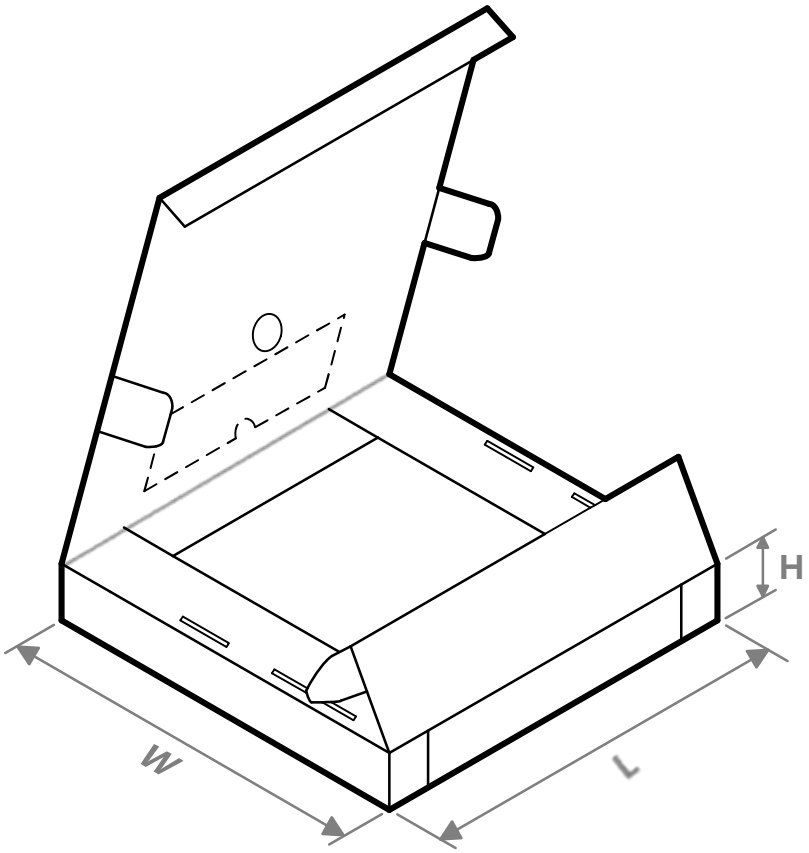
A0	Dimension designed to accommodate the component width; 料槽宽度
B0	Dimension designed to accommodate the component length; 料槽长度
K0	Dimension designed to accommodate the component thickness; 料槽厚度
W	Overall width of the carrier tape; 载带整体宽度
P1	Pitch between successive cavity centers; 相邻槽中心间距

编带 PIN1 方位象限分配
Quadrant Assignments for Pin1 Orientation in Tape



器件料号 Part No.	封装类型 Package Type	封装标识 Package Abbr.	引脚数 Pins	SPQ	料盘直径 D_R(mm)	料盘宽度 W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 象限 Quadrant
HTN5157SPER	ESOP	SPE	8	2500	330	12	6.55	5.55	1.95	8	12	Q1

■ TAPE AND REEL BOX INFORMATION



器件料号 Part No.	封装类型 Package Type	封装标识 Package Abbr.	引脚数 Pins	SPQ	长度 Length (mm)	宽度 Width (mm)	高度 Height (mm)
HTN5157SPER	ESOP	SPE	8	5000	360	345	65

IMPORTANT NOTICE
注意

Heroic Electronic Technology (Jiaxing) Co., Ltd (HT) reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any products or services. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

禾润电子科技（嘉兴）股份有限公司（以下简称HT）保留对产品、服务、文档的任何修改、更正、提高、改善和其他改变，或停止提供任何产品和服务的权利。客户在下单和生产前应确保所得到的信息是最新、最完整的。

HT assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using HT components.

HT对相关应用的说明和协助以及客户产品的板级设计不承担任何责任。

HT products are not authorized for use in safety-critical applications (such as life support devices or systems) where a failure of the HT product would reasonably be expected to affect the safety or effectiveness of that devices or systems.

HT的产品并未授权用于诸如生命维持设备等安全性极高的应用中。

The information included herein is believed to be accurate and reliable. However, HT assumes no responsibility for its use; nor for any infringement of patents or other rights of third parties which may result from its use.

本文中的相关信息是精确和可靠的，但HT并不对其负责，也不对任何可能的专利和第三方权利的侵害负责。

Following are URLs and contacts where you can obtain information or supports on any HT products and application solutions:

下面是可以联系到我公司的相关链接和联系方式：

禾润电子科技（嘉兴）股份有限公司
Heroic Electronic Technology (Jiaxing) Co., Ltd.
地址: 浙江省嘉兴市南湖区亚太路906号科创CBD园区21号楼11层
Add: 11th floor, Building 21, No. 906, Yatai Road, Jiaxing, Zhejiang Province
Sales: 0573-82586608, sales@heroic.com.cn
Support: 0573-82586151, support@heroic.com.cn
Website: www.heroic.com.cn; wap.heroic.com.cn
Wechat MP: HEROIC_JX
请及时关注禾润官方微信公众号，随时获取最新产品信息和技术资料！