20V, 20A全集成同步升压转换器

20V, 20A Fully-Integrated Synchronous Boost Converter

■ FEATURES

- Input voltage range V_{IN}: 2.7V to 20V
- Output voltage range V_{OUT}: 4.5V to 20V
- Programmable switch peak current limit: up to 20A
- High Efficiency
  96% (V_{IN} = 7.4V, V_{OUT}=15V, I_{OUT} =2A)
- 1.0μA current consumption during shutdown
- Programmable soft start
- Output overvoltage protection (at 22V), cycle-by-cycle overcurrent protection, thermal shutdown protection
- Pb-free Packages, QFN3×3-16L

- 输入电压范围V_{IN}：2.7V-20V
- 输出电压范围V_{OUT}：4.5V-20V
- 可编程峰值电流：20A
- 高转换效率：
  96% (V_{IN} = 7.4V, V_{OUT}=15V, I_{OUT} =2A)
- 低关断功耗，关断电流1uA
- 可编程软启动
- 输出过压（22V)、逐周期过流、热关断等保护
- QFN3×3-16L，无铅超薄封装

■ APPLICATIONS

- Wireless/ Speakers
- Portable Speakers
- Quick Charge Power Bank
- E-Cigarette
- Power Interface (USB Type-C, Thunderbolt)
- POS Terminal
- Tablet PC/Note Book

- 无线音箱
- 便携式音箱
- 快充移动电源
- 电子烟
- USB TYPE-C 电源传输
- 拉杆音箱
- 平板电脑，笔记本电脑
- POS机终端

■ DESCRIPTION

The HTN872A is a high-power density, fully integrated synchronous boost converter with an 8mΩ power switch and an 10mΩ rectifier switch to provide a high efficiency and small size solution in portable systems. The HTN872A has wide input voltage range from 2.7 V to 20V to support applications with single cell and two cell Lithium batteries. The device has 20A switch current capability and can provide an output voltage up to 20V.

The HTN872A uses adaptive constant off-time peak current control topology to regulate the output voltage. In moderate to heavy load condition, it works in the PWM mode. In light load condition, the device works in PFM mode to improve the efficiency. The switching frequency in the PWM mode is internally fixed at around 370kHz.

The HTN872A also implements a programmable soft-start function and an adjustable switching peak current limit function. In addition, the device provides 22V output overvoltage protection, cycle-by-cycle overcurrent protection, and thermal shutdown protection.

HTN872A是一款高功率、全集成升压转换器，集成8mΩ功率开关管和10mΩ同步整流管，为便携式系统提供高效的小尺寸解决方案。

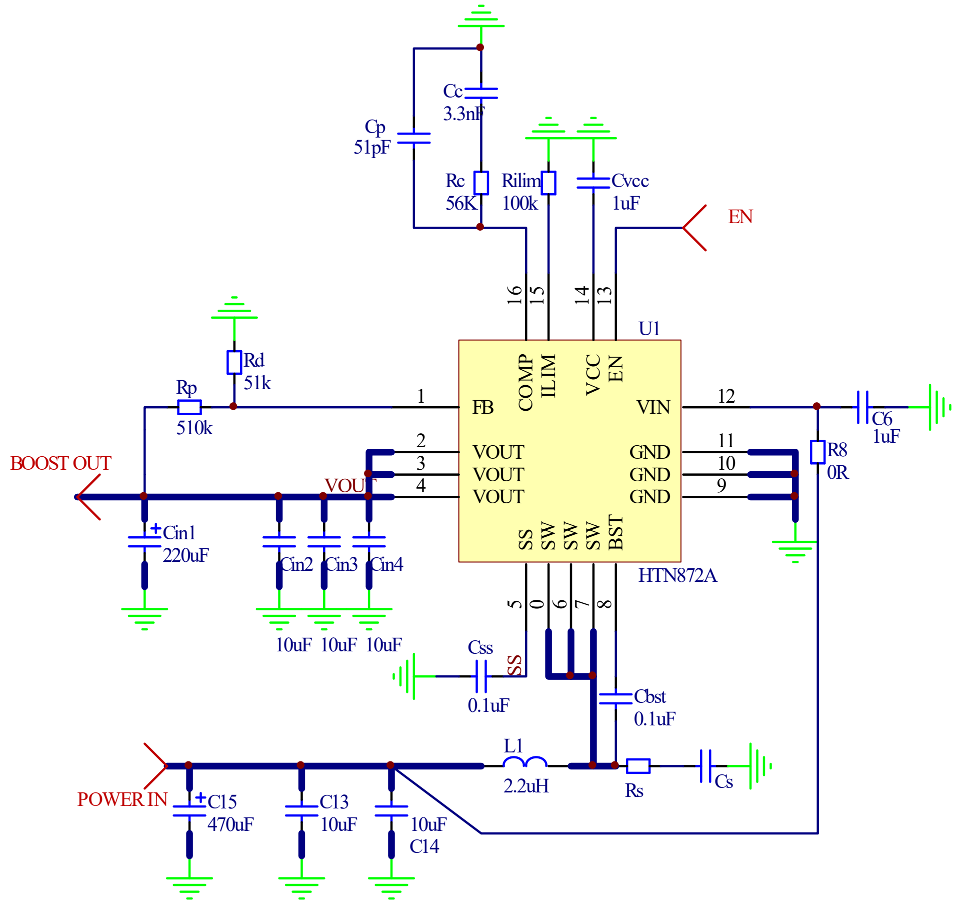
HTN872A具有2.7V至20V宽输入电压范围，可为采用单节或两节锂电池的应用提供支持。该器件具备20A开关电流能力，并且能够提供20V的输出电压。

HTN872A采用自适应恒定关断时间峰值电流控制拓扑结构来调节输出电压。在中等到重负载条件下，HTN872A工作在PWM 模式。在轻负载条件下，该器件工作在PFM模式，以提高效率。PWM模式下，HTN872A的开关频率内部固定在约370kHz。

HTN872A还支持可编程的软启动，以及可调节的开关峰值电流限制。

此外，该器件还提供有22V输出过压保护、逐周期过流保护和热关断保护。

■ TYPICAL APPLICATION

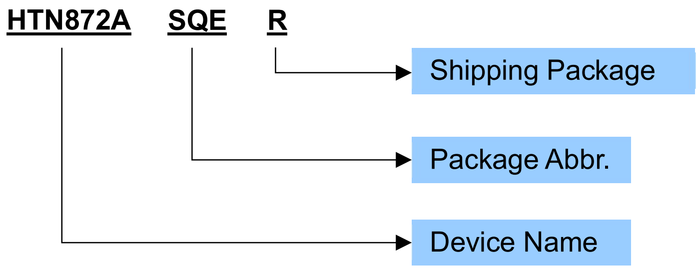


1. 升压值设置：$V_{OUT} = 1.204 \times (1 + \frac{R_P}{R_N})$
2. 升压输出电压端，VOUT电容，建议放置0.1uF//1uF//220uF的并联电容到地；
3. SS电容，设置软起动时间，典型100nF。$t_{SS}(ms) \approx \frac{1.204 \times C_{SS}(nF)}{5}$
4. 升压输入端，VIN电容，至少加入10uF电容到地；
5. 升压部分电感推荐使用2.2uH，其饱和电流$I_{SAT} > I_{LIM}$
6. SW端RC典型值：Rs = 1ohm, Cs = 3.3nF
7. EN内部下地1300k电阻。EN拉高，芯片工作；EN拉低，芯片停止工作。
8. ILIM升压部分电感峰值电流ILIM设置，通过ILIM pin下地电阻R_{ILIM}，ILIM设置建议小于电源输入端最大电流能力，并设置大于$1.4 \times \frac{P_{o_peak}}{V_{VIN} \times 70\%}$. $I_{LIM} = \frac{1500}{R_{ILIM}(kohm)}$
9. Comp端设置升压部分的补偿电路，一般使用推荐的Rc = 27k, Cc = 3.3nF, Cp = 51F。如出现输出不稳定等环路不稳定导致的异常，可调整Comp参数，具体参考使用我司excel计算工具。

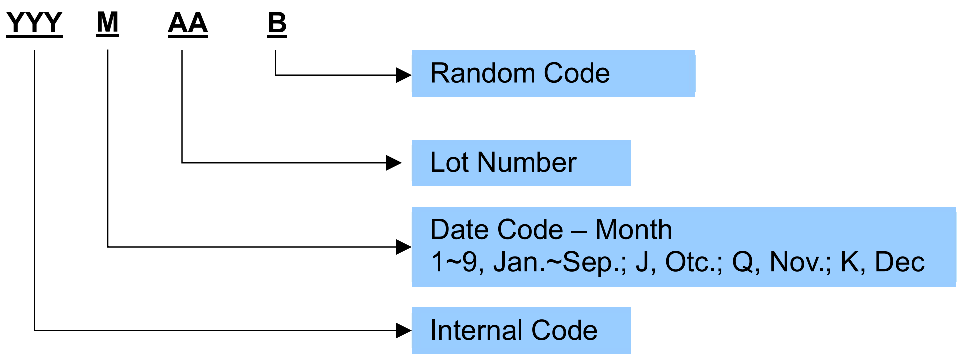
■ ORDERING INFORMATION

Part Number	Package Type	Package Abbr.	Marking	Shipping Package / MOQ
HTN872ASQER	QFN3×3-16L	SQE	HTN872A YYYMAAB[1]	Tape and Reel / TBD

Part Number

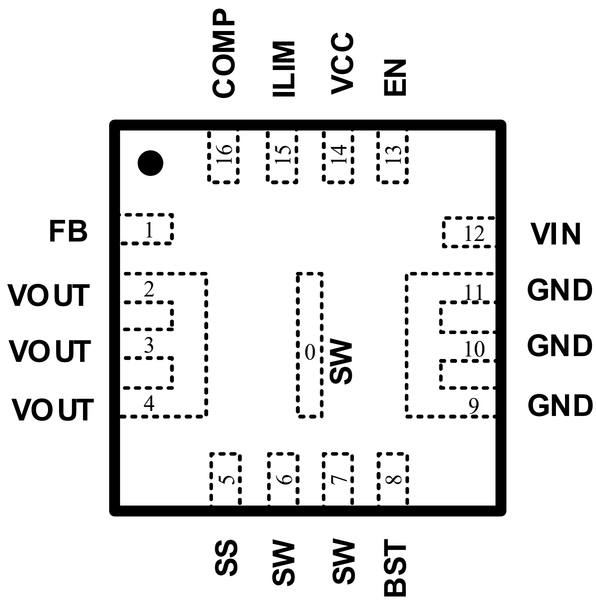


Production Tracking Code



[1] YYYMAAB is production tracking code

■ TERMINAL CONFIGURATION



Top View

■ TERMINAL FUNCTION

Terminal No.	Name	I/O[1]	Description
1	FB	I	Voltage feedback. 电压反馈
2,3,4	VOUT	P	Boost converter output. 升压输出
5	SS	O	Soft-start programming pin. An external capacitor connected to ground sets the ramp rate of the internal error amplifier's reference voltage during soft-start. 接电容到地，设置软起动时间。
0,6,7	SW	P	The switching node pin of the converter. 升压开关节点
8	BST	O	Power supply for high-side MOSTFET gate driver. A ceramic capacitor of 0.1μF must be connected between this pin and the SW pin. 接0.1uF电容到SW
9,10,11	GND	G	Ground. 地
12	VIN	P	IC power supply input. 电源输入脚
13	EN	I	Enable logic input. Logic high level enables the device. Logic low level disables the device and turns it into shutdown mode. 使能输入，接高电平使能，低电平关断
14	VCC	O	Output of the internal regulator. A ceramic capacitor of 2.2uF is required between this pin and ground. 接2.2uF到地。
15	ILIM	O	Adjustable switch peak current limit. An external resister should be connected between this pin and the AGND pin. 接电阻到地，调节开关峰值限制电流
16	COMP	O	Output of the internal error amplifier, the loop compensation network should be connected between this pin and the AGND pin. 接阻容补偿网络到地。

[1] I: Input; O: Output; G: Ground; P: Power;

■ SPECIFICATIONS[1]

● Absolute Maximum Ratings[*2]

PARAMETER		Symbol	MIN	MAX	UNIT
Voltage range	BOOT	/	-0.3	SW+7	V
	EN, SW, V_{OUT}, V_{IN}		-0.3	22	
	VCC, SS, COMP		-0.3	7	
	ILIM, FB		-0.3	3.6	
Operating temperature range		T_A	-40	85	℃
Operating junction temperature range		T_J	-40	150	℃
Storage temperature range		T_{STG}	-50	150	℃

● Recommended Operating Conditions

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
IC power supply voltage range	V_{IN}		2.7		20	V
Output voltage range	V_{OUT}		4.5		20	V
Inductance, effective value	L		0.47	2.2	10	μH
Input capacitance, effective value	C_I		10			μF
Output capacitance, effective value	C_O		6.8	47	1000	μF
Operating temperature	T_a		-40	25	85	℃
Operating junction temperature	T_J		-40		125	℃

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.

● Electrical Characteristics[*1]

Condition: Ta = 25ºC, V_{IN} = 2.7V-20V, V_{OUT}=4.5-20V, unless otherwise specified.

Power Supply

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
IC power supply voltage range	V_{IN}		2.7		20	V
Under-voltage lockout (UVLO) threshold	V_{IN_UVLO}	VIN rising		2.5		V
		VIN falling		2.3		V
VIN UVLO hysteresis	V_{IN_HYS}			200		mV
VCC UVLO threshold	V_{CC_UVLO}			2.1		V
Operating quiescent current from V_{IN}	I_Q	IC enabled, no load, V_{FB} = 1.3V, V_{OUT} = 12V		1		uA
Operating quiescent current from V_{OUT}				150		
Shutdown current into V_{IN}	I_{SD}	IC disabled, no load, no feedback resistor divider		1		uA
VCC regulation	V_{CC}	V_{IN} = 4.0V, V_{OUT} = 12V, light load		5.249		V
		V_{IN} = 4.0V, V_{OUT} = 12V, I_{LOAD} = 1A		5.008		V

EN Input

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
EN high threshold voltage	V_{ENH}				1.5	V
EN low threshold voltage	V_{ENL}		0.3			V
EN internal pull-down resistance	R_{EN}			1300		kΩ

OUTPUT

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Output voltage range	V_{OUT}		4.5		20	V
Output overvoltage protection	V_{OVP}			22		V
Reference voltage at the FB pin	V_{REF}		1.17	1.204	1.23	V
Soft-start charging current	I_{SS}			5		uA

[1] Depending on parts and pattern layout, characteristics may be changed

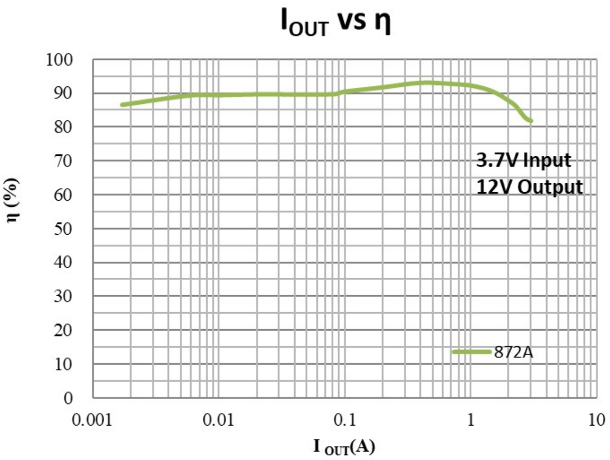
ERROR AMPLIFIER

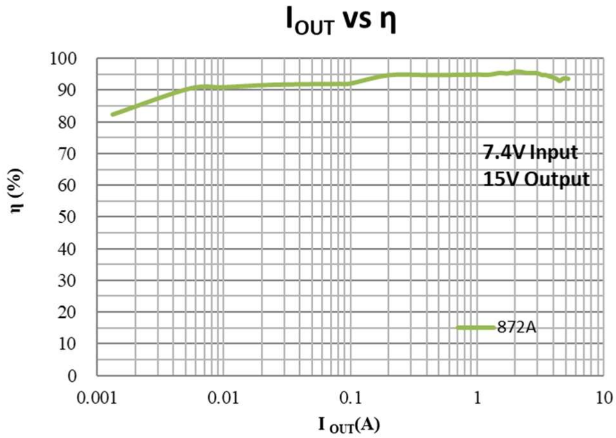
PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
COMP pin sink current	I_{SINK}	$V_{FB} = V_{REF}$ +200 mV, V_{COMP} = 1.5 V		20		uA
COMP pin source current	I_{SOURCE}	$V_{FB} = V_{REF}$ –200 mV, V_{COMP} = 1.5 V		20		uA
High clamp voltage at the COMP pin	V_{CC_LPH}	V_{FB} = 1 V, R_{ILIM} = 100 kΩ		2.1		V
Low clamp voltage at the COMP pin	V_{CC_LPL}	V_{FB} = 1.4 V, R_{ILIM} = 100 kΩ,		0.95		V
Error amplifier transconductance	G_{EA}	V_{COMP} = 1.5 V		204		uA/V

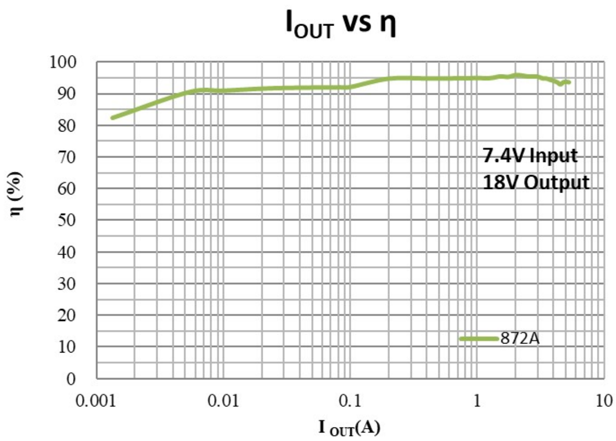
PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
POWER SWITCH						
MOSFET on-resistance	$R_{DS(on)}$	High-side MOSFET		10		mΩ
		Low-side MOSFET		8		mΩ
CURRENT LIMIT						
Peak switch current limit	I_{LIM}	R_{ILIM} = 120 kΩ		12.3		A
		R_{ILIM} = 75 kΩ		19		
Reference voltage at the ILIM pin	V_{ILIM}			1.204		V
SWITCHING FREQUENCY						
Switching frequency	f_{SW}	V_{IN} = 3.7V, V_{OUT} = 15V		370		kHz
Minimum on-time	t_{ON_min}	V_{IN} = 3.7V, V_{OUT} = 12V		230		ns
THERMAL SHUTDOWN						
Thermal shutdown threshold	T_{SD}			160		℃
Thermal shutdown hysteresis	T_{SD_HYS}			20		℃

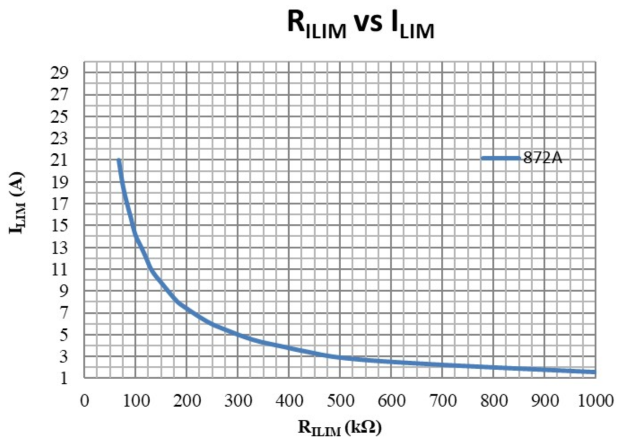
■ TYPICAL OPERATING CHARACTERISTICS

Condition: L = 2.2uH, R_{ILIM} = 75k, otherwise specified.









■ APPLICATION INFORMATION

1 Operation Mode

The synchronous boost converter HTN872A operates at a quasi-constant frequency pulse width modulation (PWM) in moderate to heavy load condition. In light load condition, the HTN872A works in PFM mode.

同步升压芯片 HTN872A 在重载时，工作在类似固定频率的 PWM 调制。在轻载时，其工作在 PFM 模式。

2 Enable and Startup (EN and SS pin)

The HTN872A has an adjustable soft start function to prevent high inrush current during start-up. To minimize the inrush current during start-up, an external capacitor, connected to the SS pin and charged with a constant current, is used to slowly ramp up the internal positive input of the error amplifier. The larger the capacitance at the SS pin, the slower the ramp of the output voltage and the longer the soft-start time. A 100nF capacitor is usually sufficient for most applications.

When the EN pin is pulled into logic low, the HTN872A goes into the shutdown mode and stops switching. Only when EN pin is pulled into logic high, the HTN872A works.

HTN872A 具有软起动功能，防止启动时的高浪涌电流。SS 脚需外界电容到地，一般 100nF，SS 使用恒定电流对该电容充电，电容越大，充电时间越长，即软起动时间越长。

EN 为芯片使能脚，EN 拉低，芯片进入关断模式，停止开关；EN 拉高，芯片进入工作状态。

3 Adjustable Peak Current Limit (ILIM pin)

To avoid an accidental large peak current, an internal cycle-by-cycle current limit is adopted. The low-side switch is turned off immediately as soon as the switch current touches the limit. The peak switch current limit can be set by a resistor (RILIM) at the ILIM pin to ground. The relationship between the current limit and the resistance is as follows:

芯片采用逐周期电流限制，避免意外的大峰值电流。当开关电流达到设置的限流值，低侧开关管立即断开。峰值开关电流限制（限流值 ILIM）可以通过 ILIM 引脚对地接 R_{ILIM} 进行设置。限制值 ILIM 和电阻 R_{ILIM} 之间的关系如下：

$$I_{LIM} = \frac{1500000}{R_{ILIM}} \quad \text{Equation 1}$$

4 Output Voltage Setting (FB pin)

The output voltage is set by an external resistor divider (R_{UP}, R_{DN} in the Typical Application Circuit):

输出电压由外部电阻分压器（R_{UP}，典型应用电路中的 R_{DN}）设置：

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_{UP}}{R_{DN}}\right) \quad \text{Equation 2}$$

Where V_{REF} = 1.204V.

Some typical output voltages can be set as the following parameters.

其中 V_{REF} = 1.204V。

部分典型电压可参考如下：

Table 1 Typical Output Voltage Settings

V_{OUT}(V)	R_{UP}(Ω)	R_{DN}(Ω)
7.3	510k	100k
9.4	510k	75k
12.2	510k	56k
15.5	510k	43k
18.3	510k	36k
19.5	510k	33k

5 Inductor Selection (SW pin)

The inductor is the most important component in switching power regulator design. Three most important specifications to the performance of the inductor are the inductor value, DC resistance, and saturation current.

To be simplified, the inductor value can be set as 2.2uH which can be used in most cases.

The rated current, especially the saturation current should be larger than the peak current during the whole operation. The peak current can be calculated as follows.

电感是该芯片的关键器件，影响性能的主要是其电感值，直流阻抗，饱和电流。

对于电感值，使用 2.2uH 的电感可以满足大部分应用。

对于额定电流，特别是饱和电流，必须大于所有工作条件下的最大峰值电流，最大峰值电流计算如下：

$$I_{Lpeak} = I_{DC} + \frac{I_{PP}}{2} \quad \text{Equation 3}$$

$$I_{DC} = \frac{V_{OUT} \times I_{OUT}}{V_{IN} \times \eta} \quad \text{Equation 4}$$

$$I_{PP} = \frac{1}{L \times \left(\frac{1}{V_{OUT}-V_{IN}} + \frac{1}{V_{IN}}\right) \times f_{SW}} \quad \text{Equation 5}$$

Boost converter efficiency is affected significantly by the inductor's DC resistance (DCR), equivalent series resistance (ESR) at the switching frequency, and the core loss. An inductor with lower DCR and ESR would increase the efficiency significantly.

The inductor should be placed as close as possible to the SW pin. For a lower EMI radiation, connecting a resistor and a capacitor in series to the ground would be helpful. 1ohm resistor and 3.3nF capacitor would be recommended in most cases.

Once the input voltage is higher than 10V, and the device is in high risk of OTP (over temperature protection) with high load current and poor thermal performance, a diode (SS14 is recommended) is required between SW and VOUT.

升压效率受电感的直流阻抗、开关频率下的等效 ESR、磁心损耗等影响。选择小的 DCR 和 ESR 可提升效率。

电感应尽可能靠近 SW 引脚放置，并靠近 SW 引脚放置 1ohm 串联 3.3nF 到地。

当输入电压超过 10V，输出负载电流较大，系统散热情况较差，芯片有过温关断风险时，SW 与 VOUT 间需增加一个二极管（SS14）。

6 Input Capacitor Selection (VIN, VCC pin)

For good input voltage filtering and small voltage ripple, we recommend low-ESR capacitors of 1uF//10uF//10uF//220uF ("//" represents paralleled) be placed as close as possible to the inductor.

The VIN pin is the power supply for the HTN872A, a 1uF paralleled with 10uF ceramic capacitor should be placed as close as possible to the VIN pin. A resistor of 100R is recommended between input power supply and VIN pin so that the power supply of HTN872A would be more stable. An extensive power supply such as the logic power supply connecting to VIN would be another choice.

The VCC pin is the output of internal LDO. A ceramic capacitor of 2.2uF is required at the VCC pin to get a stable operation of LDO.

为了良好的储能和滤波以及减小电压波动，建议电源输入端使用 1uF//10uF//10uF//220uF 组合，放置在靠近电感的大电流路径上。

VIN 脚是 HTN872A 的电源供电端，1uF 并联 10uF 对地电容放置在靠近 VIN 脚。输入电源和 VIN 脚之间可以串联 1 个 100R 电阻，已稳定 VIN 电压。VIN 还可以有系统中的逻辑电源供电。

VCC 是内部 LDO 输出，接 2.2uF 电容到地。

7 Output Capacitor Selection (VOUT pin)

To be simplified, we recommend low-ESR capacitors of 1uF//10uF//10uF//470uF ("//" represents paralleled) be placed as close as possible to VOUT pin for small output voltage ripple.

In detail, for the require output voltage ripple, use the following equations to calculate the minimum required effective capacitance C_{OUT}

简单来说，升压输出到地滤波电容建议使用 1uF//10uF//10uF//470uF 的组合，尽量靠近 Vout 引脚放置。

具体的，可以根据需要的输出电压纹波，得到需要的输出电容值：

$$V_{ripple\_dis} = \frac{(V_{OUT} - V_{IN_{MIN}}) \times I_{OUT}}{V_{OUT} \times f_{SW} \times C_{OUT}} \quad \text{Equation 6}$$

$$V_{ripple\_ESR} = I_{Lpeak} \times R_{C\_ESR} \quad \text{Equation 7}$$

Where

- Vripple_dis is output voltage ripple caused by charging and discharging of the output capacitor.
- Vripple_ESR is output voltage ripple caused by ESR of the output capacitor.
- V_{IN_MIN} is the minimum input voltage of boost converter..
- V_{OUT} is the output voltage..
- I_{OUT} is the output current.
- I_{Lpeak} is the peak current of the inductor.
- f_{SW} is the converter switching frequency.
- R_{C_ESR} is the ESR of the output capacitors.

其中：

- Vripple_dis 是对电容充放电引起的输出电压纹波.
- Vripple_ESR 是输出电容ESR引起的输出电压纹波.
- V_{IN_MIN} 是最小输入电压.
- V_{OUT} 是输出电压.
- I_{OUT} 是输出电流.
- I_{Lpeak} 是电感峰值电流.
- f_{SW} 是开关频率.
- R_{C_ESR} 是输出电容 ESR.

8 Loop Stability (COMP pin)

The HTN872A requires external compensation, which allows the loop response to be optimized for each application. The COMP pin is the output of the internal error amplifier. An external compensation network comprised of resister R_C, ceramic capacitors C_C and C_P is connected to the COMP pin.

To be simplified, R_C is 56kΩ, C_C is 3.3nF, and C_P can be floating. But notice that this setting can only be adopted in most cases. In detail, the compensation network parameters can be calculated as follows.

(1) Set the cross over frequency, f_c

The first step is to set the loop crossover frequency, f_C. The higher crossover frequency, the faster the loop response is. It is generally accepted that the loop gain cross over no higher than the lower of either 1/10 of the switching frequency, f_{SW}, or 1/5 of the RHPZ frequency, f_{RHPZ}. It's proper to use a fixed parameter of 10kHz for f_C.

HTN872A 需要外部补偿，在 COMP 引脚外接 Rc, Cc, Cp。简单来说，R_C=56kΩ, C_C=3.3nF，C_P 悬空可以满足大部分应用。以下是补偿网络的计算过程：

(1) 设置交叉频率 fc

Fc 越大，响应越快。一般其设置为开关频率的 1/10 或 1/5 的 f_{RHPZ}，或直接为 10kHz.

$$f_{RHPZ}=\frac{R_O\times(1-D)^2}{2\pi\times L}$$ Equation 8

(2) Set the compensation resistor, R_C.

(2) 设置补偿网络 Rc

$$R_C=\frac{2\pi\times V_{OUT}\times R_{sense}\times f_C\times C_O}{(1-D)\times V_{REF}\times G_{EA}}$$ Equation 9

(3) Set the compensation resistor, C_C.

(3) 设置补偿网络 Cc

$$C_C=\frac{R_O\times C_O}{2\times R_C}$$ Equation 10

(4) Set the compensation resistor, C_P.

(4) 设置补偿网络 Cp

$$C_P=\frac{R_{ESR}\times C_O}{R_C}$$ Equation 11

If the C_P is less than 10pF, it can be left open.

如果 Cp 小于 10pF，可以悬空。

- R_O is the output load resistance.
- D is the switching duty cycle. $1 - D = V_{IN} / V_{OUT}$
- R_{sense} is the equivalent internal current sense resistor, which is 0.091 Ω.
- C_O is output capacitor.
- V_{REF} is the reference voltage at the FB pin, which is 1.204V.
- G_{EA} is the amplifier's transconductance, which is 204uA/V.
- R_{ESR} is the equivalent series resistance of the output capacitor.

其中 Ro 是输出负载；

D 是占空比，$1 - D = V_{IN} / V_{OUT}$

R_{sense} 是内部等效电流感应电阻，0.076 Ω

Co 是输出电容

VREF 是 FB 电压，1.204V

G_{EA} 是跨导，204uA/V

R_{ESR} 是输出电容的等效串联电阻。

9 Selecting the Bootstrap Capacitor (BOOT pin)

The bootstrap capacitor (C_{BST}) between the BOOT and SW pin supplies the gate current to charge the high-side FET device gate during each cycle's turn-on and supplies charge for the bootstrap capacitor. The recommended value of the bootstrap capacitor is 0.1µF to 1µF. C_{BST} should be a good quality, low ESR, ceramic capacitor located at the pins of the device to minimize potentially damaging voltage transients caused by trace inductance. A value of 0.1µF can be used in most cases.

BOOT 和 SW 之间需放置一个 C_{BST} 电容，用于高端管开启时的栅极驱动。一般使用 0.1uF~1uF，大部分情况下可使用 0.1uF 电容。

10 Protection Function

10.1 Under-voltage Lockout (UVLO)

The UVLO circuit prevents the device from malfunctioning at low input voltage and the battery from excessive discharge. The HTN872A has both VIN UVLO function and VCC UVLO function. It disables the device from switching when the falling voltage at the VIN pin trips the UVLO threshold V_{IN_UVLO}, which is typically 2.3V. The device starts operating when the rising voltage at the VIN pin is 200mV above the V_{IN_UVLO}. It also disables the device when the falling voltage at the VCC pin trips the UVLO threshold V_{CC_UVLO}, which is typically 2.1V.

HTN872A 具有 VIN 和 VCC 欠压保护。当 VIN 小于 V_{IN_UVLO}（典型 2.3V）时，器件停止开关，直至 VIN 大于 V_{IN_UVLO}（典型 2.5V）,器件重新工作。当 VCC 小于 V_{CC_UVLO}（典型 2.1V）时，器件同样停止工作。

10.2 Over-voltage Protection

If the output voltage at the VOUT pin is detected above 22 V (typical value), the HTN872A stops switching immediately until the voltage at the VOUT pin drops the hysteresis value lower than the output overvoltage protection threshold. This function prevents overvoltage on the output and secures the circuits connected to the output from excessive overvoltage.

当 VOUT 电压高于 22V（典型值），HTN872A 停止工作，直到 VOUT 低于 21.5V（典型值）。

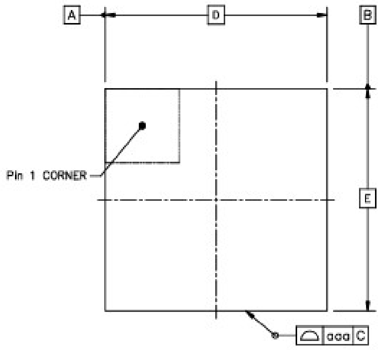
10.3 Thermal Shutdown

A thermal shutdown is implemented to prevent damages due to excessive heat and power dissipation. Typically, the thermal shutdown happens at a junction temperature of 160°C. When the thermal shutdown is triggered, the device stops switching until the junction temperature falls below typically 140°C, then the device starts switching again.

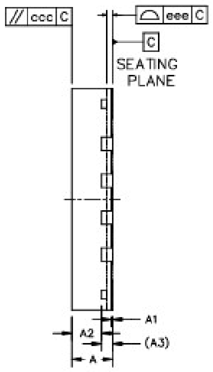
芯片具有过温关断保护功能。当结温大于 160°C（典型值），芯片关断；当结温低于 140°C（典型值），芯片恢复工作。

■ PACKAGE OUTLINE

SQE (QFN3×3-16L)

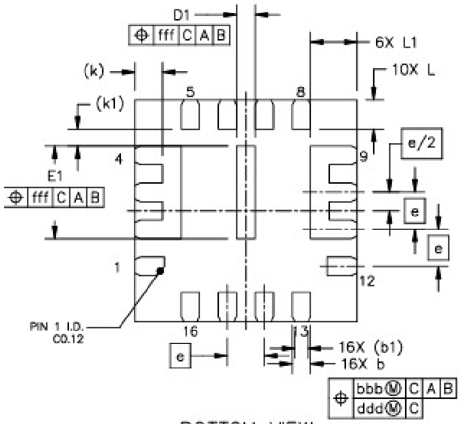


TOP VIEW



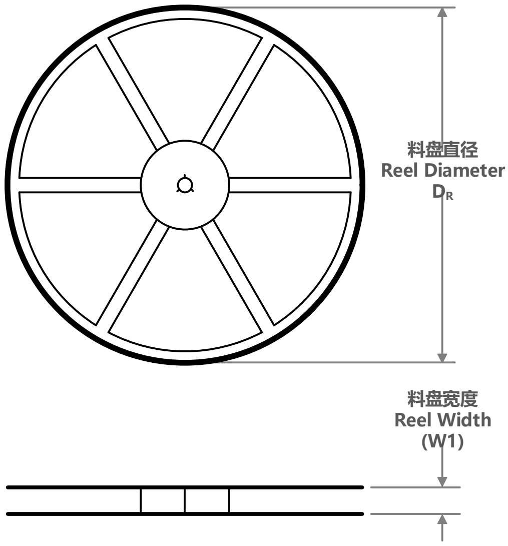
SIDE VIEW

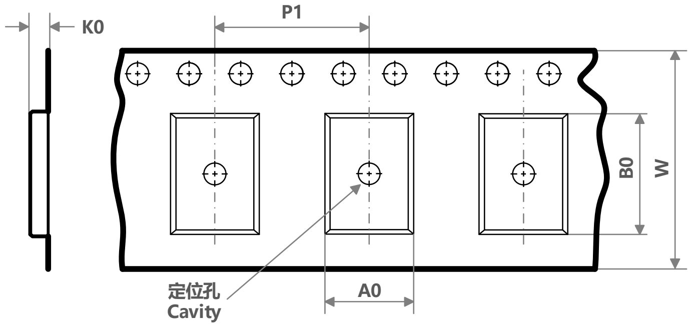
		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.5	0.55	0.6
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2	---	0.4	---
L/F THICKNESS		A3		0.152 REF	
LEAD WIDTH		b	0.2	0.25	0.3
		b1		0.18 REF	
BODY SIZE	X	D		3 BSC	
	Y	E		3 BSC	
LEAD PITCH		e		0.5 BSC	
LEAD LENGTH		L	0.3	0.4	0.5
		L1	0.525	0.625	0.725
EXPOSED PAD SIZE	X	D1	0.15	0.25	0.35
	Y	E1	1.15	1.25	1.35
LEAD EDGE TO PACKAGE EDGE		k		0.375 REF	
EXPOSED PAD EDGE TO LEAD EDGE		k1		0.225 REF	
PACKAGE EDGE TOLERANCE		aaa		0.1	
MOLD FLATNESS		ccc		0.1	
COPLANARITY		eee		0.08	
LEAD OFFSET		bbb		0.1	
		ddd		0.05	
EXPOSED PAD OFFSET		fff		0.1	



BOTTOM VIEW

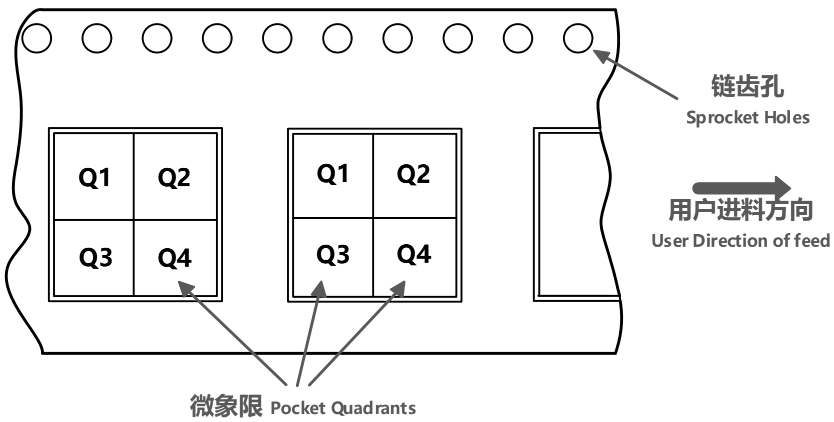
■ TAPE AND REEL INFORMATION





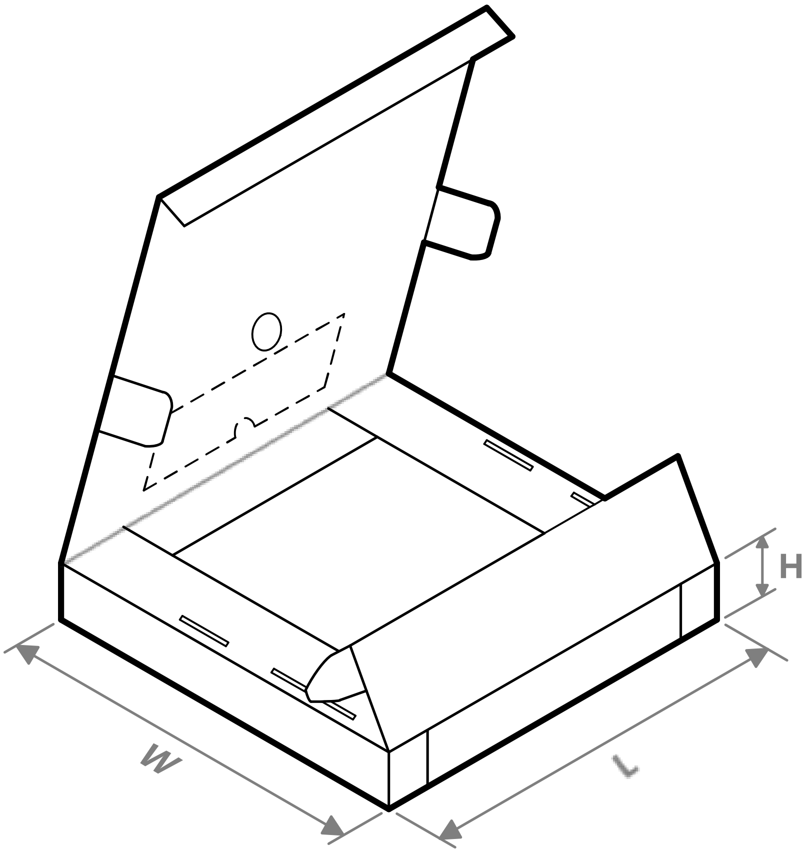
A0	Dimension designed to accommodate the component width; 料槽宽度
B0	Dimension designed to accommodate the component length; 料槽长度
K0	Dimension designed to accommodate the component thickness; 料槽厚度
W	Overall width of the carrier tape; 载带整体宽度
P1	Pitch between successive cavity centers; 相邻槽中心间距

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 Code	引脚数 Pins	SPQ	料盘直径 DR(mm)	料盘宽度 W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 象限 Quadrant
HTN872ASQER	QFN3×3	SQE	16	TBD	330	TBD	TBD	TBD	TBD	TBD	TBD	Q1

■ TAPE AND REEL BOX INFORMATION



器件料号 Part No.	封装类型 Package Type	封装标识 Package Code	引脚数 Pins	SPQ	长度 Length (mm)	宽度 Width (mm)	高度 Height (mm)
HTN872ASQER	QFN3×3	SQE	16	TBD	TBD	TBD	TBD

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