内置升压的60W立体声D类音频功放

2×60W Class D Audio Amplifier with Boost Converter

■ FEATURES

・Output Power (f_{IN} = 1kHz, R_L=4Ω, BTL)
V_{BAT} = 7.4V, 2×40W (V_{OUT}=18V, THD+N= 10%)
V_{BAT} = 12V, 2×60W (VOUT=22V, THD+N = 10%)
・Output Power (f_{IN} = 1kHz, R_L=2Ω, PBTL)
VBAT = 7.4V, 77W (VOUT=18V, THD+N= 10%)
VBAT = 12V, 120W (VOUT=22V, THD+N = 10%)
・Power Supply V_{BAT}: 2.7V~VOUT
・Spread Switching Frequency Function for AMP
・Differential / Single-ended Analog Input, BTL or PBTL Output
・Integrated boost converter: adjustable output voltage VOUT and switch peak current limit
・Over current protection/ Over temperature protection / Overvoltage protection / Low voltage malfunction prevention function with auto recovery
・Pb-free Packages, ETSSOP32 (EP UP)

・输出功率(f_{IN}=1kHz, R_L=4Ω, BTL)
双锂电7.4V：2×40W (V_{OUT}=18V, THD+N= 10%)
三锂电12V：2×60W (VOUT=22V, THD+N = 10%)
・输出功率(f_{IN}=1kHz, R_L=2Ω, PBTL)
双锂电7.4V：77W (VOUT=18V, THD+N= 10%)
三锂电12V：120W (VOUT=22V, THD+N = 10%)
・VBAT供电范围：2.7V至VOUT
・D类功放扩频功能
・模拟差分/单端输入，输出模式立体声/单声道可选
・内置升压电路：可调节的升压值和升压限流
・保护功能：过流/过热/欠压异常/过压保护功能
・无铅无卤封装，ETSSOP32 (EP UP)

■ APPLICATIONS

・Smart Speakers ・Wireless Speakers
・Portable Speakers ・2.1Channel Speakers
・Megaphone ・Portable Gamers

・智能音响 ・无线音响 ・便携式音箱
・2.1声道小音箱 ・拉杆音箱 ・便携式游戏机

■ DESCRIPTION

The HTA8128 is a stereo Class D audio amplifier integrated a boost converter. With wide input voltage range, HTA8128 supports applications with single cell, two cell Lithium batteries, 5V or 12V power supply and so on, and can drive two speakers in BTL mode or one speaker in paralleled PBTL mode.

HTA8128 built-in boost converter supports selectable output voltage by external resistors for different applications with different power requirements. It also implements an adjustable switching peak current limit function through external resistors.

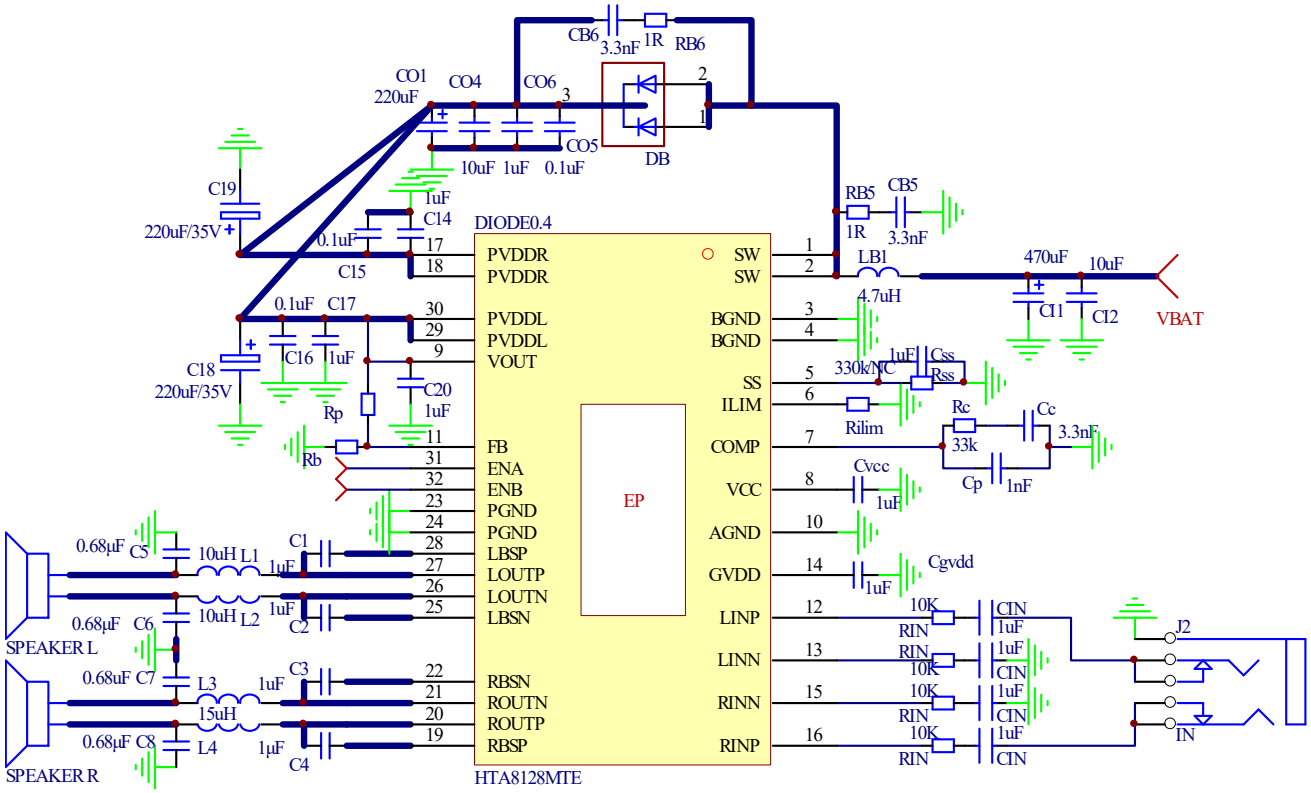
HTA8128 has a filter-less modulation circuit which can directly drive speakers. HTA8128 can be shut down so that the power consumption can be minimized. As for protection function, over current protection function for speaker output terminals, over temperature protection function, low supply voltage malfunction preventing function and over boost voltage protection are also prepared.

HTA8128是一款内置升压的立体声D类音频功率放大器，其支持单节锂电、双节锂电串联、5V、12V等多种输入，升压后的电压提供给功放供电，功放支持双通道立体声BTL输出以及并联PBTL单声道输出。

HTA8128内置的升压电路，可通过FB脚设置升压值，以满足不同的输出功率需求。其还可通过外置电阻调节开关峰值电流限值。

此外，HTA8128内部集成免滤波器调制技术，能够直接驱动扬声器，内置的关断功能使待机电流最小化，还集成了输出端过流保护、片内过温保护、输入电源欠压异常保护、升压电压过压保护等功能。

■ TYPICAL APPLICATION



1. ENA, ENB分别控制功放部分、升压部分的使能。

ENA=H: 功放工作（有两种工作方式，如下表）；ENA=L: 功放关断。功放发生过流、过热、直流保护时，ENA开漏输出低。

V_{ENA}	Working Mode
<0.5V	功放关断 Amp disabled
1.8V~2.1V	功放工作，扩频功能关闭 Spread spectrum Disabled
2.5~5.5V	功放工作，扩频功能开启 Spread spectrum Enabled

ENB=H: 升压工作；ENB=L: 不升压。

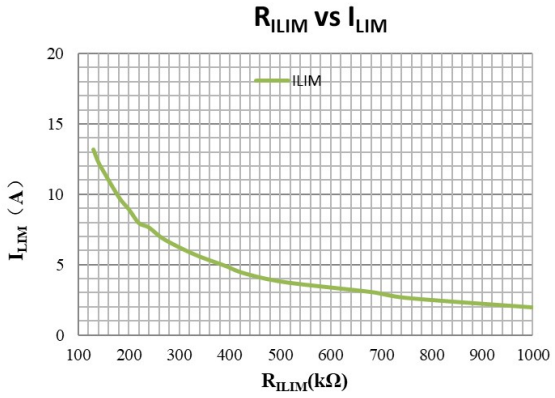
建议上电时序：VBAT上电，延时10ms后，ENB拉高，延时150ms后，ENA拉高；若ENA与ENB短接在一起拉高，则建议SS电容减小为100nF。

2. 升压电压设置，通过FB端Rp和Rd电阻。计算公式、推荐设置，如下

$$V_{OUT} = 1.204 \times (1 + \frac{R_P}{R_D})$$

V_{OUT}(V)	R_P(Ω)	R_D(Ω)
7.4	510k	100k
9	520k	82k
12.5	520k	56k
14.8	510k	47k
18.2	510k	36k
22.1	470k	27k

3. 升压部分电感峰值电流I_{LIM}设置，通过ILIM pin下地电阻R_{ILIM}，可参考下图取值，I_{LIM}设置建议小于电源输入端最大电流能力，并设置大于$1.4 \times \frac{P_{o_peak}}{V_{VIN} \times 70\%}$



4. 升压部分电感推荐使用4.7uH，其饱和电流I_{SAT} > I_{LIM}

5. 升压部分肖特基二极管推荐使用2*SS54，其V_{RMS} > 1.5*V_{OUT}, $I_{F(AV)}$ > I_{OUTmax}

6. SW端预留两组RC (RB5, CB5; RB6,CB6)，并根据SW峰值电压和EMI表现，酌情添加。电阻推荐使用1206封装。

7. SS端设置升压的软起动时间，以及SW端的tr/tf时间

   其中到地的C_{SS}电容设置软起动时间，建议使用1uF电容。软起动时间$t_{SS}(ms) \approx \frac{1.204 \times C_{SS}(nF)}{5}$

   到地的电阻R_{SS}设置tr/tf时间，不接R_{SS}时，SW端tr/tf更陡，此时芯片效率更高，但EMI表现更差；当R_{SS}=330k时，tr/tf更缓，此时芯片效率更低，但EMI表现更好。

8. Comp端设置升压部分的补偿电路，一般使用推荐的Rc = 33k, Cc = 3.3nF, Cp = 1nF。如出现输出不稳定、THD+N异常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。

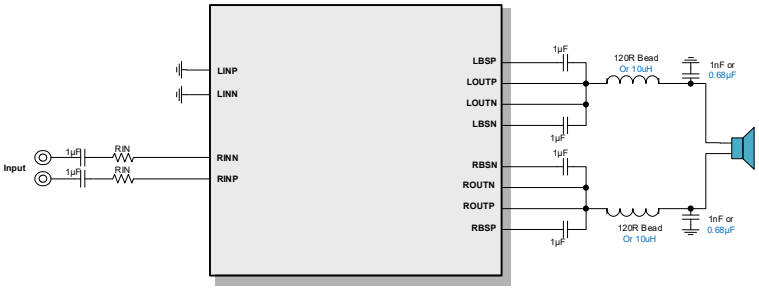
9. 升压输入端VBAT，建议加入10uF//220uF的并联电容到地；升压输出电压端(肖特基二极管端)，建议放置0.1uF//1uF//220uF的并联电容到地，电容的额定电压需留有足够的余量，其使用粗线短路径连接到PVDDL和PVDDR后，在靠近各自引脚加入0.1uF//1uF//220uF的并联电容到地。

10. 音频输入端，可接入单端或差分信号，上图按单端信号示意接入。其中R_{IN}影响系统增益，C_{IN}影响低频频响：系统增益$Gain(dB) \approx 20 \times \log\left(\frac{400k}{10k+R_{IN}}\right)$，高通滤波器（衰减低频）截止频率

$$f_c(-3dB) = \frac{1}{2\pi(10k + R_{IN}) \times C_{IN}}$$

11. 音频输出端，可使用磁珠或电感作为滤波器。使用磁珠时，使用>200R@100MHz的磁珠，配合使用1nF的下地电容；使用电感时，使用10uH+0.68uF的组合（有高频频响平滑度要求时，需配合负载阻抗使用不同的LC，具体参考使用我司excel计算工具。

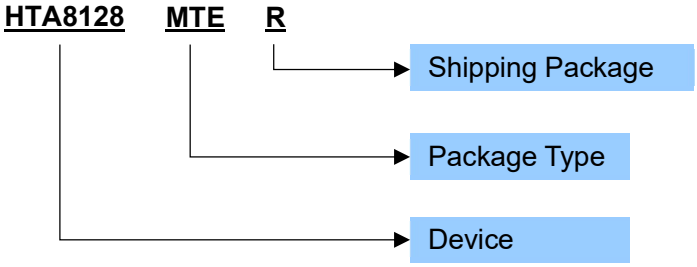
12. 芯片还可支持PBTL使用:



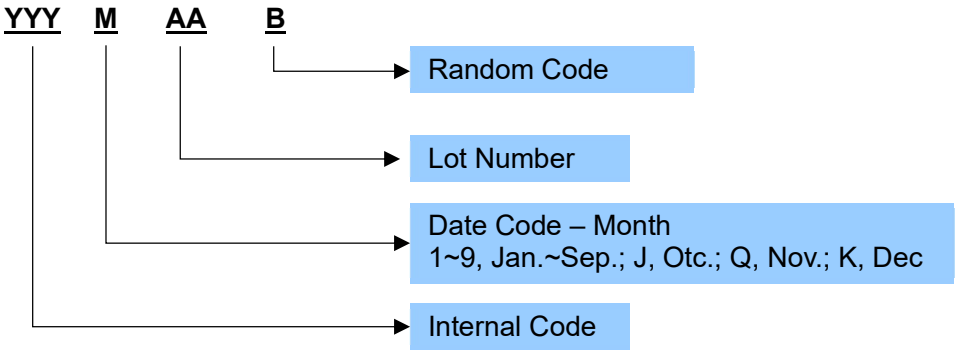
■ ORDERING INFORMATION

Part Number	Package Type	Marking	Operating Temperature Range	Shipping Package / MOQ
HTA8128MTER	ETSSOP32 (EP UP)	HTA8128 YYYMAAB[1]	-40℃～85℃	Tape and Reel 2000PCS

Part Number

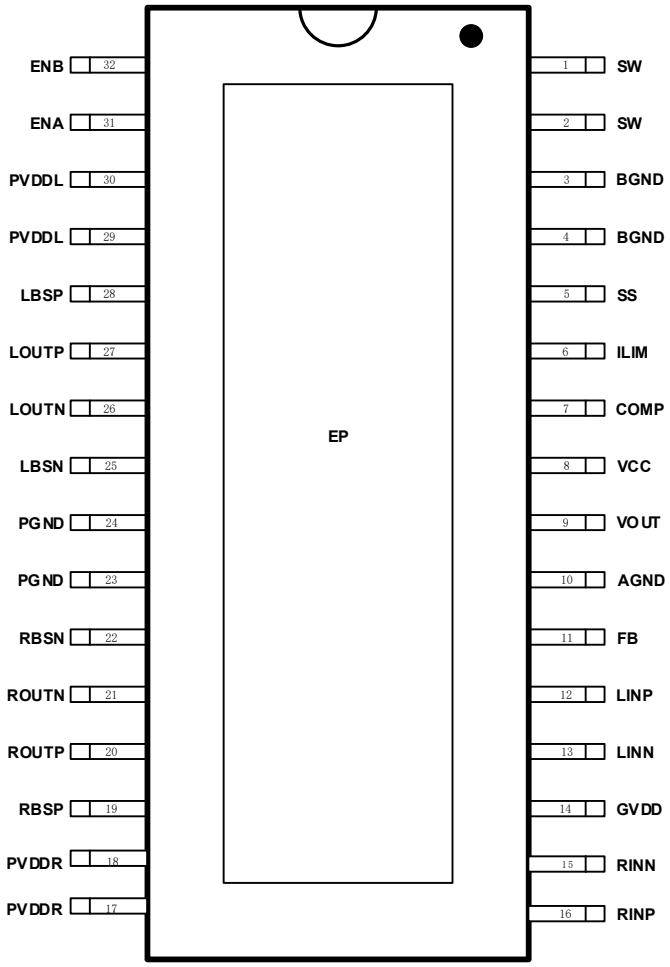


Production Tracking Code



[1] YYYMAAB is production tracking code

■ TERMINAL CONFIGURATION



Top View

■ TERMINAL FUNCTION

Terminal No.	Name	I/O[1]	Description
EP	--	-	Thermal pad up, must be good connected to heat-sink for power dissipation. 朝上的散热 PAD，需外接散热器。
32	ENB	I	Enable logic input for boost converter. Logic high level enables the device. Logic low level disables the device and turns it into bypass mode. 升压使能脚，高电平时升压开启，低电平时升压关闭
31	ENA	I	Enable logic input and operation mode selection for amplifier
29,30	PVDDL	P	Power supply terminal for left channel. 左声道功率电源端。
28	LBSP	BST	Connection point for the LOUTP bootstrap capacitor, which is used to create a power supply for the high-side gate drive for LOUTP. LOUTP 自举电容端
27	LOUTP	O	Positive output terminal (BTL+) for left channel. 左声道正端输出。
26	LOUTN	O	Negative output terminal (BTL-) for left channel.

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

			左声道负端输出。
25	LBSN	BST	Connection point for the LOUTN bootstrap capacitor, which is used to create a power supply for the high-side gate drive for LOUTN. LOUTN 自举电容端
23,24	PGND	P	Power ground for amplifier 功放功率地
22	RBSN	BST	Connection point for the ROUTN bootstrap capacitor, which is used to create a power supply for the high-side gate drive for ROUTN. ROUTN 自举电容端
21	ROUTN	O	Negative output terminal (BTL-) for right channel. 右声道负端输出。
20	ROUTP	O	Positive output terminal (BTL+) for right channel. 右声道正端输出
19	RBSP	BST	Connection point for the ROUTP bootstrap capacitor, which is used to create a power supply for the high-side gate drive for ROUTP. ROUTP 自举电容端
17,18	PVDDR	O	Power supply terminal for right channel. 右声道功率电源端。
16	RINP	I	Positive input (differential+) for audio amplifier of right channel. 音频右声道输入正端
15	RINN	I	Negative input (differential-) for audio amplifier of right channel. 音频右声道输入负端。
14	GVDD	O	Voltage regulator of amplifier, connect 1uF to GND. 功放内部电压，接 1uF 到地
13	LINN	I	Negative input (differential-) for audio amplifier of left channel. 音频左声道输入负端。
12	LINP	I	Positive input (differential+) for audio amplifier of left channel. 音频左声道输入正端。
11	FB	I	Voltage feedback. 电压反馈脚
10	AGND	G	Analog Ground. 模拟地
9	VOUT	P	Power supply for boost converter. 升压供电端
8	VCC	O	Output of the internal regulator for boost converter. A ceramic capacitor of 1uF is required between this pin and ground. 升压电路内部电压输出，接 1uF 到底。
7	COMP	O	Output of the internal error amplifier, the loop compensation network should be connected between this pin and the AGND pin. 内部补偿脚
6	ILIM	I	Adjustable switch peak current limit. An external resistor should be connected between this pin and GND. 最大限流值设置端，外部接电阻到地。
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. 升压软启动设置脚，接电容到地。 Also used as mode selection for different tr/tf, an external resistor connected to ground selects a flatter tr/tf. 同时作为 tr/tf 设置脚，当同时外接 1 个 330k 电阻到地时，选择较缓的 tr/tf。
3,4	BGND	G	Boost converter ground. 升压电路地。
1,2	SW	P	The switching node pin of the converter. 升压开关点

■ SPECIFICATIONS[1]

● Absolute Maximum Ratings[2]

PARAMETER		Symbol	MIN	MAX	UNIT
Voltage range	VOUT, PVDD	V_{IN}	-0.3	28	V
	SW	V_{SW}	-0.3	34	V
	LINP, LINN, RINP, RINN, ENA	V_I	-0.3	5.8	V
	ENB, VCC, SS, COMP	V_I	-0.3	7	V
	ILIM, FB	V_I	-0.3	3.6	V
Operating temperature range		T_A	-40	85	℃
Operating junction temperature range		T_J	-40	150	℃
Storage temperature range		T_{STG}	-50	150	℃

● Recommended Operating Condition

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
VBAT supply voltage range	V_{IN}		2.7	3.7	15	V
Output voltage range (VOUT, PVDD)	V_{OUT}		4.5		22	V
High-level input voltage of ENA, spread spectrum enabled	V_{ENAH}		2.5		5.5	V
Middle-level input voltage of ENA, spread spectrum disabled	V_{ENAM}		1.8		2.1	V
Low-level input voltage of ENA, amplifier shutdown	V_{ENAL}		0	0	0.5	V
High-level input voltage of ENB	V_{ENBH}		1.5		5.5	V
Low-level input voltage of ENB	V_{ENBL}		0		0.4	V
ENB internal pull-down resistor	R_{ENB}			800		kΩ
Inductance	L			4.7		μH
Operating temperature	T_a		-40	25	85	℃
Load impedance	R_L	BTL		4		Ω
		PBTL		2		Ω

● Electrical Characteristics

Boost Converter

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Output voltage range	V_{OUT}		4.5		22	V
Output overvoltage protection	V_{OVP}			28		V
Under-voltage lockout (UVLO) threshold for VOUT	V_{UVLO}	Rising		2.7		V
		Falling		2.5		V
Reference voltage at the FB pin	V_{FB}			1.204		V
Soft-start charging current	I_{SS}			5		uA
VCC regulation	VCC	V_{BAT} = 3.6V, V_{OUT} = 12V, light load		5.7		V
		V_{BAT} = 3.6V, V_{OUT} = 12V, I_{LOAD} = 0.5A		5.3		V
Boost converter input current limit	I_L	R_{ILIM} = 130k		13		A
Boost converter frequency	f_{BOOST}			350		kHz

[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

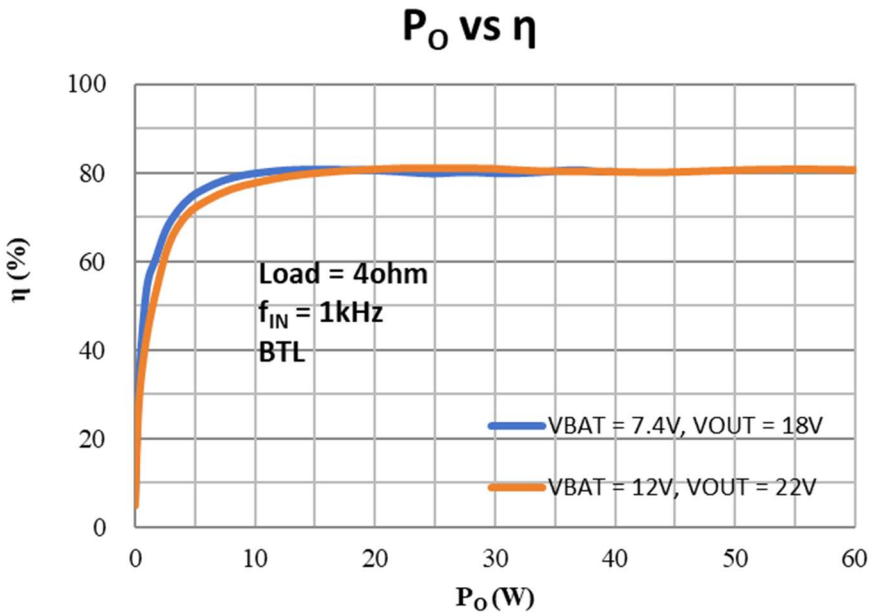
Audio Amplifier

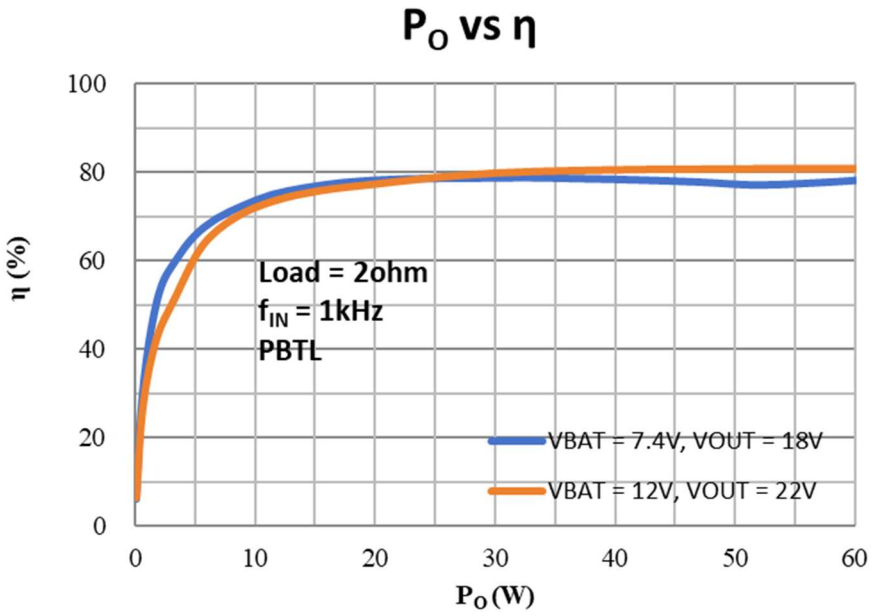
PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Amplifier Output Offset Voltage	V_{OS}	V_I = 0V, Gain = 32dB		1.5		mV
Quiescent supply current in SD mode	I_{SD}	V_{BAT} = 3.7V		11		uA
		V_{BAT} = 7.4V		24		uA
Operating quiescent current	I_{BAT}	VBAT = 12V, PVDD = 18V, ENA=ENB=H		110		mA
System Gain	Gain	Rin = 0kΩ		32		dB
		Rin = 10kΩ		26		dB
Turn-on time	t_{on}			100		ms
Turn-off time	t_{off}	Pull \SD low		5		us
Total harmonic distortion plus noise	THD+N	P_O=0.25W, R_L=4Ω, f=1kHz		0.05		%
Noise output voltage	V_N	f=20Hz~20kHz, A-weighted, 26dB		100		μV_{rms}
Class D switching frequency	$f_{Class-D}$			360		kHz
Spread frequency range				±15		kHz
GVDD regulation	GVDD			5		V
Over current trip point	OCP			8		A

Boost Converter + Class D

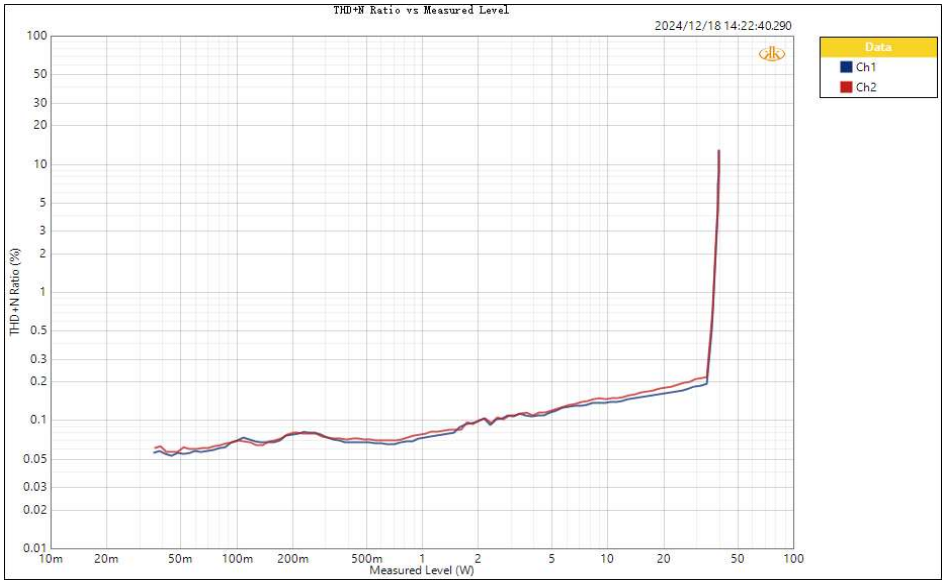
PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Efficiency (Class D + Boost)	η	V_{BAT} = 7.4V, PVDD = 18V, R_L=4Ω, Po = 2×40W		80		%
		V_{BAT} =12V, PVDD = 22V R_L=4Ω, Po = 2×60W		80		
Thermal shutdown threshold	T_{SD}			150		℃
Thermal shutdown hysteresis	T_{SD_HYS}			20		℃

■ TYPICAL OPERATING CHARACTERISTICS

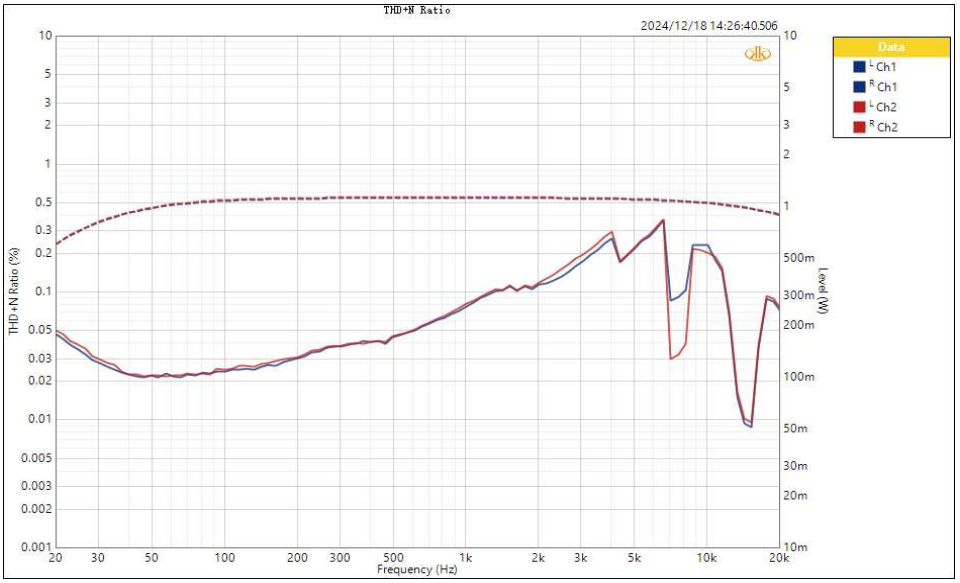




BTL mode, RL = 4ohm, f_{IN} = 1kHz, VBAT = 7.4V, PVDD=18V, R_{ILIM} = 130k, unless otherwise specified.



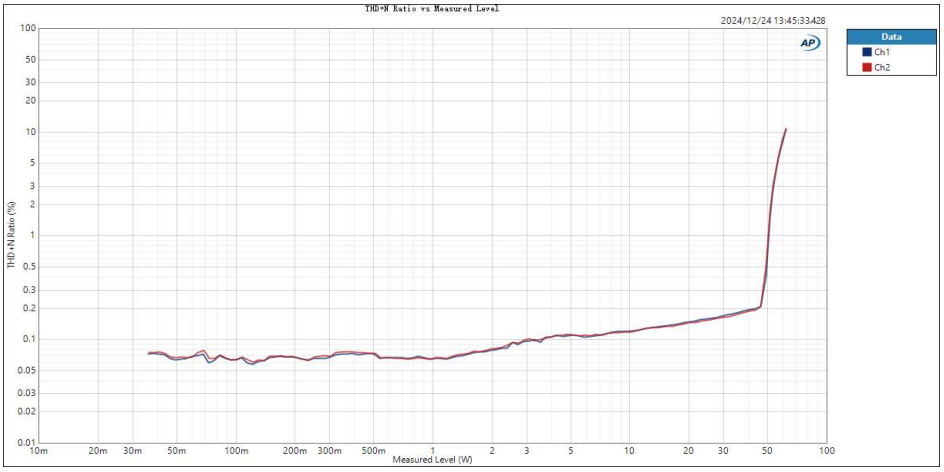
Output power vs THD+N



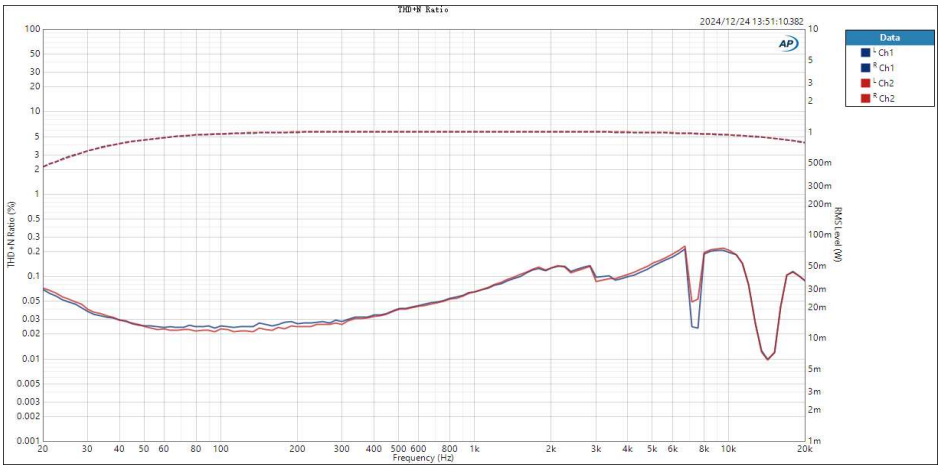
frequency vs THD+N

(Po ≈ 2×1W)

BTL mode, RL = 4ohm, f_{IN} = 1kHz, VBAT = 12V, PVDD=22V, R_{ILIM} = 130k, unless otherwise specified.



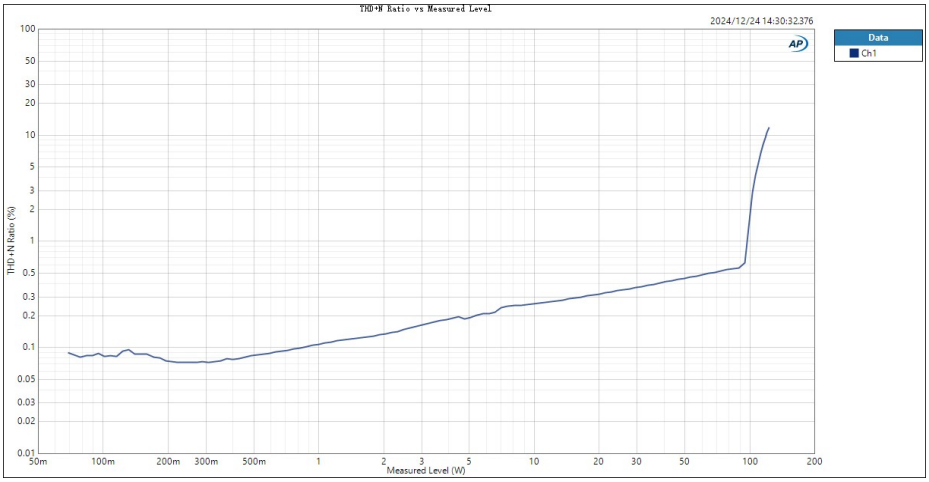
Output power vs THD+N



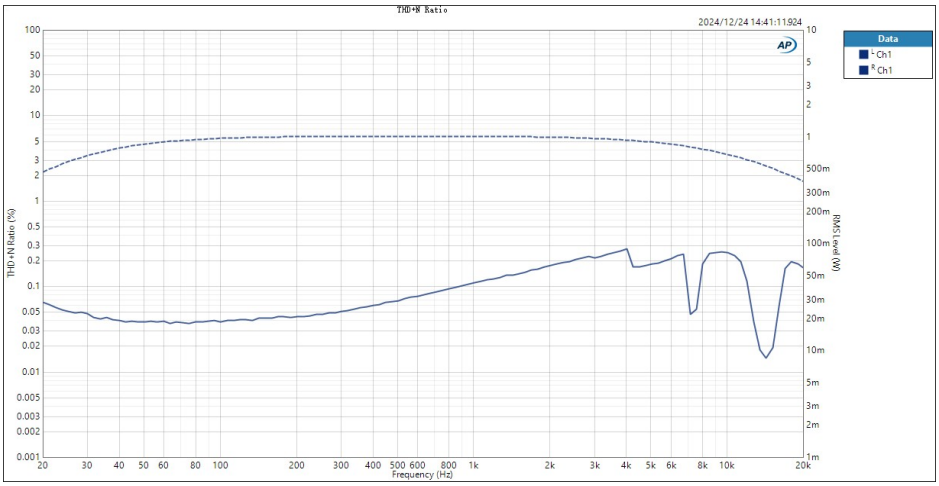
frequency vs THD+N

(Po ≈ 2×1W)

PBTL mode, RL = 2ohm, f_{IN} = 1kHz, VBAT = 12V, PVDD=22V, R_{ILIM} = 130k, unless otherwise specified.



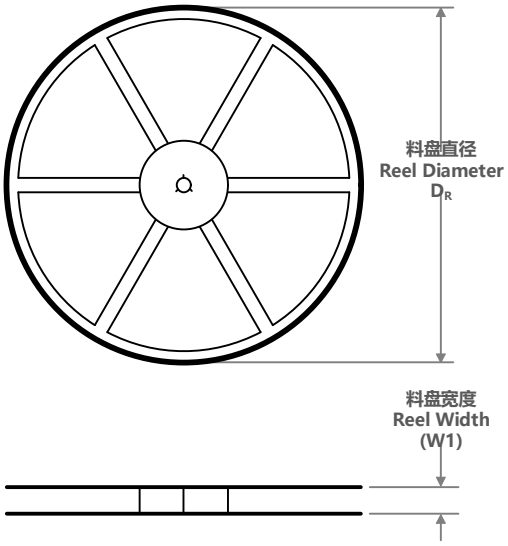
Output power vs THD+N

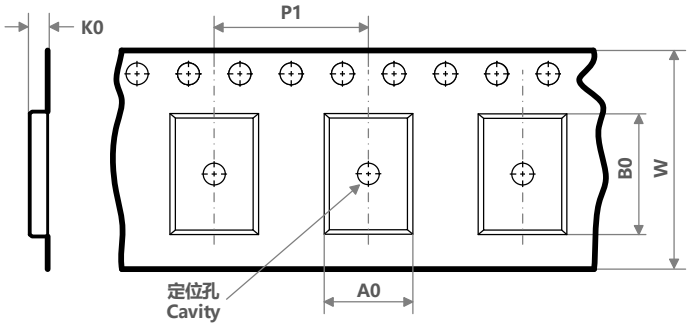


frequency vs THD+N

(Po ≈ 2×1W)

■ TAPE AND REEL INFORMATION

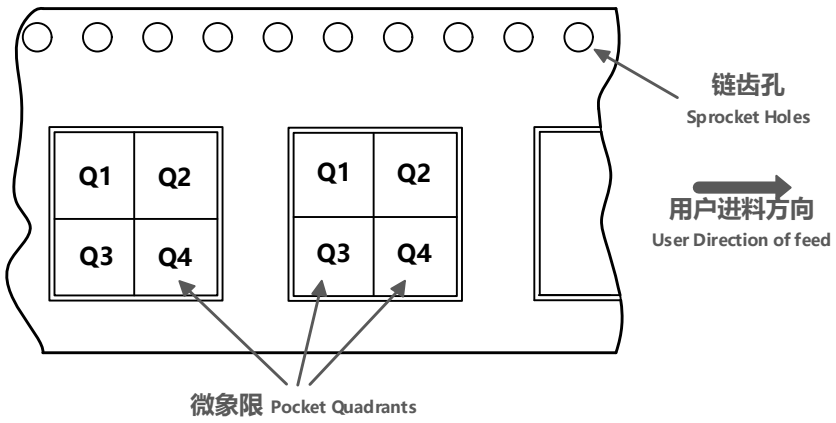




A0	Dimension designed to accommodate the component width; 料槽宽度
B0	Dimension designed to accommodate the component length; 料槽长度
K0	Dimension designed to accommodate the component thickness; 料槽厚度
W	Overall width of the carrier tape; 载带整体宽度
P1	Pitch between successive cavity centers; 相邻槽中心间距

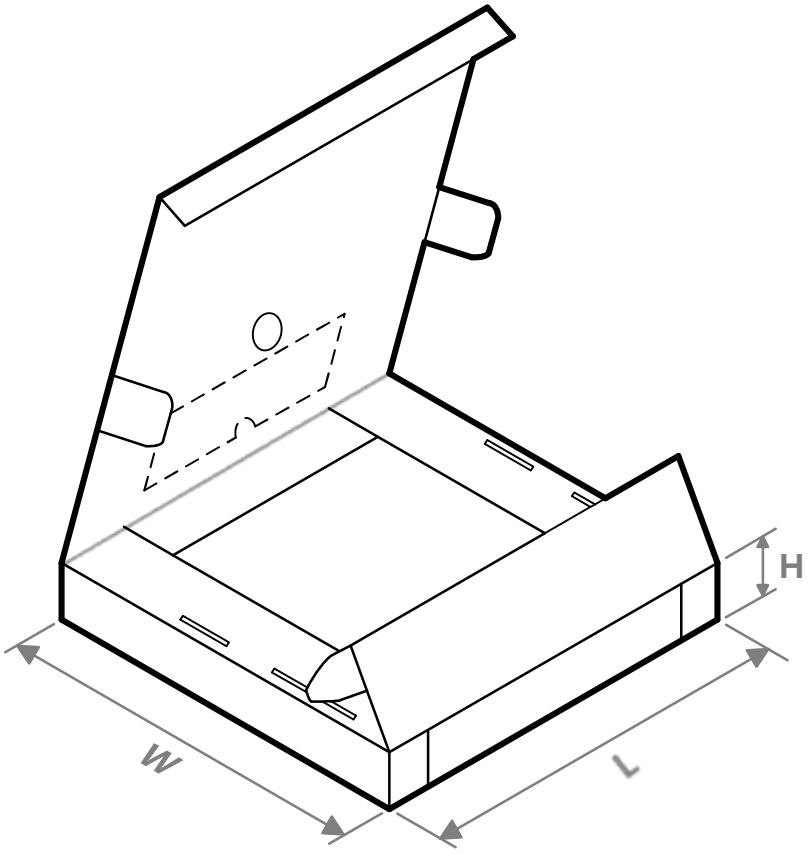
编带 PIN1 方位象限分配

Quadrant Assignments for Pin1 Orientation in Tape



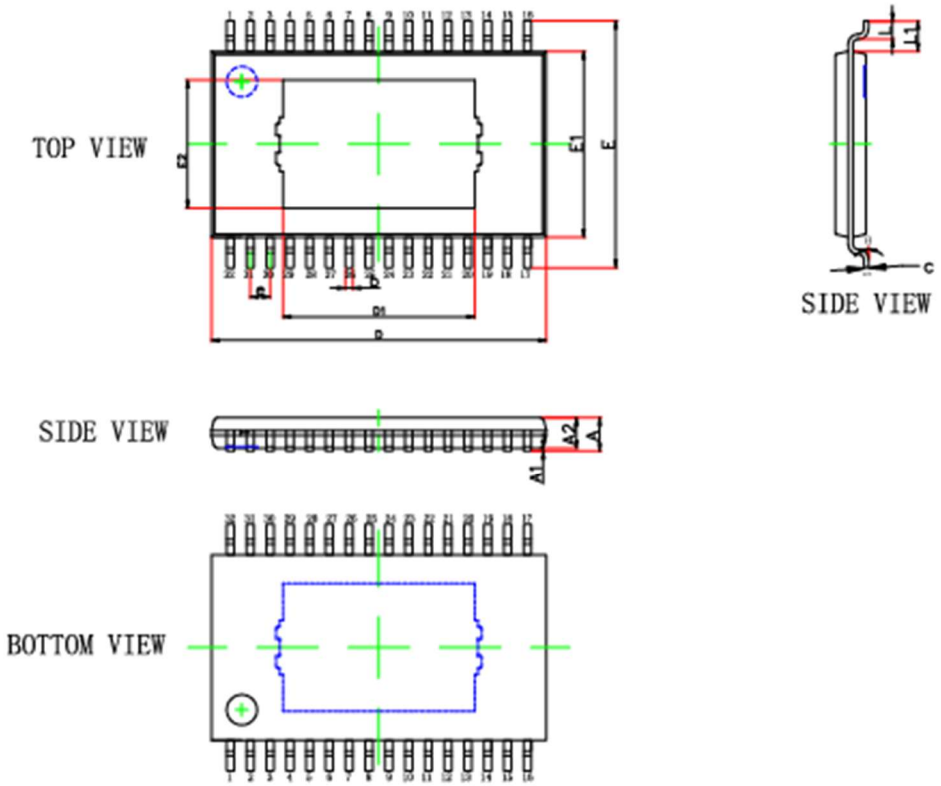
器件料号 Part No.	封装类型 Package Type	封装标识 Package Code	引脚数 Pins	SPQ	料盘直径 D_R(mm)	料盘宽度 W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 象限 Quadrant
HTA8128MTER	ETSSOP (EP UP)	MTE	32	2000	330	TBD	TBD	TBD	TBD	TBD	TBD	Q1

■ 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)
HTA8128MTER	ETSSOP (EP UP)	MTE	32	2000	336	336	48

■ PACKAGE OUTLINE



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	NOM	Max.	Min.	NOM	Max.
A	—	—	1.200	—		0.047
A1	0.000	0.075	0.150	0.000	0.003	0.006
A2	0.900	1.000	1.100	0.035	0.039	0.043
b	0.200	—	0.280	0.008	—	0.011
c	0.150	—	0.190	0.006	—	0.007
D	10.900	11.000	11.100	0.429	0.433	0.437
D1	6.200	6.300	6.400	0.244	0.248	0.252
E	7.900	8.100	8.300	0.311	0.319	0.327
E1	6.000	6.100	6.200	0.236	0.240	0.244
E2	4.100	4.200	4.300	0.161	0.165	0.169
e	0.650(BSC)			0.026(BSC)		
L	0.500	0.625	0.750	0.020	0.025	0.030
θ	0°		8°	0°		8°

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: 0573-82585539, sales@heroic.com.cn
Support: 0573-82586151, support@heroic.com.cn
Fax: 0573-82585078
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！