

120W 单声道D类音频功放

120W Class D Mono Amplifier

FEATURES

- Output Power
120W (VDD=30V, RL=4Ω, THD+N=10%)
76W (VDD=32V, RL=8Ω, THD+N=10%)
- Single Wide Voltage Supply: 4V-30V
- Low Quiescent Current: 10mA (VDD = 24V, with LC and Load)
- Anti-clipping Function (ACF)
- Power Limit (PLIMIT) function that can be used to clip the output voltage level below the supply rail
- Spread Switching Frequency, Inductor-free Operation
- Differential / Single-ended Analog Input
- Integrated Self-protection Circuits Including, Undervoltage, Overtemperature, and Overcurrent
- LF and HF Package of ETSSOP28, EPAD up
- 输出功率
120W (VDD=30V, RL=4Ω, THD+N=10%)
76W (VDD=32V, RL=8Ω, THD+N=10%)
- 单电源系统, 4V-30V宽电压输入范围
- 低静态电流: 10mA (VDD = 24V, 带LC 和负载)
- ACF防破音功能可选
- 功率限幅器功能
- 扩频功能, 免电感滤波
- 模拟差分/单端输入
- 保护功能: 过流/过热/欠压异常和短路保护
- 无铅无卤封装, ETSSOP28, 顶部散热片

APPLICATIONS

- Sound Bars
- Wireless Speakers
- 条形音箱
- 无线智能音箱
- Consumer Audio Applications
- TVs/Monitors
- 便携式音箱
- 消费类音频应用
- 拉杆音箱
- LCD电视/监视器

DESCRIPTION

HT337B is a mono efficient, Class D audio amplifier. The device can drive a speaker up to 120W/4 Ω at VDD = 30V.

Advanced EMI Suppression enables the use of inexpensive ferrite bead filters while meeting EMC requirements for system cost reduction.

HT337B is protected with Undervoltage, Overtemperature, and Overcurrent protection.

HT337B features Anti-Clipping Function (ACF) which detects output signal clip due to the over input signal and suppresses the output signal clip automatically. Also, the ACF function can adapt the output clip caused by power supply voltage down with battery. It can significantly improve the sound quality, creating a very comfortable musical enjoyment, and to protect the speakers from overload damage.

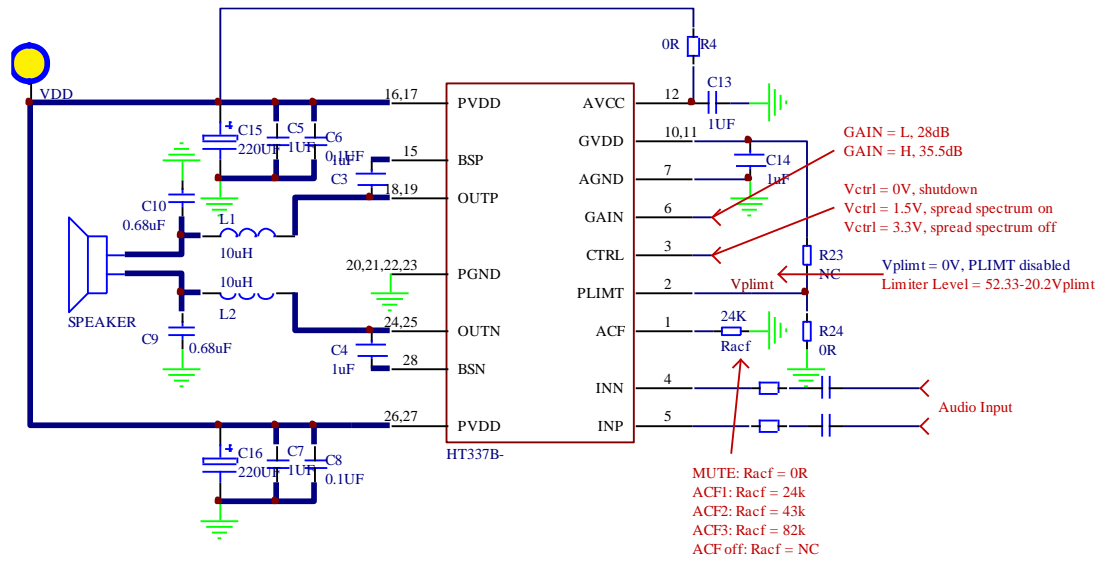
HT337B是一款高效D类音频功率放大器。32V供电、THD+N=10%条件下,能够持续提供120W/4 Ω 功率输出。

HT337B具有先进的扩频功能来抑制EMI,使用价格低廉且小体积铁氧体磁珠可满足EMC要求。

此外,HT337B内置关断功能使待机电流最小化,还集成了短路保护、热保护和电源欠压异常保护等功能。

HT337B具有防削顶失真(ACF)输出控制功能,可检测并抑制由于输入音乐、语音信号幅度过大所引起的输出信号削顶失真(破音),也能自适应地防止在电源电压下降所造成的输出削顶,显著提高音质,创造非常舒适的听音享受,并保护扬声器免受过载损坏。

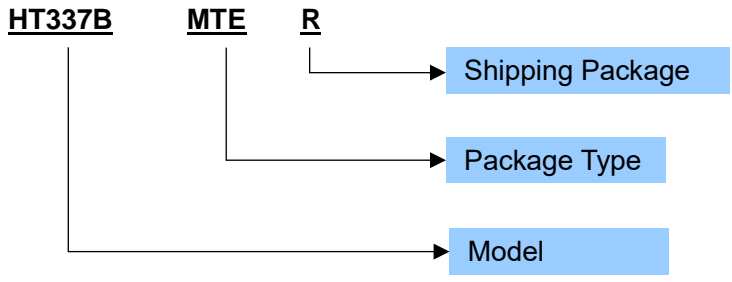
■ TYPICAL APPLICATION



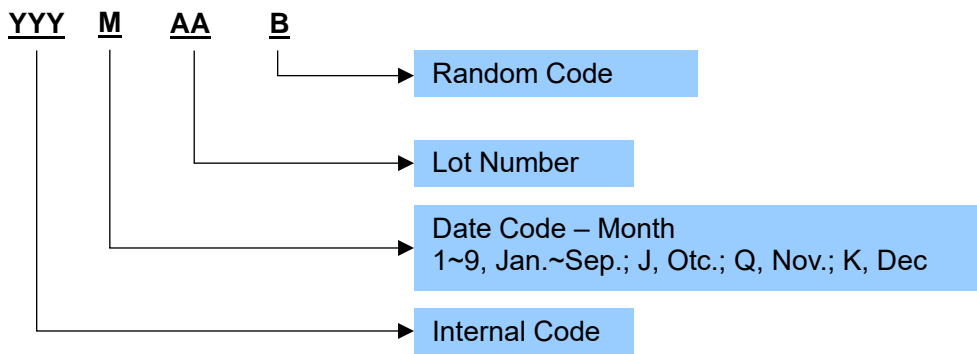
ORDERING INFORMATION

Part Number	Package Type	Marking	Operating Temperature Range	Shipping Package / MOQ
HT337BMTER	ETSSOP28 (MTE)	HT337B YYYMAAB ¹	-40°C ~ 85°C	Tape and Reel (R) / 3000pcs

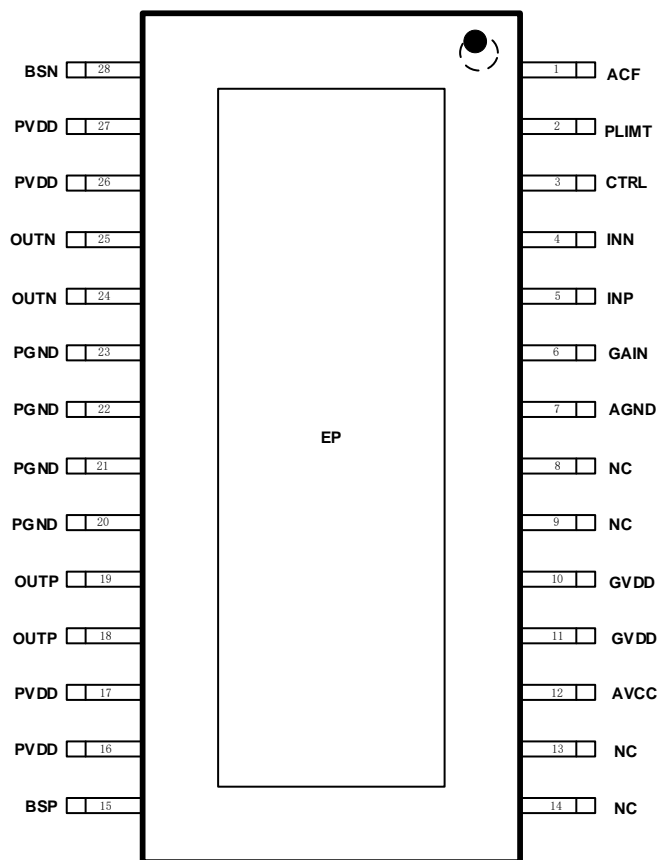
Part Number



Production Tracking Code



¹ YYYMAAB is production tracking code

■ TERMINAL CONFIGURATION

Top View
■ TERMINAL FUNCTION

Terminal No.	Name	I/O ¹	Description
1	ACF	O	ACF mode and Mute mode selection terminal
2	PLIMIT	I	Sets the maximum output voltage before clipping (Limiter Level) for PLIMIT function.
3	CTRL	I	Working mode selection terminal
4	INN	I	Negative input terminal
5	INP	I	Positive input terminal
6	GAIN	I	Gain selection terminal
7	AGND	G	Analog ground
8,9,13,14	NC	-	No connection.
10,11	GVDD	O	Internal LDO output, connect 1uF to GND
12	AVCC	P	Analog power supply
15	BSP	BST	Connection point for the OUTP bootstrap capacitor, which is used to create a power supply for the high-side gate drive for OUTP
16,17,26,27	PVDD	P	Power Supply for power stage
18,19	OUTP	O	Positive pin for differential speaker amplifier output
20,21,22,23	PGND	G	Power Ground
24,25	OUTN	O	Negative pin for differential speaker amplifier output
28	BSN	BST	Connection point for the OUTN bootstrap capacitor, which is used to create a power supply for the high-side gate drive for OUTN
EP	-	-	Provides thermal connection from the device to the board. A matching ground pad must be provided on the PCB and the device connected to it via solder. 散热PAD

¹ I: Input; O: Output; G: Ground; P: Power; BST: BOOT Strap

■ SPECIFICATIONS¹
● Absolute Maximum Ratings²

PARAMETER	Symbol	MIN	MAX	UNIT
Supply voltage range (PVDD, AVCC)	PVDD	-0.3	36	V
Input voltage range (INP, INN, CTRL, ACF, GAIN, CTRL, PLIMIT)	V _I	-0.3	5.8	V
Operating temperature range	T _A	-40	85	°C
Operating junction temperature range	T _J	-40	150	°C
Storage temperature range	T _{STG}	-50	150	°C

● Recommended Operating Conditions

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Supply voltage range (PVDD, AVCC)	V _{DD}	RL = 4ohm	4		30	V
		RL = 8ohm	4		34	V
Operating temperature	T _a		-40	25	85	°C
CTRL terminal working mode	MODE1	V _{MODE1}	spread spectrum off, Class D mode		5.5	V
	MODE2	V _{MODE2}	Spread spectrum on, Class D mode		1.7	V
	MODE4	V _{MODE4}	shutdown		0.5	V
GAIN selection	GAIN1	V _{GAIN1}	GAIN = L		1.0	V
	GAIN2	V _{GAIN2}	GAIN = H			V
Load impedance	RL	With output filter		4		Ω

● Electrical Specification³

Conditions: T_A = 25°C, PVDD = 4V-30V, Load = 4ohm, unless otherwise specified.

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Class Output Offset Voltage	V _{OS}	V _I = 0V, Gain = 26dB		1.5		mV
Quiescent supply current	I _{DD}	V _{DD} = 12V, output filter = 10uH+680nF, Load = 4ohm		8		mA
		V _{DD} = 24V, output filter = 10uH+680nF, Load = 4ohm, Class AB mode		10		mA
Quiescent supply current in MUTE mode	I _{MUTE}	Output filter = 10uH+680nF, Load = 4ohm		4.2		mA
Quiescent supply current in shutdown mode	I _{SD}	V _{DD} = 12V, With Load		240		uA
Common mode rejection ratio	CMRR	V _{IC} = 0.1V, PVDD = 12V		-65		dB
System Gain	Gain	GAIN = L		28		dB
		GAIN = H		36		dB
Turn-on time	t _{on}	Pull CTRL high or power on		190		ms
Turn-off time	t _{off}	Pull CTRL low		5		us
Delay time of MUTE	t _{MUTE}	Pull ACF low		22		us
GVDD output voltage	GVDD	PVDD = 12V, working on		4.9		V
		PVDD = 12V, shutdown		4.1		V
		PVDD = 24V, working on		4.9		V
		PVDD = 24V, shutdown		4.8		V
Input Bias Voltage	V _{INBIAS}			1.6		V

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.

³ Depending on parts and pattern layout, characteristics may be changed.

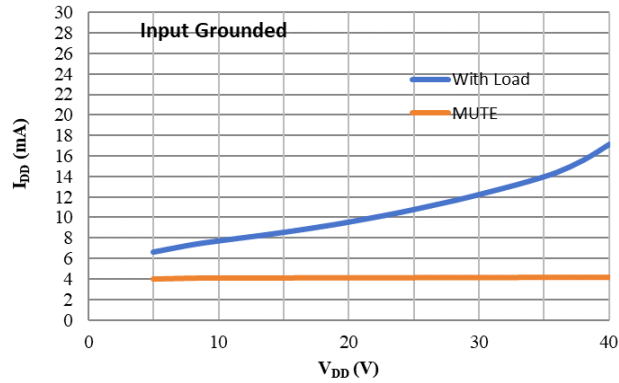
Conditions: $T_A = 25^\circ\text{C}$, $P_{VDD} = 4\text{V}-30\text{V}$, Load = Filter + R_L , Filter = $10\mu\text{H} + 680\text{nF}$, $R_L = 4\Omega$, $f_{IN} = 1\text{ kHz}$, Gain = 28dB, $C_{IN} = 1\mu\text{F}$, 20-20kHz, unless otherwise specified.

PARAMETER	Symbol	CONDITION		MIN	TYP	MAX	UNIT
Continuous output power in Class D mode	P_O	$V_{DD} = 30\text{V}$, $R_L = 4\Omega$	THD +N = 1%		100		W
			THD+N = 10%		122		W
		$V_{DD} = 32\text{V}$, $R_L = 8\Omega$	THD +N = 1%		62		W
			THD+N = 10%		76		W
Total harmonic distortion + noise	THD+N	$P_O = 10\text{W}$, $V_{DD} = 30\text{V}$, $R_L = 4\Omega$			0.2		%
Efficiency	η	$V_{DD} = 32\text{V}$, THD+N = 10%	$R_L = 8\Omega$		94		%
		$V_{DD} = 24\text{V}$, THD+N = 10%	$R_L = 4\Omega$		92		%
Output integrated noise	V_N	A-weighted, Gain = 28 dB			170		μV
Power supply rejection ratio	PSRR	200mVpp 1kHz, Input grounded			-75		dB
Oscillator frequency	f_{osc}	Class D mode			360		kHz
Over temperature protection trigger point	OTP				150		$^\circ\text{C}$
Over current trip point	OCP	Class D mode			12		A

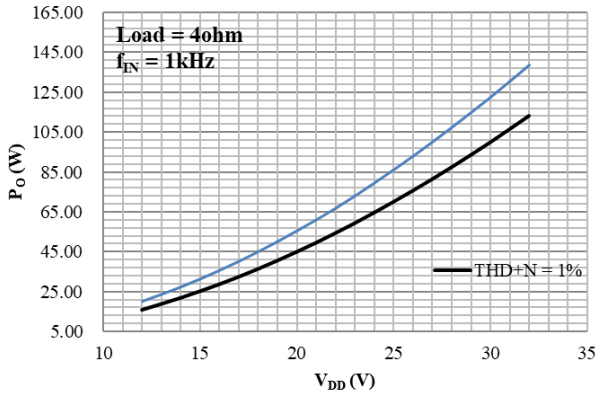
TYPICAL OPERATING CHARACTERISTICS

VDD = 24V, Load = LC+4ohm, unless otherwise specified.

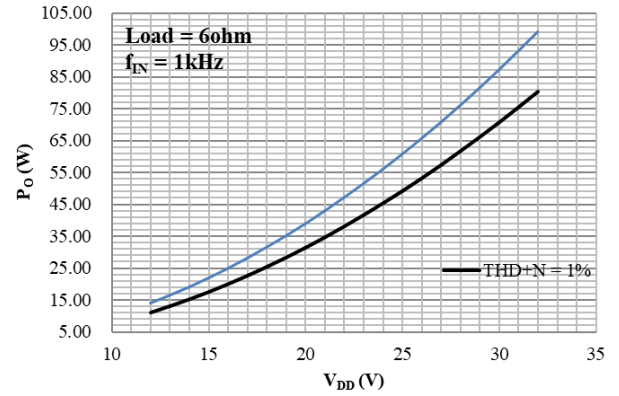
V_{DD} vs I_{DD}



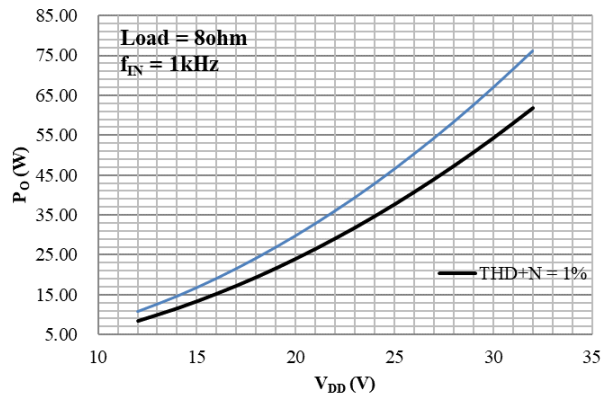
V_{DD} vs P_O

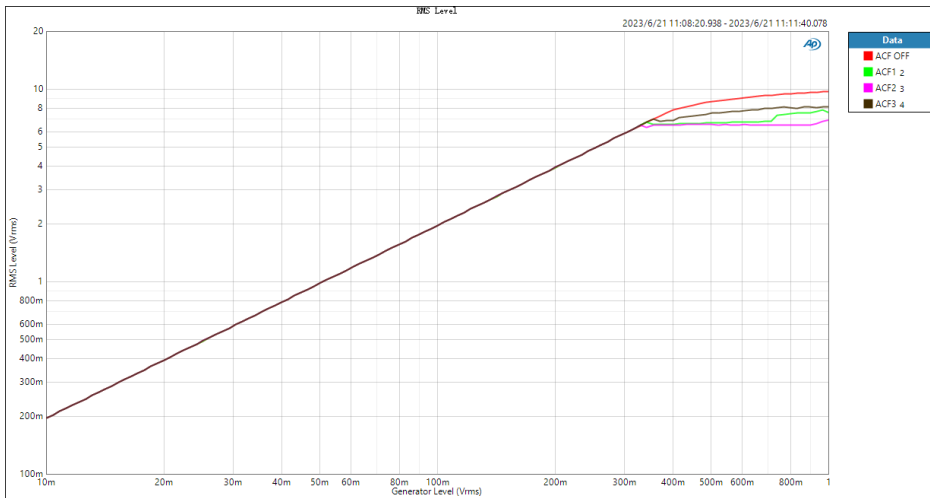
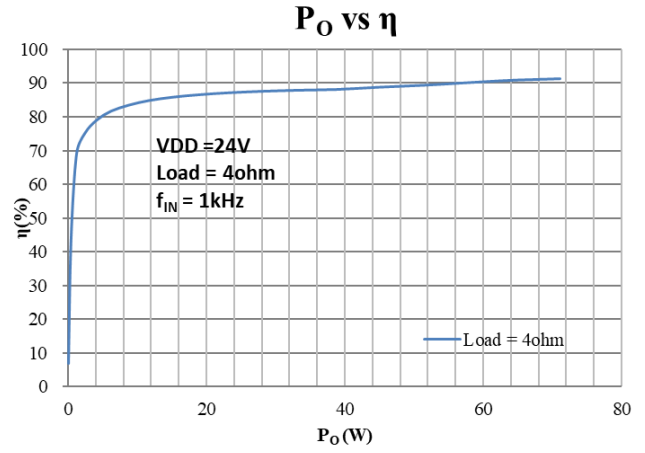
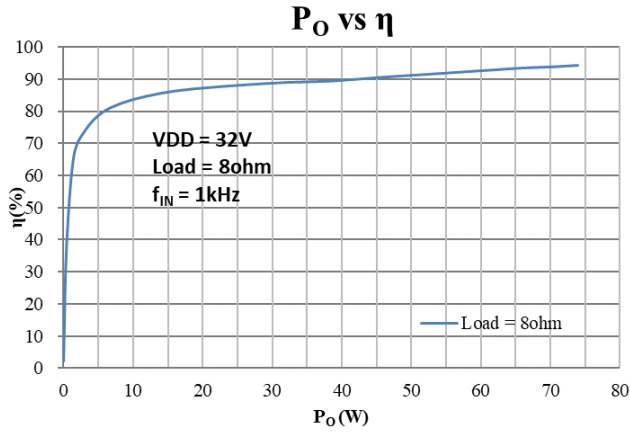


V_{DD} vs P_O



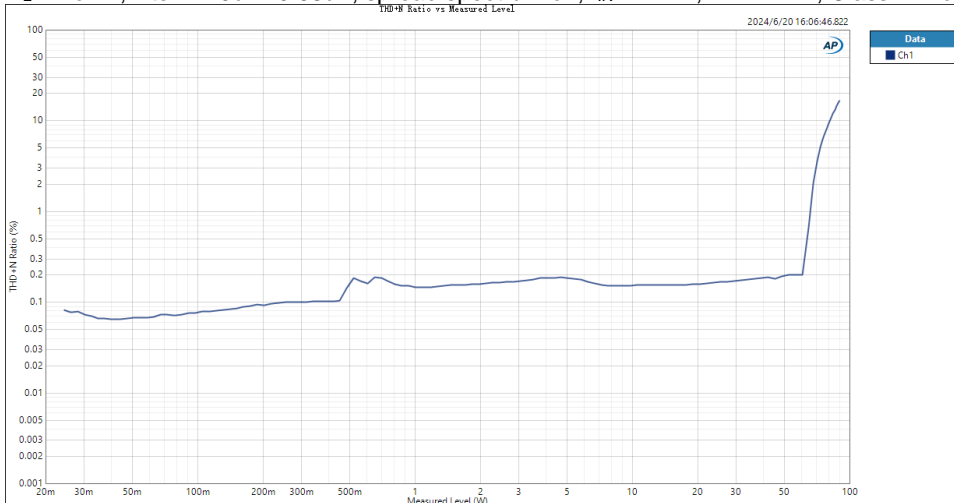
V_{DD} vs P_O



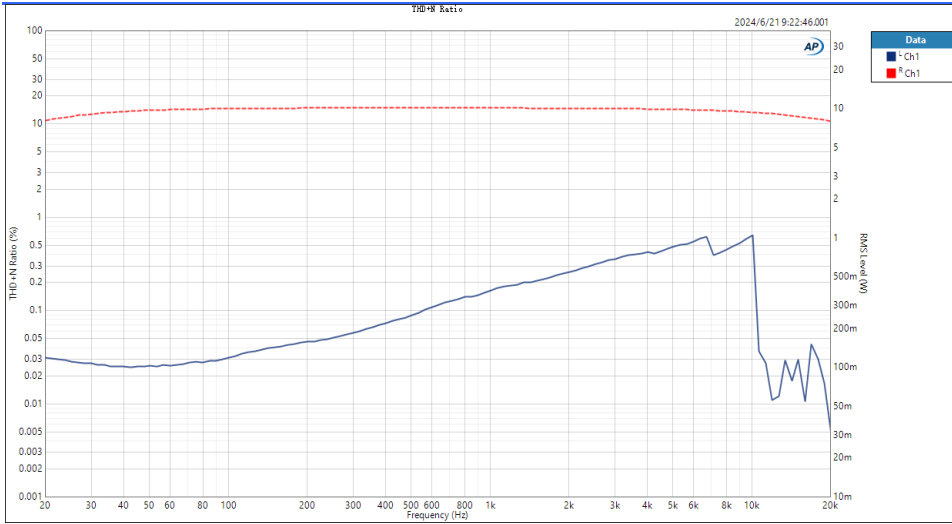


Vin vs Vout (Gain = 26dB)

$R_L = 4ohm$, filter = $10\mu H + 0.68\mu F$, spread spectrum off, $f_{IN} = 1kHz$, $V_{DD} = 24V$, Class D mode, unless otherwise specified.



$V_{DD} = 24V$, Output power vs THD+N



VDD = 24V, Po = 10W,
frequency vs THD+N

APPLICATION INFORMATION

1 Power Supply

The power supply for the HT337B only require one voltage from 4V to 30V, which supplies the analog circuitry and the power stage.

The AVCC supply feeds internal LDO including GVDD. This LDO output is connected to external pins for filtering purposes, but should not be connected to external circuits. The filtering capacitor for GVDD is recommended to be 1uF.

The PVDD feeds the power stage of the amplifier. Filtering capacitors of 100nF//1uF//220uF for PVDD of each group (pin26, 27 is one group and pin16, 17 is another group) should be placed close to the PVDD pin and PGND.

2 Amplifier Input and Output

2.1 Amplifier Input Configuration

HT337B is an amplifier with analog input (single-ended or differential).

For a differential operation, input signals into INP and INN pins via DC-cut capacitors (C_{IN}) and external input resistors R_{EIN} . See as figure 1. The system gain can be calculated by $Gain \approx 20 \times \log\left(\frac{R_F}{R_{IIN} + R_{EIN}}\right)$, where $R_{IIN} = 10k$, $R_F = 250k$ (when $GAIN = L$) or $630k$ (when $GAIN = H$). And the high pass cut-off frequency of input signal can be calculated by $f_c = \frac{1}{2\pi(R_{IIN} + R_{EIN}) \times C_{IN}}$.

For a single-ended operation, input signals to INP pin via a DC-cut capacitor (C_{IN}) and external input resistor (R_{EIN}). INN pin should be connected to ground via a DC-cut capacitor and external input resistor (with the same value of C_{IN} and R_{EIN}). See as figure 2. The Gain and high pass Cut-off frequency are the same as the above case.

HT337B 的电源只需要一个 4V 到 30V 的供电，用于提供模拟电路和功率电路。

AVCC 电源为内部 LDO(包括 GVDD)供电。这个 LDO 输出连接到外部引脚用于滤波，但不应该连接到外部电路。GVDD 的滤波电容建议为 1uF。

PVDD 为功放的功率级供电，每组 (pin26, 27 为一组，pin16, 17 为另一组) PVDD 的 100nF//1uF//220uF 滤波电容应放置在 PVDD 引脚和 PGND 引脚附近。

HT337B 接受模拟差分或单端音频信号输入，产生 PWM 脉冲输出信号驱动扬声器。

对差分输入，通过隔直电容 C_{IN} 和输入电阻 R_{EIN} 分别输入到 INP 和 INN 端，见图 1。系统增益 $Gain \approx 20 \times \log\left(\frac{R_F}{R_{IIN} + R_{EIN}}\right)$ ， $R_{IIN} = 10k$ ； $GAIN = L$ 时， $R_F = 250k$ ； $GAIN = H$ 时， $R_F = 630k$ 。高通滤波器截止频率为 $f_c = \frac{1}{2\pi(R_{IIN} + R_{EIN}) \times C_{IN}}$ 。

对单端输入，则通过 C_{IN} 耦合到 INP 端。INN 端必须通过输入电阻和电容 (与 C_{IN} 、 R_{EIN} 值相同) 接地，见图 2。增益 $Gain$ 和截止频率 f_c 与差分输入时相同。

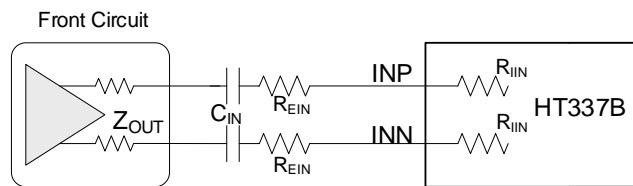


Figure 1 Differential Input configuration

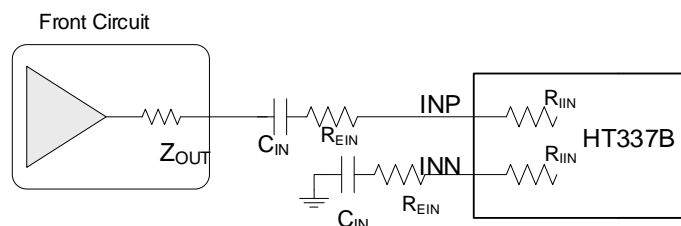


Figure 2 Single-ended Input configuration

2.2 Amplifier Output Configuration

The HT337B has been tested with a simple ferrite bead filter for a variety of applications including long speaker wires up to 10 cm and high power. One important aspect of the ferrite bead selection is the type of material used in the ferrite bead. Not all ferrite material is alike, so it is important to select a material that is effective in the 10 to 100 MHz range which is key to the operation of the class-D amplifier. The impedance of the ferrite bead can be used along with a small capacitor with a value in the range of 1000 pF to reduce the frequency spectrum of the signal to an acceptable level. For best performance, the resonant frequency of the ferrite bead/capacitor filter should be less than 10 MHz. Also, the filter capacitor can be increased if necessary, with some impact on efficiency.

HT337B 可使用简单的铁氧体珠过滤器，在各种应用中，包括高达 10 厘米的扬声器线和较大的功率。铁氧体珠选择的一个重要方面是铁氧体珠所用材料的类型。并不是所有的铁氧体材料都是一样的，所以选择一种在 10 到 100 MHz 范围内有效的材料是很重要的，这是 D 类放大器工作的关键。铁氧体珠的阻抗可与值在 1000 pF 范围内的小电容一起使用，以将信号的频谱降低到可接受的范围。

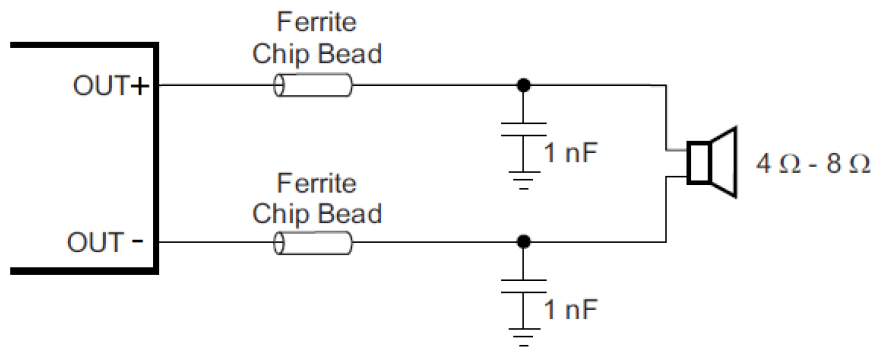


Figure 3 Output Filters with Ferrite Beads

There may be a few circuit instances where it is necessary to add a complete LC reconstruction filter. These circumstances might occur if there are nearby circuits which are sensitive to noise. In these cases, a classic second order Butterworth filter similar to those shown in the figures below can be used.

可能在一些应用场合需要添加一个完整的 LC 滤波器，比如附近有对噪声敏感的电，或 EMI 难以达到标准。此时，可以使用类似于下图所示的经典二阶巴特沃斯滤波器。

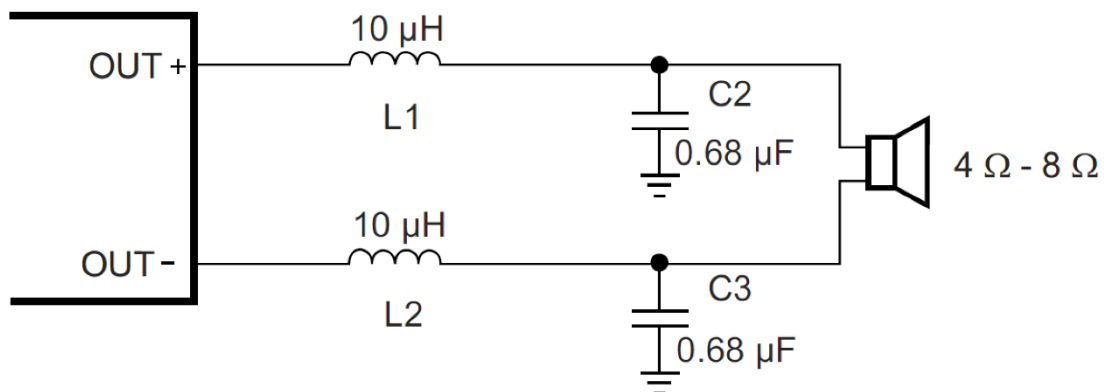


Figure 4 Output Filters with LC

3 Modulation

HT337B works in a 3-state mode that can achieve a lower power consumption with LC filter.

HT337B 工作在 3 态模式，其在 LC 滤波条件下具有更低的静态功耗。

4 Working modes (CTRL Terminal)

HT337B can work in different modes by setting the CTRL terminal, shown as follow.

HT337B 在 CTRL 端输入不同电压值，能实现多种工作模式，详见下表。

Table 1 CTRL Terminal Configuration

Mode	CTRL Voltage		
	MIN	TYP	MAX
Spread spectrum off, Class D mode	2.3V	3.3V	5.5V
Spread spectrum on, Class D mode	1.2V	1.5V	1.7V
SD(Shutdown) Mode	0V	0V	0.5V

4.1 Startup, Shutdown

The HT337B employs a shutdown mode of operation designed to reduce supply current (I_{DD}) to the absolute minimum level during periods of nonuse for power conservation. The CTRL terminal should be held low to shutdown the device to enter the low-current state.

HT337B 具有关断功能，以使芯片进入低功耗状态。当 CTRL 拉低时，芯片进入关断状态。

For a better power on and power-off pop performance, place the amplifier in the shutdown mode prior to delivering or removing the power supply.

上下电时，为减小 pop 声，在上、下电前，将功放关闭进入关断状态。

4.2 Spread Spectrum

The HT337B device has built-in spread spectrum control of the oscillator frequency to improve EMI performance. The spread spectrum scheme is internally fixed and by setting the CTRL terminal.

HT337B 器件内置了扩频控制，以提高 EMI 性能。扩频方案内部固定，通过 CTRL 引脚设置开启。

5 Anti-Clipping and MUTE Function (ACF terminal)

HT337B can work in different ACF and MUTE modes and MUTE mode by setting the ACF terminal, shown as follow.

HT337B 可工作在不同的 ACF 模式和 MUTE，通过设置 ACF 引脚进入。

Table 2 ACF Terminal Configuration

Resistor on ACF pin to GND (R_{ACF})	Working Mode
< 10k	MUTE
24k	ACF1
43k	ACF2
82k	ACF3
>200k	ACF OFF

In ACF modes, HT337B attenuates system gain to an appropriate value when an excessive input is applied, so as not to cause the clipping at the differential signal output. In this way, the output audio signal is controlled in order to obtain a maximum output level without distortion. And HT337B also follows to the clips of the output waveform due to the decrease in the power-supply voltage.

The Attack time of ACF Function is a time interval until system gain falls to target attenuation gain -3dB when a big enough signal input. And, the Release Time is a time from target attenuation gain to not working of ACF. The maximum attenuation gain is 18dB.

在 ACF 模式下，当电路检测到输入信号幅度过大而产生输出削顶时，HT337B 通过自动调整系统增益，控制输出达到一种最大限度的无削顶失真功率水平，由此大大改善了音质效果。此外，当电源电压下降时，HT337B 也能自动衰减输出增益，实现与 PVDD 下降值相匹配的最大限度无削顶输出水平。

ACF 模式下的启动时间（Attack time）指在突然输入足够大信号而产生输出削顶的条件下，ACF 启动对放大器的增益调整速率，以 ms/dB 为单位；释放时间（Release time）指产生削顶的输入条件消失，增益退出衰减状态的速率，以 ms/dB 为单位。HT337B 的最大衰减增益为 18dB。

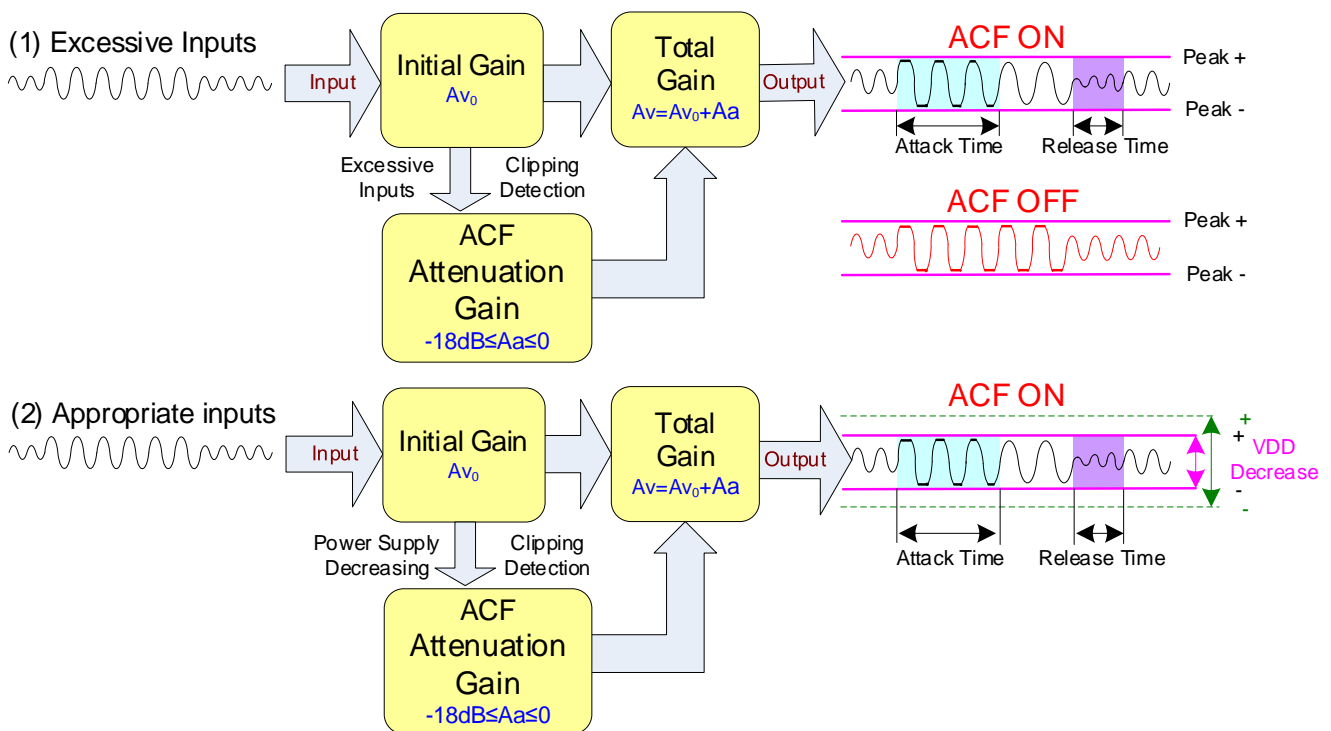


Figure 5 the ACF Function Operation Outline

Table 3 Attack time and Release time

ACF mode	Attack time	Release time
ACF3	45ms	100ms
ACF2	4ms	2.8s
ACF1	45ms	350ms

In MUTE mode, the differential output signal is muted, other internal modules are in normal operation, and the output stage becomes a high impedance state.

For a better pop performance, place the amplifier in MUTE mode prior to shutdown or enable the device.

在静音模式下，输出无声，内部其他模块仍处于工作状态，输出端切换至高阻态。

为减小 pop 声，在 shutdown/使能前，将功放 MUTE。

6 PLIMIT

The HT337B has a Power Limit (PLIMIT) function that can be used to clip the output voltage level below the supply rail.

When PLIMIT function is active, the amplifier operates as if it was powered by a lower supply voltage, and thereby enters into clipping sooner than if the circuit was not active. The result is clipping behavior very similar to that of clipping at the PVDD rail.

The point at which clipping begins is called the Limiter Level. The Limiter Level can be controlled by a resistor divider from GVDD to ground, which sets the voltage at the PLIMIT pin (V_{PLIMIT}). The Limiter Level is $52.33-20.2 \cdot V_{PLIMIT}$ (V).

The PLIMIT function is disabled when PLIMIT pin is connected to GND.

HT337B 还具有功率限幅器功能 (PLIMIT), 可用于将输出电压电平钳位到供电轨以下。

当 PLIMIT 功能工作, 放大器的工作就像是由较低的电源电压供电一样, 因此比该功能未开启时更快进入限幅。其结果是在 PVDD 轨道上的削波行为与在 PVDD 轨道上的削波行为非常相似。限幅开始的点称为限幅值。

限幅值由从 GVDD 到接地的电阻分压器控制, 该分压器设置 PLIMIT 引脚的电压 (V_{PLIMIT})。限幅值约 $52.33-20.2 \cdot V_{PLIMIT}$ (V)。

如果 PLIMIT 引脚连接到 GND, PLIMIT 功能关闭。

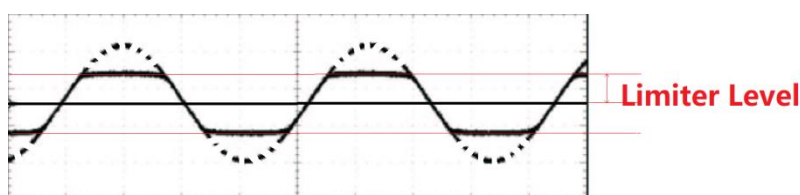


Figure 6 PLIMIT Function Description

7 Protection Function

HT337B has the protection functions such as Over-Current Protection function, Thermal Protection function, Under-Voltage Protection .

(1) Over-current Protection function (OCP)

When a short circuit occurs between one output terminal and Ground, PVDD, or the other output, the over-current protection mode starts up. In the over current protection mode, the differential output terminal becomes a high impedance state. Once the short circuit conditions are eliminated, the over current protection mode can be cancelled automatically.

(2) Thermal Protection function (OTP)

When excessive high temperature of HT337B (150°C) is detected, the thermal protection mode starts up. In the thermal protection mode, the differential output terminal becomes a high impedance state.

(3) Under-Voltage Protection (UVP)

This is the function to establish the under-voltage protection mode when power supply becomes lower than the detection voltage V_{UVLL} (Typ 2.7V), and the protection mode is canceled when the power supply becomes higher than the threshold voltage V_{UVLH} (Typ 2.6V). In the under-voltage protection mode, the differential output pin becomes a high impedance state. HT337B will start up within start-up time when the under-voltage protection mode is cancelled.

HT337B 具有以下几种保护功能: 输出端过流保护、片内过温保护、欠压保护。

(1) 过流保护

当检测到一输出端对电源、对地、或对另一输出端短路时, 过流保护启动, 输出端切换至高阻态, 防止芯片烧毁损坏。短路情况消除后, 芯片自动退出保护模式。

(2) 过温保护

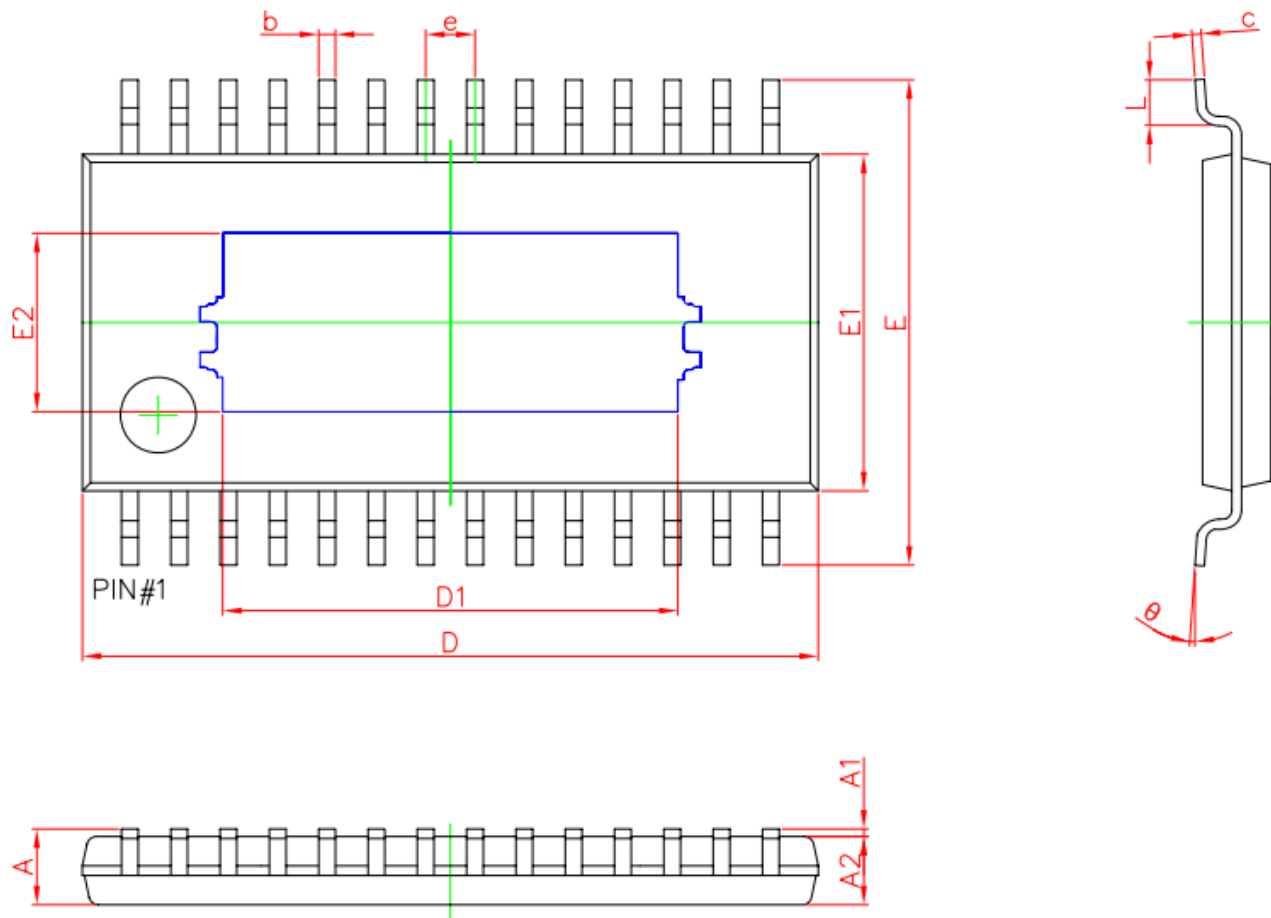
当检测到芯片内温度超过 150°C 时, 过温保护启动, 输出端切换至高阻态, 防止芯片被热击穿损坏。

(3) 欠压保护

该功能是在当电源低于检测电压 V_{UVLL} (Typ 2.7V) 时建立欠压保护模式, 当电源高于阈值电压 V_{UVLH} (Typ 2.6V) 时取消保护模式。在欠压保护模式下, 输出端切换至高阻态。取消欠压保护模式后, HT337B 会在启动时间内启动。

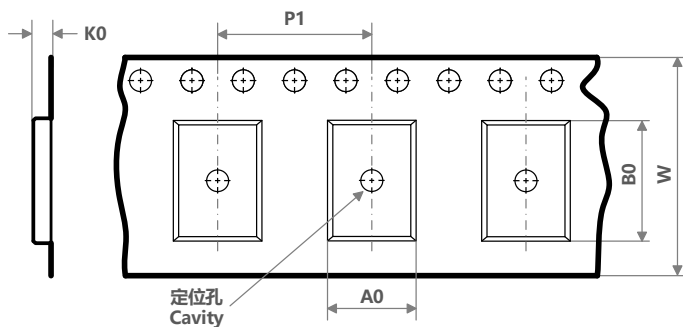
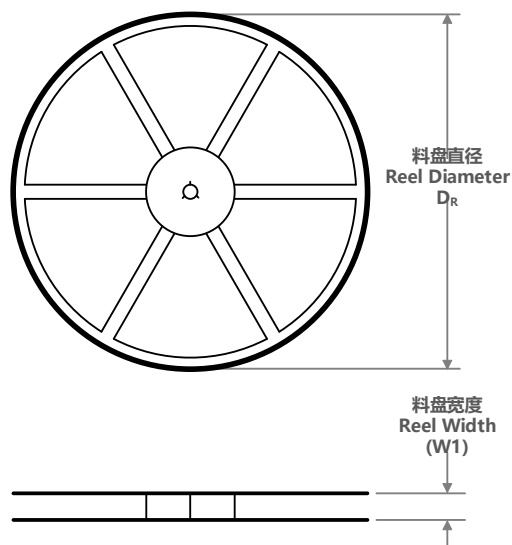
PACKAGE OUTLINE

MTE (ETSSOP28)



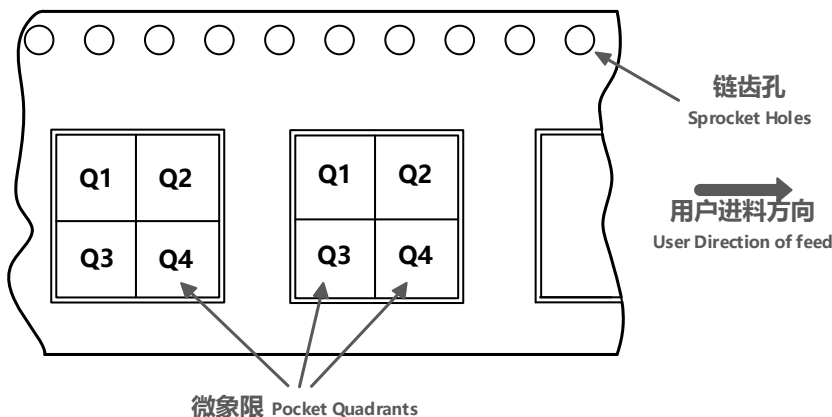
SYMBOL	MILLIMETER	
	MIN	MAX
A	/	1.200
A1	0	0.1
A2	0.800	1.050
b	0.190	0.300
c	0.090	0.200
D	9.600	9.800
D1	5.908	6.108
E	6.250	6.550
E1	4.300	4.500
E2	2.253	2.453
e	0.650BSC	
L	0.450	0.750
Θ	0°	8°

TAPE AND REEL INFORMATION

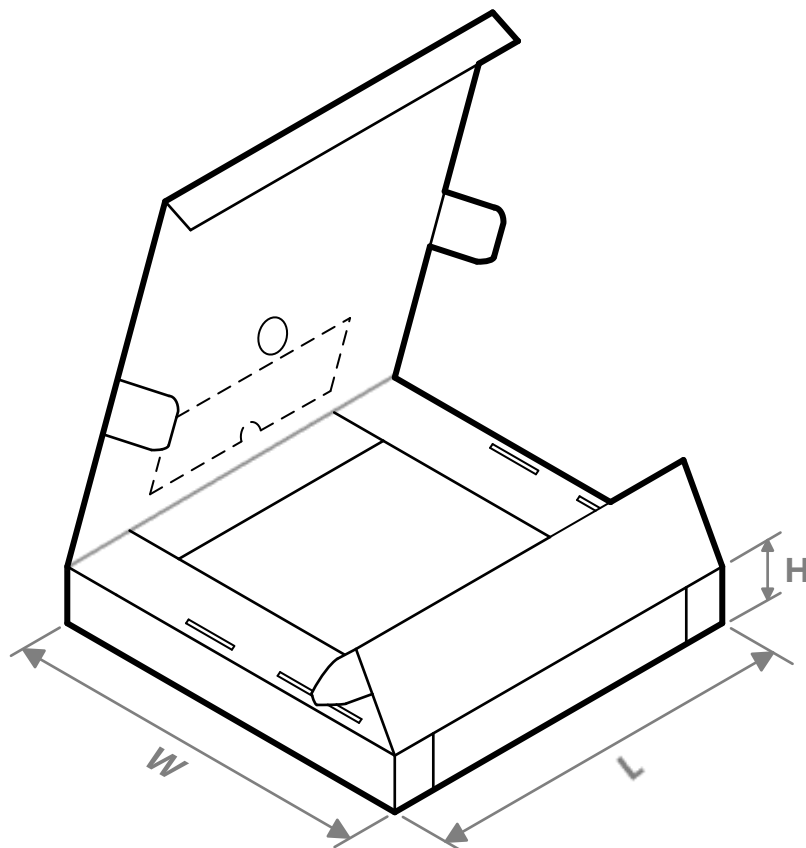


A0	Dimension designed to accommodate the component width; 料槽宽度
B0	Dimension designed to accommodate the component length; 料槽长度
K0	Dimension designed to accommodate the component thickness; 料槽厚度
W	Overall width of the carrier tape; 载带整体宽度
P1	Pitch between successive cavity centers; 相邻槽中心间距

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 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
HT337BMTER	ETSSOP	MTE	28	3000	330	16.0	6.7	9.9	1.5	12	16.0	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)
HT337BMTER	ETSSOP	MTE	28	6000	390	345	55

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