



MIX8015 4.0W Class-D Power Audio Amplifier

MIX8015 Description

MIX8015 is a high efficiency, filter less 4.0W Class D power audio amplifier with Non-Clip.

The differential input architecture and high PSRR give MIX8015 good RF noise suppression ability. The MIX8015 drives speaker load with Non-Clip signal between different level's audio sources and offering perfect music enjoy. The filter less PWM architecture and gain built-in topology reduces external components, save the PCB space and BOM cost, and simplifying design. Up to 90% efficiency, fast setup time and small package size makes MIX8015 the best choice for Bluetooth speakers and other portable audio products.

MIX8015 features shutdown function which greatly the stand by time. The thermal protection enhances the reliability of the system. Low POP noise makes system design more flexibility.

MIX8015 is available in MSOP8 package.

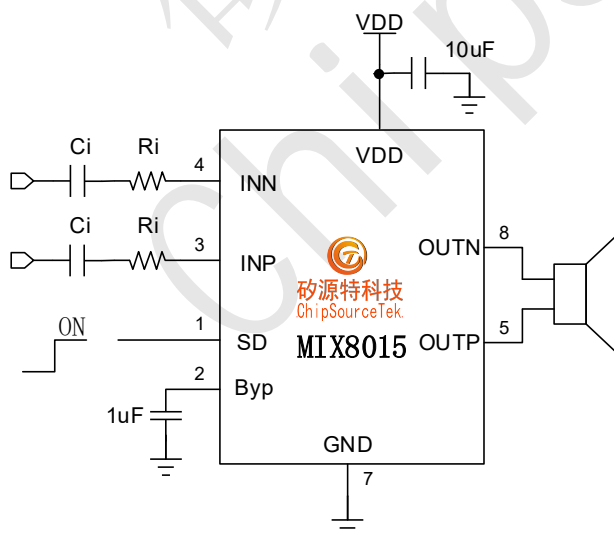
MIX8015 Features

- Output Power:
 - 4.2W (5.5V, $R_L = 4 \Omega$, THD+N=10%)
 - 2.8W (5.5V, $R_L = 6 \Omega$, THD+N=10%)
- Supply Voltage : 2.8V to 5.5V
- Low THD+N and Low Noise
- Two configurable Non-Clip Mode
- Low POP noise
- Short Current Protection
- Low SHDN current: Less than 1uA
- Over Temperature Protection

MIX8015 Application

- Bluetooth Speaker / Portable Speaker
- Smart Watch / Wear equipment
- Tablet Computer

MIX8015 Typical Application Circuits



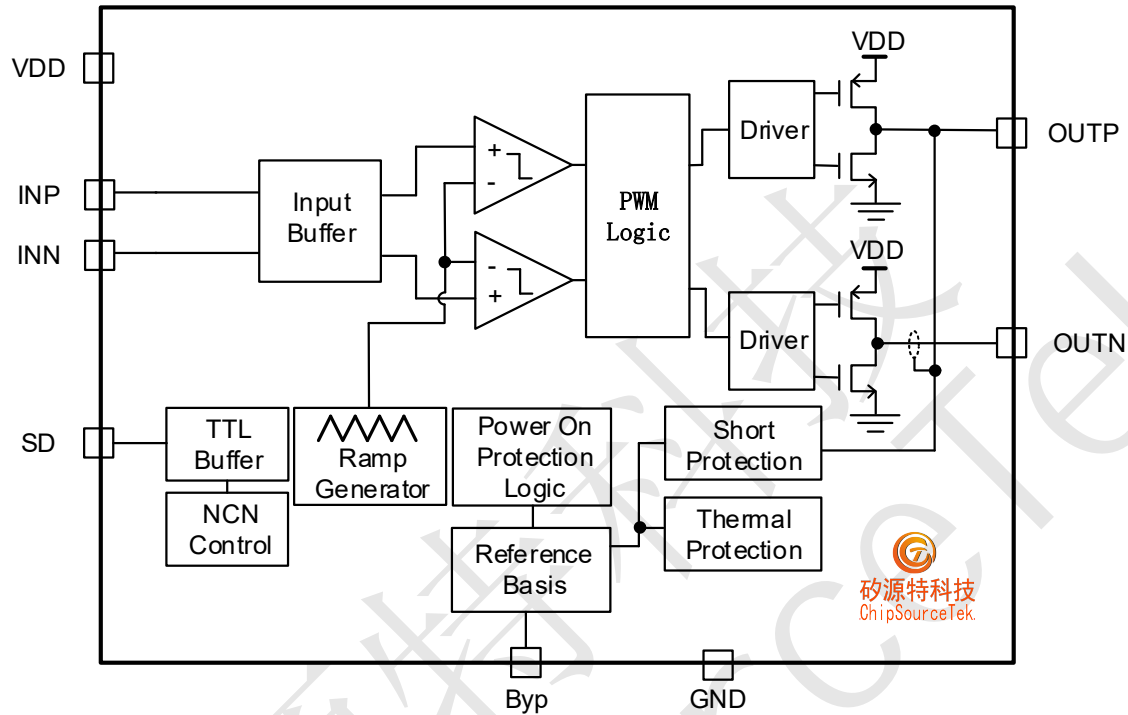
MIX8015 Pin Configuration





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MIX8015 Block Diagram



MIX8015 Pin Descriptions

Pin No.	Pin Name	I/O	Description
1	SD	I	Shutdown Control ("H" For Operation , "L" for Shutdown) With single wire Non-Clip mode control
2	Byp	I	Reference Voltage
3	INP	I	Positive Audio Input
4	INN	I	Negative Audio Input
5	OUTP	O	Positive Audio Output
6	VDD		Power Supply
7	GND		Power Ground
8	OUTN	O	Negative Audio Output



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MIX8015 Ordering Information

Part Number	Package	Marking	Shipping
MIX8015	MSOP8	MIX8015 XXXXXXX	4000Pcs / Reel

MIX8015 Absolute Maximum Rating

V_{DD}	Supply Voltage	-0.3V to 6.0V
V_I	Input Voltage	-0.3V to $V_{DD}+0.3V$
T_A	Operation Temperature Range	-40°C to 85°C
T_J	Junction Temperature Range	-40°C to 125°C
T_{STG}	Storage Temperature Range	-65°C to 150°C
T_{SLD}	Soldering Temperature	300°C, 5sec

MIX8015 Recommended Operating Condition

			MIN	MAX	UNIT
V_{DD}	Supply Voltage	V_{DD}	2.8	5.5	V
V_{IH}	SD Input High Voltage	$V_{DD}=5.0V$	1.6		V
V_{IL}	SD Input Low Voltage	$V_{DD}=5.0V$		0.6	V
Load	Minimum Load	$V_{DD}=5.0V$	4		Ω

MIX8015 Thermal Resistance Parameter

Parameter	Symbol	Package	MAX	UNIT
Thermal Resistance (Junction to Ambient)	θ_{JA}	MSOP8	60	°C/W



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MIX8015 D Mode Electrical Characteristics

($V_{DD} = 5V$, Gain=22.6dB, $R_L = 4\Omega$, $T = 25^\circ C$, unless otherwise noted.)

Symbol	Parameter	Test Conditions	MIN	TYP	MAX	UNIT
V_{IN}	Supply Voltage		2.8	-	5.5	V
P_O	Output Power	THD+N=10%, f=1KHz, $R_L=4\Omega$	$V_{DD}=5.5V$	4.0		W
			$V_{DD}=4.2V$	2.3		
			$V_{DD}=3.7V$	1.8		
		THD+N=1%, f=1KHz, $R_L=4\Omega$	$V_{DD}=5.5V$	3.4		W
			$V_{DD}=4.2V$	1.95		
			$V_{DD}=3.7V$	1.5		
		THD+N=10%, f=1KHz, $R_L=6\Omega$	$V_{DD}=5.5V$	2.8		W
			$V_{DD}=4.2V$	1.65		
			$V_{DD}=3.7V$	1.25		
		THD+N=1%, f=1KHz, $R_L=6\Omega$	$V_{DD}=5.5V$	2.4		W
			$V_{DD}=4.2V$	1.4		
			$V_{DD}=3.7V$	1.05		
THD+N	Total Harmonic Distortion Plus Noise	$V_{DD}=5.0V, P_O=1.0W, R_L=4\Omega$	f=1KHz	0.04		%
		$V_{DD}=4.2V, P_O=1.0W, R_L=4\Omega$		0.03		
		$V_{DD}=3.7V, P_O=1.0W, R_L=4\Omega$		0.03		
G_V	Gain	$V_{DD}=3.7V, R_L=4\Omega$	$R_i = 33K$	22.6		dB
CMRR	Common Mode Rejection Ratio	$V_{DD}=4.2V, V_{IN}=1V_{p-p}$	f=1KHz	-40		dB
PSRR	Power Supply Ripple Rejection	$V_{DD}=4.2V \pm 200mV_{p-p}$	f=1KHz	-70		dB
SNR	Signal-to-Noise Ratio	$V_{DD}=5.0V, V_o \text{ rms}=1V, G_V=22.6dB$	f=1KHz	-83		dB
V_n	Output Noise	$V_{DD}=4.2V, \text{Input AC_GND with } C_{IN}=0.1\mu F$	A-weighting	75		μV
			No A-weighting	100		
Dyn	Dynamic Range	$V_{DD}=5.0V, THD=1\%$	f=1KHz	-90		dB
η	Efficiency	$V_{DD}=5.0V, R_L=4\Omega, P_O=2W$	f=1KHz	86		%
		$V_{DD}=4.2V, R_L=4\Omega, P_O=2W$		86		
		$V_{DD}=3.7V, R_L=4\Omega, P_O=1W$		85		
I_Q	Quiescent Current	$V_{DD}=5.0V$	No Load	6		mA
		$V_{DD}=4.2V$		4.5		
		$V_{DD}=3.7V$		3.5		
I_{SD}	Shutdown Current	$V_{DD}=2.8V \text{ to } 5.5V$	$V_{SD}=0V$		1	μA
V_{OS}	Offset Voltage	$V_{IN}=0V, V_{DD}=5V$		5		mV



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MIX8015 D Mode Electrical Characteristics

($V_{DD} = 5V$, Gain=22.6dB, $R_L = 4\Omega$, $T = 25^\circ C$, unless otherwise noted.)

Symbol	Parameter	Test Conditions	MIN	TYP	MAX	UNIT
Fosc	Oscillator Frequency			280		KHz
Tat	ACF Attack Time	$V_{DD}=5.0V$, ACF1, $R_L=4\Omega$	Gain=22.6dB	80		mS
		$V_{DD}=5.0V$, ACF2, $R_L=4\Omega$		20		
Tre	ACF Release Time	$V_{DD}=5.0V$, ACF1, $R_L=4\Omega$	Gain=22.6dB	600		mS
		$V_{DD}=5.0V$, ACF2, $R_L=4\Omega$		2200		
Tst	Setup Time	Bypass capacitor = 1uF		180		mS
OTP	—	No Load, Junction		170		$^\circ C$
OTH	—	Temperature	$V_{DD}=5.0V$	10		

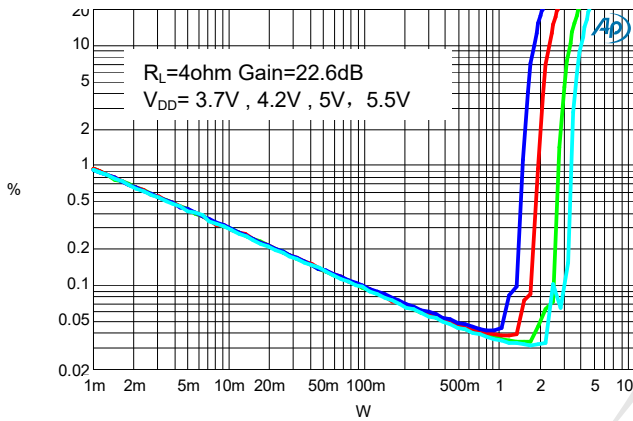


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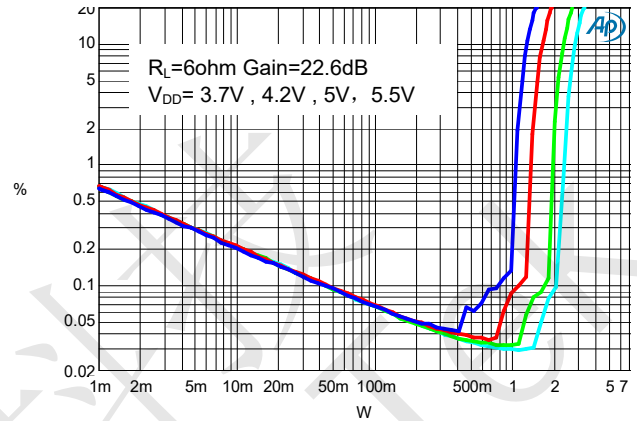
MIX8015 D Mode Typical Operating Characteristics

($V_{DD} = 5V$, Gain=22.6dB, $R_L = 4\Omega$, $T = 25^\circ C$, unless otherwise noted.)

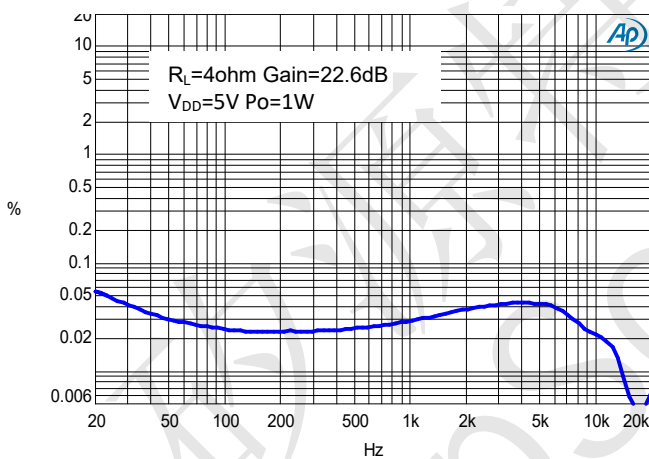
THD+N vs Output Power



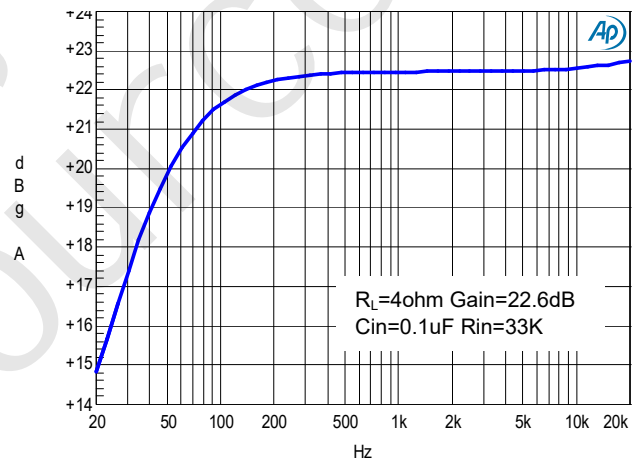
THD+N vs Output Power



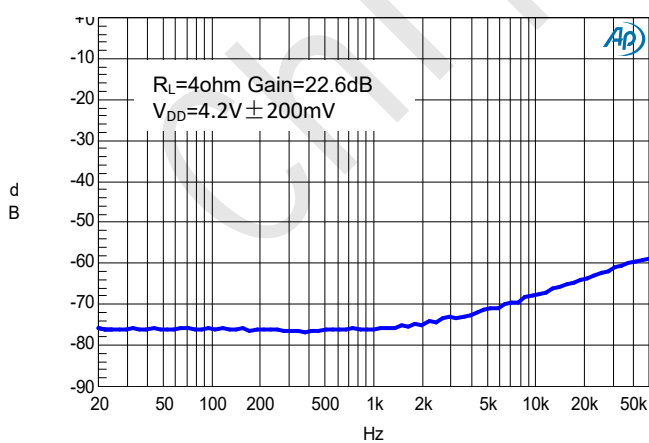
THD+N VS Frequency



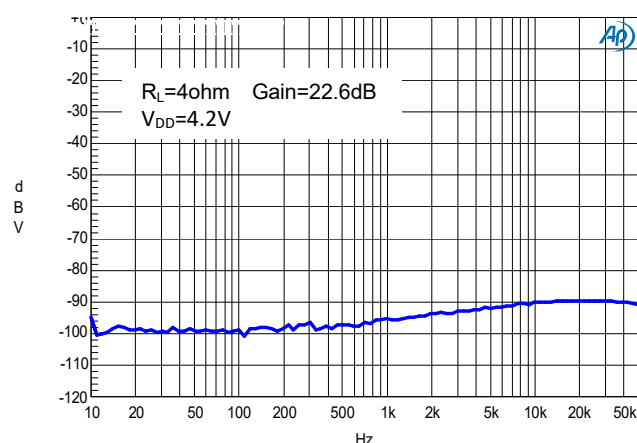
Frequency Response



PSRR



Noise VS Frequency





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MIX8015 Application Information

Input Resistor(Ri)

The input resistors (Ri) and the feedback resistor (Rf) set the gain of MIX8015. According to the equation as below:

$$A_v = 2 \times \frac{R_f}{R_i} \left(\frac{V}{V} \right)$$

Where Ri is the external input resistor and the feedback resistor Rf is 225K. (Internal feedback resistor is fixed, cannot be external adjustable) For example, set the external input resistors (Ri) to 33K, the magnification is:

$$A_v = 2 * \frac{225}{33} = 13.5 \times = 22.6\text{dB}$$

Input Capacitors (Ci)

The input capacitor and input resistor from a high-pass filter with the corner frequency, fc, determined by the below equation:

$$f_c = \frac{1}{(2\pi R_i C_i)}$$

The Ci values will not only affect the low frequency response of the circuit, but also affect the system starting and shutting down popping noise generated. Larger input capacitors need more time and more charge to reach stable operating point. Under the same conditions, popping noise generated by small input capacitance is relatively small.

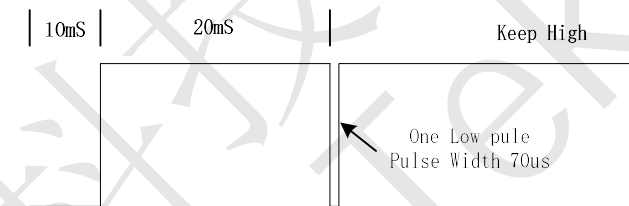
SD Control and single wire configuration

The MIX8015 Internal has shutdown circuit and it can shut off the amplifier. When the SD pin is pulled low, the amplifier is turned off; the operating current reaches a minimum level(less than 1uA). When the SD pin voltage is pulled High, the amplifier works in the normal amplify state. The SD pin default is pulled high.

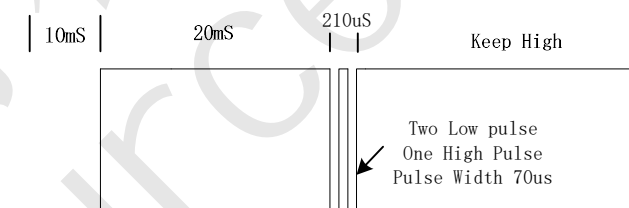
The MIX8015 built in Non-clip mode and Normal operation Mode. Both ACF1 and ACF2 are Non-Clip mode. At ACF1 mode, MIX8015 sounds louder and more distortion than at ACF2 mode.

The single wire mode control as below:

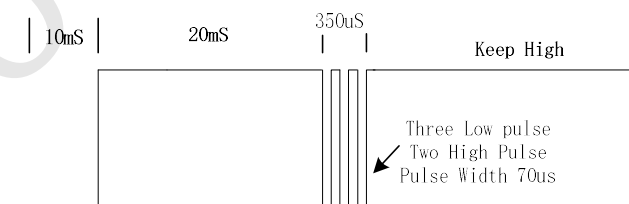
1. The waveform for **Class-D ACF1 Mode**



2. The waveform for **Class-D ACF2 Mode**



3. The waveform for **Class-D Normal operation Mode**



Analog Reference Bypass Capacitor (CBYP)

The Analog Reference Bypass Capacitor (CBYP) is the most critical capacitor and serves several important functions. During start-up or recovery from shutdown mode, C determines the rate at which the amplifier starts up.

A ceramic bypass capacitor (CBYP) with values of 0.1 μF to 1.0 μF is recommended for the best noise floor and "POP and Clip" performance.



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Thermal Protection

Thermal protection on the MIX8015 prevents damage to the device when the internal die temperature exceeds 170°C. There is a $\pm 10^\circ\text{C}$ tolerance on this trip point from device to device. Once the die temperature exceeds the thermal set point, the device enters into the shutdown state and the outputs are disabled. This is not a latched fault. The thermal fault is cleared once the temperature of the die is reduced by 10°C. The device begins normal operation at this point with no external system intervention.

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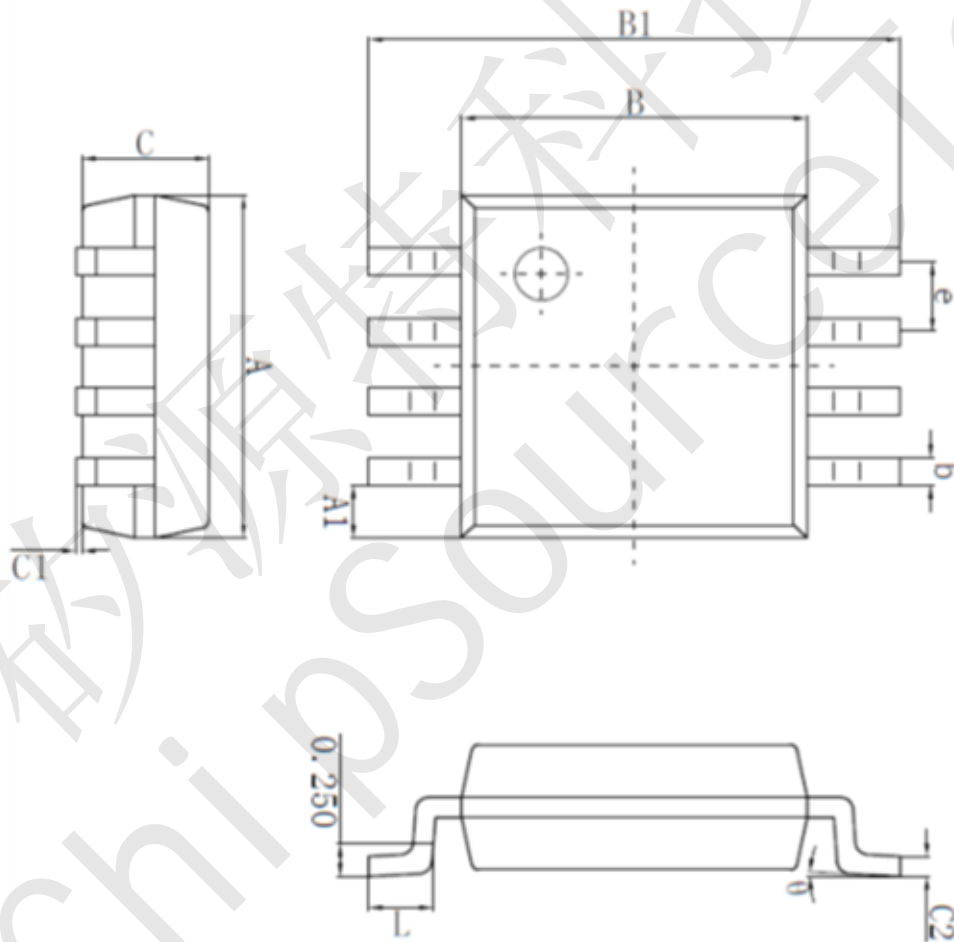


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MIX8015 Outline Dimension

(MSOP8)

SYMBOL	Unit: mm			SYMBOL	Unit: mm		
	MIN	NOM	MAX		MIN	NOM	MAX
A	2.9		3.1	C	0.78		0.94
A1		0.375		C1	0.05		0.15
e		0.65		C2	0.08		0.23
B	2.9		3.1	L	0.4		0.7
B1	4.75		5.05	θ	0°		8°
b	0.22	0.3	0.38				





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