



DESCRIPTION

A2323 is a 3-W ($V_{DD}=5.0V$, $R_L=4\Omega$) high efficiency filter-free class-D audio power amplifier .

A2323 has a “Professional Anti-Clip output control circuit” which reducing distortion of output signal due to either the over level input signal or power supply voltage down with battery.

Features like high efficiency, $-80dB$ PSRR, over-current protection and thermal protection function make the A2323 ideal for cellular handsets.

The A2323 is available in CSP9 package.

ORDERING INFORMATION

Package Type	Part Number	
CSP9	G9	A2323G9R
		A2323G9VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products Suffix “ V “ means Halogen free Package		

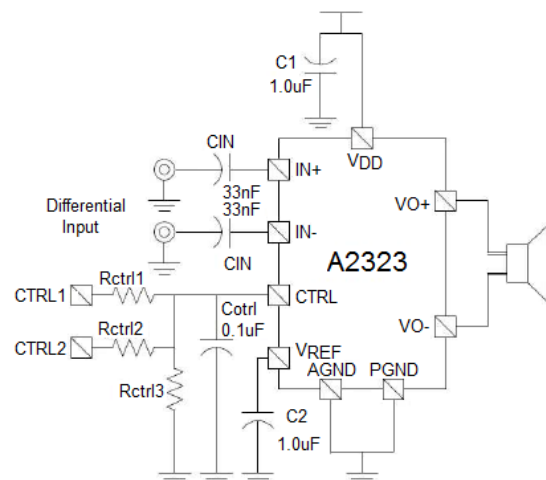
FEATURES

- Output Power
3.0W ($V_{DD}=5.0V$, $R_L=4\Omega$, THD+N=10%)
1.8W ($V_{DD}=5.0V$, $R_L=8\Omega$, THD+N=10%)
- Four mode can be selected with CTRL terminal: Anti-Clip 1, Anti-Clip 2, Anti-Clip off, Power-Down
- Low THD+N and Low Noise
- Low EMI
- Improved PSRR ($-80dB$) and Wide Supply Voltage (2.5 V to 5.0V) Eliminates Need for a Voltage Regulator
- Over-current and Thermal Protection function
- Pop noise reduction function
- Available in CSP9 Package

APPLICATION

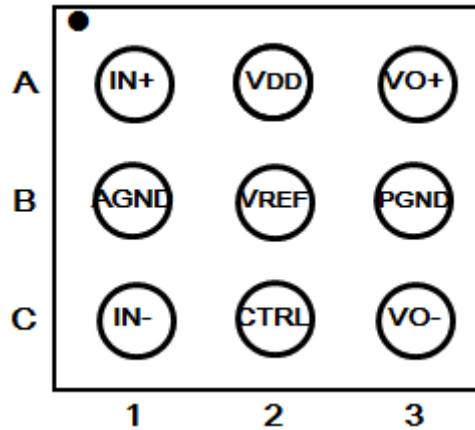
- Mobile phone, PDA
- MP3/4, PMP, GPS
- Portable electronic devices

TYPICAL APPLICATION





PIN DESCRIPTION



Top View

Pin #	Symbol	Function
A1	IN+	Positive Differential Input
A2	V _{DD}	Power Supply
A3	VO+	Positive BTL Output
B1	AGND	Analog Ground
B2	V _{REF}	Bypass Capacitor Connected
B3	PGND	Power Ground
C1	IN-	Negative Differential Input
C2	CTRL	Mode select
C3	VO-	Negative BTL output



ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature, unless otherwise noted

V _{DD} , Supply Voltage	-0.3V~+5.2V
V _I , Input Voltage	-0.3V~V _{DD} +0.3V
T _A , Operation Free-Air Temperature Range	-40°C~+120°C
T _J , Operation Free-Air Junction Temperature	-40°C~+150°C
T _{STG} , Storage Temperature Range	-65°C~+150°C
T _{SLD} , Soldering Temperature	300°C, 5sec

Stress beyond above listed "Absolute Maximum Ratings" may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN	MAX	Units
Power Supply Voltage	V _{DD}	2.5	5.0	V
Operating Ambient Temperature	T _A	-20	85	°C
Speaker Impedance	R _L	4	-	Ω



DC CHARACTERISTICS

$V_{DD} = 2.5V$ to $5V$, $T_A = 25^\circ C$, unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power Supply Start-Up Threshold Voltage	V_{UVLH}			2.5		V
Power Supply Shut-Down Threshold Voltage	V_{UVLL}			1.8		V
Anti-Clip1 Mode Setting Threshold Voltage	V_{MOD1}		1.3		V_{DD}	V
Anti-Clip2 Mode Setting Threshold Voltage	V_{MOD2}		0.85		1.15	V
Anti-Clip Off Mode Setting Threshold Voltage	V_{MOD3}		0.5		0.72	V
Power-Down Mode Setting Threshold Voltage	V_{MOD4}		V_{SS}		0.14	V
Consumption Current	I_{DD}	$V_{DD}=3.6V$, No Load, No Signal Input		5		mA
Consumption Current In Power-Down Mode	I_{PD}	$CTRL < 0.2V$			1	uA
V_{REF} Voltage	V_{REF}			$V_{DD}/2$		V

AC CHARACTERISTICS

$V_{DD} = 2.5V$ to $5V$, $T_A = 25^\circ C$, unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Start-Up Time	t_{STUP}	$V_{DD}=5V, V_r=1\mu F$		38		ms
Input Cut-Off Frequency	f_c	$C_{IN}=33nF, A_v=17.5dB$		120		Hz
Attack Time 1	t_{AT1}	$V_{DD}=5V, g=10dB$		45		ms
Release Time 1	T_{RL1}	$V_{DD}=5V, g=10dB$		3.1		s
Attack Time 2	t_{AT2}	$V_{DD}=5V, g=10dB$		10		ms
Release Time 2	T_{RL2}	$V_{DD}=5V, g=10dB$		1.8		s
Each Mode Setting Time(Except Power Down)	t_{MOD}		0.1			ms



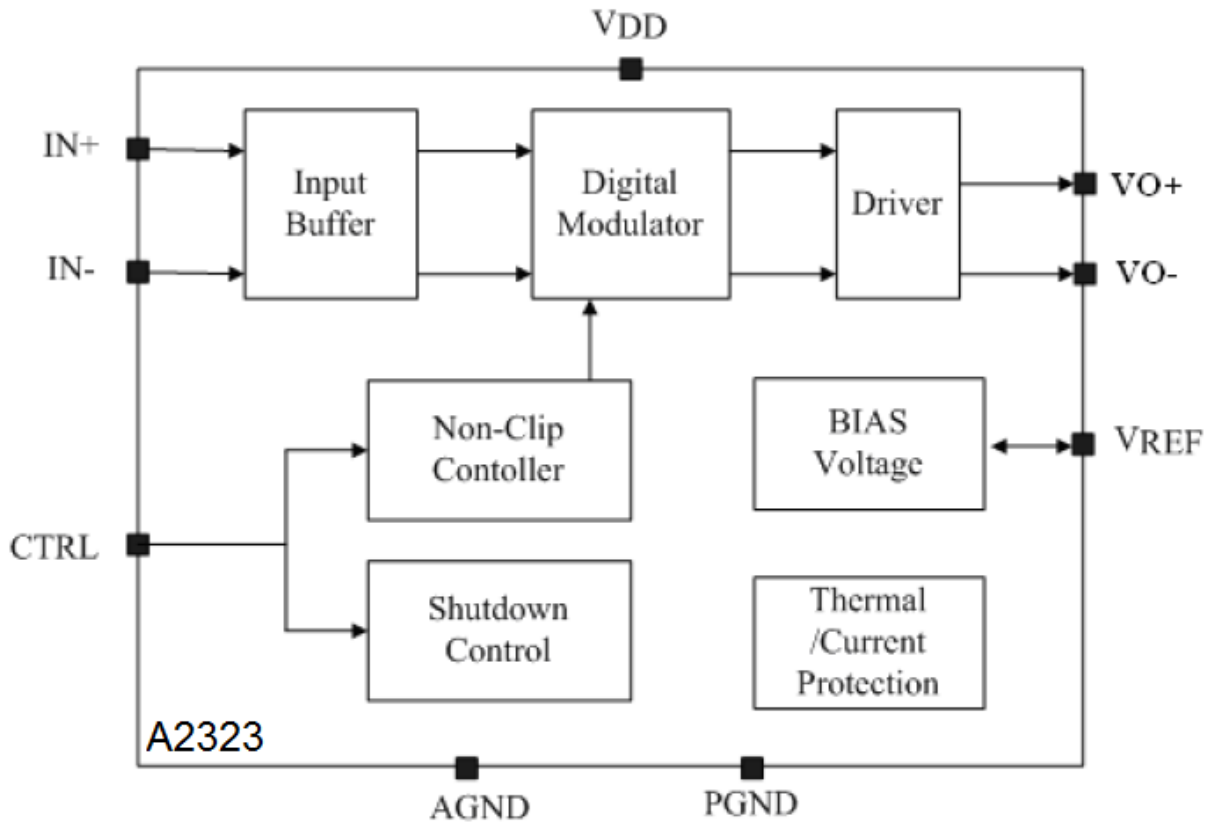
ANALOG CHARACTERISTICS

$V_{DD} = 3.6V$, $A_V = 17.5dB$, $T_A = 25^\circ C$, $C_{IN} = 100nF$, Anti-Clip off, unless otherwise noted.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Maximum Output	P_O	$R_L = 4\Omega, V_{DD} = 5V$		3		W
		$R_L = 8\Omega, V_{DD} = 5V$		1.8		
Total Harmonic Distortion Rate	THD+N	$R_L = 4\Omega, P_O = 0.65W, f = 1KHz$		0.08		%
		$R_L = 8\Omega, P_O = 0.65W, f = 1KHz$		0.06		
Residual Noise	N	$A_V = 17.5dB$ A-Weighted		60		μV_{rms}
Signal/Noise Ratio	SNR	$A_V = 17.5dB$ A-Weighted		95		dB
Power Supply Rejection Ratio	PSRR	217Hz		-80		dB
Maximum Efficiency	η	$R_L = 8\Omega, P_O = 0.6W$		85		%
		$R_L = 8\Omega, P_O = 0.1W$		80		
Output Offset Voltage	V_O			± 10		mV
Frequency Characteristics	f_{RES}	$C_{IN} = 0.1\mu F, f = 100Hz$ to 20KHz	-3		1	dB
Closed Loop Gain	G_V	$V_{DD} = 5V$ Anti-Clip Off		17.5		dB



BLOCK DIAGRAM





DETAILED INFORMATION

Application Information

Anti-Clip Control Function

This is the function to control the output in order to obtain a maximum output level without distortion when an excess input which causes clipping at the differential signal output is applied. That is, with the Anti-Clip function, A2323 lowers the Gain of the amplifier to an appropriate value so as not to cause the clipping at the differential signal output.

And, A2323 follows also to the clip of the output wave form due to the decrease in the power-supply voltage. The Attack time and the release time of Anti-Clip control are fixation two levels, and selects with the CTRL terminal. The Attack time is a time interval until from gain falls to target attenuation gain -3dB with a big signal input enough. And the Release time is a time from target attenuation gain to not working of Anti-Clip.

Attack time and Release time

Anti-Clip mode	Attack time	Release time
1(Recommendation)	45ms	3.1s
2	10ms	1.8s

Over-current Protection function

This is the function to establish the over-current protection mode when detecting a short circuit between A2323 differential output terminal and V_{SS} , V_{DD} , or another differential output. In the over current protection mode, the differential output terminal becomes a high impedance state. Once the short is removed, the device will be reactivated..

Thermal Protection function

Thermal protection on the A2323 prevents damage to the device when the internal die temperature exceeds 150°C. There is a $\pm 20^\circ\text{C}$ tolerance on this trip point from device to device. Once the die temperature exceeds the thermal set point, the outputs are disabled. This is not a latched fault. The thermal fault is cleared once the temperature of the die is reduced by 20°C. The device begins normal operation at this point with no external system intervention.

Under Voltage Lock-out (UVLO)

The A2323 incorporates circuitry designed to detect low supply voltage. When the supply voltage drops to 1.8V or below, the A2323 outputs are disabled, and the device comes out of this state and starts to normal function when $V_{DD} \geq 2.5V$.



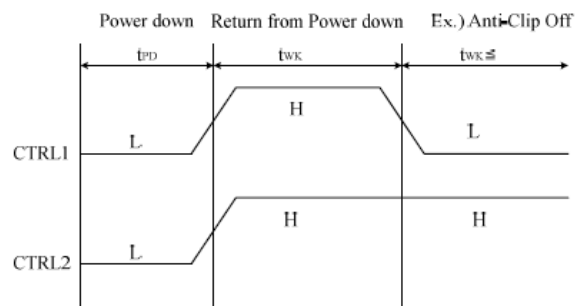
V_{REF} terminal output

The voltage of $V_{DD}/2$ is output from the V_{REF} terminal. Capacitor (1uF) is connected between the V_{REF} terminal and GND for stabilization.

Power down and Initialization function

When CTRL terminal is connected to the GND potential, the IC goes to the power-down mode. In the mode, all the circuit functions stop and its current consumption becomes the lowest.

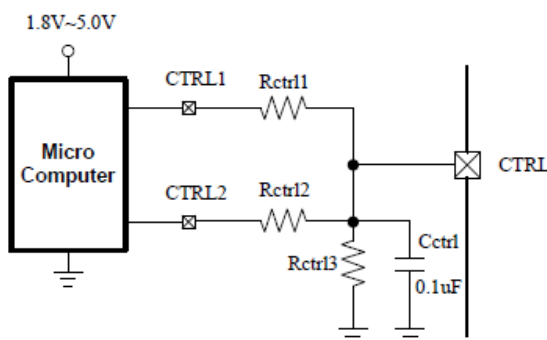
when CTRL terminal is set to H level, the power-down mode is canceled and the IC starts up after startup time (t_{STUP}). In order to return from the power-down mode a desired mode needs to be set after setting both CTRL1 and CTRL2 to H level during t_{WK} . In addition, at startup, cancel the power-down mode after supply voltages has been sufficiently stabilized.



CTRL terminal function

By connection external resistors (R_{ctrl1}, R_{ctrl2}, and R_{ctrl3}: Accuracy of 1%) to CTRL terminal, and impression setting threshold voltage of each mode to CTRL terminal, the followings can be set: Anti-Clip1, Anti-Clip2, Anti-Clip OFF, and power-down mode. When turning on the supply voltage or cancelling the power-down mode, control the CTRL terminal according to the procedure for cancelling power-down.

Connect the terminal to the ground through a capacitor C_{ctrl} (a ceramic capacitor of 0.1μF or more)



CTRL1	CTRL2	Function
H	H	Anti-Clip 1 mode
H	GND	Anti-Clip 2 mode
GND	H	Anti-Clip off mode
GND	GND	Power-down mode



“H” level indicates a microcomputer’s I/O port H level output voltage that is input to CTRL1 and CTRL2 terminals and GND indicates GND of the microcomputer.

GND level of the microcomputer must be the same as that of A2323.

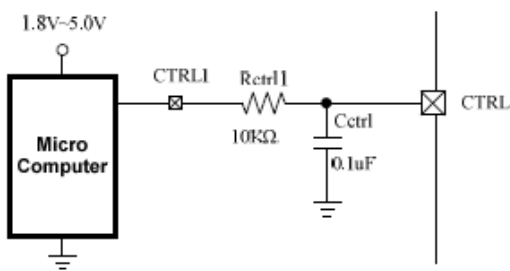
The control of CTRL terminal is based on I/O port H level output voltage of microcomputer that is connected. Set resistance constants according the I/O port H level output voltage of each microcomputer as shown below.

I/O port H level output voltage of Microcomputer	1.8V	2.6V	3.0V	3.3V	5.0V
Rctrl1	27KΩ	33KΩ	33KΩ	33KΩ	56KΩ
Rctrl2	43KΩ	51KΩ	51KΩ	51KΩ	82KΩ
Rctrl3	82KΩ	27KΩ	22KΩ	18KΩ	15KΩ

Functions of CTRL pin are designed with their control by two control pins (CTRL1 and CTRL2)

Only a Switching control between Anti-Clip1 mode and Power-down is available when a single control terminal used.

A setting voltage should be set according to V_{MOD1} and V_{MOD4} , and use a RC filter with time constant of 1msec or more in order to eliminate noise at transmission side such as Micon etc. (Example. $R_{ctrl1}=10K\Omega$ and $C_{ctrl}=0.1\mu F$).



CTRL1	Function
H	Anti-Clip 1 mode
GND	Power-down mode

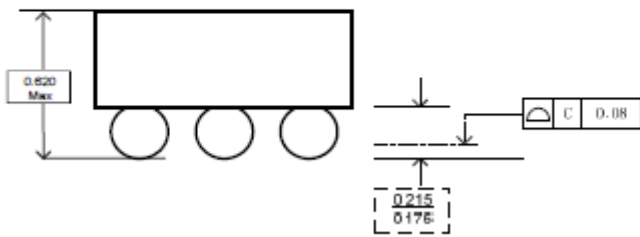
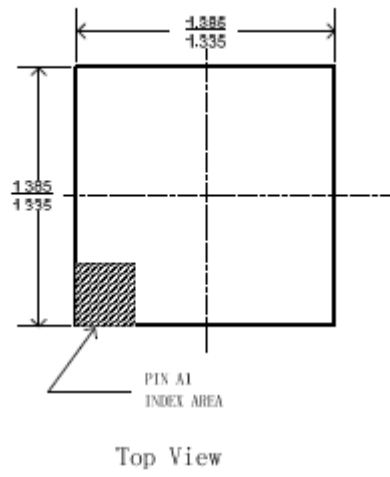
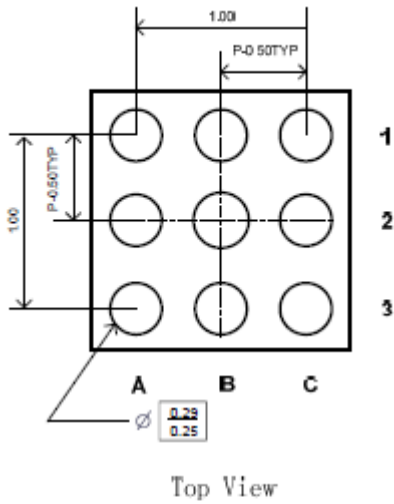
POP and Click Circuitry

The A2323 contains circuitry to minimize click and pops. For the best power-off pop performance, the amplifier should be set in shutdown mode prior to removing the power supply voltage.



PACKAGE INFORMATION

Dimension in CSP9 (Unit: mm)





IMPORTANT NOTICE

AiT Semiconductor Inc. (AiT) reserves the right to make changes to any its product, specifications, to discontinue any integrated circuit product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

AiT Semiconductor Inc.'s integrated circuit products are not designed, intended, authorized, or warranted to be suitable for use in life support applications, devices or systems or other critical applications. Use of AiT products in such applications is understood to be fully at the risk of the customer. As used herein may involve potential risks of death, personal injury, or severe property, or environmental damage. In order to minimize risks associated with the customer's applications, the customer should provide adequate design and operating safeguards.

AiT Semiconductor Inc. assumes to no liability to customer product design or application support. AiT warrants the performance of its products of the specifications applicable at the time of sale.