16-Bit Stereo Audio DAC & Headphone Driver Single Supply Voltage and Low Voltage Low Power Consumption 8.9mW Mute And Power Down Function

FEATURES

- Operation range: 2.7V~5.5V
- Excellent Power Supply Rejection Ratio(PSRR)
- No pop-noise
- Low power consumption 8.9mW at V_{DD}=3.3V
- Mute function
- Power down function
- Output voltage adjusted by the external resisters
- Component less
- No zero crossing distortion
- Fast setting time permits 2*, 4*, and 8* oversampling (serial input) or double speed operation at 4* oversampling
- Compatible with most of the Japanese input formats; time multiplexed, two's complement, TTL input level
- Cost efficient
- Housed in 16 pin SSOP, QFN package

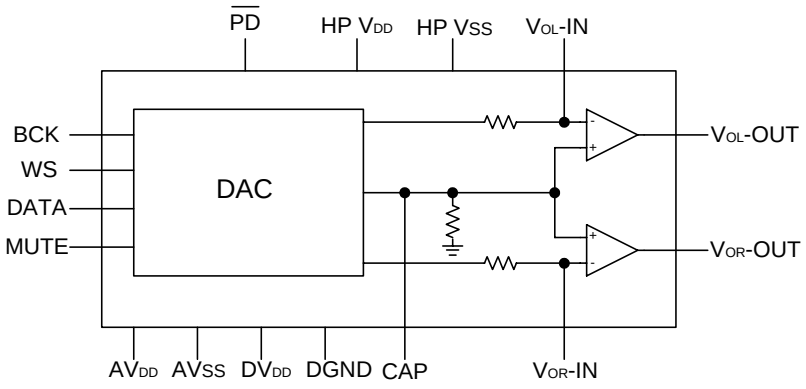
APPLICATIONS

- Multimedia system, MP3, PDA, Portable Digital Audio.

DESCRIPTION

The MS6333 is an integrated 16-bits voltage-output Digital-to-Analog Converter (DAC) and class AB stereo headphone driver. The MS6333 is with the excellent Power Supply Rejection Ratio(PSRR). It is fabricated in a CMOS process and features extremely low power dissipation, small package size and easy application. The accuracy of the matched coarse current sources, combined with the unique symmetrical decoding method, preclude zero-crossing distortion and ensures high quality audio reproduction. These unique features, combined with its exceptional performance, make the MS6333 ideally suited for use in digital audio equipment.

BLOCK DIAGRAM

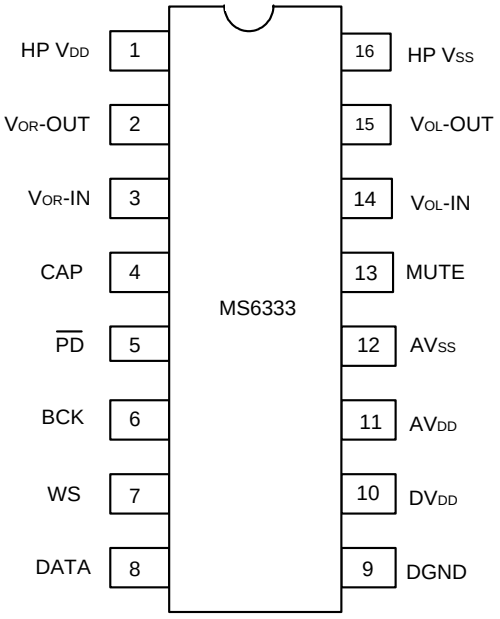


PIN CONFIGURATION

SSOP16

Symbol	Pin	Description
HP V_{DD}	1	Headphone supply voltage
V_{OR}-OUT	2	Right channel output
V_{OR}-IN	3	Right channel input (-)
CAP	4	Capacitor connected
$\overline{PD}$	5	Power down
BCK	6	Bit clock input
WS	7	Word select input
DATA	8	Data input
DGND	9	Digital ground
DV_{DD}	10	Digital supply voltage
AV_{DD}	11	Analog supply voltage
AV_{SS}	12	Analog ground
MUTE	13	Mute function
V_{OL}-IN	14	Left channel input (-)
V_{OL}-OUT	15	Left channel output
HP V_{SS}	16	Headphone ground

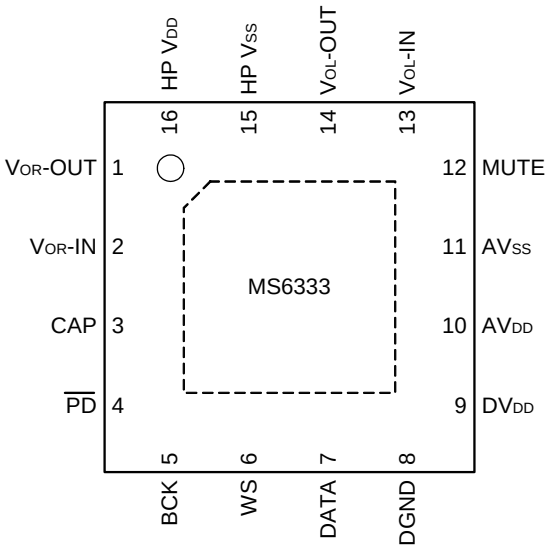
NOTE: $\overline{PD}$=0 Power down ; $\overline{PD}$=1 Normal



QFN16

Symbol	Pin	Description
V_{OR}-OUT	1	Right channel output
V_{OR}-IN	2	Right channel input (-)
CAP	3	Capacitor connected
$\overline{PD}$	4	Power down
BCK	5	Bit clock input
WS	6	Word select input
DATA	7	Data input
DGND	8	Digital ground
DV_{DD}	9	Digital supply voltage
AV_{DD}	10	Analog supply voltage
AV_{SS}	11	Analog ground
MUTE	12	Mute function
V_{OL}-IN	13	Left channel input (-)
V_{OL}-OUT	14	Left channel output
HP V_{SS}	15	Headphone ground
HP V_{DD}	16	Headphone supply voltage

NOTE: $\overline{PD}$=0 Power down ; $\overline{PD}$=1 Normal



ORDERING INFORMATION

Package	Part number	Packaging Marking	Transport Media
16-Pin SSOP	MS6333TR	MS6333	2.5k Units Tape and Reel
16-Pin SSOP	MS6333U	MS6333	100 Units Tube
16-Pin SSOP (lead free)	MS6333GTR	MS6333G	2.5k Units Tape and Reel
16-Pin SSOP (lead free)	MS6333GU	MS6333G	100 Units Tube
16-Pin QFN (lead free)	MS6333QTR	6333	5k Units Tape and Reel
16-Pin QFN (lead free)	MS6333Q	6333	490 Units Tray

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Unit
V_{DD}	Positive Supply Voltage	6	V
V_{ESD}	Electrostatic Handling	-3000 to 3000	V
T_{STG}	Storage Temperature Range	-65 to 150	℃
T_A	Operating Ambient Temperature Range	-40 to 85	℃
T_J	Maximum Junction Temperature	150	℃
T_S	Soldering Temperature, 10 seconds	260	℃
R_{THJA}	Thermal Resistance from Junction to Ambient in Free Air SSOP16 QFN16	 210 120	℃/W

OPERATING RATINGS

Symbol	Parameter	Min	Typ	Max	Unit
V_{DD}	Supply Voltage	2.7	-	5.5	V

3.3V ELECTRICAL CHARACTERISTICS

(Ta=25℃, V_{DD}=3.3V, V_{SS}=0V, f=1kHz, R_L=32Ω; unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DC Characteristics						
V_{CAP}	Voltage at CAP		1.60	1.65	1.70	V
V_{DC}	Output DC level		1.60	1.65	1.70	V
V_{FS}	Full scale output voltage	V_{FS}=0.023663* R_F *V_{DD}	V_{FS}-10%	V_{FS}	V_{FS}+10%	V
I_Q	Quiescent current	Mute on, code 0000H	-	2.7	4	mA
		Mute off, code 0000H	-	4.8	6	mA
I_{PD}	Power down current	No digital input signal	-	12	20	uA
V_{TM}	Mute control voltage	Mute on	0	-	1	V
		Mute off	2.7	-	V_{DD}	V
PSRR	Power supply rejection ratio	CAP=2.2uF (100Hz)	58	63		dB
		CAP=10uF (100Hz)	67	72		dB
CS	Channel separation		76	82	-	dB
ATT	Mute attenuation		100	110	-	dB
AC Characteristics						
Res	Resolution		-	-	16	bits
THD+N	Total harmonic distortion plus noise		-	-65	-60	dB
			-	0.056	0.1	%
S/N	Signal-to-noise ratio		86	92	-	dB
Po	Maximum output power	(THD+N)/S < 0.1%, 2 ch	49	52	-	mW
Vo	Maximum output voltage swing	(THD+N)/S < 0.1%	2.5	2.6	-	Vpp

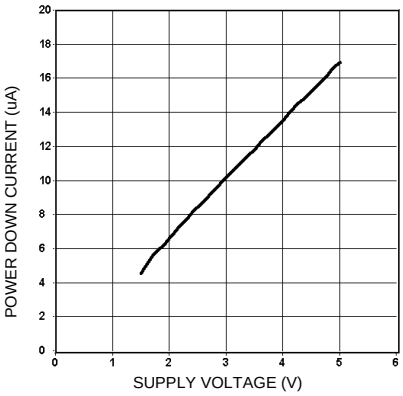
2.7V ELECTRICAL CHARACTERISTICS

(Ta=25℃, V_{DD}=2.7V, V_{SS}=0V, f=1kHz, R_L=32Ω; unless otherwise specified)

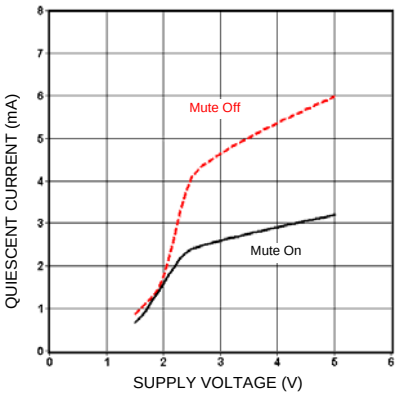
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DC Characteristics						
V_{CAP}	Voltage at CAP		1.30	1.35	1.40	V
V_{DC}	Output DC level		1.30	1.35	1.40	V
V_{FS}	Full scale output voltage	V_{FS}=0.023663* R_F *V_{DD}	V_{FS}-10%	V_{FS}	V_{FS}+10%	V
I_Q	Quiescent current	Mute on, code 0000H	-	2.5	3.7	mA
		Mute off, code 0000H	-	4.4	5.6	mA
I_{PD}	Power down current	No digital input signal	-	9	17	uA
V_{TM}	Mute control voltage	Mute on	0	-	0.9	V
		Mute off	2.5	-	V_{DD}	V
PSRR	Power supply rejection ratio	CAP=2.2uF (100Hz)	58	63	-	dB
		CAP=10uF (100Hz)	67	72	-	dB
CS	Channel separation		76	82	-	dB
ATT	Mute attenuation		100	110	-	dB
AC Characteristics						
Res	Resolution		-	-	16	bits
THD+N	Total harmonic distortion plus noise		-	-64	-60	DB
			-	0.063	0.1	%
S/N	Signal-to-noise ratio		84	90	-	dB
Po	Maximum output power	(THD+N)/S < 0.1%, 2 ch	28	33	-	mW
Vo	Maximum output voltage swing	(THD+N)/S < 0.1%	1.9	2	-	Vpp

TYPICAL PERFORMANCE CHARACTERISTICS

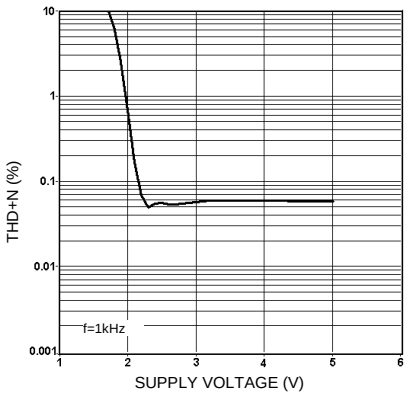
(Ta=25℃, R_L=32Ω, R_F=22k, sampling rate=4fs; unless otherwise specified)



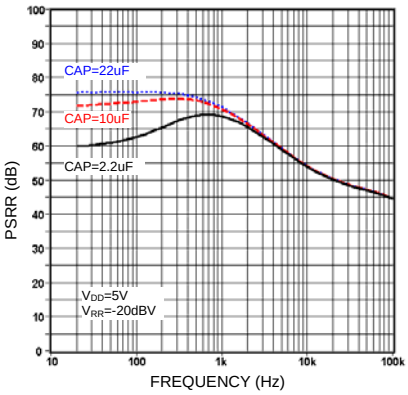
Power down current vs. supply voltage



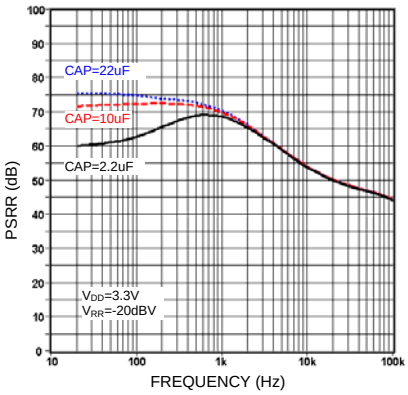
Quiescent current vs. supply voltage



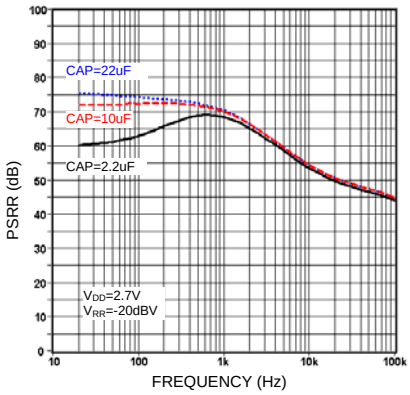
THD+N vs. supply voltage



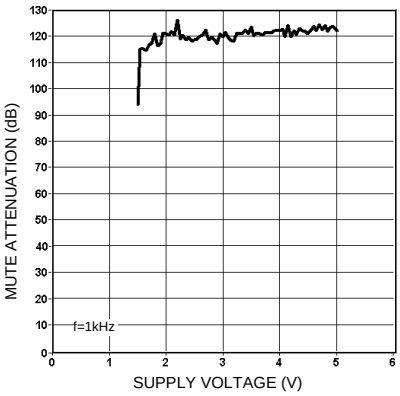
PSRR vs. frequency



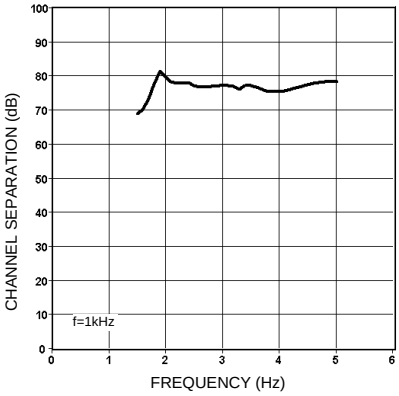
PSRR vs. frequency



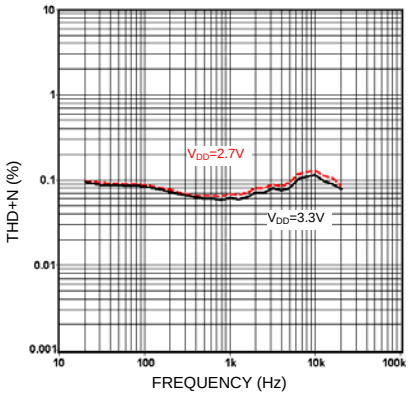
PSRR vs. frequency



Mute attenuation vs. supply voltage



Channel separation vs. frequency



THD+N vs. frequency

TIMING AND DATA FORMAT

The MS6333 accepts input serial data formats of 16-bit word length. Left and right data words are time multiplexed. The MSB must always be first. The format of data input is shown in Figs. 1 and 2.

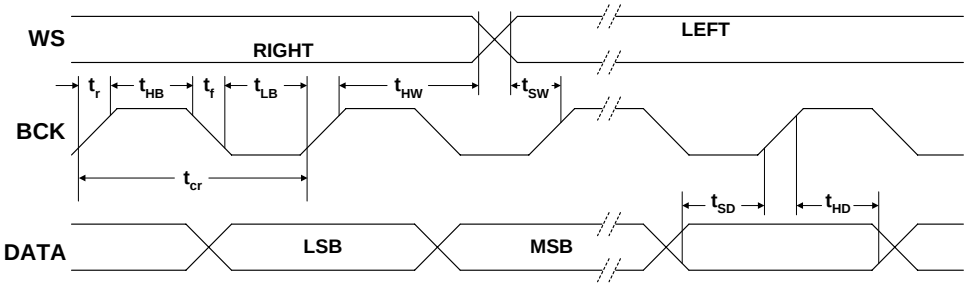


Fig.1 Timing and input signals.

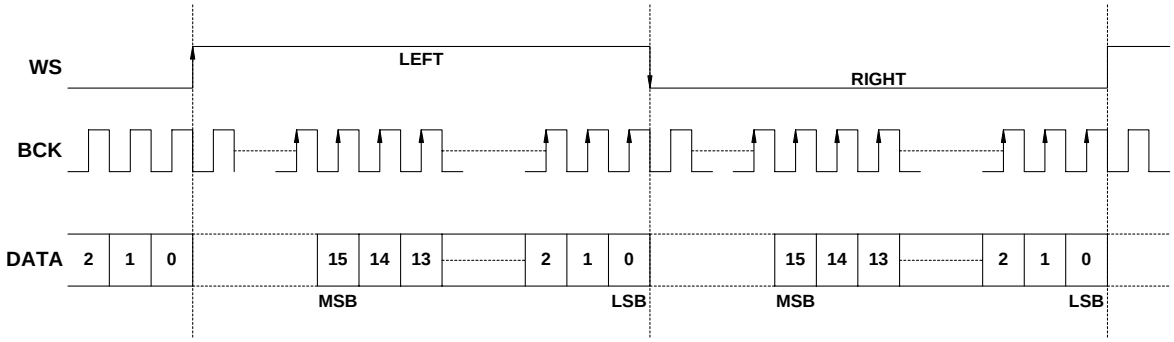


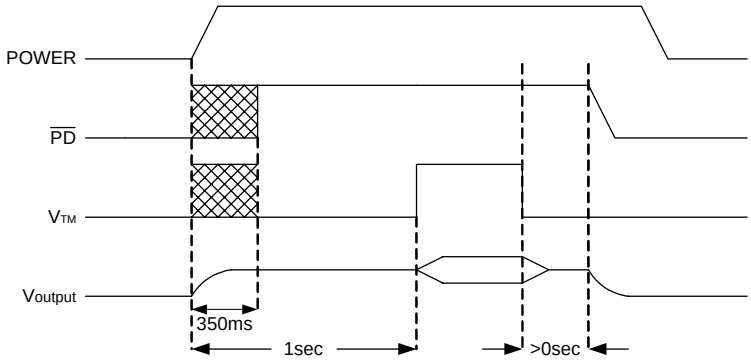
Fig.2 Format of input signals.

Data format (BCK, WS, DATA)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IL}	Input LOW level		-	-	$0.3V_{DD}$	V
V_{IH}	Input HIGH level		$0.7V_{DD}$	-	-	V
$\lvert I_{IL} \rvert$	Input Leakage Current LOW		-	-	10	μA
$\lvert I_{IH} \rvert$	Input Leakage Current HIGH		-	-	10	μA
f_{BCK}	Input Clock Frequency		-	-	18.4	MHz
BR	Bit Rate Data Input		-	-	18.4	Mbits/s
f_{WS}	Word Select Input		-	-	384	kHz
t_r	Rise Time		-	-	12	ns
t_f	Fall Time		-	-	12	ns
t_{Cr}	Bit Clock Cycle Time		54	-	-	ns
t_{HB}	Bit Clock High Time		15	-	-	ns
t_{LB}	Bit Clock Low Time		15	-	-	ns
t_{SD}	Data Set-up Time		12	-	-	ns
t_{HD}	Data Hold Time to Bit Clock		2	-	-	ns
t_{HW}	Word Select Hold Time		2	-	-	ns
t_{SW}	Word Select Set-up Time		12	-	-	ns

POWER DOWN AND MUTE FUNCTION

A microcontroller or microprocessor control power and mute function timing on MS6333 is shown in Figure 3. It could prevent pop noise effectively when power on and power off. The signals of power down function (pin5) and mute function (pin13) are ignored during initial time 350ms when power on. It is better to control mute function after 1sec. The sequence is mute on and then power down when power off.



Power on:
Delay >350msec from power on to mute off.

Power off:
Delay >0sec from mute on to power off.

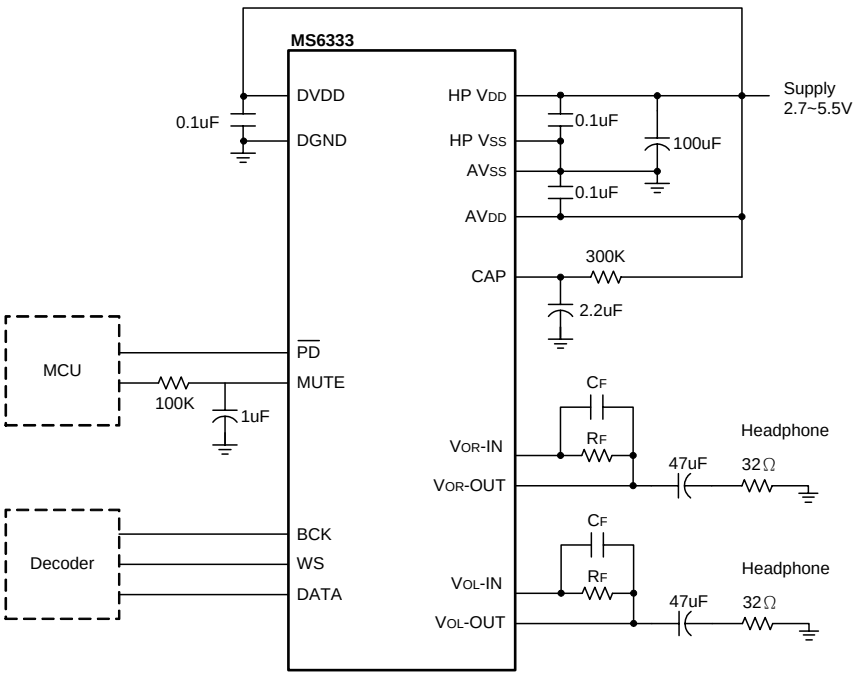
Fig.3 Power and mute function timing.

APPLICATION INFORMATION

Basic application example

A typical example of an MP3-application with the MS6333 is shown in Fig.4.

Power voltage of digital and analog can be used single supply voltage.



Note : $Vo=0.023663*R_F*V_{DD}$ Vpp

$R_F//C_F$ to decide –3dB point

V_{TM}: Mute control voltage

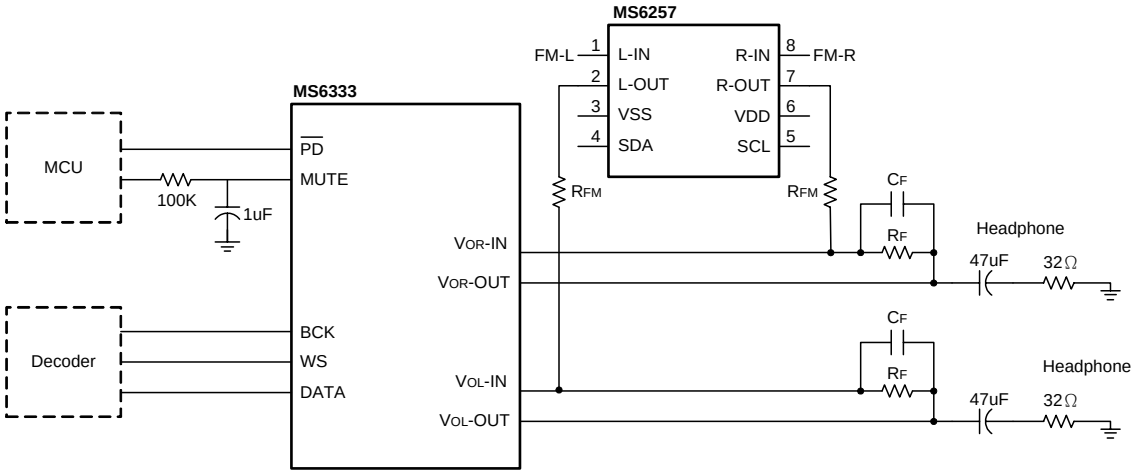
For V_{DD}=3V, R_L=32Ω, R_F =24k, C_F =390pF, Vo=1.7Vpp

R_L=16Ω, R_F =22k, C_F =470pF, Vo=1.56Vpp

Fig.4 MP3 Basic application circuit.

A MP3 with FM application

MS6333 combined with FM Function by using MS6257 as volume controller (-79dB to +15dB)

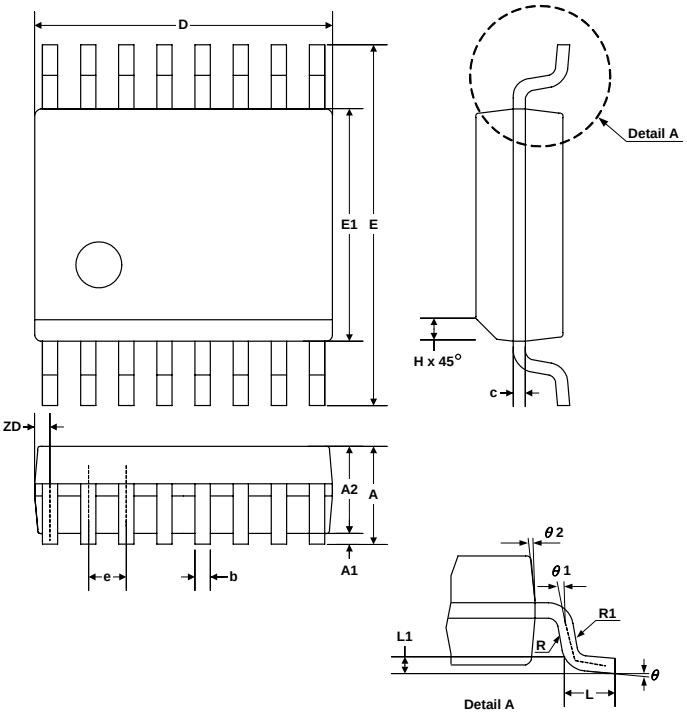


Note : FM mode, DC Gain = R_F/ R_{FM}

Fig.5 MP3 with FM application circuit.

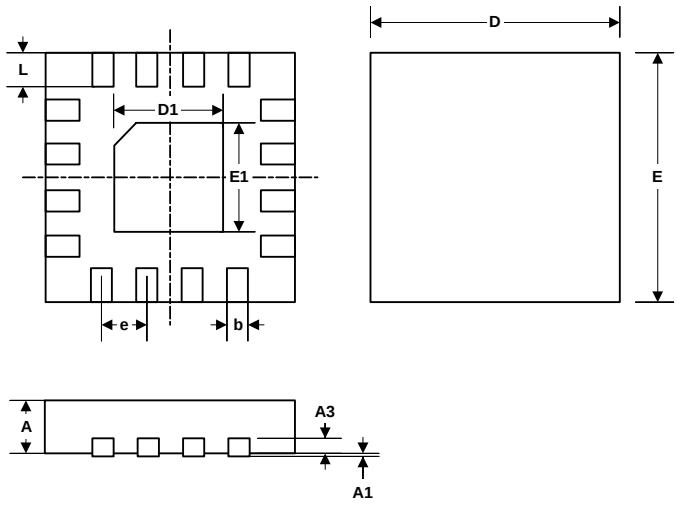
EXTERNAL DIMENSIONS

SSOP16



Symbol	Dimension in mm		Dimension in inch	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2		1.50		0.059
b	0.20	0.30	0.008	0.012
c	0.18	0.25	0.007	0.010
e	0.635 BASIC		0.025 BASIC	
D	4.80	5.00	0.189	0.197
E	5.79	6.20	0.228	0.244
E1	3.81	3.99	0.150	0.157
L	0.41	1.27	0.016	0.050
h	0.25	0.50	0.010	0.020
L1	0.254 BASIC		0.010 BASIC	
ZD	0.229 REF		0.009 REF	
R1	0.20	0.33	0.008	0.013
R	0.20		0.008	
θ	0^o	8^o	0^o	8^o
θ1	0^o		0^o	
θ2	5^o	15^o	5^o	15^o

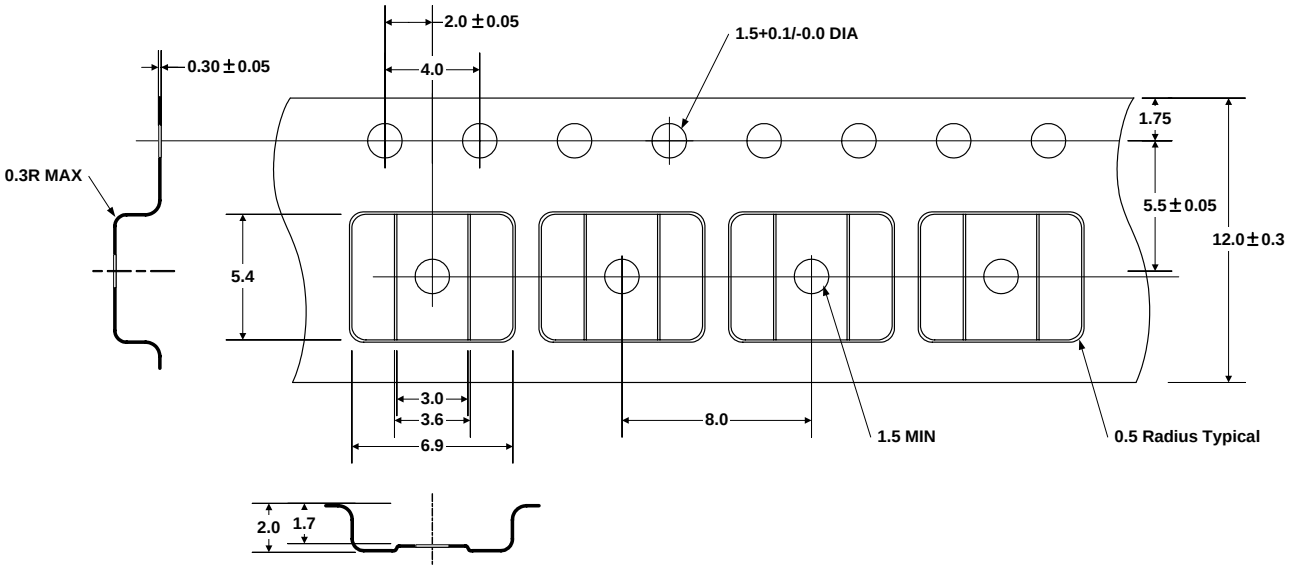
QFN16 (3x3mm)



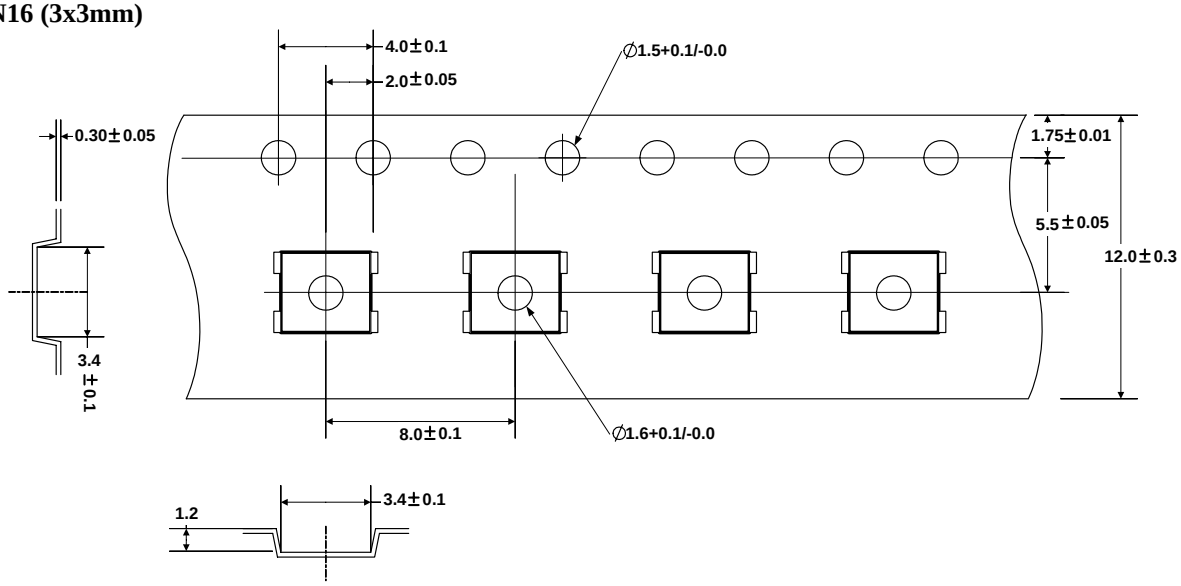
Symbol	Dimension in mm		
	Min	Nom	Max
A	0.80	0.90	1.00
A1	0	0.015	0.030
A3	-	0.20REF	-
b	0.18	0.23	0.30
D	2.85	3.00BSC	3.15
D1	-	1.48BSC	-
E	2.85	3.00BSC	3.15
E1	-	1.48BSC	-
e	-	0.50BSC	-
L	0.30	0.40	0.50

TAPE AND REEL (Unit : mm)

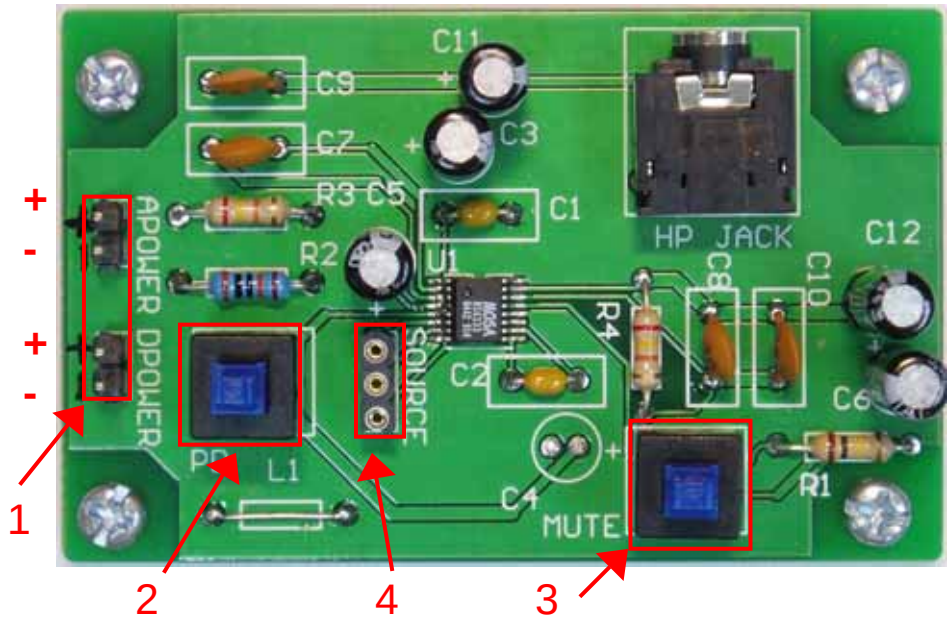
SSOP16



QFN16 (3x3mm)



Demo Board



版面說明:

1. 電源輸入：VDD使用2.7V~5.5V，極性如面板標示。
2. POWER DOWN：PD鈕壓下時POWER DOWN Enable。
   PD鈕未壓下POWER DOWN Disable。
3. MUTE：MUTE鈕壓下時MUTE ON ; MUTE鈕未壓下時MUTE OFF。
4. SOURCE : Audio digital input (BCK, WS, DATA)

