Stereo Audio Volume Controller With Soft Steps, 4 Stereo(1 quasi-differential) Inputs, Low voltage, Gain/Loss, Low power consumption.

FEATURES

- Operation range: 2.5V~6.5V.
- One quasi-differential input.
- Input Gain: 0dB ~ +15dB.
- Soft step volume control：-79dB ~ +15dB.
- Low power consumption.
- Good PSRR and low pop noise.
- I^2C interface.
- Housed in 16 pin SSOP packages.

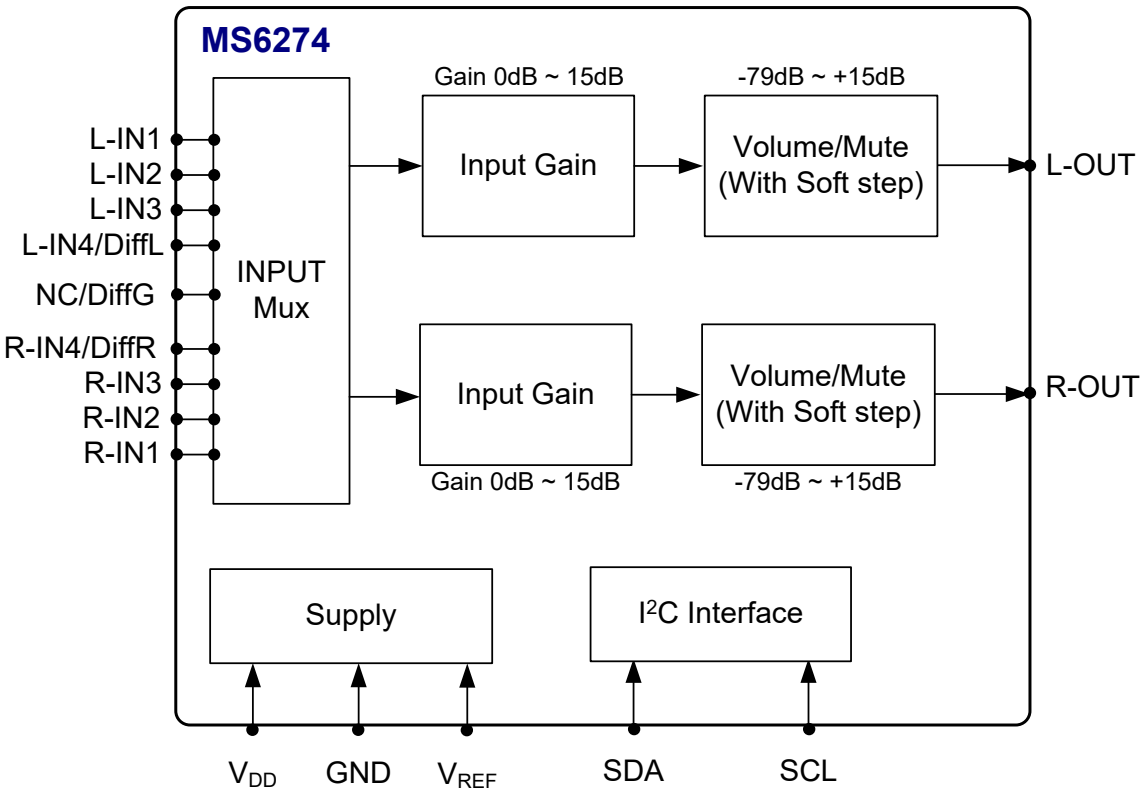
APPLICATIONS

- Multimedia system
- Hi-Fi audio system.
- Bluetooth.
- DAB

DESCRIPTION

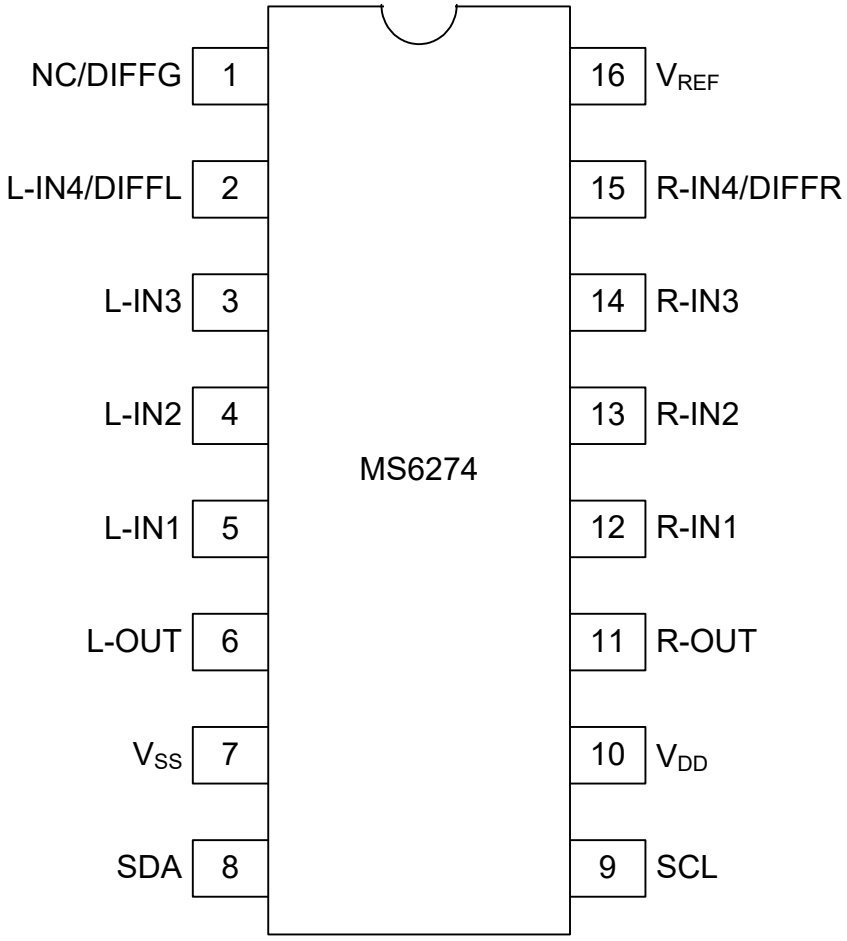
The MS6274 is a stereo audio volume controller IC with 4 sets of stereo inputs(1 quasi-differential Input). It has Input gain(0 ~ +15dB), Soft step volume control(-79dB ~ +15dB) with programmable blend times. It uses CMOS technology specially for the low voltage application with low noise, rail-to-rail output.

BLOCK DIAGRAM



PIN CONFIGURATION

Symbol	Pin	Description
NC/DIFFG	1	No Connected /Differential Stereo Input Common
L-IN4/DIFFL	2	4th Left Channel Input / Left Differential Stereo Input
L-IN3	3	3rd Left Channel Input
L-IN2	4	2nd Left Channel Input
L-IN1	5	1st Left Channel Input
L-OUT	6	Left Channel Output
V_{SS}	7	Ground
SDA	8	I^2C Data Input
SCL	9	I^2C Clock Input
V_{DD}	10	Positive Supply Voltage
R-OUT	11	Right Channel Output
R-IN1	12	1st Right Channel Input
R-IN2	13	2nd Right Channel Input
R-IN3	14	3rd Right Channel Input
R-IN4/DIFFR	15	4th Right Channel Input / Right Differential Stereo Input
V_{REF}	16	Reference Voltage = $1/2V_{DD}$



ORDERING INFORMATION

Package	Part number	Packaging Marking	Transport Media
16-Pin SSOP (lead free)	MS6274SSGTR	MS6274G	2.5k Units Tape and Reel
16-Pin SSOP (lead free)	MS6274SSGU	MS6274G	100 Units Tube

RoHS Compliance

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Unit
V_{DD}	Supply Voltage	6.5	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	120	℃
T_S	Soldering Temperature, 10 seconds	260	℃
R_{THJA}	Thermal Resistance from Junction to Ambient in Free Air SSOP16	115.9	℃/W

OPERATING RATINGS

Symbol	Parameter	Min	Typ	Max	Unit
V_{DD}	Supply Voltage	2.5	-	6.5	V

5V ELECTRICAL CHARACTERISTICS

(Ta=25℃, All stages 0dB, f=1kHz, C_{REF} =1uF, refer to the application circuit; unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply						
I_Q	Quiescent Current	V_{IN}=0V	-	4.2	-	mA
I_{PD}	Power down current	V_{IN}=0V	-	120	-	uA
PSRR	Power Supply Rejection Ratio	C_{REF} = 1uF, f = 100Hz	55	58	-	dB
Input Selectors						
R_{IN}	Input Resistance	Input 1,2,3,4		100		kΩ
$R_{IN-Diff}$	Input Resistance	Differential		100		kΩ
G_{IN}	Input Gain Range	Gain	0	-	15	dB
G_{STEP}	Step Resolution		-	1	-	dB
ERR_G	Gain Setting error		-0.2	0	0.2	dB
CMRR	Common mode rejection ratio	VCM = 1Vrms @ 1KHz	40	55	-	dB
		VCM = 1Vrms @ 10KHz	40	55	-	dB

Volume control						
CR_{VOL}	Volume Control Range	Attenuation & Gain	-79	-	+15	dB
RES_{VOL}	Volume Step Resolution		-	1	-	dB
ERR_{VOL}	Volume Setting Error	Av = +15 to -40dB	-0.5	0	1	dB
		Av = -40 to -79dB	-1	0	5	dB
MUTE	Mute Attenuation	Vin=0dBV		-90		dB
General						
VO_{MAX}	Maximum Output Voltage Swing	(THD+N)/S <0.1%	-	1.59	-	Vrms
THD+N	Total Harmonic Distortion Plus Noise	V_{OUT} = 1Vrms	-	-75	-	dB
			-	0.0177	-	%
S/N	Signal-to-Noise Ratio	V_{OUT} = 1Vrms	-	93	-	dB
CS	Channel Separation Left/Right		90	94	-	dB
Bus Input						
V_{IH}	Bus High Input Level		1.8	-	-	V
V_{IL}	Bus Low Input Level		-	-	0.8	V

3.3V ELECTRICAL CHARACTERISTICS

(Ta=25℃, All stages 0dB, f=1kHz, C_{REF} =1uF, refer to the application circuit; unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply						
I_Q	Quiescent Current	V_{IN}=0V	-	3.6	-	mA
I_{PD}	Power down current	V_{IN}=0V	-	80	-	uA
PSRR	Power Supply Rejection Ratio	C_{REF} = 1uF, f = 100Hz	65	70	-	dB
General						
VO_{MAX}	Maximum Output Voltage Swing	(THD+N)/S <0.1%	-	1	-	Vrms
THD+N	Total Harmonic Distortion Plus Noise	V_{OUT} = 0.707Vrms	-	-70	-	dB
			-	0.03	-	%
S/N	Signal-to-Noise Ratio	V_{OUT} = 0.707Vrms	-	90	-	dB
CS	Channel Separation Left/Right		90	93	-	dB

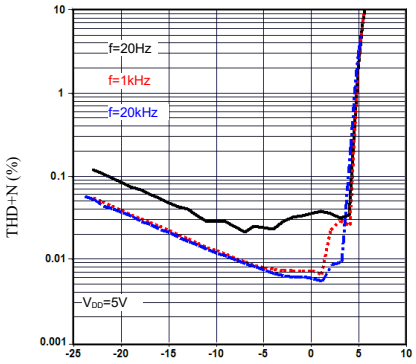
2.5V ELECTRICAL CHARACTERISTICS

(Ta=25℃, All stages 0dB, f=1kHz, C_{REF} =1uF, refer to the application circuit; unless otherwise specified)

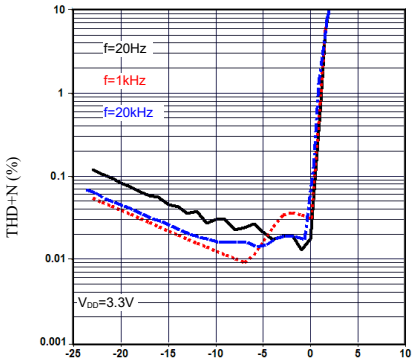
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply						
I_Q	Quiescent Current	V_{IN}=0V	-	3.3	-	mA
I_{PD}	Power down current	V_{IN}=0V	-	60	-	uA
PSRR	Power Supply Rejection Ratio	C_{REF} = 1uF, f = 100Hz	60	65	-	dB
General						
VO_{MAX}	Maximum Output Voltage Swing	(THD+N)/S <0.1%	-	0.8	-	Vrms
THD+N	Total Harmonic Distortion Plus Noise	V_{OUT} = 0.707Vrms	-	-67	-	dB
			-	0.04	-	%
S/N	Signal-to-Noise Ratio	V_{OUT} = 0.707Vrms	-	90	-	dB
CS	Channel Separation Left/Right		90	93	-	dB

TYPICAL PERFORMANCE CHARACTERISTICS

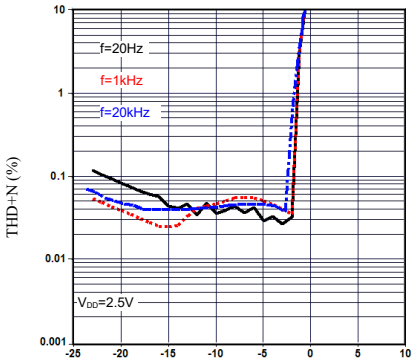
(Ta=25℃, R_L=10kΩ, C_{REF} = 1uF; unless otherwise specified)



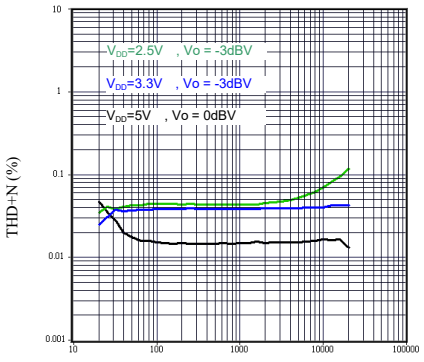
THD+N vs. output voltage



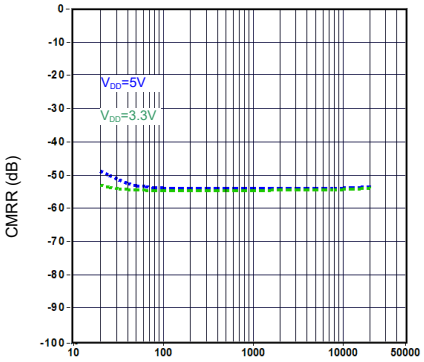
THD+N vs. output voltage



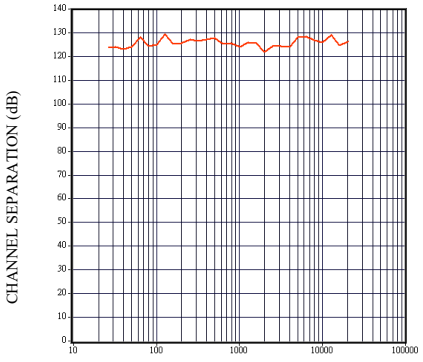
THD+N vs. output voltage



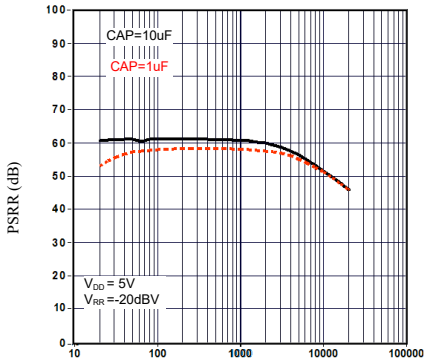
THD+N vs. frequency



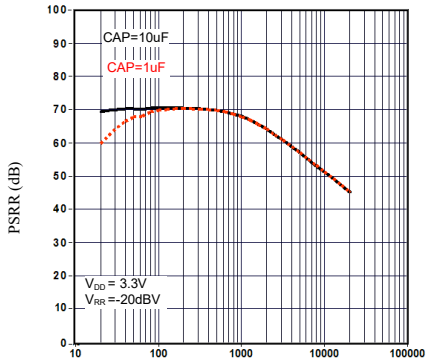
CMRR vs. frequency



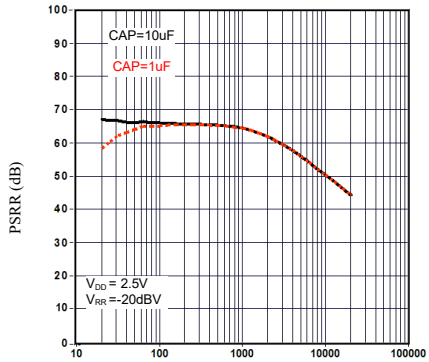
Channel separation vs. frequency



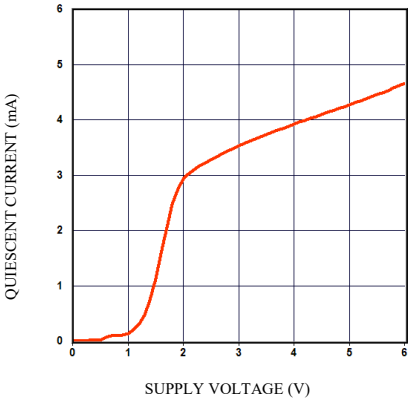
PSRR vs. frequency



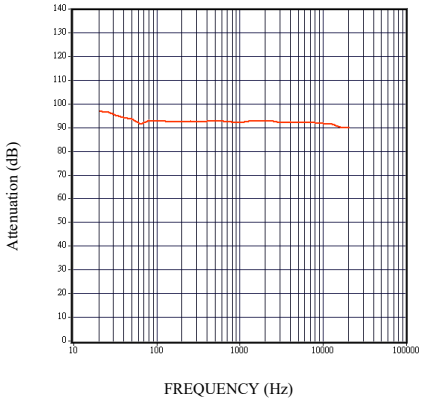
PSRR vs. frequency



PSRR vs. frequency



Quiescent current vs. supply voltage

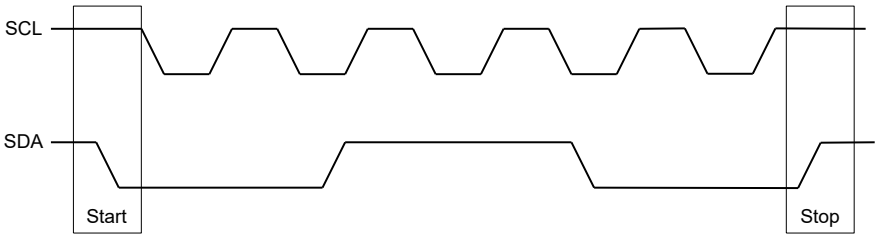


Mute vs. frequency

I²C BUS DESCRIPTION

Start and stop conditions

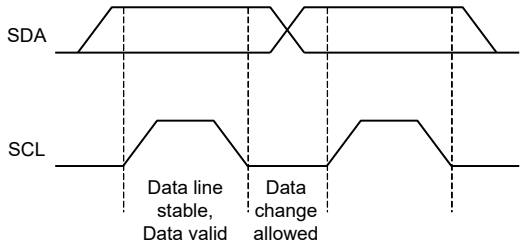
A start condition is activated when the SCL is set to HIGH and SDA shifts from HIGH to LOW state. The stop condition is activated when SCL is set to HIGH and SDA shifts from LOW to HIGH state. Please refer to the timing diagram below.



SCL : Serial Clock Line, SDA : Serial Data Line

Data validity

A data on the SDA line is considered valid and stable only when the SCL signal is in HIGH state. The HIGH and LOW states of the SDA line can only change when the SCL signal is LOW. Please refer to the figure below.

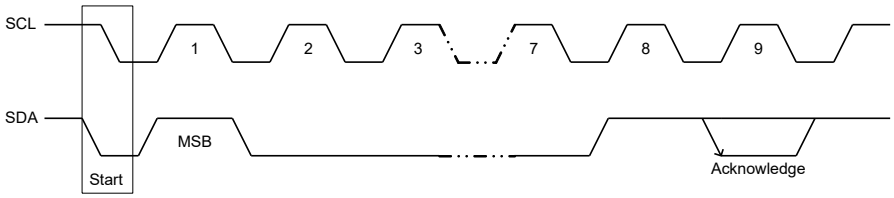


Byte format

Every byte transmitted to the SDA line consists of 8 bits. Each byte must be followed by an acknowledge bit. The MSB is transmitted first.

Acknowledge

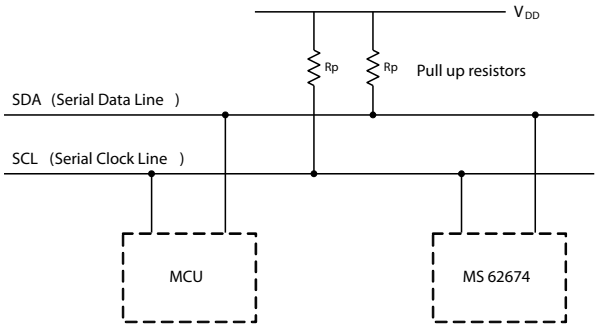
During the Acknowledge clock pulse, the master (up) put a resistive HIGH level on the SDA line. The peripheral (audio processor) that acknowledges has to pull-down (LOW) the SDA line during the Acknowledge clock pulse so that the SDA line is in a stable LOW state during this clock pulse. Please refer to the diagram below.



The audio processor that has been addressed has to generate an Acknowledge after receiving each byte, otherwise, the SDA line will remain at the HIGH level during the ninth (9th) clock pulse. In this case, the master transmitter can generate the STOP information in order to abort the transfer.

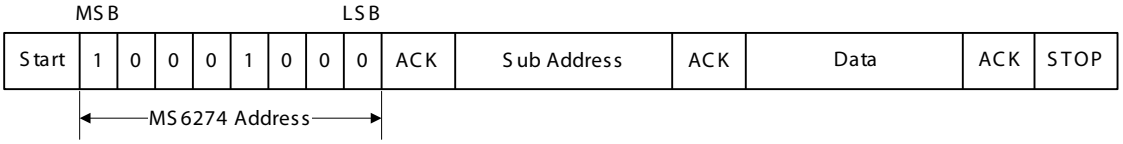
BUS INTERFACE

Data are transmitted to and from the MCU to the MS6274 via the SDA and SCL. The SDA and SCL make up the BUS interface. It should be noted that pull-up resistors must be connected to the positive supply voltage.



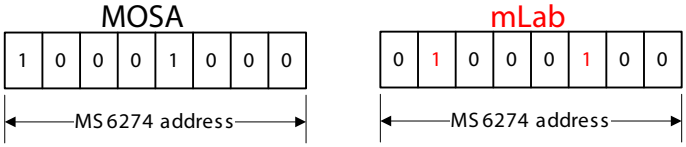
Interface protocol

The format consists of the following
•A START condition
•A chip address byte including the MS6274 address. (7bits)
•The 8th bit of the byte must be "0".
•The MS6274 must always acknowledge the end of each transmitted byte.
•A data sequence (N-bytes + Acknowledge)
•A STOP condition



Chip Address

The chip address of the MS6274 is (88H by MOSA) and 44H by mLab



SubAddress

MSB							LSB	Function
A7	A6	A5	A4	A3	A2	A1	A0	
0	0	0	0	0	0	0	0	Soft-step time /ON/OFF , SE /DIFF Selector
0	0	0	0	0	0	0	1	L-channelInput selector / Input Gain Control
0	0	0	0	0	0	1	0	R-channel Input selector / Input Gain Control
0	0	0	0	0	0	1	1	Both channels Input selector/ Input Gain Control
0	0	0	0	0	1	0	0	L-channelVolume Control
0	0	0	0	0	1	0	1	R-channelVolume Control
0	0	0	0	0	1	1	0	Both channels Volume Control
0	0	0	0	0	1	1	1	Power management

Soft-step time / ON / OFF , SE /DIFF Selector (0H)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
								Soft-step Time
					0	0	0	0.64ms
					0	0	1	1.28ms
					0	1	0	2.56ms
					0	1	1	5.12ms
					1	0	0	10.24ms
					1	0	1	20.48ms
					1	1	0	40.96ms
					1	1	1	81.92ms
								Soft-step
				0				On
				1				Off
MOSA			mLab					SE /DIFF
0			0					Differential
1			1					Single-ended

The initial condition is Single-ended, Soft-step Off, Soft-step time 40.96ms.

Input selector & Gain Control (01H , 02H , 03H)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
								Input selector
		0	0					IN 1
		0	1					IN 2
		1	0					IN 3
		1	1					IN 4 / DIFF
								Input Gain
				0	0	0	0	0dB
				0	0	0	1	1dB
				0	0	1	0	2dB
				0	0	1	1	3dB
				0	1	0	0	4dB
				0	1	0	1	5dB
				0	1	1	0	6dB
				0	1	1	1	7dB
				1	0	0	0	8dB
				1	0	0	1	9dB
				1	0	1	0	10dB
				1	0	1	1	11dB
				1	1	0	0	12dB
				1	1	0	1	13dB
				1	1	1	0	14dB
				1	1	1	1	15dB

The initial condition is IN4, 14dB. We suggest the gain is set as the power is up. For example, set and fix the gain +10dB, the volume range will be controlled from -69dB to +25dB.

Volume Control (04H , 05H , 06H)

MSB							LSB	Function
D7	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	
	0	0	0	1	1	1	1	+15dB
	0	0	0	1	1	1	0	+14dB
	:	:	:	:	:	:	:	:
	0	0	0	0	0	0	0	0dB
	0	0	1	0	0	0	0	0dB
	0	0	1	0	0	0	1	− 1dB
	:	:	:	:	:	:	:	:
	0	0	1	1	1	1	1	−15dB
	0	1	0	0	0	0	0	−16dB
	:	:	:	:	:	:	:	:
	0	1	0	1	1	1	1	−31dB
	0	1	1	0	0	0	0	−32dB
	:	:	:	:	:	:	:	:
	0	1	1	1	1	1	1	−47dB
	1	0	0	0	0	0	0	−48dB
	:	:	:	:	:	:	:	:
	1	0	0	1	1	1	1	−63dB
	1	0	1	0	0	0	0	−64dB
	:	:	:	:	:	:	:	:
	1	0	1	1	1	1	1	−79dB
	1	1	X	X	X	X	X	Mute

The initial condition is Mute.

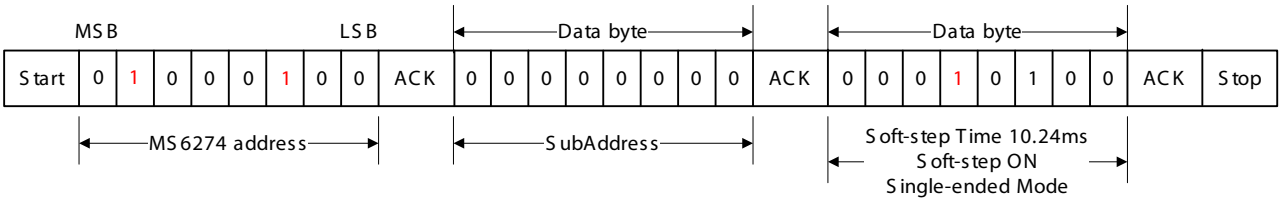
Power management (07H)

MSB							LSB	Function
D7	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	
							0	Release of V_{REF} to GND.
							1	Set the voltage of V_{REF} to middle of supply voltage.
					0	X		All devices Active
					1	1		Power down

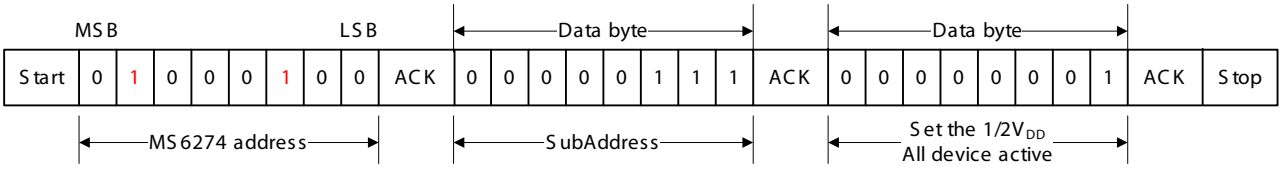
The initial condition is Power down , V_{REF} = GND.

Example

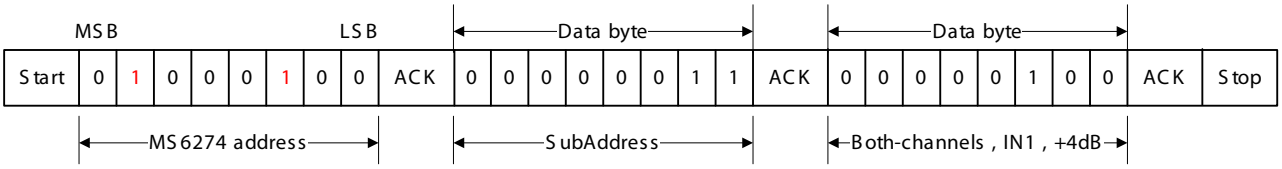
Soft-step Time 10.24ms , Soft-step ON , Single-ended Mode.



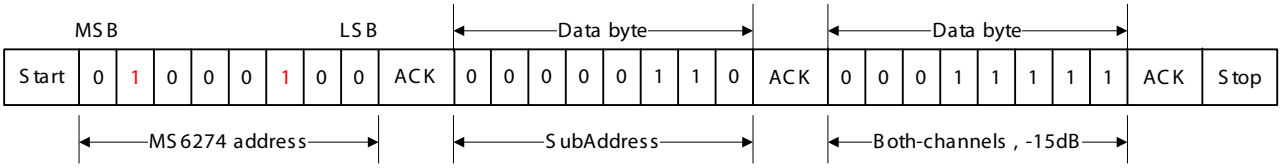
Set the 1/2V_{DD} , All device active.



Set Input gain of both channels at +4dB , select Input as IN 1.

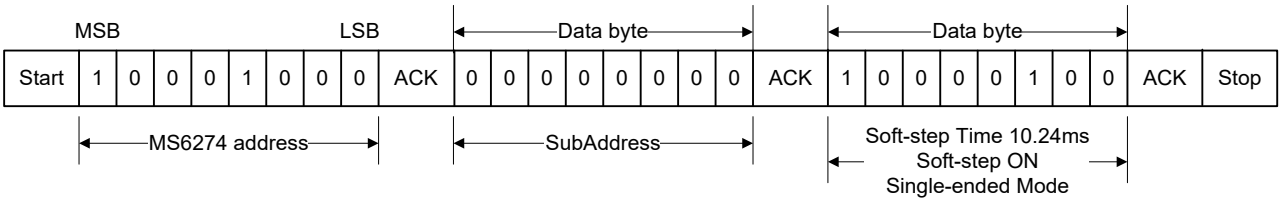


Set Volume of both-channels at-15dB

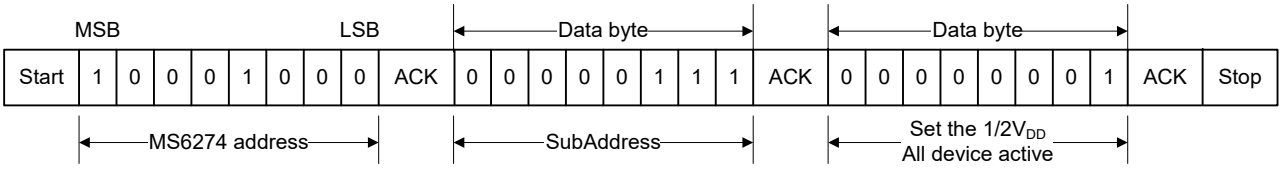


Example

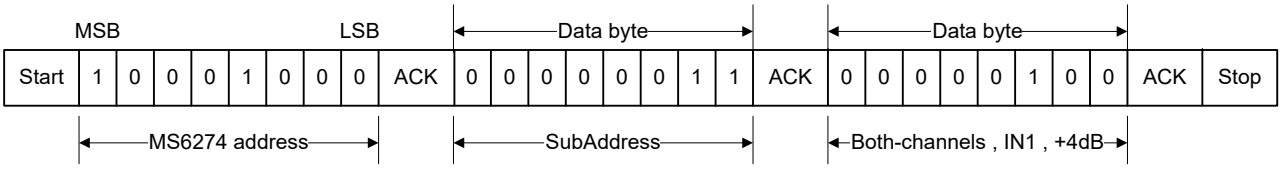
Soft-step Time 10.24ms , Soft-step ON , Single-ended Mode.



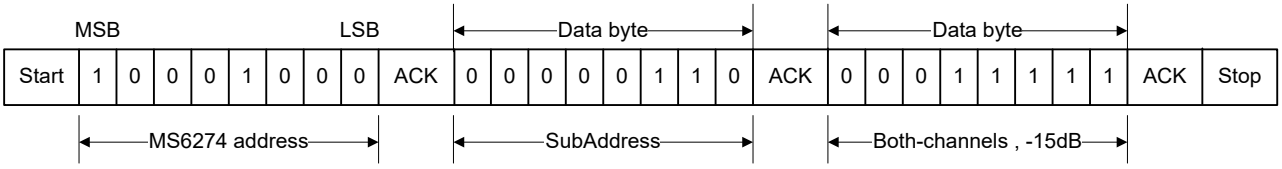
Set the $1/2V_{DD}$, All device active.



Set Input gain of both channels at +4dB , select Input as IN1.



Set Volume of both-channels at -15dB



Soft-step volume

When the volume-level is changed audible clicks could appear at the output. The root cause of those clicks could be the sudden change of the envelope of the audio signal. With the Soft-step feature, this click could be reduced to a minimum. Soft-step supports N dB volume change, including mute.

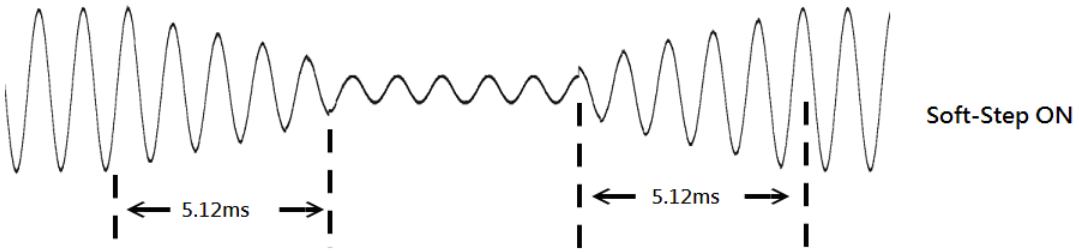
Example

Soft-Step Time = 5.12ms

0dB → -16dB → 0dB

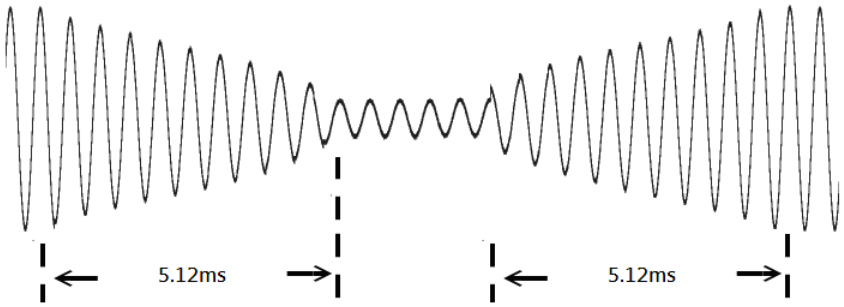
Vin = 1Vrms @ 1KHz

Soft-Step OFF



Soft-Step ON

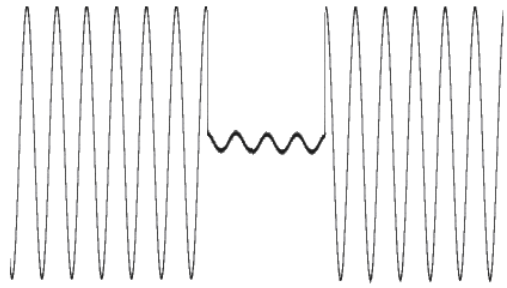
Vin = 1Vrms @ 2KHz



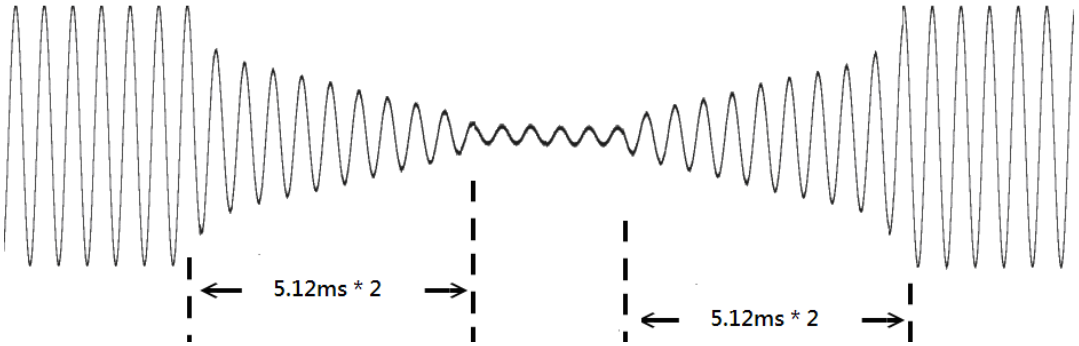
Soft-Step ON

+8dB → -16dB → +8dB

Vin = 0.5Vrms @ 1KHz



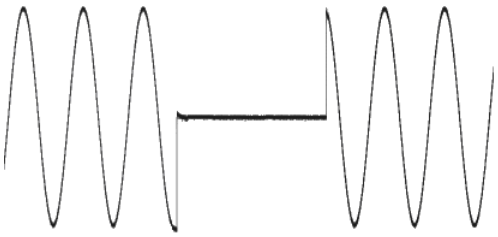
Soft-Step OFF



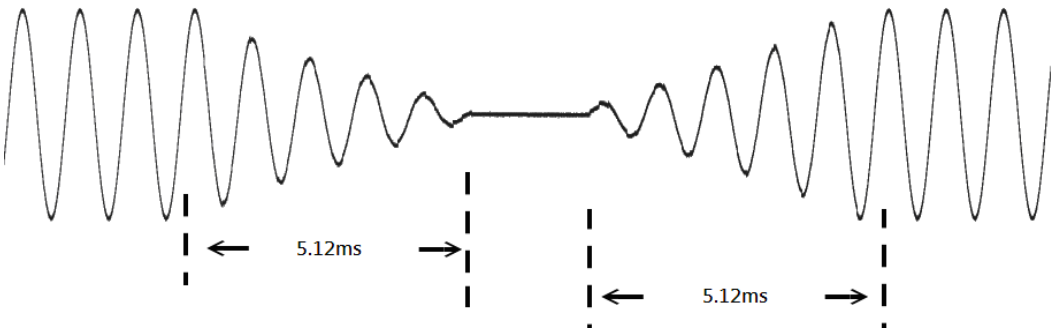
Soft-Step ON

0dB → Mute →0dB

Vin = 1Vrms @ 1KHz



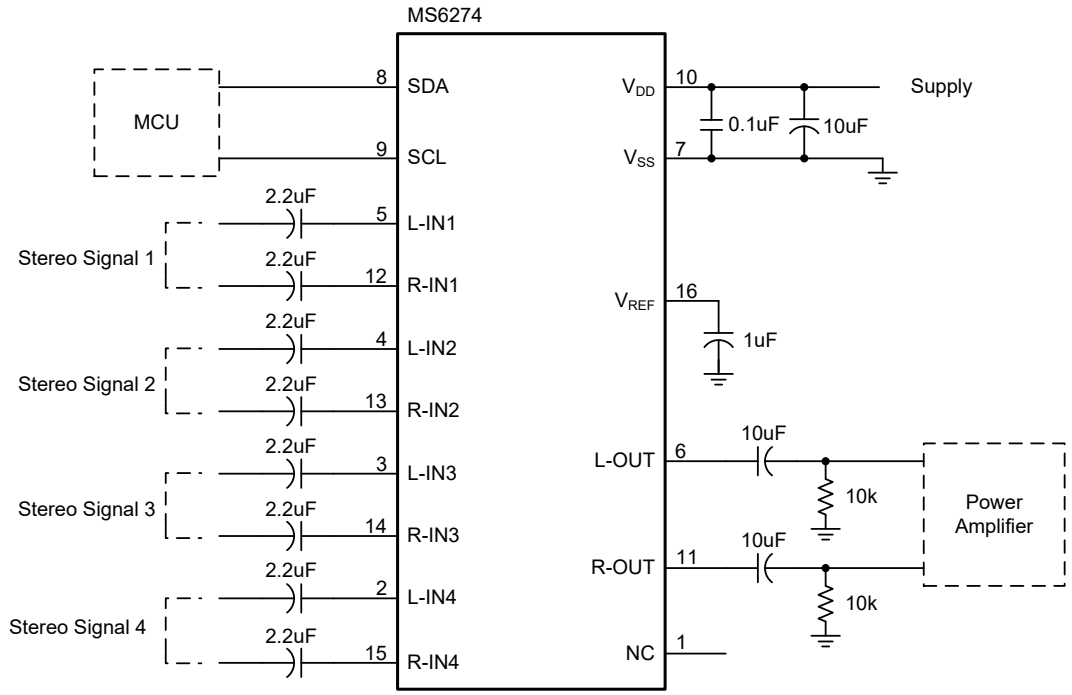
Soft-Step OFF



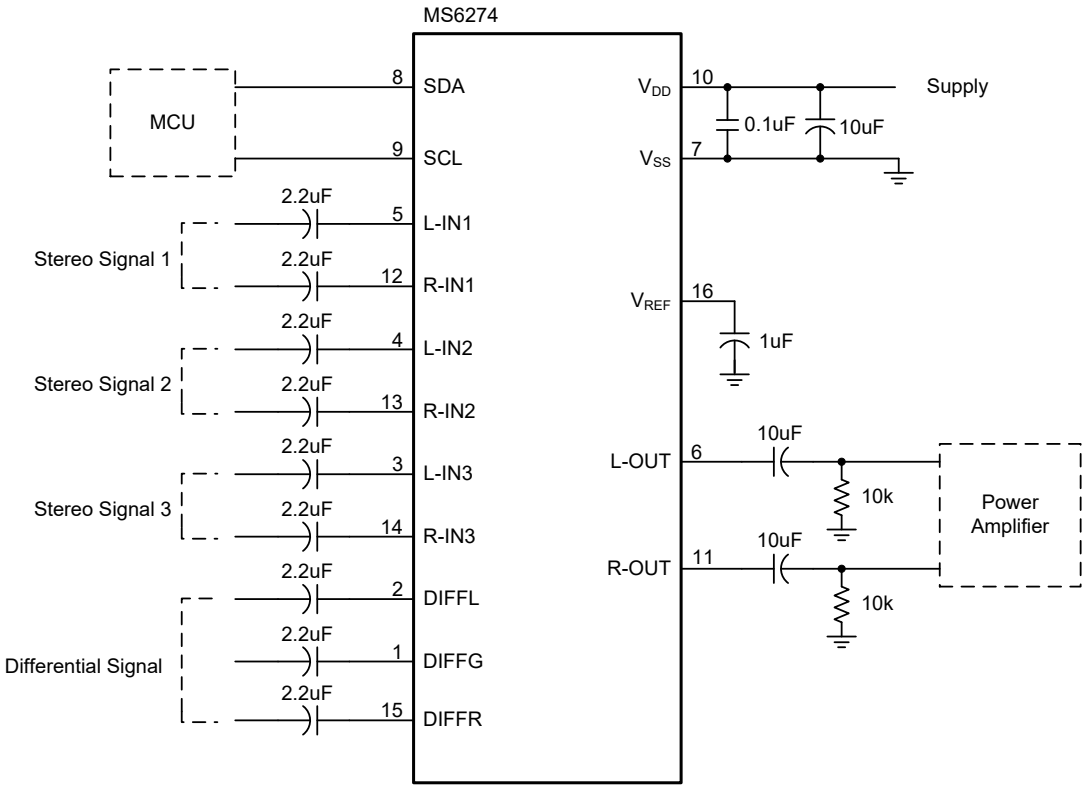
Soft-Step ON

APPLICATION INFORMATION

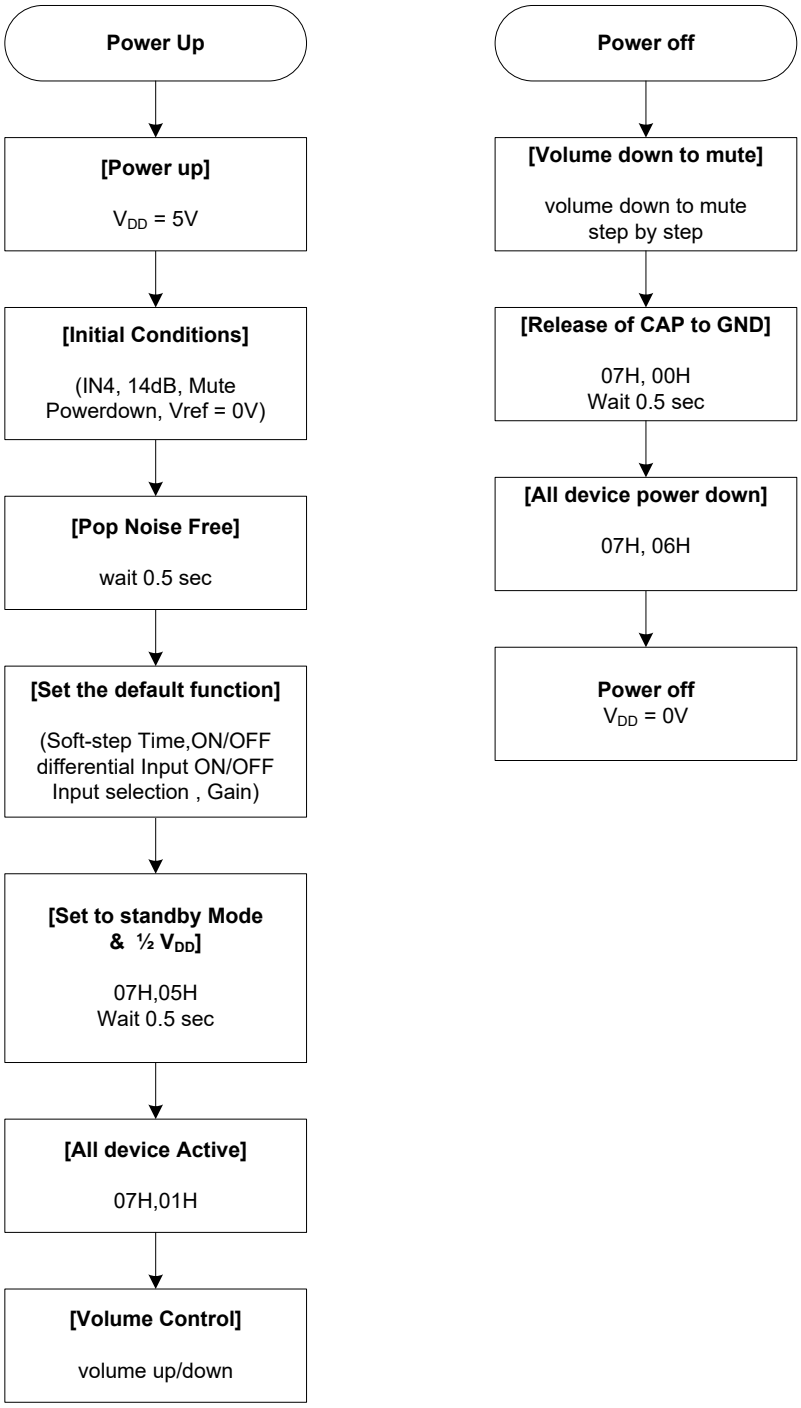
Basic application example(Single-ended Mode)



Basic application example(Differential Mode)

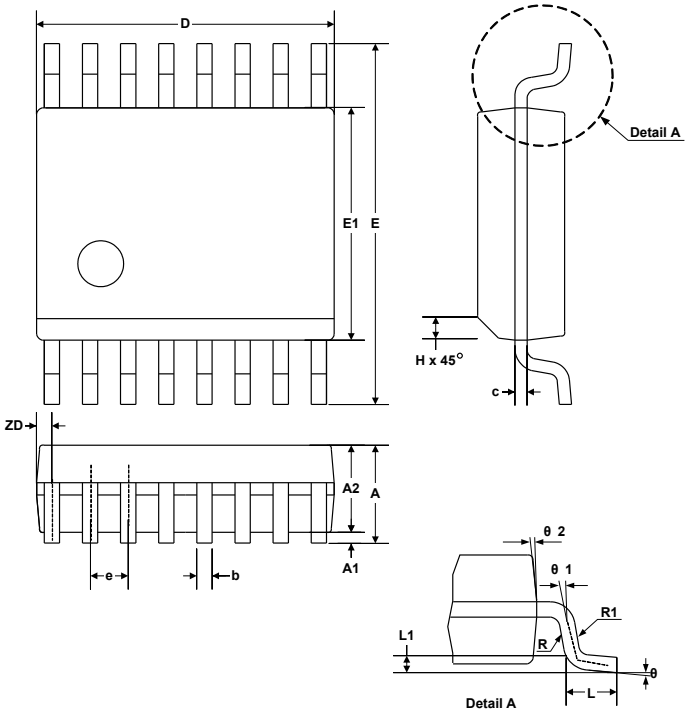


Basic application flowchart



EXTERNAL DIMENSIONS

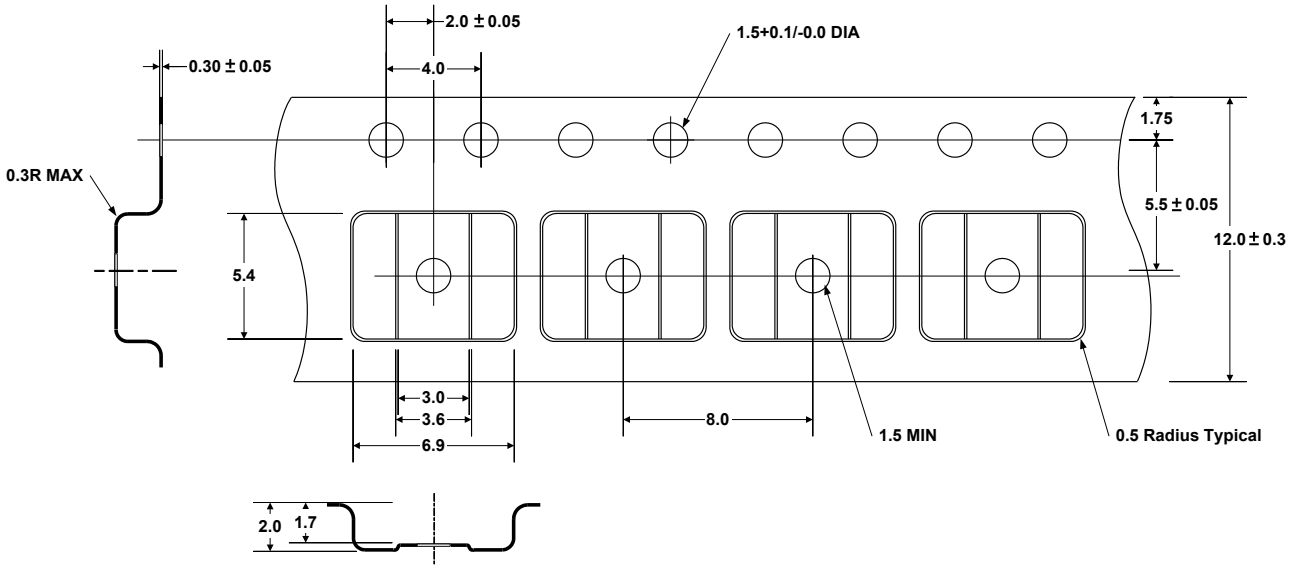
SSOP16



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°	8°	0°	8°
θ1	0°		0°	
θ2	5°	15°	5°	15°

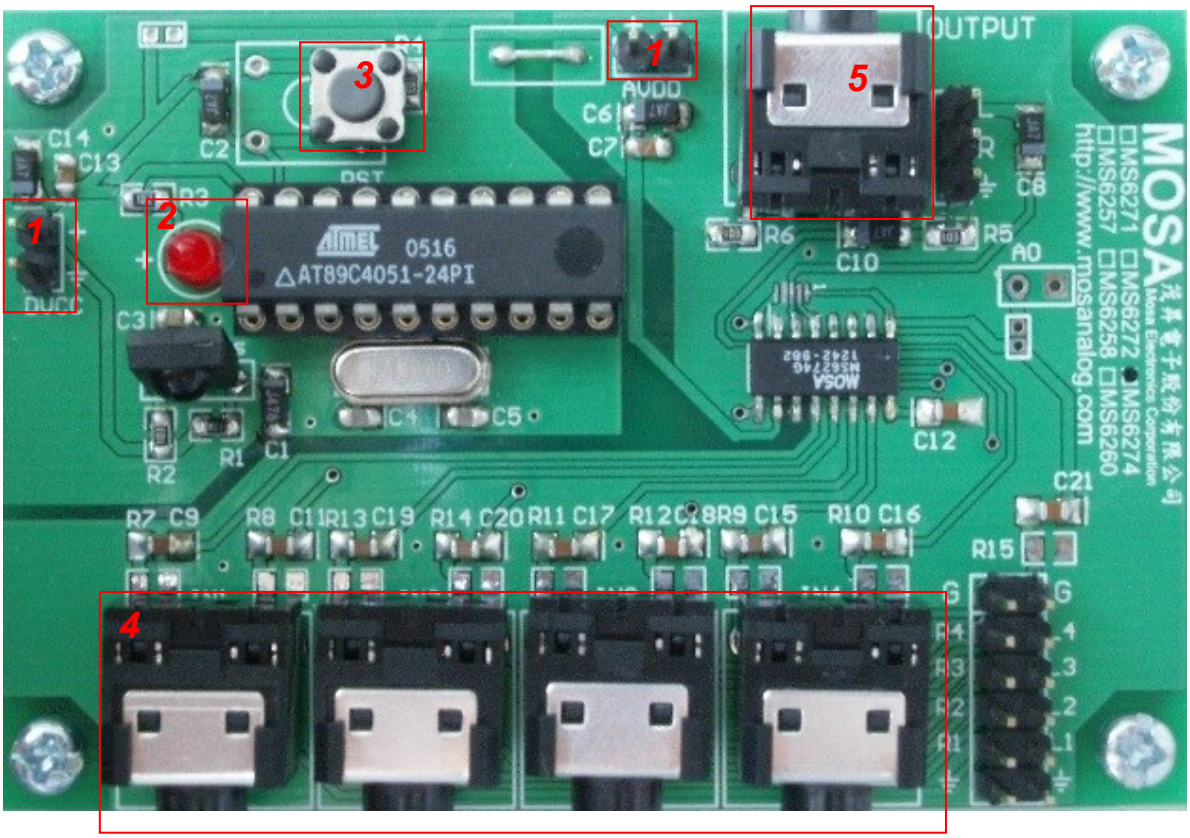
TAPE AND REEL (Unit : mm)

SSOP16



DEMO BOARD

The demo board used IR technique controller to control the MS6274. The default states of demo board are INPUT1, Input Gain 0dB, Volume 0dB, SE Mode, Softstep off, Mute off .



Label 1: Supply Voltage

The AVDD and DVDD should be the same supply voltage, the supply range is 2.5 ~ 6.5 VDC.

Label 2: LED Indicator

The LED indicates the power status and the IR received status. It is red-dark blink once when the MCU has received the function code correctly.

Label 3: MCU Reset

The MS6274 will be loaded the default values by MCU. The default states of demo board :
INPUT1, Input Gain 0dB, Volume 0dB, SE Mode, Softstep off, Mute off.

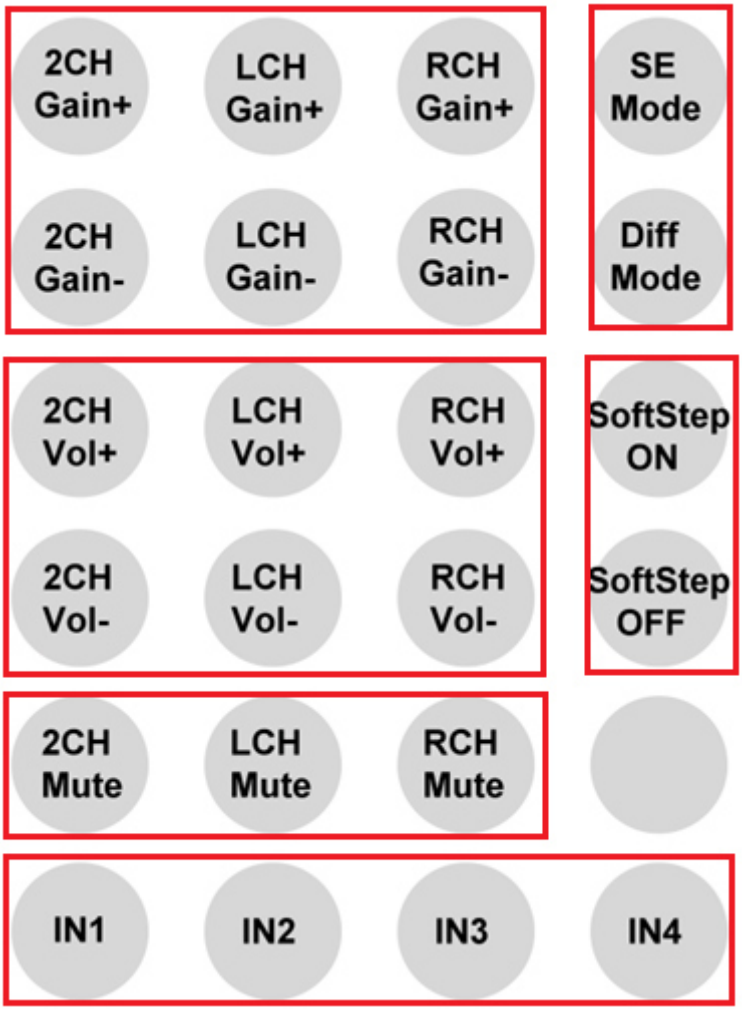
Label 4: Input Section

Please input stereo audio signal, as music or sine wave.

Label 5: Output Section

Please connected to a post-power-amplifier, as active speaker.

IR Controller



Gain+/-：The gain control keys.

The gain control in 1dB/step as the switch is pressed once, the range is 0dB to 15dB.

Vol+/-：The volume control keys.

The volume control in 1dB/step as the switch is pressed once, the range is –79dB to +15dB.

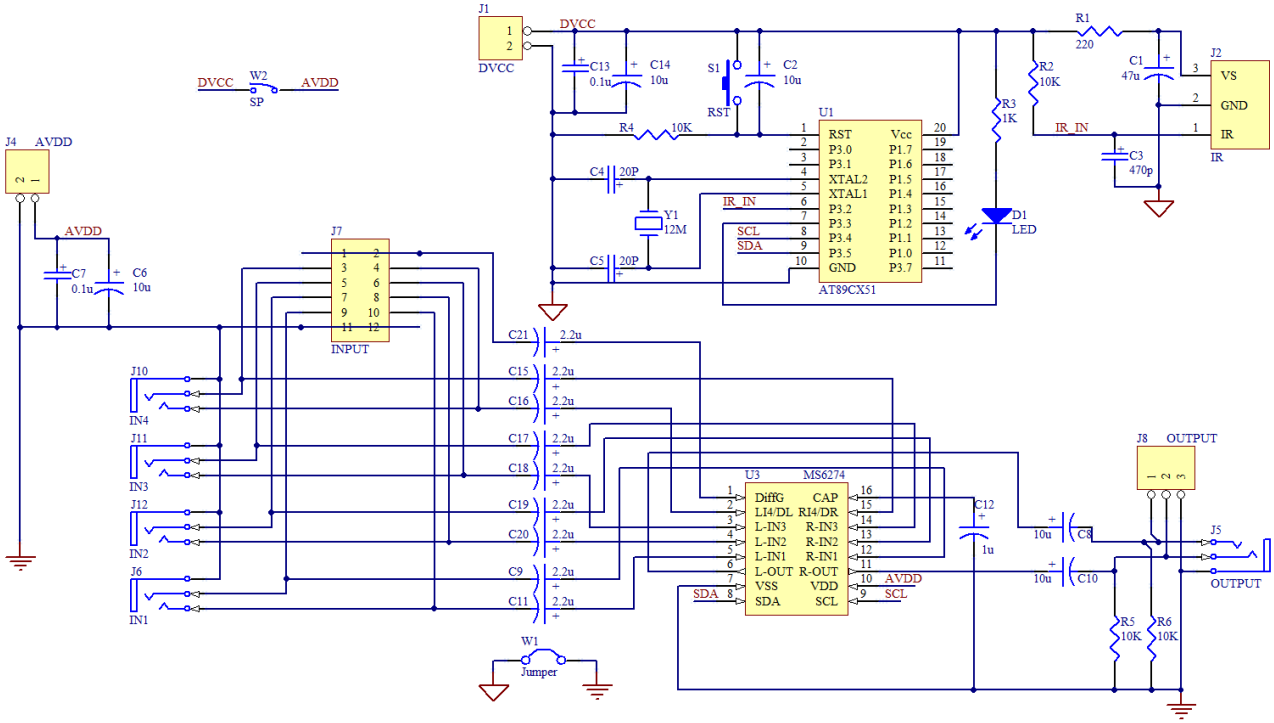
MUTE：The mute key controls all speaker outputs
Press the key once to set mute-on or mute-off.

SE/Diff Mode：The Input Mode control Keys.

SoftStep：The SoftStep key.
Press the key once to set Softstep on or SoftStep off.

IN1~IN4：Stereo channel selection
There are four sets, stereo 1 to 4. The default channel is stereo 1 on initial status.

Circuit


J1
DVCC
C13
0.1u
C14
10u
S1
RST
C2
10u
R4
10K
C4
20P
Y1
12M
C5
20P
U1
RST
P3.0
P3.1
XTAL2
XTAL1
P3.2
P3.3
P3.4
P3.5
GND
Vcc
P1.7
P1.6
P1.5
P1.4
P1.3
P1.2
P1.1
P1.0
P3.7
AT89CX51
IR_IN
SCL
SDA
R1
220
R2
10K
R3
1K
D1
LED
C1
47u
C3
470p
J2
VS
GND
IR
IR
W2
SP
J4
AVDD
C7
0.1u
C6
10u
J7
INPUT
J10
IN4
J11
IN3
J12
IN2
J6
IN1
C21
C15
C16
C17
C18
C19
C20
C9
C11
2.2u
U3
MS6274
DiffG
LI4/DL
L-IN3
L-IN2
L-IN1
L-OUT
VSS
SDA
CAP
RI4/DR
R-IN3
R-IN2
R-IN1
R-OUT
VDD
SCL
C12
1u
C8
C10
10u
J8
OUTPUT
J5
OUTPUT
R5
10K
R6
10K
W1
Jumper