Sound Processor Series for Car Audio

6ch Electronic Volume
for 5.1ch Car Theater

BD3433K

No.10085EAT01

●Description

The 6ch electronic volume for 5.1ch car theater is an electronic volume device incorporating 6ch input selector (front/rear independently-controlled), input gain amp (front/rear independently-controlled), 6ch independently-controlled electronic volume (capable of soft switching), 6ch output gain amp (2-line outputs), differential input for monophonic signals, electronic volume for monophonic signals (capable of soft switching), and mixing circuit for monophonic signals. It is provided with the high performance functions to achieve low distortion and low noise and, furthermore, to output the 5.6Vrms high voltage. The QFP44 package which realizes savings in space and components is used to be suited for applications such as car audio and car navigation.

●Features

1) High voltage output of 5.6Vrms achieved
   Provided with 2 lines of outputs to the built-in power amp and the pre-out

2) Volume switching noise is reduced by installing the advanced 6ch independently-controlled electronic volume with soft switching.

3) High performance capabilities such as low distortion rate (0.001%), low noise (3μVrms)

4) Different signals from the different sources can be outputted to the front and rear sections independently and this provides an option of rear-seat entertainment.

5) Incorporate the monophonic differential input circuit suited for inputting navigation voice and telephone speech. These monophonic voices can be mixed with the front output signals.

6) Adopting the Bi-CMOS process achieves low current consumption, which contributes to energy-saving design. It has the advantage in quality over scaling down and heat reduction of the internal regulators.

7) 3-wire serial interface supported for both of 3.3V and 5V microcomputers

●Applications

For car audio equipment, car navigation equipment, and hybrid systems.

● **Absolute maximum ratings**(Ta=25°C)

Item	Symbol	Terminal		Rating	Unit
Terminal applied voltage	VCC-GND	※1		10	V
	VEE-GND	※1		-10	
	VLGC	Control terminal　（CS/SCK/SDA）※1		5.5	
Power dissipation	Pd	※2		850	mW
Operating Temperature	Topr			-40 ～ +85	°C
Storage Temperature	Tastg			-55 ～ +125	°C

　　※1 : Maximum applied voltage based on GND.
　　※2 : Derating is done 8.5mW/°C for Ta＞25°C.
　　　　Mounted on (Material: FR4 glass epoxy board (beaten-copper area <3%), size:70mm×70mm×1.6mm)
　　※3 : No radiation-proof design

● **Operating conditions** （Operating condition at Ta=25°C）

Item	Symbol	Terminal	Condition	MIN	TYP	MAX	Unit
Operating power supply voltage	VCC	VCC-GND	※1	7.0	9	9.5	V
	VEE	VEE-GND		-9.5	-9	-7.0	V

　　※1 :　When it is within operating temperature, basic circuit function is guaranteed within operating voltage. However, setting constant and element, voltage setting, and temperature setting are required when in operation. Other than the condition stipulated within the range, the standard value of electrical characteristics could not be guaranteed, while original function is retained.

● **Electrical characteristics**
　　Abbreviations :
　　　"**Giaj**" : Setting value of Input gain adjustor　　　　"**Vol**" : Setting value of volume (1～6ch)
　　　"**Vol.Ex**" : Setting value of volume for monaural signal　　"**Goaja**" : Setting value of output gain adjustor A
　　　"**Goajb**" : Setting value of output gain adjustor B　　　"**Mix**" : ON/OFF setting for mixing switch.
　　Measurement condition (Unless specified particularly) :
　　　Ta＝25°C,　VCC=9V,　VEE=-9V,　Vin=1Vrms/1kHz,　Load resistance=10kΩ,　Load capacitance=10pF,
　　Giaj＝0dB, Vol=0dB, Goaja=0dB, Goajb=0dB, Vol.Ex=-∞dB, Mix=OFF

　　■　General characteristics

Item	Symbol	Condition	MIN	TYP	MAX	Unit
Current consumption	ICC		-	10	17	mA
	IEE		-17	-9	-	
VCO oscillation frequency	Fvco		-	400	-	kHz
Ripple rejection	RRc	Ripple = 0.1Vrms/ 1kHz (Input terminal AC short)	40	85	-	dB
	RRe	Ripple= 0.1Vrms/ 1kHz (Input terminal AC short)	30	70	-	dB
Reset operation voltage	VRS	Initialize all register data by Vcc＜VRS → Vcc＞VRS	-	3.4	-	V
Required time for Power on reset	TPOR	Minimum required time to reach 3V after Vcc voltage ON.	20	-	-	μsec

■ Logic circuit

Item	Symbol	Terminal	MIN	TYP	MAX	Unit
"H" level input voltage	VIH	CS, SCK, SDA	2.3	-	5.5	V
"L" level input voltage	VIL	CS, SCK, SDA	0	-	1.0	V
Input clock frequency	f$_{SCK}$	SCK	-	-	1.5	MHz

■ Volume circuit

| Item	Symbol	Condition			MIN	TYP	MAX	Unit
Voltage gain	GV				-1	0	1	dB
Bandwidth	FW	Frequency, which drop -1dB towards 1kHz			100	-	-	kHz
Slew rate	SR				-	1.65	-	V/μsec
Maximum input voltage	VIM	THD+N = 1% , Vol = -10dB			3.8	4.25	-	Vrms
Maximum output voltage	VOM1	THD+N = 1% Vol = +10dB			3.8	4.25	-	Vrms
	VOM2		Goaja=+2.5dB		5	5.6	-	
	VOM3		Goajb=-4.5dB		2.2	2.5	-	
Input impedance	RI				70k	100k	130k	Ω
Output impedance	RO				-	-	50	Ω
Input gain setting value error	EGI	Output reference is Giaj=0dB Giaj=6, 12 dB, Vin=0.1Vrms			-1	0	1	dB
Volume setting value error	EV1	Vol=0dB Output standard	Vol=+23～+1, -1～-20dB (+23～+1dB at Vin=0.1Vrms)		-1.0	0	1.0	dB
	EV2		Vol=-21～-40dB		-1.5	0	1.5	
	EV3		Vol=-41～-60dB		-2.0	0	2.0	
	EV4		Vol=-61～-79dB		-3.0	0	3.0	
Volume maximum attenuation	VMU	Vol=-∞dB (mute) , BW=20～20kHz			-	-108	-85	dB
Output gain setting value error	EGOA	Goaja= Goajb=0dB Output standard	Goaja=+2.5dB		-1	0	1	dB
	EGOB		Goajb=-4.5dB		-1	0	1	
Gain balance between channels	CB				-1	0	1	dB
Cross-talk between channels	CTC	BW=20～20kHz (Input terminal AC short)			85	106	-	dB
Output noise voltage	VNO	BW=A-Weight (Input terminal AC short)		Vol=0dB	-	2.5	10	μVrms
Residual output noise voltage	VNR			Vol=-∞dB	-	2	10	
THD+N	THD	BW=20～20kHz, Vout=1Vrms			-	0.001	0.05	%
Soft switching transition time	Tss1	Soft switching:ON	0.64 msec/dB		-	0.64	-	msec /dB
	Tss2		1.28 msec/dB		-	1.28	-	
	Tss3		2.56 msec/dB		-	2.56	-	
	Tss4		5.12 msec/dB		-	5.12	-	

■ Monaural signal circuit
Common condition unless specified particularly :
Vol=-∞dB,   Giaj=Goaja= Goajb=0dB,   Vol.Ex=0dB,   Mix=ON

| Item	Symbol	Condition			MIN	TYP	MAX	Unit
Voltage gain	GVe	Phase inversion between input and output			-1.0	0	1.0	dB
Maximum input voltage	VIMe	THD+N=1%, Vol.Ex=-10dB			3.8	4.25	-	Vrms
Input impedance	RIe				19	27	35	kΩ
Volume setting value error	EVe1	Vol.Ex=0dB Output standard	Vol=+15～+1, -1～-20dB (+15～+1dB at Vin=0.1Vrms)		-1.0	0	1.0	dB
	EVe2		Vol=-21～-40dB		-1.5	0	1.5	
	EVe3		Vol=-41～-60dB		-2.0	0	2.0	
	EVe4		Vol=-61～-63dB		-3.0	0	3.0	
Volume maximum attenuation	VMUe	Vol.Ex=-∞dB (mute) , BW=20～20kHz			-	-108	-85	dB
Output noise voltage	VNOe	BW=A-Weight (Input terminal AC short)	Vol.Ex = 0dB		-	4.5	15	μVrms
Residual noise voltage	VNRe		Vol.Ex = -∞dB		-	3.5	10	
THD+N	THDe	BW=20～20kHz, Vout=1Vrms			-	0.002	0.05	%
Common-mode signal rejection ratio	CMRR	BW=20～20kHz			40	60	-	dB
Soft switching transition time	Tsse1	Soft switching:ON	0.64 msec/dB		-	0.64	-	msec /dB
	Tsse2		1.28 msec/dB		-	1.28	-	
	Tsse3		2.56 msec/dB		-	2.56	-	
	Tsse4		5.12 msec/dB		-	5.12	-	

●**Timing chart**
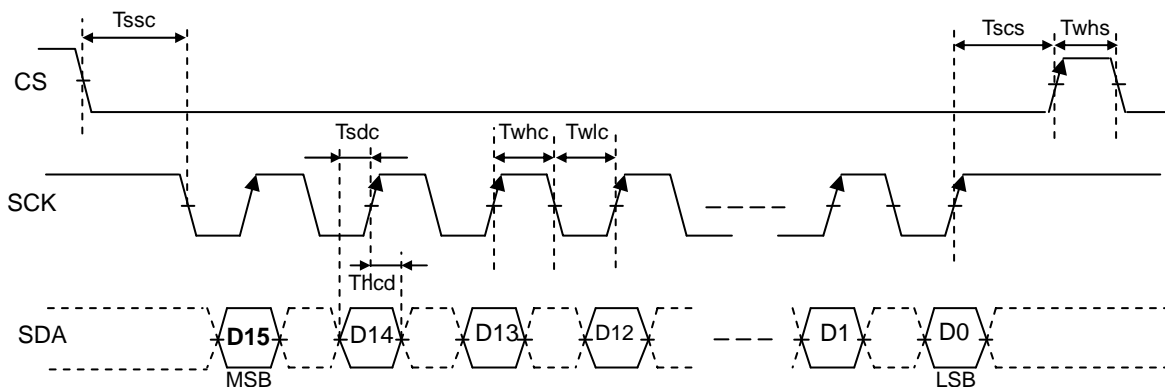
・When CS is "Low", enable micro computer control data (SCK/SDA). (It doesn't work, when it is "High"),

・Data (SDA) reads at a leading edge of clock (SCK).

・Latch reads at a leading edge of CS. (SCK has to be kept as "High" after D0 acquisition)

●**External Dimension**
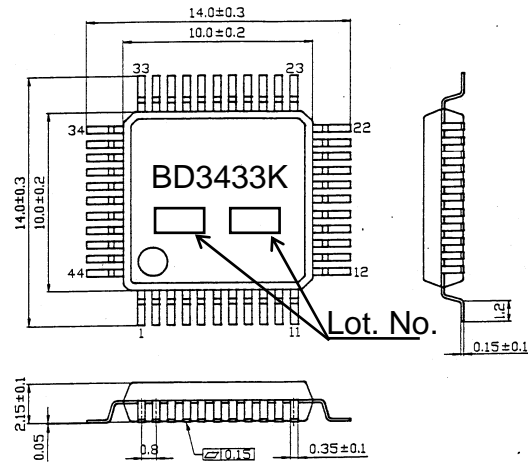
QFP44 （Unit：mm）

●Terminal Number, Terminal name：

Terminal Number	Terminal name	Terminal Number	Terminal name	Terminal Number	Terminal name	Terminal Number	Terminal name
1	AGNDE	12	INBFR	23	OUTAFR	34	DGND
2	INAFL	13	AGND4	24	OUTAC	35	SDA
3	INAFR	14	INBC	25	OUTASW	36	SCK
4	AGND1	15	INBSW	26	OUTARL	37	CS
5	INAC	16	AGND5	27	OUTARR	38	TEST
6	INASW	17	INBRL	28	OUTBFL	39	ADJ
7	AGND2	18	INBRR	29	OUTBFR	40	VEE
8	INARL	19	AGND6	30	OUTBC	41	AGNDM
9	INARR	20	SOUTRL	31	OUTBSW	42	VCC
10	AGND3	21	SOUTRR	32	OUTBRL	43	INEX+
11	INBFL	22	OUTAFL	33	OUTBRR	44	INEX-

●**Block diagram**
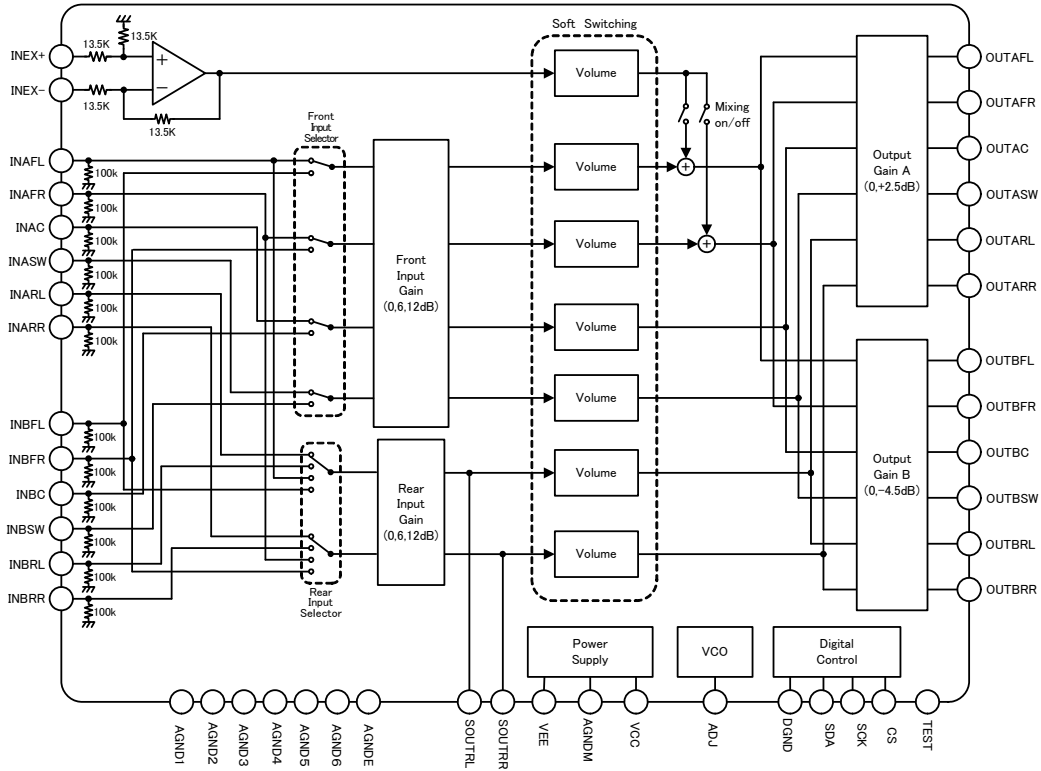
●**Notes for use**

1. Absolute Maximum Ratings;
   It may cause failure if operation is beyond absolute maximum ratings of applied voltage or operating temperature. In case of failure, it is not possible to set short mode or open mode. If particular mode requires beyond absolute maximum ratings, please take a physical safety measure.

2. VEE electrical potential
   Please minimize electrical potential of VEE terminal under any operational condition.

3. Thermal design
   Please consider power dissipation (Pd) on actual operational condition and provide enough margins for thermal design.

4. Operation in intense electric field
   Please note that malfunction may occur if operation is under intense electric field.

●**Ordering part number**

| B | D | | 3 | 4 | 3 | 3 | | K | - | E | 2 |

Part No.

Part No.

Package
K: QFP44

Packaging and forming specification
E2: Embossed tape and reel

QFP44

14.0±0.3
10.0±0.2

33   23
34   22
14.0±0.3
10.0±0.2
44   12
1   11

1.2

0.15±0.1

2.15±0.1
0.05
0.8
0.35±0.1
□ 0.15

(Unit : mm)

<Tape and Reel information>
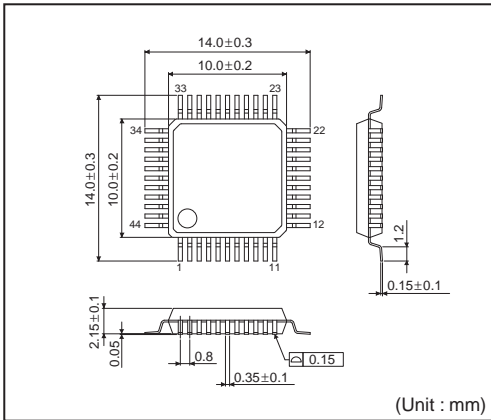
Tape	Embossed carrier tape
Quantity	1000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)

1pin

Reel

Direction of feed
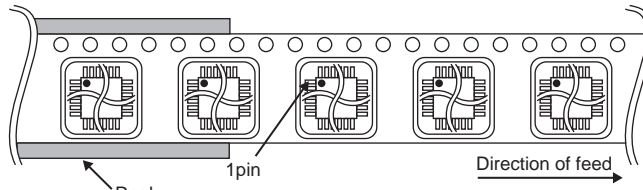
＊Order quantity needs to be multiple of the minimum quantity.

Notes

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