



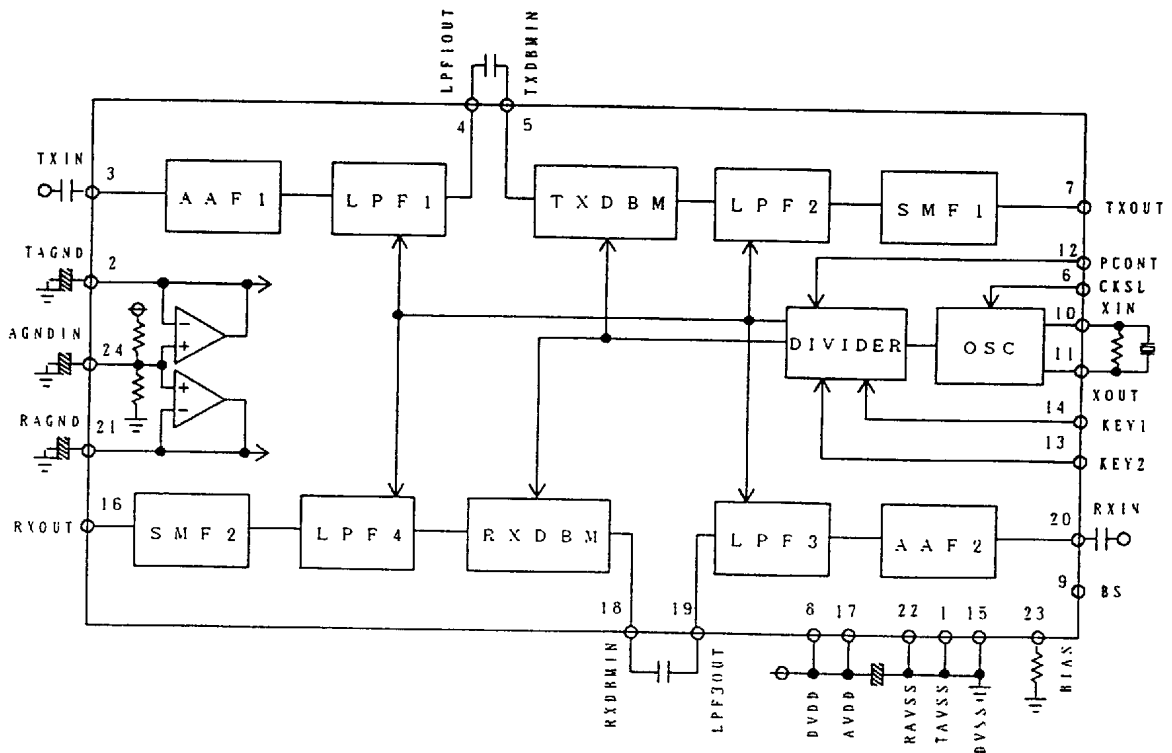
= Preliminary = AK2356E

Frequency Inverter for Cordless Telephone Sets

Features

- Frequency inverter for cordless telephone to keep privacy
- High quality decoded voice: S/N > 45dB
- Four inversion frequencies are selectable
- Scrambler/Descrambler bypass mode
- On chip oscillator circuit for 3.58MHz quartz crystal
- On chip 1/3 divider for 10.24MHz external clock
- Power down mode
- Wide operating voltage : 1.9V~5.5V
- Low power CMOS
- Package: 24 pin VSOP

Block Diagram



<KD043401>

July 2004

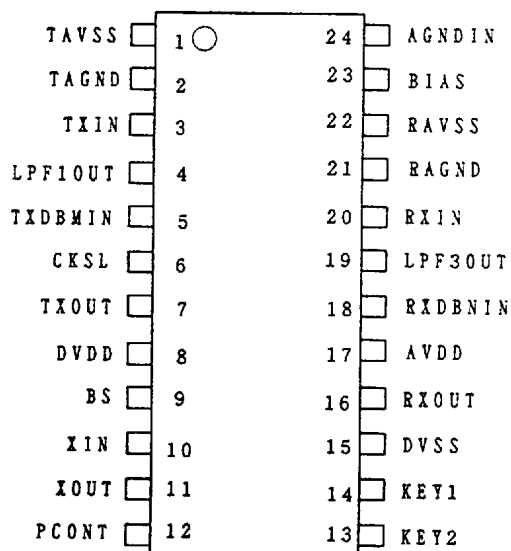
## General Description

AK2356E is an integrated CMOS frequency inverter for cordless telephone application in order to keep privacy.

Four inversion frequencies and voice pass band frequencies are selectable. Also, scrambler bypass mode and power down mode are available.

High quality descrambled voice(S/N>45dB, Distortion<-35dB) is achieved. Almost no voice degradation can be seen.

## Pin Assignment



## Circuit Configuration

Functional Block	Function
AAF1	Active low pass filter for antialiasing
LPF1	Band-limits the input signal from TXIN.
TXDBM	Transmit double balanced mixer, whose carrier frequency is selectable from four carriers by KEY1 and KEY2.
LPF2	Eliminates higher side-band components generated in TXDBM.
SMF1	Eliminates clock components of LPF2 and harmonics generated in SC circuits.
AAF2	Active low pass filter for antialiasing
LPF3	Band-limits the input signal from RXIN.
RXDBM	Double balanced mixer, whose carrier frequency is selectable.
LPF4	Eliminates higher side-band components generated in RXDBM.
SMF2	Eliminates harmonics and SC clock components from LPF4.
OSC	Generates reference clock with external crystal, or generates it from external clock with 1/3 divider when CKSL is "L".
DIVIDER	Generates clock for SCF and DBM.

Pin/Function Description																								
Pin#	Name	I/O	Function																					
1	TAVSS	-	Negative power supply pin for transmitter analog section.																					
2	TAGND	0	Analog ground pin for transmitter. Should be connected to AVSS through external capacitor.																					
3	TXIN	I	Transmit voice signal input pin. Input impedance of the pin is 100k $\Omega$ or more.																					
4	LPF1OUT	0	Transmit voice filter output pin. Should be connected to TXDBMIN through external capacitor.																					
5	TXDBMIN	I	Transmit double balanced mixer input pin.																					
6	CKSL	I	External input clock select pin. "H":Internal clock "L":External clock with 1/3 divider When this pin is "L", external RF local oscillator (10.24MHz) divided by 3 internally, and can use 3.4133MHz master clock. For internal clock operation, connect this pin to VDD.																					
7	TXOUT	0	Transmit voice signal output pin. Can drive 10k $\Omega$ load or more.																					
8	DVDD	-	Positive power supply pin for digital section.																					
9	BS	I	Battery saving control pin(with built in pull-up). "H":Battery Saving Mode (Mode 0) "L":Normal Mode (Mode 1)																					
10	XIN	I	3.58MHz oscillator input pin.																					
11	XOUT	0	Oscillator output pin When using external clock, connect XIN to DVSS and apply external clock to XOUT. In case of 10.24MHz external clock, set CKSL "L".																					
12	PCONT	I	Scrambler bypass control pin. "H" : Scrambler OFF "L" : Scrambler ON																					
13	KEY2	I	Scrambler inversion frequency and voice pass band control pins (with built in pull-up).																					
14	KEY1	I																						
				<table border="1"> <thead> <tr> <th>KEY1</th> <th>KEY2</th> <th>Carrier Frequency</th> <th>Voice Band Frequency</th> </tr> </thead> <tbody> <tr> <td>"H"</td> <td>"H"</td> <td>3.107 kHz</td> <td>280~2830 Hz</td> </tr> <tr> <td>"H"</td> <td>"L"</td> <td>3.290 kHz</td> <td>290~3000 Hz</td> </tr> <tr> <td>"L"</td> <td>"H"</td> <td>3.496 kHz</td> <td>310~3190 Hz</td> </tr> <tr> <td>"L"</td> <td>"L"</td> <td>3.729 kHz</td> <td>330~3400 Hz</td> </tr> </tbody> </table>	KEY1	KEY2	Carrier Frequency	Voice Band Frequency	"H"	"H"	3.107 kHz	280~2830 Hz	"H"	"L"	3.290 kHz	290~3000 Hz	"L"	"H"	3.496 kHz	310~3190 Hz	"L"	"L"	3.729 kHz	330~3400 Hz
KEY1	KEY2	Carrier Frequency		Voice Band Frequency																				
"H"	"H"	3.107 kHz	280~2830 Hz																					
"H"	"L"	3.290 kHz	290~3000 Hz																					
"L"	"H"	3.496 kHz	310~3190 Hz																					
"L"	"L"	3.729 kHz	330~3400 Hz																					
15	DVSS	-	Negative power supply pin for digital section.																					
16	RXOUT	0	Receive voice signal output pin. Can drive 10k $\Omega$ load or more.																					
17	AVDD	-	Positive power supply pin for analog section.																					
18	RXDBMIN	I	Receive double balanced mixer input pin.																					
19	LPF3OUT	0	Receive voice filter output pin. Should be connected to RXDBMIN through external capacitor.																					
20	RXIN	I	Receive voice signal input pin. Input impedance of the pin is 100k $\Omega$ or more.																					
21	RAGND	0	Analog ground pin for receiver. Should be connected to AVSS through external capacitor.																					
22	RAVSS	-	Negative power supply pin for receiver analog section.																					
23	BIAS	I	Bias resistor connection pin. Should connect the specific resistor between the pin and VSS.																					
24	AGNDIN	I	Analog ground input pin. Should be connected to AVSS through external capacitor.																					

<b>Absolute Maximum Rating</b>
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Parameter	Symbol	Min	Max	Units
Power Supply Voltages (TAVDD, AVDD, DVDD)	VDD	-0.3	7	V
Ground Level	VSS	0	0	V
Input Current (Excluding power supply pins)	I <sub>IN</sub>	-10	+10	mA
Analog Input Voltage	V <sub>A,IN</sub>	VSS-0.3	VDD+0.3	V
Digital Input Voltage	V <sub>D,IN</sub>	VSS-0.3	VDD+0.3	V
Storage Temperature	T <sub>stg</sub>	-55	130	°C

Note : All Voltage are referenced to VSS pin.

Exceeding absolute maximum ratings may cause permanent damage.

<b>Recommended Operating Conditions</b>
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Parameter	Symbol	Min	typ	Max	Units
Ambient Operating Temp	T <sub>a</sub>	-10		70	°C
Power Supply Voltages (AVDD, DVDD) R <sub>BIAS</sub> =47kΩ	VDD	1.9	3.0	5.5	V
Analog Ground Reference Voltage	AGND		1/2VDD		V
Power Supply Current					mA
BS='H' (MODE 0)	I <sub>dd0</sub>		0.05	0.2	
BS='L' (MODE 1)	I <sub>dd1</sub>		2.7	4.0	

Note : All voltages are referred to VSS pin.

<b>Analog Characteristics</b>
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Conditions: VDD=3V, T<sub>a</sub>=25°C

0dBm=0.775V<sub>rms</sub>

1) TX Section Characteristics

Parameter	Min	typ	Max	Units
Maximum Input Level @TXIN	0			dBm
Absolute Gain TXIN→TXOUT INPUT: 1kHz, -10dBm				
PCONT:"L"	-2	0	2	dB
PCONT:"H"	-1	0	1	
S/N TXIN→TXOUT, INPUT: 1kHz -10dBm (Note)	45			dB

Note: PCONT: "L", KEY1: "H" & KEY2: "L"

## 2) RX Section Characteristics

Parameter		Min	typ	Max	Units
Maximum Input Level	@RXIN	0			dBm
Absolute Gain	RXIN→RXOUT				
	INPUT: 1kHz -10dBm PCONT:"L"	-2	0.7	2	dB
	PCONT:"H"	-0.3	0.7	1.7	dB
S/N	RXIN→RXOUT, INPUT: 1kHz, -10dBm (Note)	45			dB

Note: PCONT: "L", KEY1: "H" & KEY2: "L"

## 3) General Characteristics

Parameter		Min	typ	Max	Units
Distortion	TXIN→RXOUT, INPUT: 1kHz, -10dBm				
	PCONT:"L"			-35	dB
	PCONT:"H" (Note1)			-40	
Crosstalk RX→TX	@TXOUT				
	RXIN: 1kHz, 0dBm TXIN: No Input (Note2)			-60	dBm
Crosstalk TX→RX	@RXOUT				
	TXIN: 1kHz, 0dBm RXIN: No Input (Note2)			-60	dBm

Note 1: Connect TXOUT and RXIN

Note 2: PCONT: "L", KEY1: "H" & KEY2: "L"

Digital Characteristics
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## 1) DC Characteristics (VDD3.0V±10%, VSS=0V, Ta=-10~70°C)

Parameter	Pin	Symbol	Condition	Min	typ	Max	Units
High Level Input Voltage	(1)(2)	V <sub>IH</sub>		0.7VDD			V
Low Level Input Voltage	(1)(2)	V <sub>IL</sub>				0.3VDD	V
High Level Input Voltage	(1)(2)	I <sub>IH</sub>	V <sub>IH</sub> =VDD			10	μA
Low Level Input Voltage 1	(1)	I <sub>IL1</sub>	V <sub>IL</sub> =0V	-150			μA
Low Level Input Voltage 2	(2)	I <sub>IL2</sub>	V <sub>IL</sub> =0V	-10			μA
Pull-up Resistor	(1)	R <sub>up</sub>		50		200	kΩ

(1) BS, PCONT, KEY1 and KEY2

(2) CKSL

## 2) AC Characteristics

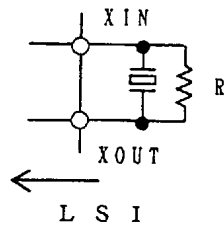
Parameter	Symbol	Min	typ	Max	Units
Master Clock Frequency CKSL="H" CKSL="L"	fclk		3.579545 10.24		MHz
TXDBM & RXDBM fclk=3.579545MHz Carrier Frequency 1 CKSL="H" KEY1 "H", KEY2 "H" "H", "L" "L", "H" "L", "L"	fd1		3.107 3.290 3.496 3.729		kHz
TXDBM & RXDBM fclk=10.24MHz Carrier Frequency 2 CKSL="L" KEY1 "H", KEY2 "H" "H", "L" "L", "H" "L", "L"	fd2		2.963 3.137 3.333 3.556		kHz

Application

■ Recommended external circuits

1) Crystal oscillator

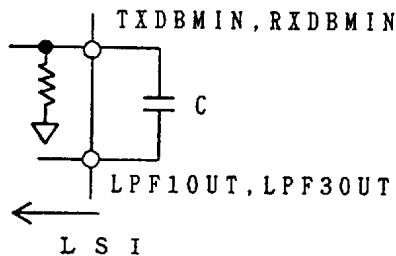
- Set CKSL "H", and connect quartz crystal and resistors as shown below, when using internal clock.
- Set CKSL "H", and connect XIN to VSS and apply external clock to XOUT, when using external clock.
- Set CKSL "L", and connect XIN to VSS and apply external clock to XOUT, when using 10.24MHz external clock with 1/3 divider.



FREQUENCY      3.58MHz  
 or                3.579545MHz  
 R=1MΩ

2) DC block capacitor

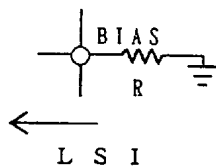
- AC coupling capacitor is recommended in order to eliminate DC offset generated in each block.



C=0.022 μF

3) Bias current setting resistor

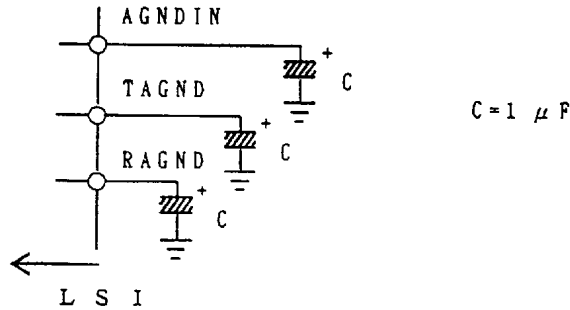
- Set the bias current of OP-AMP. Should be 47kΩ when VDD=3V.



R=47kΩ

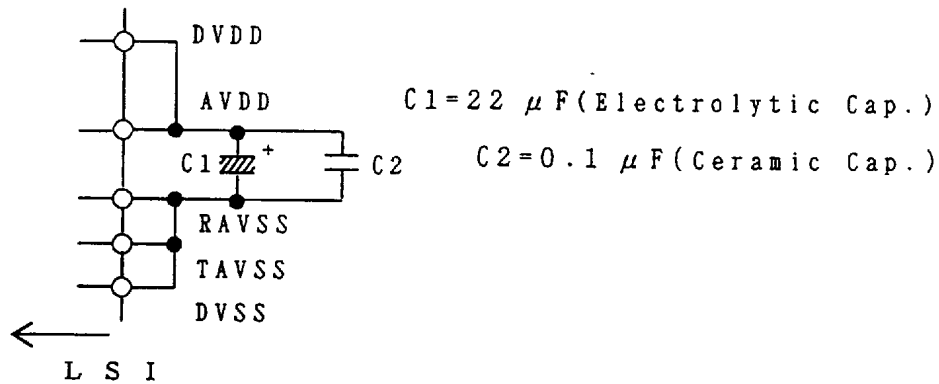
4) AGND stabilization capacitor

- 0.3 $\mu$ F or larger capacitor should be connected between TAGND and RAGND pins, and AVSS in order to stabilize analog ground. To attenuate the power supply noise, connect capacitor between AGNDIN and AVSS.



5) Power supply stabilization capacitor

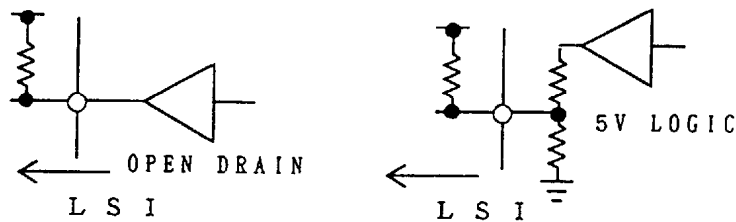
- To minimize the effect of power supply noise, a couple of capacitors should be placed between DVDD and AVDD pins, and DVSS, TAVSS and RAVSS pins.



■ Logic Interface

All digital input pins except CKSL have pull-up resistors.

Following logic interface is recommended when AK2356E is operated at 3V power supply and it interface +5V logic circuit.



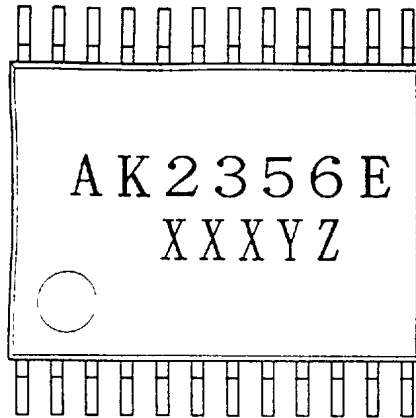
INPUT PIN



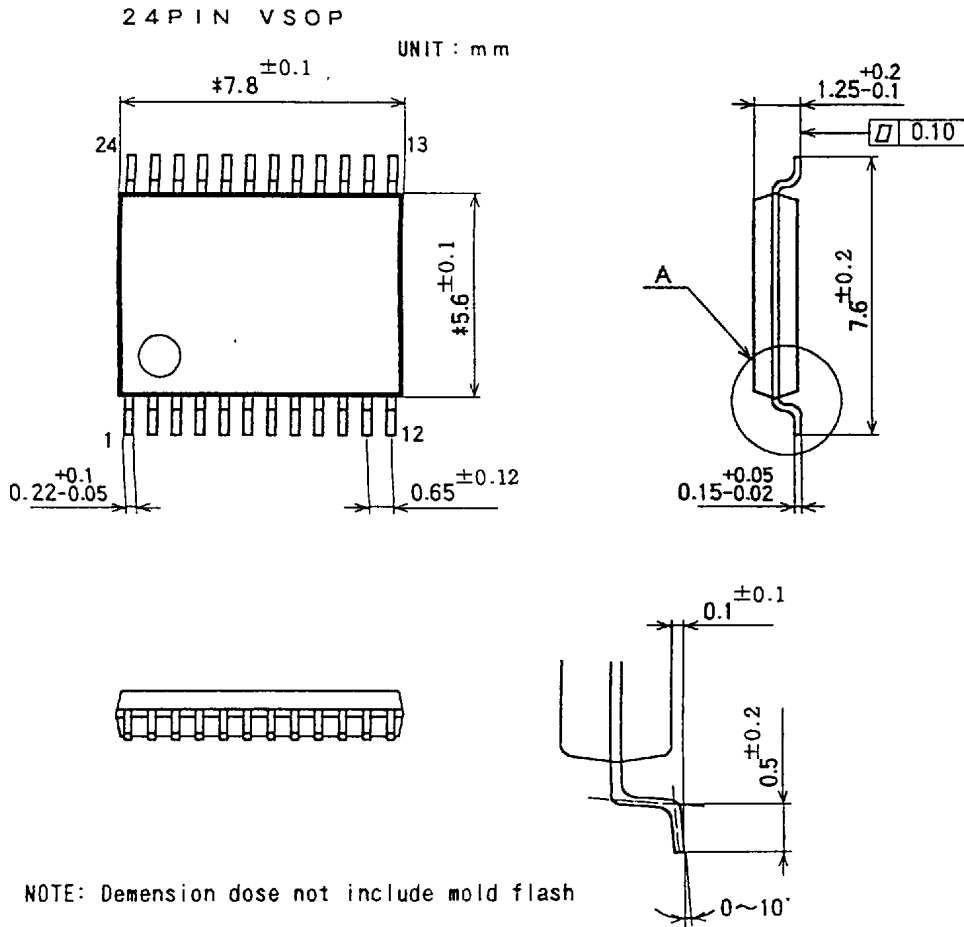
Package

24 pin VSOP

■ Marking



■ Package



NOTE: Dimension dose not include mold flash

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