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# CODEC IC for digital mobile phone

## BU8732AKV

BU8732AKV is a PCM codec IC for digital cellular phones. This includes plenty of analog input / output functions such as a 14bit precision linear  $\mu$  / A-LAW codec, a microphone amplifier with two systems, amplifiers for speaker and earphone and a switch transistor for driving a ringer. This IC is the most suitable for both PDC system and CDMA system cellular phones.

### ●Application

Digital cellular phones with CDMA system, Digital cellular phones with PDC system.

### ●Features

- 1) +3V single power supply. ( $V_{DD}=2.7$  to  $3.3V$ )
- 2) 14bit precision linear  $\mu$  / A-LAW codec.
- 3) Transmission filter of the codec block is in conformity to the ITU-T recommendation G. 714.
- 4) Built-in PLL circuit for system clock generation.
- 5) Built-in DSP I/F which is in conformity with PDC and N-CDMA.
- 6) Arbitrary setting of the clock frequency of PCM data transmission is allowed :

$\mu$ / A-LAW	64kHz to 2048kHz
Linear	128kHz to 2048kHz
- 7) Plenty of input / output analog functions :
  - Two systems of built-in microphone amplifier (differential input type, single input type)
  - Built-in speaker amplifier for receiver ( $32\Omega$  BTL type)
  - Built-in speaker amplifier for earphone ( $32\Omega$  single type)
  - Built-in speaker amplifier for REXT of call receiving system ( $600\Omega$ )
  - Built-in electronic volumes for gain adjustment. (Call-receiving system, call sending system, TONE system)
  - Built-in input / output circuit for data signal which allows external connection.
  - Pop noise of REXT earphone and receiver outputs at the time of switching on and off the power supply is reduced by means of soft mute.
- 8) A built-in function to generate DTMF signals and musical scale tones is provided in the tone signal generating block.
- 9) Built-in switch transistor for driving a ringer.
- 10) VQFP 48 pin package.

## Communication ICs

## ●Absolute maximum rating (Ta=25°C unless specified particularly)

Parameter	Symbol	Limits	Unit
Digital power supply voltage	DV <sub>DD</sub>	-0.3 to +4.5	V
Analog power supply voltage	RXV <sub>DD</sub>	-0.3 to +4.5	V
	TXV <sub>DD</sub>	-0.3 to +4.5	V
Digital pin apply voltage	V <sub>TD</sub>	DV <sub>SS</sub> -0.3 to DV <sub>DD</sub> +0.3	V
Analog pin apply voltage	V <sub>TA</sub>	RXV <sub>SS</sub> -0.3 to RXV <sub>DD</sub> +0.3	V
		TXV <sub>SS</sub> -0.3 to TXV <sub>DD</sub> +0.3	V
Input current	I <sub>IN</sub>	-10 to +10	mA
Power dissipation	P <sub>d</sub>	400 *1	mW
Storage temperature range	T <sub>stg</sub>	-50 to +125	°C
Operation temperature range	T <sub>a</sub>	-30 to +85	°C

\*1 Drops by 4.0mW per 1°C when used at more than Ta=25°C.

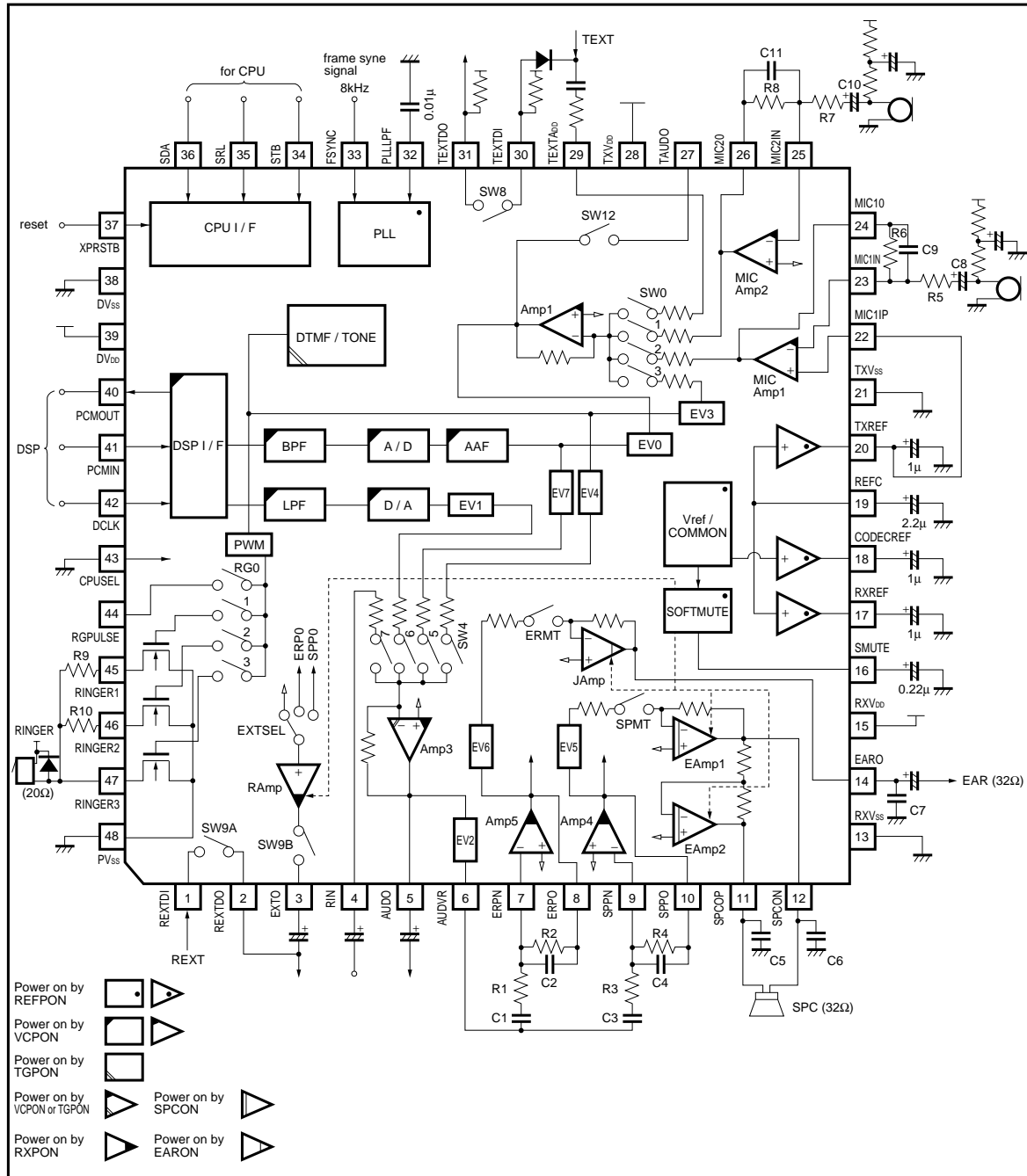
## ●Recommendable operation condition (Ta=25°C unless specified particularly)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Digital power supply voltage	DV <sub>DD</sub>	2.7	-	3.3	V
Analog power supply voltage	RXV <sub>DD</sub>	2.7	-	3.3	V
	TXV <sub>DD</sub>	2.7	-	3.3	V

©Radiation resistance is not included design.

Communication ICs

●Block diagram



## Communication ICs

## ●Pin descriptions

Pin No.	Pin name	I / O	Terminal function	Minimum load resistance[Ω]	Maximum load capacitance[F]
1	REXTDI	I / O	Input of the data signal of receive	–	–
2	REXTDO	I / O	Output of the data signal of receive	–	–
3	EXTO	O	Amplifier output for the gain adjustment of receive signal	600	–
4	RIN	I	Direct input of the voice of receive	–	–
5	AUDO	O	Direct output of receive signal	50k	50p
6	AUDVR	O	External output of receive signal	50k	50p
7	ERPNI	I	Inverted amplifier input for the earphone gain adjustment	–	–
8	ERPO	O	Amplifier output for the earphone gain adjustment	50k	50p
9	SPPNI	I	Inverted amplifier input for the speaker gain adjustment	–	–
10	SPPO	O	Amplifier output for the speaker gain adjustment	50k	50p
11	SPCOP	O	Non-inverted speaker amplifier output for the receiver	30(BTL)	–
12	SPCON	O	Inverted speaker amplifier output for the receiver	30(BTL)	–
13	RXV <sub>SS</sub>	–	Analog grounding for the receive	–	–
14	EARO	O	Speaker amplifier output for the earphone	30	–
15	RXV <sub>DD</sub>	–	Analog power source for the receive	–	–
16	SMUTE	I	Time constant terminal for the soft mute setting	–	0.22μ <sup>*1</sup>
17	RXREF	O	Analog reference voltage output for the receive	–	1μ <sup>*1</sup>
18	CODCREF	O	Analog reference voltage output for codec	–	1μ <sup>*1</sup>
19	REFC	O	Analog reference voltage output	–	2.2μ <sup>*1</sup>
20	TXREF	O	Analog reference voltage output for the transmit	–	1μ <sup>*1</sup>
21	TXV <sub>SS</sub>	–	Analog grounding for the transmit	–	–
22	MIC1IP	I	Non-inverted input of the microphone amplifier 1	–	–
23	MIC1IN	I	Inverted input of the microphone amplifier 1	–	–
24	MIC1O	O	Output of microphone amplifier 1	50k	50p
25	MIC2IN	I	Inverted input of the microphone amplifier 2	–	–
26	MIC2O	O	Output of microphone amplifier 2 output	50k	50p
27	TAUDO	O	External output of transmit signal	50k	50p
28	TXV <sub>DD</sub>	–	Analog power source for the transmit	–	–
29	TEXTADD	I	Additive input of the transmit signal	–	–
30	TEXTDI	I / O	Input of the data signal of transmit	–	–
31	TEXTDO	I / O	Output of the data signal of transmit	–	–
32	PLLLPF	I / O	Filter connection input/output for PLL	–	0.01μ <sup>*1</sup>
33	FSYNC	I	PLL reference clock input	–	–
34	STB	I	Strobe input for CPU I/F	–	–
35	SCL	I / O	Shift clock input for CPU I/F	–	–
36	SDA	I / O	Address data input for CPU I/F	–	–
37	XPRSTB	I	System reset input (L: reset)	–	–
38	DV <sub>SS</sub>	–	Grounding for digital	–	–
39	DV <sub>DD</sub>	–	Power supply for digital	–	–
40	PCMOUT	O	Output of PCM signal	–	–
41	PCMIN	I	Input of PCM signal	–	–
42	DCLK	I	Shift clock input for PCM signal	–	–

\*1 Standard value

## Communication ICs

Pin No.	Pin name	I / O	Terminal function	Minimum load resistance[Ω]	Maximum load capacitance[F]
43	CPUSEL	I	Fixed to GND, Fixed "L"	–	–
44	RGPULSE	O	Pulse output for the ringer	–	–
45	RINGER1	O	Open drain output of the ringer driving transistor	100(at 3V)	–
46	RINGER2	O	Open drain output of the ringer driving transistor	60(at 3V)	–
47	RINGER3	O	Open drain output of the ringer driving transistor	20(at 3V)	–
48	PV <sub>SS</sub>	–	Grounding for ringer	–	–

\*1 Standard value

## ●Electrical characteristics

(Ta=25°C, DV<sub>DD</sub>=RXV<sub>DD</sub>=TXV<sub>DD</sub>=3.0V, FSYNC=8kHz, gain 0dB unless specified particularly)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Current consumption(Note 1)	I <sub>DD1</sub>	–	8.0	11.5	mA	Full operation (Note2)
	I <sub>DD2</sub>	–	7.0	10.2		Reference / Voice / SPC ON (Note2)
	I <sub>DD3</sub>	–	6.0	8.6		Reference / Voice / EAR ON (Note2)
	I <sub>DD4</sub>	–	5.4	7.8		Reference / Voice / RAMP ON (Note2)
	I <sub>DD5</sub>	–	5.1	7.3		Reference / Voice ON (Note2)
	I <sub>DD6</sub>	–	3.7	5.3		Reference / Tone ON (Note2)
	I <sub>DD7</sub>	–	3.3	4.8		Reference ON (Note2)
		I <sub>DD8</sub>	–	0.1	20	μA
Digital "H" level input voltage	V <sub>IH</sub>	0.8DV <sub>DD</sub>	–	–	V	
Digital "L" level input voltage	V <sub>IL</sub>	–	–	0.2DV <sub>DD</sub>	V	
Digital "H" level input current	I <sub>IH</sub>	–	–	10	μA	V <sub>IH</sub> =DV <sub>DD</sub>
Digital "L" level input current	I <sub>IL</sub>	–10	–	–	μA	V <sub>IL</sub> =0V
Digital "H" level output voltage	V <sub>OH</sub>	DV <sub>DD</sub> -0.5	–	–	V	I <sub>OH</sub> = –1mA
Digital "L" level output voltage	V <sub>OL</sub>	–	–	0.5	V	I <sub>OL</sub> =1mA

\*1) Power supply voltage (DV<sub>DD</sub>, RXV<sub>DD</sub>, TXV<sub>DD</sub>) is 3V. Digital and analog output terminals are free from load.All the digital terminals except FSYNC. CLK terminal are connected to either DV<sub>DD</sub> or DV<sub>SS</sub>.

Analog terminals are connected with an appropriate resistance to TXREF or RXREF.

The soft mute is in the canceled status. (SMUTE="0")

\*2) FSYNC=8kHz, DCLK=256kHz

## Communication ICs

## ●Electrical characteristics

(Ta=25°C, DVDD=RXVDD=TXVDD=3.0V, FSYNC=8kHz, DCLK=256kHz, gain 0dB, input signal frequency=1 kHz, 30 kHz LFP, specified particularly)

< CODEC block >

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Transmit signal-to-distortion ratio TEXTADD→PCMOUT	SDT	35	–	–	dB	1020Hz input (LINEAR) *3)	0 to –40dBm0
		29	–	–			–40dBm0
		24	–	–			–45dBm0
Receive signal-to-distortion ratio PCMIN→AUDO	SDR	35	–	–	dB	1020Hz input (LINEAR) *3)	0 to –40dBm0
		29	–	–			–40dBm0
		24	–	–			–45dBm0
Transmit Gain error TEXTADD→PCMOUT	GTX	–0.3	–	0.3	dB	1020Hz, (LINEAR) *3) Reference level= –10dBm0	+3 to –40dBm0
		–0.6	–	0.6			–40 to –50dBm0
		–1.6	–	1.6			–50 to –55dBm0
Receive Gain error PCMIN→AUDO	GRX	–0.3	–	0.3	dB	1020Hz, (LINEAR) *3) Reference level= –10dBm0	+3 to –40dBm0
		–0.6	–	0.6			–40 to –50dBm0
		–1.6	–	1.6			–50 to –55dBm0
Transmit reference signal level	VITX	0.257	0.346	0.436	Vrms	1020Hz, 0dBm0 EV0=0dB, (LINEAR) *3)	TEXTADD→PCMOUT
Receive reference signal level	VORX	0.291	0.346	0.411	Vrms	1020Hz, 0dBm0 EV1=0dB, (LINEAR) *3)	PCMIN→AUDO
Transmit Gain relative to input signal gain at 1.02KHz TEXTADD→PCMOUT	GRTX	24	–	–	dB	1020Hz, 0dBm0 Input reference EV0=0dB, (LINEAR)	0.06kHz
		0	–	2.5			0.2kHz
		–0.3	–	0.3			0.3 to 3.0kHz
		–0.3	–	0.9			3.4kHz
		0	–	–			3.6kHz
		6.5	–	–			3.78kHz
Receive Gain relative to input signal gain at 1.02KHz PCMIN→AUDO	GRRX	–0.3	–	0.3	dB	1020Hz, 0dBm0 Input reference EV1=0dB, (LINEAR)	0.3 to 3.0kHz
		–0.3	–	0.9			3.4kHz
		0	–	–			3.6kHz
		6.5	–	–			3.78kHz
Transmit noise level TEXTADD→PCMOUT	VNTX	–	–	–65	dBV	EV0=0dB, (LINEAR) *3)	
Receive noise level PCMIN→AUDO	VNRX	–	–	–70	dBV	PCMIN= "L" fixed, EV1=0dB, (LINEAR) *3)	
Noise level of speaker amplifier for receiver	VNSPC	–	–90	–	dBV	SPCOP-SPCON, RL=32Ω Connect SPPN-SPPO *3)	
Noise level of speaker amplifier for earphone	VNEAR	–	–93	–	dBV	EARO, RL=32Ω Connect ERPV-ERPO *3)	

\*3) Using C-MESSAGE filter

## Communication ICs

&lt; Analog element (1) &gt;

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Max. Closed loop gain	GCMIC1	40	–	–	dB	MICAMP1, THD<5%
	GCMIC2	40	–	–		MICAMP2, THD<5%
	GCAMP4	40	–	–		AMP4, THD<5%
	GCAMP5	40	–	–		AMP5, THD<5%
Min. Load impedance	RLTX	50k	–	–	$\Omega$	MIC10, MIC20, TAUDOGND
	RLRX	50k	–	–		AUDO, AUDVR, ERPO, SPPO $\leftrightarrow$ GND
	RLEXT	600	–	–		EXTO $\leftrightarrow$ GND
	RLSPC	30	–	–		SPCOP-SPCON
	RLEAR	30	–	–		EARO-GND
Max. Load capacitance	CLTX	–	–	50p	F	MIC10, MIC20, TAUDO $\leftrightarrow$ GND
	CLRXL	–	–	50p		AUDO, ERPO, SPPO $\leftrightarrow$ GND
Max. Output level	VOTX	0.707	–	–	Vrms	MIC10, MIC20, TAUDO R <sub>L</sub> =50k $\Omega$ , C <sub>L</sub> =50pF, THD<5%
	VORX	0.707	–	–		AUDO, AUDVR, ERPO, SPPO R <sub>L</sub> =50k $\Omega$ , C <sub>L</sub> =50pF, THD<5%
	VOSPC	0.791	1.130	–		SPCOP-SPCON R <sub>L</sub> =32 $\Omega$ , THD<5%
	VOEAR	0.485	0.693	–		EARO R <sub>L</sub> =32 $\Omega$ , THD<5%
	VOEXT	0.393	0.562	–		EXTO R <sub>L</sub> =600 $\Omega$ , THD<5%
Absolute gain error of AMP1	GVAMP11	–1.5	–	1.5	dB	TEXTA <sub>DD</sub> $\rightarrow$ TAUDO SW0=SW12=ON, SW1=SW2=SW3=OFF
	GVAMP12	–1.5	–	1.5		MIC20 $\rightarrow$ TAUDO SW1=SW12=ON, SW0=SW2=SW3=OFF
	GVAMP13	–1.5	–	1.5		MIC10 $\rightarrow$ TAUDO SW2=SW12=ON, SW0=SW1=SW3=OFF
Absolute gain error of AMP3	GVAMP31	–1.5	–	1.5	dB	RIN $\rightarrow$ AUDO SW7=ON, SW4=SW5=SW6=OFF



## Communication ICs

&lt; Analog element (2) &gt;

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Max. Volume level	GEV0H	10.8	12	13.2	dB	EV0=12dB, TEXTADD→PCMOUT
	GEV1H	1.8	3	4.2		EV1=3dB, PCMIN→AUDIO
	GEV2H	-1.2	0	1.2		EV2=0dB, RIN→AUDVDR
	GEV3H	4.8	6	7.2		EV3=6dB, DTMF / TONE→TAUDO
	GEV4H	4.8	6	7.2		EV4=6dB, DTMF / TONE→AUDIO
	GEV5H	-1.2	0	1.2		EV5=0dB, SPPO→SPCON
	GEV6H	-1.2	0	1.2		EV6=0dB, ERPO→EARO
	GEV7H	-6.2	-5	-3.2		EV7=-5dB, TEXTADD→AUDIO, EV0=0dB
Min. volume level	GEV0L	-20.2	-19	-17.8	dB	EV0=-19dB, TEXTADD→PCMOUT
	GEV1L	-5.2	-4	-2.8		EV1=-4dB, PCMIN→AUDIO
	GEV2L	-32.2	-31	-29.8		EV2=-31dB, RIN→AUDVDR
	GEV3L	-27	-25	-23		EV3=-25dB, DTMF / TONE→TAUDO
	GEV4L	-27	-25	-23		EV4=-25dB, DTMF / TONE→AUDIO
	GEV5L	-16.2	-15	-13.8		EV5=-15dB, SPPO→SPCON
	GEV6L	-16.2	-15	-13.8		EV6=-15dB, ERPO→EARO
	GEV7L	-21.2	-20	-18.8		EV7=-20dB, TEXTADD→AUDIO, EV0=0dB
Output muting level	Gvsw0	-	-	-60	dBV	SW0=SW1=SW2=SW3=OFF, SW12=ON 0dBm0 input, TEXTADD→TAUDO
	Gvsw1	-	-	-60		SW0=SW1=SW2=SW3=OFF, SW12=ON 0dBm0 input, MIC20→TAUDO
	Gvsw2	-	-	-60		SW0=SW1=SW2=SW3=OFF, SW12=ON 0dBm0 input, MIC10→TAUDO
	Gvsw3	-	-	-60		SW0=SW1=SW2=SW3=OFF, SW12=ON HTONE 1KHz, EV3=0dB DTMF / TONE→TAUDO
	Gvsw4	-	-	-60		SW4=SW5=SW6=SW7=OFF HTONE 1KHz, EV4=0dB DTMF / TONE→TAUDO
	Gvsw5	-	-	-60		SW4=SW5=SW6=SW7=OFF 0dBm0 input, EV0=EV7=0dB TEXTADD→AUDIO
	Gvsw6	-	-	-60		SW4=SW5=SW6=SW7=OFF 0dBm0 input, EV1=0dB, PCMIN→AUDIO
	Gvsw7	-	-	-60		SW4=SW5=SW6=SW7=OFF 0dBm0 input, RIN→AUDIO
	Gvsw12	-	-	-60		SW1=SW2=SW3=OFF, SW0=SW12=ON 0dBm0 input, TEXTADD→TAUDO

## Communication ICs

## &lt; Tone block &gt;

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Tone output level	V <sub>TNH</sub>	-16	-14	-12	dBV	HTONE 2kHz, DTMF / TONE→AUDIO EV4=0dB
		-16	-14	-12		HTONE 2kHz, DTMF / TONE→TAUDIO EV3=0dB
	V <sub>TNL</sub>	-16	-14	-12		LTONE 384Hz, DTMF / TONE→AUDIO EV4=0dB
Tone distortion	S <sub>DTN</sub>	-	-	-25	dB	HTONE 1kHz, DTMF / TONE→AUDIO EV4=0dB

## &lt; Reference block &gt;

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Output reference signal Voltage	V <sub>OTX</sub>	-	1.5	-	V	TXREF, All power on
	V <sub>ORX</sub>	-	1.5	-		RXREF, All power on
	V <sub>OCODEC</sub>	-	1.4	-		CODECREF, All power on
input/output current	I <sub>OTX</sub>	-10	-	10	μA	TXREF, All power on, V <sub>OTX</sub> ±50mV
	I <sub>ORX</sub>	-10	-	10		RXREF, All power on, V <sub>ORX</sub> ±50mV
	I <sub>OCODEC</sub>	-10	-	10		CODECREF, All power on, V <sub>OCODEC</sub> ±50mV

## &lt; Ringer driver block &gt;

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Max. output drive current	I <sub>ORG1</sub>	30	-	-	mA	RINGER1=ON, V <sub>sat</sub> <0.3
	I <sub>ORG2</sub>	50	-	-		RINGER2=ON, V <sub>sat</sub> <0.4
	I <sub>ORG3</sub>	150	-	-		RINGER3=ON, V <sub>sat</sub> <0.7
Leakage current	I <sub>L1</sub>	-	-	5	μA	RINGER1=OFF, V <sub>o</sub> =3V
	I <sub>L2</sub>	-	-	5		RINGER2=OFF, V <sub>o</sub> =3V
	I <sub>L3</sub>	-	-	5		RINGER3=OFF, V <sub>o</sub> =3V

## Communication ICs

## ●Digital AC characteristics

(Ta=25°C, DVDD=RXVD=TXVDD=3.0V, FSYNC=8kHz, DCLK=256 kHz, unless specified particularly Gain= 0db)

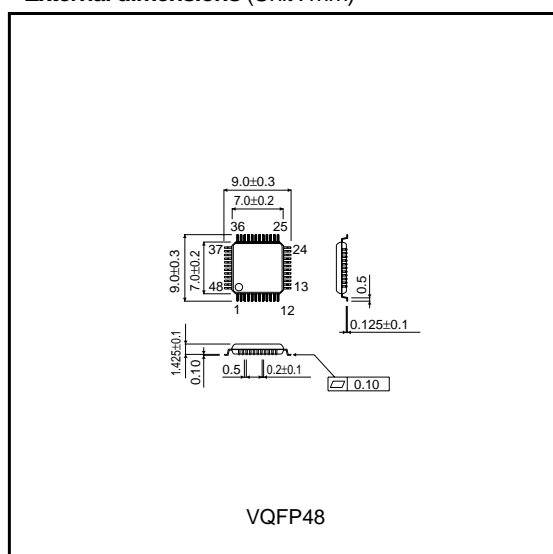
&lt; Serial interface timing &gt;

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Data clock frequency (DCLK)	f <sub>CLK</sub>	64	–	2048	kHz	μ / A-LAW
		128	–	2048		Linear
Frame Sync Frequency (FSYNC)	f <sub>SYNC</sub>	7.996	8.000	8.004	kHz	FSYNC frequency
Input transition time 0 → 1	T <sub>IR</sub>	–	–	20	ns	Signal rise time
Input transition time 1 → 0	T <sub>IF</sub>	–	–	20	ns	Signal fall time
PCMIN Set up time	T <sub>RS</sub>	100	–	–	ns	DCLK↓ –PCMIN
PCMIN Hold time	T <sub>RH</sub>	100	–	–	ns	DCLK↓ –PCMIN
Other timings	T <sub>SR</sub>	100	–	–	ns	DCLK↓ –FSYNC↑
	T <sub>SS</sub>	100	–	–		DCLK↓ –PCMOUT
	T <sub>SH</sub>	100	–	–		DCLK↓ –PCMOUT

&lt; Write timing for the internal registers &gt;

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
SCL frequency	f <sub>SCL</sub>	–	–	3	MHz	SCL clock frequency
SDA input set up time	t <sub>SU</sub> : DATA	100	–	–	ns	SDA↓ –SCL↓
SDA input hold time	t <sub>HD</sub> : DATA	100	–	–	ns	SDA↓ –SCL↑
Input hold time	t <sub>sud</sub>	333	–	–	ns	SCL↑ –STB↑
Input setup time	t <sub>htd</sub>	1000	–	–	ns	SCL↑ –STB↓
STB input hold time	t <sub>pwd</sub>	667	–	–	ns	STB↑ –STB↓

## ●External dimensions (Unit : mm)



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- Products listed in this document are no antiradiation design.

The products listed in this document are designed to be used with ordinary electronic equipment or devices (such as audio visual equipment, office-automation equipment, communications devices, electrical appliances and electronic toys).

Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.

#### About Export Control Order in Japan

Products described herein are the objects of controlled goods in Annex 1 (Item 16) of Export Trade Control Order in Japan.

In case of export from Japan, please confirm if it applies to "objective" criteria or an "informed" (by MITI clause) on the basis of "catch all controls for Non-Proliferation of Weapons of Mass Destruction.