

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 μ / 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 μ / 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 :

μ / 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 (32Ω BTL type)
 - Built-in speaker amplifier for earphone (32Ω single type)
 - Built-in speaker amplifier for REXT of call receiving system (600Ω)
 - 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 _{DD}	-0.3 to +4.5	V
Analog power supply voltage	RXV _{DD}	-0.3 to +4.5	V
	TXV _{DD}	-0.3 to +4.5	V
Digital pin apply voltage	V _{TD}	DV _{SS} -0.3 to DV _{DD} +0.3	V
Analog pin apply voltage	V _{TA}	RXV _{SS} -0.3 to RXV _{DD} +0.3	V
		TXV _{SS} -0.3 to TXV _{DD} +0.3	V
Input current	I _{IN}	-10 to +10	mA
Power dissipation	P _d	400 *1	mW
Storage temperature range	T _{stg}	-50 to +125	°C
Operation temperature range	T _a	-30 to +85	°C

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

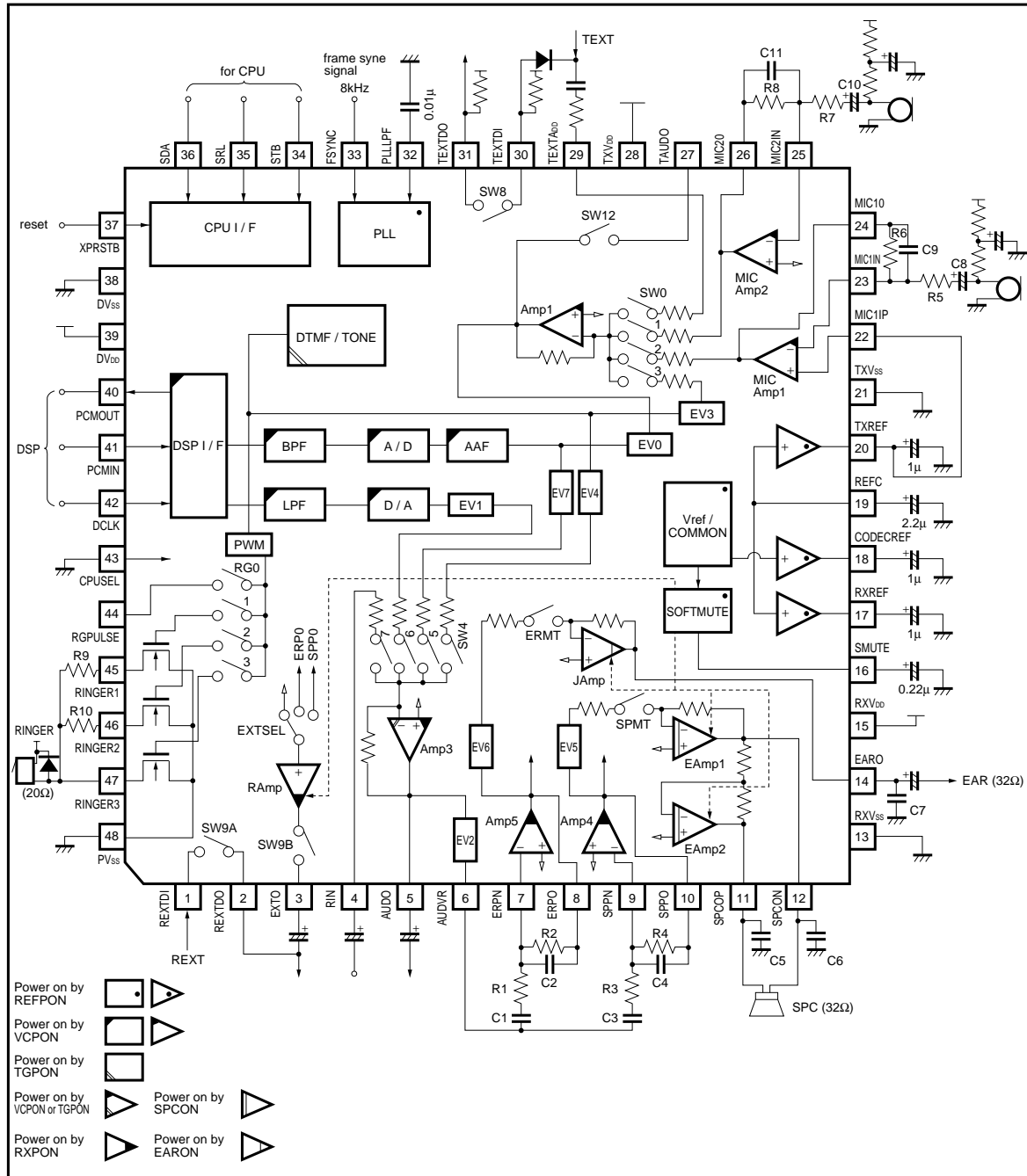
●Recommendable operation condition (Ta=25°C unless specified particularly)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Digital power supply voltage	DV _{DD}	2.7	-	3.3	V
Analog power supply voltage	RXV _{DD}	2.7	-	3.3	V
	TXV _{DD}	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 _{SS}	–	Analog grounding for the receive	–	–
14	EARO	O	Speaker amplifier output for the earphone	30	–
15	RXV _{DD}	–	Analog power source for the receive	–	–
16	SMUTE	I	Time constant terminal for the soft mute setting	–	0.22μ ^{*1}
17	RXREF	O	Analog reference voltage output for the receive	–	1μ ^{*1}
18	CODCREF	O	Analog reference voltage output for codec	–	1μ ^{*1}
19	REFC	O	Analog reference voltage output	–	2.2μ ^{*1}
20	TXREF	O	Analog reference voltage output for the transmit	–	1μ ^{*1}
21	TXV _{SS}	–	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 _{DD}	–	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 ^{*1}
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 _{SS}	–	Grounding for digital	–	–
39	DV _{DD}	–	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 _{SS}	–	Grounding for ringer	–	–

*1 Standard value

●Electrical characteristics

(Ta=25°C, DV_{DD}=RXV_{DD}=TXV_{DD}=3.0V, FSYNC=8kHz, gain 0dB unless specified particularly)

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

*1) Power supply voltage (DV_{DD}, RXV_{DD}, TXV_{DD}) is 3V. Digital and analog output terminals are free from load.All the digital terminals except FSYNC. CLK terminal are connected to either DV_{DD} or DV_{SS}.

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→PCMOU	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→PCMOU	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→ PCMOU
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→PCMOU	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→PCMOU	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 ERPN-ERPO *3)	

*3) Using C-MESSAGE filter

Communication ICs

< Analog element (1) >

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	–	–	Ω	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
	CLRX	–	–	50p		AUDO, ERPO, SPPO \leftrightarrow GND
Max. Output level	VOTX	0.707	–	–	Vrms	MIC10, MIC20, TAUDO R _L =50k Ω , C _L =50pF, THD<5%
	VORX	0.707	–	–		AUDO, AUDVR, ERPO, SPPO R _L =50k Ω , C _L =50pF, THD<5%
	VOSPC	0.791	1.130	–		SPCOP-SPCON R _L =32 Ω , THD<5%
	VOEAR	0.485	0.693	–		EARO R _L =32 Ω , THD<5%
	VOEXT	0.393	0.562	–		EXTO R _L =600 Ω , THD<5%
Absolute gain error of AMP1	GVAMP11	–1.5	–	1.5	dB	TEXTA _{DD} \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

< Analog element (2) >

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

< Tone block >

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

< Reference block >

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

< Ringer driver block >

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

Communication ICs

●Digital AC characteristics

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

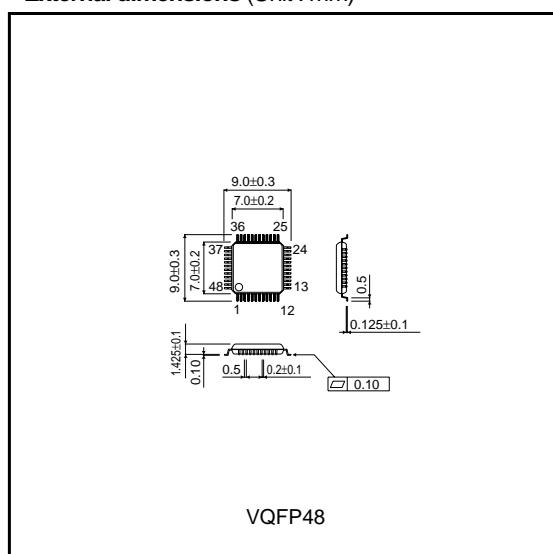
< Serial interface timing >

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

< Write timing for the internal registers >

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

●External dimensions (Unit : mm)



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