PCM codec IC for digital cellular telephones

BU8731KV

The BU8731KV is a PCM codec IC developed for use with digital cellular telephones. It contains analog input / output features such as a 14-bit linear precision, μ / A-LAW codec, mic and speaker amplifiers, and switching transistor for the ringer drive. This all makes the BU8731KV perfect for PDC and CDMA-type cellular telephones.

●Applications

Digital cellular telephones

●Features

1) +3V single power supply (V_{DD} = 2.7V to 3.3V).
2) Built-in 14-bit precision linear, μ / A-LAW codec.
3) Transmission filter for the codec unit conforms to ITU-T recommendations.
4) Built-in PLL circuit for system clock generation.
5) Clock frequency for PCM data transmission can be set anywhere between 64kHz (128kHz when linear) to 2048kHz.
6) Analog input / output functions:
   - Built-in mic amplifier.
   - Built-in receiver speaker amplifier (32Ω BTL type).
   - Built-in earphone speaker amplifier (32Ω single type).
   - Built-in drive amplifier for reception REXT (600Ω).
   - Built-in electronic volume control for gain adjustment (for reception, transmission, and tone).
   - Data signal I / O circuit allows for connection to external devices.
   - For the REXT output and earphone output, soft-mute function reduces pop noise when the power is turned on and off.
7) DTMF signal and scale tone signal generator functions are built into the tone signal generator block.
8) Internal switching transistor for ringer drive.
9) VQFP 48-pin package.

●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Digital power supply voltage	DV_{DD}	−0.3～+4.5	V
Analog power supply voltage	RXV_{DD}	−0.3～+4.5	V
	TXV_{DD}	−0.3～+4.5	V
Digital input voltage	V_{DIN}	DV_{SS}−0.3～DV_{DD}+0.3	V
Analog input voltage	V_{AIN}	RXV_{SS}−0.3～RXV_{DD}+0.3	V
		TXV_{SS}−0.3～TXV_{DD}+0.3	V
Input current	I_{IN}	−10～+10	mA
Power dissipation	Pd	400*1	mW
Operating temperature	Tstg	−50～+125	℃
Storage temperature	Topr	−20～+85	℃

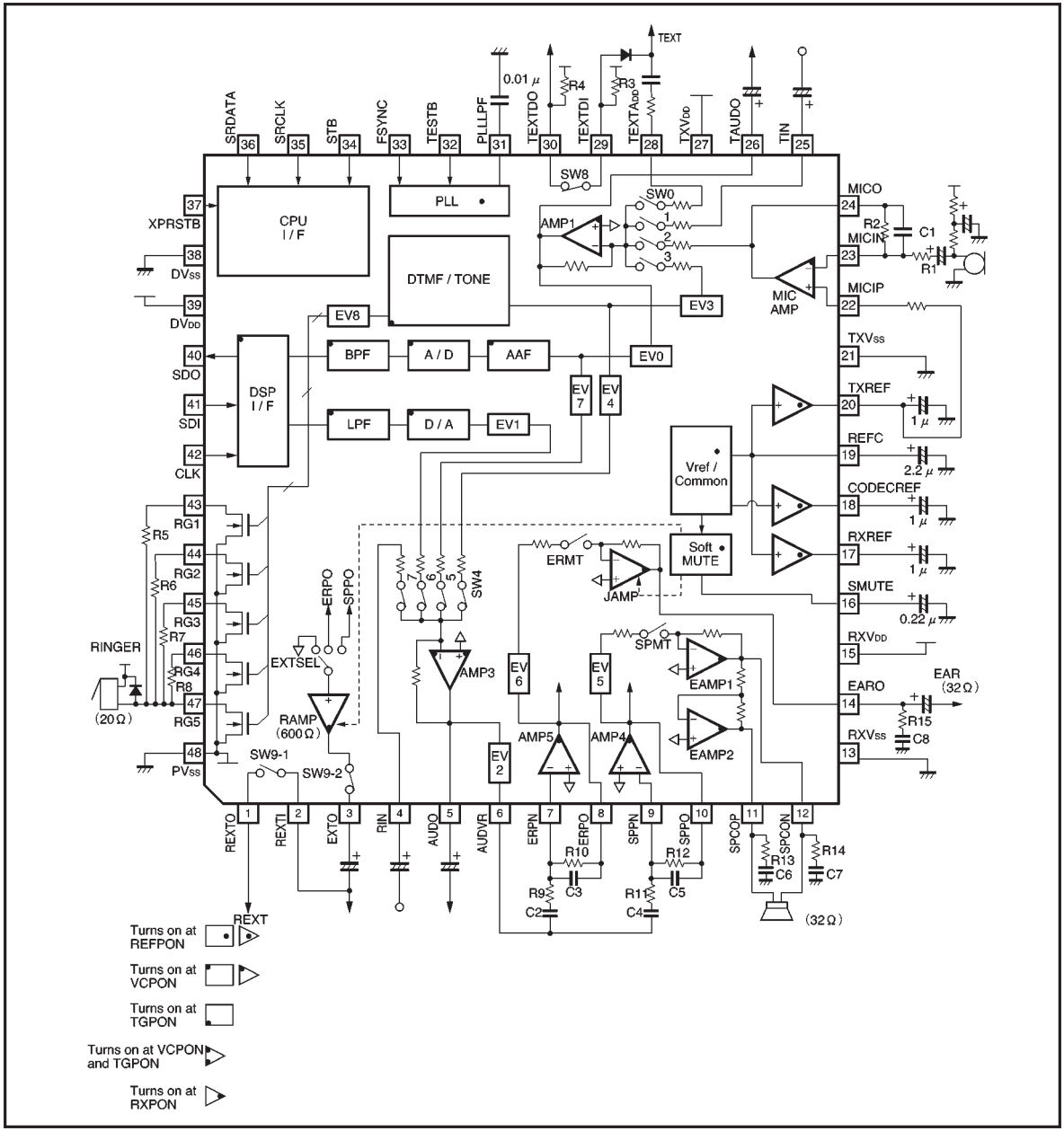
*1 Reduced by 4.0mW for each increase in Ta of 1°C over 25°C.

●Recommended operating conditions (Ta = 25°C)

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

◎Not designed for radiation resistance.

●Block diagram



●Pin descriptions

Pin No.	Pin name	I / O	Function	Minimum load resistance (Ω)	Maximum load capacitance (F)
1	REXTO	I / O	Reception data output	—	—
2	REXTI	I / O	Reception data input	—	—
3	EXTO	O	Amplifier output for reception signal gain adjustment	600	—
4	RIN	I	Reception audio direct input	—	—
5	AUDO	O	Reception signal direct output	50k	50p
6	AUDVR	O	Reception signal external output	50k	50p
7	ERPN	I	Amplifier inverse input for earphone gain adjustment	—	—
8	ERPO	O	Amplifier output for earphone gain adjustment	50k	50p
9	SPPN	I	Amplifier inverse input for speaker gain adjustment	—	—
10	SPPO	O	Amplifier output for speaker gain adjustment	50k	50p
11	SPCOP	O	Receiver speaker amplifier non-inverse output	32 (BTL)	—
12	SPCON	O	Receiver speaker amplifier inverse output	32 (BTL)	—
13	RXV_{SS}	—	Analog ground for reception	—	—
14	EARO	O	Earphone speaker amplifier output	32	—
15	RXV_{DD}	—	Analog power supply for reception	—	—
16	SMUTE	I	Time constant for soft mute setting	—	0.22 μ*1
17	RXREF	O	Analog reference voltage output for reception	—	1 μ*1
18	CODCREF	O	Analog reference voltage output for codec	—	1 μ*1
19	REFC	O	Analog reference voltage output	—	2.2 μ*1
20	TXREF	O	Analog reference voltage output for transmission	—	1 μ*1
21	TXV_{SS}	—	Analog ground for transmission	—	—
22	MICIP	I	Mic amplifier non-inverse input	—	—
23	MICIN	I	Mic amplifier inverse input	—	—
24	MICO	O	Mic amplifier output	50k	50p
25	TIN	I	Transmission audio direct input	—	—
26	TAUDO	O	Transmission analog output	50k	50p
27	TXV_{DD}	—	Analog power supply for transmission	—	—
28	$TEXTA_{DD}$	I	Transmission signal incremental input	—	—
29	TEXTDI	I / O	Transmission data signal input	—	—
30	TEXTDO	I / O	Transmission data signal output	—	—
31	PLLLPF	I / O	Input/output filter connector for PLL circuit	—	0.01 μ*1
32	TESTB	I	Test input (→DV_{DD})	—	—
33	FSYNC	I	PLL reference clock input	—	—
34	STB	I	CPU I/F strobe input	—	—
35	SRCLK	I	CPU I/F shift clock input	—	—
36	SRDATA	I	CPU I/F address data input	—	—
37	XPRSTB	I	System reset input (L: reset)	—	—
38	DV_{SS}	—	Digital ground	—	—

*1 Recommended value.

Pin No.	Pin name	I / O	Function	Minimum load resistance (Ω)	Maximum load capacitance (F)
39	DV_{DD}	—	Digital power supply	—	—
40	SDO	O	PCM signal output	—	—
41	SDI	I	PCM signal input	—	—
42	CLK	I	PCM signal shift clock input	—	—
43	RG1	O	Ringer drive transistor output 1	100 (for 3V)	—
44	RG2	O	Ringer drive transistor output 2	60 (for 3V)	—
45	RG3	O	Ringer drive transistor output 3	40 (for 3V)	—
46	RG4	O	Ringer drive transistor output 4	30 (for 3V)	—
47	PG5	O	Ringer drive transistor output 5	20 (for 3V)	—
48	PV_{SS}	—	Ground for ringer	—	—

●Electrical characteristics (unless otherwise noted, Ta = 25°C, DV_{DD} = RXV_{DD} = TXV_{DD} = 3.0V, FSYNC = 8kHz)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
〈DC characteristics〉						
Current consumption*1	$I_{DD}1$	—	8.0	(11.5)	mA	All power on (FSYNC=8kHz)
	$I_{DD}2$	—	7.0	(10.2)	mA	Reference, audio, SPC on (FSYNC=8kHz)
	$I_{DD}3$	—	6.0	(8.6)	mA	Reference, audio, earphone on (FSYNC=8kHz)
	$I_{DD}4$	—	5.4	(7.8)	mA	Reference, audio, RAMP on (FSYNC=8kHz)
	$I_{DD}5$	—	5.1	(7.3)	mA	Reference and audio on (FSYNC=8kHz)
	$I_{DD}6$	—	3.7	(5.3)	mA	Reference and tone on (FSYNC=8kHz)
	$I_{DD}7$	—	3.3	(4.8)	mA	Only reference on (FSYNC=8kHz)
	$I_{DD}8$	—	0.1	20	μA	Complete power down (FSYNC=fixed)
Digital input high level voltage	V_{IH}	0.8 DV_{DD}	—	—	V	—
Digital input low level voltage	V_{IL}	—	—	0.2 DV_{DD}	V	—
Digital input high level current	I_{IH}	—	—	10	μA	V_{IH}=DV_{DD}
Digital input low level current	I_{IL}	−10	—	—	μA	V_{IL}=0V
Digital output high level voltage	V_{OH}	DV_{DD} −0.5	—	—	V	I_{OH}=−1mA
Digital output low level voltage	V_{OL}	—	—	0.5	V	I_{OL}=1mA

*1 The power supply voltage (DV_{DD}, RXV_{DD}, and TXV_{DD}) is 3V. There is no load on the digital and analog output pins.
Digital input pins other than the FSYNC and CLK pins are connected to DV_{DD} or DV_{SS}.
Analog input pins are connected to TXREF or RXREF with the proper resistance.
With soft mute off (SMUTE=0).

●Electrical characteristics (unless otherwise noted, Ta = 25°C, DV_{DD} = RXV_{DD} = TXV_{DD} = 3.0V, FSYNC = 8kHz, gain of each attenuator = 0dB)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions		
〈Transmission characteristics〉								
Signal to total power distortion ratio (A→D) TEXTADD→SDO	S_{DT}	24	—	—	dB	1020Hz reference	−45dBm0	C-Wgt
		29	—	—			−40dBm0	
		35	—	—			0～−30dBm0	
Signal to total power distortion ratio (D→A) SDI→AUDO	S_{DR}	24	—	—	dB	1020Hz reference	−45dBm0	C-Wgt
		29	—	—			−40dBm0	
		35	—	—			0～−30dBm0	
Transmission level characteristics (A→D) TEXTADD→SDO	G_{TX}	−0.9	—	0.9	dB	1020Hz reference	−55dBm0	Reference level =−10dBm0 C-Wgt
		−0.6	—	0.6			−50dBm0	
		−0.3	—	0.3			0～−40dBm0	
Transmission level characteristics (D→A) SDI→AUDO	G_{TR}	−0.9	—	0.9	dB	1020Hz reference	−55dBm0	Reference level =−10dBm0 C-Wgt
		−0.6	—	0.6			−50dBm0	
		−0.3	—	0.3			0～−40dBm0	
Transmission output level	V_{OTX}	0.275	0.346	0.436	V_{rms}	1020Hz, 0dBm0 input reference	MICO→SDO	MICO output level is measured
		0.275	0.346	0.436	V_{rms}		TEXTADD →SDO	TEXTADD input leve is measured
Reception output level	V_{ORX}	0.291	0.346	0.411	V_{rms}	1020Hz, 0dBm0 input reference	SDI→AUDO	—
Transmission noise during no conversation	V_{NTX}	—	−75	−65	dBm0C	—	MIC→SDO	C-Wgt
Reception noise during no conversation	V_{NRX}	—	−79	−70	dBm0C	—	SDI→AUDO	C-Wgt
Transmission loss frequency characteristics (A→D) TEXTADD→SDO	G_{RX}	24	—	—	dB	1020Hz, 0dBm0 input reference	0.06kHz	—
		0	—	2.5			0.2kHz	
		−0.3	—	0.3			0.3～3.0kHz	
		−0.3	—	0.9			3.4kHz	
		0	—	—			3.6kHz	
		6.5	—	—			3.78kHz	
Transmission loss frequency characteristics (D→A) SDI→AUDO	G_{RR}	−0.3	—	0.3	dB	1020Hz, 0dBm0 input reference	0.0～3.0kHz	—
		−0.3	—	0.9			3.4kHz	
		0	—	—			3.6kHz	
		6.5	—	—			3.78kHz	

Parameter		Symbol	Min.	Typ.	Max.	Unit	Conditions		
〈Tone generator〉									
Tone output level	HTONE	V_{TNH}	−16	−14	−12	dBV	Set at 2kHz	→AUDO	30kHz LPF
			−16	−14	−12			→SDO	
	LTONE	V_{TNL}	−16	−14	−12			→AUDO	
Tone distortion		S_{DTN}	—	−40	−29	dB	HTONE set at 2kHz	→AUDO	30kHz LPF
〈Attenuator〉									
Absolute gain	EV0	G_{V0}	10	12	14	dB	MICO→SDO, EV0=12dB		
	EV1	G_{V1}	1	3	5		SDI→AUDO, EV1=3dB		
	EV2	G_{V2}	−2	0	2		SDI→AUDVR, EV2=0dB		
	EV3	G_{V3}	4	6	8		→SDO, EV3=6dB		
	EV4	G_{V4}	4	6	8		→AUDO, EV4=6dB		
	EV5	G_{V5}	12	14	16		SPPO→SPCOP-SPCON, EV5=8dB		
	EV6	G_{V6}	6	8	10		ERPO→EARO, EV6=8dB		
	EV7	G_{V7}	−7	−5	−3		MICO→AUDO, EV7=−5dB		
Volum level setting	EV0	G_{EW0}	−31	—	0	dB	→SDO		
	EV1	G_{EW1}	−7	—	0		→AUDO		
	EV2	G_{EW2}	−31	—	0		→AUDVR		
	EV3	G_{EW3}	−31	—	0		→SDO		
	EV4	G_{EW4}	−31	—	0		→AUDO		
	EV5	G_{EW5}	−15	—	0		→SPCOP-SPCON		
	EV6	G_{EW6}	−15	—	0		→EARO		
	EV7	G_{EW7}	−15	—	0		→AUDO		
Volume step width	EV0	ΔG_{E0}	0.2	1	1.8	dB	→SDO		
	EV1	ΔG_{E1}	0.2	1	1.8		→AUDO		
	EV2	ΔG_{E2}	0.2	1	1.8		→AUDVR		
	EV3	ΔG_{E3}	0.2	1	1.8		→SDO		
	EV4	ΔG_{E4}	0.2	1	1.8		→AUDO		
	EV5	ΔG_{E5}	0.2	1	1.8		→SPCOP-SPCON		
	EV6	ΔG_{E6}	0.2	1	1.8		→EARO		
	EV7	ΔG_{E7}	0.2	1	1.8		→AUDO		

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
〈Mic amplifier〉							
Closed-loop gain	G_{CMC}	0	—	40	dB	→MICO	MIC AMP
〈Reception driver〉							
Closed-loop gain	G_{CAM4}	0	—	40	dB	→SPPO	AMP4
	G_{CAM5}	0	—	40		→ERPO	AMP5
Voltage gain	G_{VRA}	−1.5	0	1.5	dB	→EXTO	RAMP, R_L=600Ω
Output power	P_{OJA}	2	15	—	mW	→EARO	JAMP, R_L=32Ω
	P_{OEA}	6.4	40	—		→SPCOP-SPCON	EAMP2-EAMP1, R_L=32Ω
Maximum output level	V_{om}	−2	—	—	dBV	→EXTO	RAMP, R_L=600Ω
〈Ringer drive〉							
Maximum output drive current	$I_{O(MAX.)}$	150	—	—	mA	VSAT（RG5）＜0.7V	
Driven output voltage 1	V_{O1}	—	—	0.7	V	I_O=150mA, RG5	
Driven output voltage 2	V_{O2}	—	—	0.6	V	I_O=100mA, RG4	
Driven output voltage 3	V_{O3}	—	—	0.5	V	I_O=75mA, RG3	
Driven output voltage 4	V_{O4}	—	—	0.4	V	I_O=50mA, RG2	
Driven output voltage 5	V_{O5}	—	—	0.3	V	I_O=30mA, RG1	
OFF leak current	I_L	—	0.1	3	μA	V_O=3V, RG1～RG5=OFF	
〈PLL block〉							
PLL lead-in time	T_{PL}	—	5	(100)	ms	Guaranteed design value	

●Digital AC characteristics

Parameter		Symbol	Min.	Typ.	Max.	Unit
〈Serial data interface / timing〉						
Data clock frequency	μ/A-LAW	f_{CLKU}	64	—	2048	kHz
	Linear	f_{CLKL}	128	—	2048	kHz
Frame sync signal frequency		f_{SYNC}	7.996	8.000	8.004	kHz
Communication sync signal timing		T_{SR}	100	—	—	ns
		T_{SS}	100	—	—	ns
		T_{SH}	100	—	—	ns
Digital input rise time		T_{IR}	—	—	20	ns
Digital input fall time		T_{IF}	—	—	20	ns
SDI setup time		T_{RS}	100	—	—	ns
SDI hold time		T_{RH}	100	—	—	ns
〈Register write timing〉						
SRCLK frequency		f_{CLK}	—	—	3	MHz
SRDATA input setup time		t_{suda}	100	—	—	ns
SRDATA input hold time		t_{htda}	100	—	—	ns
Input setup time (SRCLK high vs. STB high)		T_{sud}	333	—	—	ns
Input hold time (SRCLK high vs. STB low)		f_{htd}	1000	—	—	ns
STB strobe pulse width		f_{pwd}	667	—	—	ns

●Measurement circuit

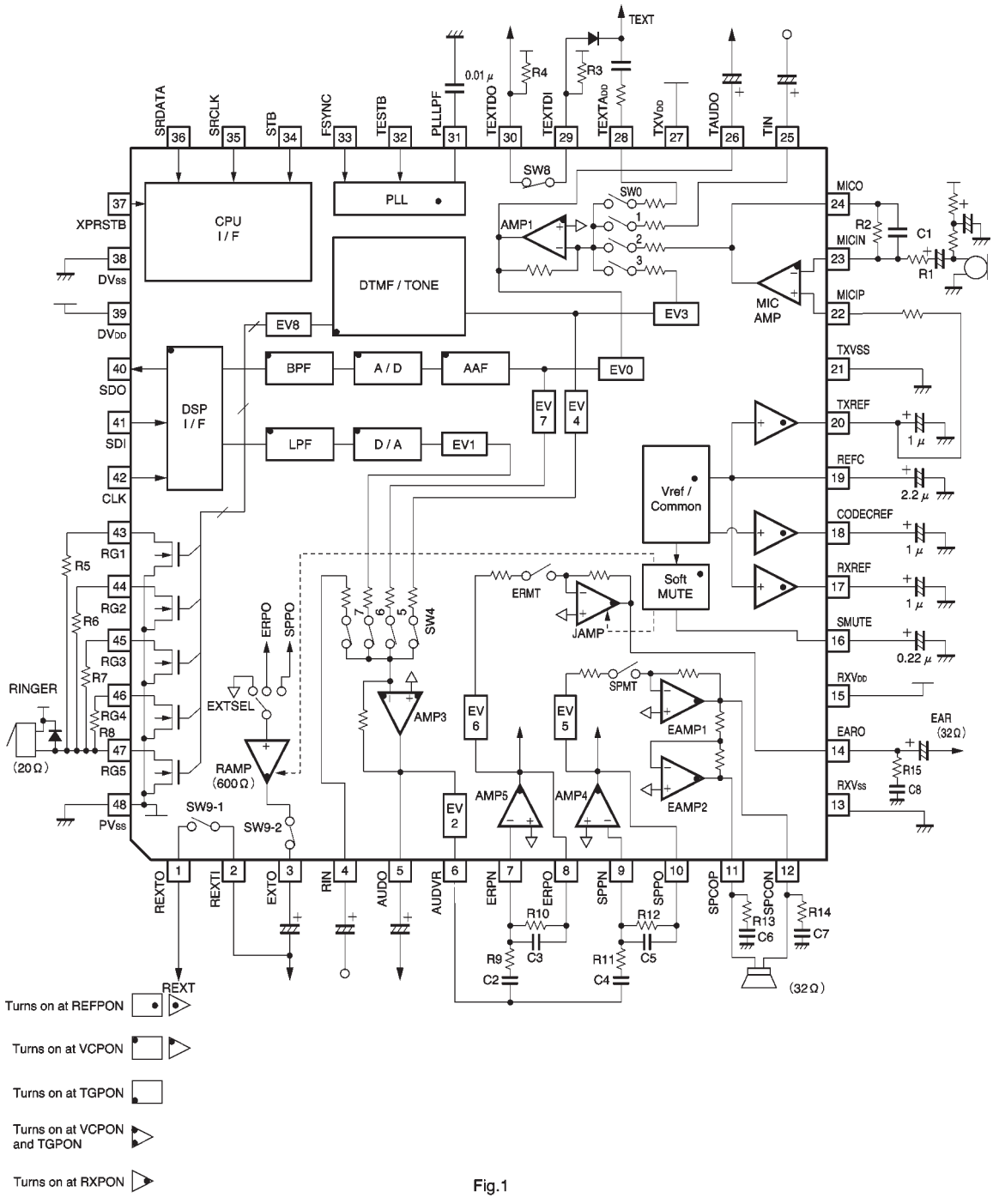
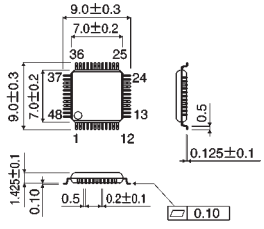


Fig.1

●External dimensions (Units: mm)



VQFP48