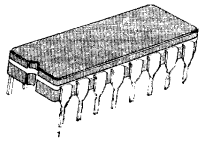
INTRODUCTION

The KT8554B/7B are single-chip PCM encoders and decoders (PCM CODECs) and PCM line filters. These devices provide all the functions required to interface a full-duplex voice telephone circuit with a time-division-multiplex (TDM) system.
These devices are designed to perform the transmit encoding and receive decoding as well as the transmit and receive filtering functions in PCM system. They are intended to be used at the analog termination of a PCM line or trunk.
These devices provide the bandpass filtering of the analog signals prior to encoding and after decoding. These combination devices perform the encoding and decoding of voice and call progress tones as well as the signalling and supervision information.

16-CERDIP



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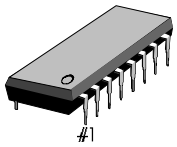


16-SOP-BD300
-SG

FEATURES

- Complete CODEC and filtering system
- Meets or exceeds AT&T D3/D4 and CCITT specifications
  μ-Law : KT8554B, A-Law : KT8557B
- On-chip auto zero, sample and hold, and precision voltage references
- Low power dissipation : 60mW (operating)
  3mW (standby)
- ± 5V operation
- TTL or CMOS compatible
- Automatic power down

ORDERING INFORMATION

Device	Package	Operating Temperature
KT8554BJ KT8557BJ	16-CERDIP	- 25 ~ 125°C
KT8557BN KT8554BN	16-DIP-300A	- 25 ~ 70°C
KT8554BD KT8557BD	16-SOP-BD300 -SG	- 25 ~ 70°C

PIN CONFIGURATION

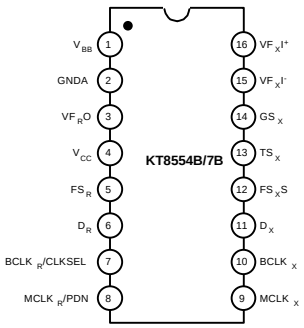


Fig. 1

PIN DESCRIPTION

Pin No	Symbol	Description
1	V_{BB}	V_{BB} = - 5V ±5%.
2	GNDA	Analog ground.
3	VF_RO	Analog output of the receive power Amp.
4	V_{CC}	V_{CC} = +5V ± 5%.
5	FS_R	Receive frame sync pulse. 8KHz pulse train.
6	D_R	PCM data input.
7	$BCLK_R$ / CLKSEL	Logic input which selects either 1.536MHz/1.544MHz or 2.048MHz for master clock in normal operation and $BCLK_X$ is used for both TX and RX directions. Alternately direct clock input available, very from 64KHz to 2.048MHz.
8	$MCLK_R$ / PDN	When $MCLK_R$ is connected continuously high, the device is powered down. Normally connected continusously low, $MCLK_X$ is selected for all DAC timing. Alternately direct 1.536MHz/1.544MHz or 2.048MHz clock input available.
9	$MCLK_X$	Must be1.536MHz/1.544MHz or 2.048MHz.
10	$BCLK_X$	May be vary from 64KHz to 2.048MHz but $BCLK_X$ is externally tied with $MCLK_X$ in normal operation.
11	D_X	PCM data output.
12	FS_X	TX frame sync pulse. 8KHz pulse train.
13	$\overline{TS_X}$	Changed from high to low during the encoder timeslot. Open drain output.
14	GS_X	Analog output of the TX input amplifier. Used to set gain through external resistor.
15	VF_XI^-	Inverting input stage of the TX analog signal.
16	VF_XI^+	Non-inverting input stage of the TX analog signal.

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

Characteristic	Symbol	Value	Unit
Positive Supply Voltage	V_{CC}	7	V
Negative Supply Voltage	V_{BB}	- 7	V
Voltage at Any Analog Input or Output	$V_{I\ (A)}$	V_{CC} + 0.3 to V_{BB} - 0.3	V
Voltage at Any Digital Input or Output	$V_{I\ (D)}$	V_{CC} + 0.3 to GNDA - 0.3	V
Operating Temperature Range	Ta	- 25 to + 125	°C
Storage Temperature Range	T_{STG}	- 65 to + 150	°C
Lead Temperature (Soldering, 10 secs)	T_{LEAD}	300	°C

ELECTRICAL CHARACTERISTICS

(Unless otherwise noted, V_{CC} = 5.0V ±5%, V_{BB} = - 5.0V ±5%, GNDA = 0V, Ta = 0 °C to 70 °C ; typical characteristics specified at V_{CC} = 5.0V, V_{BB} = - 5.0V, Ta = 25 °C ; all signals referenced to GNDA).

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Power Dissipation						
Power-Down Current	$I_{CC\ (DOWN)}$	No Load		0.5	1.5	mA
Power-Down Current	$I_{BB\ (DOWN)}$	No Load		0.05	0.3	mA
Active Current	$I_{CC\ (A)}$	No Load		6.0	9.0	mA
Active Current	$I_{BB\ (A)}$	No Load		6.0	9.0	mA
Digital Interface						
Input Low Voltage	V_{IL}				0.6	V
Input High Voltage	V_{IH}		2.2			V
Input Low Current	I_{IL}	GNDA ≤ V_{IN}≤V_{IL}, all digital inputs	-10		10	µA
Input High Current	I_{IH}	V_{IH} ≤ V_{IN} ≤ V_{CC}	-10		10	µA
Output Low Voltage	V_{OL}	D_X,I_L = 3.2mA SIG_R, I_L = 1.0mA $\overline{TS}_X$, I_L = 3.2mA,open drain			0.4 0.4 0.4	V V V
Output High Voltage	V_{OH}	D_X, I_H = -3.2mA SIG_R, I_H = -1.0 mA	2.4 2.4			V V
Output Current in High Impedance State (TRI-STATE)	$I_{O\ (HZ)}$	D_X, GNDA ≤ V_O ≤ V_{CC}	-10		10	µA
Analog Interface with Receive Filter						
Output Resistance	R_O	Pin VF_RO		1	3	Ω
Load Resistance	R_L	VF_RO = ±2.5V	600			Ω
Load Capacitance	C_L				500	pF
Output DC Offset Voltage	$V_{OO\ (RX)}$		-200		200	mV
Analog Interface with Transmit input Amplifier						
Input Leakage Current	I_{LKG}	-2.5V≤V≤+2.5V, VF_XI + or VF_XI -	-200		200	nA
Input Resistance	R_I	-2.5V≤V≤+2.5V, VF_XI + or VF_XI -	10			MΩ
Output Resistance	R_O	Closed loop, unity gain		1	3	Ω
Load Resistance	R_L	GS_X	10			KΩ
Load Capacitance	C_L	GS_X			50	pF
Output Dynamic Range	$V_{OD\ (TX)}$	GS_X, R_L≤10KW	±2.8			V
Voltage Gain	G_V	VF_XI + to GS_X	5,000			V/V
Unity Gain Bandwidth	BW		1	2		MHz
Offset Voltage	$V_{IO\ (TX)}$		-20		20	mV
Common-Mode Voltage	$V_{CM\ (TX)}$	CMRRXA > 60dB	-2.5		2.5	V
Common-Mode Rejection Ratio	CMRR	DC Test	60			dB
Power Supply Rejection Ratio	PSRR	DC Test	60			dB

TIMING CHARACTERISTICS

(Unless otherwise noted, V_{CC} = 5.0 ±5%, V_{BB} = -5.0V ±5%, GNDA = 0V, Ta = 0°C to 70°C; typical characteristics specified at V_{CC} = 5.0V, V_{BB} = -5.0V, Ta = 25°C; all signals referenced to GNDA.)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Frequency of Master Clocks	f_{MCK}	Depends on the device used and the $BCLK_R$/CLKSEL Pin. $MCLK_X$ and $MCLK_R$		1.536 1.544 2.048		MHz MHz MHz
Rise Time of Bit Clock	$t_{R\ (BCK)}$	t_{PB} = 488ns			50	ns
Fall Time of Bit Clock	$t_{F\ (BCK)}$	t_{PB} = 488ns			50	ns
Holding Time from Bit Clock Low to Frame Sync	$t_{H\ (LFS)}$	Long frame only	0			ns
Holding Time from Bit Clock High to Frame Sync	$t_{H\ (HFS)}$	Short frame only	0			ns
Set-Up Time from Frame Sync to Bit Clock Low	$t_{SU\ (FBCL)}$	Long frame only	80			ns
Delay Time from $BCLK_X$ High to Data Valid	$t_{D\ (HDV)}$	Load = 150pF plus 2 LSTTL loads	0		180	ns
Delay Time to $\overline{TS_X}$ Low	$t_{D\ (\overline{TSXL})}$	Load = 150pF plus 2 LSTTL loads			140	ns
Delay Time from $BCLK_X$ Low to Data Output Disabled	$t_{D\ (LDD)}$		50		165	ns
Delay Time to Valid Data from FS_X or $BCLK_X$, Whichever Comes Later	$t_{D\ (VD)}$	C_L = 0pF to 150pF	20		165	ns
Set-Up Time from D_R Valid to $BCLK_{R/X}$ Low	$t_{SU\ (DR\ BL)}$		50			ns
Hold Time from $BCLK_{R/X}$ Low to D_R Invalid	$t_{H\ (BL\ DR)}$		50			ns
Set-Up Time from $FS_{X/R}$ to $BCLK_{X/R}$ Low	$t_{SU\ (FBLS)}$	Short frame sync pulse (1 or 2 bit clock periods long) (Note1)	50			ns
Width of Master Clock High	$t_{W\ (MCKH)}$	$MCLK_X$ and $MCLK_R$	160			ns
Width of Master Clock Low	$t_{W\ (MCKL)}$	$MCLK_X$ and $MCLK_R$	160			ns
Rise Time of Master Clock	$t_{R\ (MCK)}$	$MCLK_X$ and $MCLK_R$			50	ns
Fall Time of Master Clock	$t_{F(\ MCK)}$	$MCLK_X$ and $MCLK_R$			50	ns
Set-Up Time from $BCLK_X$ High (and FS_X In Long Frame Sync Mode) to $MCLK_X$ Falling Edge	$t_{SU\ (BHMF)}$	First bit clock after the leading edge of FS_X				
Period of Bit Clock	t_{CK}		485	488	15,725	ns
Width of Bit Clock High	$t_{W\ (BCKH)}$	V_{IH} = 2.2V	160			ns
Width of Bit Clock Low	$t_{W\ (BCKL)}$	V_{IL} = 0.6V	160			ns

TIMING CHARACTERISTICS (Continued)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Hold Time from $BCLK_{X/R}$ Low to $FS_{X/R}$ Low	$t_{H\ (BLFL)}$	Short frame sync pulse (1 or 2 bit clock periods long) (Note 1)	100			ns
Hold Time from 3rd Period of Bit Clock Low to Frame Sync (FS_X or FS_R)	$t_{H\ (3rd)}$	Long frame sync pulse (from 3 to 8 bit clock periods long)	100			ns
Minimum Width of the Frame Sync Pulse (Low Level)	t_{WFL}	64K bit/s operating mode	160			ns

Note 1 : For short frame sync timing, FS_X and FS_R must go high while their respective bit clocks are high.

TIMING DIAGRAM

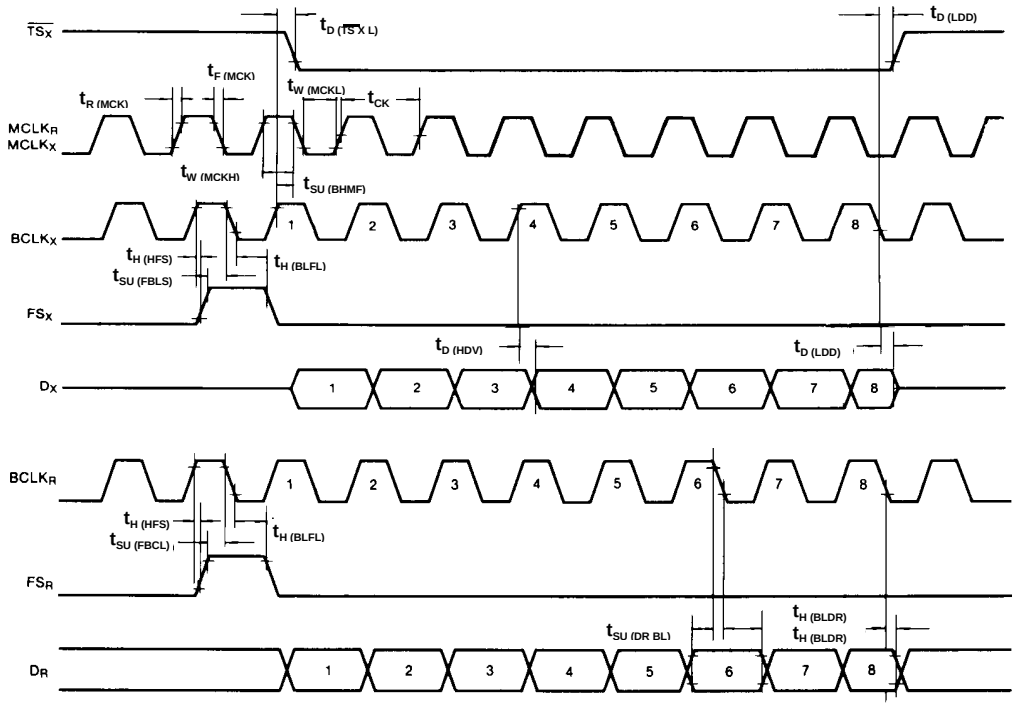


Fig. 2. Short Frame Sync Timing

TIMING DIAGRAM (Continued)

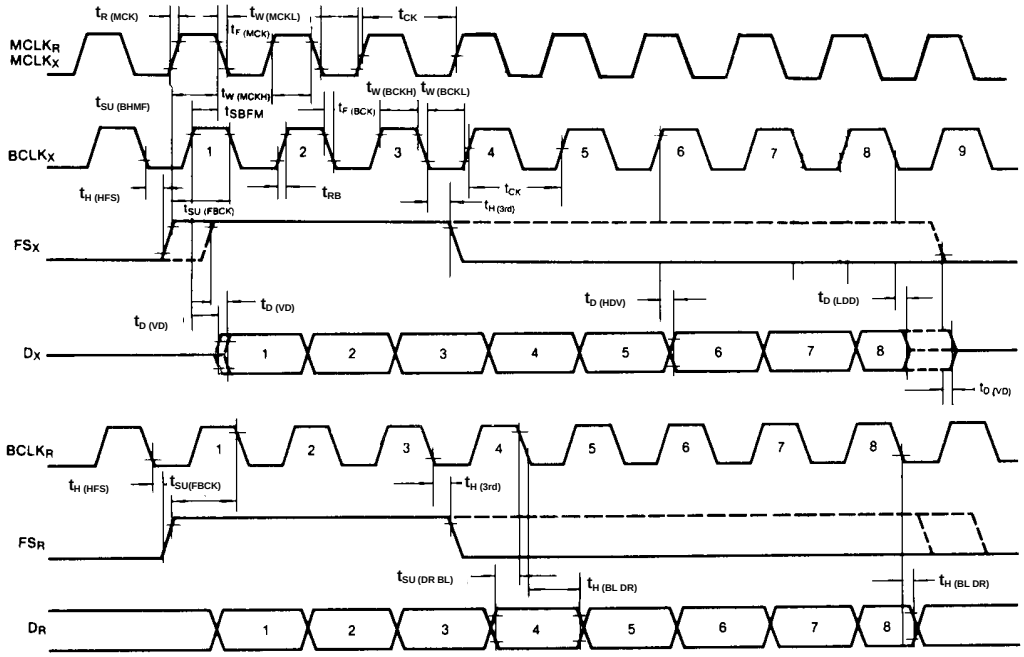


Fig. 3 Long Frame Sync Timing

TRANSMISSION CHARACTERISTICS

(Unless otherwise specified : Ta = 0°C to 70°C, V_{CC} = 5V ±5%, V_{BB} = -5V ±5%, GNDA = 0V, f = 1.02KHz, V_{IN} = 0dBm0, transmit input amplifier connected for unity-gain non-inverting.)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Amplitude Respons						
Receive Gain, Absolute	$G_{V\ (ARX)}$	Ta = 25°C, V_{CC} = 5V, V_{BB} = -5V Input = Digital code sequence for 0dBm0 signal at 1020Hz	-0.15		0.15	dB
Receive Gain, Relative to $G_{V\ (ARX)}$	$G_{V\ (RRX)}$	f = 0Hz to 3000Hz f = 3300Hz f = 3400Hz f = 4000Hz	-0.15 -0.35 -0.7		0.15 0.05 0 -14	dB dB dB dB
Absolute Receive Gain Variation with Temperature	$\Delta G_{V\ (ARX)}$ /ΔT	Ta = 0°C to 70°C			±0.1	dB
Absolute Receive Gain Variation with Supply Voltage	$\Delta G_{V\ (ARX)}$ /ΔV	V_{CC} = 5V ±5%, V_{BB} = -5V ±5%			±0.05	dB
Receive Gain Variations with Level	$\Delta G_{V\ (RXL)}$	Sinusoidal test method ; reference input PCM code corresponds to an Ideally encoded -10dBm0 signal PCM level = -40dBm0 to +3dBm0 PCM level = -50dBm0 to -40dBm0 PCM level = -55dBm0 to -50dBm0	 -0.2 -0.4 -1.2		 0.2 0.4 1.2	 dB dB dB
Receive Output Drive Level	$V_{O\ (RX)}$	R_L = 600Ω	-2.5		2.5	V
Absolute Levels	V_{AL}	Nominal 0dBm0 level is 4dBm (600Ω) 0dBm0		1.2276		V_{rms}
Max Overload Level	$V_{OL\ (MAX)}$	Max overload level (3.17dBm0): KT8554B Max overload level (3.14dBm0): KT8557B		2.501		V_{PK}
Transmit Gain, Absolute	$G_{V\ (ATX)}$	Ta = 25°C, V_{CC} = 5V, V_{BB} = -5V Input at GS_X = 0dBm0 at 1020Hz	-0.15		0.15	dB
Transmit Gain, Relative to $G_{V\ (ATX)}$	$G_{V\ (RTX)}$	f = 16Hz f = 50Hz f = 60Hz f = 200Hz f = 300Hz - 3000Hz f = 3300Hz f = 3400Hz f = 4000Hz f = 4600Hz and up, measure response from 0Hz to 4000Hz	 -1.8 -0.15 -0.35 -0.7		-40 -30 -26 -0.1 0.15 0.05 0 -14 -32	dB dB dB dB dB dB dB dB dB
Absolute Transmit Gain Variation with Temperature	$\Delta G_{V(ATX)}$ /ΔT	Ta = 0°C to 70°C			±0.1	dB
Absolute Transmit Gain Variation with Supply Voltage	$\Delta G_{V\ (ATX)}$ /ΔV	V_{CC} = 5V ±5%, V_{BB} = -5V ±5%			±0.05	dB
Transmit Gain Variations with Level	$\Delta G_{V\ (TXL)}$	Sinusoldal test method Reference level = - 10dBm0 VF_XI + = - 40dBm0 to + 3dBm0 VF_XI + = - 50dBm0 to - 40dBm0 VF_XI + = - 55dBm0 to - 50dBm0	 - 0.2 - 0.4 - 1.2		 0.2 0.4 1.2	 dB dB dB

TRANSMISSION CHARACTERISTICS (Continued)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Envelope Delay Distortion with Frequency						
Receive Delay, Absolute	$t_{D\ (ARX)}$	f = 1600Hz		180	200	µs
Receive Delay, Relative to $t_{D\ (ARX)}$	$t_{D\ (RRX)}$	f = 500Hz - 1000Hz	-40	-25		µs
		f = 1000Hz - 1600Hz	-30	-20		µs
		f = 1600Hz - 2600Hz		70	90	µs
		f = 2600Hz - 2800Hz		100	125	µs
		f = 2800Hz - 3000Hz		145	175	µs
Transmit Delay, Absolute	$t_{D\ (ATX)}$	f = 1600Hz		290	315	µs
Transmit Delay, Relative to $t_{D\ (ATX)}$	$t_{D\ (RTX)}$	f = 500Hz - 600Hz		195	220	µs
		f = 600Hz - 800Hz		120	145	µs
		f = 800Hz - 1000Hz		50	75	µs
		f = 1000Hz - 1600Hz		20	40	µs
		f = 1600Hz - 2600Hz		55	75	µs
		f = 2600Hz - 2800Hz		80	105	µs
		f = 2800Hz - 3000Hz		130	155	µs
Noise						
Receive Noise, C Message Weighted	N_{RXC}	PCM code equals alternating positive and negative zero, KT8554B		8	11	dBrnc0
Receive Noise, P Message Weighted	N_{RXP}	PCM code equals, positive zero, KT8557B		-82	-79	dBm0p
Transmit Noise, C Message Weighted	N_{TXC}	KT8554B		12	15	dBrnc0
Transmit Noise, P Message Weighted	N_{TXP}	KT8557B		74	-67	dBm0p
Noise, Single Frequency	N_{SF}	f = 0KHz to 100KHz, loop around measurement, $VF_XI+ = 0V_{rms}$			-53	dBm0
Positive Power Supply Rejection, Transmit	PSRR (PTX)	$VF_XI+ = 0V_{rms}$, $V_{CC} = 5.0V_{DC} + 100mV_{rms}$ f = 0KHz - 50KHz	40			dBC
Negative Power Supply Rejection, Transmit	PSRR (NTX)	$VF_XI+ = 0V_{rms}$, $V_{BB} = -5.0V_{DC} + 100mV_{rms}$ f = 0KHz - 50KHz	40			dBC
Positive Power Supply Rejection, Receive	PSRR (PRX)	PCM code equals positive zero $V_{CC} = 5.0V_{DC} + 100mV_{rms}$				
		f = 0Hz - 4000Hz	40			dBC
		f = 4KHz - 25KHz	40			dB
		f = 25KHz - 50KHz	36			dB
Negative Power Supply Rejection, Receive	PSRR (NRX)	PCM code equals positive zero $V_{BB} = 5.0V_{DC} + 100mV_{rms}$				
		f = 0Hz - 4000Hz	40			dBC
		f = 4KHz - 25KHz	40			dB
		f = 25KHz - 50KHz	36			dB

TRANSMISSION CHARACTERISTICS (Continued)

Characteristic	Symbol	Test Conditions	Min	typ	Max	Unit
Spurious Out-of-Band Signals at the Channel Output	SOS	Loop around measurement, 0dBm0, 300Hz - 3400Hz input PCM applied to D_R, Measure individual image signals at VF_RO 4600Hz - 760Hz 7600Hz - 8400Hz 8400Hz - 100,000Hz			 -32 -40 -32	 dB dB dB
Distortion						
Signal to Total Distortion Transmit or Receive Half-Channel	THD_{TX} THD_{RX}	Sinusoidal test method Level = 3.0dBm0 = 0dBm0 to 30dBm0 = -40dBm0 XMT RCV = -55dBm0 XMT RCV	 33 26 29 30 14 15			 dBC dBC dBC dBC dBC dBC
Single Frequency Distortion, Transmit	$THD_{SF\ (TX)}$				-46	dB
Single Frequency Distortion, Receive	$THD_{SF\ (RX)}$				-46	dB
Intermodulation Distortion	THD_{IMD}	Loop around measurement, VF_XI+ = -4dBm0 to -21dBm0, two frequencies in the range 300Hz - 3400Hz			-41	dB
Crosstalk						
Transmit to Receive Crosstalk, 0dBm0 Transmit Level	$CT_{(TX-RX)}$	f = 300Hz - 3400Hz D_R = Steady PCM code		-90	-75	dB
Receive to Transmit Crosstalk, 0dBm0 Receive Level	$CT_{(RX-TX)}$	f = 300Hz - 3400Hz, VF_XI = 0V		-90	-70 (Note1)	dB

Note 1. $CT_{(RX-TX)}$ is measured with a - 40dBm0 activating signal applied at VF_XI+

ENCODING FORMAT AT Dx OUTPUT

	m-Law KT8554B	A-Law KT8557B
V_{IN} (at GS_X) = + Full Scale	1 0 0 0 0 0 0 0	1 0 1 0 1 0 1 0
V_{IN} (at GS_X) = 0V	1 1 1 1 1 1 1 1 0 1 1 1 1 1 1 1	1 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1
V_{IN} (at GS_X) = - Full Scale	0 0 0 0 0 0 0 0	0 0 1 0 1 0 1 0

APPLICATION CIRCUIT

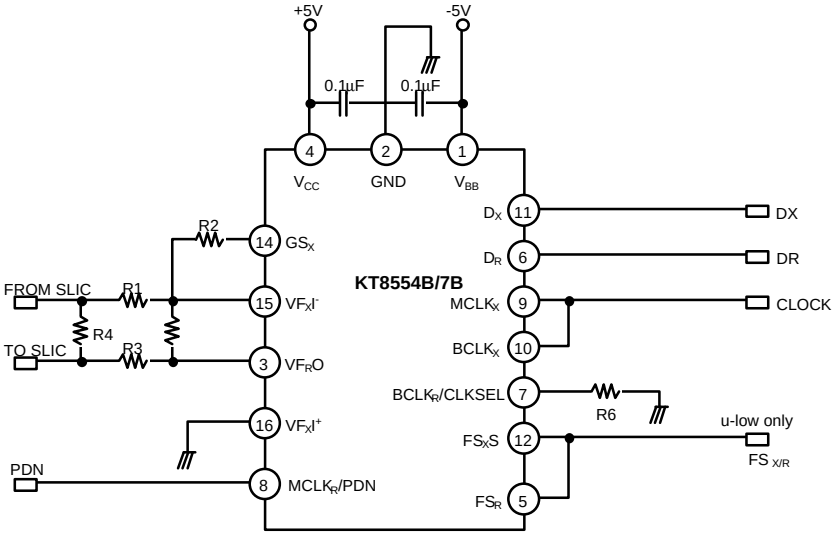


Fig. 4

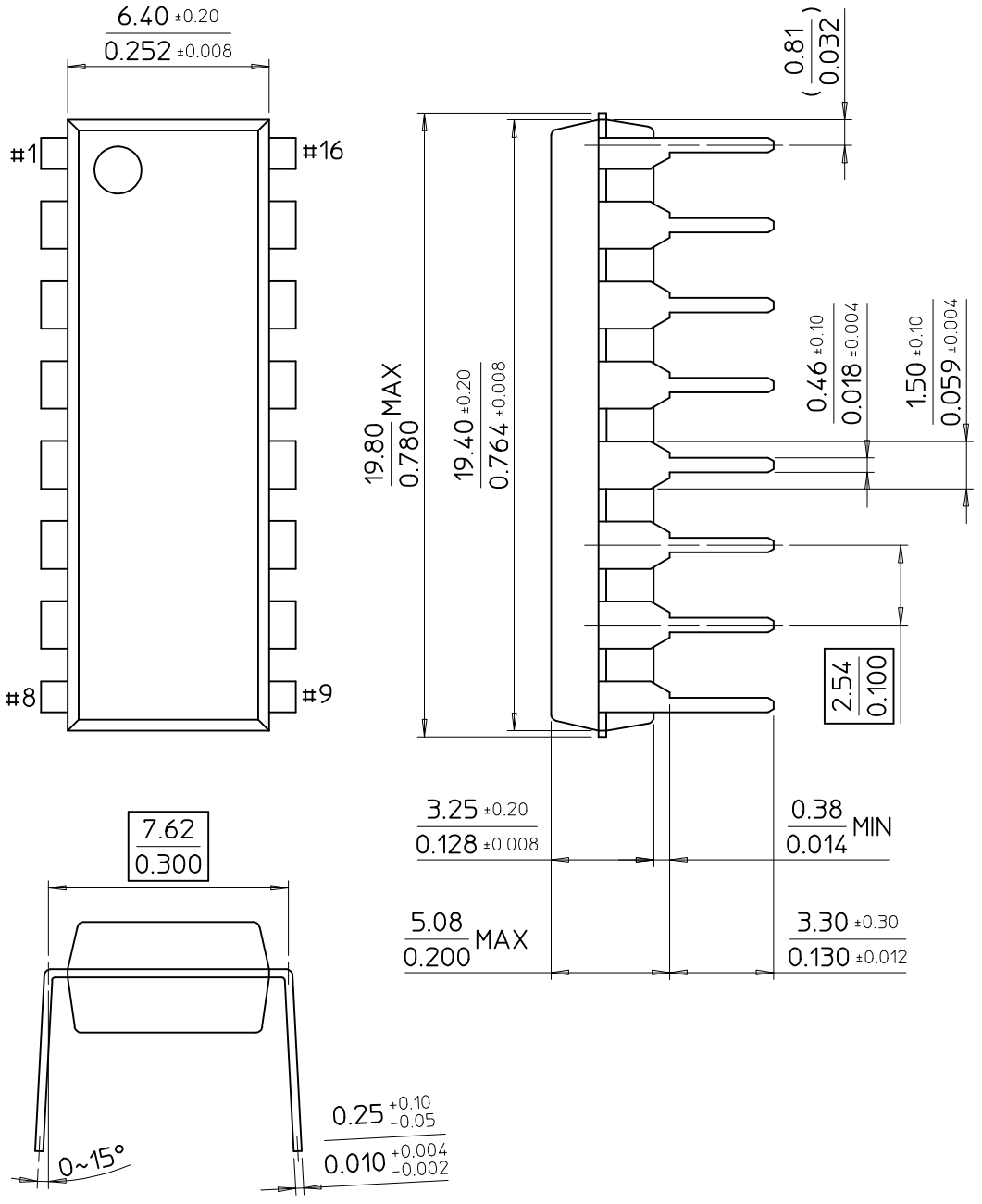
NOTE 1 : Supposing Desired Line Termination Impedance R_L = 600ohm
It is 0dBm = 0.77459Vrms
NOTE 2 : T_X Gain 20 log (R2/R1), R1 + R2 < 100Kohm, or The Correspondence of 1-CHIP CODEC 0dBm 0 = 4dBm.

SELECTION OF MASTER CLOCK FREQUENCY

BCLKR/CLKSEL	KT 8554	KT 8557
Clocked	1.536 / 1.544 MHz	2.048MHz
0	2.048 MHz	1.536 / 1.544 MHz
1 (or open)	1.536 / 1.544 MHz	2.048MHz

16-DIP-300A

Dimensions in Milimeters/inches



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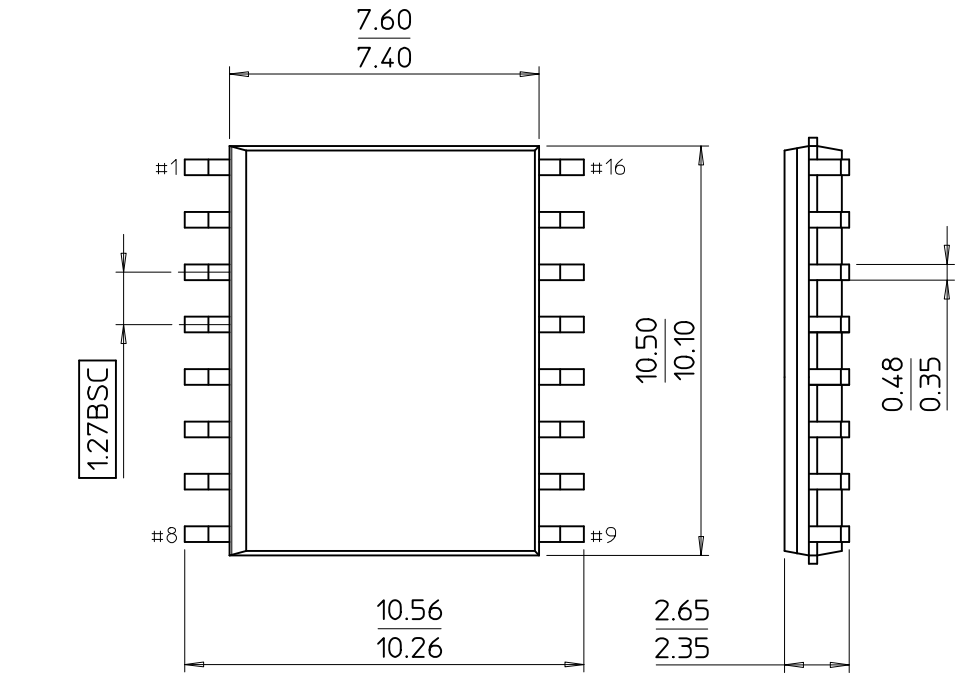
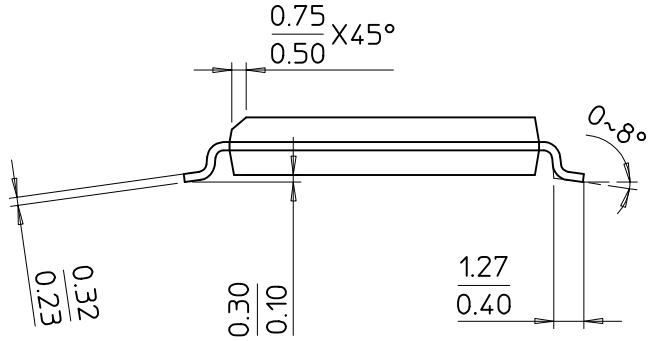
16-SOP-BD300-SG

Dimensions in Milimeters





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