

**Table 6: DC Parameters (Packaged Parts)**

Symbol	Parameters	Min <sup>(2)</sup>	Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Units	Conditions
R <sub>ANA IN</sub>	ANA IN Input Resistance	2.3	3	5	KΩ	
A <sub>PRE1</sub>	Preamp Gain 1	21	24	26	dB	AGC = 0.0 V
A <sub>PRE2</sub>	Preamp Gain 2		-15	5	dB	AGC = 2.5 V
A <sub>AUX</sub>	AUX IN/SP+ Gain		0.98	1.0	V/V	
A <sub>ARP</sub>	ANA IN to SP+/- Gain	21	23	26	dB	
R <sub>AGC</sub>	AGC Output Resistance	2.5	5	9.5	KΩ	

1. Typical values @  $T_A = 25^\circ\text{C}$  and 5.0 V.
2. All Min/Max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.
3.  $V_{CCA}$  and  $V_{CCD}$  connected together.
4. XCLK pin only.

**Table 7: AC Parameters (Packaged Parts)**

Symbol	Characteristic	Min <sup>(2)</sup>	Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Units	Conditions	
F <sub>S</sub>	Sampling Frequency	ISD2560	8.0		KHz	<sup>(7)</sup>	
		ISD2575	6.4		KHz	<sup>(7)</sup>	
		ISD2590	5.3		KHz	<sup>(7)</sup>	
		ISD25120	4.0		KHz	<sup>(7)</sup>	
F <sub>CF</sub>	Filter Pass Band	ISD2560	3.4		KHz	3 dB Roll-Off Point <sup>(3) (8)</sup>	
		ISD2575	2.7		KHz	3 dB Roll-Off Point <sup>(3) (8)</sup>	
		ISD2590	2.3		KHz	3 dB Roll-Off Point <sup>(3) (8)</sup>	
		ISD25120	1.7		KHz	3 dB Roll-Off Point <sup>(3) (8)</sup>	
T <sub>REC</sub>	Record Duration	ISD2560	58.1	60.0	62.0	sec	Commercial Operation <sup>(7)</sup>
		ISD2560	56.5	60.0	63.8	sec	Industrial Operation <sup>(7)</sup>
		ISD2575	72.6	75.0	77.5	sec	Commercial Operation <sup>(7)</sup>
		ISD2575	70.7	75.0	79.7	sec	Industrial Operation <sup>(7)</sup>
		ISD2590	87.1	90.0	93.0	sec	Commercial Operation <sup>(7)</sup>
		ISD25120	116.1	120.0	123.9	sec	Commercial Operation <sup>(7)</sup>
T <sub>PLAY</sub>	Playback Duration	ISD2560	58.1	60.0	62.0	sec	Commercial Operation
		ISD2560	56.5	60.0	63.8	sec	Industrial Operation
		ISD2575	72.6	75.0	77.5	sec	Commercial Operation
		ISD2575	70.7	75.0	79.7	sec	Industrial Operation
		ISD2590	87.1	90.0	93.0	sec	Commercial Operation
		ISD25120	116.1	120.0	123.9	sec	Commercial Operation
T <sub>CE</sub>	CE Pulse Width		100		nsec		
T <sub>SET</sub>	Control/Address Setup Time		300		nsec		
T <sub>HOLD</sub>	Control/Address Hold Time		0		nsec		

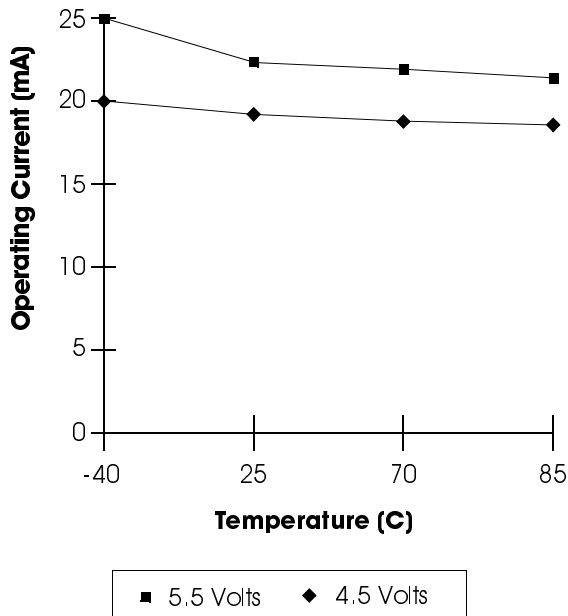
**Table 7: AC Parameters (Packaged Parts)**

Symbol	Characteristic	Min <sup>(2)</sup>	Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Units	Conditions	
T <sub>PUD</sub>	Power-Up Delay	ISD2560	24.1	25.0	27.8	msec	Commercial Operation
		ISD2560	23.5		28.5	msec	Industrial Operation
		ISD2575	30.2	31.3	34.3	msec	Commercial Operation
		ISD2575	29.3	31.3	35.2	msec	Industrial Operation
		ISD2590	36.2	37.5	40.8	msec	Commercial Operation
		ISD25120	48.2	50.0	53.6	msec	Commercial Operation
T <sub>PDR</sub>	PD Pulse Width Record	ISD2560		25		msec	
		ISD2575		31.25		msec	
		ISD2590		37.5		msec	
		ISD25120		50.0		msec	
T <sub>PDP</sub>	PD Pulse Width Play	ISD2560		12.5		msec	
		ISD2575		15.625		msec	
		ISD2590		18.75		msec	
		ISD25120		25.0		msec	
T <sub>PDS</sub>	PD Pulse Width Static		100		nsec	(6)	
T <sub>PDH</sub>	Power Down Hold		0		nsec		
T <sub>EOM</sub>	EOM Pulse Width	ISD2560		12.5		msec	
		ISD2575		15.625		msec	
		ISD2590		18.75		msec	
		ISD25120		25.0		msec	
T <sub>OVF</sub>	Overflow Pulse Width		6.5		μsec		
THD	Total Harmonic Distortion		1	2	%	@ 1 KHz	
P <sub>OUT</sub>	Speaker Output Power		12.2	50	mW	R <sub>EXT</sub> = 16 Ω <sup>(4)</sup>	
V <sub>OUT</sub>	Voltage Across Speaker Pins			2.5	V p-p	R <sub>EXT</sub> = 600 Ω	
V <sub>IN1</sub>	MIC Input Voltage			20	mV	Peak-to-Peak <sup>(5)</sup>	
V <sub>IN2</sub>	ANA IN Input Voltage			50	mV	Peak-to-Peak	
V <sub>IN3</sub>	Aux Input Voltage			1.25	V	Peak-to-Peak; R <sub>EXT</sub> = 16 Ω	

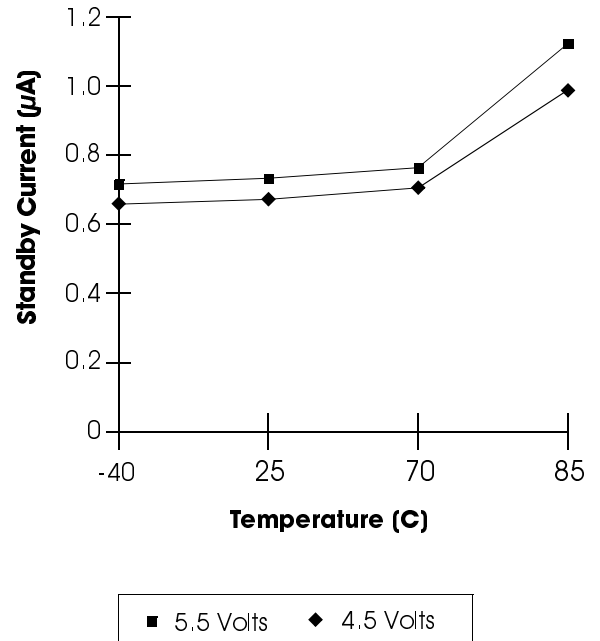
1. Typical values @ T<sub>A</sub> = 25°C and 5.0 V.
2. All Min/Max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.
3. Low-frequency cutoff depends upon the value of external capacitors (see Pin Descriptions).
4. From AUX IN; if ANA IN is driven at 50 mV p-p, the P<sub>OUT</sub> = 12.2 mW, typical.
5. With 5.1 KΩ series resistor at ANA IN.
6. T<sub>PDS</sub> is required during a static condition, typically overflow.
7. Sampling Frequency and playback Duration can vary as much as ±2.25 percent over the commercial temperature range and voltage range and ±5 percent over the industrial temperature and voltage range. For greater stability, an external clock can be utilized (see Pin Descriptions).
8. Filter specification applies to both the antialiasing filter and the smoothing filter. Therefore, from input to output, expect a 6 dB drop by nature of passing through both filters.

**TYPICAL PARAMETER VARIATION WITH VOLTAGE AND TEMPERATURE (PACKAGED PARTS)**

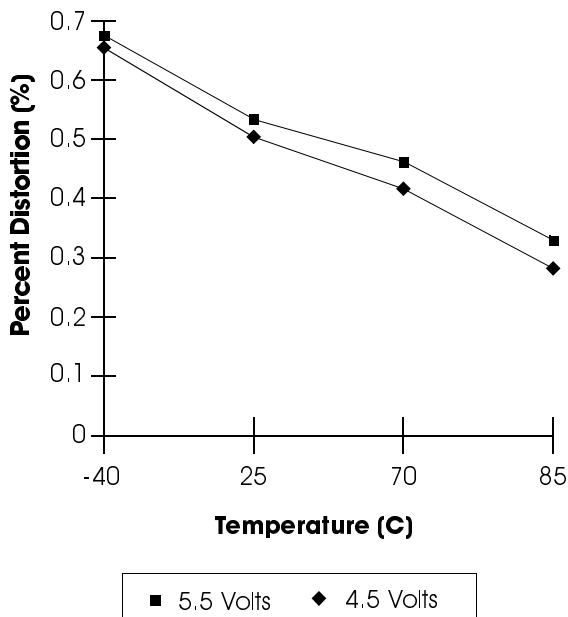
**Chart 1: Record Mode Operating Current ( $I_{CC}$ )**



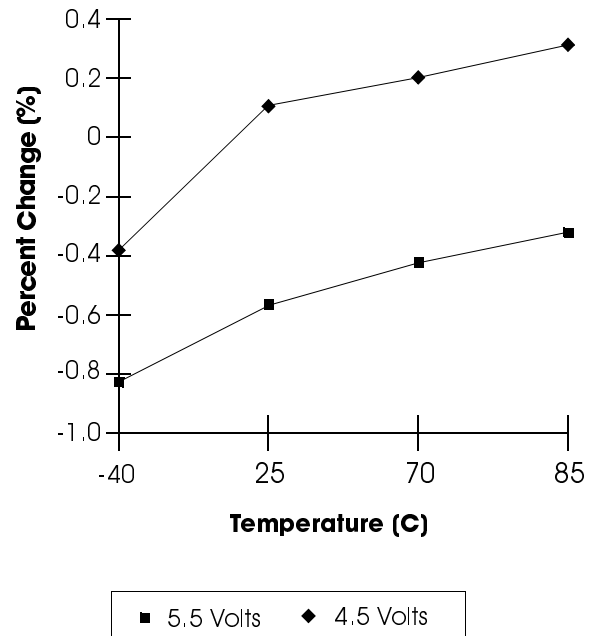
**Chart 3: Standby Current ( $I_{SB}$ )**



**Chart 2: Total Harmonic Distortion**



**Chart 4: Oscillator Stability**



**Table 8: Absolute Maximum Ratings (Die)<sup>(1)</sup>**

Condition	Value
Junction temperature	150°C
Storage temperature range	-65°C to +150°C
Voltage applied to any pad	(V <sub>SS</sub> - 0.3 V) to (V <sub>CC</sub> + 0.3 V)
Voltage applied to any pad (Input current limited to ±20 mA)	(V <sub>SS</sub> - 1.0 V) to (V <sub>CC</sub> + 1.0 V)
V <sub>CC</sub> - V <sub>SS</sub>	-0.3 V to +7.0 V

1. Stresses above those listed may cause permanent damage to the device. Exposure to the absolute maximum ratings may affect device reliability. Functional operation is not implied at these conditions.

**Table 9: Operating Conditions (Die)**

Condition	Value
Commercial operating temperature range	0°C to +50°C
Supply voltage (V <sub>CC</sub> ) <sup>(1)</sup>	+4.5 V to +6.5 V
Ground voltage (V <sub>SS</sub> ) <sup>(2)</sup>	0 V

1. V<sub>CC</sub> = V<sub>CCA</sub> = V<sub>CCD</sub>.

2. V<sub>SS</sub> = V<sub>SSA</sub> = V<sub>SSD</sub>.

**Table 10: DC Parameters (Die)**

Symbol	Parameters	Min <sup>(2)</sup>	Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Units	Conditions
V <sub>IL</sub>	Input Low Voltage			0.8	V	
V <sub>IH</sub>	Input High Voltage	2.0			V	
V <sub>OL</sub>	Output Low Voltage			0.4	V	I <sub>OL</sub> = 4.0 mA
V <sub>OH</sub>	Output High Voltage	V <sub>CC</sub> - 0.4			V	I <sub>OH</sub> = -10 μA
V <sub>OH1</sub>	OVF Output High Voltage	2.4			V	I <sub>OH</sub> = -1.6 mA
V <sub>OH2</sub>	EOM Output High Voltage	V <sub>CC</sub> - 1.0	V <sub>CC</sub> - 0.8		V	I <sub>OH</sub> = -3.2 mA
I <sub>CC</sub>	V <sub>CC</sub> Current (Operating)		25	30	mA	R <sub>EXT</sub> = ∞ <sup>(3)</sup>
I <sub>SB</sub>	V <sub>CC</sub> Current (Standby)		1	10	μA	<sup>(2)</sup>
I <sub>IL</sub>	Input Leakage Current			±1	μA	
I <sub>ILPD</sub>	Input Current HIGH with Pull Down			130	μA	Force V <sub>CC</sub> <sup>(4)</sup>
R <sub>EXT</sub>	Output Load Impedance	16			Ω	Speaker Load
R <sub>MIC</sub>	Preamp In Input Resistance	4	9	15	KΩ	MIC and MIC REF Pads
R <sub>AUX</sub>	AUX Input Resistance	5	11	20	KΩ	
R <sub>ANA IN</sub>	ANA IN Input Resistance	2.3	3	5	KΩ	
A <sub>PRE1</sub>	Preamp Gain 1	21	24	26	dB	AGC = 0.0 V

Table 10: DC Parameters (Die)

Symbol	Parameters	Min <sup>(2)</sup>	Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Units	Conditions
A <sub>PRE2</sub>	Preamplifier Gain 2		-15	5	dB	AGC = 2.5 V
A <sub>AUX</sub>	AUX IN/SP+ Gain		0.98	1.0	V/V	
A <sub>ARP</sub>	ANA IN to SP+/- Gain	21	23	26	dB	
R <sub>AGC</sub>	AGC Output Resistance	2.5	5	9.5	K $\Omega$	

1. Typical values @  $T_A = 25^\circ\text{C}$  and 5.0 V.
2. All Min/Max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.
3.  $V_{CCA}$  and  $V_{CCD}$  connected together.
4. XCLK pad only.

Table 11: AC Parameters (Die)

Symbol	Characteristic	Min <sup>(2)</sup>	Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Units	Conditions	
F <sub>S</sub>	Sampling Frequency	ISD2560	8.0		KHz	(7)	
		ISD2575	6.4		KHz	(7)	
		ISD2590	5.3		KHz	(7)	
		ISD25120	4.0		KHz	(7)	
F <sub>CF</sub>	Filter Pass Band	ISD2560	3.4		KHz	3 dB Roll-Off Point (3) (8)	
		ISD2575	2.7		KHz	3 dB Roll-Off Point (3) (8)	
		ISD2590	2.3		KHz	3 dB Roll-Off Point (3) (8)	
		ISD25120	1.7		KHz	3 dB Roll-Off Point (3) (8)	
T <sub>REC</sub>	Record Duration	ISD2560	58.1	60.0	62.0	sec	Commercial Operation <sup>(7)</sup>
		ISD2575	72.6	75.0	77.5	sec	Commercial Operation <sup>(7)</sup>
		ISD2590	87.1	90.0	93.0	sec	Commercial Operation <sup>(7)</sup>
		ISD25120	116.1	120.0	123.9	sec	Commercial Operation <sup>(7)</sup>
T <sub>PLAY</sub>	Playback Duration	ISD2560	58.1	60.0	62.0	sec	Commercial Operation <sup>(7)</sup>
		ISD2575	72.6	75.0	77.5	sec	Commercial Operation <sup>(7)</sup>
		ISD2590	87.1	90.0	93.0	sec	Commercial Operation <sup>(7)</sup>
		ISD25120	116.1	120.0	123.9	sec	Commercial Operation <sup>(7)</sup>
T <sub>CE</sub>	$\overline{\text{CE}}$ Pulse Width		100		nsec		
T <sub>SET</sub>	Control/Address Setup Time		300		nsec		
T <sub>HOLD</sub>	Control/Address Hold Time		0		nsec		
T <sub>PUD</sub>	Power-Up Delay	ISD2560	24.1	25.0	27.8	msec	Commercial Operation
		ISD2575	30.2	31.3	34.3	msec	Commercial Operation
		ISD2590	36.2	37.5	40.8	msec	Commercial Operation
		ISD25120	48.2	50.0	53.6	msec	Commercial Operation

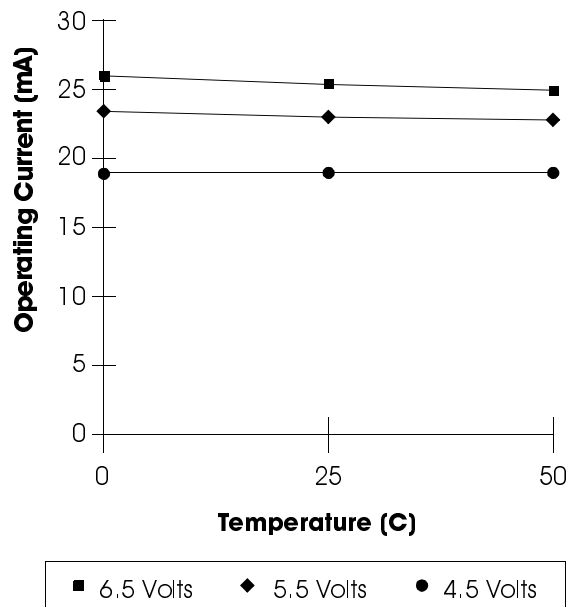
**Table 11: AC Parameters (Die)**

Symbol	Characteristic	Min <sup>(2)</sup>	Typ <sup>(1)</sup>	Max <sup>(2)</sup>	Units	Conditions
T <sub>PDR</sub>	PD Pulse Width	ISD2560	25		msec	
	Record	ISD2575	31.25		msec	
		ISD2590	37.5		msec	
		ISD25120	50.0		msec	
T <sub>PDP</sub>	PD Pulse Width Play	ISD2560	12.5		msec	
		ISD2575	15.625		msec	
		ISD2590	18.75		msec	
		ISD25120	25.0		msec	
T <sub>PDS</sub>	PD Pulse Width Static		100		nsec	<sup>(6)</sup>
T <sub>PDH</sub>	Power Down Hold		0		nsec	
T <sub>EOM</sub>	EOM Pulse Width	ISD2560	12.5		msec	
		ISD2575	15.625		msec	
		ISD2590	18.75		msec	
		ISD25120	25.0		msec	
T <sub>OVF</sub>	Overflow Pulse Width		6.5		μsec	
THD	Total Harmonic Distortion		1	3	%	@ 1 KHz
P <sub>OUT</sub>	Speaker Output Power		12.2	50	mW	R <sub>EXT</sub> = 16 Ω <sup>(4)</sup>
V <sub>OUT</sub>	Voltage Across Speaker Pins			2.5	V p-p	R <sub>EXT</sub> = 600 Ω
V <sub>IN1</sub>	MIC Input Voltage			20	mV	Peak-to-Peak <sup>(5)</sup>
V <sub>IN2</sub>	ANA IN Input Voltage			50	mV	Peak-to-Peak
V <sub>IN3</sub>	Aux Input Voltage			1.25	V	Peak-to-Peak; R <sub>EXT</sub> = 16 Ω

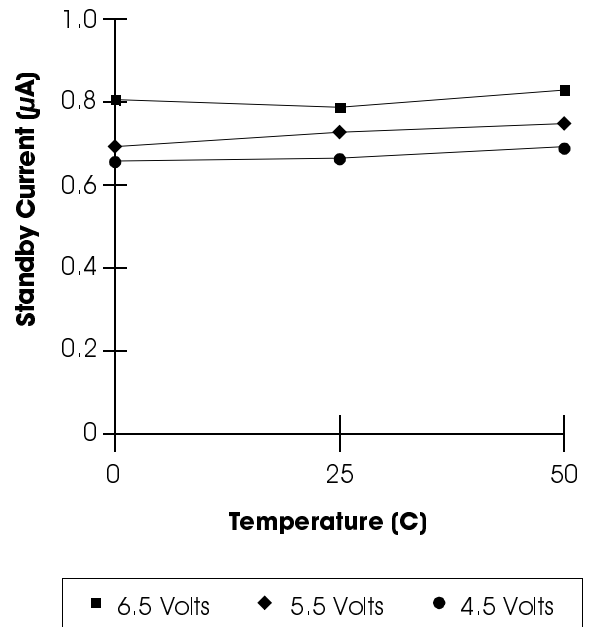
1. Typical values @ T<sub>A</sub> = 25°C and 5.0 V.
2. All Min/Max limits are guaranteed by ISD via electrical testing or characterization. Not all specifications are 100 percent tested.
3. Low-frequency cutoff depends upon the value of external capacitors (see Pin Descriptions).
4. From AUX IN; if ANA IN is driven at 50 mV p-p, the P<sub>OUT</sub> = 12.2 mW, typical.
5. With 5.1 kΩ series resistor at ANA IN.
6. T<sub>PDS</sub> is required during a static condition, typically overflow.
7. Sampling Frequency and playback Duration can vary as much as ±2.25 percent over the commercial temperature range and voltage range. For greater stability, an external clock can be utilized (see Pin Descriptions).
8. Filter specification applies to the antialiasing filter and the smoothing filter.

**TYPICAL PARAMETER VARIATION WITH VOLTAGE AND TEMPERATURE (DIE)**

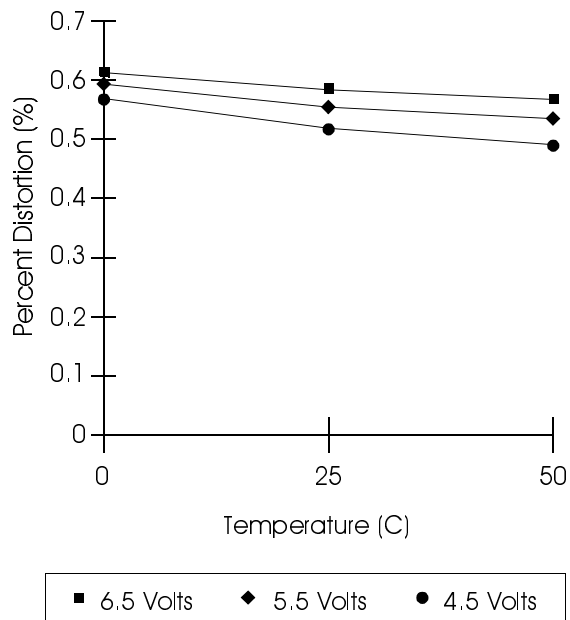
**Chart 5: Record Mode Operating Current ( $I_{CC}$ )**



**Chart 7: Standby Current ( $I_{SB}$ )**



**Chart 6: Total Harmonic Distortion**



**Chart 8: Oscillator Stability**

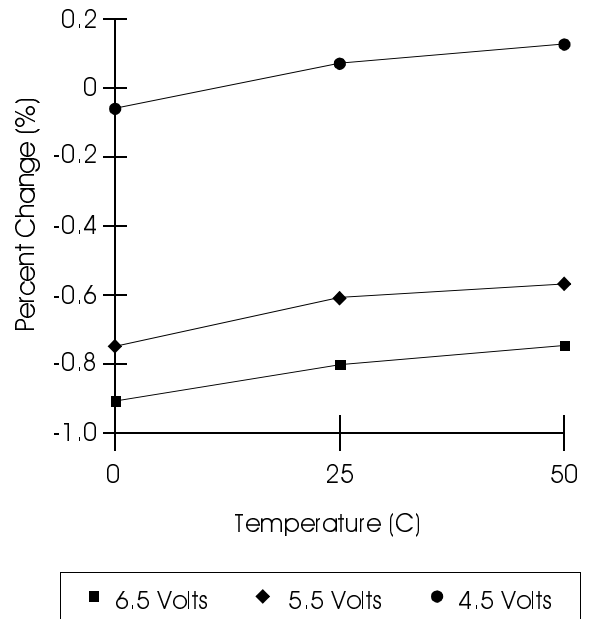
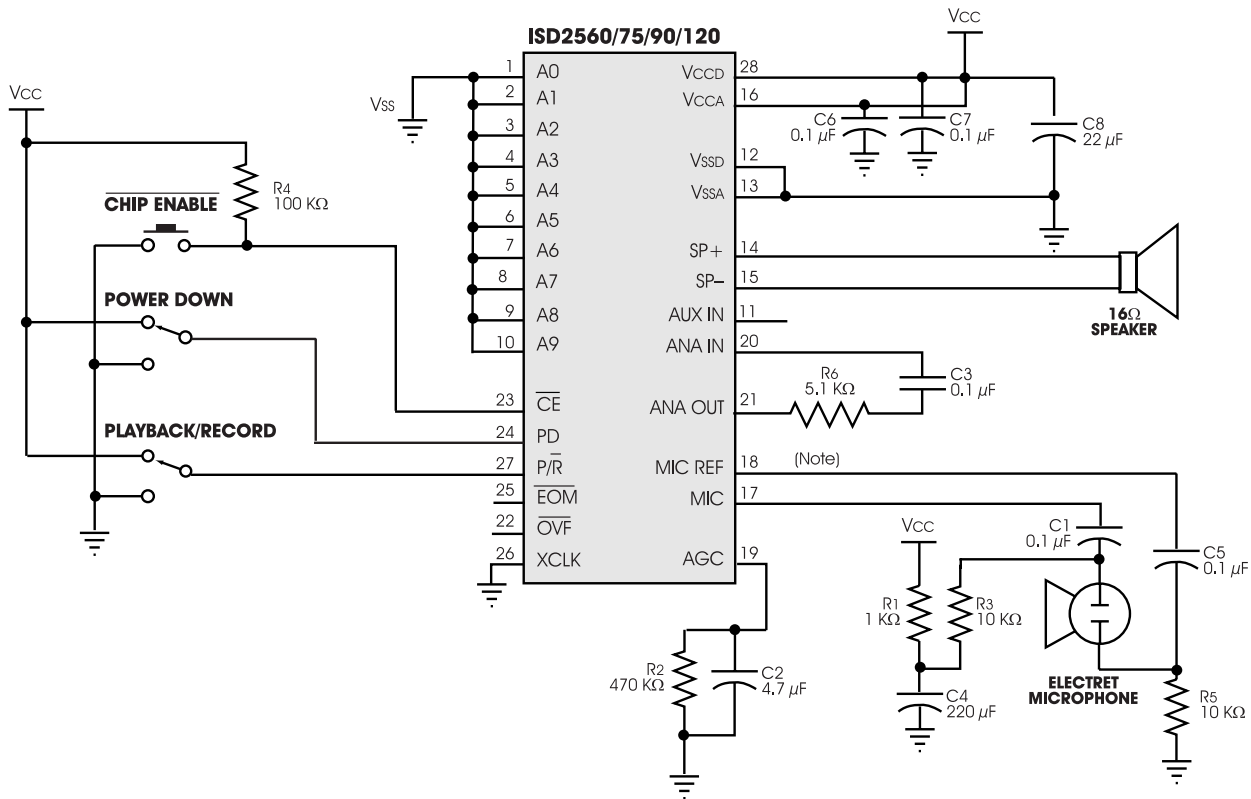


Figure 4: ISD2560/75/90/120 Application Example—Design Schematic



**NOTE:** If desired, pin 18 (PDIP package) may be left unconnected (microphone preamplifier noise will be higher). In this case, pin 18 must not be tied to any other signal or voltage. Additional design example schematics are provided in the Application Notes in this book.

Table 12: Application Example—Basic Device Control

Control Step	Function	Action
1	Power up chip and select record/playback mode	(1.) PD = LOW, (2.) P/R = As desired
2	Set message address for record/playback	Set addresses A0–A9
3A	Begin playback	P/R = HIGH, CE = Pulsed LOW
3B	Begin record	P/R = LOW, CE = LOW
4A	End playback	Automatic
4B	End record	PD or CE = HIGH



**Table 13: Application Example—Passive Component Functions**

Part	Function	Comments
R1	Microphone power supply decoupling	Reduces power supply noise
R2	Release time constant	Sets release time for AGC
R3, R5	Microphone biasing resistors	Provides biasing for microphone operation
R4	Series limiting resistor	Reduces level to prevent distortion at higher supply voltages.
R6	Series limiting resistor	Reduces level to high supply voltages
C1, C5	Microphone DC-blocking capacitor Low-frequency cutoff	Decouples microphone bias from chip. Provides single-pole low-frequency cutoff and common mode noise rejection.
C2	Attack/Release time constant	Sets attack/release time for AGC
C3	Low-frequency cutoff capacitor	Provides additional pole for low-frequency cutoff
C4	Microphone power supply decoupling	Reduces power supply noise
C6, C7, C8	Power supply capacitors	Filter and bypass of power supply

## EXPLANATION

In this simplified block diagram of a microcontroller application, the Push-Button mode and message cueing are used. The microcontroller is a 16-pin version with enough port pins for buttons, an LED, and the ISD2500 series device. The software can be written to use three buttons: one each for play and record, and one for message selection. Because the microcontroller is interpreting the buttons and commanding the ISD2500 device, software can be written for any functions desired in a particular application.

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**NOTE** *ISD does not recommend connecting address lines directly to a microprocessor bus. Address lines should be externally latched.*

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Figure 5: ISD2560/75/90/120 Application Example—Microcontroller/ISD2500 Interface

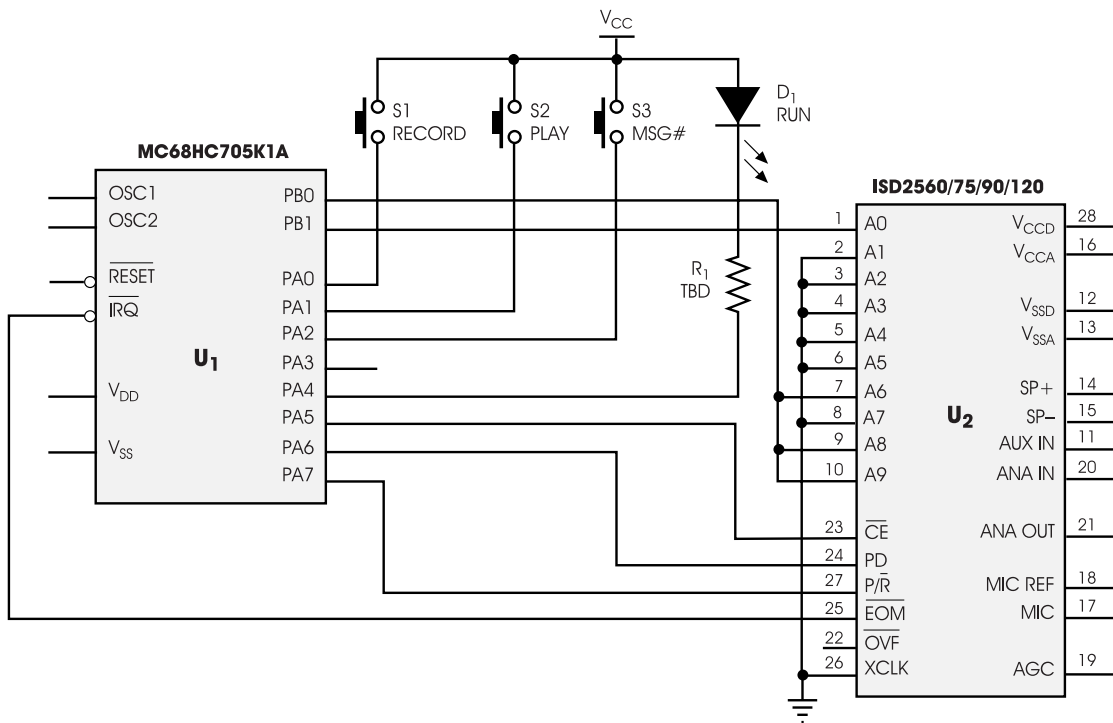
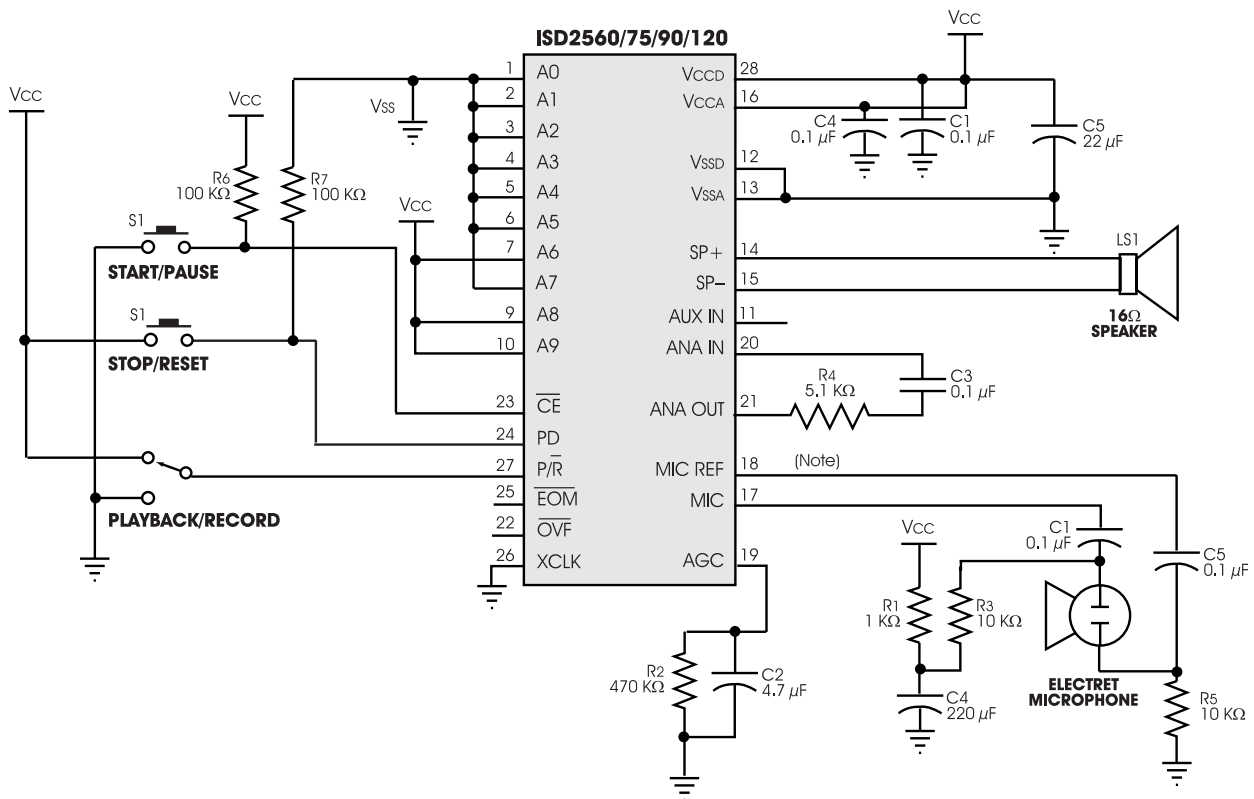


Figure 6: ISD2500 Application Example—Push-Button



**NOTE:** Please refer to Application Information.