Table 6: DC Parameters (Packaged Parts)

Symbol	Parameters	Min(2)	Typ (1)	Max(2)	Units	Conditions
$R_{ANA\ IN}$	ANA IN Input Resistance	2.3	3	5	KΩ	
A_{PRE1}	Preamp Gain 1	21	24	26	dB	AGC = 0.0 V
A_{PRE2}	Preamp Gain 2		–15	5	dB	AGC = 2.5 V
A_{AUX}	AUX IN/SP+ Gain		0.98	1.0	V/V	
A_{ARP}	ANA IN to SP+/– Gain	21	23	26	dB	
R_{AGC}	AGC Output Resistance	2.5	5	9.5	KΩ	

1. *Typical values @ T_A = 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. *V_{CCA} and V_{CCD} connected together.*
4. *XCLK pin only.*

Table 7: AC Parameters (Packaged Parts)

Symbol	Characteristic		Min(2)	Typ (1)	Max(2)	Units	Conditions
F_S	Sampling Frequency	ISD2560		8.0		KHz	(7)
		ISD2575		6.4		KHz	(7)
		ISD2590		5.3		KHz	(7)
		ISD25120		4.0		KHz	(7)
F_{CF}	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_{REC}	Record Duration	ISD2560	58.1	60.0	62.0	sec	Commercial Operation(7)
		ISD2560	56.5	60.0	63.8	sec	Industrial Operation(7)
		ISD2575	72.6	75.0	77.5	sec	Commercial Operation(7)
		ISD2575	70.7	75.0	79.7	sec	Industrial Operation(7)
		ISD2590	87.1	90.0	93.0	sec	Commercial Operation(7)
		ISD25120	116.1	120.0	123.9	sec	Commercial Operation(7)
T_{PLAY}	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_{CE}	$\overline{CE}$ Pulse Width			100		nsec	
T_{SET}	Control/Address Setup Time			300		nsec	
T_{HOLD}	Control/Address Hold Time			0		nsec	

Table 7: AC Parameters (Packaged Parts)

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

1. *Typical values @ T_A = 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_{OUT} = 12.2 mW, typical.*
5. *With 5.1 KΩ series resistor at ANA IN.*
6. *T_{PDS} 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})

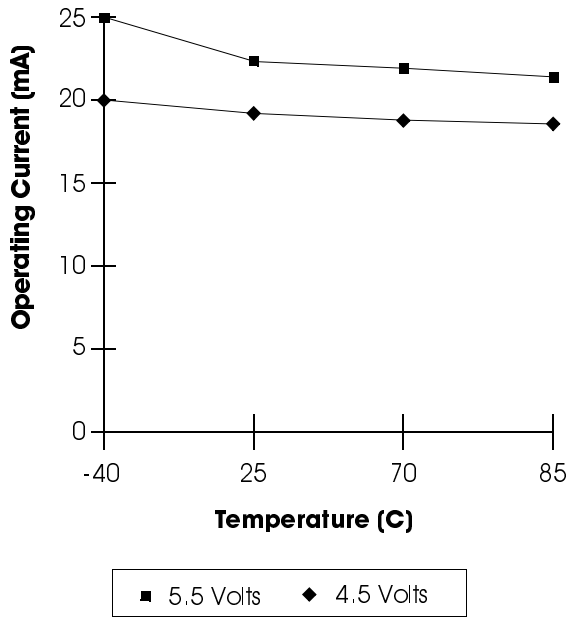


Chart 2: Total Harmonic Distortion

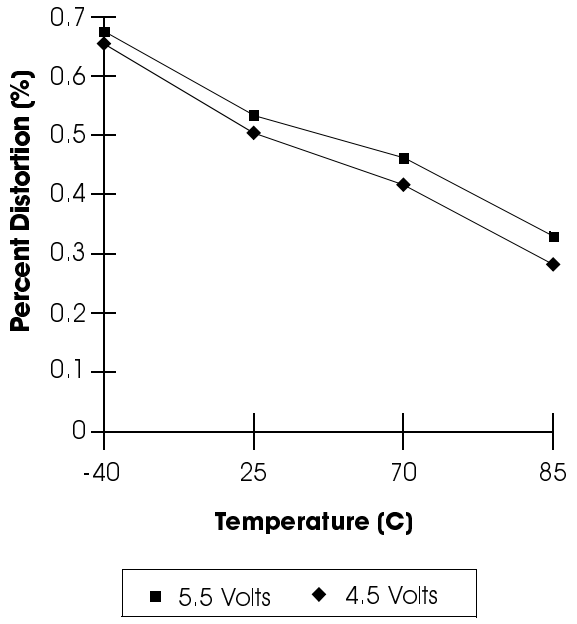


Chart 3: Standby Current (I_{SB})

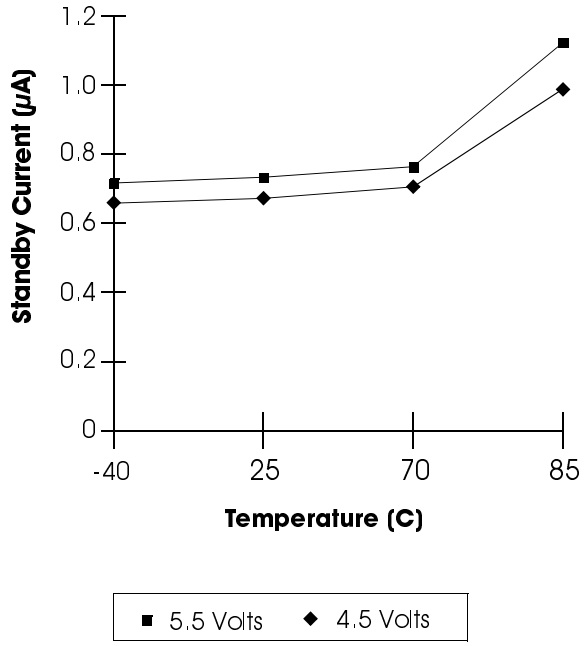


Chart 4: Oscillator Stability

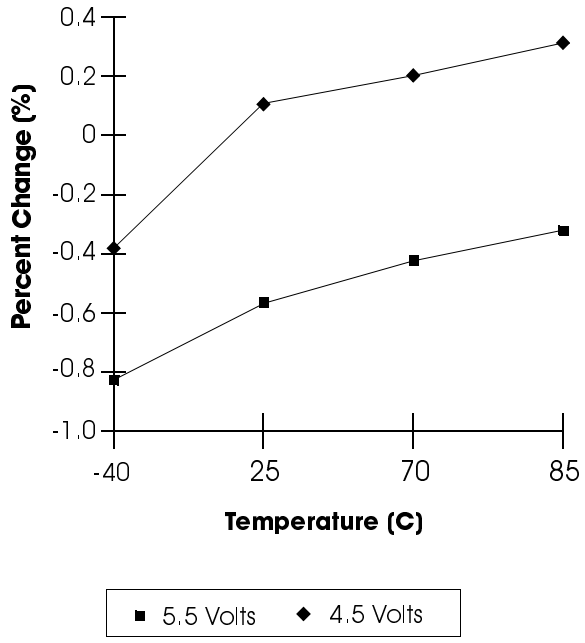


Table 8: Absolute Maximum Ratings (Die)[1]

Condition	Value
Junction temperature	150°C
Storage temperature range	–65°C to +150°C
Voltage applied to any pad	(V_{SS} – 0.3 V) to (V_{CC} + 0.3 V)
Voltage applied to any pad (Input current limited to ±20 mA)	(V_{SS} –1.0 V) to (V_{CC} + 1.0 V)
V_{CC} – V_{SS}	–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_{CC})[1]	+4.5 V to +6.5 V
Ground voltage (V_{SS})[2]	0 V

1. $V_{CC} = V_{CCA} = V_{CCD}$.
2. $V_{SS} = V_{SSA} = V_{SSD}$.

Table 10: DC Parameters (Die)

Symbol	Parameters	Min[2]	Typ [1]	Max[2]	Units	Conditions
V_{IL}	Input Low Voltage			0.8	V	
V_{IH}	Input High Voltage	2.0			V	
V_{OL}	Output Low Voltage			0.4	V	I_{OL} = 4.0 mA
V_{OH}	Output High Voltage	V_{CC} – 0.4			V	I_{OH} = –10 µA
V_{OH1}	$\overline{OVF}$ Output High Voltage	2.4			V	I_{OH} = –1.6 mA
V_{OH2}	$\overline{EOM}$ Output High Voltage	V_{CC} – 1.0	V_{CC} – 0.8		V	I_{OH} = –3.2 mA
I_{CC}	V_{CC} Current (Operating)		25	30	mA	$R_{EXT} = \infty$ [3]
I_{SB}	V_{CC} Current (Standby)		1	10	µA	[2]
I_{IL}	Input Leakage Current			±1	µA	
I_{ILPD}	Input Current HIGH with Pull Down			130	µA	Force V_{CC} [4]
R_{EXT}	Output Load Impedance	16			Ω	Speaker Load
R_{MIC}	Preamp In Input Resistance	4	9	15	KΩ	MIC and MIC REF Pads
R_{AUX}	AUX INput Resistance	5	11	20	KΩ	
$R_{ANA\ IN}$	ANA IN Input Resistance	2.3	3	5	KΩ	
A_{PRE1}	Preamp Gain 1	21	24	26	dB	AGC = 0.0 V

Table 10: DC Parameters (Die)

Symbol	Parameters	Min(2)	Typ (1)	Max(2)	Units	Conditions
A_{PRE2}	Preamp Gain 2		–15	5	dB	AGC = 2.5 V
A_{AUX}	AUX IN/SP+ Gain		0.98	1.0	V/V	
A_{ARP}	ANA IN to SP+/- Gain	21	23	26	dB	
R_{AGC}	AGC Output Resistance	2.5	5	9.5	KΩ	

1. *Typical values @ T_A = 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. *V_{CCA} and V_{CCD} connected together.*
4. *XCLK pad only.*

Table 11: AC Parameters (Die)

Symbol	Characteristic		Min(2)	Typ (1)	Max(2)	Units	Conditions
F_S	Sampling Frequency	ISD2560		8.0		KHz	(7)
		ISD2575		6.4		KHz	(7)
		ISD2590		5.3		KHz	(7)
		ISD25120		4.0		KHz	(7)
F_{CF}	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_{REC}	Record Duration	ISD2560	58.1	60.0	62.0	sec	Commercial Operation(7)
		ISD2575	72.6	75.0	77.5	sec	Commercial Operation(7)
		ISD2590	87.1	90.0	93.0	sec	Commercial Operation(7)
		ISD25120	116.1	120.0	123.9	sec	Commercial Operation(7)
T_{PLAY}	Playback Duration	ISD2560	58.1	60.0	62.0	sec	Commercial Operation(7)
		ISD2575	72.6	75.0	77.5	sec	Commercial Operation(7)
		ISD2590	87.1	90.0	93.0	sec	Commercial Operation(7)
		ISD25120	116.1	120.0	123.9	sec	Commercial Operation(7)
T_{CE}	$\overline{CE}$ Pulse Width			100		nsec	
T_{SET}	Control/Address Setup Time			300		nsec	
T_{HOLD}	Control/Address Hold Time			0		nsec	
T_{PUD}	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(2)	Typ (1)	Max(2)	Units	Conditions
T_{PDR}	PD Pulse Width Record	ISD2560		25		msec	
		ISD2575		31.25		msec	
		ISD2590		37.5		msec	
		ISD25120		50.0		msec	
T_{PDP}	PD Pulse Width Play	ISD2560		12.5		msec	
		ISD2575		15.625		msec	
		ISD2590		18.75		msec	
		ISD25120		25.0		msec	
T_{PDS}	PD Pulse Width Static			100		nsec	(6)
T_{PDH}	Power Down Hold			0		nsec	
T_{EOM}	$\overline{EOM}$ Pulse Width	ISD2560		12.5		msec	
		ISD2575		15.625		msec	
		ISD2590		18.75		msec	
		ISD25120		25.0		msec	
T_{OVF}	Overflow Pulse Width			6.5		µsec	
THD	Total Harmonic Distortion			1	3	%	@ 1 KHz
P_{OUT}	Speaker Output Power			12.2	50	mW	R_{EXT} = 16 Ω(4)
V_{OUT}	Voltage Across Speaker Pins				2.5	V p–p	R_{EXT} = 600 Ω
V_{IN1}	MIC Input Voltage				20	mV	Peak-to-Peak (5)
V_{IN2}	ANA IN Input Voltage				50	mV	Peak-to-Peak
V_{IN3}	Aux Input Voltage				1.25	V	Peak-to-Peak; R_{EXT} = 16 Ω

1. *Typical values @ T_A = 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_{OUT} = 12.2 mW, typical.*
5. *With 5.1 KΩ series resistor at ANA IN.*
6. *T_{PDS} 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})

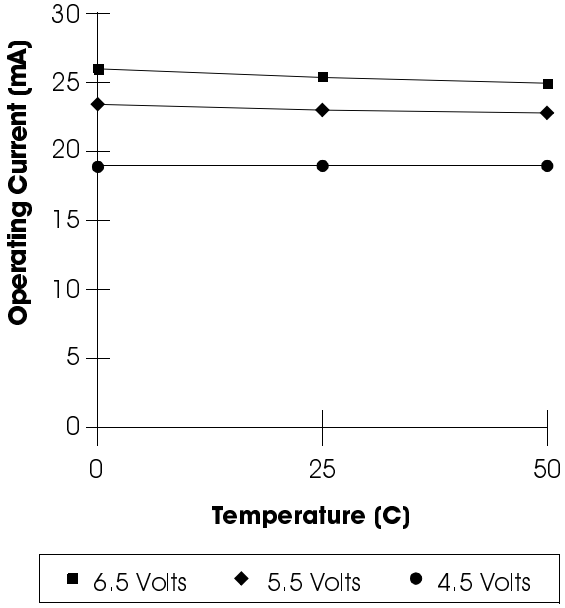


Chart 7: Standby Current (I_{SB})

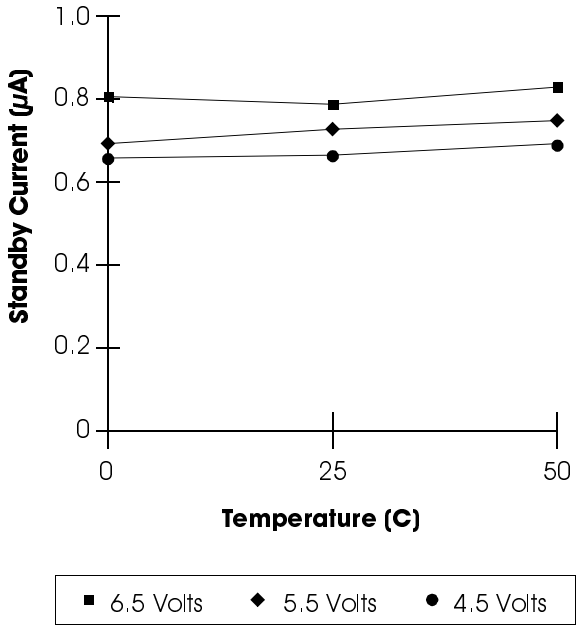


Chart 6: Total Harmonic Distortion

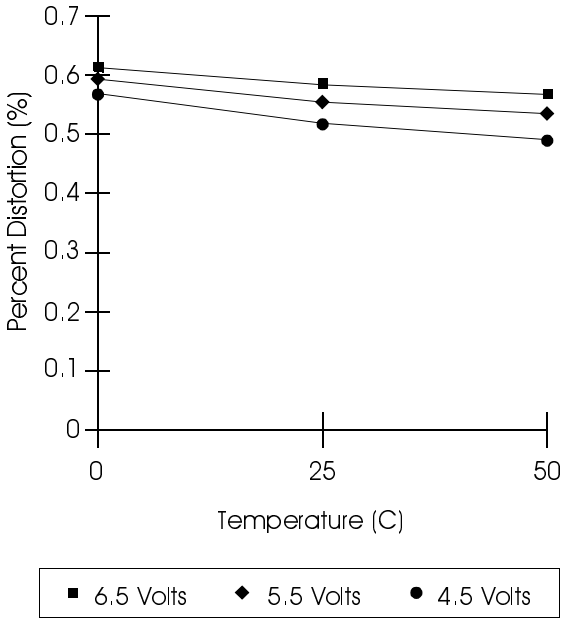


Chart 8: Oscillator Stability

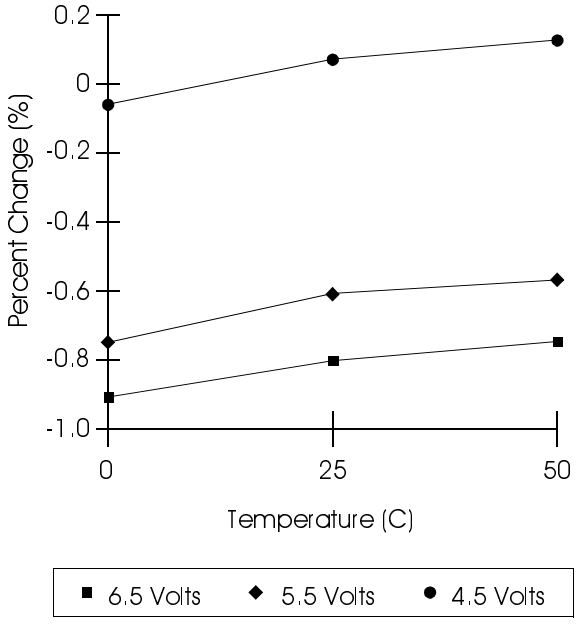
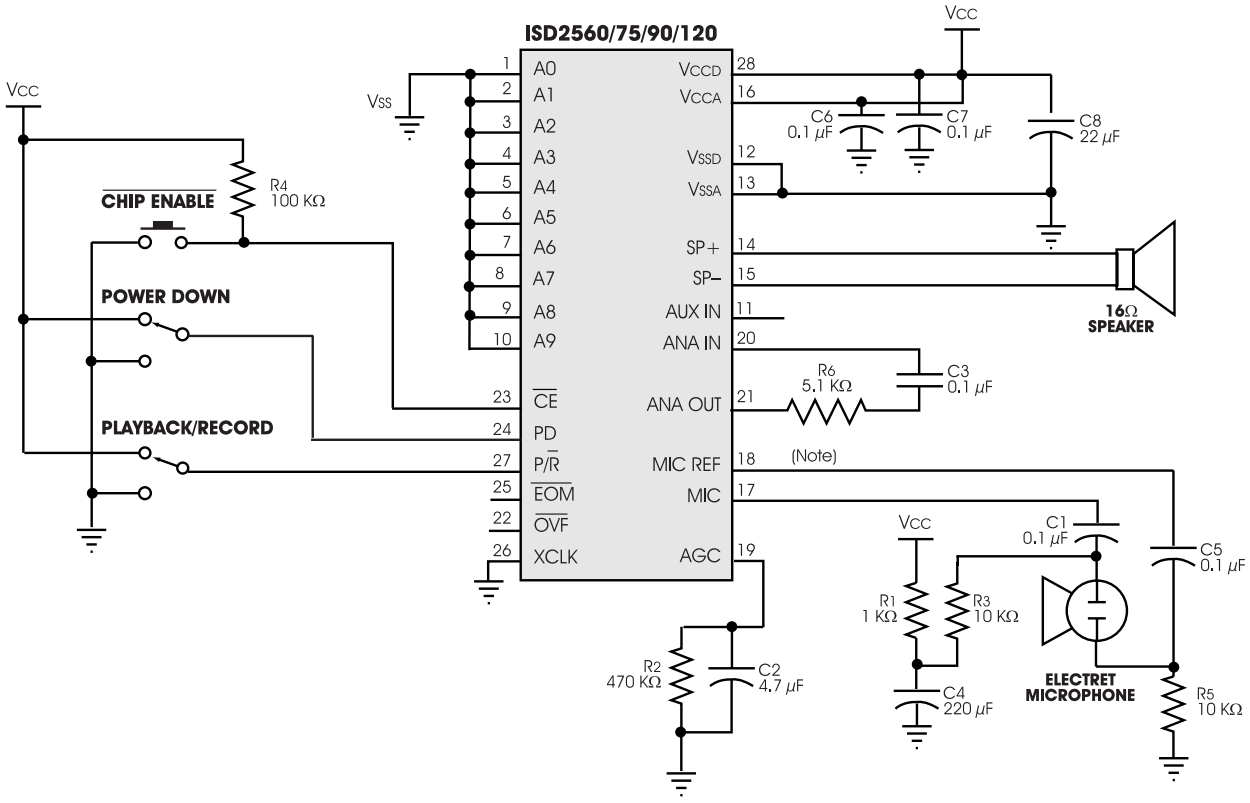


Figure 4: ISD2560/75/90/120 Application Example—Design Schematic



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/$\overline{R}$ = As desired
2	Set message address for record/playback	Set addresses A0–A9
3A	Begin playback	P/$\overline{R}$ = HIGH, $\overline{CE}$ = Pulsed LOW
3B	Begin record	P/$\overline{R}$ = LOW, $\overline{CE}$ = LOW
4A 4B	End playback End record	Automatic PD or $\overline{CE}$ = 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.

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

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

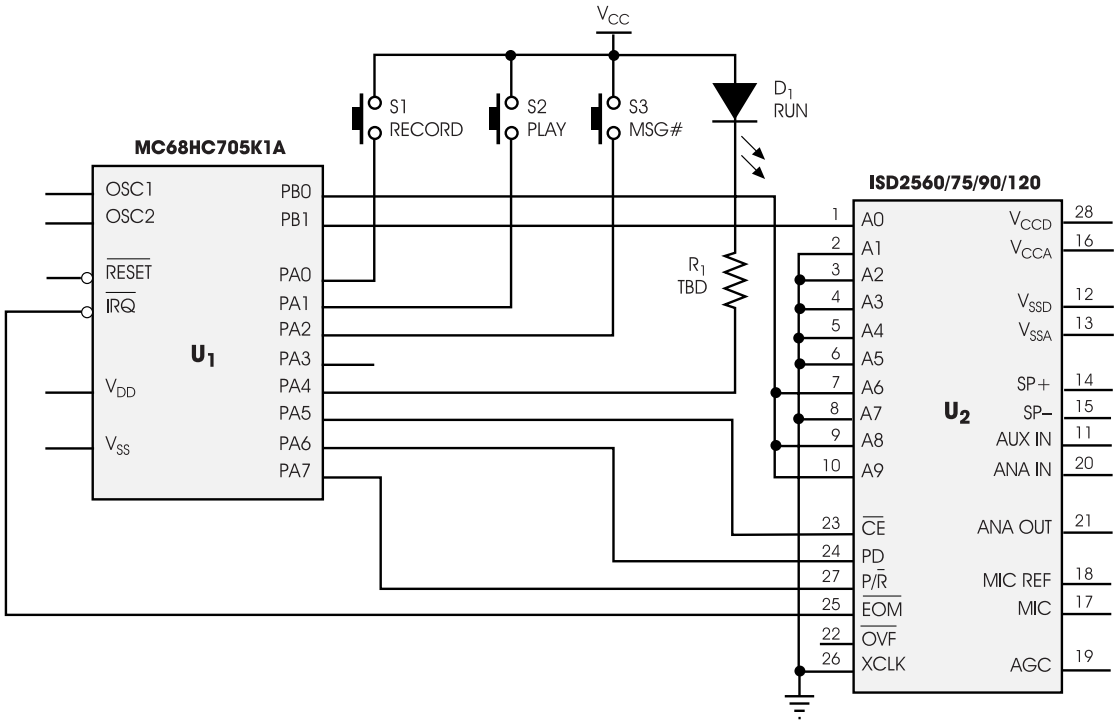
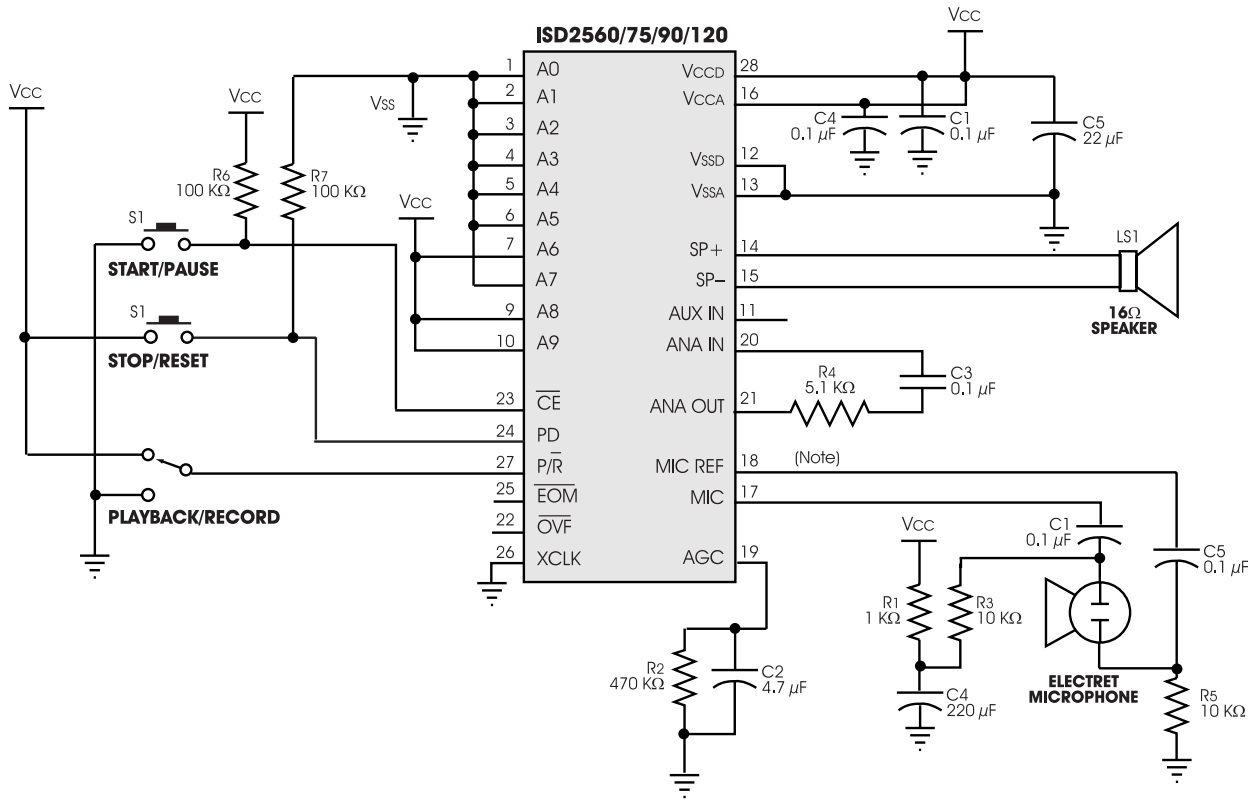


Figure 6: ISD2500 Application Example—Push-Button



NOTE: *Please refer to Application Information.*