ISD1200 SERIES

SINGLE-CHIP,

VOICE RECORD/PLAYBACK DEVICES

10- AND 12-SECOND DURATION

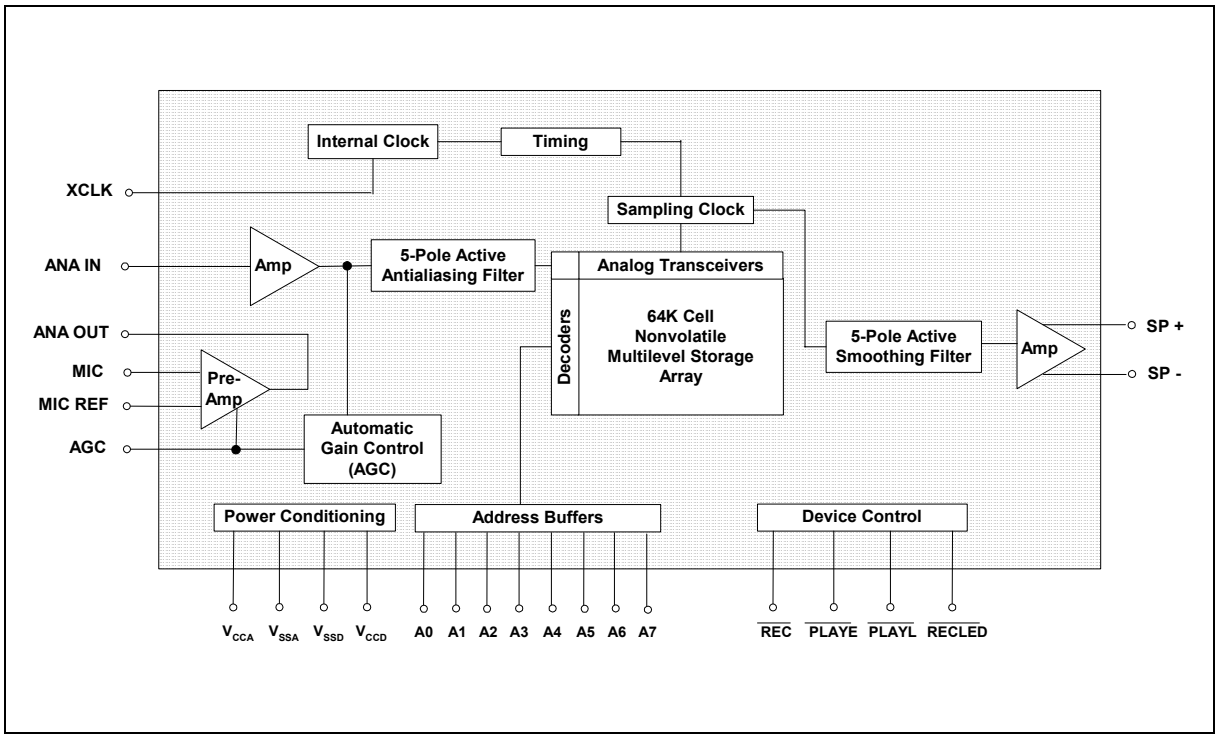
1. GENERAL DESCRIPTION

Winbond's ChipCorder® ISD1200 series provide high-quality, single-chip, Record/Playback solutions to 10- and 12-second messaging applications. The CMOS devices include an on-chip oscillator, microphone preamplifier, automatic gain control, antialiasing filter, smoothing filter, and speaker amplifier. A minimum Record/Playback subsystem can be configured with a microphone, a speaker, several passive components, two push buttons, and a power source. Recordings are stored into on-chip nonvolatile memory cells, providing zero-power message storage. This unique, single-chip solution is made possible through Winbond's patented Multi-Level Storage (MLS) technology. Voice and audio signals are stored directly into memory in their natural form, providing high-quality, solid-state voice reproduction.

2. FEATURES

- Single +5 volt power supply
- Single-chip with 10 and 12 seconds duration
- Easy-to-use single-chip, voice record/playback solution
- Push-button interface
    - Playback can be edge- or level activated
- Fully addressable to handle multiple messages
- Automatic power-down mode
    - Enters standby automatically following a record or playback cycle
    - Standby current 0.5 µA (typical)
- Zero-power message storage
    - Eliminates battery backup circuits
- High-quality, natural voice/audio reproduction
- On-chip oscillator
- No programmer or development system needed
- 100,000 record cycles (typical)
- 100-year message retention (typical)
- Available in die, PDIP, and SOIC
- Temperature: Commercial - Packaged unit : 0°C to 70°C, Die : 0°C to 50°C

3. BLOCK DIAGRAM



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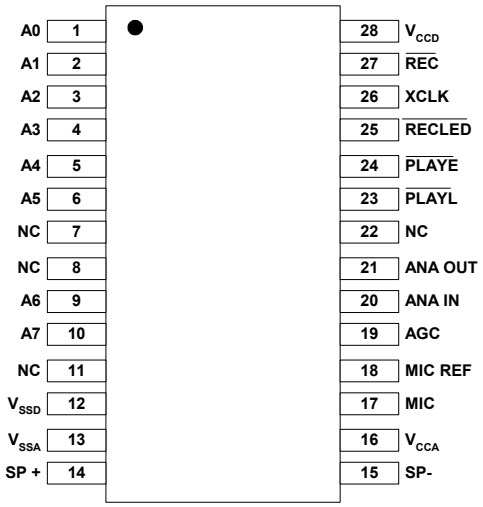
5. PIN CONFIGURATION



SOIC / PDIP

Note: NC means must No connect

6. PIN DESCRIPTION

PIN NAME	PIN NO.	FUNCTION
A0-A7	1-6, 9, 10	**Address Inputs**: The address inputs have two functions, depending on the level of the two Most Significant Bits (MSB) of the address (A6 and A7). If either or both of the two MSBs are LOW, all inputs are interpreted as address bits and are used as the start address for the current record or playback cycle. The address pins are inputs only and do not output internal address information as the operation progresses. Address inputs are latched by the falling edge of $\overline{\text{PLAYE}}$, $\overline{\text{PLAYL}}$, or $\overline{\text{REC}}$. If both A6 & A7 are HIGH, then the device is in special operational modes. Please refer to operational modes section for details.
V_{SSA}, V_{SSD}	12, 13	**Ground**: Similar to V_{CCA} and V_{CCD}, separate analog and digital ground rails provide independent analog and digital ground buses internally to minimize noise. These pins should be tied together as close as possible to the device.
SP+, SP-	14, 15	**Speaker Outputs**: The differential SP+ and SP- pins are designed to drive a 16Ω speaker and no coupling capacitor is required. Conversely, with single-ended connection, a coupling capacitor is needed between the SP pin and the speaker. Besides, the output power is about a quarter of that from differential output. The speaker outputs are in high-impedance state during recording and at V_{SSA} during power down.
V_{CCA}, V_{CCD}	16, 28	**Supply Voltages**: Separate analog and digital power rails provide power to internal analog and digital circuits respectively to minimize internal noises. These power buses are brought out to separate pads and should be tied together as close to the supply source as possible. It is important that the power supplies are decoupled as close to the device as possible.
MIC	17	**Microphone**: The microphone input transfers its signal to the on-chip preamplifier. An on-chip Automatic Gain Control (AGC) circuit controls the gain of this preamplifier from –15 to 24dB. An external microphone should be AC coupled to this pin via a series capacitor. The capacitor value, together with the internal 10 KΩ resistance on this pin, determines the low-frequency cutoff for the device passband. See Winbond's Application Information for additional information on low-frequency cutoff calculation.

PIN NAME	PIN NO.	FUNCTION
MIC REF	18	**Microphone Reference**: The MIC REF input is the inverting input to the microphone preamplifier. This provides a noise-canceling or common-mode rejection input to the device when connected to a differential microphone.
AGC	19	**Automatic Gain Control (AGC)**: The AGC input dynamically adjusts the gain of the preamplifier to compensate for the wide range of microphone input levels. The AGC allows the full range of sound, from whispers to loud sounds, to be recorded with minimal distortion. The "attack" time is determined by the time constant of a 5 KΩ internal resistance and an external capacitor (C6 of Figure 5 in Section 11) connected from the AGC pin to V_{SSA}. The "release" time is determined by the time constant of an external resistor (R5) and an external capacitor (C6) connected in parallel between the AGC pin and V_{SSA} pin. Nominal values of 470 KΩ and 4.7 µF give satisfactory results in most cases. Tying this to ground gives maximum gain, while tying it to V_{CCA} gives minimum gain for the AGC amplifier.
ANA IN	20	**Analog Input**: The ANA IN transfers an input signal to the chip for recording. For microphone usage, this ANA IN pin should be connected via an external capacitor to the ANA OUT pin. This capacitor value, together with the 3 KΩ input impedance of ANA IN, is selected to give additional cutoff at the low-frequency end of the voice passband. If the desired input is derived from a source other than a microphone, the signal can be capacitively coupled into the ANA IN pin directly.
ANA OUT	21	**Analog Output**: This pin provides the preamplifier output to the user. The voltage gain of the preamplifier is determined by the voltage level at the AGC pin.
$\overline{\text{PLAYL}}$ [2]	23	**Playback, Level-Activated**: When this input signal is held LOW, a playback cycle is initiated, and playback continues until $\overline{\text{PLAYL}}$ is pulled HIGH, or an EOM marker is detected. The device automatically powers down and enters into standby mode upon completion of a playback cycle.
$\overline{\text{PLAYE}}$ [2]	24	**Playback, Edge-Activated**: When a LOW-going transition is detected on this pin, a playback cycle begins. Taking $\overline{\text{PLAYE}}$ HIGH during a playback cycle will not terminate the current cycle. Playback continues until an EOM is encountered. Upon completion of a playback cycle, the device automatically powers down and enters into standby mode.

PIN NAME	PIN NO.	FUNCTION
$\overline{\text{RECLED}}$	25	**Record LED**: The $\overline{\text{RECLED}}$ output is LOW during a record cycle. It can be used to drive an LED to indicate a record cycle is in progress. In addition, $\overline{\text{RECLED}}$ pulses LOW momentarily when an end-of-message is encountered in a playback operation.
XCLK	26	**External Clock**: The external clock input has an internal pull-down resistor. The ISD1100 is configured at the factory with an internal sampling clock frequency that guarantees its minimum nominal record/playback time. For instance, an ISD1110 operating within specification will be observed to always have a minimum of 10 seconds of recording time. The sampling frequency is then maintained to a variation of ±2.25 percent over the commercial temperature and operating voltage ranges while still maintaining the minimum duration specified. As a result some devices will have a few percent more than nominal recording time. If greater precision is required, the device can be clocked through the XCLK pin as follows:

EXTERNAL CLOCK SAMPLE RATES

Part Number	Sample Rate	Required Clock
ISD1110	6.4 kHz	819.2 kHz
ISD1112	5.3 kHz	682.7 kHz

These recommended clock rates should not be varied because the anti-aliasing and smoothing filters are fixed, and aliasing problems can occur if the sample rate differs from the one recommended. The duty cycle on the input clock is not critical, as the clock is immediately divided by two. **If the XCLK is not used, this pin must be grounded.** Please see Application Information for the ISD1100 series for more details on external clocking.

PIN NAME	PIN NO.	FUNCTION
$\overline{\text{REC}}$ [1]	27	**Record**: The $\overline{\text{REC}}$ input is an active-LOW signal. The device records whenever $\overline{\text{REC}}$ is LOW. This signal must remain LOW for the duration of the recording. A record cycle is completed when $\overline{\text{REC}}$ is pulled HIGH or the memory space is filled up. $\overline{\text{REC}}$ takes precedence over either playback ($\overline{\text{PLAYE}}$ or $\overline{\text{PLAYL}}$) signal. If $\overline{\text{REC}}$ is pulled LOW during a playback cycle, the playback immediately ceases and recording begins. An end-of-message (EOM) marker is internally recorded, enabling a subsequent playback cycle to terminate appropriately. The device automatically powers down into standby mode when $\overline{\text{REC}}$ goes HIGH.
NC	11	**NC**: No connect

Notes:

[1] The $\overline{\text{REC}}$ signal is debounced for 50 ms on the rising edge to prevent a false retriggering from a push-button switch.

[2] During playback, if either $\overline{\text{PLAYE}}$ or $\overline{\text{PLAYL}}$ is held LOW during EOM or OVF, the device will still enter into standby mode and the internal oscillator and timing generator will stop. However, the rising edge of $\overline{\text{PLAYE}}$ and $\overline{\text{PLAYL}}$ are not debounced and any subsequent falling edge (particularly switch bounce) present on the input pins will initiate another playback.

7. FUNCTIONAL DESCRIPTION

7.1. DETAILED DESCRIPTION

Speech/Sound Quality

Winbond's patented ChipCorder® technology provides natural audio record and playback. The ISD1200 series includes devices offered at 5.3 and 6.4 kHz sampling frequencies, allowing the user a choice of speech quality options. The input voice signals are stored directly in nonvolatile EEPROM cells and are reproduced without the synthetic effect often heard with digital solid-state speech solutions. A complete sample is stored in a single cell, minimizing the memory necessary to store a recording of a given duration.

Duration

To meet end system requirements, the ISD1200 series offers single-chip solutions at 10 and 12 seconds.

TABLE 1: ISD1200 SERIES SUMMARY

Part Number	Duration (Seconds)	Input Sample Rate (kHz)	Typical Filter Pass Band* (kHz)
ISD1210	10	6.4	2.6
ISD1212	12	5.3	2.2

* 3dB roll-off-point….

EEPROM Storage

One of the benefits of Winbond's ChipCorder® technology is the use of on-chip non-volatile memory, providing zero-power message storage. The message is retained for up to 100 years typically without power. In addition, the device can be re-recorded typically over 100,000 times.

Basic Operation

The ISD1200 ChipCorder® series devices are controlled by a single record signal, $\overline{\text{REC}}$, and either of two push-button control playback signals, $\overline{\text{PLAYE}}$ (edge-activated playback), and $\overline{\text{PLAYL}}$ (level-activated playback). The ISD1200 series parts are configured for simplicity of design in a single/multiple-message application. Using the address lines will allow multiple message applications.

Automatic Power-Down Mode

At the end of a playback or record cycle, the ISD1200 series devices automatically return to a low-power standby mode, consuming typically 0.5 µA. During a playback cycle, the device powers down automatically at the end of the message. During a record cycle, the device powers down immediately after $\overline{\text{REC}}$ is pulled HIGH.

Addressing

In addition to single message application, the ISD1200 series provides a full addressing capability.

The ISD1200 series storage array has 80 distinct addressable segments, providing the following resolutions per segment. See Application Information for ISD1200 address tables.

TABLE 2: DEVICE PLAYBACK/RECORD DURATIONS

Part Number	Minimum Duration (Seconds)
ISD1210	125 ms
ISD1212	150 ms

7.2. OPERATIONAL MODES

The ISD1200 series is designed with several built-in operational modes provided to allow maximum functionality with a minimum of additional components, described in details below. The operational modes use the address pins on the ISD1200 devices, but are mapped outside the valid address range. When the two Most Significant Bits (MSBs) are HIGH (A6 and A7), the remaining address signals are interpreted as mode bits and not as address bits. Therefore, operational modes and direct addressing are not compatible and cannot be used simultaneously.

There are two important considerations for using operational modes. Firstly, all operations begin initially at address 0, which is the beginning address of the ISD1200. Later operations can begin at the other address locations, depending on the operational mode(s) chosen. In addition, the address pointer is reset to 0 when the device is changed from record to playback but not from playback to record when A4 is HIGH in Operational Mode.

Secondly, an Operational Mode is executed when any of the control inputs, $\overline{\text{PLAYE}}$, $\overline{\text{PLAYL}}$, or $\overline{\text{REC}}$, go LOW and the two MSBs are HIGH. This Operational Modes remains in effect until the next LOW-going control input signal, at which point the current address/mode levels are sampled and executed.

Note: The two MSBs (A6 & A7) are pins 9 and 10 for ISD1200 series.

7.2.1. Operational Modes Description

The Operational Modes can be used in conjunction with a microcontroller, or they can be hardwired to provide the desired system operation.

A0 – Message Cueing

Message Cueing allows the user to skip through messages, without knowing the actual physical address of each message. Each control input LOW pulse causes the internal address pointer to skip to the next message. This mode should be used for playback only, and is typically used with A4 Operational Mode.

A1 – Delete $\overline{\text{EOM}}$ Markers

The A1 Operational Modes allows sequentially recorded message to be combined into a single message with only one EOM marker set at the end of the final message. When this operational mode is configured, messages recorded sequentially are played back as one continuous message.

A2 – Unused

A3 – Message Looping

The A3 Operational Mode allows for the automatic, continuously repeated playback of the message located at the beginning of the address space.

A Message can completely fill the ISD1200 device and will loop from beginning to end. Pulsing PLAYE will start the playback and pulsing PLAYL wil end the playback.

A4 – Consecutive Addressing

During normal operations, the address pointer will reset when a message is played through to an EOM marker. The A4 Operational Mode inhibits the address pointer reset, allowing messages to be recorded or played back consecutively. When the device is in a static state; i.e., not recording or playing back, momentarily taking this pin LOW will reset the address counter to zero.

A5 – Unused

TABLE 3: OPERATIONAL MODES TABLE

Address Crtl. HIGH	Function	Typical Use	Jointly Compatible*
A0	Message cueing	Fast-forward through messages	A4
A1	Delete EOM markers	Position EOM marker at the end of the last message	A3, A4
A2	Unused		
A3	Looping	Continuous playback from Address 0	A1
A4	Consecutive addressing	Record/play multiple consecutive messages	A0, A1
A5	Unused		

Note: An asterisk [*] Indicates additional operational modes that can be used simultaneously with the given mode.

8. TIMING DIAGRAMS

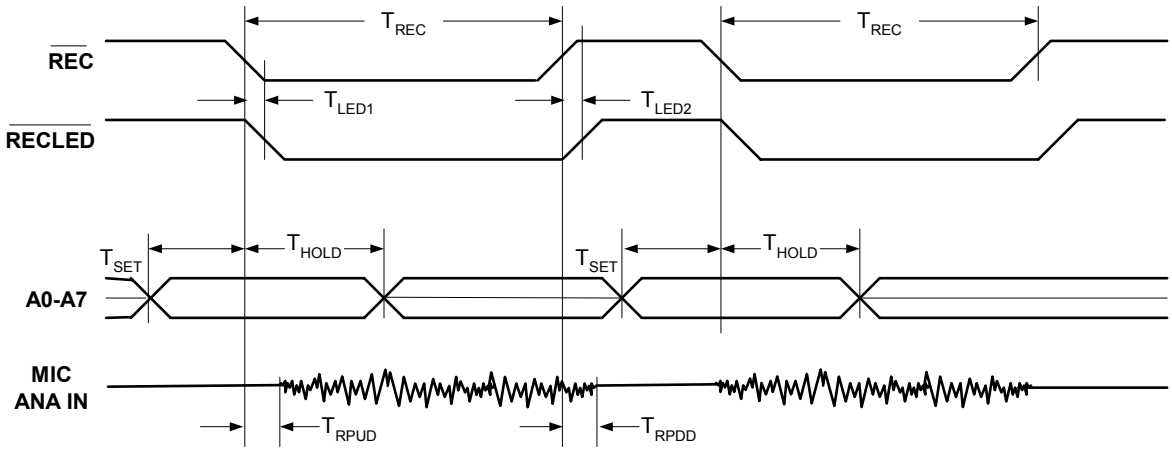
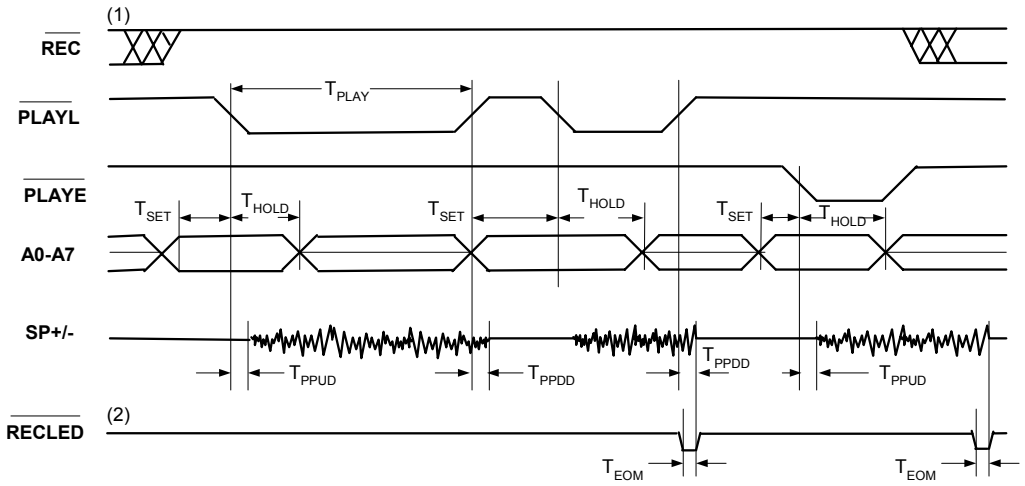


FIGURE 1: RECORD



1. $\overline{\text{REC}}$ must be HIGH for the entire duration of a playback cycle.

2. $\overline{\text{RECLED}}$ funstions as an EOM playback.

FIGURE 2: PLAYBACK

9. ABSOLUTE MAXIMUM RATINGS[1]

TABLE 4: ABSOLUTE MAXIMUM RATINGS (DIE)

CONDITIONS	VALUES
Junction temperature	150ºC
Storage temperature range	-65ºC to +150ºC
Voltage applied to any pin	(V_{SS} – 0.3V) to (V_{CC} + 0.3V)
Voltage applied to any pin (Input current limited to ±20mA)	(V_{SS} – 1.0V) to (V_{CC} + 1.0V)
V_{CC} – V_{SS}	-0.3V to +7.0V

TABLE 5: ABSOLUTE MAXIMUM RATINGS (PACKAGED PARTS)

CONDITIONS	VALUES
Junction temperature	150ºC
Storage temperature range	-65ºC to +150ºC
Voltage applied to any pin	(V_{SS} – 0.3V) to (V_{CC} + 0.3V)
Voltage applied to any pin (Input current limited to ±20 mA)	(V_{SS} – 1.0V) to (V_{CC} + 1.0V)
Lead temperature (Soldering – 10sec)	300ºC
V_{CC} – V_{SS}	-0.3V to +7.0V

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

9.1 OPERATING CONDITIONS

TABLE 6: OPERATING CONDITIONS (DIE)

CONDITIONS	VALUES
Commercial operating temperature range	0ºC to +50ºC
Supply voltage (V_{CC}) [1]	+4.5V to +6.5V
Ground voltage (V_{SS}) [2]	0V

TABLE 7: OPERATING CONDITIONS (PACKAGED PARTS)

CONDITIONS	VALUES
Commercial operating temperature range (Case temperature)	0ºC to +70ºC
Supply voltage (V_{CC}) [1]	+4.5V to +5.5V
Ground voltage (V_{SS}) [2]	0V

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

10. ELECTRICAL CHARACTERISTICS

10.1. PARAMETERS FOR PACKAGED PARTS

TABLE 8: DC PARAMETERS

PARAMETERS	SYMBOLS	MIN[2]	TYP[1]	MAX[2]	UNITS	CONDITIONS
Input Low Voltage	V_{IL}			0.8	V	
Input High Voltage	V_{IH}	2.4			V	
Output Low Voltage	V_{OL}			0.4	V	I_{OL} = 4.0 mA
Output High Voltage	V_{OH}	2.4			V	I_{OH} = -1.6 mA
V_{CC} Current (Operating)	I_{CC}		15	30	mA	V_{CC} = 5.5V[3], R_{EXT} = ∞
V_{CC} Current (Standby)	I_{SB}		0.5	10	µA	[3] [4]
Input Leakage Current	I_{IL}			±1	µA	
Input Current HIGH w/Pull Down	I_{ILPD}			130	µA	Force V_{CC} [5]
Output Load Impedance	R_{EXT}	16			Ω	Speaker Load
Preamp IN Input Resistance	R_{MIC}		10		KΩ	Pins 17, 18
ANA IN Input Resistance	$R_{ANA\ IN}$		3		KΩ	
Preamp Gain 1	A_{PRE1}		24		dB	AGC = 0.0V
Preamp Gain 2	A_{PRE2}		-45	-15	dB	AGC = 2.5V
ANA IN to SP+/- Gain	A_{ARP}		22		dB	
AGC Output Resistance	R_{AGC}		5		KΩ	
Preamp Out Source	I_{PREH}		-2		MA	@ V_{OUT} = 1.0V
Preamp In Sink	I_{PREL}		0.5		MA	@ V_{OUT} = 2.0V

[1] Typical values @ T_A = 25° and 5.0V.

[2] All Min/Max limits are guaranteed by Winbond via electronical testing or characterization. Not all specifications are 100 percent tested.

[3] V_{CCA} and V_{CCD} connected together.

[4] $\overline{REC}$, $\overline{PLAYL}$, and $\overline{PLAYE}$ must be at V_{CCD}.

[5] Pin 26.

TABLE 9: AC PARAMETERS

CHARACTERISTICS	SYMBOLS	MIN[2]	TYP[1]	MAX[2]	UNITS	CONDITIONS
Sampling Frequency	F_S					
ISD1210				6.4	kHz	[5]
ISD1212				5.3	kHz	[5]
Filter Pass Band	F_{CF}					
ISD1210			2.6		kHz	3 dB Roll-Off Point[3][6]
ISD1212			2.2		kHz	3 dB Roll-Off Point[3][6]
Record Duration	T_{REC}					
ISD1210		10			sec	
ISD1212		12			sec	
Playback Duration	T_{PLAY}					
ISD1210		10			sec	[5]
ISD1212		12			sec	[5]
$\overline{\text{RECLED}}$ ON Delay	T_{LED1}		5		msec	
$\overline{\text{RECLED}}$ OFF Delay	T_{LED2}					
ISD1210		40	48.6	100	msec	
ISD1212		50	58.3	105	msec	
A0-A7 Setup Time	T_{SET}	300			nsec	
A0-A7 Hold Time	T_{HOLD}	0			nsec	
Record Power-Up Delay	T_{RPUD}					
ISD1210			32		msec	
ISD1212			39		msec	
Record Power-Down Delay	T_{RPDD}					
ISD1210			32		msec	
ISD1212			39		msec	
Play Power-Up Delay	T_{PPUD}					
ISD1210			32		msec	
ISD1212			39		msec	
Play Power-Down Delay	T_{PPDD}					
ISD1210			8.1		msec	
ISD1212			9.7		msec	

CHARACTERISTICS	SYMBOLS	MIN[2]	TYP[1]	MAX[2]	UNITS	CONDITIONS
$\overline{EOM}$ Pulse Width ISD1210 ISD1212	T_{EOM}		 15.625 18.75		 msec msec	
Total Harmonic Distortion	THD		1		%	@ 1 kHz
Speaker Output Power	P_{OUT}		12.2		mW	R_{EXT} = 16 Ω
Voltage Across Speaker Pins	V_{OUT}		1.25	2.5	Vp-p	R_{EXT} = 600 Ω
MIC Input Voltage	V_{IN1}			20	mV	Peak-to-Peak[4]
ANA IN Input Voltage	V_{IN2}			50	mV	Peak-to-Peak

[1] Typical values @ T_A = 25º and 5.0V sample rate.

[2] All Min/Max limits are guaranteed by Winbond via electronical 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] With 5.1 K Ω series resistor at ANA IN.

[5] Sampling Frequency and playback Duration can vary as much as ±2.25 percent over the commercial temperature ranges. All devices will meet the maximum sampling frequency and minimum playback duration parameters. For greater stability, an external clock can be utilized (see Pin Descriptions)

[6] Filter specification applies to the antialiasing filter and the smoothing filter. Typical Parameter Variation with Voltage and Temperature. This parameter is not checked during production testing and may vary due to process variations and other factors. Therefore, the customer should not rely upon this value for testing purposes.

10.1.1. Typical Parameter Variation with Voltage and Temperature

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

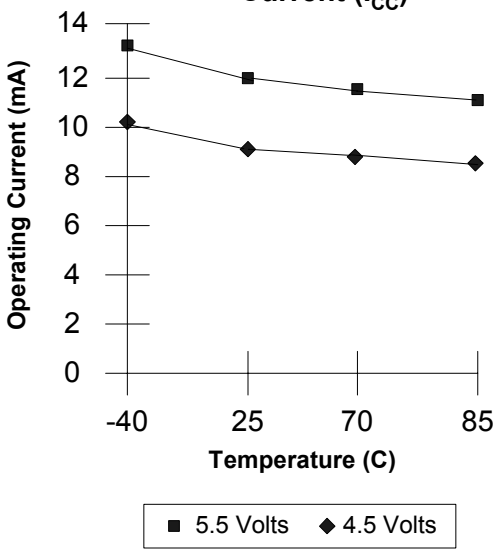


Chart 3: Standby Current (I_{SB})

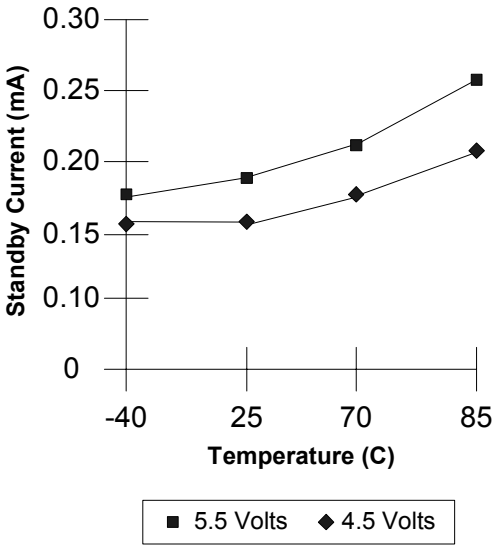


Chart 2: Total Harmonic Distortion

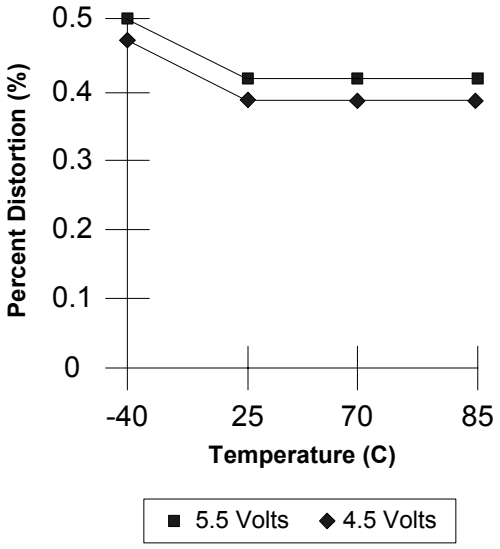
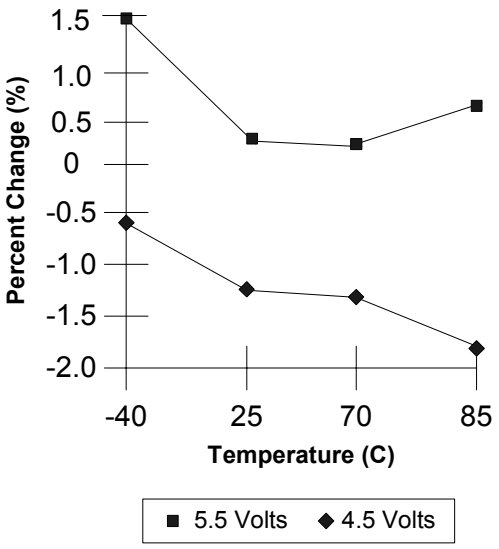


Chart 4: Oscillator Stability



10.2. PARAMETERS FOR DIE

TABLE 10: DC PARAMETERS

PARAMETERS	SYMBOLS	MIN[2]	TYP[1]	MAX[2]	UNITS	CONDITIONS
Input Low Voltage	V_{IL}			0.8	V	
Input High Voltage	V_{IH}	2.4			V	
Output Low Voltage	V_{OL}			0.4	V	I_{OL} = 4.0 mA
Output High Voltage	V_{OH}	2.4			V	I_{OH} = -1.6 mA
V_{CC} Current (Operating)	I_{CC}		15	30	mA	V_{CC} = 5.5V[3], R_{EXT} = ∞
V_{CC} Current (Standby)	I_{SB}		0.5	10	µA	[3] [4]
Input Leakage Current	I_{IL}			±1	µA	
Input Current HIGH w/Pull Down	I_{ILPD}			130	µA	Force V_{CC} [5]
Output Load Impedance	R_{EXT}	16			Ω	Speaker Load
Preamp IN Input Resistance	R_{MIC}		10		KΩ	Pads 17,18
ANA IN Input Resistance	$R_{ANA\ IN}$		3		KΩ	
Preamp Gain 1	A_{PRE1}		24		dB	AGC = 0.0V
Preamp Gain 2	A_{PRE2}		-45	-15	dB	AGC = 2.5V
ANA IN to SP+/- Gain	A_{ARP}		22		dB	
AGC Output Resistance	R_{AGC}		5		KΩ	
Preamp Out Source	I_{PREH}		-2		mA	@ V_{OUT} = 1.0V
Preamp In Sink	I_{PREL}		0.5		mA	@ V_{OUT} = 2.0V

[1] Typical values @ T_A = 25° and 5.0V.

[2] All Min/Max limits are guaranteed by Winbond via electronical testing or characterization. Not all specifications are 100 percent tested.

[3] V_{CCA} and V_{CCD} connected together.

[4] $\overline{REC}$, $\overline{PLAYL}$, and $\overline{PLAYE}$ must be at V_{CCD}.

[5] Pin 26.

TABLE 11: AC PARAMETERS

CHARACTERISTICS	SYMBOLS	MIN[2]	TYP[1]	MAX[2]	UNITS	CONDITIONS
Sampling Frequency	F_S					
ISD1210				6.4	kHz	[5]
ISD1212				5.3	kHz	[5]
Filter Pass Band	F_{CF}					
ISD1210			2.6		kHz	3 dB Roll-Off Point[3][6]
ISD1212			2.2		kHz	3 dB Roll-Off Point[3][6]
Record Duration	T_{REC}					
ISD1210		10			sec	
ISD1212		12			sec	
Playback Duration	T_{PLAY}					
ISD1210		10			sec	[5]
ISD1212		12			sec	[5]
$\overline{\text{RECLED}}$ ON Delay	T_{LED1}		5		msec	
$\overline{\text{RECLED}}$ OFF Delay	T_{LED2}					
ISD1210		40	48.5	100	msec	
ISD1212		50	58.3	105	msec	
Address Setup Time	T_{SET}	300			nsec	
Address Hold Time	T_{HOLD}	0			nsec	
Power-Up Delay	T_{RPUD}					
ISD1210			32		msec	
ISD1212			39		msec	
PD Pulse Width (Record)	T_{RPDD}					
ISD1210			32		msec	
ISD1212			39		msec	
Play Power-Up Delay	T_{PPUD}					
ISD1210			32		msec	
ISD1212			39		msec	
Play Power-Down Delay	T_{PPDD}					
ISD1210			8.1		msec	
ISD1212			9.7		msec	

CHARACTERISTICS	SYMBOLS	MIN[2]	TYP[1]	MAX[2]	UNITS	CONDITIONS
$\overline{EOM}$ Pulse Width ISD1210 ISD1212	T_{EOM}		 16.625 18.75		 msec msec	
Total Harmonic Distortion	THD		1		%	@ 1 kHz
Speaker Output Power	P_{OUT}		12.2		mW	R_{EXT} = 16 Ω[4]
Voltage Across Speaker Pins	V_{OUT}		1.25	2.5	Vp-p	R_{EXT} = 600 Ω
MIC Input Voltage	V_{IN1}			20	mV	Peak-to-Peak[4]
ANA IN Input Voltage	V_{IN2}			50	mV	Peak-to-Peak

[1] Typical values @ T_A = 25º and 5.0V sample rate.

[2] All Min/Max limits are guaranteed by Winbond via electronical 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] With 5.1 K Ω series resistor at ANA IN.

[5] Sampling Frequency and playback Duration can vary as much as ±2.25 percent over the commercial temperature range. All devices will meet the maximum sampling frequency and minimum playback duration parameters. For greater stability, an external clock can be utilized (see Pin Descriptions)

[6] Filter specification applies to the antialiasing filter and the smoothing filter. Typical Parameter Variation with Voltage and Temperature. This parameter is not checked during production testing and may vary due to process variations and other factors. Therefore, the customer should not rely upon this value for testing purposes.

10.2.1. Typical Parameter Variation with Voltage and Temperature

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

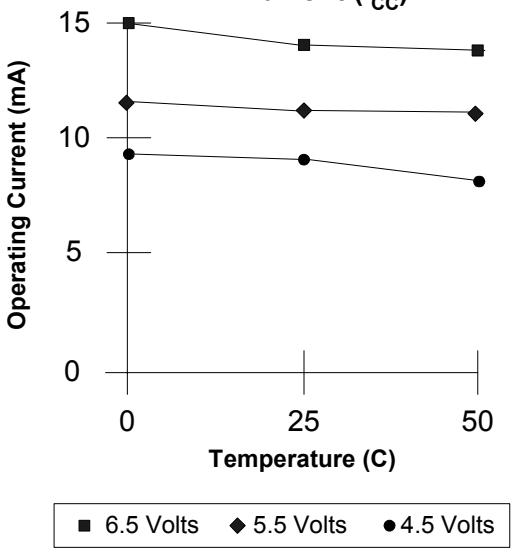


Chart 7: Standby Current (I_{SB})

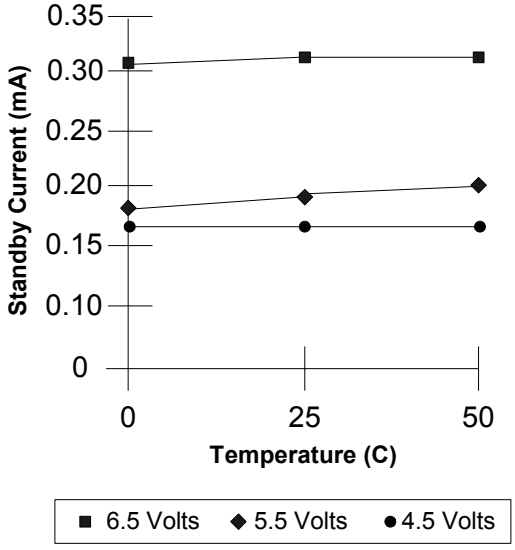


Chart 6: Total Harmonic Distortion

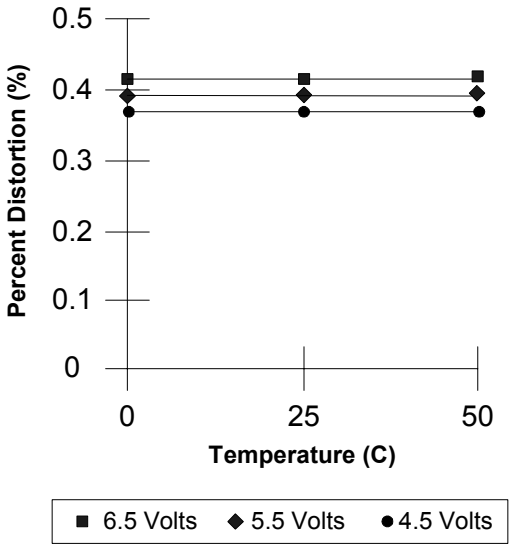
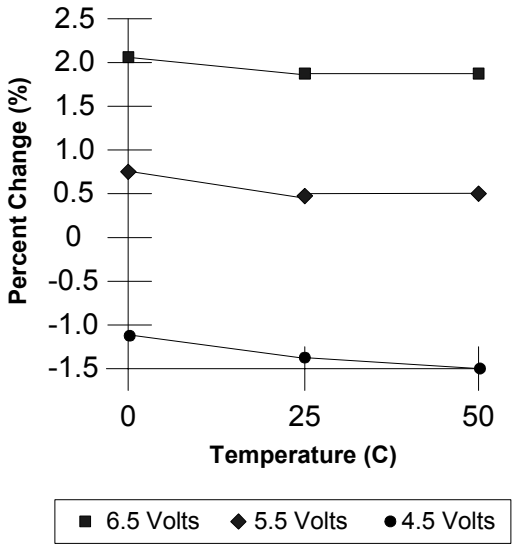


Chart 8: Oscillator Stability



11. TYPICAL APPLICATION CIRCUIT

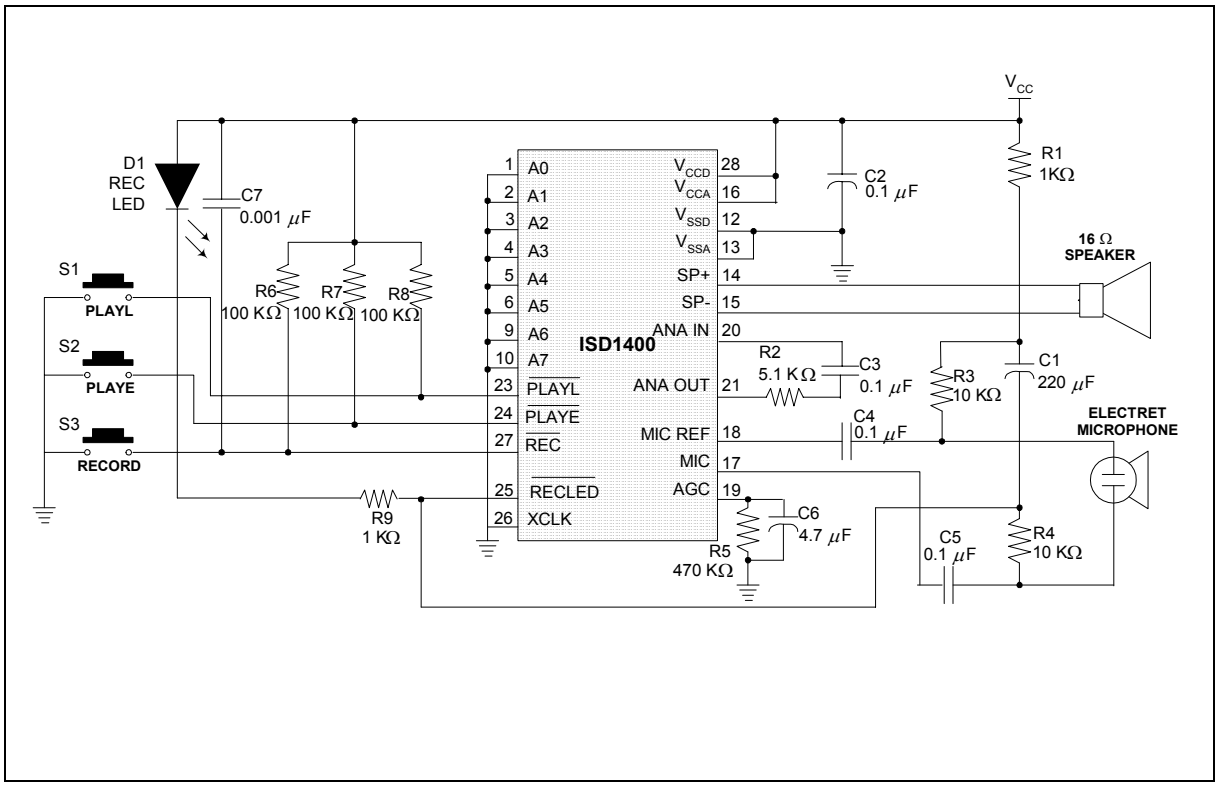


FIGURE 5: APPLICATION EXAMPLE

Functional Description Example

The following example operating sequence demonstrates the functionality of the ISD1200 series devices.

1. Record a message:

   Pulling the $\overline{\text{REC}}$ signal LOW initiates a record cycle from current location. When $\overline{\text{REC}}$ is held LOW, the recording continues. Until the memory array is filled up or when $\overline{\text{REC}}$ is pulled HIGH, recording ceases. An EOM marker is written at the end of message. Then the device will automatically power down.

2. Edge-activated playback:

   Pulling the $\overline{\text{PLAYE}}$ signal LOW initiates a playback cycle from the beginning of the message until the entire message is played. The rising edge of $\overline{\text{PLAYE}}$ has no effect on operation. When the EOM marker is encountered, the device automatically powers down. A subsequent falling edge on $\overline{\text{PLAYE}}$ initiates a new playback operation from the beginning of the message.

3. Level-activated playback:

   Holding the $\overline{\text{PLAYL}}$ signal LOW initiates a playback cycle from the beginning of the message, until $\overline{\text{PLAYL}}$ is pulled HIGH or when the EOM marker is encountered, playback operation stops and the device automatically powers down.

4. Record (interrupting playback).

   The $\overline{\text{REC}}$ signal takes precedence over playback operation. Holding $\overline{\text{REC}}$ LOW initiates a new record operation from current location, regardless of any current operation in progress.

5. $\overline{\text{RECLED}}$ operation.

   During record, the $\overline{\text{RECLED}}$ output pin provides an active-LOW signal, which can be used to drive an LED as a “record-in-progress” indicator. It returns to a HIGH state when the $\overline{\text{REC}}$ pin is pulled HIGH or when the recording is completed due to the memory being filled. However, during playback, this pin also pulses LOW to indicate an EOM at the end of a message.

Applications Note

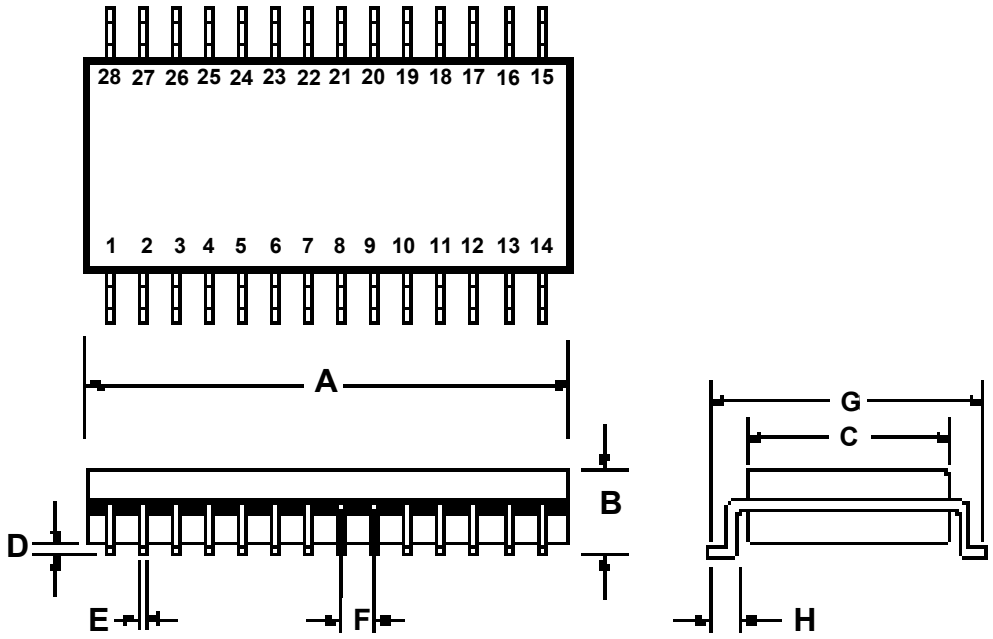
Some users may experience an unexpected recording taking place when their circuit is powered up, or the batteries are changed and V_{CC} rises faster than $\overline{REC}$. This undesired recording prevents playback of the previously recorded message. A spurious EOM marker appears at the very beginning of the memory, preventing access to the original message, and nothing is played.

To prevent this occurrence, place a capacitor (approx. 0.001 µF) between the control pin, $\overline{REC}$, and V_{CC}. This pulls the control pin voltage up with V_{CC} as it rises. Once the voltage is HIGH, the pull-up device will keep the pin HIGH until intentionally pulled LOW, preventing the false EOM marker.

Since this anomaly depends on factors such as the capacitance of the user's printed circuit board, not all circuit designs will exhibit the spurious marker. However, it is recommended, that the capacitor is included for design reliability. A more detailed explanation and resolution of this occurrence is described in Application Information.

12. PACKAGE DRAWING AND DIMENSIONS

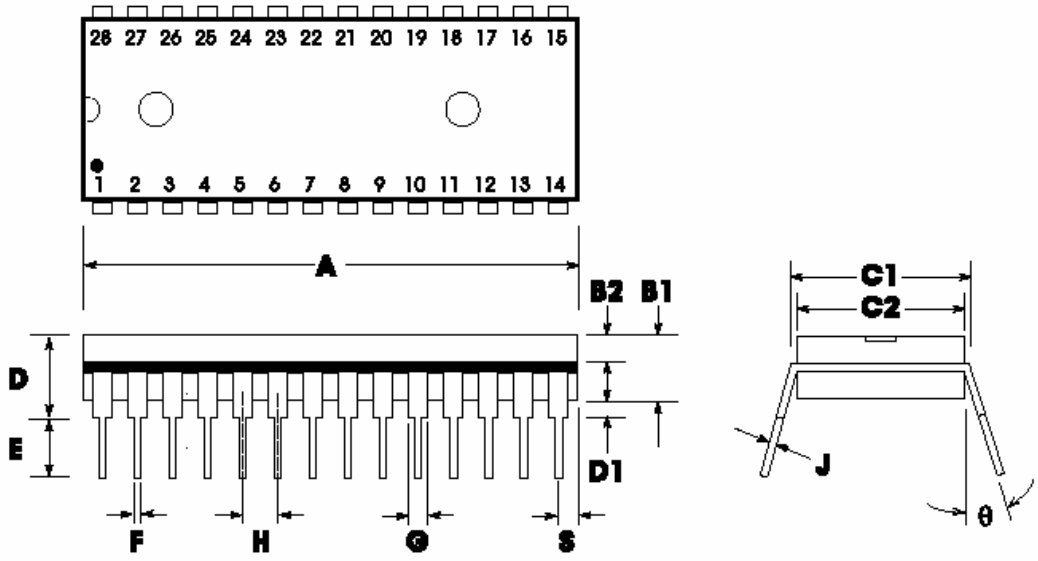
12.1. 28-LEAD 300MIL PLASTIC SMALL OUTLINE IC (SOIC)



	INCHES			MILLIMETERS		
	Min	Nom	Max	Min	Nom	Max
A	0.701	0.706	0.711	17.81	17.93	18.06
B	0.097	0.101	0.104	2.46	2.56	2.64
C	0.292	0.296	0.299	7.42	7.52	7.59
D	0.005	0.009	0.0115	0.127	0.22	0.29
E	0.014	0.016	0.019	0.35	0.41	0.48
F		0.050			1.27	
G	0.400	0.406	0.410	10.16	10.31	10.41
H	0.024	0.032	0.040	0.61	0.81	1.02

Note: Lead coplanarity to be within 0.004 inches.

12.2. 28-LEAD 600MIL PLASTIC DUAL INLINE PACKAGE (PDIP)

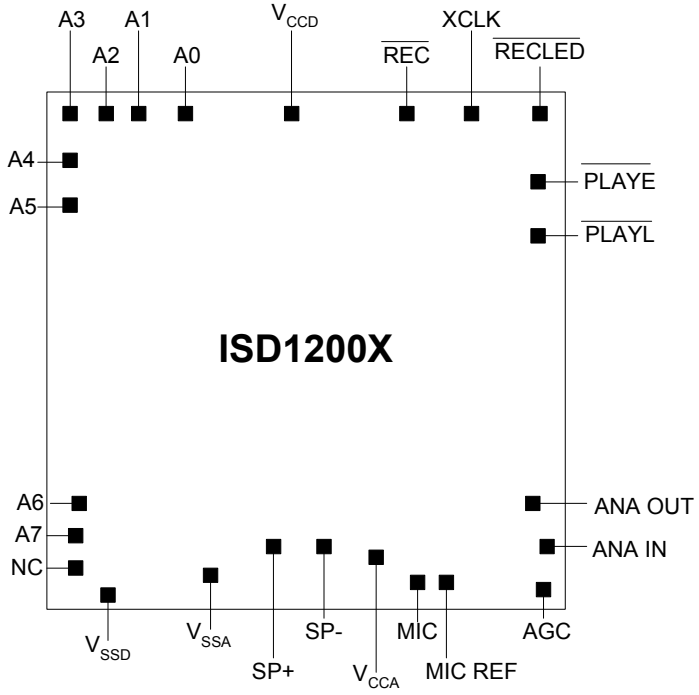


	INCHES			MILLIMETERS		
	Min	Nom	Max	Min	Nom	Max
A	1.445	1.450	1.455	36.70	36.83	36.96
B1		0.150			3.81	
B2	0.065	0.070	0.075	1.65	1.78	1.91
C1	0.600		0.625	15.24		15.88
C2	0.530	0.540	0.550	13.46	13.72	13.97
D			0.19			4.83
D1	0.015			0.38		
E	0.125		0.135	3.18		3.43
F	0.015	0.018	0.022	0.38	0.46	0.56
G	0.055	0.060	0.065	1.40	1.52	1.62
H		0.100			2.54	
J	0.008	0.010	0.012	0.20	0.25	0.30
S	0.070	0.075	0.080	1.78	1.91	2.03
q	0°		15°	0°		15°

12.3. DIE PHYSICAL LAYOUT[1]

ISD1200x

- Die Dimensions
  X: 172.2 ± 1 mils
  Y: 138.2 ± 1 mils
- Die Thickness[2]
  17.5 ± .1 mils
- Pad Opening
  88 x 112 microns
  3.46 x 4.41 mils



Notes:

[1] The backside of die is internally connected to V_{SS}. It **MUST NOT** be connected to any other potential or damage may occur.

[2] Die thickness is subject to change, please contact Winbond factory for status.

ISD1200 SERIES PAD DESIGNATIONS,

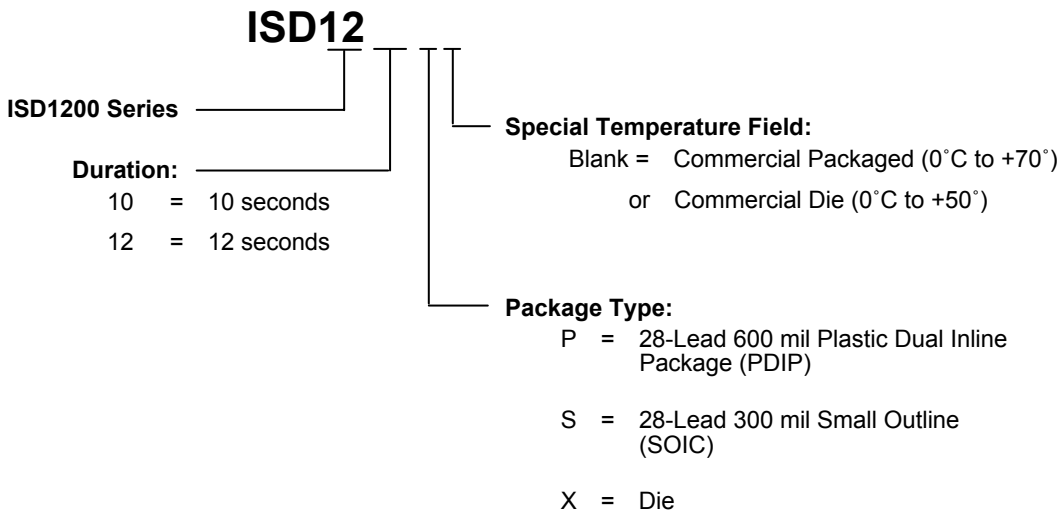
(with respect to die center)

PAD	PAD Name	X Axis (μm)	Y Axis (μm)
A0	Address 0	-1364.0	1589.6
A1	Address 1	-1648.4	1589.6
A2	Address 2	-1816.4	1589.6
A3	Address 3	-2013.6	1515.6
A4	Address 4	-2013.6	1337.6
A5	Address 5	-2013.6	1129.6
A6	Address 6	-2013.6	-831.2
A7	Address 7	-2013.6	-1022.0
NC	No Connect	-2013.6	-1361.6
V_{SSD}	Digital Ground	-1893.6	-1588.0
V_{SSA}	Analog Ground	-357.6	-1588.0
SP+	Speaker Output +	-17.2	-1512.8
SP-	Speaker Output -	412.4	-1512.8
V_{CCA}	Analog Power Supply	780.0	-1552.4
MIC	Microphone Input	992.0	-1590.0
MIC REF	Microphone Reference	1169.2	-1590.0
AGC	Automatic Gain Control	1978.4	-1590.0
ANA IN	Analog Input	2005.6	-1196.4
ANA OUT	Analog Output	1991.2	-995.2
$\overline{\text{PLAYL}}$	Level-Activated Playback	2014.4	1224.4
$\overline{\text{PLAYE}}$	Edge-Activated Playback	2014.4	1392.8
$\overline{\text{RECLED}}$	Record LED Output	2012.4	1587.6
XCLK	External Clock	1581.2	1589.6
$\overline{\text{REC}}$	Record	752.8	1589.6
V_{CCD}	Digital Power Supply	-48.0	1545.2

Note: Die dimensions and pad positions may be subject to change. Please contact Winbond Sales Office or Representatives to verify current specifications.

13. ORDERING INFORMATION

Product Number Descriptor Key



When ordering ISD1200 series devices, please refer to the following valid part numbers.

Die / Package	10-Second		12-Second	
	Product P/N	Ordering P/N	Product P/N	Ordering P/N
Die	ISD1210X	I1210X	ISD1212X	I1212X
PDIP	ISD1210P	I1210P	ISD1212P	I1212P
SOIC	ISD1210S	I1210S	ISD1212S	I1212S

For the latest product information, access Winbond's worldwide website at
http://www.winbond-usa.com

14. VERSION HISTORY

VERSION	DATE	DESCRIPTION
0	Before 2004	Initial issue
1.0	March 2004	Reformat the document. Add footnote to Filter Passband in Tables 1, 9 & 11. Revise Functional Description Example section. Revise die info. Revise ordering information.
1.1	Apr 2005	Revise the disclaim section.

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