

**ISD1600B
Series**

Single-Message

Single-Chip

6.6- to 40-Second

Voice Record & Playback Devices

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1. GENERAL DESCRIPTION

The Nuvoton® ISD1600B ChipCorder® Series is a high quality, fully integrated, single-chip single-message voice record and playback device ideally suited to a variety of electronic systems. The message duration is user selectable in ranges from 6.6 seconds to 40 seconds, depending on the specific device. The sampling frequency of each device can also be adjusted from 4 kHz to 12 kHz with an external resistor, giving the user greater flexibility in duration versus recording quality for each application. Operating voltage spans a range from 2.4 V to 5.5 V to ensure that the ISD1600B devices are optimized for a wide range of battery or line-powered applications.

The devices include an on-chip oscillator (with external resistor control), microphone preamplifier with Automatic Gain Control (AGC), anti-aliasing filter, Multi-Level Storage (MLS) array, smoothing filter, Pulse Width Modulation (PWM) Class D speaker driver, and current output. Voice signals can be fed into the chip through a differential microphone input for recording. The PWM output can directly drive a standard 8 Ω speaker or a typical buzzer, while the separate single-ended current output can drive an external amplifier.

Recordings are stored into the on-chip Flash memory cells, providing zero-power message storage. This unique single-chip solution is made possible through Nuvoton's patented Multi-Level Storage (MLS) technology. Audio data are stored directly in solid-state memory without digital compression, providing superior quality voice and music reproduction.

2. FEATURES

- User-friendly single-chip, single-message voice record & playback devices
- Wide operating voltage: 2.4V to 5.5V
- Push-button interface
 - Record is level-triggered
 - Playback is either edge- or level-triggered
- Selectable sampling frequency controlled by an external oscillator resistor

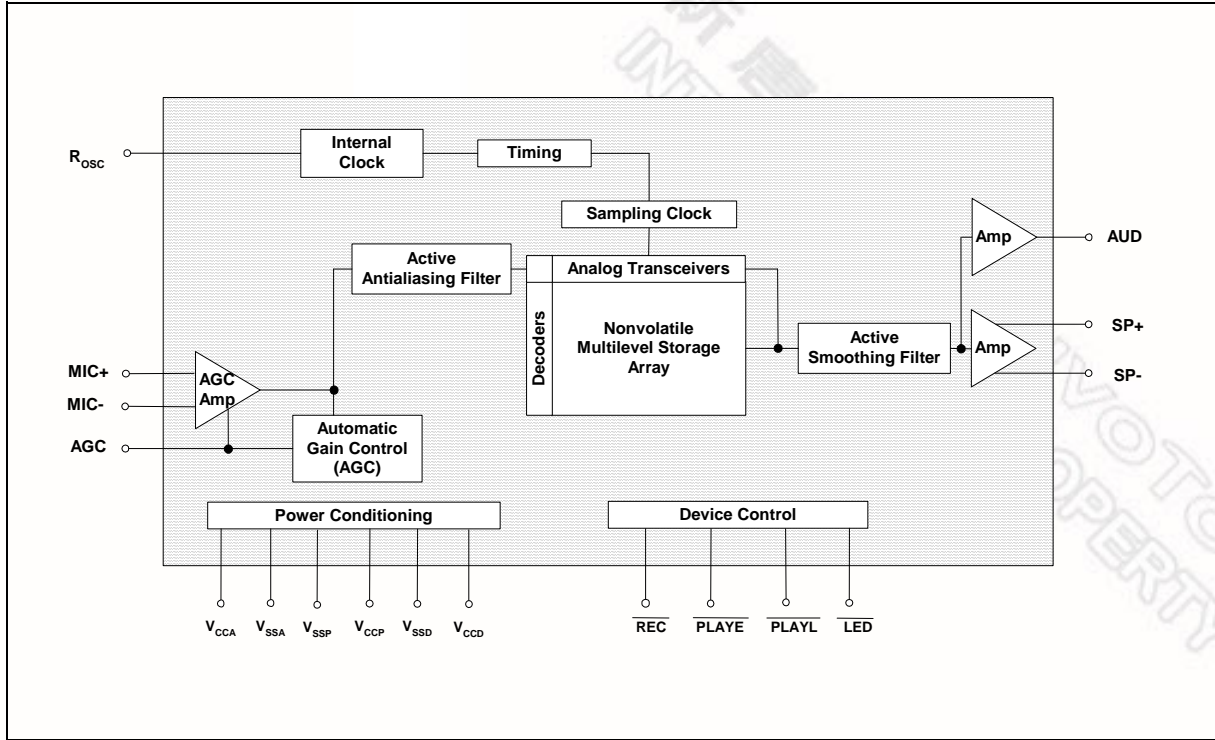
| | | | | | |
|--------------------|---------------|---------------|----------------|----------------|----------------|
| Sampling Frequency | 12 kHz | 8 kHz | 6.4 kHz | 5.3 kHz | 4 kHz |
| Rosc | 53 k Ω | 80 k Ω | 100 k Ω | 120 k Ω | 160 k Ω |

- Variable duration selected by external oscillator resistor

| Sample Frequency | 12 KHz | 8 KHz | 6.4 KHz | 5.3 KHz | 4 HKz |
|------------------|-----------|---------|-----------|---------|---------|
| ISD1610B | 6.6 secs | 10 secs | 12.5 secs | 15 secs | 20 secs |
| ISD1612B | 8 secs | 12 secs | 15 secs | 18 secs | 24 secs |
| ISD1616B | 10.6 secs | 16 secs | 20 secs | 24 secs | 32 secs |
| ISD1620B | 13.3 secs | 20 secs | 25 secs | 30 secs | 40 secs |

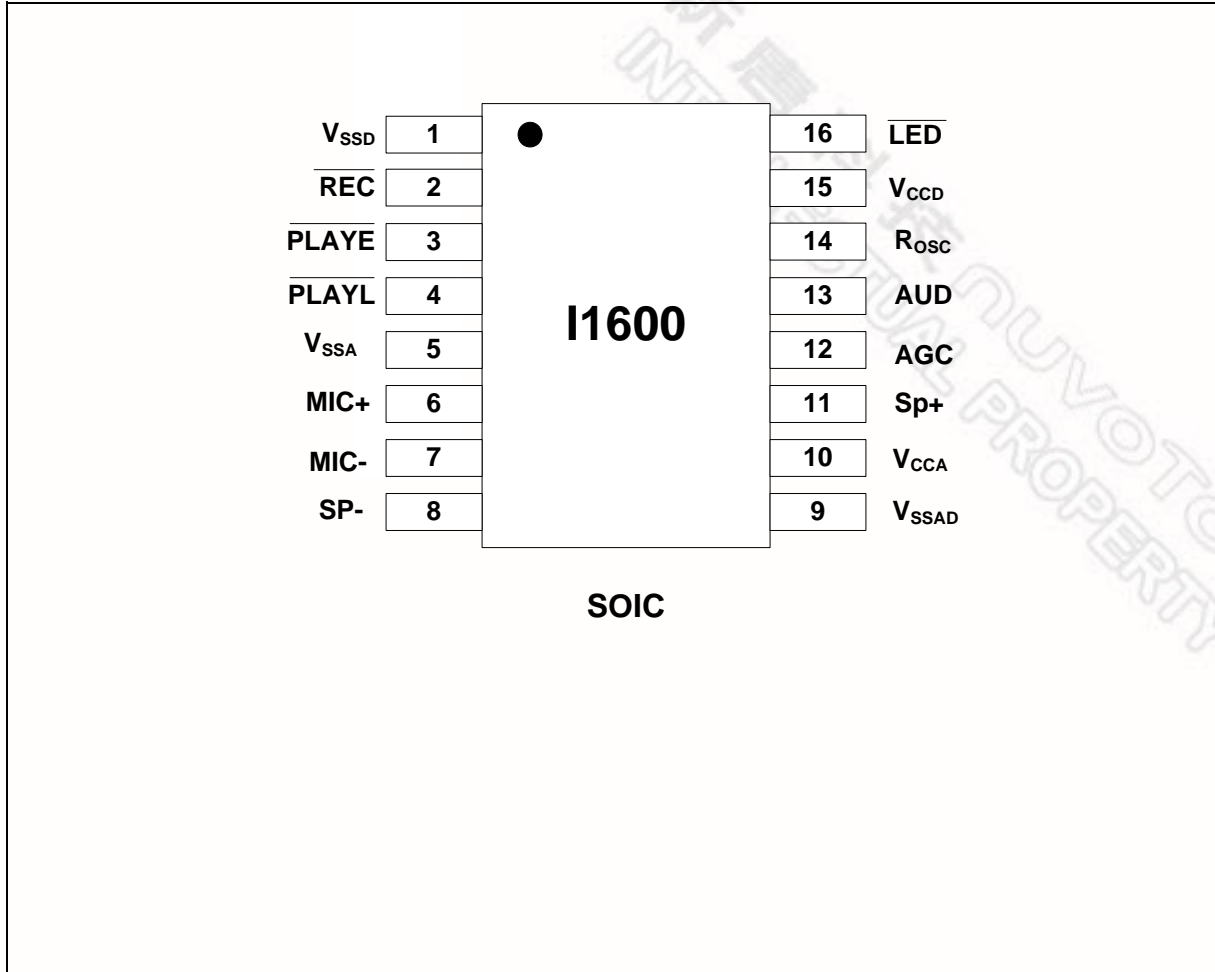
- Message and operation indicators
 - LED: stay on during recording, blink during playback operation
- Automatic power-down mode
 - Enters standby mode immediately after a record or playback cycle
 - Standby current: 1 μ A typical and 10 μ A maximum
- Dual output channels
 - PWM Class D speaker amplifier to directly drive an 8 Ω speaker or a typical buzzer
 - AUD single-ended current output to drive external power amplifier
- ChipCorder standard features
 - High-quality, natural voice and audio reproduction
 - Zero-power message storage: Eliminates battery backup circuits
 - 100-year message retention (typical)
 - 100,000 record cycles (typical)
- Package options: Leaded and Lead-free packaged units
- Available in die and 16L 150mil SOIC
- Temperature options:
 - Commercial: 0°C to +50°C (Die); 0°C to +70°C (Packaged)
 - Industrial: -40°C to +85°C (Packaged)

3. BLOCK DIAGRAM



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4. PIN CONFIGURATION



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5. PIN DESCRIPTION

| PIN NAME | SOIC / PDIP | FUNCTIONS |
|--------------------|-------------|--|
| | PIN NO. | |
| V_{SSD} | 1 | Digital Ground: V_{SSD} is the ground for digital circuits. It is important to have a separate path for each ground back to the system ground terminal to minimize noise. |
| \overline{REC} | 2 | Record: The device starts recording whenever \overline{REC} transits from High to Low and stays at Low. Recording stops when the signal returns to High. This pin has an internal pull-up resistor ^[1] and an internal debounce on falling edge. |
| \overline{PLAYE} | 3 | Edge-trigger Playback: A playback operation starts when this input detects a low going signal exceeding the specified debounced time. This pin has an internal pull-up resistor ^[1] and an internal debounce on both falling & rising edge. |
| \overline{PLAYL} | 4 | Level-trigger Playback: A playback operation begins when this input detects a low going signal and remains at Low. Playback stops when the signal returns to High. This pin has an internal pull-up resistor ^[1] and an internal debounce on falling edge. |
| V_{SSA} | 5 | Analog Ground: V_{SSA} is the ground for analog circuits. It is important to have a separate path for each ground back to the system ground terminal to minimize noise. |
| MIC+ | 6 | Microphone Positive Input: The input transfers the signal to the preamplifier. The internal Automatic Gain Control (AGC) circuit controls the gain of the preamplifier. An external microphone should be AC coupled to this pin via a series capacitor. The capacitor value, together with an internal 10 K Ω resistance on this pin, determines the low-frequency cutoff for the ISD1600B passband. |
| MIC- | 7 | Microphone Negative Input: This is the inverting input to the microphone preamplifier. It provides input noise-cancellation, or common-mode rejection, when the microphone is connected differentially to the device. |
| SP- | 8 | Speaker Negative : The SP-, Class D PWM output, provides a differential output with SP+ pin to drive 8 Ω speaker or buzzer. During power down or recording, this pin is tri-stated. |
| V_{SSP} | 9 | PWM Ground: V_{SSP} is the ground for PWM speaker driver. It is important to have a separate path for each ground back to the system ground terminal to minimize noise. |

ISD1600B SERIES

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| PIN NAME | SOIC / PDIP | FUNCTIONS |
|-------------------------|-------------|---|
| | PIN NO. | |
| V _{CCA} | 10 | Analog power supply: It is important to have a separate path for each power back to the power terminal to minimize the noises. Decoupling capacitors to V _{SSA} should be as close to the device as possible. |
| V _{CCP} | 10 | V_{CCP}: Power supply for PWM speaker drivers. It is important to have a separate path for each power back to the power terminal to minimize noise. Decoupling capacitors to V _{SSP} should be as close to the device as possible. |
| SP+ | 11 | Speaker Positive : The SP+, Class D PWM output, provide a differential output with SP- pin to drive an 8Ω speaker or buzzer directly. During power down or recording, this pin is tri-stated. |
| AGC | 12 | Automatic Gain Control: The AGC dynamically adjusts the gain of the preamplifier to compensate the wide range of microphone input levels. The AGC allows the full range of signal to be recorded with minimal distortion. Nominal values of 4.7 μF give satisfactory results in most cases. Connecting this pin to ground provides maximum gain to the preamplifier circuitry. Conversely, connecting this pin to power supply provides minimum gain to the preamplifier circuitry. |
| AUD | 13 | AUD: The AUD provides a single-ended current output to drive an external amplifier. During standby or recording, this pin is tri-stated. |
| R _{OSC} | 14 | Oscillator Resistor: This enables the user to vary the record and/or playback duration of the device. A resistor connected between the R _{OSC} pin and V _{SSA} determines the sample frequency for the ISD1600B device. Please refer to the Duration Section in Section 6.1. |
| V _{CCD} | 15 | Digital power supply: It is important to have a separate path for each power back to the power terminal to minimize noise. Decoupling capacitors should be as close to the device as possible. |
| $\overline{\text{LED}}$ | 16 | LED output: This pin is Low during a record cycle and blinks during playback cycle. It can be used to drive an LED to indicate either a record or playback cycle is in progress. |

Note: ⁽¹⁾ 600kΩ (typical).

6. FUNCTIONAL DESCRIPTION

6.1. DETAILED DESCRIPTION

6.1.1 Audio Quality

Nuvoton's patented ChipCorder[®] MLS technology provides natural high quality record and playback solution on a single chip. The input audio signals are stored directly into the non-volatile memory and are reproduced in its natural form without any compression artifacts caused by the digital speech solutions. A complete sample is stored in a single cell, minimizing the memory needed to store a single message.

6.1.2 Duration

The ISD1600B series offer single-chip solution with record & playback duration from 6.6 seconds to 40 seconds. Sampling frequency and duration are determined by an external resistor connected to the Rosc pin.

| Sampling Frequency | Rosc | ISD1610B | ISD1612B | ISD1616B | ISD1620B |
|--------------------|----------------|-----------|----------|-----------|-----------|
| 12 KHz | 53 k Ω | 6.6 secs | 8 secs | 10.6 secs | 13.3 secs |
| 8 KHz | 80 k Ω | 10 secs | 12 secs | 16 secs | 20 secs |
| 6.4 KHz | 100 k Ω | 12.5 secs | 15 secs | 20 secs | 25 secs |
| 5.3 KHz | 120 k Ω | 15 secs | 18 secs | 24 secs | 30 secs |
| 4 KHz | 160 k Ω | 20 secs | 24 secs | 32 secs | 40 secs |

6.1.3 Flash Storage

The ISD1600B product utilizes the on-chip Flash memory providing zero-power message storage. The message is retained for up to 100 years without power. In addition, the device can be re-recorded typically over 100,000 times.

6.1.4 Basic Operation

The ISD1600B ChipCorder[®] device is controlled by either the $\overline{\text{REC}}$, or one of the two playback modes, $\overline{\text{PLAYE}}$ and $\overline{\text{PLAYL}}$. The ISD1600B parts are configured for simple design in single-message application. Detailed operations are explained in Section 6.2.

6.1.5 Automatic Power-Down Mode

At the end of a playback or record cycle, the ISD1600B device automatically enters into a low-power mode, consuming typically 1 μ A, provided that $\overline{\text{PLAYE}}$, $\overline{\text{PLAYL}}$ and $\overline{\text{REC}}$ are High (see DC parameters Section). 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 released to High.

6.2. FUNCTIONAL DESCRIPTION EXAMPLE

The following example operating sequences demonstrate the functionality of the ISD1600B series.

6.2.1. Record a Message

The device starts recording from the beginning of the memory when $\overline{\text{REC}}$ transits from High to Low and stays at Low. A record cycle is completed when $\overline{\text{REC}}$ is pulled to High or entire memory is filled up. Then an End-of-Message (EOM) marker is written at the end of message, enabling a subsequent playback cycle to terminate appropriately. Hence, the device automatically enters into standby mode.

Record takes precedence over playback operation. If $\overline{\text{REC}}$ is pulled Low during a playback cycle, the playback immediately halts and recording starts from the beginning of the memory.

Holding $\overline{\text{REC}}$ Low after recording will increase standby current consumption.

6.2.2. Edge-trigger Playback

A playback operation starts from the beginning of the memory when $\overline{\text{PLAYE}}$ detects a low going signal exceeding the specified debounced time. Playback continues until an EOM marker is encountered. Upon completion of a playback cycle, the device automatically enters into standby mode.

During playback, a subsequent low going signal will terminate the current playback operation.

Holding this pin Low after playback operation will increase standby current consumption.

6.2.3. Level- trigger Playback

When $\overline{\text{PLAYL}}$ switches from High to Low and stays at Low, a playback starts from the beginning of the memory until either an EOM marker is reached, then it automatically powers down.

If $\overline{\text{PLAYL}}$ is pulled High at any time during playback, the playback operation stops immediately and the device enters into the power-down mode.

6.2.4. LED Operation

The $\overline{\text{LED}}$ is Low during recording, which turns on an LED as a recording indicator. However, during playback, the LED blinks a few times per second to indicate a playback operation. It returns to a High when operation stops.

6.2.5. R_{OSC} Operation

The duration can be varied by changing the value of R_{OSC}. This means the designer has the flexibility to choose different sampling frequency, up to 12 KHz, depending upon the needs.

This feature allows frequency shifting where a recorded audio can be played back faster or slower than normal for special sound effects.

Another feature is a "Pause" function that can be activated by taking the R_{OSC} resistor to V_{CC} to stop playback momentarily, and to resume when the resistor is switched back to ground.

7. TIMING DIAGRAMS

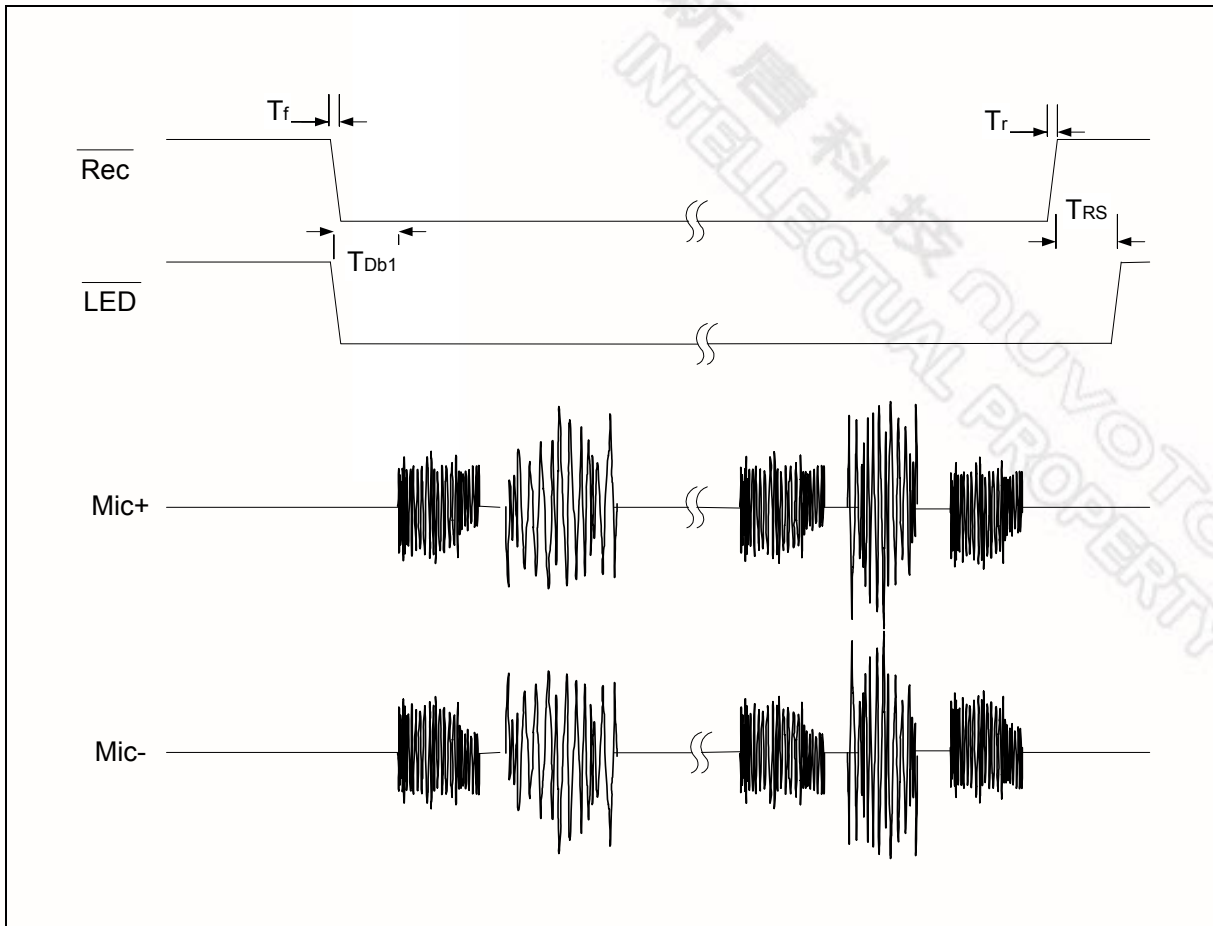


FIGURE 1: RECORD OPERATION

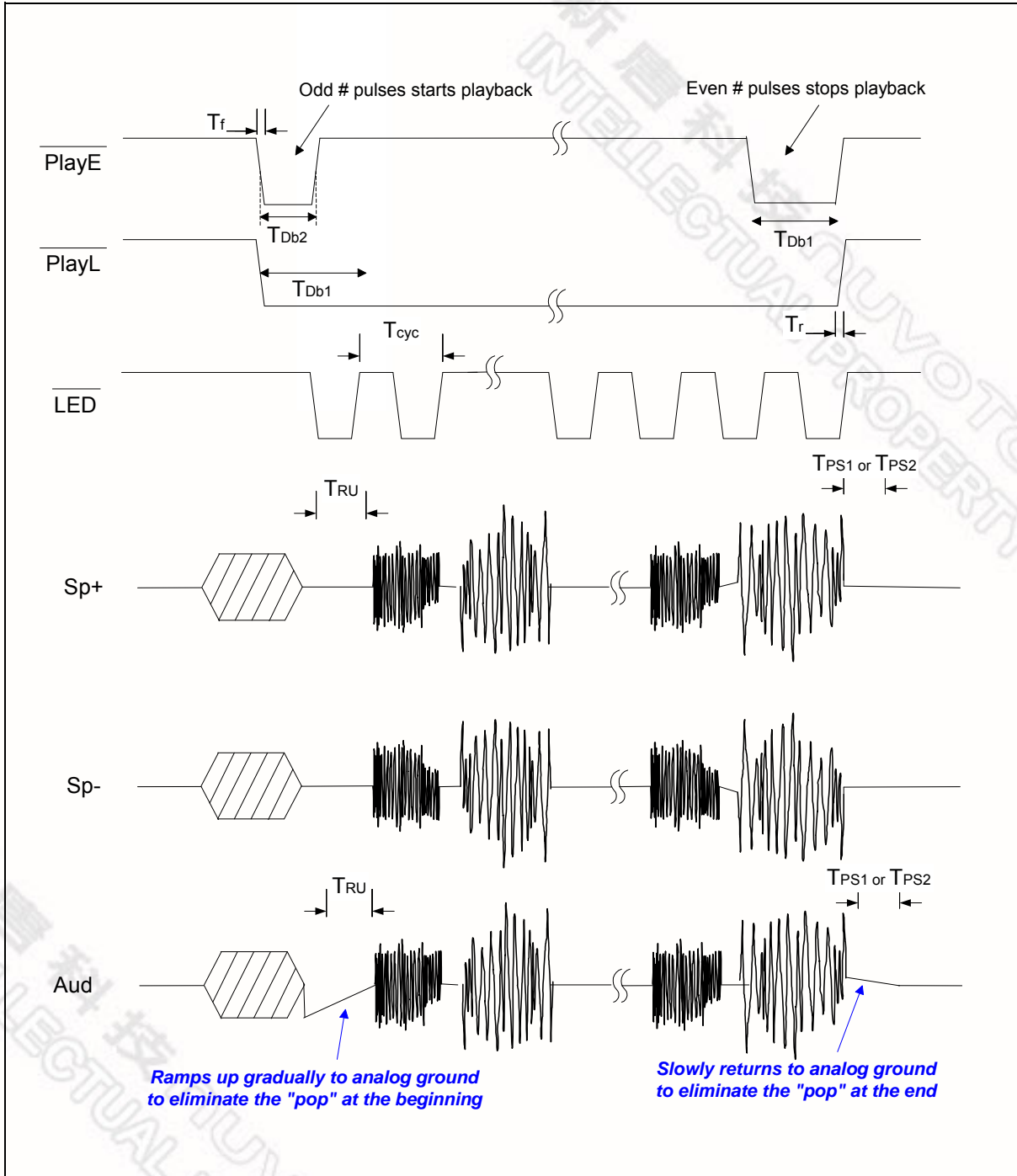


FIGURE 2: PLAYBACK OPERATION

8. ABSOLUTE MAXIMUM RATINGS

ABSOLUTE MAXIMUM RATINGS (DIE)

| CONDITIONS ^[1] | VALUES |
|--|--|
| Junction temperature | 150°C |
| Storage temperature range | -65°C to +150°C |
| Voltage applied to all pins | (V _{SS} -0.3V) to (V _{DD} +0.3V) |
| Power supply voltage to ground potential | -0.3V to +7.0V |

ABSOLUTE MAXIMUM RATINGS (PACKAGED PARTS)

| CONDITIONS ^[1] | VALUES |
|--|--|
| Junction temperature | 150°C |
| Storage temperature range | -65°C to +150°C |
| Voltage applied to all pins | (V _{SS} -0.3V) to (V _{DD} +0.3V) |
| Lead temperature (Soldering – 10 sec) | 300°C |
| Power supply voltage to ground potential | -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.

8.1 OPERATING CONDITIONS

OPERATING CONDITIONS (DIE)

| CONDITIONS | VALUES |
|--|--|
| Operating temperature range | 0°C to +50°C |
| Supply voltage (V_{DD}) ^[1] | +2.4V to +5.5V |
| Ground voltage (V_{SS}) ^[2] | 0V |
| Input voltage (V_{DD}) ^[1] | 0V to 5.5V |
| Voltage applied to any pins | ($V_{SS} - 0.3V$) to ($V_{DD} + 0.3V$) |

OPERATING CONDITIONS (PACKAGED PARTS)

| CONDITIONS | VALUES |
|--|--|
| Operating temperature range (Case temperature) | -40°C to +85°C |
| Supply voltage (V_{DD}) ^[1] | +2.4V to +5.5V |
| Ground voltage (V_{SS}) ^[2] | 0V |
| Input voltage (V_{DD}) ^[1] | 0V to 5.5V |
| Voltage applied to any pins | ($V_{SS} - 0.3V$) to ($V_{DD} + 0.3V$) |

^[1] $V_{DD} = V_{CCA} = V_{CCD} = V_{CCP}$

^[2] $V_{SS} = V_{SSA} = V_{SSD} = V_{SSP}$

9. ELECTRICAL CHARACTERISTICS

9.1. DC PARAMETERS

| PARAMETER | SYMBOL | MIN | TYP ^[1] | MAX | UNITS | CONDITIONS | |
|---------------------------|---------------------------------------|----------------------|--------------------|---------------------|-------|--|------------------------|
| Supply Voltage | V _{DD} | 2.4 | | 5.5 | V | | |
| Input Low Voltage | V _{IL} | V _{SS} -0.3 | | 0.3xV _{DD} | V | | |
| Input High Voltage | V _{IH} | 0.7xV _{DD} | | V _{DD} | V | | |
| Output Low Voltage | V _{OL} | V _{SS} -0.3 | | 0.3xV _{DD} | V | I _{OL} = 4.0 mA ^[2] | |
| Output High Voltage | V _{OH} | 0.7xV _{DD} | | V _{DD} | V | I _{OH} = -1.6 mA ^[2] | |
| Record Current | I _{DD_Record} | | | 20 | mA | V _{DD} = 5.5V, No load, Sampling freq = 12 kHz | |
| Playback Current | I _{DD_Playback} | | | 20 | mA | | |
| Standby Current | I _{SB} | | 1 | 10 | μA | ^[3] ^[4] | |
| Input Leakage Current | I _{ILPD1} | | | ±1 | μA | Force V _{DD} ^[5] | |
| Input Current HIGH | I _{ILPD2} | -3 | | -10 | μA | Force V _{SS} ^[5] | |
| Preamp Input Resistance | R _{MIC+} , R _{MIC-} | | 20 | | KΩ | Across both pins | |
| MIC Input Voltage | V _{IN} | | 15 | 300 | mV | Peak-to-Peak ^[6] | |
| Gain from MIC to SP+/- | A _{MSP} | 6 | | 40 | dB | V _{IN} = 15 to 300mV, AGC = 4.7μF, V _{DD} = 2.4V to 5.5V | |
| Output Load Impedance | R _{EXT} | 8 | | | Ω | Speaker Load | |
| Speaker Output Power | P _{out} | | 670 | | mW | 15mVp-p 1kHz freq sinewave, R _{EXT} = 8Ω; | |
| | | | 313 | | mW | | V _{DD} = 5.5V |
| | | | 117 | | mW | | V _{DD} = 4.4V |
| | | | 49 | | mW | | V _{DD} = 3V |
| Speaker Output Voltage | V _{out} | | V _{DD} | | V | R _{EXT} = 8Ω (Speaker), typical buzzer | |
| AUD | I _{AUD} | | -3.0 | | mA | V _{DD} = 4.5V, R _{EXT} = 390Ω | |
| Total Harmonic Distortion | THD | | 1 | | % | 15mV p-p 1kHz sinewave, Cmessage weighted | |

Notes: ^[1] Conditions: V_{CC} = 4.5V, 8kHz sampling frequency and T_A = 25°C, unless otherwise stated.

^[2] LED output during Record operation.

^[3] V_{CCA}, V_{CCD} and V_{CCP} are connected together. V_{SSA}, V_{SSP} and V_{SSD} are connected together.

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

^[5] $\overline{\text{REC}}$, $\overline{\text{PLAYE}}$ and $\overline{\text{PLAYL}}$ are forced to specified condition.

^[6] Balanced input signal applied between MIC and MIC REF as shown in the applications example. Single-ended MIC or MIC REF recommended to be less than 100 mV peak to peak.

9.2. AC PARAMETERS

| CHARACTERISTIC | SYMBOL | MIN | TYP ^[1] | | | | MAX | UNITS | CONDITIONS | |
|-----------------------------------|------------------|------|----------------------|---------------|---------------|---------------|-----|-----------|----------------------------|----------------------------|
| Sampling Frequency ^[2] | F _S | 4 | | | | | 12 | KHz | V _{CC} =2.4V~5.5V | |
| Duration ^[3] | Dur | | I1610B | I1612B | I1616B | I1620B | | | | |
| | | 6.6 | 8 | 10.6 | 13.3 | | Sec | SF=12kHz | V _{CC} =2.4V~5.5V | |
| | | 10 | 12 | 16 | 20 | | Sec | SF=8kHz | | |
| | | 12.5 | 15 | 20 | 25 | | Sec | SF=6.4kHz | | |
| | | 15 | 18 | 24 | 30 | | Sec | SF=5.3kHz | | |
| | | 20 | 24 | 32 | 40 | | Sec | SF=4kHz | | |
| Rising time | T _r | 0 | | | | | 100 | nsec | | |
| Falling Time | T _f | 0 | | | | | 100 | nsec | | |
| Debounce Time (Record & PlayL) | T _{Db1} | | 26.6 | 26.6 | 26.6 | 26.6 | | msec | SF=12kHz | V _{CC} =2.4V~5.5V |
| | | | 40 | 40 | 40 | 40 | | msec | SF=8kHz | |
| | | | 50 | 50 | 50 | 50 | | msec | SF=6.4kHz | |
| | | | 60.4 | 60.4 | 60.4 | 60.4 | | msec | SF=5.3kHz | |
| | | | 80 | 80 | 80 | 80 | | msec | SF=4kHz | |
| Debounce Time (PlayE) | T _{Db2} | | 13.3 | 13.3 | 13.3 | 13.3 | | msec | SF=12kHz | V _{CC} =2.4V~5.5V |
| | | | 20 | 20 | 20 | 20 | | msec | SF=8kHz | |
| | | | 25 | 25 | 25 | 25 | | msec | SF=6.4kHz | |
| | | | 30.2 | 30.2 | 30.2 | 30.2 | | msec | SF=5.3kHz | |
| | | | 40 | 40 | 40 | 40 | | msec | SF=4kHz | |
| Signal Ramp Up Time | T _{RU} | 100 | | | | | | msec | V _{CC} =2.4V~5.5V | |
| Record Stop Time | T _{RS} | | 2 Sample Clock | | | | | | V _{CC} =2.4V~5.5V | |
| PlayL Stop Time | T _{PS1} | | T _{Db1} | | | | | msec | V _{CC} =2.4V~5.5V | |
| PlayE Stop Time | T _{PS2} | | 2 X T _{Db1} | | | | | msec | V _{CC} =2.4V~5.5V | |
| LED Cycle frequency | T _{Cyc} | 1 | | | | | 6 | Hz | Playback at any SF | |

Notes:

^[1] Typical values : V_{CC} = 4.5V, sampling frequency (SF) = 8 kHz and @ T_A = 25°C, unless otherwise stated.

^[2] Sampling Frequency can vary as much as ±2.25 percent over the commercial temperature and voltage ranges, and -6/+4 percent over the industrial temperature and voltage ranges.

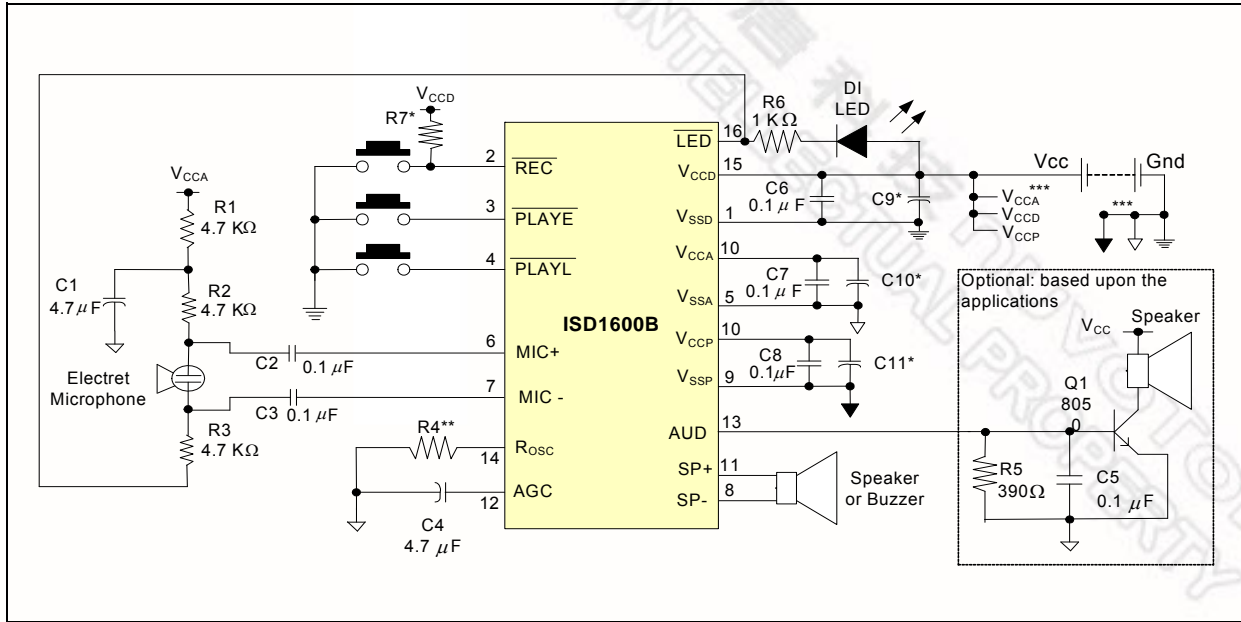
^[6] Duration can vary as much as ±2.25 percent over the commercial temperature and voltage ranges, and -6/+4 percent over the industrial temperature and voltage ranges.

ISD1600B SERIES



10. TYPICAL APPLICATION CIRCUIT

The below example illustrates a typical applications of ISD1600B device.



Schematic shows both speaker and AUD outputs

Notes:

- * These components may be needed in order to optimize for the best voice quality and system performance, which is also dependent upon the layout of the PCB. Pending upon system requirement, Cx can be 10 μ F, 4.7 μ F or other values. For R7, 1k Ω gives satisfactory result for most cases.
- ** For Sampling Freq at 8 kHz, R4 = 80 K Ω
- *** It is important to have a separate path for each ground and power back to related terminal to minimize the noise. Also, the power supplies should be decoupled as close to the device as possible.

Good Audio Design Practices

Nuvoton's ChipCorder are very high-quality single-chip voice recording and playback devices. To ensure the highest quality voice reproduction, it is important that good audio design practices on layout and power supply decoupling are followed. See Application Information links below for details.

Design considerations for ISD1600B Series

http://www.nuvoton-usa.com/products/isd_products/chipcorder/applicationbriefs/AN-CC1001.pdf

Good Audio Design Practices

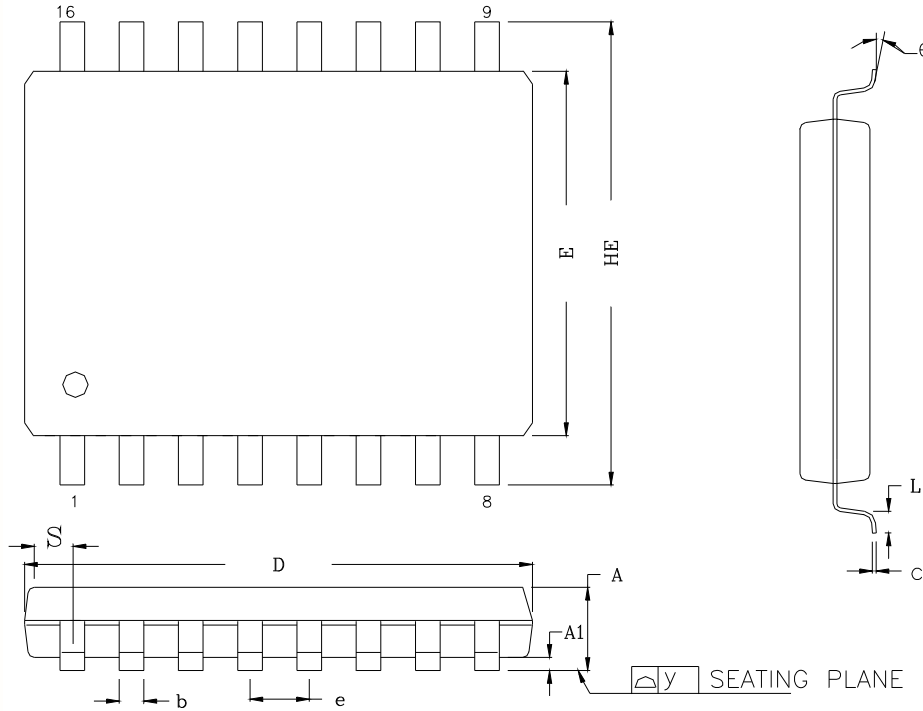
http://www.nuvoton-usa.com/products/isd_products/chipcorder/applicationinfo/apin11.pdf

Single-Chip Board Layout Diagrams

http://www.nuvoton-usa.com/products/isd_products/chipcorder/applicationinfo/apin12.pdf

11. PACKAGE DRAWING AND DIMENSIONS

11.1. 16-Lead 150mil Small Outline Integrated Circuit (SOIC) Package

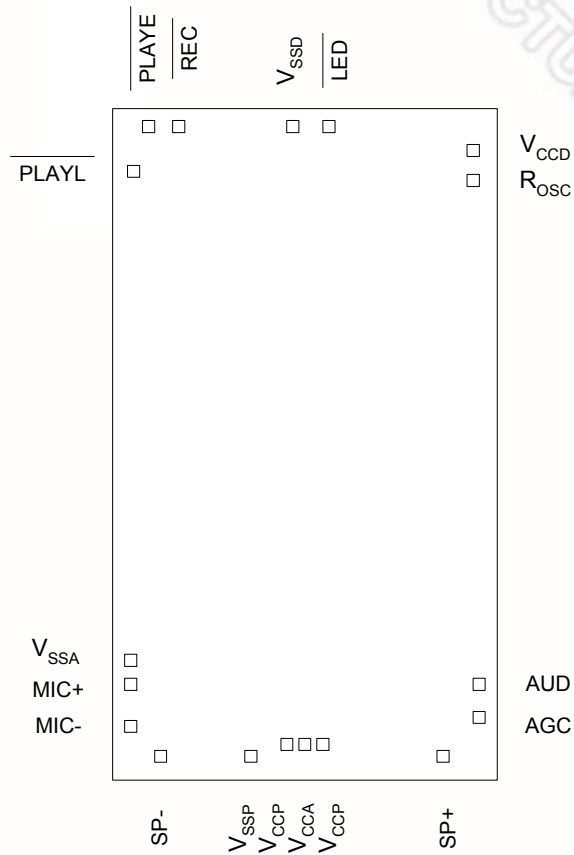


COTROL DIMENSIONS ARE IN MILLIMETERS.

| SYMBOL | MILLIMETER | | | INCH | | |
|--------|------------|------|-------|-------------|------|--------|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 1.35 | — | 1.75 | 0.053 | — | 0.069 |
| A1 | 0.10 | — | 0.25 | 0.004 | — | 0.010 |
| b | 0.33 | — | 0.51 | 0.013 | — | 0.020 |
| c | 0.19 | — | 0.25 | 0.008 | — | 0.010 |
| D | 9.8 | — | 10.00 | 0.386 | — | 0.394 |
| E | 3.8 | — | 4.0 | 0.150 | — | 0.157 |
| e | 1.27 BASIC | | | 0.050 BASIC | | |
| HE | 5.8 | — | 6.20 | 0.228 | — | 0.244 |
| θ | 0° | — | 8° | 0° | — | 8° |
| L | 0.40 | — | 1.27 | 0.016 | — | 0.050 |
| S | 0.394 | — | 0.648 | 0.0155 | — | 0.0255 |
| y | — | — | 0.10 | — | — | 0.004 |

11.2. Die Physical Layout

ISD1610B / 1612B / 1616B / 1620B



Notes:

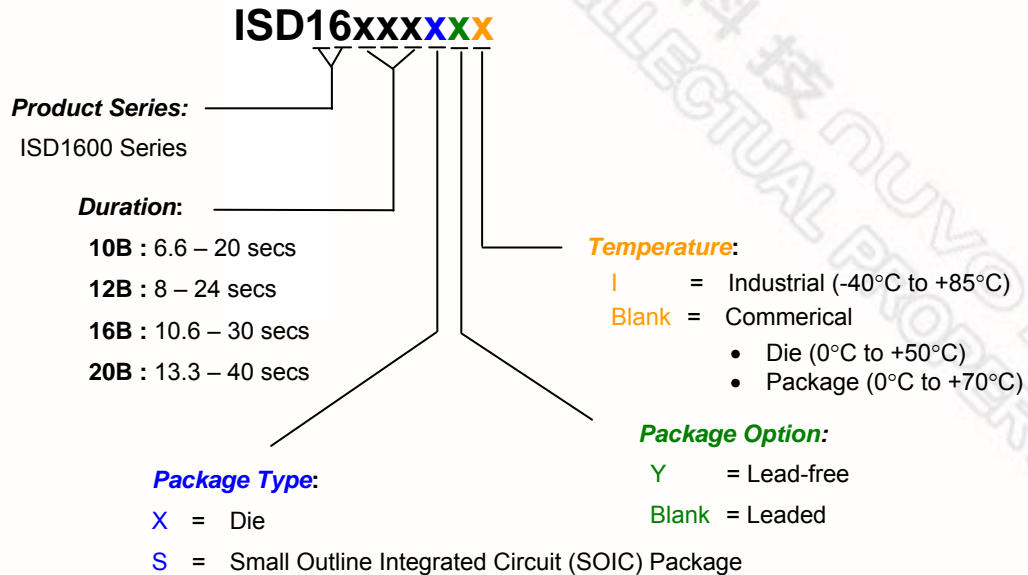
1. The backside of die is internally connected to V_{SSA} . It **MUST NOT** be connected to any other potential or damage may occur.
2. For package, V_{CCA} and V_{CCP} pads are bonded together to one pin.

ISD1600B SERIES



12. ORDERING INFORMATION

Product Number Descriptor Key



When ordering, please refer to the following valid part numbers that are supported in volume for this product series. Contact the local Nuvoton Sales Representative or Distributor for availability information.

For the latest product information, access Nuvoton's worldwide website at <http://www.nuvoton-usa.com>

13. VERSION HISTORY

| VERSION | DATE | DESCRIPTION |
|---------|----------|--|
| A1 | Apr 2005 | Initial version |
| 1 | Jan 2006 | Change to Preliminary Update Ordering info with Pb-free option |
| 1.1 | Apr 2006 | Update application diagram |
| 1.2 | Jan 2007 | Update Rosc resistor value Revise automatic power down mode Update standby current parameter Revise die physical layout section |
| 1.21 | Nov 2008 | Update Application Circuit in Section 10 Remove PDIP package information Change to Nuvoton Logo |
| 1.22 | Dec 2008 | Remove vAlert feature |

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Publication Release Date: Dec. 01, 2008

Revision 1.22