ISD18B00

SINGLE-CHIP, SINGLE-MESSAGE

VOICE RECORD/PLAYBACK DEVICE

新唐科技 NUVOTON INTELLECTUAL PROPERTY

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1. GENERAL DESCRIPTION

Nuvoton's ISD18B00 ChipCorder® Series is a single-chip single-message record/playback device with a special TryMe feature. It features wide operating voltage range, from 2.4V to 5.5V. Its sampling frequency, ranging from 4kHz to 8kHz, is externally controlled via resistor at Rosc pin. This device also includes microphone amplifier, anti-aliasing filter, multilevel storage array, smoothing filter and speaker amplifier. Two external resistors are used to adjust the microphone amplifier gain for the incoming signal. Thus, 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 non-volatile memory, providing zero-power message storage. This unique, single-chip solution is made possible through Nuvoton's patented Multi-Level Storage technology. Voice and audio signals are stored directly into memory in their natural form, providing high-quality, solid-state voice reproduction. The device is automatically power down after each operation cycle with typical standby current 1μA. With the embedded Flash memory employed, data retention up to 100 years and typical 100,000 erase/record cycles can be reached.

2. FEATURES

- Supply voltage: 2.4V to 5.5V
- User-selected sampling frequency via external resistor

Sampling Frequency	8 kHz	6.4 kHz	5.3 kHz	4 kHz
Rosc	80 KΩ	100 KΩ	120 KΩ	160 KΩ

- Variable duration selected by external resistor:

Sampling Frequency	8 kHz	6.4 kHz	5.3 kHz	4 kHz
ISD18B12	6 secs	7.5 secs	9 secs	12 secs
ISD18B24	12 secs	15 secs	18 secs	24 secs

- $\overline{\text{RECL}}$: Level recording
- $\overline{\text{RECE}}$: Edge-trigger, toggle on-off
- $\overline{\text{PLAYL}}$: Level playback or looping playback
- $\overline{\text{PLAYE}}$: Edge-trigger, toggle on-off
- $\overline{\text{LEDR}}$: LED output for recording
- $\overline{\text{LEDP}}$: LED output for playback
- $\overline{\text{FT}}$: Feed-through microphone input to speaker outputs
- Microphone amplifier gain: user control via two external resistors
- With feed-through enabled, record microphone signal into memory while feed-through path remains active
- Playback takes precedence over the Recording operation
- **TryMe** : TryMe special mode
- Package option: die only
- Temperature options: 0°C to +50°C

3. BLOCK DIAGRAM

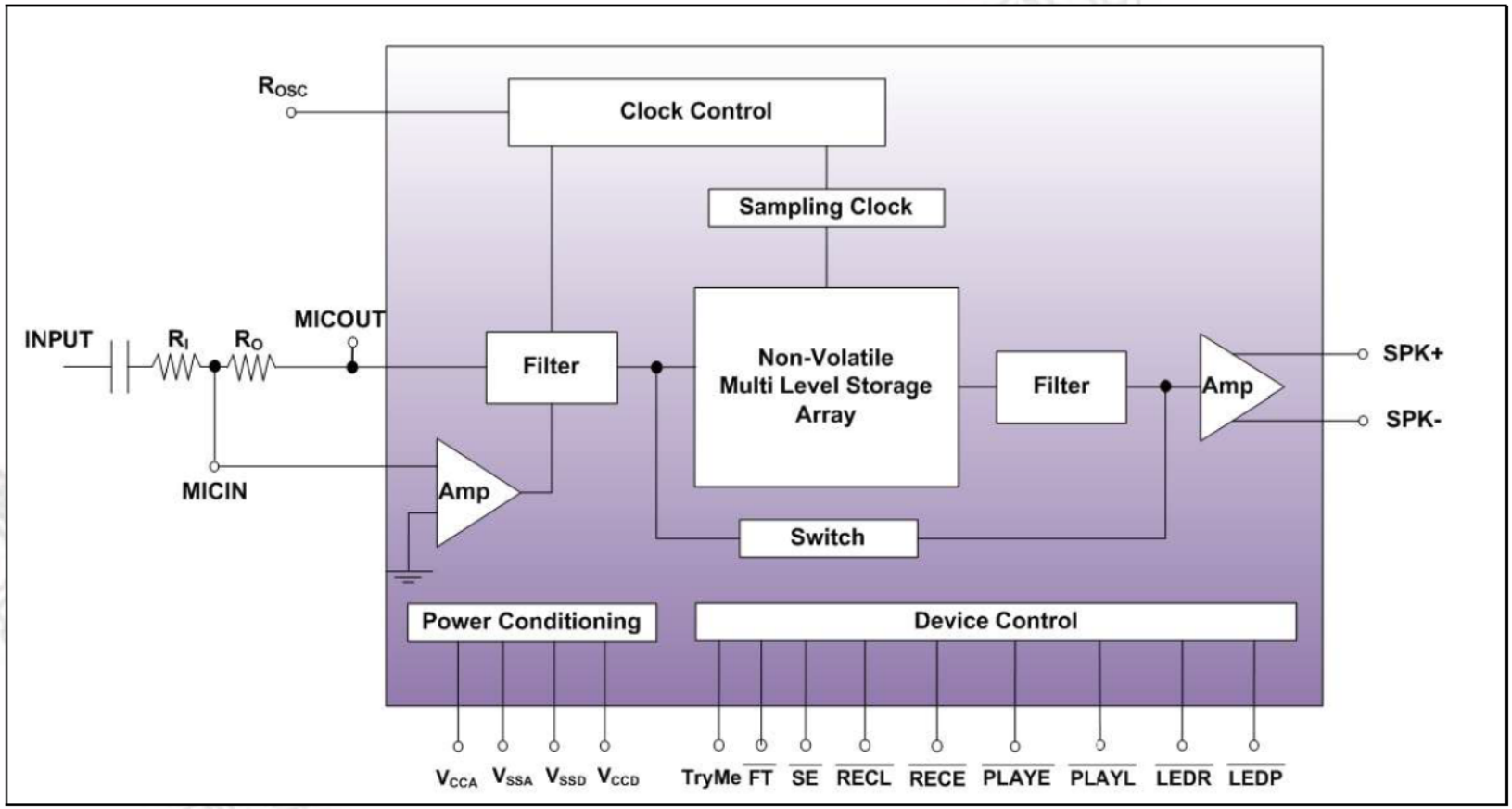


Figure 3-1 Block Diagram

4. PAD DESCRIPTION

PAD NAME	I / O	FUNCTION
V_{SSD}	I	**Digital Ground**: Ground path for digital circuits.
$\overline{\text{RECL}}$	I	**Level-Triggered Record**: Low active input, Level-hold.
$\overline{\text{PLAYE}}$	I	**Edge-Triggered Playback**: Low active input, Edge-trigger, toggle on-off.
$\overline{\text{PLAYL}}$	I	**Level-Triggered Playback**: Low active input, Level-hold.
$\overline{\text{RECE}}$	I	**Edge-Triggered Record**: Low active input, Edge-trigger, toggle on-off.
NC	--	NC: No Connect
NC	--	NC: No Connect
NC	--	NC: No Connect
NC	--	NC: No Connect
MICIN	I	**Microphone Input**: The MICIN transfers input signal to the on-chip microphone amplifier.
NC	--	NC: No Connect
MICOUT	O	**Microphone Output**: Output of the microphone amplifier.
NC	--	NC: No Connect
NC	--	NC: No Connect
SPK-	O	**SPK-**: The negative signal of the differential speaker outputs.
V_{SSA}	I	**Analog Ground**: Ground path for analog circuits.
SPK+	O	**SPK+**: The positive signal of the differential speaker outputs.
V_{CCA}	I	**Power Supply**: Power supply for analog circuits.
Rosc	I	**Oscillator Resistor**: Connect an external resistor from this pin to V_{SSA} to select the sampling frequency
$\overline{\text{FT}}$	I	**Feed-Through (FT)**: Low active input, Level-hold, Feed-through microphone input to speaker outputs while in active state.
NC	--	NC: No Connect
NC	--	NC: No Connect
TryMe	I	**TryMe Mode** : High active input, Level-hold. A special operating mode. Tied to $\overline{\text{RECL}}$ or $\overline{\text{RECE}}$ for normal operations. Tide to V_{CCD} or leave unconnected for TryMe mode.
$\overline{\text{LEDP}}$	O	**LED output for Playback**: During playback, this output is Low.
NC	--	NC: No Connect
$\overline{\text{SE}}$	I	**Sound Effect**: Low active input, Level-hold, optional beeping sound effect. Tied to $\overline{\text{LEDR}}$ to activate sound effect during record. Tied to V_{CCD} if no sound effect desired.
V_{CCD}	I	**Power Supply**: Power supply for digital circuits.

$\overline{\text{LEDR}}$	O	**LED output for Recording**: During recording, this output is Low.

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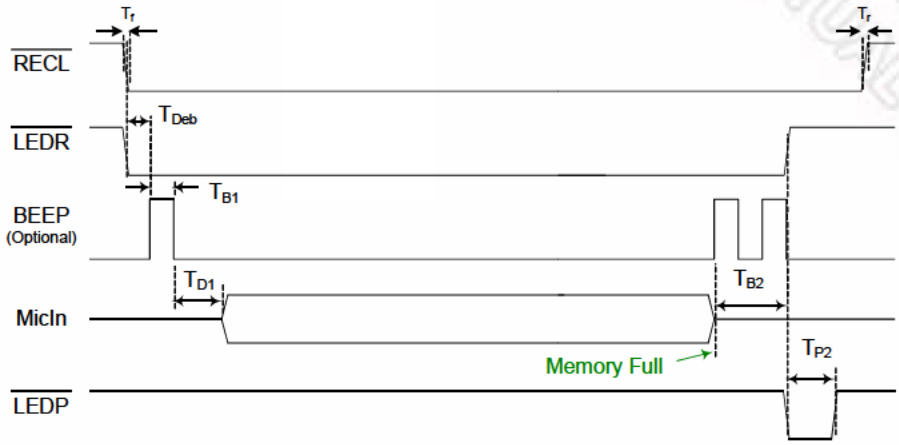
5. FUNCTIONAL DESCRIPTION

For the following related operations, if SE is not enabled, then no beep sound is heard. Also, the timing diagrams may not be in direct proportional scale.

5.1. Level-triggered Record ($\overline{\text{RECL}}$) Operation:

- Recording starts from beginning of the memory and $\overline{\text{LEDR}}$ is on.
- Recording ceases whenever $\overline{\text{RECL}}$ returns to High or when end of memory is reached and $\overline{\text{LEDR}}$ is off.
- Then device will automatically power down.

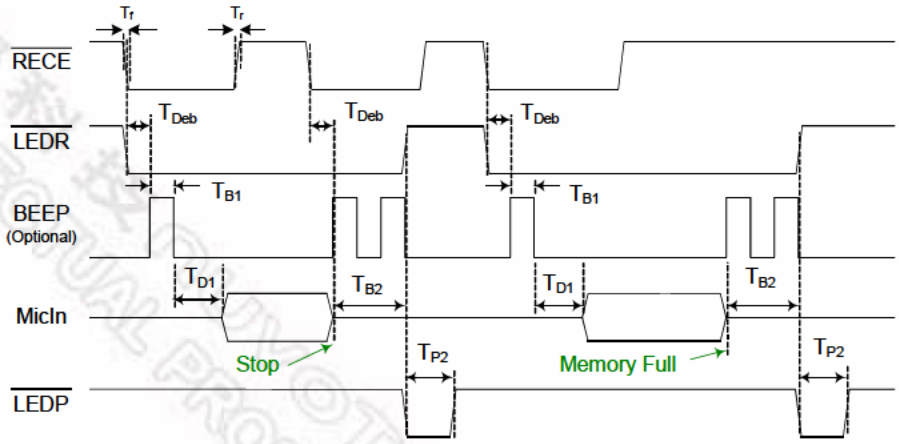
Fig. 1: Record–Level ($\overline{\text{RECL}}$) function till memory full



5.2. Edge-triggered Record ($\overline{\text{RECE}}$)Operation:

- Recording starts from beginning of the memory and $\overline{\text{LEDR}}$ is on.
- Recording ceases whenever a subsequent trigger occurs at $\overline{\text{RECE}}$ or when end of memory is reached and $\overline{\text{LEDR}}$ is off.
- Then device will automatically power down.

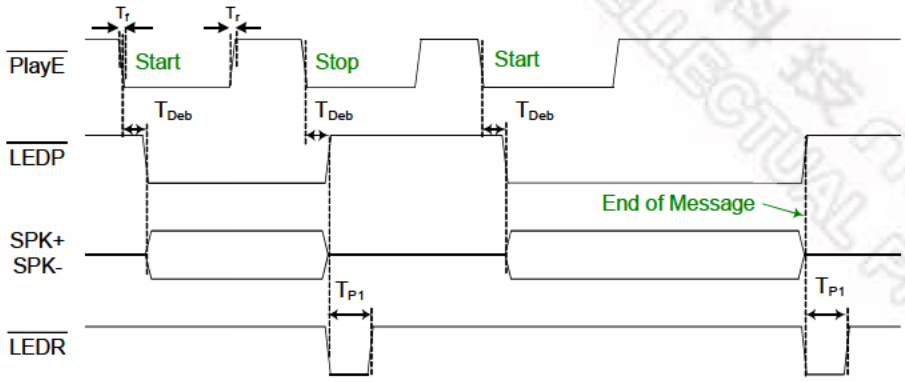
Fig. 2: Record–Edge ($\overline{\text{RECE}}$) function with on-off



5.3. Edge-triggered playback ($\overline{\text{PLAYE}}$) Operation:

- Playback starts from beginning of the memory and $\overline{\text{LEDP}}$ is on.
- Playback stops whenever end of message or a subsequent trigger occurs and $\overline{\text{LEDP}}$ is off.
- Then device will automatically power down.

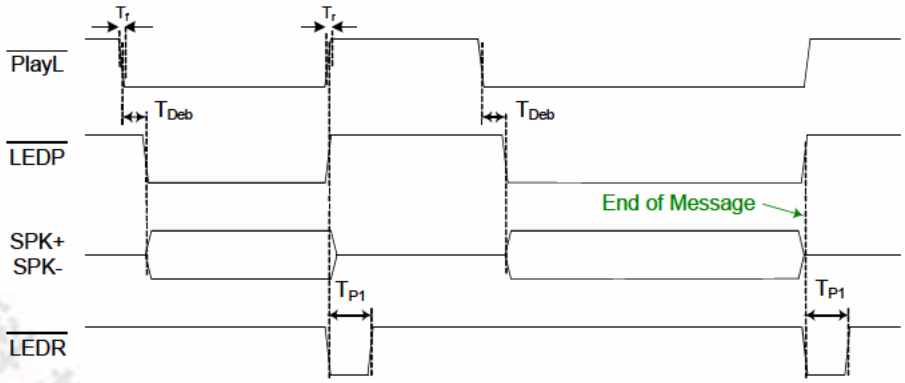
Fig. 3 : Playback–Edge ($\overline{\text{PLAYE}}$) function



5.4. Level- triggered playback ($\overline{\text{PLAYL}}$)Operation:

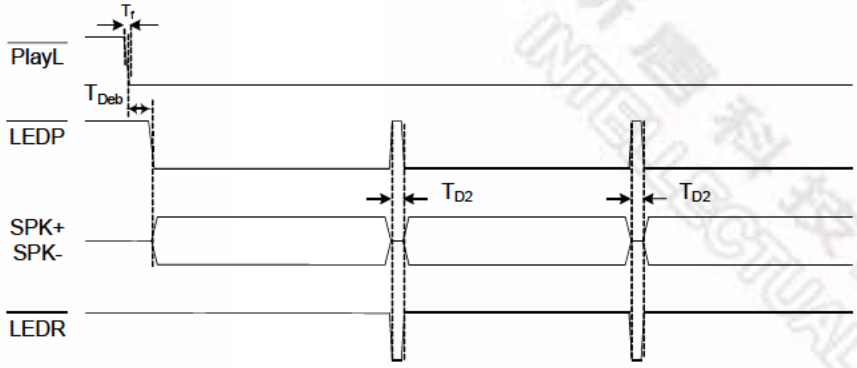
- Playback starts from beginning of the memory and $\overline{\text{LEDP}}$ is on.
- Playback stops whenever an EOM marker is reached or $\overline{\text{PLAYL}}$ returns to High and $\overline{\text{LEDP}}$ is off.
- Then device will automatically power down.

Fig. 4: Playback–Level ($\overline{\text{PLAYL}}$) function



- Holding $\overline{\text{PLAYL}}$ Low constantly will perform looping playback function.

Fig. 5: Looping playback function via $\overline{\text{PLAYL}}$



5.5. Sound Effect ($\overline{\text{SE}}$) Operation:

- Beeping feature for recording. Once active, one-beep indicates the start of recording and two-beep represents the end of recording.

5.6. Microphone amplifier gain

- Two external resistors, R_I and R_O, are used to adjust the microphone amplifier gain with respect to the incoming signal.

5.7. Playback (supersedes Record) Operation :

- Playback takes precedence over the Recording operation.
- If either $\overline{\text{PLAYE}}$ or $\overline{\text{PLAYL}}$ is activated during a recording cycle, the recording immediately ceases and playback of the just-recorded message performs accordingly.

5.8. Feed-Through mode Operation:

- As $\overline{\text{FT}}$ is held Low, the input signal from MICIN will directly transmit to the speaker outputs.
- If either $\overline{\text{RECE}}$ is triggered or $\overline{\text{RECL}}$ is held Low simultaneously after $\overline{\text{FT}}$ is enabled, then input signal will be recorded into memory while the Feed-Through mode is still on.
- After $\overline{\text{FT}}$ is enabled, activating either $\overline{\text{PLAYE}}$ or $\overline{\text{PLAYL}}$ will first disable the feed-through path and play the recorded message. Once playback is completed, the feed-through feature resumes.

5.9. $\overline{\text{LEDR}}$ Operation:

- $\overline{\text{LEDR}}$ stays on during recording.
- Also, $\overline{\text{LEDR}}$ pulses Low momentarily at the end of playback operation.

5.10. $\overline{\text{LEDP}}$ Operation :

- $\overline{\text{LEDP}}$ stays on during playback.
- Also, $\overline{\text{LEDP}}$ pulses Low momentarily at the end of recording.

5.11. Rosc Operation:

- When the R_{OSC} varies from 80 KΩ to 160 KΩ, the sampling rate changes from 8 kHz to 4 kHz accordingly.
- When R_{OSC} resistor value is changed during playback, the tone of a recorded message will alter either faster or slower.

5.12. Speaker Outputs

- **SPK+** and **SPK-** are used to drive an 8Ω speaker differentially. They are tri-state while device is in power down status.

5.13. TryMe Special Operation:

This is a special feature. When **TryMe** is High, TryMe is active. When **TryMe** is Low, TryMe is disabled. The enabling and disabling of this feature is merely permitted while the device is in power down status. Once **TryMe** is set, trigger on either $\overline{\text{RECL}}$ or $\overline{\text{RECE}}$ will initiate the TryMe operation sequence. While active, the device performs a combination of the following 3 operations sequentially: record a new message, automatic playback the just-recorded message once, and then delete the recorded message. Internal pull-up exists.

The details of each operation are described as follows:

a) Recording:
   - The recording behavior follows the characteristics of the selected record pin, $\overline{\text{RECL}}$ or $\overline{\text{RECE}}$.
   - While recording, the $\overline{\text{LEDR}}$ is on if an LED is connected appropriately.

b) Playback:
   - Upon completion of recording, the device automatic plays the just-recorded message once and stops. During this operation, change of state on any control pins is prohibited.
   - While playback, the $\overline{\text{LEDP}}$ is on if an LED is connected appropriately.

c) Erasure:
   - Upon completion of playback, the device will involuntary delete the recorded message. During this operation, change of state on any control pins is banned.

After completion of this TryMe operation, the device returns to standby state automatically. Once playback operation starts, any input on other controls is illegal.

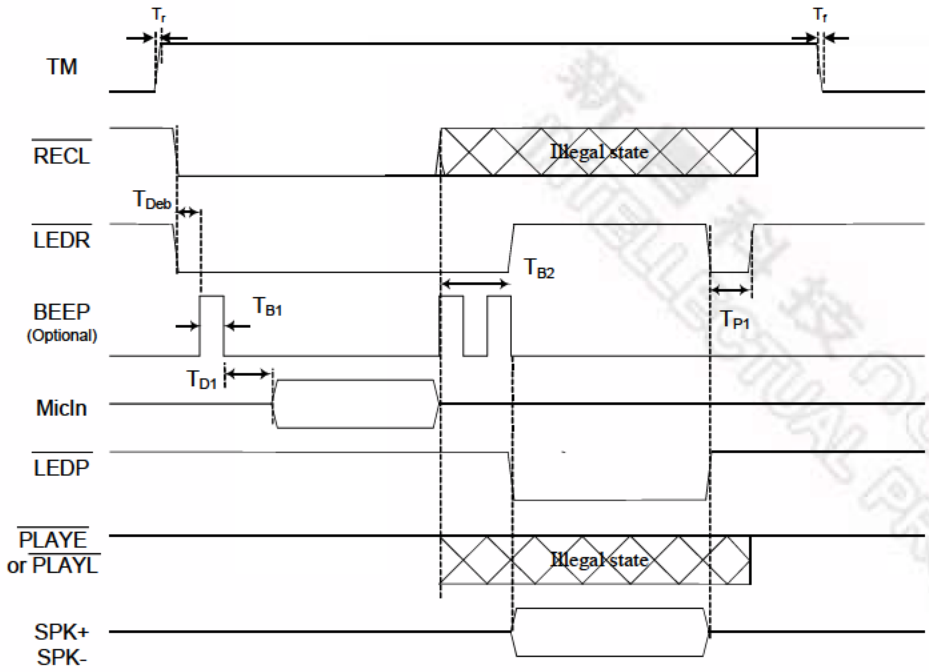
As a summary, the TryMe mode starts in the following conditions:

Pin	**TryMe**	$\overline{\text{RECL}}$	$\overline{\text{RECE}}$
Logic Level	1	0	1
	1	1	0

Under no circumstances, while this special operation is in progress, neither the power is disturbed nor any change of state on other control pins are permitted. Otherwise, it may cause the device becoming malfunction.

Fig 6: TryMe function via (**TryMe** + $\overline{\text{RECL}}$)

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5.14. Power interruption

- Any power interruption during an operation is **strongly** not recommended. If happened, it may result the device becoming malfunction.

5.15. Power-On to Playback Operation :

- If $\overline{\text{PLAYE}}$ or $\overline{\text{PLAYL}}$ is held at Low during power turns on, the device plays message accordingly with respect to which play control being employed.

5.16. Power-On to Loop Playback Operation :

- If $\overline{\text{PLAYL}}$ is hardwired to ground permanently, once power is on, the device performs looping playback non-stop. This status will sustain unless power is turned off.

5.17. Automatic Playback after Record Operation :

- If $\overline{\text{LEDP}}$ is connected to $\overline{\text{PLAYE}}$, after a record operation, then the device will automatic play message once, then powers down.

6. ABSOLUTE MAXIMUM RATINGS

ABSOLUTE MAXIMUM RATINGS [1]

CONDITION	VALUE
Junction temperature	150°C
Storage temperature range	-65°C to +150°C
Voltage applied to any pins	(V_{SS} – 0.3V) to (V_{CC} + 0.3V)
Voltage applied to Input pins (current limited to +/-20 mA)	(V_{SS} – 1.0V) to (V_{CC} + 1.0V)
Voltage applied to output pins (current limited to +/-20 mA)	(V_{SS} – 1.0V) to (V_{CC} + 1.0V)
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.

6.1 OPERATING CONDITIONS

OPERATING CONDITIONS

CONDITION	VALUE
Operating temperature range	0°C to +50°C
Operating voltage (V_{CC}) [1]	+2.4V to +5.5V
Ground voltage (V_{SS}) [2]	0V

[1] $V_{CC} = V_{CCA} = V_{CCD}$

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

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7. ELECTRICAL CHARACTERISTICS

7.1. DC PARAMETERS

PARAMETER	SYMBOL	MIN[2]	TYP[1]	MAX[2]	UNITS	CONDITIONS
Input Low Voltage	V_{IL}			0.3xVcc	V	
Input High Voltage	V_{IH}	0.7xVcc			V	
Output Low Voltage	V_{OL}			0.3xVcc	V	I_{OL} = 4.0 mA[3]
Output High Voltage	V_{OH}	0.7xVcc			V	I_{OH} = -1.6 mA[3]
Standby Current	I_{STBY}		1	10	µA	[4] [5]
Record Current	I_{REC}			15	mA	V_{CC} = 5.5V
Playback Current	I_{PLAY}			15	mA	V_{CC} = 5.5V, no speaker load
Pull-up device for $\overline{\text{RECL}}$, $\overline{\text{RECE}}$, $\overline{\text{PLAYE}}$, $\overline{\text{PLAYL}}$, $\overline{\text{FT}}$ & **TryMe** pins	R_{PU1}		40		kΩ	
Pull-up device for $\overline{\text{SE}}$	R_{PU2}		80		kΩ	
Output Load Impedance	R_{EXT}	8			Ω	Speaker load
MIC Input Voltage	V_{IN}	4		400	mV	Peak-to-peak
MIC Amplifier Gain	A_{MicAmp}	0		+34	dB	Depend on RO/RI
Gain from MIC to SP+/SP-	A_{MSP}	+12		+46	dB	Depend on RO/RI

Notes:

[1] Typical values @ T_A = 25°, V_{CC} = 5.5V and sampling frequency (Fs) at 8 kHz, unless stated.

[2] All Min/Max limits are guaranteed by design, electrical testing and/or characterization. Not all specifications are 100 percent tested.

[3] LED output during recording.

[4] V_{CCA} and V_{CCD} are connected together. Also, V_{SSA} and V_{SSD} are connected together.

[5] $\overline{\text{RECL}}$, $\overline{\text{RECE}}$, $\overline{\text{PLAYE}}$, $\overline{\text{PLAYL}}$, $\overline{\text{SE}}$, $\overline{\text{FT}}$ and **TryMe** must be at V_{CCD}. External components are biased under a separated power supply.

7.2. AC Parameters

CHARACTERISTIC	SYMBOL	MIN[2]	TYP[1]	MAX[2]	UNITS	CONDITIONS
Sampling Frequency	F_S	4		8	kHz	[3]
Record Duration	T_{REC}	6		12	sec	Depend on Fs [3]
Playback Duration	T_{PLAY}	6		12	sec	Depend on Fs [3]
Rising Time	T_r		100		nsec	[3]
Falling Time	T_f		100		nsec	[3]
Debounce Time	T_{Deb}	536k/FS			msec	[3] [4]
Beep Duration	T_{B1}		512k/FS		msec	[3] [4]
Beep-Beep Duration	T_{B2}		1536k/FS		msec	[3] [4]
Delay to start recording	T_{D1}		1552k/FS		msec	[3] [4]
Delay during looping	T_{D2}		1k/FS		msec	[3] [4]
LEDR Pulse Low Time	T_{P1}		1024k/FS		msec	[3] [4]
LEDP Pulse Low Time	T_{P2}		1280k/FS		msec	[3] [4]

Notes:

[1] Conditions are V_{CC} = 5.5V and T_A = 25°C, unless specified.

[2] All Min/Max limits are guaranteed by design, electrical testing and/or characterization. Not all specifications are 100 percent tested.

[3] The value changes accordingly to the F_S applied. Also, the internal oscillator may vary as much as ±10% over the operating temperature and voltage ranges.

[4] k=1000

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8. TYPICAL APPLICATION CIRCUIT

The following application examples are for references only. They make no representation or warranty that such applications shall be suitable for the use specified. Each design has to be optimized in its own system for the best performance on voice quality, current consumption, functionalities and etc.

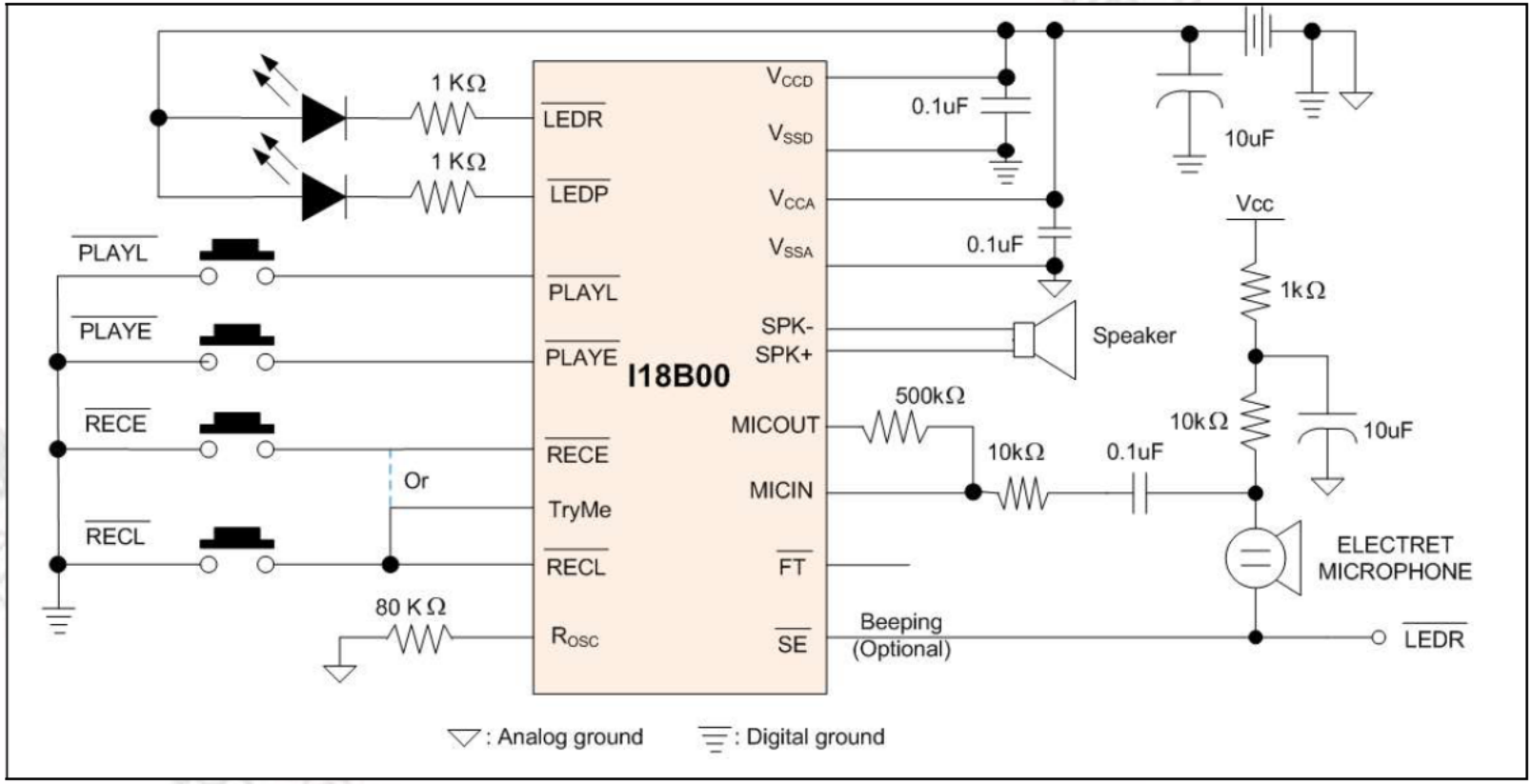


Figure 8-1 Typical Recording and Playback Operations

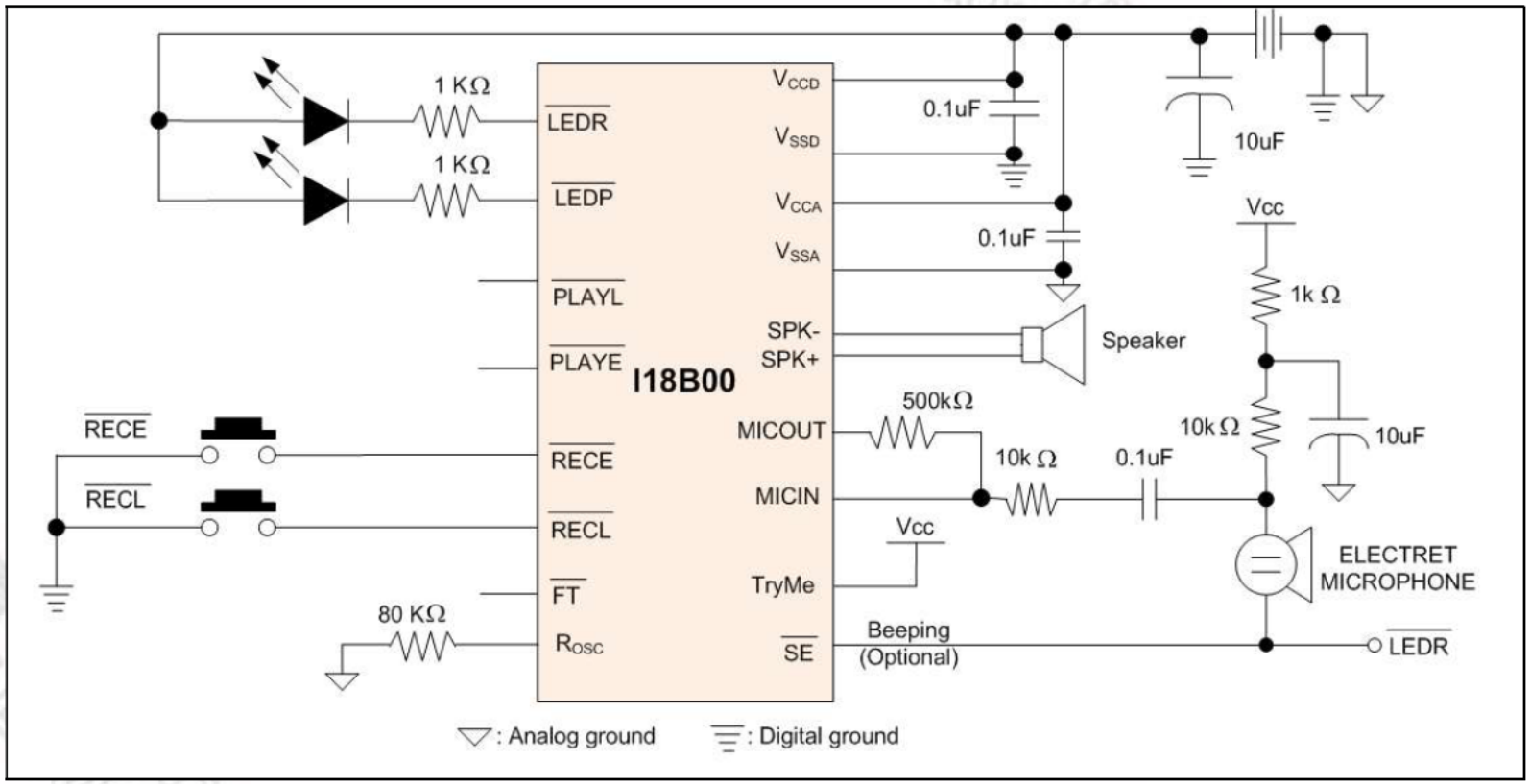


Figure 8-2 TryMe Feature

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.

Good Audio Design Practices

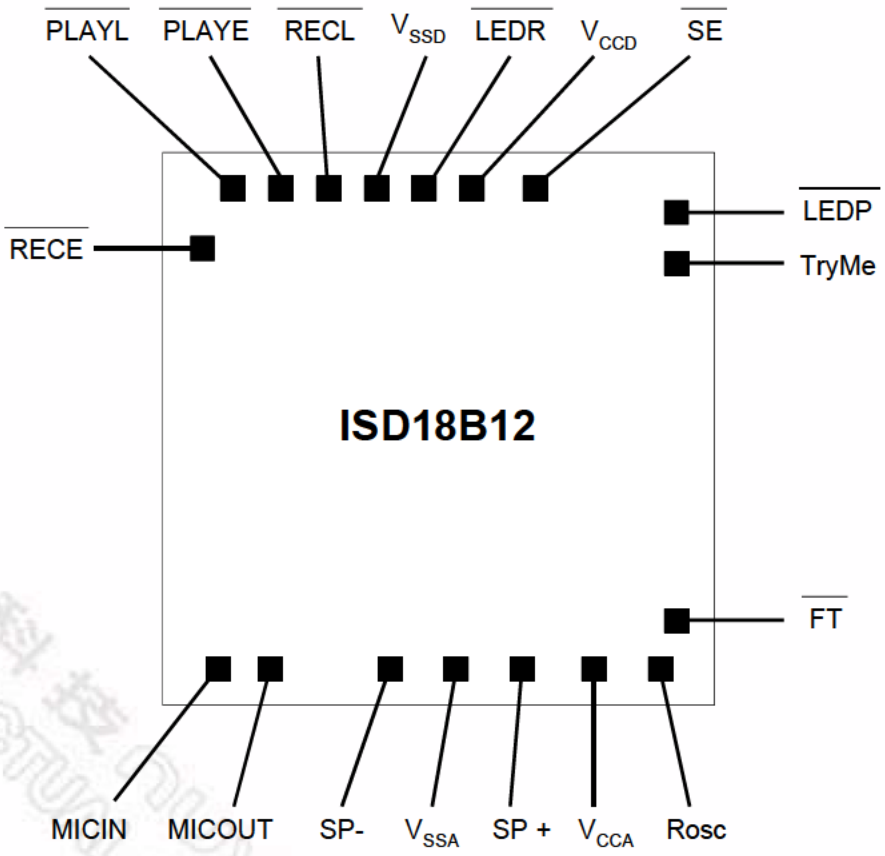
http://www.nuvoton-usa.com/products/isd_products/chipcorder/applicationinfo/apin11.pdf

Single-Chip Board Layout Diagrams

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

It is strongly recommended that before any design or layout project starts, the designer should contact Nuvoton Sales Rep for the most update technical information.

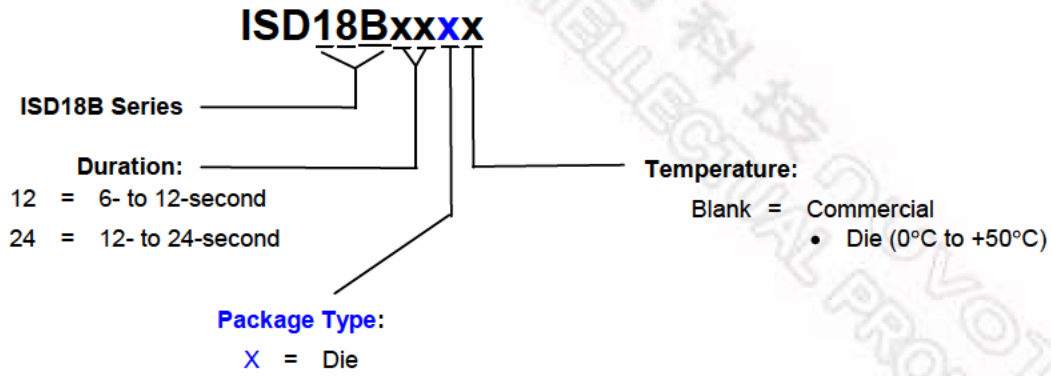
9. DIE INFORMATION



Contact Nuvoton Sales Representatives for information.

10. ORDERING INFORMATION

Product Number Descriptor Key



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

Package	Part Number	Ordering Number	Comments
Die	ISD18B12X	I18B12X	
Die	ISD18B24X	I18B24X	

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

11. VERSION HISTORY

VERSION	DATE	DESCRIPTION
0.5	Oct 2, 2008	Generalize for different derivatives.
1.0	Sep 05, 2013	Description update.

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The 100-year retention and 100K record cycle projections are based upon accelerated reliability tests, as published in the Nuvoton Reliability Report, and are neither warranted nor guaranteed by Nuvoton. This product incorporates SuperFlash®.

Information contained in this ISD® ChipCorder® datasheet supersedes all data for the ISD ChipCorder products published by ISD® prior to August, 1998.

This datasheet and any future addendum to this datasheet is(are) the complete and controlling ISD® ChipCorder® product specifications. In the event any inconsistencies exist between the information in this and other product documentation, or in the event that other product documentation contains information in addition to the information in this, the information contained herein supersedes and governs such other information in its entirety. This datasheet is subject to change without notice.

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