

# W567SXXX Data Sheet



## 8-CHANNEL SPEECH+MELODY PROCESSOR (*BandDirector*<sup>TM</sup> Series)

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## 1. GENERAL DESCRIPTION

The W567Sxxx is a powerful microcontroller (uC) dedicated to speech and melody synthesis applications. With the help of the embedded 8-bit microprocessor & dedicated H/W, the W567Sxxx can synthesize 8-channel speech+melody simultaneously.

The two channels of synthesized speech can be in different kinds of format, for example ADPCM and MDPCM. The W567Sxxx can provide 8-channel high-quality **WinMelody™**, which can emulate the characteristics of musical instruments, such as piano and violin. The output of speech/melody channels are mixed together through the on-chip digital mixer to produce colorful effects. The mixer is further processed to drive dual speakers with stereo effects. With these hardware resources, the W567Sxxx is very suitable for high-quality and sophisticated scenario applications.

The W567Sxxx is also capable of transmitting infrared (IR) signals with on-chip carrier generator. As a result, toys can be designed to interact with each other for more play values. A serial interface can be supported as external memory for memory expansion or content-updateable applications.

Besides, the W567Sxxx is equipped with a 4-channel Analog-to-Digital Converter (ADC). With ADC, a toy can respond to environment conditions such as temperature or pressure via sensory devices. Therefore, toys with ADC can behave vividly than ever before.

The W567Sxxx family contains several items with different playback duration as shown below: (@5-bit MDPCM algorithm, 6 KHz sampling rate)

|             |                 |                 |                 |                 |                 |                 |
|-------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>Item</b> | <b>W567S010</b> | <b>W567S015</b> | <b>W567S020</b> | <b>W567S025</b> | <b>W567S030</b> | <b>W567S040</b> |
| *Duration   | 14 sec.         | 18 sec.         | 27 sec.         | 31 sec.         | 35 sec.         | 52 sec.         |
| <b>Item</b> | <b>W567S060</b> | <b>W567S080</b> | <b>W567S100</b> | <b>W567S120</b> | <b>W567S150</b> | <b>W567S170</b> |
| Duration    | 60 sec.         | 104 sec.        | 116 sec.        | 129 sec.        | 163 sec.        | 197 sec.        |
| <b>Item</b> | <b>W567S210</b> | <b>W567S260</b> | <b>W567S301</b> | <b>W567S341</b> |                 |                 |
| Duration    | 232 sec.        | 265 sec.        | 300 sec.        | 334 sec.        |                 |                 |

Note:

\*: The duration time is based on 5-bit MDPCM at 6 KHz sampling rate. The firmware library and timber library have been excluded from user's ROM space for the duration estimation.



## 2. FEATURES

- Wide range of operating voltage:
  - 8 MHz @ 3.6 volt ~ 5.5 volt
  - 4 MHz @ 2.4 volt ~ 5.5 volt
- Power management:
  - 4 ~ 8 MHz system clocks, with Ring type
  - Stop mode for stopping all IC operations
- Provides up to 8 inputs and 24 I/O pins
- Current-type Digital-to-Analog Converter (DAC):
  - 8-bit resolution with programmable output current
  - 2 speaker outputs for stereo applications
- F/W speech synthesis with multiple format support: ADPCM/MDPCM/PCM
- 2 speech synthesis<sup>1</sup> channels at programmable sample rate
- 8 melody channels that can emulate characteristics of musical instruments
- 8-input/10-bit-resolution Mixer can mix the speech and melody signals flexibly
- Dynamic control of the channel assignment to the dual speaker output for stereo effects
- Built-in IR carrier generation circuit for simplifying firmware IR application
- 4-channel ADC interface (W567S301~S341) with maximum 4-KHz sampling rate and 6-bit effective resolution
- Built-in 9 timers for speech/melody synthesis and general purpose applications
- Built-in 10\*7 multiplier
- Built-in Watch-Dog Timer (WDT) and Low Voltage Detect (LVD)
- Built-in 32KHz crystal oscillator with divider for time-keeping application in W567S080 ~ S341
- Built-in Serial Interface Manager (SIM) in W567S080 ~ S341
- Support PowerScript for developing codes in easy way
- Full-fledged development system
  - Source-level ICE debugger
  - Event synchronization mechanism
  - Compatible with W566B/C & W588S system
  - User-friendly GUI environment
- Available package form: (COB is essential)
  - W567S010, S015, S020, S025, S030: LQFP48
  - W567S040, S060: QFP64
  - W567S080 ~ S120: LQFP80
  - W567S150 ~ S341: LQFP100

<sup>1</sup> More speech channels are available for 8-bit PCM format in the remaining melody channels.



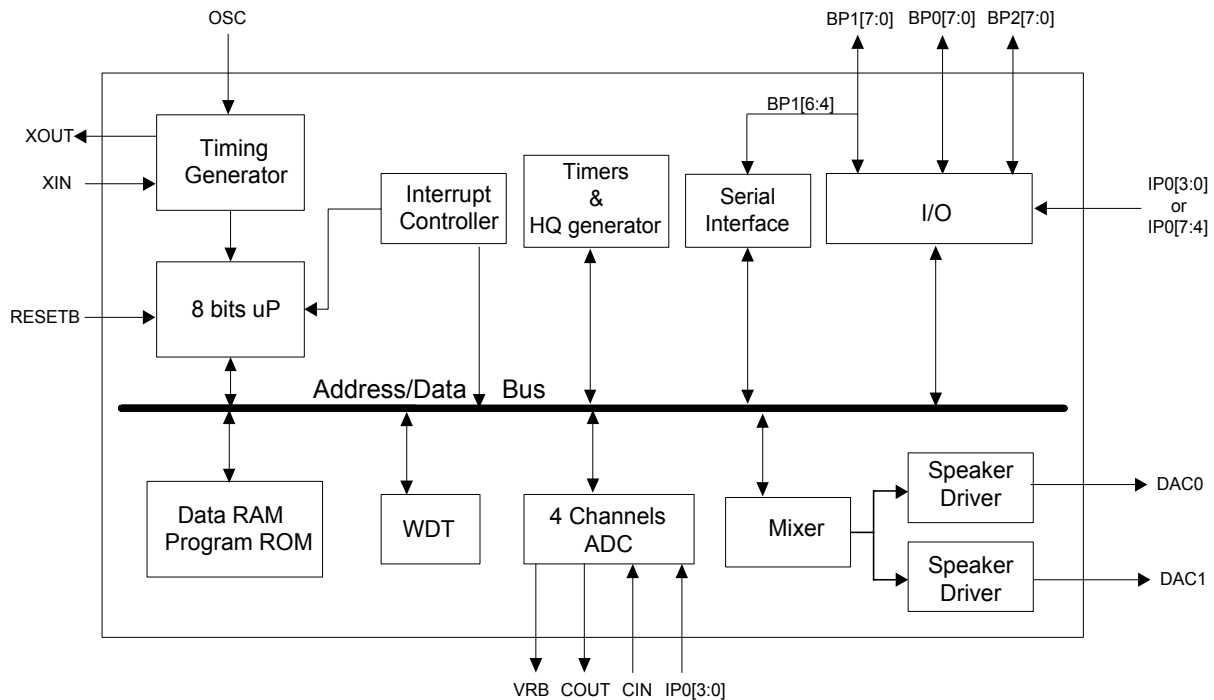
### 3. PIN DESCRIPTION

| PIN NAME               | I/O   | FUNCTION   |
|------------------------|-------|--|
| RESETB                 | In    | IC reset input, low active.  |
| XIN                    | In    | 32 KHz crystal oscillator with divider for time-keeping application  |
| XOUT                   | Out   | 32 KHz crystal oscillator with divider for time-keeping application  |
| OSC                    | In    | Main-clock oscillation input. Only Ring type is used. Connect to GND via the oscillation resistor.   |
| IP0[3:0] /<br>IP0[7:4] | In    | General input port with pull-high selection. Each 2 input pins can be programmed to generate interrupt request and used to release IC from STOP mode.<br><br>IP0[3:0] are used as the input of ADC. IP0.0 is the input pin of channel 0 and IP0.3 is the input pin of channel 3, and so on.  |
| BP0[7:0]               | I/O   | General input/output pins. When used as output pin, it can be open-drain or CMOS type and it can sink 8mA for high-current applications. When used as input pin, there may have a pull-high option and generate interrupt request to release IC from STOP mode.<br><br>When BP0[7] is used as output pin, it can be the IR transmission carrier for IR applications. |
| BP1[7:0]               | I/O   | General input/output pins. When used as output pin, it can be open-drain or CMOS type. When used as input pin, there may have a pull-high option and generate interrupt request to release IC from STOP mode.<br><br>When serial interface is enabled, BP1[6:4] are used as serial interface pins.   |
| BP2[7:0]               | I/O   | General input/output pins. When used as output pin, it can be open-drain or CMOS type. When used as input pin, there may have a pull-high option and generate interrupt request to release IC from STOP mode.  |
| *VRB                   | Out   | Reference-bottom voltage of ADC. Theoretically, the converted codes 0 ~ 255 will be uniformly distributed between VRB and AVDD. Voltages below VRB will be mapped to code 0.   |
| *CIN                   | In    | Capacitor input for ADC.   |
| *COUT                  | Out   | Capacitor output for ADC.  |
| *AVDD                  | Out   | ADC regulator output voltage.  |
| DAC0                   | Out   | Current type DAC speaker output 0.   |
| DAC1                   | Out   | Current type DAC speaker output 1.   |
| TEST                   | In    | Test input, internally pulled low. Do not connect during normal operation.   |
| VDD (VDD1)             | Power | Positive power supply.   |
| VSS (VSS1)             | Power | Negative power supply.   |
| *VDDA                  | Power | Positive power supply for ADC module.  |
| *VSSA                  | Power | Negative power supply for ADC module.  |

\*: Only W567S301~S341 provides these pins for ADC application.



## 4. BLOCK DIAGRAM



## 5. ELECTRICAL CHARACTERISTICS

### 5.1 Absolute Maximum Ratings

| PARAMETER                                   | RATING                 | UNIT |
|---|------------------------|------|
| Supply Voltage to Ground Potential          | -0.3 to +7.0           | V    |
| D.C. Voltage on Any Pin to Ground Potential | -0.3 to $V_{DD} + 0.3$ | V    |
| Operating Temperature                       | 0 to +70               | °C   |
| Storage Temperature                         | -55 to +150            | °C   |

Note: Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.



## 5.2 DC Characteristics

( $V_{DD}-V_{SS} = 4.5\text{ V}$ ,  $F_M = 8\text{ MHz}$ ,  $T_a = 25^\circ\text{C}$ , No Load unless otherwise specified)

| PARAMETER                    | SYM.      | TEST CONDITIONS                                      | SPEC.        |              |              | UNIT             |
|------------------------------|-----------|--|--------------|--------------|--------------|------------------|
|                              |           |  | Min.         | Typ.         | Max.         |                  |
| Operating Voltage            | $V_{DD}$  | $F_{SYS} = 4\text{ MHz}$                             | 2.4          | -            | 5.5          | V                |
|                              |           | $F_{SYS} = 8\text{ MHz}$                             | 3.6          | -            | 5.5          | V                |
| Operating Current            | $I_{OP}$  | $F_{SYS} = F_M$ , normal operation                   | -            | 15           | 20           | mA               |
| Standby Current              | $I_{SB}$  | STOP mode  | -            | 1            | 2            | $\mu\text{A}$    |
| 32KHz Crystal current        | $I_{32K}$ | $F_{OSC}$ disable, No load, Wake up frequency: 2Hz   | -            | 6            | 15           | $\mu\text{A}$    |
| Input Low Voltage            | $V_{IL}$  | All input pins                                       | $V_{SS}$     | -            | $0.3 V_{DD}$ | V                |
| Input High Voltage           | $V_{IH}$  | All input pins                                       | $0.7 V_{DD}$ | -            | $V_{DD}$     | V                |
| Output Low Current           | $I_{OL}$  | $V_{OUT} = 0.4\text{V}$ , all output pins except BP0 | -            | -            | 4            | mA               |
|                              |           | $V_{OUT} = 0.4\text{V}$ , BP0 only                   | -            | -            | 8            | mA               |
| Output High Current          | $I_{OH}$  | $V_{OUT} = 2.4\text{V}$ , all output pins            | -4           | -            | -            | mA               |
| DAC Full Scale Current       | $I_{DAC}$ | $V_{DD} = 4.5\text{V}$ , $R_L = 100\Omega$           | -2.4<br>-4.0 | -3.0<br>-5.0 | -3.6<br>-6.0 | mA               |
| ADC Analog Input Voltage     | $V_{AN}$  |  | $V_{RB}$     | -            | $AV_{DD}$    | V                |
| ADC Reference-Bottom Voltage | $V_{RB}$  | $I_{RB} \leq 6\text{ mA}$                            | 0.6          | 0.8          | 1.0          | V                |
| ADC Input Impedence          | $R_{ADC}$ |  | 30           | -            | -            | $\text{M}\Omega$ |
| Pull High Resistance         | $R_{IN}$  | All input pins except RESETB                         | 200          | -            | -            | $\text{K}\Omega$ |
|                              |           | RESERB   | 100          | -            | -            | $\text{K}\Omega$ |



### 5.3 AC Characteristics

(V<sub>DD</sub>-V<sub>SS</sub> = 4.5 V, F<sub>M</sub> = 8 MHz, T<sub>a</sub> = 25°C; No Load unless otherwise specified)

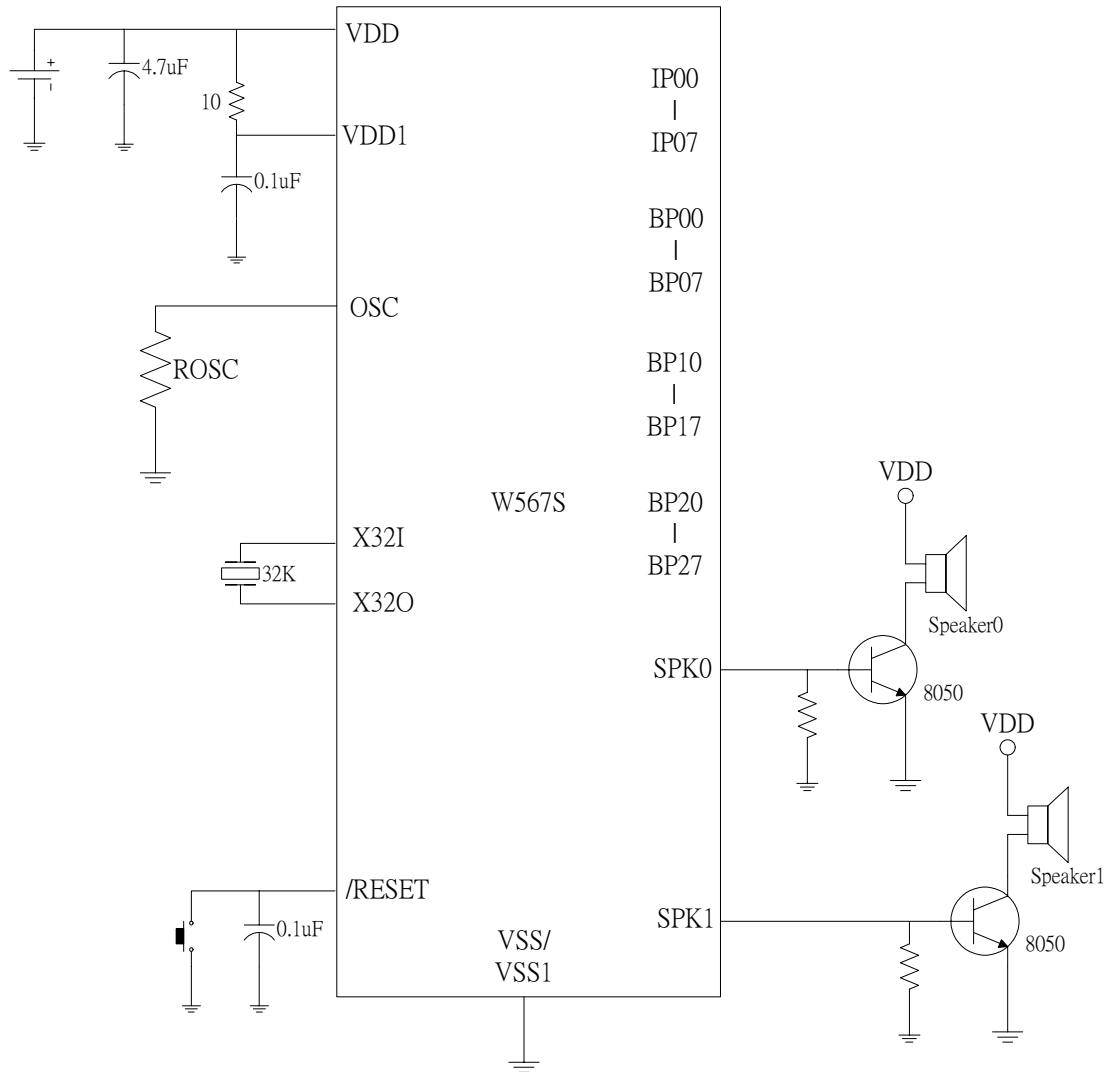
| PARAMETER                                 | SYM.                 | TEST CONDITIONS                                       | SPEC.              |      |                    | UNIT             |
|---|----------------------|---|--------------------|------|--------------------|------------------|
|   |                      |   | Min.               | Typ. | Max.               |                  |
| Main-Clock                                | F <sub>M</sub>       | Ring type, *Rosc = 330 KΩ                             | 3.6                | 4    | 4.4                | MHz              |
|   |                      | Ring type, *Rosc = 160 KΩ                             | 7.2                | 8    | 8.8                |                  |
| Cycle Time                                | T <sub>CYC</sub>     | F <sub>SYS</sub> = 8 MHz                              | 125                | -    | DC                 | nS               |
| Main-Clock Wake-up Stable Time            | T <sub>WSM</sub>     | Ring type, R = 160 KΩ                                 | -                  | 3    | 5                  | mS               |
| Main-Clock Frequency Deviation, Ring type | $\frac{\Delta F}{F}$ | $\frac{F_{MAX} - F_{MIN}}{F_{MIN}}$                   | -                  | 3    | 7.5                | %                |
| RESETB Active Width                       | T <sub>RES</sub>     | After F <sub>SYS</sub> stable                         | 4                  | -    | -                  | T <sub>CYC</sub> |
| ADC Resolution                            |                      | Fixed AV <sub>DD</sub> <sup>2</sup>                   | -                  | -    | 6                  | bits             |
|   |                      | AV <sub>DD</sub> = 3.6 ~ 5.5V                         | -                  | -    | 5                  | bits             |
| ADC Accuracy                              | E <sub>bit</sub>     |   | -                  | -    | ±1                 | LSB              |
| ADC Capacitor                             | C <sub>ADC</sub>     | Conversion rate = 8 KHz,<br>F <sub>SYS</sub> = 4 MHz  | -                  | 2000 | -                  | pF               |
|   |                      | Conversion rate = 16 KHz,<br>F <sub>SYS</sub> = 8 MHz | -                  | 1000 | -                  | pF               |
| ADC Conversion Time                       | T <sub>CON</sub>     |   | 512/F <sub>M</sub> | -    | 32K/F <sub>M</sub> | μS               |
| ADC Stable Time                           | T <sub>ADS</sub>     | AV <sub>DD</sub> = V <sub>DD</sub> = 3V               | -                  | -    | 2                  | μS               |

\*: Typical ROSC value for each part number should refer to design guide.

<sup>2</sup> AV<sub>DD</sub> is a fixed voltage, for example AV<sub>DD</sub> = 3.6V, 4.5V, or 5.5V.



## 6. TYPICAL APPLICATION CIRCUIT



### Notes:

1. The typical value of  $R_{osc}$  is 160 K $\Omega$  for 8 MHz and 320 K $\Omega$  for 4 MHz and should be connected to GND (Vss).
2. Please refer to design guide to get typical  $R_{osc}$  value for each part number.
3. For W567S080~S341, Vss1 should be connected to Vss; and VDD1 should be connected to VDD in PCB layout.
4. The  $R_s$  value is suggested in 270 $\Omega$  ~ 1K $\Omega$  to limit too large DAC output current flowing into transistor.
5. The 10 $\Omega$  and 0.1 $\mu$ F between VDD, VDD1 and GND are optional to filter power noise.
6. The capacitor, 4.7  $\mu$ F, shunts between VDD and GND is necessary as power stability. But the value of capacitor is depend on the application.
7. The above application circuits are for reference only. No warranty for mass production.



**7. REVISION HISTORY**

| REVISION | DATE          | MODIFICATIONS   |
|----------|---------------|---|
| A1       | April 2002    | Preliminary release.  |
| A2       | July 11, 2002 | W567S020 created.<br>2 speech channels for entire series.<br>Wording modification.  |
| A3       | July 31, 2002 | Modify pin description<br>Modify DC/AC electrical characteristics   |
| A4       | Oct. 15, 2002 | Remove SIM out of from W567S040 ~ S060<br>Define ROSC value in AC ELECTRICAL CHARACTERI   |
| A5       | Nov. 15, 2002 | Page 2, provides up to 8 input pins<br>Page 2, available package  |
| A6       | May 15, 2003  | Add a table to show all W567Sxxx duration in page 1<br>Add <b>PowerScript™</b> function in feature list<br>Update available package<br>Rename RTC as 32 KHz crystal<br>Update application circuit |
| A7       | Sep 10, 2003  | Change part number W567S300 as W567S301<br>Change part number W567S340 as W567S341<br>Page 3, add Low Voltage Detect (LVD) feature  |
| A8       | Oct. 15, 2003 | Update application circuit and notes.   |

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