W588SXXX

Winbond
Electronics Corp.

8-BIT MCU WITH
VOICE/MELODY SYNTHESIZER
(*PowerSpeech*™ Series)

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1. GENERAL DESCRIPTION

The W588Sxxx is a powerful microcontroller-based speech synthesizer with 3 channels of speech and melody for multi-tasking applications.

The W588Sxxx provides slow mode operation and PWM output to help reduce the power consumption for longer battery life. Also, the W588Sxxx adopts the MDPCM, ADPCM or PCM algorithm to reproduce high quality sound outputs.

Other powerful functions like IR carrier generation and event synchronization mechanism are provided to meet the requirements for more complicated multi-tasking applications.

The W588Sxxx family contains several items with different playback duration as shown below: (@5-bit MDPCM algorithm, 6KHz sampling rate)

ITEM	W588S003	W588S006	W588S010	W588S013	W588S016
*Duration	4 sec.	7 sec.	12 sec.	16 sec.	20 sec.
ITEM	W588S020	W588S025	W588S030	W588S040	W588S050
Duration	25 sec.	29 sec.	32 sec.	50 sec.	58 sec.
ITEM	W588S060	W588S080	W588S100	W588S120	-
Duration	66 sec.	100 sec.	118 sec.	133 sec.	-

**ITEM	W588S009	W588S012	W588S015
Duration	12 sec.	16 sec.	20 sec.

Note:

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

**: W588S009, S012 and S015 are a little different in RAM and I/O definition. Meanwhile, PowerScriptTM dose not support either.

2. FEATURE

- Wide Operating voltage: 2.4 ~ 5.5 volt
- Build in 8-bit MCU core with powerful programmable capability
- System clock
  - 4 MHz at 2.4 ~ 5.5 volt
  - 8 MHz at 3.6 ~ 5.5 volt
- F/W speech synthesis
  - 5-bit MDPCM, 4-bit ADPCM or 8-bit PCM algorithm can be used
  - Programmable sample rate
- Direct-drive PWM output to save power consumption (no support in W588S003 and W588S006)
- Built-in 3 timers for speech/melody synthesis and general purpose applications
  - 2 speech channels
  - 1 speech channel plus dual-tone melody
  - 2 voice melody channels
- Build in on-chip mixer
- Built-in 32 KHz crystal oscillator with divider for time-keeping application
- Provide Watch Dog Timer (WDT)
- Provide power management to save current consumption:
  - 4 ~ 8 MHz system clock, with Ring type oscillator
  - Slow mode to reduce power
  - Stop mode for stopping all IC operations
- I/O configuration
  - W588S003 ~ W588S120: 16 I/O
  - W588S009, W588S012, W588S015: 4 In, 8 I/O, 4 Out
- Shared ROM for voice, melody and program storage
- Provide IR carrier generation
- Built-in Serial Interface Manager (SIM) in W588S080 ~ W588S120
- Support **PowerScript**^{TM} for developing codes in easy way. (No support in W588S009, S012, and S015)
- Full-fledged development system
  - Source-level ICE debugger (Assembly & **PowerScript**^{TM} format)
  - Event synchronization mechanism
  - Compatible with W566B/C & W567S system
  - User-friendly GUI environment
- Available package form:
  - COB is essential
  - W588S003 ~ W588S120: LQFP48
  - W588S009, S012, S015: QFP44

3. PIN DESCRIPTION

NAME	I/O	DESCRIPTION
$V_{SS}1$	-	Negative power supply for PWM
PWM+/DAC	O	PWM driver positive output / DAC output.
PWM-	O	PWM driver negative output
$V_{DD}1$	-	Positive power supply for PWM
IP0[7:4]	I	• Input port. • Each pin of IP0 can be configured as floating or pull-high input pin. • It can generate a port interrupt. • Any pin's status change of IP0 can wake up the chip from STOP mode. • Only providing in W588S009, W588S012 and W588S015
V_{DD}	-	Positive power supply
/RESET	I	Active low reset pin, to reset whole device.
X32I	I	32 KHz crystal oscillator with divider for time-keeping application
X32O	O	32 KHz crystal oscillator with divider for time-keeping application
TEST	I	Test pin, internally pulled low.
OP0[3:0]	O	Output port. The pins of OP0 are Inverter-type output. (Only providing in W588S009, W588S012 and W588S015.)
BP0[3:0] BP0[7:4]	I/O	• I/O multiplexed port. • As output port, the pins can be set as open–drain type or CMOS type. • As input port, the pins can be set with pull-high resistor or not. Interrupt will be generated to release IC from STOP mode upon triggering. • When BP0[7] is used as output pin, it can be the IR transmission carrier output for IR applications.
BP1[7:0]	I/O	• I/O multiplexed port. • As output port, the pins can be set as open–drain type or CMOS type. • As input port, the pins can be set with pull-high resistor or not, and the generate interrupt request can be used to release IC from STOP mode. • No providing in W588S009, W588S012 and W588S015.
V_{SS}	-	Negative power supply
OSC	I	Connect ROSC to Vss to generate the master clock

4. BLOCK DIAGRAM
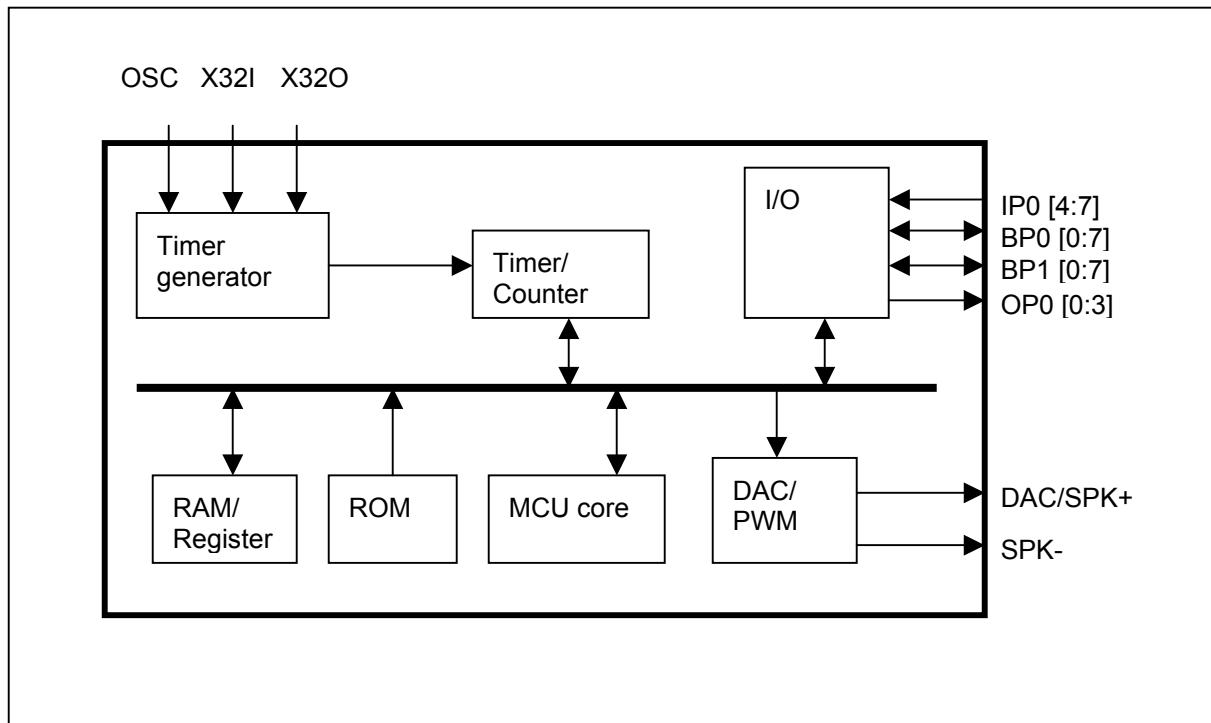
Notes:
1. IP0 and OP0 are only providing in W588S009, W588S012 and W588S015.
2. BP1 is no providing in W588S009, W588S012 and W588S015.
3. PWM is no providing in W588S003 and W588S006.

5. ELECTRICAL CHARACTERISTICS

5.1 Absolute maximum ratings

PARAMETER	SYMBOL	CONDITIONS	RATED VALUE	UNIT
Power Supply	V_{DD}–V_{SS}	-	-0.3 to +7.0	V
Input Voltage	V_{IN}	All Inputs	V_{SS} -0.3 to V_{DD} +0.3	V
Storage Temp.	T_{STG}	-	-55 to +150	°C
Operating Temp.	T_{OPR}	-	0 to +70	°C

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

5.2 D.C. Characteristics

(V_{DD}–V_{SS} = 4.5V, Ta = 25°C, No Load unless otherwise specified)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V_{DD}	-	2.4	-	5.5	V
Operating Current	I_{OP1}	No load, Fosc = 4 MHz	-	3	5	mA
Standby Current (STOP)	I_{DD1}	No load	-	1	2	μA
Slow Mode Current	Iop2	No load, Fosc = 4 MHz, CPU clock = Fosc / 128,	-	-	200	μA
32KHz Crystal Current	I32K	Fosc disable, No load, Wake up frequency: 2Hz	-	6	15	μA
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
Input Current (IP0, BP0)	I_{IN}	V_{IN} = 0V	-15	-	-45	μA
Output Current (BP0)	I_{OL}	V_{DD} = 3V, V_{OUT} = 0.4V	8	-	-	mA
	I_{OH}	V_{DD} = 3V, V_{OUT} = 2.6V	-4	-	-	mA
Output Current (OP0)	I_{OL}	V_{DD} = 3V, V_{OUT} = 0.4V	4	-	-	mA
	I_{OH}	V_{DD} = 3V, V_{OUT} = 2.6V	-4	-	-	mA
Output Current SPK0+ / SPK0-	I_{OL1}	RL=8 Ohm, [SPK+]----[RL]----[SPK-]	+200	-	-	mA
	IOH1		-200	-	-	mA
DAC Full Scale Current	I_{DAC}	RL = 100Ω	-2.4 / -4.0	-3.0 / -5.0	-3.6 / -6.0	mA
Pull-low Resistor Test	R_{PL}		50	-	150	KΩ

5.3 A.C. Characteristics

(V_{DD}-V_{SS}= 4.5 V, Ta = 25°C, No Load unless otherwise specified)

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Main-clock Frequency	FM	*ROSC = 300 Kohm / *ROSC = 160 Kohm	3.6 / 7.2	4 / 8	4.4 / 8.8	MHz
Main-clock Wake-up Delay	WDm	Ring type, CPU clock = 4MHz	-	3	5	mS
Frequency Deviation by Voltage Drop Main Oscillator, Ring	$\dfrac{\Delta F}{F}$	CPU clock = 4MHz, $\dfrac{F_{MAX} - F_{MIN}}{F_{MIN}}$	-	3	7.5	%
Cycle Time	Tcyc	CPU clock = 4MHz	250	-	DC	nS
Reset Signal Width	T_{RST}	FM is enabled	4	-	-	Clocks of F_M

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

6. TYPICAL APPLICATION CIRCUIT

6.1 DAC Mode Output
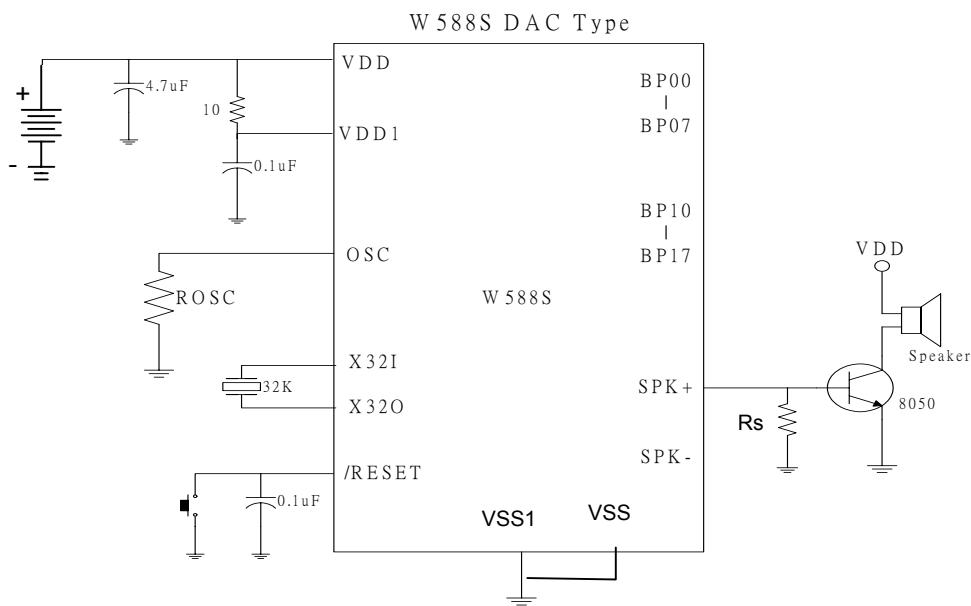
Typical Application Circuit, continued

6.2 PWM Mode Output

W 588S PWM Type
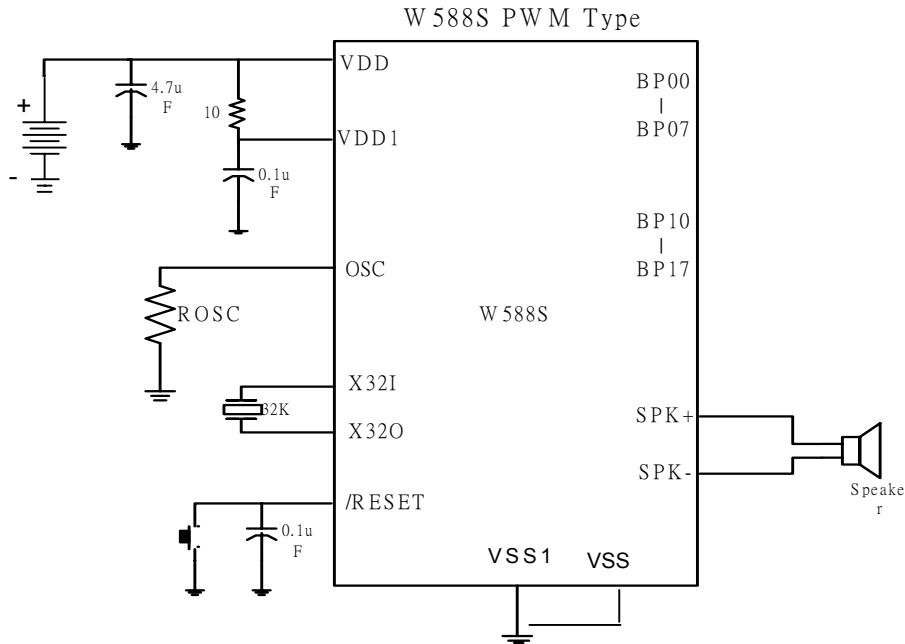
Notes:

1. The typical value of Rosc is 160 KΩ for 8MHz and 300 KΩ for 4MHz and should be connected to GND (V$_{SS}$).

2. Please refer to design guide to get typical Rosc value for each part number.

3. In PCB layout, V$_{SS}$1 should be connected to V$_{SS}$; V$_{DD}$1 should be connected to V$_{DD}$.

4. The Rs value is suggested in 270Ω ~ 1KΩ to limit too large SPK+ output current flowing into transistor.

5. The capacitor, 0.1uF, shunted between V$_{DD}$/V$_{DD}$1 and GND (V$_{SS}$/V$_{SS}$1) is necessary.

6. The 10Ω and 4.7uF between V$_{DD}$, V$_{DD}$1 and GND are optional to reduce probability of latch-up occurring.

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	May 2002	Feature modifications.
A3	July 11, 2002	Wording modification.
A3.1	Aug. 8, 2002	Create part number: W588S010, S013, S016
A4	Oct. 15, 2002	No support PWM in W588S003/006 (page 2) SIM only for W588S080~120 (page 2) Modify package form (page 2) Define ROSC value (page 6)
A5	May 15, 2003	Modify item list table in page1 and separate W588S009~S015 RTC → 32 KHz crystal …. (page 2 and page 3) Update slow mode current in maximum value Add 32 KHz crystal current value Modify application circuit in DAC and PWM (page 6)