

MS311
Programmable
SPI Recording Playing
Processor

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HEAD QUARTER

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General Description

MS311 is a simple programmable CPU that can be used for simple sound recording and playing applications. That is, with program stored in the external SPI flash, MS311 may play and record sounds to/from the same SPI¹ flash. It has a high order digital filter that can produce excellent sound quality, both recording and playing. It has also a Class-D amplifier that can output up to 0.8 Watt with very good efficiency.

Features

- Simple CPU, running the program stored in external SPI flash.
- CPU may read and write the SPI Flash at all addresses.
- CPU Program may be stored at first 4~32K bytes.
- 1024 bytes of RAM.
- Maximum 1I + 7 I/O for external RC applications, and 1 more I/O for Internal RC applications. SPI interface I/O excluded,
- Direct Amplify Mode can be used as MEGA-PHONE.
- Internal power-on reset or pin reset.
- External/Internal R-C oscillator.²
- CPU has 8 sub-routine stacks.
- One high speed timer used for key debouncing, etc.
- CPU may enter sleep mode for power saving.
- Built-in 3V LDO for external SPI Flash Memory.
- Sleep mode may be waked up by input pins.
- Microphone Amplifier programmable.
- Internal High Order Filter for ADC and sound out applications.
- Class D amplifier up to 0.8 watt, with digital volume control.
- Simple BEEP Generator.
- Simplified SPI Slave (SSPI) Interface can receive command from external SPI Master.
- MSHINE provides example C source code and Compiler for application developing.

¹ SPI Means "Serial-Parallel Interface", which is the most common NOR-type FLASH on the market.

² Special R/C circuits will be required to connect crystal oscillator or resonator, please contact MSHINE.

Block Diagram

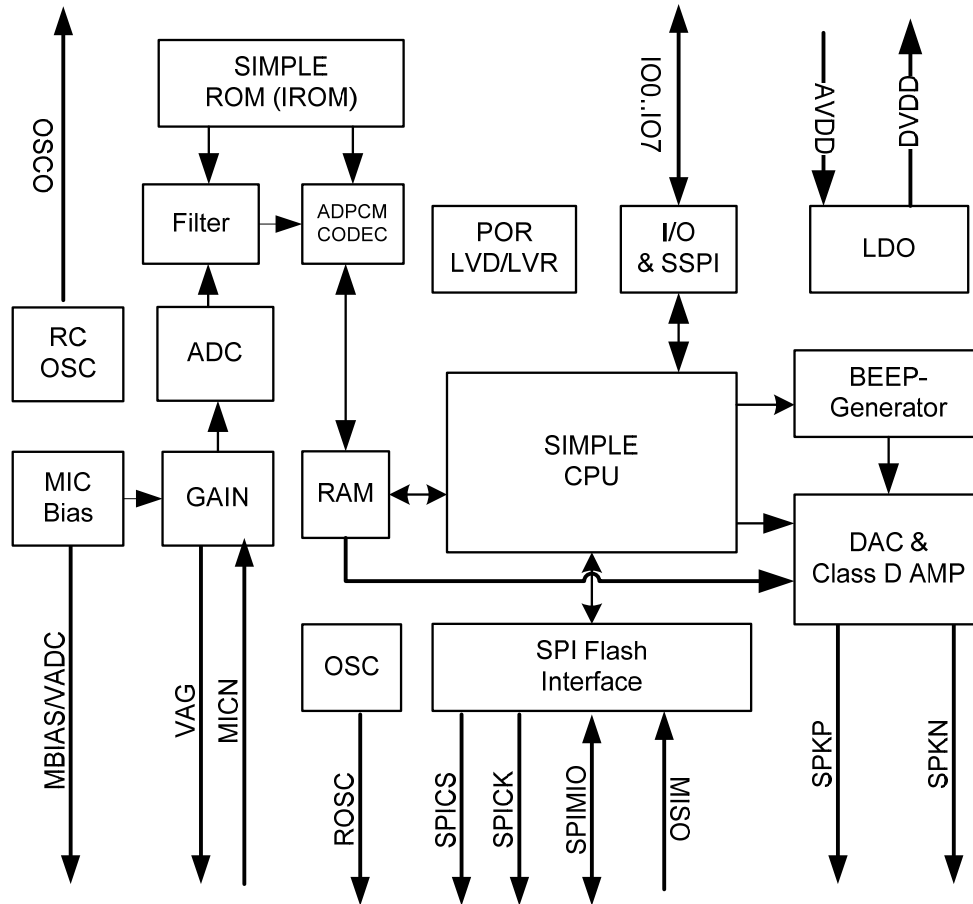


Figure 1. MS311 Block Diagram.

Application

- Sound recording toys, cards.
- Megaphone (大聲公)
- Walk Talk .
- And other sound recording/playing applications.

Package

SSOP24 Packaged.

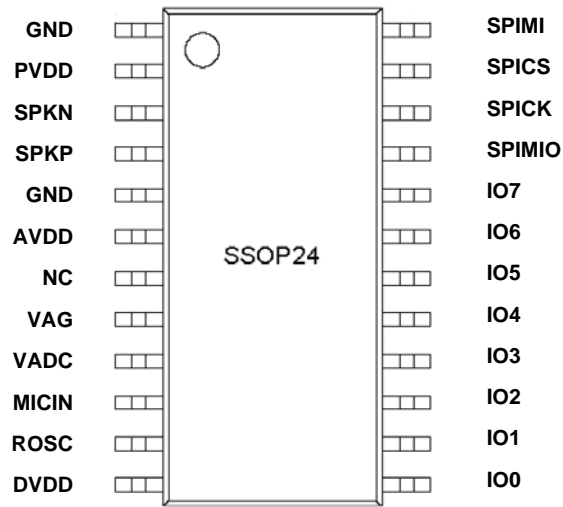


Figure 2. MS311 Package Diagram.

Pins Descriptions

Pin No.	Notation	TYPE	Functional Description
Power Pins			
12 ³	DVDD	Power	VDD power source of digital circuits. Note that this is LDO output for 3-battery applications. The power should be used for SPI Flash, and a 1uF capacitor should be connected to DVSS. For 2-battery applications, DVDD should short to AVDD/PVDD.
1	DVSS	Power	GND power of digital circuits.
6	AVDD	Power	Analog/SPK Power VDD
5	AVSS	Power	Analog/SPK Power GND
2	PVDD	Power	Power Amplifier Supply
5	PVSS	Power	Power Amplifier GND.
Special Pins			
11	ROSC	I/O	ERC (External R-C oscillator) PAD, should connect a resistor to GND if ERC is used. If internal R-C oscillator is used, this PAD can be used as general purpose I/O.
I/O Pins			
13	IO0	I	Reset/ input pin.
14~20	IO1~IO7	I/O	Input / Output pins. Note that some have special functions: IO1: Resonator/Crystal oscillator connection with ROSC. IO2: SSPI-CSB IO3: SSPI-CK

³ * means To be defined later.

			IO4: SSPI-MISO IO5: SSPI-MOSI
SPI FLASH Connection Pins			
23	SPICS	O	SPI Chip Select. It is high-Z in deep-sleep mode.
22	SPICK	O	SPI clock signal. It is high-Z in deep-sleep mode.
21	SPIMIO	I/O	Master data/command output, and dual-bit data input. High-Z in deep-sleep mode.
24	MISO	I/O	Master data input. Note that its VIH/VIL level is around AVDD/2 without Schmitt Trigger. High-Z in deep sleep mode, and output high when SPICS is high.
MIC and Analog pins			
8	VAG	O	Analog virtual ground. Capacitor of 1 UF to AVSS is required. This pin is also the positive input of the OP-AMP.
9	VADC (MBIAS)	O	Regulated ADC Power Supply, which is also the microphone bias voltage supply, 1 UF capacitor to GND is required. The capacitor makes sure the recording have good PSRR ⁴ .
10	MICIN	I	Microphone Input pin, capacitor 47~100NF to microphone input signal. This signal will connect to internal gain stages.
Speaker Driving Pins			
4	SPKP	O	Speaker output. High-Z when not playing. ⁵
3	SPKN	O	Speaker output. High-Z when not playing.

Table 1. MS311 PIN out description.

⁴ Power Supply Rejection Ratio, also known as PSRR.

⁵ Note that these pins can also be used as programmable output.

PAD Configuration

MS311 PAD Configuration is like below:

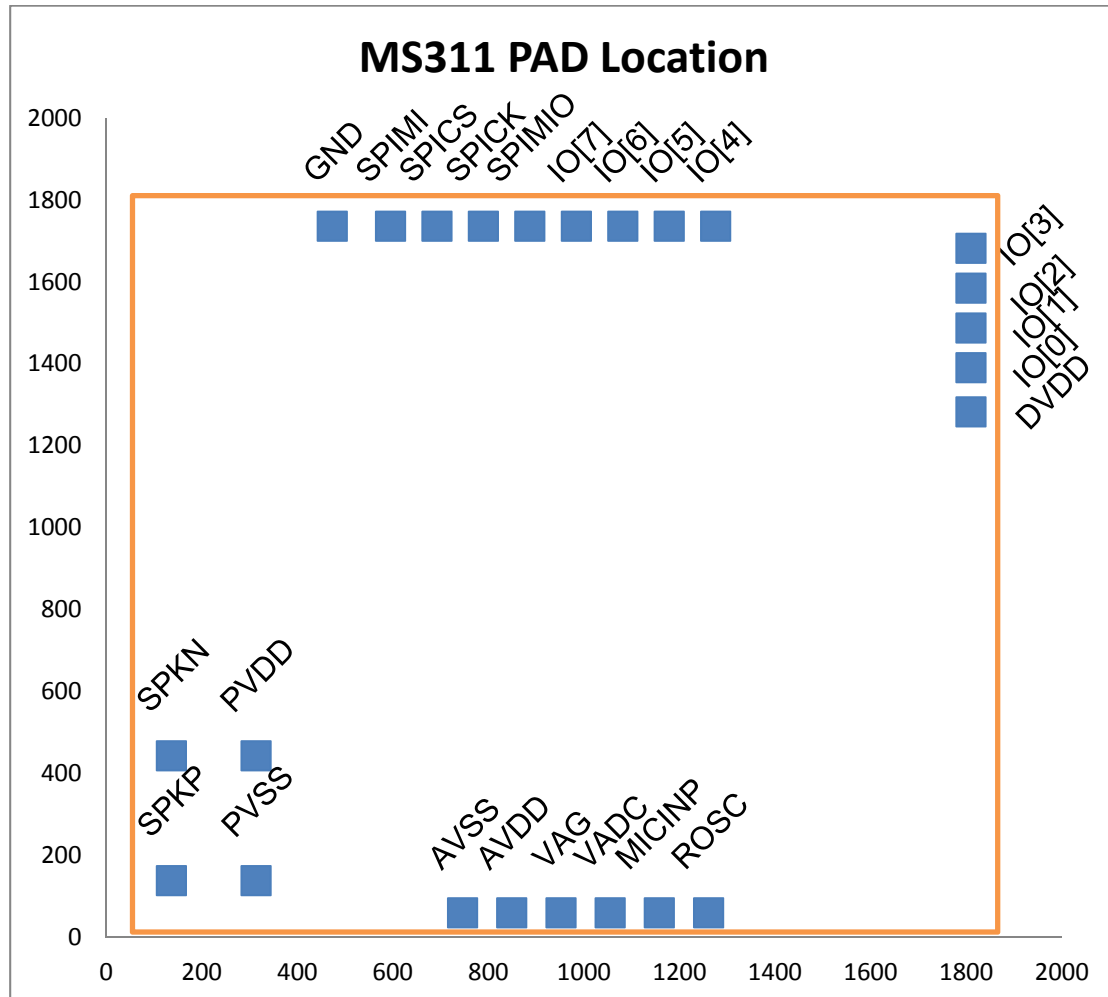
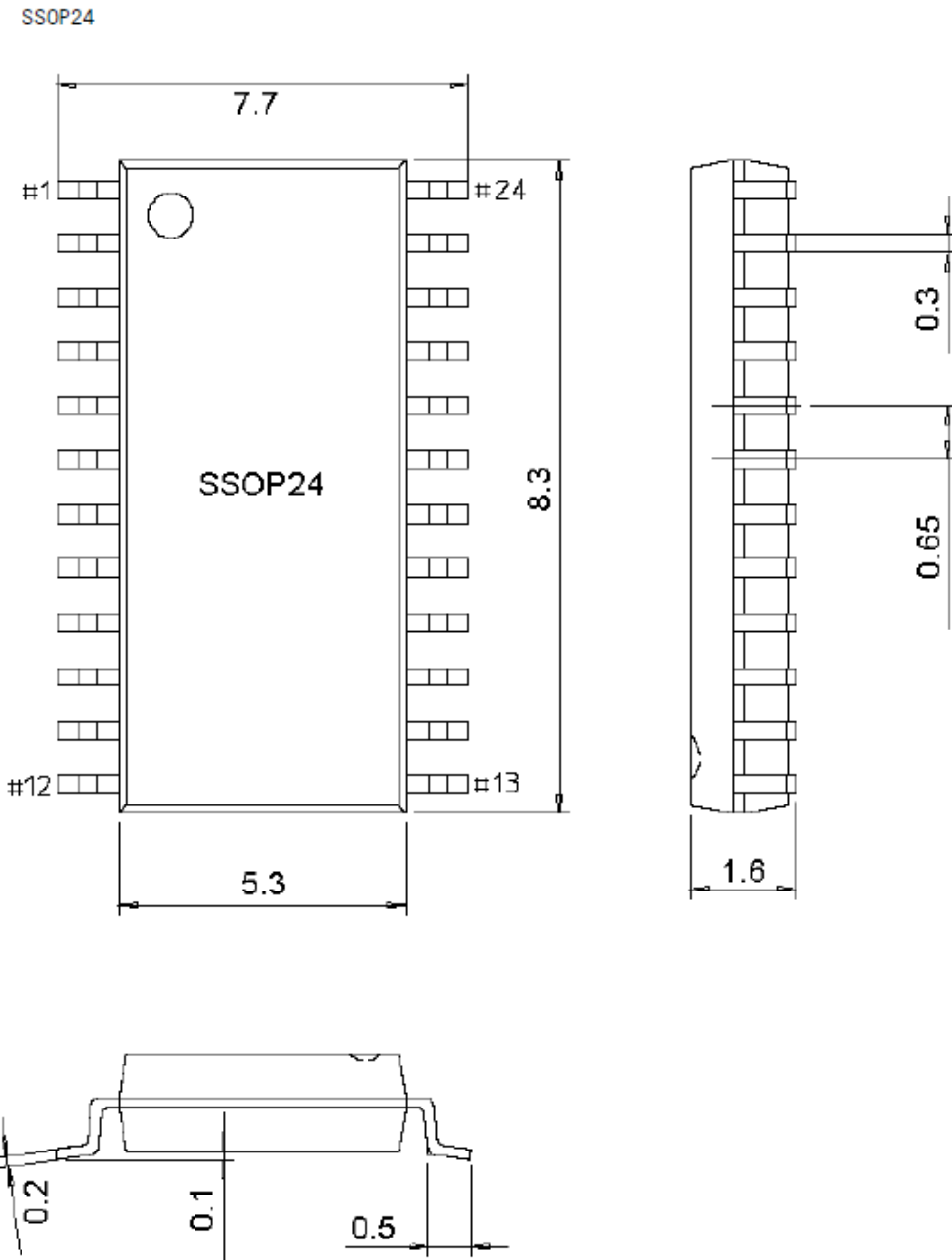


Figure 3. MS311 PAD Location

General Functional Description

MS311 is a simple programmable CPU, which have the program code stored in the external SPI flash memory. By the programs, it can record the voice from microphone/Speaker to SPI memory, and play the voice from SPI memory directly. It has microphone amplifier, ADC, filter and speaker-amplifier (PA), and is suitable for different applications need to record/play to/from SPI flash memories.

Package Out-line



UNIT is MM.

Typical Application Circuit

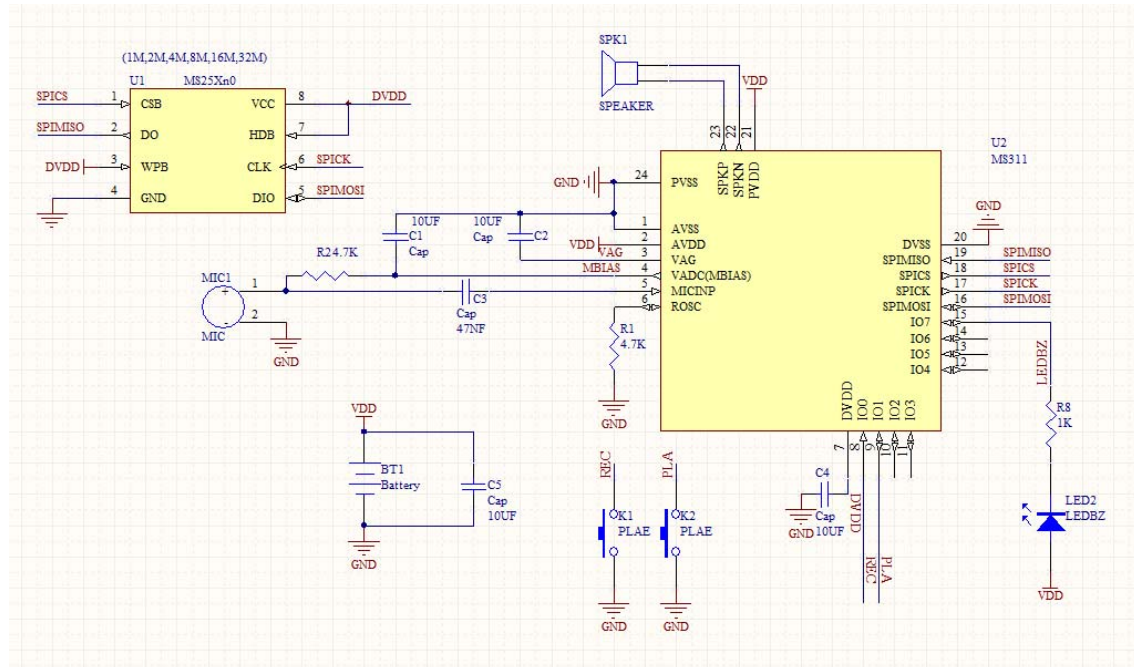


Figure 4. Typical Application Circuit (Deep-sleep Mode).

AC & DC Electrical Characteristics

Absolute Maximum Ratings

AVDD Supply Voltage.....-0.5V to + 5.5V
 DVDD Supply Voltage.....-0.5V to + 3.6V
 Input Voltage.....-0.5V to VDD + 0.5V
 Output Voltage.....-0.5V to VDD + 0.5V
 Operating Temperature.....0°C to 70° C
 Storage Temperature.....-40°C to 150° C

Never allow a stress to exceed the values listed under "Absolute Maximum Ratings", otherwise the device would suffer from a permanent damage. Nor is a stress at the listed value be allowed to persist over a period, since an extended exposure to the absolute maximum rating condition may also affect the reliability of the device, if not causing a damage thereof.

DC Characteristics

Parameters	Conditions	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	LPASS=0	V _{DD}	2.4 ⁶	4.5	5.2	V
Supply Current	CPU Run, 3.3V, LVR ON, 16 MHz, IRC, ADC off, SPK off.	I _{op}		8		mA
	Standby-Mode, 3.3V LVR OFF	I _{stdby}		3		mA
	8KHz, recording, DVDD=3.3V	I _{REC}		15		mA
	8KHz, playing, DVDD=3.3V , 8-Ohm speaker,	I _{PLA}		22	250	mA
	Power-Down Mode, DVDD=3.3V, APOR ON ⁷	I _{DD1}		5	10	uA
	Power-Down Mode, DVDD=3.3V, APOR OFF ⁸	I _{DD}		0.3	3	uA
	Power-Down Mode, LPASS=1, DVDD=3.6V	I _{DD2}			10	uA
Deep-Power-Down Mode, 4.5V	I _{DD3}			1	uA	
Output voltage	I _{OH} =1 mA, Push-pull pins.	V _{OH1}	V _{DD} -0.2	-	-	V
	I _{OL} =2 mA, push-pull pins	V _{OL1}	0.2	-	-	V
DVDD Output Voltage	LPASS=0, AVDD=3.6~5.0V, Load < 40 MA	V _{DVDD}	2.8	3.1	3.3	V
	LPASS=0, AVDD=2.8~3.6, Load <40mA	V _{DVDDL}	AVDD-0.2			V
Input voltage ⁹	All Input Pins ¹⁰	V _{IHI}	0.6 V _{DD}	0.5 V _{DD}		V
	All Input Pins	V _{IL1}		0.33 V _{DD}	0.25 V _{DD}	V
Output current	IO pins, VOL=0.5V, VOH=VDD-0.5V	I _{OL1} I _{OH1}	8		-8	mA

⁶ The supply voltage MUST be greater than the working voltage of the SPI Flash Memory.

⁷ SPI Flash's power is not included.

⁸ When APOR is OFF, IO0 will be forced to be the RESETB pin.

⁹ Schmitter Trigger level around VDD/2, VDD/3.

¹⁰ Include SPI interface pins, VDD means AVDD.

	AMP pins, 8-ohm speaker connected ¹¹	I _{OL2} I _{OH2}		-250 +250		mA
	IO pulled high input at 4.5V	I _{PH}		-0.04		mA
	IO pulled high input at 3.6V	I _{PH}		-0.03		mA
MBIAS Output Current	AVDD=4.5V	Imbo		3		mA
MBIAS Output Voltage	AVDD=4.5V			2.3		V
Initial LVR Release voltage	Temp=23° C	V _{por}		2.4		V

Table 2. DC Characteristics

AC Characteristics

Parameters	Conditions	Symbol	Min.	Typ.	Max.	Unit
IRC Frequency	VDD=3.6V,	Firc	14	16	18	MHz
External RC Frequency	DVDD=3.6V, ROsc=2K OHMS	Frc	14	16	32	MHz
Operating Frequency	LPASS=1, AVDD=DVDD=3.6V			16	32	MHz
	LPASS=0 DVDD=2.6V			16	24	MHz
Sample Rate	LPASS=0, Recording			FOSC/ 2048		Hz
Sample Rate	LPASS=0, Playing			FOSC/ 2048	FOSC/ 1024	Hz
Speech Signal SNR	VDD=4.5V	ADC _{SNR}		40 ¹²		DB
Speech Dynamic Range	VDD=3.0V	ADC _{SNDR}		60		DB
ADC POWER NOISE REJECT	VDD=3.0V	PSRR		50		DB
MBIAS Power Noise Reject Ratio	VDD=3.3V,load=2.0 mA	PSRR _{mb}		40		db

Table 3. AC Characteristics.

¹¹ Pure 8 OHM resistor can have 1.5V constant driving, about 0.3 Watt. Real speaker will get better, and much better at higher VDD.