AM4GB SERIES

DATA SHEET

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Revision History

Rev	Date	Description	Page
1.00	2008/3/13	New Release.	-
1.10	2008/7/25	1. Revise operating range. 2. Revise Fosc Variation characteristic. 3. Revise Frequency Stability characteristic at VDD = 3.4V. 4. Revise Frequency Stability characteristic at VDD = 5.1V.	-
1.11	2011/02/23	Revise Chapter 1: General Description.	3

1 General Description

The AM4GBxxxx series is a low-cost, high performance 1-channel voice synthesizer with a powerful 4-bit microprocessor. There are various features including the 4-bit ALU, ROM, RAM, I/O ports, timers, interrupt, clock generator, voice synthesizer, and direct-drive outputs, etc. Watchdog timer (WDT), low voltage reset (LVR), and infrared ray transmitter (IR) features improve system cost and reliability. Large current outputs and constant current outputs make the AM4G's application diversified. Furthermore, with CMOS technology, the HALT and STB functions can minimize power dissipation.

The RISC MCU architecture is very easy to program and control. There are 67 instructions in the AM4GBxxxx series, and most of them are executed in only single cycle. The powerful instruction set makes users developing easily and quickly. There is one superior voice synthesizing algorithms: VBR. It perform very high quality voice even if the bit rate is very low, users can therefore optimize its sound quality or ROM usage easily. The AM4GBxxxx only support the direct-drive (PWM).

2 Features

(1) Single power supply can operate from 2.2V to 5.5V at 8MHz.

(2) Program ROM can be up to 64K x 12-bit. (0000H~FFFFH)

(3) There are 6 bodies in AM4GB series:

Product	Voice Duration (sec)	ROM Size (12-bit)
AM4GB023A	23	48k
AM4GB031A	31	64k
AM4GB039A	39	80k
AM4GB047A	47	96k
AM4GB063A	63	128k
AM4GB079A	79	160k

(4) Data SRAM can be up to 96 x 4-bit. (10H~3FH per page, total 2 pages)

(5) There are total 6 I/O pins, PRA and PRC[3:2]. Each pin of all ports can be wake-up port when they are configured as input or IO mode.

(6) There is a kind of clock source in the device of AM4GBxxxx: Resistor mode (**RM**).

(7) Halt and Standby Mode
     System clock can be totally stopped in halt mode, and cause all functions stop to save power. The Standby mode is similar to halt mode, except the system clock is still working. Users can wake up AM4GBxxxx by changing data of input port as in halt mode, and standby mode can also be waked by INT of base timer.

(8) Each I/O pin can be one of four mask options: *(Mask Option)*

   a) Floating input

   b) IO with input weak pull high *(Register Control)*

   c) Input with weak pull high

   d) Output

(9) There are one port for large current output: PRA0~3

(10) Built-in infrared (IR) carrier output: *(Mask Option)*

   There are built-in infrared carrier output ports in the device that can be taken as transmission port in wireless transmission. The built-in IR carrier output can be optioned to high/low carry and be specified frequency with setting its timer value. User can set PRA3 as IR carrier pin.

(11) One channel voice

   a) There is an embedded 1-ch Voice synthesizer which supports 1 algorithm: VBR to decode high quality audio output.

   b) PCM Mode, 12-bit. (PLAYPCM)

(12) Audio output method: *(Register Control)*

   Only 10-bit direct-drive output (PWM) are supported to provide best audio output quality.

(13) 1 interrupt for two programmable interrupt sources. (BT, TO)

(14) External Reset: User can set PRC3 as reset pin. *(Mask Option)*

(15) 4 methods of internal reset:

   a) Power-on reset

   b) Watchdog reset

   c) Low voltage reset

   d) External reset

(16) Number of instruction: 67

3 Memory

3.1 ROM

The ROM memory could be divided into five portions. The first portion 0x0~0xF is addressed for the reset vector in the normal mode. The second portion 0x10~0x1F is addressed for the interrupt vector in the normal mode. The third portion 0x20~0x3FF is reserved and not for storing user program. The fourth portion 0x400~0x7FF is generally reserved for voice decoding algorithm. For users use the VBR mode, whole portion 0x400~0x7FF will be reserved. The last portion 0x800~0X27FFF could be used to store the main user program and voice data. Because the JMP and CALL instructions can only reach immediate 16-bit address wide, we recommend users to locate the main program and ISR in the 0x800~0x0FFFF address range. Of course, the program counter (PC) and other pointers all can reach to 0xFFFF.
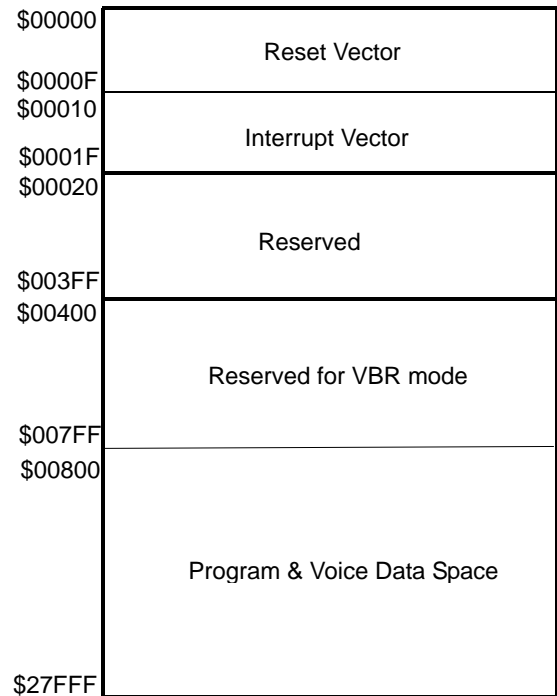
Figure 3-1 shows the AM4GBxxxx ROM map.

$00000	
	Reset Vector
$0000F	
$00010	Interrupt Vector
$0001F	
$00020	
	Reserved
$003FF	
$00400	
	Reserved for VBR mode
$007FF	
$00800	
	Program & Voice Data Space
$27FFF	

FIGURE 3-1: ROM Map of AM4GBxxxx

3.2 SRAM

Data memory is composed of the special function registers (SFR), and the SRAM. Address 0x00~0x0F is left for the SFRs. There are 2 pages SRAM in the AM4GBxxxx chip. Each of the 2 SRAM pages is from 0x10 to 0x3F address, so there are 48x4-bit in one page, and there are total 96x4-bit SRAM in 2 pages. All the SRAM can be operated easily, with our powerful instruction set. To change the SRAM page, use the SRPG instruction. The SRAM page registers will be backed up and restored automatically when an interrupt occurs and returns. The AM4G SRAM supports indirect addressing mode.
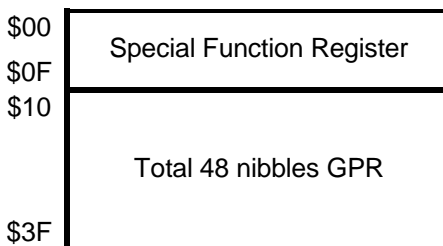
$00	Special Function Register
$0F	
$10	
	Total 48 nibbles GPR
$3F	

FIGURE 3-2: SRAM MAP OF AM4GBxxxx

4 Pin Description

Pad Name	Attr.	Description
PRA0~2	I/O	Four I/O modes can be optioned for each I/O pin: (1) Floating input mode, (2) Pull-high IO mode, (3) Pull-high input mode, (4) Output mode. Or *4 kinds of output current: (1) Normal current, (2) Constant current, (3) Large current, (4) Large and Constant current.*
PRA3 / IR	I/O	Four I/O modes can be optioned for each I/O pin: (1) Floating input mode, (2) Pull-high IO mode, (3) Pull-high input mode, (4) Output mode. Or *4 kinds of output current: (1) Normal current, (2) Constant current, (3) Large current, (4) Large and Constant current.* Or *mask option selected as an IR Carrier Output with programmable 37KHz.*
PRC3 / Reset	I/O	Four I/O modes can be optioned for each I/O pin: (1) Floating input mode, (2) Pull-high IO mode, (3) Pull-high input mode, (4) Output mode. Or *mask option selected as an external RESET pin with weak pull-high capability.*
PRC2	I/O	Four I/O modes can be optioned for each I/O pin: (1) Floating input mode, (2) Pull-high IO mode, (3) Pull-high input mode, (4) Output mode.
OSC1	I	R oscillator input for RM mode.
PWM1	O	PWM1 output.
PWM2	O	PWM2 output.
VDD1~2	Power	Positive power supply.
GND1~2	Power	Ground Potential.

5 Electrical Characteristics

The Characteristics of AM4GBxxxx series are described in the following table. All the data are measured in the room temperature. Different process lot or testing condition may cause variation of data result.

5.1 Absolute Maximum Rating

SYMBOL	RATING	UNIT
$V_{DD} \sim V_{SS}$	-0.5 ~ +6.0	V
Vin (for all input)	V_{SS}-0.3 < Vin < V_{DD}+0.3	V
Vout (for all output)	GND < Vout < V_{DD}	V
Top (Operating)	0 ~ +70	℃
Tst (Storage)	-25 ~ +85	℃

5.2 DC Characteristics

SYMBOL	PARAMETER		Vdd	MIN.	TYP.	MAX.	UNIT	CONDITION
Fosc	Operating frequency					8	MHz	5.5V, 25℃
V_{DD}	Operating voltage			2.2	3	5.5	V	8 MHz
I_{ht}	Supply current	Halt	3			1	uA	Halt mode
			4.5			2		
I_{sb}		Standby	3		90		uA	Standby mode (1 MHz)
			4.5		180			
I_{op}		Operating	3		2		mA	8MHz, RM, I/O No Loading
			4.5		4			
I_{il}	Input current (Internal weak pull-high)	Weak	3		-4.2		uA	Vil=0V
			4.5		-10.1			
		Strong	3		-8.2			
			4.5		-20.0			
I_{oh}	Output high current		3		-3.1			Voh=2.60V
			4.5		-8.7			Voh=3.70V
I_{ol}	Output low current (disable large current / disable constant current)		3		4.6			Vol=0.4V
			4.5		11.0			Vol=0.8V
I_{ol} (PRA)	Output low current (enable large current / disable constant current)		3		8.9			Vol=0.4V
			4.5		20.5		mA	Vol=0.8V
I_{ol} (PRA)	Output low current (disable large current / enable constant current)		3		6.5			Vol=0.4V
			4.5		10.3			Vol=0.8V
I_{ol} (PRA)	Output low current (enable large current / enable constant current)		3		12.3			Vol=0.4V
			4.5		19.8			Vol=0.8V
I_{PWM}	PWM output current(peak)		3	100			mA	Load=8 ohms
dF/F	Frequency Stability		3.4		± 3		%	$\frac{Fosc(3.4v) - Fosc(2.4v)}{Fosc\ (3v)}$
dF/F	Frequency Stability		5.1		± 3		%	$\frac{Fosc(5.1v) - Fosc(2.7v)}{Fosc\ (5.1v)}$
dF/F	Fosc Variation		3	-3		3	%	8MHz

5.3 Typical Rosc vs. V_{DD} for RM Mode Oscillator of AM4GBxxxx

V_{DD}	Oscillator Frequency			
	Rosc=560K	Rosc=430K	Rosc=270K	Rosc=200K
2.0 V	5.62 MHZ	7.40 MHZ	10.92 MHZ	14.34 MHZ
2.5 V	5.85 MHZ	7.81 MHZ	11.58 MHZ	15.66 MHZ
3.0 V	5.94 MHZ	7.96 MHZ	11.85 MHZ	16.06 MHZ
3.5 V	5.99 MHZ	8.04 MHZ	11.99 MHZ	16.22 MHZ
4.0 V	6.00 MHZ	8.07 MHZ	12.07 MHZ	16.35 MHZ
4.5 V	6.03 MHZ	8.09 MHZ	12.11 MHZ	16.40 MHZ
5.0 V	6.04 MHZ	8.11 MHZ	12.16 MHZ	16.48 MHZ
5.5 V	6.07 MHZ	8.14 MHZ	12.20 MHZ	16.51 MHZ

Resistance vs. Frequency(at 3V)
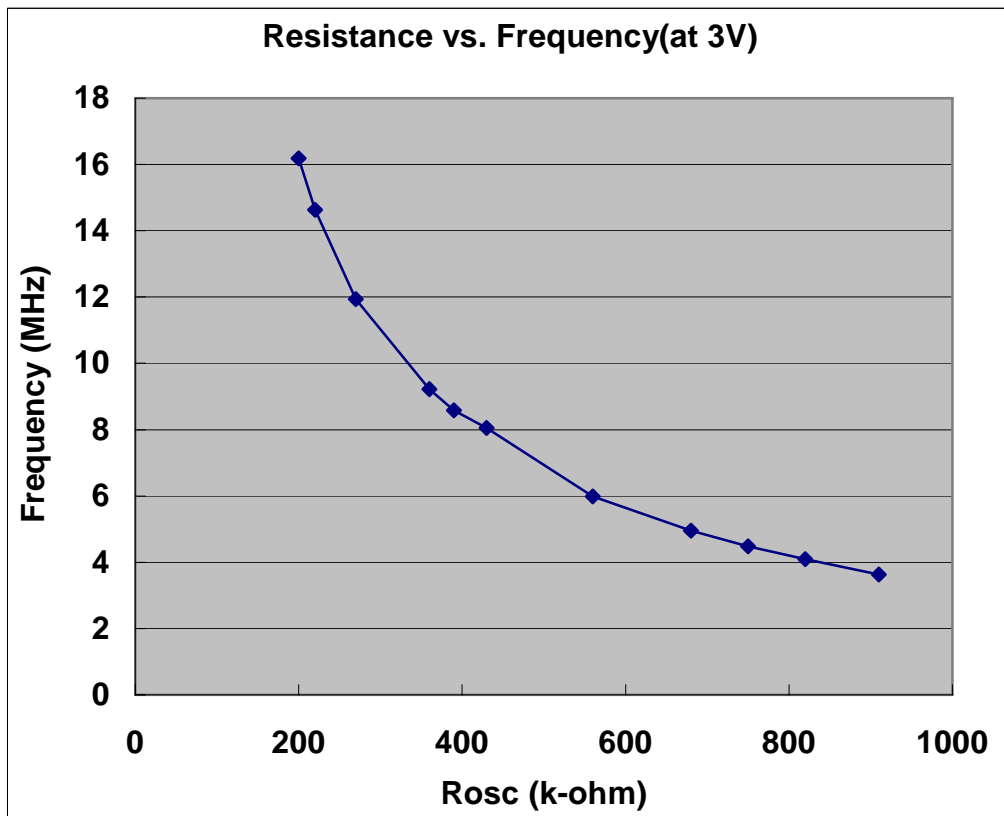
6 Application Circuit
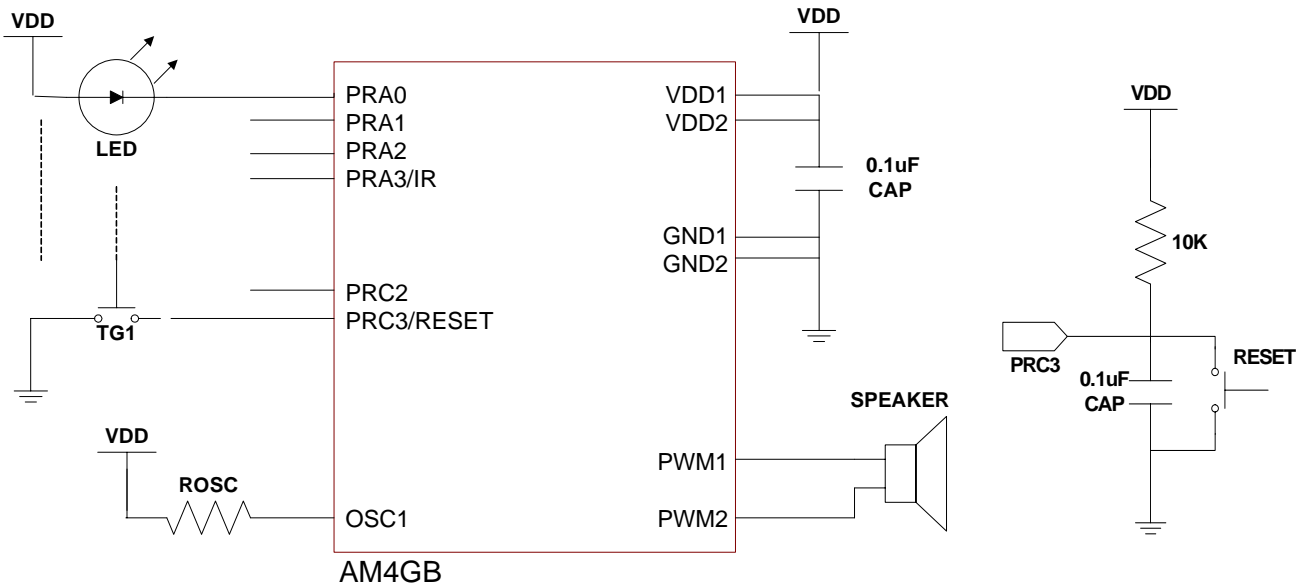
FIGURE 6-1: The application circuit for RM Mode Oscillator and PWM output.

7 Bonding Diagram

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┌─────────────────────────────────────────────────────┐
│   ┌─────────────────────────────────────────────┐    │
│   │                                             │    │
│   │                  ROM                        │    │
│   │                                             │    │
│   └─────────────────────────────────────────────┘    │
│                                                      │
│                                     GND2 │13│         │
│   │1│ PWM2                           OSC1 │12│         │
│   │2│ VDD1                           VDD2 │11│         │
│      PWM1  GND1  PRA0  PRA1  PRA2  PRA3  PRC2  PRC3    │
│      │3│   │4│   │5│   │6│   │7│   │8│   │9│  │10│      │
└─────────────────────────────────────────────────────┘
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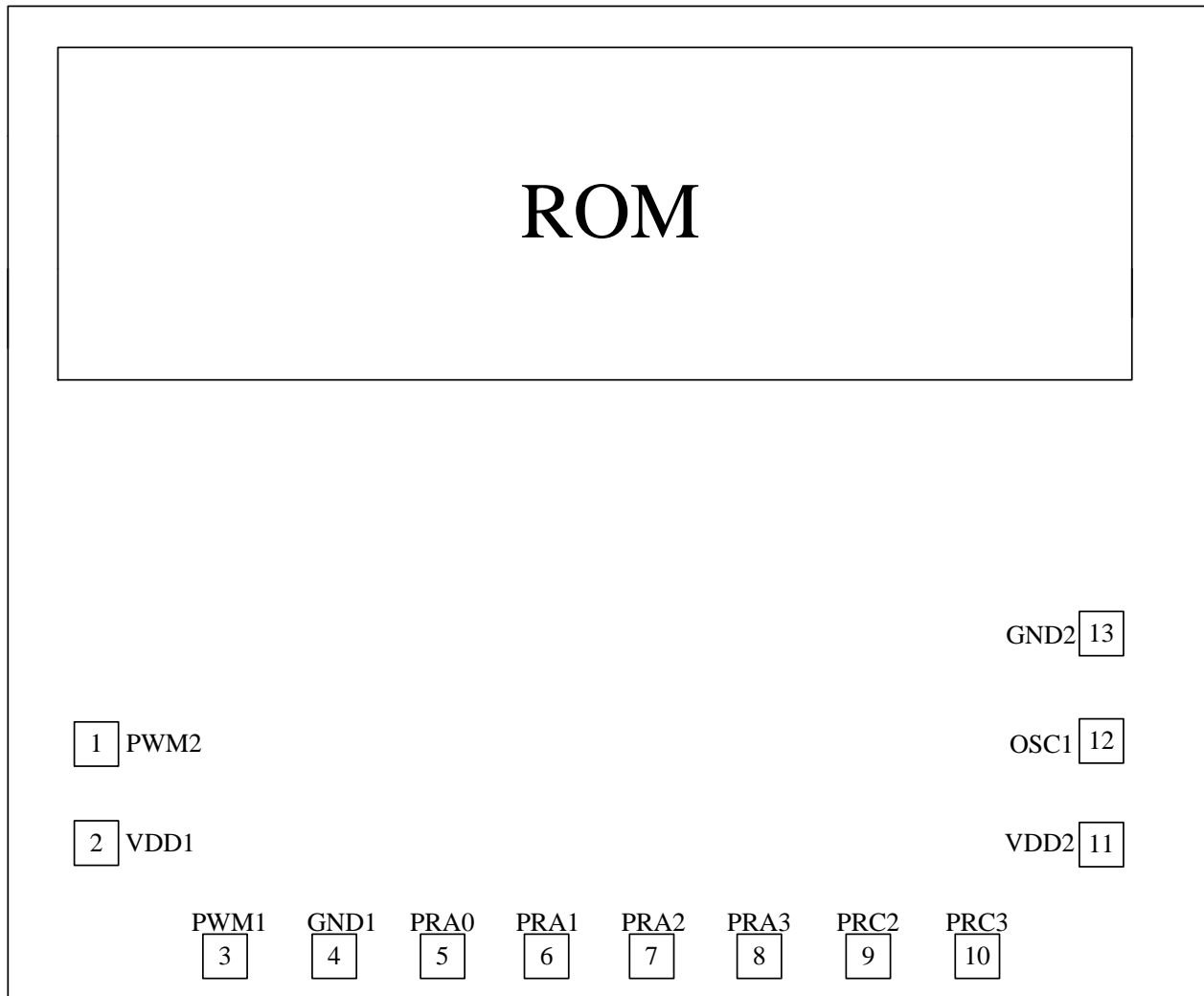
Note: The IC substrate must be connected to GND.