eAMS Series

16 Bits DSP Sound Processor

Product Specification

DOC. VERSION 1.7

ELAN MICROELECTRONICS CORP.

DEC 2009

Trademark Acknowledgments:
IBM is a registered trademark and PS/2 is a trademark of IBM.
Windows is a trademark of Microsoft Corporation.
ELAN and ELAN logo are trademarks of ELAN Microelectronics Corporation.

The contents of this specification are subject to change without further notice. ELAN Microelectronics assumes no responsibility concerning the accuracy, adequacy, or completeness of this specification. ELAN Microelectronics makes no commitment to update, or to keep current the information and material contained in this specification. Such information and material may change to conform to each confirmed order.

In no event shall ELAN Microelectronics be made responsible for any claims attributed to errors, omissions, or other inaccuracies in the information or material contained in this specification. ELAN Microelectronics shall not be liable for direct, indirect, special incidental, or consequential damages arising from the use of such information or material.

The software (if any) described in this specification is furnished under a license or nondisclosure agreement, and may be used or copied only in accordance with the terms of such agreement.

ELAN Microelectronics products are not intended for use in life support appliances, devices, or systems. Use of ELAN Microelectronics product in such applications is not supported and is prohibited.
NO PART OF THIS SPECIFICATION MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE EXPRESSED WRITTEN PERMISSION OF ELAN MICROELECTRONICS.

ELAN MICROELECTRONICS CORPORATION

Headquarters:
No. 12, Innovation Road 1
Hsinchu Science Park
Hsinchu, Taiwan 30077
Tel: +886 3 563-9977
Fax: +886 3 563-9966
http://www.emc.com.tw

Hong Kong:
Elan (HK) Microelectronics Corporation, Ltd.
Flat A, 19F., World Tech Centre 95
How Ming Street, Kwun Tong
Kowloon, HONG KONG
Tel: +852 2723-3376
Fax: +852 2723-7780
elanhk@emc.com.hk

USA :
Elan Information Technology Group (USA)
1821 Saratoga Ave., Suite 250
Saratoga, CA 95070
USA
Tel : +1 408 366-8225
Fax: +1 408 366-8220

Shenzhen:
Elan Microelectronics Shenzhen, Ltd.
3F, SSMEC Bldg., Gaoxin S. Ave. I
Shenzhen Hi-tech Industrial Park
(South Area) Shenzhen 518057
CHINA
Tel: +86 755 2601-0565
Fax: +86 755 2601-0500

Shanghai:
Elan Microelectronics Shanghai, Ltd.
23/Bldg. #115 Lane 572, Bibo Road
Zhangjiang Hi-Tech Park
Shanghai, CHINA
Tel: +86 21 5080-3866
Fax: +86 21 5080-4600

Contents

Specification Revision History

Doc. Version	Revision Description	Date
1.0	1. Added eAM096S, eAM192S and eAM384S 2. Modified the Operating temperature range in Section 7.2	2006/10/31
1.1	1. Modified the Application Circuits in Section 7 2. Modified the Boot SPI in Section 5 3. Modified the Application Circuits in Section 8 4. Modified the Sampleing Rate Range in Section 4 5. Added the IOVDD, IOVSS, AVDD, AVSS in Section 6.1	2007/04/12
1.2	1. Modified the Temperature Range in Section 7.2	2007/08/10
1.3	1. Added package information in Section 4 2. Modifed Applicatoin Circuit in Section 8	2007/11/10
1.4	1. Modified PWM current in Section 6.3	2008/01/10
1.5	1. Modified Application Circuit in Section 8	2008/10/15
1.6	1. Modified Algorithm-related information in Section 5	2009/04/15
1.7	1. Modified Application Circuit in Section 9	2009/12/1

1 General Description

The ELAN eAMS Series IC is a 16-bit DSP Sound Processor with multi-channel speech and instrument playback. It is based on ELAN 16-bit DSP platform. The series has a powerful 16-bit DSP architecture that handles most of the speech / melody functions. Speech and melody can be played back simultaneously. The speech synthesis is implemented by software and supports a wide range of compression bit rates and various volume levels. The ELAN eAMS Series provides real instrument waveform to obtain good quality melody. The ELAN eAMS peripheral includes RTC, Timer, WDT, DAC, PWM, etc.

The ELAN eAMS Series IC's offer Fast mode, Sleep mode, Green mode, and Slow mode of operation. The use of Green/Slow mode will further reduce the power consumption. Green mode also provides RTC function for wake-up purposes.

The ELAN eAMS Series enhanced features make it suitable for versatile voice and sound effect product applications. These enhanced versatile features allow users to create products with a wide variety of new fancy ideas.

The ELAN eAMS Series have extreme high performance in melody application based on powerful DSP architecture and good algorithm in audio compression.

2 Features

- MCU
  - 16-bit RISC CPU architecture
  - CPU clock**:** 20 MHz @ 3.3V
  - Programmable PLL
  - Four CPU operation modes: fast, slow, green, sleep
  - Powerful DSP Instruction Set supports multiplication, division, repeat, loop and soft interrupt instructions
  - Saturation mode is supported for multimedia applications
  - Eight general purpose registers (GPR)
  - 18 interrupt sources with 2-level priority
- Memory
  - 32K-word program memory
  - 2K-word data RAM
  - 096/128/192/256/384/512K-word data ROM
- Peripherals
  - Real Time Clock (RTC) with wake-up function
  - Four 8-bit timers, two general purpose timers, two multiple-function timers
  - 8-bit Watchdog Timer (WDT) with general purpose timer capability
  - 24 GPIO

3 Block Diagram

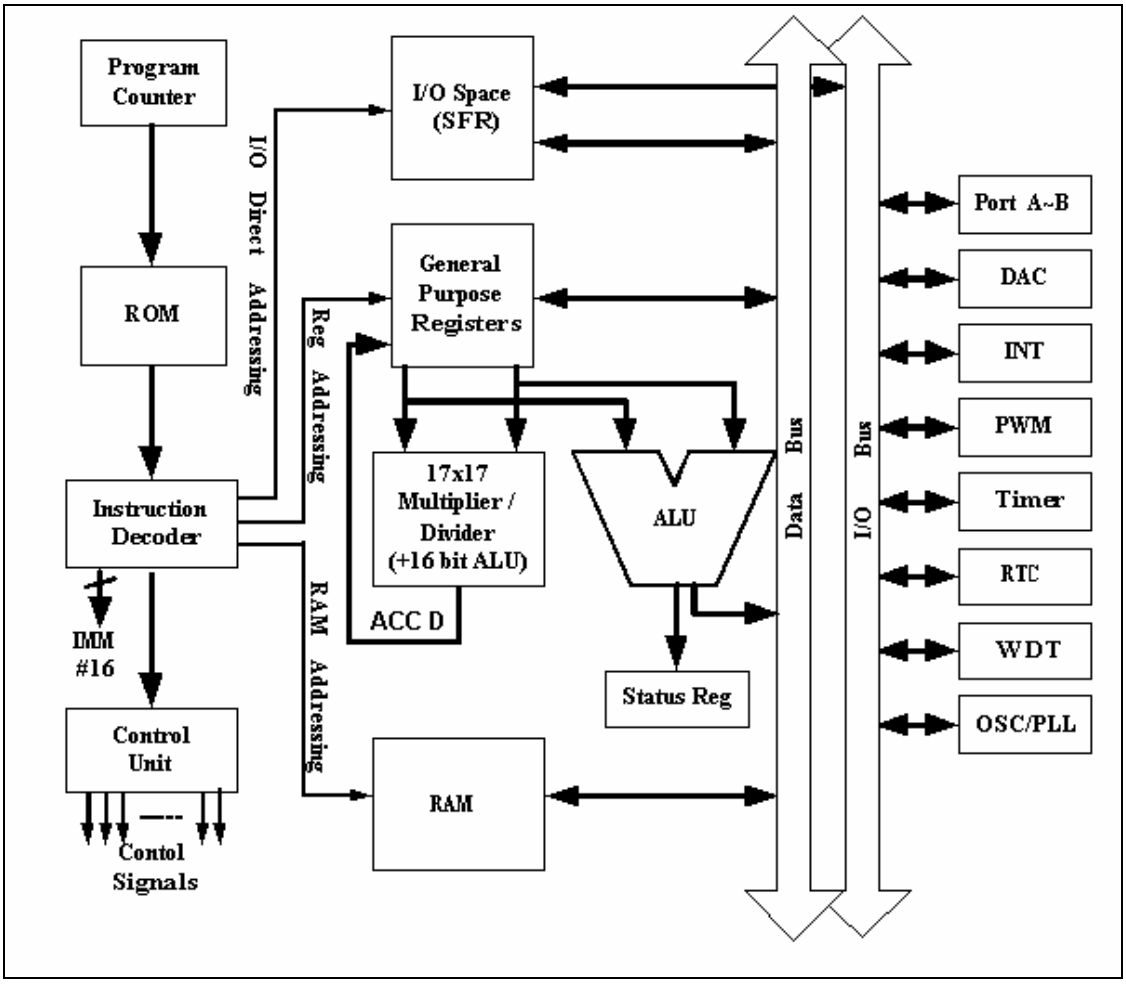


Figure 3-1 ELAN eAMS System Block Diagram

4 Selection Table

The ELAN eAMS Series integrates an extensive range of features, most of which are common to all devices, except for some distinctive features like Data ROM and Coding Type. For user convenience in the choice of the most suitable product for their application, the following table is provided, which enumerates the main features of each device.

Product No.	eAM096S	eAM128S	eAM192S	eAM256S	eAM384S	eAM512S
Pin Count	45					
Program ROM	32K × 16					
Data RAM	2K ×16					
Data ROM	96K×16	128K×16	192K×16	256K×16	384K×16	512K×16
Timer	4 × 8-bit timers					
Watchdog	Yes					
PWM	10-bit					
Current D/A	12-bit					
I/O	24 I/O ports					

5 Algorithm Selection Table

The ELAN eAMS Series algorithm feature:

- 12-bit current-steering Digital to Analog Converter (DAC)
- 10-bit resolution Pulse Width Modulation (PWM)
- Multiple flash with volume level option
- Directly controls port output value by waveform (waveform control port)
- Supports mark number in waveform with ROM optimized configuration
- Up to 16-channel melody or 12-channel melody + 4-channel speech

Product No.	eAM096S	eAM128S	eAM192S	eAM256S	eAM384S	eAM512S
Audio*	Up to 16-channel melody or 12-channel melody + 4-channel speech					
Coding Type*	4-bit ADPCM 5-bit ADPCM PCM (96K bps @ 8KHz)					
Sampling Rate Range*	6kHz ~ 48KHz					

* For more detailed information, refer to the Assembler Reference Manual and C Macro Reference Manual.

6 eAMS and eAM Series Comparison

Product No.	eSLZ000	eAM	eAMS
JTAG ICE	Yes	No	No
Boot SPI	Yes	No	No
Total I/O Number	48 I/O	48 I/O	24 I/0 (Port A + Port B 0~7)
Large Current I/O Number	8+4	8+4	4 (Port A 12~15)
Wake-up Pin	16+5	16+5	8+4
SPI	Yes	Yes	No
MIC Front-end AGC	Yes	Yes	No
ADC	Yes	Yes	No

7 Pin Description

7.1 Power Supply

Name	Type	Supply Voltage	Description
VDD_CPU	P	3V	Positive power supply for CPU, digital peripheral and DRAM
VDD_PM	P	3V	Positive power supply for PROM, DROM and POR
VDD_OSC	P	3V	Positive power supply for Oscillator system and PLL
IOVDD_PWM	P	3V, 5V	Positive power supply for PWM I/O pad
IOVDD_PB	P	3V, 5V	Positive power supply for Port A.2~15 and Port B I/O pad
IOVDD*	P	3V, 5V	Positive power supply
VSS_CPU	P	GND	Negative power supply for CPU, digital peripheral and DRAM
VSS_PM	P	GND	Negative power supply for PROM, DROM and POR
VSS_OSC	P	GND	Negative power supply for Oscillator system and PLL
IOVSS_PWM	P	GND	Negative power supply for PWM I/O pad
IOVSS_PB	P	GND	Negative power supply for Port A.2~15 and Port B I/O pad
IOVSS*	P	GND	Negative power supply
AVDD_DA	P	3V	Positive power supply for D/A
AVDD**	P	3V	Positive power supply
AVSS_DA	P	GND	Negative power supply for D/A
AVSS**	P	GND	Negative power supply
RVIN	P	5V	Regulator voltage input
RVOUT	P	3V	Regulator voltage output 3.0V

* These power pins must connect to the same VDD and VSS as IOVDD_PB and IOVSS_PB

** These power pins must connect to the same VDD and VSS as AVDD_DA and AVSS_DA

7.2 System Control

Name	Type	Description
RSTB	I	RSTB is the low active global reset input *
TEST	I	Test mode select pin (High active). Internal pull down. For chip internal test only, Normally connect to VSS.
OSCI	I	Crystal or RC oscillator connecting pin RC or Crystal selection is by OSCS pin
OSCO	O	Crystal oscillator connecting pin
OSCS	I	RC or Crystal selection: **0** = RC **1** = Crystal
PLLC	I	PLL loop filter capacitor **

* This pin has an internal pull-up 150KΩ resistor. Refer to the Application Circuit.

** This pin must connect a 47nF capacitor to ground. Refer to the Application Circuit.

7.3 DAC Output

Name	Type	Description
DACO	O	Current D/A output pin

7.4 I/O Port

- Port A Attributes and Definitions

Name	Function	Type	Description
PA[0]	GPIO	I/O	General-purpose I/O function
	PWM0	O	PWM Output 0
PA[1]	GPIO	I/O	General-purpose I/O function
	PWM1	O	PWM Output 1
PA[2]	GPIO	I/O	General-purpose I/O function
PA[3]	GPIO	I/O	General-purpose I/O function
PA[4]	GPIO	I/O	General-purpose I/O function
	TEX12	I	External Timer 2 clock input
PA[5]	GPIO	I/O	General-purpose I/O function
	TEX13	I	External Timer 3 clock input
PA [6]	GPIO	I/O	General-purpose I/O function
PA [7]	GPIO	I/O	General-purpose I/O function
PA [8]	GPIO	I/O	General-purpose I/O function
	TCCP2	I/O	Timer 2 capture input or compare output
PA [9]	GPIO	I/O	General-purpose I/O function
	TCCP3	I/O	Timer 3 capture input or compare output
PA [10]	GPIO	I/O	General-purpose I/O function
	EXINT0	I	External Interrupt 0 input
PA [11]	GPIO	I/O	General-purpose I/O function
	EXINT1	I	External Interrupt 1 input
PA [12]	GPIO	I/O	General-purpose I/O function with programmable high current
PA [13]	GPIO	I/O	General-purpose I/O function with programmable high current
PA [14]	GPIO	I/O	General-purpose I/O function with programmable high current
PA [15]	GPIO	I/O	General-purpose I/O function with programmable high current

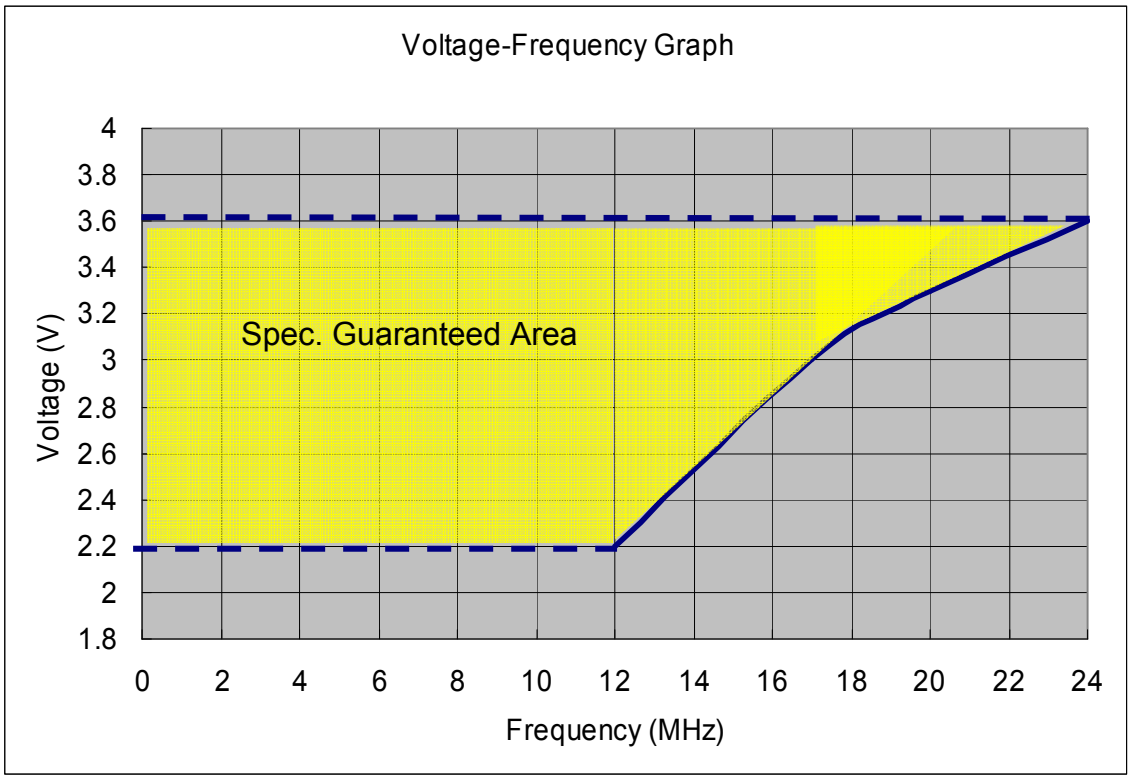
- Port B Attributes and Definitions

Name	Function	Type	Description
PB [7:0]	GPIO	I/O	General-purpose I/O function
		I	Wake-up function with programmable pull-up resistor

8 Electrical Characteristics

8.1 CPU Voltage – Frequency Graph

The speed of a MOS device depends on voltage, temperature, and process variation. Performance analysis is based on a combination of these three factors. The central operating condition is characterized at 3.3V, 25°C, and typical process parameters.



8.2 Absolute Maximum Ratings

Parameter	Pins	Symbol	Condition	Rated Value	Unit
Power supply voltage	VDD	V_{DD}	T_A=25°C	-0.3 to +6.0	V
Input voltage	All Input	V_{IN}	T_A=25°C	-0.3 to VDD+0.3	
Operating temperature range	—	T_A	—	-40 to +85	°C
Storage temperature range	—	T_{STR}	—	-65 to +150	

8.3 DC Characteristics

Standard operation conditions: VDD = 3V, GND=0V, TA = 25°C

Parameter	Pins	Symbol	Condition	Rated Value			Unit
				Min.	Typ.	Max.	
Power supply voltage	VDD[1]	V_{DD}	2 batteries	2.2	3.0	3.6	V
			3 batteries	3.6	4.5	5.5	
Input voltage	—	V_{IN1}	—	VDD×0.7	—	VDD	
	—	V_{IN2}	—	0	—	VDD×0.3	
Input threshold voltage (Schmitt Trigger)	—	—	—	0.5×VDD	—	0.75×VDD	
	—	—	—	0.2×VDD	—	0.4×VDD	
Pull-up resistor	/RESET	V_{PU1L}	Vin=GND	500	1000	1500	kΩ
	/RESET	V_{PU1H}	Vin=2V	80	100	120	
Pull-down resistor	TEST	R_{PD}	Vin=1V	80	100	120	

[1] Refer to the User Manual Voltage Regulator section for details.

Parameter	Pins	Symbol	Condition	Rated Value			Unit
				Min.	Typ.	Max.	
Ports A, B output high current	IOH0	I_{OH0}	VDD=3V VOH=2.4V	-2	-3	—	mA
Ports A, B output low current	IOL0	I_{OL0}	VDD=3V VOL=0.4V	2	3	—	
Port A [12:15] high current (HD enabled)	IOH2	I_{OH2}	VDD=3V VOH=2.4V	TBD	TBD	—	
Port A [12:15] low current (HD enabled)	IOL2	I_{OL2}	VDD=3V VOL=0.4V	TBD	TBD	—	
PWM output high current	PWM0 PWM1	I_{PWMH}	VDD=3V VOH=VDD/2 Max. volume	-140	-150	—	
PWM output low current	PWM0 PWM1	I_{PWML}	VDD=3V VOL=VDD/2 Max volume	140	150	—	
DAC output current	DACO	I_{DAC}	VDD=2.2~3.3V	2.5	3	—	
Regulator output high current	RVOUT	I_{OUTH}	RVIN = 4.5V RVOUT = 3.0V Fast, Slow mode	70	—	—	
Regulator output low current	RVOUT	I_{OUTL}	RVIN = 4.5V RVOUT = 3.0V Green, Sleep mode	7	—	—	
Fast mode current consumption increment per MHz	—	I_{FAST}	VDD=3V No load DAC off	—	700	800	µA
Slow mode current consumption	—	I_{SLOW}	VDD=3V No load DAC off	—	70	80	
Green mode current consumption	—	I_{GREEN}	VDD=3V	—	8	10	
Sleep mode current consumption	—	I_{SLEEP}	VDD=3V Regulator on	—	2	—	
			VDD = 3V Regulator off	—	1	1.2	
CPU operation frequency	—	F_{sys}	VDD = 3V	14	16	—	MHz

9 Application Circuits

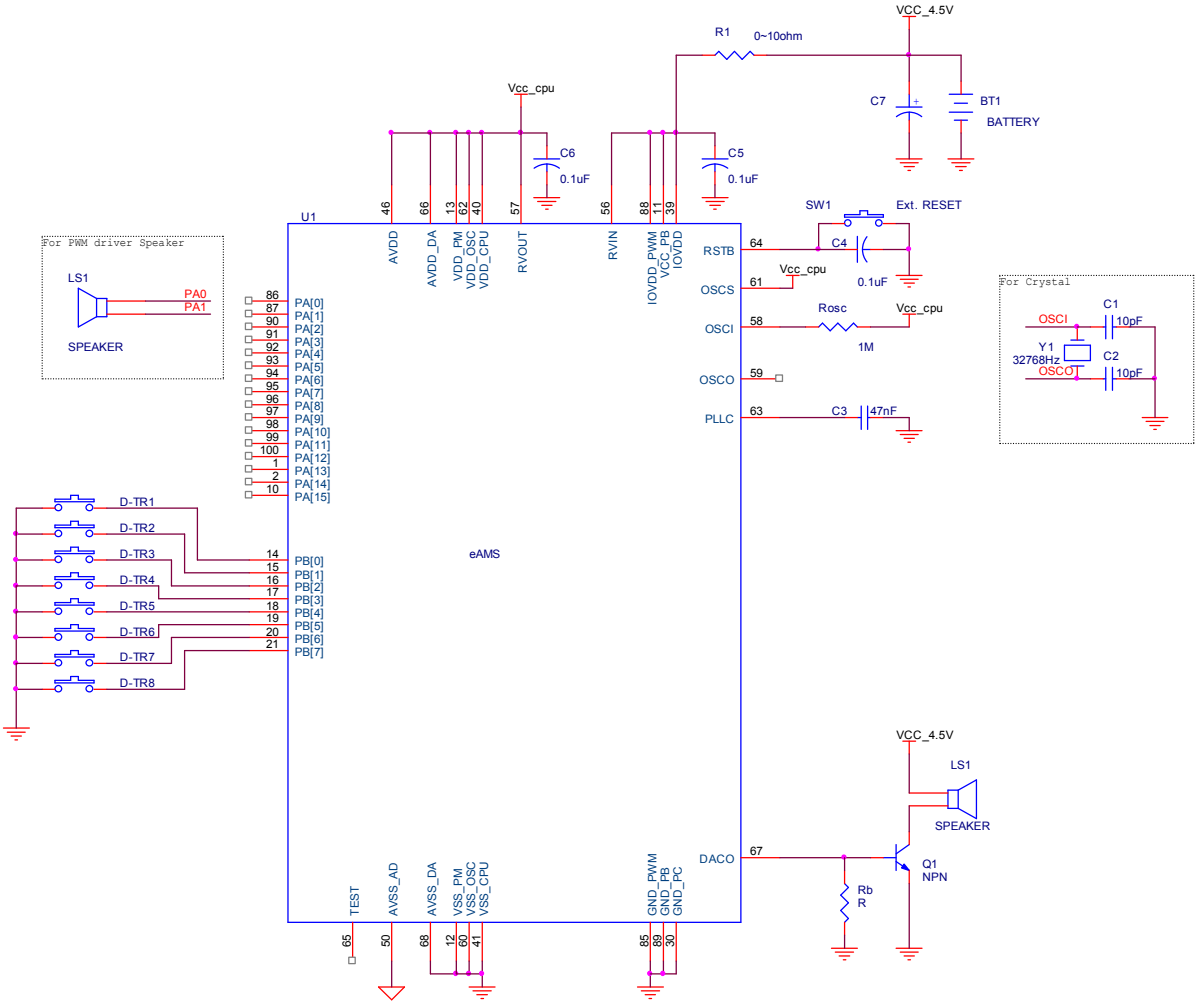


Figure 9-1 ELAN eAMS Series Application Circuit Diagram with D/A using BJT, RC OSC OR crystal OSC , and PWM for 3V/4.5V Support

NOTE

For different package type, the system characteristic issue such as power consumption due to IO pad floating must controlled by software. For example, if user don't bonding IO pad, you must set IO pad type is input with pull-up resister or output to prevent power consumption.