eSH Series

Tiny Controller with Single Speech Channel

Product Specification

DOC. VERSION 1.3

ELAN MICROELECTRONICS CORP.

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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, 19/F, World Tech Centre 95
How Ming Street, Kwun Tong
Kowloon , HONG KONG
Tel**:** +852 2723-3376
Fax**:** +852 2723-7780
elanhk@emc.com.hk

Shenzhen:

Elan Microelectronics Shenzhen, Ltd.

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

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

Shanghai:

Elan Microelectronics Shanghai, Ltd.

#23, Zone 115, Lane 572, Bibo Rd.
Zhangjiang Hi-Tech Park
Shanghai, CHINA   201203
Tel**:** +86 21 5080-3866
Fax**:** +86 21 5080-4600

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Specification Revision History

Doc. Version	Revision Description	Date
1.0	Initial Specification	2006/12/04
1.1	• Add to directly sink/drive the special motor (Page 1) • Add automatic selection of oscillator (Page 1) • Add the new eSH250/285 chip (Page 2) • Revised Application Circuits (Page 6)	2007/05/11
1.2	• Add the recommendation not to keep the P1.0 high level (Page 2) • Modify application circuit (Page 7) • Modify coding name (Page 1)	2007/08/27
1.3	• Add the frequency range • Add the application statement for speaker=PWM/Output mode	2008/09/15

1 General Description

The eSH series IC's are 4-bit microcontroller based sound processors.   The series is equipped with a synthesized speech to obtain good quality voice as well as one 4-bit input port, three 4-bit I/O ports, and one 4-bit output port (applicable to eSH007).   By programming through the microcontroller, applications, such as section combination, trigger mode, output control, keyboard matrix, and other logic functions are easily put into effect.

2 Features

- System clock**:** 2 MHz @2.4V ~ 5.5V

- 3~340 seconds voice capacity are provided (@6kHz sample rate)

- Sleep mode to conserve power, less than 1μA@3V standby current

- Crystal or RC oscillator (optional or by auto-selection)

- Built in 4-bit tiny controller

- Input/Output ports**:**
  - One Input port (P1) with software controlled pull low resistor
  - Three input/output ports (P2 ~ P4)

    P2 is software controlled with pull-low resistor

    P2/P3 has software controlled wake-up function

    P4 is applicable to eSH120/170/250/285/340
  - One output port (P5) is applicable to eSH007
  - I/O Pin P3.2 can be modulated with 38.5kHz carry signal to implement IR function
  - I/O Pin P3.3 can be configured as flash with volume application

- Flash equipped with 4 volume level options**:** 1/2, 1/4,1/8, & 1/16

- Single ROM for voice program with a maximum of 32K program addressing size

- Reset pin is available

- Readable ROM data via offset address

- 4-level stack for subroutine nesting

- Built-in traditional DAC and PWM Direct Drive.   DAC/PWM can be automatically selected.

- Small variation traditional DAC current

- Sample rate range**:** 4k~24kHz

- PCM/5-bit eDPCM/6-bit eDPCM algorithm for speech synthesis (to provide silence compression), which is transparent to user

■ Supports self-test function for checking IC status

■ Provides 4-step drive and 1-step sink current control for output pin (Vo1A / Vo1B functions as general output pin) which can directly drive/sink special motor or large loading component

■ Waveform Mark function and Waveform Control Port (WCP) are provided to control operation that synchronizes with voice

■ Support EASY/Assembly language for developing codes

■ Full-fledged development systems**:**

● User-friendly GUI environment

● Visual EZ tool for graph windows

● Download system with USB port

● EMMeSH (Emulation Module board)

● EMFeSH (Emulation Flash board)

3 Selection Table

The eSH Series integrates an extensive range of features, most of which are common to all devices, except for some distinctive features like, Program Memory capacity, Data ROM, Data RAM, I/O count, Oscillator, Reset, Timer, and PWM/DAC functions.   For your convenience in choosing the most suitable microcontroller for your application, refer to the following.

IC Type	Time (Sec)	Stack	Program Size (Bits)	ROM (bits)	RAM (Bits)	I/O	OSC	IR	Reset	PWM/DAC
eSH005	5	4	16K × 10	16K × 10	64 x 4	4I + 8I/O	RC	Yes	No	PWM
eSH010	10	4	32K × 10	32K × 10	128 x 4	4I + 8I/O	RC/Crystal	Yes	Yes	Yes
eSH015	15	4	32K × 10	48K × 10	128 x 4	4I + 8I/O	RC/Crystal	Yes	Yes	Yes
eSH020	20	4	32K × 10	64K × 10	128 x 4	4I + 8I/O	RC/Crystal	Yes	Yes	Yes
eSH030	30	4	32K × 10	96K × 10	128 x 4	4I + 8I/O	RC/Crystal	Yes	Yes	Yes
eSH040	40	4	32K × 10	128K × 10	128 x 4	4I + 8I/O	RC/Crystal	Yes	Yes	Yes
eSH060	60	4	32K × 10	192K × 10	128 x 4	4I + 8I/O	RC/Crystal	Yes	Yes	Yes
eSH085	85	4	32K × 10	256K × 10	128 x 4	4I + 8I/O	RC/Crystal	Yes	Yes	Yes
eSH120	120	4	32K × 10	384K × 10	128 x 4	4I + 12I/O	RC/Crystal	Yes	Yes	Yes
eSH170	170	4	32K × 10	512K × 10	128 x 4	4I + 12I/O	RC/Crystal	Yes	Yes	Yes
eSH250	250	4	32K × 10	768K × 10	128 x 4	4I + 12I/O	RC/Crystal	Yes	Yes	Yes
eSH285	285	4	32K × 10	864K × 10	128 x 4	4I + 12I/O	RC/Crystal	Yes	Yes	Yes
eSH340	340	4	32K × 10	1024K × 10	128 x 4	4I + 12I/O	RC/Crystal	Yes	Yes	Yes
eSH007	7	4	24K × 10	24K × 10	128 x 4	4I + 12I/O + 4O	RC/Crystal	Yes	Yes	Yes

NOTE: *Each IC is only equipped with one **voice channel for speaker***

4 Applications

- Voice playback devices
- Educational learning equipments

5 Pin Description

Symbol	I/O	Function Description
OSCI	I	Crystal oscillator in / RC oscillator input
OSCO	O	Crystal oscillator out (pin-shared with P5.3 for eSH007)
P1.0~P1.3	I	Bits 0 ~ 3 of Port 1[1, 2]
P2.0~P2.3	I/O	Bits 0 ~ 3 of Port 2[2]
P3.0~P3.3	I/O	Bits 0 ~ 3 of Port 3
P4.0~P4.3	I/O	Bits 0 ~ 3 of Port 4 (applicable to eSH120/170/250/285/340/007)
P5.0~P5.3	O	Bits 0 ~ 3 of Port 5 (applicable to eSH007)
VO1A	O	PWM voice output/Traditional DA
VO1B	O	PWM voice output
VDD	I	Digital Power
VSSD	I	Digital Ground
VCC	I	Analog Power
VSSC	I	Analog Ground
TRS	I	Test/Reset pin (internal pull-low, not applicable to eSH005)

[1] *When IC enters standby mode with the speaker pin in PWM/Output mode, keep the Pin P1.0 at Low Level.*

[2] *When IC enters standby mode, if the pins have pull-low resistors, suggest not to connect Pins P1.0 ~ P2.3 to pull-high level to minimize power consumption.*

[3] *If the speaker pin uses in PWM/Output mode, the Vo1A pin must connect a 1MΩ resistor to ground.*

6 Specifications

6.1 Absolute Maximum Ratings

Parameter	Specification
Supply voltage (VDDx – Vssx)	-0.3V to +6.0V
Input voltage	Vssx – 0.3V to VDDx + 0.3V
Operating Temperature	0°C to 70°C
Storage Temperature	-55°C to 125°C

6.2 Electrical Characteristics

V_{DD}=3V, Vssx=0V, Ta= 25°C unless otherwise specified

Items	Sym.	Condition	Min	Typ.	Max.	Unit
Operating Voltage	V_{DDx}	–	2.4	3.0	5.5	V
Standby current	I_{DDS}	V_{DD}=3V , no load	–	1	2	μA
Operating mode current	I_{op}	V_{DD}=3V, no load, D/A stop	–	700	–	μA
Drive current of P2, P4, P5	I_{OD}	V_{DD}=3V, V_{OD}=2.4V	–	5.5	–	mA
Sink current of P2, P4, P5	I_{OS}	V_{DD}=3V, V_{OS}=0.4V	–	6.5	–	mA
Drive current of P3	I_{OD}	V_{DD}=3V, V_{OD}=2.4V	–	8	–	mA
Sink current of P3	I_{OS}	V_{DD}=3V, V_{OS}=0.4V	–	10	–	mA
Input current of P1, P2	I_{IH}	V_{DD}=3V,	–	3.0	–	μA
Output current of VO1A	I_{VO1A}	V_{DD}=3V, V_{VO1A}=0.7V (traditional current DA)	–	3	–	mA
Drive current of VO1A, VO1B	I_{VOD}	V_{DD}=3V,V_{OD}=2.4V, Step=Z	–	X*	–	mA
Sink current of VO1A, VO1B	I_{VOS}	V_{DD}=3V, V_{OD}=0.4V	–	85	–	mA
Oscillation resistor	R_{osch}	V_{DD}=3V	150	100	56	KΩ
Freq. operate range	F_{High}	V_{DD}=3V	1.5	2	4	MHz
Freq. Deviation	**	V_{DD}=3V, Fosc=2MHz	-	5	7	%

*

mA / Step	Z=3	Z=2	Z=1	Z=0
X	85mA	60mA	45mA	27mA

**

ΔFosc/Fosc

7   Oscillator Frequency Deviation
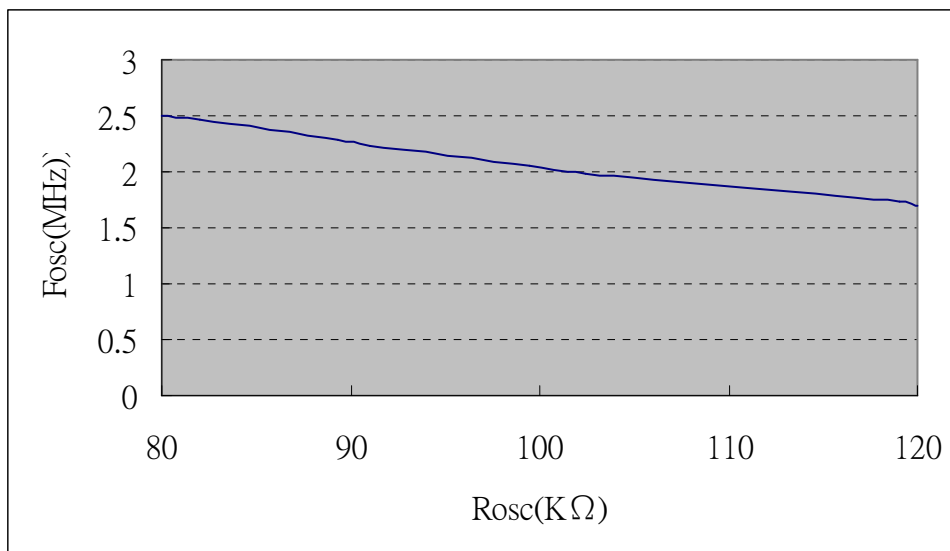
7.1 Oscillator Frequency vs. Rosc (VDD=3.0V)

Figure 7-1   Oscillator Frequency vs. Rosc Deviation

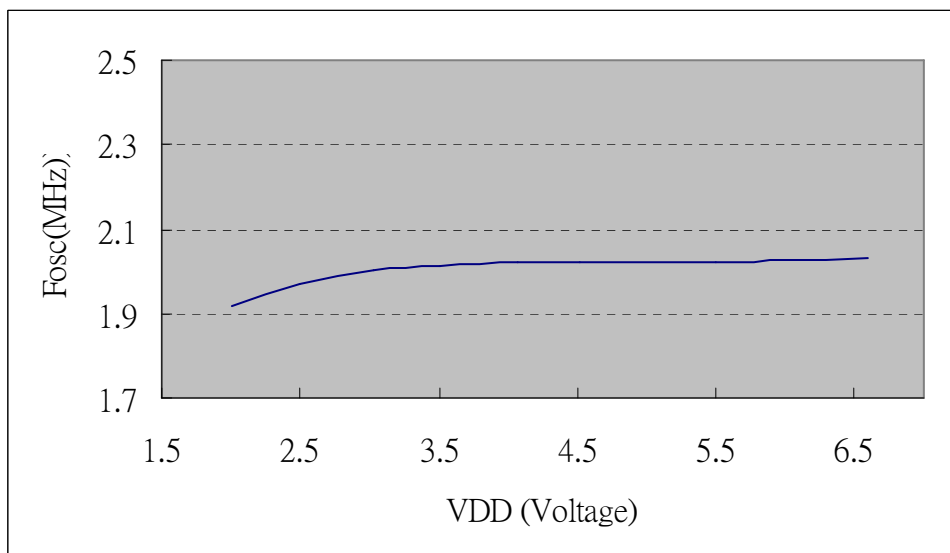## 7.2 Oscillator Frequency vs. VDD (Rosc=100KΩ)

Figure 7-2   Oscillator Frequency vs. VDD Deviation

8 Application Circuit

The following notes apply to all conditions illustrated in the application diagrams below**:**

1. For noisy power supply application, adding a ceramic capacitor between VCC and ground near the IC's VDD pad is recommended.   The recommend capacitor value is 0.1µF.

2. For heavy loading application, adding an electrolytic capacitor between VCC and ground is recommended.   The recommended capacitor value for button cell application is 10µF.

3.   For the speaker using PWM/Output mode, the Vo1A must connect a 1MΩ resistor to ground.
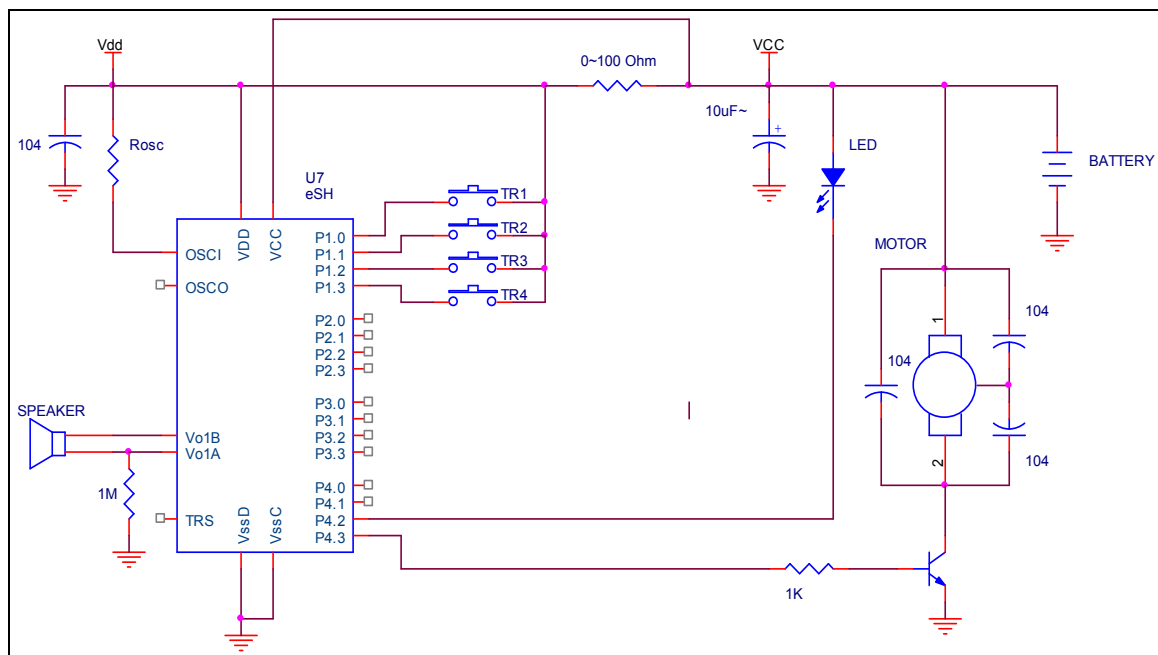

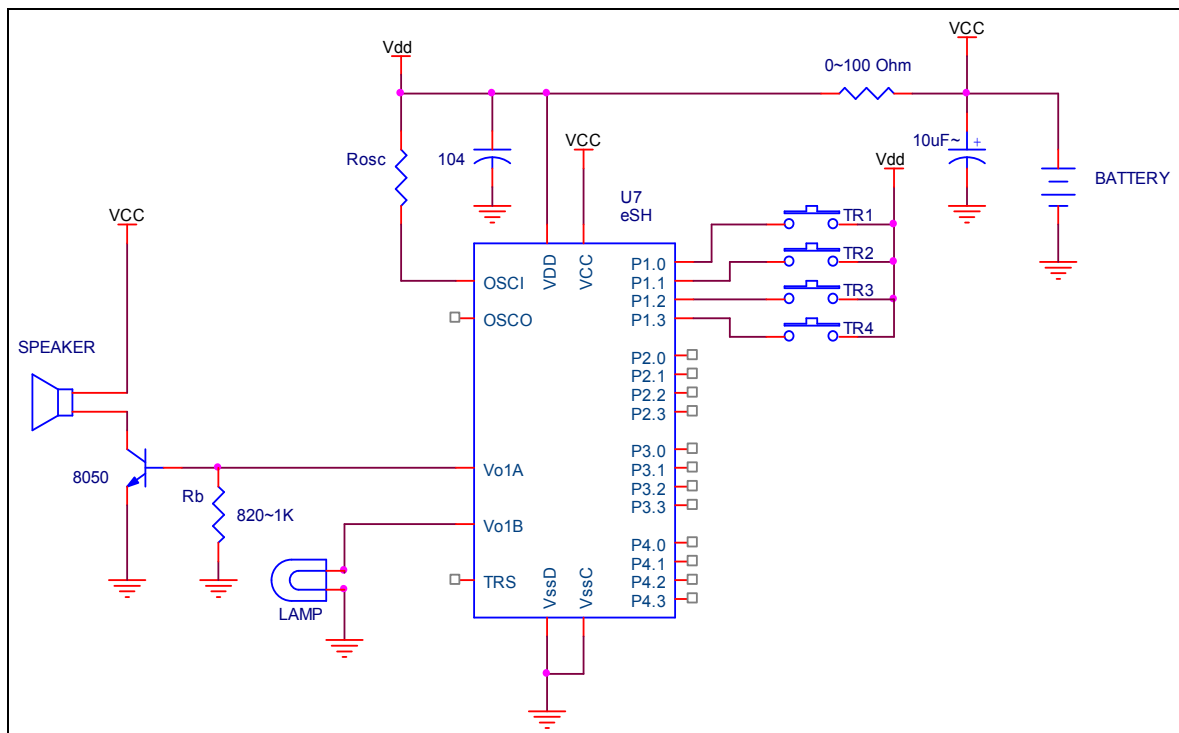*Figure 8-1   eSH Series Application Circuits for Large Loading*

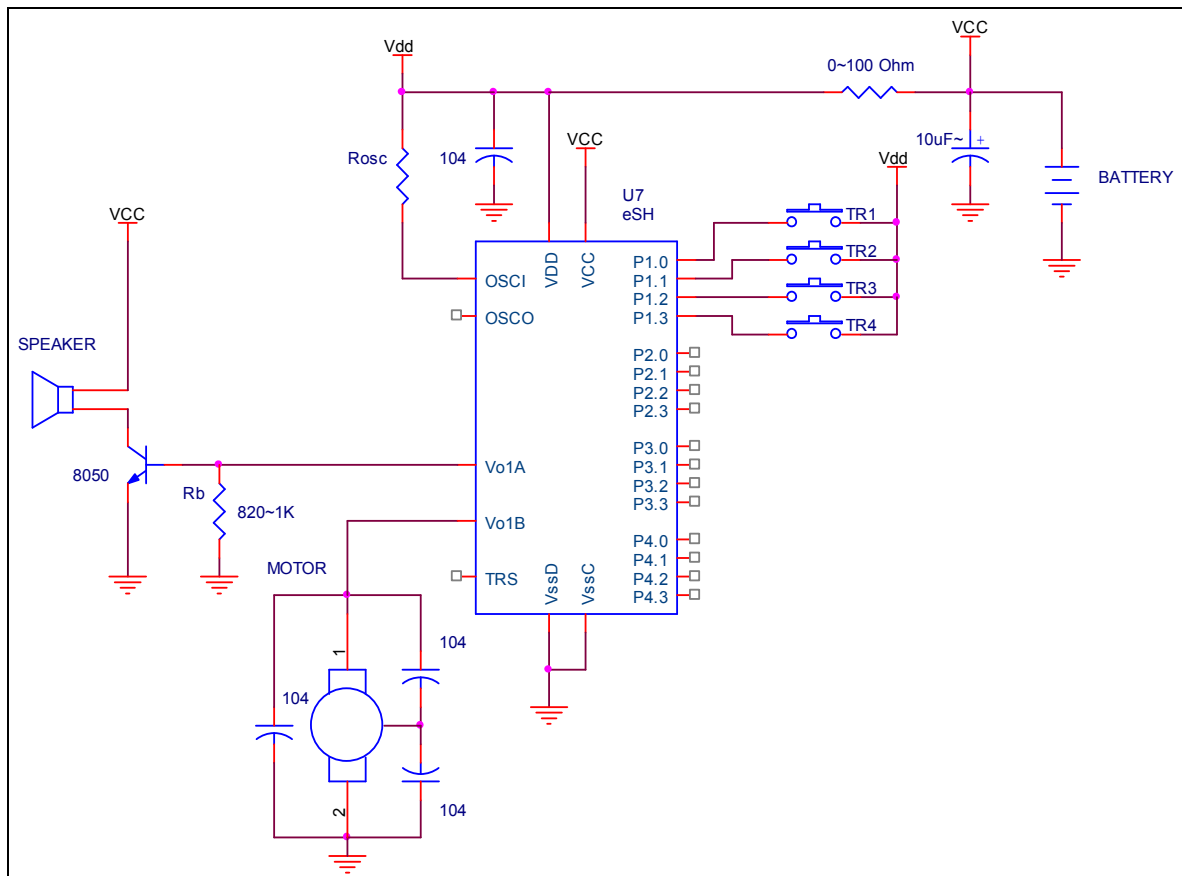*Figure 8-2   eSH Series   Application Circuits Showing Vo1B Driving Lamp*

Figure 8-3   eSH Series Application Circuits Showing Vo1B Driving Motor