Alpha Microelectronic Corp

AM4AC024A

Data Sheet

佑華微電子股份有限公司

新竹市光復路二段 295 號 9 樓之 1 號

電話: 03-573 6660

傳真: 03-573 6661

www.ealpha.com.tw

Alpha Microelectronics Corp.

9F-1, 295, Sec. 2, Kuang Fu Rd., Hsinchu, Taiwan

Tel : +886-3-573 6660

Fax: +886-3-573 6661

www.ealpha.com.tw

Rev 1.0 2006/5/26

Revision History

Rev	Date	Description	Page
1.0	2006/5/26	Initial releasing.	-

1. General Description

The AM4AC024A is low cost, very low power dissipation LCD driver and high performance voice & melody synthesizers with 4-bits microprocessor. It has various enhanced features including more program ROM (1.5k×16 bits ROM), more RAM (2 pages 64×4 bits RAM), much quality improved voice synthesizer, additional high quality dual tone melody synthesizer, PowerIO function supporting, Low voltage detector (LVDT), and built-in infrared ray transmitter (IR) etc. They give the AM4AC024A a much wider range of applications in various fields.

2. Features

(1) Single power supply required and can operate from 2.2V to 5.5V.

(2) Powerful instruction set.

- Includes 79 instructions.
- Binary addition, subtraction, logical operation in direct addressing mode.
- Single-bit manipulation (set, reset decision for branch).
- Various conditional branches.
- 16 working registers and manipulation.
- LCD driver data transfer.
- 4-bit input/output port data transfer.
- HALT instruction for saving power.

(3) Interrupt factors.

- External factors: 2 (port S and M).
- Internal factors: 3 (INT signal, timer and pre-divider).

(4) 4 levels stack for subroutine nesting.

(5) ROM/RAM capacity.

- Program ROM: up to 1536 instructions.
- Data ROM: up to 720k bits (for max 24sec @6kHz voice and melody storage).
- Data RAM: up to 128 nibbles (divided into 2 pages; includes 16 working registers).

(6) Input/Output ports.

- Input ports: 1 port / 4 pins (M port) + 1 port / 2 pins (S port).
- Output ports: 1 port / 4 pins (P port).
- I/O ports: 1 port / 2 pins (IOB port).

(7) LCD driver.

- Provides up to 112 (4 x 28) segments.
- Mask option to select static, 1/2 duty, 1/3 duty and 1/4duty driving mode for LCD panel.
- Mask option permits LCD driver output pins to be used for output ports.

- Segment PLA circuit permits any layout on the LCD panel.
- Built-in LCD voltage generator circuit (low power consumption capacitance type).

(8) Voice and melody synthesizers.

- Triggered by CPU instructions.
- Support one channel voice or two channels melody output.
- Support up to 128 voice sections and 128 melody sections.
- Playback speed can be different for each voice section.
- Auto-detected or mask option selected PWM or COUT audio output type.
- 8 COUT mask option selected current output level.

(9) CPU oscillator type. (mask option)

- Resistor mode (RM).
- 32.768kHz Crystal mode (XT).

(10) Other features.

- PowerIO function is supported.
- Built-in 32KHz / 38KHz infrared (IR) carrier output.
- Built-in LVDT (Low Voltage Detect) function.
- One 6-bit timer with mask option clock.
- External reset pin available.

3. Block Diagram

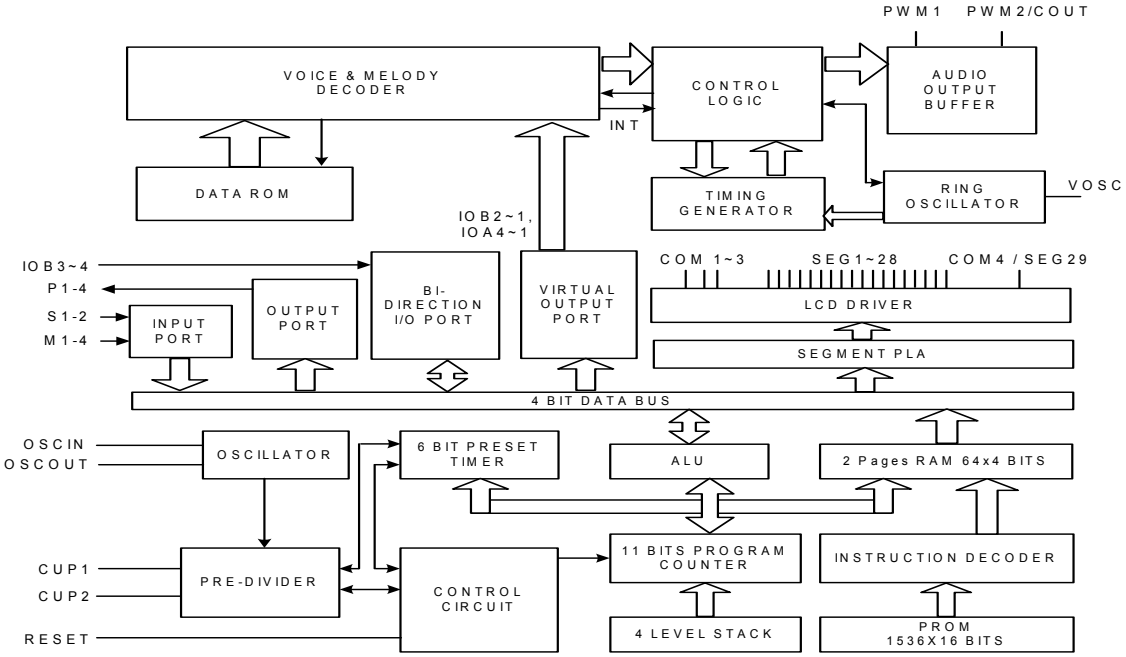


Fig. 1 Block Diagram

4. Pad Description

Pad No.	Pad Name	I/O	Function Description
1	PWM1	O	Audio signal voltage output
2	PWM2/COUT	O	Audio signal voltage output or audio signal current output
3	GND2	P	Negative power supply
4	VDD1	P	Positive power supply
5-8	M1-4	I	Input port
9-12	P1-4	O	Output port
13	S2	I	Input port
14	S1	I	Input port
15-16	IOB3-4	I/O	I/O port
17	BAK	P	Backup positive power supply
18	GND1	P	Negative power supply
19	OSCOUT	O	CPU crystal oscillator output (Xosc), 32768Hz
20	OSCIN	I	CPU crystal oscillator input (Xosc), 32768Hz
21	RESET	I	External reset
22	VDD3	P	Positive power supply
23	VOSC	I	Voice RM oscillator input
24	COM1	O	Common plate for LCD panel
25-52	SEG1-28	O	28 segment outputs for LCD panel
53	SEG29/COM4	O	Common plate and segment output for LCD panel
54	COM3	O	Common plate for LCD panel
55	COM2	O	Common plate for LCD panel
56	CUP1	I	LCD voltage generator capacitor input port
57	CUP2	I	LCD voltage generator capacitor input port
58	VCC1	P	LCD voltage generator power supply
59	TEST	I	Test pin
60	VDD2	P	Positive power supply

5. Electrical Characteristics

The electrical characteristics of AM4AC024A are described in the following tables. All the data and graphics 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
VDD~GND	- 0.5 ~ + 6.0	V
Vin	GND < Vin < VDD	V
Vout	GND < Vout < VDD	V
Top (operating)	0 ~ + 70	˚C
Tst (storage)	- 25 ~ + 85	˚C

5.2 DC Characteristics

Symbol	Parameter	VDD	Min.	Typ.	Max.	Unit	Condition
VDD	Operating Voltage		2.2	3	5.5	V	
Isb	Standby Current (XT mode, Xosc=32kHz)	3		2		μA	Halt mode, no load (non_backup mode)
		4.5		4			
Isb	Standby Current (RM mode, Xosc=32kHz)	3		6		μA	Halt mode, no load (non_backup mode)
		4.5		15			
Iop	Operating current	3		300		μA	Voice is playing, no load
		4.5		800			
Iih	Input current (Internal pull low)	3		3		μA	Input ports with weak Pull-low
		4.5		8			
Ioh	Output-high Current (P1~4, IOB3,4)	3		-8		mA	Voh= 0.8V
		4.5		-18			Voh= 1.8V
Iol	Output-low Current (P1~4, IOB3,4)	3		14		mA	Vol= 1.6V
		4.5		25			Vol= 2.0V
Ioh	Output-high Current (COM1~4)	3		-8		mA	Voh= 0.8V
		4.5		-18			Voh= 1.8V
Iol	Output-low Current (COM1~4)	3		4		mA	Vol= 2.6V
		4.5		5			Vol= 4.0V
Ioh	Output-high Current (SEG1~29)	3		-0.6		mA	Voh= 0.6V
		4.5		-1.6			Voh= 1.6V
Iol	Output-low Current (SEG1~29)	3		0.5		mA	Vol= 2.95V
		4.5		1.1			Vol= 4.39V
Icout	DAC output current (8 level option)	3	1.1~4.4			mA	(Full Scale)
		4.5	1.2~4.9				
Ioh	PWM output current	3		-40		mA	Vdd=3V, Voh=0.9 V
Iol				40			Vdd=3V, Vol=0.5 V

Symbol	Parameter	VDD	Min.	Typ.	Max.	Unit	Condition
Xosc dF/F	Xosc Frequency Stability	3	-5		5	%	Xosc(3v-2.4v) / Xosc(3v) Xosc=32kHz (Rxosc=820kΩ)
Xosc dF/F	Xosc lot variation	3	-10		10	%	Vdd=3v, Xosc=32kHz (Rxosc=820kΩ)
Vosc dF/F	Vosc Frequency Stability	3	-5		5	%	Vosc(3v-2.4v) / Vosc(3v) Rvosc=180kΩ
Vosc dF/F	Vosc lot variation	3	-10		10	%	Vdd=3v, Rvosc=180kΩ

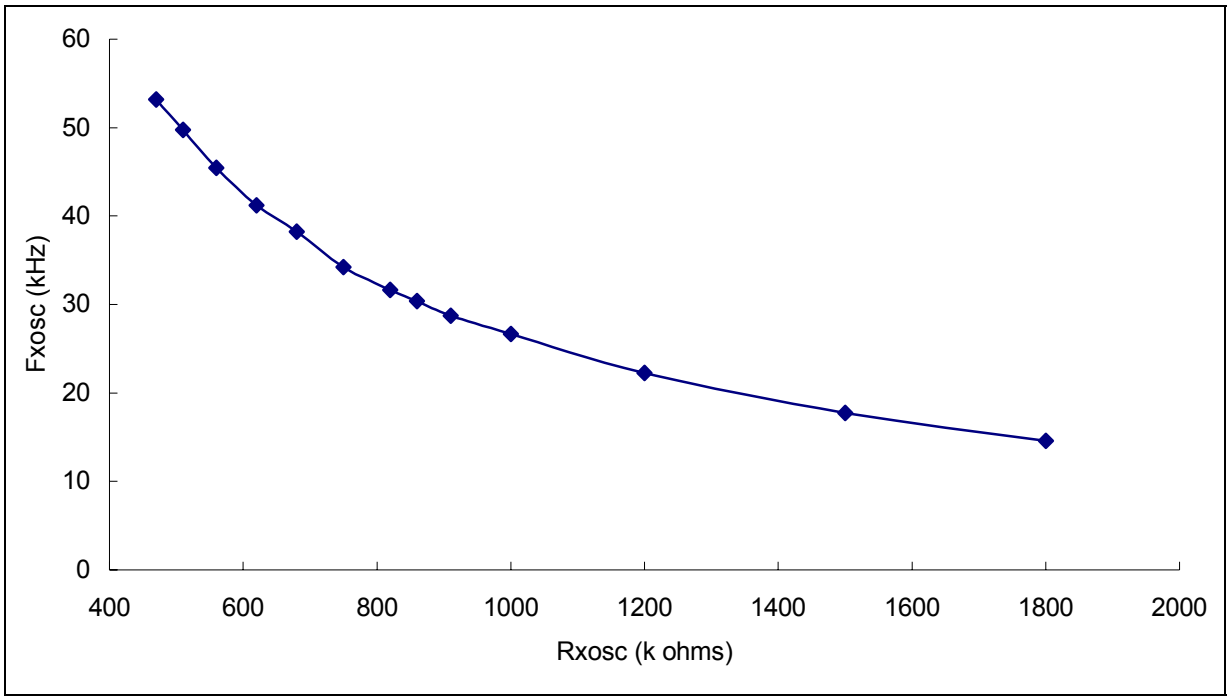
5.3 Typical DAC Output Current (Full Scale)

Cout_I	0	1	2	3	4	5	6	7
DAC Current (mA @Vdd=3.0V)	1.06	1.56	2.06	2.56	3.04	3.52	3.98	4.44

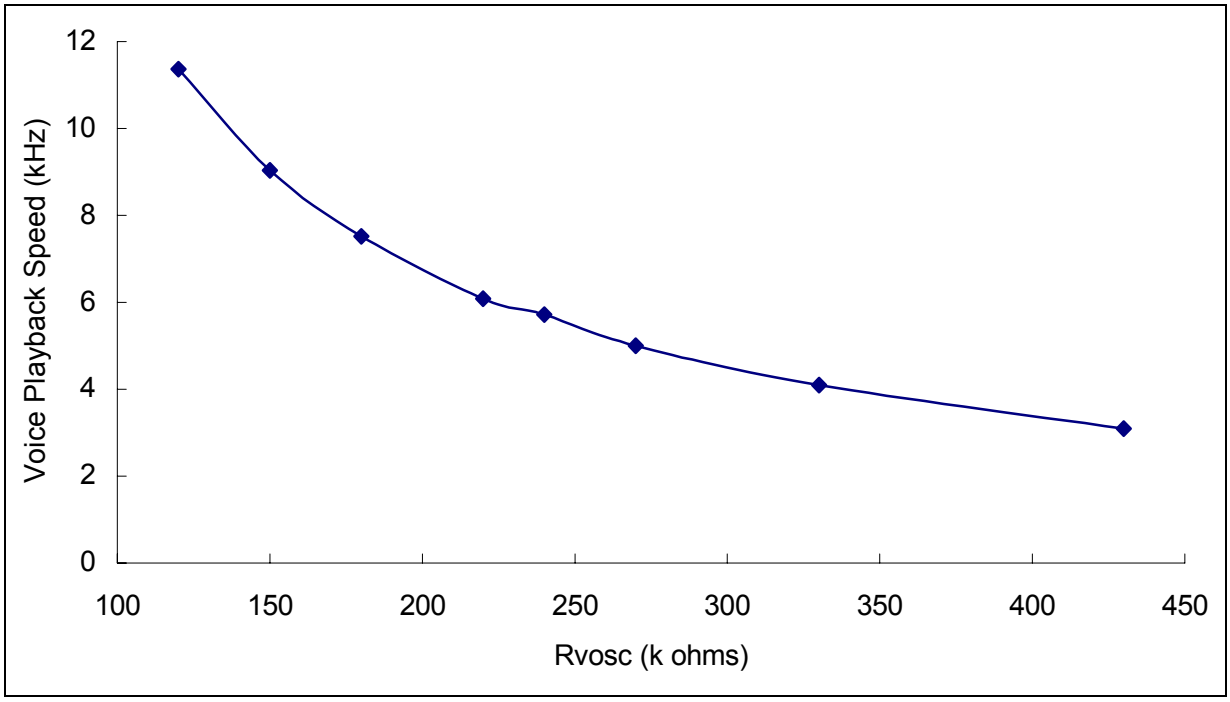
5.4 Typical LVDT Threshold Voltage

LVDT	0	1	2	3	4	5	6	7	8	9
Threshold Voltage of Vdd (V)	1.51	1.63	1.75	1.90	2.06	2.25	2.47	2.75	3.10	3.54

5.5 Xosc vs. External RM Resistance



5.6 Voice Playback Speed vs. Vosc Resistance



Note: Data are measured at 8kHz voice playback speed.

6. Typical Application Circuit

The typical application circuits for AM4AC024A are described as below.

6.1 PWM Mode

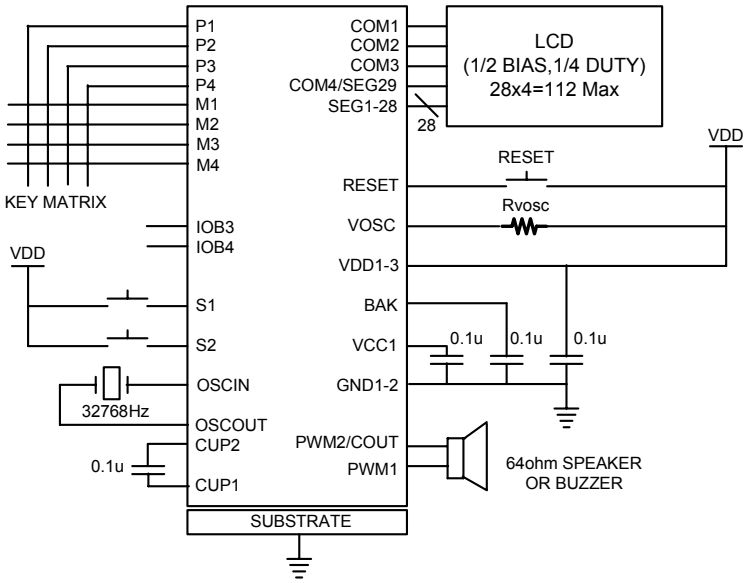


Fig. 2 Typical Application Circuit of PWM mode

6.2 COUT Mode

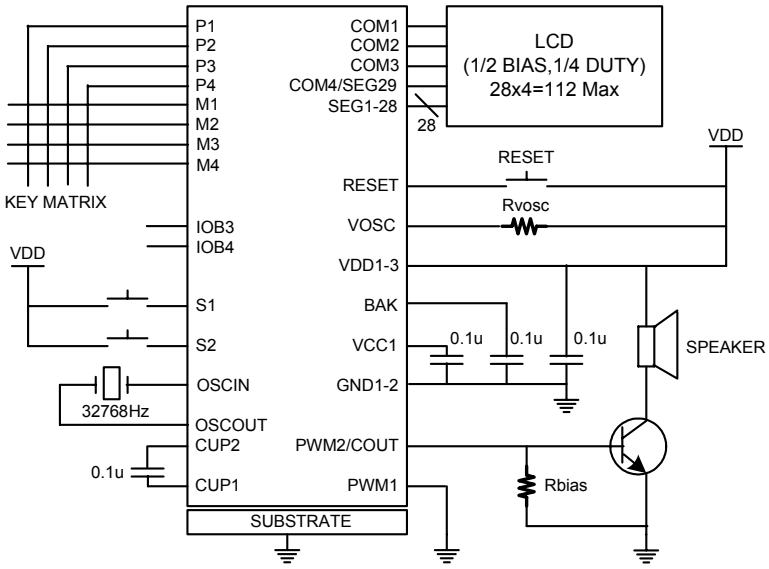


Fig. 3 Typical Application Circuit of COUT mode

6.3 R Mode Xosc

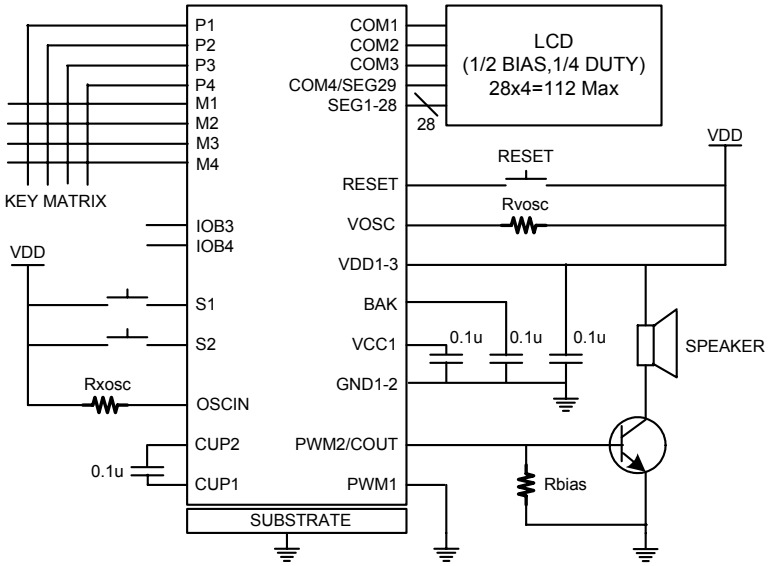


Fig. 4 Typical Application Circuit of R Mode Xosc

6.4 PowerIO and IR

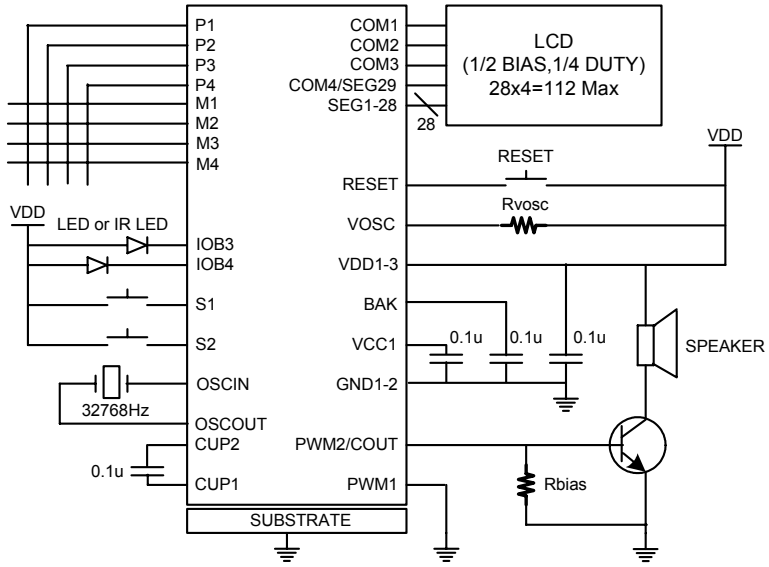
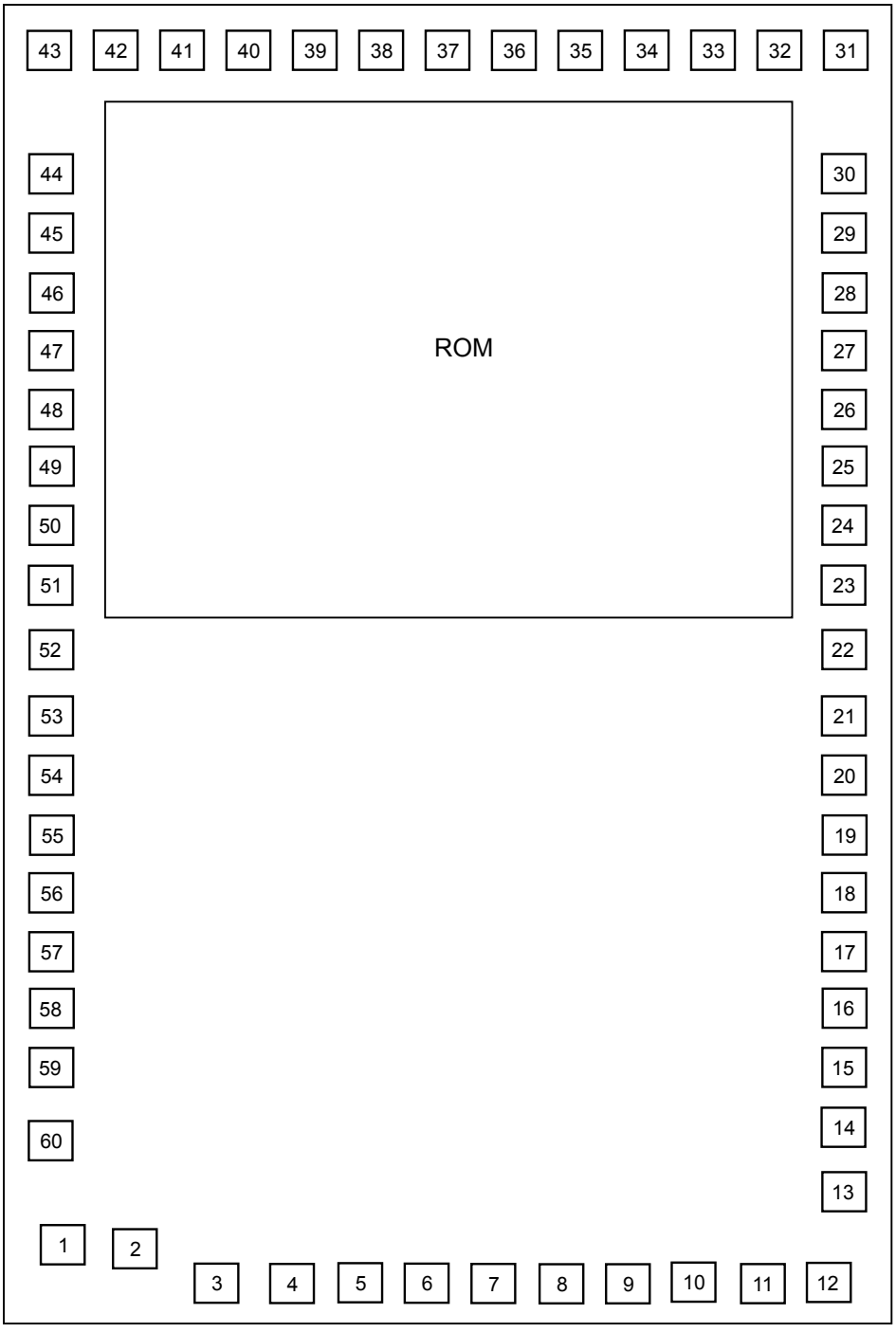


Fig. 5 Typical Application Circuit of using PowerIO and IR

7. Bonding Diagram



Note: The IC substrate must be connected to GND.

PAD No.	PAD Name	PAD No.	PAD Name
1	PWM1	31	SEG7
2	PWM2/COUT	32	SEG8
3	GND2	33	SEG9
4	VDD1	34	SEG10
5	M1	35	SEG11
6	M2	36	SEG12
7	M3	37	SEG13
8	M4	38	SEG14
9	P1	39	SEG15
10	P2	40	SEG16
11	P3	41	SEG17
12	P4	42	SEG18
13	S2	43	SEG19
14	S1	44	SEG20
15	IOB3	45	SEG21
16	IOB4	46	SEG22
17	BAK	47	SEG23
18	GND1	48	SEG24
19	OSCOUT	49	SEG25
20	OSCIN	50	SEG26
21	RESET	51	SEG27
22	VDD3	52	SEG28
23	VOSC	53	COM4/SEG29
24	COM1	54	COM3
25	SEG1	55	COM2
26	SEG2	56	CUP1
27	SEG3	57	CUP2
28	SEG4	58	VCC1
29	SEG5	59	TEST
30	SEG6	60	VDD2