OKI

MSM64P155

User's Manual

CMOS 4-bit microcontroller

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Preface

MSM64P155 is a 4-bit microcontroller, which uses built-in one time PROM (OTP) in place of built-in mask ROM in MSM64155A.

MSM64P155 is manufactured with the N-well EPROM process instead of the P-well CMOS process.

That is why the polarity of MSM64P155's power supply is different than the polarity of the chip with the P-well CMOS structure.

OTP version chips alone are not supplied to customers.

This manual explains the specific hardware of MSM64P155 and the differences from the mask ROM version of MSM64155A.

See "MSM64155 User's Manual" for further reference relating to other hardware and instruction set.

TABLE OF CONTENTS

Chapter 1

GENERAL DESCRIPTION

CHAPTER 1 GENERAL DESCRIPTION

1.1 Overview

MSM64P155 is a microcontroller which uses built-in one time PROM (OTP) in place of built-in ROM of MSM64155A.

Since the MSM64P155 has a different configuration of the mask ROM with P-well CMOS configuration, it is manufactured with the N-well EPROM process. That is why the polarity of the power source used for LCD bias generation is reversed, and the arrangement of additional circuits is different from the arrangement of this chip.

In addition, unlike the mask ROM version, the PROM (OTP version) chip alone has no supply.

For these reasons, this OTP version of MSM64P155 should be used mainly for verification of application program functions.

The MSM64P155 has two operation modes; microcontroller operation mode and PROM mode. The microcontroller operation mode is a mode to make the same operation as a mask ROM and the PROM mode is a mode to write/read PROM.

The descriptions on the microcontroller operation mode are omitted in this manual. Therefore, see "MSM64155A User's Manual". This manual explains different specifications from the mask ROM version in Chapters 2 and 3, and Chapter 4 explains the PROM mode.

1.2 Features

1) A Rich Set of Instructions Including Byte Calculating Instructions
   - 148 types of instructions
   - Byte addition and subtraction, byte transmission, byte comparing instructions
   - Bit operation instructions
   - Data exchange instructions

2) Rich Addressing Modes
   - Two types of indirect addressing modes for HL registers and XY registers
   - Bit operations for all data memory areas
   - Byte calculation for all data memory areas

3) Operating Frequency : Crystal Oscillation at 32.768 kHz
   (minimum instruction execution time: 91μs)
   : RC Oscillation at about 32 kHz

4) Built-In Program Memory : 4064 bytes (PROM)

5) Built-In Data Memory : 256 nibbles

6) I/O Ports : a total of 18 ports
   - 4 bit input-output ports (selectable open drain output/CMOS output, selectable additional pull-down resistance input) × 2
   - 2-bit input port (selectable additional pull-down resistance input)
   - 4-bit input port (selectable additional pull-down resistance input)
   - 4-bit output port (CMOS output)

7) Melody Output: 2 outputs

8) LCD Driver: a total of 64 drivers
   - Common driver × 4
   - Segment driver × 60
   - 1/4 duty, during 1/3 bias: 240 segments (60 × 4)
   - 1/3 duty, during 1/3 bias: 180 segments (60 × 3)

9) Event Counter: 1 channel

10) Interrupt Sources: 10 sources
   - Four external sources, four time base sources, two melody sources (When TST3="1", six time base sources)

11) External Appearance
   - Flat package with 100 pins
     Product name:
     MSM64P155-NGS-BK (Blanked PROM)
     MSM64P155L-NGS-BK (Blanked PROM)
     MSM64P155-XXXGS-BK (Written PROM)
     MSM64P155L-XXXGS-BK (Written PROM)

12) Operating Power Supply Voltage: (mask option)
   1.5 V : MSM64P155
   3.0 V : MSM64P155L

13) Clock Generation Circuit (mask option)
   - Crystal/RC oscillation

1.3 Block Diagram

Figure 1-1 shows the block diagram of MSM64P155.

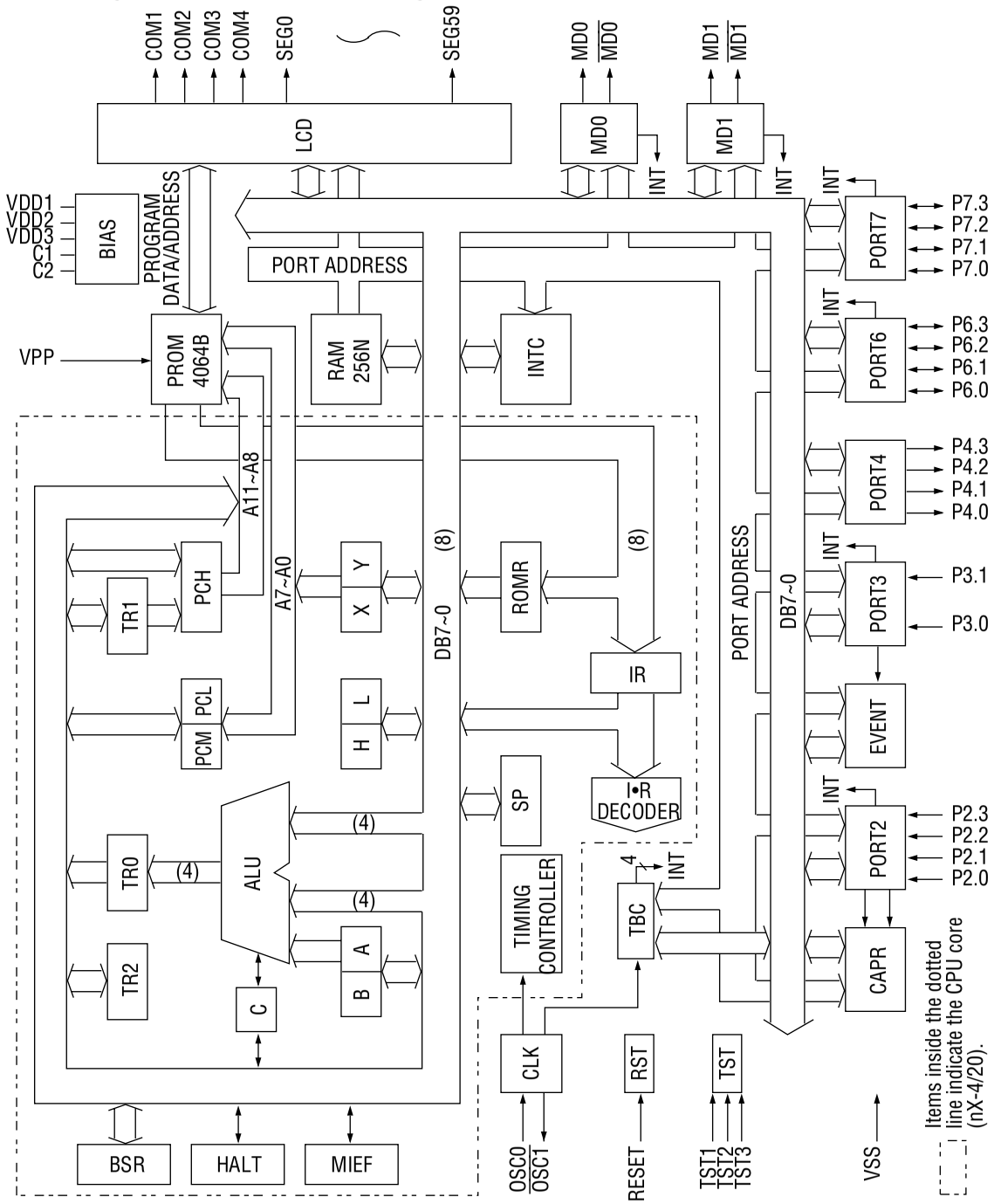
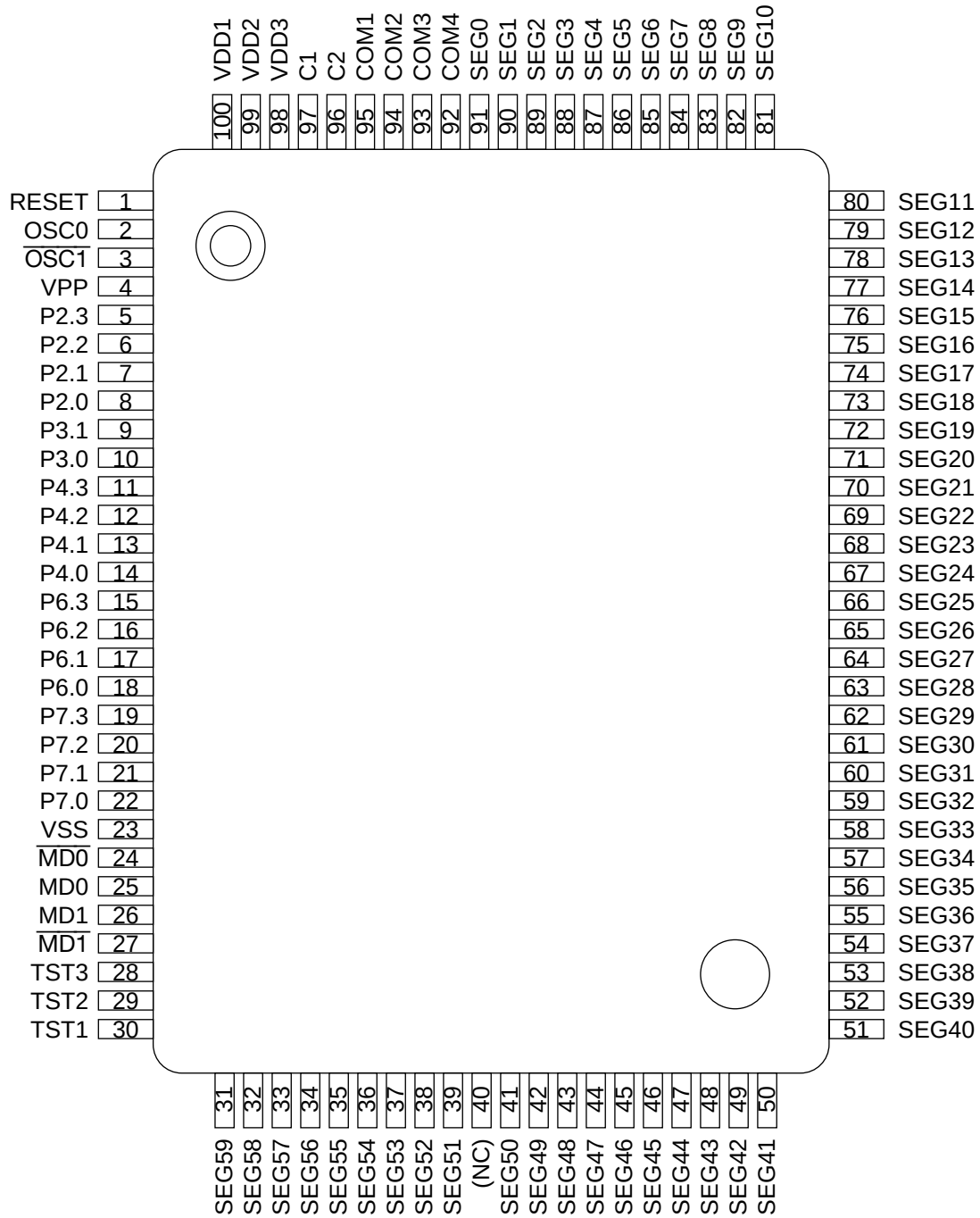


Figure 1-1 Block Diagram of MSM64P155

1.4 Pin Configuration

Figure 1-2 shows the pin configuration of MSM64P155.



Note: Please do not connect anything to the NC pin.

Figure 1-2 Pin Configuration of MSM64P155 (QFP)

1.5 Explanation of Pins

1.5.1 Explanation of Each Pin

Table 1-1 shows basic functions of each of the MSM64P155 pins and Table 1-2 shows their secondary functions.

Table 1-1 (a) Explanation of Pins (Basic Functions)

Type	Pin Name	Pin No.	Input/ Output	Function
Power Supply	VSS	23	—	Digital 0V power supply
	VDD1	100	—	Digital plus side power supply (for 1.5V specs) LCD drive bias output (for 3.0V specs)
	VDD2	99	—	Digital plus side power supply (for 3.0V specs) LCD drive bias output (for 1.5V specs)
	VDD3	98	—	LCD drive bias output (+4.5V)
	C1	97	—	LCD drive bias generating condenser connection pin
	C2	96	—	
	VPP	4	—	Plus side power supply for PROM writing (+12.5V)
Oscillation	OSC0	2	Input	Clock oscillation pin: Connect to crystal oscillator (32.768 kHz) and condenser (10 pF~30 pF) or resistor (1MΩ) are connected.
	$\overline{OSC1}$	3	Output	
Test	TST1	30	Input	Input pin for tests These are pulled down to VSS internally.
	TST2	29	Input	
	TST3	28	Input	When this pin is set to "H" level, the 256Hz and 4Hz interrupts are enabled, and the MSM64P155 can be used as an OTP version of the MSM64152A, MSM64153A and MSM64158A.
Reset	RESET	1	Input	System reset input: When this pin reaches the level "L" ⇒ "H", internal status initialization is conducted and instructions are executed from address 000H. Built-in pull-down resistance on VSS.

Table 1-1 (b) Explanation of Pins (Basic Functions)

Type	Pin Name	Pin No.	Input/ Output	Function
Port	P2.0	8	Input	4-bit input port (port 2): This is a 4-bit input port permitting selection of the pull-down resistance input/high impedance input for each bit through the controller register of port 2 (P2CON). Its secondary functios are trigger input of capture circuits and an external interrupt function. Also, system reset is run when P2.0~P2.3 reach the "H" level.
	P2.1	7		
	P2.2	6		
	P2.3	5		
	P3.0	10	Input	2-bit input port (port 3): This is a 2-bit input port permitting selection of the pull-down resistance input/high impedance input through the controller register of port 3 (P3CON). Its secondary functions are input functions for the event counter by P3.1 and an external interrupt by P3.0.
	P3.1	9		
	P4.0	14	Output	4-bit output port (port 4): This is a 4-bit CMOS output port.
	P4.1	13		
	P4.2	12		
	P4.3	11		
	P6.0	18	Input/ Output	4-bit input/output port (port 6): This is a 4-bit input/output port permitting selection of input/output through the controller register (P6CON) of port 6 (P6CON), selection of the pull-down resistance input/high impedance input during input, and selection of open drain output/CMOS output during output operations. Its secondary function is to allocate external interrupt functions.
	P6.1	17		
	P6.2	16		
	P6.3	15		
	P7.0	22	Input/ Output	4-bit input/output port (port 7): This is a 4-bit input/output port permitting selection of input/output through the controller register of port 7 (P7CON), selection of the pull-down resistance input/high impedance input during input, and selection of open drain output/CMOS output during output. Its secondary function is external interrupt function.
	P7.1	21		
	P7.2	20		
	P7.3	19		
Melody Driver	MD0	25	Output	This is the output pin of melody driver 0.
	$\overline{MD0}$	24	Output	This is the reversed phase output pin for MD0 output.
	MD1	26	Output	This is the output pin of melody driver 1.
	$\overline{MD1}$	27	Output	This is the reversed phase pin of MD1 output.
LCD Driver	COM1	95	Output	These are the LCD common signal output pins.
	COM2	94	Output	
	COM3	93	Output	
	COM4	92	Output	

Table 1-1 (c) Explanation of Pins (Basic Functions)

Type	Pin Name	Pin No.	Input/ Output	Function
LCD Driver	SEG0	91	Output	LCD segment signal output pins
	SEG1	90	Output	
	SEG2	89	Output	
	SEG3	88	Output	
	SEG4	87	Output	
	SEG5	86	Output	
	SEG6	85	Output	
	SEG7	84	Output	
	SEG8	83	Output	
	SEG9	82	Output	
	SEG10	81	Output	
	SEG11	80	Output	
	SEG12	79	Output	
	SEG13	78	Output	
	SEG14	77	Output	
	SEG15	76	Output	
	SEG16	75	Output	
	SEG17	74	Output	
	SEG18	73	Output	
	SEG19	72	Output	
	SEG20	71	Output	
	SEG21	70	Output	
	SEG22	69	Output	
	SEG23	68	Output	
	SEG24	67	Output	
	SEG25	66	Output	
	SEG26	65	Output	
	SEG27	64	Output	
	SEG28	63	Output	
	SEG29	62	Output	
	SEG30	61	Output	
	SEG31	60	Output	
	SEG32	59	Output	
	SEG33	58	Output	
	SEG34	57	Output	
	SEG35	56	Output	

Table 1-1 (d) Explanation of Pins (Basic Functions)

Type	Pin Name	Pin No.	Input/ Output	Function
LCD Driver	SEG36	55	Output	LCD segment signal output pins
	SEG37	54	Output	
	SEG38	53	Output	
	SEG39	52	Output	
	SEG40	51	Output	
	SEG41	50	Output	
	SEG42	49	Output	
	SEG43	48	Output	
	SEG44	47	Output	
	SEG45	46	Output	
	SEG46	45	Output	
	SEG47	44	Output	
	SEG48	43	Output	
	SEG49	42	Output	
	SEG50	41	Output	
	(NC)	40	—	
	SEG51	39	Output	
	SEG52	38	Output	
	SEG53	37	Output	
	SEG54	36	Output	
	SEG55	35	Output	
	SEG56	34	Output	
	SEG57	33	Output	
	SEG58	32	Output	
	SEG59	31	Output	

Table 1-2 Explanation of Pins (Secondary Functions)

Type	Pin Name	Pin No.	Input/ Output	Function
External Interrupt	P2.0	8	Input	Secondary functions of P2.0~P2.3: An external interrupt input pin which enables reception through a modified level. Also enables selection between allowed/prohibited for each bit interrupt through the P2 interrupt enable register (P21E). The system reset mode is activated after all P2.0~P2.3 pins reached the "H" level for at least two seconds. Secondary functions of P2.0 and P2.1: Trigger input pin for capture circuits.
	P2.1	7		
	P2.2	6		
	P2.3	5		
	P3.0	10	Input	Secondary function of P3.0: External interrupt input pin Reception of rising and falling edge signal and rising/falling signal enable on both edges by external interrupt input pins.
	P6.0	18	Input	Secondary function of P6.0~P6.3: An external interrupt input pin which enables reception through a modified level.
	P6.1	17		
	P6.2	16		
	P6.3	15		
	P7.0	22	Input	Secondary function of P7.0~P7.3: An external interrupt input pin which enables reception through a modified level.
	P7.1	21		
	P7.2	20		
	P7.3	19		
Event counter input	P3.1	9	Input	Secondary function of P3.1: Input pin for event counter.

1.5.2 PROM-Related Pins

Table 1-3 shows pins used to write program data to MSM64P155.

Table 1-3 Explanation of Pins (PROM Functions)

Type	Pin Name	Pin No.	Input/ Output	Function
PROM Function	VSS	23	Output	0V power supply
	VDD1*	100	—	Plus side power supply pin (+5V supplies)
	VDD2*	99	—	Plus side power supply pin (+5V supplies)
	VPP	4	—	PROM write power supply (+12.5V supplied)
	RESET	1	Input	PROM write setting pins
	TST1	30	Input	PROM mode is set by H level input
	TST2	29	Input	
	SEG0/D0	91	I/O	Pins for writing and reading of program data
	SEG1/D1	90	I/O	
	SEG2/D2	89	I/O	
	SEG3/D3	88	I/O	
	SEG4/D4	87	I/O	
	SEG5/D5	86	I/O	
	SEG6/D6	85	I/O	
	SEG7/D7	84	I/O	
	SEG8/$\overline{CE}$	83	I/O	PROM chip enable pin
	SEG9/$\overline{OE}$	82	I/O	PROM output enable signal
	SEG10/A0	81	Input	Program address input pins
	SEG11/A1	80	Input	
	SEG12/A2	79	Input	
	SEG13/A3	78	Input	
	SEG14/A4	77	Input	
	SEG15/A5	76	Input	
	SEG16/A6	75	Input	
	SEG17/A7	74	Input	
	SEG18/A8	73	Input	
	SEG19/A9	72	Input	
	SEG20/A10	71	Input	
	SEG21/A11	70	Input	
	SEG22	69	Input	Normally input H level

* PROM mode should be supplied with 5V both to VDD1 and VDD2.

1.5.3 Processing of Unused Pins

Table 1-4 shows processing of unused pins.

Table 1-4 Processing of Unused Pins

Pin	Recommended Pin Connection
TST1~3	Open
P2.0~P2.3	"L" level or open
P3.0~P3.1	"L" level or open
P4.0~P4.3	Open
P6.0~P6.3	For input setting: "L" level or open (initial value is input mode) For output setting: Open
P7.0~P7.3	For input setting: "L" level or open (initial value is input mode) For output setting: Open
MD0, MD1 $\overline{\text{MD0}}$, $\overline{\text{MD1}}$	Open
COM1~4	Open
SEG0~59	Open

Chapter 2

POWER SUPPLY SYSTEM

CHAPTER 2 POWER SUPPLY SYSTEM

2.1 Overview

MSM64P155 (OTP version) is manufactured using EPROM process for the N-well that is different from the P-well CMOS structure of the mask ROM of MSM64155A (mask ROM). Because of this, the polarity of the power supply system is completely reversed when compared to the mask ROM. In addition, note that the names of the power supply pins have also been changed.

Table 2-1 shows a table of the power supply pin functions and Table 2-2 shows the differences between MSM64155A and MSM64P155.

Table 2-1 List of Power Supply Pin Functions

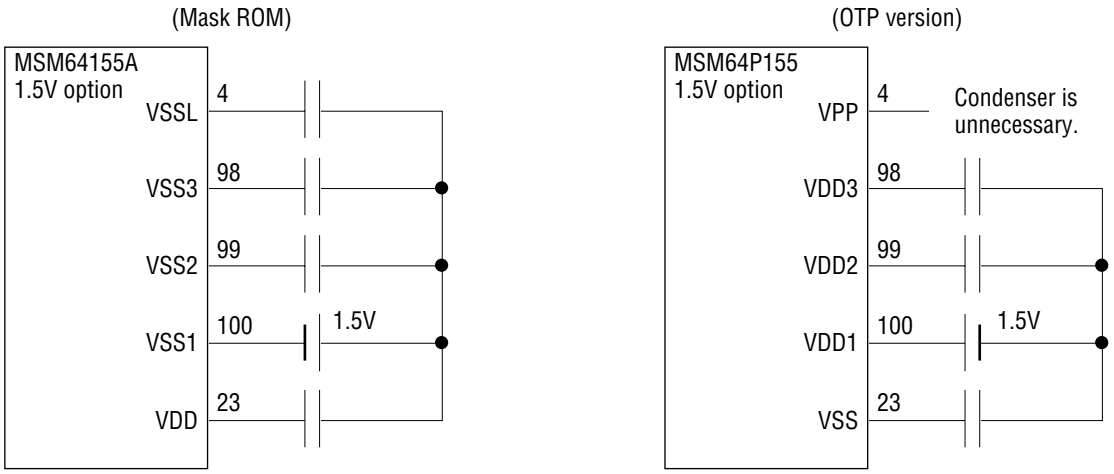
Pin Name	Pin No.	Input/ Output	Function
VSS	23	—	0V power supply
VDD1	100	—	Plus side power supply (for 1.5V specifications) Bias output for LCD drive (+1.5V) (for 3.0V specifications)
VDD2	99	—	Plus side power supply (for 3.0V specifications) Bias output for LCD drive (+3.0V) (for 1.5V specifications)
VDD3	98	—	Bias output for LCD drive (+4.5V)
VPP	4	—	Plus side power supply for PROM write (+12.5V)

Table 2-2 Differences between MSM64P155 and MSM64155A

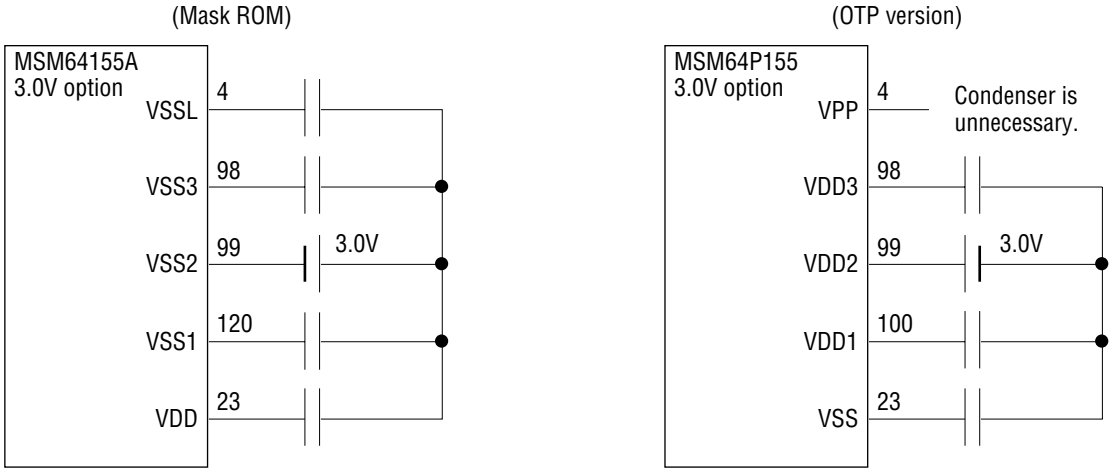
MSM64P155	MSM64155A	Different from MSM64P155
VSS (0V)	VDD (0V)	—
VDD1 (+1.5V)	VSS1 (-1.5V)	Power supply has reversed phase with 1.5V specifications
VDD2 (+3.0V)	VSS2 (-3.0V)	Power supply has reversed phase with 3.0V specifications
VDD3 (+4.5V)	VSS3 (-4.5V)	—
VPP (+12.5V)	VSSL	No external capacitor is required

2.2 Power Supply System Circuit Configuration

Figure 2-1 shows the circuit configuration of the power supply including the differences between MSM64P155 and MSM64155A.



(a) Configuration of the power supply system with the 1.5V option



(b) Configuration of the power supply system with the 3.0V option

Figure 2-1 Power Supply System Circuit Configuration

2.3 Logic Power Supply and Backup Circuits

MSM64P155 has no built-in logic power supply constant voltage (VR) or backup circuits. Internal logic is driven by the VDD1 level both for the 1.5V option and 3.0V option. The backup controller register (BUPCON) is identical to MSM64155A, it enables both reading and writing, and the 0 bit (BUPF) of the backup controller register (BUPCON) has no influence on the logic power source.

2.3.1 Configuration of the Logic Power Supply

Figure 2-2 shows the configuration of driving circuits of the logic power supply.

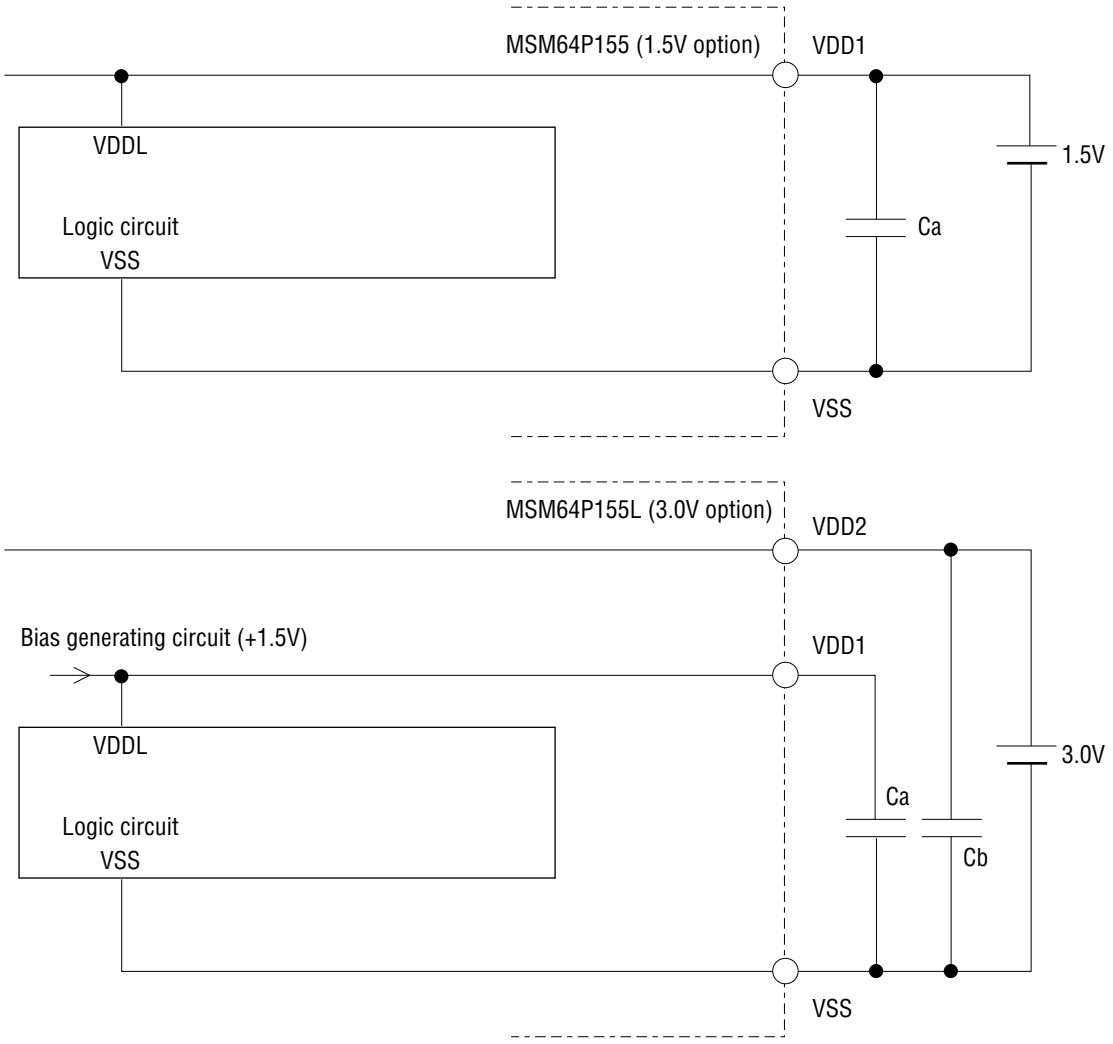


Figure 2-2 Logic Power Supply Driving Circuits

2.3.2 Operations of Optional 1.5V Logic Power Supply Circuits

1.5V optional logic power supply circuits are supplied as a power source with ordinary logic circuits for IC power supply voltage VDD1.

2.3.3 Operations of Optional 3.0V Logic Power Supply Circuits

With the 3.0V option, IC power supply voltage VDD2 is supplied to the logic circuit in the system reset mode, and 1/2 descending power output voltage is supplied for other modes.

Figure 2-3 shows the logic supply status for the system reset mode.

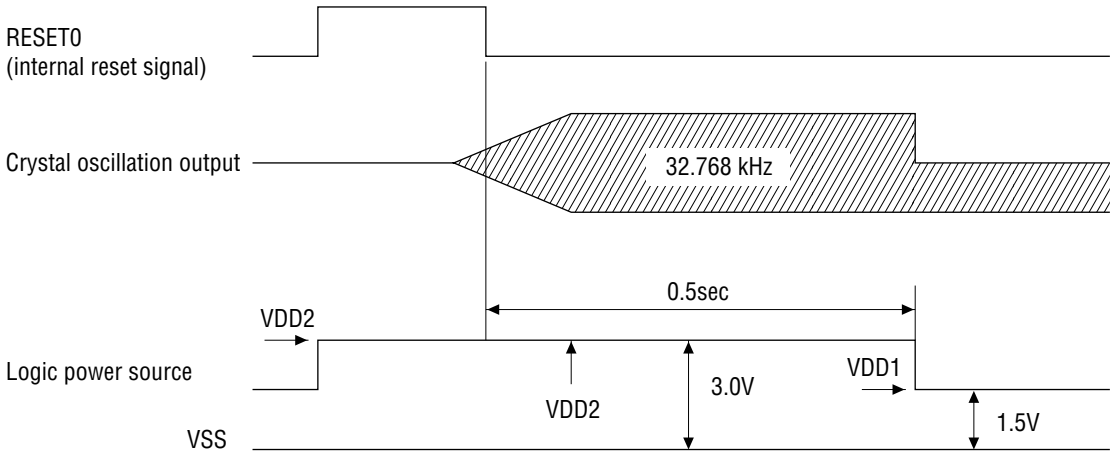


Figure 2-3 Logic Power Supply Status for System Reset Mode (3.0V Option)

Chapter 3

CRYSTAL OSCILLATION CIRCUIT

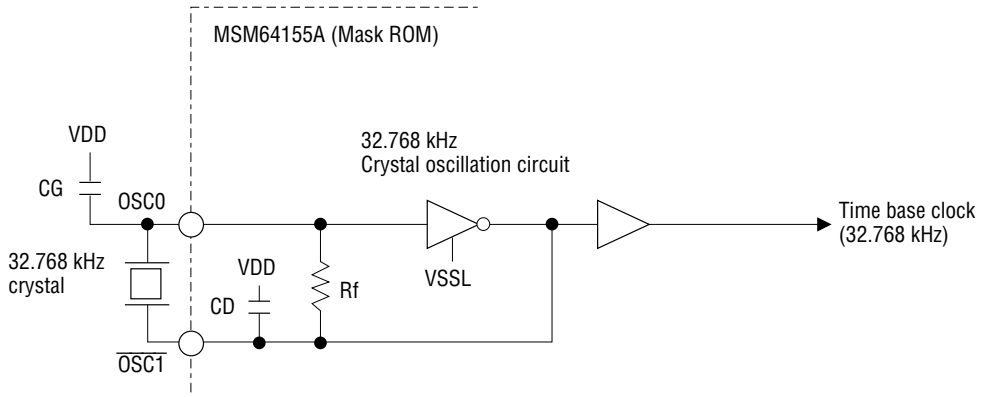
CHAPTER 3 CRYSTAL OSCILLATION CIRCUIT

3.1 Overview

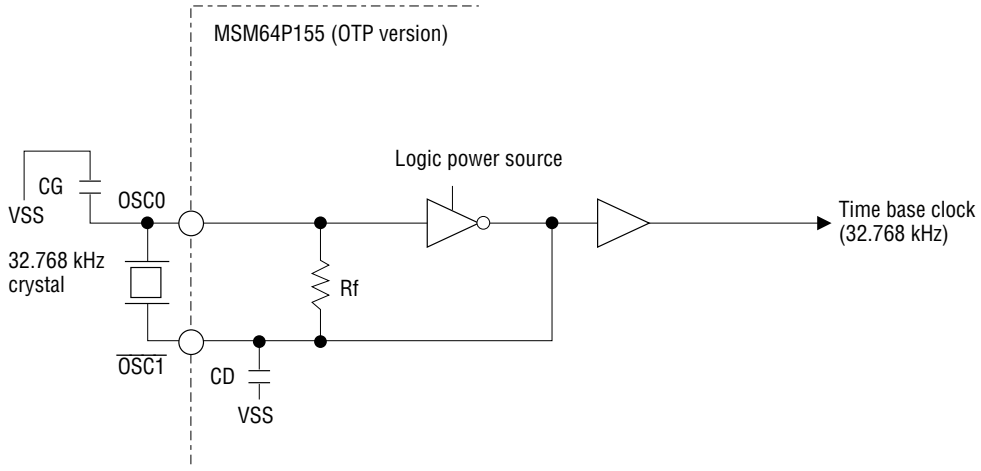
The Crystal oscillation circuit, oscillating at 32.768 kHz, can be fine-adjusted with an external capacitor, but since the phase of the power supply of MSM64P155 is reversed against MSM64155A, location of the attachment position of an external capacitor CG is placed between the VSS and OSC0 pin.
If RC oscillation is selected by mask option, use an external 1MΩ resistor like the MSM64155A.

3.2 Configuration of Crystal Oscillation Circuit

Figure 3-1 shows the configurations of the Crystal oscillation circuit both for MSM64155A (mask ROM) and MSM64P155.



(a) Configuration of Crystal Oscillation Circuit for MSM64155A



(b) Configuration of Crystal Oscillation Circuit for MSM64P155

Figure 3-1 Configurations of Crystal Oscillation Circuit

Chapter 4

PROM

CHAPTER 4 PROM

4.1 Overview

MSM64P155 uses built-in PROM as program memory. The capacity of this PROM is 4064 bytes that omitted 32 bytes from the 0FE0H address to the 0FFFH address, forming the test data area of the mask ROM.

In order to write the program data to this PROM, MSM64P155 uses a special adapter (OTP 64155F-100) which is connected to a general EPROM writer for writing. See the adapter manual for further reference.

4.2 Explanation of Pins

Table 4-1 shows PROM-related pins of MSM64P155.

Table 4-1 (a) PROM Related Pins

Pin Name	Pin No.	Input/ Output	Note
VSS	23	—	0V power supply
VDD1	100	—	Plus side power supply pin (+5V supplied)
VDD2	99	—	Plus side power supply pin (+5V supplied)
VPP	4	—	Power supply for PROM writing (+12.5V supplied)
RESET	1	Input	PROM mode setting pins PROM mode is activated when the "H" level is input to these pins.
TST1	30	Input	
TST2	29	Input	

Table 4-1 (b) PROM-Related Pins

Pin Name	Pin No.	Input/ Output	Function
SEG0/D0	91	I/O	Program data write and read pins
SEG1/D1	90	I/O	
SEG2/D2	89	I/O	
SEG3/D3	88	I/O	
SEG4/D4	87	I/O	
SEG5/D5	86	I/O	
SEG6/D6	85	I/O	
SEG7/D7	84	I/O	
SEG8/$\overline{CE}$	83	Input	PROM chip enable pin
SEG9/$\overline{OE}$	82	Input	PROM output enable signal
SEG10/A0	81	Input	Program address input pins
SEG11/A1	80	Input	
SEG12/A2	79	Input	
SEG13/A3	78	Input	
SEG14/A4	77	Input	
SEG15/A5	76	Input	
SEG16/A6	75	Input	
SEG17/A7	74	Input	
SEG18/A8	73	Input	
SEG19/A9	72	Input	
SEG20/A10	71	Input	
SEG21/A11	70	Input	
SEG22	69	Input	Normally input "H" level

4.3 PROM Mode

MSM64P155 has two different modes; PROM mode used to write to PROM and read from PROM and microcontroller operation mode used to execute programs written to PROM. When MSM64P155 is set in the PROM mode, it simply operates as PROM. These operations are explained under PROM mode.

4.3.1 Setting the PROM Mode

Setting of the PROM mode is done with RESET, TST1, and TST2, listed in Table 4-2. When the PROM mode is set, LCD pins become PROM-related pins.

Table 4-2 PROM Mode Setting

RESET	TST1	TST2	MODE
H	H	H	PROM Mode

4.3.2 PROM Mode Functions

PROM Mode functions are shown in Table 4-3.

Table 4-3 PROM Mode Functions

MODE	$\overline{CE}$	$\overline{OE}$	VPP	VDD1 VDD2	D7~D0
Read	L	L	5V	5V	Program data output
Program	L	H	12.5V	5V	Program data input
Program Verify	H	L	12.5V	5V	Program data output

4.3.3 Connection to the EPROM Writer

Use the MSM64P155 dedicated adaptor (OTP64155F-100) when writing the program data with a commercial general-purpose EPROM writer.
Set a ROM type for the EPROM writer to the 27C256 type Intel fast-writing mode (V_{PP}=12.5V, Program pulse width=1ms).
Set the write addresses of 0000H to 0FDFH.

Chapter 5

TST3 PIN

CHAPTER 5 TST3 PIN

5.1 Overview

In the MSM64P155, when the TST pin is set to "H" level, the 256Hz and 4Hz interrupt sources are added.
The two added interrupt sources enable the MSM64P155 to be used as an OTP version of the MSM64152A, MSM64153A or MSM64158A.
Table 5-1 lists the interrupt sources when TST3="H" and Figure 5-1 shows the interrupt control equivalent circuit.

Table 5-1 Interrupt sources (TST3="H")

No.	Interrupt source	Symbol	Interrupt start address
1	Melody 0 interrupt	MD0INT	023H
2	Melody 1 interrupt	MD1INT	026H
3	Port 3 external interrupt	P3INT	029H
4	Port 2 external interrupt	P2INT	02CH
5	Port 6 external interrupt	P6INT	02FH
6	Port 7 external interrupt	P7INT	032H
7	256Hz interrupt	256HzINT	038H
8	128Hz interrupt	128HzINT	03BH
9	32Hz interrupt	32HzINT	03EH
10	16Hz interrupt	16HzINT	041H
11	4Hz interrupt	4HzINT	044H
12	1Hz interrupt	1HzINT	047H

If two or more different interrupts occur at the same time, an interrupt with a smaller interrupt start address number is serviced first.
When the TST3 pin is open or set to "L" level, the contents of interrupt sources are the same as those of the MSM64155A.

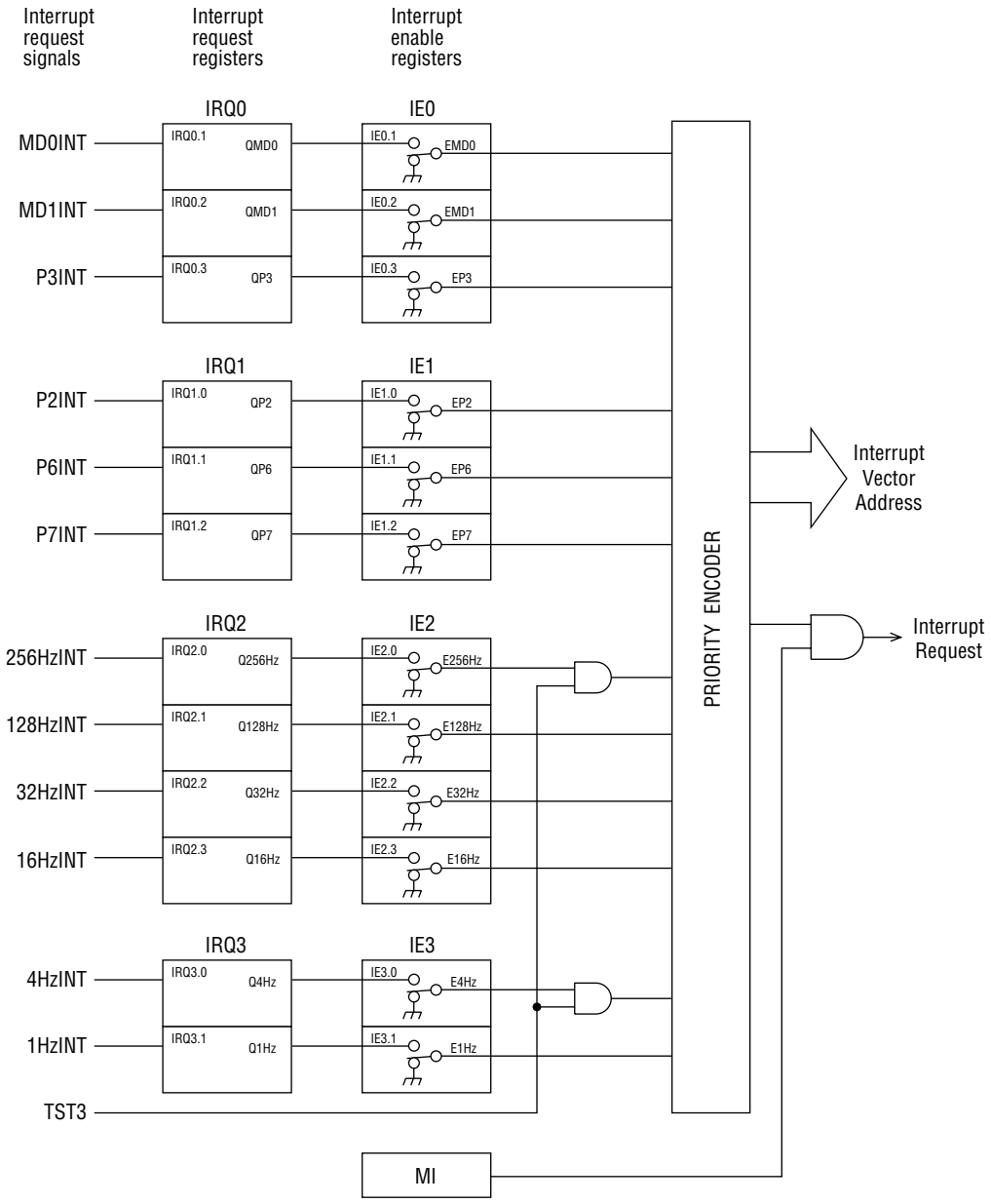
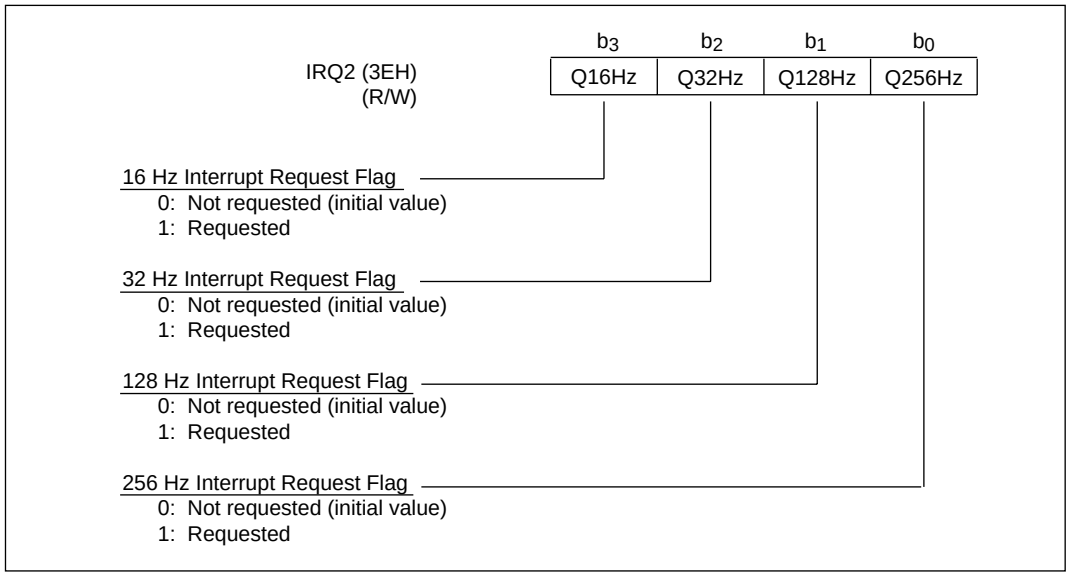


Figure 5-1 Interrupt Control Equivalent Circuit

5.2 Registers To Be Changed By TST3

When the TST3 pin is set to "H" level, the 256Hz interrupt and 4Hz interrupt are added to the interrupt request registers (IRQ2, IRQ3) and interrupt enable registers (IE2, IE3), respectively.

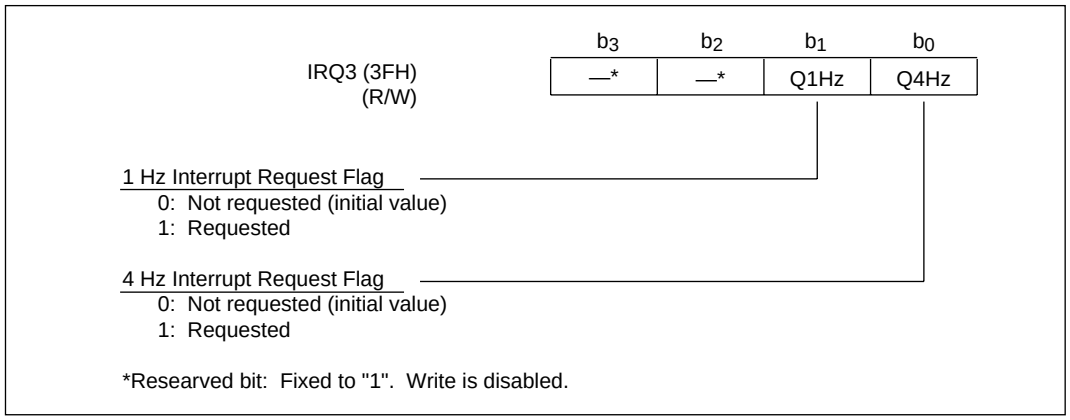


Bit 3: Q16Hz
Set to "1" at the falling edge of a 16Hz output from the time base counter.

Bit 2: Q32Hz
Set to "1" at the falling edge of a 32Hz output from the time base counter.

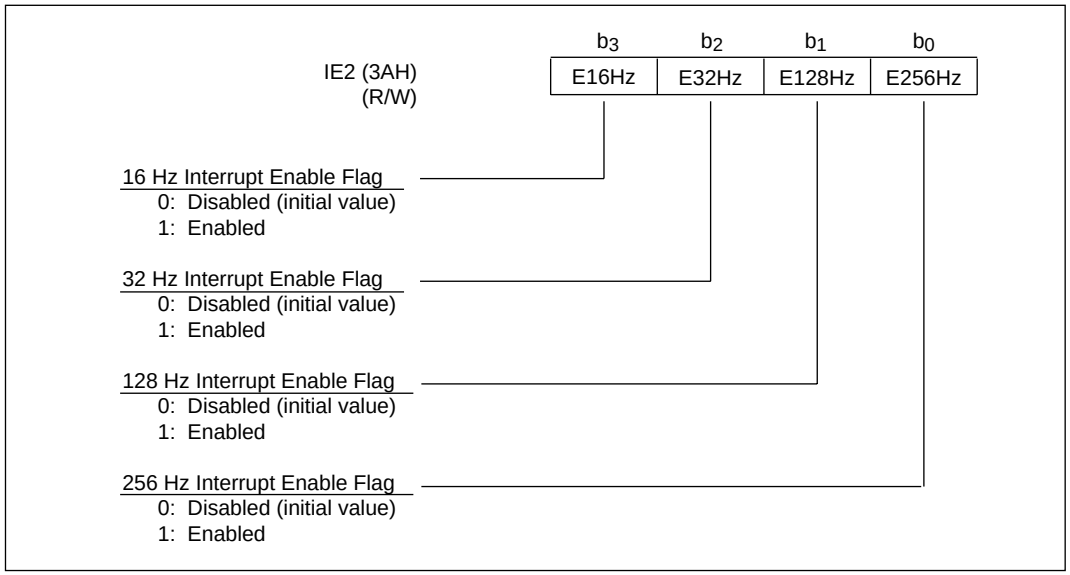
Bit 1: Q128Hz
Set to "1" at the falling edge of a 128Hz output from the time base counter.

Bit 0: Q256Hz
Set to "1" at the falling edge of a 256Hz output from the time base counter.



Bit 1: Q1Hz
Set to "1" at the falling edge of a 1Hz output from the time base counter.

Bit 0: Q4Hz
Set to "1" at the falling edge of a 4Hz output from the time base counter.



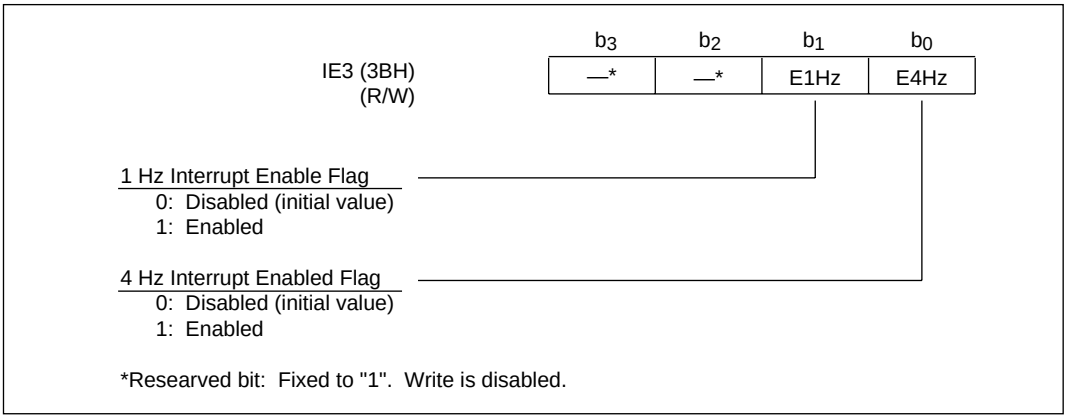


Table 5-2 lists the registers to be changed by TST3

Table 5-2 TST3-Related Registers

Name	Symbol	Address	Read/Write	Byte access	Initial value after system reset	
					TST3="0" or OPEN	TST3="1"
Interrupt Enable Register 2	IE2	3AH	R/W	Yes	1H	0H
Interrupt Enable Register 3	IE3	3BH	R/W		0DH	0CH
Interrupt Request Register 2	IRQ2	3EH	R/W	Yes	1H	0H
Interrupt Request Register 3	IRQ3	3FH	R/W		0DH	0CH

APPENDIXES

APPENDIX A PACKAGE DIMENSIONAL DRAWING

MSM64P155-NGS-BK
MSM64P155L-NGS-BK
MSM64P155-XXXGS-BK
MSM64P155L-XXXGS-BK

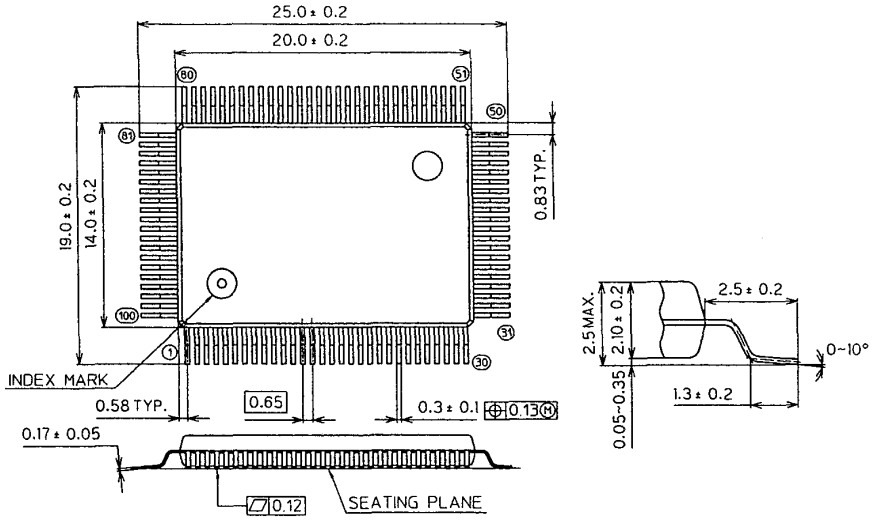


Figure A-1 100-Pin QFP

APPENDIX B ELECTRICAL CHARACTERISTICS

(1) For 1.5V Specifications in the microcontroller operation mode
Product Name: MSM64P155

- Absolute Maximum Rating

(VSS=0V)

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage 1	VDD1	Ta=25°C	–0.3~+2.0	V
Power supply voltage 2	VDD2	Ta=25°C	–0.3~+4.0	V
Power supply voltage 3	VDD3	Ta=25°C	–0.3~+5.5	V
Input voltage 1	VIN1	VDD1 system input, Ta=25°C	–0.3~VDD1+0.3	V
Output voltage 1	VOUT1	VDD1 system output, Ta=25°C	–0.3~VDD1+0.3	V
Output voltage 2	VOUT2	VDD2 system output, Ta=25°C	–0.3~VDD2+0.3	V
Output voltage 3	VOUT3	VDD3 system output, Ta=25°C	–0.3~VDD3+0.3	V
Storage temperature	TSTG	—	–55~+125	°C

- Recommended Operating Conditions

(VSS=0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	TOPE	—	0~65	°C
Operating voltage	VDD1	—	1.35~1.7	V
Crystal oscillator frequency	fXT	—	30~35	kHz
RC OSC external resistance	ROS	—	1M±10%	Ω

- DC Characteristics
  (Unless otherwise specified, VSS=0V, VDD1=1.5V, Ta=0~65°C).

(1/5)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
VDD2 voltage	VDD2	Ca, C12=1μF Cb=0.1μF	2.8	3.0	3.2	V	1
VDD3 voltage	VDD3	Ca, C12=1μF Cb=0.1μF	4.3	4.5	4.7	V	
XTOSC oscillation beginning voltage	VSTA	Within 5 seconds from the beginning of oscillations after reset	1.45	—	—	V	
XTOSC oscillation maintaining voltage	VHOLD	—	1.35	—	—	V	
XTOSC external capacity	CG	—	10	—	30	pF	
XTOSC internal capacity	CD	—	10	15	20	pF	
CROSC oscillation frequency	fCR	ROS=1MΩ	15	40	75	kHz	

Note: "XTOSC" indicates crystal oscillation circuits at 32.768 kHz.
"CROSC" indicates RC oscillation circuits at 32 kHz.

- DC Characteristics (32.768 kHz Crystal Oscillation)
  (Unless otherwise specified, VSS=0V, VDD1=1.5V, Ta=0~65˚C).

(2/5)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
Consumption current 1	IDD1	CPU is in the HALT mode	—	2	10	μA	1
Consumption current 2	IDD2	CPU is in the operating mode	—	75	100	μA	

- DC Characteristics (RC Oscillation)
  (Unless otherwise specified, VSS=0V, VDD1=1.5V, Ta=0~65˚C).

(3/5)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
Consumption current 1	IDD1	CPU is in the HALT mode	—	3	20	μA	1
Consumption current 2	IDD2	CPU is in the operating mode	—	100	200	μA	

- DC Characteristics
  (Unless otherwise specified, VSS=0V, VDD1=1.5V, VDD2=3.0V, VDD3=4.5V, Ta=0~65°C).

(4/5)

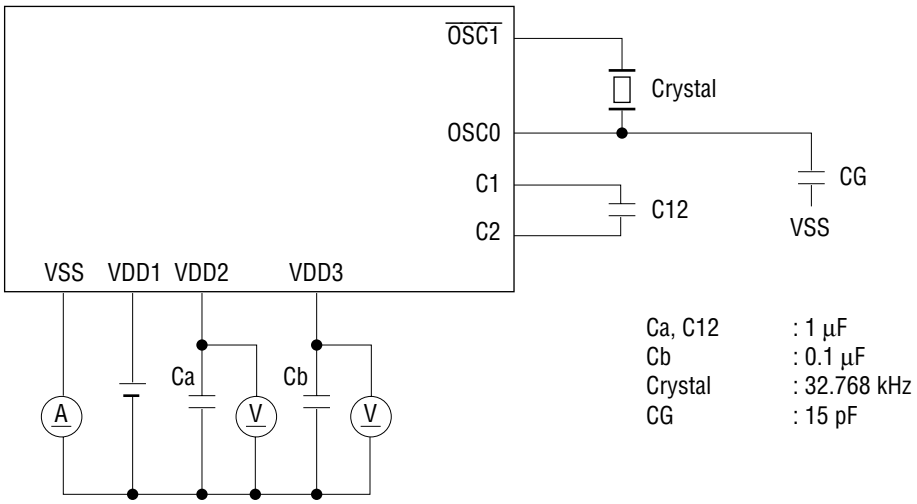
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
Output current 1 (P4.0~P4.3) (MD0, $\overline{MD0}$) (MD1, $\overline{MD1}$)	IOH1	VOH1=VDD1-0.5V	–2.0	–0.6	–0.1	mA	
	IOL1	VOL1=+0.5V	0.1	0.6	2.0	mA	
Output current 2 (SEG0~SEG59) (COM1~COM4)	IOH2	VOH2=VDD3-0.2V (VDD3 level)	—	—	–4	µA	2
	IOMH2	VOMH2=VDD2+0.2V (VDD2 level)	4	—	—	µA	
	IOMH2S	VOMH2S=VDD2-0.2V(VDD2 level)	—	—	–4	µA	
	IOML2	VOML2=VDD1+0.2V (VDD1 level)	4	—	—	µA	
	IOML2S	VOML2S=VDD1-0.2V(VDD1 level)	—	—	–4	µA	
	IOL2	VOL2=+0.2V (VSS level)	4	—	—	µA	
Output current 3 (P6.0~P6.3) (P7.0~P7.3)	IOH3	VOH3=VDD1–0.5V	–5.0	–2.1	–0.3	mA	
	IOL3	VOL3=+0.5V	0.1	0.7	2.0	mA	
Output leak (P6.0~P6.3) (P7.0~P7.3)	IOOH	VOH=VDD1	—	—	0.3	µA	
	IOOL	VOL=VSS	–0.3	—	—	µA	

- DC Characteristics
  (Unless otherwise specified, VSS=0V, VDD1=1.5V, VDD2=3.0V, VDD3=4.5V, Ta=0~65°C)

(5/5)

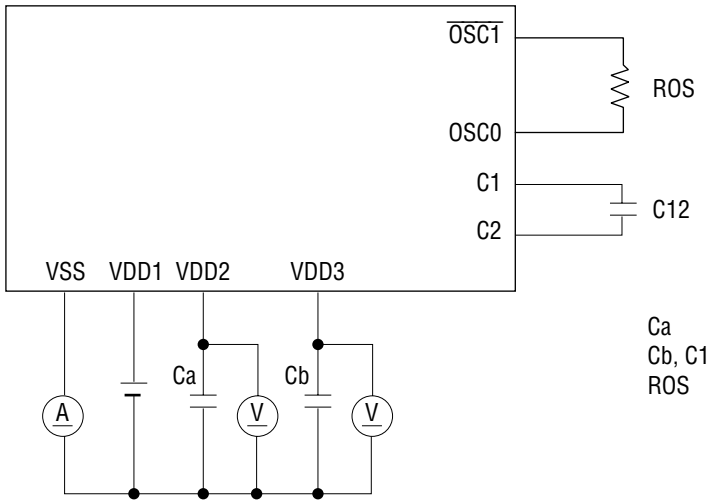
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
Input current 1 (P2.0~P2.3) (P3.0~P3.1) (P6.0~P6.3) (P7.0~P7.3)	IIH1	VIH=VDD1 (for pull-down)	1	20	100	µA	3
	IIH1Z	VIH1=VDD1 (for high impedance)	0	—	1	µA	
	IIL1	VIL1=VSS	–1	—	0	µA	
Input current 2 (TST1, TST2)	IIH2	VIH2=VDD1	50	200	800	µA	
	IIL2	VIL3=VSS	–1	—	0	µA	
Input current 3 (TST3)	IIH3	VIH3=VDD1	0.3	1	5	µA	
	IIL3	VIL2=VSS	–1	—	0	µA	
Input current 4 (RESET)	IIH4	VIH4=VDD1	2	8	30	µA	
	IIL4	VIL4=VSS	–1	—	0	µA	
Input voltage 1 (P2.0~P2.3) (P3.0~P3.1) (P6.0~P6.3) (P7.0~P7.3) (TST1, TST2, TST3) (RESET)	VIH1	—	1.2	—	1.5	V	4
	VIL1	—	0	—	0.3	V	

Measurement Circuit 1 (1)



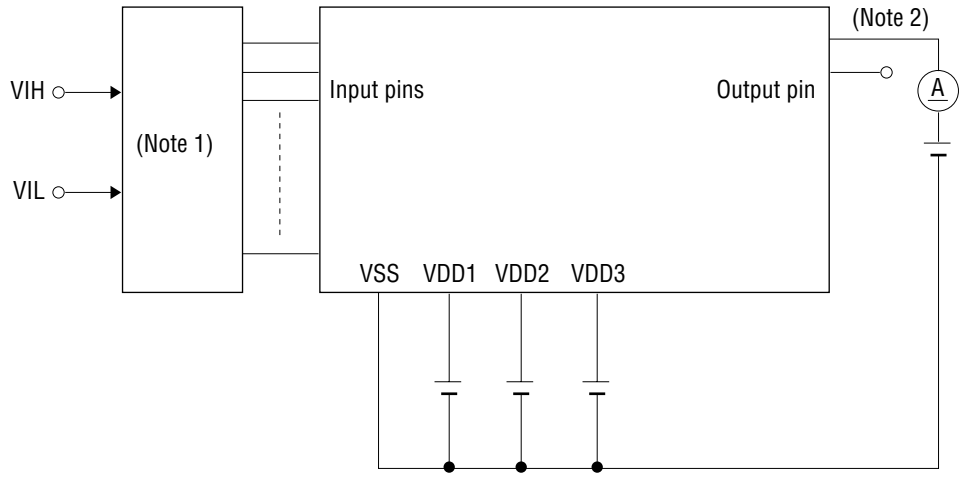
Ca, C12	: 1 μF
Cb	: 0.1 μF
Crystal	: 32.768 kHz
CG	: 15 pF

Measurement Circuit 1 (2)

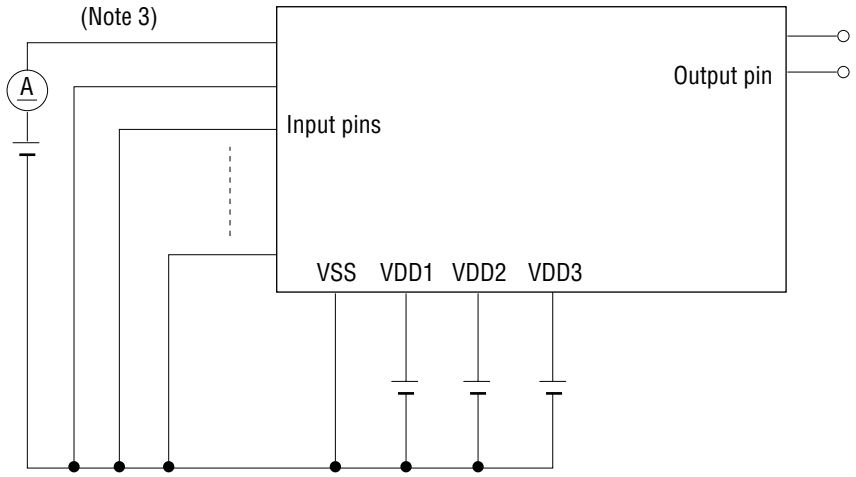


Ca	: 20 μF
Cb, C12	: 0.1 μF ~ 0.2 μF
ROS	: 1MΩ

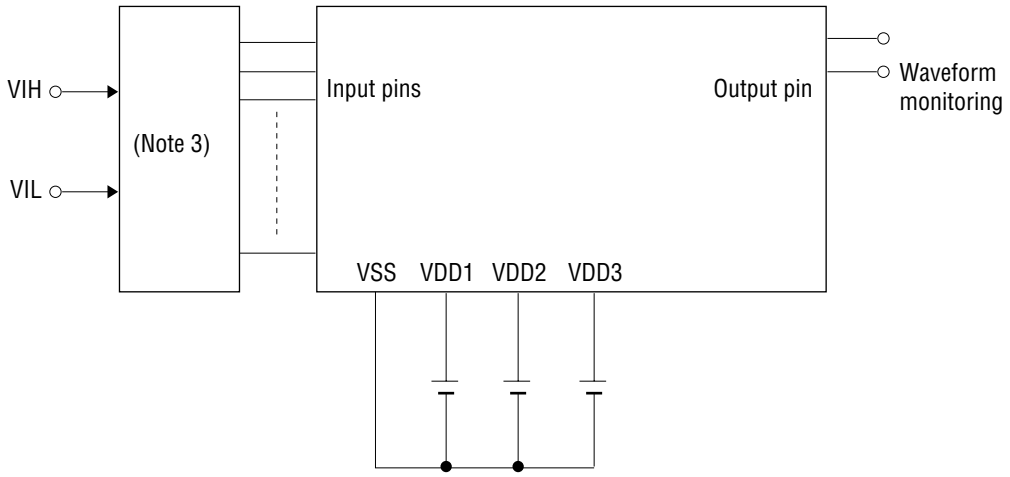
Measurement Circuit 2



Measurement Circuit 3



Measurement Circuit 4



Note 1 Input logic for specified mode
Note 2 Repeated on specified output pin
Note 3 Repeated on specified input pin

(2) For 3.0V Specifications
Product Name: MSM64P155L

- Absolute Maximum Ratings

(VSS=0V)

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage 1	VDD1	Ta=25°C	–0.3~+2.0	V
Power supply voltage 2	VDD2	Ta=25°C	–0.3~+4.0	V
Power supply voltage 3	VDD3	Ta=25°C	–0.3~+5.5	V
Input voltage 1	VIN1	VDD2 system input, Ta=25°C	–0.3~VDD2+0.3	V
Output voltage 1	VOUT1	VDD2 system output, Ta=25°C	–0.3~VDD2+0.3	V
Output voltage 2	VOUT2	VDD3 system output, Ta=25°C	–0.3~VDD3+0.3	V
Storage temperature	TSTG	—	–55~+125	°C

- Recommended Operating Conditions

(VSS=0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	TOPE	—	0~65	°C
Operating voltage	VDD2	—	2.7~3.5	V
Crystal oscillator frequency	fXT	—	30~66	kHz
RC OSC external resistance	ROS	—	1M±10%	Ω

- DC Characteristics
  (Unless otherwise specified, VSS=0V, VDD2=3.0V, Ta=0~65°C).

(1/5)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
VDD1 voltage	VDD1	Ca=1μF Cb, C12=0.1μF	1.3	1.5	1.7	V	1
VDD3 voltage	VDD3	Ca=1μF Cb, C12=0.1μF	4.3	4.5	4.7	V	
XTOSC oscillation beginning voltage	VSTA	Within 5 seconds from the beginning of oscillations after reset	2.7	—	—	V	
XTOSC oscillation maintaining voltage	VHOLD	—	2.7	—	—	V	
XTOSC external capacitance	CG	—	10	—	30	pF	
XTOSC internal capacitance	CD	—	10	15	20	pF	
CROSC oscilaltion frequency	fCR	ROS=1MΩ	15	40	75	kHz	

Note: "XTOSC" indicates crystal oscillation circuits at 32.768 kHz.
"CROSC" indicates RC oscillation circuits at 32 kHz.

- DC Characteristics (32.768 kHz Crystal Oscillation)
  (Unless otherwise specified, VSS=0V, VDD2=3.0V, Ta=0~65˚C).

(2/5)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
Consumption current 1	IDD1	CPU is in the HALT mode	—	1	5	μA	1
Consumption current 2	IDD2	CPU is in the operating mode	—	35	50	μA	

- DC Characteristics (RC Oscillation)
  (Unless otherwise specified, VSS=0V, VDD2=3.0V, Ta=0~65˚C).

(3/5)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
Consumption current 1	IDD1	CPU is in the HALT mode	—	3	15	μA	1
Consumption current 2	IDD2	CPU is in the operating mode	—	50	100	μA	

- DC Characteristics
  (Unless otherwise specified, VSS=0V, VDD1=1.5V, VDD2=3.0V, VDD3=4.5V, Ta=0~65°C).

(4/5)

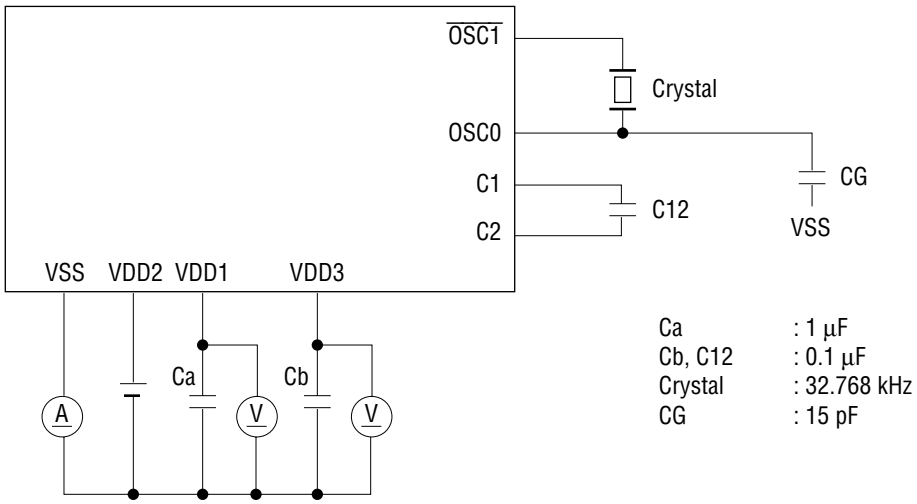
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
Output current 1 (P4.0~P4.3) (MD0, $\overline{MD0}$) (MD1, $\overline{MD1}$)	IOH1	VOH1=VDD2–0.5V	–6	–1.8	–0.7	mA	
	IOL1	VOL1=+0.5V	0.7	1.8	6	mA	
Output current 2 (SEG0~SEG59) (COM1~COM4)	IOH2	VOH2=VDD3–0.2V (VDD3 level)	—	—	–4	µA	2
	IOMH2	VOMH2=VDD2+0.2V (VDD2 level)	4	—	—	µA	
	IOMH2S	VOMH2S=VDD2–0.2V(VDD2 level)	—	—	–4	µA	
	IOML2	VOML2=VDD1+0.2V (VDD1 level)	4	—	—	µA	
	IOML2S	VOML2S=VDD1–0.2V(VDD1 level)	—	—	–4	µA	
	IOL2	VOL2=+0.2V (VSS level)	4	—	—	µA	
Output current 3 (P6.0~P6.3) (P7.0~P7.3)	IOH3	VOH3=VDD2–0.5V	–1.8	–6	–2	mA	
	IOL3	VOL3=+0.5V	0.7	1.6	6.0	mA	
Output leak (P6.0~P6.3) (P7.0~P7.3)	IOOH	VOH=VDD2	—	—	0.3	µA	
	IOOL	VOL=VSS	–0.3	—	—	µA	

- DC Characteristics
  (Unless otherwise specified, VSS=0V, VDD1=1.5V, VDD2=3.0V, VDD3=4.5V, Ta=0~65°C).

(5/5)

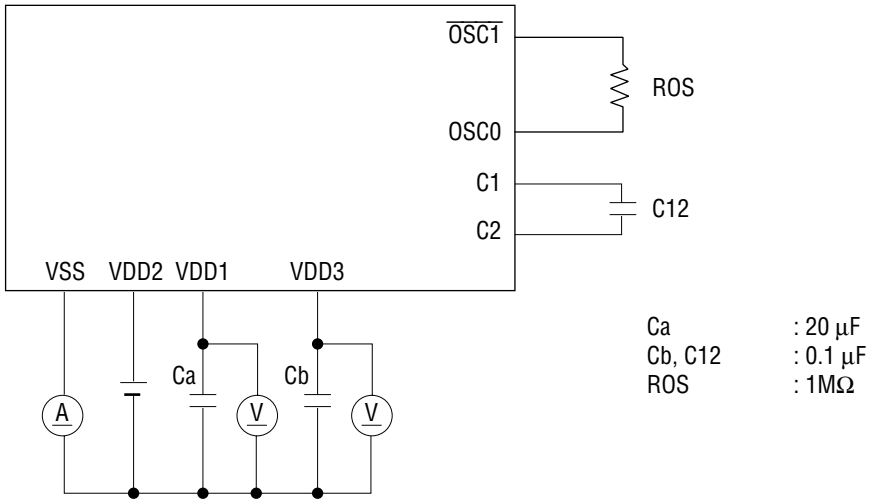
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Measure-ment circuit
Input current 1	IIH1	VIH1=VDD2 (for pull-down)	50	100	300	µA	3
(P2.0~P2.3), (P3.0~P3.1)	IIH1Z	VIH1=VDD2 (for high impedance)	0	—	1	µA	
(P6.0~P6.3), (P7.0~P7.3)	IIL1	VIL1=VSS	–1	—	0	µA	
Input current 2	IIH2	VIH2=VDD2	0.4	1.5	6	mA	
(TST1, TST2)	IIL2	VIL2=VSS	–1	—	0	µA	
Input current 3	IIH3	VIH3=VDD2	0.5	3	10	µA	
(TST3)	IIL3	VIL3=VSS	–1	—	0	µA	
Input current 4	IIH4	VIH4=VDD2	20	80	300	µA	
(RESET)	IIL4	VIL4=VSS	–1	—	0	µA	
Input voltage 1 (P2.0~P2.3) (P3.0~P3.1) (P6.0~P6.3) (P7.0~P7.3) (TST1, TST2, TST3) (RESET)	VIH1	—	2.4	—	3.0	V	4
	VIL1	—	0	—	0.6	V	

Measurement Circuit 1 (1)



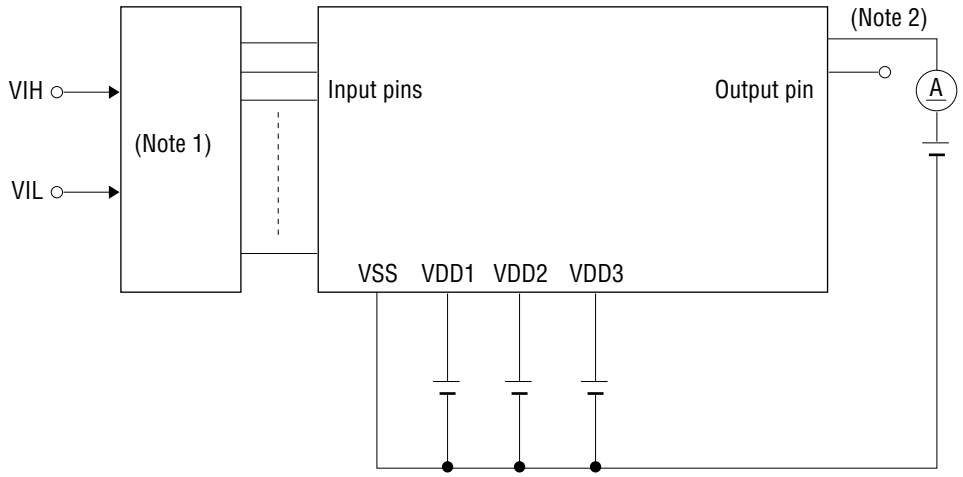
Ca : 1 μF
Cb, C12 : 0.1 μF
Crystal : 32.768 kHz
CG : 15 pF

Measurement Circuit 1 (2)

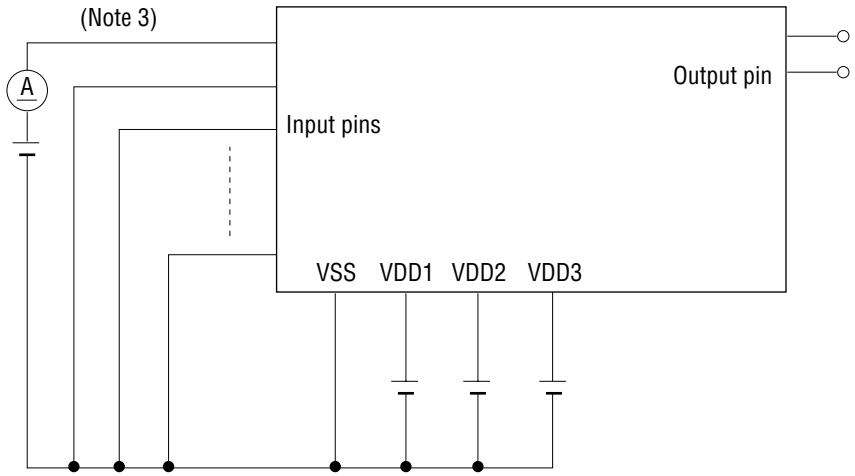


Ca : 20 μF
Cb, C12 : 0.1 μF
ROS : 1MΩ

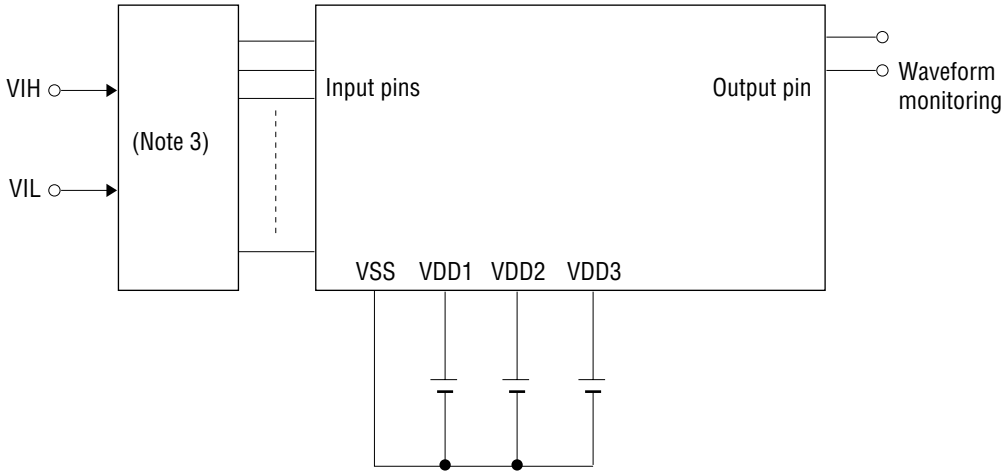
Measurement Circuit 2



Measurement Circuit 3



Measurement Circuit 4



Note 1 Input logic for specified mode
Note 2 Repeated on specified output pin
Note 3 Repeated on specified input pin

(3) PROM Operations (Common Specifications for 1.5V and 3.0V)

- Absolute Maximum Ratings

(VSS=0V)

Parameter	Symbol	Condition	Rating	Unit
PROM power source voltage	VCC	VCC=VDD1=VDD2 Ta=25°C	–0.3~+6.7	V
Program voltage	VPP	Ta=25°C	–0.3~+14.0	V
PROM input voltage	VI	VCC system input Ta=25°C	–0.3~VCC+0.3	V
PROM output voltage	VO	VCC system output Ta=25°C	–0.3~VCC+0.3	V
Storage temperature	TSTG	—	–55~+125	°C

- Recommended Operating Conditions

(VSS=0V)

Parameter	Symbol	Condition	Range	Unit
Operating temperature	TOPEP	—	0~65	°C
VCC power supply voltage	VCC	VCC=VDD1=VDD2	4.75~5.25	V
VPP power supply voltage	VPP	In read	4.75~5.25	V
		In write	12.0~13.0	V
Input voltage	VIH	VCC=VDD1=VDD2	4~VCC	V
	VIL	—	0~1	V

<Read Operation>

- DC Characteristics
  (Unless otherwise specified, VDD1=VDD2=5V±5%, Ta=25˚C±5˚C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
VCC supply voltage (Standby)	ICC1	VCC=VDD1=VDD2 $\overline{CE}$=VIH	—	—	35	mA
VCC supply voltage (Operation)	ICC2	VCC=VDD1=VDD2 $\overline{CE}$=VIL	—	—	100	mA
Input voltage	VIH	VCC=VDD1=VDD2	4	—	VCC	V
	VIL	—	0	—	1	V
Output current	IOH	VCC=VDD1=VDD2 VOH=VCC-0.5V	–2	–0.7	–0.2	mA
	IOL	VOL=0.5V	0.2	0.7	2	mA

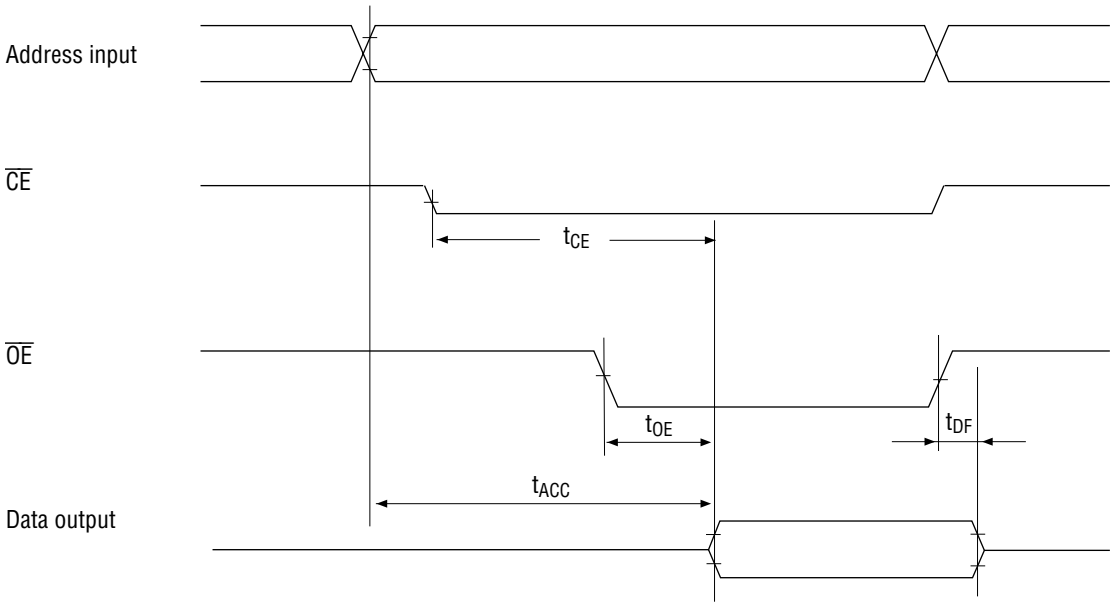
- AC Characteristics
  (Unless otherwise specified, VCC=5V±5%, VPP=VCC, Ta=0˚C~70˚C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Address access time	t_{ACC}	$\overline{OE}$=$\overline{CE}$=VIL	—	—	120	ns
$\overline{CE}$ access time	t_{CE}	$\overline{OE}$=VIL	—	—	120	ns
$\overline{OE}$ access time	t_{OE}	$\overline{CE}$=VIL	—	—	50	ns
Output disable time	t_{DF}	$\overline{CE}$=VIL	0	—	40	ns

Measurement Conditions:

Input pulse level ..... 0.45V~4.55V
During rising/falling input..... 5 ns
Threshold level ..... input 0.8V, 2V/output 0.8V, 2V

- Timing Diagram



<Write Operation>

- DC Characteristics
  (Unless otherwise specified, VSS=0V, VDD1=VDD2=5V±5%, VPP=12.5V±0.5V, Ta=25°C±5°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
VPP power supply voltage	IPP	$\overline{CE}$=VIL	—	—	50	mA
VCC power supply current	ICC	VCC=VDD1=VDD2	—	—	100	mA
Input voltage	VIH	VCC=VDD1–VDD2	4	—	VCC	V
	VIL	—	0	—	1	V
Output current	IOH	VCC=VDD1=VDD2 VOH=VCC-0.5V	–2	–0.7	–0.2	mA
	IOL	VOL=0.5V	0.2	0.7	2	mA

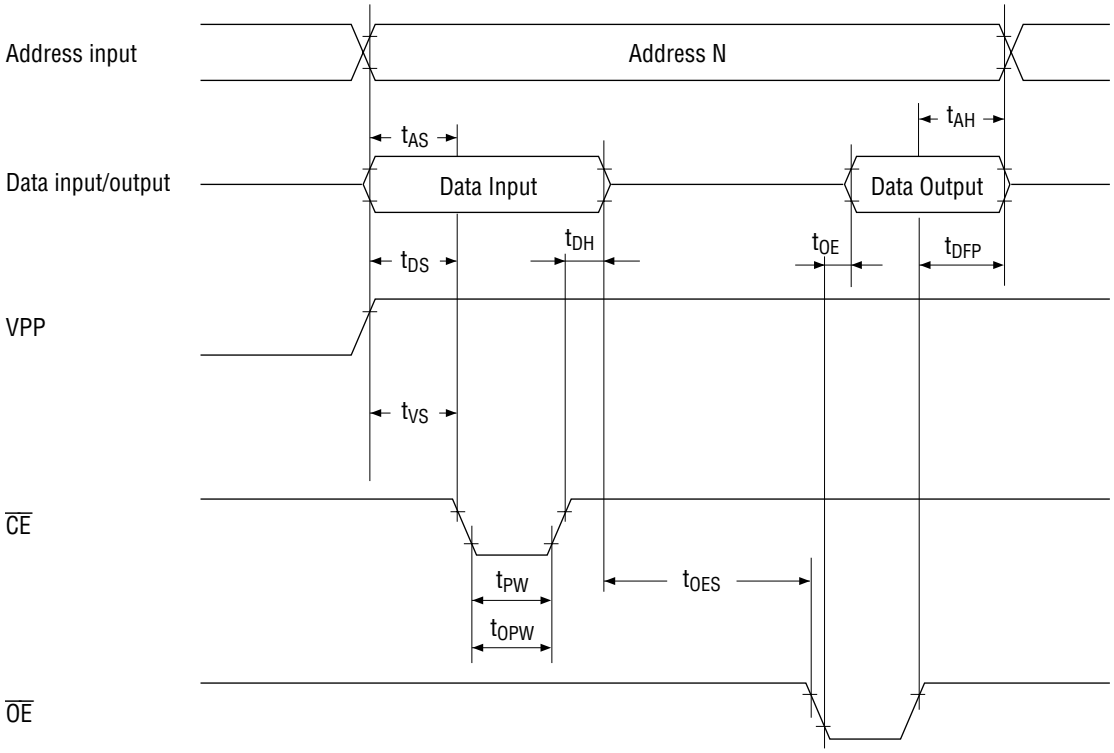
- AC Characteristics
  (Unless otherwise specified, VSS=0V, VDD1=VDD2=5V±5%, VPP=12.5V±0.5V, Ta=25°C±5°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Address setup time	t_{AS}	—	2	—	—	µs
$\overline{OE}$ setup time	t_{OES}	—	2	—	—	µs
Data setup time	t_{DS}	—	2	—	—	µs
Address hold time	t_{AH}	—	0	—	—	µs
Data hold time	t_{DH}	—	2	—	—	µs
$\overline{OE}$ output floating delay time	t_{DFP}	—	0	—	130	ns
VPP power source setup time	t_{VS}	—	2	—	—	µs
Initial program pulse width	t_{PW}	VDD1=VDD2 6V±0.25V	0.95	1.0	1.05	ms
Additional program pulse width	t_{OPW}	VDD1=VDD2 6V±0.25V	2.85	—	78.75	ms
$\overline{OE}$ output effective delay time	t_{OE}	—	—	—	150	ns

Measurement Conditions:

Input pulse level ..... 0.45V~4.55V
During rising/falling input..... less than 20 ns
Threshold level ..... input 0.8V, 2V/output 0.8V, 2V

- Program Timing Diagram



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User's Manual

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