

# SM563

## 4-Bit Single-Chip Microcomputer (LCD Driver)

### DESCRIPTION

The SM563 is a CMOS 4-bit single-chip microcomputer incorporating 4-bit parallel processing function, ROM, RAM, I/O ports, serial interface, timer/counter in a single chip.

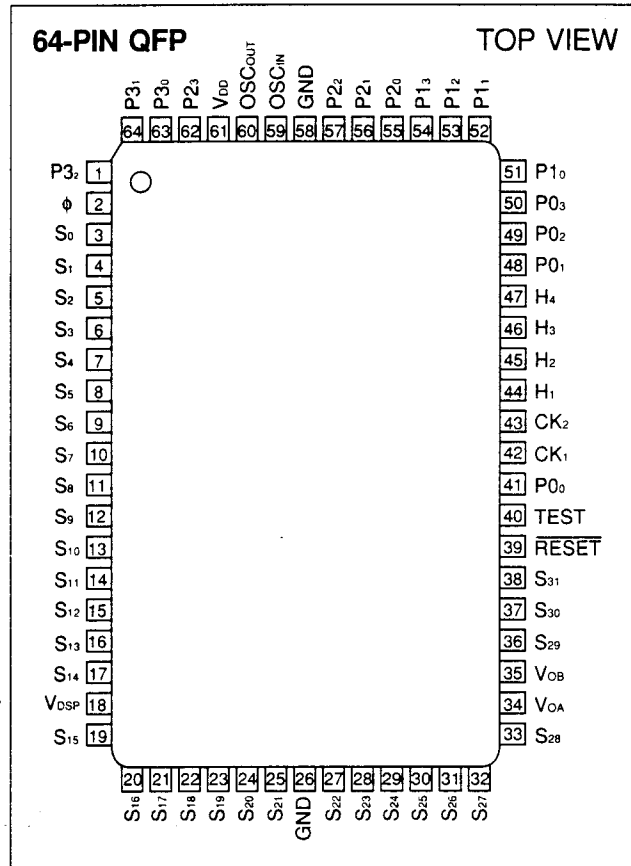
It provides 5 kinds of interrupt and subroutine stack function using the RAM area. Provided with a 128 segments LCD drive circuit, this microcomputer is applicable to Low power system with multiple LCD segments.

### FEATURES

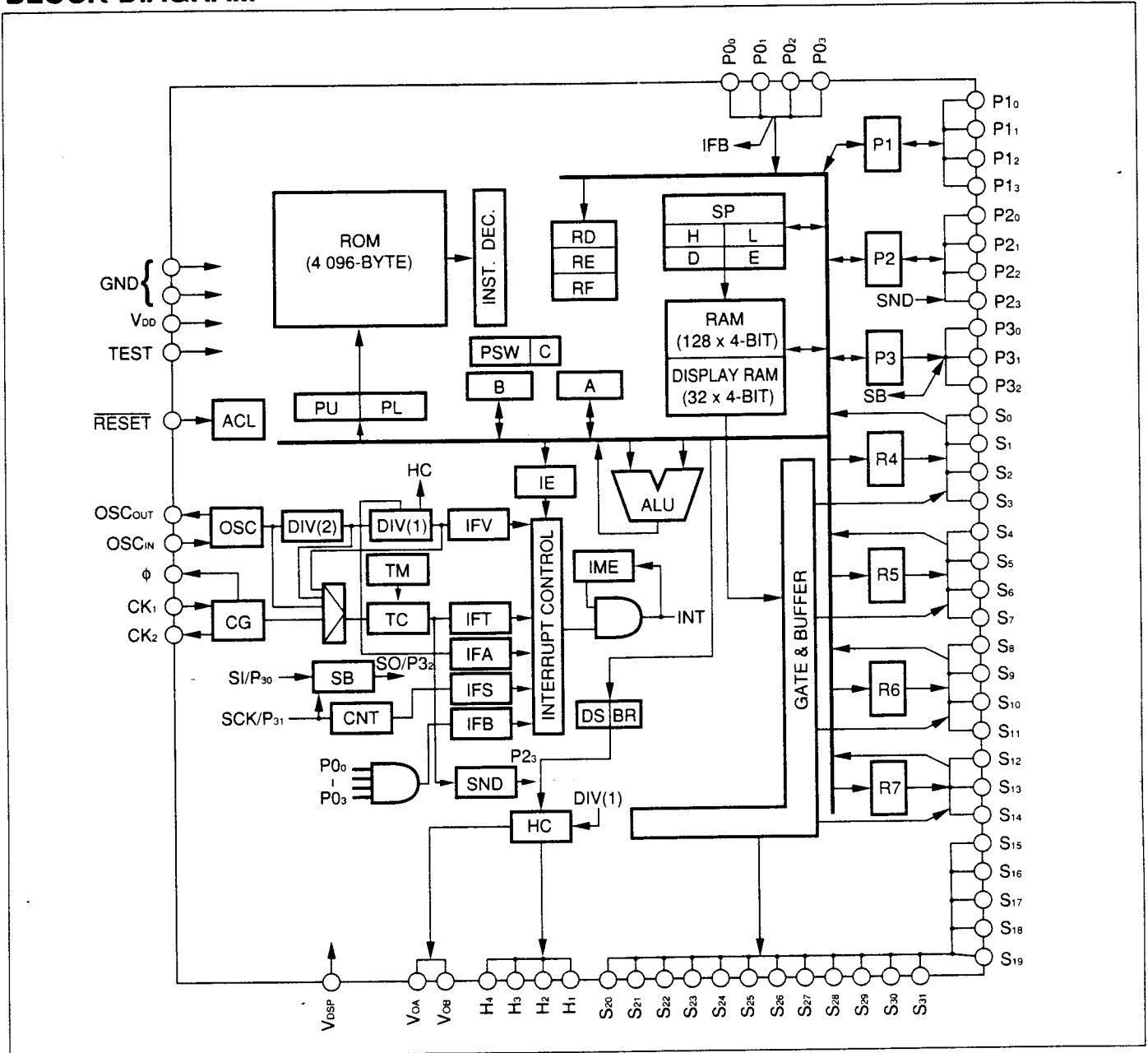
- ROM capacity : 4 096 x 8 bits
- RAM capacity : 160 x 4 bits (including 32 x 4 bits display RAM)
- Instruction sets : 98
- A RAM area is used as stack area
- I/O port :
 

Input	4
Input/output	11
	+15 (also used as LCD segment port)
- Interrupts :
  - Internal interrupt x 4 (timer/counter, f4 signal, serial I/O, divider overflow)
  - External interrupt x 1 (P0 signal)
- Timer/counter : 8 bits x 1
- Serial interface : 8 bits x 1
- Built-in main clock oscillator for system clock
- Built-in sub clock oscillator for real time clock
- Built-in 15 stages divider for real time clock
- Built-in LCD driver : 128 segments, 1/3 bias, 1/4 duty cycle (If LCD drive circuit is used, a crystal oscillator circuit needs to be constituted between OSC<sub>IN</sub> and OSC<sub>OUT</sub>)
- Instruction cycle time : 6.67  $\mu$ s (at 3V), 2  $\mu$ s (at 5V)
- Buzzer output
- Standby function
- Supply voltage : 2.7 to 5.5 V
- Package : 64-pin QFP (QFP064-P-1420)

### PIN CONNECTIONS



BLOCK DIAGRAM



Nomenclature

- |               |                             |            |                                |
|---------------|-----------------------------|------------|--------------------------------|
| A, B          | : Accumulators              | IME        | : Interrupt master enable F/F  |
| ACL           | : Auto clear                | P1-P3      | : Registers                    |
| ALU           | : Arithmetic logic unit     | PL, PU     | : Program counters             |
| BR, DS        | : Common signal control F/F | PSW        | : Program status word register |
| CG            | : Clock generator           | R4-R7      | : General-purpose registers    |
| DIV           | : Divider                   | RD, RE, RF | : Mode registers               |
| D, E, H, L    | : General-purpose registers | SB         | : Shift register               |
| HC            | : Common signal circuit     | SP         | : Stack pointer                |
| IE            | : Interrupt enable F/F      | TC         | : Count register               |
| IFA, IFB      | : Interrupt requests        | TM         | : Modulo register              |
| IFS, IFT, IFV |                             |            |                                |

## PIN DESCRIPTION

SYMBOL	I/O	CIRCUIT TYPE	FUNCTION
P0 <sub>0</sub> -P0 <sub>3</sub>	I	Pull up	Acc←P0 <sub>0</sub> -P0 <sub>3</sub>
P1 <sub>0</sub> -P1 <sub>3</sub>	I/O	Pull up	I/O selectable by instructions
P2 <sub>0</sub> -P2 <sub>3</sub>	I/O	Pull up	I/O selectable independently Sound output only when P2 <sub>3</sub> pin is used as an output
P3 <sub>0</sub> -P3 <sub>3</sub>	I/O	Pull up	Serial interface I/O by setting the mode register RE
S <sub>0</sub> -S <sub>14</sub>	O or I/O		Selectable between segment ports and I/O ports through an RC register
S <sub>15</sub> -S <sub>31</sub>	O		Display RAM contents output as LCD segment signals
H <sub>1</sub> -H <sub>4</sub>	O		4-value output capability; used for LCD common output
TEST	I	Pull down	For test (connected to GND normally)
RESET	I	Pull up	Auto clear
$\phi$	O		System clock output
CK <sub>1</sub> , CK <sub>2</sub>			For system clock oscillation
OSC <sub>IN</sub> , OSC <sub>OUT</sub>			For clock oscillation
V <sub>DSP</sub> , V <sub>OA</sub> , V <sub>OB</sub>			Power supply for LCD driver
V <sub>DD</sub> , GND			Power supply for logic circuit

## ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT	NOTE
Supply voltage	V <sub>DD</sub>	-0.3 to +7	V	1
	V <sub>DSP</sub>	-0.3 to +7	V	
Input voltage	V <sub>IN</sub>	-0.3 to V <sub>DD</sub> +0.3	V	1
Output voltage	V <sub>OUT</sub>	-0.3 to V <sub>DD</sub> +0.3	V	1
Output current	I <sub>OUT</sub>	20	mA	2
Operating temperature	T <sub>OPR</sub>	-20 to +70	°C	
Storage temperature	T <sub>STG</sub>	-55 to +150	°C	

## NOTES :

1. The maximum applicable voltage on any pin with respect to GND.
2. Sum of current from (or flowing into) output pins.

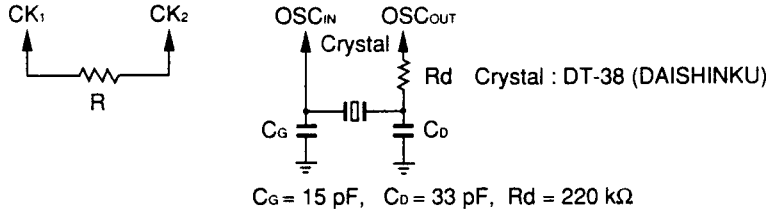
## RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Supply voltage	V <sub>DD</sub>		2.7		5.5	V	
	V <sub>DSP</sub>		2.7		V <sub>DD</sub>	V	
Basic oscillation frequency	f	V <sub>DD</sub> = 2.7 to 5.5 V	250		600	kHz	1
		V <sub>DD</sub> = 4.5 to 5.5 V	250		2 000		
Instruction cycle	t	V <sub>DD</sub> = 2.7 to 5.5 V	6.7		16	μs	
		V <sub>DD</sub> = 4.5 to 5.5 V	2		16		
Crystal oscillation frequency	f <sub>osc</sub>			32.768		kHz	

## NOTE :

1. Frequency fluctuation : ± 30%

Oscillation Circuit



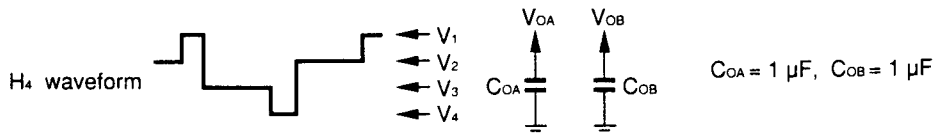
DC CHARACTERISTICS

(V<sub>DD</sub> = 2.7 to 5.5 V, T<sub>a</sub> = -20 to +70°C)

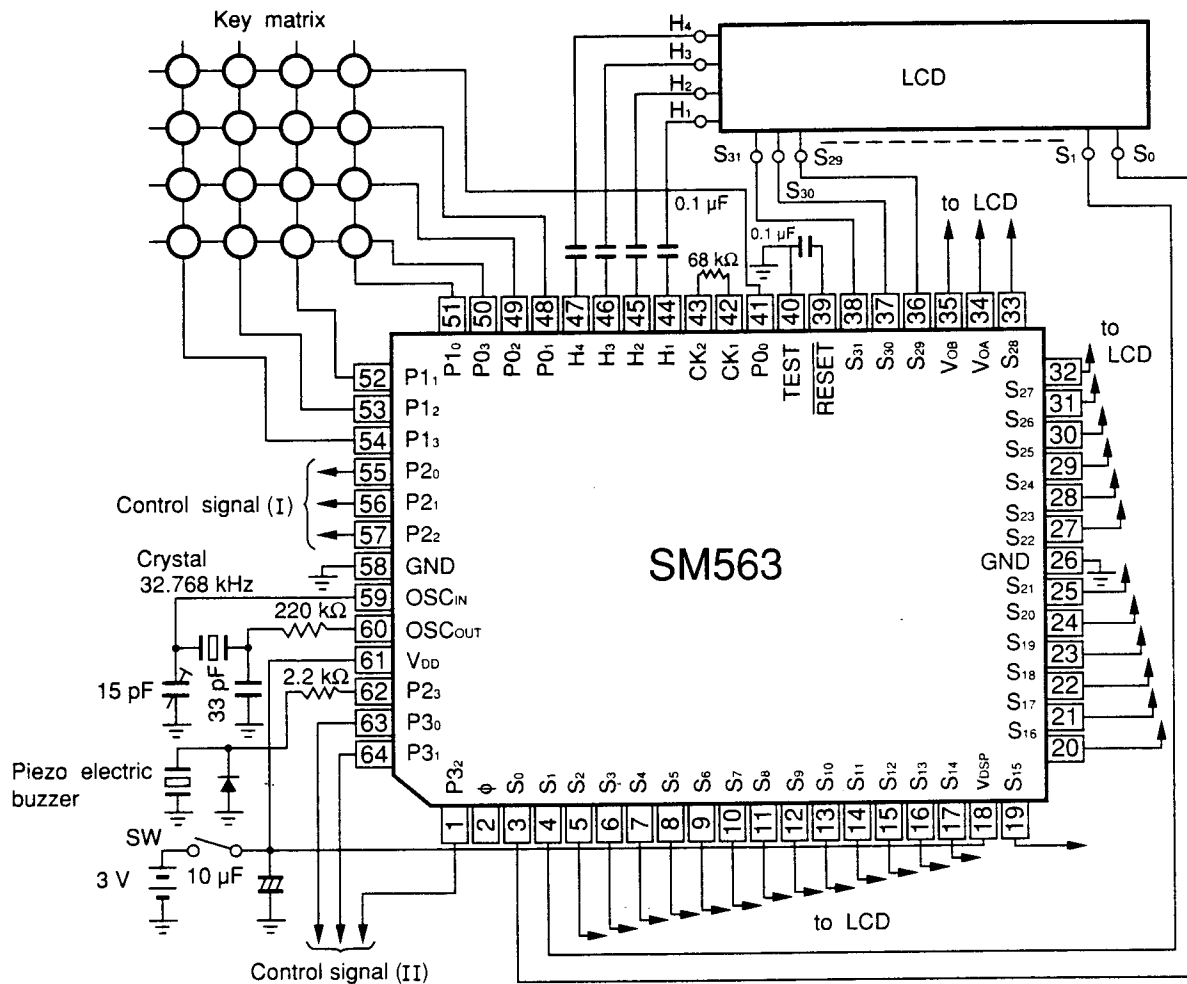
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE	
Input voltage	V <sub>IH1</sub>		0.7 × V <sub>DD</sub>		V <sub>DD</sub>	V	1	
	V <sub>IL1</sub>		0		0.3 × V <sub>DD</sub>	V		
	V <sub>IH2</sub>		V <sub>DD</sub> - 0.5		V <sub>DD</sub>	V	2	
	V <sub>IL2</sub>		0		0.5	V		
Input current	I <sub>IH</sub>	V <sub>IN</sub> = 0 V	V <sub>DD</sub> = 4.5 to 5.5 V	2		200	μA	1
				20		200		
Output current	I <sub>OH1</sub>	V <sub>OH</sub> = V <sub>DD</sub> - 0.5 V	50			μA	3	
	I <sub>OL1</sub>	V <sub>OL</sub> = 0.5 V	250			μA		
	I <sub>OH2</sub>	V <sub>OH</sub> = V <sub>DD</sub> - 0.5 V	5		250	μA	4	
	I <sub>OL2</sub>	V <sub>OL</sub> = 0.5 V	500			μA		
	I <sub>OH3</sub>	V <sub>OH</sub> = V <sub>DD</sub> - 0.5 V	V <sub>DD</sub> = 4.5 to 5.5 V	100			μA	5
				400				
I <sub>OL3</sub>	V <sub>OL</sub> = 0.5 V	V <sub>DD</sub> = 4.5 to 5.5 V	0.5			mA		
			1.6					
Output impedance	R <sub>C</sub>			5	20	kΩ	6	
	R <sub>S</sub>			10	40	kΩ	7	
Output voltage	V <sub>1</sub>	V <sub>DSP</sub> = 3.0 V No load	2.7		3	V	8	
	V <sub>2</sub>		1.7	2	2.3	V		
	V <sub>3</sub>		0.7	1	1.3	V		
	V <sub>4</sub>		0		0.3	V		
Supply current	I <sub>OP</sub>	f = 600 kHz, V <sub>DD</sub> = 3.0 V		0.4	1.5	mA	9	
	I <sub>SB</sub>	Standby current V <sub>DSP</sub> = 3.0 V V <sub>DD</sub> = 3.0 V		15	40	μA	10	
				8	20		11	

NOTES :

- Applied to pins P<sub>00</sub>-P<sub>03</sub>, RESET, P<sub>10</sub>-P<sub>13</sub>, P<sub>20</sub>-P<sub>23</sub>, P<sub>30</sub>-P<sub>32</sub> (during input mode).
- Applied to pins CK<sub>1</sub>, TEST, OSC<sub>IN</sub>.
- Applied to pin CK<sub>2</sub>.
- Applied to pins P<sub>10</sub>-P<sub>13</sub> (during output mode).
- Applied to pins P<sub>20</sub>-P<sub>23</sub>, P<sub>30</sub>-P<sub>32</sub> (during output mode), φ.
- Applied to pins H<sub>1</sub>-H<sub>4</sub>.
- Applied to pins S<sub>0</sub>-S<sub>31</sub>.
- Applied to pins H<sub>1</sub>-H<sub>4</sub>, S<sub>0</sub>-S<sub>31</sub>.
- No load condition.
- No load condition when bleeder resistance is ON.
- No load condition when bleeder resistance is OFF.



SYSTEM CONFIGURATION EXAMPLE



Singlechip LH7xxxx '790 '789 '791 SMxxxx 'K series MCU Microcontroller MPU Microprocessor  
ARM Advanced RISC Machines Databank LCD Controller LCD Driver Controllers Processors Portable  
Low Power Low Voltage High Performance Power curve MIPS MIPS/Watt Execution Cycle Multiplier  
High Speed Compact Handheld System on Chip System Integration Chip Integration Integration  
Superchip Standard Cell Core Core based IC VHDL Verilog Synthesis Chip on Board COB Chip on Flex  
COF Device on Board DOB Power Supply Controller Handy Products Development Tools Board Support  
Software Tools Tools 2.10 Software Support Emulators Evaluation Boards ICE In-Circuit Emulators  
ROM ICE SME Series Programmable User Configurable RTOS Real Time Operating Systems  
Third Party Support Software Hardware Yokogawa Digital Cosmic Compiler C Language C Like  
Assembler Linker Debugger Debug A/D D/A DAC Analog Digital 10-bit 4-bit 8-bit 16-bit 32-bit  
Address bus Data Bus