SM565

4-Bit Single-Chip Microcomputer (LCD Driver)

DESCRIPTION

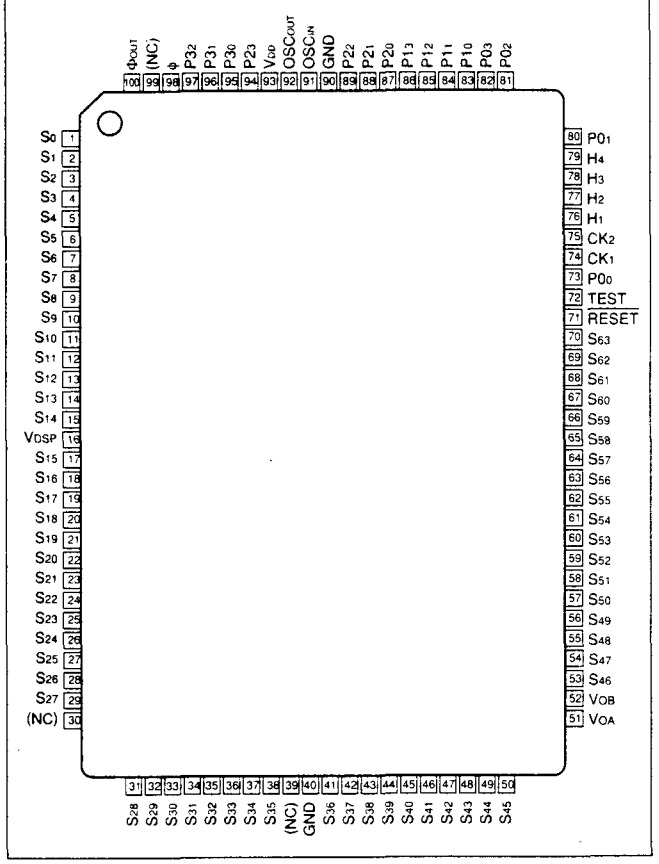
The SM565 is a CMOS 4-bit single-chip microcomputer incorporating carrier output circuit for remote control, ROM, RAM, I/O ports, serial interface, and timer/counter. It provides 5 kinds of interrupts and subroutine stack function using the RAM area. Provided with a 256 segments LCD drive circuit, this microcomputer is applicable to a multi-functional AV remote control system, high performance hand-held LCD games or any other similar system with Low power consumption.

FEATURES

- ROM capacity : 8 192 x 8 bits
- RAM capacity : 256 x 4 bits (including 64 x 4 bits display RAM)
- Instruction sets : 98
- A RAM area is used as stack area
- I/O port :
  - Input 4
  - Input/output 11
  - +16 (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 : 256 segments, 1/3 bias, 1/4 duty cycle (If LCD drive circuit is used, a crystal oscillator circuit needs to be constituted between OSC_{IN} and OSC_{OUT}.)

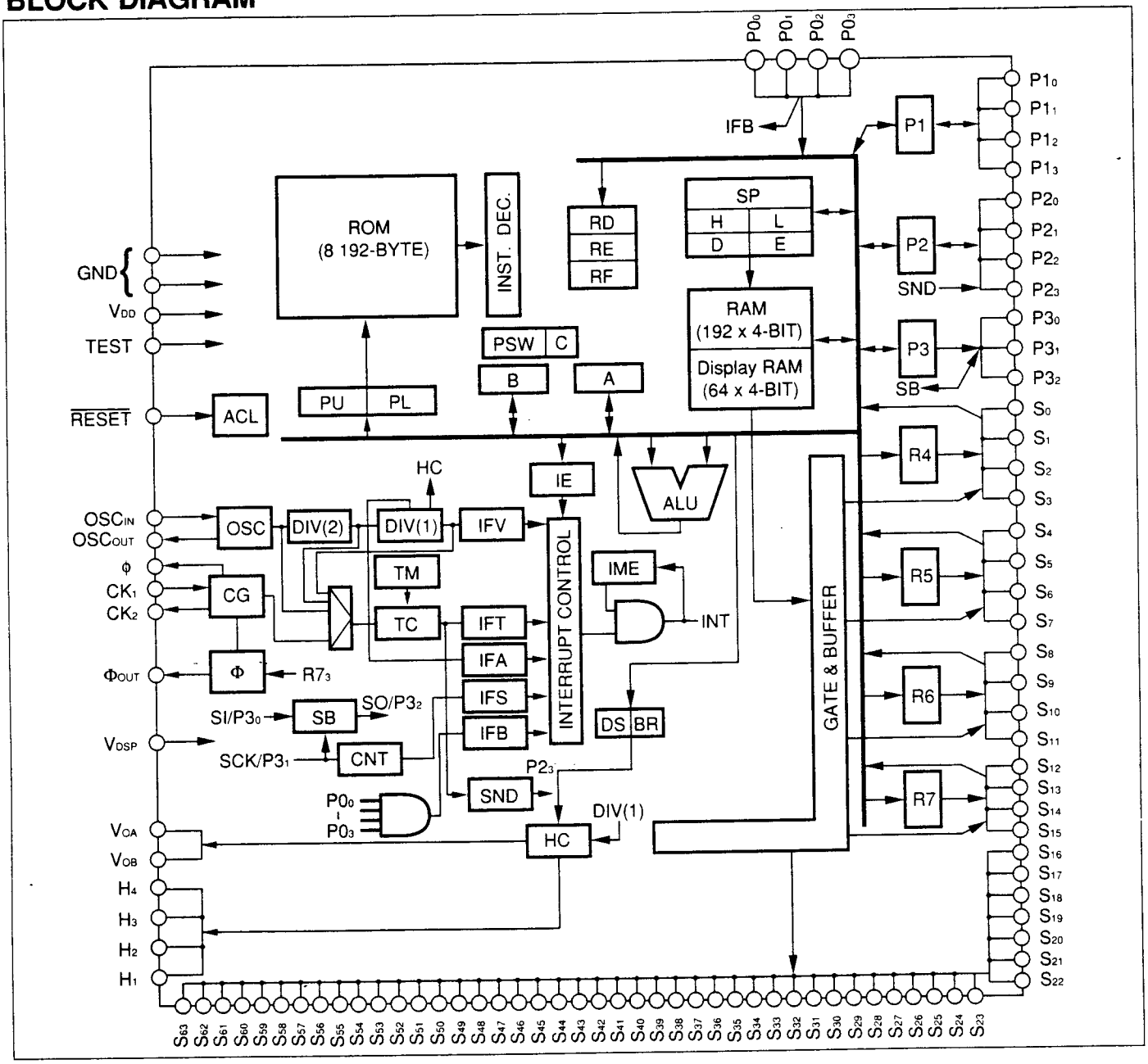
PIN CONNECTIONS

100-PIN QFP TOP VIEW



- Built-in carrier output circuit for remote control
  - Carrier frequency 37.9 kHz
  - Basic oscillation frequency (main clock) 455kHz
  - Duty cycle 1/3 or 1/2 (mask option)
  - Reversal polarity (mask option)
- Instruction cycle time :
  - 8.79 µs (TYP., 455 kHz, at 3 or 5 V)
- Buzzer output
- Standby function
- Supply voltage : 2.4 to 5.5 V
- Package : 100-pin QFP (QFP100-P-1420)

BLOCK DIAGRAM



Nomenclature

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

PIN DESCRIPTION

SYMBOL	I/O	CIRCUIT TYPE	FUNCTION
$P0_0$-$P0_3$	I	Pull up	Acc ← $P0_0$-$P0_3$
$P1_0$-$P1_3$	I/O	Pull up	I/O selectable by instructions
$P2_0$-$P2_3$	I/O	Pull up	I/O selectable independently Sound output only when $P2_3$ pin is used as an output
$P3_0$-$P3_3$	I/O	Pull up	Serial interface I/O by setting the mode register RE
S_0-S_{15}	O or I/O		Selectable between segment ports and I/O ports through an RC register
S_{16}-S_{63}	O		Display RAM contents output as LCD segment signals
H_1-H_4	O		4-value output capability; used for LCD common output
TEST	I	Pull down	For test (connected to GND normally)
$\overline{\text{RESET}}$	I	Pull up	Auto clear
ϕ	O		System clock output
Φ_{OUT}	O		Carrier output pin for remote control
CK_1, CK_2			For system clock oscillation
OSC_{IN}, OSC_{OUT}			For clock oscillation
V_{DSP}, V_{OA}, V_{OB}			Power supply for LCD driver
V_{DD}, GND			Power supply for logic circuit

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT	NOTE
Supply voltage	V_{DD}	−0.3 to +7	V	1
	V_{DSP}	−0.3 to +7	V	
Input voltage	V_{IN}	−0.3 to V_{DD} +0.3	V	1
Output voltage	V_{OUT}	−0.3 to V_{DD} +0.3	V	1
Output current	I_{OUT}	20	mA	2
Operating temperature	T_{OPR}	−20 to +70	°C	
Storage temperature	T_{STG}	−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.

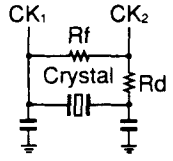
RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Supply voltage	V_{DD}		2.4		5.5	V	
	V_{DSP}		2.4		V_{DD}	V	
Basic oscillation frequency	f			455		kHz	
Instruction cycle	t			8.79		µs	
Crystal oscillation frequency	f_{OSC}			32.768		kHz	1

NOTE :

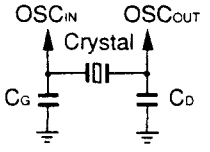
1. Starting condition : within 10 seconds after power on.

Oscillation Circuit



Oscillator circuit 1
C1 = 470 pF, C2 = 470 pF
Rf = 1 MΩ
Rd = 1 kΩ
Oscillator : KBR-455B (Kyocera)

Oscillator circuit 2
C1 = 330 pF, C2 = 330 pF
Rf = 1 MΩ
Rd = 1.5 kΩ
Oscillator : CSB455E (Murata)



C_G = 33 pF, C_D = 22 pF

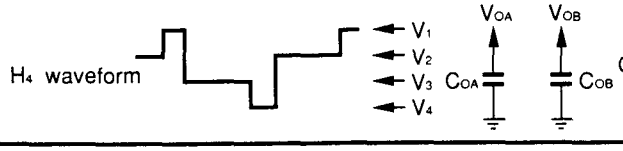
DC CHARACTERISTICS

(V_{DD} = 2.4 to 5.5 V, Ta = −20 to +70°C)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Input voltage	V_{IH1}		0.7 x V_{DD}		V_{DD}	V	1
	V_{IL1}		0		0.3 x V_{DD}	V	
	V_{IH2}		V_{DD}−0.5		V_{DD}	V	2
	V_{IL2}		0		0.5	V	
Input current	I_{IH}	V_{IN} = 0 V	2		200	µA	1
Output current	I_{OH1}	V_{OH} = V_{DD}−0.5 V	50			µA	3
	I_{OL1}	V_{OL} = 0.5 V	250			µA	
	I_{OH2}	V_{OH} = V_{DD}−0.5 V	50			µA	4
	I_{OH2D}	V_{OH} = V_{DD}−0.5 V	160			µA	5
	I_{OL2}	V_{OL} = 0.5 V	500			µA	6
	I_{OH3}	V_{OH} =V_{DD}−0.5 V	20			µA	7
	I_{OH3D}	V_{OH} =V_{DD}−0.5 V	90			µA	8
	I_{OL3}	V_{OL} = 0.5 V	0.2			mA	7
Output impedance	R_C			5	20	kΩ	9
	R_S			10	40	kΩ	10
Output voltage	V_1	V_{DSP} = 3.0 V No load	2.7		3	V	11
	V_2		1.7	2	2.3	V	
	V_3		0.7	1	1.3	V	
	V_4		0		0.3	V	
Supply current	I_{OP}	f = 455 kHz, V_{DD} = 3.0 V		160	320	µA	12
	I_{SB}	Standby current V_{DSP} = 3.0 V		15	40		13
		Standby current V_{DD} = 3.0 V		8	20		14

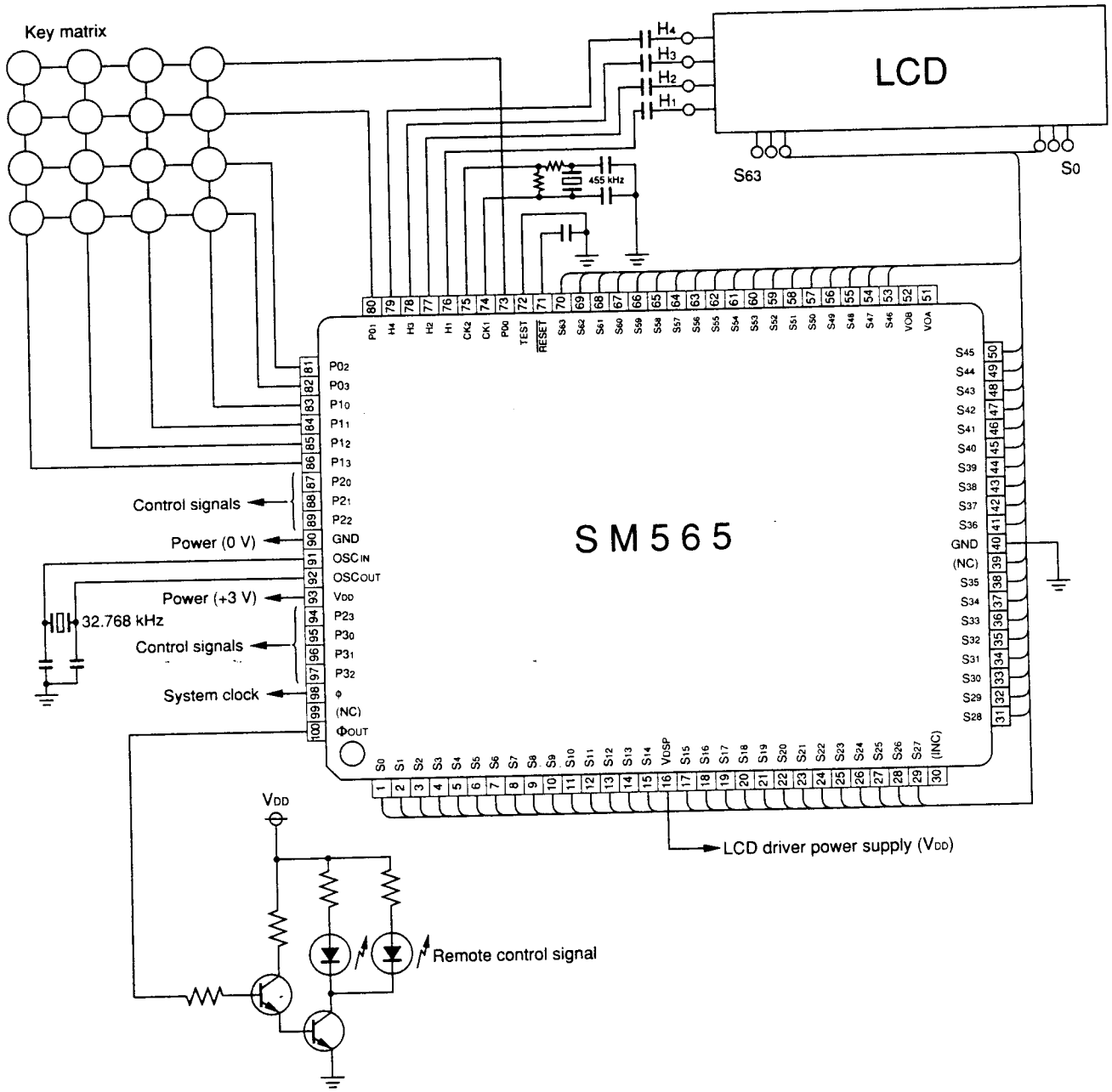
NOTES :

1. Applied to pins $P0_0$-$P0_3$, $\overline{RESET}$, $P1_0$-$P1_3$, $P2_0$-$P2_3$, $P3_0$-$P3_2$ (during input mode).
2. Applied to pins CK_1, TEST, OSC_{IN}.
3. Applied to pin CK_2.
4. Applied to pins $P1_0$-$P1_3$, $P2_0$-$P2_2$, $P3_0$-$P3_2$ (during output mode).
5. Applied to pins $P2_3$, Φ_{OUT} (during output mode).
6. Applied to pins $P1_0$-$P1_3$, $P2_0$-$P2_2$, $P3_0$-$P3_2$, Φ_{OUT} (during output mode).
7. Applied to pins S_0-S_{15} (during data output mode).
8. Pins cited in NOTE 7 are applicable with mask option used.
9. Applied to pins H_1-H_4.
10. Applied to pins S_0-S_{63} (during LCD output mode).
11. Applied to pins H_1-H_4, S_0-S_{63} (during LCD output mode).
12. No load condition.
13. No load condition when bleeder resistance is ON, V_{DSP} = 3.0 V, during 32.768 kHz crystal oscillation.
14. No load condition when bleeder resistance is OFF, during 32.768 kHz crystal oscillation.



C_{OA} = 1 µF, C_{OB} = 1 µF

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