SM3905

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

DESCRIPTION

The SM3905 is a CMOS 4-bit single-chip micro-computer incorporating 4-bit parallel processing function, 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 using a RAM area. Provided with 128 segments LCD drive circuit, this microcomputer is applicable to multi-functional AV remote control system, or any other similar system with a Low power consumption.

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
Output	11
	+15 (also used as LCD segment port)

- Interrupts :

  Internal interrupts x 4 (timer/counter, f4 signal, serial I/O, divider overflow)

  External interrupts x 1 (P0 signal)
- Timer/counter : 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_{IN} and OSC_{OUT}.)

PIN CONNECTIONS

64-PIN QFP   TOP VIEW
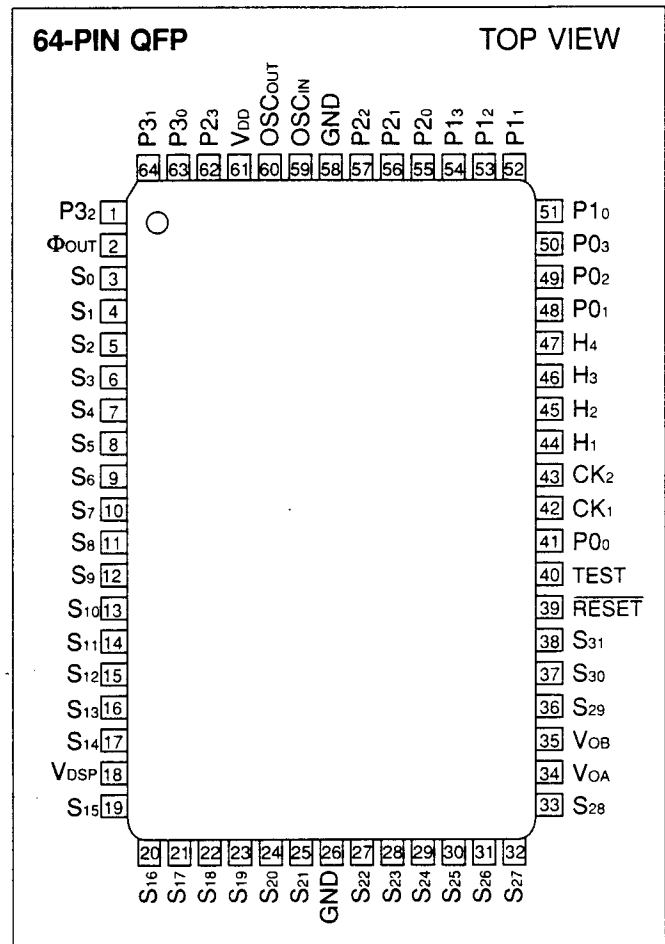
- Built-in carrier output circuit for remote control

  Carrier frequency   37.9 kHz

  Basic oscillaton frequency (main clock) 455 kHz

  Duty cycle   1/3 or 1/2 (mask option)

  Reversal polarity (mask option)
- Instruction cycle time :

  8.79 µs (TYP., 455 kHz, at 3 V)
- Buzzer output
- Standby function
- Supply voltage : 2.7 to 3.6 V
- Package : 64-pin QFP (QFP064-P-1420)

SHARP

BLOCK DIAGRAM
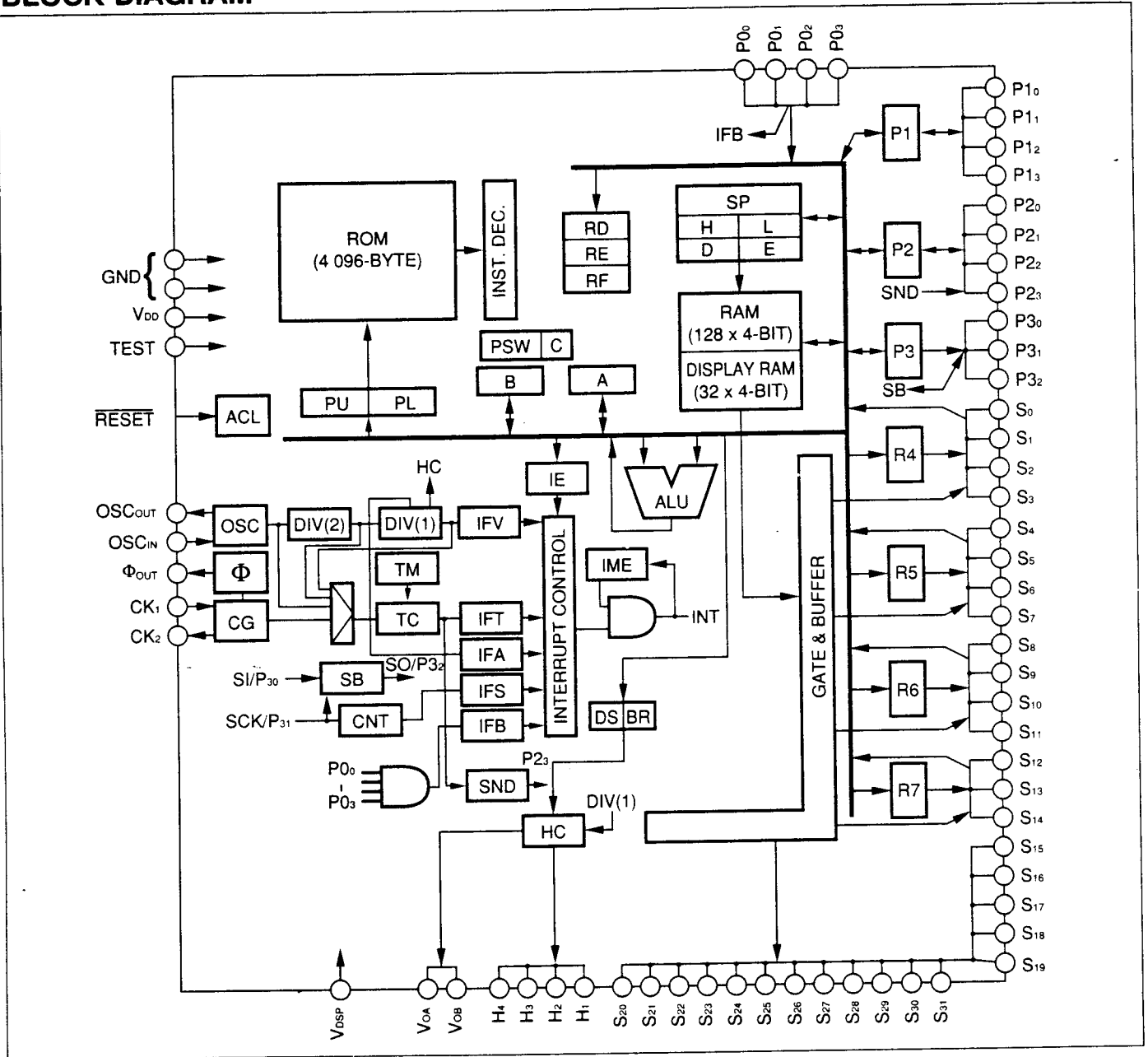
Nomenclature

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_{OUT}	: Carrier control 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_{14}	O or I/O		Selectable between segment ports and I/O ports through an RC register
S_{15}-S_{31}	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)
RESET	I	Pull up	Auto clear
Φ_{OUT}	O		Carrier output 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

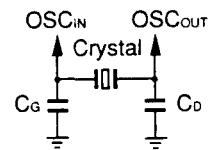| PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Supply voltage	V_{DD}		2.7		3.6	V	
	V_{DSP}		2.7		V_{DD}	V	
Basic oscillation frequency	f	V_{DD} = 2.7 to 3.6 V		455		kHz	1
Instruction cycle	t	V_{DD} = 2.7 to 3.6 V		8.79		μs	
Crystal oscillation frequency	fosc			32.768		kHz	

NOTE :

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

Oscillation Circuit
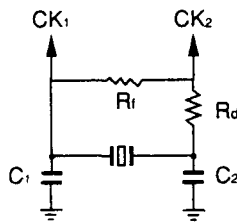
Oscillator : KBR-455B (Kyocera)
$R_f = 1\ M\Omega$
$R_d = 5.6\ k\Omega$
$C_1 = 220\ pF$
$C_2 = 100\ pF$

$C_G = 10\ pF,\quad C_D = 8\ pF$

DC CHARACTERISTICS

$(V_{DD} = 2.7\ \text{to}\ 3.6\ V,\ Ta = -20\ \text{to}\ +70°C)$

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Input voltage	V_{IH1}		$0.7 \times V_{DD}$		V_{DD}	V	1
	V_{IL1}		0		$0.3 \times V_{DD}$	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}	$V_{OL} = 0.5\ V$	0.5			mA	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		2.7		3	V	11
	V_2	$V_{DSP} = 3.0\ V$	1.7	2	2.3	V	
	V_3	No load	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		12
	I_{SB}	Standby current $V_{DSP} = 3.0\ V$		15	40	µA	13
		$V_{DD} = 3.0\ V$		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 $P1_0$-$P1_3$, $P2_0$-$P2_3$, $P3_0$-$P3_2$, Φ_{OUT} (during output mode).
7. Applied to pins S_0-S_{14} (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_{31} (in LCD output mode).
11. Applied to pins H_1-H_4, S_0-S_{31} (in 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.

H_4 waveform

$C_{OA} = 1\ µF,\ C_{OB} = 1\ µF$
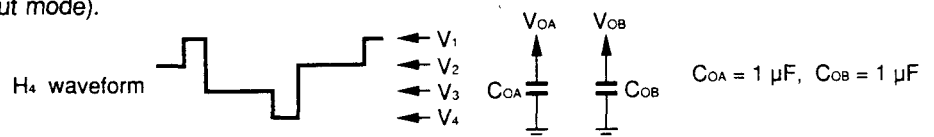
SYSTEM CONFIGURATION EXAMPLE
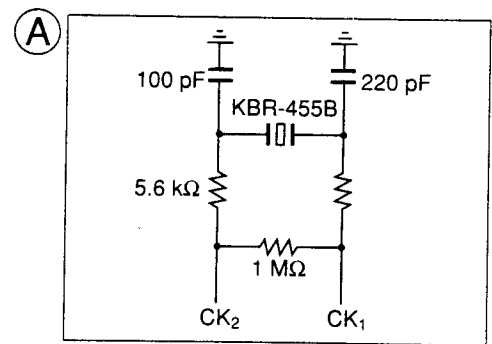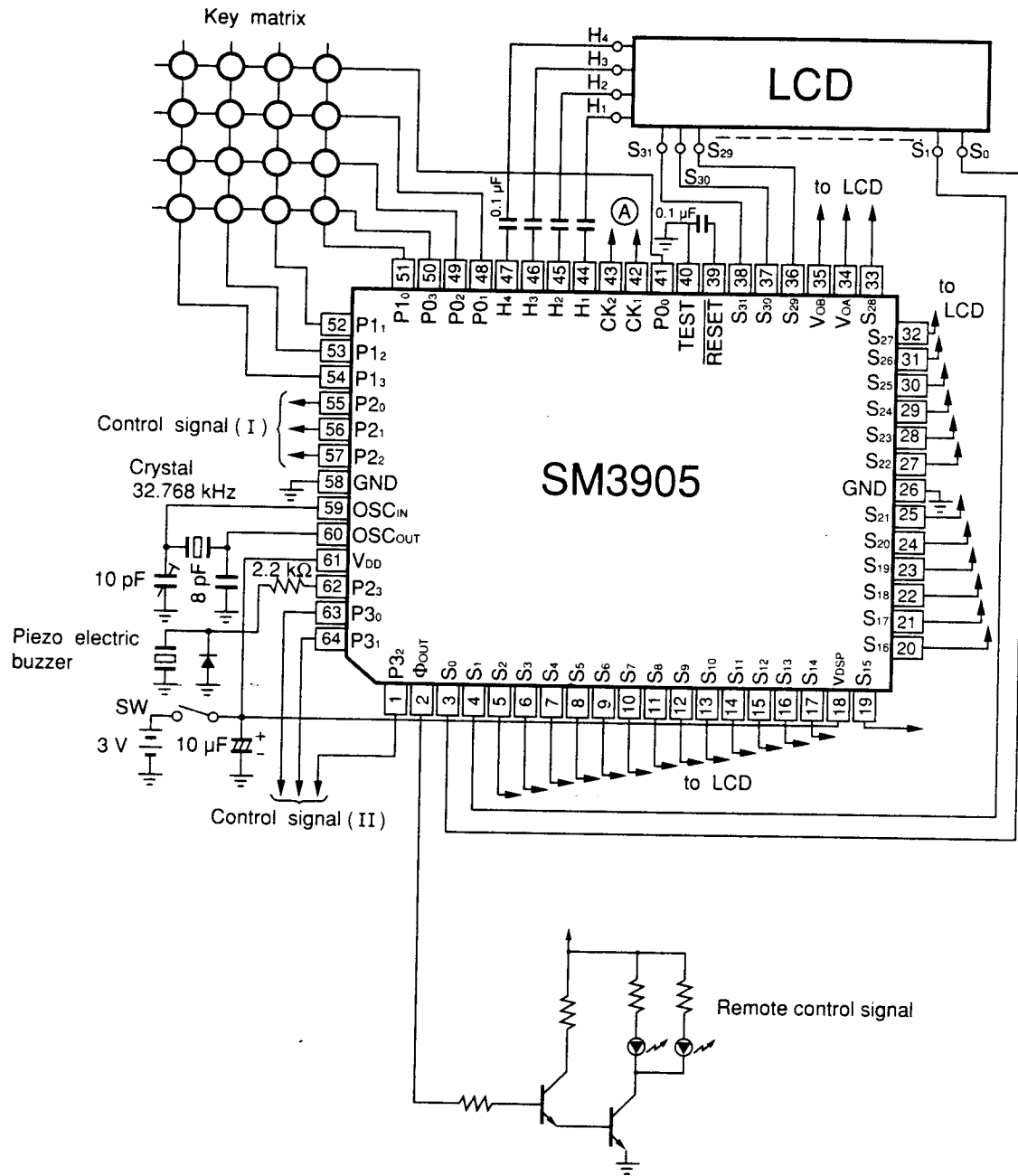
Singlechip LH7xxxx '790 '789 '791 SMxxxx 'K series MCU Microcontroller MPU Microprocessor ARM Advanced RISC Machines Databank LCD Controller LCD Driver Controllers Processors Portable Low Power Low Voltage High Performance Power curve MIPS MIPS/Watt Execution Cycle Multiplier High Speed Compact Handheld 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