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**CMOS 4-bit
1-chip MICROCOMPUTER**

S-1400CF

The S-1400CF 4-bit microcomputer integrates 8-bit programmable timer, 15-bit time base timer, key-in input, 8-bit serial input/output, and 4-level detection circuit, etc., on one chip. Driven by batteries, this microcomputer is ideal for compact portable equipment.

■ **Feature**

- Si gate CMOS process
- Low power consumption
- Single power supply (2.2 V min.)
- High-speed operation (1 MHz max.)
- ROM: 4 K×16 bits
- RAM: 512×4 bits
- 28 I/O lines
- 8-bit serial interface
- Two timers: Time base timer, programmable timer
- Interrupt function: External (four), internal (three)
- Standby function
- Built-in LCD driver that drives the LCD directly
- Built-in LCD driver power supply (constant-voltage circuit, dual booster circuit, triple booster circuit)
- Instruction execution time: 4.0 μ s/1 MHz
122 μ s/32,768 Hz
- Instructions: 37 basic instruction sets (168 if addressing modes are included)
16-level subroutine nesting
- 80-pin QFP (pin spacing: 0.65 mm)
- Piggyback: S-1408B

■ **Applications**

- VTR, TV, cassette deck, portable CD
- Office equipment, copier, medical equipment
- Toys
- Pager, security system

Figure 2

■ Terminal Functions

Table 1

Name	I/O	Functions
V _{SS}	—	GND potential terminal
V _{CC}	—	Positive power supply
V _{LC1}	—	LCD power supply (constant valtage) C = 0.1 μ F
V _{LC2}		LCD power supply (dual booster) C = 0.1 μ F
V _{LC3}		LCD power supply (triple booster) C = 0.1 μ F
$\overline{\text{TEST}}$	Input	Test input terminal
$\overline{\text{RESET}}$	Input	Reset input terminal
CL ₁	—	CR connection terminal for system clock oscillation (Ceramic resonator also connectable by mask option)
CL ₂	—	CR connection terminal for system clock oscillation (Ceramic resonator also connectable by mask option)
X ₁	—	Crystal connection terminal for count clock oscillation
X ₂	—	Crystal connection terminal for count clock oscillation
$\emptyset_1$ to $\emptyset_3$	—	LCD booster capacitor connection terminal
A _{IN}	Input	4-level detection input terminal
COM ₀ to COM ₃	Output	LCD common signal output terminal
SEG ₀ to SEG ₃₁	Output	LCD segment signal output terminal
P ₀₀ / $\overline{\text{SCK}}$	I/O	Port 0 input and serial clock input/output terminal
P ₀₁ / SO	I/O	Port 0 input and serial data output terminal
P ₀₂ / SI	Input	Port 0 input and serial data input terminal
P ₀₃	Input	Port 0 input terminal
P ₁₀ / INT0	Input	Port 1 input and external interrupt input INT0
P ₁₁ / INT1	Input	Port 1 input and external interrupt input INT1
P ₁₂	Input	Port 1 input terminal
P ₁₃	Input	Port 1 input terminal
P ₂₀ / K ₀	Input	Port 2 input and key-in input
P ₂₁ / K ₁	Input	
P ₂₂ / K ₂	Input	
P ₂₃ / K ₃	Input	
P ₃₀ / K ₄	Input	Port 3 input and key-in input
P ₃₁ / K ₅	Input	
P ₃₂ / K ₆	Input	
P ₃₃ / K ₇	Input	
P ₄₀ / K ₈	Input	Port 4 input and key-in input
P ₄₁ / K ₉	Input	
P ₄₂ / K ₁₀	Input	
P ₄₃ / K ₁₁	Input	
P ₅₀ to P ₅₃	I/O	Port 5 input/output terminal
P ₆₀ to P ₆₁	I/O	Port 6 input/output terminal
P ₆₂ to P ₆₃	I/O	Port 6 input/output terminal

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Block Diagram

The S-1400CF blocks connect with a 4-bit data bus (DB), 4-bit address bus (AB), 4-bit RAM address bus (RA), and 12-bit operation bus (OB).

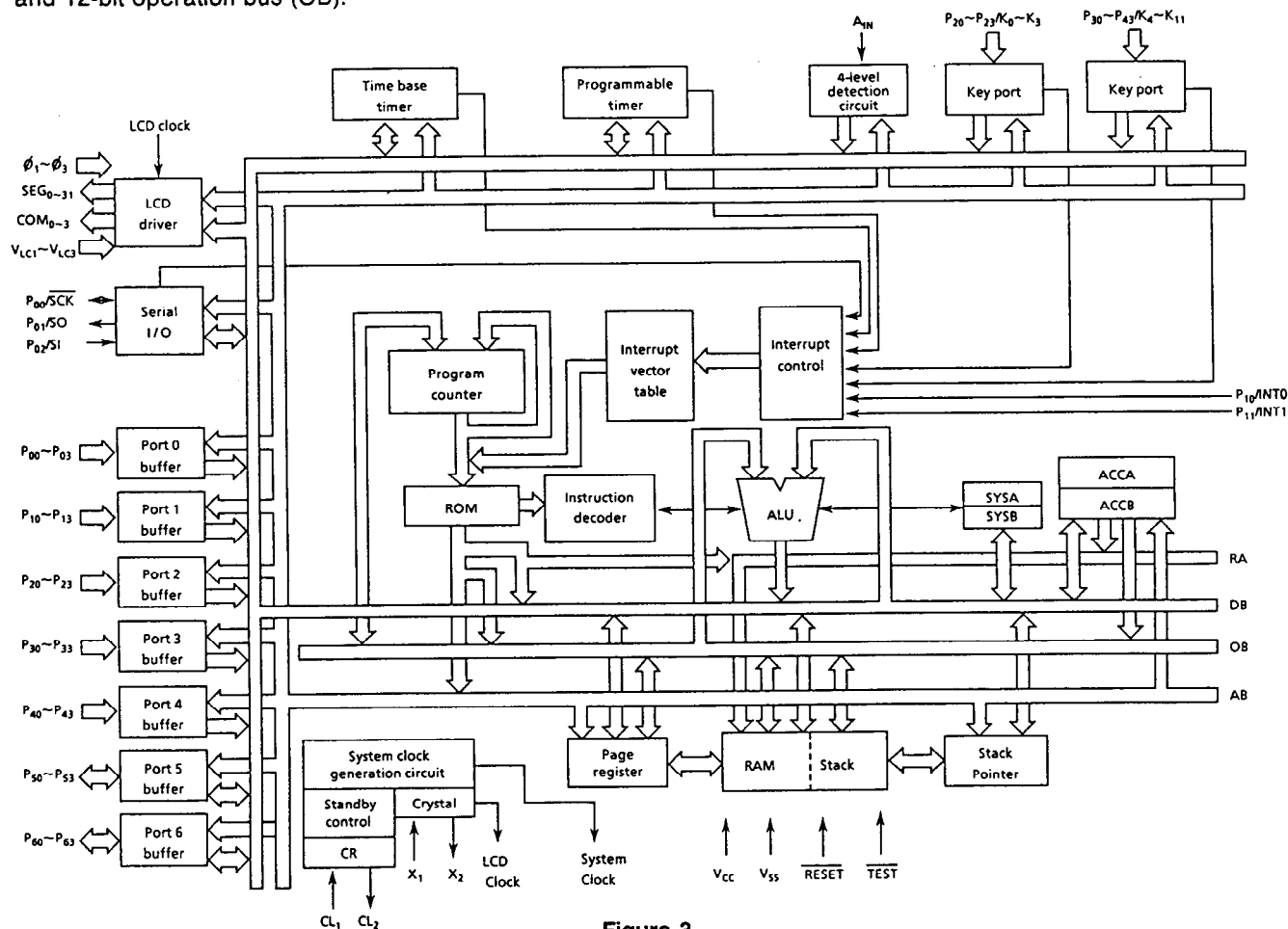


Figure 3

Absolute Maximum Ratings

Table 2

Item	Symbol	Conditions	Rating	Unit
Storage temperature	T_{stg}		-40 to +125	°C
Operating temperature	T_{opr}		-10 to +70	°C
Power supply voltage	V_{CC}	$T_a = 25^\circ\text{C}$	-0.3 to +4.0	V
Input voltage	V_{IN}	$T_a = 25^\circ\text{C}$	$V_{SS}-0.3$ to $V_{CC}+0.3$	V
Output voltage	V_{OUT}	$T_a = 25^\circ\text{C}$	V_{SS} to V_{CC}	V
Power dissipation	P_d	$T_a = 25^\circ\text{C}$	300	mW

Recommended Operating Conditions

Table 3

($T_a = -10^\circ\text{C}$ to $+70^\circ\text{C}$)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}		2.2	—	3.6	V
Input voltage	V_{IN}		0	—	V_{CC}	V
Sub-clock oscillation frequency	f_{SUB}	$V_{CC} = 2.0$ to 3.6 V	—	32,768	—	Hz
Main clock oscillation frequency	f_{main}	$V_{CC} = 2.2$ to 3.6 V, CR oscillation	0.2	0.6	1.0	MHz

■ Characteristics

Table 4

(Ta = -10 °C to +70 °C, V_{CC} = 3 V)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating current consumption1	I _{CCO1}	During FAST mode System clock : 1 MHz	—	0.5	1	mA
Operating current consumption2	I _{CCO2}	During SUB mode System clock : 32 KHz	—	18	35	μA
Standby current consumption	I _{CCS}	During STOP mode, C _G = 15 pF	—	10	18	μA
High level input voltage	V _{IH}		0.8 × V _{CC}	—	—	V
Low level input voltage	V _{IL}		—	—	0.2 × V _{CC}	V
High level input leakage current	I _{LH}	All input terminals* V _{IN} = V _{CC}	—	—	1	μA
Low level input leakage current	I _{LL}	Without pull-up resistor, All input terminals*, V _{IN} = V _{SS}	-1	—	—	μA
Low level input current 1	I _{IL1}	With pull-up resistor, P ₆₂ , P ₆₃ , V _{IN} = V _{SS}	-15	—	-2	μA
Low level input current 2	I _{IL2}	With pull-up resistor, TEST, V _{IN} = V _{SS}	-30	—	-5	μA
Low level input current 3	I _{IL3}	With pull-up resistor, All input terminals, but P ₆₂ , P ₆₃ TEST, V _{IN} = V _{SS}	-5	—	-0.35	μA
Low level input current 4	I _{IL4}	With pull-up resistor, P ₂₀ to P ₂₃ , P ₃₀ to P ₃₃ , P ₄₀ to P ₄₃ , V _{IN} = V _{CC} - 0.6 V	-30	—	-5	μA
High level output current	I _{OH}	P ₀₀ , P ₀₁ , P ₅₀ to P ₅₃ , P ₆₀ to P ₆₃ , V _{OUT} = V _{CC} - 0.5 V	—	—	-100	μA
Low level output current	I _{OL}	P ₀₀ , P ₀₁ , P ₅₀ to P ₅₃ , P ₆₀ to P ₆₃ , V _{OUT} = 0.5 V	250	—	—	μA
LCD drive output	R _{LCD}	COM ₀ to COM ₃ , SEG ₀ to SEG ₃₁	—	—	17	kΩ
Schmitt hysteresis width	V _{WD}		—	0.7	—	V
Constant voltage for LCD drive	V _{LC1}		1.45	1.55	1.65	V
Constant voltage for 4-level detection	V _{REG}		1.45	1.55	1.65	V
4-level detection voltage	V _{REF(n)}	V _{REF(n)} = V _{CC} (n)/4 × V _{REG} n = 1, 2, 3	V _{REF(n)} -0.1	V _{REF(n)}	V _{REF(n)} + 0.1	V

* All input terminals: P₀₀ to P₀₃, P₁₀ to P₁₃, P₂₀ to P₂₃, P₃₀ to P₃₃, P₄₀ to P₄₃, P₅₀ to P₅₃, P₆₀ to P₆₃
TEST, RESET, A_{IN}

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■ Instructions

- 1. Instructions are 16-bit length, and executed in a single instruction cycle (4 clocks).
- 2. The S-1400CF has 6 addressing modes.
 - 1) Direct addressing mode
 - 2) Relative addressing mode
 - 3) Immediate addressing mode
 - 4) Register addressing mode
 - 5) Accumulator indirect addressing mode
 - 6) Accumulator indexed addressing mode
- 3. Number of instructions

Table 5

	Basic	Including addressing modes
Transfer instruction	6	15
Arithmetic operation instruction	9	57
Logical operation instruction	8	66
Branch instruction	7	19
Rotate/shift instruction	2	6
CPU control instruction	5	5
Total	37	168

■ Application Example

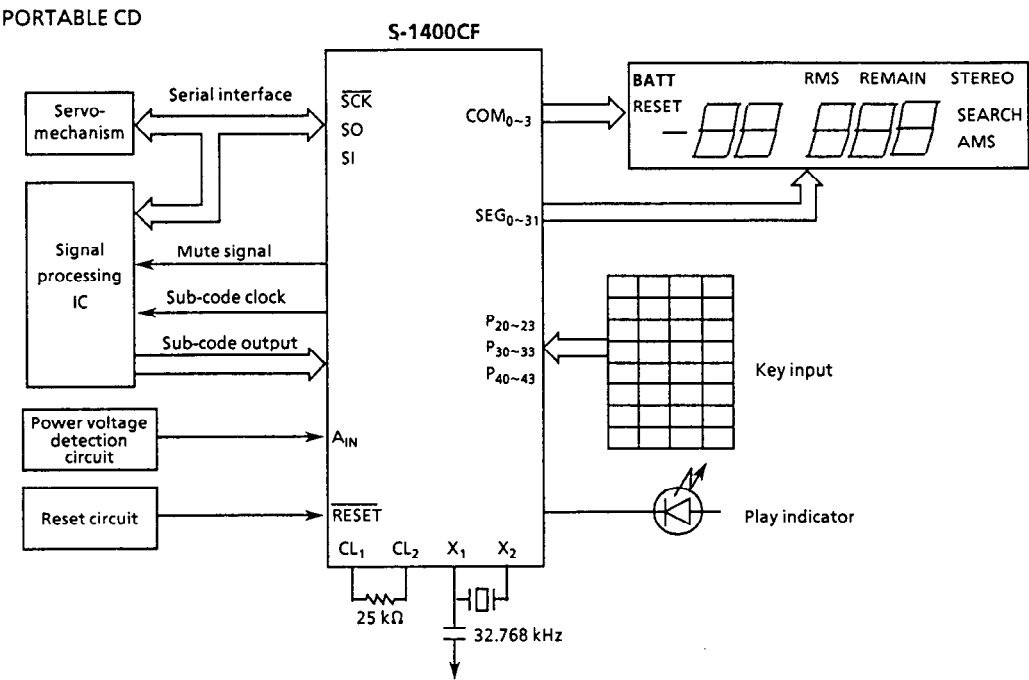


Figure 4