

The S-1810CF/1820CF is a CMOS 8-bit microcomputer, which integrates an 8K-byte ROM, a 4K-byte (S-1810CF) or 2.3K-byte (S-1820CF) RAM, a 14-bit counter, a 16-bit timer, general-purpose I/O ports, and an 8-bit serial interface on one chip. The S-1810/1820CF is ideal for high-performance remote controller.

## ■ Features

### *Characteristics*

- Power supply voltage : 2.2 to 6.0 V
- Current consumption :
  - Running : 1 mA typ., 3 mA max. at 4 MHz, 3 V operation
  - Standby : 0.1  $\mu$ A typ., 10  $\mu$ A max.
- Operating frequency : 4 MHz
- Instruction execution time : 2.0  $\mu$ s

### *Hardware functions*

- ROM : 8K  $\times$  8 bits
- RAM : 4K  $\times$  8 bits (S-1810CF)  
2.3K  $\times$  8 bits (S-1820CF)
- 32 I/O lines (4 of which have LED drivers)
- 8-bit serial port  $\times$  1 channel
- Timer/counter : 14-bit counter, 16-bit timer
- Watchdog timer
- Amplifier and waveshaping circuit for receiving signal
- Carrier generation circuit
- Low voltage detection circuit (detection voltage is regulated with external resistor)
- Interrupt function: External (two), internal (seven)
- Oscillation circuit : 4-MHz ceramic oscillator is built in
- Standby function : Stops oscillation clock at standby mode

### *Software*

- Instruction: 68 basic instruction sets (210 if addressing modes are included)
- 32-level subroutine nesting

### *Package*

- 54-pin QFP (terminal distance: 1.0 mm)

### *OTP version*

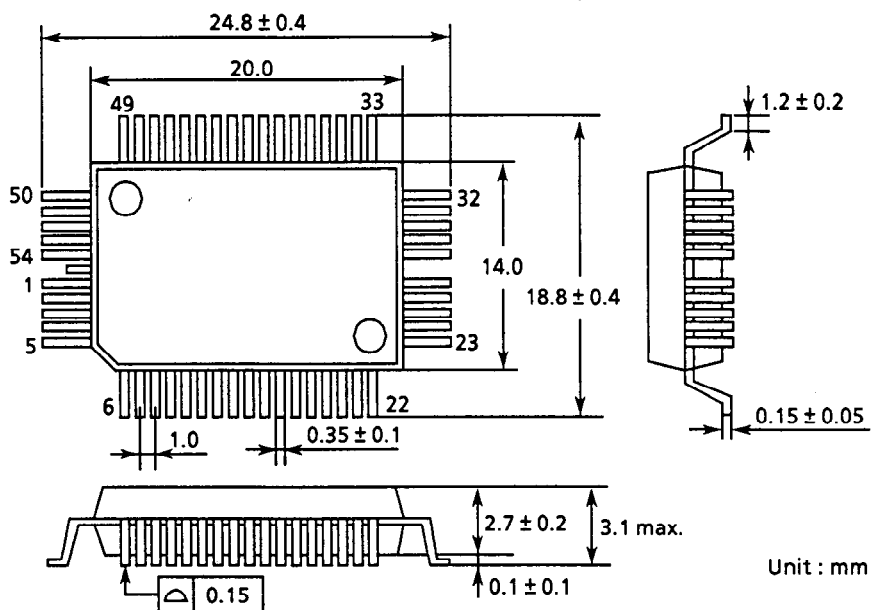
- S-18P10BF

## ■ Applications

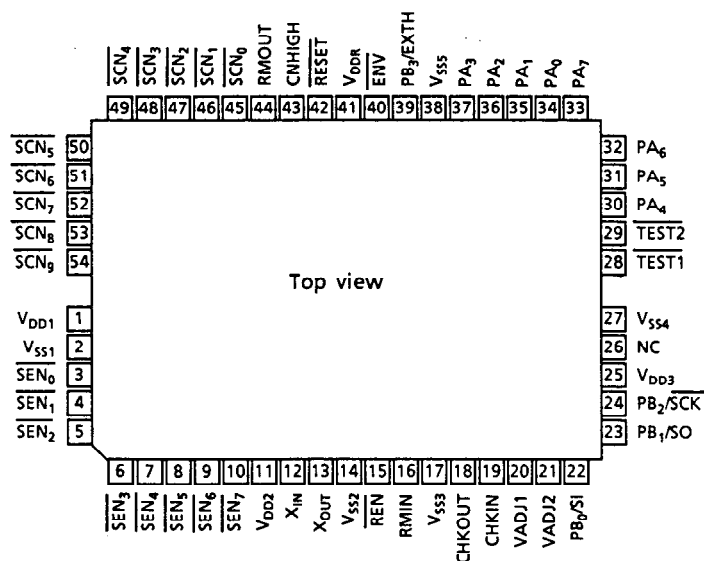
- Universal remote controller, others

# CMOS 8-bit 1-chip MICROCOMPUTER S-1810CF/1820CF

## ■ Dimensions (54-pin QFP)



## ■ Pin Assignments



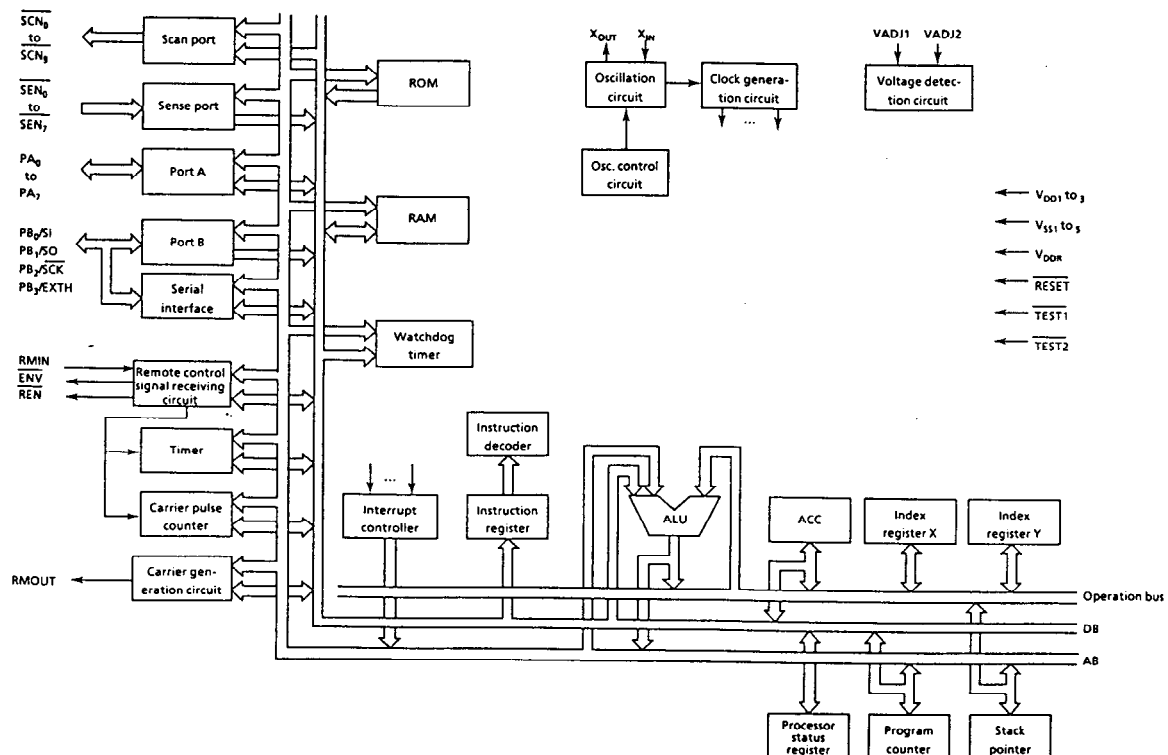
Note : It is recommended that power is supplied from all power terminals (V<sub>DD1</sub> to V<sub>DD3</sub>, V<sub>SS1</sub> to V<sub>SS5</sub>, V<sub>DDR</sub>). Even if all power terminals cannot be connected, V<sub>DDR</sub>, V<sub>DD2</sub>, V<sub>DD3</sub>, V<sub>SS2</sub>, and V<sub>SS5</sub> must be connected. Do not supply any power from terminal, that power is not supplied, to an external peripheral

## Terminal Functions

| Name                                 | I/O    | Functions                                                                                                                                          |
|--------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| V <sub>DD1</sub> to V <sub>DD3</sub> | —      | Positive power supply                                                                                                                              |
| V <sub>SS1</sub> to V <sub>SS5</sub> | —      | GND potential terminals                                                                                                                            |
| V <sub>DDR</sub>                     | —      | Power supply terminal for built-in SRAM                                                                                                            |
| X <sub>IN</sub>                      | —      | Oscillation circuit input or external clock input terminal, used by connecting ceramic oscillator between X <sub>OUT</sub> and X <sub>IN</sub>     |
| X <sub>OUT</sub>                     | —      | Oscillation circuit output, used by connecting ceramic oscillator between X <sub>OUT</sub> and X <sub>IN</sub> . Open during external clock input. |
| RESET                                | Input  | Reset input terminal                                                                                                                               |
| TEST1 to TEST2                       | Input  | Test input terminals                                                                                                                               |
| VADJ1                                | Input  | Resistor connection terminal for 1st detection voltage adjustment                                                                                  |
| VADJ2                                | Input  | Resistor connection terminal for 2nd detection voltage adjustment                                                                                  |
| SCN <sub>0</sub> to SCN <sub>9</sub> | Output | Scan output terminals of key matrix                                                                                                                |
| SEN <sub>0</sub> to SEN <sub>7</sub> | Input  | Sense input terminals of key matrix                                                                                                                |
| REN                                  | Output | Power control terminal of remote control signal receiving circuit                                                                                  |
| RMIN                                 | Input  | Input terminal of remote control receiving signal                                                                                                  |
| RMOUT                                | Output | Output terminal of remote control transmitting signal                                                                                              |
| ENV                                  | Output | Output terminal of waveshaping circuit of remote control receiving signal                                                                          |
| CHKOUT                               | Output | Output terminal of amplification circuit of remote control receiving signal                                                                        |
| CHKIN                                | Input  | Input terminal of waveshaping circuit of remote control receiving signal                                                                           |
| PA <sub>0</sub> to PA <sub>3</sub>   | I/O    | I/O ports (LED drive available)                                                                                                                    |
| PA <sub>4</sub> to PA <sub>7</sub>   | I/O    | I/O ports                                                                                                                                          |
| PB <sub>0</sub> /SI                  | Input  | Input port and serial data input terminal                                                                                                          |
| PB <sub>1</sub> /SO                  | I/O    | Input port and serial data output terminal                                                                                                         |
| PB <sub>2</sub> /SCK                 | I/O    | Input port and serial clock input/output terminal                                                                                                  |
| PB <sub>3</sub> /EXTH                | Input  | Input port and external interrupt input terminal                                                                                                   |
| CNHIGH                               | —      | Connect to V <sub>DD</sub> level                                                                                                                   |

## Block Diagram

The S-1810CF/1820CF blocks connect with an 8-bit data bus (DB) and 16-bit address bus (AB).



## ■ Absolute Maximum Ratings

| Parameter             | Symbol    | Conditions               | Ratings                | Unit |
|-----------------------|-----------|--------------------------|------------------------|------|
| Storage temperature   | $T_{stg}$ |                          | -40 to +125            | °C   |
| Operating temperature | $T_{opr}$ |                          | -10 to +70             | °C   |
| Power supply voltage  | $V_{DD}$  | $T_a = 25^\circ\text{C}$ | -0.3 to +7.0           | V    |
| Input voltage         | $V_{IN}$  | $T_a = 25^\circ\text{C}$ | -0.3 to $V_{DD} + 0.3$ | V    |
| Output voltage        | $V_{OUT}$ | $T_a = 25^\circ\text{C}$ | -0.3 to $V_{DD} + 0.3$ | V    |
| Power dissipation     | $P_D$     | $T_a = 25^\circ\text{C}$ | 500                    | mW   |

## ■ Recommended Operating Conditions

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

| Parameter             | Symbol    | Conditions                | Min. | Typ. | Max.     | Unit |
|-----------------------|-----------|---------------------------|------|------|----------|------|
| Power supply voltage  | $V_{DD}$  |                           | 2.2  | —    | 6.0      | V    |
| Input voltage         | $V_{IN}$  |                           | 0    | —    | $V_{DD}$ | V    |
| Oscillation frequency | $f_{OSC}$ | $V_{DD} = 2.2$ to $6.0$ V | —    | 4    | —        | MHz  |

## ■ DC Electrical Characteristics

( $T_a = -10^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{DD} = 3.0$  V,  $V_{DDR} = 3.0$  V)

| Parameter                        | Symbol    | Conditions(applicable terminals)                                   | Min.                | Typ. | Max.                | Unit          |
|----------------------------------|-----------|--------------------------------------------------------------------|---------------------|------|---------------------|---------------|
| Operating supply voltage         | $V_{DD}$  | $V_{DD}$ , $V_{DDR}$ , $f_{OSC} = 4$ MHz                           | 2.2                 | —    | 6.0                 | V             |
| Memory operating voltage         | $V_{OPM}$ | $V_{DDR}$                                                          | 2.0                 | —    | 6.0                 | V             |
| Operating current consumption    | $I_{DDO}$ | $V_{DD}$ , $V_{DDR}$ , no load                                     | —                   | 1    | 3                   | mA            |
| Standby current consumption      | $I_{DDs}$ | $V_{DD}$ , $V_{DDR}$                                               | —                   | 0.1  | 10                  | $\mu\text{A}$ |
| Standby current consumption      | $I_{DDs}$ | $V_{DD}$ , $V_{DDR}$ , $T_a = 25^\circ\text{C}$                    | —                   | 0.1  | 1                   | $\mu\text{A}$ |
| Low level input voltage          | $V_{IL}$  | All input pins                                                     | —                   | —    | $0.2 \times V_{DD}$ | V             |
| High level input voltage         | $V_{IH}$  | All input pins                                                     | $0.8 \times V_{DD}$ | —    | —                   | V             |
| Low level input current          | $I_{IL}$  | Input pins with pull-up resistor, $V_{IN} = V_{SS}$                | -100                | -30  | -10                 | $\mu\text{A}$ |
| Low level input leakage current  | $I_{LL}$  | Input pins without pull-up resistor, $V_{IN} = V_{SS}$             | -1                  | —    | —                   | $\mu\text{A}$ |
| High level input leakage current | $I_{LH}$  | All input pins, $V_{IN} = V_{DD}$                                  | —                   | —    | 1                   | $\mu\text{A}$ |
| Low level output current 1       | $I_{OL1}$ | $PA_0$ to $PA_3$ , $REN$ , $V_{OUT} = 0.4$ V                       | 3.2                 | —    | —                   | mA            |
| Low level output current 2       | $I_{OL2}$ | CHKOUT, $V_{OUT} = 0.4$ V                                          | 0.4                 | —    | —                   | mA            |
| Low level output current 3       | $I_{OL3}$ | Pins except $PA_0$ to $PA_3$ , $REN$ and CHKOUT, $V_{OUT} = 0.4$ V | 0.8                 | —    | —                   | mA            |
| High level output current 1      | $I_{OH1}$ | RMOU, $V_{OUT} = V_{DD} - 0.4$ V                                   | —                   | —    | -3.2                | mA            |
| High level output current 2      | $I_{OH2}$ | CHKOUT, $V_{OUT} = V_{DD} - 0.4$ V                                 | —                   | —    | -0.2                | mA            |
| High level output current 3      | $I_{OH3}$ | Pins except RMOU and CHKOUT, $V_{OUT} = V_{DD} - 0.4$ V            | —                   | —    | -0.4                | mA            |
| Input impedance                  | $R_{IN}$  | RMIN                                                               | 12                  | 25   | 50                  | k $\Omega$    |
| Amplifier gain                   | $G_V$     | RMIN, $f = 40$ kHz                                                 | —                   | 20   | —                   | dB            |

## ■ Instructions

- 1 . There are three kinds of instructions : 1-byte, 2-byte, and 3-byte instructions.  
Byte 1 is called "op code", which indicates kinds of instruction.  
Byte 2 and byte 3 are called "operand", which indicates object of instruction.  
Operand is not always necessary, and influences addressing mode.
- 2 . The S-1810CF/1820CF has 17 addressing modes, and executes memory access efficiently.
  - 1) Accumulator addressing mode : ACC
  - 2) Immediate addressing mode : IMM
  - 3) Absolute addressing mode : ABS
  - 4) Zero-page addressing mode : ZPG
  - 5) Implied addressing mode : IMP
  - 6) Zero-page indexed X addressing mode : ZPG, X
  - 7) Zero-page indexed Y addressing mode : ZPG, Y
  - 8) Absolute indexed X addressing mode : ABS, X
  - 9) Absolute indexed Y addressing mode : ABS, Y
  - 10) Relative addressing mode : REL
  - 11) Zero-page indexed indirect addressing mode : (IND, X)
  - 12) Zero-page indirect indexed addressing mode : (IND), Y
  - 13) Zero-page indirect addressing mode : (IND)
  - 14) Absolute indexed indirect addressing mode : (ABS, X)
  - 15) Absolute indirect addressing mode : (ABS)
  - 16) Zero-page bit-relative addressing mode : ZREL
  - 17) Zero-page bit addressing mode : ZBIT
- 3 . Number of instructions
  - Operation instruction : 17
  - Data transfer instruction : 21
  - Rotate/shift instruction : 4
  - Flag setting instruction : 7
  - Bit operation instruction : 2
  - Branch instruction : 15
  - Interrupt instruction : 1
  - Others : 1Total : 68 basic instructions

■ Application Example (Universal Remote Controller)

