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The S-1460BF is a CMOS 4-bit microcomputer, which integrates ROM, RAM, a timer and I/O ports on a single chip. Since the S-1460BF has a 4K×16-bit ROM, a special terminal for remote control signal output and key-on wake-up functions, it is ideal for infrared remote controller.

## ■ Features

*Characteristics*

- Power supply voltage : 2.2 to 6.0 V
- Current consumption

  Running : 0.7 mA max. at 1MHz, 3 V operation
  Standby : 0.1 μA typ., 2.0 μA max.

- Operating frequency : 1 MHz
- Instruction execution time : 4.0 μs at 1 MHz oscillation

*Hardware functions*

- ROM : 4K×16 bits
- RAM : 128×4 bits
- Port : 8-bit input, 8-bit output, 4-bit I/O
- Remote control signal output
- Standby counter
- Timer / Counter : 10-bit counter, 8-bit timer
- Watchdog timer
- Key-on wake-up
- Interrupt function: Internal (two)
- Oscillation circuit : Ceramic oscillator is built in
- Standby status : Stops oscillation, holds internal status
- Internal low-voltage detector

*Software*

- Instruction: 35 basic instruction sets (166 if addressing modes are included)
- 16-level subroutine nesting

*Package*

- 28-pin SOP

*OTP version*

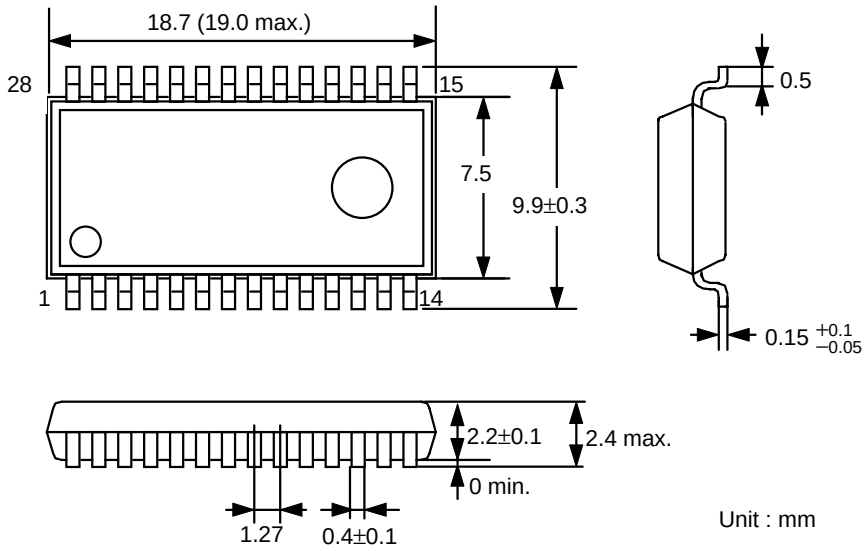
- For software evaluation, use the S-14P60AF

## ■ Applications

- Remote controller
- Other small-sized control equipment

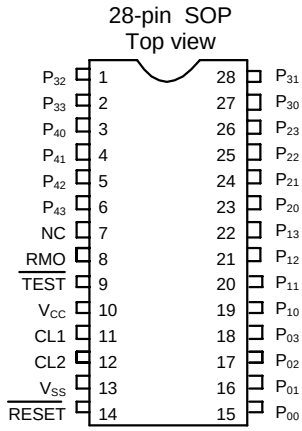
* Use S-1460CF when the operation voltage is 3 V.

## ■ Dimensions (28-pin SOP)




Unit : mm

## ■ Pin Assignment

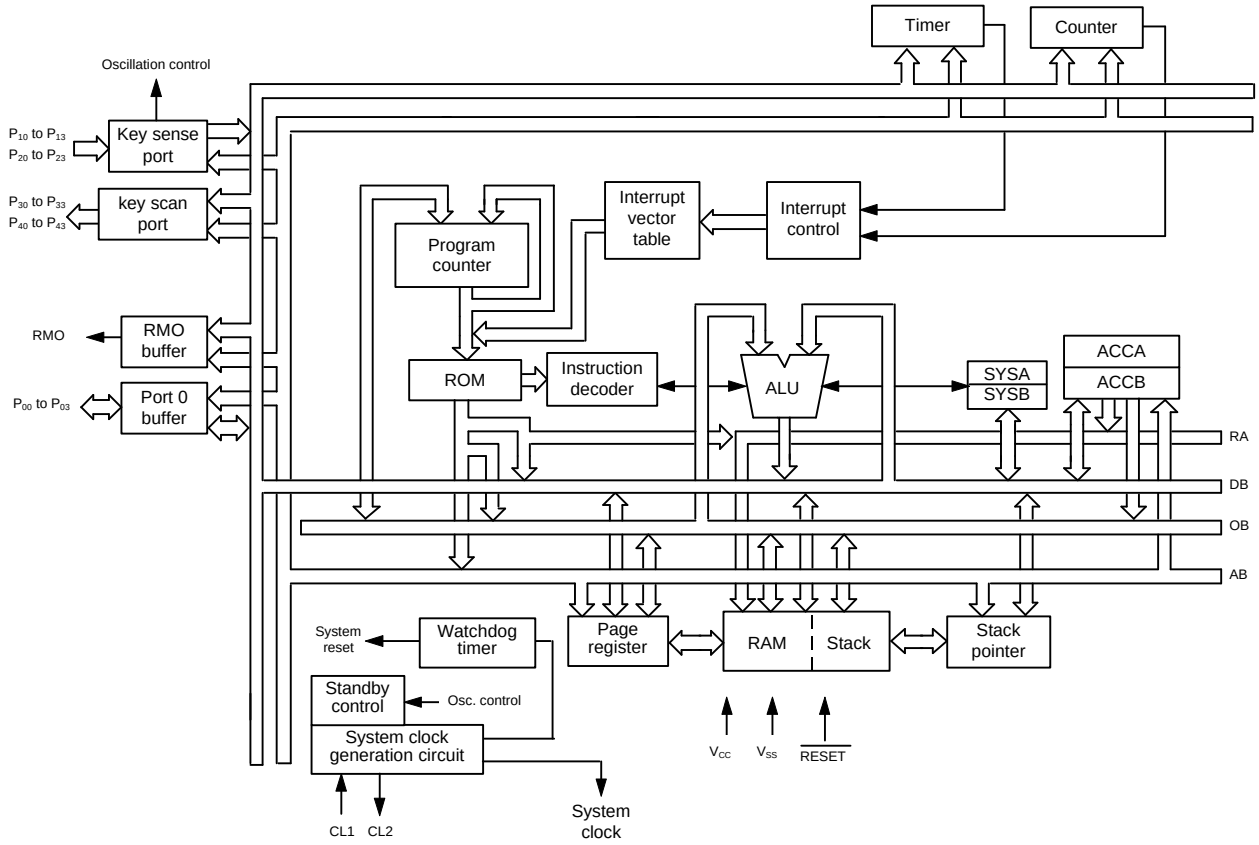



## ■ Terminal Functions

| Name | I/O | Functions |
|---|---|---|
| $V_{CC}$ | — | Positive power supply |
| $V_{SS}$ | — | GND potential terminal |
| CL1 | Input | Oscillation circuit input terminal |
| CL2 | Output | Oscillation circuit output terminal |
| $\overline{\text{RESET}}$ | Input | Reset input terminal (pull-up resistor is built in) |
| $\overline{\text{TEST}}$ | Input | Test input terminal (pull-up resistor is built in) |
| RMO | Output | Remote control signal output terminal |
| $P_{00}$ to $P_{03}$ | I/O | I/O ports, selectable in bit unit.<br>Built-in pull-up resistor and Nch opendrain output are available in mask option. |
| $P_{10}$ to $P_{13}$<br>$P_{20}$ to $P_{23}$ | Input | Input ports, also used as sense input of key matrix.<br>Standby status is released by inputting low level in standby status.<br>Pull-up resistor is built in. |
| $P_{30}$ to $P_{33}$<br>$P_{40}$ to $P_{43}$ | Output | Output ports, also used as scan output of key matrix.<br>Nch opendrain output is also available in mask option. |

## ■ Block Diagram

The S-1460BF 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).




## ■ 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 | $V_{CC}$ | Ta=25°C | -0.3 to +7.0 | V |
| Input voltage | $V_{IN}$ | Ta=25°C | $V_{SS}$-0.3 to $V_{CC}$+0.3 | V |
| Output voltage | $V_{OUT}$ | Ta=25°C | $V_{SS}$ to $V_{CC}$ | V |
| Power dissipation | $P_D$ | Ta=25°C | 300 | mW |

## ■ Recommended Operating Conditions

(Ta=-10 °C to +70 °C)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Power supply voltage | $V_{CC}$ | $f_{OSC}$=1 MHz | 2.2 | — | 6.0 | V |
| Input voltage | $V_{IN}$ | | 0 | — | $V_{CC}$ | V |
| System clock frequency | $f_{OSC}$ | $V_{CC}$=2.2 to 6.0 V | 0.2 | — | 1.0 | MHz |

## ■ DC Electrical Characteristics

- $V_{CC}$=3 V

(Ta=-10 °C to +70 °C)

| Parameter | Symbol | Conditions(applicable terminals) | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating current consumption | $I_{CCO}$ | $f_{OSC}$=1 MHz, no load | — | 0.25 | 0.7 | mA |
| Standby current consumption | $I_{CCS}$ | OFF mode (When low voltage detection is used) | — | 0.5 | 2.0 | µA |
| Standby current consumption | $I_{CCS}$ | OFF mode (When low voltage detection is not used) | — | 0.1 | 2.0 | 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 pins* $V_{IN}$=$V_{CC}$ | — | — | 1 | µA |
| Low level input leakage current | $I_{LL}$ | Without pull-up resistor $P_{00}$ to $P_{03}$, $V_{IN}$=$V_{SS}$ | -1 | — | — | µA |
| High level input current | $I_{IH}$ | $\overline{RESET}$, $V_{IN}$=$V_{CC}$-0.3V | -9 | — | -0.9 | µA |
| Low level input current 1 | $I_{IL1}$ | With pull-up resistor, $P_{00}$ to $P_{03}$, $P_{10}$ to $P_{13}$, $P_{20}$ to $P_{23}$, $V_{IN}$=$V_{SS}$ | -90 | -30 | -10 | µA |
| Low level input current 2 | $I_{IL2}$ | $\overline{RESET}$, $V_{IN}$=$V_{SS}$ | -6 | -2 | -0.6 | µA |
| Low level input current 3 | $I_{IL3}$ | $\overline{TEST}$, $V_{IN}$=$V_{SS}$ | -30 | -10 | -3 | µA |
| High level output current 1 | $I_{OH1}$ | RMO, $V_{OUT}$=2.1 V | — | — | -5.0 | mA |
| High level output current 2 | $I_{OH2}$ | $P_{00}$ to $P_{03}$, $P_{30}$ to $P_{33}$, $P_{40}$ to $P_{43}$, $V_{OUT}$=2.6 V | — | — | -100 | µA |
| Low level output current 1 | $I_{OL1}$ | RMO, $V_{OUT}$=0.4 V | 250 | — | — | µA |
| Low level output current 2 | $I_{OL2}$ | $P_{00}$ to $P_{03}$, $P_{30}$ to $P_{33}$, $P_{40}$ to $P_{43}$, $V_{OUT}$=0.4 V | 1.0 | — | — | mA |
| Schmitt hysteresis width | $V_{WD}$ | | — | 1.0 | — | V |

* $\overline{TEST}$, $\overline{RESET}$, $P_{00}$ to $P_{03}$, $P_{10}$ to $P_{13}$, $P_{20}$ to $P_{23}$

- $V_{CC}$=5 V

(Ta=-10 °C to +70 °C)

| Parameter | Symbol | Conditions(applicable terminals) | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating current consumption | $I_{CCO}$ | $f_{OSC}$=1 MHz, no load | — | 0.6 | 1.2 | mA |
| Standby current consumption | $I_{CCS}$ | OFF mode | — | 0.1 | 5.0 | 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 pins* $V_{IN}$=$V_{CC}$ | — | — | 1 | µA |
| Low level input leakage current | $I_{LL}$ | Without pull-up resistor $P_{00}$ to $P_{03}$, $V_{IN}$=$V_{SS}$ | -1 | — | — | µA |
| High level input current | $I_{IH}$ | $\overline{RESET}$, $V_{IN}$=$V_{CC}$-0.3V | -15 | — | -1.5 | µA |
| Low level input current 1 | $I_{IL1}$ | With pull-up resistor, $P_{00}$ to $P_{03}$, $P_{10}$ to $P_{13}$, $P_{20}$ to $P_{23}$, $V_{IN}$=$V_{SS}$ | -230 | -90 | -30 | µA |
| Low level input current 2 | $I_{IL2}$ | $\overline{RESET}$, $V_{IN}$=$V_{SS}$ | -15 | -6 | -2.4 | µA |
| Low level input current 3 | $I_{IL3}$ | $\overline{TEST}$, $V_{IN}$=$V_{SS}$ | -75 | -30 | -12 | µA |
| High level output current 1 | $I_{OH1}$ | RMO, $V_{OUT}$=4.1 V | — | — | -7 | mA |
| High level output current 2 | $I_{OH2}$ | $P_{00}$ to $P_{03}$, $P_{30}$ to $P_{33}$, $P_{40}$ to $P_{43}$, $V_{OUT}$=4.6 V | — | — | -250 | µA |
| Low level output current 1 | $I_{OL1}$ | RMO, $V_{OUT}$=0.4 V | 450 | — | — | µA |
| Low level output current 2 | $I_{OL2}$ | $P_{00}$ to $P_{03}$, $P_{30}$ to $P_{33}$, $P_{40}$ to $P_{43}$, $V_{OUT}$=0.4 V | 1.5 | — | — | mA |
| Schmitt hysteresis width | $V_{WD}$ | | — | 2.2 | — | V |

* $\overline{TEST}$, $\overline{RESET}$, $P_{00}$ to $P_{03}$, $P_{10}$ to $P_{13}$, $P_{20}$ to $P_{23}$

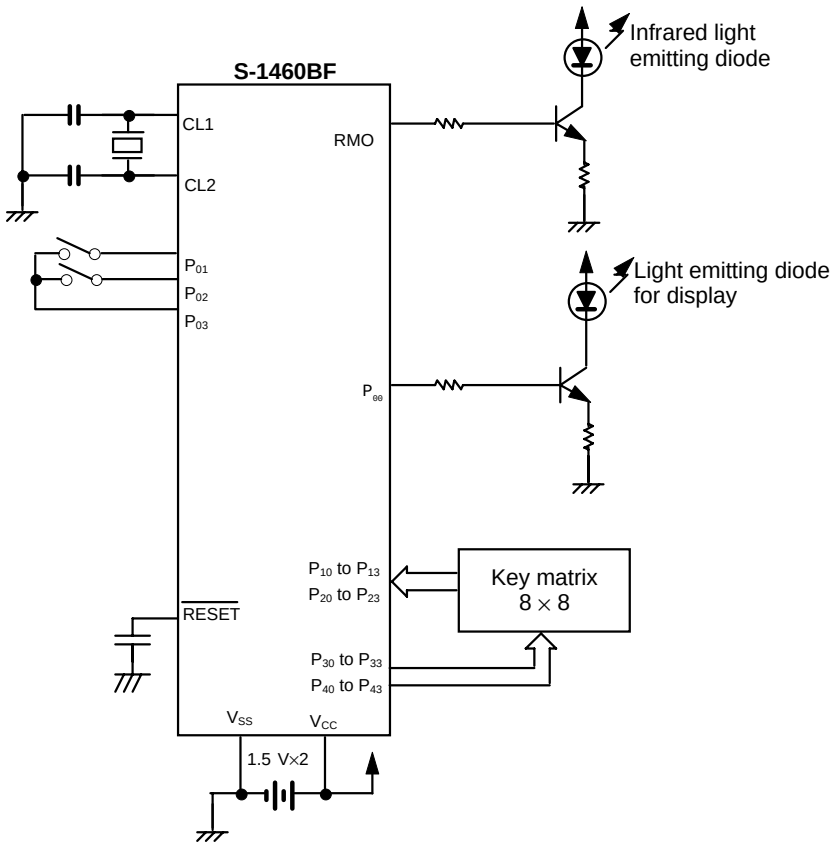
## ■ Instructions

1 . Instructions are 16-bit length, and executed in a single instruction cycle(4 clocks).

2 . The S-1460BF/14L60BF has 6 addressing modes.

1) Direct addressing modes
2) Relative addressing modes
3) Immediate addressing modes
4) Register addressing modes
5) Accumulator indirect addressing modes
6) Accumulator indexed addressing modes

3 . Number of instructions.

| | 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 | 3 | 3 |
| Total | 35 | 166 |

## ■ Appliction Example