Contents

CMOS 4-bit 1-chip MICROCOMPUTER

S-1460BF/14L60BF

The S-1460BF/14L60BF is a CMOS 4-bit microcomputer, which integrates ROM, RAM, a timer and I/O ports on a single chip. Since the S-1460BF/14L60BF 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.

Due to its low operating voltage range (1.2V to 3.6V), the S-14L60BF is suitable for single-battery powered devices.

■ Features

Characteristics

- Power supply voltage : 2.2 to 6.0 V (S-1460BF)
  1.2 to 3.6 V (S-14L60BF)
- Current consumption
  S-1460BF : Running : 0.7 mA max. at 1MHz, 3 V operation
  Standby : 0.1 μA typ., 2.0 μA max.
  S-14L60BF : Running : 0.3 mA max. at 1MHz, 1.5 V operation
  Standby : 10 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 (only for the S-1460BF)

Software

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

Package

- 28-pin SOP

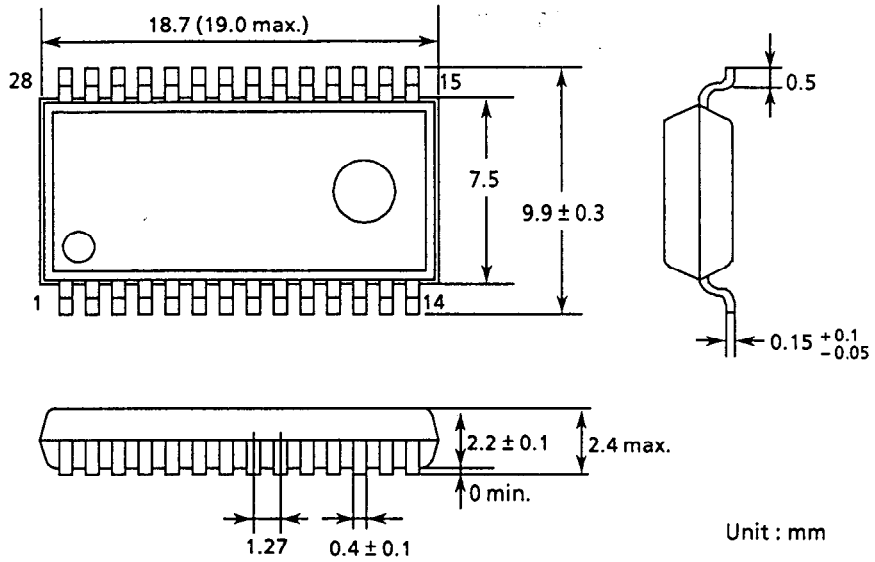
OTP version

- S-1460BF : S-14P60AF
- S-14L60BF : For software evaluation, use the S-14P60AF

■ Applications

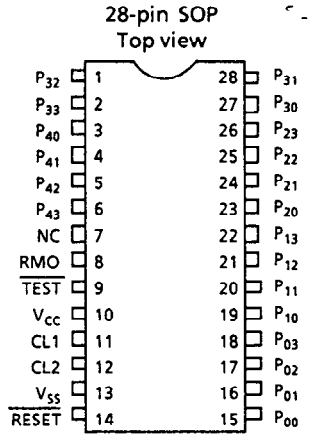
- Remote controller
- Other small-sized control equipment

■ Dimensions (28-pin SOP)



Unit : mm

■ Pin Assignment

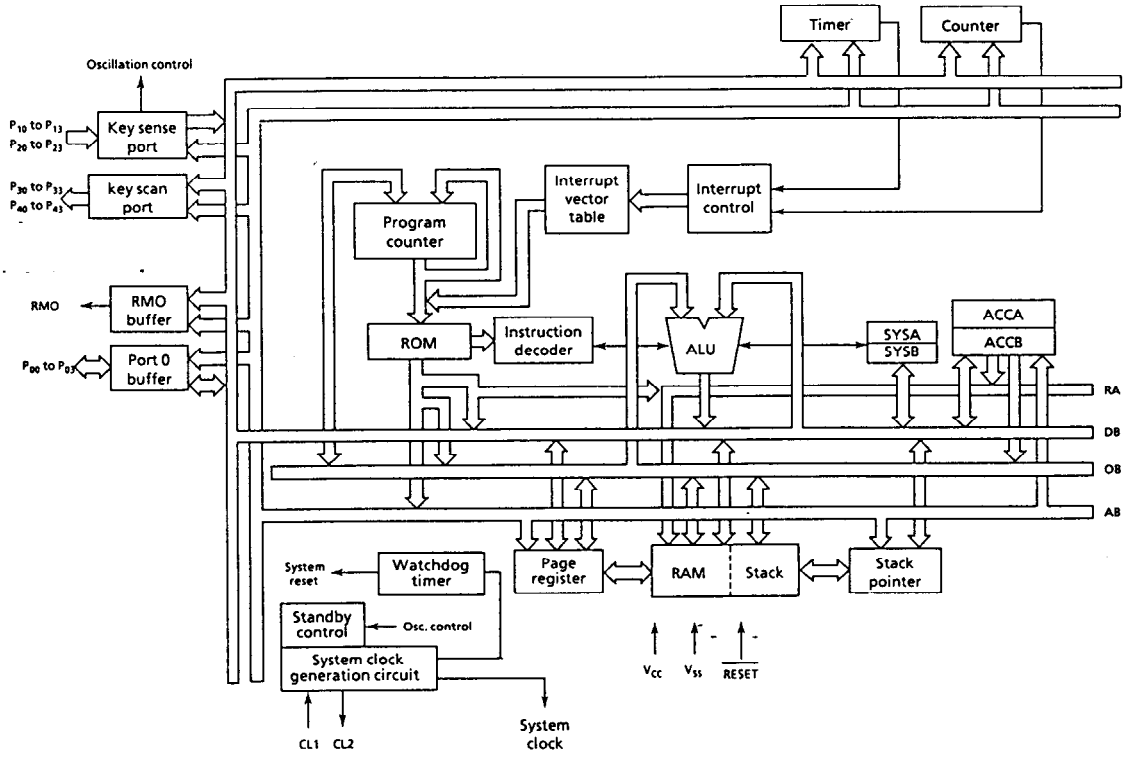


■ Terminal Functions

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
$\overline{RESET}$	Input	Reset input terminal (pull-up resistor is built in)
$\overline{TEST}$	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. Built-in pull-up resistor and Nch opendrain output are available in mask option.
P_{10} to P_{13} P_{20} to P_{23}	Input	Input ports, also used as sense input of key matrix. Standby status is released by inputting low level in standby status. Pull-up resistor is built in.
P_{30} to P_{33} P_{40} to P_{43}	Output	Output ports, also used as scan output of key matrix. Nch opendrain output is also available in mask option.

■ Block Diagram

The S-1460BF/14L60BF 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 S-1460BF	-0.3 to + 7.0	V
Power supply voltage	V_{CC}	Ta = 25°C S-14L60BF	-0.3 to + 4.0	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 S-1460BF	2.2	—	6.0	V
Power supply voltage	V_{CC}	f_{OSC} = 1 MHz S-14L60BF	1.2	—	3.6	V
Input voltage	V_{IN}		0	—	V_{CC}	V
System clock frequency	f_{OSC}	V_{CC} = 2.2 to 6.0 V (S-1460BF) V_{CC} = 1.2 to 3.6 V (S-14L60BF)	0.2	—	1.0	MHz

■ DC Electrical Characteristics

1. S-1460BF

- 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}

2. S-14L60BF
   - V_{CC} = 1.5 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	—	0.1	0.3	mA
Standby current consumption	I_{CCS}	OFF mode	—	1	10	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	-4	—	-1	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}	-30	-10	-3	μA
Low level input current 2	I_{IL2}	$\overline{RESET}$, V_{IN} = V_{SS}	-2	-0.6	-0.2	μA
Low level input current 3	I_{IL3}	$\overline{TEST}$, V_{IN} = V_{SS}	-8	-2	-0.5	μA
High level output current 1	I_{OH1}	RMO, V_{OUT} = 1.1 V	—	—	-2	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} = 1.1 V	—	—	-100	μA
Low level output current 1	I_{OL1}	RMO, V_{OUT} = 0.4 V	200	—	—	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	0.5	—	—	mA
Schmitt hysteresis width	V_{WD}		—	0.4	—	V

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

   - 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	—	0.5	1.0	mA
Standby current consumption	I_{CCS}	OFF mode	—	1	15	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	-8	—	-2	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}	-120	-50	-20	μA
Low level input current 2	I_{IL2}	$\overline{RESET}$, V_{IN} = V_{SS}	-10	-4	-1.5	μA
Low level input current 3	I_{IL3}	$\overline{TEST}$, V_{IN} = V_{SS}	-40	-16	-6	μA
High level output current 1	I_{OH1}	RMO, V_{OUT} = 2.6 V	—	—	-3	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	—	—	-200	μA
Low level output current 1	I_{OL1}	RMO, V_{OUT} = 0.4 V	400	—	—	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}

■ 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

■ Application Example (S-1460BF)