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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  $\mu$ A typ., 2.0  $\mu$ A max.
  - S-14L60BF : Running : 0.3 mA max. at 1MHz, 1.5 V operation  
Standby : 10  $\mu$ A max.
- Operating frequency : 1 MHz
- Instruction execution time : 4.0  $\mu$ s 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*

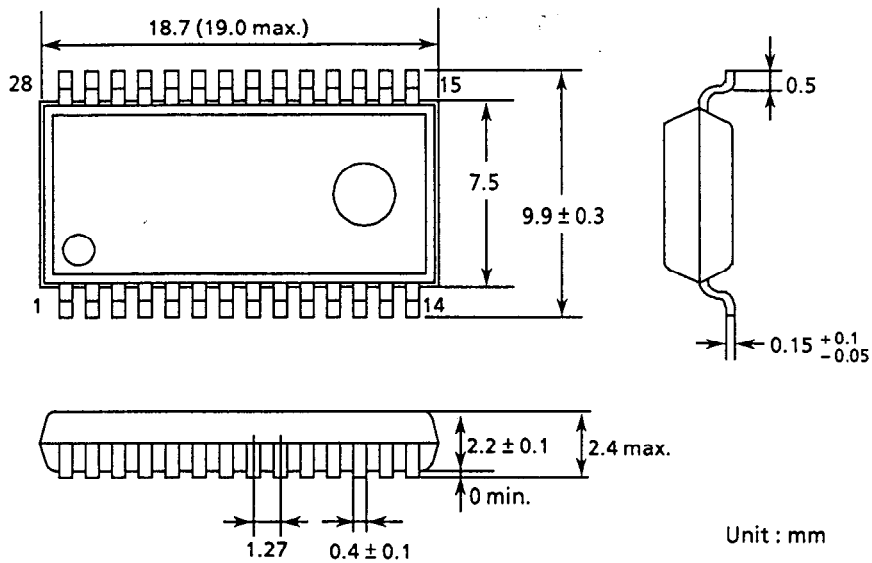
- S-1460BF : S-14P60AF
- S-14L60BF : For software evaluation, use the S-14P60AF

## ■ Applications

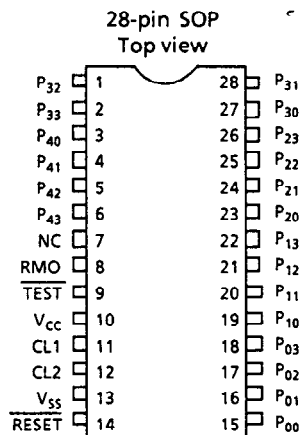
- Remote controller
- Other small-sized control equipment

# CMOS 4-bit 1-chip MICROCOMPUTER S-1460BF/14L60BF

## ■ Dimensions (28-pin SOP)



## ■ Pin Assignment

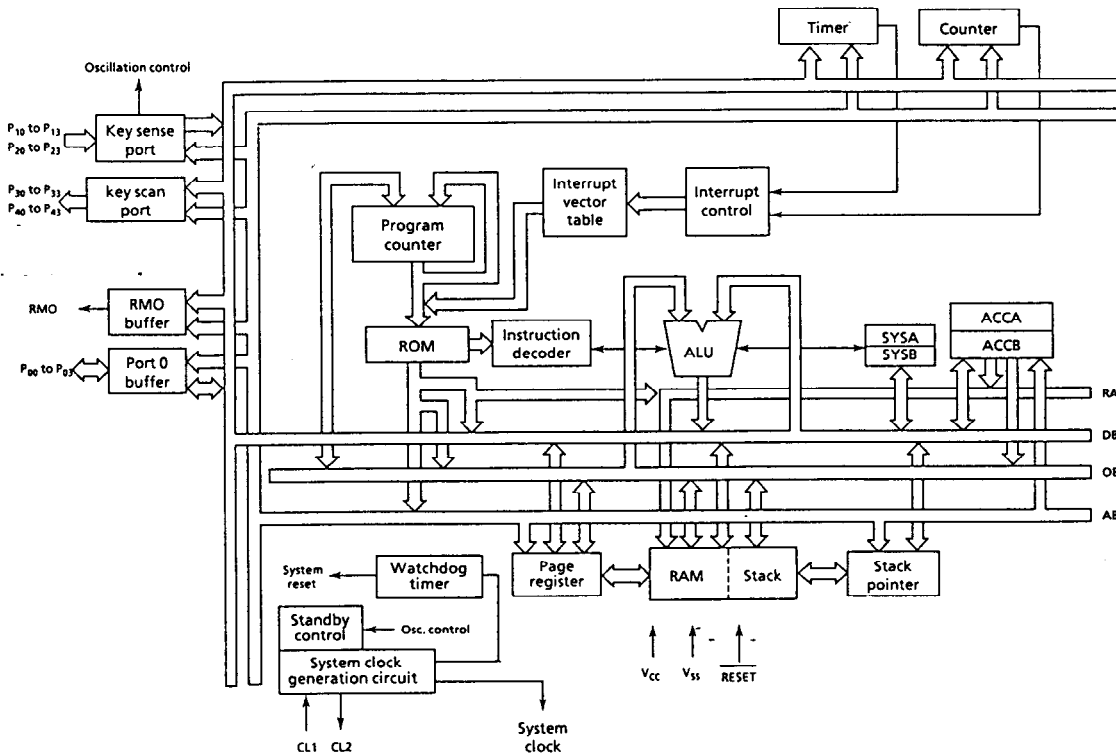


## ■ Terminal Functions

Name	I/O	Functions
V <sub>CC</sub>	—	Positive power supply
V <sub>SS</sub>	—	GND potential terminal
CL1	Input	Oscillation circuit input terminal
CL2	Output	Oscillation circuit output terminal
RESET	Input	Reset input terminal (pull-up resistor is built in)
TEST	Input	Test input terminal (pull-up resistor is built in)
RMO	Output	Remote control signal output terminal
P <sub>00</sub> to P <sub>03</sub>	I/O	I/O ports, selectable in bit unit. Built-in pull-up resistor and Nch opendrain output are available in mask option.
P <sub>10</sub> to P <sub>13</sub> P <sub>20</sub> to P <sub>23</sub>	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 <sub>30</sub> to P <sub>33</sub> P <sub>40</sub> to P <sub>43</sub>	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	$V_{CC}$	$T_a = 25^\circ\text{C}$ S-1460BF	-0.3 to +7.0	V
Power supply voltage	$V_{CC}$	$T_a = 25^\circ\text{C}$ S-14L60BF	-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

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply voltage	$V_{CC}$	$f_{osc} = 1\text{ MHz}$ S-1460BF	2.2	—	6.0	V
Power supply voltage	$V_{CC}$	$f_{osc} = 1\text{ MHz}$ 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 $6.0\text{ V}$ (S-1460BF) $V_{CC} = 1.2$ to $3.6\text{ V}$ (S-14L60BF)	0.2	—	1.0	MHz

# CMOS 4-bit 1-chip MICROCOMPUTER

## S-1460BF/14L60BF

### DC Electrical Characteristics

#### 1. S-1460BF

- $V_{CC} = 3\text{ V}$

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

Parameter	Symbol	Conditions(applicable terminals)	Min.	Typ.	Max.	Unit
Operating current consumption	$I_{CCO}$	$f_{OSC} = 1\text{ MHz}$ , no load	—	0.25	0.7	mA
Standby current consumption	$I_{CCS}$	OFF mode (When low voltage detection is used)	—	0.5	2.0	$\mu\text{A}$
Standby current consumption	$I_{CCS}$	OFF mode (When low voltage detection is not used)	—	0.1	2.0	$\mu\text{A}$
High level input voltage	$V_{IH}$		$0.8 \times V_{CC}$	—	—	V
Low level input voltage	$V_{IL}$		—	—	$0.2 \times V_{CC}$	V
High level input leakage current	$I_{LH}$	All input pins* $V_{IN} = V_{CC}$	—	—	1	$\mu\text{A}$
Low level input leakage current	$I_{LL}$	Without pull-up resistor $P_{00}$ to $P_{03}$ , $V_{IN} = V_{SS}$	-1	—	—	$\mu\text{A}$
High level input current	$I_{IH}$	$\overline{\text{RESET}}$ , $V_{IN} = V_{CC} - 0.3\text{V}$	-9	—	-0.9	$\mu\text{A}$
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	$\mu\text{A}$
Low level input current 2	$I_{IL2}$	$\overline{\text{RESET}}$ , $V_{IN} = V_{SS}$	-6	-2	-0.6	$\mu\text{A}$
Low level input current 3	$I_{IL3}$	$\overline{\text{TEST}}$ , $V_{IN} = V_{SS}$	-30	-10	-3	$\mu\text{A}$
High level output current 1	$I_{OH1}$	RMO, $V_{OUT} = 2.1\text{ V}$	—	—	-5.0	mA
High level output current 2	$I_{OH2}$	$P_{00}$ to $P_{03}$ , $P_{30}$ to $P_{33}$ , $P_{40}$ to $P_{43}$ , $V_{OUT} = 2.6\text{ V}$	—	—	-100	$\mu\text{A}$
Low level output current 1	$I_{OL1}$	RMO, $V_{OUT} = 0.4\text{ V}$	250	—	—	$\mu\text{A}$
Low level output current 2	$I_{OL2}$	$P_{00}$ to $P_{03}$ , $P_{30}$ to $P_{33}$ , $P_{40}$ to $P_{43}$ , $V_{OUT} = 0.4\text{ V}$	1.0	—	—	mA
Schmitt hysteresis width	$V_{WD}$		—	1.0	—	V

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

- $V_{CC} = 5\text{ V}$

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

Parameter	Symbol	Conditions(applicable terminals)	Min.	Typ.	Max.	Unit
Operating current consumption	$I_{CCO}$	$f_{OSC} = 1\text{ MHz}$ , no load	—	0.6	1.2	mA
Standby current consumption	$I_{CCS}$	OFF mode	—	0.1	5.0	$\mu\text{A}$
High level input voltage	$V_{IH}$		$0.8 \times V_{CC}$	—	—	V
Low level input voltage	$V_{IL}$		—	—	$0.2 \times V_{CC}$	V
High level input leakage current	$I_{LH}$	All input pins* $V_{IN} = V_{CC}$	—	—	1	$\mu\text{A}$
Low level input leakage current	$I_{LL}$	Without pull-up resistor $P_{00}$ to $P_{03}$ , $V_{IN} = V_{SS}$	-1	—	—	$\mu\text{A}$
High level input current	$I_{IH}$	$\overline{\text{RESET}}$ , $V_{IN} = V_{CC} - 0.3\text{V}$	-15	—	-1.5	$\mu\text{A}$
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	$\mu\text{A}$
Low level input current 2	$I_{IL2}$	$\overline{\text{RESET}}$ , $V_{IN} = V_{SS}$	-15	-6	-2.4	$\mu\text{A}$
Low level input current 3	$I_{IL3}$	$\overline{\text{TEST}}$ , $V_{IN} = V_{SS}$	-75	-30	-12	$\mu\text{A}$
High level output current 1	$I_{OH1}$	RMO, $V_{OUT} = 4.1\text{ V}$	—	—	-7	mA
High level output current 2	$I_{OH2}$	$P_{00}$ to $P_{03}$ , $P_{30}$ to $P_{33}$ , $P_{40}$ to $P_{43}$ , $V_{OUT} = 4.6\text{ V}$	—	—	-250	$\mu\text{A}$
Low level output current 1	$I_{OL1}$	RMO, $V_{OUT} = 0.4\text{ V}$	450	—	—	$\mu\text{A}$
Low level output current 2	$I_{OL2}$	$P_{00}$ to $P_{03}$ , $P_{30}$ to $P_{33}$ , $P_{40}$ to $P_{43}$ , $V_{OUT} = 0.4\text{ V}$	1.5	—	—	mA
Schmitt hysteresis width	$V_{WD}$		—	2.2	—	V

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

2. S-14L60BF  
•  $V_{CC} = 1.5\text{ V}$

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

Parameter	Symbol	Conditions(applicable terminals)	Min.	Typ.	Max.	Unit
Operating current consumption	$I_{CCO}$	$f_{OSC} = 1\text{ MHz}$ , no load	—	0.1	0.3	mA
Standby current consumption	$I_{CCS}$	OFF mode	—	1	10	$\mu\text{A}$
High level input voltage	$V_{IH}$		$0.8 \times V_{CC}$	—	—	V
Low level input voltage	$V_{IL}$		—	—	$0.2 \times V_{CC}$	V
High level input leakage current	$I_{LH}$	All input pins* $V_{IN} = V_{CC}$	—	—	1	$\mu\text{A}$
Low level input leakage current	$I_{LL}$	Without pull-up resistor $P_{00}$ to $P_{03}$ , $V_{IN} = V_{SS}$	-1	—	—	$\mu\text{A}$
High level input current	$I_{IH}$	RESET, $V_{IN} = V_{CC} - 0.3\text{V}$	-4	—	-1	$\mu\text{A}$
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	$\mu\text{A}$
Low level input current 2	$I_{IL2}$	RESET, $V_{IN} = V_{SS}$	-2	-0.6	-0.2	$\mu\text{A}$
Low level input current 3	$I_{IL3}$	TEST, $V_{IN} = V_{SS}$	-8	-2	-0.5	$\mu\text{A}$
High level output current 1	$I_{OH1}$	RMO, $V_{OUT} = 1.1\text{ V}$	—	—	-2	mA
High level output current 2	$I_{OH2}$	$P_{00}$ to $P_{03}$ , $P_{30}$ to $P_{33}$ , $P_{40}$ to $P_{43}$ , $V_{OUT} = 1.1\text{ V}$	—	—	-100	$\mu\text{A}$
Low level output current 1	$I_{OL1}$	RMO, $V_{OUT} = 0.4\text{ V}$	200	—	—	$\mu\text{A}$
Low level output current 2	$I_{OL2}$	$P_{00}$ to $P_{03}$ , $P_{30}$ to $P_{33}$ , $P_{40}$ to $P_{43}$ , $V_{OUT} = 0.4\text{ V}$	0.5	—	—	mA
Schmitt hysteresis width	$V_{WD}$		—	0.4	—	V

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

•  $V_{CC} = 3\text{ V}$

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

Parameter	Symbol	Conditions(applicable terminals)	Min.	Typ.	Max.	Unit
Operating current consumption	$I_{CCO}$	$f_{OSC} = 1\text{ MHz}$ , no load	—	0.5	1.0	mA
Standby current consumption	$I_{CCS}$	OFF mode	—	1	15	$\mu\text{A}$
High level input voltage	$V_{IH}$		$0.8 \times V_{CC}$	—	—	V
Low level input voltage	$V_{IL}$		—	—	$0.2 \times V_{CC}$	V
High level input leakage current	$I_{LH}$	All input pins* $V_{IN} = V_{CC}$	—	—	1	$\mu\text{A}$
Low level input leakage current	$I_{LL}$	Without pull-up resistor $P_{00}$ to $P_{03}$ , $V_{IN} = V_{SS}$	-1	—	—	$\mu\text{A}$
High level input current	$I_{IH}$	RESET, $V_{IN} = V_{CC} - 0.3\text{V}$	-8	—	-2	$\mu\text{A}$
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	$\mu\text{A}$
Low level input current 2	$I_{IL2}$	RESET, $V_{IN} = V_{SS}$	-10	-4	-1.5	$\mu\text{A}$
Low level input current 3	$I_{IL3}$	TEST, $V_{IN} = V_{SS}$	-40	-16	-6	$\mu\text{A}$
High level output current 1	$I_{OH1}$	RMO, $V_{OUT} = 2.6\text{ V}$	—	—	-3	mA
High level output current 2	$I_{OH2}$	$P_{00}$ to $P_{03}$ , $P_{30}$ to $P_{33}$ , $P_{40}$ to $P_{43}$ , $V_{OUT} = 2.6\text{ V}$	—	—	-200	$\mu\text{A}$
Low level output current 1	$I_{OL1}$	RMO, $V_{OUT} = 0.4\text{ V}$	400	—	—	$\mu\text{A}$
Low level output current 2	$I_{OL2}$	$P_{00}$ to $P_{03}$ , $P_{30}$ to $P_{33}$ , $P_{40}$ to $P_{43}$ , $V_{OUT} = 0.4\text{ V}$	1.0	—	—	mA
Schmitt hysteresis width	$V_{WD}$		—	1.0	—	V

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

# CMOS 4-bit 1-chip MICROCOMPUTER S-1460BF/14L60BF

## ■ 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)

