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S1C17001

CMOS 16-bit Single Chip Microcontroller

- ● **Low Power MCU (operating voltage 1.8 V, 0.5 μA/SLEEP, 2.5 μA/HALT)**
- ● **S1C17 High Performance 16-bit RISC CPU Core with C Optimized Compact Code and Serial ICE Support**
- ● **Infrared Remote Controller with Carrier Generator**
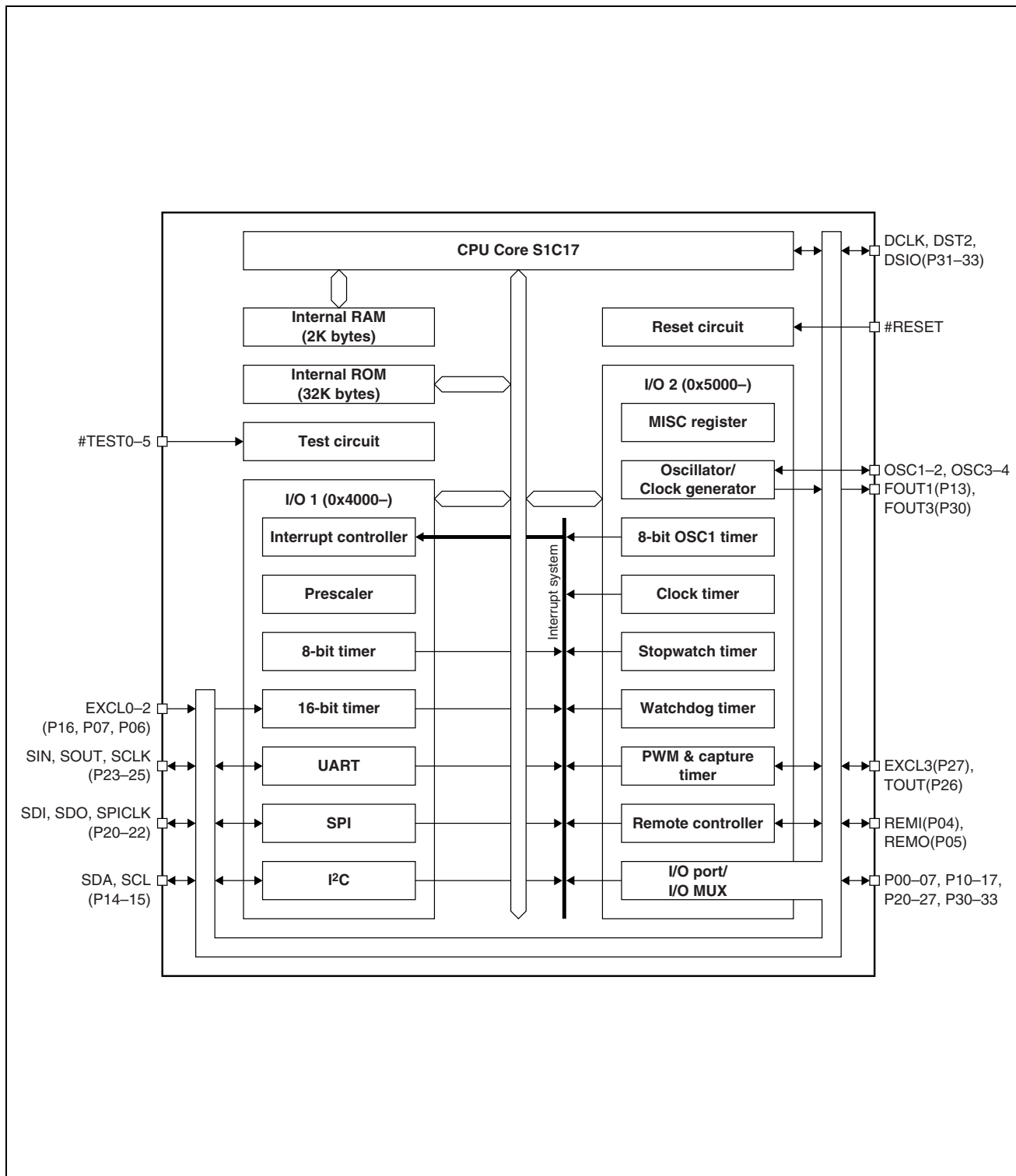- ● **32K-Byte ROM and 2K-Byte RAM**

■ DESCRIPTIONS

The S1C17001 is a 16-bit MCU that features high-speed operation, low power consumption, small size, large address space, and on-chip ICE. The S1C17001 consists of an S1C17 CPU Core, a 32K-byte ROM, a 2K-byte RAM, serial interface modules (UART that supports high bit rate and IrDA 1.0, SPI and I²C) for connecting various sensor modules, 8-bit timers, 16-bit timers, a PWM & capture timer, a clock timer, a stopwatch timer, a watchdog timer and 28 GPIO ports. The S1C17001 is capable of high-speed operation (8.2 MHz) with low operating voltage (1.8 V). Its 16-bit RISC processor executes one instruction in one clock cycle. The S1C17001 also provides an on-chip ICE function that allows on-board debugging and evaluating the program by connecting the S1C17001 to the ICD Mini (S5U1C17001H) or ICD board with only three wires.
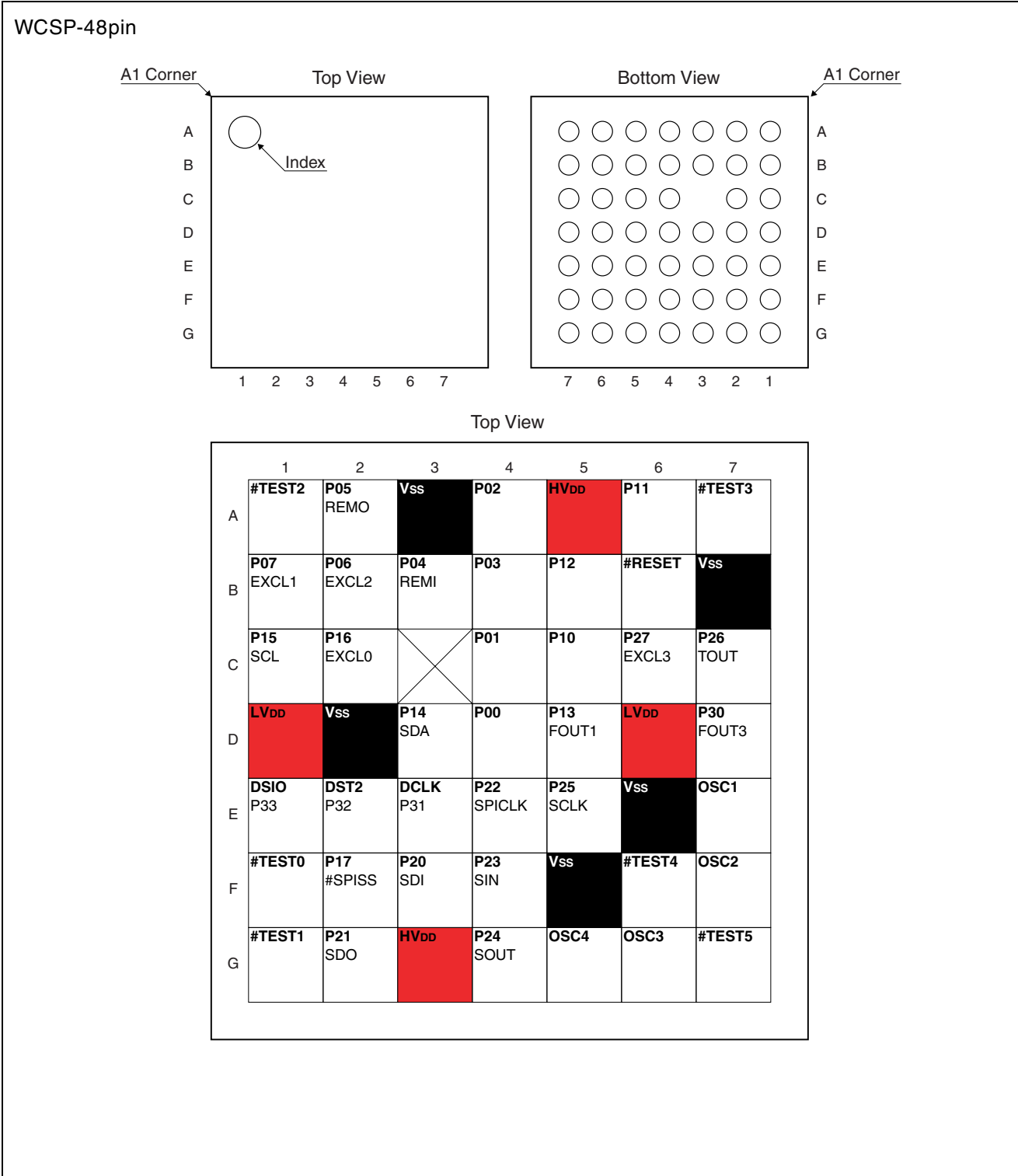
■ FEATURES

- ● CPU .... • Seiko Epson original 16-bit RISC CPU core S1C17
- ● Main (OSC3) oscillator .... • Crystal/ceramic oscillator or external clock input 8.2 MHz (max.)
- ● Sub (OSC1) oscillator.................... • Crystal oscillator or external clock input 32.768 kHz (typ.)
- ● On-chip ROM.................................. • 32K bytes
- ● On-chip RAM .... • 2K bytes
- ● I/O ports .... • Max. 28 general-purpose I/O ports (Pins are shared with the peripheral I/O.)
- ● Serial interfaces............................. • SPI (master/slave)   1 ch.
  - • I²C (master)   1 ch.
  - • UART (with IrDA 1.0)   1 ch.
  - • Remote controller (REMC)   1 ch.
- ● Timers .... • 8-bit timer (T8F)   1 ch.
  - • 16-bit timer (T16)   3 ch.
  - • PWM & capture timer (T16E)   1 ch.
  - • Clock timer (CT)   1 ch.
  - • Stopwatch timer (SWT)   1 ch.
  - • Watchdog timer (WDT)   1 ch.
  - • 8-bit OSC1 timer (T8OSC1)   1 ch.
- ● Interrupts .... • Reset
  - • NMI
  - • 14 hardware interrupts (8 levels)
- ● Power supply voltage .... • Core voltage (LV$_{DD}$)   1.65 V to 2.7 V
  - • I/O voltage (HV$_{DD}$)   1.65 V to 3.6 V
- ● Operating temperature .... • -40°C to 85°C
- ● Current consumption (typ.)........... • SLEEP state: 0.5 μA
  - • HALT state: 2.5 μA   (32 kHz)
  - • Run state: 10 μA   (32 kHz)
  -            1800 μA (8 MHz)
- ● Shipping form .... • WCSP-48pin plastic package
- ● Flash memory model for developing mask ROM code......... • S1C17704

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■ BLOCK DIAGRAM

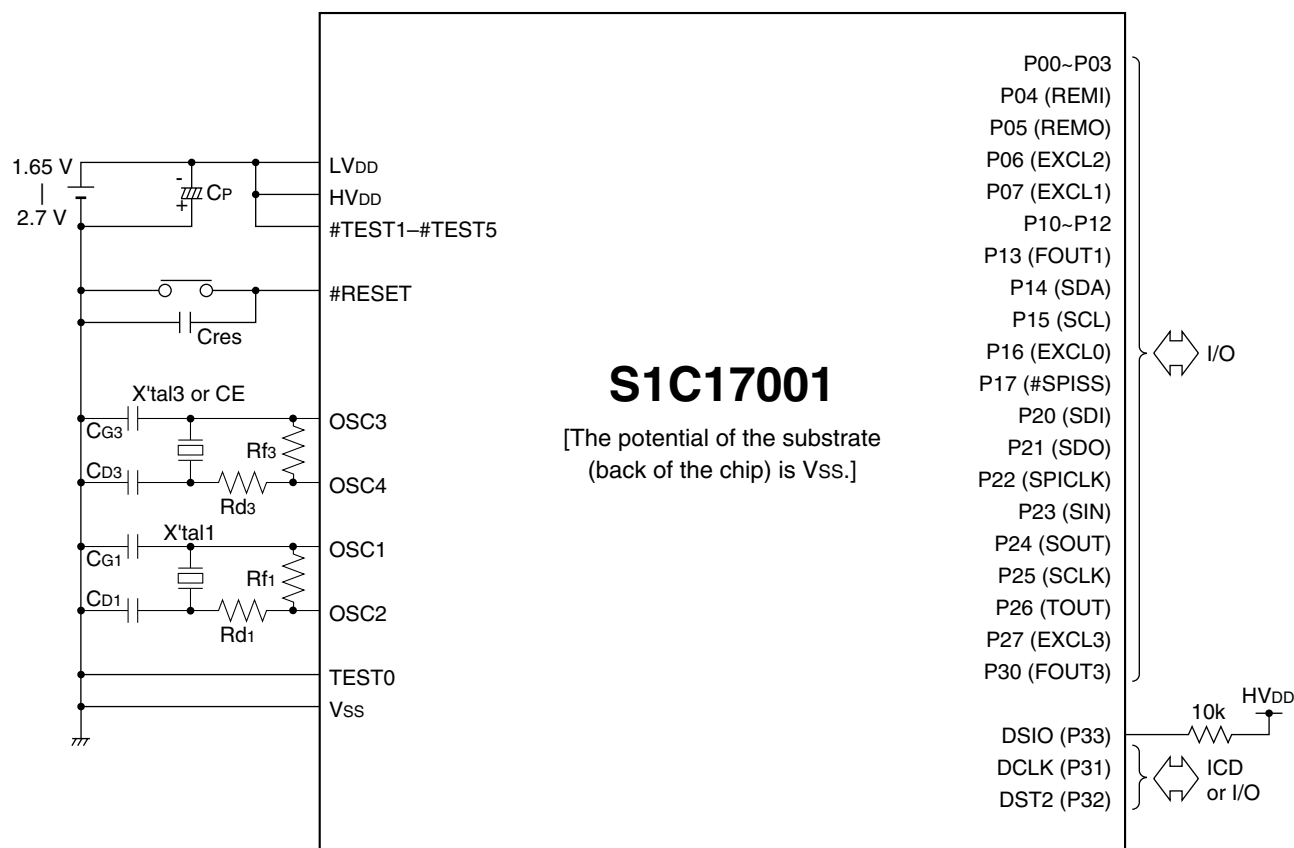|	
CPU Core S1C17	DCLK, DST2, DSIO(P31–33)

Internal RAM (2K bytes)

Reset circuit ← #RESET

Internal ROM (32K bytes)

I/O 2 (0x5000–)

MISC register

#TEST0–5 → **Test circuit**

Oscillator/ Clock generator ← OSC1–2, OSC3–4, FOUT1(P13), FOUT3(P30)

I/O 1 (0x4000–)

Interrupt controller ← **8-bit OSC1 timer**

Prescaler

Clock timer

8-bit timer → **Stopwatch timer**

EXCL0–2 (P16, P07, P06) → **16-bit timer** → **Watchdog timer**

SIN, SOUT, SCLK (P23–25) ↔ **UART** → **PWM & capture timer** ↔ EXCL3(P27), TOUT(P26)

SDI, SDO, SPICLK (P20–22) ↔ **SPI** → **Remote controller** ↔ REMI(P04), REMO(P05)

SDA, SCL (P14–15) ↔ **I²C** → **I/O port/ I/O MUX** ↔ P00–07, P10–17, P20–27, P30–33

Interrupt system

■ PIN LAYOUT DIAGRAM

WCSP-48pin

A1 Corner   Top View   Bottom View   A1 Corner

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Top View

	1	2	3	4	5	6	7
A	#TEST2	P05 REMO	Vss	P02	HVDD	P11	#TEST3
B	P07 EXCL1	P06 EXCL2	P04 REMI	P03	P12	#RESET	Vss
C	P15 SCL	P16 EXCL0		P01	P10	P27 EXCL3	P26 TOUT
D	LVDD	Vss	P14 SDA	P00	P13 FOUT1	LVDD	P30 FOUT3
E	DSIO P33	DST2 P32	DCLK P31	P22 SPICLK	P25 SCLK	Vss	OSC1
F	#TEST0	P17 #SPISS	P20 SDI	P23 SIN	Vss	#TEST4	OSC2
G	#TEST1	P21 SDO	HVDD	P24 SOUT	OSC4	OSC3	#TEST5

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■ PIN DESCRIPTION

No.	Pin name	I/O	Initial	Function
1	**Vss**	–	–	Power supply pin (GND)
2	**#TEST1**	I	I (Pull-UP)	Test pin (fix at high during normal operation)
3	**#TEST2**	I	I (Pull-UP)	Test pin (fix at high during normal operation)
4	**#TEST3**	I	I (Pull-UP)	Test pin (fix at high during normal operation)
5	**#TEST4**	I	I (Pull-UP)	Test pin (fix at high during normal operation)
6	**#TEST5**	I	I (Pull-UP)	Test pin (fix at high during normal operation)
7	**OSC3**	I	I	OSC3 oscillation input pin (external clock may be input)
8	**OSC4**	O	O	OSC3 oscillation output pin
9	**OSC1**	I	I	OSC1 oscillation input pin (external clock may be input)
10	**OSC2**	O	O	OSC1 oscillation output pin
11	**HV$_{DD}$**	–	–	Power supply pin (HV$_{DD}$+)
12	**Vss**	–	–	Power supply pin (GND)
13	**#TEST0**	I	I (Pull-UP)	Test pin (fix at high during normal operation)
14	**#RESET**	I	I (Pull-UP)	Initial reset input pin
15	**DSIO**/P33	I/O	I (Pull-UP)	On-chip debugger data I/O pin* or I/O port pin
16	**DST2**/P32	I/O	O (L)	On-chip debugger status output pin* or I/O port pin
17	**DCLK**/P31	I/O	O (H)	On-chip debugger clock output pin* or I/O port pin
18	**P30**/FOUT3	I/O	I (Pull-UP)	I/O port pin* or OSC3 divider clock output pin
19	**P27**/EXCL3	I/O	I (Pull-UP)	I/O port pin* or T16E external clock input pin
20	**P26**/TOUT	I/O	I (Pull-UP)	I/O port pin* or T16E PWM signal output pin
21	**P25**/SCLK	I/O	I (Pull-UP)	I/O port pin* or UART clock input pin
22	**P24**/SOUT	I/O	I (Pull-UP)	I/O port pin* or UART data output pin
23	**P23**/SIN	I/O	I (Pull-UP)	I/O port pin* or UART data input pin
24	**P22**/SPICLK	I/O	I (Pull-UP)	I/O port pin* or SPI clock I/O pin
25	**P21**/SDO	I/O	I (Pull-UP)	I/O port pin* or SPI data output pin
26	**P20**/SDI	I/O	I (Pull-UP)	I/O port pin* or SPI data input pin
27	**P17**/#SPISS	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or SPI slave select input pin
28	**P16**/EXCL0	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or T16 Ch.0 external clock input pin
29	**P15**/SCL	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or I^{2}C clock output pin
30	**P14**/SDA	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or I^{2}C data I/O pin
31	**P13**/FOUT1	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or OSC1 clock output pin
32	**P12**	I/O	I (Pull-UP)	I/O port pin (with interrupt)
33	**P11**	I/O	I (Pull-UP)	I/O port pin (with interrupt)
34	**P10**	I/O	I (Pull-UP)	I/O port pin (with interrupt)
35	**P07**/EXCL1	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or T16 Ch.1 external clock input pin
36	**P06**/EXCL2	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or T16 Ch.2 external clock input pin
37	**P05**/REMO	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or Remote control signal output pin
38	**P04**/REMI	I/O	I (Pull-UP)	I/O port pin (with interrupt)* or Remote control signal input pin
39	**P03**	I/O	I (Pull-UP)	I/O port pin (with interrupt)
40	**HV$_{DD}$**	–	–	Power supply pin (HV$_{DD}$+)
41	**Vss**	–	–	Power supply pin (GND)
42	**P02**	I/O	I (Pull-UP)	I/O port pin (with interrupt)
43	**P01**	I/O	I (Pull-UP)	I/O port pin (with interrupt)
44	**P00**	I/O	I (Pull-UP)	I/O port pin (with interrupt)
45	**LV$_{DD}$**	–	–	Power supply pin (LV$_{DD}$+)
46	**Vss**	–	–	Power supply pin (GND)
47	**LV$_{DD}$**	–	–	Power supply pin (LV$_{DD}$+)
48	**Vss**	–	–	Power supply pin (GND)

Note: The pin names described in boldface type and description with '*' are default settings.

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■ BASIC EXTERNAL CONNECTION DIAGRAM
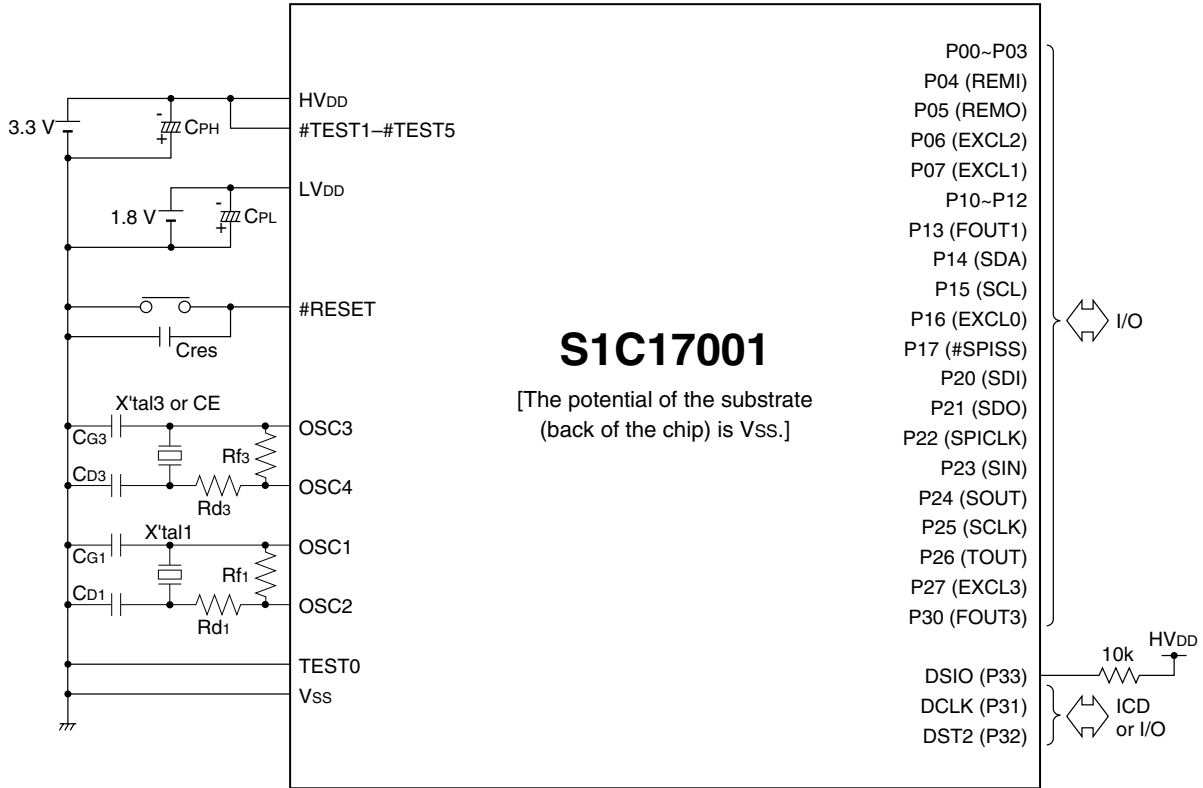
Single power supply system (LV$_{DD}$ = HV$_{DD}$)

Recommended values for external parts

Symbol	Name	Recommended value
X'tal1	Crystal oscillator	32.768 kHz (MC-146, EPSON TOYOCOM)
C$_{G1}$	Gate capacitor	7 pF
C$_{D1}$	Drain capacitor	7 pF
Rf$_1$	Feedback resistor	10 MΩ
Rd$_1$	Drain resistor	0 Ω
X'tal3	Crystal oscillator	8 MHz (CA-301, EPSON TOYOCOM)
CE	Ceramic oscillator	0.2–8 MHz
C$_{G3}$	Gate capacitor	27 pF
C$_{D3}$	Drain capacitor	27 pF
Rf$_3$	Feedback resistor	1 MΩ
Rd$_3$	Drain resistor	0 Ω
C$_P$	Capacitor for power supply	3.3 µF
Cres	Capacitor for #RESET pin	0.47 µF

Note: The above table is simply an example, and is not guaranteed to work.

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Dual-power supply system (LV$_{DD}$ ≠ HV$_{DD}$)

HV$_{DD}$
3.3 V   C$_{PH}$
#TEST1–#TEST5
LV$_{DD}$
1.8 V   C$_{PL}$

#RESET
Cres

X'tal3 or CE
C$_{G3}$ Rf$_3$ OSC3
C$_{D3}$ Rd$_3$ OSC4

X'tal1
C$_{G1}$ Rf$_1$ OSC1
C$_{D1}$ Rd$_1$ OSC2

TEST0
V$_{SS}$

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[The potential of the substrate
(back of the chip) is V$_{SS}$.]

P00~P03
P04 (REMI)
P05 (REMO)
P06 (EXCL2)
P07 (EXCL1)
P10~P12
P13 (FOUT1)
P14 (SDA)
P15 (SCL)
P16 (EXCL0)
P17 (#SPISS)
P20 (SDI)
P21 (SDO)
P22 (SPICLK)
P23 (SIN)
P24 (SOUT)
P25 (SCLK)
P26 (TOUT)
P27 (EXCL3)
P30 (FOUT3)
} I/O

HV$_{DD}$
10k
DSIO (P33)
DCLK (P31) } ICD
DST2 (P32) or I/O

Recommended values for external parts

Symbol	Name	Recommended value
X'tal1	Crystal oscillator	32.768 kHz (MC-146, EPSON TOYOCOM)
C$_{G1}$	Gate capacitor	7 pF
C$_{D1}$	Drain capacitor	7 pF
Rf$_1$	Feedback resistor	10 MΩ
Rd$_1$	Drain resistor	0 Ω
X'tal3	Crystal oscillator	8 MHz (CA-301, EPSON TOYOCOM)
CE	Ceramic oscillator	0.2–8 MHz
C$_{G3}$	Gate capacitor	27 pF
C$_{D3}$	Drain capacitor	27 pF
Rf$_3$	Feedback resistor	1 MΩ
Rd$_3$	Drain resistor	0 Ω
C$_P$	Capacitor for power supply	3.3 µF
Cres	Capacitor for #RESET pin	0.47 µF

Note: The above table is simply an example, and is not guaranteed to work.