

## CMOS 16-bit Single Chip Microcontroller

- Low Power MCU (operating voltage 1.8 V, 1  $\mu$ A/SLEEP, 2.6  $\mu$ A/HALT)
- S1C17 High Performance 16-bit RISC CPU Core with C Optimized Compact Code and Serial ICE Support
- High Quality and Stable Display LCD Driver with Voltage Booster (56 SEG  $\times$  32 COM, supports grayscale)
- Infrared Remote Controller with Carrier Generator
- 64K-Byte Flash Memory and 4K-Byte RAM

### ■ DESCRIPTIONS

The S1C17701 is a 16-bit MCU that features high-speed operation, low power consumption, small size, large address space, and on-chip ICE. The S1C17701 consists of an S1C17 CPU Core, a 64K-byte Flash memory, a 4K-byte RAM, serial interface modules (UART that supports high bit rate and IrDA 1.0, SPI and I<sup>2</sup>C) for connecting various sensor modules, 8-bit timers, 16-bit timers, a PWM & capture timer, a clock timer, a stopwatch timer, a watchdog timer, 28 GPIO ports, an LCD driver with 56-segment  $\times$  32-common outputs and a voltage booster, a supply voltage detector, 32 kHz (typ.) and 8.2 MHz (max.) oscillators, and a voltage regulator for generating the 1.8 V internal voltage. The S1C17701 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 1.5 clock cycles. The S1C17701 also provides an on-chip ICE function that allows on-board erasing/programming of the embedded Flash memory, on-board debugging and evaluating the program by connecting the S1C17701 to the serial ICD Mini (S5U1C17001H) with only three wires.

The S1C17701 is suitable for battery driven applications with sensor interfaces and up to 56  $\times$  32-dot LCD display, such as remote controllers and sports watches.

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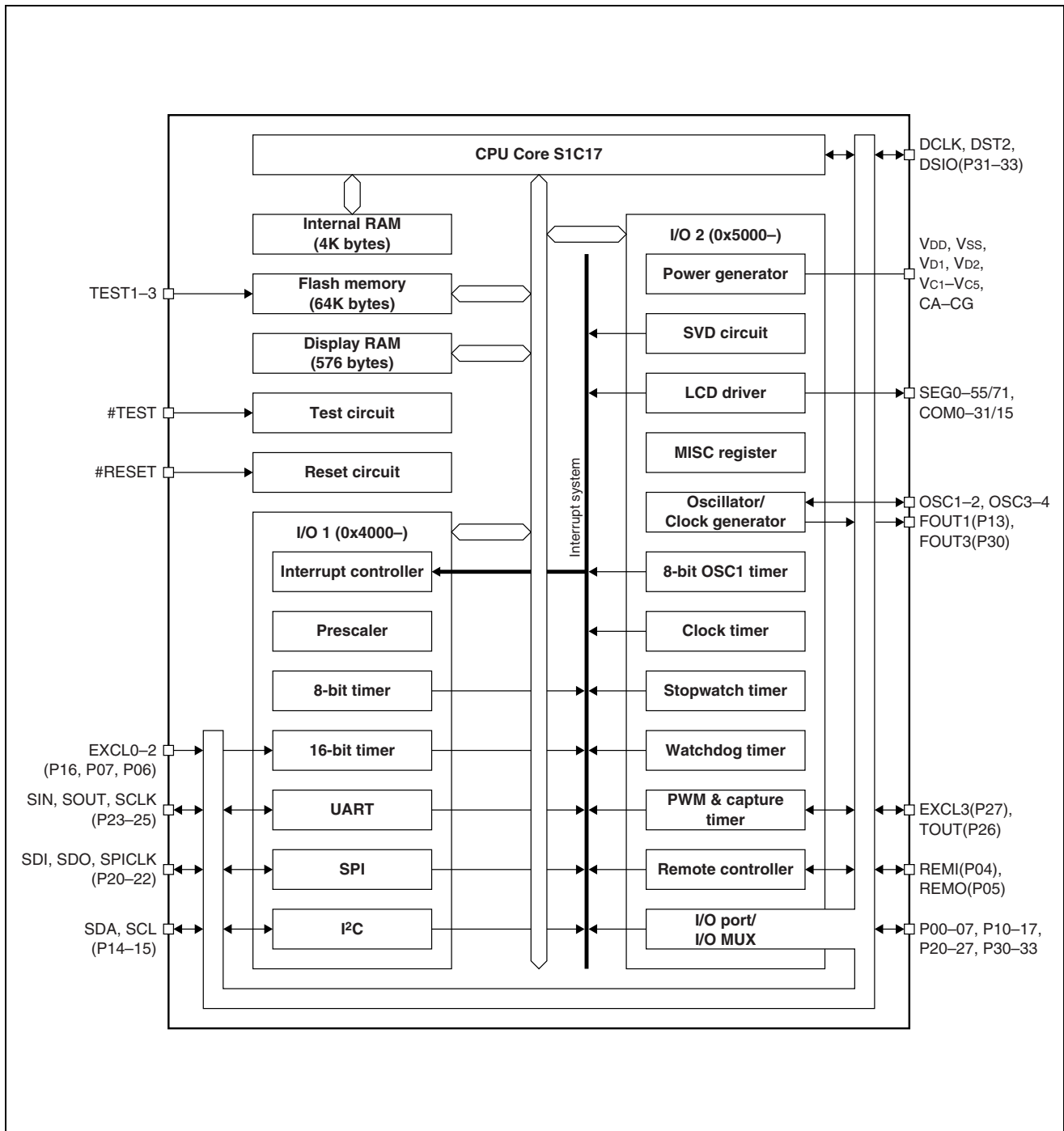
### ■ FEATURES

- CPU ..... • Seiko Epson original 16-bit RISC CPU core S1C17
- Main (OSC3) oscillator ..... • Crystal/ceramic oscillator 8.2 MHz (max.) or CR oscillator 2.2 MHz (max.)
- Sub (OSC1) oscillator..... • Crystal oscillator 32.768 kHz (typ.)
- On-chip Flash memory ..... • 64K bytes (for instructions and data)
  - 1,000 erase/program cycles
  - Read/program protection
  - On-board programming by a debugging tool such as ICD Mini (S5U1C17701H) and self-programming by software control
- On-chip RAM ..... • 4K bytes
- On-chip display RAM..... • 576 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.
  - I<sup>2</sup>C (master) 1 ch.
  - UART (115200 bps, 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.
- LCD driver..... • 56 SEG  $\times$  32 COM or 72 SEG  $\times$  16 COM (1/5 bias)
  - Built-in voltage booster
- Supply voltage detector (SVD)..... • 13 programmable detection levels (1.8 V to 2.7 V)
- Interrupts ..... • Reset
  - NMI
  - 16 programmable interrupts (8 levels)

# S1C17701

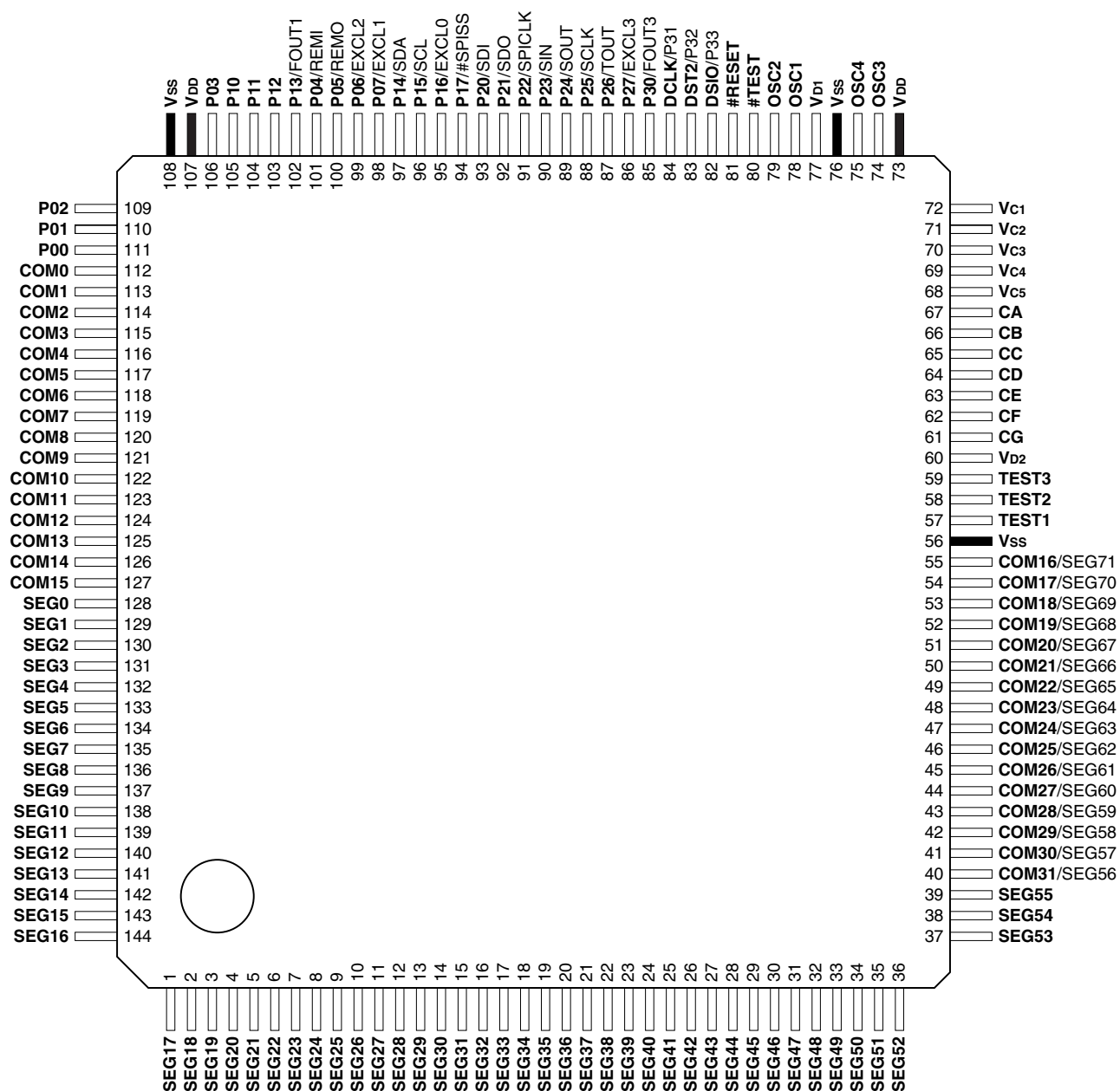
- Power supply voltage.....
  - 1.8 V to 3.6 V (for normal (low-power) operation with the 1.8 V internal voltage)
  - 2.7 V to 3.6 V (for Flash erasing/programming with the 2.5 V internal voltage)
- Operating temperature..... -20°C to 70°C
- Current consumption (typ.) .....
  - SLEEP state: 1  $\mu$ A
  - HALT state: 2.6  $\mu$ A (32 kHz OSC1 crystal oscillator, LCD off)
  - Run state: 14  $\mu$ A (32 kHz OSC1 crystal oscillator, LCD off)
  - 1800  $\mu$ A (8 MHz OSC3 ceramic oscillator, LCD off)
- Shipping form.....
  - TQFP24-144pin plastic package (16 mm  $\times$  16 mm  $\times$  1.0 mm, lead pitch: 0.4 mm)
  - Chip

## ■ BLOCK DIAGRAM



## PIN LAYOUT DIAGRAM

TQFP24-144pin



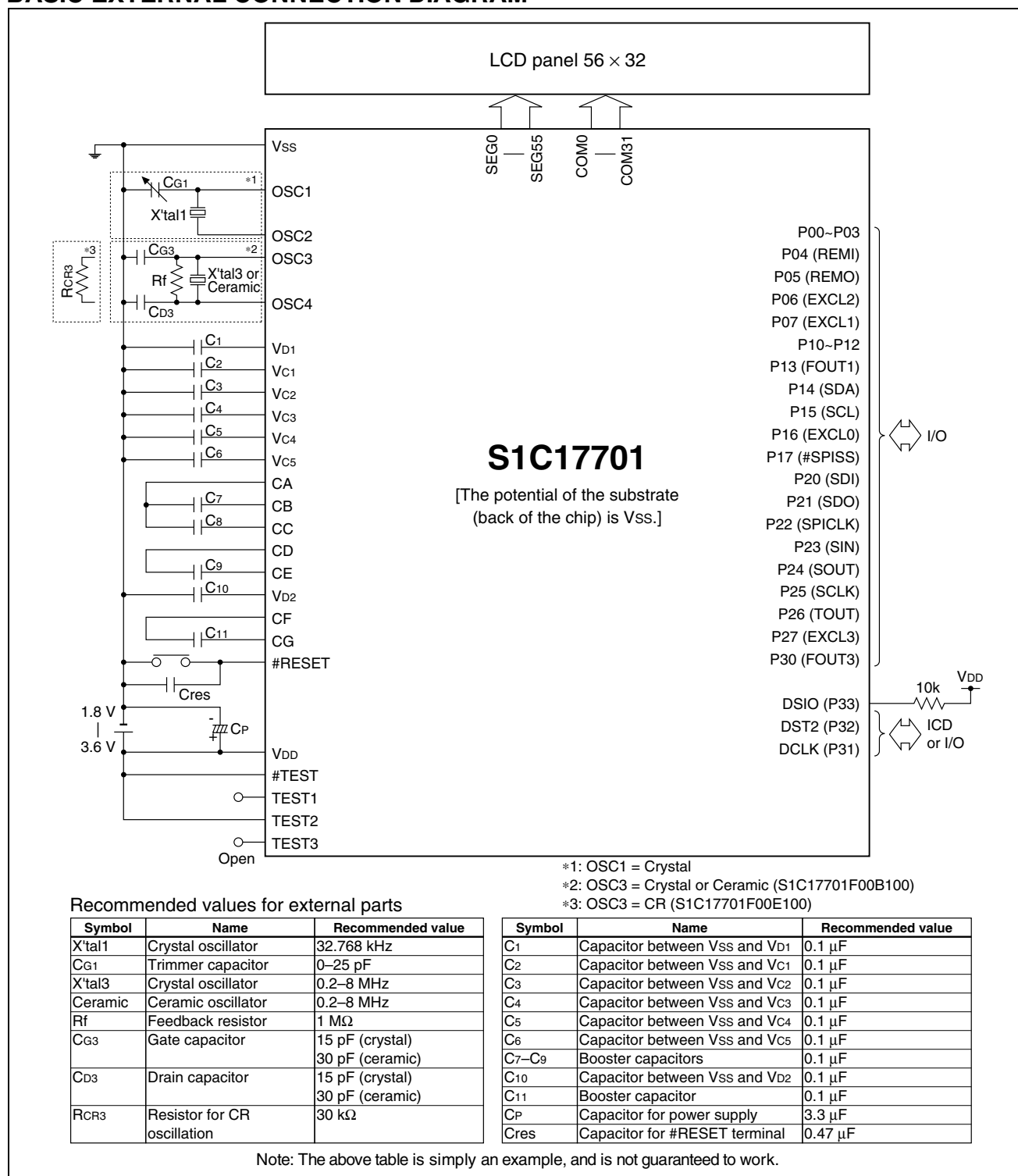
## ■ PIN DESCRIPTION

| Pin No. | Pin name                      | I/O | Initial     | Function                                                            |
|---------|-------------------------------|-----|-------------|---------------------------------------------------------------------|
| 1–39    | <b>SEG17–55</b>               | O   | O (L)       | LCD segment output pins                                             |
| 40–55   | <b>COM31–16/<br/>SEG56–71</b> | O   | O (L)       | LCD common output pins* or LCD segment output pins                  |
| 56      | <b>Vss</b>                    | –   | –           | Power supply pin (GND)                                              |
| 57      | <b>TEST1</b>                  | –   | –           | Test pin (open during normal operation)                             |
| 58      | <b>TEST2</b>                  | –   | –           | Test pin (fix at high during normal operation)                      |
| 59      | <b>TEST3</b>                  | –   | –           | Test pin (open during normal operation)                             |
| 60      | <b>Vb2</b>                    | –   | –           | LCD power voltage booster output pin                                |
| 61      | <b>CG</b>                     | –   | –           | Power voltage boosting capacitor connect pin                        |
| 62      | <b>CF</b>                     | –   | –           | Power voltage boosting capacitor connect pin                        |
| 63      | <b>CE</b>                     | –   | –           | LCD voltage boosting capacitor connect pin                          |
| 64      | <b>CD</b>                     | –   | –           | LCD voltage boosting capacitor connect pin                          |
| 65      | <b>CC</b>                     | –   | –           | LCD voltage boosting capacitor connect pin                          |
| 66      | <b>CB</b>                     | –   | –           | LCD voltage boosting capacitor connect pin                          |
| 67      | <b>CA</b>                     | –   | –           | LCD voltage boosting capacitor connect pin                          |
| 68      | <b>Vc5</b>                    | –   | –           | LCD drive voltage output pin                                        |
| 69      | <b>Vc4</b>                    | –   | –           | LCD drive voltage output pin                                        |
| 70      | <b>Vc3</b>                    | –   | –           | LCD drive voltage output pin                                        |
| 71      | <b>Vc2</b>                    | –   | –           | LCD drive voltage output pin                                        |
| 72      | <b>Vc1</b>                    | –   | –           | LCD drive voltage output pin                                        |
| 73      | <b>Vdd</b>                    | –   | –           | Power supply pin (+)                                                |
| 74      | <b>OSC3</b>                   | I   | I           | OSC3 oscillation input pin                                          |
| 75      | <b>OSC4</b>                   | O   | O           | OSC3 oscillation output pin                                         |
| 76      | <b>Vss</b>                    | –   | –           | Power supply pin (GND)                                              |
| 77      | <b>Vd1</b>                    | –   | –           | Internal logic and oscillation system voltage regulator output pin  |
| 78      | <b>OSC1</b>                   | I   | I           | OSC1 oscillation input pin                                          |
| 79      | <b>OSC2</b>                   | O   | O           | OSC1 oscillation output pin                                         |
| 80      | <b>#TEST</b>                  | I   | I (Pull-up) | Test pin (fix at high during normal operation)                      |
| 81      | <b>#RESET</b>                 | I   | I (Pull-up) | Initial reset input pin                                             |
| 82      | <b>DSIO/P33</b>               | I/O | I (Pull-up) | On-chip debugger data I/O pin* or I/O port pin                      |
| 83      | <b>DST2/P32</b>               | I/O | O (L)       | On-chip debugger status output pin* or I/O port pin                 |
| 84      | <b>DCLK/P31</b>               | I/O | O (L)       | On-chip debugger clock output pin* or I/O port pin                  |
| 85      | <b>P30/FOUT3</b>              | I/O | I (Pull-up) | I/O port pin* or OSC3 divider clock output pin                      |
| 86      | <b>P27/EXCL3</b>              | I/O | I (Pull-up) | I/O port pin* or T16E external clock input pin                      |
| 87      | <b>P26/TOUT</b>               | I/O | I (Pull-up) | I/O port pin* or T16E PWM signal output pin                         |
| 88      | <b>P25/SCLK</b>               | I/O | I (Pull-up) | I/O port pin* or UART clock input pin                               |
| 89      | <b>P24/SOUT</b>               | I/O | I (Pull-up) | I/O port pin* or UART data output pin                               |
| 90      | <b>P23/SIN</b>                | I/O | I (Pull-up) | I/O port pin* or UART data input pin                                |
| 91      | <b>P22/SPICLK</b>             | I/O | I (Pull-up) | I/O port pin* or SPI clock I/O pin                                  |
| 92      | <b>P21/SDO</b>                | I/O | I (Pull-up) | I/O port pin* or SPI data output pin                                |
| 93      | <b>P20/SDI</b>                | I/O | I (Pull-up) | I/O port pin* or SPI data input pin                                 |
| 94      | <b>P17/#SPISS</b>             | I/O | I (Pull-up) | I/O port pin (with interrupt)* or SPI slave select input pin        |
| 95      | <b>P16/EXCL0</b>              | I/O | I (Pull-up) | I/O port pin (with interrupt)* or T16 Ch.0 external clock input pin |
| 96      | <b>P15/SCL</b>                | I/O | I (Pull-up) | I/O port pin (with interrupt)* or I <sup>2</sup> C clock output pin |
| 97      | <b>P14/SDA</b>                | I/O | I (Pull-up) | I/O port pin (with interrupt)* or I <sup>2</sup> C data I/O pin     |
| 98      | <b>P07/EXCL1</b>              | I/O | I (Pull-up) | I/O port pin (with interrupt)* or T16 Ch.1 external clock input pin |
| 99      | <b>P06/EXCL2</b>              | I/O | I (Pull-up) | I/O port pin (with interrupt)* or T16 Ch.2 external clock input pin |
| 100     | <b>P05/REMO</b>               | I/O | I (Pull-up) | I/O port pin (with interrupt)* or Remote control signal output pin  |
| 101     | <b>P04/REMI</b>               | I/O | I (Pull-up) | I/O port pin (with interrupt)* or Remote control signal input pin   |
| 102     | <b>P13/FOUT1</b>              | I/O | I (Pull-up) | I/O port pin (with interrupt)* or OSC1 clock output pin             |
| 103     | <b>P12</b>                    | I/O | I (Pull-up) | I/O port pin (with interrupt)                                       |
| 104     | <b>P11</b>                    | I/O | I (Pull-up) | I/O port pin (with interrupt)                                       |
| 105     | <b>P10</b>                    | I/O | I (Pull-up) | I/O port pin (with interrupt)                                       |
| 106     | <b>P03</b>                    | I/O | I (Pull-up) | I/O port pin (with interrupt)                                       |
| 107     | <b>Vdd</b>                    | –   | –           | Power supply pin (+)                                                |
| 108     | <b>Vss</b>                    | –   | –           | Power supply pin (GND)                                              |

| Pin No. | Pin name       | I/O | Initial     | Function                      |
|---------|----------------|-----|-------------|-------------------------------|
| 109     | <b>P02</b>     | I/O | I (Pull-up) | I/O port pin (with interrupt) |
| 110     | <b>P01</b>     | I/O | I (Pull-up) | I/O port pin (with interrupt) |
| 111     | <b>P00</b>     | I/O | I (Pull-up) | I/O port pin (with interrupt) |
| 112–127 | <b>COM0–15</b> | O   | O (L)       | LCD common output pins        |
| 128–144 | <b>SEG0–16</b> | O   | O (L)       | LCD segment output pins       |

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

## BASIC EXTERNAL CONNECTION DIAGRAM



# S1C17701

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