

S2D13515 Display Controller

**S5U13515P00C100**  
**Evaluation Board User**  
**Manual**

## NOTICE

---

No part of this material may be reproduced or duplicated in any form or by any means without the written permission of Seiko Epson. Seiko Epson reserves the right to make changes to this material without notice. Seiko Epson does not assume any liability of any kind arising out of any inaccuracies contained in this material or due to its application or use in any product or circuit and, further, there is no representation that this material is applicable to products requiring high level reliability, such as, medical products. Moreover, no license to any intellectual property rights is granted by implication or otherwise, and there is no representation or warranty that anything made in accordance with this material will be free from any patent or copyright infringement of a third party. This material or portions thereof may contain technology or the subject relating to strategic products under the control of the Foreign Exchange and Foreign Trade Law of Japan and may require an export license from the Ministry of International Trade and Industry or other approval from another government agency.

All other product names mentioned herein are trademarks and/or registered trademarks of their respective companies.

©SEIKO EPSON CORPORATION 2008 - 2009, All rights reserved.

---

# Table of Contents

|                                                                 |           |
|-----------------------------------------------------------------|-----------|
| <b>Chapter 1 Introduction</b>                                   | <b>5</b>  |
| <b>Chapter 2 Features</b>                                       | <b>6</b>  |
| <b>Chapter 3 Installation and Configuration</b>                 | <b>7</b>  |
| 3.1 CNF[7:0] Configuration Inputs                               | 7         |
| 3.1.1 CNF[2:0]                                                  | 7         |
| 3.1.2 CNF[7:3]                                                  | 8         |
| 3.1.3 Host Interface Configuration                              | 9         |
| 3.2 Configuration Jumpers                                       | 10        |
| <b>Chapter 4 Technical Description</b>                          | <b>15</b> |
| 4.1 Power                                                       | 15        |
| 4.1.1 Power Requirements                                        | 15        |
| 4.1.2 Voltage Regulators                                        | 15        |
| 4.1.3 S2D13515 Power                                            | 15        |
| 4.1.4 LCD Backlight Power                                       | 15        |
| 4.2 Clocks                                                      | 16        |
| 4.3 Reset                                                       | 16        |
| 4.4 Memory                                                      | 17        |
| 4.4.1 SDRAM                                                     | 17        |
| 4.4.2 Serial Flash Memory with SPI interface                    | 17        |
| 4.5 Host Interface                                              | 17        |
| 4.5.1 Direct Host Bus Interface Support                         | 17        |
| 4.5.2 Connecting to the Epson S5U13U00P00C100 USB Adapter Board | 18        |
| 4.6 LCD Interface                                               | 19        |
| 4.6.1 FP1IO Interface                                           | 19        |
| 4.6.2 FP2IO Interface                                           | 19        |
| 4.7 Camera / I2C Interface                                      | 20        |
| 4.8 Keypad Interface                                            | 21        |
| 4.9 I2S Interface                                               | 22        |
| 4.10 PWM Connector                                              | 23        |
| 4.11 C33 Debugger Port                                          | 24        |
| 4.12 JTAG Interface                                             | 25        |
| <b>Chapter 5 Parts List</b>                                     | <b>26</b> |
| <b>Chapter 6 Schematic Diagrams</b>                             | <b>29</b> |
| <b>Chapter 7 Board Layout</b>                                   | <b>34</b> |

---

|                             |            |
|-----------------------------|------------|
| <b>Chapter 8 References</b> | <b>.36</b> |
| 8.1 Documents               | .36        |
| 8.2 Document Sources        | .36        |

# Chapter 1 Introduction

This manual describes the setup and operation of the S5U13515P00C100 Evaluation Board. The evaluation board is designed as an evaluation platform for the S2D13515 Display Controller.

The S5U13515P00C100 evaluation board can be used with many native platforms via the host connector which provides the appropriate signals to support a variety of CPUs. The S5U13515P00C100 evaluation board can also connect to the S5U13U00P00C100 USB Adapter board so that it can be used with a laptop or desktop computer, via USB 2.0.

This user manual is updated as appropriate. Please check the Epson Research and Development Website at [www.erd.epson.com](http://www.erd.epson.com) for the latest revision of this document before beginning any development.

We appreciate your comments on our documentation. Please contact us via email at [documentation@erd.epson.com](mailto:documentation@erd.epson.com).

## Chapter 2 Features

The S5U13515P00C100 Evaluation Board includes the following features:

- 256-pin PBGA S2D13515 Display Controller
- On-board SDRAM, configurable as 32MB (32-bit wide) or 16MB (16-bit wide)
- On-board Serial Flash Memory, 32Mbit
- Headers for connection to various Host Bus Interfaces (includes all S2D13515 Host Bus Interface signals)
- Headers for connection to the S5U13U00P00C100 USB Adapter board
- Headers for connection to various LCD panels (includes all S2D13515 FP1IO and FP2IO interface signals)
- Header for connection to cameras
- Header for I2S outputs
- On-board 3x3 keypad
- On-board 20MHz crystal
- 14-pin DIP socket (if an oscillator for CLKI input is required)
- 3.3V input power
- On-board voltage regulator with 1.8V output
- On-board voltage regulator with adjustable 12~25V output, 60~100mA max., to provide power for LED back-light of LCD panels.

# Chapter 3 Installation and Configuration

The S5U13515P00C100 evaluation board incorporates a DIP switch, jumpers, and 0 ohm resistors which allow it to be used with a variety of different configurations.

## 3.1 CNF[7:0] Configuration Inputs

The S2D13515 has 8 configuration inputs (CNF[7:0]), which can be configured through a combination of a DIP switch and 0 ohm resistors. CNF[2:0] are dedicated inputs and are configured using DIP switch SW1. CNF[7:3] are multiplexed with some host interface signals and are configured by 0 ohm resistors.

### 3.1.1 CNF[2:0]

CNF[2:0] are configured using DIP switch SW1 as described below.

Table 3-1: CNF[2:0] Configuration Settings

| CNF[2:0] | 1 (connected to HIOVDD)                                                                                                                                                                                         | 0 (connected to VSS)                 |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| CNF2     | CNF[2:1] are used in combination with CNF[7:3] to select the host bus interface. For a summary of the possible host bus interfaces, see Section Table 3-3 :, "Host Interface Configuration Settings" on page 9. |                                      |
| CNF1     |                                                                                                                                                                                                                 |                                      |
| CNF0     | OSCI is the source for Input Clock 1                                                                                                                                                                            | CLKI is the source for Input Clock 1 |

  = suggested settings

The following figure shows the location of DIP switch SW1 on the S5U13515P00C100 evaluation board.

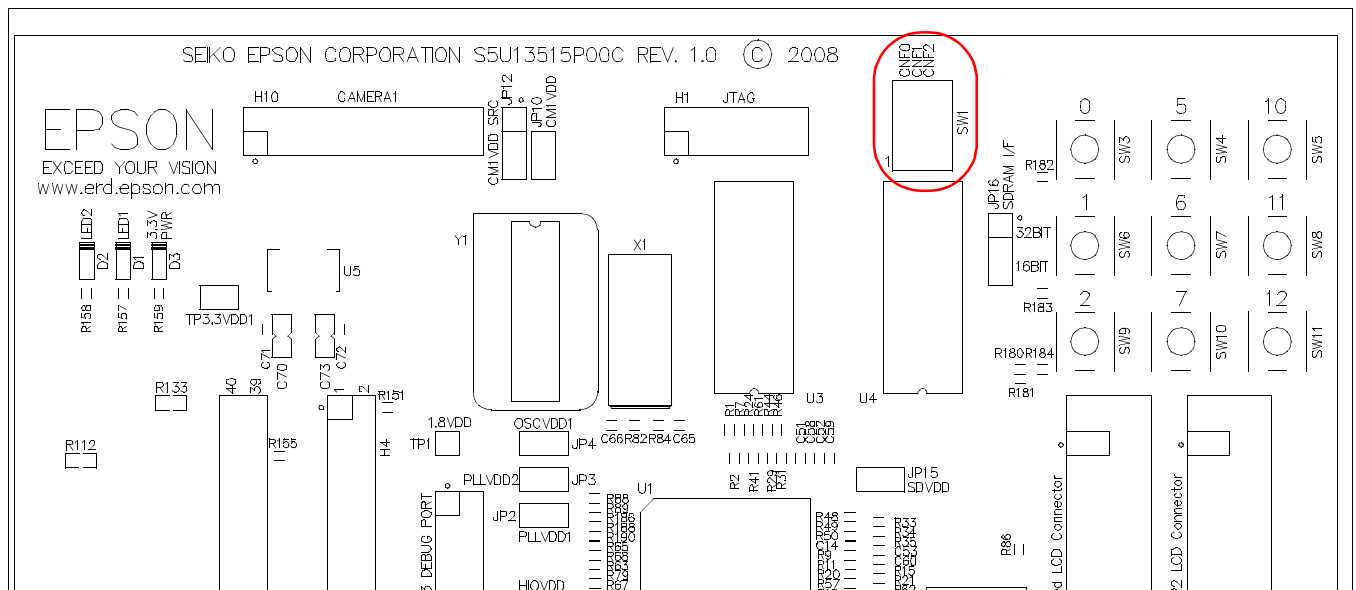


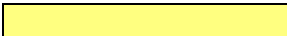
Figure 3-1: Configuration DIP Switch (SW1) Location

### 3.1.2 CNF[7:3]

CNF[7:3] are configured using 0 Ohm resistors as described below.

Table 3-2: CNF[7:3] Configuration Settings

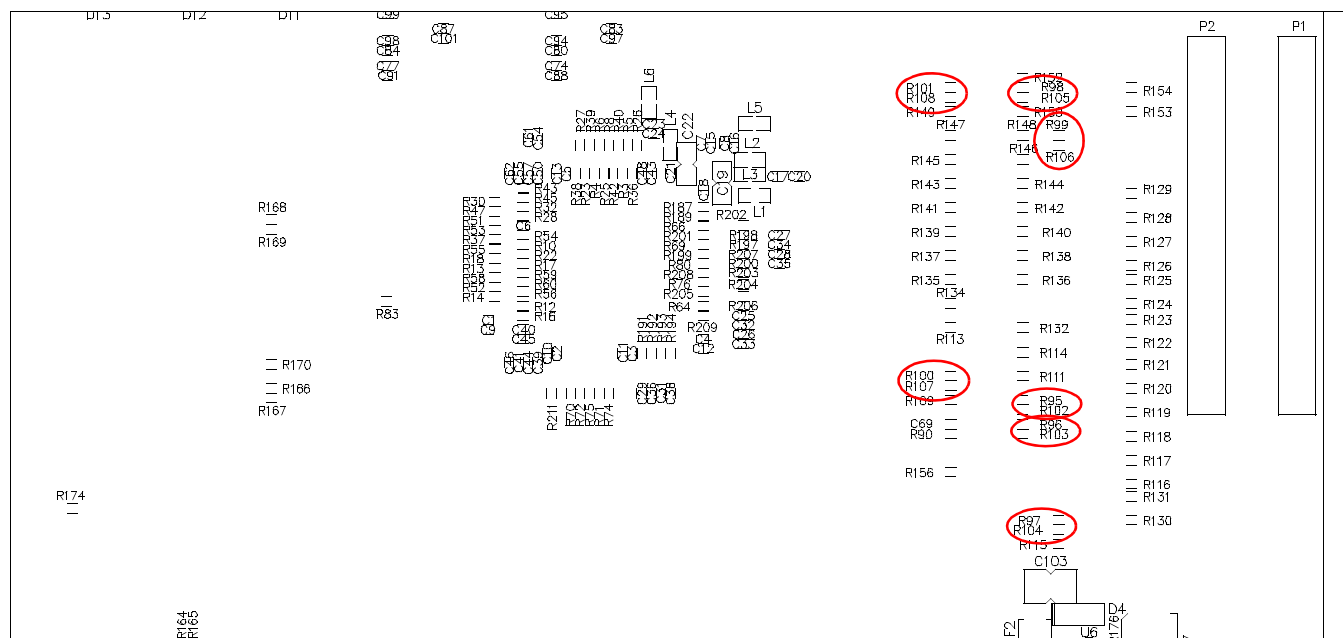
| CNF                | Pin    | 1 (connected to HIOVDD)              | 0 (connected to VSS)                 |
|--------------------|--------|--------------------------------------|--------------------------------------|
| CNF3<br>(see Note) | TEA#   | R100 populated<br>R107 not populated | R100 not populated<br>R107 populated |
|                    | AB0    | R99 populated<br>R106 not populated  | R99 not populated<br>R106 populated  |
| CNF4               | BDIP#  | R95 populated<br>R102 not populated  | R95 not populated<br>R102 populated  |
| CNF5               | BURST# | R96 populated<br>R103 not populated  | R96 not populated<br>R103 populated  |
| CNF6<br>(see Note) | AB3    | R98 populated<br>R105 not populated  | R98 not populated<br>R105 populated  |
|                    | BE1#   | R97 populated<br>R104 not populated  | R97 not populated<br>R104 populated  |
|                    | AB0    | R99 populated<br>R106 not populated  | R99 not populated<br>R106 populated  |
| CNF7               | AB4    | R101 populated<br>R108 not populated | R101 not populated<br>R108 populated |

 = default settings, required settings when using S5U13U00P00C100 USB Adapter Board

#### Note

CNF3 and CNF6 are mapped to different pins depending on the combination of the other CNF inputs.

The following figure shows the location of the 0 Ohm resistors used to configure CNF[7:3].





### 3.1.3 Host Interface Configuration

The host bus interface used by the S5U13515P00C100 evaluation board is selected using a combination of the CNF[2:1] pins and unused host interface pins. Many host bus interfaces have unused pins that can be used as configuration pins (CNF[7:3]) to select the host bus interface. The following table summarizes the available settings.

Table 3-3 : Host Interface Configuration Settings

| CNF1 | CNF2 | CNF3     | CNF4      | CNF5       | CNF6     | CNF7    | Host Interface                   |
|------|------|----------|-----------|------------|----------|---------|----------------------------------|
| 0    | 0    | 0 (TEA#) | 0 (BDIP#) | 0 (BURST#) | 0 (AB3)  | X       | Indirect, 8-bit, Intel80 Type1   |
| 0    | 0    | 0 (TEA#) | 0 (BDIP#) | 0 (BURST#) | 1 (AB3)  | X       | Indirect, 8-bit, Intel80 Type2   |
| 0    | 0    | 0 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 1 (AB3)  | 0 (AB4) | SPI                              |
| 0    | 0    | 0 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 1 (AB3)  | 1 (AB4) | I2C                              |
| 0    | 0    | 0 (TEA#) | 1 (BDIP#) | 0 (BURST#) | 0 (AB3)  | X       | Indirect, 8-bit, NEC V850 Type1  |
| 0    | 0    | 0 (TEA#) | 1 (BDIP#) | 0 (BURST#) | 1 (AB3)  | X       | Indirect, 8-bit, NEC V850 Type2  |
| 0    | 0    | 0 (TEA#) | 1 (BDIP#) | 1 (BURST#) | 0 (AB3)  | X       | Indirect, 8-bit, Renesas SH4     |
| 0    | 1    | 0 (TEA#) | 0 (BDIP#) | 0 (BURST#) | 0 (AB3)  | X       | Indirect, 16-bit, Intel80 Type1  |
| 0    | 1    | 0 (TEA#) | 0 (BDIP#) | 0 (BURST#) | 1 (AB3)  | X       | Indirect, 16-bit, Intel80 Type2  |
| 0    | 1    | 0 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 1 (AB3)  | 0 (AB4) | SPI (2-stream)                   |
| 0    | 1    | 0 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 1 (AB3)  | 1 (AB4) | I2C                              |
| 0    | 1    | 0 (TEA#) | 1 (BDIP#) | 0 (BURST#) | 0 (AB3)  | X       | Indirect, 16-bit, NEC V850 Type1 |
| 0    | 1    | 0 (TEA#) | 1 (BDIP#) | 0 (BURST#) | 1 (AB3)  | X       | Indirect, 16-bit, NEC V850 Type2 |
| 0    | 1    | 0 (TEA#) | 1 (BDIP#) | 1 (BURST#) | 0 (AB3)  | X       | Indirect, 16-bit, Renesas SH4    |
| 0    | 0    | 1 (TEA#) | 0 (BDIP#) | 0 (BURST#) | 0 (BE1#) | X       | Direct, 8-bit, Intel80 Type1     |
| 0    | 0    | 1 (TEA#) | 0 (BDIP#) | 0 (BURST#) | 1 (BE1#) | X       | Direct, 8-bit, Intel80 Type2     |
| 0    | 0    | 1 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 1 (BE1#) | 0 (AB4) | SPI                              |
| 0    | 0    | 1 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 1 (BE1#) | 1 (AB4) | I2C                              |
| 0    | 0    | 1 (TEA#) | 1 (BDIP#) | 0 (BURST#) | 0 (BE1#) | X       | Direct, 8-bit, NEC V850 Type1    |
| 0    | 0    | 1 (TEA#) | 1 (BDIP#) | 0 (BURST#) | 1 (BE1#) | X       | Direct, 8-bit, NEC V850 Type2    |
| 0    | 0    | 1 (TEA#) | 1 (BDIP#) | 1 (BURST#) | 0 (BE1#) | X       | Direct, 8-bit, Renesas SH4       |
| 0    | 1    | 1 (TEA#) | 0 (BDIP#) | 0 (BURST#) | 0 (AB0)  | X       | Direct, 16-bit, Intel80 Type1    |
| 0    | 1    | 1 (TEA#) | 0 (BDIP#) | 0 (BURST#) | 1 (AB0)  | X       | Direct, 16-bit, Intel80 Type2    |
| 0    | 1    | 1 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 0 (AB0)  | X       | Direct, 16-bit, Intel PXA3xxs    |
| 0    | 1    | 1 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 1 (AB0)  | 0 (AB4) | SPI                              |
| 0    | 1    | 1 (TEA#) | 0 (BDIP#) | 1 (BURST#) | 1 (AB0)  | 1 (AB4) | I2C                              |
| 0    | 1    | 1 (TEA#) | 1 (BDIP#) | 0 (BURST#) | 0 (AB0)  | X       | Direct, 16-bit, NEC V850 Type1   |
| 0    | 1    | 1 (TEA#) | 1 (BDIP#) | 0 (BURST#) | 1 (AB0)  | X       | Direct, 16-bit, NEC V850 Type2   |
| 0    | 1    | 1 (TEA#) | 1 (BDIP#) | 1 (BURST#) | 0 (AB0)  | X       | Direct, 16-bit, Renesas SH4      |
| 1    | 0    | 0 (AB0)  | X         | X          | X        | X       | Indirect, 16-bit, TI EBI         |
| 1    | 0    | 1 (AB0)  | X         | X          | X        | X       | Direct, 16-bit, TI EBI           |
| 1    | 1    | 0 (BE1#) | X         | X          | X        | X       | Indirect, 16-bit, MPC555         |
| 1    | 1    | 1 (BE1#) | X         | X          | X        | X       | Direct, 16-bit, MPC555           |

|   |                                                                                    |
|---|------------------------------------------------------------------------------------|
|   | = default settings, required settings when using S5U13U00P00C100 USB Adapter Board |
| X | = don't care                                                                       |

## 3.2 Configuration Jumpers

The S5U13515P00C100 has 16 jumpers which configure various evaluation board settings. The jumper positions for each function are shown below.

*Table 3-4: Configuration Jumper Settings*

| Jumper | Function                         | Position 1-2         | Position 2-3      | No Jumper                   |
|--------|----------------------------------|----------------------|-------------------|-----------------------------|
| JP1    | COREVDD                          | Normal               | —                 | COREVDD current measurement |
| JP2    | PLL1VDD                          | Normal               | —                 | PLL1VDD current measurement |
| JP3    | PLL2VDD                          | Normal               | —                 | PLL2VDD current measurement |
| JP4    | OSCVDD                           | Normal               | —                 | OSCVDD current measurement  |
| JP5    | PIO1VDD                          | Normal               | —                 | PIO1VDD current measurement |
| JP6    | HIOVDD                           | Normal               | —                 | HIOVDD current measurement  |
| JP7    | HIOVDD Source                    | H4 connector, pin 31 | 3.3VDD            | —                           |
| JP8    | PIO1VDD Source                   | H9 connector, pin 9  | 3.3VDD            | —                           |
| JP9    | PIO2VDD Source                   | H9 connector, pin 10 | 3.3VDD            | —                           |
| JP10   | CM1VDD                           | Normal               | —                 | CM1VDD current measurement  |
| JP11   | PIO2VDD                          | Normal               | —                 | PIO2VDD current measurement |
| JP12   | CM1DD Source                     | H9 connector, pin 8  | 3.3VDD            | —                           |
| JP13   | IOVDD Source                     | H9 connector, pin 7  | 3.3VDD            | —                           |
| JP14   | IOVDD                            | Normal               | —                 | IOVDD current measurement   |
| JP15   | SDVDD                            | Normal               | —                 | SDVDD current measurement   |
| JP16   | SDRAM Width Select<br>(see Note) | 32-bit wide SDRAM    | 16-bit wide SDRAM | —                           |

 = Required settings when using S5U13U00P00C100 USB Adapter board

## JP1, JP2, JP3, JP4, JP5, JP6, JP10, JP11, JP14, JP15 - Power Supplies for the S2D13515

JP1, JP2, JP3, JP4, JP5, JP6, JP10, JP11, JP14, and JP15 can be used to measure the current consumption of each S2D13515 power supply.

When the jumper is at position 1-2, normal operation is selected.

When no jumper is installed, the current consumption for each power supply can be measured by connecting an ammeter to pin 1 and 2 of the jumper.

The jumper associated with each power supply is as follows:

JP1 for COREVDD

JP3 for PLL2VDD

JP5 for PIO1VDD

JP10 for CM1VDD

JP14 for IOVDD

JP2 for PLL1VDD

JP4 for OSCVDD

JP6 for HIOVDD

JP11 for PIO2VDD

JP15 for SDVDD

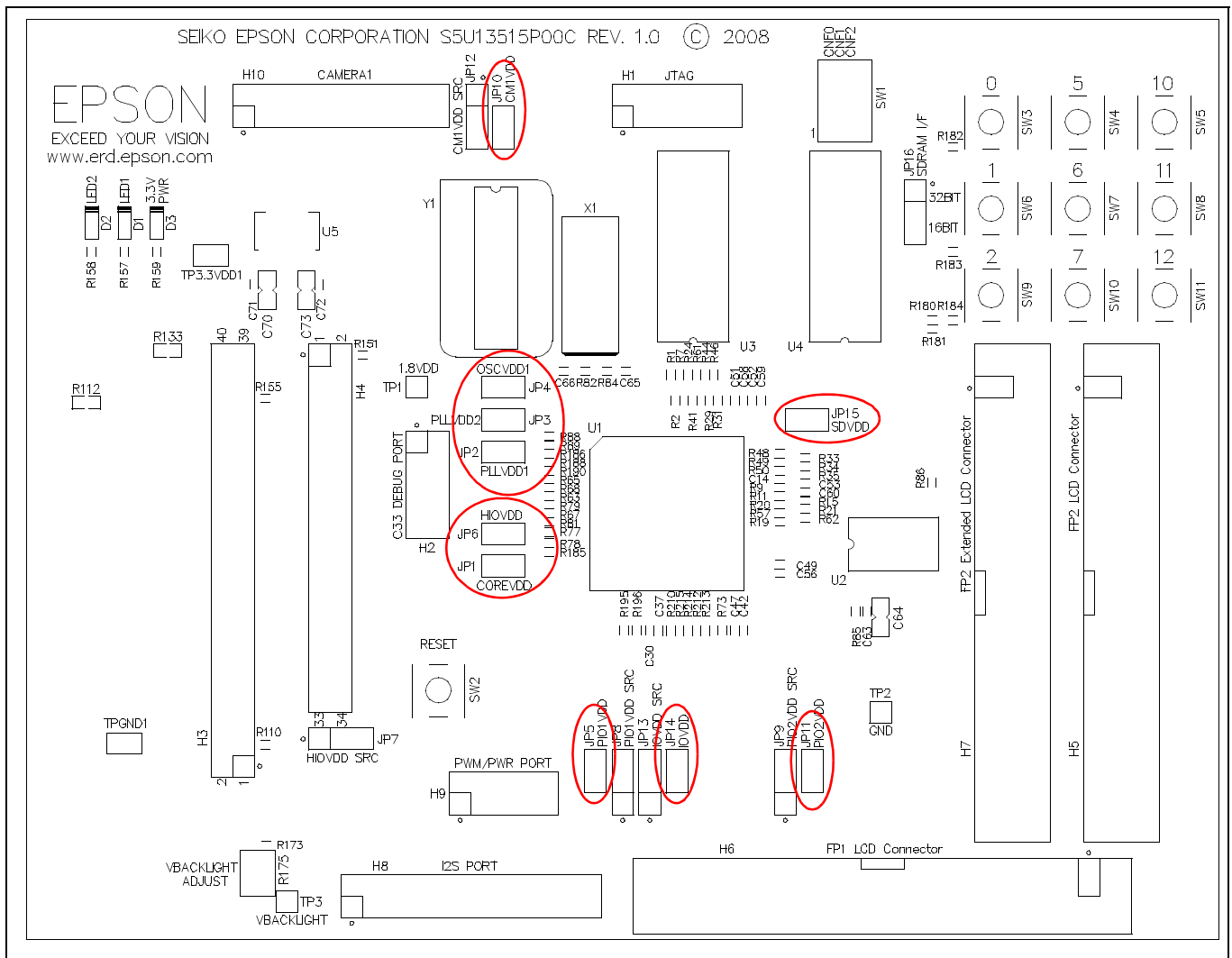


Figure 3-3: Configuration Jumper Locations (JP1, JP2, JP3, JP4, JP5, JP6, JP10, JP11, JP14, JP15)



### JP9 - PIO2VDD Source

JP9 is used to select the source for the PIO2VDD supply voltage.

When the jumper is at position 1-2, the PIO2VDD voltage must be provided to pin 10 on the H9 connector.

When the jumper is at position 2-3, the PIO2VDD voltage is provided by the 3.3V power supply of the board.

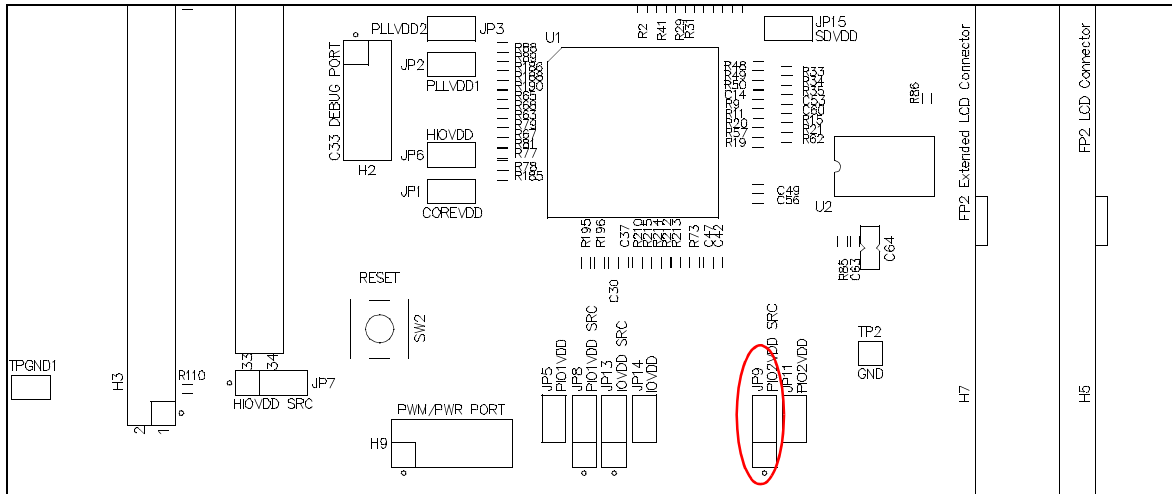


Figure 3-6: Configuration Jumper Location (JP9)

### JP12 - CM1VDD Source

JP12 is used to select the source for the CM1VDD supply voltage.

When the jumper is at position 1-2, the CM1VDD voltage must be provided to pin 8 on the H9 connector.

When the jumper is at position 2-3, the CM1VDD voltage is provided by the 3.3V power supply of the board.

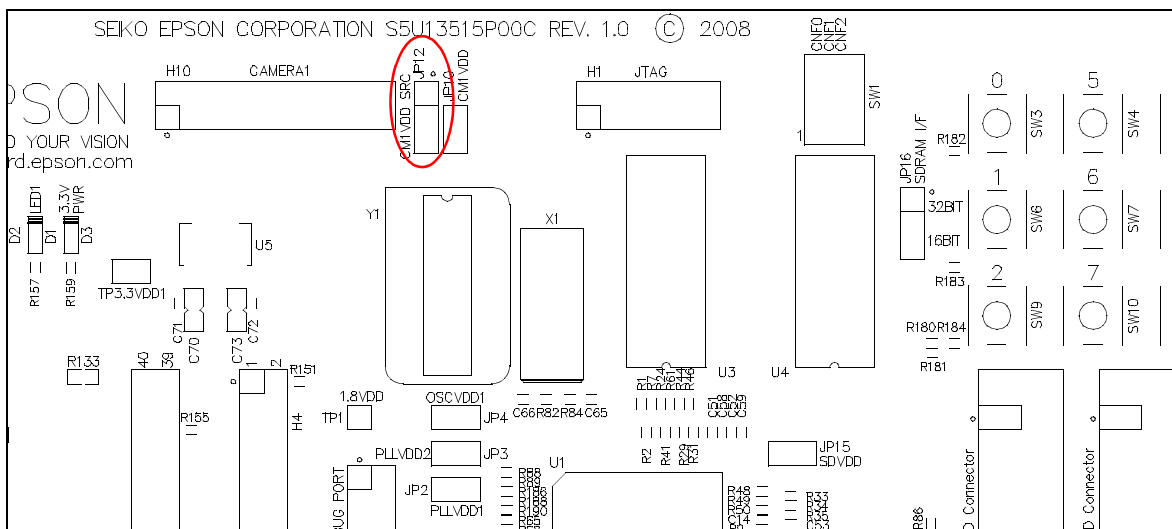


Figure 3-7: Configuration Jumper Location (JP12)

## JP13 - IOVDD Source

JP13 is used to select the source for the IOVDD supply voltage.

When the jumper is at position 1-2, the IOVDD voltage must be provided to pin 7 on the H9 connector.

When the jumper is at position 2-3, the IOVDD voltage is provided by the 3.3V power supply of the board.

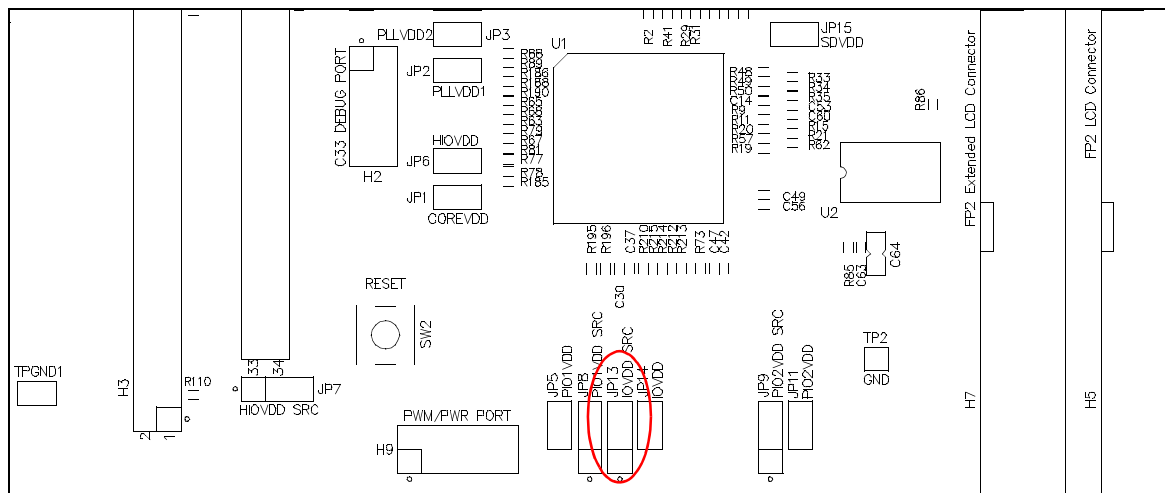


Figure 3-8: Configuration Jumper Location (JP13)

## JP16 - SDRAM Width Select

JP16 is used to select the bus width of the external SDRAM.

When the jumper is at position 1-2, the external SDRAM is 32 bits wide and the memory size is 32M bytes. In this configuration, the memory consists of 2 chips in parallel, each 16M bytes and 16 bits wide.

When the jumper is at position 2-3, the external SDRAM is 16 bits wide and the memory size is 16M bytes. In this configuration, one memory chip is disabled and only one chip is active (16M bytes and 16 bits wide).

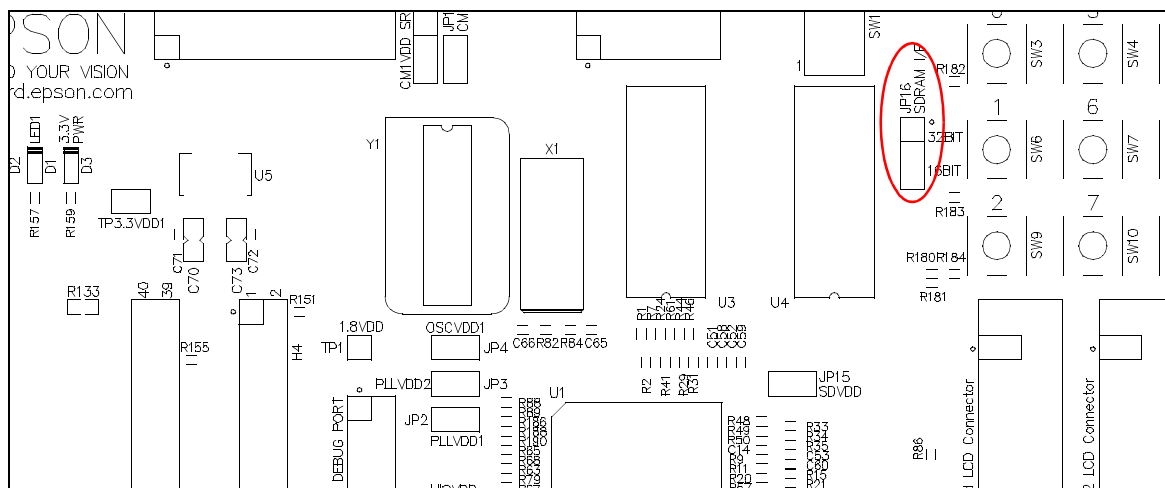


Figure 3-9: Configuration Jumper Location (JP16)

# Chapter 4 Technical Description

## 4.1 Power

### 4.1.1 Power Requirements

The S5U13515P00C100 evaluation board requires an external regulated power supply (3.3V / 1A). The power is supplied to the evaluation board through pin 33 of the H4 header, or pin 5 of the P2 header.

The green LED “3.3V Power” is turned on when 3.3V power is applied to the board.

### 4.1.2 Voltage Regulators

The S5U13515P00C100 evaluation board has an on-board linear regulator to provide the 1.8V power required by the S2D13515 Display Controller. It also has a step-up switching voltage regulator to generate adjustable 12~25V, which can be used to power the LED backlight on some LCD panels.

### 4.1.3 S2D13515 Power

The S2D13515 Display Controller requires 1.8V power and 2.3~2.7V or 3.0~3.6V power.

COREVDD, PLL1VDD, PLL2VDD, and OSCVDD require 1.8V power which is provided by an on-board linear voltage regulator.

HIOVDD, PIO1VDD, PIO2VDD, CM1VDD, and IOVDD input power may be in the range 2.3V~2.7V or 3.0V~3.6V. When JP7, JP8, JP9, JP12, or JP13 are set to the 2-3 position, the corresponding power input is connected to 3.3V. If a different voltage is required, set the corresponding jumper to the 1-2 position and connect the external power supply to the evaluation board as indicated in Table 3-4: “Configuration Jumper Settings,” on page 10.

SDVDD input power may be in the range 2.3V~2.7V or 3.0V~3.6V. On the evaluation board, SDVDD is connected to 3.3V.

### 4.1.4 LCD Backlight Power

On the evaluation board there is an adjustable 12~25V power supply. At 12V, the maximum current available is 100mA. At 25V, the maximum current available is 60mA. This power supply is intended for use to power the LED backlight on some LCD panels. The voltage is adjusted by the R175 pot.

#### Note

For LCD panels that use a CCFL backlight, an external power supply must be used to provide power to the inverter for the CCFL backlight. Usually, the inverter current consumption is higher than the maximum 100mA current available from the on-board voltage regulator.

## 4.2 Clocks

The clock for the S2D13515 Display Controller is provided by a 20MHz crystal connected to the OSCI and OSCO pins.

Additionally, the S5U13515P00C100 evaluation board can also use an oscillator if the DIP14 footprint is populated. If populated, the oscillator is connected to the CLKI input clock of the S2D13515 Display controller.

### Note

For details on the S2D13515 clock structure, refer to the *S2D13515 Hardware Functional Specification*, document number X83A-A-001-xx.

## 4.3 Reset

The S2D13515 Display Controller on the S5U13515P00C100 evaluation board can be reset using a push-button switch (SW2), or via an active low reset signal from the host development platform (pin 30 on the H4 connector).

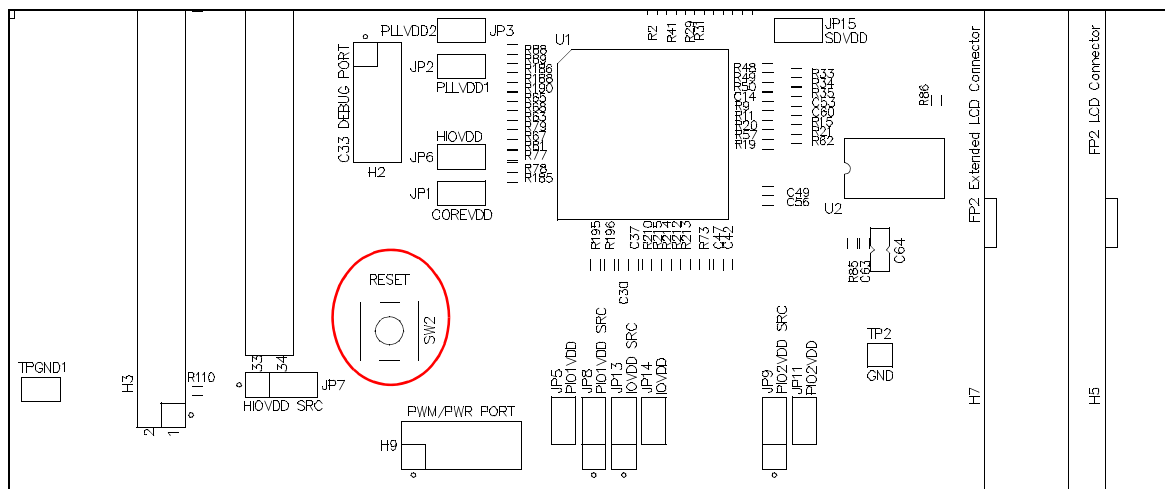


Figure 4-1: Reset Switch (SW2) Location



## 4.4 Memory

### 4.4.1 SDRAM

The S5U13515P00C100 evaluation board has 2 SDRAM ICs, each 128Mbit x16-bit, CL=2 in a TSOP54 package. When the S2D13515 Display Controller is configured for 32-bit wide DRAM bus, both SDRAM ICs are used. When the S2D13515 Display Controller is configured for 16-bit wide DRAM bus, only one of the SDRAM ICs is used and the other SDRAM ICs is disabled by having its chip select input pulled high to inactive state, by putting jumper JP16 in 2-3 position.

### 4.4.2 Serial Flash Memory with SPI interface

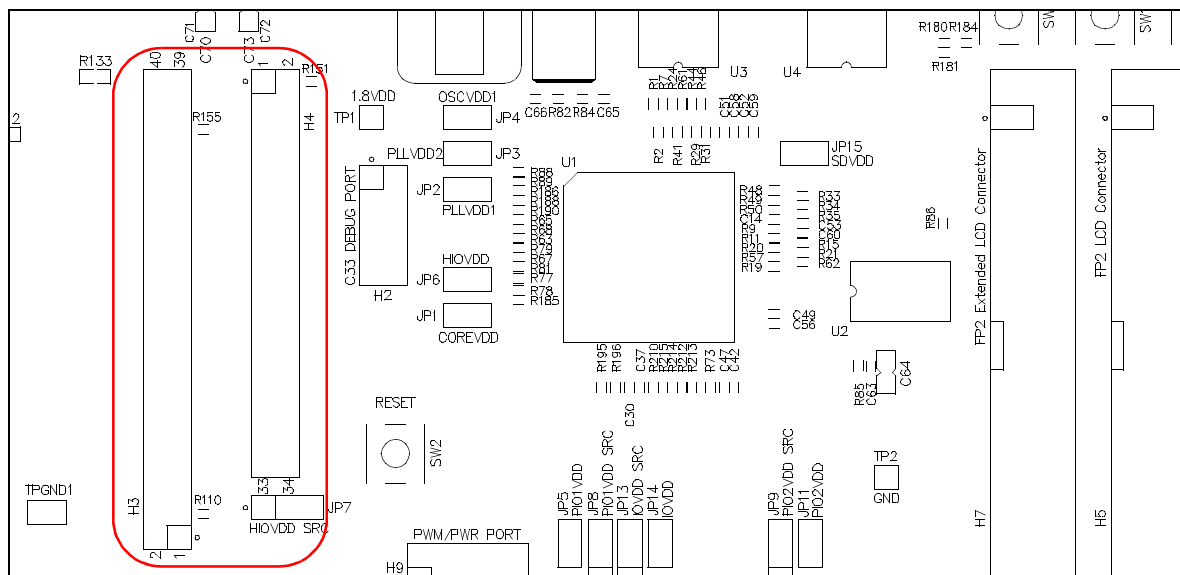
The S2D13515 Display Controller has a SPI Flash Memory interface which is connected to a 32Mbit Flash EPROM.

## 4.5 Host Interface

### 4.5.1 Direct Host Bus Interface Support

All S2D13515 host interface pins are available on connectors H3 and H4. This allows the S5U13515P00C100 evaluation board to be connected to a variety of development platforms. For S2D13515 host interface pin mapping, refer to the *S2D13515 Hardware Functional Specification*, document number X83A-A-001-xx.

The following figure shows the location of host bus connectors H3 and H4. H3 is a 0.1" x 0.1" 40-pin header (20x2) and H4 is a 0.1" x 0.1" 34-pin header (17 x 2).



## 4.5.2 Connecting to the Epson S5U13U00P00C100 USB Adapter Board

The S5U13515P00C100 evaluation board is designed to connect to a S5U13U00P00C100 USB Adapter Board. The USB adapter board provides a simple connection to any computer via a USB 2.0 connection. The S5U13515P00C100 directly connects to the USB adapter board through connectors P1 and P2.

The USB adapter board also supplies the 3.3V power required by the S5U13515P00C100 evaluation board. HIOVDD should be configured for 3.3V and JP7 should be set to the 2-3 position.

When the S5U13515P00C100 is connected to the S5U13U00P00C100 USB Adapter board, there are 2 LEDs on the S5U13515P00C100 which provide a quick visual status of the USB adapter. LED1 blinks to indicate that the USB adapter board is active. LED2 turns on to indicate that the USB has been enumerated by the PC.

The following diagram shows the location of connectors P1 and P2. P1 and P2 are 2mm x 2mm, 40-pin headers (20 x 2) located on the underside of the board.

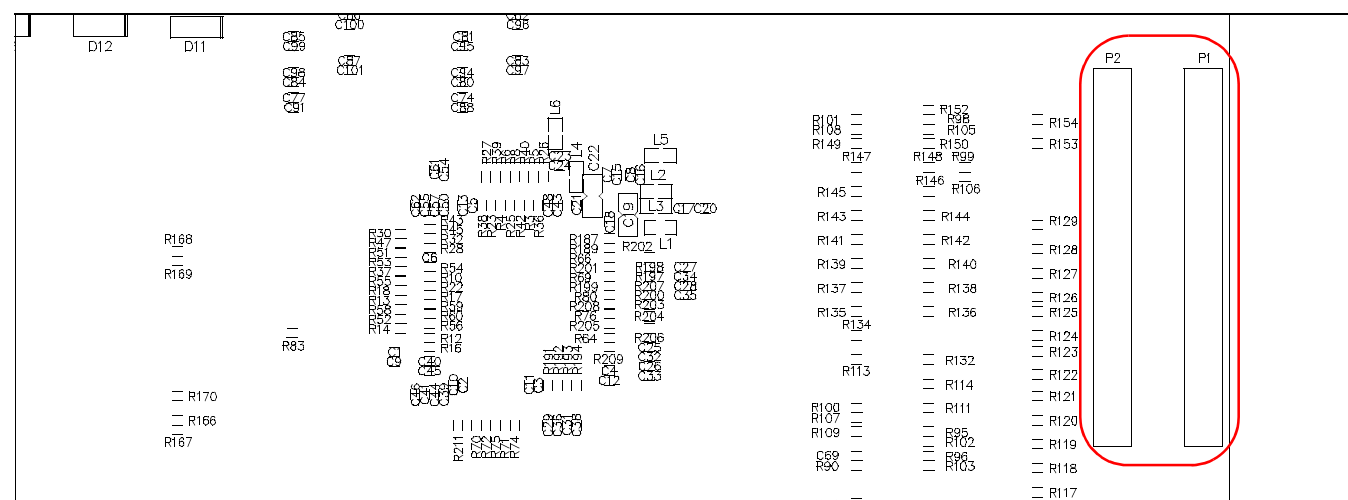


Figure 4-3: USB Adapter Connector Locations (P1 and P2)

For the pinout of connectors P1 and P2, see Section Chapter 6, “Schematic Diagrams” on page 29.

### Note

A windows driver must be installed on the PC when the S5U13515P00C100 is used with the S5U13U00P00C100 USB Adapter Board. The S1D13xxxUSB driver is available at [www.erd.epson.com](http://www.erd.epson.com).

## 4.6 LCD Interface

The LCD interface uses the FP1IO[23:0] and FP2IO[27:0] pins. All signals on these pins are available on connectors H5, H6, and H7.

Connectors H5, H6, and H7 are 0.1" x 0.1", 40-pin headers (20 x 2). The following diagram shows the location of these connectors.

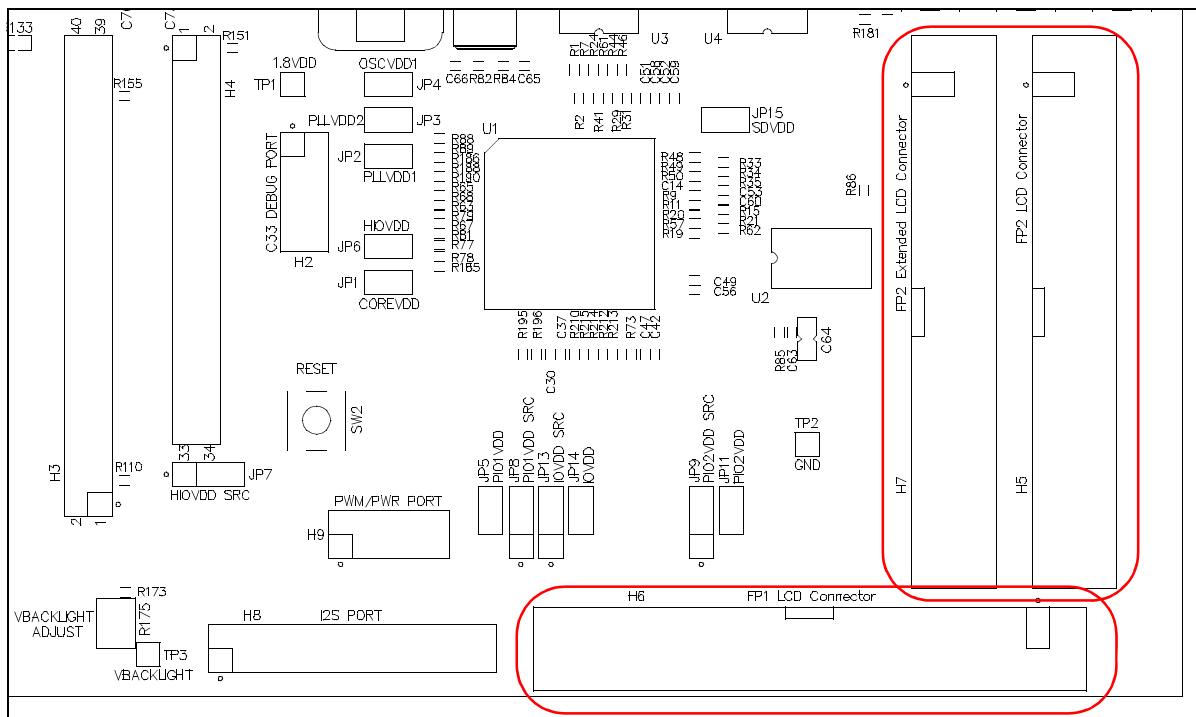


Figure 4-4: FP1IO and FP2IO Connectors Location (H5, H6, H7)

For the pinout of connectors H5, H6, and H7, see Section Chapter 6, “Schematic Diagrams” on page 29.

### 4.6.1 FP1IO Interface

The FP1IO interface signals have multiplexed functions. All FP1IO interface signals, except FP1IO18 and FP1IO19, are available on connector H6. FP1IO18 and FP1IO19 signals go through 0 ohm resistors and are available on connector H7.

The FP1IO interface can be configured as a LCD interface, 18-bit RGB input stream interface, or 8-bit YUV camera interface and keyboard interface. For S2D13515 FP1IO interface pin mapping, refer to the *S2D13515 Hardware Functional Specification*, document number X83A-A-001-xx.

### 4.6.2 FP2IO Interface

All FP2IO interface signals are available on connectors H5 and H7. For S2D13515 FP2IO interface pin mapping, refer to the *S2D13515 Hardware Functional Specification*, document number X83A-A-001-xx.

## 4.7 Camera / I2C Interface

The S2D13515 Display Controller has a Camera interface. All the camera interface signals are available on connector H10. To control the camera, the S2D13515 Display Controller has an I2C master interface. The SDA and SCL signals are pulled high to CM1VDD by 2.2 k $\Omega$  resistors and are available on connector H10. The reset signal provided on H10 is active low and is pulled to HIOVDD when inactive.

Connector H10 is a 0.1" x 0.1", 20-pin header (10 x 2). The following figure shows the location of the connector H10.

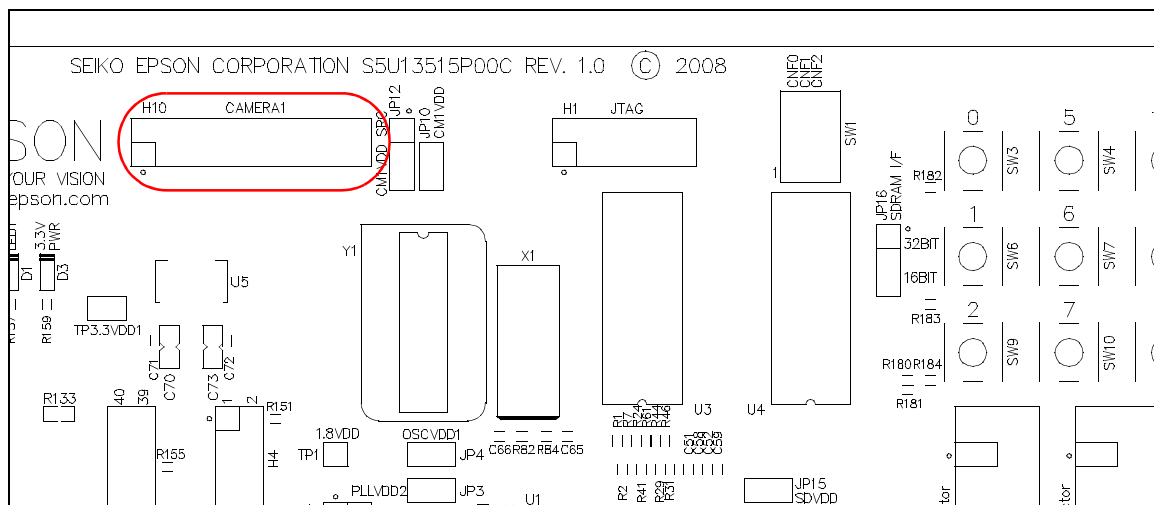


Figure 4-5: Camera Connector Location (H10)

For the pinout of connector H10, see Section Chapter 6, “Schematic Diagrams” on page 29.

## 4.8 Keypad Interface

### Note

The keyboard is non-operational with the buttons SW3-SW11, mounted as they are on the board. In order to make the keyboard operational, the user must remove the buttons SW3-SW11 from the board and mount them back on the board, but rotated by 90 degrees or 270 degrees. The buttons will not match the footprint on the PCB, but this is how they must be mounted on the board.

The S2D13515 Display Controller can support up to a 5x5 matrix keypad, but the S5U13515P00C100 evaluation board includes only a 3x3 keypad. The keypad interface can be configured to use either the FPIO1 interface or Host interface pins. For S2D13515 pin mapping, refer to the *S2D13515 Hardware Functional Specification*, document number X83A-A-001-xx. The keypad interface is configured for either the FPIO1 interface or Host Interface pins using 0 ohm resistors.

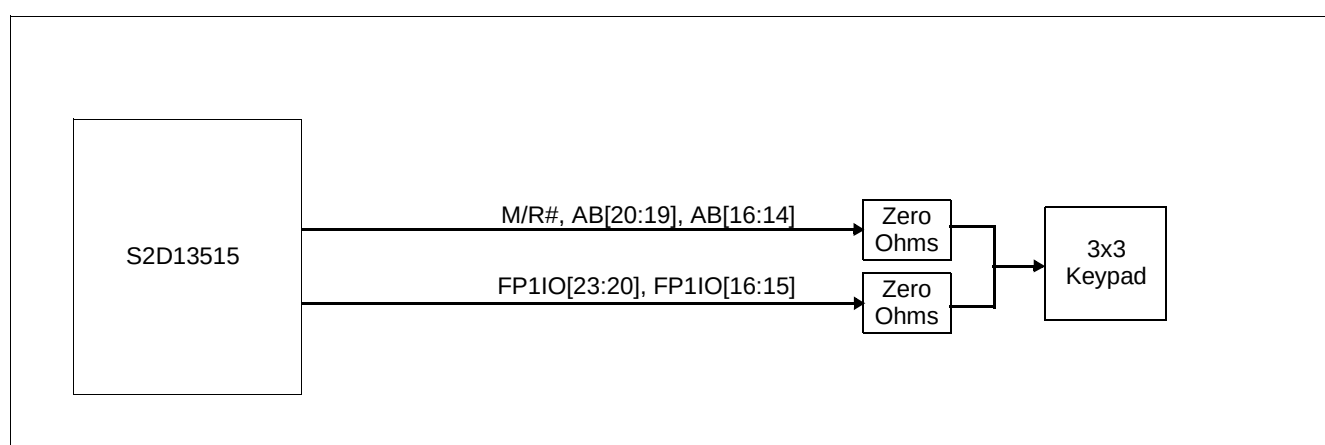


Figure 4-6: Keypad Interface Zero Ohm Resistor Overview Diagram

The keypad can be configured to connect to 1 of 2 source pins on the S2D13515. Depending of the configuration, the input lines must be pulled high to corresponding power supply. The source connection for the keypad is determined by populating the correct set of zero ohm resistors as described below.

Table 4-1: Keypad Zero Ohm Resistor Summary

| Keypad Pin Function          | Populate only 1 set of the zero ohm resistors below |                             |
|------------------------------|-----------------------------------------------------|-----------------------------|
|                              | Zero Ohm For FP1IO                                  | Zero Ohm For Host Interface |
| KBR0                         | R191                                                | R185                        |
| KBR1                         | R192                                                | R186                        |
| KBR2                         | R193                                                | R187                        |
| KBC0                         | R194                                                | R188                        |
| KBC1                         | R195                                                | R190                        |
| KBC2                         | R196                                                | R189                        |
| Power<br>(HIOVDD or PIO1VDD) | R181                                                | R180                        |

S5U13515P00C100 evaluation board comes configured with the keyboard interface from the Host Interface pins, so resistors R185 ~ R190 and R180 are populated and R191 ~ R196 and R181 are not populated.

## 4.9 I2S Interface

The S2D13515 Display Controller has an I2S Audio output interface. All of the I2S interface signals are available on connector H8. The I2C signals, available on the same connector, can be used to program an external I2S Audio DAC IC.

Connector H8 is a 0.1" x 0.1", 24-pin header (12x2). The following figure shows the location of the connector H8.

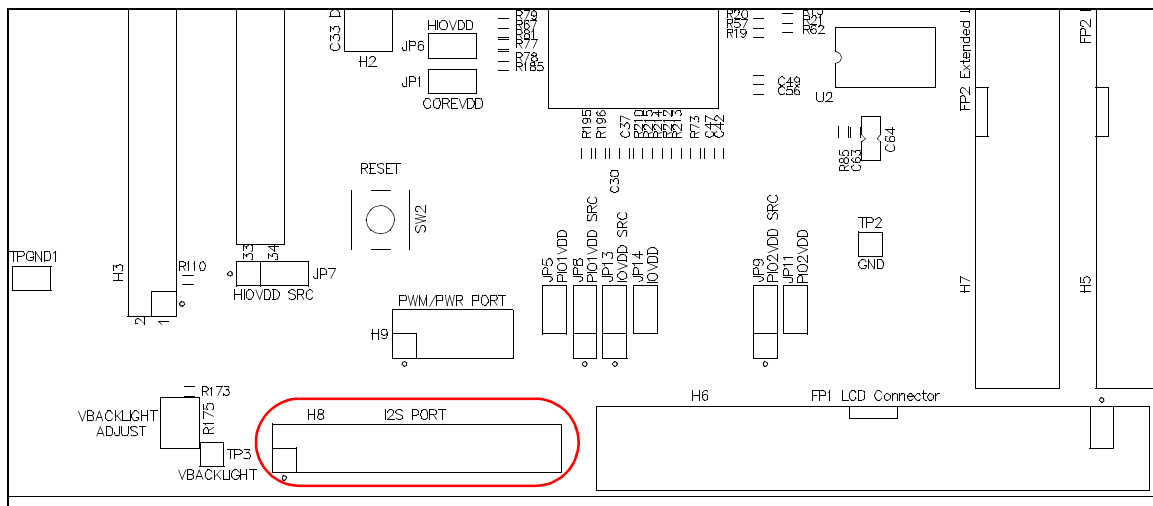


Figure 4-7: I2S Connector Location (H8)

For the pinout of connector H8, see Section Chapter 6, “Schematic Diagrams” on page 29.

## 4.10 PWM Connector

The S2D13515 Display Controller has two PWM outputs which are available on connector H9. The other pins on connector H9 are used to connect the external power supplies to CM1VDD, IOVDD, PIO1VDD, and PIO2VDD, if a voltage level different than 3.3V is required. Note that connector H9 is not populated on the S5U13515P00C100 evaluation board.

Connector H9 is a 0.1" x 0.1", 10-pin header (5x2). The following figure shows the location of the connector H9.

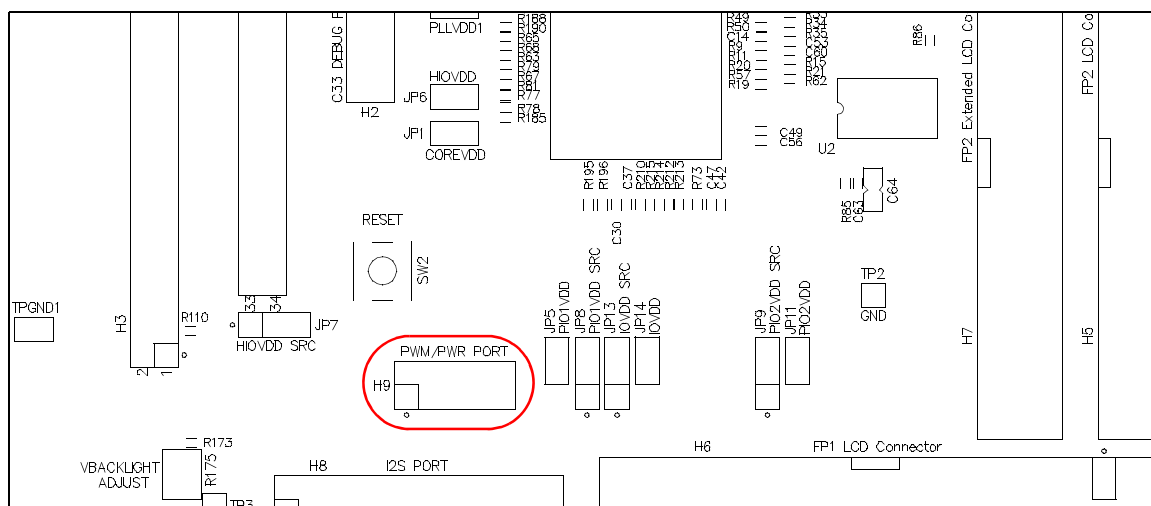


Figure 4-8: PWM Connector Location (H9)

For the pinout of connector H9, see Section Chapter 6, “Schematic Diagrams” on page 29.

## 4.11 C33 Debugger Port

The S2D13515 contains an embedded C33 microprocessor core. The debug monitor interface is available on connector H2 for firmware debugging using C33 Debugger. In order to use connector H2, zero ohm resistors must be configured depending on the desired S2D13515 configuration.

The C33 debugger function can be sourced from 2 sets of the host interface pins or from a set of FP2IO pins.

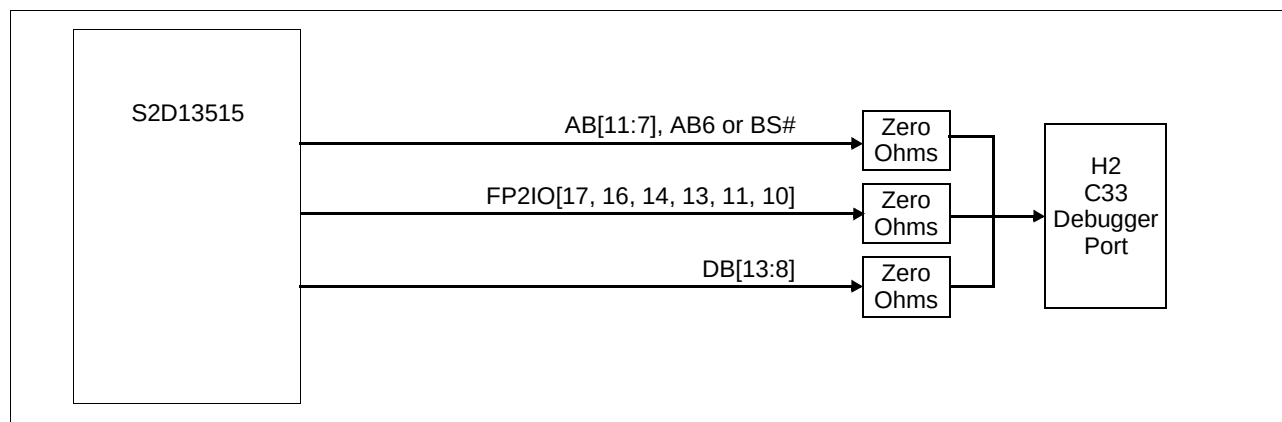


Figure 4-9: C33 Debugger Zero Ohm Resistor Overview Diagram

The connection to the C33 Debugger port is determined by populating the correct set of zero ohm resistors as described below.

Table 4-2: C33 Debugger Port H7 Zero Ohm Selection

| C33 Pin Function | Populate only 1 set of the zero ohm resistors below |                                                     |                                      |
|------------------|-----------------------------------------------------|-----------------------------------------------------|--------------------------------------|
|                  | C33 Debugger port from FP2IO pins                   | C33 Debugger port from AB[11:7], AB6 or BS# pins    | C33 Debugger port from DB[13:8] pins |
| PEDST0           | R74 populated<br>R210 not populated                 | R65 populated<br>R202 not populated                 | R80 populated<br>R208 not populated  |
| PEDST1           | R73 populated<br>R211 not populated                 | R66 populated<br>R201 not populated                 | R79 populated<br>R207 not populated  |
| PEDST2           | R72 populated<br>R212 not populated                 | R67 populated<br>R200 not populated                 | R78 populated<br>R206 not populated  |
| PEDCLK           | R70 populated<br>R213 not populated                 | R69 populated<br>R199 not populated                 | R76 populated<br>R205 not populated  |
| PEDSIO           | R71 populated<br>R215 not populated                 | R68 populated<br>R198 not populated                 | R77 populated<br>R204 not populated  |
| PEDPCPO          | R75 populated<br>R214 not populated                 | R63 populated (from AB6)<br>R64, R197 not populated | R81 populated<br>R203 not populated  |
|                  |                                                     | R64 populated (from BS#)<br>R63, R209 not populated |                                      |

S5U13515P00C100 board comes configured for the C33 Debugger port from the Host Interface AB[11:6] pins, so resistors R63, R65 ~ R69 are populated and R197 ~ R202 are not populated, R203 ~ R215 are populated and R64, R70 ~ R81 are not populated.



Connector H2 is a 0.1" x 0.1", 10-pin header (5x2). The following figure shows the location of the connector H2.

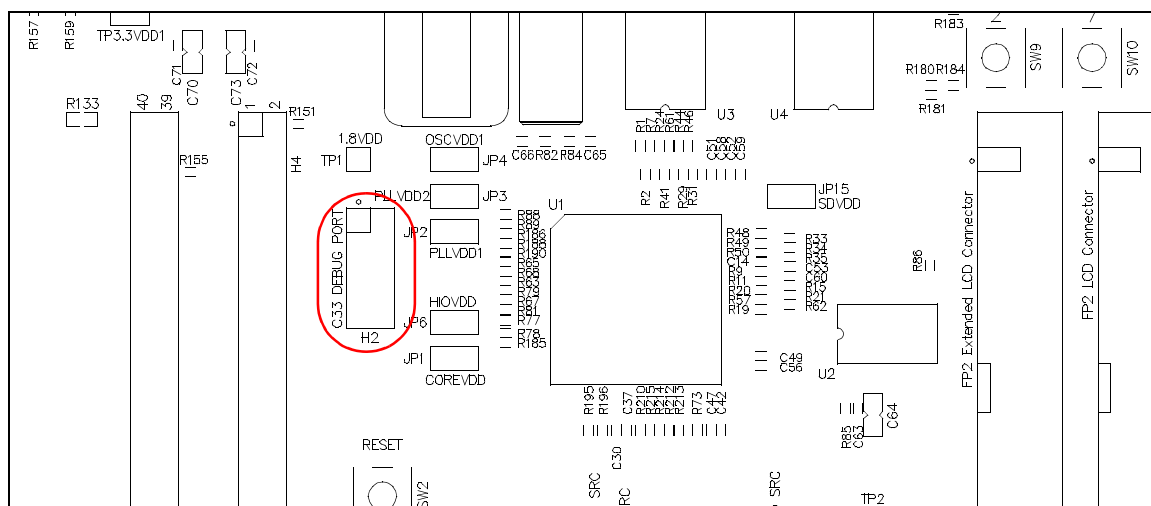


Figure 4-10: C33 Debugger Connector Location (H2)

For the pinout of connector H2, see Section Chapter 6, “Schematic Diagrams” on page 29.

## 4.12 JTAG Interface

The S2D13515 Display Controller has a JTAG interface. All the JTAG signals are available on connector H1. Note that connector H1 is not populated on the S5U13515P00C100 evaluation board.

Connector H1 is a 0.1" x 0.1", 12-pin header (6x2). The following figure shows the location of the connector H1.

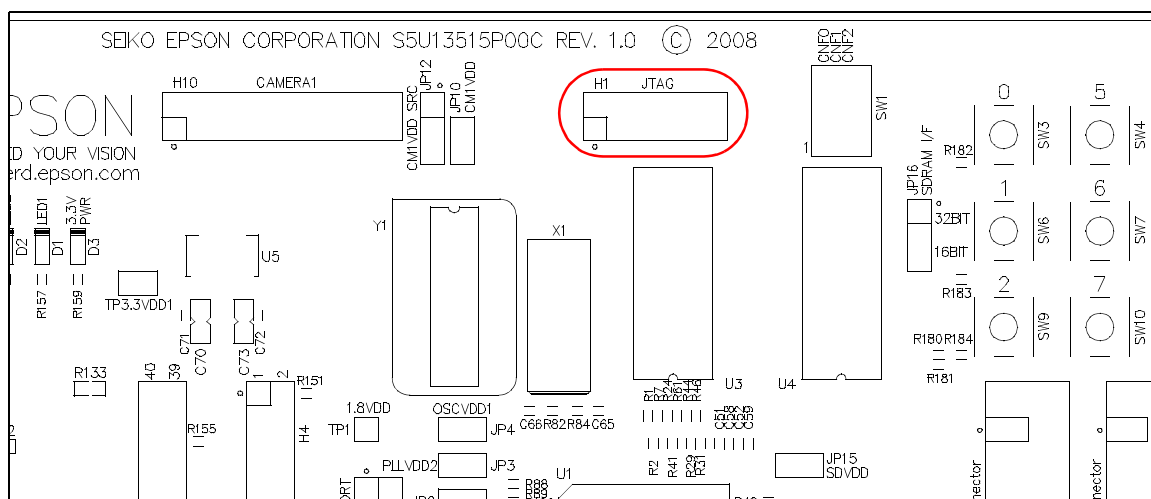


Figure 4-11: JTAG Connector Location (H1)

For the pinout of connector H1, see Section Chapter 6, “Schematic Diagrams” on page 29.

## Chapter 5 Parts List

Table 5-1 : S5U13515P00C100 Parts List

| Item | Quantity | Reference                                                                                                                                                                                        | Part          | Description                                                               |
|------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------|
| 1    | 50       | C1,C2,C3,C4,C5,C6,C7,C8,C17,C20,C24,C25,C26,C27,C28,C29,C30,C31,C39,C40,C41,C42,C43,C49,C50,C51,C52,C53,C54,C55,C63,C67,C69,C71,C72,C74,C75,C76,C77,C78,C79,C80,C81,C82,C83,C84,C85,C86,C87,C106 | 0.1uF         | Yageo America 04022F104Z7B20D, C0402                                      |
| 2    | 43       | C9,C10,C11,C12,C13,C14,C15,C16,C23,C32,C33,C34,C35,C36,C37,C38,C44,C45,C46,C47,C48,C56,C57,C58,C59,C60,C61,C62,C68,C88,C89,C90,C91,C92,C93,C94,C95,C96,C97,C98,C99,C100,C101                     | 0.01uF        | Yageo America 0402ZRY5V7BB103, C0402                                      |
| 3    | 2        | C18,C21                                                                                                                                                                                          | 1nF           | Yageo America 04022R102K9B20D, C0402                                      |
| 4    | 5        | C19,C22,C64,C70,C73                                                                                                                                                                              | 10uF          | Panasonic - ECG ECJ-CV50J106M, C0805                                      |
| 5    | 2        | C65,C66                                                                                                                                                                                          | 18pF          | Panasonic - ECG ECJ-0EC1H180J, C0402                                      |
| 6    | 1        | C102                                                                                                                                                                                             | 2.2uF 10V     | Taiyo Yuden LMK212BJ225KG-T, C0805, CAP CER 2.2UF 10V X7R 0805            |
| 7    | 1        | C103                                                                                                                                                                                             | 10uF 35V      | Taiyo Yuden GMK325BJ106KN-T, C1210, CAP CER 10UF 35V X5R 1210             |
| 8    | 1        | C104                                                                                                                                                                                             | 150pF         | Panasonic - ECG ECJ-0EC1H151J, C0402                                      |
| 9    | 1        | C105                                                                                                                                                                                             | 1uF           | Panasonic - ECG ECJ-0EB0J105M, C0402                                      |
| 10   | 3        | D1,D2,D3                                                                                                                                                                                         |               | Panasonic - SSG LNJ308G8LRA, LED0603, LED GREEN SS TYPE LOW CUR SMD       |
| 11   | 10       | D4,D5,D6,D7,D8,D9,D10,D11,D12,D13                                                                                                                                                                | MBR0540       | Micro Commercial Co. MBR0540-TP, SOD-123, DIODE SCHOTTKY 40V 500MA SOD123 |
| 12   | 1        | F1                                                                                                                                                                                               | ACH32C-333-T  | TDK ACH32C-333-T, FILTR 3TERM 10MHZ TO 300MHZ SMD                         |
| 13   | 1        | F2                                                                                                                                                                                               | ACF451832-222 | TDK ACF451832-222, FILTER 3-TERM 60MHZ 300MA SMD                          |
| 14   | 0        | H1                                                                                                                                                                                               | JTAG          | Samtec TSW-106-07-G-D<br>Do not populate                                  |
| 15   | 1        | H2,H9                                                                                                                                                                                            |               | Samtec TSW-105-07-G-D, Do not populate H9                                 |
| 16   | 1        | H3                                                                                                                                                                                               | HEADER_20X2   | Samtec TSW-120-07-G-D                                                     |
| 17   | 1        | H4                                                                                                                                                                                               | HEADER_17X2   | Samtec TSW-117-07-G-D                                                     |
| 18   | 3        | H5,H6,H7                                                                                                                                                                                         |               | Samtec TST-120-01-G-D                                                     |
| 19   | 1        | H8                                                                                                                                                                                               | I2S PORT      | Samtec TSW-112-07-G-D                                                     |
| 20   | 1        | H10                                                                                                                                                                                              | CAMERA1       | Samtec TSW-110-07-G-D                                                     |

Table 5-1 : S5U13515P00C100 Parts List

| Item | Quantity | Reference                                                                                                                                                                                                                                                                                                                                                                                        | Part        | Description                                                          |
|------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------|
| 21   | 10       | JP1,JP2,JP3,JP4,JP5,JP6<br>JP10,JP11,JP14,JP15                                                                                                                                                                                                                                                                                                                                                   |             | SIP2 CONN HEADER VERT 2POS .100 TIN or<br>GENERIC                    |
| 22   | 6        | JP7,JP8,JP9,JP12,JP13,J<br>P16                                                                                                                                                                                                                                                                                                                                                                   |             | SIP3 CONN HEADER VERT 3POS .100 TIN or<br>GENERIC                    |
| 23   | 6        | L1,L2,L3,L4,L5,L6                                                                                                                                                                                                                                                                                                                                                                                | Ferrite     | Steward HZ0603B751R-10, R0603,<br>FERRITE 200MA 938 OHMS 0603 SMD    |
| 24   | 1        | L7                                                                                                                                                                                                                                                                                                                                                                                               | 10uH        | Panasonic - ECG ELL-6SH100M, IND_ELL6,<br>COIL 10UH 1300MA CHOKE SMD |
| 25   | 2        | P1,P2                                                                                                                                                                                                                                                                                                                                                                                            | HEADER_20X2 | 3M 151240-8422-RB, HDR2X20/2MM                                       |
| 26   | 61       | R1,R2,R3,R4,R5,R6,R7,R<br>8,R9,R10,R11,R12,R13,R<br>14,R15,R16,R17,R18,R19,<br>R20,R21,R22,R23,R24,R2<br>5,R26,R27,R28,R29,R30,<br>R31,R32,R33,R34,R35,R3<br>6,R37,R38,R39,R40,R41,<br>R42,R43,R44,R45,R46,R4<br>7,R48,R49,R50,R51,R53,<br>R54,R55,R57,R58,R59,R6<br>0,R61,R62,R88                                                                                                               | 33 1%       | R0402                                                                |
| 27   | 0        | R52,R64,R70,R71,R72,R7<br>3,R74,R75,R76,R77,R78,<br>R79,R80,R81,R95,R96,R9<br>7,R98,R99,R100,R101,R1<br>04,R106,R108,R134,R135,<br>R136,R137,R138,R139,R1<br>40,R141,R142,R143,R144,<br>R145,R146,R147,R148,R1<br>49,R150,R151,R161,R163,<br>R165,R167,R169,R170,R1<br>81,R191,R192,R193,R194,<br>R195,R196,R197,R198,R1<br>99,R200,R201,R202,R216,<br>R217,R218,R219                            | 0_np        | R0402<br>Do not populate                                             |
| 28   | 68       | R56,R63,R65,R66,R67,R6<br>8,R69,R83,R85,R86,R87,<br>R102,R103,R105,R107,R1<br>09,R110,R111,R113,R114,<br>R115,R116,R117,R118,R1<br>19,R120,R121,R122,R123,<br>R124,R125,R126,R127,R1<br>28,R129,R130,R131,R132,<br>R152,R153,R154,R155,R1<br>60,R162,R164,R166,R168,<br>R171,R180,R185,R186,R1<br>87,R188,R189,R190,R203,<br>R204,R205,R206,R207,R2<br>08,R209,R210,R211,R212,<br>R213,R214,R215 | 0           | R0402                                                                |
| 29   | 1        | R82                                                                                                                                                                                                                                                                                                                                                                                              | 1M          | R0402                                                                |
| 30   | 1        | R84                                                                                                                                                                                                                                                                                                                                                                                              | 1k          | R0402                                                                |

Table 5-1 : S5U13515P00C100 Parts List

| Item | Quantity | Reference                                                              | Part                     | Description                                                                            |
|------|----------|------------------------------------------------------------------------|--------------------------|----------------------------------------------------------------------------------------|
| 31   | 10       | R89,R91,R92,R93,R94,R156,R174,R182,R183,R184                           | 10k                      | R0402                                                                                  |
| 32   | 1        | R90                                                                    | 150k 1%                  | R0402                                                                                  |
| 33   | 3        | R112,R133,R172                                                         | 0                        | R0603                                                                                  |
| 34   | 3        | R157,R158,R159                                                         | 270 1%                   | R0402                                                                                  |
| 35   | 1        | R173                                                                   | 120k                     | R0402                                                                                  |
| 36   | 1        | R175                                                                   | 200k                     | Panasonic - ECG EVN-5ESX50B25,<br>POT 200K OHM 3MM CARBON TRIM SMD                     |
| 37   | 1        | R176                                                                   | 56k                      | R0402                                                                                  |
| 38   | 1        | R177                                                                   | 13.3k 1%                 | R0402                                                                                  |
| 39   | 2        | R178,R179                                                              | 2.2k                     | R0402                                                                                  |
| 40   | 16       | SH1,SH2,SH3,SH4,SH5,SH6,SH7,SH8,SH9,SH10,SH11,SH12,SH13,SH14,SH15,SH16 | .100 in. Jumper<br>Shunt | Sullins Electronics Corp. STC02SYAN<br>JUMPER SHORTING TIN                             |
| 41   | 1        | SW1                                                                    | SW4_DIPSW4               | CTS Corp 218-4LPST, DIPSW4,<br>SWITCH DIP HALF PITCH 4POS                              |
| 42   | 10       | SW2,SW3,SW4,SW5,SW6,SW7,SW8,SW9,SW10,SW11                              | SW TACT-SPST             | ITT Industries KSC201JLFS,<br>SWITCH TACT SILVR 120GF J-LEAD                           |
| 43   | 2        | TPGND1,TP3.3VDD1                                                       | TP_SMT                   | Keystone 5015, TP_1206,<br>PC TEST POINT MINIATURE SMT                                 |
| 44   | 1        | U1                                                                     | S2D13515PBGA256          |                                                                                        |
| 45   | 1        | U2                                                                     | M25P32-VMF               | ST Microelectronics M25P32-VMF6P,<br>IC SRL FLASH 32MBIT 3V 16-SOIC                    |
| 46   | 2        | U3,U4                                                                  | 128M16 DRAM              | Qimonda HYB39S128160FE-7,<br>IC SDRAM 128MBit 54-TSOP                                  |
| 47   | 1        | U5                                                                     | MIC37100-1.8WS           | Micrel MIC37100-1.8WS, SOT-223,<br>Alternate MIC39100-1.8WS                            |
| 48   | 1        | U6                                                                     | LM2733Y                  | National Semiconductor LM2733YMF/NOPB,<br>SOT23-5,<br>IC CONV BOOST 40V FET SW SOT23-5 |
| 49   | 1        | X1                                                                     | MA-506 20.0000M          | Epson MA-506 20.0000M,<br>CRYSTAL 20.0000MHZ 18PF SMD                                  |
| 50   | 0        | Y1                                                                     | 14-Pin DIP               | AMP 2-641609-1<br>Do not populate                                                      |

# Chapter 6 Schematic Diagrams













# Chapter 7 Board Layout

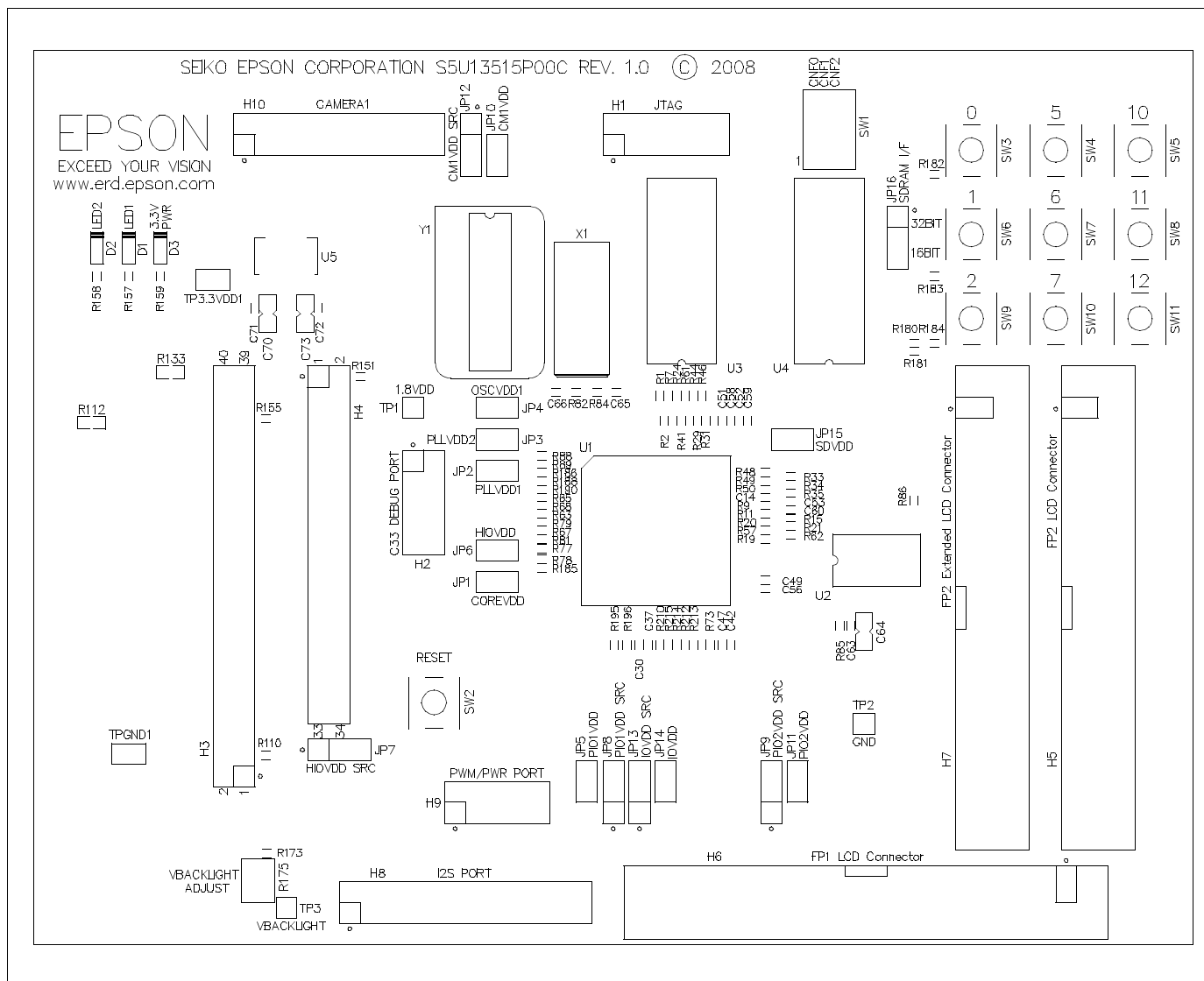


Figure 7-1: S5U13515P00C100 Board Layout - Top View

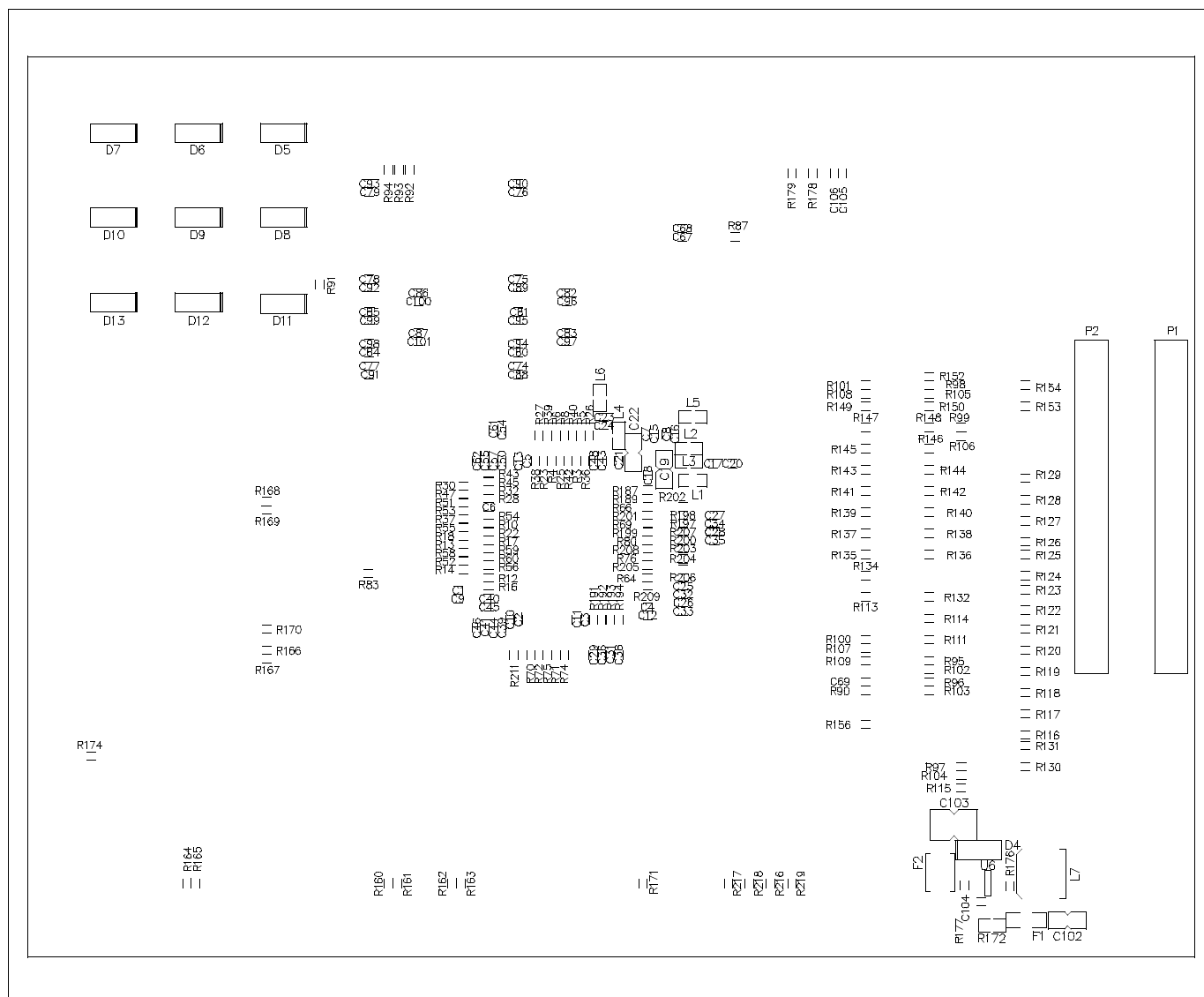


Figure 7-2: S5U13515P00C100 Board Layout - Bottom View

## Chapter 8 References

### 8.1 Documents

- Epson Research and Development, Inc., *S2D13515 Hardware Functional Specification*, document number X83A-A-001-xx.

### 8.2 Document Sources

- Epson Research and Development Website: <http://www.erd.epson.com>.

# Change Record

## **X83A-G-001-01 Revision 1.1 - Issued: September 9, 2009**

- section 4.8 Keypad Interface - add note “The keyboard is non-operational with the buttons SW3-SW11, mounted as they are on the board...” to start of section

## **X83A-G-001-01 Revision 1.0 - Issued: January 20, 2009**

- Release as Revision 1.0
- section 3.1.2 CNF[7:3] - correct typo in table change “R104” to “R107”
- chapter 6 Schematic Diagrams - replace figure 6-3

## **X83A-G-001-00 Revision 0.03 - Issued: June 3, 2008**

- globally add missing Figures
- globally add missing resistor numbers
- chapter 2 Features -in second bullet change “64MB” to “32 MB” and “32MB” to “16MB” respectively
- chapter 5 Parts List - add parts list data
- chapter 6 Schematic Diagrams - update all schematic diagrams
- chapter 7 Board Layout - add figures

## **X83A-G-001-00 Revision 0.02 - Issued: April 24, 2008**

- section 2, changed package from QFP22 to PBGA
- section 2, changed “Headers for connection to cameras” to “Header for connection to cameras”
- section 2, removed “On-board video decoder allowing direct connection of an analog camera”
- section 2, changed on-board keypad from “5x5” to “3x3”
- section 4.4.1, changed the SDRAM size from 256Mbit to 128Mbit
- section 4.7.1, removed Analog Camera and Video Decoder section
- section 4.8, changed 5x5 keypad to 3x3 keypad and updated keypad diagram
- section 6, updated schematic diagrams

## **X83A-G-001-00 Revision 0.01 - Issued: February 11, 2008**

- initial draft of the user manual
- minor edits and formatting

### AMERICA

---

**EPSON ELECTRONICS AMERICA, INC.**

2580 Orchard Parkway  
San Jose, CA 95131, USA  
Phone: +1-800-228-3964      FAX: +1-408-922-0238

### EUROPE

---

**EPSON EUROPE ELECTRONICS GmbH**

Riesstrasse 15, 80992 Munich,  
GERMANY  
Phone: +49-89-14005-0      FAX: +49-89-14005-110

### ASIA

---

**EPSON (CHINA) CO., LTD.**

7F, Jinbao Bldg., No.89 Jinbao St.,  
Dongcheng District,  
Beijing 100005, CHINA  
Phone: +86-10-6410-6655      FAX: +86-10-6410-7320

**SHANGHAI BRANCH**

7F, Block B, High-Tech Bldg., 900, Yishan Road,  
Shanghai 200233, CHINA  
Phone: +86-21-5423-5522      FAX: +86-21-5423-5512

**SHENZHEN BRANCH**

12F, Dawning Mansion, Keji South 12th Road,  
Hi-Tech Park, Shenzhen 518057, CHINA  
Phone: +86-755-2699-3828      FAX: +86-755-2699-3838

**EPSON HONG KONG LTD.**

20/F, Harbour Centre, 25 Harbour Road  
Wanchai, Hong Kong  
Phone: +852-2585-4600      FAX: +852-2827-4346  
Telex: 65542 EPSCO HX

**EPSON TAIWAN TECHNOLOGY & TRADING LTD.**

14F, No. 7, Song Ren Road,  
Taipei 110, TAIWAN  
Phone: +886-2-8786-6688      FAX: +886-2-8786-6660

**EPSON SINGAPORE PTE., LTD.**

1 HarbourFront Place,  
#03-02 HarbourFront Tower One, Singapore 098633  
Phone: +65-6586-5500      FAX: +65-6271-3182

**SEIKO EPSON CORP.****KOREA OFFICE**

50F, KLI 63 Bldg., 60 Yoido-dong  
Youngdeungpo-Ku, Seoul, 150-763, KOREA  
Phone: +82-2-784-6027      FAX: +82-2-767-3677

---

**SEIKO EPSON CORP.****SEMICONDUCTOR OPERATIONS DIVISION****IC Sales Dept.****IC International Sales Group**

421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN  
Phone: +81-42-587-5814      FAX: +81-42-587-5117



**Стандарт  
Электрон  
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

**Наши контакты:**

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331