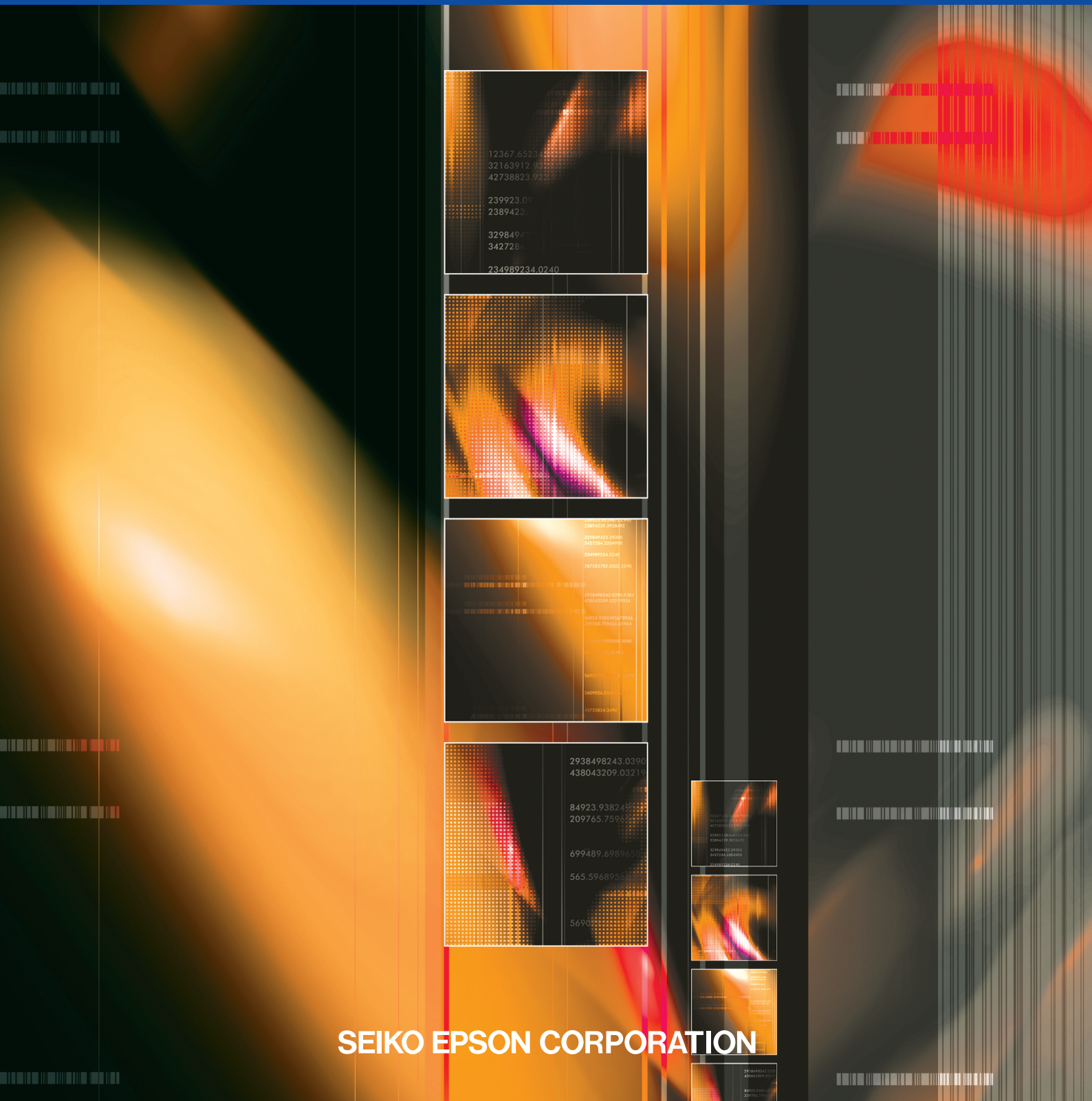
EPSON
EXCEED YOUR VISION

ASSPs

Application Specific Standard Products

2023



SEIKO EPSON CORPORATION

Business Concept

The widespread of smartphones and tablets make improvements of broadband and wireless communications, then the advanced information and telecommunications network society has become a reality. In particular, semiconductors for use in portable devices, information terminals, in-vehicle devices and FA devices are expected to provide higher performance in terms of thinner structure, lighter weight, and longer operation with limited power supply. We have been focusing on the creation of compact, low-power semiconductors since we started the development of CMOS LSI for watches in 1969. Since then, we have steadily built up our expertise in energy-saving, space-saving, and time-saving designs. This has enabled us to quickly obtain the semiconductor development technology needed to meet the demands of the new era of the advanced information and telecommunications network society. Our concept is to develop "saving technologies" to reduce power consumption, development times, and implementation space. Our goal is to be a true partner for you, providing you with strategic advantages, enhancing your customer value based on our "saving technologies" and mixed analog/digital technologies that we have cultivated, as well as our design capabilities, manufacturing capabilities and stable supply that can satisfy your detailed requirements.

Environmental Responsibility

Epson semiconductor technology provides environmental value to customers by creating and manufacturing eco-friendly products.

1) We Epson's products are surely complying with the Eu-RoHS (2011/65/EU) Directive.
2) We are releasing information about the containing chemical substances of products at web-site.
   Product of QFP & BGA are described in the following URL.
   global.epson.com/products_and_drivers/semicon/information/package_lineup.html *Some products are excluded.

Environmental management system third party certification status
ISO14001

Type of certification : ISO 14001: 2015, JIS Q 14001: 2015
Awarded to : TOHOKU EPSON CORPORATION, SEIKO EPSON CORPORATION
(Fujimi Plant, Suwa Minami Plant)
Certified by : Bureau Veritas Japan Co., Ltd.
Date of certification : April 3, 1999

Type of certification : ISO 14001: 2015
Awarded to : Singapore Epson Industrial Pte. Ltd.
Certified by : SGS
Date of certification : Jan 12, 1999

Epson's Quality Policy

Keeping the customer in mind at all times, we make the quality of our products and services our highest priority. In order to continue to creating products and services that please our customers and earn their trust. Epson's Semiconductor Business has acquired ISO9001 and IATF16949 certification with its IC, module and their application products.

Quality Management system third party certification status
ISO9001

Type of Certification : ISO9001: 2015 , JIS Q 9001: 2015
Awarded to : TOHOKU EPSON CORPORATION, SEIKO EPSON CORPORATION
(Fujimi Plant, Suwa Minami Plant, Tokyo Office)
Certified by : Bureau Veritas Japan Co., Ltd.
Certificate No. : 3762381
Initial Date of Certification : October 10, 1993

Type of Certification : ISO9001: 2015
Awarded to : Singapore Epson Industrial Pte. Ltd.
Certified by : SGS
Certificate No. : SG03/00011
Initial Date of Certification : February 4, 2003

IATF16949

Type of Certification : IATF16949:2016
Awarded to : TOHOKU EPSON CORPORATION, SEIKO EPSON CORPORATION
(Fujimi Plant, Tokyo Office), Epson Europe Electronics GmbH, Epson America, Inc., Epson Canada Ltd.(Vancouver Design Center)
Certified by : Bureau Veritas Japan Co., Ltd.
Certificate No. : 281371
Initial Date of Certification : Dec 9, 2017

Type of Certification : IATF16949:2016
Awarded to : Singapore Epson Industrial Pte. Ltd.
Certified by : SGS
Certificate No. : SG07/00021
Initial Date of Certification : May 2, 2018

ASSPs

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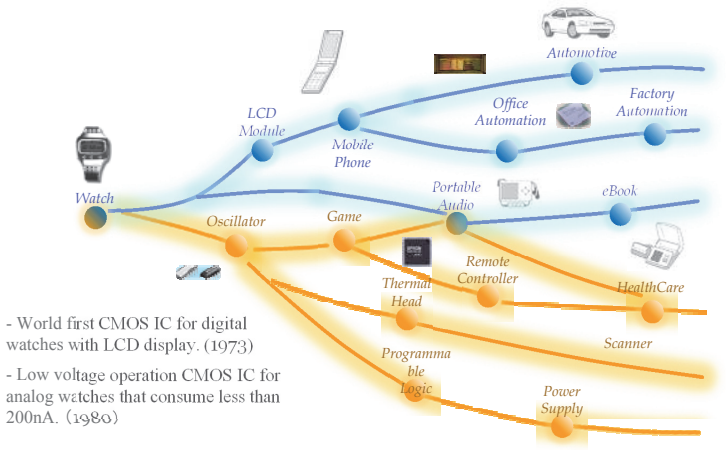
History of Epson semiconductor

History of Epson Semiconductor's Technology

As the semiconductor division of "worldwide watch maker Seiko", semiconductor business has expanded into LCD Drivers, ASICs and MCUs from IC for Watches. These businesses are all based on Epson's energy-saving technology.

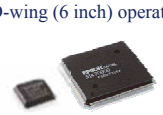


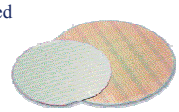
- World first CMOS IC for digital watches with LCD display. (1973)
- Low voltage operation CMOS IC for analog watches that consume less than 200nA. (1980)

Energy-Saving Technology ; Technology that reduces power consumption from both sides of process and circuit have been nurtured by Epson over 40 years since division was founded.

Epson Semiconductor's History

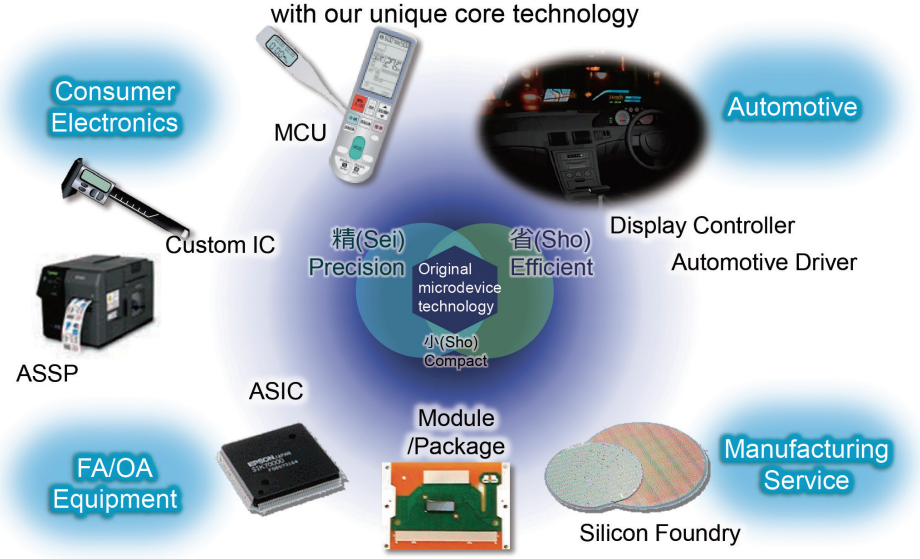
1969	Development of CMOS IC for watches started
1973	CMOS IC production started in Headquarter
1980	Fujimi plant (B-wing, 4 inch) operation started
1984	A-wing (5 inch) operation started
1985	D-wing (6 inch) operation started
1991	Sakata plant (S-wing,6 inch) operation started
1993	ISO9000 series certified
1994	Singapore assembly plant (SEP) operation started
1997	T-wing (8 inch, Sakata) operation started
	ISO14001 certified
2001	T-wing manufacturing line expanded
2006	ISO/TS16949 certified
2010	Microdevices Operations Division started
2017	IATF16949 certified



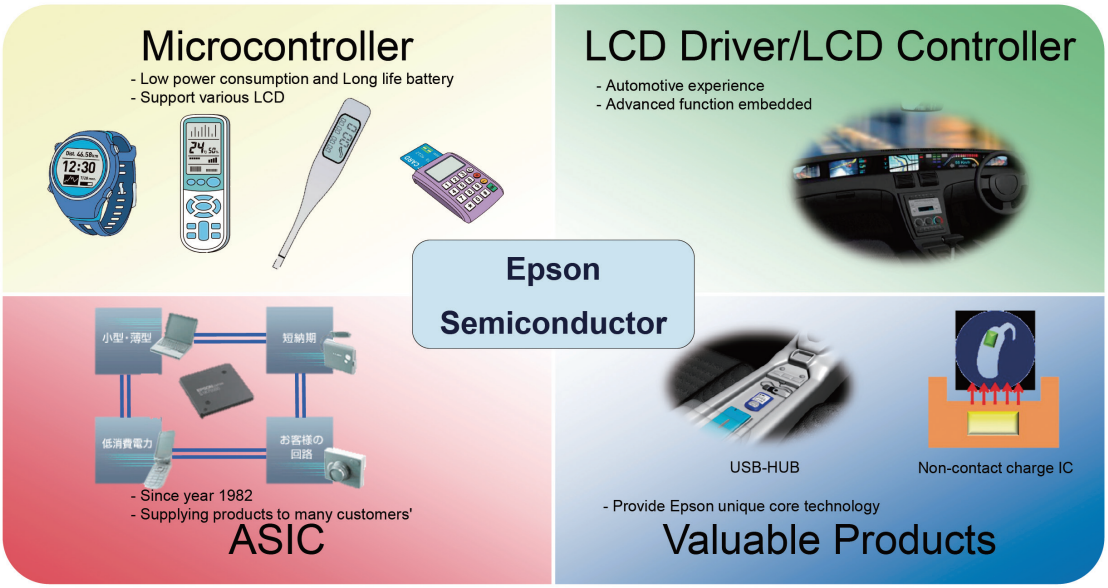


Vision and Target Application

Epson aspires to be a device maker that contributes customers' business by valuable products with our unique core technology



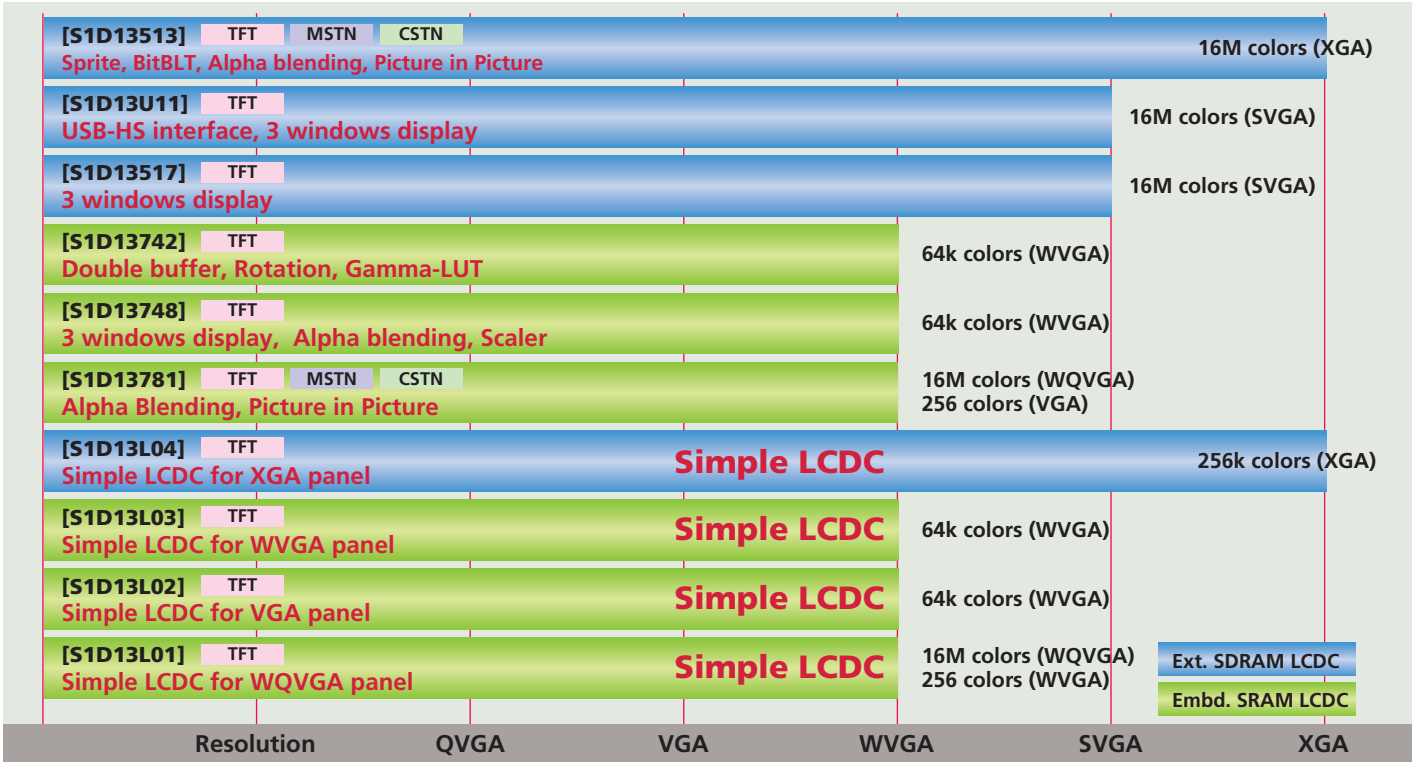
Epson Product Line-up



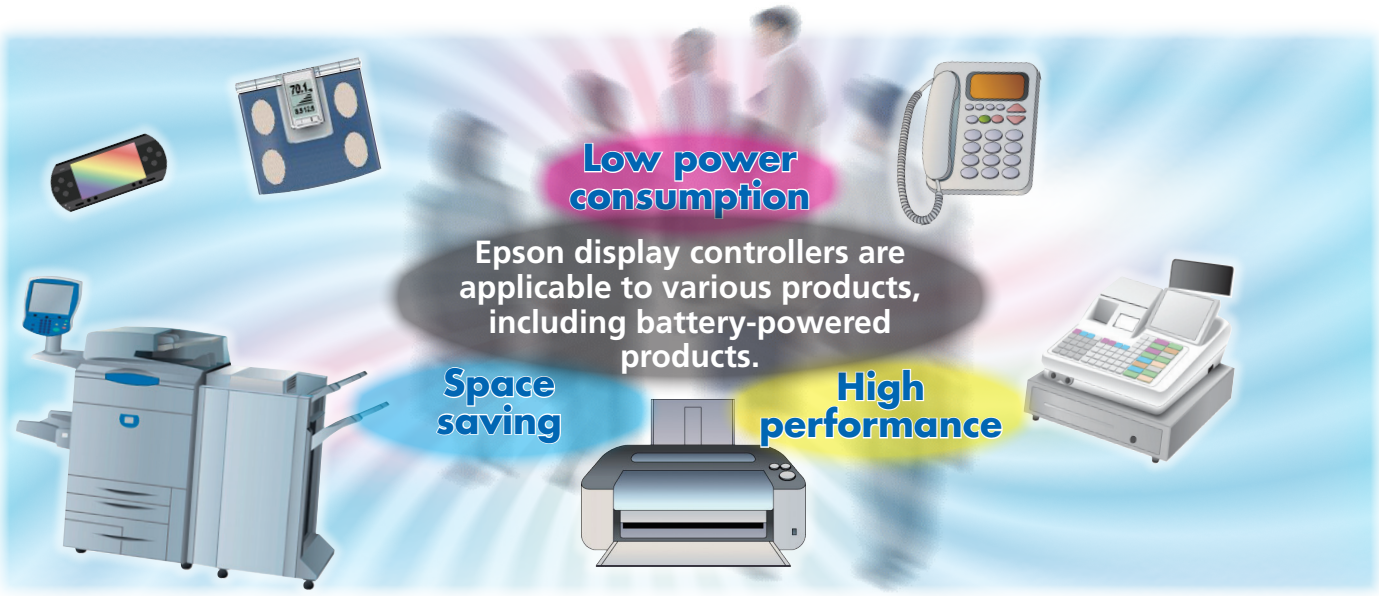
Display Controller Product Line up

Epson display controllers can reduce load on the host CPU at rendering, allow high-speed rendering with its original image processing engine, while also realizing an industgry-leading minimal level of power consumption. We have a lineup of products supporting various display devices such as TFT/STN LCD panels, memory display, providing the most suitalble solution for embedded devices for factory automation, office automation, household equipment and other applications.

Display Controller Product Line up



Display controller's example of application



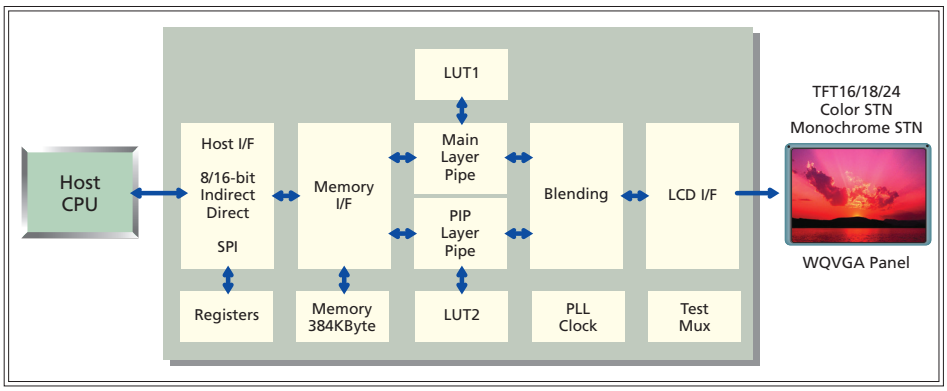
Display Controller Product Line up

■ LCD Controller with Built-in VRAM

A single-chip LCD controller with built-in display memory allowing for low power consumption, low noise, and space-saving ability.
This product is most suitable for the display control of mobile terminals and operation panels.

Product	CPU Interface Support	LCD Interface Support				Color Depth (Max.)	Internal Memory Capacity	Supply Voltage		Additional Features	Package
		Monochrome STN	Color STN	TFT	Typical Resolution			Core	IO		
S1D13700F02A	8-bit I/F, Direct addressing Indirect addressing	4-bit	n/a	n/a	QVGA	16 grayscale	32KB, SRAM	3.0V to 3.6V	3.0V to 5.5V	3 overlay screens	TQFP13-64
S1D13705F00A	8-bit I/F (with external logic) 16-bit I/F, Direct addressing	4-bit / 8-bit	4-bit / 8-bit	9-bit / 12-bit	QVGA	MSTN:16 grayscale CSTN:256 colors TFT:256 colors	80KB, SRAM	2.7V to 3.6V	2.7V to 5.5V	SwivelView	QFP14-80
S1D13706F00A	8-bit I/F(with external logic), 16-bit I/F, Direct addressing	4-bit / 8-bit	4-bit / 8-bit / 16-bit	9-bit / 12-bit / 18-bit	QVGA	MSTN:64 grayscale CSTN:64K colors TFT:64K colors	80KB, SRAM	1.8V to 3.6V	1.8V to 3.6V	SwivelView, PinP	TQFP15-100
S1D13742F01A	8-bit / 16-bit I/F Indirect addressing	n/a	n/a	18-bit	VGA	256K colors	768KB, SRAM	1.4V to 1.6V	1.65V to 3.60V	SwivelView	QFP20-144
S1D13743F00A	8-bit / 16-bit I/F Indirect addressing	n/a	n/a	18-bit / 24-bit	WQVGA	16M colors	464KB, SRAM	1.4V to 1.6V	1.65V to 3.60V	SwivelView	QFP20-144
S1D13748F00A S1D13748B00B	16-bit I/F, Indirect addressing	n/a	n/a	18-bit / 24-bit	WVGA	64K colors	1024KB, SRAM	1.35V to 1.65V	1.62V to 3.60V	PinP	QFP20-144 PFBGA10U-121
S1D13781F00A	8-bit / 16-bit I/F, Direct addressing Indirect addressing, SPI	4-bit / 8-bit	8-bit / 16-bit	16-bit / 18-bit / 24-bit	WQVGA	MSTN:64 grayscale CSTN:64K colors TFT:16M colors	384KB, SRAM	1.35V to 1.65V	1.62V to 3.60V	PinP, a-Blend, 2D BitBLT	QFP15-100
S1D13A04F00A	8-bit I/F (with external logic) 16-bit I/F, Direct addressing	4-bit / 8-bit	4-bit / 8-bit / 16-bit	9-bit / 12-bit / 18-bit	QVGA	MSTN:64 grayscale CSTN:64K colors TFT:64K colors	160KB, SRAM	1.8V to 2.75V	3.0V to 3.6V	2D BitBLT, SwivelView, USB client 1.1	TQFP15-128 PFBGA10U-121
S1D13A05B00B	8-bit I/F (with external logic) 16-bit I/F, Direct addressing	4-bit / 8-bit	4-bit / 8-bit / 16-bit	9-bit / 12-bit / 18-bit	QVGA	MSTN:64 grayscale CSTN:64K colors TFT:64K colors	256KB, SRAM	1.8V to 2.75V	3.0V to 3.6V	2D BitBLT, SwivelView, USB client 1.1	PFBGA10U-121

■ S1D13781 Block Diagram



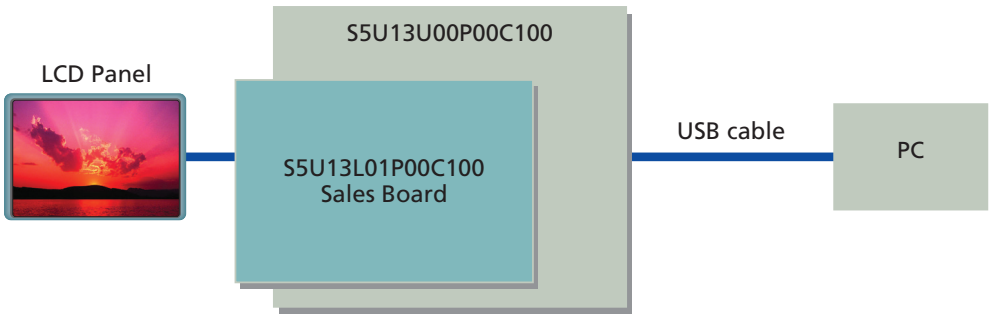
Display Controller Product Line up

■ Simple LCD Controller

LCD controller with simple function.

Product	CPU Interface Support	LCD Interface Support				Color Depth (Max.)	Internal Memory Capacity	External Memory Capacity	Supply Voltage		Additional Features	Package
		Monochrome STN	Color STN	TFT	Typical Resolution				Core	IO		
S1D13L01F00A	8-bit / 16-bit I/F, Direct addressing Indirect addressing, SPI	n/a	n/a	16-bit / 18-bit / 24-bit	WQVGA	16M colors	384KB, SRAM	n/a	1.35V to1.65V	1.62V to 3.6V	Picture in picture	QFP15-128
S1D13L02F00A	16-bit I/F, Indirect addressing	n/a	n/a	18-bit / 24-bit	WVGA	16M colors	1024KB, SRAM	n/a	1.35V to1.65V	1.62V to 3.6V	Picture in picture	QFP22-208
S1D13L03F00A	8-bit /16-bit I/F Indirect addressing	n/a	n/a	18-bit	WVGA	256K colors	768KB, SRAM	n/a	1.4V to 1.6V	1.65V to 3.6V	n/a	QFP21-176
S1D13L04F00A	16-bit I/F, Direct addressing Indirect addressing, Serial I/F	n/a	n/a	18-bit	XGA	256K colors	n/a	Up to 16MB. SDRAM	1.65V to 1.95V	3.0V to 3.6V	Picture in picture, Alpha blend	QFP22-208

■ S1D13L01 Structure of Sales Board

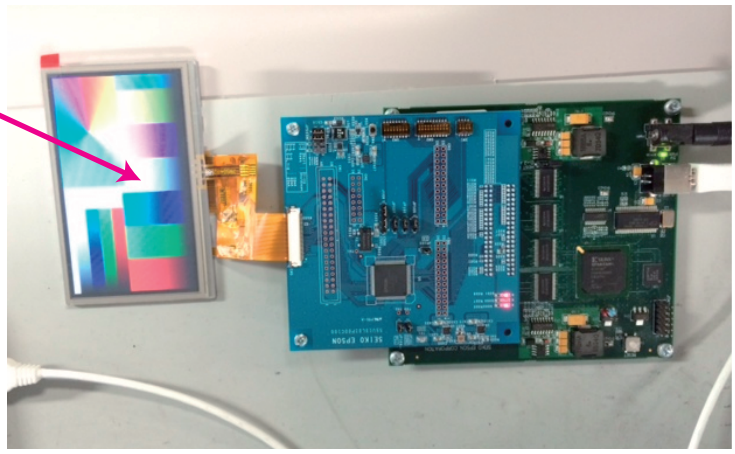


Checked available panel:

Newhaven Display International, Inc.
NHD-4.3-480272EF-ATXL# (WQVGA)

Kyocera
TCG043WQLBAANN-GN00 (WQVGA)

KOE
TX11D06VM2APA (WQVGA)



Display Controller Product Line up

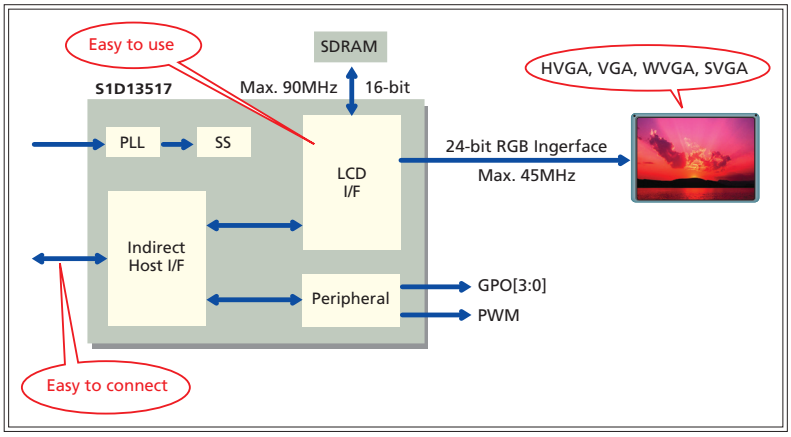
ASSPs

■ LCD Controller with External VRAM

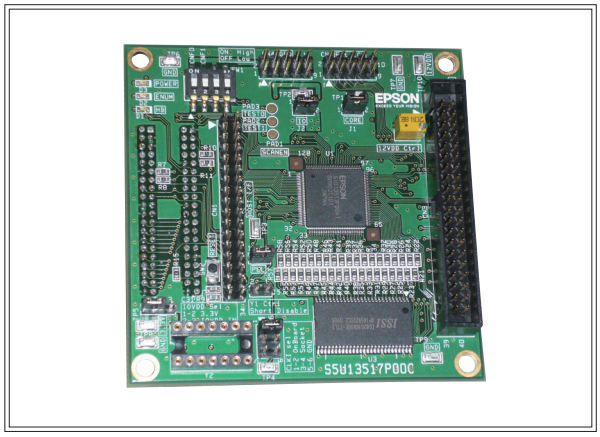
LCD controller for application in a wide range of small- to large-size panel types.
This product is most suitable for the display control of OA or FA equipment operation panels as well as for in-vehicle devices.

Product	CPU Interface Support	LCD Interface Support				Color Depth (Max.)	External Memory Capacity	Supply Voltage		Additional Features	Package
		Monochrome STN	Color STN	TFT	Typical Resolution			Core	IO		
S1D13513F01A	16-bit I/F, Direct addressing, Indirect addressing, Serial I/F	8-bit	8-bit	18-bit	XGA	MSTN:64 grayscale CSTN:256K colors TFT:256K colors	Up to 16MB SDRAM	1.65V to 1.95V	3.0V to 3.6V	2D Sprite, 2D BitBLT	QFP22-208
S1D13513B01B	16-bit I/F, Direct addressing, Indirect addressing, Serial I/F	8-bit	8-bit	18-bit / 24-bit	XGA	MSTN:64 grayscale CSTN:256K colors TFT:16M colors	Up to 64MB SDRAM	1.65V to 1.95V	3.0V to 3.6V	2D Sprite, 2D BitBLT	PBGA1UC256
S1D13515F00A B00B	16-bit I/F, Direct addressing, Indirect addressing, Serial I/F	n/a	n/a	18-bit / 24-bit	XGA	16M colors	Up to 64MB SDRAM	1.65V to 1.95V	3.0V to 3.6V	Prewarping Embedded RISC CPU	QFP22-256 PBGA1UC256
S1D13517F00A	8-bit /16-bit I/F Indirect addressing	n/a	n/a	18-bit / 24-bit	SVGA	16M colors	Up to 16MB SDRAM	2.3V to 2.7V	3.0V to 3.6V	PinP α-Blend	QFP15-128

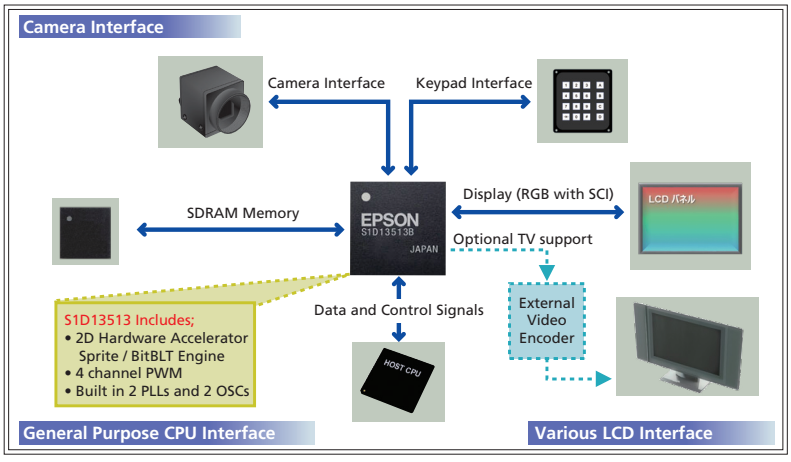
■ S1D13517 Block Diagram



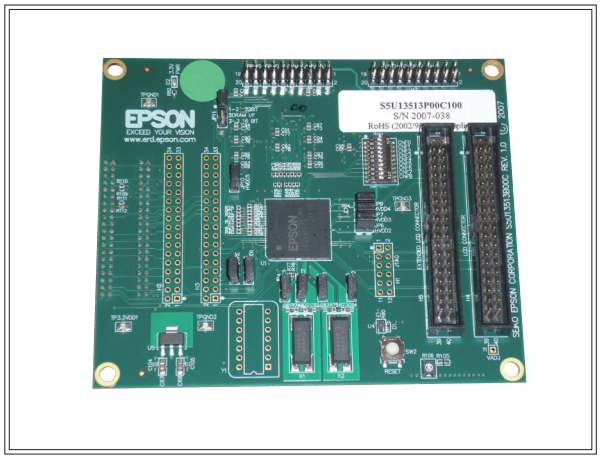
■ S1D13517 Evaluation Board (S5U13517P00C100)



■ S1D13513 Block Diagram



■ S1D13513 Evaluation Board (S5U13513P00C100)



ASSPs

Display Controller Product Line up

■ LCD Controller Supporting Camera Interface

With the installation of a camera interface, this LCD controller can display camera images on the panel without placing load on the CPU.
This product is most suitable for the display control of a wide variety of applications such as mobile terminals and security devices.

Product	CPU Interface Support	LCD Interface Support		Color Depth (Max.)	Internal Memory Capacity	External Memory Capacity	Camera (pixel)	JPEG Codec	Supply Voltage		Additional Features	Package
		TFT	Typical Resolution						Core	IO		
S1D13515F00A B00B	16-bit I/F, Direct addressing, Indirect addressing, Serial I/F	18-bit / 24-bit	XGA	16M colors	0	Up to 64MB SDRAM	0.3MP	n/a	1.65V to 1.95V	3.0V to 3.6V	Prewarping Embedded RISC CPU	QFP22-256 PBGA1UC256
S1D13719B00B	16-bit I/F, Direct addressing, Indirect addressing	18-bit / 24-bit	QVGA	16M colors	512KB, SRAM	n/a	2.0MP	Encode/ Decode	1.65V to 1.95V	2.30V to 3.25V	2D BitBLT, SwivelView, SD memory card I/F	PFBGA10U-180

■ In-vehicle LCD Controller

In our line-up of display controller products, this controller complies with in-vehicle quality.

Product	CPU Interface Support	LCD Interface Support				Color Depth (Max.)	Internal Memory Capacity	External Memory Capacity	Camera (pixel)	JPEG Codec	Supply Voltage		Temperature Range	Additional features	Package
		Monochrome STN	Color STN	TFT	Typical Resolution						Core	IO			
S2D13719F00A	16-bit I/F, Direct addressing, Indirect addressing	n/a	n/a	18-bit / 24-bit	QVGA	16M colors	512KB, SRAM	n/a	2.0MP	Encode/ Decode	1.65V to 1.95V	2.3V to 3.6V	-40 to +105°C	2D BitBLT, SwivelView, SD memory card I/F	QFP22-208

■ Memory Display Controller

This product is for vaious memory display (color and B/W) available in the market.
It has graphic acceleration hardware and voltage generators for memory displays.
Its low power but powerful graphic features are suitable for wearable products.

Products	CPU Interface Support	Panel Interface Support	Color Depth (Max.)	Internal Memory Capacity	Supply Voltage	Additional Features	Package
S1D13C00F00C B00C	SPI, QSPI, Indirect 8-bit	6-bit color MIP, 3-bit or 1-bit Memory LCD with SPI	64 colors	96KB	1.8V to 5.5V	RTC, SPI, QSPI, I²C, DMAC, Sound Generator, IR remote control transmitter	TQFP13-64 WCSP64

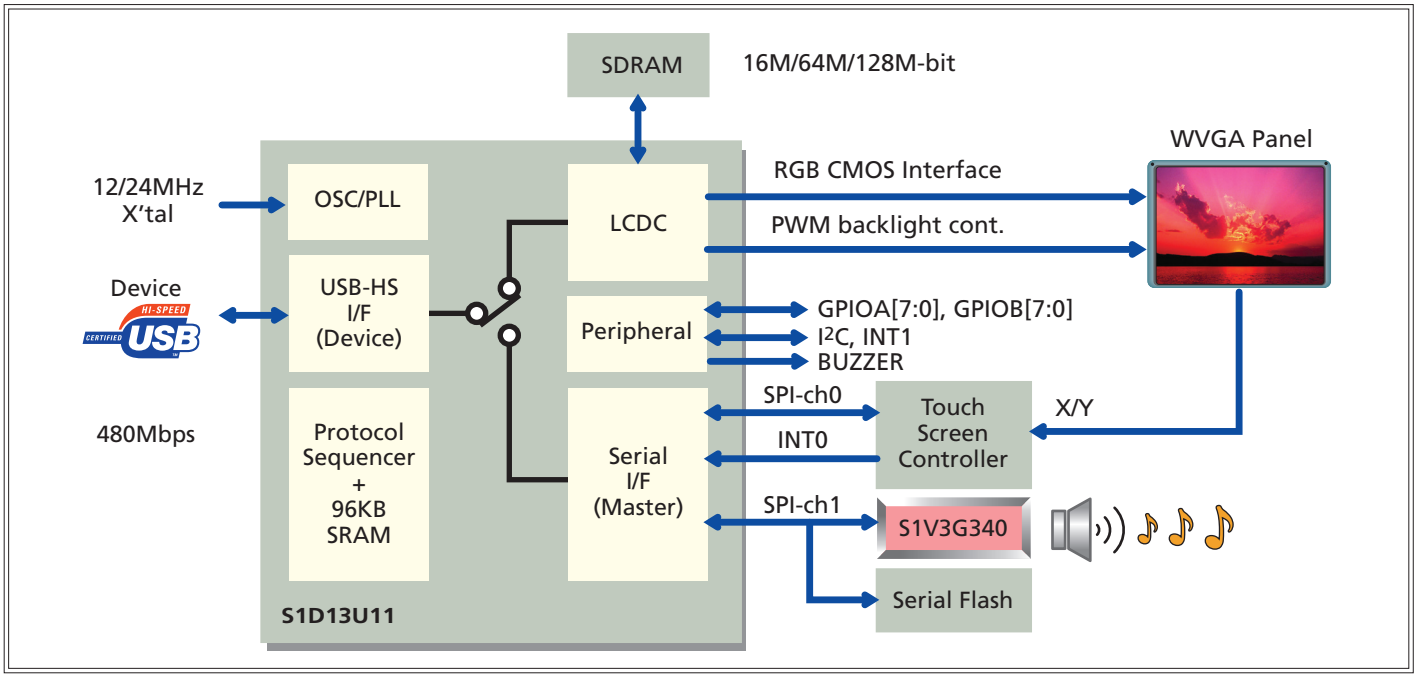
Display Controller Product Line up

■ USB Interface LCD Controller

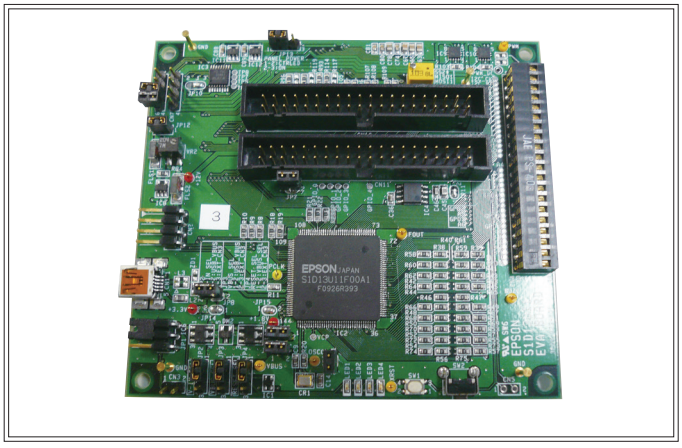
LCD controller allowing for reception of display data and transmission of touch-screen coordinate data at high speed via USB2.0-HS.
Most suitable for application to OA equipment such as multi-functional printers with long lengths of cabling between the host CPU and LCD panel, and to in-vehicle devices such as rear entertainment displays.

Product	CPU Interface Support	LCD Interface Support				Color Depth (Max.)	Internal Memory Capacity	External Memory Capacity	Supply Voltage		Additional Features	Package
		Monochrome STN	Color STN	TFT	Typical Resolution				Core	IO		
S1D13U11F00A	USB2.0 HS	n/a	n/a	18-bit / 24-bit	SVGA	16M colors	0	Up to 16MB SDRAM	1.65V to 1.95V	3.0V to 3.6V	PinP α-Blend	QFP20-144

■ S1D13U11 Block Diagram



■ S1D13U11 Evaluation Board (S5U13U11P00C100)



Display Controller S1D13513

■ Overview

The S1D13513 is a highly integrated Display Controller capable of outputting to LCD or TV. With the flexibility of an external SDRAM memory interface, this low cost, low power, device supports a wide range of CPUs, panels, and a camera port that can be configured as 2x 8-bit ports. The S1D13513 feature set and architecture are designed to meet the requirements of embedded systems such as Mobile Communications, Hand-Held PC's, Office Automation, and Automotive applications.
The S1D13513 features both Sprite and 2D BitBLT engines designed to reduce the load on the Host, while increasing the performance of graphics intensive operations. Additionally, the S1D13513 offers such features as multiple windows, alpha blending, gamma correction, and mirror/rotation function which allow user configurability of various images on the Main/PIP1/PIP2 displays. While focusing on devices targeted by the Microsoft Windows CE Operating System, the S1D13513's impartiality to CPU type or operating system makes it an ideal display solution for a wide variety of applications.

■ Example of Application

External Display Buffer
- Uses external SDRAM or mobile SDRAM as display buffer
- Supports x16 / x32 SDRAM interface (Size: 8M byte, 16M byte, 32Mbyte or 64Mbyte) (x32 and 32/64Mbyte not supported for QFP package)
- SDRAM clock: 100MHz Maximum
- Automatic re-entry into self refresh mode
- Provides linear access to first 1M bytes and four configurable 256KB windows into the remaining memory

Display Support
- RGB Interface single panel
  - 16/18/24-bit Color TFT (24-bit not supported for QFP)
  - Optional serial command interface
- 8-bit Monochrome passive panel
- 8-bit Color Type 2 passive panel
- YUV Digital Output (YUV 4:2:2) which supports NTSC/PAL TV Output via an external Video Encoder
- Color Depths up to 32 bpp
- Example resolutions
  S1D13513F: 1024x768 at a color depth of 18 bpp
  S1D13513B: 1024x768 at a color depth of 24 bpp

Display Features
- Multiple window (layer) support
- Mirror and 180° rotation functions
- Double Buffering support
- Alpha Blending
- Gamma Correction
- Pseudo Color Expansion
- Hardware cursor support via the Sprite engine
- Camera image can be displayed on the PIP1/PIP2 window
- Interrupts available
  - Supports maskable non-display (Vsync) interrupt
  - Supports delayed version of Vsync Interrupt

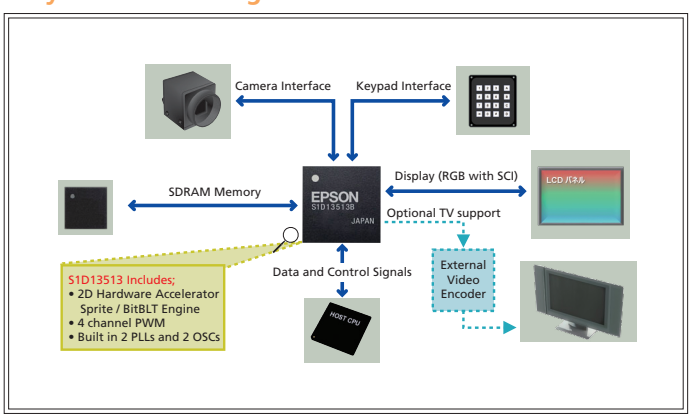
CPU Interface
- Direct and indirect interface support for most popular CPU interfaces
- Serial Host Interface
- Supports 20-50MHz Host bus clock
- Registers are memory-mapped - M/R# input selects between memory and register address space

Digital Video
- Dual Camera / Video Input port can be configured as 2x 8-bit camera ports
  - Supports ITU-R BT656 (CCIR-656) YUV format
  - Supports resize function of the video in stream
  - Supports raw JPEG capture from JPEG capable camera
- Captures YUV data into SDRAM as YUV 4:2:2 format
- View Image can be displayed to LCD or TV
- Resize function built-in for both View and Capture path

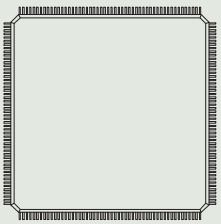
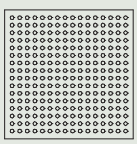
Acceleration
- 2D BitBLT Engine (Read, Write, Move, and Fill BLTs)
- 2D Sprite Engine (up to 16 sprites)
- Unified Command FIFO for both BitBLT and Sprite

Miscellaneous
- Internal system clock: 50MHz maximum (half of SDRAM clock)
- 4 channel PWM for backlight control
- I^2C Interface (typically used for camera)
- Keypad Interface with 5 x 5 matrix support
- Software initiated power save mode
- Multiple General Purpose IO pins
- Flexible clock structure:
  - Two embedded PLLs
  - Two built-in crystal inputs
  - Four digital clock inputs
  - Clocks dynamically turned off when modules are not needed
- COREVDD 1.8 volts and IOVDD 3.3 volts
- Package: S1D13513F: QFP 208-pin
  S1D13513B: BGA 256-pin

■ System Block Diagram



■ Package

PKG type	Body size (mm)	Lead pitch / Ball pitch (mm)
QFP22-208 	28x28x1.4	0.5
PBGA1UC256 	17x17x1.3	1.0

Display Controller S1D13U11

■ Overview

The S1D13U11 is a color LCD graphics controller with an external SDRAM display buffer. The S1D13U11 supports a USB2.0 High-speed device port interface while providing high performance bandwidth to external SDRAM, allowing for fast screen updates. The S1D13U11 supports displays up to 800x600@24bpp with added display functions such as Picture-in-Picture, Double-buffer and Display scroll.
Additionally the S1D13U11 supports I²C and two SPI serial interfaces. It can be connected to an external touch screen controller and serial flash ROM. The S1D13U11 is the best choice of LCD controller to connect between host CPU and LCD panel via the USB port.

■ Features

- External 16/64/128M-bit SDRAM memory support
- USB2.0 High-speed device port (480Mbps)
- Embedded USB protocol sequencer
- High performance SDRAM controller
- Input data formats: RGB 8:8:8, RGB 5:6:5
- Active Matrix TFT interface: 16/18/24-bit interface
- Supports resolutions up to 800x600 @ 24bpp
- I²C master and two SPI master interface
- Main and two Picture-in-Picture display window
- Multi-buffer display or Double-buffer display
- PWM output for LED backlight control
- Buzzer output for touch screen input
- Internal 12M/24M oscillator and PLL
- 8x8 Hardware Key scan interface
- 1.8 volts and 3.3 volts power
- QFP20-144 (20mm x 20mm x 1.7mm)

■ Description

Host CPU Interface
- USB2.0 High-speed device port (1-port)
  - HS (480Mbps) and FS (12Mbps) transfer support
  - Embedded FS/HS termination
- Endpoint
  - Five embedded endpoint FIFO
- Embedded Protocol sequencer
  - 23 kinds of USB protocol command
  - Device class: Vender class
  - Protocol control data (need the download via USB port or external serial flash ROM)

Frame Buffer
- External 16M/64M/128M-bit SDRAM memory
  - Maximum 96MHz SDRAM clock
  - 16-bit bus width

Input Data Format
- RGB 8:8:8, RGB 5:6:5

Display Support
- Active Matrix TFT
  - 16/18/24-bit interface
- Supports resolution up to 800x600 (SVGA)@24bpp
  - QVGA, WQVGA, HVGA, VGA, WVGA

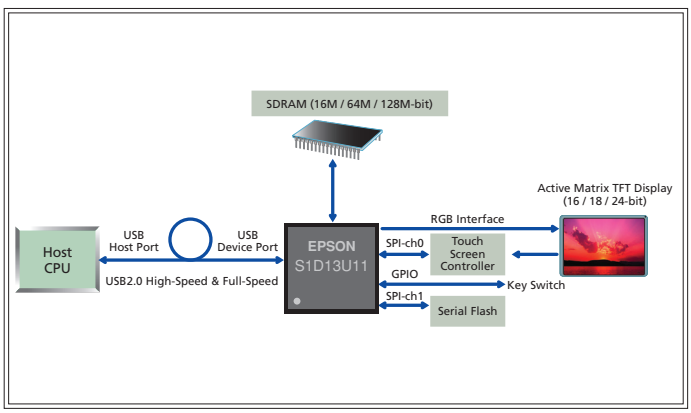
Display Features
- 24 bit-per-pixel (bpp) or 16bpp color depths
- Two Picture-in-Picture window
- Software multi-buffer, Hardware double-buffer display
- Virtual display with smooth scroll

Peripherals
- I²C master interface
- Two SPI master interface
- Key scan interface (8x8, 8x4 or 8x2)
- PWM output for LED backlight control
- Buzzer output for touch screen input

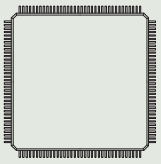
Clock Source
- 12MHz or 24MHz X'tal oscillator
- Internal programmable PLL (Maximum 96MHz)
- LCD pixel clock (Maximum PCLK = 48MHz)
- SDRAM clock (Maximum SDCLK = 96MHz

Miscellaneous
- USBVDD 3.3 volts, IOVDD 3.3 volts and CORE/PLLVDD 1.8 volts
- QFP20 144-pin package (20mm x 20mm x 1.7mm)

■ System Block Diagram



■ Package

PKG type	Body size (mm)	Lead pitch / Ball pitch (mm)
QFP20-144 	20x20x1.7	0.5

Display Controller S1D13517

■ Overview

The S1D13517 is a color LCD graphics controller which uses an external SDRAM display buffer. The S1D13517 supports an 8/16-bit indirect host interface while providing high performance bandwidth to external SDRAM, allowing for fast screen updates.
The S1D13517 supports displays up to 960x540 (QHD) @ 24 bpp or 800x600 (SVGA)@ 24bpp, controlling a main the window and up to two Picture-in-Picture windows. Additionally, the S1D13517 is designed with a 2D Graphics Engine with Alpha Blending. The S1D13517 uses a double-buffer architecture to prevent any visual tearing during streaming video screen updates.

■ Features

- Easy to use, Easy to connect
- External 16M-bit, 64M-bit or 128M-bit SDRAM
- High performance SDRAM controller
- 8/16-bit asynchronous indirect parallel interface (used for display or register data)
- Input data formats: RGB 8:8:8, RGB 5:6:5
- Active Matrix TFT interface: 18/24-bit interface
- Supports resolutions up to 960x540 or 800x600
- Software Power Save mode
- Main Display Window with two Picture-in-Picture windows
- 180° hardware rotation and mirror of display image
- Double-Buffer available to prevent image tearing during streaming input
- PWM output for LCD backlight control
- Internal programmable PLL
- SS (Spread spectrum) clock available
- General Purpose Output pins

■ Description

Frame Buffer
- External 16M-bit, 64M-bit or 128M-bit SDRAM memory support
  - Maximum 90MHz SDRAM clock
  - 16-bit bus width
  - Maximum 16-Buffer separation available

Host Interface
- 8/16-bit asynchronous parallel interface (used for display or register data)
  - Indirect addressing Intel80 interface
  - Burst and rectangular write available for memory

Input Data Format
- RGB 8:8:8, RGB 5:6:5

Display Support
- Active Matrix TFT
  - 18/24-bit interface
- Supports resolution up to 960x560 (QHD)
  - HVGA, VGA, WVGA, SVGA

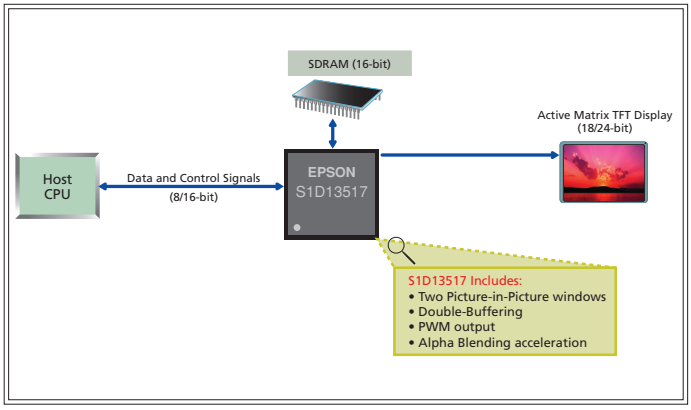
Power
- COREVDD 2.5 volts, PLLVDD 2.5 volts and IOVDD 3.3 volts

Display Features
- 24 bit-per-pixel (bpp) color depths
- Display window
- Two Picture-in-Picture windows
- 2D graphics engine (Alpha blending, Copy)
- 180° hardware rotation and mirror of display image.
- Double-Buffer available to prevent image tearing during streaming input
- Software Multi-Buffer available for simple animation
- TE (Tearing Effect) output

Clock Source
- Internal programmable PLL (Maximum 180MHz)
- Spread Spectrum clock available for PCLK and SDCLK (note: frequency: 31MHz to 80MHz)
- LCD pixel clock (Maximum PCLK = 45MHz)
- SDRAM clock (Maximum SDCLK = 90MHz

Miscellaneous
- PWM output for LCD backlight control
- Software Power Save mode
- General Purpose Output pins are available (GPO[3:0])
- QFP15 128-pin package (14mm x 14mm x 1.7mm)

■ System Block Diagram



■ Package

PKG type	Body size (mm)	Lead pitch / Ball pitch (mm)
QFP15-128 	14x14x1.7	0.4

Display Controller S1D13781

ASSPs

■ Overview

The S1D13781 is a simple, multi-purpose Graphics LCD Controller with 384KByte embedded SRAM display buffer which supports both RGB interface TFT and CSTN panels. The S1D13781 supports most popular CPU interfaces in both 8/16-bit and Direct/Indirect variations. The embedded display buffer allows WQVGA up to 480x272 at 24bpp or 800x480 8bpp for single layer display, or 480x272 at 16bpp (Main Layer) and 480x272 at 8bpp (PIP Layer) for two layer display.

The S1D13781's combination of multiple CPU interfaces and display interface types offers a versatile, yet easy to develop display system. Additionally, it offers Multiple Window support, Transparency and Alpha Blending functions, as well as 2D BitBLT functions. It is a flexible, low cost, low power, single chip solution designed to meet the demands of embedded markets such as low end IP phone devices where total system cost and battery life are major concerns. It's impartiality to CPU type or operating system also makes it an ideal display solution for a wide variety of other applications such as Office Automation and Factory Automation applications.

■ Description

CPU Interface

- Support for most popular CPU interfaces
- Direct/Indirect Addressing
- 8/16-bit interface support
- SPI

Display Support

- Single panel implementation can be:
  - RGB Interface TFT panel
  - Color and Monochrome STN
- Programmable resolutions up to 800x480@8bpp
- Programmable color depths up to 24 bpp

Display Features

- Multiple Window (Layer) support for Main and PIP
- Alpha Blending and Transparency
- PIP Flashing
- LUT 256wordx24-bitx3pcs for both Main and PIP layer
- Rotation (Swivel View) 90°/180°/270°

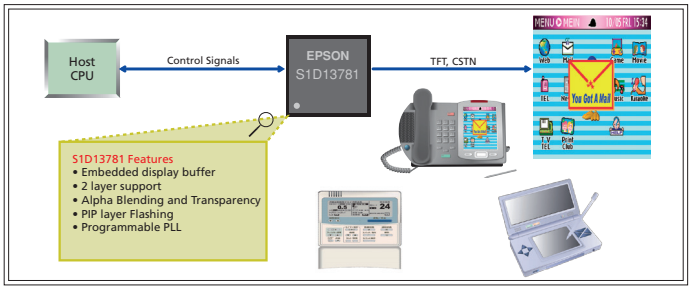
384KByte Embedded Memory

- Maximum Resolution for WQVGA:
  - 1 layer: 480x272 at 24bpp or 800x480 at 8bpp
  - 2 layer: Main 480x272 at 16bpp and PIP 480x272 at 8bpp

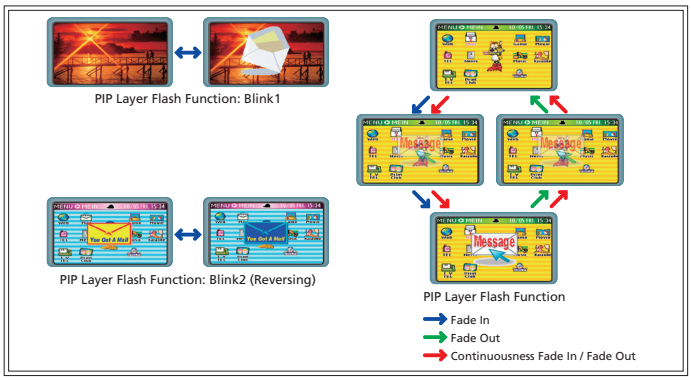
Miscellaneous

- 2D BitBLT
- Internal System Speed: TBD
- Software initiated power save mode
- Multiple General Purpose IO pins
- Flexible clock structure:
  - Embedded PLL
  - Digital clock inputs
- Operating Temperature Range: -40° to 85°
- Low Operating Voltage:
  PLL/COREVDD 1.5 volts and
  PIO/HIOVDD 3.3 or 1.8 volts
- Package: QFP 100-pin, 0.5mm pin pitch

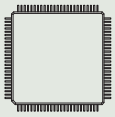
■ System Block Diagram



■ Example of Display Features



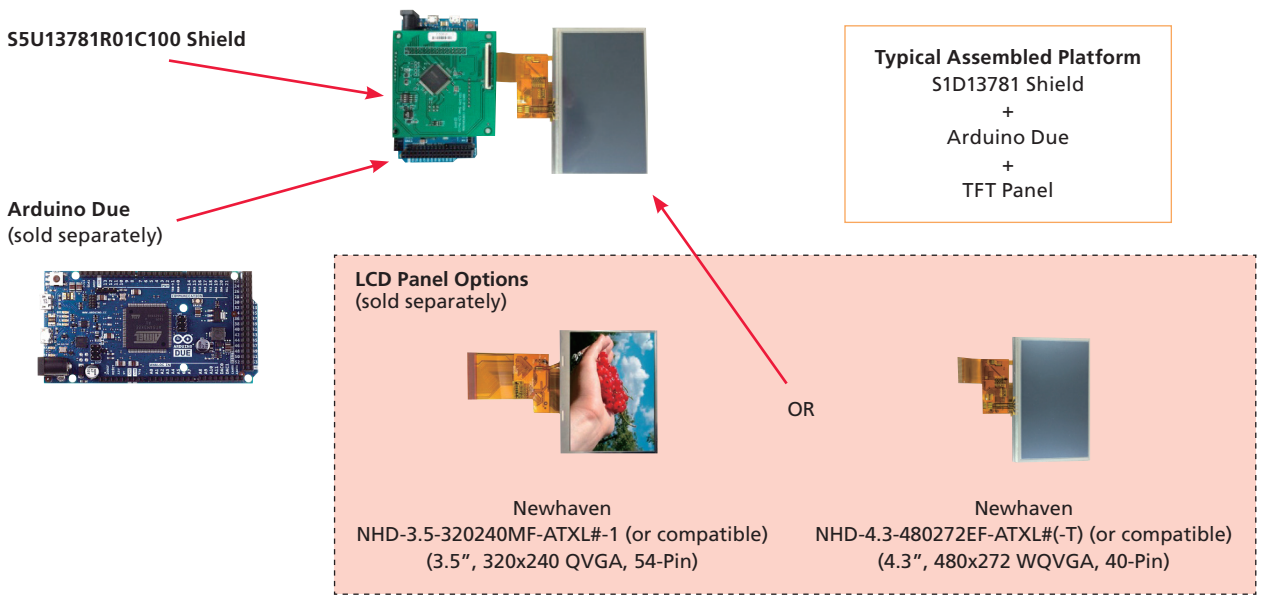
■ Package

PKG type	Body size (mm)	Lead pitch / Ball pitch (mm)
QFP15-100 	14x14x1.7	0.5

Display Controller Reference Design

■ S5U13781R01C100 Shield TFT Board Overview

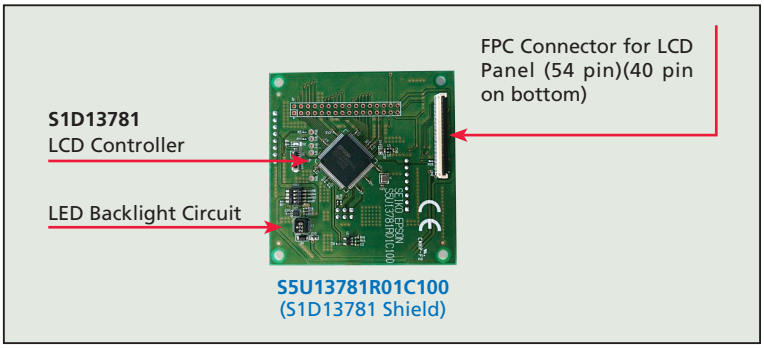
The **Epson S5U13781R01C100 Shield TFT Board** connects to an Arduino Due board to provide support for up to WQVGA TFT graphics. It includes two FPC connectors (40-pin and 54-pin) which can be used to connect to a WQVGA or QVGA TFT panel available separately. Epson provides a software library for use with the Arduino Sketch IDE with hardware IO, simple graphics, and text drawing functions.



■ S5U13781R01C100 Shield TFT Board Hardware Description

The S5U13781R01C100 Shield TFT Board adds support for up to WQVGA TFT graphics to the Arduino Due. It is designed to provide evaluation of the S1D13781 LCD controller and enables rapid prototyping on the Arduino Due board. It uses the Arduino Due’s standard SPI interface, providing a simple hardware connection which is powered by the Arduino Due board. The S1D13781 Shield board includes two FPC connectors (40-pin and 54-pin) which can be used to connect a WQVGA or QVGA TFT panel, available separately.
The S5U13781R01C100 Shield TFT Board integrates a S1D13781 LCD controller which is a simple,multi-purpose Graphics LCD Controller designed to support RGB interface TFT panels. It includes a 384KByte embedded SRAM display buffer which allows up to WQVGA displays. A typical implementation is 480x272 at 24bpp, or 480x272 at 16bpp (Main Layer) and 480x272 at 8bpp (PIP Layer) for two layer display. The S1D13781 is a flexible, low power, single chip solution designed to meet the demands of embedded markets and devices where total system cost and battery life are major concerns.

The S5U13781R01C100 features:
- Simple connection with Arduino Due using SPI
- Graphics Library for use with Arduino Sketch IDE
- 40-pin FPC Connector for 480x272 TFT
- 54-pin FPC Connector for 320x240 TFT
- LED Backlight Driver included on Shield board
- 3.3V IO
- Integrated Epson S1D13781 LCD Controller with:
  - 384KByte Embedded Memory
  - Multiple Window (Layer) support for Main and PIP
  - Rotation (SwivelView™) 90°, 180°, 270°
  - Alpha Blending, Transparency, Flashing



Note: The S1D13781 Shield TFT Board can also be used to evaluate the low cost S1D13L01 LCD Controller which shares the same features as the S1D13781 except for BitBLT functionality. Refer to the S1D13781 and S1D13L01 Hardware Specifications for a complete feature list.

■ S5U13781R01C100 Shield TFT Board Software Library

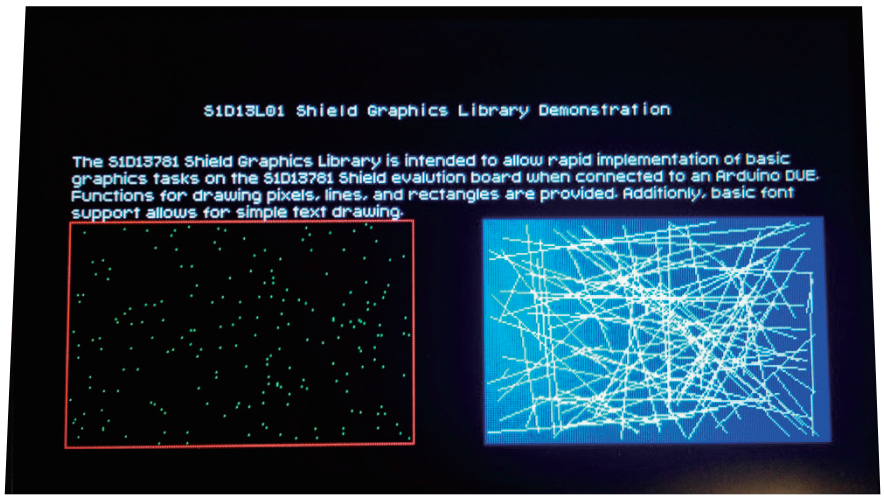
The S5U13781R01C100 Shield Graphics Library is designed for use with the Arduino Sketch IDE. It provides hardware access/control and simple graphics routines which enable users to quickly display graphics and text to a TFT panel connected to the S5U13781R01C100 Shield TFT Board.

The S5U13781R01C100 Shield Graphics Library consists of a collection of C++ methods organized into 2 classes which provide hardware IO access to the S1D13781, simple graphics functions such as pixel draw, line draw, and rectangle draw, and basic text display using a customizable font.

Full source code and documentation is provided allowing easy customization and modification by the user.

Graphics Library Functions:
- Direct Hardware Access – routines for Register and Memory IO, and functions to control S1D13781 features
- Fill Window – fills the display with a selected color
- Draw Pixel – draws pixel at specified x,y location using selected color
- Draw Line – draws line between specified x,y locations using selected color
- Draw Rectangle – draws rectangle (or filled rectangle) using selected color
- Draw Text – draws text and multiline text to the specified window using a customizable font
- Copy Area – routine which uses the BitBLT function to copy image data to another area of the display

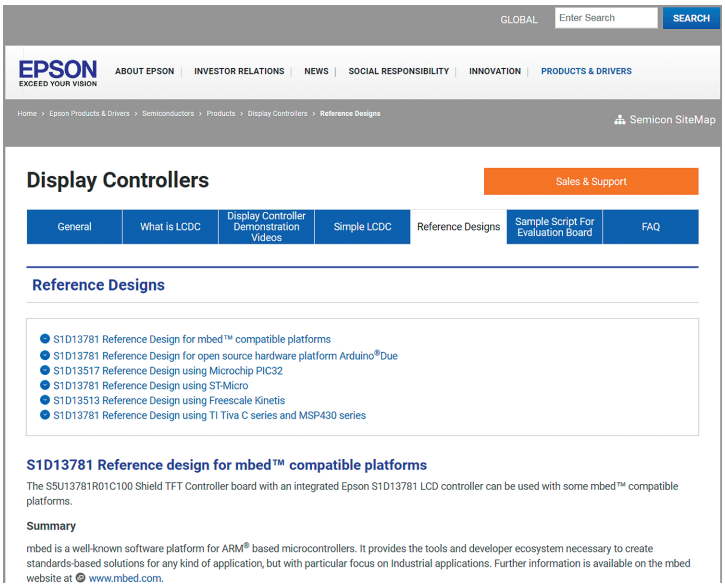
Graphics Library Example Display



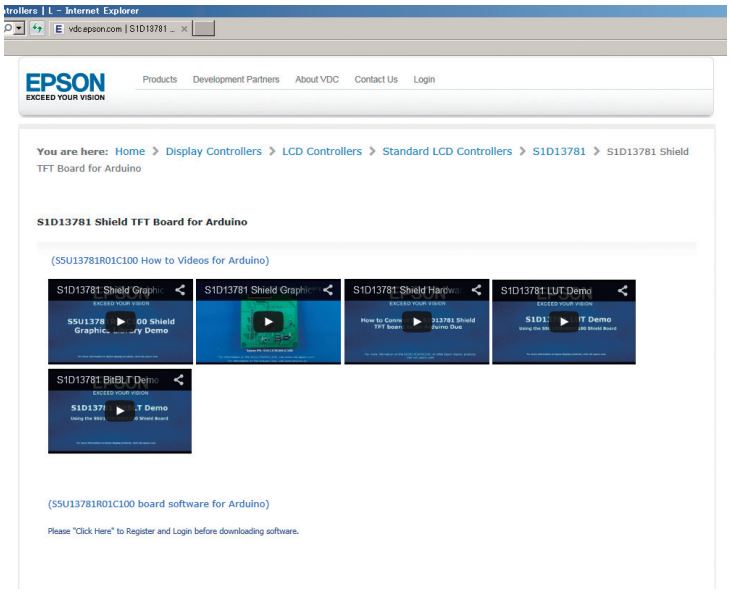
Display Controller Reference Design

■ S5U13781R01C100 information web site

Top page:
global.epson.com/products_and_drivers/semicon/products/display_controllers/reference_design.html



Technical information page:



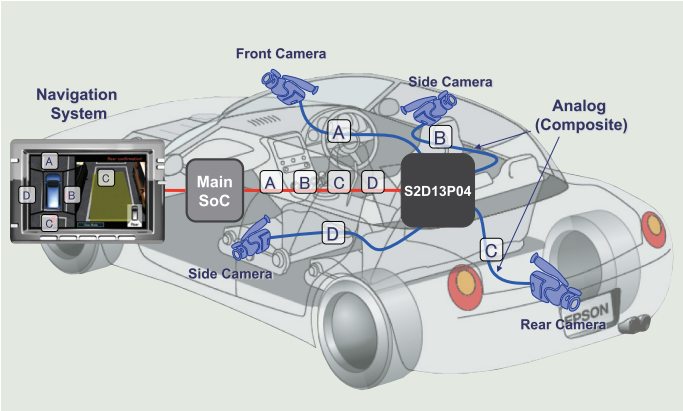
Camera Interface Product Line up

■ In-vehicle Multi-Camera Interface IC

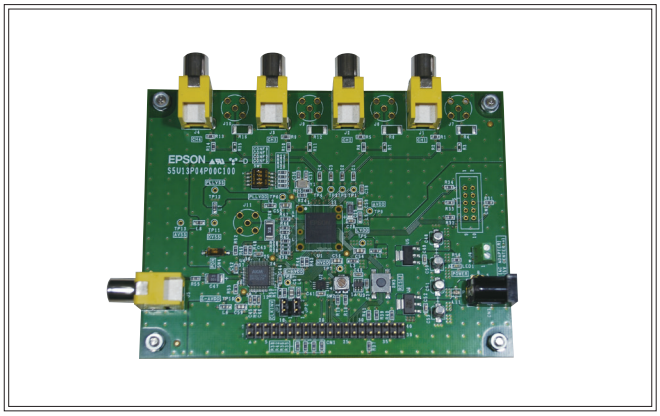
An interface IC that synthesizes input images from multi-channel analog cameras and outputs the images.
This product complies with in-vehicle quality requirements. Most suitable for security-related applications such as monitoring cameras and in-vehicle camera systems.

Product	Host CPU Interface	Function	Temperature Range	Supply Voltage		Package
				Core	IO / Analog	
S2D13P04F00A S2D13P04B00B	I²C SPI	Including four channels of NTSC/PAL decoders 8-bit digital output (supporting ITU-R BT656) Equipped with multi-image synthesis mode Distortion correction function	-40°C to +85°C	1.65V to 1.95V	3.0V to 3.6V	QFP15-100 PFBGA10U-121
S2S65P10F00A	I²C	8-bit digital output (supporting ITU-R BT656) Equipped with multi-image synthesis mode	-40°C to +105°C	1.8V±0.15V	2.4V to 3.6V (IO)	QFP15-100

■ S2D13P04 System Configuration Example



■ S2D13P04 Evaluation Board (S5U13P04P00C100)



Camera Interface S2D13P04

■ Overview

The S2D13P04 is a camera interface IC suitable for on-board camera systems.
The S2D13P04 is integrated with four-channel video decoders to connect four analog cameras simultaneously. The internal VRAM synchronously outputs the asynchronously input image data of each camera. This product is also equipped with image processing functions, such as composition of the image data of the four cameras, distortion correction and interlaced/progressive conversion.
Since the S2D13P04 is equipped with a built-in large capacity VRAM, it is not necessary to connect an external RAM.

■ Features

Video Input
- Video Decoder: 4 channels
- Analog Video (CVBS) Input: 4 inputs
- NTSC-M, NTSC-J
- PAL-M
- PAL-B, PAL-D, PAL-G, PAL-I, PAL-N

Video Output
- Digital Output: 8 bit YCbCr422(With synchronized signal) ITU-R BT.656 *1
- Interlaced Output *2, 3
- Progressive Output

Video Output Mode
- Fixed Mode
- Auto Scan Mode *4
- Merge Mode *2
- Compression Mode *2, 4

Image Processing
- Scaler Function
- Interlaced/Progressive Conversion
- Distortion Correction *3, 4

Output at Stable Frame Rates
- 720×480i 30fps (NTSC interlaced output)
- 640×480p 30fps (NTSC progressive output)
- 640×480p 30fps (NTSC with distortion correction ON)
- 720×576i 25fps (PAL interlaced output)
- 768×576p 25fps (PAL progressive output)
- 640×480p 25fps (PAL with distortion correction ON)

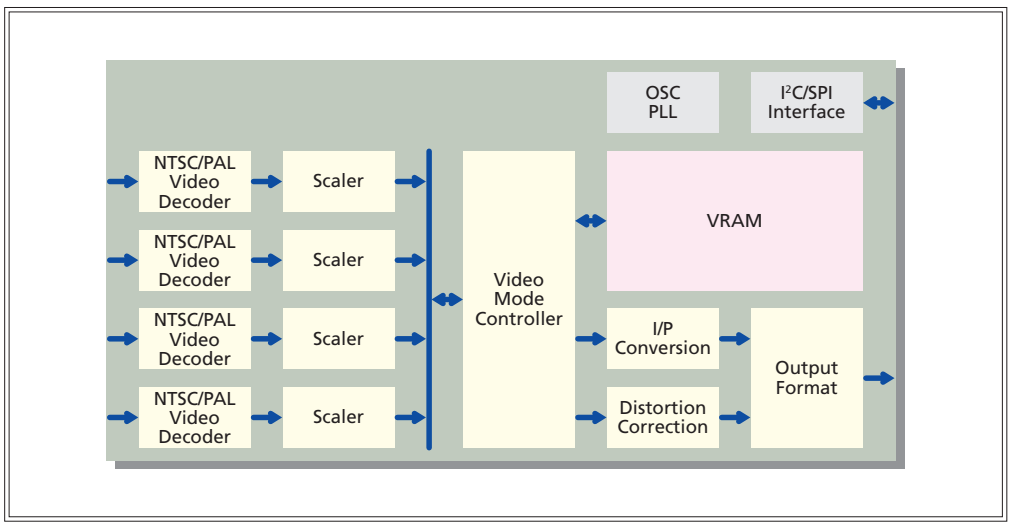
Host Interface
- I²C Interface (Slave)
- SPI Interface (Slave)
- **External RAM not required**
- **Guaranteed Operation Temperature: –40 to +85 °C (Ta)**

Operating Voltage
Analog: 3.3 ± 0.3 V; IO: 3.3 ± 0.3 V
Core: 1.8 ± 0.15 V, PLL: 1.8 ± 0.15 V

Packages
- S2D13P04B00B100
  PFBGA10UX121 (10 mm × 10 mm × 1.2 mm, 0.8 mm pitch)
- S2D13P04F00A100
  QFP15-100pin (14 mm × 14 mm × 1.7 mm, 0.5 mm pitch)

*1: The number of the pixels per line may not comply with the ITU-R BT.656 standard.
*2: In Merge Mode and Compression Mode, outputs are compatible with interlaced output.
*3: When the distortion correction is ON, interlaced output is not supported.
*4: The Auto Scan Mode and Compress Mode are not supported with the distortion correction function.

■ Block Diagram

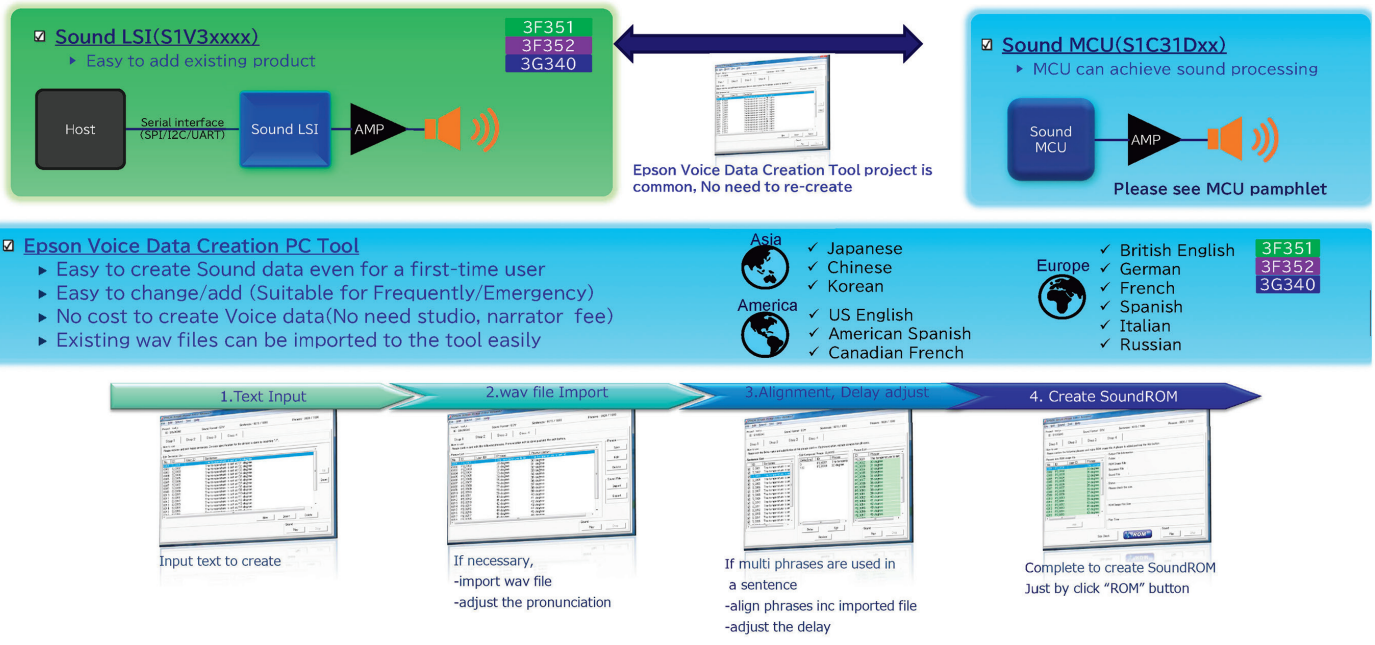


Speech & Audio Product Line up

Epson provides the integrated support of sound including ♪**Voice** and **Music**♪.
Turn to Epson for all sound-related products.

■ Speech & Audio Product Line up

	S1V3F351	S1V3F352	S1V3G340
Functional Information			
Sound Flash	Approx 30sec	Approx 80sec	–
External SPI-Flash I/F	supported(up to 16MB)		
Sound Data streaming	–	–	supported
Sound Play Algorithm	EOV(EPSON Original High Compress & High Quality Format) / 16bit PCM		EOV(EPSON Original High Compress & High Quality Format)
Sound Play channels	2ch Mixing Play(e.g. Ch.0:Voice, Ch.1:BGM)		1ch
Sampling Frequency	15.625kHz(Suitable for Back Ground Music)		16kHz(Suitable for Back Ground Music)
Bitrate	EOV:16/24 kbps	EOV:16/24/32/40 kbps	EOV:16/24/32/40 kbps
Multi-SoundROM	supported		–
Gapless Sound Play	supported		
Volume Setting	supported(0db to -63.0db:0.5db step, silence)		supported(-48 to +18db:1db step, silence)
Repeat Setting	supported(1 to 255times, repeat until stop command)		supported(1 to 65534times, repeat until stop command)
Voice Speed Conversion	75% - 125% (5% step)		–
Voice Pitch Conversion	75% - 125% (5% step)	–	–
Tone Generation	supported	–	–
Buzzer Voice/Melody	supported		–
Record/play	supported(1データのみ)		–
Hardware Information			
Host Interface	SPI/UART/I2C		
Standby mode	supported		
ADC for record	supported		–
Internal Oscillator	supported		–
Ext Oscillator circuit	supported(16MHz)		supported(32.768kHz)
Operation power supply	1.8v to 5.5v		
SPI-Flash power supply	supported(>3.3v)		–
Flash Programming	2.2 to 5.5 V	2.4 to 5.5 V	–
Package	P-TQFP048-0707-0.50(0.5mm pitch)	P-TQFP048-0707-0.50(0.5mm pitch)	P-LQFP048-0707-0.50(0.5mm pitch) P-VQFN048-0707-0.50(0.5mm pitch) P-LQFP052-1010-0.65(0.65mm pitch)

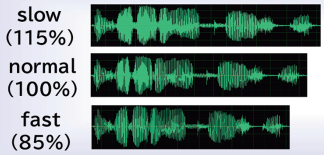


Speech & Audio Product Line up

☑ **Realtime Voice Speed/Pitch Conversion**
- Providing ease of listening to individual end users

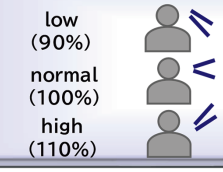
☑ **produce a sense of luxury by 2ch Mixing Play**
- Voice play with background music.

☑ **Realtime Voice Speed Conversion**



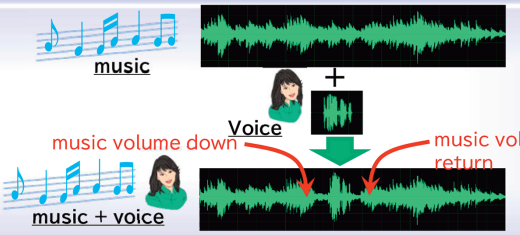
3F351
3F352

☑ **Realtime Voice Pitch Conversion**



3F351

☑ **2ch Mixing play**



3F351
3F352
3G340

☑ **High Quality & High Compression Sound Algorithm**
- 1/4 size comparison with same sampling frequency(16kHz)
- Small size(2/3) comparison with even low sampling frequency(8kHz)
- Many sound data, long music can be stored.
- Multiple language can be integrated.

Epson High Compress & High Quality Algorithm

	Format	sampling rate	ADPCM bit	bitrate	Speech time 1 [min]	2 [min]	3 [min]	4 [min]	5 [min]	10 [min]
others	ADPCM	16 [kHz]	4 [bit]	64 [kbps]	480 [kB]	960 [kB]	1,440 [kB]	1,920 [kB]	2,400 [kB]	4,800 [kB]
		8 [kHz]	4 [bit]	32 [kbps]	240 [kB]	480 [kB]	720 [kB]	960 [kB]	1,200 [kB]	2,400 [kB]
		8 [kHz]	3 [bit]	24 [kbps]	180 [kB]	360 [kB]	540 [kB]	720 [kB]	900 [kB]	1,800 [kB]
EPSON	EOV (original)	16 [kHz]	–	16 [kbps]	120 [kB]	240 [kB]	360 [kB]	480 [kB]	600 [kB]	1,200 [kB]

3F351
3F352
3G340

☑ **Select Sound Output mode** by a product requirement
- **Speaker**
- **Buzzer**(Electromagnetic Buzzer, Piezoelectric Buzzer)

3F351
3F352

☑ Standard:AMP + Speaker

D50 D51 D41

☑ Balance:external circuit+ Speaker

D51 D41

☑ Buzzer:external circuit + Buzzer

D51 D41

USB HUB Controller S2R72A54

Specially developed for Automotive, the S2R72A54 is a USB HUB controller LSI which can be used under the highest operating temperature in the industry from –40°C to +105°C.
The greatest feature of this product is that stable communication can be performed even in severe environments where there are excessively long cables, many junctions and etc.
Furthermore, the S2R72A54 also supports low power consumption designs and on-board quality.

■ Automotive Quality

- AEC-Q100 support.

■ Featurs

- Down stream port x 4 (HSx4)

■ Low Voltage Operation

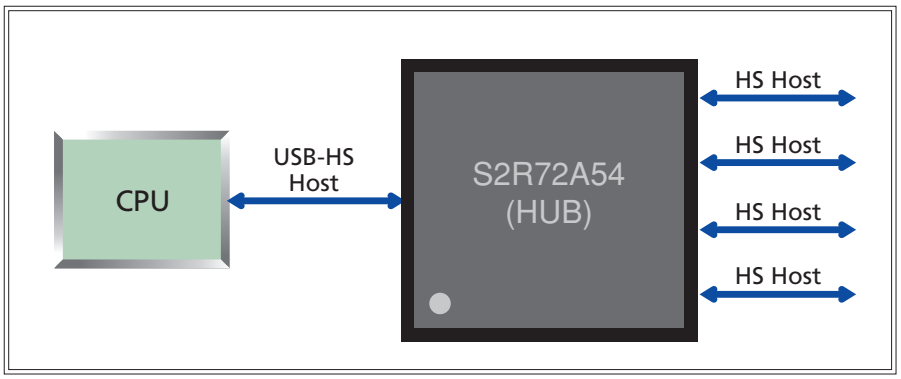
- HVDD 3.3V (±0.3V)

■ Small Size Package

- QFP48-pin 7mm x 7mm, QFN36-pin 6mm x 6mm, QFN36-pin 6mm x 6mm Wettable

■ Extensive Operating Temperature Range

- –40°C to +105°C



■ Other Groups

-S2R72A42: Down stream port × 2 (HS×2)
-S2R72A43: Down stream port × 3 (HS×2, FS×1)
-S2R72A44: Down stream port × 4 (HS×2, FS×2)

USB Re-Synchronization IC S2R72A21

S2R72A21 is the Re-Synchronization IC which re-synchronizes the HS packet of USB 2.0 (Universal Serial Bus Specification Revision 2.0).
Stable longer connection using various USB applications, such as car navigation / car display audio to the smart phone / portable audio player.
S2R72A21 is complying with the automotive level grade quality and support the max temperature range up to 105°C.

■ Automotive Quality

- AEC-Q100 support.

■ Excellent data communication characteristics (HS 480Mbps)

- HS transmission: Transmission waveform with low jitter - Support HS transmission current control
  - Support HS transmission current control
- HS reception: Very high reception tolerance

■ Automatic USB line monitor and control function

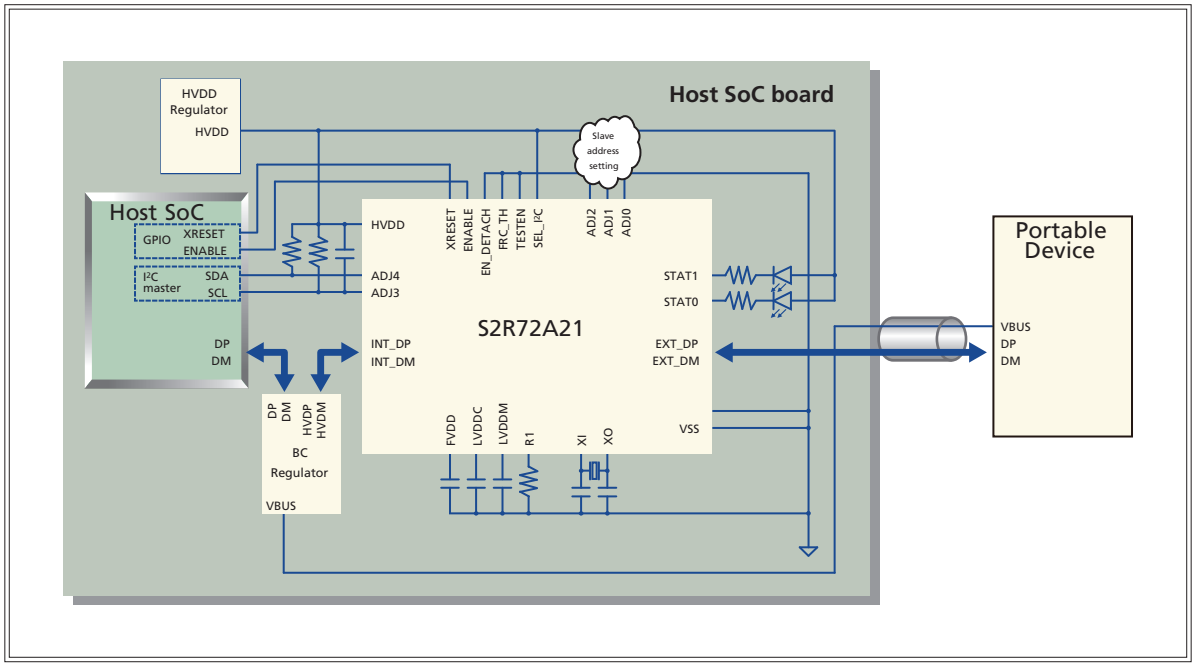
- HS communication: Re-synchronize with HS Synchronizer
- Except for HS communication: Passes through with analog switch

■ Small Size Package

- QFN32-pin 5mm x 5mm Wettable

■ Extensive Operation Temperature Range

- –40°C to +105°C



Memo

Memo

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Document code : 710234421
First Issue April 2006
Revised March 2023 in JAPAN (F)