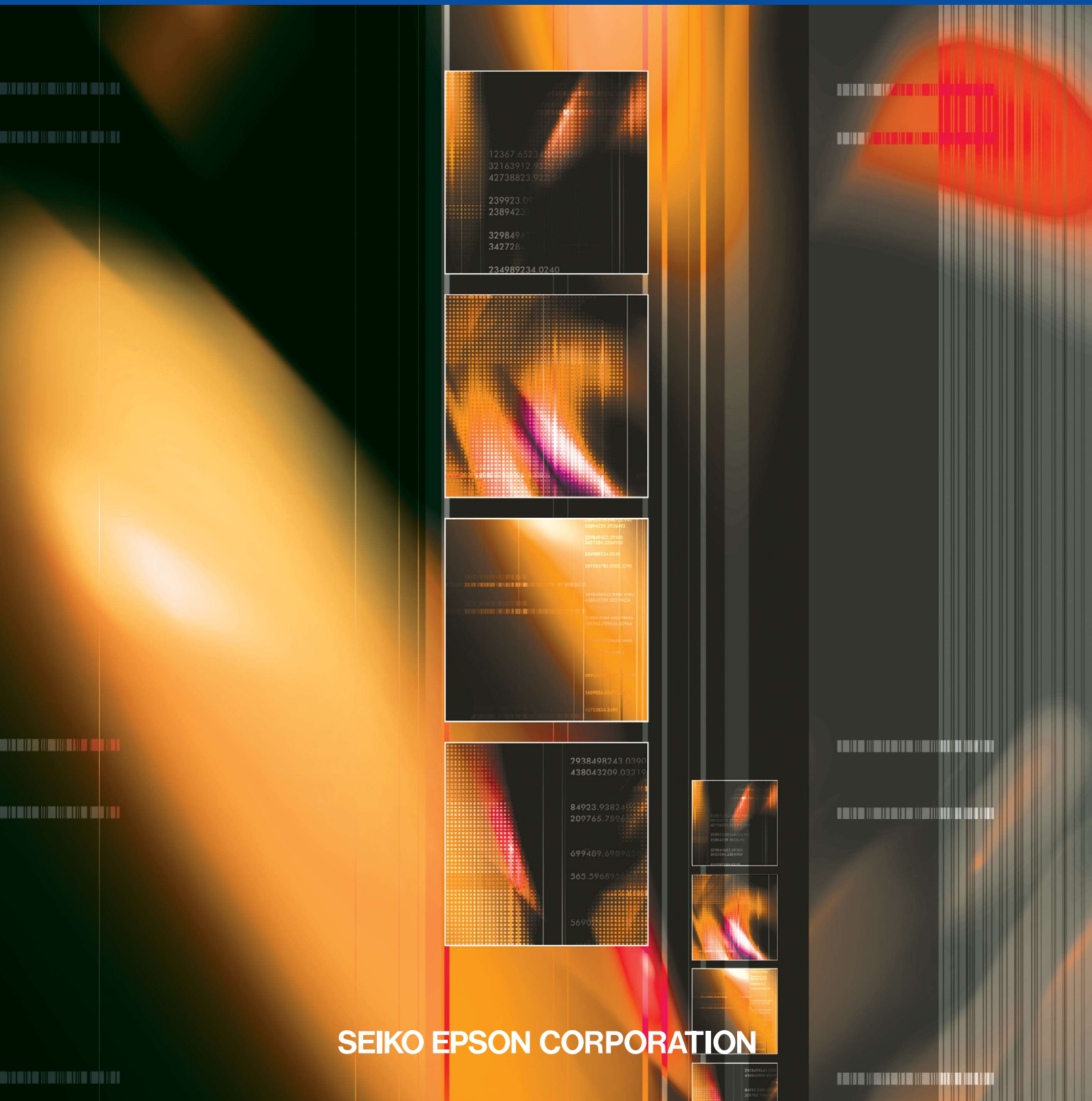
EPSON
EXCEED YOUR VISION

ASSPs

Application Specific Standard Products

2021



SEIKO EPSON CORPORATION

Business Concept

Expanding use of smartphones and tablets is giving broadband internet and wireless communications even greater roles in our daily lives, and making the arrival of the ubiquitous network society an inevitable 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 ubiquitous networks. 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. From the quality-assurance efforts of each employee to the quality of our company as a whole, we devote ourselves to creating products and services that please our customers and earn their trust.
Epson 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, Suwa Minami 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

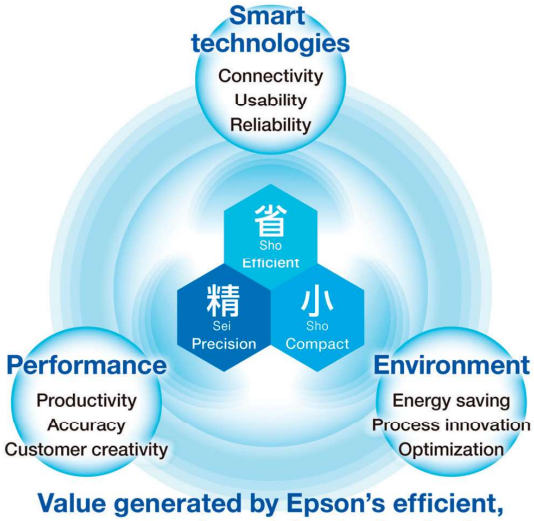
Type of Certification : IATF16949:2016
Awarded to : Singapore Epson Industrial Pte. Ltd.
Certified by : SGS
Certificate No. : SG07/00021
Initial Date of Certification : May 2, 2018

ASSPs

C O N T E N T S

History of Epson semiconductor

Value Generated by Epson Technologies



Value generated by Epson's efficient, compact and precision technologies

Smart technologies

Create convenient and easy-to-use products that can be used anytime and anywhere, and which help customers reduce waste, and save effort, time and money.

Environment

Leverage Epson products to reduce environmental impact by improving customers' work processes, and contribute to a sustainable society.

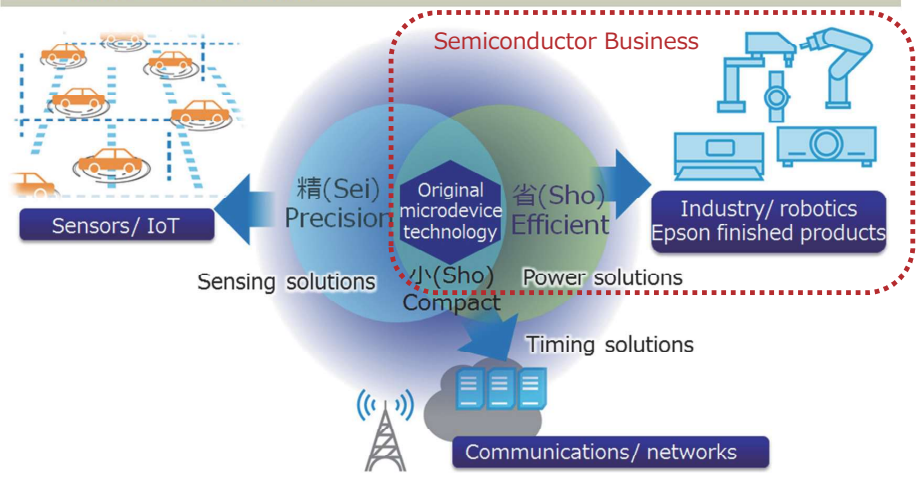
Performance

Use outstanding products to contribute to customers' performance through productivity, accuracy and creativity.

The role of Microdevices Div. and Semiconductor Business

Microdevices Vision and Strategy: Supporting the Four Innovations

Contribute to Epson's finished products and to the development of smart communications, power, transportation and manufacturing systems with advanced Epson quartz timing and sensing solutions and low-power semiconductor solutions.

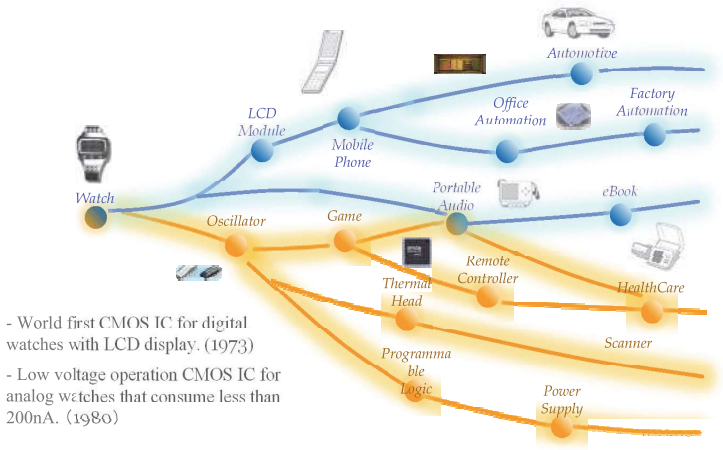


Semiconductor business contribute to the value creation of the Epson finished product, by advanced "Power Saving" solutions.

History of Epson semiconductor

History of Epson Semiconductor's Technology

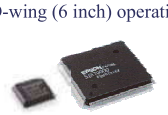
As the semiconductor division of "worldwide watch maker Seiko", semiconductor business has expanded into LCD Drivers, ASICs and MCUs from IC for Watches. These businesses are all based on Epson's energy-saving technology.

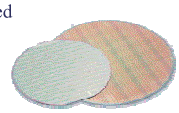


Energy-Saving Technology ; Technology that reduces power consumption from both sides of process and circuit have been nurtured by Epson over 40 years since division was founded.

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



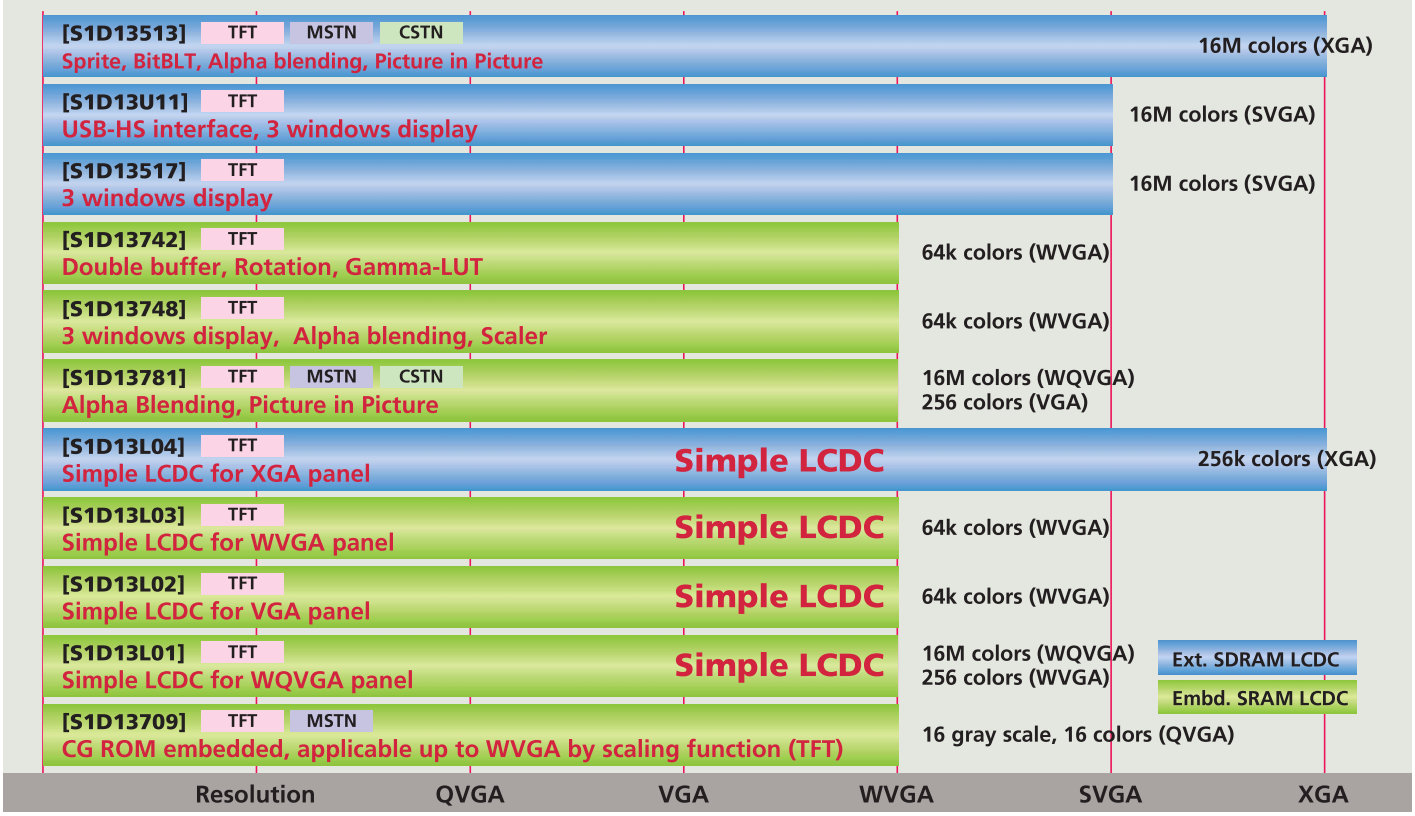


1991	Sakata plant (S-wing,6 inch) operation started
1993	ISO9000 series certified
1994	Singapore assembly plant (SEP) operation started
1997	T-wing (8 inch, Sakata) operation started
	ISO14001 certified
2001	T-wing manufacturing line expanded
2006	ISO/TS16949 certified
2010	Microdevices Operations Division started
2017	IATF16949 certified

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 industry-leading minimal level of power consumption. We have a lineup of products supporting various display devices such as LCD panels, VFD, organic EL, electronic paper and NTSC/PAL TV, providing the most suitable solution for embedded devices, mobile terminals, in-vehicle devices and other applications.

Display Controller Product Line up



Display controller's example of application

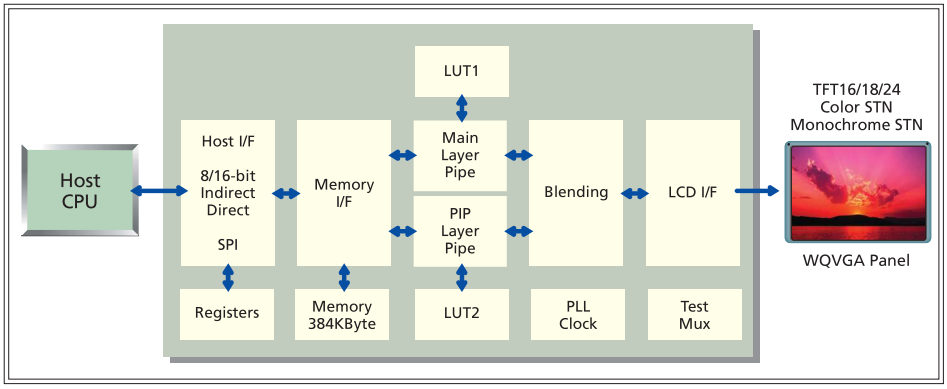
Display Controller Product Line up

■ 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
S1D13709F00A	8-bit I/F, Direct addressing Indirect addressing	4-bit	n/a	4-bit mono/ 6-bit color	QVGA	MSTN:16 grayscale TFT:64 colors	32KB, SRAM	3.0V to 5.5V	3.0V to 5.5V	3 overlay screens	TQFP14-80
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 B00B	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



■ S1D13781 Evaluation Board (S5U13781P00C100)

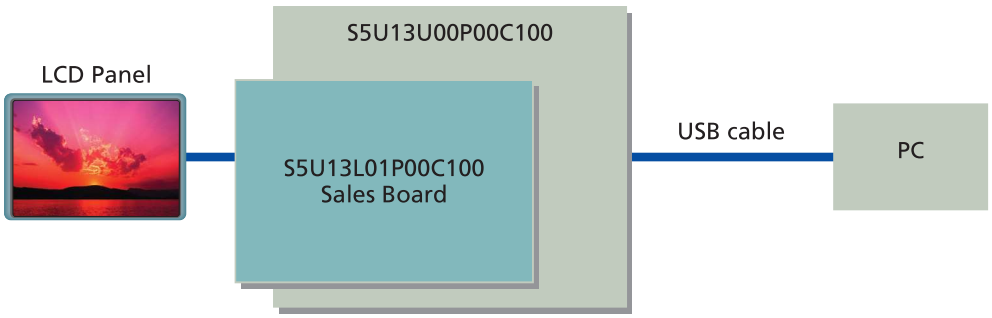
Display Controller Product Line up

■ 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

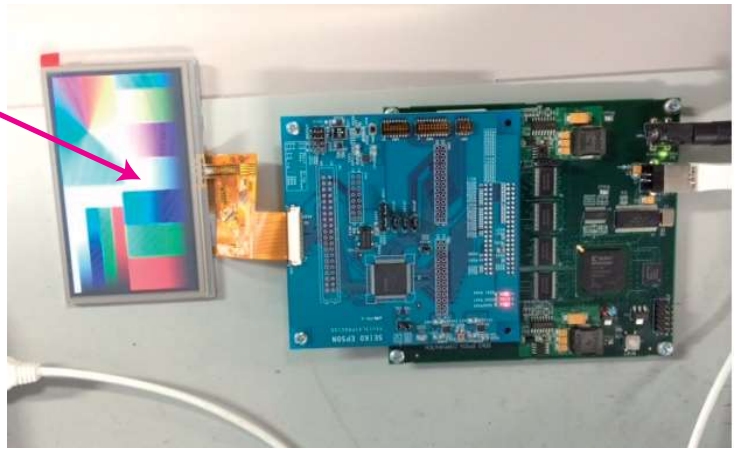


Checked available panel:

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

Kyocera
TCG043WQLBAANN-GN00 (WQVGA)

KOE
TX11D06VM2APA (WQVGA)



Display Controller Product Line up

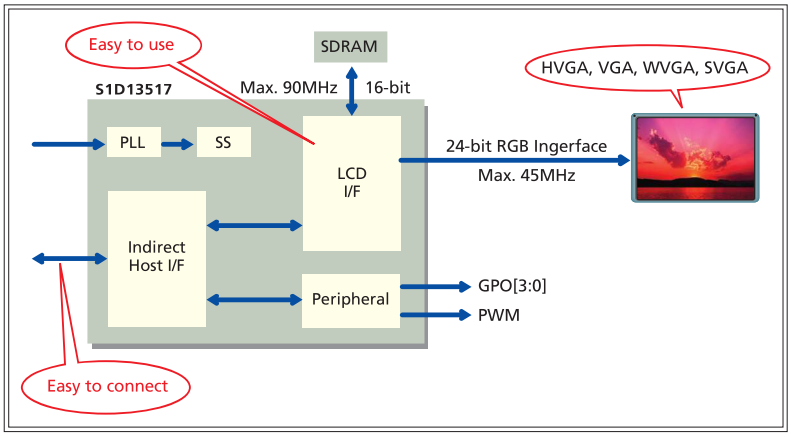
ASSPs

■ LCD Controller with External VRAM

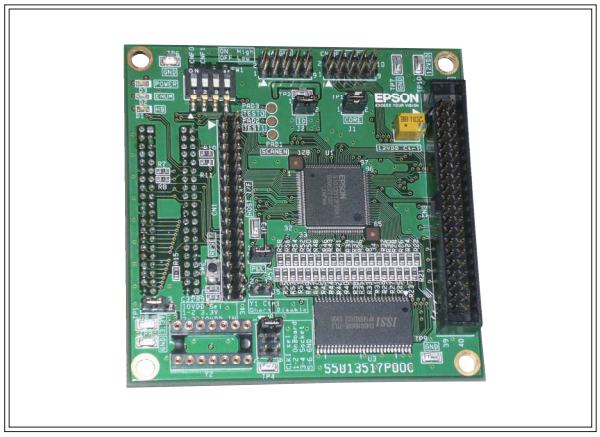
LCD controller for application in a wide range of small- to large-size panel types.
This product is most suitable for the display control of OA or FA equipment operation panels as well as for in-vehicle devices.

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

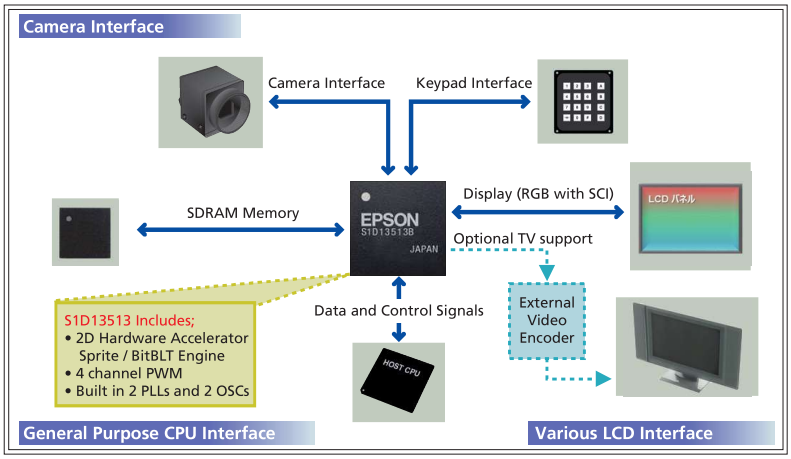
■ S1D13517 Block Diagram



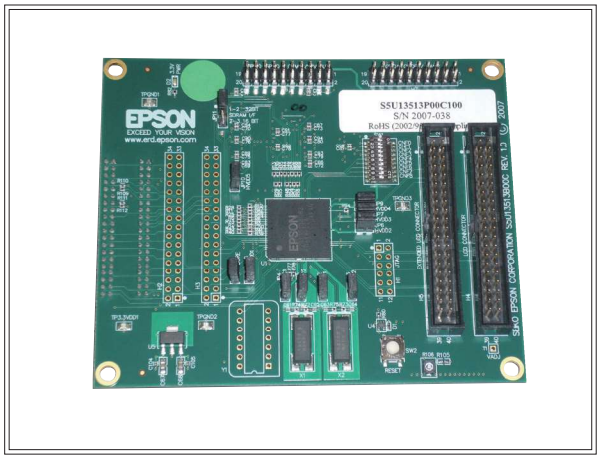
■ S1D13517 Evaluation Board (S5U13517P00C100)



■ S1D13513 Block Diagram



■ S1D13513 Evaluation Board (S5U13513P00C100)



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			
S2D13513B01B	16-bit I/F, Direct addressing, Indirect addressing, Serial I/F,	8-bit	8-bit	18-bit / 24-bit	XGA	64 grayscale 16M colors	0	Up to 64MB SDRAM	0.3MP	n/a	1.65V to 1.95V	3.0V to 3.6V	-40 to +105°C	2D Sprite, 2D BitBLT	PBGA1UC256
S2D13515F00A	16-bit I/F, Direct addressing, Indirect addressing, Serial I/F,	n/a	n/a	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	-40 to +105°C	Prewarping Embedded RISC CPU	QFP22-256
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

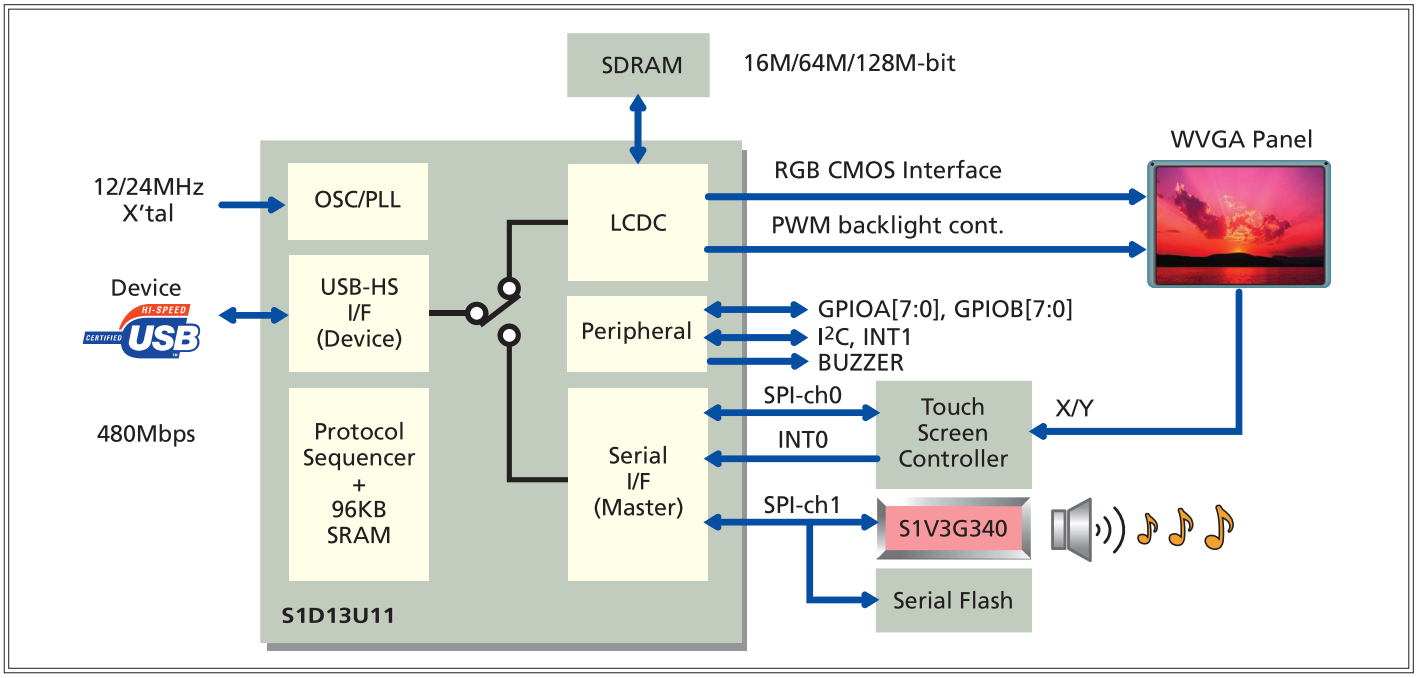
Display Controller Product Line up

■ USB Interface LCD Controller

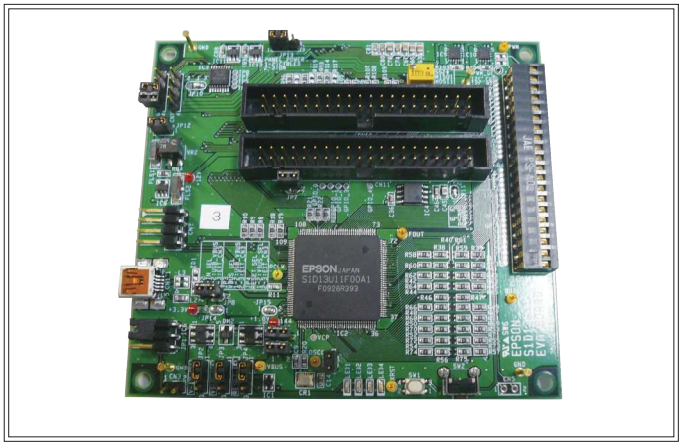
LCD controller allowing for reception of display data and transmission of touch-screen coordinate data at high speed via USB2.0-HS.
Most suitable for application to OA equipment such as multi-functional printers with long lengths of cabling between the host CPU and LCD panel, and to in-vehicle devices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



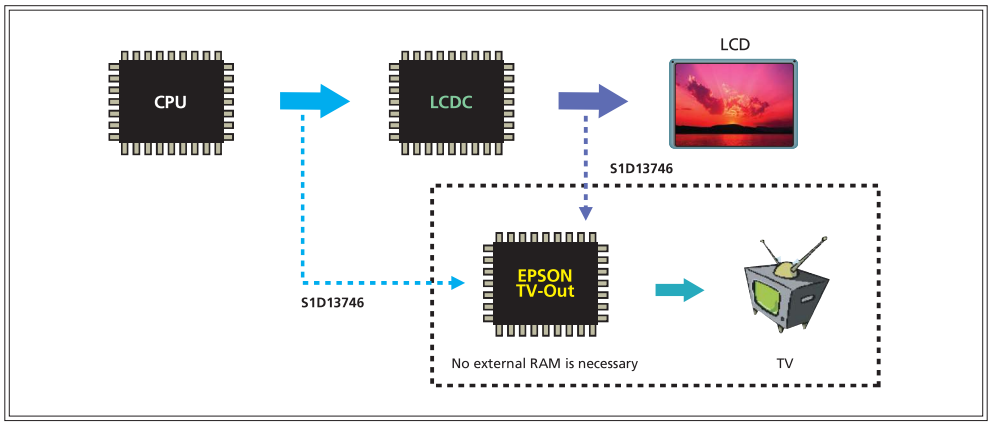
Display Controller Product Line up

Video Encoder

A video encoder with built-in VRAM, able to be connected directly with the host CPU bus and TFT panel interface.
This product is most suitable for various applications that display images on televisions, because it supports a wide array of input formats and complies with NTSC/PAL standards.

Product	CPU Interface Support	TV Output	TV Standard	Input Data Format		Internal Memory Capacity	External Memory Capacity	Supply Voltage			Additional Features	Package
				RGB	YUV			Core	IO	DAC		
S1D13746F01A B01B	8-bit / 16-bit I/F Direct addressing, Serial I/F (only for register access)	Composite / S-video	PAL:B, D, G, H, I, M, N, Nc NTSC:M, J	8:8:8 6:6:6 5:6:5 3:3:2	4:2:2 4:2:0	312KB, SRAM	n/a	1.35V to 1.65V	1.62V to 3.6V	2.7V to 3.3V	SwivelView, Image Enhancement Engine	QFP15-128 PFBGA7U-100

S1D13746 System Block Diagram



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 S1D13513

ASSPs

■ 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

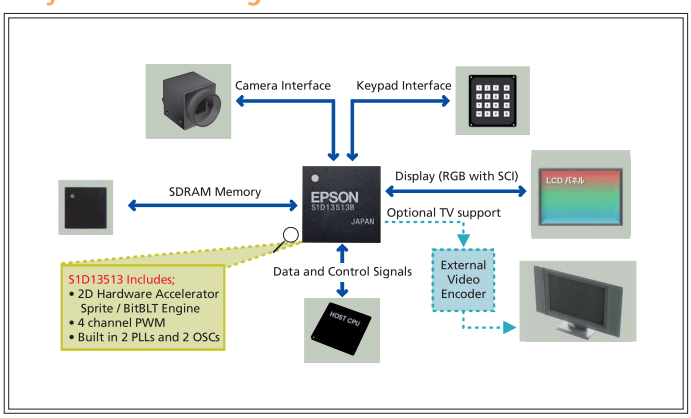
CPU Interface
- Direct and indirect interface support for most popular CPU interfaces
- Serial Host Interface
- Supports 20-50MHz Host bus clock
- Registers are memory-mapped - M/R# input selects between memory and register address space

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

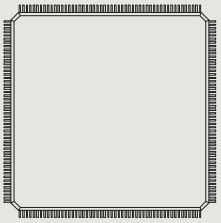
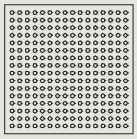
Acceleration
- 2D BitBLT Engine (Read, Write, Move, and Fill BLTs)
- 2D Sprite Engine (up to 16 sprites)
- Unified Command FIFO for both BitBLT and Sprite

Miscellaneous
- Internal system clock: 50MHz maximum (half of SDRAM clock)
- 4 channel PWM for backlight control
- I²C 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

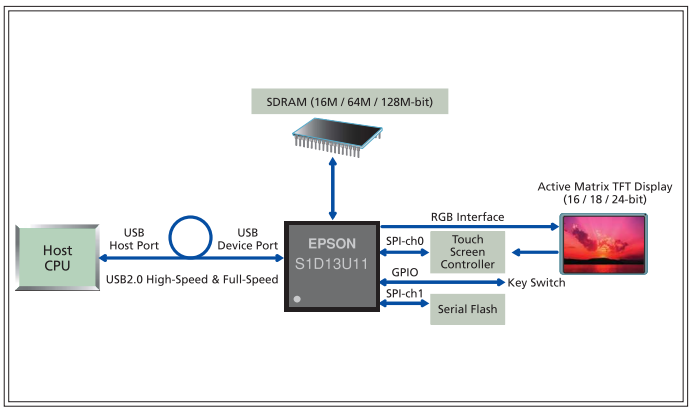
Display Features
- 24 bit-per-pixel (bpp) or 16bpp color depths
- Two Picture-in-Picture window
- Software multi-buffer, Hardware double-buffer display
- Virtual display with smooth scroll

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

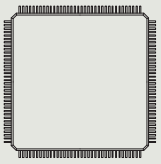
Clock Source
- 12MHz or 24MHz X'tal oscillator
- Internal programmable PLL (Maximum 96MHz)
- LCD pixel clock (Maximum PCLK = 48MHz)
- SDRAM clock (Maximum SDCLK = 96MHz

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

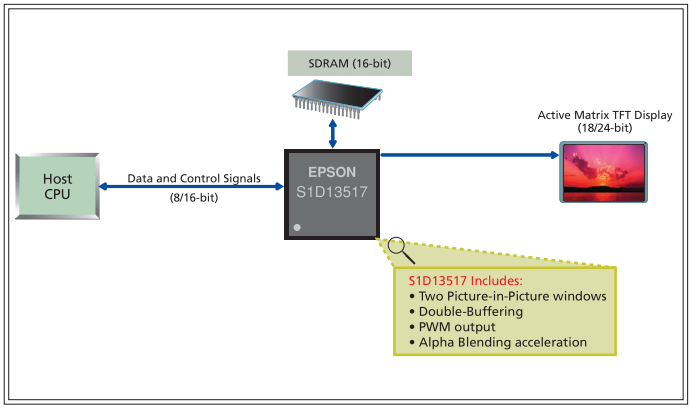
Power
- COREVDD 2.5 volts, PLLVDD 2.5 volts and IOVDD 3.3 volts

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

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

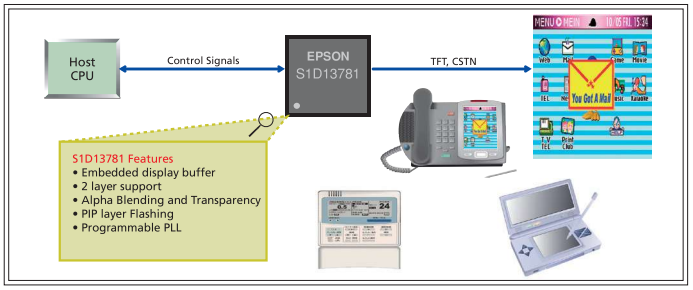
Display Support
- Single panel implementation can be:
  - RGB Interface TFT panel
  - Color and Monochrome STN
- Programmable resolutions up to 800x480@8bpp
- Programmable color depths up to 24 bpp

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°

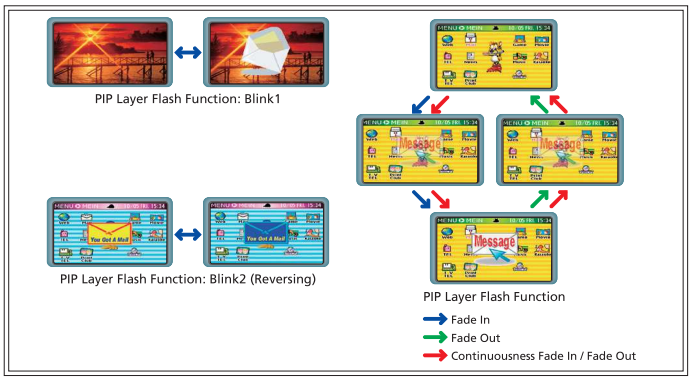
384KByte Embedded Memory
- Maximum Resolution for WQVGA:
  1 layer: 480x272 at 24bpp or
  800x480 at 8bpp
  2 layer: Main 480x272 at 16bpp and
  PIP 480x272 at 8bpp

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

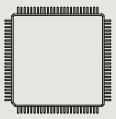
System Block Diagram



Example of Display Features

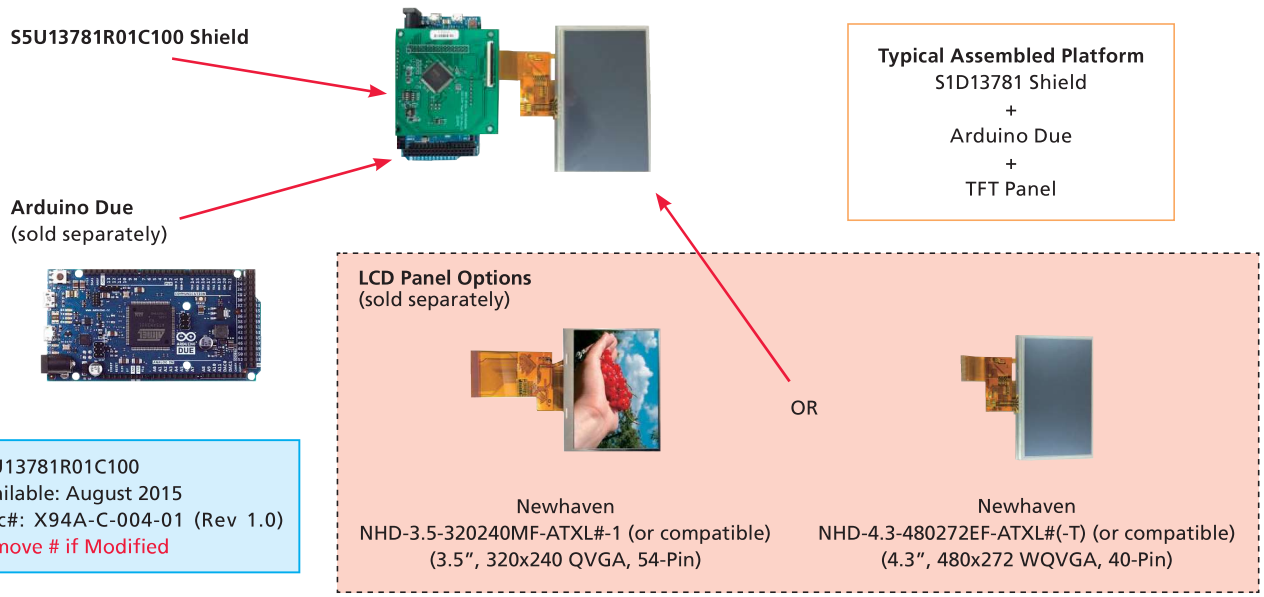


Package

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

■ S5U13781R01C100 Shield TFT Board Overview

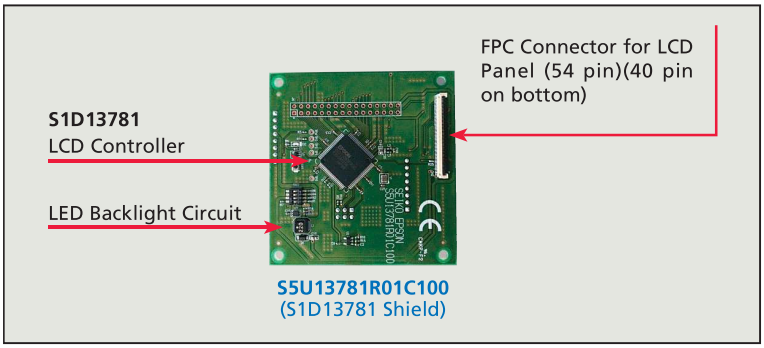
The **Epson S5U13781R01C100 Shield TFT Board** connects to an Arduino Due board to provide support for up to WQVGA TFT graphics. It includes two FPC connectors (40-pin and 54-pin) which can be used to connect to a WQVGA or QVGA TFT panel available separately. Epson provides a software library for use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

Display Controller Reference Design

S5U13781R01C100 Shield TFT Board Software Library

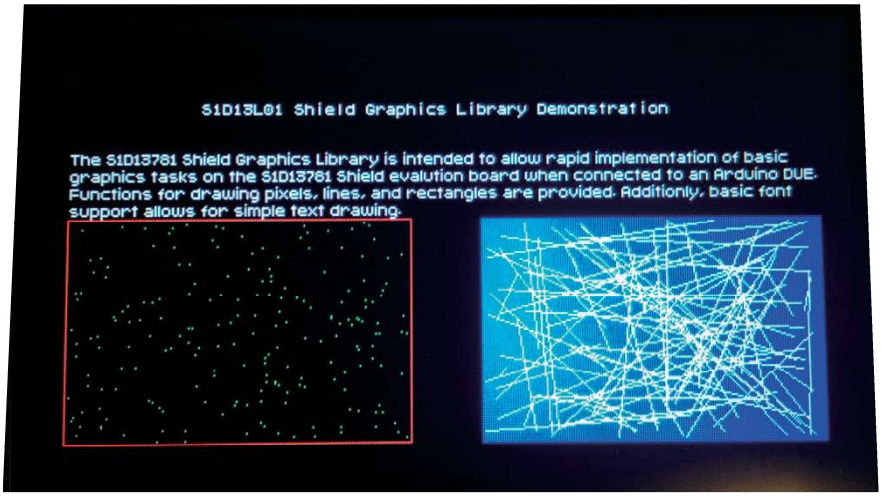
The S5U13781R01C100 Shield Graphics Library is designed for use with the Arduino Sketch IDE. It provides hardware access/control and simple graphics routines which enable users to quickly display graphics and text to a TFT panel connected to the S5U13781R01C100 Shield TFT Board.

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.

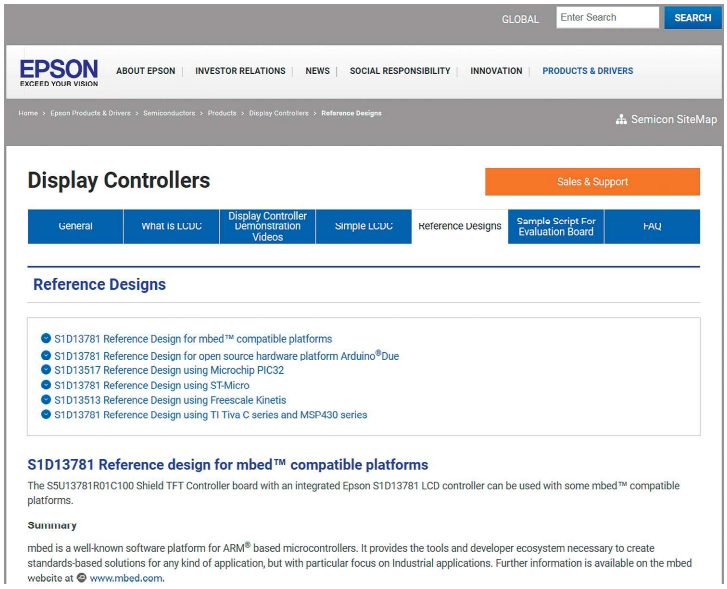
Graphics Library Functions:
- Direct Hardware Access – routines for Register and Memory IO, and functions to control S1D13781 features
- Fill Window – fills the display with a selected color
- Draw Pixel – draws pixel at specified x,y location using selected color
- Draw Line – draws line between specified 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

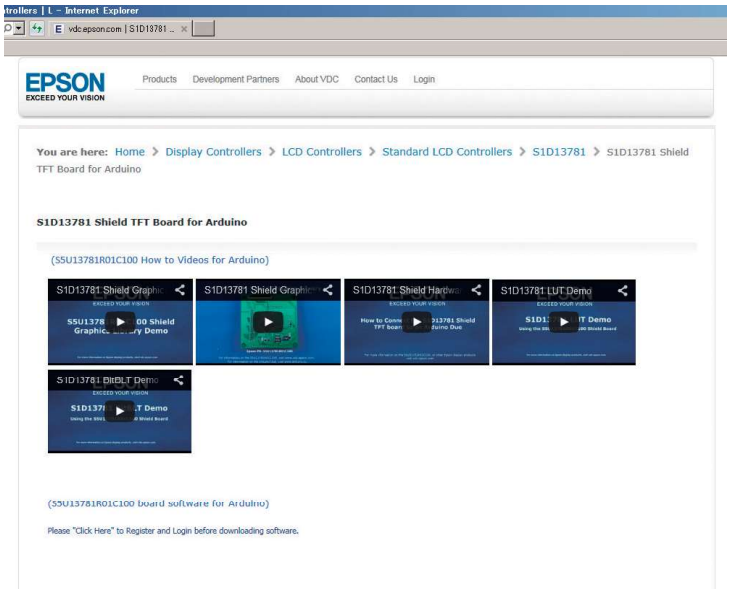


■ S5U13781R01C100 information web site

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



Technical information page:



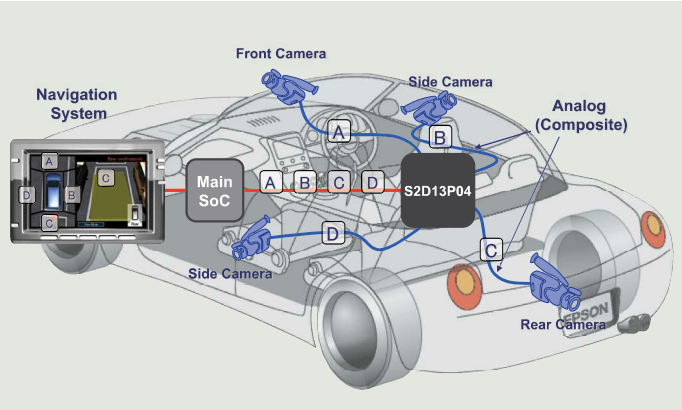
Camera Interface Product Line up

■ In-vehicle Multi-Camera Interface IC

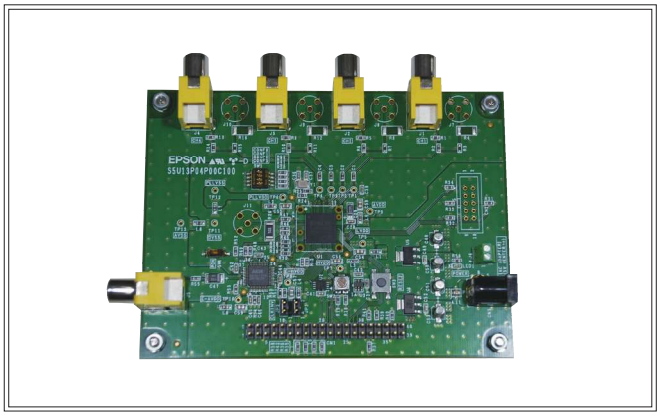
An interface IC that synthesizes input images from multi-channel analog cameras and outputs the images.
This product complies with in-vehicle quality requirements. Most suitable for security-related applications such as monitoring cameras and in-vehicle camera systems.

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

■ 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)

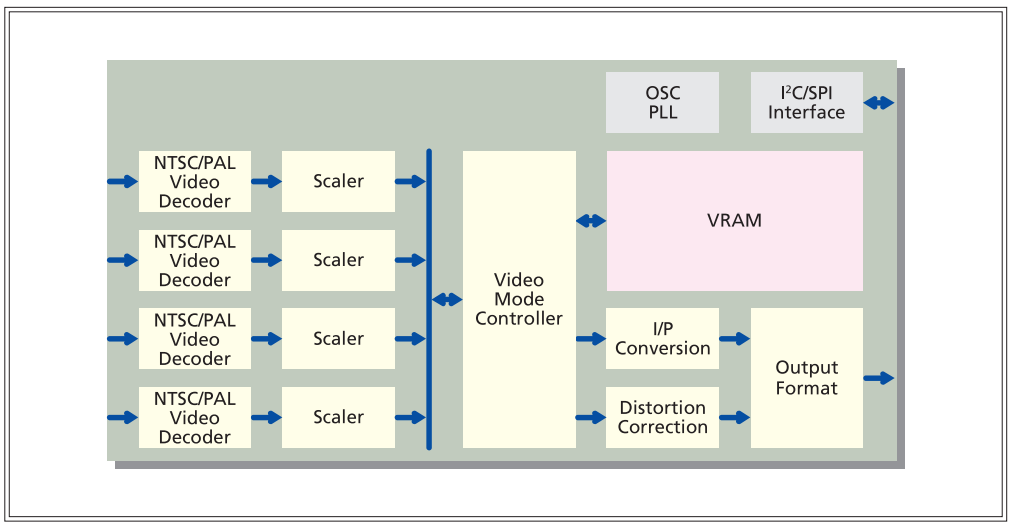
Host Interface
- I²C Interface (Slave)
- SPI Interface (Slave)
- **External RAM not required**
- **Guaranteed Operation Temperature: –40 to +85 °C (Ta)**

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



ASSPs

Speech & Audio Product Line up

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

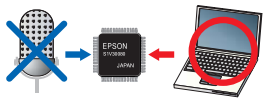
■ Speech & Audio Product Line up

Series Name	S1V3G340	S1V30080
Supply Voltage	5.5v - 2.2v single	5.5v - 2.2v single
Clock	32.768kHz or 12.288MHz	8.192MHz (fs: 8kHz) 16.384MHz (fs: 16kHz)
Host Interface	SPI/UART/I²C (Command Control)	SPI/I²C (Command Control) standalone mode
Sound Decode Format	Epson Original Format	
Sound Decode Output Sampling Frequency	16kHz	4, 8, 12, 16kHz
Supported Bitrates	16/24/32/40kbps	8-bit/10-bit mode
Melody Synthesizer	–	Supports 5ch,5 Octaves
Sound Phrase Combination Function	Supported	
Setting of Delay Between Phrases	0ms or 20 - 2047ms (1ms step)	0ms - 1000ms (10ms step)
Sound Data Streaming Regeneration	Supported by command control via the host interface.	Melody data streaming supported
Internal ROM Size (Time)	–	Approx. 15sec (fs:16kHz)
External SPI-Flash I/F	Supported	–
DAC	High precision 16-bit DAC incorporated	10-bit DAC
Package	QFP13-52 (10mm□, 0.65mm pitch) QFP12-48 (7mm□, 0.5mm pitch) SQFN7-48 (7mm□, 0.5mm pitch)	QFP13-52 (10mm□, 0.65mm pitch) QFP12-48 (7mm□, 0.5mm pitch)
Supported Languages	Languages supported by Epson Voice Data Creation PC tool: (No language restrictions when used for studio recording) Asia : Japanese, Chinese (Mandarin), Korean America : American English, American Spanish, Canadian French Europe : British English, German, French, Spanish, Italian, Russian	
Evaluation Board	Supported	
Sample Code (For the Host)	Supported	

■ Features of "Silky Voice" Voice Guide LSI
Opening new worlds through spoken communication.

Feature 1 No studio recording required!

Epson Voice Guide LSI does not require arrangement of dubbing artists or studios to create sound data. This contributes to a drastic reduction in the amount of time and cost required by the customer. By using Epson Voice Data Creation PC tool offered you can easily create and edit sound data using a PC.



[Supported languages]
Asia : Japanese, Chinese(Mandarin), Korean
America : American English, American Spanish, Canadian French
Europe : British English, German, French, Spanish, Italian, Russian

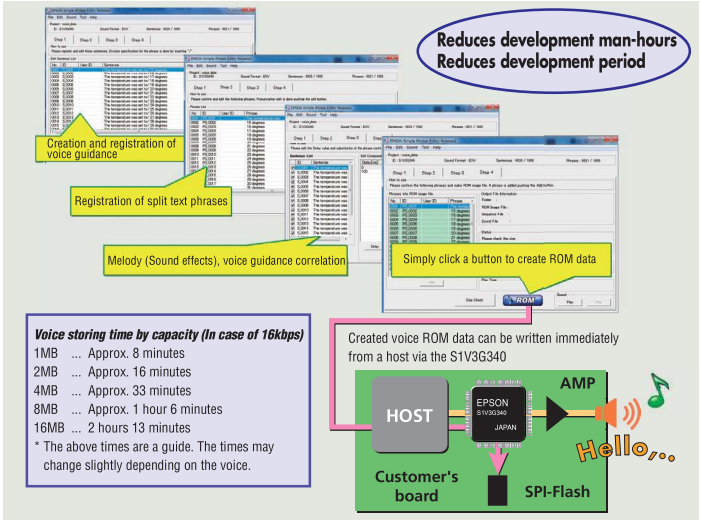
Feature 2 High-quality sound and double to quad message amount!

Using the high-compression Epson format provides a maximum 1/4 compression ratio as compared to the conventional ADPCM method.
Using sound quality that is dramatically higher than that of the ADPCM method with the incorporated high-quality DAC enables playback of high-quality sound by combining "Silky Voice" and sound effects.

	Epson (16kHz)	ADPCM (16kHz)	ADPCM (8kHz)
Bit rate	16[kbps]	64[kbps]	32[kbps]
Memory size (10sec.)	160[kbit]	640[kbit]	320[kbit]
Memory size (1min.)	960[kbit]	3,840[kbit]	1,920[kbit]
Memory size (2min.)	1,920[kbit]	7,680[kbit]	3,840[kbit]
Memory size (3min.)	2,880[kbit]	11,520[kbit]	5,760[kbit]

■ Easy Development Flow

The combination of the All in One PC tool "Silky Voice" generator, and use of external SPI-Flash with the S1V3G340 makes it easy to create, write and evaluate voice data. The created voice ROM data can be written to SPI-Flash from a Host CPU via the S1V3G340. The use of high-quality audio and a high-compression format also enables the loading of large voice data capacity.



Speech & Audio Product Line up
S1V3G340

■ Overview

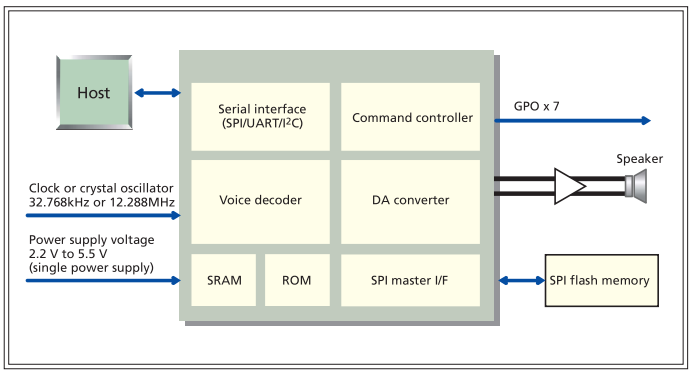
The S1V3G340 is an LSI incorporating high-compression, high-quality audio decoding functions, external SPI flash memory interface, and a DA converter, making it ideal for use in voice guidance products. Epson Voice Data Creation PC tool allows easy creation of high-quality voice data without the need for studio recording. Use of external SPI flash memory allows a large size voice data and easy interchanging of voice data. Voice data can be transferred from a host when required. All functions are controlled by commands via a serial interface for easy addition to any existing system incorporating a host.
The S1V3G340 will help users reduce time-to-market for products incorporating built-in voice guidance functions.

■ Features

- **Audio playback**
  - High-compression, high-quality audio decoder (proprietary Epson data format)
  - Bitrate: 40 kbps, 32 kbps, 24 kbps, 16 kbps
  - Sampling rate: 16 kHz
- **Sequencer function (phrase interval setting)**
  - Sequence setting for up to 64 phrases (unlimited combinations)
  - Variable phrase interval delay setting: 0 ms or 20 ms to 2,047 ms (in 1 ms steps)
- **External SPI flash memory interface**
  - Clock synchronized serial interface (SPI)
  - Maximum approx. 2 hour 13 minutes (16 Mbytes)
- **GPO**
  - 7 pins
- **Host interface**
  - Clock synchronized serial interface, supporting UART and I²C
  - Command control
- **High-quality 16-bit DA converter**
  - Sampling rate (fs): 16 kHz
  - Input bits: 16-bit
- **Clock**
  - Clock input: 32.768 kHz or 12.288 MHz
  - Crystal oscillator: 32.768 kHz
- **Package**
  - QFP-52 pin (10 mm x 10 mm) 0.65 mm pin pitch
  - QFP-48 pin (7 mm x 7 mm) 0.5 mm pin pitch
  - SQFN-48 pin (7 mm x 7 mm) 0.5 mm pin pitch
- **Power supply voltage**
  -2.2 V to 5.5 V (single power supply)

■ Standard Application System

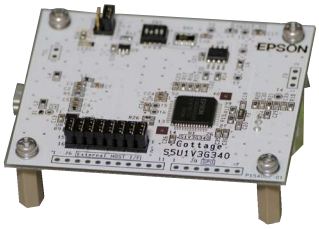
The S1V3G340 standard application system is configured as shown in the diagram below. The S1V3G340 is command-controlled by the host using a messaging protocol via the serial interface.
Controlled by commands sent from the host via the serial interface the S1V3G340 outputs voice audio while internally decoding and processing external SPI Flash memory or streamed (via host command transfer) compressed audio data.



■ Development Tools

- Evaluation board*1
- Audio data creation tool
- Sample programs

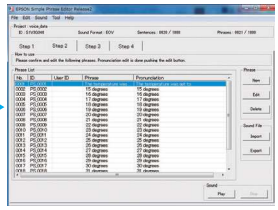
Cottage



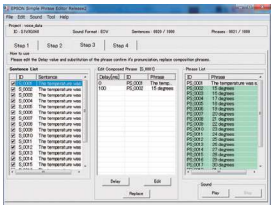
[Overview of voice data creation tool]

Step.1: Voice guidance registration

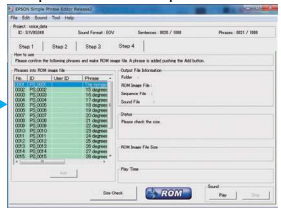
Step.2: Pronunciation editing



Step.3: Phrase editing



Step.4: ROM data production



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

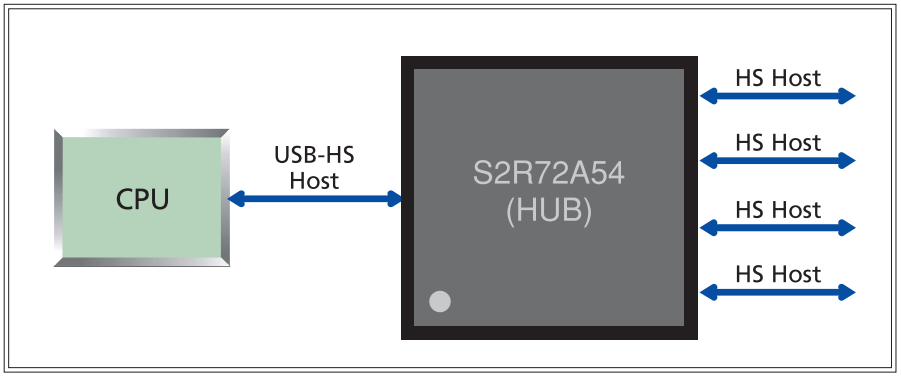
- HVDD 3.3V (±0.3V)

■ 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 S2R72A11

S2R72A11 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.
S2R72A11 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

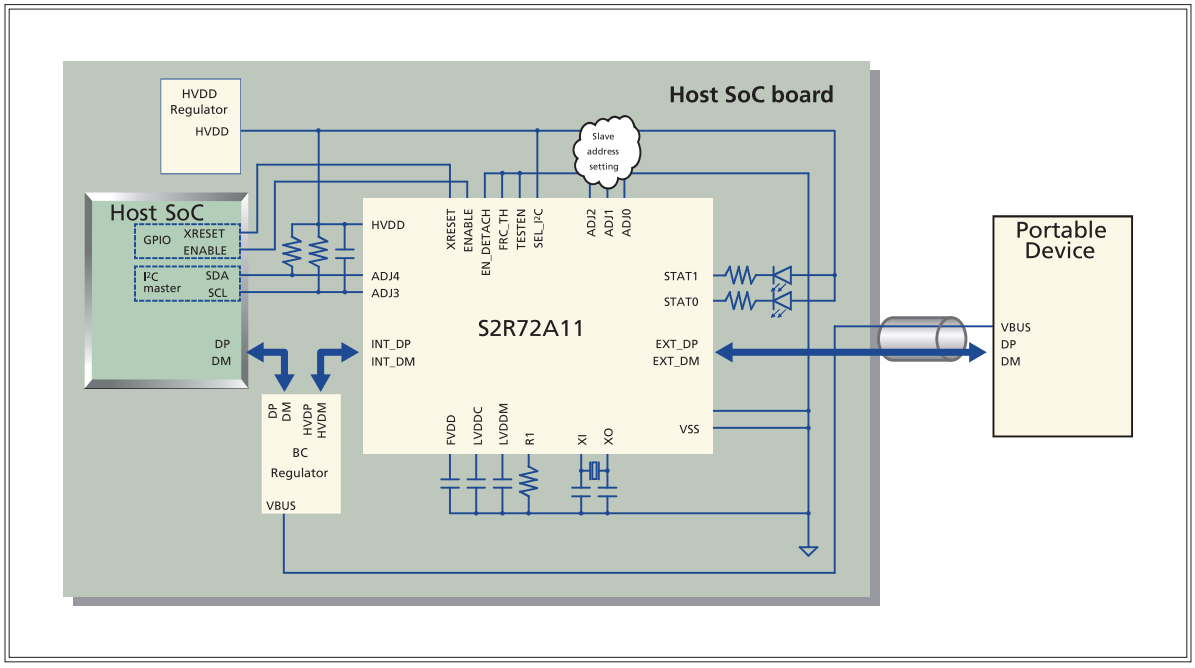
- HS communication: Re-synchronize with HS Synchronizer
- Except for HS communication: Passes through with analog switch

■ Small Size Package

- QFN32-pin 5mm x 5mm Wettable

■ Extensive Operation Temperature Range

- –40°C to +105°C



Memo

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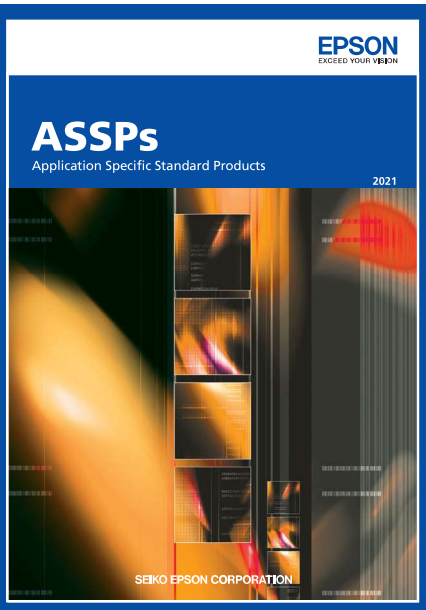

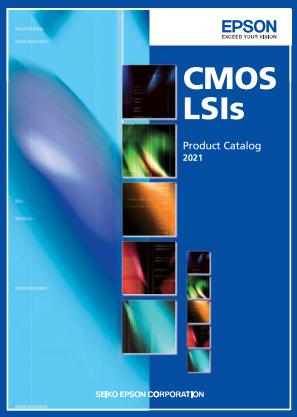

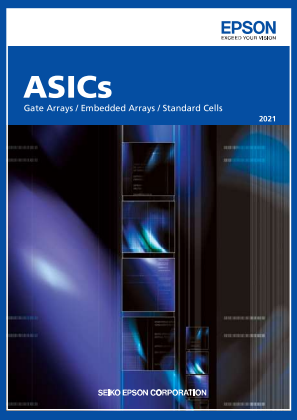

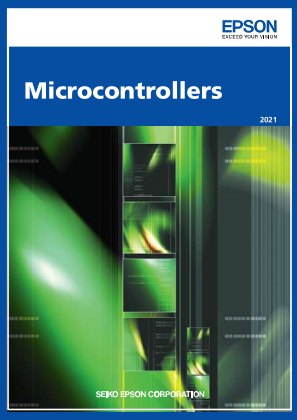

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