New Arm® Microcontroller "S1C31W73"
# with High-capacity Flash memory and High-resolution LCD driver

- Ideal for Office, Industrial equipment and Wearable products with LCD display -

Seiko Epson Corporation ("Epson") has developed S1C31W73, an Arm®Cortex®-M0+ processor and built-in high-resolution LCD driver. It features high-capacity Flash memory, USB controller, other peripherals on chip, and it operates at temperatures up to 105℃ and at voltage between 1.8 V to 5.5 V which is able to be used under various environment.

The number of functions provided in electronic equipment has been growing in recent years, and program sizes are increasing, as the amount of information is displayed. Meanwhile, equipment manufacturers need either maintain or further shrink the size of their products, making it essential to reduce the number of parts and save board space.

To solve these problems, Epson developed the S1C31W73, a single-chip microcontroller that has 384 kB of built-in Flash memory and a liquid crystal driver that can directly drive a display of up to 2,560 dots. By combining Epson's strong microcontroller display driver technology with the proven Arm®Cortex®-M0+ processor, Epson will help customers to increase the functionality and performance of their products while also reducing their development burden.
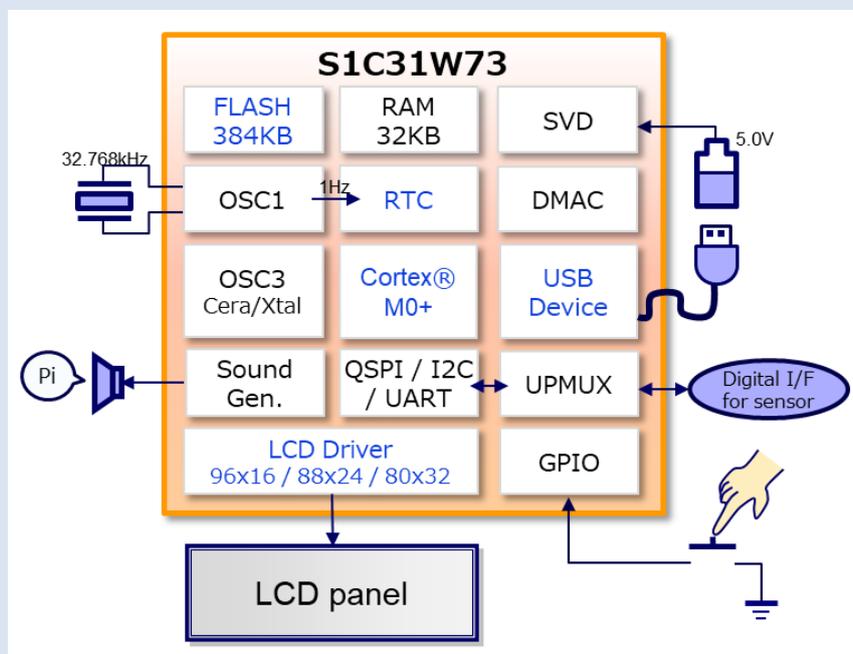
S1C31W73 system block diagram

This document introduces the features of S1C31W73 as follows.

Various peripherals on one chip

In addition to high-capacity Flash memory and high-resolution LCD driver, S1C31W73 offer a wide range of built-in peripherals, including real-time clock (RTC), an USB 2.0 full-speed device controller, an A/D converter, and a temperature sensor. It enables to achieve the functionality required for user application without the need for external devices. Furthermore, less devices can simplify the board layout and reduce the effect of noise in the communication line with external components.

Of course, it has other essential peripherals such as oscillation circuits, Input-output port, various timers and serial interfaces.

High-resolution Dot-matrix LCD driver

Generally, the LCD driver on MCU is mainly a segment display that drives several tens to hundreds of dots by 4-8 commons, but the display pattern is fixed and the information that can be displayed on the LCD display is limited. S1C31W73 is equipped with high-resolution dot-matrix LCD driver that can directly drive a maximum 2,560 dots (80 segments x 32 commons), which is the top class onto MCU, and it is possible to add rich expressive display.

Segment display
Display only in a fixed pattern

Dot-matrix display
Display in any pattern such as menu screen
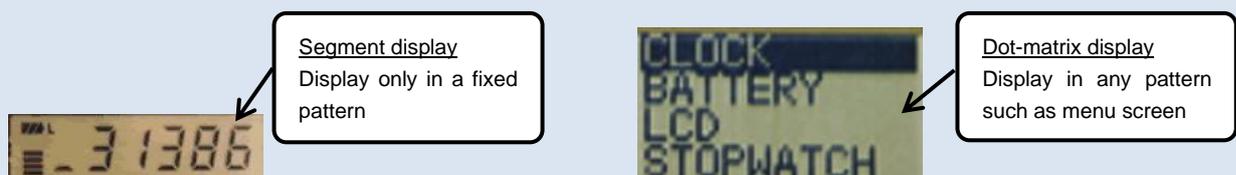
Example of Segment and Dot-matrix LCD display

S1C31W73 LCD driver includes a power supply for 1/4 or 1/5 bias for panel driving. Since the bias voltage can be kept constant even if power source fluctuates, the display contrast can be maintained regardless of battery level. It has contrast adjustment function by software, so that it allows not only for adding various contrast setting to the user application, but also for supporting voltage matching with the LCD panel at development phase.

Low power consumption

Based on the low current consumption technology, which is a feature of Epson MCUs, 0.7µA in Sleep mode, 1.2µA in RTC mode and 150µA/MHz[1] operating current have been realized. In addition, the LCD driver has also a low power consumption only 3.0µA (all-on) and 10.6µA (checker pattern) including the bias power supply circuit. It achieves low current consumption in parallel to high-resolution dot-matrix display, and it contributes to extending the battery life of user products.

Supporting various operation environments

S1C31W73 offers high performance by adopting an Arm® processor and integrating oscillator circuit with a maximum 33 MHz operating frequency. To reduce current consumption, it supports low power mode such as low-speed operation with 32.768 kHz crystal oscillation or 32 kHz built-in oscillation circuit, and Sleep and Halt mode. The operating temperature can be expanded up to 105℃ which can be used for the product with severe operating environment such as industrial equipment. The operating voltage is in a wide range from 1.8 V to 5.5 V, not only 3 V battery operation but also 5 V direct drive is supported. It is possible to construct a system that does not require an external power management IC.

Summary

S1C31W73 is a single-chip microcontroller that integrates a variety of peripherals such as high-capacity Flash memory, high-resolution LCD driver, USB controller, real-time clock, an A/D converter, and a temperature sensor. By combining Epson's strong microcontroller display driver technology and low power, with the proven Arm® Cortex® M0+ processor, Epson will help customers to increase the functionality and performance of their products while also reducing development burden.

■**Product specifications**

Model No.	S1C31W73
CPU core	32-bit RISC processor Arm®Cortex®-M0+
Flash memory	384 Kbytes
RAM	32 Kbytes
Operating voltage	1.8 V to 5.5 V
Operating frequency	Max. 33 MHz (VD1 voltage mode: mode0) Max. 2.1 MHz (VD1 voltage mode: mode1)
LCD driver	Max. 2,560 dots (80 segment x 25-32 common) Max. 2,112 dots (88 segment x 17-24 common) Max. 1,536 dots (96 segment x 1-16 common)
Serial interfaces	UART: 2 channels SPI: 2 channels I²C: 1 channel QSPI: 1 channel
USB	2.0 full-speed device controller, 1ch
A/D converter	12-bit successive-approximation ADC External signal inputs: Max.7 Internal signal inputs: 1 Connect temperature sensor output
Temperature sensor / Reference voltage generator circuit	Sensor output can be read by the A/D converter The A/D converter reference voltage is selectable (2.0 V, 2.5 V, VDD or external source)
Supply voltage detector	32 levels (1.7 V to 5.0 V)
Timers	16-bit timer: 8 channels 16-bit PWM timer: 2 channels Watchdog timer Real-time clock
I/O ports	Max. 73 bits Universal port multiplexer: 32 bits
Current consumption (typical)	Sleep mode: 0.7 µA RTC mode: 1.2 µA RUN mode: 220 µA/MHz (VD1 voltage mode: mode0) RUN mode: 150 µA/MHz (VD1 voltage mode: mode1) LCD driver: 10.6 µA (checker pattern) 3.0 µA (all on)
Package	Aluminum pad chip [pad pitch: 80 µm (min.)] P-LQFP216-2424-0.40 (pin pitch: 0.4 mm)

S1C31W73 product information

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*1 VD1 voltage mode: mode1