

Epson Develops New 16-Bit Microcontroller “S1C17F63” with e-Paper Driver

- Ideal for smart cards and other applications using small e-paper screens -

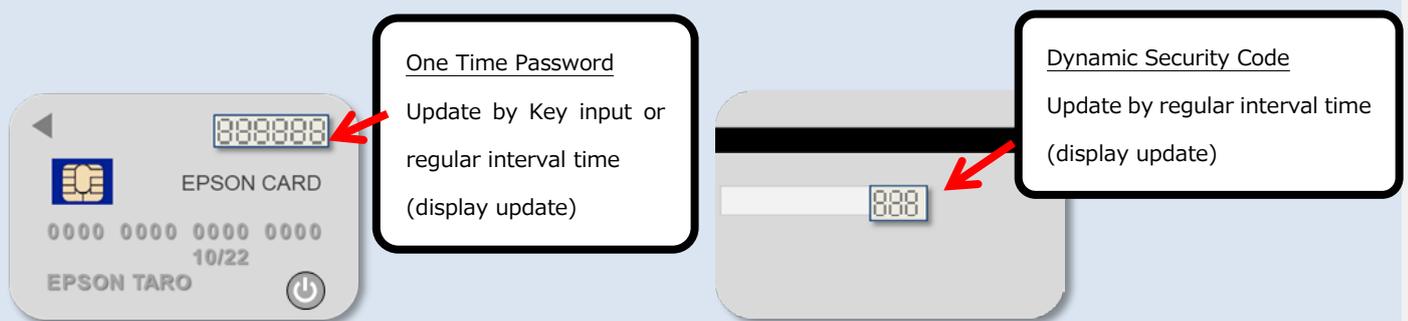
Seiko Epson Corporation ("Epson") has developed S1C17F63, a 16-bit microcontroller unit (MCU) with a built-in driver that is ideal for driving small e-paper displays such as smart cards. It features a low power consumption and small chip size by utilizing Epson's efficient, compact, and precision technologies.



QFP15-100

The market for e-paper displays is expanding. These displays are flexible, offer paper-like legibility, and consume very little power, since no power is needed to keep data on the screen. They are being used in place of liquid crystal displays for everything from e-books and signage to electronic shelf labels and particularly smart cards. In smart cards, one-time password cards and dynamic CVV/CVC¹ cards with security codes that change at regular intervals are seen as a means to provide stronger protection against phishing attacks, which are causing mounting losses as online banking and payments become increasingly common.

However, there are problems that need to be addressed with current embedded-display cards, which are susceptible to electronic component damage if bent or subjected to other physical stresses and which have limited battery capacity due to the limitations of the card configuration.

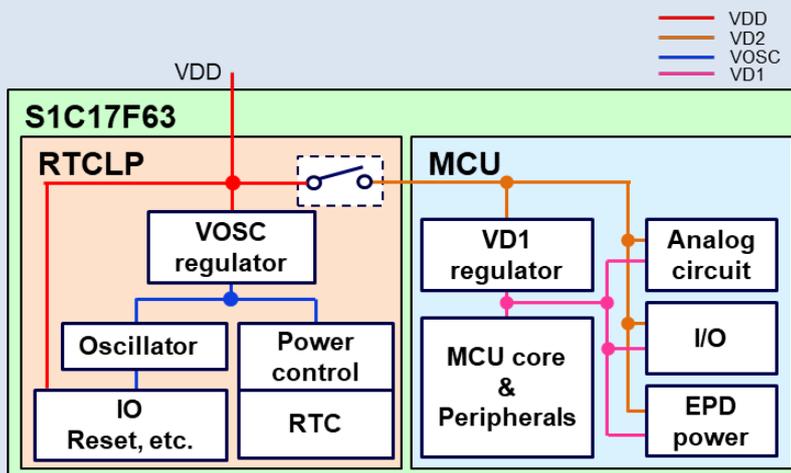


Examples of smart card with display

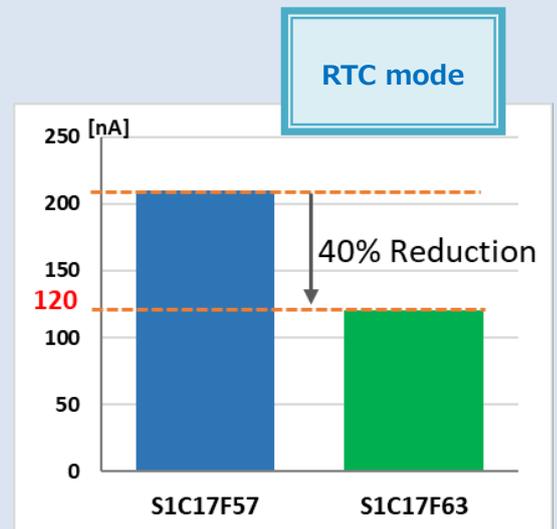
To solve these problems, Epson developed a single-chip microcontroller with built-in driver circuitry engineered specifically for e-paper displays. This document introduces the features of S1C17F63 as follows.

Low current consumption real time clock circuit to extend battery life time

Since the time is always counting in the display cards, the power consumption at time count is important. Epson develops low power hardware real time clock circuit, and makes this circuit independent of MCU block. At time counting without CPU operation (stand-by mode), it achieves 120nA low current consumption.

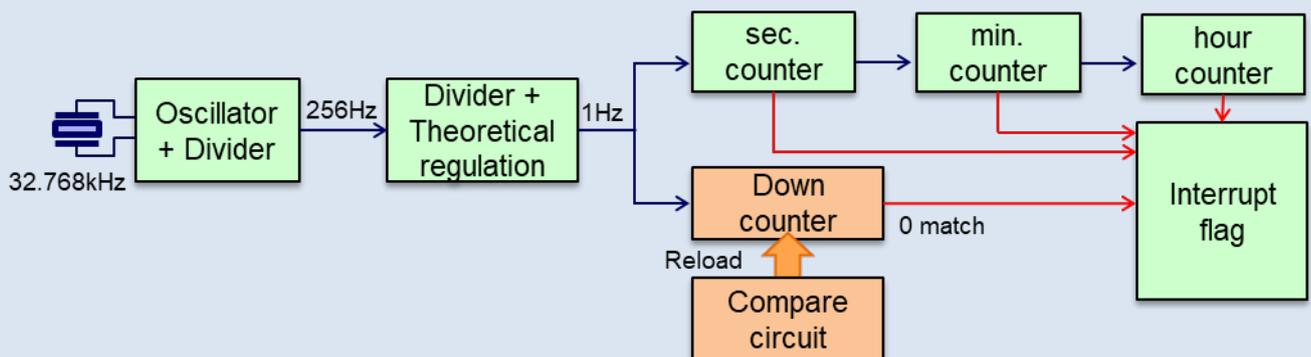


S1C17F63 block diagram



Comparison with existing product

This circuit supports programmable periodic timer interrupt in addition to day/hour/minute/second. It reduces CPU load, and system can keep stand-by mode as long as possible.



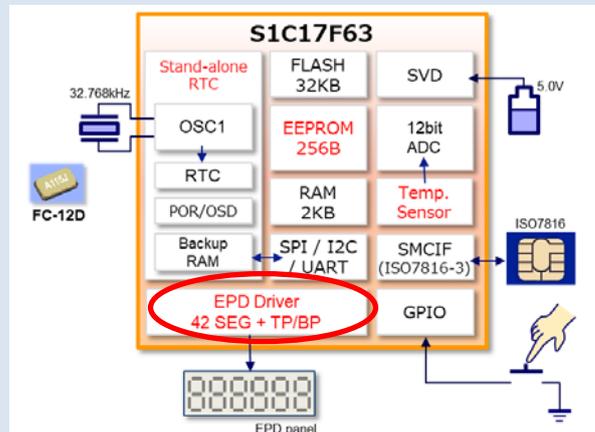
Real time clock circuit

Because the e-paper display can keep display without power consumption until it is updated, it is also suitable for display cards which require long battery life.

According to the features both S1C17F63 and e-paper display, it is possible for display card to extend battery life time from 3-years to 4- or 5-years.

Card durability improvement through chip downsizing and built-in driver

S1C17F63 integrates e-paper display driver and power circuit. Since there is no external driver and power management ICs required, it offers not only the cost reduction for external parts but the card durability improvement. The peripheral circuits are optimized for chip downsizing. In addition to e-paper display feature such as physical flexibility, the application can be more robust toward the stress like a bending.



S1C17F63 system image

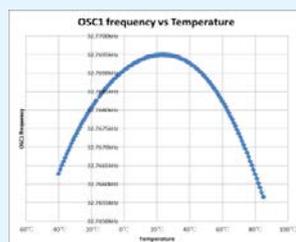
Advanced security by high accuracy time count and low power consumption

S1C17F63 integrates a temperature sensor. The built-in temperature sensor can be used to compensate display quality effects arising from the temperature characteristics of e-paper displays. The sensor can also be used together with a theoretical regulation function* to compensate for temperature-induced frequency drift in crystals. Updating passwords requires synchronization between a card terminal and system server, so accurate time measurements that are not affected by the ambient environment increase the security system value of customers. The feature of low power consumption also gives higher security by shortening the valid time of one password or security code, because user can allocate extra power to display update by reducing standby current.

Feedback of frequency error

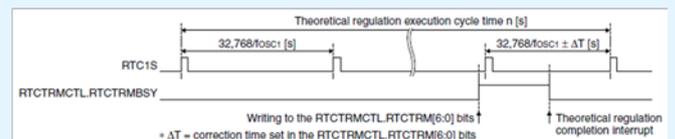
Prepare look-up table of frequency error vs. temperature

Temp.	Freq. [kHz]	Freq. error [ppm]
-15°C	32.768376	11.47
-14°C	32.768434	13.23
....
58°C	32.768384	11.71
59°C	32.768312	9.53



Compensate frequency error

Adjust to 32.768kHz (1sec.) based on look-up table



*Theoretical Regulation function

The function to correct frequency error by software setting without changing any external parts.

Summary

S1C17F63 is a single-chip 16-bit microcontroller that features low power consumption. It includes Flash memory, EEPROM, driver for e-paper, timers, a temperature sensor, A/D converter and various serial interfaces. It is suitable for battery-driven applications that require an e-paper display and a temperature measurement function, especially security products such as display cards.

■Product specifications

Model No.	S1C17F63
CPU core	16-bit RISC processor
Flash memory	32 Kbytes
EEPROM	256 bytes
RAM	2 Kbytes
EPD controller/driver	Segment output: 42 Top plane output: 1 Back plane output: 1 Output voltage 48 values Built-in display drive power supply circuit
Real-time clock	Second, minute, hour, day of the week, month, and year counters Automatic leap year compensation Day/hour/minute/second, alarm, and programmable periodic timer interrupts
Serial interfaces	UART: 1 channel SPI: 2 channels I ² C: 1 channel Smart card interface: 1 channel
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 (1.2 V to 5.0 V)
Timers	16-bit timer: 4 channels 16-bit PWM timer: 2 channels Watchdog timer
I/O ports	Max. 17 bits Universal port multiplexer: 14 bits
Operating voltage	1.8 V to 5.5 V
Current consumption	Real-time clock mode: 120 nA (typ.) RUN: 5 μA @ 32 kHz (typ.) RUN: 120 uA/MHz (typ.)
Package	Gold bump chip [bump pitch: 85 μm (min.)] Aluminum pad chip [pad pitch: 85 μm (min.)] QFP15-100 (pin pitch: 0.5 mm)

S1C17F63 product information

- [S1C17F63 information](#)
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