

16-bit Single Chip Microcontroller

- Built-in measurement function for digital multimeter, various terminal switching circuits for measurement. (measurement network)
- Built-in SD ADC, over sampling configurable
- Built-in Digital filter circuit, effective value calculation circuit
- Built-in LCD display drive circuit, up to 32 SEG x 4 COM
- Built-in 32/ 64 Kbytes Flash memory
- Support for C language programming

■ OVERVIEW

The S1C17M02/M03 is a compact 16-bit MCU specializing in a DMM (Digital Multi-Meter) function that supports C programming. This MCU has implemented the functions ($\Sigma\Delta$ A/D converter, pin switching circuit, and reference voltage generator) required for composing a DMM that is able to measure voltage, current, resistance, capacitance, diode, frequency, and continuity check. Also it is possible to setup optimal measurement conditions with programmable oversampling settings and to reduce a load on software processing with an embedded square root circuit. The S1C17M02/M03 includes a low-power LCD driver, various serial interfaces, a crystal oscillator and various timers as well, thus it is suitable for battery drive measurement equipment not only a DMM. It not only has a Flash memory but also an EEPROM that can be reprogrammed from application software.

■ FEATURES

機種	S1C17M02	S1C17M03
CPU		
CPU core	Epson original 16-bit RISC CPU core S1C17	
Others	On-chip debugger	
Embedded Flash memory		
Capacity	32K bytes (for both instructions and data)	64K bytes (for both instructions and data)
Erase/program count	1000 times (min.)	
Others	<ul style="list-style-type: none"> • Security function to protect from reading/programming by ICDmini • On-board programming function using ICDmini • Self programing function 	
Embedded RAM		
Capacity	2K bytes	
Embedded display RAM		
Capacity	16 bytes	32 bytes
Embedded E²PROM		
Capacity	256 bytes	
DMM controller (DSADC16)		
DC / AC voltage measurement	Supports up to 5 ranges (600 mV / 6 V / 60 V / 600 V / 1000 V)	
DC / AC current measurement	Supports up to 6 ranges (600 uA / 6 mA / 60 mA / 600 mA / 6 A / 10 A)	
Resistance measurement	Current application measurement : Up to 3 ranges (600 k Ω / 6 M Ω / 60 M Ω) Voltage application measurement : Up to 3 ranges (600 Ω / 6 k Ω / 60 k Ω)	
Conduction check	Resistance measurement minimum range equivalent	
Capacity measurement	Current input : Frequency conversion measurement: Up to 4 ranges supported (1uF/ 10 μ F / 100 μ F / 1000uF) Voltage input : Frequency conversion measurement: Up to 2 ranges supported (10 nF / 100 nF)	
Diode measurement	VF = 2.0V correspondence	
Frequency measurement	Counter measurement : Up to 4 ranges (5Hz ~100kHz)	
A / D Conversion method, resolution	Sigma delta type16bit, Built-in peak hold circuit	
Others	Built-in digital filter, Built-in RMS circuit	
Clock generator (CLG)		
System clock source	4 sources (IOSC / OSC1 / OSC3/ EXOSC)	
IOSC oscillator circuit (boot clock source)	700 kHz embedded oscillator, Starting clock	
OSC1 oscillator circuit	32kHz(typ.) embedded oscillator	
	32.768kHz (typ.) crystal oscillator	
	Oscillation stop detection circuit included	
OSC3 oscillator circuit	6.4 / 3.2 MHz switchable embedded oscillator.	

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EXOSC clock input	6.72 MHz (max.)	
Others	Configurable system clock division ratio	
	Configurable system clock used at wake up from SLEEP state	
	Operating clock frequency for the CPU and all peripheral circuits is selectable.	
I/O port (PPORT)		
Number of ports that support universal port multiplexer (UPMUX)	16 bits (max.)	40 bits (max.)
	A peripheral circuit I/O function selected via software can be assigned to each port.	
Debugger I/F poart	3 bits	
Timers		
Watchdog timer (WDT)	Generates NMI or watchdog timer reset.	
	NMI / reset generation cycle can be set	
16-bit timer (T16)	4 channels	
Serial interfaces		
UART (UART3)	1 channel	
SPIA	1 channel	
I ² C (I2C)	1 channel	
Supply voltage detector (SVD4)		
Detection level	19 levels (1.7 to 3.6 V)	
Other	Intermittent operation mode	
	Generates an interrupt or reset according to the detection level evaluation.	
LCD driver (LCD4B)		
LCD output	16 SEG × 1–4 COM (max.)	32 SEG × 1–4 COM (max.)
LCD contrast	29 levels	
Other	1/3 bias power supply included	
Multiplier/divider(COPRO2)		
Arithmetic functions	16-bit × 16-bit multiplier	
	16-bit × 16-bit + 32-bit multiply and acculation unit	
	32-bit ÷ 32-bit divider	
Reset		
#RESET pin	Reset when the reset pin is set to low.	
Power-on reset	Reset at power on.	
Brown-out reset	When voltage drops	
Watchdog timer reset	Reset when the watchdog timer overflows (can be enabled/disabled using a register).	
Supply voltage detector reset	Reset when the supply voltage detector detects the set voltage level (can be enabled/disabled using a register).	
Interrupt		
Non-maskable interrupt	4 systems (Reset, address misaligned interrupt, debug, NMI)	
Programmable interrupt	External interrupt: 1 systems	
	Internal interrupt: 17 systems	
Power supply voltage		
VDD operating voltage	2.1V to 3.6V	
Analog circuit operating voltage	2.2V to 3.6V	
Operating temperature		
Operating temperature range	-40°C to 85°C	
Current consumption (Typ.)		
SLEEP mode	0.24 uA IOSC = OFF, OSC1 = OFF, OSC3 = OFF	
	1.8uA IOSC = OFF, OSC1 = 32 kHz (internal oscillator) , OSC3 = OFF	
RUN mode	6.0uA IOSC = OFF, OSC1 = 32 kHz (internal oscillator), OSC3 = OFF, CPU = OSC1	
	825uA IOSC = OFF, OSC1 = 32.768 kHz (crystal oscillator), OSC3 = 6.4 MHz, CPU = OSC3	
Package		
	QFP13-64PIN (P-LQFP064-1010-0.50)	QFP15-100PIN (P-LQFP100-1414-0.50)

■ PIN ASSIGNMENT

- Explanation of terminals on S1C17M03. The terminal with the same name as S1C17M02 has the same function.

Name	allocation signal	I/O	Default status	Tolerant fail-safe structure	function
VDD	VDD	P	-		Power supply(+)
VSS	VSS	P	-		GND
VD1	VD1	P	-		Internal logic system voltage regulator output
VPP	VPP	P	-		Flash programming/erasing power supply
AVDDH	AVDDH	P	-		Analog power supply
VCP	VCP	P	-		Regulator output (2.1V output, power supply for charge pump)
AGND	AGND	P	-		Analog GND
VDD2	VDD2	P	-		Power boost output
CA	CA	A	-		Capacitive connection terminal for boosting
CB	CB	A	-		Capacitive connection terminal for boosting
VMIN	VMIN	A	-		Input terminal for measurement
A00	A00	A	-		Measurement terminal
A01	A01	A	-		Measurement terminal
A02	A02	A	-		Measurement terminal
A03	A03	A	-		Measurement terminal
A04	A04	A	-		Measurement terminal
A05	A05	A	-		Measurement terminal
A10	A10	A	-		Measurement terminal
A11	A11	A	-		Measurement terminal
A20	A20	A	-		Measurement terminal
A21	A21	A	-		Measurement terminal
A22	A22	A	-		Measurement terminal
A23	A23	A	-		Measurement terminal
FCP	FCP	A	-		Filter capacity connection terminal
FCN	FCN	A	-		Filter capacity connection terminal
VC3	VC3	A	-		LCD system power supply circuit output
VC2	VC2	A	-		LCD system power supply circuit output
VC1	VC1	A	-		LCD system power supply circuit output
CP1	CP1	A	-		Voltage boost capacitor connecting pin for LCD system power supply circuit
CP2	CP2	A	-		Voltage boost capacitor connecting pin for LCD system power supply circuit
PD0	DST2	O	O(L)		On-chip debugger status output
	PD0	I/O			I/O port
PD1	DSIO	I/O	I(Pull-up)		On-chip debugger data input/output
	PD1	I/O			I/O port
PD2	DCLK	O	O(H)		On-chip debugger clock output
	PD2	O			Output port
P00	P00	I/O	Hi-Z	✓	I/O port
	EXOSC	I			Clock generator external clock input
	UPMUX	I/O			Number of ports that support universal port multiplexer
P01	P01	I/O	Hi-Z	✓	I/O port
	LFRO	O			LCD frame signal monitor output
	UPMUX	I/O			Number of ports that support universal port multiplexer
P02	P02	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	EXSVD	A			External power supply voltage detection input
P03	P03	I/O	Hi-Z		I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer

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P04	P04	I/O	Hi-Z		I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
P05	P05	I/O	Hi-Z		I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
P06	P06	I/O	Hi-Z		I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
P07	P07	I/O	Hi-Z		I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
P10	P10	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG15	A			LCD segment output
P11	P11	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG14	A			LCD segment output
P12	P12	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG13	A			LCD segment output
P13	P13	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG12	A			LCD segment output
P14	P14	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG11	A			LCD segment output
P15	P15	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG10	A			LCD segment output
P16	P16	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG9	A			LCD segment output
P17	P17	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG8	A			LCD segment output
P20 (M03)	P20	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG31	A			LCD segment output
P21 (M03)	P21	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG30	A			LCD segment output
P22 (M03)	P22	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG29	A			LCD segment output
P23 (M03)	P23	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG28	A			LCD segment output
P24 (M03)	P24	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG27	A			LCD segment output
P25 (M03)	P25	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG26	A			LCD segment output
P26 (M03)	P26	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG25	A			LCD segment output

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P27 (M03)	P27	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG24	A			LCD segment output
P30 (M03)	P30	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG23	A			LCD segment output
P31 (M03)	P31	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG22	A			LCD segment output
P32 (M03)	P32	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG21	A			LCD segment output
P33 (M03)	P33	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG20	A			LCD segment output
P34 (M03)	P34	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG19	A			LCD segment output
P35 (M03)	P35	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG18	A			LCD segment output
P36 (M03)	P36	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG17	A			LCD segment output
P37 (M03)	P37	I/O	Hi-Z	✓	I/O port
	UPMUX	I/O			Number of ports that support universal port multiplexer
	SEG16	A			LCD segment output
P40 (M03)	P40	I/O	Hi-Z	✓	I/O port
P41 (M03)	P41	I/O	Hi-Z	✓	I/O port
P42 (M03)	P42	I/O	Hi-Z	✓	I/O port
P43 (M03)	P43	I/O	Hi-Z	✓	I/O port
P44 (M03)	P44	I/O	Hi-Z	✓	I/O port
P45 (M03)	P45	I/O	Hi-Z	✓	I/O port
P46 (M03)	P46	I/O	Hi-Z	✓	I/O port
P47 (M03)	P47	I/O	Hi-Z	✓	I/O port
SEG07	SEG7	A	Hi-Z		LCD segment output
SEG06	SEG6	A	Hi-Z		LCD segment output
SEG05	SEG5	A	Hi-Z		LCD segment output
SEG04	SEG4	A	Hi-Z		LCD segment output
SEG03	SEG3	A	Hi-Z		LCD segment output
SEG02	SEG2	A	Hi-Z		LCD segment output
SEG01	SEG1	A	Hi-Z		LCD segment output
SEG00	SEG0	A	Hi-Z		LCD segment output
COM0	COM0	A	Hi-Z		LCD common output
COM1	COM1	A	Hi-Z		LCD common output
COM2	COM2	A	Hi-Z		LCD common output
COM3	COM3	A	Hi-Z		LCD common output
OSC1	OSC1	A	-		OSC1A oscillation input

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OSC2	OSC2	A	-		OSC1A oscillation output
#RESET	#RESET	I	I(Pull-up)		Initial reset input

Symbol meanings

Assigned signal: The signal listed at the top of each pin is assigned in the initial state. The pin function must be switched via software to assign another signal.

I/O:
 I = Input
 O = Output
 I/O = Input/output
 P = Power supply
 A = Analog signal
 Hi-Z = High impedance state

Initial state:
 I (Pull-up) = Input with pulled up
 I (Pull-down) = Input with pulled down
 Hi-Z = High impedance state
 O (H) = High level output
 O (L) = Low level output

Tolerant fail-safe structure:

✓ = Over voltage tolerant fail-safe type I/O cell included.

The over voltage tolerant fail-safe type I/O cell allows interfacing without passing unnecessary current even if a voltage exceeding VDD is applied to the port.

Also unnecessary current is not consumed when the port is externally biased without supplying VDD.

Universal port multiplexer (UPMUX)

The universal port multiplexer (UPMUX) allows software to select the peripheral circuit input/output function to be assigned to each pin from those listed below.

Peripheral circuit	Signal to be assigned	I/O	Function
Synchronous serial interface (SPIA)	SDI	I	SPIA data input
	SDO	O	SPIA data output
	SPICLK	I/O	SPIA clock input/output
	#SPISS	I	SPIA slave-select input
I2C (I2C)	SCL	I/O	I2C clock input/output
	SDA	I/O	I2C data input/output
UART (UART3)	USIN	I	UART data input
	USOUT	O	UART data output
SNDA	BZOUT	O	Sound generator output
	#BZOUT	O	Sound generator inverted output
CLG	FOUT	O	Clock external output

■ Electrical characteristics

Absolute maximum rating

(VSS = 0V)

Item	Symbol	Condition	Rated value	Unit	
Power-supply voltage	VDD		-0.3~7.0	V	
Flash programming voltage	VPP		-0.3~8.0	V	
LCD power supply voltage	VC1		-0.3~7.0	V	
	VC2		-0.3~7.0	V	
	VC3		-0.3~7.0	V	
Input voltage	VI	P00-02, P10-17, P20-27, P30-37, P40-47, VMIN, A00-05, A10-11, A20-23, FCP, FCM	-0.3~7.0	V	
		PD0-D2, #RESET	-0.3~VDD+0.5	V	
Output voltage	VO		-0.3~VDD+0.5	V	
High level output current	IOH	1 terminal	P00-07, P10-17, P20-27, P30-37, P40-47, PD0-D2	-10	mA
		Total of all terminals		-20	mA
Low level output current	IOL	1 terminal	P00-07, P10-17, P20-27, P30-37, P40-47, PD0-D2	10	mA
		Total of all terminals		20	mA
Operating temperature	Ta		-40~85	°C	
storage temperature	Tstg		-65~125	°C	

Recommended operating conditions

(VSS = 0V) *1

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Power supply voltage	VDD	For normal operation	2.1	-	3.6	V	
		When analog circuits are operated	2.2	-	3.6	V	
		For Flash programming	When VPP is supplied externally	2.2	-	3.6	V
			When VPP is generated internally	2.2	-	3.6	V
		For EEPROM programming	When VPP is generated internally	2.2	-	3.6	V
Flash programming voltage	VPP		7.3	7.5	7.7	V	
LCD power supply voltage	VC1	When an external voltage is applied, VC1 ≤ VC2 ≤ VC3, VC1 ≤ VDD	-	1.0	1.8	V	
	VC2		-	2.0	3.6	V	
	VC3		-	3.0	5.4	V	
OSC1 oscillator oscillation frequency	fosc1	Crystal oscillator	-	32.768	-	kHz	
EXOSC external clock frequency	fexosc	When supplied from an external oscillator	0.016	-	6.72	MHz	

*1 The potential variation of the VSS voltage should be suppressed to within ±0.3 V on the basis of the ground potential of the MCU mounting board while the Flash is being programmed, as it affects the Flash memory characteristics (programming count).

*2 The VC1-VC3 pins can be left open when the LCD driver is not used. Furthermore, the CP1-CP2 pins are not used.

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