

## 16-bit Single Chip Microcontroller

- Low voltage operation from 1.2 V with a single alkaline or silver oxide button battery.
- Ultra low standby power consumption (0.3  $\mu$ A during HALT state in super economy mode)

### DESCRIPTIONS

The S1C17W13 is a 16-bit MCU that features low-voltage operation from 1.2 V even though Flash memory is included. The embedded high-efficiency DC-DC converter generates the constant-voltage to drive the IC with lower power consumption than 4-bit MCUs. This IC includes a real-time clock, a stopwatch, an LCD driver, and a PWM timer capable of being used to generate drive waveforms for a motor driver as well as a high-performance 16-bit CPU. It is suitable for battery-driven applications that require an LCD display.

### FEATURES

Model	S1C17W13		
	TQFP12-48pin	SQFN7-48pin	QFP13-64pin or chip
<b>CPU</b>			
CPU core	Seiko Epson original 16-bit RISC CPU core S1C17		
Other	On-chip debugger		
<b>Embedded Flash memory</b>			
Capacity	48K bytes (for both instructions and data)		
Erase/program count	1,000 times (min.) * Programming by the debugging tool ICDmini		
Other	Security function to protect from reading/programming by ICDmini On-board programming function using ICDmini * An external smoothing capacitor is required.		
<b>Embedded RAM</b>			
Capacity	2K bytes		
<b>Embedded display RAM</b>			
Capacity	26 bytes		
<b>Clock generator (CLG)</b>			
System clock source	4 sources (IOSC/OSC1/OSC3/EXOSC)		
System clock frequency (operating frequency)	1.1 MHz (max.) $V_{DD} = 1.2$ to $1.6$ V 4.2 MHz (max.) $V_{DD} = 1.6$ to $3.6$ V		
IOSC oscillator circuit (boot clock source)	700 kHz (typ.) embedded oscillator 23 $\mu$ s (max.) starting time (time from cancelation of SLEEP state to vector table read by the CPU)		
OSC1 oscillator circuit	32.768 kHz (typ.) crystal oscillator 32 kHz (typ.) embedded oscillator Oscillation stop detection circuit included		
OSC3 oscillator circuit	4.2 MHz (max.) crystal/ceramic oscillator	–	4.2 MHz (max.) crystal/ceramic oscillator
	250, 384, 500 kHz, 1, 2, and 4 MHz-switchable embedded oscillator		
	2.1 MHz (max.) CR oscillator (an external R is required)	–	2.1 MHz (max.) CR oscillator (an external R is required)
EXOSC clock input	4.2 MHz (max.) square or sine wave input		
Other	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.		
<b>I/O port (PPORT)</b>			
Number of general-purpose I/O ports	Input/output port: 25 bits (max.) Output port: 1 bit (max.)		Input/output port: 31 bits (max.) Output port: 1 bit (max.)
	Pins are shared with the peripheral I/O.		
Number of input interrupt ports	21 bits (max.)	23 bits (max.)	27 bits (max.)
Number of ports that support universal port multiplexer (UPMUX)	21 bits	23 bits	
LED drive pin		–	2 bits, Nch open drain, output current 5 mA (max.)
<b>Timers</b>			
Watchdog timer (WDT2)	Generates NMI or watchdog timer reset. Programmable NMI/reset generation cycle		
Real-time clock (RTCA)	128–1 Hz counter, second/minute/hour/day/day of the week/month/year counters Theoretical regulation function for 1-second correction Alarm and stopwatch functions		
16-bit timer (T16)	3 channels Generates the SPIA master clock.		

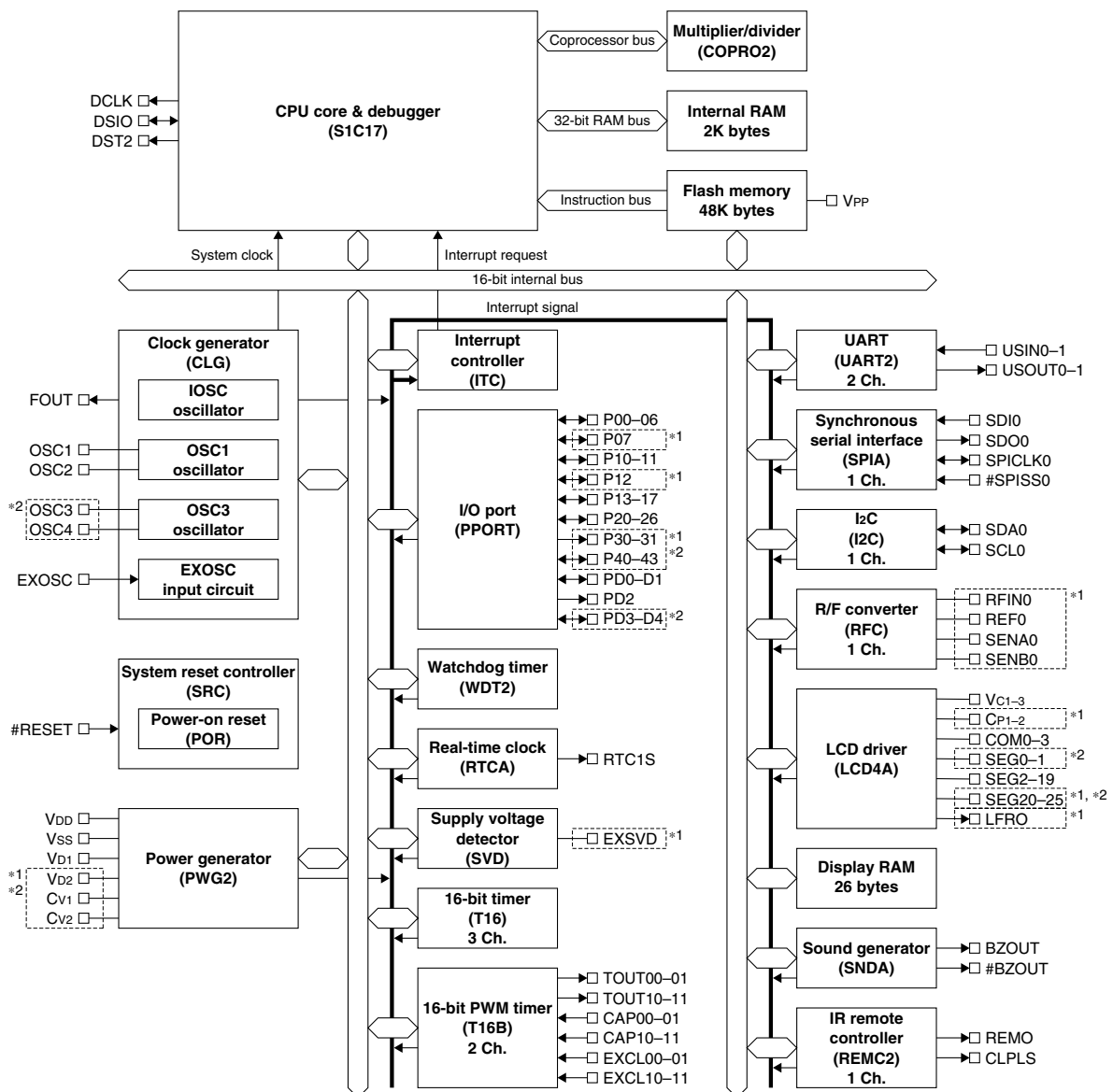
# S1C17W13

Model	S1C17W13		
	TQFP12-48pin	SQFN7-48pin	QFP13-64pin or chip
<b>Timers</b>			
16-bit PWM timer (T16B)	2 channels Event counter/capture function PWM waveform generation function Number of PWM output or capture input ports: 2 ports/channel		
<b>Supply voltage detector (SVD)</b>			
Detection level	30 levels (1.2 to 3.6 V)		
Detection accuracy	±3 %		
Other	Intermittent operation mode Generates an interrupt or reset according to the detection level evaluation.		
<b>Serial interfaces</b>			
UART (UART2)	2 channels Baud-rate generator included, IrDA1.0 supported Open drain output, signal polarity, and baud rate division ratio are configurable.		
Synchronous serial interface (SPIA)	1 channel 2 to 16-bit variable data length The 16-bit timer (T16) can be used for the baud-rate generator in master mode.		
I <sup>2</sup> C (I2C)	1 channel Baud-rate generator included		
<b>Sound generator (SNDA)</b>			
Buzzer output function	512 Hz to 16 kHz output frequencies One-shot output function		
Melody generation function	Pitch: 128 Hz to 16 kHz ≈ C3 to C6 Duration: 7 notes/rests (Half note/rest to thirty-second note/rest) Tempo: 16 tempos (30 to 480) Tie/slur may be specified.		
<b>IR remote controller (REMC2)</b>			
Number of transmitter channels	1 channel		
Other	EL lamp drive waveform can be generated for an application example.		
<b>LCD driver (LCD4A)</b>			
LCD output	20 SEG × 1–4 COM (max.)	18 SEG × 1–4 COM (max.)	26 SEG × 1–4 COM (max.)
LCD contrast	– 16 levels		
LCD drive power supply	External power supply	1/3 bias power supply included (External voltage can be applied.)	
<b>R/F converter (RFC)</b>			
Conversion method	– CR oscillation type with 24-bit counters		
Number of conversion channels	1 channel (Up to two sensors can be connected.)		
Supported sensors	DC-bias resistive sensors, AC-bias resistive sensors		
<b>Multiplier/divider (COPRO2)</b>			
Arithmetic functions	16-bit × 16-bit multiplier 16-bit × 16-bit + 32-bit multiply and accumulation unit 32-bit ÷ 32-bit divider		
<b>Reset</b>			
#RESET pin	Reset when the reset pin is set to low.		
Power-on reset	Reset at power on.		
Key entry reset	Reset when the P00 to P01/P02/P03 keys are pressed simultaneously (can be enabled/disabled using a register).		
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).		
<b>Interrupt</b>			
Non-maskable interrupt	4 systems (Reset, address misaligned interrupt, debug, NMI)		
Programmable interrupt	External interrupt: 1 system (8 levels) Internal interrupt: 17 systems (8 levels)	External interrupt: 1 system (8 levels) Internal interrupt: 18 systems (8 levels)	
<b>Power supply voltage</b>			
V <sub>DD</sub> operating voltage	1.2 to 3.6 V		
V <sub>DD</sub> operating voltage for Flash programming	1.8 to 3.6 V (V <sub>PP</sub> = 7.5 V external power supply is required.)		
V <sub>DD</sub> operating voltage for super economy mode	–		2.5 to 3.6 V
<b>Operating temperature</b>			
Operating temperature range	-40 to 85 °C		
<b>Current consumption (Typ. value)</b>			
SLEEP mode	0.15 μA IOSC = OFF, OSC1 = OFF, OSC3 = OFF		
HALT mode	0.5 μA OSC1 = 32.768 kHz (crystal oscillator), RTC = ON		

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Model	S1C17W13		
	TQFP12-48pin	SQFN7-48pin	QFP13-64pin or chip
<b>Current consumption (Typ. value)</b>			
HALT mode	-		0.3 $\mu$ A OSC1 = 32.768 kHz (crystal oscillator), RTC = ON, super economy mode
RUN mode	4 $\mu$ A OSC1 = 32.768 kHz (crystal oscillator), RTC = ON, CPU = OSC1		2 $\mu$ A OSC1 = 32.768 kHz (crystal oscillator), RTC = ON, CPU = OSC1, super economy mode
	-		
	140 $\mu$ A OSC3 = 1 MHz (ceramic oscillator), OSC1 = 32.768 kHz (crystal oscillator), RTC = ON, CPU = OSC3		
<b>Shipping form</b>			
1	QFP13-64pin (Lead pitch: 0.5 mm)		
2	SQFN7-48pin (Lead pitch: 0.5 mm)		
3	TQFP12-48pin (Lead pitch: 0.5 mm)		
4	Die form (Pad pitch: 80 $\mu$ m (min.))		

## ■ BLOCK DIAGRAM



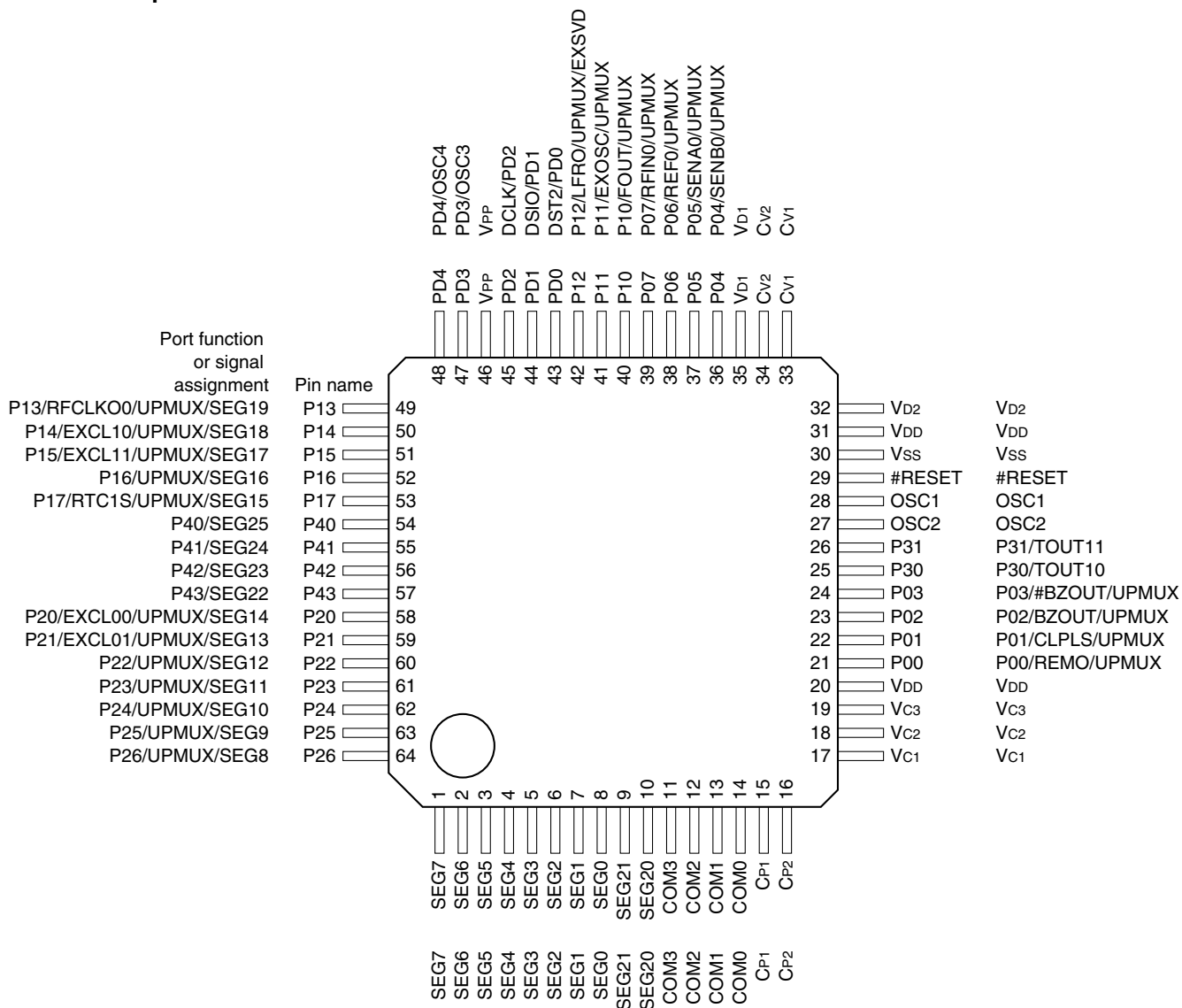
\*1 These pins do not exist in the TQFP12-48pin package.

\*2 These pins do not exist in the SQFN7-48pin package.

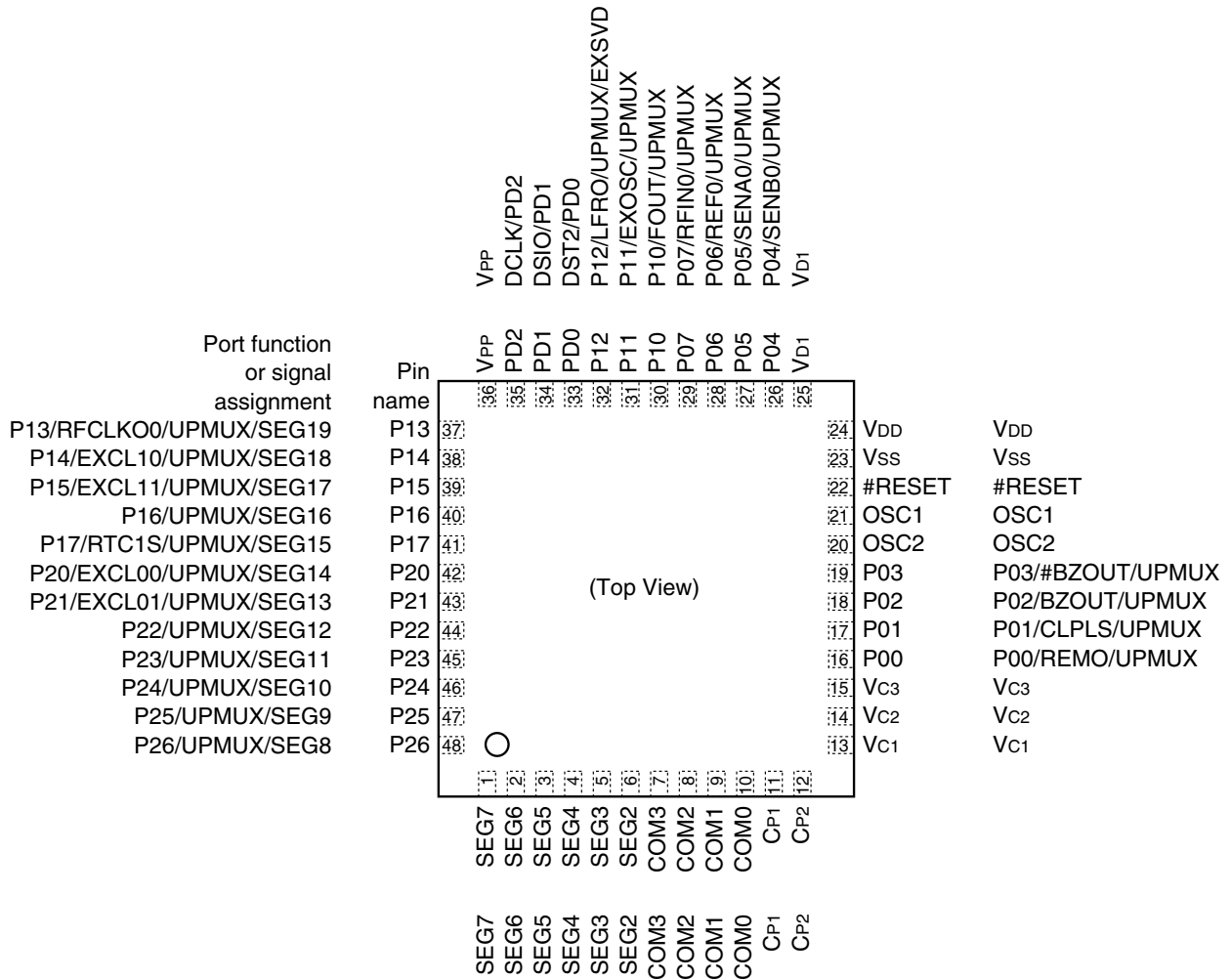
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## ■ PIN CONFIGURATION DIAGRAMS

QFP13-64pin



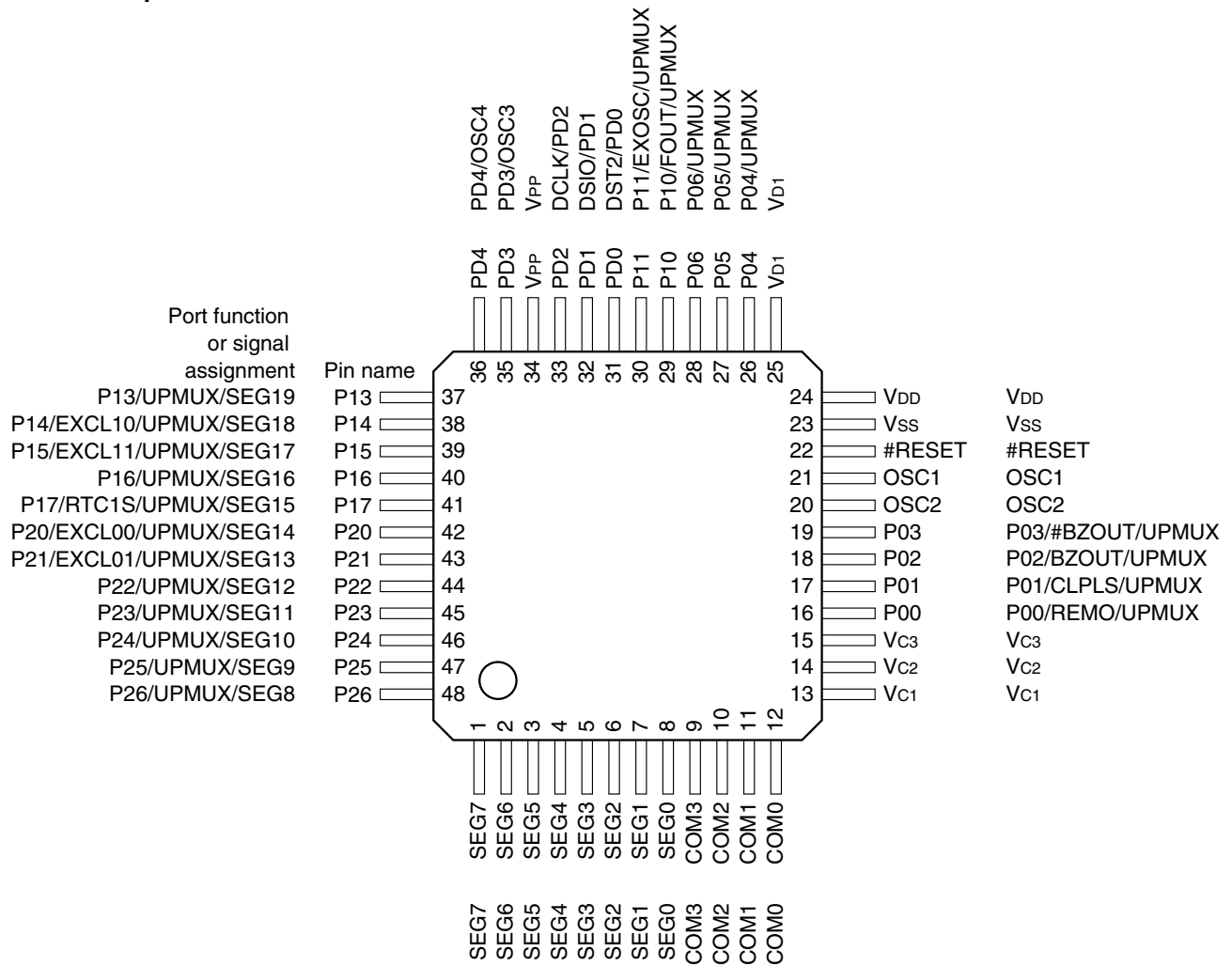
## SQFN7-48pin



**Note:** The model in this package cannot be placed into super economy mode, as it does not have the V<sub>D2</sub>, C<sub>V1</sub>, and C<sub>V2</sub> pins.

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TQFP12-48pin



**Note:** The model in this package cannot be placed into super economy mode, as it does not have the V<sub>D2</sub>, C<sub>v1</sub>, and C<sub>v2</sub> pins.



# S1C17W13

## ■ PIN DESCRIPTIONS

### 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 (see the “I/O Ports” chapter).

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 (see the “I/O Ports” chapter)  
 The over voltage tolerant fail-safe type I/O cell allows interfacing without passing unnecessary current even if a voltage exceeding  $V_{DD}$  is applied to the port. Also unnecessary current is not consumed when the port is externally biased without supplying  $V_{DD}$ .

Pin/pad name	Assigned signal	I/O	Initial state	Tolerant fail-safe structure	Function	64pin/chip	SQFN7-48pin	TQFP12-48pin
$V_{DD}$	$V_{DD}$	P	–	–	Power supply (+)	✓	✓	✓
$V_{SS}$	$V_{SS}$	P	–	–	GND	✓	✓	✓
$V_{PP}$	$V_{PP}$	P	–	–	Power supply for Flash programming	✓	✓	✓
$V_{D1}$	$V_{D1}$	A	–	–	DC-DC converter output	✓	✓	✓
$V_{D2}$	$V_{D2}$	A	–	–	DC-DC converter stabilization capacitor connect pin	✓	–	–
$CV_{1-2}$	$CV_{1-2}$	A	–	–	DC-DC converter charge pump capacitor connect pins	✓	–	–
$VC_{1-3}$	$VC_{1-3}$	P	–	–	LCD panel driver power supply	✓	✓	✓
$CP_{1-2}$	$CP_{1-2}$	A	–	–	LCD power supply booster capacitor connect pins	✓	✓	–
OSC1	OSC1	A	–	–	OSC1 oscillator circuit input	✓	✓	✓
OSC2	OSC2	A	–	–	OSC1 oscillator circuit output	✓	✓	✓
#RESET	#RESET	I	I (Pull-up)	–	Reset input	✓	✓	✓
P00	P00	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	REMO	O			IR remote controller transmit data output	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P01	P01	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	CLPLS	O			IR remote controller clear pulse output	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P02	P02	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	BZOUT	O			Sound generator output	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P03	P03	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	#BZOUT	O			Sound generator inverted output	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P04	P04	I/O	Hi-Z	–	I/O port	✓	✓	✓
	SENB0	A			R/F converter Ch.0 sensor B oscillator pin	✓	✓	–
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P05	P05	I/O	Hi-Z	–	I/O port	✓	✓	✓
	SENA0	A			R/F converter Ch.0 sensor A oscillator pin	✓	✓	–
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P06	P06	I/O	Hi-Z	–	I/O port	✓	✓	✓
	REF0	A			R/F converter Ch.0 reference oscillator pin	✓	✓	–
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P07	P07	I/O	Hi-Z	–	I/O port	✓	✓	–
	RFIN0	A			R/F converter Ch.0 oscillation input	✓	✓	–
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	–



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Pin/pad name	Assigned signal	I/O	Initial state	Tolerant fail-safe structure	Function	64pin/chip	SQFN7-48pin	TQFP12-48pin
P10	P10	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	FOUT	O			Clock external output	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P11	P11	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	EXOSC	I			Clock generator external clock input	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
P12	P12	I/O	Hi-Z	✓	I/O port	✓	✓	-
	LFRO	O			LCD frame signal monitor output	✓	✓	-
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	-
	EXSVD	A			External power supply voltage detection input	✓	✓	-
P13	P13	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	RFCLKO0	O			R/F converter Ch.0 clock monitor output	✓	✓	-
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG19	A			LCD segment output	✓	✓	✓
P14	P14	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	EXCL10	I			16-bit PWM timer Ch.1 event counter input 0	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG18	A			LCD segment output	✓	✓	✓
P15	P15	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	EXCL11	I			16-bit PWM timer Ch.1 event counter input 1	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG17	A			LCD segment output	✓	✓	✓
P16	P16	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG16	A			LCD segment output	✓	✓	✓
P17	P17	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	RTC1S	O			Real-time clock 1-second cycle pulse output	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG15	A			LCD segment output	✓	✓	✓
P20	P20	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	EXCL00	I			16-bit PWM timer Ch.0 event counter input 0	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG14	A			LCD segment output	✓	✓	✓
P21	P21	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	EXCL01	I			16-bit PWM timer Ch.0 event counter input 1	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG13	A			LCD segment output	✓	✓	✓
P22	P22	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG12	A			LCD segment output	✓	✓	✓
P23	P23	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG11	A			LCD segment output	✓	✓	✓
P24	P24	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG10	A			LCD segment output	✓	✓	✓
P25	P25	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG9	A			LCD segment output	✓	✓	✓
P26	P26	I/O	Hi-Z	✓	I/O port	✓	✓	✓
	UPMUX	I/O			User-selected I/O (universal port multiplexer)	✓	✓	✓
	SEG8	A			LCD segment output	✓	✓	✓
P30	P30	O	Hi-Z	-	LED drive port	✓	-	-
	TOUT10	O			16-bit PWM timer Ch.1 PWM output 0	✓	-	-
P31	P31	O	Hi-Z	-	LED drive port	✓	-	-
	TOUT11	O			16-bit PWM timer Ch.1 PWM output 1	✓	-	-
P40	P40	I/O	Hi-Z	✓	I/O port	✓	-	-
	SEG25	A			LCD segment output	✓	-	-
P41	P41	I/O	Hi-Z	✓	I/O port	✓	-	-
	SEG24	A			LCD segment output	✓	-	-
P42	P42	I/O	Hi-Z	✓	I/O port	✓	-	-
	SEG23	A			LCD segment output	✓	-	-

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Pin/pad name	Assigned signal	I/O	Initial state	Tolerant fail-safe structure	Function	64pin/chip	SQFN7-48pin	TQFP12-48pin
P43	P43	I/O	Hi-Z	✓	I/O port	✓	-	-
	SEG22	A			LCD segment output	✓	-	-
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	✓	✓	✓
PD3	PD3	I/O	Hi-Z	-	I/O port	✓	-	✓
	OSC3	A			OSC3 oscillator circuit input	✓	-	✓
PD4	PD4	I/O	Hi-Z	-	I/O port	✓	-	✓
	OSC4	A			OSC3 oscillator circuit output	✓	-	✓
COM0-3	COM0-3	A	Hi-Z	-	LCD common output	✓	✓	✓
SEG0-1	SEG0-1	A	Hi-Z	-	LCD segment output	✓	-	✓
SEG2-7	SEG2-7	A	Hi-Z	-	LCD segment output	✓	✓	✓
SEG20-21	SEG20-21	A	Hi-Z	-	LCD segment output	✓	-	-

## 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. Note, however, that a function cannot be assigned to two or more pins simultaneously.

Peripheral circuit	Signal to be assigned	I/O	Channel number $n$	Function
Synchronous serial interface (SPIA)	SDIn	I	$n = 0$	SPIA Ch. $n$ data input
	SDOn	O		SPIA Ch. $n$ data output
	SPICLK $n$	I/O		SPIA Ch. $n$ clock input/output
	#SPISS $n$	I		SPIA Ch. $n$ slave-select input
I <sup>2</sup> C (I2C)	SCL $n$	I/O	$n = 0$	I2C Ch. $n$ clock input/output
	SDAn	I/O		I2C Ch. $n$ data input/output
UART (UART2)	USIN $n$	I	$n = 0, 1$	UART2 Ch. $n$ data input
	USOUT $n$	O		UART2 Ch. $n$ data output
16-bit PWM timer (T16B)	TOUT $n$ 0/CAP $n$ 0	I/O	$n = 0, 1$	T16B Ch. $n$ PWM output/capture input 0
	TOUT $n$ 1/CAP $n$ 1	I/O		T16B Ch. $n$ PWM output/capture input 1

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