

16-bit Single Chip Microcontroller

- Wide operating voltage range from 1.8 V to 5.5 V.
- A maximum of 88 general-purpose I/O ports are available.
- Equipped with a two-channel 10-bit A/D converter with eight inputs/channel.
- Allows up to 24 (four channels × six ports) PWM outputs.

■ DESCRIPTIONS

The S1C17589 is a 16-bit embedded Flash MCU that features wide operating voltage range from 1.8 V to 5.5 V. It includes a lot of general-purpose I/O ports and A/D converter input ports and is suitable for various kinds of sensing applications from battery-driven equipment to home electrical products.

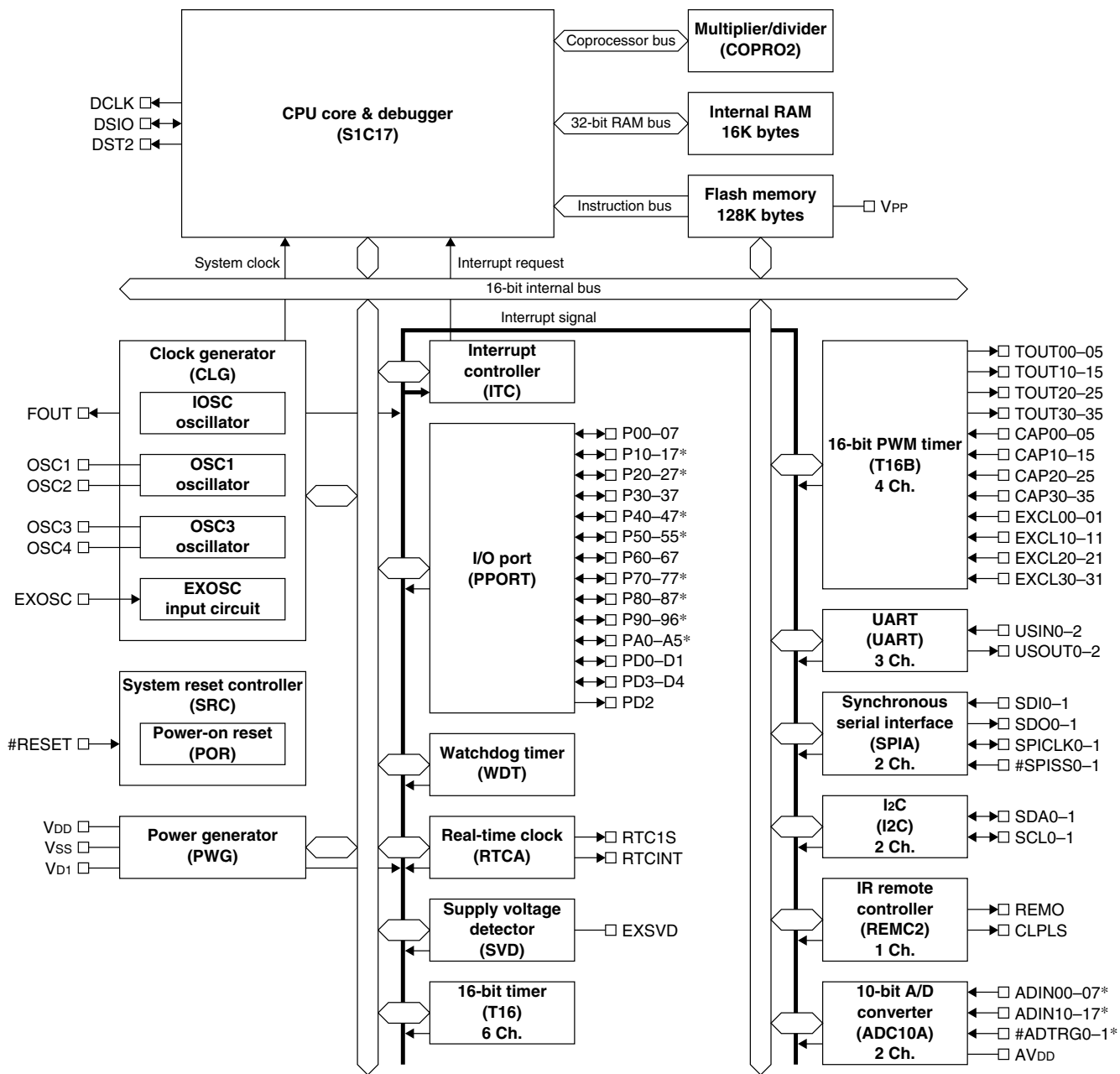
■ FEATURES

Model	S1C17589
CPU	
CPU core	Seiko Epson original 16-bit RISC CPU core S1C17
Other	On-chip debugger
Embedded Flash memory	
Capacity	128K bytes (for both instructions and data)
Erase/program count	50 times (min.) * Programming by the debugging tool ICDmini
Other	Security function to protect from reading/programming by ICDmini On-board programming function using ICDmini
Embedded RAM	
Capacity	16K bytes
Clock generator (CLG)	
System clock source	4 sources (IOSC/OSC1/OSC3/EXOSC)
System clock frequency (operating frequency)	16.8 MHz (max.)
IOSC oscillator circuit	16/12/8 (boot clock source)/4 MHz (typ.) selectable via software 10 μs (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 Oscillation stop detection circuit included
OSC3 oscillator circuit	16.8 MHz (max.) crystal/ceramic oscillator
EXOSC clock input	16.8 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.
I/O port (PPORT)	
Number of general-purpose I/O ports	Input/output port: 87 bits (max.) (Chip, QFP15-100pin) 67 bits (max.) (QFP14-80pin) 51 bits (max.) (QFP13-64pin) Output port: 1 bit (max.) Pins are shared with the peripheral I/O.
Number of input interrupt ports	83 bits (max.) (Chip, QFP15-100pin) 63 bits (max.) (QFP14-80pin) 47 bits (max.) (QFP13-64pin)
Number of ports that support universal port multiplexer (UPMUX)	32 bits (Chip, QFP15-100pin, QFP14-80pin) 31 bits (QFP13-64pin) A peripheral circuit I/O function selected via software can be assigned to each port.
Timers	
Watchdog timer (WDT)	Generates NMI or watchdog timer reset.
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)	6 channels Generates the SPIA master clocks and the ADC10A trigger signals.
16-bit PWM timer (T16B)	4 channels Event counter/capture function PWM waveform generation function Number of PWM output or capture input ports: 6 ports/channel

S1C17589

Supply voltage detector (SVD)	
Detection level	20 levels (1.8 to 3.7 V)
Other	Intermittent operation mode Generates an interrupt or reset according to the detection level evaluation.
Serial interfaces	
UART (UART)	3 channels Baud-rate generator included, IrDA1.0 supported
Synchronous serial interface (SPIA)	2 channels 2 to 16-bit variable data length The 16-bit timer (T16) can be used for the baud-rate generator in master mode.
I ² C (I2C)	2 channels Baud-rate generator included
IR remote controller (REMC2)	
Number of transmitter channels	1 channel
Other	EL lamp drive waveform can be generated (by the hardware) for an application example.
10-bit A/D converter (ADC10A)	
Conversion method	Successive approximation type
Resolution	10 bits
Number of conversion channels	2 channels (Chip, QFP15-100pin, QFP14-80pin) 1 channel (QFP13-64pin)
Number of analog signal inputs	Ch.0: 8 ports, Ch.1: 8 ports (Chip, QFP15-100pin) Ch.0: 8 ports, Ch.1: 3 ports (QFP14-80pin) Ch.0: 7 ports, Ch.1: none (QFP13-64pin)
Multiplier/divider (COPRO2)	
Arithmetic functions	16-bit × 16-bit multiplier 16-bit × 16-bit + 32-bit multiply and accumulation 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.
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).
Interrupt	
Non-maskable interrupt	4 systems (Reset, address misaligned interrupt, debug, NMI)
Programmable interrupt	External interrupt: 1 system (8 levels) Internal interrupt: 23 systems (8 levels)
Power supply voltage	
V _{DD} operating voltage	1.8 to 5.5 V
V _{DD} operating voltage for Flash programming	1.8 to 5.5 V (V _{PP} = 7.5 V external power supply is required.)
AV _{DD} operating voltage	2.7 to 5.5 V
Operating temperature	
Operating temperature range	-40 to 85 °C
Current consumption (Typ. value)	
SLEEP mode	0.2 μA IOSC = OFF, OSC1 = OFF, OSC3 = OFF
HALT mode	0.6 μA OSC1 = 32 kHz, RTC = ON
RUN mode	9 μA OSC1 = 32 kHz, RTC = ON, CPU = OSC1 280 μA OSC3 = 1 MHz (ceramic osillator), OSC1 = 32 kHz, RTC = ON, CPU = OSC3
Shipping form	
1	QFP15-100pin (Lead pitch: 0.5 mm)
2	QFP14-80pin (Lead pitch: 0.5 mm)
3	QFP13-64pin (Lead pitch: 0.5 mm)
4	Die form (Pad pitch: 80 μm (min.))

■ BLOCK DIAGRAM

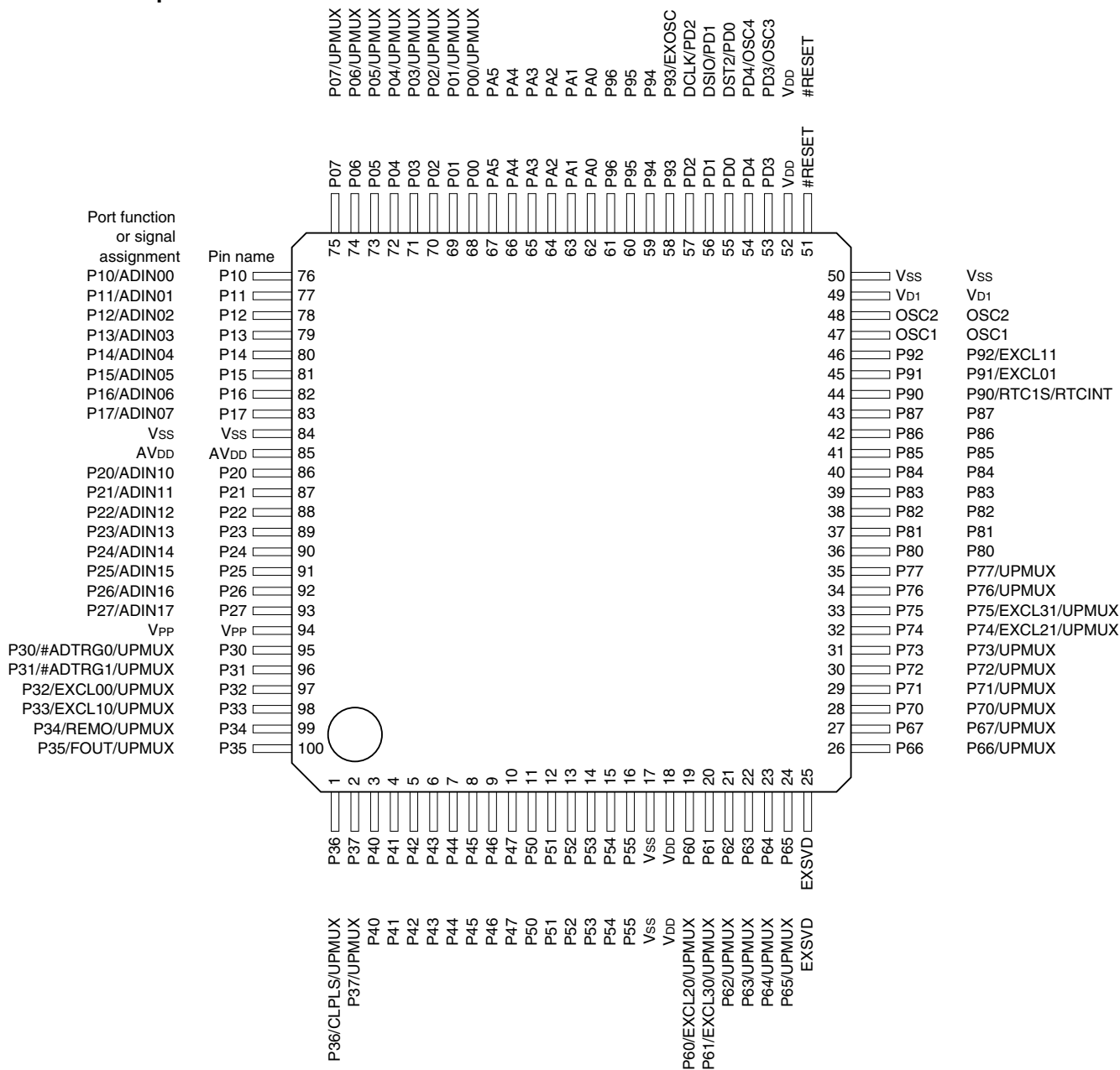


* The pin configuration depends on the package type.

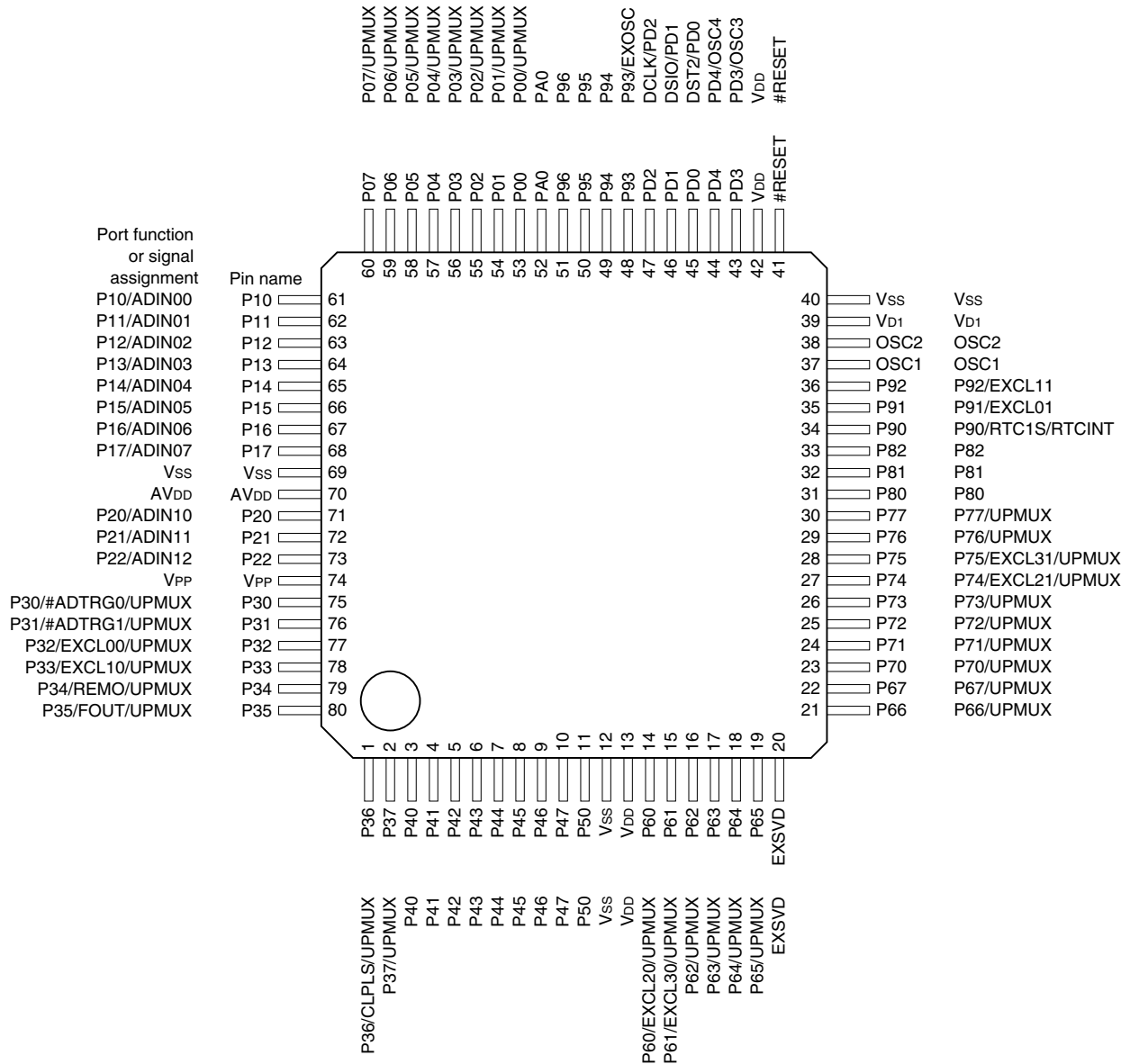
S1C17589

■ PIN CONFIGURATION DIAGRAMS

QFP15-100pin

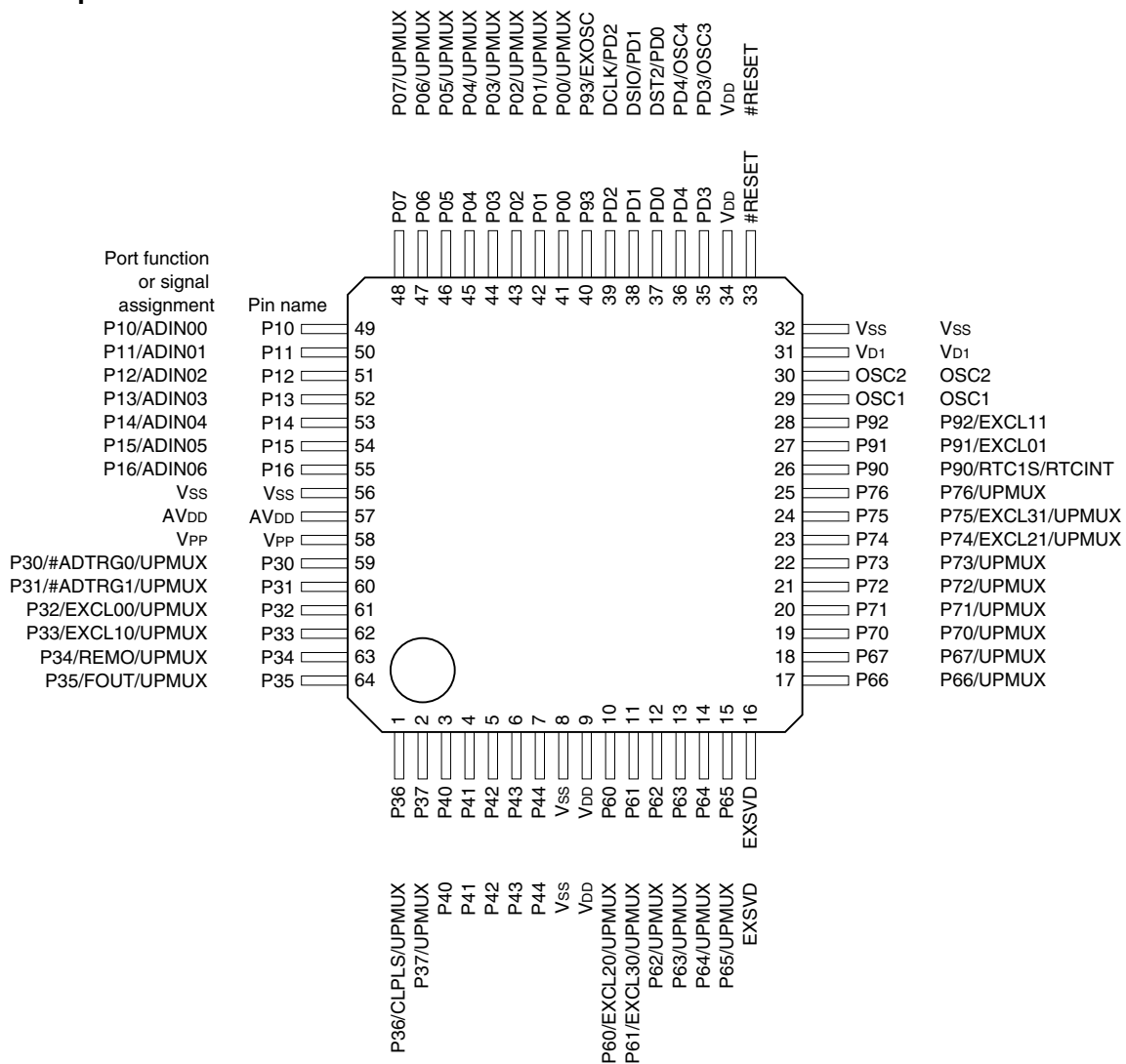


QFP14-80pin

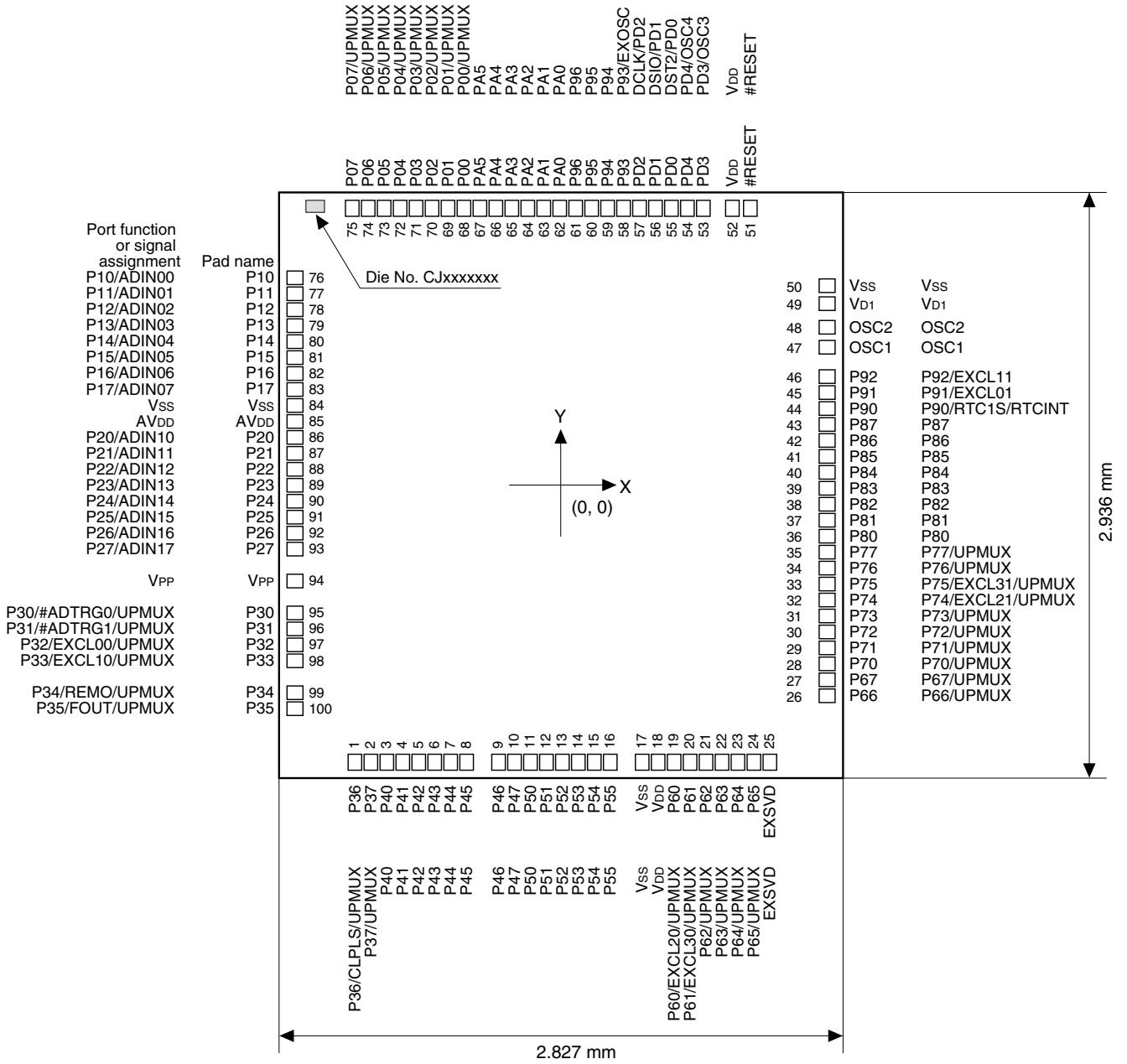


S1C17589

QFP13-64pin



Chip



S1C17589

■ 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

Chip	QFP15-100pin	QFP14-80pin	QFP13-64pin	Pin/pad name	Assigned signal	I/O	Initial state	Function
✓	✓	✓	✓	V _{DD}	V _{DD}	P	–	Power supply (+)
✓	✓	✓	✓	AV _{DD}	AV _{DD}	P	–	Analog power supply (+)
✓	✓	✓	✓	V _{SS}	V _{SS}	P	–	GND
✓	✓	✓	✓	V _{PP}	V _{PP}	P	–	Power supply for Flash programming
✓	✓	✓	✓	V _{D1}	V _{D1}	A	–	Internal voltage regulator output
✓	✓	✓	✓	EXSVD	EXSVD	A	–	Supply voltage detector input
✓	✓	✓	✓	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
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P01	P01	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P02	P02	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P03	P03	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P04	P04	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P05	P05	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P06	P06	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P07	P07	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P10	P10	I/O	Hi-Z	I/O port
					ADIN00	A		10-bit A/D converter Ch.0 analog signal input 0
✓	✓	✓	✓	P11	P11	I/O	Hi-Z	I/O port
					ADIN01	A		10-bit A/D converter Ch.0 analog signal input 1
✓	✓	✓	✓	P12	P12	I/O	Hi-Z	I/O port
					ADIN02	A		10-bit A/D converter Ch.0 analog signal input 2
✓	✓	✓	✓	P13	P13	I/O	Hi-Z	I/O port
					ADIN03	A		10-bit A/D converter Ch.0 analog signal input 3
✓	✓	✓	✓	P14	P14	I/O	Hi-Z	I/O port
					ADIN04	A		10-bit A/D converter Ch.0 analog signal input 4
✓	✓	✓	✓	P15	P15	I/O	Hi-Z	I/O port
					ADIN05	A		10-bit A/D converter Ch.0 analog signal input 5

Chip	QFP15-100pin	QFP14-80pin	QFP13-64pin	Pin/pad name	Assigned signal	I/O	Initial state	Function
✓	✓	✓	✓	P16	P16	I/O	Hi-Z	I/O port
					ADIN06	A		10-bit A/D converter Ch.0 analog signal input 6
✓	✓	✓	–	P17	P17	I/O	Hi-Z	I/O port
					ADIN07	A		10-bit A/D converter Ch.0 analog signal input 7
✓	✓	✓	–	P20	P20	I/O	Hi-Z	I/O port
					ADIN10	A		10-bit A/D converter Ch.1 analog signal input 0
✓	✓	✓	–	P21	P21	I/O	Hi-Z	I/O port
					ADIN11	A		10-bit A/D converter Ch.1 analog signal input 1
✓	✓	✓	–	P22	P22	I/O	Hi-Z	I/O port
					ADIN12	A		10-bit A/D converter Ch.1 analog signal input 2
✓	✓	–	–	P23	P23	I/O	Hi-Z	I/O port
					ADIN13	A		10-bit A/D converter Ch.1 analog signal input 3
✓	✓	–	–	P24	P24	I/O	Hi-Z	I/O port
					ADIN14	A		10-bit A/D converter Ch.1 analog signal input 4
✓	✓	–	–	P25	P25	I/O	Hi-Z	I/O port
					ADIN15	A		10-bit A/D converter Ch.1 analog signal input 5
✓	✓	–	–	P26	P26	I/O	Hi-Z	I/O port
					ADIN16	A		10-bit A/D converter Ch.1 analog signal input 6
✓	✓	–	–	P27	P27	I/O	Hi-Z	I/O port
					ADIN17	A		10-bit A/D converter Ch.1 analog signal input 7
✓	✓	✓	✓	P30	P30	I/O	Hi-Z	I/O port
					#ADTRG0	I		10-bit A/D converter Ch.0 trigger input
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P31	P31	I/O	Hi-Z	I/O port
					#ADTRG1	I		10-bit A/D converter Ch.1 trigger input
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P32	P32	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)
✓	✓	✓	✓	P33	P33	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)
✓	✓	✓	✓	P34	P34	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)
✓	✓	✓	✓	P35	P35	I/O	Hi-Z	I/O port
					FOUT	O		Clock external output
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P36	P36	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)
✓	✓	✓	✓	P37	P37	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P40	P40	I/O	Hi-Z	I/O port
✓	✓	✓	✓	P41	P41	I/O	Hi-Z	I/O port
✓	✓	✓	✓	P42	P42	I/O	Hi-Z	I/O port
✓	✓	✓	✓	P43	P43	I/O	Hi-Z	I/O port
✓	✓	✓	✓	P44	P44	I/O	Hi-Z	I/O port
✓	✓	✓	–	P45	P45	I/O	Hi-Z	I/O port
✓	✓	✓	–	P46	P46	I/O	Hi-Z	I/O port
✓	✓	✓	–	P47	P47	I/O	Hi-Z	I/O port
✓	✓	✓	–	P50	P50	I/O	Hi-Z	I/O port
✓	✓	–	–	P51	P51	I/O	Hi-Z	I/O port

S1C17589

Chip	QFP15-100pin	QFP14-80pin	QFP13-64pin	Pin/pad name	Assigned signal	I/O	Initial state	Function
✓	✓	-	-	P52	P52	I/O	Hi-Z	I/O port
✓	✓	-	-	P53	P53	I/O	Hi-Z	I/O port
✓	✓	-	-	P54	P54	I/O	Hi-Z	I/O port
✓	✓	-	-	P55	P55	I/O	Hi-Z	I/O port
✓	✓	✓	✓	P60	P60	I/O	Hi-Z	I/O port
					EXCL20	I		16-bit PWM timer Ch.2 event counter input 0
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P61	P61	I/O	Hi-Z	I/O port
					EXCL30	I		16-bit PWM timer Ch.3 event counter input 0
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P62	P62	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P63	P63	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P64	P64	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P65	P65	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P66	P66	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P67	P67	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P70	P70	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P71	P71	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P72	P72	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P73	P73	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P74	P74	I/O	Hi-Z	I/O port
					EXCL21	I		16-bit PWM timer Ch.2 event counter input 1
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P75	P75	I/O	Hi-Z	I/O port
					EXCL31	I		16-bit PWM timer Ch.3 event counter input 1
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	✓	P76	P76	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	-	P77	P77	I/O	Hi-Z	I/O port
					UPMUX	I/O		User-selected I/O (universal port multiplexer)
✓	✓	✓	-	P80	P80	I/O	Hi-Z	I/O port
✓	✓	✓	-	P81	P81	I/O	Hi-Z	I/O port
✓	✓	✓	-	P82	P82	I/O	Hi-Z	I/O port
✓	✓	-	-	P83	P83	I/O	Hi-Z	I/O port
✓	✓	-	-	P84	P84	I/O	Hi-Z	I/O port
✓	✓	-	-	P85	P85	I/O	Hi-Z	I/O port
✓	✓	-	-	P86	P86	I/O	Hi-Z	I/O port
✓	✓	-	-	P87	P87	I/O	Hi-Z	I/O port
✓	✓	✓	✓	P90	P90	I/O	Hi-Z	I/O port
					RTC1S	O		Real-time clock 1-second cycle pulse output
					RTCINT	O		Real-time clock interrupt signal output
✓	✓	✓	✓	P91	P91	I/O	Hi-Z	I/O port
					EXCL01	I		16-bit PWM timer Ch.0 event counter input 1

Chip	QFP15-100pin	QFP14-80pin	QFP13-64pin	Pin/pad name	Assigned signal	I/O	Initial state	Function
✓	✓	✓	✓	P92	P92	I/O	Hi-Z	I/O port
					EXCL11	I		16-bit PWM timer Ch.1 event counter input 1
✓	✓	✓	✓	P93	P93	I/O	Hi-Z	I/O port
					EXOSC	I		Clock generator external clock input
✓	✓	✓	-	P94	P94	I/O	Hi-Z	I/O port
✓	✓	✓	-	P95	P95	I/O	Hi-Z	I/O port
✓	✓	✓	-	P96	P96	I/O	Hi-Z	I/O port
✓	✓	✓	-	PA0	PA0	I/O	Hi-Z	I/O port
✓	✓	-	-	PA1	PA1	I/O	Hi-Z	I/O port
✓	✓	-	-	PA2	PA2	I/O	Hi-Z	I/O port
✓	✓	-	-	PA3	PA3	I/O	Hi-Z	I/O port
✓	✓	-	-	PA4	PA4	I/O	Hi-Z	I/O port
✓	✓	-	-	PA5	PA5	I/O	Hi-Z	I/O port
✓	✓	✓	✓	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

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)	SDI n	I	$n = 0, 1$	SPIA Ch. n data input
	SDO n	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 ² C (I2C)	SCL n	I/O	$n = 0, 1$	I2C Ch. n clock input/output
	SDA n	I/O		I2C Ch. n data input/output
UART (UART)	USIN n	I	$n = 0, 1, 2$	UART Ch. n data input
	USOUT n	O		UART Ch. n data output
16-bit PWM timer (T16B)	TOUT n 0/CAP n 0	I/O	$n = 0, 1, 2, 3$	T16B Ch. n PWM output/capture input 0
	TOUT n 1/CAP n 1	I/O		T16B Ch. n PWM output/capture input 1
	TOUT n 2/CAP n 2	I/O		T16B Ch. n PWM output/capture input 2
	TOUT n 3/CAP n 3	I/O		T16B Ch. n PWM output/capture input 3
	TOUT n 4/CAP n 4	I/O		T16B Ch. n PWM output/capture input 4
	TOUT n 5/CAP n 5	I/O		T16B Ch. n PWM output/capture input 5

S1C17589

NOTICE:

No part of this material may be reproduced or duplicated in any form or by any means without the written permission of Seiko Epson. Seiko Epson reserves the right to make changes to this material without notice. Seiko Epson does not assume any liability of any kind arising out of any inaccuracies contained in this material or due to its application or use in any product or circuit and, further, there is no representation that this material is applicable to products requiring high level reliability, such as, medical products. Moreover, no license to any intellectual property rights is granted by implication or otherwise, and there is no representation or warranty that anything made in accordance with this material will be free from any patent or copyright infringement of a third party. When exporting the products or technology described in this material, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You are requested not to use, to resell, to export and/or to otherwise dispose of the products (and any technical information furnished, if any) for the development and/or manufacture of weapon of mass destruction or for other military purposes.

All brands or product names mentioned herein are trademarks and/or registered trademarks of their respective companies.

©Seiko Epson Corporation 2015, All rights reserved

SEIKO EPSON CORPORATION

MICRODEVICES OPERATIONS DIVISION

Device Sales & Marketing Department

421-8 Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: +81-42-587-5814 FAX: +81-42-587-5117

EPSON semiconductor website

<http://global.epson.com/products/semicon/>

Document Code: 412962000
Issue March 2015 in JAPAN ©