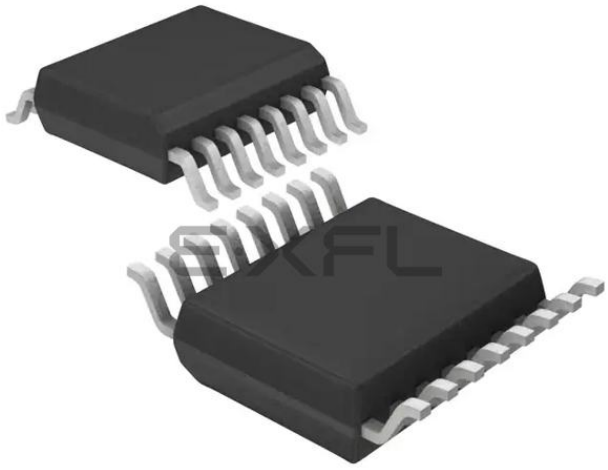
Renesas Electronics America Inc - R5F10Y46ASP#30 Datasheet



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What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	RL78
Core Size	16-Bit
Speed	20MHz
Connectivity	CSI, I²C, LINbus, UART/USART
Peripherals	DMA, LVD, POR, PWM, WDT
Number of I/O	10
Program Memory Size	2KB (2K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	256 x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 5.5V
Data Converters	A/D 7x8/10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	16-SSOP (0.173", 4.40mm Width)
Supplier Device Package	16-SSOP
Purchase URL	https://www.e-xfl.com/product-detail/renesas-electronics-america/r5f10y46asp-30

○ ROM, RAM capacities

Flash ROM	RAM	10 pins	16 pins
4 KB	512 B	–	R5F10Y47ASP Note 2
2 KB	256 B	R5F10Y16ASP	R5F10Y46ASP Note 2
1 KB	128 B	R5F10Y14ASP	R5F10Y44ASP Note 2

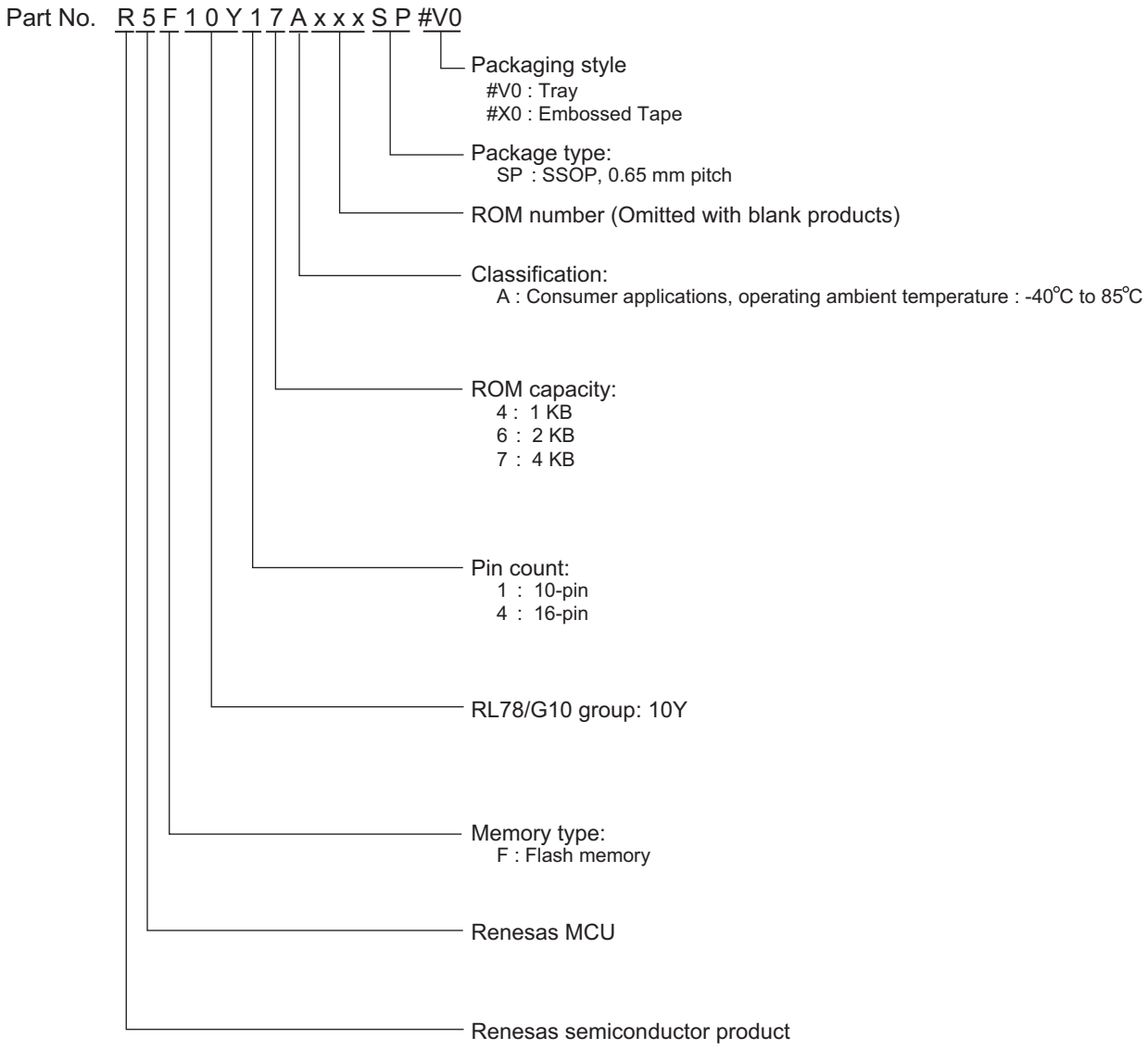
Notes 1. 16-pin products only

2. Under development

Remark The functions mounted depend on the product. See **1.6 Outline of Functions**.

1.2 List of Part Number

Figure 1-1. Classification of Part Number



Pin count	Package	Part Number
10 pins	10-pin plastic LSSOP (4.4 × 3.6 mm, 0.65mmpitch)	R5F10Y16ASP#V0, R5F10Y16ASP#X0
		R5F10Y14ASP#V0, R5F10Y14ASP#X0
16 pins	16-pin plastic SSOP (4.4 × 5.0 mm, 0.65mmpitch)	R5F10Y47ASP Note
		R5F10Y46ASP Note
		R5F10Y44ASP Note

Note Under development

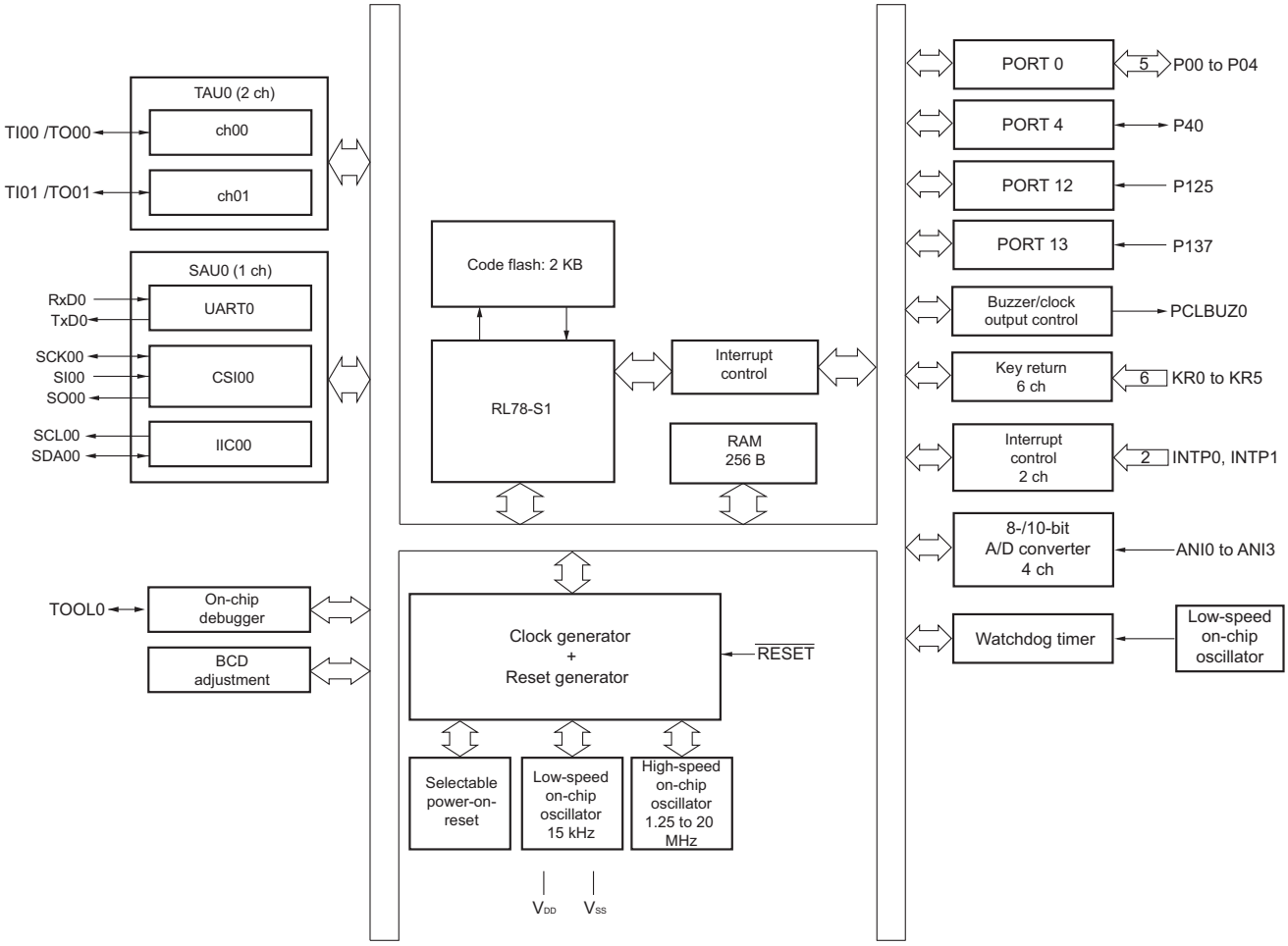
Caution The part number represents the number at the time of publication.
Be sure to review the latest part number through the target product page in the Renesas Electronics Corp.website.

1.4 Pin Identification

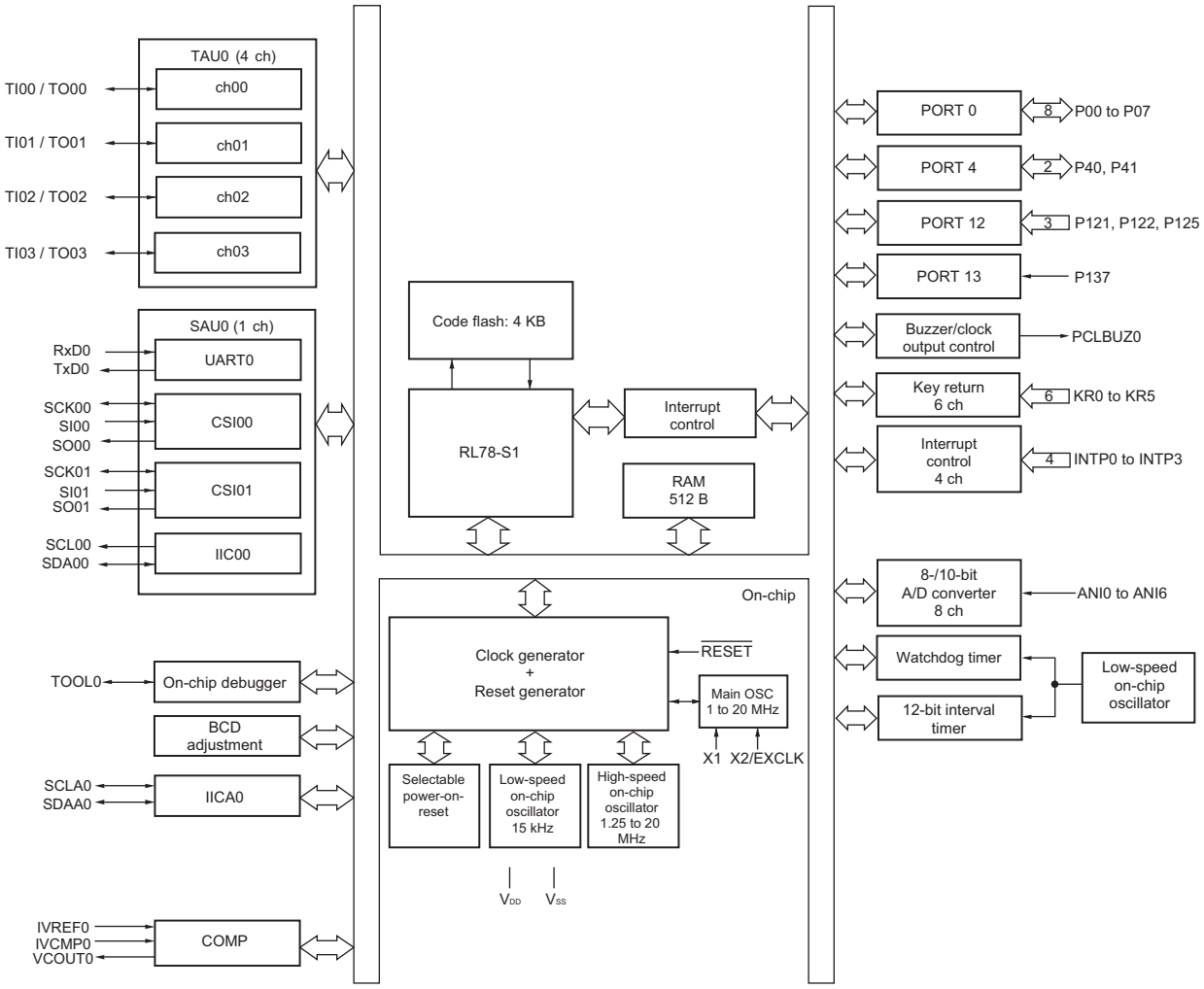
ANI0 to ANI6 : Analog Input
INTP0 to INTP3 : External Interrupt Input
KR0 to KR5 : Key Return
P00 to P07 : Port 0
P40, P41 : Port 4
P121, P122, P125 : Port 12
P137 : Port 13
PCLBUZ0 : Programmable Clock Output/ Buzzer Output
EXCLK : External Clock Input
X1, X2 : Crystal Oscillator
IVCMP0 : Comparator Input
VCOUT0 : Comparator Output
IVREF0 : Comparator Reference Input
$\overline{\text{RESET}}$: Reset
RxD0 : Receive Data
SCK00, SCK01 : Serial Clock Input/Output
SCL00, SCLA0 : Serial Clock Output
SDA00, SDAA0 : Serial Data Input/Output
SI00, SI01 : Serial Data Input
SO00, SO01 : Serial Data Output
TI00 to TI03 : Timer Input
TO00 to TO03 : Timer Output
TOOL0 : Data Input/Output for Tool
TxD0 : Transmit Data
V_{DD} : Power Supply
V_{SS} : Ground

1.5 Block Diagram

1.5.1 10-pin products



1.5.2 16-pin products



1.6 Outline of Functions

This outline describes the function at the time when Peripheral I/O redirection register (PIOR) is set to 00H.

Item		10-pin		16-pin		
		R5F10Y16ASP	R5F10Y14ASP	R5F10Y47ASP	R5F10Y46ASP	R5F10Y44ASP
Code flash memory		2 KB	1 KB	4 KB	2 KB	1 KB
RAM		256 B	128 B	512 B	256 B	128 B
Main system clock	High-speed system clock	—		X1, X2 (crystal/ceramic) oscillation, external main system clock input (EXCLK): 1 to 20 MHz: V_{DD} = 2.7 to 5.5 V 1 to 5 MHz: V_{DD} = 2.0 to 5.5 V		
	High-speed on-chip oscillator clock	• 1.25 to 20 MHz (V_{DD} = 2.7 to 5.5 V) • 1.25 to 5 MHz (V_{DD} = 2.0 to 5.5 V)				
Low-speed on-chip oscillator clock		15 kHz (TYP)				
General-purpose register		8-bit register × 8				
Minimum instruction execution time		0.05 μs (20 MHz operation)				
Instruction set		• Data transfer (8 bits) • Adder and subtractor/logical operation (8 bits) • Multiplication (8 bits × 8 bits) • Rotate, barrel shift, and bit manipulation (set, reset, test, and Boolean operation), etc.				
I/O port	Total	8		14		
	CMOS I/O	6 (N-ch open-drain output (V_{DD} tolerance): 2)		10 (N-ch open-drain output (V_{DD} tolerance): 4)		
	CMOS input	2		4		
Timer	16-bit timer	2 channels		4 channels		
	Watchdog timer	1 channel				
	12-bit interval timer	—		1 channel		
	Timer output	2 channels (PWM output: 1)		4 channels (PWM outputs: 3[Note 1])		
Clock output/buzzer output		1				
		2.44 kHz to 10 MHz: (Peripheral hardware clock: f_{MAIN} = 20 MHz operation)				
Comparator		—		1		
8-/10-bit resolution A/D converter		4 channels		8 channels		
Serial interface		[10-pin products] CSI: 1 channel/simplified I^2C: 1 channel/UART: 1 channel [16-pin products] CSI: 2 channels/simplified I^2C: 1 channel/UART: 1 channel				
	I^2C bus	—		1 channel		
Vectored interrupt sources	Internal	8		14		
	External	3		5		
Key interrupt		6				
Reset		• Reset by $\overline{\text{RESET}}$ pin • Internal reset by watchdog timer • Internal reset by selectable power-on-reset • Internal reset by illegal instruction execution [Note 2] • Internal reset by data retention lower limit voltage				
Selectable power-on-reset circuit		Detection voltage: 2.0 V/2.4 V/2.7 V/4.0 V				
On-chip debug function		Provided				
Power supply voltage		V_{DD} = 2.0 to 5.5 V				
Operating ambient temperature		T_A = - 40 to + 85 °C				

2. ELECTRICAL SPECIFICATIONS

Cautions 1. This chapter explains the electrical specifications of two products, the R5F10Y16ASP and the R5F10Y14ASP.

2. Electrical specifications for the 16-pin products are T. B. D. because these products are under development.

3. The RL78/G10 has an on-chip debug function, which is provided for development and evaluation. Do not use the on-chip debug function in products designated for mass production, because the guaranteed number of rewritable times of the flash memory may be exceeded when this function is used, and product reliability therefore cannot be guaranteed. Renesas Electronics is not liable for problems occurring when the on-chip debug function is used.

4. The pins mounted depend on the product. Refer to 2.1 Port Functions and 2.2.1 Functions for each product in the RL78/G10 User's Manual.

2.1 Absolute Maximum Ratings

(T_A = 25°C)

Parameter	Symbols	Conditions		Ratings	Unit
Supply Voltage	V_{DD}			−0.5 to +6.5	V
Input Voltage	V_{I1}			−0.3 to V_{DD} + 0.3[Note]	V
Output Voltage	V_{O1}			−0.3 to V_{DD} + 0.3	V
Output current, high	I_{OH1}	Per pin		−40	mA
		Total of all pins -140 mA	P40	−40	mA
			P00 to P04	−100	mA
Output current, low	I_{OL1}	Per pin		40	mA
		Total of all pins 140 mA	P40	40	mA
			P00 to P04	100	mA
Operating ambient temperature	T_A			−40 to +85	°C
Storage temperature	T_{stg}			−65 to +150	°C

Note Must be 6.5 V or lower.

Caution Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

Remarks 1. Unless specified otherwise, the characteristics of alternate-function pins are the same as those of the port pins.

2. The reference voltage is V_{SS}.

2.2 Oscillator Characteristics

2.2.1 On-chip oscillator characteristics

(T_A = −40 to +85°C, 2.0 V ≤ V_{DD} ≤ 5.5 V, V_{SS} = 0 V)

Oscillators	Parameters	Conditions	MIN.	TYP.	MAX.	Unit
High-speed on-chip oscillator oscillation clock frequency [Notes 1, 2]	f_{IH}		1.25		20	MHz
High-speed on-chip oscillator oscillation clock frequency accuracy		T_A = -20 to +85°C	-2.0		+2.0	%
		T_A = -40 to -20°C	-3.0		+3.0	%
Low-speed on-chip oscillator oscillation clock frequency [Note 3]	f_{IL}			15		kHz
Low-speed on-chip oscillator oscillation clock frequency accuracy			-15		+15	%

Notes 1. High-speed on-chip oscillator frequency is selected by bits 0 to 2 of option byte (000C2H).

2. This only indicates the oscillator characteristics. Refer to AC Characteristics for instruction execution time.

3. This only indicates the oscillator characteristics.

- Total output current of pins = (I_{OH} × 0.7)/(n × 0.01)
  <Example> Where n = 80 % and I_{OH} = - 10.0 mA
  Total output current of pins = (- 10.0 × 0.7)/(80 × 0.01) ≅ - 8.7 mA
- Total output current of pins = (I_{OL} × 0.7)/(n × 0.01)
  <Example> Where n = 80 % and I_{OL} = 10.0 mA
  Total output current of pins = (10.0 × 0.7)/(80 × 0.01) ≅ 8.7 mA

However, the current that is allowed to flow into one pin does not vary depending on the duty factor. A current higher than the absolute maximum rating must not flow into one pin.

4. Value of current at which the device operation is guaranteed even if the current flows from an output pin to the V_{SS} pin.
5. The value under the condition which satisfies the high-level output current (I_{OH1}).
6. The value under the condition which satisfies the low-level output current (I_{OL1}).

Cautions 1. P00 and P01 do not output high level in N-ch open-drain mode.
2. The maximum value of V_{IH} of P00 and P01 is V_{DD} even in N-ch open-drain mode.

Remark Unless specified otherwise, the characteristics of alternate-function pins are the same as those of the port.

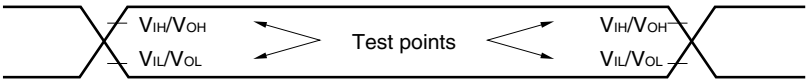
2.4 AC Characteristics

(T_A = –40 to +85°C, 2.0 V ≤ V_{DD} ≤ 5.5 V, V_{SS} = 0 V)

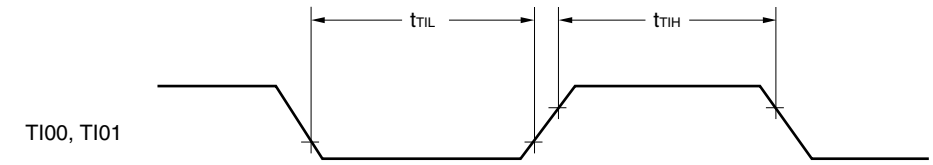
Items	Symbol	Conditions		MIN.	TYP.	MAX.	Unit
Instruction cycle (minimum instruction execution time)	T_{CY}	Main system clock (f_{MAIN}) operation	2.7 V ≤ V_{DD} ≤ 5.5 V	0.05		0.8	μs
			2.0 V ≤ V_{DD} ≤ 5.5 V	0.2		0.8	μs
TI00, TI01 input high-level width, low-level width	t_{TIH}, t_{TIL}	Noise filter is not used		1/f_{MCK} + 10			ns
TO00, TO01 output frequency	f_{TO}	4.0 V ≤ V_{DD} ≤ 5.5 V				10	MHz
		2.7 V ≤ V_{DD} < 4.0 V				5	MHz
		2.0 V ≤ V_{DD} < 2.7 V				2.5	MHz
PCLBUZ0 output frequency	f_{PCL}	4.0 V ≤ V_{DD} ≤ 5.5 V				10	MHz
		2.7 V ≤ V_{DD} < 4.0 V				5	MHz
		2.0 V ≤ V_{DD} < 2.7 V				2.5	MHz
$\overline{\text{RESET}}$ low-level width	t_{RSL}			10			μs

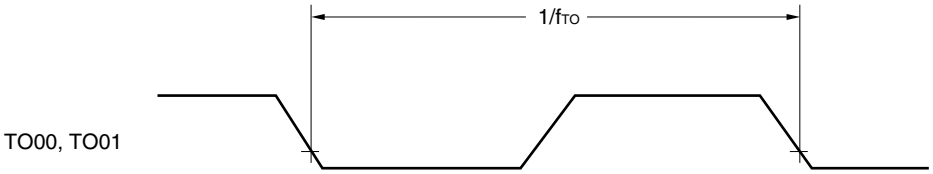
Remark f_{MCK}: Timer array unit operation clock frequency

AC Timing Test Points



TI/TO Timing





2.5 Serial Communication Characteristics

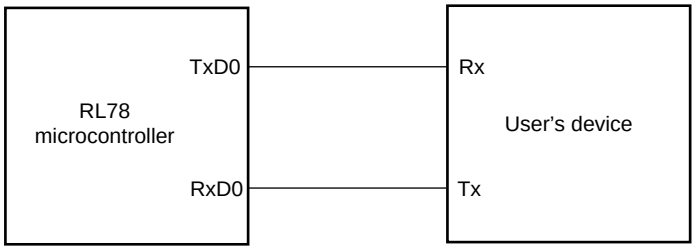
2.5.1 Serial array unit

(1) UART mode

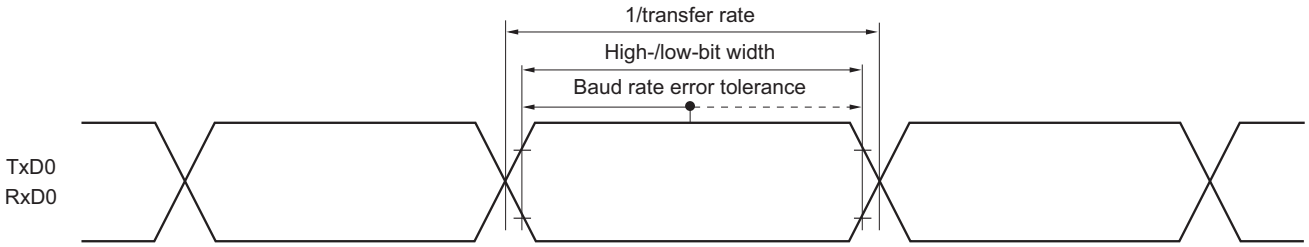
(T_A = −40 to +85°C, 2.0 V ≤ V_{DD} ≤ 5.5 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Transfer rate					f_{MCK}/6	bps
		Theoretical value of the maximum transfer rate f_{CLK} = f_{MCK} = 20 MHz			3.3	Mbps

UART mode connection diagram



UART mode bit width (reference)



Remark f_{MCK}: Serial array unit operation clock frequency
(Operation clock to be set by the CKSmn bit of serial mode register mn (SMRmn).
m: Unit number, n: Channel number (mn = 00))

(3) CSI mode (slave mode, SCKp... external clock input)

(T_A = –40 to +85°C, 2.0 V ≤ V_{DD} ≤ 5.5 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions		MIN.	TYP.	MAX.	Unit
SCKp cycle time	t_{KCY2}	2.7 V ≤ V_{DD} ≤ 5.5 V	f_{MCK} = 20 MHz	8/f_{MCK}			ns
			f_{MCK} ≤ 10 MHz	6/f_{MCK}			ns
		2.0 V ≤ V_{DD} < 2.7 V		6/f_{MCK}			ns
SCKp high-/low-level width	t_{KH2}, t_{KL2}	2.0 V ≤ V_{DD} ≤ 5.5 V		t_{KCY2}/2			ns
SIp setup time (to SCKp↑)[Note 1]	t_{SIK2}	2.7 V ≤ V_{DD} ≤ 5.5 V		1/f_{MCK} + 20			ns
		2.0 V ≤ V_{DD} < 2.7 V		1/f_{MCK} + 30			ns
SIp hold time (from SCKp↑) [Note 2]	t_{KSI2}	2.0 V ≤ V_{DD} ≤ 5.5 V		1/f_{MCK} + 31			ns
Delay time from SCKp↓ to SOp output [Note 3]	t_{KSO2}	C = 30 pF [Note 4]	2.7 V ≤ V_{DD} ≤ 5.5 V			2/f_{MCK} + 50	ns
			2.0 V ≤ V_{DD} < 2.7 V			2/f_{MCK} + 110	ns

Notes 1. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The SIp setup time becomes "to SCKp↓" when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

2. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The SIp hold time becomes "from SCKp↓" when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

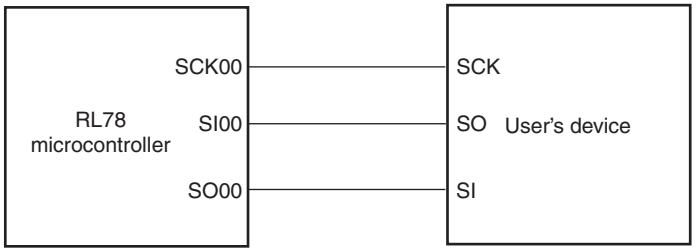
3. When DAPmn = 0 and CKPmn = 0, or DAPmn = 1 and CKPmn = 1. The delay time to SOp output becomes "from SCKp↑" when DAPmn = 0 and CKPmn = 1, or DAPmn = 1 and CKPmn = 0.

4. C is the load capacitance of the SOp output lines.

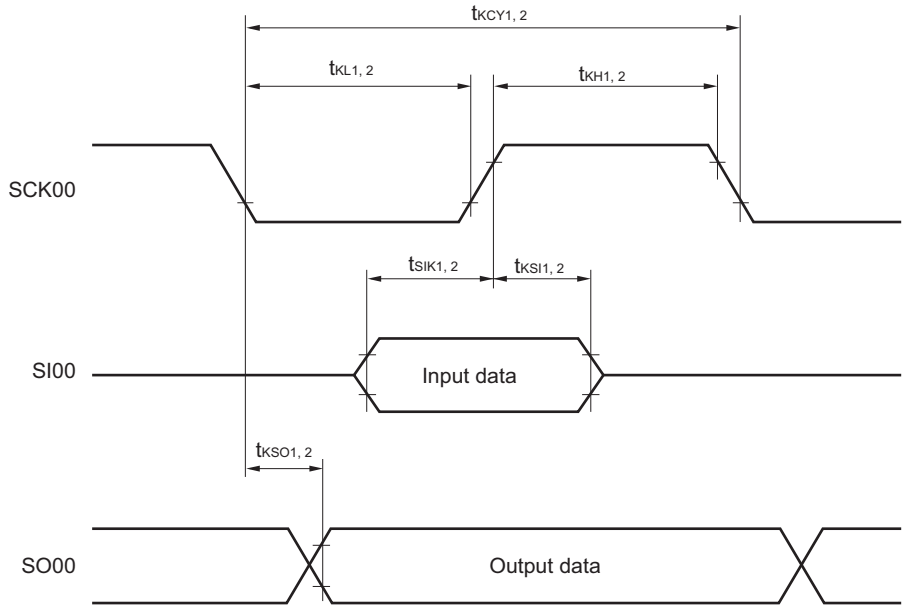
Remarks 1. p: CSI number (p = 00), m: Unit number (m = 0), n: Channel number (n = 0)

2. f_{MCK}: Serial array unit operation clock frequency
(Operation clock to be set by the CKSmn bit of serial mode register mn (SMRmn). m: Unit number, n: Channel number (mn = 00))

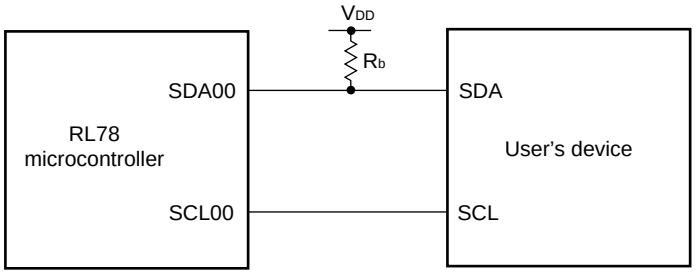
CSI mode connection diagram



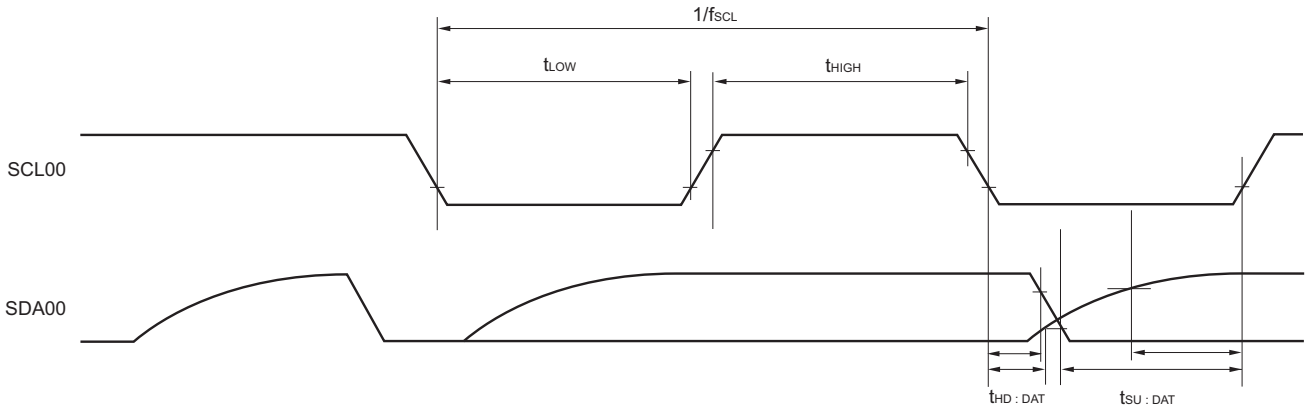
CSI mode serial transfer timing
(When DAP00 = 0 and CKP00 = 0, or DAP00 = 1 and CKP00 = 1.)



Simplified I²C mode connection diagram



Simplified I²C mode serial transfer timing



2.6 Analog Characteristics

2.6.1 A/D converter characteristics

(Target ANI pin : ANI0 to ANI3)

(T_A = –40 to +85°C, 2.4 V ≤ V_{DD} ≤ 5.5 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions		MIN.	TYP.	MAX.	Unit
Resolution	R_{ES}			8		10	bit
Overall error[Note 1]	AINL	10-bit resolution	V_{DD} = 5 V		±1.7	±3.1[Note 2]	LSB
			V_{DD} = 3 V		±2.3	±4.5[Note 2]	LSB
Conversion time	t_{CONV}	10-bit resolution	2.7 V ≤ V_{DD} ≤ 5.5 V	3.4		18.4	µs
			2.4 V ≤ V_{DD} ≤ 5.5 V	4.6		18.4	µs
Zero-scale error[Note 1]	E_{ZS}	10-bit resolution	V_{DD} = 5 V			±0.19[Note 2]	%FSR
			V_{DD} = 3 V			±0.39[Note 2]	%FSR
Full-scale error[Note 1]	E_{FS}	10-bit resolution	V_{DD} = 5 V			±0.29[Note 2]	%FSR
			V_{DD} = 3 V			±0.42[Note 2]	%FSR
Integral linearity error[Note 1]	ILE	10-bit resolution	V_{DD} = 5 V			±1.8[Note 2]	LSB
			V_{DD} = 3 V			±1.7[Note 2]	LSB
Differential linearity error[Note 1]	DLE	10-bit resolution	V_{DD} = 5 V			±1.4[Note 2]	LSB
			V_{DD} = 3 V			±1.5[Note 2]	LSB
Analog input voltage	V_{AIN}			0		V_{DD}	V

Notes 1. Excludes quantization error (±1/2 LSB).

2. This is the characteristic evaluation value plus or minus 3. These values are not used in the shipping inspection.

2.6.2 SPOR circuit characteristics

(T_A = –40 to +85°C, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Detection supply voltage	V_{SPOR0}	Power supply rise time	4.08	4.28	4.45	V
		Power supply fall time	4.00	4.20	4.37	V
	V_{SPOR1}	Power supply rise time	2.76	2.90	3.02	V
		Power supply fall time	2.70	2.84	2.96	V
	V_{SPOR2}	Power supply rise time	2.44	2.57	2.68	V
		Power supply fall time	2.40	2.52	2.62	V
	V_{SPOR3}	Power supply rise time	2.05	2.16	2.25	V
		Power supply fall time	2.00	2.11	2.20	V
Minimum pulse width[Note]	T_{SPW}		300			µs

Note Time required for the reset operation by the SPOR when V_{DD} becomes under V_{SPDR}.

2.6.3 Power supply voltage rising slope characteristics

(T_A = –40 to +85°C, V_{SS} = 0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Power supply voltage rising slope	S_{VDD}				54	V/ms

2.7 Flash Memory Programming Characteristics

(T_A = 0 to + 40°C, 4.5 V ≤ V_{DD} ≤ 5.5 V, V_{SS} = 0 V)

Parameter	Symbol	Conditions		MIN.	TYP.	MAX.	Unit
Code flash memory rewritable times Notes 1, 2, 3	C_{erwr}	Retained for 20 years.	T_A = + 85°C	1000			Times

Notes 1. 1 erase + 1 write after the erase is regarded as 1 rewrite. The retaining years are until next rewrite after the rewrite.

2. When using flash memory programmer.

3. These are the characteristics of the flash memory and the results obtained from reliability testing by Renesas Electronics Corporation.

2.8 Dedicated Flash Memory Programmer Communication (UART)

(T_A = 0 to + 40°C, 4.5 V ≤ V_{DD} ≤ 5.5V, V_{SS} = 0 V)

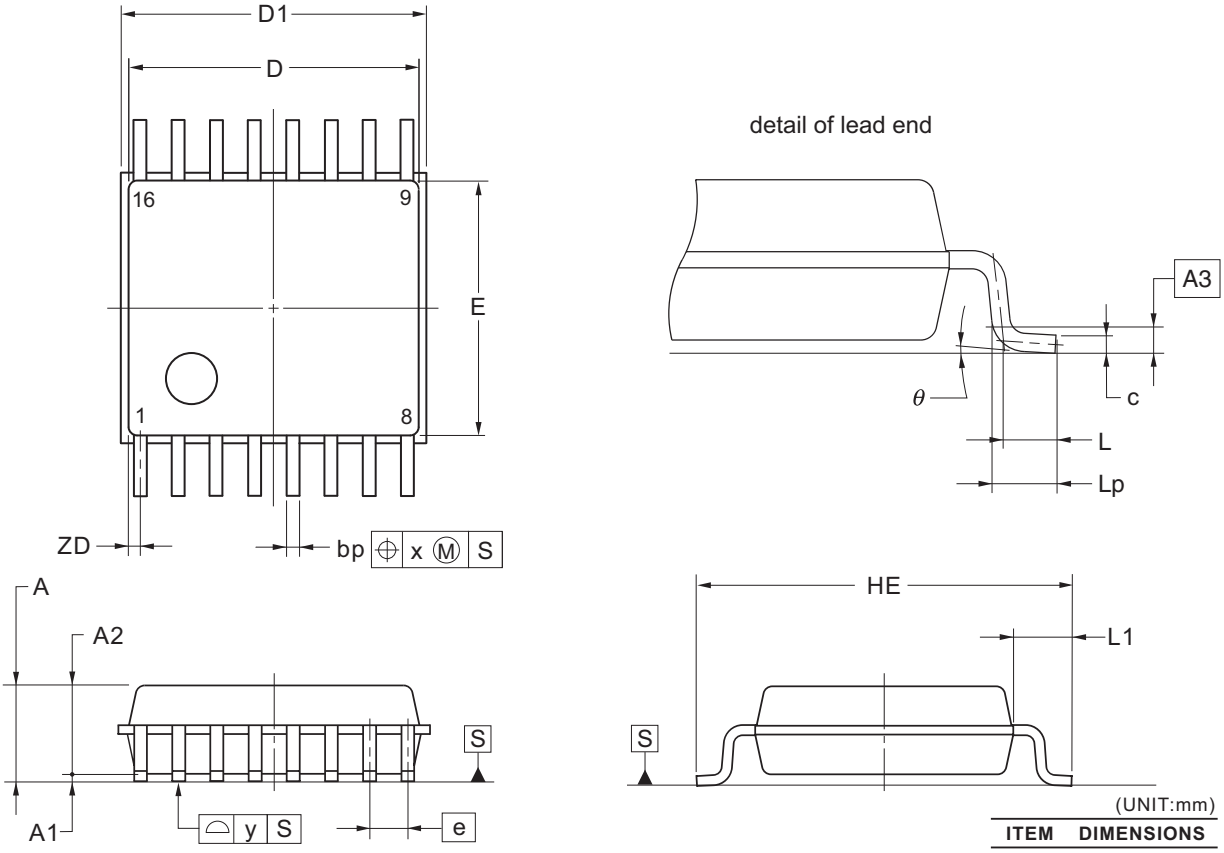
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Transfer rate				115,200		bps

Remark The transfer rate during flash memory programming is fixed to 115,200 bps.

3.2 16-pin products

R5F10Y47ASP, R5F10Y46ASP, R5F10Y44ASP

JEITA Package Code	RENESAS Code	Previous Code	MASS (TYP.) [g]
P-SSOP16-4.4x5-0.65	PRSP0016JC-A	P16MA-65-FAA-2	0.08



(UNIT:mm)

ITEM	DIMENSIONS
D	5.00±0.15
D1	5.20±0.15
E	4.40±0.20
HE	6.40±0.20
A	1.725 MAX.
A1	0.125±0.05
A2	1.50
A3	0.25
e	0.65
bp	$0.22^{+0.08}_{-0.07}$
c	$0.15^{+0.03}_{-0.04}$
L	0.50
Lp	0.60±0.10
L1	1.00±0.20
x	0.13
y	0.10
θ	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
ZD	0.325

Revision History	RL78/G10 Data Sheet

Rev.	Date	Description	
		Page	Summary
1.00	Apr 15, 2013	-	First Edition issued

Caution: This product uses SuperFlash® technology licensed from Silicon Storage Technology, Inc.

NOTES FOR CMOS DEVICES

(1) VOLTAGE APPLICATION WAVEFORM AT INPUT PIN: Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between VIL (MAX) and VIH (MIN) due to noise, etc., the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between VIL (MAX) and VIH (MIN).

(2) HANDLING OF UNUSED INPUT PINS: Unconnected CMOS device inputs can be cause of malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to VDD or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

(3) PRECAUTION AGAINST ESD: A strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it when it has occurred. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

(4) STATUS BEFORE INITIALIZATION: Power-on does not necessarily define the initial status of a MOS device. Immediately after the power source is turned ON, devices with reset functions have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. A device is not initialized until the reset signal is received. A reset operation must be executed immediately after power-on for devices with reset functions.

(5) POWER ON/OFF SEQUENCE: In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current. The correct power on/off sequence must be judged separately for each device and according to related specifications governing the device.

(6) INPUT OF SIGNAL DURING POWER OFF STATE : Do not input signals or an I/O pull-up power supply while the device is not powered. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

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Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

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