Low EMI, Spread Modulating, Clock Generator

Features:

- ICS91720 is a Spread Spectrum Clock targeted for Mobile PC and LCD panel applications that generates an EMI-optimized clock signal (EMI peak reduction of 7-14 dB on 3rd-19th harmonics) through use of Spread Spectrum techniques.
- ICS91720 focuses on the lower input frequency range of 14.318 to 80.00 MHz with a spread modulation of 20kHz to 40kHz.

Specifications:

- Supply Voltages: V_{DD} = 3.3V ±0.3V
- Frequency range: 14.318 MHz ≤ Fin ≥ 80 MHz
- Cyc to Cyc jitter: <150ps
- Output duty cycle 45-55%
- Guarantees +85°C operational condition.
- 8-pin SOIC/TSSOP
- Reference input

Pin Configuration

8 Pin SOIC/TSSOP

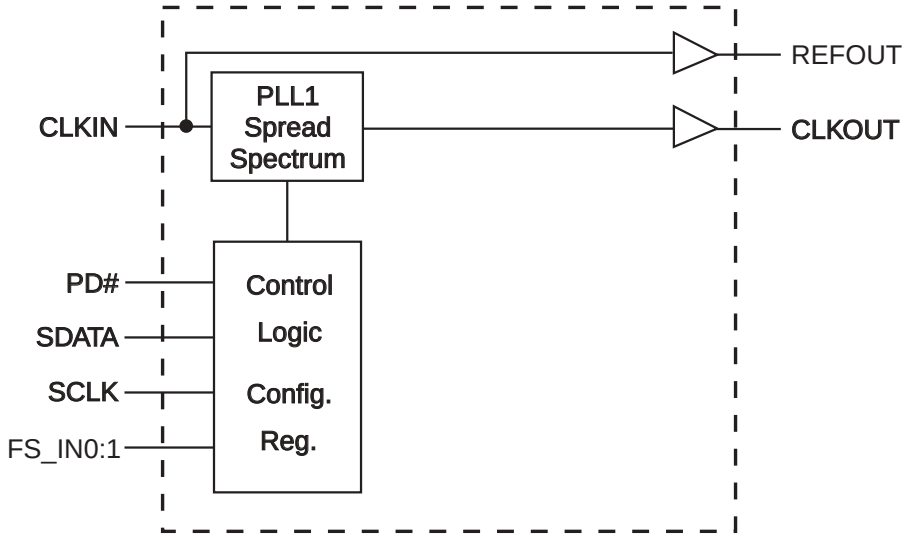
* Internal Pull-Up Resistor

** Internal Pull-Down Resistor

Functionality

FSIN_1	FSIN_0	MHz	Spread % default
0	0	14.318 MHz in --> 27MHz out	-0.8 down spread
0	1	14.318MHz -->14.318MHz out	-1.00 down spread
1	0	27.00MHz in --> 27.00MHz out	-1.25 down spread
1	1	48.00MHz in -->48.00 MHz out	-0.8 down spread

Block Diagram



Pin Description

PIN #	PIN NAME	PIN TYPE	DESCRIPTION
1	CLKIN	PWR	Input for reference clock.
2	VDD	IN	Power supply, nominal 3.3V
3	GND	OUT	Ground pin.
4	**CLKOUT/FS_IN0	I/O	Modulated clock output. Frequency select latch input. Refer to the functionality table.
5	REF_OUT/FS_IN1*	I/O	Un-modulated 3.3V reference clock output. Frequency select latch input. Refer to the functionality table.
6	SDATA	PWR	Data pin for I2C circuitry 5V tolerant
7	SCLK	PWR	Clock pin of I2C circuitry 5V tolerant
8	PD#*	PWR	Asynchronous active low input pin used to power down the device into a low power state. The internal clocks are disabled and the VCO and the crystal are stopped. The latency of the power down will not be greater than 1.8ms.

* Internal Pull-Up Resistor ** Internal Pull-Down Resistor

Table 1: Frequency Configuration Table (See I2C Byte 0)

	FS4	FS3	FS2	FS1	FS0	Sprd Type	Sprd %
14in/27out	0	0	0	0	0	DOWN SPREAD (-)	0.60
	0	0	0	0	1		0.80
	0	0	0	1	0		1.00
	0	0	0	1	1		1.25
	0	0	1	0	0		1.50
	0	0	1	0	1		2.00
	0	0	1	1	0	CENTER SPD (+/-)	0.50
	0	0	1	1	1		1.00
14in/14out 27in/27out	0	1	0	0	0	DOWN SPREAD (-)	0.60
	0	1	0	0	1		1.00
	0	1	0	1	0		-0.80
	0	1	0	1	1	CNTR SPD	+/-0.3
	0	1	1	0	0	DOWN SPREAD (-)	1.50
	0	1	1	0	1		1.75
	0	1	1	1	0		2.00
	0	1	1	1	1		2.50
	1	0	0	0	0		3.00
	1	0	0	0	1		-1.25
	1	0	0	1	0	CENTER SPREAD (+/-)	0.40
	1	0	0	1	1		0.50
	1	0	1	0	0		0.70
	1	0	1	0	1		1.00
	1	0	1	1	0		1.20
	1	0	1	1	1		1.50
48in/48out 66in/66out	1	1	0	0	0	DOWN SPREAD (-)	0.60
	1	1	0	0	1		0.80
	1	1	0	1	0		1.00
	1	1	0	1	1		1.25
	1	1	1	0	0		1.50
	1	1	1	0	1		2.00
	1	1	1	1	0	CENTER SPD (+/-)	0.50
	1	1	1	1	1		1.00

Above is the hard coded 5 bit (32 entry) ROM table.
FS2:0 are ONLY accessible through I2C software programming bits (byte0 bits5:7). FS3 and FS4 can also be decoded from FS_IN0:1 latched input hardware pins.
FS_IN0 → FS3 and FS_IN1 → FS4. Upon power-up the default is to use hardware selections of FS_IN0:1 latched values.
FS2 = 0, FS1 = 0, FS0 = 1 upon power-up (refer to the functionality table on page 1).
To access non-default spread entries in the ROM, byte0 programming should be used. In order to change the power up default of FS_IN1:0 = 10 (-1.25% down spread) to any other spread % entry, first change byte0bit 0 to software selection by switching this bit to a '1' and then program the desired percentage by changing byte0 bits 7:3.

General I²C serial interface information

How to Write:

- Controller (host) sends a start bit.
- Controller (host) sends the write address D4 (H)
- ICS clock will ***acknowledge***
- Controller (host) sends the begining byte location = N
- ICS clock will ***acknowledge***
- Controller (host) sends the data byte count = X
- ICS clock will ***acknowledge***
- Controller (host) starts sending ***Byte N through Byte N + X -1***
  (see Note 2)
- ICS clock will ***acknowledge*** each byte ***one at a time***
- Controller (host) sends a Stop bit

How to Read:

- Controller (host) will send start bit.
- Controller (host) sends the write address D4 (H)
- ICS clock will ***acknowledge***
- Controller (host) sends the begining byte location = N
- ICS clock will ***acknowledge***
- Controller (host) will send a separate start bit.
- Controller (host) sends the read address D5 (H)
- ICS clock will ***acknowledge***
- ICS clock will send the data byte count = X
- ICS clock sends ***Byte N + X -1***
- ICS clock sends ***Byte 0 through byte X (if X (H) was written to byte 8)***.
- Controller (host) will need to acknowledge each byte
- Controllor (host) will send a not acknowledge bit
- Controller (host) will send a stop bit

Index Block Write Operation

Controller (Host)		ICS (Slave/Receiver)
T	starT bit	
Slave Address D4(H)		
WR	WRite	
		ACK
Beginning Byte = N		
		ACK
Data Byte Count = X		
		ACK
Beginning Byte N	X Byte	
		ACK
○		
○		○
○		○
		○
Byte N + X - 1		
		ACK
P	stoP bit	

Index Block Read Operation

Controller (Host)		ICS (Slave/Receiver)	
T	starT bit		
Slave Address D4(H)			
WR	WRite		
		ACK	
Beginning Byte = N			
		ACK	
RT	Repeat starT		
Slave Address D5(H)			
RD	ReaD		
		ACK	
		Data Byte Count = X	
ACK			
		X Byte	Beginning Byte N
ACK			
			○
○			○
○			○
○			
			Byte N + X - 1
N	Not acknowledge		
P	stoP bit		

0698D—10/05/04

Byte 0	Affected Pin			Type	Bit Control		PWD
	Pin #	Name	Control Function		0	1	
Bit 7	-	FS0	Spread/FS0	RW	Spread percentage See Table 1 These are I2C bits only		1
Bit 6	-	FS1	Spread/FS1	RW			0
Bit 5		FS2	Spread/FS2	RW			0
Bit 4		FS3	Spread/FS3	RW			0
Bit 3		FS4	FS4	RW			0
Bit 2		PD# Tri_Sate	PD# Tri_Sate	RW	Hi-Z	LOW	1
Bit 1		Spread Enable	Spread Enable	RW	OFF	ON	1
Bit 0		HW/SW Control	Spread Spectrum Control FS 3:4 Hard/Software Select	RW	HW	SW	0

Byte 1	Affected Pin			Type	Bit Control		PWD
	Pin #	Name	Control Function		0	1	
Bit 7		REF_OUT	REF_OUT_Enable	RW	Disable	Enable	1
Bit 6	-	REF_OUT	Slew Rate REF-OUT	RW	Nominal	Fast	1
Bit 5		FS-IN_1	FS-IN_1 Readback	R	-	-	X
Bit 4		FS-IN_0	FS-IN_0 Readback	R	-	-	X
Bit 3		CLK_OUT	Slew Rate CLK-OUT	RW	Nominal	Fast	1
Bit 2		CLK_OUT	CLK_OUT_Enable	RW	Disable	Enable	1
Bit 1		(Reserved)	(Reserved)	R	-	-	1
Bit 0		(Reserved)	(Reserved)	R	-	-	1

Byte 2	Affected Pin			Type	Bit Control		PWD
	Pin #	Name	Control Function		0	1	
Bit 7	x	-	(Reserved)	-	-	-	1
Bit 6	x	(Reserved)	(Reserved)	RW	-	-	1
Bit 5	x	(Reserved)	(Reserved)	RW	-	-	1
Bit 4	x	(Reserved)	(Reserved)	RW	-	-	1
Bit 3	x	(Reserved)	(Reserved)	RW	-	-	1
Bit 2	x	(Reserved)	(Reserved)	RW	-	-	1
Bit 1	x	(Reserved)	(Reserved)	RW	-	-	1
Bit 0	x	(Reserved)	(Reserved)	RW	-	-	1

Byte 3	Affected Pin			Type	Bit Control		PWD
	Pin #	Name	Control Function		0	1	
Bit 7	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 6	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 5	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 4	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 3	x	(Reserved)	(Reserved)	RW	-	-	1
Bit 2	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 1	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 0	X	(Reserved)	(Reserved)	RW	-	-	1

Byte 4	Affected Pin			Type	Bit Control		PWD
	Pin #	Name	Control Function		0	1	
Bit 7	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 6	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 5	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 4	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 3	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 2	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 1	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 0	X	(Reserved)	(Reserved)	RW	-	-	1

Byte 5	Affected Pin			Type	Bit Control		PWD
	Pin #	Name	Control Function		0	1	
Bit 7	X	(Reserved)	(Reserved)	-	-	-	1
Bit 6	X	(Reserved)	(Reserved)	-	-	-	1
Bit 5	X	(Reserved)	(Reserved)	-	-	-	1
Bit 4	X	(Reserved)	(Reserved)	-	-	-	1
Bit 3	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 2	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 1	X	(Reserved)	(Reserved)	RW	-	-	1
Bit 0	X	(Reserved)	(Reserved)	RW	-	-	1

Byte 6	Affected Pin			Type	Bit Control		PWD
	Pin #	Name	Control Function		0	1	
Bit 7	X	Revision ID Bit 3	(Reserved)	R	-	-	1
Bit 6	X	Revision ID Bit 2	(Reserved)	R	-	-	1
Bit 5	X	Revision ID Bit 1	(Reserved)	R	-	-	1
Bit 4	X	Revision ID Bit 0	(Reserved)	R	-	-	1
Bit 3	X	Vendor ID Bit 3	(Reserved)	R	-	-	1
Bit 2	X	Vendor ID Bit 2	(Reserved)	R	-	-	1
Bit 1	X	Vendor ID Bit 1	(Reserved)	R	-	-	1
Bit 0	X	Vendor ID Bit 0	(Reserved)	R	-	-	1

Absolute Maximum Ratings

Supply Voltage . . . . . 3.3 V
Voltage on any pin with respect to GND . . . -0.5 to +7.0 V
Storage Temperature . . . . . –55°C to +125°C
Operating Temperature . . . . . 0°C to +85°C
Ambient Operating Temperature under Bias . -55 to +125 °C
Power Dissipation . . . . . 0.5 W

Stresses above those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only and functional operation of the device at these or any other conditions above those listed in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

Electrical Characteristics - Input/Supply/Common Output Parameters

T_A = 0 - 85°C; Supply Voltage V_{DD} = 3.3 V +/-5%

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input High Voltage	V_{IH}		2		V_{DD} + 0.3	V
Input Low Voltage	V_{IL}		V_{SS} - 0.3		0.8	V
Input High Current	I_{IH}	V_{IN} = V_{DD}	-5		5	mA
Input Low Current	I_{IL1}	V_{IN} = 0 V; Inputs with no pull-up resistors	-5			mA
Powerdown Current	$I_{DD3.3PD}$			3	5	mA
Input Frequency	Fi	V_{DD} = 3.3 V	14.318	-	80	MHz
Pin Inductance	Lpin				7	nH
Input Capacitance[1]	C_{IN}	Logic Inputs			5	pF
	C_{OUT}	Output pin capacitance			6	pF
	C_{INX}	X1 & X2 pins	27	36	45	pF
Transition time[1]	T_{trans}	To 1st crossing of target frequency			3	ms
Settling time[1]	Ts	From 1st crossing to 1% target frequency			3	ms
Clk Stabilization[1]	T_{STAB}	From V_{DD} = 3.3 V to 1% target frequency			3	ms
Delay[1]	t_{PZH},t_{PZL}	Output enable delay (all outputs)	1		10	ns

[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics - CLKOUT

T_A = 0 - 85°C; V_{DD} = 3.3V +/-5%; C_L = 10-20 pF (unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V_{OH3}	I_{OH} = -1 mA	2.4			V
Output Low Voltage	V_{OL3}	I_{OL} = 1 mA			0.4	
Rise Time	tr3	V_{OL} = 0.41V, V_{OH} = 0.86V	0.5	0.6	1	ns
Fall Time	tf3	V_{OH} = 0.86V V_{OL} = 0.41V	0.5	0.6	1	ns
Duty Cycle	d_{t3}	measurement from differential wavefrom -0.35V to +035V	45	50	55	%
Jitter, Cycle to cycle	$t_{jcyc-cyc}$[1]	V_T = 50%		50	150	ps

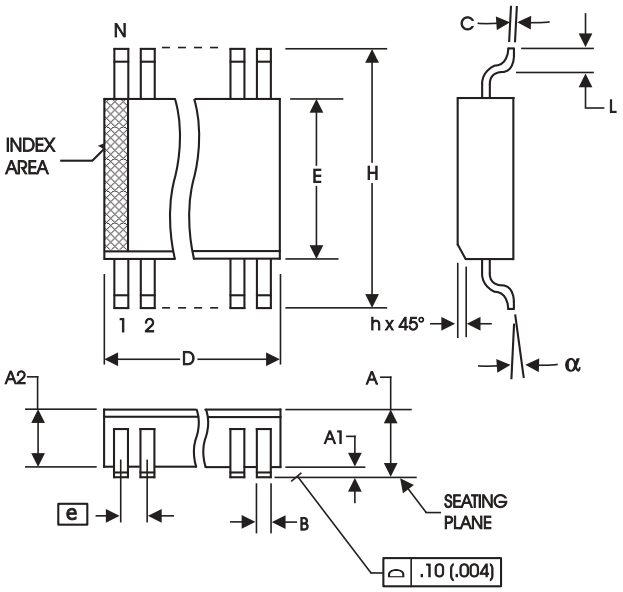
[1]Guaranteed by design, not 100% tested in production.

Electrical Characteristics - REF

T_A = 0 - 85°C; V_{DD} = 3.3V +/-5%; C_L = 10-20 pF (unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Frequency	F_{O1}					MHz
Output Impedance	R_{DSP1}[1]	$V_O = V_{DD}$*(0.5)	20	48	60	Ω
Output High Voltage	V_{OH}[1]	I_{OH} = -1 mA	2.4			V
Output Low Voltage	V_{OL}[1]	I_{OL} = 1 mA			0.4	V
Output High Current	I_{OH}[1]	$V_{OH@MIN}$ = 1.0 V, $V_{OH@MAX}$ = 3.135 V	-29		-23	mA
Output Low Current	I_{OL}[1]	$V_{OL@MIN}$ = 1.95 V, $V_{OL@MAX}$ = 0.4 V	29		27	mA
Rise Time	t_{r1}[1]	V_{OL} = 0.4 V, V_{OH} = 2.4 V	1	1.2	2	ns
Fall Time	t_{f1}[1]	V_{OH} = 2.4 V, V_{OL} = 0.4 V	1	1.2	2	ns
Duty Cycle	d_{t1}[1]	V_T = 1.5 V	45	51	55	%
Jitter	$t_{jcyc-cyc}$[1]	V_T = 1.5 V		105	300	ps

[1]Guaranteed by design, not 100% tested in production.



8-pin SOIC

150 mil (Narrow Body) SOIC

SYMBOL	In Millimeters COMMON DIMENSIONS		In Inches COMMON DIMENSIONS	
	MIN	MAX	MIN	MAX
A	1.35	1.75	.0532	.0688
A1	0.10	0.25	.0040	.0098
B	0.33	0.51	.013	.020
C	0.19	0.25	.0075	.0098
D	SEE VARIATIONS		SEE VARIATIONS	
E	3.80	4.00	.1497	.1574
e	1.27 BASIC		0.050 BASIC	
H	5.80	6.20	.2284	.2440
h	0.25	0.50	.010	.020
L	0.40	1.27	.016	.050
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°

VARIATIONS

N	D mm.		D (inch)	
	MIN	MAX	MIN	MAX
8	4.80	5.00	.1890	.1968

Reference Doc.: JEDEC Publication 95, MS-012

10-0030

Ordering Information

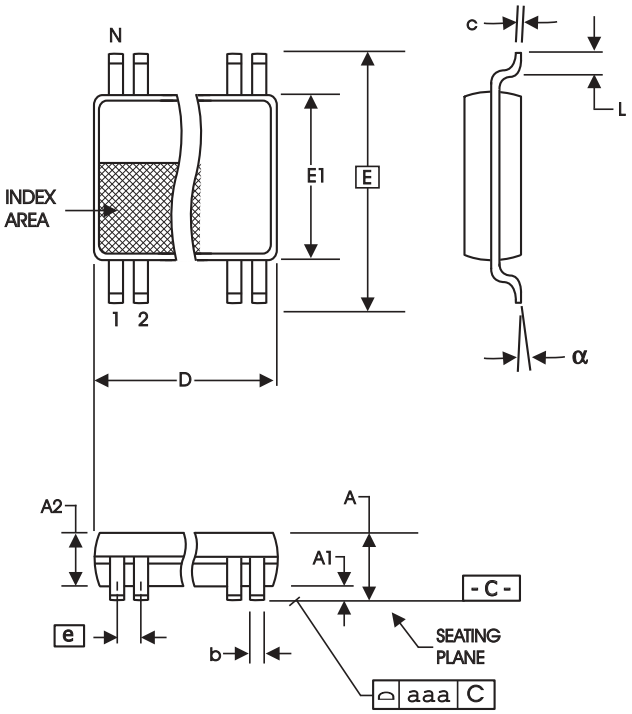
ICS91720yMLF-T

Example:

ICS XXXX y M LF- T

- **Designation for tape and reel packaging**
- **Lead Free (Optional)**
- **Package Type**
  M = SOIC
- **Revision Designator** (will not correlate with datasheet revision)
- **Device Type**
- **Prefix**
  ICS = Standard Device

0698D—10/05/04



8-pin TSSOP

4.40 mm. Body, 0.65 mm. Pitch TSSOP
(173 mil) (25.6 mil)

SYMBOL	In Millimeters COMMON DIMENSIONS		In Inches COMMON DIMENSIONS	
	MIN	MAX	MIN	MAX
A	--	1.20	--	.047
A1	0.05	0.15	.002	.006
A2	0.80	1.05	.032	.041
b	0.19	0.30	.007	.012
c	0.09	0.20	.0035	.008
D	SEE VARIATIONS		SEE VARIATIONS	
E	6.40 BASIC		0.252 BASIC	
E1	4.30	4.50	.169	.177
e	0.65 BASIC		0.0256 BASIC	
L	0.45	0.75	.018	.030
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°
aaa	--	0.10	--	.004

VARIATIONS

N	D mm.		D (inch)	
	MIN	MAX	MIN	MAX
8	2.90	3.10	.114	.122

Reference Doc.: JEDEC Publication 95, MO-153

10-0035

Ordering Information

ICS91720yGLF-T

Example:

ICS XXXX y G LF- T

- **Designation for tape and reel packaging**
- **Lead Free (Optional)**
- **Package Type**
  G = TSSOP
- **Revision Designator** (will not correlate with datasheet revision)
- **Device Type**
- **Prefix**
  ICS = Standard Device

0698D—10/05/04

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Rev.1.0 Mar 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.