

Four Output Low Power Differential Fanout Buffer for PCI Express Gen1, Gen2, Gen3, and QPI

9DBL411B

General Description:

The ICS9DBL411B is a 4 output lower power differential buffer. Each output has its own OE# pin. It has a maximum operating frequency of 150 MHz.

Recommended Application:

PCI-Express Gen 1/2/3 or QPI fanout buffer

Features/Benefits:

- Low power differential outputs for PCI-Express and QPI clocks
- Power down mode when all OE# are high
- Available in I-temp
- 20-pin MLF or TSSOP packaging

Output Features:

- 4 - low power differential output pairs
- Individual OE# control of each output pair

Key Specifications:

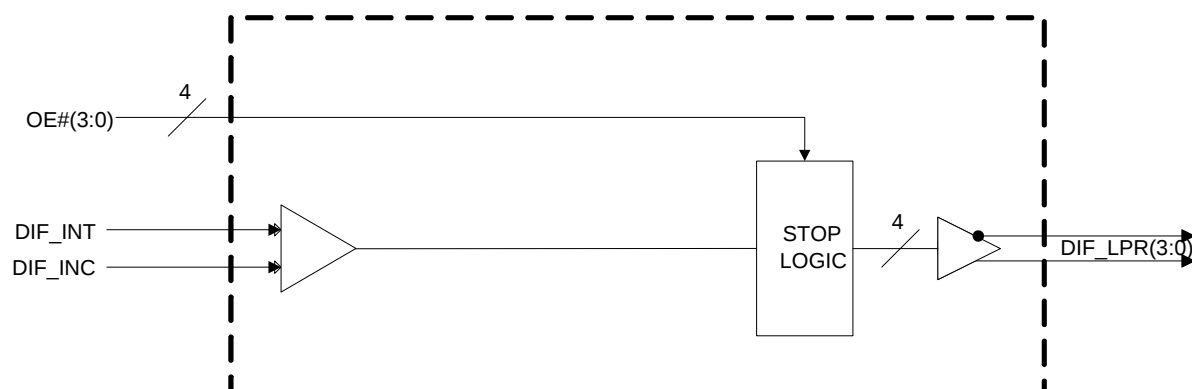
- Output cycle-cycle jitter < 15ps additive
- Output to output skew: < 50ps

Power Groups

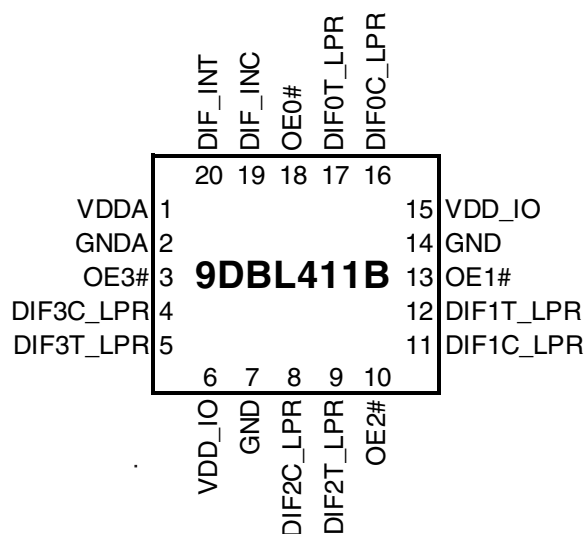
Pin Number (TSSOP)		Description
VDD	GND	
9,18	10,17	VDD_IO for DIF(3:0)
4	5	3.3V Analog VDD & GND

Pin Number (MLF)		Description
VDD	GND	
6,15	7,14	VDD_IO for DIF(3:0)
1	2	3.3V Analog VDD & GND

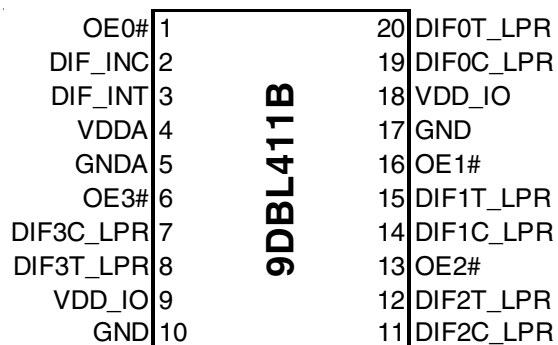
Functional Block Diagram



Pin Configurations

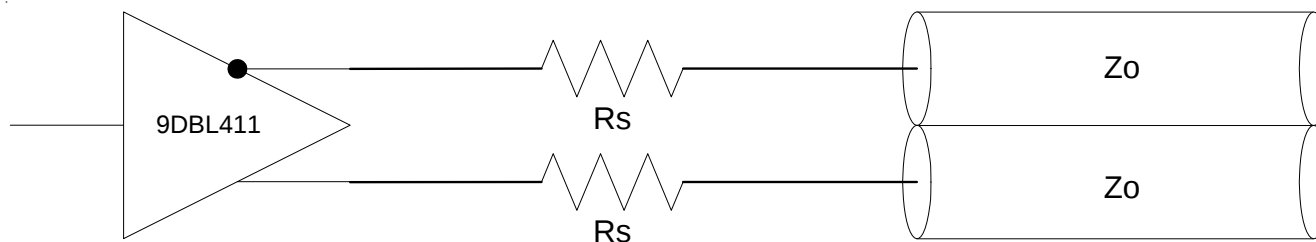


20-pin MLF



20-pin TSSOP

Terminations



$Z_o - 17 = R_s$ (ohms), where Z_o is the single-ended intrinsic impedance of the board transmission line. Single-ended intrinsic impedance is $\frac{1}{2}$ that of the differential impedance.

Single Ended Impedance (Z_o)	R_s 5% tolerance	R_s 2% tolerance	Notes
50	33	33.2	In general, 5% resistors may be used. All values are in ohms.
45	27	27.4	
42.5	24 or 27	24.9	

TSSOP Pin Description

PIN # (TSSOP)	PIN NAME	PIN TYPE	DESCRIPTION
1	OE0#	IN	Output Enable for DIF0 output. Control is as follows: 0 = enabled, 1 = Low-Low
2	DIF_INC	IN	Complement side of differential input clock
3	DIF_INT	IN	True side of differential input clock
4	VDDA	PWR	3.3V Power for the Analog Core
5	GNDA	GND	Ground for the Analog Core
6	OE3#	IN	Output Enable for DIF3 output. Control is as follows: 0 = enabled, 1 = Low-Low
7	DIF3C_LPR	OUT	Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
8	DIF3T_LPR	OUT	True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
9	VDD_IO	PWR	Power supply for low power differential outputs, nominal 1.05V to 3.3V
10	GND	GND	Ground pin
11	DIF2C_LPR	OUT	Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
12	DIF2T_LPR	OUT	True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
13	OE2#	IN	Output Enable for DIF2 output. Control is as follows: 0 = enabled, 1 = Low-Low
14	DIF1C_LPR	OUT	Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
15	DIF1T_LPR	OUT	True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
16	OE1#	IN	Output Enable for DIF1 output. Control is as follows: 0 = enabled, 1 = Low-Low
17	GND	GND	Ground pin
18	VDD_IO	PWR	Power supply for low power differential outputs, nominal 1.05V to 3.3V
19	DIF0C_LPR	OUT	Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
20	DIF0T_LPR	OUT	True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)

MLF Pin Description

PIN # (MLF)	PIN NAME	PIN TYPE	DESCRIPTION
1	VDDA	PWR	3.3V Power for the Analog Core
2	GNDA	GND	Ground for the Analog Core
3	OE3#	IN	Output Enable for DIF3 output. Control is as follows: 0 = enabled, 1 = Low-Low
4	DIF3C_LPR	OUT	Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
5	DIF3T_LPR	OUT	True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
6	VDD_IO	PWR	Power supply for low power differential outputs, nominal 1.05V to 3.3V
7	GND	GND	Ground pin
8	DIF2C_LPR	OUT	Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
9	DIF2T_LPR	OUT	True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
10	OE2#	IN	Output Enable for DIF2 output. Control is as follows: 0 = enabled, 1 = Low-Low
11	DIF1C_LPR	OUT	Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
12	DIF1T_LPR	OUT	True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
13	OE1#	IN	Output Enable for DIF1 output. Control is as follows: 0 = enabled, 1 = Low-Low
14	GND	GND	Ground pin
15	VDD_IO	PWR	Power supply for low power differential outputs, nominal 1.05V to 3.3V
16	DIF0C_LPR	OUT	Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
17	DIF0T_LPR	OUT	True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed)
18	OE0#	IN	Output Enable for DIF0 output. Control is as follows: 0 = enabled, 1 = Low-Low
19	DIF_INC	IN	Complement side of differential input clock
20	DIF_INT	IN	True side of differential input clock

Absolute Maximum Ratings

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
Maximum Supply Voltage	VDDA	Core Supply Voltage		4.6	V	1,7
Maximum Supply Voltage	VDD_IO	Low-Voltage Differential I/O	0.99	3.8	V	1,7
Maximum Input Voltage	V _{IH}	3.3V LVCMOS Inputs		4.6	V	1,7,8
Minimum Input Voltage	V _{IL}	Any Input	V _{SS} - 0.5		V	1,7
Ambient Operating Temp	TambCOM	Commercial Range	0	70	°C	1
	TambIND	Industrial Range	-40	85	°C	1
Storage Temperature	Ts	-	-65	150	°C	1,7
Input ESD protection	ESD prot	Human Body Model	2000		V	1,7

Electrical Characteristics - Input/Supply/Common Output Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
Supply Voltage	VDDA	Supply Voltage	3.000	3.600	V	1
Supply Voltage	VDDxx_IO	Low-Voltage Differential I/O Supply	0.99	3.600	V	1
Input High Voltage	V _{IHSE}	Single-ended inputs	2	V _{DD} + 0.3	V	1
Input Low Voltage	V _{ILSE}	Single-ended inputs	V _{SS} - 0.3	0.8	V	1
Differential Input High Voltage	V _{IHDIF}	Differential inputs (single-ended measurement)	600	1.15	V	1
Differential Input Low Voltage	V _{ILDIF}	Differential inputs (single-ended measurement)	V _{SS} - 0.3	300	mV	1
Input Slew Rate - DIF_IN	dv/dt	Measured differentially	0.4	8	V/ns	2
Input Leakage Current	I _{IN}	V _{IN} = V _{DD} , V _{IN} = GND	-5	5	uA	1
Operating Supply Current	I _{DD 3.3V}	VDDA supply current		20	mA	1
	I _{DD_IO 133M}	VDD_IO supply @ fOP = 133MHz		20	mA	1
Power Down Current (All OE# pins High)	I _{DD SB 3.3V}	VDDA supply current, Input stopped, OE# pins all high		750	uA	1
	I _{DD SBIO}	VDD_IO supply, Input stopped, OE# pins all high		150	uA	1
Input Frequency	F _i	V _{DD} = 3.3 V	15	150	MHz	2
Pin Inductance	L _{pin}			7	nH	1
Input Capacitance	C _{IN}	Logic Inputs	1.5	5	pF	1
	C _{OUT}	Output pin capacitance		6	pF	1
OE# latency (at least one OE# is low)	T _{OE#LAT}	Number of clocks to enable or disable output from assertion/deassertion of OE#	1	3	periods	1
Clock stabilization time (from all OE# high to first OE# low).	T _{STAB}	Delay from assertion of first OE# to first clock out (assumes input clock running and device in power down state))		150	ns	1
Tdrive_OE#	T _{DROE#}	Output enable after OE# de-assertion		10	ns	1
Tfall_OE#	T _{FALL}	Fall/rise time of OE# inputs		5	ns	1
Trise_OE#	T _{RISE}			5	ns	1

AC Electrical Characteristics - DIF Low Power Differential Outputs

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	NOTES
Rising Edge Slew Rate	t_{SLR}	Differential Measurement	1.5	4	V/ns	1,2
Falling Edge Slew Rate	t_{FLR}	Differential Measurement	1.5	4	V/ns	1,2
Slew Rate Variation	t_{SLVAR}	Single-ended Measurement		20	%	1
Maximum Output Voltage	V_{HIGH}	Includes overshoot		1150	mV	1
Minimum Output Voltage	V_{LOW}	Includes undershoot	-300		mV	1
Differential Voltage Swing	V_{SWING}	Differential Measurement	1200		mV	1
Crossing Point Voltage	V_{XABS}	Single-ended Measurement	300	550	mV	1,3,4
Crossing Point Variation	$V_{XABSVAR}$	Single-ended Measurement		140	mV	1,3,5
Duty Cycle Distortion	$D_{CYCDISO}$	Differential Measurement, $f_{IN} \leq 133.33\text{MHz}$		3	%	1,6
Additive Cycle to Cycle Jitter	$DIFJ_{C2CADD}$	Differential Measurement, Additive		15	ps	1
DIF[3:0] Skew	DIF_{SKEW}	Differential Measurement		50	ps	1
Propagation Delay	t_{PD}	Input to output Delay	2.5	3.5	ns	1
Additive Phase Jitter - PCIe Gen1	t_{phase_add} PCIG1	1.5MHz < 22MHz		6	ps Pk-Pk	1,9
Additive Phase Jitter - PCIe Gen2 High Band	t_{phase_add} PCIG2HI	High Band is 1.5MHz to Nyquist (50MHz)		0.16	ps rms	1,9
Additive Phase Jitter PCIe Gen2 Low Band	t_{phase_add} PCIG2LO	Low Band is 10KHz to 1.5MHz		0.07	ps rms	1,9
Additive Phase Jitter PCIe Gen3	t_{phase_add} PCIG2LO	2M-4M, 2M-5M filter		0.2	ps rms	1,9
Additive Phase Jitter QPI133 (6.4GBs, 12 UI)	t_{phase_add} QPI6G4	11MHz to 33MHz		0.04	ps rms	1,9

Notes on Electrical Characteristics (all measurements use 9LRS3187B as clock source and $R_S=33\Omega$ /C_L=2pF test load):

¹Guaranteed by design and characterization, not 100% tested in production.

² Slew rate measured through V_{swing} centered around differential zero

³ V_{xabs} is defined as the voltage where CLK = CLK#

⁴ Only applies to the differential rising edge (CLK rising and CLK# falling)

⁵ Defined as the total variation of all crossing voltages of CLK rising and CLK# falling. Matching applies to rising edge rate of CLK and falling edge of CLK#. It is measured using a +/-75mV window centered on the average cross point where CLK meets CLK#.

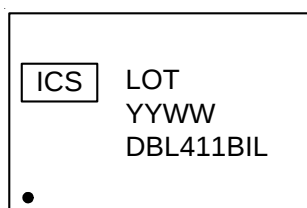
⁶ This figure refers to the maximum distortion of the input wave form.

⁷ Operation under these conditions is neither implied, nor guaranteed.

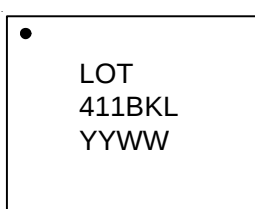
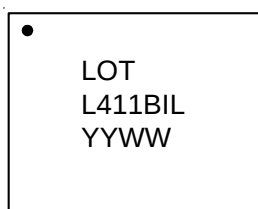
⁸ Maximum input voltage is not to exceed maximum VDD

⁹ The 9DBL411B has no PLL, so the part itself contributes very little jitter to the input clock. But this also means that the 9DBL411 cannot 'de-jitter' a noisy input clock. Values calculated per PCI SIG and per Intel Clock Jitter tool version 1.5

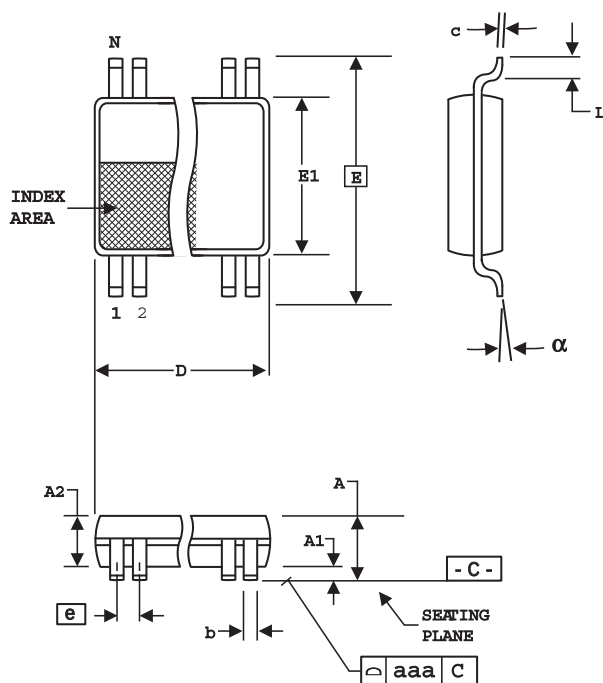
20-pin TSSOP Marking Diagrams



20-pin MLF Marking Diagrams



20-pin TSSOP Package Drawing and Dimensions



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

SYMBOL	In Millimeters		In Inches	
	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	
a	0°	8°	0°	8°
aaa	--	0.10	--	.004

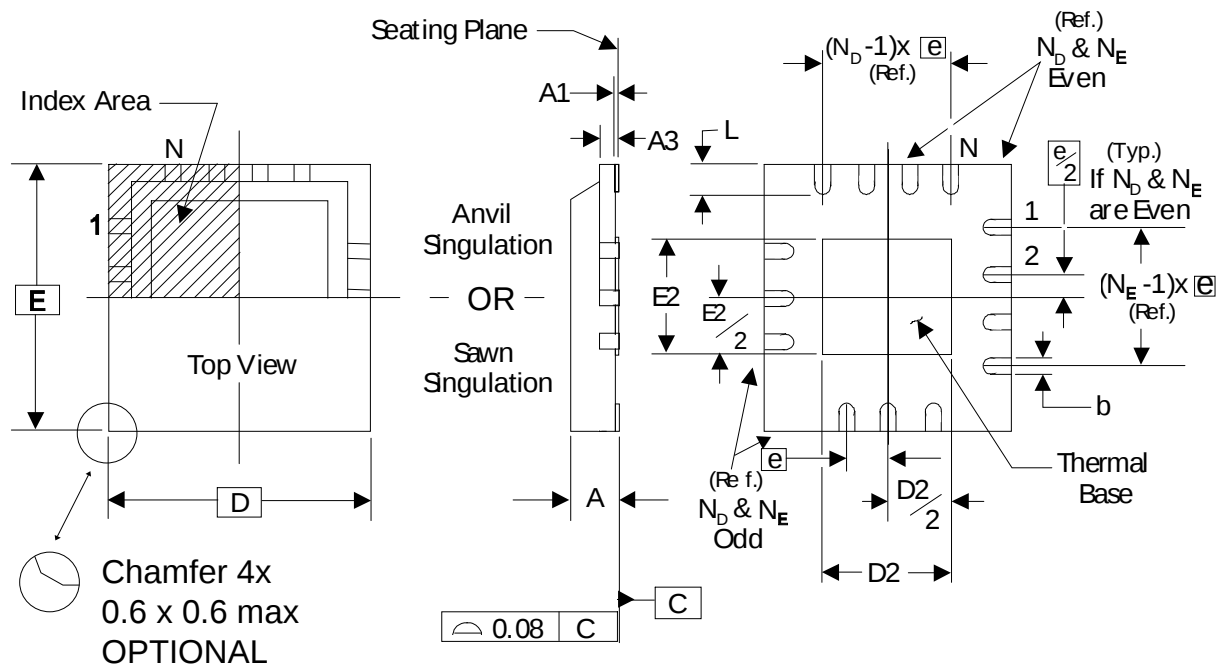
VARIATIONS

N	D mm.		D (inch)	
	MIN	MAX	MIN	MAX
20	6.40	6.60	.252	.260

Reference Doc.: JEDEC Publication 95, MO-153

10-0035

20-pin MLF Package Drawing and Dimensions



DIMENSIONS

SYMBOL	MIN.	MAX.
A	0.8	1.0
A1	0	0.05
A3	0.20 Reference	
b	0.18	0.3
e	0.50 BASIC	

DIMENSIONS

SYMBOL	ICS 20L TOLERANCE
N	20
N _D	5
N _E	5
D x E BASIC	4.00 x 4.00
D2 MIN. / MAX.	2.00 / 2.25
E2 MIN. / MAX.	2.00 / 2.25
L MIN. / MAX.	0.45 / 0.65

Ordering Information

Part / Order Number	Shipping Packaging	Package	Temperature
9DBL411BKLF	Tubes	20-pin MLF	0 to +70°C
9DBL411BKLF	Tape and Reel	20-pin MLF	0 to +70°C
9DBL411BGLF	Tubes	20-pin TSSOP	0 to +70°C
9DBL411BGLF	Tape and Reel	20-pin TSSOP	0 to +70°C
9DBL411BKILF	Tubes	20-pin MLF	-40 to +85°C
9DBL411BKILF	Tape and Reel	20-pin MLF	-40 to +85°C
9DBL411BGILF	Tubes	20-pin TSSOP	-40 to +85°C
9DBL411BGILF	Tape and Reel	20-pin TSSOP	-40 to +85°C

"LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

"B" is the device revision designator (will not correlate to the datasheet revision).

Revision History

Rev.	Issue Date	Description	Page #
0.1	1/8/2010	Initial Release. Compared with A rev the following have changed: 1. Added I-temp version 2. Updated electrical tables for I-temp 3. Revised Phase Jitter specs and added QPI.	
A	1/8/2010	Released to final.	
B	4/23/2010	Changed Input Frequency from 33 min to 15 MHz min	5
C	10/18/2010	Updated Supply Voltage min/max ratings.	5
D	3/22/2012	Updated phase jitter table for PCIe Gen3.	
E	6/28/2012	Typo in "Differential Input Low Voltage" units; changed "V" to "mV"	
F	8/16/2013	Correct typo on top-side marking for MLF (commercial temp.) from "L411BKL" to "411BKL".	
G	9/25/2018	Replaced "Trays" with "Tubes" in Ordering Information.	

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
 2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
 3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
 4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
 5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
 6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
 7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
 8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
 9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
 10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
 11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
 12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.
- (Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
- (Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

Corporate Headquarters

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

Trademarks

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

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.IDT.com/go/support