GENERAL DESCRIPTION

The 8302 is a low skew, 1-to-2 LVCMOS/LVTTL Fanout Buffer. The 8302 has a single ended clock input. The single ended clock input accepts LVCMOS or LVTTL input levels. The 8302 features a pair of LVCMOS/ LVTTL outputs. The 8302 is characterized at full 3.3V for input V_{DD}, and mixed 3.3V and 2.5V for output operating supply modes (V_{DDO}). Guaranteed output and part-to-part skew characteristics make the 8302 ideal for clock distribution applications demanding well defined performance and repeatibility.

FEATURES

- 2 LVCMOS / LVTTL outputs

- LVCMOS / LVTTL clock input accepts LVCMOS or LVTTL input levels

- Maximum output frequency: 200MHz

- Output skew: 25ps (typical)

- Part-to-part skew: 250ps (typical)

- Small 8 lead SOIC package saves board space

- Full 3.3V or 3.3V core, 2.5V supply modes

- 0°C to 70°C ambient operating temperature

- Lead-Free package fully RoHS compliant

BLOCK DIAGRAM

CLK — Q0
— Q1

PIN ASSIGNMENT

V_{DDO}	1	8	Q0
V_{DD}	2	7	GND
CLK	3	6	V_{DDO}
GND	4	5	Q1
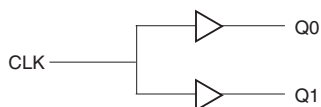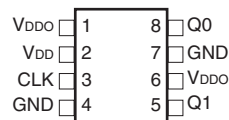
8302
8-Lead SOIC
3.8mm x 4.8mm, x 1.47mm package body
M Package
Top View

Number	Name	Type		Description
1, 6	V_{DDO}	Power		Output supply pins.
2	V_{DD}	Power		Core supply pin.
3	CLK	Input	Pulldown	LVCMOS / LVTTL clock input.
4,7	GND	Power		Power supply ground.
5	Q1	Output		Single clock output. LVCMOS / LVTTL interface levels.
8	Q0	Output		Single clock output. LVCMOS / LVTTL interface levels.

NOTE: *Pullup* and *Pulldown* refer to internal input resistors. See Table 2, Pin Characteristics, for typical values.

TABLE 2. PIN CHARACTERISTICS

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
C_{IN}	Input Capacitance			4		pF
C_{PD}	Power Dissipation Capacitance (per output)	V_{DD}, V_{DDO} = 3.465V		22		pF
		V_{DD} = 3.465V, V_{DDO} = 2.625V		16		pF
$R_{PULLDOWN}$	Input Pulldown Resistor			51		kΩ
R_{OUT}	Output Impedance		5	7	12	Ω

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{DD}	4.6V
Inputs, V_I	-0.5V to V_{DD} + 0.5 V
Outputs, V_O	-0.5V to V_{DDO} + 0.5V
Package Thermal Impedance, θ_{JA}	112.7°C/W (0 lfpm)
Storage Temperature, T_{STG}	-65°C to 150°C

NOTE: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in the *DC Characteristics* or *AC Characteristics* is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

TABLE 3A. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 3.3V \pm 5\%$, TA = 0°C TO 70°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Core Supply Voltage		3.135	3.3	3.465	V
V_{DDO}	Output Power Supply Voltage		3.135	3.3	3.465	V
I_{DD}	Power Supply Current				13	mA
I_{DDO}	Output Supply Current				4	mA

TABLE 3B. LVCMOS / LVTTL DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 3.3V \pm 5\%$, TA = 0°C TO 70°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage			2		V_{DD} + 0.3	V
V_{IL}	Input Low Voltage			-0.3		0.8	V
I_{IH}	Input High Current	CLK	$V_{DD} = V_{IN} = 3.465V$			150	µA
I_{IL}	Input Low Current	CLK	$V_{DD} = 3.465V$, $V_{IN} = 0V$	-5			µA
V_{OH}	Output High Voltage		50Ω to V_{DDO}/2	2.6			V
			$I_{OH} = -100µA$	2.9			V
V_{OL}	Output Low Voltage		50Ω to V_{DDO}/2			0.5	V
			$I_{OL} = 100µA$			0.2	V

TABLE 4A. AC CHARACTERISTICS, $V_{DD} = V_{DDO} = 3.3V \pm 5\%$, TA = 0°C TO 70°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Output Frequency				200	MHz
tp_{LH}	Propagation Delay, Low-to-High; NOTE 1	$f \leq 200MHz$	1.9	2.35	2.8	ns
*t*sk(o)	Output Skew; NOTE 2, 4			25	85	ps
*t*sk(pp)	Part-to-Part Skew; NOTE 3, 4			250	800	ps
t_R	Output Rise Time	20% to 80%	300		800	ps
t_F	Output Fall Time	20% to 80%	300		800	ps
odc	Output Duty Cycle	$f \leq 133MHz$	45		55	%
		$133MHz < f \leq 200MHz$	40		60	%

Parameters measured at f_{MAX} unless otherwise noted.
NOTE 1: Measured from V_{DD}/2 of the input to V_{DDO}/2 of the output.
NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at V_{DDO}/2.
NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at V_{DDO}/2.
NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.

TABLE 3C. POWER SUPPLY DC CHARACTERISTICS, V_{DD} = 3.3V±5%, V_{DDO} = 2.5V±5%, T_A = 0°C TO 70°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Core Supply Voltage		3.135	3.3	3.465	V
V_{DDO}	Output Supply Voltage		2.375	2.5	2.625	V
I_{DD}	Power Supply Current				13	mA
I_{DDO}	Output Supply Current				4	mA

TABLE 3D. LVCMOS / LVTTL DC CHARACTERISTICS, V_{DD} = 3.3V±5%, V_{DDO} = 2.5V±5%, T_A = 0°C TO 70°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage			2		V_{DD} + 0.3	V
V_{IL}	Input Low Voltage			-0.3		0.8	V
I_{IH}	Input High Current	CLK	$V_{DD} = V_{IN}$ = 3.465V			150	µA
I_{IL}	Input Low Current	CLK	V_{DD} = 3.465V, V_{IN} = 0V	-5			µA
V_{OH}	Output High Voltage		50Ω to V_{DDO}/2	1.8			V
			I_{OH} = -100µA	2.2			V
V_{OL}	Output Low Voltage		50Ω to V_{DDO}/2			0.5	V
			I_{OL} = 100µA			0.2	V

TABLE 4B. AC CHARACTERISTICS, V_{DD} = 3.3V±5%, V_{DDO} = 2.5V±5%, T_A = 0°C TO 70°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Output Frequency				200	MHz
tp_{LH}	Propagation Delay, Low-to-High; NOTE 1	$f \leq$ 200MHz	2.3		3.3	ns
tsk(o)	Output Skew; NOTE 2, 4				85	ps
tsk(pp)	Part-to-Part Skew; NOTE 3, 4			250	800	ps
t_R	Output Rise Time	20% to 80%	250		650	ps
t_F	Output Fall Time	20% to 80%	250		650	ps
odc	Output Duty Cycle	$f \leq$ 133MHz	45		55	%
		133MHz < $f \leq$ 200MHz	40		60	%

Parameters measured at f_{MAX} unless otherwise noted.
NOTE 1: Measured from V_{DD}/2 of the input to V_{DDO}/2 of the output.
NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at V_{DDO}/2.
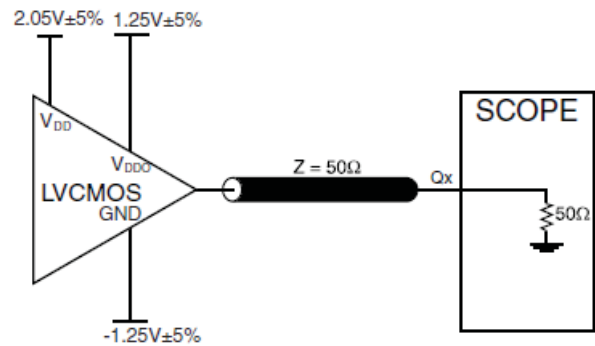NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at V_{DDO}/2.
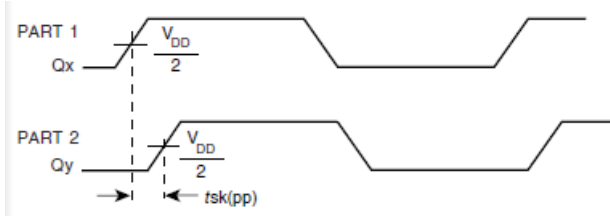NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.

PARAMETER MEASUREMENT INFORMATION
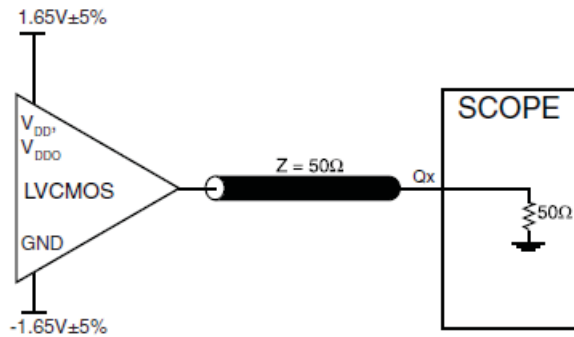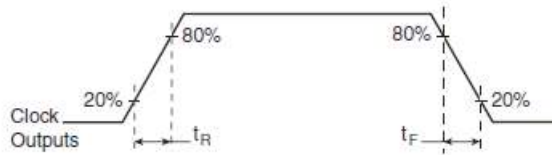
3.3V OUTPUT LOAD AC TEST CIRCUIT
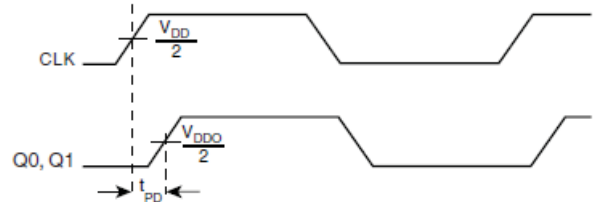
3.3V/2.5V OUTPUT LOAD AC TEST CIRCUIT

PART-TO-PART SKEW

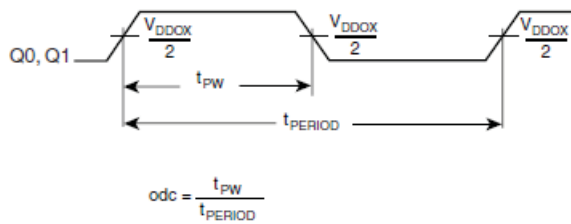### OUTPUT SKEW

OUTPUT RISE/FALL TIME

PROPAGATION DELAY

OUTPUT PULSE WIDTH/PERIOD

$$odc = \frac{t_{PW}}{t_{PERIOD}}$$

RELIABILITY INFORMATION

TABLE 5. θ_{JA} VS. AIR FLOW TABLE FOR 8 LEAD SOIC

θ_{JA} by Velocity (Linear Feet per Minute)			
	0	**200**	**500**
Single-Layer PCB, JEDEC Standard Test Boards	153.3°C/W	128.5°C/W	115.5°C/W
Multi-Layer PCB, JEDEC Standard Test Boards	112.7°C/W	103.3°C/W	97.1°C/W

NOTE: Most modern PCB designs use multi-layered boards. The data in the second row pertains to most designs.

TRANSISTOR COUNT

The transistor count for 8302 is: 322

PACKAGE OUTLINE - SUFFIX M FOR 8 LEAD SOIC

TABLE 6. PACKAGE DIMENSIONS

SYMBOL	Millimeters	
	MINIMUN	MAXIMUM
N	8	
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BASIC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.27
α	0°	8°

Reference Document: JEDEC Publication 95, MS-012

TABLE 7. ORDERING INFORMATION

Part/Order Number	Marking	Package	Shipping Packaging	Temperature
8302AMLF	8302AMLF	8 lead "Lead Free" SOIC	tube	0°C to 70°C
8302AMLFT	8302AMLF	8 lead "Lead Free" SOIC	tape & reel	0°C to 70°C

			REVISION HISTORY SHEET	
Rev	**Table**	**Page**	**Description of Change**	**Date**
B	T1 T2 T3A & T3C T4A & T4B	2 2 3, 4 3, 4	Pin Description table, revised V_{DD} description. Pin Characteristics table, deleted R_{PULLUP} row. Power Supply table, changed V_{DD} parameter to correspond with description. AC Characteristics tables - added note "Parameters measured at f_{MAX} unless otherwise noted." tp_{LH} Test Conditions, added f ≤ 200MHz.	2/4/03
C	T2 T7	2 8	Pin Chararcteristics table - changed C_{IN} 4pF max. to 4pF typical. Added 5Ω min. and 12Ω max. to R_{OUT} row. Ordering Information table - added "Lead-Free" part number.	6/15/04
D	T3B & T3D T7	3, 4 8	LVCMOS DC Characteristics Table - changed V_{IL} max. from 1.3V to 0.8V. Ordering Information Table - added Lead-Free note.	5/17/05
D	T7	8 10	Updated datasheet's header/footer with IDT from ICS. Removed ICS prefix from Part/Order Number column. Added Contact Page.	7/30/10
D	T7	8	Ordering Information - removed leaded devices. Updated data sheet format.	11/19/15
D			Updated header and footer.	3/4/16

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 o any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer 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.