



Integrated  
Circuit  
Systems, Inc.

# PRELIMINARY

## ICS8316 Low SKEW, 1-TO-16, LVCMOS / LVTTTL FANOUT BUFFER W/1.2V LVCMOS OUTPUTS

### GENERAL DESCRIPTION



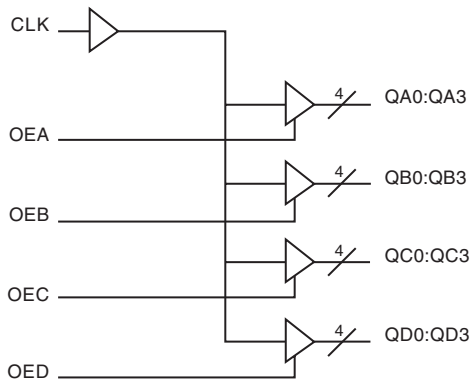
The ICS8316 is a low skew, 1-to-16 LVCMOS / LVTTTL Fanout Buffer with 1.2V LVCMOS Outputs and a member of the HiPerClockS™ family of High Performance Clock Solutions from ICS. The ICS8316 single ended clock input accepts LVCMOS or LVTTTL input levels. The low impedance LVCMOS outputs are designed to drive 50Ω series or parallel terminated transmission lines.

Guaranteed output and part-to-part skew characteristics along with the 1.2V output makes the ICS8316 ideal for high performance, single ended applications that also require a limited output voltage.

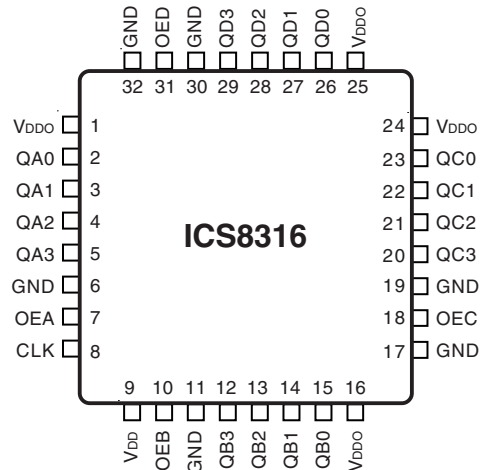
### FEATURES

- Sixteen 1.2V LVCMOS / LVTTTL outputs
- LVCMOS / LVTTTL clock input
- Maximum output frequency: 150MHz
- Output skew: TBD
- Propagation delay: 3.5ns (typical)
- 3.3V core/1.2V output operating supply mode
- 0°C to 70°C ambient operating temperature
- Industrial temperature information available upon request
- Available in both standard and lead-free RoHS-compliant packages

### BLOCK DIAGRAM



### PIN ASSIGNMENT



**32-Lead VFQFN**  
5mm x 5mm x 0.95 package body  
**K Package**  
Top View

The Preliminary Information presented herein represents a product in prototyping or pre-production. The noted characteristics are based on initial product characterization. Integrated Circuit Systems, Incorporated (ICS) reserves the right to change any circuitry or specifications without notice.



**TABLE 1. PIN DESCRIPTIONS**

Number	Name	Type		Description
1, 16, 24, 25	V <sub>DDO</sub>	Power		Output supply pins.
2, 3, 4, 5	QA0, QA1, QA2, QA3	Output		Bank A clock outputs. LVCMOS / LVTTTL interface levels.
6, 11, 17, 19, 30, 32	GND	Power		Power supply ground.
7	OEA	Input	Pullup	Bank A output enable pin. Controls enabling and disabling of QA0:QA3 outputs. LVCMOS / LVTTTL interface levels.
8	CLK	Input	Pulldown	Clock input. LVCMOS / LVTTTL interface levels.
9	V <sub>DD</sub>	Power		Core supply pin.
10	OEB	Input	Pullup	Bank B output enable pin. Controls enabling and disabling of QB0:QB3 outputs. LVCMOS / LVTTTL interface levels.
12, 13, 14, 15	QB3, QB2, QB1, QB0	Output		Bank B clock outputs. LVCMOS / LVTTTL interface levels.
18	OEC	Input	Pullup	Bank C output enable pin. Controls enabling and disabling of QC0:QC3 outputs. LVCMOS / LVTTTL interface levels.
20, 21, 22, 23	QC3, QC2, QC1, QC0	Output		Bank C clock outputs. LVCMOS / LVTTTL interface levels.
26, 27, 28, 29	QD0, QD1, QD2, QD3	Output		Bank D clock outputs. LVCMOS / LVTTTL interface levels.
31	OED	Input	Pullup	Bank D output enable pin. Controls enabling and disabling of QD0:QD3 outputs. LVCMOS / LVTTTL 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 <sub>IN</sub>	Input Capacitance			4		pF
C <sub>PD</sub>	Power Dissipation Capacitance (per output)	V <sub>DDO</sub> = 1.26V		TBD		pF
R <sub>PULLUP</sub>	Input Pullup Resistor			51		kΩ
R <sub>PULLDOWN</sub>	Input Pulldown Resistor			51		kΩ
R <sub>OUT</sub>	Output Impedance	V <sub>DDO</sub> = 1.2 ± 5%		15		Ω

**TABLE 3A. OUTPUT ENABLE AND CLOCK ENABLE FUNCTION TABLE**

Control Inputs	Outputs
OE[A:D]	Qx0:Qx3
0	Hi-Z
1	Active

**TABLE 3B. CLOCK INPUT FUNCTION TABLE**

Inputs		Outputs
OE[A:D]	CLK	Qx0:Qx3
1	0	LOW
1	1	HIGH



#### ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $V_{DD}$	4.6V
Inputs, $V_I$	-0.5V to $V_{DD} + 0.5V$
Outputs, $V_O$	-0.5V to $V_{DDO} + 0.5V$
Package Thermal Impedance, $\theta_{JA}$	34.8°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 4A. POWER SUPPLY DC CHARACTERISTICS,  $V_{DD} = 3.3V$ ,  $V_{DDO} = 1.2V \pm 5\%$ ,  $T_A = 0^\circ C$  TO  $70^\circ C$

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		1.14	1.2	1.26	V
$I_{DD}$	Power Supply Current			TBD		$\mu A$
$I_{DDO}$	Output Supply Current			TBD		$\mu A$

TABLE 4B. LVCMOS DC CHARACTERISTICS,  $T_A = 0^\circ C$  TO  $70^\circ C$

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	$\mu A$
		OEA:OED	$V_{DD} = V_{IN} = 3.465V$		5	$\mu A$
$I_{IL}$	Input Low Current	CLK	$V_{DD} = 3.465V$ , $V_{IN} = 0V$	-5		$\mu A$
		OEA:OED	$V_{DD} = 3.465V$ , $V_{IN} = 0V$	-150		$\mu A$
$V_{OH}$	Output High Voltage	$V_{DDO} = 1.2V \pm 5\%$ ; NOTE 1	$V_{DD} * 0.7$			V
$V_{OL}$	Output Low Voltage	$V_{DDO} = 1.2V \pm 5\%$ ; NOTE 1			$V_{DD} * 0.3$	V

NOTE 1: Outputs terminated with  $50\Omega$  to  $V_{DDO}/2$ . See Parameter Measurement section, "Load Test Circuit" diagram.

TABLE 5. AC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 1.2V \pm 5\%$ ,  $T_A = 0^\circ C$  TO  $70^\circ C$

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				150	MHz
$tp_{LH}$	Propagation Delay Low to High; NOTE 1			3.5		ns
$tsk(o)$	Output Skew; NOTE 2, 5			TBD		ps
$tsk(pp)$	Part-to-Part Skew; NOTE 3, 5			TBD		ps
$t_r/t_f$	Output Rise Time; NOTE 4	20% to 80%		650		ps
odc	Output Duty Cycle			50		%

All parameters measured at  $f_{MAX}$  unless noted otherwise.

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  $V_{DDO}/2$ .

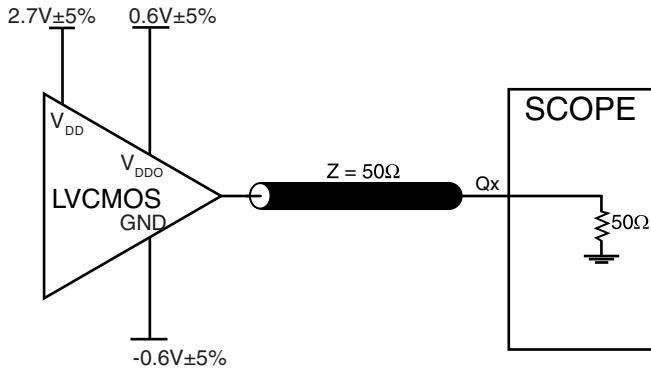
NOTE 3: Defined as the skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at  $V_{DDO}/2$ .

NOTE 4: These parameters are guaranteed by characterization. Not tested in production.

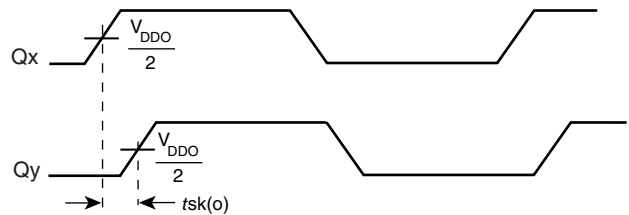
NOTE 5: This parameter is defined in accordance with JEDEC Standard 65.



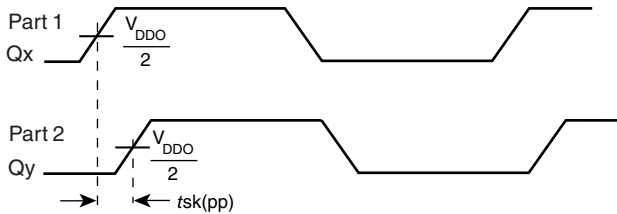
**PARAMETER MEASUREMENT INFORMATION**



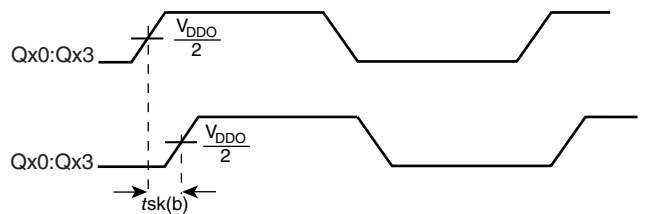
**3.3V CORE/1.2V OUTPUT LOAD AC TEST CIRCUIT**



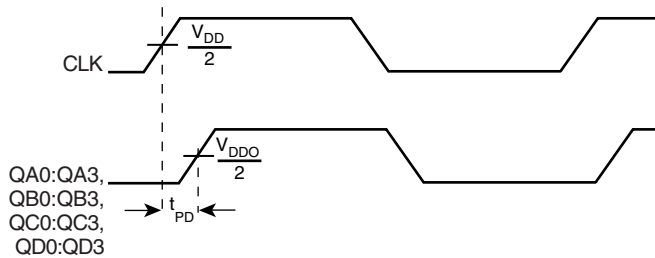
**OUTPUT SKEW**



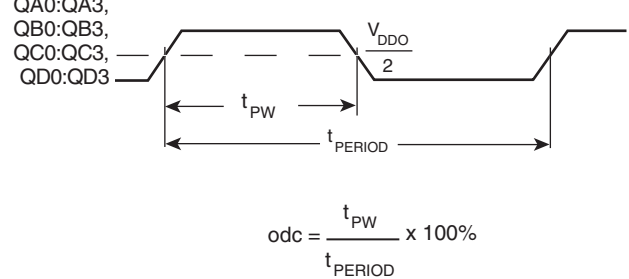
**PART-TO-PART SKEW**



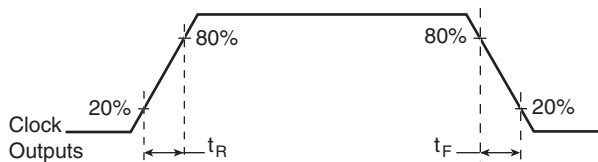
**BANK SKEW (where x denotes outputs in the same bank)**



**PROPAGATION DELAY**



**OUTPUT DUTY CYCLE/PLUSE WIDTH/PERIOD**



**OUTPUT RISE/FALL TIME**



**APPLICATION INFORMATION**

**RECOMMENDATIONS FOR UNUSED INPUT AND OUTPUT PINS**

**INPUTS:**

**LVCMOS CONTROL PINS:**

All control pins have internal pull-ups or pull-downs; additional resistance is not required but can be added for additional protection. A 1kΩ resistor can be used.

**OUTPUTS:**

**LVCMOS OUTPUT:**

All unused LVCMOS output can be left floating. We recommend that there is no trace attached.

**RELIABILITY INFORMATION**

**TABLE 6.  $\theta_{JA}$  vs. AIR FLOW TABLE FOR 32 LEAD VFQFN**

$\theta_{JA}$ vs. 0 Air Flow (Linear Feet per Minute)	
	0
Multi-Layer PCB, JEDEC Standard Test Boards	34.8°C/W

**TRANSISTOR COUNT**

The transistor count for ICS8316 is: 416



PACKAGE OUTLINE AND DIMENSIONS - K SUFFIX FOR 32 LEAD VFQFN

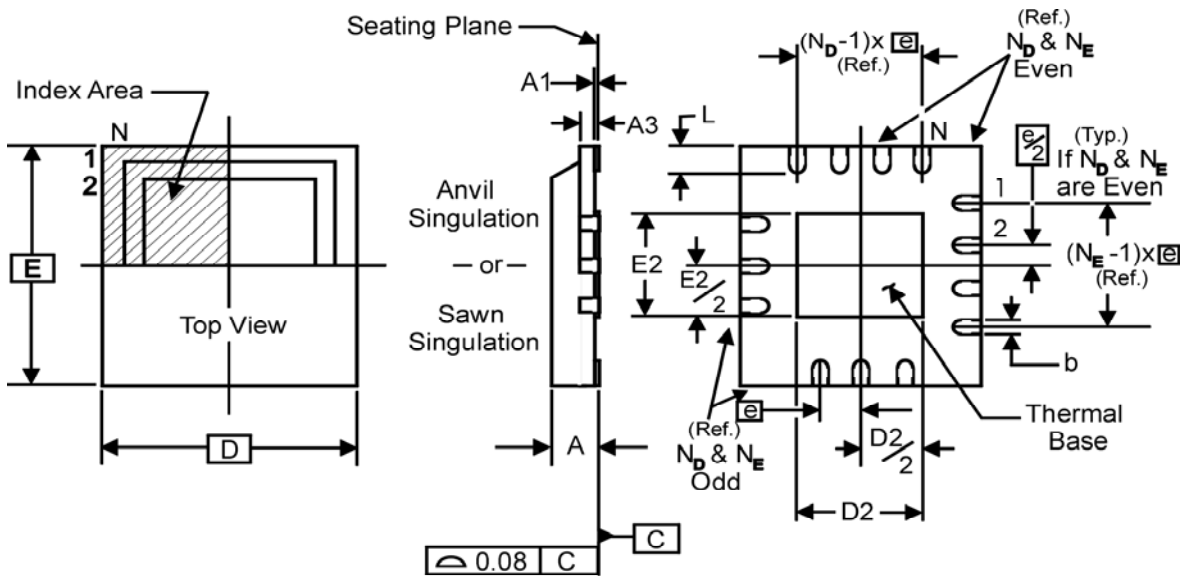


TABLE 7. PACKAGE DIMENSIONS

JEDEC VARIATION ALL DIMENSIONS IN MILLIMETERS			
SYMBOL	VHHD-2		
	MINIMUM	NOMINAL	MAXIMUM
N	32		
A	0.80	--	1.00
A1	0	--	0.05
A3	0.25 Ref.		
b	0.18	0.25	0.30
$N_D$			8
$N_E$			8
D	5.00 BASIC		
D2	1.25	2.25	3.25
E	5.00 BASIC		
E2	1.25	2.25	3.25
e	0.50 BASIC		
L	0.30	0.40	0.50

Reference Document: JEDEC Publication 95, MO-220



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## ICS8316

LOW SKEW, 1-TO-16, LVCMOS / LVTTTL  
FANOUT BUFFER W/1.2V LVCMOS OUTPUTS

**TABLE 8. ORDERING INFORMATION**

Part/Order Number	Marking	Package	Shipping Packaging	Temperature
ICS8316AK	ICS8316AK	32 Lead VFQFN	tray	0°C to 70°C
ICS8316AKT	ICS8316AK	32 Lead VFQFN	2500 tape & reel	0°C to 70°C
ICS8316AKLF	TBD	32 Lead "Lead-Free" VFQFN	tray	0°C to 70°C
ICS8316AKLFT	TBD	32 Lead "Lead-Free" VFQFN	2500 tape & reel	0°C to 70°C

NOTE: Parts that are ordered with an "LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

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