



Integrated
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Systems, Inc.

ICS83940 Low Skew, 1-to-18 LVPECL-to-LVCMOS Fanout Buffer

GENERAL DESCRIPTION



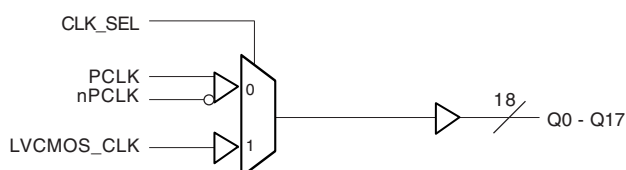
The ICS83940 is a low skew, 1-to-18 LVPECL-to-LVCMOS Fanout Buffer and a member of the HiPerClockS™ family of High Performance Clock Solutions from ICS. The ICS83940 has two selectable clock inputs. The PCLK, nPCLK pair can accept LVPECL, CML, or SSTL input levels. The LVCMOS_CLK can accept LVCMOS or LVTTTL input levels. The low impedance LVCMOS outputs are designed to drive 50Ω series or parallel terminated transmission lines.

The ICS83940 is characterized at full 3.3V, full 2.5V and mixed 3.3V input and 2.5V output operating supply modes. Guaranteed output and part-to-part skew characteristics make the ICS83940 ideal for those clock distribution applications demanding well defined performance and repeatability.

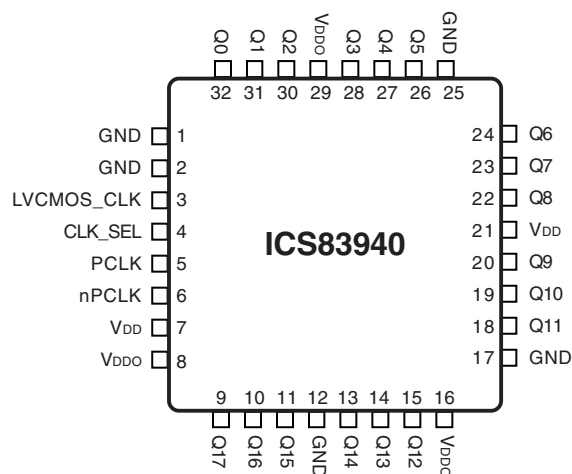
FEATURES

- 18 LVCMOS outputs, 23Ω typical output impedance
- Selectable LVCMOS_CLK or LVPECL clock inputs
- PCLK, nPCLK supports the following input types: LVPECL, CML, SSTL
- LVCMOS_CLK accepts the following input levels: LVCMOS or LVTTTL
- Maximum output frequency up to 250MHz
- Output skew: 150ps (maximum)
- Part to part skew: 750ps (maximum)
- Full 3.3V, 2.5V or mixed 3.3V, 2.5V supply modes
- 0°C to 70°C ambient operating temperature
- Industrial temperature information available upon request
- Pin compatible with the MPC940L

BLOCK DIAGRAM



PIN ASSIGNMENT



32-Lead LQFP

7mm x 7mm x 1.4mm package body

Y 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, 2, 12, 17, 25	GND	Power		Power supply ground. Connect to ground.
3	LVCMOS_CLK	Input	Pulldown	Clock input. LVCMOS / LVTTTL interface levels.
4	CLK_SEL	Input	Pulldown	Clock select input. Selects LVCMOS / LVTTTL clock input when HIGH. Selects PCLK, nPCLK inputs when LOW.
5	PCLK	Input	Pulldown	Non-inverting differential LVPECL clock input.
6	nPCLK	Input	Pullup	Inverting differential LVPECL clock input.
7, 21	V _{DD}	Power		Positive supply pins. Connect to 3.3V or 2.5V.
8, 16, 29	V _{DDO}	Power		Output supply pins. Connect to 3.3V or 2.5V.
9, 10, 11, 13, 14, 15, 18, 19, 20, 22, 23, 24, 26, 27, 28, 30, 31, 32	Q17, Q16, Q15, Q14, Q13, Q12, Q11, Q10, Q9, Q8, Q7, Q6, Q5, Q4, Q3, Q2, Q1, Q0	Output		Clock outputs. 23Ω typical output impedance. LVCMOS interface levels

NOTE: *Pullup* and *Pulldown* refers 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		10		pF
R _{PULLUP}	Input Pullup Resistor			51		KΩ
R _{PULLDOWN}	Input Pulldown Resistor			51		KΩ
R _{OUT}	Output Impedance			23		Ω

TABLE 3A. CLOCK SELECT FUNCTION TABLE

Control Input	Clock	
CLK_SEL	PCLK, nPCLK	LVCMOS_CLK
0	Selected	De-selected
1	De-selected	Selected

TABLE 3B. CLOCK INPUT FUNCTION TABLE

Inputs				Outputs	Input to Output Mode	Polarity
CLK_SEL	LVCMOS_CLK	PCLK	nPCLK	Q0 thru Q17		
0	—	0	1	LOW	Differential to Single Ended	Non Inverting
0	—	1	0	HIGH	Differential to Single Ended	Non Inverting
0	—	0	Biased; NOTE 1	LOW	Single Ended to Single Ended	Non Inverting
0	—	1	Biased; NOTE 1	HIGH	Single Ended to Single Ended	Non Inverting
0	—	Biased; NOTE 1	0	HIGH	Single Ended to Single Ended	Inverting
0	—	Biased; NOTE 1	1	LOW	Single Ended to Single Ended	Inverting
1	0	—	—	LOW	Single Ended to Single Ended	Non Inverting
1	1	—	—	HIGH	Single Ended to Single Ended	Non Inverting

NOTE 1: Please refer to the Application Information section on page 11, Figure 8, which discusses wiring the differential input to accept single ended levels.



ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{DDx}	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, θ_{JA}	47.9°C/W (0 lfpm)
Storage Temperature, T_{stg}	-65°C to 150°C

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. DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 3.3V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Input Supply Voltage		3.135	3.3	3.465	V
V_{DDO}	Output Supply Voltage		3.135	3.3	3.465	V
I_{DD}	Input Supply Current				25	mA
I_{DDO}	Output Supply Current				40	mA

TABLE 4B. LVCMOS DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 3.3V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage	LVCMSO_CLK	2		$V_{DD} + 0.3$	V
		CLK_SEL	2		$V_{DD} + 0.3$	V
V_{IL}	Input Low Voltage	LVCMSO_CLK	-0.3		1.3	V
		CLK_SEL	-0.3		0.8	V
I_{IH}	Input High Current	LVCMSO_CLK, CLK_SEL $V_{DD} = V_{IN} = 3.465V$			150	μA
I_{IL}	Input Low Current	LVCMSO_CLK, CLK_SEL $V_{DD} = 3.465V, V_{IN} = 0V$	-5			μA
V_{OH}	Output High Voltage	$V_{DDO} = 3.135V, I_{OH} = -20mA$	2.4			V
V_{OL}	Output Low Voltage	$V_{DDO} = 3.135V, I_{OH} = 20mA$			0.5	V

TABLE 4C. LVPECL DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 3.3V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
I_{IH}	Input High Current	PCLK $*V_{DDx} = V_{IN} = 3.465V$			150	μA
		nPCLK $*V_{DDx} = V_{IN} = 3.465V$			5	μA
I_{IL}	Input Low Current	PCLK $*V_{DDx} = 3.465V, V_{IN} = 0V$	-5			μA
		nPCLK $*V_{DDx} = 3.465V, V_{IN} = 0V$	-150			μA
V_{PP}	Peak-to-Peak Input Voltage		0.3		1	V
V_{CMR}	Input Common Mode Voltage; NOTE 1, 2		GND + 1.5		V_{DD}	V

NOTE 1: For single ended applications, the maximum input voltage for PCLK, nPCLK is $V_{DD} + 0.3V$.

NOTE 2: Common mode voltage is defined as V_{IH} .

NOTE: $*V_{DDx}$ denotes V_{DD} and V_{DDO} .



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

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Output Frequency				250	MHz
t_{pLH}	Propagation Delay;	PCLK, nPCLK; NOTE 1, 5	$0 < f \leq 200\text{MHz}$	2.5	4.2	ns
		LVC MOS_CLK; NOTE 2, 5	$0 < f \leq 200\text{MHz}$	2.3	3.7	ns
$tsk(o)$	Output Skew; NOTE 3, 5	Measured on rising edge @ $V_{DDO}/2$			150	ps
$tsk(pp)$	Part-to-Part Skew; NOTE 4, 5	Measured on rising edge @ $V_{DDO}/2$			750	ps
$tsk(pp)$	Part-to-Part Skew; NOTE 5, 6	PCLK, nPCLK			1.7	ns
		LVC MOS_CLK			1.4	ns
t_R	Output Rise Time	20% to 80%				ps
t_F	Output Fall Time	20% to 80%				ps
odc	Output Duty Cycle	$f \leq 134\text{MHz}$	45	50	55	%
		$134 < f \leq 200\text{MHz}$				%

All parameters measured at 200MHz unless noted otherwise.

NOTE 1: Measured from the differential input crossing point to the output $V_{DDO}/2$.

NOTE 2: Measured from $V_{DD}/2$ to $V_{DDO}/2$.

NOTE 3: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at $V_{DDO}/2$.

NOTE 4: Defined as skew between outputs on different devices operating at the same supply voltages, same temperature, and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at $V_{DDO}/2$.

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

NOTE 6: Defined as skew between outputs on different devices, across temperature and voltage ranges, and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at $V_{DDO}/2$.

TABLE 4D. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = 3.3V \pm 5\%$; $V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Input Power Supply Voltage		3.135	3.3	3.465	V
V_{DDO}	Output Power Supply Voltage		2.375	2.5	2.625	V
I_{DD}	Input Supply Current				25	mA
I_{DDO}	Output Supply Current				40	mA

TABLE 4E. LVCMOS DC CHARACTERISTICS, $V_{DD} = 3.3V \pm 5\%$; $V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage	LVC MOS_CLK	2		$V_{DD} + 0.3$	V
		CLK_SEL	2		$V_{DD} + 0.3$	V
V_{IL}	Input Low Voltage	LVC MOS_CLK	-0.3		1.3	V
		CLK_SEL	-0.3		0.8	V
I_{IH}	Input High Current	$V_{DD} = V_{IN} = 3.465V$			150	μA
I_{IL}	Input Low Current	$V_{DD} = 3.465V$, $V_{IN} = 0V$	-5			μA
V_{OH}	Output High Voltage	$V_{DDO} = 2.375V$, $I_{OH} = -12mA$	1.8			V
V_{OL}	Output Low Voltage	$V_{DDO} = 2.375V$, $I_{OL} = 12mA$			0.5	V



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TABLE 4F. LVPECL DC CHARACTERISTICS, $V_{DD} = 3.3V \pm 5\%$; $V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
I_{IH}	Input High Current	PCLK	$V_{DD} = V_{IN} = 3.465V$		150	μA
		nPCLK	$V_{DD} = V_{IN} = 3.465V$		5	μA
I_{IL}	Input Low Current	PCLK	$V_{DD} = 3.465V, V_{IN} = 0V$	-5		μA
		nPCLK	$V_{DD} = 3.465V, V_{IN} = 0V$	-150		μA
V_{PP}	Peak-to-Peak Input Voltage		0.3		1	V
V_{CMR}	Input Common Mode Voltage; NOTE 1, 2		GND + 1.5		V_{DD}	V

NOTE 1: For single ended applications, the maximum input voltage for PCLK, nPCLK is $V_{DD} + 0.3V$.

NOTE 2: Common mode voltage is defined as V_{IH} .

TABLE 5B. AC CHARACTERISTICS, $V_{DD} = 3.3V \pm 5\%$; $V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Output Frequency				250	MHz
t_{pLH}	Propagation Delay;	PCLK, nPCLK; NOTE 1	$0 < f \leq 200MHz$	2.0	3.8	ns
		LVCMSO_CLK; NOTE 2	$0 < f \leq 200MHz$			ns
$t_{sk(o)}$	Output Skew; NOTE 3, 5	Measured on rising edge @ $V_{DDO}/2$			150	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 4, 5	Measured on rising edge @ $V_{DDO}/2$			750	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 5, 6	PCLK, nPCLK			1.8	ns
		LVCMSO_CLK			1.8	ns
t_R	Output Rise Time	20% to 80%				ps
t_F	Output Fall Time	20% to 80%				ps
odc	Output Duty Cycle	$f \leq 134MHz$	45		55	%
		$134 < f \leq 200MHz$				%

All parameters measured at 200MHz unless noted otherwise.

NOTE 1: Measured from the differential input crossing point to the output at $V_{DDO}/2$.

NOTE 2: Measured from $V_{DD}/2$ to $V_{DDO}/2$.

NOTE 3: Defined as skew between outputs at the same supply voltage, same temperature, and with equal load conditions. Measured at $V_{DDO}/2$.

NOTE 4: 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 5: This parameter is defined in accordance with JEDEC Standard 65.

NOTE 6: Defined as skew between outputs on different devices, across temperature and voltage ranges, and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at $V_{DDO}/2$.

TABLE 4G. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{DD}	Input Supply Voltage		2.375	2.5	2.625	V
V_{DDO}	Output Supply Voltage		2.375	2.5	2.625	V
I_{DD}	Input Supply Current				25	mA
I_{DDO}	Output Supply Current				40	mA



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TABLE 4H. LVCMOS DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage	LVC MOS_CLK	2		$V_{DD} + 0.3$	V
		CLK_SEL	2		$V_{DD} + 0.3$	V
V_{IL}	Input Low Voltage	LVC MOS_CLK	-0.3		1.3	V
		CLK_SEL	-0.3		0.8	V
I_{IH}	Input High Current	LVC MOS_CLK, CLK_SEL $V_{DD} = V_{IN} = 2.625V$			150	μA
I_{IL}	Input Low Current	LVC MOS_CLK, CLK_SEL $V_{DD} = 2.625V$, $V_{IN} = 0V$	-5			μA
V_{OH}	Output High Voltage	$V_{DDO} = 2.375V$, $I_{OH} = -12mA$	1.8			V
V_{OL}	Output Low Voltage	$V_{DDO} = 2.375V$, $I_{OL} = 12mA$			0.5	V

TABLE 4I. LVPECL DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
I_{IH}	Input High Current	PCLK $V_{DD} = V_{IN} = 3.465V$			150	μA
		nPCLK $V_{DD} = V_{IN} = 3.465V$			5	μA
I_{IL}	Input Low Current	PCLK $V_{DD} = 3.465V$, $V_{IN} = 0V$	-5			μA
		nPCLK $V_{DD} = 3.465V$, $V_{IN} = 0V$	-150			μA
V_{PP}	Peak-to-Peak Input Voltage		0.3		1	V
V_{CMR}	Input Common Mode Voltage; NOTE 1, 2		GND + 1.5		V_{DD}	V

NOTE 1: For single ended applications, the maximum input voltage for PCLK, nPCLK is $V_{DD} + 0.3V$.

NOTE 2: Common mode voltage is defined as V_{IH} .

TABLE 5C. AC CHARACTERISTICS, $V_{DD} = V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ$ TO 70°

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Output Frequency				200	MHz
t_{pLH}	Propagation Delay;	PCLK, nPCLK; NOTE 1 $0 < f \leq 200MHz$	2.6		5.2	ns
		LVC MOS_CLK; NOTE 2 $0 < f \leq 200MHz$	3.0		4.7	ns
$t_{sk(o)}$	Output Skew; NOTE 3, 5	Measured on rising edge @ $V_{DDO}/2$			200	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 4, 5	Measured on rising edge @ $V_{DDO}/2$			1	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 5, 6	PCLK, nPCLK			2.6	ns
		LVC MOS_CLK			1.7	ns
t_R	Output Rise Time	20% to 80%				ps
t_F	Output Fall Time	20% to 80%				ps
odc	Output Duty Cycle	$f \leq 134MHz$	45		55	%
		$134 < f \leq 200MHz$				%

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

NOTE 1: Measured from the differential input crossing point to the output at $V_{DDO}/2$.

NOTE 2: Measured from $V_{DD}/2$ to $V_{DDO}/2$.

NOTE 3: Defined as skew between outputs at the same supply voltage, same temperature, and with equal load conditions. Measured at $V_{DDO}/2$.

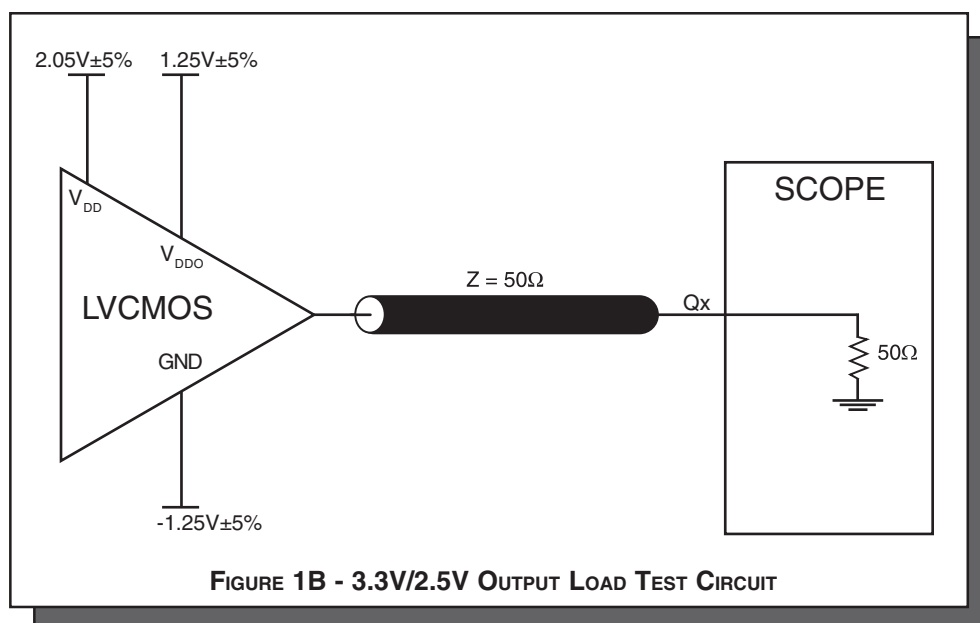
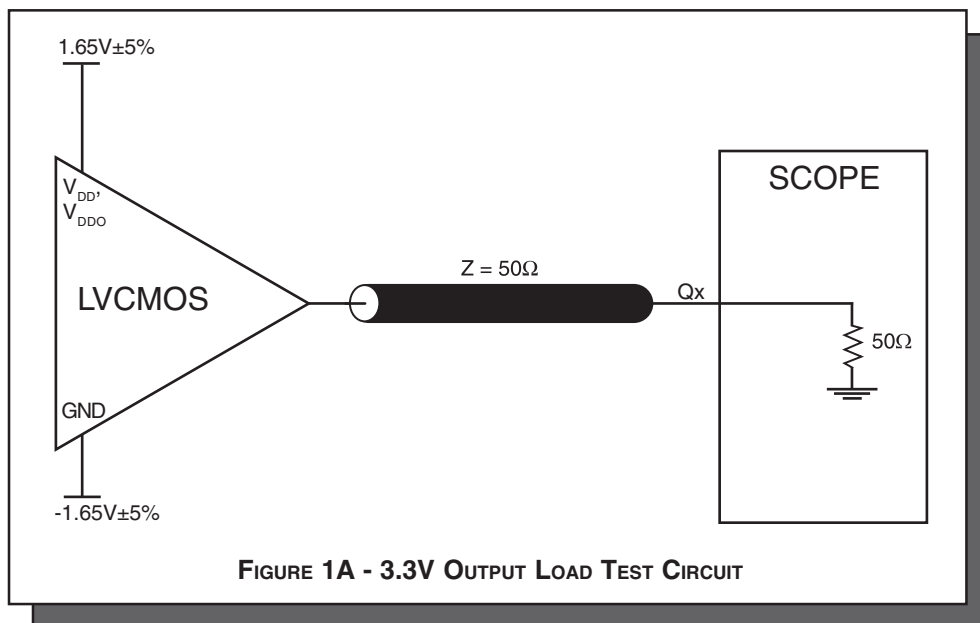
NOTE 4: Defined as skew between outputs on different devices operating at the same supply voltages, and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at $V_{DDO}/2$.

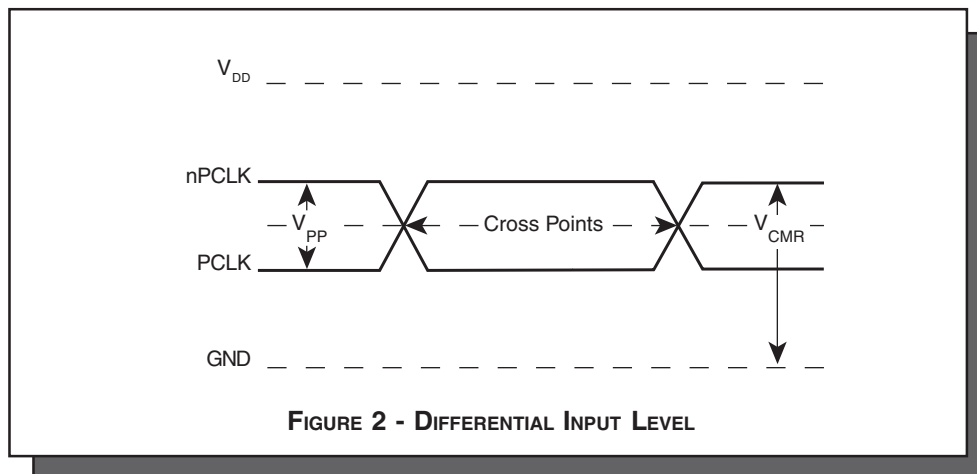
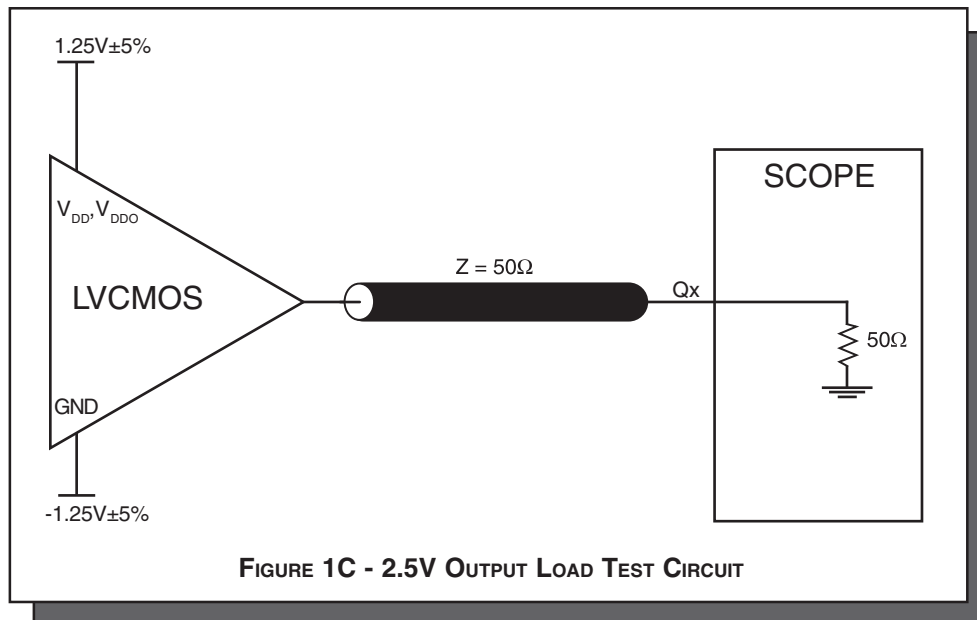
NOTE 5: This parameter is defined in accordance with JEDEC Standard 65.

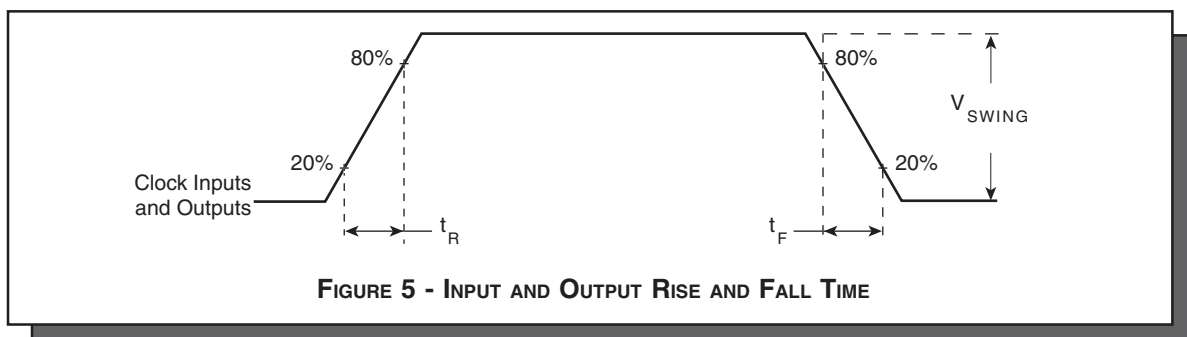
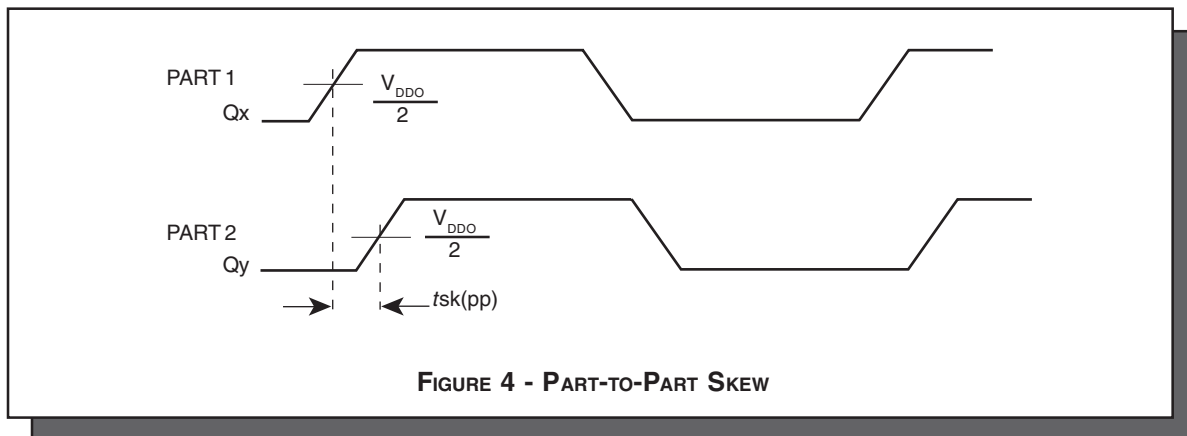
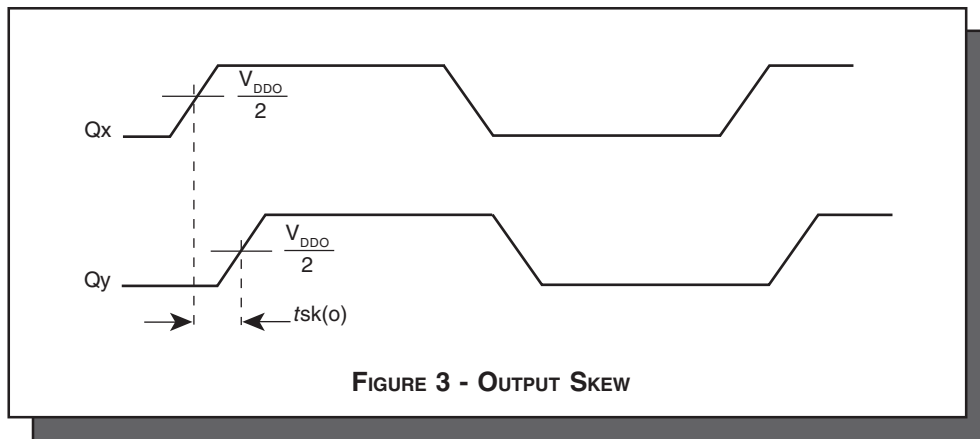
NOTE 6: Defined as skew between outputs on different devices, across temperature and voltage ranges, and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at $V_{DDO}/2$.



PARAMETER MEASUREMENT INFORMATION





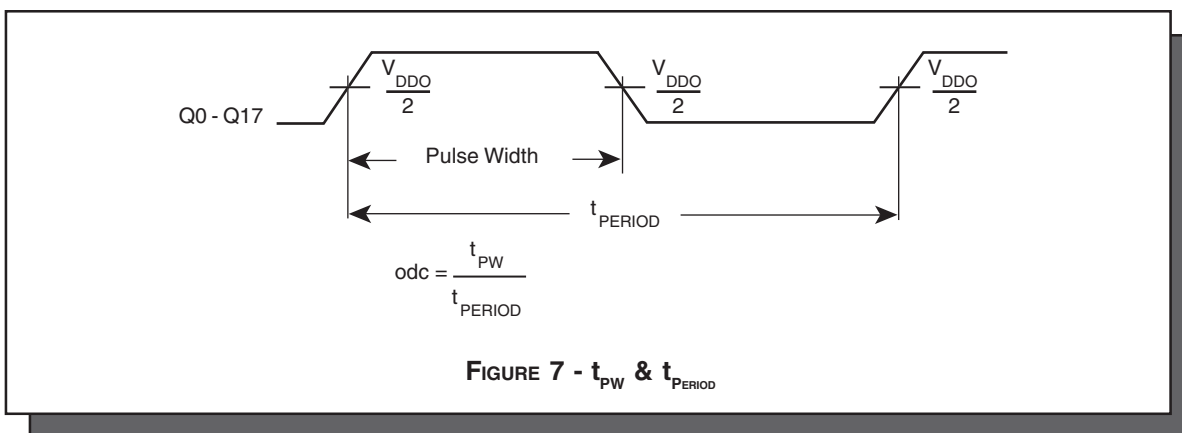
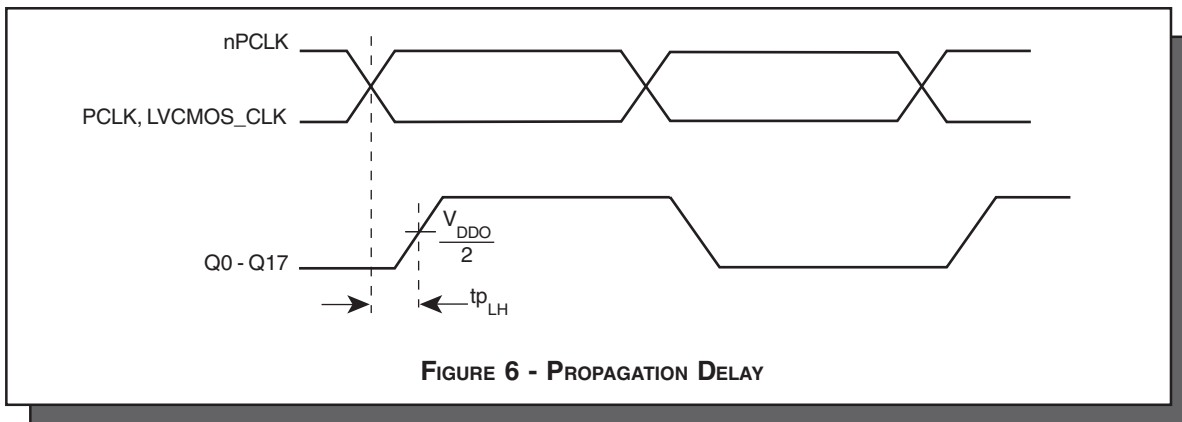




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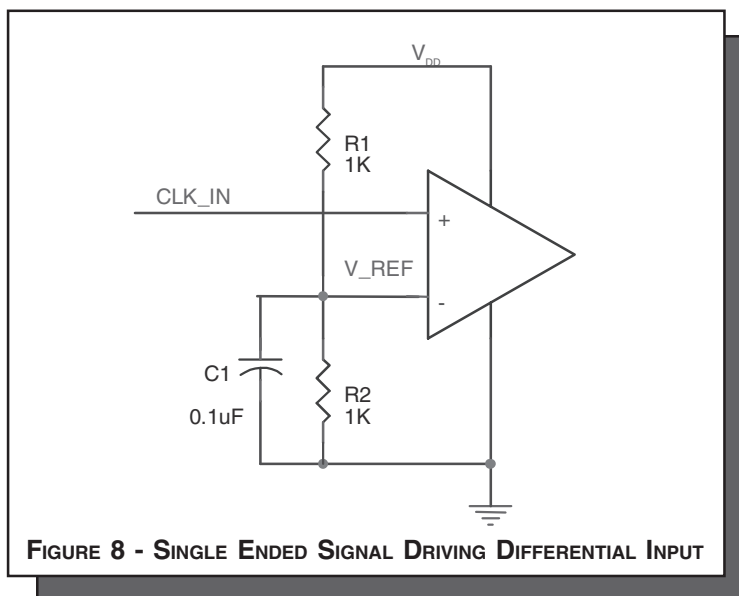




APPLICATION INFORMATION

WIRING THE DIFFERENTIAL INPUT TO ACCEPT SINGLE ENDED LEVELS

Figure 8 shows how the differential input can be wired to accept single ended levels. The reference voltage $V_{REF} = V_{DD}/2$ is generated by the bias resistors R1, R2 and C1. This bias circuit should be located as close as possible to the input pin. The ratio of R1 and R2 might need to be adjusted to position the V_{REF} in the center of the input voltage swing. For example, if the input clock swing is only 2.5V and $V_{DD} = 3.3V$, V_{REF} should be 1.25V and $R2/R1 = 0.609$.





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RELIABILITY INFORMATION

TABLE 6. θ_{JA} VS. AIR FLOW TABLE

θ_{JA} by Velocity (Linear Feet per Minute)			
	0	200	500
Single-Layer PCB, JEDEC Standard Test Boards	67.8°C/W	55.9°C/W	50.1°C/W
Multi-Layer PCB, JEDEC Standard Test Boards	47.9°C/W	42.1°C/W	39.4°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 ICS83940 is: 820



PACKAGE OUTLINE - Y SUFFIX

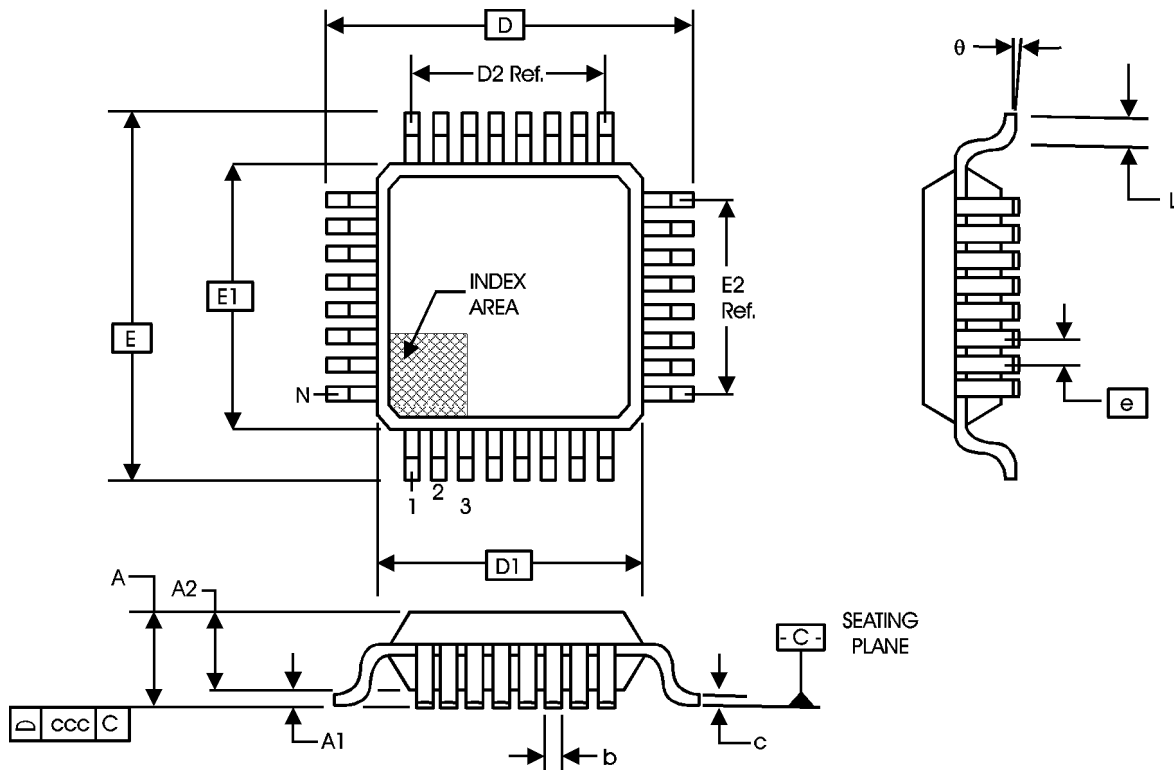


TABLE 7. PACKAGE DIMENSIONS

JEDEC VARIATION ALL DIMENSIONS IN MILLIMETERS			
SYMBOL	BBA		
	MINIMUM	NOMINAL	MAXIMUM
N	32		
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
b	0.30	0.37	0.45
c	0.09	--	0.20
D	9.00 BASIC		
D1	7.00 BASIC		
D2	5.60 Ref.		
E	9.00 BASIC		
E1	7.00 BASIC		
E2	5.60 Ref.		
e	0.80 BASIC		
L	0.45	0.60	0.75
θ	0°	--	7°
ccc	--	--	0.10

REFERENCE DOCUMENT: JEDEC PUBLICATION 95, MS-026



TABLE 8. ORDERING INFORMATION

Part/Order Number	Marking	Package	Count	Temperature
ICS83940AY	ICS83940AY	32 Lead LQFP	250 per tray	0°C to 70°C
ICS83940AYT	ICS83940AY	32 Lead LQFP on Tape and Reel	1000	0°C to 70°C

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