QUALITY SEMICONDUCTOR, INC.

High Speed 3.3V CMOS 8-Bit Buffers/Line Drivers

QS74LCX240
QS74LCX244

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FEATURES/BENEFITS

- 5V tolerant inputs and outputs
- 10µA I_{CCQ} quiescent power supply current
- Hot insertable
- 2.0V-3.6V V_{CC} supply operation
- ±24mA balanced output drive
- Power down high impedance inputs and outputs
- Meets or exceeds JEDEC 36 specifications
- C speed performance:
  LCX240 t_{PD} = 4.3ns
  LCX244 t_{PD} = 4.1ns
- Input hysteresis for noise immunity
- Operating temperature range:
  –40°C to +85°C
- Latch–up performance exceeds 500mA
- ESD performance:
  Human body model > 2000V
  Machine model > 200V
- Packages available:
  20-pin QSOP
  20-pin SOIC

DESCRIPTION

The LCX240 and LCX244 are 8-bit buffers/line drivers with three-state outputs that are ideal for driving high capacitance loads such as memory address and data buses. The 3.3V LCX family features low power, low switching noise, and fast switching speeds for low power portable applications as well as high-end, advanced workstation applications. 5V tolerant inputs and outputs allow these LCX products to be used in mixed 5V and 3.3V applications. To accomodate hot-plug or live insertion applications, these products are designed not to load an active bus when V_{CC} is removed.

Figure 1. Functional Block Diagram

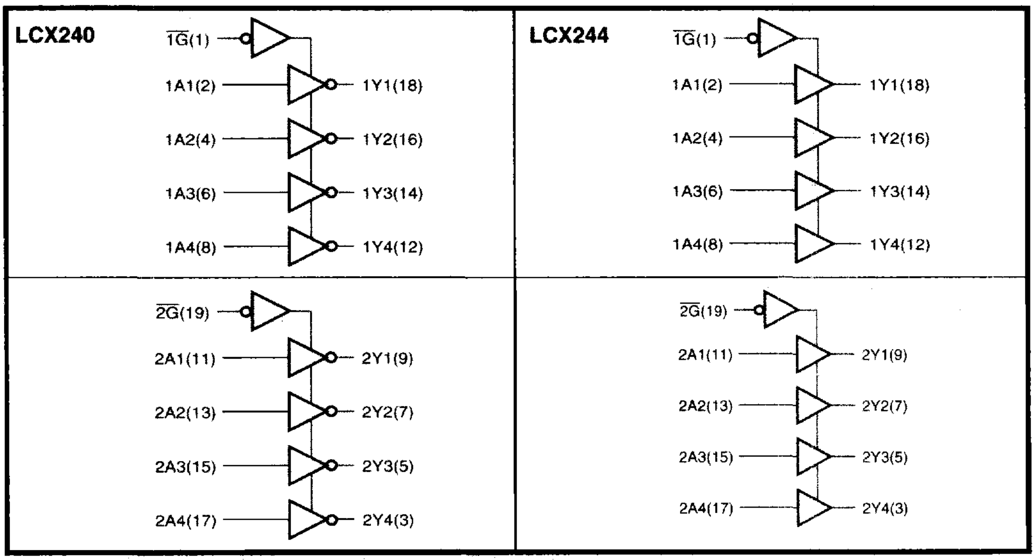


Figure 2. Pin Configurations (All Pins Top View)

SOIC, QSOP

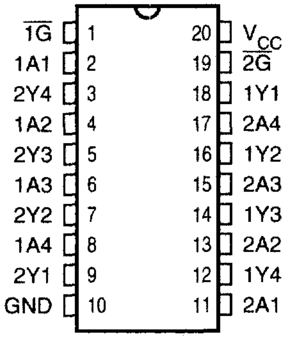


Table 1. Pin Description

Name	I/O	Description
xA1-xA4	I	Data Inputs
xY1-xY4	O	Three-State Data Outputs
$\overline{1G}$	I	Three-State Output Enable
$\overline{2G}$	I	Three-State Output Enable

Table 2. Function Tables

LCX240

$\overline{1G}/\overline{2G}$	Input A	Output Y
H	X	Z
L	L	H
L	H	L

LCX244

$\overline{1G}/\overline{2G}$	Input A	Output Y
H	X	Z
L	L	L
L	H	H

Table 3. Capacitance

Symbol	Pins	Typ	Unit	Conditions
C_{IN}	Input Capacitance	7.0	pF	V_{IN} = 0V, V_{OUT} = 0V, f = 1MHz
$C_{I/O}$	I/O Capacitance	8.0	pF	V_{IN} = 0V, V_{OUT} = 0V, f = 1MHz
C_{PD}	Power Dissipation Capacitance	20	pF	V_{CC} = 3.3V, V_{IN} = 0V or V_{CC} f = 10MHz

Note: Capacitance is characterized but not production tested.

Table 4. Absolute Maximum Ratings

Supply Voltage to Ground	–0.5V to +7.0V
DC Output Voltage V_{OUT}	
Outputs HIGH-Z	–0.5V to +7.0V
Ouputs Active	–0.5V to V_{CC} +0.5V
DC Input Voltage V_{IN}	–0.5V to +7.0V
DC Input Diode Current with V_{IN} < 0	–50mA
DC Output Diode Current	
V_O<0	-50mA
V_O>V_{CC}	+50mA
DC Output Source/Sink Current (I_{OH}/I_{OL})	±50mA
DC Supply Current per Supply Pin	±100mA
DC Ground Current per Ground Pin	±100mA
T_{STG} Storage Temperature	–65° to +150°C

Note: Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to QSI devices that result in functional or reliability type failures.

Table 5. Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply Voltage, Operating	2.0	3.6	V
V_{IN}	Input Voltage	0	5.5	V
V_{OUT}	Output Voltage in Active State	0	V_{CC}	V
V_{OUT}	Output Voltage in "OFF" State	0	5.5	V
I_{OH}/I_{OL}	Output Current V_{CC} = 3.0 – 3.6V V_{CC} = 2.7V	—	±24 ±12	mA
Δt/Δv	Input Transition Slew Rate	—	10	ns/V
T_A	Operating Free Air Temperature	–40	+85	°C

Table 6. DC Electrical Characteristics Over Operating Range

Industrial Temperature Range, T_A = –40°C to +85°C.

Symbol	Parameter	Test Conditions[1]	Min	Typ[2]	Max	Unit
V_{IH}	Input HIGH Voltage	Logic HIGH for All Inputs	2.0	—	—	V
V_{IL}	Input LOW Voltage	Logic LOW for All Inputs	—	—	0.8	V
V_{OH}	Output HIGH Voltage	V_{CC} = 2.7V, I_{OH} = –100µA V_{CC} = 2.7V, I_{OH} = –12mA V_{CC} = 3.0V, I_{OH} = –18mA V_{CC} = 3.0V, I_{OH} = –24mA	V_{CC}– 0.2 2.2 2.4 2.2	— — — —	— — — —	V
V_{OL}	Output LOW Voltage	V_{CC} = 2.7V, I_{OL} = 100µA V_{CC} = 2.7V, I_{OL} = 12mA V_{CC} = 3.0V, I_{OL} = 16mA V_{CC} = 3.0V, I_{OL} = 24mA	— — — —	— — — —	0.2 0.4 0.4 0.5	V
ΔV_T	Input Hysteresis[3]	V_{TLH} – V_{THL} for All Inputs	—	150	—	mV
$\|I_{OZ}\|$	Off-State Output Current (Hi-Z)	V_{CC} = 3.6V, V_O = 0V, V_O = 5.5V	—	—	1	µA
I_{OS}	Short Circuit Current[3,4]	V_{CC} = 3.6V, V_{OUT} = GND	–60	—	–240	mA
V_{IK}	Input Clamp Voltage	V_{CC} = 2.7V, I_{IN} = –18mA	—	–0.7	–1.2	V
I_I	Input Leakage Current	V_I = 0V, V_I = 5.5V, V_{CC} = 3.6V	—	—	±1.0	µA
I_{OFF}	Power Off Leakage	V_{CC} = 0V, V_I or V_O = 5.5V	—	—	10	µA

Notes:
1. For conditions shown as Max. or Min. use appropriate value specified under Recommended Operating Conditions for the applicable device type.
2. *Typical values are at V_{CC} = 3.3V and T_A = 25°C.*
3. These parameters are guaranteed by characterization, but not production tested.
4. Not more than one output should be tested at one time. Duration of test should not exceed one second.

Table 7. Power Supply Characteristics

Symbol	Parameter	Test Conditions[1]		Typ[2]	Max	Unit
I_{CC}	Quiescent Power Supply Current	V_{CC} = 3.6V Freq = 0 V_{IN} = GND or V_{CC}		0.1	10	µA
ΔI_{CC}	Supply Current per Input @ TTL HIGH[3]	V_{CC} = 3.6V V_{IN} = V_{CC}–0.6V, Freq = 0		2.0	30	µA
I_{CCD}	Supply Current per Input per MHz[4]	V_{CC} = 3.6V Outputs Open One Bit Toggling @ 50% Duty Cycle x$\overline{G}$ = GND		50	75	µA/ MHz
I_C	Total Power Supply Current[6]	V_{CC} = 3.6V Outputs Open One Bit Toggling @ 50% Duty Cycle x$\overline{G}$ = GND, f = 10MHz	V_{IN} = V_{CC}–0.6V V_{IN} = GND	0.5[5]	0.8[5]	mA
		V_{CC} = 3.6V Outputs Open Eight Bits Toggling @ 50% Duty Cycle x$\overline{G}$ = GND, f = 2.5MHz	V_{IN} = V_{CC}–0.6V V_{IN} = GND	1.0[5]	1.7[5]	mA

Notes:
1. For conditions shown as Min. or Max., use the appropriate values specified under Recommended Operating Conditions for applicable device type.
2. Typical values are at V_{CC} = 3.3V, +25°C ambient.
3. Per TTL driven input. All Other Inputs at V_{CC} or GND.
4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
5. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed by design but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$.
   $I_C = I_{CCQ} + \Delta I_{CC} D_H N_T + I_{CCD} f N_O$.
   I_{CCQ} = Quiescent Current (I_{CCL}, I_{CCH}, and I_{CCZ}).
   ΔI_{CC} = Power Supply Current for a TTL-High Input (V_{IN} = V_{CC}-0.6V).
   D_H = Duty Cycle for TTL High Inputs.
   N_T = Number of TTL High Inputs.
   I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL).
   f = Average Switching Frequency per Output.
   N_O = Number of Outputs Switching.

Table 8. Dynamic Switching Characteristics[1]

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = 25°C Typical	Units
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	C_L = 50pF, V_{IH} = 3.3V, V_{IL} = 0V	3.3	0.8	V
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	C_L = 50pF, V_{IH} = 3.3V, V_{IL} = 0V	3.3	0.8	V

Note:
1. Characterized but not production tested.

Table 9. LCX240 Switching Characteristics Over Operating Range

Industrial Temperature Range, $T_A = -40°C$ to $+85°C$.
$C_{LOAD} = 50pF$, $R_{LOAD} = 500\Omega$ unless otherwise noted.

Symbol	Description[1]	240 $V_{CC} = 3.3 \pm 0.3V$ Min	240 $V_{CC} = 3.3 \pm 0.3V$ Max	240 $V_{CC} = 2.7V$[2] Min	240 $V_{CC} = 2.7V$[2] Max	240C $V_{CC} = 3.3 \pm 0.3V$ Min	240C $V_{CC} = 3.3 \pm 0.3V$ Max	Unit
t_{PHL} t_{PLH}	Propagation Delay Ai to Yi	1.5	6.5	1.5	7.5	1.5	4.3	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{G}$ to Yi	1.5	8.0	1.5	9.0	1.5	5.8	ns
t_{PHZ} t_{PLZ}	Output Disable Time[2] $\overline{G}$ to Yi	1.5	7.0	1.5	8.0	1.5	5.2	ns
$t_{SK(O)}$	Output Skew[3]	—	0.5	—	—	—	0.5	ns

Table 10. LCX244 Switching Characteristics Over Operating Range

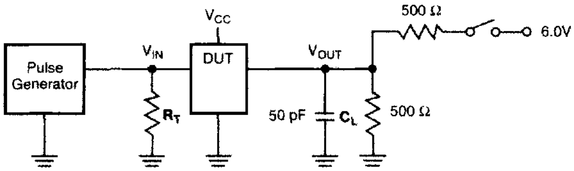
Industrial Temperature Range, $T_A = -40°C$ to $+85°C$.
$C_{LOAD} = 50pF$, $R_{LOAD} = 500\Omega$ unless otherwise noted.

Symbol	Description[1]	244 $V_{CC} = 3.3 \pm 0.3V$ Min	244 $V_{CC} = 3.3 \pm 0.3V$ Max	244 $V_{CC} = 2.7V$[2] Min	244 $V_{CC} = 2.7V$[2] Max	244C $V_{CC} = 3.3 \pm 0.3V$ Min	244C $V_{CC} = 3.3 \pm 0.3V$ Max	Unit
t_{PHL} t_{PLH}	Propagation Delay Ai to Yi	1.5	6.5	1.5	7.5	1.5	4.1	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{G}$ to Yi	1.5	8.0	1.5	9.0	1.5	5.8	ns
t_{PHZ} t_{PLZ}	Output Disable Time[2] $\overline{G}$ to Yi	1.5	7.0	1.5	8.0	1.5	5.2	ns
$t_{SK(O)}$	Output Skew[3]	—	0.5	—	—	—	0.5	ns

Notes:
1. Minimums guaranteed but not production tested. See test circuit and waveforms.
2. Guaranteed by characterization.
3. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by characterization but not production tested.

TEST CIRCUIT AND WAVEFORMS

Figure 3. Test Circuit



SWITCH POSITION

Test	Switch
Open Drain Disable LOW Enable LOW	6V
Disable HIGH Enable HIGH	GND
All Other Inputs	Open

DEFINITIONS:
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse generator.

Figure 4. Setup, Hold, and Release Timing

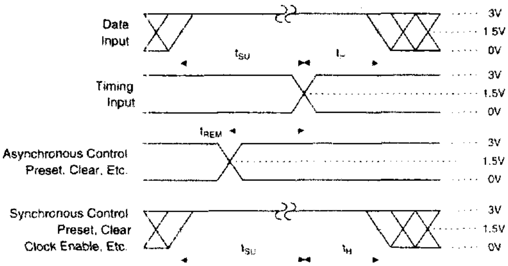


Figure 6. Pulse Width

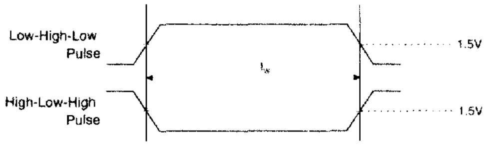


Figure 5. Enable and Disable Timing

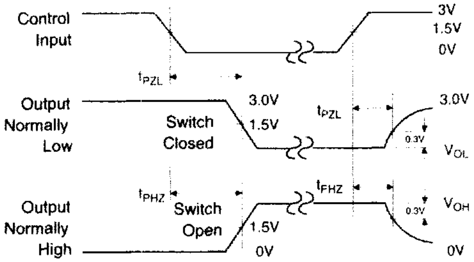
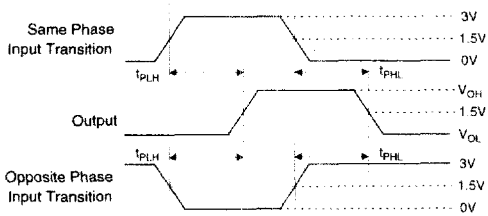


Figure 7. Propagation Delay



Notes:
1. Input Control Enable = LOW and input Control Disable = HIGH.
2. Pulse Generator for All Pulses: Rate ≤ 1.0 MHz; $Z_{OUT} \leq 50\Omega$; t_F, $t_R \leq$ 2.5 ns.