National Semiconductor

February 1999

54ACQ240 • 54ACTQ240
Quiet Series Octal Buffer/Line Driver with TRI-STATE® Outputs

General Description

The 'ACQ/'ACTQ240 is an inverting octal buffer and line driver designed to be employed as a memory address driver, clock driver and bus oriented transmitter or receiver which provides improved PC board density. The 'ACQ/'ACTQ utilizes NSC Quiet Series technology to guarantee quiet output switching and improve dynamic threshold performance. FACT Quiet Series™ features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

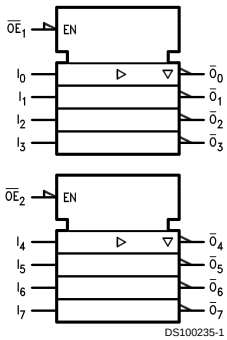
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Improved latch-up immunity
- Inverting TRI-STATE outputs drive bus lines or buffer memory address registers
- Outputs source/sink 24 mA
- Faster prop delays than the standard 'ACT240
- 4 kV minimum ESD immunity
- Standard Microcircuit Drawing (SMD) 'ACTQ240: 5962-92184

Features

- I_{CC} and I_{OZ} reduced by 50%

Logic Symbol

IEEE/IEC

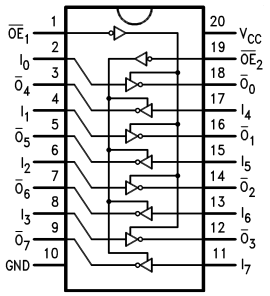


DS100235-1

Pin Names	Description
$\overline{OE}_1$, $\overline{OE}_2$	TRI-STATE Output Enable Inputs
I_0–I_7	Inputs
$\overline{O}_0$–$\overline{O}_7$	Outputs

Connection Diagrams

Pin Assignment for DIP and Flatpak



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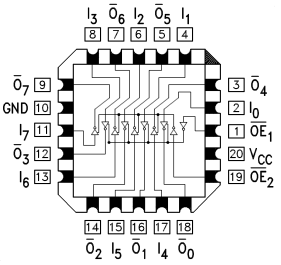
Pin Assignment for LCC



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TRI-STATE® is a registered trademark of National Semiconductor Corporation.
FACT® is a registered trademark of Fairchild Semiconductor Corporation.
FACT Quiet Series™ is a trademark of Fairchild Semiconductor Corporation.

Truth Tables

Inputs		Outputs
$\overline{OE}_1$	I_n	(Pins 12, 14, 16, 18)
L	L	H
L	H	L
H	X	Z

Inputs		Outputs
$\overline{OE}_2$	I_n	(Pins 3, 5, 7, 9)
L	L	H
L	H	L
H	X	Z

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Diode Current (I_{IK})	
V_I = −0.5V	−20 mA
V_I = V_{CC} + 0.5V	+20 mA
DC Input Voltage (V_I)	−0.5V to V_{CC} + 0.5V
DC Output Diode Current (I_{OK})	
V_O = −0.5V	−20 mA
V_O = V_{CC} + 0.5V	+20 mA
DC Output Voltage (V_O)	−0.5V to V_{CC} + 0.5V
DC Output Source or Sink Current (I_O)	±50 mA
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})	±50 mA
Storage Temperature (T_{STG})	−65˚C to +150˚C
DC Latch-Up Source or Sink Current	±300 mA
Junction Temperature (T_J)	
CDIP	175˚C

Recommended Operating Conditions

Supply Voltage (V_{CC})	
'ACQ	2.0V to 6.0V
'ACTQ	4.5V to 5.5V
Input Voltage (V_I)	0V to V_{CC}
Output Voltage (V_O)	0V to V_{CC}
Operating Temperature (T_A)	
54ACQ/ACTQ	−55˚C to +125˚C
Minimum Input Edge Rate ΔV/Δt	
'ACQ Devices	
V_{IN} from 30% to 70% of V_{CC}	
V_{CC} @ 3.0V, 4.5V, 5.5V	125 mV/ns
Minimum Input Edge Rate ΔV/Δt	
'ACTQ Devices	
V_{IN} from 0.8V to 2.0V	
V_{CC} @ 4.5V, 5.5V	125 mV/ns

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT® circuits outside databook specifications.

Note 2: All commercial packaging is not recommended for applications requiring greater than 2000 temperature cycles from −40˚C to +125˚C.

DC Characteristics for 'ACQ Family Devices

Symbol	Parameter	V_{CC} (V)	54ACQ T_A = −55˚C to +125˚C Guaranteed Limits	Units	Conditions
V_{IH}	Minimum High Level Input Voltage	3.0	2.1	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		4.5	3.15		
		5.5	3.85		
V_{IL}	Maximum Low Level Input Voltage	3.0	0.9	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		4.5	1.35		
		5.5	1.65		
V_{OH}	Minimum High Level Output Voltage	3.0	2.9	V	I_{OUT} = −50 μA
		4.5	4.4		
		5.5	5.4		
					(Note 3) V_{IN} = V_{IL} or V_{IH}
		3.0	2.4	V	I_{OH} = −12 mA
		4.5	3.7		I_{OH} = −24 mA
		5.5	4.7		I_{OH} = −24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0	0.1	V	I_{OUT} = 50 μA
		4.5	0.1		
		5.5	0.1		
					(Note 3) V_{IN} = V_{IL} or V_{IH}
		3.0	0.50	V	I_{OL} = 12 mA
		4.5	0.50		I_{OL} = 24 mA
		5.5	0.50		I_{OL} = 24 mA
I_{IN}	Maximum Input Leakage Current	5.5	±1.0	μA	V_I = V_{CC}, GND (Note 5)

DC Characteristics for ’ACQ Family Devices (Continued)

Symbol	Parameter	V_{CC} (V)	54ACQ T_A = −55˚C to +125˚C Guaranteed Limits	Units	Conditions
I_{OLD}	Minimum Dynamic (Note 4)	5.5	50	mA	V_{OLD} = 1.65V Max
I_{OHD}	Output Current	5.5	−50	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5	80.0	µA	$V_{IN} = V_{CC}$ or GND (Note 5)
I_{OZ}	Maximum TRI-STATE Leakage Current	5.5	±5.0	µA	V_I (OE) = V_{IL}, V_{IH} $V_I = V_{CC}$, GND $V_O = V_{CC}$, GND
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	5.0	1.5V	V	(Notes 6, 7)
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	5.0	−1.2V	V	(Notes 6, 7)

Note 3: All outputs loaded; thresholds on input associated with output under test.

Note 4: Maximum test duration 2.0 ms, one output loaded at a time.

Note 5: I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}.

I_{CC} for 54ACQ @ 25˚C is identical to 74ACQ @ 25˚C.

Note 6: Plastic DIP package.

Note 7: Max number of outputs defined as (n). Data inputs are driven 0V to 5V. One output @ GND.

Note 8: Max number of data inputs (n) switching. (n −1) inputs switching 0V to 5V (’ACQ). Input-under-test switching: 5V to threshold (V_{ILD}), 0V to threshold (V_{IHD}), f = 1 MHz.

DC Characteristics for ’ACTQ Family Devices

Symbol	Parameter	V_{CC} (V)	54ACTQ T_A = −55˚C to +125˚C Guaranteed Limits	Units	Conditions
V_{IH}	Minimum High Level Input Voltage	4.5 5.5	2.0 2.0	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{IL}	Maximum Low Level Input Voltage	4.5 5.5	0.8 0.8	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{OH}	Minimum High Level Output Voltage	4.5 5.5	4.4 5.4	V	I_{OUT} = −50 µA
					(Note 9) $V_{IN} = V_{IL}$ or V_{IH}
		4.5 5.5	3.70 4.70	V	I_{OH} = −24 mA I_{OH} = −24 mA
V_{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.1 0.1	V	I_{OUT} = 50 µA
					(Note 9) $V_{IN} = V_{IL}$ or V_{IH}
		4.5 5.5	0.50 0.50	V	I_{OL} = 24 mA I_{OL} = 24 mA
I_{IN}	Maximum Input Leakage Current	5.5	±1.0	µA	$V_I = V_{CC}$, GND
I_{OZ}	Maximum TRI-STATE Leakage Current	5.5	±5.0	µA	V_I = V_{IL}, V_{IH} $V_O = V_{CC}$, GND

DC Characteristics for 'ACTQ Family Devices (Continued)

Symbol	Parameter	V_{CC} (V)	54ACTQ T_A = −55°C to +125°C Guaranteed Limits	Units	Conditions
I_{CCT}	Maximum I_{CC}/Input	5.5	1.6	mA	$V_I = V_{CC} - 2.1V$
I_{OLD}	Minimum Dynamic (Note 10)	5.5	50	mA	V_{OLD} = 1.65V Max
I_{OHD}	Output Current	5.5	−50	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5	80.0	µA	$V_{IN} = V_{CC}$ or GND (Note 11)
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	5.0	1.5V	V	(Notes 12, 13)
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	5.0	−1.2V	V	(Notes 12, 13)

Note 9: All outputs loaded; thresholds on input associated with output under test.

Note 10: Maximum test duration 2.0 ms, one output loaded at a time.

Note 11: I_{CC} for 54ACTQ @ 25°C is identical to 74ACTQ @ 25°C.

Note 12: Plastic DIP package.

Note 13: Max number of Data Inputs defined as (n). n−1 Data Inputs are driven 0V to 3V. One Data Input @ V_{IN} = GND.

Note 14: Max number of Data Inputs (n) switching. (n−1) Inputs switching 0V to 3V ('ACTQ). Input-under-test switching: 3V to threshold (V_{ILD}), 0V to threshold (V_{IHD}), f = 1 MHz.

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V) (Note 15)	54ACQ T_A = −55°C to +125°C C_L = 50 pF		Units	Fig. No.
			Min	Max		
t_{PHL}, t_{PLH}	Propagation Delay Data to Output	3.3	1.0	12.5	ns	
		5.0	1.0	9.0		
t_{PZL}, t_{PZH}	Output Enable Time	3.3	1.0	13.5	ns	
		5.0	1.0	10.0		
t_{PHZ}, t_{PLZ}	Output Disable Time	3.3	1.0	11.0	ns	
		5.0	1.0	9.0		

Note 15: Voltage Range 5.0 is 5.0V ±0.5V

Voltage Range 3.3 is 3.3 ±0.3V.

Note 16: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH to LOW (t_{OSHL}) or LOW to HIGH (t_{OSLH}). Parameter guaranteed by design.

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V) (Note 17)	54ACTQ T_A = −55°C to +125°C C_L = 50 pF		Units	Fig. No.
			Min	Max		
t_{PHL}, t_{PLH}	Propagation Delay Data to Output	5.0	1.5	9.0	ns	
t_{PZL}, t_{PZH}	Output Enable Time	5.0	1.5	11.0	ns	
t_{PHZ}, t_{PLZ}	Output Disable Time	5.0	1.5	10.0	ns	

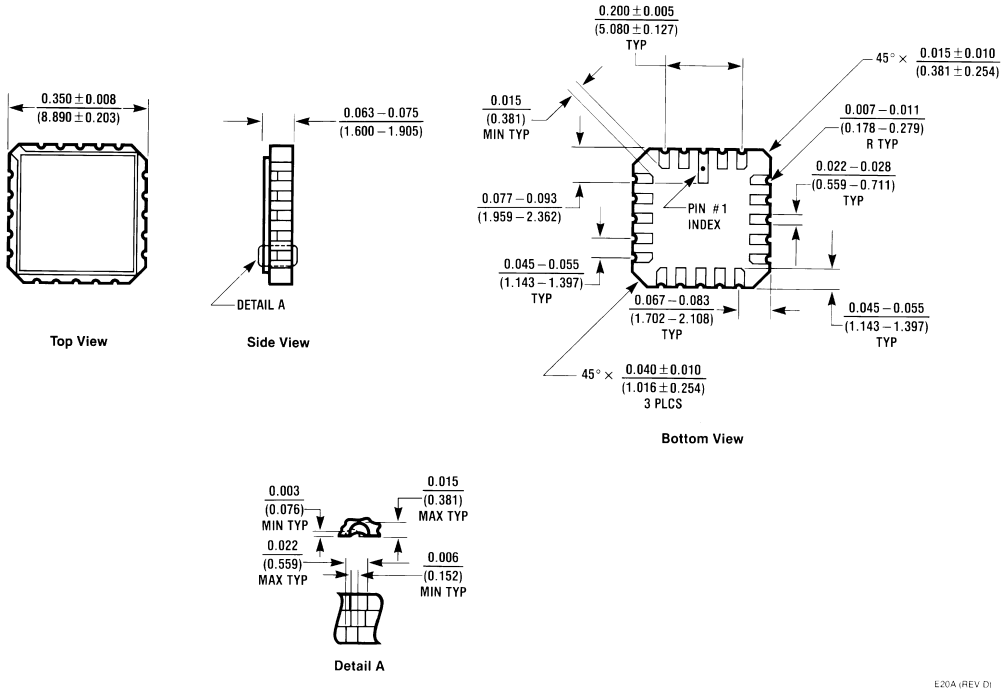
Note 17: Voltage Range 5.0 is 5.0V ±0.5V

Note 18: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH to LOW (t_{OSHL}) or LOW to HIGH (t_{OSLH}). Parameter guaranteed by design.

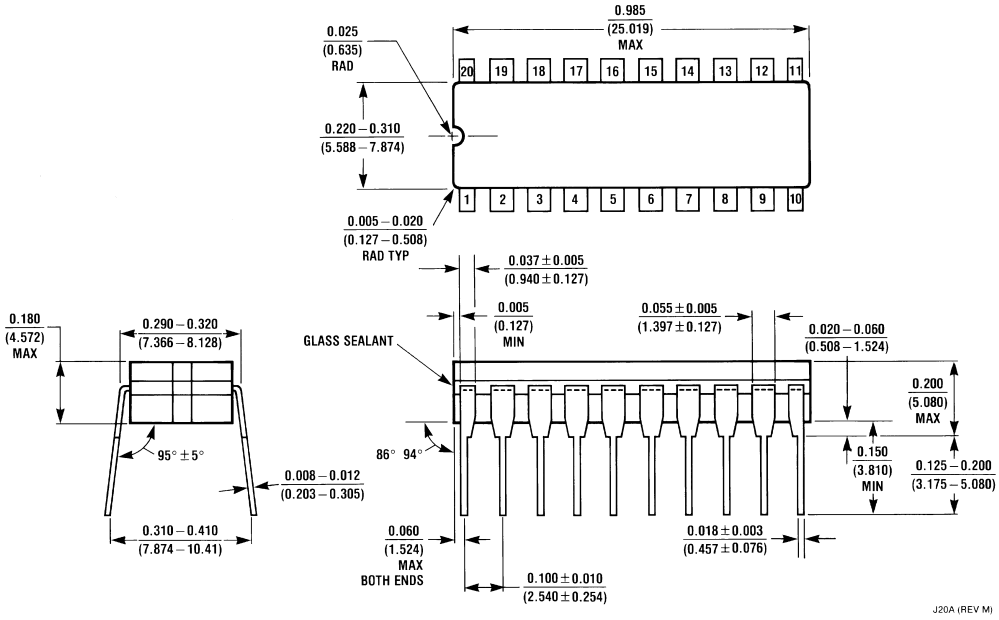
Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = OPEN
C_{PD}	Power Dissipation Capacitance	70	pF	V_{CC} = 5.0V

Physical Dimensions inches (millimeters) unless otherwise noted

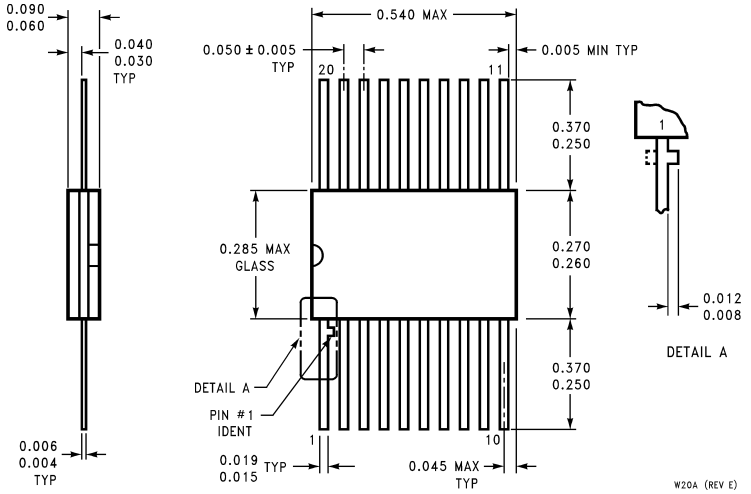


20-Terminal Ceramic Leadless Chip Carrier (L)
NS Package Number E20A



20-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J20A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



20-Lead Ceramic Flatpak (F)
NS Package Number W20A

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