National Semiconductor

September 1998

54ACQ373 • 54ACTQ373
Quiet Series Octal Transparent Latch with TRI-STATE® Outputs

General Description

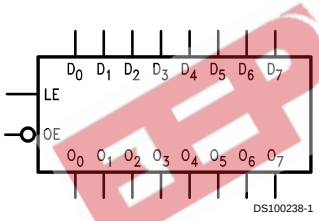
The 'ACQ/'ACTQ373 consists of eight latches with TRI-STATE outputs for bus organized system applications. The latches appear transparent to the data when Latch Enable (LE) is HIGH. When LE is low, the data satisfying the input timing requirements is latched. Data appears on the bus when the Output Enable (OE) is LOW. When OE is HIGH, the bus output is in the high impedance state.

The 'ACQ/'ACTQ373 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.

Features

- I_{CC} and I_{OZ} reduced by 50%
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Improved latch up immunity
- Eight latches in a single package
- TRI-STATE outputs drive bus lines or buffer memory address registers
- Outputs source/sink 24 mA
- Faster prop delays than the standard 'AC/'ACT373
- 4 kV minimum ESD immunity ('ACQ)
- Standard Military Drawing (SMD)
  - 'ACTQ373: 5962-92188
  - 'ACQ373: 5962-92178

Logic Symbols



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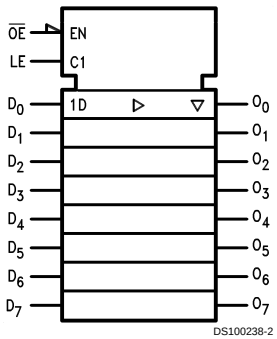
IEEE/IEC



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Pin Names	Description
D_0–D_7	Data Inputs
LE	Latch Enable Input
$\overline{OE}$	Output Enable Input
O_0–O_7	TRI-STATE Latch Outputs

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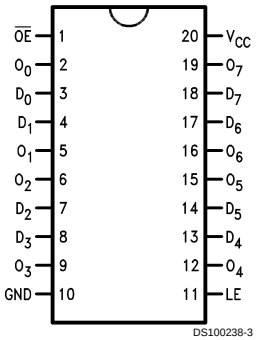
FACT Quiet Series™ is a trademark of Fairchild Semiconductor Corporation.

Connection Diagrams

Pin Assignment for DIP and Flatpak



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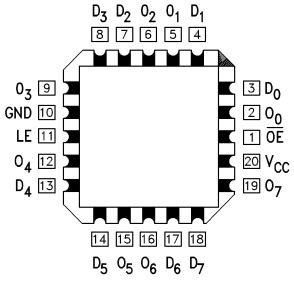
Pin Assignment for LCC



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Functional Description

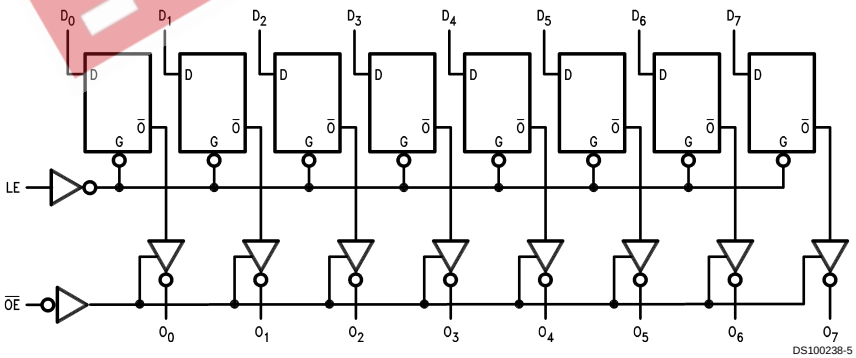
The 'ACQ/'ACTQ373 contains eight D-type latches with TRI-STATE standard outputs. When the Latch Enable (LE) input is HIGH, data on the D_n inputs enters the latches. In this condition the latches are transparent, i.e., a latch output will change state each time its D input changes. When LE is LOW, the latches store the information that was present on the D inputs a setup time preceding the HIGH-to-LOW transition of LE. The TRI-STATE standard outputs are controlled by the Output Enable ($\overline{OE}$) input. When $\overline{OE}$ is LOW, the standard outputs are in the 2-state mode. When $\overline{OE}$ is HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the latches.

Truth Table

Inputs			Outputs
LE	$\overline{OE}$	D_n	O_n
X	H	X	Z
H	L	L	L
H	L	H	H
L	L	X	O_0

H = HIGH Voltage Level
L = LOW Voltage Level
Z = High Impedance
X = Immaterial
O_0 = Previous O_0 before HIGH to Low transition of Latch Enable

Logic Diagram



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Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

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

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.

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 2) 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 2) 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 4)

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 3)	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 4)
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	1.5	V	(Notes 5, 6)
V_{OLV}	Quiet Output Maximum Dynamic V_{OL}	5.0	−1.2	V	(Notes 5, 6)

Note 2: All outputs loaded; thresholds on input associated with output under test.

Note 3: Maximum test duration 2.0 ms, one output loaded at a time.

Note 4: 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 5: Plastic DIP package.

Note 6: Max number of outputs defined as (n). Data inputs are driven 0V to 5V. One output @ GND.

Note 7: 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 8) $V_{IN} = V_{IL}$ 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 8) $V_{IN} = V_{IL}$ 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	5.5	50	mA	V_{OLD} = 1.65V Max
I_{OHD}	Output Current (Note 9)	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 10)
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	5.0	1.5	V	(Notes 11, 12)
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	5.0	−1.2	V	(Notes 11, 12)

Note 8: All outputs loaded; thresholds on input associated with output under test.

Note 9: Maximum test duration 2.0 ms, one output loaded at a time.

Note 10: I_{CC} for 54ACTQ @ 25°C is identical to 74ACTQ @ 25°C.

Note 11: Plastic DIP package.

Note 12: Max number of outputs defined as (n). Data inputs are driven 0V to 3V. One output @ GND.

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V) (Note 13)	54ACQ T_A = −55°C to +125°C C_L = 50 pF Min	54ACQ Max	Units
t_{PHL}, t_{PLH}	Propagation Delay D_n to O_n	3.3	1.0	15.0	ns
		5.0	1.0	9.5	
t_{PHL}, t_{PLH}	Propagation Delay LE to O_n	3.3	1.0	16.0	ns
		5.0	1.0	9.5	
t_{PZL}, t_{PZH}	Output Enable Time	3.3	1.0	14.5	ns
		5.0	1.0	10.5	
t_{PHZ}, t_{PLZ}	Output Disable Time	3.3	1.0	12.0	ns
		5.0	1.0	10.5	

Note 13: Voltage Range 5.0 is 5.0V ±0.5V.
Voltage Range 3.3 is 3.3V ±0.3V.

AC Operating Requirements

Symbol	Parameter	V_{CC} (V) (Note 14)	54ACQ $T_A = -55^\circ C$ to $+125^\circ C$ $C_L = 50$ pF Guaranteed Minimum	Units
t_s	Setup Time, HIGH or LOW D_n to LE	3.3	3.0	ns
		5.0	3.0	
t_h	Hold Time, HIGH or LOW D_n to LE	3.3	1.5	ns
		5.0	1,5	
t_w	LE Pulse Width, HIGH	3.3	5.0	ns
		5.0	5.0	

Note 14: Voltage Range 5.0 is 5.0V ±0.5V.
Voltage Range 3.3 is 3.3V ±0.3V.

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V) (Note 15)	54ACTQ $T_A = -55^\circ C$ to $+125^\circ C$ $C_L = 50$ pF		Units
			Min	Max	
t_{PHL}, t_{PLH}	Propagation Delay D_n to O_n	5.0	1.5	10.5	ns
t_{PHL}, t_{PLH}	Propagation Delay LE to O_n	5.0	1.5	11.5	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	10.5	ns

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

AC Operating Requirements

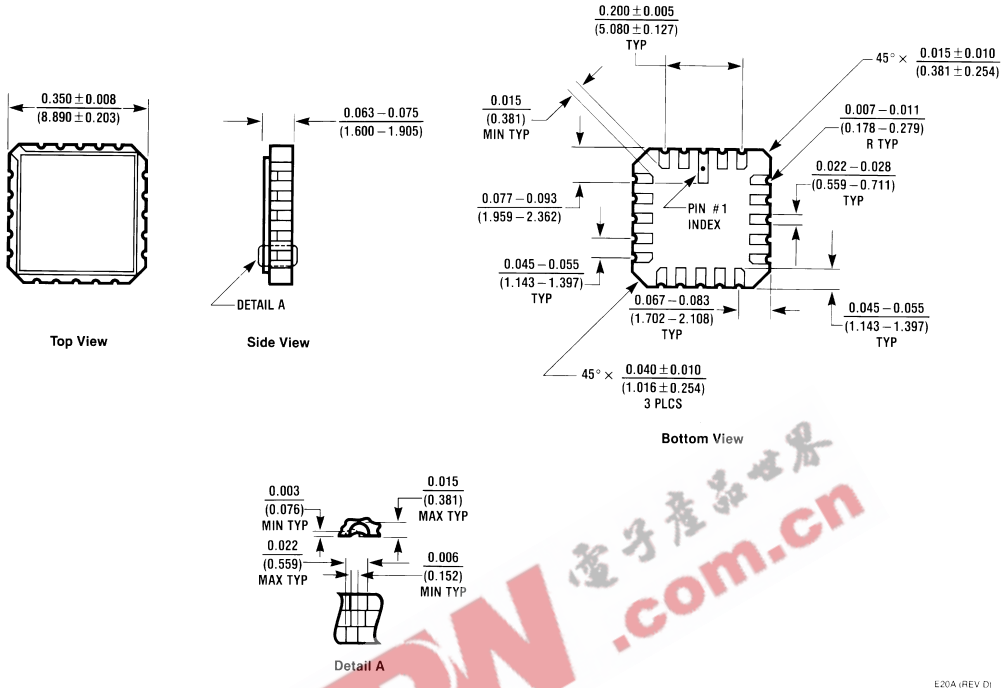
Symbol	Parameter	V_{CC} (V) (Note 16)	54ACTQ $T_A = -55^\circ C$ to $+125^\circ C$ $C_L = 50$ pF Guaranteed Minimum	Units
t_s	Setup Time, HIGH or LOW D_n to LE	5.0	3.5	ns
t_h	Hold Time, HIGH or LOW D_n to LE	5.0	1.5	ns
t_w	LE Pulse Width, HIGH	5.0	5.0	ns

Note 16: Voltage Range 5.0 is 5.0V ±0.5V

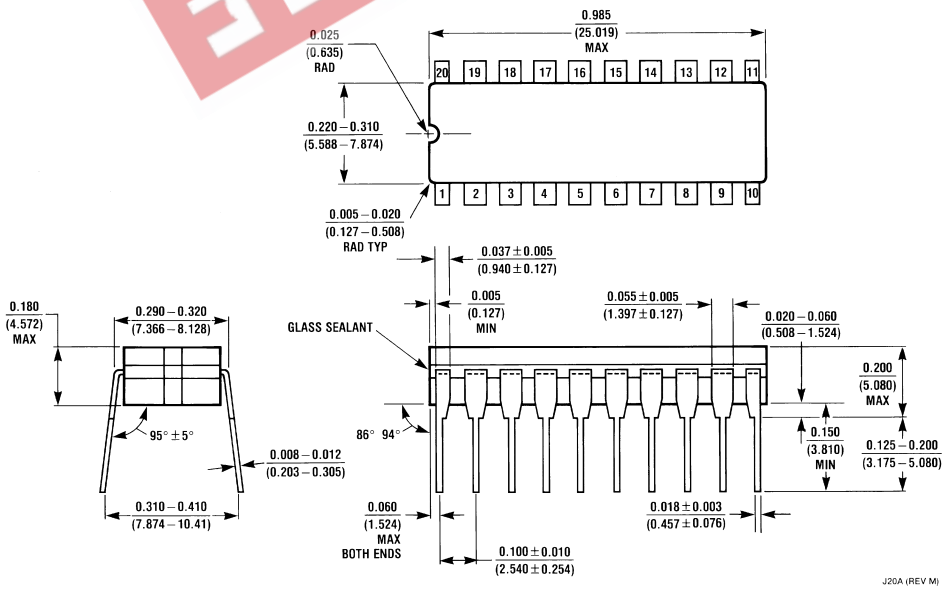
Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = OPEN
C_{PD}	Power Dissipation Capacitance	44.0	pF	V_{CC} = 5.0V

Physical Dimensions inches (millimeters) unless otherwise noted

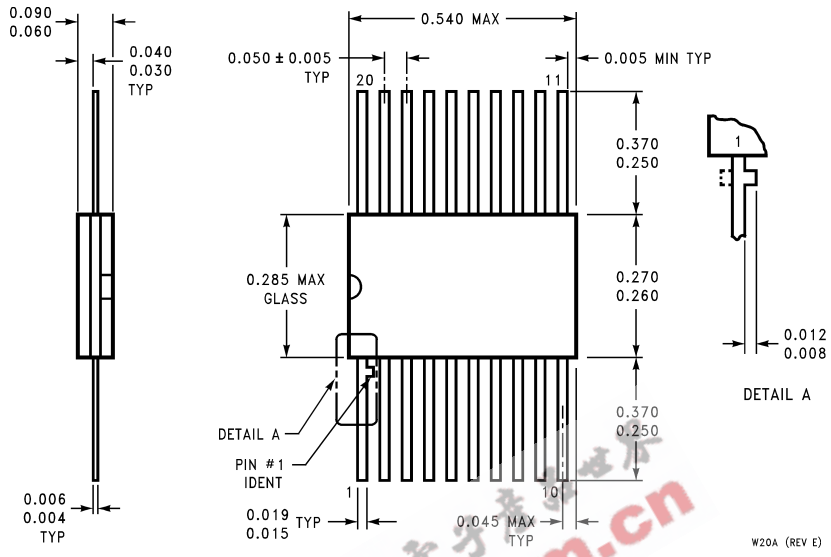


20-Terminal Ceramic Leadless Chip Carrier (L)
NS Package Number E20A



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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