National Semiconductor

54AC/74AC153 • 54ACT/74ACT153
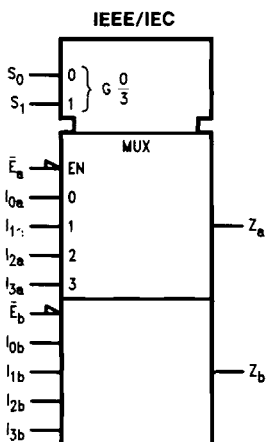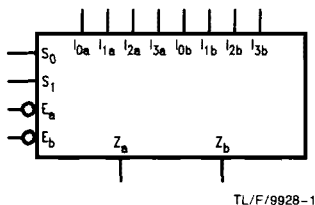# Dual 4-Input Multiplexer

General Description

The 'AC/'ACT153 is a high-speed dual 4-input multiplexer with common select inputs and individual enable inputs for each section. It can select two lines of data from four sources. The two buffered outputs present data in the true (non-inverted) form. In addition to multiplexer operation, the 'AC/'ACT153 can act as a function generator and generate any two functions of three variables.

Features

- I_{CC} reduced by 50%
- Outputs source/sink 24 mA
- 'ACT153 has TTL-compatible inputs
- Standard Military Drawings (SMD)
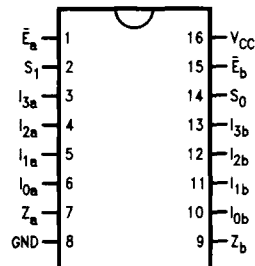 - 'AC153: 5962-87625
  - 'ACT153: 5962-87698

Ordering Code: See Section 8

Logic Symbols

TL/F/9928-1

IEEE/IEC

TL/F/9928-2

Pin Names	Description
I_{0a}–I_{3a}	Side A Data Inputs
I_{0b}–I_{3b}	Side B Data Inputs
S_0, S_1	Common Select Inputs
$\bar{E}_a$	Side A Enable Input
$\bar{E}_b$	Side B Enable Input
Z_a	Side A Output
Z_b	Side B Output

Connection Diagrams

Pin Assignment for DIP, Flatpak and SOIC

TL/F/9928-3

Pin Assignment for LCC

TL/F/9928-4

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Functional Description

The 'AC/'ACT153 is a dual 4-input multiplexer. It can select two bits of data from up to four sources under the control of the common Select inputs (S_0, S_1). The two 4-input multiplexer circuits have individual active-LOW Enables ($\bar{E}_a$, $\bar{E}_b$) which can be used to strobe the outputs indepedently. When the Enables ($\bar{E}_a$, $\bar{E}_b$) are HIGH, the corresponding outputs Z_a, Z_b) are forced LOW. The 'AC/'ACT153 is the logic implementation of a 2-pole, 4-position switch, where the position of the switch is determined by the logic levels supplied to the Select inputs. The logic equations for the outputs are shown below.

$$Z_a = \bar{E}_a \cdot (I_{0a} \cdot \bar{S}_1 \cdot \bar{S}_0 + I_{1a} \cdot \bar{S}_1 \cdot S_0 + I_{2a} \cdot S_1 \cdot S_0 + I_{3a} \cdot S_1 \cdot S_0)$$
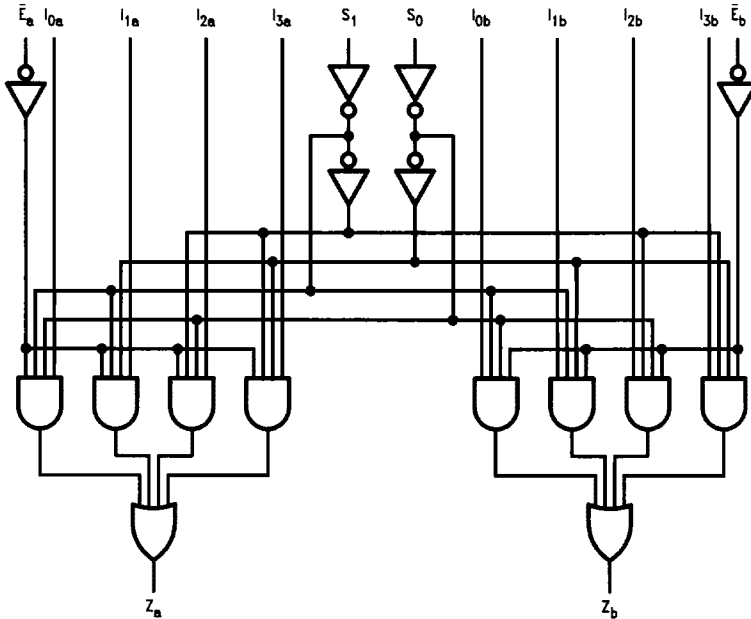
$$Z_b = \bar{E}_b \cdot (I_{0b} \cdot \bar{S}_1 \cdot \bar{S}_0 + I_{1b} \cdot \bar{S}_1 \cdot S_0 + I_{2b} \cdot S_1 \cdot S_0 + I_{3b} \cdot S_1 \cdot S_0)$$

Truth Table

Select Inputs		Inputs (a or b)					Output
S_0	S_1	$\bar{E}$	I_0	I_1	I_2	I_3	Z
X	X	H	X	X	X	X	L
L	L	L	L	X	X	X	L
L	L	L	H	X	X	X	H
H	L	L	X	L	X	X	L
H	L	L	X	H	X	X	H
L	H	L	X	X	L	X	L
L	H	L	X	X	H	X	H
H	H	L	X	X	X	L	L
H	H	L	X	X	X	H	H

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

Logic Diagram

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

TL/F/9928–5

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 $+150°C$
Junction Temperature (T_J)	
CDIP	175°C
PDIP	140°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.

Recommended Operating Conditions

Supply Voltage (V_{CC})	
'AC	2.0V to 6.0V
'ACT	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)	
74AC/ACT	$-40°C$ to $+85°C$
54AC/ACT	$-55°C$ to $+125°C$
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
'AC Devices	
V_{IN} from 30% to 70% of V_{CC}	
V_{CC} @ 3.3V, 4.5V, 5.5V	125 mV/ns
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
'ACT Devices	
V_{IN} from 0.8V to 2.0V	
V_{CC} @ 4.5V, 5.5V	125 mV/ns

DC Characteristics for 'AC Family Devices

Symbol	Parameter	V_{CC} (V)	74AC $T_A = +25°C$		54AC $T_A = -55°C$ to $+125°C$	74AC $T_A = -40°C$ to $+85°C$	Units	Conditions
			Typ	Guaranteed Limits				
V_{IH}	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	3.15	3.15	3.15		
		5.5	2.75	3.85	3.85	3.85		
V_{IL}	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	1.35	1.35	1.35		
		5.5	2.75	1.65	1.65	1.65		
V_{OH}	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	2.9	V	$I_{OUT} = -50\ \mu A$
		4.5	4.49	4.4	4.4	4.4		
		5.5	5.49	5.4	5.4	5.4		
		3.0		2.56	2.4	2.46	V	*$V_{IN} = V_{IL}$ or V_{IH} I_{OH} -12 mA
		4.5		3.86	3.7	3.76		-24 mA
		5.5		4.86	4.7	4.76		-24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	0.1	V	$I_{OUT} = 50\ \mu A$
		4.5	0.001	0.1	0.1	0.1		
		5.5	0.001	0.1	0.1	0.1		
		3.0		0.36	0.50	0.44	V	*$V_{IN} = V_{IL}$ or V_{IH} I_{OL} 12 mA
		4.5		0.36	0.50	0.44		24 mA
		5.5		0.36	0.50	0.44		24 mA
I_{IN}	Maximum Input Leakage Current	5.5		± 0.1	± 1.0	± 1.0	μA	$V_I = V_{CC}$, GND

*All outputs loaded; thresholds on input associated with output under test.

DC Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V_CC (V)	74AC T_A = +25°C		54AC T_A = −55°C to +125°C	74AC T_A = −40°C to +85°C	Units	Conditions
			Typ		Guaranteed Limits			
I_{OLD}	†Minimum Dynamic Output Current	5.5			50	75	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5			−50	−75	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5	4.0		80.0	40.0	μA	V_{IN} = V_{CC} or GND

†Maximum test duration 2.0 ms, one output loaded at a time.

Note: 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 54AC @ 25°C is identical to 74AC @ 25°C.

DC Characteristics for 'ACT Family Devices

Symbol	Parameter	V_CC (V)	74ACT T_A = +25°C		54ACT T_A = −55°C to +125°C	74ACT T_A = −40°C to +85°C	Units	Conditions
			Typ		Guaranteed Limits			
V_{IH}	Minimum High Level Input Voltage	4.5	1.5	2.0	2.0	2.0	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		5.5	1.5	2.0	2.0	2.0		
V_{IL}	Maximum Low Level Input Voltage	4.5	1.5	0.8	0.8	0.8	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		5.5	1.5	0.8	0.8	0.8		
V_{OH}	Minimum High Level Output Voltage	4.5	4.49	4.4	4.4	4.4	V	I_{OUT} = −50 μA
		5.5	5.49	5.4	5.4	5.4		
		4.5		3.86	3.70	3.76	V	*V_{IN} = V_{IL} or V_{IH} −24 mA
		5.5		4.86	4.70	4.76		I_{OH} −24 mA
V_{OL}	Maximum Low Level Output Voltage	4.5	0.001	0.1	0.1	0.1	V	I_{OUT} = 50 μA
		5.5	0.001	0.1	0.1	0.1		
		4.5		0.36	0.50	0.44	V	*V_{IN} = V_{IL} or V_{IH} 24 mA
		5.5		0.36	0.50	0.44		I_{OL} 24 mA
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	±1.0	μA	V_I = V_{CC}, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	0.6		1.6	1.5	mA	V_I = V_{CC} − 2.1V
I_{OLD}	†Minimum Dynamic Output Current	5.5			50	75	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5			−50	−75	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5	4.0		80.0	40.0	μA	V_{IN} = V_{CC} or GND

*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

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

AC Electrical Characteristics: See Section 2 for Waveforms

Symbol	Parameter	V_CC* (V)	74AC T_A = +25°C C_L = 50 pF			54AC T_A = −55°C to +125°C C_L = 50 pF		74AC T_A = −40°C to +85°C C_L = 50 pF		Units	Fig. No.
			Min	Typ	Max	Min	Max	Min	Max		
t_{PLH}	Propagation Delay S_n to Z_n	3.3	2.5	9.5	15.0	1.0	19.5	2.5	17.5	ns	2-3,4
		5.0	2.0	6.5	11.0	1.0	14.0	2.0	12.5		
t_{PHL}	Propagation Delay S_n to Z_n	3.3	3.0	8.5	14.5	1.0	18.0	2.5	16.5	ns	2-3,4
		5.0	2.5	6.5	11.0	1.0	13.5	2.0	12.0		
t_{PLH}	Propagation Delay $\bar{E}$ to Z_n	3.3	2.5	8.0	13.5	1.0	16.5	2.0	16.0	ns	2-3,4
		5.0	1.5	5.5	9.5	1.0	12.5	1.5	11.0		
t_{PHL}	Propagation Delay $\bar{E}$ to Z_n	3.3	2.5	7.0	11.0	1.0	14.0	2.0	12.5	ns	2-3,4
		5.0	2.0	5.0	8.0	1.0	10.0	1.5	9.0		
t_{PLH}	Propagation Delay I_n to Z_n	3.3	2.5	7.5	12.5	1.0	16.0	2.0	14.5	ns	2-3,4
		5.0	1.5	5.5	9.0	1.0	11.5	1.5	10.5		
t_{PHL}	Propagation Delay I_n to Z_n	3.3	1.5	7.0	11.5	1.0	14.5	1.5	13.0	ns	2-3,4
		5.0	1.5	5.0	8.5	1.0	10.5	1.5	10.0		

*Voltage Range 3.3 is 3.3V ±0.3V
Voltage Range 5.0 is 5.0V ±0.5V

AC Electrical Characteristics: See Section 2 for Waveforms

Symbol	Parameter	V_CC* (V)	74ACT T_A = +25°C C_L = 50 pF			54ACT T_A = −55°C to +125°C C_L = 50 pF		74ACT T_A = −40°C to +85°C C_L = 50 pF		Units	Fig. No.
			Min	Typ	Max	Min	Max	Min	Max		
t_{PLH}	Propagation Delay S_n to Z_n	5.0	3.0	7.0	11.5	1.0	15.0	2.0	13.5	ns	2-3,4
t_{PHL}	Propagation Delay S_n to Z_n	5.0	3.0	7.0	11.5	1.0	14.5	2.5	13.5	ns	2-3,4
t_{PLH}	Propagation Delay $\bar{E}_n$ to Z_n	5.0	2.0	6.5	10.5	1.0	13.5	2.0	12.5	ns	2-3,4
t_{PHL}	Propagation Delay $\bar{E}_n$ to Z_n	5.0	3.0	6.0	9.5	1.0	11.5	2.5	11.0	ns	2-3,4
t_{PLH}	Propagation Delay I_n to Z_n	5.0	2.5	5.5	9.5	1.0	12.5	2.0	11.0	ns	2-3,4
t_{PHL}	Propagation Delay I_n to Z_n	5.0	2.0	5.5	9.5	1.0	12.0	2.0	11.0	ns	2-3,4

*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	65.0	pF	V_{CC} = 5.0V

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