National Semiconductor

April 1993

54FCT138
1-of-8 Decoder/Demultiplexer

General Description

The 'FCT138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed bipolar memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three 'FCT138 devices or a 1-of-32 decoder using four 'FCT138 devices and one inverter.

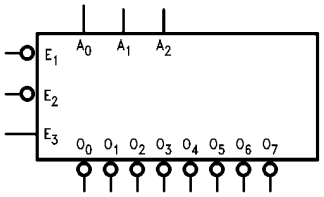
FACT™ FCT utilizes NSC quiet series technology to provide improved quiet output switching and dynamic threshold performance.

FACT FCT features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

Features

- NSC 54FCT138 is pin and functionally equivalent to IDT 54FCT138
- Demultiplexing capability
- Multiple input enable for easy expansion
- Active LOW mutually exclusive outputs
- Input clamp diodes to limit bus reflections
- TTL/CMOS input and output level compatible
- 32 mA (Mil)
- CMOS power levels
- ESD immunity ≥ 4 kV typ
- Military Product compliant to MIL-STD 883 and Standard Military Drawing #5962-87654

Logic Symbols



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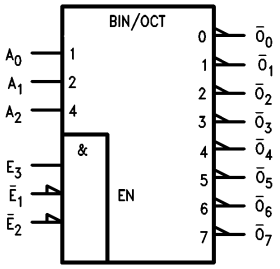
IEEE/IEC



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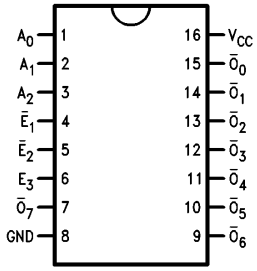
Connection Diagrams

Pin Assignment for DIP and Flatpak



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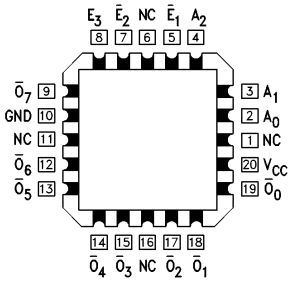
Pin Assignment for LCC



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Pin Names	Description
A_0–A_2	Address Inputs
$\overline{E}_1$–$\overline{E}_2$	Enable Inputs
E_3	Enable Input
$\overline{O}_0$–$\overline{O}_7$	Outputs

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RRD-B30M105/Printed in U. S. A.

Functional Description

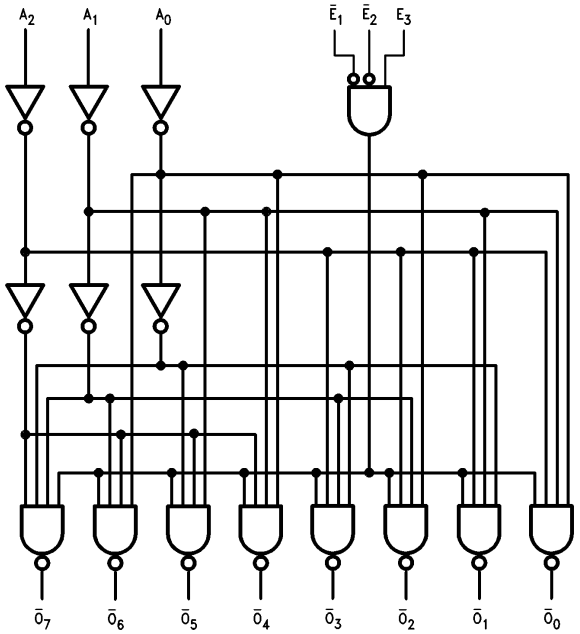
The 'FCT138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs (A_0, A_1, A_2) and, when enabled, provides eight mutually exclusive active-LOW outputs ($\overline{O}_0$–$\overline{O}_7$). The 'FCT138 features three Enable inputs, two active-LOW ($\overline{E}_1$, $\overline{E}_2$) and one active-HIGH (E_3). All outputs will be HIGH unless $\overline{E}_1$ and $\overline{E}_2$ are LOW and E_3 is HIGH. This multiple enable function allows easy parallel expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four 'FCT138 devices and one inverter (see *Figure 1*). The 'FCT138 can be used as an 8-output demultiplexer by using one of the active LOW Enable inputs as the data input and the other Enable inputs as strobes. The Enable inputs which are not used must be permanently tied to their appropriate active-HIGH or active-LOW state.

Truth Table

Inputs						Outputs							
$\overline{E}_1$	$\overline{E}_2$	E_3	A_0	A_1	A_2	$\overline{O}_0$	$\overline{O}_1$	$\overline{O}_2$	$\overline{O}_3$	$\overline{O}_4$	$\overline{O}_5$	$\overline{O}_6$	$\overline{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

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

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.

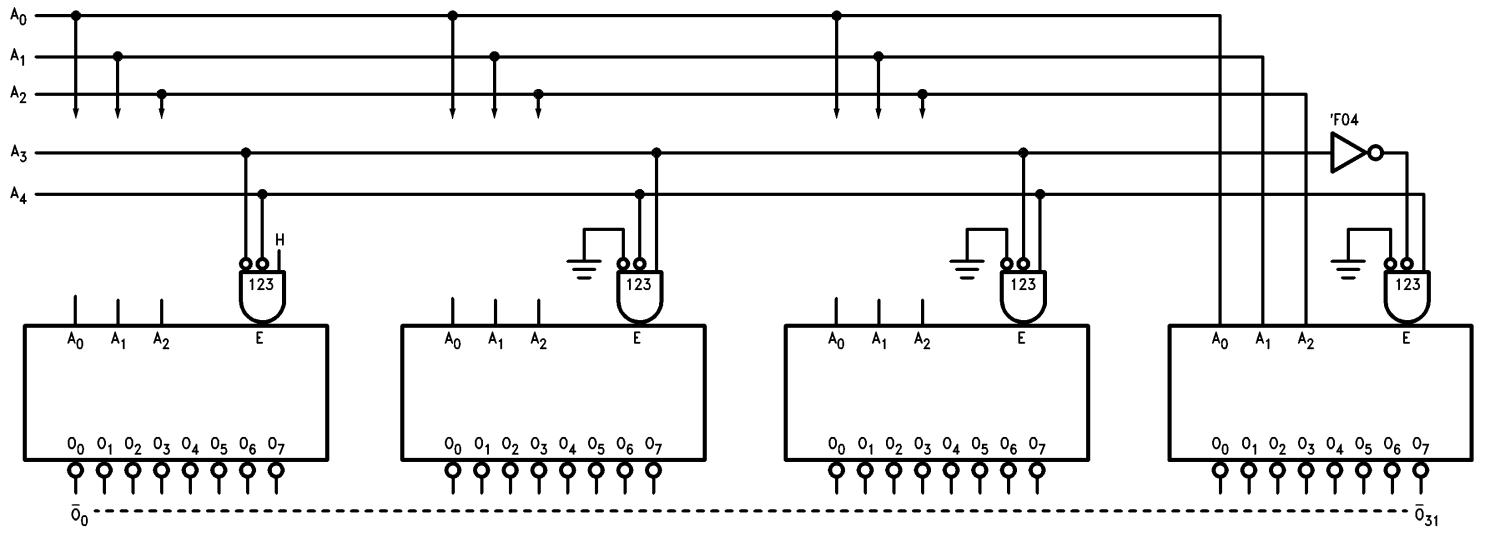


FIGURE 1. Expansion to 1-of-32 Decoding

Absolute Maximum Rating (Note 1)

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

Terminal Voltage with Respect to GND (V_{TERM})
54FCT −0.5V to 7.0V

Temperature under Biad (T_{BIAS})
54FCT −65°C to +135°C

Storage Temperature (T_{STG})
54FCT −65° to +150°C

Power Dissipation (P_T) 0.5W

DC Output Current (I_{OUT}) 120 mA

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})
54FCT 4.5V to 5.5V

Input Voltage 0V to V_{CC}

Output Voltage 0V to V_{CC}

Operating Temperature (T_A)
54FCT −55°C to +125°C

Junction Temperature (T_A)
CDIP 175°C

DC Characteristics for 'FCT Family Devices

Symbol	Parameter	V_{CC} (V)	54FCT 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} = 0.2V or V_{CC} − 0.2V
V_{IL}	Maximum Low Level Input Voltage	4.5 5.5	0.8 0.8	V	V_{OUT} = 0.2V or V_{CC} − 0.2V
V_{OH}	Minimum High Level Output Voltage	4.5	4.3	V	I_{OUT} = −300 μA
		4.5	2.40	V	*V_{IN} = V_{IL} or V_{IH} I_{OH} −12 mA
V_{OL}	Maximum Low Level Output Voltage	4.5	0.2	V	I_{OUT} = 300 μA
		4.5	0.50	V	*V_{IN} = V_{IL} or V_{IH} I_{OL} 32 mA
I_{IN}	Maximum Input Leakage Current	5.5	±5.0	μA	V_I = V_{CC}, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	2.0	mA	V_I = V_{CC} − 2.1V
I_{OLD}	†Minimum Dynamic Output Current	5.5	57	mA	V_{OLD} = 1.1V Max
I_{OHD}		5.5	−50	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5	1.5	mA	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.

AC Electrical Characteristics

Symbol	Parameter	V_{CC}* (V)	54FCT $T_A = -55°C$ to $+125°C$ $C_L = 50$ pF		Units
			Min	Max	
t_{PLH}	Propagation Delay A_n to $\overline{O}_n$	5.0	1.5	12.0	ns
t_{PHL}	Propagation Delay A_n to $\overline{O}_n$	5.0	1.5	12.0	ns
t_{PLH}	Propagation Delay $\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$	5.0	1.5	12.5	ns
t_{PHL}	Propagation Delay $\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$	5.0	1.5	12.5	ns
t_{PLH}	Propagation Delay E_3 to $\overline{O}_n$	5.0	1.5	12.5	ns
t_{PHL}	Propagation Delay E_3 to $\overline{O}_n$	5.0	1.5	12.5	ns

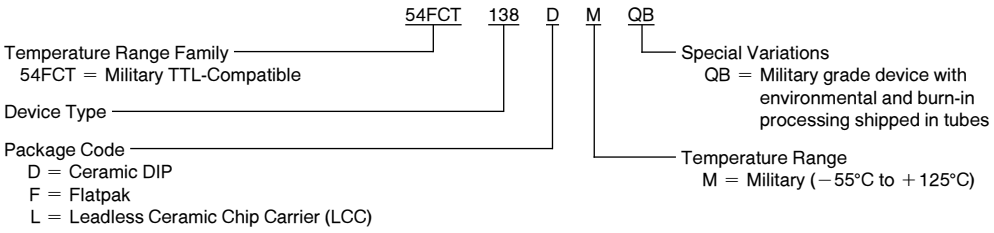
*Voltage Range 5.0 is 5.0V ±0.5V

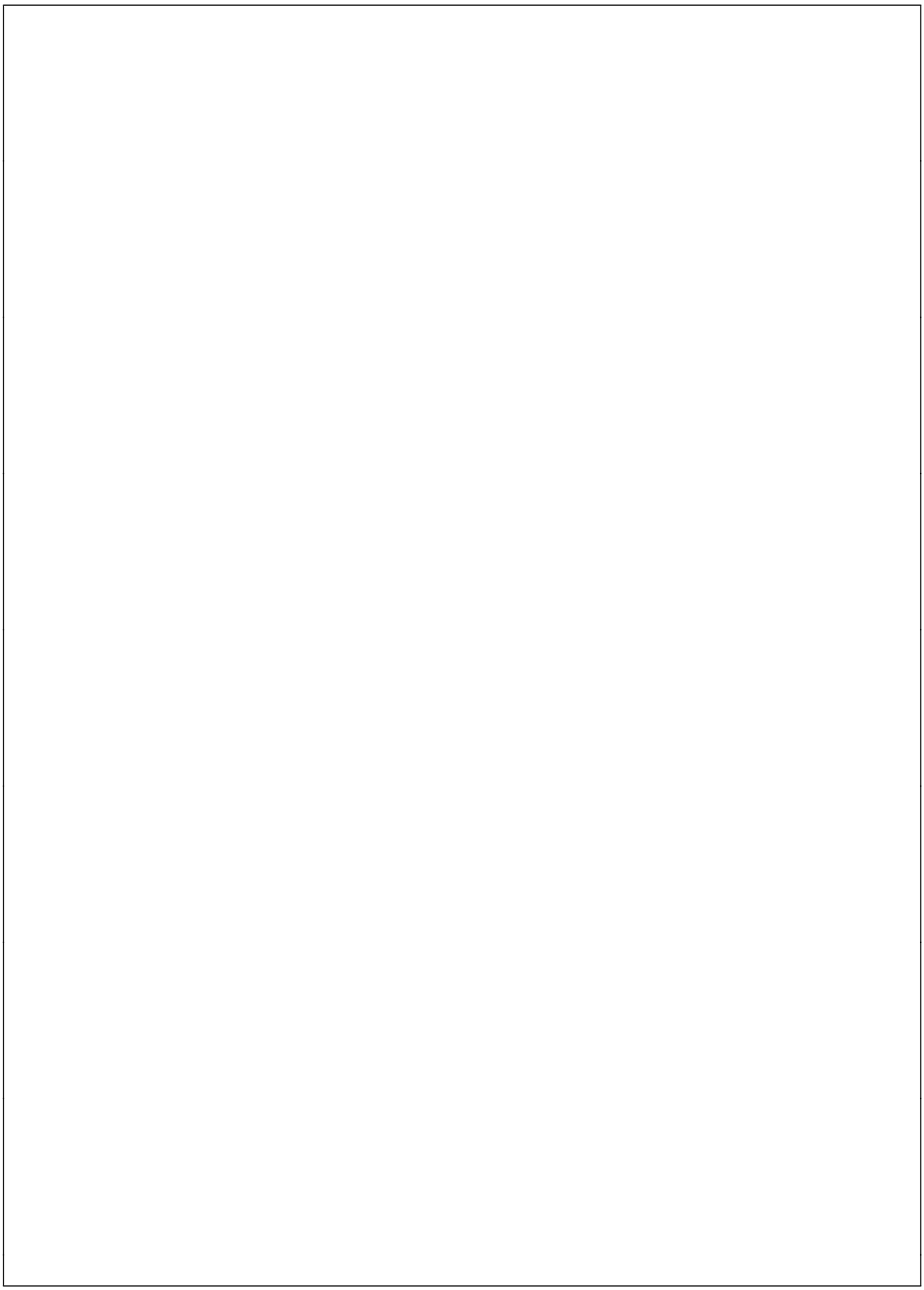
Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = OPEN
C_{PD}	Power Dissipation Capacitance	60.0	pF	V_{CC} = 5.0V

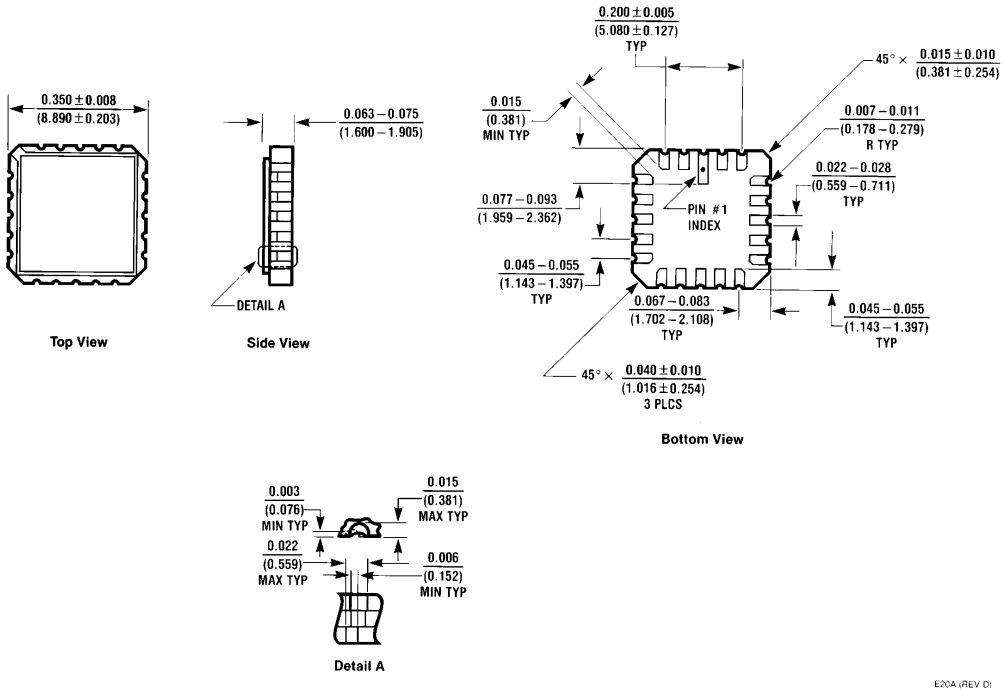
Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:

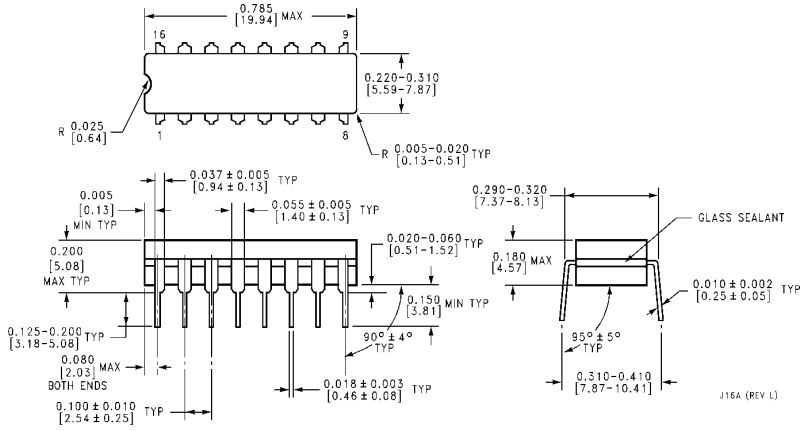




Physical Dimensions inches (millimeters)

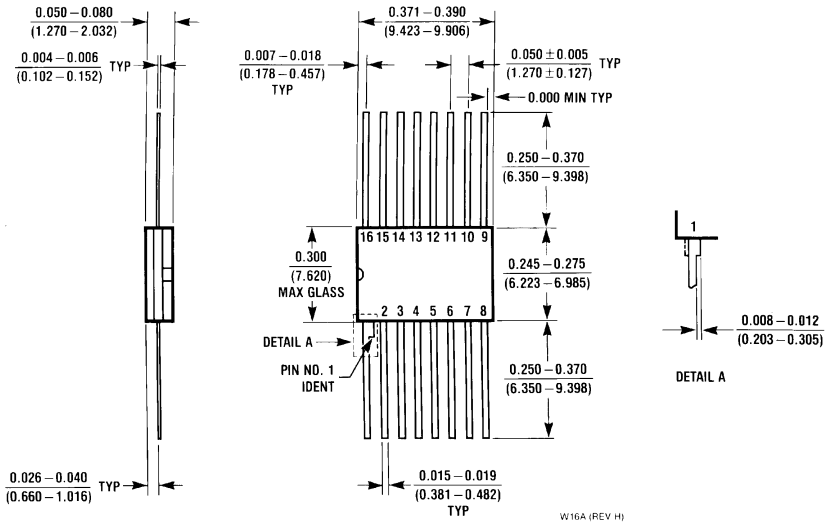


20-Terminal Ceramic Leadless Chip Carrier (L)
NS Package Number E20A



16-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J16A

Physical Dimensions inches (millimeters) (Continued)



16-Lead Ceramic Flatpak (F)
NS Package Number W16A

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