

P54/74FCT138/A/C (P54/74PCT138/A/C)

HIGH SPEED 1-OF-8 DECODER

FEATURES

- Function, Pinout, and Drive Compatible with the FCT and F Logic
- FCT-C speed at 4.7ns max. (Com'I)
FCT-A speed at 5.8ns max. (Com'I)
- CMOS V_{OH} Levels for Low Power Consumption
— Typically 1/3 of FAST Bipolar Logic
- Edge-rate Control Circuitry for Significantly Improved Noise Characteristics
- ESD protection exceeds 2000V
- Inputs and Outputs Interface Directly with TTL, NMOS, and CMOS Devices
- Outputs Meet Levels Required for CMOS Static RAM Low Power Standby Mode
- 64 mA Sink Current (Com'I), 48 mA (MII)
15 mA Source Current (Com'I), 12 mA (MII)
- Dual 1-of-8 Decoder with Enables
- Manufactured In 0.8 micron PACE Technology™

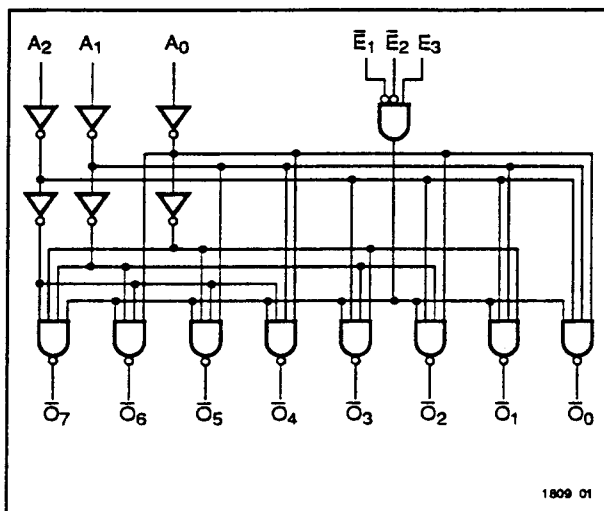
DESCRIPTION

The 'FCT138 are 1-of-8 decoders. The 'FCT138 accepts three binary-weighted inputs (A_0, A_1, A_2) and, when enabled, provide eight mutually exclusive active LOW outputs ($\bar{O}_0 - \bar{O}_7$). The 'FCT138 features three enable inputs, two active LOW ($\bar{E}_1, \bar{E}_2$) and one active HIGH (E_3). All outputs will be HIGH unless $\bar{E}_1$ and $\bar{E}_2$ 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.

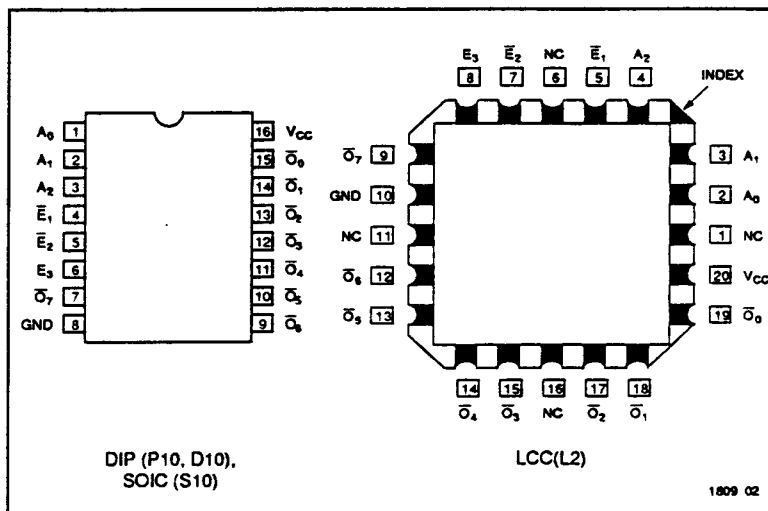
The 'FCT138 is manufactured using PACE Technology™ which is Performance Advanced CMOS Engineered to use 0.8 micron effective channel lengths giving 500 picoseconds loaded* internal gate delays. PACE Technology includes two-level metal and epitaxial substrates. In addition to very high performance and very high density, the technology features latch-up protection, single event upset protection, and is supported by a Class 1 environment volume production facility.

*For a fan-in/fan-out of 4, at 85°C junction temperature and 5.0V.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATIONS



ABSOLUTE MAXIMUM RATINGS^{1,2}

Symbol	Parameter	Value	Unit
T_{STG}	Storage Temperature	-65 to +150	°C
T_A	Ambient Temperature Under Bias	-65 to +135	°C
V_{CC}	V_{CC} Potential to Ground	-0.5 to +7.0	V
I_{IN}	Input Current	-30 to +5.0	mA

Notes:

1809 Tbl 01

1. Operation beyond the limits set forth in the above table may impair the useful life of the device. Unless otherwise noted, these limits are over the operating free-air temperature range.

Symbol	Parameter	Value	Unit
I_{OUTPUT}	Current Applied to Output	120	mA
V_{IN}	Input Voltage	-0.5 to $V_{CC} + 0.5$	V
V_{OUT}	Voltage Applied to Output	-0.5 to $V_{CC} + 0.5$	V

1809 Tbl 02

2. Unused inputs must always be connected to an appropriate logic voltage level, preferably either V_{CC} or ground.

RECOMMENDED OPERATING CONDITIONS

Free Air Ambient Temperature	Min	Max
Military	-55°C	+125°C
Commercial	0°C	+70°C

1809 Tbl 03

Supply Voltage (V_{CC})	Min	Max
Military	+4.5V	+5.5V
Commercial	+4.75V	+5.25V

1809 Tbl 04

DC ELECTRICAL CHARACTERISTICS (Over recommended operating conditions)

Symbol	Parameter	Min	Typ ¹	Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage	2.0		$V_{CC} + 0.5$	V		
V_{IL}	Input LOW Voltage	-0.5		0.8	V		
V_H	Hysteresis		0.35		V		All inputs
V_{CD}	Input Clamp Diode Voltage		-0.7	-1.2	V	MIN	$I_{IN} = -18mA$
V_{OH}	Output HIGH Voltage	$V_{CC} = 3V, V_{IN} = 0.2V, \text{ or } V_{CC} - 0.2V$		$V_{CC} - 0.2$	V_{CC}	V	$I_{OH} = -32\mu A$
		Military/Commercial (CMOS)		$V_{CC} - 0.2$	V_{CC}	V	$I_{OH} = -300\mu A$
		Military (TTL)		2.4	4.3	V	$I_{OH} = -12mA$
		Commercial (TTL)		2.4	4.3	V	$I_{OH} = -15mA$
V_{OL}	Output LOW Voltage	$V_{CC} = 3V, V_{IN} = 0.2V, \text{ or } V_{CC} - 0.2V$		GND	0.2	V	$I_{OL} = 300\mu A$
		Military/Commercial (CMOS) ³		GND	0.2	V	$I_{OL} = 300\mu A$
		Military (TTL)		0.3	0.5	V	$I_{OL} = 32mA$
		Commercial (TTL)		0.3	0.5	V	$I_{OL} = 48mA$
		Commercial (TTL)		0.3	0.5	V	$I_{OL} = 64mA$
I_{IH}	Input HIGH Current			5	μA	MAX	$V_{IN} = V_{CC}$
I_{IL}	Input LOW Current			-5	μA	MAX	$V_{IN} = GND$
I_{IH}	Input HIGH Current ³			5	μA	MAX	$V_{OUT} = 2.7V$
I_{IL}	Input LOW Current ³			-5	μA	MAX	$V_{OUT} = 0.5V$
I_{OS}	Output Short Circuit Current ²	-60	-120		mA	MAX	$V_{OUT} = 0.0V$
C_{IN}	Input Capacitance ³		5	10	pF		All inputs
C_{OUT}	Output Capacitance ³		9	12	pF		All outputs

Notes:

1809 Tbl 05

1. Typical limits are at $V_{CC} = 5.0V, T_A = +25^\circ C$ ambient.
 2. Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high speed test apparatus and/or sample and hold techniques are preferable in order to minimize internal chip heating and more accurately reflect

operational values. Otherwise prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, I_{OS} tests should be performed last.

3. This parameter is guaranteed but not tested.

DC CHARACTERISTICS (Over recommended operating conditions unless otherwise specified.)

Symbol	Parameter	Typ ¹	Max	Units	Conditions
I_{CC}	Quiescent Power Supply Current (CMOS inputs)	0.003	0.5	mA	$V_{CC} = \text{MAX}$, $f_1 = 0$, Outputs Open, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$
ΔI_{CC}	Quiescent Power Supply Current (TTL inputs)	0.5	2.0	mA	$V_{CC} = \text{MAX}$, $V_{IN} = 3.4V^2$, $f_1 = 0$, Outputs Open
I_{CCD}	Dynamic Power Supply Current ³	0.15	0.3	mA/ mHz	$V_{CC} = \text{MAX}$, One Input Toggling, 50% Duty Cycle, Outputs Open, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$
I_C	Total Power Supply Current ⁵	1.7	4.5	mA	$V_{CC} = \text{MAX}$, $f_1 = 10\text{MHz}$, 50% Duty Cycle, Outputs Open, One Input Toggling, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$
		2.0	5.5	mA	$V_{CC} = \text{MAX}$, $f_1 = 10\text{MHz}$, 50% Duty Cycle, Outputs Open, One Input Toggling, $V_{IN} = 3.4V$ or $V_{IN} = \text{GND}$

Notes:

- Typical values are at $V_{CC} = 5.0V$, $+25^\circ\text{C}$ ambient and maximum loading.
- Per TTL driven input ($V_{IN} = 3.4V$); all other inputs at V_{CC} or GND.
- This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
- Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
- $I_C = I_{\text{QUIESCENT}} + I_{\text{INPUTS}} + I_{\text{DYNAMIC}}$
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD}(f_o/2 + f_1 N_1)$
 ΔI_{CC} = Quiescent Current with CMOS input levels

ΔI_{CC} = Power Supply Current for a TTL High Input
($V_{IN} = 3.4V$)

D_H = Duty Cycle for TTL Inputs High

N_T = Number of TTL Inputs at D_H

I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)

f_o = Clock Frequency for Register Devices (Zero for Non-Register Devices)

f_1 = Output Frequency

N_1 = Number of Inputs at f_1

All currents are in milliamps and all frequencies are in megahertz.

1809 TMI 06

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	H	H	H	H	H	H	L	H	H	H
L	L	H	L	H	H	H	H	H	H	H	L	H	H
L	L	H	H	H	H	H	H	H	H	H	H	L	L

H = HIGH Voltage Level, L=LOW Voltage Level, X=Don't Care

1809 TMI 07

AC CHARACTERISTICS

Sym	Parameter	'FCT138				'FCT138A				'FCT138C				Units	Fig. No.
		MIL		COM'L		MIL		COM'L		MIL		COM'L			
		Min. ¹	Max.	Min. ¹	Max.	Min. ¹	Max.	Min. ¹	Max.	Min. ¹	Max.	Min. ¹	Max.		
t_{PLH} t_{PHL}	Prop Delay A_0 to $\overline{O}_n$	1.5	12.0	1.5	9.0	1.5	7.8	1.5	5.8	1.5	6.0	1.5	4.7	ns	1, 5
t_{PLH} t_{PHL}	Prop Delay $\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$	1.5	12.5	1.5	9.0	1.5	8.0	1.5	5.9	1.5	6.5	1.5	5.0	ns	1, 5
t_{PLH} t_{PHL}	Prop Delay E_3 to $\overline{O}_n$	1.5	12.5	1.5	9.0	1.5	8.0	1.5	5.9	1.5	6.5	1.5	5.0	ns	1, 5

1809 Tbl 06

Notes:

1. Minimum limits are guaranteed but not tested on Propagation Delays.
2. With one data channel toggling, $t_w(L) = t_w(H) = 2.0ns$ and $t_i = t_f = 1.0ns$

DEFINITION OF FUNCTIONAL TERMS

PIN Names	Description
$A_0 - A_2$	Address Inputs
$\bar{E}_1 - \bar{E}_2$	Enable Inputs (Active LOW)
E_3	Enable Input (Active HIGH)
$\bar{O}_0 - \bar{O}_7$	Outputs (Active LOW)

1809 Tbl 09

ORDERING INFORMATION

PxxFCT Temp. Class	xxxx Device type	xx Package	x Processing	
				Blank M MB
				P D SO L
				138 138A 138C
				74 54
				Commercial Military Temperature MIL-STD-883, Class B Plastic DIP CERDIP Small Outline IC Leadless Chip Carrier 1 of 8 Decoder Fast 1 of 8 Decoder Very Fast 1 of 8 Decoder Commercial Military

1809 03

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