MC74HCT138A

1-of-8 Decoder/ Demultiplexer with LSTTL Compatible Inputs

High−Performance Silicon−Gate CMOS

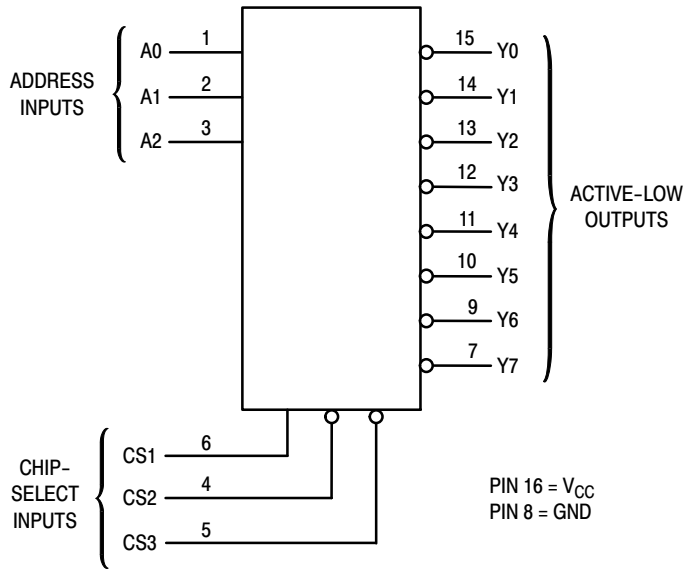
The MC74HCT138A is identical in pinout to the LS138. The HCT138A may be used as a level converter for interfacing TTL or NMOS outputs to High Speed CMOS inputs.

The HCT138A decodes a three−bit Address to one−of−eight active−lot outputs. This device features three Chip Select inputs, two active−low and one active−high to facilitate the demultiplexing, cascading, and chip−selecting functions. The demultiplexing function is accomplished by using the Address inputs to select the desired device output; one of the Chip Selects is used as a data input while the other Chip Selects are held in their active states.

Features

- Output Drive Capability: 10 LSTTL Loads
- TTL/NMOS Compatible Input Levels
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 4.5 to 5.5 V
- Low Input Current: 1.0 μA
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 122 FETs or 30.5 Equivalent Gates
- These are Pb−Free Devices

LOGIC DIAGRAM



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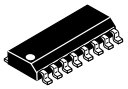
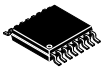
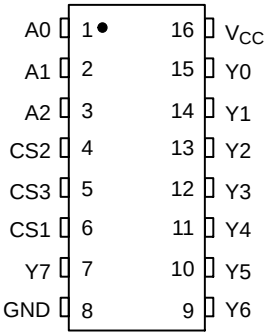


SOIC−16
D SUFFIX
CASE 751B



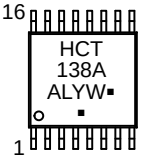
TSSOP−16
DT SUFFIX
CASE 948F

PIN ASSIGNMENT



MARKING DIAGRAMS

SOIC−16



TSSOP−16

A	=	Assembly Location
WL, L	=	Wafer Lot
YY, Y	=	Year
WW, W	=	Work Week
G or ▪	=	Pb−Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

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Design Criteria	Value	Units
Internal Gate Count*	30.5	ea.
Internal Gate Propagation Delay	1.5	ns
Internal Gate Power Dissipation	5.0	μW
Speed Power Product	.0075	pJ

*Equivalent to a two−input NAND gate.

FUNCTION TABLE

Inputs						Outputs							
CS1	**CS2**	**CS3**	**A2**	**A1**	**A0**	**Y0**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**
X	X	H	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
L	X	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	L	H	H	H	H	H	L	H	H	H	H
H	L	L	H	L	L	H	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	H	L	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

H = high level (steady state)
L = low level (steady state)
X = don't care

MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	–0.5 to +7.0	V
V_{in}	DC Input Voltage (Referenced to GND)	–0.5 to V_{CC} + 0.5	V
V_{out}	DC Output Voltage (Referenced to GND)	–0.5 to V_{CC} + 0.5	V
I_{in}	DC Input Current, per Pin	±20	mA
I_{out}	DC Output Current, per Pin	±25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	±50	mA
P_D	Power Dissipation in Still Air SOIC Package†	500	mW
	TSSOP Package†	450	
T_{stg}	Storage Temperature	–65 to +150	°C
T_L	Lead Temperature, 1 mm from Case for 10 Seconds (TSSOP or SOIC Package)	260	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
†Derating: SOIC Package: –7 mW/°C from 65° to 125°C
TSSOP Package: −6.1 mW/°C from 65° to 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high−impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range GND ≤ (V_{in} or V_{out}) ≤ V_{CC}.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	4.5	5.5	V
V_{in}, V_{out}	DC Input Voltage, Output Voltage (Referenced to GND)	0	V_{CC}	V
T_A	Operating Temperature, All Package Types	–55	+125	°C
t_r, t_f	Input Rise and Fall Time (Figure 1)	0	500	ns

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V_{CC} V	Guaranteed Limit			Unit
				–55 to 25°C	≤ 85°C	≤ 125°C	
V_{IH}	Minimum High−Level Input Voltage	V_{out} = 0.1 V or V_{CC} – 0.1 V $\|I_{out}\| \le 20$ μA	4.5 5.5	2.0 2.0	2.0 2.0	2.0 2.0	V
V_{IL}	Maximum Low−Level Input Voltage	V_{out} = 0.1 V or V_{CC} – 0.1 V $\|I_{out}\| \le 20$ μA	4.5 5.5	0.8 0.8	0.8 0.8	0.8 0.8	V
V_{OH}	Minimum High−Level Output Voltage	V_{in} = V_{IH} or V_{IL} $\|I_{out}\| \le 20$ μA	4.5 5.5	4.4 5.4	4.4 5.4	4.4 5.4	V
		V_{in} = V_{IH} or V_{IL} $\|I_{out}\| \le 4.0$ mA	4.5	3.98	3.84	3.7	
V_{OL}	Maximum Low−Level Output Voltage	V_{in} = V_{IH} or V_{IL} $\|I_{out}\| \le 20$ μA	4.5 5.5	0.1 0.1	0.1 0.1	0.1 0.1	V
		V_{in} = V_{IH} or V_{IL} $\|I_{out}\| \le 4.0$ mA	4.5	0.26	0.33	0.4	
I_{in}	Maximum Input Leakage Current	V_{in} = V_{CC} or GND	6.0	±0.1	±1.0	±1.0	μA
I_{CC}	Maximum Quiescent Supply Current (per Package)	V_{in} = V_{CC} or GND I_{out} = 0 μA	5.5	4.0	40	160	μA
ΔI_{CC}	Additional Quiescent Supply Current	V_{in} = 2.4 V, Any One Input V_{in} = V_{CC} or GND, Other Inputs I_{out} = 0 μA	5.5	≥ –55°C 2.9	25°C to 125°C 2.4		mA

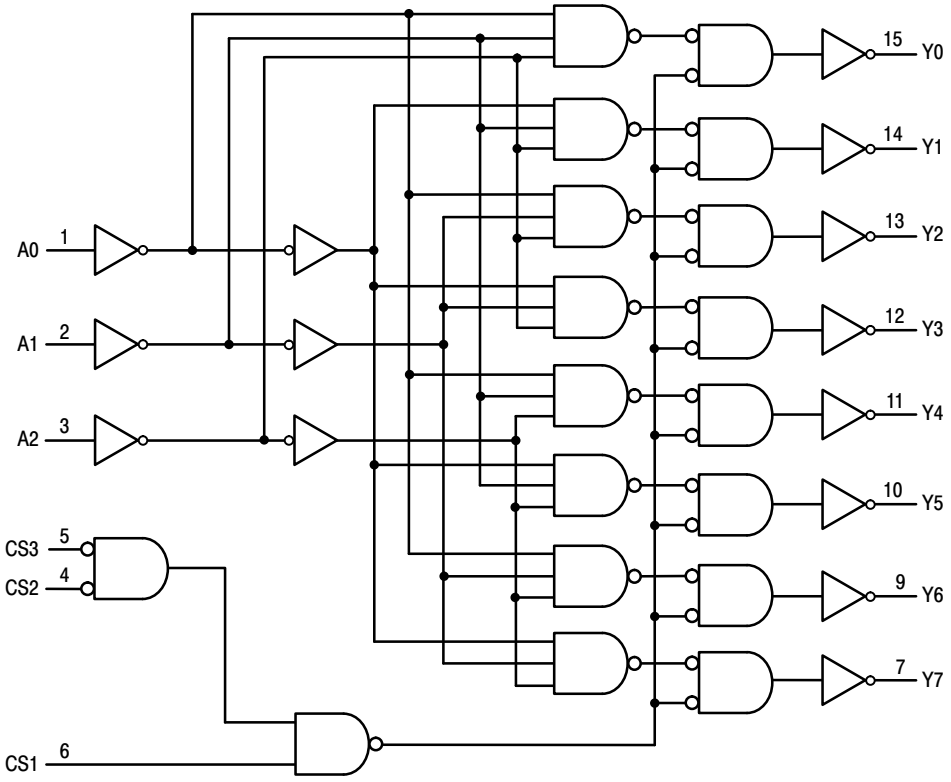
AC ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 V ±10%, C_L = 50 pF, Input t_r = t_f = 6.0 ns)

Symbol	Parameter	Guaranteed Limit			Unit
		–55 to 25°C	≤ 85°C	≤ 125°C	
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Input A to Output Y (Figures 1 and 4)	30	38	45	ns
t_{PLH}, t_{PHL}	Maximum Propagation Delay, CS1 to Output Y (Figures 2 and 4)	27	34	41	ns
t_{PLH}, t_{PHL}	Maximum Output Transition Time, CS2 or CS3 to Output Y (Figures 3 and 4)	30	38	45	ns
t_{TLH}, t_{THL}	Maximum Output Transition Time, Any Output (Figures 2 and 4)	15	19	22	ns
t_r, t_f	Maximum Input Rise and Fall Time	500	500	500	ns
C_{in}	Maximum Input Capacitance	10	10	10	pF

		Typical @ 25°C, V_{CC} = 5.0 V	
C_{PD}	Power Dissipation Capacitance (Per Enabled Output)*	51	pF

* Used to determine the no−load dynamic power consumption: $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$.

EXPANDED LOGIC DIAGRAM



SWITCHING WAVEFORMS

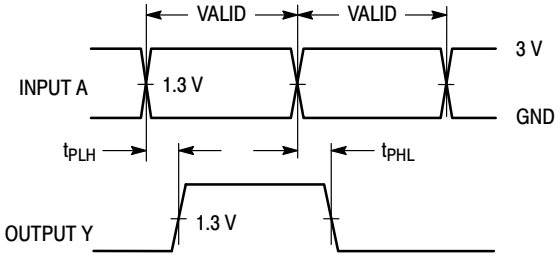


Figure 1.

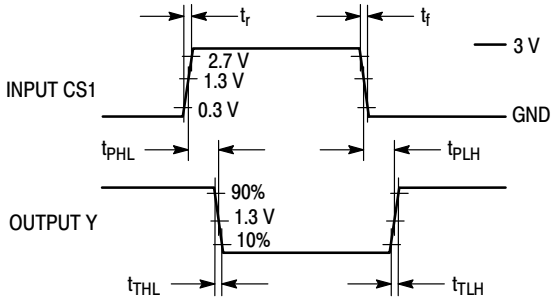


Figure 2.

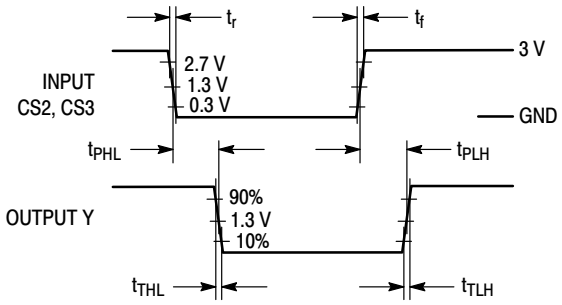
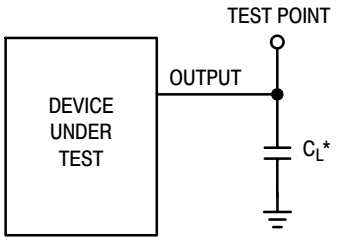


Figure 3.

TEST CIRCUIT



*Includes all probe and jig capacitance

Figure 4.

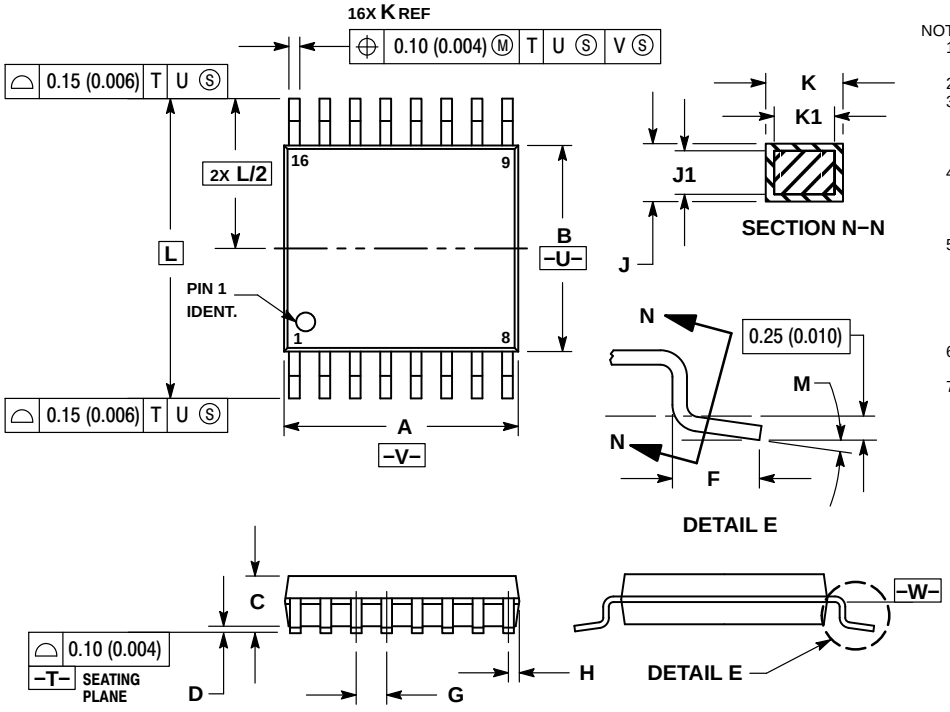
ORDERING INFORMATION

Device	Package	Shipping†
MC74HCT138ADG	SOIC−16 (Pb−Free)	48 Units / Rail
MC74HCT138ADR2G	SOIC−16 (Pb−Free)	2500 Units / Tape & Reel
MC74HCT138ADTR2G	TSSOP−16 (Pb−Free)	2500 Units / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PACKAGE DIMENSIONS

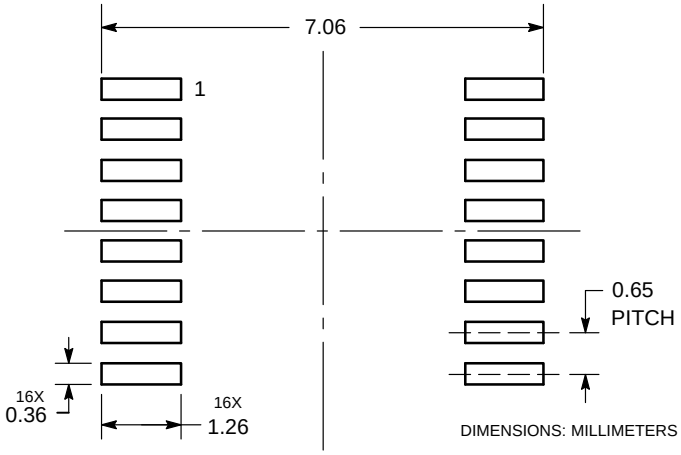
TSSOP−16
CASE 948F
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	1.20	−−−	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0 °	8 °	0 °	8 °

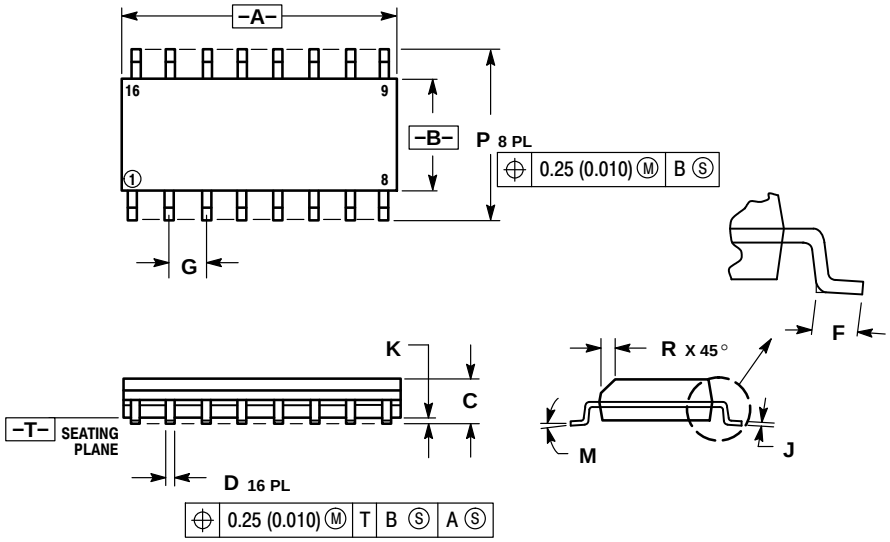
SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

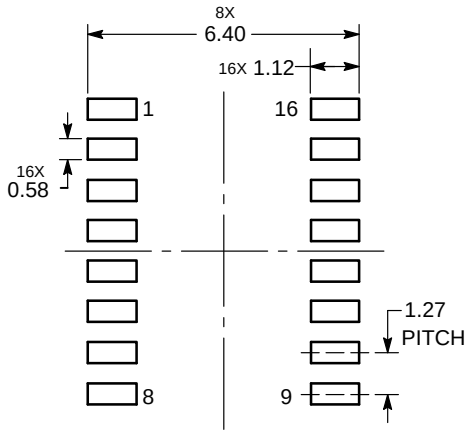
SOIC−16
CASE 751B−05
ISSUE K



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

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