SDFS051B - MARCH 1987 - REVISED JULY 1996

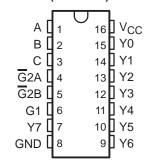
- Designed Specifically for High-Speed Memory Decoders and Data Transmission Systems
- Incorporates Three Enable Inputs to Simplify Cascading and/or Data Reception
- Package Options Include Plastic Small-Outline Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs

#### description

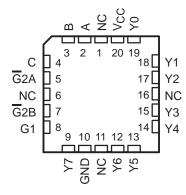
The 'F138 is designed to be used in high-performance memory-decoding or datarouting applications requiring very short propagation delay times. In high-performance memory systems, these decoders can be used to minimize the effects of system decoding. When employed with high-speed memories utilizing a fast enable circuit, the delay times of this decoder and the enable time of the memory are usually less than the typical access time of the memory. This means that the effective system delay introduced by the decoder is negligible.

The conditions at the binary-select inputs and the three enable inputs select one of eight output lines. Two active-low and one active-high enable inputs reduce the need for external gates or inverters when expanding. A 24-line decoder can

SN54F138 . . . J PACKAGE SN74F138 . . . D OR N PACKAGE (TOP VIEW)



SN54F138 . . . FK PACKAGE (TOP VIEW)



NC - No internal connection

be implemented without external inverters and a 32-line decoder requires only one inverter. An enable input can be used as a data input for demultiplexing applications.

The SN54F138 is characterized for operation over the full military temperature range of  $-55^{\circ}$ C to  $125^{\circ}$ C. The SN74F138 is characterized for operation from  $0^{\circ}$ C to  $70^{\circ}$ C.



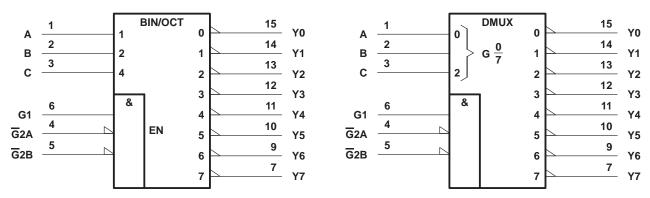
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



#### **FUNCTION TABLE**

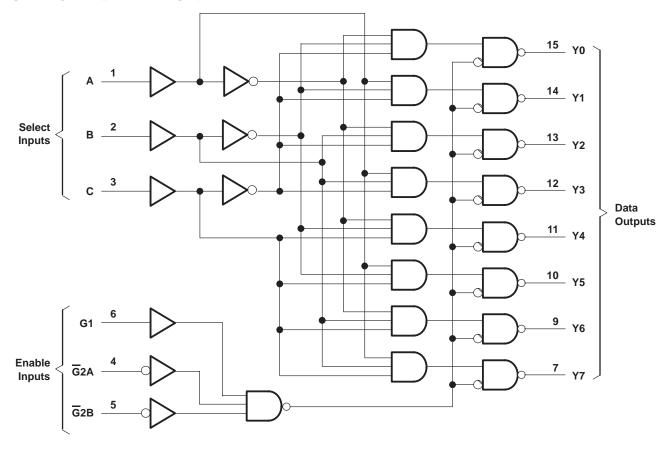
ENA	BLE INF	PUTS	SEL	ECT INP	UTS				OUTI	PUTS			
G1	G2A	G <sub>2</sub> B	С	В	Α	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
Х	Н	Χ	Х	Χ	Χ	Н	Н	Н	Н	Н	Н	Н	Н
X	X	Н	Х	X	X	Н	Н	Н	Н	Н	Н	Н	Н
L	X	Χ	Х	Χ	Χ	Н	Н	Н	Н	Н	Н	Н	Н
Н	L	L	L	L	L	L	Н	Н	Н	Н	Н	Н	Н
Н	L	L	L	L	Н	Н	L	Н	Н	Н	Н	Н	Н
Н	L	L	L	Н	L	Н	Н	L	Н	Н	Н	Н	Н
Н	L	L	L	Н	Н	Н	Н	Н	L	Н	Н	Н	Н
Н	L	L	Н	L	L	Н	Н	Н	Н	L	Н	Н	Н
Н	L	L	Н	L	Н	Н	Н	Н	Н	Н	L	Н	Н
Н	L	L	Н	Н	L	Н	Н	Н	Н	Н	Н	L	Н
Н	L	L	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	L

# logic symbols (alternatives)†



<sup>&</sup>lt;sup>†</sup> These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

# logic diagram (positive logic)



Pin numbers shown are for the D, J, and N packages.

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#### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage range, V <sub>CC</sub>	$-0.5\;V$ to 7 $V$
Input voltage range, V <sub>I</sub> (see Note 1)	$-1.2\;V$ to 7 $V$
Input current range	$-30 \text{ mA}$ to $5 \text{ mA}$
Voltage range applied to any output in the high state	$\dots$ -0.5 V to V <sub>CC</sub>
Current into any output in the low state	40 mA
Operating free-air temperature range: SN54F138	$-55^{\circ}$ C to $125^{\circ}$ C
SN74F138	$0^{\circ}C$ to $70^{\circ}C$
Storage temperature range	−65°C to 150°C

<sup>†</sup> Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The input voltage ratings may be exceeded provided the input current ratings are observed.

#### recommended operating conditions

		s	N54F138	N54F138 SN74F138			3	UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	UNII
Vсс	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
VIH	High-level input voltage	2			2			V
VIL	Low-level input voltage			8.0			0.8	V
liK	Input clamp current			-18			-18	mA
IOH	High-level output current			<b>–</b> 1			-1	mA
loL	Low-level output current			20			20	mA
TA	Operating free-air temperature	-55		125	0		70	°C

#### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEG	ST CONDITIONS	S	N54F13	3	S	N74F138	3	UNIT
PARAMETER	les les	ST CONDITIONS	MIN	TYP‡	MAX	MIN	TYP‡	MAX	UNII
VIK	$V_{CC} = 4.5 \text{ V},$	$I_{I} = -18 \text{ mA}$			-1.2			-1.2	V
Vou	$V_{CC} = 4.5 \text{ V},$	$I_{OH} = -1 \text{ mA}$	2.5	3.4		2.5	3.4		V
VOH	$V_{CC} = 4.75 \text{ V},$	I <sub>OH</sub> = – 1 mA				2.7			٧
VOL	$V_{CC} = 4.5 \text{ V},$	$I_{OL} = 20 \text{ mA}$		0.3	0.5		0.3	0.5	V
lį	$V_{CC} = 5.5 \text{ V},$	V <sub>I</sub> = 7 V			0.1			0.1	mA
lіН	$V_{CC} = 5.5 \text{ V},$	V <sub>I</sub> = 2.7 V			20			20	μΑ
I <sub>Ι</sub> L	V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 0.5 V			- 0.6			- 0.6	mA
I <sub>OS</sub> §	V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 0	-60		-150	-60		-150	mA
ICC	V <sub>CC</sub> = 5.5 V,	See Note 2		13	20		13	20	mA

<sup>&</sup>lt;sup>‡</sup> All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^{\circ}\text{C}$ .

NOTE 2: ICC is measured with outputs enabled and open.



<sup>§</sup> Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

# SN54F138, SN74F138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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# switching characteristics (see Note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 5 V, C <sub>L</sub> = 50 PF, R <sub>L</sub> = 500 Ω, T <sub>A</sub> = 25°C			V <sub>C</sub> C C <sub>L</sub> R <sub>L</sub> T <sub>A</sub>	UNIT				
			′F138			SN54	F138	SN74			
			MIN	TYP	MAX	MIN	MAX	MIN	MAX		
<sup>t</sup> PLH	A, B, or C	Υ	2.7	5.2	7.5	2.7	12	2.7	8.5	ns	
<sup>t</sup> PHL	A, B, of C	Ť	3.2	5.7	8	3.2	9.5	3.2	9	115	
<sup>t</sup> PLH	G2A or G2B	Υ	2.7	5	7	2.7	11	2.7	8	no	
t <sub>PHL</sub>	GZA OF GZB	Y	2.2	4.9	7	2.2	8	2.2	7.5	ns	
t <sub>PLH</sub>	G1	Y	3.2	5.8	8	3.2	12.5	3.2	9	ns I	
<sup>t</sup> PHL	Gi	ľ	2.7	5.2	7.5	2.7	8.5	2.7	8.5		

<sup>†</sup> For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions. NOTE 3: Load circuits and waveforms are shown in Section 1.







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#### **PACKAGING INFORMATION**

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish (6)	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
5962-9758201Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9758201Q2A SNJ54F 138FK	Sample
5962-9758201QEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9758201QE A SNJ54F138J	Samples
5962-9758201QFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9758201QF A SNJ54F138W	Samples
JM38510/33701B2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	JM38510/ 33701B2A	Samples
JM38510/33701BEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	JM38510/ 33701BEA	Samples
JM38510/33701BFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	JM38510/ 33701BFA	Samples
M38510/33701B2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	JM38510/ 33701B2A	Samples
M38510/33701BEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	JM38510/ 33701BEA	Samples
M38510/33701BFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	JM38510/ 33701BFA	Samples
SN54F138J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	SN54F138J	Samples
SN74F138D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	F138	Samples
SN74F138DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	F138	Samples
SN74F138DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	F138	Samples
SN74F138DRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	F138	Samples
SN74F138DRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	F138	Samples



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#### PACKAGE OPTION ADDENDUM

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Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking	Samples
SN74F138N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	(4/5) SN74F138N	Samples
SN74F138N3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI	0 to 70		
SN74F138NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74F138N	Samples
SN74F138NSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	74F138	Samples
SNJ54F138FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9758201Q2A SNJ54F 138FK	Samples
SNJ54F138J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9758201QE A SNJ54F138J	Samples
SNJ54F138W	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-9758201QF A SNJ54F138W	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): Tl's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, Tl Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.





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(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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#### OTHER QUALIFIED VERSIONS OF SN54F138, SN74F138:

Catalog: SN74F138

Military: SN54F138

NOTE: Qualified Version Definitions:

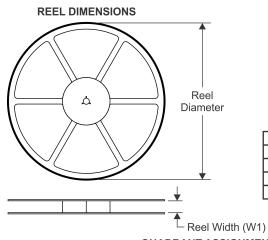
Catalog - TI's standard catalog product

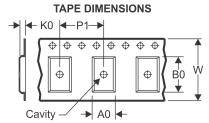
Military - QML certified for Military and Defense Applications

PACKAGE MATERIALS INFORMATION

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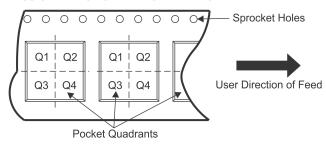
#### TAPE AND REEL INFORMATION





A0	
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

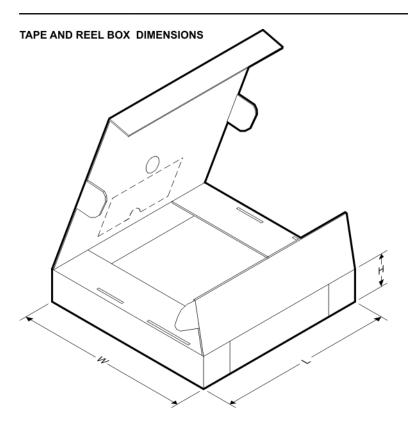
#### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing			Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74F138DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

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#### \*All dimensions are nominal

I	Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
I	SN74F138DR	SOIC	D	16	2500	333.2	345.9	28.6

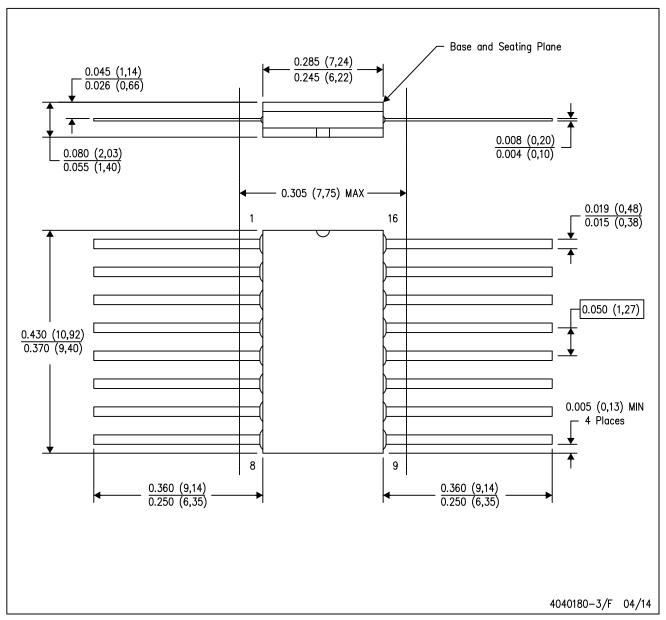
#### 14 LEADS SHOWN



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package is hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
- E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

# W (R-GDFP-F16)

# CERAMIC DUAL FLATPACK



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification only.
- E. Falls within MIL STD 1835 GDFP2-F16



# FK (S-CQCC-N\*\*)

# LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a metal lid.
- D. Falls within JEDEC MS-004



# N (R-PDIP-T\*\*)

# PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
- The 20 pin end lead shoulder width is a vendor option, either half or full width.



# D (R-PDS0-G16)

#### PLASTIC SMALL OUTLINE



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AC.



# D (R-PDSO-G16)

# PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



#### **MECHANICAL DATA**

# NS (R-PDSO-G\*\*)

# 14-PINS SHOWN

#### PLASTIC SMALL-OUTLINE PACKAGE



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.



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