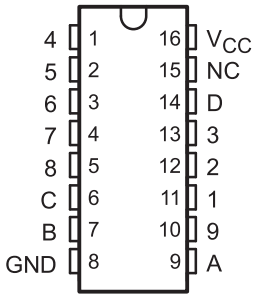
’147, ’LS147

- **Encode 10-Line Decimal to 4-Line BCD**
- **Applications Include:**
  - **Keyboard Encoding**
  - **Range Selection**

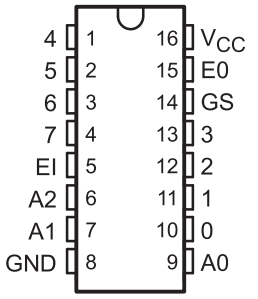
’148, ’LS148

- **Encode 8 Data Lines to 3-Line Binary (Octal)**
- **Applications Include:**
  - **n-Bit Encoding**
  - **Code Converters and Generators**

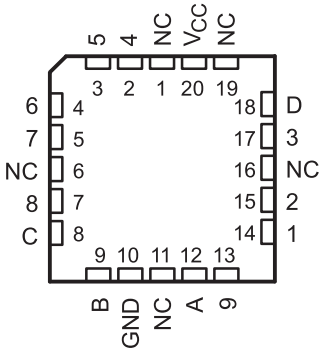
SN54147, SN54LS147 . . . J OR W PACKAGE
SN74147, SN74LS147 . . . D OR N PACKAGE
(TOP VIEW)



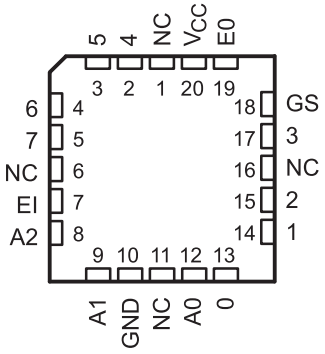
SN54148, SN54LS148 . . . J OR W PACKAGE
SN74148, SN74LS148 . . . D, N, OR NS PACKAGE
(TOP VIEW)



SN54LS147 . . . FK PACKAGE
(TOP VIEW)



SN54LS148 . . . FK PACKAGE
(TOP VIEW)



NC − No internal connection

TYPE	TYPICAL DATA DELAY	TYPICAL POWER DISSIPATION
’147	10 ns	225 mW
’148	10 ns	190 mW
’LS147	15 ns	60 mW
’LS148	15 ns	60 mW

NOTE: The SN54147, SN54LS147, SN54148, SN74147, SN74LS147, and SN74148 are obsolete and are no longer supplied.

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.

description/ordering information

These TTL encoders feature priority decoding of the inputs to ensure that only the highest-order data line is encoded. The ’147 and ’LS147 devices encode nine data lines to four-line (8-4-2-1) BCD. The implied decimal zero condition requires no input condition, as zero is encoded when all nine data lines are at a high logic level. The ’148 and ’LS148 devices encode eight data lines to three-line (4-2-1) binary (octal). Cascading circuitry (enable input EI and enable output EO) has been provided to allow octal expansion without the need for external circuitry. For all types, data inputs and outputs are active at the low logic level. All inputs are buffered to represent one normalized Series 54/74 or 54/74LS load, respectively.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP − N	Tube	SN74LS148N	SN74LS148N
	SOIC − D	Tube	SN74LS148D	LS148
		Tape and reel	SN74LS148DR	
	SOP − NS	Tape and reel	SN74LS148NSR	74LS148
−55°C to 125°C	CDIP − J	Tube	SNJ54LS148J	SNJ54LS148J
	CFP − W	Tube	SNJ54LS148W	SNJ54LS148W
	LCCC − FK	Tube	SNJ54LS148FK	SNJ54LS148FK

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE − ’147, ’LS147

INPUTS									OUTPUTS			
1	2	3	4	5	6	7	8	9	D	C	B	A
H	H	H	H	H	H	H	H	H	H	H	H	H
X	X	X	X	X	X	X	X	L	L	H	H	L
X	X	X	X	X	X	X	L	H	L	H	H	H
X	X	X	X	X	X	L	H	H	H	L	L	L
X	X	X	X	X	L	H	H	H	H	L	L	H
X	X	X	X	L	H	H	H	H	H	L	H	L
X	X	X	L	H	H	H	H	H	H	L	H	H
X	X	L	H	H	H	H	H	H	H	H	L	L
X	L	H	H	H	H	H	H	H	H	H	L	H
L	H	H	H	H	H	H	H	H	H	H	H	L

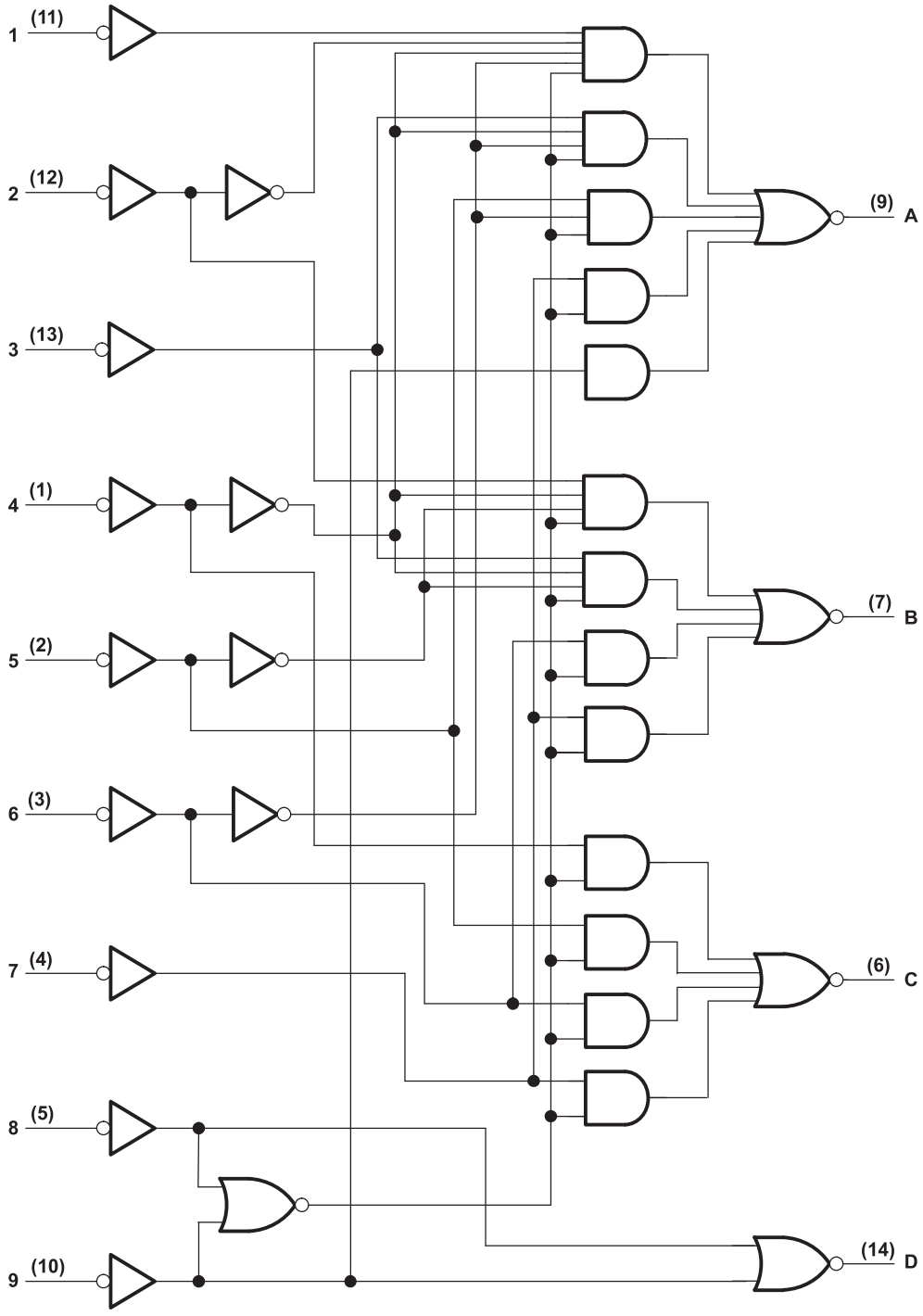
H = high logic level, L = low logic level, X = irrelevant

FUNCTION TABLE – ’148, ’LS148

INPUTS									OUTPUTS				
EI	0	1	2	3	4	5	6	7	A2	A1	A0	GS	EO
H	X	X	X	X	X	X	X	X	H	H	H	H	H
L	H	H	H	H	H	H	H	H	H	H	H	H	L
L	X	X	X	X	X	X	X	L	L	L	L	L	H
L	X	X	X	X	X	X	L	H	L	L	H	L	H
L	X	X	X	X	X	L	H	H	L	H	L	L	H
L	X	X	X	X	L	H	H	H	L	H	H	L	H
L	X	X	X	L	H	H	H	H	H	L	L	L	H
L	X	X	L	H	H	H	H	H	H	L	H	L	H
L	X	L	H	H	H	H	H	H	H	H	L	L	H
L	L	H	H	H	H	H	H	H	H	H	H	L	H

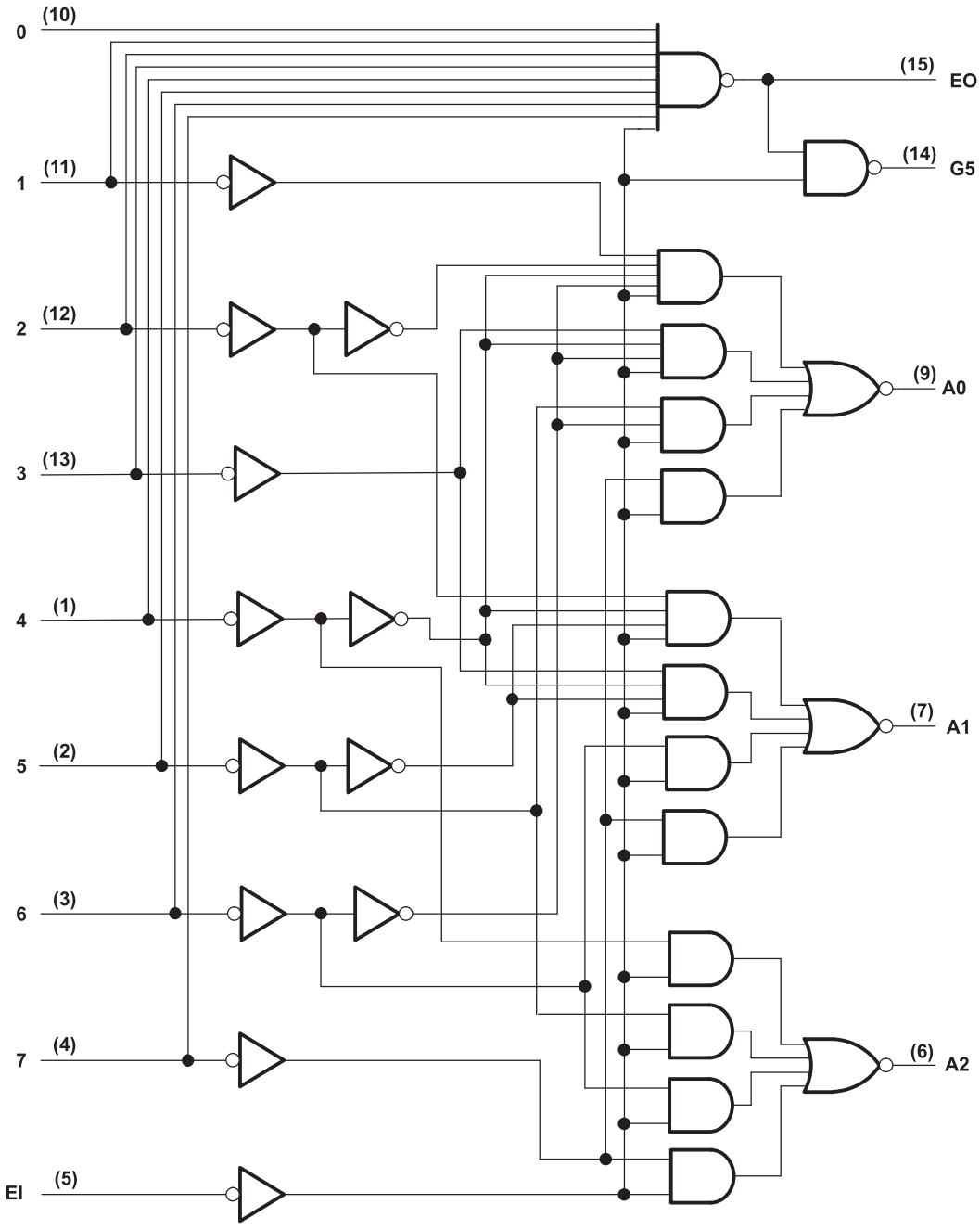
H = high logic level, L = low logic level, X = irrelevant

’147, ’LS147 logic diagram (positive logic)



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

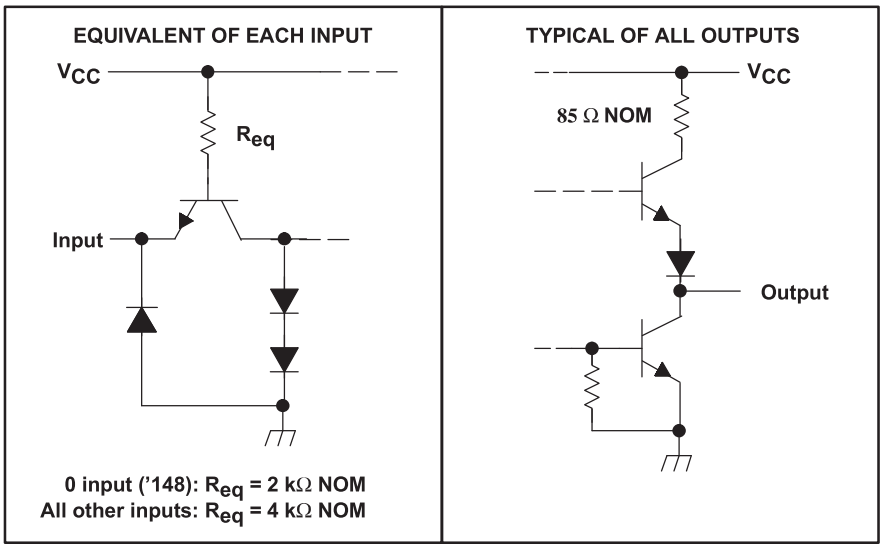
’148, ’LS148 logic diagram (positive logic)



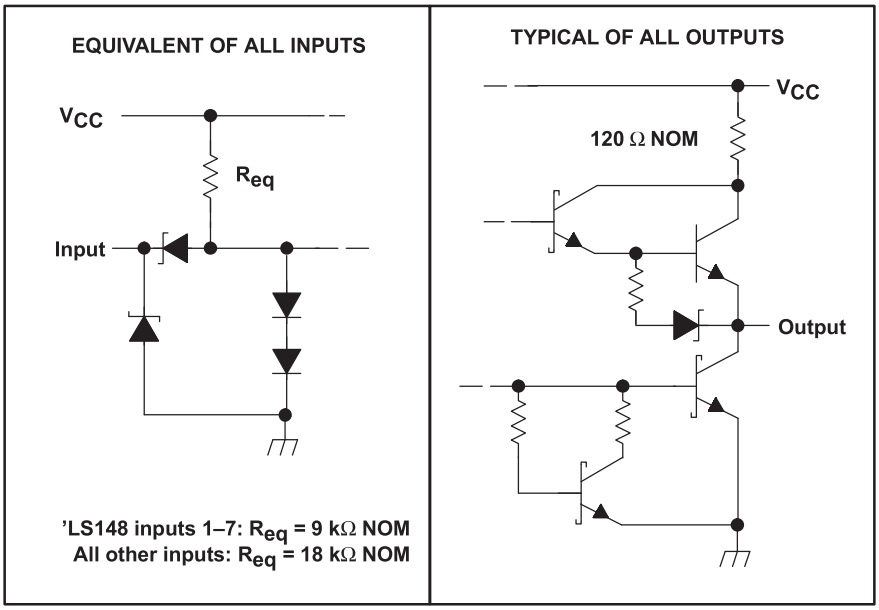
Pin numbers shown are for D, J, N, NS, and W packages.

schematics of inputs and outputs

'147, '148



'LS147, 'LS148



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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage, V_I: ’147, ’148 . . . . . 5.5 V
’LS147, ’LS148 . . . . . 7 V
Inter-emitter voltage: ’148 only (see Note 2) . . . . . 5.5 V
Package thermal impedance θ_{JA} (see Note 3): D package . . . . . 73°C/W
N package . . . . . 67°C/W
NS package . . . . . 64°C/W
Storage temperature range, T_{stg} . . . . . −65°C to 150°C

† 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.

NOTES: 1. Voltage values, except inter-emitter voltage, are with respect to the network ground terminal.
2. This is the voltage between two emitters of a multiple-emitter transistor. For ’148 circuits, this rating applies between any two of the eight data lines, 0 through 7.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4)

		SN54’			SN74’			SN54LS’			SN74LS’			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	4.5	5	5.5	4.75	5	5.25	V
I_{OH}	High-level output current			−800			−800			−400			−400	μA
I_{OL}	Low-level output current			16			16			4			8	mA
T_A	Operating free-air temperature	−55		125	0		70	−55		125	0		70	°C

NOTE 4: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER			TEST CONDITIONS†		'147			'148			UNIT
					MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage				2			2			V
V_{IL}	Low-level input voltage						0.8			0.8	V
V_{IK}	Input clamp voltage		V_{CC} = MIN,	I_I = −12 mA			−1.5			−1.5	V
V_{OH}	High-level output voltage		V_{CC} = MIN, V_{IL} = 0.8 V,	V_{IH} = 2 V, I_{OH} = −800 μA	2.4	3.3		2.4	3.3		V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IL} = 0.8 V,	V_{IH} = 2 V, I_{OL} = 16 mA		0.2	0.4		0.2	0.4	V
I_I	Input current at maximum input voltage		V_{CC} = MIN,	V_I = 5.5 V			1			1	mA
I_{IH}	High-level input current	0 input	V_{CC} = MAX,	V_I = 2.4 V						40	μA
		Any input except 0					40			80	
I_{IL}	Low-level input current	0 input	V_{CC} = MAX,	V_I = 0.4 V						−1.6	mA
		Any input except 0					−1.6			−3.2	
I_{OS}	Short-circuit output current§		V_{CC} = MAX		−35		−85	−35		−85	mA
I_{CC}	Supply current		V_{CC} = MAX (See Note 5)	Condition 1		50	70		40	60	mA
				Condition 2		42	62		35	55	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time.
NOTE 5: For '147, I_{CC} (Condition 1) is measured with input 7 grounded, other inputs and outputs open; I_{CC} (Condition 2) is measured with all inputs and outputs open. For '148, I_{CC} (Condition 1) is measured with inputs 7 and EI grounded, other inputs and outputs open; I_{CC} (Condition 2) is measured with all inputs and outputs open.

SN54147, SN74147 switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Any	Any	In-phase output	C_L = 15 pF, R_L = 400 Ω		9	14	ns
t_{PHL}						7	11	
t_{PLH}	Any	Any	Out-of-phase output			13	19	ns
t_{PHL}						12	19	

SN54148, SN74148 switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Figure 1)

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	1–7	A0, A1, or A2	In-phase output	C_L = 15 pF, R_L = 400 Ω		10	15	ns
t_{PHL}						9	14	
t_{PLH}	1–7	A0, A1, or A2	Out-of-phase output			13	19	ns
t_{PHL}						12	19	
t_{PLH}	0–7	EO	Out-of-phase output			6	10	ns
t_{PHL}						14	25	
t_{PLH}	0–7	GS	In-phase output			18	30	ns
t_{PHL}						14	25	
t_{PLH}	EI	A0, A1, or A2	In-phase output			10	15	ns
t_{PHL}						10	15	
t_{PLH}	EI	GS	In-phase output			8	12	ns
t_{PHL}						10	15	
t_{PLH}	EI	EO	In-phase output			10	15	ns
t_{PHL}						17	30	

† t_{PLH} = propagation delay time, low-to-high-level output.
t_{PHL} = propagation delay time, high-to-low-level output.

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

PARAMETER			TEST CONDITIONS†		SN54LS' MIN	SN54LS' TYP‡	SN54LS' MAX	SN74LS' MIN	SN74LS' TYP‡	SN74LS' MAX	UNIT
V_{IH}	High-level input voltage				2			2			V
V_{IL}	Low-level input voltage						0.7			0.8	V
V_{IK}	Input clamp voltage		V_{CC} = MIN,	I_I = −18 mA			−1.5			−1.5	V
V_{OH}	High-level output voltage		V_{CC} = MIN, V_{IL} = 0.8 V,	V_{IH} = 2 V, I_{OH} = −400 μA	2.5	3.4		2.7	3.4		V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL} MAX	I_{OL} = 4 mA		0.25	0.4		0.25	0.4	V
				I_{OL} = 8 mA					0.35	0.5	
I_I	Input current at maximum input voltage	'LS148 inputs 1–7	V_{CC} = MAX,	V_I = 7 V			0.2			0.2	mA
		All other inputs					0.1			0.1	
I_{IH}	High-level input current	'LS148 inputs 1–7	V_{CC} = MAX,	V_I = 2.7 V			40			40	μA
		All other inputs					20			20	
I_{IL}	Low-level input current	'LS148 inputs 1–7	V_{CC} = MAX,	V_I = 0.4 V			−0.8			−0.8	mA
		All other inputs					−0.4			−0.4	
I_{OS}	Short-circuit output current§		V_{CC} = MAX		−20		−100	−20		−100	mA
I_{CC}	Supply current		V_{CC} = MAX (See Note 6)	Condition 1		12	20		12	20	mA
				Condition 2		10	17		10	17	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time.
NOTE 6: For 'LS147, I_{CC} (Condition 1) is measured with input 7 grounded, other inputs and outputs open; I_{CC} (Condition 2) is measured with all inputs and outputs open. For 'LS148, I_{CC} (Condition 1) is measured with inputs 7 and EI grounded, other inputs and outputs open; I_{CC} (Condition 2) is measured with all inputs and outputs open.

SN54LS147, SN74LS147 switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Figure 2)

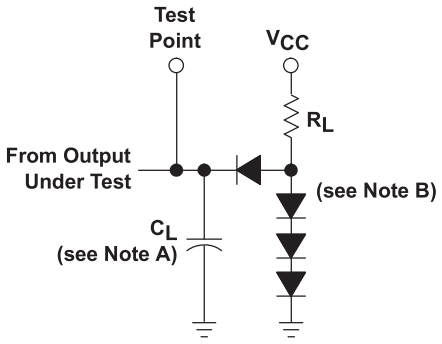
PARAMETER	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Any	Any	In-phase output	C_L = 15 pF, R_L = 2 kΩ		12	18	ns
t_{PHL}						12	18	
t_{PLH}	Any	Any	Out-of-phase output			21	33	ns
t_{PHL}						15	23	

SN54LS148, SN74LS148 switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Figure 2)

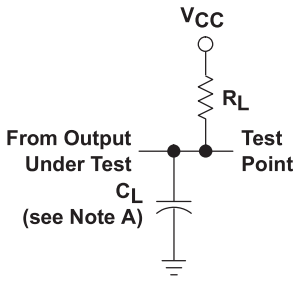
PARAMETER†	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	1–7	A0, A1, or A2	In-phase output	C_L = 15 pF, R_L = 2 kΩ		14	18	ns
t_{PHL}						15	25	
t_{PLH}	1–7	A0, A1, or A2	Out-of-phase output			20	36	ns
t_{PHL}						16	29	
t_{PLH}	0–7	EO	Out-of-phase output			7	18	ns
t_{PHL}						25	40	
t_{PLH}	0–7	GS	In-phase output			35	55	ns
t_{PHL}						9	21	
t_{PLH}	EI	A0, A1, or A2	In-phase output			16	25	ns
t_{PHL}						12	25	
t_{PLH}	EI	GS	In-phase output			12	17	ns
t_{PHL}						14	36	
t_{PLH}	EI	EO	In-phase output			12	21	ns
t_{PHL}						23	35	

† t_{PLH} = propagation delay time, low-to-high-level output
t_{PHL} = propagation delay time, high-to-low-level output

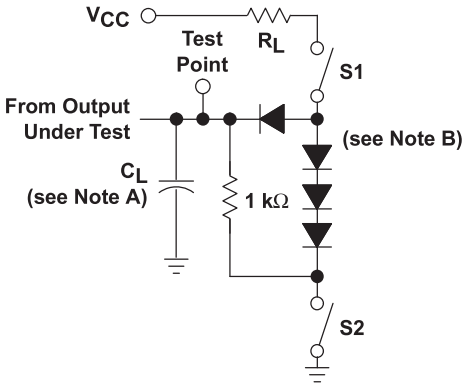
PARAMETER MEASUREMENT INFORMATION
SERIES 54/74 DEVICES



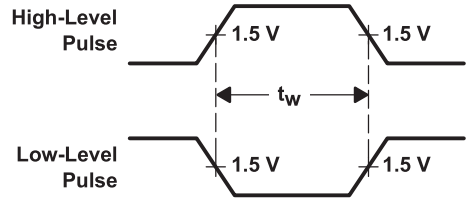
LOAD CIRCUIT
FOR 2-STATE TOTEM-POLE OUTPUTS



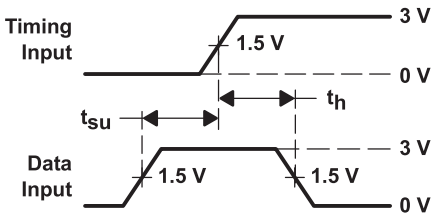
LOAD CIRCUIT
FOR OPEN-COLLECTOR OUTPUTS



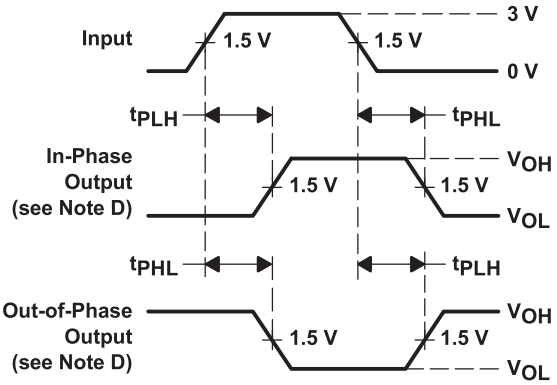
LOAD CIRCUIT
FOR 3-STATE OUTPUTS



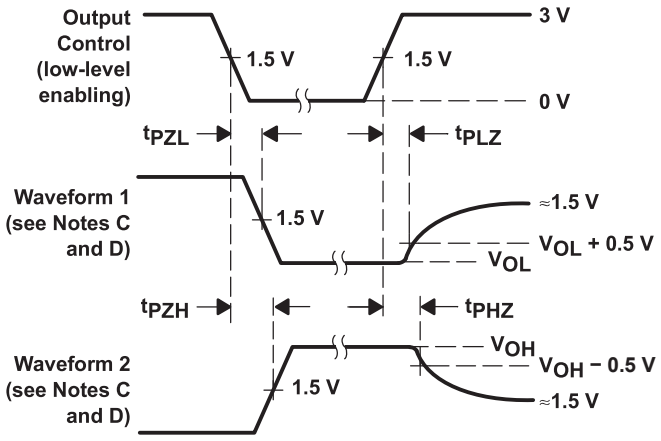
VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

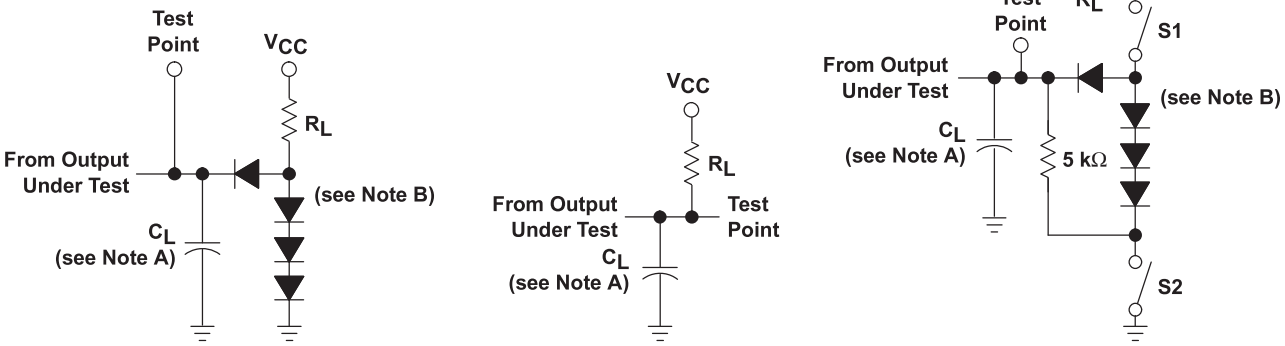


VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

NOTES: A. C_L includes probe and jig capacitance.
B. All diodes are 1N3064 or equivalent.
C. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
D. S1 and S2 are closed for t_{PLH}, t_{PHL}, t_{PHZ}, and t_{PLZ}; S1 is open, and S2 is closed for t_{PZH}; S1 is closed, and S2 is open for t_{PZL}.
E. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, $Z_O \approx 50\ \Omega$; t_r and $t_f \leq 7$ ns for Series 54/74 devices and t_r and $t_f \leq 2.5$ ns for Series 54S/74S devices.
F. The outputs are measured one at a time, with one input transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

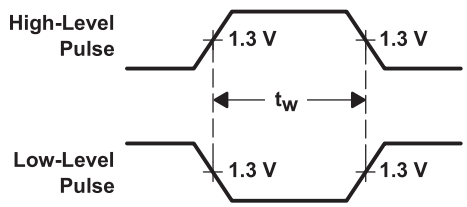
PARAMETER MEASUREMENT INFORMATION
SERIES 54LS/74LS DEVICES



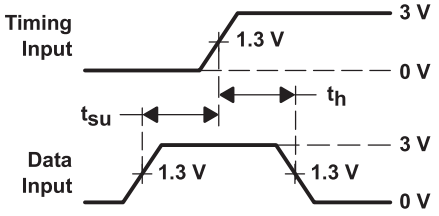
LOAD CIRCUIT
FOR 2-STATE TOTEM-POLE OUTPUTS

LOAD CIRCUIT
FOR OPEN-COLLECTOR OUTPUTS

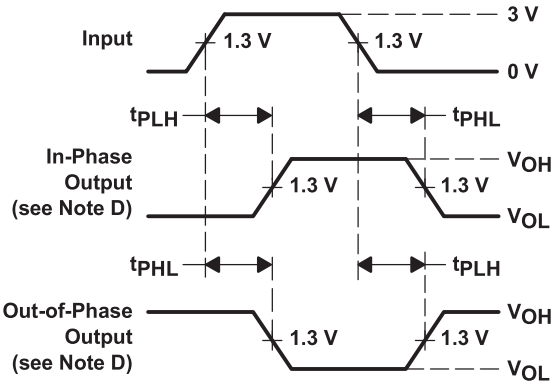
LOAD CIRCUIT
FOR 3-STATE OUTPUTS



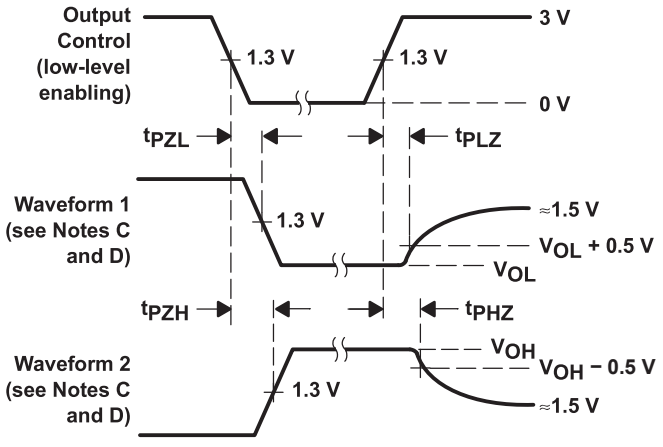
VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

NOTES: A. C_L includes probe and jig capacitance.
B. All diodes are 1N3064 or equivalent.
C. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
D. S1 and S2 are closed for t_{PLH}, t_{PHL}, t_{PHZ}, and t_{PLZ}; S1 is open, and S2 is closed for t_{PZH}; S1 is closed, and S2 is open for t_{PZL}.
E. Phase relationships between inputs and outputs have been chosen arbitrarily for these examples.
F. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, $Z_O \approx 50\ \Omega$, $t_r \le 1.5$ ns, $t_f \le 2.6$ ns.
G. The outputs are measured one at a time, with one input transition per measurement.

Figure 2. Load Circuits and Voltage Waveforms

APPLICATION INFORMATION

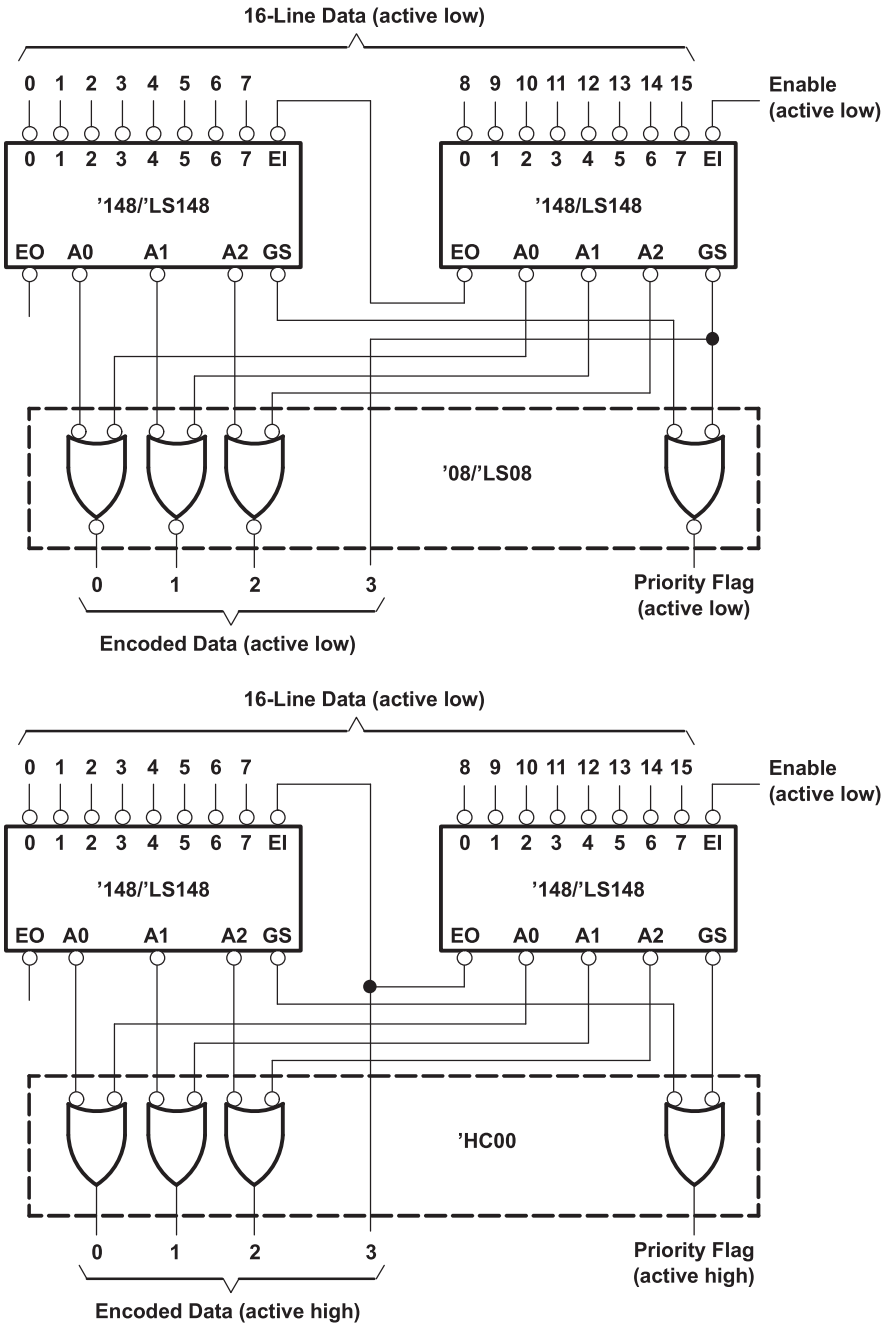


Figure 3. Priority Encoder for 16 Bits

Because the '147/'LS147 and '148/'LS148 devices are combinational logic circuits, wrong addresses can appear during input transients. Moreover, for the '148/'LS148 devices, a change from high to low at EI can cause a transient low on GS when all inputs are high. This must be considered when strobing the outputs.

PACKAGING INFORMATION

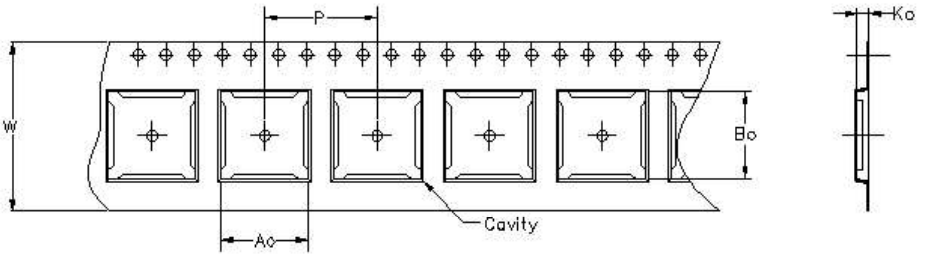
Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
78027012A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
7802701EA	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
7802701FA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
JM38510/36001B2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
JM38510/36001BEA	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
JM38510/36001BFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
SN54148J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI
SN54LS148J	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SN74147N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74148J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI
SN74148N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74148N3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS147DR	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI
SN74LS147N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS148D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS148DE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS148DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS148DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS148DRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS148DRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS148J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI
SN74LS148N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS148N3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS148NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS148NSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS148NSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS148NSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54148J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI
SNJ54148W	OBSOLETE	CFP	W	16		TBD	Call TI	Call TI
SNJ54LS148FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54LS148J	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
SNJ54LS148W	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type

(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.

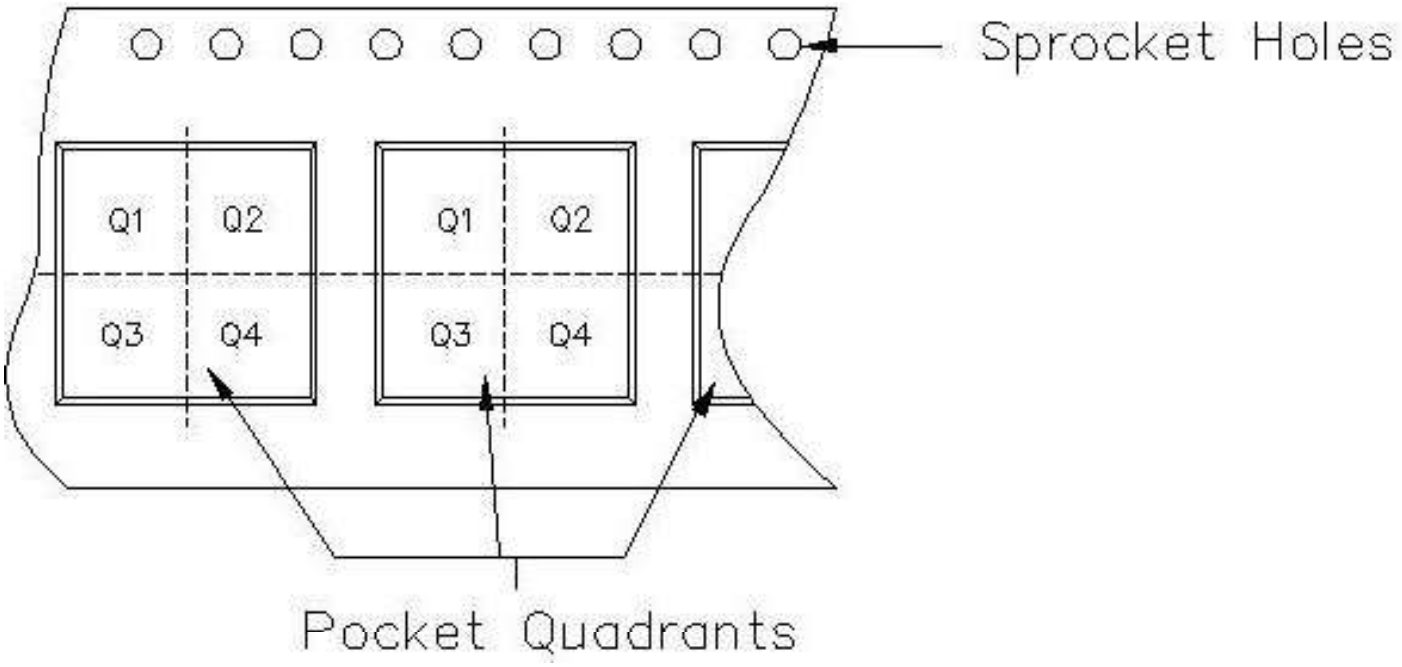
(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI'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, TI 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.



Carrier tape design is defined largely by the component lentgh, width, and thickness.

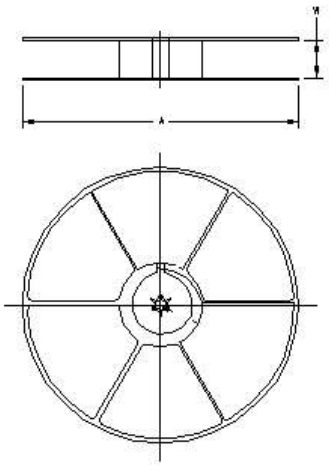
Ao = Dimension designed to accommodate the component width.
Bo = Dimension designed to accommodate the component length.
Ko = Dimension designed to accommodate the component thickness.
W = Overall width of the carrier tape.
P = Pitch between successive cavity centers.



TAPE AND REEL INFORMATION

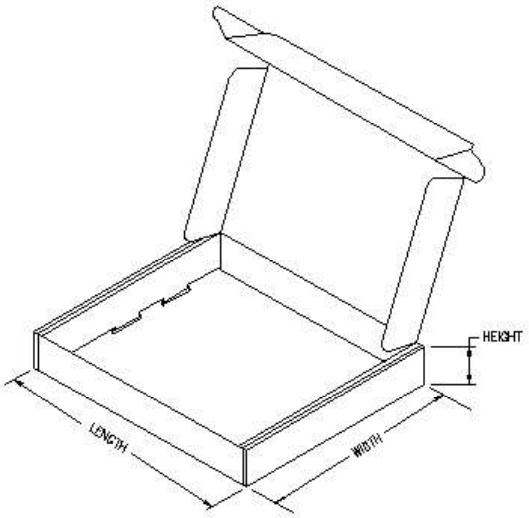
PACKAGE MATERIALS INFORMATION

Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LS148DR	D	16	FMX	330	16	6.5	10.3	2.1	8	16	Q1
SN74LS148NSR	NS	16	MLA	330	16	8.2	10.5	2.5	12	16	Q1



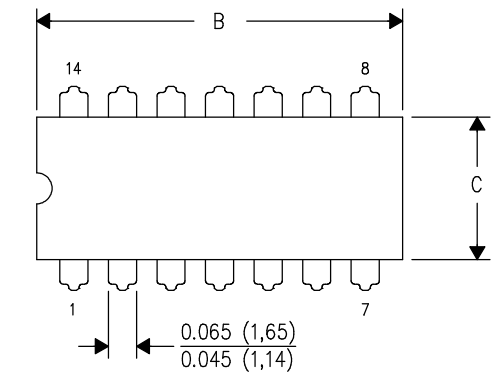
TAPE AND REEL BOX INFORMATION

Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
SN74LS148DR	D	16	FMX	342.9	336.6	28.58
SN74LS148NSR	NS	16	MLA	342.9	336.6	28.58

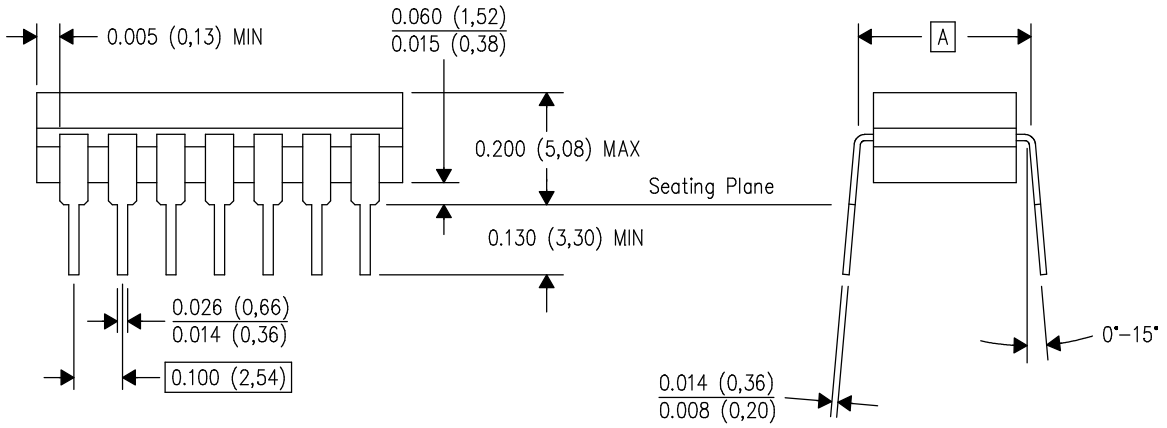


J (R–GDIP–T**) CERAMIC DUAL IN–LINE PACKAGE

14 LEADS SHOWN



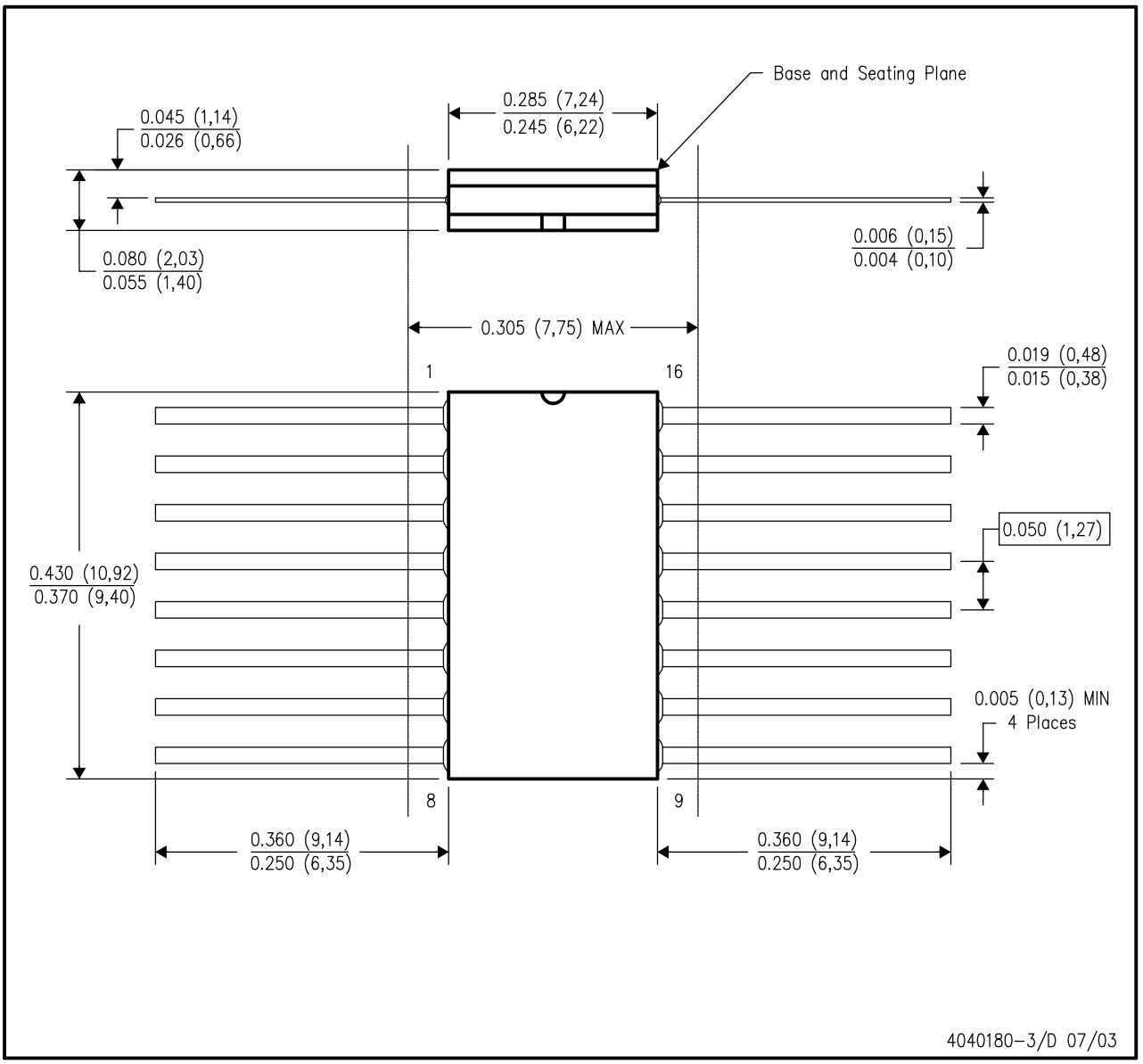
DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

NOTES:
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



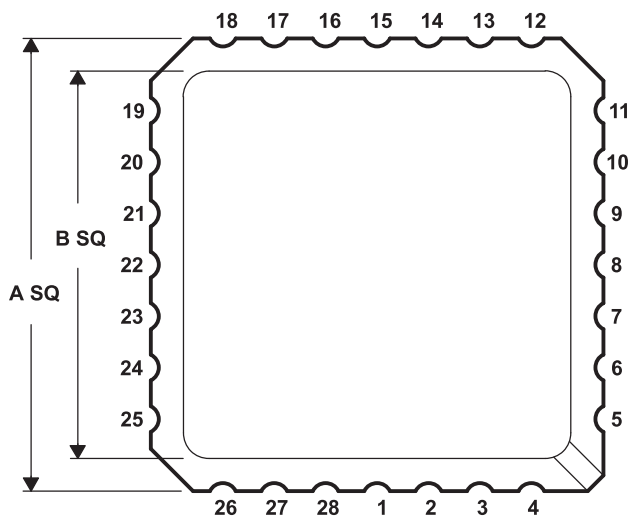
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only.
E. Falls within MIL STD 1835 GDFP1–F16 and JEDEC MO–092AC

MLCC006B – OCTOBER 1996

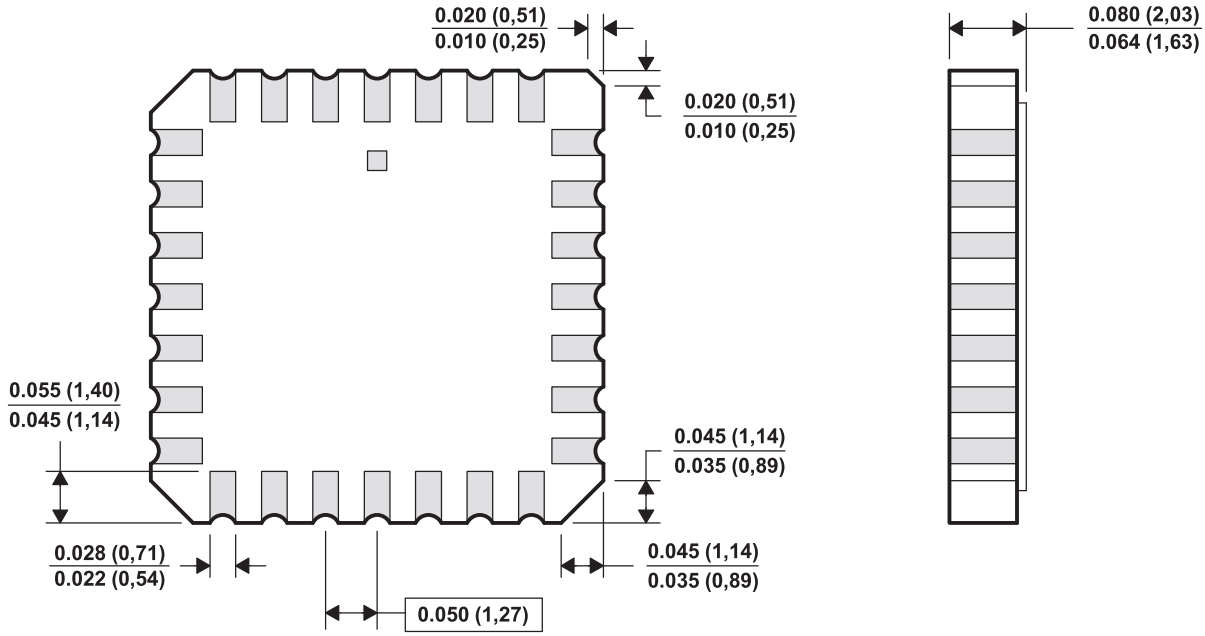
FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



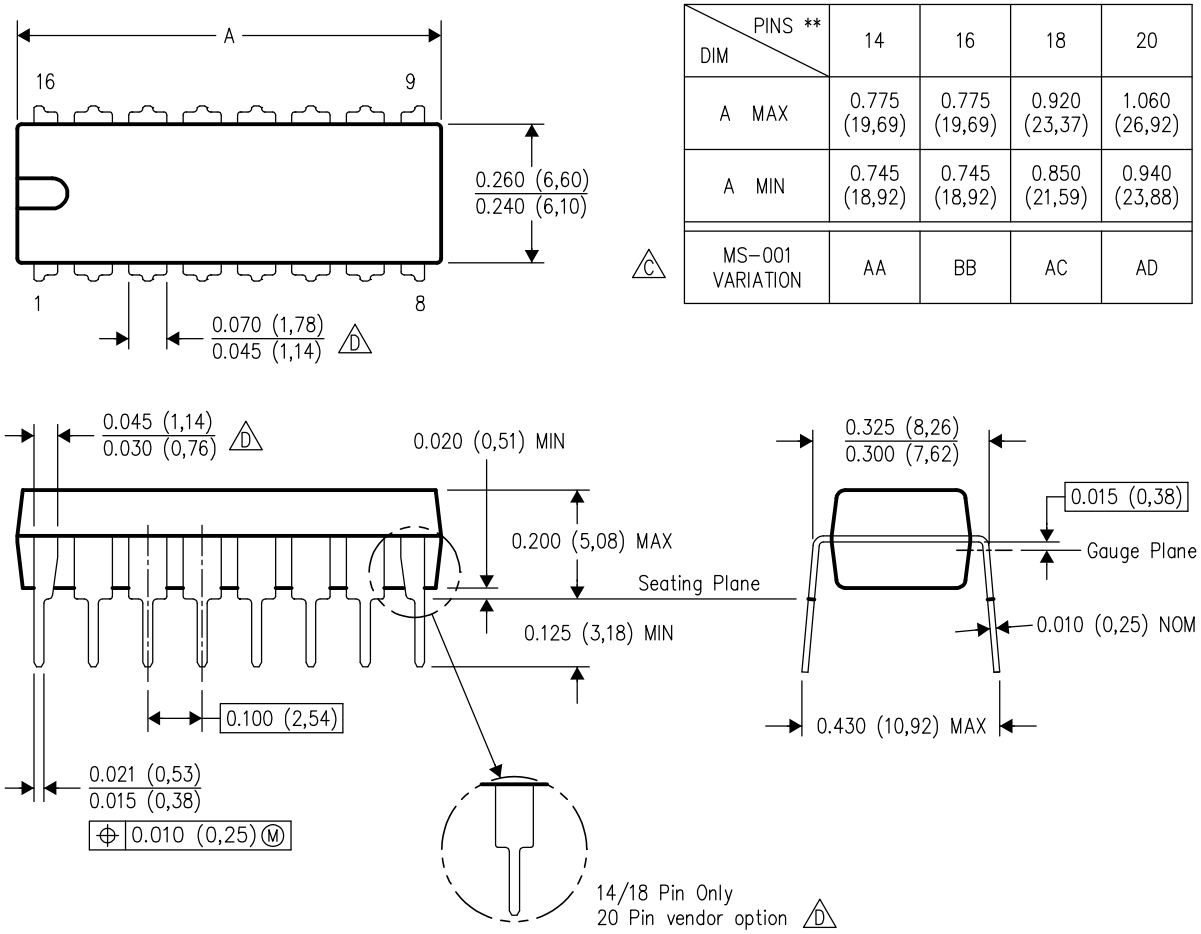
4040140/D 10/96

NOTES: 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. The terminals are gold plated.
E. Falls within JEDEC MS-004

N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN

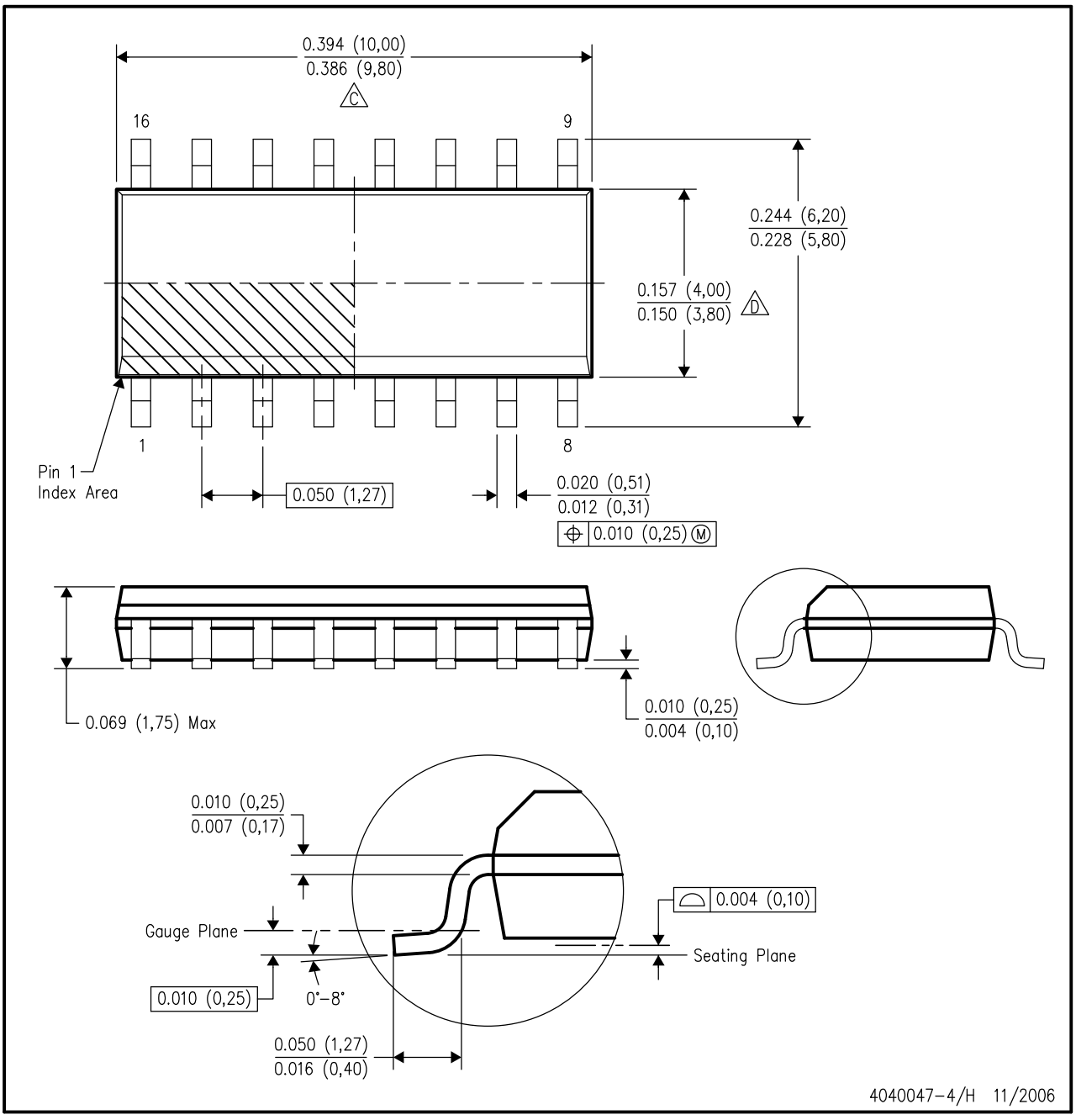


DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
C MS–001 VARIATION	AA	BB	AC	AD

4040049/E 12/2002

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

D (R–PDSO–G16) PLASTIC SMALL–OUTLINE PACKAGE

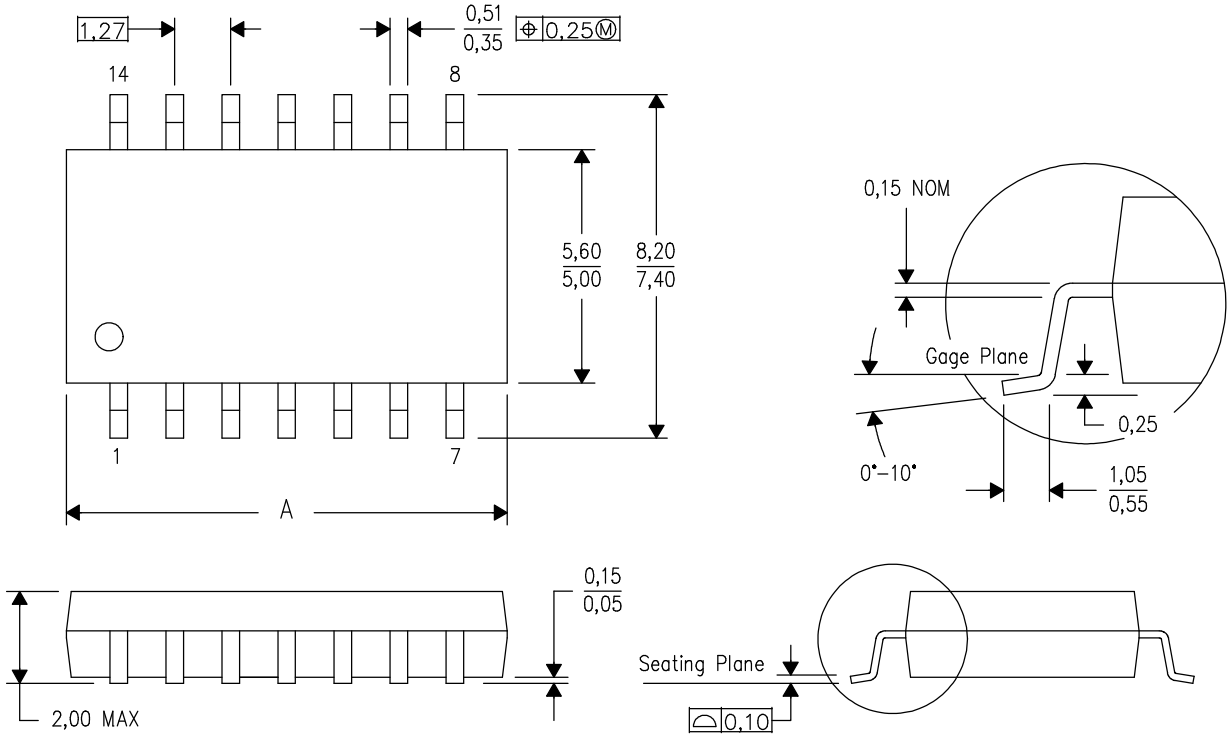


NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS–012 variation AC.

MECHANICAL DATA

NS (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14-PINS SHOWN



DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

NOTES:
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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