CMOS Hex Schmitt Triggers

High-Voltage Types (20-Volt Rating)

■ CD40106B consists of six Schmitt-trigger circuits. Each circuit functions as an inverter with Schmitt-trigger action on the input. The trigger switches at different points for positive- and negative-going signals. The difference between the positive-going voltage (V_P) and the negative-going voltage (V_N) is defined as hysteresis voltage (V_H) (see Fig.6).

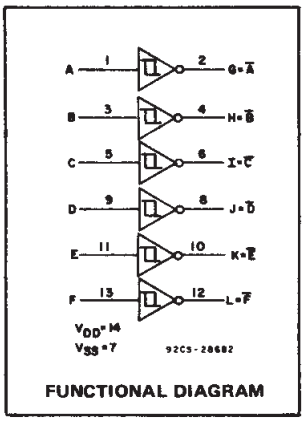
The CD40106B types are supplied in 14-lead hermetic dual-in-line ceramic packages (F3A suffix), 14-lead dual-in-line plastic packages (E suffix), 14-lead small-outline packages (M, MT, M96, and NSR suffixes), and 14-lead thin shrink small-outline packages (PW and PWR suffixes).

Features:

- **Schmitt-trigger action with no external components**
- **Hysteresis voltage (typ.) 0.9 V at V_{DD} = 5 V, 2.3 V at V_{DD} = 10 V, and 3.5 V at V_{DD} = 15 V**
- **Noise immunity greater than 50%**
- **No limit on input rise and fall times**
- **Standardized, symmetrical output characteristics**
- **100% tested for quiescent current at 20 V**
- **Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C**
- **Low V_{DD} to V_{SS} current during slow input ramp**
- **5-V, 10-V, and 15-V parametric ratings**
- **Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"**

Applications:

- **Wave and pulse shapers**
- **High-noise-environment systems**
- **Monostable multivibrators**
- **Astable multivibrators**



FUNCTIONAL DIAGRAM

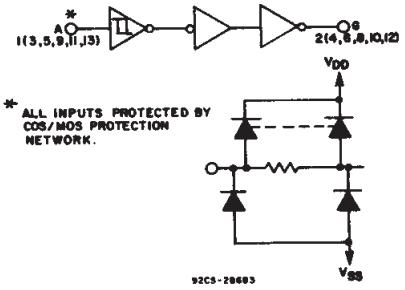


Fig.1 – Logic diagram (1 of 6 Schmitt triggers).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE RANGE, (V_{DD})
(Voltages referenced to V_{SS} Terminal) ..... -0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS ..... -0.5V to V_{DD} +0.5V
DC INPUT CURRENT, ANY ONE INPUT ..... ±10mA
POWER DISSIPATION PER PACKAGE (P_D):
For T_A = -55°C to +100°C 500mW
For T_A = +100°C to +125°C ..... Derate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR
FOR T_A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) 100mW
OPERATING-TEMPERATURE RANGE (T_A) ..... -55°C to +125°C
STORAGE TEMPERATURE RANGE (T_{stg}) ..... -65°C to +150°C
LEAD TEMPERATURE (DURING SOLDERING):
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max ..... +265°C

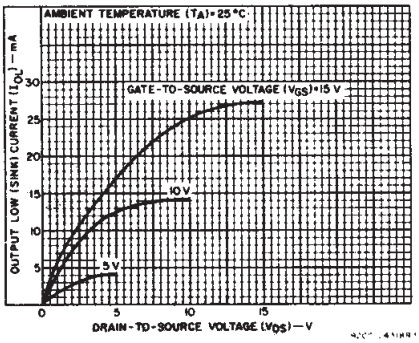


Fig.2 – Typical output low (sink) current characteristics.

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	LIMITS		UNITS
	MIN.	MAX.	
Supply-Voltage Range (For T_A Full Package-Temperature Range)	3	18	V

DYNAMIC ELECTRICAL CHARACTERISTICS

At T_A = 25°C, Input t_r, t_f = 20 ns, C_L = 50 pF, R_L = 200 kΩ

CHARACTERISTIC	TEST CONDITIONS	LIMITS			UNITS
		V_{DD} (V)	TYP.	MAX.	
Propagation Delay Time: t_{PHL}, t_{PLH}		5	140	280	ns
		10	70	140	
		15	60	120	
Transition Time: t_{THL}, t_{TLH}		5	100	200	ns
		10	50	100	
		15	40	80	
Input Capacitance, C_{IN}	Any Input		5	7.5	pF

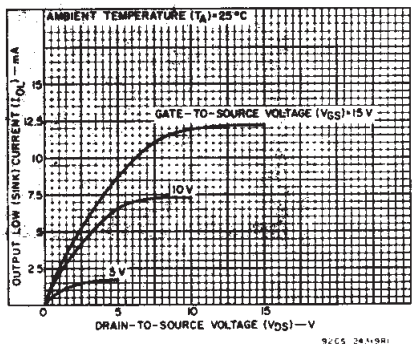
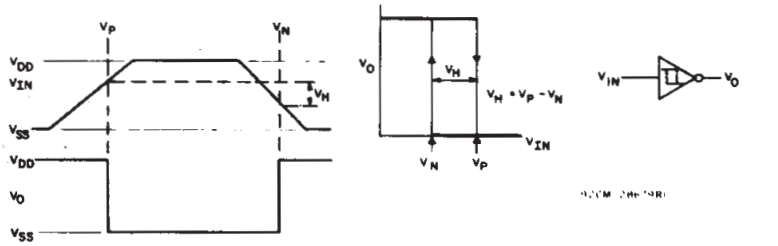


Fig.3 – Minimum output low (sink) current characteristics.

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V_O (V)	V_{IN} (V)	V_{DD} (V)	−55	−40	+85	+125	+25 Min.	+25 Typ.	+25 Max.	
Quiescent Device Current, I_{DD} Max.	–	0,5	5	1	1	30	30	–	0.02	1	μA
	–	0,10	10	2	2	60	60	–	0.02	2	
	–	0,15	15	4	4	120	120	–	0.02	4	
	–	0,20	20	20	20	600	600	–	0.04	20	
Positive Trigger Threshold Voltage V_P Min.	–	–	5	2.2	2.2	2.2	2.2	2.2	2.9	–	V
	–	–	10	4.6	4.6	4.6	4.6	4.6	5.9	–	
	–	–	15	6.8	6.8	6.8	6.8	6.8	8.8		
V_P Max.	–	–	5	3.6	3.6	3.6	3.6	–	2.9	3.6	
	–	–	10	7.1	7.1	7.1	7.1	–	5.9	7.1	
	–	–	15	10.8	10.8	10.8	10.8	–	8.8	10.8	
Negative Trigger Threshold Voltage V_N Min.	–	–	5	0.9	0.9	0.9	0.9	0.9	1.9	–	V
	–	–	10	2.5	2.5	2.5	2.5	2.5	3.9	–	
	–	–	15	4	4	4	4	4	5.8	–	
V_N Max.	–	–	5	2.8	2.8	2.8	2.8	–	1.9	2.8	
	–	–	10	5.2	5.2	5.2	5.2	–	3.9	5.2	
	–	–	15	7.4	7.4	7.4	7.4	–	5.8	7.4	
Hysteresis Voltage V_H Min.	–	–	5	0.3	0.3	0.3	0.3	0.3	0.9	–	V
	–	–	10	1.2	1.2	1.2	1.2	1.2	2.3	–	
	–	–	15	1.6	1.6	1.6	1.6	1.6	3.5	–	
V_H Max.	–	–	5	1.6	1.6	1.6	1.6	–	0.9	1.6	
	–	–	10	3.4	3.4	3.4	3.4	–	2.3	3.4	
	–	–	15	5	5	5	5	–	3.5	5	
Output Low (Sink) Current, I_{OL} Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	–	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	–	
	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	–	
Output High (Source) Current, I_{OH} Min.	4.6	0,5	5	−0.64	−0.61	−0.42	−0.36	−0.51	−1	–	
	2.5	0.5	5	−2	−1.8	−1.3	−1.15	−1.6	−3.2	–	
	9.5	0,10	10	−1.6	−1.5	−1.1	−0.9	−1.3	−2.6	–	
	13.5	0,15	15	−4.2	−4	−2.8	−2.4	−3.4	−6.8	–	
Output Voltage Low-Level, V_{OL} Max.	–	5	5	0.05				–	0	0.05	V
	–	10	10	0.05				–	0	0.05	
	–	15	15	0.05				–	0	0.05	
Output Voltage High Level, V_{OH} Min.	–	0	5	4.95				4.95	5	–	
	–	0	10	9.95				9.95	10	–	
	–	0	15	14.95				14.95	15	–	
Input Current, I_{IN} Max.	–	0,18	18	±0.1	±0.1	±1	±1	–	$\pm 10^{-5}$	±0.1	μA



a) Definition of V_P, V_N, V_H *b) Transfer characteristics of 1 of 6 gates*

Fig.6 – Hysteresis definition, characteristics, and test set-up.

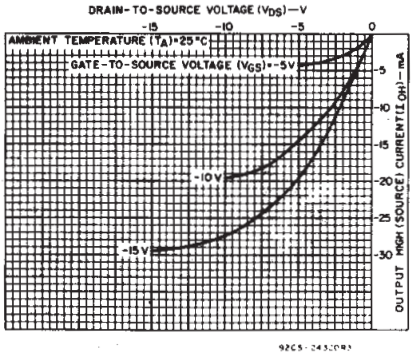


Fig.4 – Typical output high (source) current characteristics.

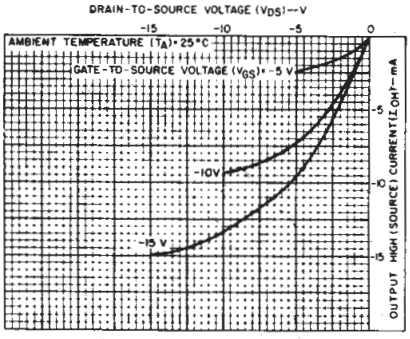


Fig.5 – Minimum output high (source) current characteristics.

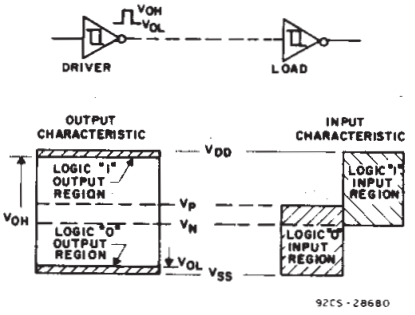


Fig.7 – Input and output characteristics.

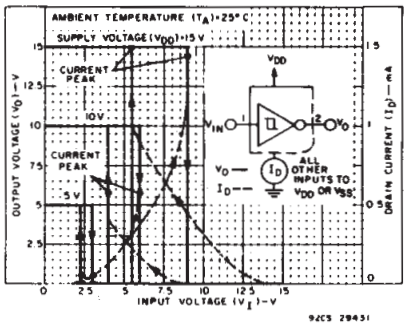


Fig.8 – Typical current and voltage transfer characteristics.

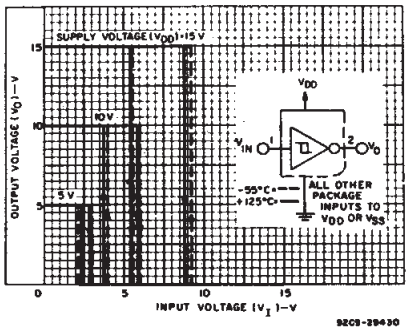


Fig.9 — Typical voltage transfer characteristics as a function of temperature.

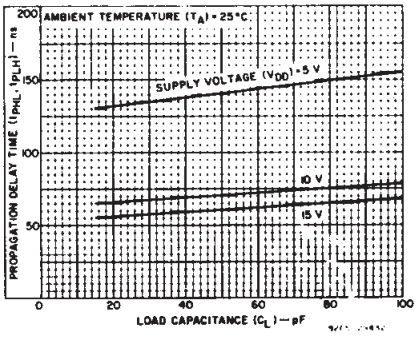


Fig.10 — Typical propagation delay time as a function of load capacitance.

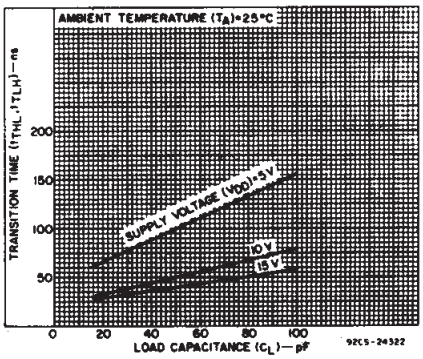


Fig.11 — Typical transition time as a function of load capacitance.

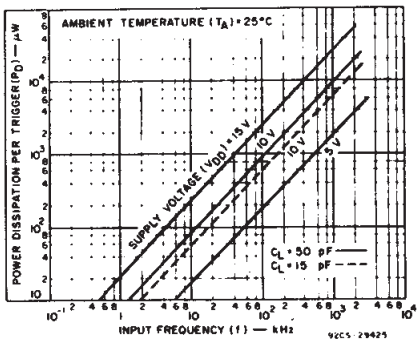


Fig.12 — Typical power dissipation per trigger as a function of input frequency.

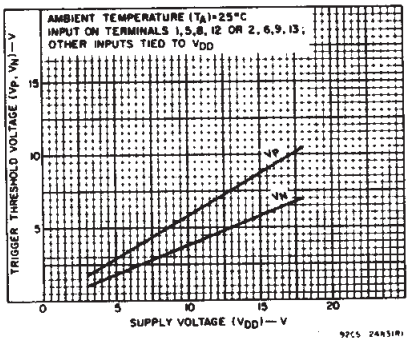


Fig.13 — Typical trigger threshold voltage as a function of supply voltage.

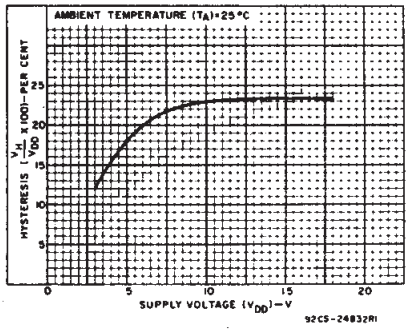


Fig.14 — Typical per cent hysteresis as a function of supply voltage.

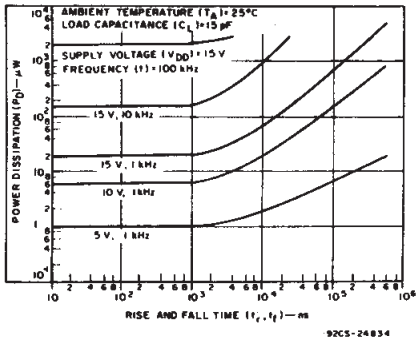


Fig.15 — Typical power dissipation as a function of rise and fall times.

APPLICATIONS

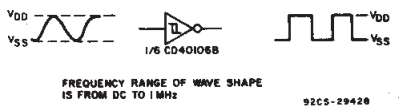


Fig.16 — Wave shaper.

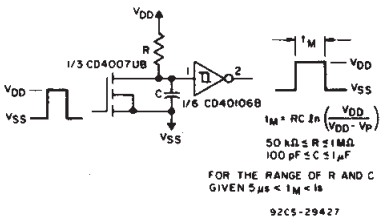


Fig.17 — Monostable multivibrator.

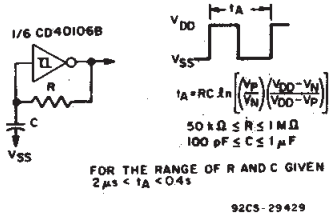


Fig.18 — Astable multivibrator.

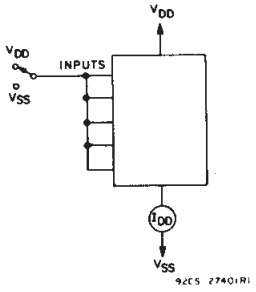


Fig.19 — Quiescent device current test circuit.

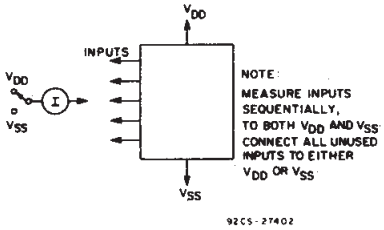


Fig.20 — Input current test circuit.

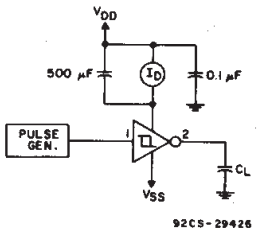
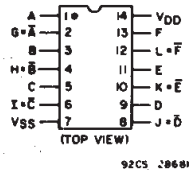
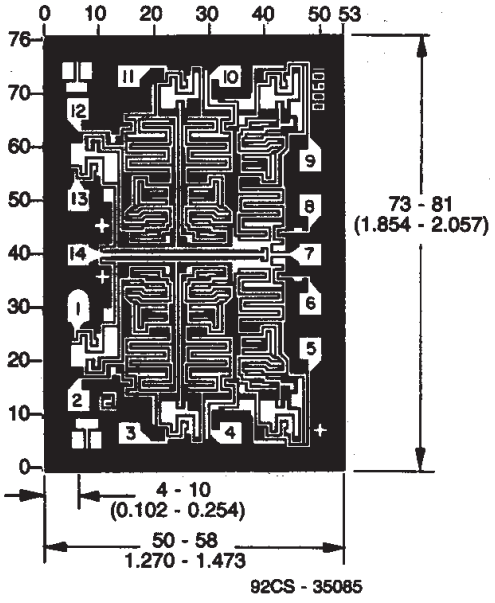


Fig.21 – Dynamic power dissipation test circuit.



TERMINAL ASSIGNMENT



Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

Dimensions and Pad Layout for CD40106BH

3 COMMERCIAL CMOS HIGH VOLTAGE ICs

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
CD40106BE	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD40106BF	ACTIVE	CDIP	J	14	1	None	Call TI	Level-NC-NC-NC
CD40106BF3A	ACTIVE	CDIP	J	14	1	None	Call TI	Level-NC-NC-NC
CD40106BM	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD40106BM96	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD40106BMT	ACTIVE	SOIC	D	14	250	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD40106BNSR	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD40106BPW	ACTIVE	TSSOP	PW	14	90	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
CD40106BPWR	ACTIVE	TSSOP	PW	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM

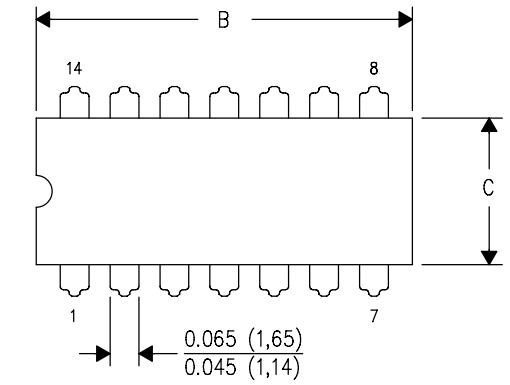
[1] The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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 - May not be currently available - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
None: Not yet available Lead (Pb-Free).
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.
Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

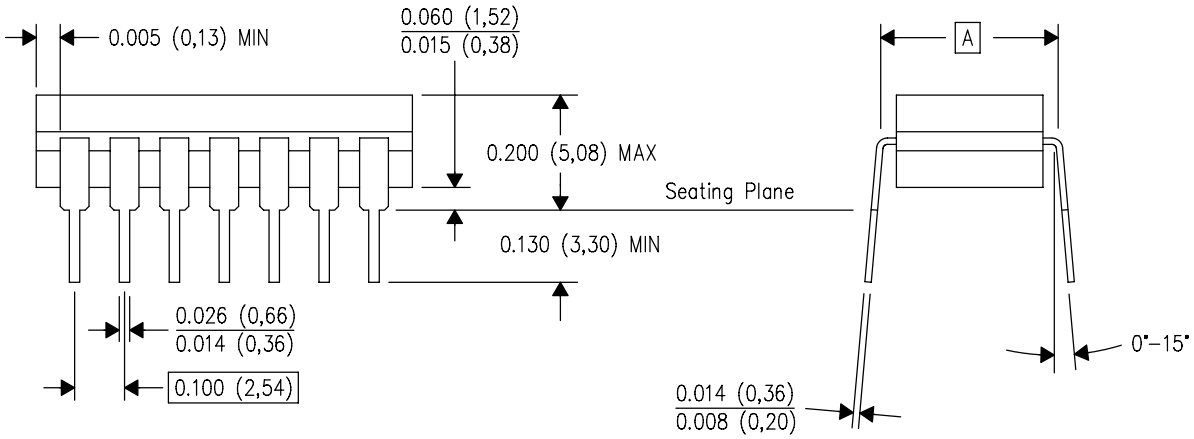
[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDECindustry standard classifications, and peak solder temperature.

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)

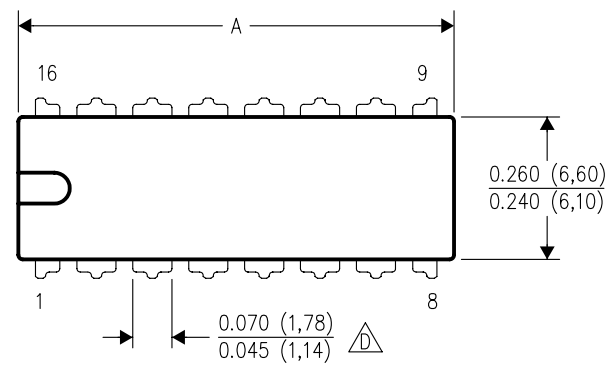


4040083/F 03/03

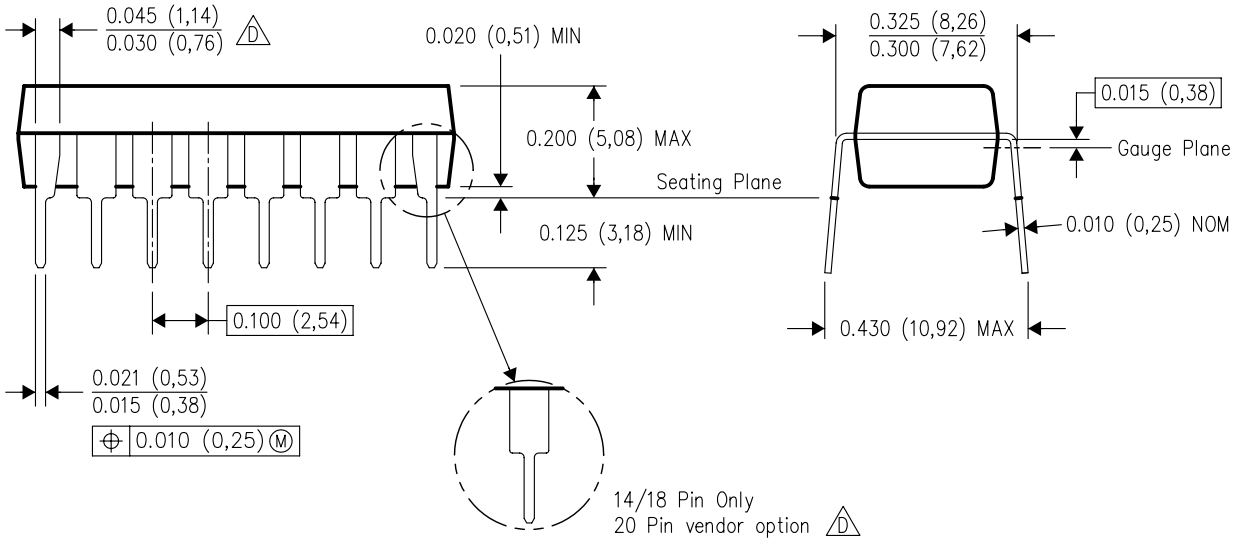
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls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

N (R–PDIP–T**) PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



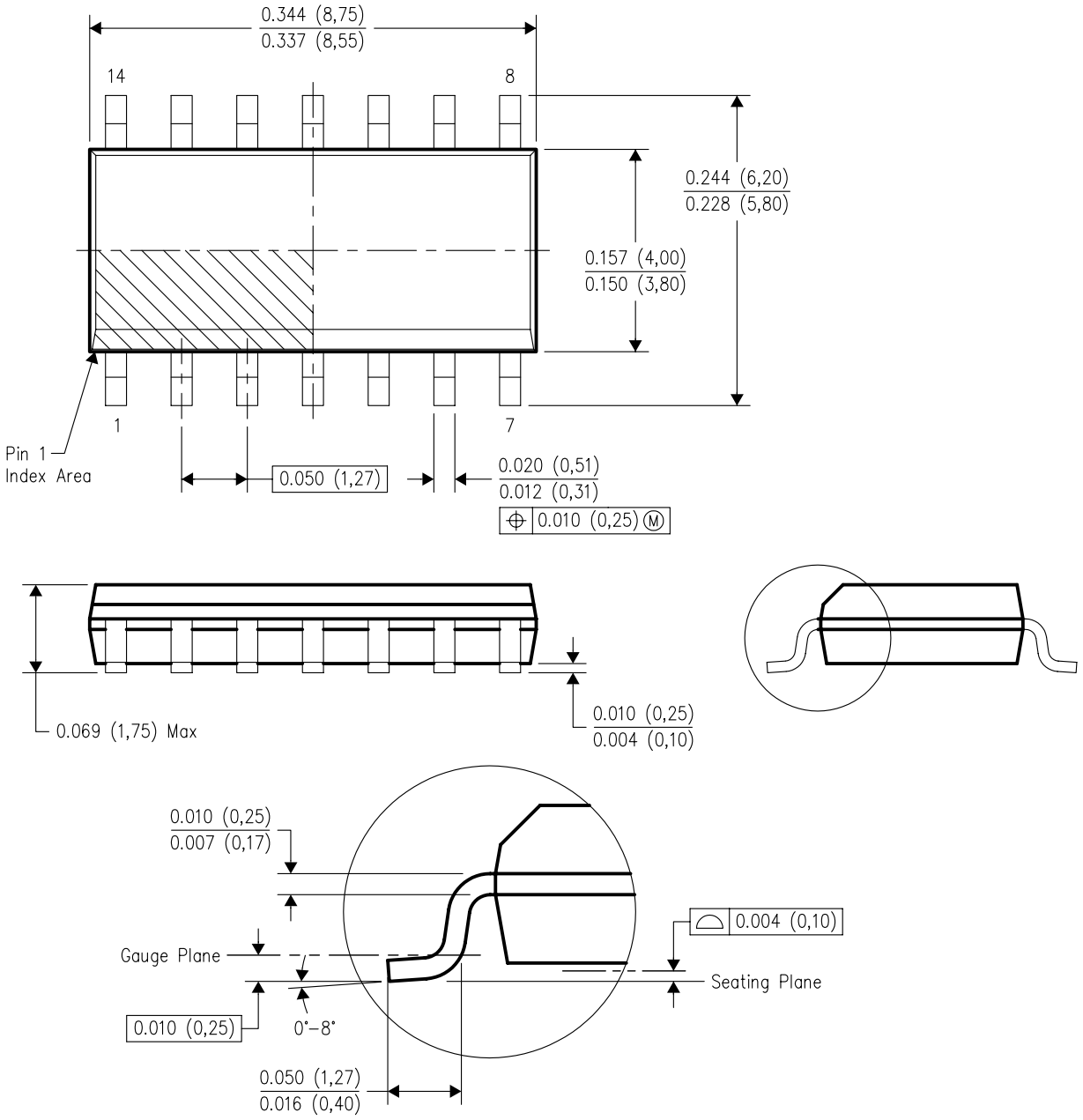
DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



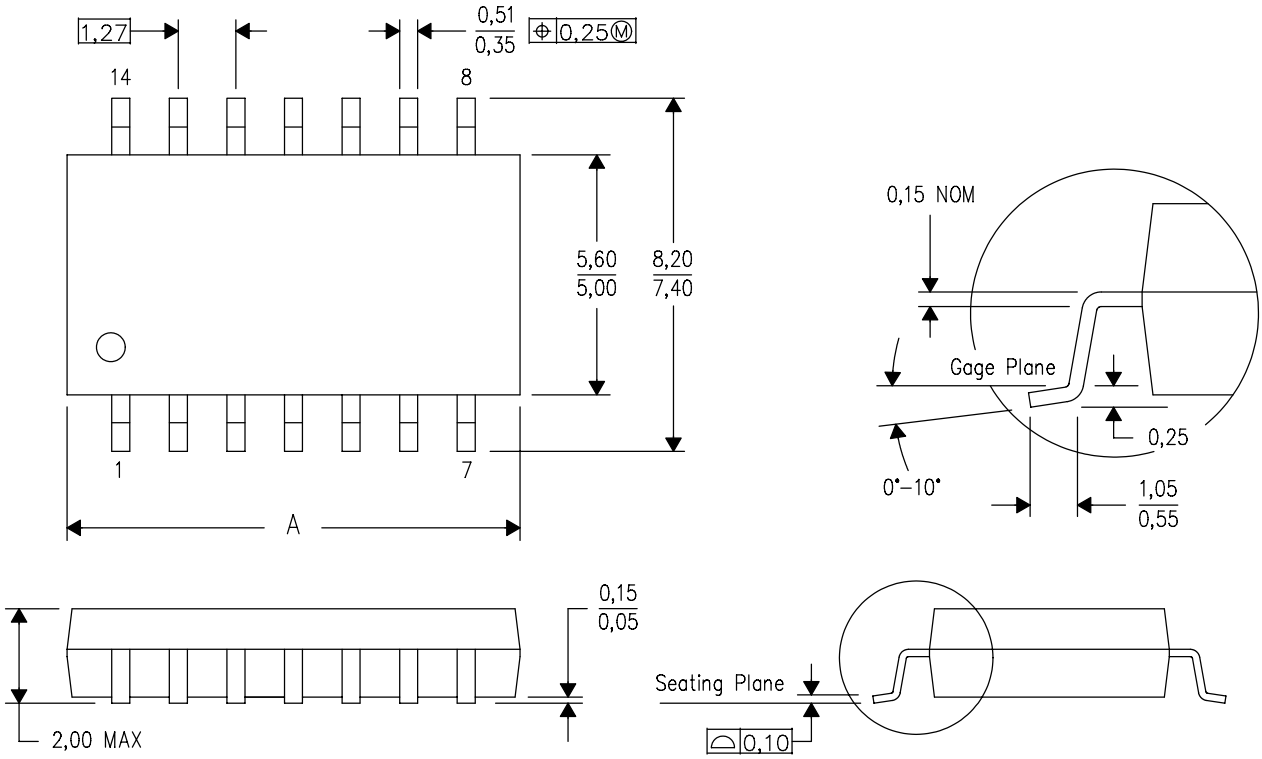
4040049/E 12/2002

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–G14) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–012 variation AB.



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

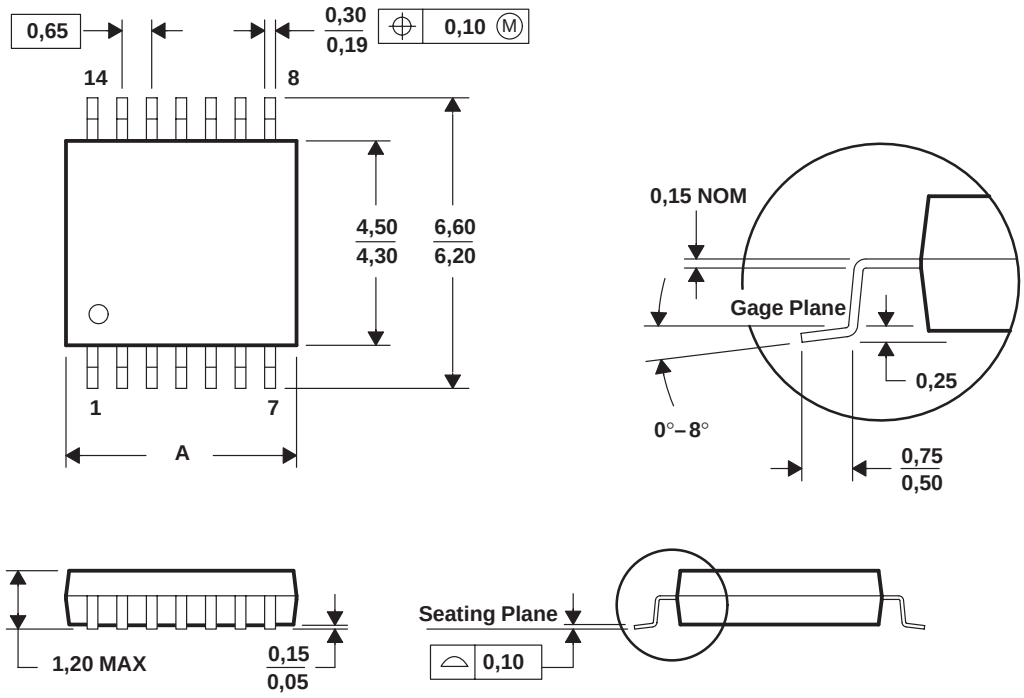
4040062/C 03/03

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.

MTSS001C – JANUARY 1995 – REVISED FEBRUARY 1999

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

14 PINS SHOWN



DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064/F 01/97

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.
D. Falls within JEDEC MO-153

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