

CMOS Dual Monostable Multivibrator

High-Voltage Types (20-Volt Rating)

■ CD4098B dual monostable multivibrator provides stable retriggerable/resettable one-shot operation for any fixed-voltage timing application.

An external resistor (R_X) and an external capacitor (C_X) control the timing for the circuit. Adjustment of R_X and C_X provides a wide range of output pulse widths from the Q and $\bar{Q}$ terminals. The time delay from trigger input to output transition (trigger propagation delay) and the time delay from reset input to output transition (reset propagation delay) are independent of R_X and C_X .

Leading-edge-triggering (+TR) and trailing-edge-triggering (–TR) inputs are provided for triggering from either edge of an input pulse. An unused +TR input should be tied to V_{SS} . An unused –TR input should be tied to V_{DD} . A RESET (on low level) is provided for immediate termination of the output pulse or to prevent output pulses when power is turned on. An unused RESET input should be tied to V_{DD} . However, if an entire section of the CD4098B is not used, its RESET should be tied to V_{SS} . See Table I.

In normal operation the circuit triggers (extends the output pulse one period) on the application of each new trigger pulse. For operation in the non-retriggerable mode, $\bar{Q}$ is connected to –TR when leading-edge triggering (+TR) is used or Q is connected to +TR when trailing-edge triggering (–TR) is used.

The time period (T) for this multivibrator can be approximated by: $T_X = \frac{1}{2} R_X C_X$ for $C_X \geq 0.01 \mu F$. Time periods as a function of R_X for values of C_X and V_{DD} are given in Fig. 8. Values of T vary from unit to unit and as a function of voltage, temperature, and $R_X C_X$.

The minimum value of external resistance, R_X , is 5 k Ω . The maximum value of external capacitance, C_X , is 100 μF . Fig. 9 shows time periods as a function of C_X for values of R_X and V_{DD} .

The output pulse width has variations of $\pm 2.5\%$ typically, over the temperature range of $-55^\circ C$ to $125^\circ C$ for $C_X = 1000$ pF and $R_X = 100$ k Ω .

For power supply variations of $\pm 5\%$, the output pulse width has variations of $\pm 0.5\%$ typically, for $V_{DD} = 10$ V and 15 V and $\pm 1\%$ typically, for $V_{DD} = 5$ V at $C_X = 1000$ pF and $R_X = 5$ k Ω .

These types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, and MT suffixes), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

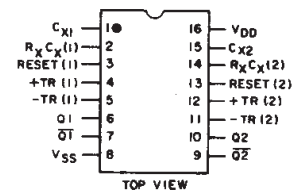
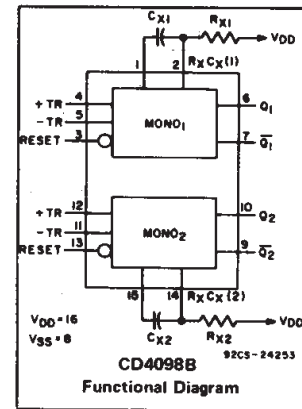
The CD4098B is similar to type MC14528.

Features:

- Retriggerable/resettable capability
- Trigger and reset propagation delays independent of R_X , C_X
- Triggering from leading or trailing edge
- Q and $\bar{Q}$ buffered outputs available
- Separate resets
- Wide range of output-pulse widths
- 100% tested for maximum 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 $25^\circ C$
- Noise margin (full package-temperature range):
 - 1 V at $V_{DD} = 5$ V
 - 2 V at $V_{DD} = 10$ V
 - 2.5 V at $V_{DD} = 15$ V
- 5-V, 10-V, and 15-V parametric ratings
- Standardized, symmetrical output characteristics
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices."

Applications:

- Pulse delay and timing
- Pulse shaping
- Astable multivibrator



TERMINALS 1, 8, 15 ARE
ELECTRICALLY CONNECTED
INTERNALLY

92CS-24648R1

TERMINAL ASSIGNMENT

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 $V_{DD} + 0.5$ V

DC INPUT CURRENT, ANY ONE INPUT

± 10 mA

POWER DISSIPATION PER PACKAGE (P_D):

For $T_A = -55^\circ C$ to $+100^\circ C$

500 mW

For $T_A = +100^\circ C$ to $+125^\circ C$

Derate Linearly at 12 mW/ $^\circ C$ to 200 mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR

FOR $T_A =$ FULL PACKAGE-TEMPERATURE RANGE (All Package Types)

100 mW

OPERATING-TEMPERATURE RANGE (T_A)

$-55^\circ C$ to $+125^\circ C$

STORAGE TEMPERATURE RANGE (T_{stg})

$-65^\circ C$ to $+150^\circ C$

LEAD TEMPERATURE (DURING SOLDERING):

At distance $1/16 \pm 1/32$ inch (1.59 ± 0.79 mm) from case for 10 s max

$+265^\circ C$

RECOMMENDED OPERATING CONDITIONS

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

CHARACTERISTIC	V_{DD} V	LIMITS		UNITS
		MIN.	MAX.	
Supply-Voltage Range (For $T_A =$ Full Package-Temperature Range)	–	3	18	V
Trigger Pulse Width $t_W(TR)$	5 10 15	140 60 40	– – –	ns
Reset Pulse Width $t_W(R)$ (This is a function of C_X)	–	See Dynamic Char. Chart and Fig. 10		–
Trigger Rise or Fall Time $t_r(TR)$, $t_f(TR)$	5–15	–	100	μs

CD4098B Types

TABLE I

CD4098B FUNCTIONAL TERMINAL CONNECTIONS

FUNCTION	V _{DD} TO TERM. NO.		V _{SS} TO TERM. NO.		INPUT PULSE TO TERM. NO.		OTHER CONNECTIONS	
	MONO ₁	MONO ₂	MONO ₁	MONO ₂	MONO ₁	MONO ₂	MONO ₁	MONO ₂
Leading-Edge Trigger/Retriggerable	3, 5	11, 13			4	12		
Leading-Edge Trigger/Non-retriggerable	3	13			4	12	5-7	11-9
Trailing-Edge Trigger/Retriggerable	3	13	4	12	5	11		
Trailing-Edge Trigger/Non-retriggerable	3	13			5	11	4-6	12-10
Unused Section	5	11	3, 4	12, 13				

NOTES:

1. A RETRIGGERABLE ONE-SHOT MULTIVIBRATOR HAS AN OUTPUT PULSE WIDTH WHICH IS EXTENDED ONE FULL TIME PERIOD (T_X) AFTER APPLICATION OF THE LAST TRIGGER PULSE. The minimum time between retriggering edges (or trigger and retrigger edges) is 40 per cent of (T_X).

2. A NON-RETRIGGERABLE ONE-SHOT MULTIVIBRATOR HAS A TIME PERIOD T_X REFERENCED FROM THE APPLICATION OF THE FIRST TRIGGER PULSE.

INPUT PULSE TRAIN

RETRIGGERABLE MODE PULSE WIDTH (+TR MODE)

NON-RETRIGGERABLE MODE PULSE WIDTH (+TR MODE)

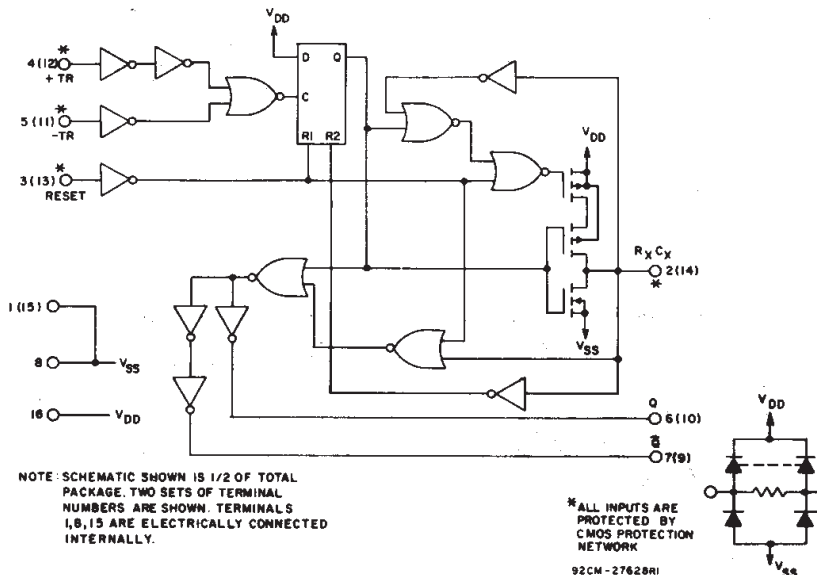


Fig. 4 — CD4098B logic diagram.

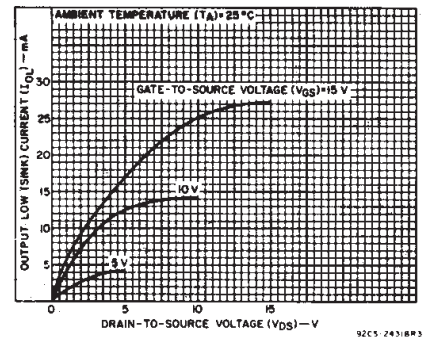


Fig. 1 — Typical output low (sink) current characteristics.

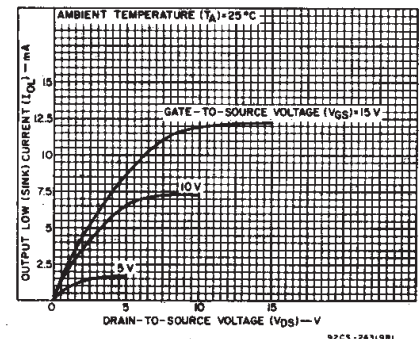


Fig. 2 — Minimum output low (sink) current characteristics.

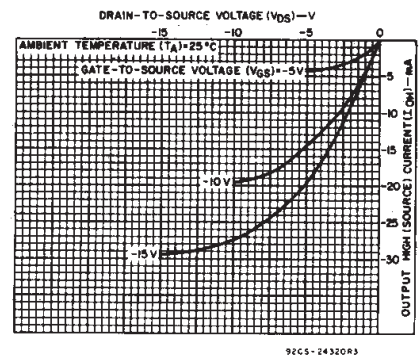


Fig. 3 — Typical output high (source) current characteristics.

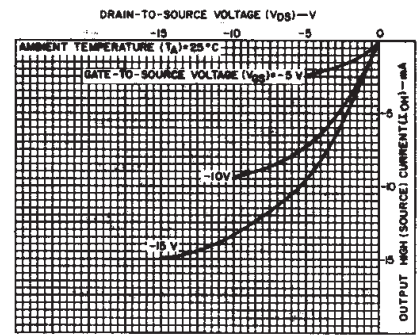


Fig. 5 — Minimum output high (source) current characteristics.

3
COMMERCIAL CMOS
HIGH VOLTAGE ICs

CD4098B Types

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.	Typ.	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	
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	—	mA
	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.	—	0.5	5	0.05				—	0	0.05	V
	—	0.10	10	0.05				—	0	0.05	
	—	0.15	15	0.05				—	0	0.05	
Output Voltage: High-Level, V _{OH} Min.	—	0.5	5	4.95				4.95	5	—	V
	—	0.10	10	9.95				9.95	10	—	
	—	0.15	15	14.95				14.95	15	—	
Input Low Voltage, V _{IL} Max.	0.5,4.5	—	5	1.5				—	—	1.5	V
	1.9	—	10	3				—	—	3	
	1.5,13.5	—	15	4				—	—	4	
Input High Voltage, V _{IH} Min.	0.5,4.5	—	5	3.5				3.5	—	—	V
	1.9	—	10	7				7	—	—	
	1.5,13.5	—	15	11				11	—	—	
Input Current, I _{IN} Max.	—	0.18	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁵	±0.1	μA

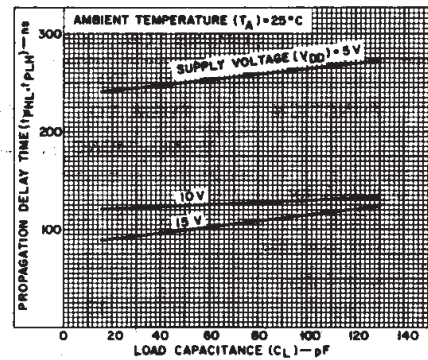


Fig. 6 – Typical propagation delay time vs. load capacitance, trigger into Q out. (All values of C_X and R_X.)

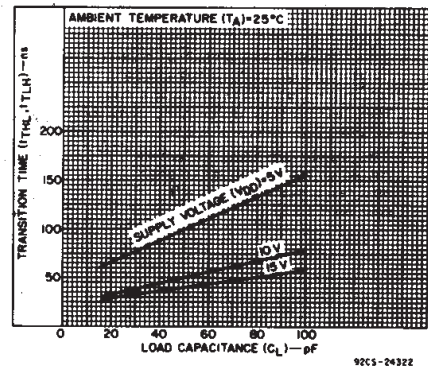


Fig. 7 – Transition time vs. load capacitance for R_X = 5 k Ω -10000 k Ω and C_X = 15 pF-10000 pF.

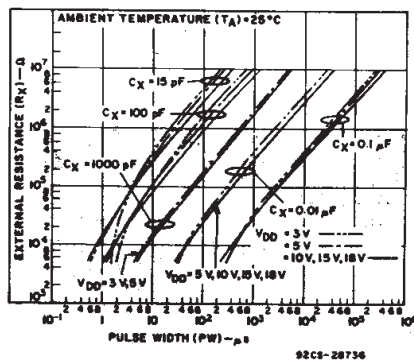


Fig. 8 – Typical external resistance vs. pulse width.

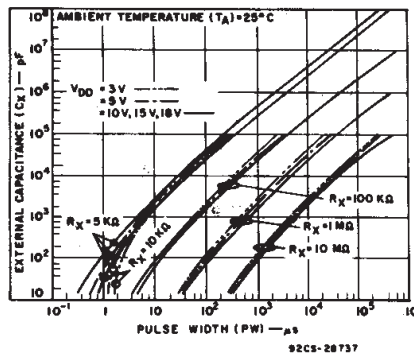


Fig. 9 – Typical external capacitance vs. pulse width.

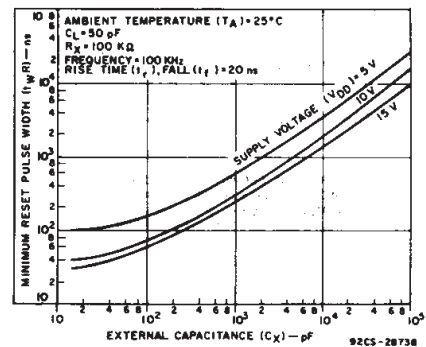


Fig. 10 – Typical minimum reset pulse width vs. external capacitance.

CD4098B Types

DYNAMIC ELECTRICAL CHARACTERISTICS

At $T_A = 25^\circ\text{C}$; Input $t_r, t_f = 20\text{ ns}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}\Omega$

CHARACTERISTIC	TEST CONDITIONS			LIMITS		UNITS
	R_X (k Ω)	C_X (pF)	V_{DD} (V)	Typ.	Max.	
Trigger Propagation Delay Time +TR, -TR to Q, $\bar{Q}$ t_{PHL} , t_{PLH}	5 to 10,000	≥ 15	5 10 15	250 125 100	500 250 200	ns
Minimum Trigger Pulse Width, t_{WH} , t_{WL}	5 to 10,000	≥ 15	5 10 15	70 30 20	140 60 40	ns
Transition Time, t_{TLH}	5 to 10,000	≥ 15	5 10 15	100 50 40	200 100 80	ns
t_{THL}	5 to 10,000	15 to 10,000	5 10 15	100 50 40	200 100 80	
	5 to 10,000	0.01 μF to 0.1 μF	5 10 15	150 75 65	300 150 130	
	5 to 10,000	0.1 μF to 1 μF	5 10 15	250 150 80	500 300 160	
Reset Propagation Delay Time, T_{PHL} , T_{PLH}	5 to 10,000	≥ 15	5 10 15	225 125 75	450 250 150	ns
Minimum Reset Pulse Width, t_{WR}	100	15	5 10 15	100 40 30	200 80 60	ns
			5 10 15	600 300 250	1200 600 500	
		0.1 μF	5 10 15	25 15 10	50 30 20	μs
			5 10 15	5 7.5 7.5	10 15 15	
Trigger Rise or Fall Time t_r (TR), t_f (TR)	—	—	5 to 15	—	100	μs
Pulse Width Match Between Circuits in Same Package	10	10,000	5 10 15	5 7.5 7.5	10 15 15	%
Input Capacitance, C_{IN}	Any Input			5	7.5	pF

TEST CIRCUITS

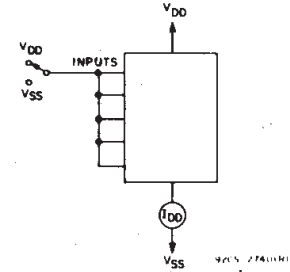


Fig. 12 - Quiescent-device-current test circuits.

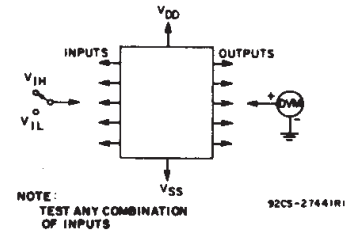


Fig. 13 - Input-voltage test circuit.

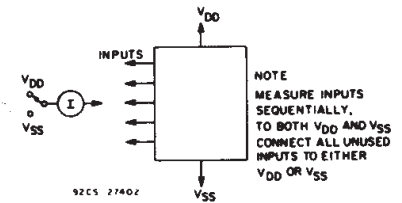


Fig. 14 - Input leakage current test circuit.

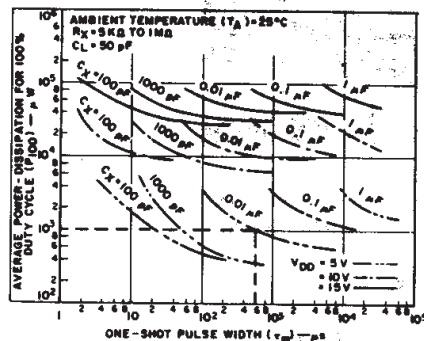
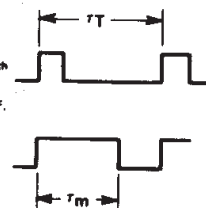


Fig. 11 - Average power dissipation vs. one-shot pulse width.

To calculate average power dissipation (P) for less than 100% duty cycle:
 P_{100} = average power for 100% duty cycle
 $P = \left(\frac{t_m}{T}\right) P_{100}$ where t_m = one-shot pulse width
 T = trigger pulse period
 e.g. For $t_m = 600\text{ }\mu\text{s}$, $T = 1000\text{ }\mu\text{s}$, $C_X = 0.01\text{ }\mu\text{F}$,
 $V_{DD} = 5\text{ V}$
 $P = \left(\frac{600}{1000}\right) 10^{-3}\text{ W} = 600\text{ }\mu\text{W}$ (see dotted line on graph)



92CN-28739

CD4098B Types

APPLICATIONS

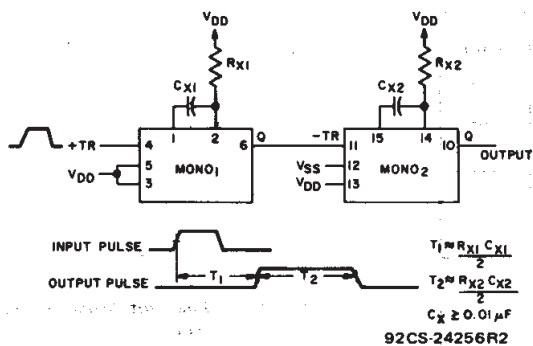


Fig. 15 – Pulse delay.

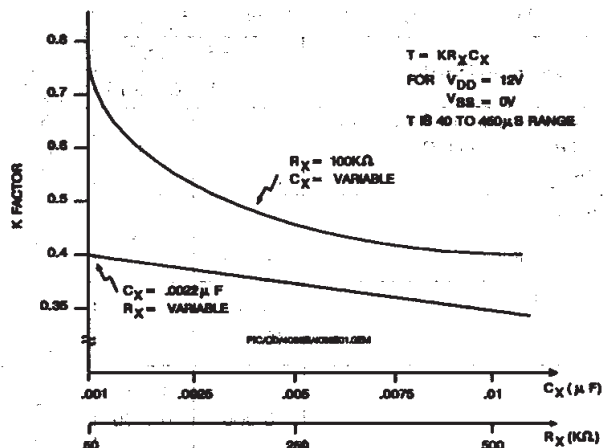


Fig. 17 – K-Factor for $V_{DD} = 12V$.

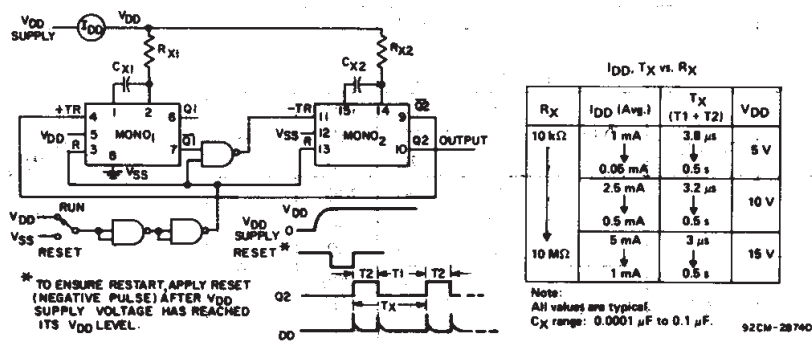
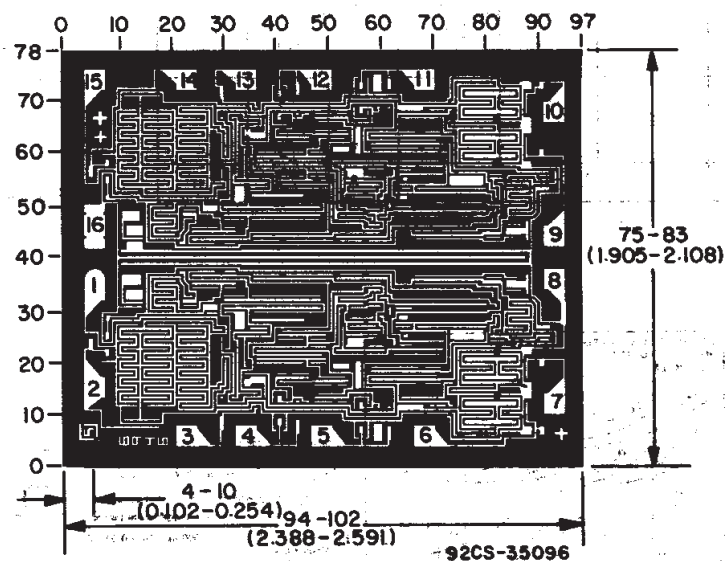


Fig. 16 – Astable multivibrator with restart after reset capability.



Dimensions and Pad Layout for CD4098BH

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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD4098BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-55 to 125	CD4098BE	Samples
CD4098BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-55 to 125	CD4098BE	Samples
CD4098BF	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	CD4098BF	Samples
CD4098BF3A	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	CD4098BF3A	Samples
CD4098BFB	ACTIVE	CDIP	J	16	1	TBD	Call TI	Call TI	-55 to 125		Samples
CD4098BM	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4098BM	Samples
CD4098BM96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4098BM	Samples
CD4098BM96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4098BM	Samples
CD4098BMG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4098BM	Samples
CD4098BMT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4098BM	Samples
CD4098BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM098B	Samples
CD4098BPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM098B	Samples
JM38510/17504BEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	JM38510/ 17504BEA	Samples
M38510/17504BEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	JM38510/ 17504BEA	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): 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.

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

⁽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 CD4098B, CD4098B-MIL :

- Catalog: [CD4098B](#)
- Military: [CD4098B-MIL](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


A0	Dimension designed to accommodate the component width
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

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD4098BM96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4098BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4098BM96	SOIC	D	16	2500	333.2	345.9	28.6
CD4098BPWR	TSSOP	PW	16	2000	367.0	367.0	35.0

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	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**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	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	AA	BB	AC	AD



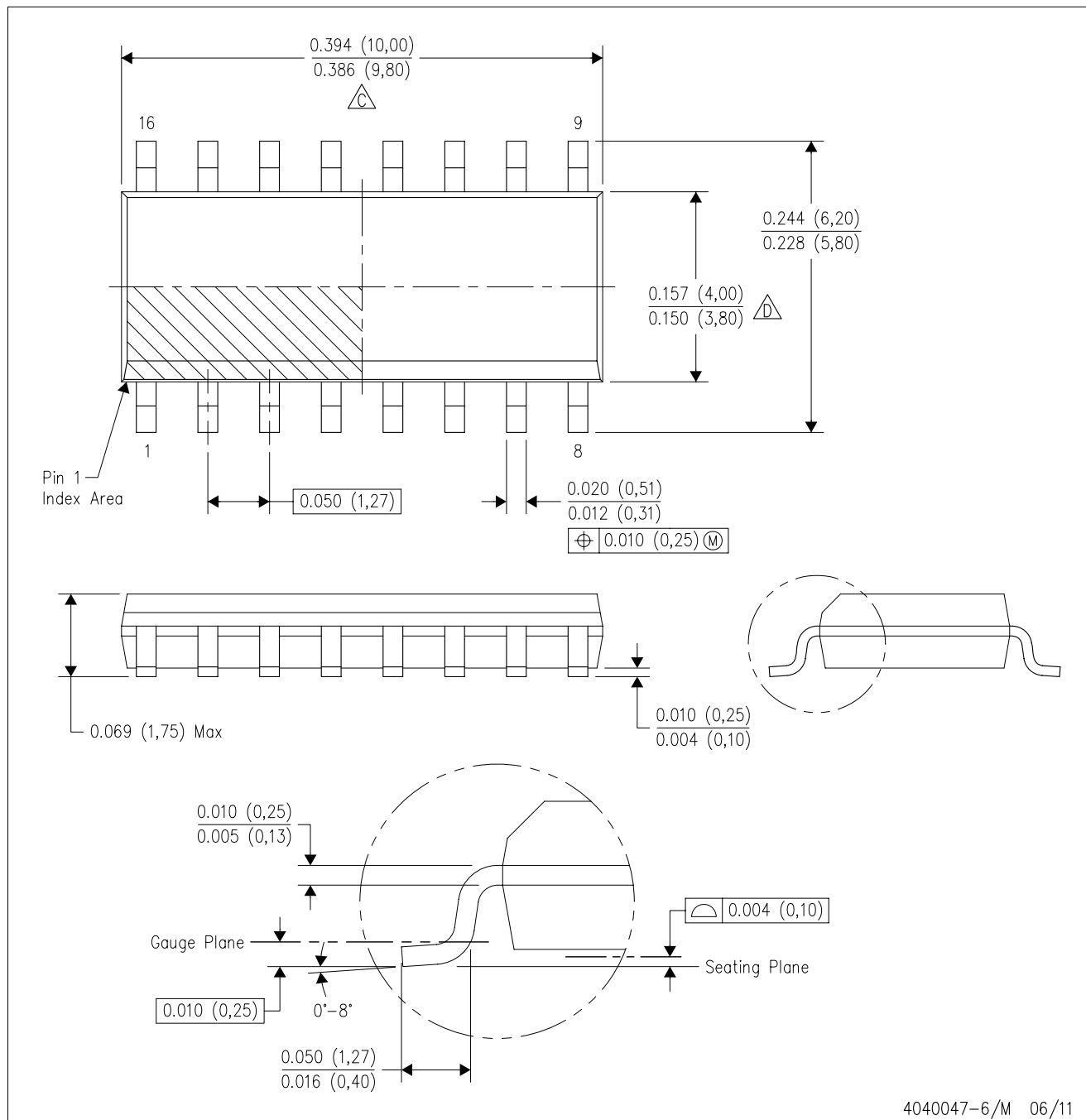
4040049/E 12/2002

NOTES:

- A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
-  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-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- 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 0.006 (0,15) each side.
 - D. 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)

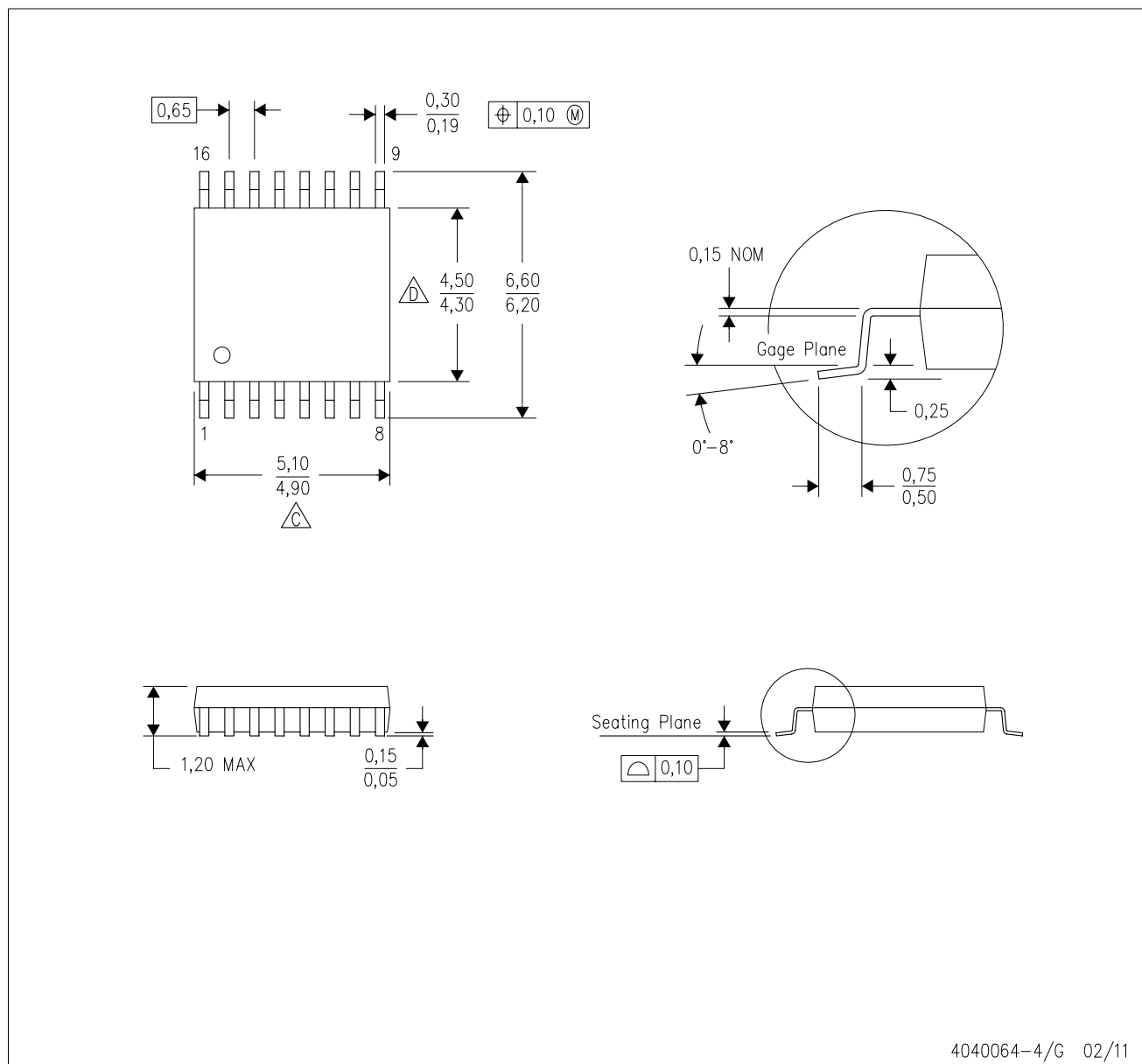
PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - 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.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE

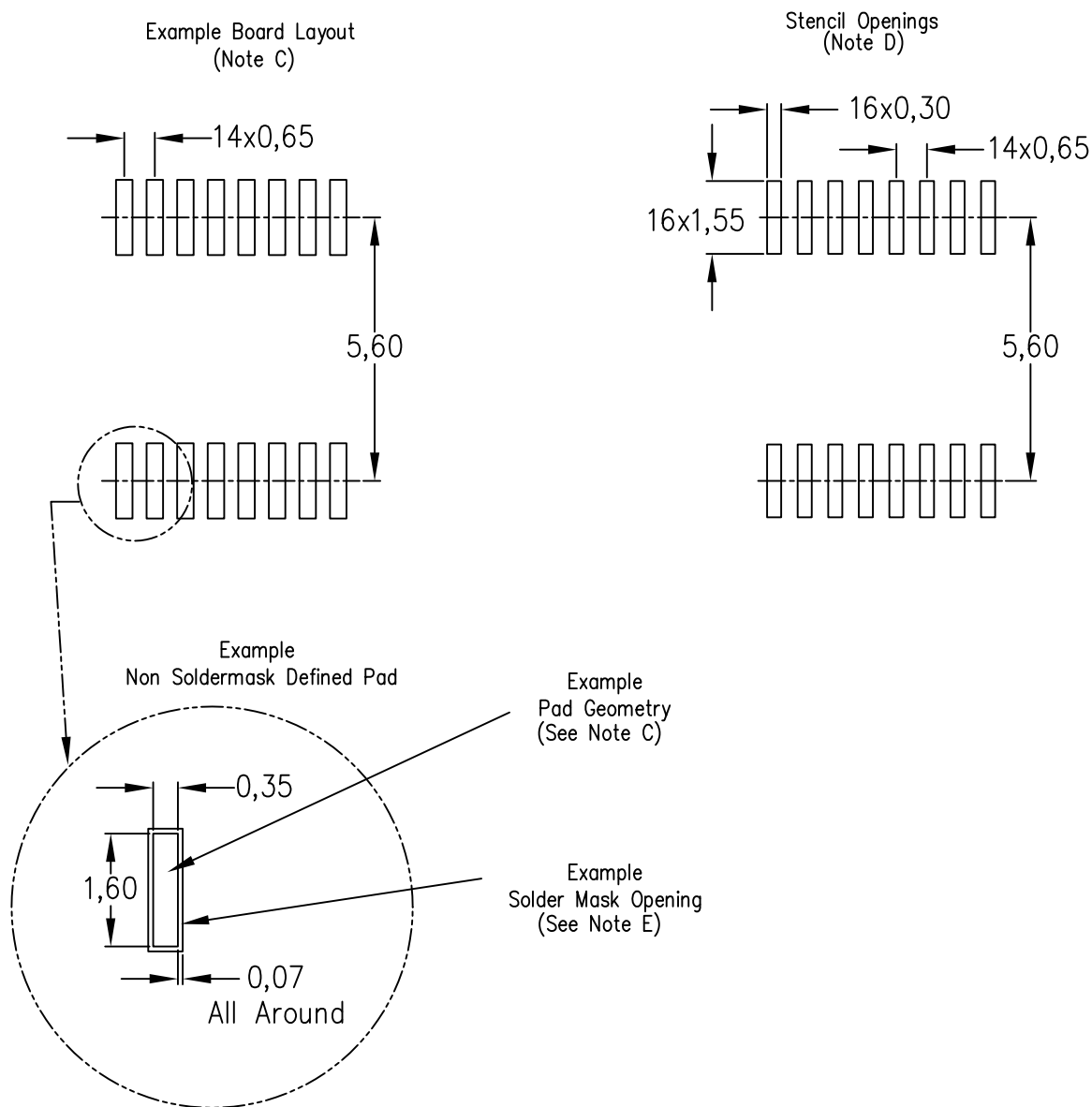


4040064-4/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - 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 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4211284-3/F 12/12

- NOTES:
- 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.

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