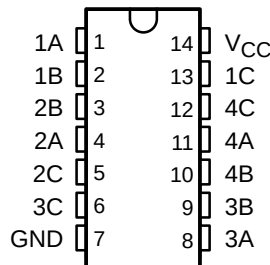


SN74HC4066 QUADRUPLE BILATERAL ANALOG SWITCH

SCLS325G – MARCH 1996 – REVISED JULY 2003

- Wide Operating Voltage Range of 2 V to 6 V
- Typical Switch Enable Time of 18 ns
- Low Power Consumption, 20- μ A Max I_{CC}
- Low Input Current of 1 μ A Max
- High Degree of Linearity
- High On-Off Output-Voltage Ratio
- Low Crosstalk Between Switches
- Low On-State Impedance . . .
50- Ω TYP at $V_{CC} = 6$ V
- Individual Switch Controls

D, DB, N, NS, OR PW PACKAGE
(TOP VIEW)



description/ordering information

The SN74HC4066 is a silicon-gate CMOS quadruple analog switch designed to handle both analog and digital signals. Each switch permits signals with amplitudes of up to 6 V (peak) to be transmitted in either direction.

Each switch section has its own enable input control (C). A high-level voltage applied to C turns on the associated switch section.

Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

ORDERING INFORMATION

T_A	PACKAGE [†]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP – N	Tube of 25	SN74HC4066N	SN74HC4066N
	SOIC – D	Tube of 50	SN74HC4066D	HC4066
		Reel of 2500	SN74HC4066DR	
	SOP – NS	Reel of 250	SN74HC4066DT	HC4066
		Reel of 2000	SN74HC4066NSR	
	SSOP – DB	Reel of 2000	SN74HC4066DBR	HC4066
	TSSOP – PW	Tube of 90	SN74HC4066PW	HC4066
		Reel of 2000	SN74HC4066PWR	
		Reel of 250	SN74HC4066PWT	

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

FUNCTION TABLE (each switch)

INPUT CONTROL (C)	SWITCH
L	OFF
H	ON



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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The diagram shows a 4-to-1 multiplexer circuit. On the left, three inverters are connected in series to the input **C**. The output of the third inverter is connected to the base of a PNP transistor. The emitter of this transistor is connected to V_{CC} , and its collector is connected to the output **A**. The base of an NPN transistor is connected to the output of the second inverter. The emitter of this transistor is connected to ground, and its collector is also connected to the output **A**. The output of the first inverter is connected to the base of another PNP transistor. The emitter of this transistor is connected to V_{CC} , and its collector is connected to the output **B**. The base of another NPN transistor is connected to the output of the third inverter. The emitter of this transistor is connected to ground, and its collector is also connected to the output **B**. The output **A** is connected to the input **C** through a feedback loop.

Supply voltage range, V_{CC} (see Note 1)	−0.5 V to 7 V
Control-input diode current, I_I ($V_I < 0$ or $V_I > V_{CC}$)	±20 mA
I/O port diode current, I_I ($V_I < 0$ or $V_{I/O} > V_{CC}$)	±20 mA
On-state switch current ($V_{I/O} = 0$ to V_{CC})	±25 mA
Continuous current through V_{CC} or GND	±50 mA
Package thermal impedance, θ_{JA} (see Note 2):	
D package	86°C/W
DB package	96°C/W
N package	80°C/W
NS package	76°C/W
PW package	113°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. All voltages are with respect to ground unless otherwise specified.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

SN74HC4066

QUADRUPLE BILATERAL ANALOG SWITCH

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recommended operating conditions (see Note 3)

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	2 [†]	5	6	V
$V_{I/O}$	I/O port voltage	0		V_{CC}	V
V_{IH}	High-level input voltage, control inputs	$V_{CC} = 2\text{ V}$	1.5	V_{CC}	V
		$V_{CC} = 4.5\text{ V}$	3.15	V_{CC}	
		$V_{CC} = 6\text{ V}$	4.2	V_{CC}	
V_{IL}	Low-level input voltage, control inputs	$V_{CC} = 2\text{ V}$	0	0.3	V
		$V_{CC} = 4.5\text{ V}$	0	0.9	
		$V_{CC} = 6\text{ V}$	0	1.2	
$\Delta t/\Delta v$	Input transition rise/fall time	$V_{CC} = 2\text{ V}$		1000	ns
		$V_{CC} = 4.5\text{ V}$		500	
		$V_{CC} = 6\text{ V}$		400	
T_A	Operating free-air temperature	-40		85	°C

[†] With supply voltages at or near 2 V, the analog switch on-state resistance becomes very nonlinear. It is recommended that only digital signals be transmitted at these low supply voltages.

NOTE 3: 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	V_{CC}	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
			MIN	TYP	MAX			
r_{on}	On-state switch resistance	2 V		150				Ω
		4.5 V		50	85		106	
		6 V		30				
$r_{on(p)}$	Peak on-state resistance	2 V		320				Ω
		4.5 V		70	170		215	
		6 V		50				
I_I	Control input current	$V_C = 0$ or V_{CC}	6 V	± 0.1	± 100		± 1000	nA
I_{soff}	Off-state switch leakage current	$V_I = V_{CC}$ or 0, $V_O = V_{CC}$ or 0, $V_C = V_{IL}$ (see Figure 2)	6 V		± 0.1		± 5	μA
I_{son}	On-state switch leakage current	$V_I = V_{CC}$ or 0, $V_C = V_{IH}$ (see Figure 3)	6 V		± 0.1		± 5	μA
I_{CC}	Supply current	$V_I = 0$ or V_{CC} , $I_O = 0$	6 V		2		20	μA
C_i	Input capacitance	A or B	5 V	9				pF
		C		3	10			
C_f	Feed-through capacitance	A to B		0.5				pF
C_o	Output capacitance	A or B	5 V	9				pF



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QUADRUPLE BILATERAL ANALOG SWITCH

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switching characteristics over recommended operating free-air temperature range

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V _{CC}	T _A = 25°C			MIN	MAX	UNIT
					MIN	TYP	MAX			
t _{PLH} , t _{PHL} Propagation delay time	A or B	B or A	C _L = 50 pF (see Figure 4)	2 V		10	60		75	ns
				4.5 V		4	12		15	
				6 V		3	10		13	
t _{PZH} , t _{PZL} Switch turn-on time	C	A or B	R _L = 1 kΩ, C _L = 50 pF (see Figure 5)	2 V		70	180		225	ns
				4.5 V		21	36		45	
				6 V		18	31		38	
t _{PLZ} , t _{PHZ} Switch turn-off time	C	A or B	R _L = 1 kΩ, C _L = 50 pF (see Figure 5)	2 V		50	200		250	ns
				4.5 V		25	40		50	
				6 V		22	34		43	
f _I Control input frequency	C	A or B	C _L = 15 pF, R _L = 1 kΩ, V _C = V _{CC} or GND, V _O = V _{CC} /2 (see Figure 6)	2 V		15				MHz
				4.5 V		30				
				6 V		30				
Control feed-through noise	C	A or B	C _L = 50 pF, R _{in} = R _L = 600 Ω, V _C = V _{CC} or GND, f _{in} = 1 MHz (see Figure 7)	4.5 V		15				mV (rms)
				6 V		20				

operating characteristics, V_{CC} = 4.5 V, T_A = 25°C

PARAMETER	TEST CONDITIONS	TYP	UNIT
C _{pd} Power dissipation capacitance per gate	C _L = 50 pF, f = 1 MHz	45	pF
Minimum through bandwidth, A to B or B to A [†] [20 log (V _O /V _I)] = -3 dB	C _L = 50 pF, V _C = V _{CC} , R _L = 600 Ω, (see Figure 8)	30	MHz
Crosstalk between any switches [‡]	C _L = 10 pF, f _{in} = 1 MHz, R _L = 50 Ω, (see Figure 9)	45	dB
Feed through, switch off, A to B or B to A [‡]	C _L = 50 pF, f _{in} = 1 MHz, R _L = 600 Ω, (see Figure 10)	42	dB
Amplitude distortion rate, A to B or B to A	C _L = 50 pF, f _{in} = 1 kHz, R _L = 10 kΩ, (see Figure 11)	0.05%	

[†] Adjust the input amplitude for output = 0 dBm at f = 1 MHz. Input signal must be a sine wave.

[‡] Adjust the input amplitude for input = 0 dBm at f = 1 MHz. Input signal must be a sine wave.



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PARAMETER MEASUREMENT INFORMATION

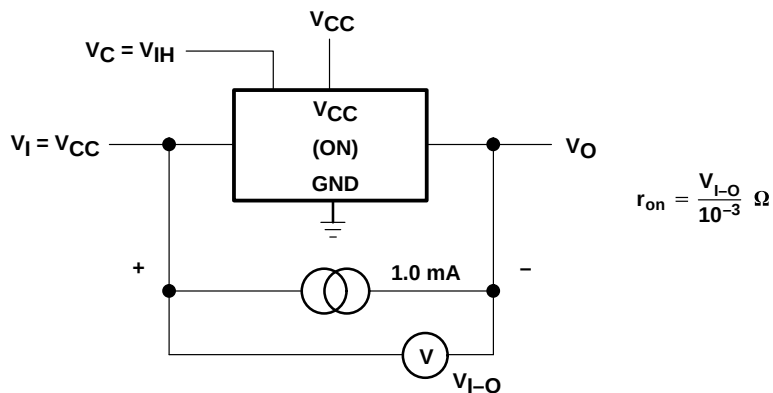


Figure 1. On-State Resistance Test Circuit

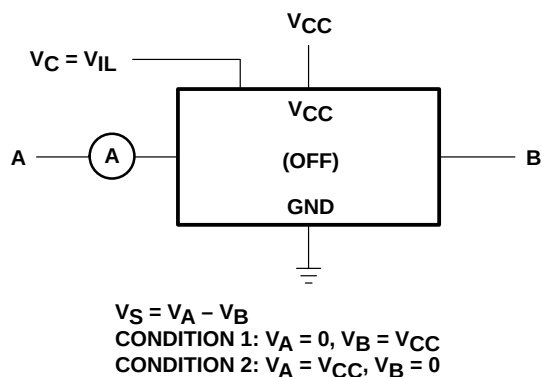


Figure 2. Off-State Switch Leakage-Current Test Circuit

SN74HC4066
QUADRUPLE BILATERAL ANALOG SWITCH

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PARAMETER MEASUREMENT INFORMATION

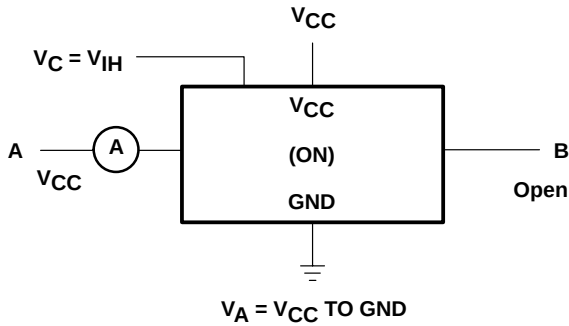


Figure 3. On-State Leakage-Current Test Circuit

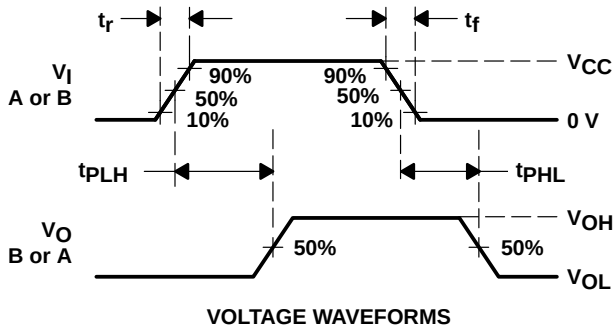
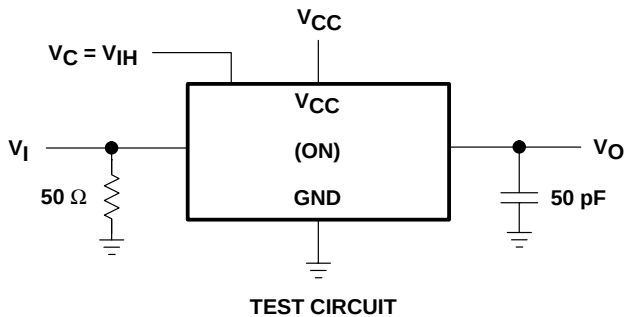
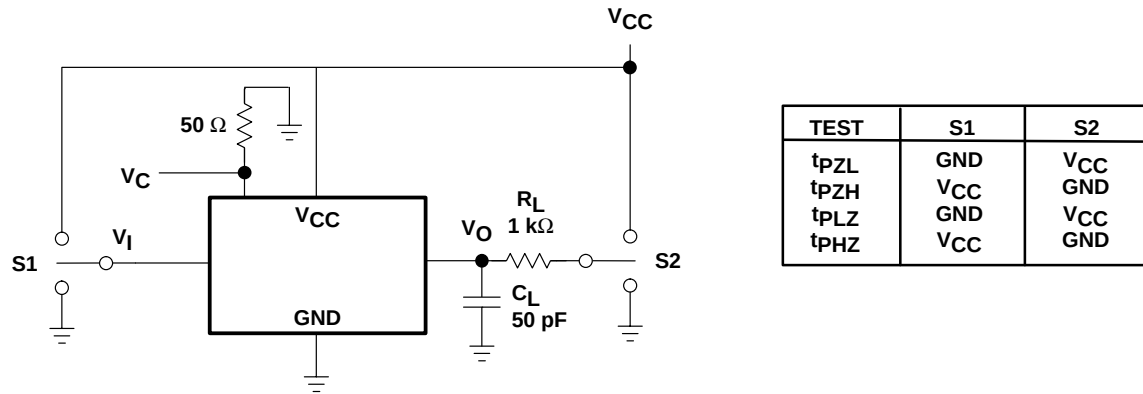
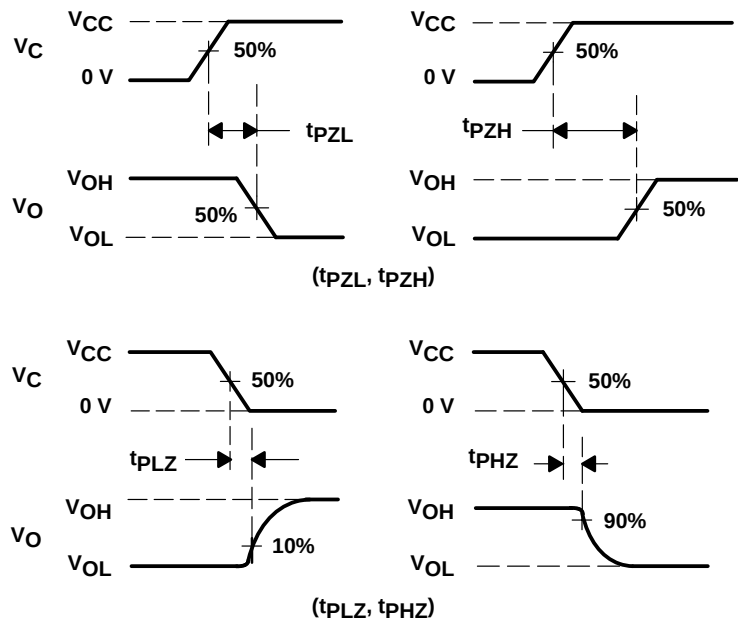


Figure 4. Propagation Delay Time, Signal Input to Signal Output

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

Figure 5. Switching Time (t_{pZL} , t_{pLZ} , t_{pZH} , t_{pHZ}), Control to Signal Output

SN74HC4066 QUADRUPLE BILATERAL ANALOG SWITCH

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PARAMETER MEASUREMENT INFORMATION

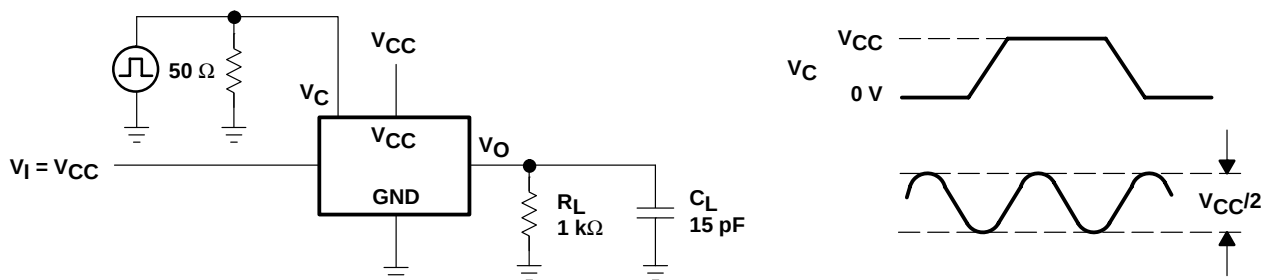


Figure 6. Control-Input Frequency

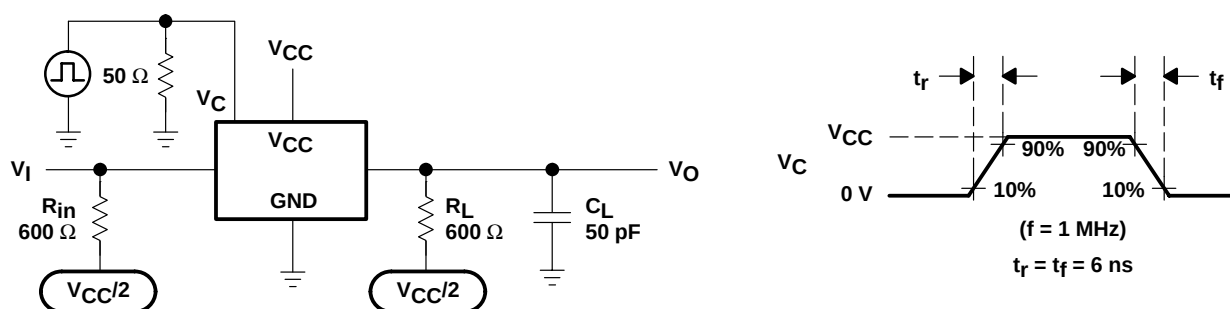


Figure 7. Control Feed-Through Noise

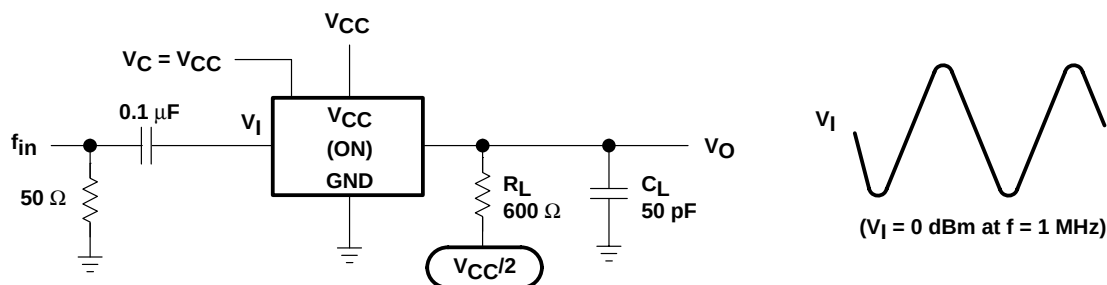


Figure 8. Minimum Through Bandwidth

PARAMETER MEASUREMENT INFORMATION

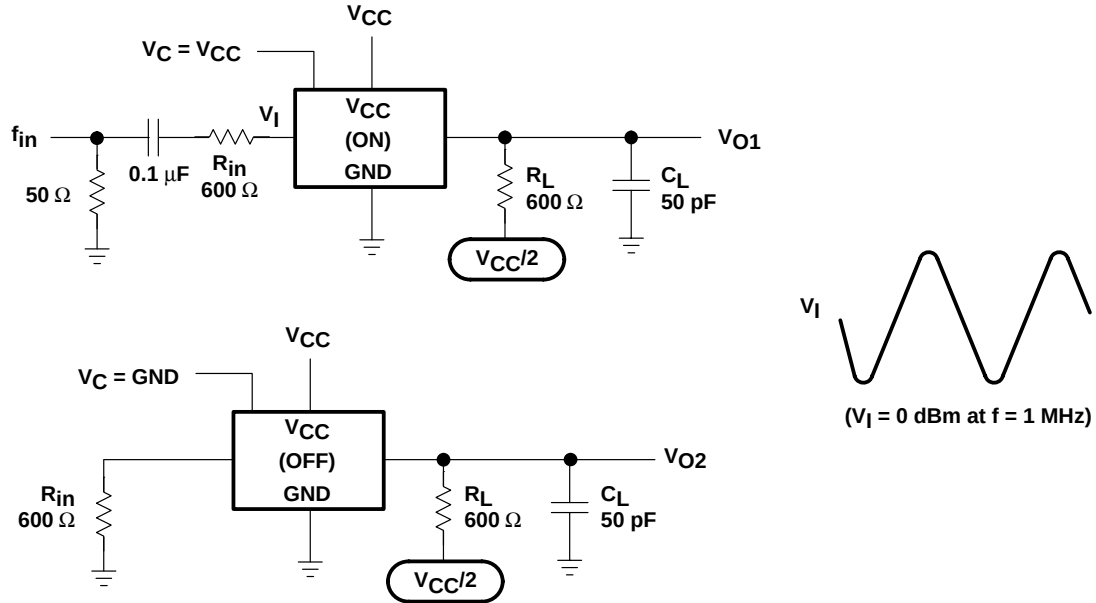


Figure 9. Crosstalk Between Any Two Switches

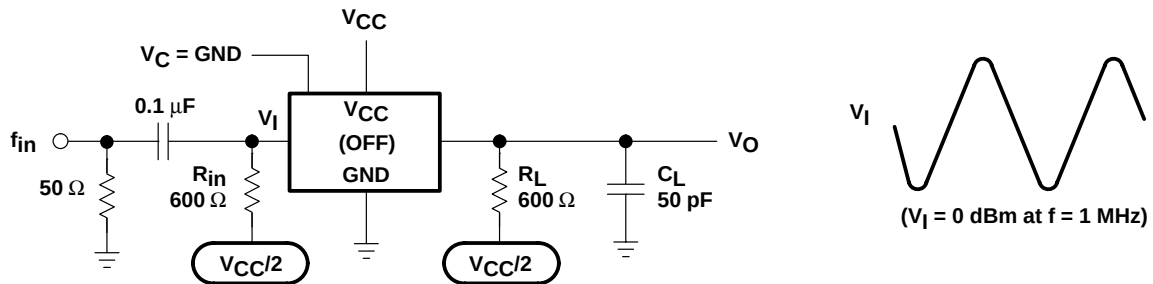


Figure 10. Feed Through, Switch Off

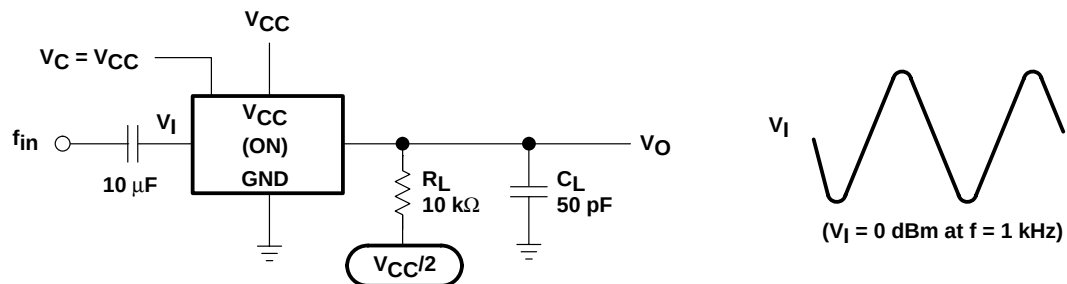


Figure 11. Amplitude-Distortion Rate

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74HC4066D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DBLE	OBSOLETE	SSOP	DB	14		TBD	Call TI	Call TI
SN74HC4066DBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DBRE4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DBRG4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DT	ACTIVE	SOIC	D	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DTE4	ACTIVE	SOIC	D	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066DTG4	ACTIVE	SOIC	D	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74HC4066NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74HC4066NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066NSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066PW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066PWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066PWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066PWLE	OBSOLETE	TSSOP	PW	14		TBD	Call TI	Call TI
SN74HC4066PWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066PWRE4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066PWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066PWT	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC4066PWTE4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
no Sb/Br)								
SN74HC4066PWTG4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-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 - 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.

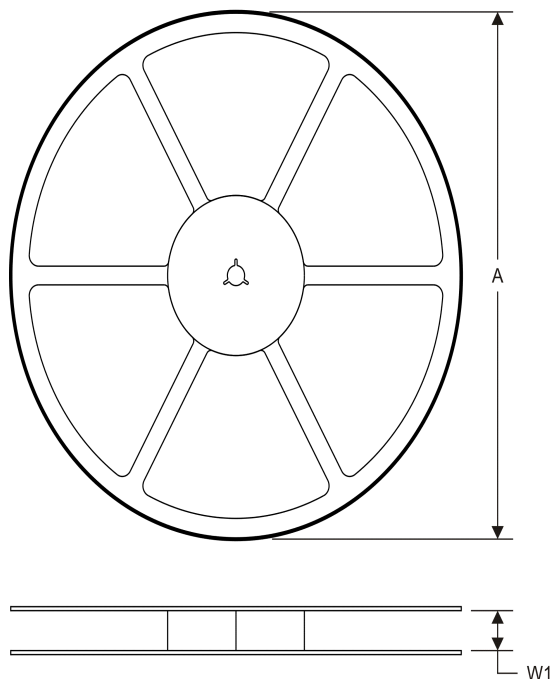
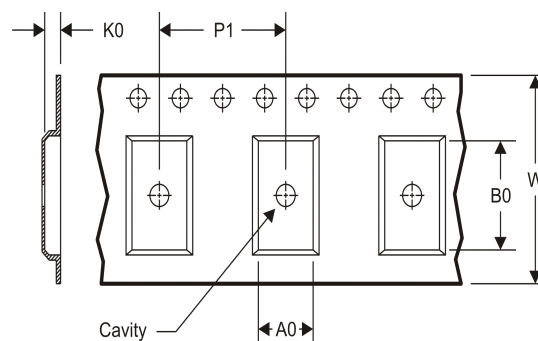
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


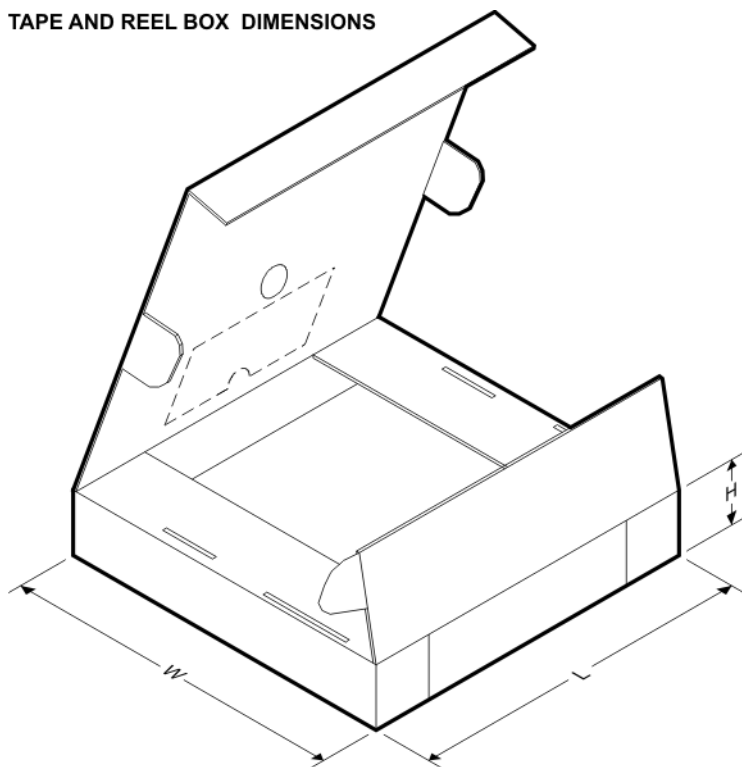
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
SN74HC4066DBR	SSOP	DB	14	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN74HC4066DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74HC4066DT	SOIC	D	14	250	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74HC4066NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN74HC4066PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74HC4066PWT	TSSOP	PW	14	250	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



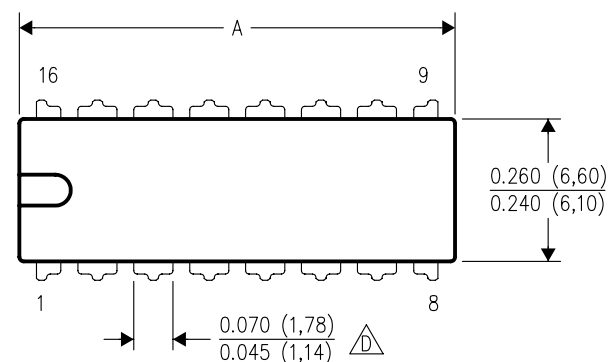
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC4066DBR	SSOP	DB	14	2000	367.0	367.0	38.0
SN74HC4066DR	SOIC	D	14	2500	367.0	367.0	38.0
SN74HC4066DT	SOIC	D	14	250	367.0	367.0	38.0
SN74HC4066NSR	SO	NS	14	2000	367.0	367.0	38.0
SN74HC4066PWR	TSSOP	PW	14	2000	367.0	367.0	35.0
SN74HC4066PWT	TSSOP	PW	14	250	367.0	367.0	35.0

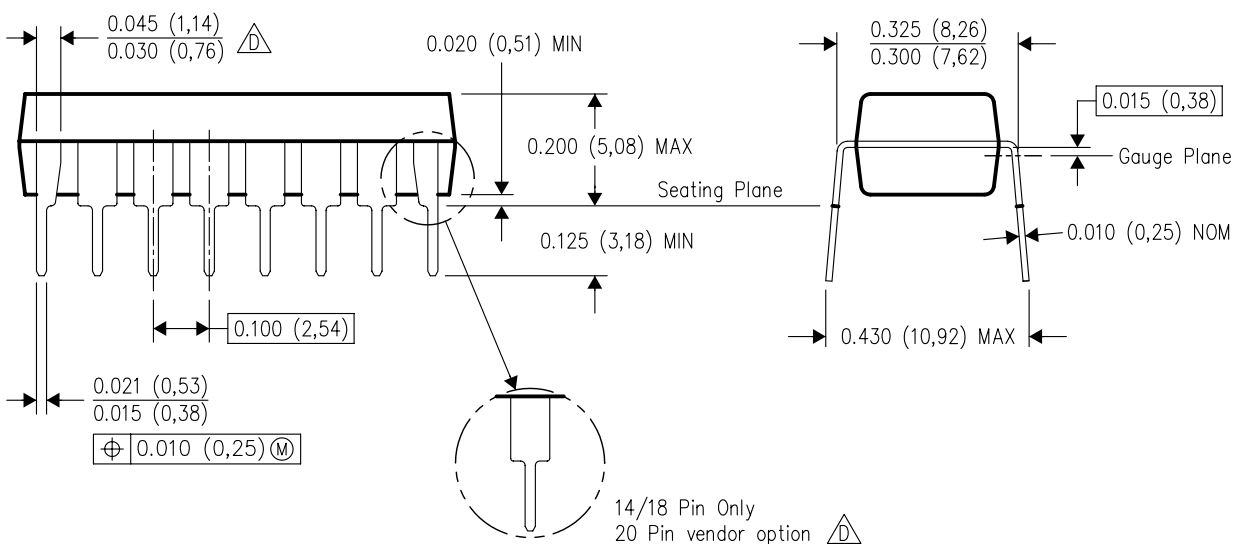
N (R-PDIP-T**)

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



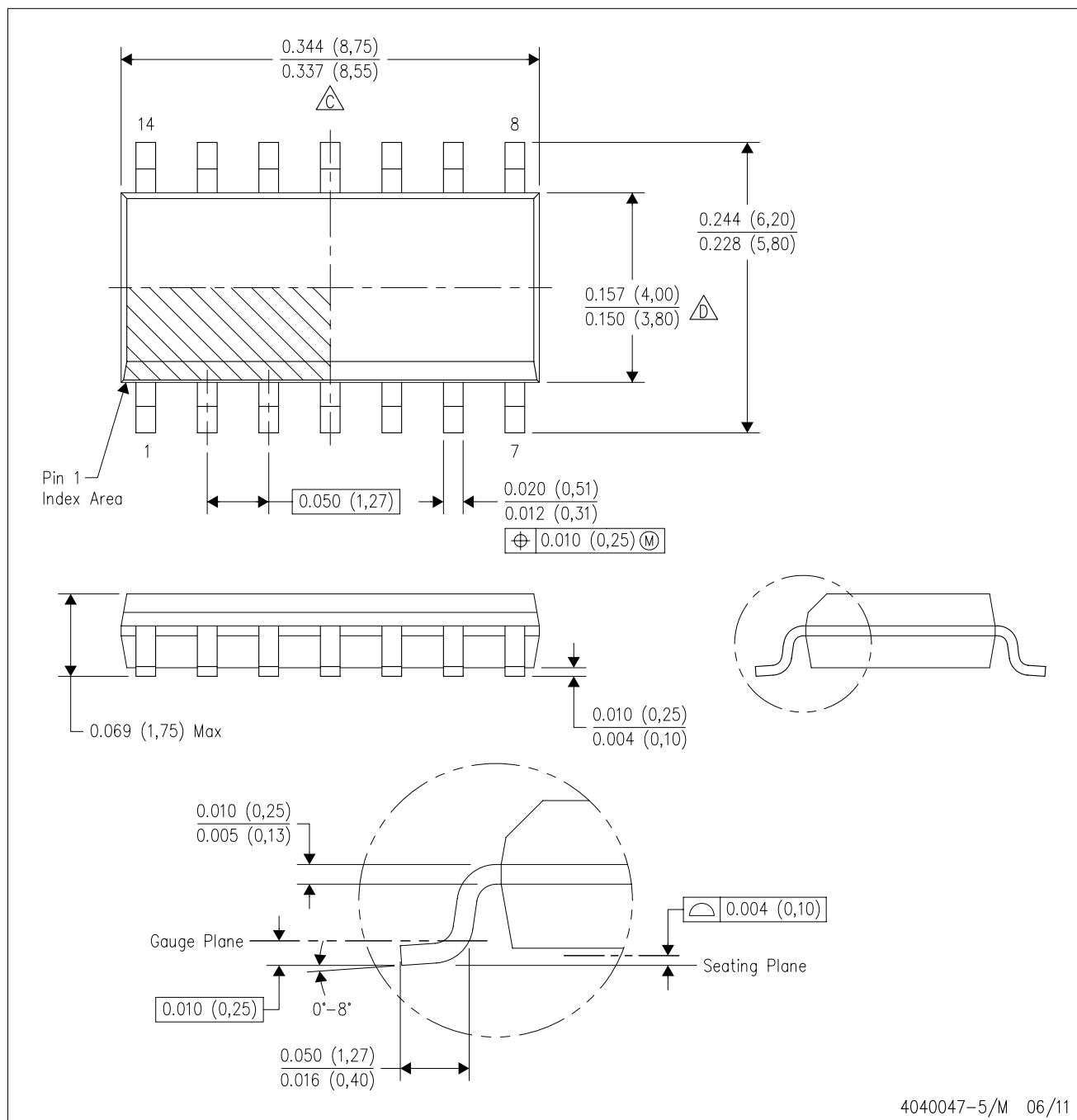
4040049/E 12/2002

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-G14)

PLASTIC SMALL OUTLINE



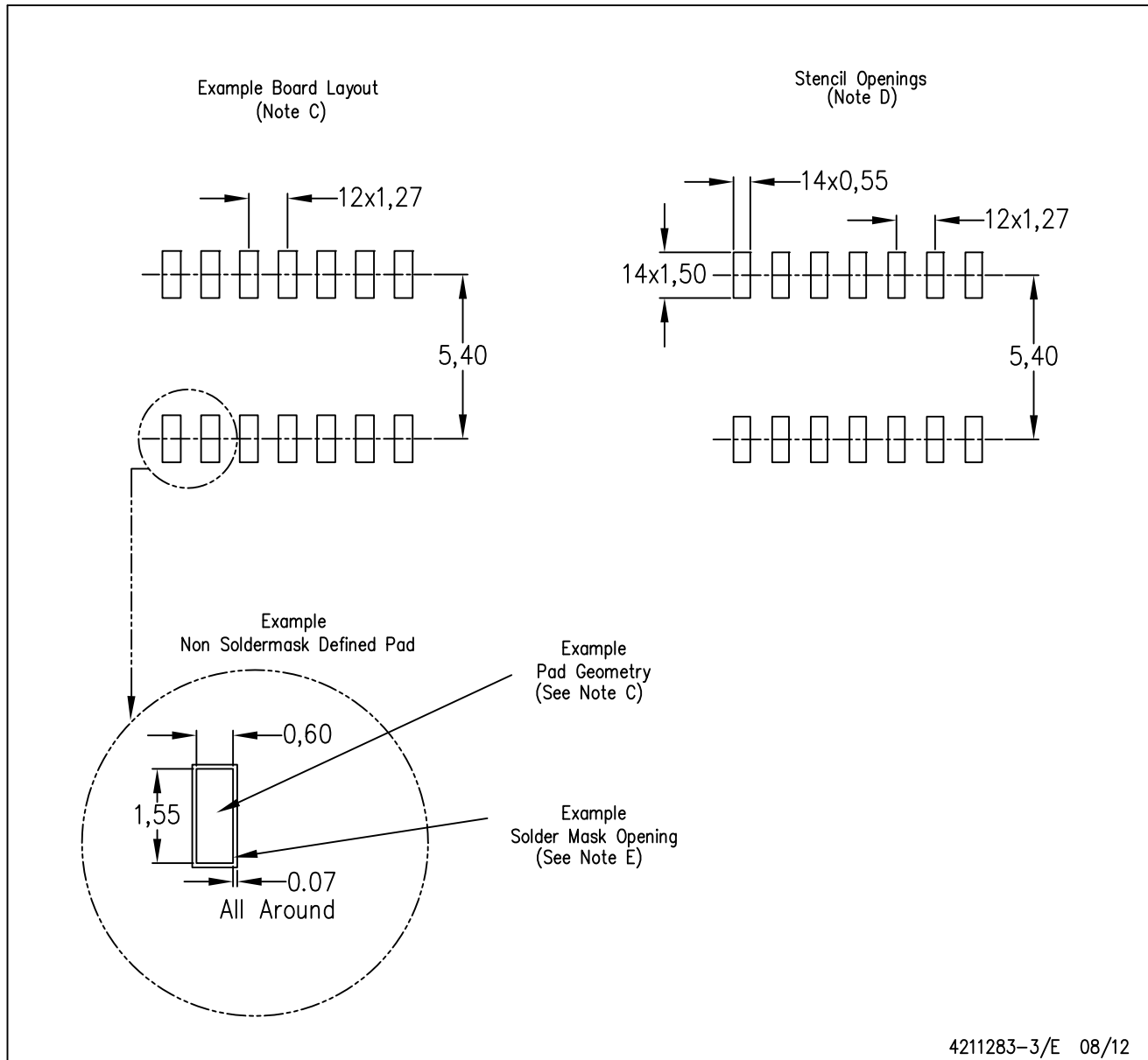
4040047-5/M 06/11

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 AB.

D (R-PDSO-G14)

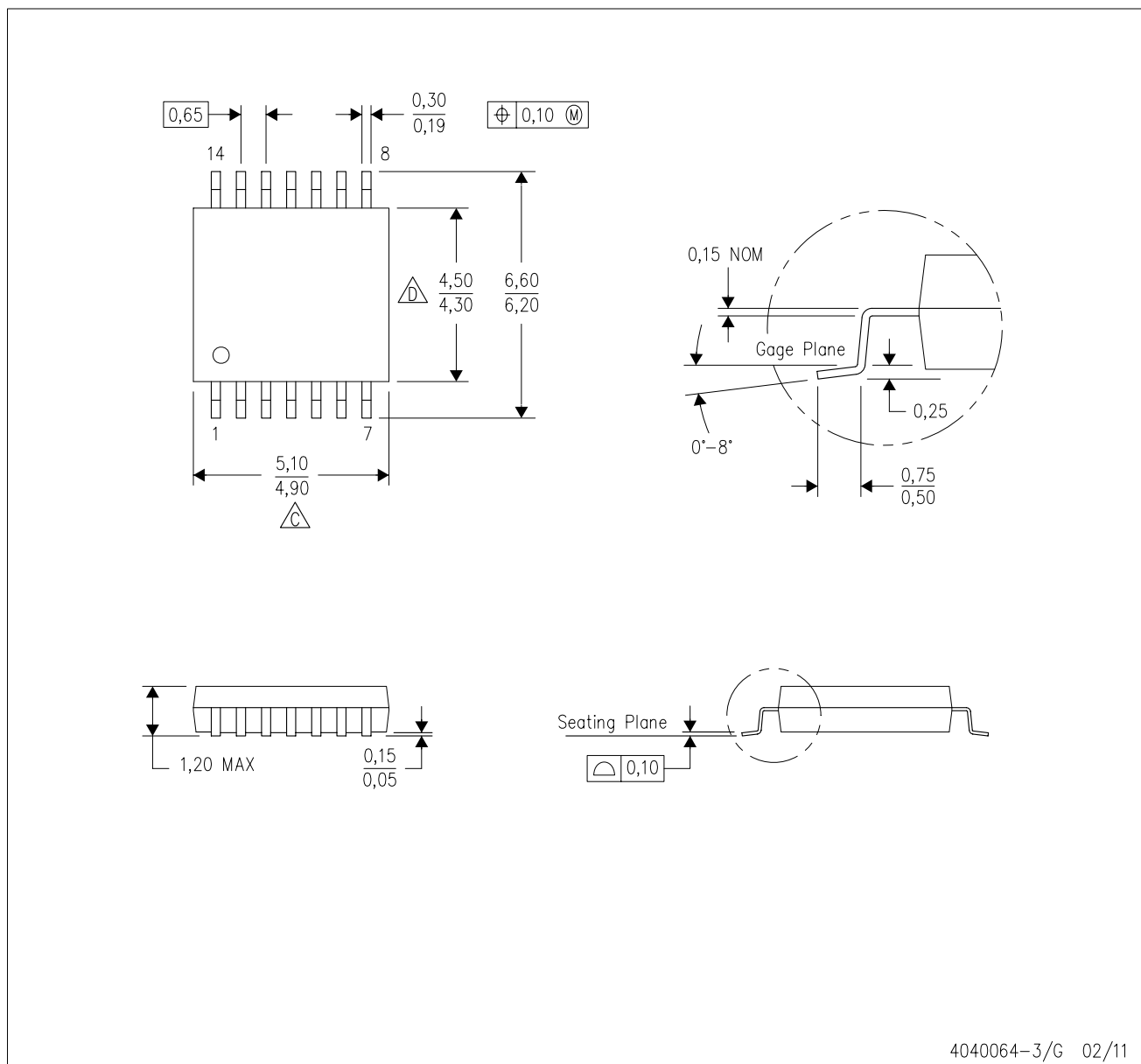
PLASTIC SMALL OUTLINE



- 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.

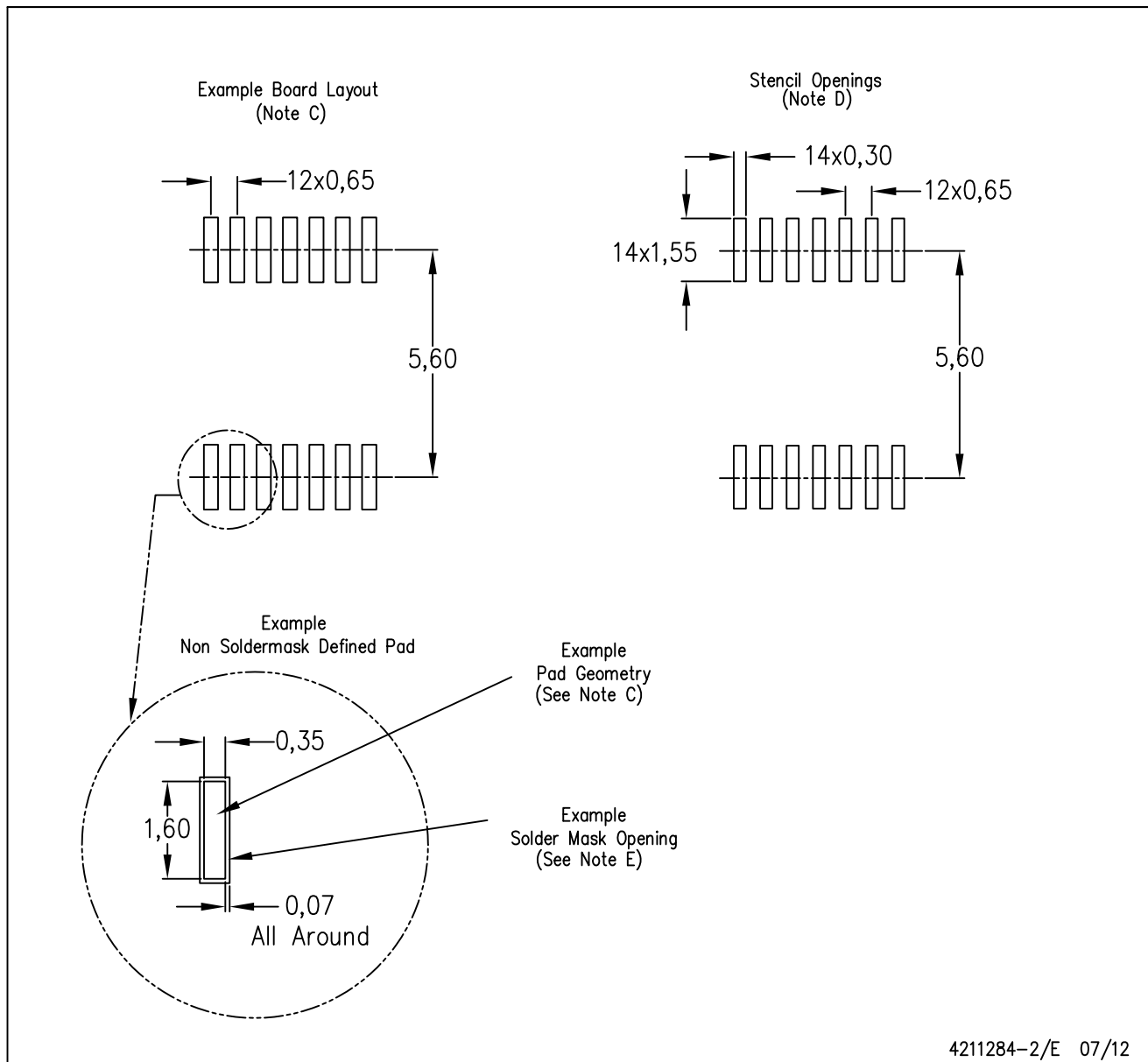
PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



NOTES:

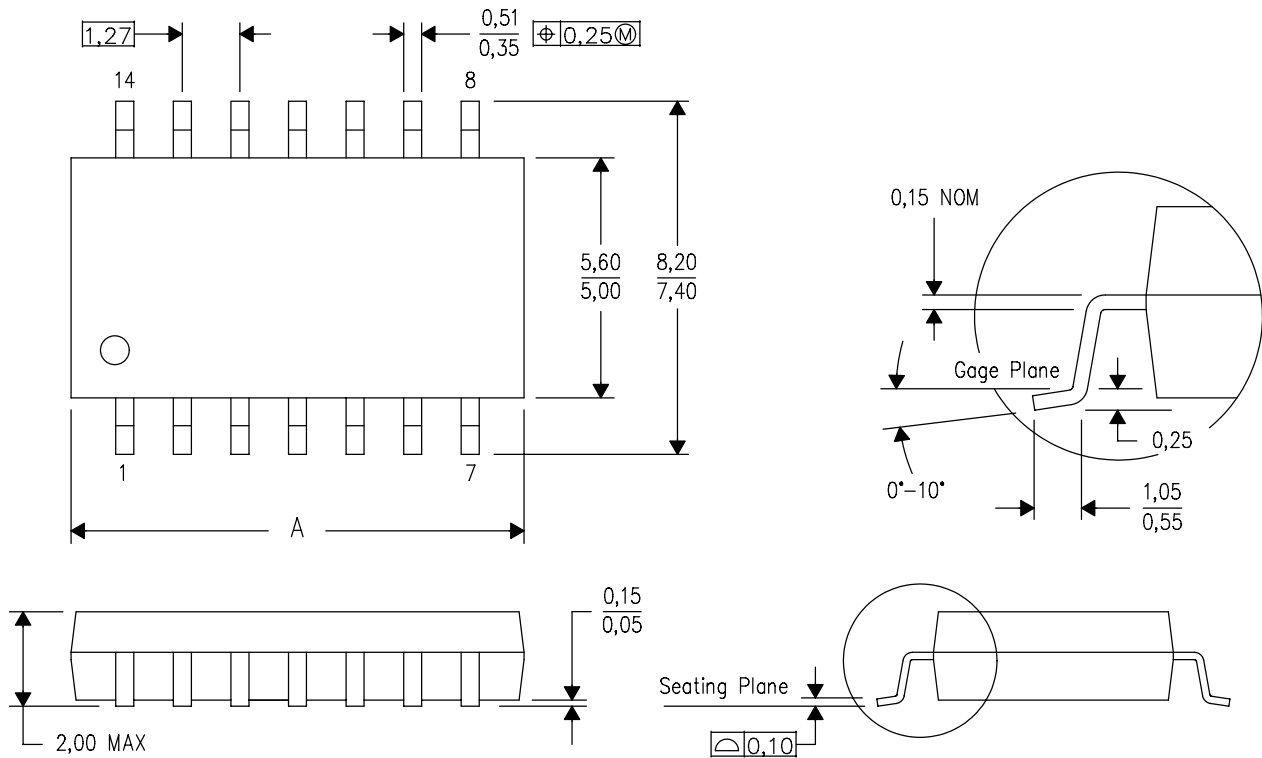
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact 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.

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

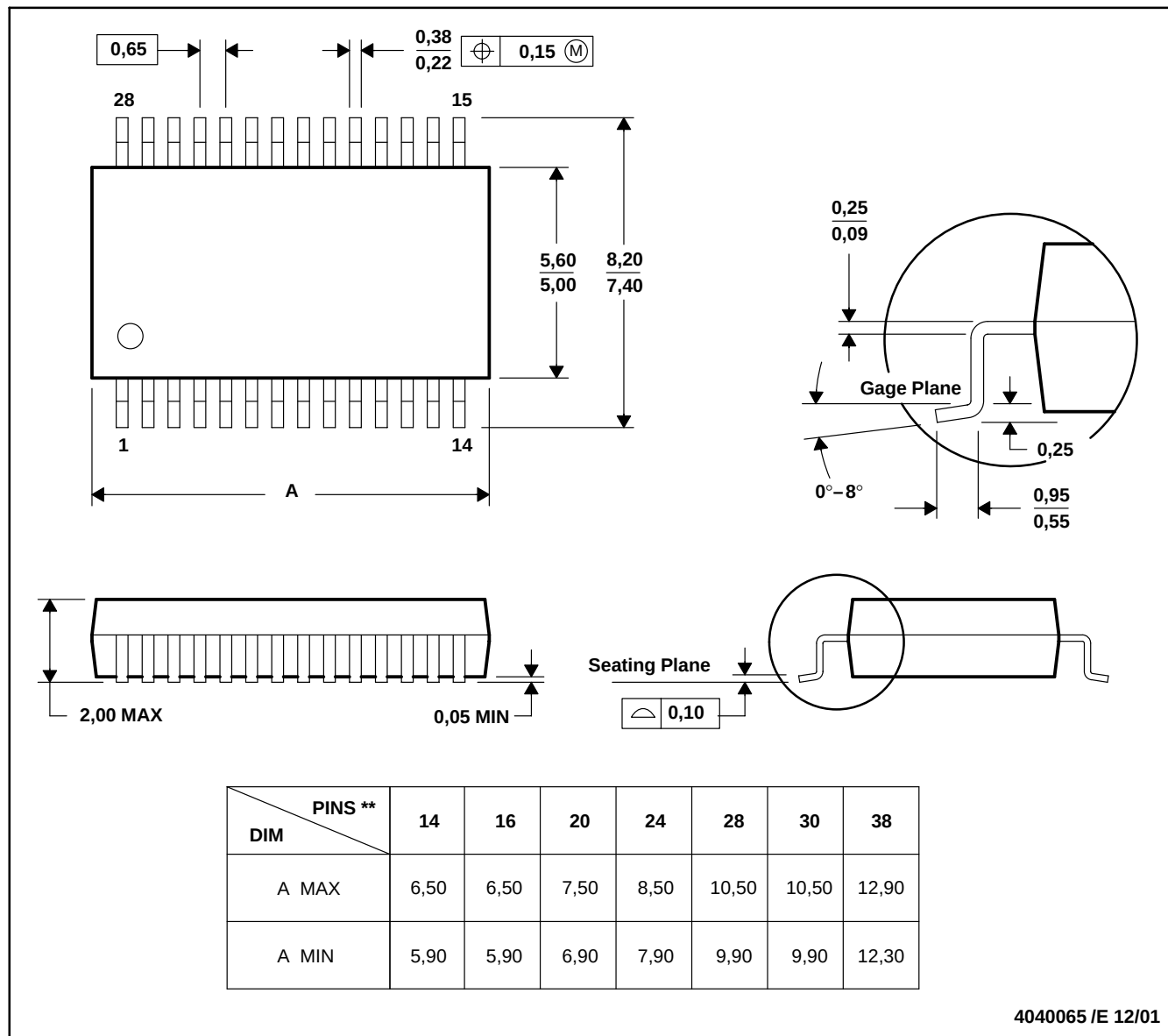
4040062/C 03/03

- 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.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- 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-150

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Электрон
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