8-BIT SHIFT REGISTERS WITH 3-STATE OUTPUT REGISTERS

Check for Samples: SN54HC595 SN74HC595

FEATURES

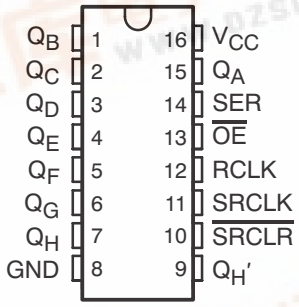
- **8-Bit Serial-In, Parallel-Out Shift**
- **Wide Operating Voltage Range of 2 V to 6 V**
- **High-Current 3-State Outputs Can Drive Up To 15 LSTTL Loads**
- **Low Power Consumption: 80-μA (Max) I_{CC}**
- **t_{pd} = 13 ns (Typ)**
- **±6-mA Output Drive at 5 V**
- **Low Input Current: 1 μA (Max)**
- **Shift Register Has Direct Clear**

DESCRIPTION

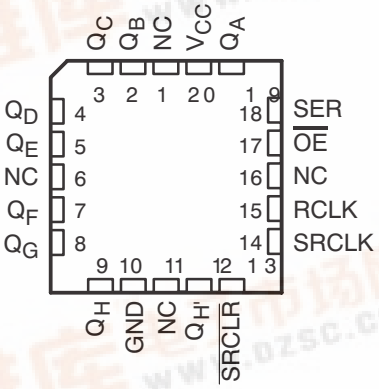
The 'HC595 devices contain an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has parallel 3-state outputs. Separate clocks are provided for both the shift and storage register. The shift register has a direct overriding clear ($\overline{SRCLR}$) input, serial (SER) input, and serial outputs for cascading. When the output-enable ($\overline{OE}$) input is high, the outputs are in the high-impedance state.

Both the shift register clock (SRCLK) and storage register clock (RCLK) are positive-edge triggered. If both clocks are connected together, the shift register always is one clock pulse ahead of the storage register.

SN54HC595...J OR W PACKAGE
SN74HC595...D, DB, DW, N, NS, OR PW PACKAGE
(TOP VIEW)



SN54HC595...FK PACKAGE
(TOP VIEW)



NC – No internal connection

ORDERING INFORMATION(1)

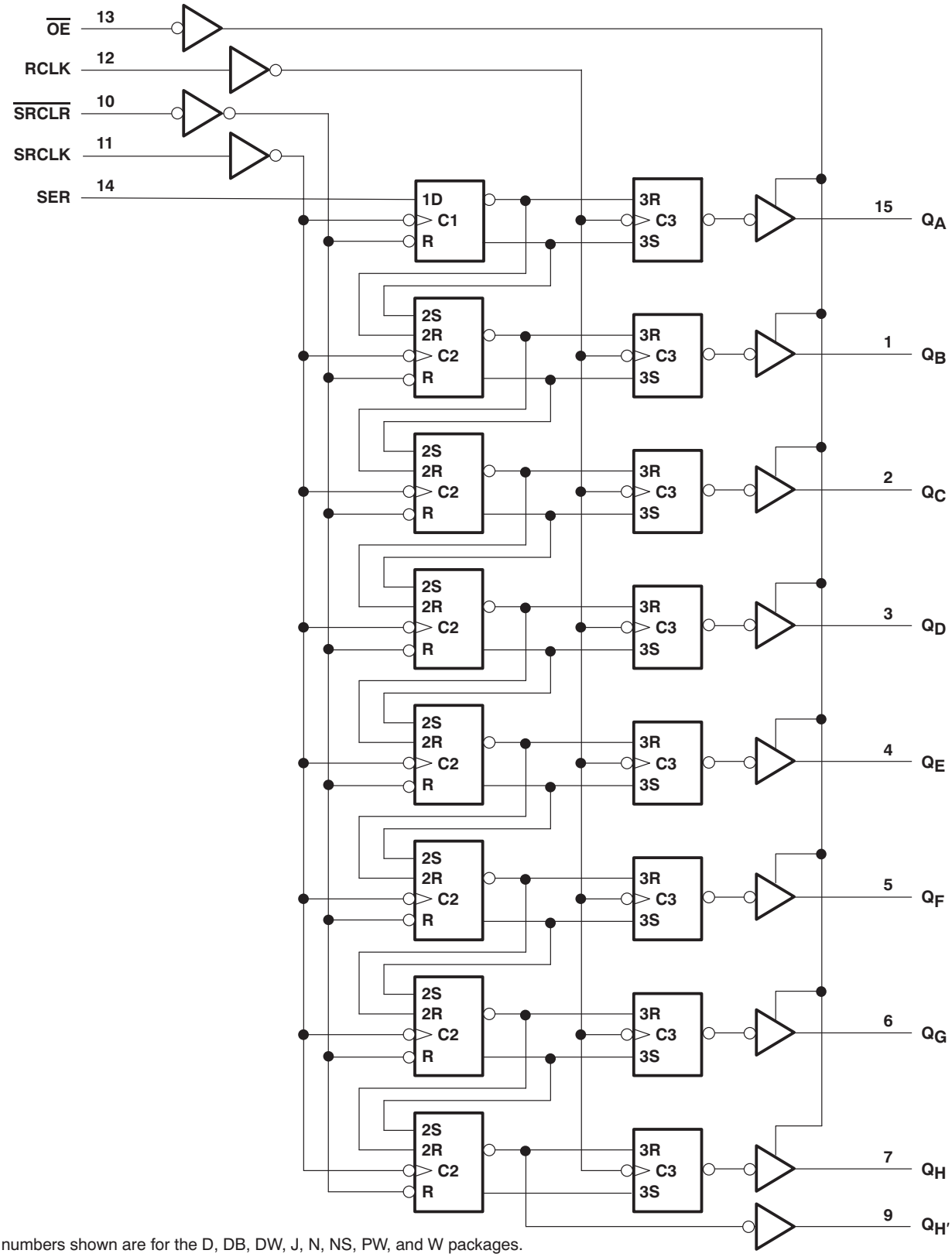
T_A	PACKAGE (2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	PDIP – N	Tube of 25	SN74HC595N	SN74HC595N
	SOIC – D	Tube of 40	SN74HC595D	HC595
		Reel of 2500	SN74HC595DR	
		Reel of 250	SN74HC595DT	
	SOIC – DW	Tube of 40	SN74HC595DW	HC595
		Reel of 2000	SN74HC595DWR	
	SOP – NS	Reel of 2000	SN74HC595NSR	HC595
	SSOP – DB	Reel of 2000	SN74HC595DBR	HC595
	TSSOP – PW	Tube of 90	SN74HC595PW	HC595
		Reel of 2000	SN74HC595PWR	
–55°C to 125°C	CDIP – J	Tube of 25	SNJ54HC595J	SNJ54HC595J
	CFP – W	Tube of 150	SNJ54HC595W	SNJ54HC595W
	LCCC – FK	Tube of 55	SNJ54HC595FK	SNJ54HC595FK

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

Table 1. FUNCTION TABLE

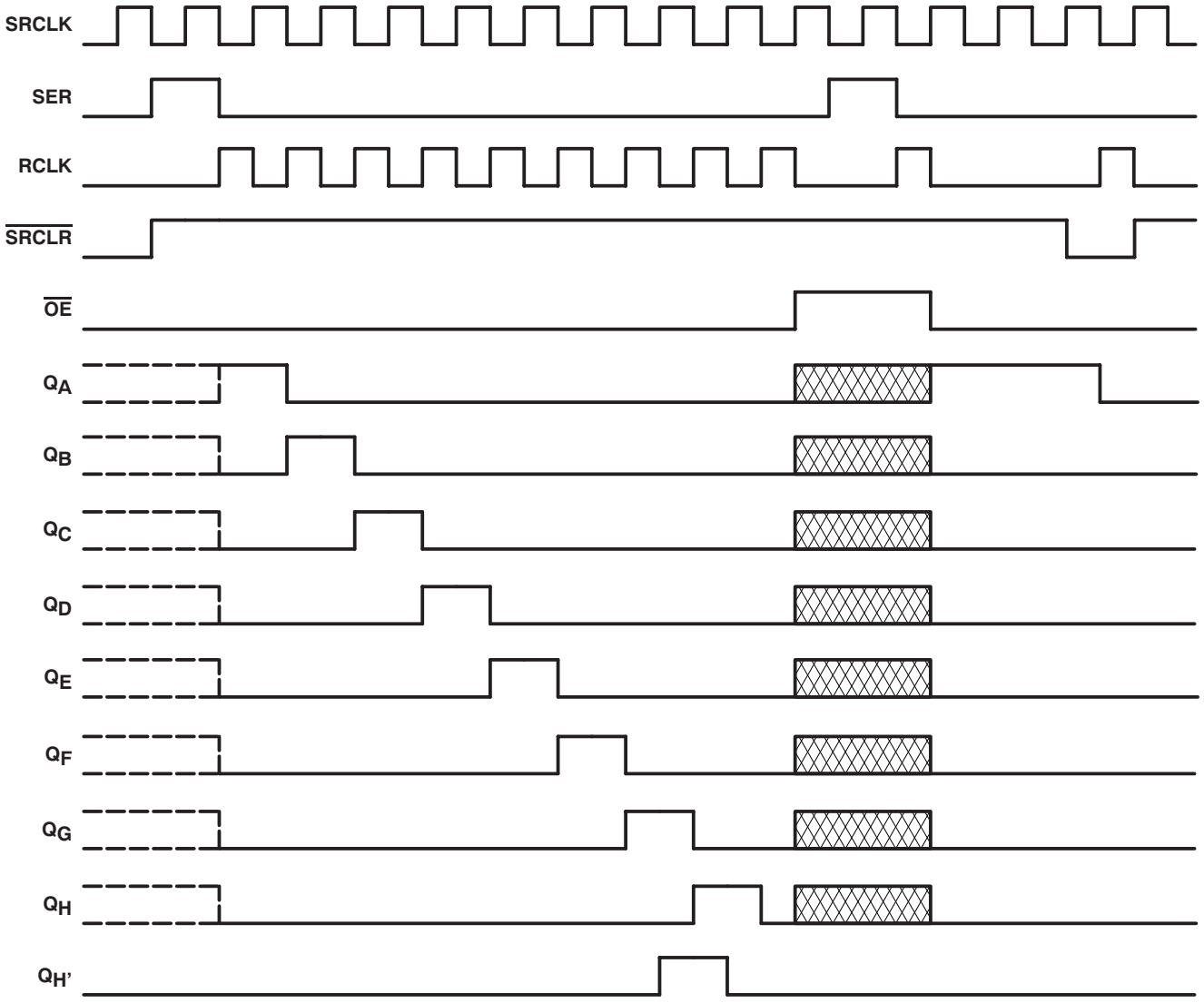
INPUTS					FUNCTION
SER	SRCLK	$\overline{SRCLR}$	RCLK	$\overline{OE}$	
X	X	X	X	H	Outputs Q_A–Q_H are disabled.
X	X	X	X	L	Outputs Q_A–Q_H are enabled.
X	X	L	X	X	Shift register is cleared.
L	↑	H	X	X	First stage of the shift register goes low. Other stages store the data of previous stage, respectively.
H	↑	H	X	X	First stage of the shift register goes high. Other stages store the data of previous stage, respectively.
X	X	X	↑	X	Shift-register data is stored in the storage register.

LOGIC DIAGRAM (POSITIVE LOGIC)



Pin numbers shown are for the D, DB, DW, J, N, NS, PW, and W packages.

TIMING DIAGRAM



NOTE: ▨ implies that the output is in 3-State mode.

ABSOLUTE MAXIMUM RATINGS(1)

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

V_{CC}	Supply voltage range		−0.5 V to 7 V
I_{IK}	Input clamp current(2)	$V_I < 0$ or $V_I > V_{CC}$	±20 mA
I_{OK}	Output clamp current (2)	$V_O < 0$ or $V_O > V_{CC}$	±20 mA
I_O	Continuous output current	$V_O = 0$ to V_{CC}	±35 mA
	Continuous current through VCC or GND		±70 mA
θ_{JA}	Package thermal impedance(3)	D package	73°C/W
		DB package	82°C/W
		DW package	57°C/W
		N package	67°C/W
		NS package	64°C/W
		PW package	108°C/W
T_{stg}	Storage temperature range		−65°C to 150°C

(1) 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.
(2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
(3) The package thermal impedance is calculated in accordance with JESD 51-7.

RECOMMENDED OPERATING CONDITIONS(1)

			SN54HC595			SN74HC595			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		2	5	6	2	5	6	V
V_{IH}	High-level input voltage	V_{CC} = 2 V	1.5			1.5			V
		V_{CC} = 4.5 V	3.15			3.15			
		V_{CC} = 6 V	4.2			4.2			
V_{IL}	Low-level input voltage	V_{CC} = 2 V			0.5			0.5	V
		V_{CC} = 4.5 V			1.35			1.35	
		V_{CC} = 6 V			1.8			1.8	
V_I	Input voltage		0		V_{CC}	0		V_{CC}	V
V_O	Output voltage		0		V_{CC}	0		V_{CC}	V
$\Delta t/\Delta v$	Input transition rise/fall time(2)	V_{CC} = 2 V			1000			1000	ns
		V_{CC} = 4.5 V			500			500	
		V_{CC} = 6 V			400			400	
T_A	Operating free-air temperature		–55		125	–40		85	°C

(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. See the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
(2) If this device is used in the threshold region (from V_{IL}max = 0.5 V to V_{IH}min = 1.5 V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at t_t = 1000 ns and V_{CC} = 2 V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS		V_{CC}	T_A = 25°C			SN54HC595		SN74HC595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}	V_I = V_{IH} or V_{IL}	I_{OH} = −20 µA	2 V	1.9	1.998		1.9		1.9		V
			4.5 V	4.4	4.499		4.4		4.4		
			6 V	5.9	5.999		5.9		5.9		
		$Q_{H'}$, I_{OH} = −4 mA	4.5 V	3.98	4.3		3.7		3.84		
		Q_A–Q_H, I_{OH} = −6 mA		3.98	4.3		3.7		3.84		
		$Q_{H'}$, I_{OH} = −5.2 mA	6 V	5.48	5.8		5.2		5.34		
		Q_A–Q_H, I_{OH} = −7.8 mA		5.48	5.8		5.2		5.34		
V_{OL}	V_I = V_{IH} or V_{IL}	I_{OL} = 20 µA	2 V		0.002	0.1		0.1		0.1	V
			4.5 V		0.001	0.1		0.1		0.1	
			6 V		0.001	0.1		0.1		0.1	
		$Q_{H'}$, I_{OL} = 4 mA	4.5 V		0.17	0.26		0.4		0.33	
		Q_A–Q_H, I_{OL} = 6 mA			0.17	0.26		0.4		0.33	
		$Q_{H'}$, I_{OL} = 5.2 mA	6 V		0.15	0.26		0.4		0.33	
		Q_A–Q_H, I_{OL} = 7.8 mA			0.15	0.26		0.4		0.33	
I_I	V_I = V_{CC} or 0		6 V		±0.1	±100		±1000		±1000	nA
I_{OZ}	V_O = V_{CC} or 0, Q_A–Q_H		6 V		±0.01	±0.5		±10		±5	µA
I_{CC}	V_I = V_{CC} or 0, I_O = 0		6 V			8		160		80	µA
C_i			2 V to 6 V		3	10		10		10	pF

TIMING REQUIREMENTS

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

			V_{CC}	T_A = 25°C		SN54HC595		SN74HC595		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		2 V		6		4.2		5	MHz
			4.5 V		31		21		25	
			6 V		36		25		29	
t_w	Pulse duration	SRCLK or RCLK high or low	2 V	80		120		100		ns
			4.5 V	16		24		20		
			6 V	14		20		17		
		$\overline{SRCLR}$ low	2 V	80		120		100		
			4.5 V	16		24		20		
			6 V	14		20		17		
t_{su}	Setup time	SER before SRCLK↑	2 V	100		150		125		ns
			4.5 V	20		30		25		
			6 V	17		25		21		
		SRCLK↑ before RCLK↑ (1)	2 V	75		113		94		
			4.5 V	15		23		19		
			6 V	13		19		16		
		$\overline{SRCLR}$ low before RCLK↑	2 V	50		75		65		
			4.5 V	10		15		13		
			6 V	9		13		11		
		$\overline{SRCLR}$ high (inactive) before SRCLK↑	2 V	50		75		60		
			4.5 V	10		15		12		
			6 V	9		13		11		
t_h	Hold time, SER after SRCLK↑		2 V	0		0		0		ns
			4.5 V	0		0		0		
			6 V	0		0		0		

(1) This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			SN54HC595		SN74HC595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			2 V	6	26		4.2		5		MHz
			4.5 V	31	38		21		25		
			6 V	36	42		25		29		
t_{pd}	SRCLK	$Q_{H'}$	2 V		50	160		240		200	ns
			4.5 V		17	32		48		40	
			6 V		14	27		41		34	
	RCLK	Q_A–Q_H	2 V		50	150		225		187	
			4.5 V		17	30		45		37	
			6 V		14	26		38		32	
t_{PHL}	$\overline{SRCLR}$	$Q_{H'}$	2 V		51	175		261		219	ns
			4.5 V		18	35		52		44	
			6 V		15	30		44		37	
t_{en}	$\overline{OE}$	Q_A–Q_H	2 V		40	150		255		187	ns
			4.5 V		15	30		45		37	
			6 V		13	26		38		32	
t_{dis}	$\overline{OE}$	Q_A–Q_H	2 V		42	200		300		250	ns
			4.5 V		23	40		60		50	
			6 V		20	34		51		43	
t_t		Q_A–Q_H	2 V		28	60		90		75	ns
			4.5 V		8	12		18		15	
			6 V		6	10		15		13	
		$Q_{H'}$	2 V		28	75		110		95	
			4.5 V		8	15		22		19	
			6 V		6	13		19		16	

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, C_L = 150 pF (unless otherwise noted)

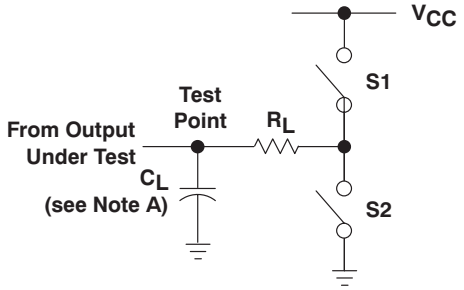
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			SN54HC595		SN74HC595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{pd}	RCLK	Q_A–Q_H	2 V		60	200		300		250	ns
			4.5 V		22	40		60		50	
			6 V		19	34		51		43	
t_{en}	$\overline{OE}$	Q_A–Q_H	2 V		70	200		298		250	ns
			4.5 V		23	40		60		50	
			6 V		19	34		51		43	
t_t		Q_A–Q_H	2 V		45	210		315		265	ns
			4.5 V		17	42		63		53	
			6 V		13	36		53		45	

OPERATING CHARACTERISTICS

T_A = 25°C

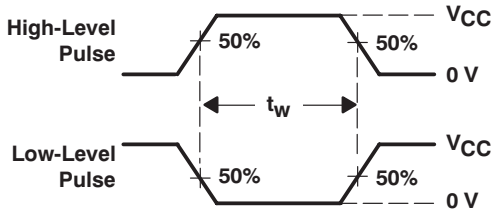
PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	400	pF

PARAMETER MEASUREMENT INFORMATION

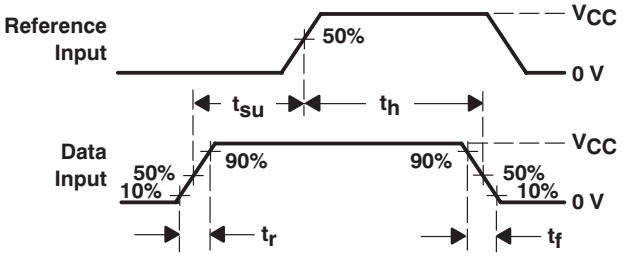


LOAD CIRCUIT

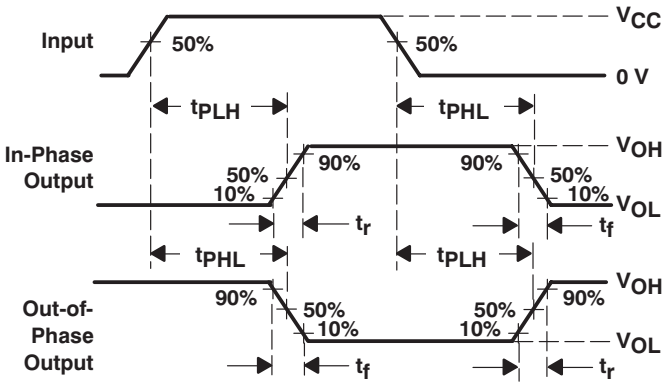
PARAMETER		R_L	C_L	S1	S2
t_{en}	t_{PZH}	1 kΩ	50 pF or 150 pF	Open	Closed
	t_{PZL}			Closed	Open
t_{dis}	t_{PHZ}	1 kΩ	50 pF	Open	Closed
	t_{PLZ}			Closed	Open
t_{pd} or t_t			50 pF or 150 pF	Open	Open



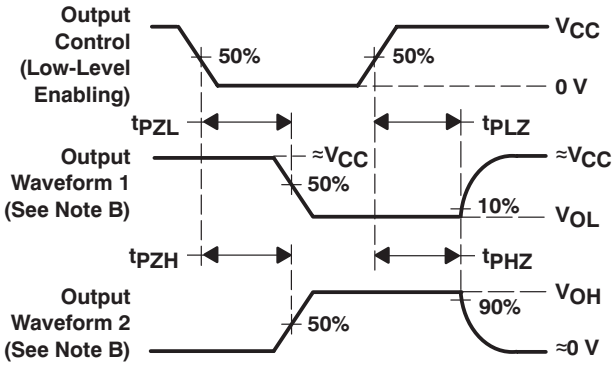
VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES FOR 3-STATE OUTPUTS

NOTES: A. C_L includes probe and test-fixture capacitance.
B. 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.
C. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r = 6 ns, t_f = 6 ns.
D. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
E. The outputs are measured one at a time, with one input transition per measurement.
F. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
G. t_{PZL} and t_{PZH} are the same as t_{en}.
H. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Pea
5962-86816012A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg
5962-8681601EA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg
5962-8681601VEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg
5962-8681601VFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg
SN54HC595J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg
SN74HC595D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	Call TI	Level-1-260
SN74HC595DBRE4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	Call TI	Level-1-260
SN74HC595DBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	Call TI	Level-1-260
SN74HC595DE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DRG3	PREVIEW	SOIC	D	16	2500	TBD	Call TI	Call TI
SN74HC595DRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DTG4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260

TEXAS INSTRUMENTS

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Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Pea
SN74HC595DWE4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DWRE4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595DWRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg
SN74HC595NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg
SN74HC595NSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595NSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595NSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595PW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595PWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595PWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595PWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595PWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SN74HC595PWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
SNJ54HC595FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg
SNJ54HC595J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg

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Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Pea
SNJ54HC595W	OBSOLETE			16		TBD	Call TI	Call TI

(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
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.
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
lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable fo
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,
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 retard
in homogeneous material)

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

OTHER QUALIFIED VERSIONS OF SN54HC595, SN54HC595-SP, SN74HC595 :

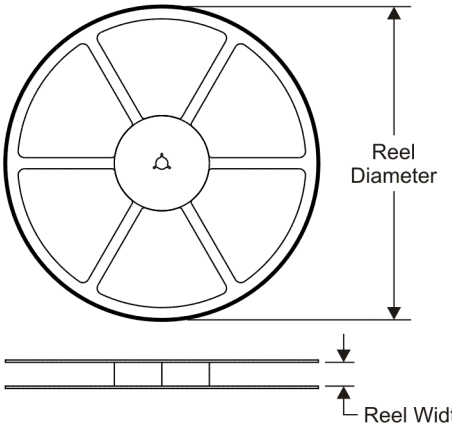
- Catalog: SN74HC595, SN54HC595
- Enhanced Product: SN74HC595-EP, SN74HC595-EP
- Military: SN54HC595
- Space: SN54HC595-SP

NOTE: Qualified Version Definitions:

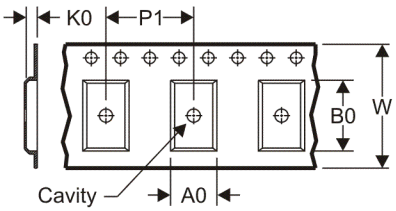
- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TAPE AND REEL INFORMATION

REEL DIMENSIONS

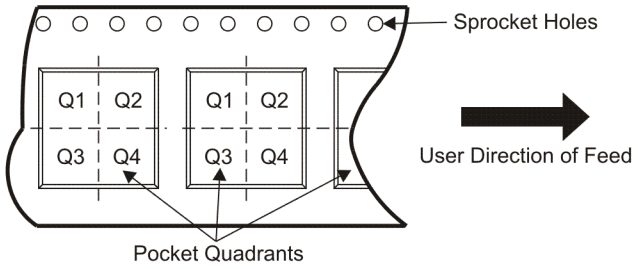


TAPE DIMENSIONS



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

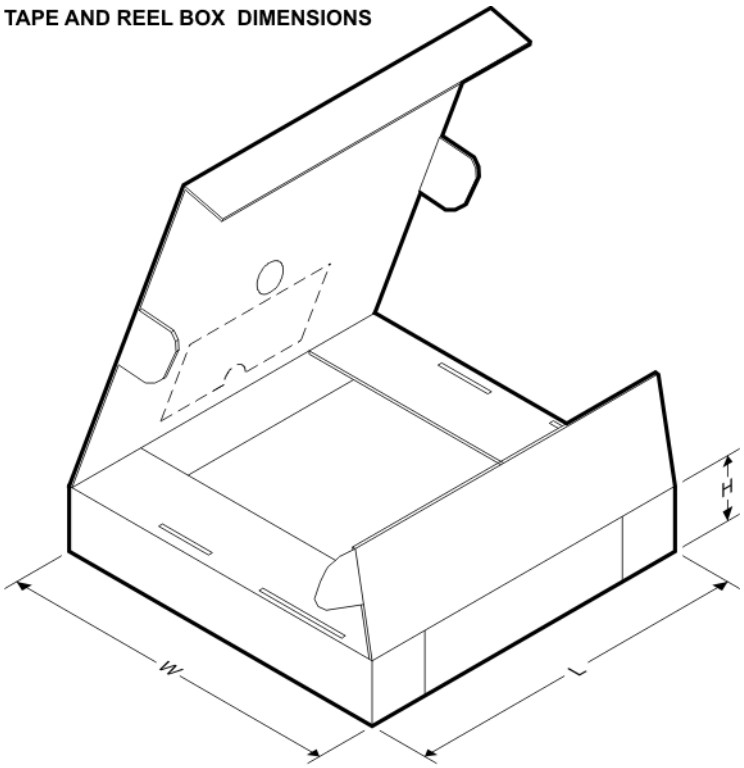
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74HC595DBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN74HC595DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN74HC595DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN74HC595DWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
SN74HC595NSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN74HC595PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

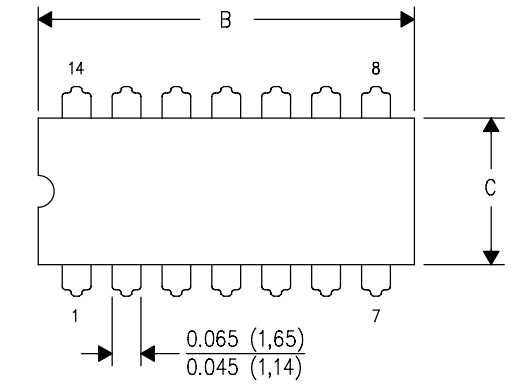


*All dimensions are nominal

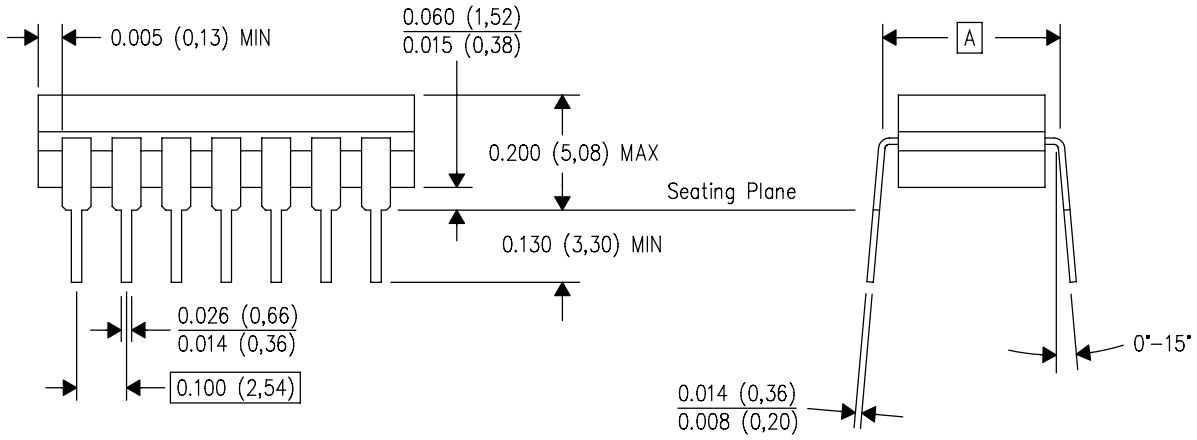
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC595DBR	SSOP	DB	16	2000	346.0	346.0	33.0
SN74HC595DR	SOIC	D	16	2500	346.0	346.0	33.0
SN74HC595DR	SOIC	D	16	2500	333.2	345.9	28.6
SN74HC595DWR	SOIC	DW	16	2000	346.0	346.0	33.0
SN74HC595NSR	SO	NS	16	2000	346.0	346.0	33.0
SN74HC595PWR	TSSOP	PW	16	2000	346.0	346.0	29.0

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

14 LEADS SHOWN



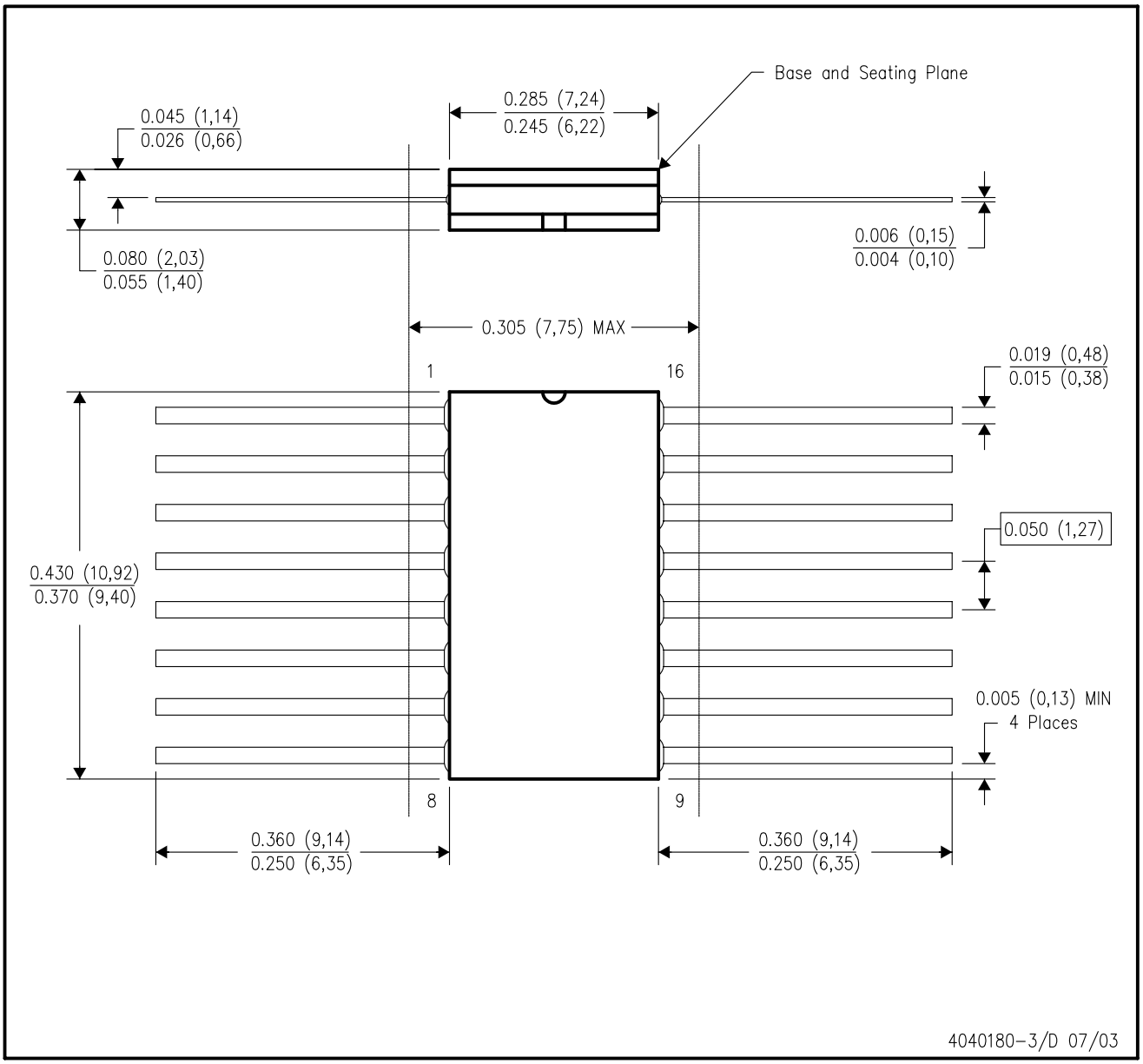
DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



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.

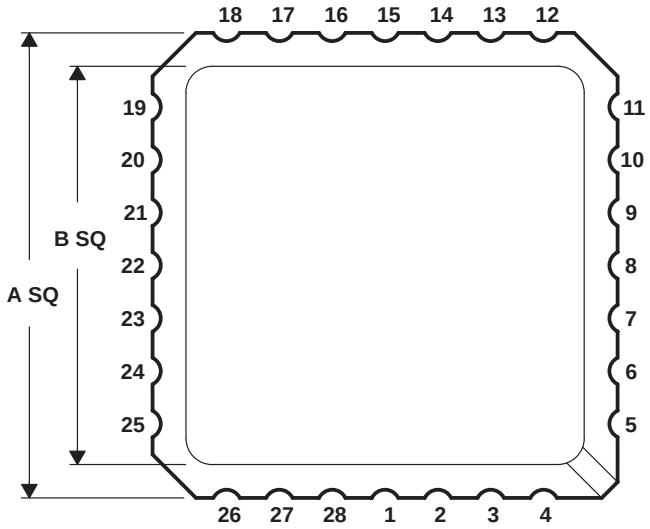
W (R–GDFP–F16) CERAMIC DUAL FLATPACK



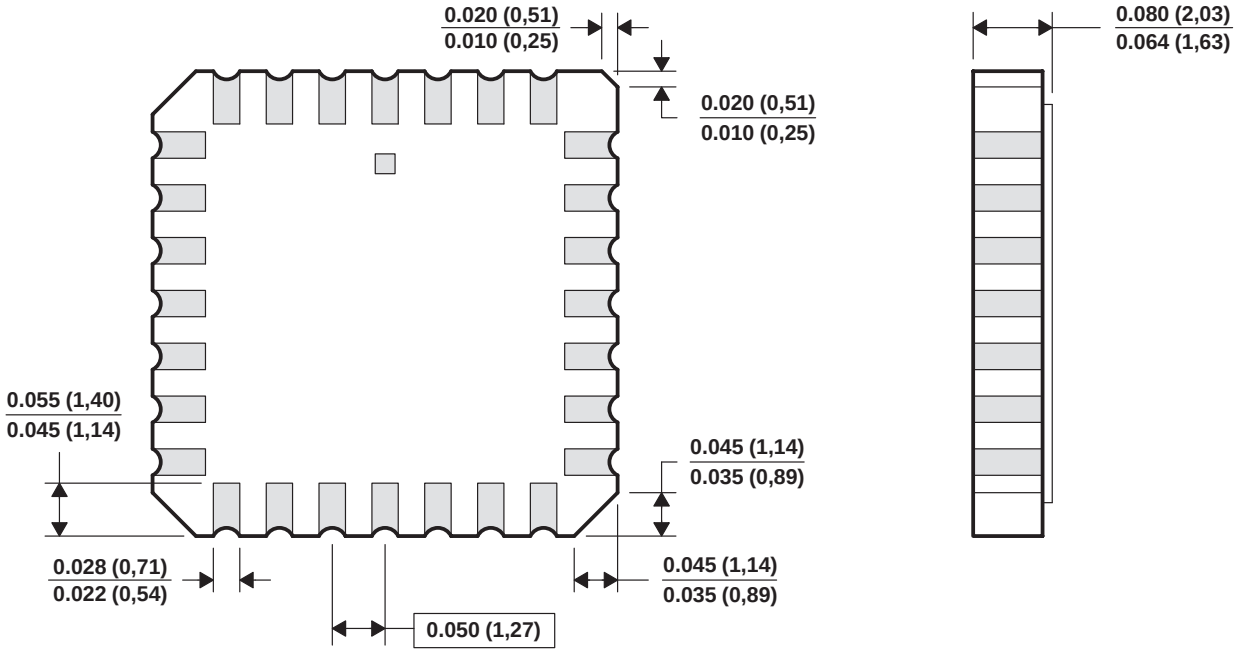
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only.
E. Falls within MIL STD 1835 GDFP1–F16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

FK (S-CQCC-N)** **LEADLESS CERAMIC CHIP CARRIER**

28 TERMINAL SHOWN



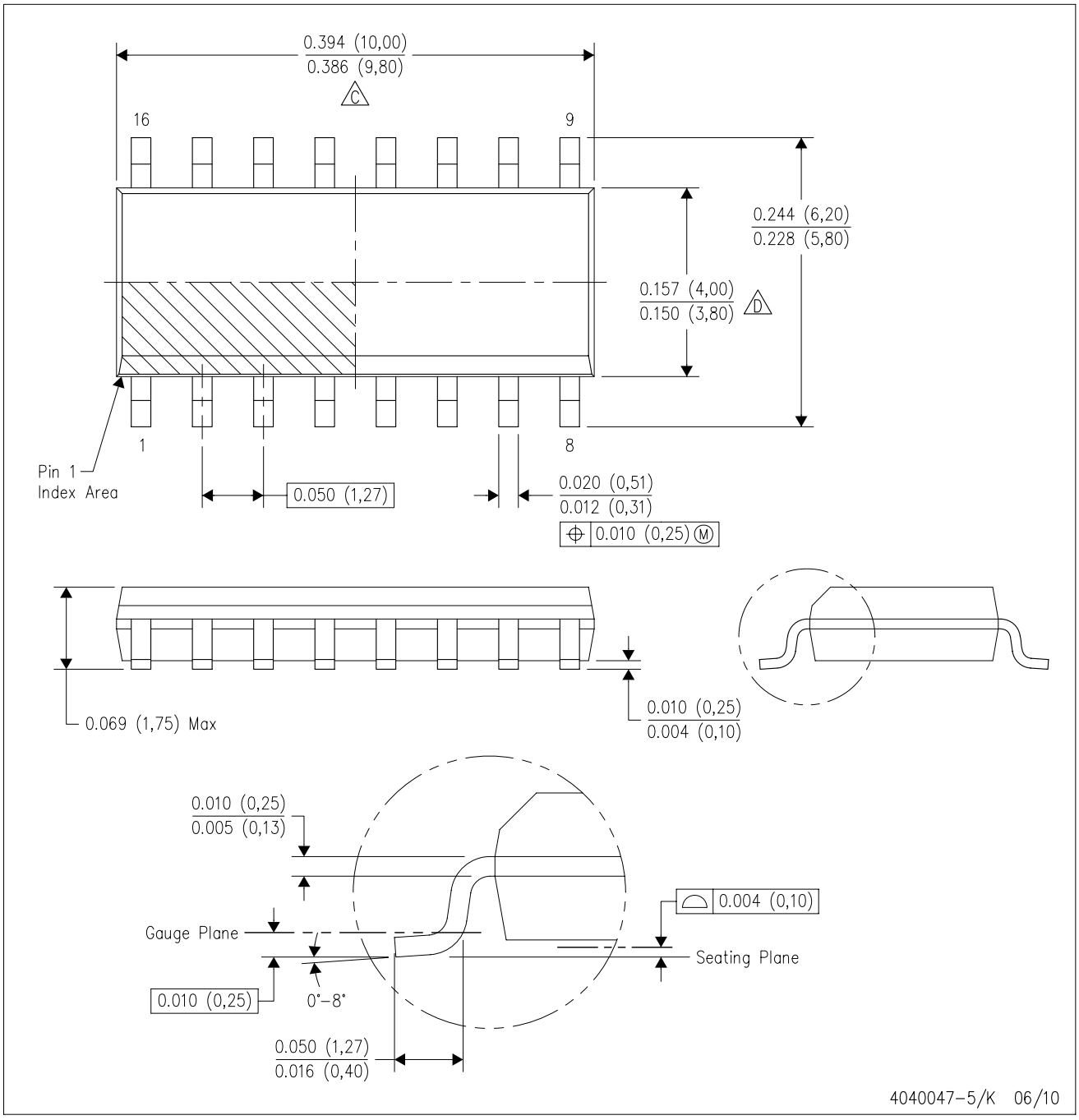
NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)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

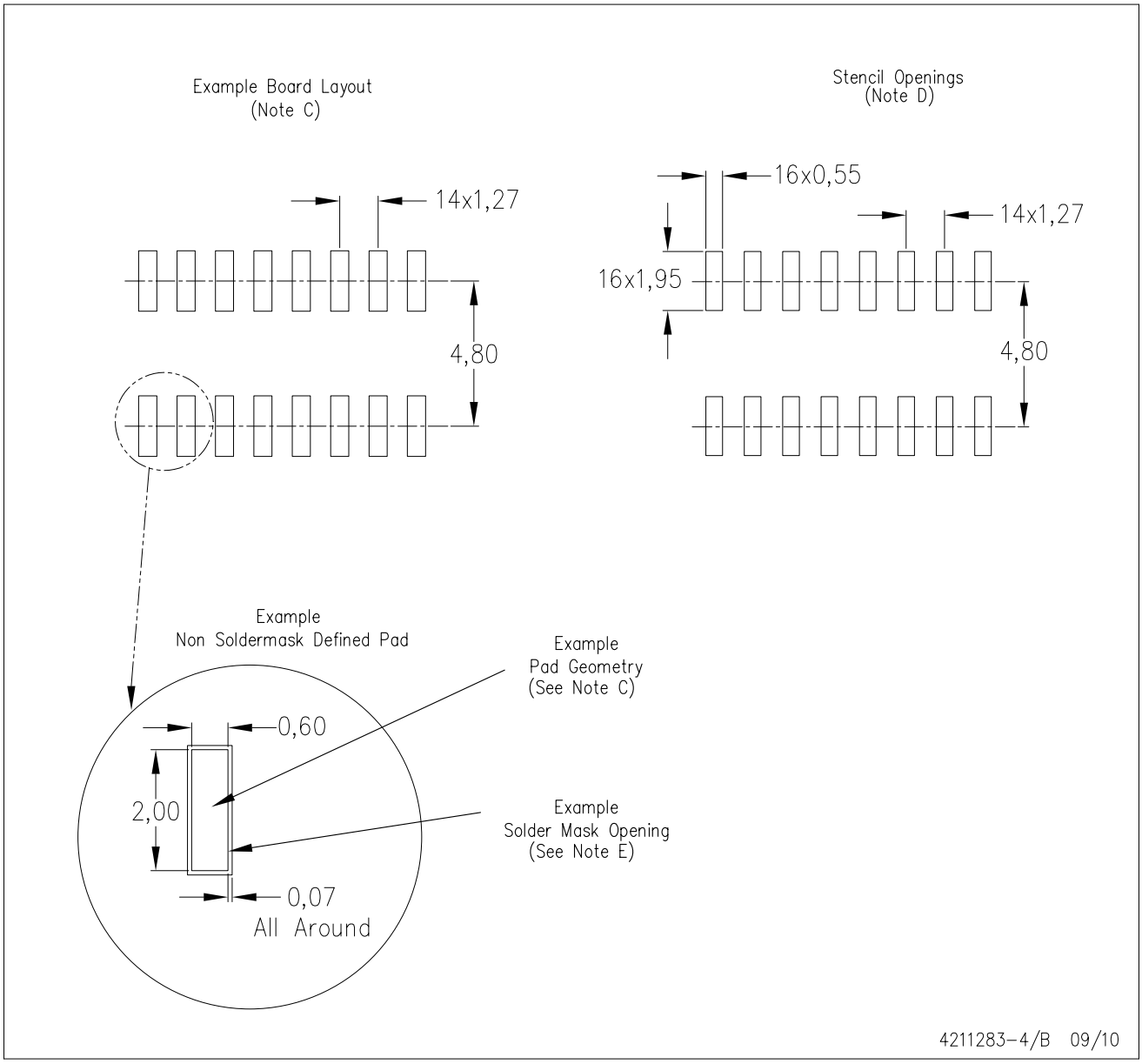
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals are gold plated.
E. Falls within JEDEC MS-004

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



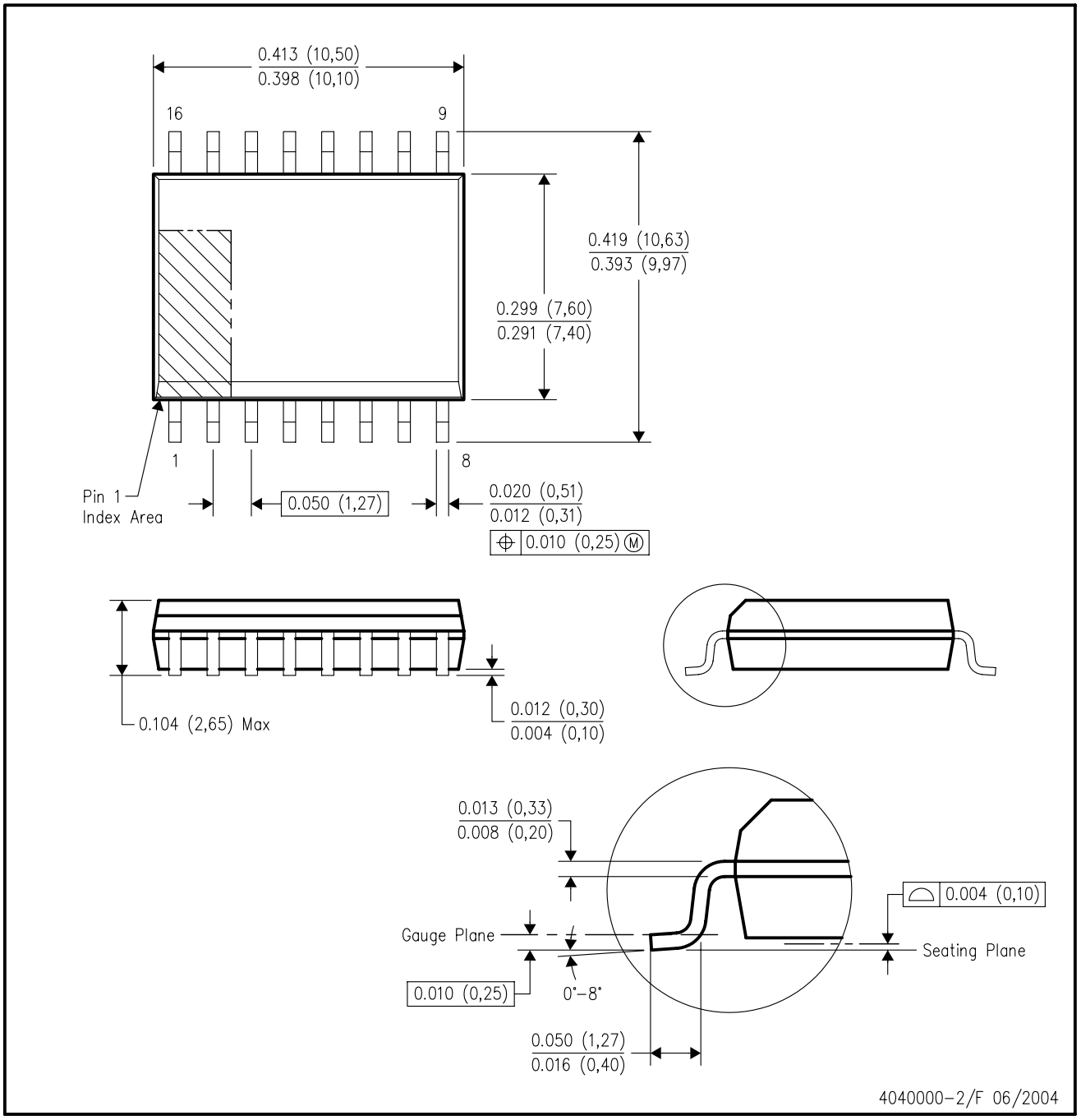
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
D. Body width does not include interlead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

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



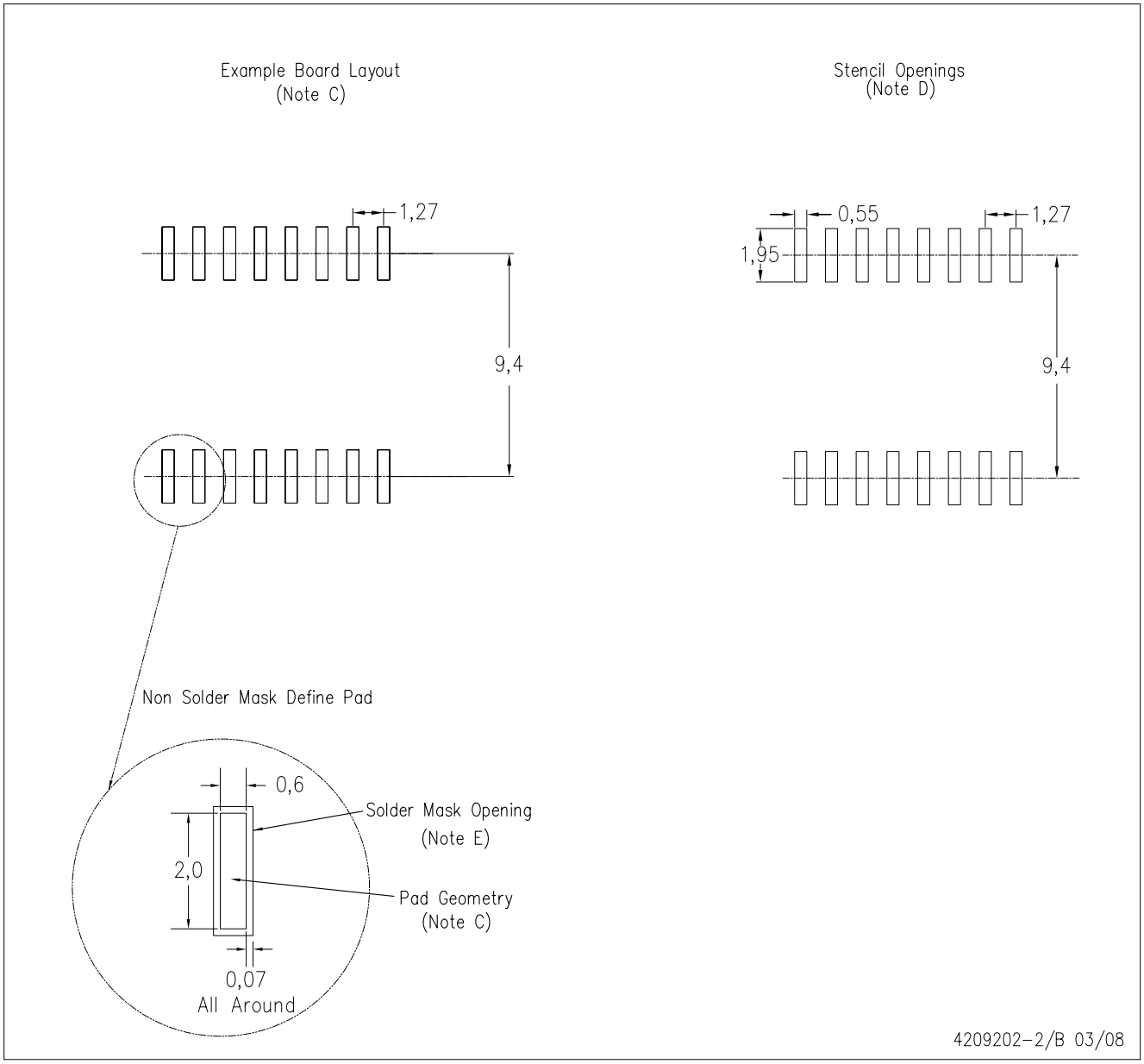
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact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

DW (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 dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–013 variation AA.

DW (R-PDSO-G16)

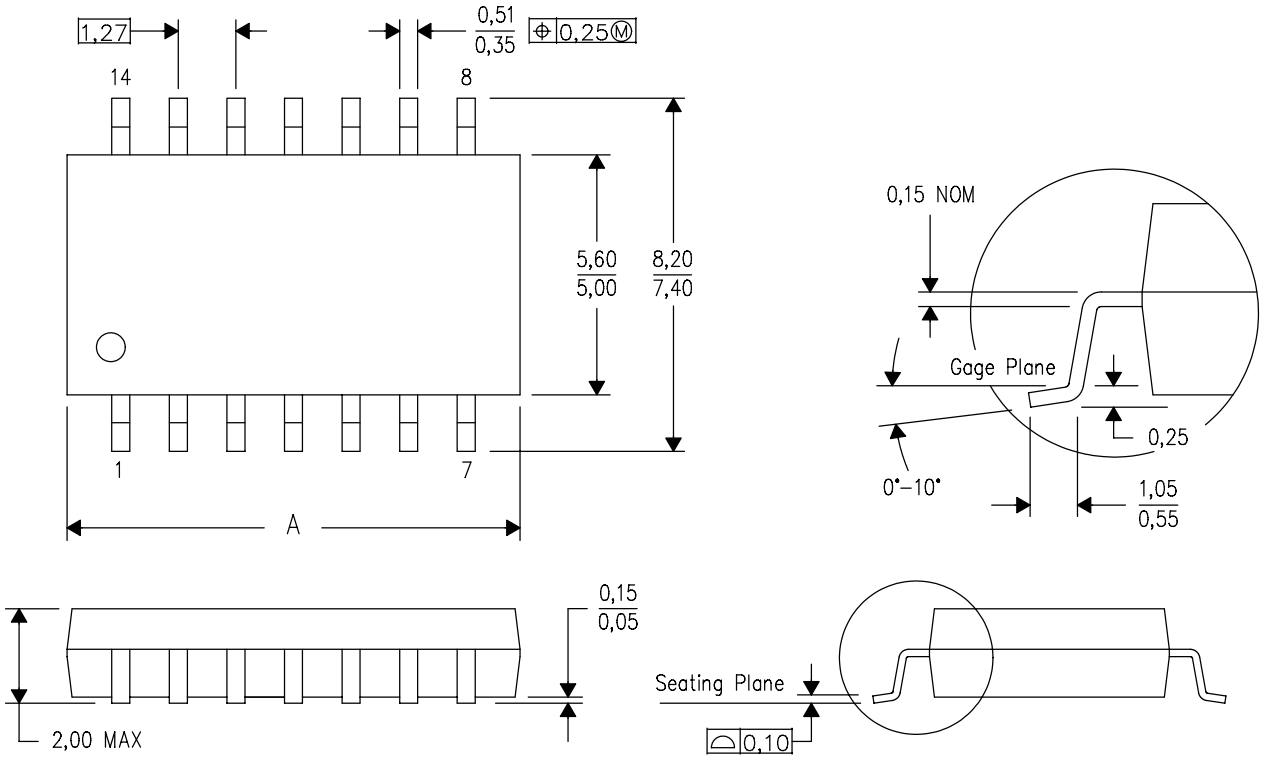


NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Refer to IPC7351 for alternate board design.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
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



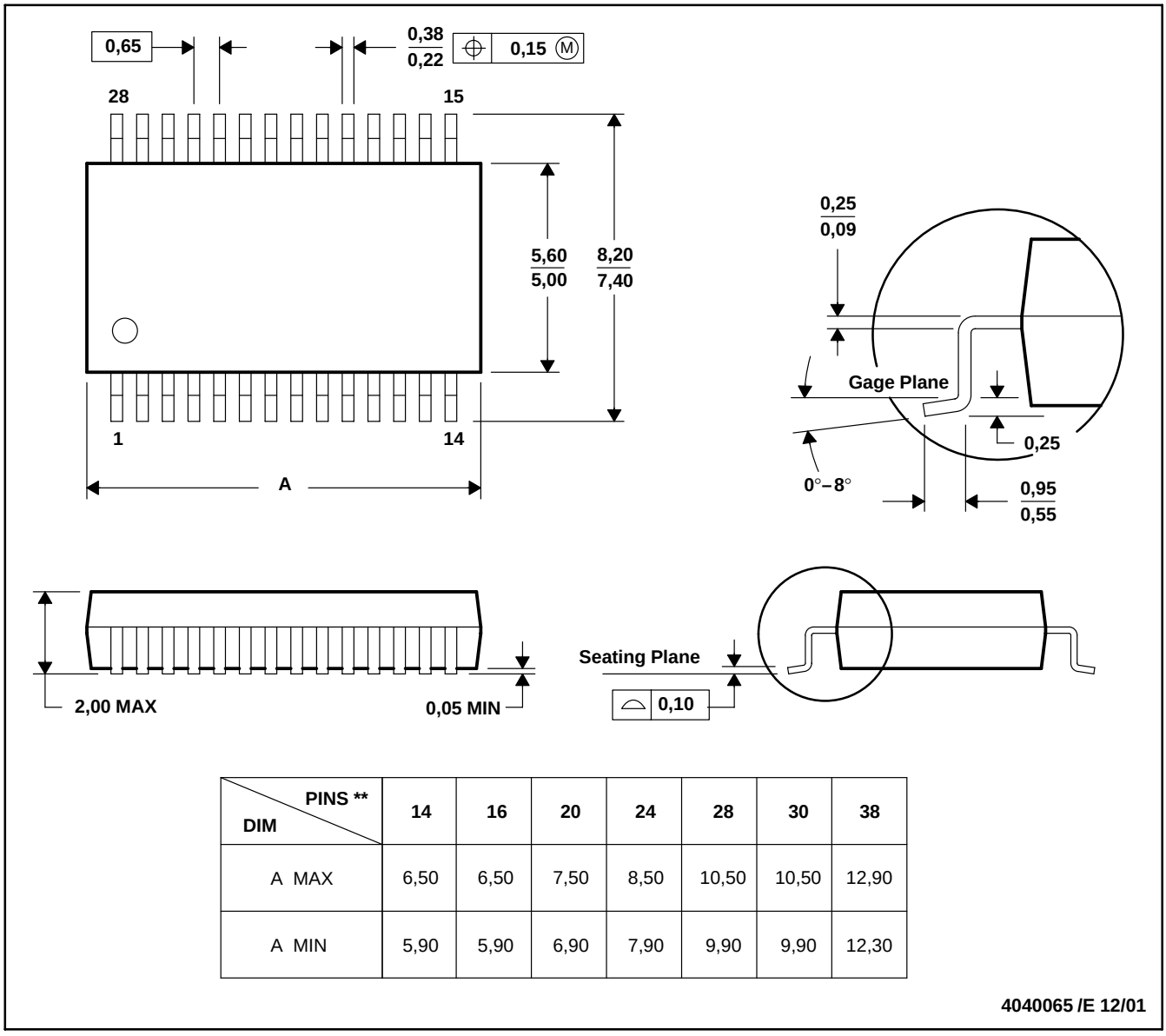
DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

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



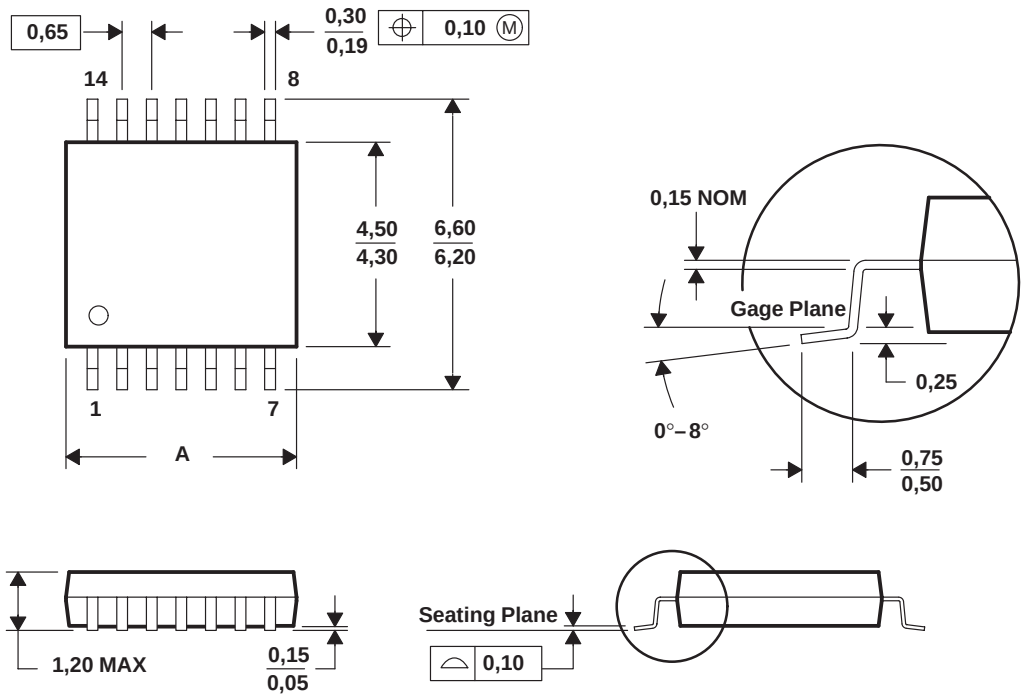
DIM \ PINS **	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

4040065 /E 12/01

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

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

14 PINS SHOWN

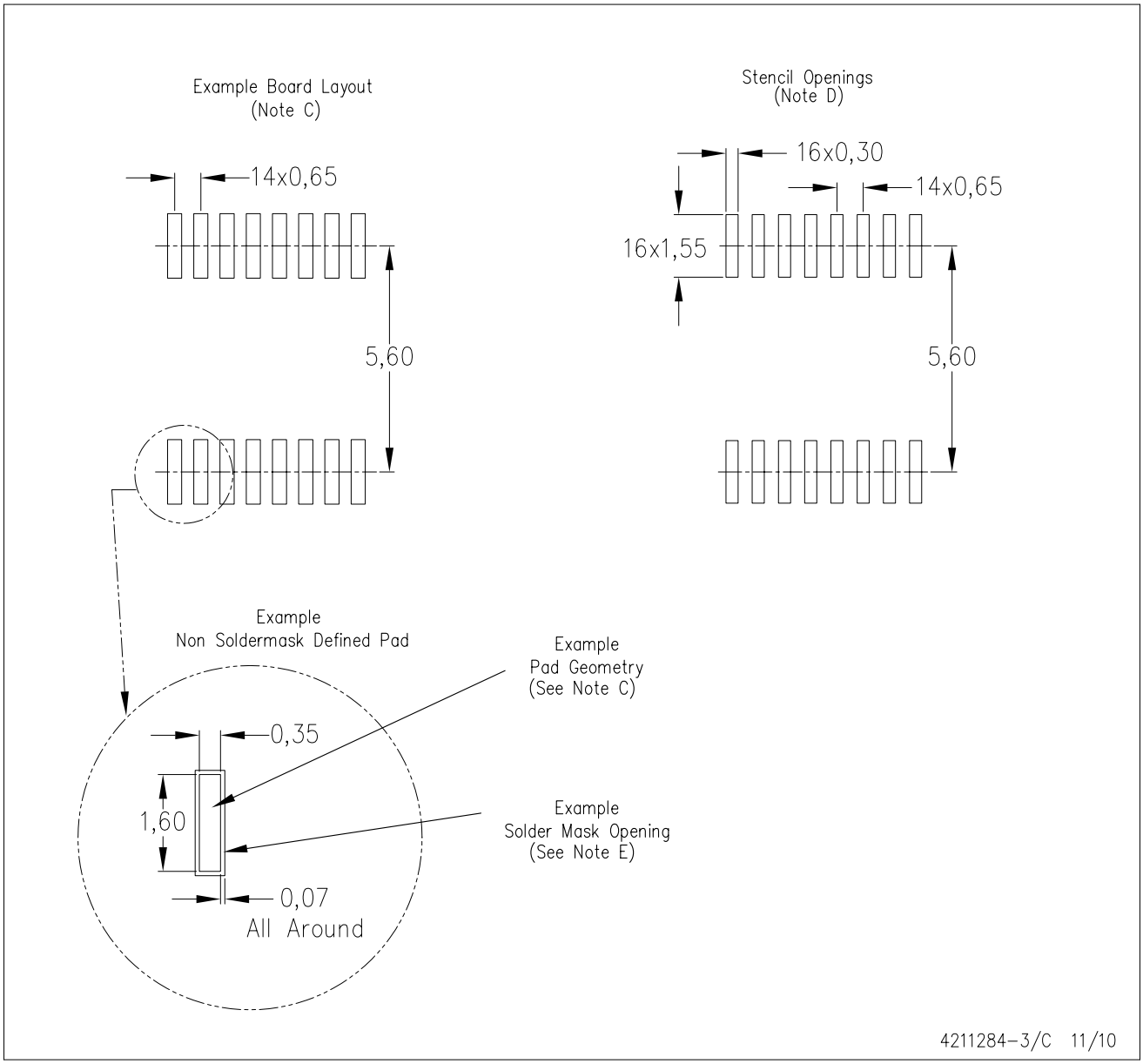


DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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

PW (R-PDSO-G16) 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.

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