- **Qualified for Automotive Applications**
- **Wide Operating Voltage Range of 2 V to 6 V**
- **Outputs Can Drive Up To 10 LSTTL Loads**
- **Low Power Consumption, 80-μA Max I_{CC}**
- **Typical t_{pd} = 20 ns**
- **$\pm$4-mA Output Drive at 5 V**
- **Low Input Current of 1 μA Max**
- **Look-Ahead Circuitry Enhances Cascaded Counters**

- **Fully Synchronous in Count Modes**
- **Parallel Asynchronous Load for Modulo-N Count Lengths**
- **Asynchronous Clear**

PW PACKAGE
(TOP VIEW)

|			
B	1	16	V_{CC}
Q_B	2	15	A
Q_A	3	14	CLR
DOWN	4	13	$\overline{BO}$
UP	5	12	$\overline{CO}$
Q_C	6	11	$\overline{LOAD}$
Q_D	7	10	C
GND	8	9	D

description/ordering information

The SN74HC193 device is a 4-bit synchronous, reversible, up/down binary counter. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change simultaneously with each other when dictated by the steering logic. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple-clock) counters.

The outputs of the four flip-flops are triggered on a low-to-high-level transition of either count (clock) input (UP or DOWN). The direction of counting is determined by which count input is pulsed while the other count input is high.

All four counters are fully programmable; that is, each output may be preset to either level by placing a low on the load ($\overline{LOAD}$) input and entering the desired data at the data inputs. The output changes to agree with the data inputs independently of the count pulses. This feature allows the counters to be used as modulo-N dividers simply by modifying the count length with the preset inputs.

A clear (CLR) input has been provided that forces all outputs to the low level when a high level is applied. The clear function is independent of the count and $\overline{LOAD}$ inputs.

This counter was designed to be cascaded without the need for external circuitry. The borrow ($\overline{BO}$) output produces a low-level pulse while the count is zero (all outputs low) and DOWN is low. Similarly, the carry ($\overline{CO}$) output produces a low-level pulse while the count is maximum (9 or 15), and UP is low. The counter then can be cascaded easily by feeding $\overline{BO}$ and $\overline{CO}$ to DOWN and UP, respectively, of the succeeding counter.
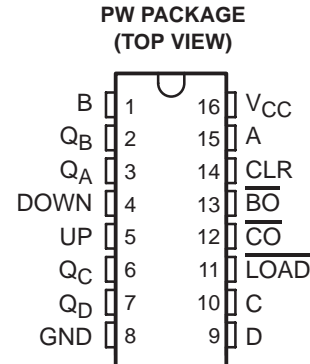
ORDERING INFORMATION[†]

T_A	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 125°C	TSSOP – PW	Reel of 2000	SN74HC193QPWRQ1	HC193Q
−40°C to 85°C	TSSOP – PW	Reel of 2000	SN74HC193IPWRQ1	HC193I

† 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 http://www.ti.com.
‡ Package drawings, thermal data, and symbolization are available at http://www.ti.com/packaging.

TEXAS INSTRUMENTS

logic diagram (positive logic)

TEXAS
INSTRUMENTS
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

typical clear, load, and count sequence

The following sequence is illustrated below:

1. Clear outputs to 0

2. Load (preset) to binary 13

3. Count up to 14, 15, carry, 0, 1, and 2

4. Count down to 1, 0, borrow, 15, 14, and 13

NOTES: A. CLR overrides LOAD, data, and count inputs.
B. When counting up, count-down input must be high; when counting down, count-up input must be high.

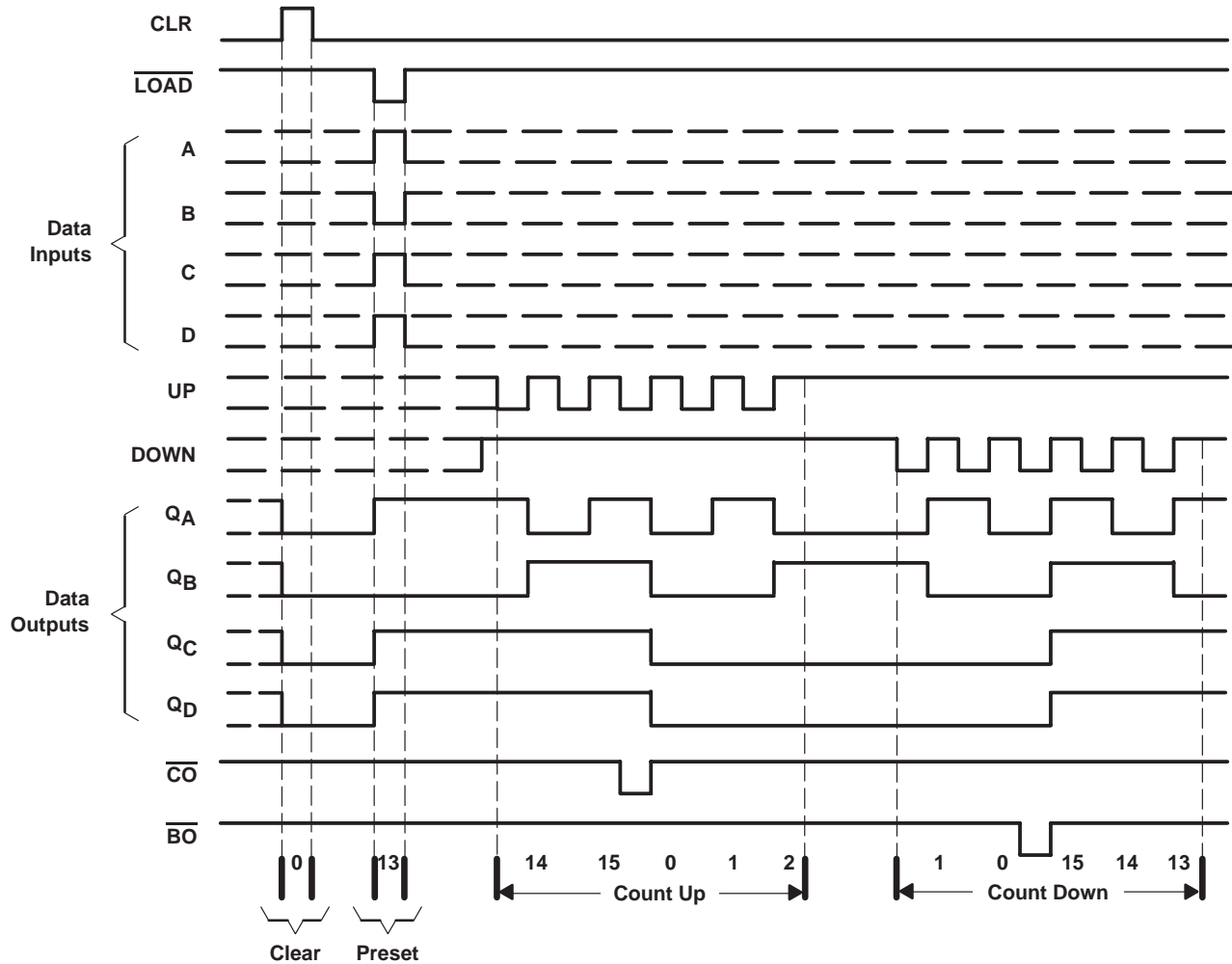## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} . . . . −0.5 V to 7 V
Input clamp current, I_{IK} (V_I < 0 or V_I > V_{CC}) (see Note 1) . . . . ±20 mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{CC}) (see Note 1) . . . . ±20 mA
Continuous output current, I_O (V_O = 0 to V_{CC}) . . . . ±25 mA
Continuous current through V_{CC} or GND . . . . ±50 mA
Package thermal impedance, θ_{JA} (see Note 2) . . . . 108°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. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
 2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

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

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.

‡ 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 MIN	TYP	MAX	T_A = −40°C TO 125°C MIN	MAX	T_A = −40°C TO 85°C MIN	MAX	UNIT
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		
		I_{OH} = −4 mA	4.5 V	3.98	4.3		3.7		3.84		
		I_{OH} = −5.2 mA	6 V	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	
		I_{OL} = 4 mA	4.5 V		0.17	0.26		0.4		0.33	
		I_{OL} = 5.2 mA	6 V		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_{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 recommended operating free-air temperature range (unless otherwise noted)

		V_{CC}	$T_A = 25°C$ MIN	MAX	$T_A = -40°C$ TO 125°C MIN	MAX	$T_A = -40°C$ TO 85°C MIN	MAX	UNIT
f_{clock}	Clock frequency	2 V		4.2		2.8		3.3	MHz
		4.5 V		21		14		17	
		6 V		24		16		19	
t_w	Pulse duration	CLR high 2 V	120		180		150		ns
		4.5 V	24		36		30		
		6 V	21		31		26		
		$\overline{LOAD}$ low 2 V	120		180		150		
		4.5 V	24		36		30		
		6 V	21		31		26		
		UP or DOWN, high or low 2 V	120		180		150		
		4.5 V	24		36		30		
		6 V	21		31		26		
t_{su}	Setup time	Data before $\overline{LOAD}$ inactive 2 V	110		165		140		ns
		4.5 V	22		33		28		
		6 V	19		28		24		
		CLR inactive before UP↑ or DOWN↓ 2 V	110		165		140		
		4.5 V	22		33		28		
		6 V	19		28		24		
		$\overline{LOAD}$ inactive before UP↑ or DOWN↓ 2 V	110		165		140		
		4.5 V	22		33		28		
		6 V	19		28		24		
t_h	Hold time	Data after $\overline{LOAD}$ inactive 2 V	5		5		5		ns
		4.5 V	5		5		5		
		6 V	5		5		5		

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

switching characteristics over recommended operating free-air temperature range, C$_L$ = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V$_{CC}$	T$_A$ = 25°C			T$_A$ = −40°C TO 125°C		T$_A$ = −40°C TO 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f$_{max}$			2 V	4.2	8		2.8		3.3		MHz
			4.5 V	21	55		14		17		
			6 V	24	60		16		19		
t$_{pd}$	UP	$\overline{CO}$	2 V		75	165		250		205	ns
			4.5 V		24	33		50		41	
			6 V		20	28		43		35	
	DOWN	$\overline{BO}$	2 V		75	165		250		205	
			4.5 V		24	33		50		41	
			6 V		20	28		43		35	
	UP or DOWN	Any Q	2 V		190	250		375		315	
			4.5 V		40	50		75		63	
			6 V		35	43		64		54	
	$\overline{LOAD}$	Any Q	2 V		190	260		390		325	
			4.5 V		40	52		78		65	
			6 V		35	44		66		55	
t$_{PHL}$	CLR	Any Q	2 V		170	240		360		300	ns
			4.5 V		36	48		72		60	
			6 V		31	41		61		51	
t$_t$		Any	2 V		38	75		110		95	ns
			4.5 V		8	15		22		19	
			6 V		6	14		19		17	

operating characteristics, T$_A$ = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C$_{pd}$	Power dissipation capacitance	No load	50	pF

PARAMETER MEASUREMENT INFORMATION

LOAD CIRCUIT

From Output Under Test — Test Point

$C_L = 50$ pF (see Note A)
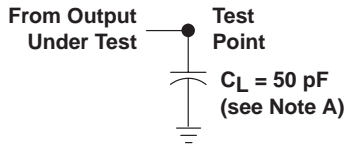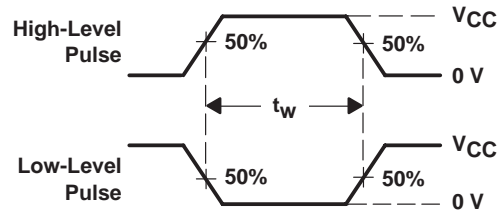
VOLTAGE WAVEFORMS
PULSE DURATIONS

High-Level Pulse — 50% — 50% — V_{CC} / 0 V — t_w

Low-Level Pulse — 50% — 50% — V_{CC} / 0 V
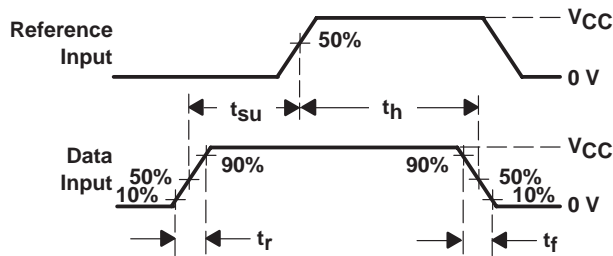
VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES

Reference Input — 50% — V_{CC} / 0 V

t_{su} — t_h

Data Input — 50% 10% — 90% — 90% — 50% 10% — V_{CC} / 0 V

t_r — t_f
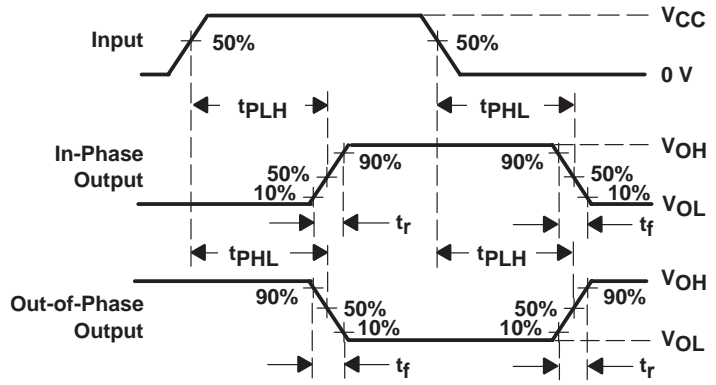
VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES

Input — 50% — 50% — V_{CC} / 0 V

t_{PLH} — t_{PHL}

In-Phase Output — 50% 10% — 90% — 90% — 50% 10% — V_{OH} / V_{OL}

t_r — t_f

t_{PHL} — t_{PLH}

Out-of-Phase Output — 90% — 50% 10% — 50% 10% — 90% — V_{OH} / V_{OL}

t_f — t_r

NOTES: A. C_L includes probe and test-fixture capacitance.
  B. 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.
  C. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
  D. The outputs are measured one at a time, with one input transition per measurement.
  E. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

TEXAS INSTRUMENTS

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN74HC193QPWRG4Q1	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC193Q
SN74HC193QPWRG4Q1.A	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC193Q

(1) Status: For more details on status, see our product life cycle.

(2) Material type: When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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.

OTHER QUALIFIED VERSIONS OF SN74HC193-Q1 :

- Catalog : SN74HC193

- Military : SN54HC193

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

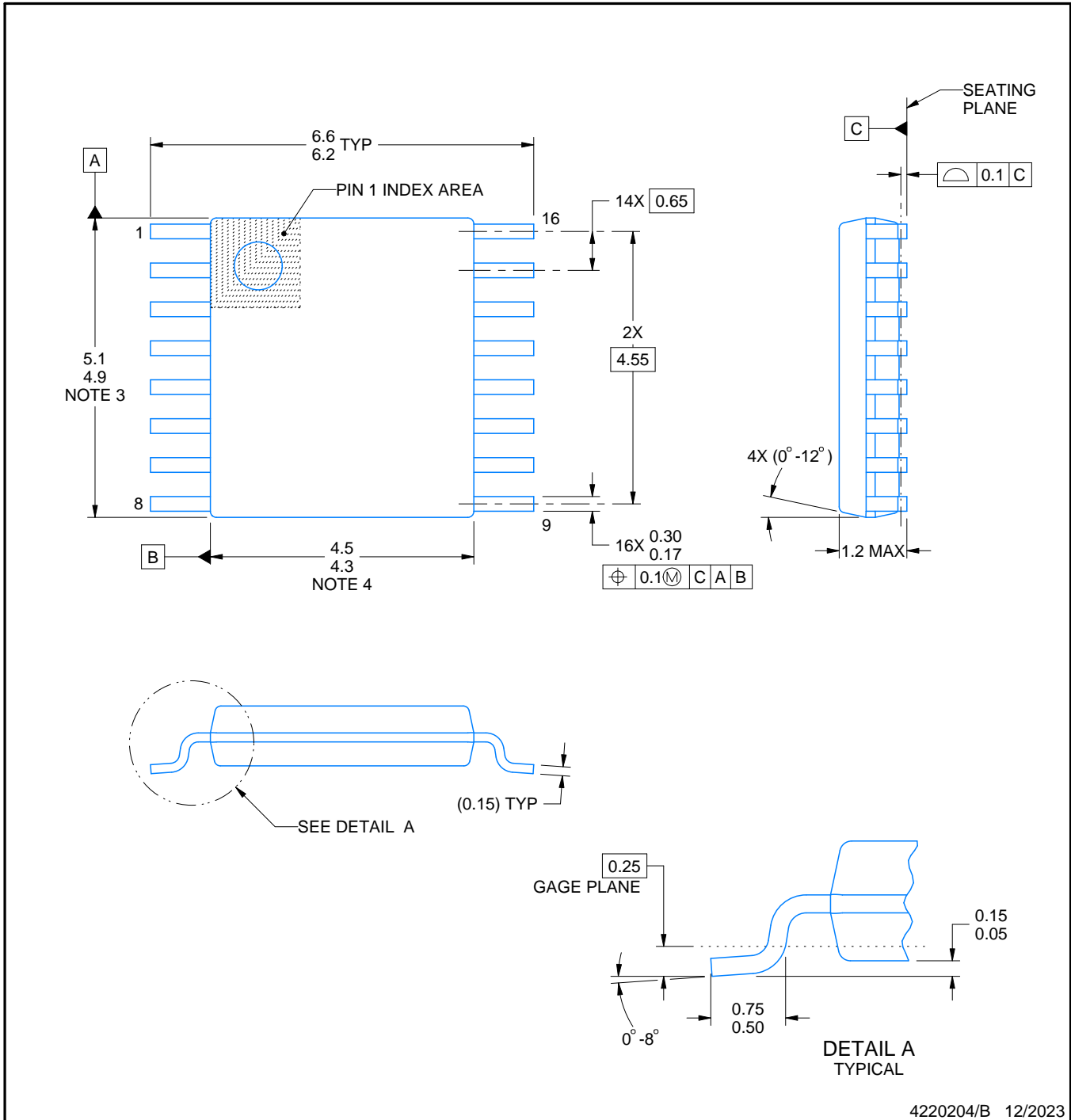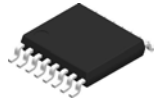**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

*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
SN74HC193QPWRG4Q1	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)
SN74HC193QPWRG4Q1	TSSOP	PW	16	2000	353.0	353.0	32.0

6.6
6.2 TYP

A

PIN 1 INDEX AREA

1

16

14X [0.65]

2X
[4.55]

5.1
4.9
NOTE 3

8

9

B

4.5
4.3
NOTE 4

16X 0.30
0.17

⊕ 0.1 Ⓜ C A B

SEATING
PLANE

C

◻ 0.1 C

4X (0°-12°)

1.2 MAX

SEE DETAIL A

(0.15) TYP

0.25

GAGE PLANE

0°-8°

0.75
0.50
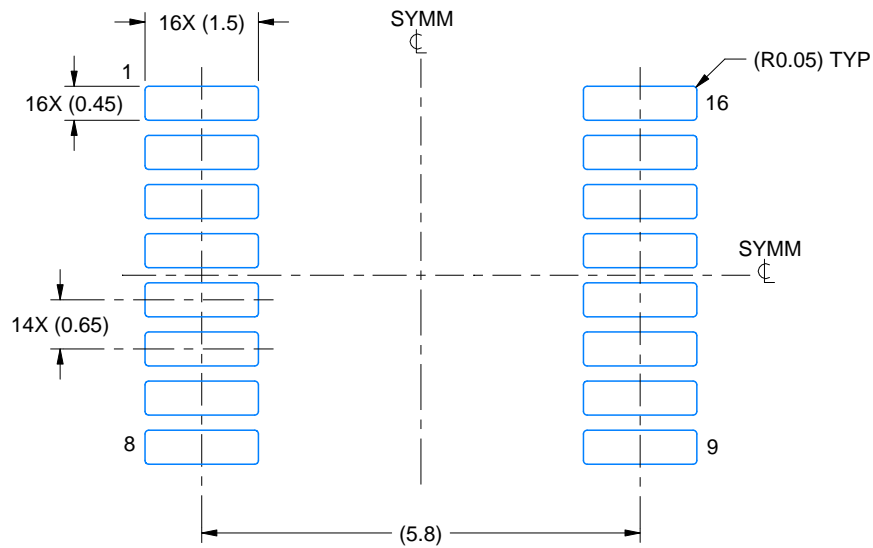
0.15
0.05

DETAIL A
TYPICAL

4220204/B   12/2023

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
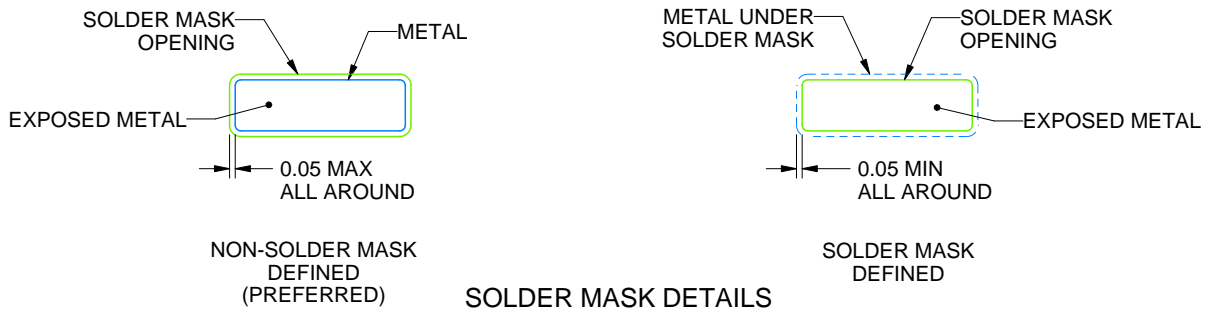5. Reference JEDEC registration MO-153.

16X (1.5)
SYMM
(R0.05) TYP
1
16X (0.45)
16
SYMM
14X (0.65)
8
9
(5.8)

LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

SOLDER MASK OPENING
METAL
EXPOSED METAL
0.05 MAX ALL AROUND
NON-SOLDER MASK DEFINED (PREFERRED)

METAL UNDER SOLDER MASK
SOLDER MASK OPENING
EXPOSED METAL
0.05 MIN ALL AROUND
SOLDER MASK DEFINED

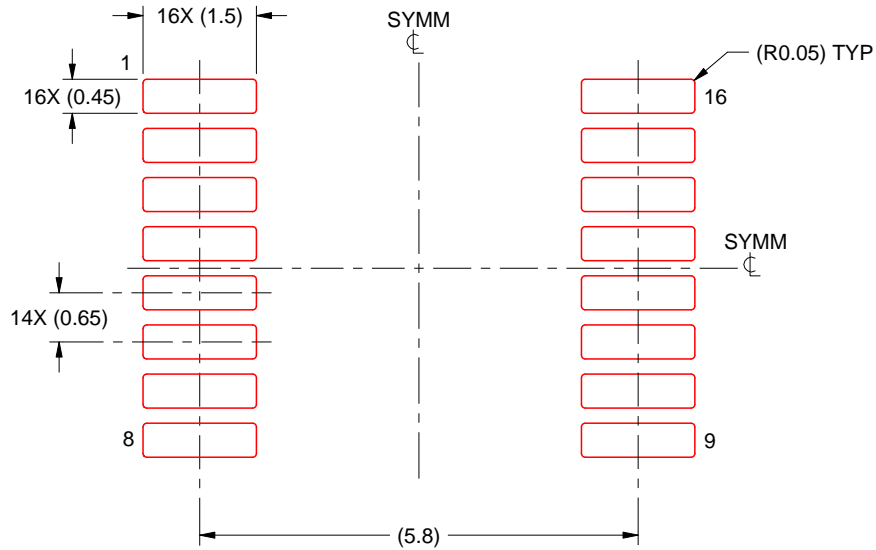**SOLDER MASK DETAILS**

4220204/B   12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220204/B   12/2023

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale, TI's General Quality Guidelines, or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2025, Texas Instruments Incorporated

Last updated 10/2025