Triple Inverter Gate

Check for Samples: SN74LVC3G04

FEATURES
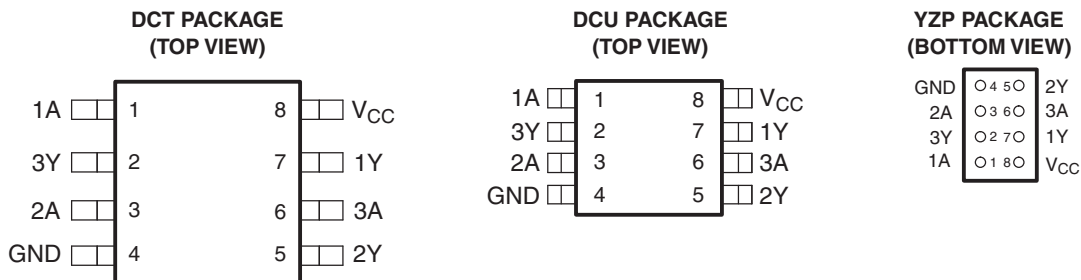
- **Available in the Texas Instruments NanoFree™ Package**
- **Supports 5-V V_{CC} Operation**
- **Inputs Accept Voltages to 5.5 V**
- **Max t_{pd} of 4.1 ns at 3.3 V**
- **Low Power Consumption, 10-µA Max I_{CC}**
- **±24-mA Output Drive at 3.3 V**
- **Typical V_{OLP} (Output Ground Bounce) <0.8 V at V_{CC} = 3.3 V, T_A = 25°C**
- **Typical V_{OHV} (Output V_{OH} Undershoot) >2 V at V_{CC} = 3.3 V, T_A = 25°C**
- **I_{off} Supports Live Insertion, Partial-Power- Down Mode, and Back-Drive Protection**
- **Can Be Used as a Down Translator to Translate Inputs From a Max of 5.5 V Down to the V_{CC} Level**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **200-V Machine Model (A115-A)**
  - **1000-V Charged-Device Model (C101)**

DESCRIPTION

This triple inverter is designed for 1.65-V to 5.5-V V_{CC} operation. The SN74LVC3G04 device performs the Boolean function $Y = \overline{A}$.

NanoFree™ package technology is a major breakthrough in IC packaging concepts, using the die as the package.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

DCT PACKAGE (TOP VIEW)

1A	1	8	V_{CC}
3Y	2	7	1Y
2A	3	6	3A
GND	4	5	2Y

DCU PACKAGE (TOP VIEW)

1A	1	8	V_{CC}
3Y	2	7	1Y
2A	3	6	3A
GND	4	5	2Y

YZP PACKAGE (BOTTOM VIEW)

GND	O 4 5 O	2Y
2A	O 3 6 O	3A
3Y	O 2 7 O	1Y
1A	O 1 8 O	V_{CC}

See mechanical drawings for dimensions.

⚠ 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.

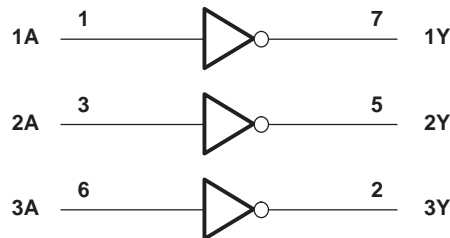NanoFree is a trademark of Texas Instruments.

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Function Table
(Each Inverter)

INPUT A	OUTPUT Y
H	L
L	H

Logic Diagram (Positive Logic)

Absolute Maximum Ratings[1]

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range		−0.5	6.5	V
V_I	Input voltage range[2]		−0.5	6.5	V
V_O	Voltage range applied to any output when the output is in the high-impedance or power-off state[2]		−0.5	6.5	V
V_O	Voltage range applied to any output when the output is in the high or low state[2][3]		−0.5	V_{CC} + 0.5	V
I_{IK}	Input clamp current	V_I < 0		−50	mA
I_{OK}	Output clamp current	V_O < 0		−50	mA
I_O	Continuous output current			±50	mA
	Continuous current through V_{CC} or GND			±100	mA
θ_{JA}	Package thermal impedance[4]	DCT package		220	°C/W
		DCU package		227	
		YZP package		102	
T_{stg}	Storage temperature range		−65	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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
(3) The value of V_{CC} is provided in the recommended operating conditions table.
(4) The package thermal impedance is calculated in accordance with JESD 51-7.

Product Folder Links: *SN74LVC3G04*

Recommended Operating Conditions[(1)]

			MIN	MAX	UNIT
V_{CC}	Supply voltage	Operating	1.65	5.5	V
		Data retention only	1.5		
V_{IH}	High-level input voltage	V_{CC} = 1.65 V to 1.95 V	$0.65 \times V_{CC}$		V
		V_{CC} = 2.3 V to 2.7 V	1.7		
		V_{CC} = 3 V to 3.6 V	2		
		V_{CC} = 4.5 V to 5.5 V	$0.7 \times V_{CC}$		
V_{IL}	Low-level input voltage	V_{CC} = 1.65 V to 1.95 V		$0.35 \times V_{CC}$	V
		V_{CC} = 2.3 V to 2.7 V		0.7	
		V_{CC} = 3 V to 3.6 V		0.8	
		V_{CC} = 4.5 V to 5.5 V		$0.3 \times V_{CC}$	
V_I	Input voltage		0	5.5	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 1.65 V		−4	mA
		V_{CC} = 2.3 V		−8	
		V_{CC} = 3 V		−16	
				−24	
		V_{CC} = 4.5 V		−32	
I_{OL}	Low-level output current	V_{CC} = 1.65 V		4	mA
		V_{CC} = 2.3 V		8	
		V_{CC} = 3 V		16	
				24	
		V_{CC} = 4.5 V		32	
$\Delta t/\Delta v$	Input transition rise or fall rate	V_{CC} = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V		20	ns/V
		V_{CC} = 3.3 V ± 0.3 V		10	
		V_{CC} = 5 V ± 0.5 V		5	
T_A	Operating free-air temperature		−40	125	°C

(1) 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}	–40°C to 85°C			–40°C to 125°C			UNIT
				MIN	TYP[1]	MAX	MIN	TYP[1]	MAX	
V_{OH}		I_{OH} = –100 µA	1.65 V to 5.5 V	V_{CC} – 0.1			V_{CC} – 0.1			V
		I_{OH} = –4 mA	1.65 V	1.2			1.2			
		I_{OH} = –8 mA	2.3 V	1.9			1.9			
		I_{OH} = –16 mA	3 V	2.4			2.4			
		I_{OH} = –24 mA		2.3			2.3			
		I_{OH} = –32 mA	4.5 V	3.8			3.8			
V_{OL}		I_{OL} = 100 µA	1.65 V to 5.5 V			0.1			0.1	V
		I_{OL} = 4 mA	1.65 V			0.45			0.45	
		I_{OL} = 8 mA	2.3 V			0.3			0.3	
		I_{OL} = 16 mA	3 V			0.4			0.4	
		I_{OL} = 24 mA				0.55			0.55	
		I_{OL} = 32 mA	4.5 V			0.55			0.75	
I_I	A inputs	V_I = 5.5 V or GND	0 to 5.5 V			±5			±5	µA
I_{off}		V_I or V_O = 5.5 V	0			±10			±10	µA
I_{CC}		V_I = 5.5 V or GND, I_O = 0	1.65 V to 5.5 V			10			10	µA
ΔI_{CC}		One input at V_{CC} – 0.6 V, Other inputs at V_{CC} or GND	3 V to 5.5 V			500			500	µA
C_i		V_I = V_{CC} or GND	3.3 V		3.5					pF

(1) All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74LVC3G04 –40°C to 85°C								UNIT
			V_{CC} = 1.8 V ± 0.15 V		V_{CC} = 2.5 V ± 0.2 V		V_{CC} = 3.3 V ± 0.3 V		V_{CC} = 5 V ± 0.5 V		
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	Y	3.2	7.9	1.5	4.4	1.4	4.1	1.1	3.2	ns

Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74LVC3G04 –40°C to 125°C								UNIT
			V_{CC} = 1.8 V ± 0.15 V		V_{CC} = 2.5 V ± 0.2 V		V_{CC} = 3.3 V ± 0.3 V		V_{CC} = 5 V ± 0.5 V		
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	Y	3.2	8.9	1.5	5.4	1.4	5.1	1.1	3.8	ns

Operating Characteristics

T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CC} = 1.8 V	V_{CC} = 2.5 V	V_{CC} = 3.3 V	V_{CC} = 5 V	UNIT
			TYP	TYP	TYP	TYP	
C_{pd}	Power dissipation capacitance	f = 10 MHz	16	16	16	18	pF

Product Folder Links: *SN74LVC3G04*

Parameter Measurement Information
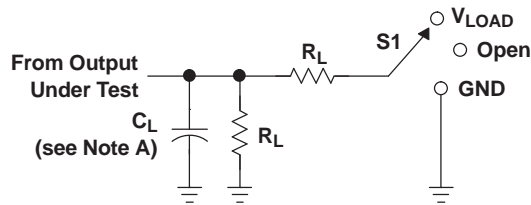
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

LOAD CIRCUIT

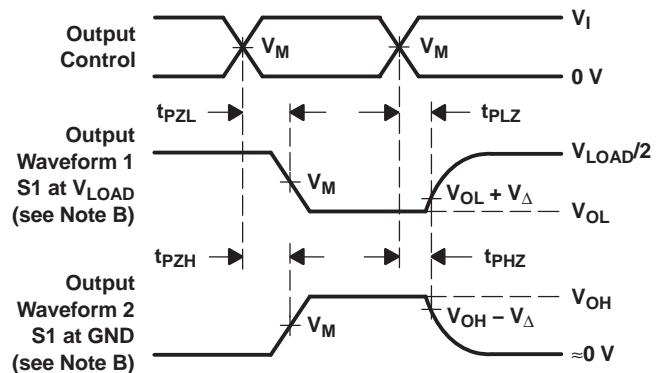| V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_r/t_f					
$1.8\ V \pm 0.15\ V$	V_{CC}	$\leq 2\ ns$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 kΩ	0.15 V
$2.5\ V \pm 0.2\ V$	V_{CC}	$\leq 2\ ns$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
$3.3\ V \pm 0.3\ V$	3 V	$\leq 2.5\ ns$	1.5 V	6 V	50 pF	500 Ω	0.3 V
$5\ V \pm 0.5\ V$	V_{CC}	$\leq 2.5\ ns$	$V_{CC}/2$	$2 \times V_{CC}$	50 pF	500 Ω	0.3 V
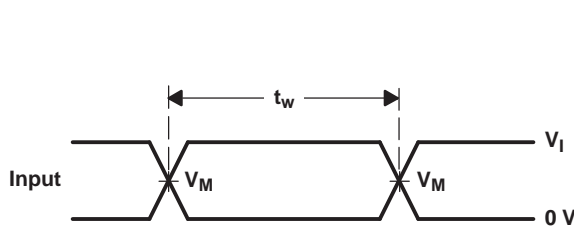
VOLTAGE WAVEFORMS
PULSE DURATION
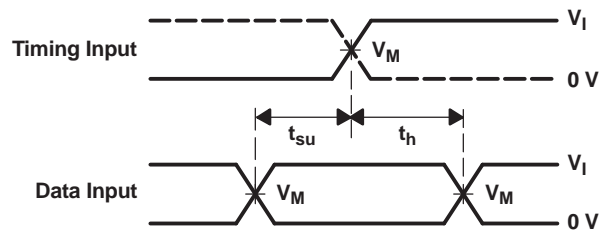
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES
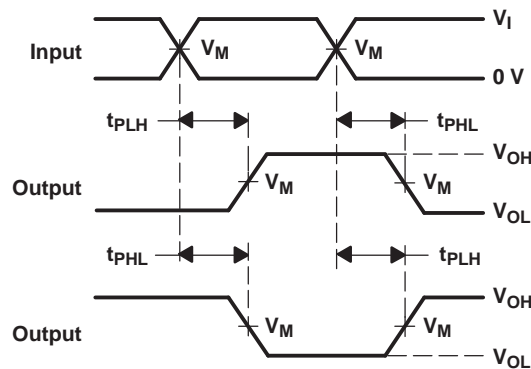
VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS

VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

NOTES: A. C_L includes probe and jig 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. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω.
D. The outputs are measured one at a time, with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PLH} and t_{PHL} are the same as t_{pd}.
H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

REVISION HISTORY

Changes from Revision K (May 2007) to Revision L   **Page**

Product Folder Links: *SN74LVC3G04*

PACKAGE OPTION ADDENDUM

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
SN74LVC3G04DCTR	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C04 Z	Samples
SN74LVC3G04DCTRE4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C04 Z	Samples
SN74LVC3G04DCTRG4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C04 Z	Samples
SN74LVC3G04DCUR	ACTIVE	VSSOP	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	(C04Q ~ C04R)	Samples
SN74LVC3G04DCURG4	ACTIVE	VSSOP	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C04R	Samples
SN74LVC3G04DCUT	ACTIVE	VSSOP	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU | CU SN	Level-1-260C-UNLIM	-40 to 125	(C04Q ~ C04R)	Samples
SN74LVC3G04YZPR	ACTIVE	DSBGA	YZP	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	(CC7 ~ CCN)	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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PACKAGE MATERIALS INFORMATION

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
SN74LVC3G04DCTR	SM8	DCT	8	3000	180.0	13.0	3.35	4.5	1.55	4.0	12.0	Q3
SN74LVC3G04DCUR	VSSOP	DCU	8	3000	178.0	9.5	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G04DCUR	VSSOP	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G04DCURG4	VSSOP	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G04DCUT	VSSOP	DCU	8	250	178.0	9.5	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G04YZPR	DSBGA	YZP	8	3000	178.0	9.2	1.02	2.02	0.63	4.0	8.0	Q1

![Texas Instruments logo]

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC3G04DCTR	SM8	DCT	8	3000	182.0	182.0	20.0
SN74LVC3G04DCUR	VSSOP	DCU	8	3000	202.0	201.0	28.0
SN74LVC3G04DCUR	VSSOP	DCU	8	3000	202.0	201.0	28.0
SN74LVC3G04DCURG4	VSSOP	DCU	8	3000	202.0	201.0	28.0
SN74LVC3G04DCUT	VSSOP	DCU	8	250	202.0	201.0	28.0
SN74LVC3G04YZPR	DSBGA	YZP	8	3000	220.0	220.0	35.0

DCT (R-PDSO-G8)   **PLASTIC SMALL-OUTLINE PACKAGE**
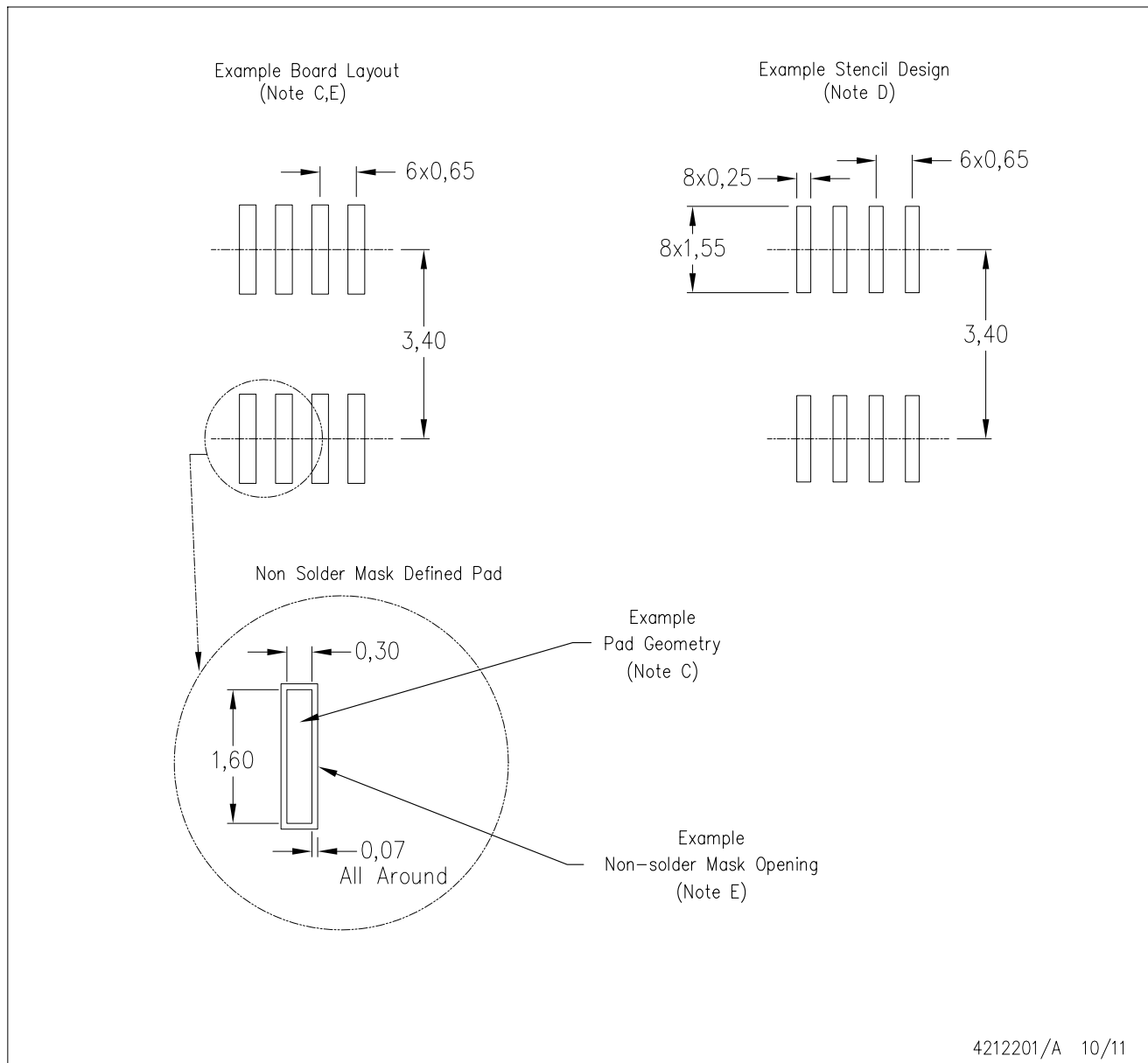
4188781/C 09/02

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
   D. Falls within JEDEC MO-187 variation DA.

DCT (R−PDSO−G8)   PLASTIC SMALL OUTLINE

Example Board Layout
(Note C,E)

Example Stencil Design
(Note D)

6x0,65

8x0,25

6x0,65

8x1,55

3,40

3,40

Non Solder Mask Defined Pad

0,30

Example
Pad Geometry
(Note C)

1,60

0,07
All Around

Example
Non−solder Mask Opening
(Note E)

4212201/A   10/11

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.
         E.   Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DCU (R−PDSO−G8)   PLASTIC SMALL−OUTLINE PACKAGE (DIE DOWN)

4200503/F 07/05

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. Mold flash and protrusion shall not exceed 0.15 per side.
        D. Falls within JEDEC MO−187 variation CA.

DCU (S−PDSO−G8)   PLASTIC SMALL OUTLINE PACKAGE (DIE DOWN)

Example Board Layout
(Note C,E)

6x 0,5

3,1

Example Stencil Design
(Note D)

8x 0,25   6x 0,5

8x 0,75

3,1

0,3

0,8

Example
Solder Mask Opening

Pad Geometry

0,05

All Around

4210064/C 04/12

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.

YZP (R-XBGA-N8)   DIE-SIZE BALL GRID ARRAY

E

A

B

D

Ball A1 Index Area

0,50

0,25

D

C

B

A

1   2

Bottom View

0,25

1,50

0,50

8X Ø $\frac{0,25}{0,21}$

| ⊕ | Ø 0,015 Ⓜ | C | A | B |

0,50 Max

□ 0,05 C

Seating Plane

$\frac{0,19}{0,15}$

C

D: Max = 1.918 mm, Min =1.858 mm

E: Max = 0.918 mm, Min =0.858 mm

4204741-5/M   11/13

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.   NanoFree™ package configuration.

NanoFree is a trademark of Texas Instruments.

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