

FDC2212, FDC2214, FDC2112, FDC2114 EMI-Resistant 28/12-Bit Capacitance to Digital Converter for Proximity and Level Sensing Applications

1 Features

- EMI-Resistant Architecture
- Number of channels: 2, 4
- Maximum input capacitance: 250 nF (@10 kHz with 1 mH inductor)
- Maximum output rates (one active channel):
 - 13.3 ksp/s (FDC2112, FDC2114)
 - 4.08 ksp/s (FDC2212, FDC2214)
- Resolution: 28-bit, 12-bit
- Noise floor: 0.3 fF @ 100 sps
- Sensor excitation frequency: 10 kHz to 10 MHz
- Supply voltage: 2.7 V to 3.6 V
- Power consumption: Active: 2.1 mA
- Low-Power Sleep Mode: 35 μ A
- Shutdown: 200 nA
- Interface: I²C
- Temp range: -40°C to +125°C

2 Applications

- EMI-resistant proximity sensor
- EMI-resistant gesture recognition
- Level sensor for liquids, including conductive ones such as detergent, soap, and ink
- EMI-resistant collision avoidance
- EMI-resistant Rain / fog / ice / snow sensor
- Automotive door / kick sensors
- Material size detection

3 Description

Capacitive sensing is a low-power, low-cost, high-resolution contactless sensing technique that can be applied to a variety of applications ranging from proximity detection and gesture recognition to remote liquid level sensing. The sensor in a capacitive sensing system is any metal or conductor, allowing for low cost and highly flexible system design.

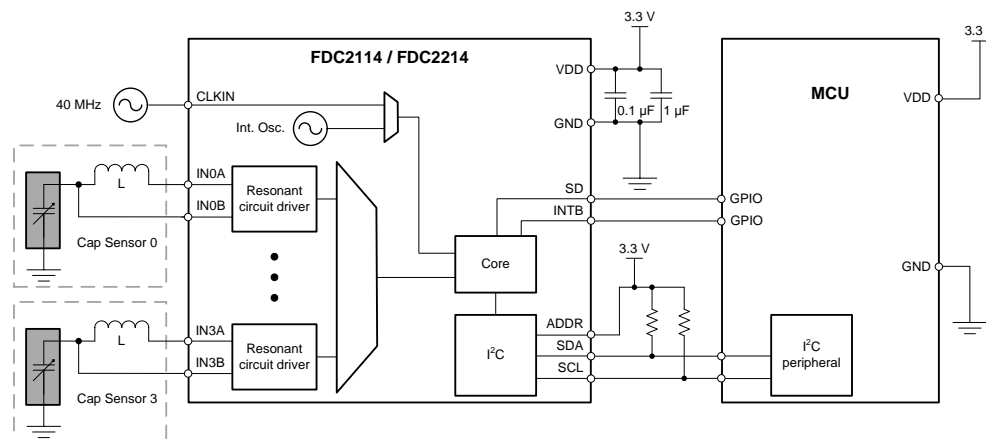
The FDC2x1x is a multi-channel family of noise and EMI-resistant, high-resolution, high-speed capacitance to digital converters for implementing capacitive sensing solutions. The devices employ an innovative narrow-band based architecture to offer high rejection of noise and interferers while providing high resolution at high speed. The devices support excitation frequencies from 10 kHz to 10 MHz, offering flexibility in system design; at 10 MHz, the upper end of the excitation frequency range is especially useful for reliable sensing of conductive liquids such as detergent, soap, and ink.

Device Information⁽¹⁾

PART NUMBER	RESOLUTION	PACKAGE	BODY SIZE (NOM)
FDC2112	12 bit	WSO-12	4 mm x 4 mm
FDC2114	12 bit	WQFN-16	4 mm x 4 mm
FDC2212	28 bit	WSO-12	4 mm x 4 mm
FDC2214	28 bit	WQFN-16	4 mm x 4 mm

(1) For all available packages, see the orderable addendum at the end of the datasheet.

Simplified Schematic



4 Description continued

The FDC221x is optimized for high resolution, up to 28 bits, while the FDC211x offers fast sample rate, up to 13.3ksps, for easy implementation of applications that use fast moving targets. The very large input capacitance of 250 nF allows for the use of remote sensors, as well as for tracking environmental changes over time, temperature and humidity.

The FDC2x1x family is targeting proximity sensing and liquid level sensing applications for any type of liquids. For non-conductive liquid level sensing applications in the presence of interferences such as human hands, use the FDC1004 instead, which has integrated shield drivers.

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5 Revision History

DATE	REVISION	NOTES
May 2015	*	Initial release.

PRODUCT PREVIEW

6 Device and Documentation Support

6.1 Device Support

6.1.1 Development Support

For related links, see the following:

- Texas Instruments' WEBENCH tool: <http://www.ti.com/webench>

6.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 1. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
FDC2212	Click here	Click here	Click here	Click here	Click here
FDC2214	Click here	Click here	Click here	Click here	Click here
FDC2112	Click here	Click here	Click here	Click here	Click here
FDC2114	Click here	Click here	Click here	Click here	Click here

6.3 Trademarks

All trademarks are the property of their respective owners.

6.4 Electrostatic Discharge Caution



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.

6.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

7 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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
FDC2112DNTR	PREVIEW	WSON	DNT	12	4500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	FDC2112	
FDC2112DNTT	PREVIEW	WSON	DNT	12	250	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	FDC2112	
FDC2114RGHR	PREVIEW	WQFN	RGH	16	4500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	FDC2114	
FDC2114RGHT	PREVIEW	WQFN	RGH	16	250	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	FDC2114	
FDC2212DNTR	PREVIEW	WSON	DNT	12	4500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	FDC2212	
FDC2212DNTT	PREVIEW	WSON	DNT	12	250	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	FDC2212	
FDC2214RGHR	PREVIEW	WQFN	RGH	16	4500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	FDC2214	
FDC2214RGHT	PREVIEW	WQFN	RGH	16	250	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	FDC2214	

(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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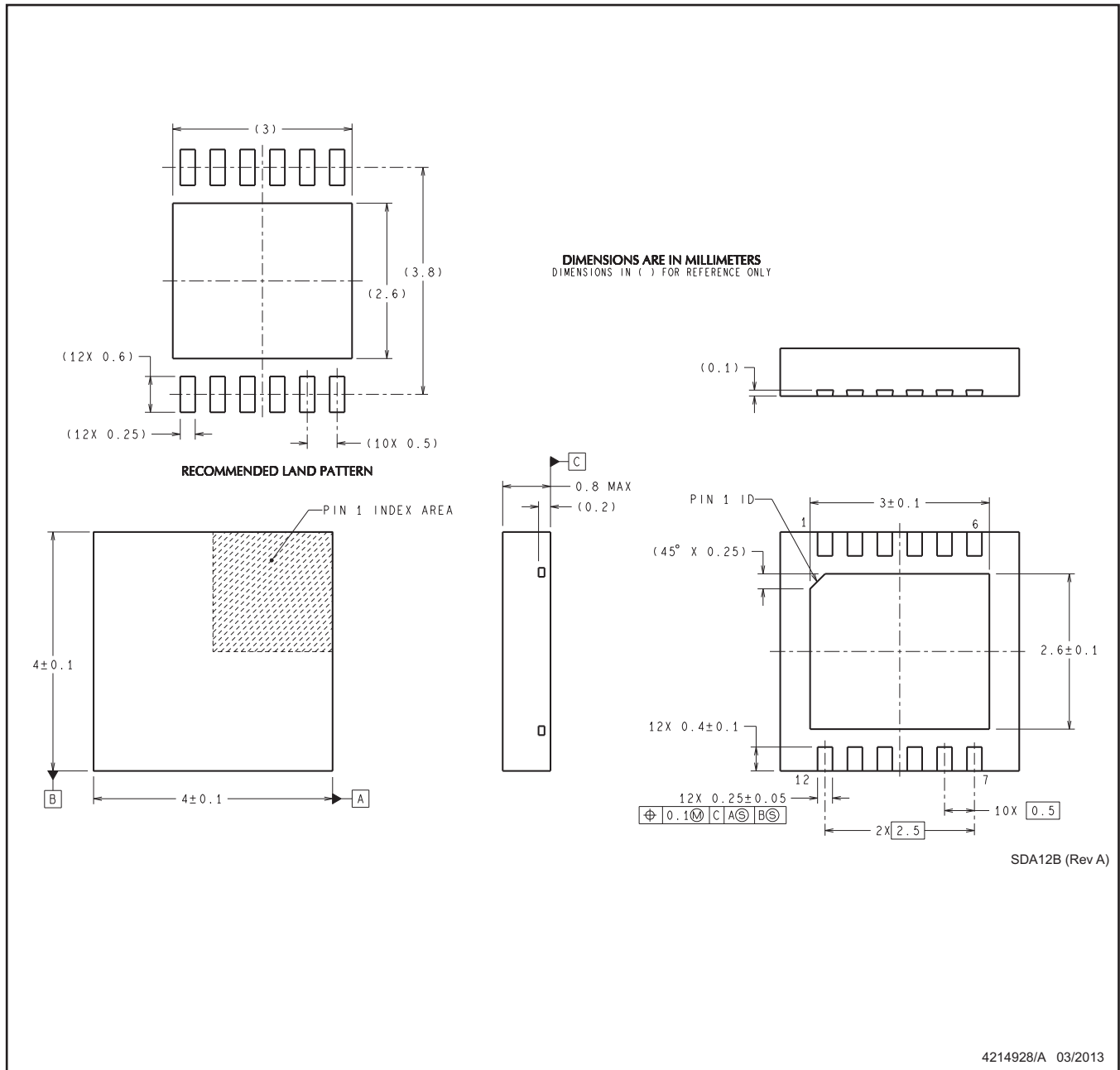
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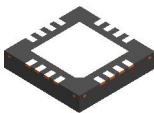
DNT0012B

WSO - 0.8mm max height

SON (PLASTIC SMALL OUTLINE - NO LEAD)



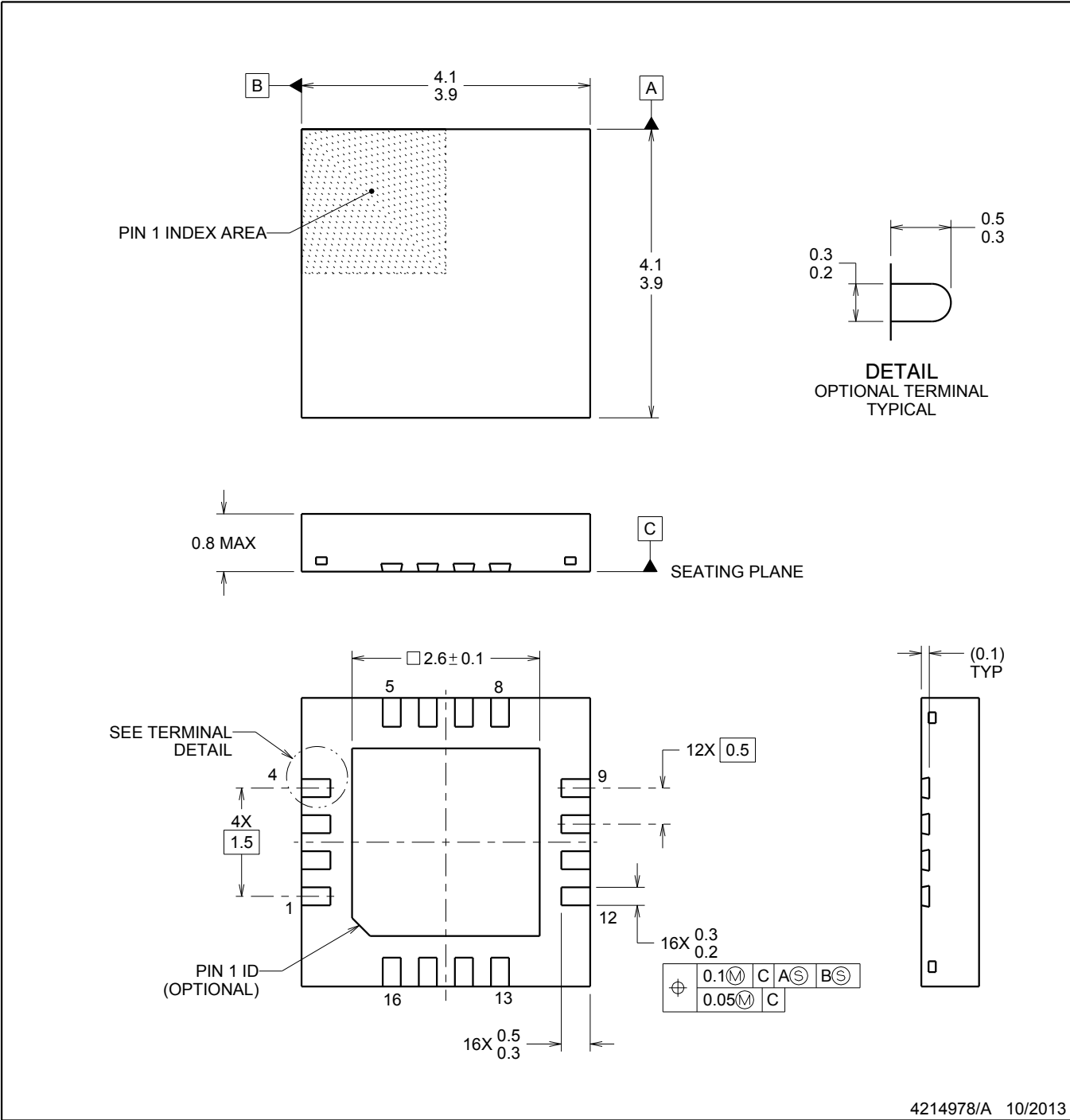
- NOTES: 1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is designed to be soldered to a thermal pad on the board for thermal and mechanical performance. For more information, refer to QFN/SON PCB application note in literature No. SLUA271 (www.ti.com/lit/slua271).



RGH0016A

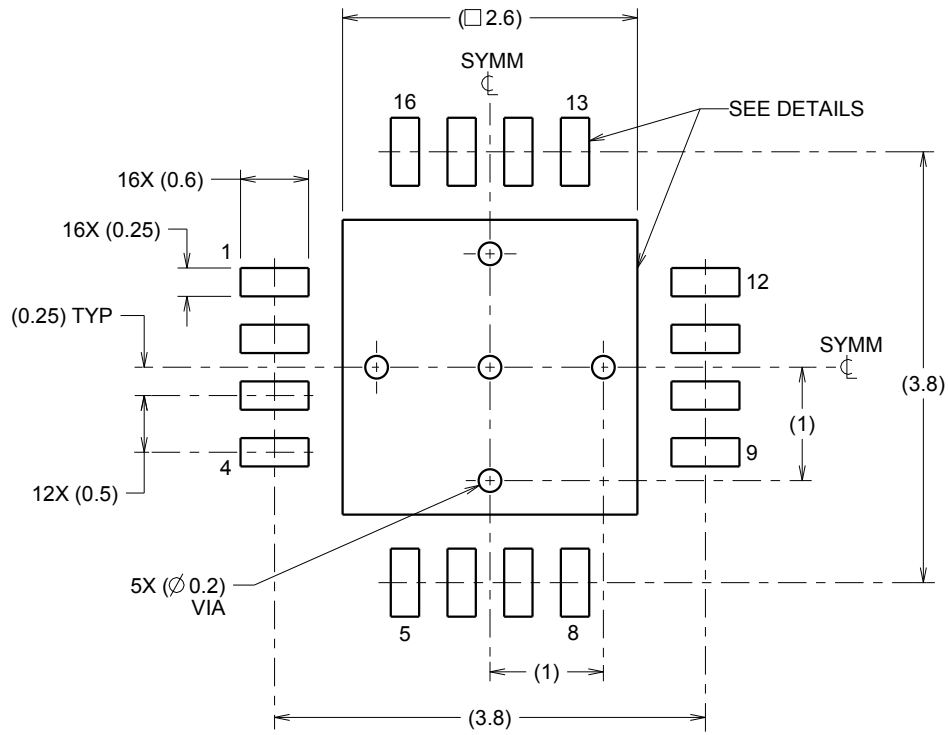
WQFN - 0.8 mm max height

WQFN

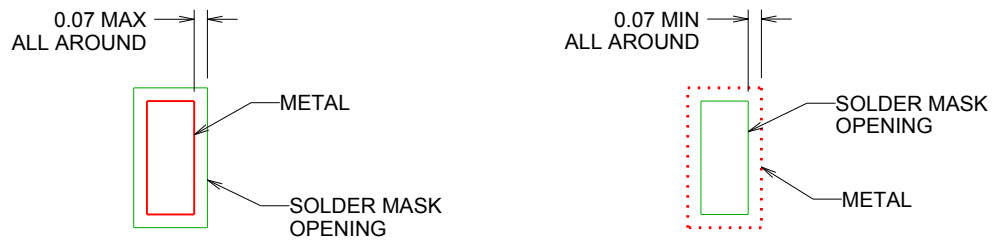


NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE
SCALE:15X



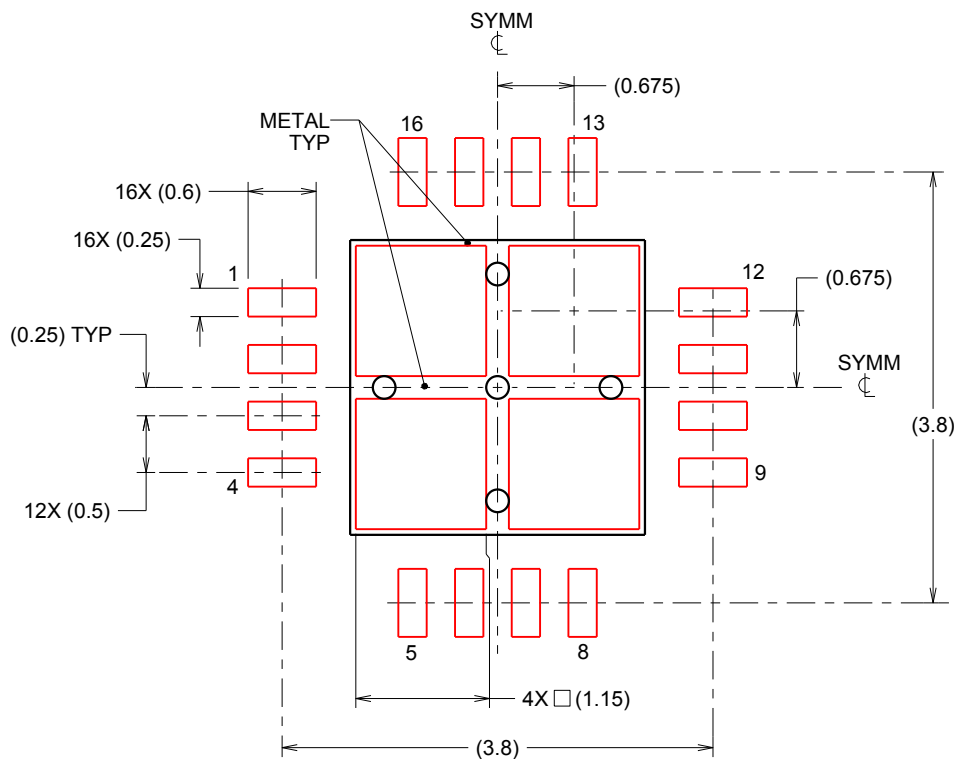
NON SOLDER MASK
DEFINED
(PREFERRED)

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see QFN/SON PCB application report in literature No. SLUA271 (www.ti.com/lit/slua271).



SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL
 EXPOSED PAD
 78% PRINTED SOLDER COVERAGE BY AREA
 SCALE:15X

4214978/A 10/2013

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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