



**THE DATASHEET OF  
DS15BA101SD/NOPB**



## DS15BA101 1.5 Gbps Differential Buffer with Adjustable Output Voltage

Check for Samples: [DS15BA101](#)

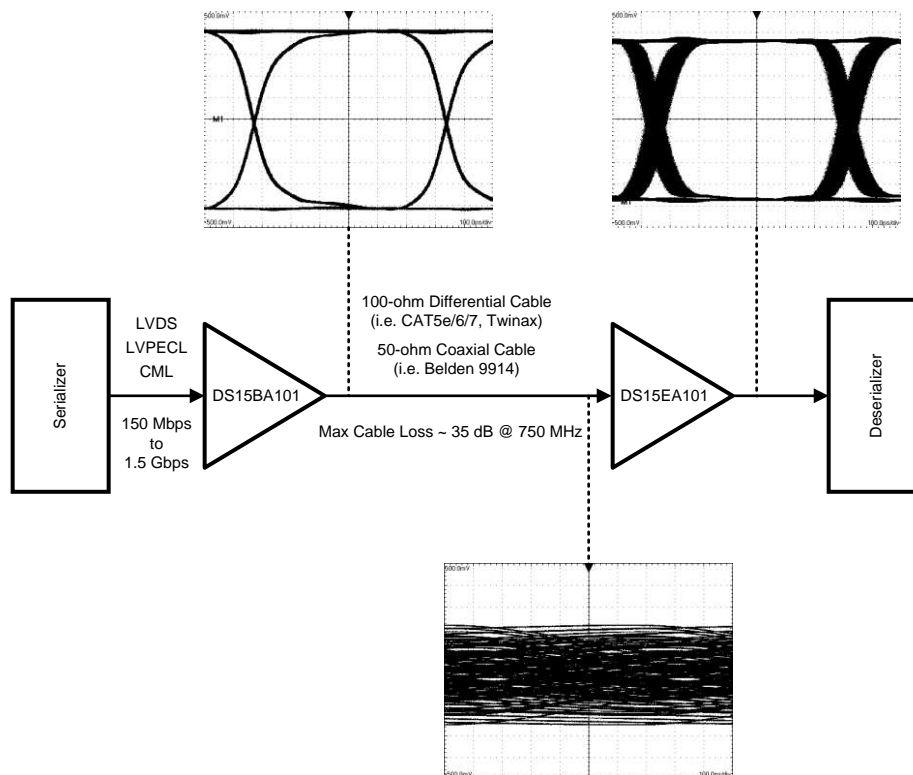
### FEATURES

- Data Rates from DC to 1.5+ Gbps
- Differential or Single-ended Input
- Adjustable Output Amplitude
- Single 3.3V Supply
- Industrial -40°C to +85°C Temperature
- Low Power: 150 mW (typ) at 1.5 Gbps
- Space-saving 3 x 3 mm WSON-8 Package

### APPLICATIONS

- Cable Extension Applications
- Level Translation
- Signal Buffering and Repeating
- Security Cameras

### Typical Application



### DESCRIPTION

The DS15BA101 is a high-speed differential buffer for cable driving, level translation, signal buffering, and signal repeating applications. Its fully differential signal path ensures exceptional signal integrity and noise immunity and it drives both differential and single-ended transmission lines at data rates in excess of 1.5 Gbps.

Output voltage amplitude is adjustable via a single external resistor for level translation and cable driving applications into 50-ohm single-ended and 100-ohm differential mode impedances.

The DS15BA101 is powered from a single 3.3V supply and consumes 150 mW (typ) at 1.5 Gbps. It operates over the full -40°C to +85°C industrial temperature range and is available in a space saving 3x3 mm WSON-8 package.



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.

All trademarks are the property of their respective owners.



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.

### Absolute Maximum Ratings<sup>(1)</sup>

Supply Voltage		-0.5V to 3.6V
Input Voltage (all inputs)		-0.3V to $V_{CC}+0.3V$
Output Current		28 mA
Storage Temperature Range		-65°C to +150°C
Junction Temperature		+150°C
Lead Temperature (Soldering 4 Sec)		+260°C
Package Thermal Resistance	$\theta_{JA}$ WSON-8	+90.7°C/W
	$\theta_{JC}$ WSON-8	+41.2°C/W
ESD Rating (HBM)		5 kV
ESD Rating (MM)		250V

- (1) "Absolute Maximum Ratings" are those parameter values beyond which the life and operation of the device cannot be ensured. The stating herein of these maximums shall not be construed to imply that the device can or should be operated at or beyond these values. The table of "Electrical Characteristics" specifies acceptable device operating conditions.

### Recommended Operating Conditions

Supply Voltage ( $V_{CC} - GND$ ):	3.3V $\pm 5\%$
Operating Free Air Temperature ( $T_A$ ) DS15BA101SD	-40°C to +85°C

### DC Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified.<sup>(1)(2)</sup>

Symbol	Parameter	Conditions	Reference	Min	Typ	Max	Units
$V_{ICM}$	Input Common Mode Voltage	See Note <sup>(3)</sup>	IN+, IN-	0.8		$V_{CC} - V_{ID}/2$	V
$V_{ID}$	Differential Input Voltage Swing			100		2000	mV <sub>P-P</sub>
$V_{OS}$	Output Common Mode Voltage		OUT+, OUT-		$V_{CC} - V_{OUT}/2$		V
$V_{OUT}$	Output Voltage	Single-ended, 25 $\Omega$ load $R_{VO} = 953\Omega$ 1%,			400		mV <sub>P-P</sub>
		Single-ended, 25 $\Omega$ load $R_{VO} = 487\Omega$ 1%,			800		mV <sub>P-P</sub>
$I_{CC}$	Supply Current	See Note <sup>(4)</sup>			45	49	mA

- (1) Current flow into device pins is defined as positive. Current flow out of device pins is defined as negative. All voltages are stated referenced to GND.  
 (2) Typical values are stated for  $V_{CC} = +3.3V$  and  $T_A = +25^\circ C$ .  
 (3) Specification is ensured by characterization.  
 (4) Maximum  $I_{CC}$  is measured at  $V_{CC} = +3.465V$  and  $T_A = +70^\circ C$ .

## AC Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified<sup>(1)</sup>.

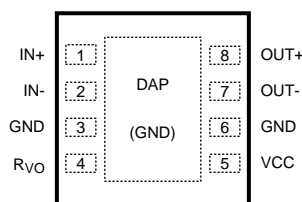
Symbol	Parameter	Conditions	Reference	Min	Typ	Max	Units
DR <sub>MAX</sub>	Maximum Data Rate	See Note <sup>(2)</sup>	IN+, IN-	1.5	2.0		Gbps
t <sub>LHT</sub>	Output Low to High Transition Time	20% – 80% <sup>(3)</sup>	OUT+, OUT-		120	220	ps
t <sub>HLT</sub>	Output High to Low Transition Time				120	220	ps
t <sub>PLHD</sub>	Propagation Low to High Delay	See Note <sup>(2)</sup>		0.95	1.10	1.35	ns
t <sub>PHLD</sub>	Propagation High to Low Delay	See Note <sup>(2)</sup>		0.95	1.10	1.35	ns
t <sub>TJ</sub>	Total Jitter	1.5 Gbps			26		pSp.p

(1) Typical values are stated for V<sub>CC</sub> = +3.3V and T<sub>A</sub> = +25°C.

(2) Specification is ensured by characterization.

(3) Specification is ensured by characterization and verified by test.

## CONNECTION DIAGRAM



**Figure 1. 8-Pad WSON  
See NGQ Package**

## PIN DESCRIPTIONS

Pin #	Name	Description
1	IN+	Non-inverting input pin.
2	IN-	Inverting input pin.
3	GND	Circuit common (ground reference).
4	R <sub>VO</sub>	Output voltage amplitude control. Connect a resistor to V <sub>CC</sub> to set output voltage.
5	V <sub>CC</sub>	Positive power supply (+3.3V).
6	GND	Circuit common (ground reference).
7	OUT-	Inverting output pin.
8	OUT+	Non-inverting output pin.

## DEVICE OPERATION

### INPUT INTERFACING

The DS15BA101 accepts either differential or single-ended input. The inputs are self-biased, allowing for simple AC or DC coupling. DC-coupled inputs must be kept within the specified common-mode range. The IN+ and IN- pins are self-biased at approximately 2.1V with  $V_{CC} = 3.3V$ . The following three figures illustrate typical DC-coupled interface to common differential drivers.

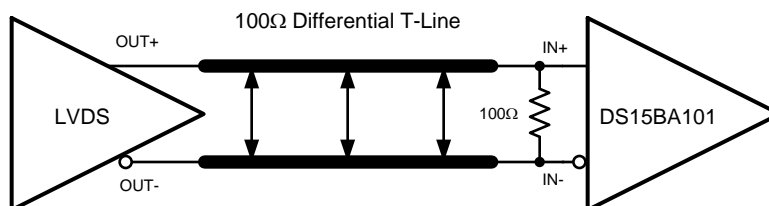


Figure 2. Typical LVDS Driver DC-Coupled Interface to DS15BA101 Input

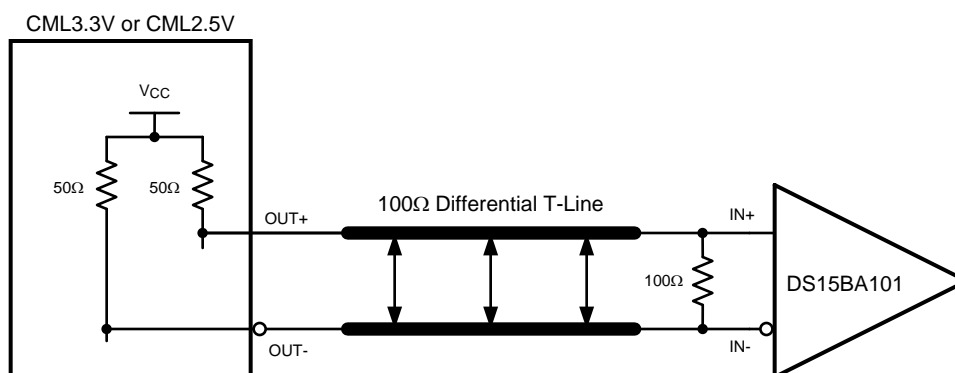


Figure 3. Typical CML Driver DC-Coupled Interface to DS15BA101 Input

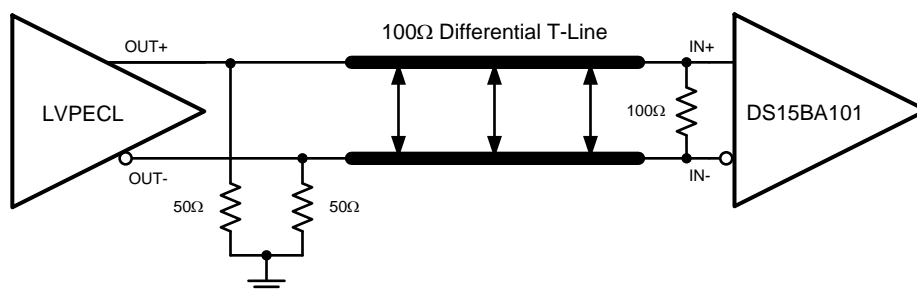


Figure 4. Typical LVPECL Driver DC-Coupled Interface to DS15BA101 Input

### OUTPUT INTERFACING

The DS15BA101 uses current mode outputs. Single-ended output levels are 400 mV<sub>P-P</sub> into AC-coupled 100Ω differential cable (with  $R_{VO} = 953\Omega$ ) or into AC-coupled 50Ω coaxial cable (with  $R_{VO} = 487\Omega$ ). Output level is controlled by the value of the  $R_{VO}$  resistor connected between the  $R_{VO}$  and  $V_{CC}$ .

The  $R_{VO}$  resistor should be placed as close as possible to the  $R_{VO}$  pin. In addition, the copper in the plane layers below the  $R_{VO}$  network should be removed to minimize parasitic capacitance. The following figure illustrates typical DC-coupled interface to common differential receivers and assumes that the receivers have high impedance inputs. While most receivers have a common mode input range that can accommodate CML signals, it is recommended to check respective receiver's datasheet prior to implementing the suggested interface implementation.

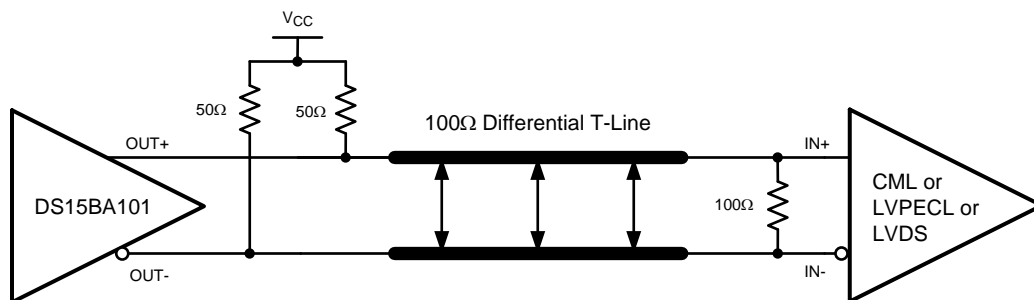


Figure 5. Typical DS15BA101 Output DC-Coupled Interface to an LVDS, CML or LVPECL Receiver

**CABLE EXTENDER APPLICATION**

The DS15BA101 together with the DS15EA101 form a cable extender chipset optimized for extending serial data streams from serializer/deserializer (SerDes) pairs and field programmable gate arrays (FPGAs) over 100Ω differential (i.e. CAT5e/6/7 and twinax) and 50Ω coaxial cables. Setting correct DS15BA101 output amplitude and proper cable termination are keys for optimal operation. The following two figures show recommended chipset configuration for 100Ω differential and 50Ω coaxial cables.

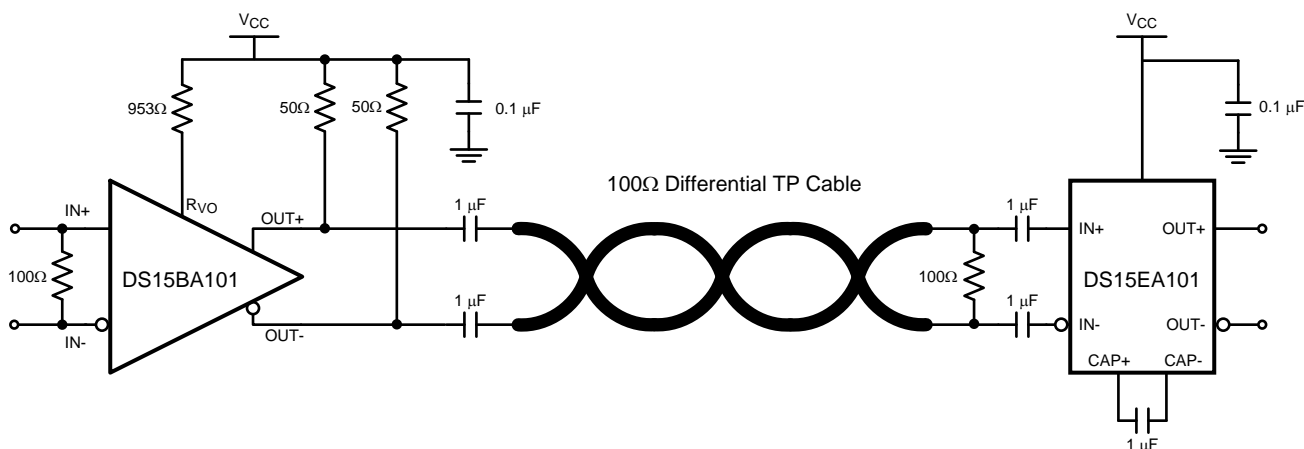


Figure 6. Cable Extender Chipset Connection Diagram for 100Ω Differential Cables

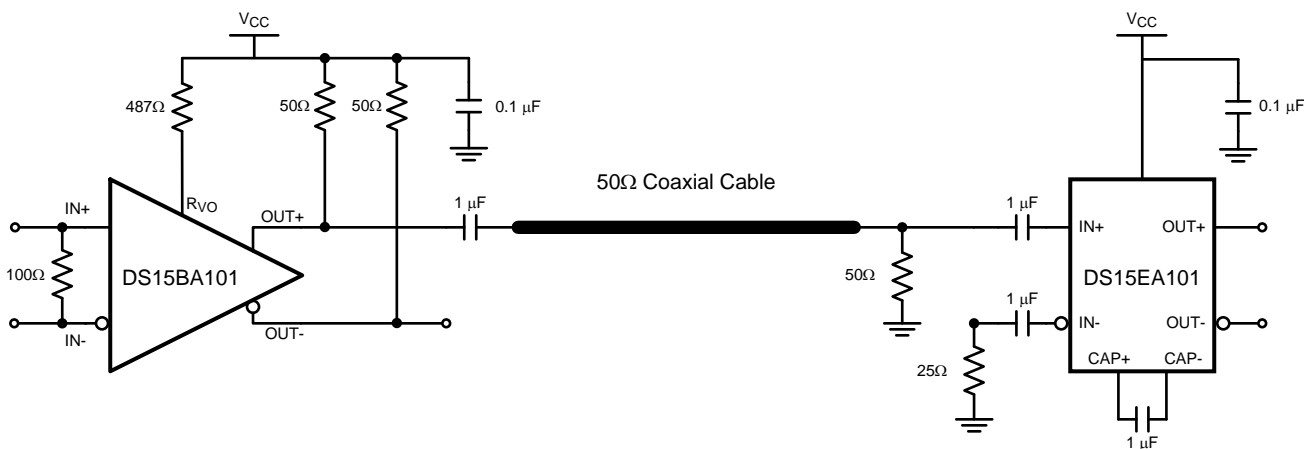


Figure 7. Cable Extender Chipset Connection Diagram for 50Ω Coaxial Cables

## REFERENCE DESIGN

There is a complete reference design (P/N: DriveCable02EVK) available for evaluation of the cable extender chipset (DS15BA101 and DS15EA101). For more information, visit <http://www.ti.com/tool/drivecable02evk>.

### Typical Performance

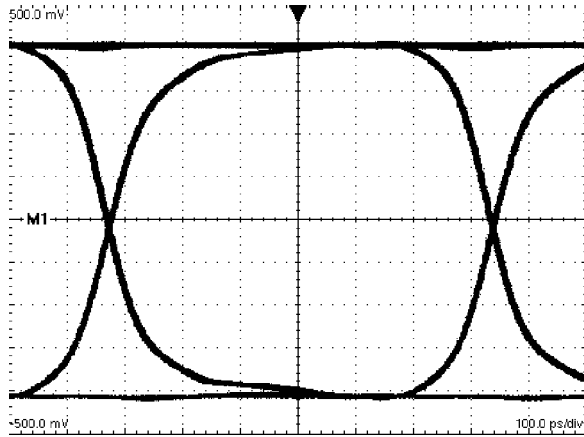


Figure 8. 1.5 Gbps Differential DS15BA101 Output  
 $R_{VO} = 953\Omega$ , H:100 ps / DIV, V:100 mV / DIV

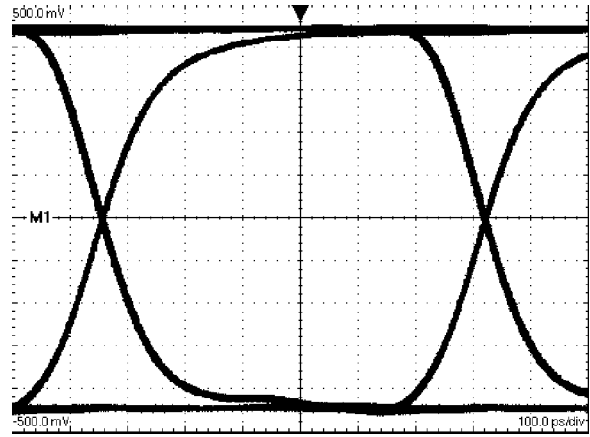


Figure 9. 1.5 Gbps Single-ended DS15BA101 Output  
 $R_{VO} = 487\Omega$ , H:100 ps / DIV, V:100 mV / DIV

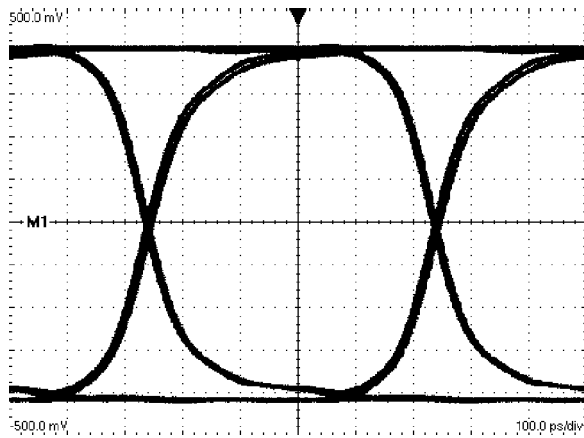


Figure 10. 2.0 Gbps Differential DS15BA101 Output  
 $R_{VO} = 953\Omega$ , H:100 ps / DIV, V:100 mV / DIV

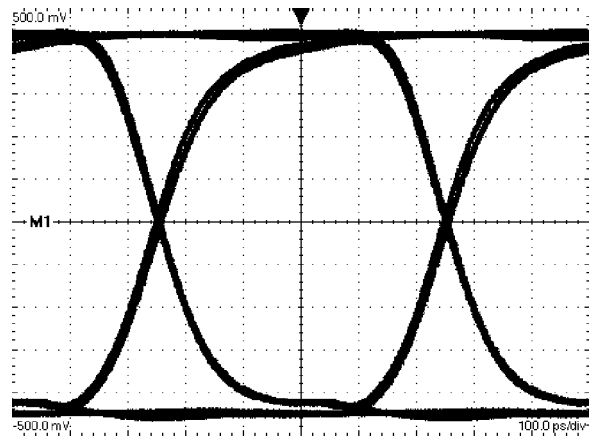


Figure 11. 2.0 Gbps Single-ended DS15BA101 Output  
 $R_{VO} = 487\Omega$ , H:100 ps / DIV, V:100 mV / DIV

---

**REVISION HISTORY**

<b>Changes from Revision I (April 2013) to Revision J</b>	<b>Page</b>
<hr/> <ul style="list-style-type: none"><li>• Changed layout of National Data Sheet to TI format .....</li></ul>	<hr/> <b>6</b>

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
DS15BA101SD/NOPB	ACTIVE	WSON	NGQ	8	1000	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 85	BA101	<a href="#">Samples</a>
DS15BA101SDE/NOPB	ACTIVE	WSON	NGQ	8	250	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 85	BA101	<a href="#">Samples</a>
DS15BA101SDX/NOPB	ACTIVE	WSON	NGQ	8	4500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 85	BA101	<a href="#">Samples</a>

(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) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side 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.

**TAPE AND REEL INFORMATION**

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

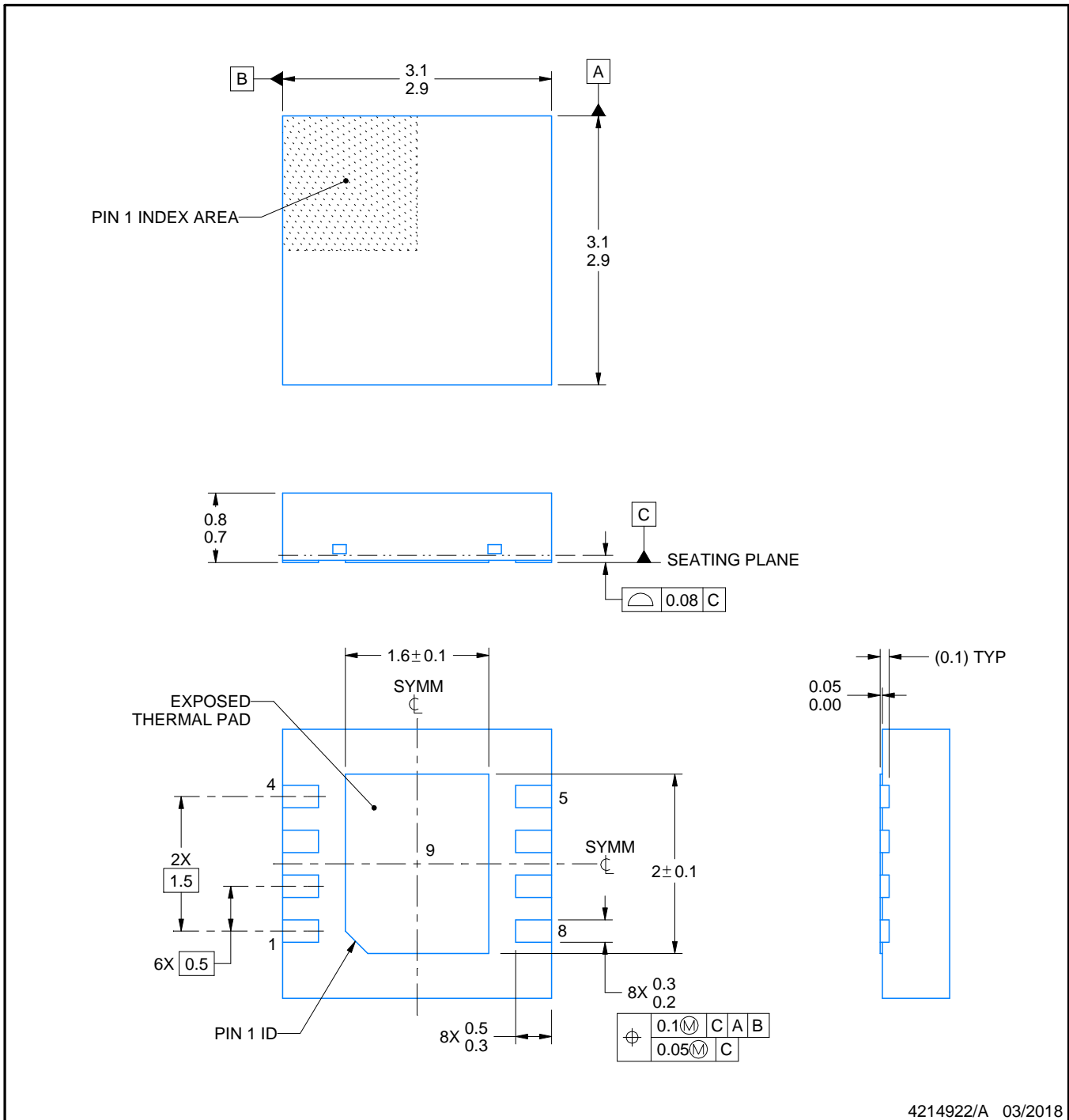
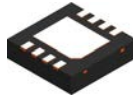

\*All dimensions are nominal

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
DS15BA101SD/NOPB	WSON	NGQ	8	1000	178.0	12.4	3.3	3.3	1.0	8.0	12.0	Q1
DS15BA101SDE/NOPB	WSON	NGQ	8	250	178.0	12.4	3.3	3.3	1.0	8.0	12.0	Q1
DS15BA101SDX/NOPB	WSON	NGQ	8	4500	330.0	12.4	3.3	3.3	1.0	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)
DS15BA101SD/NOPB	WSON	NGQ	8	1000	210.0	185.0	35.0
DS15BA101SDE/NOPB	WSON	NGQ	8	250	210.0	185.0	35.0
DS15BA101SDX/NOPB	WSON	NGQ	8	4500	367.0	367.0	35.0



NOTES:

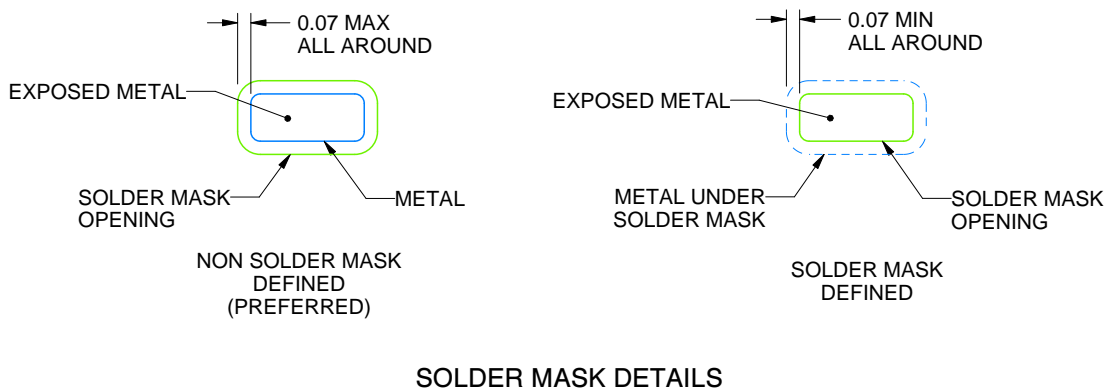
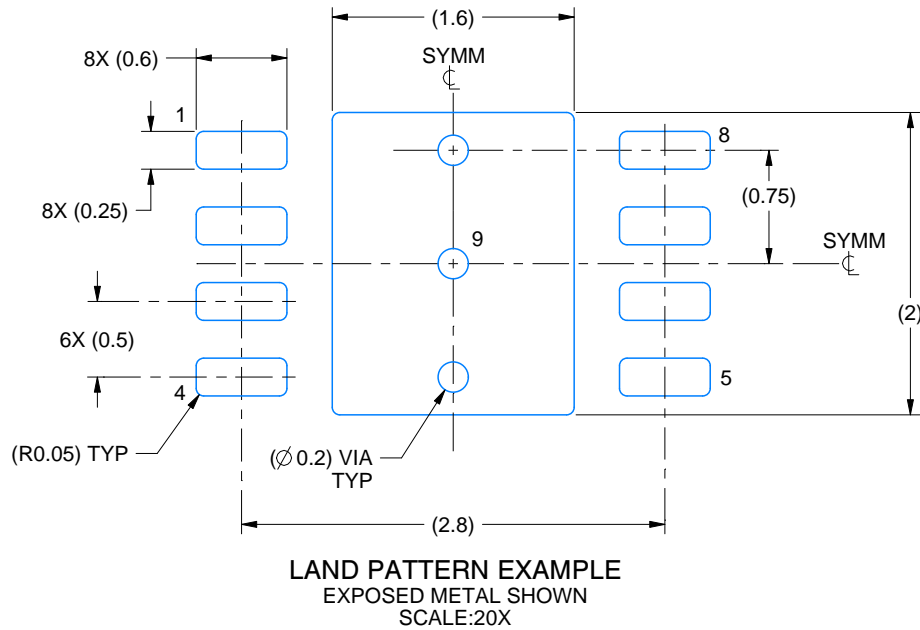
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

# EXAMPLE BOARD LAYOUT

NGQ0008A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



4214922/A 03/2018

NOTES: (continued)

- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).
- Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



## IMPORTANT NOTICE

Texas Instruments Incorporated (TI) reserves the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

TI's published terms of sale for semiconductor products (<http://www.ti.com/sc/docs/stdterms.htm>) apply to the sale of packaged integrated circuit products that TI has qualified and released to market. Additional terms may apply to the use or sale of other types of TI products and services.

Reproduction of significant portions of TI information in TI data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate TI products (collectively, "Designers") understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all TI products used in or for Designers' applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include TI products, Designer will thoroughly test such applications and the functionality of such TI products as used in such applications.

TI's provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using TI Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer's company) agrees to use any particular TI Resource solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

Designer is authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Unless TI has explicitly designated an individual product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949 and ISO 26262), TI is not responsible for any failure to meet such industry standard requirements.

Where TI specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may not use any TI products in life-critical medical equipment unless authorized officers of the parties have executed a special contract specifically governing such use. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Such equipment includes, without limitation, all medical devices identified by the U.S. Food and Drug Administration as Class III devices and equivalent classifications outside the U.S.

TI may expressly designate certain products as completing a particular qualification (e.g., Q100, Military Grade, or Enhanced Product). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers' own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection.

Designer will fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer's non-compliance with the terms and provisions of this Notice.

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

- ⊖ [View DS15BA101SD/NOPB on WIN SOURCE](#)
- ⊖ [Texas Instruments](#) Information

## Optimize Your Supply Chain with WIN SOURCE Solutions

- ✓ Global Sourcing Solution
- ✓ Obsolete Management
- ✓ Cost Control Management
- ✓ Shortage Management
- ✓ Alternative Solution
- ✓ Excess Inventory Management