

## Precision Quad SPDT Analog Switch

### DESCRIPTION

The DG333A, DG333AL consist of four independently controlled single-pole double-throw analog switches. These monolithic switch is designed to control analog signals with a high degree of accuracy. The DG333A, DG333AL minimize measurement errors by offering low on-resistance ( $25\ \Omega$  typ), low leakage ( $20\ \text{pA}$  typ.) and low charge injection performance. The DG333AL features micro-power operation ( $< 1\ \mu\text{W}$  typ.). This is ideal for battery operated systems. Pin 15 is not connected on the DG333A.

An improved charge injection compensation design minimizes switching transients. These switches can handle up to  $\pm 22\ \text{V}$  signals and have an improved continuous current of  $30\ \text{mA}$ .

The DG333A, DG333AL is fabricated in Vishay Siliconix's proprietary HVSG-2 CMOS process, resulting in higher speed and lower power consumption. An epitaxial layer prevents latchup. Each switch conducts equally well in both directions when on. When off, they block voltages up to the power-supply levels.

### FEATURES

- $\pm 22\ \text{V}$  supply voltage range
- TTL and CMOS compatible logic
- Low on-resistance ( $25\ \Omega$ )
- On-resistance matched between channels ( $< 2\ \Omega$ )
- Flat on-resistance over analog signal range ( $\Delta < 3\ \Omega$ )
- Low charge injection ( $1\ \text{pC}$ )
- Low leakage ( $0.2\ \text{nA}$ )
- Fast switching ( $175\ \text{ns}$ )
- Single-supply operation ( $5\ \text{V}$  to  $40\ \text{V}$ )
- ESD tolerance  $> 2\ \text{kV}$  per 3015.x
- Low power ( $< 1\ \mu\text{A}$ ) - DG333A, DG333AL

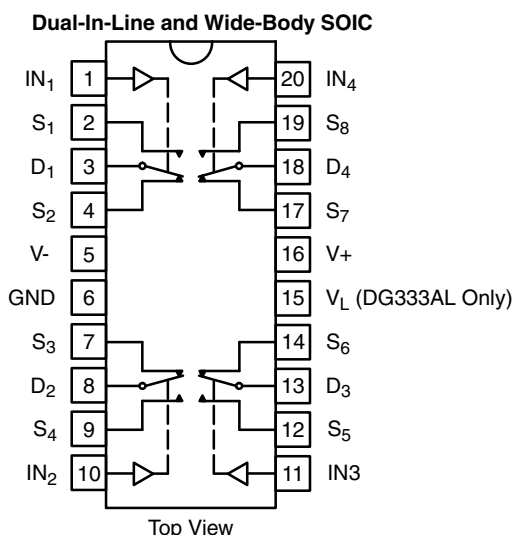
### BENEFITS

- Rail-to-rail analog signal range
- Simple logic interface
- High precision and accuracy
- Minimal transients
- Low distortion
- Reduced power consumption
- Improved reliability
- Break-before-make switching action

### APPLICATIONS

- Audio switching
- Test equipment
- Portable instrumentation
- Communication systems
- PBX, PABX
- Computer peripherals
- Mass storage systems
- Switched-capacitor networks
- Battery-powered systems

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



#### TRUTH TABLE

| Logic | SW1, 4, 5, 8<br>Normally Open | SW2, 3, 6, 7<br>Normally Closed |
|-------|-------------------------------|---------------------------------|
| 0     | OFF                           | ON                              |
| 1     | ON                            | OFF                             |

Logic "0"  $\leq 0.8\ \text{V}$

Logic "1"  $\geq 2.4\ \text{V}$

#### ORDERING INFORMATION

| Temp. Range      | Package                                             | Part Number <sup>a</sup> |
|------------------|-----------------------------------------------------|--------------------------|
| - 40 °C to 85 °C | 20-Pin Plastic DIP                                  | DG333ADJ-E3              |
|                  |                                                     | DG333ALDJ-E3             |
|                  | 20-Pin Wide-Body SOIC<br>(shipped in tubes)         | DG333ADW-E3              |
|                  |                                                     | DG333ALDW-E3             |
|                  | 20-Pin Wide-Body SOIC<br>(shipped in tape and reel) | DG333ADW-T1-E3           |
|                  |                                                     | DG333ALDW-T1-E3          |
|                  | 20-Pin TSSOP<br>(shipped in tape and reel)          | DG333ADQ-T1-E3           |
|                  |                                                     | DG333ALDQ-T1-E3          |

Note:

a. For standard tin/lead external termination, remove the "-E3" from the ordering part number.

| ABSOLUTE MAXIMUM RATINGS                                    |                                 |                                                                                    |      |
|-------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------|------|
| Parameter                                                   |                                 | Limit                                                                              | Unit |
| Voltages Referenced V <sub>+</sub> to V <sub>-</sub>        |                                 | 44                                                                                 | V    |
| GND                                                         |                                 | 30                                                                                 |      |
| V <sub>+</sub> to GND                                       |                                 | 30                                                                                 |      |
| Digital Inputs <sup>a</sup> V <sub>S</sub> , V <sub>D</sub> |                                 | (V <sub>-</sub> ) - 2 to (V <sub>+</sub> ) + 2<br>or 30 mA, whichever occurs first |      |
| Current, Any Terminal                                       |                                 | 30                                                                                 | mA   |
| Peak Current S or D (Pulsed at 1 ms, 10 % Duty Cycle Max.)  |                                 | 100                                                                                |      |
| Storage Temperature                                         |                                 | - 65 to 125                                                                        | °C   |
| Power Dissipation (Package) <sup>b</sup>                    | 20-Pin Plastic DIP <sup>c</sup> | 890                                                                                | mW   |
|                                                             | 20-Pin Wide SOIC <sup>d</sup>   | 800                                                                                |      |

Notes:

a. Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> exceeding V<sub>+</sub> or V<sub>-</sub> will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

b. All leads welded or soldered to PC board.

c. Derate 12 mW/°C above 75 °C.

d. Derate 10 mW/°C above 75 °C.

## SCHEMATIC DIAGRAM (Typical Channel)

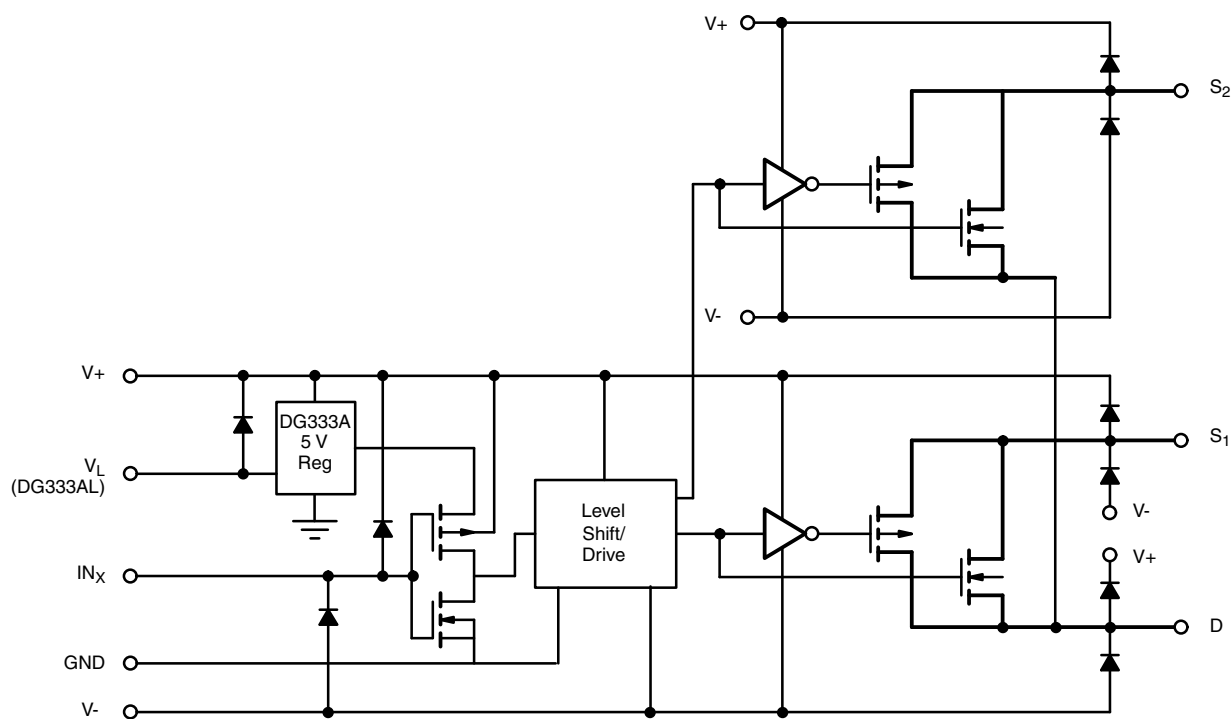


Figure 1.

**SPECIFICATIONS**

| Parameter                                               | Symbol                               | Test Conditions<br>Unless Otherwise Specified<br>V <sub>+</sub> = 15 V, V <sub>-</sub> = - 15 V<br>V <sub>IN</sub> = 2.4 V or 0.8 V <sup>e</sup> | Temp. <sup>a</sup> | Limits D Suffix<br>- 40 °C to 85 °C |                   |                   | Unit |
|---------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------|-------------------|-------------------|------|
|                                                         |                                      |                                                                                                                                                  |                    | Min. <sup>b</sup>                   | Typ. <sup>c</sup> | Max. <sup>b</sup> |      |
| Analog Switch                                           |                                      |                                                                                                                                                  |                    |                                     |                   |                   |      |
| Analog Signal Range <sup>d</sup>                        | V <sub>ANALOG</sub>                  |                                                                                                                                                  | Full               | V-                                  |                   | V+                | V    |
| Channel On-Resistance                                   | R <sub>DS(on)</sub>                  | I <sub>S</sub> = - 10 mA, V <sub>D</sub> = ± 10 V                                                                                                | Room Full          |                                     | 25                | 45<br>90          | Ω    |
| On-Resistance Flatness                                  |                                      | I <sub>S</sub> = - 10 mA, V <sub>D</sub> = ± 5 V<br>V <sub>+</sub> = 16.5 V, V <sub>-</sub> = - 16.5 V                                           | Room Full          |                                     |                   | 3<br>5            |      |
| R <sub>DS(on)</sub> Match Between Channels <sup>f</sup> | ΔR <sub>DS(on)</sub>                 | I <sub>S</sub> = - 10 mA, V <sub>D</sub> = ± 10 V                                                                                                | Room Full          |                                     |                   | 2<br>4            |      |
| Source Off Leakage Current                              | I <sub>S(off)</sub>                  | V <sub>D</sub> = 15.5 V, V <sub>S</sub> = 15.5 V<br>V <sub>+</sub> = 16.5 V, V <sub>-</sub> = - 16.5 V                                           | Room Hot           | - 0.25<br>- 20                      |                   | 0.25<br>20        | nA   |
| Channel On Leakage Current                              | I <sub>D(on)</sub>                   | V <sub>D</sub> = ± 15.5 V, V <sub>S(open)</sub> = ± 15.5 V<br>V <sub>+</sub> = 16.5 V, V <sub>-</sub> = - 16.5 V                                 | Room Hot           | - 0.75<br>- 60                      |                   | 0.75<br>60        |      |
| Digital Control                                         |                                      |                                                                                                                                                  |                    |                                     |                   |                   |      |
| Input Voltage High                                      | V <sub>INH</sub>                     |                                                                                                                                                  | Full               | 2.4                                 |                   |                   | V    |
| Input Voltage Low                                       | V <sub>INL</sub>                     |                                                                                                                                                  | Full               |                                     |                   | 0.8               |      |
| Input Current                                           | I <sub>INL</sub> or I <sub>INH</sub> | V <sub>INH</sub> or V <sub>INL</sub>                                                                                                             | Full               | - 1                                 |                   | 1                 | μA   |
| Dynamic Characteristics                                 |                                      |                                                                                                                                                  |                    |                                     |                   |                   |      |
| Turn-On Time                                            | t <sub>ON</sub>                      | See switching time test circuit see figure 2                                                                                                     | Room               |                                     |                   | 175               | ns   |
| Turn-Off Time                                           | t <sub>OFF</sub>                     |                                                                                                                                                  | Room               |                                     |                   | 145               |      |
| Break-Before-Make Time Delay                            | t <sub>D</sub>                       | See figure 3                                                                                                                                     | Room               | 5                                   |                   |                   |      |
| Charge Injection <sup>d</sup>                           | Q                                    | C <sub>L</sub> = 10 nF, V <sub>gen</sub> = 0 V, R <sub>gen</sub> = 0 Ω                                                                           | Room               |                                     |                   | 10                | pC   |
| Off-Isolation                                           | OIRR                                 | R <sub>L</sub> = 75 Ω, C <sub>L</sub> = 5 pF<br>V <sub>D</sub> = 2.3 V <sub>RMS</sub> , f = 1 MHz                                                | Room               |                                     | 72                |                   | dB   |
| Channel-to-Channel Crosstalk                            | X <sub>TALK</sub>                    |                                                                                                                                                  | Room               |                                     | 80                |                   |      |
| Off Capacitance                                         | C <sub>OFF</sub>                     | f = 1 MHz, V <sub>S</sub> = 0 V                                                                                                                  | Room               |                                     | 8                 |                   | pF   |
| Channel On Capacitance                                  | C <sub>ON</sub>                      |                                                                                                                                                  | Room               |                                     | 12                |                   |      |
| Power Supplies                                          |                                      |                                                                                                                                                  |                    |                                     |                   |                   |      |
| Positive Supply Current                                 | I <sub>+</sub>                       | DG333A: V <sub>IN</sub> = 0 or 5 V                                                                                                               | Room               |                                     |                   | 200               | μA   |
| Negative Supply Current                                 | I <sub>-</sub>                       |                                                                                                                                                  | Room               | - 1                                 |                   |                   |      |
| Positive Supply Current                                 | I <sub>+</sub>                       | DG333AL: V <sub>IN</sub> = 0 or 5 V, V <sub>L</sub> = 5 V                                                                                        | Room               |                                     |                   | 1                 |      |
| Logic Supply Current                                    | I <sub>L</sub>                       |                                                                                                                                                  | Room               |                                     |                   | 1                 |      |
| Negative Supply Current                                 | I <sub>-</sub>                       |                                                                                                                                                  | Room               | - 1                                 |                   |                   |      |
| Supply Voltage Range                                    | V <sub>+</sub> /V <sub>-</sub>       |                                                                                                                                                  | Full               | ± 4                                 |                   | ± 22              |      |

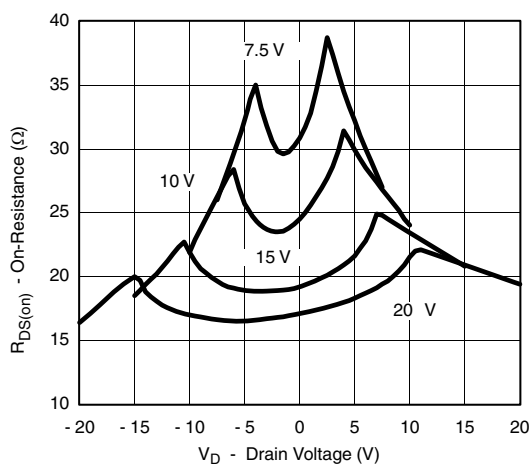
| SPECIFICATIONS (Unipolar Supplies) |                     |                                                                                                                       |                    |                                    |                   |                   |      |
|------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------|--------------------|------------------------------------|-------------------|-------------------|------|
| Parameter                          | Symbol              | Test Conditions<br>Unless Otherwise Specified<br>V <sub>+</sub> = 12 V, V <sub>-</sub> = 0 V<br>T <sub>A</sub> = 25°C | Temp. <sup>a</sup> | Limits D Suffix<br>- 40 °C to 85°C |                   |                   | Unit |
|                                    |                     |                                                                                                                       |                    | Min. <sup>b</sup>                  | Typ. <sup>c</sup> | Max. <sup>b</sup> |      |
| Analog Switch                      |                     |                                                                                                                       |                    |                                    |                   |                   |      |
| Analog Signal Range <sup>d</sup>   | V <sub>ANALOG</sub> |                                                                                                                       | Full               | V-                                 |                   | V+                | V    |
| Channel On-Resistance              | R <sub>DS(on)</sub> | I <sub>S</sub> = - 10 mA, V <sub>D</sub> = 10, 1 V                                                                    | Room               |                                    | 35                | 75                | Ω    |
| Source Off Leakage Current         | I <sub>S(off)</sub> | V <sub>D</sub> = 11 V, V <sub>S(open)</sub> = 1 V                                                                     | Room               |                                    |                   | 0.25              | nA   |
| Channel On Leakage Current         | I <sub>D(on)</sub>  | V <sub>D</sub> = 11 V, V <sub>S(open)</sub> = 0 V<br>V <sub>D</sub> = 1 V, V <sub>S(open)</sub> = V+                  | Room               |                                    |                   | 0.75              |      |
| Dynamic Characteristics            |                     |                                                                                                                       |                    |                                    |                   |                   |      |
| Turn-On Time                       | t <sub>ON</sub>     | See switching time test circuit see figure 2                                                                          | Room               |                                    | 90                |                   | ns   |
| Turn-Off Time                      | t <sub>OFF</sub>    |                                                                                                                       | Room               |                                    | 45                |                   |      |
| Break-Before-Make Time Delay       | t <sub>D</sub>      | See figure 3                                                                                                          | Room               | 5                                  | 10                |                   |      |
| Power Supplies                     |                     |                                                                                                                       |                    |                                    |                   |                   |      |
| Positive Supply Current            | I <sub>+</sub>      | DG333A: V <sub>IN</sub> = 0 or 5 V                                                                                    | Room               |                                    |                   | 200               | μA   |
|                                    |                     |                                                                                                                       | Room               |                                    |                   | 1                 |      |
| Positive Supply Current            | I <sub>+</sub>      | DG333AL: V <sub>IN</sub> = 0 or 5 V, V <sub>L</sub> = 5 V                                                             | Room               |                                    |                   | 1                 |      |
| Logic Supply Current               | I <sub>L</sub>      |                                                                                                                       | Room               |                                    |                   | 1                 |      |
| Positive Supply Range              | V <sub>+</sub>      |                                                                                                                       | Room               | 5                                  |                   | 40                | V    |

Notes:

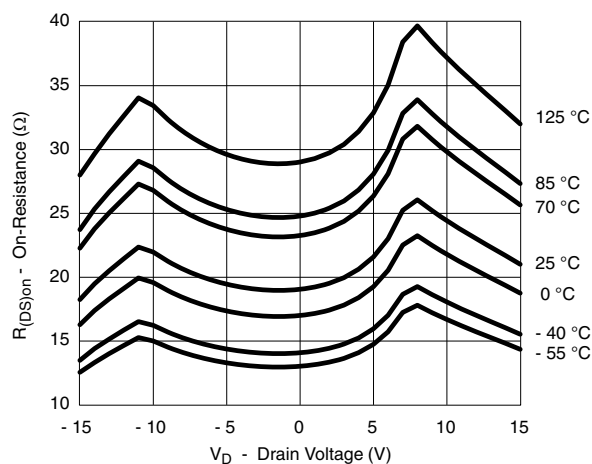
- Room = 25 °C, Full = as determined by the operating temperature suffix.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- Guaranteed by design, not subject to production test.
- $V_{\text{IN}}$  = input voltage to perform proper function.
- On-resistance match and flatness are guaranteed only for bipolar supply operation.

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

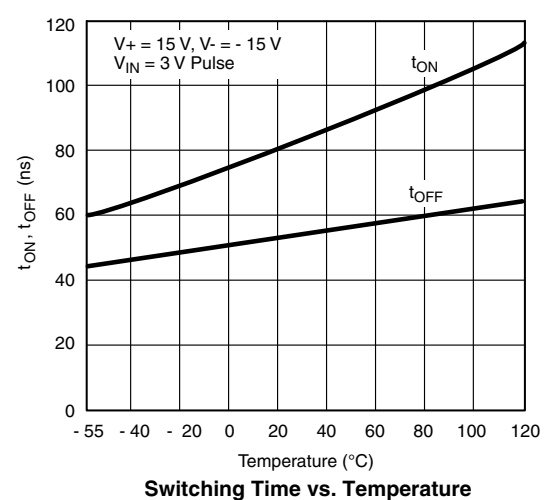
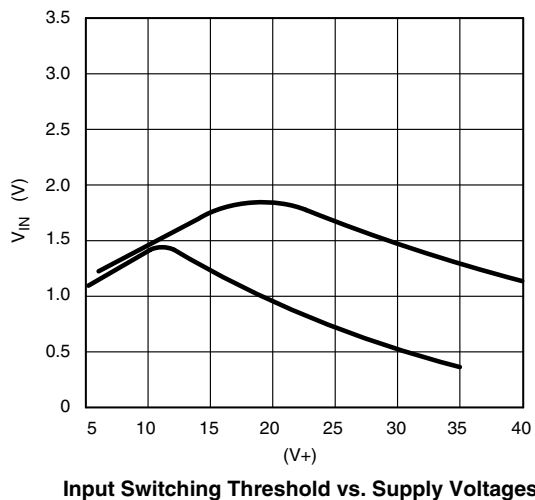
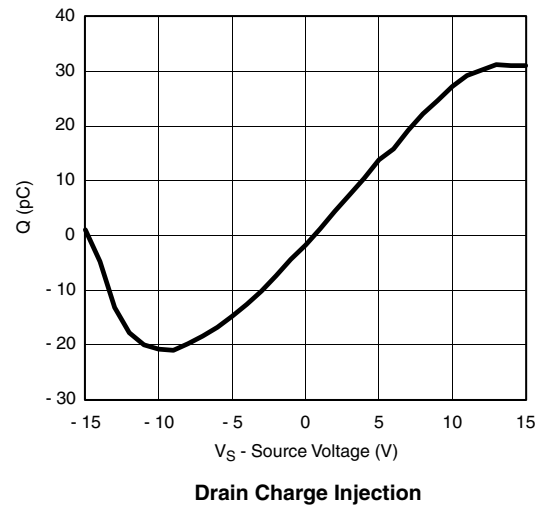
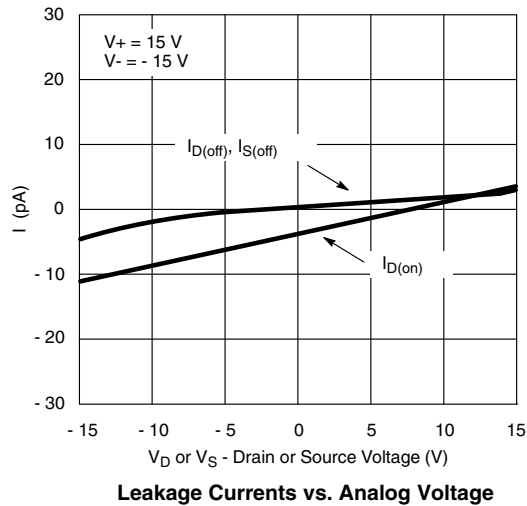
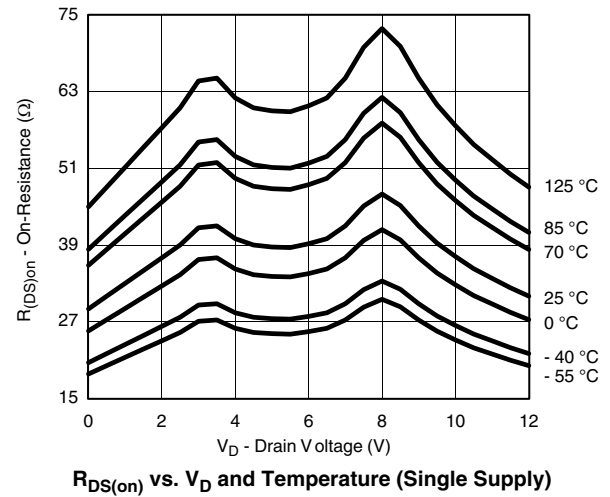
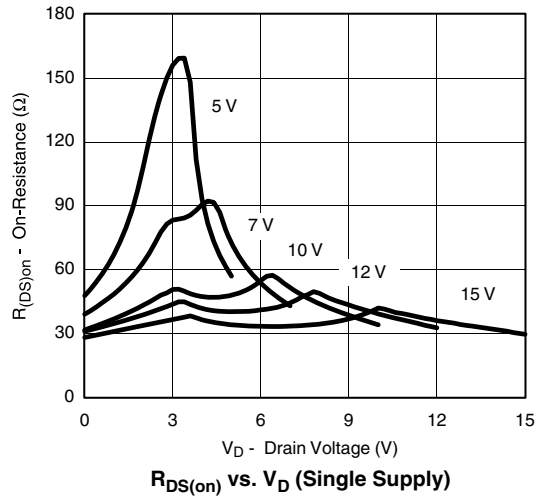
## TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



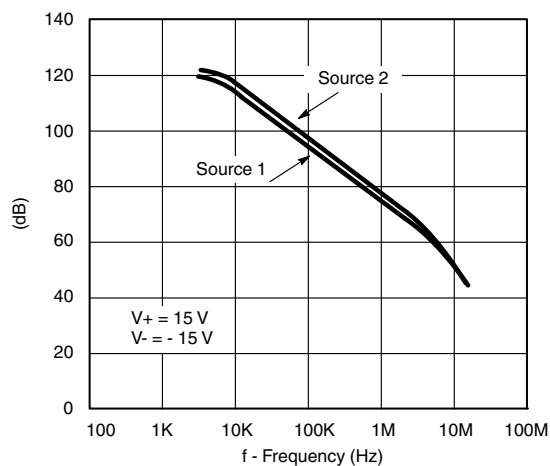
$R_{\text{DS(on)}}$  vs.  $V_D$  (Dual Supply)



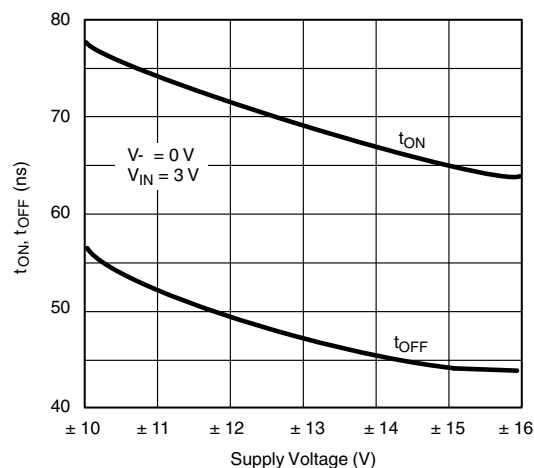
$R_{\text{DS(on)}}$  vs.  $V_D$  and Temperature (Dual Supply)

**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)


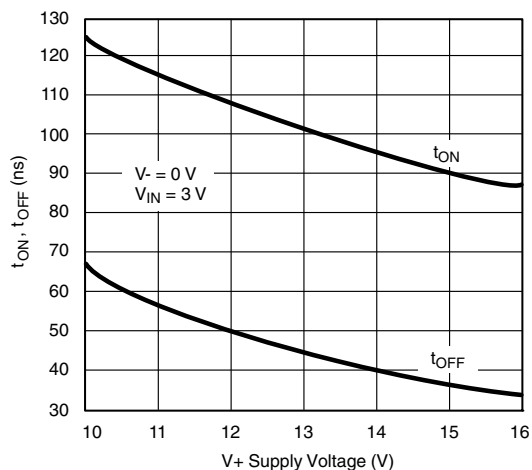
## TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



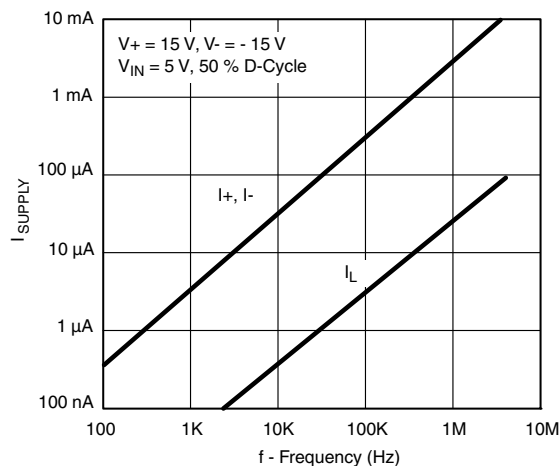
Crosstalk and Off Isolation vs. Frequency



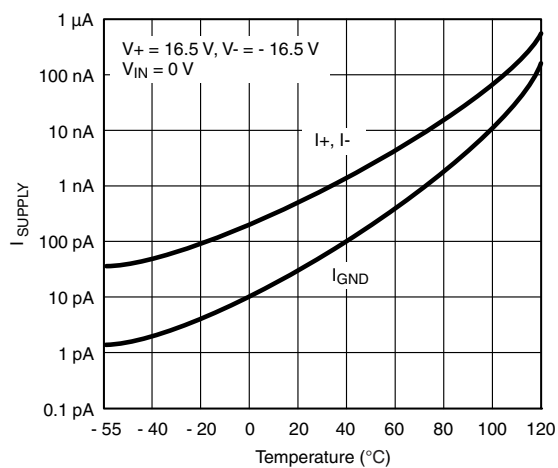
Switching Time vs. Supply Voltages



Switching Time vs.  $V_+$

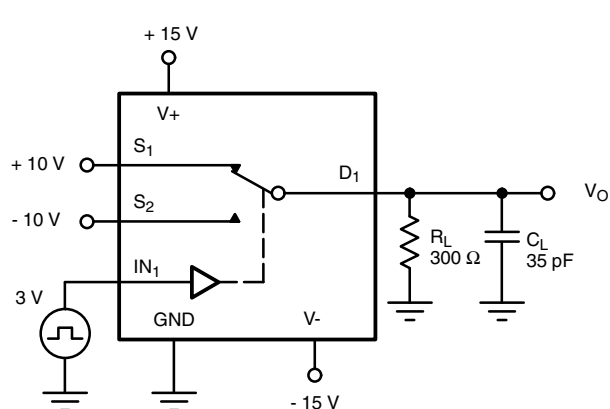


Power Supply Currents vs. Switching Frequency



Supply Current vs. Temperature

## TEST CIRCUITS



Repeat Test for IN<sub>2</sub>, IN<sub>3</sub> and IN<sub>4</sub>

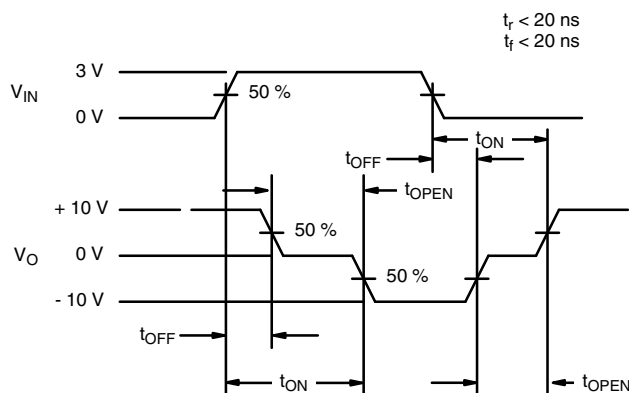
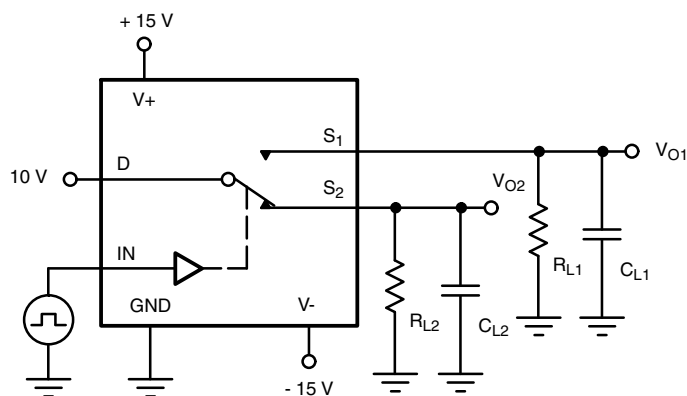


Figure 2. Switching Time



$R_L = 300 \, \Omega$ ,  $C_L = 35 \, \text{pF}$   
 $C_L$  (includes fixture and stray capacitance)

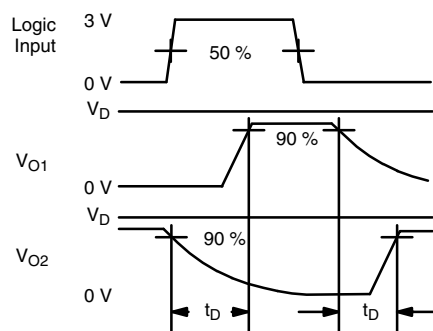


Figure 3. Break-Before-Make

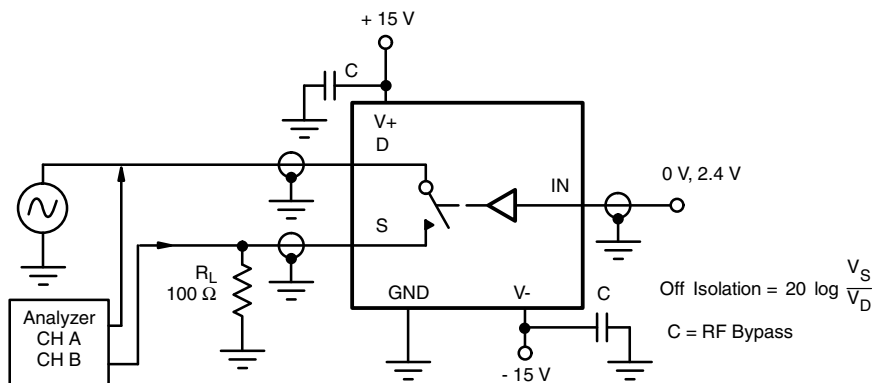


Figure 4. Off Isolation

## TEST CIRCUITS

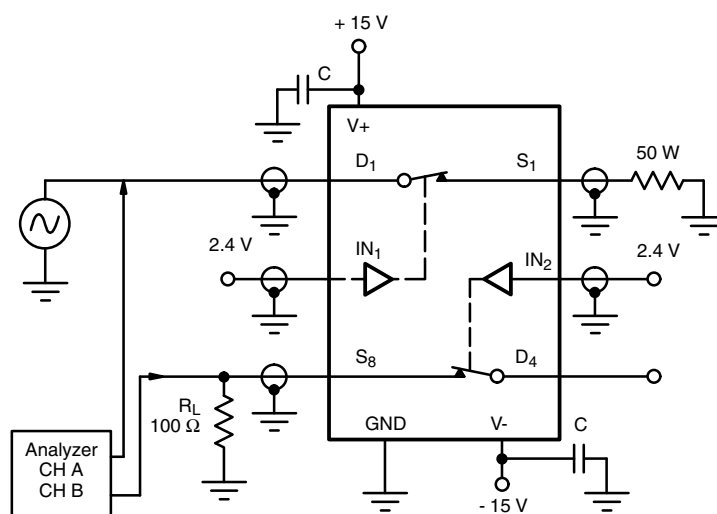


Figure 5. Crosstalk

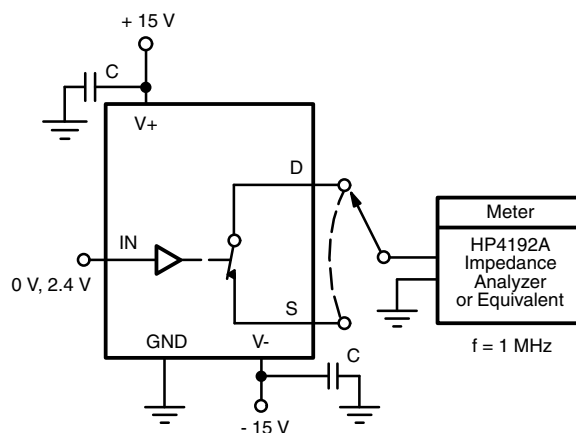


Figure 6. Capacitances

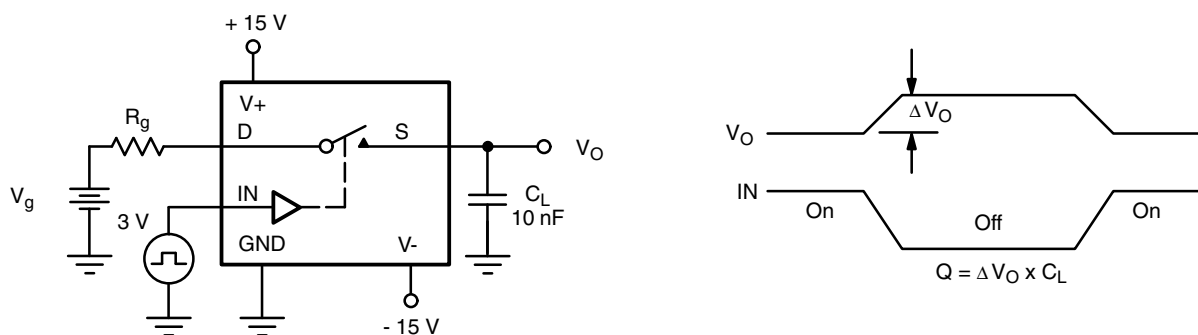


Figure 7. Charge Injection

## APPLICATIONS

### Band-Pass Switched Capacitor Filter

Single-pole double-throw switches are a common element for switched capacitor networks and filters. The fast switching times and low leakage of the DG333A, DG333AL allow for higher clock rates and consequently higher filter operating frequencies. Figure 8 shows two capacitors being switched.

The DG333A, DG333AL is capable of switching four capacitors.

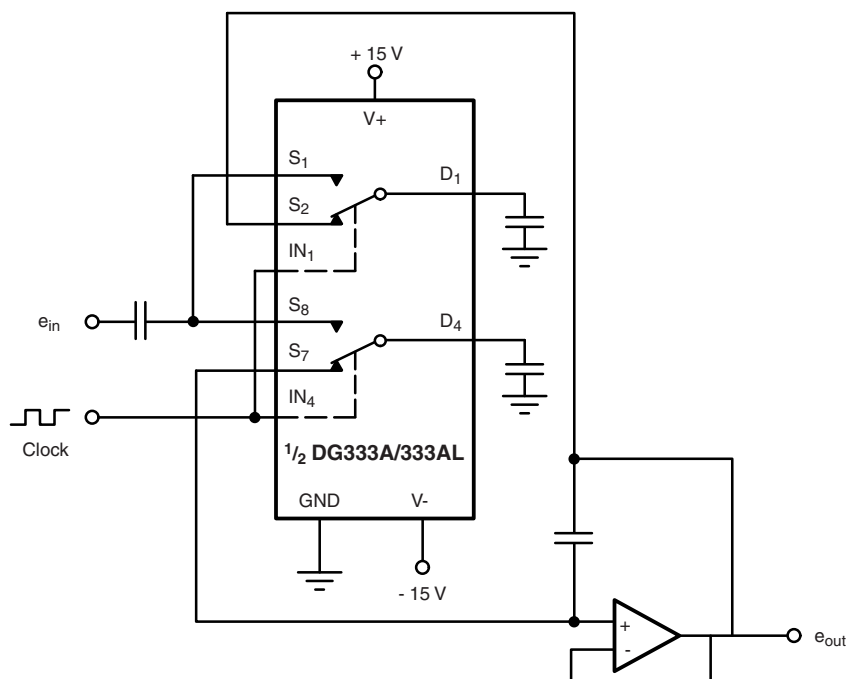
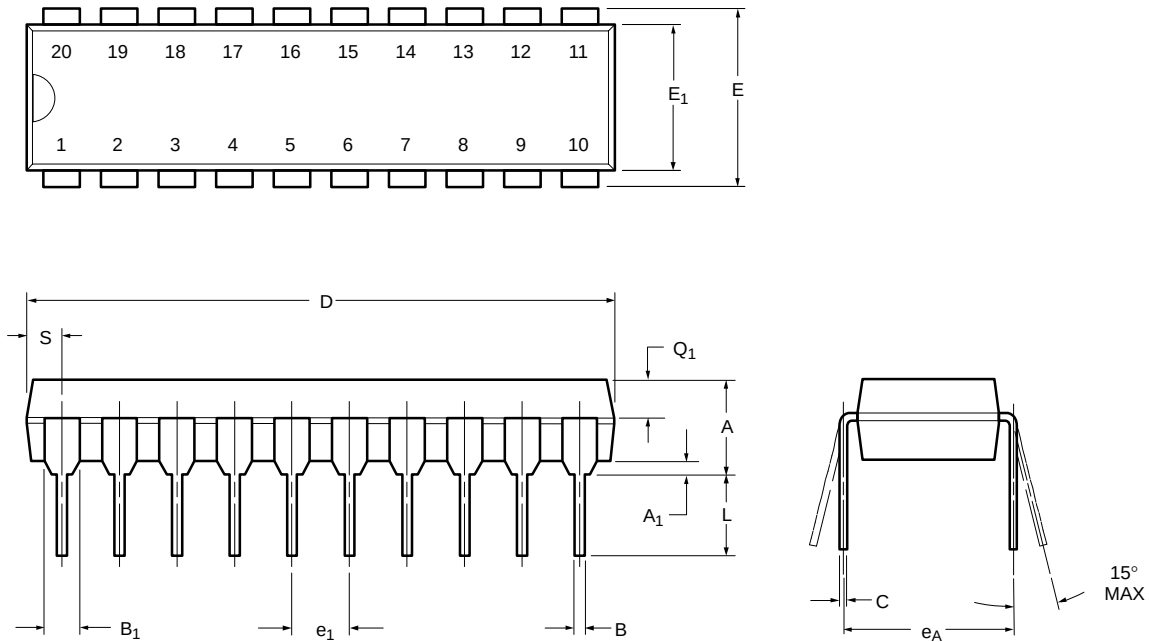


Figure 8. Band-Pass Switched Capacitor Filter

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?70803](http://www.vishay.com/ppg?70803).



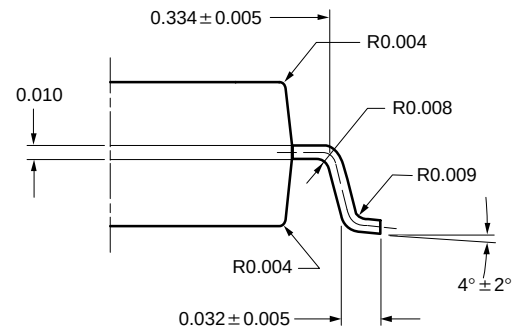
**PDIP: 20-LEAD**



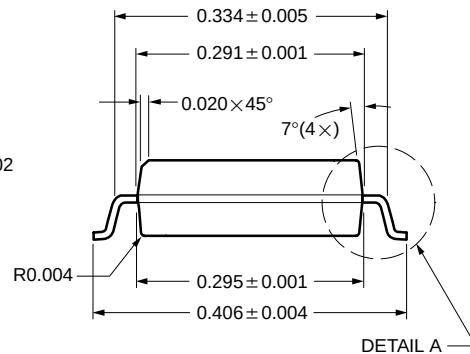
| Dim            | MILLIMETERS |       | INCHES |       |
|----------------|-------------|-------|--------|-------|
|                | Min         | Max   | Min    | Max   |
| A              | 3.81        | 5.08  | 0.150  | 0.200 |
| A <sub>1</sub> | 0.38        | 1.27  | 0.015  | 0.050 |
| B              | 0.38        | 0.51  | 0.015  | 0.020 |
| B <sub>1</sub> | 0.89        | 1.65  | 0.035  | 0.065 |
| C              | 0.20        | 0.30  | 0.008  | 0.012 |
| D              | 24.89       | 26.92 | 0.980  | 1.060 |
| E              | 7.62        | 8.26  | 0.300  | 0.325 |
| E <sub>1</sub> | 5.59        | 7.11  | 0.220  | 0.280 |
| e <sub>1</sub> | 2.29        | 2.79  | 0.090  | 0.110 |
| e <sub>A</sub> | 7.37        | 7.87  | 0.290  | 0.310 |
| L              | 3.175       | 3.81  | 0.123  | 0.150 |
| Q <sub>1</sub> | 1.27        | 2.03  | 0.050  | 0.080 |
| S              | 1.02        | 2.03  | 0.040  | 0.080 |

ECN: S-03946—Rev. B, 09-Jul-01  
DWG: 5484

ECN: S-03946—Rev. C, 09-Jul-01  
DWG: 5848



Technical drawing of a 10-hole punch tool. The drawing shows a side view of a cylindrical tool with 10 holes. Key dimensions are labeled: overall length  $0.504 \pm 0.001$ , hole diameter  $0.091 \pm 0.001$ , hole spacing  $0.017 \pm 0.0003$ , hole depth  $0.041 \pm 0.001$ , and hole pitch  $0.050$  TYP. The tool has a total height of  $0.098 \pm 0.002$  and a base thickness of  $0.006 \pm 0.002$ .



**1**



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**



**Стандарт  
Электрон  
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

**Наши контакты:**

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331