

## Precision Wide Bandwidth Quad Analog Switches

## Features

- Single-Supply Operation (+2V to +6V)
- Rail-to-Rail Analog Signal Range
- Low On-Resistance (6-ohm typ @ 5V) Minimizes Distortion and Error Voltages
- R<sub>ON</sub> Matching Between Channels, 0.4-ohm typ
- On-Resistance Flatness, 2-ohm typ
- Low Charge Injection. Q=4pC typ. Reduces Step errors, "clicking, popping" noise
- High Speed. t<sub>ON</sub>, 10ns typ
- Very Low Crosstalk: -72dB @ 30 MHz
- Wide -3dB Bandwidth: >200 MHz
- High-Current Channel Capability: >100mA
- TTL/CMOS Logic Compatible
- Low Power Consumption (0.5 $\mu$ W typ)
- Pin-compatible with DG3XX, DG4XX, MAX39X
- Packaging (Pb-free & Green):
  - 16-pin QSOP (Q)

## Description

The 392A is a monolithic analog switches designed for low-voltage, single-supply operation. This high-precision device is ideal for low-distortion audio, video, signal switching and routing applications.

The PI5A392A has four normally open (NO) switches. Each switch conducts current equally well in either direction when on. When off they block voltages up to the power-supply rails.

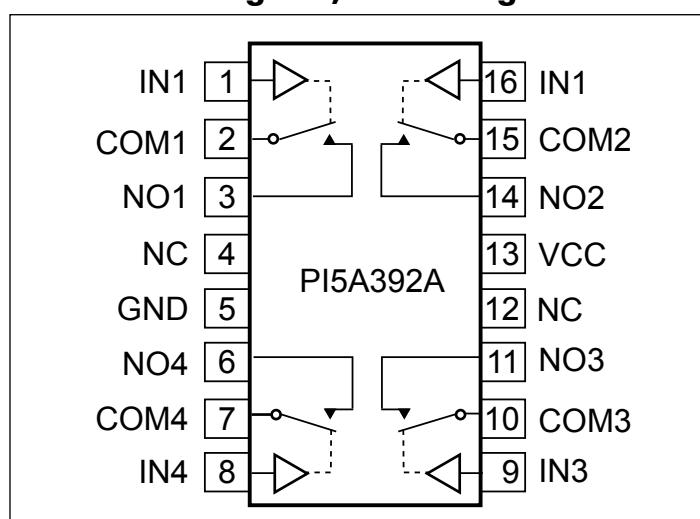
The 392A is fully specified with +5V, and +3.3V supplies. With +5V, they guarantee <12-ohm on-resistance. On-resistance matching between channels is within 2-ohm. On-resistance flatness is less than 4ohm over the full signal range. The PI5A39X family guarantees fast switching speeds (t<sub>ON</sub> < 20ns).

This product is available in the 16-pin QSOP package for operation over the industrial (-40oC to +85 oC) temperature range.

## Applications

- Audio, Video Switching and Routing
- Battery-Powered Communication Systems
- Computer Peripherals
- Telecommunications
- Portable Instrumentation
- Mechanical Relay Replacement

## Functional Diagram, Pin Configuration and Truth Tables



Logic	Switch
0	OFF
1	ON

Switch IS shown with logic "0" input.

PI5A392A

## Absolute Maximum Ratings

Parameter	Min.	Max.	Units
Storage Temperature	-65	150	°C
Ambient Temperature with Power Applied	-40	85	°C
Supply Voltage to Ground Potential	-0.5	7.0	V
DC Input Voltage	-0.5	0.5	V
DC Output Current		120	mA
Power Dissipation		0.5	W

Stress beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

## DC Characteristics (Over the Operating Range, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ , $V_{CC} = 5\text{V} \pm 10\%$ , GND = 0V)

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ.	Max.	Units
$V_{ANALOG}$	Analog Signal Range		0		$V_{CC}$	V
$R_{ON}$	ON-Resistance	$I_{NC}$ or $I_{NO} = 10\text{ mA}$ to $30\text{ mA}$		6	18	ohm
$\Delta R_{ON}$	Match Between Channels			0.4	2	
$R_{FLAT(ON)}$	RON Flatness	$I_{ON} = 1\text{ mA}$ , $V_{NO}$ , $V_{NC} = 0\text{V}$ TO $5\text{V}$		1	2	
$I_{NO(OFF)}$ $I_{NO(ON)}$	On/Off Leakage Current	$V_{NO}$ , $V_{NC} = 4.5\text{V}$	-30		30	nA
$I_{CC}$	Quiescent Supply Current	$V_{CC} = 5.5\text{V}$ , $V_{IN} = 0\text{V}$ OR $V_{CC}$			100	
$I_O$	Output Current	$V_{NO}$ , $V_{NC}$ or $V_{COM} = 0\text{V}$ to $5\text{V}$	100			mA
$V_{IH}$	Input High Voltage	Guaranteed Logic HIGH Level	2.0			V
$V_{IL}$	Input Low Voltage	Guaranteed Logic LOW Level	-0.5		0.8	
$I_{IH}$	Input High Current	$V_{CC} = \text{Max.}$ , $V_{IN} = V_{CC}$			$\pm 1$	$\mu\text{A}$
$I_{IL}$	Input Low Current	$V_{CC} = \text{Max.}$ , $V_{IN} = \text{GND}$			$\pm 1$	

### Notes:

1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for applicable device type.

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## Dynamic Electrical Characteristics

(Over the Operating Range,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 5\text{V} \pm 10\%$ , GND = 0V)

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ.	Max.	Units
$t_{ON}$	Turn-on Time	$V_{COM} = 3.0\text{V}$ , see Figure 1		10	20	NS
$t_{OFF}$	Turn-off Time	$V_{COM} = 3.0\text{V}$ , see Figure 1		5	10	NS
$X_{TALK}$	Crosstalk	$R_L = 100\text{ ohm}$ , $f = 30\text{ MHz}$ , see Figure 4		-72		dB
$C_{(OFF)}$	NC or NO Capacitance	$f = 1\text{ kHz}$		13		pF
OIRR	Off Isolation	$R_L = 100\text{ ohm}$ , $f = 30\text{ MHz}$ , see Figure 5		-55		dB
BW	Bandwidth $-3\text{ dB}$	$R_L = 100\text{ ohm}$ , see Figure 3		200		MHz
D	Distortion $\Delta R_{ON}/R_L^{(2)}$	$R_L = 100\text{ ohm}$		2		%
Q	Charge Injection	$C_L = 1\text{ nF}$ , $V_{Gen} = 0\text{V}$		3	5	pC

## DC Characteristics (Over the Operating Range, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ , $V_{CC} = 3.3\text{V} \pm 10\%$ , GND = 0V)

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ.	Max.	Units
$V_{ANALOG}$	Analog Signal Range		0		$V_{CC}$	V
$R_{ON}$	ON-Resistance	$I_{NC}$ or $NO = 10\text{ mA}$ to $30\text{ mA}$		15	28	ohm
$\Delta R_{ON}$	Match Between Channels			0.4	2	
$R_{FLAT(ON)}$	$R_{ON}$ Flatness	$I_{ON} = 1\text{ mA}$ , $V_{NO}$ , $V_{NC} = 0\text{V}$ TO $5\text{V}$		1	2	
$I_{NO(OFF)}$ $I_{NO(ON)}$	On/Off Leakage Current	$V_{NO}$ , $V_{NC} = 4.5\text{V}$	-30		30	nA
$I_{CC}$	Quiescent Supply Current	$V_{CC} = 5.5\text{V}$ , $V_{IN} = 0\text{V}$ OR $V_{CC}$			100	
$I_O$	Output Current	$V_{NO}$ , $V_{NC}$ or $V_{COM} = 0\text{V}$ to $5\text{V}$	80			mA
$V_{IH}$	Input High Voltage	Guaranteed Logic HIGH Level	2.0			V
$V_{IL}$	Input Low Voltage	Guaranteed Logic LOW Level	-0.5		0.8	
$I_{IH}$	Input High Current	$V_{CC} = \text{Max.}$ , $V_{IN} = V_{CC}$			$\pm 1$	$\mu\text{A}$
$I_{IL}$	Input Low Current	$V_{CC} = \text{Max.}$ , $V_{IN} = \text{GND}$			$\pm 1$	

## Dynamic Electrical Characteristics

(Over the Operating Range,  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 5\text{V} \pm 10\%$ ,  $\text{GND} = 0\text{V}$ )

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ.	Max.	Units
$t_{ON}$	Turn-on Time	$V_{COM} = 3.0\text{V}$ , see Figure 1		20	40	NS
$t_{OFF}$	Turn-off Time	$V_{COM} = 3.0\text{V}$ , see Figure 1		10	20	NS
$X_{TALK}$	Crosstalk	$R_L = 100 \text{ ohm}$ , $f = 30 \text{ MHz}$ , see Figure 4		-72		dB
$C_{(OFF)}$	NC or NO Capacitance	$f = 1 \text{ kHz}$		15		pF
OIRR	Off Isolation	$R_L = 100 \text{ ohm}$ , $f = 30 \text{ MHz}$ , see Figure 5		-55		dB
BW	Bandwidth $-3 \text{ dB}$	$R_L = 100 \text{ ohm}$ , see Figure 3		190		MHz
D	Distortion $\Delta R_{ON}/R_L^{(2)}$	$R_L = 100 \text{ ohm}$		2		%
Q	Charge Injection	$C_L = 1 \text{ nF}$ , $V_{Gen} = 0\text{V}$		3	10	pC

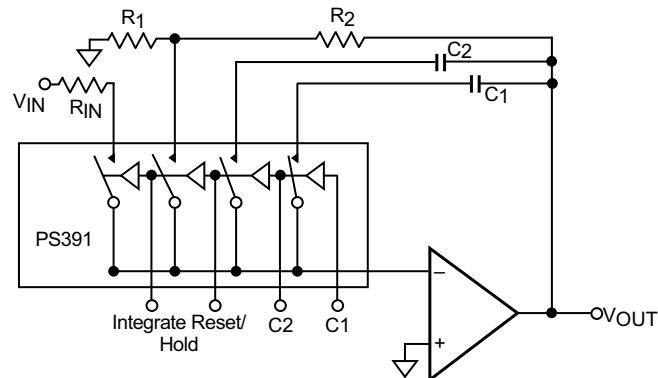
**Notes:**

1. For conditions shown as Max or Min, use appropriate value specified under Electrical Characteristics for applicable device type.

2.  $\Delta R_{ON} = \Delta R_{ON\ max} - R_{ON\ min}$ .

3. Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.

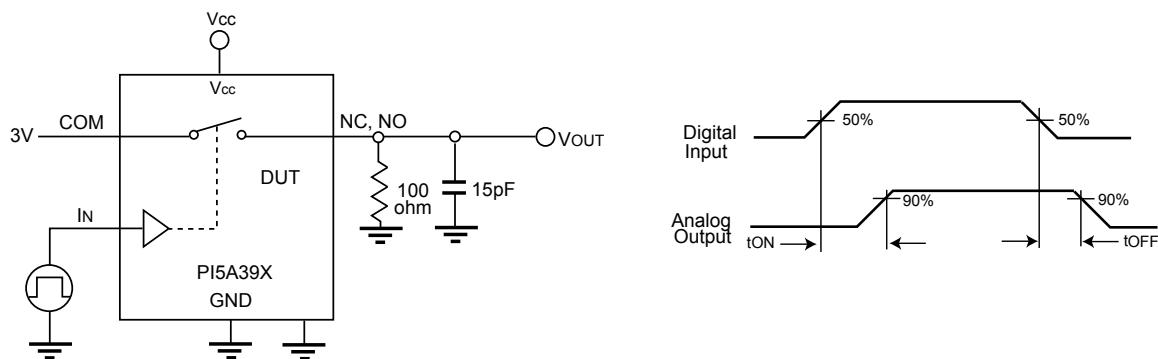
## Applications



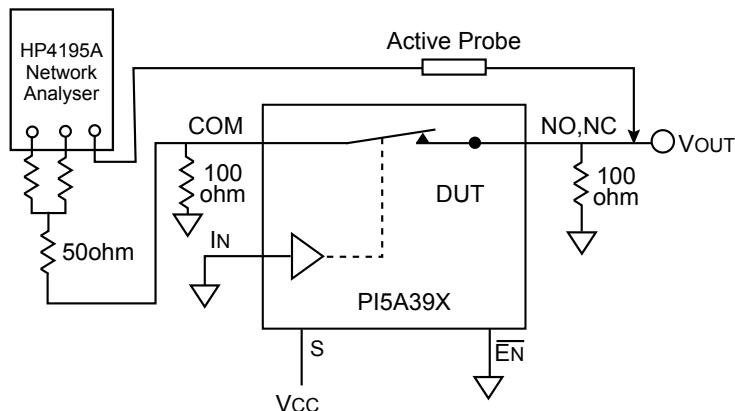
**Figure 1. Programmable Integrator and Sample/Hold**

The 5A39X can be used to insert various capacitors ( $C_1, C_2$ ) and set proper RC times for integration. Resistors  $R_1$  and  $R_2$  set initial gain. The  $R_{IN}$  resistor  $\times C_1$  or  $C_2$  sets the RC time. The reset switch discharges the hold capacitor through  $R_{IN}$ .

## Test Circuits

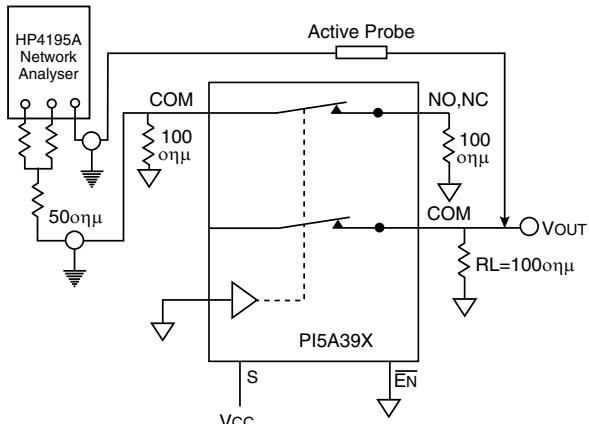


**Figure 2. Switching Time**

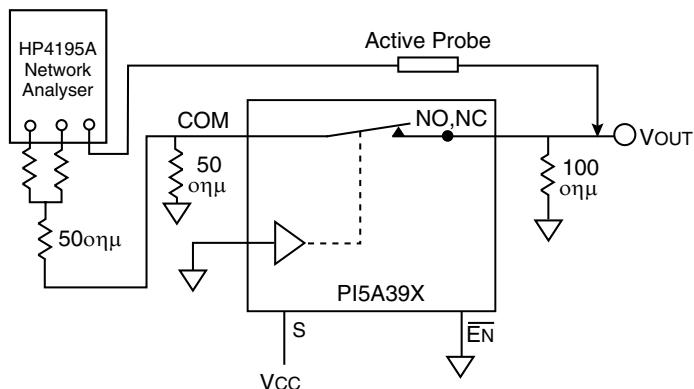


**Figure 3. Bandwidth**

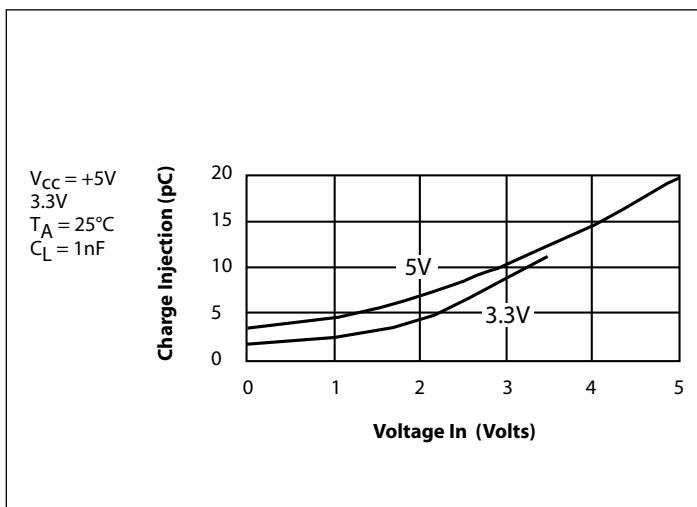
## Typical Operating Characteristics



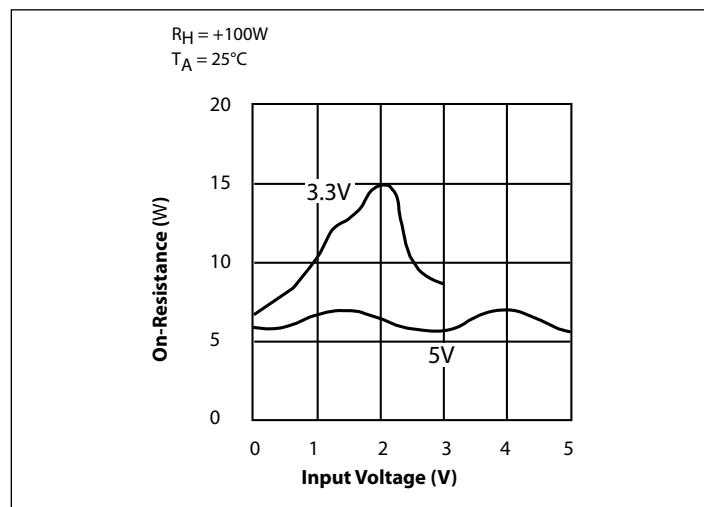
**Figure 4. Crosstalk**



**Figure 5. Off Isolation**



**Figure 6. Charge Injection vs Voltage In**



**Figure 7. On-Resistance vs Input Voltage**

PI5A392A

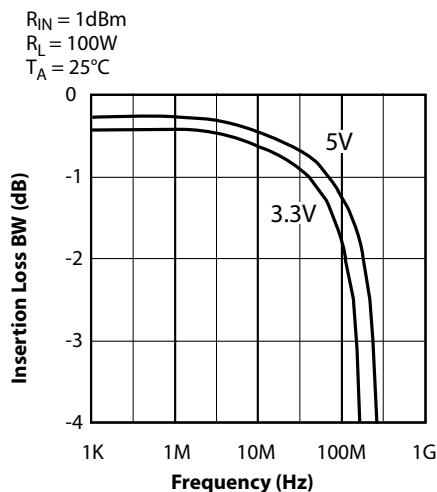


Figure 8. Insertion Loss vs Frequency

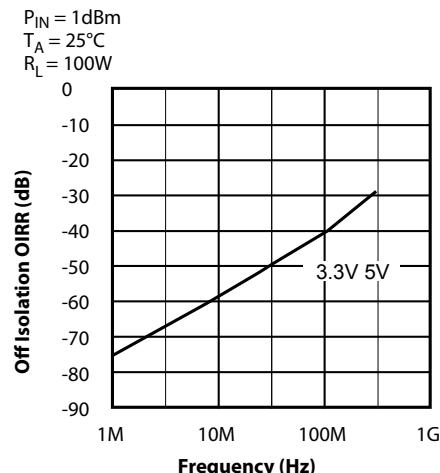


Figure 9. Off Isolation vs Frequency

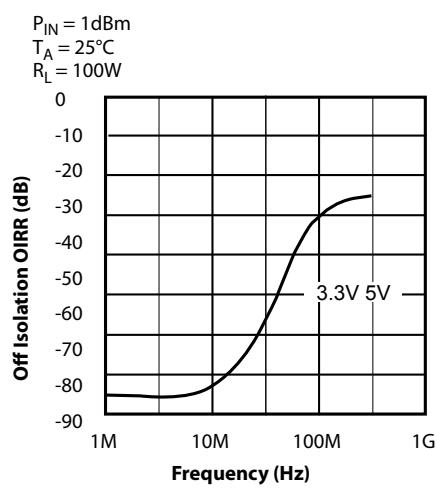
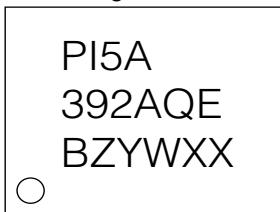


Figure 10. Crosstalk vs Frequency

## Part Marking

Q Package



B: Fab 2 Port Code

Z: Die Rev Code

Y: Year

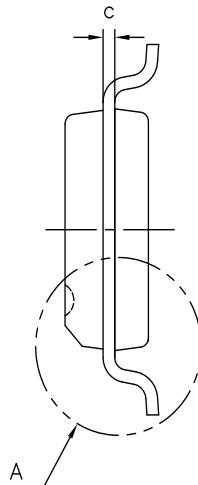
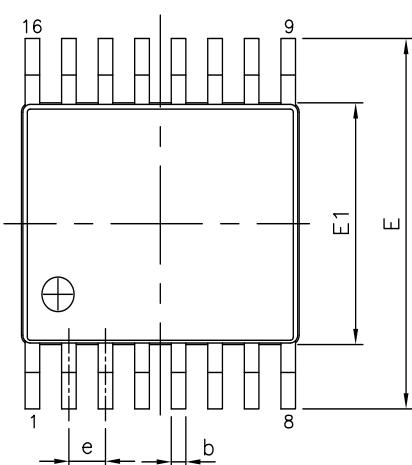
W: Workweek

1st X: Assembly Code

2nd X: Fab Code

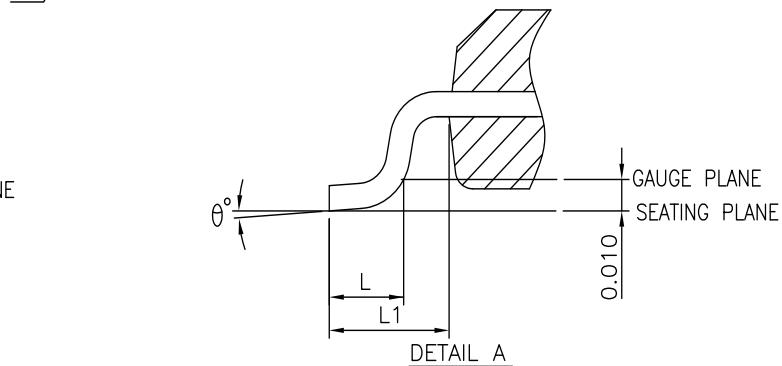
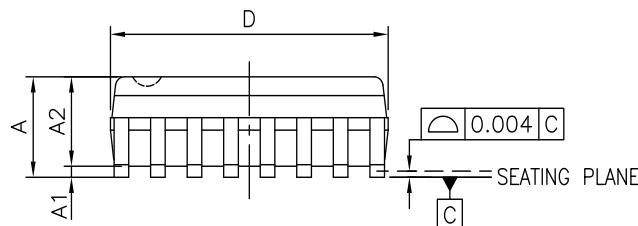
PI5A392A

## Packaging Mechanical: 16-QSOP (Q)



SYMBOLS	MIN.	NOM.	MAX.
A	—	—	0.069
A1	0.004	—	0.0098
A2	0.049	—	—
b	0.008	—	0.012
c	0.004	—	0.010
D	0.189	0.193	0.197
E1	0.150	0.154	0.158
E	0.228	0.236	0.244
L	0.016	—	0.050
L1	0.041	REF.	
e	0.025	BSC.	
$\theta^\circ$	0	—	8

UNIT : INCH



NOTES:  
1. ALL DIMENSIONS IN INCH. ANGLES IN DEGREES.  
2. JEDEC MO-137E  
3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

16-0056

For latest package info.

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## Ordering Information

Ordering Code	Package Code	Package Type	Operating Temperature
PI5A392AQEX	Q	16-pin 150-mil Wide (QSOP)	-40°C to +85°C

Notes:

- EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant. All applicable RoHS exemptions applied.
- See <http://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free. Thermal characteristics can be found on the company web site at [www.diodes.com/design/support/packaging/](http://www.diodes.com/design/support/packaging/)
- E = Pb-free and Green
- X suffix = Tape/Reel

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