

Precision Wide Bandwidth Quad Analog Switches

Features

- Single-Supply Operation (+2V to +6V)
- Rail-to-Rail Analog Signal Range
- Low On-Resistance (60hm typ @ 5V)
Minimizes Distortion and Error Voltages
- R_{ON} Matching Between Channels, 0.4 ohm typ
- On-Resistance Flatness, 2ohm typ
- Low Charge Injection. $Q=4pC$ typ.
Reduces Step errors, "clicking, popping" noise
- High Speed. t_{ON} , 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 μ W typ)
- Pin-compatible with DG3XX, DG4XX, MAX39X

Applications

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

Description

The PI5A391A/392A/393A are monolithic analog switches designed for low-voltage, single-supply operation. These high-precision devices are ideal for low-distortion audio, video, signal switching and routing applications.

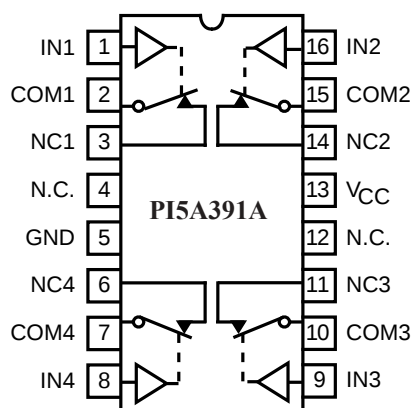
The PI5A391A is a quad single-pole single-throw (SPST), normally closed (NC) switch. The PI5A392A has four normally open (NO) switches. The PI5A393A has two NC and two NO switches per package.

Each switch conducts current equally well in either direction when on. When off they block voltages up to the power-supply rails.

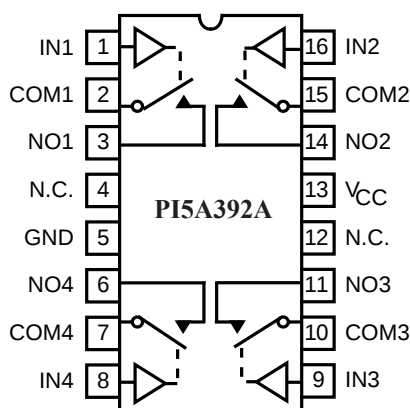
The PI5A391A/392A/393A are fully specified with +5V, and +3.3V supplies. With +5V, they guarantee <12-ohm on-resistance. On-resistance matching between channels is within 2-ohm. On-resistance flatness is less than 4ohm over the full signal range. The PI5A39X family guarantees fast switching speeds ($t_{ON} < 20ns$).

These products are available in the 16-pin narrow-body SOIC, and QSOP packages for operation over the industrial (-40°C to +85 °C) temperature range.

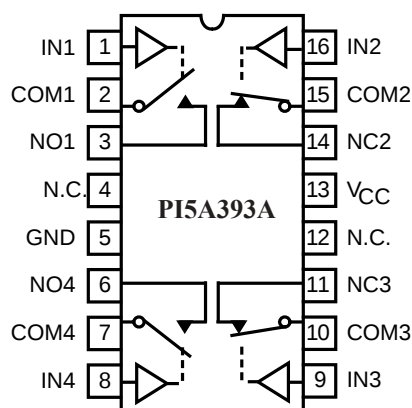
Functional Diagram, Pin Configuration and Truth Tables



PI5A391	
Logic	Switch
0	ON
1	OFF



PI5A392A	
Logic	Switch
0	OFF
1	ON



PI5A393A		
Logic	Switches 1,4	Switches 2,3
0	OFF	ON
1	ON	OFF

Switches are shown with logic "0" input.

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature	–65°C to +150°C
Ambient Temperature with Power Applied	–40°C to +85°C
Supply Voltage to Ground Potential	–0.5V to +7.0V
DC Input Voltage	–0.5V to V _{CC} +0.5V
DC Output Current	120mA
Power Dissipation	0.5W

Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Single 5.0V Supply

DC Electrical Characteristics (Over the Operating Range, T_A = –40°C to +85°C, V_{CC} = 5V ±10%, GND = 0V)

Parameters	Description	Test Conditions ⁽¹⁾	Min.	Typ ⁽²⁾	Max.	Units
V _{ANALOG}	Analog Signal Range		0	—	V _{CC}	V
R _{ON}	ON-Resistance	I _{NC} or I _{NO} = 10 mA to 30 mA	—	6	18	ohm
ΔR _{ON}	Match Between Channels		—	0.4	2	ohm
R _{FLAT(ON)}	R _{ON} Flatness	I _{ON} = 1 mA, V _{NO} , V _{NC} = 0V to 5V	—	1	2	ohm
I _{NO(OFF)} I _{NC(ON)}	On/Off Leakage Current	V _{NO} , V _{NC} = 4.5V	–30	—	30	nA
I _{CC}	Quiescent Supply Current	V _{CC} = 5.5V, V _{IN} = 0V or V _{CC}	—	—	100	nA
I _O	Output Current	V _{NO} , V _{NC} or V _{COM} = 0V to 5V	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	V
I _{IH}	Input HIGH Current	V _{CC} = Max., V _{IN} = V _{CC}	—	—	±1	μA
I _{IL}	Input LOW Current	V _{CC} = Max., V _{IN} = GND	—	—	±1	μA

Notes:

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

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

Parameters	Description	Test Conditions ⁽¹⁾	Min.	Typ ⁽²⁾	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
O _{IRR}	Off Isolation	$R_L = 100\text{ ohm}$, $f = 30\text{ MHz}$, see Figure 5	—	-55	—	dB
BW	Bandwidth -3 dB	$R_L = 100\text{ ohm}$, see Figure 3	—	200	—	MHz
D	Distortion $\Delta R_{ON}/R_L$	$R_L = 100\text{ ohm}$	—	2	—	%
Q	Charge Injection	$C_L = 1\text{ nF}$, $V_{Gen} = 0\text{V}$	—	3	5	pC

Single 3.3V Supply
DC Electrical Characteristics⁽¹⁾ (Over the Operating Range, $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = 3.3\text{V} \pm 10\%$, $GND = 0\text{V}$)

Parameters	Description	Test Conditions ⁽¹⁾	Min.	Typ ⁽²⁾	Max.	Units
V _{ANALOG}	Analog Signal Range		0	—	V_{CC}	V
R _{ON}	ON-Resistance	$I_{ON} = 10\text{ mA to }30\text{ mA}$	—	15	28	Ω
ΔR_{ON}	Match Between Channels		—	0.4	2	Ω
R _{FLAT(ON)}	R _{ON} Flatness	$I_{ON} = 1\text{ mA}$, V_{NO} , $V_{NC} = 0\text{V to }5\text{V}$	—	1	2	Ω
I _{NO(OFF)} I _{NC(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	nA
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	V
I _{IH}	Input HIGH Current	$V_{CC} = \text{Max.}$, $V_{IN} = V_{CC}$	—	—	± 1	μA
I _{IL}	Input LOW Current	$V_{CC} = \text{Max.}$, $V_{IN} = GND$	—	—	± 1	μA

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

Parameters	Description	Test Conditions ⁽¹⁾	Min.	Typ ⁽²⁾	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
O _{IRR}	Off Isolation	$R_L = 100\text{ ohm}$, $f = 30\text{ MHz}$, see Figure 5	—	-55	—	dB
BW	Bandwidth -3 dB	$R_L = 100\text{ ohm}$, see Figure 3	—	190	—	MHz
D	Distortion $\Delta R_{ON}/R_L$	$R_L = 100\text{ ohm}$	—	2	—	%
Q	Charge Injection	$C_L = 1\text{ nF}$, $V_{Gen} = 0\text{V}$	—	3	10	pC

Notes:

- For conditions shown as Max or Min, use appropriate value specified under Electrical Characteristics for applicable device type.
- Guaranteed by design.
- $\Delta R_{ON} = R_{ON\text{ max}} - R_{ON\text{ min}}$.
- Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.

Applications

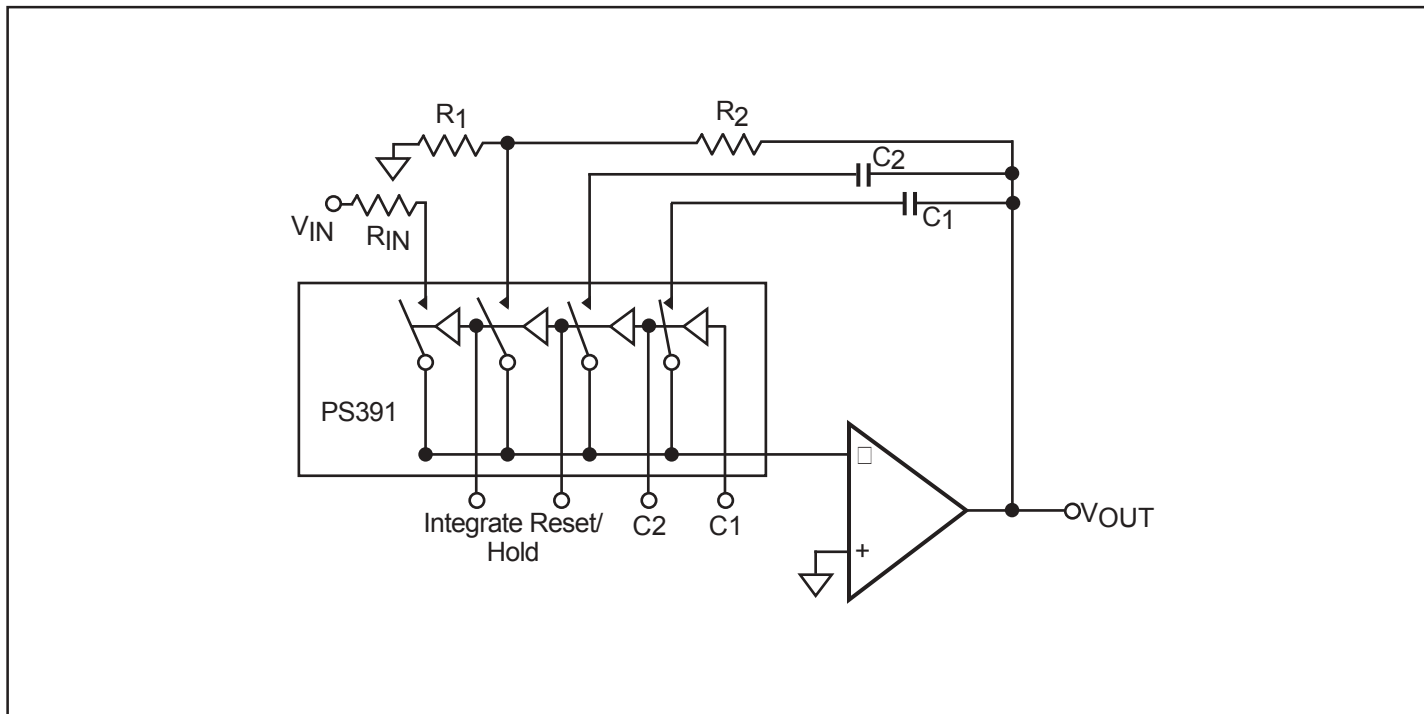


Figure 1. Programmable Integrator and Sample/Hold

The 5A39X can be used to insert various capacitors ($C1$, $C2$) and set proper RC times for integration. Resistors R_1 and R_2 set initial gain. The R_{IN} resistor X $C1$ or $C2$ sets the RC time. The reset switch discharges the hold capacitor through R_{IN} .

Test Circuits

Figure 2. Switching Time

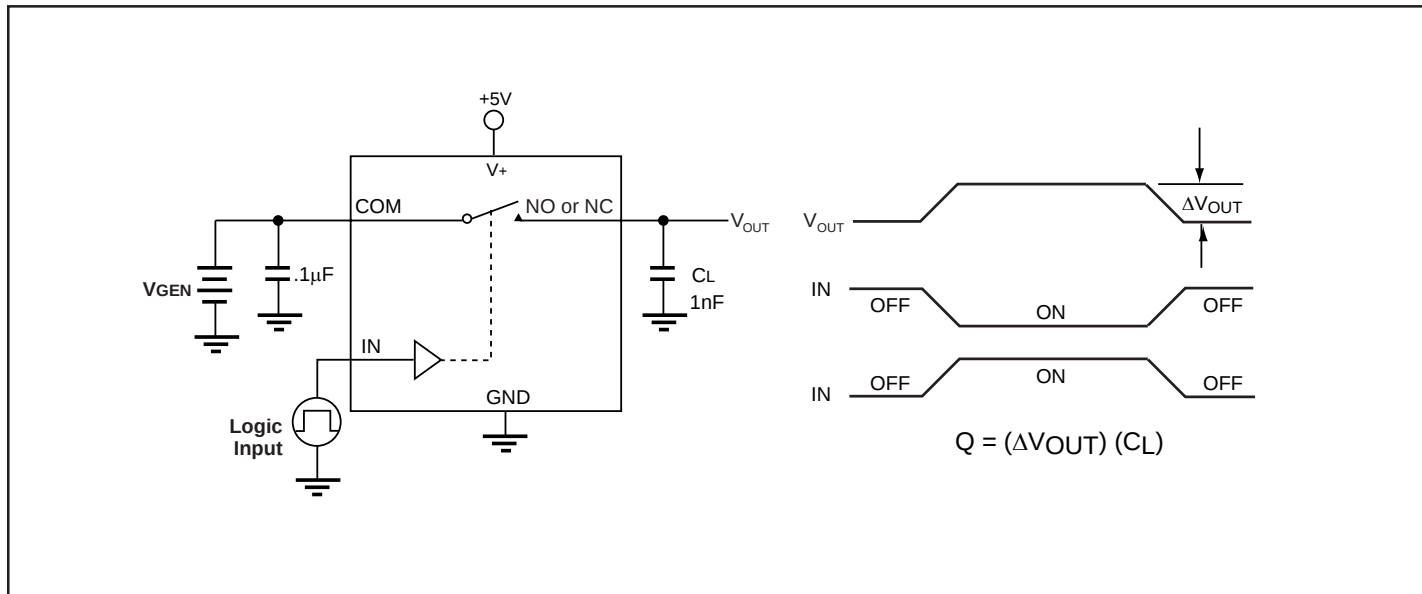
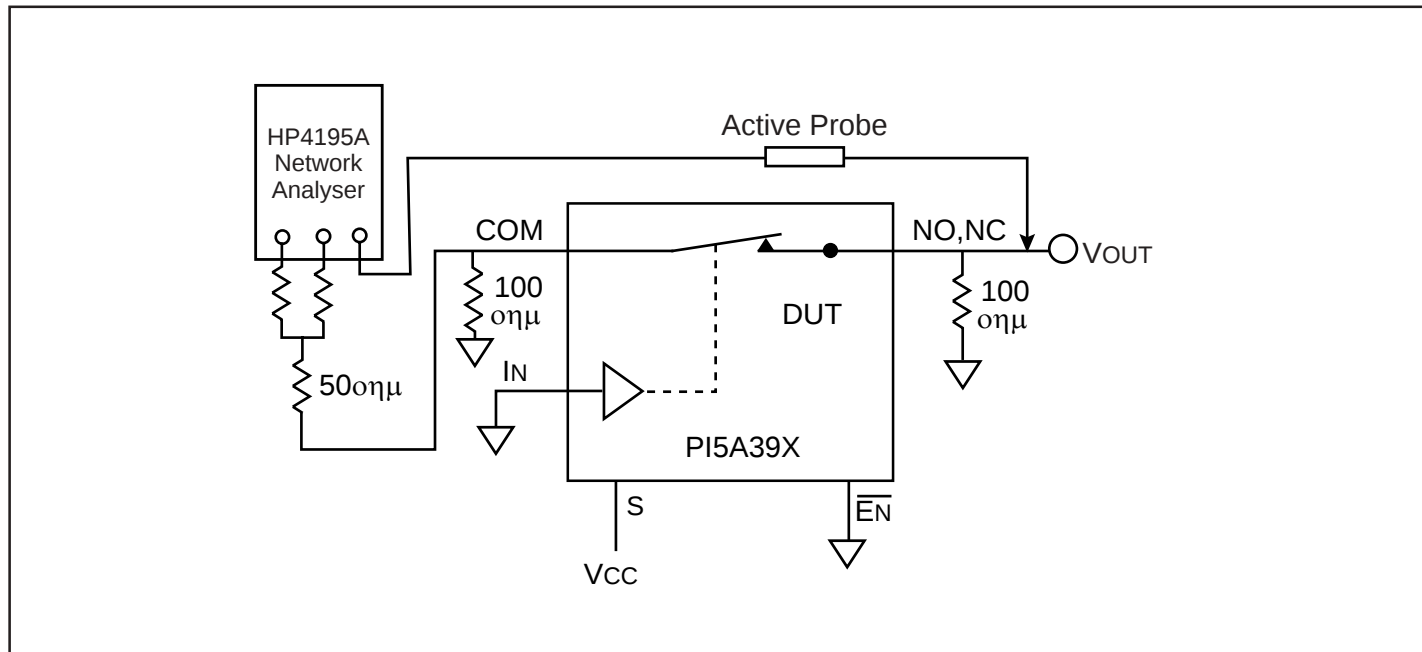


Figure 3. Bandwidth



Typical Operating Characteristics

Figure 4. Crosstalk

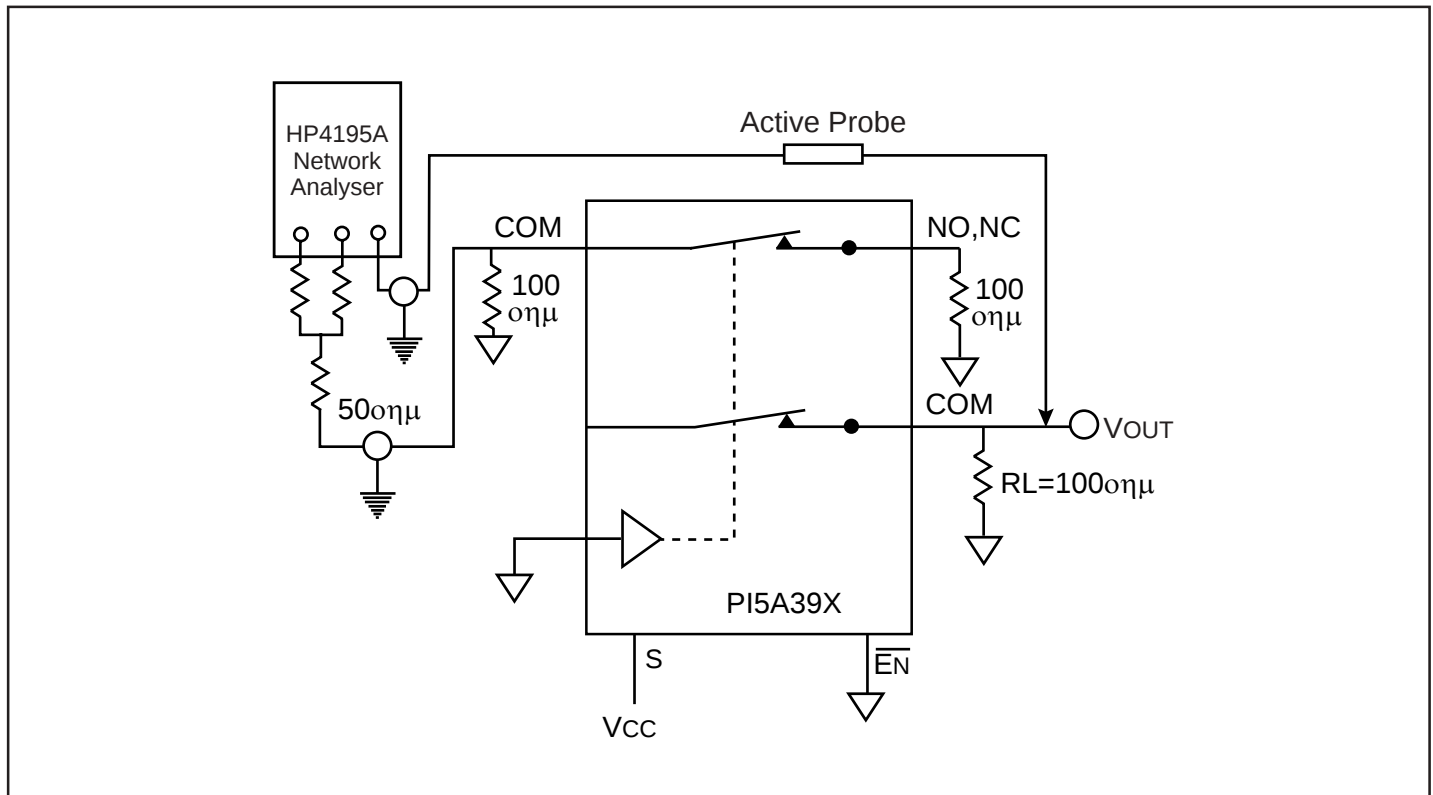


Figure 5. Off Isolation

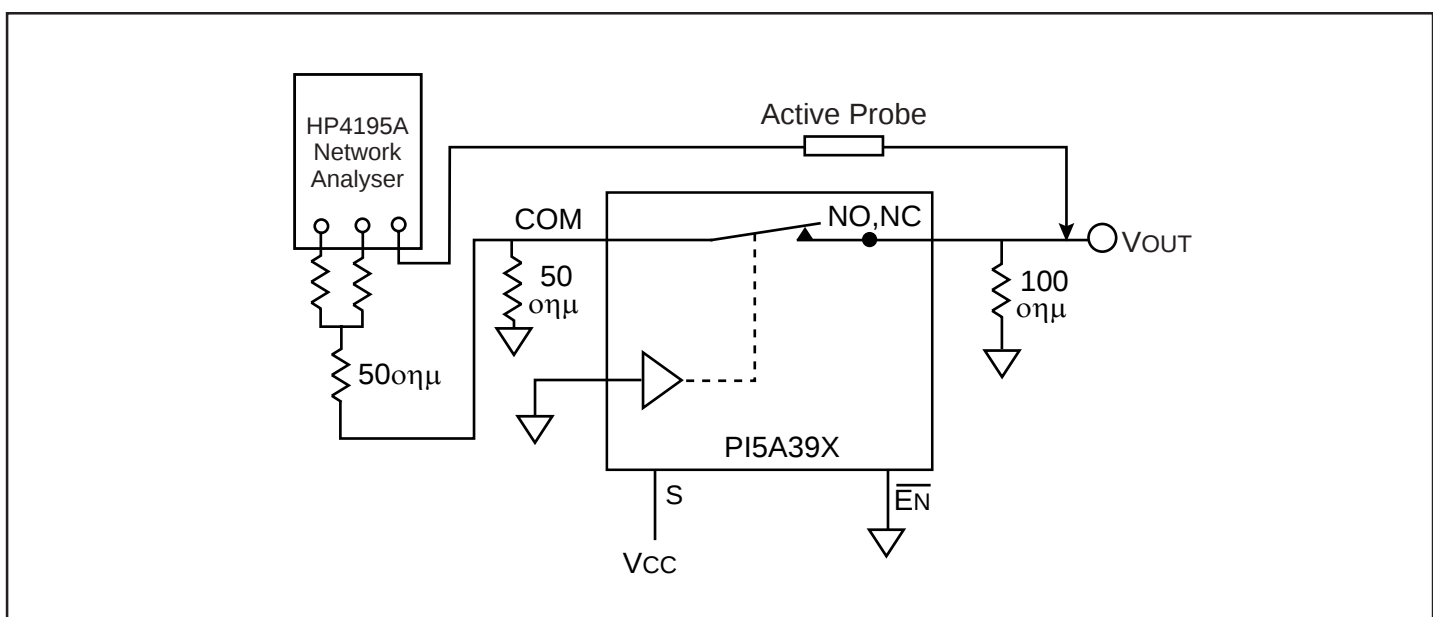


Figure 6. Charge Injection vs Voltage In

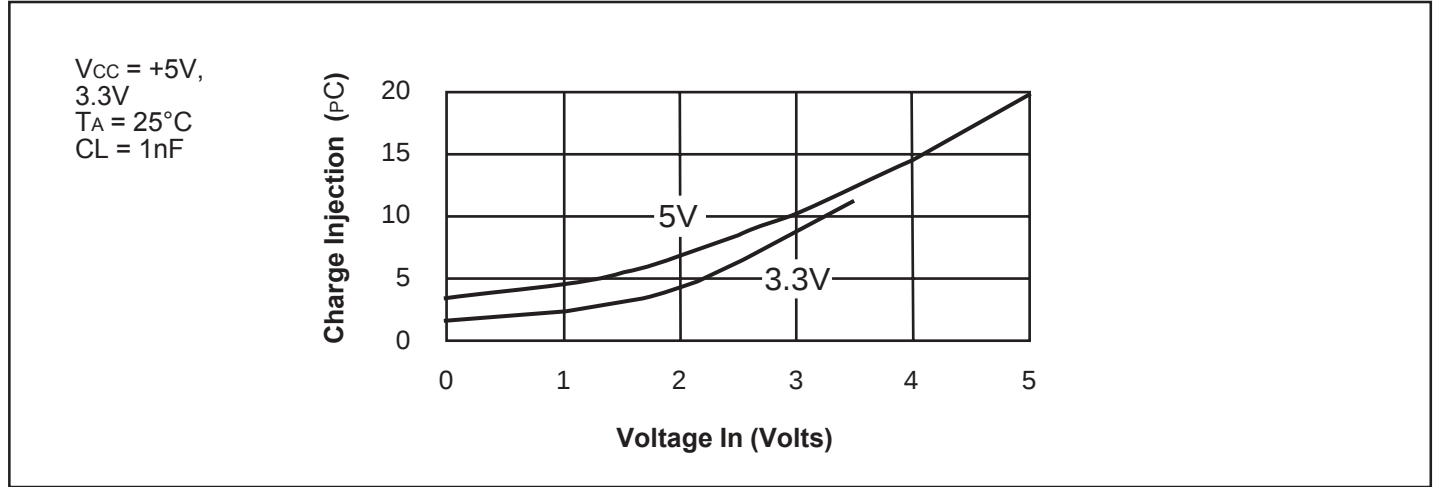


Figure 7. On-Resistance vs Input Voltage

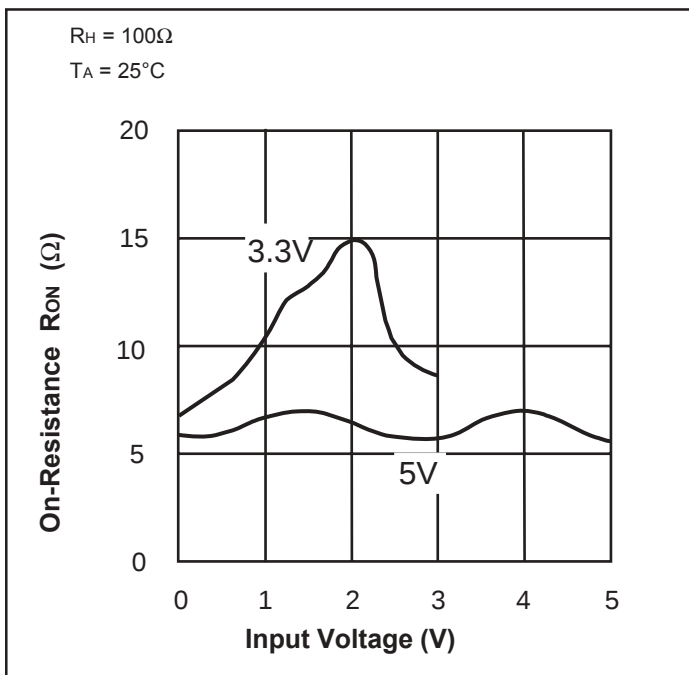


Figure 8. Insertion Loss vs Frequency

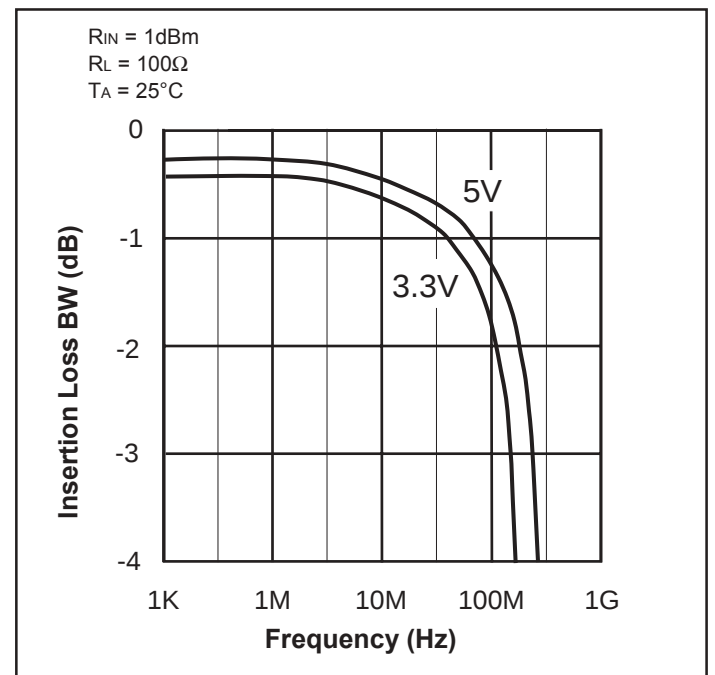


Figure 9. Off Isolation vs Frequency

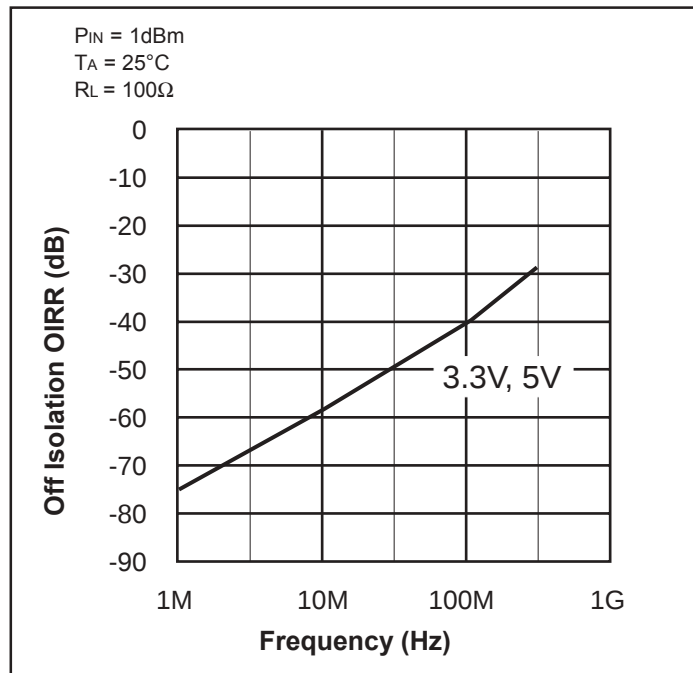
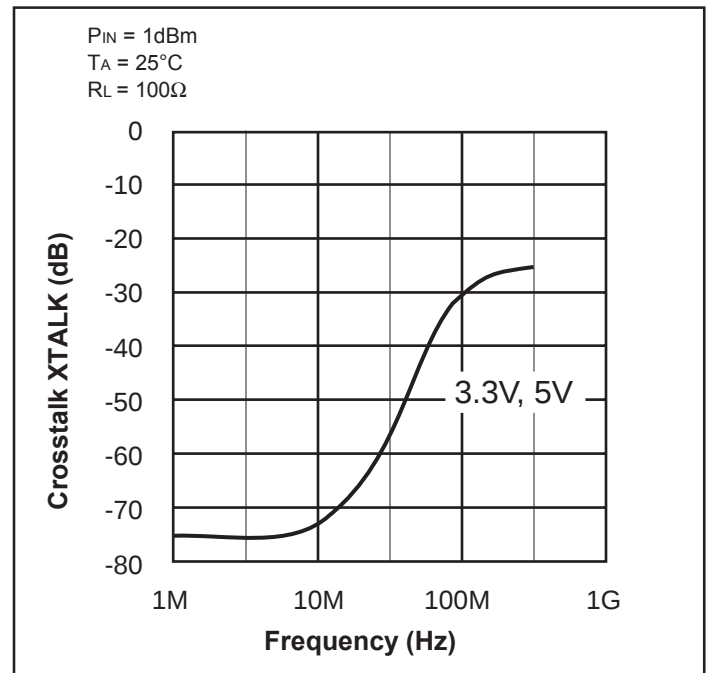
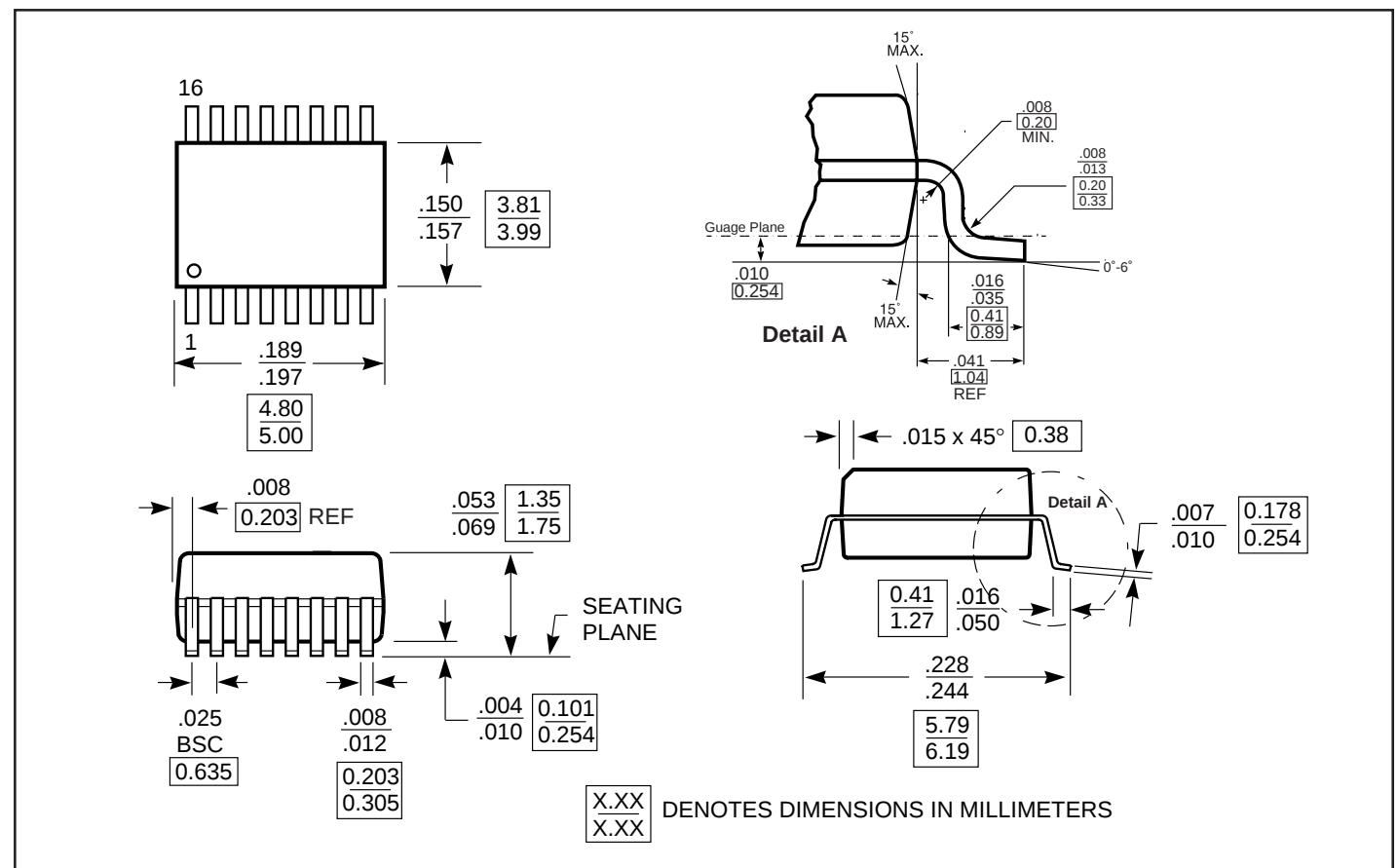


Figure 10. Crosstalk vs Frequency



Packaging Mechanical: 16-Pin, QSOP





The drawing illustrates the mechanical specifications of a 16-pin DIP package. It includes three views: a top view, a side view, and a detail view of the lead profile.

Top View Dimensions:

- Pin 16 is at the top, and Pin 1 is at the bottom.
- Overall width: .386 in (9.80 mm)
- Pin pitch: .0393 in (10.00 mm)
- Body width: .149 in (3.78 mm)
- Body height: .157 in (3.99 mm)

Side View Dimensions:

- Overall height: .053 in (1.35 mm)
- Lead height: .068 in (1.75 mm)
- Seating Plane is indicated.
- Lead thickness: .0040 in (0.10 mm)
- Lead width: .0098 in (0.25 mm)
- Lead spacing: .050 in (1.27 mm)
- Lead thickness at base: .013 in (0.330 mm)
- Lead width at base: .020 in (0.508 mm)
- Reference dimensions: .0155 in, .0260 in, .0393 in, .0660 in

Detail View Dimensions:

- Lead thickness: .0099 in (0.25 mm)
- Lead width: .0196 in (0.50 mm)
- Lead angle: 45°
- Lead thickness at base: .0075 in (0.19 mm)
- Lead width at base: .0098 in (0.25 mm)
- Lead angle at base: 0-8°
- Overall width: .2284 in (5.80 mm)
- Overall height: .2440 in (6.20 mm)
- Lead thickness at base: .041 in (1.27 mm)
- Lead width at base: .016 in (0.050 mm)

Legend:

X.XX DENOTES DIMENSIONS IN MILLIMETERS

Part Number	Package	Package Code	Temperature
PI5A391AQ	16-Pin, QSOP	Q16	–40°C to +85°C
PI5A391AW	16-Pin, SOIC	W16	
PI5A392AQ	16-Pin, QSOP	Q16	
PI5A392AW	16-Pin, SOIC	W16	
PI5A393AQ	16-Pin, QSOP	Q16	
PI5A393AW	16-Pin, SOIC	W16	