1.7 Ω, Low On Resistance, +12 V, +5 V, +3 V, ± 5 V, SPST Switches

DESCRIPTION

The DG9421E and DG9422E are monolithic single-pole-single-throw (SPST) analog switches. The DG9421E has a normally closed function. The DG9422E has a normally open function.

Processed with high density BiCMOS technology, the parts achieve low resistance, fast switching speed, low power dissipation, high -3dB bandwidth, and low voltage logic control threshold.

The DG9421E and DG9422E operate on single and dual supplies. Single supply voltage ranges from +3 V to +16 V while dual supply operation is recommended with ± 3 V to ± 8 V. Each switch conducts equally well in both direction when on, and blocks input voltages up to the supply levels when off.

The low and flat on resistance over the full input signal voltage range brings excellent linearity, reduces insertion loss and signal distortion, makes them ideal for data acquisition and programmable gain control applications. These switch characters also make them ideal fit for audio signal switch and reed relay replacement.

Operation temperature is specified from -40 °C to +85 °C. The DG9421E and DG9422E are available in 6 lead TSSOP packages.

BENEFITS

• Wide operation voltage range
• Low signal errors and distortion
• Fast switching time
• Simple interfacing

FEATURES

• 3 V to 16 V single supply or ± 3 thru ± 8 V dual supply operation
• Low on resistance: 1.7 Ω typical at 12 V
• 2.4 V logic compatible for control
• Bi-directional rail to rail signal switching
• Fast switching speed
• High bandwidth: 161 MHz
• Control logic input can be over V+
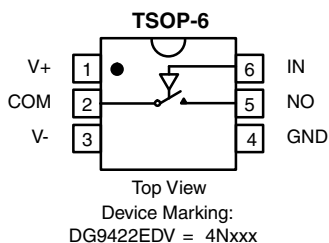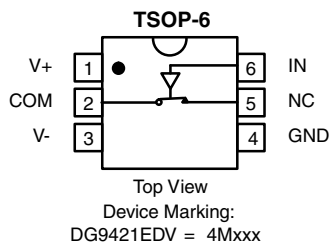• Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Note
* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

Pb-free
Available

RoHS*
Available

HALOGEN
FREE

APPLICATIONS

• Automatic test equipment
• Data acquisition systems
• Meters and instruments
• Medical and healthcare systems
• Communication systems
• Audio and video signal routing
• Relay replacement
• Battery powered systems
• Computer peripherals
• Audio and video signal routing

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

TSOP-6

V+ [1] [6] IN
COM [2] [5] NC
V- [3] [4] GND

Top View
Device Marking:
DG9421EDV = 4Mxxx

TSOP-6

V+ [1] [6] IN
COM [2] [5] NO
V- [3] [4] GND

Top View
Device Marking:
DG9422EDV = 4Nxxx

TRUTH TABLE

LOGIC	DG9421E	DG9422E
0	On	Off
1	Off	On

Notes
• Logic "0" ≤ 0.8 V
• Logic "1" ≥ 2.4 V
• Switches shown for logic "0" input

ORDERING INFORMATION

TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	6-pin TSOP	DG9421EDV-T1-GE3
		DG9422EDV-T1-GE3

ABSOLUTE MAXIMUM RATINGS

PARAMETER		LIMIT	UNIT
V+ reference to V-		-0.3 to +18	V
IN		-0.3 to +18	
V+ reference to GND		-0.3 to +18	
GND reference to V-		-0.3 to +18	
COM, NC, NO [a]		(V-) - 0.3 V to (V+) + 0.3 V or 50 mA, whichever occurs first	-
Continuous current (any terminal)		50	mA
Peak current, NO, NC or COM (pulsed at 1 ms, 10 % duty cycle)		100	
Storage temperature		-65 to +150	°C
Power dissipation (packages) [b]	6-pin TSOP [c]	570	mW
ESD / HBM	JS-001	2000	V
ESD / CDM	JS-002	2000	
Latch up	per JEDEC78	300	mA

Notes

a. Signals on NO, NC, COM exceeding V+ or V- 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 7 mW/°C above 25 °C

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.

SPECIFICATIONS [a] (Single supply 12 V)

PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 12 V, V- = 0 V, V_{IN} = 2.4 V, 0.8 V [f]	TEMP. [b]	LIMITS -40 °C to +85 °C			UNIT
				MIN. [d]	TYP. [c]	MAX. [d]	
Analog Switch							
Analog signal range [a]	V_{ANALOG}		Full	0	-	12	V
Drain-source on-resistance	$R_{DS(on)}$	V+ = 10.8 V, V- = 0 V, $I_{NO/NC}$ = 5 mA, V_{COM} = 2 V / 9 V	Room	-	1.7	2.7	Ω
			Full	-	-	3.2	
Switch off leakage current [g]	$I_{NO/NC(off)}$	V_{COM} = 1 V / 11 V, $V_{NO/NC}$ = 11 V / 1 V	Room	-1	± 0.004	1	nA
			Full	-10	± 1.06	10	
	$I_{COM(off)}$		Room	-1	± 0.004	1	
			Full	-10	± 0.23	10	
Channel-on leakage current [g]	$I_{COM(on)}$	$V_{NO/NC}$ = V_{COM} = 11 V / 1 V	Room	-1	± 0.002	1	
			Full	-10	± 0.454	10	
Digital Control							
Input current, V_{IN} low	I_{IL}	V_{IN} under test = 0.8 V	Full	-1	0.001	1	µA
Input current, V_{IN} high	I_{IH}	V_{IN} under test = 2.4 V	Full	-1	0.001	1	
Dynamic Characteristics							
Turn-on time [e]	t_{ON}	R_L = 300 Ω, C_L = 35 pF, V_S = 5 V	Room	-	28	36	ns
			Full	-	-	41	
Turn-off time [e]	t_{OFF}		Room	-	12	20	
			Full	-	-	22	
Charge injection [e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	-	19	-	pC
Bandwidth [e]	BW	R_L = 50 Ω, C_L = 5 pF	Room	-	161	-	MHz
Off-isolation [e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-58	-	dB
Source off capacitance [e]	$C_{NO/NC(off)}$	f = 1 MHz	Room	-	34	-	pF
Drain off capacitance [e]	$C_{COM(off)}$		Room	-	36	-	
Channel on capacitance [e]	$C_{COM(on)}$		Room	-	68	-	
Power Supplies							
Positive supply current	I+	V_{IN} = 0 V or 12 V	Room	-	0.001	1	µA
			Full	-	-	5	
Negative supply current	I-		Room	-1	-0.001	-	
			Full	-5	-	-	
Ground current	I_{GND}		Room	-1	-0.001	-	
			Full	-5	-	-	

For technical questions, contact: powerictechsupport@vishay.com

SPECIFICATIONS [a] (Dual supply ± 5 V)

PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 5 V, V- = -5 V, V_{IN} = 2.4 V, 0.8 V [f]	TEMP. [b]	LIMITS -40 °C to +85 °C MIN. [d]	TYP. [c]	MAX. [d]	UNIT
Analog Switch							
Analog signal range [e]	V_{ANALOG}		Full	-5	-	5	V
Drain-source on-resistance	$R_{DS(on)}$	V+ = 5 V, V- = 5 V $I_{NO/NC}$ = 5 mA, V_{COM} = ± 3.5 V	Room	-	1.9	2.9	Ω
			Full	-	-	3.4	
Switch off leakage current [g]	$I_{NO/NC(off)}$	V+ = 5.5 V, V- = 5.5 V V_{COM} = ± 4.5 V, $V_{NO/NC}$ = ∓ 4.5 V	Room	-1	± 0.004	1	nA
			Full	-10	± 1.012	10	
	$I_{COM(off)}$		Room	-1	± 0.003	1	
			Full	-10	± 0.188	10	
Channel-on leakage current [g]	$I_{COM(on)}$	V+ = 5.5 V, V- = -5.5 V $V_{NO/NC}$ = V_{COM} = ± 4.5 V	Room	-1	± 0.002	1	
			Full	-10	± 0.425	10	
Digital Control							
Input current, V_{IN} low [e]	I_{IL}	V_{IN} under test = 0.8 V	Full	-1	0.001	1	µA
Input current, V_{IN} high [e]	I_{IH}	V_{IN} under test = 2.4 V	Full	-1	0.001	1	
Dynamic Characteristics							
Turn-on time	t_{ON}	R_L = 300 Ω, C_L = 35 pF, V_S = ± 3.5 V	Room	-	39	54	ns
			Full	-	-	62	
Turn-off time	t_{OFF}		Room	-	28	33	
			Full	-	-	42	
Charge injection [e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	-	57	-	pC
Bandwidth [e]	BW	R_L = 50 Ω, C_L = 5 pF	Room	-	179	-	MHz
Off-isolation [e]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-58	-	dB
Source off capacitance [e]	$C_{NO/NC(off)}$	f = 1 MHz	Room	-	34	-	pF
Drain off capacitance [e]	$C_{COM(off)}$		Room	-	36	-	
Channel on capacitance [e]	$C_{COM(on)}$		Room	-	68	-	
Power Supplies							
Positive supply current [e]	I+	V_{IN} = 0 V or 5 V	Room	-	0.001	1	µA
			Full	-	-	5	
Negative supply current [e]	I-		Room	-1	-0.001	-	
			Full	-5	-	-	
Ground current [e]	I_{GND}		Room	-1	-0.001	-	
			Full	-5	-	-	

## SPECIFICATIONS [a] (Single supply 5 V)

PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 5 V, V- = 0 V, V_{IN} = 2.4 V, 0.8 V [f]	TEMP. [b]	LIMITS -40 °C to +85 °C			UNIT
				MIN. [d]	TYP. [c]	MAX. [d]	
Analog Switch							
Analog signal range [e]	V_{ANALOG}		Full	0	-	5	V
Drain-source on-resistance	$R_{DS(on)}$	V+ = 4.5 V, $I_{NO/NC}$ = 5 mA, V_{COM} = 1 V, 3.5 V	Room	-	3.04	5.4	Ω
			Full	-	-	7	
Dynamic Characteristics							
Turn-on time [e]	t_{ON}	R_L = 300 Ω, C_L = 35 pF, V_S = 3.5 V	Room	-	57	82	ns
			Hot	-	-	95	
Turn-off time [e]	t_{OFF}		Room	-	24	34	
			Hot	-	-	40	
Charge injection [e]	Q	V_g = 0 V, R_g = 0 Ω, C_L = 1 nF	Room	-	12	-	pC
Power Supplies							
Positive supply current [e]	I+	V_{IN} = 0 V or 5 V	Room	-	0.001	1	µA
			Hot	-	-	5	
Negative supply current [e]	I-		Room	-1	-0.001	-	
			Hot	-5	-	-	
Ground current [e]	I_{GND}		Room	-1	-0.001	-	
			Hot	-5	-	-	

SPECIFICATIONS [a] (Single supply 3 V)

PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V+ = 3$ V, $V- = 0$ V, $V_{IN} = 2.4$ V, 0.4 V [f]	TEMP. [b]	LIMITS -40 °C to +85 °C MIN. [d]	TYP. [c]	MAX. [d]	UNIT
Analog Switch							
Analog signal range [e]	V_{ANALOG}		Full	0	-	3	V
Drain-source on-resistance	$R_{DS(on)}$	$V+ = 2.7$ V, $V- = 0$ V $I_{NO/NC} = 5$ mA, $V_{COM} = 0.5$ V, 2.2 V	Room	-	7.3	11.5	Ω
			Full	-	-	18	
Switch off leakage current [g]	$I_{NO/NC(off)}$	$V+ = 3.3$ V, $V- = 0$ V $V_{NO/NC} = 1$ V, 2 V, $V_{COM} = 2$ V, 1 V	Room	-1	± 0.003	1	nA
			Full	-10	± 0.9	10	
	$I_{COM(off)}$		Room	-1	± 0.0008	1	
			Full	-10	± 0.042	10	
Channel-on leakage current [g]	$I_{COM(on)}$	$V+ = 3.3$ V, $V- = 0$ V $V_{COM} = V_{NO/NC} = 1$ V, 2 V	Room	-1	± 0.0014	1	
			Full	-10	± 0.41	10	
Digital Control							
Input current, V_{IN} low [e]	I_{IL}	V_{IN} under test = 0.4 V	Full	-1	0.001	1	µA
Input current, V_{IN} high [e]	I_{IH}	V_{IN} under test = 2.4 V	Full	-1	0.001	1	
Dynamic Characteristics							
Turn-on time	t_{ON}	$R_L = 300$ Ω, $C_L = 35$ pF, $V_S = 1.5$ V	Room	-	124	215	ns
			Full	-	-	222	
Turn-off time	t_{OFF}		Room	-	58	101	
			Full	-	-	106	
Charge injection [e]	Q	$V_g = 0$ V, $R_g = 0$ Ω, $C_L = 1$ nF	Room	-	6	-	pC
Off-isolation [e]	OIRR	$R_L = 50$ Ω, $C_L = 5$ pF, $f = 1$ MHz	Room	-	-58	-	dB
Source off capacitance [e]	$C_{NO/NC(off)}$		Room	-	36	-	pF
Drain off capacitance [e]	$C_{COM(off)}$	$f = 1$ MHz	Room	-	38	-	
Channel on capacitance [e]	$C_{COM(on)}$		Room	-	70	-	

Notes

a. Refer to PROCESS OPTION FLOWCHART

b. Room = 25 °C, full = as determined by the operating temperature suffix

c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing

d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet

e. Guaranteed by design, not subject to production test

f. V_{IN} = input voltage to perform proper function

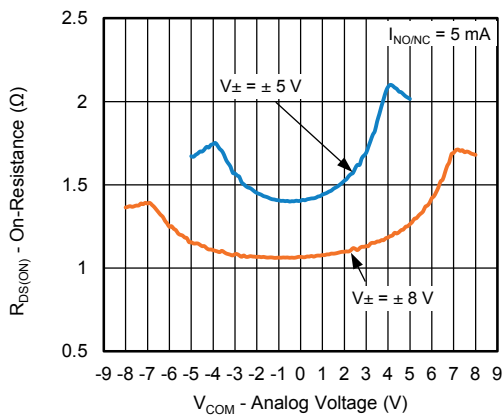g. Leakage parameters are guaranteed by worst case test conditions and not subject to test
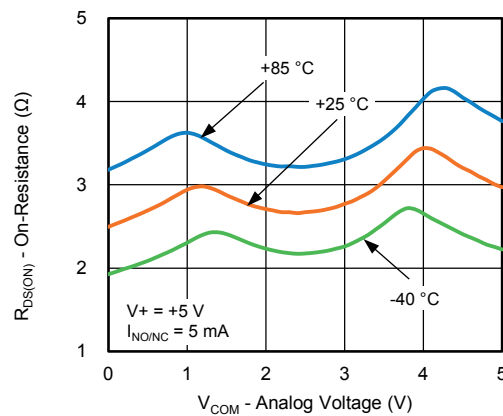
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)
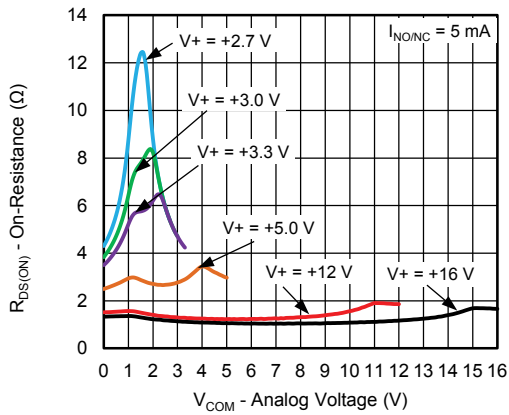
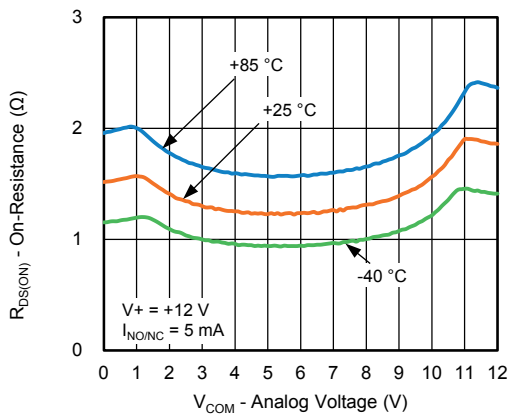R$_{ON}$ vs. V$_{COM}$ and Single Supply Voltage
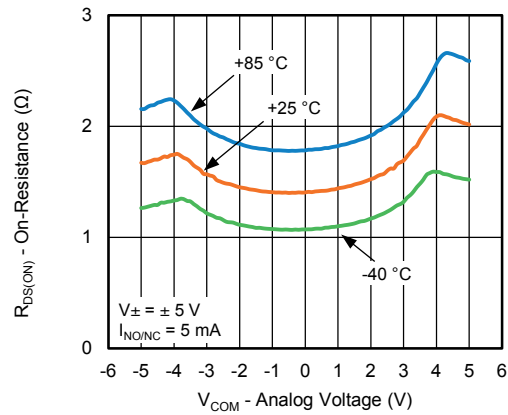
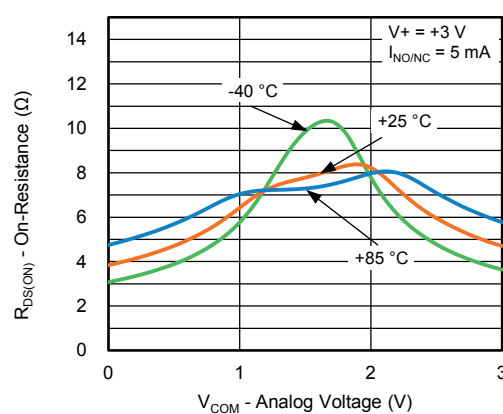R$_{DS(on)}$ vs. Analog Voltage and Temperature

R$_{ON}$ vs. V$_{COM}$ and Dual Supply Voltage

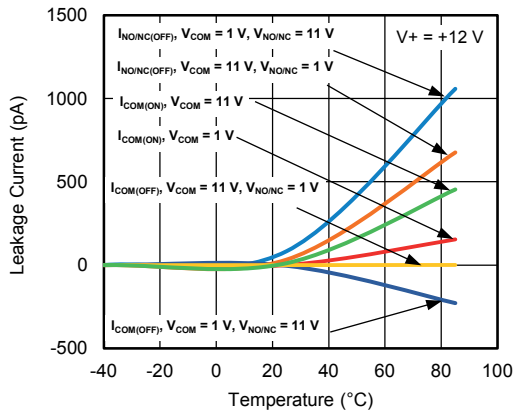R$_{DS(on)}$ vs. Analog Voltage and Temperature

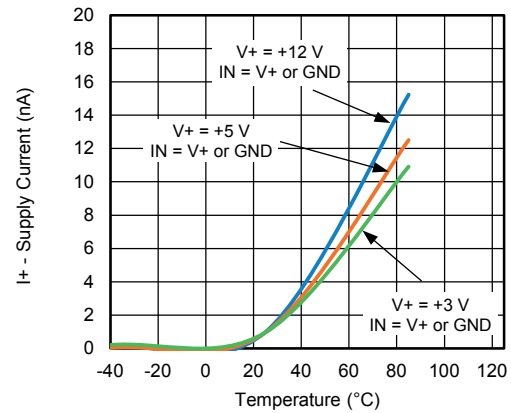R$_{DS(on)}$ vs. Analog Voltage and Temperature
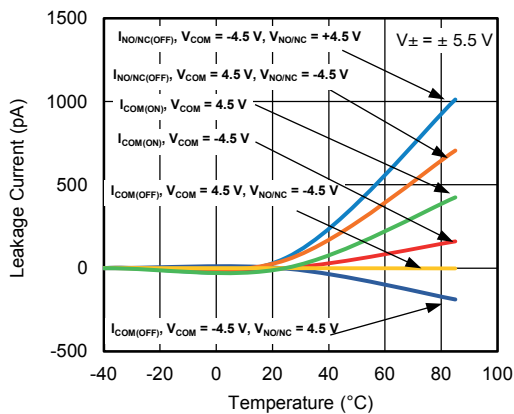

R$_{DS(on)}$ vs. Analog Voltage and Temperature

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TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Leakage Current vs. Temperature

Supply Current vs. Temperature

Leakage Current vs. Temperature
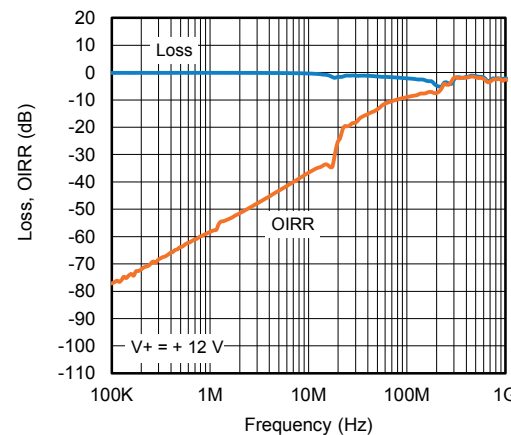
Insertion Loss, Off-Isolation vs. Frequency
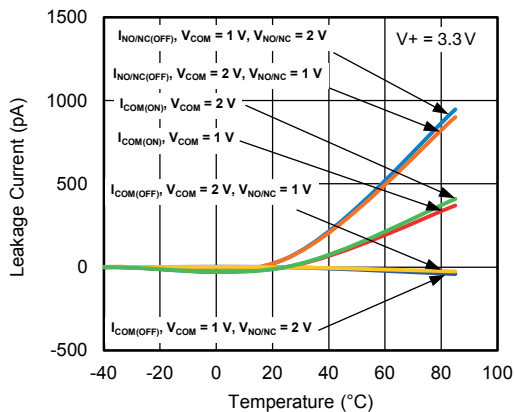
Leakage Current vs. Temperature
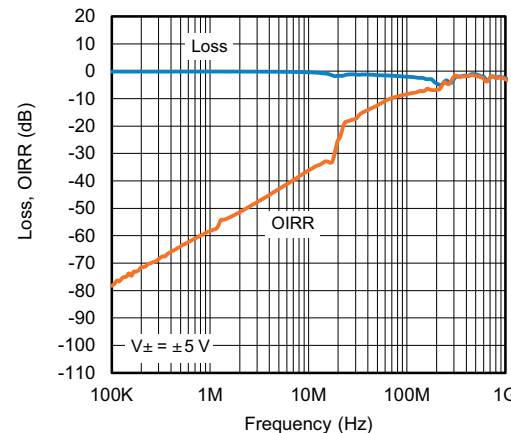
Insertion Loss, Off-Isolation vs. Frequency

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)
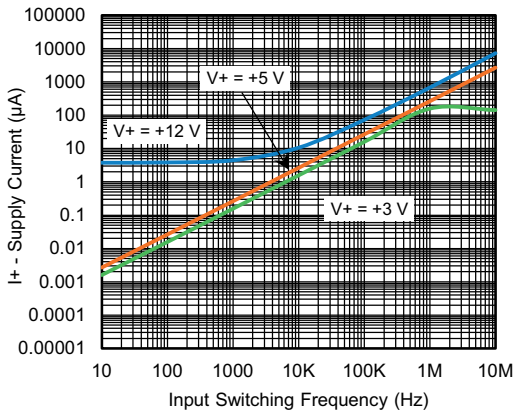
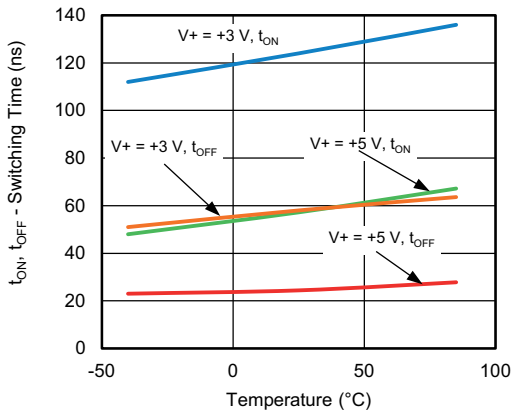**Supply Current vs. Input Switching Frequency**
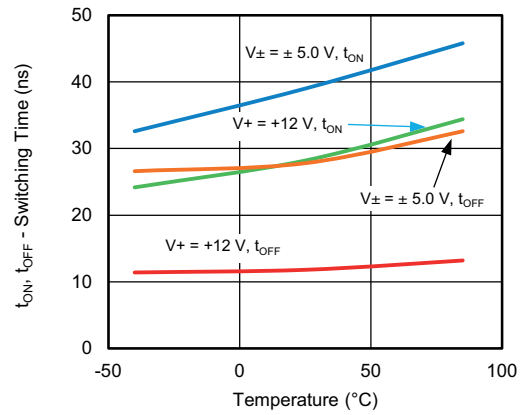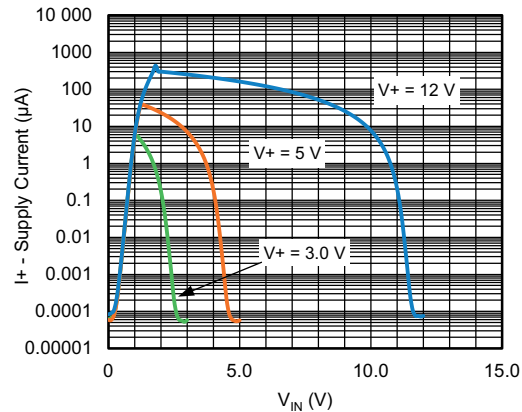

Switching Time vs. Temperature
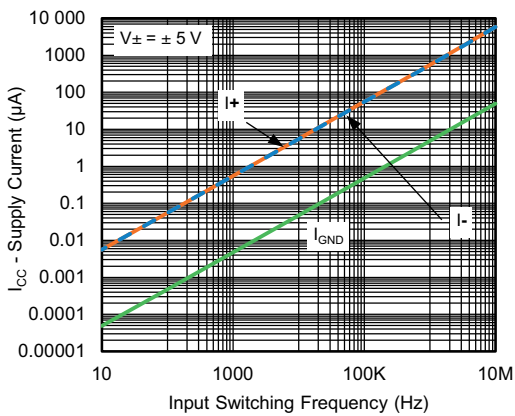
Supply Current vs. Input Switching Frequency
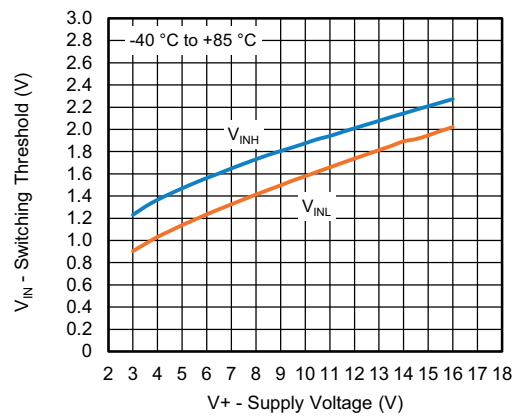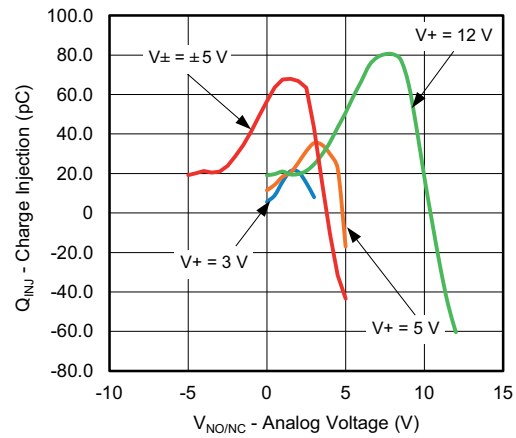

Switching Threshold vs. Supply Voltage

Switching Time vs. Temperature

Supply Current vs. Enable Input Voltage

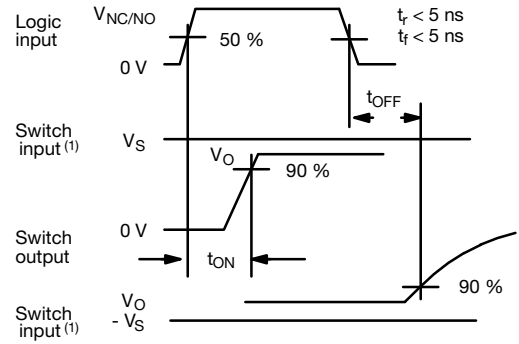For technical questions, contact: powerictechsupport@vishay.com

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Charge Injection vs. Analog Voltage

SCHEMATIC DIAGRAM (typical channel)

DG9421E, DG9422E

Vishay Siliconix
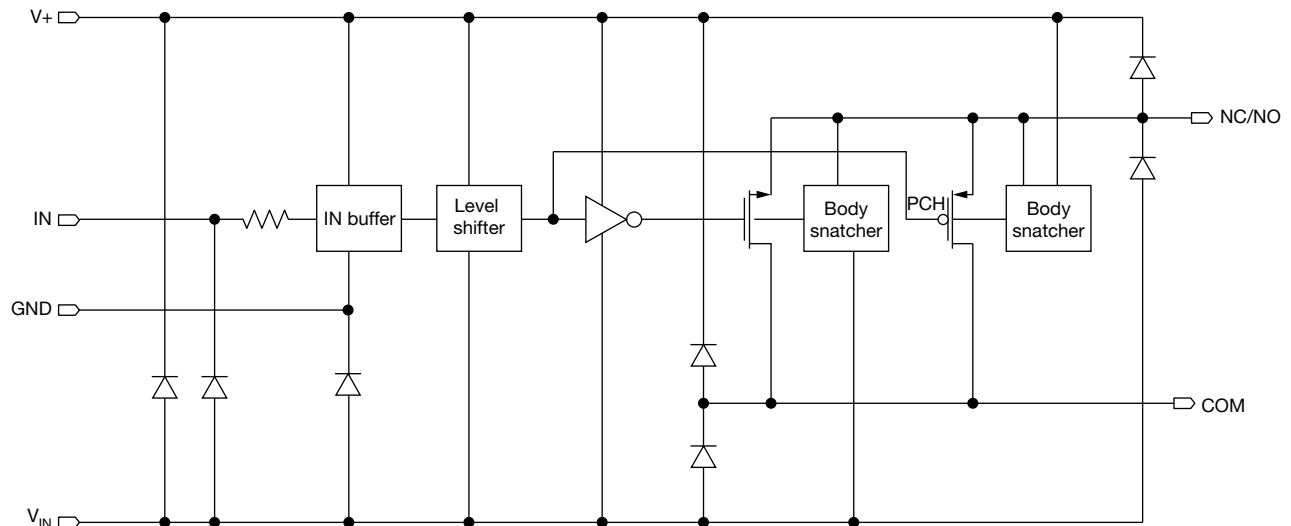
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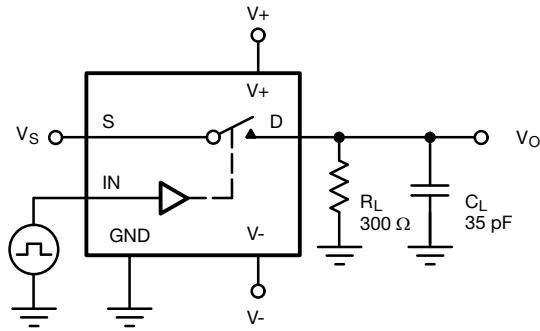
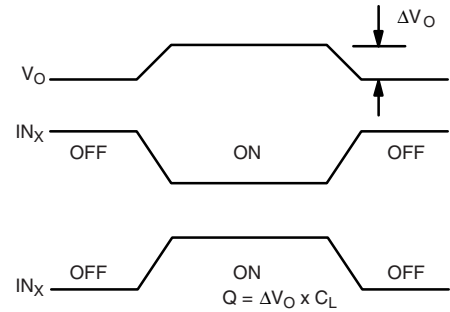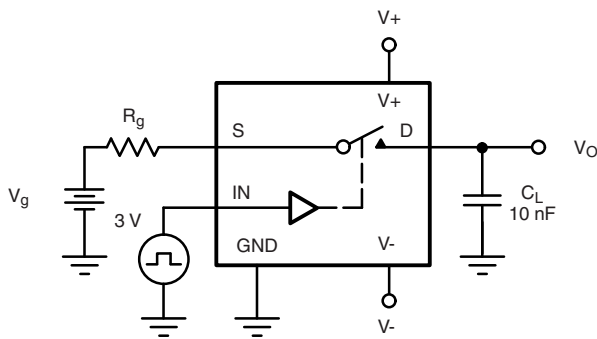C_L (includes fixture and stray capacitance)
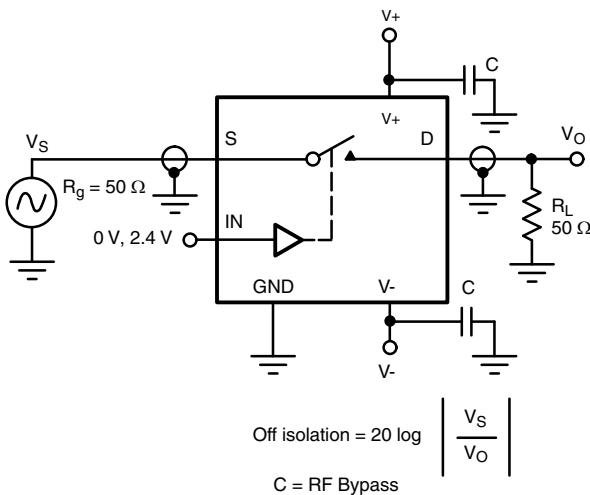
$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$

Note
[1] Logic input waveform is inverted for switches that have the opposite logic sense control

Fig. 1 - Switching Time

$Q = \Delta V_O \times C_L$

IN_X dependent on switch configuration Input polarity determined by sense of switch.

Fig. 2 - Charge Injection

Off isolation = $20 \log \left| \dfrac{V_S}{V_O} \right|$

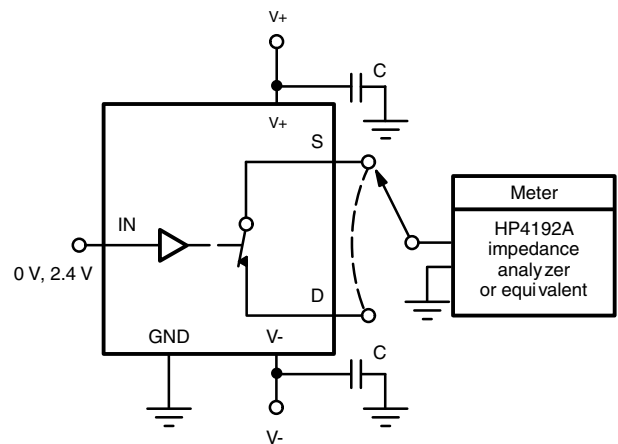C = RF Bypass

Fig. 3 - Off Isolation

**Fig. 4 - Source/Drain Capacitances**

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?75411.
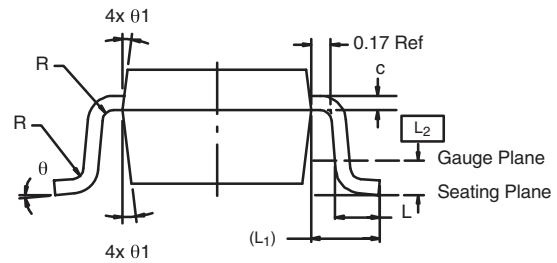
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JEDEC Part Number: MO-193C
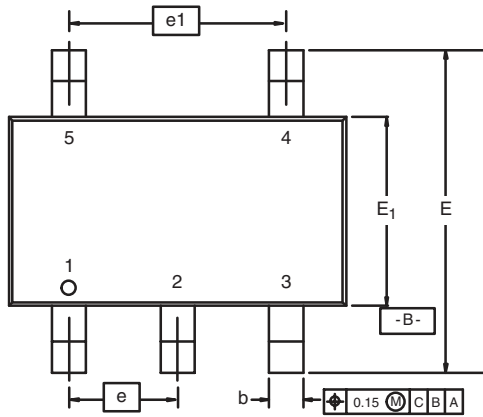
5-LEAD TSOP
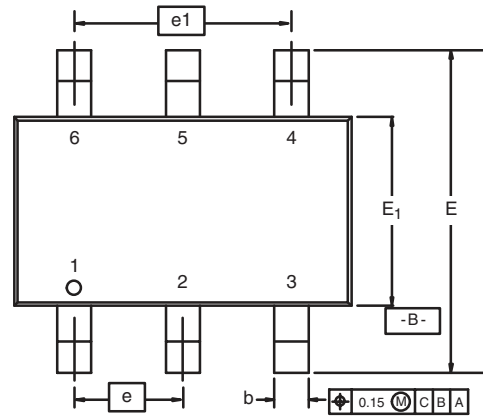
6-LEAD TSOP
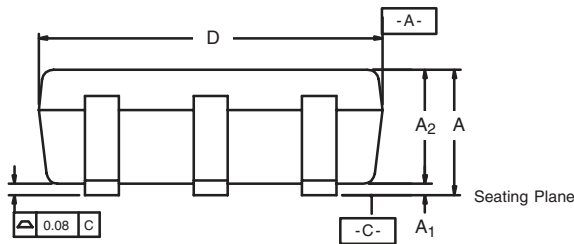
Dim	MILLIMETERS			INCHES		
	Min	**Nom**	**Max**	**Min**	**Nom**	**Max**
A	0.91	-	1.10	0.036	-	0.043
A$_1$	0.01	-	0.10	0.0004	-	0.004
A$_2$	0.90	-	1.00	0.035	0.038	0.039
b	0.30	0.32	0.45	0.012	0.013	0.018
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.95	3.05	3.10	0.116	0.120	0.122
E	2.70	2.85	2.98	0.106	0.112	0.117
E$_1$	1.55	1.65	1.70	0.061	0.065	0.067
e	0.95 BSC			0.0374 BSC		
e$_1$	1.80	1.90	2.00	0.071	0.075	0.079
L	0.32	-	0.50	0.012	-	0.020
L$_1$	0.60 Ref			0.024 Ref		
L$_2$	0.25 BSC			0.010 BSC		
R	0.10	-	-	0.004	-	-
θ	0°	4°	8°	0°	4°	8°
θ$_1$	7° Nom			7° Nom		
ECN: C-06593-Rev. I, 18-Dec-06 DWG: 5540						

Recommended Land Pattern For TSOP-5L / TSOP-6L

TSOP 5L

TSOP 6L

0.095 [2.408]	
0.136 [3.444]	0.064 [1.626]
0.037 [0.950]	0.036 [0.922]
0.020 [0.508]	0.017 [0.442]
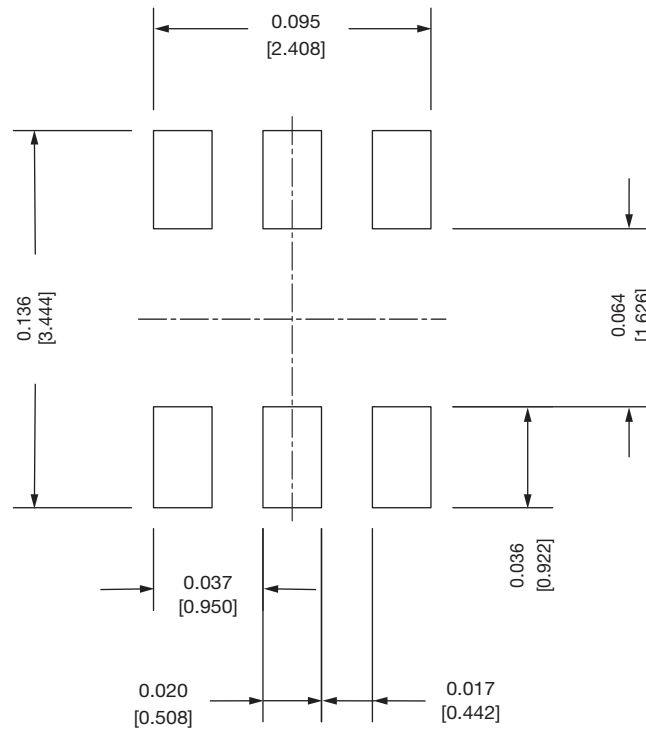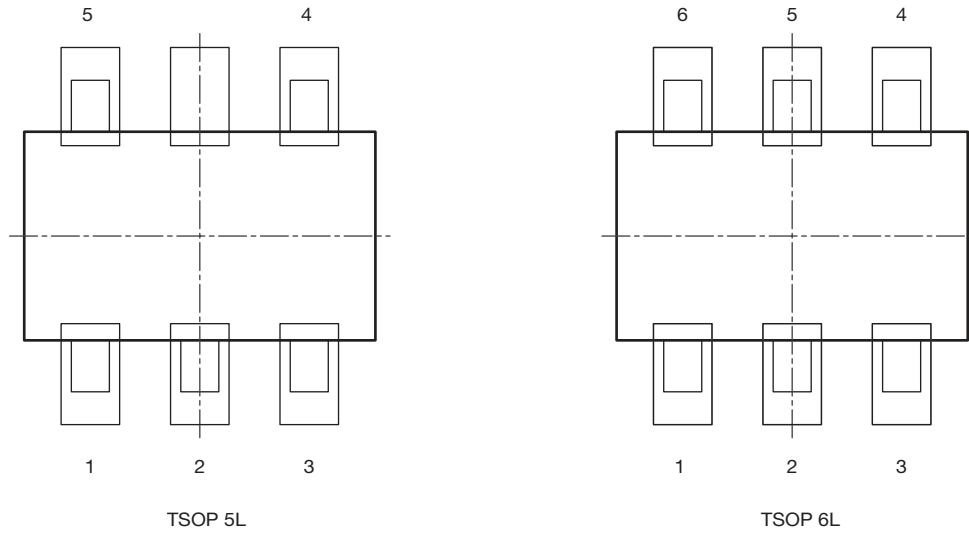
Note

- All dimensions are in inches (millimeter)

ECN: C22-0860-Rev. B, 24-Oct-2022
DWG: 3010

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