2.5 Ω, High Bandwidth, Dual SPDT Analog Switch

DESCRIPTION

The DG2032E is a low-voltage dual single-pole / double-throw monolithic CMOS analog switch. Designed to operate from 1.8 V to 5.5 V power supply, the DG2032E achieves a bandwidth of 221 MHz while providing low on-resistance (2.5 Ω), excellent on-resistance matching (0.4 Ω) and flatness (1 Ω) over the entire signal range.

The DG2032E offers the advantage of high linearity that reduces signal distortion, making ideal for audio, video, and USB signal routing applications.

Built on Vishay Siliconix's proprietary sub-micron high-density process, the DG2032E brings low power consumption at the same time as reduces PCB spacing with the QFN12 package.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. The QFN12 package has a nickel-palladium-gold device termination and is represented by the lead (Pb)-free "-GE4" suffix. The nickel-palladium-gold device terminations meet all JEDEC® standards for reflow and MSL ratings.

FEATURES

- 1.8 V to 5.5 V single supply operation
- Low R_{ON}: 2.5 Ω at 4.5 V
- 221 MHz, -3 dB bandwidth
- Low off-isolation, -63 dB at 1 MHz
- +1.6 V logic compatible
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

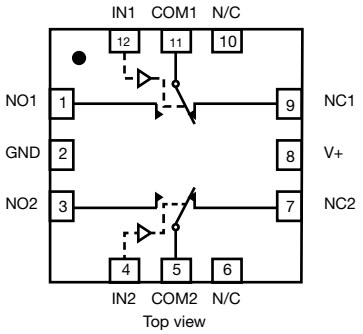
BENEFITS

- High linearity
- Low power consumption
- High bandwidth
- Full rail signal swing range

APPLICATIONS

- USB / UART signal switching
- Audio / video switching
- Cellular phone
- Media players
- Modems
- Hard drives
- PCMCIA

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Top view

TRUTH TABLE

LOGIC	NC1 AND NC2	NO1 AND NO2
0	ON	OFF
1	OFF	ON

ORDERING INFORMATION

TEMP. RANGE	PACKAGE	PART NUMBER
-40 °C to +85 °C	12-Pin QFN (3 mm x 3 mm)	DG2032EDN-T1-GE4

ABSOLUTE MAXIMUM RATINGS

PARAMETER		LIMIT	UNIT
Reference to GND			
V+		-0.3 to +6	V
IN, COM, NC, NO [a]		-0.3 to (V+ + 0.3)	
Continuous current (any terminal)		± 50	mA
Peak current (pulsed at 1 ms, 10 % duty cycle)		± 200	
Storage temperature (D suffix)		-65 to +150	°C
Power dissipation (packages) [b]	12-Pin QFN (3 mm x 3 mm) [c]	1295	mW
ESD / HBM	EIA / JESD22-A114-A	7.5k	V
ESD / CDM	EIA / JESD22-C101-A	1.5k	
Latch up	JESD78	300	mA

Notes

a. Signals on NC, NO, or COM or IN exceeding 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 4 mW/°C above 70 °C

SPECIFICATIONS (V+ = 3 V)

PARAMETER	SYMBOL	TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 3 V, ± 10 %, V_{INL} = 0.5 V, V_{INH} = 1.5 V [e]	TEMP. [a]	LIMITS -40 °C to +85 °C MIN. [c]	TYP. [b]	MAX. [c]	UNIT
Analog Switch							
Analog signal range [d]	V_{ANALOG}		Full	0	-	V+	V
Drain-source on-resistance	$R_{DS(on)}$	V+ = 1.8 V, $V_{NC/NO}$ = 0.4 V / V+, $I_{NC/NO}$ = 8 mA	Room	-	7	11	Ω
			Full	-	-	13	
		V+ = 2.7 V, V_{COM} = 0.8 V / 1.8 V, I_{COM} = 10 mA	Room	-	4.6	5.5	
			Full	-	-	6.5	
On-resistance matching	$\Delta R_{DS(on)}$	V+ = 2.7 V, V_{COM} = 0.8 V / 1.4 V / 1.8 V, I_{COM} = 10 mA	Room	-	0.02	0.3	
			Full	-	-	0.6	
On-resistance flatness [d, f]	$R_{flat(on)}$		Room	-	0.62	1	
			Full	-	-	1.5	
Off leakage current [g]	$I_{NC/NO(off)}$	V+ = 3.6 V, $V_{NC/NO}$ = 1 V / 3.2 V, V_{COM} = 3.2 V / 1 V	Room	-1	0.01	1	nA
			Full	-5	-	5	
Channel-on leakage current [g]	$I_{COM(on)}$	V+ = 3.3 V, V_{COM} = $V_{NC/NO}$ = 1 V / 3.2 V	Room	-1	0.01	1	
			Full	-5	-	5	
Digital Control							
Input current [d]	I_{INL} or I_{INH}		Full	-1	-	1	µA
Input high voltage [d]	V_{INH}		Full	1.5	-	-	V
Input low voltage [d]	V_{INL}		Full	-	-	0.4	
Digital input capacitance [d]	C_{IN}		Room	-	3	-	pF
Dynamic Characteristics							
Turn-on time	t_{ON}	$V_{NC/NO}$ = 3 V, C_L = 35 pF, R_L = 300 Ω	Room	-	19	45	ns
			Full	-	-	50	
Turn-off time	t_{OFF}		Room	-	9	35	
			Full	-	-	45	
Break-before-make time [d]	t_{BBM}		Room	4	11	-	
			Full	3	-	-	
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{gen} = 1.5 V, R_{gen} = 0 Ω	Room	-	-9	-	pC
Bandwidth [d]	BW	C_L = 5 pF (set up capacitance)	Room	-	226	-	MHz
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-65	-	dB
		R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room	-	-39	-	
Channel-to-channel crosstalk [d]	X_{TALK}	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-65	-	
		R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room	-	-39	-	
NO, NC off capacitance [d]	$C_{NO(off)}$	V+ = 2.7 V, f = 1 MHz	Room	-	7	-	pF
	$C_{NC(off)}$		Room	-	7	-	
Channel-on capacitance [d]	$C_{NO(on)}$		Room	-	23	-	
	$C_{NC(on)}$		Room	-	23	-	
Power Supply							
Power supply range	V+			2.7	-	3.3	V
Power supply current [d]	I+	V+ = 2.7 V, V_{IN} = 0 V or 2.7 V	Full	-	-	1	µA

Notes

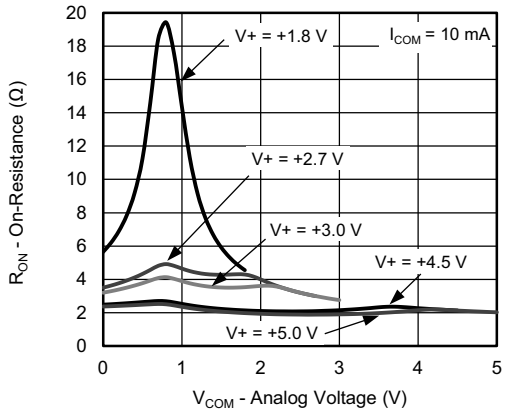
a. Room = 25 °C, Full = as determined by the operating suffix
b. Typical values are for design aid only, not guaranteed nor subject to production testing
c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
d. Guarantee by design, not subjected to production test
e. V_{IN} = input voltage to perform proper function
f. Difference of min. and max. values
g. Guaranteed by 5 V testing

SPECIFICATIONS (V+ = 5 V)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 5 V, ± 10 %, V_{INL} = 0.5 V, V_{INH} = 2 V [e]**	**TEMP. [a]**	**LIMITS -40 °C to +85 °C**			**UNIT**
				MIN. [c]	**TYP. [b]**	**MAX. [c]**	
Analog Switch							
Analog signal range [d]	V_{ANALOG}		Full	0	-	V+	V
Drain-source on-resistance	$R_{DS(on)}$	V+ = 4.5 V, V_{COM} = 0.8 V / 3.5 V; I_{COM} = 10 mA	Room	-	2.5	3.1	Ω
			Full	-	-	4	
On-resistance matching	$\Delta R_{DS(on)}$	V+ = 4.5 V, V_{COM} = 0.8 V / 2.5 V / 3.5 V, I_{COM} = 10 mA	Room	-	0.01	0.4	
			Full	-	-	0.6	
On-resistance flatness [d, f]	$R_{flat(on)}$		Room	-	0.61	1	
			Full	-	-	1.5	
Off leakage current [g]	$I_{NC/NO(off)}$	V+ = 5.5 V, $V_{NC/NO}$ = 1 V / 4.5 V, V_{COM} = 4.5 V / 1 V	Room	-2	0.15	2	nA
			Full	-10	-	10	
Channel-on leakage current [g]	$I_{COM(on)}$	V+ = 5.5 V, V_{COM} = $V_{NC/NO}$ = 1 V / 4.5 V	Room	-2	0.20	2	
			Full	-10	-	10	
Power down leakage [d]	I_{PD}	V+ = 0 V, V_{COM} = 5.5 V, NC/NO open	Full	-	0.01	5	µA
		V+ = 0 V, $V_{NC/NO}$ = 5.5 V, COM, open	Full	-	0.01	3	mA
Digital Control							
Input current [d]	I_{INL} or I_{INH}		Full	-1	-	1	µA
Input high voltage [d]	V_{INH}		Full	2	-	-	V
Input low voltage [d]	V_{INL}		Full	-	-	0.5	
Digital input capacitance [d]	C_{IN}		Room	-	3	-	pF
Dynamic Characteristics							
Turn-on time	t_{ON}	$V_{NC/NO}$ = 3 V, C_L = 35 pF, R_L = 300 Ω	Room	-	13	40	ns
			Full	-	-	43	
Turn-off time	t_{OFF}		Room	-	7	33	
			Full	-	-	35	
Break-before-make time [d]	t_{BBM}		Room	3	6	-	
			Full	2	-	-	
Propagation delay [d]	tpd	V+ = 5 V, no R_L	Room	-	380	-	ps
Charge injection [d]	Q_{INJ}	C_L = 1 nF, V_{gen} = 2.5 V, R_{gen} = 0 Ω	Room	-	-19.4	-	pC
Bandwidth [d]	BW	C_L = 5 pF (set up capacitance)	Room	-	221	-	MHz
Off-isolation [d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-63	-	dB
		R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room	-	-22	-	
Channel-to-channel crosstalk [d]	X_{TALK}	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room	-	-65	-	
		R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room	-	-40	-	
NO, NC off capacitance [d]	$C_{NO(off)}$	V+ = 5 V, f = 1 MHz	Room	-	7	-	pF
	$C_{NC(off)}$		Room	-	7	-	
Channel-on capacitance [d]	$C_{NO(on)}$		Room	-	23	-	
	$C_{NC(on)}$		Room	-	23	-	
Power Supply							
Power supply range	V+			4.5	-	5.5	V
Power supply current [d]	I+	V+ = 5.5 V, V_{IN} = 0 V or 5.5 V	Full	-	-	1	µA

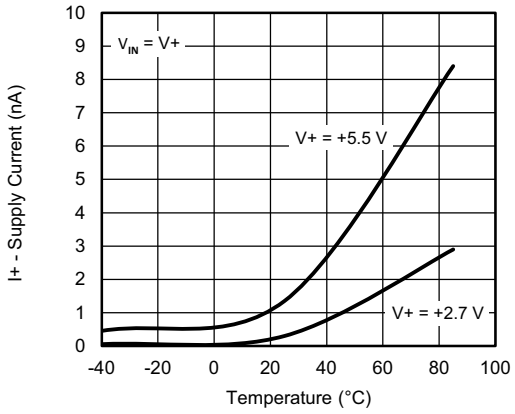
Notes
a. Room = 25 °C, Full = as determined by the operating suffix
b. Typical values are for design aid only, not guaranteed nor subject to production testing
c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
d. Guarantee by design, not subjected to production test
e. V_{IN} = input voltage to perform proper function
f. Difference of min. and max. values
g. Guaranteed by 5 V testing

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.

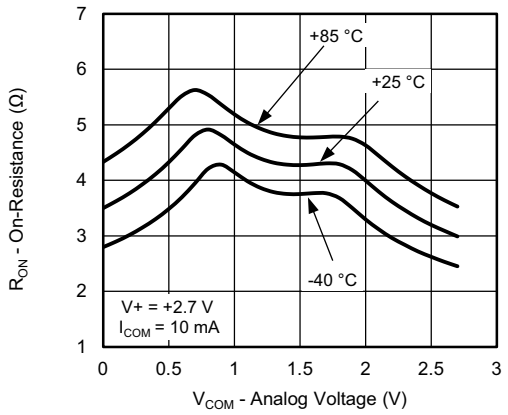
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



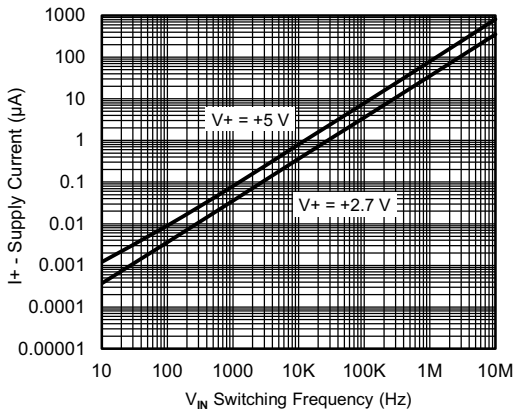
R_{ON} vs. V_{COM} and Single Supply Voltage



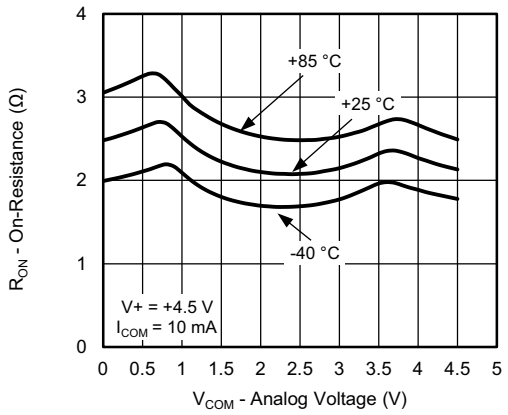
Supply Current vs. Temperature



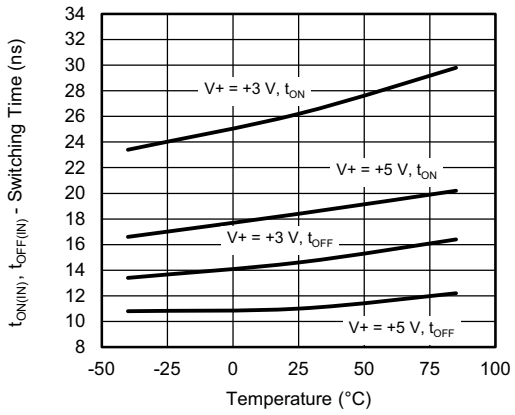
R_{ON} vs. Analog Voltage and Temperature



Positive Supply Current vs. Switching Frequency

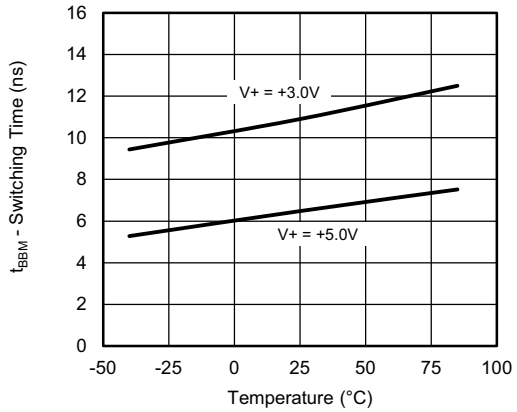


R_{ON} vs. Analog Voltage and Temperature

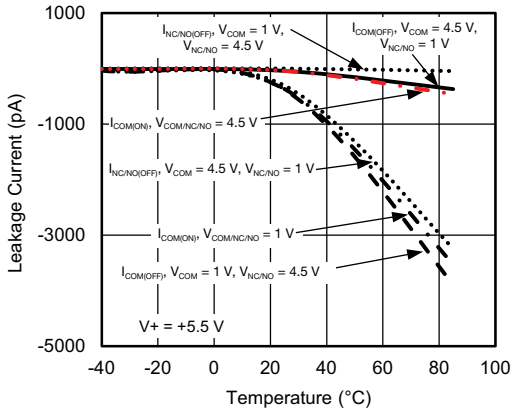


Switching Time vs. Temperature

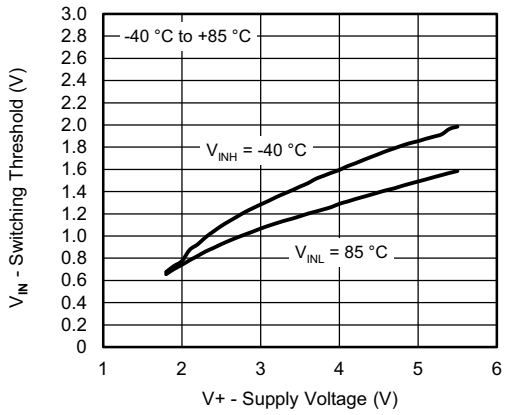
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



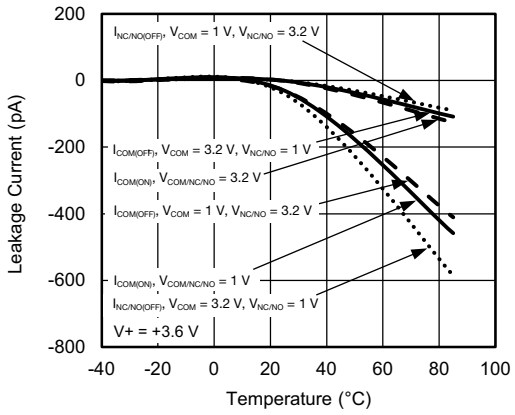
Switching Time vs. Temperature



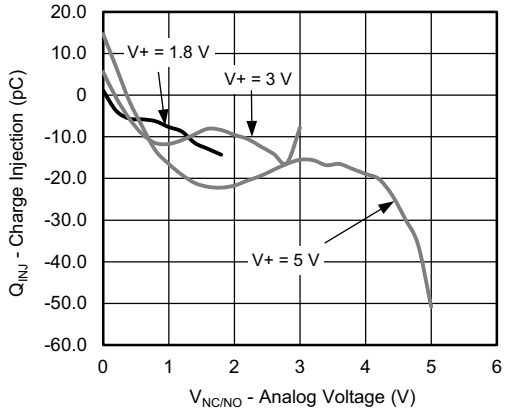
Leakage Current vs. Temperature



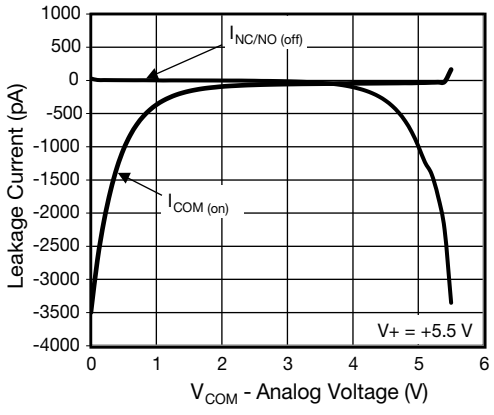
Switching Threshold vs. Supply Voltage



Leakage Current vs. Temperature

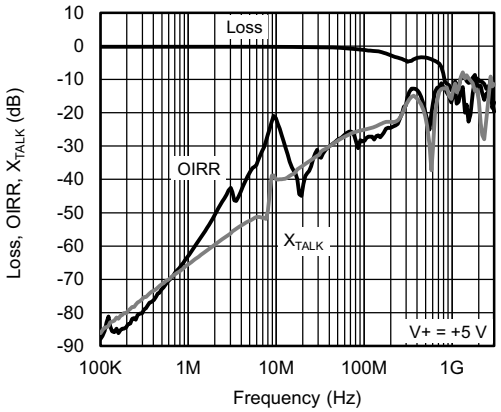


Charge Injection vs. Source Voltage



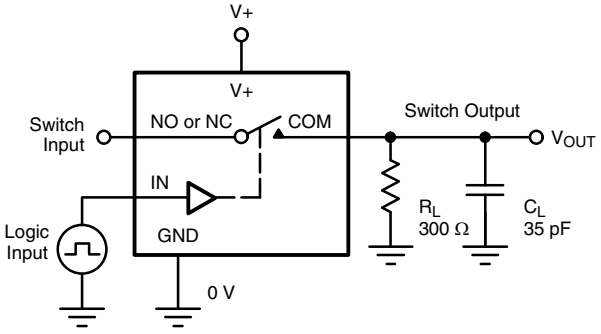
Leakage Current vs. Analog Voltage

TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



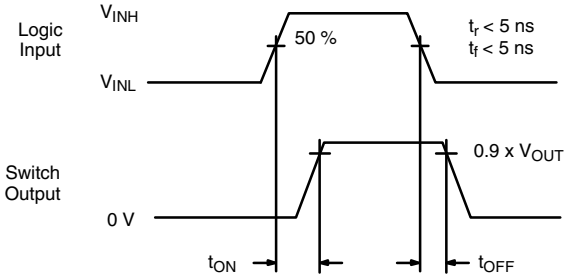
Loss, OIRR, X_{TALK} vs. Frequency

TEST CIRCUITS



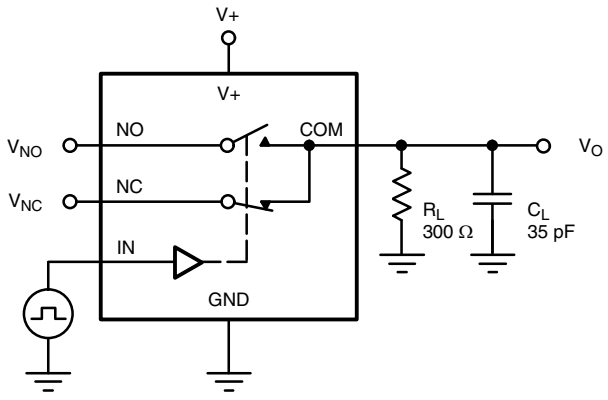
C_L (includes fixture and stray capacitance)

$$V_{OUT} = V_{COM}\left(\frac{R_L}{R_L + R_{ON}}\right)$$



Logic "1" = Switch On
Logic input waveforms inverted for switches that have the opposite logic sense.

Fig. 1 - Switching Time



C_L (includes fixture and stray capacitance)

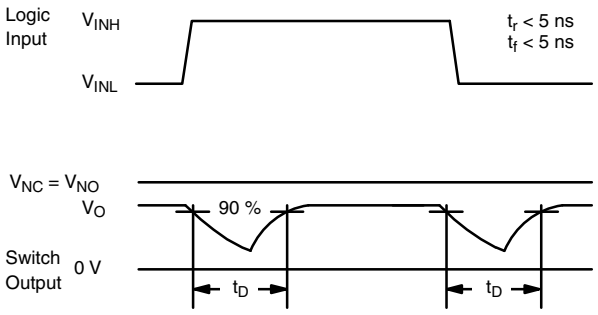
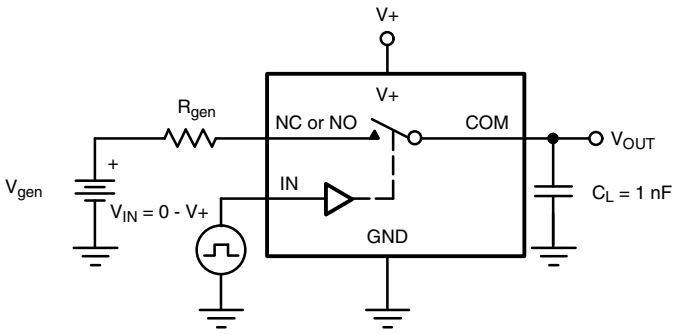
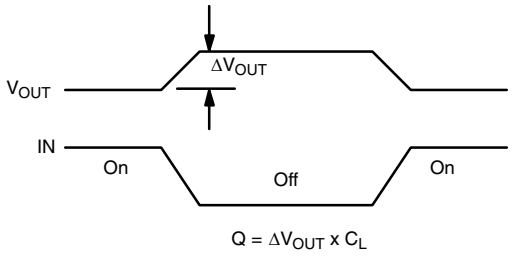


Fig. 2 - Break-Before-Make Interval

TEST CIRCUITS





IN depends on switch configuration: input polarity determined by sense of switch.

Fig. 3 - Charge Injection

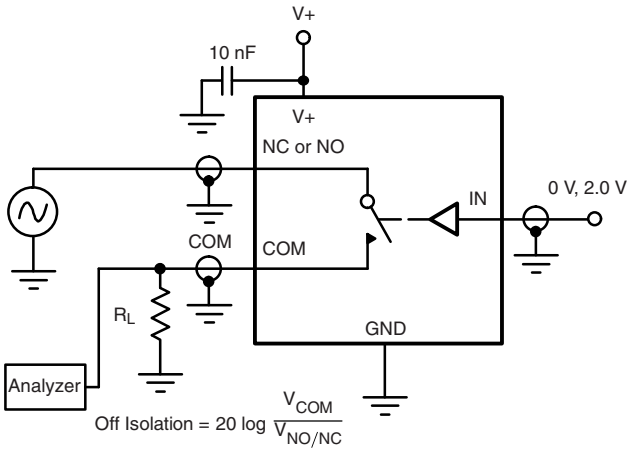


Fig. 4 - Off-Isolation

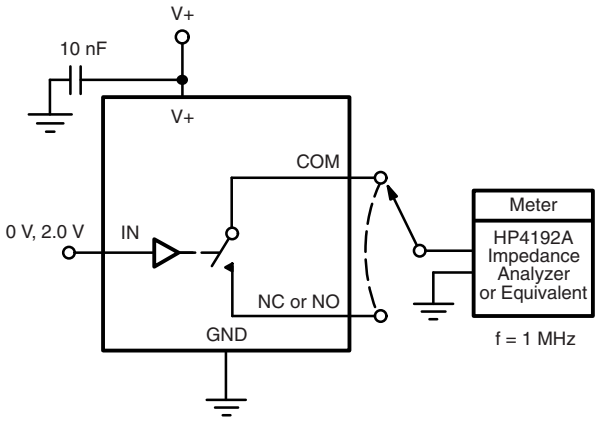


Fig. 5 - Channel Off / On Capacitance

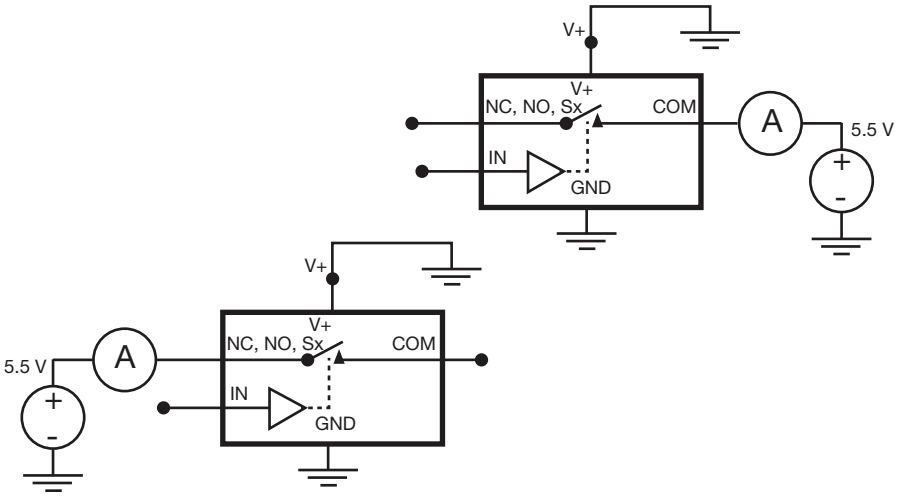
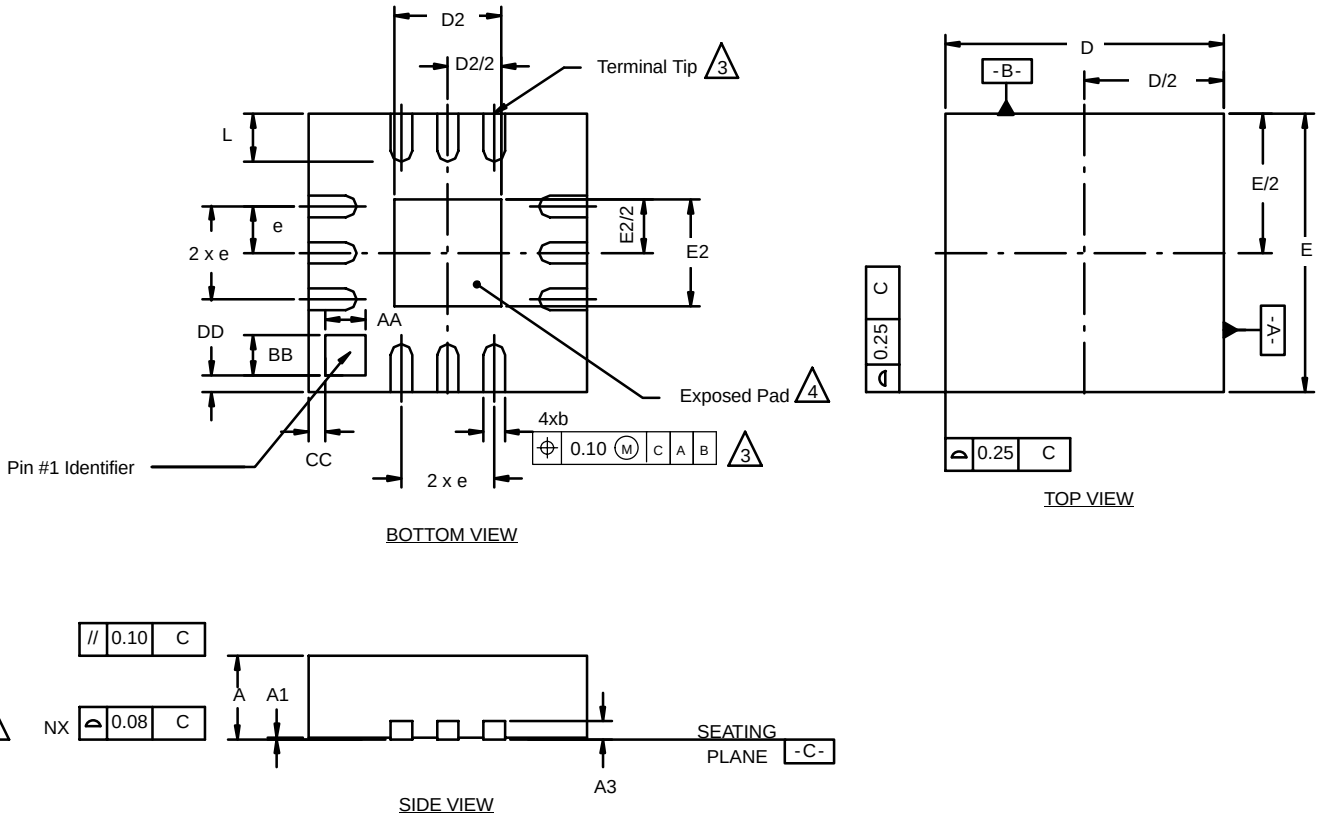


Fig. 6 - Source / Drain Power Down Leakage

PRODUCT SUMMARY	
Part number	DG2032E
Status code	2
Configuration	SPDT x 2
Single supply min. (V)	1.8
Single supply max. (V)	5.5
Dual supply min. (V)	-
Dual supply max. (V)	-
On-resistance (Ω)	2.5
Charge injection (pC)	-19
Source on capacitance (pF)	23
Source off capacitance (pF)	7
Leakage switch on typ. (nA)	0.01
Leakage switch off max. (nA)	1
-3 dB bandwidth (MHz)	226
Package	QFN-12 3 x 3
Functional circuit / applications	Multi purpose, instrumentation, medical and healthcare, portable
Interface	Binary
Single supply operation	Yes
Dual supply operation	-
Turn on time max. (ns)	45
Crosstalk and off isolation (dB)	44

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?78604.

QFN-12 LEAD (3 X 3)



NOTES:

1. All dimensions are in millimeters.
2. N is the total number of terminals.
3. Dimension b applies to metallized terminal and is measured between 0.25 and 0.30 mm from terminal tip.
4. Coplanarity applies to the exposed heat sink slug as well as the terminal.
5. The pin #1 identifier may be either a mold or marked feature, it must be located within the zone iindicated.

Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.80	0.90	1.00	0.032	0.035	0.039
b	0.18	0.23	0.30	0.007	0.009	0.012
D		3.00 BSC			0.118 BSC	
D2	1.00	1.15	1.25	0.039	0.045	0.049
E		3.00 BSC			0.118 BSC	
E2	1.00	1.15	1.25	0.039	0.045	0.049
e		0.50 BSC			0.02 BSC	
L	0.45	0.55	0.65	0.018	0.022	0.026
AA		0.435			0.017	
BB		0.435			0.017	
CC		0.18			0.007	
DD		0.18			0.007	

ECN: C-03092—Rev. A, 14-Apr-03
DWG: 5898

Disclaimer

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