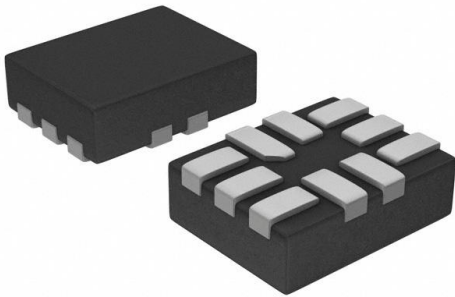


NL3HS2222MUTBG Datasheet

www.digi-electronics.com



<https://www.DiGi-Electronics.com>

DiGi Electronics Part Number	NL3HS2222MUTBG-DG
Manufacturer	onsemi
Manufacturer Product Number	NL3HS2222MUTBG
Description	IC USB 2.0 SWITCH DPDT UQFN10
Detailed Description	USB Switch IC 1 Channel 10-UQFN (1.4x1.8)



Tel: +00 852-30501935

RFQ Email: Info@DiGi-Electronics.com

DiGi is a global authorized distributor of electronic components.

Purchase and inquiry

Manufacturer Product Number:

NL3HS2222MUTBG

Series:

-

Applications:

USB

Switch Circuit:

DPDT

On-State Resistance (Max):

70ohm

Voltage - Supply, Dual (V±):

-

Features:

-

Mounting Type:

Surface Mount

Supplier Device Package:

10-UQFN (1.4x1.8)

Manufacturer:

onsemi

Product Status:

Obsolete

Multiplexer/Demultiplexer Circuit:

2:4

Number of Channels:

1

Voltage - Supply, Single (V+):

1.65V ~ 4.5V

-3db Bandwidth:

950MHz

Operating Temperature:

-40°C ~ 85°C (TA)

Package / Case:

10-UQFN

Base Product Number:

NL3HS2222

Environmental & Export classification

RoHS Status:

ROHS3 Compliant

REACH Status:

REACH Unaffected

HTSUS:

8542.39.0001

Moisture Sensitivity Level (MSL):

1 (Unlimited)

ECCN:

EAR99

NL3HS2222

High-Speed USB 2.0 (480 Mbps) DPDT Switches

The NL3HS2222 is a DPDT switch optimized for high-speed USB 2.0 applications within portable systems. It features ultra-low on capacitance, $C_{ON} = 7.5$ pF (typ), and a bandwidth above 950 MHz. It is optimized for applications that use a single USB interface connector to route multiple signal types. The C_{ON} and R_{ON} of both channels are suitably low to allow the NL3HS2222 to pass any speed USB data or audio signals going to a moderately resistive terminal such as an external headset. The device is offered in a UQFN10 1.4 mm x 1.8 mm package.

Features

- Optimized Flow-Through Pinout
- R_{ON} : 5.0 Ω Typ @ $V_{CC} = 4.2$ V
- C_{ON} : 7.5 pF Typ @ $V_{CC} = 3.3$ V
- V_{CC} Range: 1.65 V to 4.5 V
- Typical Bandwidth: 950 MHz
- 1.4 mm x 1.8 mm x 0.50 mm UQFN10
- OVT on Common Signal Pins D+/D- up to 5.25 V
- 8 kV HBM ESD Protection on All Pins
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

Typical Applications

- High Speed USB 2.0 Data
- Mobile Phones
- Portable Devices

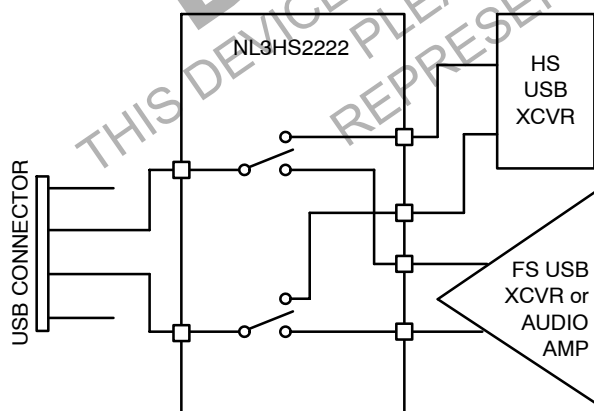


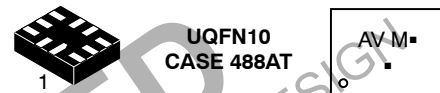
Figure 1. Application Diagram



ON Semiconductor®

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MARKING DIAGRAM



AV = Device Code
M = Date Code
▪ = Pb-Free Device

(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping [†]
NL3HS2222MUTBG	UQFN10 (Pb-Free)	3000 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

NL3HS2222

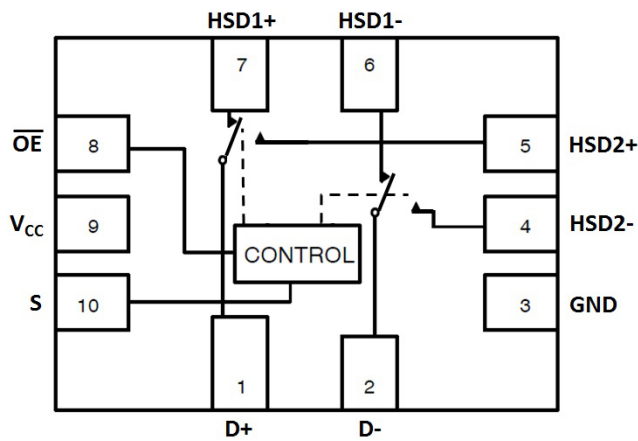


Figure 2. Pin Connections and Logic Diagram (Top View)

Table 1. PIN DESCRIPTION

Pin	Function
S	Control Input
\overline{OE}	Output Enable
HSD1+, HSD1-, HSD2+, HSD2-, D+, D-	Data Ports

Table 2. TRUTH TABLE

\overline{OE}	S	HSD1+, HSD1-	HSD2+, HSD2-
1	X	OFF	OFF
0	0	ON	OFF
0	1	OFF	ON

MAXIMUM RATINGS

Symbol	Pins	Parameter	Value	Unit
V_{CC}	V_{CC}	Positive DC Supply Voltage	-0.5 to +5.5	V
V_{IS}	HSDn+, HSDn-	Analog Signal Voltage	-0.5 to $V_{CC} + 0.3$	V
	D+, D-		-0.5 to +5.25	
V_{IN}	S, \overline{OE}	Control Input Voltage, Output Enable Voltage	-0.5 to +5.5	V
I_{CC}	V_{CC}	Positive DC Supply Current	50	mA
T_S		Storage Temperature	-65 to +150	°C
I_{IS_CON}	HSDn+, HSDn-, D+, D-	Analog Signal Continuous Current—Closed Switch	± 300	mA
I_{IS_PK}	HSDn+, HSDn-, D+, D-	Analog Signal Continuous Current 10% Duty Cycle	± 500	mA
I_{IN}	S, \overline{OE}	Control Input Current, Output Enable Current	± 20	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

RECOMMENDED OPERATING CONDITIONS

Symbol	Pins	Parameter	Min	Max	Unit
V_{CC}		Positive DC Supply Voltage	1.65	4.5	V
V_{IS}	HSDn+, HSDn-	Analog Signal Voltage	GND	V_{CC}	V
	D+, D-		GND	4.5	
V_{IN}	S, \overline{OE}	Control Input Voltage, Output Enable Voltage	GND	V_{CC}	V
T_A		Operating Temperature	-40	+85	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

ESD PROTECTION

Symbol	Parameter	Value	Unit
ESD	Human Body Model – All Pins	8.0	kV

NL3HS2222**DC ELECTRICAL CHARACTERISTICS****CONTROL INPUT, OUTPUT ENABLE VOLTAGE** (Typical: T = 25°C)

Symbol	Pins	Parameter	Test Conditions	V _{CC} (V)	-40°C to +85°C			Unit
					Min	Typ	Max	
V _{IH}	S, \overline{OE}	Control Input, Output Enable HIGH Voltage (See Figure 11)		2.7 3.3 4.2	1.25 1.3 1.4	-	-	V
V _{IL}	S, \overline{OE}	Control Input, Output Enable LOW Voltage (See Figure 11)		2.7 3.3 4.2	-	-	0.35 0.4 0.5	V
I _{IN}	S, \overline{OE}	Current Input, Output Enable Leakage Current	$0 \leq V_{IS} \leq V_{CC}$	1.65 - 4.5	-	-	±1.0	μA

SUPPLY CURRENT AND LEAKAGE (Typical: T = 25°C, V_{CC} = 3.3 V)

Symbol	Pins	Parameter	Test Conditions	V _{CC} (V)	-40°C to +85°C			Unit
					Min	Typ	Max	
I _{CC}	V _{CC}	Quiescent Supply Current	$0 \leq V_{IS} \leq V_{CC}$; I _D = 0 A $0 \leq V_{IS} \leq V_{CC} - 0.5$ V	1.65 - 3.6 3.6 - 4.5	-	-	1.0 1.0	μA
I _{OZ}		OFF State Leakage	$0 \leq V_{IS} \leq V_{CC}$	1.65 - 4.5	-	±0.1	±1.0	μA
I _{OFF}	D+, D-	Power OFF Leakage Current	$0 \leq V_{IS} \leq V_{CC}$	0	-	-	±1.0	μA

LIMITED V_{IS} SWING ON RESISTANCE (Typical: T = 25°C)

Symbol	Pins	Parameter	Test Conditions	V _{CC} (V)	-40°C to +85°C			Unit
					Min	Typ	Max	
R _{ON}		On-Resistance (Note 1)	I _{ON} = 8 mA V _{IS} = 0 V to 0.4 V	2.7 3.3 4.2	-	6.0 5.5 5.0	8.6 7.6 7.0	Ω
R _{FLAT}		On-Resistance Flatness (Notes 1 and 2)	I _{ON} = 8 mA V _{IS} = 0 V to 0.4 V	2.7 3.3 4.2	-	0.55 0.30 0.20	-	Ω
ΔR _{ON}		On-Resistance Matching (Notes 1 and 3)	I _{ON} = 8 mA V _{IS} = 0 V to 0.4 V	2.7 3.3 4.2	-	0.60 0.60 0.60	-	Ω

1. Guaranteed by design.
2. Flatness is defined as the difference between the maximum and minimum value of On-Resistance as measured over the specified analog signal ranges.
3. ΔR_{ON} = R_{ON(max)} - R_{ON(min)} between HSD1⁺ and HSD1⁻ or HSD2⁺ and HSD2⁻.

FULL V_{IS} SWING ON RESISTANCE (Typical: T = 25°C)

Symbol	Pins	Parameter	Test Conditions	V _{CC} (V)	-40°C to +85°C			Unit
					Min	Typ	Max	
R _{ON}		On-Resistance	I _{ON} = 8 mA V _{IS} = 0 V to V _{CC}	2.7 3.3 4.2	-	10 8.0 7.0	13.5 9.75 8.50	Ω
R _{FLAT}		On-Resistance Flatness (Notes 4 and 5)	I _{ON} = 8 mA V _{IS} = 0 V to V _{CC}	2.7 3.3 4.2	-	4.5 3.0 2.5	-	Ω
ΔR _{ON}		On-Resistance (Note 4 and 6)	I _{ON} = 8 mA V _{IS} = 0 V to V _{CC}	2.7 3.3 4.2	-	0.60 0.60 0.60	-	Ω

4. Guaranteed by design.
5. Flatness is defined as the difference between the maximum and minimum value of On-Resistance as measured over the specified analog signal ranges.
6. ΔR_{ON} = R_{ON(max)} - R_{ON(min)} between HSD1⁺ and HSD1⁻ or HSD2⁺ and HSD2⁻.

NL3HS2222**AC ELECTRICAL CHARACTERISTICS****TIMING/FREQUENCY** (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 35 pF, f = 1 MHz)

Symbol	Pins	Parameter	Test Conditions	V _{CC} (V)	-40°C to +85°C			Unit
					Min	Typ	Max	
t _{ON}	Closed to Open	Turn-ON Time (See Figures 4 and 5)		1.65 – 4.5	–	13.0	30.0	ns
t _{OFF}	Open to Closed	Turn-OFF Time (See Figures 4 and 5)		1.65 – 4.5	–	12.0	25.0	ns
T _{BBM}		Break-Before-Make Time (See Figure 3)		1.65 – 4.5	2.0	–	–	ns
BW		-3 dB Bandwidth (See Figure 10)	C _L = 5 pF	1.65 – 4.5	–	950	–	MHz

ISOLATION (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 5 pF)

Symbol	Pins	Parameter	Test Conditions	V _{CC} (V)	-40°C to +85°C			Unit
					Min	Typ	Max	
O _{IRR}	Open	OFF-Isolation (See Figure 6)	f = 240 MHz	1.65 – 4.5	–	-22	–	dB
X _{TALK}	HSDn+ to HSDn-	Non-Adjacent Channel Crosstalk	f = 240 MHz	1.65 – 4.5	–	-24	–	dB

CAPACITANCE (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 5 pF)

Symbol	Pins	Parameter	Test Conditions	-40°C to +85°C			Unit
				Min	Typ	Max	
C _{IN}	S, OE	Control Pin, Output Enable Input Capacitance	V _{CC} = 0 V, f = 1 MHz	–	1.5	–	pF
			V _{CC} = 0 V, f = 10 MHz	–	1.0	–	
C _{ON}	D+ to HSD1+ or HSD2+	ON Capacitance	V _{CC} = 3.3 V, OE = 0 V, f = 1 MHz S = 0 V or 3.3 V	–	7.5	–	pF
			V _{CC} = 3.3 V, OE = 0 V, f = 10 MHz S = 0 V or 3.3 V	–	6.5	–	
			V _{CC} = 3.3 V, OE = 0 V, f = 240 MHz S = 0 V or 3.3 V	–	5	–	
C _{OFF}	HSD1n or HSD2n	OFF Capacitance	V _{CC} = V _{IS} = 3.3 V; OE = 0 V, S = 3.3 V or 0 V, f = 1 MHz	–	3.8	–	pF
			V _{CC} = V _{IS} = 3.3 V; OE = 0 V, S = 3.3 V or 0 V, f = 10 MHz	–	2.0	–	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

NL3HS2222

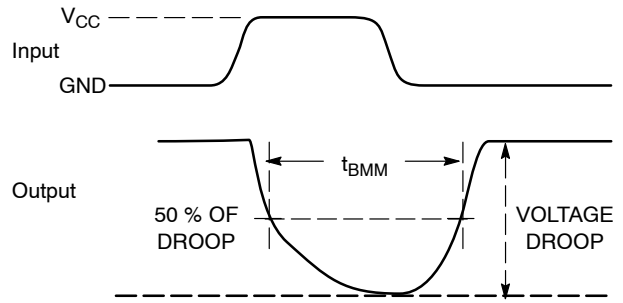
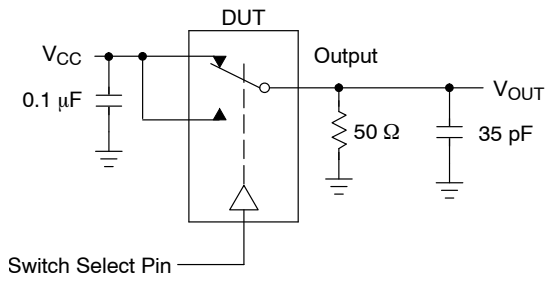


Figure 3. t_{BMM} (Time Break-Before-Make)

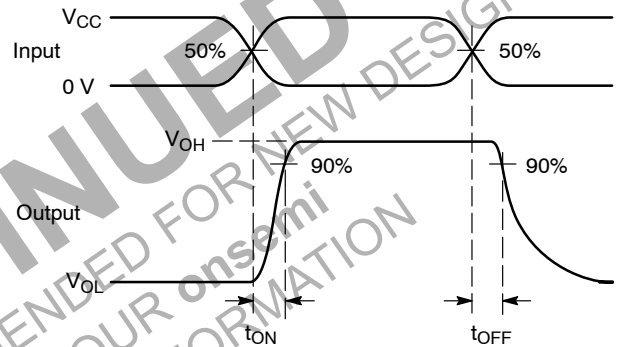
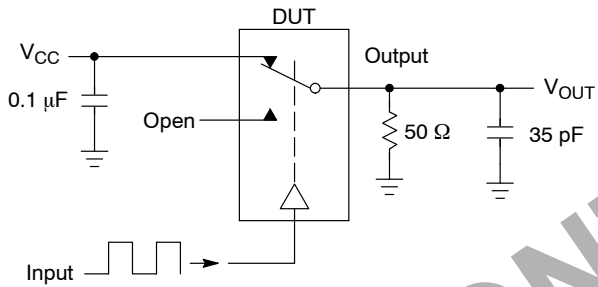


Figure 4. t_{ON}/t_{OFF}

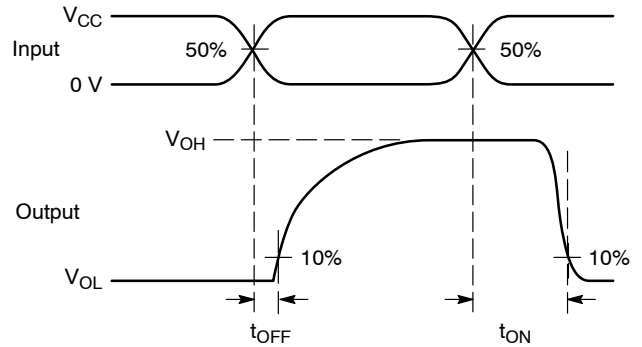
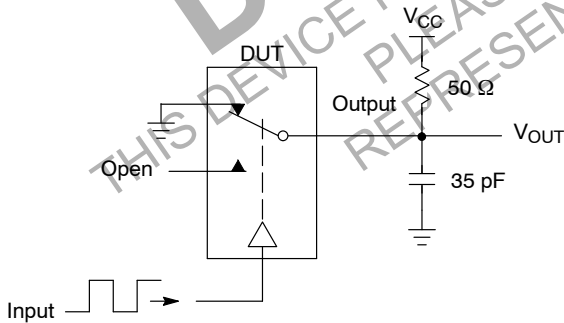
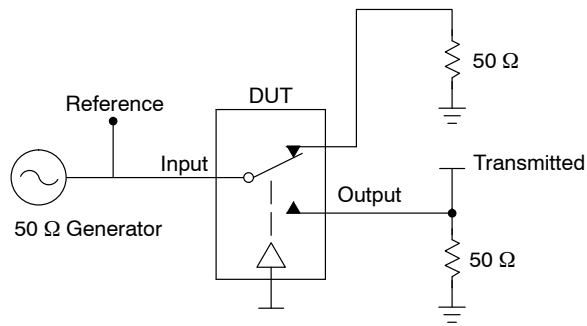


Figure 5. t_{ON}/t_{OFF}

NL3HS2222

Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch. V_{ISO} , Bandwidth and V_{ONL} are independent of the input signal direction.

$$V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log} \left(\frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

$$V_{ONL} = \text{On Channel Loss} = 20 \text{ Log} \left(\frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz to } 50 \text{ MHz}$$

Bandwidth (BW) = the frequency 3 dB below V_{ONL}

V_{CT} = Use V_{ISO} setup and test to all other switch analog input/outputs terminated with 50 Ω

Figure 6. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/ V_{ONL}

DETAILED DESCRIPTION**High Speed (480Mbps) USB 2.0 Optimized**

The NL3HS2222 is a DPDT switch designed for USB applications within portable systems. The R_{ON} and C_{ON} of both switches are maintained at industry-leading low levels in order to ensure maximum signal integrity for USB 2.0 high speed data communication. The NL3HS2222 switch can be used to switch between high speed (480Mbps) USB signals and a variety of audio or data signals such as full speed USB, UART or even a moderately resistive audio terminal.

Over Voltage Tolerant

The NL3HS2222 features over voltage tolerant I/O protection on the common signal pins D+/D-. This allows the switch to interface directly with a USB connector. The D+/D- pins can withstand a short to V_{BUS} , up to 5.25 V, continuous DC current for up to 24 hours as specified in the USB 2.0 specification. This protection is achieved without the need for any external resistors or protection devices.

NL3HS2222

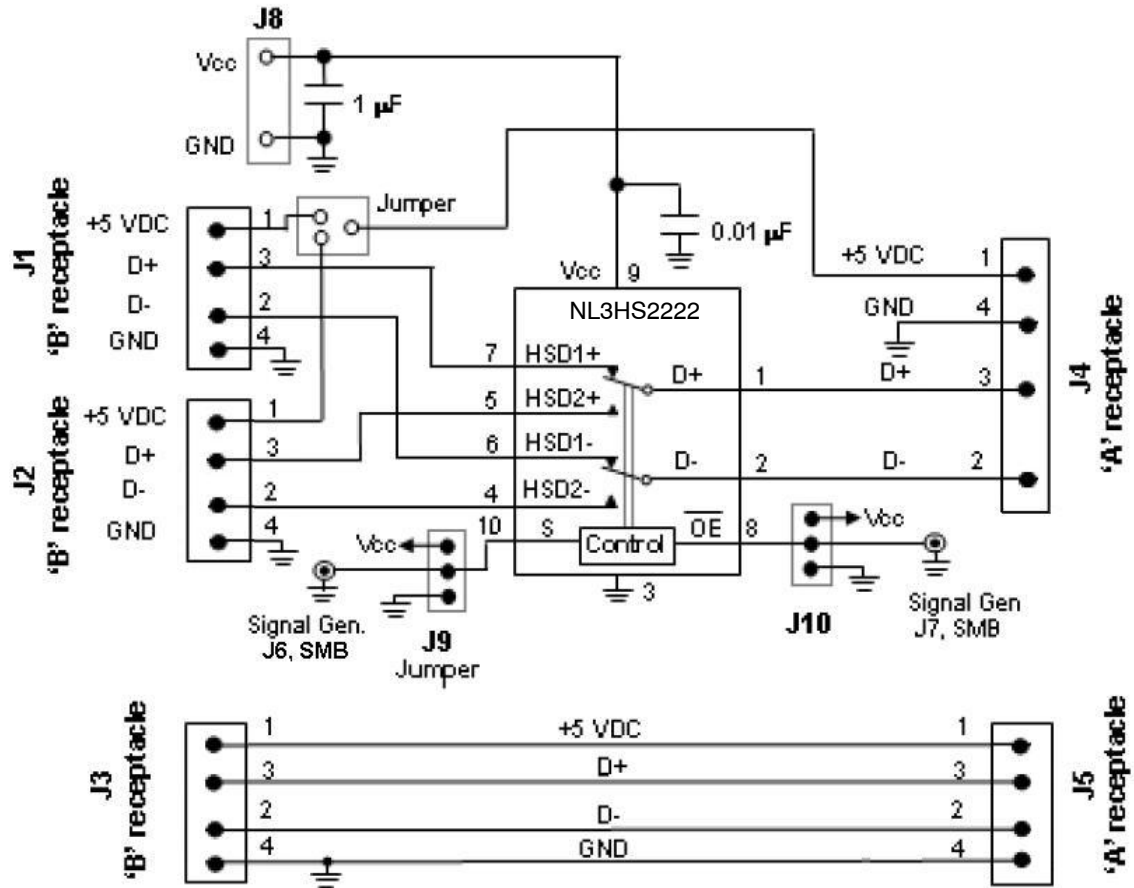


Figure 7. Board Schematic

DISCOVER
 THIS DEVICE IS NOT RECOMMENDED FOR IN-CIRCUIT TESTING.
 PLEASE CONTACT YOUR REPRESENTATIVE FOR INFORMATION.

NL3HS2222

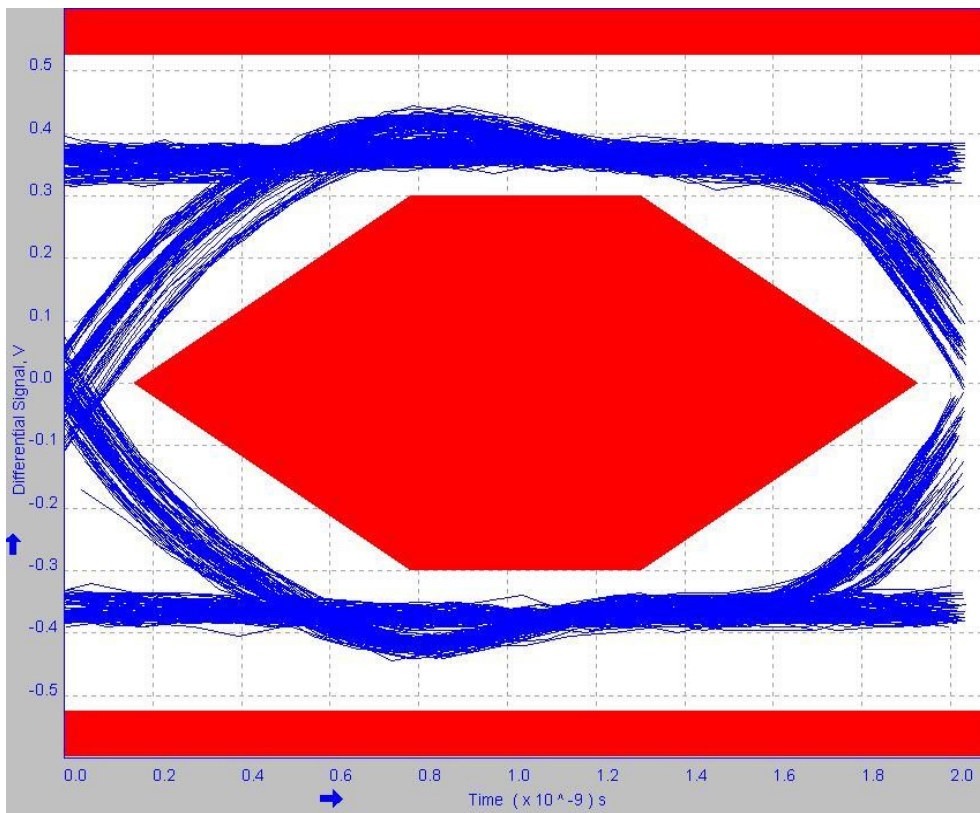


Figure 8. Signal Quality

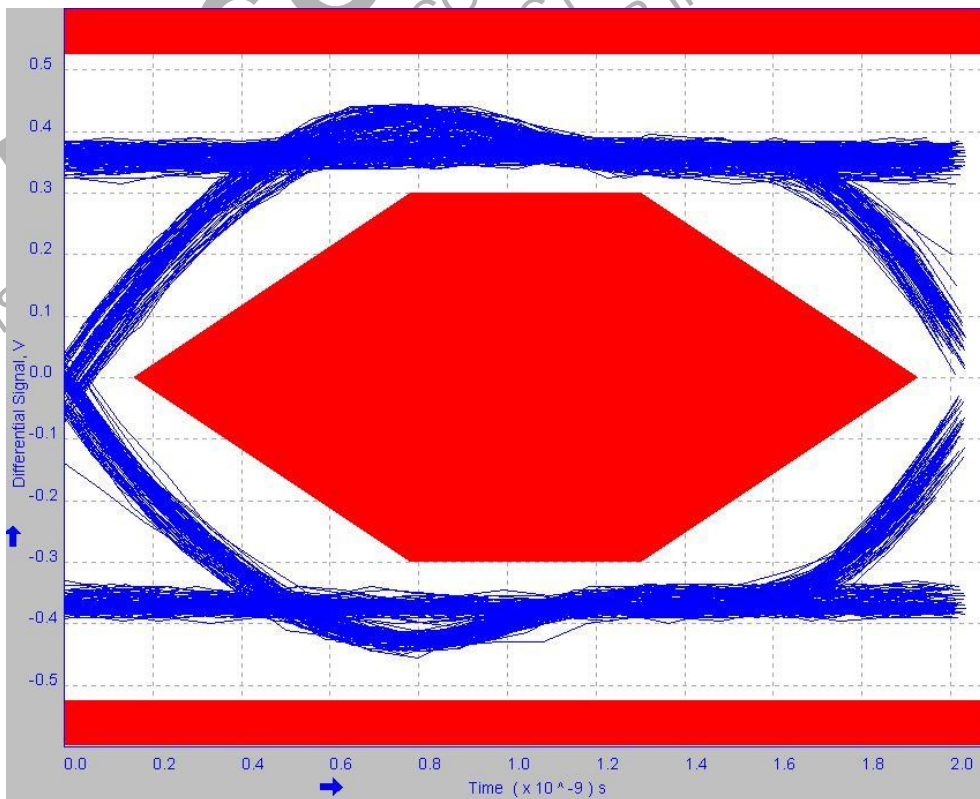
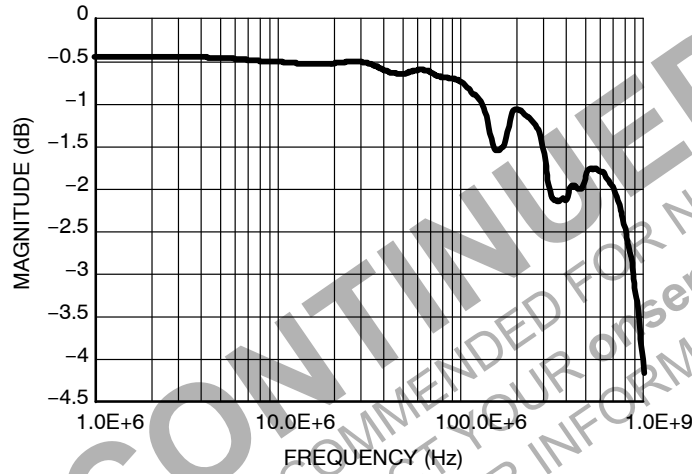


Figure 9. Near End Eye Diagram

NL3HS2222

Near End Test Data:					Min	Max
Std.	Consecutive jitter range	-54.37	73.21	ps	-200 ps	+200 ps
	Paired JK jitter range	-59.14	59.56	ps		
	Paired KJ jitter range	-50.79	34.57	ps		
N.C.	Consecutive jitter range	-74.43	81.65	ps	-200 ps	+200 ps
	Paired JK jitter range	-61.60	58.55	ps		
	Paired KJ jitter range	-55.31	48.43	ps		
N.O.	Consecutive jitter range	-82.55	80.33	ps	-200 ps	+200 ps
	Paired JK jitter range	-53.50	71.65	ps		
	Paired KJ jitter range	-62.60	47.30	ps		



**Figure 10. Magnitude vs. Frequency
@ V_{CC} = 3.3 V, All Temperatures**

I_{CC} Leakage Current as a Function of V_{IN} Voltage (25°C)

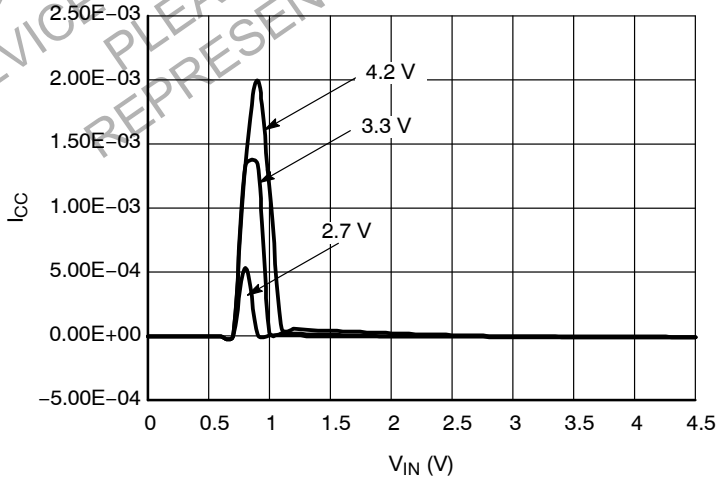


Figure 11. I_{CC} vs. V_{IN}, Select Pin, All V_{CC}'s, 25°C

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