

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, $C_{ON} = 7.5 \text{ pF}$ (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} : 5.0Ω Typ @ $V_{CC} = 4.2 \text{ V}$
- C_{ON} : 7.5 pF Typ @ $V_{CC} = 3.3 \text{ V}$
- 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

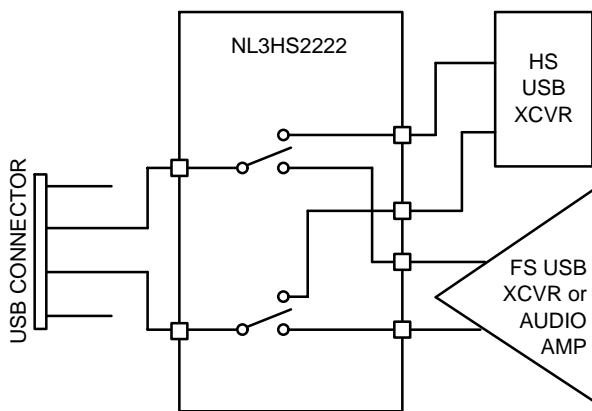


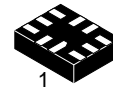
Figure 1. Application Diagram



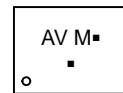
ON Semiconductor®

www.onsemi.com

MARKING DIAGRAM



**UQFN10
CASE 488AT**



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

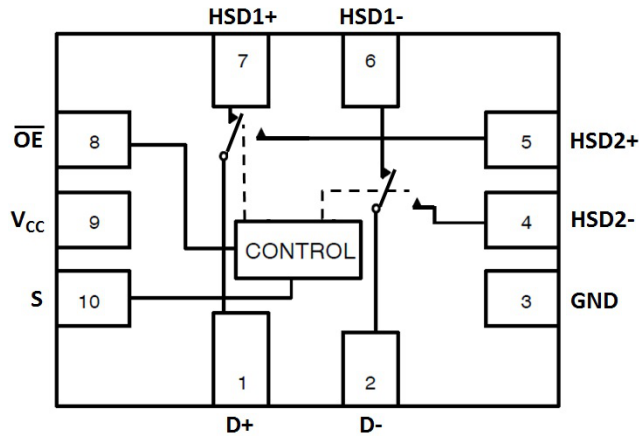


Figure 2. Pin Connections and Logic Diagram (Top View)

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. $\Delta R_{ON} = R_{ON(max)} - R_{ON(min)}$ 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. $\Delta R_{ON} = R_{ON(max)} - R_{ON(min)}$ 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, \overline{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; \overline{OE} = 0 V, f = 1 MHz S = 0 V or 3.3 V	–	7.5	–	pF
			V _{CC} = 3.3 V; \overline{OE} = 0 V, f = 10 MHz S = 0 V or 3.3 V	–	6.5	–	
			V _{CC} = 3.3 V; \overline{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; \overline{OE} = 0 V, S = 3.3 V or 0 V, f = 1 MHz	–	3.8	–	pF
			V _{CC} = V _{IS} = 3.3 V; \overline{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

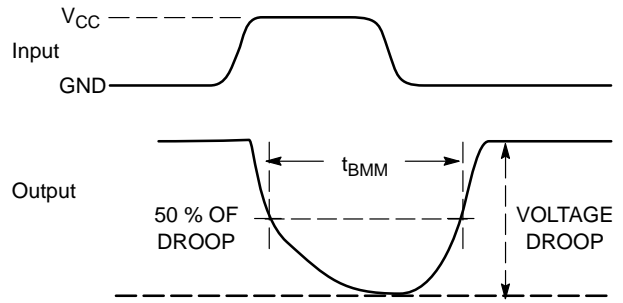
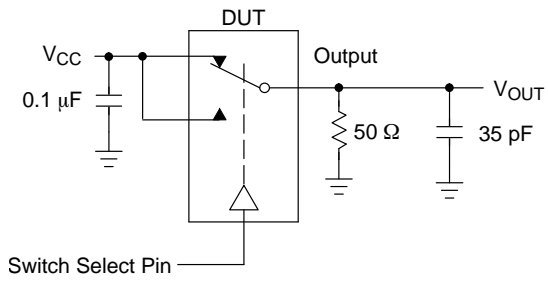


Figure 3. t_{BMM} (Time Break-Before-Make)

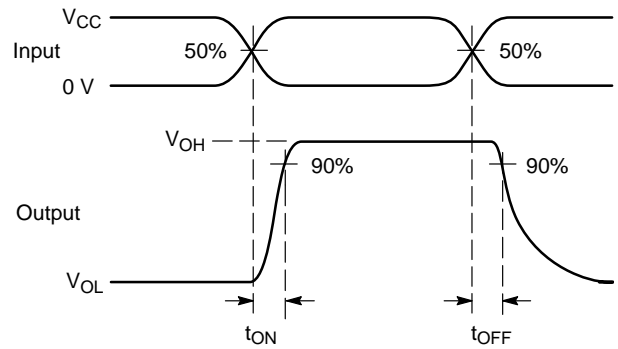
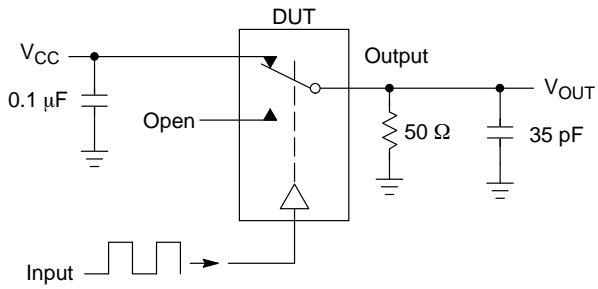


Figure 4. t_{ON}/t_{OFF}

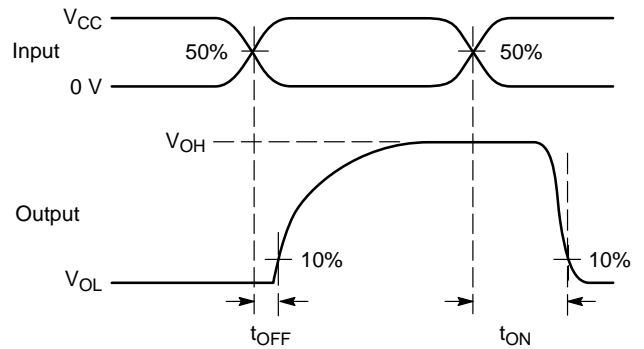
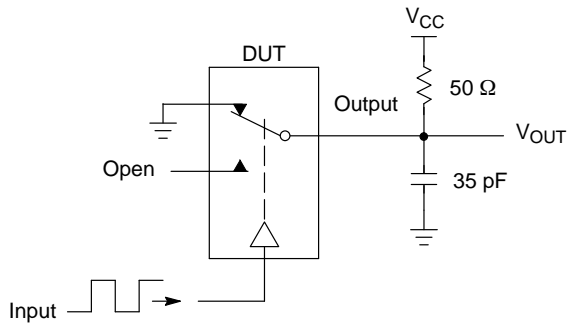
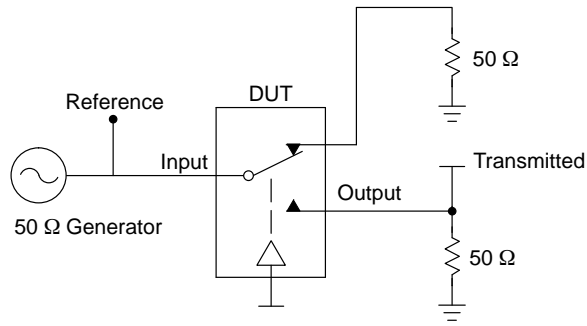


Figure 5. t_{ON}/t_{OFF}

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

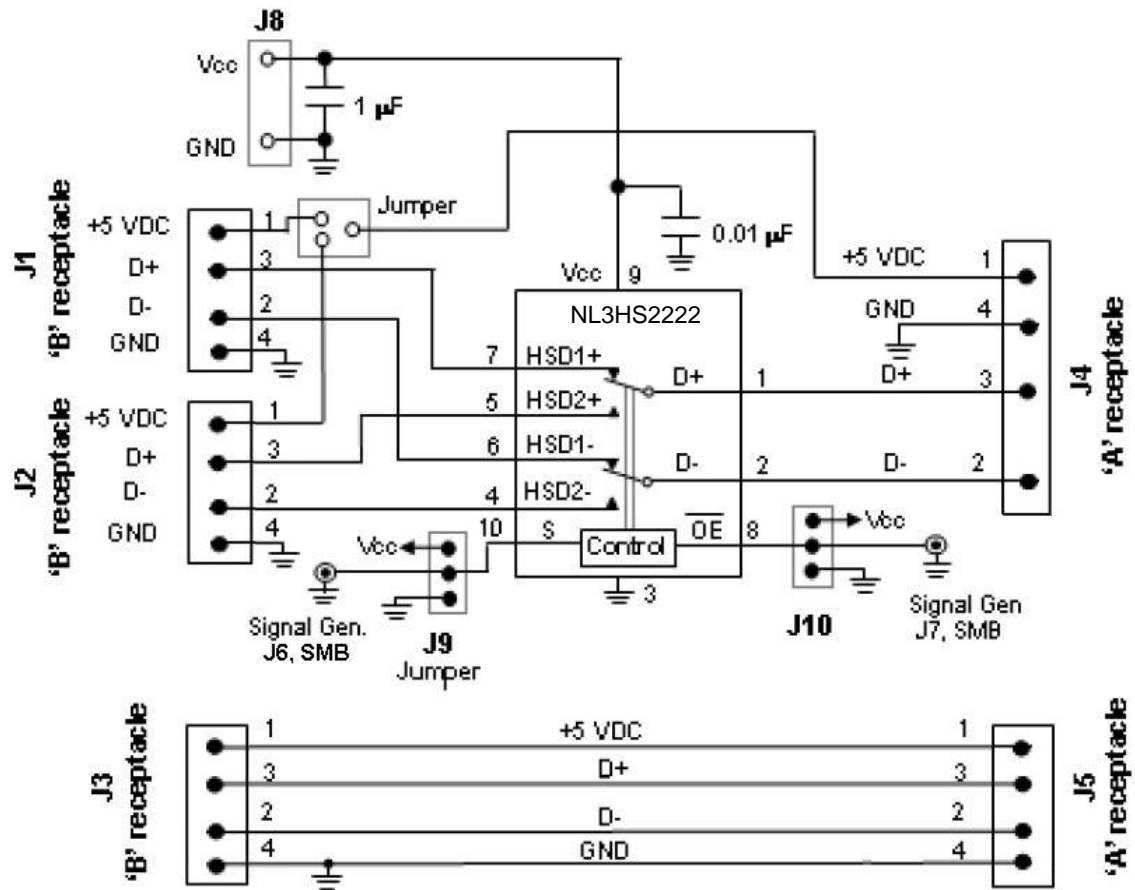


Figure 7. Board Schematic

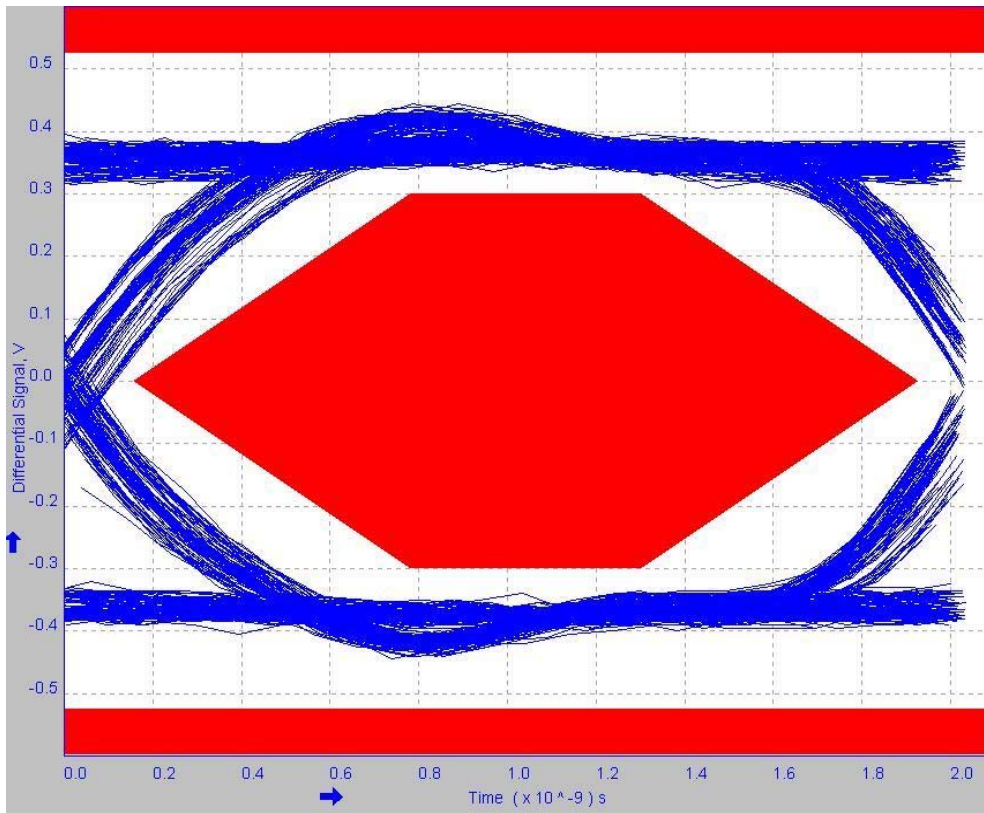


Figure 8. Signal Quality

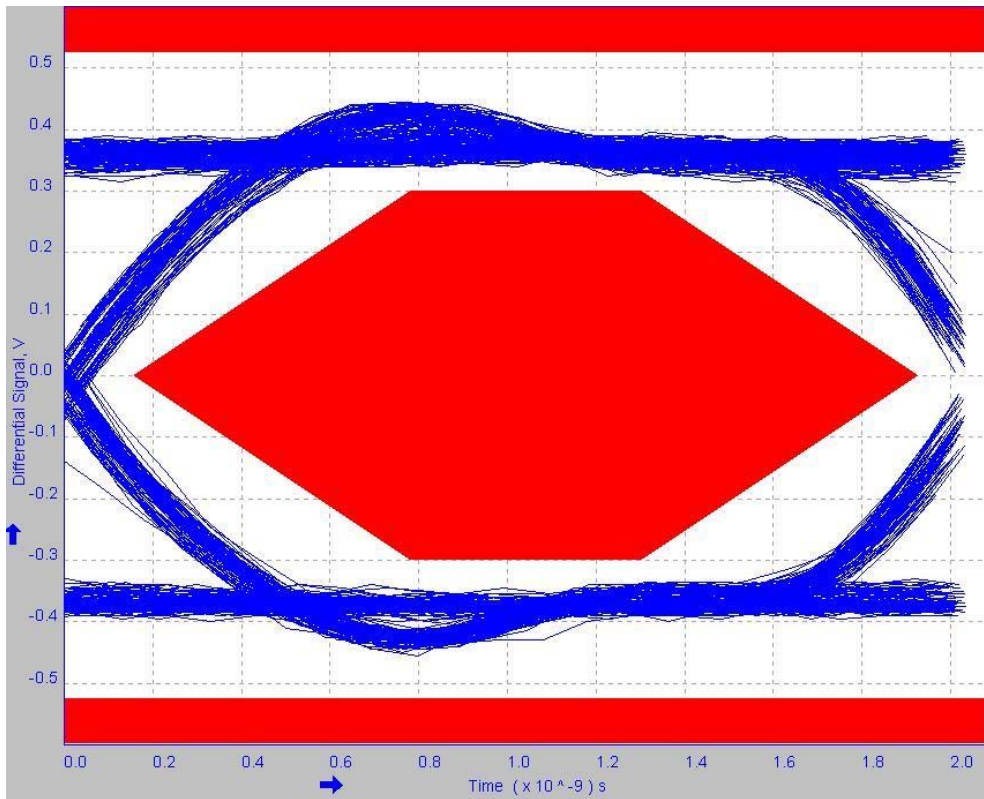
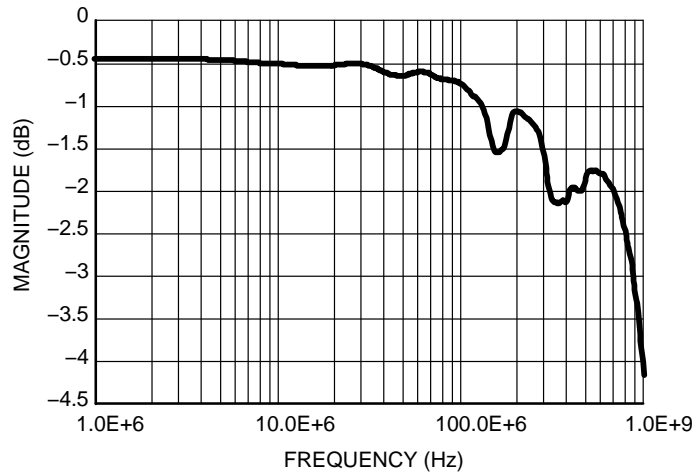


Figure 9. Near End Eye Diagram

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)

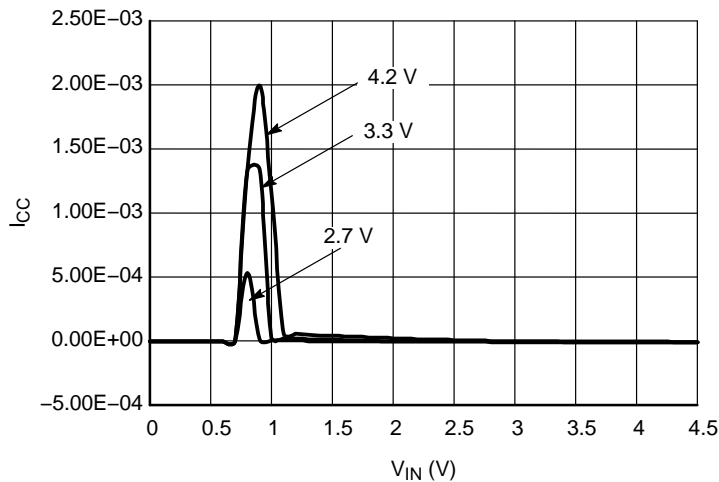
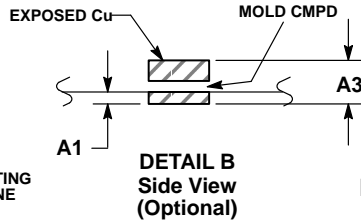
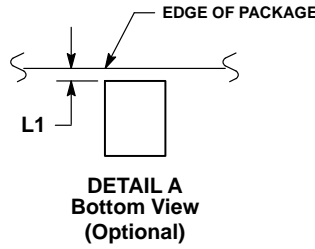
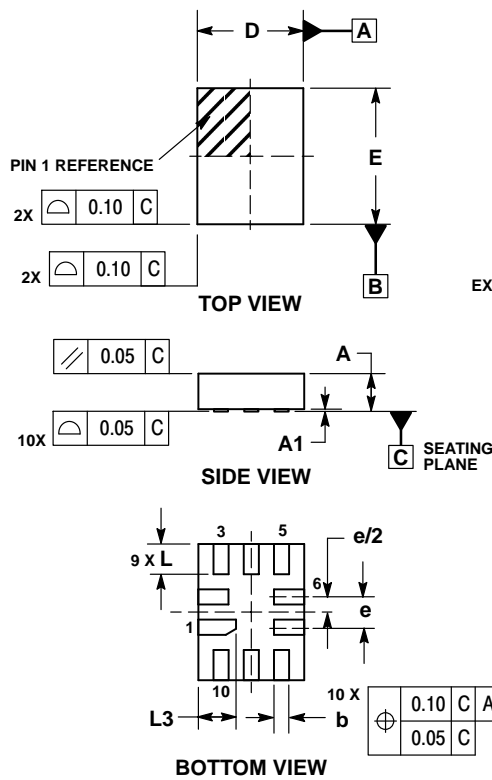


Figure 11. I_{CC} vs. V_{IN}, Select Pin, All V_{CC}'s, 25°C

NL3HS2222

PACKAGE DIMENSIONS

UQFN10 1.4x1.8, 0.4P CASE 488AT ISSUE A

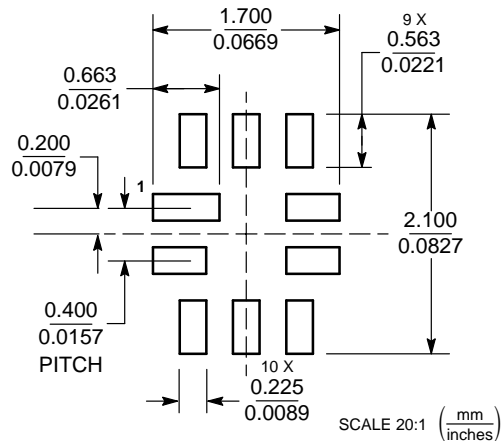


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

MILLIMETERS		
DIM	MIN	MAX
A	0.45	0.60
A1	0.00	0.05
A3	0.127	REF
b	0.15	0.25
D	1.40	BSC
E	1.80	BSC
e	0.40	BSC
L	0.30	0.50
L1	0.00	0.15
L3	0.40	0.60

MOUNTING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and the are registered trademarks of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries. SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marketing.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А