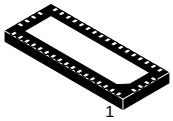
3.3 / B 3.1 -2
10 C /
D o
B7 1004



WQFN42
CASE 510AP

MARKING DIAGRAM

NB7N1004 = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
G = Pb−Free Package

Description

The NB7NPQ1004M is a high performance 2−Port linear redriver designed for USB 3.1 Gen 1 and USB 3.1 Gen 2 applications that supports both 5 Gbps and 10 Gbps data rates. Signal integrity degrades from PCB traces, transmission cables, and inter−symbol interference (ISI). The NB7NPQ1004M compensates for these losses by engaging varying levels of equalization at the input receiver, and flat gain amplification on the output transmitter.

The NB7NPQ1004M offers programmable equalization and flat gain for each independent channel to optimize performance over various physical mediums.

The NB7NPQ1004M contains an automatic receiver detect function which will determine whether the output is active. The receiver detection loop will be active if the corresponding channel's signal detector is idle for a period of time. The channel will then move to Unplug Mode if a load is not detected, or it will return to Low Power Mode (Slumber mode) due to inactivity.

The NB7NPQ1004M comes in a 3.5 x 9 mm WQFN42 package and is specified to operate across the entire industrial temperature range, –40°C to 85°C.

ORDERING INFORMATION

Device	Package	Shipping†

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

Features

- 3.3 V ± 0.3 V Power Supply
- 5 Gbps & 10 Gbps Serial Link with Linear Amplifier
- Device Supports USB 3.1 Gen 1 and USB 3.1 Gen 2 Data Rates
- Automatic Receiver Detection
- Integrated Input and Output Termination
- Pin Adjustable Receiver Equalization and Flat Gain
- 100−Ω Differential CML I/O's
- Auto Slumber Mode for Adaptive Power Management
- Hot−Plug Capable
- ESD Protection ±2 kV HBM
- Operating Temperature Range Industrial: −40°C to +85°C
- Package: WQFN42, 3.5 x 9 mm
- This is a Pb−Free Device

Typical Applications

- USB3.1 Type−A and Type−C Signal Routing
- Mobile Phone and Tablet
- Computer, Laptop and Notebook
- External Storage Device
- Docking Station and Dongle
- Active Cable, Back Planes
- Gaming Console, Smart T.V.

Table 1. PIN DESCRIPTION

Pin Number	Pin Name	Type	Description
1	FGA	INPUT	DC flat gain for channel A. 4−level input pin. Internal 100 k−Ω pull−up and 200 k−Ω pull−down.
2	EN_AB	INPUT	Channel AB Enable. Internal 300 k−Ω pull−up. High−Channel is in normal operation. Low−Channel is in power down mode.
3	VDD	POWER	3.3 V power supply. VDD pins must be externally connected to power supply.

Power Management

The NB7NPQ1004M has an adaptive power management feature in order to minimize power consumption. When the receiver signal detector is idle, the corresponding channel will change to low power slumber mode. Accordingly, both channels will move to low power slumber mode individually.

While in the low power slumber mode, the receiver signal detector will continue to monitor the input channel. If a channel is in low power slumber mode, the receiver detection loop will be active again. If a load is not detected, then the channel will move to Device Unplug Mode and continuously monitor for the load. When a load is detected, the channel will return to Low Power Slumber Mode and receiver detection will be active again per 6 ms.

Table 2. OPERATING MODES

Mode	R_{IN}	R_{OUT}
PD	67 k−Ω to GND	High−Z
Unplug Mode	High−Z	40 k−Ω to VDD
Low Power Slumber Mode	50−Ω to VDD	40 k−Ω to VDD
Active	50−Ω to VDD	50−Ω to VDD

Table 3. EQUALIZATION SETTING
EQ A/B/C/D are the selection pins for the equalization.

EQA/B/C/D	Equalizer Setting (dB)	
	@2.5 GHz	@5 GHz
L (Tie 0−Ω to GND)	5.1	10.9
R (Tie Rext to GND)	1.9	6.7
F (Leave Open)	3.5	8.9 (Default)
H (Tie 0−Ω to VDD)	6.8	13.1

Table 4. FLAT GAIN SETTING
FGA/B/C/D are the selection pins for the DC gain.

FGA/B/C/D	Flat Gain Settings (dB)
L (Tie 0−Ω to GND)	−3
R (Tie Rext to GND)	−1.5
F (Leave Open)	0 (Default)
H (Tie 0−Ω to VDD)	+2

Table 5. CHANNEL ENABLE SETTING
EN_AB / EN_CD are the channel enable pins for channels A&B and C&D respectively.

EN	Channel Enable Setting
0	Disabled
1	Enabled (Default)

Table 6. ATTRIBUTES

Parameter		
ESD Protection	Human Body Model Charged Device Model	± 2 kV > 1.5 kV
Moisture Sensitivity, Indefinite Time Out of Dry pack (Note 1)		Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V−O @ 0.125 in
Transistor Count		81034
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latch-up Test		

1. For additional information, see Application Note AND8003/D.

Table 7. ABSOLUTE MAXIMUM RATINGS Over operating free−air temperature range (unless otherwise noted)

Parameter	Description	Min	Max	Unit
Supply Voltage (Note 2)	V_{DD}	−0.5	4.6	V
Voltage range at any input or output terminal	Differential I/O	−0.5	V_{DD} + 0.5	V

Table 8. RECOMMENDED OPERATING CONDITIONS Over operating free−air temperature range (unless otherwise noted)

Parameter	Description		Min	Typ	Max	Unit
V_{DD}	Main power supply		3.0	3.3	3.6	V
T_A	Operating free−air temperature	Industrial Temperature Range	−40			

Table 11. CML RECEIVER AC/DC CHARACTERISTICS

Table 12. TRANSMITTER AC/DC CHARACTERISTICS
VDD = 3.3 V +/− 0.3 V Over operating free−air temperature range (unless otherwise noted)

Parameter		Test Conditions	Min	Typ	Max	Unit
CHANNEL PERFORMANCE						
Gp	Peaking gain (Compensation at 5 GHz, relative to 100 MHz, 100 mVp−p sine wave input)	EQx = L		10.9		dB
		EQx = R		6.7		
		EQx = F		8.9		
		EQx = H		13.1		
		Variation around typical	−			

PARAMETER MEASUREMENT DIAGRAMS

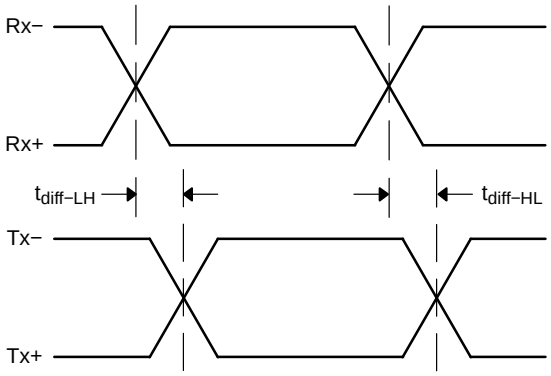


Figure 3. Propagation Delay

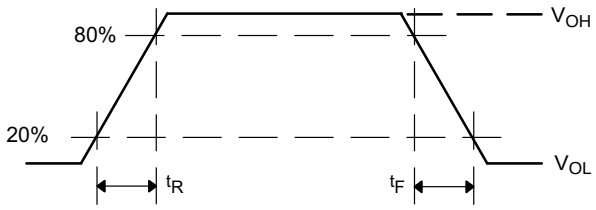


Figure 4. Output Rise and Fall Times

APPLICATION GUIDELINES

LFPS Compliance Testing

As part of USB 3.1 compliance test, the host or peripheral must transmit a LFPS signal that adheres to the spec parameters. The NB7NPQ1004M is tested as a part of a USB compliant system to ensure that it maintains compliance while increasing system performance.

LFPS Functionality

USB 3.1, Gen1 and Gen2 use Low Frequency Periodic Signaling.

(LFPS) to implement functions like exiting low−power modes, performing warm resets and providing link training between host and peripheral devices. LFPS signaling consists of bursts of frequencies ranging between 10 to 50 MHz and can have specific burst lengths or repeat rates.

Ping.LFPS for TX Compliance

During the transmitter compliance, the system under test must transmit certain compliance patterns as defined by the USB−IF. In order to toggle through these patterns for various tests, the receiver must receive a ping.LFPS signal from either the test suite or a separate pattern generator. The standard signal comprises of a single burst period of 100 ns at 20 MHz.

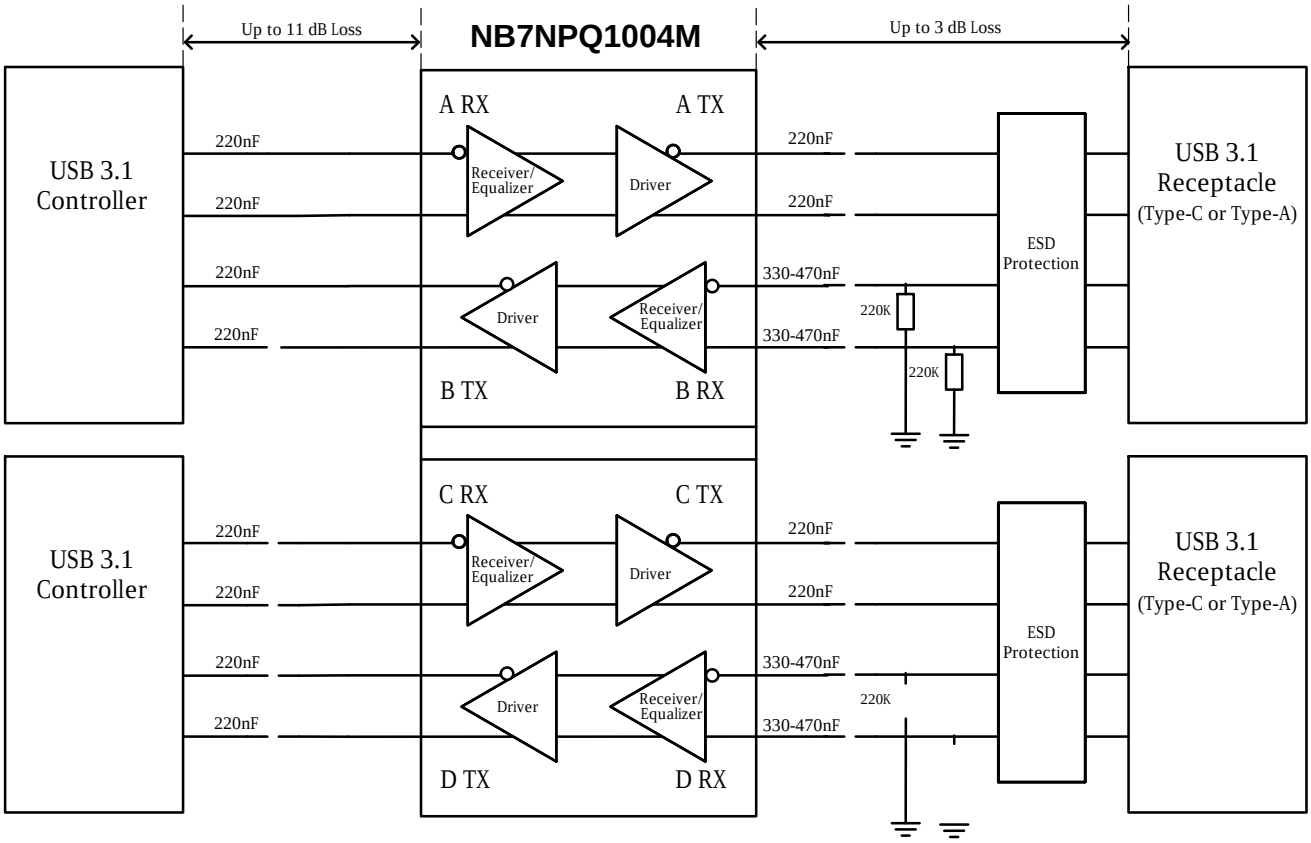
Control Pin Settings

Control pins A1, A0, B1, and B0 control the Flat Gain and the Equalization of channels A and B and control pins C1, C0, D1, and D0 control the Flat Gain and the Equalization of channels C and D of the NB7NPQ7041M Device.

The Float (Default) Setting “F” can be set by leaving the control pins in a floating state. The Redriver will internally bias the control pins to the correct voltage to achieve this if the pin is not connected to a voltage source. The low Setting “L” is set by pulling the control pin to ground. Likewise the high setting “H” is set by pulling the pin high to VCC. The $R_{external}$ setting can be set by adding a 68−K resistor from the control pin to ground. This will bias the Redriver internal voltage to 33% of VCC.

Linear Equalization

The linear equalization that the NB7NPQ1004M provides compensates for losses that occur naturally along board traces and cable lines. Linear Equalization boosts high frequencies and lower frequencies linearly so when transmitting at varying frequencies, the voltage amplitude will remain consistent. This compensation electrically counters losses and allows for longer traces to be possible when routing.


Up to 11 dB Loss
NB7NPQ1004M
Up to 3 dB Loss
USB 3.1 Controller
A RX
A TX
220nF
220nF
Receiver/ Equalizer
Driver
220nF
220nF
220nF
220nF
Driver
Receiver/ Equalizer
330-470nF
330-470nF
220K
220K
B TX
B RX
ESD Protection
USB 3.1 Receptacle (Type-C or Type-A)
USB 3.1 Controller
C RX
C TX
220nF
220nF
Receiver/ Equalizer
Driver
220nF
220nF
220nF
220nF
Driver
Receiver/ Equalizer
330-470nF
330-470nF
220K
D TX
D RX
ESD Protection
USB 3.1 Receptacle (Type-C or Type-A)

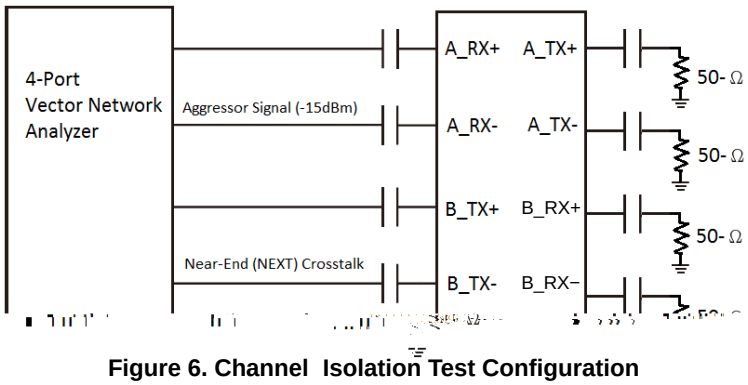
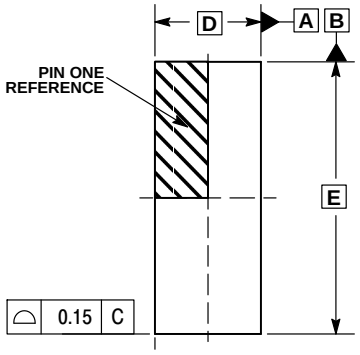


Figure 6. Channel Isolation Test Configuration

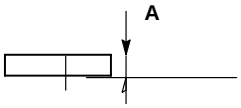
WQFN42 3.5x9, 0.5P
CASE 510AP
ISSUE O

DATE 15 FEB 2010

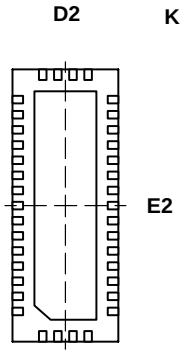
SCALE 2:1



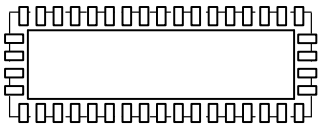
TOP VIEW



SIDE VIEW



BOTTOM VIEW



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 0.15 AND 0.30 MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.