Introduction
The NB7NPQ7021MMUGAEVB evaluation board was developed to provide a convenient platform to quickly verify the operation of the NB7NPQ7021M redriver in a USB type−A system environment.
This evaluation board manual contains:

- Information on the NB7NPQ7021M Evaluation Board
- Board Schematics
- Bill of Materials

Board Features

- Accommodates the Functional Evaluation of the NB7NPQ7021M
- Acts as a Reference Design that Can Easily be Modified for Active Cables, UFP (Upstream Facing Port), DFP (Downstream Facing Port), and DRP (Dual Role Port) Applications
- Type−A Plug and Receptacle to Easily Place in the Existing System Environment
- On Board Control Pins for Adjusting Settings without Compromising Form Factor

Part Description
The NB7NPQ7021M is a 3.3 V dual channel, linear redriver for USB 3.1 applications that supports both 5 and 10 Gbps data rates. Signal integrity degrades from PCB traces and transmission cables which may cause inter−symbol interference (ISI). The NB7NPQ7021M compensates for these losses by engaging varying levels of equalization at the input receiver. The output transmitter circuitry provides user selectable flat gain settings to create the best eye openings for the outgoing data signals. The flexibility of this part allows it to fit into many system applications.

After power up, the NB7NPQ7021M periodically checks both of the TX output pairs for a SuperSpeed USB receiver. When the receiver is detected, the RX termination becomes enabled and the NB7NPQ7021M is set to perform the redriver function.

The NB7NPQ7021M comes in a small 3 mm x 3 mm UQFN−16 package and is specified to operate across the entire industrial temperature range, −40°C to 85°C.

This manual should be used in conjunction with the device datasheet which contains full technical details on the device specifications and operation.
**BOARD MAP AND FUNCTIONAL SUMMARY**

Jumper “J1”: This jumper connects the 5V USB bus voltage to the input of a 3.3V LDO.

Jumper “J2”: This jumper connects the 3.3V output of the LDO to the VCC pins of the NB7NPQ7021M Device.

VCC and GND pins: These pins can be used to measure the power going to the NB7NPQ7021M devices. They are used to power the NB7NPQ7021M directly with a 3.3V supply and to measure the current through the device.

Resistors “R2 and R3”: These are 0Ω resistors that connect the USB 2.0 data lines. These can be removed in order to guarantee that only the super speed data lines are active.

EQ and Flat Gain Control pin Jumpers: These control the EQ and FG settings. Each 4-level control pin can be set to “H”, Floating, “R”, or “L”.

Jumpers are provided for CTRL_A0, CTRL_A1, CTRL_B0, and CTRL_B1.

*Please see the data sheet for the table of control pin settings and corresponding EQ and FG.

Figure 2. NB7NPQ7021M Evaluation Board Important Connection Information
External Power Supply Instructions

- Do Not connect this jumper.
- Connecting this jumper is optional and will not cause any issues if left on.
- Connect a 3.3V supply to the VCC Pin of this jumper and the ground to the GND pin of this jumper. The power Supply current limit should be set to 200mA.

Figure 3. NB7NPQ7021M Evaluation Board – Connecting to an External Power Supply
Select Power Source

The NB7NPQ7021MMUGAEVB has the flexibility to be powered through USB’s VBUS, or an external power supply. Table 1 and Figure 3 describe the jumper settings for each of the configurations:

Monitoring Current / Power

There are two easy ways to monitor the current consumed by the redriver. If you are using an external power supply, you can simply use the current meter commonly found on the power supplies. If you would like to use a current probe, simply solder the probe between the VCC pin and the power supply. This will allow monitoring of the NB7PQ7021M’s current consumption.

Step 4: USB 2.0 Data Lines

The USB 2.0 lines can be disconnected by removing the 0Ω resistors R2 and R3 on the D+ and D− lines. This is useful if you cannot easily tell whether the downstream facing port has acknowledged a super speed (+) connection with the inserted loss, or if it stepped down to high speed data rates. When a receiver is detected through RxDetect, the DFP will initialize link training. It will send a test signal out at the highest data rate and expect to see the same signal sent back by the UFP. If the signals do not match due to ISI (or any other connection issues) then it will drop down the data rate to USB 2.0 speeds.

On Windows machines, an easy way to tell that a super speed connection was not established is to look for a pop-up in the task bar letting the user know that “This device can perform faster”. A disk benchmarking tool like Crystal Disk Mark that lets you test read and write speeds to a peripheral storage can also be used.

---

![Figure 4. Power Source Selection](image)

**Table 1. Selecting a Power Source**

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB VBUS</td>
<td>Place jumper on J1 and a Jumper on J2</td>
</tr>
<tr>
<td>External Supply</td>
<td>Open J1 and connect positive lead of external supply to VCC and apply 3.3 V. Ensure that GND is connected to ground and that current limit is set to 200mA.</td>
</tr>
</tbody>
</table>
Complete Board Schematics
Figure 5. NB7NPQ7021M USB Type-A Evaluation Board Schematics
### BILL OF MATERIAL

#### Table 2. BILL OF MATERIALS

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Reference</th>
<th>Manufacturer</th>
<th>Manufacturer PN#</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USB 3.1 Redriver</td>
<td>U1</td>
<td>ON Semiconductor</td>
<td>NB7NPQ7021M</td>
</tr>
<tr>
<td>1</td>
<td>USB Type-A Receptacle</td>
<td>CN1</td>
<td>Amphenol Commercial Products</td>
<td>GSB4111312HR</td>
</tr>
<tr>
<td>1</td>
<td>USB Type-A Plug</td>
<td>CN2</td>
<td>Amphenol Commercial Products</td>
<td>GSB416445CHR</td>
</tr>
<tr>
<td>4</td>
<td>Capacitor 1UF (0603)</td>
<td>C1,C4,C8,C9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Capacitor 0.1UF (0402)</td>
<td>C11,C12,C16,C17, C18,C19,C20,C21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Blue LED</td>
<td>D2</td>
<td>Rohm Semiconductor</td>
<td>SMLE12BC7TT86</td>
</tr>
<tr>
<td>1</td>
<td>Header, 0.100&quot;</td>
<td>J1</td>
<td>Amphenol FCI</td>
<td>68001-203HLF</td>
</tr>
<tr>
<td>13</td>
<td>Header, 0.100&quot;</td>
<td>J2,J4,J5,J6,J7,J8,J9,J10,J11,J12,J13,J14,J15</td>
<td>Samtec Inc</td>
<td>TSW-150-14-G-S</td>
</tr>
<tr>
<td>2</td>
<td>Resistor 0.0 Ohm (0402)</td>
<td>R2,R3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Resistor 68K (0402)</td>
<td>R4,R5,R6,R7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Resistor 1 K (0402)</td>
<td>R21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TEST POINT</td>
<td>TP1,TP2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Resistor 220K (0402)</td>
<td>R22,R23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3.3V Voltage Regulator</td>
<td>U3</td>
<td>ON Semiconductor</td>
<td>NCP4625DSN33T1G</td>
</tr>
</tbody>
</table>

---

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, and does ON Semiconductor 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.

---

**PUBLIC INFORMATION**

**LITERATURE FULFILLMENT:**

USA/Canada

Europe, Middle East and Africa Technical Support:

Phone: 421 23 790 2910

Japan Customer Focus Center

Phone: 81-3-5817-1050

N. American Technical Support: 800-282-9855 Toll Free

ON Semiconductor Website: www.onsemi.com

---

**Publications Ordering Information**

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

For additional information, please contact your local Sales Representative.
NB7NPQ702MEVK, NB7VPQ702MEVK