# NB3W800LMNGEVB
# Evaluation Board Manual

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EVALUATION BOARD MANUAL

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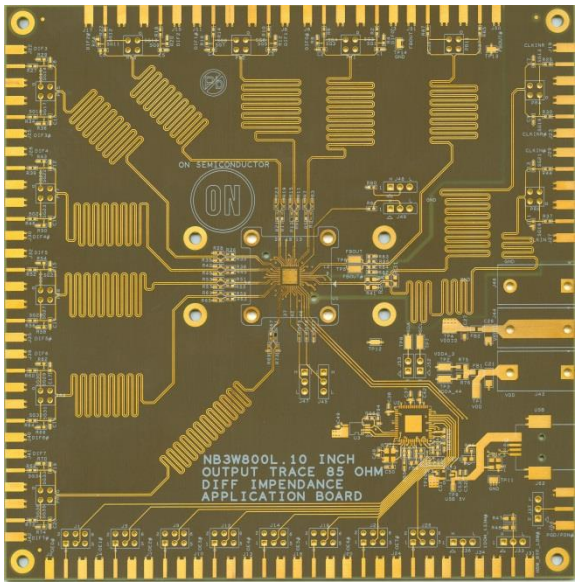
### Introduction

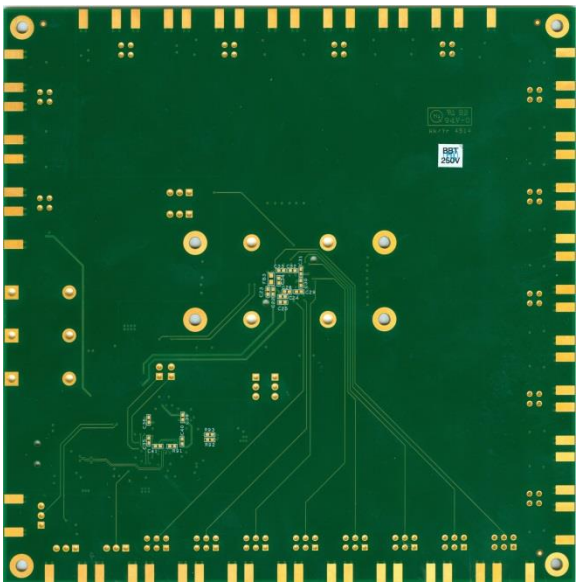
The NB3W800LMNGEVB evaluation board was developed for the NB3W800L (HCSL-Compatible low power NMOS push pull Output). This evaluation board was designed to provide a flexible and convenient platform to quickly evaluate, characterize and verify the operation of the NB3W800L devices.
This evaluation board manual contains:

- Information on the NB3W800L Evaluation Board
- Assembly Instructions
- Test and Measurement Setup Procedures
- Board Schematic and Bill of Materials

This manual should be used in conjunction with the device datasheet which contains full technical details on the device specifications and operation.




Top View



Bottom View

## Board Features

**One Board Design/Layout:**

- Accommodates the electrical characterization of the NB3W800L (Low power NMOS Push pull outputs)
- Accommodates a custom QFN-48 pogo-pin socket for lab evaluation, or a soldered down QFN-48 package.
- Incorporates on board SDI I2C/SMBus interface circuitry; powered from a USB connection, minimizing cabling.
- Convenient and compact board layout
- 3.3V power supply device operation
- Differential inputs and output signals are accessed via SMA connectors or high impedance probes

The evaluation board is with 10" output traces, with 85-Ω differential trace impedance.

All Inputs & Outputs have signal access via side-launch SMA connectors, installed, except SDA and SCL.

- SDA and SCL can be externally accessed by means of jumper headers & "test-point" anvils (for use with mini-grabber cables)

Each control pin can be managed directly through an SMA connector or manually with a H/L jumper header; H = VCC, L = DUTGND.

Other Board Features

There are no vias on the differential I/O metal traces so as to eliminate via impedance and stub effects on the high-speed I/Os.
This board accommodates a custom QFN-48 socket for lab evaluation, so there is a socket keep-out area.
Stand-offs are installed.

## Board Layout

The NB3W800L QFN-48 Evaluation Board provides a high bandwidth, 43-Ω controlled impedance environment and is implemented in four layers.
All layers are constructed with FR4 dielectric material.
The first layer is the primary signal layer, including all of the differential inputs and outputs.
The second layer is the ground plane. It is dedicated for the SMA connector ground plane and for DUT ground.
The third layer is dedicated as the power plane. A portion of this 3rd layer is designated for the device VDD and VDDIO power planes.
The fourth layer contains control lines, power supply banana jacks and device power pin bypass capacitors.

Layer Stack

L1 (top) Signal (FR4)
L2 DUTGND (device ground) and SMA Ground, SMAGND
L3 VDD, VDDIO (separate device power supplies)
L4 (bottom), power supply by-pass capacitors, control pin traces and banana jacks

## Power Supplies

Each VDD, VDDIO and GND power supply have a separate side-launch banana jack

Board Layer #2 = SMAGND = DUTGND = 0V.

GND Banana Jack = negative power supply for DUTGND and SMAGND.

**Exposed Pad (EP):** The exposed pad footprint on the board is mechanically connected (soldered) to the exposed pad of the QFN-48 package, and is electrically connected to DUTGND power supply, the negative supply of the device.

Board Layer #3 = VDDx Power Supplies

VDD = positive power supply for VDDA (pins #3, 44)

VDDIO = positive power supply for VDDIO (pins #10, 15, 19, 27, 34, 38, 42)

VDD & VDDIO have the power supply filtering per datasheet, and the bypass caps are located on top, by the banana jacks.

All VDD/VDDA /VDDIO device pins have 0.1uF bypass caps installed on bottom side of package pins.

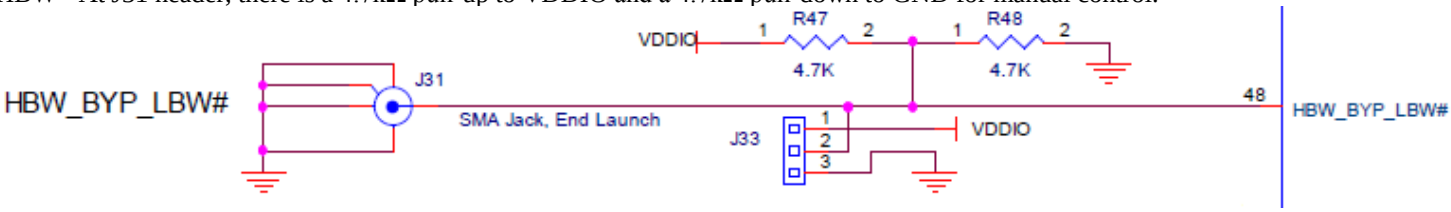
Board is capable of measuring device IDD & IDDIO.

## Control Pins

Each control pin can be managed directly through an SMA connector or manually with a H/L jumper header;

**Tri-Level Input Pins - HBW_BYP_LBW#**

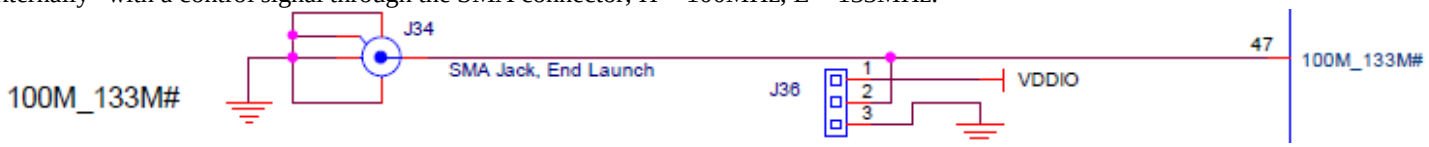
On the 85ohm, 10inch output trace boards, the tri level input pin, HBW, has a 4.7kohm pull up to VDD and a 4.7kohm pull down to GND resistors; defaults to midlevel. Need to jumper for a High or jumper for a Low.
HBW - At J31 header, there is a 4.7kΩ pull-up to VDDIO and a 4.7kΩ pull-down to GND for manual control.



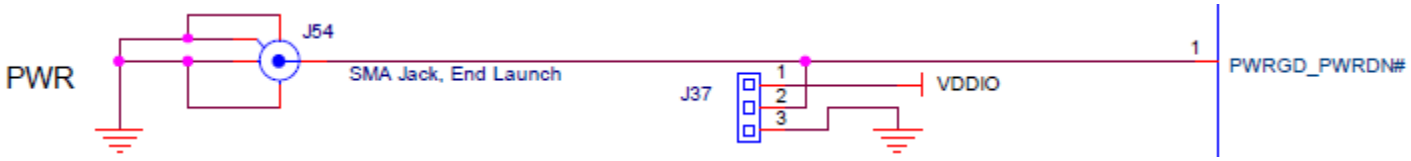

**OE# Pins** (Output Enable/Disable Function)
There are eight OE# pins available to control differential outputs
DIF0/0# to DIF7/7#. All of the OE#s can be controlled individually:

1) externally via the SMA connector for evaluation purposes, no jumper installed on OE#.
2) automatically by GUI control when jumper is installed on OE# in middle header.
3) manually with the convenient High/Low OE# jumper headers.

**100M_133M# -** Frequency Selection
The 100M_133M# frequency selection pin can be controlled manually with the High/Low header jumper (J34) at the SMA or externally with a control signal through the SMA connector; H = 100MHz, L = 133MHz.




**PWRGD/PWRDN**
The PWRGD/PWRDN pin can be controlled manually with the High/Low header jumper (J54) at the SMA connector or externally with a control signal through the SMA connector; H = PWRGD, L = PWRDN.



## Differential Clock Inputs and Outputs

Differential Inputs - CLK_IN & CLK_IN#

The differential Clock input traces, CLK_IN/CLK_IN#, are routed from the SMA connectors on the right side directly to the DUT; there are no vias on metal traces.

CLK_IN & CLK_IN# have resistor pads (R40 & R41) to GND just outside the keep-out area of the socket to terminate a signal generator, if used. 50-ohm resistors are installed. **Remove these resistors** if CLK_IN & CLK_IN# are driven by another IC device.

Differential Outputs - DIFx and DIFx#

All eight differential output metal traces are designed to have equal length from the device under test (DUT) pins to the SMA connectors. These outputs have 43-ohm trace impedance (FR4), 85-ohm line-to-line.

All of the outputs have SMA connectors installed; there are no vias on the metal traces.

Each DIFx output has a provision for $C_{Load}$ at the SMA; **2pF capacitors are installed on all outputs**.

Rs & Rp – Located close to DUT, just outside socket area.

43-ohm board - Installed with Rs = 27-Ω and Rp = not installed.

HCSL outputs are typically terminated with 50-Ω to ground. This can be easily accomplished by connecting the HCSL outputs to the 50-Ω internal impedance in the oscilloscope.

### Series R provision at SMA

A 0-ohm series resistor is installed between the end of the transmission line and the SMA connector:

- For measuring HCSL outputs with a Hi-Z probe.
- For measuring HCSL outputs with a 50-Ω scope head.

### Hi-Z Probe Use

1) Single-ended Hi-Z probes or,
2) Differential Hi-Z probe; (see layout below)

A "solder gap" is employed at each output SMA connector.

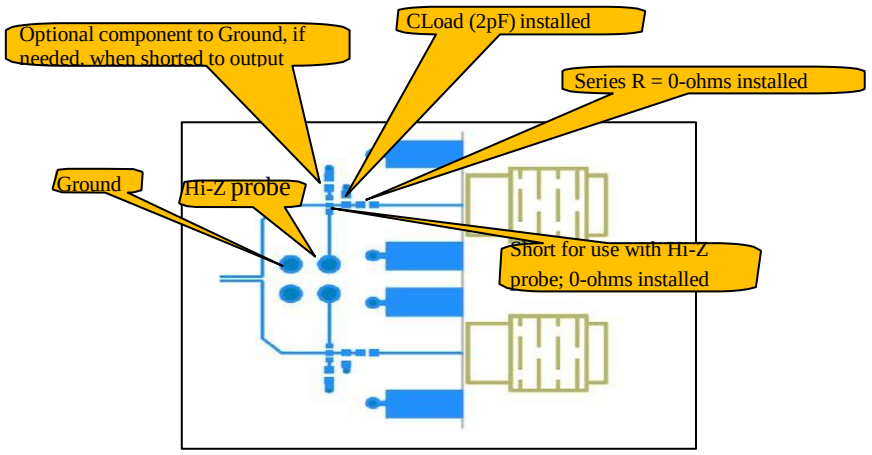
Short the gap with a solder blob or 0-Ω resistor to enable use of a Hi-Z probe. This solder gap is shorted with a 0-ohm resistor.

Holes for headers to connect to Hi-Z probes are available, but the header pins are not installed.

An optional component can be installed on each output. Additional capacitance loading can be accomplished with this board feature.

The NB3W800L EVB was designed with the flexibility to configure the board to measure the differential HCSL or low power NMOS Push Pull outputs with a 50-ohm scope head or High impedance FET probe.

The following figure describes the board's output features:



**FB_OUT & FB_OUT#** - External Feedback Termination

Since the FB_OUT & FB_OUT# pins do not drive transmission lines, the board layout has these pins loaded/terminated per datasheet;
These pins have series R pads, R82 & R83, to GND located close to the DUT, just outside the socket area.

### USB & I2C / SMBus Interface

The NB3W800L EVB has an on-board I2C/SMBus interface circuitry located in the lower left section of the board.
This circuitry will interface with the program and the device via the SDA and SCL input pins, and can control the OE# pins, PLL Mode and Frequency Select directly from the GUI.

**SCL & SDA** - The SMBus Clock (SCL) and Data (SDA) pins are exercised through the on-board I2C interface.

In order to enable the I2C control of the DUT, **header jumpers J52 & J53 must be shorted.**

The I2C / SMBus interface circuitry is powered separately from the USB type-B connection and is isolated from device VDD and VDDIO. The USB GND is connected to DUTGND.

"Test-point anvils" TP7 & TP8 are available for external control of the device's SCL and SDA pins by another off-board programmer, allowing other SMBus emulators to be used to program the DUT. If used, remove both jumpers J52 & J53.

## NB3W800L Evaluation Board
## Quick Start Lab Set-Up User's Guide

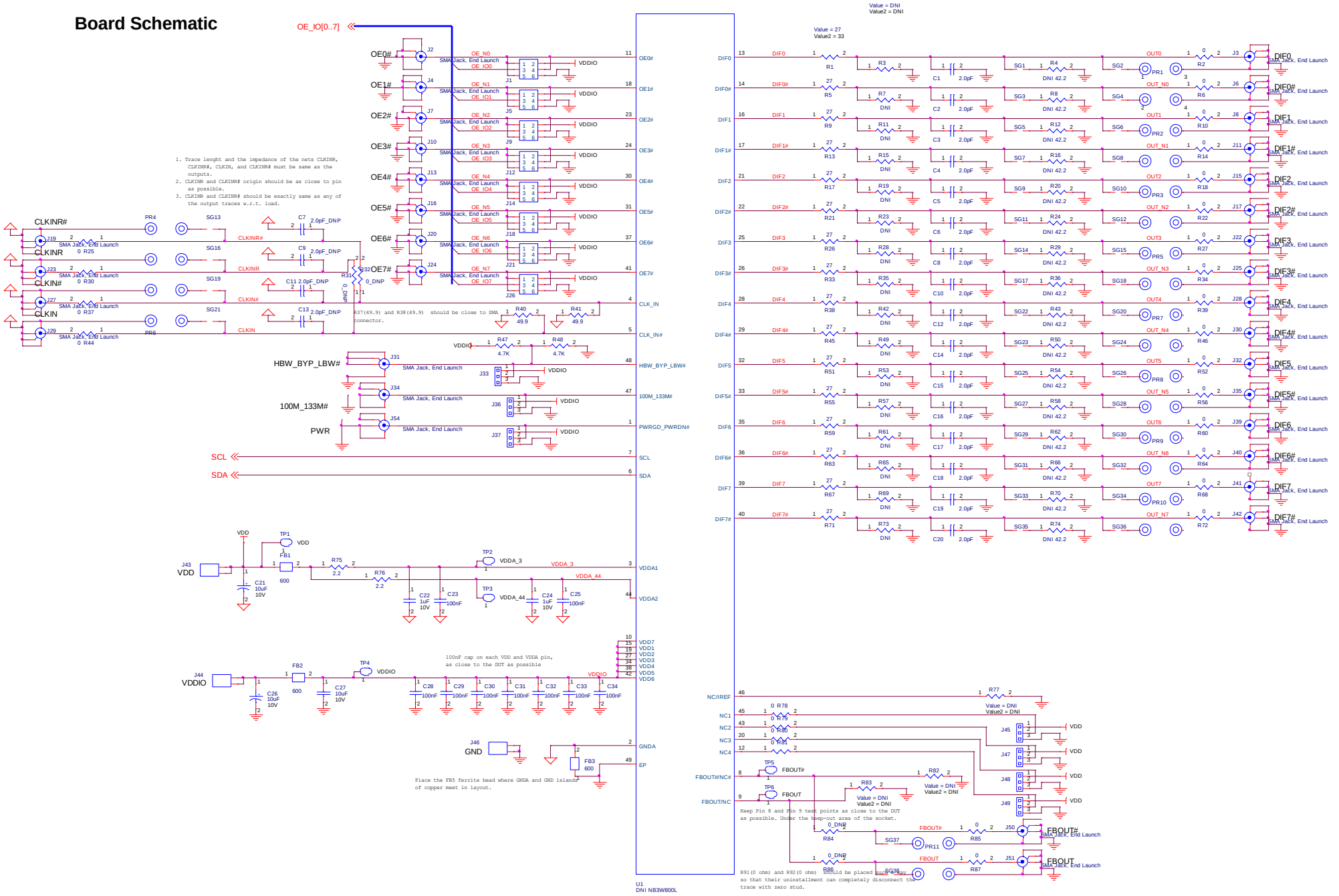
### Pre Power Up

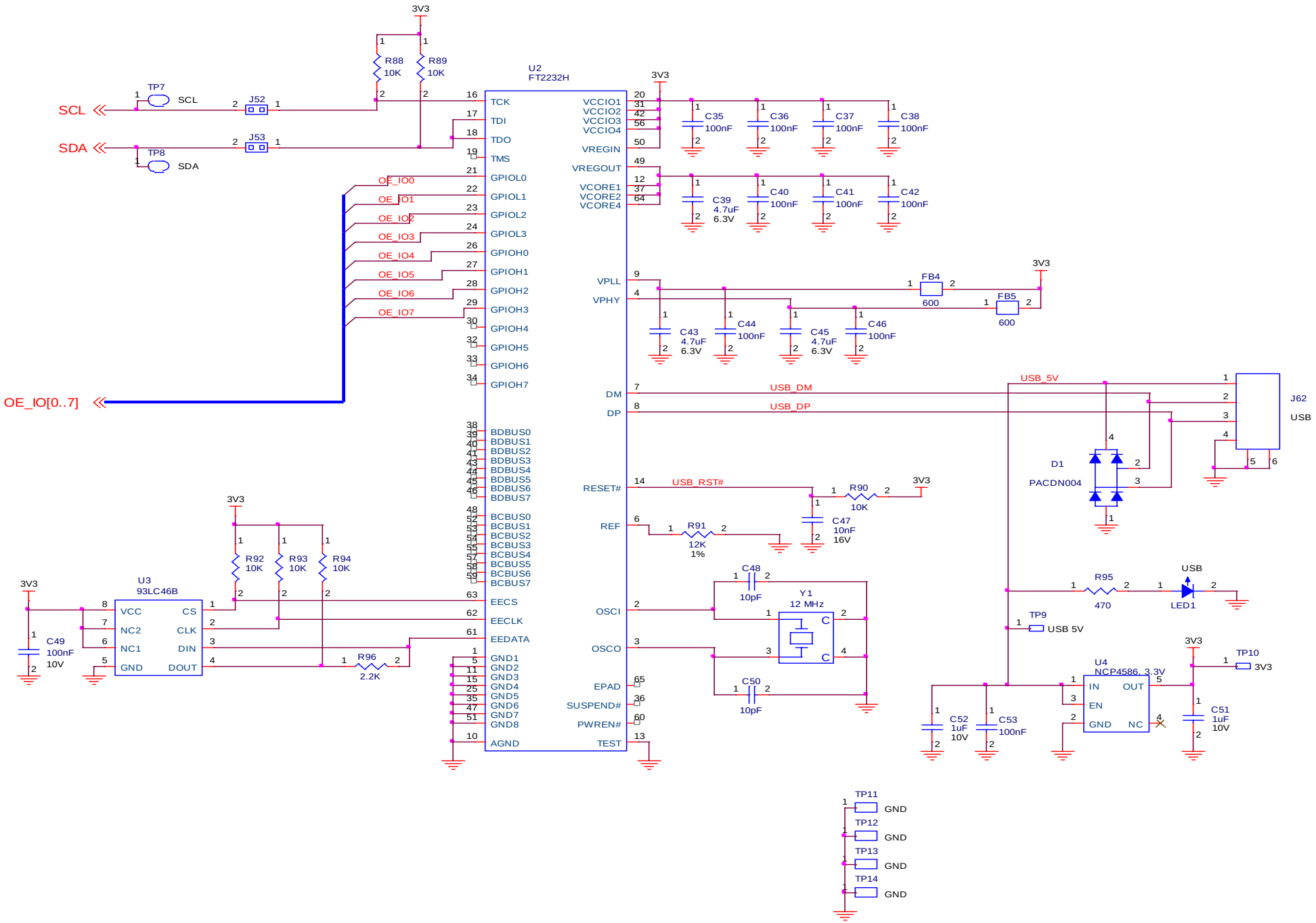
1) Connect power supply cables to VDD, VDDIO and DUTGND banana jacks; (do not turn power on, yet)
2) Connect a signal generator to the SMA connectors for the CLK_IN & CLK_IN# inputs, pins 4 and 5. 50-ohm termination resistors are installed for a signal generator on the board. Set-up appropriate input signal levels according to the device data sheet.
3) Ensure the PWRGD/PWRDN# pin (Pin #1) is in the Low state before power up (PWRDN#). There is a jumper (J37) on pin 1 to easily select between High and Low.
4) The 100M_133M# and HBW_BYP_LBW pins need to be hardware selected with jumpers J36 and J33 respectively.

### Power Up Sequence

1) Turn on power supply, 3.3V (VDD & VDDIO)
2) Move PWRGD/PWRDN# jumper to logic High, PWRGD
3) Turn on the Differential Clock Signal for the CLK_IN inputs (HCSL input, VIL = 0V, VIH = 700mV, Frequency based on J36 selection to 100 MHz or 133MHz)
4) Monitor DIF_x/DIF_x# outputs on oscilloscope

# Board Schematic




U2
FT2232H
3V3
SCL
SDA
TP7
TP8
J52
J53
R88 10K
R89 10K
TCK
TDI
TDO
TMS
GPIOL0
GPIOL1
GPIOL2
GPIOL3
GPIOH0
GPIOH1
GPIOH2
GPIOH3
GPIOH4
GPIOH5
GPIOH6
GPIOH7
OE_IO0
OE_IO1
OE_IO2
OE_IO3
OE_IO4
OE_IO5
OE_IO6
OE_IO7
OE_IO[0..7]
BDBUS0
BDBUS1
BDBUS2
BDBUS3
BDBUS4
BDBUS5
BDBUS6
BDBUS7
BCBUS0
BCBUS1
BCBUS2
BCBUS3
BCBUS4
BCBUS5
BCBUS6
BCBUS7
EECS
EECLK
EEDATA
GND1
GND2
GND3
GND4
GND5
GND6
GND7
GND8
AGND
VCCIO1
VCCIO2
VCCIO3
VCCIO4
VREGIN
VREGOUT
VCORE1
VCORE2
VCORE4
C35 100nF
C36 100nF
C37 100nF
C38 100nF
C39 4.7uF 6.3V
C40 100nF
C41 100nF
C42 100nF
VPLL
VPHY
FB4 600
FB5 600
C43 4.7uF 6.3V
C44 100nF
C45 4.7uF 6.3V
C46 100nF
DM
DP
USB_DM
USB_DP
USB_5V
J62
USB
D1
PACDN004
RESET#
USB_RST#
R90 10K
C47 10nF 16V
REF
R91 12K 1%
C48 10pF
Y1 12 MHz
C50 10pF
OSCI
OSCO
EPAD
SUSPEND#
PWREN#
TEST
R95 470
LED1
TP9
USB 5V
U4
NCP4586, 3.3V
IN
OUT
EN
GND
NC
C51 1uF 10V
C52 1uF 10V
C53 100nF
TP10
3V3
U3
93LC46B
VCC
CS
NC2
CLK
NC1
DIN
GND
DOUT
R92 10K
R93 10K
R94 10K
R96 2.2K
C49 100nF 10V
TP11
TP12
TP13
TP14
GND

## Bill Of Materials

NB3W800L 85 Ohms, 10" trace board

| Item | Quantity | Part Number | Reference | Part | PCB Footprint | Vendor | Vendor PN | Mfr | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 1 | 20 | C1005C0G1H020C | C1,C2,C3,C4,C5,C6,C7,C8, C9,C10,C11,C12,C13,C14, C15,C16,C17,C18,C19,C20 | 2.0pF | c0402 | DigiKey | 445-4863-1-ND | TDK | DNP C7, C9, C11, C13 |
| 2 | 2 | TR3A106K010C2000 | C21,C26 | 10uF | c1206 | DigiKey | 718-1300-1-ND | Vishay | |
| 3 | 4 | GRM155R61A105ME15D | C22,C24,C51,C52 | 1uF | c0402 | DigiKey | 490-5409-1-ND | Murata | |
| 4 | 20 | 0402ZD104KAT2A | C23,C25,C28,C29,C30,C31, C32,C33,C34,C35,C36,C37, C38,C40,C41,C42,C44,C46, C49,C53 | 100nF | c0402 | DigiKey | 478-1129-1-ND | AVX | |
| 5 | 1 | C1608X5R1A106M | C27 | 10uF | c0603 | DigiKey | 445-6853-1-ND | TDK | |
| 6 | 3 | C1005X5R0J475M | C39,C43,C45 | 4.7uF | C0402 | DigiKey | 445-7395-1-ND | TDK | |
| 7 | 1 | 0402YC103KAT2A | C47 | 10nF | C0402 | DigiKey | 478-1114-1-ND | AVX | |
| 8 | 2 | GRM1555C1H100JZ01D | C48,C50 | 10pF | C0402 | DigiKey | 490-1278-1-ND | Murata | |
| 9 | 1 | PACDN004SR | D1 | PACDN004 | sot_143 | Mouser | 748-PACDN004SR | ON Semi | |
| 10 | 3 | BLM18KG601SN1D | FB1,FB2,FB3 | 600 | L0603 | DigiKey | 490-5258-1-ND | Murata | |
| 11 | 2 | BLM15AG601SN1D | FB4,FB5 | 600 | L0402 | DigiKey | 490-1006-1-ND | Murata | |
| 12 | 8 | 67996-206HLF | J1,J5,J9,J12,J14,J18,J21, J26 | Header 2x3 Thru-Hole | berg_2x3_2p54 | DigiKey | 609-3210-ND | FCI | |
| 13 | 33 | 142-0701-801 | J2,J3,J4,J6,J7,J8,J10, J11,J13,J15,J16,J17,J19, J20,J22,J23,J24,J25,J27, J28,J29,J30,J31,J32,J34, J35,J39,J40,J41,J42,J50, J51,J54 | SMA Jack, End Launch | sma_jack_end_launch | Digikey<br>Digikey<br>Digikey<br>Digikey<br>Digikey<br>Digikey | J502-ND<br>J502-ND<br>J502-ND<br>J502-ND<br>J502-ND<br>J502-ND | Johnson Components<br>Johnson Components<br>Johnson Components<br>Johnson Components<br>Johnson Components<br>Johnson Components | |
| 14 | 7 | 961103-6404-AR | J33,J36,J37,J45,J47,J48, J49 | Header 3-pin | hdr_1x3_2p54 | DigiKey | 3M9448-ND | 3M | |
| 15 | 1 | 571-0500 | J43 | Banana Jack, Thru-Hole, Red | con_571-0500 | Mouser | 164-6219 | Deltron | |
| 16 | 1 | 571-0700 | J44 | Banana Jack, Thru-Hole, Yellow | con_571-0500 | Mouser | 164-7170 | Deltron | |
| 17 | 1 | 571-0100 | J46 | Banana Jack, Thru-Hole, Black | con_571-0500 | Mouser | 164-6218 | Deltron | |
| 18 | 2 | 961102-6404-AR | J52,J53 | Header 2-pin | hdr_1x2_2p54 | DigikEY | 3M9447-ND | 3M | |
| 19 | 1 | USB-B1SMHSW6 | J62 | Conn, USB-B, SMT | con_usb_b_ra | DigiKey | ED2994-ND | On Shore Technology | |
| 20 | 1 | LTST-C190KGKT | LED1 | LED, Green | led_0603 | DigiKey | 160-1435-1-ND | Lite-On | |
| 21 | 11 | No Part | PR1,PR2,PR3,PR4,PR5,PR6, PR7,PR8,PR9,PR10,PR11 | 4 Round Pads, .060 with .040 Hole | berg_2x2_2p54 | | | | |
| 22 | 16 | ERJ-2GEJ270X | R1,R5,R9,R13,R17,R21,R26, R33,R38,R45,R51,R55,R59, R63,R67,R71 | 27 | r0402 | DigiKey | P27JCT-ND | Panasonic | |
| 23 | 27 | CRCW04020000Z0ED | R2,R6,R10,R14,R18,R22, R25,R27,R30,R34,R37,R39, R44,R46,R56,R60,R64,R68, R72,R78,R79,R80,R81,R84, R85,R86,R87 | 0 | r0402 | DigiKey | 541-0.0JCT-ND | Vishay | DNP R78, R79, R80, R81, R84, R86 |
| 24 | 19 | ERJ-2RKF42R2X | R3,R7,R11,R15,R19,R23, R28,R35,R42,R49,R53,R57, R61,R65,R69,R73,R77,R82, R83 | DNI | r0402 | DigiKey | P42.2LCT-ND | Panasonic | |
| 25 | 16 | ERJ-2RKF42R2X | R4,R8,R12,R16,R20,R24, | DNI 42.2 | r0402 | DigiKey | P42.2LCT-ND | Panasonic | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | R29,R36,R43,R50,R54,R58,<br>R62,R66,R70,R74 | | | | | | |
| 26 | 2 | CRCW06030000Z0EA | R31,R32 | 0 | r0603 | DigiKey | 541-0.0JCT-ND | Vishay | DNP R31, R32 |
| 27 | 2 | ERJ-3EKF49R9V | R40,R41 | 49.9 | r0603 | DigiKey | P49.9HCT-ND | Panasonic | |
| 28 | 2 | ERJ-3GEYJ472V | R47,R48 | 4.7K | r0603 | DigiKey | P4.7KGCT-ND | Panasonic | |
| 29 | 1 | CRCW04020000Z0ED | R52 | 0 | r0402 | DigiKey | 541-0.0JCT-ND | Vishay | |
| 30 | 2 | ERJ-3GEYJ2R2V | R75,R76 | 2.2 | r0603 | DigiKey | P2.2GCT-ND | Panasonic | |
| 31 | 6 | ERJ-2GEJ103X | R88,R89,R90,R92,R93,R94 | 10K | r0402 | DigiKey | P10KJCT-ND | Panasonic | |
| 32 | 1 | ERJ-2RKF1202X | R91 | 12K | r0402 | DigiKey | P12.0KLCT-ND | Panasonic | |
| 33 | 1 | ERJ-2GEJ471X | R95 | 470 | r0402 | DigiKey | P470JCT-ND | Panasonic | |
| 34 | 1 | ERJ-2GEJ222X | R96 | 2.2K | r0402 | DigiKey | P2.2KJCT-ND | Panasonic | |
| 35 | 38 | No Part | SG1,SG2,SG3,SG4,SG5,SG6,<br>SG7,SG8,SG9,SG10,SG11,<br>SG12,SG13,SG14,SG15,SG16,<br>SG17,SG18,SG19,SG20,SG21,<br>SG22,SG23,SG24,SG25,SG26,<br>SG27,SG28,SG29,SG30,SG31,<br>SG32,SG33,SG34,SG35,SG36,<br>SG37,SG38 | Solder Gap | r0201 | | | | |
| 36 | 8 | 5015 | TP1,TP2,TP3,TP4,TP5,TP6,<br>TP7,TP8 | Test Point, SMT | tp_70_135 | DigiKey | 5015KCT-ND | Keystone | |
| 37 | 2 | No Part | TP9,TP10 | Test Pad 30 x 60 mil | tp_30_60 | | | | |
| 38 | 4 | No Part | TP11,TP12,TP13,TP14 | Test Pad 50 x 100 mil | tp_50_100 | | | | |
| 39 | 1 | DNI NB3W800L | U1 | DNI NB3W800L | MODULE_48QFN_0P40 | On Semi | - | ON Semi | |
| 40 | 1 | FT2232HQ-REEL | U2 | FT2232H | qfn_64_0p5 | DigiKey | 768-1025-1-ND | FTDI | |
| 41 | 1 | 93LC46BT-I/ST | U3 | 93LC46B | tssop_8_4p4w_0p65 | DigiKey | 93LC46BT-I/STCT-ND | Microchip | |
| 42 | 1 | NCP4586DSN33T1G | U4 | NCP4586, 3.3V | sot23_5p | ON Semi | NCP4586DSN33T1G | ON Semi | |
| 43 | 1 | ABM8G-12.000MHZ-4Y-T3 | Y1 | 12 MHz | CRY-4P-SMD1 | DigiKey | 535-10901-1-ND | Abracon Corp | |