NBIoT_Inband_UL_RX_TestBench

Where To Find This Example

Select **Help > Open Examples...** from the menus and type either the example name listed above or one of the keywords below.

Or in Version 13 or higher you can open the project directly from this page using this button. Make sure to select the **Enable Guided Help** before clicking this button.

Open Install Example

Design Notes

NB-IoT In-band Uplink eNB RX Test Bench

This example demonstrates operation of NB-IoT inside an LTE signal band. The NB-IoT uplink signal is configured as in-band, NPUSCH format 1, compliant with 3GPP Release 13 specification.

NB-IoT signal is placed in an unused RB within the LTE band.

Configuration options include:

• Carrier frequency (in MHz)

• Transmit power sweep for BER and throughput test (TxOutLvlStart_dBm, TxOutLvlSpan_dBm, TxOutLvlStep_dBm).

The TxOutLvl parameters are specified for "total transmit power". The BER plot, however,

uses derived "per-subcarrier power" in the x-axis so that the BER performance of various

subcarrier modes can be compared.

• NB-IoT subcarrier mode (NBIoT_SCMode)

0: 3.75kHz single tone (use NBIoT_SCAssign parameter to specify between 0-47)

1: 15kHz single tone (use NBIoT_SCAssign parameter to specify between 0-11)

2-5: 15kHz three tone {0,1,2}, {3,4,5}, {6,7,8}, or {9,10,11}

6,7: 15kHz six tone {0,1,...,5} or {6,7,..., 11}

8: 15kHz with twelve tone

•NB-IoT subcarrier assignment when NBIoT_SCMode is 0 or 1 (NBIoT_SCAssign)

•NB-IoT resource block location (NBIoT_RB)

- Use NBIoT_RB<0 or NBIoT_RB>N_RB_UL for guard band operation

- Use NBIoT_RB between 0 and N_RB_UL for in-band operation

•NB-IoT modulation type (NBIoT_ModType)

- Supports pi/2-BPSK or pi/4-QPSK (rotated)

•LTE source has selectable UL RB occupancy using N_RB_Channel. Default is {15,34} which means that the PUSCH0 occupies the first 15RBs and PUSCH2 the 34RBs. N_RB_Buffers parameter is used to select the buffer RBs between PUSCH0 and PUSCH1. Default setting is N_RB_Buffer=1 such that RB location 16 is left open for NB-IoT transmission. Thus selecting "NBIoT_RB=15" places the NB-IoT signal in RB location 16 which is blanked in the LTE UL configuration.

The test bench can be used to monitor:

• The TX signal spectrum at various points in the link

• NB-IoT link performance in the presence of LTE UL signal

• IQ constellation of the transmitted and demodulated signals

• Bit error rate (BER), block error rate (BLER), and throughput

• CRC error for each block

References:

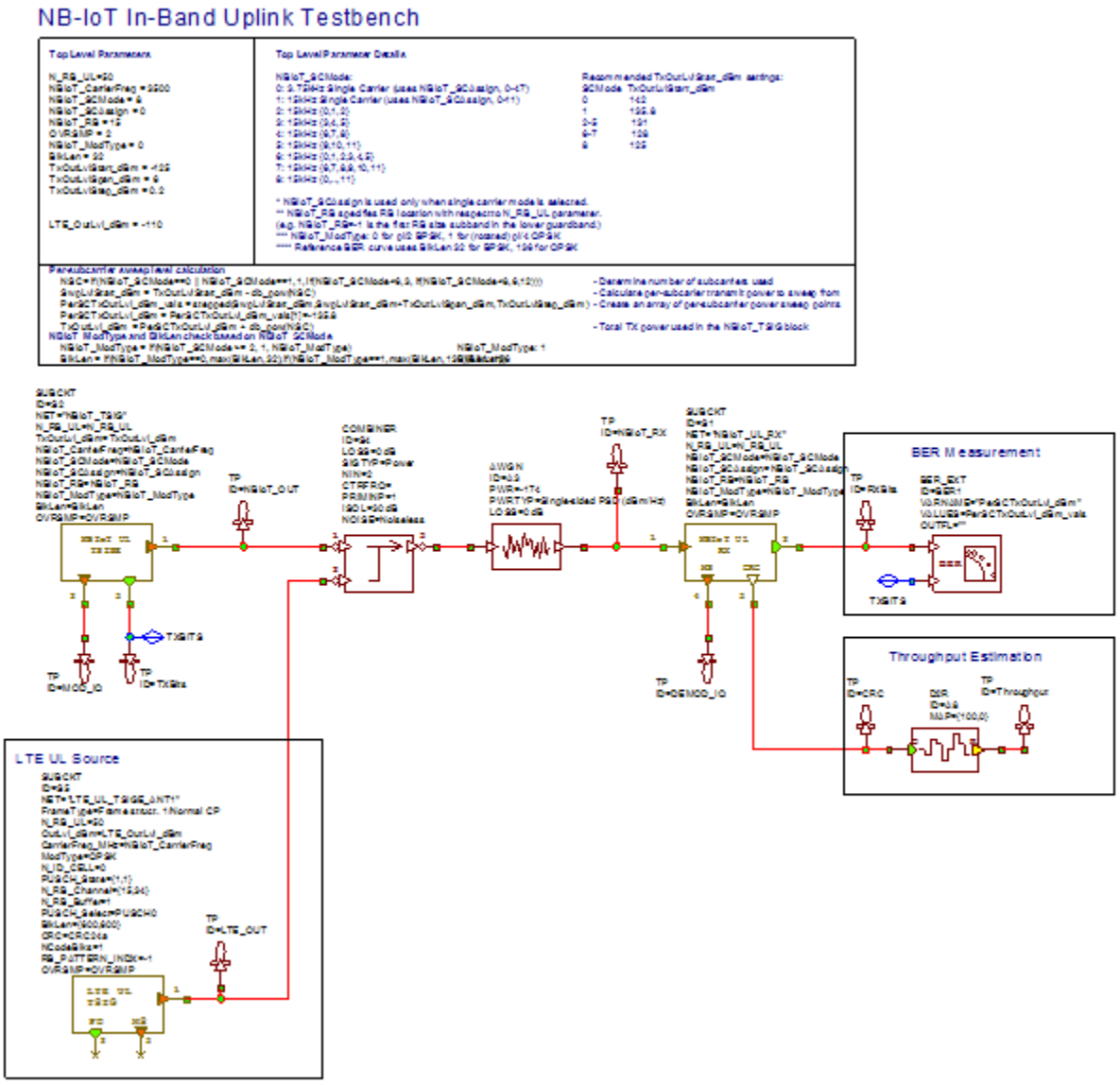
TS 36.211 Release 13, Chapter 10

TS 36.212 Release 13, Chapter 6

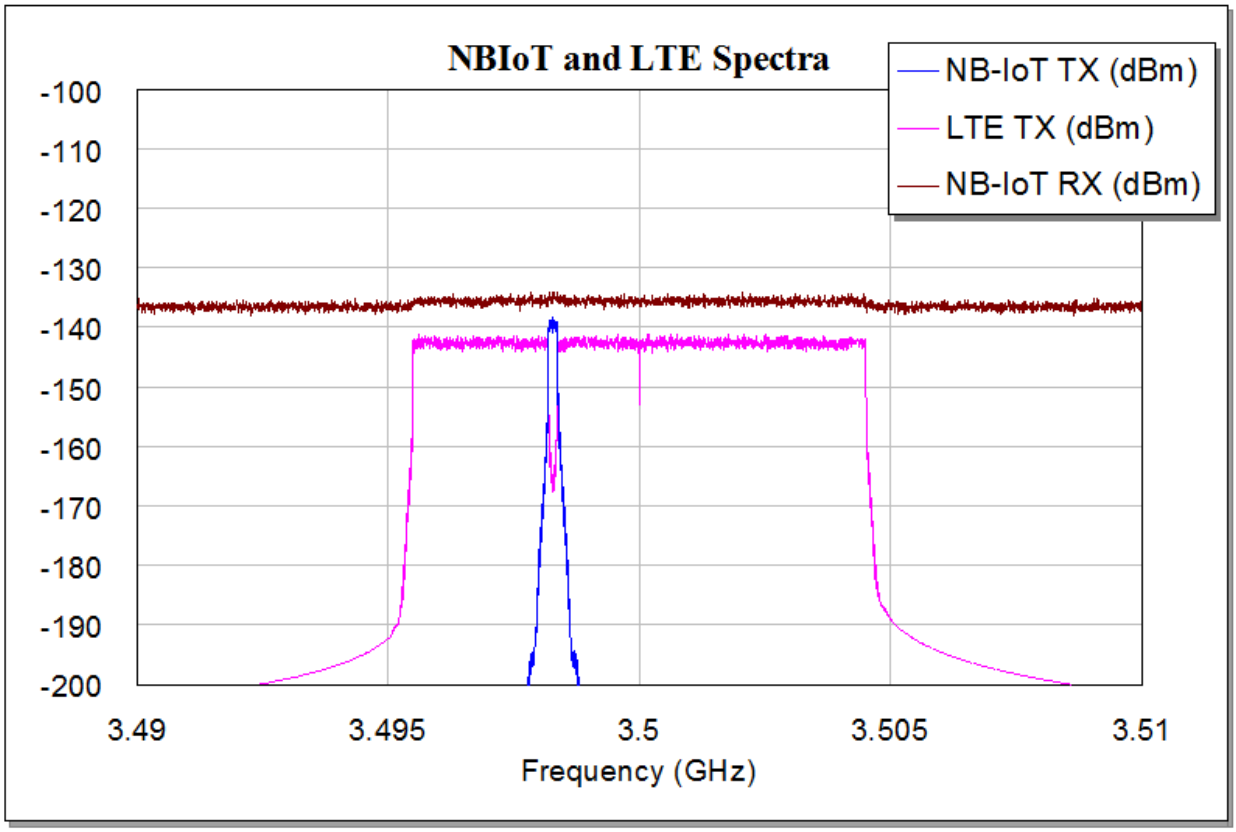
TS 36.213 Release 13, Chapter 16

TS 36.104 Release 13.5, Appendix A.16 Fixed Reference Channels for NB-IoT NPUSCH Format 1

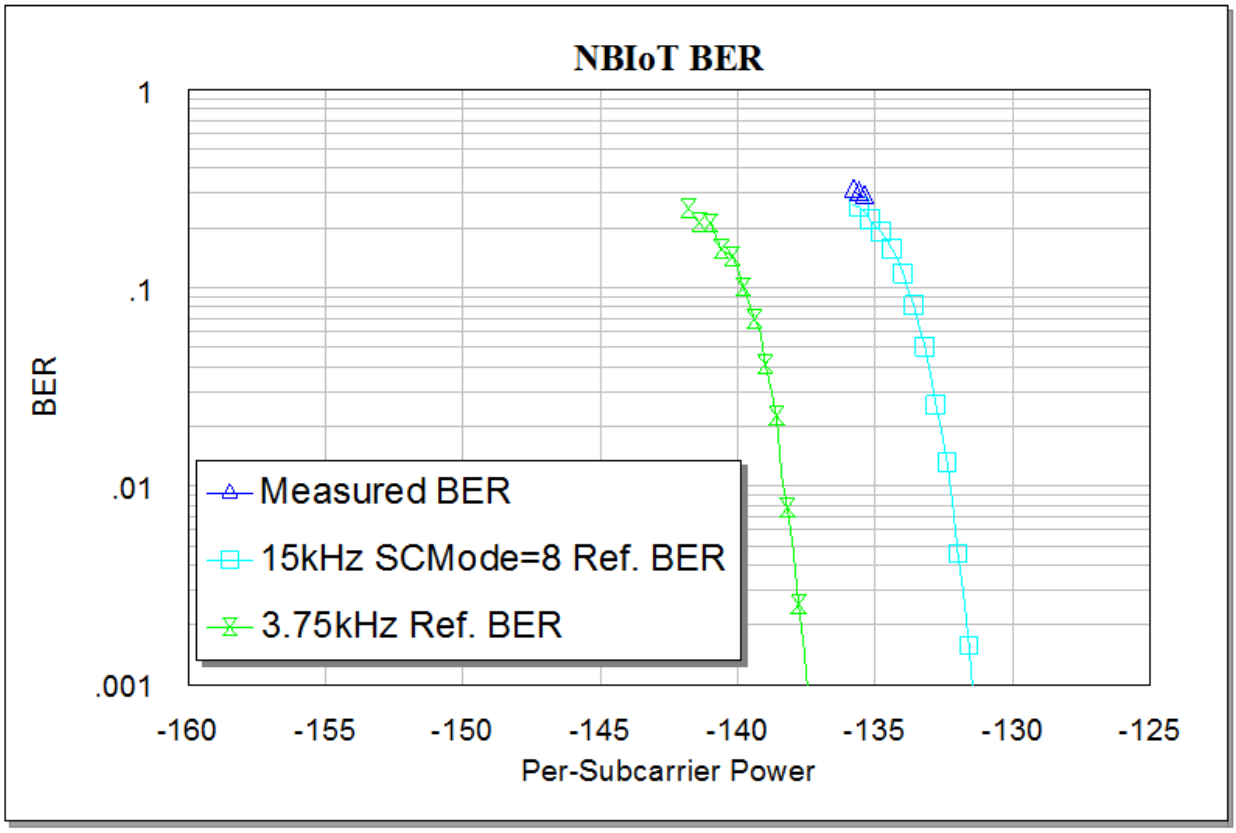
System Diagram - NB IoT Testbench



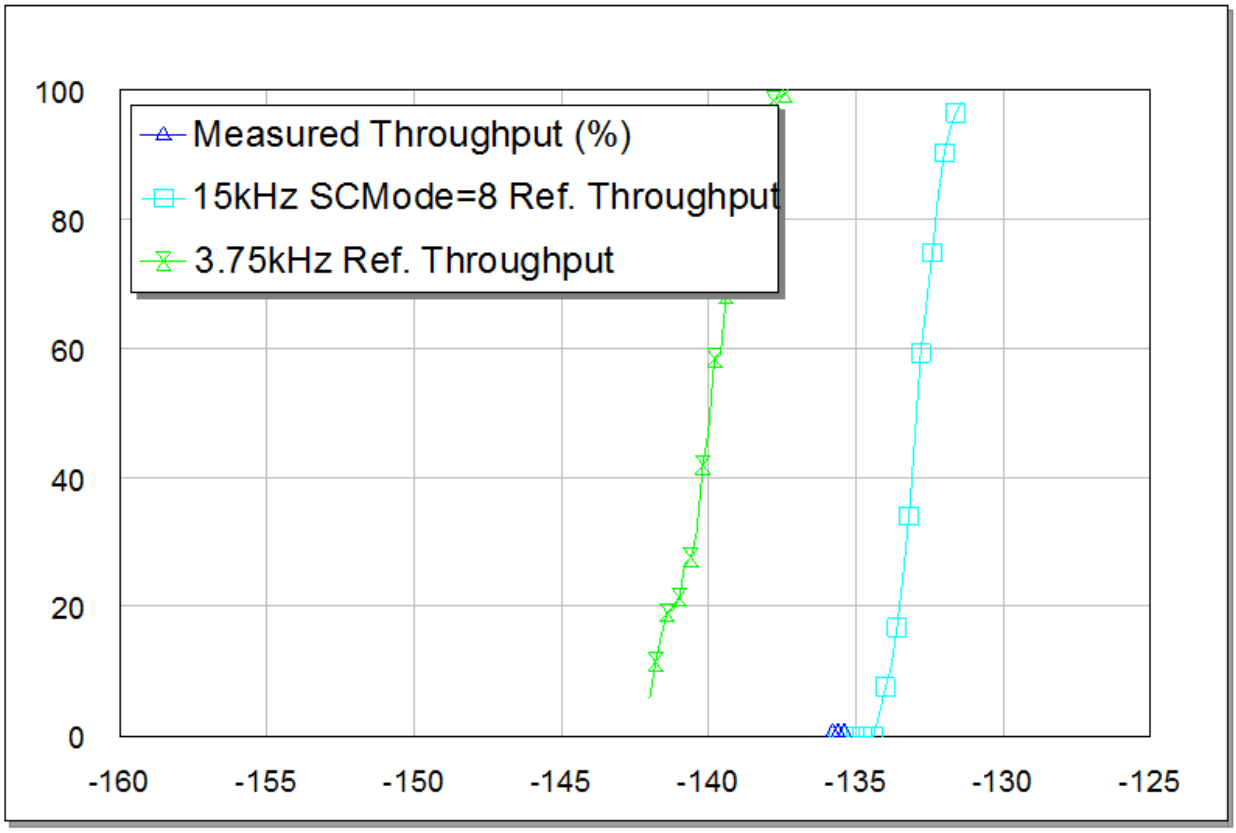
Graph - NBIoT and LTE Spectra



Graph - NBIoT BER



Graph - NBIoT Throughput


Measured Throughput (%)
15kHz SCMode=8 Ref. Throughput
3.75kHz Ref. Throughput
100
80
60
40
20
0
-160
-155
-150
-145
-140
-135
-130
-125