Application Note：

Telink BLE PHY Test Manual

AN-BLE-16032100-E2

Ver 1.1.0

2016/7/15

Brief：

This document is the guide for Telink BLE PHY layer test.

TELINK SEMICONDUCTOR

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Revision History

Version	Major Changes	Date	Author
1.0.0	Initial release	2016/3	C.Q.W., L.X., Cynthia
1.1.0	Modified UART command examples.	2016/7	C.Q.W., Cynthia

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1 Brief Introduction

This document mainly takes Telink 8267 EVK as a DUT example and presents how to test BLE (Bluetooth Low Energy) PHY layer based on Bluetooth Core Specification v4.1 by using Anritsu Bluetooth test device MT8852B.

2 Hardware and Software List

✧ DUT: Telink 8267 EVK (SN: C1T80A20_V1.0) preloaded with "*bleplus_phy_test_slave.bin*" file.

Note that the bin file follows the command format in "*vol6:core system package[Low Energy Controller]——>PartF: Direct Test Mode——>3UART Test Interface*" of Bluetooth Core Specification v4.1.
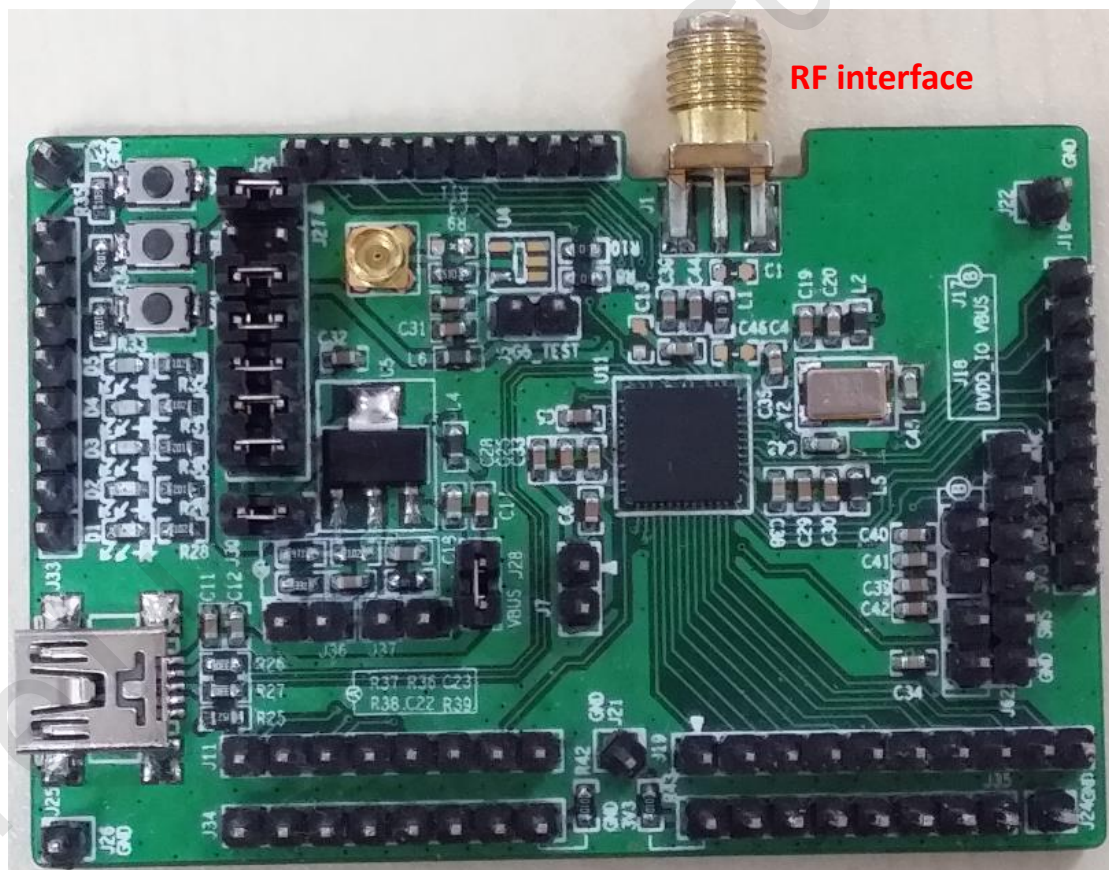
Figure 1　　Telink 8267 EVK (DUT)

✧ Bluetooth Test Set: Anritsu MT8852B

Figure 2   Bluetooth Test Set "MT8852B"

✧ RS232 TO TTL Module: The module is used to transform RS232 level into TTL level.
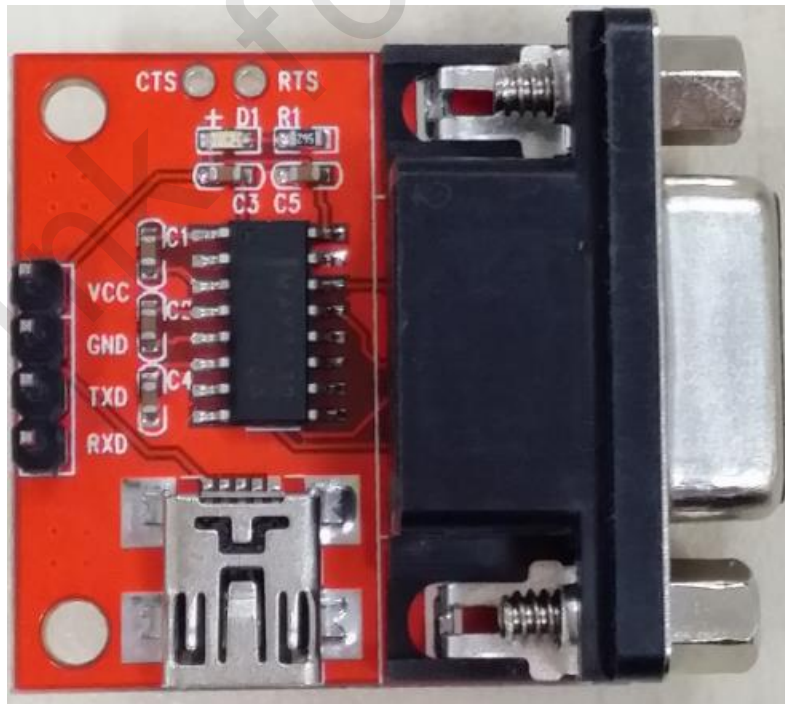
Figure 3   RS232 TO TTL Module sample

✧ PC with measurement software (e.g. "Bluetooth low energy Measurement Software") and PC GPIB driver (e.g. NI for Agilent driver) installed.

Bluetooth low energy
Measurement Software
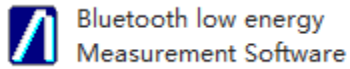
✧ USB_TO_GPIB connection cable: Agilent GPIB cable. It's used to connect PC USB with MT8852B GPIB interface.

✧ RF cable: This cable is used to connect RF Port of MT8852B with RF interface of DUT.

Figure 4   RF cable

✧ Flexible cables: The cables are used to connect "EUT Control Port" of "MT8852B" with RS232-TO-TTL module, as well as connect RS232-TO-TTL module and DUT.

✧ USB cable: The cable is used to connect PC USB with USB interface of Telink 8267 EVK (DUT) to supply power for DUT.

3 EUT Control Port Introduction
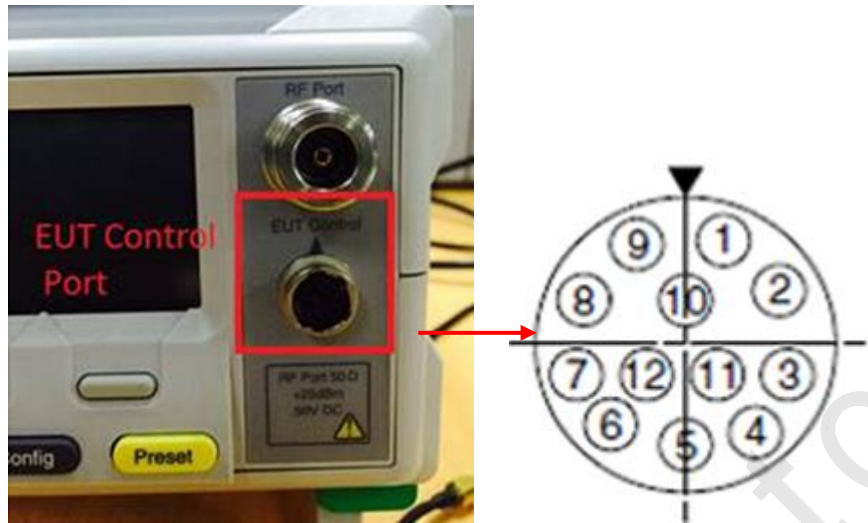
Figure 5   EUT Control Port

EUT Control Port of MT8852B supports RS232 and USB output, and RS232 9-pin is used as communication interface in this test sample.

1. EUT Control Port	2. RS232 9-Pin Connector
Pin Signal	1. Not connected
1 Tx Out (RS232)	2. DUT_TX
2 Rx Out (RS232)	3. DUT_RX
3 GND (RS232 and USB)	4. DUT_DTR
4 GND (RS232 and USB)	5. GND
5 RTS Out (RS232)	6. DUT_DSR
6 CTS Out (RS232)	7. DUT_RTS
7 DIn (USB)	8. DUT_CTS
8 Dout (USB)	9. Not connected
9 N/C	
10 N/C	
11 DSR Out (RS232) - Supply USB	
12 DTR Out (RS232) - Supply USB	

4 Test Sample: Script Testing

4.1 Connect hardware
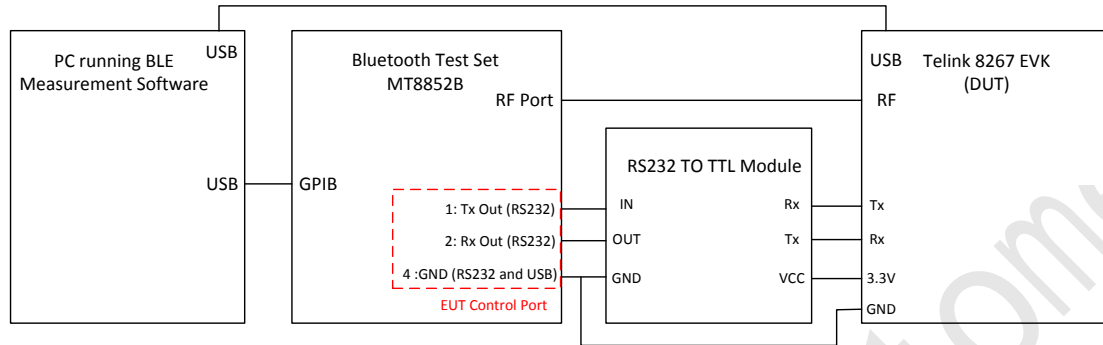
Figure 6 Connection chart

1) Connect PC USB interface with MT8852B GPIB interface via a GPIB cable.

   Note that it's needed to install driver for GPIB cable on PC side.

2) Connect PC USB with USB interface of Telink 8267 EVK (DUT) via an USB cable.

3) Connect the RF Port of MT8852B with the RF interface of Telink 8267 EVK via a RF cable.

4) Connect the three pins of MT8852B EUT Control Port with corresponding pins of RS232-TO-TTL module via three flexible cables according to Table 1.

Table 1 Cable connection between EUT Control Port and RS232-TO-TTL module

MT8852B EUT Control Port	RS232-TO-TTL module
pin_1: Tx Out (RS232)	pin_3(IN)
pin_2: Rx Out (RS232)	pin_2(OUT)
pin_4: GND (RS232)	pin_5(GND)
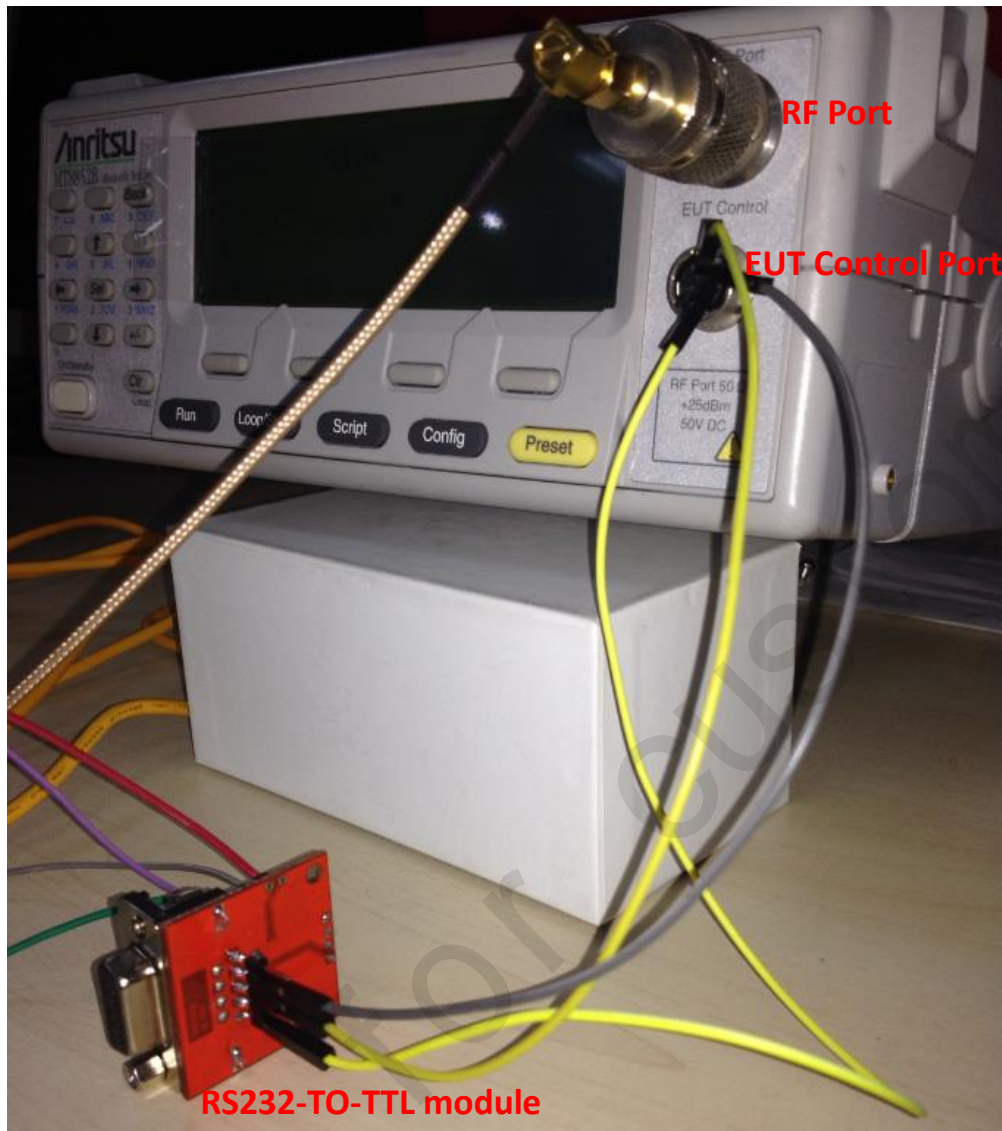
Figure 7   RF Port and EUT Control Port connection chart

5) Connect the UART and power interfaces of Telink 8267 EVK with corresponding pins of RS232-TO-TTL module via four flexible cables according to Table 2.

Table 2 Cable connection between DUT and RS232-TO-TTL module

Telink 8267 EVK	RS232-TO-TTL module
UART Tx (ANA_C<2>)	Rx
UART Rx (ANA_C<3>)	Tx
3.3V	VCC
GND	GND

Figure 8   Total connection chart

4.2 Set BLE measurement software

After hardware connection is ready, user to start MT8852B and configure "Bluetooth low energy Measurement Software" on PC side.

Figure 9   Start MT8852B and Bluetooth low energy Measurement Software

Figure 10　"Connection" window of BLE Measurement Software

4.2.1　Check connection

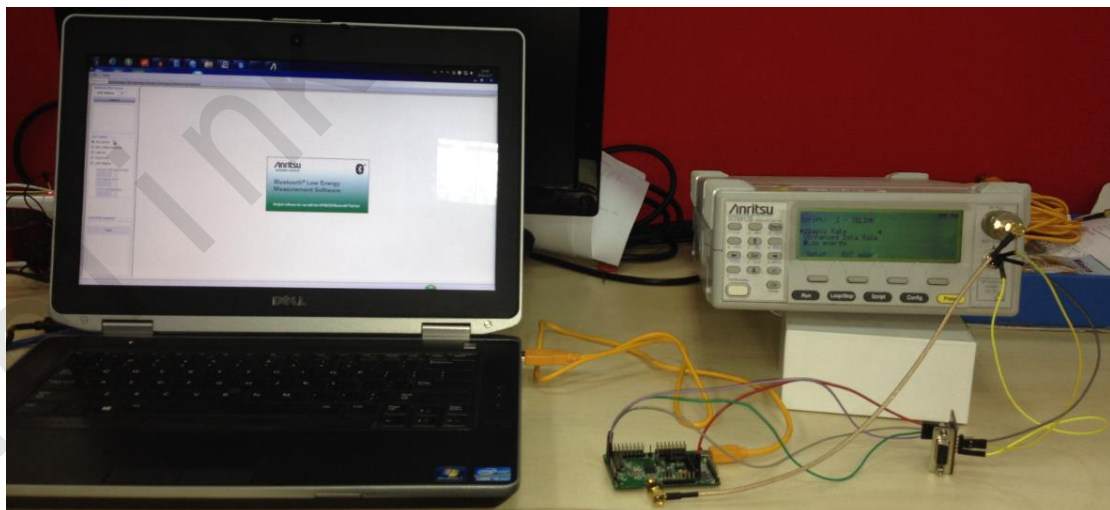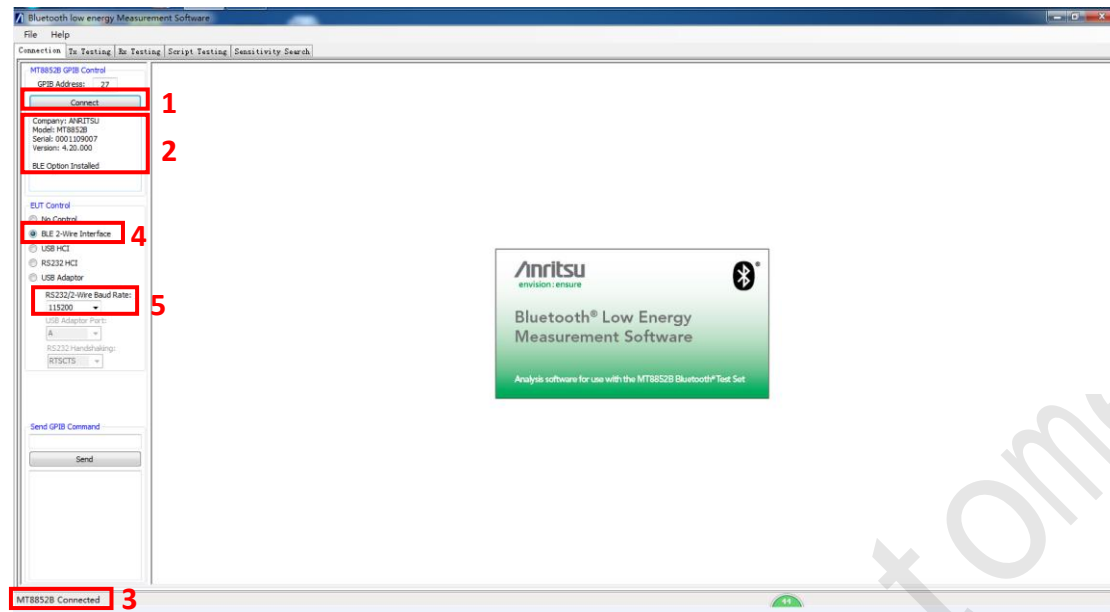Click the "Connect" button (as shown in mark 1 of Figure 10) in the software interface. Indication information will be available in the interface to indicate successful connection between PC software and MT8852B, as shown in mark 2 and mark 3 of Figure 10.

4.2.2　Configure connection options

In "Connection" window, two options should be configured, as shown below:

1) Tick "BLE 2-Wire Interface" for "EUT Control" option, as shown in mark 4 of Figure 10.

2) Select "115200" for "RS232/2-Wire Baud Rate" option according to EUT setting, as shown in mark 5 of Figure 10.

4.2.3　Configure EUT Tx Power for Script Testing

To run script testing, it's needed to switch to "Script Testing" window and set "EUT Tx Power" option. Generally it's selected as "Range 1: +22 to +7dBm" (as shown

in mark 1 of Figure 11). If test item fails with error indication of "Signal Under Range" due to attenuation of RF cable, user should select "Range 2" for "EUT Tx Power" option instead.
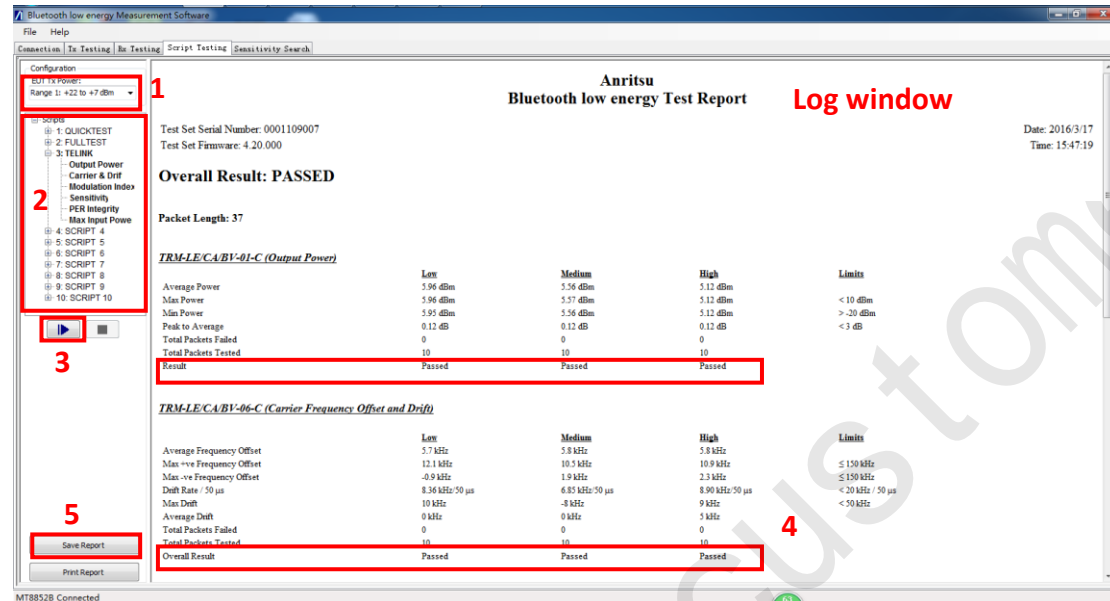

Figure 11 "Script Testing" window

4.3 Run TP value calibration script

Before starting Script Testing, it's needed to run the TP value calibration script file first.

4.4 Test Script items

In "Scripts" option (as shown in mark 2 of Figure 11), it's not recommended to modify the two test items including "QUICKTEST" and "FULLTEST". User can select any script test item from SCRIPT 3 to SCRIPT 10 (e.g. Output Power/Carrier & Drift/Modulation Index/Sensitivity/PER Integrity/Max Input Power).

Click the "Start" button (as shown in mark 3 of Figure 11) to start testing specified script item.

After 10 seconds or so, test process will be finished, and test result is available on the log window, as shown in mark 4 of Figure 11.

✧ Success indication: "Overall Result: PASSED"

✧ Failure indication: "Overall Result: FAILED"

By clicking the "Save Report" button (as shown in mark 5 of Figure 11), current test report can be saved.

5 Appendix 1: Non-signaling Test Mode
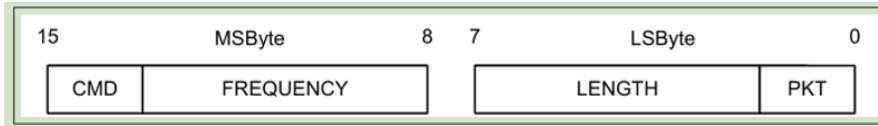
5.1 UART command format

15	MSByte	8	7	LSByte	0
CMD	FREQUENCY			LENGTH	PKT

Figure 3.1: Command message format

CMD (command): Size: 2 Bits

Value b_1b_0	Parameter Description
00	Reset
01	Receiver Test
10	Transmitter Test
11	Test End

Frequency: Size: 6 Bits

Value	Parameter Description
N	When N = 0x00 – 0x27: N = (F-2402)/2 Frequency Range 2402 MHz to 2480 MHz
	Where N = 0x28 – 0x3F: Reserved

Length: Size: 6 Bits

Value	Parameter Description
N	When N = 0x00 – 0x25: Length in octets of payload data in each packet
	When N = 0x26 – 0x3F: Reserved

PKT (Packet Type): Size: 2 Bits

Value b_1b_0	Parameter Description
00	PRBS9 Packet Payload
01	11110000 Packet Payload
10	10101010 Packet Payload
11	Vendor specific

5.2 UART command examples

1. Rx test

   ✧ UART Send: 0x40 0x94, carry out RF Rx test at the frequency point of 2402MHz

   ✧ UART Send: 0x58 0x94, carry out RF Rx test at the frequency point of 2450MHz

   ✧ UART Send: 0x67 0x94, carry out RF Rx test at the frequency point of 2480MHz

*Note: Each Rx test should end with an "END" frame "0xc0, 0x00". The number of successfully received packets will be returned after the "End" frame is sent; since the number is indicated by 2 bytes with highest bit negligible, no more than 32767 (2^15) frames are allowed to be sent.

2. Tx test

   ✧ UART send: 0x80 0x95, carry out RF Tx test at the frequency point of 2402MHz, content to be transmitted is "0x0f", and frame length is 37-Byte.

   ✧ UART send: 0x93 0x95, carry out RF Tx test at the frequency point of 2440MHz, content to be transmitted is "0x0f", and frame length is 37-Byte.

   ✧ UART send: 0xa7 0x96, carry out RF Tx test at the frequency point of 2480MHz, content to be transmitted is "0x55", and frame length is 37-Byte.

*Note: Each Tx test should end with an "END" frame "0xc0, 0x00".
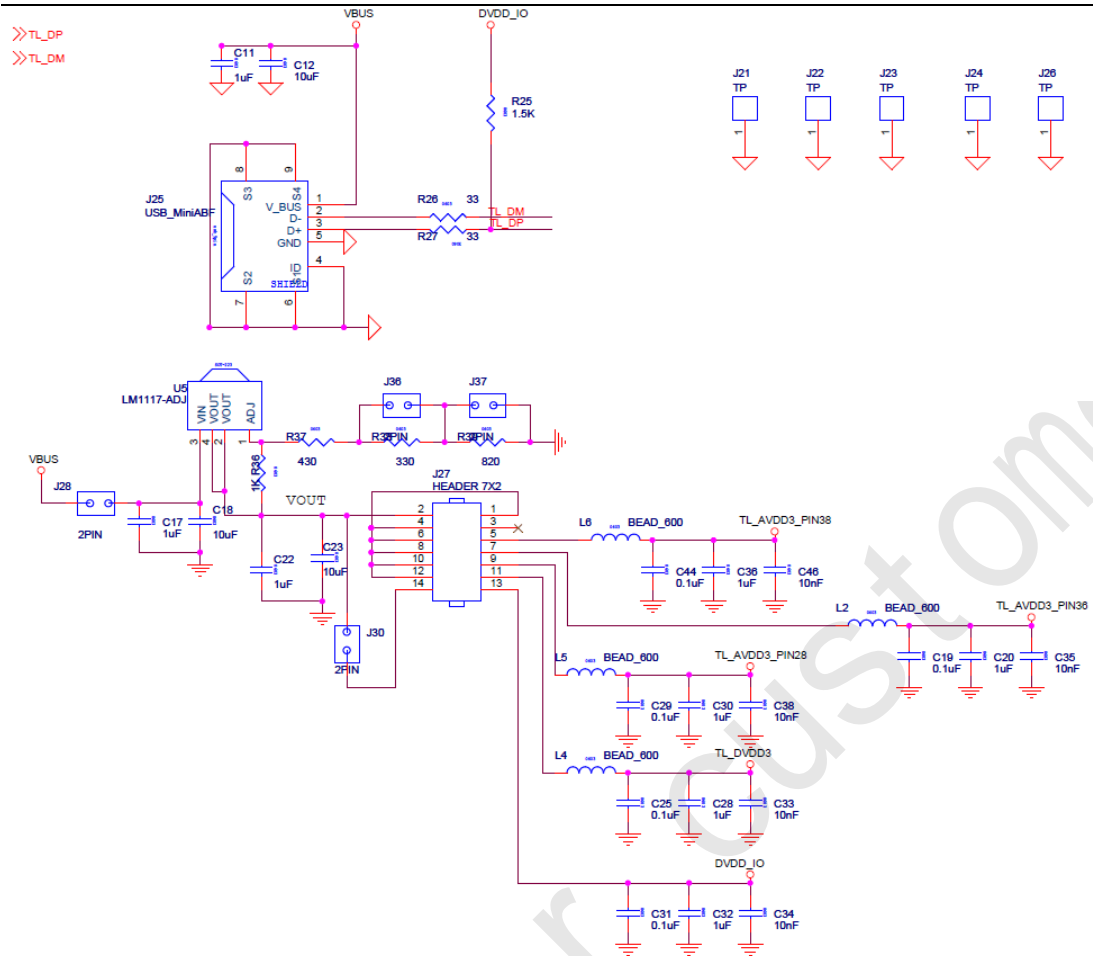
6 Appendix 2: Schematic for Telink 8267 EVK
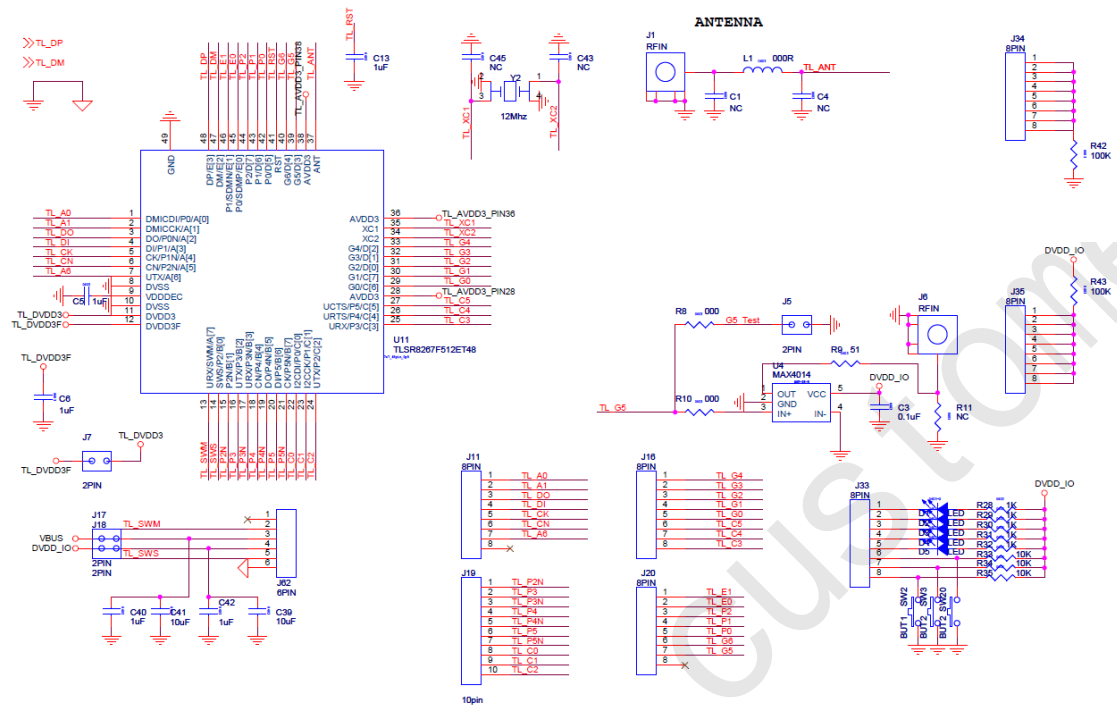
Figure 12   Telink 8267 EVK schematic