USB 3.2 RFI System-Level Test Procedure
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A. Test Applicability

This test is only applicable to systems with Type C Connector and support data speeds 5Gbps and above
- USB 3.2 Hosts End Product (This includes embedded hosts)
- USB 3.2 Hubs End Product
- DRD

B. Equipment List

<table>
<thead>
<tr>
<th>No</th>
<th>Equipment Name</th>
<th>Vendor</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Signals/Spectrum Analyzer</td>
<td>Anritsu/Keysight/R&amp;S</td>
<td>MS2830A/N9000B/FPL1007</td>
</tr>
<tr>
<td>2</td>
<td>RFI System Level Test Fixture</td>
<td>Luxshare-ICT</td>
<td>MEU-58P1F</td>
</tr>
<tr>
<td>3</td>
<td>RF Cable 1m</td>
<td>Junkosha</td>
<td>MWX121-01000DMSDMS</td>
</tr>
<tr>
<td>4</td>
<td>RF Cable 0.5m</td>
<td>Junkosha</td>
<td>MWX121-00500DMSDMS</td>
</tr>
<tr>
<td>5</td>
<td>Shielding Box</td>
<td>Lab105</td>
<td>SHD6001A</td>
</tr>
<tr>
<td>6</td>
<td>AC Power Filter Module</td>
<td>SpeedTech</td>
<td>L08PT02-00001</td>
</tr>
<tr>
<td>7</td>
<td>Banana Plug Filter Module</td>
<td>SpeedTech</td>
<td>L08PT04-00001</td>
</tr>
<tr>
<td>8</td>
<td>USB Type C Filter Module</td>
<td>SpeedTech</td>
<td>L08PT03-00001</td>
</tr>
<tr>
<td>9</td>
<td>USB Type A Filter Module</td>
<td>SpeedTech</td>
<td>L08PT05-00001</td>
</tr>
<tr>
<td>10</td>
<td>Test Table</td>
<td>Luxshare-ICT</td>
<td>MEU-39P1F</td>
</tr>
<tr>
<td>11</td>
<td>5 in-lbs. torque wrench</td>
<td>Luxshare-ICT</td>
<td>MEW-40A11</td>
</tr>
</tbody>
</table>

Please contact Od.Liao@luxshare-ict.com for Luxshare and Lab105 parts.
B1. USB RFI System Level Test Fixture

![USB RFI System Level Test Fixture](image1.png)

B2. RF Cable Requirements
RF Cable should be rated for frequencies higher than 6GHz

B3. Shielding Box Requirements
The shielding box isolation level must be higher than 80dB for full test frequency range (500MHz to 6GHz) and inside dimensions must be large enough for a desktop computer. Below is recommend shielding box dimension and real item picture:
B4. Filter Modules

1. **AC power filter**

   AC power filter support is 100V~220V, 50Hz to 60Hz

![AC power filter](image1)

2. **Banana plug filter (DC power filter)**

![Banana plug filter](image2)

3. **USB Type C filter (USB signals)**

   Supports USB 3.2 Gen1/Gen2

![USB Type C filter](image3)

4. **USB Standard filter (USB signals)**

   Supports USB 3.2 Gen1/Gen2

![USB Standard filter](image4)
C. Signal/Spectrum Analyzer Test Configuration

It is highly recommended to have the built-in preamplifier function option for the signal analyzer.

List of approved Signal/Spectrum Analyzers:

Anritsu MS2830A

Keysight N9000B

Rohde & Schwarz FPL1007
<table>
<thead>
<tr>
<th>Setting</th>
<th>ANRITSU</th>
<th>KEYSIGHT</th>
<th>ROHDE &amp; SCHWARZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>Frequency&gt; Start: 500MHz Stop: 6GHz</td>
<td>Frequency&gt; Start: 500MHz Stop: 6GHz</td>
<td>Frequency&gt; Start: 500MHz Stop: 6GHz</td>
</tr>
<tr>
<td>500MHz to 6GHz</td>
<td>Start: 500MHz Stop: 6GHz</td>
<td>Start: 500MHz Stop: 6GHz</td>
<td>Start: 500MHz Stop: 6GHz</td>
</tr>
<tr>
<td>RBW:</td>
<td>BW&gt; RBW: 100KHz VBW: 100KHz</td>
<td>BW&gt; RBW: 100KHz VBW: 100KHz</td>
<td>A/D Bandwidth&gt; RBW: 100KHz VBW: 100KHz</td>
</tr>
<tr>
<td>100KHz, VBW: 100KHz</td>
<td>RBW: 100KHz VBW: 100KHz</td>
<td>RBW: 100KHz VBW: 100KHz</td>
<td></td>
</tr>
<tr>
<td>Average Detector</td>
<td>Average type&gt; Trace&gt; Detector&gt; Detector: RMS</td>
<td>Trace&gt; Detector&gt; Detector: Average</td>
<td>Analysis&gt; Trace&gt; Detector: RMS</td>
</tr>
<tr>
<td>Average times: 100</td>
<td>Storage count: 100 Avg. Hold number: 100</td>
<td>Average times: 100</td>
<td></td>
</tr>
<tr>
<td>Attenuation</td>
<td>AMPTD&gt; Attenuation: 0dB</td>
<td>AMPTD&gt; Attenuation: 0dB</td>
<td>Amplitude&gt; Att: 0dB</td>
</tr>
<tr>
<td>Trace type</td>
<td>Trace&gt; Storage mode: Average</td>
<td>Trace&gt; Trace type: Average</td>
<td>Analysis&gt; Trace: Average</td>
</tr>
<tr>
<td>Trigger source</td>
<td>Trig: Free run (default)</td>
<td>Trig: Free run (default)</td>
<td>Trig: Free run (default)</td>
</tr>
<tr>
<td>Pre-AMP</td>
<td>AMPTD&gt; Signal path&gt; Internal Premap: Full range (on)</td>
<td>AMPTD&gt; Signal path&gt; Internal Premap: Full range (on)</td>
<td>Amplitude&gt; Preamp: on</td>
</tr>
<tr>
<td>De-embedding RF cable loss</td>
<td>AMPTD&gt; Offset&gt;Setting loss value&gt; Enter</td>
<td>1. AMPTD&gt; External gam/off&gt; Setting value</td>
<td>Transducer&gt;dB&gt;New line&gt;Import loss csv. file</td>
</tr>
<tr>
<td>Test environment</td>
<td>Shielding box</td>
<td>Shielding box</td>
<td>Shielding box</td>
</tr>
</tbody>
</table>
D. Test Setup

D1. Mobile Devices (Laptops/Notebooks/Smartphone)

Note: DUT must be in airplane mode during testing
D2. DUT with AC power source
D3. Dock/Hub type with AC power source

*Note: Host does not need to be Known Good Host.
D4. Dock/Hubs

*Note: Host does not need to be Known Good Host.
E. Testing Procedure

Before testing, test operator needs to be able to identify port assignments on DUT.

This can be done by asking the customer for port assignments or attaching a USB 3.2 hub/device with Type C connector to each port and checking what port it enumerates under using Device Manager or USBDView.

**USBView**

[https://docs.microsoft.com/en-us/windows/hardware/drivers/debugger/usbdview](https://docs.microsoft.com/en-us/windows/hardware/drivers/debugger/usbdview)

E1. Configure Signal Analyzer

Follow Section D settings for the analyzer being used.

E2. Check Noise Floor

Evaluate Noise floor using the setup diagram below. RFI Fixture should be attached to analyzer RFI Input and left open inside a closed Shielding Box.

Start sweep and export data as CSV. Make sure that Noise floor does not exceed -105 dBm by making a graph with the data and setting the limit line.

**Steps to make graph:**

1. Add two columns next to Wave Data: (1) Frequency and (2) Noise Floor Limit
2. Column for Noise Floor Limit should be -105 for all rows of Wave Data
3. Column for Frequency
   a. First Wave Data Item should be 500 MHz (5E+8)
   b. Last Wave Data Item should be 6 GHz (6E+9)
   c. Select all rows from First to Last item in Frequency
d. Use **Fill >>> Series** to automatically fill in the empty cells with equal sized steps of frequency from 500 MHz to 6 GHz

4) Select all three columns and make chart **Scatter with Smooth Lines**

Format graph and add labels as appropriate.

Below is an example of a failed Noise Floor measurement.

![Noise Floor Check - FAIL](image)

E3. **Set DUT to Compliance Mode**
Test operator needs to be able to put DUT into compliance mode and have PUT generate pattern CP0 for the duration of the test.

E3.1. **Windows-based Systems**
xHSETT can be used on Windows-based Systems to enter compliance mode.

<table>
<thead>
<tr>
<th>USB xHSETT Utility</th>
<th>64-bit OS</th>
<th><a href="https://usb.org/document-library/xhsett-x64">https://usb.org/document-library/xhsett-x64</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>32-bit OS</td>
<td><a href="https://usb.org/document-library/xhsett-x32">https://usb.org/document-library/xhsett-x32</a></td>
<td></td>
</tr>
</tbody>
</table>

*Note: User Account Control must be turned off to use this tool.

Open xHSETT. Select **Host/Hub DSF Ports** under SuperSpeed. Select the corresponding Host Controller for the DUT and click **TEST.**
Enumerate Bus and Select Host.

In Controls, select \texttt{TX\_COMPLIANCE\_MODE} and the port number of the PUT and click execute. Make sure status windows says “Operation Successful”.

PUT should now be generating CP0.
E3.2 Non-Windows-based Systems

Currently there are no known supported tools for putting a DUT into compliance mode.

If test operator cannot get help from vendor or customer to put DUT into compliance mode, it might be necessary to write a program to put PUT into TX_COMPLIANCE_MODE.

E4. Connect Test Setup

Follow the appropriate Test Setup in Section D to connect DUT. Be sure to read all notes.

E5. Gather and Evaluate Data

After connecting DUT and closing Shielding Box, start sweep.

Pass/Fail Criteria

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 MHz to 4 GHz</td>
<td>Noise level &lt;= -100 dBm</td>
<td>Noise level &gt; -100 dBm</td>
</tr>
<tr>
<td>5 GHz to 6 GHz</td>
<td>Noise level &lt;= -102 dBm</td>
<td>Noise level &gt; -102 dBm</td>
</tr>
</tbody>
</table>

NOTE: PUT must be tested in both orientations and must Pass in both orientations (normal and flipped) for Frequency Range.

Evaluate data by adding limit lines to analyzer or export data as CSV to make a graph.

Steps to make graph:

1) Add two columns next to Wave Data: (1) Frequency and (2) Noise Limit
2) Column for Limit
   a. If Frequency is less than 4 GHz, Noise Limit is -100 dBm
   b. If Frequency is greater than 5 GHz, Noise Limit is -102 dBm
3) Column for Frequency
   a. First Wave Data Item should be 500 MHz (5E+8)
   b. Last Wave Data Item should be 6 GHz (6E+9)
   c. Select all rows from First to Last item in Frequency Range
   d. Use Fill >>> Series to automatically fill in the empty cells with equal sized steps of frequency from 500 MHz to 6 GHz
4) Select all three columns and make chart Scatter with Smooth Lines
F. Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>8/21/2020</td>
<td>Initial Release</td>
<td>Joshua Talactac</td>
</tr>
<tr>
<td>1.1</td>
<td>11/19/2020</td>
<td>Improved Clarity, Fixed Formatting and added sections &quot;Optional Tools and Accessories&quot;, Pass/Fail Criteria and &quot;Test Procedure for non-Windows based Operating Systems&quot; and updated equipment P/N</td>
<td>Joshua Talactac</td>
</tr>
<tr>
<td>1.2</td>
<td>05/03/2021</td>
<td>Added R&amp;S as to the list of approved signal analyzers with settings and config. Added 4 filter modules. Added Test Setups for other DUT Types</td>
<td>Joshua Talactac</td>
</tr>
<tr>
<td>1.3</td>
<td>05/26/2021</td>
<td>Clarified pass/fail criteria: added third condition. Added note to mobile devices test setup: must be in airplane mode during test.</td>
<td>Joshua Talactac</td>
</tr>
<tr>
<td>1.4</td>
<td>08/17/2021</td>
<td>Changed set limit lines in the Analyzer for the compliance test for pass/fail from &gt;=-100dBm to = -100dBm at 500MHz to 4GHz and from &gt;=-102dBm to = -102dBm at 5GHz to 6GHz Clarified pass/fail criteria: Pass range include = -100dBm at 500MHz to 4GHz, and =-102dBm at 5GHz to 6GHz</td>
<td>Ngan Ho</td>
</tr>
<tr>
<td>1.5</td>
<td>07/20/2022</td>
<td>Improved Clarity, Fixed Formatting. Added steps for Noise Floor measurement. Added steps for making graph. Adding setting for RF cable lost</td>
<td>Aaron Chan</td>
</tr>
</tbody>
</table>

For questions, please feel free to contact techadmin@usb.org for more information.