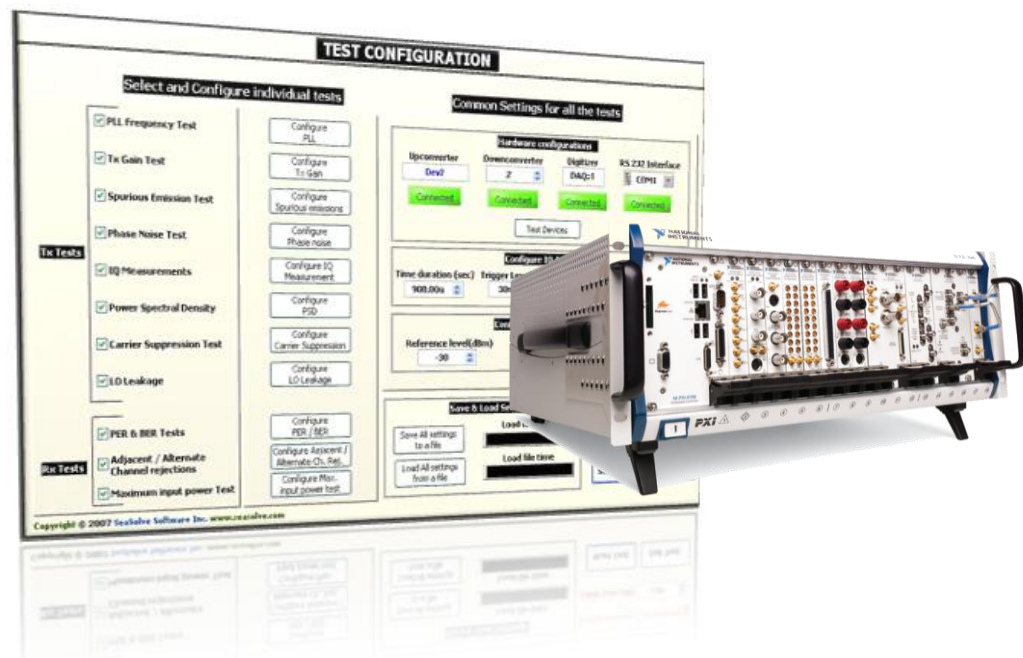


## Application Note

# ZigBee - Automated Compliance Test Solution



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### **Overview**

Compliance testing ensures standardization globally and multi-vendor interoperability. The tests provided in the solution are optimized for speed to reduce test times and are verified for their accuracy with various RF Chipsets from leading manufacturers.

This application note contains information about compliance test measurements of ZigBee devices and how one can make the whole procedure automated. ZigBee aCT includes a sequence of transmitter and receiver tests which generate detailed test reports and checks the conformance of the DUT with the IEEE 802.15.4 standard.

The main advantage of this solution includes test automation with minimal user input and the ability to save test results in easy-to-read report formats. ZigBee aCT performs several compliance tests on any or all of the 16 frequency channels 2.405 GHz to 2.480 GHz. With the help of the DUT's Firmware, the control of the DUT is handled by ZigBee aCT through RS-232 communication.

### **Features**

- Automation of multiple compliance tests.
- Run All or Selected Tx/Rx tests.
- Detailed reports for each test.
- Save reports in .html or .xls formats.
- Configure individual Tests.
- Load and Save test configurations.
- Configurable test limits.
- Optimized for Speed to target manufacturing industry

### **Purpose of Transmitter Tests**

- 1) **PLL Frequency Test**
  - To verify that the DUT transmitted signal is as per the channel frequency requirements i.e., transmit signals should not deviate from the channel centre frequency from more than +/-20 ppm.
- 2) **Transmitter Gain Test**
  - To verify that the DUT responds correctly to various gain settings. i.e., DUT is able to transmit signals at various power levels at 0 dBm, -10 dBm as required by the user.
- 3) **Spurious Emission Test**
  - This test verifies that the DUT does not transmit spurious emissions, both inband and out of band during operation. Spurious emissions act as interference and may cause problems for other ZigBee nodes.
- 4) **Phase Noise Test**
  - This test verifies the Phase Noise characteristics of the DUT, at various frequency offsets. Phase Noise causes poor EVM performance and results in demodulation errors.
- 5) **IQ measurement**
  - To Verify EVM and IQ parameters such as IQ Magnitude error, IQ Phase error, IQ Offset, Frequency offset are met as per the standards using IQ Measurements.
- 6) **PSD Test**
  - Power Spectrum Density shows the distribution of the ZigBee transmitted packet over the selected frequency range. This test verifies Power Spectral parameters are met as per the Standards.

### *Purpose of Receiver Tests*

#### 1) **PER & BER Test**

- PER / BER Tests are used to verify receiver sensitivity. One of the features offered in the PER and BER Test is the ability to characterize the parameters at varying power or SNR levels of the test signal. This in turn provides an accurate measurement of RSSI.

#### 2) **Adjacent/Alternate Channel Rejection Test**

- The adjacent and alternate channel rejection test also runs a sensitivity test. Power levels can be seen for the adjacent or alternate channel, along with a PER of the test channel.

#### 3) **Maximum Input Power Test**

- Max Input Power Test is used to verify maximum power that can be transmitted by the DUT without packet errors

### *System requirements*

#### Hardware

- PXI Chassis.
- NI-PXI 5671/5670 RF Signal Generator
  - NI PXI 5441/5421 (AWG)
  - NI PXI 5610 (Upconverter)
- NI-PXI 5661/5660 RF Signal Analyzer
  - NI PXI 5600 (Downconverter)
  - NI PXI 5142/5620 (Digitizer)
4. PC/ NI Controller with 100 MB disk space (1 GB recommended)
5. Power Combiner
6. RS 232 port

#### Software

- Drivers: NI PXI RFSG 5670 Ver. 1.1 or above
- Drivers: NI PXI RFSA 5660 Ver. 1.5 or above
- LabVIEW Runtime Engine 7.1
- OS: Windows 2000/XP

### *Test Procedure*

1. Connect the Equipment for ZigBee aCT as shown in Figure 1: Set UP.
2. Power on the PXI system.
3. Install RFSA driver and RFSG driver [This will install MAX (Measurement and Automation Explorer)].Also install the Controller of the same DUT.
4. Open MAX and then test all the selected devices connected.
5. Now all to begin with ZigBee aCT, the DUT first of all needs to be Reset using HyperTerminal Program by setting the Reset buttons on the DUT.
6. Configure and select the appropriate device number for NI-PXI 5671/5670 RF Signal Generator - 5441/5421 (AWG) and 5610 (Upconverter), Also for NI-PXI 5661/5660 RF Signal Analyzer - 5600 (Downconverter) and 5142/5620 (Digitizer).

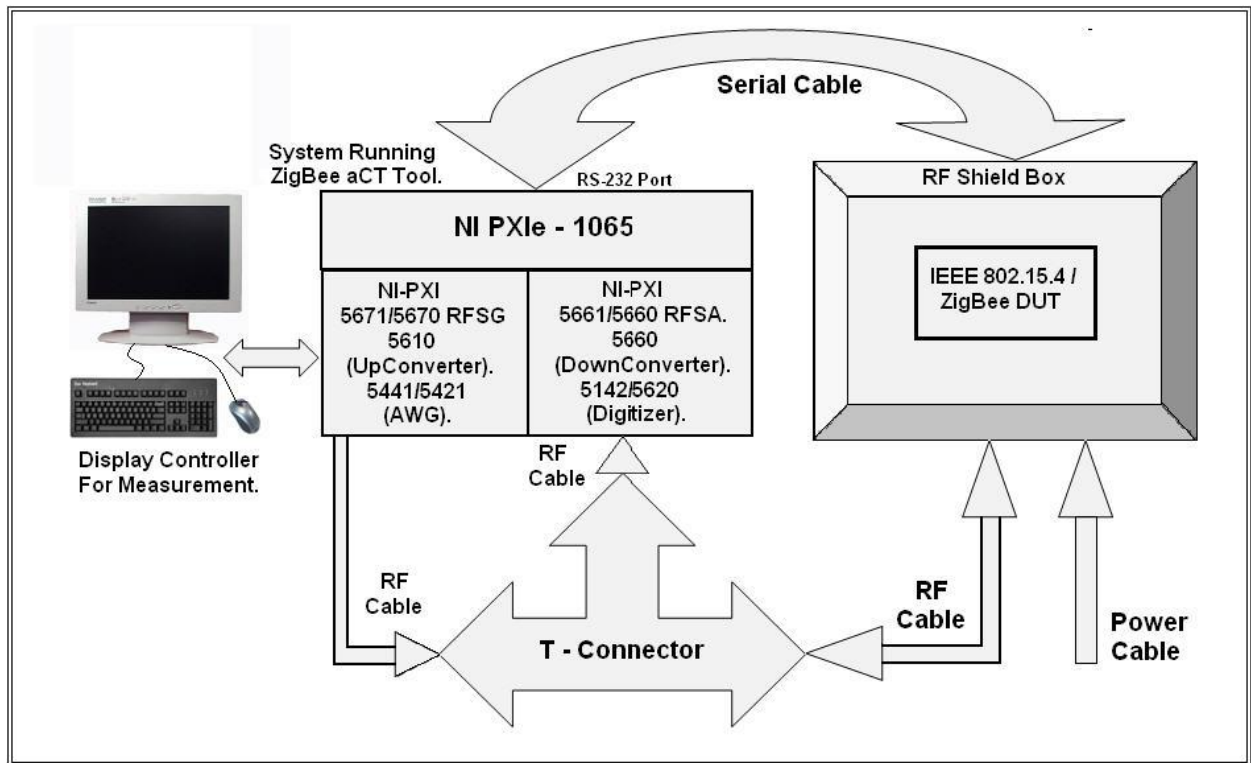


Figure 1: Set UP

7. Starting with ZigBee aCT testing, Select the appropriate Test type (Run all the tests/Run Selected Tests/Run Transmitter tests/Run Receiver Tests) and Select the new folder for saving the reports followed by “Proceed” button in aCT solution.
8. In the RS 232 Interface, Select the COM ports available on the user’s PC listed to which RS 232 is connected. Also select the appropriate RS 232 baud rate from the dropdown list (9.6 kbps, 19.2 kbps, 38.4 kbps, 57.6 kbps & 115.2 kbps).
9. After performing Hardware configurations click on Test Devices to test the devices. If the devices are properly configured all the LED’s will glow GREEN and read as connected else RED will glow and read as Failed.
10. Configuring IQ Acquisition –  
The following IQ Acquisition settings must be configured:
  - i. Time Duration
  - ii. Trigger Level
  - iii. Bandwidth
  - iv. Reference level
11. Configuring Spectrum Analysis –  
The following Spectrum Analysis settings must be configured:
  - i. Span
  - ii. Reference level
  - iii. Resolution Bandwidth
12. Cable Loss – Configure cable loss as per cable Specifications.
13. All above test configuration settings can be Load/Save by the option given in ZigBee aCT Solution.

14. *Transmitter Tests* – ZigBee aCT provides the following transmitter tests. The configuration command for that test will appear only if that particular test is selected:

i. PLL Frequency Test: The following settings must be configured for PLL Frequency Test.

- Select Channels
- Transmitting Mode
- Set Output
- Threshold level
- Averaging parameter
- Maximum frequency deviation

ii. Transmitter Gain Test – The following settings must be configured for TX Gain Test.

- Select Channels
- Select Power levels
- Transmitting Mode
- Threshold level
- Peak hold iteration count

iii. Spurious Emissions Test: The following settings must be configured for Spurious Emissions Test.

- Select Channels
- Span
- Transmitting Mode
- Resolution Bandwidth
- Set Output
- Reference level
- Span to be ignored around center frequency
- Threshold level for peak measurement
- Iteration count

iv. Phase Noise Test: The following settings must be configured for Phase Noise Test.

- Select Channels
- Transmitting Mode
- Set output
- Offset start
- Offset Stop
- Desired Offset
- Averaging Parameters

v. IQ Measurements Test: The following settings must be configured for Phase Noise Test.

- Select Channels
- Set output
- Averaging Parameters
- Maximum EVM
- Maximum Offset EVM

vi. Power Spectral Density: The following settings must be configured for PSD Test.

- Select Channels
- Set output
- Peak hold loop count
- Spectrum type to be used for measurement

15. *Receiver Tests* – ZigBee aCT provides the following receiver tests. The configuration command for that test will appear only if that particular test is selected:

vii. PER and BER Tests: The following settings must be configured for PER and BER Tests.

- Variable test parameter
- Fixed output SNR
- RFSG Variable Power settings
- Select Channels
- External attenuator inserted
- Delay between frames
- PN Sequence
- Frame type
- Number of Octets of payload
- Number of packets for PER Test

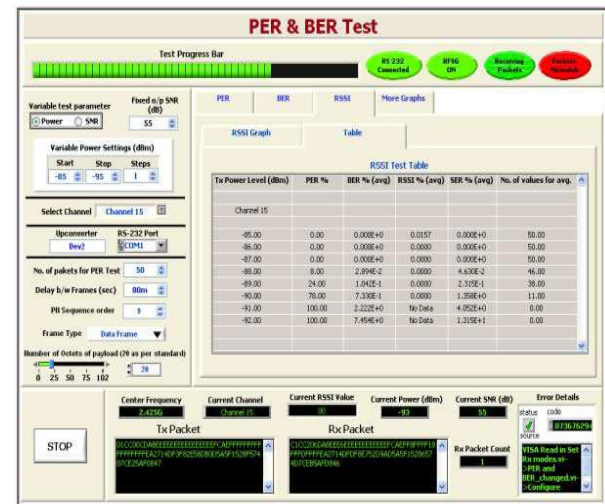
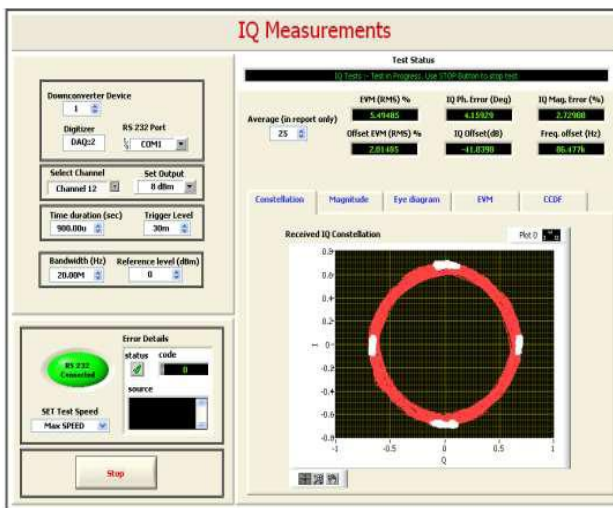
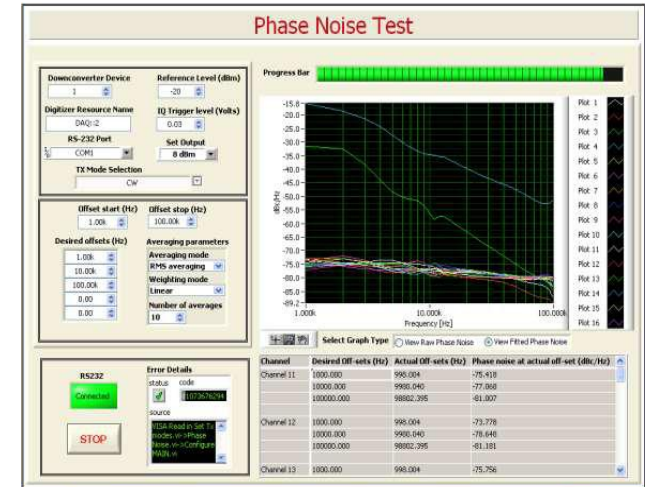
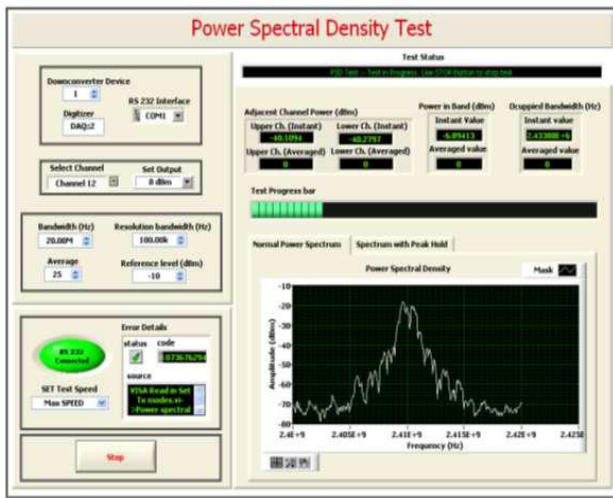
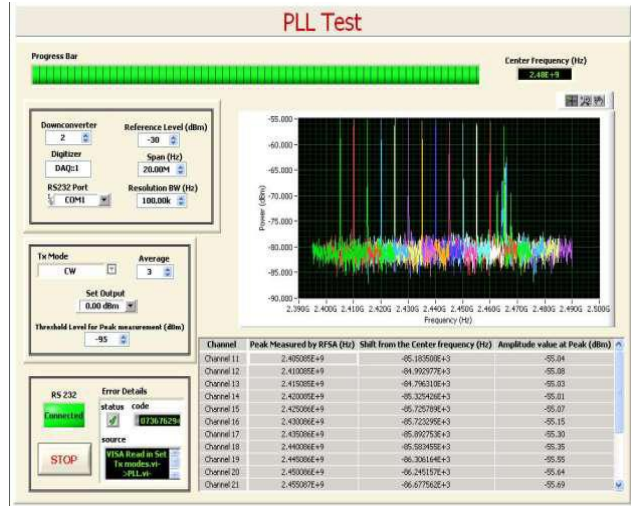
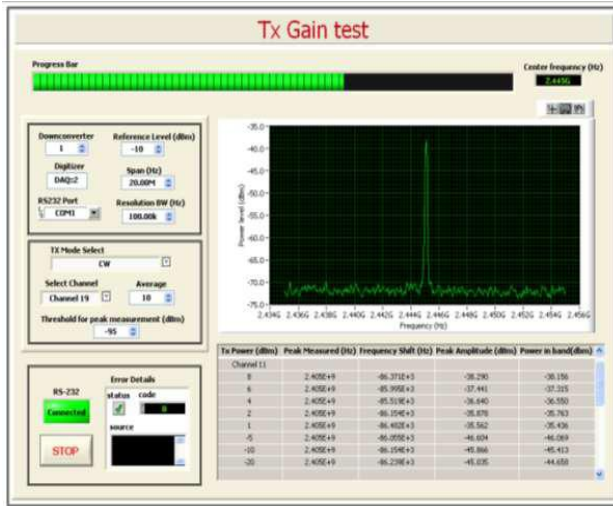
viii. Maximum Input Power Test: The following settings must be configured for PER and BER Tests

- Select Channels
- Number of packets for PER Test
- Delay between frames
- Power Settings
- PN Sequence
- Frame type
- Number of Octets of payload

After all above settings and configurations made in order to conduct any or all Transmitter and Receiver tests, the following steps are to be followed:

- a) Select the desired test, from the list available, on the ZigBee aCT front panel.
- b) Ensure that the correct device numbers, resource names are provided, i.e. the devices have been configured properly.
- c) Select the channel of operation. Both the DUT and the ZigBee aCT have to operate in the same channel.
- d) Configure, the DUT as per the test procedure provided for the selected test.
- e) Run the test and observe results.

Result –



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