iQ2015

IQ2015™
Connectivity Test System

LITEPOINT

Introduction

LitePoint's IQ2015 Connectivity Test System is the first product to specifically address the testing needs of multi-radio products and devices (Multicom™), which include some combination of multiple wireless functionalities. The IQ2015 test system provides the solution to the crucial test needs of these products and devices by testing WiFi, Bluetooth, GPS, GNSS, FM, WiMAX, NFC, ZigBee, and WAVE technologies in a single, integrated instrument. Manufacturers of advanced mobile handsets and other multi-radio devices are being forced to test these growing wireless functionalities in a single integrated circuit (IC) or module. By addressing the imperative needs of wireless test capabilities in a concurrent test architecture, the IQ2015 test system allows for significantly reduced test times.

The IQ2015 test system provides a variety of RF ports allowing flexible connection to accommodate a number of device configurations. GPS, GNSS, NFC and FM signals are carried on dedicated RF ports, while WiFi, WiMAX, Bluetooth, and WAVE run on common ports. Using concurrent testing, the IQ2015 tests functions, such as GPS, GNSS and FM, in parallel with WiFi or Bluetooth. As a result, users can test multi-radio devices much more quickly. In addition to concurrent test capabilities, the IQ2015 test system offers sequence-based test (SBT) and Fast Packet Error Rate (PER) test, reducing test time up to six fold for WiFi transmit tests and four fold in WiFi receive tests.

Users can achieve maximum equipment utilization through technology application licensing. For example, an IQ2015 test system can be purchased initially with the desired options, then other test features can be added using a software license key. This avoids the cost and downtime associated with upgrades that require sending the unit back to a service center. By tailoring the IQ2015 to a manufacturing line's specific needs, users gain production flexibility and save on capital expenditures.

Features

Full support to most common wireless standards

- WiFi (802.11 a/b/g/n)
- WAVE (802.11p)
- Bluetooth (1.0 / 2.0 / 2.1 / 3.0 / 4.0)

Optional support to several application-specific wireless standards for maximum versatility

- GPS, GNSS
- FM TX / RX
- WiMAX (802.16 d/e)
- Near Field Communication (ISO 18092)
- ZigBee (802.15.4)

Key communication frequency support

- 76 to 108 MHz (FM)
- 1.57542 GHz (GPS)
- 1598 to 1606 MHz (GNSS)
- 2.15 to 2.7 GHz (WiFi, BT, WiMAX, ZigBee)
- 3.3 to 3.8 GHz (WiMAX)
- 4.9 to 6 GHz (WiFi, WiMAX)
- 5.9 to 6 GHz (WAVE)

Reduced test time with concurrent test capability

- GPS, GNSS and FM can be tested independently of WiFi / BT / WiMAX / NFC / ZigBee / WAVE

Superior Equipment Utilization

- Standards-based SW licensing allows for purchasing of only the required capabilities initially and the convenience of easily adding additional capabilities
- Ability to purchase other standards at any time

Basic Functional Description

The IQ2015 test system uses multiple hardware blocks to provide concurrent test capabilities for GPS, GNSS and FM technologies in parallel with WiFi, Bluetooth, WiMAX, ZigBee, NFC, and WAVE technologies. Multiple vector signal generator (VSG) sections provide signal generation capabilities for FM transmit (76 to 108 MHz), GPS transmit (1.57542 GHz), GNSS transmit (1598 to 1606 MHz), WiFi / WAVE transmit (2.15 to 2.7 GHz and 4.9 to 6 GHz), Bluetooth transmit (2.4 to 2.5 GHz), WiMAX transmit (2.15 to 2.7 GHz, 3.3 to 3.8 GHz, and 4.9 to 6 GHz), ZigBee transmit (2.4 to 2.5 GHz), and Near Field Communication (NFC) transmit from DC to 35 MHz.

Multiple vector signal analyzer (VSA) sections provide matching capabilities covering identical frequency bands as the VSG sections. Each VSA section consists of two digitizer (DIG) channels (I and Q) and associated quadrature downconverter. The VSG section consists of two arbitrary waveform generator (AWG) sections and a quadrature upconverter. NFC testing utilizes the independent AWG channels and DIG channels of the VSA and VSG sections to provide or accept signals to BNC connectors on the rear panel of the IQ2015 test system.

The IQ2015 test system includes software libraries specific to the particular communication standard of interest. A variety of signal creation and analysis routines are provided and are available through either a graphical user interface (GUI) or a C++ API. All data captured on the IQ2015 test system is sent to the controlling PC over a USB 2.0 link and then processed according to the user's instructions. All measurement functions provided in the GUI are also available through the C++ API for custom test-program automation in either manufacturing or design characterization testing.

Four RF device connection ports allow the IQ2015 test system to accommodate a wide range of DUT configurations containing multiple communication standards. The IQ2015 test system includes dedicated RF connection ports for GPS, GNSS and FM DUT connections, and two common ports that allow for WiFi, WiMAX, and Bluetooth DUT connections. These dedicated ports allow the user to easily configure the IQ2015 test system to the precise port topology of their DUT, ensuring maximum flexibility.
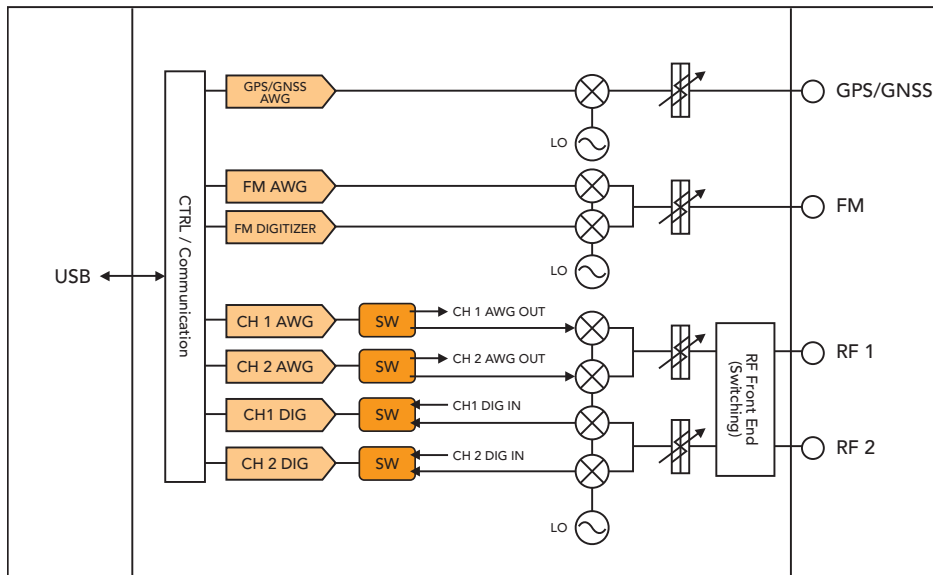

Figure 1: IQ2015 Test System—Hardware Block Diagram

Typical Use Scenario

The IQ2015 test system addresses the RF calibration, verification, and testing needs of all connectivity radios within the supported multi-radio devices. With a single insertion, the test station can test a multitude of radio devices. Users can implement a wide range of DUT cabling scenarios using the IQ2015's port flexibility. Table 1 provides example connection scenarios showing flexibility for DUT connections.

Table 1: Example Connection Scenarios

Device Port Scenario	IQ2015 Connection Path
GPS, GNSS + Bluetooth	GPS, GNSS and RF1 (RF2) ports with coupler or combiner
WLAN (802.11 a/g)	RF1 or RF2 ports
WLAN + Bluetooth	RF1 or RF2 ports
GPS, GNSS + FM	GPS, GNSS and FM ports with coupler or combiner
Near Field Communication	DIG1, DIG2 and AWG1, AWG2 ports

Users can apply the IQ2015 test system as a standalone configuration, or in concert with configurations that support concurrent testing of multiple technologies. For example, the system can be used to test a DUT for GPS, GNSS only in a standalone configuration, or it can be used to test a multi-radio DUT that combines GPS, GNSS with other technologies, such as WiMAX and FM.
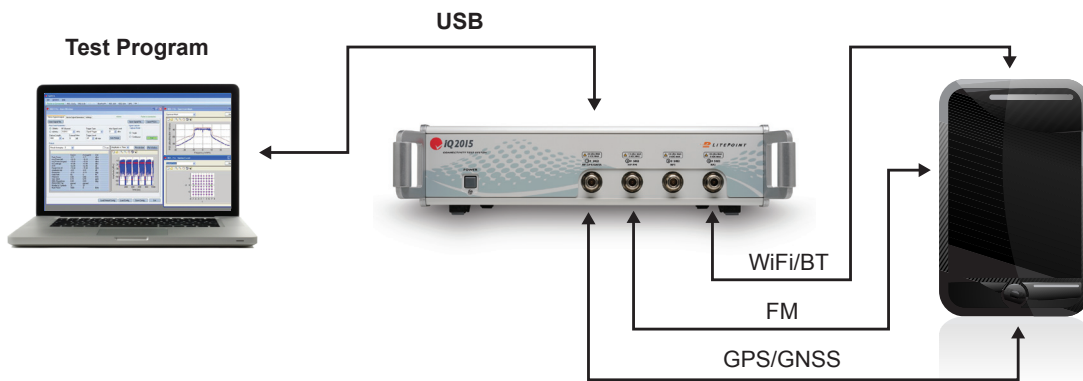

Figure 2: IQ2015 Test System—Testing Connectivity Functions of a Mobile Device

Manufacturing Test Versatility

The IQ2015 test system is designed to provide high-volume device manufacturers with key advantages for multi-radio device testing.

These include:

- Concurrent test architecture
- Sequence-based test resulting in greatly reduced test times
- Software-licensable standards / capabilities

- Common hardware configuration
- Simplicity of a one-box testing with a unified interface

Concurrent Test Architecture

The IQ2015 test system can test multiple device radios in parallel. This can greatly reduce the test time as more and more radios are added to the Multicom devices. As an example, a typical Multicom device might contain the following radios / functions:

- WLAN (802.11)
- Bluetooth
- GPS, GNSS
- FM (TX or TX/RX)

Using traditional test approaches, all these radios would be tested serially, possibly even at different test stations. This results in increased device insertions (connections) which results in more handling time and possible damage because of handling errors. Additionally, the tests are run serially resulting in test times that increase as more and more device functionality is added.

With concurrent testing, the IQ2015 test system allows for reduced test time, which could be as much as 75% in this scenario. Figure 3 illustrates this reduction in test time where GPS, GNSS and FM are tested in parallel with the WiFi and Bluetooth capabilities.
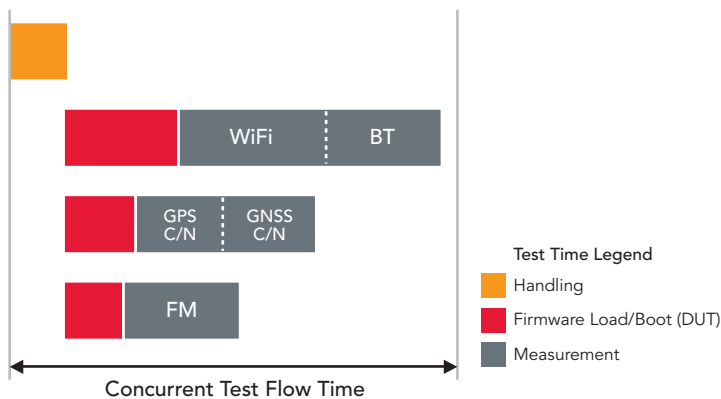

Figure 3: Concurrent Test Flow

Sequence-Based Test (SBT)

The IQ2015 test system features proprietary, sequence-based test flow capability, which dramatically reduces WiFi test-time for supported devices.

Sequence-based test reduces the test time for WiFi technologies in the key area of transmit multi-data-rate EVM / Power measurements. In transmit multi-data-rate testing, the IQ2015 test system can sequence or step in concert with the device under test because the test system can capture outputs at different data rates. With the appropriate device driver and test sequence support, the IQ2015 test system can capture the various data-rate bursts from the DUT in a single capture, reducing the communication time to the DUT and thereby reducing test times by up to six times for transmit testing and calibration.
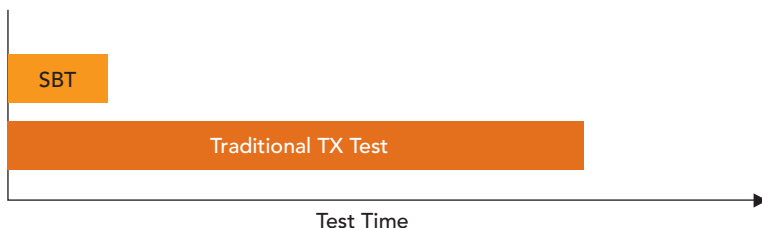

Figure 4: WiFi SBT Transmit (Tx) Test Time vs. Traditional Test Approaches

Fast Packet Error Rate (PER)

While performing a PER receive (Rx) test, when packets are transmitted to the DUT, the IQ2015 test system uses specialized built-in circuits to detect the acknowledgement signals from the DUT. These acknowledgement signals provide confirmation of the received data, and PER can be calculated without requiring extensive DUT communication. This approach to PER receive testing, named Fast PER, provides up to four times reduction in test and calibration time as compared with traditional approaches.
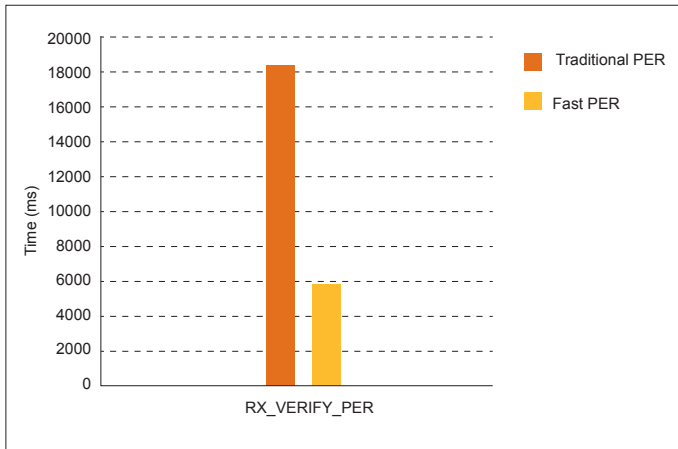

Figure 5: WiFi Fast PER vs. Traditional PER Receive (RX) Test Time

Software Licensable Standards

Device manufacturers often face unpredictable combination of devices and manufacturing volumes. Having a unified "superset" test system that allows for testing of every possible device combination and permutation often results in capital equipment that is underutilized, resulting in more test capabilities than what is actually needed. Alternatively, with standards-specific test systems, balancing the demand for capabilities to test new technologies in short time-periods—often measured in days—is difficult.

The IQ2015 test system features a common hardware platform with standards-specific features that are enabled through software licenses. These licenses can be purchased as needed, enabling capabilities to be "turned on" in the field, without the need to send equipment back to a service center or the factory. As a result, manufacturers can quickly add new measurement capabilities to their existing IQ2015 installed testers and rapidly meet production needs. Conversely, manufacturers can begin their IQ2015 installations with only WiFi and Bluetooth testing capabilities, and add other standards as their needs grow. This provides an overall optimum equipment and capital utilization.

LitePoint is offering of software licensable standards include:

- GPS, GNSS
- FM TX / RX
- WiMAX (802.16 d/e)

- Near Field Communication (ISO 18092)
- ZigBee (802.15.4)

Users of IQ2015 test systems can refer to the IQ2015 User Guide for a complete description of the measurement supported by each software option.

One-Box Tester Simplicity with a Unified Interface

The IQ2015 test system carries on the LitePoint tradition of providing measurement capabilities that are focused on addressing the exact needs of manufacturing testing. The IQ2015 test system provides measurement coverage for up to six different standards —all with a unified software and hardware interface. This helps eliminate the complexity of the test system having to communicate with multiple instruments and software interfaces. A single USB connection provides the essential control connectivity to the

IQ2015 test system. And, the compact size of the IQ2015 (2U high and only 13 inches wide) test system ensures that the production floor space is minimized.

On the production floor, the complete connectivity test and calibration coverage provided by the IQ2015 test system allows for easy accommodation of rapid changes in product configurations. The unified hardware that is common between test stations in an IQ2015 test system allows for new standards to be added with only an update to the existing software license file. The manufacturing test and calibration system can therefore respond to quick changes in market needs with a minimal disruption to the factory floor.

Software Designed for Multi-Radio Devices

The IQ2015 test system features software that is designed to ease the testing of multi-radio devices. A C++ application programming interface (API) and a graphical user interface (GUI) provides a consistent look and feel across the multiple supported standards. Additionally, the GUI is arranged by technology, allowing users to quickly find the relevant measurement functions and controls needed to test their Multicom devices. The user can easily choose the technology of interest using the technology dashboard which then launches the appropriate settings window. Each technology is contained in its own window, allowing the user to to quickly switch back and forth between technologies to adjust settings and analyze data.

Figure 6: IQ2015 Graphical User Interface (802.11 Example Shown)

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