

Keysight Technologies

Solutions for Testing NFC Devices

Using an Accurate, Configurable
and Versatile Test Bench with
Qualified Test Tools to Address
Test Challenges Throughout the
NFC Product Development Cycle

Application Note

Overview

Near Field Communication (NFC) is standards-based, short range communication technology that integrates Radio Frequency Identification (RFID) technology with mobile communication devices (e.g., smartphones, tables and eReaders) and the wireless Internet infrastructure. NFC-enabled devices establish radio communication by touching or coming into close proximity with one another. Communication is also possible between an NFC device and an unpowered NFC chip or tag. NFC standards are based on existing short-range, High Frequency (HF) standards working at 13.56 MHz, including

those defined by the NFC Forum non-profit industry association. The technology operates at a distance of up to 10 cm with a data exchange rate of up to 848 kbps, and has three modes of operation: peer-to-peer, card emulation and reader/writer; although higher bit rates are anticipated in future versions of the NFC standard. It is compatible with modern contactless RFID technologies and complements both *Bluetooth*® and Wi-Fi technologies.

Today, NFC technology is rapidly being adopted in a range of popular electronic

devices. Soon, millions of consumers are expected to be equipped with NFC-enabled devices capable of interacting with other NFC infrastructure devices for the purposes of transport, retail, healthcare, payment, entertainment, access control, and information collection and exchange. To guarantee a successful roll out, compliance and interoperability testing are required. Some industry organizations, such as the NFC Forum, have already developed technical and test specifications to enable developers to successfully test and certify their NFC devices (Figure 1).

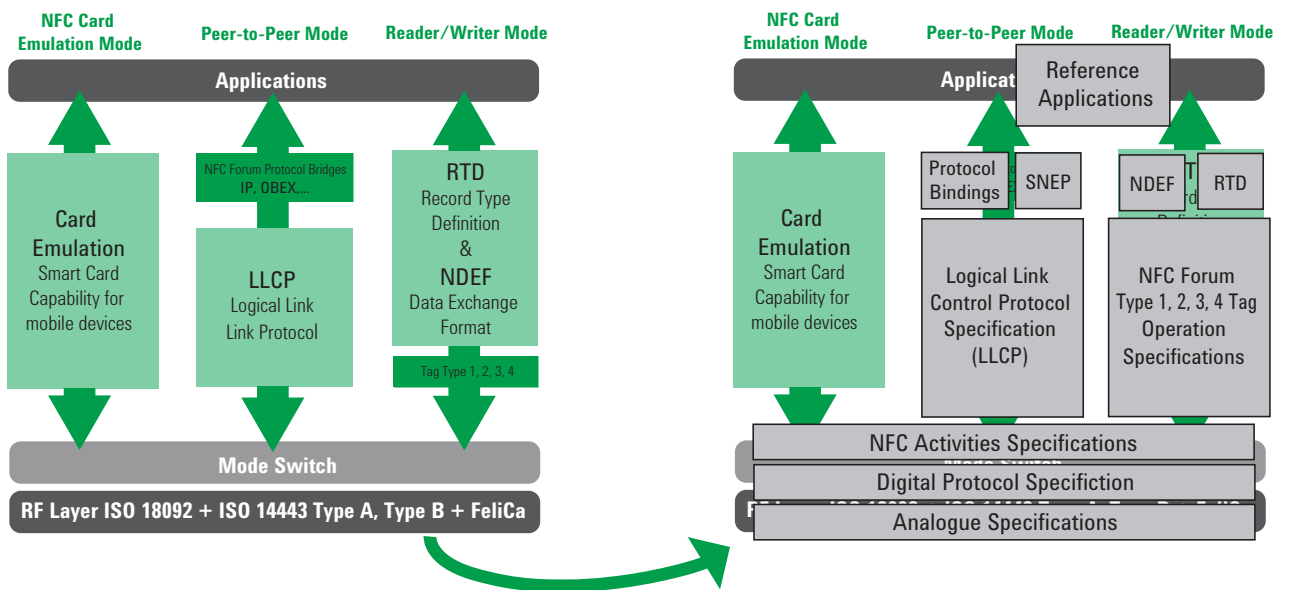


FIGURE 1. Shown here are the current NFC Forum specifications supporting NFC Forum modes of operation: peer-to-peer, card emulation and reader/writer.

Problem

By enabling contactless communication with a simple touch, NFC technology simplifies consumers' ability to make transactions, exchange digital content and connect electronic devices. It also opens the door to a world of new mobile applications and application scenarios, from baggage tracking and personal identification, to payment and mobile RFID. However, reaping these benefits requires that mobile device developers quickly and accurately test their NFC devices throughout all phases of the product development cycle—from R&D to final certification—to ensure their proper operation and interoperability before reaching the market.

When testing NFC components or devices, both analog (RF) and digital (protocol) tests must be performed. Analog tests measure such things as power levels, waveform quality, frequency accuracy, and modulation, while digital tests check for things like low-layer protocol exchanges, link timings and framing, as well as higher level protocols layers like Logical Link Control Protocol (LLCP) and Simple NDEF Exchange Protocol (SNEP). Different testing strategies are required to perform these tests at each stage of development (Figure 2). Complicating matters further, NFC device developers must contend with contactless legacy standards and the NFC Forum

specifications, as well as, the NFC technical standard's air interface specifications. Most conventional test systems require external instrumentation to configure a test bench capable of addressing all of these various test needs. The result is a complex test system that is difficult for developers to learn quickly, which in turn increases cost and decreases return on investment. Further, as NFC technology is enhanced, a new certification and compliance process will be required, forcing existing test benches to be modified and developers to face a new learning curve.

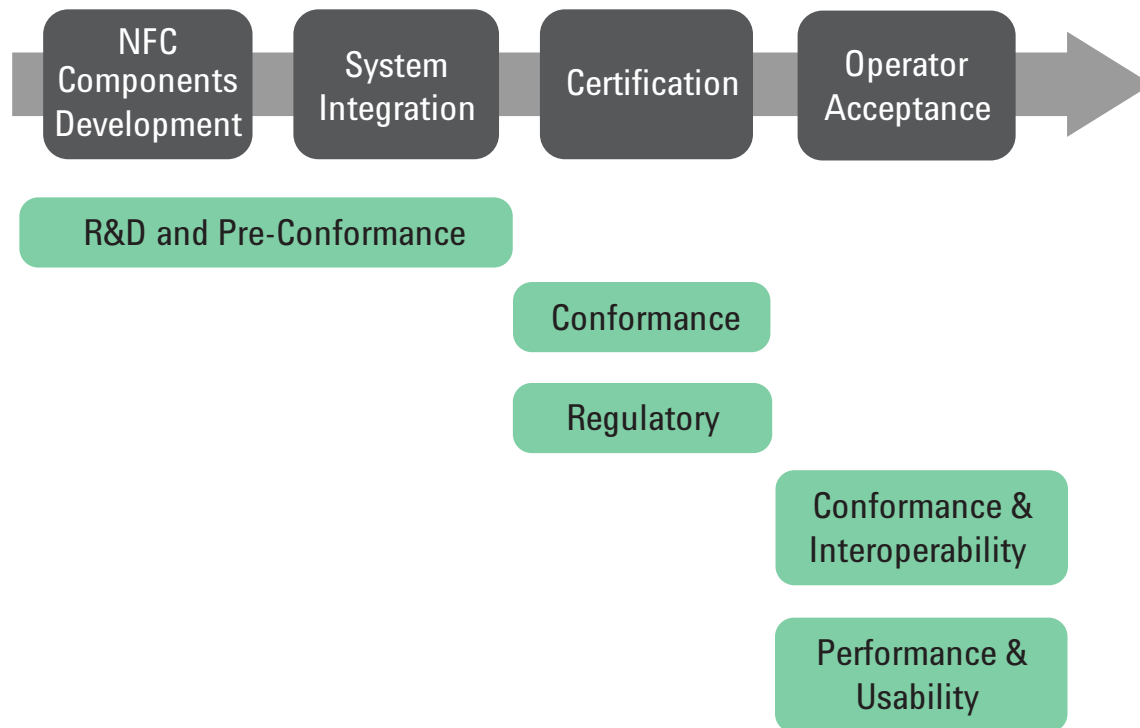


FIGURE 2. Different testing strategies are required at various NFC development stages.

Solution

Accurately, cost-effectively and quickly dealing with the complexities and test challenges created by NFC technology and its associated standards demands a test bench comprised of qualified test tools that are highly accurate, configurable and versatile. The tools must be able to execute RF and protocol measurements covered in the NFC standards throughout all phases of product development and be flexible enough to adapt to evolving NFC standards. Specific features and functionality that must be available within the test bench are: an NFC device (both reader and tag role) emulator; signal generation, acquisition and analysis; protocol code and decoding capabilities, conformance features, automatic positioning tools, and uncertainties.

A prime example of a solution enabling this mix of functionality is Keysight Technologies, Inc. RIDER HF Test System for NFC manufacturers and testing laboratories (Figure 3). The solution enables NFC R&D and Conformance testing throughout all product development phases and is a recognized tool for NFC Forum certification. Unlike other test systems that require external instruments to set a complete test bench, the RIDER Test System is a one-box, stand-alone solution comprising all necessary measurement tools in a compact package based on the T1141A RFID HF Test Set, control PC and necessary test interfaces. The T1142A Automatic Positioning Robot can be added for accurate, automatic positioning of test interfaces as required by NFC Forum specifications.

The RIDER Test System can execute most RF and protocol measurements covered in the current high-frequency NFC and RFID technology standards. Specific standards that can be tested include: the NFC Forum's Digital Protocol, Analog, LLCP and SNEP specifications; ISO standards for NFC (ISO/IEC 14443 & ISO/IEC 18092) and ISO standards for RFID HF (ISO/IEC 18000-3 & ISO/IEC 15693). Users can also build and automatically execute their own test cases, and even emulate NFC and RFID devices.

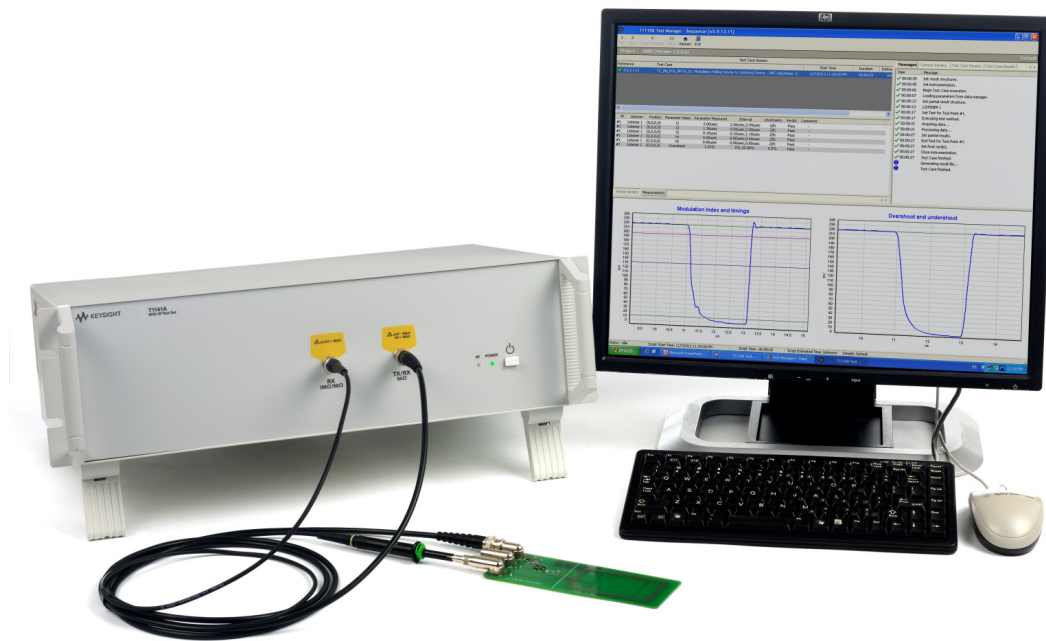


FIGURE 3. The one-box RIDER Test System reduces test bench complexity and is extremely easy to learn and use.

The RIDER Test System is available in two models: the T3111S RFID HF Conformance Test System and the T3121S RFID HF R&D Test System. Both feature all hardware components needed to manage signals received through different test interfaces, as well as, communication with the test applications installed in the control PC through which they may be operated. The Test Manager application serves as the user interface and project management tool, providing automatic control and execution of test cases and report generation for evaluation of test campaigns during RF and conformance testing (Figure 4).

Virtual Panel is a software application interface that allows users to sniff and analyze signals coming from the Device-under-Test (DUT), a capability that is especially useful when preparing samples for certification during R&D (Figure 5). By enabling users to find bugs early in the development process, Virtual Panel reduces debug time and cost.

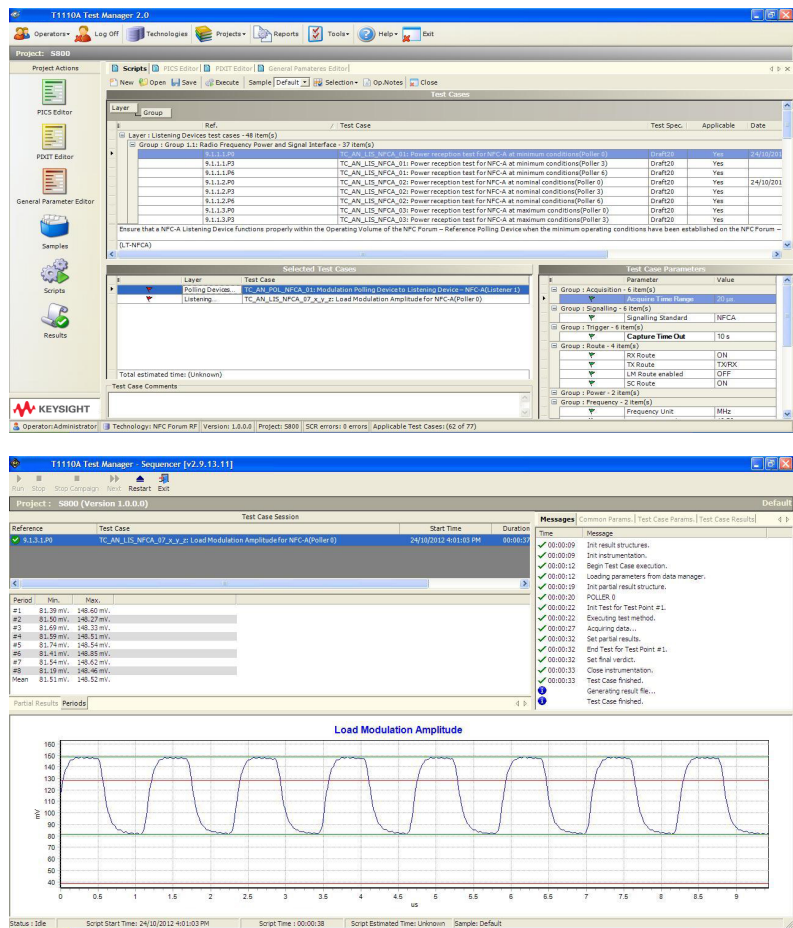


FIGURE 4. The Test Manager user interface (left) is based on several modules. The sequencer module, shown on the right, enables two types of operation: individual execution of test cases, or batch execution using an XML script.

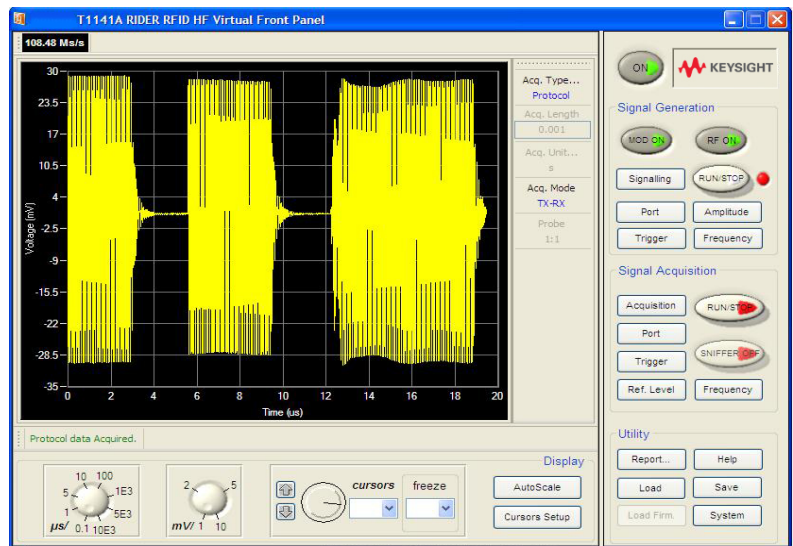


FIGURE 5. Shown here is the R&D Virtual Panel software interface. The application offers a number of acquisition options, including: waveform, envelope, logical, and protocol type signals.

NFC Conformance Test

NFC conformance testing determines whether an NFC component or device conforms to specifications and is performed at various stages of the development cycle. To ease the burden of conformance testing, the T3111S Test System supports both individual execution of test cases and automatic batch execution. A reporting engine facilitates analysis of test results (Figure 6).

In some instances, the developer may want to test the behavior of the DUT outside specification limits and it may not be sufficient to simply execute conformance test cases. In this case, customization of test case parameters and free test definition is required. The RIDER Test System's hardware and software offers users the flexibility to change test case parameters to cope with different testing situations. Additionally, an API allows users to define their own test cases.

NFC R&D Test

During R&D testing, developers test NFC device signal modulation, bit-level coding, bit rates, frame formats, protocol and command sets. They also verify that protocol commands and sequences are implemented correctly. The T3121S supports R&D testing for NFC devices, smartcards, RFID readers and tags, as well as, devices based on RFID technology operating in the HF band. Its Virtual Panel interface allows users to develop their own test applications programmed in VEE, LabView, C/C++, Lab Windows/CVI, or Visual Basic.

With the T3121S, developers can capture and analyze signals transmitted by the DUT without using external instrumentation and generate the signaling needed to interact with the DUT. Various module options allow the solution to be tailored specifically for R&D RF measurement, or as a protocol analyzer or sniffer. During RF testing, for example, users can create their own interface and set of measurements, configuring parameters related to the acquisition signals (e.g., acquisition time and type, reference level, and type of trigger),

the signal generation (e.g., modulation index, data rate and amplitude) or representation signal (e.g., display markers and scales). With protocol analysis, the T3121S emulates different devices' behaviors to build and send all types of messages described in the protocol communication rules, and receive and process every equipment-under-test response for further analysis.

The T3121S test system also generates signaling and produces communication scenarios outside the limits and the requirements defined in the standards. To perform protocol testing based on invalid behaviors, the payload information must be modified in every single packet transmitted by the test tool. Protocol scenarios with link timing responses over the specific limits can also be produced.

Summary of Results

While the rapid adoption of NFC technology in smartphones and other similar mobile electronic devices bodes well for consumers eyeing easier, more convenient transactions, exchange of digital content and device connectivity, it also poses some unique challenges. NFC-enabled devices have highly complex protocols and applications, and the standard is continually evolving with technologies like NFC Forum 15693, NFC Forum Wireless Charging and NFC Forum Active Mode under investigation—all of which makes quick and accurate testing difficult. Further complicating matters, different tests and testing strategies are required at each stage of NFC device development. Addressing these challenges requires a test bench of qualified test tools like the RIDER Test System that is highly accurate, configurable, versatile, and can be used for testing strategies throughout all phases of NFC product development phases—from R&D to final certification. Such functionality is critical to supporting the successful ongoing rollout of NFC-enabled devices worldwide.

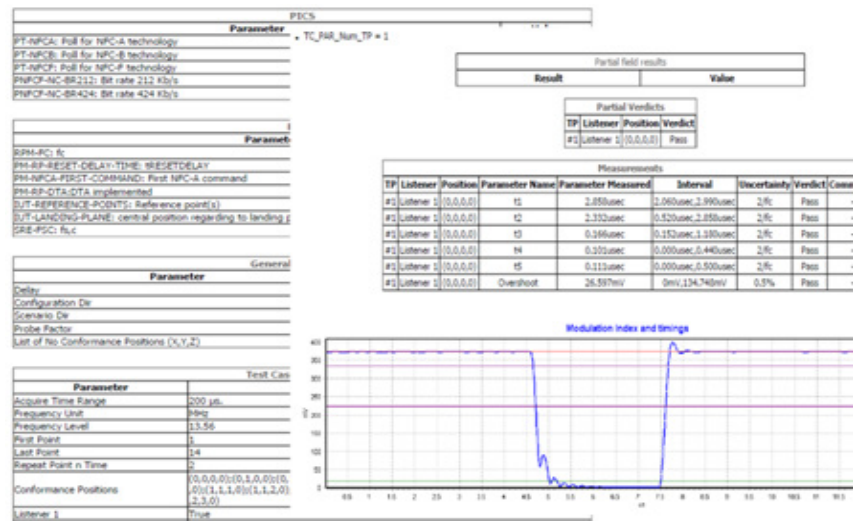


FIGURE 6. Shown here is an example of a NFC Forum RF test case result (right side) with some test case configuration parameters.

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Related Applications

- NFC R&D and Pre-Conformance testing for chipsets and antenna designers
- NFC Pre-Conformance testing for device manufacturers
- NFC Conformance at NFC Forum Authorized Labs
- Quality test and spot testing at MNOs or other stakeholders deploying NFC-enabled terminals or NFC-dependent services and applications

Related Keysight Products

- T3111S RFID HF Conformance Test System and accessories
- T3121S RFID HF R&D Test System and accessories
- T1142A Automatic Positioning Robot

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

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