

Tektronix Solutions Support Broad Range of Project 25 Test Needs

I. Introduction

In the last decade, new digital land mobile radio (LMR) communications systems have been developed to meet the growing communications needs of public safety. These systems were developed in part to ease the migration of LMRs to the narrower channel plans mandated by the Federal Communications Commission (FCC) and National Telecommunications and Information Administration (NTIA), but they also offer a host of advanced new features, such as encryption. Operation on narrow channel plans requires higher performance transceivers, in order to ensure the integrity of mission critical communications. In an effort to satisfy public safety users' expectations, LMR manufacturers involved in Project 25¹ are establishing a "Compliance Assessment Program" that will evaluate Project 25 equipment for compliance with respect to performance, interoperability and conformance standards.

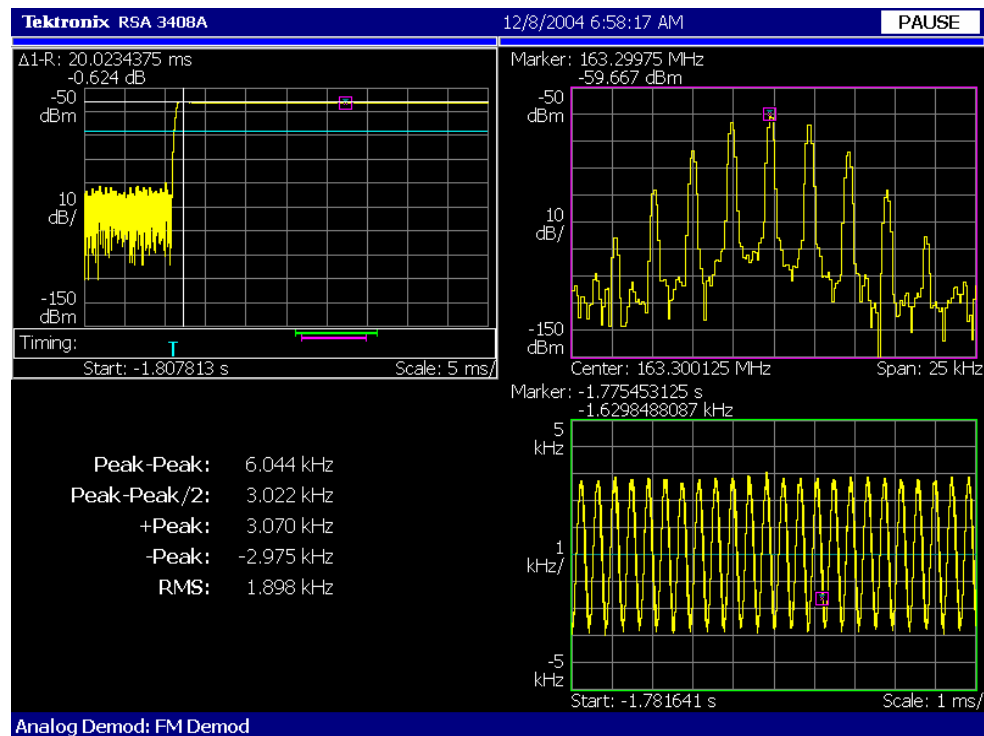


Figure 1. RSA3408A Correlated views of Time Domain, Spectrum, and Frequency Deviation display and statistics of Project 25 radio.

The performance tests defined for Project 25 LMRs require high quality test equipment to measure increasingly stringent operational parameters and to ensure that only compliant products reach the market. Once this equipment is deployed in the field, though, well implemented frequency plans are essential to circumvent interference between neighboring systems. The up-front equipment testing, planning, monitoring and continued maintenance of deployed systems require flexible testing solutions. Tektronix has added key support capability to its award-winning RSA3300/3408A Real-Time Spectrum Analyzer (RTSA) and the RF Scout™ Interference Hunter to

¹ Project 25 is an open interface, standards-based LMR technology which is being developed under the auspices of the Telecommunications Industry Association in cooperation with public safety communications officials

assist with the many aspects of testing these new digital standards, planning, monitoring and maintaining these networks.

II. Performance Testing Made Easy with Simplified Solution

Recently, the Institute for Telecommunication Sciences (ITS), the chief research and engineering arm of the National Telecommunications and Information Administration (NTIA), selected the Real-Time Spectrum Analyzer (RTSA) platform for its automated performance testing implementation that it is developing for the Project 25 Compliance Assessment Program. ITS was able to simplify the execution of a number of the transmitter tests defined in TIA-102.CAAA by exploiting the wide range of functionality in the instrument. Numerous tests that once required a multitude of dedicated instruments (e.g., Modulation Analyzer, RF Signal Generator, Audio Analyzer, Spectrum Analyzer, Power Meter, and even an Oscilloscope) are now able to be done by using a single instrument - the Tektronix RTSA

The basic power and spectrum measurements are standard in the RTSA to test transmitter performance. For the more complex tests, optional software enables the RSA3300 and RSA3408A products to perform a host of additional Project 25 tests:

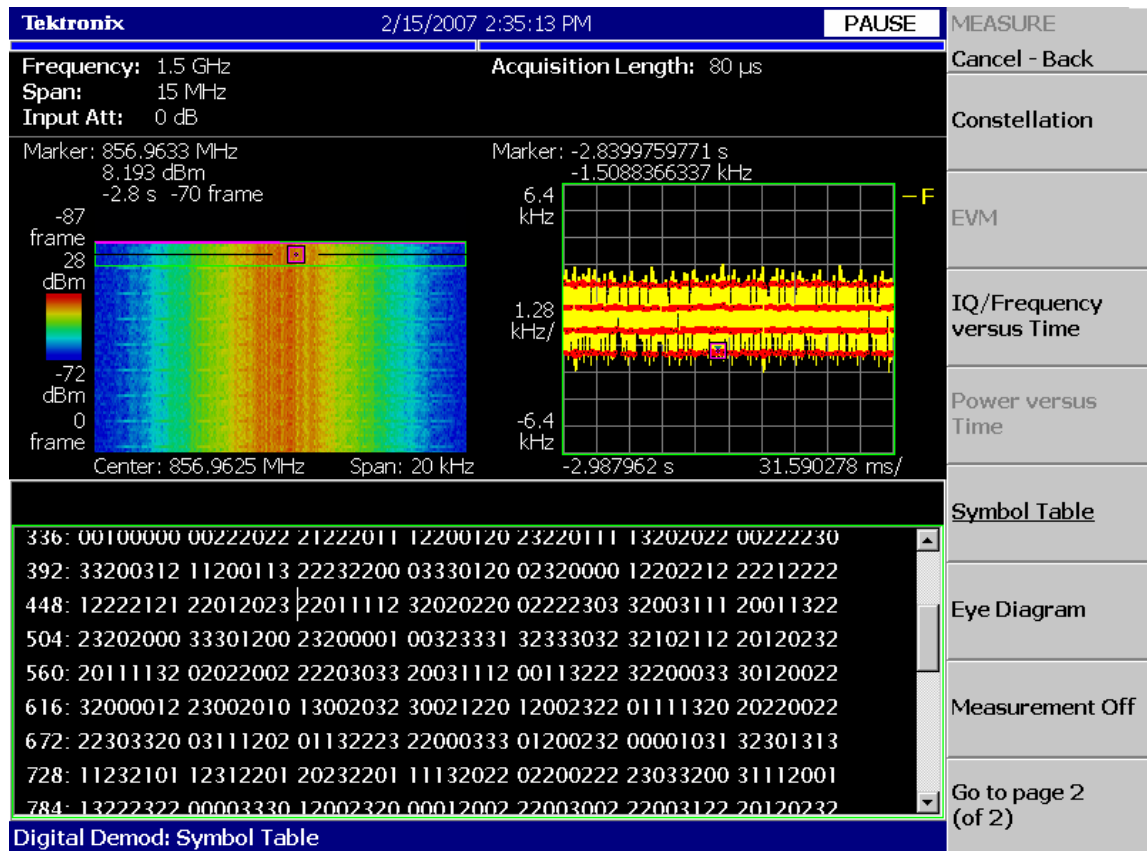


Figure 2. RSA3408A Measurements showing Spectrogram, C4FM Modulation vs Time, and Symbol table of Project 25 radio.

Digital Project 25 TX measurements

- C4FM Modulation Fidelity
- Frequency Deviation for C4FM
- Modulation Emission Spectrum
- Unwanted Emissions: Adjacent Channel Power Ratio
- Transient Frequency Behavior
- Transmitter Power and Encoder Attack Time
- Transmitter Power and Encoder Attack Time with Busy/Idle Operation

- Transmitter Throughput Output

Analog TX measurements required for backward compatibility:

- Total harmonic distortion of FM demod
- SINAD of FM demod
- Hum & noise of FM demod

Analog Project 25 RX measurements required for backward compatibility:

- Total harmonic distortion of baseband
- SINAD of baseband
- Hum & noise of baseband

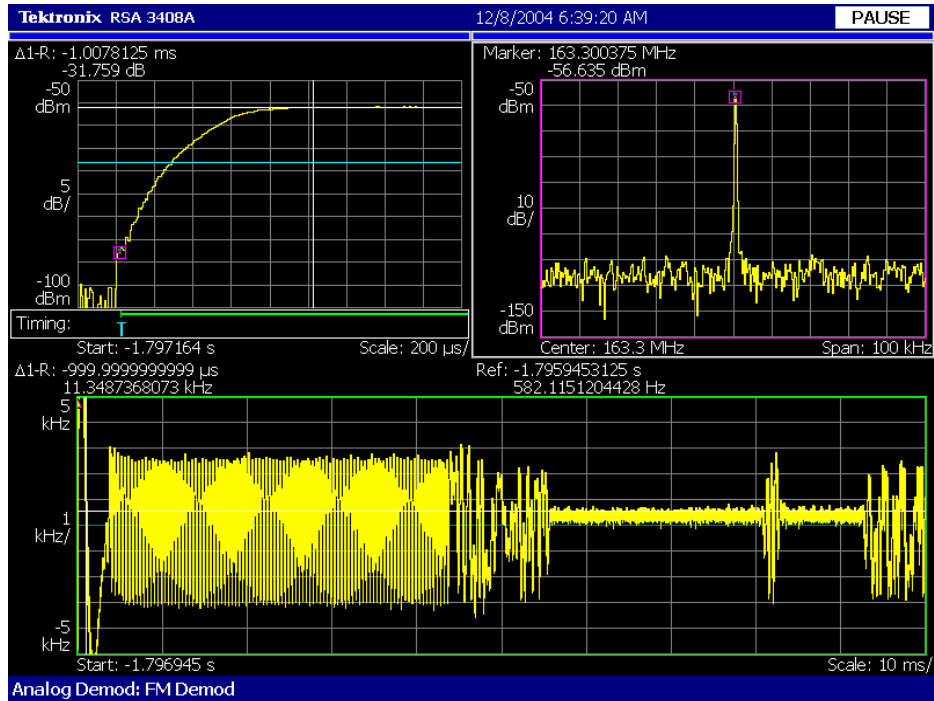


Figure 3. RSA3408A Measurement of turn on transient in FM Mode of Project 25 radio.

III. Assistance in RF Design and Debug of Project 25 radios

The Tektronix Real-Time Spectrum Analyzer (RTSA) has the unique capability to capture difficult to detect transients and settling behavior that cannot be seen with other spectrum analyzers or functional testers. Spectral data can be seamlessly captured over time and time-correlated analysis can be provided in multiple domains – frequency, time, modulation, and more. The accumulated time record makes it possible to evaluate events before and after the trigger.

Events, such as turn-on transients and PLL settling, can be triggered by the unique Frequency Mask Trigger on the RTSA, thus eliminating the need for complex triggering on spectrum analyzers. Singles will be captured for analysis on the RTSA that would otherwise be missed by other spectrum analyzers and functional tests.

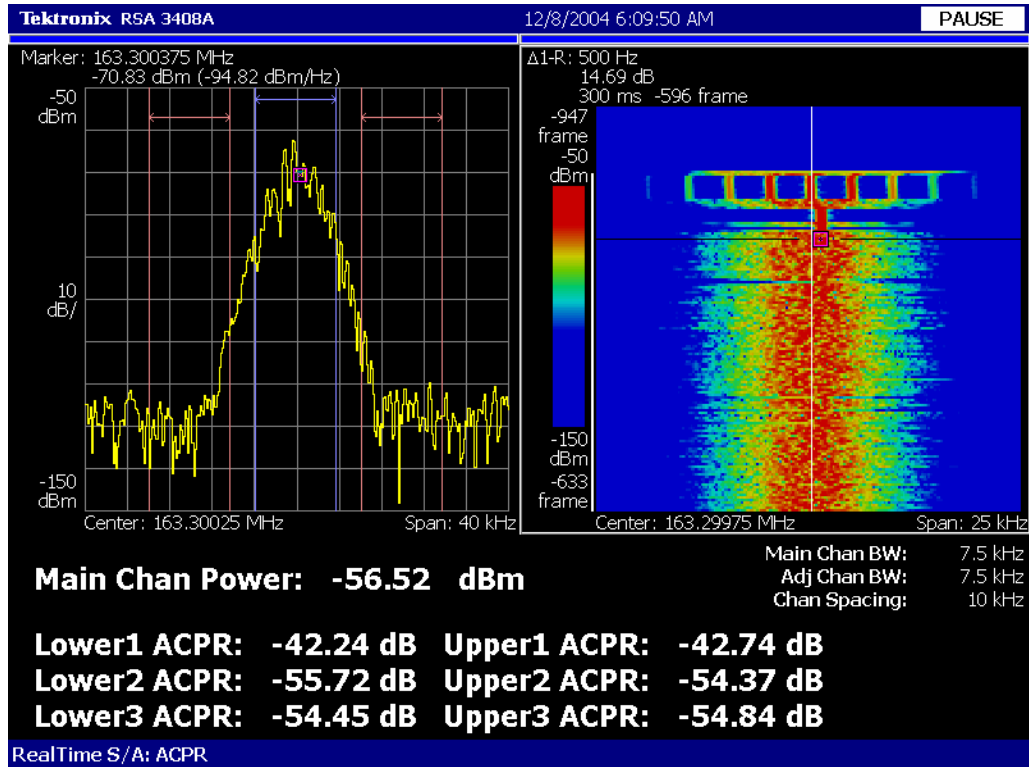


Figure 4. RSA3408A Frequency Mask Trigger initiates the spectrogram capture during tuning.

Figure 4 shows the turn-on and settling of a Project 25 radio with side by side spectrum and spectrogram views. The instantaneous Adjacent Channel Power Ratio (ACPR) can be seen in the measurement results as the correlated measurement marker is scrolled down the spectrogram.

IV. Testing other converged Wireless technologies

As end user devices might incorporate several wireless technologies, the extensive demodulation analysis capability in the Real-Time Spectrum Analyzer (RTSA) can assist the complete testing of the radio. These integrated technologies might include other analog or cellular modulations and nomadic technologies.

- First generation Project 25 standards analog modulation
- Testing cellular standards like 1xEV-DO, GSM, W-CDMA, HSxPA, and WiMax
- Testing nomadic technologies like W-LAN IEEE 802.11 a,b,g,n

The RTSA's time-correlated multi-domain display delivers views of the frequency, time, and modulation domains. Analyze EVM, frequency, I/Q versus time, constellation diagrams, and eye diagrams – all time-correlated to one another and computed from the same underlying data.

V. Interference detection and recording for end user environments

No less important than radio performance in mission critical LMR communications is the proper maintenance and management of the radio spectrum. Frequency planners, engineers and technicians must have the ability to detect and mitigate both authorized and unauthorized transmissions that might induce interference on neighboring systems. While interference from co-channel or adjacent channel transmissions can be incapacitating, it is often intermittent in nature, which frustrates troubleshooting efforts. The advanced triggering and real time capture capabilities of the Real-Time Spectrum Analyzer (RTSA) allow field personnel to:

- Detect interference signals and illegal signals
- Monitor the spectrum occupancy and record observations
- Automatically trigger and record to disk interference signals

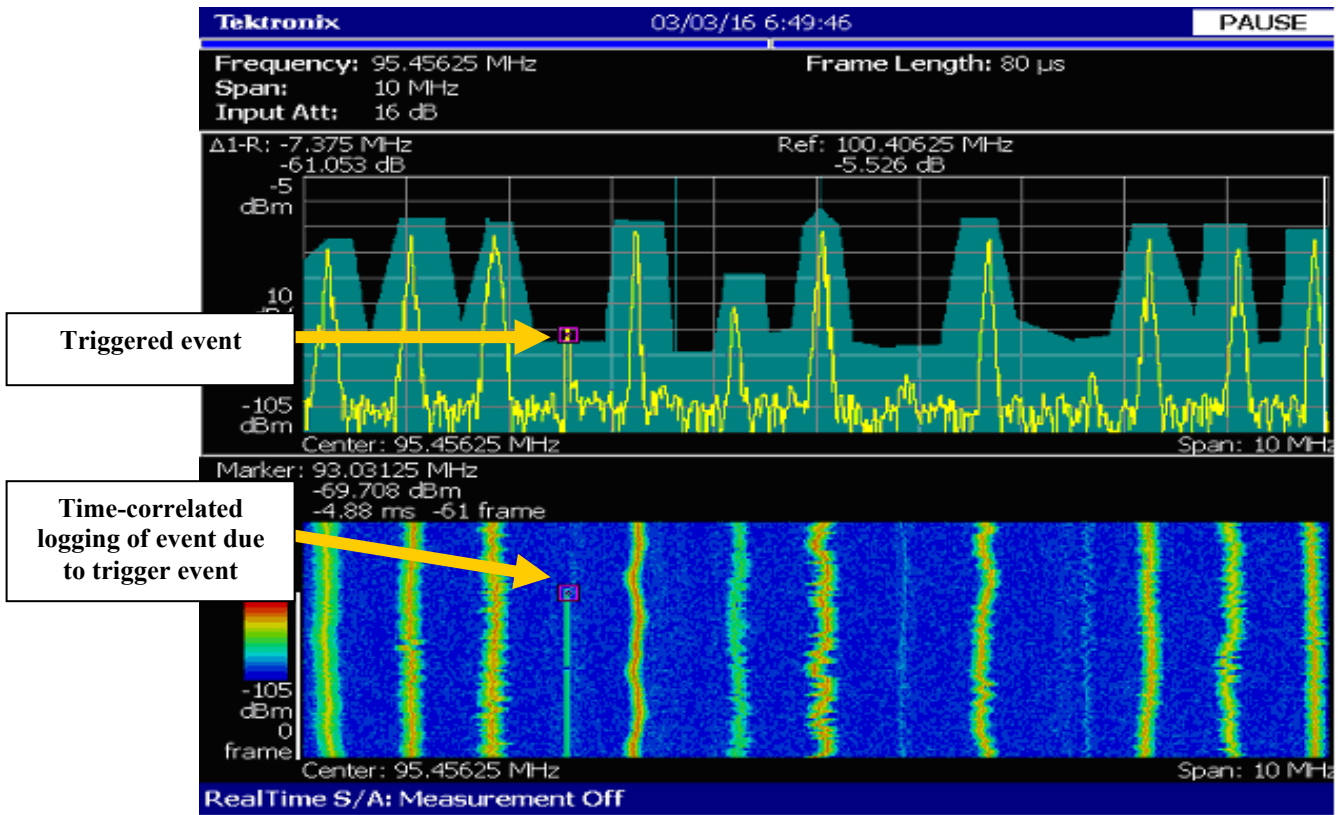


Figure 5. RSA3408A Shows the ability of the RTSA to detect and trigger on small signals in the presence of large signals.

VI. Network Planning and Site Preparation

Coupled with the change to the new Digital C4FM Modulation format is the migration and rebanding of spectrum in the 800MHz band. Signal mapping and site preparation are important tasks in the migration of the new National Telecommunications and Information Administration, (NTIA) bands and finding interfering signals using signal monitoring and subsequent interference detection and hunting requires portable spectrum analyzers with identification and mapping capabilities.

The RF Scout™ Interference Hunter is the only portable spectrum analyzer with built in GPS capability and integrated mapping (iMap) for indoor and outdoor support. The RF Scout™ is handheld (weighing less than 5.5kg) and rugged with a touch screen for improved usability. Data is easily exported to network planning and support tools commonly used in the industry.

Discovery and logging of intermittent signals is enabled by easy to use masking triggering and automatic logging functionality.

Figure 6 shows the integrated mapping capability for the network planning necessary in the rebanding efforts for Project 25. As new bands and channel allocations are assigned, it is important to assess, monitor, and map the potential spectrum prior to determining your network design. The RF Scout™ is a high performance spectrum analyzer with a Noise Figure < 10dB, and is ideal for mapping the noise performance prior to installation.

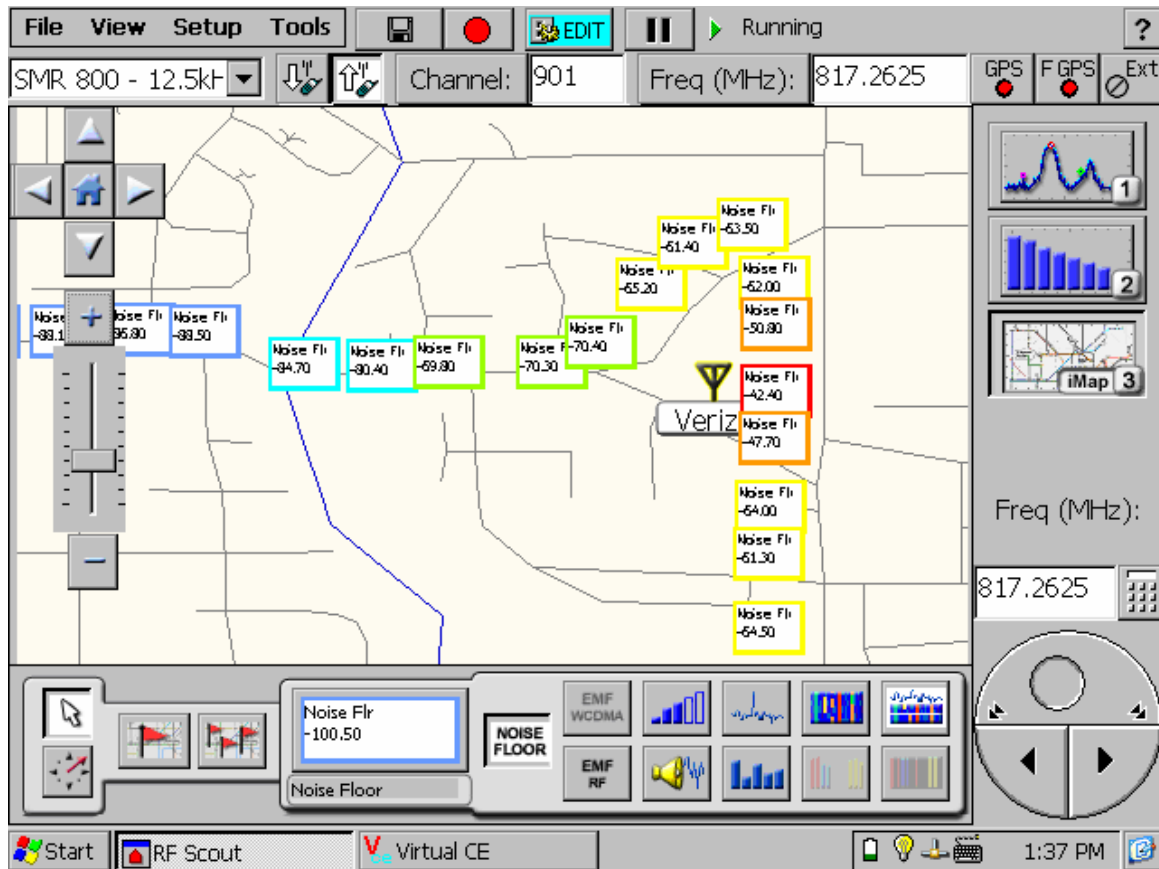


Figure 6. RF Scout Shows the noise floor mapping in the LMR band for new rebanding and frequency planning activities near adjacent towers operating in cellular bands, and important consideration for LMR network performance.

VII. Conclusion

The Tektronix's Real-Time Spectrum Analyzer (RTSA) provides essential test capability for the new Project 25 performance requirements. The RSA3300/3408A are ideal solutions for equipment manufacturers and network operators testing and deploying new Project 25 communications networks, and the RF Scout™ is an indispensable tool for the planning, management, and maintenance of Project 25 networks.