

SECTION 6.

ENGINEERING

TESTING GSM/LTE/5G MODULES IN CONDITIONS OF NO OR UNSTABLE CELLULAR COMMUNICATION

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For manufacturers of electronics and smart sensors, ensuring the reliability of cellular communication modules (GSM, LTE, 5G) during final product testing is a significant challenge. In many locations, mobile network coverage can be unreliable or non-existent, making it impossible to validate device performance under real-world conditions.

This issue is particularly critical for meter and IoT-device manufacturers. The inability to verify the correct operation of a GSM/LTE/5G module or its firmware during final inspection leads to substantial risks, including product failures, costly returns, and damage to brand reputation.

Consequences for Production Line:

- **Delayed Time-to-Market:** Finished devices cannot be tested, causing production bottlenecks and potential breaches of contractual obligations.
- **Undetected Manufacturing Defects:** Risk of shipping products with faulty modules or incorrect firmware, resulting in mass returns and customer complaints.
- **Uncontrolled Quality Assurance:** The testing process becomes random and non-repeatable, making it impossible to objectively compare results across different production batches.

Traditional workarounds like field testing or using signal repeaters are inefficient. They fail to provide the predictable, repeatable, and comprehensive test environment required for a production line due to:

- Complete signal absence ("dead zones" or remote locations).
- Unstable signal strength (fading, interference).
- Inability to control network parameters (signal level, frequency, latency, packet loss).

- Inability to simulate rare but critical network events (handovers, base station failure).

Field trials cannot deliver the controlled and stable conditions essential for streamlined final quality control. The only reliable solution is to bring the test network directly into the manufacturer's laboratory using a self-contained simulator GSM/LTE/5G base station.

The Industry-Standard Solution: In-Lab Network Emulation

While a network emulator is the core of the solution, it must be paired with a robust testing methodology, ideally automated. Leading test equipment vendors typically provide software with capabilities for creating automated test suites.

Key Suppliers of Base Station Emulators and Test Solutions [1]:

1. Keysight Technologies

Models: E7515B UXM 5G, E7515A UXM Wireless

Price Range: ~\$150,000 - \$500,000+

Key Features:

- 3GPP-compliant conformance testing
- Protocol conformance testing
- Throughput testing
- Mobility and handover testing
- Power consumption analysis

2. Rohde & Schwarz [2]

Models: CMW500

Price Range: ~\$100,000 - \$400,000

Key Features:

- RF parametric tests
- Protocol and functional testing
- Interoperability testing

3. Anritsu [3]

Models: MD8475B

Price Range: ~\$80,000 - \$300,000

Key Features:

- Simplified functional testing
- Basic protocol testing

4. Unitest [4]

Models: Various customised solutions

Price Range: \$20,000 - \$100,000

Key Features:

- Protocol conformance testing
- Throughput testing
- Simplified functional testing

Key Advantage:

- Localised technical support and customisation

Solutions from Keysight, Rohde & Schwarz, and Anritsu are powerful but are designed for extensive 3GPP certification testing. This level of testing is often too time-consuming and complex for high-speed production line checks.

The specialized base station emulator from **Unitess** [1] offers a distinct advantage for final quality control, providing a cost-effective solution to deploy a local, fully isolated GSM/LTE/5G network within your facility, tailored to your specific product validation needs.

How the Unitess Solution Works in Your Factory

1. **Local Network:** The compact Unitess base station emulator creates a low-power, lab-safe cellular signal within your testing area.

2. **Control Software:** The included software allows you to launch the cellular network with pre-set parameters (frequency, power, modulation scheme, etc.), which can be customised by Unitess engineers to match your specific test scenarios.

3. **Device Under Test (DUT):** Your smart sensor recognises the emulator as a real operator's base station and performs all standard procedures: network registration, data transmission, and command reception.

4. **Automated Reporting:** After the automated test cycle, a detailed report is generated, confirming whether the device passed all customer-defined tests and met the required performance thresholds.

Key Parameters Validated During Final Inspection:

Table 1.

Parameter	What it Measures	Why it Matters
Sensitivity	The minimum signal level for maintaining a stable connection.	Defines coverage area and suitability for challenging environments.
Current Consumption	Power draw in different operational modes.	Critical for the battery life of autonomous IoT devices.
Data Throughput	Actual uplink (UL) and downlink (DL) speeds.	Validates the quality of protocol stack implementation.
Procedure Success Rate	Reliability of network attach, calls, and handovers.	Characterises the stability and robustness of the module.

Key Benefits for the Manufacturer:

- **Operator Independence:** Conduct tests 24/7, regardless of external network availability.

- **Speed and Efficiency:** Automated final inspection takes minutes instead of days of uncertain waiting.
- **100% Quality Control:** Every device leaving the factory undergoes an identical, repeatable, and objective test of its communication module.
- **Warranty & Return Protection:** Drastically reduces the risk of shipping defective devices due to faulty cellular connectivity.

Conclusion

Implementing a **Unitess** base station emulator transforms cellular module testing into a standardised, controlled, and efficient production operation. This approach not only mitigates supply chain risks but also strengthens your reputation as a supplier of reliable, high-quality products. Furthermore, compared to competing solutions, **Unitess** offers superior value, cost-effectiveness for its feature set, and the accessibility of localised support.

Reference:

1. Electronic resource: <https://www.keysight.com/us/en/home.html>
2. Electronic resource: https://www.rohde-schwarz.com/us/home_48230.html
3. Electronic resource: <https://www.anritsu.com/en-au/>
4. Electronic resource: <https://solutions.unitess.ru/product/imitator-bazovoj-stanczii4g-5g-ntn/>