Agilent Technologies 8960 Series 10 Wireless Communications Test Set

Product Note

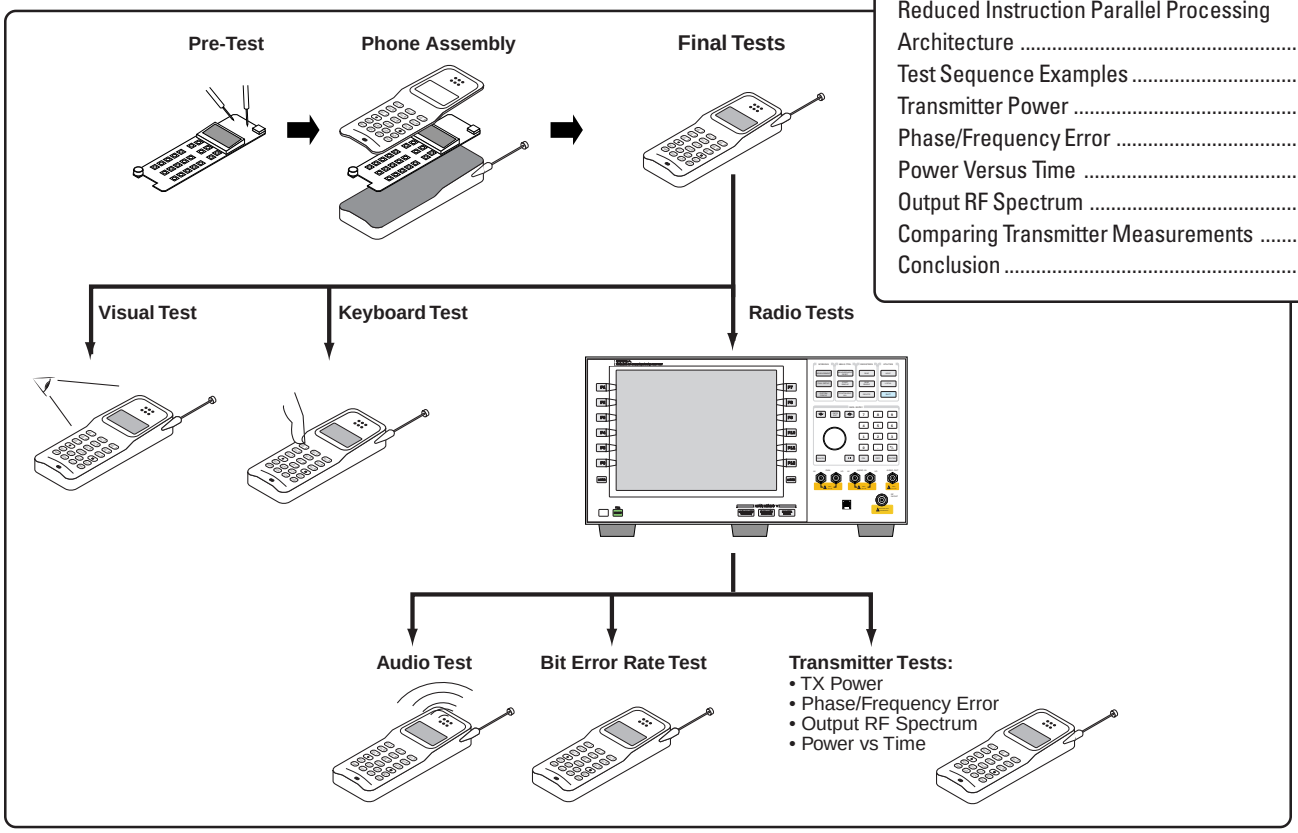
Increase Your Throughput with Reduced Instruction Parallel Processing

Ensuring that mobile stations meet specifications versus minimizing the time it takes to perform the required measurements creates two conflicting strategies for the final-test phase of production. Thoroughly testing a mobile requires making many measurements, yet increasing throughput means reducing test time. Agilent Technologies resolves this conflict with the Agilent Technologies 8960 Series 10 wireless communications test set. Designed to maximize measurement speed, the 8960 Series 10 is effective anywhere that high-speed transmitter measurements are advantageous. Its ability to run transmitter tests concurrently with BER tests makes final test a perfect place to use the 8960 Series 10.

The 8960 Series 10 is based on Agilent Technologies' proprietary reduced instruction parallel processing (RIPP) architecture. You get the proven benefits of Agilent's accuracy and repeatability, along with a test platform that maximizes measurement speed. As compared to previous GSM mobile station manufacturing test sets, the 8960 Series 10 can save 50% or more of the time in the final-test stage of GSM testing.

This product note provides a look at the speed advantage of the 8960 Series 10. Use the Agilent website at **www.agilent.com/find/8960support** to find more information on how the 8960 Series 10 can help you be more successful and competitive in manufacturing GSM mobile phones.

Contents



Agilent Technologies

Innovating the HP Way

Reduced Instruction Parallel Processing Architecture

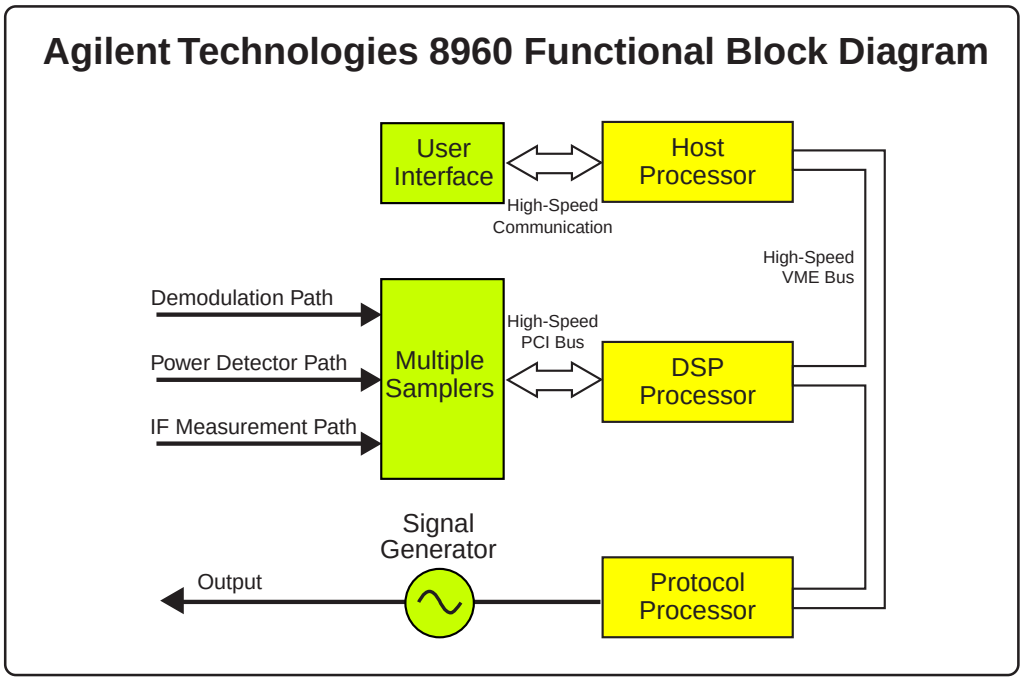
RIPP is Agilent Technologies' proprietary architecture that addresses everything from overall system architecture to specific measurement architecture. A key result from RIPP is that the manual user interface and the remote user interface are independent of each other, increasing operation speed and simplifying programming. Overall, RIPP provides improved individual measurement speed, optimal test sequence speed, and allows for concurrent receiver and transmitter tests.

Reduced Instruction specifically refers to the most compact and easy-to-use remote user interface in the industry. The commands and their structure are easy to learn, and the resulting code is more than 25% less than for other test sets. Statistical results, measurement timeouts, and data integrity are features provided with standard commands. Commands are available to fully synchronize the 8960 Series 10 with the mobile phone and an external controller. No extra code development or maintenance is required for full-featured production tests.

Parallel Processing means hardware designed to accommodate fast microprocessors running in parallel. Using a true multi-tasking operating system, the 8960 Series 10 can handle multiple processes at the same time. With optimized algorithms and tasks optimally distributed among the processors, full advantage is taken of the high-speed internal communication available on the VME bus. Complementing parallel processing are dual-receiver paths and multiple samplers.

Dual-Receiver Paths - With two independent receiver paths, call processing is completely separate from making measurements. The digital signal processing (DSP) processor makes measurements while the protocol processor maintains the link. Any non-ADC hardware control is handled concurrently by the host processor and master serial control chips, providing high-speed parallel communication.

Multiple Samplers - Multiple analog to digital converters (samplers) provide multiple signal access to the DSP processor. The DSP processor controlling the samplers over a high-speed PCI bus provides the 8960 Series 10 with the ability to optimize a sequence of measurements. Look at "Comparing Transmitter Measurements" in this document to understand the measurement speed of the 8960 Series 10.



RIPP architecture provides measurement speed which is typically 10 to 30 times faster than currently available test sets. This speed significantly increases the throughput on your production lines.

Test Sequence Examples

The graph in figure 1 is a performance comparison of the Agilent Technologies 8960 Series 10 and Agilent Technologies 8922 test sets. Two test sequences were used to demonstrate the complete speed advantage that is provided by RIPP architecture for final test.

- **Test Sequence 1** is representative of what might be used today in final test; transmitter power (TX power) and power-versus-time measurements at 3 power levels on 2 channels, and phase/frequency error measurements at 1 power level per channel.

  Although there can be an advantage in measuring multiple bursts of the waveform measurements (power vs time and phase/frequency error), the time penalty incurred with current generation test sets usually prohibits multiple measurements. In this test sequence, 5 bursts are measured on both power versus time and phase/frequency error to demonstrate the viability of the 8960 Series 10 for high-speed multi-burst measurements.
- **Test Sequence 2** is not typical of what is used in final test today, but was chosen to demonstrate the flexibility the 8960 Series 10 has in meeting potentially challenging test scenarios. Measuring output RF spectrum or making high burst count measurements results in a high cost of test time when using the current generation of test sets. In this test sequence a 50 burst output RF spectrum measurement at 2 offsets, both modulation and switching, is included with the TX power measurement at 3 power levels on 2 channels and a 20 burst phase/frequency error measurement at 1 power level per channel.

These test sequences are just two examples of the extraordinary speed of the 8960 Series 10. Use the data from "Comparing Transmitter Measurements" in this document to calculate the 8960 Series 10 speed on your test sequence.

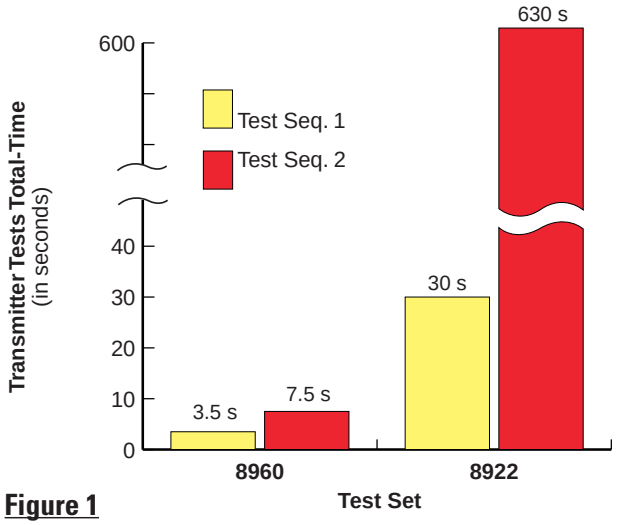


Figure 1

Test Sequence 1 (for the Agilent Technologies 8960 Series 10)

Call Processing Time (varies with mobile phone) + Phase/Frequency Error 5 bursts 0.130 s x 2 + TX Power 1 burst 0.012 s x 6 + Power vs Time 5 bursts 0.200 s x 6 ≃ Total Test Time 3.5 s

Test Sequence 2 (for the Agilent Technologies 8960 Series 10)

Call Processing Time (varies with mobile phone) + Phase/Frequency Error 20 bursts 0.480 s x 2 + TX Power 1 burst 0.012 s x 6 + Output RF Spectrum 50 bursts 0.740 s x 6 ≃ Total Test Time 7.5 s

The 8960 Series 10 reduces multi-channel, multi-power, and multi-burst test sequences by a factor of 5 to 20. Full-featured test times under 5 seconds are achievable.

Transmitter Power

Transmitter power is the most frequently made measurement in the GSM mobile station manufacturing process. It is critical that mobile phones operate to GSM standards. To meet these standards and to conserve battery life, transmitter power levels on the mobile are typically adjusted and set in an extensive calibration test mode process (non-call processing); and power levels are then measured again in an active cell test sequence (call processing). All this means that many transmitter power measurements are performed during GSM mobile manufacturing.

High-speed, accurate transmitter power measurements not only provide a tremendous benefit in reducing manufacturing test time, but they also allow for fast detection of phone instability. The 8960 Series 10 provides fast transmitter power measurements with single bursts timed at 12 ms and multi-burst measurements timed at the GSM frame rate.

Figure 2 shows the timing of a measurement, compared with the GSM bursts, to demonstrate that the 8960 Series 10 actually is faster than the GSM frame rate.

The transmitter power measurement starts with a proprietary power detector circuit that has greater than 50 dB dynamic range, less than 5 µs full response time, 3 GHz wide-band coverage and independent calibration. The measurement completes in the DSP processor with an optimized algorithm and real-time control of calibration. What this means is the 8960 Series 10 provides high-speed GSM transmitter power measurements with *no user calibration* required. The only overhead with measurements is call processing or mobile station control. There is never any power-calibration overhead.

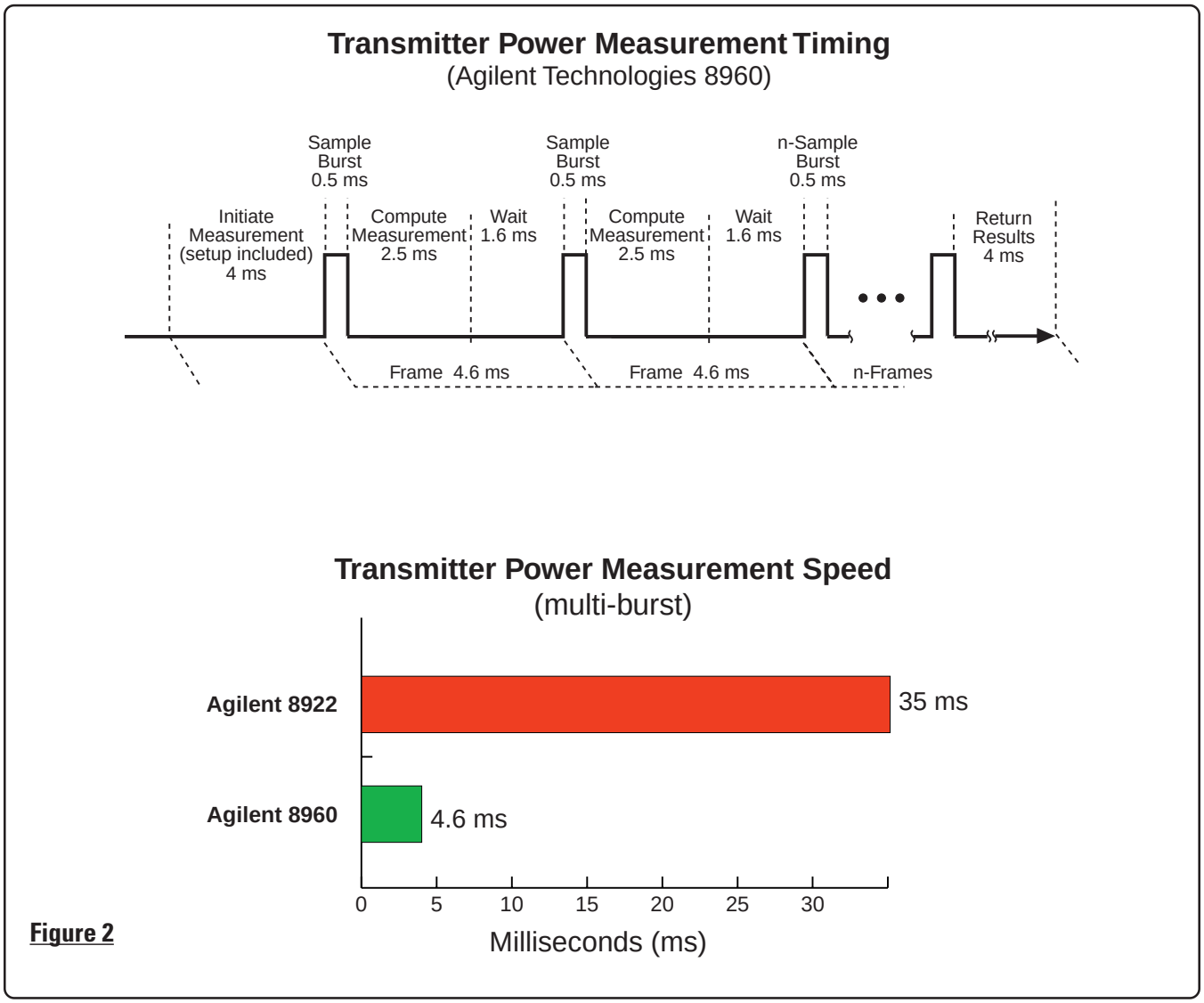


Figure 2

Phase/Frequency Error

The phase/frequency error measurement quantifies the transmitter's modulation performance of the mobile phone, and provides a means of measuring the frequency accuracy. GSM modulation precludes the use of a traditional frequency counter. Although this measurement is done less often than the transmitter power measurement, due to the variability inherent in the mobile station, it is generally desired as a multi-burst measurement.

So although high-speed, accurate phase/frequency error measurements will also reduce manufacturing test time, they also allow for a better measurement in the same or reduced time. The 8960 Series 10 provides fast phase/frequency error measurement in with single bursts timed at 40 ms and multi-burst measurements timed at 23 ms/burst. The phase/frequency error measurement is based on a proprietary algorithm that depends on a high-speed ADC to capture the waveform and a high-speed DSP processor for measurement computation.

Figure 3 shows the timing of a measurement, to demonstrate the paralleling of burst sampling and measurement computation within RIPP architecture to optimize test speed in the 8960 Series 10.

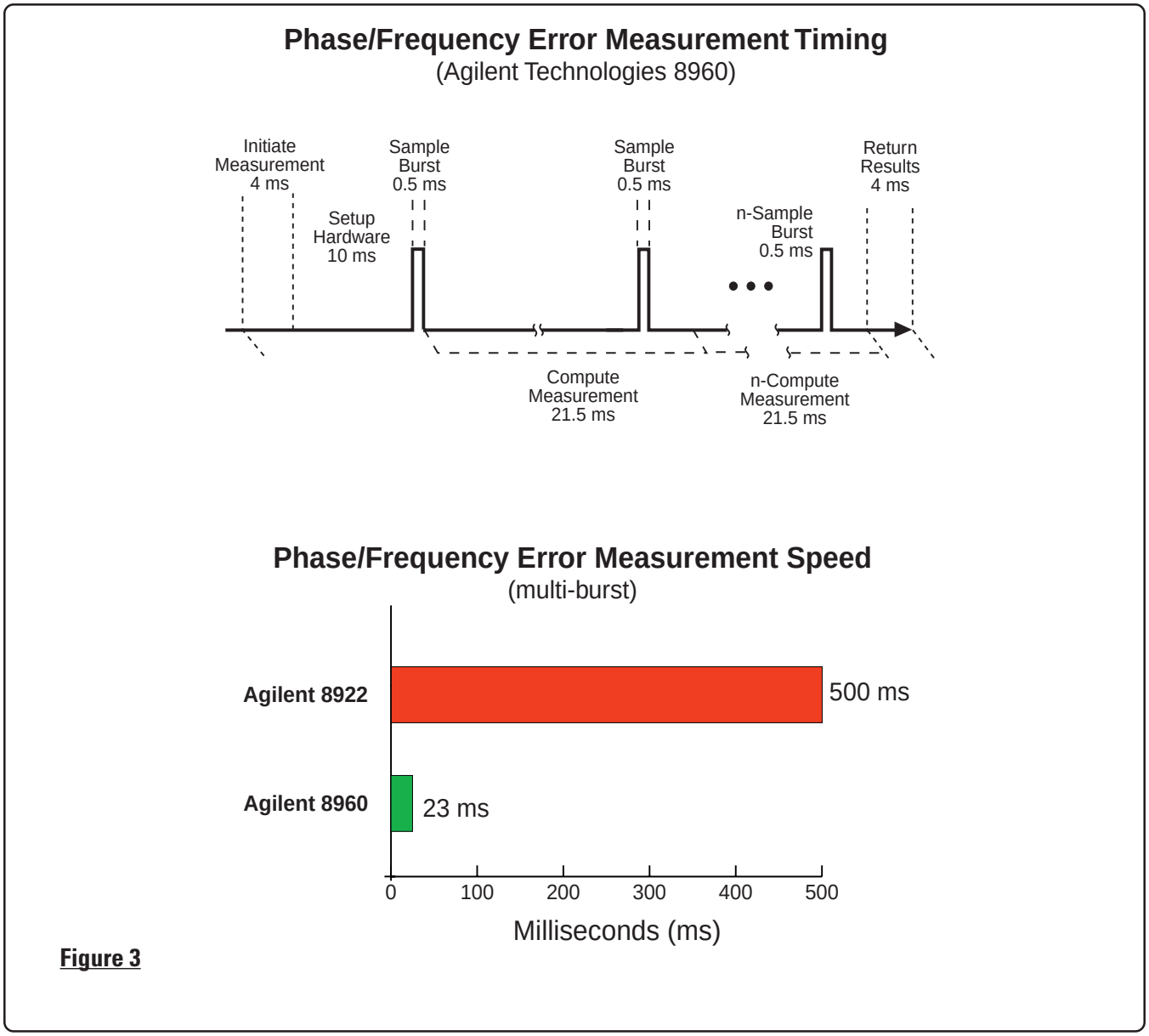


Figure 3

Power Versus Time

The power versus time measurement verifies that the mobile's burst shape meets the mask as defined by the GSM standards. This is a critical measurement because of the timing requirements in the GSM system. Power versus time measurements can be done almost as often as transmitter power measurements and even a short multi-burst measurement is generally more desirable than a single burst measurement.

High-speed, accurate power versus time measurements will definitely reduce test times, as well as provide more confidence in the phone's performance.

The 8960 Series 10 provides the fastest power versus time measurement in the industry with single bursts timed at 53 ms and multi-burst measurements at 37 ms/burst. The timing graphic in figure 4 demonstrates the paralleling of burst sampling and measurement computation within RIPP architecture.

The power versus time measurement uses the wide dynamic range of the power detector circuit and the high-speed sampling of the IF. The result is a fast measurement which returns a pass/fail result that is based on the entire burst, not just the user-specified offsets.

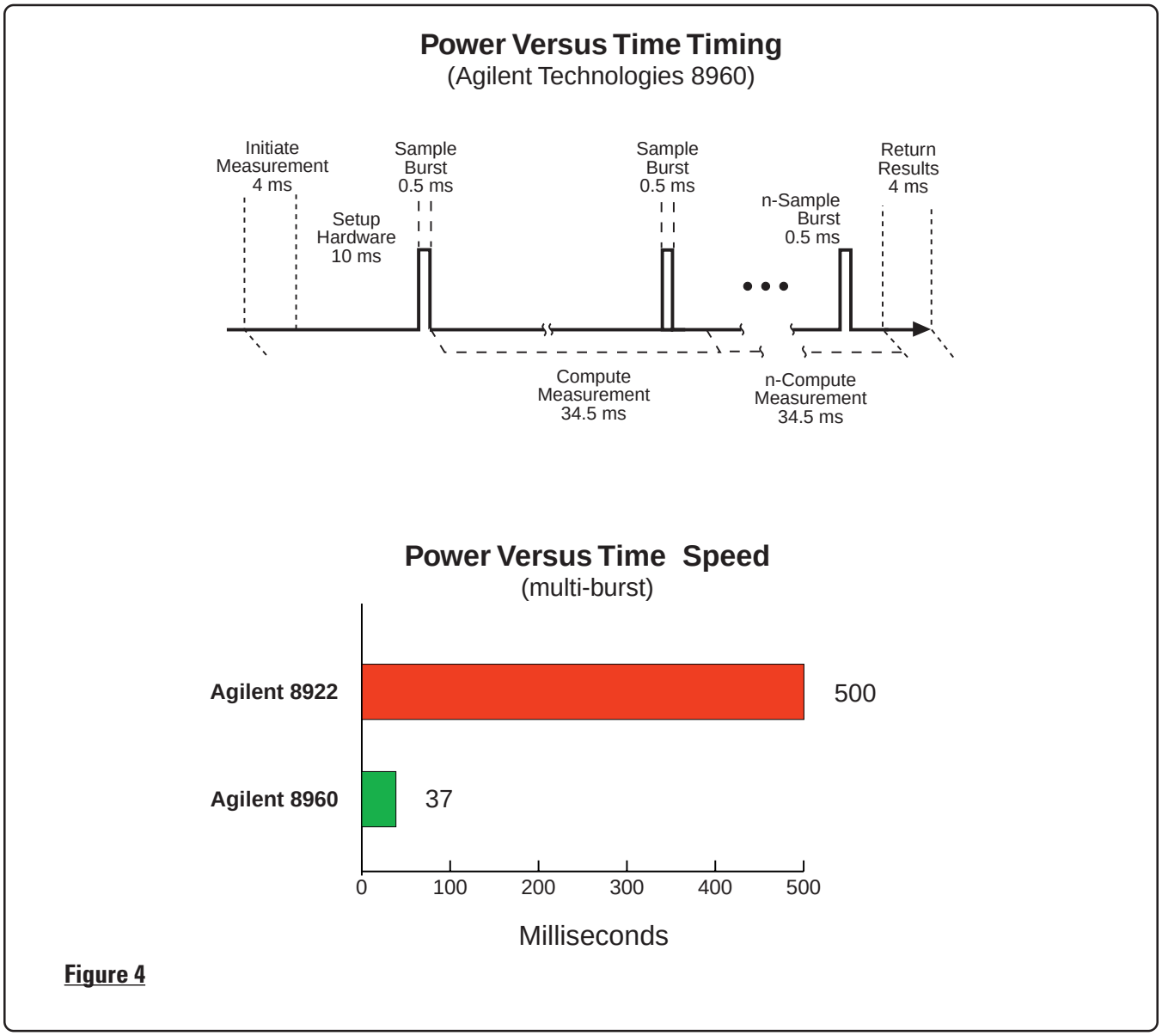


Figure 4

Output RF Spectrum

The output RF spectrum (ORFS) measurement measures the out-of-channel emissions of a phone. These emissions can be caused by either modulation or switching. Both of these must be kept to low levels to prevent interference to adjacent channels. Because of the desire of GSM system providers to provide optimum performance in their networks, there is increasing pressure on GSM manufacturers for ORFS measurement data.

The 8960 Series 10 allows GSM manufacturers to include a high-speed, accurate, ORFS measurement in the mobile station manufacturing process. The initial burst of an ORFS measurement with both modulation and switching at two offsets is timed at 130 ms, with subsequent bursts timed at 13 ms/burst.

Figure 5 shows the timing of a single-burst, two offset ORFS measurement. The ORFS measurement probably best represents how RIPP addresses specific measurement architecture. Due to the proprietary nature of this measurement that information can not be shared, but what can be seen is the ease-of-use and the speed of this measurement. As with all measurements in the 8960 Series 10, a few easy steps manually or a few high-level commands remotely, result in fast and accurate results.

The ORFS measurement uses the wide dynamic range of the power detector circuit and the high-speed sampling of the IF. It also uses an optimized DSP processing algorithm to provide measurement results that are twice as fast as any test set on the market today. The proprietary Agilent Technologies approach actually provides for 2 modulation measurements per burst.

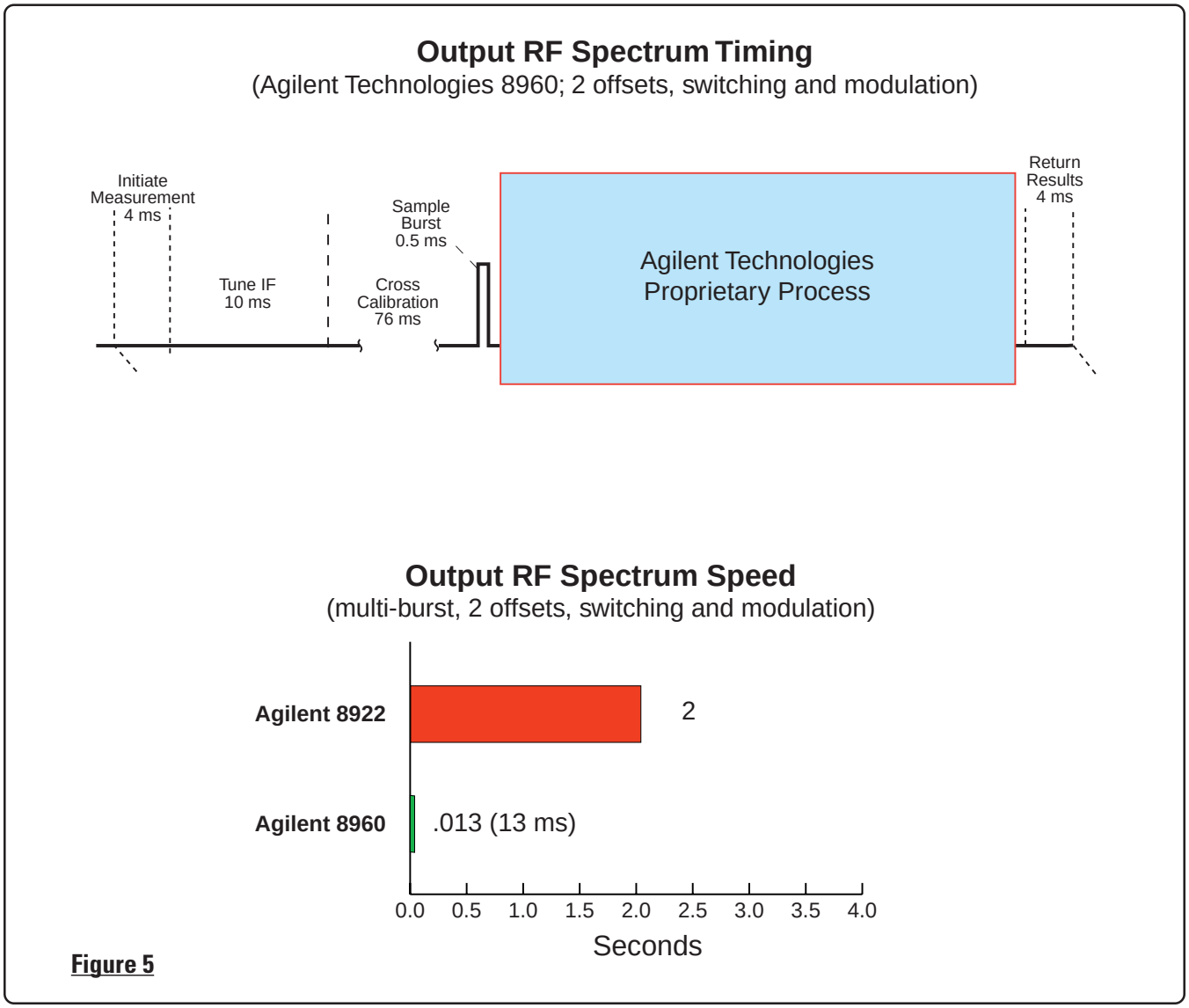


Figure 5

Comparing Transmitter Measurements

MEASUREMENT	NUMBER OF BURSTS	8922 TIME	8960 TIME
Transmitter Power	1	0.35 s	0.012 s
	5	0.175 s	0.03 s
	20	0.7 s	0.1 s
Phase/Frequency Error	1	0.6 s	0.04 s
	5	2.6 s	0.13 s
	20	10 s	0.48 s
Output RF Spectrum (400 kHz and 600 kHz offsets, modulation and switching)	1	4 s	0.13 s
	5	12 s	0.18 s
	50	100 s	0.74 s
Power vs Time	1	0.8 s	0.053 s
	5	2.8 s	0.2 s
	20	10.3 s	0.74 s

Conclusion

The Agilent Technologies 8960 Series 10 test set provides ease of use and measurement speed along with accuracy and repeatability. The result is high measurement throughput that does not sacrifice the integrity of the measurement process. Test costs are reduced, a high volume of phones that meet specifications are passed, and failed phones are quickly and accurately identified. With the 8960 Series 10 test set, you receive high throughput along with high confidence in the measurement results.

For more information about the 8960 Series 10 Wireless Communications Test Set visit our web site at:

http://www.agilent.com/find/8960support

For more information about Agilent Technologies test and measurement products, applications, services, and for a current sales office listing, visit our web site at:

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