5000 SMART^E™

SMART ENVIRONMENT 5000 SERIES

Model 5300 General RF-Microwave Test Environment Product Brochure

AEROFLEX
A passion for performance.

- Complete Synthetic Test Environment
  Optimized for RF-Microwave testing of components, assemblies and subsystems
- Instrument Centric Interface
  IVI drivers provided for emulation of standard instruments
- Full Range of Required Mixed Signal Capabilities
  DC, Digital, Analog, RF-Microwave
- System Level Architecture
  Calibration, Verification, Alignment
- Open System Architecture
  System Hardware and Software, TPS'

The SMART^E™ 5300 is a complete test environment for testing RF-Microwave components, modules, assemblies, and subsystems. It provides the stimulus and measurement resources required to perform a complete set of tests traditionally performed with discrete RF instruments but with greater speed, measurement quality and half the physical size of traditional instrumentation.

The SMART^E™ 5300 Test Environment is a member of the SMART^E™ 5000 Series, which is a complete test solutions environment from Aeroflex. The Model 5300 encompasses hardware, software, test practices and support along with standard and customizable test programs tailored to emulate measurements typically associated with individual RF instruments.

The Aeroflex SMART^E™ 5300 Test Environment represents the 6th generation evolution of Aeroflex's synthetic test technology. Aeroflex synthetic test systems are successfully deployed in a variety of high performance test applications including satellite payload test, advanced T/R module test and military ATE.

SMART^E™ 5300 RF-Microwave Test Environment Summary

SMART^E™ 5300 Features

- Optimized for general RF-Microwave testing of component, assemblies, and subsystems
- Contains a core synthetic system which generates stimulus, measures response and processes data to generate the required data sets
- Emulates legacy discrete RF instruments
- Remotely controlled via instrument-centric IVI drivers or directly as a synthetic instrument
- Locally controlled via the Aeroflex Measurement Console (AMC) or the System Console Graphical User Interface (GUI)
  - System Console provides an instrument-centric control via instrument soft front panels
  - AMC provides both instrument and measurement type panels and controls the system via TestStand™ Sequences
- Delivered with complete system level calibration and diagnostic software
- Available as a standalone turn key solution or as a subsystem to be included as part of a larger ATE system

SMART^E™ 5300 Performance Specifications

- Stimulus, response and measurement performance of the SMART^E™ 5300 system is specified for typical operating conditions
- Majority of the specifications apply at the system interface rather than the instrument inside the rack
- Performance of the 5300 is specified in the terminology of legacy RF instruments to facilitate compliance determination
- Complete performance specifications are provided in the SMART^E™ 5300 General RF-Microwave data sheet

The following instrument-centric functions are supported by the SMART^E™ 5300

- Stimulus (RF Signal Generator)
- Response (Spectrum Analyzer, RF Counter)
- Stimulus/Response (MTA, s-parameters)
- Noise Figure (Noise Figure Meter)
- Time Domain (MTA)
- Phase Noise (Phase Noise Analyzer)

The following IVI drivers are available for the SMART^E™ 5300 system

- IVI Class Compliant Specific Drivers
  - IviRFSigGen (RF Signal Generator)
  - IviSpecAn (Spectrum Analyzer)
  - IviPwrMeter (Power Meter)
- IVI Custom Specific Drivers
  - IviMTA (Microwave Transition Analyzer)
  - IviPhNoise (Phase Noise Test Set)
  - IviVNA (Vector Network Analyzer)
  - IviNoiseFigure (Noise Figure Meter)
  - IviCounter (RF Counter)
  - IviMeasAn (Measurement Analyzer)
  - IviSysUtils (System Utilities)

SMART^E™ 5300 RF-Microwave Test Environment - The Synthetic Advantage

There are many advantages to a synthetic system. These include the following:

- Shared hardware modules support multiple requirements which provide low cost, physically efficient configuration
- Adaptability to enable emulation of obsolete instruments
- Ability to modify performance and functionality to emulate the performance of legacy instruments for purposes of TPS compatibility
- Flexibility to provide new capability with minimal hardware additions
- Modularity to support system upgrades and provide obsolescence protection

One of the main advantages of a synthetic architecture is that common hardware modules can be shared across multiple requirements. This offers many benefits including lower cost, a physically smaller design, extension to new measurements with little or no additional hardware cost and the ability to upgrade the system to take advantage of new technology without a major re-investment in new hardware.

This sharing of resources is particularly evident for large test systems that contain many different instruments. In these cases a common set of modules can be used to perform the measurements typically associated with many different instruments.

Figure 1 shows a physical comparison of a traditional system made up of legacy instruments and a SMART^E™ 5300. The SMART^E™ 5300 provides equivalent or better performance in a much smaller form factor.

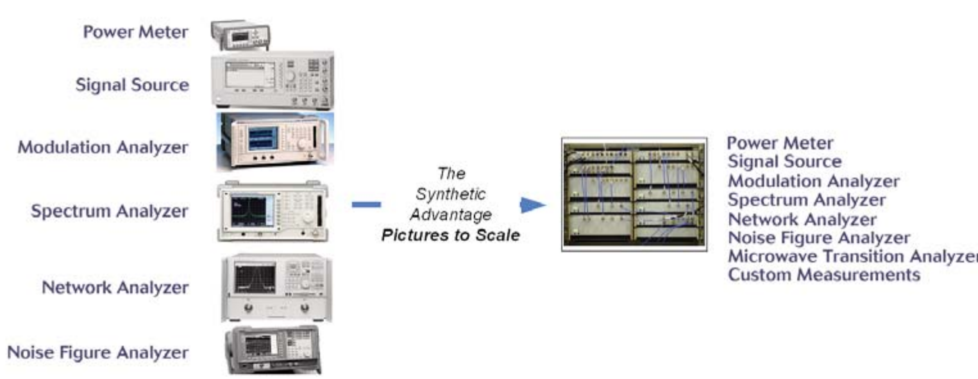

Figure 1. Size Comparison SMART^E™ 5300 versus Traditional Legacy Instruments

Another significant advantage of the synthetic architecture is the ability to provide the functionality, measurements and performance provided by legacy instruments which may be obsolete. The Microwave Transition Analyzer (MTA) is a perfect example of this advantage. This instrument, utilized in legacy ATE's, is not currently manufactured or supported. The MTA provides several different measurements including time domain and relative amplitude and phase measurements. Additionally, the unit can integrate the control of an RF Source with a measurement to perform frequency response measurements. This capability is emulated in the SMART^E™ system using the response system and one of the stimulus sources. The performance of the system is better than with the original MTA, particularly in the areas of dynamic range and relative amplitude and phase measurements. In addition to returning the same data products, an IVI driver is provided with the system that provides a functional software interface similar to the original MTA. The combination of performance, functionality and identical software interface supports the overall legacy ATE's mission to provide full TPS' compatibility.

In addition to the measurement capability defined for current requirements, it is also possible to add additional measurement capability simply by adding software. Measurements that are currently in place with other SMART^E™ synthetic systems include frequency measurements, modulation measurements, power measurements with many modes of operation, relative amplitude and phase measurements and others. In addition to traditional measurements, the synthetic architecture offers the ability to sample a RF signal, digitize the signal and then provide these raw data as an output of the system. This provides the capability to add new measurement types as they are defined. This offers users of the system the ability to develop measurements and measurement algorithms that may be sensitive or classified without involving the original providers of the system.

Another advantage of the synthetic architecture is the modularity of the system. This modularity allows upgrades to be made to the system without replacing an entire instrument. A good example is the PXI digitizer module. This module is responsible for the conversion of the response signal and typically sets the instantaneous dynamic range of the system. Configurations of the SMART^E™ system that were delivered through mid-2009 utilize a 14-bit A/D converter. In the last year, new PXI digitizer modules have become available from multiple vendors that provide 16-bit A/D converters at a similar cost point. These new modules will improve the instantaneous dynamic range of the system by up to 12 dB. Converter technology will continue to develop over the lifetime of the system and low cost, low risk performance upgrades to the system will be possible throughout the lifetime of the system.

SMART^E™ 5300 RF-Microwave Test Environment Calibration

The SMART^E™ system includes a mature, system level calibration methodology that insures calibrated power is set in the stimulus and measured by the response. This calibration methodology is applied to all hardware that is included within the calibration plane of the system and can include hardware not specifically manufactured by Aeroflex. In addition, this calibration methodology can be used to extend the calibration through any RF switching to the user interface (connectors on front panel) of the system.

The calibration period of the system is 1 year and is performed at the system level. Unlike traditional calibration techniques, it is not required that the calibration be performed on every unit in the system. In addition, the calibration does not require an extensive suite of calibration equipment or a specialized calibration cart. Instead, the calibration utilizes calibration standards that can be removed from the system and calibrated in a calibration lab. There are two phases of the calibration process; primary calibration and operational calibration.

Primary calibration is the calibration of the calibration standards that are included as part of the system. In the proposed configuration, the only items that must be removed are the power meters and power sensors. These modules are removed from the system and then calibrated using the standard processes and procedures recommended by the vendor.

Once the power meters and sensors are calibrated, operational calibration is then performed to transfer the calibration from the calibration standards to the remainder of the system. The entire operational calibration procedure typically requires less than 4 hours.

The calibration procedure calibrates the stimulus and response hardware to a single point in the system. However, this single point is not the plane at which the system is used. Therefore, an additional calibration must be performed to extend this calibration to the user interface on the system. Reference Plane Origin (RPO) calibration allows this calibration to be extended to the user interface of the system. This RPO calibration is a system level operation that is supported by the System Utilities IVI driver.

A final calibration consideration is the loss of the cables between the user interface on the rack and the Device Under Test (DUT). It is possible to characterize these cables either with the system or with an external device such as a network analyzer and then provide this information to the system. If this loss information is known by the system, then the software can automatically compensate the stimulus or response and extend the calibration reference plane to the DUT. This information is referred to as the Reference Plane Extension (RPE) data.

SMART^E™ 5300 RF-Microwave Test Environment Software

The software for the SMART^E™ 5300 is hosted on a Windows™ based system computer. It is made up of a variety of components that work together to provide a complete turnkey solution. The code base has been refined over past years, resolving issues and incorporating new features, to create a mature product. The software has been developed in a way that it is extremely customizable to the unique needs of the customer. The following software components are typically provided with a SMART^E™ 5300:

- Aeroflex Measurement Console (AMC)
  - A universal test management interface that provides a full interface for test development, setup, execution and data analysis
- IVI Drivers
  - A set of IVI compliant drivers which emulate legacy instruments and provide access to system maintenance functions
- System Resource Arbiter
  - A software component which arbitrates the use of a single set of synthetic hardware among multiple IVI drivers
- Host Interface
  - An API which provides full access to the low level instrument functions (in the Target Software)
- Target Software
  - An application for controlling system hardware which includes measurement algorithms and system functions, such as calibration
- System Console
  - A user interface that provides soft front panels for the emulated legacy instruments and debug of IVI driver interfaces

In developing the SMART^E™ environment for the new Model 5000 Series product, Aeroflex has introduced a universal test management interface called the Aeroflex Measurement Console (AMC). From this interface the test engineer or operator may select and execute tests, create sequences of tests, input variable parameters, access test results, set up default settings and parameters, and perform a wide variety of test related functions.

Figure 2 illustrates the topology of the AMC User Interface. This includes a tree view of available test sequences, an area for user interactive input of variable parameters presented by the test sequence, and a window for viewing the results of the tests. Test data are presented in graphs, tables, and records of various scalar values associated with the test. Examples include test execution times and all the parameter settings active at the time of execution, as well as debug and error logs.

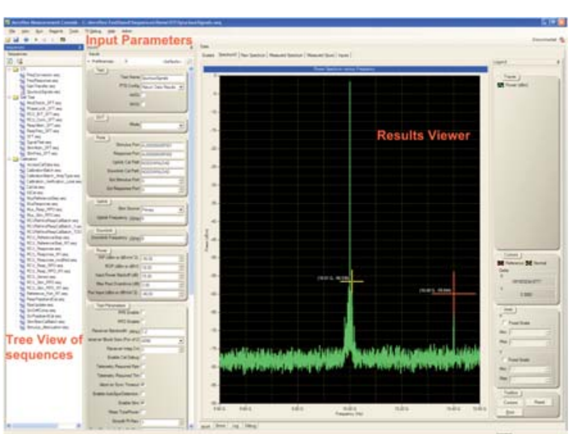

Figure 2. Topology of the Aeroflex Measurement Console (AMC)

Figure 3 depicts the application of the AMC to a pulse characterization test that has been executed and displayed in a graph showing pulse shape as a function of time.

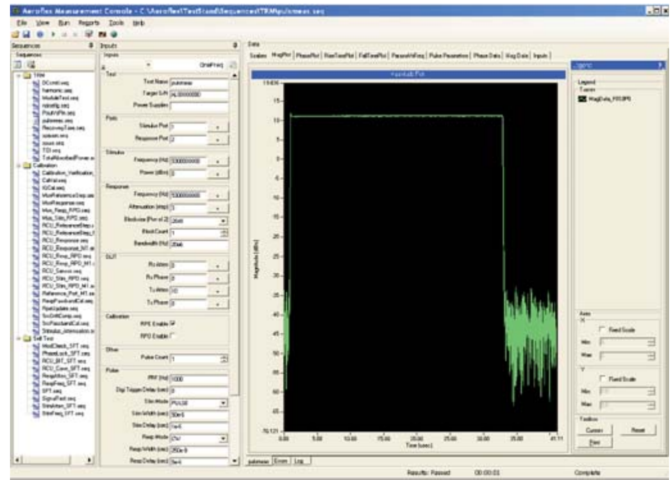

Figure 3. Pulse Measurement

Selecting another tab in the results display window (Figure 4) provides access to the rise time characteristics of the pulse as derived from the magnitude-time samples which were measured.

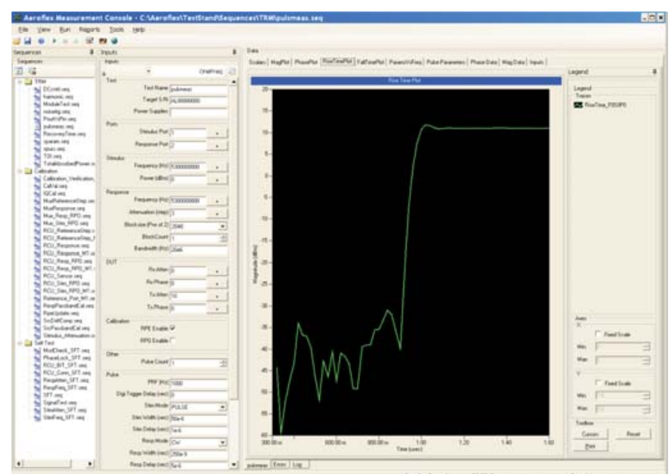

Figure 4. Pulse Rise Time

The test results area is programmed as a tabbed window where various result format choices and derivative tabulated data sets may be presented as seen in Figure 5. Results can be automatically saved to files with file names reflecting test type, date, and time of execution. Reports are saved in XML formatted files. Integration with existing data storage schemas is easily implemented. All results can be exported to Excel or CSV files.

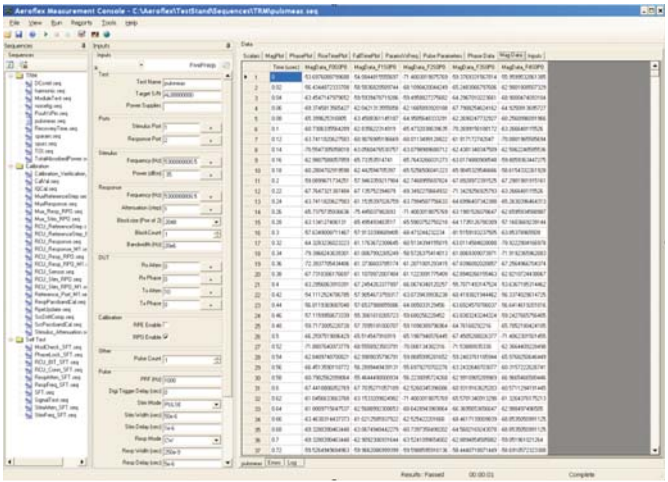

Figure 5. Tabbed Measurement Results

In this case the test system utilizes one of two digitizers configured in the baseband of the measurement response channel; one for narrow band measurements and one for broadband measurements, to be applied to time measurements such as rise time.

The test results may be transferred to an Excel workbook with the tabbed results mapped to spreadsheets on a one-to-one basis as illustrated in Figure 6.

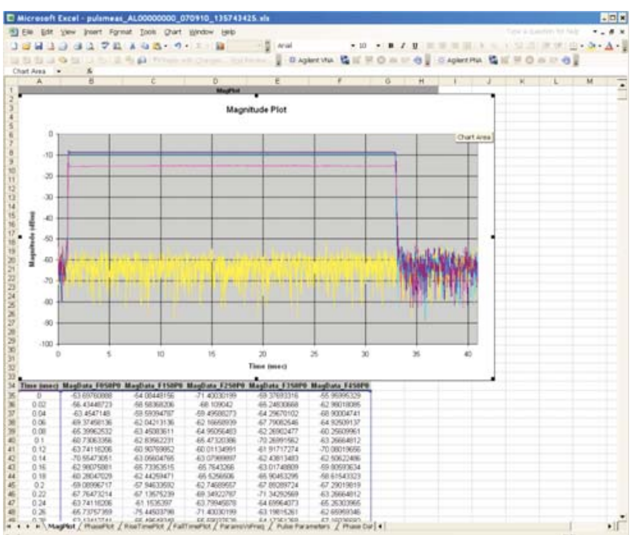

Figure 6. Test Results Exported to Excel Workbook

Graphical analysis and interpretation tools are provided in conjunction with the results window. Figure 7 shows the results of an s21 measurement with markers activated for interactive use in interpreting the results of the s-parameter measurement.

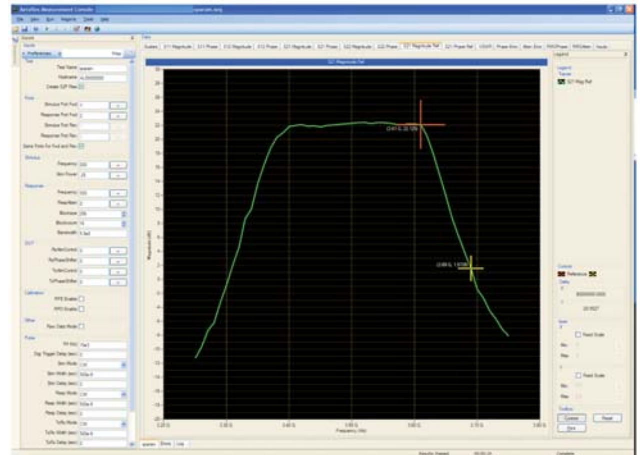

Figure 7. S-parameter Plot with Cursors Activated

The System Console is a graphical user interface which integrates soft front panels for each of the IVI legacy instrument drivers. Multiple windows are supported, allowing simultaneous execution of the emulated instruments. Error and debug logs are also displayed to enhance troubleshooting capability. The System Console interfaces directly with each IVI driver in the same manner as would the system test executive. A soft front panel is also provided for the IVI system utility driver to provide a user friendly interface for calibration, alignment, and self test of the RF subsystem. An example screenshot of the System Console is shown in Figure 8.

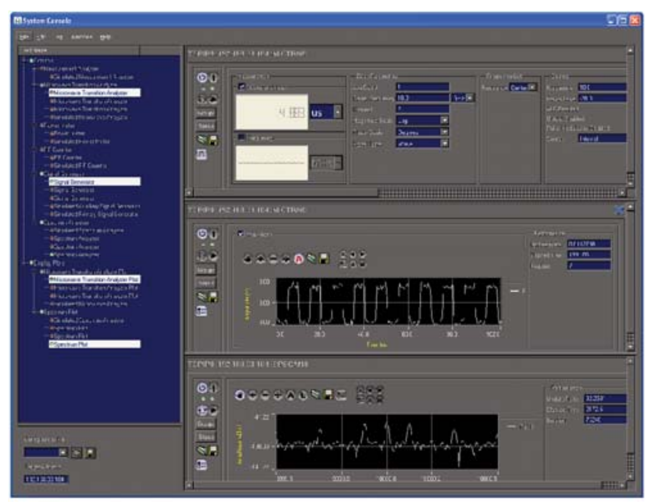

Figure 8. System Console

SMART^E™ 5300 RF-Microwave Test Environment Options

There are many options for the SMART^E™ 5300. The exact configuration of the 5300 depends on the requirements of the specific application. General options for the 5300 are listed below. Consult the SMART^E™ 5300 RF-Microwave Test Environment data sheet for additional details.

- Stimulus (Sources)
  - Frequency coverage to 40 GHz
  - Fast frequency switching (sub micro second)
  - High power
  - Vector modulation
  - Noise
  - Various baseband options to match required instantaneous bandwidth and dynamic range
- Response
  - Frequency coverage to 40 GHz
  - Multiple channels for phase coherent simultaneous measurements
  - Repetitive time sampling for fine resolution time domain measurements
  - Various baseband options to match required instantaneous bandwidth and dynamic range
- Measurement Options (power, spectrum and time domain are standard)
  - Noise figure
  - S-parameter measurements
  - Phase noise measurements
  - Microwave transition analyzer emulation
- Physical Connectivity
  - Emulation of legacy system interfaces
  - Multiple port RF interfaces to 40 GHz
  - Custom interfaces to match physical interfaces and signal routing of legacy systems
  - Blind mate interfaces.

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