Keysight Technologies

Textron Systems has Developed Improved ATE Systems Using the N6700 Modular Power System

Case Studies

KEYSIGHT TECHNOLOGIES

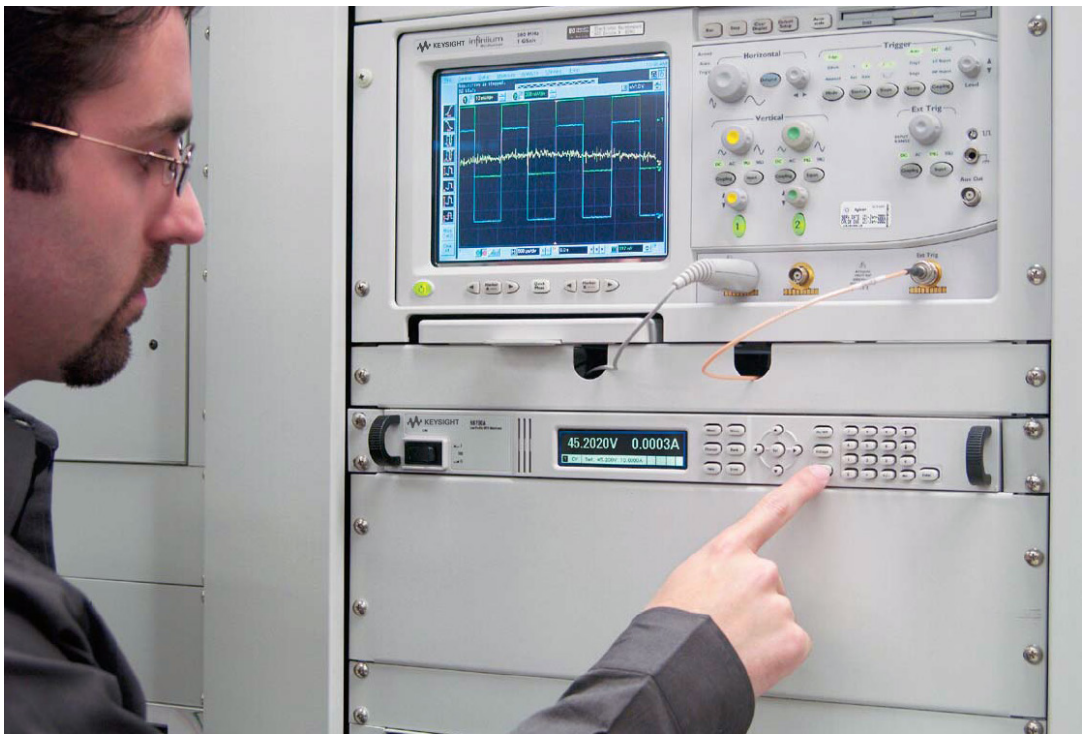
Introduction

Textron Systems

Textron Systems is a leading developer of smart munitions, sensor and surveillance systems, vehicle protection systems, as well as software and electronics to meet the needs of global aerospace and defense industries. Located in Wilmington, Massachusetts, USA, Textron Systems manufactures innovative precision strike weapons, smart submunitions, intelligent ground munitions, and ground and airborne surveillance systems. The Sensor Fuzed Weapon, a smart anti-armor weapon, made its combat debut in Operation Iraqi Freedom where accounts of its successful use describe the destruction of multiple armored tanks with a single weapon. In 2003, the company was awarded several major contracts in the area of unattended ground sensors (UGS) including Future Combat Systems Tactical and Urban UGS for the U.S. Army and remote Unattended Ground Sensor systems for the U.S. Air Force and U.S. Marine Corps.

Textron Systems' Test Equipment and Tool Engineering Group employs the latest technology to solve complex testing problems and to create stateof-the-art ATE systems for Textron Systems' internal customers. By partnering with other companies, each who lead their own industries, the company has created a worldclass custom ATE systems capability.

In this document, Steve Teahan, Director of Test Engineering, along with Textron Systems' test equipment development engineers share how they have used the Keysight Technologies, Inc. N6700 Modular Power System in three different ATE systems, and how the Keysight N6700 has made it possible for Textron Systems to deploy systems that are better, smarter, and less expensive.



Case Study #1
The ATP System

This case study explores how Textron Systems took advantage of the built-in sophisticated measurements of the Keysight N6700 to simplify their system design when making pulsed current measurements to determine run time of a battery powered device.

Case Study #2
The ESS-Vibration System

This case study explores how Textron Systems needed a small and flexible DC power source, and so by selecting the Keysight N6700, they were able to find a solution that is small in size while reducing costs by leveraging the knowledge and inventory assets from the ATP system.

Case Study #3
The Sensor Fused Weapon ATE System

This case study explores how Textron Systems needed a reliable way to test a sophisticated IR sensor. Textron Systems selected the Keysight N6700 because of its easy connectivity to the PC over LAN. But perhaps more importantly, the Keysight N6700 provided the ability to run independent from the controlling PC, ensuring IR sensor safety in the event of a PC hang-up during the test.

Background on the Keysight N6700

The Keysight N6700 Low-Profile Modular Power System (MPS) gives test system integrators in the aerospace/defense, consumer electronics, computers and peripherals, communications, semiconductor and automotive industries the flexibility to optimize performance, power and price to match test needs. The Keysight N6700 is a family of 20 modules ranging in power from 50 W to 300 W at three different performance levels (basic, high-performance, and precision). Test system integrators can mix-and-match any of these 20 modules in any of the three MPS mainframes to create a DC power system of 1 to 4 outputs totaling 400 W, 600 W or 1200 W of DC power, at prices starting at $1,000 per output.

The Keysight N6700 modular power system offers industry leading processing speeds up to 10 to 50 times faster than other programmable power supplies, built-in digital multimeters, a wide selection of 50 W, 100 W and 300 W output power levels at various voltage/current combinations, and the choice of three performance levels in a 1U-high package. The Keysight N6700 MPS also offers highspeed test extensions and autoranging output capabilities that help simplify system configuration and enable one power supply to do the job of several traditional ones.

The Keysight N6700 is a systemready test instrument that provides universal serial bus (USB 2.0), 10/100 Base-T Ethernet (LAN) and generalpurpose interface bus (GPIB) interfaces as standard features, allowing quick and simple connectivity to a PC, or to a network for access across an engineering workgroup. The Keysight N6700 can also be remotely operated from any browser by connecting to its built-in Web page for control and monitoring of power supply operations. The Keysight N6700 is fully compliant with the LXI Class C specification.

Case Study #1
The ATP System

Textron Systems' team has developed an ATP (Acceptance Test Procedure) system for a new program under development within the company. On this system, 100% sampling is done of devices within the new program. The ATP system is running on a Windows 2000® PC. Textron Systems has selected Keysight VEE 7.0 to develop the software. Instruments are interfaced to the PC using GPIB, while RS-232 is used to control the DUT and the RF test gear.

Textron Systems has selected the Keysight N6700 Modular Power System as the DC power source and measurement solution for the ATP system. Textron Systems made this decision based on the small size and advanced measurement capabilities of the Keysight N6700.

Each ATP system has one Keysight N6700 Low-Profile Modular Power System Mainframe with four DC Power Modules: three modules provide DC power the DUT and one module provides power other auxiliary circuits in the ATP system. The Keysight N6700 also simplified Textron Systems' system design because it is small, and according to Steve's team "smaller is better". The ATP system is a 3 bay, 1.6 meter system. By dedicating only 1U of rack space to the DC source, the Textron System team was afforded the most flexibility possible for the remainder of the other test equipment needed to test this DUT.

Among many other tests that are done, the ATP system needs to make pulsed current measurements on a radio transceiver within the DUT. The ATP system must capture transient current levels during transmit pulses that are 12 milliseconds wide. Measuring the current consumed during a transmit pulse is an important measurement to determine how the transmitter runs down the batteries within the DUT. Commonly known as a battery drain test, this measurement will allow Textron Systems to determine the run time of the DUT, which must be able to manage battery life during the fixed life of its mission.

Although most DC power supplies can measure current, measuring current during a transient event, such as this transmit pulse, can be challenging. Many power supplies use an integrating measurement and the period of integration is much longer than 12 milliseconds in order to integrate out noise. As a result, the one single measurement that is obtained via this integration method will contain signal information that is before, during, and after the 12 millisecond wide pulse, so the reading will not properly represent the current during the pulse. And even if the user could select the integration window so that the measurement would be less than 12 milliseconds wide, there would still be the challenge of synchronizing or triggering the measurement to ensure that the measurement was taken during the pulse. So integrating measurements could not be used, and so the only solution would be to digitize the pulse.

Figure 1: The Sensor Fused Weapon ATE System employs two N6700 Modular Power Systems. For more information, see case study #3 on page 6.

Case Study #1
The ATP System (continued)

Thanks to the Keysight N6700's built in digitizer, the ATP system can make digitized current measurements on the 12 ms wide pulse. Running at up to 50,000 readings per second into a 4096 reading buffer, the Keysight N6700 can capture current drawn during the transmit pulse and return the digitized values back to the PC. From there, calculations can be done to determine the current drain on the DUT battery.

Without the Keysight N6700, the alternatives for making this dynamic current measurement would be

- Current probe and oscilloscope
- Current shunt and oscilloscope
- Design/fabricate custom circuitry to make a pulsed current measurement

By using the Keysight N6700

- Textron Systems' team saved the engineering time that would be needed to design the measurement solution. With the N6700, the solution was off-the-shelf and performance was specified by Keysight.
- Textron Systems' team saved development time when writing the code in the ATP system to drive the instruments to make the measurement: With the N6700, it took just a few commands to digitize the waveform.
- No calibration of special equipment was required, as would be in the case of a custom design.
- There was no loss of signal voltage across a shunt, as would be the case when using a shunt resistor to make dynamic current measurements. This loss of signal voltage could cause improper device operation or other interference in the test.

Furthermore, the Keysight N6700 command processing time and output response time are very fast. While not critical at this stage in the life cycle of the program, ATE system speed and throughput will be significant requirements when going to full production, and the Keysight N6700 has the specifications and performance that Textron Systems needs when increased throughput is required.

Case Study #2
The ESS-Vibration System

One of the many systems that Textron Systems has designed and built is the ESS-Vibration System. This system is an Environmental Stress System that simultaneously tests four DUTs from various programs.

Each DUT being tested requires 1 DC power source, so there are 4 sources needed to test 4 DUTs simultaneously. The ESS-Vibration System also has 4 DC sources dedicated to powering four repeater assemblies. This brings the total number of DC sources needed to 8 DC sources.

The ESS-Vibration System is constructed in a 1-bay ATE rack. Because this is a 1 bay system, rack space is truly at a premium.

Textron Systems chose to use the Keysight N6700 because of its small size. With 4 independent DC sources of 50 W, 100 W, or 300 W in a 1-U package, the Keysight N6700 packs a lot of sources into a small space.

By using the Keysight N6700, the test system designers who built the ESS-Vibration system could leverage the investments made by the aforementioned ATP System designers:

- Knowledge investment – Textron Systems' engineers had developed a knowledge base on how to use the N6700, so this knowledge base that could be leveraged.
- Asset utilization – Since the N6700 is a modular system, Textron Systems could purchase extra modules as a spares inventory and share them among various systems (like the ESS-Vibration System and the ATP System), thus lowering their overall investment.

Case Study #3
The Sensor Fused Weapon ATE System

Textron's Sensor Fuzed Weapon (SFW) wins in more ways than one. Superior lethality makes it the standoff weapon of choice for anti-armor, anti-air defense and other air combat missions. The SFW, a 1,000-pound class weapon, is the first smart air-tosurface munition to enter into production for the U.S. Air Force. Combat proven on April 2, 2003 in Operation Iraqi Freedom, SFW took out multiple tanks in a single pass.

A key element in this weapon is a sophisticated infrared (IR) sensor. This sensor must be handled with care during testing. For example, during the test, the voltage to the IR sensor's thermoelectric cooler must be applied for a given amount of time or it will be damaged. The SFW ATE System (shown in figure 1 on page 4) is controlled by a PC running Windows XP Pro. In this test, timing is critical, and getting accurate timing under Windows XP can be difficult. The Textron Systems' team was challenged to find ATE instruments that could do the job to meet the accurate timing requirements, since the software platform itself could not be relied upon to generate the necessary timing and synchronization.

Textron Systems selected the Keysight N6700 to power the IR sensor's thermoelectric cooler because of the N6700's ability to run a LIST independent of computer software control and timing. A LIST is a series of voltage, current, and dwell time setpoints. With each LIST, the user can download up to 512 setpoints of voltage and current. For each setpoint, the user can specify a dwell time from 1 millisecond to 262 seconds. To begin executing the LIST, the controlling program issues a trigger. The N6700 will step thru the LIST, staying at each setpoint for the programmed dwell time, and then it will move on to the next point. This speeds up execution by removing the computer I/O from the process. The result is a DC source that automatically changes according to the programmed LIST without the PC providing direct control or timing. So the built-in hardware speed controls of the Keysight N6700 alleviate the need for the controlling PC to have accurate timing controls.

Textron Systems uses the Keysight N6700 in LIST mode to ensure that the IR sensor does not overheat. Since the LIST executes without the computer telling the Keysight N6700 when to change its output settings, the actions of the Keysight N6700 are independent of the computer. Thus, if there is a problem with the software, PC, or IO communications, the Keysight N6700 will provide a safe test because it will continue to execute the right steps at the right time thanks to its internal LIST.

Case Study #3
The Sensor Fused Weapon ATE System (continued)

In addition, the Keysight N6700 can be programmed to generate a trigger out pulse, which is a hardware signal available on the rear panel of the N6700. This trigger out pulse is used to synchronize the power supply output with a mirror position encoder. Once again, this tight synchronization would not be possible if all control had to flow through the Windows computer running the test system.

The SFW ATE system is housed in 2 bay, 2 meter rack. The system has two Keysight N6700s, with one powering the test station and the second providing ±15 V to the thermoelectric cooler. Since the Keysight N6700 is only 1U tall, only 2U of rack height is dedicated to DC power in this system. The nearest alternative would have been 6U in rack height, so the Keysight N6700 saved 4U. This prevented the system from growing in size into a third bay. By keeping the system in 2 bays, Textron Systems engineers saved a lot of money and space.

The SFW ATE System is based on the Keysight Open system architecture. Thanks to the choices provided by Keysight Open, Textron Systems could choose from any industry standard interface and software environment. So to keep system interfacing costs down, Textron Systems chose to use LAN and USB to interface to their instruments. Given that these low costs interfaces are standard in PCs, there is need to open the PC to add a GPIB card. The controlling software is Keysight VEE 7.5, which uses the Keysight IO Libraries to communicate with the instruments. Through Keysight VEE and the Keysight IO Libraries, set up was easy because all instruments are plug-n-play. The PC contains 2 Ethernet cards, with one connected to the test system instrumentation and the second connected to Textron Systems' LAN for test results database access. This keeps the two LANs isolated from each other.

For future projects, Textron Systems expects to go with systems that are all LAN, because "that's where things are going", according to Paul Muckerheide, Test Development Engineer at Textron Systems. Paul also hopes to take advantage in the future of remote control, remote diagnostics, and remote troubleshooting that is made possible by LAN and Web control.

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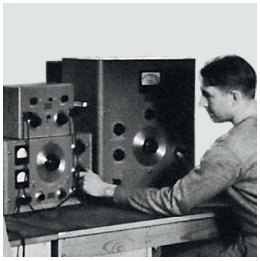

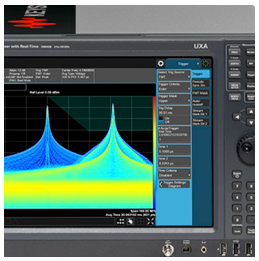

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