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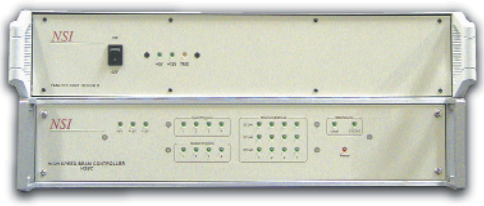

A Powerful Alternative for High Speed Near-field or Far-field Antenna Measurements

A high speed receiver and beam controller has been introduced to address the growing need for faster antenna measurements. This article describes the Panther 6000 system and will show how it can benefit the antenna range operator by allowing more complex CW and pulsed antennas to be tested in less time.

Many of today's high performance antennas are broadband, multi-beam, multi-port and polarization-selective devices. Technology improvements, including micro-electro-mechanical system (MEMS) devices and novel adaptive algorithms, are enabling increasingly complex antennas for satellite communications, radar, telecom, wireless and automotive applications. New and complex architectures are also being implemented, including adaptive arrays, multiple-reflector and digital beamforming antennas.

One impact of these new antenna technologies on the test range has been to dramatically increase test time requirements. Since antenna test is often the last link in the production chain, schedule slips build up until the end where test managers are often asked to do more testing with less available time. The "schedule crunch" at the end of the job results in additional costs due to overtime, and all too often, late deliveries and missed opportunities.

To solve this dilemma, Nearfield Systems has introduced the Panther 6000 receiver and beam controller for CW and pulsed antenna measurements. The Panther 6000 is a two-channel, 20 MHz IF receiver system that can be used with appropriate downconversion to make antenna measurements from VHF

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through millimeter-wave bands. Capable of 80,000 amplitude and phase measurements per second (mps), the Panther 6000 is faster than other microwave receivers currently being used for antenna measurements.

The Panther 6000 has a dynamic range of 60 dB at 80,000 mps. Averaging is easily increased to 113 averages to achieve approximately the same dynamic range as the popular Agilent 8530A at an equivalent measurement rate. This flexibility allows the user to trade off dynamic range with receiver speed as the need arises. The Panther 6000 can be quickly configured for high speed production test and just as quickly reconfigured for high dynamic range characterization testing at a lower data rate.

EXAMPLE OF TEST TIME REDUCTION

A 2 m reflector that requires a 3 m × 3 m X-Y scan takes approximately two hours to test eight ports at 36 GHz using a NSI 300V-12 × 12 planar near-field scanner with a 20-inch per second (ips) scan axis and a competitive receiver at a single frequency. In the same two hours, the Panther receiver could measure 500 ports. By measuring each data point in approximately 4 µs, the Panther 6000 allows the scan axis to achieve its maximum motor speed.

At lower test frequencies, increased data point spacing allows more time between planar near-field measurement points. For example, at 10 GHz the comparison receiver measures 128 ports in two hours. The Panther 6000 would reduce the test time by 59 percent for an overall test time of 0.8 hours. The percent improvement grows as the number of test ports increase. When the number of ports is 16 or fewer, the measurement speed is limited by the scanner speed.

If the test requires multiple frequencies, then the number of frequencies and the switching time of the synthesizer will need to be included in the analysis. If a large number of frequencies is required to be measured or if the synthesizer is slow relative to the receiver, then the speed of the synthesizer rather than the receiver will become the significant factor in determining the overall test time. The Panther 6000 is compatible with many high speed sources and supports parallel BCD, GPIB and IEEE 1394 Firewire interfaces through the same software interface, making it easy to upgrade to faster synthesizers at any time.

SYSTEM CONFIGURATION

The Panther 6000 consists of a receiver, beam controller, a host computer running the Windows operating system and Dynamic Link Library (DLL) software. The receiver is a high speed phase coherent instrumentation receiver intended for antenna measurement applications. The receiver is compatible with the Agilent 85309A LO/IF distribution unit with remote mixers. The inputs to the receiver are a 20 MHz IF signal channel, a 20 MHz IF reference channel and a TTL measurement trigger input. The TTL trigger input is functionally equivalent to the TTL trigger signal input of the Agilent 8530A receiver. Each trigger pulse will initiate a single S_{21} amplitude and phase measurement. The amplitude and phase data is made available to the application software through a DLL driver for processing and display.

The receiver can support both triggered and untriggered processing of the reference and test channel signals. In the untriggered mode, the receiver processes data continuously at a rate determined by the specified receiver averaging. In the triggered mode, an external negative going trigger pulse is used to command the receiver to process one or more raw data samples depending upon the specified averaging.

The external trigger for the Panther receiver is typically provided by the unit's beam controller, which also provides sequencing and general purpose digital I/O for control of the following:

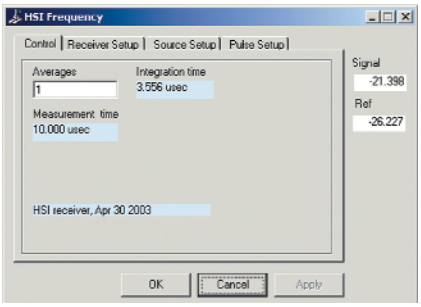

Fig. 1 Receiver control screen.

- One or two Comstron FS2000 or FS5000B RF synthesizers. The beam controller provides differential BCD outputs, but can accommodate single-ended Comstron inputs with a differential to single-ended adapter.
- Up to three independent Agilent 85331A or 85332A switch control units (SCU), each equipped with an RS-422 8-bit control interface. The switch control units are used to control multiple RF PIN switches. These SCU interface ports may also be used to control other PIN switches or devices.
- Four single-ended TTL trigger outputs for use as receiver or source triggers.
- Four RS-422 digital outputs for applications requiring long cable distances and greater noise immunity.
- Four single-ended TTL trigger inputs for use as major position trigger inputs or other applications.
- Four RS-422 digital inputs.

The purpose of the beam controller is to establish and maintain a predefined set of measurement input conditions. With two sets of 64-bit control words, at a rate of 1,000,000 output words per second, the beam controller is capable of simultaneous control of two sources, three sets of switches, and various input and output triggers.

The beam controller maintains a list of frequencies (LO and RF) and PIN switch ports (up to three) in local memory in order to provide triggers and control for real-time data collection. Using NSI 2000 antenna measurement software, the Panther 6000 allows multi-port and multi-frequency data to be collected in a random order (arbitrary list) at rates up to 80,000 measurements per second.

Fig. 2 Panther 6000 mounted in a rack.

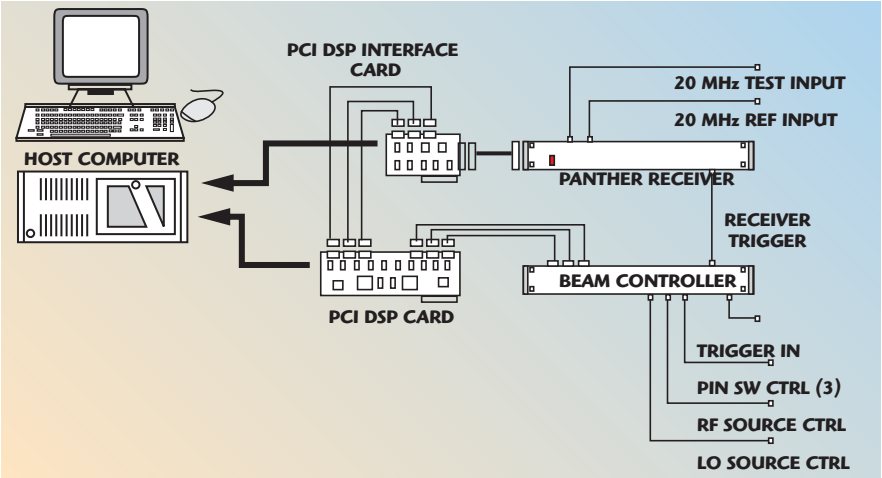

Fig. 3 Panther receiver components.

TABLE I

PANTHER 6000 SPECIFICATIONS

Measurement speed (1 avg) (pts/sec)	80,000
Receiver integration time (1 avg) (µs)	4.2
IF bandwidth (1 avg) (kHz)	800
Number of channels	2 (test and reference)
Buffer size (memory available for single cut)	2,000,000 measurement points
IF frequency (nominal, others optional) (MHz)	20
Compression (20 MHz IF level) (dBm)	–17
Sensitivity (1 avg) (20 MHz IF level) (dBm)	–77
Dynamic range (1 avg) (dB)	60
Beam controller setup time (µs) (min)	8.4
Beam controller timing resolution (µs)	1.0
Multiplexing capacity	9000 measurements per trigger
Switch control unit (SCU) ports	Three (3) ports, 8 bits per port, RS-422 differential outputs
Frequency source control interfaces	Parallel (two 47-bit ports), RS-422 differential, GPIB, IEEE-1394 Firewire
Trigger inputs (4)	Four (4) single-ended trigger inputs
Trigger outputs (8)	Four (4) single-ended trigger outs Four (4) differential trigger outs
Size (receiver and beam controller)	3.5"H × 17"W × 12"D
Power requirements	100–240 VAC, 50/60 Hz, 135 W max with three active SCUs
Controls and indicators	Power on/off switch, DC power LEDs, trigger LEDs, switch state LEDs

SOFTWARE

The host computer contains the hardware and software resources to support operation of the receiver and beam controller, and hosts the receiver DLL software. The Panther 6000 user-interface is provided by the applications software that calls the receiver DLL. A Visual Basic (VB) program is provided with source code to demonstrate the use of the DLL for users who wish to write their own control interface to the Panther 6000. The ability to integrate the Panther 6000 DLL into customer specific automated test programs is fully supported. The NSI 2000 Antenna Measurement Software, which must be purchased separately, also supports the Panther 6000 Receiver (see ***Figure 1***).

The receiver and beam controller are functionally independent and need not coexist. However, both units require the host computer. The Panther 6000 components, as shown in ***Figure 2***, occupy only 14 inches of vertical rack space (8 EIA Units).

A typical Panther 6000 system, as shown in ***Figure 3***, includes the following items:

Receiver:
- 2U (3.5") high rack mount unit
- PCI DSP card – plugged into PCI slot of host computer
- PCI DSP interface card – plugged into PCI slot of host computer
- Control cable – DB37(m,m) Panther to host computer
- Power cable

Beam controller:
- 2U (3.5") high rack mount unit
- Control ribbon cables (3) – to DSP card in host computer
- Power cable

Host computer:
- 4U (7") high rack mount unit
- Windows PC with at least two available PCI slots
- 20 GB hard drive
- 256 MB memory
- 17-inch monitor, keyboard, mouse
- Windows 2000, or later version
- Receiver DLL – software module running in the host computer
- VB diagnostic program – a Visual Basic test program that runs in the host computer.

The Panther 6000 receiver is easily extended to 320 GHz with the appropriate microwave or millimeter-wave frequency extension kit. The wide IF bandwidth allows flexibility in wideband pulsed antenna testing for high PRF, peak response and full pulse characterization. The receiver is also capable of pulse synchronization for maximum performance with pulsed antennas and may also be used for pulse profile measurements. ***Table 1*** lists the Panther 6000 specifications.

Advances in technology, new antenna designs and shorter production cycles will require faster test capabilities in the antenna range. The Panther 6000 System answers this need through faster, more flexible antenna measurements. Additional information may be obtained via e-mail at sales@nearfield.com.

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