StingRay

Gated-CW Radar Architecture - A Complete RCS Measurement System

High speed, flexibility and multiple application scenarios

The StingRay Gated-CW RCS measurement system, developed to work in conjunction with the Agilent Technologies Performance Network Analyzer (PNA), offers significant improvements in RCS measurement speed and sensitivity. The system provides performance enhancements beyond other VNA based Gated-CW radars while providing a lower cost alternative to pulsed IF radar implementation.

SOLUTION FOR

- **RCS measurements**

Key Features

- Base **sensitivity** improvements: 10-20dB over previous systems
- **Accuracy:** efficient packaging means additional performance gains
- High **speed** data acquisition; Increased measurement speed: 10 x faster than previous versions
- **Flexibility** in setting up various complex measurement scenarios

How does it work?

The StingRay Gated-CW RCS measurement system uses a pulsed transmit signal and gated receive path in conjunction with an IF section of the receiver that is restricted in bandwidth such that it does not pass the entire received pulse spectrum of frequency components, but rather only the central component. It therefore measures only Continuous Waves (CW) in the receiver back end (thus the designation Gated-CW). The Gated-CW radar experiences losses termed “duty-cycle” losses, as these losses are proportional to the duty cycle of the waveform. The system is most efficient and effective indoors or on short outdoor ranges where duty-cycle losses may be readily compensated. The baseline radar operates from 2-18 GHz, while other frequency options are available for order.

System Configuration

Equipment

- ■ Pulse Modulator Assembly (FR8x05 Series)
- ■ Pulse Modulator Timing Unit- Agilent 81150A,
- ■ VNA – PNA N522x series, PNA-X N524x series, PNA-L N5230 series
- ■ Data Acquisition System – 959 Spectrum Software Base
- ■ Antenna System- monostatic or quasi-monostatic configuration
- □ AL-22000 series compact range feeds, or other MVG broadband antennas

Add ons

- □ FR6400 Series Diagonal Horns
- □ Anechoic Chamber
- □ OFR9800A High Speed Switch Control Unit with Dual 959Spectrum-RF2 Dual RF SPDT PIN Switch Units for Fully Polarimetric Measurements
- □ Knowbell 2-D ISAR Imaging Software
- □ Additional Frequency Bands
- □ Rear Panel RF Outputs
- □ 959Spectrum-AN5 Single Target Full Polarimetric Calibration Software
- □ 959Spectrum-AN3 Coded Frequencies Package
- □ 959Spectrum-AS2 959 Spectrum Analysis Workstation Software (RCS)
- □ AL-22000 Series Compact Range
- □ AL-28000 Series RCS Pylon
- □ Foam Column/Positioner Assembly

Accessories

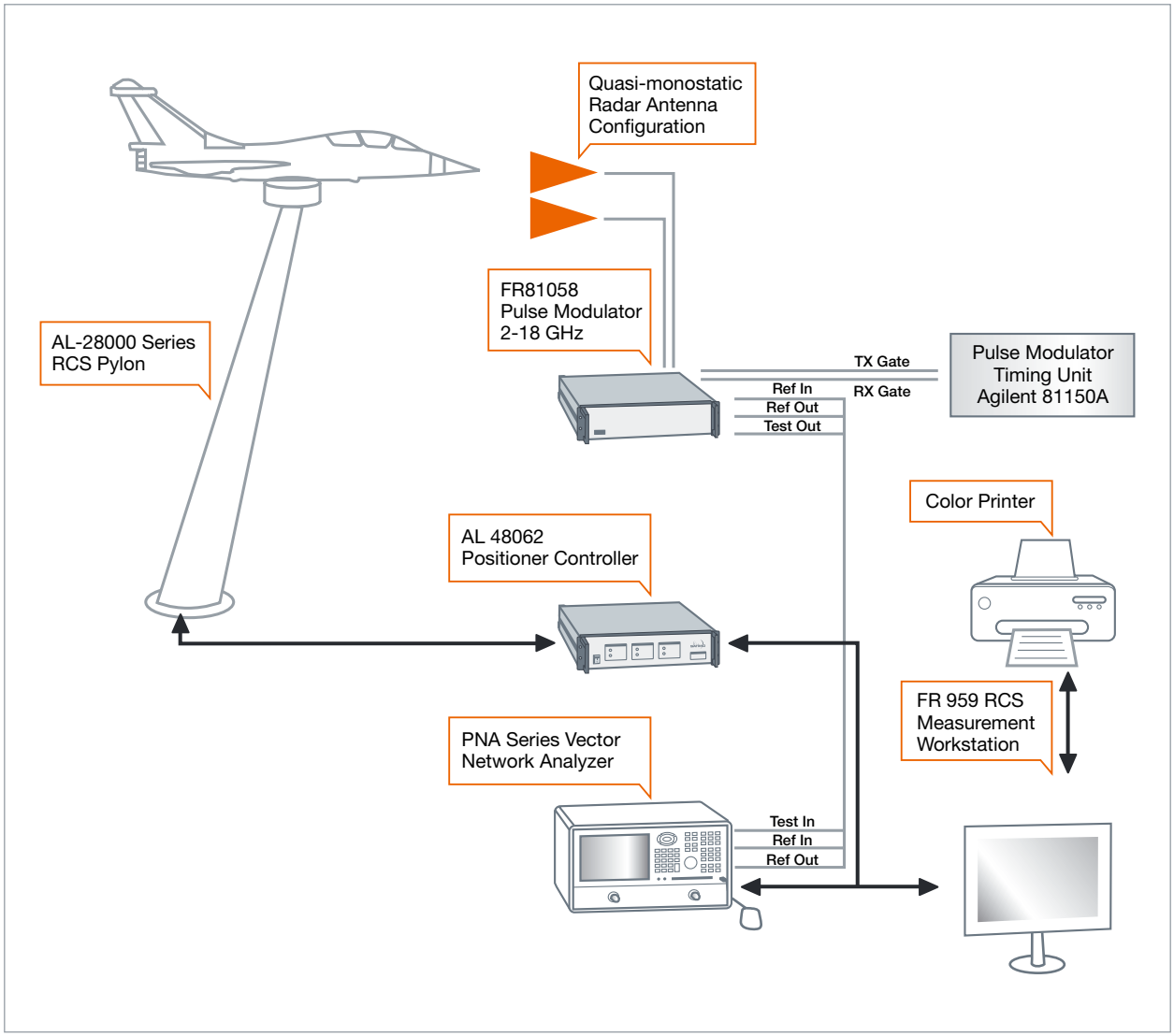
- □ Mono-static Antenna Interface
- □ Absorber Upgrades

■ Included □ Optional ○ Required

System Specifications

Frequency range	2-18 GHz continuous (additional bands upon request)
Polarization	VV, HH, HV, VH depending on options
System noise figure	7dB typ. at Rx Port input
Peak transmit power	+23 dBm typ. (higher powers available upon request)
Pulse/Gate width	0 to 10 µs in 1 ns steps
Pulse repetition frequency	0 to 99 MHz
Tx/Rx Gate Delay	0 to 10 µs in 1 ns steps
Data acquisition speed (10 KHz IF BW selected)	100-300 µs in step frequency mode typ., 120 µs in CW mode typ.
IF bandwidth (selectable)	1 Hz to 1 MHz typ.
Dynamic range	100+ dB typ.
Calibration targets	Optional squat cylinders, spheres, trihedrals, dihedrals, flat plates, user-defined and others
Pylons	500 lbs to 3 tons typ., up to 35 tons
Compact range	AL-22000 series 1’ x 1’ QZ and up

System overview



SENSITIVITY

A clutter-free environment

Improvement (between 10-20 dB) is derived by using a power amplifier inside the pulse modulator which adds to the sensitivity of the PNA. It is preceded by a low noise amplifier on the receive side. The use of high isolation antennas, in conjunction with the pulse modulation capability of the radar, provides a clutter –free environment that effectively takes advantage of the system sensitivity.

ACCURACY

Efficient packaging means performance gains and more accuracy

The streamlined and compact size of the radar (approximately half the size of previous versions), allows the unit to be located inside the anechoic chamber and close to the radar antennas. This more efficient packaging means additional performance gains as RF cable lengths can be kept short, eliminating, for example, the use of remote mixers for the primary microwave band. As a result of this efficiency, high accuracy can be obtained. The effective I/Q circularity obtained with this Gated-CW radar also outperforms equivalent pulsed IF radars.

SPEED
High speed data acquisition

> Speed/sensitivity trade-off readily optimized

Data acquisition speed is greatly increased over that previously available by taking advantage of the order of magnitude improvement in frequency switching speed offered by the PNA synthesizer as well as the improvement in sampling speed. The wide range of IF bandwidth choices available in the PNA adds to this capability.

> Several methods to rapidly attain access to data

- Export to: ASCII, Microsoft Excel, MATLAB, or Mathematica
- Access binary data files directly through a File System API and a File System COM Automation Server
- C language programs can be written using the API
- Programs written in development environments such as .NET, Visual Basic, Microsoft Office©, or LabView™ can be written using the COM Server

> Sequence scripting for customized results and analyses

Preprogram a series of tests to be executed without operator intervention by using either multiple 959 Spectrum acquisitions and DataPro RCS analyses or executing any third party program.

FLEXIBILITY in measurement scenarios

> Flexibility in calibration(1)

- From the current specialized calibration target file
- From another file
- “Turned off” for the current calibration application

> Complex measurement scenarios possible in many configurations

- Support for many common calibration targets using calculated theoretical RCS values
- Support of calibration and test targets measured at different distances from the radar
- Single or multiple angle background subtraction
- Real time display of data versus angle, frequency or time
- Full scattering matrix collection - measure the entire HH, VV, VH, HV sequence of polarization combinations in a single scan
- Storage of data by sweep or by scan to optimize file access times
- Wide range of pulse width, delay, and PRF selection

> A selection of different elements can be included in the comprehensive radar calibration equation

- Reference target data
- Test target background
- Reference target background
- Test target pre-gate parameters
- Reference target pre-gate parameters
- Space loss correction
- Theoretical target parameters/data

Calibration Equation

$$\sigma = SL \times Theo \times (PG_{test} \times [TT - TB]) / (PG_{ref} \times [RT - RB])$$

WHERE

σ: calibrated radar cross section (RCS)
SL: space loss correction for cal/test target locations
Theo: absolute RCS value of cal target
PG: pre-gate settings for test or reference target as appropriate
TT: measured test target signal as function of frequency and angle
TB: measured test background signal as function of frequency and angle
RT: measured reference target signal as function of frequency
RB: measured reference background signal as function of frequency

Related publications

1. A NEW GATED-CW RADAR IMPLEMENTATION, John F. Aubin, John Caserta, and Mark A. Bates, AMTA 2003 Proceedings
2. MULTI-PURPOSE RCS/ANTENNA TEST FACILITY AT NURAD TECHNOLOGIES, INC. John Aubin and Christopher Kelly, ORBIT/FR Inc.,Andy Humen, Randy Engle, Curtis Hodnefield, and Jeff Platt, Nurad Technologies, Inc.,AMTA 2004 Proceedings
3. A COMBINED MICROWAVE/MILLIMETER WAVE COMPACT RANGE BASED RCS MEASUREMENT FACILITY, J. F. Aubin and C.J Arnold, AMTA 1997 Proceedings

(1) The import features for calibration files allows ease in use of specific calibration targets, such as the NIST squat cylinder series, commonly used for range certification. The files of these theoretical RCS values are provided with the purchase of a calibration target.

Contact your local sales representative for more information
salesteam@mvg-world.com
www.mvg-world.com/positioners