VXI Enhanced Programmable Video Generator and Analyzer
with DVI and Image Acquisition Redisplay Options

This product is protected by one or more of the following patents:
6396536, 6502045, 7289159, 7180477, 7253792, 7289159, 7495674, 7768533, 7978218

Advanced Testing Technologies, Inc.
**Overview**

The PVGA series of video test instruments from Advanced Testing Technologies, Inc. provide a comprehensive solution set for video generating and acquisition requirements in a UUT test environment. The first generation PVGA garnered multinational acceptance and is successfully supporting the B-1B, F-15, C-17, Eurofighter, T-50, and other diverse military platforms. The experience derived with these applications has been integrated into the next generation, the ePVGA. The ePVGA supports dual channel RGB composite video generation, stroke video generation, mixed video generation, NTSC video/S-video generation, component video (YPbPr) generation, raster video generation, and video acquisition. The ePVGA is also available with options such as hardware-based image acquisition video redisplay, automatic code generation, and DVI generation and capture. New standard features include dual configuration (differential/single-ended) analog outputs and differential digital I/O. As a self-sufficient instrument, the ePVGA represents a lower cost of ownership over a la carte generic instrumentation, such as arbitrary waveform generators, by eliminating the need for complex signal switching between instruments, integration of software interfaces from multiple vendors, and the need for ancillary signal sources. Reduced nonrecurring development man-hours directly provide the benefit of shorter TPS development times and lower expenses. The new ePVGA integrated software tool environment also supports the goal of shorter TPS development times. With video instrument obsolescence issues arising, careful attention was given to supporting legacy CASS, ESTS, and RT-CASS video requirements, making the ePVGA an excellent replacement candidate. The availability of hardware-based acquisition redisplay and DVI digital video generation makes the ePVGA an excellent candidate for new state-of-the-art platforms such as eCASS and VDATS.

**ePVGA 510 Features**

- Composite RGB video generation
- NTSC video/S-video generation
- Component video generation (YPbPr)
- Raster video generation
- Polar raster video generation
- Mixed video (stroke over composite/raster)
- Stroke video generation
- Digital video (parallel digital/flat panel, DVI, SD-HDI (VESA and HD formats))
- Full EDID processing functionality
- Integrated software tool environment with powerful features including GUI-based ePVGA operation, automatic C-code or macro generation, stand-alone test sequencer, expanded video imaging testing capabilities with oscilloscope-like waveform viewing, and electronic template comparison
- Supports RS170, RS343, RS330, STANAG 3350A, STANAG 3350C standards
- Automatic run time alignment of all analog parameters with remote sense capabilities
- Sophisticated control structure provides the ability to simulate dynamic and interactive displays
- Straightforward interfacing with complex UUTs such as HUDs and MPDs/MFDs
- Dual configuration analog outputs and digital I/O (differential, single-ended)
- Secondary composite video generation with differential high voltage outputs
- Full frame video acquisition (composite video, NTSC, raster video, polar raster video, DVI, SD-HDI)
- Captured video information available as raw or BMP/JPEG file types (still) or AVI (continuous)
- Voltage and timing analysis measurements for composite video
- Parallel digital video capture resolution (24 bit)
- Continuous near real-time video acquisition image redisplay via host PC monitor
- Continuous real-time video acquisition image redisplay to an external SVGA monitor
- Expanded I/O suite of signals - two standard digital 100-pin connectors and one 44-pin D-Sub 150-Ohm differential I/O connector
- General purpose user programmable timing signals for UUT synchronization
- VXI Plug & Play compatible
- Multiple DoD ATS Standards Compliance
- Built-in test
- Integrated signal routing between composite and stroke video modes to eliminate external wiring in mixed video mode

**VXI Programmable Video Generator and Analyzer Board**
Description
The ePVGA is a single slot, C-sized VXI instrument integrating multiple video format/multiple output video generation for general purpose testing of military or commercial platforms. All video elements are capable of fully independent and simultaneous operation. The generator elements can be used separately to test single format video displays, or in combination to test mixed video format displays. Since all outputs are automatically aligned at run time, the ePVGA delivers high accuracy signals with no periodic maintenance.

Primary Composite Video (PCV)
The PCV generates high-resolution bit-mapped images for cathode ray tube (analog) and flat panel (parallel digital) displays. Standard and non-standard scan formats are directly supported by the PCV. Two memory bitmaps (foreground and background overlay) support complex dynamic imagery. The background overlay may be superimposed on the main image. It can be updated from frame to frame as content, position, or foreground/background status.

Primary Composite Mode
- **Timing**
  - Total frame: up to 4096 lines/frame by up to 4096 pixels/line
  - Image resolution: up to 4096 active lines by 2048 active pixels
  - Pixel rate: (RGB) 125 MHz maximum
  - Horizontal scan rate: 0.001 Hz to 200 kHz (100 ppm)
  - Vertical scan rate: 1 Hz to 1 kHz
  - Sync and blanking: any pattern with timing from 0 to full line time
  - Timing resolution for all parameters: 1 pixel
  - Scan mode: progressive, interlaced, reverse, alternate, repeat
- **Analog Outputs**
  - Maximum range: +/- 3 volts into 75 Ohms (PCV)
  - Analog accuracy: 0.5% accuracy (local sense) and 0.2% (remote sense)
  - Bandwidth: exceeds 65 MHz
- Background bitmap size: ranging from one 2048 by 2048 to 256 dynamically selectable segments of 128 by 128.
- Video patterns: vectors, circles/arcs, bars, crosshatch, grayscale, RGB, dots, border, checkerboard, user-supplied bitmaps.
- Real time dynamic image movement.
- Position control modes:
  - Continuous
  - Externally gated
  - Externally triggered
  - Repeat/non-repeat
- Image priority:
  - Overlay image in front of primary image
  - Overlay image behind primary image

**Secondary Video Source (SVS)**

The SVS generates medium resolution bit-mapped images in any synchronized scan format. In addition, the SVS supports NTSC video to support commercial broadcast-type video. The purpose of the SVS is to produce a second video signal of either identical or different format than that of the PCV. The two video signals - PCV and SVS - can be used together (master/slave configuration) to test multi-scan monitors, video switching systems, channel isolation et al., or separately to simultaneously test multiple displays.

**Secondary Composite Mode**

- **Timing**
  - Image resolution: 1024 active lines by 1024 active pixels (RGB)
    480 active lines by 640 active pixels (NTSC)
  - Output resolution: 2048 lines (with line doubling)
  - Pixel rate: 40 MHz maximum (RGB) 13.5 MHz maximum (NTSC)
  - Sync and blanking: any pattern with timing from 0 to full line time
  - Timing resolution: 1 pixel time
- Analog outputs: +/- 10 volts into 75 Ohms (single-ended) +/- 20 volts into 75 Ohms (differential)
- Digital outputs
  - Horizontal marker
  - Vertical marker
  - Composite sync
  - Blanking
**Stroke Generator (SG)**

Unlike composite video, which is a scanned technology, stroke video utilizes direct point-to-point scanning with controlled slew rates. Due to its dynamic environment, the stroke video image is continually being modified for content, flashing indicators and updating aircraft or targeting positions. With the exception of very simple patterns, such as static crosshairs and basic geometric shapes, the construction of XYZ stroke video waveforms can be a demanding, time-intensive task that will overwhelm most generic waveform generators and test development schedules. The ePVGA’s SG represents the most complete stroke video generator commercially available and is designed to support military stroke video avionics. Complex, interactive images can be produced by the SG by means of its patented programmable sequence control structure which manages the order, duration, and position of image elements.

- **Stroke Analog Outputs**
  - +/- 10 volts into 75 Ohms (single-ended)
  - +/- 20 volts into 75 Ohms (differential) with 12-bit resolution and 0.5% accuracy (local sense) and 0.2% accuracy (remote sense)
  - Digital image storage: an arbitrary series of user programmed image constructs contained in a 1M by 16-bit memory
  - Digital sequence control structure storage: up to 64K sequence control blocks
  - Stroke clock: 50 MHz maximum with resolution of 0.25%
  - Image content: any user image that can be comprised of an arbitrary series of lines and arcs. Image library of alphanumeric characters and geometric shapes available through API
- **Programmable Sequence Control commands**
  - Display
    - Continuous
    - Timed
    - Until external trigger
    - Gated
  - Jump
    - Goto
    - GoSub
    - For loop
    - Real-time branch
  - Dynamic motion
    - Static offset
    - Offset increment
    - Offset register select (128 available registers)

**Raster Scan Video Generation**

- **Modes**
  - XYZ deflection driven scanned video is supported in standard and nonstandard formats with image features as specified in the PCV module above.
    - Rectilinear
    - Polar (modulated)
- **Timing**
  - Line rate: any from 0.01 to 100 kHz
  - Field rate: any from 1e-3 to 1 kHz
- **Bandwidth**
  - Exceeds 5 MHz (X and Y)
  - Exceeds 40 MHz (Z)
- **Analog Outputs**
  - Line and field: +/- 10 volts into 75 Ohms (SE)
    - +/- 20 volts into 75 Ohms (differential) with 12-bit resolution; 0.5% accuracy (local sense) and 0.2% accuracy (remote sense)
  - Filters: 2 kHz, 20 kHz, 2 MHz (assigned as a function of mode and rate)
**Real Time Capture (RTC)**

The RTC performs full frame video image capture on both analog and digital video in either synchronized or deflection driven format. Captured video may be continuously redisplayed on the computer's video monitor in near real-time.

**Capture Formats**
- Composite video
- Analog video with separate syncs
- Digital video with separate syncs
- Deflection scan (raster) video
- Stroke (XYZ) video

**Capture Redisplay**
- Image redisplayed on station monitor (no external equipment required) at a rate of up to 1/2 the input frame rate
- Compatible with all format and capture modes
- Captured images can be archived in still image format (JPEG or BMP) or motion image format (AVI)

**Analog Input Channels**
- Full scale range: +/- 0.5 volts minimum to +/- 10 volts maximum
- Bandwidth: greater than 40 MHz
- Input line rate: 4.0 to 150 kHz
- Input impedance: 75 Ohms
- Analog accuracy: run-time aligned to +/- 0.2% (card input pin)

**Digital Video Input**
- Parallel digital video inputs (8 bits by 3 channels)

**Control Modes**
- Internal
- External - gated
- External - triggered

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**Video Integrated Development Software (VID-SOFT)**

The ePVGA is now available with a powerful integrated software suite, VID-SOFT. VID-SOFT is a broad software tool environment designed to accelerate test development, minimize or eliminate programming, and offer powerful automated and visual tools with which to automatically validate a wide spectrum of video formats.

The components of VID-SOFT are:

**ePVGA Graphical User Interface**
- Point-and-click programming of the ePVGA, VRT, and VSA components
- Automatic code generation linked to GUI panel selections
- Macro recorder to combine statements for later playback
- ePVGA programming wizards

**Video Redisplay Tool (VRT)**
- Continuous redisplay of the captured video image on the host PC's monitor

![Diagram of VID-SOFT components](image-url)
Video Redisplay Tool
The Video Redisplay Tool software allows all video formats captured with the RTC (Real Time Capture mode) to be continuously streamed to the host PC and displayed on the host monitor for visual operator verification. Options such as frame averaging, threshold clipping, and display adjustments are available to aid in the visual presentation.

Available Performance Levels for the ePVGA Enhanced Version
The ePVGA is factory-configured at time of purchase.
- Video Redisplay
  - Real-time hardware-based scan conversion of video capture
  - Converts special format video signals to a video signal viewable with an external analog monitor
  - Upgrades all video acquisition modes to real-time continuous capture
- DVI Digital Video (Double-Slot VXI Module)
  - DVI Digital Video Generation (162 MHz maximum rate)
  - DVI video capture
  - Full EDID capabilities

Virtual Spectrum Analyzer (VSA)
- Patented waveform analysis software
- Continuous three-channel (RGB) video waveform display with overlays, error bounds, analog persistence, filtering, averaging, peak detection
- Image measurements via 2D threshold analysis and image validation via electronic template comparison with programmable accuracy

Test Sequencer Module
- Stand-alone tool to automatically execute ePVGA macros by invoking ePVGA, VRT, and VSA functions
- Programmable error limits with pass/fail reporting
EPVGA Custom Packaging

Supports Advanced and Legacy DoD Video Applications in:
- HUDs
- Radars
- MPDs/MFDs
- Sonars

Aircraft Actively Supported:
- A-10
- B-1B
- C-17
- F-15
- Eurofighter
- T-50

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Advanced Testing Technologies, Inc. www.attinet.com
Description
The ATTI Enhanced Programmable Video Generator and Analyzer (ePVGA) Stand Alone/Rack Mount is a true VXI instrument integrating multiple function, multiple output video generation, and video-specific digitizer/analyzer capabilities into a complete general purpose test platform for military or commercial applications. It is housed in a 2U rack-mount chassis for full stand alone capability.

Features
- Four autonomous video functions
- Compatible with analog and digital video systems
- Automatic run time alignment of all analog parameters
- Sophisticated control structure provides the ability to simulate dynamic and interactive displays
- Continuous video acquisition image redisplay via host PC monitor
- Straightforward interfacing with complex UUTs such as HUDs and MPDs/MFDs
- New graphical interface panel with automatic software generation
- New dual configuration analog outputs and digital I/O (differential, single-ended)
- New NTSC/PAL, S-Video, and YPbPR video format generation
- All timing parameters now support single pixel resolution
- Expanded digital video capture resolution (94 bit)
- Expanded video generation rates (composite to 125 MHz) and Raster/Stroke acquisition rates (to 40 MHz)
- Expanded I/O suite of signals - two standard digital 100-pin connectors and one 44-pin D-Sub 150 Ohm differential I/O connector
- Three additional remote sense pairs
- Additional user programmable timing signals for UUT synchronization
- Plug & Play compatible
- IVI and LXI compatible
- Multiple DoD ATS Standards Compliance
- Built-in test
- Improved core signal measurement linearity and resolution (19 to 16 bit)
- New daughter board capability to support future expandability such as DVI and real-time image acquisition redisplay via external monitor
- Additional internal signal routing between composite and stroke video modes to eliminate external wiring in mixed video mode

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Interface Options

<table>
<thead>
<tr>
<th>Mode Summary</th>
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<tbody>
<tr>
<td>✓ Dual Composite Video Generators</td>
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<tr>
<td>✓ Raster Video</td>
</tr>
<tr>
<td>✓ Modulated Raster Video</td>
</tr>
<tr>
<td>✓ Stroke Video</td>
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<tr>
<td>✓ Mixed Video</td>
</tr>
<tr>
<td>✓ DVI, HD-SDI Video</td>
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<tr>
<td>✓ Video Frame Capture</td>
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<tr>
<td>✓ Continuous Capture Redisplay</td>
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Summary
In order to meet the requirements of military video testing, all components of the ePVGA were created with the same design philosophy - total flexibility to handle both standard and nonstandard test requirements, and the ability to perform as a standalone unit. The ePVGA is a mature field proven design developed from decades of field experience. The ePVGA has been selected by several major aerospace companies in support of the B-1B, F-15, C-17, Eurofighter and T-50 aircraft. The requirements of these technically diverse systems are met by the ePVGA.

Whether considered as a legacy instrument replacement or for new testing capability, the ePVGA represents tangible and realizable benefits. By leveraging a full set of ancillary outputs, flexible external controls and standalone capability, the customer realizes a significantly higher level of capability, simpler interface test adapters, shorter TPS development times and elimination of the need for supplemental instrumentation. The combination of these advantages translates directly into reduced test development costs making the ePVGA an attractive video testing solution.
ATTI Product Announcement

**VXI Programmable Digital Video Generator and Analyzer**

Features of the Programmable Digital Video Generator and Analyzer are as follows:

- Digital Video Generation and digital Video Capture integrated into a single instrument
- Supports parallel and serial digital formats through 1080p
- All functions completely autonomous
- Sophisticated control structure for Video Generation provides the ability to simulate displays ranging from static test patterns to complex, interactive dynamic patterns
- Video Capture channel stores the received video as a fully formatted image in memory for efficient transfer and analysis
- Comprehensive software driver interfaces directly with high level languages
- Plug and Play compatible
- Standard video programming simplified with predefined macros
- Built-in test
- All I/O via standard connectors (DVI-I)
- Turnkey operation
- Patented Video Generation architecture allows virtually unlimited control over format
- Video Capture Channel interfaces directly to additional software modules for value-added functionality
  - Continuous video redisplay to the host computer's monitor
  - Continuous video redisplay to an external monitor
  - Eliminates the requirement for separate display devices
  - The ATTI Virtual Spectrum Analyzer software package provides extensive measure and video analysis capability as well as automatic image verification for all video formats
  - Automatic code generation from GUI panels
- DVI compliant
  - Supports all standard formats from VGA to UXGA and arbitrary non-standard
  - Skew tolerant
  - Monitor detection through Hot-Plug and receiver detection
- Full EDID emulation and functional testing
  - Supports all standard formats from SVGA to QXGA and arbitrary non-standard
  - Supports Dual and Single pixel mode
  - Skew tolerant

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TOTAL SOLUTION VIDEO TESTING

Enhanced Programmable Video Generator & Analyzer

Features:

- **Video Generation**
  - New: DVI and HD-SDI Support

- **Video Capture**
  - Automatic image verification

- **Video Redisplay**
  - Image reconstruction on host computer monitor.
  - New: Continuous Real Time Video Redisplay on standard SVGA monitor

Converts any video format compatible with the ePVGA-510 video acquisition module (composite, raster, stroke) to SVGA 800 by 600 60 Hz format.

**Demonstration:**

Source: RS-343 875 line 30 Hz. RGB interlaced video

Output: SVGA 800 by 600 line 60 Hz. progressive.

- Eliminates the need for multiple OEM monitors.
- Eliminates additional frame conversion instrumentation.

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**Introduction**

There is a deficiency in capability when commercial video test instrumentation is applied to military applications.
- Instrumentation will not support video formats used by military platforms.
- Instrumentation is not capable of supporting required nonstandard variations and implementations.
- Video signal measurement methods do not support image content validation.
- Separate instruments are required to generate, capture, analyze and redisplay video signals.

In this era of military downsizing, a single instrument should be able to:
- Generate and capture all military video formats (RGB composite, NTSC, raster, stroke video, DVI, HD-SDI).
- Measure timing, amplitude parameters, as well as, automatically validate image content of the captured video.
- View the captured video on either the host computer monitor or a standard SVGA monitor in real-time.
- Generate source code automatically for custom driver development.
- Operate in manual (troubleshooting), embedded (TPS) or standalone (production line) configurations.

Image content validation has been conspicuously missing in test instrumentation despite its importance in identifying video UUT anomalies. Due to the complexity of executing content validation methods, the best industry implementations rely on simple manufacturer-specified test patterns, simple measurements and primarily manual image inspection using the platform’s specific EOM monitor in a hot mockup configuration. For some applications, upgrading an established test to automation entails too much risk and expense.

**The Solution**

The ATTI Programmable Video Generator and Analyzer (ePVGA) is the only commercially available instrument that fully supports the video requirements enumerated above. For the first time, a single instrument provides a true video frame conversion function for legacy requirements, as well as totally automated video image verification for new requirements.

**Summary**

**Single “C” Slot Card**
- Standard and Non-Standard Video
- Video Capture and Generation Capability
- Both Analog and Digital Real Time Capture
- Operates in a Windows Environment

**Adaptable to DOD and Commercial ATS**
- In Production/Deployed Legacy Systems
- For ATS Presently in Development

**Designed as a “Self Sufficient” Test Instrument**
- Requires No Additional Hardware
- All Video test Modules on a Single Card
- Capable of Fully Independent and/or Simultaneous Operation
- Performs Mixed Mode Testing
- Product Maintenance and Logistic Support In Place
Video testing and validation remains a complex issue in today’s commercial and military world. In this era of military downsizing, a single instrument should be able to:

- Generate and capture all military video formats (composite, raster, stroke video, DVI, SDI).
- Measure timing, amplitude parameters, and automatically validate image content of the captured video.
- View the captured video on either the host computer monitor or a standard SVGA monitor in real-time.
- Automatically generate code with macro playback capability for accelerated driver development.
- Operate in manual (troubleshooting), embedded (TPS) or standalone (production line) configurations.

Commercial video generation and analysis testing solutions often rely on multiple, sometimes inadequate, test instruments to fulfill the video generation and analysis suite required by most military airframes. Though not as diverse as military applications, commercial requirements face similar difficulties, such as image content validation. Historically, image content analysis depends on operator defined voltage measurements at known time intervals in order to perform a rudimentary evaluation.

There exists a need for a unified hardware and software video ‘toolkit’ which is a) versatile enough to interface with sophisticated military platforms, b) have the capability to expediently validate the broad format spectrum of military and commercial equipment and c) have the versatility to function as a standalone module or be integrated into an existing test bench environment.

Recognizing this requirement, the VIDGEN-510 is now available with the VID-SOFT software package. The VID-SOFT package is a natural extension to the capabilities of the 510 instrument. VID-SOFT is a comprehensive integrated development environment designed to accelerate test development, minimize or eliminate manual programming, and offer powerful automated and visual tools with which to automatically validate video formats and video image content without resorting to extensive signal analysis.

VID-SOFT is comprised of 4 software tools developed by ATTI:

1) The Video Programming Tool (VPT) provides a graphical interface to the VidGen-510 offering point-and-click programming for accelerated software development, the ability to save programming steps to a macro for external playback via a single function call, and automatic API code generation for the ePVGA and other software modules keyed from entries selected the graphical interface.
2) Image content validation has been conspicuously missing in automatic test instrumentation despite its importance in identifying video UUT anomalies. Due to the complexity of executing content validation methods, the best industry implementations rely on simple manufacturer-specified test patterns, simple measurements and predominately, manual image inspection. Unfortunately, even simple image analysis can result in false positives. UUT anomalies can produce degraded signals (i.e. rise/fall times, noise, spikes, clipping, ringing, amplitude) or minor image defects that are not easily detected during a simple ‘crosshatch image’ bench test, but will be visible and flagged by a pilot looking at a complex situational display in the cockpit. Electronic template testing will remove manual image inspection methods.
The **Virtual Spectrum Analyzer tool (VSA)** provides waveform-based analysis and patented automatic image validation of composite, raster/stroke and DVI video images. The VSA provides a single step method to easily characterize a known-good signal from one or more UUTs and compare that ‘golden’ electronic template to a (video) signal under test for completely automated signal verification encompassing voltage, timing and image content criteria resulting in a pass or fail status. In addition, the VSA will reconstruct the image under test and highlight the portion of the image that is not in compliance to assist with fault isolation of the underlying subsystem. The VSA removes manual image inspection methods for all video signals, but will also excel with any complex electronic waveform.

3) **The Video Redisplay Tool (VRT)** provides software-based video image redisplay on the host computer’s monitor capable of viewing composite video, raster video and stroke video formats for operator-in-the-loop testing.

4) **The Video Test Sequencer (VTS)** provides a standalone application to develop and execute user-developed test macros and sequences developed with the VPT and compare measurement results to established limits. The VTS may be invoked externally for integration into any software environment.

Together, the VIDGEN-510 instrument and the VIDSOFT software provide unique capabilities within a single slot VXI card that are not matched by any commercial instrument vendor. As a video instrument, the 510 is:

a) Capable of composite, raster, stroke, parallel digital, DVI and HD-SDI video generation, acquisition and image redisplay.

b) Capable of performing automatically defining and performing ‘electronic template’ video testing.

c) Designed to interface with diverse discrete signals from military platforms.

d) A suitable candidate for all new and legacy military video testers including VDATS, IFTE, ESTES, CASS, ADATS and NGATS.
ATTI Company Profile

The corporation:
- Has designed, developed and manufactured ATE since 1987
- Has delivered and supported many test systems in both the commercial and military sectors
- Is an innovator in developing and implementing VXI technology solutions
- Has developed over one thousand test program sets, covering the test spectrum from simple to extremely complex
- Has numerous satisfied customers, including:
  - Agusta, Italy
  - Boeing
  - Esad, Turkey
  - Havelsan, Turkey
  - Hellenic Air Force
  - Japanese Air Force
  - KLM Royal Dutch Airlines
  - Lockheed Martin
  - NATO
  - Northrop Grumman
  - Palomar Products, Inc.
  - Royal Saudi Air Force
  - US Air Force
  - US Navy

ATTI Worldwide Support

The corporation:
- Has developed Obsolescence Mitigation Replacement (OMR) technology which represents ATTI's corporate commitment to customer use and TPS investment in our test systems
- Has delivered BRAT test systems worldwide
- Offers one of the most experienced service, training and support teams in the world
- Has worked with our customers solving diverse test challenges in digital, analog, and RF applications
- Is committed to total hardware and software support including service, spares, upgrades, documentation, training, and configuration control
- Has the financial efficacy to guarantee long-term commitments

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