

## Errata

**Document Title:** Missile System Testing (AN 421-19)

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### HP References in this Application Note

This application note may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this application note copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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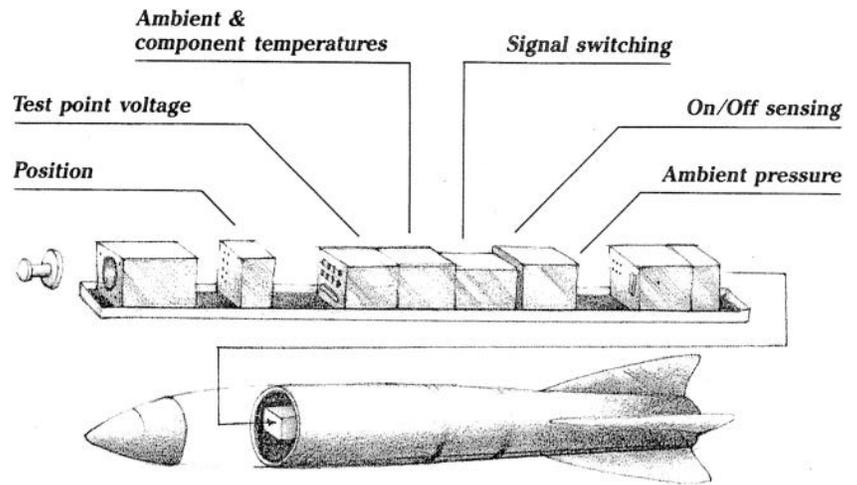
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# Missile System Testing



**Description** The U.S. Department of Defense has a large number of missile programs under way. Each missile has many sub-systems that make up the propulsion, guidance, and warhead systems. The DOD awards a contract to a general contractor who subcontracts many of the sub-systems. Each must be thoroughly tested to ensure functionality and proper interfacing with sub-systems built by different companies. Modules are often tested while inside environmental chambers. The chambers are set to extreme temperatures, humidities, and pressures that stress the modules to their design limits.

**Problem** Many inputs and loads must be simulated while accurately measuring sub-system responses. Test volumes are relatively low, changes are frequent, and deadlines are very important. The test system must be easy to start up, easy to reconfigure, accurate, flexible, and have control as well as measurement capabilities.

**Solution** The optimum solution depends on the exact nature of the sub-system being tested. An electronic switch system is the best answer if the sub-system is primarily electronic or has a large amount of communications circuitry because these sub-systems usually require special sophisticated test equipment not available on a plug-in card. Individual sources and detectors must be switched to and from the device-under-test as various tests are performed.

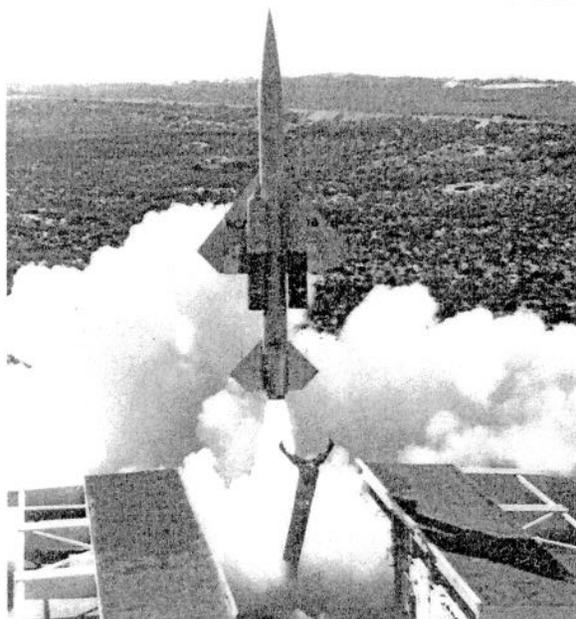
If the sub-system has a lot of electro-mechanical apparatus, requires a lot of temperature measurement, or needs a significant amount of control, a data acquisition system will be the best fit. Data acquisition systems are good at interfacing with transducers, making measurements quickly, computing new parameters, and outputting control signals.

## Applications

Electronics  
Defense electronics  
Aerospace

## Departments

Test engineering  
Research and development  
Reliability  
Quality assurance



## IMPLEMENTATION

**Ambient and component temperature** Thermocouples and thermistors are used to measure temperatures inside of modules, on circuit boards, on individual components, and inside the environmental chamber. High accuracy is required to meet DOD requirements and might exceed  $\pm 0.5$  degrees C in some cases.

**Ambient pressure** Pressure transducers are used to monitor atmospheric pressure conditions inside the environmental chamber. Pressure transducers output analog voltages, analog currents, or digital words to indicate measured pressure so the appropriate input card must be specified for the test system.

**Position** Two types of positions are common to missile sub-system testing. Gyroscope outputs must be correlated with a three-dimensional positioning system to test guidance system performance. Measuring linear and rotary position is usually associated with testing missile guidance fin positioning systems. Usually these outputs are digital words or pulse trains.

**Test point voltage** Voltages are often measured directly from test points inside a circuit module. Voltage outputs that feed other sub-systems are also common. Accuracy requirements can exceed 100 parts per million for these measurements.

**On/off sensing** Many test signals in missile systems are simple on/off signals. They indicate status, start and stop operations, and show presence or absence of various system conditions. When used as outputs, on/off signals can start and stop missile guidance fin positioning motors, open and close fuel valves, and control heaters in environmental chambers.

**Signal switching** Often, special test equipment must be used to test certain module functions, particularly when high frequencies are involved. A programmable switch will connect specific test equipment to the device under test in a predictable, repeatable manner so that test results are consistent.

## KEY SYSTEM FEATURES

- Thermocouple and thermistor linearization
- Local intelligence
- Down-loadable subroutines
- Limit checking
- Front panel programming
- Interrupt handling

## TYPICAL CONFIGURATION

Data Acquisition System	Qty
HP3852A or HP3235A	1
HP3853A or HP3235E extender	0-3
Integrating DVM	1
High-Speed DVM	0-1
Relay multiplexer channels	10-100
FET multiplexer channels	0-50
Digital input channels	8-64
Digital output channels	8-24
Counter channels	1-5
D/A converter channels	0-4
Actuators	2-8

## Computer/Software

- HP Series 300 technical computer
- Disc drive (HP 9153B)
- Software — HP BASIC and HP DACQ/300 software (program scheduling, database, data communications)

## Other Equipment

- Programmable power supply
- Programmable switch (HP 3488A)
- VHF switch cards
- UHF multiplexer cards

## TYPICAL SYSTEM PRICE:

**\$10,000 to \$35,000 per test station**

## INSTRUMENTATION

Integrating DVM  
Relay multiplexer with  
thermocouple compensation

Integrating DVM  
FET multiplexer  
Digital input

Digital input  
Counter

Integrating DVM  
FET multiplexer  
Relay multiplexer

Digital input  
Digital output  
Actuator

VHF matrix card  
UHF multiplexer card  
General purpose multiplexer