



PROPULSION TEST DATA ACQUISITION AND CONTROL SYSTEMS (DACs)

SUMMARY

The Propulsion Test Office at White Sands Test Facility (WSTF) currently operates the second generation of automated Data Acquisition and Control Systems (DACs). These systems have proven their merit in tests of space shuttle components, including the improved auxiliary power unit, orbital maneuvering subsystem, aft reaction control subsystem, and a myriad of reaction control thrusters. Custom control and monitoring software has also been developed and implemented for such applications as safely establishing closed loop startup and shutdown profiles for a liquid propellant rocket engine with turbopump feed system. The four DACs incorporate current computing technology features for efficient and safe testing. Extensive use of both high-speed memory networks and standard network communications allows for safely automated test operations and the distribution of test results in near real-time. Graphical user interface technology provides optimum test article telemetry monitoring and control system interaction. The DACs provides customer data processing and analysis service both in real-time for test control and monitoring at WSTF, and posttest at the customer's place of business. All improvements have resulted in reductions of both maintenance costs and energy usage.

The Propulsion Test Office at WSTF is currently procuring and installing the third generation of automated DACs that is designed and built on lessons learned with the previous generations. The following information reflects this third generation system.

DIGITAL DATA ACQUISITION AND AUTOMATED CONTROL CAPABILITIES PER TEST STAND

- On-site computer engineering services for customized real-time data and control solutions
- 4 million samples per second (SPS) aggregate data acquisition
- Maximum single channel sample rate of 100,000 SPS
- Automated firing sequence for 64 discrete channels and 8 analog channels with 1 ms precision
- Large online firing profile list (100 maximum)
- Up to 100 scan lists for data acquisition and storage of selected measurements.
- Automated limit monitoring, alarms, and firing sequence shutdown
- Graphical user interface provides windows of tabular and trend plot data display
- Near real-time displays on-site via local area network (LAN)
- Up to 32 computed measurement algorithms processed every 250 milliseconds (normal)
- Up to 32 computed measurement algorithms processed every 10 milliseconds (fast)
- Flexible LAN accessed, multi-user, integrated instrumentation data base

Data Storage

- 173 gigabyte redundant array of independent disks
- 950 gigabyte automated data backup tape library archive

One Analog to Digital Converter per Channel

- 4 million SPS aggregate for each system
- 300,000 SPS aggregate from each system rack of 30 analog channels
- Single channel sample rates 1-100,000 SPS
- Effective digital resolution (16 bits including sign, range -32767 to 32768)



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Two Dedicated Processors per System

- Acquisition and storage server
- Display, real-time processing, and control server, with associated embedded control computer

User Workstations and Peripherals

- Six user workstations
- High-speed laser printer/plotter

GENERAL INSTRUMENTATION AND ANALOG DATA RECORDING CAPABILITY

Typical instrumentation signal conditioning

- Pressure
- Temperature
- Flow
- Acceleration
- Strain
- Force
- Voltage
- Current
- Position

Dewetron Electronic Chart Recorders (paper optional)

- Up to 200kSPS per channel
- Three 64-channel units in the 400 test area
- Five 64-channel high speed units in the 300 test area

One general purpose 512 channel, 1 millisecond resolution, discrete event recorder per test area

DATA ANALYSIS AND DISTRIBUTION SYSTEM

System of Networks and File Servers

- Provides data and data analysis tools to the user
- Serves all online DACS posttest data. Off-line data restorable from archive
- Test data retained 5 years or longer at customer request for restoration on-line from tape
- Test data may be downloaded to other computers via SCP/sFTP
- Download to personal workstations in comma separated variable (CSV), WINPLOT, and other formats as determined by customer's need
- Access on site via LAN and off site via NASA Integrated Services Network
- Download customer-defined reduced data formats to compact discs or other media

Predefined DADS Interactive Data Reduction Applications

- Various combinations of min/max/average/median/standard deviation/integral
- User-defined time intervals over which to compute, and time increments to report data points
- Engine chamber pressure OK, fire switch search, and limit checking event analysis
- Multiple reaction control thruster propulsion system evaluation
- Reaction control thruster acceptance test performance evaluation
- Thrust measurement system evaluation and calibration
- On-site computer engineering services for customer-defined application development

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