ORTEC®

DSPEC®
Digital Gamma-Ray Spectrometer

Hardware Manual

Advanced Measurement Technology, Inc.

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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Quality Control

Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

Repair Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone [(865) 482-4411] or by facsimile transmission [(865) 483-2133], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation.

Damage in Transit

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

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Safety Instructions and Symbols

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER   Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING   Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION   Indicates a hazard that could result in property damage if the safety instruction is not observed.

In addition, the following symbols may appear on the product:

   DANGER–High Voltage

   ATTENTION–Refer to Manual

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

Cleaning Instructions

To clean the instrument exterior:
- Disconnect the instrument from the power source.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

> **CAUTION**   To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

- Allow the instrument to dry completely before reconnecting it to the power source.

1. INTRODUCTION

ORTEC's **DSPEC** (pronounced D–Spec) is an industry first — the first integrated, digital-signal-processor-based, digital gamma-ray spectrometer for use with all types of germanium detectors, including super-large detectors.

DSPEC combines all the best features of low- and high-rate analog systems in a single, PC-based package that is easily connected to local area networks (LANs). This highly automated, yet flexible, hardware and software combination is suitable for most spectroscopy applications.

From all sides, environmental measurement through physics research to on-line industrial measurements, the question has often been posed: "Why can't one system provide the best in resolution, throughput, and stability simultaneously? Why do we always have to make a less-than-ideal compromise when the detector itself is capable of more performance?" Until now, these questions have remained unanswered. Now DSPEC provides those answers:

- In Environmental Counting, DSPEC provides extremely high stability over long counting times. DSPEC solves the ballistic deficit problem that often degrades the resolution of large HPGe detectors. It delivers the best resolution of which any detector is capable. A *statistical preset optimizes sample throughput, and delivers lower cost per sample*.

- DSPEC is *highly automated*, ending forever the need to use screwdriver or oscilloscope to achieve the best performance.

- Recognizing that not all counting rooms provide "laboratory conditions," DSPEC also provides *unprecedented temperature stability* for varying ambient temperature.

- For applications involving high or widely varying count rates — such as intermediate-level waste measurement or post accident sampling — DSPEC has *unmatched count-rate stability* in both peak position and resolution.

- For industrial applications and when LANs are a requirement, DSPEC's *built-in Ethernet port* allows direct connection to the network. No other integrated instrument can do this.

- Those wanting to wring the last drop of resolution performance from their detector will appreciate the *built-in InSight*™ *"Virtual Oscilloscope."*

DSPEC is a truly unique package, providing real benefits "where it counts," for all gamma spectroscopy operations: *STABILITY*, *RESOLUTION*, and *AUTOMATION*.

1.1. What is DSPEC?

One germanium or silicon gamma or x-ray detector, one PC, and one DSPEC comprise a complete spectroscopy system. The detector provides a signal proportional to the gamma-ray energy; the PC provides the user interface, data display, and storage; and the DSPEC provides everything else.

DSPEC includes an analog prefilter, fast digitizing circuits, and digital signal processing to optimize energy resolution and data rate, via variable rate baseline restoration, automatic pulse pile-up rejection, automatic pole-zero cancellation, ballistic deficit correction and zero effective-conversion-time peak detection, measurement, and storage. Spectral data is maintained in the DSPEC battery-backed data memory until transferred to the PC by the user. DSPEC also includes the high-speed data link to the PC, with a choice of ORTEC's ultra-fast, direct Dual-Port Memory interface or standard Ethernet interface. You can even connect multiple DSPEC units into networks and control them all from anywhere on the network!

1.2. About this Manual

This manual describes the ORTEC DSPEC Digital Gamma-Ray Spectrometer, and provides all the information necessary to prepare the DSPEC for use and connect it into a complete spectroscopy system. Because the DSPEC is almost completely computer controlled, this manual is short. Details on running the control software are contained in the MAESTRO™ and GammaVision™ software manuals. A condensed version of some key MAESTRO and GammaVision information is provided in the ORTEC publication entitled "*DSPEC Digital Gamma-Ray Spectrometer and Its Use with MAESTRO™ or GammaVision™.*"

2. GETTING STARTED

2.1. What You Will Learn in this Chapter

In this chapter you will:

- Become acquainted with the DSPEC front- and rear-panel indicators and controls.
- Set the electrical power input for your local conditions.
- Learn whether you need to change the factory settings of the internal switches.

2.2. The Front Panel

Figure 1 shows the DSPEC front panel.

Fig. 1. DSPEC Front Panel.

Starting from the left, there are four LEDs indicating the status of the detector bias supply. Illumination of the **HV ON** light indicates that the rear-panel high voltage connector is powered. Either the **HV POS** or **HV NEG** light will be illuminated to show the internal setting of the detector bias polarity switch.

The **OVERLOAD** light indicates that the power supply is overloaded and shut down. (This condition usually indicates a shorted output due to a faulty cable or improper connection.)

The **PROCESSOR BUSY** light flashes to indicate functions of the internal microprocessor.

The **STABILIZER GAIN** and **OFFSET** numeric displays indicate the settings of the internal digital spectrum stabilizer. If the stabilizer is not being used, the displays indicate "off."

The **SPECTROMETER ACCEPT** and **REJECT** lights indicate the operation of the internal pulse pile-up rejector. If pulses from the detector are too close together in time to be accurately measured, they are rejected and the **REJECT** light flashes. Each measured pulse causes the **ACCEPT** light to flash.

Additional information on the rate of data acquisition is available from the **SPECTROMETER DEADTIME** numeric display. The dead time of the system is the fraction of time that the system is busy and unavailable to process pulses. As the count rate increases, the number of events rejected by the pile-up rejector increases and the dead time increases. At 50% dead time, half of the pulses occur so closely together that they are rejected.

The **POWER** switch turns the instrument on or off and indicates its status with a lighted indicator.

2.3. The Rear Panel

Figure 2 shows the DSPEC rear panel.

Fig. 2. DSPEC Rear Panel.

Under the cooling fan is the power input block, into which is plugged an international standard AC power cord suitable for local power distribution. A small printed circuit board can be accessed behind a sliding plastic window. This board can be inserted in four different ways, allowing you to select 100, 120, 220, or 240 volts. The selected voltage is the only one that can be read through the window. The correct fuse size, power cord, and voltage setting are supplied with the instrument.

PREAMP POWER, both ±12 and ±24 volts DC, is provided via a standard 9-pin D-type connector.

The **HIGH VOLTAGE** section has three components. A 10-turn potentiometer sets the value of the detector bias. A BNC connector receives the signal indicating a warmed-up detector, requiring removal of detector bias. The **OUTPUT** connector is an SHV-type connector carrying the detector bias voltage.

The next section has three BNC connectors. The **INPUT** connector receives the low-level analog signal from the preamplifier. The **ADC GATE** connector is an input which can be used to cause the system to accept or reject a pulse under the control of external electronics. The **TRP INHIBIT** is an input used to reject pulses during the reset period of detectors with transistor-reset preamplifiers.

CHANGE SAMPLE is a logic output used to control sample changers. **SAMPLE READY** is a logic input used to report that the sample changer has completed changing the sample. (Use of these features requires software support discussed in the software manuals.)

Connection to the computer is by means of either the **DUAL-PORT MEMORY** 37-pin D-Type connector or the **ETHERNET** BNC connector. Most new systems will use the more convenient Ethernet connection; the Dual-Port Memory method is provided for compatibility with existing systems. The **RS-232-C** connector provides a low-speed serial link to the PC and is normally not used.

2.4. Internal Switches

NOTE   If you are using P-type detectors, such as ORTEC's GEM Series, or if you have purchased a complete system, you may skip the remainder of this section.

There are two internal settings which must be correctly set for your particular type of detector. Changing these settings requires removal of the DSPEC cover:

> **DANGER**   Turn off the DSPEC, remove its power cord, and wait several minutes for the power supply to discharge before performing this operation!

1. Place the DSPEC upside down on a clean workbench, preferably covered with cloth or clean paper to prevent scratching the cover.

2. Remove the four Phillips-head screws that secure the cover. There is one screw at each corner, just outside the rubber feet.

> **CAUTION**   The cover is not secured to the chassis; therefore, if the chassis is supported only by the cover and tilted with the back panel downward, the chassis can slide free and fall!

3. Carefully place the DSPEC back on its rubber feet.

4. Slide the cover forward to free it from the chassis. Figure 3 shows the internal details of the DSPEC.

Note the amplifier input polarity switch (note the pointer slightly right of bottom center). This switch must be set to match the output polarity of your detector's preamplifier. The factory setting is positive, which is appropriate for ORTEC GEM detectors and most other P-type detectors. For those ordering a complete system, the setting will be set correctly during system checkout.

Changing the detector bias supply polarity is easy to do but not easy to explain:

1. Remove the cover as described above.

2. Turn the DSPEC so that its right side (opposite the power supply and fan) faces you.

3. The high-voltage power supply board is the bottom board in the stack of four boards.

4. Locate the bias selector board (BSB), shown in Fig. 4. The BSB is a printed circuit board approximately 180 mm × 15 mm. It has eight pairs of jumper pins that plug into the high-voltage power supply board.

   The BSB moves one jumper location left or right to select between HPGe detectors or NaI detectors. The leftmost position is correct for HPGe detectors.
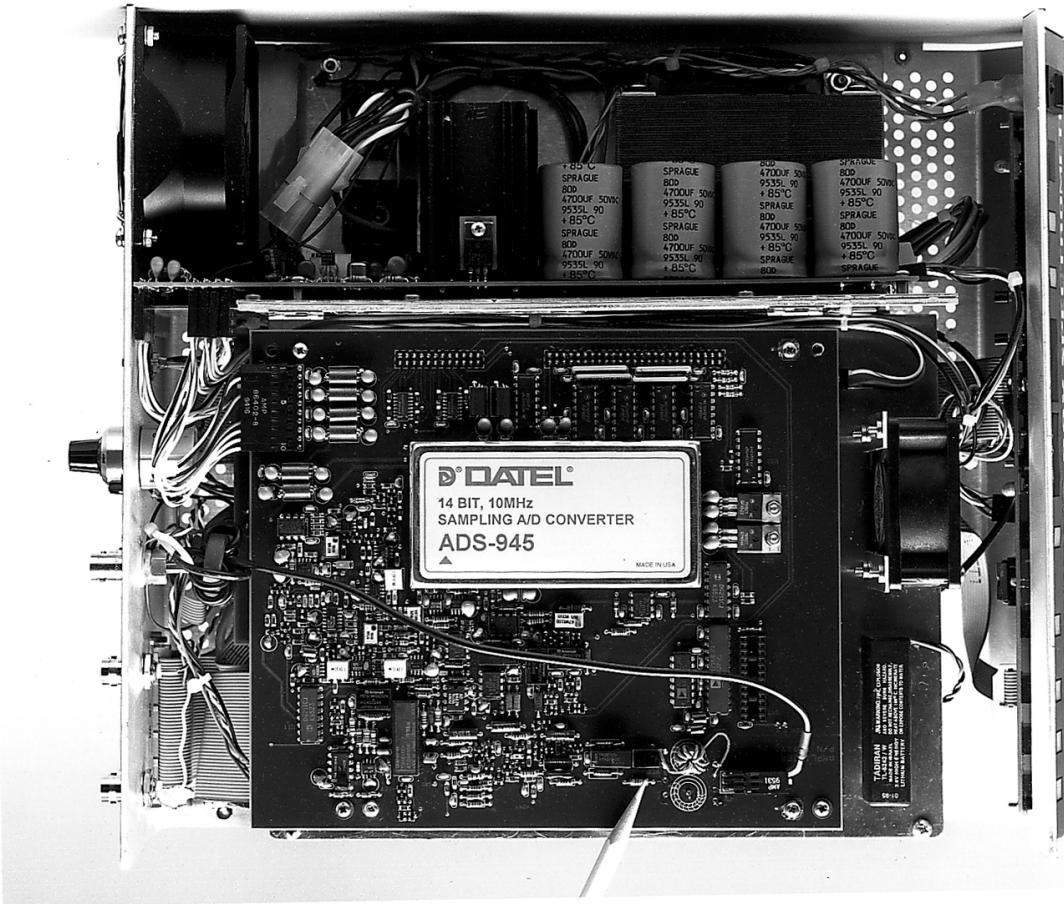
Fig. 3. Internal Details and Amplifier Input Polarity Switch.

Moving one jumper location from the edge of the board toward the center selects negative or positive bias. The jumpers closest to the edge of the high-voltage power supply board select positive voltage; the jumpers toward the center select negative voltage.

5. There are two ways to move the BSB. The easiest way for most people is to place the index finger of each hand on the ends of the BSB and lift up about one centimeter until the jumpers clear the board. Move the BSB to the correct set of jumpers and position the jumpers into the high-voltage power supply board. The BSB can then be completely reseated by pressing down from the top with your fingertips.

Alternatively, the BSB can be lifted and moved using tools. Two electronics-type needlenose pliers, one held in each hand, can be used to grip the BSB near each end. Lift and move to the required jumper position, then position the jumpers with a *gentle* downward pressure. Press the BSB completely into place using either the pliers or your fingertips, as above.

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Fig. 4. Bias Selector Board (BSB).

2.5. Internal Battery

An internal lithium battery provides backup of settings when the power to the unit is off. Should the battery become depleted, replace it with ORTEC Part Number 739460.

3. SYSTEM CONNECTION

3.1. What You Will Learn in this Chapter

In this chapter you will learn how to:

● Connect a single-detector/single-computer spectroscopy system.
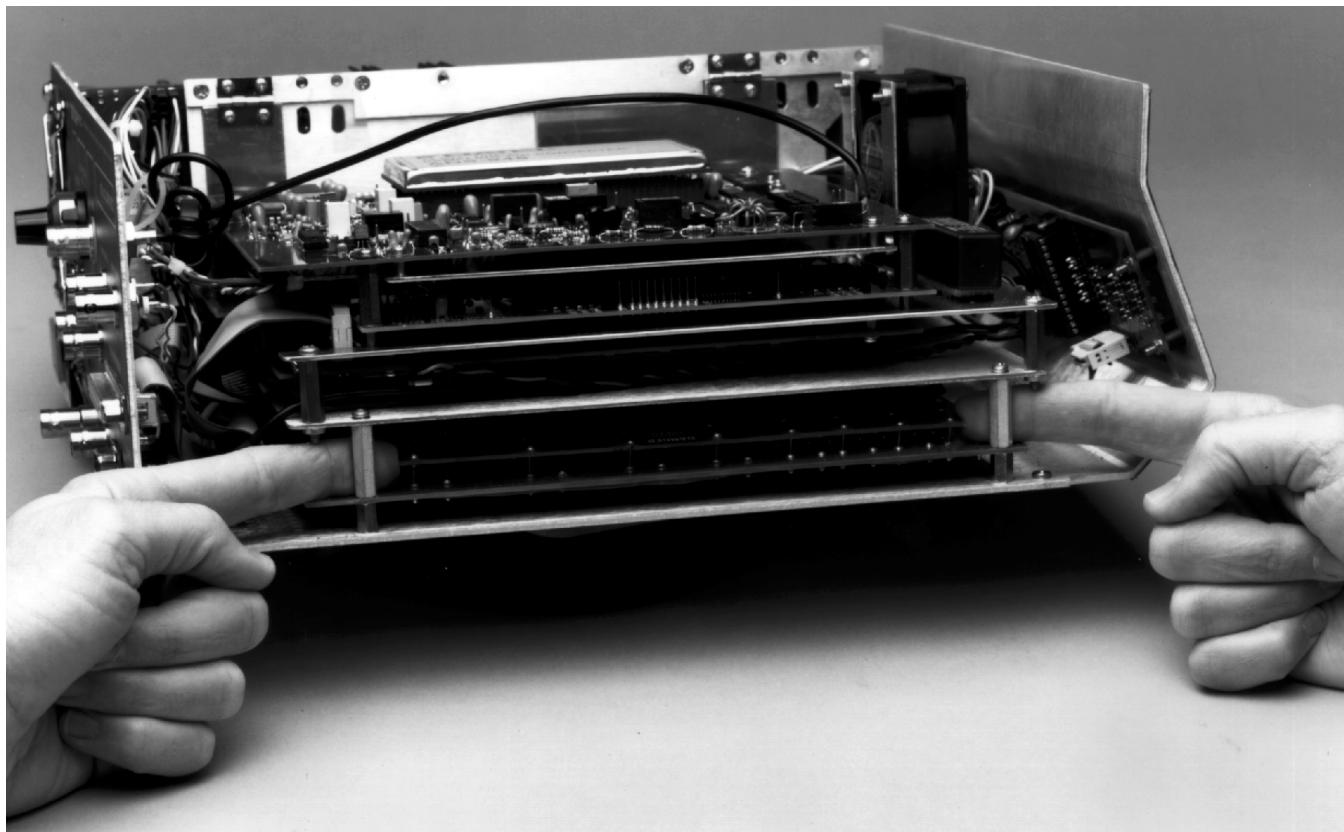● Add multiple detectors to the basic system.

3.2. Building a System

3.2.1. Single-Detector, Non-Networked System

1. Connect the detector preamplifier power, using the 9-pin D-type connector and the supplied power cable. The DSPEC provides this power from its rear-panel PREAMP POWER connector.

2. Connect the detector high-voltage bias. This is usually an SHV-type high-voltage coaxial connector on the detector preamplifier. The DSPEC supplies this bias voltage from its rear-panel 0–5 kV OUTPUT connector.

3. Connect the bias voltage shutdown circuit. Most cryogenic detectors signal if they are warming up and should have the bias removed.

> **CAUTION** Detectors can be seriously damaged if this protection is ignored.

4. Connect the Preamplifier Energy Output to the DSPEC rear-panel INPUT connector. The cable used is normally 100-Ω coaxial cable with BNC type connectors.

5. Connect the data link from the DSPEC to the computer. The normal connection is Ethernet standard 50-Ω cable with BNC type connectors. Alternatively, the ORTEC Dual-Port Memory connection can be used. This connection requires that the ORTEC interface card be installed in your computer. ORTEC can supply the special cable, with 37-pin D-type connections.

6. Plug in the power and you are ready to take data!

If your detector has a pulsed-reset type preamplifier (ORTEC's "PLUS" Series), use BNC coaxial cable to connect the detector's INHIBIT or RESET output to the DSPEC rear-panel INHIBIT input.

3.2.2. Multiple Detectors

Each DSPEC processes the output of a single detector. If your lab has more than one detector, multiple systems can be set up as described above. It is usually far more convenient to control all the detectors from a single computer. This is easy to do with DSPEC-based systems. Using the Ethernet data link connection method, it is only necessary to chain all DSPECs together into a single LAN using BNC T-connectors at each DSPEC. (Don't forget the 50-Ω terminator required at the last DSPEC in the chain.) ORTEC software handles all the details of finding the detectors and allowing them to be named individually.

If the Dual-Port Memory data link has been chosen, it is still convenient to connect up to eight DSPEC controlled detectors (or many other combinations of ORTEC MCBs) to one computer. The only requirement is a special cable available from ORTEC, plus the standard software.

When more than one ORTEC MCB is connected to a single computer via the Dual-Port Memory Interface, each MCB in the system must have a unique MCB address. The MCB address for a DSPEC is set with a jumper inside the unit. To change the jumper setting do the following:

1. Remove the cover of the DSPEC as outlined above.

2. On the inside of the DSPEC, follow the ribbon cable connected to the Dual-Port Memory connector to the location at which it plugs into the circuit board. The DPM address jumper is located just behind the ribbon-cable connection point toward the rear of the DSPEC. The jumper consists of two parallel rows of eight right-angle pins.

3. Move the jumper to the desired address. Address 1 is represented by the two pins closest to the outside edge of the DSPEC. Address 8 is represented by the two pins closest to the center of the DSPEC. Figure ? shows the appropriate jumper location for each address.

4. Replace the DSPEC cover.

3.2.3. Multiple Computers

Adding multiple computers is as easy as adding multiple detectors. Using the LAN described above, multiple computers can control single or multiple detectors using standard Microsoft® operating systems and ORTEC software. Such systems are cost-effective, redundant, reliable, and easy to use.

4. THEORY OF OPERATION

4.1. What You Will Learn in this Chapter:

- Briefly review a high purity germanium (HPGe) gamma-ray spectroscopy system.
- Learn how a shaping amplifier controls the tradeoffs between energy resolution and data rate in an HPGe system.
- Compare analog and digital spectroscopy systems.

4.2. Review of the HPGe System

An HPGe detector is a semiconductor diode. Its operation is similar to that of a photodiode except that it is a few thousand times larger. The detector is operated under reverse bias (typically a few thousand volts) and at about the temperature of liquid nitrogen. An evacuated cryostat provides the clean vacuum and low temperature needed by the detector.

When the detector absorbs a gamma-ray photon, electron-hole pairs are created. The resulting charge pulse is integrated by a charge-sensitive preamplifier to produce a voltage step proportional to the energy of the gamma ray.

The signal produced by the HPGe detector is very small. A 1-MeV gamma-ray photon produces a signal of about one-tenth of a volt out of the preamplifier. This small signal must be amplified, filtered to produce the best signal-to-noise ratio, and measured to a precision of one part in 16,000 in a few microseconds. The amplitude measurement is used to increment the appropriate element (channel) of an array in data memory. The result of many such measurements is the spectrum of gamma-ray energies seen by the detector.

4.3. The Shaping Amplifier

The signal produced by the preamplifier must be further processed before being digitized. Three problems must be addressed:

1. The signals are not referenced to any particular voltage level (such as the system ground) but instead have a random DC component.

2. Improvements in signal-to-noise ratio can be made by appropriate filtering.

3. The signals are not matched to the range of typical analog-to-digital circuits (ADCs).

The classic solution to these problems is performed by a device called the Shaping Amplifier. The dc component is removed and low-frequency noise reduced by electronically differentiating (high-pass filtering) the signal. High-frequency noise is reduced by multiple integrations (low-

pass filtering). Variable gain allows matching the range of gamma-ray signals to the range of the ADC.

The shape and time duration of the shaping amplifier output pulse determine the electronic noise and maximum data rate of the system. Analog systems typically use a Gaussian shape (like the standard probability curve) or a modified triangular shape. These perform well, but the optimum shape has an exponential rising edge, a flattop of duration about equal to the detector rise time, and an exponentially falling edge with the same time constant as the rising edge. This shape is referred to as a *flattop cusp*. Obtaining this shape is very difficult with analog electronics.

There is no advantage to adjusting the time duration of the output pulse to a value longer than the minimum required. If the optimum duration is too long for the existing count rate, shorter values are used to allow higher rates accompanied by somewhat degraded energy resolution. Analog amplifiers typically allow two shapes and 5–10 durations (shaping times).

These systems have been in continuous development for over 30 years. Modern analog systems include special circuits called *baseline restorers* to maintain the reference voltage level, and *pile-up rejectors* that reject signals that occur so close to another signal that they are distorted.

4.4. Analog vs. Digital

If the output of the preamplifier is sampled at a very high rate by a fast ADC, digital signal processing can be used to perform all the functions performed by the analog shaping amplifier. The output of the "shaping amplifier" exists as a sequence of numbers instead of a voltage signal, but there is an exact equivalence to the analog system. The optimum shape and time duration are the same. The tradeoff of noise and data rate are the same. The differences, however, are many:

- The digital system can generate the ideal flattop cusp. The shape of the rising and falling edges (the "cuspiness") are adjustable to match the detector's noise characteristics or improve data rate. The width of the flattop is adjustable to match the rise time.

- Changing the shaping time in the analog system involves mechanical switches changing several components. Consequently, the number of shaping times available is limited. The shaping time in the digital system is determined by constants in the DSPEC computer code and can be changed at will. Many more values are available.

- The gain in analog systems depends on the value of electronic components and drifts with temperature and time. Digital systems do not exhibit such changes. As the DSPEC is almost totally digital, it drifts much less than analog systems.

● The reference baseline in analog systems varies with count rate. This causes peaks in the spectrum to shift and broaden. Digital systems have no such effects. Again, as most of the DSPEC is digital, such problems are vastly reduced.

5. SPECIFICATIONS

5.1. System Performance

DSPEC is unlike analog systems consisting of discrete components such as an amplifier or ADC. Whereas it is conventional in an analog system to specify the gain instability of the ADC in ppm/°C, in DSPEC many of these conventional functions are emulated in the digital world by firmware; therefore, such specifications are DSPEC SYSTEM specifications. Comparison should be made ONLY with SYSTEM specifications in the analog world.

System Gain   0.35 to 100, continuously computer-adjustable; minimum gain step is 1/85,000.

Coarse Gain   Computer-selectable as 1, 2, 5, 10, 20, 50, and 100.

Fine Gain   Computer-adjustable from 0.35 to 1.00.

Shaping-Time Constants

- **Rise and Fall**   32 rise and fall times ranging from 0.8 to 25.6 µs in 0.8-µs steps; computer-selectable.

- **Flattop**   5 flattop times ranging from 0.8 to 2.4 µs in 0.4-µs steps; computer selectable.

- **Cusp Parameter** (adjusts the curvature of the rise and fall time) 6 values that range from 0.5 to <1; computer-selectable.

Memory Segment Size   Computer-selectable as 16384, 8192, 4096, 2048, 1024, or 512 channels full scale.

Example of System Conversion Gain

Typical Sensitivities for ORTEC preamplifiers are:

Coaxial	150 mV/MeV
GLP	1.7 mV/keV
LO-AX	300 mV/MeV
IGLET	3 mV/keV
SLP	1.7 mV/keV

DSPEC converts the VOLTAGE output signal from a charge-sensitive preamplifier into a count in a memory location of the histogram memory. This conversion follows the relationship:

Memory Location = V_{in} × K × Total Gain × Total Channels

where:
   V_{in} is the step-height of the preamplifier signal in volts;
   K is a constant equal to (0.855)(total channels)/volt;
   Total Gain is the product of the fine and coarse gains;
   Total Channels is the total number of channels in the spectrum.

For example: At 16,384 channels, with the DSPEC set for a total gain of 2.5, a 200-mV preamplifier signal (corresponding to a 1.33-MeV gamma ray event in a coaxial detector) would be stored in:

Channel Location   = (0.2)(0.855)(2.5)(16,384)

                    = 7004.16

or channel 7004, which corresponds to an overall system conversion gain of 0.19 keV per channel.

System Conversion Gain   The overall gain of the system is appropriate for use with all types of Ge detectors.

- **Coaxial**   "GEM" (P-type) and "GAMMA-X" (N-type).

- **Low Energy**   "LO-AX" (low-energy coaxial), "GLP" (planar Ge), "IGLET" and "IGLET-X" (ultra-thin window planar Ge), and SLP (SiLi).

Dead-Time Correction   Extended live-time correction according to Gedcke–Hale method.[1] Accuracy: area of reference peak changes ≤±3% from 0 to 50,000 counts/s.

Linearity

- **Integral Nonlinearity**   <±0.025% over top 99.5% of spectrum, measured with a mixed source (^{55}Fe @ 5.9 keV to ^{88}Y @ 1836 keV).

- **Differential Nonlinearity**   <±1% (measured with a BNC pulser and ramp generator).

- **Temperature Coefficient**

- **Gain**   <50 ppm/°C. [Typically 30 ppm/°C.][2]

- **Offset**   <10 ppm/°C, referred to the input with a total gain greater than 50; rise and fall times of 16 µs, and flattop of 1.2 µs. (Similar to analog 6-µs shaping.)

Overload Recovery   At maximum gain, recovers to within 2% of rated output from X1000 overload in 2.5 non-overloaded pulse widths (measured using the InSight Virtual Oscilloscope).

Pulse Pile-Up Rejector   Automatically set threshold. Pulse-pair resolution typically 500 ns.

Automatic Pole-Zero   Computer-controlled. Can be set automatically or manually.

LLD   Digital lower level discriminator set in channels. Hard cutoff of data in channels below the LLD setting.

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[1]Ron Jenkins, R.W. Gould, and Dale Gedcke, *Quantitative X-Ray Spectrometry* (New York: Marcel Dekker, Inc.), 1981, pp 266–267.

[2]Note that this performance is superior to that of typical analog systems for which the specification is 70 ppm/°C (50 ppm for the amplifier in quadrature with 50 ppm for the ADC).

Data Memory   16384 channels of non-volatile data memory; $2^{31}-1$ (2 billion) counts per channel.

Presets   Multiple presets may be set on any or all of the following:

- **Statistical**   Allows setting the required statistical accuracy on a key peak (for example, stop counting when the activity of ^{60}Co is known to be better than 5%).

- **Real/Live Time**   In multiples of 1 s.

- **Region of Interest**   Peak count.

- **Region of Interest**   Integral count adjustable to maximum value of $2^{32}-1$ counts (4 billion).

- **Data Overflow**   Terminates acquisition when data in any channel exceeds $2^{31}-1$ counts.

Digital Spectrum Stabilizer (controlled via the computer)

- **Stabilization**   Peak centroid (zero and gain) channel 2 to 16384; stabilization window width (zero and gain) ±1 to ±256 channels.

- **Zero Correction Resolution**   ±64 channels with a minimum adjustment of 0.1 channel out of 16384 total channels.

- **Gain Correction Resolution**   0.00025% (from 99.5% to 100.5% in 4096 steps).

Bias Supply   0 to ±5000 V, continuously variable by potentiometer with an output current between 0 and 100 µA; or ±1500 V, continuously variable by a potentiometer with an output current between 0 and 500 µA. ON/OFF via computer control.

5.1.1. Indicators

High Voltage   Front-panel LEDs for bias polarity, HV ON/OFF, and bias supply overload.

Processor BUSY   Front-panel LED indicates microprocessor activity.

Stabilizer   Front-panel, 7-segment LEDs indicate gain and offset values of the Stabilizer.

- **GAIN**   –999 to +999.

- **OFFSET**   –999 to +999.

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Front-Panel LEDs

- **ACCEPT** Green LED indicates an input has been processed.

- **REJECT** Red LED indicates an input has been rejected.

- **DEADTIME** 7-segment LED indicates system dead time, 0 to 99%.

- **POWER** Front-panel LED indicates system power is ON.

5.1.2. Inputs and Outputs

INPUT Rear-panel BNC accepts preamplifier signals of either polarity, with rise times less than the selected Flattop Time setting and exponential decay time constant in the range of 40 µs to infinity (including transistor-reset and pulsed-optical reset preamplifiers). Input impedance >500 Ω, input is dc-coupled and protected to ±25 V.

ADC GATE Rear-panel BNC accepts slow positive NIM input; computer selectable as coincidence or anti-coincidence. ADC GATE must overlap and precede the flattop region by 0.5 µs, and extend beyond the flattop region by 0.5 µs. The InSight Oscilloscope allows easy alignment of the ADC GATE signal with the digital output pulse.

TRP INHIBIT Rear-panel BNC connector accepts reset signals from transistor-reset (TRP) or pulsed-optical (OF) preamplifiers. Positive NIM logic or TTL level can be used. Inhibit input initiates the protection against distortions caused by preamplifier reset. This includes turning off the baseline restorer, monitoring the overload recovery, and generating the pile-up reject and busy signals for the duration of the overload. These last two signals are used internally to provide information to the dead-time correction circuitry.

HIGH VOLTAGE OUTPUT Rear-panel SHV connector, 0–5 kV (Z_o = 2 MΩ). Computer-sensed.

REMOTE SHUTDOWN Rear-panel BNC is used to turn off the bias supply voltage in the event that the detector warms up. This remote shutdown is compatible with any ORTEC detector. The REMOTE SHUTDOWN must be connected to the Bias Shutdown of the detector, or the high voltage will not turn on. For use with a detector with an incompatible shutdown circuit, this feature can be defeated by placing a 100-, 50-, or 0-Ω terminator on the REMOTE SHUTDOWN input.

> **NOTE THESE REMOTE SHUTDOWN PROPERTIES:** An open circuit applied to the REMOTE SHUTDOWN input indicates a warm detector; therefore, the high voltage is turned off. Drawing a current of ≤ 500 µA from the REMOTE SHUTDOWN input indicates a cool detector; therefore, the high voltage can be turned on.

The REMOTE SHUTDOWN input is clamped at -700 mV by an internal clamp.

CHANGE SAMPLE   Rear-panel BNC provides TTL signal level to control an external device such as a sample changer. CHANGE SAMPLE can be set for either TTL level via software command.

SAMPLE READY   Rear-panel BNC accepts TTL signal level from an external device such as a sample changer. SAMPLE READY can be set to read either TTL level via software control.

PREAMP POWER   Rear-panel, 9-pin D connector; provides ±24 V and ±12 V for preamplifier power.

5.1.3. Controls

HIGH VOLTAGE BIAS   0–5 kV, rear-panel 10-turn precision potentiometer sets the value of the bias voltage.

5.1.4. Interface Connectors

DUAL-PORT MEMORY   Interface bus, rear-panel, 37-pin D connector.

RS-232-C   Rear-panel standard RS-23-C, 9-pin D connector, male, wired as DTE to run at 19.2K baud maximum, with modem control.

ETHERNET   Rear-panel BNC connector accepts IEEE 802.3 10BASE2 (thin coax).

5.2. Electrical and Mechanical

Dimensions   31 cm W × 35 cm D × 14 cm H (12–1/4 in. W × 13–3/4 in. D × 5–1/2 in. H).

Weight   7.7 kg (17 lbs).

Power Consumption   110 watts.

Operating Environment   0° to 50°C.

5.3. Prerequisites

5.3.1. Hardware

A IBM®-compatible PC capable of running Microsoft® Windows® for Workgroups 3.11 is required. Windows for Workgroups requires a 386 or higher processor, 8 megabytes (MB) of RAM, and a 100-MB hard disk. At least 12 MB of RAM are recommended. For Ethernet, an operating Windows for Workgroups network is required.

If running Windows 95 or Windows NT, the PC must have a 486 or higher processor, 12 MB of RAM, and a 500-MB hard disk.

The software is supplied on 3.5-inch diskettes.

5.3.2. Software

Windows for Workgroups 3.11, Windows 95, or Windows NT.

6. COMMANDS AND RESPONSES

Communication with a DSPEC consists of sending command records to the MCB and receiving response records from the MCB. Both command and response records consist of a sequence of printable ASCII characters followed by an ASCII carriage return. The single exception to this rule is the "#B" response record for the WRITE command, which contains binary integer numbers. All commands eventually respond with a percent response record (so named because it begins with an ASCII percent sign "%") which signifies the completion of the command. SHOW and STEP commands respond with a dollar response record (begins with an ASCII dollar sign "$") followed by a percent response record. The WRITE command can respond with multiple pound sign records (begins with an ASCII pound sign "#") but eventually completes by sending a percent response record. All other commands result in a single percent response record upon completion.

6.1. Command Records

Commands consist of a command header that may be followed by numeric parameter values. The header consists of a verb or a verb and noun separated by an underscore; or a verb, noun, and modifier, each separated by underscores. The verbs, nouns, and modifiers in the command header are mnemonic words such as the verb ENABLE or the noun OVERFLOW that relate to the function performed by the MCB when it executes the command. The first four letters of any word will always be enough to uniquely identify the word when composing commands for an MCB. For example, the command **ENABLE_OVERFLOW_PRESET** can be abbreviated to **ENAB_OVER_PRES**.

Numeric parameters follow the command header separated by one or more spaces. Specific commands require up to three parameters, separated by commas, which specify numeric quantities related to the operation of the MCB, such as live time or conversion gain. The command **SET_WINDOW 0,16384** has two parameters, 0 and 16384, which set the window of interest to start at channel 0 and continue for 16384 channels.

Some parameters listed in the command dictionary are considered optional and are distinguished from mandatory parameters by being surrounded by brackets in the command prototype line (e.g., **SET_WINDOW [start,length]**). Commands that have optional parameters may be sent to the MCB without the optional parameters, in which case the behavior will be changed as explained in the command description.

An optional checksum may be added to the end of any command sent to an MCB. The checksum is a 1-byte unsigned integer sum of all of the characters in a command, treated as unsigned integers, up to and including the comma or space(s) that separates the checksum from the command. The checksum simply appears as an extra parameter added to the end of the command parameter list. For commands that do not normally have parameters, the checksum appears as the

only parameter separated from the header by one or more spaces. All optional parameters must be included in a command if a checksum.

is to be provided so that the checksum is not mistaken by the MCB as a parameter. For example, the SET_WINDOW command must include the two optional parameters, start and length, if the checksum is provided (e.g., **SET_WINDOW 0,16384,209**).

6.2. Percent Response Records

The MCB responds to all commands with a percent response record that signifies the completion of the command. Percent response records contain two error code numbers and a 1-byte checksum as follows:

<div align="center">

%aaabbbccc<CR>

</div>

where % represents the ASCII % character, **aaa** represents the macro error code, **bbb** represents the micro error code, **ccc** represents the checksum and <CR> represents the ASCII carriage return character signifying the end of the record. The macro error code represents the general class of error with 0 meaning no error, and the micro error code represents the sub-class of error with 0 meaning no error. Following is a list of all percent responses for the DSPEC.

Unconditional Success:

%000000069<CR>	No errors detected. Command executed as specified.
%000005074<CR>	Device already started or stopped. The START or STOP command was ignored.
%000006075<CR>	Device preset already exceeded. The START command was ignored.
%000016076<CR>	START requested but amplifier not Pole-Zeroed since last power-up. START was attempted anyway.
%000032074<CR>	START requested but High Voltage not enabled START was attempted anyway.
%000064079<CR>	Specified parameter was rounded to the closest legal value.

Note that the above responses can be combined to indicate a combination of warnings such as:

%000048081<CR>	Amplifier was not Pole-Zeroed nor was High Voltage enabled. The START was attempted anyway.
%000037079<CR>	Device already started and High Voltage not enabled. The command was ignored.
%000053077<CR>	Device already started, High Voltage not enabled and amplifier was not pole-zeroed. The command was ignored.

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%000038080<CR>	Device preset already exceeded and High Voltage not enabled. The command was ignored.
%000054078<CR>	Device preset already exceeded, High Voltage not enabled and amplifier was not pole-zeroed. The command was ignored.

Power-Up Alert:	Power-up just occurred and the selftest results are:
%001000070<CR>	All power-up selftest passed.
%003000072<CR>	Battery backed-up data lost.

Command Syntax Errors:	
%129001082<CR>	Invalid command verb.
%129002083<CR>	Invalid command noun.
%129003084<CR>	Invalid command verb and noun.
%129004085<CR>	Invalid command modifier.
%129005086<CR>	Invalid command verb and modifier.
%129006087<CR>	Invalid command noun and modifier.
%129007088<CR>	Invalid command verb, noun, and modifier.
%129132087<CR>	Invalid command (verb, noun, and modifier valid but not together).

Communication Errors:	
%130001074<CR>	Serial line buffer overrun.
%130002075<CR>	Serial line parity error.
%130003076<CR>	Serial line buffer overrun and parity error.
%130004077<CR>	Serial line framing error.
%130005078<CR>	Serial line buffer overrun and framing error.
%130006079<CR>	Serial line parity error and framing error.
%130007080<CR>	Serial line buffer overrun, parity error, and framing error.
%130008081<CR>	Serial line break detected.
%130128084<CR>	Command checksum incorrect (only when optional checksum provided).
%130129085<CR>	Command (or WRITE handshake) record too long.
%130131078<CR>	WRITE command aborted by "HA" handshake.
%130132079<CR>	WRITE command aborted by timeout.
%130133080<CR>	WRITE command aborted by invalid handshake.

Execution Errors:	
%131128085<CR>	Invalid 1st command parameter.
%131129086<CR>	Invalid 2nd command parameter.
%131130078<CR>	Invalid 3rd command parameter.
%131132080<CR>	Invalid number of command parameters.
%131134082<CR>	Invalid device or segment selected.

%131135083<CR>	Command not allowed while acquisition in progress.
%131136084<CR>	Command not allowed in current mode of operation.
%131137085<CR>	Hardware failure detected while processing command.

6.3. Dollar Response Records

SHOW and STEP commands respond with a single dollar response record followed immediately by a percent response record. All valid dollar response records for each command are listed in the command dictionary.

The following list provides the general form of each dollar response record for an MCB. In this list, lower case letters represent numeric values. The letters "**ccc**" always represent an 8-bit unsigned checksum of all characters on the record up to but not including the checksum characters, and **<CR>** represents the ASCII carriage return character.

$Axxxccc<CR>	xxx is a single 8-bit unsigned number.
$Cxxxxxccc<CR>	xxxxx is a single 16-bit unsigned number.
$Dxxxxxyyyyyccc<CR>	xxxxx and yyyyy are 16-bit unsigned numbers.
$Exxxxxccc<CR>	xxxxx is a single 16-bit alarm mask.
$Fssss...<CR>	ssss... is a variable length ASCII character sequence (no checksum is sent with this record).
$Gxxxxxxxxxccc<CR>	xxxxxxxxx is a single 32-bit unsigned number.
$IT<CR>	True response to a SHOW command (no checksum).
$IF<CR>	False response to a SHOW command (no checksum).
$Jxxxxxyyyyy...ccc<CR>	Response to SHOW_CONFIGURATION command.
$Mxxxxxxxxxx...ccc<CR>	Response to SHOW_STATUS command.
$Nxxxyyyzzzccc<CR>	xxx, yyy, and zzz are 8-bit unsigned numbers.

6.4. Command Catalog

This section lists each command with a description of its operation. The descriptions include a list of any unusual responses that may result. As described in previous sections, the usual response from a command is a **%000000069<CR>** response, which represents a macro error code of 0 and a micro error code of 0 (no errors).

All execution error responses, if any, are listed for each command. Though syntax and communication error responses may result from any command, in practice, these error responses rarely occur on systems with reliable communication hardware running debugged software. Refer to Section 6.2 for information about error responses.

In the following catalog, the commands are listed in alphabetical order, each starting with a command prototype line. Upper-case letters, numeric digits, blank spaces, and special symbols such as the underscore (_) and comma (,) in the prototype line are *literal text to be sent to the MCB exactly as they appear*. Lower-case letters in the prototype line represent numeric values as described in the accompanying text and should not be sent literally to the MCB but should be *replaced by an appropriate numeric value*. Lower-case letters enclosed in quotes represent *alphanumeric character strings* rather than numerical values. Items in the command prototype that are surrounded by square brackets "[...]" are optional items and are not always required.

In this section the term **<CR>** represents the ASCII carriage return character, decimal value 13, and the character "_" represents the ASCII underscore character, decimal value 95.

CLEAR

The channels of spectral data in the window of interest (see SET_WINDOW command) for the currently selected device (see SET_DEVICE command) are set to zero. The live time and true time counters for the currently selected device are also set to zero. This command is equivalent to the combination of CLEAR_COUNTERS and CLEAR_DATA commands.

CLEAR_ALL

This command is equivalent to the combination of CLEAR_COUNTERS, CLEAR_DATA, CLEAR_PRESETS, and CLEAR_ROI commands.
Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in progress. No action was taken.

CLEAR_COUNTERS

The live time and true time counters for the currently selected device (see SET_DEVICE command) are set to zero.

CLEAR_DATA

The channels of spectral data in the window of interest (see SET_WINDOW command) for the currently selected device (see SET_DEVICE command) are set to zero. The ROI flags are not changed, nor are the presets changed.

CLEAR_PRESETS

The live time, true time, ROI integral, ROI peak, and overflow presets are all set to zero (disabled) for the currently selected device (see SET_DEVICE command).
Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in progress. No action was taken.

CLEAR_ROI

The region-of-interest flags for the channels in the window of interest (see SET_WINDOW command) in the currently selected device (see SET_DEVICE command) are cleared.
Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in progress. No action was taken.

CLOSE_FILE "filename"

Completes download of file to RAM Disk in the MCB. See OPEN_FILE and WRITE_FILE. This command may also be used to terminate a download to the FLASH without reprogramming the FLASH.

CLOSE_FILE_FLASH crc

Completes download of FLASH data. Crc is the CRC checksum of the data which was downloaded. See OPEN_FILE_FLASH and WRITE_FILE_FLASH.
Execution Errors:

%131132080<CR>   Invalid number of command parameters.

COMPUTER

Prepares the serial line for communication with a computer. In computer mode, text sent to the DSPEC does not echo back to the host, and response records sent to the host by the DSPEC are terminated only with a carriage return (no accompanying line feed). This command has no effect when sent via the mailbox. See also TERMINAL.

DELETE_FILE "filename.ext"

Removes the specified file from the RAM Disk. This is not normally used.
Execution Errors:

%131128085<CR>   Filename required.
%131137085<CR>   Hardware failure.

DISABLE_ALARM

Ends the transmission of alarm responses when a device stops counting. Alarm responses are disabled for the serial line and the mailbox communication paths independently. See also ENABLE_ALARM and SHOW_ALARM.

DISABLE_BLRE_AUTOMATIC

Disables the automatic determination of baseline restorer time constant. See also ENABLE_BLRE_AUTOMATIC, SET_BLRE, and SHOW_BLRE.

DISABLE_GAIN_STABILIZATION

Stops stabilization of the gain peak while data is being acquired. The gain stabilization adjustment is held at its current value until either gain stabilization is reenabled with the ENABLE_GAIN_STABILIZATION command or reinitialized with the INITIALIZE_GAIN_STABILIZATION, SET_GAIN_PEAK or SET_GAIN_WIDTH command. See also SHOW_GAIN_STABILIZATION.

DISABLE_HV

Turns off the high-voltage output on the rear panel of the DSPEC. Note that with no external load on the high-voltage output it takes approximately 60 seconds for the high voltage to drop to zero volts. See the section on the bias supply for more information about the high-voltage output. See also ENABLE_HV and SHOW_HV.

DISABLE_OVERFLOW_PRESET

Disables the overflow preset for the currently selected device (see SET_DEVICE command). Channels that receive a count when they contain 2147483647 counts, the maximum number of counts, will roll over to zero counts if the overflow preset is disabled. See also ENABLE_OVERFLOW_PRESET and SHOW_OVERFLOW_PRESET.

DISABLE_PZ_AUTOMATIC

Disables the automatic pole zero mode. See also ENABLE_PZ_AUTOMATIC.

DISABLE_REMOTE

Disables the recognition of commands on the alternate communication paths. If this command is sent to the DSPEC via the mailbox communication path, it disables command recognition on the serial path. If this command is sent via the serial path, it disables command recognition on the mailbox communication path. See also ENABLE_REMOTE and SHOW_REMOTE.

DISABLE_THRESHOLD_AUTOMATIC

Disables automatic positive and negative threshold determination. See ENABLE_THRESHOLD_AUTOMATIC, SET_THRESHOLD_NEGATIVE, and SET_THRESHOLD_POSITIVE.

DISABLE_THRESHOLD_SAMPLE

Allows InSight Oscilloscope to free-run without a trigger. See ENABLE_THRESHOLD_SAMPLE and SET_THRESHOLD_SAMPLE.

DISABLE_ZERO_STABILIZATION

Stops stabilization of the zero peak while data is being acquired. The zero stabilization adjustment is held at its current value until either zero stabilization is reenabled with the

ENABLE_ZERO_STABILIZATION command or reinitialized with the INITIALIZE_ZERO_STABILIZATION, SET_ZERO_CHANNEL or SET_ZERO_WIDTH commands. See also SHOW_ZERO_STABILIZATION.

ENABLE_ALARM

Begins the transmission of alarm responses, $E records, when an input stops counting. A $E response record will be transmitted only when no host commands are being processed (after a % response from a previous command and before another command is sent). Alarm responses are enabled for the serial line and the mailbox communication paths independently. If the command is sent to the MCB via the mailbox, then alarms will be sent to the mailbox. If the command is sent via the serial line, then alarms will be sent via the serial line. Alarms can be enabled for both communication paths at the same time. See also DISABLE_ALARM and SHOW_ALARM.

ENABLE_BLRE_AUTOMATIC

Enables the automatic determination of baseline restorer time constant. See also DISABLE_BLRE_AUTO, SHOW_BLRE, and SET_BLRE.

ENABLE_GAIN_STABILIZATION

Enables the stabilization of the gain peak by the previously selected method, either Gauss mode or point mode (see SET_MODE_GAUSS and SET_MODE_POINT). Spectrum stabilization is available only on device 1. See also DISABLE_GAIN_STABILIZATION, SHOW_GAIN_STABILIZATION, and INITIALIZE_GAIN_STABILIZATION.

ENABLE_HV

Turns on the high-voltage output on the rear panel of the DSPEC. The voltage selected on the rear panel will be present on the high-voltage output within 60 seconds after this command is received unless the output is overloaded or the output is shut down by the high-voltage shutdown. See also DISABLE_HV and SHOW_HV.
Execution Errors:

%131137085<CR>   The high voltage could not be enabled due to a high voltage shutdown condition.

ENABLE_OVERFLOW_PRESET

Enables the overflow preset for the currently selected device (see SET_DEVICE command). Channels that receive a count when they contain 2147483647 counts, the maximum number of counts, will stop the acquisition for that channel's device if the overflow preset is enabled. The channel that caused the preset to complete will contain 2147483647 counts. An alarm response record will be sent to the host if alarms are enabled for the device whose acquisition is stopped (see ENABLE_ALARM command). See also DISABLE_OVERFLOW_PRESET and SHOW_OVERFLOW_PRESET commands.

ENABLE_PZ_AUTOMATIC
Enables the automatic pole zero mode. See also DISABLE_PZ_AUTO and SHOW_PZ_AUTO.

ENABLE_REMOTE
Enables the recognition of commands on the alternate communication path. If this command is sent to the DSPEC via the mailbox it enables command recognition on the serial line. If this command is sent via the serial line it enables command recognition in the mailbox.

ENABLE_THRESHOLD_AUTOMATIC
Enables automatic determination of the positive and negative thresholds. See also DISABLE_THRESHOLD_AUTO, SHOW_THRESHOLD_AUTO, SET_THRESHOLD_NEGATIVE, and SET_THRESHOLD_POSITIVE.

ENABLE_THRESHOLD_SAMPLE
Enables the trigger threshold in InSight mode. See also DISABLE_THRESHOLD_SAMPLE, SET_THRESHOLD_SAMPLE, and SHOW_THRESHOLD_SAMPLE.

ENABLE_ZERO_STABILIZATION
Enables the stabilization of the zero peak by the previously selected method, either Gauss mode or point mode (see SET_MODE_GAUSS and SET_MODE_POINT). See also DISABLE_ZERO_STABILIZATION, SHOW_ZERO_STABILIZATION, and INITIALIZE_ZERO_STABILIZATION.

INITIALIZE_GAIN_STABILIZATION
Resets the gain peak stabilization adjustment to unity (no adjustment). This value is reported as 2048 by the SHOW_GAIN_ADJUSTMENT command. See also SET_GAIN_ADJUSTMENT, ENABLE_GAIN_STABILIZATION, and DISABLE_GAIN_STABILIZATION.

INITIALIZE_ZERO_STABILIZATION
Resets the zero peak stabilization adjustment to unity (no adjustment). This value is reported as 2048 by the SHOW_ZERO_ADJUSTMENT command. See also SET_ZERO_ADJUSTMENT, ENABLE_ZERO_STABILIZATION, and DISABLE_ZERO_STABILIZATION.

OPEN_FILE "filename.ext"
A filename is needed to open a file. Begins the download of a file to the RAM Disk by opening filename.ext on the RAM Disk. See WRITE_FILE and CLOSE_FILE.

OPEN_FILE_FLASH

    Begins the download of a new FLASH (ROM DISK). This command removes all files on the RAM Disk except **autoexec.bat** and **ini83905.exe** to make room for **ROMDISK.ABS**. It also stops all acquisitions which are in progress. See WRITE_FILE_FLASH and CLOSE_FILE_FLASH.

PAUSE_INPUT [input-num]

    Waits for the next transition on the Sample Ready input or the beginning of the next command before responding with a % response record. If input-num is present, it must be 0. This parameter is provided for compatibility with other ORTEC modules.
    Responses:
    %000000069<CR>   Transition on Sample Ready input occurred.
    %130131041<CR>   Command was aborted by beginning of next command.

PAUSE_INPUT_HIGH [input-num]

    Waits for a high level to be detected on the Sample Ready input or for the beginning of the next command before responding with a % response record. The input level must remain high until the MCB responds; otherwise, it may not be detected. If input-num is provided, it must be zero. This parameter is provided for compatibility with other ORTEC modules.
    Responses:
    %000000069<CR>   High level was detected on the input.
    %130131041<CR>   Command was aborted by beginning of next command.

PAUSE_INPUT_LOW [input-num]

    Waits for a low level to be detected on the Sample Ready input or for the beginning of the next command before responding with a % response record. The input level must remain low until the MCB responds; otherwise, it may not be detected. If input-num is provided, it must be zero. This parameter is provided for compatibility with other ORTEC modules.
    Responses:
    %000000069<CR>   Low level was detected on the input.
    %130131041<CR>   Command was aborted by beginning of next command.

REBOOT

    Reboots the MCB. This command is not normally used and may terminate communication. MCB returns a 000130.

RESET

    Resets the DSPEC to the state just after power is applied. This command responds with a % response that indicates power-up just occurred.

RESET_DSP value

Resets all or part of the digital signal processor. A value of 0 resets the entire processor, 1 resets the programmable logic only, and 2 resets the digital signal processor (DSP) chips. This command is only used for test purposes.

RESET_REMOTE

Resets any UART error conditions when sent to the DSPEC via the mailbox. Resets mailbox communications when sent to the DSPEC via the serial communications path.

SAMPLE

Sending this command causes another waveform to be captured in InSight mode. This command is invalid when not in InSight mode.
Execution Errors:
%131136084<CR> Command not allowed in current mode of operation.

SET_ADC_HOLDOFF holdoff

Prevents data acquisition from monopolizing the microprocessor, so the microprocessor can perform other tasks such as communication with the host computer. Holdoff can be from 0–65535. This command is not normally used. See also SHOW_ADC_HOLDOFF.

SET_BLRE baseline

This sets the baseline restorer time constant to the value baseline. Baseline is in microseconds with a range from 10–100. The specified value is only used if automatic baseline restorer mode is disabled. See also ENABLE_BLRE, DISABLE_BLRE, and SHOW_BLRE.
Execution Warnings:
%000064079<CR> Value was rounded to the closest legal value.

SET_CONFIGURATION_UART "bbbbbpds"

A syntax error. See also SHOW_CONFIGURATION_UART. Sets the baud rate, parity, number of data bits and the number of stop bits for serial port communication. The parameter is an ASCII string which specifies the settings where bbbbb is the baud rate with leading zeros if necessary, p is replaced with O, E, or N to indicate odd, even, or no parity, d is replaced with the number of data bits (5–8), and s is replaced with the number of stop bits (1–2). For example SET_CONFIG_UART "09600N81" sets the baud rate to 9600, disables parity checking, sets the number of bits to 8 and the number of stop bits to 1.

SET_CORRECTION_FLAT flat

This sets the flattop correction to flat. The flattop correction is normally determined with the OPTIMIZE command. See also SHOW_CORRECTION_FLAT.

SET_DATA [start, chans],value
>   If the optional start and chans parameters are included in this command, the range of channels specified by start and chans is loaded with value. Sets all channels of spectral data in the window of interest (see SET_WINDOW command) for the currently selected device (see SET_DEVICE command) to the specified count. ROI flags are not affected.

SET_DATE day,month,year
>   Sets the date stored in the battery backed-up system clock to the specified values. Day can be any value from 1–31; month any value from 1–12; and year any value from 0–99. The current date and time are stored for a device when an acquisition is started. See also SHOW_DATE, SET_TIME, and SHOW_TIME.

SET_DATE_START day,month,year
>   Sets the start date for the currently selected device (see SET_DEVICE command) to the specified values. Normally the start date and time are set automatically whenever a device is started with the START command. See also SHOW_DATE_START, SET_TIME_START, and SHOW_TIME_START.

SET_DCREST value
>   This controls the speed of the analog DC restorer. The smaller the value, which must be between 0 and 4095, the slower the DC restorer operates. The default setting, 2000, is normally sufficient. See also SHOW_DCREST.

SET_DEBUG level
>   Sets the debug level to level, which must be between 0 and 255. Setting level to a non-zero value causes debugging information to be transmitted to the serial port. See also SHOW_DEBUG.

SET_DELAY_COLLECTION value
>   Controls the pile-up rejector by setting a width threshold such that if a fast channel discriminator pulse is wider than value, the pulse is rejected. This portion of the pile-up rejector rejects pulses that are too close together to be detected separately by the fast channel. Value is in microseconds with a range from 0.250–1.6 in steps of 0.05. See also SHOW_DELAY_COLLECTION.

SET_DELAY_SAMPLE num
>   Delays the waveform collected in InSight mode by num points. Num must be between 0 and 65535. See also SHOW_DELAY_SAMPLE.

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SET_DEVICE device
>   This command is provided for compatibility with the Model 919. Only device number 1 is valid for a DSPEC.

SET_DSP num, command,value
>   This is a debugging command that can be used to directly modify parameters within the digital signal processor chips. Num (1–4) selects the DSP chip that will receive the command; command (0–7) indicates which parameter will be changed; and value (–8388608 to 8388607 or –1.0 to 1.0) specifies the new value as either a 24-bit signed integer or a floating point value. See also SHOW_DSP.
>   Execution Errors:

%131132080<CR>	There are three parameters.
%131128085<CR>	The first parameter is incorrect.
%131129086<CR>	The second parameter is incorrect.
%131130078<CR>	The third parameter is incorrect.

SET_GAIN_ADJUSTMENT value
>   Sets the gain stabilization adjustment to an arbitrary value from –65535 to 65535. This adjustment is usually made only by the gain stabilizer, and reset to 0 with the INITIALIZE_GAIN_STABILIZATION command. See also SHOW_GAIN_ADJUSTMENT.
>   Execution Errors:

%131134082<CR>	The command was attempted when the currently selected device was other than device 1.

SET_GAIN_CHANNEL chan
>   Sets the center channel for the stabilizer gain peak. If a gain channel is chosen such that the beginning channel or ending channel would be below channel 0 or above the maximum channel as determined by the conversion gain, the gain peak width is reduced until the peak fits the device boundaries. A gain channel and width must be set before gain stabilization can be enabled.
>   Execution Errors:

%131128085<CR>	The specified channel number would create a peak that was less than the minimum width (3 channels) or would be outside the device's range.
%131136084<CR>	The command was attempted while gain stabilization was enabled.

SET_GAIN_COARSE num
>   This sets the coarse gain to num, which must be one of the following: 1, 2, 5, 10, 20, 50, 100. See also SHOW_GAIN_COARSE.

SET_GAIN_CONVERSION chans

Sets the conversion gain. The conversion gain defines the number of channels within the device that will used for spectral data. This has the effect of altering the resolution of the ADC from 14 bits (conversion gain = 16384) to 9 bits (conversion gain = 512) for the device. See also SHOW_GAIN_CONVERSION.

<u>Legal Commands:</u>

SET_GAIN_CONVERSION 0<CR>	Conv. gain set to default (16384).
SET_GAIN_CONVERSION 512<CR>	Conv. gain set to 512 channels.
SET_GAIN_CONVERSION 1024<CR>	Conv. gain set to 1024 channels.
SET_GAIN_CONVERSION 2048<CR>	Conv. gain set to 2048 channels.
SET_GAIN_CONVERSION 4096<CR>	Conv. gain set to 4096 channels.
SET_GAIN_CONVERSION 8192<CR>	Conv. gain set to 8192 channels.
SET_GAIN_CONVERSION 16384<CR>	Conv. gain set to 16384 channels.

SET_GAIN_FINE value

This sets the fine gain to value. Value is a floating point value from 0–0.999995. See also SHOW_GAIN_FINE.

SET_GAIN_PRESET count

Sets the Gauss mode stabilization preset for the gain peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the gain peak before the gain is evaluated by the stabilizer and potentially adjusted. See also SHOW_GAIN_PRESET.

SET_GAIN_WIDTH chans

Sets the width in channels for the stabilizer gain peak. The gain width must be chosen such that the beginning channel is no lower than channel 0 and the ending channel is no higher than the maximum channel as determined by the conversion gain. The gain channel and width must be set before gain stabilization can be enabled. The absolute minimum width for the gain peak is 3 channels, and the absolute maximum width for the gain peak is 256 channels in Gauss mode. In point mode there is no maximum peak width, though the chosen width must allow the peak to fit within the device's channel limits as stated above. See also SHOW_GAIN_WIDTH, SET_GAIN_CHANNEL and SHOW_GAIN_CHANNEL.

<u>Execution Errors:</u>

%131128085<CR>	The specified number of channels would create a peak that was less than the minimum (3 channel) width or would be outside the device's range.
%131136084<CR>	The command was attempted while gain stabilization was enabled.

SET_GATE_ANTICOINCIDENT
Causes the DSPEC to expect the ADC gate input signal in anticoincident mode. See also SET_GATE_OFF, SET_GATE_COINCIDENT, and SHOW_GATE.

SET_GATE_COINCIDENT
Causes the DSPEC to expect the ADC gate input signal in coincident mode. See also SET_GATE_OFF, SET_GATE_ANTICOINCIDENT, and SHOW_GATE.

SET_GATE_OFF
Causes the DSPEC to ignore the state of the ADC gate input signal. See the section on the ADC gate input for more information. See also SET_GATE_COINCIDENT, SET_GATE_ANTICOINCIDENT, and SHOW_GATE.

SET_GATE_SYNC
Debugging command that causes the gate input to become a trigger output in InSight mode.

SET_INTEGRAL_PRESET count
Sets the ROI integral preset to the specified count. During data acquisition when the sum of the counts contained in the channels that have the ROI flag set reaches the integral preset count, the preset is complete and the acquisition is stopped. The actual number of counts in the ROI integral may exceed the preset value by up to 512 counts due to the pipelined architecture of the DSPEC. Setting an integral preset to 0 counts disables the preset. The integral preset may be set to from 0 (disabled) to 4294967295 counts. See also CLEAR_PRESETS and SHOW_INTEGRAL_PRESET.
Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_LIVE ticks
Sets the live-time counter to the specified number of ticks. The number represents live time in units of 20 milliseconds (50 ticks per second). Normally this value is set by the DSPEC during data acquisition. See also CLEAR_COUNTERS and SHOW_LIVE.
Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_LIVE_PRESET ticks
Sets the live-time preset to the specified number of ticks. During data acquisition when the live-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. Setting a live-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_LIVE_PRESET.

Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_LLD chan

Sets the lower level discriminator to chan, which must be between 0 and 16383. See also SHOW_LLD.

SET_LOCATION_SAMPLE num

Sets which location in the digital filter will be displayed in InSight mode. Normally, num is set to 3 to sample the output of the digital filter. Setting num to 0–2 samples intermediate points in the filter for debugging purposes. See also SHOW_LOCATION_SAMPLE.

SET_MODE_GAUSS

Sets the method of stabilization for both gain and zero stabilization peaks to Gauss mode. The maximum peak width is 256 channels in Gauss mode, so that either the gain or zero (or both) peak(s) may be reduced in width. See also SET_MODE_POINT.

SET_MODE_PHA

The mode is set to PHA.

SET_MODE_POINT

Sets the method of stabilization for both gain and zero stabilization peaks to point mode. See also SET_MODE_GAUSS.

SET_MODE_TEST value

Sets the test mode to value. Value = 0 exits test mode, 1 is ADC test mode, and 2 is DSP test mode.

SET_MODE_SAMPLE

Starts InSight Oscilloscope mode.

SET_NETWORK_ID id

Establishes a new network identifier which is to be used by the MCB for ethernet communication. The setting only takes effect after a REBOOT. id should be no more than 15 characters. See also SHOW_NETWORK_ID.

SET_NETWORK_ADDRESS [company,]addr

Establishes the Ethernet address used by the 83905 Ethernet chip. The company portion of the address is usually not included causing the ORTEC ID (41020) to be used. The addr portion should not be the same on any two MCBs connected to the network. This address is

assigned at the factory and should normally never be changed. See also SHOW_
NETWORK_ADDRESS.
Execution Errors:

%131128085<CR>   The number must be between 0 and 16777215.

SET_OUTPUT port, value

This sends the value to the port. The port number can be 0 or 1; 0 is the change sample
output and 1 is the serial port. Value must be between 0 and 255. See also SHOW_OUTPUT.

SET_OUTPUT_HIGH [output-num]

Sets the Change Sample output to a high level. If output-num is provided, it must be zero.
This parameter is provided for compatibility with other ORTEC modules.

SET_OUTPUT_LOW [output-num]

Sets the Change Sample output to a low level. If output-num is provided, it must be zero.
This parameter is provided for compatibility with other ORTEC modules.

SET_PAGE num

Debugging command that maps the DPM to page num; num can range from 1–4. See also
SHOW_PAGE.

SET_PEAK_DELAY value

Sets the peak detect delay parameter to value. Value can range from 0–7; it is normally set
to 2. See also SHOW_PEAK_DELAY.

SET_PEAK_LENGTH value

Sets the peak detect length parameter to value. Value can range from 0–7; it is normally set
to 3. See also SHOW_PEAK_LENGTH.

SET_PEAK_PRESET count

Sets the ROI peak preset to the specified count. During data acquisition when the contents of
any channel of a device that has the ROI flag set reaches the peak preset count, the preset is
complete and the acquisition is stopped. The actual number of counts in the ROI peak may
exceed the preset value by a small number of counts due to the pipelined architecture of the
DSPEC. Setting a peak preset to 0 counts disables the preset. The peak preset may be set to
from 0 (disabled) to 2147483647 counts. See also CLEAR_PRESETS and
SHOW_PEAK_PRESET.
Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in
                            progress. No action was taken.

SET_PZ num

This sets the pole zero to num, which must be between 0 and 4095. See also ENABLE
_PZ_AUTO, SHOW_PZ, and DISABLE_PZ_AUTO.

SET_PZ_DELAY num

Sets the time in 400-ns to wait after the peak of a pulse before sampling the baseline to
evaluate the quality of the PZ adjustment when automatic pole-zero adjustment is in
progress. Num should be between 0 and 200. Normally, the parameter is selected
automatically by the DSPEC, based on the rise time setting. See also SHOW_PZ_DELAY.
Execution Errors:

%131128085<CR>   The number is incorrect.
%131132080<CR>   A number must be included.

SET_RADIX_BINARY

This command is provided for compatibility with other ORTEC MCBs. It specifies that
binary records are to be used by the WRITE command for sending spectral data to the host
computer via the serial line. This is the only radix supported by the DSPEC.

SET_ROI start_chan,number_of_chans

Sets the ROI flags for the specified channels. This command can be used multiple times to
set ROI flags without affecting previously set flags. ROI flags specify channels within a
device that are considered for ROI integral and ROI peak presets.

SET_ROI_SAMPLE num

Selects which controls signals are displayed as an ROI on the captured waveform. The
selected signals are logically anded and if the result is not zero, the ROI bit is turned on. The
following signals may be selected with the associated bit.

Bit 0:   Pile-up Reject
Bit 1:   Negative Baseline Threshold
Bit 2:   Baseline Restorer Gate
Bit 3:   Positive Baseline Threshold
Bit 4:   Busy
Bit 5:   Gate
Bit 6:   Reserved
Bit 7:   Peak Detect
Bit 8:   Reserved

SET_ROI_UNCERTAINTY start, chans

Sets the region to be used for the uncertainty preset calculation. See also
SHOW_ROI_UNCERTAINTY.

SET_SEGMENT number

Provided for compatibility with Model 918-type MCBs. This command has no effect for the DSPEC. The segment number may be any value from 1 through 16.

Execution Errors:

%131128085<CR>   The specified segment number was either zero or a value greater than 16.

SET_SHAP_CUSP value

Sets the cusp factor to value. Valid values are 0.2–1.0. See also SHOW_SHAP_CUSP.

SET_SHAP_FLAT value

Sets the width of the flattop to value. Value is in microseconds, ranging from 0.8–2.0 in steps of 0.4. See also SHOW_SHAP_FLAT.

SET_SHAP_RISE value

Sets the risetime to value. Value is in microseconds, ranging from 0.8–25.6 in steps of 0.8. See also SHOW_SHAP_RISE.

SET_SNUM "serialnumber"

Stores the serial number of the unit in non-volatile memory inside the MCB. The serial number must be 8 characters or less. See also SHOW_SNUM.

SET_THRESHOLD_NEGATIVE value

Sets the negative threshold to value. The negative threshold is normally set automatically by the DSPEC. See also ENABLE_THRESHOLD_AUTOMATIC and SHOW_THRESHOLD_NEGATIVE.

SET_THRESHOLD_POSITIVE value

Sets the positive threshold to value. The positive threshold is normally set automatically by the DSPEC. See also ENABLE_THRESHOLD_AUTOMATIC and SHOW_THRESHOLD_POSITIVE.

SET_THRESHOLD_SAMPLE value

Sets the sample threshold to value. In InSight mode the sample threshold is used as the trigger level. See also SHOW_THRESHOLD_SAMPLE.

SET_TIME hour,min,sec

Sets the time stored in the battery backed-up system clock to the specified values. hour can be any value from 0–23; min and sec can be any value from 0–59. The current date and time are stored for a device when an acquisition is started. See also SHOW_TIME, SET_DATE, SHOW_DATE, SET_TIME_START, and SHOW_TIME_START.

Execution Errors:

%131137085<CR>   The time could not be set due to a hardware malfunction. Hardware service may be required.

SET_TIME_START hour,min,sec

Sets the start time to the specified values. Normally the start date and time are set automatically whenever a device is started with the START command. See also SHOW_TIME_START, SET_DATE_START, SHOW_DATE_START, SET_DATE, and SET_TIME.

SET_TRUE ticks

Sets the true-time counter to the specified number of ticks. The number represents true time in units of 20 milliseconds (50 ticks per second). Normally this value is set by the DSPEC during data acquisition. See also CLEAR_COUNTERS and SHOW_TRUE.

Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_TRUE_PRESET ticks

Sets the true-time preset to the specified number of ticks. During data acquisition when the true-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. Setting a true-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_TRUE_PRESET.

Execution Errors:

%131135083<CR>   The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_UNCERTAINTY_PRESET percent

Sets the uncertainty preset to the specified value in percent. percent is a floating point value from 0–99.9999. See also SHOW_UNCERTAINTY_PRESET.

Execution Errors

%131128085<CR>   The value is incorrect.
%131132080<CR>   A value must be included.

SET_WIDTH bytes

Sets the maximum number of bytes that may be sent to the host computer by the WRITE command.

Legal Commands:

SET_WIDTH 0<CR>	Width set to default (512).
SET_WIDTH 12<CR>	Width set to minimum value of 12 bytes.
...	**...**
SET_WIDTH 512<CR>	Width set to maximum value of 512 bytes.

SET_WINDOW [start, length]

Sets the window of interest to the specified start channel and number of channels. The channels of spectral data in the window of interest are affected by commands such as LEAR, SET_DATA, and WRITE. If neither start nor length is provided, the window is set to the maximum size allowed by the conversion gain specified. The window of interest is always set to the maximum size after a SET_DEVICE command or a SET_SEGMENT command.

Execution Errors:

%131128085<CR>	The start channel was higher than the conversion gain.
%131129086<CR>	The length specified one or more channels that were too high conversion gain.
%131132080<CR>	The start channel was specified without a length. If one value is given, the other must also be given.

SET_ZERO_ADJUSTMENT value

Sets the zero stabilization adjustment to an arbitrary value from –65535 to 65535. The total range of the adjustment value represents ±256 channels. This adjustment is usually only made by the gain stabilizer, and reset to 0 with the INITIALIZE_ZERO_STABILIZATION command. See also SHOW_ZERO_ADJUSTMENT.

SET_ZERO_CHANNEL chan

Sets the center channel for the stabilizer zero peak. If a zero channel is chosen such that the beginning channel or ending channel would be below channel 0 or above the maximum channel, as determined by the conversion gain, the zero peak width is reduced until the peak fits the device boundaries. A zero channel and width must be set before zero stabilization can be enabled. See also ENABLE_ZERO_STABILIZATION.

Execution Errors:

%131128085<CR>	The specified channel number would create a peak that was less than the minimum width (3 channels) or would be outside the device's range.
%131136084<CR>	The command was attempted while zero stabilization was enabled.

SET_ZERO_PRESET count

Sets the Gauss mode stabilization preset for the zero peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the zero peak

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before the zero offset is evaluated by the stabilizer and potentially adjusted. See also SHOW_ZERO_PRESET.

SET_ZERO_WIDTH chans

Sets the width in channels for the stabilizer zero peak. The zero width must be chosen such that the beginning channel is no lower than channel 0 and the ending channel is no higher than the maximum channel as determined by the conversion gain. The zero channel and width must be set before zero stabilization can be enabled. The absolute minimum width for the zero peak is 3 channels, and the absolute maximum width for the zero peak is 256 channels in Gauss mode. In point mode there is no maximum peak width, though the chosen width must allow the peak to fit within the device's channel limits as stated above.

Execution Errors:

%131128085<CR>	The specified number of channels would create a peak that was less than the minimum width (3 channels) or would be outside the devices range.
%131136084<CR>	The command was attempted while zero stabilization was enabled.

SHOW_ACTIVE

Returns a 1 if the DSPEC is active (i.e., acquiring spectral data) or 0 if it is not active.

Responses:

$C00000087<CR>	Not active.
$C00001088<CR>	Active.

SHOW_ACTIVE_DEVICES

Returns a bit mask of the currently active devices as follows:

Responses:

$C00000087<CR>	No devices are active.
$C00001088<CR>	Only device 1 is active.

SHOW_ADC_CONVERSION

Debugging command that returns the most recent conversion from the ADC. Returns 0 if no conversion is available. See also SET_ADC_CONVERSION command.

Responses:

$C00000087<CR>	No conversion available.
$C00405096<CR>	405 was the most recent conversion.

SHOW_ALARM

Returns a record showing whether the alarm responses are enabled or disabled for a particular communication path. If SHOW_ALARM is received on the serial line, the response indicates whether alarms are enabled for the serial line. If SHOW_ALARM is received by the mailbox, the response indicates whether alarms are enabled for the mailbox.

Responses:

$IT\<CR>	Alarms are enabled for the specified communication path.
$IF\<CR>	Alarms are disabled for the specified communication path.

SHOW_BLRE

Shows the baseline restorer time constant in microseconds. See also SET_BLRE.
Responses:

BLUE 000000000000091   Time constant is 91 µs.

SHOW_BLRE_AUTOMATIC

Shows whether automatic selection of the baseline restorer constant is off or on.
Responses:

$IT\<CR>	Automatic baseline is enabled.
$IF\<CR>	Automatic baseline is disabled.

SHOW_CONFIGURATION

Returns a record that indicates the hardware configuration of the MCB. The record contains information about the number of segments in an MCB device (always 1 for the DSPEC), and the current conversion gain for each segment. The record is organized as follows:

$J1638400001aaaaa00000[65 zeros here for total of 75 zeros]00000ccc

where **aaaaa** represents the conversion gain for the one and only segment in the currently selected device, and **ccc** represents the record checksum. See the section on response records in this chapter for more information about response records and checksums.

SHOW_CONFIGURATION_UART

Reports the baud rate, parity option, number of data bits, and number of stop bits for the serial interface.
Responses:

$F09600N81	9600 baud, no parity, 8 data bits, 1 stop bit.
$F19200E82	19200 baud, even parity, 8 data bits, 2 stop bits.
$F02400O71	2400 baud, odd parity, 7 data bits, 1 stop bits.

SHOW_CORRECTION_FLAT

Shows the flattop correction value. See also SET_CORR_FLAT.
Responses:

CORR_FLAT 000000000000000

SHOW_DATE

Returns the day, month, and year of the current date as maintained in the battery-backed-up real time clock, in the form dddmmmyyy. The day is returned as a 3-digit integer number

from 001–031, month as a 3-digit integer number from 001–012, and year as a 3-digit integer number from 000–099. See also SET_DATE_START.

<u>Responses:</u>

$N001001088052<CR>	Date reported as Jan 1, 1988.
...	**...**
$N031012099059<CR>	Date reported as Dec 31, 1999.
$N001001000036<CR>	Date reported as Jan 1, 2000.
...	**...**
$N031012087056<CR>	Date reported as Dec 31, 2087.

SHOW_DATE_START

Returns the day, month and year of the acquisition start date in the form dddmmmyyy. The day is returned as a 3-digit integer number from 001–031, month as a 3-digit integer number from 001–012, and year as a 3-digit integer number from 000–099. See also SET_DATE_START.

<u>Responses:</u>

$N001001088052<CR>	Date reported as Jan 1, 1988.
...	**...**
$N031012099059<CR>	Date reported as Dec 31, 1999.
$N001001000036<CR>	Date reported as Jan 1, 2000.
...	**...**
$N031012087056<CR>	Date reported as Dec 31, 2087.

SHOW_DCREST

Shows the DC restorer setting. See also SET_DCREST.

<u>Responses:</u>

DCRE002000

SHOW_DEBUG

Shows the debug level. See also SET_DEBUG.

<u>Responses:</u>

$A003248	Returns the Debug state as $Axxxccc, where xxx is the Debug level and ccc is the checksum.

SHOW_DELAY_COLLECTION

Shows the Delay Collection setting. See also SET_DELAY_COLLECTION.

<u>Responses:</u>

DEL_COLL 0000000000001.6

SHOW_DELAY_SAMPLE
Shows the Delay Sample setting. See also SET_DELAY_SAMPLE.
Responses:

$C00003090	The sample number is 00003, and 090 is the checksum.

SHOW_DEVICE
Returns the number of the currently selected device (see SET_DEVICE command). See also START and STOP.
Responses:

$A001246<CR>	Device number 1 is currently selected device.
$A002247<CR>	Device number 2 is currently selected device.
$A003248<CR>	Device number 3 is currently selected device.
$A004249<CR>	Device number 4 is currently selected device.

SHOW_DIRECT ["filename.ext"]
Responds with the first item in the RAM Disk or ROM Disk directory which matches the specified file name. Wildcards are permissible and if a drive letter is included, A: should be used for the ROM Disk and C: should be used for the RAM Disk. If no drive letter is included, C: is used. If no filename is included, C:*.* is used. SHOW_DIRECTORY_NEXT returns the next entry in the directory list.
Responses:
MCBLOCAL.INI   97   01-10-1997 04:24

SHOW_DIRECT_ALL ["filename.ext"]
Responds with the directory entries on the RAM Disk or ROM Disk directory which match the specified filename. Wildcards are permissible and if a drive letter is included, A: should be used for the ROM Disk and C: should be used for the RAM Disk. If no drive letter is included, C: is used. If no filename is included, C:*.* is used. This command returns multiple response records until all matching directory entries have been returned.
Responses:
MCBLOCAL.INI   97   01-10-1997 04:24

SHOW_DIRECT_NEXT
Responds with the next matching directory entry which matches the filename specified in a SHOW_DIRECTORY command. If there are no more matching entries, a %131137 response is returned.
Execution Errors:

%131137085<CR>	No more matching entries.

SHOW_DITHER

Show the status of the dither.

<u>Responses:</u>

DITH_ENA 000000   Dither is enabled.

DITH_DIS 000000   Dither is disabled.

SHOW_DSP num, command

Debugging command that can be used to directly read parameters within the digital signal processor chips. Num (1–4) selects which DSP chip will receive the command and command (0–7) indicates which parameter will be reported. The command responds with both a 24-bit signed representation and a floating point representation of the parameter.

<u>Responses:</u>

DSP 000000004194304 0000000000000.5   Parameter is set to 0.5.

SHOW_GAIN_ADJUSTMENT

Returns the current gain peak stabilization adjustment as a number from –32767 to 32767. This value changes dynamically when gain stabilization is enabled. See also SET_GAIN_ADJUSTMENT.

<u>Responses:</u>

GAIN_ADJ 00000000000   No adjustment.

GAIN_ADJ 00000032767   Maximum adjustment.

GAIN_ADJ –00000032767   Minimum adjustment.

SHOW_GAIN_CHANNEL

Reports the current center channel for the stabilizer gain peak. See also SET_GAIN_CHANNEL.

<u>Responses:</u>

$C00000087<CR>   Gain channel has not been set.

$C00002089<CR>   Gain channel is channel 2 (lowest possible channel).

   ...   **...**

$C16382107<CR>   Gain channel is channel 16382 (highest possible channel).

SHOW_GAIN_COARSE

Returns the coarse gain for the DSPEC internal amplifier. In operation, the resulting signal gain is the product of the coarse gain, the fine gain, and the super-fine gain (used by stabilizer). The coarse gain is returned in terms of an integer gain multiplier. This command is available only on Model 92X MCBs.

<u>Responses:</u>

$C00001089<CR>   Coarse gain reported as 1.

$C00002089<CR>   Coarse gain reported as 2.

$C00005091<CR>   Coarse gain reported as 5.

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$C00010088<CR>	Coarse gain reported as 10.
$C00020089<CR>	Coarse gain reported as 20.
$C00050090<CR>	Coarse gain reported as 50.
$C00100088<CR>	Coarse gain reported as 100.

SHOW_GAIN_CONVERSION

This command returns the conversion gain.

Responses:

$C00512095<CR>	Conversion gain reported as 512 channels.
$C01024094<CR>	Conversion gain reported as 1024 channels.
$C02048101<CR>	Conversion gain reported as 2048 channels.
$C04096106<CR>	Conversion gain reported as 4096 channels.
$C08192107<CR>	Conversion gain reported as 8192 channels.
$C16384109<CR>	Conversion gain reported as 16384 channels.

SHOW_GAIN_FINE

Returns the current fine gain setting. See SET_GAIN_FINE.

Sample Response:

GAIN_FINE 0000000000000.5 Parameter is set to 0.5.

SHOW_GAIN_PRESET

Reports the Gauss mode stabilization preset for the gain peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the gain peak before the gain is evaluated by the stabilizer and potentially adjusted. See also SET_GAIN_PRESET and CLEAR_PRESETS.

Responses:

$G0000000010076<CR>	Gain preset currently 10 counts (minimum).
$G0000000011076<CR>	Gain preset currently 11 counts.
...	**...**
$G2147483647121<CR>	Gain preset currently 2147483647 counts (maximum).

SHOW_GAIN_STABILIZATION

Reports the state of gain peak stabilization. See also ENABLE_GAIN_STABILIZATION and DISABLE_GAIN_STABILIZATION.

Responses:

$IT<CR>	Gain stabilization is currently enabled.
$IF<CR>	Gain stabilization is currently disabled.

SHOW_GAIN_WIDTH

Reports the current width for the stabilizer gain peak. See also SET_GAIN_WIDTH, SET_GAIN_CHANNEL, and SHOW_GAIN_CHANNEL.

<u>Responses:</u>

$C00001088<CR>	Gain width has not been set.
$C00003089<CR>	Gain width is 3 channels (lowest possible width).
...	...
$C00256100<CR>	Gain width is 256 channels (highest possible width in Gauss mode).
...	...
$C16383108<CR>	Gain width is 16383 channels (highest possible width in point mode with gain channel set to 8192).

SHOW_GATE

Reports the current mode of operation of the ADC gate input. See also SET_GATE_OFF, SET_GATE_COINCIDENT, and SET_GATE_ANTICOINCIDENT.

<u>Responses:</u>

$FOFF<CR>	Reports the ADC gate is off or ignored.
$FCOI<CR>	Reports the ADC gate is in coincident mode.
$FANT<CR>	Reports the ADC gate is in anticoincident mode.

SHOW_HV

Reports the current high voltage and the status of the high voltage power supply in the form

$$\textbf{\$Dvvvvvsssssccc}$$

Where vvvvv represents the current output voltage if the high voltage is enabled, or the rear-panel high voltage setting if the high voltage is disabled. sssss represents the status of the high voltage bias supply as a 16-bit decimal number with the following bit definitions:

Bit 0 (LSB):	Bias Supply Polarity (0=positive, 1=negative).
Bit 1:	Bias Supply Overload (0=overload, 1=normal).
Bit 2:	High Voltage Enabled (0=disabled, 1=enabled).

<u>Example Responses:</u>

$D0200000003077<CR>	2000 volts, Negative, Not Overloaded, Disabled.
$D0200000002076<CR>	2000 volts, Positive, Not Overloaded, Disabled.
$D0200000007082<CR>	2000 volts, Negative, Not Overloaded, Enabled.

SHOW_INPUT [0]

Reports the state of the Sample Ready input. See also PAUSE_INPUT, PAUSE_INPUT_HIGH, and PAUSE_INPUT_LOW.

<u>Responses:</u>

$C00000087<CR>	Sample Ready input is low.
$C00001088<CR>	Sample Ready input is high.

SHOW_INTEGRAL [start_chan,number_of_chans]

Reports the sum of the specified group of spectral data channels. If start_chan and number_of_chans is not provided, SHOW_INTEGRAL reports the sum of all channels in the currently selected segment that have their ROI flag set.

Responses:

$G0000000000075<CR>	Integral reported as 0.
...	**...**
$G4294967294131<CR>	Integral reported as 4294967294.
$G4294967295132<CR>	Integral reported as greater than or equal to 4294967295 (maximum reportable value).

SHOW_INTEGRAL_PRESET

Reports the current ROI integral preset value. For more information about the ROI integral preset, see SET_INTEGRAL_PRESET. See also SHOW_INTEGRAL.

Responses:

$G0000000000075<CR>	Integral preset reported as 0.
...	**...**
$G4294967295132<CR>	Integral reported as 4294967295.

SHOW_INTEGRAL_REMAINING

Reports the current ROI integral remaining value. For more information about the ROI integral remaining, see SET_INTEGRAL_REMAINING. See also SHOW_INTEGRAL.

Responses:

$G0000000000075<CR>	Integral remaining reported as 0.
...	**...**
$G4294967295132<CR>	Integral reported as 4294967295.

SHOW_LIVE

Reports the contents of the live-time counter in units of 20 milliseconds (50 ticks per second). See also CLEAR_COUNTERS and SET_LIVE.

Responses:

$G0000000000075<CR>	Live time reported as 0 ticks.
$G0000000001076<CR>	Live time reported as 1 tick (20 milliseconds).
...	**...**
$G4294967295132<CR>	Live time reported as 4294967295 ticks (over 23000 days).

SHOW_LIVE_PRESET

Reports the current live-time preset in units of 20 milliseconds (50 ticks per second). See also CLEAR_PRESETS and SET_LIVE_PRESET.

Responses:

$G0000000000075<CR>	Live-time preset reported as disabled.
$G0000000001076<CR>	Live-time preset reported as 1 tick.
...	**...**
$G4294967295132<CR>	Live-time preset reported as 4294967295 ticks.

SHOW_LIVE_REMAINING

Reports the current live-time remaining in units of 20 milliseconds (50 ticks per second). See also SET_LIVE_REMAINING.

Responses:

$G0000000000075<CR>	Live-time remaining reported as disabled.
$G0000000001076<CR>	Live-time remaining reported as 1 tick.
...	**...**
$G4294967295132<CR>	Live-time remaining reported as 4294967295 ticks.

SHOW_LLD

Shows the lower level discriminator setting. See also SET_LLD.

Responses:

$C00050092	The lower level discriminator is 50.

SHOW_LOCATION_SAMPLE

Shows the location sample number. See also SET_LOCATION_SAMPLE.

Responses:

$A003248	Sample number 3.

SHOW_MODE

Reports the current mode of operation (PHA or Sample). See also SET_MODE_PHA and SET_MODE_SAMPLE.

Responses:

$FPHA<CR>	PHA mode.
$FSAM<CR>	Sample mode (InSight).

SHOW_MODE_STABILIZATION

Reports the current stabilization mode of operation. See also SET_MODE_POINT and SET_MODE_GAUSS.

Responses:
$FPOINT<CR>
$FGAUSS<CR>

SHOW_NETWORK_ADDRESS

Returns in a $H record the Ethernet address used by the 83905 Ethernet chip. The address is composed of a 32-bit company portion of the address which is usually set to the ORTEC ID (41020) followed by the address portion. See also SET_NETWORK_ADDRESS.

Responses:

$H00000410200000000016058   Company ID=41020, Address=16

SHOW_NETWORK_ALL

Responds with multiple records indicating which computers are currently connected to the MCB via the network. See also SET_NETWORK_ALL.

SHOW_NETWORK_ID

Responds with a $F record indicating the network identifier which will be used by the MCB for all network communication. The default host name is DSPEC-xxxx, where xxxx is the serial number of the MCB. See also SET_NETWORK_ID.

Responses:

$FDSPEC-100

SHOW_NEXT

Used in conjunction with the SHOW_ROI command, SHOW_NEXT reports the next continuous group of channels that have the ROI flag set. The response is of the form

<p align="center">$Dssssnnnnnccc<CR></p>

where sssss represents an integer number that is the number of the first channel of the "next" group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. If no more channels have their ROI bit set, SHOW_NEXT returns a first channel of 0 and a number of channels of 0. The SHOW_ROI command is used to report the "first" group of channels that all have their ROI bit set.

Example Responses:

$D0100000050078<CR>	Next ROI group starts at channel 1000 and is 50 channels long.
$D0215000150086<CR>	Next ROI group starts at channel 2150 and is 150 channels long.
$D0000000000072<CR>	No other ROI groups to report.

SHOW_OUTPUT [0]

Reports the status of the "Change Sample" output port. The output port status is reported as a 16-bit number that is either 0 or 1, depending on the level last set by a SET_OUTPUT_HIGH or SET_OUTPUT_LOW command.

Responses:

$C00000087<CR>	Change Sample output currently at a low level.
$C00001088<CR>	Change Sample output currently at a high level.

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SHOW_OVERFLOW_PRESET
    Reports the state of the overflow preset.
    <u>Responses:</u>

$IT\<CR>	Overflow preset enabled.
$IF\<CR>	Overflow preset disabled.

SHOW_PAGE
    See also SET_PAGE.
    <u>Responses:</u>

$A001246	Page number 1.

SHOW_PEAK
    This command returns the contents of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The maximum possible value is 2147483647, which is the maximum number of counts that can be stored in a 31-bit channel.
    <u>Responses:</u>

$G0000000000075\<CR>	Maximum count in an ROI channel is zero or no ROI channels were found.
$G0000000001076\<CR>	Maximum count in an ROI channel is 1.
...	**...**
$G2147483646120\<CR>	Maximum count in an ROI channel is 2147483646.
$G2147483647121\<CR>	Maximum count in an ROI channel is 2147483647.

SHOW_PEAK_CHANNEL
    This command returns the number of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The lowest number ROI channel with the largest count is reported if more that one channel contains the largest number of counts. Channel 16383 is the highest numbered channel in any device.
    <u>Responses:</u>

$C00000087\<CR>	Maximum count was found in channel 0 or no ROI channels were found (see errors below).
$C00001088\<CR>	Maximum count was found in channel 1.
...	**...**
$C16382107\<CR>	Maximum count was found in channel 16382.
$C16383108\<CR>	Maximum count was found in channel 16383.

SHOW_PEAK_DELAY
    Reports the Peak Delay setting. See also SET_PEAK_DELAY.
    <u>Responses:</u>

$A003248	Peak Delay = 3.

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SHOW_PEAK_LENGTH
Shows the Peak Length setting. See also SET_PEAK_LENGTH.
Responses:
$A002247   Peak Length = 2.

SHOW_PEAK_PRESET
Reports the value of the ROI peak preset. See SET_PEAK_PRESET for information about the ROI peak preset.
Responses:
$G0000000000075<CR>   Peak preset disabled.
$G0000000001076<CR>   Peak preset set to 1 count.

  ...   **...**
$G2147483646120<CR>   Peak preset set to 2147483646 counts.
$G2147483647121<CR>   Peak preset set to 2147483647 counts.

SHOW_PZ
Displays the PZ setting. See also SET_PZ.
Responses:
PZ_ENA 002200   Pole zero enabled and set to 2200.
PZ_DIS 001000   Pole zero disabled and set to 1000.

SHOW_PZ_AUTOMATIC
Shows the state of the automatic PZ. See also SET_PZ_AUTOMATIC.
Responses:
$IT<CR>   Pole zero enabled.
$IF<CR>   Pole zero disabled (TRP).

SHOW_PZ_DELAY
Reports the PZ Delay setting. See also SET_PZ_DELAY.
Responses:
$C00075099

SHOW_RADIX
This command is for compatibility with other ORTEC MCBs. It always reports that the number base radix for the WRITE command is binary.
Responses:
$FBIN<CR>   Number base set to binary radix.

SHOW_REMOTE
See also SET_REMOTE.

Responses:

$IT<CR>	The remote is enabled.
$IF<CR>	The remote is disabled.

SHOW_ROI

Used in conjunction with the SHOW_NEXT command, SHOW_ROI reports the first continuous group of channels that have the ROI flag set. The response is of the form

$Dssssssnnnnnccc<CR>

where sssss represents an integer number that is the number of the first channel of the "first" group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. The SHOW_NEXT command is used to report the "next" group of channels that all have their ROI bit set.

Responses:

$D0100000050078<CR>	First ROI group starts at chan 1000 and is 50 channels long.
$D0215000150086<CR>	First ROI group starts at chan 2150 and is 150 channels long.
$D0000000000072<CR>	No ROI groups to report.

SHOW_ROI_SAMPLE

Displays the ROI Sample setting. See also SET_ROI_SAMPLE.

Responses:

$C00001088

SHOW_ROI_UNCERTAINTY

Reports the start channel and number of channels used in the uncertainty preset calculation. See also SET_ROI_UNCERTAINTY.

Response:

$D0700000050ccc	Calculation is performed on channels 7000–7049.

SHOW_SEGMENT

This command is for compatibility with other ORTEC MCBs. It reports the last value that was set with the SET_SEGMENT command. Segments have no meaning in DSPECs.

Responses:

$A001246<CR>	Segment last set to 1.

SHOW_SHAP_CUSP

Shows the Cusp Factor setting. See also SET_SHAP_CUSP.

Responses:

SHAP_CUSP 000000.99999988

SHOW_SHAP_FLAT
   Reports the width of the flattop in µs. See also SET_SHAP_FLAT.
   <u>Responses:</u>
   SHAP_FLAT 0000000000001.2

SHOW_SHAP_RISE
   Displays the Rise Time setting in µs. See also SET_SHAP_RISE.
   <u>Responses:</u>
   SHAP_RISE 0000000000003.2

SHOW_SNUM
   Responds with a $F record indicating the serial number of the MCB. See SET_SNUM.
   <u>Responses:</u>
   $F100   Serial Number = 100.

SHOW_STATUS
   Returns system status information in the following format:
   $Mlllllllllllltttttttttttaaaaahhhhhccc<CR>
   where **lllllllllll** represents the live time as returned by the SHOW_LIVE command, **ttttttttttt**
   represents the true time for the current device as returned by the SHOW_TRUE command,
   aaaaa represents the active device mask as returned by the SHOW_ACTIVE_DEVICES
   command, and **hhhhh** represents the hardware status, which is an ASCII representation of a
   16 bit decimal number with the following bit definitions:
   Bit 0 (LSB):   Bias Supply Polarity (0=positive, 1=negative).
   Bit 1:   Bias Supply Overload (0=overload, 1=normal).
   Bit 2:   High Voltage Enabled (0=disabled, 1=enabled).
   Bit 3:   Unused.
   Bit 4:   Amplifier PZ'd since initialization (0=normal, 1=needs PZ'ing).
   Bit 5   Optimization since initialization (0=normal, 1=needed).
   Bits 6–7:   Unused.
   Bit 8:   Amplifier Automatic PZ (1=Auto PZ in progress, 0=normal).
   Bit 9:   Optimization (0=normal, 1=in progress).
   Bits 10–14:   Unused.
   Bit 15 (MSB):   Reserved.

SHOW_THRESHOLD_AUTOMATIC
   See also SET_THRESHOLD_AUTOMATIC.
   <u>Responses:</u>
   $IT<CR>   Automatic threshold is enabled.
   $IF<CR>   Automatic threshold is disabled

SHOW_THRESHOLD_NEGATIVE
See also SET_THRESHOLD_NEGATIVE.
<u>Responses:</u>
THR_NEG 0000379791   Negative threshold is 379791.

SHOW_THRESHOLD_POSITIVE
See also SET_THRESHOLD_POSITIVE.
<u>Responses:</u>
THR_POS 00000126811   Positive threshold is 126811.

SHOW_THRESHOLD_SAMPLE
See also ENABLE_THRESHOLD_SAMPLE, SET_THRESHOLD_SAMPLE.
<u>Responses:</u>
THR_DIS 00000000003   Threshold set to 3 and disabled.
THR_ENA 00000005000   Threshold set to 5000 and enabled.

SHOW_TIME
Reports the time from the battery backed-up system clock in the form
$$\textbf{\$Nhhhmmmssscc<CR>}$$
where hhh represents a 3-digit integer hour (0 through 23), mmm represents a 3-digit integer minute (0 through 59), and sss represents a 3-digit integer second (0 through 59). See also SET_TIME, SET_DATE, and SHOW_DATE.
<u>Example Responses:</u>
$N010054017052<CR>   Time returned 10:54:17 (10 hours, 54 min, 17 sec).
$N020013037050<CR>   Time returned 20:13:37 (20 hours, 13 min, 37 sec).

SHOW_TIME_START
Reports the time of the last START command in the form
$$\textbf{\$Nhhhmmmssscc<CR>}$$
where hhh represents a 3-digit integer hour (0 through 23), mmm represents a 3-digit integer minute (0 through 59) and sss represents a 3-digit integer second (0 through 59). See also SET_TIME_START, SET_DATE_START, and SHOW_DATE_START.
<u>Example Responses:</u>
$N010054017052<CR>   Time returned 10:54:17 (10 hours, 54 min, 17 sec).
$N020013037050<CR>   Time returned 20:13:37 (20 hours, 13 min, 37 sec).

SHOW_TRUE
Reports the contents of the true-time (real-time) counter in units of 20 milliseconds (50 ticks per second). See also CLEAR_COUNTERS and SET_TRUE.

Responses:

$G0000000000075\<CR>	True time reported as 0 ticks.
$G0000000001076\<CR>	True time reported as 1 tick (20 milliseconds).
...	**...**
$G4294967295132\<CR>	True time reported as 4294967295 ticks (over 23000 days).

SHOW_TRUE_PRESET

Reports the current true-time (real-time) preset in units of 20 milliseconds (50 ticks per second). See also CLEAR_PRESETS and SET_TRUE_PRESET.

Responses:

$G0000000000075\<CR>	True time preset reported as disabled.
$G0000000001076\<CR>	True time preset reported as 1 tick.
...	**...**
$G4294967295132\<CR>	True time preset reported as 4294967295 ticks.

SHOW_TRUE_REMAINING

Reports the current true time (real time) remaining in units of 20 milliseconds (50 ticks per second). See also SET_TRUE_REMAINING.

Responses:

$G0000000000075\<CR>	True time remaining reported as disabled.
$G0000000001076\<CR>	True time remaining reported as 1 tick.
...	**...**
$G4294967295132\<CR>	True time remaining reported as 4294967295 ticks.

SHOW_UNCERTAINTY

Returns the current value of the uncertainty for the peak in the uncertainty preset. See also SET_UNCERTAINTY.

Responses:

UNCE 0000000000008.5	Uncertainty of the peak is 8.5%.

SHOW_UNCERTAINTY_PRESET

Returns the current uncertainty preset setting. See also SET_UNCERTAINTY_PRESET.

Responses:

UNCE_PRES 000000000000000	No preset.
UNCE_PRES 0000000000008.5	Preset set to 8.5%.

SHOW_VERSION

Reports the DSPEC firmware Version number in the form

Fmmmm-vvv\<CR>

where mmmm is a 4-character model designator and vvv is a 3-character version designator.

Example Responses:

$FDSPE–002<CR>   Model DSPEC firmware Version 2 reported.

SHOW_WIDTH

Reports the maximum number of bytes that may be sent by the DSPEC to the host computer as a result of the WRITE command. See also SET_WIDTH and WRITE.

Responses:

$C00012090<CR>   Width reported as 12 bytes (minimum width).

$C00013091<CR>   Width reported as 13 bytes.

   ...   **...**

$C00512095<CR>   Width reported as 512 bytes (maximum width).

SHOW_WINDOW

Reports the start channel and number of channels in the window of interest, in the form

$Dxxxxxyyyyyccc<CR>

where xxxxx is the start channel (0–16383) and yyyyy is the number of channels (1–16384). See SET_WINDOW for more information about the window of interest.

Example Responses:

$D0000016384094<CR>   Window of interest reported as starting at channel 0 and continuing for 16384 channels.

$D0000008192092<CR>   Window of interest reported as starting at channel 0 and continuing for 8192 channels (first 1/2).

$D0819208192112<CR>   Window of interest reported as starting at channel 8192 and continuing for 8192 channels (last 1/2).

SHOW_ZERO_ADJUSTMENT

Returns the current zero peak stabilization adjustment as a number from –32767 to 32767. This value changes dynamically when zero stabilization is enabled. See also SET_ZERO_ADJUSTMENT and INITIALIZE_ZERO_STABILIZATION.

Responses:

ZERO_ADJ 00000005000

ZERO_ADJ 00000000000

SHOW_ZERO_CHANNEL

Reports the center channel for the stabilizer zero peak. See also SET_ZERO_CHANNEL, SET_ZERO_WIDTH, and SHOW_ZERO_WIDTH.

Responses:

$C00000087<CR>   Zero channel has not been set.

$C00002089<CR>   Zero channel is channel 2 (lowest possible channel).

   ...   **...**

$C16382107<CR>   Zero channel is channel 16382 (highest possible channel).

SHOW_ZERO_PRESET

Reports the Gauss mode stabilization preset for the zero peak. The preset represents the minimum number of incremental counts that must be collected in any one channel of the zero peak before the zero offset is evaluated by the stabilizer and potentially adjusted. See also SET_ZERO_PRESET and CLEAR_PRESETS.
Responses:

$G0000000010076<CR>	Zero preset currently 10 counts (minimum).
$G0000000011076<CR>	Zero preset currently 11 counts.
...	**...**
$G2147483647121<CR>	Zero preset currently 2147483647 counts (maximum).

SHOW_ZERO_STABILIZATION

Reports the state of zero peak stabilization. See also ENABLE_ZERO_STABILIZATION and DISABLE_ZERO_STABILIZATION.
Responses:

$IT<CR>	Zero stabilization is currently enabled.
$IF<CR>	Zero stabilization is currently disabled.

SHOW_ZERO_WIDTH

Reports the current width for the stabilizer zero peak. See also SET_ZERO_WIDTH, SET_ZERO_CHANNEL, and SHOW_ZERO_CHANNEL.
Responses:

$C00001088<CR>	Zero width has not been set.
$C00003089<CR>	Zero width is 3 channels (lowest possible width).
...	**...**
$C00256100<CR>	Zero width is 256 channels (highest possible width in Gauss mode).
...	**...**
$C16383108<CR>	Zero width is 16383 channels (highest possible width in point mode with zero channel set to 8192).

START [seg-mask]

Starts the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and may be any value from 0 to 65535 but is ignored by the DSPEC.
Execution Warnings:

%000004073<CR>	No segment selected (occurs with other warnings).
%000005074<CR>	The acquisition is already started (no changes made).
%000006075<CR>	A preset was exceeded (acquisition was not started).
%000008073<CR>	Unit not optimized since initialization.
%000016076<CR>	Amplifier not PZ'd since initialization.
%000032074<CR>	High voltage is disabled.

The actual response record may be a combination of any of the above records depending on the warning conditions. For example:

%000048081<CR>   Amplifier not PZ'd and high voltage disabled.

START_OPTIMIZE

Starts optimization of PZ and flattop correction for all rise times.

START_PZADJUST_AUTO

Starts the automatic PZ process. The automatic PZ is not complete until indicated by the auto PZ status bit. This bit is returned by the SHOW_STATUS command. Spectral data can be corrupted if automatic PZ is initiated while a device is collecting data.

Execution Errors:

%131136084<CR>   The command was attempted while the amplifier was set for a transistor reset preamplifier. No action was taken.

STEP_OUTPUT [0]

Causes a pulse to be output on the Change Sample output port. The level of the Change Sample output is changed then returned to the level present when the STEP_OUTPUT command is received. The duration of the intermediate level varies but is never less than 2 µs. Use the SET_OUTPUT_HIGH or SET_OUTPUT_LOW commands to establish an initial output level.

Responses:

$C00000087<CR>   The initial and final level on Change Sample was low.
$C00001088<CR>   The initial and final level on Change Sample was high.

STOP [seg-mask]

Stops the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and may be any value from 0 to 65535 but is ignored.

Execution Warnings:

%000005074   Acquisition already stopped (no changes made).

STOP_OPTIMIZE

Stops the optimization in progress. The DSPEC may be in an indeterminate mode. See also START_OPTIMIZE.

STOP_PZ_AUTOMATIC

Stops the optimization in progress. The DSPEC may be in an indeterminate mode. See also START_PZ_AUTOMATIC.

TERMINAL

Prepares the serial line for communication with a terminal. In terminal mode, text sent to the DSPEC echoes back to the host and response records sent to the host by the DSPEC are terminated with a carriage return and line feed. This command has no effect when sent via the mailbox. See also COMPUTER.

TEST mask

Performs any combination of the DSPEC internal selftests where mask represents a 16-bit integer with each bit set specifying a test as follows:

Bit 1: Spectral data memory test (destroys spectral data).
Bit 3: Serial line test (serial loop-back connector required)
Bit 5: Mailbox memory test (may cause mailbox comm error).
Bit 6: Front-panel LED test.

Execution Errors:

%004016080<CR> Spectral Data Memory or Mailbox Memory failed test.
%004064083<CR> Serial Line failed test.

VERIFY_BLRE blue[,inc]

Allows exploration of the legal baseline restorer time constants. It responds with the closest legal baseline restorer time constant to blue. If inc is included, the number reported is inc steps from the closest legal value of blue. See SET_BLRE.

Sample Response:

BLUE 000000000000010 10 is a legal setting.

Execution Errors:

%131128085<CR> The first value is incorrect.
%131132080<CR> A value is needed.

VERIFY_CORRECTION_FLAT corr[,inc]

Allows exploration of the flattop correction settings. It responds with the closest legal setting to corr. If inc is included, the number reported is inc steps from the closest legal value of corr. See SET_CORRECTION_FLAT.

Sample Response:

CORR_FLAT 000000.51234114 0.1234114 is a legal setting.

Execution Errors:

%131128085<CR> The first value is incorrect.
%131132080<CR> A value is needed.

VERIFY_DELAY_COLLECTION delay[,inc]

Allows the collection delay settings to be explored. It responds with the closest legal setting to delay. If inc is included, the number reported is inc steps from the closest legal value of delay. See SET_DELAY_COLLECTION.

Sample Response:

DEL_COLL 0000000000001.5   1.5 is a legal setting.

Execution Errors:

%131128085<CR>   The first value is incorrect.

%131132080<CR>   A value is needed.

VERIFY_GAIN_COARSE cg[,inc]

Allows exploration of the legal coarse gain settings. It returns the closest legal coarse gain setting to cg. If inc is included, the number reported is inc steps from the closest legal value of cg.

Example Command and Response:

VERI_GAIN_COAR 15.1

$C00020ccc   20 is the closest coarse gain to 15.1.

VERI_GAIN_COAR 15,1

$C00050ccc   50 is one step above the closest coarse gain to 15.

VERI_GAIN_COAR 15,–1

$C00010ccc   10 is one step below the closest coarse gain to 15.

VERIFY_GAIN_FINE fg[,inc]

Allows the legal fine gain settings to be explored. It returns the closest legal setting to gain. If inc is included, the number reported is inc steps from the closest legal value of fg.

Sample Response:

GAIN_FINE 0000000000000.5   0.5 is a legal setting.

VERIFY_SHAP_CUSP cusp[,inc]

Allows the cusp settings to be explored. It responds with the closest legal setting to cusp. If inc is included, the number reported is inc steps from the closest legal value to cusp. See SET_SHAP_CUSP.

Sample Response:

SHAP_CUSP 0000000000000.5   0.5 is a legal setting.

Execution Errors:

%131128085<CR>   The first value is incorrect.

%131132080<CR>   A value is needed.

VERIFY_SHAP_FLAT flat [,inc]

Allows exploration of the flattop width settings. It returns the closest legal setting to flat. If inc is included, the number reported is inc steps from the closest legal value to flat. See SET_SHAP_FLAT.

Sample Response:

SHAP_FLAT 0000000000001.2   1.2 is a legal setting.

Execution Errors:

%131128085<CR>   The first value is incorrect.

%131132080<CR>   A value is needed.

VERIFY_SHAP_RISE rise[,inc]

Allows exploration of the rise time settings. It responds with the closest legal setting to rise. If inc is included, the number reported is inc steps from the closest legal value to rise. See SET_SHAP_RISE.

Sample Response:

SHAP_RISE 0000000000000.8   0.8 is a legal setting.

Execution Errors:

%131128085<CR>   The first value is incorrect.

%131132080<CR>   A value is needed.

VERIFY_THRESHOLD_SAMPLE thresh[,inc]

Allows the threshold sample settings to be explored. It returns the closest legal setting to thresh. If inc is included, the number reported is inc steps from the closest legal value to thresh. See SET_THRESHOLD_SAMPLE.

Sample Response:

THR 000000000001005   1005 is a legal setting.

Execution Errors:

%131128085<CR>   The first value is incorrect.

%131132080<CR>   A value is needed.

WRITE

Starts the transmission of the spectral data in the window of interest (see SET_WINDOW command) from the DSPEC to the host computer. The WRITE command responds with a binary data record as follows:

<p style="text-align:center">**#Bllcc?111122223333 ... nnnns**</p>

In this record ll represents a 16-bit binary integer that is the record length, cc represents a 16-bit binary integer that is the number of the first channel in the record, **?** is an unused byte, 1111 represents a 32-bit binary integer that is the contents of the first channel in the record, 2222 represents the second channel in the record, etc., nnnn represents the nth channel in the record, and s represents an 8-bit binary checksum of the entire record up to the checksum byte itself.

After the DSPEC responds with a binary data record, the host computer must prompt for the next record with one of the following handshake prompts: **GO<CR>**, **RE<CR>**, or **HA<CR>**; these must be entered in uppercase letters. GO causes the next binary data record

to be sent by the DSPEC or the % response if the last record has already been sent. RE causes the previous binary data record to be resent exactly as it was the last time. HA causes the WRITE command to be halted and responds with a **%130131078<CR>** record.

The number of channels that are sent on a binary data record depends on the record width as set by the SET_WIDTH command and the number of channels remaining in the window of interest to be sent. If the record is the last record to be sent, it will contain the number of channels remaining in the window of interest. This may or may not be the same number of channels as the previous record(s). If the record is not the last record to be sent, it will contain as many channels as will fit without creating a binary data record that is longer than the limit set by the SET_WIDTH command. The following formula can be used to determine the number of channels that will be sent on a record that isn't the last record:

$$CHANS = \frac{(WIDTH - 8)}{4}$$

In the above formula CHANS is the integer number of channels that will be sent on the record and WIDTH is the current record width as set by the SET_WIDTH command (maximum value is 512 bytes).

WRITE_FILE "aabbccddeeff"
Writes a block of data to the file which was opened with the OPEN_FILE command. Each byte of data is encoded as a two hexadecimal character. In the example above, 5 bytes are sent. Multiple WRITE_FILE commands can be used to send a long file to the MCB.

WRITE_FILE_FLASH "aabbccddeeff"
Writes a block of data to be written to the flash memory beginning with the first byte in the flash memory. The OPEN_FILE_FLASH command must be set before using this command. Each byte of data is encoded as two hexadecimal characters. In the example above, 5 bytes are sent. Multiple WRITE_FILE_FLASH commands are used to send the entire block of data.