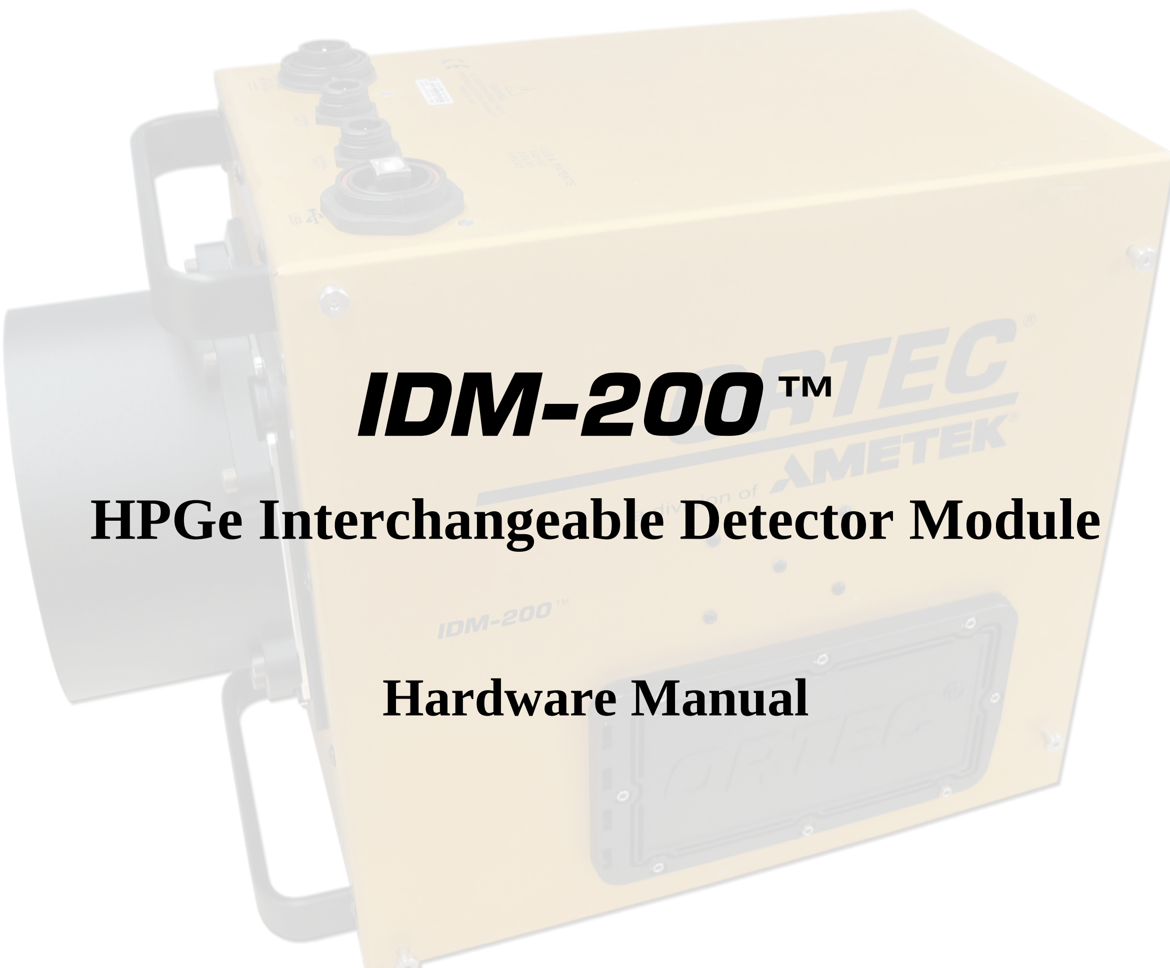
ORTEC®



IDM-200™

HPGe Interchangeable Detector Module

Hardware Manual

Printed in U.S.A. ORTEC Part No. 932540 0314
Manual Revision B

Advanced Measurement Technology, Inc.

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

WARRANTY

ORTEC* warrants that the items will be delivered free from defects in material or workmanship. ORTEC makes no other warranties, express or implied, and specifically NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

ORTEC's exclusive liability is limited to repairing or replacing at ORTEC's option, items found by ORTEC to be defective in workmanship or materials within one year from the date of delivery. ORTEC's liability on any claim of any kind, including negligence, loss, or damages arising out of, connected with, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair, or use of any item or services covered by this agreement or purchase order, shall in no case exceed the price allocable to the item or service furnished or any part thereof that gives rise to the claim. In the event ORTEC fails to manufacture or deliver items called for in this agreement or purchase order, ORTEC's exclusive liability and buyer's exclusive remedy shall be release of the buyer from the obligation to pay the purchase price. In no event shall ORTEC be liable for special or consequential damages.

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.

ADDITIONAL WARRANTY STATEMENT

The IDM-200 contains ***no user-serviceable parts***. Except for the battery hatch on the left side panel, which can be opened when the battery requires replacement, breaking the seal on the case ***voids your warranty***. The IDM-200 should be opened only by ORTEC-authorized service personnel.

If you have any questions about the use or maintenance of this instrument, please contact your ORTEC representative or our Global Service Center first.

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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.


ORTEC
a division of AMETEK
IDM-200™

1. INTRODUCTION

The ORTEC IDM-200™ is designed as a gamma-ray detection "building block" for systems such as portal monitors. The IDM-200 is a completely self-contained subsystem comprising a single, mechanically cooled high-purity germanium (HPGe) detector of standardized crystal dimensions, and all necessary electronics in a rugged package sized for benchtop use or mounting in a standard 19 inch (48.3 cm) rack. It has everything needed to detect gamma rays and send either the energy histogram or a digitized pulse stream to a PC for analysis, ready for use in a variety of systems where nuclide monitoring and identification is needed.

IDM-200s are designed for long, reliable service and can be swapped out for service quickly, limiting downtime to an absolute minimum. To bring a new IDM-200 online, run the accompanying gain stabilization setup application, and it is ready for installation in your system.

For OEM applications, ORTEC CONNECTIONS programmers' toolkits are available. Contact your ORTEC representative or our Global Service Center for more information.

Before using the IDM-200, it must be set up and cooled, and the gain stabilizer adjusted with the accompanying Stabilizer Setup Application, as described in Chapter 2.

1.1. Rugged, Reliable, Rapidly Interchangeable

- Uniform, large-area 85 mm × 30 mm HPGe detector crystal gives high efficiency at low energies
- High-capacity, high-reliability Stirling cooler cools rapidly to operating temperature
- Integrated high-voltage supply
- Hardened cryostat designed for long operational life
- Can be temperature-cycled at any time, even from partial warmup
- Low power consumption
- Mains (ac) powered
- High-speed USB bus for rapid data transfer to and from a host PC
- High performance, digitally stable signal processing
- Easy substitution of IDM-200 modules while in operational state — reduced down-time.
- Continuous data collection, no dead spots, using List Mode.
- Low Frequency Rejector[1] (LFR) improves spectrum resolution in noisy environments.

[1]Patent pending.

1.2. Special Hardware Features

The IDM-200 is an advanced all-in-one HPGe gamma-ray spectrometer which can be deployed as a component in a variety of measuring systems.

Pulse Height Analysis (PHA) Mode — The instrument's most familiar function is data acquisition in pulse height analysis (PHA) mode, in which a data histogram of events versus channel number (a spectrum) is gathered and stored in the onboard data memory. For each pulse digitized, the spectrum is incremented by one count in the channel corresponding to the energy of the gamma ray.

List Mode — In List Mode, the IDM-200 records and stores the pulse value with a time-stamp for every pulse generated by the detector. With List Mode, you can write your own programs that can reconstruct histograms for any time segment without dead time between histograms, or make histograms for overlapping time slices. Data can be stored easily for reconstruction of any time frame needed. For more information, see Chapter 6.

Low-Frequency Rejector (LFR) Filter Our Low-Frequency Rejector digital filter surpasses all signal processing methods for reducing the effects of microphonics, ground loops, and virtually all other sources of periodic noise for HPGe and NaI(Tl) spectrometry.

Digital Signal Processing (DSP) DSP offers more options for optimizing the output signal of HPGe detectors. The built-in InSight™ Virtual Oscilloscope makes it simple to optimize detector performance for a given application from the PC, the automatic baseline restorer[2] and the highly accurate Gedcke-Hale extended live-time correction method.[3]

[2]Patent number 5,912,825.

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

AMETEK® ADVANCED MEASUREMENT TECHNOLOGY

2. GETTING STARTED

This chapter covers the steps you will need to prepare the IDM-200 for use.

2.1. Major System Components

The specific components for your instrument will depend on the model and options you purchased, but typically they will include a USB cable, the appropriate documentation set, an ac power input cable, a CD containing the Stabilizer Setup Application (P/N 980638). You must also have the appropriate CONNECTIONS Driver Update Kit (P/N 797230) CD, which will either be packaged with this instrument or otherwise supplied as part of a multi-component system.

NOTE Be sure to keep the box and foam and use it for shipping the instrument.

Any options will be packaged separately, and will include instructions for that option.

2.2. The IDM-200

Figures 1 and 2 show the IDM-200's major features.

CAUTION The IDM-200 is significantly ***nose-heavy***. Keep this in mind when lifting and positioning the unit.

2.2.1. Front Panel

- **On/Off Button** Located below and left of the HPGe detector endcap. Press to turn on the IDM-200. If connected to external power or if the internal battery is sufficiently charged, the unit will power up and the cooler will start automatically. Note the outer edge of the On/Off button, which illuminates when the power is on. This indicator is *steady* when the IDM-200 is *ready* for data acquisition, and *blinks* if unit is *not ready* (for instance, if the detector is warm).

- The IDM-200 also has a remote power on/off capability for integrating the unit into a larger system. See the specification on page 27 in Chapter 5.

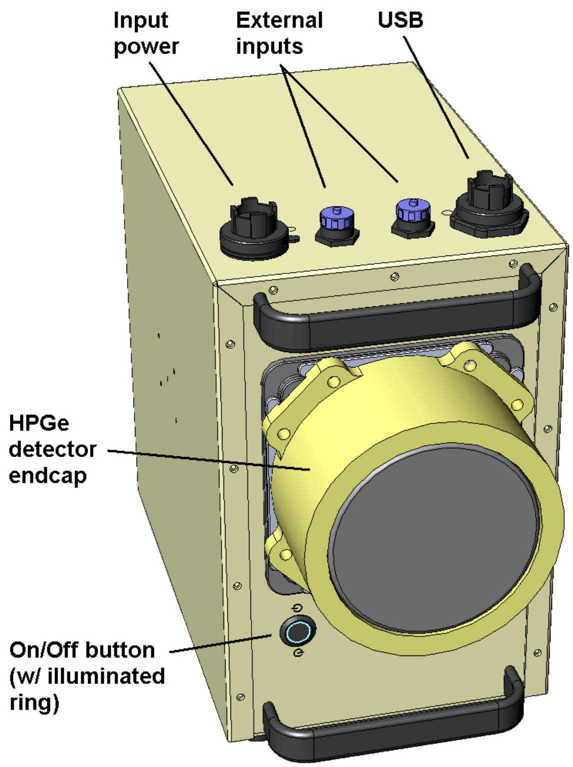

Fig. 1. Front- and Top-Panel Features.

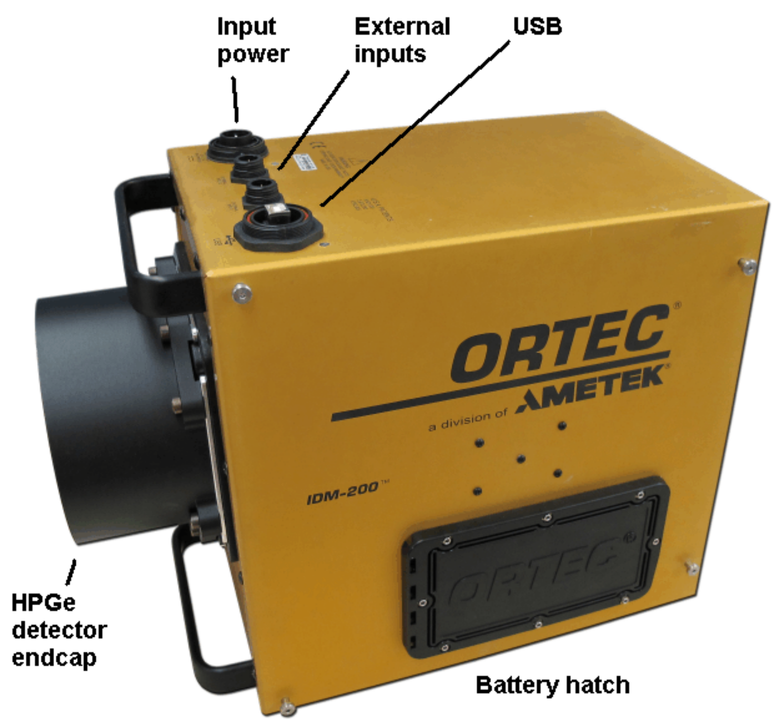

Fig. 2. Top-Panel Features.

2.2.2. Top-Panel Connectors

- **INPUT POWER** — Supplies external power for operating the IDM-200 and recharging the internal battery. Waterproof INPUT POWER connector is position-keyed and secured with a screw collet. When not connected to external power, seal the connector with its threaded, waterproof cap.

- **EXTERNAL 1 and 2** ports — Connect to neutron detectors, occupancy sensors, other peripherals; 0 V to +5 V with adjustable threshold. Set and monitor thresholds with firmware commands SET_THRESH_AUX, SHOW_THRESHOLD_AUX, SHOW_INPUT, ENAB_ COUNT_LIST, and DISA_COUNT_LIST.[4] Waterproof threaded cap should be left in place when a port is not in use.

- **USB** port ( ) — Used to connect the IDM-200's microprocessor to the controlling PC. Waterproof threaded cap should be left in place when the port is not in use.

CAUTION	If using a USB cable with a threaded cap (such as the cable suppled with the IDM-200), ***be sure the cable is oriented and inserted correctly in the USB port before tightening the threaded cap***, otherwise the port receptacle may be damaged and require factory repair!

2.2.3. The Internal Battery

When the internal battery no longer holds a charge (typically, after 3–5 years), contact ORTEC for the appropriate battery replacement kit. See Chapter 8 for instructions on replacing it. Note that the battery hatch is the only part of the IDM-200 case that can be opened without voiding the warranty.

2.3. Software Installation

2.3.1. Step 1: Install the CONNECTIONS Driver Update

The first step is to install the CONNECTIONS Driver Update Kit on the host PC according to the kit's instruction sheet. *This product must be installed before your spectroscopy application is*

[4]Note that these thresholds cannot be set within ORTEC spectroscopy applications such as MAESTRO®.

installed. On the Instrument Families page, be sure to mark the **USB-based** instruments check-box. *Otherwise, the IDM-200 will not be able to communicate with ORTEC applications*.

2.3.2. Step 2: Install the MAESTRO MCA Emulation Software

Install MAESTRO on the host PC according to the instructions in its *User's Manual*.

2.3.3. Step 3: Install the IDM-200 Stabilizer Setup Application

If this instrument is a component in a larger system, such as a portal monitor, your system design may require you to run the accompanying Stabilizer Setup Application (P/N 797230) before it can be used in the larger system. Install it according to its instruction sheet (P/N 932540).

2.4. Startup and Cooldown

- Remove the IDM-200 from its shipping carton.

- Connect the power input cable to an ac power source and to the IDM-200's top-panel INPUT POWER connector.[5]

- Press the On/Off button. Within a few seconds, the cooler will activate (it is very quiet, but you may be able to feel its vibration). The outer ring of the On/Off button will blink until the detector is cool and the detector high voltage turns on, at which point the blinking will change to steady illumination.

- If you wish to monitor the detector and hardware status during cooldown, start MAESTRO, select **MCB Properties...** from the **Acquire** menu, click on the Status tab, and view the various monitored parameters. Refer to the MAESTRO *User's Manual* for more information on this feature.

- The IDM-200 typically requires <15 hours to fully cool. When the detector reaches operating temperature, the IDM-200 bias voltage will automatically turn on, and the outer ring of the On/Off button will remain steady on.

- Note that the internal battery will not charge until the detector has reached operating temperature. After that, the battery will typically reaches full charge in 3–4 hours.

[5]Alternatively, you can use a 12 V dc auto accessory adapter. If using a vehicle battery as a power source, note that cooling the detector to operating temperature can significantly discharge the vehicle battery.

NOTE Once the IDM-200 is cooled, you can turn the instrument off for a brief period (e.g., 10 to 20 minutes) without significantly warming the detector. As soon as the unit is powered up again, it typically returns to ready status (outer ring of On/Off button illuminated steady on) within a few seconds. The IDM-200 can be restarted at any time without harming the detector crystal, regardless of whether the detector is warm, partially cooled, or cooled to operating temperature.

The IDM-200 also has a remote power on/off capability. See the specification on page 27 in Chapter 5.

2.5. Connect the IDM-200 to Your PC

Attach the IDM-200 to a USB port on your PC. Windows will display a series of "new hardware" messages, followed by the Found New Hardware wizard. Choose to *automatically* locate the driver, and *do not* search the internet for the driver. In the unlikely event Windows cannot locate the driver, it is in C:\Program Files\Common Files\ORTEC Shared\UMCBI. When all new-hardware processing is finished, you're ready to run the MCB Configuration program (Section 2.6).

2.6. Run MCB Configuration to Establish Communication with the IDM-200

NOTE This is a very abbreviated discussion of the operation and use of the MCB Configuration program. We *strongly* recommend that you read the instructions for the CONNECTIONS Driver Update Kit for complete details on customizing MCB ID Numbers and Descriptions, changing your Windows firewall settings to allow MCB access across a network, enabling additional device drivers, and troubleshooting.

1) Make sure the IDM-200 is connected and powered on. Otherwise, the MCB Configuration program will not detect it during installation. Any instruments not detected can be configured at a later time.

2) Enter **mcb con** in the "search programs and files" box, then click on the **MCB Configuration** search result; or open the Windows Start menu and select **MAESTRO**, **MCB Configuration**.

3) The MCB Configuration program will locate all of the powered-on ORTEC MCBs on the local PC and the network, display the *Master Instrument List* of instruments found (Fig. 3).

2.6.1. Configuring a New Instrument

The first time a new instrument is detected, the dialog shown in Fig. 4 will remind you that all new instruments must be assigned a unique, *non-zero* ID number.[6] Click on **OK**. See the CONNECTIONS Driver Update Kit for instructions on customizing ID Numbers and Descriptions, or simply click on the **Renumber New** button to renumber only the new instruments.

NOTE We strongly recommend *not* using the **Renumber All** button.

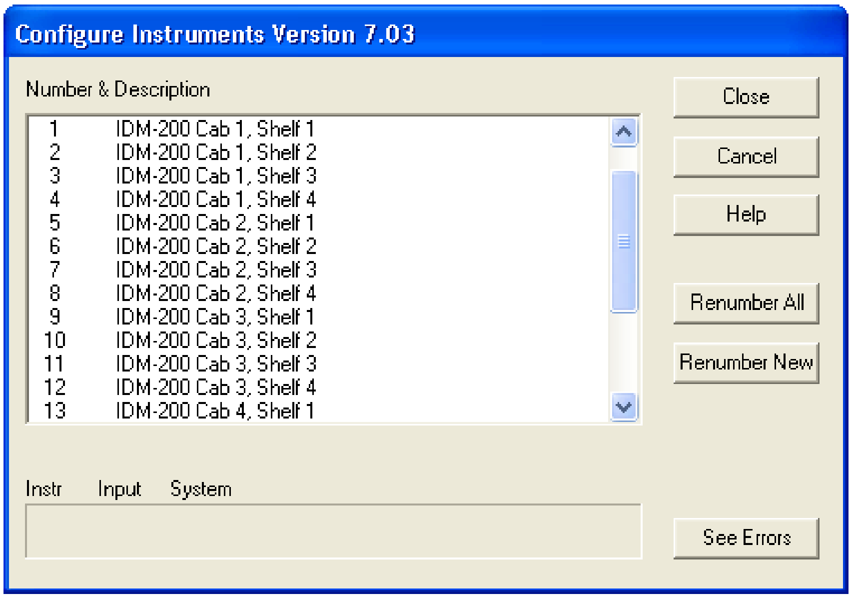

Fig. 3. MCB Numbering and Descriptions.

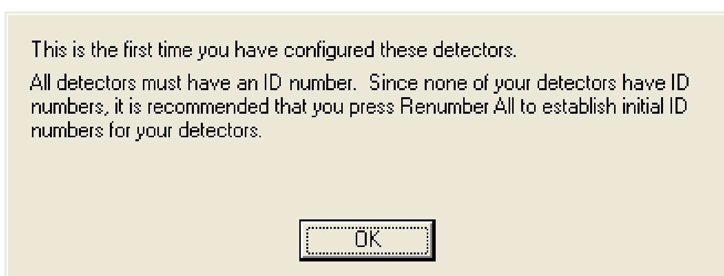

Fig. 4. New Instruments Must Have a Non-Zero ID Number.

[6]If this is a first-time installation of ORTEC products, all your instruments will be "new."

2.7. Option: Running the Stabilizer Setup Application

If this IDM-200 is a component in a larger system (as opposed to a benchtop MCA), your system may call for use of the accompanying IDM-200 Stabilizer Setup Application. Follow its instruction sheet (P/N 934070). When the setup routine successfully completes, the IDM-200 is ready for use in your monitoring solution.

2.8. Connecting to and Disconnecting from the PC

The IDM-200 can be connected to and disconnected from the system without shutting down either. If this unit is a component of a larger system, the system’s design will govern how connection and disconnection are handled. If you are using the instrument as a benchtop MCA with MAESTRO or other ORTEC spectroscopy applications, and disconnect from the PC during data acquisition (leaving the IDM-200 under power so that the high voltage stays on), the IDM-200 will continue data collection. To redisplay the spectrum in your spectroscopy application, simply reconnect the IDM-200, then close and reopen the spectrum window for that input.

2.9. Notes on IDM-200 Power Usage

The IDM-200 uses internal and external power as follows:

- The internal battery provides>2 hours of operation. The internal battery can start the cooler, however, it cannot completely cool the detector from room temperature; *external power is required*. The transition from internal to external power is automatic and does not interfere with data collection. When recharging an exhausted internal battery, keep in mind that the battery does not begin charging until *after the detector is cooled down to operating temperature* (cooldown nominally takes <15 hours). At that point, fully recharging the battery takes 3–4 hours.

- The power adaptor provides external power to simultaneously start and operate the IDM-200, as well as charge the internal battery.

- Other external power (supplied by external battery belt or 12 V automobile battery) can start, cool, and operate the IDM-200, as well as charge the internal battery. When connected to an external battery, the IDM-200 relies on external power until the external voltage drops below 9 V. It then switches to the internal battery. The instrument makes the transition smoothly, and there is no effect on the energy resolution. If you begin with both batteries fully charged, the sum of the two battery capacities will be achieved. If the external battery has its own charge indicator, this can be used to determine when the changeover will occur. The IDM-200 battery monitor indicates the available capacity in the internal battery, and when the switchover occurs, this indicator runs down in the usual manner.

NOTE When all power is exhausted, the high voltage and cooler shut down and the detector begins to warm. The IDM-200 cannot be used again until the unit has cooled enough that the high voltage automatically switches on and the outer edge of the On/Off button illuminates steady on, indicating the unit is ready for use.

2.10. Operating Cautions and Notes

- Remember that there are no user-serviceable parts inside the IDM-200. Opening the IDM-200 (except the battery hatch to replace the internal battery) voids the warranty.
- The cooler and detector are shock-sensitive, with a maximum tolerance of 20 g, so be careful not to drop the unit. A shock in excess of this value will void the warranty.
- The IDM-200 must be protected from exposure to moisture and dust.
- Allow air to circulate freely around the unit to dissipate heat from the cooler.
- The power adaptor/charger should not be exposed to water, and should generally be protected from moisture and dirt. Make sure the recharging connector on both the IDM-200 and power adaptor are clean and dry before attaching to an the input power supply.
- The IDM-200 is designed for use at temperatures between −10°C to +50°C, at a relative humidity 100%, non-condensing.
- The HPGe detector assembly is designed to be continuously cooled. If the instrument is turned off and allowed to warm between uses, it must be cooled and brought to operational status (outer edge of On/Off button steady on) for *at least 48 hours every month*. Failure to do this may result in degraded performance or cooling system failure. Read Section 5.5.
- To avoid damaging the cooler (and, where applicable, to comply with transportation regulations), be sure to turn the IDM-200 *off* before packaging and shipping the IDM-200. The unit can be shipped as soon as the cooler is turned off; there is no need to wait until the detector warms up.

- If using a USB cable with a threaded cap (such as the cable suppled with the IDM-200), ***be sure the cable is oriented and inserted correctly in the USB port before tightening the threaded cap***, otherwise the port receptacle may be damaged and require factory repair.

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3. MCB PROPERTIES IN MAESTRO

The IDM-200 was designed as a detector subsystem for applications such as portal monitoring. However, when you connect it to a Windows 7 PC running an ORTEC spectroscopy application such MAESTRO, you can use the it as a high-performance HPGe spectrometer/digital MCA. This section discusses the hardware setup dialogs you will see within MAESTRO when you use the **MCB Properties...** command on the **Acquire** menu.[7] The MCB Properties dialog contains all of the instrument controls including acquisition presets, amplifier gain adjustments, pole-zero controls, high voltage monitor, hardware status indicators, and access to the InSight Virtual Oscilloscope. For more details on use, see the MAESTRO *User's Manual*.

NOTES The changes you make on most property tabs take place immediately. There is no cancel or undo option for this dialog.

Returning to service — No matter the changes you make to the various hardware settings (e.g., amplifier, stabilizers, presets), returning it to service as a system component is easy. Just cycle the instrument's power off/on, then re-run the gain stabilizer setup application (Section 2.7).

3.1. Amplifier

Figure 5 shows the Amplifier tab, which displays the **Fine Gain**, **Baseline Restore**, and **Pole Zero** controls.

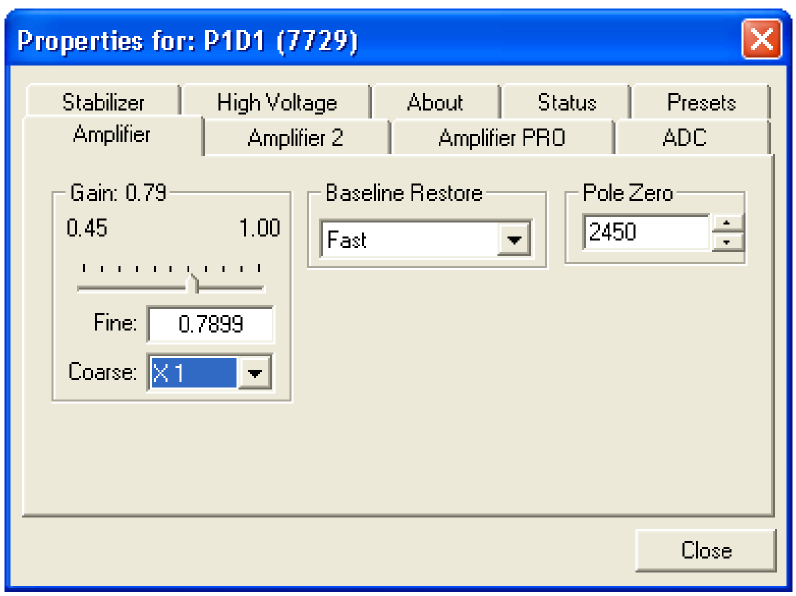

Fig. 5. Amplifier Tab.

3.1.1. Gain

Set the amplifier **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.45 to 1.00. The Coarse gain has only an ×1 setting.

3.1.2. Baseline Restore

The **Baseline Restore** is used to return the baseline of the pulses to the true zero between incoming pulses. This improves the resolution by removing low frequency noise from dc shifts or mains power ac pickup. The baseline settings control the time constant of the circuit that returns the baseline to zero. There are three fixed choices (**Auto**,[2] **Fast**, and **Slow**); the default for the IDM-200 is **Fast**. The fast setting is used for high count rates, the slow

[7]In MAESTRO, GammaVision®, etc., the **Download Spectra** and **View ZDT Corrected** commands on the **Acquire** menu and the **Smooth** and **Strip** commands on the **Calculate** menu are disabled for the IDM-200.

for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The time constant can be manually set on the InSight display; for more information, see the discussion on Marks in the MAESTRO *User's Manual*.

3.1.3. Pole Zero Adjustment

To maintain optimum energy resolution and peak position stability to high counting rates, it is important to enter the correct value for the pole-zero cancellation. Use the default value as the starting point.

To make a fine adjustment of the **Pole Zero** setting:

1) On the Amplifier PRO tab, unmark (disable) **LFR** mode.

2) Use a radioactive source that produces a well-defined peak near the upper limits of the energy spectrum. At low counting rates, note the symmetry of the peak.

3) Move the source closer to the detector to achieve much higher counting rates. If the peak maintains the symmetry observed at low counting rates no further adjustment of the **Pole Zero** is needed. If high counting rates generate a tail on the high energy side of the peak, slightly decrease the pole-zero value until the tail disappears. If high counting rates generate a tail on the low-energy side of the peak, slightly increase the pole-zero value until the tail disappears.

4) Make a final adjustment to balance the symmetry of the peak as closely as possible to the symmetry observed at low counting rates. This will result in the optimum pole-zero adjustment.

3.2. Amplifier 2

Figure 6 shows the Amplifier 2 tab, which accesses the advanced shaping controls including the InSight™ Virtual Oscilloscope mode.

Use the up/down arrows to adjust the **Rise Time** within the range of 3.2 to 23.0 μs. The many choices of **Rise Time** let you precisely control the tradeoff between resolution and throughput. Starting with the default value, you should increase the rise time for better resolution for expected lower count rates; or, when you anticipate unusually high count rates, reduce the rise time for higher throughput with somewhat worse resolution.

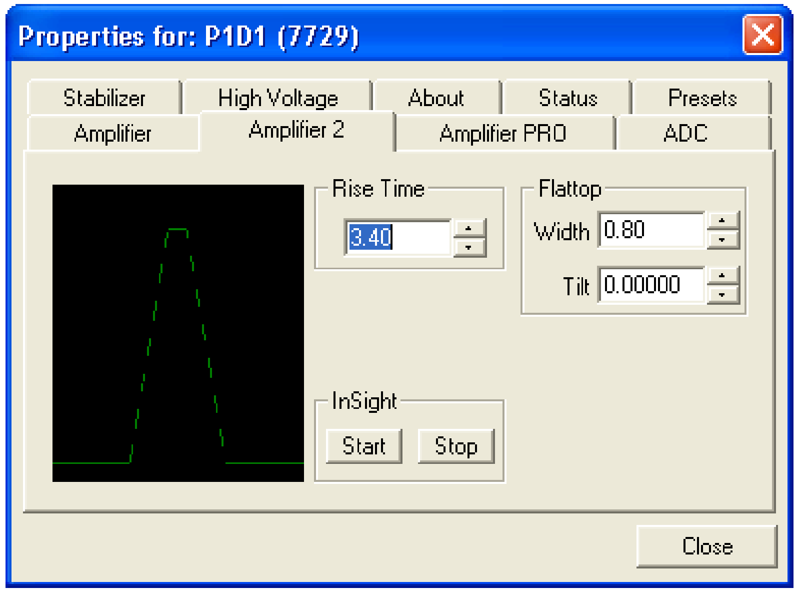

Fig. 6. Amplifier 2 Tab.

For the more advanced user, the InSight mode allows you to directly view all the parameters and adjust them interactively while collecting live data. To access the InSight mode, go to the **Insight** section on the Amplifier 2 tab and click on **Start**. The InSight mode is discussed in detail in the MAESTRO *User's Manual*.

The **Rise Time** value is for both the rise and fall times; thus, changing the rise time has the effect of spreading or narrowing the quasi-trapezoid symmetrically.

The **Flattop** controls adjust the top of the quasi-trapezoid. The **Width** adjusts the extent of the flattop (from 0.3 to 2.4 µs). The **Tilt** adjustment varies the "flatness" of this section slightly. The **Tilt** can be positive or negative (range: −1.0 to +0.99219). Choosing a positive value results in a flattop that slopes downward; choosing a negative value gives an upward slope.

The dead time per pulse is approximately $(3 \times \mathit{Rise\ Time}) + (2 \times \mathit{Flattop\ Width})$.

When you are satisfied with the settings, **Close** the Properties dialog and prepare to acquire data.

Once data acquisition is underway, the advanced user might wish to return to the Amplifier 2 tab and use InSight mode to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape.

3.3. Amplifier PRO

Figure 7 shows the Amplifier PRO tab, which contains the **Low Frequency Rejector** (LFR)[8] filter. Turning it off causes shifting and/or broadening of peaks in addition to the acquisition of noise in the lowest-energy channels. We strongly recommend the LFR be enabled during all data acquisitions. Note, however, that you must turn the LFR *off* to pole-zero the IDM-200. Subsequent measurements can then be taken with the LFR filter on.

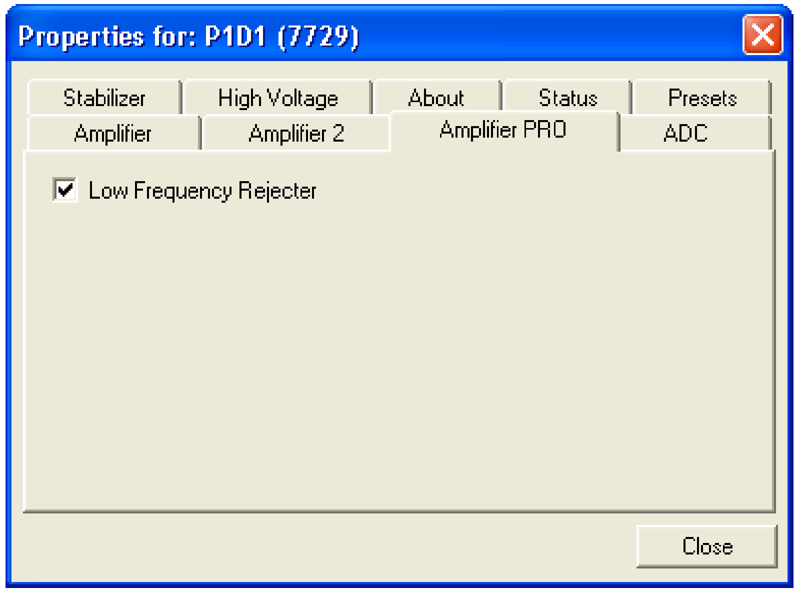

Fig. 7. Amplifier PRO Tab.

3.4. ADC

This tab (Fig. 8) contains the **Conversion Gain**, **Lower Level Disc**riminator, and **Upper Level Disc**riminator controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

The **Conversion Gain** sets the maximum channel number in the spectrum. If set to 16384, the energy scale is divided into 16384 channels. This parameter is entered in powers of 2 (e.g., 8192, 4096, 2048, 1024, 512).

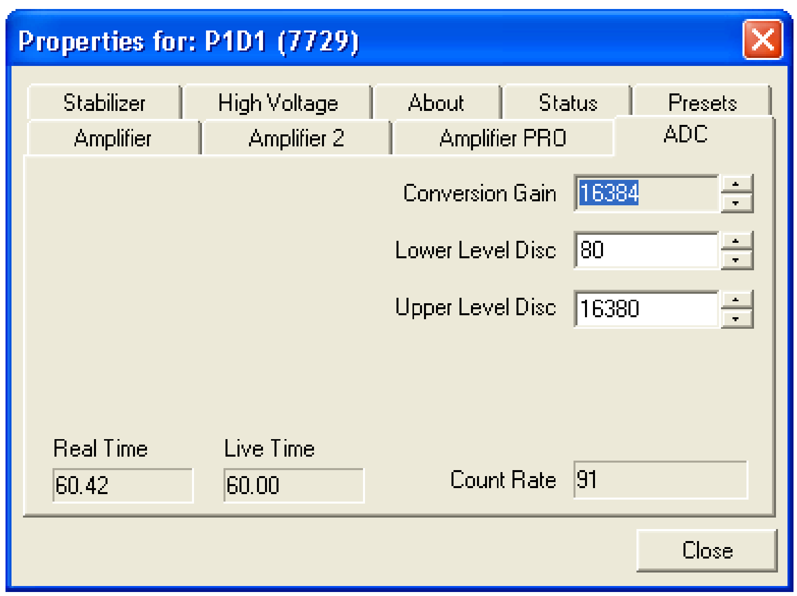

Fig. 8. ADC Tab.

[8]Patent pending.

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The **Lower Level Disc**riminator sets the level of the lowest amplitude pulse that will be stored. This level establishes a lower-level cutoff by channel number for ADC conversions. Because of the mechanical cooler, we recommend a minimum setting of 40 (in addition to leaving the LFR on at all times).

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff by channel number for storage.

3.5. Stabilizer

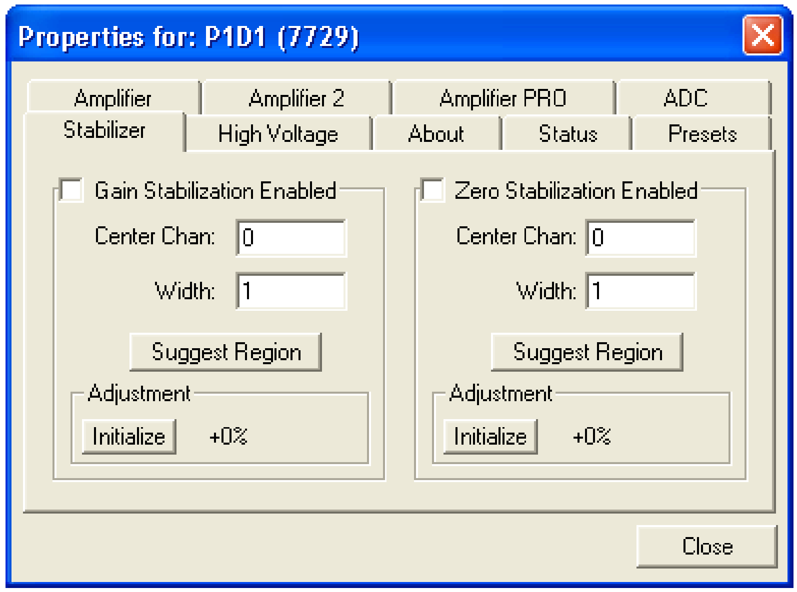

Fig. 9. Stabilizer Tab.

The IDM-200 has both a gain stabilizer and a zero stabilizer. The Stabilizer tab (Fig. 9) shows the current values for the stabilizers. The value in each **Adjustment** section shows how much adjustment is currently applied. The **Initialize** buttons set the adjustment to 0. If the value approaches 90% or above, the amplifier gain should be adjusted so the stabilizer can continue to function — when the adjustment value reaches 100%, the stabilizer cannot make further corrections in that direction. The **Center Chan**nel and **Width** fields show the peak currently used for stabilization.

To enable the stabilizer, enter the **Center Chan**nel and **Width** values manually or click on the **Suggest Region** button. **Suggest Region** reads the position of the marker and inserts values into the fields. If the marker is in an ROI, the limits of the ROI are used. If the marker is not in an ROI, the center channel is the marker channel and the width is 3 times the FWHM at this energy. Now click on the appropriate **Enabled** checkbox to turn the stabilizer on. Until changed in this dialog, the stabilizer will stay enabled even if the power is turned off. When the stabilizer is enabled, the **Center Chan**nel and **Width** cannot be changed. For more detailed information on gain and zero stabilization, see the MAESTRO *User's Manual*.

3.6. High Voltage

Figure 10 shows the High Voltage tab, which allows you to turn the bias voltage off and on, and monitor the **Actual** bias. You cannot adjust the bias voltage, nor can you change the **Shutdown** mode, which is fixed as **SMART**.[9]

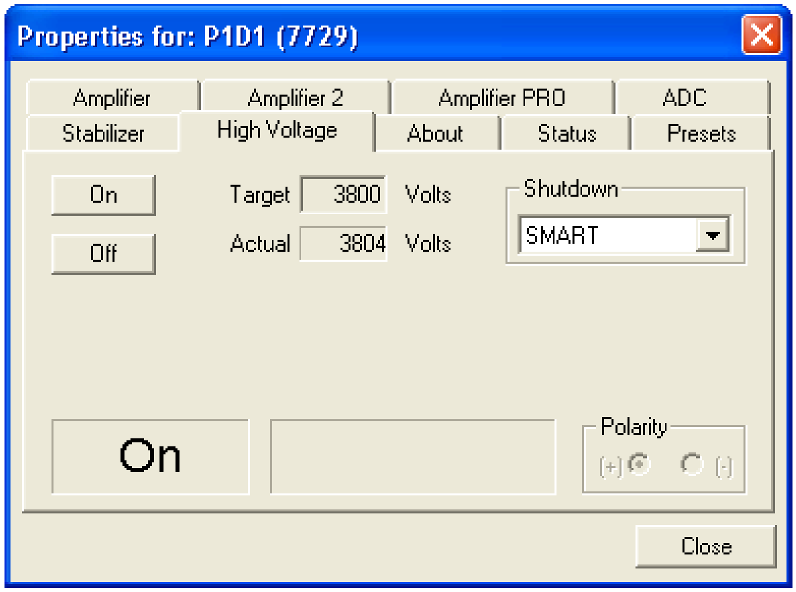

Fig. 10. High Voltage Tab.

3.7. About

This tab (Fig. 11) displays hardware and firmware information about the IDM-200 as well as the data **Acquisition Start Time**. In addition, the **Access** field shows whether the Detector is currently locked with a password by MAESTRO. **Read/ Write** indicates the Detector is unlocked and **Read Only** means it is locked. See the MAESTRO *User's Manual*.

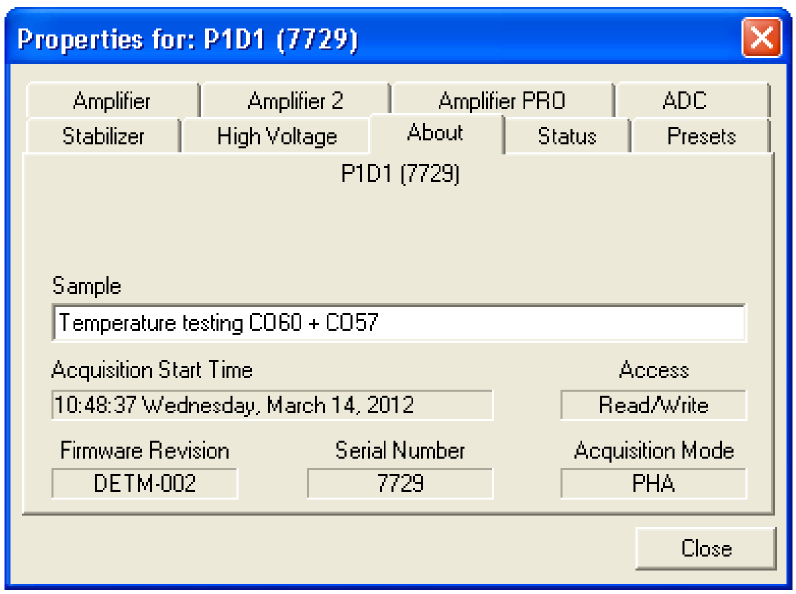

Fig. 11. About Tab.

Use the **Firmware Revision** field to determine the instrument type and firmware version. This para-

[9]This is a reference to the IDM-200's SMART-1® detector technology. For more information on SMART-1, see the ORTEC catalog or visit www.ortec-online.com.

meter is formatted *DETM-nnn*, where *DETM* is for the IDM-200 and *nnn* is the firmware version. In the accompanying illustration, *DETM-002* indicates an IDM-200 running firmware v2. You can also use the About tab to view this information for .SPC-format spectra downloaded from the IDM-200.

3.8. Status

Figure 12 shows the Status tab. All parameters are continuously monitored in real time. Satisfactory status is reported as OK or a numerical value. A failure is reported as ERR or a descriptive message. Use the list-boxes to select any six parameters to be displayed simultaneously on the Status tab. You can change the selected parameters at any time.

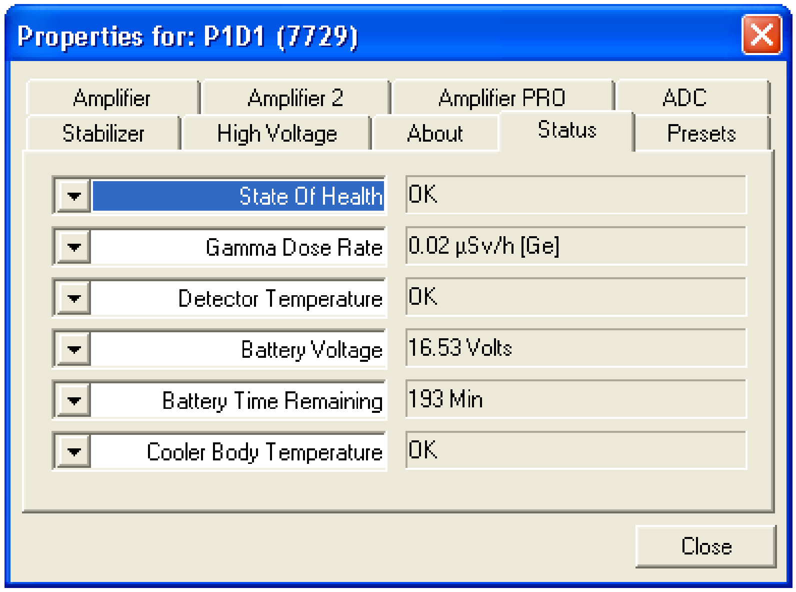

Fig. 12. Status Tab.

The monitored parameters are:

- Detector **State of Health** — Reported as OK or ERR.
- **Gamma Dose Rate** — Reported in µSv/h, and indicating whether this reading was made with the detector (Ge for low dose rates) or the Geiger-Müller tube (GM for high dose rates). See **Gamma Dose-Rate Determination**, page 25, for further discussion of the two dose-rate meters.
- **Detector Temperature** — Reported as OK or ERR.
- **Battery Voltage** — Reported in volts.
- **Battery Time Remaining** — In minutes.
- **Cooler Body Temperature** — OK or ERR.
- **Cooler Drive Voltage** — OK or ERR.
- **Cold-Tip Temperature** — OK or ERR.

- **HV Bias** — In volts.

- **External In 1** — The format is *N* Cnts (*input level*), where *N* is the number of rising edges on this input since the current data acquisition started; and the input level is `1` (high) or `0` (low).

- **External In 2** — Same format as External In 1.

- **Ion Pump Diag. Code** — For maintenance purposes only.

To resolve status problems, refer to the troubleshooting chapter. For further assistance, contact your ORTEC representative or our Global Service Center.

3.9. Presets

Figure 13 shows the Presets tab. The presets can only be set when the IDM-200 is not acquiring data (during acquisition the preset field backgrounds are gray indicating that they are inactive). You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

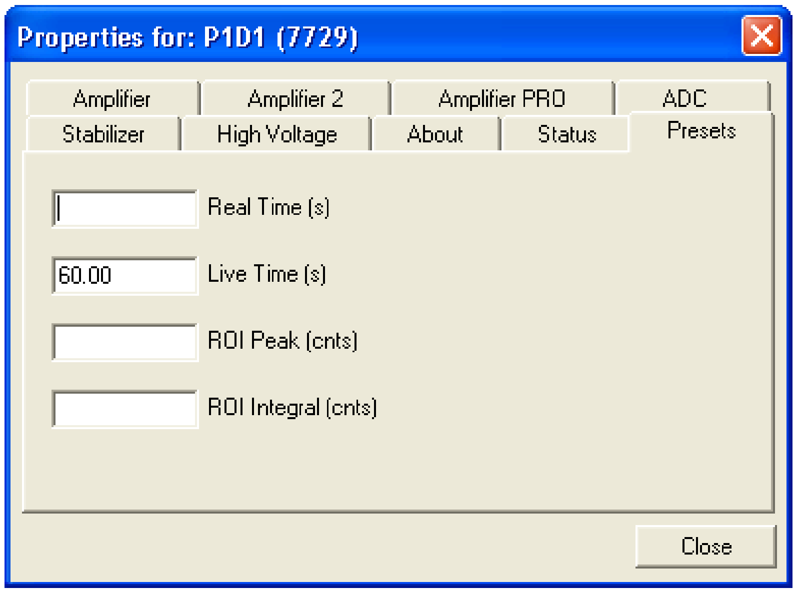

Fig. 13. Presets Tab.

When more than one preset is enabled (set to a non-zero value), the first condition met during the acquisition causes the Detector to stop. This can be useful when you are analyzing samples of widely varying activity and do not know the general activity before counting. For example, the **Live Time** preset can be set so that sufficient counts can be obtained for proper calculation of the activity in the sample with the least activity. But if the sample contains a large amount of this or another nuclide, the dead time could be high, resulting in a long counting time for the sample. If you set the **ROI Peak** preset in addition to the **Live Time** preset, the low-level samples will be counted to the desired fixed live time while the very active samples will be counted for the ROI peak count. In this circumstance, the **ROI Peak** preset can be viewed as a “safety valve.”

The values of all presets for the currently selected Detector are shown on the Status Sidebar. These values do not change as new values are entered on the Presets tab; the changes take place only when you **Close** the Properties dialog.

Enter the **Real Time** and **Live Time** presets in units of seconds and fractions of a second. These values are stored internally with a resolution of 20 milliseconds (ms) since the Detector clock increments by 20 ms. *Real time* means elapsed time or clock time. *Live time* refers to the amount of time that the Detector is available to accept another pulse (i.e., is not busy), and is equal to the real time minus the *dead time* (the time the Detector is not available).

Enter the **ROI Peak** count preset value in counts. With this preset condition, the Detector stops counting when any ROI channel reaches this value unless there are no ROIs marked in the Detector, in which case that Detector continues counting until the count is manually stopped.

Enter the **ROI Integral** preset value in counts. With this preset condition, the Detector stops counting when the sum of all counts in all channels for this Detector marked with an ROI reaches this value. This has no function if no ROIs are marked in the Detector.

[Intentionally blank]

4. TROUBLESHOOTING

4.1. If the On/Off Button Does Not Stop Flashing

If the illuminated ring on the IDM-200's On/Off button begins flashing during normal operation, or if you start up a warm unit and the button does not stop flashing after 20 or more hours of cool-down:

- Connect the unit to the PC on which the accompanying CONNECTIONS Driver Update Kit and MAESTRO were installed, start MAESTRO, and select the IDM-200 from the detector list. If you receive a "bad state of health" notification, click on **OK**.

- On the menu bar, select **Acquire/MCB Properties...**, then click on the Status tab and refer to Section 3.8. The state of health, detector temperature, cooler body temperature, cooler drive voltage, and cold-tip temperature readouts should be OK. On the High Voltage tab, the actual HV should be within a few percent of the factory-set target voltage. If any of the status monitors read ERR and/or the HV is off, allow the unit to cool for a few more hours. If it does not return to ready status, contact your ORTEC representative or our Global Service Center.

4.2. If You Drop the IDM-200

The IDM-200 has been designed to be a rugged instrument, and should survive reasonable levels of mechanical abuse. It has been drop-tested to destruction in development and is known to have a high degree of survivability to "normal" shock and vibration.

If the instrument is dropped:

- Disconnect from any external power source, disconnect any USB connection, and cycle the power off/on. It should turn on and return to ready status (outer ring of On/Off button illuminated steady on) immediately.

- Inspect the exterior for evidence of mechanical damage or distortion.

- *Listen* to the cooler: If you hear any unusual noises (rattling or pinging) emanating from the cooler, contact your ORTEC representative or our Global Service Center.

- Monitor the unit for the next few hours to ensure that it remains ready (outer ring of On/Off button illuminated steady on) and performs as expected with test sources.

If the unit fails in one or more of these respects or if one or more hardware diagnostic settings (Section 3.8) indicate a hardware failure, contact your ORTEC representative or our Global

Service Center for further assistance. *Remember that there are no user-serviceable parts inside the IDM-200, and opening the case will void the warranty.*

4.3. If the IDM-200 Will Not Turn On

- Connect the IDM-200 to an external power source; it should automatically boot up, turn the cooler on, and start the IDM-200 software application. The unit can start the cooler using internal battery power, but *must* be connected to an external power source to fully cool a warm detector.

- If the internal batteries have become exhausted but can still hold a charge, see the next section.

- If the battery does not hold a charge, ensure that it is properly installed. If properly installed, the battery must be replaced according to the instructions in Chapter 8.

4.4. Troubleshooting MAESTRO-Related Problems

4.4.1. MAESTRO Does Not Connect with the IDM-200

If properly installed and functioning MAESTRO software (or other CONNECTIONS programs) cannot find and communicate with the IDM-200 when it is connected via the USB port and being used as an MCA:

- Make sure the USB cable is competent and properly connected to both the IDM-200 and PC.

- Make sure USB hubs are correctly connected and functioning.

- Make sure the IDM-200 is turned on and ready for data acquisition (On/Off button light steady on).

- Check the Master Instrument List on the PC to ensure that the IDM-200 is on the list. If it is not listed, manually run the MCB Configuration program from the Windows Start menu. See the MAESTRO *User's Manual* for detailed instructions on this operation.

5. SPECIFICATIONS[10]

Gamma-Ray Detector Internal, coaxial HPGe detector. P-type high-purity germanium. Nominal 85 mm diameter × 30 mm deep. All-metal, sealed, long-life cryostat; no molecular sieve.

Internal Compensated Geiger-Müller Tube LND 7149 Geiger Müller tube. GM tube specifications are available on request.

Gamma Dose-Rate Determination The IDM-200 uses two detectors to determine the gamma dose rate over a wide range from <0.05 μSv/h to >10000 μSv/h, a dose-rate range of around six decades. For low dose rates (below ~20 μSv/h) the dose rate is determined from the Ge detector spectrum. For dose rates above this value, the internal compensated GM tube is used. The IDM-200 switches between the two automatically.[11]

NOTE The dose rate function in the IDM-200 should not be considered as adequate for accurate dosimetry purposes. Its primary purpose is to protect the IDM-200 user from high radiation fields.

Cooler High-reliability, low-power Stirling cooler. Power usage when cold <2 A. Initial cooldown time depends on ambient temperature, but at 25°C is typically <15 hours.

System Gain Settings 0.45 to 1.

System Conversion Gain Software selectable from 512 to 16384 channels.

Shaping-Time Constants

- Rise time: Default Mode: 3.4 μs, fixed. MCA Mode: 3.2 μs to 23 μs.
- Flattop: Default Mode: 0.8 μs width, fixed. MCA Mode: 0.3 μs to 2.4 μs width.

Dead-Time Correction Extended live-time correction according to Gedcke-Hale method.[12] Accuracy: area of reference peak changes <±3% from 0 to 50000 cps.

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[10]Subject to change without notice.

[11]For radiation fields from extended sources (e.g., from a container full of NORM) or far-field point sources (>1 ft [0.3 m] from the instrument), the precise location of the detector in use is not important. When point sources are close to the instrument, the detector readings might not be in agreement because they are in different places within the instrument and the dose rate is varying rapidly with position.

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

Linearity

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

- Differential Nonlinearity: <±1% (measured with a BNC pulser and ramp generator) over top 99% of range.

Overload Recovery At maximum gain, recovers to within 2% of rated output from ×1000 overload in 2.5 non-overloaded pulse widths (measured using our InSight™ Virtual Oscilloscope).

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

Low Frequency Rejector (LFR) Filter[13] When set to ON, removes low-frequency (<3 kHz) input noise from spectrum. Designed to reduce microphonic and low-frequency periodic noise from surrounding electronics and equipment or ground loops.

Presets Multiple presets can be set within MAESTRO for any or all of the following:

- **Real Time** Stops data collection when the real time reaches this value (in increments of 1 s).

- **Live Time** Stops data collection when the live time reaches this value (in increments of 1 s).

- **ROI Integral** Integral count stops data collection when the sum of all ROI channels reaches this value.

- **ROI Peak** Peak count stops data acquisition when any ROI channel reaches this value (maximum value of $2^{32}-1$ counts [4×10^9]).

5.1. Electrical and Mechanical

Dimensions Maximum overall dimensions including handle, Ge detector endcap, neutron detector and shock absorbers: 41.3 cm L × 34.0 cm W × 21.2 cm H (16.3 in. × 13.4 in. × 8.3 in.)

Weight 17.7 kg (39 lb).

[13]Patent pending.

Input Power 10 to 17 V dc from battery or dc power supply (universal mains supply included). Battery charger circuit is inside instrument.

Power Usage Greatest during cooldown: <100 W. While charging battery: 5 A nominal. Cold with fully charged battery: <2 A.

Remote Power On/Off Opto-isolated input on pins 5 and 6 of the power connector turns off the IDM-200 if the input voltage exceeds 2 V. Power is turned on if the voltage between the two pins is less than 0.25 V. Power is on if pins are left disconnected. The voltage on the pins should not exceed 24 V. Input is not polarized. Only the absolute voltage between the two pins is significant. Input Impedance 2000 Ω.

Maximum Shock Tolerance 20 g. An accelerometer inside the instrument tracks the maximum shock to which the unit has been subjected, and a shock in excess of 20 g will void the warranty.

Ambient Operating Environment −10°C to +50°C, at a relative humidity 100%, non-condensing.

Internal Battery Rechargeable, nominal 14.4 V lithium-ion battery pack. Charging circuitry and battery management circuitry internal to the power adaptor/ charger. Battery lifetime 3–5 years; replacement kit available from ORTEC. The compartment is semi-sealed and protects against penetration of dirt and moisture. See Chapter 8 for instructions on replacing the battery.

Battery Life When HPGe detector is cold, >2 hours at 25°C, <4 hour charge time. Battery life can be extended indefinitely by the use of optional, external battery belt. The unit is expected to be kept running once cold.

Note that the internal battery charge can start the mechanical cooler but cannot fully cool a warm detector; external power is required. In addition, an exhausted internal battery should be charged for 2 hours before the identifier is cooled using external power. If the internal battery is completely exhausted but can still hold a charge, see troubleshooting Section 4.3. Note that using an automobile battery to cool the detector could significantly discharge the auto battery.

CE Conforms to CE standards for radiated and conducted emissions, susceptibility, and low-voltage power directives.

5.2. Connectors

USB (⭠) Top-panel high-speed USB port connects the IDM-200's microprocessor to the controlling PC. Waterproof threaded cap should be left in place when the port is not in use.

INPUT POWER Top-panel external power input, with dust cover, 12–17 V dc, <90 W, or from battery or ac mains.

EXTERNAL 1 and 2 ports — Connect to neutron detectors, occupancy sensors, other peripherals; 0 V to +5 V with adjustable threshold. Set thresholds with firmware commands SET_THRESH_AUX (page 46) and SHOW_THRESHOLD_AUX (page 58).[14] Waterproof threaded cap should be left in place when a port is not in use.

5.3. PC Prerequisites

The IDM-200 operates in conjunction with ORTEC CONNECTIONS software such as MAESTRO, on PCs running Microsoft Windows 7 or XP Professional SP3.

5.4. Shipping the IDM-200

To avoid damaging the cooler and, where applicable, to comply with transportation regulations, be certain to turn the IDM-200 ***off*** before packaging and shipping. The unit can be shipped as soon as the cooler is turned off. There is no need to wait until the detector warms up.

5.5. Long-Term Shutdown/Storage

CAUTION

This instrument should be cooled and brought to operational status (illuminated outer ring of On/Off button steady on) for at least 48 hours every month. Failure to do this may result in degraded performance or cooling system failure.

This instrument uses a Stirling cycle refrigerator and all-metal-sealed cryostat designed for long operational life. The vacuum integrity inside the cryostat is maintained by "getters," which scavenge traces of residual material when cold; and by an ion pump that operates when the instrument is powered up. These two techniques maintain the system vacuum in peak condition during

[14]Note that these thresholds cannot be set within ORTEC spectroscopy applications such as MAESTRO®.

normal use. A good vacuum yields rapid cooldown and ensures operation at the high end of the instrument's operating temperature range.

Over time, in any cryostat system, residual contaminants can be released from the materials inside the evacuated cryostat by a process called *outgassing*.[15] It has become apparent that, in extended storage, the vacuum in our mechanically cooled identifiers may degrade to the point that, on trying to restart, the gas load inside the cryostat is too high and the unit fails to cool. The remedy is straightforward, if inconvenient: a "pump and bake" of the instrument is required at an ORTEC service center.

Fortunately, you can easily avoid this problem: ***We strongly recommend that instruments used only occasionally be turned on once a month, fully cooled to ready status, and allowed to run for at least 48 hours. Doing this starts the ion pump and activates the internal getters, ensuring that the vacuum is maintained in good condition.***

As well as maintaining the vacuum, this procedure keeps the system battery "topped up" and also provides peace of mind that the system will cool when required.

[15]This is not to be confused with a vacuum leak, although both result in a degradation of the vacuum.

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6. LIST MODE

The IDM-200 is equipped with a *List Mode* that is useful in real-time monitoring applications. Because of the widely varying requirements for a real-time monitoring application, no standard software is provided for collecting and analyzing List Mode data. To enter List Mode, issue the SET_MODE_LIST command; use SET_MODE_PHA to exit List Mode.

This chapter provides details about the List Mode that will enable experienced programmers, using the ORTEC CONNECTIONS Programmer's Toolkit with Microsoft® ActiveX® Controls (A11-B32), to write a custom software application program that can collect List Mode data and write it to a disk file.

6.1. Spectrometer Data Format

List Mode data is retrieved from the IDM-200 spectrometer by calls to the CONNECTIONS MIOGetData() DLL function or the CONNECTIONS control GetRawData() method. A minimum of 4 and a maximum of 16384 32-bit words of data can be requested at a time. Each request for data returns a block of 32-bit list mode words that begin with a 32-bit integer number of valid bytes followed by a 3-word CONNECTIONS time stamp, thus the minimum of 4 words in a request. The first word is the number of bytes returned, not including the first 4 bytes. The minimum value returned here is 12, indicating 3 CONNECTIONS time stamp words only, and the maximum is 65532, indicating 3 CONNECTIONS time stamp words plus 16383 data words.

The CONNECTIONS time stamp represents the 64-bit Windows file time that corresponds to the exact time that the request for data is sent to the spectrometer. At the exact time the CONNECTIONS requests data from the spectrometer, the spectrometer creates a hardware time word in the list mode data stream that indicates the corresponding time within the spectrometer. The 16-bit real time number on the hardware time word is from the same time source as the 16-bit real time stamps on each of the ADC words. Using the CONNECTIONS time stamp and the hardware time word you can determine the 64-bit Windows time associated with each ADC word in the buffer. Refer to the Win-32 function GetSystemTimeAsFileTime() for more information about the 64-bit time format contained in these words.

In the case where the data acquisition program does not get all of the data from the spectrometer, the data block will not contain a hardware time word. In this case the data acquisition program must immediately request another block of data from the spectrometer in order to find the corresponding hardware time stamp. Note that the second block will begin with another CONNECTIONS time stamp, which will correspond to another hardware time word. The data acquisition program must associate the first CONNECTIONS time stamp to the first hardware time word and the second CONNECTIONS time stamp to the second hardware time word even though the first hardware time word appears after the second CONNECTIONS time stamp. For example, if you request 16384 words and the first returned word is 65532 indicating that 16380 data words plus 4 overhead words were returned, you should immediately request another block of data.

The IDM-200 has buffer storage for up to 96k 32-bit words. Therefore, six requests may be needed to drain the buffer and find all of the hardware time words. In practice, a program buffer of 96k words would always hold enough data to drain an instrument buffer assuming that all six requests were made in less than 1 second.

The following tables describe the format for the list-mode data as returned by CONNECTIONS from the IDM-200 spectrometer:

Table 1. Spectrometer List Mode Data Format.

	31 30	29 — 16	15 — 0
ADC Word	1 1	14-bit ADC value	16-bit real time in 200nS ticks
RT Word	1 0	30-bit real time in 10 ms ticks	
LT Word	0 1	30-bit live time in 10 ms ticks	

Table 2. Spectrometer List Mode Data Format.

	31 — 24	23 — 16	15 — 8	7 — 0
Hdw Time	00000000	00000000	16-bit real time in 200nS ticks	
CONNECTIONS Time	00000001	Byte 2	Byte 1	Byte 0
CONNECTIONS Time	00000010	Byte 5	Byte 4	Byte 3
CONNECTIONS Time	00000011	00000000	Byte 7	Byte 6
ADC CRM	00000100	00000000	Counts per 10 ms period	
Ext Counter 1	00000101	00000000	Counts per 10 ms period	
Ext Counter 2	00000110	00000000	Counts per 10 ms period	
GM Counter (IDM-200 Only)	00000111	00000000	Counts per 10 ms period	

The ADC Word contains a 14-bit ADC value and a 16-bit real time stamp. The Hardware Time Word contains the same 16-bit real time stamp. In both cases this value represents the time that the word was created as represented by an internal clock that increments every 200 ns. The 200 ns clock rolls over from 49999 to 0, which gives it a period of 10 ms. Every time the 200 ns clock rolls over a RT Word and LT Word are created. The 30-bit real time stamp on the RT word corresponds to the number of times the 200 ns clock rolls over. The 10 ms real time clock and the 10 ms live time clocks are cleared when the CLEAR command is sent to the spectrometer. Otherwise they increment every 10 ms while data is collecting. Using the RT Word as a time standard and the 200 ns time stamps from the ADC Word you can determine the time that any ADC event occurred, ±200 ns, relative to the beginning of the acquisition.

LT Words are created by the spectrometer at the same time as are RT Words. The 30-bit live time stamp represents the ADC live seconds since the beginning of the acquisition (or since the last CLEAR command). By calculating the relative change in live time between any two LT Words in a list mode stream you can calculate the live time for a given block of data, ±10 ms.

The ADC CRM Word is generated at the same time as the RT Word, and always appears just after the LT Word in the list data. This word reports the number of gamma rays detected in the preceding 10 ms. The count is incremented each time the ADC fast channel detects a pulse. Since many pulses may be rejected before one is converted into a valid ADC event, this number is not the simple sum of the ADC events over the past 10 ms; instead it represents the true input count-rate during the 10 ms interval.

The Ext Counter Words are generated at the same time as the RT Word. They represent the number of rising edges that arrived on the External inputs in the preceding 10 ms. Note that an external input must remain high for at least 40 ns for the pulse to be counted.

Optionally, the external counters can be configured to be a simple level sensitive input (see the ENAB_COUNT_LIST command on page 39). In this case the counter value is 0 or 1, depending on the level of the input at the time the counter word is generated.

The GM Counter Word is generated at the same time as the RT Word. It reports the number of counts registered in the Geiger-Müller tube in the preceding 10 ms (the GM tube specification is on page 25).

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7. FIRMWARE COMMANDS AND RESPONSES

Most software communication with the IDM-200 will be through the CONNECTIONS software layer. CONNECTIONS is used by all ORTEC software and can be accessed for other software development with our CONNECTIONS Programmer's Toolkit with Microsoft ActiveX® Controls (A11-B32). Use the DLL interface call MIOComm or the ActiveX control UCONN's Comm method to send commands to instruments and receive responses.

7.1. Command Format

The commands consist of a command header that may be followed by numeric parameter values. The header consists of a verb; a verb and noun; or a verb, noun, and modifier; each separated by underscores. The first four letters of a word in a command will always be enough to uniquely identify that word when composing commands for the instrument. For example, the command **ENABLE_GAIN_STABILIZATION** can be abbreviated to **ENAB_GAIN_STAB**.

Numeric parameters are unsigned integer numbers that follow the command header separated by one or more spaces. Specific commands require multiple parameters, separated by commas, that specify numeric quantities related to the operation of the MCB, such as live time or conversion gain. The command **SET_WINDOW 0,8192** has two parameters, 0 and 8192, which set the window of interest to start at channel 0 and continue for 8192 channels.

Some parameters are optional and are delimited by square brackets in the command prototype line to distinguish them from mandatory parameters (e.g., SET_WINDOW [start,length]). Commands with optional parameters can be sent to the MCB without the optional parameters, in which case the instrument behavior will be explained in the command description.

7.2. Error Codes

On each completion of the command, the MCB returns a macro error code and micro error code. 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. In case of error condition, you can use the MIOGetLastError (DLL interface) or GetErrMajor, GetErrMinor (ActiveX control interface).

Macro error codes:

0	Success
1	Power-up just occurred
2	Battery-backed data lost
129	Command syntax error
131	Command execution error
132	Invalid Command

For macro code 129 (syntax error) or 131 (execution error), the following apply:

1	Invalid Verb
2	Invalid Noun
4	Invalid Modifier
128	Invalid first parameter
129	Invalid second parameter
130	Invalid third parameter
131	Invalid fourth parameter
132	Invalid number of parameters
133	Invalid command
134	Response buffer too small
135	Not applicable while active
136	Invalid command in this mode
137	Hardware error
138	Requested data not found

Micro error codes:

0	Success
1	Input already started/stopped
2	Preset already exceeded
4	Input not started/stopped
64	Parameter was rounded (for decimal numbers)
128	No sample data available

7.2.1. 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 the MCB API. 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).
$Gxxxxxxxxxxccc<CR>	xxxxxxxxxx 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.

7.2.2. Command Catalog

This section lists each command with a description of its operation. This section lists each command with a description of its operation. The descriptions include a list of any error codes that may result. As described in the two preceding sections, the usual response is a macro error code of 0 and a micro error code of 0 (no errors). 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.

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. 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) are set to zero. The live time and true time counters 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.

CLEAR_PRESETS

The live time, true time, ROI integral, ROI peak, and overflow presets are all set to zero (disabled).

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.

DISABLE_BLRE_AUTOMATIC

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

DISABLE_COOLER

Powers off the cooler. Typically used only for troubleshooting.

DISA_COUNT_LIST x

In the List Mode data stream, data from the external inputs can either be returned as a counter, or a level. This command sets the specified input to be used as a “Level” (0 = EXTERNAL 1, 1 = EXTERNAL 2). See also ENAB_COUNT_LIST.

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. See also ENABLE_HV and SHOW_HV.

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_BLRE_AUTOMATIC

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

ENABLE_COOLER

Powers on the cooler. Typically used only for troubleshooting.

ENAB_COUNT_LIST x

In the List Mode data stream, data from the external inputs can either be returned as a counter, or a level. This command sets the specified input to be used as a “Counter” (0 = EXTERNAL 1, 1 = EXTERNAL 2). See also DISA_COUNT_LIST.

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). See also DISABLE_GAIN_ STABILIZATION, SHOW_GAIN_STABILIZATION, and INITIALIZE_GAIN_STABILIZATION.

ENABLE_HV

Turns on the high-voltage. See also DISABLE_HV and SHOW_HV.

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

Returns the IDM-200 to the factory default settings.

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.

LIST_BLRE

Lists the valid settings of the baseline restore function.

LIST_CORR_FLAT

Lists the valid settings of the flattop width.

LIST_GAIN_COARSE

Lists the valid coarse-gain settings (the IDM-200 supports only the setting **1**).

LIST_GAIN_CONV

Lists legal conversion gain settings.

Response:

GAIN_CONV 512 1024 2048 4096 8192 16384

LIST_GAIN_FINE

Lists the valid fine-gain settings.

LIST_HV

Lists the valid high-voltage settings.

LIST_ROI_SAMPLE

Lists the valid ROI sample settings.

LIST_SHAP_FLAT

Lists the valid flattop width settings.

LIST_SHAPE_RISE

Lists the valid rise-time settings.

LIST_SHUT

Lists the valid shutdown settings.

LIST_TRIG_SAMPLE

Lists the valid sample trigger settings.

RESTORE_CAL

Initializes spectrum stabilizers, returns fine gain to factory calibration, and returns energy calibration to factory calibration.

RESTORE_CAL_ENERGY

Returns energy calibration to factory calibration.

RESTORE_GAIN_FINE

Returns fine gain to factory calibration.

SAMPLE

Sending this command causes another waveform to be captured in InSight mode. This command is invalid when not in InSight mode.

SET_BLRE baseline

This sets the baseline restorer time constant to the value baseline. Baseline is in microseconds with a range from 10 to 100. The specified value is only used if automatic baseline restorer mode is disabled. See also ENABLE_BLRE, DISABLE_BLRE, and SHOW_BLRE.

SET_CAL_ADJUST fff.ff

Adjusts fine gain by the ratio:

$$\textit{New fine gain} = \textit{Current fine gain} * (1 + \textit{fff.ff})$$

where fff.ff can be positive or negative.

SET_CORRECTION_FLAT value

This sets the flattop correction to value. 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. If start and chans are not specified, sets all channels of spectral data in the window of interest (see SET_WINDOW command) to the specified value. ROI flags are not affected.

SET_DATA_APPLICATION “string1",”string2"

This is used to store information in the IDM-200 internal memory that can be used by other programs, such as sample descriptions and energy calibrations. CONNECTIONS makes use of this feature. String1 = the data identifier, 32 bytes maximum; string2 = the data, 128 bytes maximum.

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 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_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.

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.

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.

SET_GAIN_COARSE num

Num always = 1 for the IDM-200. 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.

Legal Commands:

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

SET_GAIN_FINE value

This sets the fine gain to value. Value is a floating point value from 0.45 to 1.0. See also SHOW_GAIN_FINE.

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.

SET_HV value

The HV in this unit is fixed.

SET_ID "<id string>"

Sets the sample id string. This string can be up to 16 characters long and can be set to any arbitrary value. The id string is intended to uniquely identify the sample being analyzed. The id string is also set by the BARCODE command and is stored with each spectrum acquired in field mode. See also SHOW_ID.

Examples:
SET_ID "Site 123"
SET_ID "Sample 123456789"

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 IDM-200. 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.

SET_LENGTH_SAMPLE length
Sets the number of points in the Insight mode display to the specified value. Normally this setting would remain at 1000.

SET_LIVE ticks
Sets the live-time counter to the specified number of ticks. The number represents live time in units of 20 ms (50 ticks/s). Normally this value is set by the IDM-200 during data acquisition. See also CLEAR_COUNTERS and SHOW_LIVE.

SET_LIVE_PRESET ticks
Sets the live-time preset to the specified number of ticks (20 ms/tick). During data acquisition when the live-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. The preset should always be set to a multiple of 1 second. Setting a live-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_LIVE_PRESET.

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

SET_MODE_LIST
Sets the IDM-200 to list mode. See also SHOW_MODE.

SET_MODE_PHA
The mode is set to PHA.

SET_MODE_SAMPLE

Starts InSight Virtual Oscilloscope mode.

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 IDM-200. 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.

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. Only a single bit can be turned on at a time. The following signals can be selected with the associated bit.

Bit 0: Pileup 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_SHAP_FLAT value

Sets the width of the flattop to value. Value is in microseconds, ranging from 0.3 to 2.4 in steps of 0.1. See also SHOW_SHAP_FLAT.

SET_SHAP_RISE value

Sets the rise time to value. Value is in microseconds, ranging from 3.2 to 23 in steps of 0.2. See also SHOW_SHAP_RISE.

SET_THRESH_AUX value,n
Sets the threshold, in volts, for the top-panel EXTERNAL 1 and EXTERNAL 2 inputs; value ranges from 0 to 4.98 V; n is 0 for EXTERNAL 1 and 1 for EXTERNAL 2. For example, SET_THRESH_AUX .3,0 sets the threshold for EXTERNAL 1 to 0.3 V.

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.

SET_TRIG_SAMPLE setting
Selects the triggering source in Insight Mode. See LIST_TRIG_SAMP for legal trigger sources.

SET_TRUE ticks
Sets the true-time counter to the specified number of ticks. The number represents true time in units of 20 ms (50 ticks/sec). Normally this value is set by the IDM-200 during data acquisition. See also CLEAR_COUNTERS and SHOW_TRUE.

SET_TRUE_PRESET ticks
Sets the true-time preset to the specified number of ticks (20 ms/tick). 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. The preset should always be set to a multiple of one second. See also CLEAR_PRESETS and SHOW_TRUE_PRESET.

SET_ULD value
This sets the upper level discriminator to value, in channels.

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.

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.

SHOW_ACTIVE

Returns a 1 if the IDM-200 is active (i.e., acquiring spectral data) or 0 if it is not active.

Responses:

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

SHOW_BATT_LIFE

Shows the remaining battery life in minutes.

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 IDM-200), 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_MASK

Returns two masks, the first of which can be “anded” with data from the MCB to clear the ROI bit from the data. When the second mask value is “anded” with data from the MCB, the data bits are removed and only the ROI bit remains.

Response:

CONF_MASK 02147483647 02147483648

SHOW_COOLER

Shows whether the cooler is on or off.

Responses:

$IT<CR>	Cooler is on/enabled.
$IF<CR>	Cooler is off/disabled.

SHOW_CORRECTION_FLAT

Shows the flattop correction value. See also SET_CORR_FLAT.

Responses:

CORR_FLAT 000000000000000

SHOW_CRM

Returns the current reading of the count-rate meter.

Response:

$G0000050781096	Current input count rate is 50781 counts/s.

SHOW_DATA_APPLICATION “string”

If string matches “string1" in a previous SET_DATA_APPLICATION command, then string2 from that command is returned. The response is a $F record.

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.

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Responses:

$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.

Responses:

$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_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_DET_TEMP

Shows detector temperature relative to factory set point, in kelvins (K).

SHOW_DOSE

Returns dose in microSieverts (μSv).

SHOW_FEATURES

Responds with four 32-bit masks indicating which features are present in the MCB.

Example Response:

FEATURES 00003774783 01083064332 00195036416 00000050313

SHOW_GAIN_ADJUST

Returns the gain stabilizer amplifier setting.

SHOW_GAIN_CHANNEL

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

Responses:

$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 IDM-200 internal amplifier, which is always 1. In operation, the resulting signal gain is the product of the coarse gain, the fine gain, and the super-fine gain (used by stabilizer).

Responses:

$C00001088<CR>	Coarse gain reported as 1.

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	Gain is 0.5.

SHOW_GAIN_POLARITY

Returns the polarity of the amplifier input as $F records.

Responses:

$INEG<CR>	The amplifier input is set to negative.
$IPOS<CR>	The amplifier input is set to positive.

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.

Responses:

$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_HV

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

$Dvvvvvsssssccc<CR>

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).

Example Responses:

$D0200000003077<CR>	2000 V, negative, not overloaded, disabled.
$D0200000002076<CR>	2000 V, positive, not overloaded, disabled.
$D0200000007082<CR>	2000 V, negative, not overloaded, enabled.

SHOW_HV_ACTUAL

Returns the value of HV actually on the detector.

SHOW_HV_HEALTH

Returns the status of the state of health for the detector as reported by the DIM or SMART-1.

SHOW_HV_POLARITY

Always returns a positive record for the IDM-200.

$FPOS<CR> The HV is set to positive.

SHOW_HV_TARGET

Under normal operation, the HV will go to this value when the HV is enabled. Reports the current HV setting (see SET_HV) and the status of the HV power supply in the form:

$Dvvvvvsssssccc<CR>

where **vvvvv** represents the HV setting, and **sssss** represents the status of the HV 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: HV enabled (0=disabled, 1=enabled).

Example Responses:

$D0200000003077<CR> 2000 V, negative, not overloaded, disabled.
$D0200000002076<CR> 2000 V, positive, not overloaded, disabled.
$D0200000007082<CR> 2000 V, negative, not overloaded, enabled.

SHOW_HV_POLARITY

Always returns positive polarity for the IDM-200.

Responses:

$IPOS<CR> The HV is set to positive.

SHOW_INPUT

Returns the state of the two external inputs

Responses:

$C00000087<CR> Both external inputs are low (less than the auxiliary threshold setting).
$C00001088<CR> EXTERNAL 1 is greater than its auxiliary threshold setting and EXTERNAL 2 is less than its threshold setting.
$C00002089<CR> EXTERNAL 2 is greater than its auxiliary threshold setting and EXTERNAL 1 is less than its threshold setting.
$C00003090<CR> Both external inputs are high (greater than the auxiliary threshold setting).

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_LENGTH_SAMPLE

Reports the number of points in the Insight Mode Waveform.

Response:

$C010000088	1000 points in the waveform.

SHOW_LFR

Tells whether LFR mode is enabled.

Responses:

$IF	LFR mode disabled.
$IT	LFR mode enabled.

SHOW_LIVE

Reports the contents of the live-time counter in units of 20 ms (50 ticks/s). 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 ms).
...	**...**
$G4294967295132<CR>	Live time reported as 4294967295 ticks (over 23000 days).

SHOW_LIVE_PRESET

Reports the current live-time preset in units of 20 ms (50 ticks/s). 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 ms (50 ticks/s). 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 LLD is 50.

SHOW_MODE

Reports the current mode of operation (PHA, List, or Sample [InSight Virtual Oscilloscope]). See also SET_MODE_PHA and SET_MODE_SAMPLE.

Responses:

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

SHOW_MONI_LABEL num

Returns with an ASCII string label designation for the monitor num.

SHOW_MONI_LIVE num

Returns with an ASCII representation of the real-time value for the monitor.

SHOW_MONI_MAX

Returns with the number of monitors available for viewing.

SHOW_MONI_VALUE num

Returns with an ASCII representation of the value for the monitor at the end of the last acquisition.

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

$Dsssssnnnnnccc<CR>

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_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.

Responses:

$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 32767 is the highest numbered channel in any device.

Responses:

$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.
...	...
$C16383108<CR>	Maximum count was found in channel 16383.

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_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

$Dssssnnnnnccc<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 channel 1000 and is 50 channels long.
$D0215000150086<CR>	First ROI group starts at channel 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_SHAP_FLAT

Reports the width of the flattop in µs. See also SET_SHAP_FLAT.

Responses:

SHAP_FLAT 0000000000001.2

SHOW_SHAP_RISE

Displays the rise-time setting in µs. See also SET_SHAP_RISE.

Responses:

SHAP_RISE 0000000000003.2

SHOW_SHUTDOWN

Shows the type of HV shutdown selected. Always SMART-1 for this unit.

Responses:

$FSM1	SMART-1 mode selected

SHOW_SHUT_ACTUAL

Returns the current status of the bias remote shutdown input signal. This command is valid whether the bias supply is turned on or off.

Responses:

$IT	Shutdown is active (supply is shut down or can't be turned on).
$IF	Shutdown is inactive (supply is on or can be turned on).

SHOW_SNUM

Responds with a $F record indicating the serial number of the IDM-200.

Response:

$F100	Serial number is 100.

SHOW_STATUS

Returns system status information in the following format:

$Mllllllllltttttttttaaaaahhhhhccc<CR>

where **lllllllll** represents the live time as returned by the SHOW_LIVE command, **ttttttttt** 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_AUX n

Returns the threshold setting for EXTERNAL 1 (n = 0) and EXTERNAL 2 (n = 1) inputs.

SHOW_TIME

Reports the time from the battery backed-up system clock in the form

$Nhhhmmmsssccc<CR>

where hhh represents a 3-digit integer hour (0–23), mmm represents a 3-digit integer minute (0–59), and sss represents a 3-digit integer second (0–59). See also SET_TIME, SET_DATE, and SHOW_DATE.

Example Responses:

$N010054017052<CR>	Time returned 10:54:17 (10 h, 54 min, 17 s).
$N020013037050<CR>	Time returned 20:13:37 (20 h, 13 min, 37 s).

SHOW_TIME_START

Reports the time of the last START command in the form:

$Nhhhmmmsssccc<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.

Example Responses:

$N010054017052<CR>	Time returned 10:54:17 (10 h, 54 min, 17 s).
$N020013037050<CR>	Time returned 20:13:37 (20 h, 13 min, 37 s).

SHOW_TRIG_SAMPLE

Reports the trigger source in Insight Mode.

Responses:

$F0LLD	LLD is source.
$F1PKD	Peak-detect is source.
$F2RANDOM	Trigger happens randomly.
$F3Gate	Gate Input triggers the waveform.

SHOW_TRIGGER_SPECIAL

Not used; included for backward compatibility.

SHOW_TRUE

Reports the contents of the true-time counter in units of 20 ms (50 ticks/s). 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 ms).
...	...
$G4294967295132<CR>	True time reported as 4294967295 ticks (over 23000 days).

SHOW_TRUE_PRESET

Reports the current true-time preset in units of 20 ms (50 ticks/s). 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 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_ULD

Returns the value of the ULD in channels, as a $C record.

SHOW_VERSION

Reports the IDM-200 firmware version number in the form

FDETx-vvv<CR>

where the DETx string designates the model and vvv designates the firmware version. In the model string, x is `M` for the IDM-200.

Example Responses:

$FDETM–002<CR>	Model IDM-200 firmware version 2 reported.

SHOW_VMON 3

Returns the major detector and HV state-of-health parameters as a $F response in a comma delimited string as follows:

aaaa,bbb.bb,c.cc,dddd,eeee,ffff,g,hh,iii,-jjj,kkk.kk,lll.ll,mm.m,nnnn,oooo,pppp,q,r

where:

aaaa	=	the battery time remaining, in minutes
bbb.bb	=	the gamma dose, in microSieverts (μSv)
c.cc	=	the cooler drive, in volts
dddd	=	the actual HV, in volts
eeee	=	the target HV, in volts
ffff	=	the HV Status word (see SHOW_HV)
g	=	cooler on/off state; 1 = on, 0 = off
hh	=	the 3.3V voltage, in units of 0.1V
iii	=	the +12V voltage, in units of 0.1V
-jjj	=	the −12V voltage, in units of 0.1V
kkk.kk	=	the detector temperature, in kelvins
lll.ll	=	the detector cold tip temperature, in kelvins
mm.m	=	the detector body temperature, in degrees Celsius
nnnn	=	the ion pump voltage
oooo	=	the ion pump current
pppp	=	the stabilizer percentage, in units of 0.1%

q	=	the battery state (0 = charging, 1 = external power (not charging), 2 = internal battery)
r	=	gain stabilizer state; 1 = on, 0 = off

SHOW_ZERO_ADJ

Returns the value of the zero offset for the zero stabilizer.

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_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 IDM-200.

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.

8. CHANGING THE INTERNAL BATTERY

The typical service life of the IDM-200's 14.4 V lithium ion battery is 3–5 years. When the internal battery no longer retains a charge, it must be replaced with the appropriate ORTEC battery replacement kit. This is a straightforward operation that takes just a few minutes, so the detector does not significantly warm up during the procedure. When connected to external power, the detector will be cooled to operating temperature first, then the new battery will charge, typically reaching full charge within 3–4 hours. For more information, contact your ORTEC representative or our Global Service Center.

To change the battery:

1. Remove the eight (8) screws from the hatch with the provided 2.5 mm hex wrench and remove the hatch to expose the battery.

2. The end of the battery closest to the front of the IDM-200 has a pull tab. Gently pull it outward, as if opening a book cover or door, until the battery slips off the connector terminals located at the lower rear of the compartment. Figure 14 shows the pull tab on the front side of the battery and the connector terminals on the lower back edge.

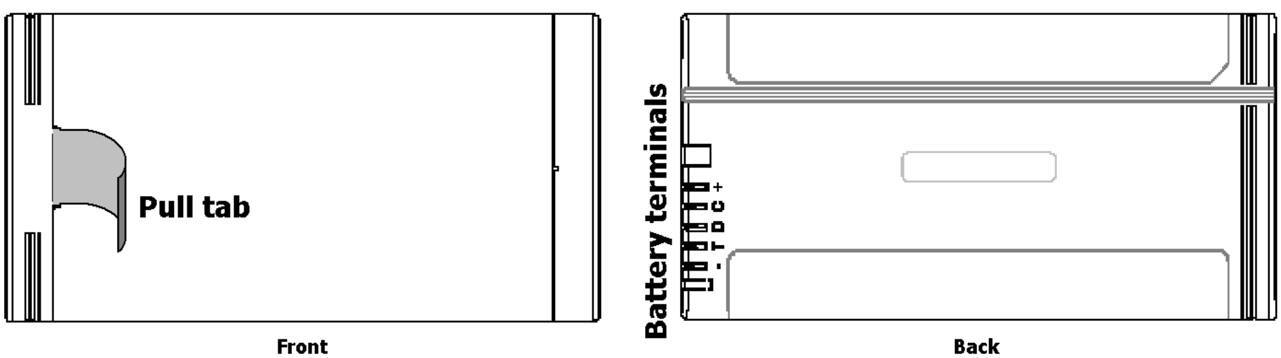

Fig. 14. Front and Back of Internal Battery.

3. Guide the new battery onto the connector terminals and press it into place, ensure the battery’s pull tab is tucked into the battery compartment and cannot interfere with the o-ring seal, check the o-ring to ensure it is free of particulates and fully seated in the hatch, and replace the hatch.

   CAUTION *Do not damage or distort the hatch by overtightening its screws!*

4. Connect the IDM-200 to external power and (if necessary) wait for the illuminated outer edge of the On/Off button to remain steady on.

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