ORTEC®

Micro-UF6 ™

Portable UF6 Cylinder Verification System

Software Version 2.3

User's Manual

Printed in U.S.A. ORTEC Part No. 932500 0518
Manual Revision D

Advanced Measurement Technology, Inc.
(“AMT”)

WARRANTY

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

AMT’s exclusive liability is limited to repairing or replacing at AMT’s option, items found by AMT to be defective in workmanship or materials within one year from the date of delivery. AMT’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 AMT fails to manufacture or deliver items called for in this agreement or purchase order, AMT’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 AMT be liable for special or consequential damages.

Quality Control

Before being approved for shipment, each AMT 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, AMT 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 AMT 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 AMT 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 AMT 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 AMT of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

ADDITIONAL WARRANTY STATEMENT

Please note that the computer that controls the Micro-UF6 is intended exclusively for the tasks detailed in this user's manual. Using this computer for any other purpose ***could void your warranty.***

In addition, the Micro-UF6 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 Micro-UF6 should be opened only by ORTEC-authorized service personnel.

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

IMPORTANT

The Micro-UF6 is designed to function with the Regional Settings in Microsoft® Windows® Mobile™ set to the English (United States) region and all of its default settings, as discussed in Section 7.10. ***Using other than the factory default settings can cause operational problems.***

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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 – Hazardous voltage

ATTENTION – Consult the manual in all cases where this symbol is marked in order to determine the nature of the potential hazards and any actions that must be taken to avoid them

Protective earth (ground) terminal

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®

1. INTRODUCTION

The ORTEC® Micro-UF6™ system has been developed as a variant on our standard Micro-trans-SPEC®. It is designed for use in the verification of uranium hexafluoride (UF6) storage cylinders. The hardware primarily differs from the standard Micro-trans-SPEC in that it has a specially designed tungsten collimator and graded-Z liner; while the application software is specific to UF6 measurement and is based on the well-known "enrichment meter" principle.

IMPORTANT The removable tungsten UF6 collimator is only available as part of a complete MICRO-UF6-PKG-1 system. This is because the collimator is large, due to the requirements of the application, requiring modification to the sheet metal casing of the Micro-trans-SPEC. Part of the shielding is internal to the instrument and cannot be removed. Therefore this collimator can only be ordered as part of a UF6 system. Other collimators are available for the standard Micro-trans-SPEC.

The MICRO-UF6 includes the full-featured Micro-trans-SPEC® "smart MCA" software application. An easy-to-use application *Launcher* interface makes it simple to switch between the two programs.

1.1. Features

- High-performance portable HPGe gamma spectrometer requires no liquid nitrogen.
- Rugged battery-powered, high-resolution HPGe gamma spectrometer with 16k resolution digital electronics in a single package, designed for continuous availability and operation.
- P-type ("ORTEC GEM") HPGe detector crystal, nominally 50 mm × 30 mm, cooled by miniature, high-reliability mechanical cooler that runs from internal battery, supplemental external battery, line power, or automobile power outlet, all with automatic switchover. The miniature Stirling cooler has a very long operational life measured in years.
- ORTEC Low Frequency Rejector[1] (LFR) digital noise filter minimizes microphonic noise.
- Detector element encapsulated in high-reliability, low-loss, all-metal sealed cryostat.
- Digitally stable: consistent answers for long counts, changing count rates and temperatures.

[1]Patent pending.

- Color touchscreen provides all software controls and live display of acquiring data. You can access the instrument's full capabilities without attaching it to a computer.
- Energy calibration using the touchscreen.
- Uses SecureDigital™ memory cards for unlimited spectrum storage capacity.
- Operates in standalone mode or attached to a computer via high-speed USB connection (ORTEC MAESTRO® MCA Emulator Software included).
- Built-in global positioning (GPS) hardware. Spectra saved in the `.SPC` spectrum file format include the GPS coordinates captured at the end of acquisition.
- IEEE 802.11 wireless connectivity can be implemented with third-party software (see technical note, P/N 932735).

Full hardware specifications are provided in Chapter 8.

1.1.1. Additional Information

The Micro-UF6's integrated computer runs under Microsoft® Windows® Mobile™. Software operation is controlled by soft buttons in much the same way as any other Windows program. A soft keyboard is automatically displayed when alphanumeric input is needed. Setup parameters can be viewed and changed to ensure correct operation.

The Micro-UF6's spectrum display is patterned after our MAESTRO software. The 240×160 pixel LCD display makes it easy to set up and monitor data acquisition and instrument settings status.

MAESTRO is a member of the CONNECTIONS family of ORTEC products, all of which provide full networking with other ORTEC spectrometers and supporting computers. MAESTRO includes features for identifying peaks: editing libraries; and creating, printing and saving ROIs, performing energy calibrations, automating tasks using simple "job streams," and more. For more information on these operations, see Appendix D.

Spectral data can be saved and later reanalyzed in more detail using a more sophisticated computer-based analysis package such as GammaVision® or ISOTOPIC.

To operate the Micro-UF6 with your own software, we recommend using the CONNECTIONS Programmer's Toolkit with Microsoft® ActiveX® Controls (A11-BW). The instrument's firmware commands are given in Appendix E.

1.2. Notes on Using the Micro-UF6

- **Startup is simple** — Unpack the Micro-UF6, connect it to an ac power supply to automatically start its computer and cooler, allow the HPGe detector to cool down to operating temperature, and you're ready to begin setting up your inspection item database and measuring calibration standards as described in Section 3.

- **Cooling the detector** — Detector cooldown time depends on ambient conditions but typically takes <12 hours. Once cold, the Micro-UF6 requires only a few tens of watts to sustain it. The cooler is designed for years of continuous operation so there is no need to turn it off except during shipping and maintenance.

- **Battery-powered operation** — The Micro-UF6's internal lithium-ion battery charges in approximately 3 hours and provides >3 hours of operation. To reduce current draw during charging, the battery does not begin to charge until the HPGe detector has cooled down. The automobile accessory connector (included) allows you to charge and operate the instrument from a 12 V automobile battery. In addition, ORTEC offers optional battery belts to extend the remote operation time. For more information about startup and charging the battery, see Section 2.5.

- **User and administrator password protection** — Setting a user and/or administrator password allows you to block unauthorized access to the Micro-UF6 program. In addition, if you set both a user password and an administrator password, only an administrator can change the passwords, adjust the amplifier gain to shift the center of the U-235 185.7 keV peak, or change the analysis settings. For details on passwords, see Section 3.7.

- **Energy calibration is fast and straightforward** — The energy calibration feature allows you to quickly touch up the amplifier gain to keep the 185.7 keV peak of U-235 centered in channel 2476. See Section 3.6 for more information.

1.3. Data Collection, Storage, Transfer, and Viewing

The Micro-UF6 software application is designed to collect the following types of data:

- Calibration (i.e., control) spectra from U-235 reference sources. Each inspection item is compared to a calibration spectrum to determine the item's percent UF6 enrichment.

- A verification spectrum for each inspection measurement.
- An ASCII text analysis report for each verification spectrum.

- Optional energy calibration spectra (you are not required to save them) acquired when adjusting the detector amplifier gain to center the 185.7 keV peak in channel 2476.[2]

You can choose to save the spectrum files in one of two ORTEC spectrum file formats: the default Integer .SPC format or the simpler Integer .CHN format. In addition, you can select the storage location (Section 3.3). .SPC files contain calibration and analysis parameter data. They also contain two parameters in addition to the contents specified in the *ORTEC Software File Structure Manual for DOS and Windows Systems* (P/N 753800): the GPS coordinates and the type of portable identifier used. The .CHN format does not store GPS, calibration, or analysis information. Note that if you exit the UF6 Enrichment application, on restart the instrument will default to the .SPC file format.

We recommend that files be stored on user-supplied, removable SecureDigital (SD) storage cards.[3] A limited number of files can be stored in the Micro-UF6's My Documents folder, however, we recommend against storing files there. All files are retained even when power is turned off and the battery is removed. Available storage capacity depends on the capacity of the SD card. Before starting a measurement or calibration, be sure to check the readout on the upper-right corner of the screen to see how many spectra can be stored in the current location. If you try to store a spectrum or verification report when the selected storage location is full, you will not be able to save the data for that acquisition. Spectrum files (but not reports) can be displayed and/or deleted; see Section 3.3.

1.3.1. File Transfer

If you choose to store the spectrum files on SD cards, they can be transferred directly to your computer with an SD card reader and Windows Explorer. Alternatively, files stored on SD card or in the unit's My Documents folder can be downloaded via the USB port to any computer running under Microsoft Windows 8 or 7 (via the Windows Mobile Device Center), or Microsoft Windows XP® Professional SP3 (via Microsoft ActiveSync®). See Chapter 6 for detailed instructions.

IMPORTANT *Before connecting the Micro-UF6 to a computer for the first time*, install Windows Mobile Device Center or ActiveSync ***first.*** Otherwise, the Micro-UF6 may not be able to communicate properly with the computer. *Be sure to read Chapter 6.*

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[2]Channel 2476 was chosen to maintain a 0.075 keV-per-channel slope for the 4096 channel spectrum.

[3]Note that the Micro-UF6's computer also has a CF type II CompactFlash slot. However, the dust cover, which must be in place to prevent contaminating the card slots, blocks full insertion of CF cards.

1.3.2. Spectrum Filenaming Conventions

Filenames are automatically generated and are formatted as follows.

1.3.2.1. Verification Spectrum and Report Files, and Calibration Spectrum Files

The base filename is formatted as:

[Facility Code]_[Item ID]_YYYY-MM-DD_hh.mm.ss

where the Facility Code is defined in the Inspection Data file (Section 4.1), Item ID is defined in the Item Database (Section 4.2), YYYY-MM-DD is the acquisition year/month/day, and hh.mm.ss is the hour/minute/second. The date/time stamp is based on the Micro-UF6 computer's current time and time zone settings.

The file extension is either .SPC or .CHN, depending on the currently selected file format (Section 3.3.2). Verification reports use the .TXT extension.

1.3.2.2. Energy Calibration Files

The base filename is formatted as:

[Facility Code]_YYYY-MM-DD_hh.mm.ss

where the Facility Code is defined in the Inspection Data file (Section 4.1), YYYY-MM-DD is the acquisition year/month/day, and hh.mm.ss is the hour/minute/second.

The file extension is either .SPC or .CHN, depending on the currently selected file format (Section 3.3.2).

1.4. The "Launcher" Interface for Multiple Identifier Applications

ORTEC supports our versatile Micro-Detective®/Micro-trans-SPEC platform with a wide range of nuclide identification applications. When only one identifier application is installed on your Detective-series instrument, each time the unit is powered on or rebooted, it automatically starts up that application. If subsequent ORTEC applications are added to your instrument, our easy-to-use application "Launcher" interface runs first, making it easy to switch between the ORTEC identifier programs, and exit to Windows Mobile. Simply tap the desired program.

Alternatively, if you wish to choose one of the applications to auto-start when the Micro-UF6 is rebooted, just mark the checkbox beside the desired application.

Figure 1 illustrates the Launcher screen for the Micro-UF6 (which includes the Micro-trans-SPEC application). Note that the **UF6 Enrichment** program is marked for auto-start.[4] (Note that the Launcher may have multiple pages if many applications are installed; tap the scroll/paging indicator as needed.)

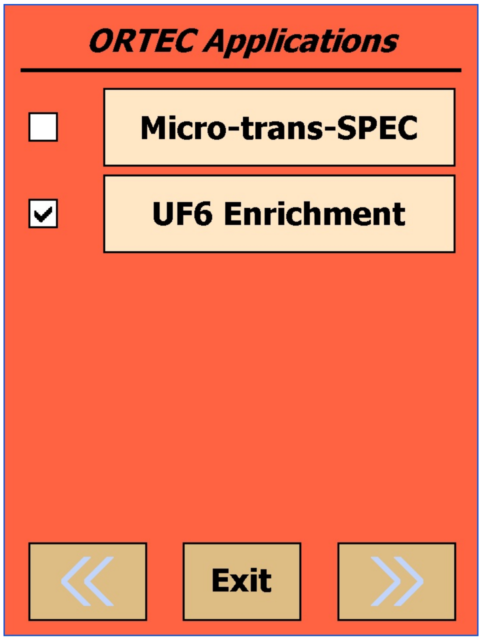


Figure 1. The Launcher Screen.

1.5. Should You Take a Computer Into the Field?

The Micro-UF6 is designed so that you don't need a computer to operate it. However, there are a few situations in which a computer is useful in field operations. One is for advanced analysis of the spectra onsite. In this case, software such as GammaVision, ISOTOPIC, or other specialist applications can be used to process the spectra at the work site. The second is to provide storage for more spectra than the Micro-UF6 stored-spectrum memory capacity; however, SD cards typically make this unnecessary.

[4]If, on reboot, the Microsoft® Windows® Mobile desktop is displayed instead of the Launcher or a spectroscopy application, tap **Start** then **Launcher**. Alternatively, you can bypass the Launcher and start either program by tapping **Start**, **Programs**, and the application name.

2. THE MICRO-UF6

This chapter takes you through the setup and startup procedures.

2.1. Major System Components[5]

The complete contents of your shipping container(s) will depend on the model and options you ordered. However, your system will include at least the following major components:

- The Micro-UF6 portable identifier and USB cable.
- The Micro-UF6 *User's Manual* (P/N 932500).
- The Micro-trans-SPEC *User's Manual* (P/N 931041)
- Padded carrying strap, ac power adapter/charger, and 12 V dc automobile accessory adapter.
- Technical note, *Transporting ORTEC Instruments With Pressurized* ^{3}*He Tubes* (P/N 932722), which contains important information you will need to know to ship the Micro-UF6 or take it aboard commercial carriers.

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

IMPORTANT

If your Micro-UF6 was shipped in a foam-lined box rather than a high-impact plastic case, be sure to keep the box and foam and use it whenever shipping the unit.

2.2. Features

Figure 2 shows the Micro-UF6's major features.

2.2.1. Front Panel

- **ON/OFF Button** Located below the touchscreen, on the base of the bezel. When you turn on the unit's computer, it initializes (this may take a few minutes), then either starts the UF6 Enrichment (Micro-UF6) application or displays the Launcher program, which gives you quick access to all ORTEC applications installed on the instrument (see Section 1.4). The computer operates independent of the mechanical cooler (which is controlled by the Micro-UF6 software application).

[5]Subject to change.

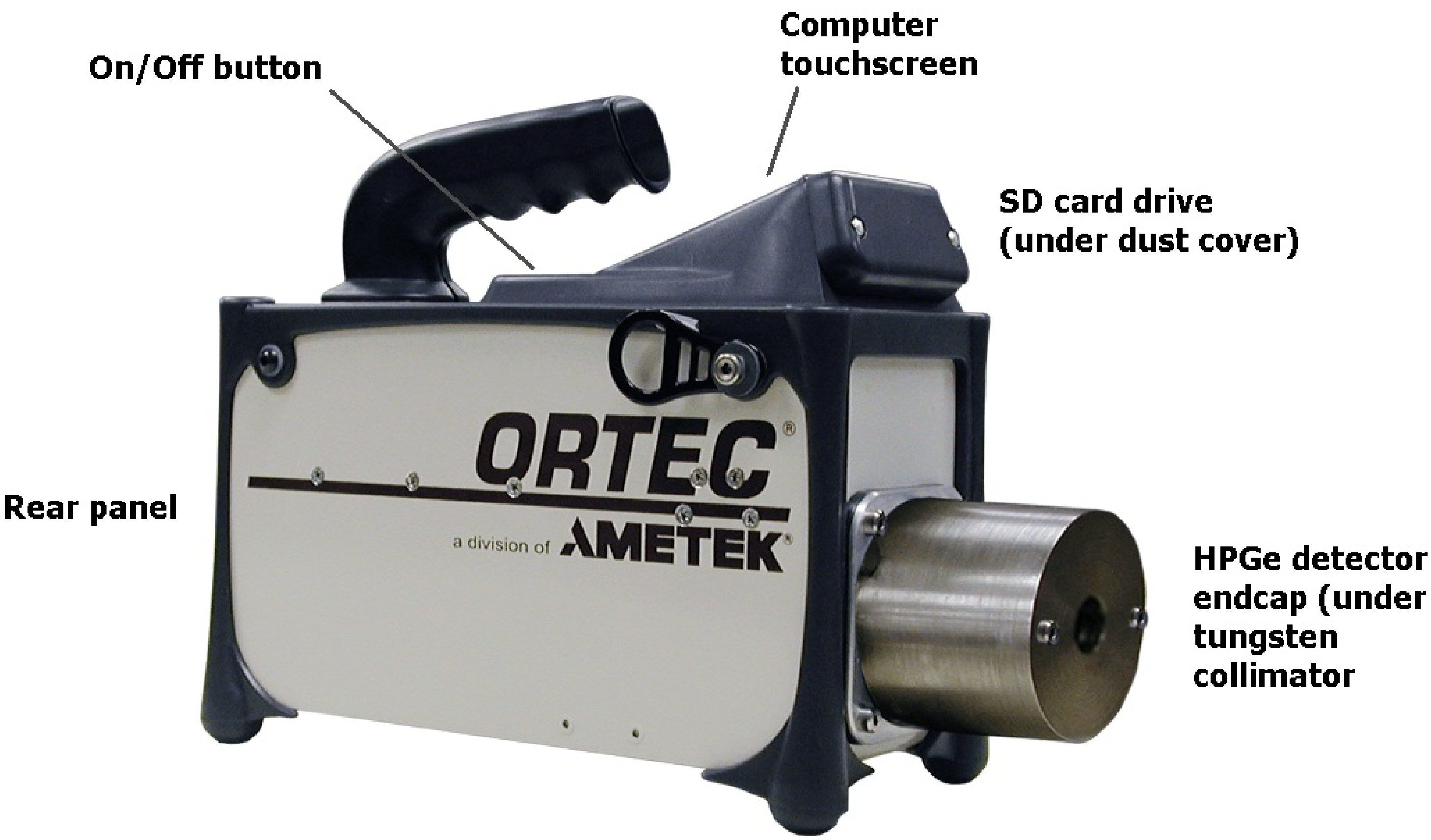


Figure 2. Micro-UF6 Features.

To reboot the computer, press and hold the power button for ~3 seconds and release, displaying a Power Menu that allows you to shut down, reset (reboot), align the touchscreen, and so on. Tap the **Reset** button to reboot; the cooler will stay on.

- **SD Card Slot** This is located on the front panel under the protective dust cover. To release the cover, press and turn the two captured, bayonet-mount screws 1/4 turn. To remove the SD card, use your fingertip, the eraser end of a pencil, the touchscreen stylus, or a similar instrument to *gently* press it all the way into the slot, then quickly release it. The card will pop partway out of the slot. If you are wearing gloves, you might need forceps to remove it. The SD slot is keyed so the memory card can only be inserted in one orientation. To replace the SD card, press it *gently* into the slot until it clicks into place. *Do not use force!* Replace and tighten the protective cap.

CAUTION *We strongly recommend that the front-panel dust cover be fastened in place at all times to protect the card slots from moisture and dust.*

2.2.2. Rear-Panel Connectors

- **INPUT POWER** — Supplies external power for operating the Micro-UF6 and recharging the internal battery.

- **USB** port ( ) — Used to connect the Micro-UF6's microprocessor to a computer to retrieve stored spectra in **ActiveSync** mode; and to connect to the Micro-UF6's MCA board in **MCA Mode**. See Section 3.2.

- Headphone jack () — The speaker volume can be adjusted as described in Section 3.7.

CAUTION Each connector includes a dust cover. *We strongly recommend that all covers be kept closed except when the connectors are in use.*

2.2.3. The Touchscreen

The Micro-UF6 has a high-resolution color touchscreen for viewing data acquisitions as well as monitoring and changing the instrument settings.

To select a function, tap it with your finger or a stylus; *pens, pencils, and other objects will scratch the touch-screen and should not be used*.

2.2.4. Attaching the Carrying Strap

The carrying strap (Fig. 3) should be installed on the top-diagonal corners of the Micro-UF6; that is, looking down on the display panel, the strap should be anchored to the left-front and right-rear corners or vice versa.

If you wish to change the factory orientation, use a 5/32-in. hex wrench to exchange positions of the strap-hanger studs and the regular hex-head screws. Thread the strap-hanger stud through the hanger bracket, followed by the two spacers, then insert the stud into the Micro-UF6 and tighten until the hanger bracket resists rotation but still turns (*do not overtighten*).

Figure 3. Carrying Strap Attachment.

2.3. Collimator Attachment

The Collimator is shipped in an additional shipping container. Dust Cover must be removed before the Collimator and Tin Filter are attached, they are held in place by magnets.

- Remove the four dust cover shoulder bolts using a 1/8" hex wrench.

Figure 4. Dust Cover Bolt Removal.

- Remove the dust cover and stiffening plate by sliding it off the end of the instrument.

Figure 5. Dust Cover Removal.

- Install four shoulder lock screws where the shoulder bolts were removed using a #2 screw driver. Be sure to fully seat the lock screws. The shoulder will recess inside the mount hole.

Figure 6. Lock Screw Installation.

- Slide the collimator over the end cap and align the collimator mount holes.

Figure 7. Collimator Installation.

- Slide the collimator over the lock screws and push the collimator flush with the front panel of the instrument. The indicating arrow should be pointing towards the top of the instrument.

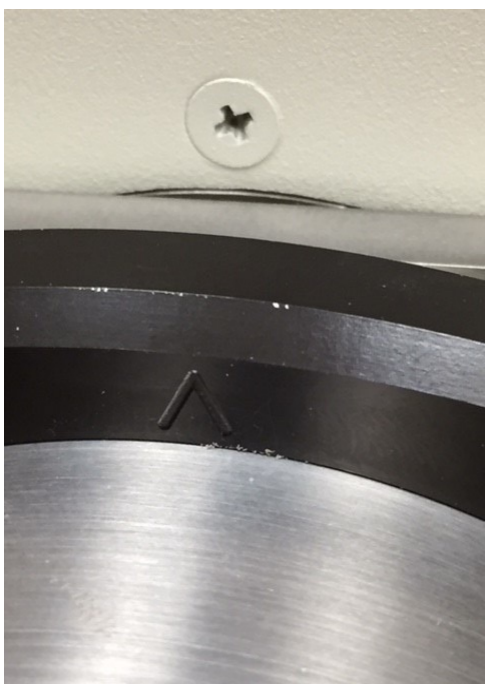


Figure 8. Collimator Alignment.

- Slide the lock ring over the lock screws and twist counter clockwise to lock the collimator in place.

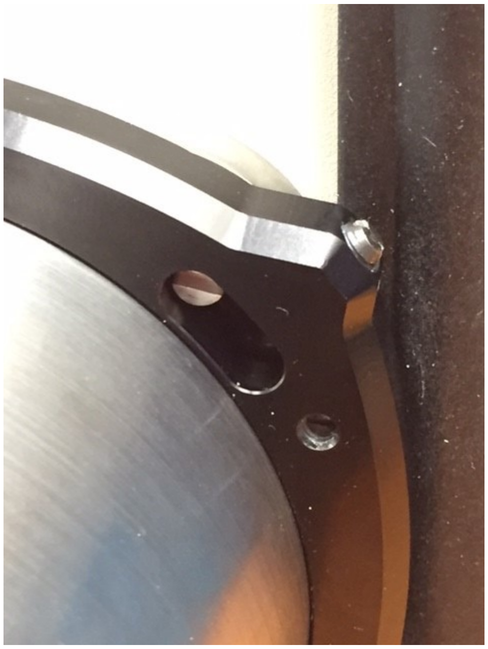


Figure 9. Collimator Unlocked.

Figure 10. Collimator Locked.

- The collimator end caps are held on with magnets.

Figure 11. Collimator without End Caps.

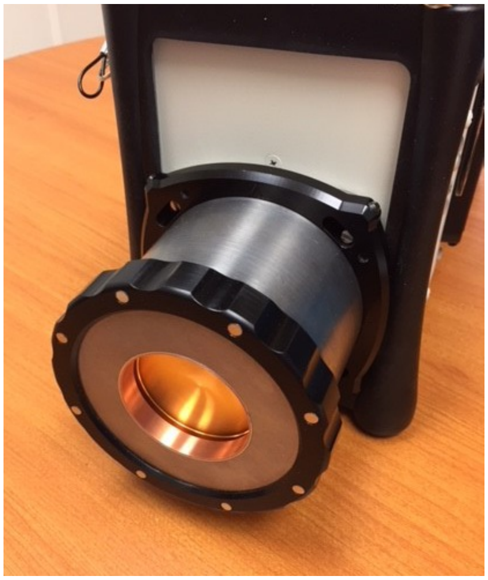


Figure 12. Collimator with Open End Cap.

Figure 13. Collimator with Full End Cap.

- The Tin Filter is also held in place by the magnets. The filter can be placed over either endcap.

Figure 14. Tin Filter Attached.

2.4. Internal vs. External Power

The Micro-UF6 uses power in these ways:

- The internal battery provides 3+ hours of operation. The internal battery can start the cooler but its charge is not sufficient to 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*. At that point, fully recharging the battery takes 3–4 hours.

- The power adapter provides external power to start, cool, and operate the Micro-UF6, as well as charge the internal battery. It can be powered from ac mains or a 12 V source.

- Other external power (supplied by external battery belt or 12 V automobile battery) can start, cool, and operate the Micro-UF6, as well as charge the internal battery. When connected to an external battery, the Micro-UF6 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 Micro-UF6 battery monitor indicates the available capacity in the internal battery, and when the switchover occurs, this indicator runs down in the usual manner.

NOTE If you are using a standard automobile battery as the external power source, note that detector cooling can significantly discharge the battery.

The icon in the upper right corner of the screen (Fig. 15) shows whether the Micro-UF6 is operating on battery power or the charger.

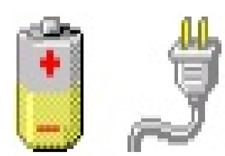


Figure 15. Power Source Indicators.

When all power is exhausted, the high voltage and cooler shut down and the detector begins to warm. The Micro-UF6 cannot be used again until the unit has cooled enough that the high voltage automatically switches on.

2.4.1. The Internal Battery

The internal battery typically lasts 3–5 years. Contact ORTEC for a battery replacement kit (see also Appendix C). Note that the battery hatch is the only part of the Micro-UF6 case that can be opened without voiding the warranty.

2.5. Startup, Cooldown, and Shutdown

2.5.1. Powerup

- Place the power adapter/charger on a hard, level surface. See the cautions in Section 2.8 (page 22).
- Connect the power adapter/charger to an ac power source and to the Micro-UF6 rear-panel INPUT POWER connector. Alternatively, you can use the 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 battery.
- As soon as power is applied, the computer automatically begins its boot-up sequence, and within 20–40 seconds the cooler begins running. If the cooler does not auto-start, tap **Settings** and **Turn Cooler On**. You should immediately hear the cooler activate. Typically, the cooler is somewhat noisy for the first few minutes of operation, then settles into a quiet hum. Tap **Back** to return to the Main Menu.
- After the computer initializes (this can take 1–2 minutes), the Launcher program will start up, displaying the **UF6 Enrichment** (Micro-UF6) and **Micro-trans-SPEC** applications (Fig. 16). If the Launcher does not start automatically, you will instead see the Microsoft® Windows® Mobile desktop. In this case, tap **Start** then **Launcher**.
- When the red Launcher screen is displayed, tap **UF6 Enrichment** to start the Micro-UF6 software application.[6] Figure 17 shows the program's main menu. The program requires 15–20 seconds to initialize and become responsive to commands. Until the unit is fully initialized, the storage capacity and battery readouts may not display accurate values. Note that because the detector is warm, the hardware status line at the top of the touchscreen will read Error, as shown in Fig. 17.

[6]Alternatively, the Micro-UF6 program can be started by tapping **Start**, **Programs**, **UF6**.

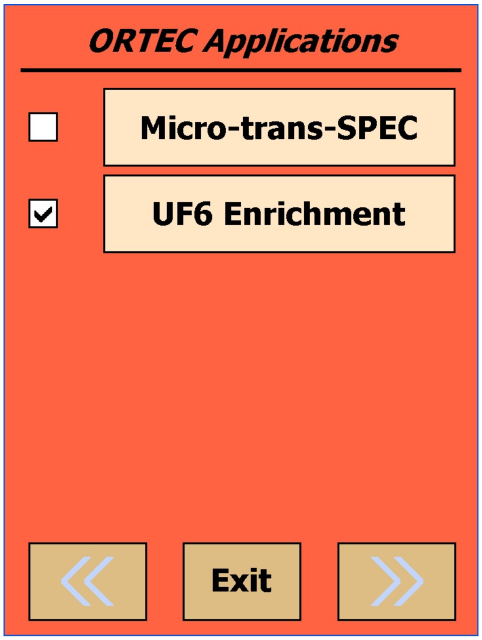


Figure 16. The Launcher Screen.

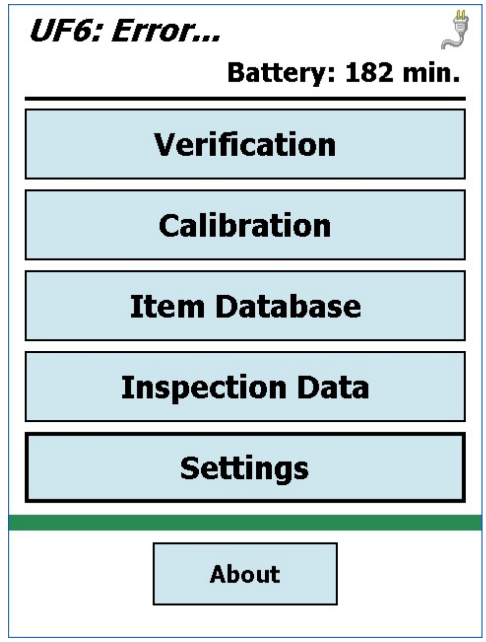


Figure 17. Main Menu.

- No password is set at the factory, so on first use you will not encounter the password screen. On subsequent use, if an administrator password has been set, enter the password according to Section 2.6.2, page 19.

- Tapping **Settings/State of Health** will show that the detector temperature and cold tip temperatures are too high, and the detector high voltage is off. Figure 18 shows a typical State of Health screen for a warm detector.

- When the detector reaches operating temperature, the high voltage will automatically turn on, all ERR state-of-health messages will change to OK, and the status message at the top of the touchscreen will change to Ready..., as shown in Fig. 19. The Micro-UF6 is now ready for software configuration and calibration.

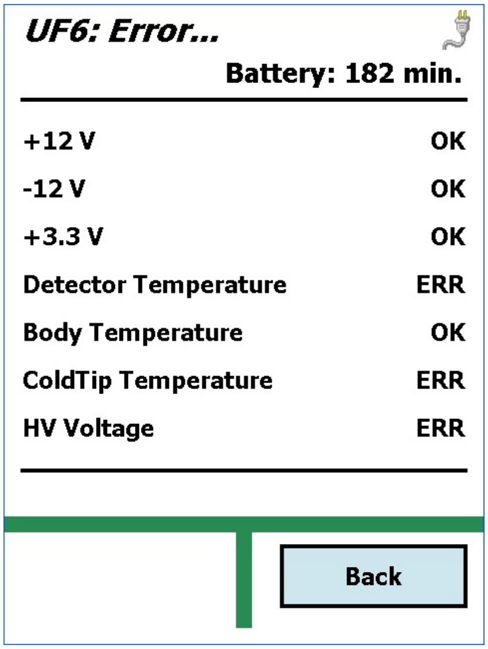


Figure 18. Hardware Status Readouts for Warm Detector.

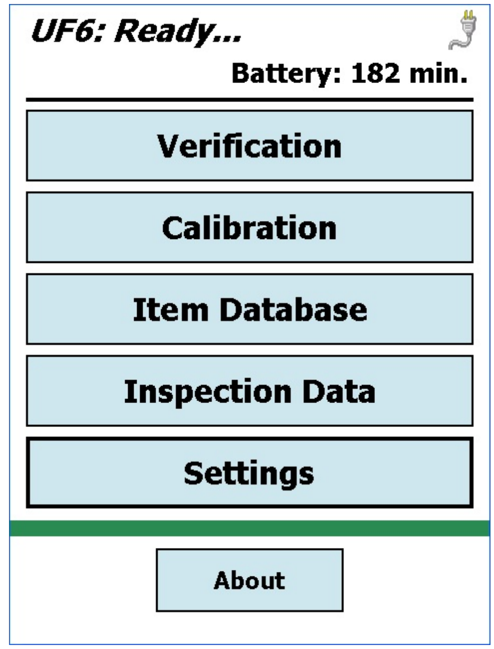


Figure 19. Cooled and Ready Micro-UF6.

2.5.1.1. Turning the Cooler and Computer Off

The computer and cooler operate independently of one another. Therefore, you can turn off the computer and leave the cooler running, or vice versa.

To turn off the cooler, tap **Settings** and select **Turn Cooler Off**. You will hear the cooler shut down. The computer will remain on.

To turn off the computer, use the On/Off button as described in Section 2.2.1.

2.6. The User Interface

2.6.1. Moving Through the Menus

- Figure 19 shows the Main Menu screen. It is designed to present the most often used function — verification — at the top of the menu, and the less frequently used options at the bottom. Chapter 3 tells how to set up the Micro-UF6's **Settings** options. Chapter 4 gives the instructions for calibration and verification.

- To move through the menus and dialogs, tap the soft buttons with a stylus or your finger. The functions available are shown on the buttons. Do not use pens, pencils, or other objects as a stylus. They will scratch the touchscreen.

- To return to the preceding menu or screen, tap **Back**. For example, tapping **Back** from the Settings screen returns you to the Main Menu.

2.6.2. Data Entry

The Micro-UF6 captures four types of data: (1) passwords, (2) numeric data for verification and calibration measurements; and (3) alphanumeric and (4) numeric data on the Inspection Data and Item Database screens. Figure ? shows the screens for data types 1 and 2.

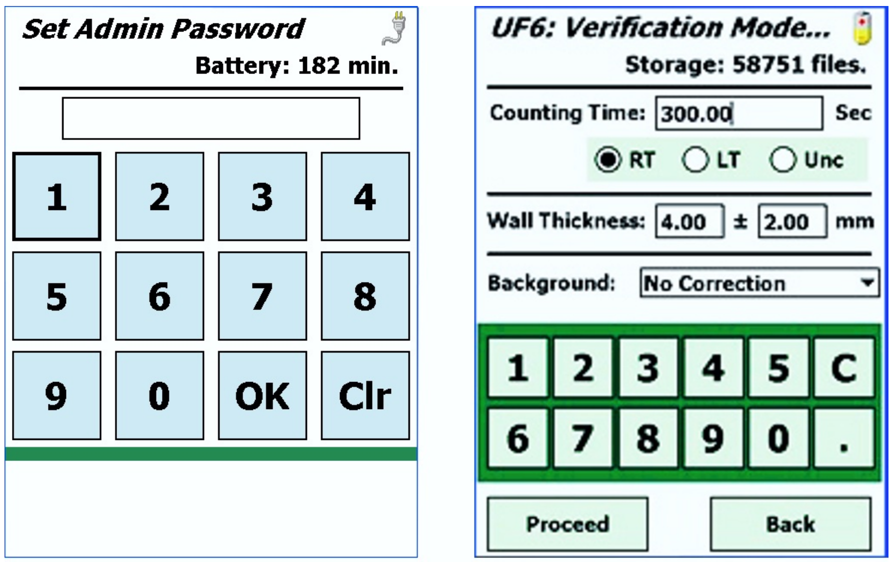


Figure 20. Data Entry Screens: Password and Numeric Data for Verification and Calibration.

1) **Password** — To create or enter a password, tap in the password field (if the cursor does not automatically position itself there), tap the appropriate number button(s), then tap **OK**. If you make a mistake, tap **Clr**, then re-enter the password.

2) **Numeric Data (verification and calibration measurements)** — Tap in the desired field, tap **C** to clear the existing entry, then tap the appropriate number button(s). To proceed with the verification or calibration measurement, tap **Begin**.

Figure 21 shows the screens for data types 3 and 4.

3) **Alphanumeric Data** — Tap in the desired field to open the keyboard shown on the left side of Fig. 21. Use **BkSp** to backspace over errors. To accept the new value and return to the preceding screen, tap **Done**. To retain the existing value, tap **Cancel**.

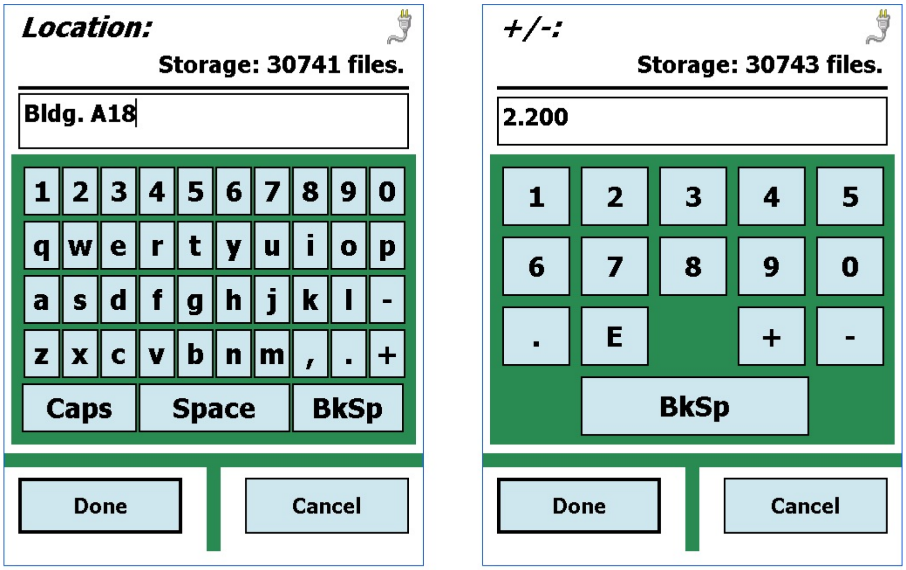


Figure 21. Data Entry Screens: Alphanumeric and Numeric Data for Item Database and Inspection Data.

4) **Numeric Data** — Tap in the desired field to open the keyboard shown on the right side of Fig. 21. Note that the **E** (exponent) and +/− buttons allow you to enter values using scientific notation. To accept the new value and return to the preceding screen, tap **Done**. To retain the existing value, tap **Cancel**.

2.6.3. Spectrum Window

The spectrum window (Fig. 22) is displayed when you energy calibrate the Micro-UF6, and during verification and calibration measurements. In addition, the **Spectra** option on the Settings menu lets you review all spectra stored on the Micro-UF6. Figure 23 shows a representative spectrum window and its viewing controls.

The spectrum display area is limited so it uses a modified version of scientific notation on the Y-axis for numbers greater than or equal to 10,000: The number of trailing zeros in the number is replaced by "E" followed by the number of zeros. Some examples: 10,000 becomes **1E4**; 12,000 becomes **12E3**.

2.6.3.1. Spectrum Display Controls

These controls allow you to zoom in and move through the spectrum for better interpretation of the data.

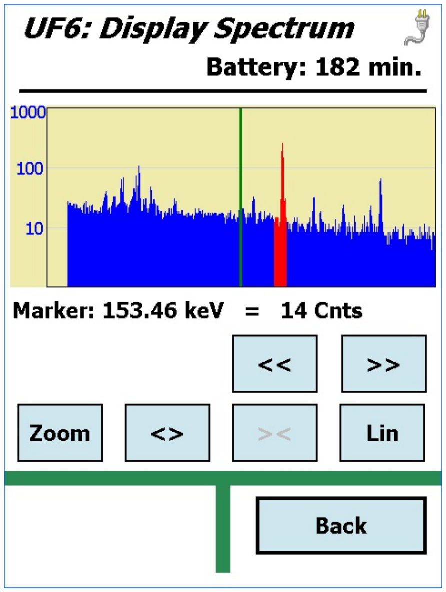


Figure 22. The Spectrum Window.

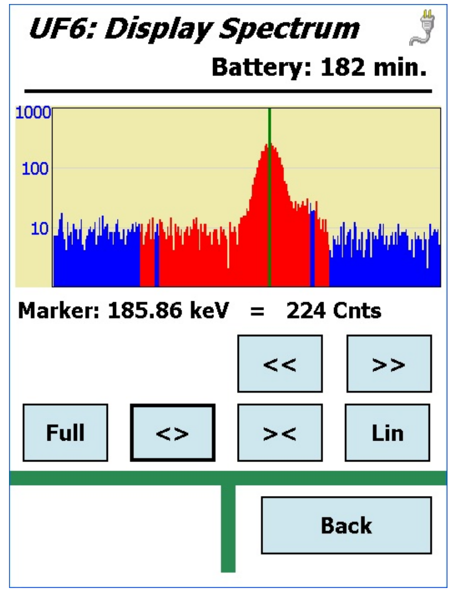


Figure 23. Zoomed View Shows 185.7 keV Peak and Flanking Background ROIs.

Zoom / Full

Zoom expands the spectrum around the current view's center channel. Full restores the display to a view of all channels in the spectrum. In this way, you can easily look at the peaks in the spectrum in detail (**Zoom in**) and move quickly from energy to energy in Full mode.

<> — Zoom In

The **Zoom In** button expands the display by halving the number of channels in the current spectrum view, so the peaks appear wider. The marker position becomes the center channel of the new view. The vertical scaling does not change.

>< — Zoom Out

The **Zoom Out** button contracts the display by doubling the number of channels, so the peaks appear narrower. The marker position becomes the center channel of the new view. The vertical scaling does not change.

<< >> — Next / Previous ROI

These buttons allow you to move between the three ROIs in a verification spectrum, e.g., the 185.7 keV peak and the low- and high-background ROIs. Typically, you must zoom in to distinguish the ROIs from one another.

Lin / Log

This button toggles between logarithmic vertical scaling and linear mode with automatic vertical limits. The **Lin** button changes to **Log** in the linear mode, and vice versa.

2.7. Software and Firmware Version: The About Screen

This About screen (Fig. 24), located at the bottom of the Main Menu, displays version information for the software application and instrument firmware that will be useful should you need technical support.

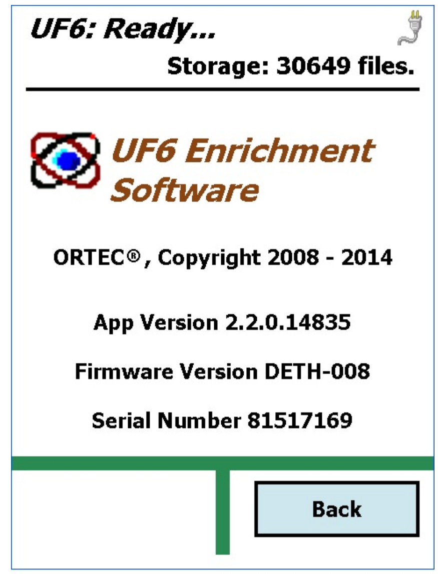


Figure 24. About the UF6 Enrichment Application.

2.8. Cautions and Operating Limits

- Remember that there are no user-serviceable parts inside the Micro-UF6. Opening the Micro-UF6 (except the battery hatch and the SD card drive's dust cover) voids the warranty.

- The cooler and detector are shock-sensitive, with a maximum tolerance of 20 g, so be careful not to drop the Micro-UF6. A shock in excess of this value will void the warranty.

- The Micro-UF6's enclosure is sealed with polymer o-rings and gaskets; if all seals are in place, the instrument can survive *brief* immersion in water. However, care should generally be taken to protect it from prolonged or heavy rainfall and from immersion. The front-panel memory card slots and rear panel connectors include dust caps; *keep the card slots and all unused connectors capped*.

- Heat is dissipated from the cooler via the Micro-UF6 baseplate; therefore, do not place the unit in mud, loose soil or sand, standing water, dense grass; or on thick carpet. Wrap or cover the unit to keep it clean and dry. Where possible, avoid placing it on warm surfaces, such as sun-heated pavement, for extended periods.

- The power adapter/charger should not be exposed to water. Make sure the recharging connector on both the Micro-UF6 and power adapter are clean and dry before connecting to the input power supply.
- The Micro-UF6 is designed for use at temperatures between −10°C to +40°C, at a relative humidity <90% at 35°C, non-condensing.
- You can turn the cooler off for a brief period (e.g., 10 to 20 minutes) without warming the detector significantly. As soon as the cooler is restarted, the Micro-UF6 typically posts a Ready status within a few seconds. In addition, the cooler can be restarted at any time, without harming the detector crystal, regardless of whether the detector is warm, partially cooled, or cooled to the operating temperature range.
- The Micro-UF6 cooler is designed for years of continuous operation so there is no need to turn it off except for shipping and maintenance. If the instrument is turned off and allowed to warm between uses, it must be cooled and brought to operational status (Status: Ready) for *at least 48 hours every month*. Failure to do this may result in degraded performance or cooling system failure. *Read Section 8.8.*
- To avoid damaging the cooler by overheating it (and, where applicable, to comply with transportation regulations), be sure the cooler is turned off before shipping the Micro-UF6.

> **NOTE** The unit can be shipped as soon as the cooler is turned off. There is no need to wait until the detector warms up. Leave the battery in its compartment during shipping.

- For best results, we recommend that you not allow the instrument’s internal battery to become exhausted, and that you read Section 2.3, 2.4 on the Micro-UF6's internal and external power sources.

3. THE SETTINGS MENU

This chapter tells how to use the **Settings** options (Fig. 25) to set the data storage options; view stored spectra; monitor hardware status; control the mechanical cooler, USB communication mode, and audio volume; set up administrator and user passwords, and advanced analysis options.

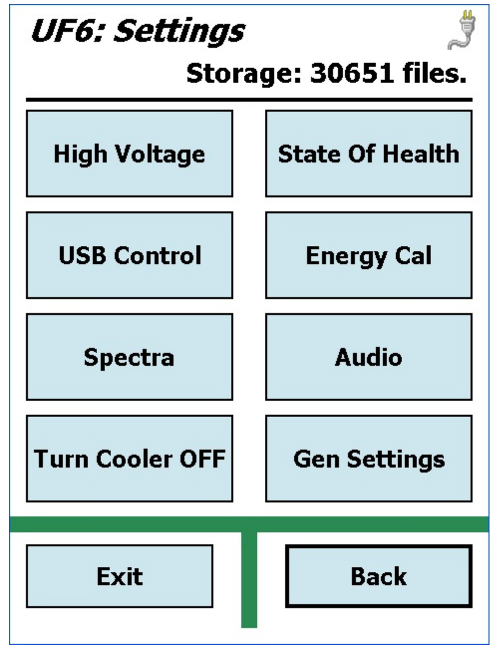


Figure 25. General Settings Menu.

The **High Voltage** and **State of Health** functions show the detector temperature and bias status in real time. The **USB Control** function allows you to set the rear-panel USB port to communicate with the instrument's computer (**Active Sync** mode) or with its MCA board (**MCA Mode**).

Once the detector is cool, passwords have optionally been assigned (**Gen Settings**), and the desired spectrum file format and storage location have been selected (**Spectra**), you are ready to use the **Energy Cal** function to adjust the amplifier gain for proper performance.

Be sure to read the notes on the user interface in Section 2.6.

3.1. High Voltage

This dialog (Fig. 26) displays the HV on/off setting, the target and actual bias, and the current detector temperature. The detector bias is factory-set and cannot be changed or turned off within the Micro-UF6 application. However, with the Micro-UF6 connected to a computer in MCA Mode, you can adjust the bias and turn it on/off within MAESTRO (Section D.3.6).

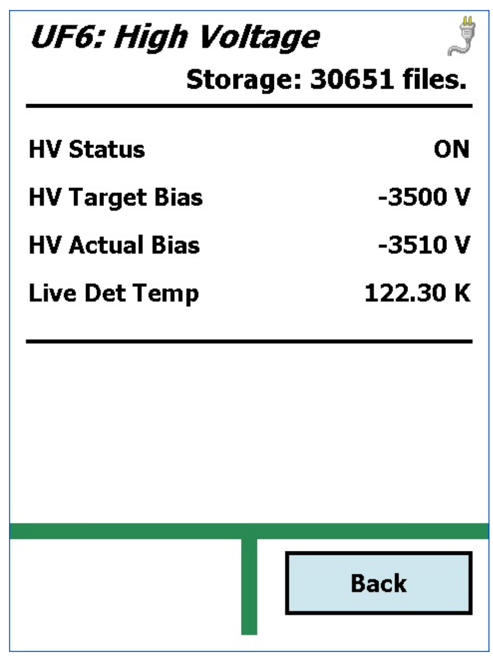


Figure 26. High Voltage Settings.

To see additional hardware status information, use the **State of Health** command (Section 3.5).

NOTE If you change the high voltage within MAESTRO, that new setting will remain in use when you return to the Micro-UF6

application. ***Before changing the high voltage, record the factory default setting (typically −3500 V) so you can reset it before exiting MAESTRO.***

If the high voltage has been changed and you are unsure of the factory setting for your particular unit, you can reset the Micro-UF6 to all its factory settings. ***Note that this includes resetting your current fine and coarse gain settings.*** To reset the instrument, switch to MCA Mode and connect it to the computer. On the computer, go to C:\Program Files\ Common Files\ORTEC Shared\UMCBI and open Diag.exe. From the droplist at the top, select the Micro-UF6. In the **Command** field, enter the INITIALIZE command and click **Send**. Initialization takes about 10 seconds, after which an "instrument reported error" warning will be displayed. Click **OK** to return to the Diag dialog, click **Quit**, return to the Micro-UF6, and switch back to ActiveSync Mode.

3.2. USB Control

Use the screen shown in Fig. 27 to set the USB port to access the Micro-UF6's computer(**Active Sync** mode) for file transfer or the MCA board (**MCA Mode**) for use with MAESTRO or other spectroscopy applications.

In **Active Sync** mode, you can move through and/or exit the Micro-UF6 software application. In **MCA Mode**, the screen and all functions except the ON/OFF button are disabled until you switch back to **Active Sync** Mode.

When you switch modes, the Micro-UF6 will take a few seconds to initialize in the new mode. If you switch modes while connected to the PC's USB port, the computer should generate a USB disconnect/connect signal (because you have disconnected the unit's computer and connected its MCA board).

3.3. Spectra

Figure 28 shows the Spectra screen. These options allow you to view and manage the spectra stored on the Micro-UF6, and select the file format and storage location. See Section 1.3.2 for filename conventions.

3.3.1. Data Location

Use this option to store spectra and report files on a removable **Storage Card** (the latter location is only displayed if a card is present), or in the Micro-UF6 computer's **My Documents** folder; we recommend the storage card option.[7] Tap to open the list, then tap to choose the location. If you choose the storage card option, the Micro-UF6 application will create a Data folder on the SD card and store the files there. Data location can be changed at any time.

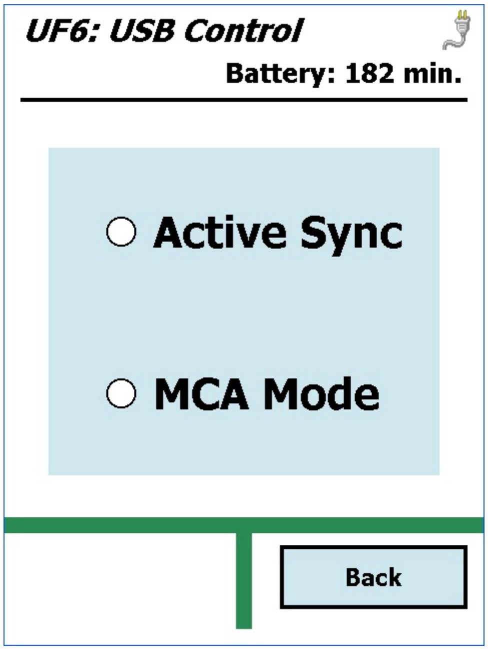


Figure 27. Set the USB Port's Communication Mode.

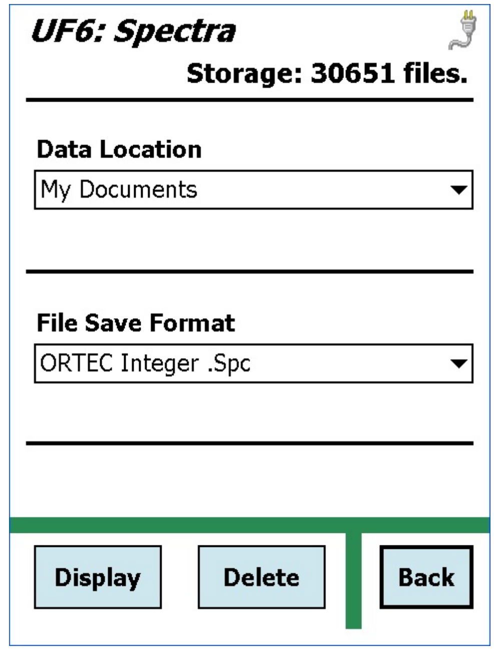


Figure 28. Spectra Settings.

3.3.2. File Save Format

Tap to select the spectrum file format. The default is ORTEC Integer .Spc; you can also choose the simpler ORTEC Integer .Chn format (see Section 1.3 and the *File Structures Manual* for more details on these file formats). *Note that if you exit the **UF6 Enrichment** application, on restart the instrument will default to the .SPC file format.*

3.3.3. Displaying a Stored Spectrum

To display a stored spectrum, select the desired **Data Location**, then tap **Display** to show the list of spectra for that location (Fig. 29). Tap to highlight the desired file, then tap **Choose** to display it (Fig. 30). The display screen shows the filename and spectrum, and provides a subset of the Home screen's display control buttons.

---

[7] If you use the **My Documents** folder, ***do not allow it to become full***; the computer's operating system requires a certain amount of empty disk space for normal operation. We recommend writing all data to SD card.

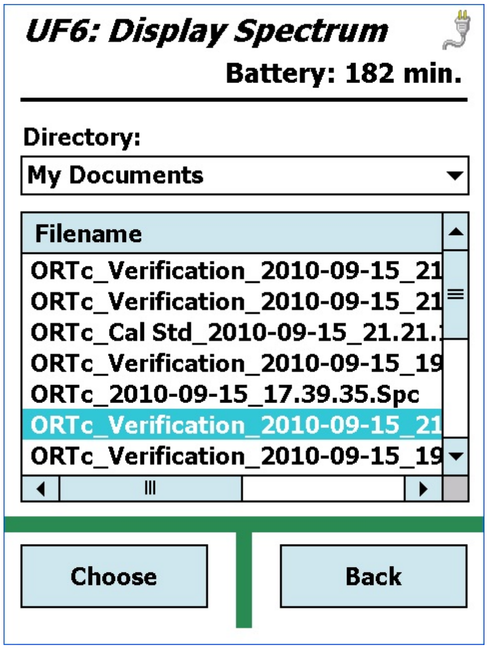


Figure 29. Choose the Spectrum to be Displayed.

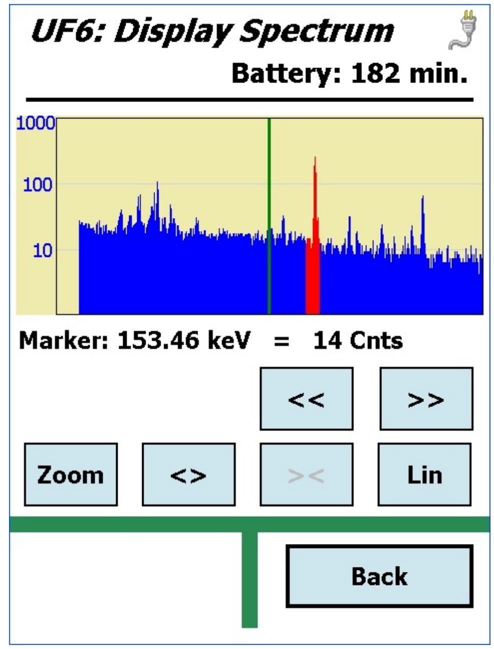


Figure 30. Display Stored Spectrum File.

3.3.4. Deleting a Spectrum File

The **Delete** command permanently removes a spectrum file (.SPC or .CHN) from the currently selected data location. *Note that the .TXT verification reports are not deleted.* Select the desired **Data Location**, then tap **Delete** to display the list of available files (Fig. 31). Tap to highlight the desired file, tap **Choose**, then tap **Yes** to confirm that you wish to delete.

IMPORTANT	***There is no "undo" for this operation.***

To archive spectrum and verification report files, and for easiest data management, see the instructions for file transfer to computer in Chapter 6.

3.4. Turn Cooler OFF/ON

This is a simple on/off toggle for the mechanical cooler (Fig. 32). The button label changes to reflect the next available action. As noted in Section 2.8, you can turn the cooler off for a brief period (e.g., 10 to 20 minutes) without significantly warming the detector.

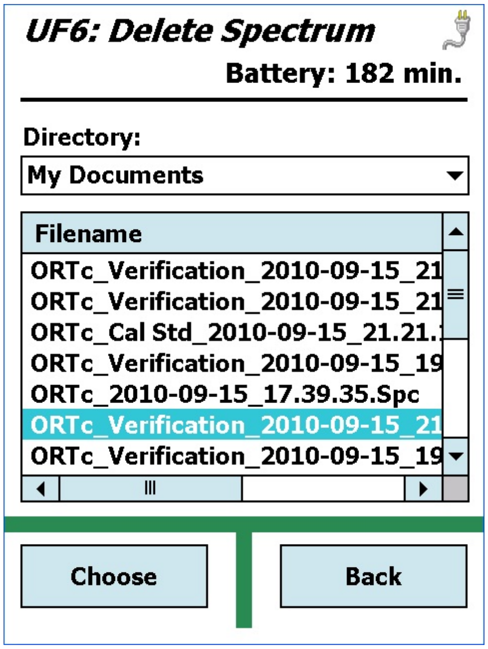


Figure 31. Choose the Spectrum to be Deleted.

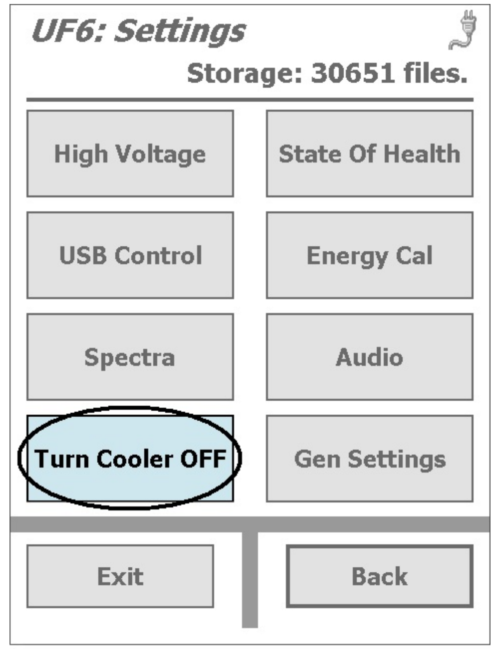


Figure 32. Cooler is On.

3.5. State of Health

Shows the Micro-UF6's current, live diagnostic status. Figure 33 shows the display for a Micro-UF6 that is fully cooled and ready for use.

To see more detailed readouts for the detector bias voltage and detector temperature, use the **High Voltage** command (Section 3.1).

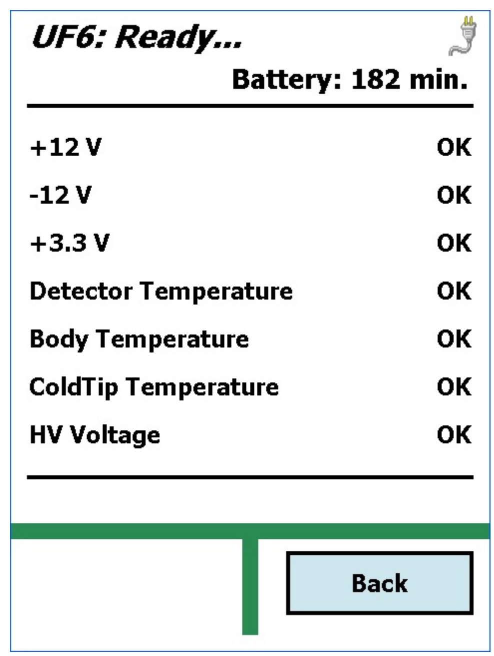


Figure 33. State of Health.

3.6. Energy Calibration

This screen (Fig. 34) lets you quickly "touch up" the amplifier gain to keep the 185.7 keV peak of U-235 centered in channel 2476. Channel 2476 was chosen to maintain a 0.075 keV-per-channel slope for the 4096-channel spectrum.

The gain changes you make are applied immediately. Simply position a U-235 source and tap **Energy Cal**.

Data acquisition begins as soon as the **Energy Cal** command is issued, and the screen displays the accumulating spectrum in real time. Use the ∧ / ∨ arrows and slider to position the 185.7 keV peak on the green marker line in channel 2476. To change the coarse gain, tap **Coarse** to open the screen shown in Fig. 35. Tap the desired gain setting, then tap **Back** to return to the Calibration screen (data acquisition continues in the background). To re-evaluate the spectrum as you adjust the fine gain, tap **Clear**.

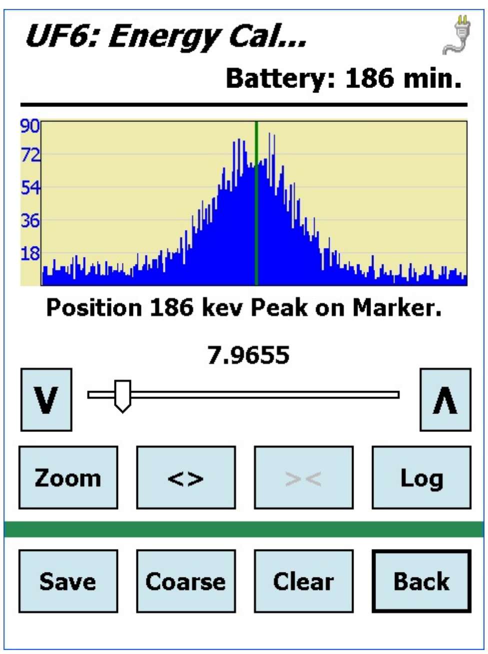


Figure 34. Adjust the Fine Gain to Center the 185.7 keV Peak in Channel 2476.

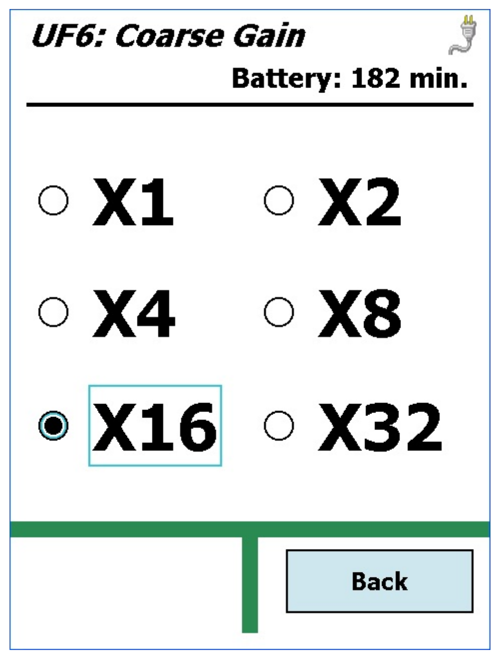


Figure 35. Amplifier Coarse Gain Settings.

Use the three zoom controls to adjust the horizontal axis, and the **Log/Lin** button to switch the vertical scaling. As the peak shifts closer to the green marker line, zoom in for more precise positioning.

Once a well-defined peak is centered in channel 2476, the unit is energy calibrated. You may **Save** this calibration spectrum in the current data format and location (Section 3.3), in which case it will be named according to the convention in Section 1.3.2.2; or return to the Settings Menu without saving **(Back**).

NOTE When the Micro-UF6 is connected to a computer, the spectroscopy application (e.g., MAESTRO, GammaVision) will read this energy calibration. If you "destroy" the energy calibration in MAESTRO or GammaVision, the Micro-UF6 program will restore it, along with all other settings, when you disconnect from the computer and return to **ActiveSync** mode for standalone operation.

3.7. Audio

Drag the slider, or tap the desired slider position to adjust the volume for the speaker and headphones (Fig. 36).

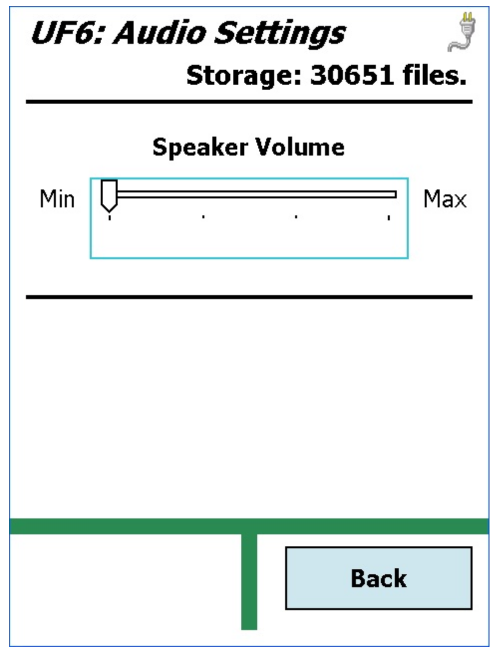


Figure 36. Audio Settings.

3.8. General Settings

Figure 37 shows the General Settings menu.

3.8.1. Set User Pwd and Set Admin Pwd

Both password screens function in the same way. Fig. 38 shows the administrator password screen. The "enter password" screen is identical except for the screen title. To enter a password, tap the number buttons, then tap **OK**. After a brief delay, the program will start up. If you make a mistake, tap **Clr** and try again.

NOTE *There is no master administrator password.* If you lose this password, contact your ORTEC service representative.

- **Set Admin Pwd** — Setting an administrator password allows non-administrators to start the Micro-UF6 application, but prevents them from changing the energy calibration. The password is limited to 9 digits.

- **Set User Pwd** — Setting a user password prevents unauthorized use of the Micro-UF6 program. The password is limited to 9 digits. When the user password has been set, the Micro-UF6 prompts for it on program startup.

- Only administrators can create or clear passwords.

  — **Create** — To create a password, tap the number buttons, tap **Done**, then back out to the Main Menu and tap **Exit** to return to the Launcher screen. Finally, tap **UF6 Enrichment** to restart the program and put the password into effect.

  — **Clear** — To clear either password, open the desired screen and tap **Clear** then **Done**. It is not necessary to exit and restart the Micro-UF6 application.

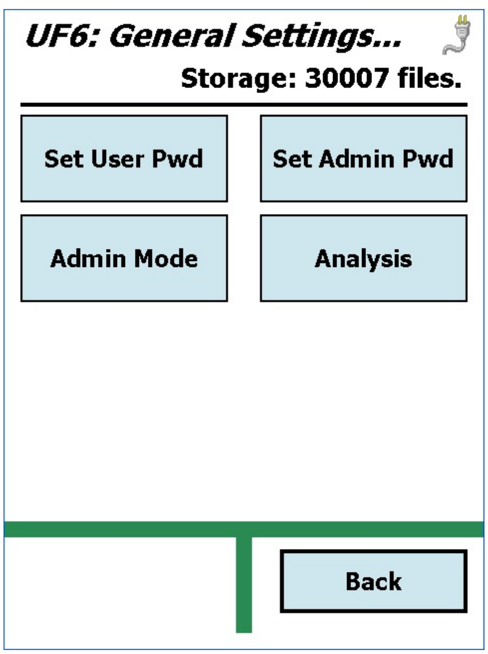


Figure 37. General Settings Menu.

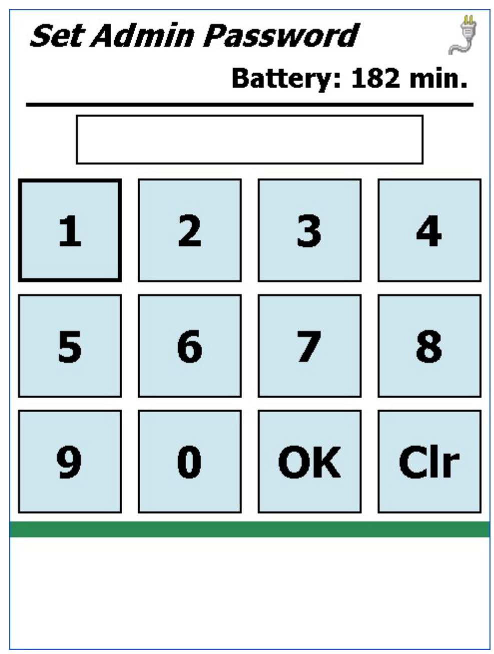


Figure 38. Create Password.

- If the administrator password *is not set*, entering the user password grants full administrator access to all functions.

- If the administrator password *is set*, entering the user password on application startup grants limited access (**Energy Cal**ibration is disabled in user mode). Entering the administrator password in the "user password" screen grants full access.

- If the user and administrator passwords *are identical*, entering either password grants full access.

3.8.2. Admin Mode

This command allows you to enter the administrator password so you can switch from user mode to administrator mode and change Micro-UF6 settings. It is not necessary to exit and restart the Micro-UF6 application.

3.8.3. Analysis

The Analysis Data screen (Fig. 39) allows an administrator to change the peak-fitting parameters. The fields are defined as follows, the default values are listed in Table 1, and more detailed information on the field definitions and analysis are in Section A.1.1.

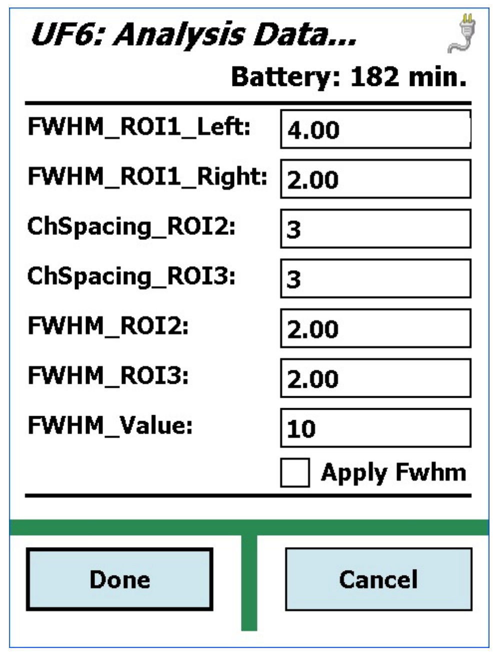


Figure 39. Analysis Data.

- **FWHM_ROI_Left** — Number of FWHMs from the 186 keV peak centroid to the left limit channel of the center ROI (ROI1).

- **FWHM_ROI_Right** — Number of FWHMs from the 186 keV peak centroid to the right limit channel of the center ROI (ROI1).

- **ChSpacing_ROI2** — Number of channels between the most left channel of ROI1 and the most right channel of the low background ROI (ROI2).

- **ChSpacing_ROI3** — Number of channels between the most right channel of ROI1 and the most left channel of the high background ROI (ROI3).

- **FWHM_ROI2** — Number of FWHMs for the width of the left background ROI (ROI2).

- **FWHM_ROI3** — Number of FWHMs for the width of the right background ROI (ROI3).

- **FWHM_Value** — Value for the FWHM in channels.

- **Apply_FWHM** — If this box is marked, the **FWHM_Value** above is used for the calculations, otherwise, the FWHM is calculated from the spectrum.

Table 1. Default Analysis Parameters.

FWHM_ROI_Left	4.00
FWHM_ROI_Right	2.00
ChSpacing_ROI2	3
ChSpacing_ROI3	3
FWHM_ROI2	2.00
FWHM_ROI3	2.00
FWHM_Value	10
Apply_FWHM	Unmarked (disabled)

3.8.4. Exit

This closes the Micro-UF6 application and returns you to the Launcher program. Tapping the Launcher's **Exit** button then takes you to the Windows Mobile operating system. To restart the application, tap **Start**, **Programs**, **Launcher**, then select **UF6 Enrichment**.[8] Note that if you exit the UF6 Enrichment application, on restart the instrument will default to the .SPC file format (see Section 3.3.2).

[8]It is also possible to bypass the Launcher and go directly to the Micro-UF6 program by tapping **Start**, **Programs**, **UF6**.

4. CALIBRATION AND VERIFICATION

As noted earlier, the Main Menu (Fig. 40) presents the most often used function — verification — at the top of the menu; and the less frequently used options at the bottom.

This chapter covers the calibration and verification functions. They are discussed in reverse order, reflecting the order in which you will set up the Micro-UF6 for field use: We will begin with instructions on establishing the inspection data and inspection item database, follow with the steps for calibrating the system with a reference U-235 source(s), and end with the details of performing verification measurements.

Be sure to read the notes on the user interface in Section 2.6 and the setup and monitoring instructions in Chapter 3.

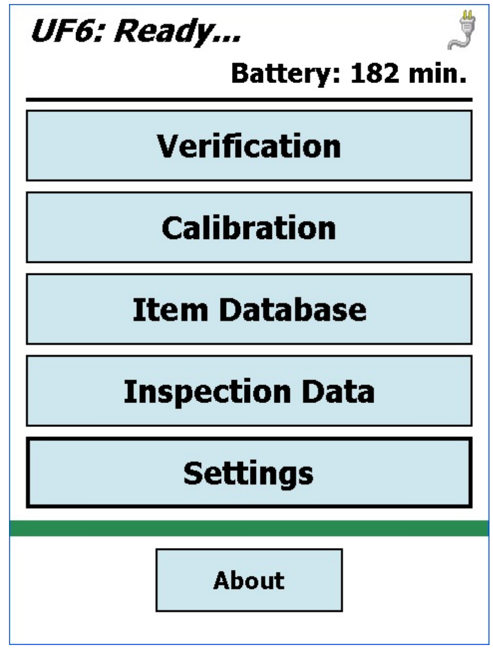


Figure 40. The Main Menu.

4.1. Inspection Data

The next step is to enter the Inspection Data for the current project (Fig. 41). This includes mandatory information including the inspector name(s); codes for country, facility, material balance area; and inspection number. There are also optional fields for location description and other comments. This information is used in the [Inspection Data] section of the verification report (Chapter 5), and can be changed as needed.

See Section 2.6.2 (page 19) for instructions on using the data entry soft keyboards.

Tap **Done** to return to the Main Menu.

For details on the syntax of this file, see Section B.2.

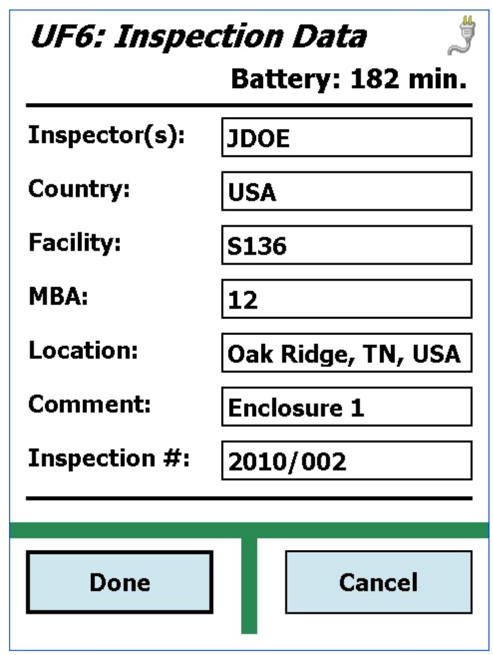


Figure 41. Enter the Inspection Data.

4.2. Item Database

Next, enter and/or edit the list of inspection items (i.e., items to be verified) and calibration standards on the Item Database screen. You can populate this list either by entering data via the Micro-UF6 user interface, or by creating a UF6.IDB text file on the computer and transferring it to the Micro-UF6. For details on the contents and syntax of this file, see Section B.1.

Figure 42 shows the current **Item List**. Figure 43 shows the editor screen for adding or editing an item. *All fields are required.* To add a new item, tap **Add**. To select an item for editing, tap to highlight it, then tap **Edit**. See Section 2.6.2 (page 19) for instructions on using the data entry soft keyboards.

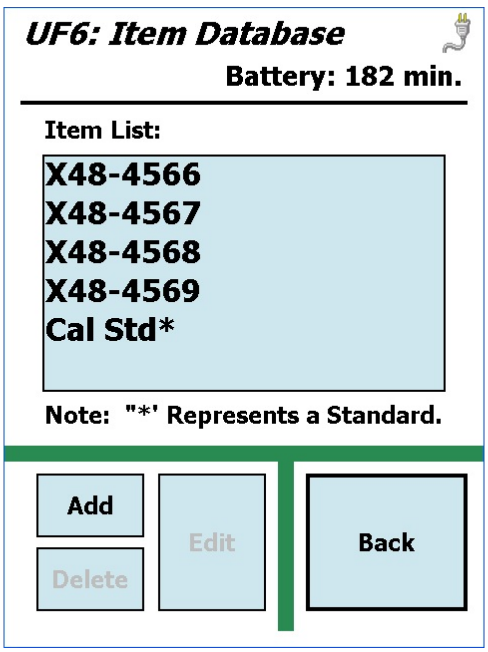


Figure 42. Enter the Inspection Items and Calibration Standards.

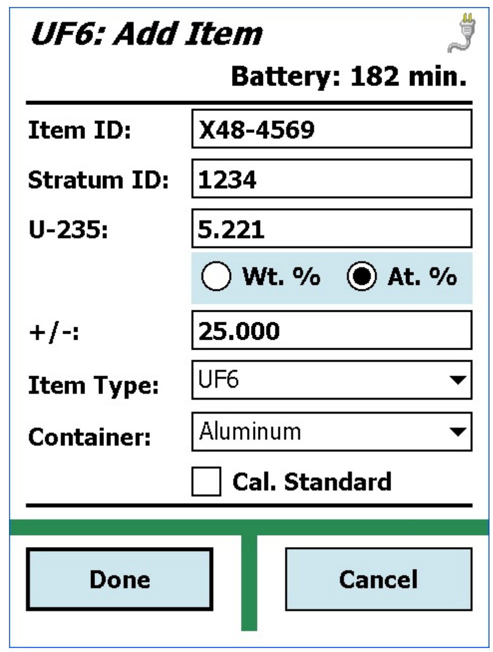


Figure 43. Add a New Item.

You may edit the information for any item (whether it was created on the Micro-UF6 screen or imported from a computer) before verifying it.

If an item is to be used as a calibration standard, be sure to mark the **Cal. Standard** checkbox. It will be displayed with an asterisk (*) beside it on the Item List for the Calibration and Verification screens.

To save the new or edited item and return to the Item Database screen, tap **Done**. To return to the Item Database screen without saving the new or edited entry, tap **Cancel**. To return to the Main Menu, tap **Back**.

4.2.1. Deleting an Item

To delete an item, tap to highlight it, then tap **Delete**. You will be asked to confirm the deletion. *There is no undo for this operation*.

4.3. Calibration

The Calibration mode is used to set the calibration constant based on expected results from a defined calibration standard. The calibration constant and uncertainty generated in this process are used as the default values in all Verification measurements until another Calibration is executed.

To calibrate:

- Enter the Inspection Data for the acquisition and analysis.
- Select a previously defined calibration standard item (marked with *) from the list.
- Acquire and analyze the calibration spectrum.
- Store the calibration constant to the Configuration File described in Section B.3.

Figure 44 shows the Calibration screen. Only Item Database items designated as calibration standards (*) are listed on this screen.

To select a calibration standard for acquisition and analysis, tap to highlight the Item ID, then tap **Select** to open the screen shown in Fig. ?. Enter the **Counting Time** in seconds and **Wall Thickness** and uncertainty (±) in mm, designate the count preset as real-time (**RT**) or live-time (**LT**). If the background correction is not needed, select **No Correction** and tab **Begin** to start a calibration measurement. If background correction is needed, follow the steps below:

1.If the background net count rate has been measured before, select the **Use Previous** background option. Then tab **Begin** to start calibration data acquisition. The calibration will then be performed with background correction.

2.If a background has not been measured before, the background data acquisition is needed at first before calibration. Select the **Measure & Update** background option. Tab **Begin** to start a background data acquisition. After the background measurement is finished, the background count rate and the corresponding uncertainty will be displayed to the user. Note that after the OK button on the dialog is clicked to dismiss it, the background data acquisition and analysis have completed, but the calibration has not been performed yet. To do a calibration with background correction, users need to click the **Calibration** button again from the top UF6 menu and then follow the steps in (1) above.

Figure 46 shows the spectrum window for a completed calibration. This screen shows a portion of the spectrum (150 keV to 210 keV) with an ROI marked around the 185.7 keV peak. ROIs are also marked around the low and high background ROIs and may or may not be visible due to scaling of the data. During the acquisition, the calibration results including the ROIs, count rate, and the current value of the calibration constant are periodically updated and displayed below the spectrum.

To interrupt calibration and return to the main Calibration screen, tap **Abort**.

To save the completed calibration, wait until acquisition is complete and tap **Save**. This stores the spectrum in the current format and file location (Section 3.3), and updates the current data in the [Calibration] section of the Configuration File (Section B.3). The resulting spectrum file is named according to the convention in Section 1.3.2.1. The calibration information is written to the [Calibration] section of the verification report (Chapter 5).

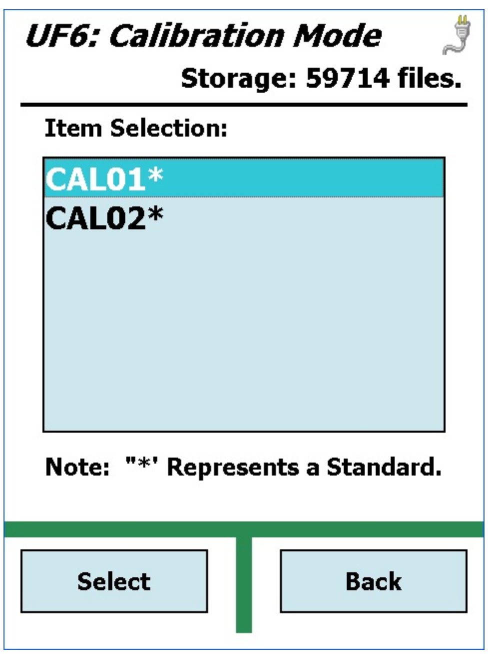


Figure 44. Select the Item for Calibration.

Figure 45. Enter the Count Time, Wall Thickness, Preset Type, and Background.

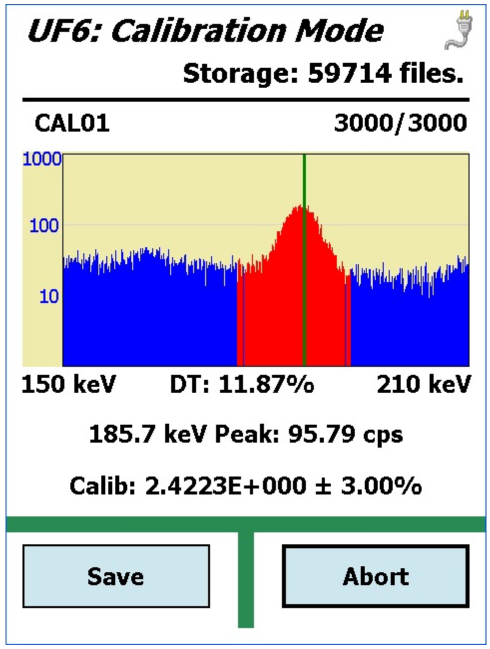


Figure 46. Spectrum and Calibration Constants for Completed Calibration Acquisition.

4.4. Verification

Verification involves the following steps:

- Selecting an Item ID from the item database list.
- Entering the Inspection Data for the acquisition and analysis.
- Optionally entering an Inspection Data comment that will be printed on the report.
- Select a background option. If the option chosen is Measure & Update, see section 4.4.2.
- Acquiring the spectrum and analyzing it using the most recent Calibration standard data.
- Storing the spectrum file, creating a verification analysis report file (Chapter 5), and displaying it onscreen.

Figure 47 shows the Verification screen. It lists both calibration standards (*) and verification items.

To select an item for verification, tap in the item selection list to highlight its Item ID, then tap **Select** to open the screen shown in Fig. ?. Enter the **Counting Time** in seconds and **Wall Thickness** and uncertainty (±) in mm; and designate the count preset as real time (**RT**), live time (**LT**), or uncertainty (**Unc**).

NOTE The calculation used to determine if the uncertainty preset is met is given in Eqn. 21 in Section A.1.5.

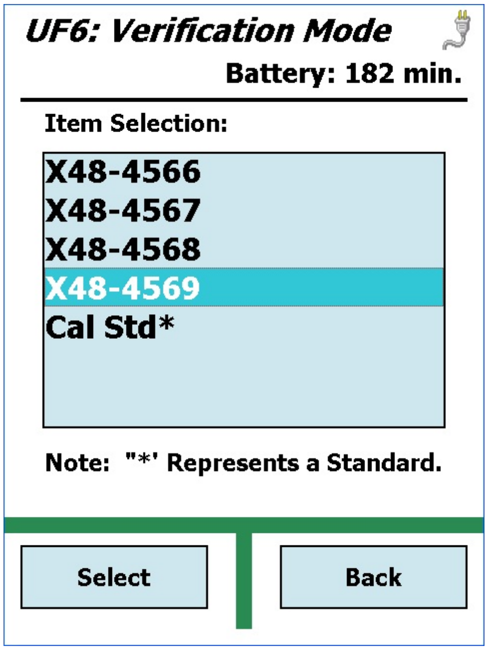


Figure 47. Select an Item for Verification.

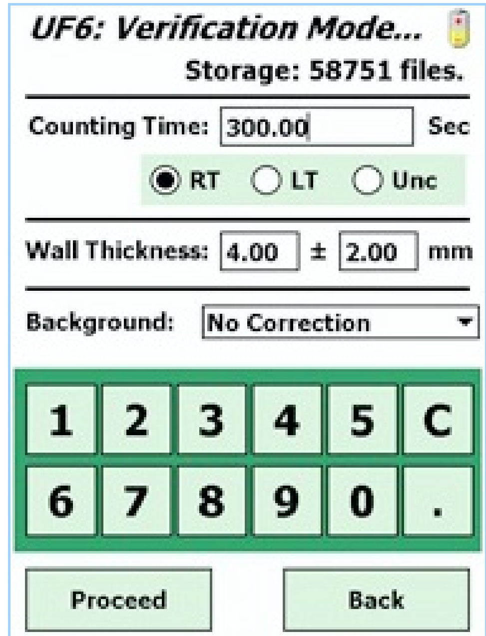


Figure 48. Enter the Count Time, Wall Thickness, Preset Type, and Background.

Tap **Proceed** to continue to the Comment (optional) screen shown in Fig. 49. See Section 2.6.2 (page 19) for instructions on using the soft keyboards.

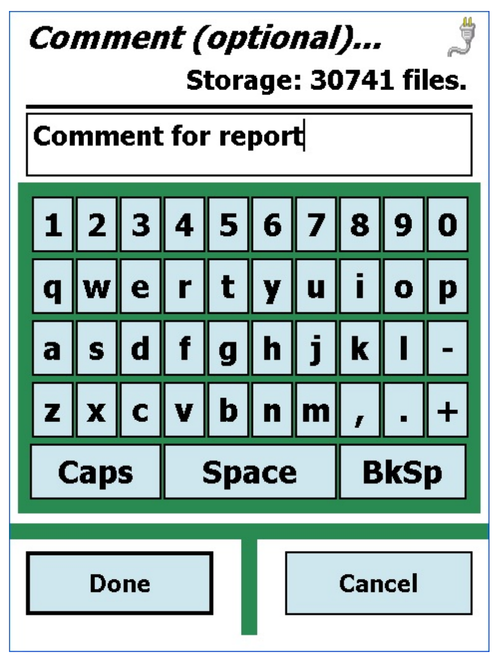


Figure 49. Optionally Enter a Comment.

To start verification, tap **Begin**. The spectrum screen shown in Fig. 50 will be displayed and spectrum data will begin to accumulate. Figure 50 shows a portion of the spectrum (150 keV to 210 keV) with an ROI marked around the 185.7 keV peak. ROIs are also marked around the low and high background ROIs, and may or may not be visible due to scaling of the data. During acquisition, the U-235 enrichment results including the ROIs, count rate, and the current enrichment value are periodically updated and displayed below the spectrum.

When acquisition is complete, tap **Done**. This stores the spectrum and report files in the current format and file location (Section 3.3). The spectrum and report file are named according to the convention in Section 1.3.2.1. A popup box gives you the option of viewing the verification report onscreen (Fig. 51). See Chapter 5 for details on the report.

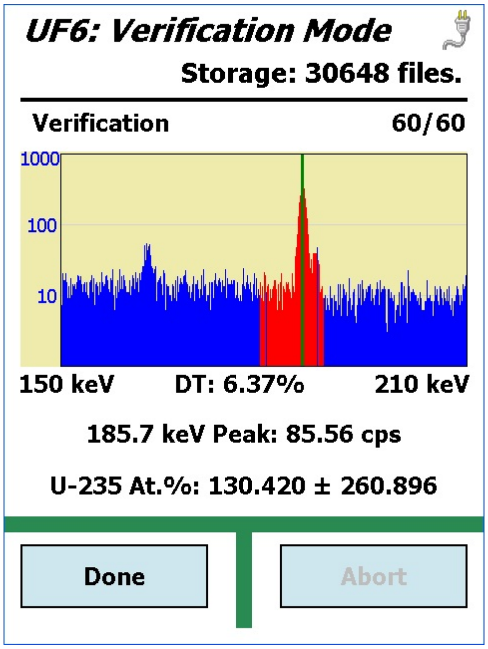


Figure 50. Spectrum and Enrichment Data for Completed Verification.

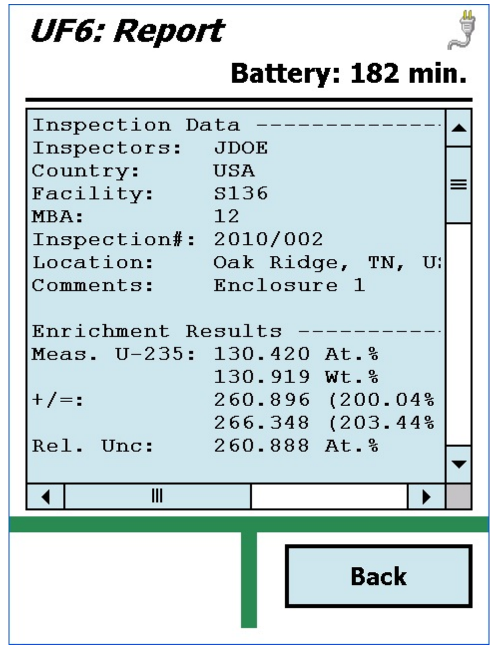


Figure 51. Verification Analysis Report.

4.4.1. Aborting Verification With Or Without Spectrum Analysis

To interrupt verification and return to the main Verification screen, tap **Abort**. A message box will ask if you wish to analyze the spectrum. Answering **Yes** will complete the verification as if the preset had already met. Note that the actual live time, rather than the preset value is used in all enrichment calculations, so the results do not depend on the preset value.

4.4.2. Background Measurement

Background contribution can be subtracted out from the verification or from calibration measurements. To start a background data acquisition, select the **Measure & Update** background option on the data acquisition page. For convenience, background data acquisition can be started from the Verification mode or from the Calibration mode. The real time or live time preset for the background measurement should be long since the 185.7 keV background peak count rate is small in typical settings. When background data acquisition is in progress, the following screen is shown. The 186 keV peak background count rate and the corresponding uncertainty will be updated periodically. The message “Background …” will be displayed while background data acquisition is in progress.

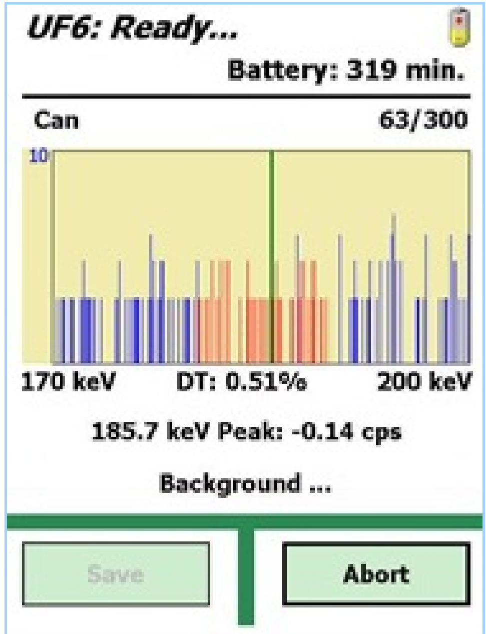


Figure 52. Background data acquisition in progress.

When the background acquisition is completed, press the **Save** button. The background spectrum acquired will be saved and analyzed. The calculated background count rate and count rate uncertainty (in cps) will be displayed on a dialog.

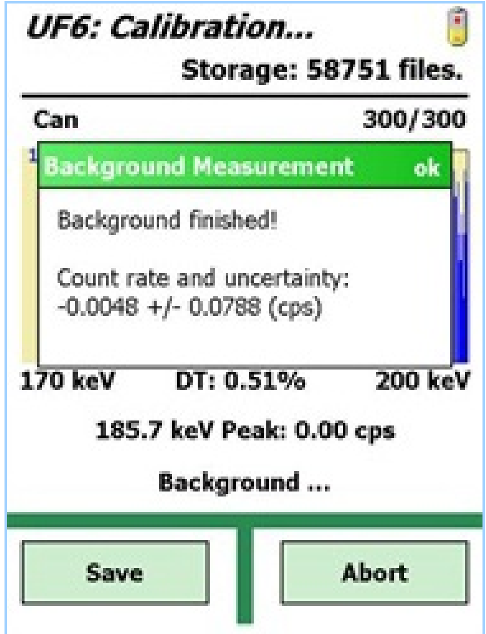


Figure 53. At the end of background data acquisition, the background peak count rate and uncertainty are displayed.

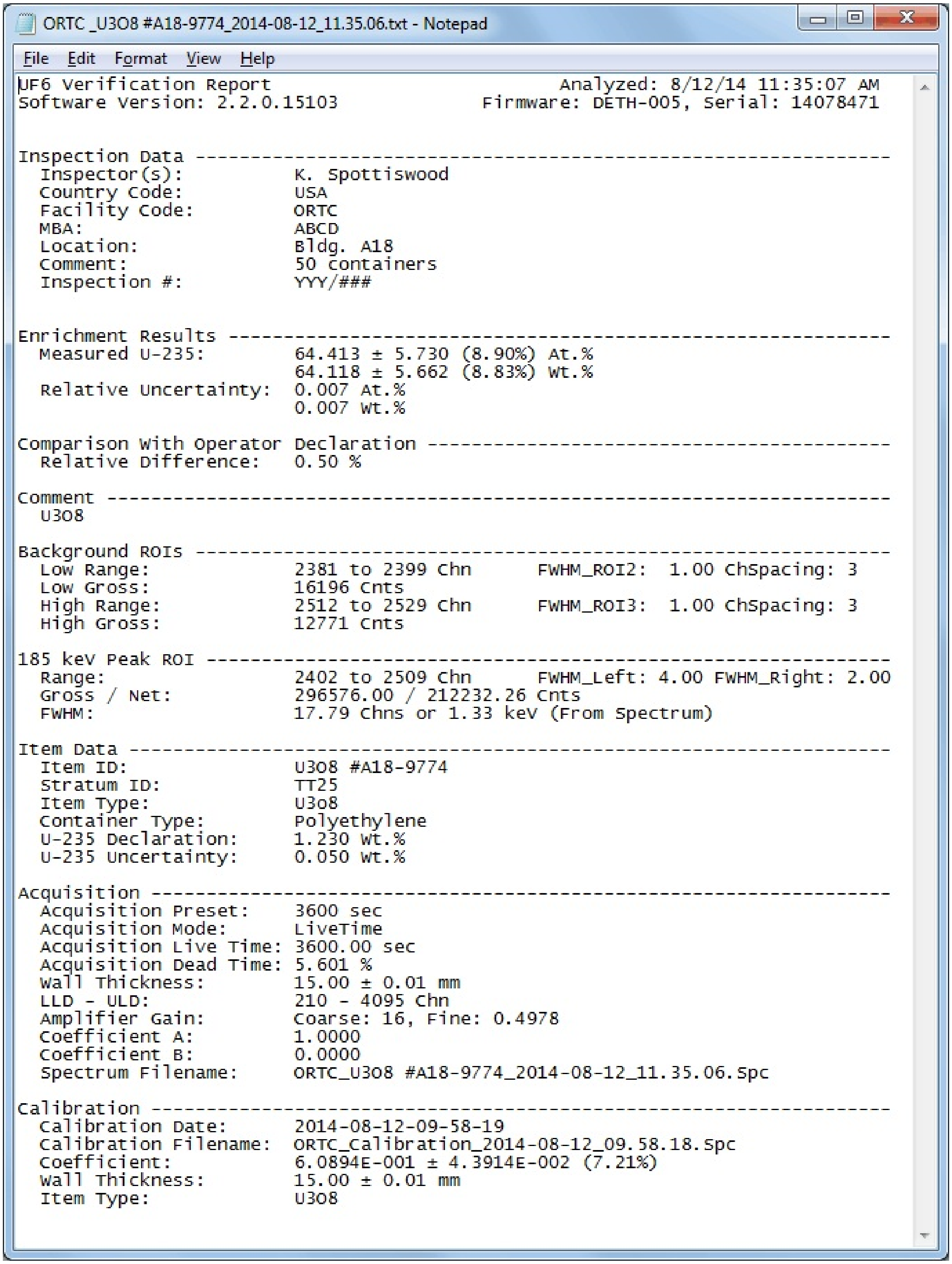
The background peak count rate will be used in sub-sequent background subtraction if background subtraction is enabled. If the background corrected net count rate is negative, R_B is set to zero, but the uncertainty should be non-zero.

4.4.3. Background Subtraction

If the background option is **Use Previous**, then that background peak count rate obtained (see section 4.4.2) will be subtracted out the net count rate calculated from the Verification or Calibration spectrum, depending what is the current mode. Then the background corrected net count rate will be used in subsequent calculations. Within the 185 keV Peak ROI section on the Verification Report, the background peak count rate and uncertainty used for subtraction are printed as the first additional line. The background corrected net counts is also printed on the next line. For details about the calculations, see the corresponding section in the Appendix. If a background spectrum has not been measured before, the background correction will be zero with zero uncertainty, and the net effect is as if there is no background correction. If background correction is enabled, the background net count rate and uncertainty will be printed on the report, even if both are zero.

5. THE VERIFICATION REPORT

Figure 54 shows an example of the ASCII verification report displayed in Windows Notepad.




```
UF6 Verification Report                              Analyzed: 8/12/14 11:35:07 AM
Software Version: 2.2.0.15103                 Firmware: DETH-005, Serial: 14078471


Inspection Data ---------------------------------------------------------------
  Inspector(s):            K. Spottiswood
  Country Code:            USA
  Facility Code:           ORTC
  MBA:                     ABCD
  Location:                Bldg. A18
  Comment:                 50 containers
  Inspection #:            YYY/###


Enrichment Results ------------------------------------------------------------
  Measured U-235:          64.413 ± 5.730 (8.90%) At.%
                           64.118 ± 5.662 (8.83%) Wt.%
  Relative Uncertainty:    0.007 At.%
                           0.007 Wt.%

Comparison With Operator Declaration ------------------------------------------
  Relative Difference:     0.50 %

Comment -----------------------------------------------------------------------
  U3O8

Background ROIs ---------------------------------------------------------------
  Low Range:               2381 to 2399 Chn      FWHM_ROI2:  1.00 ChSpacing: 3
  Low Gross:               16196 Cnts
  High Range:              2512 to 2529 Chn      FWHM_ROI3:  1.00 ChSpacing: 3
  High Gross:              12771 Cnts

185 keV Peak ROI --------------------------------------------------------------
  Range:                   2402 to 2509 Chn      FWHM_Left: 4.00 FWHM_Right: 2.00
  Gross / Net:             296576.00 / 212232.26 Cnts
  FWHM:                    17.79 Chns or 1.33 keV (From Spectrum)

Item Data ---------------------------------------------------------------------
  Item ID:                 U3O8 #A18-9774
  Stratum ID:              TT25
  Item Type:               U3O8
  Container Type:          Polyethylene
  U-235 Declaration:       1.230 Wt.%
  U-235 Uncertainty:       0.050 Wt.%

Acquisition -------------------------------------------------------------------
  Acquisition Preset:      3600 sec
  Acquisition Mode:        LiveTime
  Acquisition Live Time:   3600.00 sec
  Acquisition Dead Time:   5.601 %
  Wall Thickness:          15.00 ± 0.01 mm
  LLD - ULD:               210 - 4095 Chn
  Amplifier Gain:          Coarse: 16, Fine: 0.4978
  Coefficient A:           1.0000
  Coefficient B:           0.0000
  Spectrum Filename:       ORTC_U3O8 #A18-9774_2014-08-12_11.35.06.Spc

Calibration -------------------------------------------------------------------
  Calibration Date:        2014-08-12-09-58-19
  Calibration Filename:    ORTC_Calibration_2014-08-12_09.58.18.Spc
  Coefficient:             6.0894E-001 ± 4.3914E-002 (7.21%)
  Wall Thickness:          15.00 ± 0.01 mm
  Item Type:               U3O8
```

Figure 54. Typical Verification Report.

The report contains the following information:

Inspection Data

Item	Derived From
Inspector(s)	Current inspection data file (.IDB)
Country Code	Current inspection data file (.IDB)
Facility Code	Current inspection data file (.IDB)
MBA	Current inspection data file (.IDB)
Inspection #	Current inspection data file (.IDB)
Location	Current inspection data file (.IDB)
Comments	Current inspection data file (.IDB)

Item Data

Item	Derived From
Item ID	Current entry from item database file (.ISL)
Item Stratum ID	Current entry from item database file (.ISL)
Item Type [material type]	Current entry from item database file (.ISL)
Container Type	Current entry from item database file (.ISL)
Item U-235 Declaration	Current entry from item database file (.ISL)
	Both Atom% and Weight%
Item U-235 Uncertainty (absolute)	Current entry from item database file (.ISL)
	Both Atom% and Weight%

Acquisition

Item	Derived From
Acquisition Preset [s]	Current configuration file (.INI)
Preset Mode [LT/RT/UNC]	Current configuration file (.INI)
Live Time [s]	Stored spectrum.
Dead Time (%)	Stored spectrum.
Wall Thickness	Current configuration file (.INI)
Wall Thickness Uncertainty	Current configuration file (.INI)
LLD – ULD	Stored spectrum.
Amplifier Gain	Stored spectrum.

Item	Derived From
Coefficient A	Current configuration file (.INI)
Coefficient B	Current configuration file (.INI)
Spectrum Filename	Stored spectrum name

Calibration

Item	Derived From
Calibration Date	Current configuration file (.INI)
Calibration Spectrum	Current configuration file (.INI)
Calibration Coefficient	Current configuration file (.INI)
Calibration Coefficient Uncertainty	Current configuration file (.INI)
Calibration Wall Thickness	Current configuration file (.INI)
Calibration Wall Thickness Uncertainty	Current configuration file (.INI)
Calibration Item Type	Current configuration file (.INI)

Enrichment Results

Item	Derived From
Item Measured U-235	Calculated value (Atom Pct and Weight Pct)
Item Measured U-235 Uncertainty	Calculated value
Relative Uncertainty	Difference between declared and calculated

Comparison with Operator Declaration

Item	Derived From
Relative Difference	Difference between declared and calculated 100.0 * (DV−MV) / DV, where DV = Declared, MV = Measured. This field is reported in percent.

Background ROIs

Item	Derived From
Low Range	Calculated start and end channels
Low Gross Counts	Calculated start and end channels

Item	Derived From
High Range	Calculated start and end channels
High Gross Counts	Calculated start and end channels
ROI 2 Width and Location	User parameter from UF6.INI file
ROI 3 Width and Location	User parameter from UF6.INI file

185 keV Peak ROI

Item	Derived From
Range	Calculated start and end channels
Gross Counts	Calculated value
Net Counts	Calculated value
Peak FWHM	Calculated value
ROI1 Width	User parameter from UF6.INI file

If background correction is enabled (i.e., **Use Previous** is selected), then there are two extra lines are printed on the report. An example is shown below:

Bkgd. CR: 0.0054 +/- 0.0165 (cps)
Corr. Net: 34.60 (Cnts)

6. FILE TRANSFER TO COMPUTER

The Micro-UF6 creates both spectrum files for verification and calibration (in the ORTEC .SPC and/or .CHN formats), and ASCII verification report files. Once you have downloaded the spectrum files to computer, you can view and analyze them with applications such as MAESTRO, GammaVision, and ISOTOPIC. The file transfer method depends on your computer operating system and where your spectrum files are stored on the Micro-UF6.

- Spectra stored on the SD card (recommended) — The simplest method is to move the card to a computer with a memory card reader and Windows Explorer. Otherwise, transfer files using the Windows Mobile Device Center or ActiveSync as described below.

- Spectra stored in the Micro-UF6's My Documents folder:

  — **Windows 7/8**: You must download and install Windows Mobile Device Center, as described in Section 6.1, then copy files via Windows Explorer.

  — **Windows XP**: You must download and install Microsoft ActiveSync driver, as described in Section 6.2, then copy files via Windows Explorer.

IMPORTANT	*Before connecting the Micro-UF6 to a computer for the first time*, install Windows Mobile Device Center or ActiveSync ***first***. Otherwise, the Micro-UF6 may not be able to communicate properly with the computer. Contact our Global Service Center if you need assistance.

6.1. Windows 7 and 8

1) Download and install the free Windows Mobile Device Center from the Microsoft Download Center. Follow the wizard prompts, restart the computer, then start the Windows Mobile Device Center program.

2) If the Micro-UF6 is in MCA Mode, tap the **Data (ActiveSync)** option to return it to stand-alone identifier mode (see Section 3.2).

3) Connect the Micro-UF6's USB port to the computer. If this is the first time the Micro-UF6 has been connected to this computer, Windows 7 and 8 will indicate that the hardware driver has been installed. Windows XP will display a series of “new hardware” messages indicating a mobile device (e.g., the Micro-UF6 computer) has been detected and its driver installed.

Windows Mobile Device Center will then take several seconds to communicate with the Micro-UF6 and indicate the its integrated computer is **Connected** (Fig. 55). If Windows Mobile Device Center cannot connect to the Micro-UF6, see the troubleshooting steps in Section 7.8.

4) Click **Connect without setting up your device**. This will prevent the host computer and Micro-UF6 from automatically synchronizing (i.e., exchanging files). ***Do not modify the Program and Services, transfer graphics or music to the Micro-UF6 computer, or change the Mobile Device Settings.***

IMPORTANT *Remember that the Micro-UF6 is not to be used for purposes beyond the monitoring tasks described in the user manual, and no changes should be made to the operating system settings.*

5) Hover over **File Management** to expand its topics, and click **Browse the contents of your device** (Fig. 56).

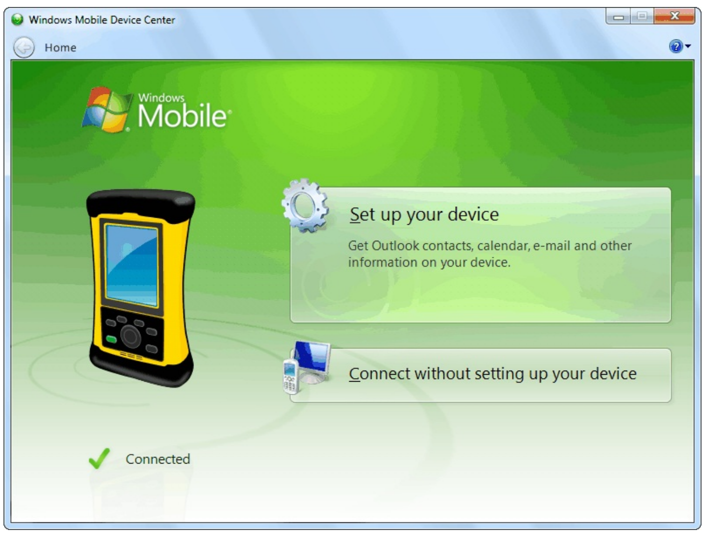


Figure 55. The Micro-UF6 is Connected to the Computer.

Figure 56. Choose the File Management Browse Option.

6) Windows Explorer will open and the Micro-UF6's computer will be listed as shown in Fig. 57. Stored search and identification files will be located in the SD card's Data folder or in the My Documents folder, depending on the location set on the Spectra dialog (see Section 3.3.1).

7) If your files are stored on the SD card, select the Storage Card and open the Data folder. If

your files are in the My Documents folder, select the Documents item on the left sidebar. Identification Mode spectra in the .SPC format have a "spectrum" icon with a green background. Search Mode files in the .CHN format have a "spectrum" icon with a gray background. Text files have the default file icon.

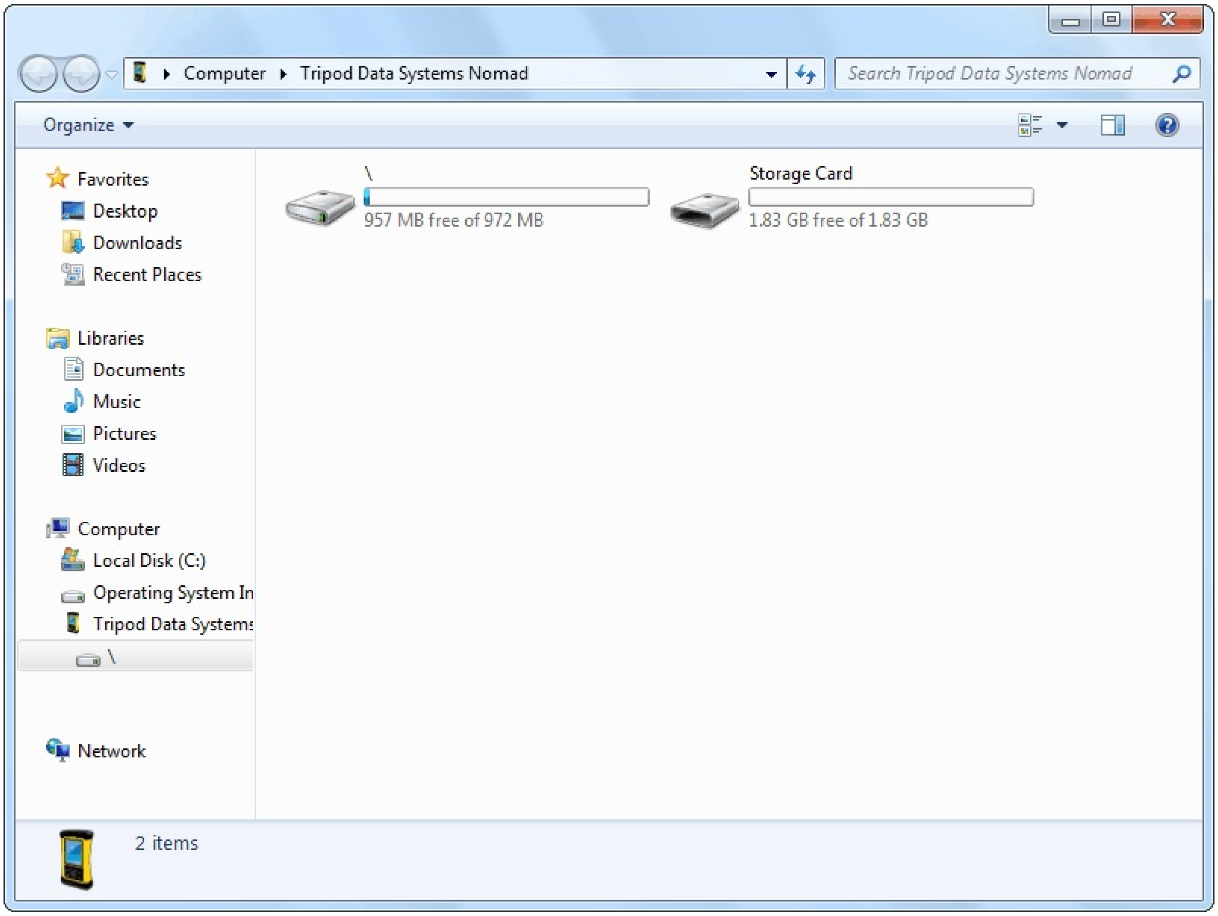


Figure 57. The Micro-UF6 Computer's Top-Level File Structure.

6.2. Windows XP

1) Download the free ActiveSync v4.5 or higher from the Microsoft Download Center. When download is complete, select **Run**. This will automatically start installation. Follow the wizard prompts and restart the computer.

2) If the Micro-UF6 is in MCA Mode, tap the **Data (ActiveSync)** option to return it to stand-alone identifier mode (see Section 3.2).

3) Connect the Micro-UF6's USB port to the computer. If this is the first time the Micro-UF6 has been connected to this computer, Windows will display a series of "Found New Hardware" messages indicating a mobile device (e.g., the Micro-UF6 computer) has been detected. The Synchronization Setup Wizard will start. Follow the wizard prompts for a standard partnership according to step (4).

4) On the Synchronization Options screen, ***unmark ALL checkboxes, scrolling down as needed to ensure all items have been deselected*** (Fig. 58). This will prevent the host computer and Micro-UF6 from automatically exchanging files.

IMPORTANT *Remember that the Micro-UF6 is not to be used for purposes beyond the monitoring tasks described in the user manual, and no changes should be made to the operating system settings. Doing so could void your warranty.*

5) Continue with installation as directed. At the end of the wizard, the ActiveSync dialog will indicate the Micro-UF6 computer is **Connected** (Fig. 59). If ActiveSync cannot connect to the Micro-UF6, see the troubleshooting steps in Section 7.8.

Figure 58. Unmark All Synchronization Options.

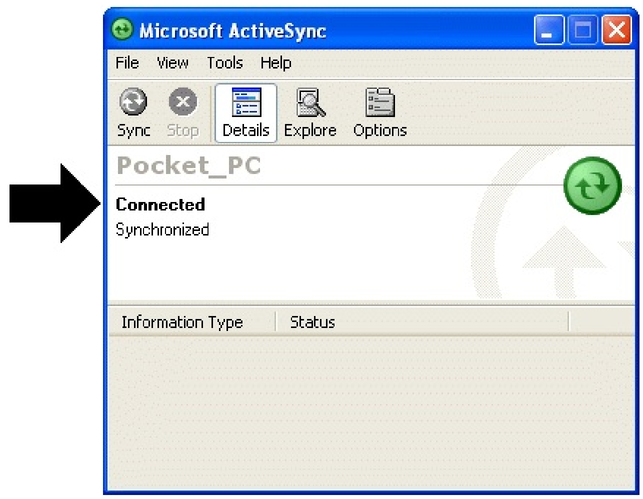


Figure 59. Connection Established.

6) You can now click the **Explore** toolbar button in the ActiveSync dialog to open Windows Explorer and view the new connection and its menu tree.

From the host computer, the Micro-UF6 is dis-played as My Windows Mobile-Based Device in the Mobile Device folder under My Computer (Fig. 60). Stored search and identification files will be located in the SD card's Data folder or the My Documents folder or, depending on the location set on the Spectra dialog (see Section 3.3.1). These locations are indicated by arrows in Fig. 60.

Identification Mode spectra in the .SPC format have a "spectrum" icon with a green background. Search Mode files in the .CHN format have a "spectrum" icon with a gray background. Text files have the default file icon.

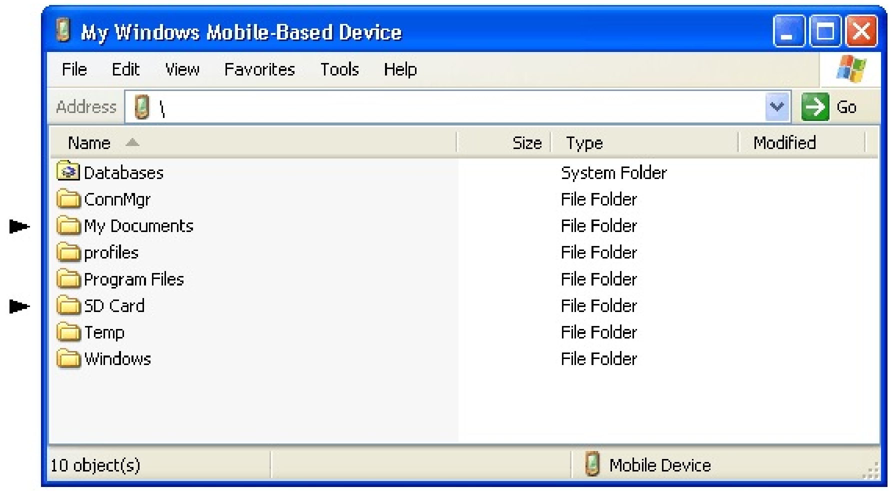


Figure 60. Exploring the Micro-UF6 Computer's Files from the ActiveSync Window.

6.3. When File Transfer Is Complete

To return the Micro-UF6 to standalone service, simply disconnect it from the USB cable and navigate back to the home screen.

7. TROUBLESHOOTING

7.1. “Error saving spectrum file” Message

This message is generated during a file-save operation if the storage location is full or there is no card in the specified drive. *In either case, the data for this calibration or verification will be lost.* Do not begin a data acquisition if the indicator in the upper right of the screen shows that no storage space is available. We recommend that you *not* use the computer’s My Documents folder for file storage. However, if you use that folder, do not allow it to become full; the computer’s operating system requires a certain amount of empty disk space for normal operation.

7.2. If the Micro-UF6 Program Stops

The Micro-UF6 incorporates a computer running the Windows Mobile operating system. Occasionally, the operating system will stop responding to external commands. The power button is located below the display on the base of the computer. To reboot the computer, press and hold the power button for ~3 seconds and release, displaying a menu that allows you to shut down, reset (reboot), align the touchscreen, and so on. Tap the **Reset** button to reboot; the cooler will stay on. This will reset the operating system and automatically run the ORTEC Launcher program. Tap **UF6 Enrichment** to start the Micro-UF6 application.

7.3. If You Drop the Micro-UF6

The Micro-UF6 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, press and hold the On/Off button for approximately 3 seconds, then release to display the Micro-UF6 computer’s Power Menu. Select **Shutdown**. Wait 5 seconds, then turn the unit back on. This should reset any mechanical relays that might have been deactivated by the drop.

- 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 State of Health screen (Section 3.5) for the next few hours to ensure that the cooler and bias voltage are functioning properly, and ensure that it is still energy calibrated. If the calibration is significantly changed, this could indicate a problem.

If the unit fails in one or more of these respects or if any message boxes indicate a failure, contact your ORTEC representative or our Global Service Center for further assistance. *Remember that there are no user-serviceable parts inside the Micro-UF6 and opening the case will void the warranty.*

7.4. If the Micro-UF6 Will Not Turn On

- Connect the Micro-UF6 to an external power source. It should automatically boot up, turn the cooler on, and start the Micro-UF6 software application.

- If the internal batteries are 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 Appendix C.

7.4.1. Starting from an Exhausted Battery

If the internal battery is completely exhausted:

- **Recharge the battery** — Connect the Micro-UF6 to external power. The cooler will start automatically. If the detector has warmed up, it will cool to operating temperature before the battery begins recharging. If the battery is completely discharged, it will typically reach full charge in 3–4 hours after the detector is cool.

- If the cooler does not automatically restart, go to the Main Menu and tap **Turn Cooler ON**.

7.5. If the Display is Lost or Posts a "Display Disabled" Message

Press and hold the ON/OFF button, located on the base of the display, until the shutdown warning screen counts down and the display goes dark. Wait 15–20 seconds, then press the ON/OFF button to restart the computer. When restart is completed, the Launcher program will restart. Tap **UF6 Enrichment** to launch the Micro-UF6 application.

For further assistance, contact your ORTEC representative or our Global Service Center.

7.6. If You Forgot the Administrator Password

There is no master password. Contact your ORTEC representative or our Global Service Center for assistance.

7.7. GPS Issues

7.7.1. Delayed Display of Location Coordinates

If your GPS has not received signals from GPS satellites for >30 days (e.g., if it has not been in use or has been used continuously indoors), it may take 10–15 minutes for the unit to update and begin displaying location information.

7.8. Windows Connectivity Problems

Typically, if ActiveSync or Windows Mobile Device Center cannot find the Micro-UF6, it is because the Windows connectivity software was not installed ***first***, before the unit was connected to the computer. If the Windows connectivity software has not been installed, when you attach the Micro-UF6 to the computer for the first time, the "new hardware" bubbles in the lower right corner of the screen will indicate that device driver installation failed.

- Confirm the USB cable is good. If connecting via a USB hub, ensure that it is correctly connected and functioning. If this does not resolve the issue, go to the next step.

- In Control Panel, open the Device Manager and check for an **Unknown Device** entry that disappears when you disconnect the Micro-UF6 from the computer. If such an entry exists, reconnect the Micro-UF6, right-click the **Unknown Device**, select **Uninstall**, and confirm that you wish to uninstall the instrument. Disconnect the Micro-UF6 from the computer.

- Download and install (or uninstall and reinstall) the ActiveSync or Windows Mobile Device Center software, making sure you have downloaded the correct version; restart the computer; and start the connectivity program.

- Restart the Micro-UF6 by pressing and holding the On/Off button for 5 seconds, until the screen goes dark and the instrument reboots. When the UF6 Enrichment program has fully reinitialized, reconnect to the computer. You should see one or more "new hardware" bubble messages indicating the Micro-UF6 was successfully detected.

- If these steps do not resolve the issue, contact your ORTEC representative or our Global Service Center. In the meantime, if your spectrum files are stored in the instrument's My Documents folder, you may wish to exit the UF6 Enrichment program, use the Windows Mobile File Explorer program to copy the spectra to an SD card, then mount the SD card in the computer and transfer the files that way.

7.9. Troubleshooting MAESTRO-Related Problems

7.9.1. MAESTRO Does Not Connect with the Micro-UF6

If properly installed and functioning MAESTRO software (or other CONNECTIONS programs) cannot find and communicate with the Micro-UF6 when it is connected via the USB port and being used as an MCA:

- Make sure the USB cable is properly connected to both the Micro-UF6 and computer.

- Make sure the USB hub (if applicable) is correctly connected and functioning.

- Make sure the Micro-UF6 is turned on and the USB Control setting is **MCA Mode**. If you switch USB control modes while connected to a computer, the computer should generate a USB disconnect/connect signal. If you do not hear this signal, see step 5.

- Run the MCB Configuration program from the MAESTRO Start menu and confirm that it locates the Micro-UF6. (See the accompanying MAESTRO *User's Manual* for instructions on this operation.)

- If the preceding steps do not establish communication, return the USB Control setting to **ActiveSync** Mode, exit and restart the UF6 Enrichment application, then switch the USB Control setting back to **MCA Mode**. If connected to a computer when you switch modes, the computer should generate a USB disconnect/connect signal.

7.10. Other Problems with the Micro-UF6

Should the Micro-UF6 exhibit other unusual behavior, confirm that the Regional Settings in the Windows Mobile operating system are set correctly, and restore them if necessary. The Micro-

UF6 is designed to function with Windows Mobile set to the **English (United States)** region and its default values for decimal symbol, digit grouping symbol, and time and date formats, as described below. *Using other than the factory default settings can cause operational problems.*

To check these settings:

- On the Main Menu screen, tap **Exit**, then confirm that you wish to end the Micro-UF6 program.
- On the Windows desktop, tap the **Start** square in the upper left corner of the screen, then tap **Settings**.
- In the Settings dialog, tap the System tab, then select **Regional Settings**.
- On the Region tab, select **English (United States)** from the droplist.
- On the Number tab, choose the period (**.**) for the **Decimal symbol** and the comma (**,**) for the **Digit grouping symbol**.
- On the Time tab, select *h:mm:ss tt* as the **Time style** and the full colon (**:**) as the **Time separator**.
- On the Date tab, use *M/d/yy* as the **Short date**, the forward slash (/) as the **Date separator**, and the **Long date** format *dddd, MMMM dd, yyyy*.
- Tap the upper right **OK** circle, then the upper right **X** circle to return to the Windows desktop.
- Restart the Micro-UF6 application by tapping **Start**, **Programs**, **Launcher**, then choosing **UF6 Enrichment**.

For further assistance, contact your ORTEC representative or our Global Service Center.

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8. SPECIFICATIONS[9]

8.1. HPGe Detector

Gamma-Ray Detector Internal, coaxial HPGe detector. P-type high-purity germanium, 50 mm diameter × 30 mm deep (nominal).

- Relative efficiency: 15% typical (ANSI/IEEE 325-1996)
- Resolution: 1450 eV @ 122 keV and 2.15 keV @ 1332 keV (FWHM warranted at optimum settings).
- Peak shape: 1.9 typical (FWTM/FWHM).

If you must test the dose-rate measurement capability with a point source, especially at close range, it is important to know the reference points of the unit's detector, since test procedures such as ANSI or IAEA prescribe use of point sources at specified distances from the reference point of the instrument. The reference point is the geometric center of the Ge detector endcap disk (see Fig. 61).

8.2. Removable Collimator

The removable tungsten collimator has been designed to provide 99.999% absorption of gamma rays below 200 keV from all directions except the front field of view. This is accomplished by closely fitting the collimator to the cryostat mount to eliminate straight line of sight to the detector from all angles. This reduces the background coming from the back, sides, and front of the unit. At the same time, the front of the collimator has a 50 mm aperture to match the diameter of the detector crystal to maximize detection of "wanted" counts. The entire inside surface facing the detector crystal has a graded-Z (copper/tin) liner to minimize the fluorescence spectrum from the tungsten, especially the 59 keV x-ray.

8.3. MCA Specifications

Display Color LCD touchscreen provides live spectrum display, status information, and analysis results.

Presets Live time, real time, integral peak count, peak count, uncertainty, and Multi-Nuclide MDA. Up to 20 nuclide ROIs can be specified. Acquisition halts when all MDA requirements have been satisfied. Real time and live time in multiples of 1 sec.

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[9]Specifications subject to change without notice.

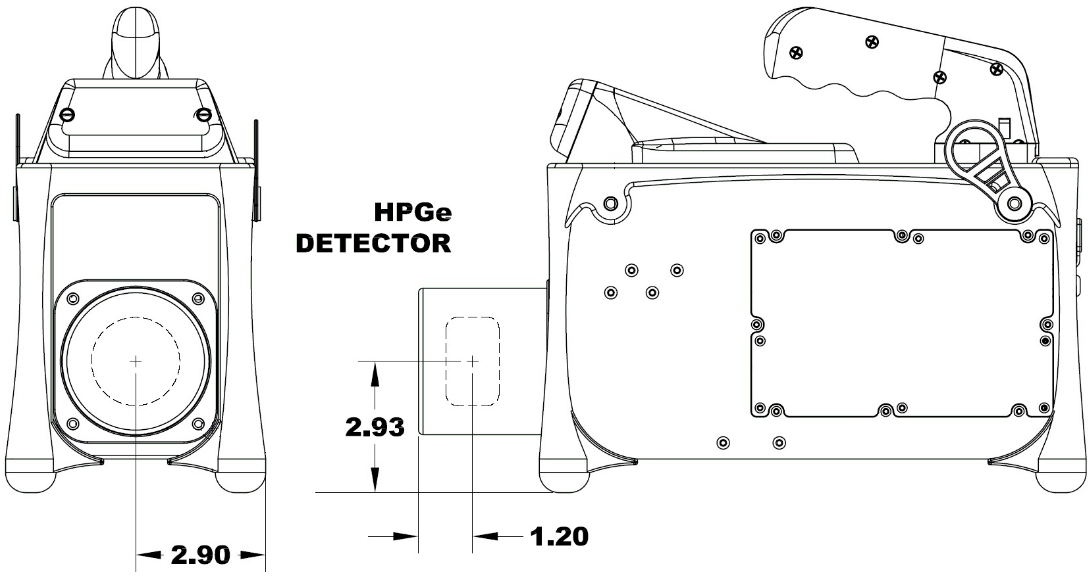

Figure 61. Reference Points for the HPGe Detector (all measurements in inches).

System Gain Settings

- Conversion gain: Software controlled from 512 to 16k.
- Coarse gain: 1, 2, 4, 8, 16, or 32.
- Fine gain: 0.45 to 1.

With the available range of gain settings, the achievable full-scale energy range is 187 keV to ~7 MeV.

Shaping-Time Constants

- Rise time: 0.8 µs to 23 µs.
- Flattop: 0.3 µs to 2.4 µs width.

Dead-Time Correction Extended live-time correction according to Gedcke-Hale method.[10] Accuracy: area of reference peak changes <±3% from 0 to 50000 cps.

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).

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

Digital Spectrum Stabilizer Controlled via computer, stabilizes gain and zero errors.

Temperature Coefficient

- Gain: <35 ppm/°C. [Typically 30 ppm/°C.]
- Offset: <3 ppm/°C.

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

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

Digital Gated Baseline Restorer Computer controlled adjustment of the restorer rate (High, Low, and Auto).

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

ULD Digital upper level discriminator, set in channels. Hard cutoff of data in channels above the ULD setting.

Ratemeter Count-rate display on MCA and/or computer screen.

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]).

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

- **MDA** Stops data collection when the value of the minimum detectable activity (MDA) for up to 20 user-specified MDA nuclides reaches the needed value. The presets are implemented in hardware so the computer does not have to poll the Micro-UF6 for the preset to operate.

Low Frequency Rejector (LFR) Filter[11] The digital signal processor incorporates ORTEC's exclusive LFR filter, designed to reduce microphonic and low-frequency periodic noise from germanium detector output signals, thereby producing significant improvement in spectral resolution. The LFR is specifically beneficial in systems cooled by mechanical coolers, which are known to often contribute microphonic noise to the spectrum (thereby degrading spectral resolution). The LFR is also capable of reducing any periodic noise signal resulting from surrounding electronics and equipment or ground loops.

Cooler High-reliability, low-power Stirling cooler, dual-piston design, 1 W nominal lift at 100 K. Initial cool-down time depends on ambient temperature, but at 25°C is typically <12 hours.

Stored-Spectrum Memory The Micro-UF6 can store spectrum files on removable Secure-Digital cards.[12] The number of spectra stored on an individual card depends on the capacity of the card.

Wireless Communication Built-in IEEE 802.11b wireless hardware; third-party software can be used to implement this option.

GPS Internal NMEA-compliant WAAS-capable.

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[11]Patent pending.

[12]Note that the computer also has a CF type II CompactFlash slot. However, the dust cover, which must be in place to prevent contaminating the card slots, blocks full insertion of the CF card.

8.4. Electrical and Mechanical

Dimensions

- **Maximum Overall Dimensions** 37.4 cm L × 16.6 cm W × 27.9 cm H (14.7 in. × 5.8 in. × 11 in.) including handle, Ge detector endcap, neutron detector and shock absorbers.

- **Weight** 6.9 kg (15.2 lb) without collimator.

Maximum Shock Tolerance 20 g. An accelerometer inside the instrument tracks the maximum shock to which the Micro-UF6 has been subjected, and a shock in excess of 20 g will void the warranty.

Ambient Operating Environment −10°C to +40°C, at a relative humidity <90% at 35°C, non-condensing.

Internal Battery Rechargeable, nominal 14.4-V lithium-ion battery pack in a semi-sealed compartment that protects against dirt and moisture penetration. Charging circuitry and battery management circuitry internal to the power adapter/charger. Battery lifetime 3–5 years; contact ORTEC for the appropriate replacement battery kit (see also Appendix C).

Battery Life >3 hours at 25°C when HPGe detector is cold. <4 hr 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 using an automobile battery to cool the detector could significantly discharge the auto battery.)

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

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

8.5. Connectors

USB (•⭠) Rear-panel Universal Serial Bus connector, with dust cover, for communication with computer for file transfer with the **Data (ActiveSync)** setting and for use as an MCA with the **Control (MCA Mode)** setting.

INPUT POWER Rear-panel external power input, with dust cover, 12–17 V dc, 60 W, or from battery or ac power adapter/charger.

Headphones ( ) Rear-panel female connector, with dust cover, accepts standard male headphone jack. Headphone volume controllable from the Micro-UF6 touchscreen.

8.6. Computer Prerequisites

In addition to completely independent, standalone operation, the Micro-UF6 can also be used as a benchtop MCA, in conjunction with ORTEC CONNECTIONS software such as MAESTRO, by connecting it via USB to any computer running Microsoft Windows 8, 7, or XP Professional SP3.

8.7. Shipping the Micro-UF6

To avoid damaging the cooler by overheating (and, where applicable, to comply with transportation regulations), be certain to turn the cooler off before shipping the Micro-UF6. To do this, tap **Settings/Turn Cooler OFF**. The unit can be shipped as soon as the cooler is turned off. There is no need to wait until the detector warms up.

8.8. Long-Term Shutdown/Storage

CAUTION

This instrument should be cooled and brought to operational status (Status: Ready) 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 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*. [13] 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 reasonably 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.

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

APPENDIX A. CALCULATIONS

A.1. Micro-UF6 Calculations

A.1.1. Count Rate in 186 keV Peak

The count rate in the 186 keV peak is calculated based on the three regions marked in Fig. 62. The three regions are periodically updated during verification and calibration.

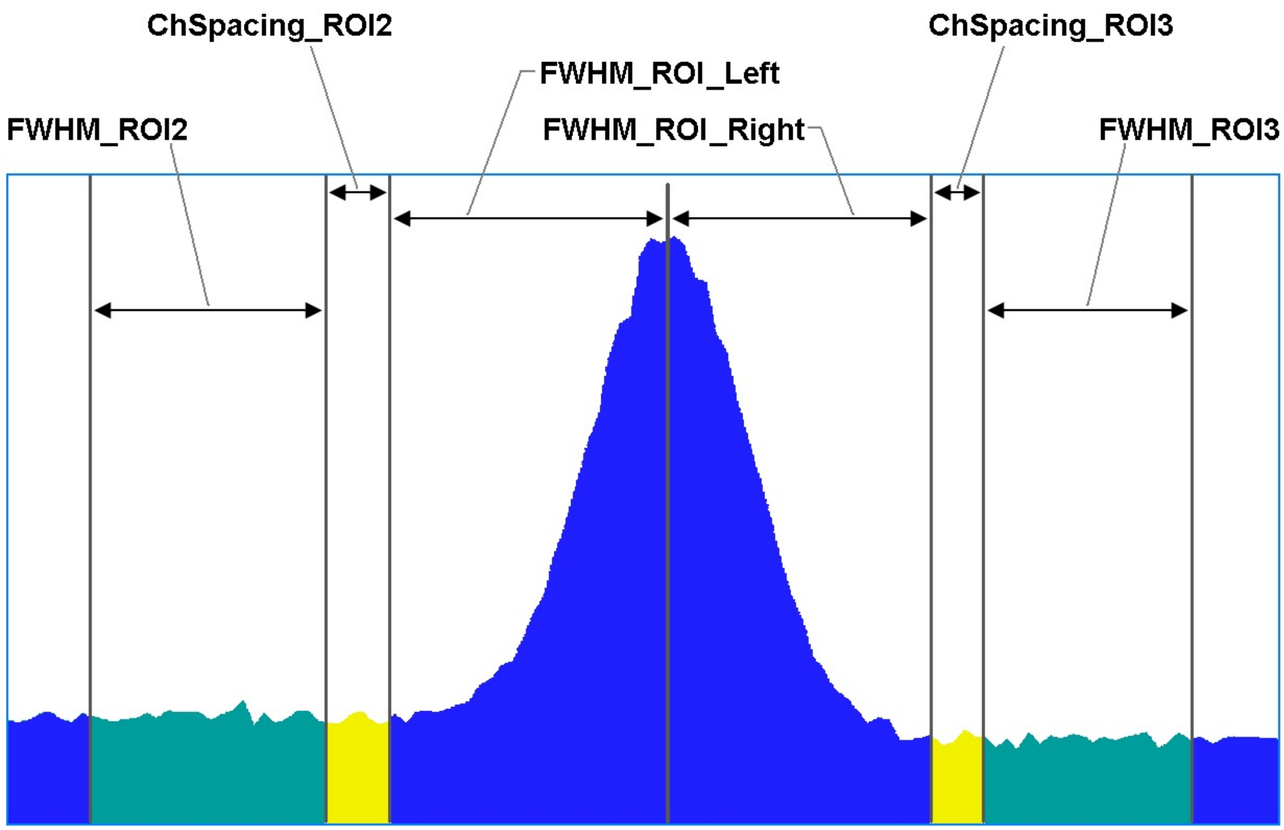


Figure 62. Analysis ROIs and Channel Spacing.

A.1.1.1. Parameters

The parameters are defined as follows:

FWHM_ROI_Left Number of FWHMs from the 186 keV peak centroid to the left limit channel of the center ROI (ROI1). Default value = 4.00.

FWHM_ROI_Right Number of FWHMs from the 186 keV peak centroid to the right limit channel of the center ROI (ROI1). Default value = 2.00.

ChSpacing_ROI2 Number of channels between the most left channel of ROI1 and the most right channel of the low background ROI (ROI2). Default value = 3.

ChSpacing_ROI3 Number of channels between the most right channel of ROI1 and the most left channel of the high background ROI (ROI3). Default value = 3.

FWHM_ROI2 Number of FWHMs for the width of the left background ROI (ROI2). Default value = 2.00.

FWHM_ROI3 Number of FWHMs for the width of the right background ROI (ROI3). Default value = 2.00.

FWHM_Value Value for the FWHM in channels. Default value = 10.

Apply_FWHM If this box is marked, the **FWHM_Value** above is used for the calculations, otherwise, the FWHM is calculated from the spectrum. Default = unmarked (disabled).

A.1.1.2. Peak Centroid Calculation

1) Calculate the peak centroid using the First Moment Method:

$$X = \frac{\sum (i * Cnt_i)}{\sum Cnt_i} \quad \textbf{(1)}$$

where:

Ch_C = The channel containing the maximum net counts in the region from channel 2456 to 2496

i = (Ch_C-20) to (Ch_C+20)

Cnt_i = The counts in channel i

$$Ch_C = Integer(X) \quad \textbf{(2)}$$

2) Repeat step 1.

A.1.1.3. FWHM Calculation

Calculate the FWHM in channels for the peak centered at channel 2476:

- If the **Apply_FWHM** value is non-zero:

  1) Use the **FWHM_Value** as the FWHM,

- Otherwise:

  1) Find the maximum net counts and channel in the region (ChC−20 to Ch_C+20).
  2) Divide the maximum net counts by 2. This is the half maximum value.
  3) Find the left and right shoulders with a pair of channels crossing the required half net maximum value.
  4) Interpolate to precise half net maximum channel on both sides and return the difference.

A.1.1.4. Peak ROI Determination

Once the FWHM is calculated, the ROI is determined as follows:

$$Lo_{ROI1} = Ch_C - [FWHM\_ROI\_Left] * FWHM \quad \textbf{(3)}$$

$$Hi_{ROI1} = Ch_C + [FWHM\_ROI\_Right] * FWHM \quad \textbf{(4)}$$

A.1.1.5. Background ROI Determination

Start and end channels of the left background ROI:

$$Lo_{ROI2} = Lo_{ROI1} - [ChSpacing\_ROI2] - ([FWHM\_ROI2] * FWHM) \quad \textbf{(5)}$$

$$Hi_{ROI2} = Lo_{ROI1} - [ChSpacing\_ROI2] \quad \textbf{(6)}$$

Start and end channels of the right background ROI:

$$Lo_{ROI3} = Hi_{ROI1} + [ChSpacing\_ROI3] \quad \textbf{(7)}$$

$$Hi_{ROI3} = Hi_{ROI1} + [ChSpacing\_ROI3] + ([FWHM\_ROI3] * FWHM) \quad \textbf{(8)}$$

A.1.1.6. Net Count Rate Calculation

The net count rate *R* for the 186 keV peak is:

$$R = \frac{G - \left[\left(\frac{B_2}{N_{B2}} + \frac{B3}{N_{B3}}\right) * \frac{N_G}{2}\right]}{LT} \quad \textbf{(9)}$$

where:

- G = Sum of contents in the 186 keV ROI channels, including endpoints
- N_G = Number of channels in the 186 keV ROI, including endpoints
- B_2 = Sum of contents in the ROI2 (left background) channels, including endpoints
- N_{B2} = Number of channels in ROI2, including endpoints
- B_3 = Sum of contents in the ROI3 (right background) channels, including endpoints
- N_{B3} = Number of channels in ROI3, including endpoints
- LT = The acquisition live time in seconds

A.1.1.7. Count Rate Uncertainty

The count rate uncertainty, σ_R, is:

$$\sigma_R = \frac{\sqrt{G + \left[\frac{B_2}{4} * \left(\frac{N_G}{N_{B2}}\right)^2\right] + \left[\frac{B_3}{4} * \left(\frac{N_G}{N_{B3}}\right)^2\right]}}{LT} \quad \textbf{(10)}$$

A.1.1.8. Count Rate Uncertainty

If the background correction option is set to Use Previous, then the net count rate calculated from Eq. (9) in above section will be corrected as shown below:

$$R_c = R - R_B \tag{11}$$

Where R is the net count rate calculated from Eq. (9) in section A1.1.6 with the measured sample spectrum, and R_B is the net count rate calculated from Eq. (9) with the measured background spectrum. This background corrected net count rate will then be used (instead of R above) for both sample verification and for calibration. The background net count rate is typically small. For calibration, net count rate R from the calibration standard is usually much larger than the background count rate so the correction is small. The effect to the calibration constant should be small as well. For verification of very low enrichment, when the background correction is enabled, the background corrected net count rate could be statistically close to zero. Thus, the calculated enrichment could be statistically close to zero as well.

The uncertainty for the background corrected net count rate is:

$$\sigma_{R_c} = \sqrt{(\sigma_R)^2 + (\sigma_{R_B})^2} \tag{12}$$

σ_R is calculated from Eq. (10) with the sample spectrum, and σ_{R_B} is calculated from Eq. (10) with the background spectrum. Unlike the background net count rate, the uncertainty term should always be positive, unless the background spectrum has not been measured before.

A.1.2. U-235 Weight Percent and U-235 Atom Percent

Calculations for the weight % and atom % conversions are performed in the same manner as described in Appendix C of the *MODEL S572 IMCA 2000 Nuclear Safeguards Software* user manual, with a few changes.

The *WeightPct* value is calculated from *AtomPct* value as follows:

$$E_w = (M_{235} * E_a) / (M_{238} - 0.03 * E_a) \quad \textbf{(13)}$$

and the *AtomPct* value is calculated from *WeightPct* value as follows:

$$E_a = (M_{238} * E_w) / (M_{235} + 0.03 * E_w) \quad \textbf{(14)}$$

where:

E_a = Enrichment in atom %

E_w = Enrichment in weight %

M_{235} = Atomic mass of U-235 (235.0349)

M_{238} = Atomic mass of U-238 (238.0508)

A.1.3. Sample Container Wall Correction Factor

The Sample Container Wall Correction Factor F_{Cont} is calculated as follows:

$$F_{Cont} = e^{(Attn * A * (1 - B * Wall) * Wall)} \quad \textbf{(15)}$$

where:

$Attn$ = Attenuation coefficient

$Wall$ = Wall thickness in cm

A = Constant A from `UF6.INI` file (defaults to 1)

B = Constant B from `UF6.INI` file (defaults to 0)

The attenuation coefficient is defined based on the Container Type material as follows:

Material	**Attenuation (1/cm)**
Steel	1.210
Aluminum	0.340
Zircaloy-2	1.640
Polyethylene	0.132
Monel	1.480
Glass	0.312

These values are taken from the `UF6.INI` file and may be added to or modified by the operator.

The uncertainty of F_{Cont} is calculated as follows:

$$\sigma_F = F_{Cont} * \sqrt{(Wall * \sigma_A)^2 + (Attn * \sigma_T)^2} \qquad \textbf{(16)}$$

where

F_{Cont} = Sample Container Wall Correction Factor

$Wall$ = Wall thickness in cm

σ_A = Uncertainty in the attenuation coefficient = 0.01

$Attn$ = Attenuation coefficient

σ_T = Uncertainty in the wall thickness

A.1.4. Calibration Constant

The calibration constant K_i is calculated in the same manner as described in Appendix C of the *MODEL S572 IMCA 2000 Nuclear Safeguards Software* user manual. Note that a single sample calibration constant is used instead of an average calibration constant for this application. It is calculated as follows:

$$K_i = E_a / (R * F_{Cont}) \qquad \textbf{(17)}$$

where:

E_a = Declared U-235 enrichment in AtomPct

R = Count rate in the 186 keV peak (Section A.1.1)

F_{Cont} = Sample Container Wall Correction Factor (Section A.1.3)

The uncertainty in the Calibration Constant is calculated as follows:

$$\sigma_{K_i} = K_i * \sqrt{(\sigma_E / E_a)^2 + (\sigma_R / R)^2 + (\sigma_F / F_{Cont})^2} \qquad \textbf{(18)}$$

where:

K_i = Calculated calibration constant

σ_E = Declared U-235 uncertainty in AtomPct

E_a = Declared U-235 enrichment in AtomPct

σ_R = Uncertainty in the count rate (Section A.1.1)

R = Net count rate in the 186keV peak (Section A.1.1)

σ_F = Uncertainty in the Sample Container Wall Correction Factor (Section A.1.3)

F_{Cont} = Sample Container Wall Correction Factor (Section A.1.3)

A.1.5. Enrichment Calculation

The enrichment calculation E_a is calculated in the same manner as described in Appendix C of the *MODEL S572 IMCA 2000 Nuclear Safeguards Software* user manual.

The equation is as follows:

$$E_a = K_i * R * F_{Material} * F_{Cont} \quad \textbf{(19)}$$

where:

K_i = Calibration constant (Section A.1.3)

R = Net count rate in 187 keV Peak (Section A.1.1)

$F_{Material}$ = Sample Material Composition Correction Factor

F_{Cont} = Sample Container Wall Correction Factor (Section A.1.2)

The Sample Material Composition Correction Factor ($F_{Material}$) is derived from Table 3 of the *MODEL S572 IMCA 2000 Nuclear Safeguards Software* user manual.

Table 3
Matrix Material Composition Correction Factors

		Nuclear Material of Item Measured									
		U	UC	UN	UC_2	UO_2	U_3O_8	UO_3	UF_4	UF_6	Uranyl Nitrate
Nuclear Material of Calibration Standard	U	1.000	1.004	1.005	1.008	1.011	1.014	1.016	1.025	1.038	1.090
	UC	0.996	1.000	1.001	1.004	1.007	1.010	1.012	1.021	1.033	1.086
	UN	0.995	0.999	1.000	1.003	1.006	1.009	1.011	1.020	1.032	1.085
	UC_2	0.992	0.996	0.997	1.000	1.003	1.006	1.008	1.017	1.030	1.082
	UO_2	0.989	0.993	0.994	0.997	1.000	1.003	1.005	1.014	1.026	1.078
	U_3O_8	0.986	0.990	0.991	0.994	0.997	1.000	1.002	1.011	1.023	1.075
	UO_3	0.984	0.988	0.989	0.992	0.995	0.998	1.000	1.009	1.021	1.073
	UF_4	0.975	0.979	0.980	0.983	0.986	0.989	0.991	1.000	1.012	1.063
	UF_6	0.964	0.968	0.969	0.972	0.975	0.978	0.980	0.989	1.000	1.051
	Uranyl Nitrate	0.917	0.921	0.922	0.925	0.927	0.930	0.932	0.941	0.952	1.000

The uncertainty in the enrichment value is calculated as follows:

$$\sigma_{E_a} = E_a * \sqrt{(\sigma_{K_i}/K_i)^2 + (\sigma_R/R)^2 + (\sigma_F/F_{Cont})^2} \qquad \textbf{(20)}$$

where:

E_a = Calculated enrichment in AtomPct

σ_K = Uncertainty in the calibration constant

K_i = Calibration constant

σ_R = Uncertainty in the net count rate in the 186 keV peak

R = Net count rate in the 186 keV peak

σ_F = Uncertainty in the Sample Container Wall Correction Factor

F_{Cont} = Sample Container Wall Correction Factor

The uncertainty in percent that is used to calculate the preset for verification mode is calculated as follows:

$$\sigma_{E_a\%} = (\sigma_{E_a} / E_a) * 100.0 \qquad \textbf{(21)}$$

where:

E_a = Calculated enrichment in AtomPct

σ_{Ea} = Uncertainty in the enrichment from Eqn. 20.

A.2. MAESTRO Calculations

A.2.1. The Nuclide Report

The Nuclide Report displays the activity of up to 9 user-selected peaks. Once the report is set up you can view the Nuclide Report at any time. The peak area calculations are the same as the calculations in MAESTRO and other ORTEC software, so the Nuclide Report contents can be duplicated using the spectra stored in the computer. The calculated value is computed by multiplying the net peak count rate by a user-defined constant. If the constant includes the efficiency and branching ratio, the displayed value will be activity. The nuclide label and the activity units are entered by the user.

The report has this format:

Nuclide	keV	Bq	±%
CO-60	1332.5	1.21E+01	10.2
CO-60	1173.2	1.09E+01	12.3
CO-57	122.1	1.48E+00	86.2

A.2.1.1. Calculations

These are the calculations used to generate the Nuclide Report’s activity, uncertainty, and peak values.

Activity

Activity is calculated as follows:

$$Activity = \frac{NetCounts \times Constant}{LiveTime}$$

where:

Constant is the **Constant** value entered on the Edit Nuclide ROI screen (Section D.3.11). This is normally the inverse of the product of the efficiency and the yield (branching ratio). Note that the efficiency is the absolute counting efficiency for the source-detector geometry being used. Thus, in order to get meaningful activity results, as in any counting situation, you must have efficiency factors appropriate to the actual counting geometry. If *Constant* is set to 1, you will get the peak count rate on the display.

LiveTime is the current live time.

NetCounts is computed with the following equation:

$$NetCounts = GrossCounts - Background$$

GrossCounts is the sum of the counts in the ROI, excluding the first and last 3 channels of the ROI.

Background is:

$$Background = \frac{AvgCount\ first\ 3\ chan + AvgCount\ last\ 3\ chan}{2} \cdot ROIWidth$$

ROIWidth is:

$$ROIWidth = EndChannel - StartChannel + 1 - 6$$

Uncertainty

Uncertainty (in percent) is calculated as follows:

$$Uncertainty = \frac{\sqrt{GrossCounts + Background \cdot \frac{ROIWidth}{6}}}{NetCounts} * 100$$

Peak

Peak is the position of the maximum count and is computed with the following equation:

$$Peak = MaximumROIChan * EnergySlope + EnergyIntercept$$

where:

MaximumROIChan is the channel in the ROI with the most counts. If there are no data, the center channel of the ROI is used.

EnergySlope and *EnergyIntercept* are the energy calibration values as entered on the touchscreen (in standalone mode) or by software (when connected to a computer). If the values are not present, the result is given in channels.

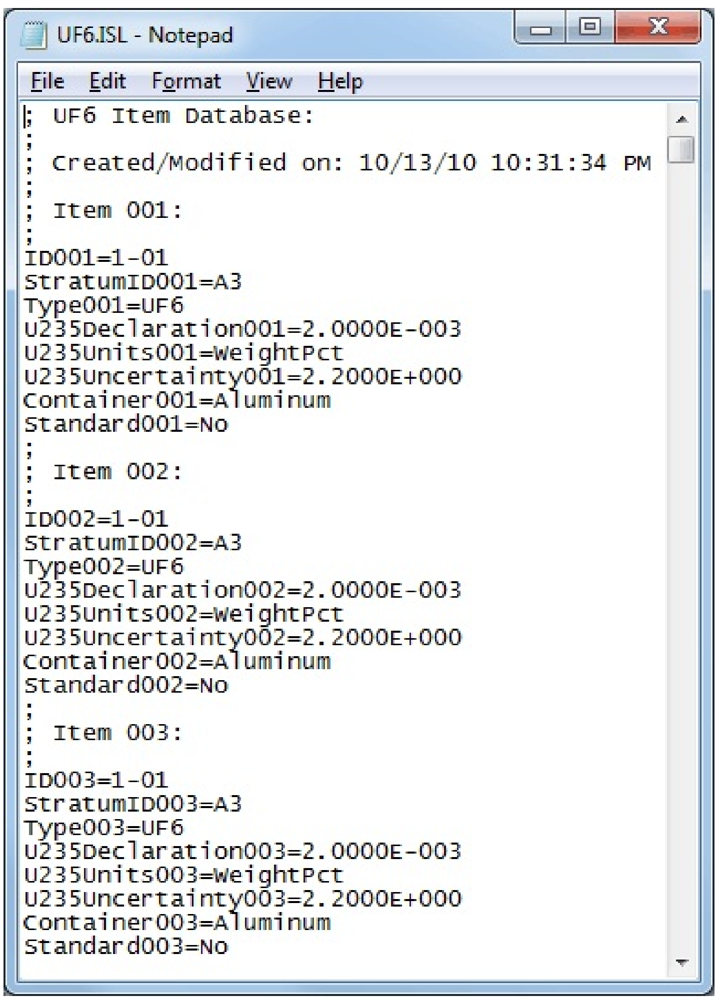
[Intentionally blank]

APPENDIX B. FILE STRUCTURES

This section describes the structure of the text files used by the Micro-UF6 application.

B.1. Item Database File UF6.ISL

Figure 66 shows an example of an Item Database file. You may create this file on the computer and copy it to the Micro-UF6. If you do so, the file name must be UF6.ISL *and must reside in the UF6 application directory,* \Program Files\UF6*, or it will not be recognized by the Micro-UF6 program*. If you assign a filename other than UF6.ISL, the next time the Micro-UF6 application starts, it will ignore your file and continue using its current copy of UF6.ISL; or, if no UF6.ISL file is present, the program will create a new, blank UF6.ISL file.



```
UF6.ISL - Notepad
File  Edit  Format  View  Help
; UF6 Item Database:
;
; Created/Modified on: 10/13/10 10:31:34 PM
;
; Item 001:
;
ID001=1-01
StratumID001=A3
Type001=UF6
U235Declaration001=2.0000E-003
U235Units001=WeightPct
U235Uncertainty001=2.2000E+000
Container001=Aluminum
Standard001=No
;
; Item 002:
;
ID002=1-01
StratumID002=A3
Type002=UF6
U235Declaration002=2.0000E-003
U235Units002=WeightPct
U235Uncertainty002=2.2000E+000
Container002=Aluminum
Standard002=No
;
; Item 003:
;
ID003=1-01
StratumID003=A3
Type003=UF6
U235Declaration003=2.0000E-003
U235Units003=WeightPct
U235Uncertainty003=2.2000E+000
Container003=Aluminum
Standard003=No
```

Figure 66. Typical Item Database (.ISL) File Contents.

The Item Database list can contain a maximum of 1000 items. Each entry in this file is suffixed by a three-character sequential number (thus the limit of 1000 entries per item database file). Comments begin with semicolons.

The fields are defined as follows:

- **ID** — Item ID. Identifier for this item. This string is used in various dialogs and reports to designate a particular item. Maximum of 16 characters.
- **StratumID** — Stratum ID. Text field for accounting. Maximum of 4 characters.
- **Type** — Uranium compound type: U, UC, UN, UC_2, UO_2, U_3O_8, UO_3, UF_4, UF_6, UNO_3.
- **U235Declaration** — Expected amount of U-235 in either atom % or weight % (as selected in U235Units field).
- **U235Uncertainty** — Absolute uncertainty (+/−) in expected amount of U-235.
- **U235Units** — Choose atom % or weight %.
- **Container** — Container material: (1) Steel, (2) Aluminum, (3) Zircaloy-2, (4) Polyethylene, (5) Monel, (6) Glass.
- **Standard** — Yes = Calibration standard; No = Not a calibration standard.

B.1.1. Creating An Item Database File

Use a text editor such as Windows Notepad, and *save the file as ANSI or Unicode text*.

If you connect the Micro-UF6 to the computer and ActiveSync or the Vista/Windows 7 file synchronization does not automatically take place, disconnect from the computer, tap **Settings/ USB Control** and enable the **ActiveSync** option, then reconnect to the computer.

Copy the file(s) from the computer to the Micro-UF6's `\Programs\UF6 folder`.

Exit and restart the Micro-UF6 application to load the contents of the new file(s).

You may edit the information for any item (whether it was created on the Micro-UF6 screen or imported from a computer) before verifying it.

B.1.1.1. Troubleshooting

If you import an Item Database (`UF6.ISL`) file and the resulting list of items on the Item Database screen is missing expected items or displays empty spaces between entries, this indicates formatting errors in the text file. If your imported file contains errors that make it unusable, when you restart the Micro-UF6 application, the software will create a default (empty) UF6.ISL that over-writes the imported file.

B.2. Inspection Data File Structure

Figure 67 shows an example of an Inspection Data file. *The file name must be* UF6.IDB *and must reside in the UF6 application directory,* \Program Files\UF6, *or it will not be recognized by the Micro-UF6 program* (in which case, the application will create a blank [default] UF6.IDB file). Comments begin with semicolons.

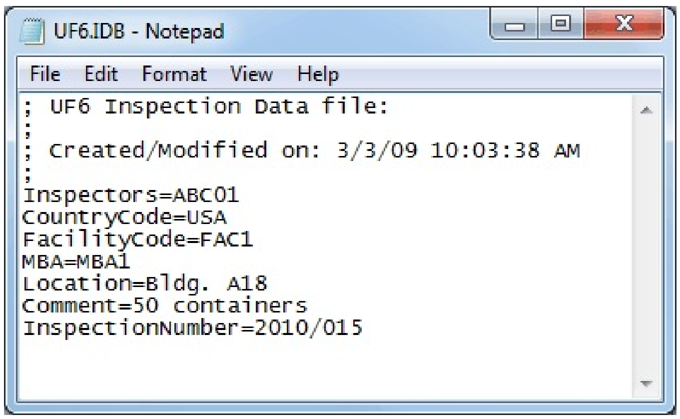


Figure 67. Typical Inspection Data (.IDB) File Contents.

The fields are defined as follows:

- **Inspectors** Required field, maximum 255 characters.
- **CountryCode** Required field, maximum 4 characters.
- **FacilityCode** Required field, maximum 4 characters.
- **MBA** (Material Balance Area) Required field, maximum 4 characters.
- **Location** Optional field, maximum 255 characters.
- **Comment** Optional field, maximum 255 characters.
- **InspectionNumber** Required field, maximum 8 characters formatted as YYYY/###.

B.3. Configuration File

The UF6 configuration file (Fig. 68) contains default settings for the Micro-UF6 application. The information in this file is dynamically updated by the Micro-UF6 application. It is formatted as a standard .INI file. *The filename must be* UF6.INI *and must reside in the UF6 application directory,* \Program Files\UF6*, or it will not be recognized by the Micro-UF6 program.*

UF6.INI - Notepad

File Edit Format View Help

```
; UF6 Configuration file:
;
; Created/Modified on: 12/14/11 9:44:25 AM
;
; Calibration Section:
;
[Calibration]
Date=2011-12-12-16-05-42
Spectrum=\Storage Card\Data\ORTC_Toms Calibration_2011-12-12_16.05.41.Spc
Coefficient=3.12183732E-002
CoefficientUncertainty=2.58392756E-003
AcquisitionTime=3600.00
Mode=LT
WallThickness=15.00
WallThicknessUncertainty=0.00000000E+000
ItemType=U308
;
; Acquisition Section:
;
[Acquisition]
AcquisitionTime=8.25
Mode=UNC
WallThickness=15.00
WallThicknessUncertainty=0.00000000E+000
A=1.0000
B=0.0000
ChartLow=170
ChartHigh=200
;
; Hardware Section:
;
[Hardware]
ConversionGain=4096
CoarseGain=8
FineGain=0.9061379231770830
LLD=210
ULD=4095
;
; Analysis Section:
;
[SpectrumAnalysis]
FWHM_ROI1_Left=4.00
FWHM_ROI1_Right=2.00
ChSpacing_ROI2=3
ChSpacing_ROI3=3
FWHM_ROI2=1.00
FWHM_ROI3=1.00
FWHM_Value=11
Apply_FWHM=1
BackgroundPoints=3
;
; Container Section:
;
[Containers]
Steel=1.210
Aluminum=0.340
Zircalloy2=1.640
Polyethylene=0.132
Monel=1.480
Glass=0.312
;
```

Figure 68. Typical Configuration (.INI) File Contents.

The fields are defined as follows:

[Calibration]

- **Date** Calibration Date in YYYY-MM-DD-hh-mm-ss format.
- **Spectrum** Calibration spectrum full pathname.
- **Coefficient** Calibration coefficient.
- **CoefficientUncertainty** Calibration coefficient uncertainty.
- **AcquisitionTime** Last acquisition time used by the operator.
- **Mode** Last acquisition mode used by the operator.
- **WallThickness** Wall thickness in mm.
- **WallThicknessUncertainty** Wall thickness uncertainty [+/− %] in mm.
- **ItemType** Item Type (uranium compound type, e.g., U, UC, UN, UC_2, UO_2, U_3O_8, UO_3, UF_4, UF_6, UNO_3.).

[Acquisition]

- **AcquisitionTime** Acquisition time in seconds.
- **Mode** Acquisition mode (real time, live time, or uncertainty)
- **WallThickness** Wall thickness for last acquisition.
- **WallThicknessUncertainty** Wall thickness uncertainty [+/− %] in mm.
- **A** Constant A for Eqn. 15.
- **B** Constant B for Eqn. 15.
- **ChartLow** Low-energy value for the verification plot.
- **ChartHigh** High-energy value for the verification plot.

[Hardware]

- **ConversionGain** Conversion gain (fixed at 4096 channels).
- **CoarseGain** Amplifier coarse gain setting.
- **FindGain** Amplifier fine gain setting.
- **LLD** Lower-lever discriminator value.
- **ULD** Upper-level discriminator value.

[Containers]

- **Name**= Value pairs for container name (type) and attenuation value.

[Intentionally blank]

APPENDIX C. CHANGING THE INTERNAL BATTERY

The typical service life of the Micro-UF6'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. ***If you connect the Micro-UF6 to external power, the battery can be "hot swapped" without shutting down the program or computer.*** After battery change (unless the battery has been pre-charged), the Micro-UF6 must remain connected to external power for 3–4 hours to charge the replacement battery. For more information, contact your ORTEC representative or our Global Service Center.

1) If external power is available, connect the Micro-UF6 to the power source. Otherwise shut down its computer by pressing and holding the on/off button for 1–3 seconds to display the power menu, then tapping the **Shutdown** option.

2) Figure 69 shows the quick-release battery hatch. The two release latches are located on the top edge. Slide the latches up and open the hatch as shown in Fig. 70.

Figure 69. Quick-Access Battery Hatch, Closed.

3) The end of the battery closest to the HPGe detector endcap has a pull tab. Gently pull it outward, as if opening a book cover or door, until the battery slips off the connector terminals at the lower rear of the compartment. Figure 71 shows the pull tab on the front side of the battery and the connector terminals on the lower back edge.

4) Guide the new battery onto the connector terminals and press it into place, then close the hatch and slide the latches closed.

5) If the Micro-UF6 was connected to external power when you changed the battery, the unit is ready for use.

If you powered off the Micro-UF6, restart it by pressing the on/off button, then wait for the unit to start and fully initialize (this will take several minutes). If you did not turn the cooler off, it will restart by itself. Once the program is fully initialized, wait another 5 minutes for any alarms to clear. Typical alarms may include a warm detector error, a detector bias voltage error, and/or a detector gain stabilizer error. If a gain stabilizer error is posted, wait another 5 minutes to see if it clears. If it does not, run a background measurement.

In both cases, unless the new battery was pre-charged, it must charge for 3–4 hours before the Micro-UF6 is ready for extended, standalone use without external power.

Figure 70. Quick-Access Latches Up and Hatch Open.

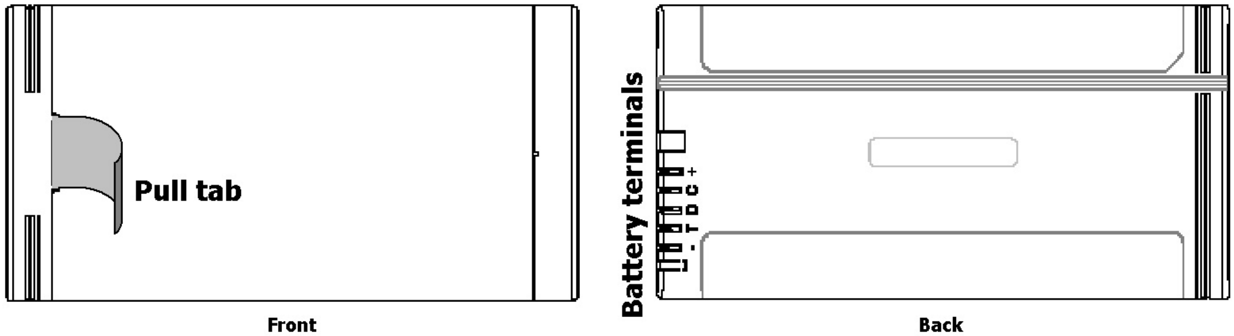


Figure 71. Front and Back of Internal Battery.

6) Return the old battery to ORTEC for recycling.

APPENDIX D. USING THE MICRO-UF6 WITH ORTEC SPECTRUM ANALYSIS PROGRAMS

The Micro-UF6 is intended for completely independent operation, with no computer required. However, when you connect it to a computer running ORTEC CONNECTIONS spectroscopy applications, such MAESTRO or GammaVision, you can use it as a high-performance HPGe spectrometer/ digital MCB.

Be sure to install the accompanying CONNECTIONS Driver Update Kit (P/N 797230) and version of MAESTRO. When installing MAESTRO, *choose the **USB-Based Instruments** selection to install the correct driver for the Micro-UF6*. ***Otherwise, MAESTRO may not be able to communicate with the Micro-UF6.*** If you have any questions about software/hardware compatibility, contact your ORTEC representative or our Technical Services Group. The MAESTRO *User's Manual* contains complete instructions on software installation and configuration of the MCBs attached to your computer.

IMPORTANT	When you disconnect the Micro-UF6 from the computer and exit its MCA Mode, ***any changes made to the hardware settings in MAESTRO will remain in effect until changed from the touchscreen.***

D.1. Connecting the Micro-UF6 to a Computer

From the Home screen, tap **Menu**, **General Settings**, **USB Control**, then tap the **MCA Mode** radio button (Fig. 72). This sets the Micro-UF6's USB port so the instrument's MCA can be connected to a host computer. The other Micro-UF6 features are disabled. The Micro-UF6 can then be used as a high-performance HPGe MCA controlled by MAESTRO and other ORTEC CONNECTIONS spectroscopy applications.

The first time this Micro-UF6 is connected to a particular computer for use as an MCA, Windows 8 and 7 will install the driver without a wizard. In XP, the new hardware installation wizard will open. Click **Next**, indicate you *do not* wish to connect to the internet or the Microsoft website to locate the driver, choose the "automatically locate driver" option, and follow the remaining prompts to completion.

The final step is to run the **MCB Configuration** program from the MAESTRO start menu to build **Master Instrument List** of all ORTEC MCBs accessible to the computer.

To monitor the battery time remaining from within MAESTRO, go to the Status tab under **Acquire/MCB Properties...**.

D.1.1. Returning to Standalone Operation

To return the Micro-UF6 to standalone operation, simply tap the **Active Sync** radio button. Within a few seconds, the touchscreen will become active in the normal standalone mode. Any changes made to the hardware settings via the computer will remain in effect until changed from the touchscreen.

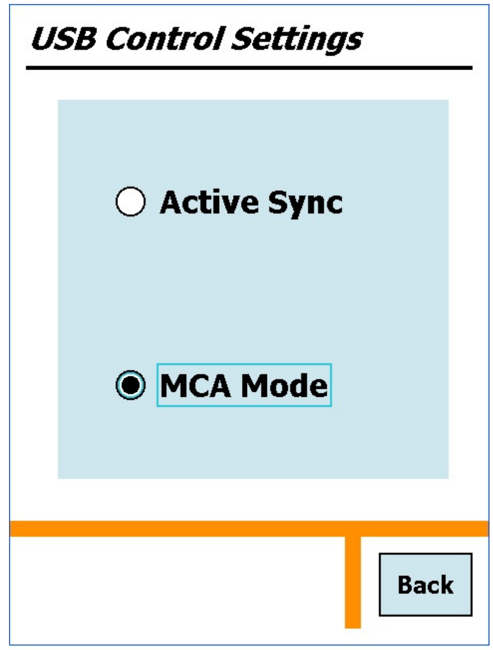


Figure 72. Micro-UF6 in MCA Mode.

NOTE MAESTRO and other ORTEC CONNECTIONS programs have a **Lock/Unlock Detector** command to prevent unauthorized users from changing detector settings, starting and stopping data acquisition, and clearing the detector memory. This locking command functions separately from the Micro-UF6 passwords. If the Micro-UF6 is password-locked within MAESTRO, you can still use it in the field without knowing the password; however, you cannot reconnect it to a computer and erase its spectrum memory. In addition, the next time you use it in MCA Mode with MAESTRO, it will still be locked.

D.2. Quantitative Analysis of Micro-UF6 Spectra in GammaVision and ISOTOPIC

The Micro-UF6 can be used to collect data for quantitative analysis, either as a standalone field instrument or a benchtop MCB connected to a computer. In both usage modes, the data are stored as .SPC-format spectrum files. The .SPC files can then be quantitatively analyzed on a computer using GammaVision or ISOTOPIC.

Note, however, that the Micro-UF6 is not designed to store efficiency information in the .SPC files it creates. Therefore, for quantitative determinations, special attention is needed to prepare the calibration (.CLB) file so that GammaVision or ISOTOPIC will add the efficiency information during processing.

To prepare this calibration file, load a Micro-UF6 calibration spectrum into GammaVision or ISOTOPIC. Use the software application's **Calibration Wizard** to obtain the additional efficiency calibration, keeping the existing energy calibration. After the efficiency calibration is computed, save the complete set of calibrations as a .CLB file.

To add the efficiency information to an existing .SPC file (typically from a standalone Micro-UF6):

- Transfer the .SPC file from the Micro-UF6 to the computer (see Chapter 6).
- Recall the .SPC file in GammaVision or ISOTOPIC.
- Load the .CLB file containing the proper efficiency information. This can be done either with the application's **Recall Calibration** command; or by specifying the .CLB file as the calibration override in the GammaVision analysis options (.SDF) file or the ISOTOPIC configuration.
- Save the .SPC file with or without further analysis.

NOTE If the .CLB file is specified in the GammaVision .SDF file or ISOTOPIC configuration, the .An1 file generated during analysis will contain the proper calibration information but the original .SPC file (without the efficiency information) will not change.

To load the efficiency information before acquiring a new spectrum (with the Micro-UF6 attached to a computer):

- Load the .CLB file either with the **Recall Calibration** command; or by specifying the .CLB file as the calibration override in the GammaVision .SDF file or ISOTOPIC configuration.

- Acquire a new spectrum and save it in .SPC format.

D.3. Micro-UF6 MCB Properties in MAESTRO

This section discusses the hardware setup dialogs you will see within MAESTRO when you use the **MCB Properties...** command on the **Acquire** menu. The MCB Properties dialog contains all of the instrument controls including acquisition presets, high voltage, hardware status indicators, and amplifier settings. To view the hardware parameters and Identification Mode reports for spectra downloaded from the Micro-UF6, simply move from tab to tab. Click **Close** when finished. Note that, in MAESTRO, 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 this instrument.

When setting up a data acquisition, note that as you enter characters in the data-entry fields the characters will be underlined until you move to another field or until 5 seconds have lapsed since a character was last entered. During the time the entry is underlined, no other program can modify this value.

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

D.3.1. Amplifier

Figure 73 shows the Amplifier tab, which displays the **Coarse** and **Fine Gain** and **Pole Zero** controls.

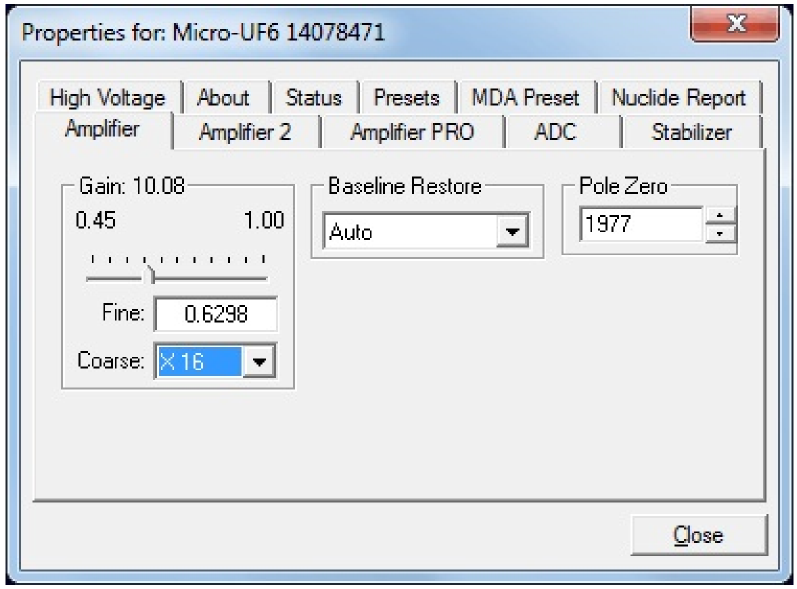


Figure 73. Micro-UF6 Amplifier Tab.

Gain — Set the amplifier coarse gain by selecting from the **Coarse** droplist, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.45 to 1.00. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 0.45 to 32.

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 such as 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**,[14] **Fast**, and **Slow**). The fast setting is used for high count rates, the slow for low count rates. **Auto** adjusts the time constant as appropriate for the input count rate. The settings (auto, fast, or slow) are saved in the Micro-UF6 even when the power is off. The time constant can be manually set on the InSight Virtual Oscilloscope display on the Amplifier 2 tab.

You can view the time when the baseline restorer is active on the InSight display as a **Mark** region. In the automatic mode, the current value is shown on the InSight sidebar. For a low-count-rate system, the value will remain at about 90. See the accompanying MAESTRO *User's Manual* for complete information on InSight Mode.

[14]U.S. Patent No. 5,912,825.

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) 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.

2) 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.

3) 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.

D.3.2. Amplifier 2

Figure 74 shows the Amplifier 2 tab, which accesses the advanced shaping controls including the InSight Virtual Oscilloscope mode.

The many choices of **Rise Time** allow you to precisely control the tradeoff between resolution and throughput. Starting with the default value, you should increase values of the rise time for better resolution for expected lower count rates, or when unusually high count rates are anticipated, reduce the rise time for higher throughput with somewhat worse resolution.

Use the up/down arrows to adjust the **Rise Time** within the range of 0.8 µs to 23.0 µs.

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 **Start**. The InSight mode is discussed in detail in the MAESTRO *User's Manual*.

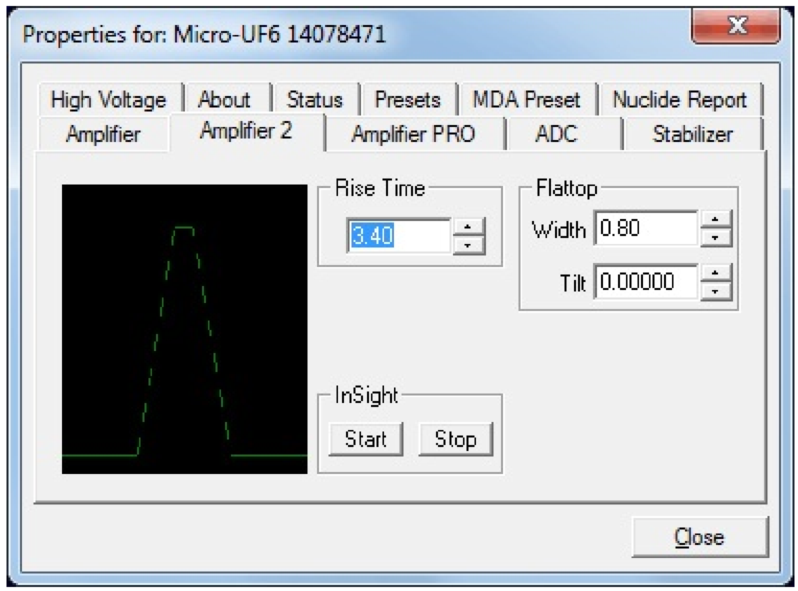


Figure 74. Micro-UF6 Amplifier 2 Tab.

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 × *Rise Time*) + (2 × *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 click the **Insight** section's **Start** button to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape.

D.3.3. Amplifier PRO

Figure 75 shows the Amplifier PRO tab, which contains the **Low Frequency Rejector** (LFR) filter control. 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 Micro-UF6. Subsequent measurements can then be taken with the LFR filter on.

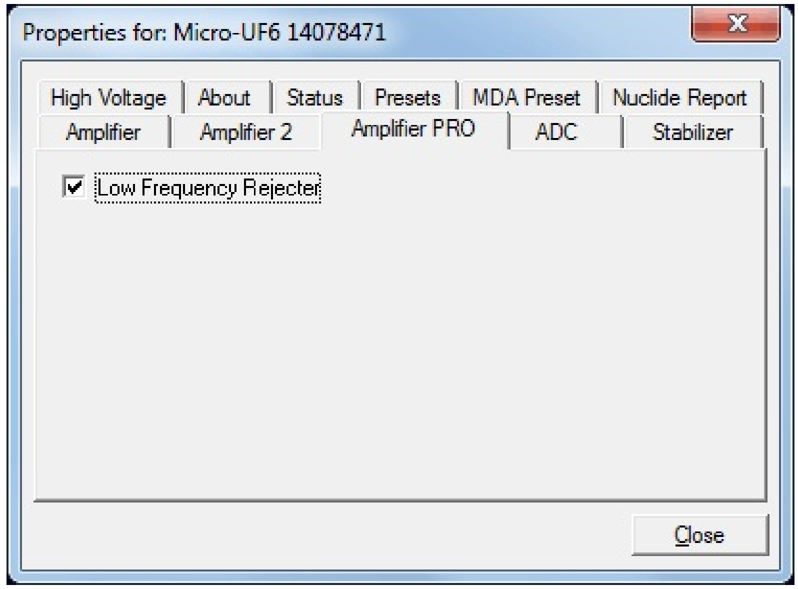


Figure 75. Micro-UF6 Amplifier PRO Tab.

D.3.4. ADC

This tab (Fig. 76) contains the **Conversion Gain**, **Lower Level Discr**iminator, and **Upper Level Discr**iminator controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

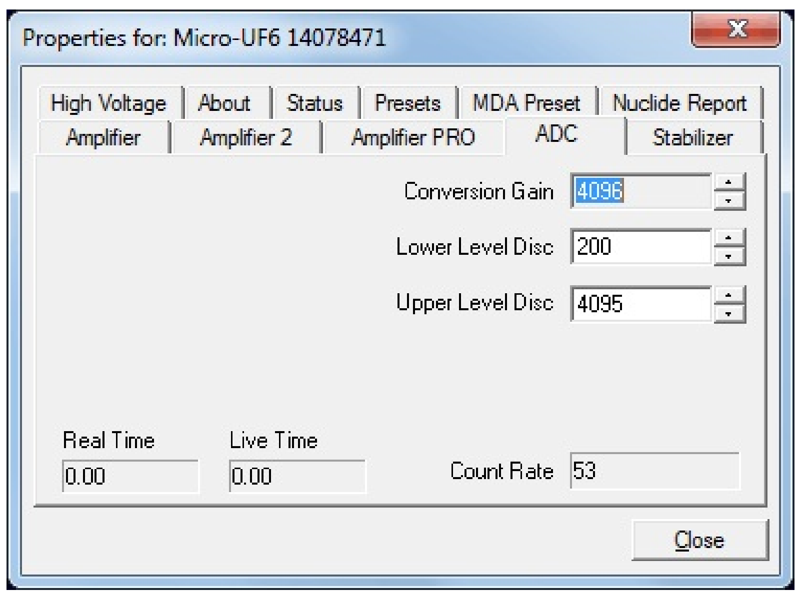


Figure 76. Micro-UF6 ADC Tab.

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). The up/down arrow buttons step through the valid settings.

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.

D.3.5. Stabilizer

The Micro-UF6 has both a gain stabilizer and a zero stabilizer. See the MAESTRO *User's Manual* for a more detailed discussion of each.

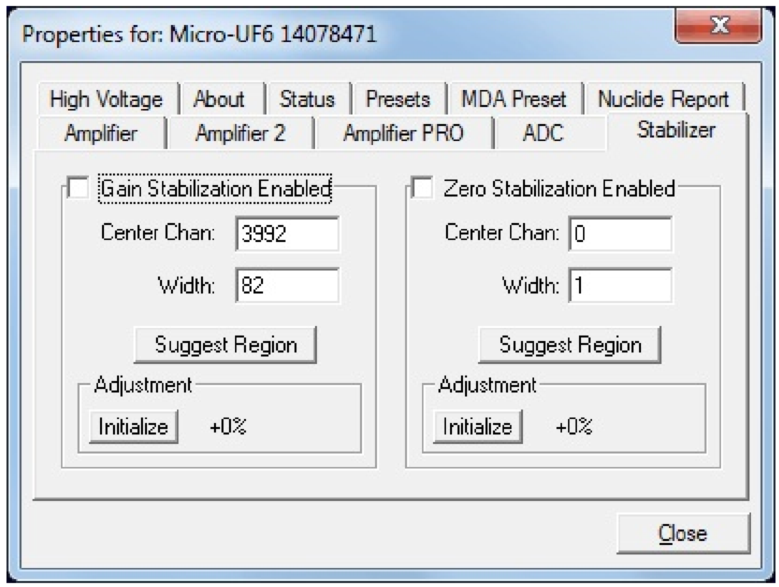


Figure 77. Micro-UF6 Stabilizer Tab.

The Stabilizer tab (Fig. 77) 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 set up the stabilizer, enter the **Center Cha**nnel and **Width** values manually or click 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 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 Cha**nnel and **Width** cannot be changed.

D.3.6. High Voltage

Figure 78 shows the High Voltage tab, which allows you to turn the bias voltage off and on, and monitor the **Actual** bias. You cannot change the polarity or **Shutdown** mode, which is fixed as **SMART**.[15]

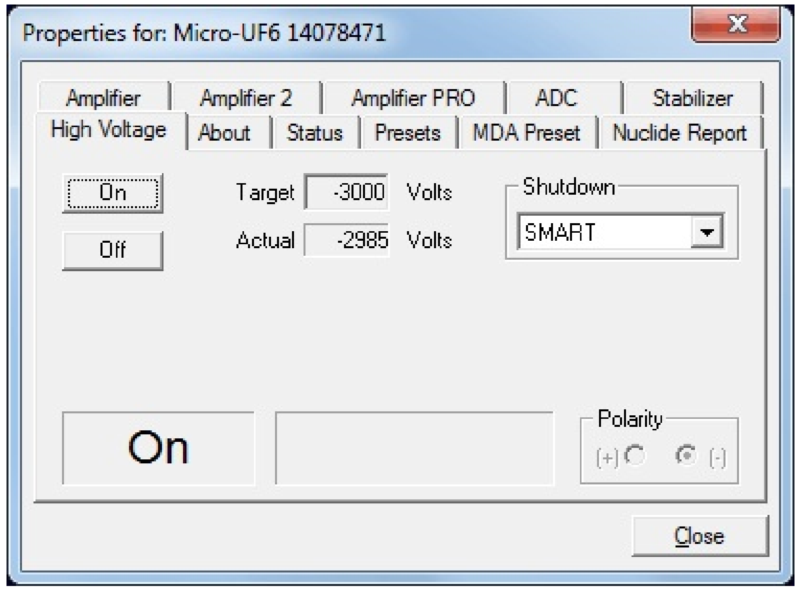


Figure 78. Micro-UF6 High Voltage Tab.

[15]This is a reference to the Micro-UF6's SMART-1™ detector technology. For more information on SMART-1, see the ORTEC catalog or visit www.ortec-online.com.

D.3.7. About

This tab (Fig. 79) displays hardware and firmware information about the Micro-UF6 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* for more information.

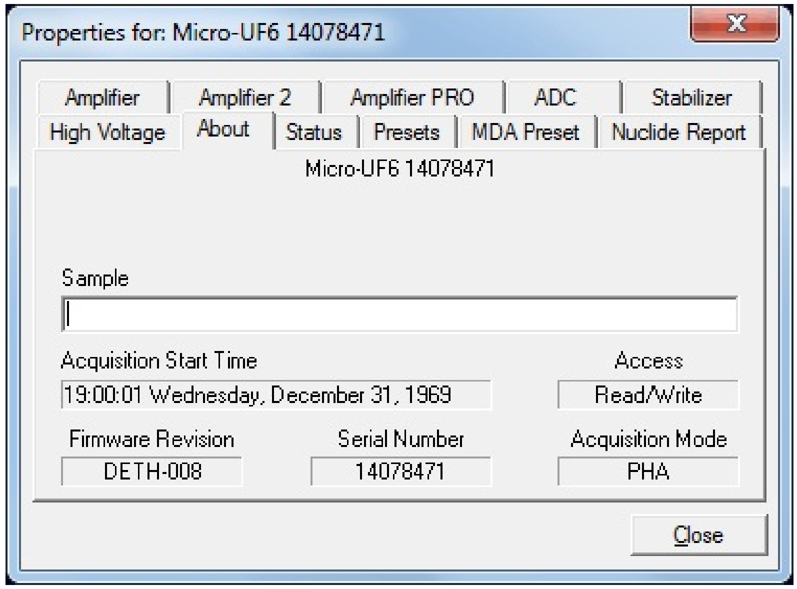


Figure 79. Micro-UF6 About Tab.

Use the **Firmware Revision** field to determine the instrument type and firmware version. This parameter is formatted *DETH-nnn*, where *nnn* is the firmware version. In the accompanying illustration, *DETH-008* indicates a Micro-UF6 running firmware v5. You can also use the About tab to view this information for .SPC-format spectra downloaded from the Micro-UF6.

D.3.8. Status

Figure 80 shows the Status tab. Ten 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 droplists to select any six parameters to be displayed simultaneously on the Status tab. You can change the selected parameters at any time.

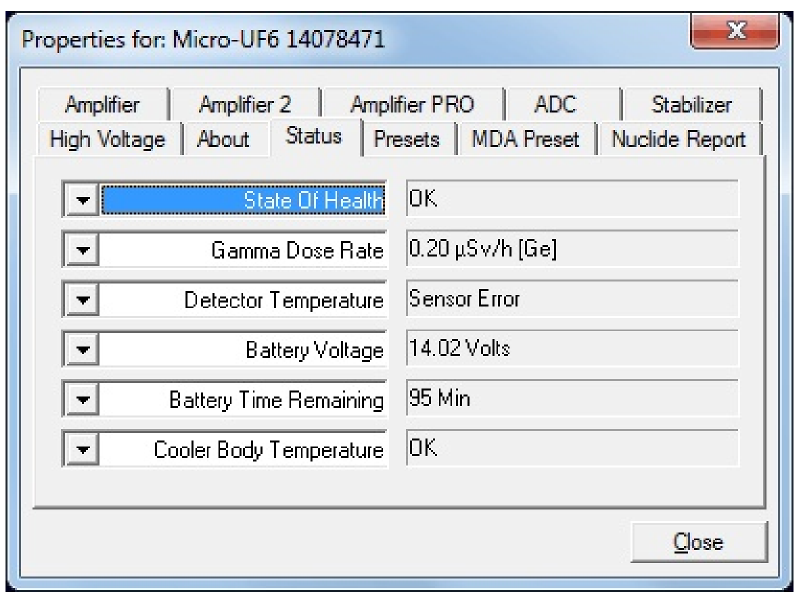


Figure 80. Micro-UF6 Status Tab.

The monitored parameters are:

- Detector **State of Health** — reported as OK or ERR.
- **Gamma Dose Rate** — reported in µSv/h.
- **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.
- **ID Table Version** — not used by the Micro-UF6.

To resolve status problems, refer to Chapter 7. For further assistance, contact your ORTEC representative or our Technical Services Group.

D.3.9. Presets

Figure 81 shows the Presets tab. The presets can only be set when the Micro-UF6 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.

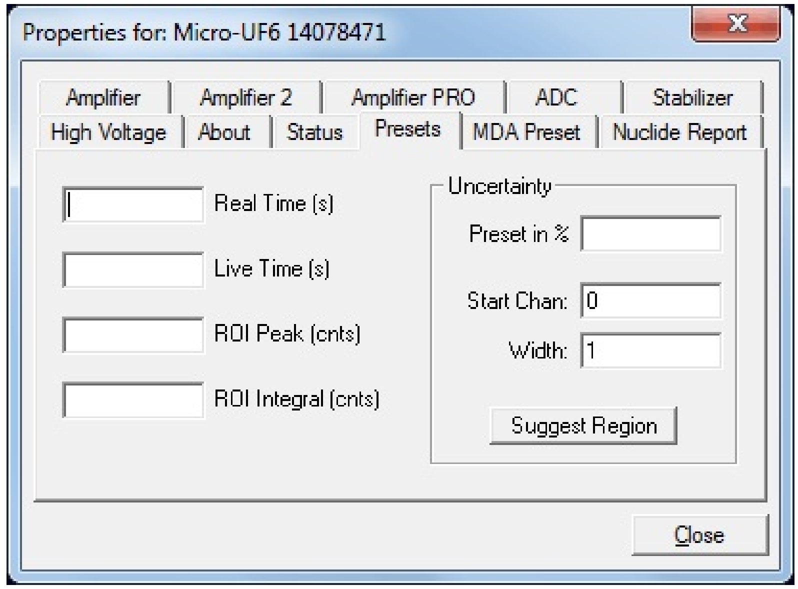


Figure 81. Micro-UF6 Presets Tab.

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.

The **Uncertainty** preset stops acquisition when the statistical or counting uncertainty of a user-selected net peak reaches the value you have entered. Enter the **Preset in %** value as percent uncertainty at 1 sigma of the net peak area. The range is from 99% to 0.1% in 0.1% steps. You have complete control over the selected peak region. The region must be at least 7 channels wide with 3 channels of background on each side of the peak. Note that MAESTRO calculates this preset once per 40 seconds. Therefore, the software will continue data acquisition up to 40 seconds after the preset has been reached, and the uncertainty achieved for a high count-rate sample may be lower than the preset value.

Use the **Start Chan**nel and **Width** fields to enter the channel limits directly, or click **Suggest Region**. If the marker is positioned in an ROI around the peak of interest, **Suggest Region** reads the limits of the ROI with the marker and display those limits in the **Start Chan** and **Width** fields. The ROI can be cleared after the preset is entered without affecting the uncertainty calculation. If the marker is not positioned in an ROI, the start channel is 1.5 times the FWHM below the marker channel and the width is 3 times the FWHM.

The net peak area and statistical uncertainty are calculated in the same manner as for the MAESTRO **Peak Info** command.

D.3.10. MDA Preset

The MDA preset (Fig. 82) can monitor up to 20 nuclides at one time, and stops data collection when the values of the minimum detectable activity (MDA) for *all* of the user-specified MDA nuclides reach the needed value. Presets are expressed in Bq, and are evaluated every 40 seconds. The detector must be calibrated for energy in all ORTEC spectroscopy applications, and for efficiency in all applications but MAESTRO.

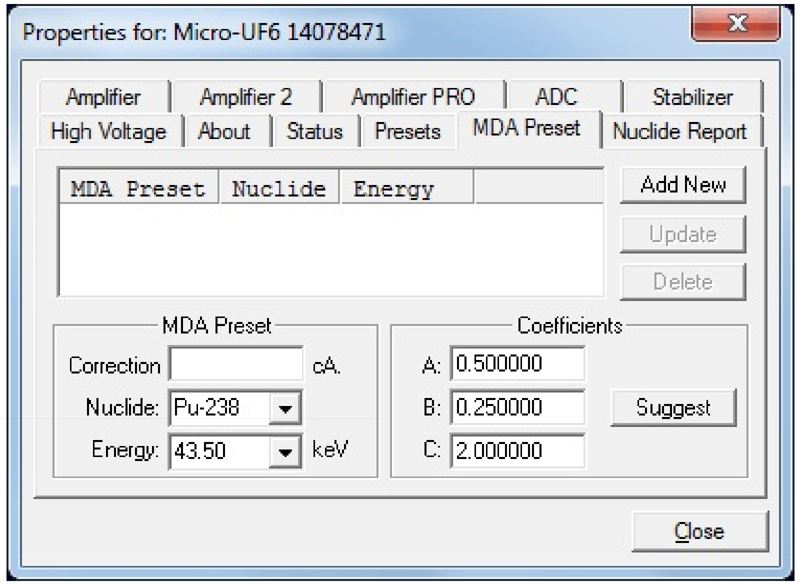


Figure 82. Micro-UF6 MDA Preset.

The MDA presets are implemented in the MCB (i.e., the entries you make on this screen are saved in the MCB memory), and have no direct link to MDA methods selected in the analysis options for applications such as GammaVision, ScintiVision, ISOTOPIC, etc. The MDA preset calculation uses the following formula:

$$MDA = \frac{a + \sqrt{b + c * Counts}}{Live\ time * (CorrectionFactor)}$$

where:

a, *b*, and *c* are determined by the MDA criteria you choose.

Counts is the gross counts in an ROI that is 2.5×FWHM around the target peak energy.

Live time is evaluated in 40 second intervals for the MDA presets.

CorrectionFactor is the product of the calibration efficiency at the specified peak energy and the peak's branching ratio (yield) as listed in the working (active) library.

NOTE MAESTRO does not support efficiency calibration. The efficiency component in the *CorrectionFactor* is set to 1.0; the preset field is labeled **Correction** instead of **MDA**; and the preset is based on counting activity (**cA**) instead of becquerels. You can enter the MDA preset either in counts; or corrected for factors such as sample volume, attenuation, or calculated efficiency. For example, if you manually calculate the efficiency for a peak, you can enter a corrected MDA target value by multiplying the desired MDA value times the calculated efficiency, and entering the product as the **Correction**.

To add an MDA preset, enter the preset value in the **MDA** or **Correction** field; select the **Nuclide** and **Energy**; enter the desired values for coefficients *a*, *b*, and *c*; then click **Add New**.

To edit an existing preset, click to highlight it in the table. This will load its **Nuclide, Energy**, and coefficients in the lower sections of the dialog. Change as needed, then click **Update**.

To remove a preset, click to high-light it in the table, then click **Delete**.

IMPORTANT These MDA presets *are not dynamically calculated.* Each time you add an MDA preset to this table, its *CorrectionFactor* value is calculated and stored in the MCB's memory. If you then load a different library, change the efficiency calibration, or change the system geometry, the spectroscopy application *will not update* the existing *CorrectionFactor*s, and your MDA presets may no longer be applicable.

When using spectrum analysis applications such as GammaVision and Scinti-Vision, you can create an analysis options file (.SDF or .SVD file) for each system geometry that you use; and include in it a set of MDA presets specific to that geometry, efficiency calibration, and nuclide library. You can then recall this tailored analysis options file as needed.

D.3.11. Nuclide Report

Figure 83 shows the Nuclide Report tab. The Nuclide Report displays the activity of up to 9 user-selected peaks. Once the report is set up you can view the Nuclide Report at any time on the Micro-UF6 display. The peak area calculations in the hardware use the same methods as the MAESTRO **Peak Info** calculation, so the Nuclide Report display is the same as the **Peak Info** display on the selected peak in the spectra stored in the computer. The calculated value is computed by multiplying the net peak count rate by a user-defined constant. If the constant includes the efficiency and branching ratio, the displayed value is the activity. You enter the nuclide label and the activity units.

The report format and calculations are discussed in detail in Section A.2.1.

D.3.11.1. Add New

Manual Add

Nuclides can be added to the list using the library to assist in the region definition or manually. To add a nuclide manually, enter the nuclide name, ROI start and end channels, multiplicative factor and units in the Report section. Now press **Add New** to add this nuclide to the list. The units need only be entered once, since they are the same for all nuclides in the table.

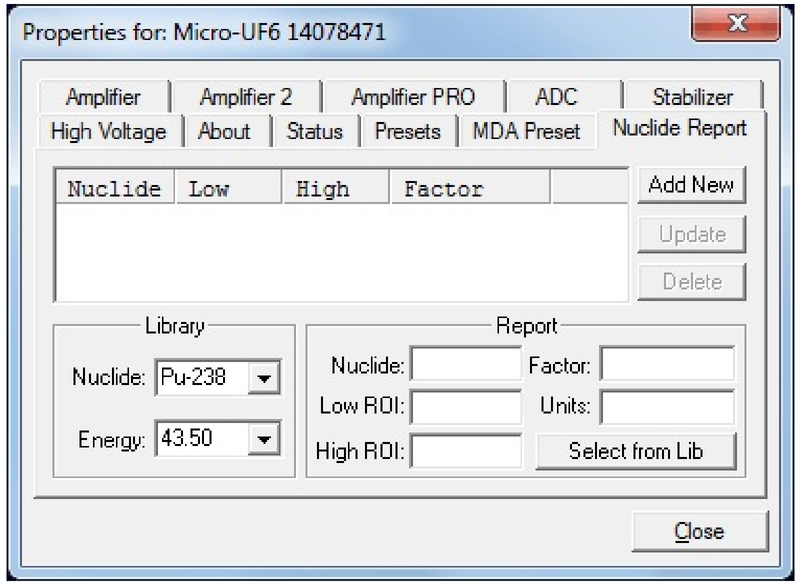


Figure 83. Micro-UF6 Nuclide Report.

Library Add

To use the library to aid in the definition, select the nuclide from the library nuclide drop down list. Now select the gamma-ray energy from the Energy drop down list. This defines what gamma ray to use. Now Press the **Select from Lib** button in the Report section. This will update all the entries in this section and show (as a yellow band) the region to be used in both the expanded spectrum and the full window. Now press **Add New** to add this nuclide to the list.

Edit

To change any of the current nuclides, select the nuclide in the list (use the scroll bars if needed). This will show the current settings for this nuclide. Make any changes needed. Any or all of the entries can be changed. When finished with the changes, click **Update**.

Delete

To remove an entry, select the entry and press **Delete**.

When you close the Properties dialog, all the values entered are written to the Micro-UF6 and are used when you view the Nuclide Report on the Micro-UF6 display.

APPENDIX E. FIRMWARE COMMANDS AND RESPONSES

Most software communication with the Micro-UF6 will take place 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). Use the DLL interface call MIOComm or the ActiveX control UCONN's Comm method to send commands to instruments and receive responses.

E.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.

E.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

E.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.

E.2.2. MCB Commands

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.

The commands are listed in alphabetical order, each starting with a command prototype line. Uppercase letters, numeric digits, blank space, and special symbols such as the underscore "**_**" and comma 13 "**,**" in the prototype line are *literal text to be sent to the MCB exactly as they appear*. Lowercase letters in the prototype line represent numeric values as described in the accompanying text; they should not be sent literally to the MCB but should be replaced by an appropriate numeric value. In this section the term **<CR>** represents the ASCII carriage return character, decimal value 13; and the character "**_**" represents the ASCII underscore character, decimal value 95.

CLEAR

The channels of spectral data in the window of interest (see SET_WINDOW command) 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_DATA

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

CLEAR_HV_HEALTH

Clears (resets) the state-of-health bits.

CLEAR_MDA_PRESET

Clears all MCA preset values. This command is used to quickly clear the list of MDA preset values.

CLEAR_NUCLIDE [PeakNumber]

Clears all parameters for a specific nuclide peak number. This command is used to quickly clear the list of nuclide values.

CLEAR_NUCLIDE_ALL

Clears all nuclide values. This command is used to quickly clear the list of nuclide values.

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.

CLEAR_SPECTRUM_ALL

Clears all stored spectra from stored spectrum memory.

COMP

Selects the computer mode for the communication replies.

DISABLE_BLRE_AUTOMATIC

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

DISABLE_GAIN_STABILIZATION

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

DISABLE_HV

Turns off the high-voltage enable signal of the Micro-UF6. See the section on the bias supply for more information about the high-voltage output. See also ENABLE_HV and SHOW_HV.

DISABLE_THRESHOLD_AUTOMATIC

DISABLE_THRESHOLD_SAMPLE

DISABLE_TRIGGER_SPECIAL

No function in the Micro-UF6; included for backward compatibility.

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_GAIN_STABILIZATION

Enables the stabilization of the gain peak. See also DISABLE_GAIN_ STABILIZATION, SHOW_GAIN_STABILIZATION, and INITIALIZE_GAIN_STABILIZATION.

ENABLE_HV

Turns on the high-voltage enable output of the Micro-UF6. See also DISABLE_HV and SHOW_HV.

ENABLE_THRESHOLD_AUTOMATIC

Enables automatic determination of the positive and negative thresholds. See also DISABLE_THRESHOLD_AUTO, SHOW_THRESHOLD_ AUTO, SET_THRESHOLD_NEGATIVE, and SET_THRESHOLD_ POSITIVE.

ENABLE_THRESHOLD_SAMPLE

ENABLE_TRIGGER_SPECIAL

No function in the Micro-UF6; included for backward compatibility.

ENABLE_ZERO_STABILIZATION

Enables the stabilization of the zero peak. See also DISABLE_ZERO_ STABILIZATION, SHOW_ZERO_STABILIZATION, and INITIALIZE_ZERO_STABILIZATION.

INITIALIZE

Returns the Micro-UF6 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_CORR_FLAT

Lists the valid settings of the flattop width.

Response:

CORR_FLAT -1.0 0.992 0 255 Flattop width ranges from −1.0 to +0.992 in 255 steps.

LIST_GAIN_COARSE

Lists the valid coarse-gain settings.

LIST_GAIN_FINE

Lists the valid fine-gain settings (e.g., 1, 2, 4, 8, 16, 32).

LIST_HV

Lists the valid high-voltage settings.

LIST_ROI_SAMPLE

Lists the valid ROI sample settings.

LIST_SHAP_CUSP

Lists the valid cusp shape 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 for InSight mode.

RESET

Resets the Micro-UF6 to the state just after power is applied. This command responds with a % response that indicates power-up just occurred.

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_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 Micro-UF6 internal memory that can be used by other programs, such as sample descriptions and energy calibrations. CONNECTIONS uses 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_COLLECTION value

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

SET_DELAY_SAMPLE num

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

SET_DEVICE

SET_DISPLAY

SET_FRONT_BYPASS

No function in the Micro-UF6; included for backward compatibility.

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

This sets the coarse gain to num, which must be 1, 2, 4, 8, 16, or 32. 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 15 bits (conversion gain = 32768) 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_CONVERSION 32768<CR>	Conversion gain set to 32768 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 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_GATE_ANTICOINCIDENT

Causes the Micro-UF6 to use the ADC gate input signal in anticoincident mode. See also SET_GATE_OFF, SET_GATE_COINCIDENT, and SHOW_GATE.

SET_GATE_COINCIDENT

Causes the Micro-UF6o use the ADC gate input signal in coincident mode. See also SET_GATE_OFF, SET_GATE_ANTICOINCIDENT, and SHOW_GATE.

SET_GATE_OFF

Causes the Micro-UF6 to ignore the state of the ADC gate input signal. See also SET_GATE_COINCIDENT, SET_GATE_ANTICOINCIDENT, and SHOW_GATE.

SET_HV value

This sets the HV bias to value, in volts.

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.

Example:

SET_ID “Site 123"

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 Micro-UF6. 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 Micro-UF6 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_MDA_COEF a,b,c

Sets the coefficients in the MDA preset calculation to the specified values. A, b, and c are floating-point values. The MDA preset checks for the following condition to be met:

$$MDA\ Preset_i > \frac{a + \sqrt{b + c * CountsinROI_i}}{Live\ Time}$$

The calculation is performed once every 30 seconds with *i* starting at 0 and advancing through each of up to 20 unique MDA presets. *i* only advances once the preset has been met. Note that a, b, and c are the same for each of the unique presets. Only the ROI range and the MDA preset change when *i* advances. Once *i* reaches 20 or $MDAPreset_i$ equals 0, the acquisition terminates.

SET_MDA_PRESET MDAPreset,[PeakNumber]

Sets or reports the MDAPreset PeakNumber value as shown in the equation in the SET_MDA_COEF description above. MDAPreset is usually the product of the desired MDA, the yield and the efficiency. PeakNumber is a parameter that specifies which of up to 20 (0–19) MDA presets to change. If PeakNumber is omitted in the set command, all MDA preset values will be set to 0 (disabled), and the supplied value will be applied to MDA Preset 0. This provides compatibility with old GammaVision products.

SET_MODE_PHA

The mode is set to PHA.

SET_MODE_SAMPLE

Starts InSight Virtual Oscilloscope mode.

SET_NUCLIDE_COEF NucCoef, [PeakNumber]

Sets or reports the NucCoef PeakNumber value as shown in the equation above. NucCoef is usually the product of the yield and the efficiency. PeakNumber is a parameter that specifies which of up to 9 (0–8) peaks to change. The coefficient can be any value from 0 to 65535.996 in steps of 1/256. (The add-in will convert the value to an unsigned long with a binary point between the left of the least significant byte.)

SET_NUCLIDE_DESC PeakNumber,"NucLabel"

Sets the nuclide label for the specified peak to the specified value. The label must be 6 characters or less.

SET_NUCLIDE_UNITS "units"

Sets the activity units to the specified string. The string may be no more than 6 characters.

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 Micro-UF6. 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_RADIX_BINARY

No function in the Micro-UF6; included for backward compatibility.

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_MDA start,numchans, [PeakNumber]

Sets the region to use to compute the gross counts in the MDA calculation. PeakNumber is an optional parameter (assumed 0 if not present) that specifies which of up to 20 (0–19) MDA Presets to change.

SET_ROI_NUCLIDE start,numchans, [PeakNumber]

Sets the region to use to compute the net counts in the activity calculation. PeakNumber is an optional parameter (assumed 0 if not present) that specifies which of up to 9 (0–8) peaks to change.

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_ROI_UNCERTAINTY start, chans

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

SET_SEGMENT

SET_SHAPE_CUSP

No function in the Micro-UF6; included for backward compatibility.

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 0.2 to 23 in steps of 0.2. See also SHOW_SHAP_RISE.

SET_THRESHOLD_NEGATIVE value

Sets the negative threshold to value. The negative threshold is normally set automatically by the Micro-UF6. See also ENABLE_ THRESHOLD_AUTOMATIC and SHOW_THRESHOLD_NEGATIVE.

SET_THRESHOLD_POSITIVE value

Sets the positive threshold to value. The positive threshold is normally set automatically by the Micro-UF6. See also ENABLE_THRESHOLD_AUTOMATIC and SHOW_THRESHOLD_ POSITIVE.

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_TIME_START hour,min,sec

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

SET_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 Micro-UF6 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_UNCERTAINTY_PRESET percent

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

SET_WINDOW [start, length]

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

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 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 Micro-UF6 is active (i.e., acquiring spectral data) or 0 if it is not active.

Responses:

$C00000087<CR> Not active.

$C00001088<CR>	Active.

SHOW_ADC_CONV

Returns the ADC conversion gain.

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_CLICKER

Shows state of audio clicker.

Responses:

$IT<CR>	Clicker is enabled.
$IF<CR>	Clicker is disabled.

SET_CLICKER_SENSITIVITY sens

Sets sensitivity of clicker. Sens is an index into the list of sensitivity settings. Valid sens values are: 0, 1, 2, or 3 which correspond to Maximum, High, Medium, and Low, respectively.

SHOW_CLICKER_SENSITIVITY

Reports clicker sensitivity. Possible values are 0, 1, 2, or 3.

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 Micro-UF6), 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_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.

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_DEBUG

Shows the debug level of the software.

SHOW_DELAY_COLLECTION

Shows the width of the PUR signal setting. See also SET_DELAY_ COLLECTION.

Responses:

DEL_COLL 0000000000001.6

SHOW_DELAY_SAMPLE

Shows the Delay Sample setting. See also SET_DELAY_SAMPLE.

Responses:

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

SHOW_DET_SMART

Indicates whether the detector is SMART-1 and the shutdown mode is set for a SMART-1 HPGe Detector. Responses are true and false.

Responses:

$IT<CR>	SMART-1 shutdown set.
$IF<CR>	TTL or ORTEC shutdown set.

SHOW_DEV

Shows the currently selected device. Always 1 for Micro-UF6.

SHOW_FEATURES

Responds with four 32-bit masks indicating which features are present in the MCB. See Section E.3 for a complete description of each bit in the mask.

Example Response:

FEATURES 00003774783 01083068428 00262149392 00000263177

SHOW_GAIN_ADJUST

Returns the gain-stabilize 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 Micro-UF6 internal amplifier. In operation, the resulting signal gain is the product of the coarse gain, the fine gain, and the super-fine gain (used by stabilizer). The coarse gain is returned in terms of an integer gain multiplier.

Responses:

$C00001088<CR>	Coarse gain reported as 1.
$C00002089<CR>	Coarse gain reported as 2.
$C00004091<CR>	Coarse gain reported as 4.
$C00008095<CR>	Coarse gain reported as 8.
$C00016094<CR>	Coarse gain reported as 16.
$C00032092<CR>	Coarse gain reported as 32.

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.
$C32768113<CR>	Conversion gain reported as 32768 channels.

SHOW_GAIN_FINE

Returns the current fine gain setting in the range from 0.45 to 1.0. See SET_GAIN_FINE.

Sample Response:

GAIN_FINE 0000000000000.5	Gain is 0.5.
GAIN_FINE 000000.49784342	Gain is 0.4978.

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).
...	**...**
$C16383108<CR>	Gain width is 16383 channels (highest possible width in point mode with gain channel set to 8192).

SHOW_GATE

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

Responses:

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

SHOW_HV

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

$Dvvvvvssssscccc<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).

<u>Example Responses:</u>

$D020000003077<CR>	2000 V, negative, not overloaded, disabled.
$D020000002076<CR>	2000 V, positive, not overloaded, disabled.
$D020000007082<CR>	2000 V, negative, not overloaded, enabled.

SHOW_HV_ACTUAL

Returns the value of HV actually on the detector.

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:

$Dvvvvvssssscccc<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).

<u>Example Responses:</u>

$D020000003077<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

This returns the HV polarity setting in the Micro-UF6 as a $F record.

Responses:

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

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_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_MDA [PeakNumber]

Reports current MDA for the MDA Preset selected by PeakNumber. PeakNumber is assumed to be 0 if not supplied.

Example response:

MDA 0000000000010.7

SHOW_MDA_COEF

Reports the current settings for coeffficients a, b, and c used for the MDA calculation. See SET_MDA_COEF.

Example Responses:

MDA_COEF 000000000002.71 000000000000000 00000021.700001

Coefficient a = 2.71, b = 0, and c = 21.7.

SHOW_MDA_PRESET [PeakNumber]

Reports MDA preset PeakNumber. If PeakNumber is omitted, 0 is assumed.

Example Response:

MDA_PRES 0000000000025.7

SHOW_MODE

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

Responses:

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

SHOW_MONI_LABEL num

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

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.

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_NUCLIDE [PeakNumber]

Reports current activity and uncertainty for the nuclide selected by PeakNumber. PeakNumber is assumed to be 0 if not supplied.

Example:

NUCLIDE 0000000000010.7 0000000000001.2 Activity is 10.7 and uncertainty is 1.2%.

SHOW_NUCLIDE_COEFFICIENT [PeakNumber]

Reports the coefficient for a specific peak as a floating-point number that corresponds to the number set with SET_NUCLIDE_COEF.

Example:

NUCLIDE_COEF 0000000000010.7

SHOW_NUCLIDE_DESC PeakNumber

Reports the nuclide label for the specified peak in a $F record.

SHOW_NUCLIDE_UNITS

Reports the nuclide activity units in a $F record.

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_RADIX

SHOW_RATE_ZDT

SHOW_REMOTE

No function in the Micro-UF6; included for backward compatibility.

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

$Dsssssnnnnnccc<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_MDA

Reports the start channel and number of channels used in the MDA preset calculation.

Example Response:

$D0700000050ccc	Calculation is performed on channels 7000–7049.

SHOW_ROI_NUCLIDE [PeakNumber]

Reports the region to use to compute the counts in the activity calculation. PeakNumber (assumed 0 if not present) specifies which of up to 9 (0–8) peaks to report.

Example Response:

$D0083200052092	Region starts at channel 832 and is 52 channels wide.

SHOW_ROI_SAMPLE

Displays the ROI Sample setting. See also SET_ROI_SAMPLE.

Responses:

$C00001088

SHOW_ROI_UNCERTAINTY

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

Response:

$D0700000050ccc	Calculation is performed on channels 7000–7049.

SHOW_SEGMENT

Returns the current segment number. Always 1 for the Micro-UF6.

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 (only SMART-1) is available.

Responses:

$F0SMA	SMART-1 shutdown mode.

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 last 4 digits of the instrument's serial number.

Response:

$F7237	Last 4 digits of the serial number are 7237.

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_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_UNCERTAINTY

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

Responses:

UNCE 0000000000008.5	Uncertainty of the peak is 8.5%.

SHOW_UNCERTAINTY_PRESET

Returns the current uncertainty preset setting. See also SET_UNCERTAINTY_PRESET.

Responses:

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

SHOW_VERSION

Reports the Micro-UF6 firmware version number in the form

Fmmmm-vvv<CR>

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

Example Responses:

$FDETH–005<CR>	Model Micro-UF6 firmware version 5 reported.

SHOW_WINDOW

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

$Dxxxxxyyyyyccc<CR>

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

Example Responses:

$D0000016384094<CR>	Window of interest reported as starting at channel 0 and continuing for 16384 channels.
$D0000008192092<CR>	Window of interest reported as starting at channel 0 and continuing for 8192 channels (first 1/2).
$D0819208192112<CR>	Window of interest reported as starting at channel 8192 and continuing for 8192 channels (last 1/2).

SHOW_ZDT

No function in the Micro-UF6; included for backward compatibility.

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).
...	**...**
$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 Micro-UF6.

Execution Warnings:

%000004073<CR>	No segment selected (occurs with other warnings).
%000005074<CR>	The acquisition is already started (no changes made).
%000006075<CR>	A preset was exceeded (acquisition was not started).

%000008073<CR>	Unit not optimized since initialization.
%000016076<CR>	Amplifier not PZ'd since initialization.
%000032074<CR>	High voltage is disabled.

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

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

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.

VERIFY_CORR_FLAT

VERIFY_SHAPE_FLAT

VERIFY_SHAPE_RISE

These test the argument against the list of valid settings and return true if valid.

E.3. Feature Mask Bits

The following table describes the feature bits from the SHOW_FEATURES command discussed on page 137. If the feature is supported in the Micro-UF6 the bit is set to 1; if the feature is not supported, the bit is 0.

Bit	Meaning
0	Software-selectable conversion gain
1	Software-selectable coarse gain
2	Software-selectable fine gain
3	Gain stabilizer
4	Zero stabilizer
5	PHA mode functions available
6	MCS mode functions available

Bit	Meaning
7	List mode functions available
8	Sample mode functions available
9	Digital offset (e.g., 920)
10	Software-selectable analog offset
11	HV power supply
12	Enhanced HV (SET_HV, SET/SHOW_HV_POL, SHOW_HV_ACT)
13	Software-selectable HV range (ENA_NAI, DIS_NAI)
14	Auto PZ (START_PZ_AUTO)
15	Software-selectable manual PZ (SET/SHOW_PZ)
16	Battery-backed, real-time clock (SHOW_DATE/TIME, SHOW_DATE/TIME_START)
17	Sample changer support (SET/SHOW_OUTPUT, SHOW_INPUT)
18	One-button acquisition (ENA/DIS/SHOW_TRIG_SPEC, MOVE)
19	Nomadic (likely to move between opens)
20	Local app data (SET_DATA_APP, SHOW_DATA_APP)
21	Software-retrievable serial number
22	Power management commands
23	Battery status support (SHOW_STAT_BATT)
24	Software-selectable AMP polarity (SET/SHOW_GAIN_POLAR)
25	Support for flattop optimization (ENA/DIS_OPTI)
26	Stoppable AutoPZ (STOP_PZ_AUTO)
27	Network support (e.g., DSPEC)
28	Multi-drop serial support (e.g., MicroNOMAD®[2])
29	Software-selectable DPM address (SET_DPM_ADDR)
30	Multiple devices (e.g., 919)
31	Software-selectable ADC gate mode (SET_GATE...)
	Begin second word
32	Software-downloadable firmware
33	Time histogramming functions available (e.g., 9308)
34	Software-selectable lower level discriminator
35	Software-selectable upper level discriminator
36	MCS-mode SCA input available
37	MCS-mode positive TTL input available
38	MCS-mode fast-negative NIM input available
39	MCS-mode discriminator input available
40	Software-switchable MCS-mode discriminator edge
41	Software-programmable MCS-mode discriminator level

Bit	Meaning
42	Software-programmable SCA upper and lower thresholds
43	Software-selectable MCS-mode input sources
44	Uncertainty/statistical preset (SET_UNCERT_PRES)
45	Features vary by input (SHOW_FEATURES depends on device/segment; multi-input MCBs only)
46	Software-selectable HV shutdown mode (SET/SHOW/VERI_SHUT)
47	Software-selectable shaping time constants (SET_SHAP)
48	Explorable shaping time constants (SHOW_CONFIG_SHAP)
49	Advanced shaping time (SET_SHAP_RISE, SET_SHAPE_FLAT, etc.)
50	Software-selectable BLR (ENA/DIS/SHO_BLR_AUTO SET/SHO/VERI_BLR)
51	SHOW_STATUS command supported (returns $M record)
52	Overflow preset (ENA/DIS/SHO_OVER_PRES)
53	Software-enabled, MicroNOMAD-style audio clicker (ENA/DIS_CLICK)
54	Software-readable thermistor (SHOW_THERM)
55	Floating-point fine gain (SET/SHO/VERI/LIST_GAIN_FINE)
56	Software-enabled pileup rejector. (ENA/DIS/SHO_PUR, SET/VERI_WIDT_REJ)
57	Alpha-style HV power (SHOW_HV_CURRENT)
58	Software-readable vacuum (SHOW_VACUUM)
59	Acquisition alarms (ENA/DIS/SHO_ALARM)
60	Hardware acquisition trigger (ENA/DIS/SHO_TRIG)
61	Ordinal numbers for shaping times (SET_SHAP 0, SET_SHAP 1, ...)
62	Query gain ranges (LIST/VERI_GAIN_FINE, ..._COAR, ..._CONV)
63	Routable inputs (SET/SHOW_INPUT_ROUTE)
	Begin third word
64	External dwell support (ENA/DIS_DWELL_EXT)
65	Selectable SUM or REPLACE MCS modes (ENA/DIS_SUM)
66	External start of pass support (ENA/DIS/SHO_START_EXT)
67	Explorable with MCS list commands (LIST_SOURCE, LIST_LLSCA & LIST_ULSCA)
68	Device supports the MDA preset
69	Software-selectable ADC type (Matchmaker™)
70	Has ability to daisy-chain MCBs (DART)
71	ZDT functions available (DSPEC® Plus)
72	DSPEC Plus-style Insight triggering (LIST/SET_TRIG_SAMP)
73	Multiple inputs per connection (for example, OCTÊTE® Plus)
74	Hardware count-rate meter (SH_CRM)
75	Has multiple ZDT modes (SET/SHOW/LIST_MODE_ZDT)
76	Has multi-nuclide MDA preset

Bit	Meaning
77	Has MCS Replace then Sum Mode (SET_RPLSUM)
78	Has programmable external dwell voltage capability
79	No Peak Preset feature (M^3CA and OASIS)
80	Programmable pulser (OASIS)
81	Programmable Vacuum/HV interlock (OASIS)
82	Programmable Current/HV interlock (OASIS)
83	Explorable Stabilizer (LIST_GAIN_ADJU,LIST_ZERO_ADJU)
84	Has programmable input impedance (MCS)
85	Advanced shaping-time feature has no CUSP (Micro-trans-SPEC)
86	Selectable HV rise-time (SET/SHOW/LIST_HV_RISE) (SBS-60)
87	—
88	Monitor command support (SHOW_MONI_MAX/LABEL/VALUE)
89	SMART-1 Detector support (SHOW_SMART_DET, SHOW_SNUM_DET, SHOW_HV_RECO)
90	Nuclide report (SET/SHOW_NUCL_COEF, SET/SHOW_ROI_NUCL, ...)
91	Interactive Display Features Such as Nuclide Report
92	Advanced Stored Spectra (SH_SPEC_COUNT, SET/SHOW_SPEC_ID, MOVE)
93	SET/SHOW_VIEW in MCBs with Dual-Port Memory or printer port interfaces, LIST_VIEW in all MCBs
94	Connected to MCB via RS-232 (slow) port
95	No SET_HV_POSI, SET_HV_NEGA, ENA_NAI and DIS_N
	Begin fourth word
96	Low Frequency Rejecter (ENA/DIS/SHOW_LFR)
97	Resolution Enhancer (ENA/DIS/SH_RENHANCER, SET/SHOW_RETABLE idx,val)
98	SET_MODE_RELIST for Resolution Enhancer List Mode
99	Readable Sample mode time per channel (SH_TIME_SAMPLE)
100	Adjustable Sample mode time per channel (SET/LIST_TIME_SAMPLE)
101	List Mode data streamed and formatted as in digiBASE
102	Supports ETP mode (ENA/DIS/SHOW_ETP)
103	List Mode data streamed and formatted as in DSPEC Pro
104	SET/SHOW/LIST_PZ using floating point microseconds
105	Rise time, flattop width and cusp not changeable from property page
106	HV not user changeable from property page (requires Bit 12)
107	Coarse and fine gain not user changeable from property page
108	PZ and flattop tilt not user-selectable from property page
109	LFR not user changeable from property page (requires Bit 96)

Bit	Meaning
110	Portal Monitor style List Mode Synch is available
111	DSPEC-Pro Auxilliary BNC input available
112	SET_DISPLAY is NOT used to select ZDT data view (requires Bit 93)
113	ID Reports (DO_ID, SHOW_REPORT, SHOW_REPO_LINES)
114	Has neutron detector (SHOW_CRM 2 returns valid number)
115	—
116	—
117	—
118	—
119	—
120	—
121	—
122	—
123	—
124	—
125	—
126	—
127	Extended feature mask available (SH_FEAT_EXT)

[Intentionally blank]

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