ORTEC®

Model 926
ADCAM® Multichannel Buffer
Hardware Manual

QUALITY THAT TOUCHES THE UNIVERSE

MODEL NO. 926

SERIAL NO. 07030364

THIS INSTRUMENT HAS UNDERGONE A COMPLETE PROGRAM OF INSPECTION AND TEST AND HAS BEEN DEMONSTRATED TO MEET ITS PUBLISHED SPECIFICATIONS.

TECHNICIAN CW

DATE 02-05-2007

QUALITY THAT TOUCHES THE UNIVERSE

MODEL NO. DPM-USB

SERIAL NO. 7047853

THIS INSTRUMENT HAS UNDERGONE A COMPLETE PROGRAM OF INSPECTION AND TEST AND HAS BEEN DEMONSTRATED TO MEET ITS PUBLISHED SPECIFICATIONS.

TECHNICIAN C BRYANT

DATE 2-20-07

Advanced Measurement Technology, Inc.

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

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Repair Service

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

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

CONTENTS

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.

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

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

ATTENTION – Refer to Manual

DANGER – High Voltage

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

SAFETY WARNINGS AND CLEANING INSTRUCTIONS

DANGER Opening the cover of this instrument is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

WARNING Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

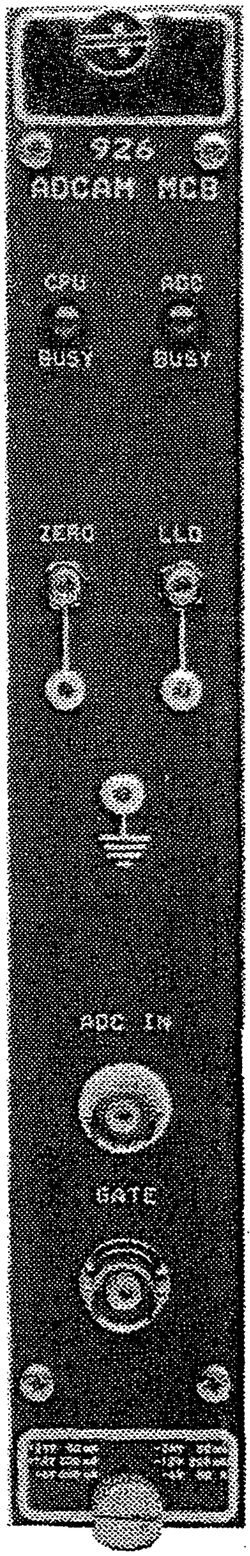
Cleaning Instructions

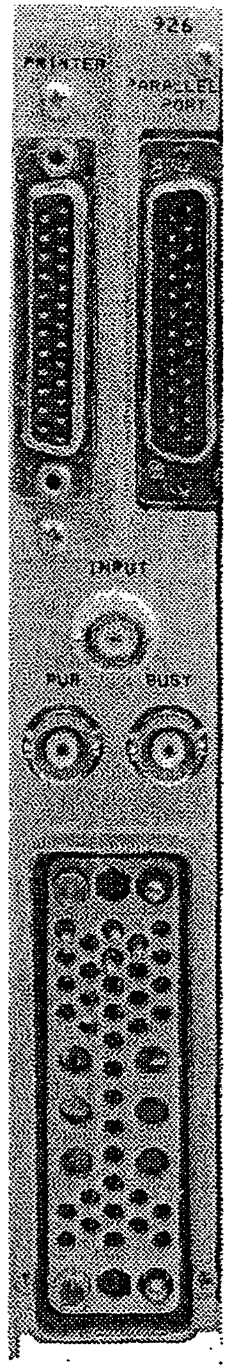
To clean the instrument exterior:

- Unplug the instrument from the ac power supply.
- 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.


926
ADCAM MCB
CPU
ADC
BUSY
BUSY
ZERO
LLD
ADC IN
GATE


926
PRINTER
PARALLEL
PORT
INPUT
PUR
BUSY

ORTEC MODEL 926
ADCAM MULTICHANNEL BUFFER

1. DESCRIPTION

1.1. GENERAL

The ORTEC Model 926 Multichannel Buffer (MCB) is a NIM module designed for high-performance data acquisition in nuclear spectroscopy applications. The Model 926 is a hardware component of the ORTEC ADCAM® architecture of Advanced Data Collection and Management, in which a personal computer is interfaced to a task-specific hardware system with the functions of data acquisition/storage and display/analysis shared between the special hardware and PC-based software, respectively. The 926 uses the display and peripheral storage in existing computer equipment and is controlled by issuing ASCII commands to the internal microprocessor from the computer.

MCA Emulation software and Quantitative Analysis software are available for use with a variety of personal computers.

1.2. INTENDED AUDIENCE

This manual is intended to be used for the initial setup and installation of the Model 926 hardware. Refer to the MCA Emulation Software Reference Manual for information on installation of the software. Section 1 of this manual gives a brief description of what can be found inside the 926 system. Section 2 gives the Model 926 specifications for reference. Section 3 describes the setup and installation of the Model 926. Section 4 describes the basics of MCA operation. Section 5 gives some troubleshooting information, designed to point out possible causes for some potential problems. The Appendices are intended for the user who wishes to write custom software to control the Model 926. These Appendices explain the commands used to control the system, along with sample programs and explanations of the interfaces and protocol.

2. SPECIFICATIONS

2.1. PERFORMANCE

ADC Successive-approximation type with sliding-scale linearization.

Max Resolution Software selectable as 8192, 4096, 2048, 1024, and 512.

Dead Time per Event 8 µs, including memory transfer.

Integral Nonlinearity $\leq\pm0.025\%$ over the top 99% of the dynamic range.

Differential Nonlinearity $<\pm1\%$ over the top 99% of the dynamic range.

Gain Instability $\leq\pm50$ ppm/°C.

Dead-Time Correction Printed wiring board jumper selects either Extended Live-time correction according to the Gedcke-Hale method,[1] or Simple Live-time correction with the clock turned off during the conversion time.

Data Memory 8k channels of battery backed-up memory; 2^{31}-1 counts per channel (over 2 billion).

Presets
- **Real Time/Live Time**: Multiples of 20 ms.
- **Region-of-Interest**: Peak count/Integral count.
- **Data Overflow**: Terminates acquisition when any channel exceeds 2^{31}-1.

Microprocessor Intel 80C188; 32k Dual-Port RAM with battery backup; 16k "scratchpad" RAM with battery backup. 32k program memory.

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

2.2. INDICATORS AND CONTROLS

CPU BUSY Red, busy-rate LED; intensity indicates the relative activity of the microprocessor.

ADC BUSY Red, busy-rate LED flashes once for each pulse digitized by the ADC.

ADC ZERO Front-panel screwdriver potentiometer, ±250 mV.

ADC LLD Front-panel screwdriver potentiometer, from 0 to 10% full scale.

2.3. INPUTS

INPUT Accepts positive unipolar, positive gated integrator, or positive-leading bipolar analog pulses in the dynamic range from 0 to +10 V; +12 V maximum; semi-Gaussian-shaped or gated-integrator-shaped time constants from 0.25 to 30 µs, or delay-line-shaped with width >0.25 µs. $Z_{in} \approx 1$ kΩ, dc-coupled. No internal delay. BNC connectors on front and rear panels.

ADC GATE Optional, slow-positive NIM input. Computer-selectable Coincidence or Anticoincidence. Signal must occur prior to and extend 0.5 µs beyond the peak of the pulse; front-panel BNC connector. $Z_{in} \sim 1$ kΩ.

PUR Pile-up rejection input; accepts slow-positive NIM signal; signal must occur prior to peak detect. $Z_{in} > 1$ kΩ. BNC connector on rear panel.

BUSY Busy input used by live-time correction circuits. Accepts slow-positive NIM signal; signal must occur prior to peak detect. $Z_{in} > 1$ kΩ. BNC connector on rear panel.

2.4. INTERFACE CONNECTORS

PARALLEL PORT Provides for control of the instrument and access to the data memory from a standard IBM PC printer port. Rear-panel mounted, 25-pin D-shaped male connector.

PRINTER Optional connection provided to either connect to another 926 MCB or a printer to the system. Rear-panel mounted, 25-pin D-shaped female connector.

DUAL-PORT MEMORY Optional 37-pin D connector provides the PC with a communication link and direct access to the Model 926's internal data memory. The DUAL-PORT MEMORY connector replaces the PRINTER connector on the rear panel when installed.

2.5. ELECTRICAL AND MECHANICAL

POWER REQUIRED +12 V, 200 mA; -12 V, 200 mA; +6 V, 600 mA.

WEIGHT Net 0.9 kg (2 lb), Shipping 2.25 kg (5 lb).

DIMENSIONS NIM-standard single-wide 3.43 x 22.13 cm (1.35 x 8.714 in.) front panel per DOE/ER-0457T.

3. INSTALLATION

This section describes the steps that must be taken to set up a standard system. Section 3.1 describes the selection of the live-time correction mode. Section 3.2 describes the setting of the MCB address switch. Section 3.3 describes the setting of the MCB/Printer Jumper. Section 3.4 describes the connection of the Model 926 to the computer via a printer-port interface. Section 3.5 describes the connection of the Model 926 to the computer via the Dual-Port Memory. Section 3.6 describes the cabling required for a standard detector system. Sections 3.7 and 3.8 describe the proper technique for adjusting the Lower-Level discriminator and the Zero Level. Section 3.9 describes the Gate Input.

3.1. LIVE-TIME MODE

The Model 926 has two different live-time correction modes: Extended and Simple. The Extended mode is the Gedcke-Hale correction mode which corrects for losses caused by pileup in the shaping amplifier. This is the default setting and is usually the correct setting for energy spectroscopy systems. The Simple Live-Time correction mode simply stops the live-time clock when the BUSY signal is active, the Model 926 detects that a pulse is arriving at its input, or the 926 is busy digitizing data. The Simple Live-Time mode is appropriate only in very specialized situations and is not the correct setting for most users.

To change the live-time correction mode, remove the right side plate of the Model 926 by removing the four screws. Figure 1 shows the location of the live-time correction mode jumper. Place the jumper across the lower two pins for Extended Live-Time correction and across the upper two pins for Simple Live-Time correction.

3.2. MCB ADDRESS

The 926 Multichannel Buffer (MCB) can be placed in a system with any other ORTEC MCB. To prevent conflicts in systems with more than one MCB, every MCB in the system must be assigned a MCB address. If the system has only one MCB, assign Address 1 to that MCB. If the system has more than one MCB, assign addresses sequentially to each MCB connected via a Dual-Port Memory Interface starting with Address 1. Next, assign addresses sequentially to each MCB connected via the Printer Port starting with 1. (If two MCBs are in the system, they can both have address 1 if one is connected via the Dual-Port memory and the other is connected via the Printer Port.)

Once an address is established for each MCB in the system, the hardware must be set to that address. On the Model 926 the address is set with a rotary switch highlighted in Fig. 1. The switch should be set to 1 less than the MCB address. For example if the MCB address is 1, set the switch to 0. The right side plate must be removed to access the switch.

Note: The default setting for the MCB address switch is correct for a single 926 system.

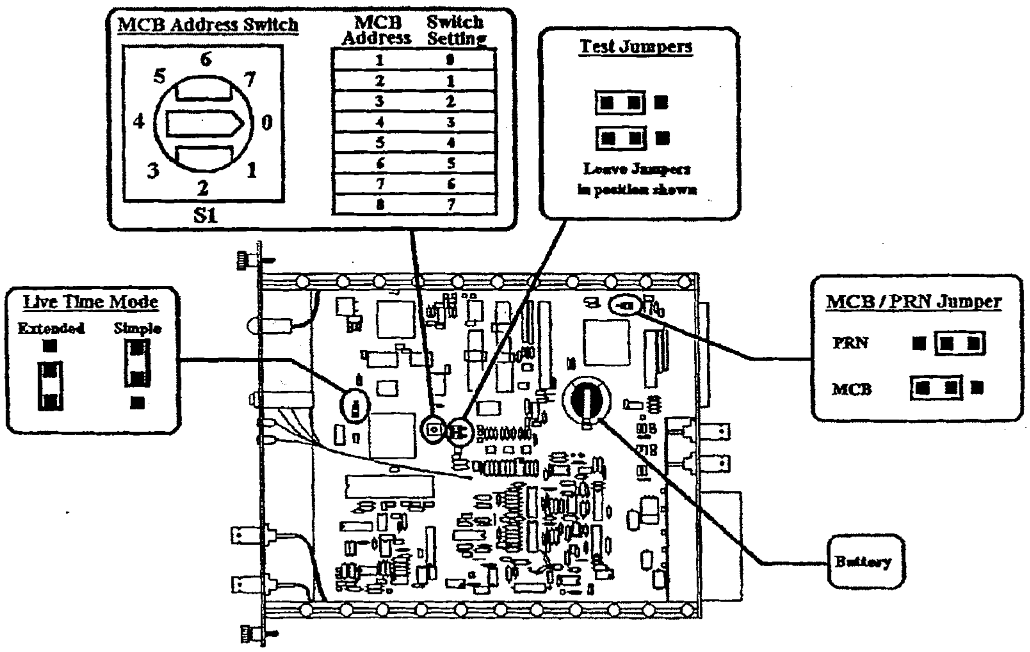


Fig. 1. 926 Address Switch and Jumpers.

3.3. SETTING MCB/PRN JUMPER

The MCB/PRN jumper must be correctly set when the printer-port interface is used. If the jumper is in the PRN position, a printer may be connected to the PRINTER connector on the rear panel of the Model 926. If the jumper is in the MCB position, a MCB may be connected to the PRINTER connector. Figures 2 and show two printer port systems with the jumper settings for the various 926s.

The jumper is set to PRN when the Model 926 leaves the factory. To change the MCB/PRN jumper, remove the right side plate of the Model 926 by removing the four screws. Figure 1 shows the location of the jumper. Place the jumper across the right two pins for PRN and across the left two pins for MCB.

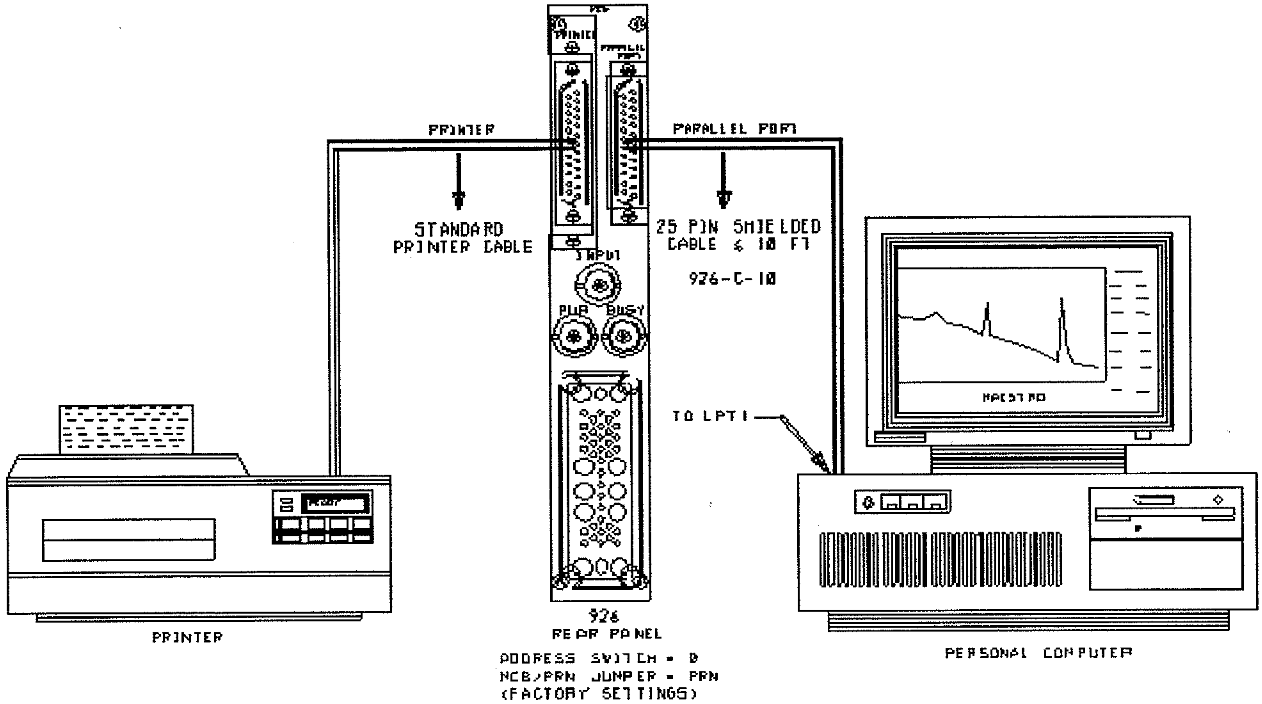


Fig. 2. Single Model 926 Using Printer-Port Interface.

3.4. INSTALLATION FOR PRINTER-PORT INTERFACE

The Model 926 as delivered from the factory is set up for use with the printer-port interface. If the Dual-Port Memory Option has been installed in the 926, the Printer Option must be reinstalled if a printer or 2nd MCB is to be connected to the 926. To install the Printer Option do the following:

1. Remove the right side plate by removing the four screws which hold it in place.
2. Using a 3/16" nut driver, remove the two hex nuts which hold the Dual-Port Memory (DPM) connector to the rear panel.
3. Slide the connector out of the rear-panel slot.
4. Disconnect the DPM cable from the Model 926 board by pulling straight up on the header which connects the DPM cable to the board.
5. Store the cable, hex nuts, and washers in a safe place.
6. Carefully plug the Printer Option in to the row of pins close to the rear panel (see Figure 4). The connector is keyed for proper installation.
7. Slide the other end of the cable into the rear panel of the 926. Secure the connector with two screws.
8. Replace the side plate.

Figures 2 and 3 show wiring diagrams for several printer port systems. The cables used are 25-pin shielded male-female cables. The cable from the computer to the first Model 926 should be no longer than 10 feet (3 meters). Cables connecting additional 926s should be no longer than 2 feet (0.6 meters). These cables are available from ORTEC by ordering Model 926-C-10 for a 10-foot cable and Model 926-C-2 for a 2-foot cable. The cable used to connect a Model 926 to a printer is a standard printer cable which normally connects a computer to a printer.

3.5. INSTALLATION FOR DUAL-PORT MEMORY INTERFACE

This section describes how to set up a Model 926 for use with the Dual-Port Memory Interface. When the 926 is shipped from the factory, it is configured to be used with the Printer-port interface. If the Dual-Port Memory Interface is to be used, the Dual-Port Memory Option must be installed in the 926. This option is included with each 926. It is a 37-pin ribbon cable with a 37-pin D connector on one end and a 40-pin header on the other end.

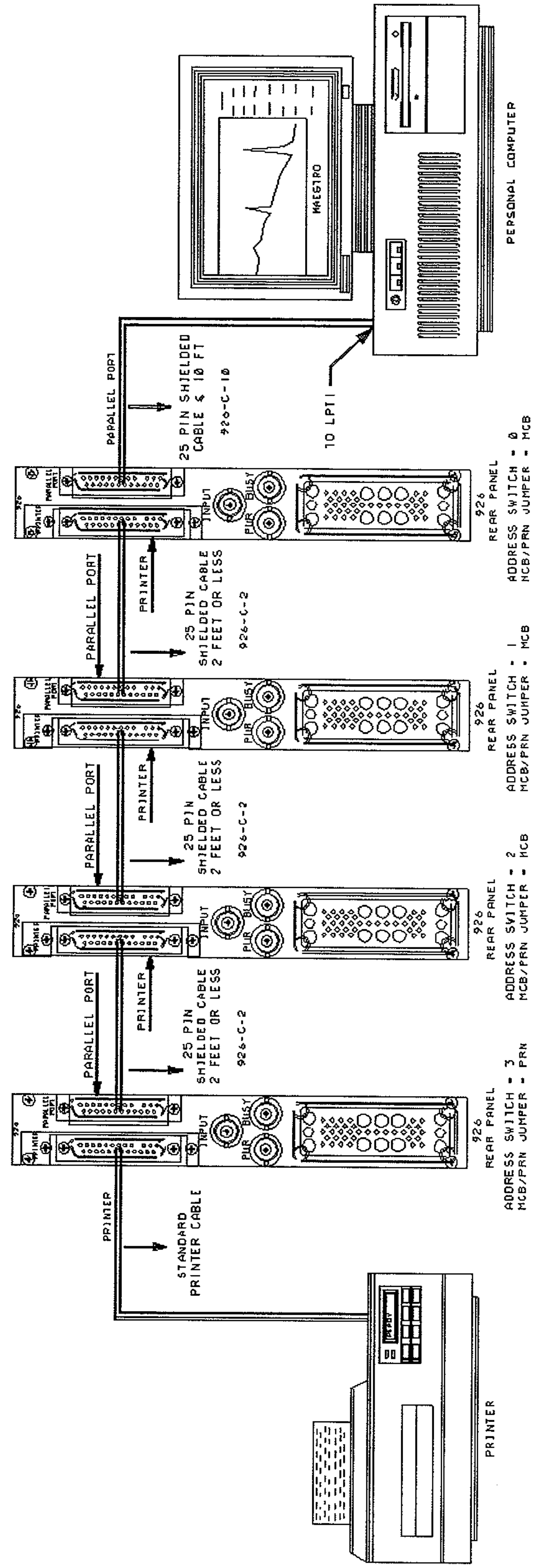


Fig. 3. Printer Port System with Four 926s.

To install the Dual-Port Memory Option, do the following (refer to Fig. 4):

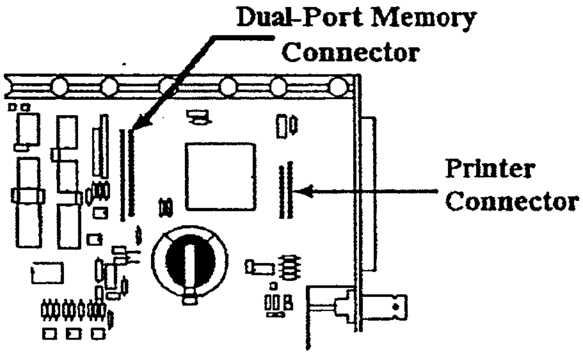


Fig. 4. Location of Option Connectors.

1. Remove the right side plate by removing the four screws which hold it in place.
2. Remove the two Phillips screws that hold the PRINTER panel in place.
3. Slide the PRINTER panel out of the rear-panel slot.
4. Disconnect the PRINTER option from the Model 926 board by pulling straight up on the header which connects the ribbon cable to the board.
5. Store the cable and screws in a safe place.
6. Carefully plug the Dual-Port Memory option
7. Slide the connector into the rear panel of the 926. Secure the connector with 3/16" hex nuts and washers provided.
8. Replace the side plate.

To use the Dual-Port Memory option, a Dual-Port Memory interface board must be purchased to make the connection to the computer. Follow the instructions which came with the Dual-Port Memory interface to set up the interface and install it in the computer.

If only one MCB is connected to the interface, plug the 37-pin D cable provided with the Dual-Port Memory interface from the Dual-Port Memory connector on the 926 rear panel to the Interface board in the computer. If more than one MCB is connected to the interface, a Dual-Port Fanout module must be used to provide a connector for each MCB.

3.6. CABLING A SYSTEM

The standard cabling of a 926 in a HPGe detector system is shown in Fig. 5. If the detector has a TRP preamplifier ("-PLUS" model), all connections shown should be made. If the preamplifier is a resistive-feedback preamplifier, the INHIBIT OUTPUT does not exist, so the connection to INHIBIT is not made. (INHIBIT is left open.)

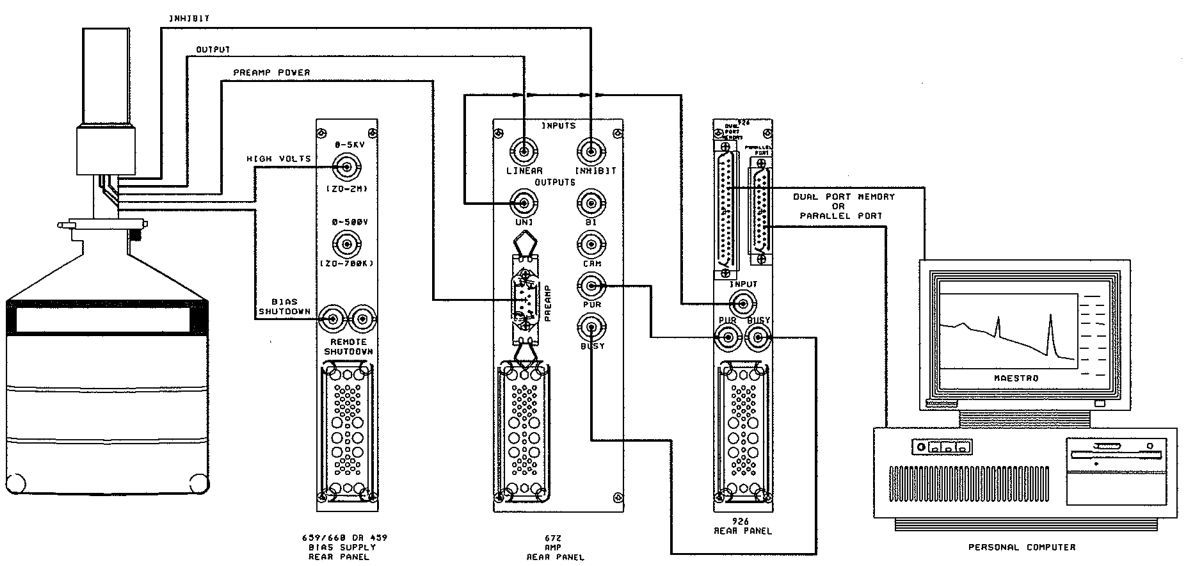


Fig. 5. HPGe System Cabling.

3.7. ADJUSTING LOWER-LEVEL DISCRIMINATOR

The Lower-Level Discriminator (LLD) adjustment is used to prevent small noise pulses from being converted by the ADC. Converting the noise pulses, causes the ADC to incur a large amount of dead time, thereby preventing the ADC from converting the actual pulses of interest. When the Model 926 is shipped from the factory, the LLD setting is approximately 75 mV, so no pulses smaller than 75 mV are converted or histogrammed. This setting is adequate for most systems.

If the system has high noise or there is a very low energy peak in the spectrum, it may be advantageous to adjust the LLD setting. In the high noise system, start collecting data and observe the dead time on the screen along with the number of counts arriving at the low end of the spectrum. With a small screwdriver, turn the LLD adjustment on the front panel clockwise, until the dead time drops or the peaks due to noise at the low end of the spectrum stop getting new counts. If there is a low energy peak in the spectrum, it may be necessary to lower the LLD setting to prevent the peak from being rejected. Start data acquisition and observe the low end of the spectrum while turning the LLD adjustment on the front panel counterclockwise. Continue the adjustment until the peak is in the spectrum. *Caution: Do not lower the adjustment until the dead time goes to 100%.*

3.8. ADJUSTING ZERO ADJUSTMENT

The Zero Adjustment is provided to add or subtract a dc level from the input signal. The Zero Adjustment is on the front panel of the Model 926. Usually no zero adjustment is required or recommended, since most modern spectroscopy amplifiers have very little dc offset. Should offset adjustment be necessary, turn the screwdriver adjustment clockwise to move peaks in the spectrum to the right and counterclockwise to move them to the left.

3.9. ENABLING THE GATE INPUT

The Gate on the front panel operates in one of three modes:

- *Off* — The Gate Input does nothing.
- *Coincident* — For a pulse to be converted, the Gate Input must be active (>2.5 V) when the pulse reaches its peak and for 0.5 µs thereafter.
- *Anticoincident* — For a pulse to be converted, the Gate Input must be inactive (<0.8 V) when the pulse reaches its peak and for 0.5 µs thereafter.

When the Model 926 is shipped from the factory, the Gate Input is set *Off*. To change the Gate Input mode, a SET_GATE command must be sent to the 926. In current releases of the MCA Emulation software, the SET_GATE command must be sent with a command file (DOS Emulator) or a Job File (Windows Emulator). If the DOS Emulator is being used, type the following at the DOS prompt to create a command file to set the Gate to *Coincident*.

COPY CON COIN.TXT↵
SEND_MESSAGE "SET_GATE_COIN"↵
<Ctrl-Z>↵

↵ is the Enter key, <Ctrl-Z> is created by holding down the Ctrl key and pressing the letter Z, and _ is the underscore character, on most keyboards it is created by holding the Shift key and pressing the minus key. To create a file to set the gate to *Anticoincident*, replace COIN in the example above with ANTI. To create a file to set the gate to *Off*, replace COIN with OFF. Once the command file has been created, the file must be PARSE'd. The PARSE program is on the disk with the DOS Emulator software. Issue the following command at the DOS prompt to parse the COIN.TXT file.

PARSE COIN↵

A similar command would be required to PARSE ANTI.TXT and OFF.TXT if they were created. To execute the command file, select **Run CMD File** from the MAESTRO **Services** menu, while looking at the MCB that is to be modified.

If Windows Emulator software is used, create a .JOB file as follows to set the gate to Coincidence:

1. Go to the **Services** menu.
2. Select **Job Control**.
3. Select **Edit File** (takes you to Notepad).
4. Type:
   SEND_MESSAGE"SET_GATE_COIN" ↵
5. Save as COIN.JOB then exit Notepad.
6. Refresh display by reentering **Job Control**.
7. Select COIN.JOB and click on **OK**.

To set gate to *Anticoincident* or to disable the GATE, replace COIN in Steps 4 and 5 with ANTI or

OFF. Refer to the software manual for more information on creating JOB files. The Gate Mode setting is stored in battery backed-up memory, so the command or job file need only be executed once, unless the battery fails.

4. MCA BASICS

This section of the manual contains some basic information about Multichannel Analyzers. ORTEC has taken the classical Multichannel Analyzer and partitioned it into two components: a Multichannel Buffer and a personal computer. The Multichannel Buffer (MCB) contains the circuitry required to create a spectrum while the personal computer is used for display of the spectrum and control of the instrument. The first half of this section describes the circuitry found on the Model 926 board (MCB) while the second half describes the dead-time effects encountered in an MCA.

4.1. MCB OPERATION

This section contains a very basic description of the input circuitry and the chain of events that occurs in the Model 926 when an input pulse arrives to be histogrammed. Figure 6 shows the basic block diagram of the input section of the 926 Multichannel Buffer. First a description of each block in the circuit:

- Buffer — The buffer is provided to properly match impedances between the input and the Model 926 circuitry.

- Linear Gate — The Linear Gate protects the peak stretcher during conversion of an event. When the Linear Gate is "open," its output is identical to its input. When the Linear Gate is "closed," its output is always zero.

- Peak Stretcher — The peak stretcher operates in one of two modes: Track or Hold. In Track mode, the output of the peak stretcher is identical to its input. In Hold mode, the peak stretcher acts like a maximum function. It outputs the maximum value which is applied to the input. The Peak Stretcher also has a Peak Detect output which goes active when its output is greater than the value at its input.

- Analog-to-Digital Converter — The Analog-to-Digital Converter (ADC) takes an analog signal and converts it to a digital equivalent.

- Zero-Level, Lower-Level, and Upper-Level Discriminators — The discriminators provide 3 control signals which help control the conversion process. The Zero-Level Discriminator (ZLD) is active, when the input signal is greater than 1/2 of the Lower-Level Discriminator setting. The Lower-Level Discriminator (LLD) is active, when the input signal is greater than the Lower-Level Discriminator setting. The Upper-Level Discriminator (ULD) is active when the input signal is greater than the maximum possible ADC output. The Lower-Level Discriminator settings is set with a screwdriver adjustment on the front panel.

- ADC Control — This circuit accepts all of the various status signals and provides the control signals required to complete a conversion.

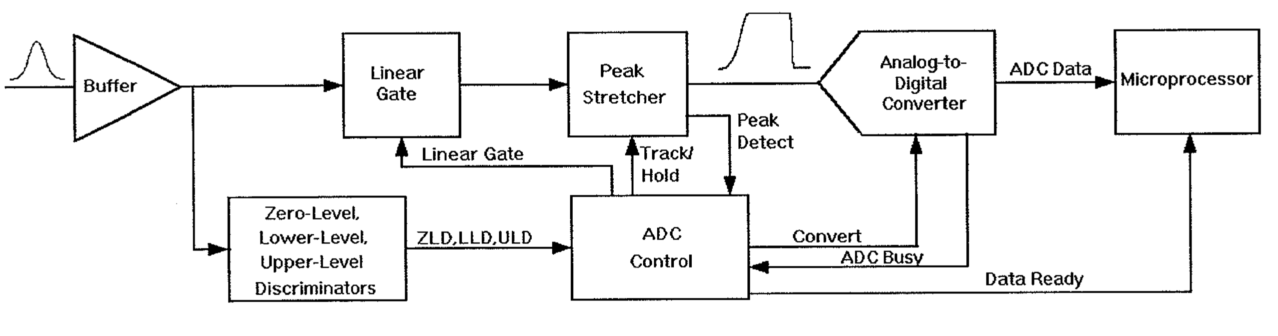


Fig. 6. TRUMP Input Block Diagram.

- Microprocessor — The microprocessor accepts the digital data and adds it to the spectrum.

Upon arrival of an input pulse, the sequence of events is as follows:

- ZLD goes active when the input reaches 1/2 of the LLD setting.

- When ZLD goes active, the peak stretcher is switched to Hold mode.

- When Peak Detect goes active, LLD, PUR, GATE, and ULD are sampled. If any of these signals rejects the pulse, then the Peak Stretcher is returned to Track mode. If the pulse is accepted, the Linear Gate is closed and the ADC is given the convert signal.

- When the ADC is finished converting, the data is transferred to the microprocessor for histogramming, the Linear Gate is opened, and the Peak Stretcher is returned to Track mode.

4.2. DEAD TIME IN MCA AND AMPLIFIER

When a detector, preamplifier, spectroscopy amplifier, and MCA are combined to form a spectroscopy system, the dead times of the amplifier and the MCA are in series (see Fig. 7). The combination of the amplifier extending dead time followed by the MCA non-extending dead time T_M yields a throughput described by:

$$r_0 = \frac{r_i}{\exp[r_i(T_W + T_P)] + r_i[T_M - (T_W - T_P)]U[T_M - (T_W - T_P)]}$$

The rate of events arriving at the detector is r_i, and r_o is the rate of analyzed events in the MCA spectrum. T_W is the width of the amplifier pulse at the noise discriminator threshold (Figure 7). T_P is the time from the start of the amplifier pulse to the point at which the MCA detects peak amplitude and closes the linear gate. $U[T_M - (T_W - T_P)]$ is a unit step function that changes from 0 to 1 when T_M is greater then $(T_W - T_P)$. T_M is the conversion time of the ADC and includes the time required to transfer the data to the subsequent memory.

The 926 Extended Live Timer utilizes the Gedcke-Hale method to correct for the dead-time losses implied by the equation above. When the counts in a full-energy peak are divided by the live time, the resulting counting rate is an accurate estimate of the true counting rate for that gamma-ray energy at the detector output. The Gedcke-Hale method uses the amplifier analog output, BUSY and PUR (Pile-Up-Reject) signals. The amplifier dead time is combined with the ADC conversion and readout dead time to obtain the overall system dead time. For accurate live time, the PUR and BUSY signals must be connected from the amplifier to the 926.

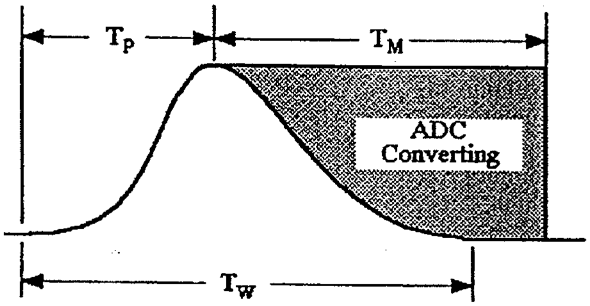


Fig. 7. The Sources of Dead Time with an Amplifier and MCA.

The Gedcke-Hale live-time clock works as follow:

- Either the leading edge of the amplifier BUSY signal or the crossing of the ADC Lower-Level Discriminator (LLD) by the ADC input causes the live-time clock to start counting backwards.

- The live-time clock is turned off by the ADC peak detect or by the amplifier PUR signal.

- The live-time clock resumes counting forward after all of the following signal conditions are satisfied:

  - .... The ADC conversion and readout is complete.
  - .... The ADC input has returned below the LLD threshold.
  - .... The PUR and BUSY signals have returned to the inactive state.

Turning off the live-time clock compensates for the probability of losing a second pulse during the processing of the first pulse. Subtracting live time compensates for the probability of losing two pulses when the second pulse distorts the amplitude of the first pulse.

5. TROUBLESHOOTING GUIDE

This section of the manual contains some troubleshooting hints to help when something goes wrong. Below are listed several common problems and possible solutions:

5.1. DUAL-PORT MEMORY DOES NOT EXIST

- Carefully review the instructions in the section labeled *MCB Address*. Ensure that the MCB address has been properly set.

- Look for conflicts in the computer memory space. The Model 926 uses addresses D000:0000-D000:FFFF when the Dual-Port Memory Interface is used. The following are known to conflict with this address space:

  1. EXPANDED MEMORY cards (not EXTENDED MEMORY).
  2. Some local area network (LAN) cards. Not all LANs conflict with the 926. Ones that do can usually be remapped to a different address space. See the information provided with the LAN card to change the addresses required.
  3. 16-bit graphics adapter cards (video cards). Most can be mapped to a different address space or switched to 8-bit mode to relieve the conflict.

- Check for proper software installation:

  1. If the EMM386 driver is loaded in the CONFIG.SYS file, it must have /X=D000-DFFF on the end of the line.
  2. If Windows software is used on the computer, the SYSTEM.INI file should have the following line in the [386Enh] section:
     EMMExclude=D000-DFFF
     Add the line with NOTEPAD if it is not present.

5.2. BATTERY BACKUP FAILS

The memory in the Model 926 has battery backup to maintain data when power is turned off. The battery used is a lithium battery with a nominal voltage of 3 V.

To replace battery: Remove the right-side plate. Locate battery on the top right corner of the 926 (see Figure 1). Remove the old battery from the holder and slide a new one in. It may be necessary to bend the battery holder down after removing the old battery to get good contact with the new battery.

BATTERY SPECIFICATION:
Type Lithium Coin Cell
Model Panasonic CR-2354
ORTEC Part Number 739480

APPENDIX A. SHARED MEMORY INTERFACE

The following section describes the Dual-Port Memory Interface. This chapter provides the necessary information required to write a program to communicate with the Model 926 via the Dual-Port Memory. A program to communicate with the 926 via the printer-port interface is much more difficult. Software toolkits are available from ORTEC to perform this function, so no description of the printer-port interface is given.

When the Dual-Port Memory Interface is used, it occupies one entire page of PC-Bus address space from D0000 to DFFFF hex, plus one PC I/O port, port number 292 hex. The following sections describe how to communicate with a 926 through the shared memory interface. The shared memory interface is implemented on most ORTEC multichannel buffers, so software used to communicate with the 926 board will also function with most other ORTEC MCBs.

A.1. PAGE SELECT PORT

The page select I/O port selects one of up to 16 different pages of MCB memory which can be mapped to the shared memory page of the PC. The first eight pages of MCB memory are data memory pages that correspond to MCBs 1 through 8, respectively. The last eight pages are mailbox pages that correspond to the same MCBs (1 through 8) as the eight data memory pages. For example, when a binary 0 is output to the page select port, MCB 1 (the first MCB) data memory is mapped to the shared memory page. When binary 8 is output to the page select port, MCB 1 mailbox is mapped to the shared memory page.

```
/* Wait for MCB response */
        time(&start_time);
        time(&present_time);
        while ((*mcb_inflg == FALSE) && (present_time - start_time < 5))
          time(&present_time);

        if (present_time - start_time >= 5) {
          printf("MCB not responding\n");
          strcpy(resp_buf,"err");
          return(resp_buf);
        }

/* Get number of characters in response and read */
        num_chars = (int)*mcb_inlenlo + 256 * (int)*mcb_inlenhi;
        memset(resp_buf,'\0',512);
        for (counter = 0; counter < num_chars; counter++)
          resp_buf[counter] = *(mcb_inbuf + (2 * counter));

/* reset input buffer flag and return response address  */
        *mcb_inflg = FALSE;
        return(resp_buf);
```

APPENDIX D. GLOSSARY

ACQUISITION
The process of collecting data from a detector and storing the data in memory.

ALARM RESPONSE RECORD
The response record that is sent to the host computer when one or more devices are stopped.

ASCII
American Standard Code for Information Interchange. The ASCII code is defined by ANSI (American National Standards Institute) Standard X3.4 - 1977. This standard describes the representation of characters as 8-bit binary numbers. This representation for characters is used by most mini and personal computers.

CHECKSUM
The sum of bytes in a record used to detect when communication errors occur.

CLOCK
A component of a device that keeps track of some form of time. 926 MCBs have live-time and true-time clocks.

COUNTER
Another name for a 926 clock (live-time or true-time).

DEAD TIME
The time that data acquisition is active but the MCB cannot process detector pulses (is dead). Dead time is equal to the true time minus the live time for a device.

DEVICE

The entity within an MCB that collects and stores spectral data. A device corresponds to the MCB's inputs. Model 919 MCBs have 4 inputs and thus 4 devices, while 926 MCBs have only 1 input and thus 1 device. A device can be started, stopped, cleared, and selected.

HOST

The computer that sends commands to an MCB and receives responses from the MCB.

LIVE TIME

The time that data acquisition is active and the MCB is capable of processing detector pulses (is live). Live time is equal to the true time minus the dead time for a device.

MAILBOX

A portion of the 926 shared memory that is used for communication with a host computer by techniques discussed in Appendix A: Shared Memory Interface.

PRESET

A limit set for a clock or region-of-interest count that if exceeded during an acquisition will cause the acquisition to stop. 926 MCBs have live time, true time, ROI integral, ROI peak, and overflow presets for each device in the MCB.

PROGRAM MEMORY

The ROM memory inside the 926 MCB that contains the microprocessor instructions and fixed data that control the operation of the MCB.

RAM

Random Access Memory.

RECORD

A sequence of related bytes. 926 command, percent, and dollar records are composed of printable ASCII characters and end with an ASCII carriage return.

ROI CHANNEL

A channel that has the ROI flag set.

ROI FLAG

A set of internal MCB flags (one for each channel) which, when set, identifies the channel as being part of the region-of-interest. All channels in a device that have the ROI flag set are considered when ROI integral or ROI peak presets are evaluated.

ROM

Read-Only Memory.

SCRATCHPAD MEMORY

The RAM memory inside the 926 MCB that is used for various overhead operations. The scratchpad memory is all the memory that is not used for storage of spectral data or mailbox communications.

SEGMENT

A subdivision of a device. Segments are not implemented on 926 MCBs and are referenced only for compatibility with other MCBs.

SELFTEST

A test of internal MCB components initiated by the TEST command or MCB power-up.

SHARED MEMORY

A block of RAM memory that is shared by the 926 MCB and the host computer. This memory contains the spectral data for each device in the MCB as well as a mailbox used for communicating commands and responses. See Appendix A: Shared Memory Interface, for more information.

TICK

The minimum unit of time associated with a clock such as the real-time or live-time clocks — a clock tick.

TRUE TIME

The actual time that data acquisition is active regardless of the MCB's ability to process detector pulses. True time is also known as real time.

WINDOW-OF-INTEREST

The continuous group of channels affected by commands like CLEAR and SET_DATA. The window-of-interest is set by the SET_WINDOW command, as well as by the SET_DEVICE and SET_SEGMENT commands.

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