SERIES 35 PLUS MULTICHANNEL ANALYZER

1288A

Operator's Manual
Version 2

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Series 35 PLUS Manual
Addenda

Serial Port Baud Rate

The Series 35 PLUS's standard RS-232 Serial Port has been factory set for 9600 baud. If you need to change the baud rate, refer to Appendix A.5.

Enabling the Gate Mode

With the current ADC board, the ADC will be enabled with an open GATE input in both the coincidence and anticoincidence modes.

Section 2.6, GATE, last paragraph. Add the underlined text.

> In the Anitcoincidence Mode, the logic is reversed. That is, a low logic level <u>or open input</u> will enable the ADC and a high level will disable the ADC.

Changes for Firmware Version V3.0

Besides saving spectral data, the MCA's data collection mode is now saved as well.

> Section 2.2, System Reset -- omit last paragraph
> Section 4.20, MCSR -- omit second paragraph
> Section 4.26, PHA -- omit second paragraph

Formerly, the Tag Number was incremented with each readout. In V3, the Tag Number is incremented with each Collect instead.

> Section 5.1, Data Readout
> Tag Number -- change last sentence to read:
> "The Tag Number increments by one at the end of each Collect cycle."

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The Series 35 PLUS is offered with data memory of 2048, 4096 or 8192 channels. Memory storage in RAM can take place in the full memory, either half of the memory or any quarter of the memory as selected by the operator. Data storage may be either in the Pulse Height Analysis (PHA) mode, the Sampled Voltage Analysis (SVA) mode, or the Multichannel Scaling (MCS) mode. For both PHA and MCS, the data may be added to or subtracted from the memory.

The display section of the Series 35 PLUS directs the data in the memory to the large screen display and organizes it in readily understood format. The operator is supplied with a clear picture of the spectral data in memory and with appropriate information in alphanumeric form as an aid in interpreting the data displayed.

The signal processing section includes a preamplifier/amplifier that may be configured by the operator to accept either charge-sensitive input signals or voltage-sensitive input signals, depending on the type of detector to be used. The signals are passed to an Analog-to-Digital Converter (ADC), which converts the input linear signals to digital form and routes them to the appropriate memory location for storage and subsequent display, analysis and readout.

The operator/MCA interface allows the operator to direct the tasks of the MCA by means of the settings of the control switches and pushbutton keys on the front panel. The operator's instructions are routed through the keyboard interface to the RAM section of the memory by way of the microprocessor and the 3500 bus.

The input/output (I/O) section controls the data flow between the RAM section of the memory and the various peripheral devices. As a standard feature, this section includes the I/O interfacing needed to handle current-loop (Teletype, a registered trademark of Teletype Corporation) and either EIA RS232 devices or the Canberra Model 5421M Cassette Recorder.

Provision is made for the operator to read prerecorded data into the memory as well as reading data out of the memory in the operator's choice of: full, half or quarter memory; any Regions of Interest, as specified by the operator.

By dividing the MCA's full range of operating features and analysis functions between several sections controlled by a high-speed microprocessor, the Series 35 PLUS has been made into an instrument that is well suited to both basic and advanced nuclear analysis needs.

1.2 APPLICATIONS

From a data acquisition point of view, all Series 35 PLUS Multichannel Analyzer applications can be placed into one of two categories: Pulse Height Analysis (PHA) or Multichannel Scaling (MCS). These two analysis modes and their applications are discussed in the following sections.

This same data is then shown in histogram form in figure 1.3, where the horizontal axis divisions correspond to the voltage divisions on the original signal. It is this type of pulse height distribution analysis that is performed by the Series 35 MCA during PHA mode data acquisition.

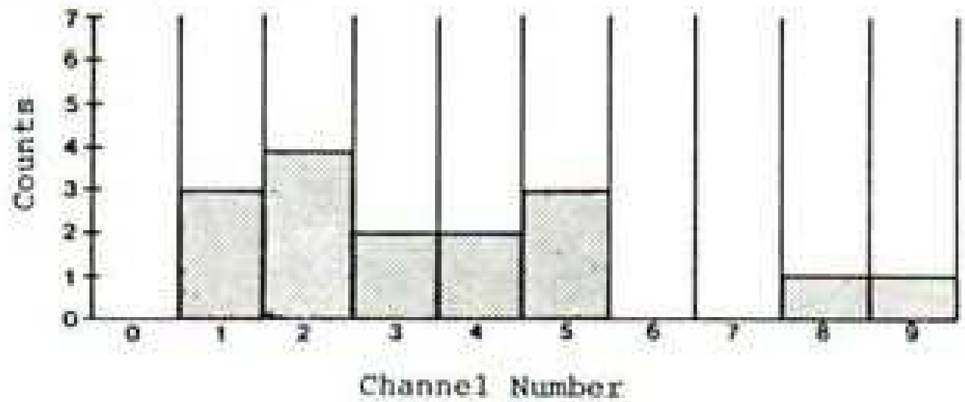


Figure 1.3
PHA Histogram

The primary application of PHA operation is in the quantification of the output signals from the class of radiation detectors whose output is a current or voltage pulse proportional in amplitude to the energy absorbed by the detector. Typical of such detectors are Scintillation detectors such as NaI (Tl), Semiconductor detectors such as Ge, HPGe, Si(Li), and Gas Proportional detectors.

A common characteristic of all these detectors is that each current or voltage pulse produced by the detector corresponds to the energy deposited by an individual photon or particle. Since the nuclear or atomic decay which generates the incident radiation is a randomly occurring process, the pulse train from the detector to the Series 35 PLUS is a time-random mixture of pulses of all possible amplitudes.

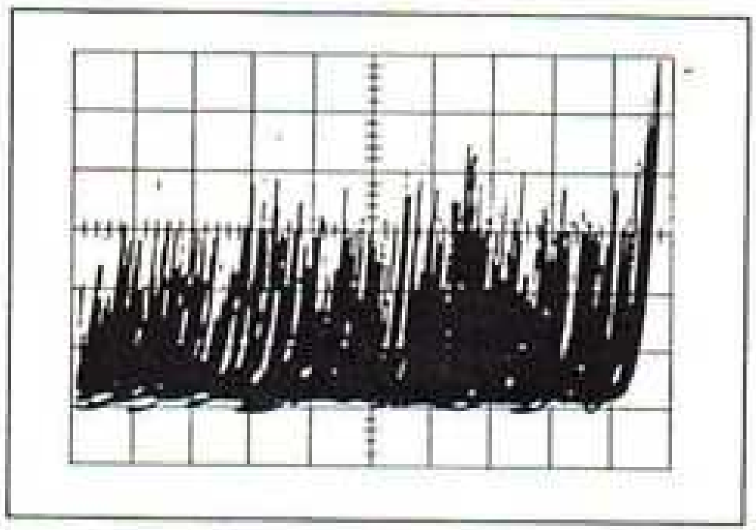


Figure 1.4
Voltage Train Output
from a Ge detector

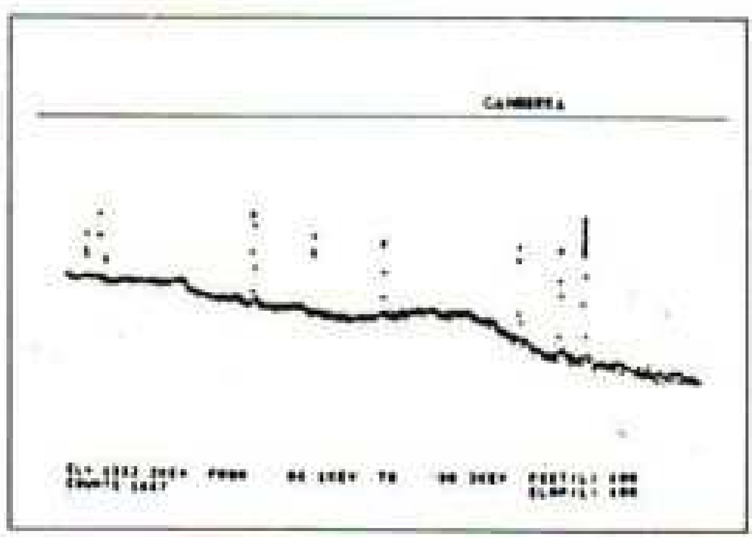


Figure 1.5
Resultant PHA
Histogram

The job of the Series 35 PLUS, in PHA operation, is to sort this pulse train by amplitude and store the resultant spectrum. This can be seen graphically in figures 1.4 and 1.5, where both the detector output and PHA histogram for a mixed gamma source are shown.

The 1024 channel histogram shown in figure 1.5 is directly analogous to the ten channel histogram in figure 1.3 but is of far greater resolution. That is, the input pulses have been sorted into 1024 discrete amplitude levels rather than just ten levels. Each point in the figure 1.5 display represents the number of counts accumulated in one particular channel; it is still a pulse height distribution histogram.

From an analytical point of view, a PHA distribution histogram (spectrum) can provide both qualitative and quantitative results. Since channel number corresponds to input voltage, and input voltage corresponds to the energy of the radiation striking the detector, the energy of any peak in the spectrum can be easily determined; and from the energy (or energies) present one can determine the source.

The spectrum can also yield quantitative data. Since all measurements of radiation intensity are based upon the number of events per unit time, one need only divide the number of occurrences of a given energy by the total acquisition time to get a measure of the activity present. This is, of course, an oversimplification, since there are many other physics-related factors that must also be considered. But conceptually, the principle of "counts divided by time" is valid.

1.4 True Time

Because of this, when operating in PHA mode, the Series 35 PLUS stores acquisition time along with the spectral data. Channels 0 and 1 of the Series 35 PLUS's memory are reserved for the time storage function. Channel 1 stores true (real) time.

1.5 Live Time

The time value stored in channel 0 is generated by a special circuit called a "live time clock", and the value accumulated is called the "live time". The need for this special time circuit can be seen by examining in closer detail the operation of the Series 35 PLUS PHA in relation to the input pulse train.

From a time standpoint, the input pulse train is totally random in nature. Therefore, since it does take the analog-to-digital converter (ADC) a finite amount of time to convert a pulse amplitude into a channel number, some pulses will arrive at the ADC only to discover that it is busy processing the previous pulse. The ADC is effectively "dead" and this datum (pulse) is lost.

1.6 DEAD TIME

Because of this "dead-time" phenomenon, a time correction circuit is required to compensate for the fact that the number of input pulses per unit time can vary considerably from the number of events stored per unit time.

This time correction circuit, called the "live time clock", extends the total elapsed counting time to compensate for the percentage of time that the ADC is "busy". This circuitry can be seen in operation via the Percent Dead Time bar-graph at the top of the Series 35 PLUS's display.

For PHA operation, the primary goals are, therefore, the ability to measure the distribution of input pulse heights and to keep track of the system live counting time. The time function is automatically handled via the live time clock and requires no parametric input. However, the Series 35 PLUS does provide several methods for modifying the parameters of the pulse height distribution function.

1.7 ADC GAIN

One of the factors affecting the generation of a pulse height distribution histogram is the system resolution; that is, the number of discrete voltage levels--or channels--into which the input pulses will be sorted. In ADC terminology, this is called the ADC Conversion Gain. For example, our initial histogram (in figure 1.3) used ten separate one-volt levels for sorting; it had an ADC Gain of 10.

For most PHA operations, the intent is to analyze the input voltage over its entire 0 to 10 volt range. To do this with maximum resolution, the ADC Gain is set equal to the Memory Size. For a 4096 channel (4K) memory, this corresponds to an ADC Gain of 4096.

Alternatively, an ADC Gain of 2048 channels would allow two separate spectra to be stored in either half of the 4096 channel memory.

1.8 DIGITAL OFFSET

For situations requiring greater resolution, the Series 35 PLUS ADC provides an ADC Gain of up to 8192 channels. However, since a 4K memory provides only 4096 channels of storage, only a portion of the input voltage range can be examined at one time using the 8192 channel ADC resolution.

If one were interested only in the first five volts of the zero to ten volt input range, the experiment's setup would be quite straight-forward, as shown in figure 1.6. Pulses below the five volt (channel 4096) level are converted and stored; those above are ignored.

But what if the objective is to analyze those pulses in the five to ten volt range: how can this be accomplished? It is in this situation where the value of ADC Offset can be seen.

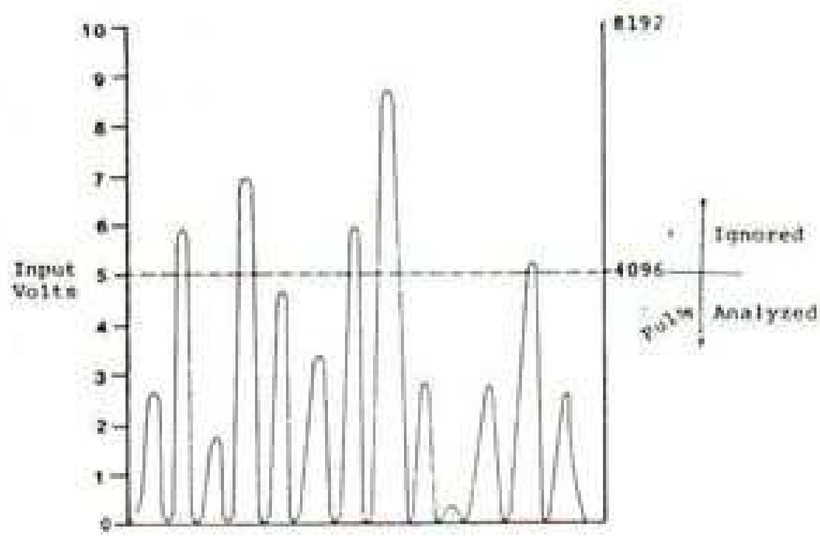


Figure 1.6
Effect of 8K Gain and 4K Memory

Up to this point, it has been assumed that ADC channel numbers and memory channel numbers are the same. In reality they are independent, and it is the ADC Offset control which establishes their relationship.

When the ADC and memory channel numbers are the same, the ADC Offset is said to be zero. This relationship can be shifted linearly via the ADC Offset control.

For example, to analyze the upper five to ten volt range of the input using a 8192 channel ADC Gain and a 4096 channel memory, what is needed is to "shift" the zero channel of the memory to correspond to channel 4096 of the ADC. In other words, an ADC Offset of 4096 channels is required.

The Series 35 PLUS includes 32 different ADC Offset settings to allow the selection of the optimum value for any given situation.

1.9 MULTICHANNEL SCALING

MCS analysis yields a histogram representing number of events (radiation intensity) versus time. Just as in PHA, the input signal is a train of pulses, each representing a single event. However, MCS analysis does not concern itself with the amplitude of these pulses; the data stored is simply the number of individual pulses which were received in a given period of time.

As pulses are detected at the input of the Series 35 PLUS, MCS mode operation counts them one-by-one into the current memory channel for a predetermined period of time. At the end of this time period, which is called the dwell time, the MCS time base advances to the next memory channel address. Pulses are now counted into this channel for the dwell time period. Each memory channel is thus sequentially selected as a function of time.

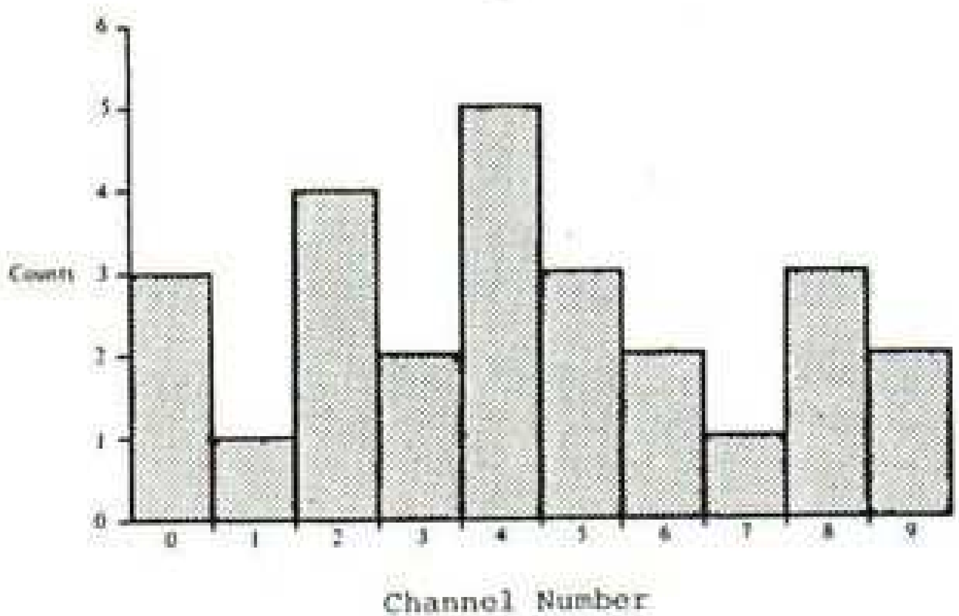
1.10 MCS HISTOGRAM

This operation can be seen in a simplified form in figures 1.7 and 1.8. The input pulse train in 1.7 would generate the histogram shown in 1.8. Note that an MCS analysis produces an integral histogram; each channel represents the summation of all counts within the given time period and not the instantaneous count rate.

MCS analysis finds use in several applications involving the study of the distribution of events as a function of time. One such application is the study of nuclear decay; the resultant MCS histogram represents the exponential decay curve.

Figure 1.7
MCS Input
Pulse Train

Figure 1.8
MCS Histogram



1.11 MÖSSBAUER SPECTROMETRY

Many other applications--such as Mössbauer spectrometry--involve the synchronization of the MCS scan to an external device. In this case, the time axis really relates to an external device position or condition, such as source velocity in the case of Mössbauer work.

1.12 DWELL TIME

For all applications an appropriate dwell time must be selected prior to the analysis. Several factors can influence this choice.

1. Desired time for the entire scan.
2. Number of channels to be used for data storage.
3. Desired counting statistics (number of counts per channel).
4. Operating rate of an external device.

In many cases, several of these criteria may be incompatible. For example, the sweep rate of a Mössbauer spectrometer may be too rapid to allow collection of adequate statistics in a single data acquisition scan. For these situations the Series 35 PLUS provides for multiple MCS cycles, which allows recurring MCS acquisition sweeps.

Depending upon the external device being used, it may be necessary to synchronize these recurring sweeps to the mechanical motion. The standard External Control/Mössbauer Wiring provides this capability.

SECTION 2
BASIC SERIES 35 PLUS OPERATION

This section describes the operation of the Series 35 PLUS, its data collection modes, and its basic dialogue rules.

2.1 POWER ON

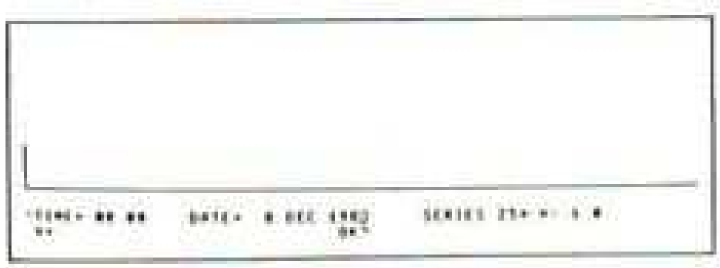
Power is applied to the Series 35 PLUS with the ac power switch on the Analyzer's rear panel. Before applying power, check the voltage selection card inside the fuse compartment on the rear panel. This is easily done by moving the plastic fuse shield to the left and looking directly under the fuse; the operating voltage will be visible. To change the operating voltage, refer to Appendix A.1.

The Analyzer will be set for either 50 Hz or 60 Hz operation. To change the line frequency, refer to Appendix A.2.

The intensity of the display is controlled by the INTENSITY potentiometer located to the right of the display screen. A few seconds after power on, the display will appear and will look as shown in figure 2.1. The time and date shown are the clock's last readout when the power was turned off.

Note: In an Analyzer with a Model 3571, 3572, or 3573 interface, the display of figure 2.1 will not be seen at power on if the rear panel control switch is in the REMOTE position.

Figure 2.1
Initial Display



Note that the LED indicator for PHA+ on the Control Panel is illuminated. The Analyzer's default state assumes that the most common operating mode will be used; changing these modes is done by pressing a pushbutton for another mode. See section 4 for examples.

The usual first step after power is applied is the setting of the clock and the calendar to current values. The procedure for entering new values is:

1. Using the numeric keypad, enter the correct time in the form Hours.Minutes on a 24-hour basis. Note that the value is first entered in the X Register.

2. If an error is made in the entry, the CLR (clear) key on the keypad can be used to erase the value of X. A new value may then be entered in the X Register.

3. Press STORE on the keypad to transfer the entry from the X Register to the TIME variable.

4. Press NO to move the * to DATE and enter the new value for the date in the form DD.MM.YY and press STORE. Note: The year must be entered using the year's last two digits only. That is, 1984 is entered as 84.

5. Press YES (in answer to the question OK?) to have the new values accepted. The system's normal display will appear.

Note that the clock does not run when ac power is off. When ac power is restored, the clock will show its last reading as of power off time.

2.2 SYSTEM RESET

Associated with the INDEX and HOME keys is the System Reset command. The command is issued by simultaneously pressing these two keys.

Issuing a System Reset command aborts any operation in progress but does not alter any time or data information nor does it alter any operator-set parameters.

System Reset does not normally need to be used to abort an operation because most operations can be terminated simply by turning the function off.

Performing System Reset causes the display to revert to the initial power-on display seen in figure 2.1. It can be used to check the status of the system time and date clock and the system's firmware version. Answering YES to the question OK? will return the system to the normal display.

Note that System Reset causes the system to return to the PHA+ mode from any other data acquisition mode previously selected.

2.3 BASIC DIALOGUE PROCEDURES

The brief process of entering the current time and date, described in section 2.1, illustrates many of the basic dialogue "rules" common to all Series 35 PLUS operations. As the remainder of the manual is read, many additional examples will be seen. The following is a summary of those rules which are, in general, applicable to any dialogue sequence.

1. If a dialogue sequence is capable of accepting a numeric parameter, the X Register (X=) will be displayed on the lower left portion of the CRT.

2. During the entry of a numeric parameter, it is displayed as it is typed in the X Register. Errors may be corrected by pressing CLR and re-entering the value.

3. Touching STORE causes the entry in X to be evaluated and transferred to the parameter field being modified.

4. A numeric entry, up to 16 displayed characters, can be entered as an arithmetic operation. For instance, 5120 can be entered as X = 4096 + 1024. This entry will be evaluated and stored as 5120 when the STORE key is pressed.

5. The parameter field currently selected for modification is the one adjacent to the blinking *. To select a different parameter for modification, the blinking * must be moved to the desired parameter field.

6. When several choices are listed on a line, touching NO moves the blinking * to the next parameter on the line.

7. When the question NEXT? is displayed, pressing YES will mean "what is displayed is acceptable; go on to the next step." When the question OK? appears, YES will mean "I agree, end the dialogue."

8. If a dialogue procedure is aborted (by turning off the function rather than answering all questions), all original values are maintained as if the function was never started.

9. An illegal entry will generate an error message. To proceed, touch CLR on the numeric keypad and enter the correct value.

10. Under some conditions, a numeric display may show a series of "greater than" signs (>>>>). This indicates that the number is too large for the display field but will be correctly stored in memory.

The Series 35 PLUS also offers an additional operating characteristic that most users will find very beneficial after some "hands on" experience is gained: Function Type-ahead. That is, as keys are pushed, the code for each is stored in list (on a First In, First Out basis) and then retrieved in sequence for execution.

This allows an operator who is familiar with a procedure to quickly touch all needed keys, in the correct sequence, without waiting for the displayed dialogue to "catch up".

2.4 LED INDICATORS

Many of the front panel keys have a built-in light-emitting diode (LED) indicator to show the status of the associated function.

When any key is pressed, the function is enabled, and the LED, if there is one, is illuminated to show the status of the function. Pressing the key a second time will disable the function, turn off the LED, and abort any process that was initiated when the function was enabled.

Note that any prerequisites must be fulfilled before some of the functions can be enabled. For example, OVLAP cannot be enabled unless the MEMORY switch is in a position other than 1/1.

2.5 SIGNAL CONNECTORS

There are three BNC-type signal connectors at the upper left corner of the rear panel (figure 2.2). Two of these, labeled ADC IN and AMP IN, are analog signal inputs. The other connector, labeled GATE IN, accepts logic signals to condition the ADC to either accept or reject analog signals for conversion. See section 2.6 for information concerning use of the GATE input.

Figure 2.2
Signal Connectors

The AMPlifier INput can route signals from an external preamplifier to the internal amplifier or from a detector to the internal preamplifier (See section 2.7). The ADC INput accepts 0 to 10 V signals from an external amplifier which can then be processed by the ADC.

The adjacent ADC IN switch must be in the correct position for the input connector used. The AMPlifier position allows signals from the internal amplifier to be routed to the ADC; the EXTernal position connects the ADC INput connector directly to the ADC, bypassing the internal amplifier.

Care should be taken to keep the signal cables away from the display because it is possible for the display to induce noise on the input lines.

2.6 GATE

The GATE function allows the operator to enable or disable the ADC for acceptance and conversion of linear signals at its input. Depending on the criteria for the experiment in progress, the operator may use the GATE input in the factory-set coincidence mode or may change the function to the anticoincidence mode by moving a jumper on the ADC board (see Appendix A.3).

In order for the linear input signal to be considered by the ADC, it must be coincident in time with the GATE input signal.

In the Coincidence mode:

1. A low logic level (0 to 0.8 V) at the GATE connector will disable the ADC. It will neither accept nor process any linear signals while the GATE is low.

2. A high logic level (2.5 to 5.5 V) at the GATE connector will enable the ADC. It will accept and convert all linear signals received while the GATE input is high.

3. If the GATE input is left open (unconnected), the ADC will act as if the GATE Input is high and will accept and convert all linear signals received.

In the Anticoincidence mode, the logic is reversed. That is, a low logic level will enable the ADC and a high level (or an open input) will disable the ADC.

2.7 INPUT MODE

The Series 35 PLUS is factory-set to accept voltage pulses from an external preamplifier. These inputs signals are routed from the AMP IN connector to the internal amplifier.

The Analyzer can accept charge inputs directly from a detector, as in the charge-sensitive setup in section 3.1, by moving a jumper on the ADC Board (see Appendix A.3). Moving the jumper will route the AMP IN signals to the internal preamplifier before they are passed to the amplifier.

2.8 POSITIVE/NEGATIVE INPUTS

In the Voltage sensitive input mode (only), the Analyzer is factory-set for Positive-going input signals. See Appendix A.3 for instructions on accepting negative-going signals.

2.9 SAMPLED VOLTAGE ANALYSIS

In the Sampled Voltage Analysis (SVA) mode, analog voltages (dc or slowly changing ac voltages) can be sampled by the ADC, resulting in an amplitude distribution curve. The input signal must be a 0 to +10 volt signal and must fall between the settings of the LLD and ULD controls to be considered.

The GATE input is used as the sampling signal, which must be coincident with the voltage to be sampled.

To use the Analyzer in the SVA mode, the factory-set PHA jumper on the ADC board must be changed to the SVA position. See Appendix A.3. To return the Analyzer to the PHA mode, the jumper must be restored to the PHA position.

2.10 DEAD TIME

Any signal that is present at the input during the time that the ADC is processing a previous signal is ignored by the ADC. This is because the ADC is busy converting that previous signal and cannot accept another input until finished with the first. This busy time is referred to as the Dead Time.

The Dead Time is shown on the Series 35 PLUS's display as a bar graph, as in figure 2.3. It is displayed only in the PHA COLLECT mode.

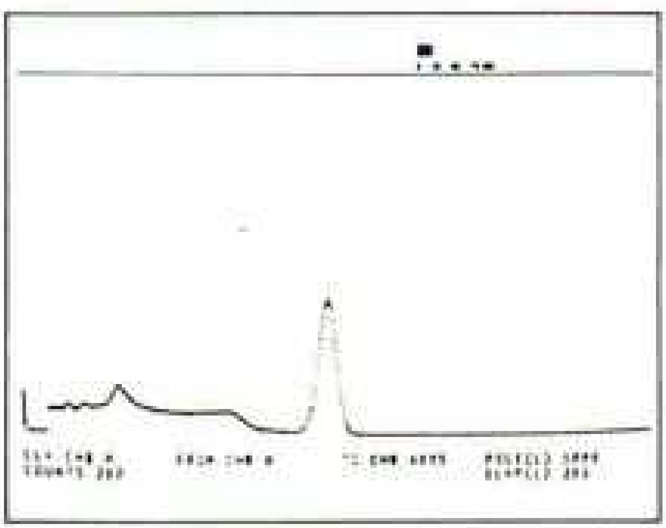


Figure 2.3
Typical Spectral
Display

SECTION 3
USING PHA AND MCS

This section will outline three experimental setups using the Series 35 PLUS and either a charge-sensitive input (from a scintillation detector, such as Canberra's Model 802 series) or a voltage-sensitive input (from any other type of detector).

See Appendix A.3 for instructions on changing from one type of input to the other. If a scintillation detector is connected to an external preamplifier the preamp's output can be connected to the Series 35 PLUS as a voltage sensitive input.

3.1 SETUPS

For a charge sensitive input, the following equipment, or equivalent, will be required:

- Series 35 PLUS Analyzer
- Model 3100-01 or Model 4261 High Voltage Power Supply (HVPS)
- Model 802 series Scintillation Detector
- Model 2007 Photomultiplier Tube Base
- Cables for interconnection as shown in figure 3.1

Figure 3.1
Charge Sensitive
System Setup

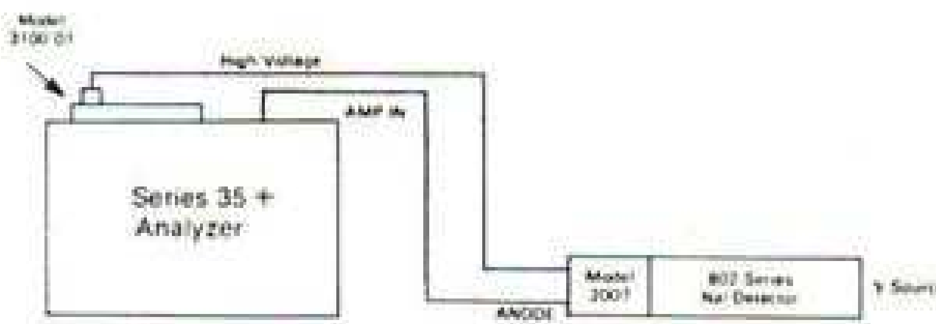
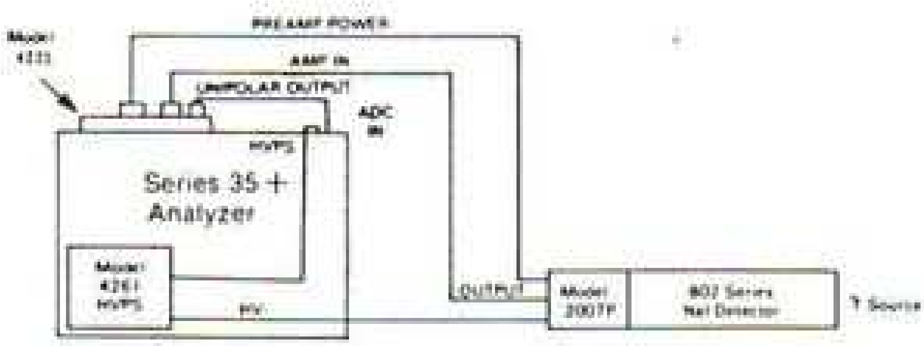


Figure 3.2
Voltage Sensitive
(NaI) System Setup



For a voltage sensitive input, the following equipment, or equivalent, will be required:

- Series 35 PLUS Analyzer
- Model 4261 High Voltage Power Supply (HVPS)
- Model 4225 Spectroscopy Amplifier. Note: NaI detectors can use the internal amplifier
- A Ge detector with a Model 2001 Preamplifier or a Model 802 Detector with a Model 2007P Preamplifier
- Cables for interconnection as shown in figure 3.2 or figure 3.3.

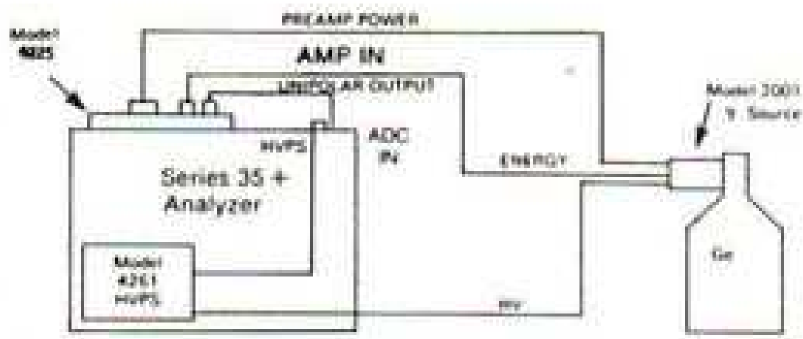


Figure 3.3
Voltage Sensitive
(Ge) System Setup

3.2 PHA DATA ACQUISITION

Initial Control Panel Settings:

ADC IN SWITCH	EXT for figures 3.2 and 3.3 AMP for figure 3.1
VERTICAL RANGE	1K or LOG
MEMORY	1/1
ADC GAIN	2048 (for Model 3501)4096 (for Model 3502) 8192 (for Model 3503)
ADC OFFSET	None: all switches down.
SCA LLD	0.20
SCA ULD	Fully clockwise
MODE	PHA+ (default state).

1. Turn on the Series 35 PLUS with the ac power switch, set time and date if desired, and press YES.

2. Turn on the HVPS with its separate switch.

3. Set the HVPS to the correct operating voltage for the detector being used.

4. Place a radioactive source near the face of the detector.

5. Press COLLECT to start data acquisition. Note that the LED indicator is illuminated in the COLLECT pushbutton, showing that acquisition is in progress. Note the Dead Time meter displayed at the top of the screen.

6. Adjust the AMPLIFIER GAIN so that the spectrum (data being displayed) is positioned conveniently on the screen.

7. Pressing CLEAR DATA repeatedly while adjusting the AMPLIFIER GAIN will aid in positioning the spectrum.

8. Allow the data to accumulate for a few minutes.

9. Press COLLECT again to stop acquisition. Note that the LED indicator is no longer illuminated.

3.3 DATA MANIPULATION

To see the effects of some of the front panel functions:

1. Change the MEMORY switch to 1/4.

2. Press XFER. The Analyzer displays two quarters with the upper data offset by 20% above the lower data. The dialogue asks if the operator wants to transfer Q#3 to Q#1 (memory quarter number three to memory quarter number one).

3. Press YES to enable the transfer. Note that the upper data trace is no longer displayed and the data has been copied into the memory section being viewed (Q#1).

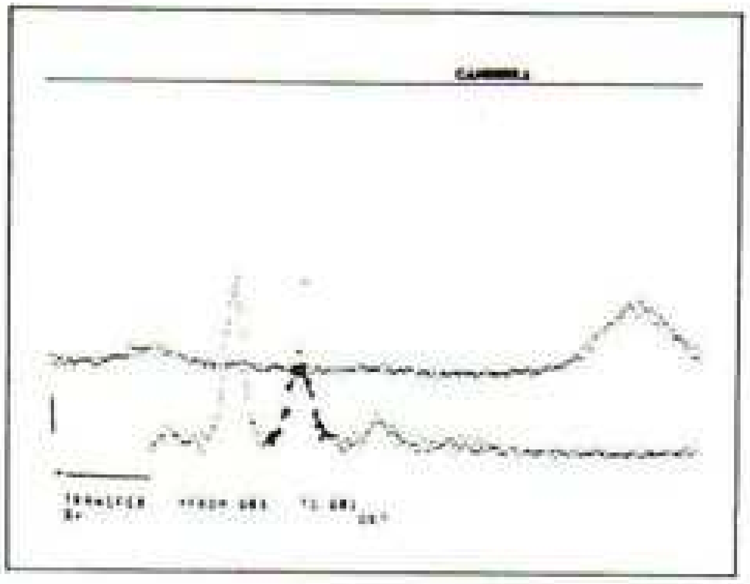


Figure 3.4
XFER Display

4. The cursor is moved by turning the Variscan control knob (SCAN) below the display. Turning the knob clockwise moves the cursor to the right; turning the knob counter-clockwise moves it to the left.

5. Move the cursor to the left side of a spectral peak, then press ENTER ROI. SCAN the cursor to the right side of the peak. Note that the peak's data points are intensified as the cursor moves through them.

6. Stop scanning and press ENTER ROI once more to disable the function. A Region of Interest has now been entered around the peak.

7. Repeat steps 5 and 6 for several more peaks.

8. Press INDEX and watch the cursor jump from the beginning of one ROI to the beginning of each succeeding ROI in turn. Note that the cursor will index from the last ROI in the spectrum to the first ROI.

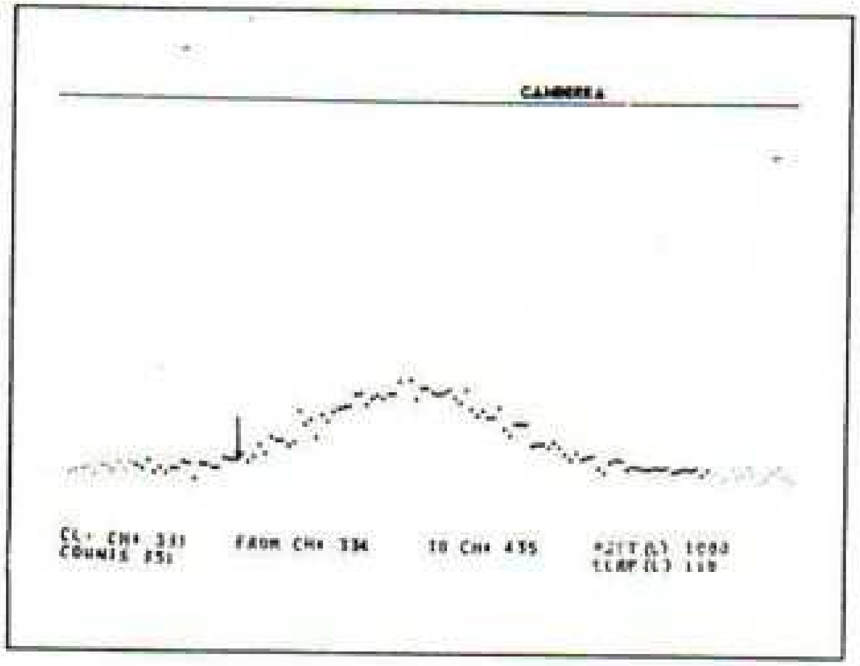


Figure 3.5
WINDOW Display

9. Press WINDOW to see the display change to include only 128 channels.

10. Press ROLL and then SCAN the cursor to the right. Note that the cursor stays at the same point in the display and the data appears to move to the left as the 128-channel Window is scanned to the right through the spectrum.

11. Press WINDOW again to disable the function. Note that the ROLL function is disabled simultaneously.

12. Press INDEX to move the cursor to an ROI.

13. Press AREA/INTEG and note that the area's histogram bars are displayed. The value of the net area is shown at the bottom of the screen, as is the value of the ROI's integral. (The Glossary defines these terms.) Disable AREA/INTEG.

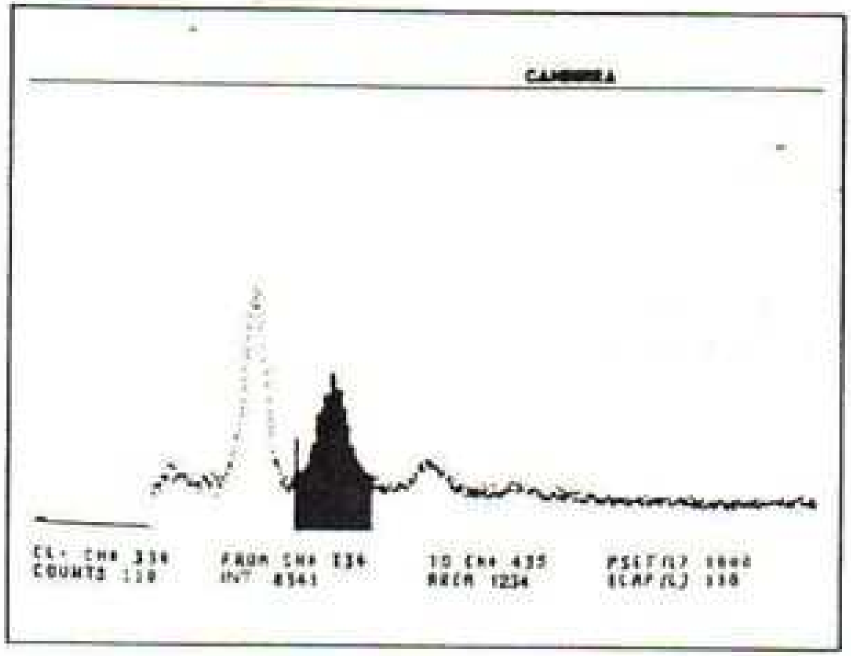


Figure 3.6
AREA/INT Display

14. The data displayed in Q#1 can be read out to a peripheral device by using the READ OUT function. See section 5, Input/Output, for instructions.

15. Press HOME. Note that the cursor has returned to channel 0, the first channel of the displayed segment.

16. Press CLEAR TIME. Look at the counts displayed for channel 0 (CL counts) and the ELAP (L) on the lower part of the display. Both should now read 0 (time has been cleared from memory). No data channels are affected by this function.

17. Press CLEAR DATA and note that all data has been cleared from memory. This function clears only the displayed section of memory; other sections are not affected. If CLEAR TIME had not been performed in the last step, pressing CLEAR DATA would have reset the two time channels, as well as all of the displayed data channels, to zero.

3.4 MCSR DATA ACQUISITION

To see the effect of MCSR operation, use the same setup and control settings as for the preceding PHA experiment.

1. If there are data in the memory, press CLEAR DATA.

2. With the sample near the face of the detector, press COLLECT.

3. Increase the LLD control setting until no pulse storage takes place below the energy of interest, such as one or more of the peaks. Repeatedly pressing CLEAR DATA while increasing the LLD control will aid in finding the desired setting.

4. Lock the LLD control, press COLLECT to stop acquisition and press CLEAR DATA to clear the memory.

5. The ULD control can be decreased in the same manner if data acquisition is not wanted above a specific energy level.

6. Press MCSR to change the analyzer to the MCSR+ mode.

7. Press COLLECT and observe the type of data displayed as a result of this different type of acquisition. Figure 3.7 shows a typical MCSR spectrum.

8. Press COLLECT to stop the MCSR sweeps.

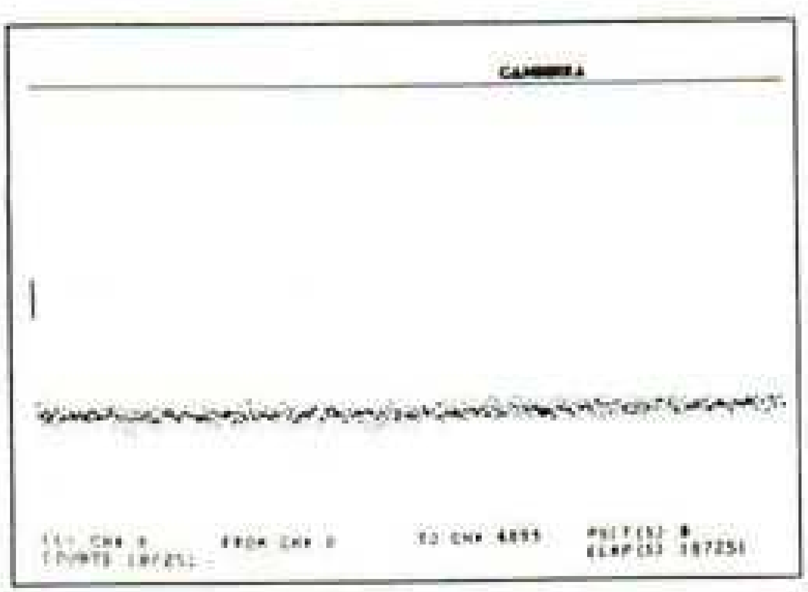


Figure 3.7
MCSR Display

SECTION 4
FRONT PANEL CONTROLS

All of the operator's controls for the Series 35 PLUS are located on the front panel, except for the Model 3573's Remote/Local switch, which is on the rear panel.

This section starts with a description of the keypad, then lists all of the other front panel controls alphabetically.

The controls for optional functions are listed separately. Section 7 covers the Model 3541 Define/Use/Ap-Pak option and section 8 covers the Models 3543 Isotope Analysis and 3544 X-ray Analysis options.

4.1 KEYPAD

The KEYPAD comprises ten digits, four arithmetic operators, a decimal point, and a CLR (clear) key. The Keypad enters parameters through the X Register and enters equations for the Define/Use/Ap-Pak options.

The CLR key clears incorrect entries from the X register. It also ends an error condition and clears the error message from the display.

There are three associated keys to the left of the decimal point. YES and NO are used in parameter selection; refer to section 2.3. The STORE key moves the contents of the X register into memory.

4.2 ADC GAIN

This six-position rotary switch is used to establish the full scale resolution of the ADC, as discussed in the Introduction, section 1.3.1. The ADC Gain is commonly set to equal the number of channels of data acquisition memory; that is, a 4K memory (4096 channels) would commonly use an ADC GAIN of 4096.

For finer resolution over a narrower energy range, the ADC GAIN switch, in conjunction with the ADC OFFSET, can be used to display the energy range of interest.

4.3 ADC OFFSET

The ADC OFFSET establishes the relationship between memory channel zero and the ADC channel assignments. The effect of the Offset is to shift the spectrum by a selected number of channels.

For instance, if an ADC GAIN of 4096 is selected but only 1024 channels of memory are being used for acquisition, then the upper 75% of the spectrum will not be stored in the memory. If the upper 25% of the spectrum is to be stored in the memory, the ADC OFFSET will have to be changed from zero to some number that will shift the spectrum by the desired number of channels.

In this example, an Offset of 3072 (1024 + 2048), which equals the 4096 Gain less the 1024 memory size, will accomplish the shift by moving the zero channel of memory to ADC channel 3072. Converted pulses whose value is less than 3074, will be discarded and pulses which convert to 3074 will be stored in the first data channel of the memory (channel 2). Note that the offset switches are additive.

With ADC Gains of 512 or 256, the Offset indicated by the switches is divided by 2 or 4, respectively.

4.4 AMPLIFIER GAIN

The coarse and fine gain controls are provided to adjust the gain of the internal amplifier to the desired spectral energy range. Together they provide a gain range of 3 to 1170.

The coarse gain control is a five-position rotary switch. The fine gain control is a ten-turn precision potentiometer that multiples the setting of the coarse gain control by a variable factor which can be set as low as 0.3 or as high as 1.3.

The fine gain control is factory set to read 0.3 at its minimum setting so that its dial reads the variable factor directly, allowing the operator to set the amplifier's total gain with precision.

4.5 ANLYZ (Analyze)

The ANALYZE key can be used only when a Define/Use/Ap-Pak option is installed in the Series 35 PLUS.

Section 7 covers the option and the use of this key.

4.6 AREA/INTEG

This function will display the Area, its histogram bars, and the Integral of all of the data points in:

1. The current ROI (defined below) if ROIs are entered.
2. The entire memory segment displayed if no ROIs are entered. Histogram bars are not shown in this case.

The Integral is the total sum of all counts in the current ROI or in the displayed memory segment.

The Area is the Integral less the counts in the calculated background. The Area, Background, and Integral algorithms are given in Appendix D.

The current ROI is the ROI containing the cursor. If the cursor is not in an ROI, then the current ROI is the next ROI to the right of the cursor.

If the cursor is to the right of the right-most ROI, the calculation will be made for the left-most ROI in the spectrum.

4.7 CLR

The CLR key, located on the keypad, is used to clear incorrect entries from the X Register. It also aborts an error condition and clears the error message from the display.

4.8 CLEAR ALL

CLEAR ALL clears all ROIs from the displayed memory section.

In clearing any ROI, the data is not affected. Only the intensification is cleared from the memory.

4.9 CLEAR DATA

The K1 function is covered in section 7.

This function clears all channels in the chosen memory segment, including the time channels.

CLEAR DATA is usually used to reset the entire memory to zero before starting a new experiment or a new run of the current experiment.

4.10 CLEAR ONE

CLEAR ONE, if the cursor is not located within an ROI, clears the current ROI.

Current ROI is the ROI in which the cursor is located, or if the cursor is not in an ROI, the ROI immediately to the right of the cursor.

If the cursor is located within an ROI, CLEAR ONE clears those channels within the ROI that are to the right of the cursor, as well as the channel containing the cursor.

In clearing any ROI, the data is not affected. Only the intensification is cleared from the memory.

4.11 CLEAR TIME

The "√" function is covered in section 7.

This function clears the first two channels in the memory segment chosen by the MEMORY switch.

CLEAR TIME can be used to reset the two time channels to zero without erasing the existing data. The operator may wish to add or subtract new data using the same preset conditions as for the first data collection.

4.12 COLLECT

The COLLECT function starts or stops data acquisition in the mode already chosen by the operator. (The PHA+ mode, for instance.)

If MCSR acquisition is in progress, the firmware allows the operator to "STOP" or "ABORT" when terminating COLLECT. STOP = terminate at the end of the current sweep; ABORT = terminate immediately. ABORT is given as a choice only when the selected dwell time is equal to or greater than 2 ms.

When Collect is enabled or disabled, the analyzer reads the position of the Memory switch to start or stop data acquisition in that memory section. The Memory switch can then be changed in order to examine, manipulate or Read In/Read Out data in another section of memory.

4.13 ECAL

The "(" function is covered in section 7.

Energy Spectra

The Series 35 PLUS can calibrate the displayed spectrum in energy units (KEV.3 replaces MEV if X-ray Analysis is the current ISO ANALYZ library):

EV, KEV, MEV

The cursor location and the limits of any entered ROIs will then be shown in those units instead of a channel address. Using this displayed energy information, an unknown radioisotope can be identified.

Other Spectra

The ECAL function also offers time units for calibrating MCS Spectra, and two additional units, CM for Mössbauer Spectra and UNITS for other applications:

MSEC, SEC, MIN
CM and UNITS

Number of Calbrations

The Series 35 PLUS will accept up to 7 ECAL equations, one for Full memory, one for each Half and one for each Quarter of memory.

The method uses a first order (straight line) calibration and is accomplished by answering the questions in the ECAL dialogue.

Calibration

To calibrate a spectrum:

1. Press the front panel ECAL key to start.
2. If this memory segment was previously calibrated, the equation will be displayed (see the example in step 8). Press YES to accept the displayed equation.

3. Press NO to delete the old equation and write a new one. Advance the * to the desired calibration unit.

```
UNITS:  *EV   KEV   MEV   MSEC   SEC   MIN   CM   UNITS
                NEXT?
```

4. Press YES to go to the next level.

```
LOW:   CH#  0    0.0 KEV    HIGH:  CH#  0    0.0 KEV
* X=                OK?
```

5. Enter the LOW channel either as a channel number or by pressing STORE to enter the current cursor location.

6. Press NO to advance the *. Enter the Low energy and press STORE.

7. Press NO to advance the *. Enter the HIGH channel and energy as in steps 5 and 6.

8. Press YES to display the ECAL equation:

```
USE   ENERGY =  0.45656E01  *  CH#   + 0.106E00  KEV
                   OK?
```

9. Press YES again to see the calibrated display.

4.14 ENTER ROI

The Series 35 PLUS has provision for entering Regions of Interest (ROIs) to mark significant peaks in the spectrum for later analysis and readout. To enter an ROI, simply position the cursor at one limit of a peak with the SCAN control, press ENTER ROI, and SCAN the cursor to the other limit of the peak.

Each data point that the cursor passes through while ENTER ROI is enabled will be intensified to indicate that the data is within the ROI. When the further limit of the desired ROI is reached, stop moving the cursor and press ENTER ROI once again to disable the function.

Any number of ROIs may be entered as long as they are separated by at least one channel. That is, ROIs may not overlap. Also see Section 4.25.4, Peak Search.

4.15 HOME

Pressing HOME moves the cursor to the left end of the display, either the memory section being displayed or the expanded display if WINDOW is enabled.

4.16 INDEX

The INDEX function is used to quickly move the cursor to the next ROI.

INDEX will move the cursor to the left limit of the next ROI to the right.

INDEX will "wrap around" the memory. That is, the cursor can be moved from last ROI on the display's right to the first ROI on the left simply by INDEXing.

If ROLL is enabled, INDEX will move the expanded data region to the next ROI and display its data.

4.17 INTENSITY

The INTENSITY control varies the brightness of the display. Turning the control clockwise will increase the intensity; counterclockwise decreases the intensity.

4.18 ISO ANLYZ

The Isotope Analysis key can be used when the Model 3543 Iso Analyze or Model 3544 X-ray Elemental Analysis option is installed in the Series 35 PLUS.

Section 8 covers the use of this key for the Models 3543 and 3544.

4.19 LLD (Lower Level Discriminator)

This ten-turn, locking potentiometer is used to establish the lower energy limit for input signals that are to be converted by the ADC. Input signals that are below the LLD setting in amplitude are not converted. If signals below the LLD setting are above the factory set threshold, those signals will add an increment of deadtime equal to the signal's width.

For MCSR operation, the LLD is usually set just below the energy of interest.

4.20 MCSR

The V1 function is covered in section 7.

The MCSR key selects the Multichannel Scaling, Recurring sweep made of data acquisition. The MCSR mode is described in section 1.4.

The Series 35 PLUS defaults to the PHA+ mode at power on or when the System Reset command is issued; refer to section 2.2.

When the MCSR key is first pressed, the additive (+) mode is selected. Pressing the key again enables the subtractive (-) mode.

In the additive (+) mode, all newly acquired data is added to the data already in memory.

In the subtractive (-) mode, all newly acquired data is subtracted from the data already in memory.

In the MCSR mode, channel 0 records the number of sweeps completed. Channel 1 is used as a dwell time register; refer to Dwell Time Coding in section 4.27.2. Channels 0 and 1 are always additive.

4.21 MEMORY

The MEMORY switch selects the section of memory to be:

- addressed by the ADC for data storage
- displayed by the CRT
- read out of or read into

The operator may select full memory, either half or any of the quarters.

- 1/1 refers to the full memory
- 1/2 refers to the first half of the memory
- 2/2 refers to the second half of the memory
- 1/4 refers to the first memory quarter
- 2/4 refers to the second quarter
- 3/4 refers to the third quarter
- 4/4 refers to the fourth quarter

Regardless of the memory segment chosen, the first two channels of the segment are used to register PHA Live and True time or MCS sweep count and Dwell Time code.

4.22 MIXER/ROUTER

The V2 function is covered in section 7.

If the Model 3531A Mixer/Router Wiring or Model 3523 Multi-ADC Interface is installed in the analyzer, pressing the M/R key will allow the operator to choose how many inputs the analyzer is to accept. The dialogue will read:

```
NO. INPUTS *2    4    8†    16†
                 OK?
```

†For the Model 3523, 8 and 16 are not shown

Choosing the number of inputs with the * will cause the Firmware to divide the full memory into the selected number of equal parts for separate data storage for each input.

To use the Series 35 PLUS with one input, the M/R key should not be used. The Mixer/Router should be disconnected from the system when a single input is desired.

Refer to the Mixer/Router's Operator's Manual or to the Model 3523 Multi-ADC Interface operating instructions, section 10.3, for more information.

4.23 NO

The NO key is used in parameter selection. Refer to section 2.3.

4.24 OVLAP (Overlap)

The OVLAP function is used to make a visual comparison between two spectra by superimposing a corresponding half or quarter memory over the currently displayed section of memory. Note that the function cannot be enabled if the MEMORY switch is in the 1/1 position.

The corresponding memory sections are:

Current Display	Overlapped Section
1/2	2/2
2/2	1/2
1/4	3/4
2/4	4/4
3/4	1/4
4/4	2/4

The operator can modify the first half of the OVLAP dialogue to display another overlapped section of corresponding size simply by entering the desired number by way of the X Register. The second half of the dialogue is always the memory section currently being displayed. The MEMORY switch must be changed to show the correct display before enabling the function.

The overlapped data are always displayed offset by 20% of the selected VERTICAL RANGE.

When the dialogue has been completed, pressing YES (in answer to OK?) will terminate the dialogue; the overlapped memory section will remain on the screen until the function is turned off by pressing OVLAP again.

After the Overlap dialogue has been completed, the MEMORY switch can be changed between halves or between quarters. This will allow other memory segments to be compared with the overlapped segment.

Note that if the MEMORY switch is changed outside of the original size memory segments, the function will turn itself off.

4.25 PEAK

The ")" function is covered in section 7.

The PEAK function can find valid peaks either manually, via the front panel key, or by way of a Task step. A valid peak is one which is found by the Peak Search algorithm using the selected sigma, or level of confidence.

4.25.1 Manual Peak

When manually started, the PEAK function searches the spectrum for valid radioisotope peaks, enters ROIs, and reports the Centroid and Full Width at Half Maximum (FWHM) for the current ROI.

Current ROI is the ROI in which the cursor is located, or if the cursor is not in an ROI, the ROI immediately to the right of the cursor.

4.25.2 Task Peak

PEAK as a Task step searches for valid peaks and enters ROIs, but the Centroid and FWHM are not calculated. For a Task Peak Search to be successful, all previous ROIs must be cleared before the search starts.

4.25.3 Peak Sigma

In the PEAK function, sigma is used to determine if the peak is statistically significant compared to its background level. That is, if a small peak on a high background level is analyzed, a high sigma value will cause the routine to find that the peak is not significant.

In Peak Search, a peak that is not considered significant will not be marked with an ROI.

Press the PEAK key to see:

```
SIGMA:  0.41  *1.65   3.27
                 OK?
```

The * will be shown at the last used sigma value. The factory default is 1.65.

Select SIGMA to correspond to the desired peak confidence level and press YES:

0.41 = 66% confidence
1.65 = 95% confidence
3.27 = 99% confidence

4.25.4 Peak Search

After SIGMA has been selected, enabling PEAK again will result in:

1. If ROIs are present in the displayed memory, a blinking cursor will appear at the peak channel of the current ROI. The value of the ROI's Full Width Half Maximum (FWHM) and CENTroid will be shown. The INDEX key can be used to select a new ROI.

2. If no ROIs are present, a blinking "SEARCHING" message will appear and ROIs will be placed around any spectrum peaks found by the search.

   At the end of the peak search, the current ROI's Centroid and FWHM will be displayed. If no valid peak is found, the function will automatically be disabled.

   Current ROI is the ROI in which the cursor is located, or if the cursor is not in an ROI, the ROI immediately to the right of the cursor.

The algorithms for FWHM, Centroid, and Peak Search are given in appendix D.

4.25.5 Aborting the Search

To stop Peak Search before is it complete, press the CLEAR key.

4.26 PHA

The PHA key selects the Pulse Height Analysis mode of data acquisition. The PHA mode is described in section 1.3.

The Series 35 PLUS defaults to PHA+ (additive mode) at power on or when the System Reset command is issued; refer to section 2.2.

Pressing the PHA key will change the mode to PHA- (subtractive mode).

In the additive (+) mode, all newly acquired data is added to the data already in memory.

In the subtractive (-) mode, all newly acquired data is subtracted from data already in memory. Channels 0 and 1 are always additive.

In the PHA mode, channels 0 and 1 are used to record elapsed Live and True Time, respectively; refer to section 1.3. If Group Counts preset is selected, channel 2 records the preset's count and channel 3 records the preset's channel.

4.27 PRESET

The K2 function is covered in section 7.

Each mode of data acquisition has its own default preset which can be changed as desired by the operator.

4.27.1 PHA Preset

The Series 35 PLUS provides six preset conditions for ending PHA data acquisition:

1. Live or true time.
2. Channel counts: counts in a specific channel in the current memory segment.
3. Group counts: counts in any channel in the current memory segment.
4. Total Integral of a Region of Interest.
5. Total net Area of a Region of Interest.
6. Value of a USE equation with a Define/Use/Ap-Pak option. (Section 7.9 covers the Use Equation preset.)

Enabling PRESET brings up the following dialogue:

```
*TIME (L)  TIME (T)  COUNTS  INT  AREA  USER  VAL= nn "units"
 X=                    OK?
```

The previous preset value (VAL= nn preset "units") is shown. It may be changed via the X Register.

Using NO to advance the * allows the choice of True time, any of the three computational presets, or the user defined preset, which will bring up the question NEXT? in place of the question OK?

Channel Counts

When the * is at COUNTS, press YES to change to the dialogue for the Counts preset. For the Channel Counts preset, assign the preset count value, advance the *, and enter the specific channel that the analyzer is to monitor for that count value.

When the * is at CHANNEL #, the cursor's current location can be entered by pressing STORE.

Group Counts

To enter the Group Counts preset, assign the preset count value to channel zero. The Group Counts preset will stop Collect when any channel in the current memory segment reaches the preset value.

The current memory segment is defined by the position of the MEMORY switch at the moment Collect starts. Note: In the case of a multi-input device, only one input's Group Counts preset can be active at a time.

In this mode, the program continually sweeps the memory segment looking for a channel which has reached the preset. Collect will stop on the next Live Time tick after the preset is found.

When Collect stops, its count value will be reported in the display's ELAP field and in channel 3. The number of the channel that contains this value will be reported in channel 2.

Note: To avoid having spectral data overwrite the Group Counts preset data, the LLD control must be set so that spectral data is never collected in channels 2 and 3.

Int/Area

If INT or AREA is chosen, the next line of dialogue will read

```
INT (or AREA)    nnn COUNTS    ROI FROM CH # n TO CH # n
X=                           OK?
```

Enter the number of counts and press NO to advance the * to ROI. Pressing STORE will enter the limits of the current ROI. When the * is moved to FROM or TO, the ROI limits may be entered manually or by pressing STORE, which will enter the current cursor address.

Current ROI is the ROI in which the cursor is located, or if the cursor is not in an ROI, the ROI immediately to the right of the cursor.

It should be noted that, except in the case of Live Time, acquisition does not stop exactly at the preset parameter. This is because Series 35 PLUS's Firmware prevents fraction of a second errors in the keeping of Live Time. When the Analyzer reaches preset, collection will stop at the next tick of the Live Time clock.

A high Dead Time could cause a long real time to elapse before the next tick of the Live Time clock. In this case, Collect may be aborted by disconnecting the signal cable or by performing a System Reset (section 2.2).

4.27.2 MCSR Preset

If MCSR has been enabled, the PRESET dialogue is:

```
DWELL (Nx10↑M USEC) N= 1 M= 2     SWEEPS = 0
X=                        OK?
```

The formula in parentheses is read as "N" times 10 to the "M" power microseconds. The preset shown is set for 100 microseconds dwell time per channel.

The MCSR preset is defined by the following rules:

1. "N" can be set for 1 through 15.
2. When "M" is set to 9, the dwell will be expressed as "N" minutes.
3. When "M" is set to 10, the dwell will be expressed as "N" hours.
4. When "M" is set to 11, the dwell time will be set to "N" times 10 minutes.
5. When "M" is set to 15, the channel advance, and thus the dwell time per channel, will be under EXTernal control.
6. Setting the preset to EXTernal will cause the firmware to count "N" External pulses before executing a channel advance.

The number of sweeps may be preset for the required number through the X Register. If the default parameter of zero is retained, the analyzer will interpret this as infinity. That is, the analyzer will continue to sweep through the memory until stopped manually or remotely.

If MCSR acquisition is in progress, the firmware allows the operator to "STOP" or "ABORT" when terminating COLLECT. STOP = terminate at the end of the current sweep; ABORT = terminate immediately. ABORT is given as a choice only when the selected dwell time is equal to or greater than 2 ms.

NOTE: The number of sweeps performed may, under some conditions, exceed the preset slightly.

Dwell Time Coding

When MCSR Collect is started, the dwell time will be encoded and stored in channel one. If the number in channel one is divided by 16, the result will be the "N" factor. A remainder of 1 to 8 will be the "M" factor in microseconds; a remainder of 9 to 15 is explained in the next paragraph.

If the remainder is 9, M = minutes x 1.
If the remainder is 10, M = hours.
If the remainder is 11, M = minutes x 10.
If the remainder is 15, M = external pulses.

4.28 READ IN AND READ OUT

The "EEX" and "TL" functions are covered in section 7.

These keys control the input/output flow of data from or to a peripheral data storage device, such as a Cassette Tape or a Plotter. Their use is covered in detail in section 5.

4.29 ROLL

When enabled, ROLL allows the Window to be moved through the spectrum by means of the SCAN control. Scanning the Window will cause the data channels to appear to move in the opposite direction from the direction of scan, while the cursor remains in place.

Since this function is dependent on WINDOW, enabling the function automatically enables WINDOW if it is not already enabled. Similarly, disabling WINDOW will automatically disable ROLL.

4.30 SCAN

The VARISCAN control, below the center of the display, moves the cursor through the spectrum.

- Turn the VARISCAN control clockwise to move the cursor to the right.
- Turn the VARISCAN control counterclockwise to move the cursor to the left.
- Turn the VARISCAN control slowly to move the cursor through one channel at a time.
- Turn the VARISCAN control rapidly to move the cursor through a large number of channels.

Note: Turning the VARISCAN control generates a current proportional to the rate of turn. If you turn the control very slowly, the current won't be detected and the cursor won't move.

4.31 SMOOTH

Smoothing is used to decrease or eliminate random fluctuations in spectral data.

The function examines three channels at a time and averages the data in each channel with the data in the channel to either side. The Smoothing algorithm is listed in appendix D.

If WINDOW is enabled, only the expanded channels are smoothed. If ROIs are entered, only the current ROI is smoothed.

The current ROI is the ROI containing the cursor. If the cursor is not in an ROI, then the current ROI is the next ROI to the right of the cursor.

While the smooth operation is being performed a "BUSY" message will be displayed in the lower right corner of the display.

4.32 STORE

The STORE key moves the contents of the X Register into memory. Refer to section 2.3.3.

4.33 STRIP

The STRIP function allows the operator to subtract a factor-specified part of one spectrum, the reference, from another spectrum of the same size, the sample. The Strip algorithm is given in appendix D.

Before enabling the function, use the MEMORY switch to display the sample spectrum.

Press STRIP, which also enables OVLAP, to display the reference spectrum above the sample spectrum. The overlapped memory segment will be the one corresponding to the setting of the MEMORY switch as listed in section 4.24, OVLAP.

If the overlapped memory segment is not the desired segment, use the X Register to change the first part of the displayed dialogue.

```
STRIP *Q#1     FROM Q#3     F = 1.00
X=                  OK?
```

The factor (F) shown will be the last factor entered or the default parameter of 1.00. It can be changed by advancing the * by way of NO and entering another factor through the X Register. Leading and trailing zeros don't need to be entered.

The Factor's range is 0 through ± 327.67.

4.34 TASK

The Task key is used to select the LEARN/EXECUTE function of the Series 35 PLUS. Use of this function is explained in section 6.

4.35 ULD (Upper Level Descriminator)

This screwdriver-adjustable potentiometer controls the upper energy limit for pulses to be processed by the ADC. Input signals that are above the ULD setting in amplitude are not converted.

For MCS operation, the ULD is usually set just above the particular energy of interest.

4.36 VERTICAL RANGE

This eight position rotary switch selects the desired full-scale count value for the display, from 256 to 1048K (1 048 575) counts per channel, plus LOGarithmic display. The highest setting equals $2^{20}-1$ counts.

The switch is normally set so that the highest peak in the spectrum is no higher than the top of the display. If a channel accumulates more counts than can be displayed, the channel will "overflow". This is seen as a peak which appears to have its top cut off and is increasing in height again from the baseline. If a channel overflows the VERTICAL RANGE, increase the VERTICAL RANGE setting.

4.37 WINDOW

For a detailed visual analysis of the peaks within a spectrum, the Series 35 PLUS provides a variable horizontal expansion of the display.

Enabling WINDOW will cause the displayed data to change from the full display to an expanded portion of the display, 128 channels wide. The cursor will be located at the 49th channel of the expanded Window.

If the cursor is within 49 channels of the left end or within 79 channels of the right end of the normal display, it will remain in its original position.

INDEX will move the expanded window from the current ROI to the next ROI.

The current ROI is the ROI containing the cursor. If the cursor is not in an ROI, then the current ROI is the next ROI to the right of the cursor.

In order to examine peaks of interest that may fall outside of the Window, the Series 35 PLUS allows the size of the Window to be multiplied by a factor of two. Pressing the "X" key on the keypad will double the number of channels in the Window, expanded around the cursor. The cursor's location will not change: it will remain in the same channel and will still be at the 38% point of the multiplied Window.

4.39 YES

The YES key is used in parameter selection. Refer to section 2.3.

4.40 ZERO

The analyzer is shipped with the ZERO control set for the memory size installed.

The ZERO control is a screwdriver-adjustable potentiometer which shifts the ADC zero relative to a zero energy (0 volts) input. This is done by shifting the spectrum by up to 5% of the ADC GAIN being used. It can be used like the ADC OFFSET to provide a fine control for positioning peaks.

The ZERO should be recalibrated each time the ADC GAIN is changed but is not critical. The result of not readjusting the ZERO will be a slight shift in the spectrum's peaks and slight change in linearity.

When performing experiments which require better linearity, channel zero of the Analyzer is usually made to correspond to zero energy input. Appendix C lists two methods for setting the ZERO control.

4.41 DIAGNOSTICS

The MCA's built-in diagnostic programs, Checksum, RAM test, and Character test, are selected by pressing a hidden front panel key which is to the left of and about 2 inches below the top of the display bezel.

These diagnostic programs are covered in detail in the Series 35 Plus Service Manual.

In addition, there is a PC-communications test, which is enabled by pressing the second hidden key, just below the Diagnostics hidden key. Its use is covered in the Model 3575 PC Interface Manual.

SECTION 5
INPUT/OUTPUT

The READ OUT and READ IN functions are used to store or retrieve data. This section covers the use of these two functions.

5.1 DATA READOUT

The READ OUT pushbutton allows the operator to transfer data from the Series 35 PLUS's memory to a peripheral recording device. When enabled, the last-used readout parameters are displayed with current tag number, time, date, and Data ID. For example:

```
DEV: EIA   MEM: ROI   MODE: ASCII   TAG: 2   (TIME AND DATE)
ID: SERIES 35+ V-1.0      OK?
```

Answering YES (to OK?) will start the readout using those parameters. Answering NO will allow the parameters to be changed:

```
DEV=  TTY  *EIA                    TAG = 0
X=                          OK?
```

DEVice= TTY Selects current-loop device readout.
DEVice= EIA Selects EIA (RS-232C) device readout. Mutually exclusive with CAS.

Additional device codes will appear if their I/O interfaces are present in the Analyzer:

- CAS Selects Cassette readout. Sets the baud rate (1200) and blank leader generation for the Model 5421M Cassette Recorder. Mutally exclusive with EIA.
- X-Y Selects Model 3551 X-Y Plotter.
- LPT Selects Model 3552A Serial Printer.
- PLT Selects Model 3552A Serial Plotter.
- GRA Selects Model 3553 Graphics Plotter.
- MT Selects Model 3554 Magnetic Tape.
- PIO Selects Model 3576 Parallel Interface

Tag Number

The last item in the dialogue line allows the operator to set a Tag Number for identifying a particular readout; its use is not necessary to obtain a readout. The Tag Number automatically increments by one with each readout.

EIA/CAS

When a Model 5421F Cassette Interface is attached to the TTY/EIA port (J101) and the 5421F's TERMINAL/CASSETTE switch is in the OUT position, the EIA label will be changed to CAS the next time I/O dialogue is seen.

If this switch is pressed IN, the CAS label will be changed to EIA the next time I/O dialogue is seen, which allows Terminal I/O at the 5421F's TERMINAL connector.

Models 5107 (Model 4320-AAK Teletype, a registered trademark of Teletype Corporation) and 5113 (Teletype Model ASR 43) connect to the TTY/EIA port (J101) using the supplied C1506 Cable. The dialogue must read EIA, not CAS. If dialogue does not read EIA, see appendix A.5 for information on changing the position of internal switch S1-8.

With some I/O devices, pressing YES will start the readout. With others, answering YES to the question OK? will bring up the next line of the dialogue:

```
MEM+MODE    *ROI+ASCII    FULL+ASCII    ROI BRIEF    FULL+BINARY
                              OK?
```

MEMory plus MODE refers to the choices on the remainder of the line: memory choice and readout mode choice.

The modes offered are different data transfer codes. Most peripheral devices can recognize only one mode; the instructions for each device will specify which mode is to be used.

MEM: FULL will read out all of the data in the memory segment selected by the MEMORY switch position.

ROI will read out the Live and True times and the data in all Regions of Interest in the selected segment of memory.

MODE: ASCII puts the read out data in a format suitable for a terminal. BINARY puts the read out data in a format suitable for the Model 5421M Cassette Recorder.

ROI BRIEF will provide an ASCII readout of ROI summaries without the raw data.

If the wrong mode is chosen for the peripheral device being used, the data read out will be unintelligible.

5.2 DATA READIN

To read prerecorded data into memory or to enter a Data ID (section 5.6), press READIN to see:

DEV = TTY *EIA (see note in section 5.1)
OK?

Select the device and press YES to start the readin.

5.3 CASSETTE READOUT

The Model 5421M Cassette Recorder provides a convenient low-cost means of storing spectra collected with the Series 35 PLUS. This section describes the operating procedures for storing and retrieving (reading out and reading in) data using the Cassette Recorder. It will accept data in either the ASCII mode or the binary mode. The binary mode is normally used because ASCII characters use more tape space and take more time to transmit.

Model 5421M Cassette Recorder:
Connect the interface cable's three plugs to the recorder's EAR, MIC, and REM sockets.
Connect the other end of the cable to the Model 5421M's CASSETTE connector.
Connect the Cassette's line cord to a source of ac power.

Model 5421F Cassette Interface:
Connect the MCA connector to J101 (EIA) on the Series 35 PLUS's rear panel with the supplied cable.
Be sure the TERMINAL/CASSETTE switch is in the OUT position.

Recording Data

1. Put a blank cassette in the Recorder.
2. To rewind the cassette, press the Model 5421F's REMOTE button in and turn it clockwise to lock; press the Model 5421M's REWIND button.
3. Reset the recorder's counter to zero by pressing the button next to the counter.
4. Turn the 5421F's REMOTE button counter-clockwise to release it.
5. Press the RECORD button.
6. Press READ OUT on the Series 35 PLUS's front panel.
7. Select CAS and Press YES.
8. Select Full Memory and Binary Mode (FULL+BINARY).
9. Press YES again to start the readout.

Series 35, Series 35 PLUS, Series 40, Series 80, and Series 85 recorded data are mutually compatible and data from all of these MCAs can be read in to the Series 90.
Series 30 recorded data can be read in to any of these MCAs.

After the readout is finished, wait a few seconds for tape motion to stop. When the tape has stopped, record the number shown on the digital counter. This will be the spectrum identification number associated with the next spectrum recorded. To record another spectrum, repeat the procedures listed above, starting with step 4.

5.4 CASSETTE READIN

To read data into the Series 35 PLUS from a cassette tape, follow these instructions.

1. Insert the cassette containing the desired data into the Recorder.
2. Rewind the cassette to its beginning with the REV/REW button.
3. Reset the Recorder's digital counter to zero by pressing the button next to the counter's readout.
4. Using the CUE/FFWD button on the Recorder, search the tape until the desired spectrum ID number is displayed on the digital counter. If the number is overshot, use REV/REW to back up the tape as needed. Note that positioning of the tape is not critical: ±1 digit is adequate.
5. Press the PLAY button.
6. Press the READ IN button on the Series 35 PLUS's front panel.
7. Select CAS and press YES to start the read in.

Tag number, ID, and ECAL equation will be read in with the data.

5.5 TELETYPE I/O (TTY)

In addition to the EIA/Cassette interface, the Series 35 PLUS also includes a standard Teletype current-loop interface. For the Models 5107 and 5113, use the supplied C1506 cable to the EIA connector (J101) and refer to the Model 5107 or 5113 Operator's Manual for details of operation. To use the current loop (TTY) port, a Model C1406 cable is required.

Note that an ASCII-encoded paper tape is mutually compatible with the Series 35, Series 40, Series 80, and Series 85. A paper tape made by a Series 30 can be read into the Series 35 PLUS.

Connect the Teletype to J102 (TTY, the current loop port) on the Series 35 PLUS's rear panel. Apply ac power to the Teletype and move its mode switch to the LINE position.

1. Press READ OUT on the Series 35 PLUS's front panel.
2. Select TTY and press YES.
3. Select either FULL+ASCII or ROI+ASCII.
4. Press YES to start the readout.

The results of a FULL+ASCII hard copy readout are shown in figure 5.1. The results of a ROI+ASCII hard copy readout are shown in figure 5.2. The results of an energy calibrated ROI+ASCII hard copy readout are shown in figure 5.3.

Figure 5.1
Full Memory Readout

TAG NØ. = 1 FULL MEMORY READØUT PAGE 1
MEMORY= 1/2 LIVE TIME= 4ØØ TRUE TIME= 473 3 APR 84 13:25

CHANNEL#	DATA							
Ø	4ØØ	473	13Ø	12Ø	14Ø	14Ø	146	127
8	149	144	131	151	14Ø	133	149	135
16	165	163	151	1Ø4	155	167	159	153
24	153	149	135	134	154	13Ø	16Ø	156
32	121	14Ø	149	149	141	141	137	145
4Ø	149	157	157	14Ø	159	16Ø	119	129
48	14Ø	127	132	153	133	147	145	135
56	142	131	125	151	143	147	146	125
64	123	149	16Ø	152	141	149	116	161
72	156	121	125	127	152	148	126	143
8Ø	142	146	15Ø	163	126	155	167	142
88	153	14Ø	151	141	158	144	131	12Ø
96	132	141	134	135	117	153	139	156
1Ø4	135	13Ø	147	146	16Ø	145	13Ø	135
112	136	149	137	13Ø	162	127	146	139
12Ø	152	147	136	156	142	1Ø3	158	159
128	133	123	142	13Ø	135	145	139	13Ø
136	146	148	153	126	134	[illegible]		154
144	142	15Ø	142	147				
152	15Ø	13Ø	143					
16Ø	135	143						
168	143	123						
176	14Ø							
184								

```
TAG NO.  =        2         READOUT OF 2 ROIS                      PAGE    1
MEMORY= 1/2  LIVE TIME=     4000 TRUE TIME=      4080      3 APR 84  13:23

ROI#    1   FROM      162 CH#  TO      179 CH#
            INTEGRAL       31204        AREA      8299
            CENTROID  0.16922E03        FWHM  0.36774E01

ROI#    2   FROM      236 CH#  TO      252 CH#
            INTEGRAL       40229        AREA     17844
            CENTROID  0.2437E03         FWHM  0.39598E01



TAG NO.  =        2         READOUT OF 2 ROIS                      PAGE    2
MEMORY= 1/2  LIVE TIME=     4000 TRUE TIME=      4080      3 APR 84  13:23

CHANNEL#                                DATA
   162          1279     1281     1299     1363     1633     2189     2926     3335
   170          3054     2331     1692     1368     1260     1234     1230     1232
   178          1235     1243

   236          1317     1318     1314     1362
   244          5625     4646     3089
   252          1265
```

Figure 5.2
ROI Readout

```
TAG NO   =        3         ECAL ROI READOUT                       PAGE    1
MEMORY= 1/2  LIVE TIME=     4000 TRUE TIME=      4080      3 APR 84  13:32

ENERGY(KEV )=   0.45664E00 * CH# -  0.10623E02

ROI#    1   FROM     65.3 KEV  TO     91.2 KEV
            INTEGRAL       26215        AREA      7511
            CENTROID  0.66099E02        FWHM  0.17296E01

ROI#    2   FROM    118.6 KEV  TO    125.9 KEV
            INTEGRAL       40229        AREA     17844
            CENTROID  0.12211E03        FWHM  0.18082E01



TAG NO   =        3         ECAL ROI READOUT                       PAGE    2
MEMORY= 1/2  LIVE TIME=     4000 TRUE TIME=      4080      3 APR 84  13:32

CHANNEL#                                DATA
   163          1281     1299     1363     1633     2189     2926     3335     3054
   171          2331     1692     1365     1260     1234     1230

   236          1317     1318     1314
   244          5625     4646
   252          1265
```

Figure 5.3
Energy Calibrated
ROI Readout

5.6 DATA ID

As an aid in identifying the data recorded in a given readout, the Series 35 PLUS provides a means of entering an alphanumeric identification (ID) label of up to 24 characters.

To enter an alphanumeric ID label with a current-loop device (TTY) or an EIA terminal:

1. Press READIN.
2. Choose TTY or EIA.
3. Press YES to activate the terminal keyboard.
4. On the terminal keyboard type:
   a. CTRL/B (press CTRL and the letter B).
   b. Any alphanumeric label of up to 24 characters.
   c. CTRL/D (press CTRL and the letter D).
5. When the CTRL/D is received, Readin will terminate. Press READ OUT to display the label.

This ID label will be read out with all data from the Analyzer and read in with all data from an external recording device.

5.7 MODEL 3551 X-Y PLOTTER

The Model 3551 X-Y Plotter Interface is compatible with standard X-Y point plotters, such as the Hewlett-Packard 7041A (Canberra Model 5202A) or the HP7004B (former Canberra Model 5202). It will also support the Houston 2600CZ (former Canberra Model 5201).

If the interface is to be used with any other point plotter, refer to Section 5.7.2 for Specifications and Signals and to Appendix A.7 for interface board jumper locations and uses.

5.7.1 HP Plotter Operation

Set the Hewlett-Packard plotter's front panel switches to:

Null Detector	ON
Recorder	MUTE
Plot Rate	EXT

Refer to the plotter's operating manual for detailed operating instructions. Connect the Interface cable to P1 and P2 on the underside of the plotter's rear panel.

The Model 3551 Interface plots spectral data only; it generates a plot that corresponds to the spectral portion of the display. Therefore, the desired display should be set up before starting a plot readout.

1. If WINDOW is enabled, the plot will show the expanded section of the display only.
2. If OVLAP is enabled, the plot will show both traces as seen on the display.
3. Data in the section of memory being read out should not be changed during readout.
4. After readout has started, the MEMORY switch may be changed to display another section of memory without affecting the data being read out.
5. Data in another section of memory may be altered without affecting the data being read out.

Starting a Plot Readout

1. Press READ OUT on the Series 35 PLUS.
2. Select X-Y as the readout device.
3. Press YES to start the readout.

The tag word will not be read out by the plotter. A typical plot is shown in figure 5.4.

5.7.2 Specifications and Signals

Data can be recorded in either log or linear format in the line plot or point plot mode on X-Y or T-Y plotters.

A. Specifications

Signal Amplitude	0 to + 5 V
Resolution	1 part in 1024 (10 bits)
Output Impedance	= 93 ohms.
Integral Nonlinearity	<±0.1% of full scale per °C.
Zero-Drift	<±0.0 % of full scale per °C
Gain-Drift	<±0.02% of full scale per °C
Internal Rate Control (RV1)	Adjustable from 2 to >10 channels/sec. Factory set at 2 per second.
External Rate Control	Must exceed internally set rate. Maximum advance rate is >100 per sec.

B. Signals

J107 (or J108), 25-pin connector

Pin	Signal	Description
23	PLTX	0 to + 5 V analog signal.
2	XGND	Ground.
21	PLTY	0 to + 5 V analog signal.
4	YGND	Ground.
5	SEEK	Nominal 100 μsec output pulse when plot signals are changed; TTL compatible; positive true polarity is standard; internal jumper plug (D-E) inverts polarity.
6	CPC	Completed plot input from plotter; ac coupled; advances on negative going edge; minimum excursion = 4 V; rise time <0.5 μsec.
9	NABL	Plotter enable output; TTL compatible; negative true polarity is standard; internal jumper plug (B-A) inverts polarity.
14	GND	Ground.

5.7.3 Hewlett-Packard Plotter Cable Connections

The Hewlett-Packard 7041A Plotter uses a Canberra-supplied interconnecting cable. The cable pin-out is:

HP 25-PIN CONNECTOR	Series 35 PLUS J107 (or J108)	SIGNAL
1	21	PLTY
2	4	YGND
6	14	Ground
14	23	PLTX
15	2	XGND
HP 9-PIN CONNECTOR		
2	5	SEEK
3	14	Ground
4	6	CPC
5	9	NABL

5.7.4 Model C1513 General Purpose X-Y Plotter Cable

25-Pin Connector	Wire Color	Plug Color	Signal
21	Red	Red	PLTY
4	Orange	Black	YGND
23	Blue	Red	PLTX
2	Green	Black	XGND
14	Black	Black	Ground

5.8 MODEL 3553 Graphics Plotter

The Model 3553 Graphics Plotter Interface can be used with the Hewlett-Packard HP 7470A (Canberra Model 5207A) two-color Graphics Plotter. It can also be used with the HP 7225, with 7603 Personality Module and the HP 7220 Plotters (former Canberra Models 5207 and 5206).

The Plotter Interface is set to the Line Plot mode. To change the mode to Point Plot, refer to the instructions for the interface's M-N jumper in appendix A.8.

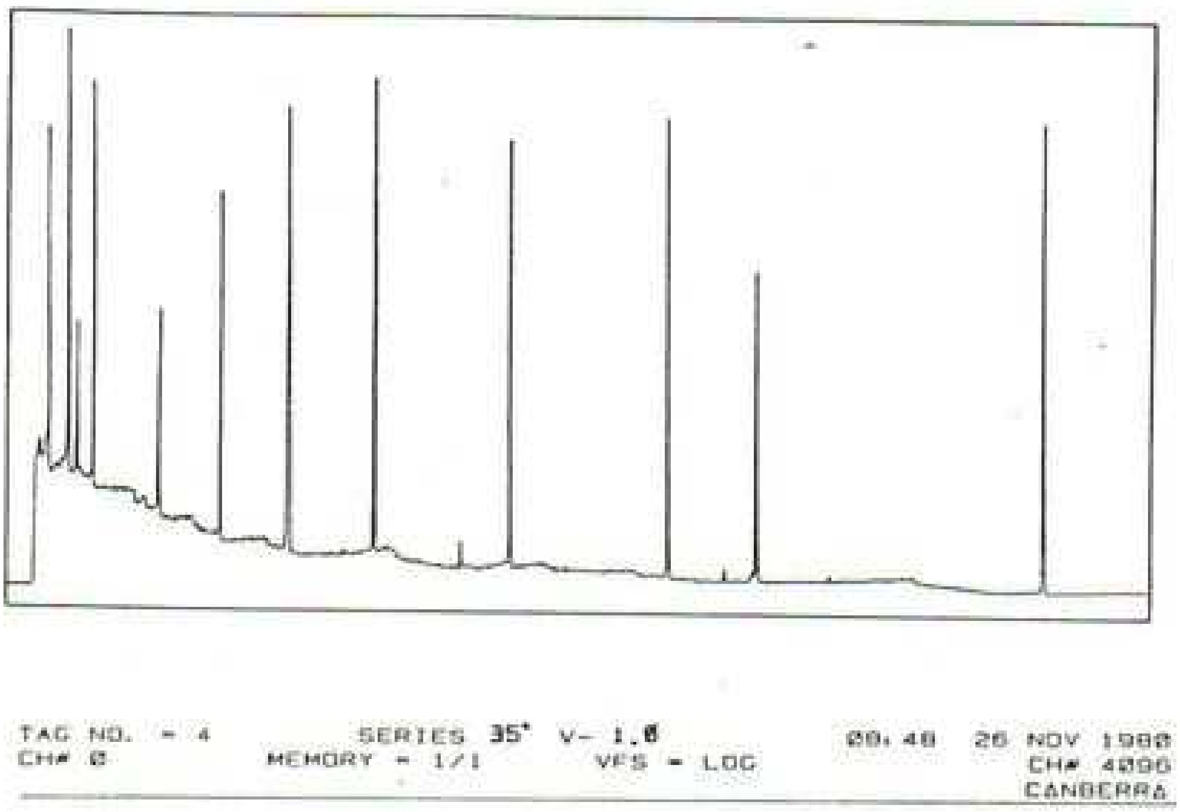


Figure 5.4
Typical X-Y Plotter Readout

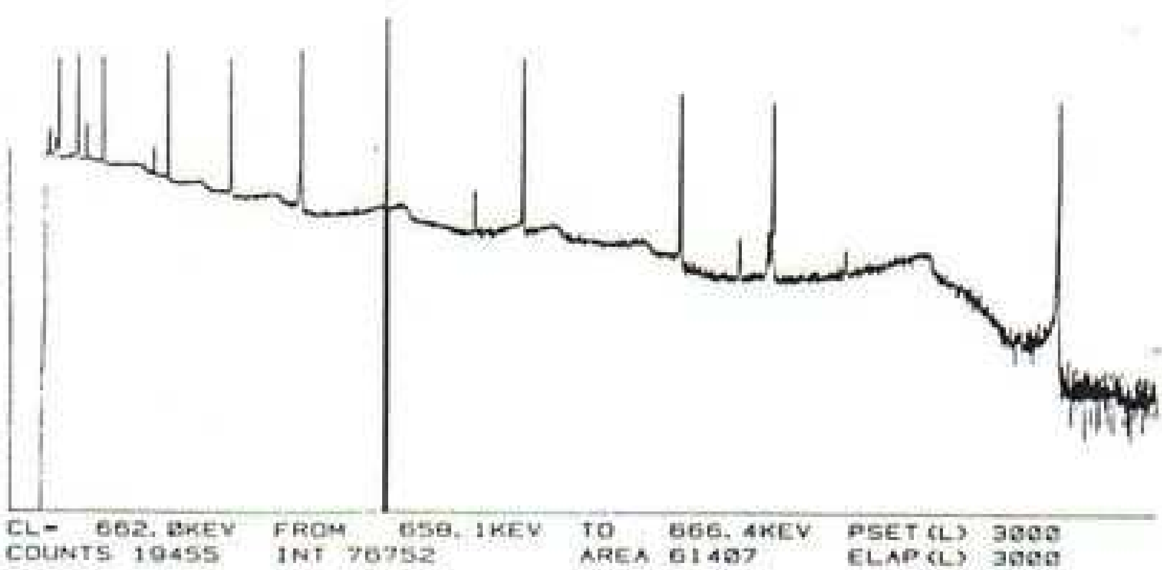


Figure 5.5
Typical Graphics Plotter Readout

5.8.1 Model 5207A Setup

The Model 5207A Plotter's rear panel has an 8-pole rocker switch:

Pole	Setting
S2	0
S1	0
D/Y	1
A4/US	1
B4	1
B3	0
B2	0
B1	0

Refer to the HP operator's manual for the meaning of these switches and for specific instructions on plotter setup.

Connect one end of the supplied cable to J107 (or J108) on the Analyzer and the other to the Plotter's EIA connector.

5.8.2 Plotter Operation

When the Plotter is set up and connected to the Analyzer, press READ OUT and select GRA as the readout device. Now press YES to start the readout.

The Series 35 PLUS must be on before the Plotter is turned on to assure proper operation.

The Plotter will read out the alphanumerics and the spectrum currently displayed. The MEMORY switch and AREA/INTEGRAL, ECAL, and USE, if desired, must be selected before starting the readout.

Figure 5.5 shows a typical Graphics Plotter readout.

5.9 OTHER I/O DEVICES

Operation of options 3552A, 3554, 3571, 3572 and 3573 is explained in the separate manuals for each of these devices.

SECTION 6
TASK (LEARN/EXECUTE)

The Series 35 PLUS Task function offers a means of defining and automatically executing a Task. That is, a sequence of Analyzer functions.

- Up to four tasks can be entered.
- Any one task can be executed at a time.
- While the task is in progress, no analysis or control functions are available to the operator. Display functions can still be enabled, however.
- Any running task can be stopped manually.
- A task may be entered manually (LEARN) or by way of a previously learned task which has been stored externally (LOAD).
- A Define/Use equation may be entered as a step by pressing ANALYZ during task entry.
- The data collection mode (PHA or MCS) can't be learned. The mode must be manually set before Execute is enabled.
- If the Model 3575 option is installed and the rear panel REMOTE/SHARED/LOCAL switch is in REMOTE or SHARED, the front panel READ IN and READ OUT keys will be disabled. Furthermore, the EIA and TTY rear panel connectors cannot be used for Load or Save operations.

Table 6.1
Bytes per Function

Analyzer Function	Dialogue Mnemonic	Bytes Used
CLEAR DATA	CLRDATA	2
CLEAR ROI	CLRROI	2
CLEAR TIME	CLRTIME	2
COLLECT	COLLECT	2
ENTER ROI[1]	ENTROI	6
PEAK[2]	PEAK	2
PRESET MCS	PSET MCS	5
PRESET PHA	PSET PHA	11
READ IN	READIN	4
READ OUT	READOUT	5
SMOOTH	SMOOTH	3
STRIP	STRIP	5
TRANSFER	TRANSFER	3
USE EQUATION #n[3]	USE EQU #n	2

The notes refer to E.1, E.2, and E.3 in section 6.1.

6.1 TASK RULES

A task is Learned (entered manually) by pressing the key associated with the desired function and completing the dialogue associated with that function. During the Learning process, the following rules apply:

A. Entering a task manually (LEARN) is simply a process of responding to the dialogue presented by the analyzer for each function.

B. Each task may occupy up to 64 bytes of memory. See table 6.1.

C. The number of bytes remaining for the task will be displayed at the right side of the dialogue portion of the display (TO GO =).

D. After entering a step, a response of YES will move the task on to the next step.

E. The learning process will terminate if the operator presses TASK again, disabling the function and erasing all entered steps.

E.1. In the ENTER ROI dialogue, press STORE to enter the current cursor location (channel) or enter a channel number.
E.2. Choose Peak Sigma before executing a task. For correct peak search in a task, all ROIs in the memory must be cleared first. They may be cleared manually or by a task step.
E.3. An equation must be defined before entering it as a task step.

F. If the dialogue asks if the current memory segment, as selected by the MEMORY switch, is acceptable; the only response that can be made is YES. To change to another segment, the function must be turned off, the MEMORY switch changed to another position and the function turned on again.

G. When task entry is complete, the dialogue allows the operator to save the task on a peripheral recording device (section 6.5).

H. Storing a task externally is accomplished by reading out a binary-encoded record to a Cassette tape, to a punched paper tape (TTY), or to any EIA device that can record binary data.

I. If LOAD (from an external device) is selected instead of LEARN, the operator may select TTY (Teletype, a registered trademark of the Teletype Corporation) or CASsette as the device to Load from. A response of YES starts the Loading readin.

J. If, in entering a task, all of the available bytes of memory are used, an attempt to enter another step will cause the message NO ROOM to be displayed. Pressing CLR will remove the message from the display and allow the operator to exit the task dialogue.

The steps are displayed only as each one is learned, so it might be helpful to make a list of the steps before entering them into a task. This will ensure that the correct steps are entered in the proper order.

At the beginning of the task, and again as each step is entered, the display shows "GO TO 1". This command, which uses 2 of the 64 bytes, is included in every task as the final step. This allows the task to be repeated from a given point (in the default case, from step one) in multiple runs of the task.

6.2 ENTERING A TASK

Pressing TASK will show:

```
ENTER   EXECUTE
           OK?
```

The * defaults to EXECUTE if there is at least one task already defined. Otherwise it defaults to ENTER.

Any entered task may be executed; refer to section 6.7.

To enter a task, press YES with the * at ENTER. The dialogue will change to:

```
*TASK # 1
X=              OK?
```

Task number one is shown as an example, the actual number seen will be the last task number assigned. It can be changed to another number at this point.

Pressing YES in answer to OK? will show:

```
*LEARN   LOAD
             OK?
```

The operator must choose to enter a task manually (LEARN) or by way of a previously recorded task (LOAD).

6.3 LOADING A TASK

A YES answer to LOAD will allow the choice of I/O device to read the task in from:

```
DEV= TTY  *EIA
             OK?
```

Pressing YES again will start the Readin.

6.4 LEARNING A TASK

A YES answer to LEARN yields:

```
STEP #1    GO TO 1
X=            OK?           TO GO = 62
```

At this point the operator may change the GO TO command from Step 1 to any other step, as desired.

Note that "GO TO" uses 2 of the 64 bytes.

To enter a function as step number one, press the key associated with the desired function. For instance, CLEAR DATA, which will start the task with a cleared memory.

The display will ask if the currently selected memory segment is acceptable for the operation:

```
FULL
              OK?
```

Note: See general rule "F" at the beginning of this section.

Press YES to accept this step. The display will revert to:

```
STEP #2   GO TO 1
X=
               OK?           TO GO = 60
```

Step number two may now be entered and the GO TO command may be altered, if desired. This dialogue will be displayed at the completion of every step, changing only the step number for the next succeeding step and the bytes TO GO total.

After entering all desired functions into the task, up to the limit of 64 bytes of memory per task, the operator will answer YES (to OK?) to exit the task dialogue.

6.5 SAVING A TASK

After the task has been defined, it may be recorded externally to be read and used at another time.

Answering YES will change the dialogue to:

```
SAVE TASK # 1
                    OK?
```

Pressing NO bypasses the SAVE operation, leaves the task in memory, and returns the display to normal. A response of YES gives the operator the choice of recording device:

```
DEV  TTY  *EIA
                    OK?
```

Pressing YES allows the binary-encoded readout to start.

6.6 EDITING A TASK

After the task has been entered and accepted, it can be corrected by deleting incorrect steps or by adding omitted steps. To start the Editing process, press TASK and YES to see:

```
*TASK # 1
X=              OK?
```

The operator can change the task number through the X Register or can accept the displayed number. Pressing YES will show:

```
*LEARN  LOAD
                OK?
```

Accepting the Learn mode will show a new dialogue line:

```
USE OLD
                 OK?
```

Answering NO will delete the entire task; answering YES will allow the operator to review the task step by step, correcting as necessary:

1. Using the plus key (+) will advance through the sequence one step at a time.
2. Using the minus key (-) will back up through the sequence one step at a time.
3. Using the NO key will delete the currently displayed step.
4. Another step may be entered in the usual manner.
5. Instead of entering a new step, + or - may be pressed to go on with the editing process.
6. During the editing process, the task will show the total number of bytes left in the task (TO GO=). This number will change only if a step in the task is changed to one using a different number of bytes or if a step is added or removed.
7. If enough bytes remain, new steps may be entered at any point in the current sequence. New steps will be inserted before the displayed step.
8. When editing is complete, answering YES to the OK? will display the SAVE TASK dialogue as in section 6.5.

6.7 EXECUTING A TASK

To begin the sequence, the operator presses TASK, selects EXECUTE, and responds to two questions:

```
*TASK # 1
X=               OK?
```

The task number can be accepted or changed through the X Register. YES brings up:

```
*CYCLES=1
X=              OK?
```

The X Register here allows the operator to change the number of cycles of task repetition from one to any desired number between two and 255. If indefinite repetition is desired, enter 0. The task will recycle until aborted. (See section 6.8.)

A response of YES starts the execution of the task.

Note that the Execute function cannot be enabled while the analyzer is in Collect, Readin or Readout.

6.8 STOPPING A TASK

To stop an active Task, press TASK. The dialogue will show:

```
*ABORT  STOP            CYCLES=nn
                             OK?
```

Abort

ABORT will stop the Task immediately. If MCS collect is the current step, the task will continue to the end of the current sweep.

Stop

STOP will stop the task at the end of the current cycle.

Note that the number of cycles remaining to be run is also displayed. If you want only to check the number of cycles remaining, press TASK once more. This response will allow the Task to continue. Be careful not to press YES at this point or the Task will be aborted.

SECTION 7
MODELS 3541x STANDARD AND OPTIONAL DEFINE/USE/AP-PAKS

The optional DEFINE/USE allows the operator to enter and use, either manually or from an external device, up to four algebraic equations. The equations may use one or two Constants and one or two Variables plus Live time (TL). All operations are performed in Floating Point arithmetic.

The AP-PAK part of the option provide 10 predefined equations for solving common analysis problems. The AP-PAKs are covered in detail in section 7.12.

The equations are accessed by pressing the front panel ANLYZ key. Analyze comprises six functions, each covered in a separate section:

Editing (7.2)   Define (7.3)   Save (7.4)   Use (7.5)   Load (7.6)   Acc (7.7)

7.1 EQUATION RULES

1. Parenthetical nesting is provided up to four levels.
2. An equation may be a maximum of 57 displayed characters. Note that some operations require more than one character: Square Root, for instance, is displayed as SQRT: a total of 4 characters of the 57 available.
3. Computation is performed according to the hierarchy of operations shown in the following list. Within a given level, computation is performed from left to right.

Operation	Hierarchy
√ (SQRT) ex (EEX) Unary minus (-)	First level
Multiplication (*) Division (/)	Second level
Add (+) Subtract (-)	Third level

4. In addition to the usual operators, the Series 35 PLUS provides exponential notation to the base e (natural logarithm), as well as to the base 10. The EEX key on the keypad is used for both bases.

   The Firmware picks which base to use by the following rules:

   A. If a numeric entry precedes the EEX, the Firmware will use the base 10. That is, an entry of 4.7, EEX, 4 will be read as 4.7 X 10^4. It will be displayed as 4.7E4.

   B. If there is no number preceding the EEX, the Firmware will use the base e. That is, an entry of 5, X, EEX, 3 will be read as 5 times e^3. It will be displayed as 5 X EXP3.

      Note that the exponential notation on the display varies with each base: when the base ten is raised to a power, the display shows "E"; when the base e is raised to a power, the display shows "EXP".

5. Constants may be defined for each equation as K1 or K2 or entered as numeric literals in integer, fixed decimal, or exponential format. Constants are always displayed exponentially; base e cannot be used.

6. Each equation may have two variables, which are defined as:

   1. CL#: The current Cursor Location (channel number). If the spectrum is energy calibrated, energy units rather than a channel number will be used in the calculation.

   2. CNT@CH#: The count in a specified channel. A specific channel number may be entered, or STORE may be pressed to enter the channel number of the current cursor location. Entering channel zero as the channel number will be interpreted as the current cursor channel.

3. INTG#: Integral of a specified ROI. Entering zero as the region number will be interpreted as the current ROI. If more than one ROI has been entered, the ROIs are counted from left to right to signify which ROI# is being referred to.

   Current ROI is defined as the ROI in which the cursor is located, or if the cursor is not in an ROI, the ROI immediately to the right of the cursor.

4. AREA#: Area of a specified ROI. ROI defined as in Step 3.

5. EQ#: The current value of the specified equation. This function allows equations to be chained: If the current equation needs to have more than two Variables, further Variables can be defined in another equation and referred to with this function. Reference to the current equation number is not legal.

6. CENT#: The peak centroid of a specified ROI. ROI defined as in Step 3.

7. FWHM#: The full width half maximum of a specified ROI. ROI defined as in Step 3.

7.2 EDITING

As the equation is entered, a mistaken entry can be deleted by pressing NO, which will delete the most recent entry. If the mistake is several entries back in the equation, it may be deleted by pressing NO several times, which will erase each final entry. When the mistake has been deleted, the correct entry can be made and the equation continued.

In addition, the entire equation may be erased by pressing the CLR key.

If neither was specified as part of the equation, this section may be disregarded. In either case, pressing YES will reveal:

```
V1= CL#  CNT@CH#  INTEG#  AREA#  EQ#  CENT#  FWHM#
X=                 OK?
```

If Variable one (V1) was specified in the equation, it will be entered here. If not specified, press YES to go on to the dialogue for variable two (V2), which uses the same format.

When the two Variables have been entered, pressing YES will reveal:

```
    SAVE EQU #n     OK?
```

The displayed equation number is the number of the current equation. NO will terminate the dialogue. YES will allow the choice of devices for saving the equation.

7.3.1 Redefine

If ANLYZ is pressed again after entering an equation, the same initial dialogue is displayed; after DEFINE is accepted with a YES, a new line of dialogue will be displayed:

```
    USE OLD EQU # n
                  OK?
```

The current equation "n" will be displayed in the X Register. If it is to be retained, pressing YES will allow the dialogue for the equation to proceed. If NO is pressed, the current equation will be deleted from memory, allowing a new equation to be entered in its place. If ANLYZ is disabled at this point, the equation will no longer be available.

If YES is pressed, to USE OLD equation, the dialogue will go on to the Constant parameters that were entered for the equation so that they may be altered if desired.

Pressing YES to accept the existing, or the altered, Constant parameters will allow the dialogue to proceed to the first of the Variable parameters for review as with the Constant parameters.

Pressing YES again will bring up the second of the Variable parameters for review and pressing YES once more will show the SAVE dialogue. (See Section &.3)

7.4 SAVE

Once an equation has been entered in memory, it can be saved by reading it out to an extermal device. Answering the SAVE dialogue (at the end of the Define dialogue) with a YES will reveal:

```
DEV=   TTY   *CAS
```

After selecting the appropriate readout device, press YES to start the readout. Pressing NO bypasses the SAVE operation, leaves the equation in memory and returns the display to normal.

7.5 LOAD

To enter an externally recorded equation into memory, the Load feature is used. The second line of the Define dialogue allows the choice of Learn, Load or Use. Answering YES to LOAD shows:

```
DEV=   TTY   *EIA
```

After selecting the appropriate readin device, press YES to start the readin.

7.6 USE

To Use an entered equation, press ANLYZ, enter the desired equation number using STORE, then YES. This brings up:

```
*DEFINE    USE    LOAD
```

Select USE, then press YES to enable the selected equation. The result of the equation will appear in the lower right part of the display, in place of Preset, as USER=.

As data is accumulated, the equation will repeatedly be evaluated and the display updated.

Note that the program converts the decimal entries to a digital form for manipulation and then convert back to decimal form for display. The conversion process has a small rounding off error, but the displayed evaluation results are accurate to at least ±1 least significant digit.

7.7 ACCUMULATOR

Define/Use also includes a floating point register that can be used as an accumulator (ACC) of instantaneous equation results. When USE is enabled, the Accumulator can be enabled by pressing STORE, which will allow the register to be used to keep a running total of the results of the equation's continual evaluation of the data.

Mathematically, the Accumulator will perform ACC = ACC + VAL each time STORE is pressed, where VAL is the equation value currently displayed in the USER register. This feature can be used to sum the results of several equations or of several runs of one equation.

7.8 RESULTS IN A READ OUT

If USE is enabled when a Read Out is started, the current equation will be printed in the Report Header, along with the values for the Constants and Variables for that equation. If ROI # n is specified, the results of the equation for that ROI will be printed in the Header. Figure 7.1 shows a typical Define/Use readout.

If the equation contains a reference to ROI # 0 (the current ROI) and the Read Out is a ROI type, the equation will be re-evaluated for each ROI and the equation's value will be included in the data summary for each ROI.

Current ROI is defined as the ROI in which the cursor is located, or if the cursor is not in an ROI, the ROI immediately to the right of the cursor.

Note that if either of the Variables is not defined, it will be shown in the readout as V1 (or V2)=CL, the default state for the Variables.

Figure 7.1
Define/Use
Brief Readout

```
TAG NO  =        4        3541 ROI BRIEF READOUT                   PAGE    1
MEMORY= 1/2  LIVE TIME=     4000 TRUE TIME=     4080      3 APR 84  13:31

EQU# 1 =(V1-V2)/V1
K1= 0.00E00       K2= 0.00E00       V1=INTG#0     V2=AREA#0
USER= 0.33025E00

ROI#   1  FROM      162 CH#  TO      179 CH#         USER   0.33025E00
          INTEGRAL      33218        AREA      8421
          CENTROID  0.16909E03       FWHM  0.20677E01

ROI#   2  FROM      236 CH#  TO      252 CH#         USER   0.55247E00
          INTEGRAL      40248        AREA     18012
          CENTROID  0.24384E03       FWHM  0.31074E01

ROI#   3  FROM      332 CH#  TO      347 CH#         USER   0.63671E00
          INTEGRAL      23874        AREA      8674
          CENTROID  0.31968E03       FWHM  0.32449E01

ROI#   4  FROM      581 CH#  TO      596 CH#         USER   0.49771E00
          INTEGRAL      17443        AREA      8760
          CENTROID  0.58808E03       FWHM  0.32456E01

ROI#   5  FROM      826 CH#  TO      844 CH#
          INTEGRAL      38504
          CENTROID  0.83446E0
```

7.9 SAMPLE EQUATION

One useful equation that might be entered is the one that defines the percent error (%ERR) of the integral of a given region. This equation will be used to show how a complex equation can be entered with the Define/Use option. The equation reads:

$$\%ERR=1.65\times100(INT+((N\div2)^{2}(A+B)))^{1/2}\div(INT-((N\div2)X(A+B)))$$

Where
- N = the number of channels in the region being evaluated,
- A = the number of counts in the last channel before the region,
- B = the number of counts in the first channel after the region,
- INT = the integral value of the region.

To enter this equation in a form acceptable to the firmware, it must first be slightly altered and entered as:

$$K1\ X\ \sqrt{(V1+(K2\ X\ K2\ X\ V2))}\div(V1-(K2\ X\ V2))$$

Where K1 = 1.65, for a 90% confidence level, X 100
- V1 = Integral of the region,
- K2 = (N ÷ 2),
- V2 = (A + B).

Since A and B are also variables and since the equation only allows for two variables, which have already been defined, they must be entered in a second equation. The second equation, EQU#2, can be defined as V1 + V2, which will correspond to A and B of the first equation.

In entering K2, the evaluative feature of the X Register, mentioned in section 2.3.4, can be used. Enter the ROI's Stop channel number minus Start channel number plus one, divide by 2 and STORE. For example, 419-342+1÷2 will be evaluated and stored as 39.

7.12 THE OPTIONAL AP-PAKS

The standard Model 3541 Ap-Pak is described in section 7.13. Appendix F contains a full listing of the 3541's equations.

The Model 3541C Chromatography Ap-Pak and the Model 3541N Nuclear Medicine Ap-Pak are covered in separate manuals.

These optional Ap-Paks extend the capability of the Define/Use option by providing the predefined functions, each of which will solve a common analysis problem. These equations, numbered 5 through 14, are a part of MCA program memory and will not be lost when power is turned off.

Any defined equation can be accessed by pressing ANLYZ to see:

```
*EQU #1
X=              OK?
```

Enter the Ap-Pak equation number through the X Register. This displays:

```
*DEFINE   USE   LOAD
                OK?
```

Select DEFINE to view the selected equation. If the equation contains constants K1 or K2, these must be defined using the X Register.

To Use an Ap-Pak equation, follow the procedure of section 7.6, using the X Register to enter the desired equation number.

7.13 THE STANDARD AP-PAK (3541)

Table 7.1
Standard Ap-Pak Equations

Number	Name	Callout
5	Minimum Detectable Activity	MDA
6	Compton Edge	COMPT
7	Counts per second	CPS
8	Percent Error of an Area	%ERR
9	Percent Dead Time	%DT
10	part of equations 11 and 13	HLIFE see note
11	Efficiency	EFFIC
12	Activity in μCuries	ACTIV see note
13	Decay Corrected Activity	DCACT see note
14	Dose Rate in mR/hr	DOSE see note

NOTE:

Equation 10 is used to enter the half life for equations 11 and 13. Equation 12 uses the results of equations 10 and 11. Equations 13 and 14 use the results of equations 10, 11, and 12.

Equations 6 through 9 are complete; no further entry is required. Equation 5 and equations 10 through 14 need more data: The values for K1 and K2 must be entered manually before the equation can be solved.

Current ROI means the ROI in which the cursor is located. If the cursor is indexed to another ROI, the equation will be recalculated for that ROI.

#5 Minimum Detectable Activity

Calculates the lowest detectable activity in microcuries for the current ROI. Enter:

- K1 = Gammas per disintegration for the isotope being analyzed.
- K2 = The results of Equation #11.

#6 Compton Edge

Calculates the Compton Edge for the current ROI in a keV energy calibrated spectrum.

#7 Counts per Second	Calculates CPS for all of the displayed spectrum or for the current ROI if one has been entered.
#8 Percent error	Calculates the % error of the Area of the displayed spectrum or of the current ROI if one has been entered.
#9 Percent dead time	Calculates the spectrum's dead time to several decimal places.
#10 Half life for #11 and #13	K1 = Half life of the isotope being measured.
#11 Efficiency	Calculates the detector's efficiency at the energy of the current ROI. Enter: K1 = Gammas/sec for energy being measured. K2 = Decay time in the same time units as the half life in equation 10.
#12 Activity	Calculates the current ROI's activity in microcuries. Equations #10 and #11 must be completed first. Enter: K1 = Gammas per disintegration. K2 = The results of equation 11
#13 Decay Corrected Activity	Corrects equation 12 for decay. Equations #10, #11, and #12 must be completed first. Enter: K1 = Decay time of the isotope in the same time units as the half life in equation 10.
#14 Dose Rate	Calculates the dose rate in milliroentgens per hour for the current ROI. The spectrum must be Energy Calibrated in keV. Equations #10, #11, and #12 must be completed first. Enter: K1 = Yield (gamma quanta per disintegration). K2 = Detector to source distance in meters.

SECTION 8
MODEL 3543 ISOTOPE ANALYSIS OPTION

Model 3543 includes both Isotope Analysis and X-ray Elemental Analysis. It allows the user to perform both qualitative analysis of radioisotope spectra and element analysis of X-ray spectra. Using the included Isotope and X-Ray Libraries, the user can identify unknown radioisotopes or x-ray K, L, and M lines in a spectrum. Appendix G lists the Isotope Library and Appendix H lists the X-ray Library.

In addition to the Library, the ISO ANLYZ function allows the user to select the window width, in energy units, that will be used to evaluate the spectrum. The user also has the option of selecting MANUAL or AUTOmatic operation.

8.1 CHOOSING THE LIBRARY

To use ISO ANLYZ, the spectrum must be ECAL'ed first (section 4.13). Once this is done, ISO ANLYZ can be selected. The first time the ISO ANLYZ key is pressed, the display will show:

```
MODE:     *AUTO  MANUAL     LIBRARY  WINDOW
```

Move the * to LIBRARY and press YES to choose either the Gamma Library or the X-ray Library.

```
LIBRARY:  *GAMMA  X-RAY
```

If the X-Ray Library is chosen, the ECAL dialogue is changed to replace the MEV selection with KEV.3. This allows the user to specify energy in keV with 3 places after the decimal point. This maximum energy entry is limited to to 65.535 keV.

Whenever the Library is changed, the ISO ANLYZ function will turn itself and ECAL off. This allows you to enter ECAL again to choose a new energy for the changed library.

Figure 8.1
Isotope Analysis
Brief Readout

```
MEMORY= 1/2  LIVE TIME=     4000 TRUE TIME=      4080       3 APR 84  13:

ENERGY(KEV )=   0.43664E00 * CH# =  0.10829E02      WINDOW= 2.0   KEV

ROI#    1  FROM    84.8 KEV  TO     92.6 KEV
           INTEGRAL      31204        AREA      8299
           CENTROID  0.881E02         FWHM  0.17706E01

                CD-109    AT     88.0
                NP-237    AT     86.5

ROI#    2  FROM   118.6 KEV  TO    125.9 KEV
           INTEGRAL      40229        AREA     17866
           CENTROID  0.12211E03       FWHM  0.18082E01

                CO-57     AT    122.1

ROI#    3  FROM   162.9 KEV  TO    169.3 KEV
           INTEGRAL      23855        AREA      8263
           CENTROID  0.16597E03       FWHM  0.18343E01

                BA-139    AT    165.9
                CE-139    AT    165.9

ROI#    4  FROM   276.1 KEV  TO    283.0 KEV
           INTEGRAL      17399        AREA      851
           CENTROID  0.27944E03       FWHM

                HG-203    AT
                NP-23
```

Figure 8.2
X-ray Analysis
Brief Readout

```
TAG NO   =         6                                                    PAGE
MEMORY= 3/4  LIVE TIME=     3000 TRUE TIME=          0      3 APR 84  13

ENERGY(EV  )=    0.1994E02  * CH# =  0.22689E02      WINDOW= 20    EV

ROI#    1  FROM  1358.9 EV    TO  2036.8 EV
           INTEGRAL       9554        AREA      7752
           CENTROID  0.17367E04       FWHM  0.12454E03

                SI 14 KA12  AT  1.739  (150)
                RB 37 LB1   AT  1.752  (45 )

ROI#    2  FROM  3053.8 EV    TO  4230.2 EV
           INTEGRAL      34254        AREA     31944
           CENTROID  0.33127E04       FWHM  0.14704E03

                K 19 KA12  AT  3.312  (150)
                CD 48 LB1   AT  3.316  (42 )

ROI#    3  FROM  4310.0 EV    TO  4788.6 EV
           INTEGRAL       5142        AREA      3917
           CENTROID  0.45114E04       FWHM  0.16933E03

                TI 22 KA12  AT  4.508  (150)
                I 53 LB     AT  4.507  (17 )

ROI#    4  FROM  5705.8 EV    TO  7360.8 EV
           INTEGRAL     143970        AREA
           CENTROID  0.64019E04

                FE 26 KA12
```

e Series 35 PLUS includes as standard both External Control/Mössbauer wiring ection 9.1) and Pulse Pileup Rejection/Live Time Correction wiring (section 2).

e options are Model 3531A Mixer/Router wiring (section 9.3) and Model 3533 gital Stabilizer wiring (section 9.4).

1 EXTERNAL CONTROL WIRING External Control wiring provides for Remote Control of the Series 35 PLUS. TTL compatible signals on a rear panel 25-pin connector (J112) allow Mode and MCS Control, provide a Sample Changer interface, and provide signals for Mössbauer applications.

The signals on this connector are divided into five categories:

1. External MCS Signals--which function with the High Performance MCS.

2. Sample Changer Signals--which allow interfacing between the Series 35 PLUS and a Sample Changer mechanism.

3. Remote Control Signals--which allow external control of the Series 35 PLUS when the Serial Computer Interface (Model 3573) is not required.

4. Mössbauer--which allow interfacing to Mössbauer experiments.

5. X-ray analysis signals; option 3544.

Note that the signal receivers and drivers are not designed for rejecting >1 V of common mode or normal mode noise. If the interconnecting cable between the Series 35 PLUS and the remote control device is greater than 3 m (10 feet) in length, it may be necessary to use noise rejection to assure reliable operation.

Some noise rejection techniques that have been used successfully are:

- RC filtering
- Twisted Pair or Coaxial Cable
- Terminating resistors
- Level Shifting drivers and complementary receivers
- Differential drivers and receivers
- Opto-isolators

9.1.1 External MCS Signals

4 External Advance In--Logic 1 = High, Logic 0 = Low. With the MCS set for External Dwell time (section 4.27.2), the leading edge (↑) of the pulse advances the MCS address logic. In the Expand display mode, the minimum dwell is approximately 10 μs. In other modes, the minimum dwell time is 30 μs.

5 External Trigger In--Logic 1 = High or open, Logic 0 = Low. Minimum pulse width = 1 μs. Each MCS sweep will start when the External Trigger is at Logic 1.

22 AOF Out--Logic 1 = High, Logic 0 = Low. Pulse width = 12 μs to 18 μs. Generated at the end of each MCS sweep. The next sweep will start at the end of the pulse if the External Trigger is at Logic 1.

21 AMS IN--Logic 1 = High at 1 mA, Logic 0 = Low or open. Causes the MCS sweep to end and AOF to be generated. The sweep counter (channel zero) will be incremented.

15 Gate IN--Logic 1 = High at 1 mA, Logic 0 = Low. Can be used to enable the Gate function of the Series 35 PLUS. The function is determined by the ANTI/COINC jumper on the ADC board.

9.1.2 Sample Changer Interface Signals

8 Device Busy IN--Logic 1 = Low at 1 mA, Logic 0 = High or open. Collect can start only when this signal is at Logic 0, indicating that the Sample Changer is not busy. Collect will start about 30 ms after the signal goes to Logic 0.

6 Sample Changer Advance Out--Logic 1 = High, Logic 0 = Low. Pulse width = 75 ms to 125 ms. The Pulse is generated at the end of Collect, signalling that the Sample can be changed. The Device Busy In signal can be used to delay the start of the next Collect cycle.

9.1.3 External Control Signals

7 MCA Busy Out--Logic 1 = Low, Logic 0 = High. Indicates that the Series 35 PLUS is not able to accept an input command. Busy goes to Logic 1 during Readout and Clear Data.

9 Collect Status Out--Logic 1 = Low, Logic 0 = High. Indicates that the Series 35 PLUS is in the Collect mode.

10 Readout Status Out--Logic 1 = Low, Logic 0 = High. Indicates that the Series 35 PLUS is in the Readout mode.

11 Stop Collect In--Logic 1 = Low. Logic 0 = High or open. Maximum pulse width = 70 μs. If the pulse is received while the Series 35 PLUS is in Collect and not Busy, Collect will end on the next increment of Live time or at the end of the current MCS sweep. Functions with the Series 35 PLUS under Computer control.

12 Start Collect In--Logic 1 = Low, Logic 0 = High or open. Maximum pulse width = 70 μs. Input to start Collect within about 30 ms using current Preset and Function (PHA or MCS) in the memory group selected by the Memory Switch. Will not be recognized or remembered if the Series 35 PLUS is Busy or under Computer control.

13 Clear Data In--Logic 1 = Low, Logic 0 = High or open. Maximum pulse width = 70 µs. Input to clear data in the memory group selected by the Memory Switch. Will not be recognized or remembered if the Series 35 PLUS is Busy or under Computer control. Causes Series 35 PLUS Busy signal to go Low for about 200 ms.

25 Start Readout In--Logic 1 = Low, Logic 0 = High or open. Maximum pulse width = 70 µs. Input to start Readout with the current Readout parameters from the memory group selected by the Memory Switch. Will not be recognized or remembered if the Series 35 PLUS is Busy or under Computer control.

9.1.4 Mössbauer Signals

14 Address Advance Out--Logic 1 = Low, Logic 0 = High. Pulse width = 1 µsec nominal. Output pulse indicates MCS sweep has advanced to next channel.

16 Sweep Out--Logic 1 = High, Logic 0 = Low. Output level indicates that MCS sweep is active.

17	$SA2^9$/	Latched outputs from
18	$SA2^{10}$/	ADC Address Register
19	$SA2^{11}$/	Logic 1 = Low
20	$SA2^{12}$/	Logic 0 = High

6 Signal Description

J111 (BNC)--COUNT INput for the Model 3522 High Performance MCS.

> Logic 0 < + 0.3 V at 0 mA
> Logic 1 > + 3.0 V at <1 mA
> Pulse Width = 25 ns minimum
> Pulse Pair Resolution = 50 ns minimum

J112 (25-pin Female D-style mating connector furnished)--EXTERNAL CONTROL connector. Signals on this connector are all TTL compatible.

All inputs
> High = 2.4 to 5.0 V or open
> Low 0.0 to +0.3 V at <2 mA
> Pulse Widths >0.5 µs, except as noted.

All outputs
> High + 2.4 to 5.0 V at <0.4 mA (2.4 V)
> Low 0.0 to 0.5 V at <0.4 mA.

2 PUR/LTC WIRING

The pulse Pile Up Rejection and Live Time Correction (PUR/LTC) wiring adapts the Series 35 PLUS internal ADC for use with a Model 2020 PUR/LTC amplifier, or equivalent. The REJ jumper plug in the amplifier should be set for POSitive polarity.

The amplifier's PUR circuit inspects each input for the pulse pileup condition and permits the ADC to convert only single-event signals. If a pileup condition is detected, the REJ signal from the PUR circuit causes the ADC to discard this pulse. Refer to section A.11.11 for the signal description.

The ADC signals each acquisition (linear gate time) to the amplifier by signal LG. The rising edge of LG signifies that the pulse gate is now closed and the pile-up inspection circuit can be disabled. If a pulse has been rejected, the Live Time Correction circuit provides a busy signal (DT) to the Analyzer's live time circuit to correct for the additional dead time.

The amp's 3-pin PUR connector is connected to the S-35 PLUS's PUR connector (J116). The amp's DT connector is connected to the Series 35 PLUS's

3 OPTIONAL MIXER/ROUTER WIRING (Model 3531A)

This option allows the connection of a four-input Mixer/Router (Canberra Model 8222A or 8222B, or equivalent) to the Series 35 PLUS's Mixer/Router connector (J105). One Mixer/Router expands the single-input ADC to four inputs. Two or four Model 8222As may be connected to expand to eight or sixteen inputs.

The Mixer/Router, the Model 3521 ADC, and Model 3531A wiring combine to give multi-input PHA or MCS data acquisition capability to the Series 35 PLUS. Note: the Model 3522 High Performance MCS is single-input only.

The M/R key (section 4.22) on the Series 35 PLUS enables the MCA for routing. Pressing the key allows the operator to choose how many inputs are to be routed. With the M/R function enabled, the full memory will be equally divided between the selected number of inputs.

With two or four inputs, each input can be independantly started, stopped, or have its data manipulated.

With eight or sixteen inputs, the inputs are tied together in groups of four inputs each for starting or stopping data acquisition, or for data manipulation.

If only one input is to be used, the Mixer/Router should not be connected because its Dead Time and Inhibit signals can affect data storage.

The signal description for the Mixer/Router Wiring is listed in section A.11.3.

4 OPTIONAL DIGITAL STABILIZER WIRING (Model 3533)

The Model 3533 wiring option allows a Digital Stabilizer to be connected to the Series 35 PLUS's internal ADC through the J106 connector. The Stablizer can stabilize the ADC Gain, the ADC Zero, or both. The operation of the Analyzer with the Stabilizer is detailed in the Stabilizer's Operator's Manual.

The signal description for the Stabilizer Wiring is listed in section A.11.4.

SECTION 10
SIGNAL PROCESSING OPTIONS

he signal processing options available for the Series 35 PLUS are the Model 521 AMP/ADC (section 10.1), the Model 3522 High Performance MCS (section 0.2), the Model 3523 Multi-ADC Interface (section 10.3), and the Model 3524 xternal ADC Interface (section 10.4).

0.1 MODEL 3521 AMPLIFIER/ADC

The Model 3521's use is covered in sections 2, 3, and 4 of this manual. It can be supplemented by the Model 3522 High-Performance MCS option or replaced by the Model 3524 External ADC Interface option or Model 3523 Multi-ADC Interface option.

0.2 MODEL 3522 HIGH-PERFORMANCE MCS

The Model 3522 High-Performance MCS option is used to allow a higher count rate in MCS operation. The standard MCS is limited to a count rate of about 20 kHz, maximum, while the Model 3522 allows an input count rate of up to 20 MHz. The Model 3522 is optional with the Model 3521 Amp/ADC, but must be used for MCS operation with the Model 3523 Multi-ADC Interface or Model 3524 External ADC Interface.

Refer to section 4.20 for MCS operation, to section 4.27.2 for MCS Preset, and to section 9.1.1 for external MCS control.

For this option, the output signal from an external high-speed SCA unit is connected to the rear panel's COUNT IN connector (J111).

Note that if the selected dwell time is equal to or less than 30 µsec, the data portion of the display will be blanked during High-Performance MCS Collect. This is done to allow the option more access time to the memory. The data collected will be visible on the screen when Collect ends.

If four inputs have been selected, each ADC will be stored in one quarter of the memory, with ADC #1 in the first quarter, ADC #2 in the second quarter, and so forth.

The MEMORY switch allows control of the individual inputs. With the MEMORY switch in the 1/1 position, all ADCs will be started or stopped together.

If the MEMORY switch is in the 1/2 or 2/2 position, all ADCs assigned to that half of the memory will be started or stopped together. For instance, if two inputs are selected, either of the two ADCs may be started or stopped independently. If four inputs are selected, ADCs 1 and 2 or 3 and 4 may be started or stopped together. With the MEMORY switch in the 1/4, 2/4, 3/4, or 4/4 position, each of the four ADCs may be started or stopped independently.

In a similar manner, the MEMORY switch position will control the use of a region's Preset, Clear Data/Clear Time or Energy Calibrate functions.

Note that if the MEMORY switch is set to an inactive region of the memory, the display will show the Canberra logo. If the MEMORY switch is set to an active section of memory, the Dead Time Meter will be displayed, showing that the region is collecting.

The Series 35 PLUS's Firmware checks the ADCs at about a one microsecond scan rate to see if any ADC's conversion is complete. The first ADC found ready will have its converted address gated onto an address bus.

If the address is within the ADC's assigned range, is not inhibited by INHAD/ (see the Signal List in appendix A.11.9) and is not channel address zero or one, a PHA add one or subtract one cycle is performed. The Data Accepted signal is then generated to release the ADC for another conversion. Note that the address from the ADC must be stable during the entire memory cycle.

The ADC is prevented from storing an address beyond its assigned memory group. In order to minimize ADC dead time, the ADC's RANGE switch should be set to equal the assigned memory size for that ADC.

10.3.3 MCS Operation

Single-input MCS operates as described in the Multichannel Scaling operating instructions (section 4.20). To perform single-input MCS data acquisition, the M/R front panel function must be turned off and either the Model 3522 High Performance MCS option or an external MCS unit must be used.

A jumper plug on the Model 3523 Interface Board is provided for inverting the Count Enable Gate polarity. In the COINCidence position, an open connector (nothing connected) or a positive TTL level will enable counting; a TTL low level or ground will disable counting.

In the ANTIcoincidence position, an open connector or a positive TTL level will disable counting; a TTL low level or ground will enable counting.

10.3.4 Mixer/Router

The Model 8222 Mixer/Router can be used with any of the external ADCs to provide routing of up to 16 inputs to the memory. Using the Mixer/Router will allow its inputs to be routed to that ADC's memory segment. See the Model 8222 Operator's Manual for complete instructions.

Note: To use a Model 8220 Mixer/Router with the Series 35 PLUS, consult the factory.

10.3.5 Signals

Refer to figure 10.1 for PHA Cycle Timing Diagram.

Chassis connectors (J106, J113, J114, J115): female 25-pin; Amphenol type 17-10250.

Logic levels:
    Logic Hi = +2.4 to +5 volts;
    Logic LO = 0.0 to +0.3 volts.

ADC INTERFACE

Canberra ADC to store PHA data in the Series 35 PLUS's memory. The ADC is provided with Preset, Start/Stop Collect, Clear Data and Energy Calibrate functions. Live and True Timers are provided for the ADC.

10.4.1 Setup

For ADC operating instructions, refer to the Operator's Manual for the ADC being used. To connect the ADC to the Series 35 PLUS, use the 25-pin cable supplied with the ADC. A 25-pin cable can be made in the field by referring to the Signal List in section A.11.9.

On the Series 35 PLUS's rear panel, connect the external ADC to J106. Adjust the ADC's Gain, Range and Offset as desired.

10.4.2 PHA Operation

The ADC will store data in the MCA's memory as determined by the position of the MEMORY switch.

Gain, Range and Offset will be selected at the ADC.

The ADC is prevented from storing an address beyond its assigned memory group. In order to minimize ADC dead time, the ADC's RANGE switch should be set to equal the assigned memory size.

10.4.3 MCS Operation

Single-input MCS operates as described in the Multichannel Scaling operating instructions (section 4.20). To perform single-input MCS data acquisition, either the Model 3522 High Performance MCS option or an external MCS unit must be used.

A jumper plug on the Model Interface Board is provided for inverting the Count Enable Gate polarity. In the COINCidence position, an open connector (nothing connected) or a positive TTL level will enable counting; a TTL low level or ground will disable counting.

In the ANTIcoincidence position, an open connector or a positive TTL level will disable counting; a TTL low level or ground will enable counting.

10.4.4 Mixer/Router Operation

The Model 8222 Mixer/Router can be used with the external ADC to provide routing of up to 16 inputs to the memory. See the Mixer/Router Operator's Manual for complete instructions.

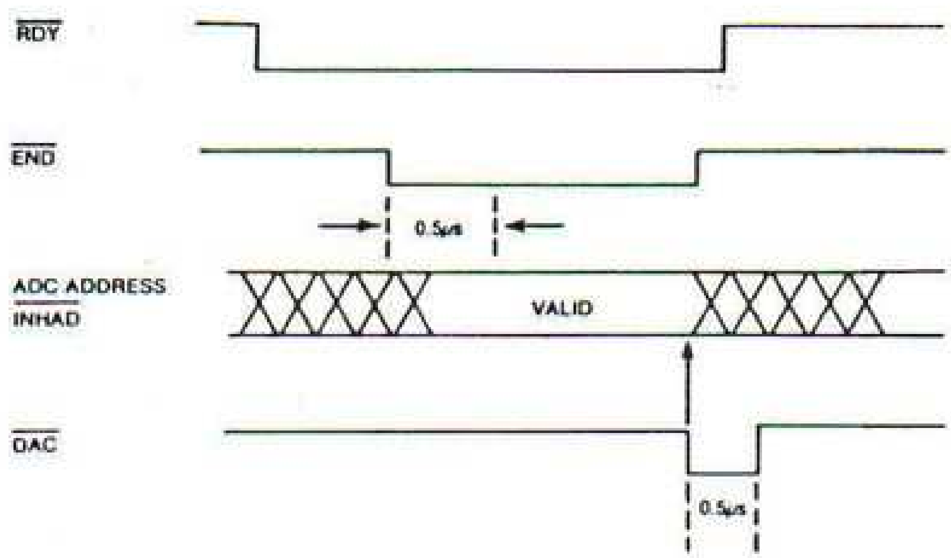


Figure 10.1
PHA Cycle
Timing Diagram

10.4.5 Signals

Chassis connector (J106): Female 25-pin; Amphenol type 17-10250.

Logic levels:
Logic HI = +2.4 to +5 volts;
Logic LO = 0.0 to +0.3 volts.

APPENDIX A
INTERNAL CONTROLS AND CONNECTORS

This appendix provides information that will be helpful in case of equipment malfunction. With common test equipment, such as an oscilloscope and a voltmeter, and reference to the information contained in this section, it will usually take no more than a telephone call or a letter to Canberra's Customer Service Department or your local Canberra Representative to quickly pinpoint the fault.

In the signal lists, negative true signals are shown with a slash (/) after the signal name. For instance, Dead Time is shown as DT/.

NOTE

> Internal controls and jumpers that are not specifically mentioned in the following sections are either for test purposes or for factory installed options. They must not be moved.

A.1 OPERATING VOLTAGE SELECTION (figure A.1)

To change the operating voltage of the analyzer, move the plastic fuse shield, next to the ac line cord socket, to one side. The voltage selection printed circuit card (J4) is located just below the fuse. The operating voltage that the analyzer is set for will be visible on the card.

To change between 120 and 240 volts or to change to low-line voltage (100 or 220 volts), pull J4 out of its socket and replace it so that the desired voltage is visible beneath the fuse. A pair of needle-nose pliers is useful here.

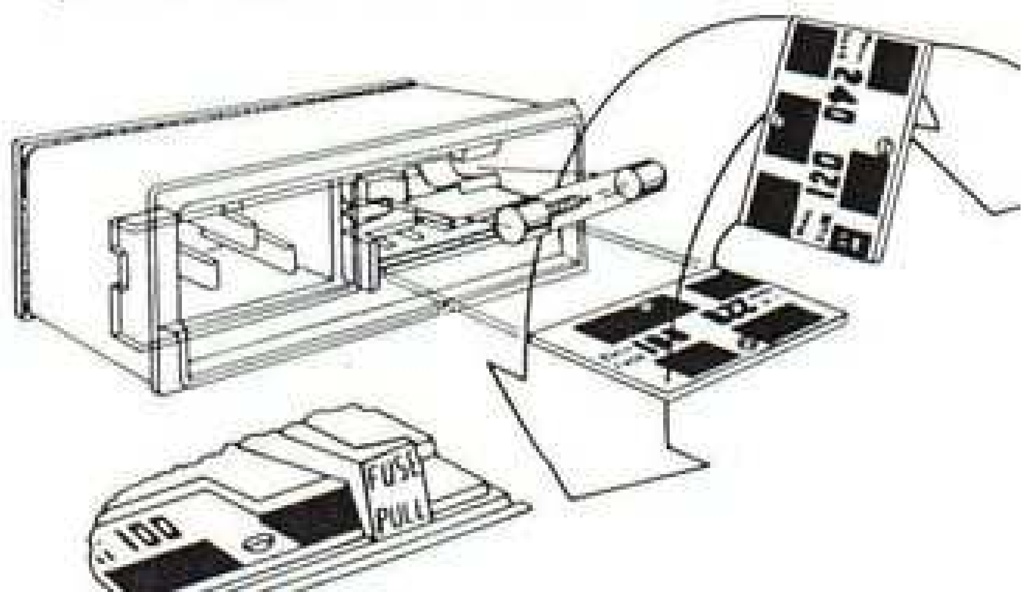


Figure A.1
Voltage Selection

Be certain to check the fuse rating when changing the operating voltage; a change from 100/120 volts to 220/240 volts, or the reverse, will require a change of fuse to the proper rating as well. See table A.1.

Table A.1
Series 35 PLUS Line Voltage Selection

Position	Operating Range	Line Fuse Rating
100	85 V to 110 V	1.5 A slow-blow
120	105 V to 130 V	1.5 A slow-blow
220	190 V to 240 V	3/4 A slow-blow
240	210 V to 260 V	3/4 A slow-blow

NOTE: For domestic operation at 220 volts, the supplied power cord should be replaced with an Underwriters' Laboratories listed, 220 V power cord, such as Belden's part number 17566.

A.2 CPU BOARD (figure A.2)

The D-E jumper supplies keep-alive power to the memory. Position D connects the on-board battery to the memory. Moving the jumper to E for about a minute, then back to D, will clear the memory and reset all parameters to factory default.

The 50 Hz wire jumper must be in place in areas using a 50 Hz line frequency and must be removed in areas with a 60 Hz line frequency. It defines the True Time clock's time base. If this jumper is changed, be sure to move the D-E jumper as mentioned in the paragraph above.

A.3 ADC BOARD (figure A.3)

AN/CO jumper selects ANticoincidence gating or COincidence gating. Shipped in the CO position.

PHA/SVA jumper selects Pulse Height Analysis or Sampled Votage Analysis. Shipped in the PHA position.

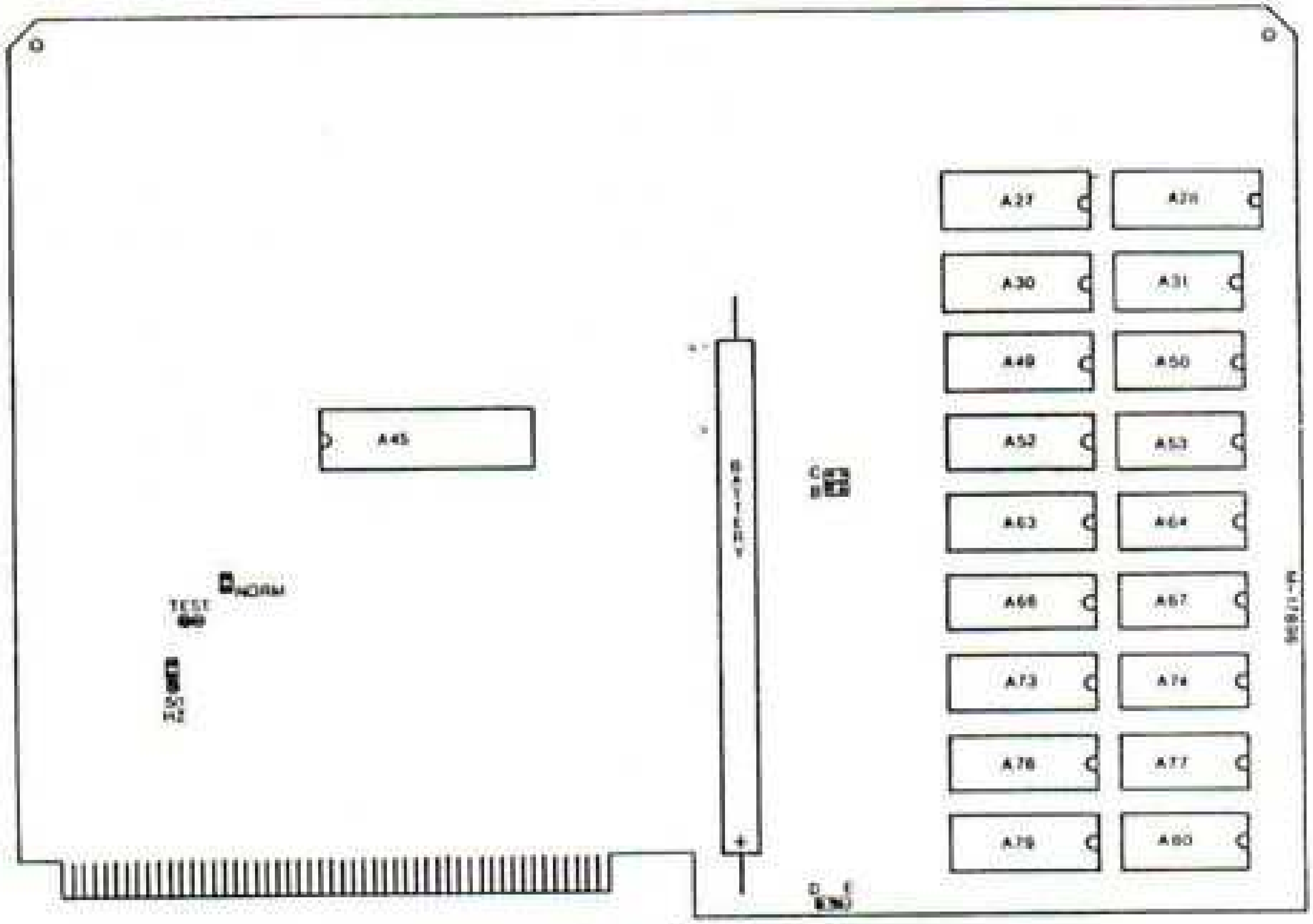
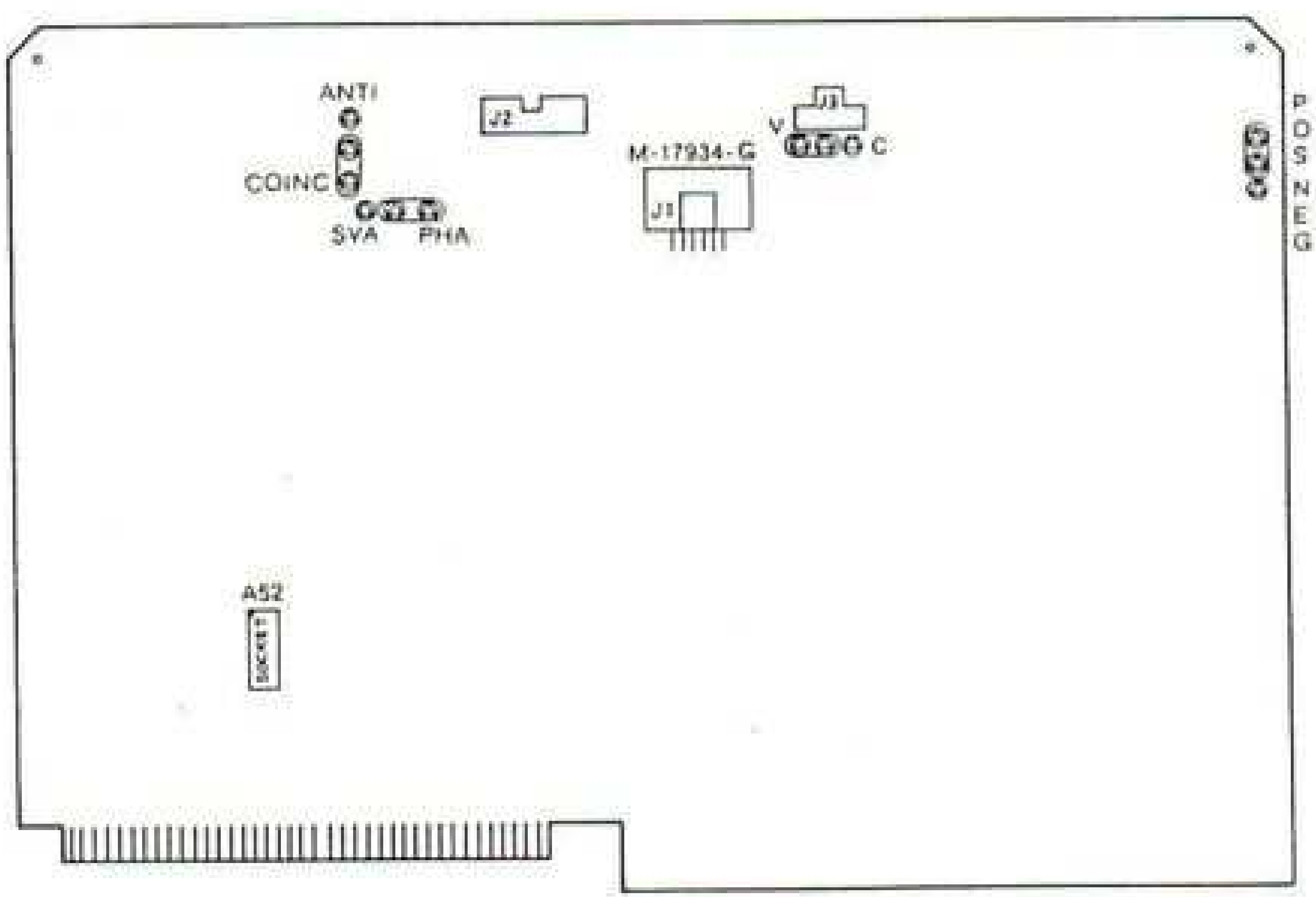


Figure A.2 CPU Board



V/C jumper to select the Voltage sensitive input mode or the Charge sensitive input mode. Shipped in the V position.

P/N jumper to select Positive inputs or Negative inputs in the Voltage sensitive mode only. Shipped in the Positive position.

A52 in the lower left corner of the board receives a plug for the Model 3531A Mixer/Router option. The plug, which is shipped with the option, is configured for a particular memory size; it must be used for that memory size only.

A.4 DISPLAY BOARD AND MONITOR

The only user control on the Display board is the Test Switch, S1, located at the rear of the top edge of the board. Depressing this switch will superimpose a test pattern, composed of rows of dots, on the screen. Its primary use is in checking the linearity of the monitor.

The switch may be locked in the test position by rotating it clockwise after it has been depressed. The switch must be restored to its normal, unlocked, position before proceeding with normal operation of the analyzer.

There is a connector on the monitor's CRT. Its pinout, from right to left when connected to the CRT, is:

Pin	Signal
1	+15 volt return and LSYNC return
6	LSYNC
7	+15 volt supply
8	VIDEO
9	FSYNC/
10	VIDEO return and FSYNC/ return

A.5 MISCELLANEOUS LOGIC BOARD (figure A.4)

C-IN/C-OUT jumper controls the transmission of control codes to a peripheral device. Control codes are used by Canberra MCAs during Readin. The jumper is shipped in the C-IN position, which enables transmission of the codes. Appendix E lists the I/O control codes.

Since some Readout-only devices will not accept control codes, the jumper may have to be moved to the C-OUT position. If a peripheral device is ordered from Canberra at the same time as the Series 35 PLUS, the jumper will be positioned correctly for that device.

Jumper A-B controls signal Ready. In the A position, DTR (Data Terminal Ready) generates Ready. Position B allows either DTR or RRDY (Receiver Buffer Empty) to generate Ready; used with faster EIA devices. Shipped in the A position.

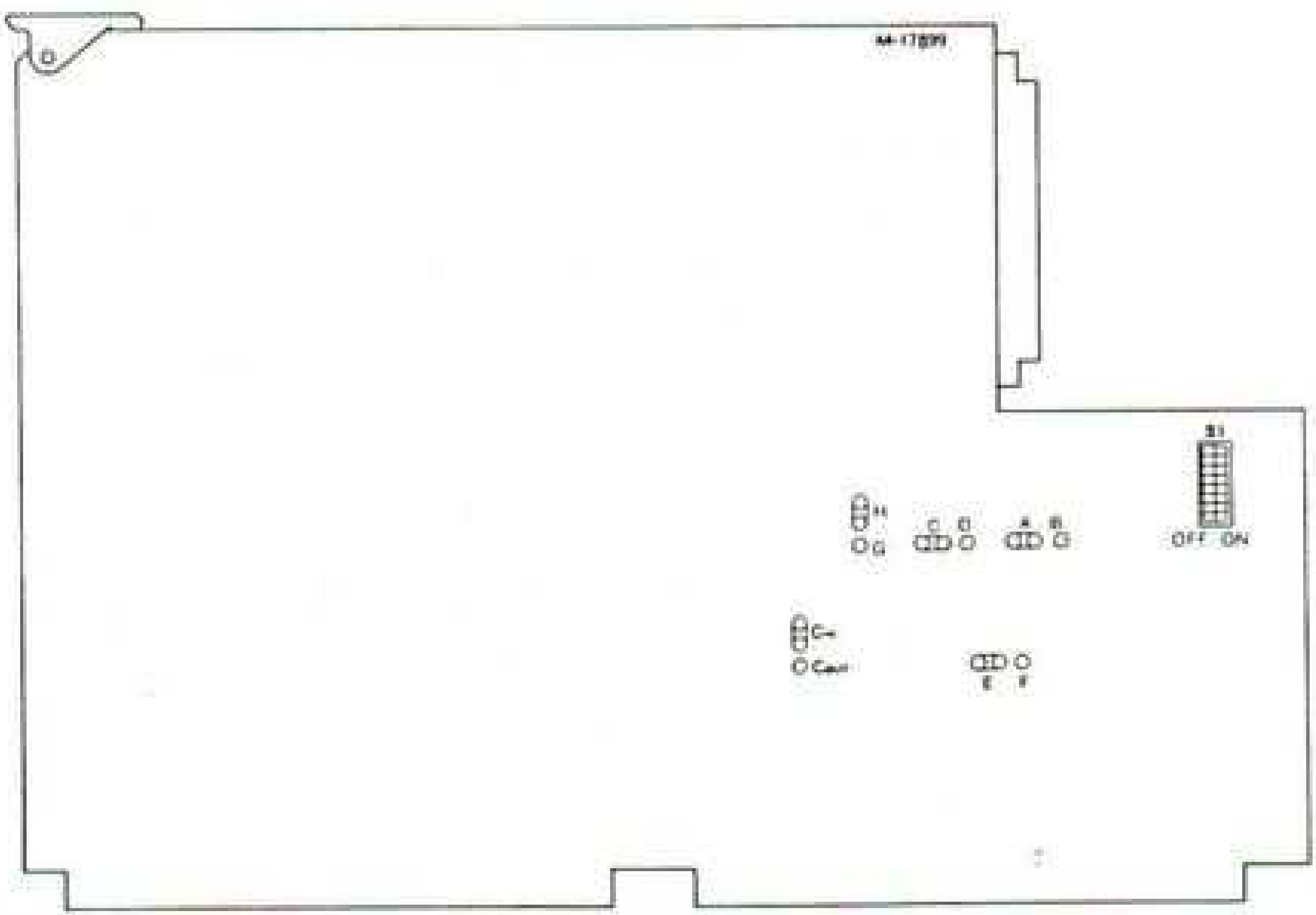


Figure A.4
Miscellaneous Logic Board

Jumper C-D controls signal Interrupt. In the C position, TXMT (Transmitter Buffer Empty) signals the USART Interrupt. In the D position TRDY (Transmitter Empty) signals the USART Interrupt; used with faster EIA devices. Shipped in the C position.

Jumper E-F controls the polarity of the BUSY flag, which is used to enable the Model 5421M Cassette Recorder's tape drive motor and to provide a Busy indication to an EIA device during Readin. Shipped in the E (negative true) position. If a positive true flag is required, the jumper must be changed to the F position.

Set the G-H jumper as follows:

- G- For use with a Model 8222A or 8222B Mixer/Router WITHOUT the -01 Live Time Option, or for the Model 3523 Multi-ADC Interface.
- H- For use with a Model 8222A or 8222B Mixer/Router WITH the -01 Live Time Option or for the Models 3524 External ADC Interface or 3521 Amp/ADC not using a Mixer/Router.

The DIPswitch, S1, controls several functions concerned with data I/O, as follows:

Shipped	Number	Function	On	Off
OFF	1-3	Set EIA rate	See table A.2	
ON	4	EIA rate	Variable	110 baud
ON	5	Parity select	Enable	Disable
ON	6	Parity	Even	Odd
ON	7	TTY rate	300 baud	110 baud
OFF	8	CAS/EIA	Cassette	EIA device

NOTE: Switches 7 and 8 can be set to the OFF position and, by grounding J101-pin 23 for switch 7 or J101-pin 18 for switch 8, can be remotely set to the ON position.

The Model 5421F Cassette Interface can be used for both the cassette and an EIA device. When the interface's TERMINAL/CASSETTE switch is moved "out", switch 8 will be remotely set to ON and the Analyzer will be set for cassette operation. Refer to the Model 5421 manual for details of operation.

Table A.2
Standard I/O Baud Selection

Baud Rate	Switch Numbers 1	2	3
300	OFF	OFF	OFF
600	ON	OFF	OFF
1200	OFF	ON	OFF
2400	ON	ON	OFF
4800	OFF	OFF	ON
9600	ON	OFF	ON

A.6 LOW VOLTAGE POWER SUPPLY

The Low Voltage Power Supply has five LED indicators at the top of the board which show that each supply is functioning. The indicators, from front to back, are:

+ 5 volts
-24 volts
+24 volts
+12 volts
-12 volts

Connector J1, also at the top of the board, has the following pinout:

Pin	Signal
1	ac to + 5 regulator
2	ac to + 5 regulator
3	ac return from + 5 regulator
4	ac return from + 5 regulator
5	ac return from ±12 and +15 regulators
8	+24 volts to preamp connector
11	preamp connector ground
12	HVPS connector ground
13	ac to ±24 regulator
14	ac to +5 regulator
15	ac return from +5 regulator
16	ac to ±12 and +15 regulators
17	ac to ±12 and +15 regulators
18	ac return from ±12 and +15 regulators
20	+24 to HVPS connector
21	-12 volts to preamp connector
22	+12 volts to preamp connector
23	-24 volts to preamp connector
24	ac return from ±24 regulator
25	ac return from +24 regulator

A.7 X-Y PLOTTER BOARD (figure A.5)

Control NABL is a factory set for low level true. To invert this level, change jumper B-C to B-A.

Control SEEK is factory set for high level true. To invert this level, change jumper E-F to E-D.

The pinout of the 25-pin connector at the top of the board is the same as the pinout of the X-Y Plotter connector (J107 or J108) on the analyzer's rear panel.

For line plotters that do not provide an Advance output, the plot rate can be adjusted from 2 to >10 channels per second with RV1. Line plotters without an external disable must have their servos turned OFF when not in the Plot mode.

Refer to section A.11.5 for rear panel connector signal list.

A.8 SERIAL INTERFACE BOARD (figure A.6)

The 52/53/73 jumper defines the use of this board; the jumper must be in the 52 position for use with the Model 3552A Printer/Plotter Interface, in the 53 position for use with the Model 3553 Graphics Plotter Interface or in the 73 position for use with the Model 3571 or 3573 Computer Interface.

The C-D jumper must be in the position specified in the option's operating instructions.

The H-I jumper must be in the H position for the Model 3571 or 3573 Computer Interface. Other options use the I position.

The M-N jumper has a unique function for the Models 3252A and 3253; it has no function for the Model 3571, 3573, and 3573B.

3252A: The M-N jumper enables transmission of control (CTL) characters.

- N (or OUT) - CTL characters are transmitted.
- M - inhibits CTL. For readout-only devices which will not accept control characters.

Refer to section A.11.5 for rear panel connector signal list.

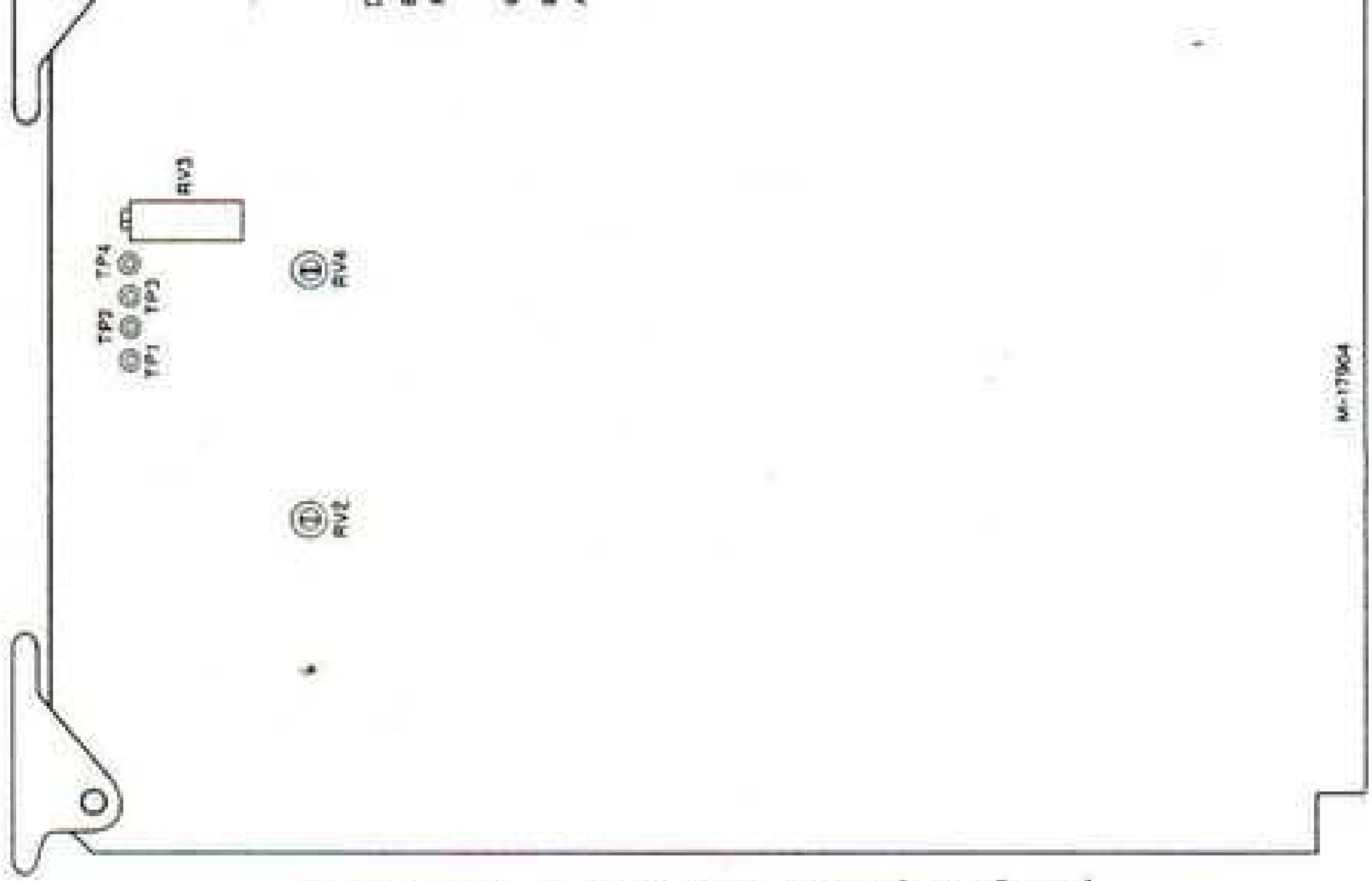


Figure A.5 X-Y Plotter Interface Board

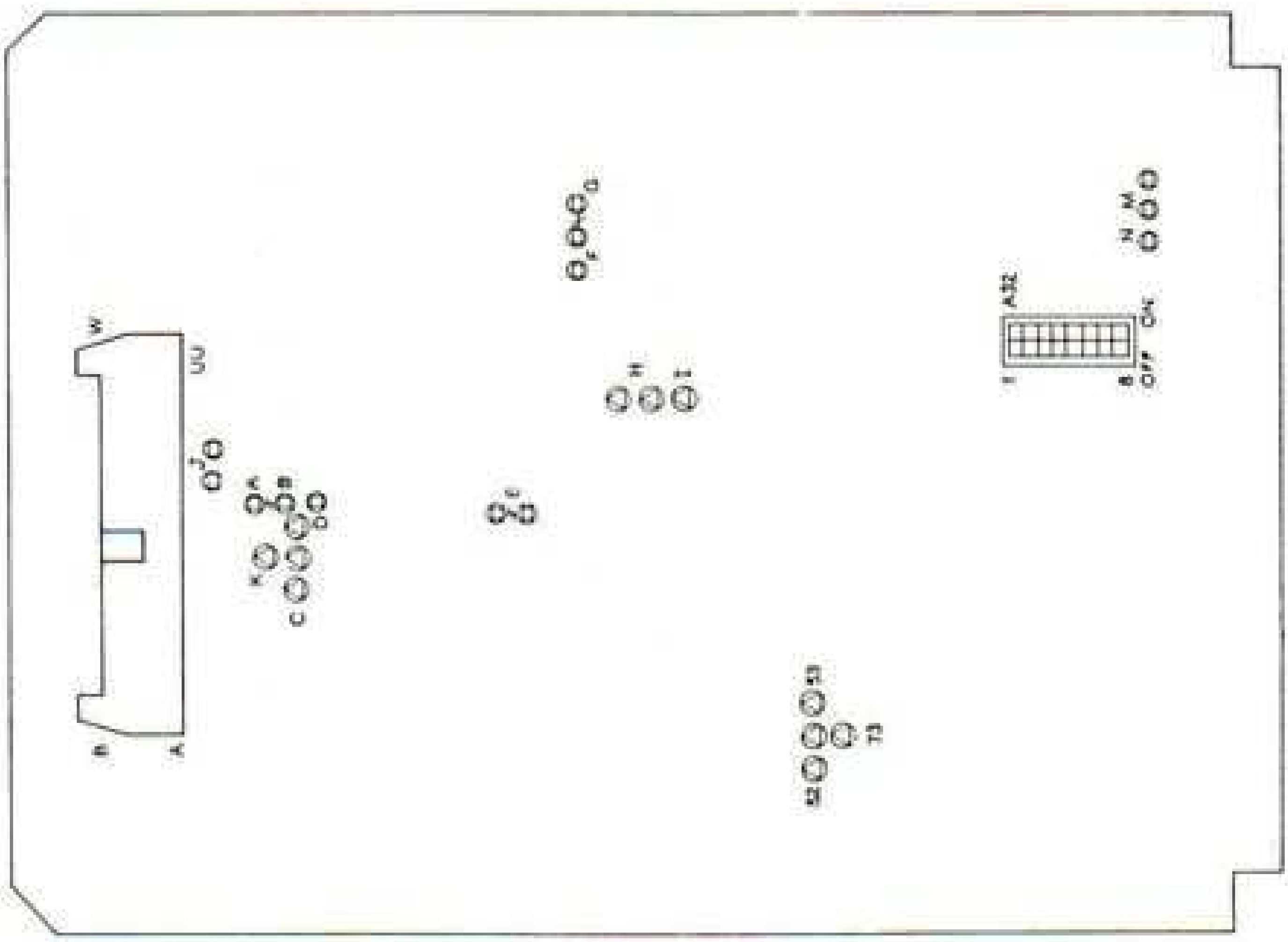


Figure A.6 Serial Interface Board

3553: the M-N jumper controls plot mode
N (or OUT) - line-plot mode is enabled.
M - point-plot mode is enabled.

3571, 3573, and 3573B: M-N jumper has no effect. The board is shipped with no M-N jumper installed

The DIPswitch at the bottom of the board controls several functions as defined below:

Number	Function	On	Off
1-4	Set baud rate	See table A.3	
5	Word Length	7 Characters	8 Characters
6	Parity Select	Disables	Enables
7	Parity	Odd	Even
8	Stop Bits	One	Two

Table A.3
Serial I/O Baud Rate Selection

Baud Rate	Switch Numbers 1	2	3	4
75	OFF	ON	ON	ON
110	ON	OFF	ON	ON
134.5	OFF	OFF	ON	ON
150	ON	ON	OFF	ON
300	OFF	ON	OFF	ON
600	ON	OFF	OFF	ON
1200	OFF	OFF	OFF	ON
1800	ON	ON	ON	OFF
2000	OFF	ON	ON	OFF
2400	ON	OFF	ON	OFF
3600	OFF	OFF	ON	OFF
4800	ON	ON	OFF	OFF
7200	OFF	ON	OFF	OFF
9600	ON	OFF	OFF	OFF
19200	OFF	OFF	OFF	OFF

For the External Clock option (available by special order), set all switches to ON.

See the option's operating instructions for the correct switch settings.

The connector at the top of the board has the following pinout:

For RS 232 (Models 3552, 3553 3571 and 3573B) Pin	Signal	For RS 422 (Model 3573) Pin	Signal
A	Ground	LL	Clear to send +
M	Data in	KK	Clear to send -
C	Data out	PP	Carrier detect +
L	RTS	RR	Carrier detect -
H	CTS	TT	Data set ready +
D	DSR	SS	Data set ready -
B	Ground	NN	Data out +
J	DCD	MM	Data out -
K	Flag	VV	Ground
N	DTR	UU	Ground
E	Busy	CC	Data in +
Z	422 In	DD	Data in -
X	Ground	FF	Data term ready +
Y	422 Out	EE	Data term ready -
W	Ground	HH	Request to send +
		JJ	Request to send -
		AA	Ground
		BB	Ground

A.9 MAGNETIC TAPE INTERFACE BOARD (figure A.7)

The ABC, DEF, and GHI jumpers define the data-block size. Factory set to 256 channels/block.

Block Size	Jumper Configuration		
note 1	B-C	E-F	H-I
256	A-B	E-F	H-I
512	B-C	D-E	H-I
1024	A-B	D-E	H-I
2048	B-C	E-F	G-H
4096	A-B	E-F	G-H
8192	B-C	D-E	G-H
note 2	A-B	D-E	G-H

Note 1: not valid; defaults to 256.
Note 2: not valid; defaults to 8192.

Refer to section A.11.5 for rear panel connector signal list.

The XYZ jumper allows the interface to record a time-of-readout Tag: a six-character Time-of-Day Code followed by a six-character Data Code at the start of each block. Factory set to disable the Tag Word.

Position	Tag Word
Y-Z	Disabled
X-Y	Enabled

The KLM jumper is set to K-L to enable communication between the interface and the Model 8531A Controller. The L-M position is not currently used.

The 2716/2732 jumper is set to 2716, the type of chip in socket A50. The 2732 position is not currently used.

Refer to section A.11.5 for rear panel connector signal list.

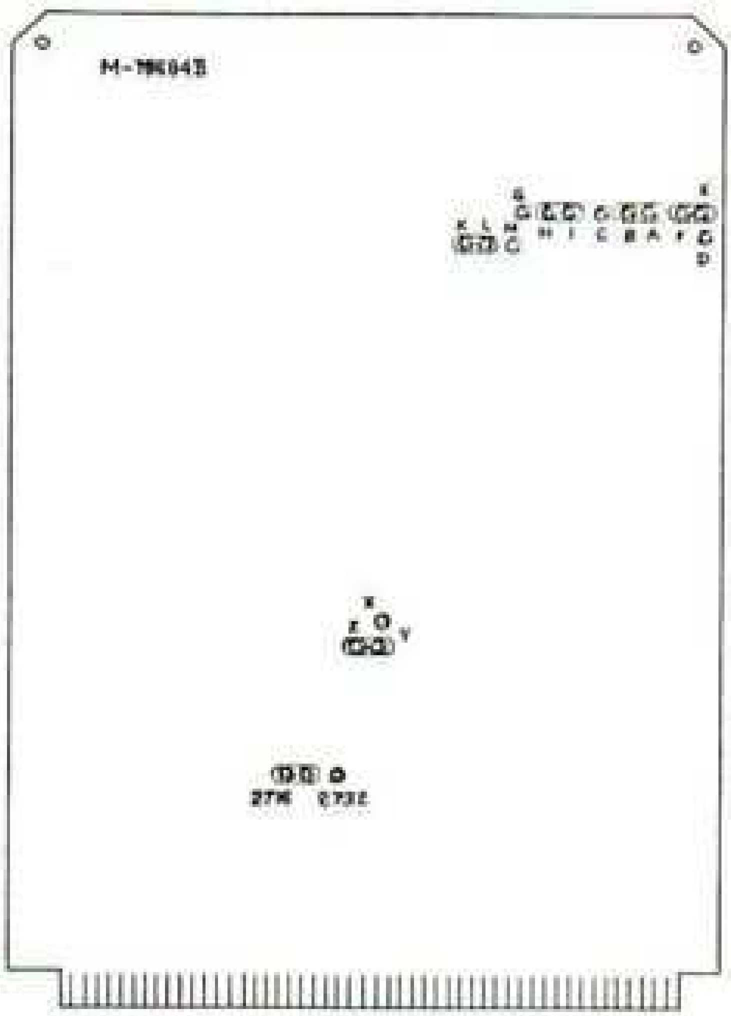


Figure A.7
Mag Tape Interface Board

A.10 GPIB INTERFACE BOARD (figure A.8)

The GPIB board has one jumper, which must always be in the B0 position, and an 8-pole rocker switch. Refer to the Model 3572 GPIB Interface manual for the switch settings.

Refer to Section A.11.5 for rear panel connector signal list.

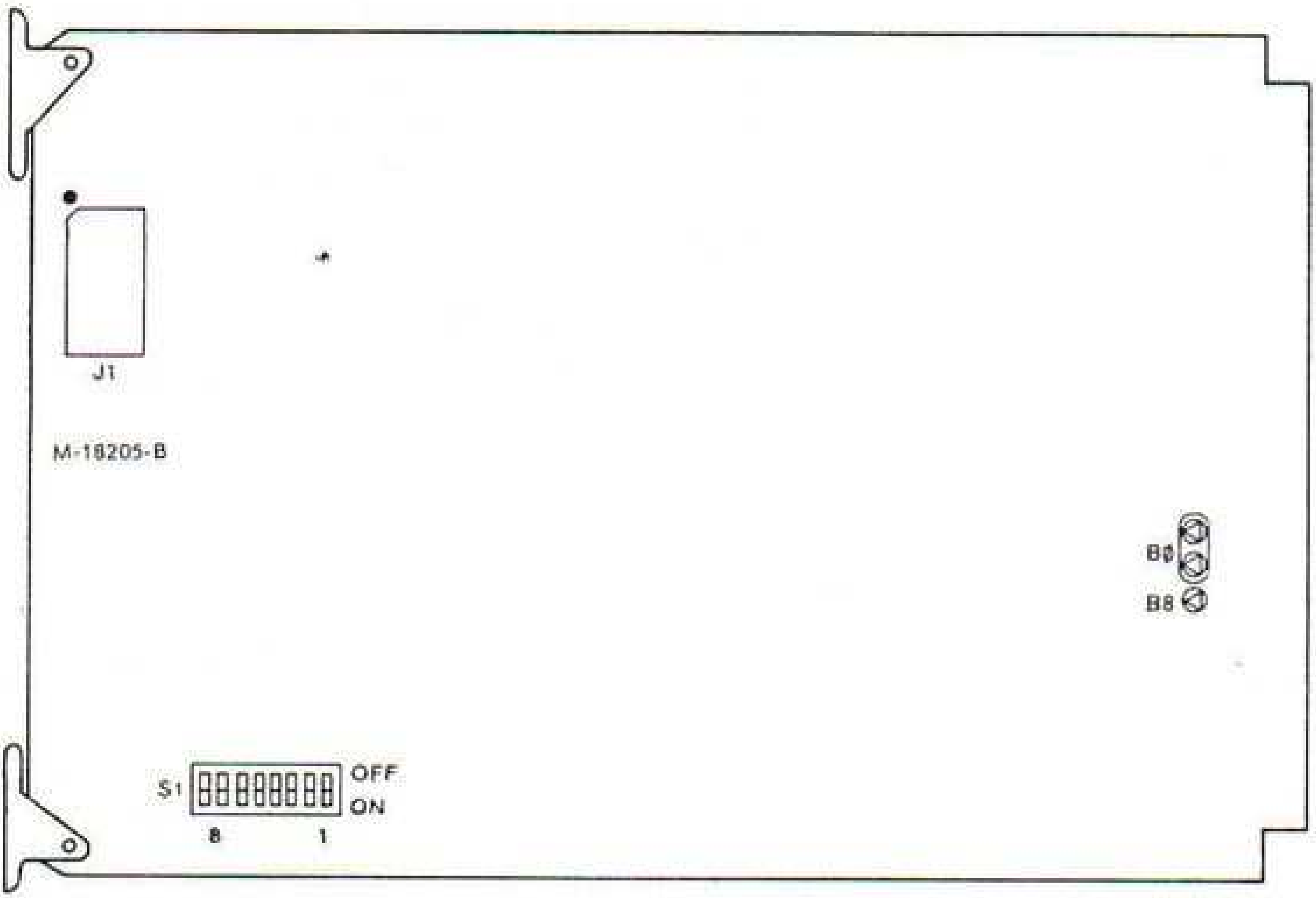


Figure A.8 GPIB Board

A.11 REAR PANEL CONNECTORS (figure B.4)

Jack#	Function	Connector Siz
J101	EIA (RS232)	25 pin
J102	TTY	9 pin
J104	AC Power In	-
J105	Mixer/Router	25 pin
J106	Stabilizer/External ADC	25 pin
J107}	I/O Options (any 2 of following)	25 pin
J108	3551,-52,-53,-54,-71,-72,-73,-74	25 pin
J109	HVPS Power Enable	3 pin
J110	Preamp Power	9 pin
J111	MCS Count In	BNC
J112	Mössbauer/External Control	25 pin
J113	External ADC	25 pin
J114	External ADC	25 pin
J115	External ADC	25 pin
J116	Pileup Rejector	3 pin
J117	Pileup Rejector	BNC

Note 1: J116 and J117 are assembled on one plate; indentified "PUR"
Note 2: J111 and J112 are assembled on one plate; identified "REMOTE"
Note 3: The Model 3572 connector has 24 pins

A.11.1 J101 - EIA

Pin	Signal	Description
1	AA	Ground
2	BA	Received data (in from device)
3	BB	Transmitted data (out to device)
4	CA	Ready to send (in from device)
5	CB	Clear to send (out to device)
6	CC	Data set ready
7	AB	Ground
8	CF	Received line signal detector
9	--	+12V dc out
10	--	-12V dc out
11	--	Flag (in from device)
18	--	5421M external enable
20	CD	Data terminal ready
23	--	TTY baud select
25	--	Busy (to device)

A.11.2 J102 TTY Signals

Pin	Signal	Description
1	TTY Sol –	Motor Start Return
2	Tx +	Transmit
3	Gnd	Ground
4	TTY Sol +	Motor Start
6	Rx –	Receive Return
7	Rx +	Receive
9	Tx –	Transmit Return

A.11.3 J105 Mixer/Router Signals

Pin	Signal	Description	Direction Referred to Series 35+
1	EG3	Enable Group 3	Out
2	HIMR/	High Performance M/R	In
3	RA	Time Code Bit 0	In
4	MRAK/	Time Code Transfer Complete	Out
5	RB	Time Code Bit 1	In
6	EG4	Enable Group 4	Out
7	EG2	Enable Group 2	Out
8	IND/	Enable 16 Inputs	Out
9	$2N_{-2}$	Routing Code Bit 0	In
10	$2N_{-1}$	Routing Code Bit 1	In
11	2N	Routing Code Bit 2	In
12	2M	Routing Code Bit 3	In
13	INA/	Enable 2 Inputs	Out
14	TRMR/	ADC Conversion Complete	Out
15	CTM/	Clear Timers	Out
16	IA1/	Inhibit Add 1	In
17	TRMR/	ADC Conversion Complete	Out
18	EG1	Enable Group 1	Out
19	MRTT/	Time Tick Ready	In
20	GND	Ground	--
21	DT/	Dead Time	In
22	GND	Ground	--
23	INB	Enable 4 Inputs	Out
24	GND	Ground	--
25	INC/	Enable 8 Inputs	Out

Signal Levels

High (H) 2.4 to 5 V at <0.4 mA (2.4 V)

Low (L) 0.0 to 0.3 V at 2 mA

Mixer/Router Address Routing

The following chart is a truth table for the routing code bits (J105, pins 9, 10, 11, and 12). It also shows the relationship between the selected number of inputs and the memory segment where each input is stored.

Where
1 = >+3.0V
0 = <+0.3V
X = don't care

Inputs	Memory	2^M	2^N	2^{N-1}	2^{N-2}
1	Full	x	x	x	x
2	1/2	0	x	x	x
	2/2	1	x	x	x
4	1/4	0	0	x	x
	2/4	0	1	x	x
	3/4	1	0	x	x
	4/4	1	1	x	x
8	1/4	0	0	0	x
		0	0	1	x
	2/4	0	1	0	x
		0	1	1	x
	3/4	1	0	0	x
		1	0	1	x
	4/4	1	1	0	x
		1	1	1	x
16	1/4	0	0	0	0
		0	0	0	1
		0	0	1	0
		0	0	1	1
	2/4	0	1	0	0
		0	1	0	1
		0	1	1	0
		0	1	1	1
	3/4	1	0	0	0
		1	0	0	1
		1	0	1	0
		1	0	1	1
	4/4	1	1	0	0
		1	1	0	1
		1	1	1	0
		1	1	1	1

A.11.4 J106 Stabilizer Data/External ADC:

Pin	Signal	Description
1	$SA2_0$/	Gated Binary Address Data
2	$SA2_1$/	Gated Binary Address Data
3	$SA2_2$/	Gated Binary Address Data
4	$SA2_3$/	Gated Binary Address Data
5	$SA2_4$/	Gated Binary Address Data
6	$SA2_5$/	Gated Binary Address Data
7	$SA2_6$/	Gated Binary Address Data
8	$SA2_7$/	Gated Binary Address Data
9	$SA2_8$/	Gated Binary Address Data
10	$SA2_9$/	Gated Binary Address Data
11	$SA2_{10}$/	Gated Binary Address Data
12	$SA2_{11}$/	Gated Binary Address Data
13	$SA2_{12}$/	Gated Binary Address Data
14	ADCRDY/	ADC Ready
16	IA1/	Inhibit Add One
17	DACCP/	Data Accept
18	ENCOL	Enable Collect
20	STAB GAIN	Stabilizer Gain (±5 V)
21	STAB ZERO	Stabilizer Zero (±5 V)
22	ENDATA/	Enable Data
23	STAB TRIG	Stabilizer Trigger
24	GND	Ground

Note: When Model 3523 or 3524 is installed, J106 is defined as in A.11.9.

A.11.5 J107 and J108 I/O Connectors

These Connectors are used for any two of the following I/O Options (see note):

Model Number	Interface Type
3551	X-Y Point Plotter Interface
3552A	EIA Printer/Plotter Interface
3553	Graphics Plotter Interface
3554	Magnetic Tape Interface
3571	9.6 kbaud Computer Interface
3572	GPIB Interface
3573	19.2 kbaud Computer Interface

NOTE: Models 3551, 3552A, and 3553 are mutually exclusive. Models 3571, 3572, 3573, and 3573B are mutually exclusive.

Each connector is covered in detail on the following pages.

2	XGND	X Ground
4	YGND	Y Ground
5	SEEK	Coordinate Control Out
6	CPC	Completed Plot Control In
9	NABL	Plotter Enable Out
14	GND	Ground
21	PLTY	Y Plot
23	PLTX	X Plot

Model 3552A/3553
Connector (RS232)

Pin	Signal	Description
1	GND	Ground
2	DATA IN	Received Data from device
3	DATA OUT	Transmitted Data to device
4	RTS	Ready to Send from device
5	CTS	Clear to Send to device
6	DSR	Data Set Ready
7	GND	Ground
8	DCD	Received Line Signal Detect
11	FLAG	Flag from device
20	DTR	Data Terminal Ready
25	BUSY	Busy to device

Pin 11: a TTL or RS232 low level input from the device stops data output after the current character. A high level signals device Ready.

Model 3554 Connector

Pin	Signal	Direction referred to Series 35 PLUS
1	WD1/	Out
2	WD0/	Out
3	WD2/	Out
4	WD3/	Out
5	GND	--
6	GND	--
7	RD3/	In
8	RD2/	In
9	GND	--
10	RD1/	In
11	RD0/	In
12	BCD/	Out
13	RI/	Out
14	ESPI/	Out
15	RO/	Out
16	ADDRESS/	Out
17	MT/	Out
18	ADRNO/	In
19	I/O ATX/	In
20	GAP/	In
21	SP/	In

Model 3571 Connector (RS232)

Pin	Signal	Direction referred to Series 35 PLUS
1	Ground	---
2	Data In	In
3	Data Out	Out
4	Request to Send (RTS)	In
5	Clear to Send (CTS)	Out
6	Data Set Ready (DSR)	Out
7	Ground	---
8	Carrier Detect (CD)	Out
11[1]	Flag	In

1. Active input normally on Pin 11. Internal jumper to use pin 4.

Model 3572
GPIB Connector

Pin	Signal	Description
1	DIO1	Data I/O 1
2	DIO2	Data I/O 2
3	DIO3	Data I/O 3
4	DIO4	Data I/O 4
5	EOI	End or Identify
6	DAV	Data Valid
7	NRFD	Not Ready for Data
8	NDAC	Not Data Accepted
9	IFC	Interface Clear
10	SRQ	Service Request
11	ATN	Attention
12	Shield	To Earth Ground
13	DIO5	Data I/O 5
14	DIO6	Data I/O 6
15	DIO7	Data I/O 7
16	DIO8	Data I/O 8
17	REN	Remote Enable
18	Twisted Pair with pin 6	
19	Twisted Pair with pin 7	
20	Twisted Pair with pin 8	
21	Twisted Pair with pin 9	
22	Twisted Pair with pin 10	
23	Twisted Pair with pin 11	
24	GND	Signal Ground

Model 3573 Connector
(RS422)

Pin	Signal	Direction referred to Series 35 PLUS
1	GND	---
3	Received Data +	In
6	Request to Send +	In
8	Clear to Send -	Out
10	Data Set Ready +	Out
11	Terminal Ready +	In
12	Carrier Detect +	Out
13	GND	---
14	GND	---
15	Received Data -	In
17	Transmitted Data -	Out
18	Request to Send -	In
20	Clear to Send +	Out
22	Data Set Ready -	Out
23	Terminal Ready -	In
24	Carrier Detect -	Out
25	GND	---

Model 3573B Connector (RS232)

Pin	Signal	Direction referred to Series 35 PLUS
1	Ground	---
2	Data In	In
3	Data Out	Out
4[1]	Request to Send (RTS)	In
5	Clear to Send (CTS)	Out
6	Data Set Ready (DSR)	Out
7	Ground	---
8	Carrier Detect (CD)	Out
11	Flag	In
20	Data Terminal Ready (DTR)	In
25[2]	Busy	Out

1. Active input normally on pin 4. Internal jumper to use pin 11.

2. No function in this interface.

A.11.6 J109 High Voltage Power Supply Connector

Pin	Signal	Description
1	GND	Ground
2	+24 V	+24 volt dc supply
3	---	No connection

A.11.7 J110-Preamp Power Connector

Pin	Signal	Description
1	GND	Ground
2	GND	Clean Ground
4	+12 V	+12 volt dc supply
6	-24 V	-24 volt dc supply
7	+24 V	+24 volt dc supply
9	-12 V	-12 volt dc supply

A.11.8 J111 and J112 External Control/ Mössbauer Connector

Pin	Signal	Description
J111-BNC	COUNT	MCS Count Input (Model 3522)
J112:		
1	GND	Ground
2	GND	Ground
3	GND	Ground
4	EXT ADV	MCS External Advance In
5	EXT TRIG	MCS External Trigger In
6	SCADV	Sample Changer Advance Out
7	BSYOUT/	MCA Busy Out
8	BSYIN	Device Busy In
9	COLLECT/	Status Out
10	I/O/	Status Out
11	STOPCOL/	Stop Collect In
12	STARTCOL/	Start Collect In
13	CLRDAT/	Clear Data In
14	AADV/	Address Advance Out
15	GATE	Gate In
16	SWOUT	Sweep Out
17	$SA2^{9}$/	Gated Binary Address Data
18	$SA2^{10}$/	Gated Binary Address Data
19	$SA2^{11}$/	Gated Binary Address Data
20	$SA2^{12}$/	Gated Binary Address Data
21	AMS	Abort MCS Sweep In
22	AOF	MCS Address Overflow Out
23	CIR	Count in ROI
24	CIAR	Count in Area ROI
25	STARTIO/	Start Readout In

1.9 J106, J113, J114, J115- External ADC Connectors

Chassis connectors (J106, J113, J114, J115): female 25-pin; Amphenol type 17-10250. J106 is used for the fourth external ADC.

Logic levels:
Logic High = +2.4 to +5 V
Logic Low = 0.0 to +0.3 V

Pin	Signal	Description
1	2^{0}/	
2	2^{1}/	
3	2^{2}/	
4	2^{3}/	
5	2^{4}/	ADC Address input:
6	2^{5}/	Logic 1 = low; 2^{0} to 2^{11}
7	2^{6}/	require positive drive.
8	2^{7}/	2^{12} has a pull-up
9	2^{8}/	resistor on its input for
10	2^{9}/	use with 12-bit ADCs.
11	2^{10}/	
12	2^{11}/	
13	2^{12}/	
14	RDY/	ADC Converversion Ready input; Logic 1 = low; open circuit = Logic 0.
16	INHAD/	Inhibit Storage of Current Conversion input; Logic 1 = low; open circuit = Logic 0.
17	DAC/	Data Accepted output; 0.5 µs pulse; Logic 1 = low
21	DT	ADC Dead Time input; Logic 1 = high; open circuit = Logic 0.
22	ENDATA/	Enable ADC Address output; Logic 1 = low.
24	GND	Ground

11.10 NIM Slot

This Rear Panel Connector provides dc power to the following modules:

3100-01	Detector Bias Supply
3100-02	Spectroscopy Amplifier
4225	Spectroscopy Amplifier
8222B	Mixer/Router

No other modules may be installed in this connector.

.11.11 J116, J117-PUR/LTC Connectors

Pin	Signal	Description
J116 1	LG/	Linear Gate Out
2	REJ	Reject In
3	GND	Ground
J117 BNC	ADC BUSY/	Busy In

APPENDIX B
FIELD INSTALLATION INSTRUCTIONS

B.1 INTRODUCTION

The Monitor (CRT Assembly) and individual boards can be removed or replaced by following the instructions included in this Appendix. Also included are detailed Field Installation instructions for options purchased later.

B.1.1 Cover Removal

Before removing the covers, turn off the ac power and remove the ac line cord from the rear of the Analyzer.

To remove the top and bottom covers, simply remove the four (4) black Phillips-head screws from each side of the covers, lift off the top cover, and lift the Analyzer out of the bottom cover. After replacing a board or installing an option, reconnect the ac line cord to the Analyzer, turn on the ac power and check the operation of the unit before replacing the covers

If any question arises during the installation or the operational check-out, please contact your local Canberra Representative or Canberra's Customer Service Department.

B.1.2 Board Removal and Replacement

The Printed Circuit (PC) Boards may be removed from the Analyzer by applying equal pressure to the card ejectors at each end of the board and pulling up.

The boards are installed by aligning the board in the card guide slots mounted on the front and back of the card cage and sliding the board all the way down. Press the board firmly down into the Mother Board socket, flexing the board if necessary to align it with the socket. Be sure the board is firmly seated in the Mother Board socket.

The cable entry opening shown at the rear of the Monitor compartment (see figure B.1) is used to pass the wiring of various options from the rear panel connectors to the Mother Board edge connectors.

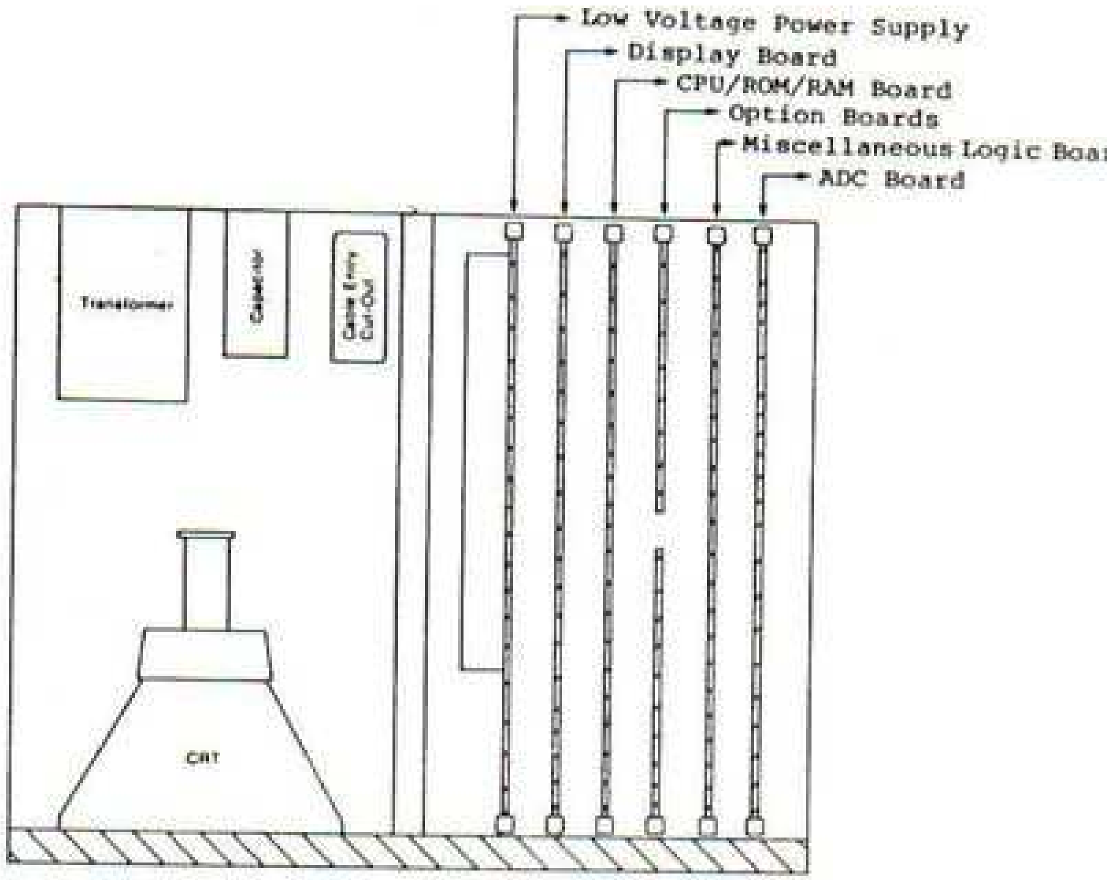


Figure B.1
Series 35 PLUS
Board Locations

B.1.3 Firmware Update

To change the basic Firmware set to a later version, all programmable chips, including any option chips, must be updated to the same Firmware revision level to allow proper operation of the Analyzer. Programmable chips are indicated by a label naming chip location and Firmware revision level.

To install the firmware:

1. Remove the CPU Board from the Analyzer.
2. Using a small screwdriver or an LSI chip-puller, carefully remove the programmable chips.
3. Insert the chips of the new Firmware set into the socket named on each chip's label.

When inserting a chip, take care to insert it firmly into the socket without bending any pins under the chip or leaving any pins outside of the socket.

Be sure that the chip is plugged in with the notch in the chip toward the right side of the board. The socket has a notch at this side as a guide.

CAUTION

Inserting a chip reversed will cause permanent damage to the chip when power is applied.

Be certain that all chips are inserted correctly before replacing the CPU Board in the Analyzer.

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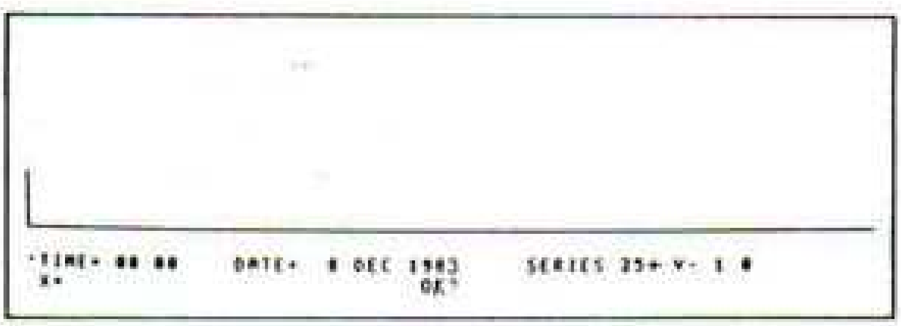
4. Move the CPU Board's D-E jumper to the E position for about one minute, then move it back to D. Replace the board in the Analyzer.
5. Before replacing the covers, check the installation for proper operation.
6. On power up, check Firmware version number displayed (see figure B.2) to verify that the correct Firmware set has been installed.

   Note: In an Analyzer with a Model 3571, 3572, or 3573 interface, the display of figure B.2 will not be seen at power on if the rear panel control switch is in the REMOTE position.

Figure B.2
Display at
Power On



B.1.4 Monitor Replacement

The Monitor Assembly can be removed by pulling the connector off of the rear of the Monitor Assembly printed circuit board and removing the four (4) screws, one in each corner of the bottom of the Monitor frame. A Phillips screwdriver with a 23 cm (9 in.) shank will make removal of the screws easier.

The Model 3562 Service Kit includes the 23 cm Phillips screwdriver and other useful servicing aids.

Pull the Monitor slightly to the rear and carefully lift it straight up and out of the Analyzer.

To reinstall the Monitor, reverse the removal procedure. Be sure that the wiring connector is seated securely on the printed circuit board edge connector and the four (4) screws are tightened down.

B.1.5 Field Installation of Options

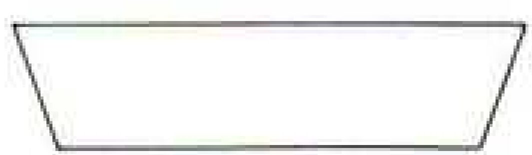
After removing the covers (see section B.1.1), proceed to the appropriate section of the manual for the option being installed.

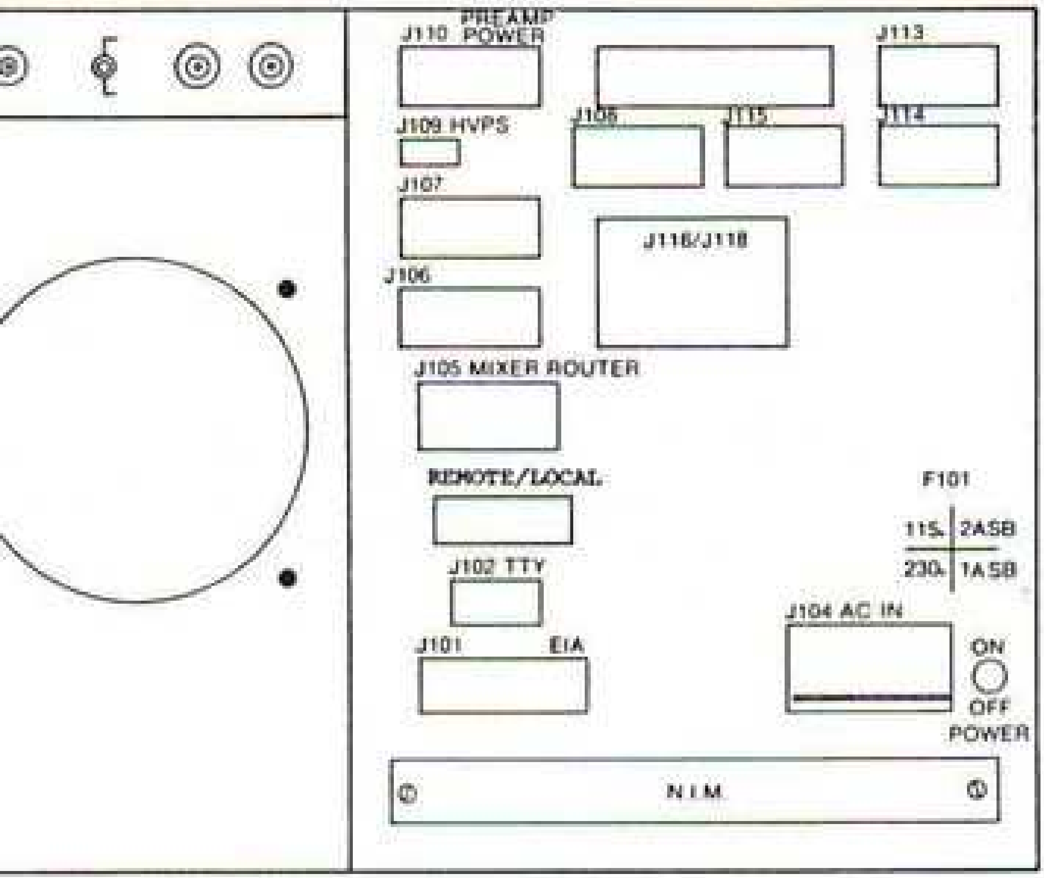
After installing the option, move jumper D-E on the CPU board to the E position, let it stay there for about one minute, then move it back to D. This allows the system to recognize the presence of the option when the power is turned on.

Before replacing the covers, check the installation for proper operation.

When installing options that have a D-type male connector to be mounted on the Analyzer's rear panel, be sure to mount the connector narrow side down. Refer to figure B.3.

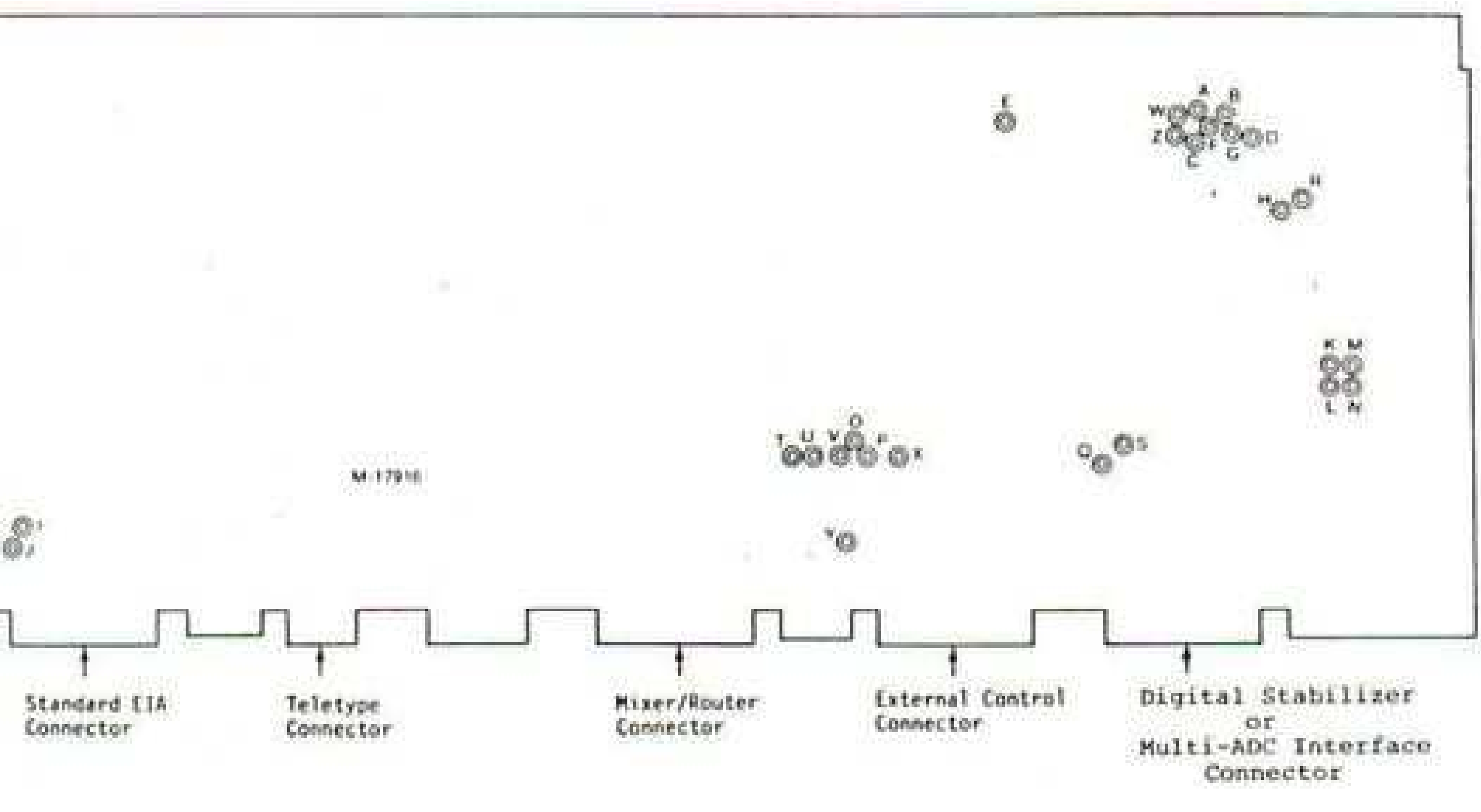
Figure B.3
Connector Orientation





Location	Designation
J101.............	EIA Connector
J102.............	Teletype Connector
J104.............	AC Line Input
J105.............	Mixer Router
J106.............	Stabilizer Data/External A
J107/J108........	I/O Options
J109.............	High Voltage Power Supply
J110.............	Preamplifier Power Supply
J111/J112........	MCS/Moessbauer/Ext. Contro
J113/J114/J115..	External ADC 2,3,and 4
J116/J118........	Pile-up Rejector

Figure B.4 Series 35 PLUS Rear Panel



B.2 MODEL 3522 HIGH-PERFORMANCE MCS OPTION

The Model 3522 High Performance MCS option consists of a small plug-in printed circuit (PC) board. To install it:

1. Remove the Miscellaneous Logic Board from the Analyzer.
2. Plug the small PC board into J1, the connector at the top right corner of the Miscellaneous Logic Board.
3. Replace the board in the Analyzer.
4. Remove the CPU Board from the Analyzer. Move its D-E jumper to the E position for about one minute, then move it back to D. Replace the CPU Board in the Analyzer.
5. Before replacing the Analyzer's covers, check the installation for proper operation.

B.3 MODEL 3523 MULTI-ADC INTERFACE

The Model 3523 Multi-ADC Interface consists of the interface board with three (3) ribbon cables attached to it and a single separate ribbon cable.

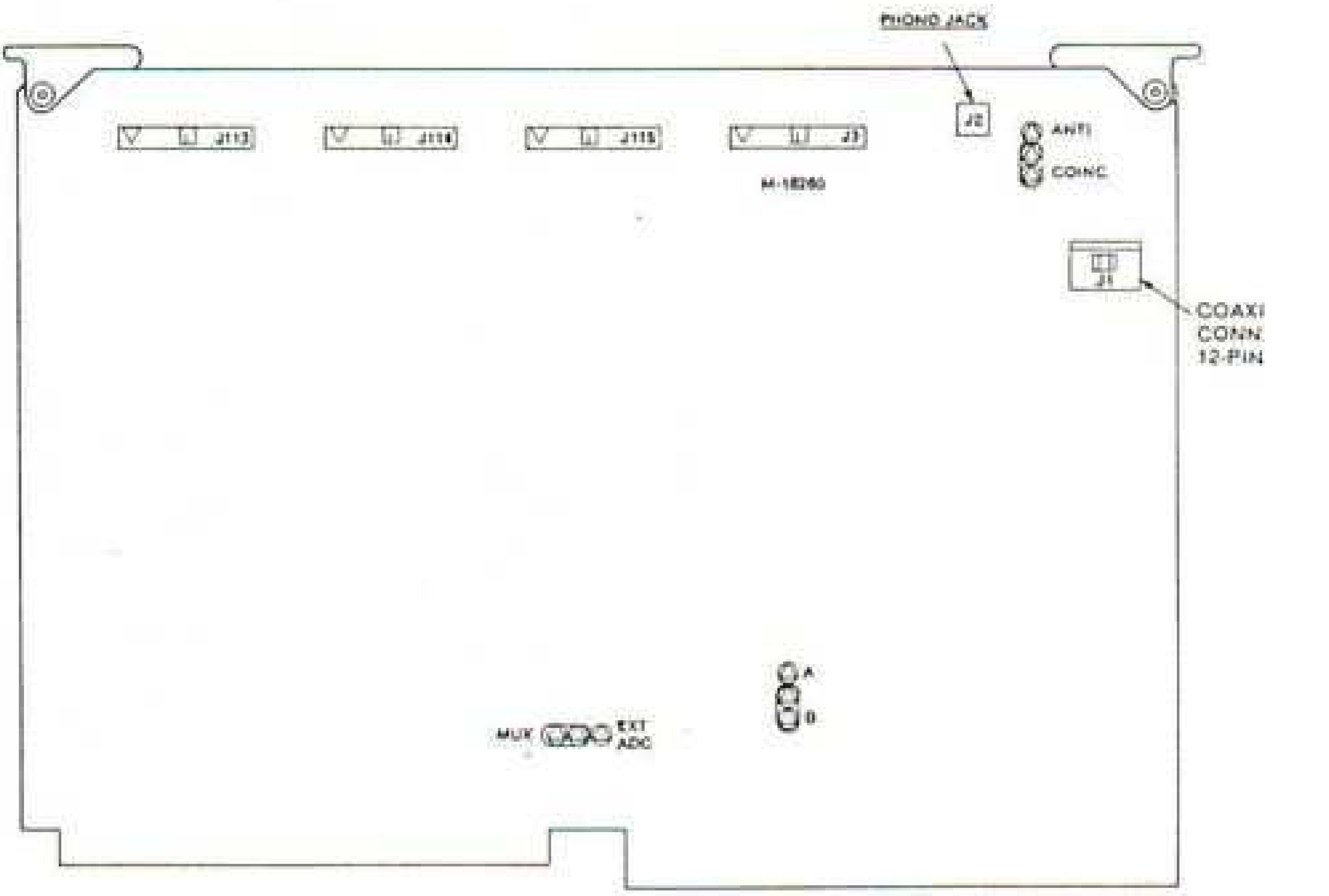
Before installing the Interface Board, be sure that the jumpers are set correctly (figure B.6):

ANTI-COINC - Refer to section 10.3.3.
A-B - Used for testing only. Leave in the B position.
MUX-EXT ADC - Set to MUX position.

To install the interface:

1. Remove the cover plates from the Analyzer's rear panel, which are marked J113, J114, J115, and J106 (see figure B.4).
2. Remove the cables from J1, J2, and J3 on the Model 3521 ADC Board.
3. Remove the 3521 ADC Board from the Analyzer and replace it with the Model 3523 Interface.
4. Install the three attached ribbon cables, as marked, in J113, J114, and J115.
5. Install the separate ribbon cable in J106.
6. Fasten the connectors in place with the hardware supplied with the option.
7. Dress the three ribbon cables attached to the board across the back of the boards and place any cable slack inside the Monitor compartment.

9. Route the single separate ribbon cable (from J106) through the cable entry opening at the bottom right rear of the Monitor compartment.
10. Connect the three cables removed from the 3521 ADC Board to the mating connectors on the 3523 Interface Board.
11. Turn the Analyzer over. Remove the three nuts holding the cable retaining bracket and remove the bracket.
12. Plug the cable's plastic connector onto the Mother Board's rear-most (Stabilizer) edge connector with the blue stripe on the cable to the right (see figure B.5).
13. Reinstall the cable retaining bracket and its three nuts.
14. Turn the Analyzer right side up and remove the Miscellaneous Logic Board.
15. Change jumper "H" to position "G" on the Miscellaneous Logic Board (see figure B.7).
16. Remove the CPU Board from the Analyzer. Move its D-E jumper to the E position for about one minute, then move it back to D. Replace the CPU Board in the Analyzer.
17. Before replacing the covers on the Analyzer, check the installation for proper operation.



B.4 MODEL 3524 EXTERNAL ADC INTERFACE

The Model 3524 External ADC Interface consists of an interface board and a ribbon cable.

Before installing the Interface Board, be sure that the jumpers are set correctly (see figure B.6):

ANTI-COINC - Refer to section 10.4.3.
A-B - Used for testing only. Leave in the B position.
MUX-EXT ADC - Set to EXT ADC position.

To install the interface:

1. Remove the cover plate from the Analyzer's rear panel labeled J106.
2. Remove cables J1, J2 and J3 from the Model 3521 ADC board.
3. Remove the 3521 ADC board from the Analyzer.
4. Insert the 3524 board in its place.
5. Connect J1, J2, and J3 (removed from the 3521 ADC Board) to the mating connectors on the Interface board.
6. Install the ribbon cable in J106.
7. Fasten the connector in place with the hardware supplied with the option.
8. Carefully route the ribbon cable from J106 through the cable entry opening at the bottom right rear of the Monitor compartment.
9. Turn the Analyzer over. Remove the three nuts holding the cable retaining bracket and remove the bracket.
10. Plug the plastic connector on the cable from J106 into the rear-most edge connector, marked Stabilizer, of the Mother Board (see figure B.5) with the blue stripe on the cable to the right.
11. Reinstall the cable retaining bracket and its three nuts.
12. Turn the Analyzer right side up and remove the Miscellaneous Logic Board.
13. Set the Miscellaneous Logic Board jumper G-H to the "H" position (see figure B.7).
14. Remove the CPU Board from the Analyzer. Move its D-E jumper to the E position for about one minute, then move it back to D. Replace the CPU Board in the Analyzer.
15. Before replacing the covers on the Analyzer, check the installation for proper operation.

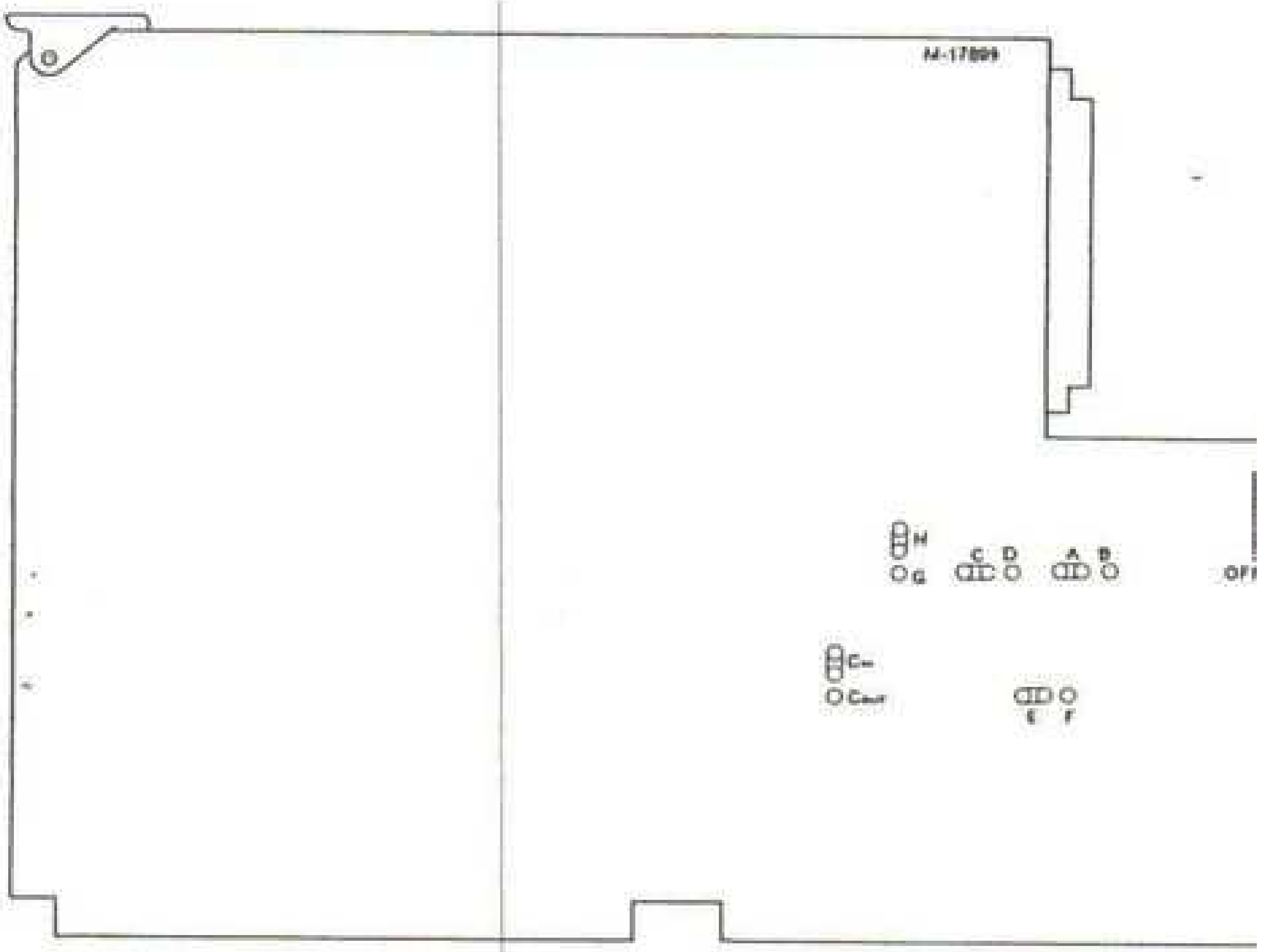


Figure B.7 Miscellaneous Logic Board

B.5 MODEL 3531A MIXER/ ROUTER WIRING

The Model 3531A Wiring option consists o cable with a 25-pin, D-type connector at and a plastic edge connector at the othe and three DIP jumper plugs.

1. Remove the cover plate on the Analyz panel, marked J105 (see figure B.4).
2. Mount the Model 3531A connector in t opening and fasten it in place with hardware supplied with the option.
3. Carefully route the ribbon cable thr cable entry opening at the bottom ri of the Monitor compartment (see figu