APPENDIX A
OPTIONS OPERATION

A.1 MODEL 2150/2160 HANDLER INTERFACE OPTION

Handler Interface options enable the Model 2150/2160 to operate with a mechanical parts handler. The option accepts a START signal to initiate measurements, provides a BUSY signal which may be used to arrest handler operation during test, and offers a contact closure output corresponding to one of thirteen preselected component bins (refer to Section 2.7 for component sorting operation). Additionally, an End of Conversion signal can be enabled which allows calculations during handler movement. However, one less accept bin is available in this mode (see Table 2-1, test code 16).

Three standard handler interface options are available. They are:

ESI Part No. 47895 -- "General", for interfacing the Engineered Automation, Ismeca, Q-Corp, Heller, Systemation and other handlers.

ESI Part No. 47896 -- "Daymarc", for interfacing the Daymarc handlers.

ESI Part No. 47897 -- "MCT Browne", for interfacing MCT Browne handlers.

> **NOTE:** Circuit differences between options are depicted in the schematic section (Appendix B) as follows:
>
> "General" (Figure B-1)--U7 is a TIL119 Opto-Isolator (P/N 44224). W3 is connected to pin 6 of U6.
>
> "Daymarc" (Figure B-3)--U7 is a 4N28 Opto-Isolator (P/N 20674). W3 is connected to pin 6 of U6.
>
> "MCT Browne" (Figure B-2)--U7 is a 4N28 Opto-Isolator(P/N 20674). W3 is connected to pin 5 of U6.

Contact the factory for information concerning the use of other part handlers with the Model 2150 or 2160.

A.1.1 Hardware Included

Handler Interface Option 47895
    Handler Interface Circuit Assembly
    Instruction Sheet

Handler Interface Option 47896
    Handler Interface Circuit Assembly
    Instruction Sheet

Handler Interface Option 47897
    Handler Interface Circuit Assembly
    Instruction Sheet

A.1.2 Installation

WARNING

TO AVOID PERSONAL INJURY FROM ELECTRIC SHOCK DO NOT REMOVE INSTRUMENT COVERS OR PERFORM ANY MAINTENANCE OTHER THAN DESCRIBED IN THIS MANUAL. INSTALLATION AND MAINTENANCE PROCEDURES DESCRIBED IN THIS MANUAL ARE TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY.

CAUTION

TO AVOID DAMAGE TO CIRCUITRY, TURN POWER OFF WHILE PLUGGING IN OR REMOVING CIRCUIT ASSEMBLIES.

Remove strap from unused card slots on the motherboard. Insert the Handler Interface Assembly into slot J4 ONLY (see Figure A-1). Replace strap across J1-J3. Installation of the BNC-to-BNC cables and the Handler Interface cable assembly, for option part number 47895, are dependent upon the component handler being used. The BNC cables connect the VideoBridge HI and LO unknown terminals to the part handler's component contactors. The Handler Interface Cables make all logic connections between the VideoBridge rear panel OUTPUTS connector and the component handler.
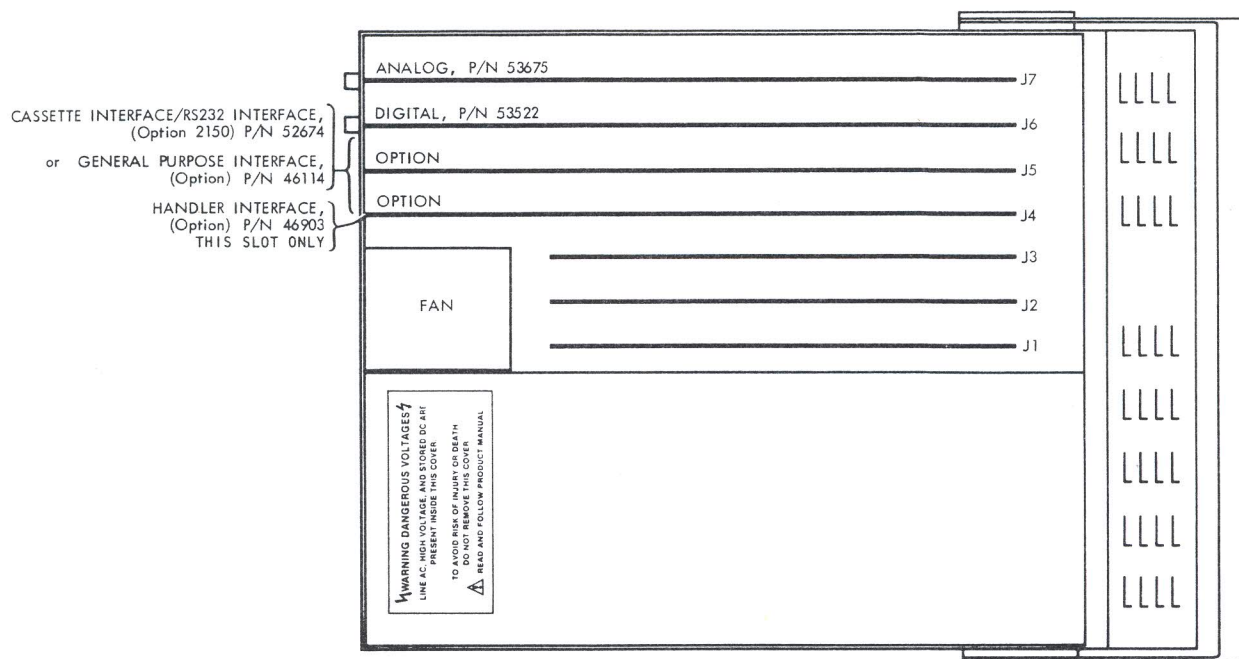
Figure A-1. Handler Interface Circuit Assembly Location

A.1.3 Operation

Before installing the Handler Interface option, set the desired bin limits along with the nominal value and enter test code 8 or -8. This puts the VideoBridge into SINGLE measurement mode. Component sorting begins immediately upon receipt of START pulses from the handler.

The Handler Interface Option can only be used with test code 8 (handler mode without display) or test code -8 (with display). Refer to Section 2.7 for more information on SORT mode and test codes 8 and -8.

To deactivate either test code, do one of the following:

1. Temporarily ground Pin 21 of the Handler Interface rear
    panel connector. Grounding is accomplished by connecting
    Pin 21 to Pin 13 (System Ground) on the same connector.

2. Turn instrument power OFF then ON again. In this case, the
    nominal value, bin limits, and bin counters are zeroed
    (unless the Non-Volatile Memory option is present and has
    been enabled). See Section A.3.

The Handler Interface provides the following functions:

NOTE: Indicated polarity must be observed for each function.

1. START TEST -- is the active HIGH input to an opto-isolator. To
    initiate a measurement, it requires a holding current of 20mA to
    70mA for a minimum of 10ms.

2. BUSY -- is the active HIGH, open collector output of an opto-
    isolator. This signal is used to arrest handler operation during
    test and can be changed to active LOW by moving jumper W3 on the
    Handler Interface Circuit Card. The opto-isolator for Browne and
    Daymarc handlers (TIL119) can sink a maximum current of 125mA and
    has a continuous power dissipation rating of 150mW. The opto-
    isolator for the General handler (4N28) can sink a maximum
    current of 3mA.

3. END OF CONVERSION (ANALOG BUSY) -- is the active LOW relay
    closure from common to the output of BIN 11 (see Figure B-1.)
    This signal allows the handler to advance to the next component
    for testing while calculations are still being made on the
    previous device under test. The EOC capability is enabled by
    programming test code 16 and cleared by test code -16.

4. Output Relays -- are active LOW contact closures which select bins according to preset limits (see Section 2.7, Component Sorting). One relay is closed at a time. The relays are rated at 100VDC, 250mA switching current, and 10 million operations. Higher currents may cause a possible reduction in operation life, especially if contacts arc on opening. Resistive loads are more desirable than inductive loads. Relay switching may take 3-4ms.

5. 5V TTL (open collector) Outputs -- are available at the rear panel OUTPUTS connector (active HIGH). They require the addition of a jumper wire in place of each output relay.

Programming 8 CODE (handler mode without display) is recommended for fastest handler interface operation. -8 CODE is slower but displays results: the BUSY signal is extended approximately 110ms for display update time before the next START signal will be recognized.

In addition, test code 10 can be used in conjunction with either test code 8 or -8 for remote output to channel B of the RS-232C Interface option. This also extends the BUSY signal approximately 110ms before the next START signal will be recognized (for a total of approximately 220ms in test code -8).

The Handler Interface times listed under Figure A-2 were determined under these test conditions (other setups may affect times):

Test Frequency = 1kHz   Test Signal = 1000mV
Settling Time = 2ms   Integration Time = 2ms
Number of Averages = 1   Baud Rate = 9600
RANGE HOLD   Value of component-under-test = 1nF
FAST
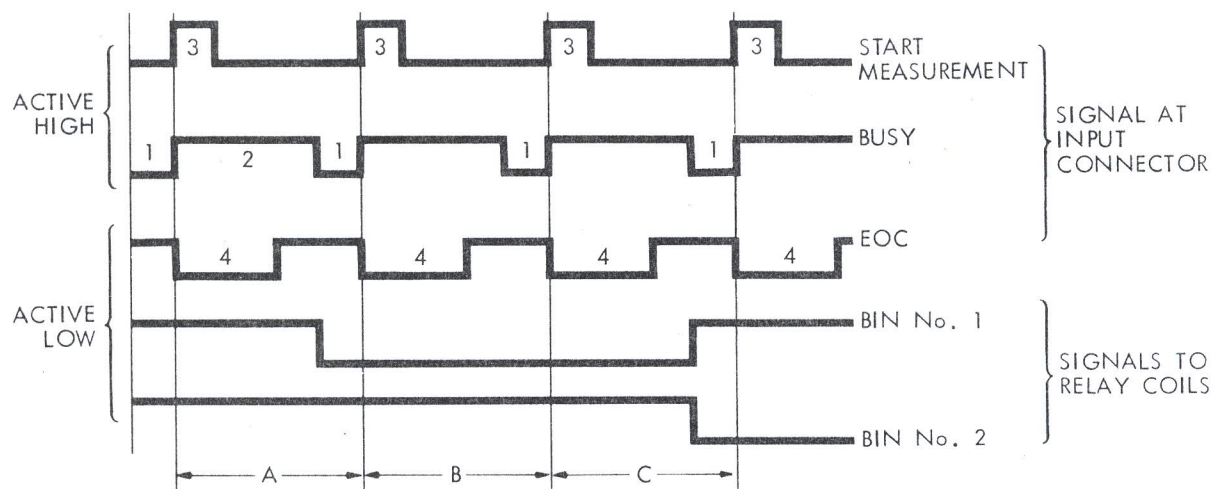
A. First part was in bin No. 1 (low signal to relay coil).
B. Second part was also in bin No. 1 (low signal to relay coil).
C. Third part was in bin No. 2 (low signal to relay coil).

Figure A-2.   Handler Interface Option Signal Timing

NOTE: Numbered intervals in this diagram vary with each
handler interface configuration and are not depicted propor-
tionally. All times listed are approximate and may vary by
5ms (except Interval 3, which is always a minimum of 10ms).

NOTE: When using 10 CODE for printer output, a CTS (Clear To
Send) signal may add more time to Interval 1. To assure
proper coordination of signals, adequate time must always be
allowed in this interval before sending a START signal.

Interval 1.   Time from offset of BUSY to onset of START. No minimum
    (dependent upon handler speed; can be less than 1ms).

Interval 2.   Measurement Time. Time from onset of BUSY to offset of
    BUSY. Refer to instrument test conditions as noted.

                8 CODE -- approximately 100ms.
                8 CODE and 10 CODE -- approximately 290ms.
               -8 CODE -- approximately 290ms.
               -8 CODE and 10 CODE -- approximately 400ms.

Interval 3.   Time from onset of START to offset of START, minimum 10ms
    for all four test code combinations. Measurement is initiated on
    the HIGH level of the START signal. Bin decisions are not made
    until after START goes LOW.

Interval 4.   Time from onset of EOC to offset of EOC (active LOW).
    Approximately 40ms for all four test code combinations.

All Handler Interface outputs are available via the VideoBridge rear panel OUTPUTS connector. Table A-1 lists the functions for each pin of the OUTPUTS connector.

Table A-1. VideoBridge OUTPUTS Connector Wiring

PIN NUMBER	FUNCTION
1	COMMON
2	BIN 0
3	BIN 1
4	BIN 2
5	BIN 3
6	BIN 4
7	BIN 5
8	BIN 6
9	BIN 7
10	BIN 8
11	BIN 9
16	BIN 10
17	BIN R
15	BIN 11 (EOC)
12*	+5V (SYSTEM) OUT
13*	SYSTEM GROUND
14	START IN
18	BUSY OUT
19	BUSY COM
20	START COM
21	KEYBOARD UNLOCK

*ESI recommends that Pin 12 (+5V OUT) and Pin 13 (SYSTEM GROUND) not be used. Noise introduced into the Model 2150/2160 through these connections may affect measurements results.

NOTE: Pin 17 is Bin R which is the Reject Bin. Do not use 16 CODE to enable EOC (pin 15) unless Bin 11 limits have been set to zero.

NOTE: The Handler Interface cabling used with ESI's Model 296, 296V and 410 will not be compatible with the Model 2150/2160's connections since pin 21 is not connected in the Model 296 cable. Contact ESI factory for further details.

START COM/BUSY COM

The Handler Interface Option is shipped with the START COM (pin 20) and BUSY COM (pin 19) lines tied to the COMMON (pin 1) side of the relay closures. START COM and BUSY COM may be disconnected from relay COMMON (pin 1) and connected to SYSTEM GROUND (pin 13), if the binning operation requires relay COMMON (Pin 1) be raised above ground potential. The following procedure tells how to do this:

STEP 1.   Turn instrument power OFF and remove its cover.

STEP 2.   Remove the circuit card hold-downs and the Handler Interface circuit card.

STEP 3.   Locate and cut the connecting stripes labeled W4 and W5 (see Figure A-3).
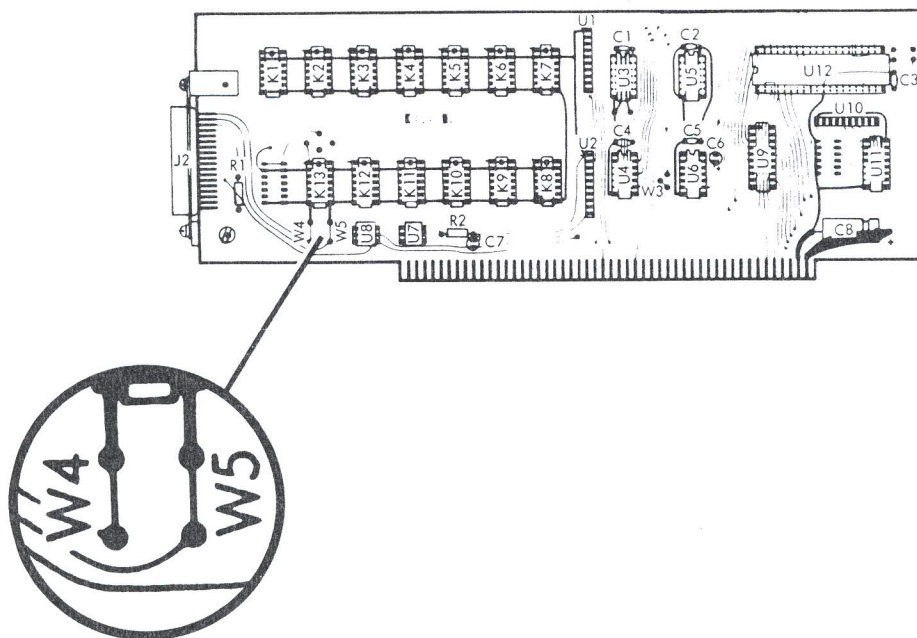

Figure A-3.   Handler Interface Circuit Card

STEP 4.   Add jumper wires to the rear panel connector (J2) of the Handler Interface Card. Connect START COM (pin 20) and BUSY COM (pin 19) to SYSTEM GROUND (pin 13).

STEP 5.   Re-install the Handler Interface circuit card and instrument cover.

   NOTE: ESI recommends that Pin 12 (+5V OUT) and Pin 13 (SYSTEM GROUND) not be used. Noise introduced into the Model 2150/2160 through these connections may affect measurement results.

Connections to the Handler Interface Option should be made with a 36 contact receptacle that has a trapizoidal, polarized shell. Use Amphenol P/N 57-40360 or ESI P/N 15738.

A.1.4.   Calibration

The VideoBridge needs no adjustment, other than normal calibration, when a Handler Interface Option is installed. The Handler Interface Assembly contains no service adjustments.

A.2 MODEL 2150/2160 REMOTE PROGRAMMING OPTIONS (GPIB AND RS-232C)

A.2.1 Introduction

The Model 2150/2160 VideoBridge can be fitted with General Purpose Interface Bus (GPIB) or RS-232C remote programming capabilities. Sections A.2.2 to A.2.8 describe the GPIB option. Sections A.2.9 to A.2.14 describe the RS-232C option.

Information from both remote devices is seen as the same by the VideoBridge. Section A.2.16 lists instrument setup common to both GPIB and RS-232C options.

The GPIB option (P/N 46725) allows the VideoBridge to communicate on the bus structure defined by IEEE 488-1978 specifications (see ANSI IEEE Standard Digital Interface for Programmable Instrumentation.) The bus itself is a passive structure. It is the active components on the interface option that enable the 2150/2160 to operate according to this universal standard. With the GPIB option installed, the 2150/2160 can be connected directly to the bus, and operated by a controller and the appropriate programming instructions. The instructions to and the data generated by the instrument are coded in ASCII code.

The RS-232C Interface option (P/N 46724) is used to interface the 2150/2160 VideoBridge to peripheral equipment; i.e. video display terminals, keyboards, printers, etc. With this option installed, the 2150/2160 can interface with RS-232C systems.

A.2.2 GPIB Bus Structure and Supported Interface Functions

The IEEE-488 bus is a set of sixteen signal lines that can be grouped functionally into three specifically dedicated buses.

1. 8 bidirectional data lines -- DIO 1 through DIO 8.
2. 3 interface signal lines -- DAV, NRFD, and NDAC
3. 5 general management lines -- ATN, EOI, IFC, REN, and SRQ.

Information is transferred along the bus in bit-parallel, byte-serial fashion by an asynchronous handshake. The handshake signals (interface signals DAV, NRFD, NDAC) guarantee the transfer of each byte of data from an addressed talker to all addressed listeners. This allows instruments with different data transfer rates to operate together on the bus as long as they conform to the handshake state diagrams defined in the IEEE standard.

Instruments connected to the bus are classified as either talkers, listeners, or controllers. A talker is capable of transmitting data on the data lines; there can be only one talker at a time to avoid confusion in message and data transfer. A listener is capable of responding to data received on the data lines; there can be more than one listener at a time. A controller designates which devices are to talk or listen and exercise other bus management functions. There can be a system controller as well as other controllers on the bus. However, there can be only one controller-in-charge at a time.

A device need not always be a talker or listener or controller, it may be idle part of the time. An instrument may alternate as a talker and a listener depending on whether it is generating data or receiving instructions. Figure A-4 is a typical system based on the IEEE-488 bus structure.

Table A-2 lists the IEEE-488 Interface Function repertoire including the subsets of each function supported by the VideoBridge. The ANSI/ IEEE standard describes these functions in more detail.
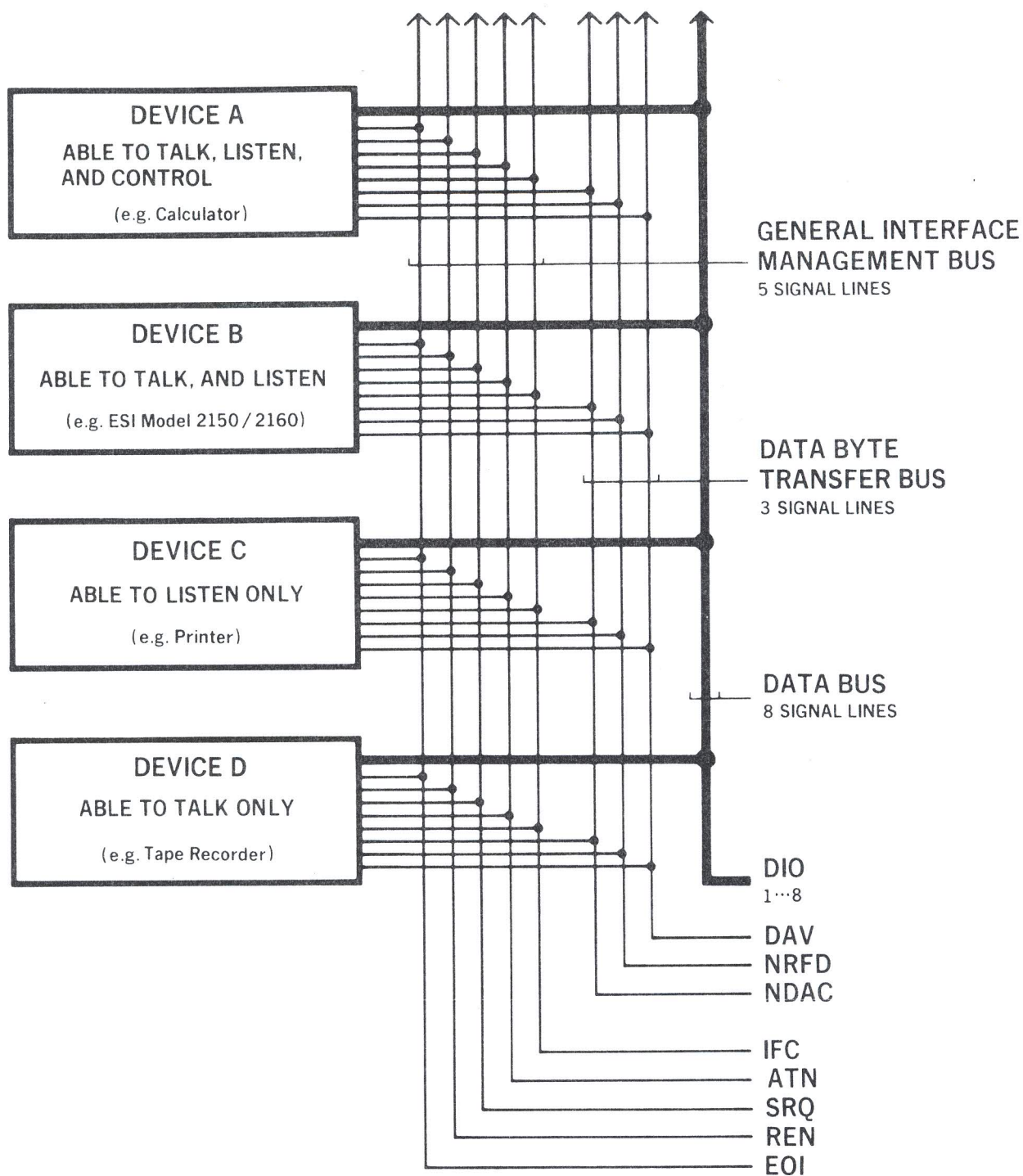
Figure A-4. A Typical IEEE-488 Bus Based System

SH1	Source handshake -- complete capability
AH1	Acceptor handshake -- complete capability
T2	Talker -- Basic Talker, Serial Poll capabilities
TEØ	Extended Talker -- no capability
L2	Listener -- Basic Listener capability
LEØ	Extended Listener -- no capability
SR1	Service Request -- complete capability
RLØ	Remote Local -- no capability
PPØ	Parallel Poll -- no capability
DCØ	Device Clear -- no capability
DT1	Device Trigger -- complete capability
CØ	Controller -- no capability

NOTE: Device Trigger capability (DT1) means the Group Execute Trigger (GET) interface message can be used by the controller-in-charge to start instrument operation. For more information on this or any other Interface Function, refer to the ANSI/IEEE Std 488-1978.

A.2.3 Number of Devices

The IEEE-488 bus can handle up to 15 devices. More than 15 devices can be interfaced if they are not directly connected to the bus but are interfaced through another device. At least two-thirds of the main devices connected to the bus at any time must be powered up for the system to be operational.

A.2.4 Cable Length

The maximum cable length that can be used to connect a group of devices within one bus system is:

   2 meters times the number of devices, or 20 meters, whichever is
   less.

Cables may be interconnected in either star or linear configuration, or in any combination of the two methods (see Figure A-5).
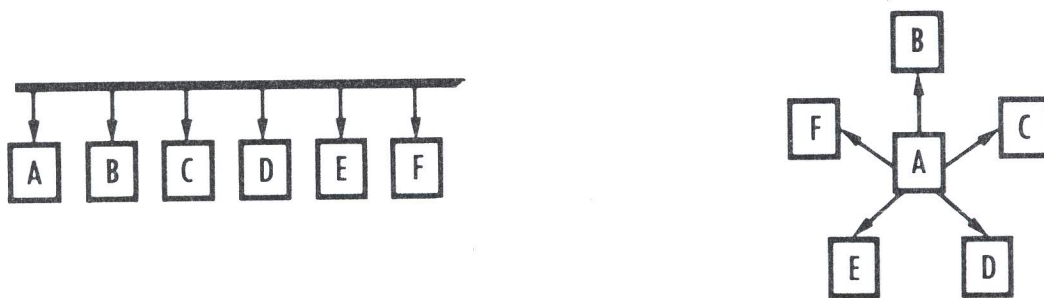

Figure A-5. IEEE-488 Bus Interconnection Configurations

A.2.5 Electrical Specifications

The relationship between the binary logic states and their voltage
levels is as follows:

LOGIC STATE	VOLTAGE LEVEL
0	$\geq$ +2.0V High is inactive state
1	$\leq$ +0.8V Low is active state

The high and low electrical states are based on standard TTL
(transistor-transistor logic) levels where the power source does not
exceed +5.25VDC and is referenced to logic ground.

A.2.6 Signal Lines

The IEEE-488 bus is divided by function into three separate busses as
shown in Figure A-4: an eight-line data bus, a three-line transfer
bus, and a five-line management bus. Table A-3 indicates the contacts
corresponding to these lines as well as the seven signal ground
returns and the bus shield.

The data bus (signal lines DIO 1 through DIO 8) are used to convey
data or device-dependent messages. DIO 1 represents the least
significant bit in the transmitted byte; DIO 8 represents the most
significant bit. One eight-bit word can be transmitted bidirection-
ally in byte-serial, bit parallel fashion. The data lines are con-
sidered active when their signal level is low.

The transfer bus is a three-wire handshake process that is executed
between the talker and all designated listeners each time a byte is
transferred over the data bus. This handshake process assures that
new data is not placed on the data bus faster than the slowest
listener can receive it. The three transfer bus lines and their
functions are:

NRFD (Not Ready For Data) -- This signal line is low until all
addressed listeners are ready to receive the next data byte. When all
addressed listeners are ready, they release the NRFD line, the NRFD
signal goes high, allowing the talker to place the next byte on the
data line.

DAV (Data Valid) -- The DAV signal line is set low by the talker a
short time after placing a valid byte on the data lines. This signal
tells each listener to capture the byte presently on the data lines.
DAV can not be set low until the NRFD signal goes high.

NDAC (Not Data Accepted) -- The NDAC signal line is set low by each
addressed listener until they all have captured the byte currently on
the data lines. When all listeners have captured the data byte, the
NDAC signal goes high. With the NDAC signal high, the talker is able
to remove the byte from the data lines and at that point set the DAV
line high until the handshake cycle is repeated.
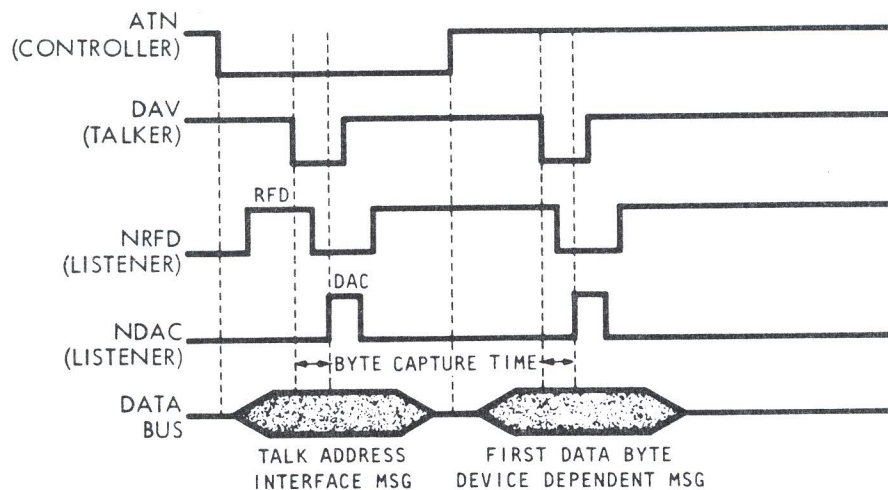
Figure A-6. A Typical Handshake Cycle

The group of signal lines used to control the orderly flow of information across the IEEE-488 data bus is called the management bus. These signal lines perform such important tasks as detecting interrupts, setting a device to remote control, and announcing the end of a message. The five management bus signals are:

ATN (Attention) -- The controller-in-charge uses this signal to specify how data on the bus are to be interpreted. It also specifies which devices along the bus must respond to the data. When ATN is set low, the data bus will convey addressed commands, universal commands, listen addresses (MLA), talk addresses (MTA), or secondary addresses. The codes corresponding to these commands and addresses are defined in Appendix E of the IEEE-488 standard.

SRQ (Service Request) -- The controller-in-charge receives this signal set low by a device requesting service. The controller conducts a poll to determine which device on the data bus activated the interrupt. The controller can take the appropriate action by branching to an interrupt service routine.

EOI (End Or Identify) -- The EOI line is set low to indicate the end of a multiple byte transfer sequence. The controller-in-charge executes a parallel polling sequence when the EOI and the ATN lines are set low simultaneously. The VideoBridge does not support the parallel polling mode.

IFC (Interface Clear) -- The system controller sets this signal low to initialize the interface functions of all devices connected to the data bus, i.e., set them to an inactive state, then return control to the system controller.

REN (Remote Enable) -- The system controller sets this line low to activate the remote mode, disabling front panels of instruments on the bus. This management line is not supported by the VideoBridge, so its state will be ignored.

A.2.7 Bus Connector

Instruments that connect to the IEEE-488 bus use a 24 contact, trapizoidal, polarized shell connector. The contact assignments for the connector are shown in Table A-3.

Table A-3. IEEE-488 Bus Connector Contact Assignments

CONTACT	SIGNAL LINE	CONTACT	SIGNAL LINE
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EOI	17	REN
6	DAV	18	Gnd (6)
7	NRFD	19	Gnd (7)
8	NDAC	20	Gnd (8)
9	IFC	21	Gnd (9)
10	SRQ	22	Gnd (10)
11	ATN	23	Gnd (11)
12	SHIELD	24	Gnd LOGIC

NOTE: Gnd (n) refers to the signal ground return of the
referenced contact.

A.2.8 Instrument Address Selection

Bus addresses for the 2150/2160 are set via switches on the GPIB interface circuit card (see Figure A-7). Primary bus addresses can be set over the full range allowed by the IEEE-488 standard: 32 to 62 (decimal) for LISTEN addresses and 64 to 94 (decimal) for TALK addresses. However, the values of the LISTEN and TALK addresses are not independent since they share the same switch setting (see Figure A-7). The address switches are set in binary fashion. The LISTEN address is achieved by the instrument's software automatically adding 32 to the switch setting. The TALK address is achieved by adding 64 to the switch setting.

The first five switch positions, starting with the top switch position, are used to set the LISTEN and TALK addresses. A switch position is activated when its left side is down, see Figure A-7. The decimal values for the first five switch positions are: 1, 2, 4, 8, and 16. In Figure A-7, switch positions 1 and 2 are activated providing: a value of 3, a LISTEN address of 35, and a TALK address of 67.
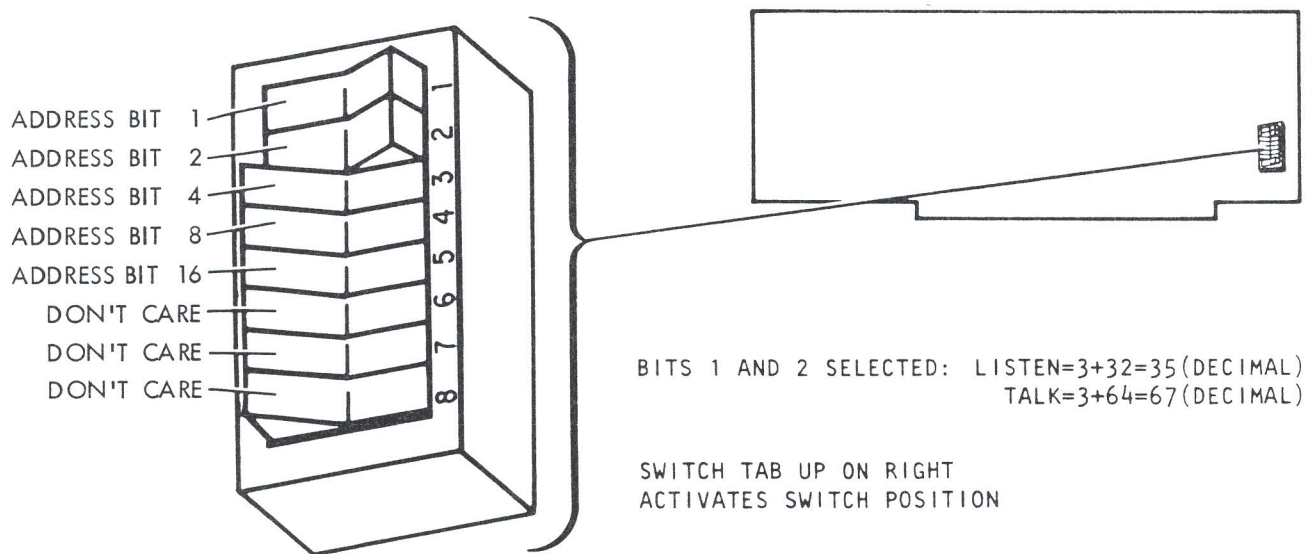


```
ADDRESS BIT  1
ADDRESS BIT  2
ADDRESS BIT  4
ADDRESS BIT  8
ADDRESS BIT 16
   DON'T CARE
   DON'T CARE
   DON'T CARE
```

BITS 1 AND 2 SELECTED: LISTEN=3+32=35(DECIMAL)
                           TALK=3+64=67(DECIMAL)

SWITCH TAB UP ON RIGHT
ACTIVATES SWITCH POSITION

Figure A-7.   GPIB Address Switches

A.2.9 RS-232C Interface (Optional on 2150/Standard on 2160)

In 1963, the Electronic Industry Association (EIA) established a standard to govern the Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Interchange. The latest revision of this standard has been in effect since 1969 and is known as RS-232C. The RS-232C standard defines electrical, logical, and mechanical specifications for the transmission of bit serial information. The VideoBridge's RS-232C option supports one bidirectional communication channel (channel B) that is used to communicate instrument setup and measurement information.

> **NOTE:** ESI supports the use of RS-232C Channel B only. Channel A is strictly an input channel and is reserved for applications programming features. Since Channel B is the secondary RS-232C channel, some VideoBridge pin connections do not conform to standard configurations. To ensure proper data transfer, consult the RS-232C standard and/or the manual of the device being connected.

A.2.9.1 Channel B

Channel B is used in two ways:

1. As a serial output for driving a printer.

2. As a means to provide remote programming. Programming instrument setups is very similar to that used on the IEEE-488 Interface Bus.

Data flowing into Channel B are put in an intermediate queue on an interrupt basis. Up to two hundred characters of input are allowed before overflow occurs. Full lines of data can be transmitted without concern about lost data.

> **NOTE:** Entries made through channel B are not echoed back for display.

The Channel B output buffer transmits data in five sections when the remote display mode is activated (by including the command REMOTEON as part of the setup program) and the measurement is completed.

1. A two digit error code.
2. Measurement from the top window of the instrument.
3. Measurement from the bottom window of the instrument.
4. Identification of top and bottom window functions.
5. Bin number.

See Section A.2.16.2 for measurement output information.

A.2.9.2 RS-232C Signal Flow

Use of the RS-232C bus requires three lines.

VIDEOBRIDGE CONNECTOR PIN Channel B	SIGNAL NAME
14	Receive Data
16	Transmit Data
7	Signal Ground

"Transmit" and "receive" are as viewed from the VideoBridge.

Figure A-8 indicates this setup when the VideoBridge is connected to a terminal or controller--the VideoBridge transmits data on pin 16 and receives data on pin 14.

Figure A-9 indicates a slightly different setup when connected to a printer: the VideoBridge still transmits data on pin 16 but receives a "Clear To Send" signal (CTS) from the printer on pin 13.
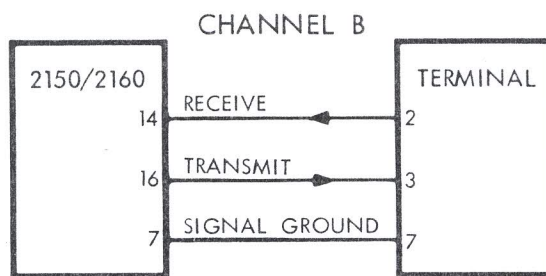
CHANNEL B

Figure A-8.   RS-232C VideoBridge-to-Terminal Connections
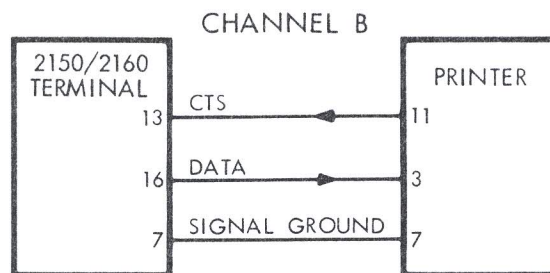
CHANNEL B

Figure A-9.   RS-232C VideoBridge-to-Printer Connections

RS-232C HANDSHAKE FUNCTIONS ARE NOT SUPPORTED BY THE MODEL 2150/2160.

This is because the RS-232C handshake signal lines are internally tied together within the VideoBridge, disabling the functions.

Pin 4 -- Request to Send (RTS)
Pin 5 -- Clear to Send (CTS)
Pin 8 -- Data Carrier Detect (DCD)

are connected together.

Pin 6 -- Data Set Ready (DSR)
Pin 20 -- Data Terminal Ready (DTR)

are connected together.

A.2.10 Data Format

The VideoBridge transmits and receives RS-232C data in 8-character word lengths: 7-bit ASCII data plus one Null bit. Also included in the string are one Start bit and one Stop bit.
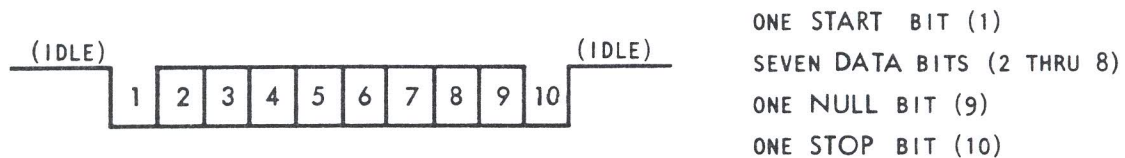
THERE ARE NO PARITY GENERATION OR CHECKING BITS.

ONE START BIT (1)
SEVEN DATA BITS (2 THRU 8)
ONE NULL BIT (9)
ONE STOP BIT (10)

Figure A-10. Data Format

A.2.11 Signal Levels

Tables A-4 and A-5 show the signal levels specified by the RS-232C standard. The signal states shown in Table A-4 apply to the Receive and Transmit signals. Table A-5 applies to all control inputs.

Table A-4. RS-232C Receive and Transmit Signal Levels

NOTATION	SIGNAL STATE	
	POSITIVE	NEGATIVE
BINARY STATE	1	0
SIGNAL CONDITION	TRUE	FALSE
VOLTAGE LEVEL	+3V to +25V	-3V to -25V

Table A-5. RS-232C Control Signal Levels

NOTATION	SIGNAL STATE	
	POSITIVE	NEGATIVE
BINARY STATE	0	1
SIGNAL CONDITION	SPACING	MARKING
FUNCTION	ON	OFF
VOLTAGE LEVEL	+3V to +25V	-3V to -25V

A.2.12 Bus Connector

Connections to the RS-232C option require a 25-contact, trapezoidal, polarized-shell connector; ESI P/N 26430, Manufacturer P/N CINCH DB-25P. "Transmit" and "receive" are as viewed from the VideoBridge. Pin assignments used by the RS-232C option are as follows:

Table A-6. RS-232C Pin Assignments

CONNECTOR PIN	SIGNAL LINE
1	Chassis Ground
2	Received Data from terminal (RS-232C IN)
3	Transmitted Data to terminal (RS-232C OUT)
4	Request to Send (Channel A)
5	Clear to Send (Channel A)
6	Data Set Ready (Channel A)
7	Signal Ground
8	Data Carrier Detect
13	Clear to Send (Channel B)
14	Receive Data (Channel B)
16	Transmit Data (Channel B)
20	Data Terminal Ready (Channel A)

A.2.13 Selecting the Baud Rate

Baud rate is equivalent to bits per second. Both communication
channels of the RS-232 Interface can be switched to any one of the
following nine baud rates:

1--9600	4--1200	7-- 150
2--4800	5-- 600	8--1800
3--2400	6-- 300	9-- 110

As shown in Figure A-11, there is a switch for each channel on the
RS-232/Cassette Interface circuit card (P/N 52674). The
corresponding switch position precedes each available rate. Position
10 on either switch is not connected. The RS-232/Cassette Interface
circuit card is shipped with channels A and B switched to 9600 baud
(position 1).

To select another baud rate for channel B, slide the lever on switch
S2 to the appropriate number for the desired rate. For channel A, do
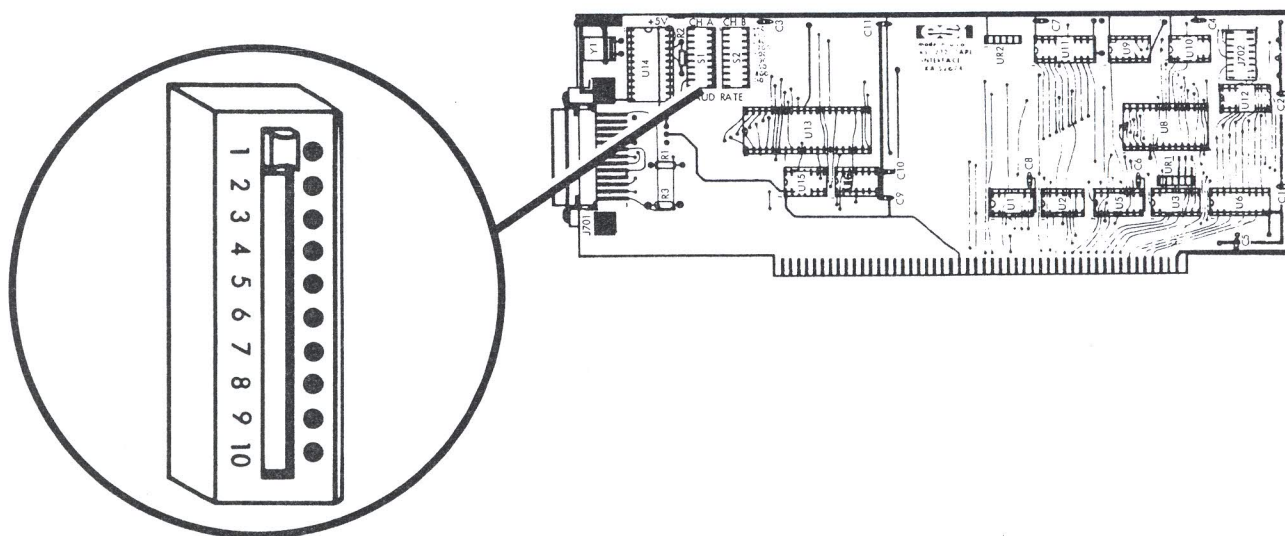the same on switch S1.

Figure A-11. Selecting the Baud Rate

A.2.14 Cable Length

Cable length for RS-232C transmission will vary according to the baud rates selected. For maximum transmission rate of 9600 baud, a cable length of less than 100 feet must be used. The capacitance of the cable must be less than 5000 picofarads. The essential parameter is the signal risetime which must be less than 1/2 the bit width so that the sampled signal will be correct.

Each time the baud rate is halved the allowable risetime doubles and the acceptable cable capacitance doubles. Therefore, 4800 baud can be transmitted over 200 feet; 2400 baud will work at 400 feet.

A.2.15 Remote Device Option Installation

WARNING

TO AVOID PERSONAL INJURY FROM ELECTRIC SHOCK DO NOT REMOVE INSTRUMENT COVERS OR PERFORM ANY MAINTENANCE OTHER THAN DESCRIBED IN THIS INSTRUCTION MANUAL. INSTALLATION AND MAINTENANCE PROCEDURES DESCRIBED HERE ARE TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY.

CAUTION

TO AVOID DAMAGE TO CIRCUITRY, TURN AC POWER OFF WHILE PLUGGING IN OR REMOVING CIRCUIT CARDS.

Installation of remote device options involves plugging in the GPIB circuit card (ESI P/N 46114) or the RS-232C Interface circuit card (ESI P/N 52674).

The remote device circuit card may be plugged into either J4 or J5 (Figure A-12). J1, J2 and J3 are not used. All empty circuit card slots should be covered with the jumper wires provided.

The Model 2160 comes with RS-232C Interface capability standard. It is installed in card slot J5. Either the GPIB option or the Handler Interface option may be installed in card slot J4.

The Model 2150 can accommodate any two of the three available VideoBridge options -- Handler, GPIB, or RS-232C. The Handler card MUST be installed in card slot J4, but the GPIB and RS-232C cards may be installed in either J4 or J5.
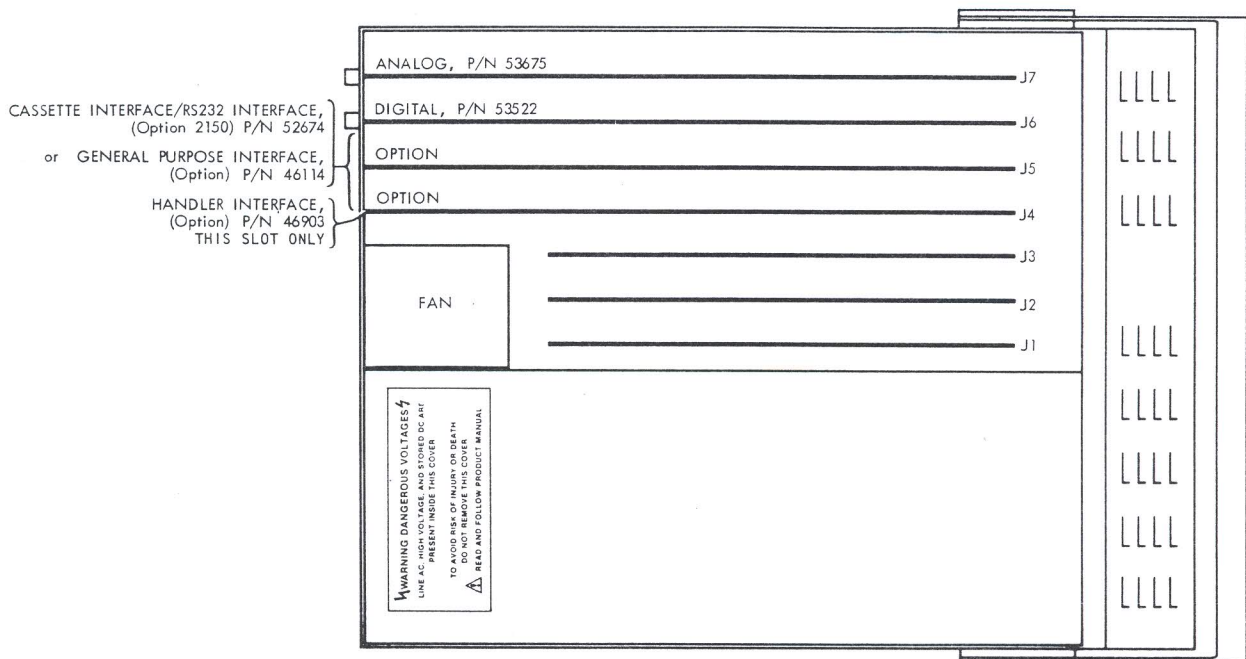
Figure A-12. Remote Device Options Circuit Card Locations

A.2.16 Remote Programming

For convenience, using the IEEE-488 bus or Channel B of the RS-232C Interface can be split into two phases: Instrument Setup and Result Accumulation.

A.2.16.1 Instrument Setup

The VideoBridge continuously checks for input from the remote device bus as it takes measurements or waits for input. If remote input is available, the instrument keyboard may be disconnected while the IEEE-488 or the RS-232C (Channel B) bus is connected as the input device. Characters are received from either bus as ASCII character strings and submitted to the 2150/2160 in the same manner as keyboard characters. In other words, transmitting the string:

    5 1 BIN# <CR> <LF>

over the remote bus will be like performing the same operation at the 2150/2160 keyboard. The key to programming is that the string submitted over the remote bus must be <u>exactly what appears on the CRT when the 2150/2160 keys are pushed</u> (see Table A-7). For example, when the mV button is pushed, MILLIVOLTS appears on the screen in the operator communication area. It is always what appears on the Video-Bridge CRT and <u>not</u> what appears on the keyboard which must be transmitted over the remote bus.

> **NOTE:** Neither the CALIBRATE function nor any of the cassette tape functions via remote programming are supported by the VideoBridge. Test codes 22 and -22 <u>are</u> supported, but once stored zero offsets have been erased, any new ones must be entered from the VideoBridge keyboard.

> **NOTE:** Neither messages nor data entries are displayed in the bottom portion of the CRT when input by remote programming.

Table A-7. Model 2150/2160 Remote Setup Dictionary

KEYBOARD COMMANDS	REMOTE PROGRAMMING COMMANDS	DESCRIPTION
UNIT CONTROL		
C	C	Capacitance
L	L	Inductance
Y/Z	Y/Z	Admittance (Y)/Impedance (Z)
G/R	G/R	Conductance (G)/Resistance (R)
B/X	B/X	Susceptance (B)/Reactance (X)
D	D	Dissipation factor
Q	Q	Quality factor

NUMBER SCALING CONTROL

KEYBOARD COMMANDS	REMOTE PROGRAMMING COMMANDS	DESCRIPTION	
ap	aPICO	Pico	10^{-12}
an	aNANO	Nano	10^{-9}
au	aMICRO	Micro	10^{-6}
am	aMILLI	Milli	10^{-3}
ak	aKILO	Kilo	10^{3}
aM	aMEGA	Mega	10^{6}

MAIN CONTROL

KEYBOARD COMMANDS	REMOTE PROGRAMMING COMMANDS	DESCRIPTION
FAST	FAST	Set to 5 samples/measurement sequence
MED	MEDIUM	Set to detector (or generator) reversal, take normal measurement
SLOW	SLOW	Set to detector (or generator) reversal, take higher accuracy measurement
STAT	STATUS	Go to status screen
SGL	SINGLE	Take a single measurement
CONT	CONTINUOUS	Take measurements continuously
-7 CODE	-7 CODE	Simulate power-up reset
22 CODE	22 CODE	Suspend use of zero offset corrections
-22 CODE	-22 CODE	Erase all stored zero offset corrections

GENERATOR CONTROL

KEYBOARD COMMANDS	REMOTE PROGRAMMING COMMANDS	DESCRIPTION
aHz	aHZ	Set test frequency
amV	aMILLIVOLTS	Set test level (voltage)
amA	aMILLIAMPS	Set test level (current)
AUTO	AUTO	Auto range on
HOLD	HOLD	Range hold on (hold range of d-u-t)
an 5 CODE	aNANO 5 CODE	Set to delay range hold for anF
a bn 5 CODE	a b NANO 5 CODE	Set to delay range hold + specific tolerance for anF (see Section 2.5.3.1)

NOTE: Numerical arguments are indicated by a, b, c,... for commands requiring them.

KEYBOARD COMMANDS	REMOTE PROGRAMMING COMMANDS	DESCRIPTION
GENERATOR CONTROL (cont)		
25 CODE	25 CODE	Use generator reversal if <200Hz
-25 CODE	-25 CODE	Use detector reversal
MEASUREMENT CONTROL		
aSETL	aMS-SETTLING-TIME	Set explicit settling time in ms
aI.T.	aINTEGRATION-TIME	Set explicit integration time in ms
aAVG	aSAMPLES-AVERAGED	Set explicit number of averages
DISPLAY CONTROL		
% MODE	*%MODE	Set to percent mode
ABS MODE	ABSMODE	Set to absolute mode
DEV	DEVIATION	Go to absolute/percent deviation display
DIR	DIRECT	Go to direct reading display
SORT	SORT	Go to sort mode display
26 CODE	26 CODE	Display values in SORT display on VideoBridge CRT
a 27 CODE	a 27 CODE	Set minimum digits
21 CODE	21 CODE	Go to GO/NO-GO display
17 CODE	17 CODE	Go to Auto LRC display
8 CODE	8 CODE	Go to no-display handler mode
-8 CODE	-8 CODE	Go to handler mode with values displayed
4 CODE	4 CODE	Display D in parts per million
-4 CODE	-4 CODE	Display D normally
BIN CONTROL		
aMINOR	aMINOR	Minor reject limit
a b cBIN#	a b cBIN#	Set upper and lower limits a, b on Bin c
a bBIN#	a bBIN#	Set limits of +/- a% on Bin b
aNOMINAL	aNOMINAL	Set nominal value
NOMINAL	NOMINAL	Set nominal value to current reading
2 CODE	2 CODE	Clear bin counts
-2 CODE	-2 CODE	Clear all bin limits and counts
15 CODE	15 CODE	Bin priority (bad D, low C into bin 0)
-15 CODE	-15 CODE	Bad D into bin R (normal)

NOTE: Numerical arguments are indicated by a, b, c,... for commands requiring them.

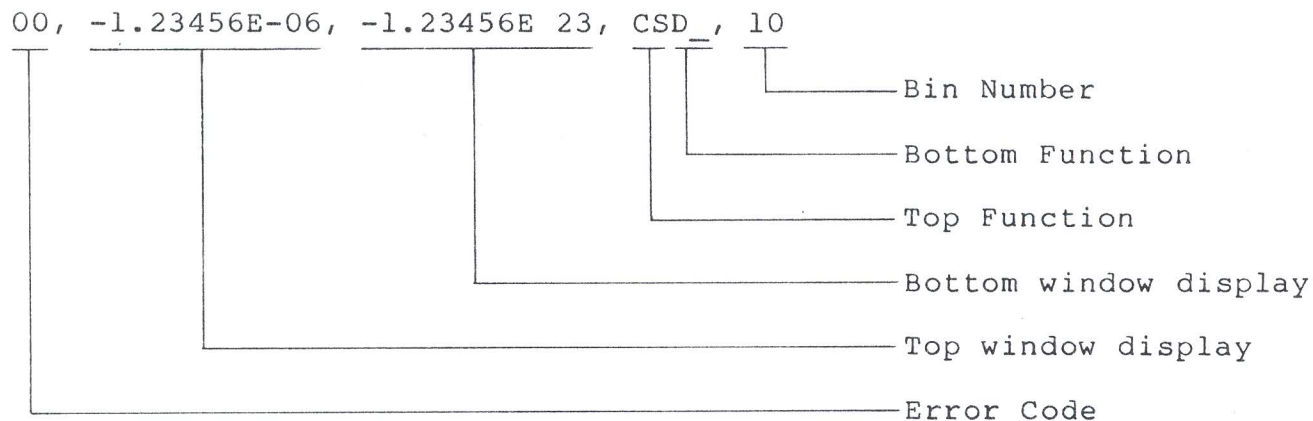| KEYBOARD COMMANDS	REMOTE PROGRAMMING COMMANDS	DESCRIPTION
BIN CONTROL (cont)		
16 CODE	16 CODE	Use output of bin 11 for end of conversion (analog busy)
-16 CODE	-16 CODE	Use output of bin 11 for binning
INPUT CONTROL		
	LOCK	Lock keyboard
	UNLOCK	Unlock keyboard
9 CODE	9 CODE	Lock keyboard (except SGL key)
-9 CODE	-9 CODE	Unlock keyboard
OUTPUT CONTROL		
	SCREENON	Update values on screen
	SCREENOFF	Don't update values on screen
	REMOTEON	Output measurements to GPIB or RS-232C
	REMOTEOFF	Don't output to GPIB or RS-232C
	REMOTE[	Temporarily disconnect the keyboard and the external START switch (start of setup)
	]	Reactivate the keyboard and external START switch at the end of the setup, unless the command was part of the setup
1 CODE	1 CODE	Turn Bias On
-1 CODE	-1 CODE	Turn Bias Off
10 CODE	10 CODE	Output measurements to Channel B (RS-232C only)
-10 CODE	-10 CODE	Stop output to Channel B (RS-232C only)
11 CODE	11 CODE	Output setup and binning data Channel B (RS-232C only)
23 CODE	23 CODE	Turn off SRQ when addressed to talk (GPIB only)
-23 CODE	-23 CODE	Turn off SRQ only on serial poll (GPIB only)
24 CODE	24 CODE	Display GPIB address setting (GPIB only)
ZERO-POWER RAM (NON-VOLATILE MEMORY)		
6 CODE	6 CODE	Save all VideoBridge data into ZRAM, update bin counts
-6 CODE	-6 CODE	Retrieve data from ZRAM, begin updating bin counts

KEYBOARD COMMANDS	REMOTE PROGRAMMING COMMANDS	DESCRIPTION

KEYBOARD COMMANDS <u>NOT</u> SUPPORTED FOR REMOTE USAGE

CODE	20 CODE
3 CODE	-20 CODE
7 CODE	LOAD
12 CODE	SAVE
13 CODE	'
14 CODE	DEL
18 CODE	ENTER
19 CODE	CAL

OUTPUT STRING FORMAT AND ERROR CODES

```
00, -1.23456E-06, -1.23456E 23, CSD_, 10
```

- Bin Number
- Bottom Function
- Top Function
- Bottom window display
- Top window display
- Error Code

Error code assignments for 2150/2160.

00	No error
01	Can't Supply
02	Analog Error
03	Analog Error--Can't Supply
04	Calculation Error
05	Calculation Error--Can't Supply

The remote input is not echoed on the screen. Carriage returns <CR> are necessary; line feeds <LF> are optional. With the exception of "REMOTE[" and "]", multiple commands can appear on the same line.

SETUP COMMENTS

The percent sign (%) is used to separate comments from the information which is to be acted upon by the 2150/2160. Therefore, comments can be included with the setup information as shown in the example that follows.

SEPARATORS

All numbers, words, and comments in the setup strings must be separated by either SPACES, TABS, or be followed by a CARRIAGE RETURN.

LINE TERMINATION

Line feeds are accepted and discarded. A carriage return is all that is required.

UPPER AND LOWER CASE

Lower case characters are equivalent to upper case characters when naming definitions in the dictionary. When in doubt, use upper case characters. Comments can be either upper or lower case characters.

REMOTE[

REMOTE[disables the 2150/2160 keyboard and directs error messages normally appearing in the bottom reverse video line of the 2150/2160 to the remote device. It also disables the instrument from taking measurements during the setup phase. <u>It is absolutely necessary that this word appear on a line by itself!</u>

]

"]" restores the instrument to measurement mode and, if the setup
didn't lock out the keyboard, re-enables the keyboard, and generally
undoes any change made by REMOTE[. "]" also must appear on a line by
itself!

ERRORS DURING SETUP

If one or more errors occured during the remote setup, (between
"REMOTE[" and "]") the message "ERRORS SEEN" will be transmitted. If
the setup went well, the string "NO ERRORS" will be transmitted. This
information becomes available after the "]" is processed by the
instrument.

DATA OVERFLOW

Data flowing into the RS-232C Interface option is placed in an inter-
mediate queue, on an interrupt basis, allowing up to 200 characters
of input to back-up before overflow occurs. This technique allows
full lines of data to be transmitted without concern about lost data.

Data overflow temporarily suspends the bus (NRFD is activated on the
GPIB option) and should be considered carefully if several
instruments require prompt service. One may always construct the
setup in multiple phases of less than 200 characters each and then
wait for phase completion before transmission of the next phase.

SETUP CAUTIONS

During the setup phase it is convenient to issue a STATUS command so the process of bin setup is visible on the screen. Remember that when the setup is complete, STATUS must be issued again to toggle the instrument back to the chosen measurement mode. Otherwise, the SINGLE measurement commands will not result in the transmission of measurement data to the remote device.

To allow fastest setup times and also to ensure that the remote input will not be disturbed by keyboard or measurement input between successive lines of setup information, the first character output (instruction in the program) should be:

REMOTE[

which temporarily disconnects the keyboard and external START switch (i.e. do not use SINGLE or CONTINUOUS). This entry must be on a line by itself followed by a carriage return before additional input will be accepted by the 2150/2160.

The "]" character is issued at the end of the setup phase to restore the instrument to its measurement loop and make the keyboard active again. "]" automatically transmits error information. The setup program must explicitly lock the keyboard out if that is desired. This may be done with the LOCK command. After the desired measurements have been made, the instrument can be UNLOCKed.

In summary, the procedure for remote setup is:

STEP 1. Sit down with a pad of paper and write what appears on the
         screen as you push the keys and manually set up the
         instrument.

STEP 2. Insert "REMOTE[" at the start of this list of words and "]"
         at the end. Be sure that these two entries are each entered
         on a separate line apart from the other entries.

STEP 3. Write a program, in the language of the computer which will
         be setting up the 2150/2160, which outputs this list of
         words to the remote programming device.

STEP 4. AFTER THE LIST HAS BEEN TRANSMITTED, REQUEST AN OUTPUT FROM
         THE 2150/2160 (TAKE ONE READING WITH 'SINGLE') AND MAKE
         CERTAIN NO ERRORS ARE ENCOUNTERED.

Example Setup:

```
    REMOTE[
        REMOTEON              % MEASUREMENT RESULTS INTO REMOTE BUFFER
        SCREENOFF             % LOCK OUT CRT DISPLAY
        LOCK                  % LOCK OUT THE KEYBOARD
        1000 HZ               % SET FREQUENCY
        FAST                  % SET TO PRESET 'FAST' SPEED
        C D                   % MEASUREMENT FUNCTIONS
        SERIES                % SERIES EQUIVALENT CIRCUIT
        1   1 BIN#
        5   2 BIN#
       10   3 BIN#
       20   4 BIN#            % SET UP BIN VALUES
      100 NANO NOMINAL        % NOMINAL VALUE
    .0005 MINOR               % SET MINOR REJECT VALUE
        ]                     % END OF SETUP
        SINGLE                % REQUEST FIRST READING
```

A.2.16.2 Result Accumulation
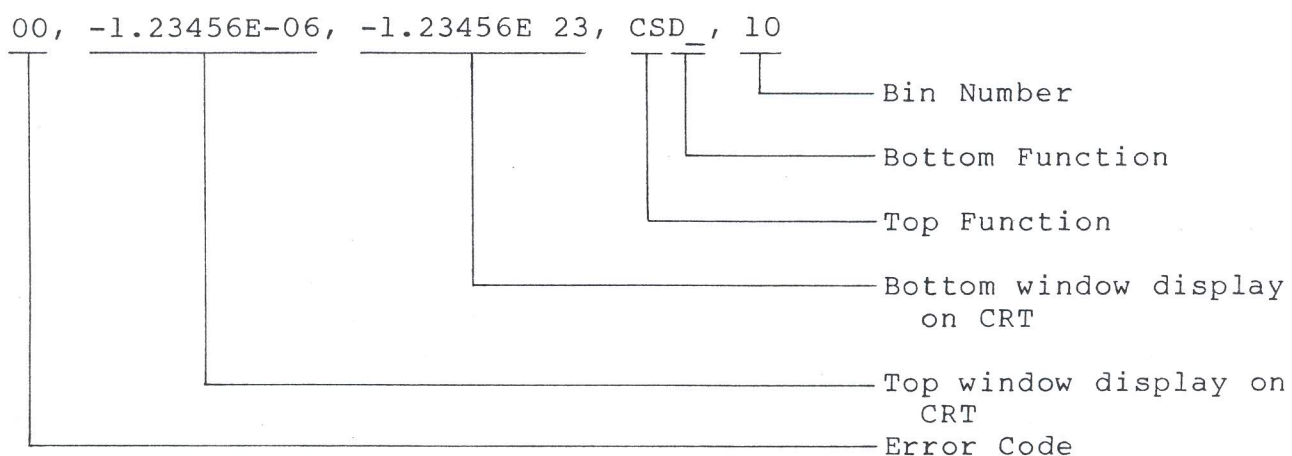
Special Display Words

A word display is used to indicate some form of output (see Table
A-7). One form is the top and bottom displays on the instrument
screen--the one formed in large characters. Another is the more
standard floating point numbers which are output to the remote device
after it has issued a SINGLE command. The conversion of an inner
floating point representation to a string of characters suitable for
display takes considerable processing time. The following words were
devised so the time between measurements can be as brief as possible.

SCREENON/SCREENOFF

This pair of words enables and disables the large video display on
the screen of the 2150/2160. When the instrument is not being
monitored on site and the measurement results are being transmitted
by remote output, SCREENOFF will greatly increase measurement speed.

REMOTEON/REMOTEOFF

REMOTEON must be part of the setup information before measurement
results are transmitted to the remote device which last transmitted
information to the 2150/2160. The output string looks like this:

```
00, -1.23456E-06, -1.23456E 23, CSD_, 10
```

- Bin Number
- Bottom Function
- Top Function
- Bottom window display on CRT
- Top window display on CRT
- Error Code

The field sizes are fixed so FORTRAN programs can use fixed field format statements to receive the input.

LOCK/UNLOCK

LOCK is issued in the setup phase to lock out the keyboard of the instrument during remote operation. UNLOCK can be issued at the termination of a run to restore control, -9 CODE can be entered, or the keyboard can be unlocked by temporarily grounding pin 21 of the Handler Interface circuit card. This overrides the remote device.

A.2.16.3 Measurement Protocol

The protocol for taking GPIB measurements is

-Controller addresses the 2150/2160 as a listener.
-Controller issues a SINGLE command.
-2150/2160 takes a measurement and stores the result in a buffer, sets the service request (SRQ) line at completion.
-Controller performs a serial poll and inputs the status byte from the 2150/2160.
-Controller addresses the 2150/2160 as a talker and reads the buffer.

Refer to Section A.2.18, GPIB Sample Program.

> **NOTE:** If the controller is unable to conduct a serial poll (which is necessary to unassert the SRQ line), enter 23 CODE. The SRQ line will now be automatically reset after the measurement results have been read by the controller. This prevents the SRQ line from remaining asserted once the VideoBridge data is no longer in the buffer.

> **NOTE:** VideoBridge protocol does not support continuous mode measurement. The controller must initiate each measurement with a SINGLE command. If continuous mode is used, the VideoBridge may write to the middle of the buffer at the same time the controller is reading the buffer.

When a serial poll is conducted, the VideoBridge returns a status byte to the controller. This byte will have one of three values:

(0) -- all bits are zero: the VideoBridge is not busy, and SRQ has not been asserted.

(1) -- the first bit is one, the rest are zero: the VideoBridge is busy, SRQ has not been asserted.

(64) -- the seventh bit is one, the rest are zero: the SRQ has been asserted. An error message will be transmitted.

If the controller does not conduct a serial poll between commanding measurements, the previous measurement will be written over.

A.2.17 Calibration

The 2150/2160 needs no adjustment, other than normal calibration, when the GPIB or the RS-232C option is installed. Neither circuit assembly contains service adjustments.

WARNING

TO AVOID PERSONAL INJURY FROM ELECTRIC SHOCK DO NOT REMOVE INSTRUMENT COVERS OR PERFORM ANY MAINTENANCE OTHER THAN DESCRIBED IN THIS INSTRUCTION SHEET. INSTALLATION AND MAINTENANCE PROCEDURES DESCRIBED IN THIS INSTRUCTION SHEET ARE TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY.

A.2.18 GPIB Sample Program

A sample GPIB program written on a Hewlett-Packard HP85B is listed, followed by remarks. The HPIB address is 700 and the 2150/2160 IEEE address was set at 1, so talk or listen functions will show the address 701 in the program.

Program:	Remarks:
400 DIM A$ [50]	400 Open field for measurement string.
500 DIM C$ [50]	500 Open field for command string.
550 OUTPUT 701 ; "REMOTEON"	550 Send REMOTEON to 2150/2160.
600 OUTPUT 701 ; "REMOTE["	600 Temporarily disconnect keyboard and start switch.
800 PRINT "ENTER SETUP COMMAND"	
900 PRINT "THEN PRESS RETURN"	
1000 PRINT "IF NO MORE COMMANDS"	
1100 PRINT "TYPE '0 RETURN'"	
1200 INPUT C$	1200 Input one command from remote setup dictionary.
1300 PRINT C$	
1350 PRINT ""	
1400 CLEAR	
1500 IF C$="0" THEN GOTO 1800	1500 If C$=0 then goto measurement portion of program.
1600 OUTPUT 701 ; C$	1600 Address 2150/2160 and send command.
1700 GOTO 1200	1700 Return to setup routine if C$ not 0.
1800 OUTPUT 701 ; "]"	1800 Re-activate screen and keyboard at end of setup.
1900 PRINT "# OF MEASUREMENTS"	
2000 INPUT J	2000 Operator inputs number of single cycle operations the 2150/2160 will perform.
2100 PRINT J	
2200 FOR I=1 TO J	2200 'I' will be the number of operations.
2300 OUTPUT 701 ; "SINGLE"	2300 Address the 2150/2160 and send the 'SINGLE' command.
2400 S=0	2400 Set variable S to 0.
2500 S=SPOLL (701)	2500 Monitor the 2150/2160 to see if the SRQ has been set.
2600 IF S>=64 THEN GOTO 2800	2600 If SRQ is set then address the 2150/2160 and print the measurement string.
2700 IF S=0 THEN GOTO 2400	2700 If SRQ has not been set then remain in SRQ monitor mode.
2800 ENTER 701 ; A$	2800 Address 2150/2160 and read output string.

Program:	Remarks:
2900 PRINT A$	2900 Print output string.
3000 NEXT I	3000 Repeat single cycles until operator number is reached.
3100 GOTO 800	3100 Return to setup routine.
3200 END	

Sample Output (see Section A.2.16.2 for Output String format):

ENTER SETUP COMMAND
THEN PRESS RETURN
IF NO MORE COMMANDS
TYPE '0 RETURN'
-2 CODE
100 NANO NOMINAL

.005 MINOR
 1   1 BIN #
 5   2 BIN #
10   3 BIN #
20   4 BIN #
1000 HZ
LOCK
FAST
C
D
SCREENOFF
0
OF MEASUREMENTS   10

```
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
00,  100.7E-09,  800.E-06, CSD ,  1
```


ENTER SETUP COMMAND
THEN PRESS RETURN
IF NO MORE COMMANDS
TYPE '0 RETURN'

A.2.19 RS-232C Sample Program

A sample RS-232C program written on a Hewlett-Packard HP85B is listed, followed by output and remarks. The program address code is 1Ø.

Program:

```
 1Ø DIM A$[5Ø]

 2Ø DIM C$[5Ø]
 3Ø OUTPUT 1Ø ; "REMOTEON"
 4Ø OUTPUT 1Ø ; "REMOTE["

 5Ø CLEAR
 6Ø RESET 1Ø
 7Ø DISP "ENTER SETUP COMMAND"
 8Ø DISP "THEN PRESS 'RETURN'"
 9Ø DISP "IF NO MORE COMMANDS"
1ØØ DISP "TYPE 'Ø RETURN'"
11Ø INPUT C$

12Ø DISP C$
13Ø CLEAR
14Ø IF C$="Ø" THEN GOTO 17Ø

15Ø OUTPUT 1Ø ;C$

16Ø GOTO 11Ø

17Ø OUTPUT 1Ø ;"]"

18Ø ENTER 1Ø ;C$
19Ø DISP "# OF MEASUREMENTS"
2ØØ INPUT J


21Ø DISP J
22Ø FOR I=Ø TO J

23Ø OUTPUT 1Ø ;"SINGLE"

24Ø ENTER 1Ø ; A$

25Ø DISP A$
26Ø NEXT I



27Ø GOTO 3Ø
28Ø END
```

Remarks:

1Ø Open field for measurement string.
2Ø Open field for command string.
3Ø Send "REMOTEON" to 215Ø/216Ø.
4Ø Temporarily disconnect keyboard and start switch.

6Ø Clears HP85B RS-232C buffer

11Ø Input one command from remote setup dictionary.

14Ø If C$=Ø, then go to measurement portion of program.
15Ø Address 215Ø/216Ø and send command.
16Ø Return to setup routine if C$ not Ø.
17Ø Re-activate screen and keyboard at end of setup.

2ØØ Operator inputs number of single cycle operations the 215Ø/216Ø will perform.

22Ø 'I' will be the number of operations.
23Ø Address the 215Ø/216Ø and send the 'SINGLE' command.
24Ø Address the 215Ø/216Ø and read the output string.
25Ø Print the output string.
26Ø Repeat single cycle measurements until operator number is reached.
27Ø Return to setup routine.

Sample Output (see Section A.2.16.2 for Output String format):

```
ENTER SETUP COMMAND
THEN PRESS RETURN
IF NO MORE COMMANDS
TYPE 'Ø RETURN'
-2 CODE
1ØØ NANO NOMINAL

.ØØ5 MINOR
 1   1 BIN #
 5   2 BIN #
1Ø   3 BIN #
2Ø   4 BIN #
1ØØØ HZ
LOCK
FAST
C
D
SCREENOFF
Ø
# OF MEASUREMENTS    1Ø
NO ERRORS

ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1
ØØ,   1ØØ.7E-Ø9,   8ØØ.E-Ø6,  CSD ,   1


ENTER SETUP COMMAND
THEN PRESS RETURN
IF NO MORE COMMANDS
TYPE 'Ø RETURN'
```

A.3   NON-VOLATILE MEMORY

The Non-Volatile Memory option allows the VideoBridge to save measurement and binning information when line voltage drops sufficiently to affect power supply levels or when the instrument is turned off. The option consists of a factory-installed 2K ZRAM (Zero Power Random Access Memory, P/N 55843) chip, U31, located on the motherboard. To engage this option, program test code 6 according to the instructions in Section 2.1.1.1.

When 6 CODE is programmed, the VideoBridge still functions in the normal manner. The ZRAM, however,

1) stores the display and binning setup, including all zero calibration offsets. This data is not updated; it is retained regardless of changes made after entering 6 CODE.

2) continuously updates the bin count. It is, in a sense, "waiting" for a power loss condition, when it will retain its last updated bin count data.

NOTE: Zero offsets are valid only under the conditions they were taken. Calibrated offsets retrieved from ZRAM may not be valid due to changes from original calibration conditions. If there is any question as to the validity of these stored offsets (due to repositioned test leads, changes in environment, different test fixture, etc.), simply take a measurement of the fixture or clips. The resistance reading should be zero, or nearly zero. If not, the fixture or clips need to be re-calibrated.

Once power has been restored, enter -6 CODE to recall the last updated bin count from the ZRAM (the ZRAM will also recall the original direct display setup, including zero calibration information present at the time 6 CODE was entered). Push <STAT> and the VideoBridge will display the bin count it had at the time of the power loss.

Entering 2 CODE will reset all bin counters to zero in both normal RAM and ZRAM. -2 CODE will reset bin limits and bin counters in normal RAM along with the bin counters in ZRAM.

> **NOTE:** When 6 CODE is first programmed, zero calibration offsets are stored for convenient retrieval in case of power outage. Should different calibration offsets be made before an intentional power down, -6 CODE will recall the <u>original</u> calibration settings. To prevent the use of an undesired setup, enter -6 CODE, -22 CODE, and re-calibrate.

```
〜〜〜〜〜〜〜〜
{  CAUTION  }
〜〜〜〜〜〜〜〜
```

DO NOT ENTER TEST CODE 6 OR TEST CODE -6 WITHOUT ZRAM OPTION INSTALLED.

After power has been turned off and back on again, the VideoBridge will be in its normal power-up condition--Auto LRC.

Handler modes (8 and -8 CODE) and Keyboard Lock (9 CODE) are not saved in Non-Volatile Memory. When power is restored and -6 CODE is entered, any of these test codes which had been previously activated must be re-entered to completely restore operation.

A.4 +200 VOLT DC BIAS OPTION (SP5240)

The Model SP5240 is a Model 2150 or 2160 VideoBridge with a factory installed option of extended DC bias capability. All other SP5240 features, functions, and specifications are identical to those of the Model 2150 or 2160.

A DC bias of up to +200V can be applied to the rear panel bias terminals. Be sure to observe polarity. The Bias Voltage is not applied to the unknown until test code 1 is programmed. Measurements with bias are available for capacitance only. The bias supply must have low ripple with internal current limit of 100mA and its AC output impedance must be less than 1 ohm at the test frequency. If the bias source impedance is not low compared to the unknown, a bypass capacitor whose impedance is 1/5 of the range resistor used can be connected across the bias terminal posts. The procedure for applying and removing +200V DC bias is the same as described for +50V DC bias in Section 2.10 of this manual.

Changes to the analog card for the +200VDC option are as follows:

Analog Circuit Assembly, P/N 53675 changes to P/N 56482

C4 and C29, P/N 45645 (100V rating), change to P/N 56473 (250V rating)

CR22, P/N 55494 (surge arrestor) changes to P/N 56474 (surge arrestor).

DANGER

ELECTRICAL SHOCK HAZARD EXISTS WHEN A BIAS SUPPLY IS CONNECTED TO THIS INSTRUMENT. USER SUPPLIED BIAS VOLTAGE MAY BE PRESENT AT INSTRUMENT TERMINALS AND TEST FIXTURES. USE ONLY BIAS VOLTAGES UP TO +200VDC AND BIAS SUPPLIES CURRENT LIMITED AT 100mA. DO NOT TOUCH, CONNECT, OR DISCONNECT THE UNKNOWN COMPONENT OR BNC CABLES WHILE A BIAS VOLTAGE IS APPLIED. FAILURE TO OBSERVE THIS WARNING MAY RESULT IN SEVERE INJURY OR DEATH.