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RMS?

Purpose: Returns the RMS of the waveform segment described by WINDOW.

Type: Query only

Query Syntax: `RMS?`

Query Parameters: None

Query Response: The measured value

Description: This query will return the RMS of a waveform segment.
RMS is the root-mean-squared of the waveform.
A waveform segment is described by WINDOW:LOC, WINDOW:START and WINDOW:STOP.

Examples: Command: `RMS?`
Response: `RMS 317.7E-03;`

Related Commands: `WINDOW:LOC, WINDOW:START, WINDOW:STOP`

SET?

Purpose: Returns the complete list of current instrument setups.

Type: Query only

Default Value: None

Query Syntax: `SET?`

Query Parameters: None

Query Response: The response will be all current instrument settings. This response will be accepted as a command message by the instrument. This provides a way to extend locally stored settings.

Note that waveform data is not accessed with this query.

Description: This query returns the complete instrument settings.

Examples: Command: `SET?`
Response: `CH1:ACQUIRE:NUM 1;LOC 1;MODE NORMAL . . .;`

Related Commands: `CH1?, CH2?`

SUB

Purpose: Algebraically subtracts two waveforms.

Type: Operational

Command Syntax: `SUB <source1>,<source2>,<destination>`

Command Parameters:
<source1> = specifies the first source waveform location
<source2> = specifies the second source waveform location
<destination> = specifies the result waveform location

Description: This command allows two waveforms to be algebraically subtracted, using raw data values.

Examples: Command: `SUB 1,2,3`

Related Commands: ADD

TMODE

Purpose: Specifies how the TOP voltage will be determined.

Type: Setting

Command Syntax: `TMODE:<arg1> [<arg2>]`

Command Parameters: <arg1> = { ABSOLUTE | HISTOGRAM | MINMAX } (HISTOGRAM)

ABSOLUTE - Selects the top value through BTLINES

MINMAX - Sets the top value as the maximum waveform value

HISTOGRAM - Selects the histogram distribution method to set the top value. Note that MEAN or MODE must be specified in the following parameter.

<arg2> = { MEAN | MODE }

MEAN - Sets the TOP value of the waveform to the MEAN value of the histogram distribution

MODE - Sets the TOP value of the waveform to the MODE value (the most frequently occurring value) of the histogram distribution

Default Value: HISTOGRAM MODE

Description: This command allows you to change the way TOP voltage is determined. Along with BMODE, this allows control over the way pulse analysis functions and thus obtains reliable measurements from complex waveforms.

Examples:
Command: `TMODE:HISTOGRAM MEAN;`
Command: `TMODE:HISTOGRAM MODE;`
Command: `TMODE:MINMAX;`
Command: `TMODE:ABSOLUTE;:REFUNITS VOLTS;:BTLINES:TOPLINE -1.0;`

Related Commands: `BMODE, REFUNITS, BTLINES`

TOP?

Purpose: Returns the TOP of the waveform segment described by WINDOW.

Type: Query only

Query Syntax: `TOP?`

Query Parameters: None

Query Response: The measured value

Description: This query will return the TOP of a waveform segment.
Top is the topline voltage representing the nominal top of the waveform.
A waveform segment is described by WINDOW:LOC, WINDOW:START and WINDOW:STOP.

Examples: Command: `TOP?`
Response: `TOP 998.1E-03;`

Related Commands: `WINDOW:LOC, WINDOW:START, WINDOW:STOP`

TOVER?

Purpose: Returns the TOP OVERSHOOT of the waveform segment described by WINDOW.

Type: Query only

Query Syntax: `TOVER?`

Query Parameters: None

Query Response: The measured value

Description: This query will return the TOVER of a waveform segment.
TOVER is the percentage of top overshoot.
A waveform segment is described by WINDOW:LOC, WINDOW:START and WINDOW:STOP.

Examples: Command: `TOVER?`
Response: `TOVER 176.2E-03;`

Related Commands: `WINDOW:LOC, WINDOW:START, WINDOW:STOP`

Event Code: 222 "Sample Interval limited" An invalid sample interval has been selected with the CHx:SAMPLE:INTERVAL command. See Table 1-5. Timebase Capabilities in Section 1 for a list of valid sample rates.

Event Code: 222 "Transfer count adjusted" A data transfer count was specified with DATA:COUNT that extended beyond the end of the waveform record.

Event Code: 222 "Transfer start adjusted" A data transfer start was specified with DATA:START that extended beyond the end of the waveform record.

Event Code: 222 "Trigger delay adjusted" This error can be generated from two different sources: a trigger delay has been requested while in equivalent time mode; or the sample rate was changed to equivalent time while trigger delay is selected.

Event Code: 222 "Trigger level adjusted" The full scale range has been changed with the CHx:RANGE command that makes the current trigger level invalid.

Event Code: 223 "Waveform length truncated" An attempt has been made to download a waveform into the VX4250 that is longer than specified in the DATA command.

Event Code: 350 "Too many events" The event queue in the VX4250 is five messages long. This event is placed in the event queue to notify the user that event messages have been lost.

Event Code: 402 "Acquisition complete" This event indicates that a waveform acquisition has completed and stored in waveform memory.

Event Code: 402 "Event Found" This event indicates that a comparison test has failed. See the CHx:COMPARE commands for more information.

Event Code: 500 "Acquisition pending" This error is usually the result of a CHx:START command while the VX4250 is already acquiring data. In order to restart the acquisition, the current acquisition must complete or can be terminated with a CHx:STOP.

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TST?

Purpose: Invokes extended self-test and returns failure information.

Type: Query only

Default Value: None

Query Syntax: `TST?`

Query Parameters: None

Query Response: The number of errors found will be returned as <INTEGER> with a description of the problem. The response "0, no errors found" means all tests pass.

Description: This query invokes the instrument extended self-test. The command also has an extended set of arguments for use by service technicians to troubleshoot the instrument when it fails. Detailed information about this extended argument set is contained in the Diagnostics section of the Service Manual.

Examples: Command: `TST?`
Response: `0, selftest complete`

Related Commands: None

Note:

The internal diagnostics normally take 7—10 seconds to complete. Some interface device channels will time out prior to the normal completion of the TST? query. If a normal response is not obtained from the TST? command, check the time out setting of the system interface device and/or controller before continuing troubleshooting.

WFMCMP?

Purpose: Compares a waveform or envelope to a reference envelope and returns the results.

Type: Query only

Default Value: None

Query Syntax: `WFMCMP?`

Query Parameters: None

Query Response: The response will indicate the total number of samples with excursions from the template.

Description: This query will invoke a template comparison between an acquired signal and a stored envelope. The source waveform is defined by WINDOW:LOC. and the bounds of comparison by WINDOW:START and WINDOW:STOP. The template waveform is defined by TEMPLATE:LOC.

If the compare was successful (i.e.,: no excursions from the envelope were detected), the response will be: "WFMCMP 0".

Examples: Command: `WFMCMP?`
Response: `WFMCMP 10;`

Related Commands: `MARGINS`

WFMPRE?

Purpose: Returns scaling information for data returned with CURVE?

Type: Query only

Default Value: None

Query Syntax: `WFMPRE?`

Query Parameters: None

Query Response: ENCDG – the data encoding scheme (ASCII, RIB, RIP). This is a query only.

NRPT – the number of points in the waveform (2044). This is a query only.

XINCR – the time interval between points

YMULT – the value of an LSB in volts

YZERO – the offset voltage value

BYTNR – The number of bytes in each binary data field.

PTOFF – The PRETRIGGER offset in seconds.

Description: This query returns scaling information needed to convert raw acquisition data to real world units.

Examples: Command: `WFMPRE?`
Response: `ENCDG ASCII,NRPT 2044,XINCR 100E-6,YMULT .1,YZERO 0;`

Related Commands: `CURVE`

WIDTH?

Purpose: Returns the WIDTH of the waveform segment described by WINDOW.

Type: Query only

Query Syntax: `WIDTH?`

Query Parameters: None

Query Response: The measured value

Description: This query will return the WIDTH of a waveform segment.
Width is the time between the first and second mesial points.
A waveform segment is described by WINDOW:LOC, WINDOW:START and WINDOW:STOP.

Examples: Command: `WIDTH?`
Response: `WIDTH 1.3;`

Related Commands: `WINDOW:LOC, WINDOW:START, WINDOW:STOP`

WINDOW

Purpose: Defines a waveform segment to which waveform measurements will apply.

Type: Setting

Command Syntax: `WINDOW:<arg1> <arg2>`

Command Parameters: <arg1> = { LOC | START | STOP }

LOC - The waveform location to be used

START - the start of the waveform segment

STOP - the end of the waveform segment

<arg2> = { <waveform location> | <waveform point> }

Default Value: None

Query Syntax: `WINDOW:<arg1>?`

Query Parameters: <arg1> = { LOC | START | STOP }

Query Response: The measured value

Description: Defines a waveform segment to which waveform measurements will apply. Each waveform location keeps its own start and stop parameters. Thus, the segment defined for locations 1 and 2 may remain different.

Examples: Command: `WINDOW:LOC 1;START 24;STOP 2024;`

Related Commands: All measurements

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System Commands

This subsection provides an alphabetical description of IEEE 488.2 common commands supported by the instrument.

System commands are recognized by the preceding * (asterisk) designating them as 488.2 common commands.

All 488.2 common commands have versions without the preceding * (asterisk) that behave identically (with the exception of the *TST? command). The unstarred versions are intended to be used with the VX5520 Slot0 Resource Manager.

***ESE** Sets the value in the Event Status Enable register.

***ESE?** Returns the value in the Event Status Enable register.

***ESR?** Returns the value in the Event Status Register.

***IDN?** Returns "TEK VX4250,0,<firmware version>".

***OPC** Causes the device to generate the operation complete message when all pending operations are complete.

***OPC?** Causes the device to put a "1" in the output queue when all pending operations are complete.

***RCL** Restores both previously saved channel sequence setups.

***SAV** Stores both channel sequence setups (steps) in a stored setting location.

***SRE** Sets the value in the Service Request Enable register.

***SRE?** Returns the value in the Service Request Enable register.

***STB?** Returns the value in the status byte. (A serial poll would get the same information if GPIB).

***TST?** Same as TST? but returns only the numeric argument. Zero (0) indicates no failures; any other number indicates the failure code.

***WAI** This synchronization command will stop the execution of commands until both channels have completed their channel sequences.

*ESE,*ESE?

Purpose: **ESE* sets the Event Status Enable Register bits.
**ESE?* queries the setting of the Event Status Enable Register bits.

Command Syntax:
```
*ESE <integer>
 ESE <integer>
```

Query Syntax:
```
*ESE?
 ESE?
```

Command Parameters: <integer> An integer in the range of 0—255 that represents the desired setting of the Event Status Enable Register bits.

Query Parameters: None

Description: If an out-of-range integer is entered for the value of <integer>, an execution error is generated.

The `*ESE?` query generates an integer response (in the range of 0—255) that corresponds to the bits set in the Event Status Enable Register.

Note:

For further information regarding the bit definitions of the Event Status Enable Register, refer to Figure 7-1. Register Bit Definitions.

Command Example: In the following example, the `*ESE` command sets bits 1 and 2:

```
*ESE 3
```

Query Example: In the following example, the `*ESE?` query determines that bits 1, 2, and 6 are set:

```
*ESE?
9;
```

Related Commands: None

*ESR?

Purpose: Reads the contents of the Event Status Register.

Syntax:
```
*ESR?
 ESR?
```

Parameters: None

Description: The `*ESR?` query clears the Event Status Register after reading. The response to this query is identical to that of `*ESE?`.

Note:

For further information regarding the bit definitions of the Event Status Register, refer to Figure 7-1.

Example: In the following example, the `*ESR?` query determines that bits 1, 2, and 6 are set:

```
*ESR?
9;
```

Related Commands: None

*IDN?

Purpose: Returns the unique identification of the instrument.

Syntax:

```
*IDN?
 IDN?
```

Parameters: None

Description: The VX4250 response to this command is organized into four fields identifying the Manufacturer, Model, and Firmware Level (or equivalent) of the instrument and is reported in the form:

```
TEKTRONIX,<model>,0,<firmware version>
```

such as:

```
TEKTRONIX,VX4250,0,CF:88.1CN RM:1.0;
```

Related Commands: `ID?`

*OPC,*OPC?

Purpose: *OPC sets the operation complete bit in the Standard Event Status Register when the current operation is complete.
*OPC? queries the VX4250 to determine if the operation is complete.

Command Syntax:
```
*OPC
 OPC
```

Query Syntax:
```
*OPC?
 OPC?
```

Command Parameters: None

Query Parameters: None

Description: The *OPC command asserts the *OPC within the status register when both channels have completed acquisition.

The *OPC query returns a "1" when the operation is complete.

Note:

For further information regarding the bit definitions of the Standard Event Status Register, refer to Figure 7-1.

Command Example:
```
*OPC
```

Query Example:
```
*OPC?
1
```

Related Commands: None

*RCL

Purpose: Recalls instrument setup.

Syntax:
```
*RCL <number>
 RCL <number>
```

Parameters: <number> A numeric value, 1—8.

Description: This command recalls the previously saved instrument setup identified by <number>. <number> is an integer with a range of 1—8.

Related Commands: *RST, *SAV

*SAV

Purpose: Saves the current state.

Syntax:
```
*SAV <number>
 SAV <number>
```

Parameters: <number> A numeric value, 1—8; the destination location for the instrument setup information.

Description: This command saves the current state of the VX4250. Note that when power is interrupted, all saved setups are lost. <number> is an integer with a range of 1—8, and is user selectable.

Related Commands: `*RCL, *RST`

*SRE,*SRE?

Purpose: *SRE sets the bits in the Service Request Enable Register.

*SRE? queries the bit settings of the Service Request Enable Register.

Command Syntax:
```
*SRE <number>
 SRE <number>
```

Command Parameters: <number> Decimal numeric program data in the range of 0—255. This number, when rounded to an integer value and expressed in binary, represents the desired bit values of the Service Request Enable Register.

Query Syntax:
```
*SRE?
 SRE?
```

Query Parameters: None

Description: When using the *SRE command, the value specified for Bit 6 will be ignored. (Bit 6 is always 0.)

The response to the *SRE? query is an INTEGER in the ranges of 0—63 or 128—191. When converted to binary, this number represents the current bit values of the Service Request Enable Register. Bit 6 of the Service Request Enable Register bit values will always be 0.

Note:

For further information regarding the bit definitions of the Service Request Enable Register, refer to Figure 7-1.

Related Commands: None

*STB?

Purpose: Reads the status byte from the Status Byte Register.

Syntax:
```
*STB?
 STB?
```

Parameters: None

Description: The response to the `*STB?` query is an integer that corresponds to the bits set in the Status Byte Register.

Note

For further information regarding the bit definitions of the Status Byte Register, refer to Figure 7-1.

Example: In the following example, the `*STB?` query indicates that bits 1 and 2 of the Status Byte Register are set:

```
*STB?
3;
```

Related Commands: None

*TST?

Purpose: Causes the instrument to execute its power-up self-test routines (excluding the power-up kernel verification tests) and return the number of failures found.

Syntax: `*TST?`

Parameters: None

Description: The `*TST?` command invokes the instrument self-test and returns the number of errors found.

Related Commands: `TST?`

*WAI

Purpose: Sets the operation complete bit in the Standard Event Status Register when the current operation is complete.

Syntax:
```
*WAI?
 WAI?
```

Parameters: None

Description: This command will assert the `*WAI` within the status register when both channels have completed acquisition.

Note:

For further information regarding the bit definitions of the Standard Event Status Register, refer to Figure 7-1.

Related Commands: None

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Section 7
Errors, Warnings, and Events

Error and Event Reporting

The VX4250 uses the error and event reporting mechanism described in Section 11 of the ANSI/IEEE-488.2 standard. This error reporting mechanism allows the user to select the types of errors that are reported. The user can also set the error reporting mechanism to provide interrupts when errors or events occur.

An Overview of the Event Reporting Mechanism

The Event Reporting Mechanism gives the user the flexibility to ignore certain types of events, and to specify which type of events will result in a service request interrupt.

Events are divided into eight types, as listed in Table 7-1:

Table 7-1. Event Types

Event Mnemonic	Event Name
PON	Power ON
URQ	User Request
CME	Command Error
EXE	Execution Error
DDE	Device Dependent Error
QYE	Query Error
RQC	Request Control
OPC	Operation Complete

Of these eight types, the VX4250 supports the CME, DDE, EXE, and OPC events.

To better understand how an event may propagate through the Event Reporting Mechanism, refer to Figure 7-1. An event will enter the Event Message Mechanism (as shown at the top of Figure 7-1) through the Device Event Status Enable Register (DESE). Notice how the DESE is divided into eight bits, with each bit corresponding to one of the event types listed in Table 7-1.

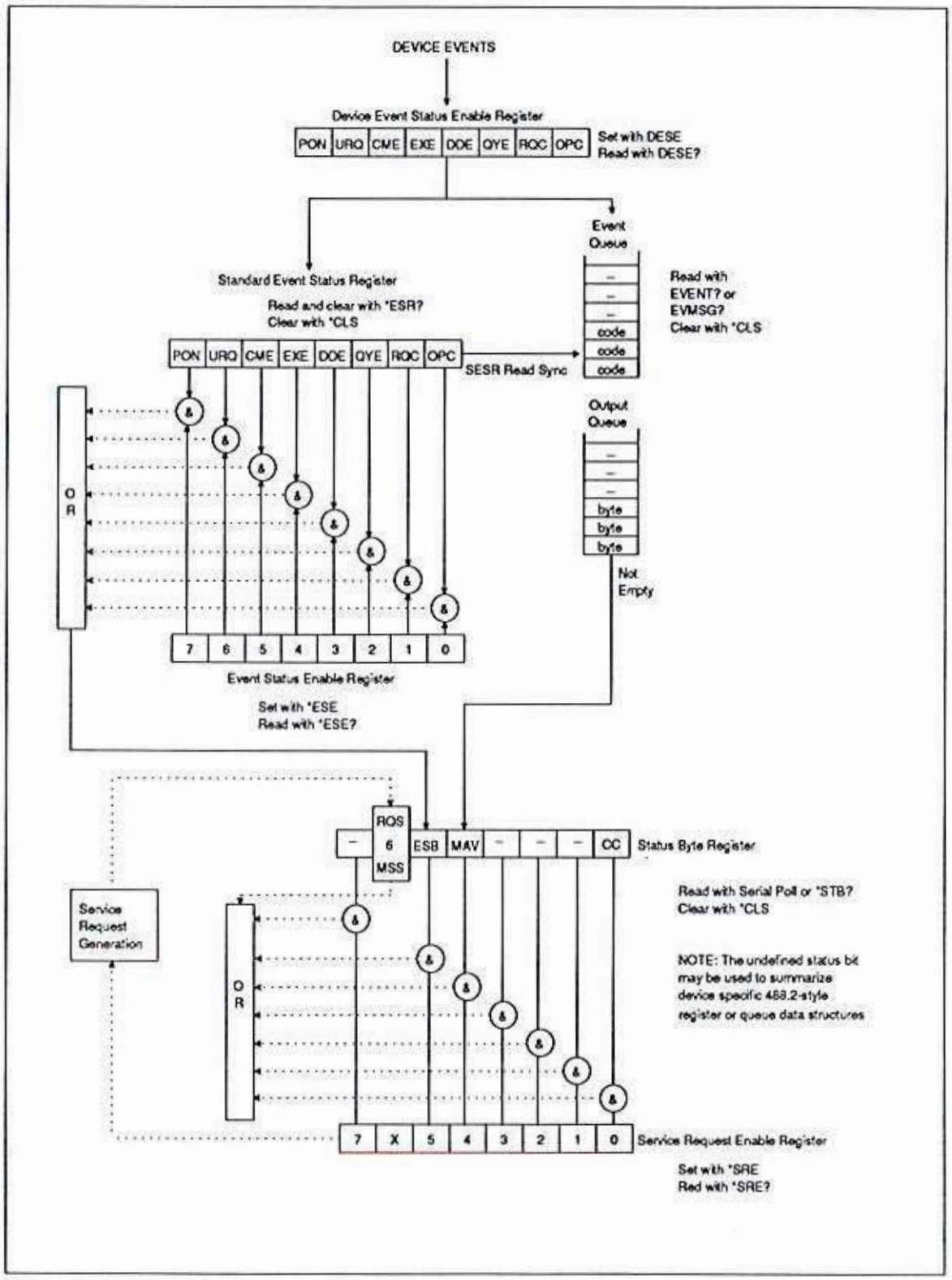


Figure 7-1. Register Bit Definitions.

For an event to enter the Event Reporting Mechanism, the event's type must have a 1 in the appropriate field within the DESE. For example, if the event is an Execution Error, the EXE bit within the DESE must be set to 1 for the event to be added to the Event Reporting Mechanism. Otherwise, the event is ignored.

Each event is composed of an Event Code and a Event Message. Table 7-3, later in this section, lists the event codes and messages used in the VX4250. If the event is accepted, two things happen: First, the Event Code and Event message are placed in the Event Queue which will handle up to five messages. Second, the appropriate bit is set within the Event Status Register. Note that the bit definitions for the Event Status Register and the Device Event Status Enable Register are the same.

Now that the event has been placed in the Event Message Queue, the user has the option to set the ESB bit in the Status Byte Register (the ESB bit and the Status Byte Register are explained later in this section).

In order to set the ESB bit, the bit representing event type must have the corresponding bit within the Event Status Enable Register set to 1. For example, if an Execution Error (EXE) is in the Event Queue, bit 4 of the Event Status Enable Register must be set to a one for the ESB bit to be set.

Now that the Execution Error has propagated through two enable registers, it has finally set the ESB bit within the Status Byte Register.

Notice that the Status Byte Register is paired with an enable register in the same manner as the Event Status Register. (The Status Byte Register is explained in more detail in the next topic.) Notice that if bit 5 of the Service Request Enable Register is set, the Execution Error now generates a Service Request interrupt.

The manner for handling interrupts from the VX4250 will depend on the type of slot 0 card being used. See the manual for your slot 0 device for more information.

Status Byte Register and Service Request Enable Register

The Status Byte Register is the basic error reporting mechanism. Three bits are defined in the VX4250 status byte. Each of these bits represent a particular error type or event. The Status Byte Register has a companion register called the Service Request Enable Register which controls the ability of the VX4250 to generate a Service Request (interrupt). Each bit in the Status Byte Register has a corresponding bit in the Service Request Enable Register. In order to generate (inhibit) a Service Request, the corresponding Service Request Enable bit is set to 1 (0 to inhibit) as shown in Figure 7-1.

The Status Byte Register is read via the `*STB?` command and cleared with the `*CLS` command.

Command Complete. Bit 0 of the status byte register is the command complete bit. This will be set every time a valid command is received by the VX4250. The use of this bit is restricted to slot 0 resource managers that require synchronized communications.

The Command Complete bit is bit zero in the Status Byte Register. In order to use the VX4250 with a controller that requires synchronized communications, bit 0 of the Service Request Enable Register must be set to 1.

Message Available (MAV). The Message Available bit in the Status Byte Register indicates the presence of a message in the output queue of the VX4250. This bit is set exclusively as a result of a query command.

Event Status Byte (ESB). The Event Status Byte indicates the presence of a message in the Event Status Register (see Event Status Register).

RQS/MSS. The RQS bit is set if a Service Request has been generated.

Event Status Register

The Event Status Register contains information regarding the type of Error or Event that has occurred within the VX4250. The ANSI/IEEE-488.2 standard defines eight bits within this register. As stated previously, the VX4250 uses the CME, DDE, EXE, and OPC (event) bit types.

In order for a particular event type to set the ESB bit in the Status Byte Register, the corresponding Event Status Enable Register bit must be set. This operation is similar to the Status Byte Register. The difference is that the Status Byte Register generates a Service Request while the Event Status Register sets the ESB bit. Please refer to Table 7-3 which documents all of the VX4250 errors and events, and their associated Event Number and Event Status Register bit.

Command Error (CME). The Command Error bit is set whenever an unrecognized command is received or 488.2 syntax error is detected.

Device Dependent Error (DDE). If the VX4250 should ever get into a state from which it must perform a reset, the DDE bit will be set. This rarely happens.

Execution Error (EXE). Execution errors are generated by program data arguments that are outside the range of the instrument or a valid message could not be executed due to device dependent conditions.

Operation Complete (OPC). Operation Complete is bit zero in the Event Status Register. The VX4250 uses this bit to signify one of two events—either an acquisition is complete, or a measurement event has occurred.

Using the Status/Event Reporting System Commands

The following table describes the commands used to maintain and query data from the Status/Event reporting system:

Table 7-2. Status and Event Commands

Command	Register/Queue	Description
*STB?	Status Byte	Returns the Status Byte value.
*SRE	Service Request Enable	Sets the Service Request Enable Register. This allows the user to select which Errors/Event types will generate a interrupt.
*SRE?	Service Request Enable	Returns the contents of the Service Request Register
*ESR?	Event Status Register	Returns the contents of the Event Status Register. All event types since the last *ESR?, EVENT?, EVMSG?, or *CLS, will be reported and the Event Status Register cleared.
*ESE	Event Status Enable	Sets the Event Status Enable Register. This allows the user to select the event type(s) that will set the ESB bit in the Status Byte Register.
*ESE?	Event Status Enable	Returns the contents of the Event Status Enable Register.
EVENT?	Event Queue	Returns the oldest Event Code in the Event Queue (See Table 7-3 for a listing of event codes).
EVMSG?	Event Queue	Returns the oldest Event Code and Event Message in the Event Queue (See Table 7-3 for a listing of event messages).
DESE	Device Event Status Enable	Sets the Device Event Status Enable Register. This allows the user to select the event type that will be placed in the Event Queue.
DESE?	Device Event Status Enable	Returns the contents of the Event Status Enable Register.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

Example Interrupt Generation

As an example, in order to generate an interrupt after every acquisition cycle, the appropriate enable bits in three registers must be set.

First, the acquisition complete interrupt is an *Operation Complete* (OPC) function. Therefore, the OPC bit of the Device Event Status Enable Register must be set to a one.

Setting the OPC bit in the DESE register	
Command: DESE 1	Sets the OPC bit in the DESE register

Next, the OPC bit in the Event Status Enable Register must be set.

Setting the OPC bit in the ESE register	
Command: ESE 1	Sets the OPC bit in the ESE register

Finally, in order for the event to be reported via an interrupt, the ESB bit in the Service Request Enable Register is set to a one.

Setting the ESB bit in the Service Request Enable register	
Command: SRE 32	Sets the ESB bit in the SRE register

This will allow all acquisition complete messages to generate an interrupt to the controller/slot 0 card. For information on how to handle the interrupt, refer to your controller/slot 0 manual.

Event Queue Length

The event reporting mechanism is capable of holding five error messages. If the event queue overflows, the message "350, Too Many Events" will be placed in the queue.

Errors, Warnings, and Events

The errors, warnings and events generated by the VX4250 are listed in Table 7-3 which follows. Event codes can be read using the EVENT? command. Use the EVMSG? command to read the event code and its associated error message (see Section 5, *Command Notation and Formats*, in this manual).

Table 7-3. Errors, Warnings, and Events

Event #	Event Bit	Primary Event Description	Secondary Event Description
0		No events to report	
100	CME	Command error	Command not found
100	CME	Command error	Illegal identifier after program data separator
200	EXE	Execution error	VXI trigger source error
200	EXE	Execution error	Both trigger sources set to XCH
200	EXE	Execution error	ASCII waveform download is not allowed
200	EXE	Execution error	Envelope waveform not valid as source
200	EXE	Execution error	Odd byte count when BYTNR set to 2
220	EXE	Parameter error	Invalid units
220	EXE	Parameter error	Invalid parameter(s)
221	EXE	Settings conflict	Trigger coupling not used
221	EXE	Settings conflict	Trigger level not used
221	EXE	Settings conflict	Trigger slope not used
221	EXE	Settings conflict	Trigger source not used
222	EXE	Data out of range	Invalid reference values
222	EXE	Data out of range	Invalid save setting
222	EXE	Data out of range	Invalid waveform record number
222	EXE	Data out of range	Invalid window start/stop value
222	EXE	Data out of range	Waveform record zero filled
222	EXE	Data out of range	Channel input range limited
222	EXE	Data out of range	Channel offset voltage adjusted
222	EXE	Data out of range	Data transfer settings adjusted
222	EXE	Data out of range	External trigger level limited
222	EXE	Data out of range	Invalid waveform memory segment
222	EXE	Data out of range	Sample interval limited
222	EXE	Data out of range	Transfer count adjusted
222	EXE	Data out of range	Transfer start adjusted
222	EXE	Data out of range	Trigger delay adjusted
222	EXE	Data out of range	Trigger level adjusted
223	EXE	Too much data	Waveform length truncated
300	DDE	Internal error	
350		Too many events	
402	OPC	Operation complete	Acquisition Complete
402	OPC	Operation complete	Event found
500	EXE	Execution warning	Acquisition pending

Explanation of VX4250 event codes

The event codes, messages, and what they mean follow. The event message for each event code has quotation marks around it, e.g., "No events to report".

Event Code: 0, "No events to report" This message is the result of a EVMSG?, or, EVENT? commands when the event message queue is empty.

Event Code: 100, "Command not found" Any command unrecognized by the VX4250 parser will generate this error message. Please note that any commands sent after the invalid command and before the EOM will be discarded.

Event Code: 100, "Illegal Identifier after program data separator" This is usually the result of a 488.2 syntax error.

Event Code: 200, "Envelope waveform not valid as source" Generated by the pulse measurement routines when asked to perform pulse analysis on an envelope waveform. Check the WINDOW:LOC command.

Event Code: 200, "VXI trigger source error" Two different VXI backplane trigger sources have been requested. When using the TTLTRG or ECLTRG lines as trigger sources, both channels must be programmed for the same trigger line. Check the CHx:TRIGGER:SOURCE command.

Event Code: 200, "Both trigger sources set to XCH" Channel 1 and channel 2 trigger sources were set to XCH (cross trigger). Check the TRIGGER:SOURCE command for both channels.

Event Code: 200, "ASCII waveform download is not allowed" The VX4250 will not accept waveform data downloaded in ASCII format. Check the DATA:ENCDG parameter.

Event Code: 200, "Envelope waveform not valid as source" An attempt has been made to acquire a waveform into a template waveform locaton. Template compares must be done on two different waveform locations. Check COMPARE:TYPE, COMPARE:LOC, and ACQUIRE:LOC commands.

Event Code: 200, "Odd byte count when BYTNR set to 2" When downloading envelope waveforms, each point must contain two bytes.

Event Code: 200, "Invalid Units" This error is the result of specifying the wrong type of units to REFUNITS commands. Reference units must be percent or volts.

Event Code: 220 "Invalid parameter(s)" This is a catch all error returned by commands that have been passed invalid parameters or an invalid number of parameters.

Event Code: 221 "Trigger coupling not used" This message warns that the trigger coupling applies only to the external trigger. The message is generated if the current trigger source is a VXI backplane trigger. The external trigger coupling will be changed but will have no affect. This is a warning only.

Event Code: 221 "Trigger level not used" If the current trigger source is a VXI backplane trigger then adjusting the trigger level has no effect. The value of the trigger level will be changed if valid. This is a warning only.

Event Code: 221 "Trigger slope not used" If the current trigger source is a VXI backplane trigger then adjusting the trigger slope has no effect. The slope will be changed if valid. This is a warning only.

Event Code: 221 "Trigger source not used" If the VX4250 is in trigger freerun mode, then changing the trigger source will have no effect. The trigger slope will be changed if valid. This is a warning only.

Event Code: 222 "Invalid reference values" This is the result of programming the reference values, with REFLINES incorrectly. The proximal values must be less than the mesial value and the mesial value must be less than the distal value.

Event Code: 222 "Invalid save setting" This error is generated by the following commands: CHx:SAVE, CHx:RECALL, *SAV, and *RCL. Save setting parameters range from 1 to 8.

Event Code: 222 "Invalid waveform record number" The waveform record requested in the ADD and SUB commands was out of range. Valid values are 1 through 8.

Event Code: 222 "Invalid window start/stop value" The start and stop points defined in the WINDOW command were invalid. This is usually the result of setting the start point greater than the stop point.

Event Code: 222 "Waveform record zero filled" This occurs when downloading a waveform into the VX4250. If the waveform being downloaded contains fewer points that specified by the DATA command, the remainder of the record will be zero filled.

Event Code: 222 "Channel input range limited" The VX4250 has a fixed set of full scale ranges to choose from. This error message results from setting CHx:RANGE to an invalid value. See Table 1-4. Range, Offset, and Trigger Capabilities in Section 1 of this manual for a listing of valid full scale ranges.

Event Code: 222 "Channel offset voltage adjusted" The available offset is dependent upon the current full-scale range. See Table 1-4. Range, Offset, and Trigger Capabilities in Section 1 of this manual for a listing of offset limits verses full scale range.

Event Code: 222 "Data transfer settings adjusted" This indicates an error has been made when setting up data transfer parameters with the DATA command. For example, if DATA:START 1024;COUNT 2044 the data requested exceeds the record length of the VX4250.

Event Code: 222 "External trigger level limited" The external trigger level is limited to –5.12V to 5.08V. Check the trigger source and trigger level values.

Event Code: 222 "Invalid waveform memory segment" An invalid waveform location was selected. This error is generated by the DATA and MARGINS commands.

Section 8
Maintenance

Introduction

This section provides information on assembling and disassembling the VX4250 module, preventative maintenance, diagnostic information for isolating failed sections, and a cable dress drawing.

Static-Sensitive Components

The following precautions are applicable when performing any maintenance involving internal access to the instrument.

CAUTION

Static discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge or static electric fields. When performing maintenance, observe the following precautions to avoid component damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers or in a static shielding bag. Label any packaging that contains static-sensitive components or assemblies.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these components. Servicing static-sensitive components or assemblies should be performed only at a static-free work station by qualified service personnel.
4. Nothing capable of generating or holding a static charge should be allowed on the work surface.
5. Use a soldering iron that is connected to earth ground.
6. Use only approved antistatic, vacuum-type desoldering tools for component removal.

Assembling and Disassembling the VX4250

Tools Required

The following tools are needed to assemble and disassemble the VX4250:

3/16" Nut driver

#1 POZIDRIVE® screwdriver

Disassembly Instructions

Follow these steps to disassemble the VX4250 instrument into its field replaceable units:

A. The right side cover is held on by 11 POZIDRIVE screws, eight of which are on the right side of the instrument and three of which are on the bottom of the instrument. Remove these screws and lift the right side cover off.

B. The L-shaped Interface board, located along the top and back of the instrument, is held in by five standoffs with lock washers. Remove these with the nut driver.

C. The Digital Acquisition board is mounted to its shield, located in the bottom front corner of the instrument. Remove the seven screws accessible from the top of the shield.

D. Two cables are attached to J880 and J980, located in the lower right-hand corner of the L-shaped Interface board. Disconnect these cables by pulling them out of their jacks.

E. Carefully lift the back end of the L-shaped Interface board approximately one inch so that the board clears the standoff located under the upper right-hand corner of the shield.

F. Disconnect the L-shaped Interface board from the Digital Acquisition board by pulling the L-shaped Interface board towards the top of the instrument. The Digital Acquisition board should stay in place.

G. Remove the cables from the front panel BNC connectors. The Digital Acquisition board and shield may now be removed from the left side cover.

H. The Digital Acquisition board is held in place by plastic clips underneath the shield. Turn the Digital Acquisition board and shield assembly over and remove the Digital Acquisition board from the shield by pulling the clips away from the circuit board. Then the Digital Acquisition board can be lifted out of the shield.

SERVICE SAFETY SUMMARY

Only qualified personnel should perform service procedures. This Service Safety Summary and the General Safety Summary should be read before performing service procedures.

DO NOT SERVICE ALONE

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

USE CARE WHEN SERVICING WITH POWER ON

To avoid personal injury from high current, remove jewelry such as rings, watches, and other metallic objects, before servicing the instrument. Do not touch exposed connections and components while power is on. Disconnect power before soldering, removing protective panels, or replacing components.

USE CARE WITH COVERS REMOVED

To avoid personal injury, remove jewelry such as rings, watches, and other metallic objects before removing the cover. Do not touch exposed connections and components within the product while the power cord is connected.

DO NOT SERVICE WITH INPUTS CONNECTED

Hazardous voltages applied to the input connectors may be present on internal components. To avoid possible contact with hazardous voltages, disconnect all input cables from the instrument before removing any covers.

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Assembly Instructions

Hardware Required

This list shows the hardware you will need to reassemble the VX4250 instrument:

- Left side cover, with standoffs for the shield and front panel, and with BNC connectors, cables and handles installed (see Figure 10-1. *Exploded View Drawing*).
- Right side cover
- Shield with plastic ECB clips attached (see Figure 10-1. *Exploded View Drawing*).
- Digital Acquisition board
- L-shaped Interface board
- 7 - #4 1/4 inch panhead screws
- 5 - 3/16" hex standoffs with 4-40 threads, 0.997" long
- 5 - #4 lock washers
- 11 - 4-40 1.88 inch flathead POZIDRIVE screws

Assembly Steps

To reassemble the VX4250, follow these steps:

CAUTION

Overtightening of screws and standoffs may cause damage to the instrument or to the part being attached. In general, all screws and standoffs should not be tightened to more than 5 inch pounds.

A. Connect the six cables to the Digital Acquisition board as shown in the cable dress diagram at the end of this section. Cable locations are important to maintain signal integrity and to keep cables clear of adjustment holes.

Note:

Do not attach the cables to the front panel BNC connectors or the L-shaped Interface Card yet!

CAUTION

Be careful not to bend the signal pin on the Peltola cable connectors when inserting them. Also, watch for stray wires from the shield of the cable connectors which may short to the signal pin.

B. Place the shield upside down in front of you with the large lip pointing up and away from you. Lay the Digital Acquisition board over the shield with the 48 pin connector pointing towards you.

C. Clip the Digital Acquisition board into the shield with the plastic clips on the shield. There are three clips on the top of the circuit board and three clips on the bottom of the circuit board.

D. The clips on the back of the circuit board (on the right it lies in front of you) should come to the edge of the circuit board. Slide the Digital Acquisition board into the clips to align it.

E. Turn the Digital Acquisition board and shield assembly over and put in the #4 screw below the label for U105 on the shield.

F. Lay the Digital Acquisition card and shield into the left side cover. Attach the Peltola cables to the front panel BNC connectors as shown in the cable dress diagram at the end of this section.

G. Slide the Digital Acquisition board and shield into place between the standoffs on the left side cover.

H. Lift the back side of the Digital Acquisition board and shield approximately one inch to clear the standoffs. Attach the L-shaped Interface board to the Digital Acquisition board at the 48 pin connector.

I. Lay the two boards and the shield into place over the standoffs.

J. Loosely put in the remaining six #4 screws on the shield and five standoffs with #4 lock washers on the L-shaped Interface board.

K. With the mounting screws loose, the board set can be shifted around to assure that all of the parts line up. Be sure the bottom right-hand corner of the shield and the corner of the L-shaped Interface board and the clips at that location do not overlap.

L. Tighten all of the screws and standoffs into place.

M. Attach the trigger cable to the L-shaped Interface board at J880 and J980. See Figure 8-1. *Cable Dress Diagram,* which shows the connections and where to lay the cables.

N. Place the right side cover over the right side of the instrument and attach it with the 11 POZIDRIVE screws.

O. Follow the instructions for Performance Verification in Section 9, *Checks and Adjustments.*

Cable Dress Diagram

Figure 8-1 shows where the connectors and VX4250 cables are located. Table 8-1 lists the connector numbers, cable colors, and connections.

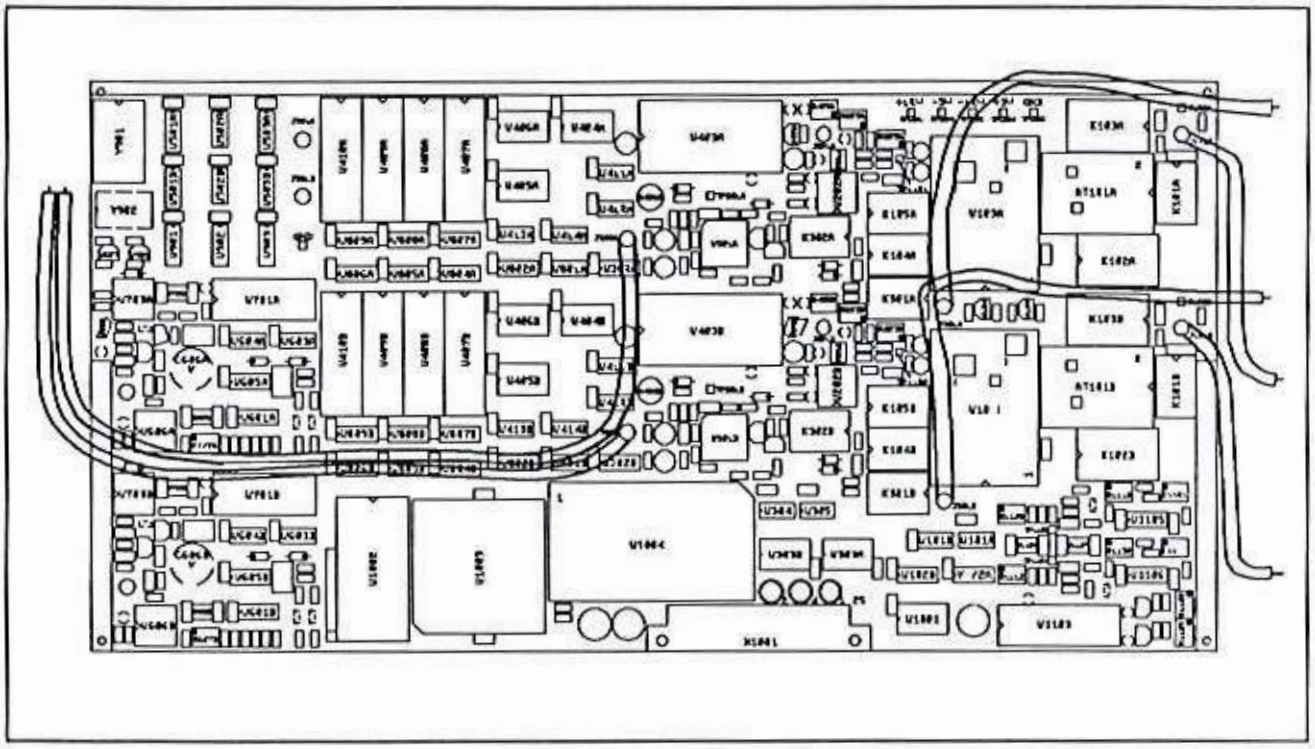


Figure 8-1. Cable Dress Diagram.

Table 8-1. VX4250 Cables, Connectors, and Connections.

Connector	Cable Color	Connection
J101B	white with orange	CH1 BNC
J101A	white with orange & black	CH2 BNC
J301B	white with red	CH1 Trig BNC
J301A	white with red & black	CH2 Trig BNC
J302B	white with brown	J880
J302A	white with black and brown	J980

Preventative Maintenance

The VX4250 is designed to require a minimum of periodic preventative maintenance. The frequency of maintenance depends on the environment where this product is used.

Accumulations of dirt will reduce the efficiency of heat transfer from the components. Periodically vacuum dirt and dust from inside the VX4250. Remove heavy accumulations of dirt with a soft brush.

Troubleshooting

Introduction

The purpose of this troubleshooting topic is help diagnose a problem to the point where the defective Field Replaceable Unit can be identified and replaced. The Field Replaceable Units are listed in Section 10, *Replaceable Parts List of Field Replaceable Units.*

CAUTION

Static discharge can damage any semiconductor component in this instrument. When troubleshooting, observe the precautions listed in Section 8, Maintenance, to avoid damage to the instrument.

Troubleshooting Aids

It may be helpful to refer to Figure 8-2, *VX4250 Hardware Block Diagram,* near the end of this section as you check various functional blocks.

Troubleshooting Equipment

The equipment listed in Table 9-1, *Suggested Test Equipment for Calibration and Performance Verification,* or equivalent equipment, may be useful when troubleshooting this instrument.

Troubleshooting Techniques

The following procedure is intended to help when a failure is suspected in a particular function of the instrument. The first check is a visual inspection that should be conducted no matter what the problem may be. The remaining checks may be selected based on the type of suspected failure. If no particular functional block is suspected, then each check should be done in the order presented here.

1. Visual Inspection

A. External Inspection. Inspect the external portion of the instrument for damage, wear, and missing parts, using Figure 10-1, *Exploded View Drawing* as a guide. Instruments appearing to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance.

B. Internal Inspection. Inspect the internal portions of the instrument for damage and wear. Check all cables and connectors for bent or missing pins and proper seating. If any physical damage is identified on either circuit board assembly, replace that assembly.

2. Power-up Sequence

When power is applied to a VX4250 in a VXIbus mainframe with a Slot 0 controller and Resource Manager, the green READY light should be the only LED lit on the front panel after all system configuration is complete. If this is not the case, follow the flow chart in Figure 8-3, *Troubleshooting Power-Up Operations*, at the end of this section to identify the problem.

3. Word Serial Protocol

If a problem is suspected in the Word Serial communication protocol, remove the VX4250 from the VXIbus system and place another known working, VXIbus message-based instrument in the same slot. If Word Serial communication works with this known good instrument, then replace the Interface board on the VX4250.

4. Fuses

The fuses for the VX4250 reside on the Interface board. With power applied to the instrument, verify that the nominal voltage specified below is present on each side of the fuse. Fuse locations are identified on the shield covering the Acquisition board.

F940	+12 V
F941	-12 V
F942	+5 V
F960	-5.2 V

5. Built-In Self-Tests

The VX4250 has 10 built-in self-tests which run every time the instrument is powered up or when the `TST?` command is received by the instrument. The tests and errors are listed in Table 8-2. Note that the `TST?` command may take up to 10 seconds to complete.

Table 8-2. Built-In Self-Test Error Codes

#	# Test Function	Possible Errors and Corrective Action
1.	ROM Checksum	`ROM checksum FAILURE;` * Replace the Interface board.
2.	Shared Memory Test	`Shared Memory FAILURE;` * Replace the Interface board.
3.	VXI Register Tests	`VXI interface FAILURE;` * Replace the Interface board.

4.	Acquisition Board Data Test	`Acquisition board not connected;`
		`Acquisition board data bit stuck;`
		* Check the connections between the Interface board and the Acquisition board.
		See Check 1, Visual Inspection.
		* Replace the Acquisition board if no visual problems are found.

5.	CH1 Acquisition Start/Stop	`CH1 Failed to Start;` * Probe the sixth pin (from the front of the instrument) on the top of the 48-pin connector between the Interface board and the Acquisition board. Rerun the self-tests and watch for a pulse on this pin. If no pulse is found, replace the Interface board; otherwise, replace the Acquisition board. `CH1 Failed to Stop;` *Replace the Acquisition board.
6.	CH2 Acquisition Start/Stop	`CH2 Failed to Start;` * Probe the sixth pin (from the front of the instrument) on the top of the 48-pin connector between the Interface board and the Acquisition board. Rerun the self-tests and watch for a pulse on this pin. If no pulse is found, replace the Interface board; otherwise, replace the Acquisition board. `CH2 Failed to Stop;` *Replace the Acquisition board.

7.	CH1 Real-Timebase Check	`CH1 timebase test failed to complete at 10 ns;`
		`CH1 timebase test failed to complete at 25 ns;`
		`CH1 timebase test failed to complete at 50 ns;`
		`CH1 timebase test failed to complete at 500 ns;`
		`CH1 timebase test failed to complete at 5 us;`
		`CH1 timebase test failed to complete at 50 us;`
		`CH1 timebase test failed to complete at 500 us;`
		*Replace the Acquisition board.

8.	CH2 Real-Timebase Check	`CH2 timebase test failed to complete at 10 ns`
		`CH2 timebase test failed to complete at 25 ns;`
		`CH2 timebase test failed to complete at 50 ns;`
		`CH2 timebase test failed to complete at 500 ns;`
		`CH2 timebase test failed to complete at 5 us;`
		`CH2 timebase test failed to complete at 50 us;`
		`CH2 timebase test failed to complete at 500 us;`
		*Replace the Acquisition board.

9.	CH1 Equivalent-Timebase Check	`CH1 ET timebase test failed - completed too soon;`
		`CH1 ET test - failed to complete;`
		*Replace the Acquisition board.

10.	CH2 Equivalent-Timebase Check	`CH1 ET timebase test failed - completed too soon;`
		`CH1 ET test - failed to complete;`
		*Replace the Acquisition board.

6. Shared Memory Communication

Shared Memory Communication problems could be attributed to either system communication problems or problems in the Shared Memory itself. If the built-in self-test for Shared Memory does not indicate errors, attempt D16/A24 communication with another VXIbus device in the same slot. If no problems are found, replace the Interface board.

7. VMEbus Interrupts

The VMEbus Interrupt Bus is highly dependent on the system and its configuration. If problems are suspected, first check these system-dependent functions:

A. Mainframe configuration. Most VXIbus mainframes require jumper configuration for the Interrupt Daisychain structure. Consult the Configuration section of the mainframe user's manual.

B. Interrupt Handler. The Interrupt Handler is the name of the device intended to receive the interrupt generated by the instrument. Verify the operation of this device using a know good interrupter in the same slot that the VX4250 is using.

If the VX4250 VMEbus Interrupter continues to have problems, replace the VX4250 Interface board.

8. Sending VXIbus Triggers

Sending Triggers to the VXIbus backplane TTLTRGn lines includes system dependencies as well as multiple Field Replaceable Units. Operation of this function can be tested by applying a signal with a frequency of approximately 1 kHz, and an amplitude of 80 mV or more centered around 0 V to both CH1 and CH2 inputs, and then sending the command:

```
TST? VXITRIGS
```

Note:

Initiating this test will place triggers on the backplane TTLTRGx lines. Be sure that these triggers do not cause problems with other instruments in the mainframe.

If this test fails, the offending Field Replaceable Unit must be found. This should be done using the setup in which the problem is seen. First, verify that the TTLTRGn line which the instrument is attempting to drive is not being used by another instrument in the system. This can be done by checking the configuration and specifications of the other instruments.

If a system dependency is not found, verify that the channel acting as the source for the trigger is actually able to trigger itself with the instrument settings in effect.

Next, verify that the VXI Trigger Routing circuit is receiving the trigger signal. Check TP981 (if channel 2 is the source) or TP980 (if channel 1 is the source) for trigger pulses between 0—3 Volts. If the pulses are not seen, replace the cable assemblies.

If no other problems have been found, replace the Interface board.

9. Receiving VXIbus Triggers

Receiving Triggers from a TTLTRGn or ECLTRGn line is also a system and multiple Field Replaceable Unit function. Operation of this function for the TTLTRGn lines can be tested by applying a signal with a frequency of approximately 1 kHz, and an amplitude of 80 mV or more centered around 0 V to both CH1 and CH2 inputs, and then sending the command:

```
TST? VXITRIGS
```

Note:

Initiating this test will place triggers on the backplane TTLTRGx lines. Be sure that these triggers do not cause problems with other instruments in the mainframe.

If this test fails or the problem exists with an ECLTRGn line, the offending Field Replaceable Unit must be found. First, verify that F960 for the -5.2 V supply on the Interface card is intact by measuring the voltage on each side of it relative to ground. This supply is used when interfacing with the ECLTRGn lines. The fuse should be replaced if a problem is found.

If the fuse and supply are good, then the problem may exist on either of the two circuit board assemblies. Using another instrument, provide a steady trigger on the trigger line suspected and configure the VX4250 to receive that trigger. Probe the 6th pin (from the front of the instrument) on the top of the 48-pin connector between the Interface board and the Acquisition board. If trigger pulses are not present, replace the Interface board. Otherwise, replace the Acquisition board.

10. Other Acquisition Problems

The front panel BNC connectors and cables can be interchanged to test for failure. A common failure in the cables is a bent center conductor. If this occurs, simply bend the center conductor to straighten it; this should solve the problem.

Other problems with acquisition will probably require replacement of the Acquisition board.

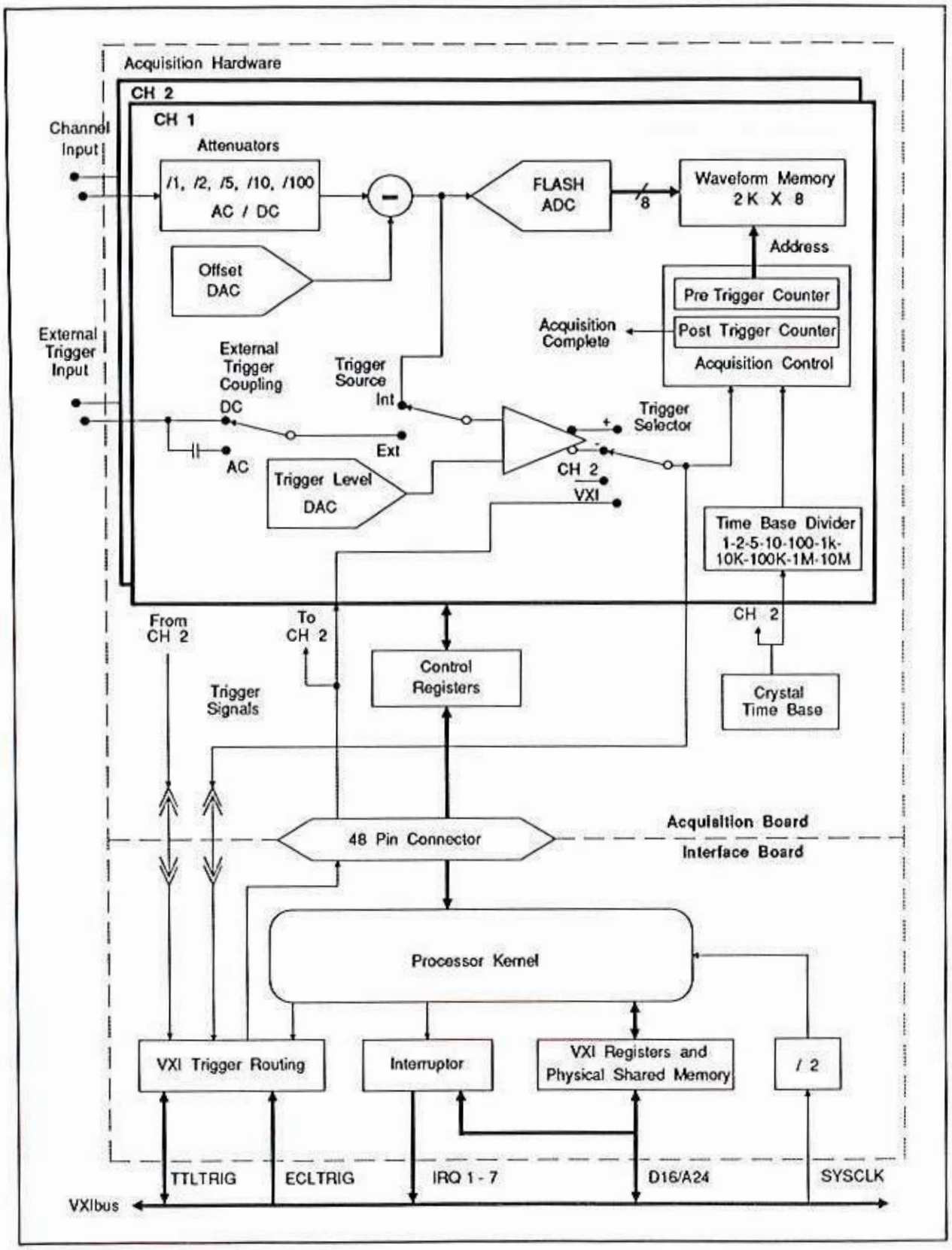


Figure 8-2. VX4250 Hardware Block Diagram.

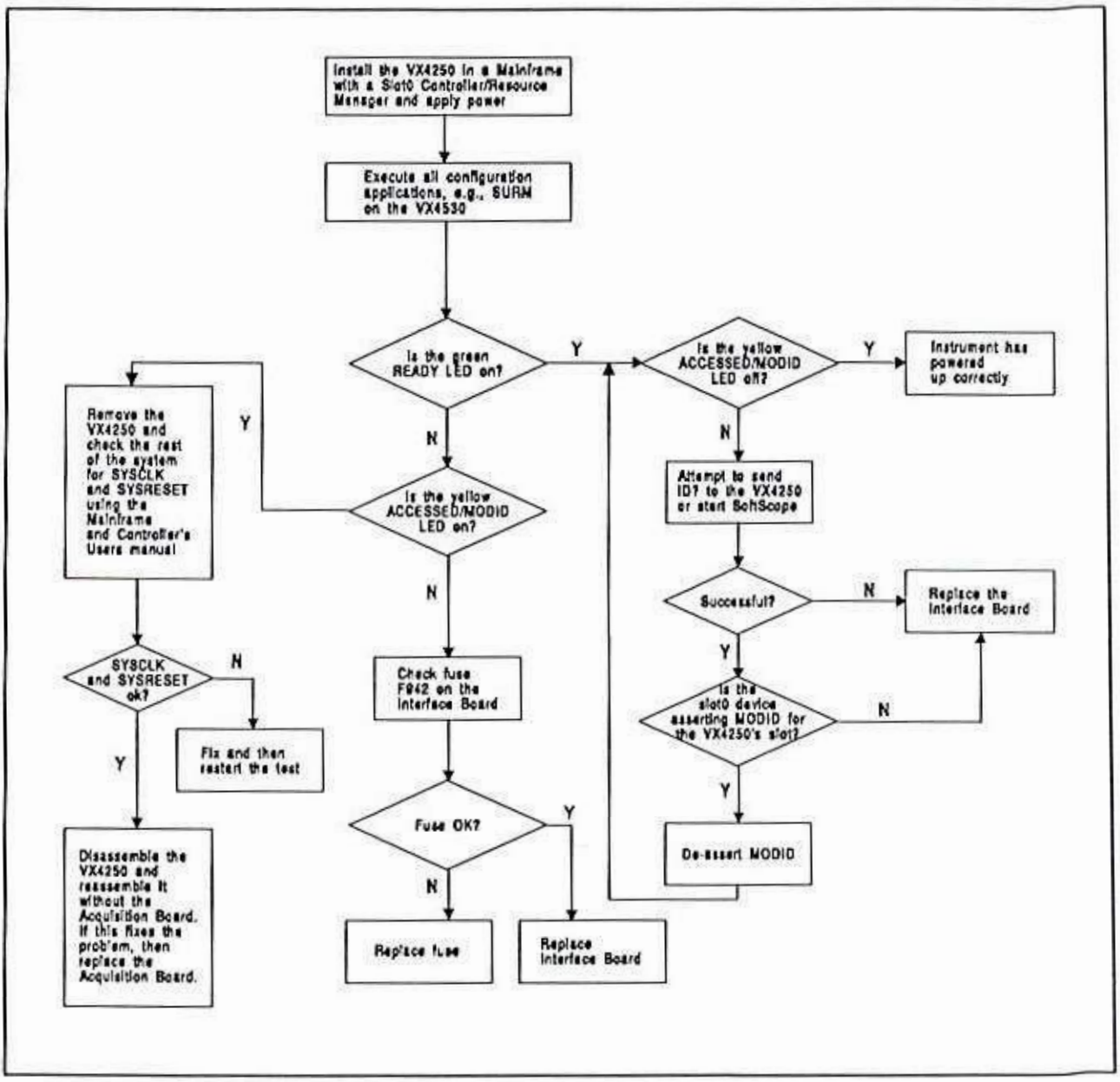


Figure 8-3. Troubleshooting Power-up Operations.

Section 9
Checks and Adjustments

Introduction

This section presents Performance Verification Procedures and Instrument Calibration for the VX4250.

Static-Sensitive Components

CAUTION

Static Discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge or static electric fields. When performing checks and adjustments, observe the precautions listed in Section 8, *Maintenance,* to avoid damage to the instrument.

VX4250 Calibration

This section provides procedures to manually calibrate the VX4250 Waveform Tester. Calibration should be performed following repair or during routine maintenance. The recommended calibration interval for the VX4250 is one year. Many steps in the procedure build on each other; hence, it is necessary to perform the steps in the order given. As an aid in troubleshooting, a short description of the effect of each calibration step is included.

Test Equipment Required

Table 9-1 contains suggested test equipment for use in calibration and performance calibration. The procedure steps are based on the test equipment listed, but other equipment which meet these specifications may be substituted. Test results, setup information, and related connectors and adaptors may be altered if you use other equipment.

Table 9-1. Suggested Test Equipment for Calibration and Performance Verification

Description	Minimum Specification	Suggested Instrument
VXI Mainframe	C or D size Mainframe must allow access to the right side of the instrument for probing and adjustment.	Tektronix VX1405
Calibration Generator	Amplitude (square wave) from 10 mV to 5 V ± 0.5% into 1 MΩ	Tektronix PG506A in a TM500 series mainframe
Time Mark Generator	Time mark generation from 20 ns to 1 µs ± 0.5%	Tektronix TG501A in a TM500 series mainframe
Digital Multimeter with test leads	0.1% DC Accuracy min. res. 1 mV on 2 V scale	Tektronix DM504A in a TM500 series mainframe
Subminiature Oscilloscope Probe	200 MHz Must have 0.095" diameter barrel to mate with test jacks	Tektronix P6131
Subminiature-to-miniature Probe Tip Adapter		Tektronix 013-0202-02
Test Oscilloscope	300 MHz Analog or DSO	Tektronix 2465
Leveled Sine Wave Generator	60 mV -5.5 V ± 3% from 50 kHz to 100 MHz Amplitude flatness ≤ 3%	Tektronix SG503 in a TM500 series mainframe
Low Capacitance Adjustment Tool		Tektronix 003-1364-01
50 Ω BNC Terminator		Tektronix 011-0049-01
50 Ω 10X Attenuator		Tektronix 011-0059-02
(2) Precision BNC to BNC 50 Ω coaxial cables		Tektronix 012-0482-00
BNC T (tee)		Tektronix 103-0030-00

Table 9-1. Suggested Test Equipment for Calibration and Performance Verification (continued)

Description	Minimum Specification	Suggested Instrument
(2) Square Pin Adapters		Tektronix 206-0193-00
VXI Slot 0 Interface and Instrument Controller	Must support Word Serial Protocol and provide an interactive "talker-listener" interface	Tektronix VX4544 with VX4250 SoftScope™ demo software

Calibration and Performance Verification should be performed in a VXI mainframe that allows access to the adjustments, such as a VX1405. Remove the right side cover of the VX4250 and install the instrument in the most accessible slot of the mainframe. (Refer to Section 8, *Maintenance,* for disassembly procedures.) Prior to calibration, allow the instrument to reach normal operation temperature by applying power for at least 20 minutes.

Several circuits and adjustments are referenced to internal voltages. Adjustment may not be possible if an internal supply is out of tolerance. If an out of tolerance condition is encountered, first verify that the mainframe voltages are in tolerance. Refer to the mainframe instruction manual for information on how to verify its power supplies. If the mainframe voltages are within specification and the VX4250 voltages are out of tolerance, the VX4250 must be repaired prior to continuing with the calibration procedure.

Note:

The procedures should be followed in order. Some steps assume instrument states which may have been set up in previous steps.

1. VERIFY POWER SUPPLY VOLTAGES

A. Connect the negative lead of the DMM to the TP1005 ground Test Point using a square pin adapter.

B. Using the positive DMM lead, touch each test point indicated and verify that the respective voltage is within the tolerance indicated:

Voltage	Test Point	Min	Max
+5	TP1004	4.75	5.25
-12	TP1003	-12.60	-11.40
-5.2	TP1002	-5.25	-4.75
+12	TP1001	+11.40	+12.60

Leave the negative DMM lead connected to the ground test point for the next step.

2. VERIFY REFERENCE VOLTAGES

Internal reference voltages are used by the vertical preamplifiers, the trigger level, and offset circuits.

A. Using the positive DMM lead, verify the following voltages by probing the indicated points with the positive DMM lead.

Voltage	Test Point	Min	Max
+7.5	U104 pin 2 (center lead)	7.175	7.875
-7.5	U105 pin 2 (center lead)	-7.875	-7.175

Leave the negative DMM lead connected to the ground test point for the next step.

3. VERIFY FAST RAMP REFERENCE VOLTAGE

This reference voltage is used in the equivalent time circuits.

A. Using the positive DMM lead, probe U607 pin 2 (center lead).

B. Verify that the measured voltage is between 2.430 and 2.757 volts.

Leave the negative DMM lead connected to the ground test point for the next step.

4. VERIFY SLOW RAMP REFERENCE VOLTAGE

This voltage is used as a reference by the DACs which produce the slow ramp used in the Equivalent Time base.

A. Probe U705 pin 2 (center lead) with the positive DMM lead.

B. Verify that the voltage is between 3.92 and 4.08 Volts.

C. Remove both DMM leads.

5. VERIFY CURRENT SOURCE REFERENCE VOLTAGE

This reference voltage is used to set the current source that produces the fast ramp used in the equivalent time base.

A. Connect the negative lead of the DMM to +12 Volts at TP1002, using a square pin adapter. Probe U608 pin 2 (center lead) with the Positive DMM lead.

B. Verify that the reference voltage is between -7.695 and -8.505 volts with respect to the +12 Volt supply.

6. ADJUST POSITION (OFFSET) REFERENCE

This adjustment affects the gain of the position (offset) DACs.

A. Connect the negative DMM lead to the ground test point (TP1005), using a square pin adapter. Probe U1103 pin 4 with the positive lead.

B. ADJUST R1102 for a DMM reading of 8.000 V ± 0.020 V.

Leave the negative DMM lead connected to the ground test point for the next step.

7. ADJUST TRIGGER LEVEL REFERENCE

This adjustment affects the gain of the trigger level DACs.

A. Connect the positive DMM lead to U1103 pin 20.

B. ADJUST R1105 for a DMM reading of 5.120 V ± 0.020 V.

Leave the negative DMM lead connected to the ground test point for the next step.

8. ADJUST CH 1 & CH 2 POSITION DAC REFERENCE

These adjustments establish the zero point of the offset (position) DACs for each channel.

A. Make sure that both channels of the VX4250 are programmed for 0.00 V offset. This can be done by cycling the mainframe power, or by sending the following command:

```
INIT
```

B. Connect the positive DMM lead to TP1102 with a square pin adapter.

C. ADJUST R1112 for a DMM reading of 0.000 V ± 0.001 V.

D. Connect the positive DMM lead to TP1101 with a square pin adapter.

E. ADJUST R1108 for a DMM reading of 0.000 V ± 0.001 V.

F. Remove the DMM lead from TP1101.

Leave the negative DMM lead connected to the ground test point for the next step.

9. ADJUST CH 1 & CH 2 ADC REFERENCE

These adjustments set the digitizer reference voltage for each channel. Because trigger level and offset (position) gain are not adjustable, the ADC reference must be calibrated to a set level and not used to adjust vertical gain.

A. Probe U403B pin 11 with the positive DMM lead (U403B has 28 pins).

B. ADJUST R405B for a DMM reading of -2.000 V ± 0.010 V.

C. Probe U403A pin 11 with the positive DMM lead (U403A has 28 pins).

D. ADJUST R405A for a DMM reading of -2.000 V ± 0.010 V.

Leave the negative DMM lead connected to the ground test point for the next step.

10. ADJUST CH 1 & CH 2 STATIC POSITION

These adjustments set the static zero point of the input buffer amplifiers. This adjustment can only be made with the Offset programmed to 0.0 V (as set up in step 8), and with no input signal present.

A. Connect the positive DMM lead to TP201B with a square pin adapter.

B. ADJUST R203B for a DMM reading of -1.000 V ± 0.005 V.

C. Connect the positive DMM lead to TP201A with a square pin adapter.

D. ADJUST R203A for a DMM reading of -1.000 V ± 0.005 V.

E. Remove both DMM leads.

11. ADJUST CH 1 & CH 2 DC BALANCE

DC Balance is adjusted to null out any preamp input current. Input current drawn by a preamp will interact with the attenuator network, showing up as an offset voltage into the ADC. The resulting offset voltage will change when different attenuator ranges are selected and can be seen as a "trace shift" on an oscilloscope screen. By minimizing this "trace shift", this input current can be balanced between other offset sources.

A. Remove the attenuator cover from the P6131 subminiature probe and attach a Subminiature-to-miniature Probe Tip Adapter in its place. Attach a ground lead with a .025" square pin jack to the probe as well.

B. Connect the P6131 subminiature passive probe to CH1 of the TEST OSCILLOSCOPE.

C. Connect the P6131 passive probe tip to TP201B with a Square Pin Adapter. Connect the ground lead of the P6131 passive probe to TP1005.

D. Set the TEST OSCILLOSCOPE to: Display Mode CH1, 200 µs/division, 100 mV/division, AUTO Trigger Mode, and 20 MHz BW Limit ON. Adjust the Vertical Position so the trace can be seen on the screen.

E. Set the VX4250 to the following configuration:

```
CH1:RANGE 0.4
CH1:SAMPLE:INTERVAL 5E-6
CH1:OFFSET 0
CH1:TRIGGER:SOURCE FREERUN
CH1:STEP:EXIT NEVER
CH1:START
```

13. ADJUST CH 1 & CH 2 INTERNAL TRIGGER LEVEL OPERATING POINT

This adjustment sets the zero offset of the trigger comparators when using internal trigger.

Note:

This offset is different than the external trigger offset because the vertical buffer amplifier output swing is scaled and centered around -1 V while the external trigger is centered around 0 V.

A. In order to make these adjustments, both channels of the VX4250 must be set for a trigger level of 0.0 V, with internal trigger selected. This can be done by sending the `INIT` command.

B. Connect the DMM negative lead to the ground test point, TP1005 with a square pin adapter.

C. Connect the DMM positive lead to Test Point TP1104 with a square pin adapter.

D. ADJUST R1130 for a DMM reading of -1.000 V ± 0.010 V.

E. Connect the DMM positive lead to Test Point TP1103 with a square pin adapter.

F. ADJUST R1118 for a DMM reading of -1.000 V ± 0.010 V.

Leave the negative DMM lead connected to the ground test point for the next step.

14. ADJUST CH 1 & CH 2 EXTERNAL TRIGGER LEVEL OPERATING POINT

This adjustment sets the zero offset of the trigger comparators when using external triggers.

A. In order to make these adjustments, both channels of the VX4250 must be set for a trigger level of 0.0 V, with external trigger selected. This can be done by sending the following commands:

```
INIT
CH1:TRIGGER:SOURCE EXT
CH2:TRIGGER:SOURCE EXT
CH1:START
CH2:START
```

B. Connect the DMM positive lead to Test Point TP1104 with a square pin adapter.

C. ADJUST R1133 for a DMM reading of 0.000 V - +0.010 V.

D. Connect the DMM positive lead to Test Point TP1103 with a square pin adapter.

E. ADJUST R1121 for a DMM reading of 0.000 V ± 0.010 V.

F. Remove both DMM leads.

15. ADJUST CH 1 & CH 2 LF GAIN COMPENSATION

These adjustments set the gain of the low frequency drift compensation in the buffer amplifier.

A. Send the following commands to the VX4250:

```
CH1:STOP;RANGE 0.08
CH1:START
```

B. Set the CALIBRATION GENERATOR to 50 mV, STD amplitude.

C. Connect the output BNC connector of the CALIBRATION GENERATOR through a BNC to BNC cable to a BNC T. Connect the BNC T to the VX4250 CHANNEL 1 input and to the CH2 input of the TEST OSCILLOSCOPE through another BNC cable.

D. Attach a P6131 or equivalent subminiature passive probe to the CH1 input of the TEST OSCILLOSCOPE.

Note:

Only subminiature probes with a 0.095" barrel will fit in the VX4250 test jacks.

E. Set the TEST OSCILLOSCOPE to: Display Mode CH 1, 200 µs/division, 20 mV/division, AC coupling, CH2 Trigger Source.

F. Set the TEST OSCILLOSCOPE trigger level for a stable trigger.

G. Remove the attenuator cover from the P6131 passive probe. Plug the bare attenuator cartridge of the probe into test jack J201B.

H. ADJUST R205B for minimum amplitude square wave display on the TEST OSCILLOSCOPE.

I. Send these commands to the VX4250:

```
CH2:STOP;RANGE 0.08
CH2:OFFSET 0
CH2:START
```

J. Move the probe to test jack J201A.

K. Move the BNC T to the CHANNEL 2 input of the VX4250.

L. ADJUST R205A for minimum amplitude square wave display on the TEST OSCILLOSCOPE.

T. ADJUST C606B clockwise if the query response is greater than 100E-09, or counter-clockwise if the response is less than 100E-09.

U. Repeat steps S and T until the measurement is 100E-09 ± 1.5E-09 (98.5E-09 to 101.5E-09).

V. Because R607B and C606B interact with each other, repeat steps L through U above.

W. Remove the TIME MARK GENERATOR cable from the VX4250 CHANNEL 1 Input connector.

21. LATCH ENABLE DELAY

This step adjusts the clock signal delay between the ADC and the digital latches on the ADC output. An incorrect setting will cause data errors which will result in small spikes in the data.

A. Send these commands to the VX4250:

```
CH2:STOP
CH2:RANGE 40
CH2:OFFSET 0
CH2:SAMPLE:INTERVAL 10E-9
CH2:TRIGGER:SOURCE FREERUN
WINDOW:LOC 2
CH2:STEP:EXIT NEVER
CH2:START
```

B. ADJUST R406A to the fully clockwise position. This is the default position for R406A.

C. Send this query to the VX4250 and read the response:

```
PK2PK?
```

D. ADJUST R406A and repeat step C and the adjustment for a minimum peak-to-peak measurement. If no change is seen, reset R406A to its fully clockwise position.

E. Send these commands to the VX4250:

```
CH1:STOP
CH1:RANGE 40
CH1:OFFSET 0
CH1:SAMPLE:INTERVAL 10E-9
CH1:TRIGGER:SOURCE FREERUN
WINDOW:LOC 1
CH1:STEP:EXIT NEVER
CH1:START
```

F. Send this query to the VX4250 and read the response:

```
PK2PK?
```

G. ADJUST R406B and repeat step B and the adjustment for a minimum peak-to-peak measurement. If no change is seen, reset R406B to its fully clockwise position.

Replace the side cover of the VX4250.

This completes the calibration of the VX4250. It is suggested that the Performance Verification procedure be conducted now to verify the calibration.

VX4250 Performance Verification

This section provides procedures to verify the instrument specifications for the VX4250 Waveform Tester. Performance verification should be performed following repair, calibration, or during routine maintenance.

Test Equipment Required for Performance Verification:

Refer to Table 9-1 for a list of suggested test equipment for use in performance verification. The procedure steps are based on the test equipment listed in Table 9-1; however, other equipment which meet these specifications may be substituted. Test results, setup information, and related connectors and adaptors may be altered if you use other equipment.

The Performance Verification procedure should be performed after the instrument has warmed up for at least 20 minutes within the environmental limits listed in Table 1-3, *Environmental and Mechanical Specifications.*

Note:

The following procedure assumes that the instrument is in its default power-up state. This state can be initiated by turning the instrument off and on again, or by issuing the `INIT` *command to the instrument.*

1. Check DC Gain Accuracy

The DC Gain Accuracy specification covers error in the vertical system from the front panel to the ADC (3% of Signal), error due to quantization (0.8% of Range), error in the offset system from the DAC reference to the ADC (2% of Offset), and error due to amplifier offset (2 mV). Each procedure attempts to test one part of the accuracy specification by minimizing the effects of the other parts.

Part 1A: DC Gain Accuracy (Balance) = ± 0.8% of Range ± 2 mV

A. Attach a 50 Ω Terminator to the input of CHANNEL 1.

B. Send these commands to the VX4250:

```
CH1:STOP
CH1:TRIGGER:SOURCE FREERUN
WINDOW:LOC 1
EXTMODE WINDOW
```

C. Send the following commands to the VX4250:

```
CH1:STOP;RANGE 0.08
CH1:START
```

J. Send this query to the VX4250 and read the response:

```
MEAN?
```

Verify that the response is 0 ± .7018 V.

Part 1C: DC Gain Accuracy (Vertical Gain)
± 3% of Signal ± 0.8% of Range ± 2% of Offset ± 2 mV

A. Connect the CALIBRATION GENERATOR to the input of CHANNEL 1 with a BNC to BNC cable.

B. Send these commands to the VX4250:

```
CH1:STOP
CH1:TRIGGER:SOURCE FREERUN
CH1:SAMPLE:INTERVAL 1E-6
WINDOW:LOC 1
```

C. Set the CALIBRATION GENERATOR output voltage to 50 mV.

D. Send these commands to the VX4250 for selecting Range and Offset:

```
CH1:RANGE 0.08
CH1:OFFSET 0.0156
CH1:START
```

E. Send this query to the VX4250 and read the response:

```
AMPLITUDE?
```

Record the measurement returned in Table 9-3 and verify that it is within the specification limits.

F. Repeat steps C through E for all ranges in Table 9-3.

G. Send these commands to the VX4250:

```
CH2:STOP
CH2:TRIGGER:SOURCE FREERUN
CH2:SAMPLE:INTERVAL 1E-6
WINDOW:LOC 2
```

H. Move the BNC to BNC cable from the CALIBRATION GENERATOR to CHANNEL 2.

I. Repeat steps C through E for all ranges in Table 9-3, substituting `CH2` for each instance of `CH1`.

Table 9-3. Gain Accuracy Verification – Vertical Amplifier.

Full Scale Range	Offset Value	Cal. Gen. Voltage	Measured Amplitude		Test Limits	
			CHANNEL 1	CHANNEL 2	Min	Max
.08 V	+0.0156 V	50 mV			45.9 mV	54.1 mV
.08 V	+0.036 V	50 mV			45.9 mV	54.1 mV
.16 V	+0.0286 V	100 mV			93.7 mV	106.3 mV
.16 V	+0.0722 V	100 mV			93.7 mV	106.3 mV
.4 V	+0.0156 V	200 mV			188.8 mV	211.2 mV
.4 V	+0.1805 V	200 mV			188.8 mV	211.2 mV
.8 V	+0.1370 V	500 mV			476.6 mV	523.4 mV
.8 V	+0.3611 V	500 mV			476.6 mV	523.4 mV
1.6 V	+0.2739 V	1.0 V			955.2 mV	1.045 V
1.6 V	+0.7222 V	1.0 V			955.2 mV	1.045 V
4 V	+0.1556 V	2.0 V			1.906 V	2.094 V
4 V	+1.805 V	2.0 V			1.906 V	2.094 V
8 V	+1.307 V	5.0 V			4.784 V	5.216 V
8 V	+3.611 V	5.0 V			4.784 V	5.216 V
16 V	+2.615 V	10.0 V			9.57 V	10.43 V
16 V	+7.222 V	10.0 V			9.57 V	10.43 V
40 V	+1.245 V	20.0 V			19.08 V	20.92 V
40 V	+18.054 V	20.0 V			19.08 V	20.92 V

2. Check Bandwidth

The VX4250 Waveform Tester bandwidth specification is 100 MHz on all ranges.

A. Send these commands to the VX4250:

```
CH1:STOP
CH1:OFFSET 0
CH1:TRIGGER:SOURCE FREERUN
CH1:SAMPLE:INTERVAL 1E-6
CH1:STEP:EXIT NEVER
WINDOW:LOC 1
```

B. Connect the LEVELED SINE WAVE GENERATOR output via a BNC to BNC cable and a 50 Ω Terminator to the VX4250 CHANNEL 1 input connector.

C. Send the following commands to the VX4250:

```
CH1:RANGE 4
CH1:START
```

D. Set the generator to produce a 50 kHz sine wave. Set the amplitude of the generator so that the response from the `AMPLITUDE?` query is 3.0 V.

E. Verify that the response from the AMPLITUDE? query maintains a voltage value above 2.1 V as the frequency is increased up to 101 MHz.

Note:

The SG503 is not capable of providing enough peak-to-peak voltage to test the 16 V and 40 V ranges. If this testing is required, a high frequency leveled source must be found capable of at least 20 V_{p-p} at 100 MHz.

F. Move the cable and 50 Ω Terminator from the CHANNEL 1 input connector to the CHANNEL 2 input connector.

G. Send these commands to the VX4250:

```
CH1:STOP
CH2:STOP
CH2:OFFSET 0
CH2:TRIGGER:SOURCE FREERUN
CH2:SAMPLE:INTERVAL 1E-6
CH2:STEP:EXIT NEVER
WINDOW:LOC 2
```

H. Repeat steps C through E substituting CH2 for CH1 where necessary.

I. Send this command to the VX4250:

```
CH2:STOP
```

3. Timebase Accuracy

The VX4250 Waveform Tester Timebase accuracy is ± 3% for the Equivalent Time timebases (20 ns/division to 1 µs/division), and ± 0.1% for the Real Time timebases (2 µs/division to 20 s/division).

A. Connect the TIME MARK GENERATOR to the CHANNEL 1 input via a 50 Ω cable and a 50 Ω Terminator.

B. Send these commands to the VX4250:

```
CH1:STOP
CH1:RANGE 1.6
CH1:COUPLING AC
CH1:TRIGGER:SOURCE INT
CH1:TRIGGER:LEVEL 0
CH1:OFFSET 0
WINDOW:LOC 1
CH1:STEP:EXIT NEVER
```

C. Set the TIME MARK GENERATOR to output a 100 ns Time Mark.

D. Send these commands to the VX4250:

```
CH1:STOP
CH1:SAMPLE:INTERVAL 100E-12
CH1:START
```

E. Send this query to the VX4250 and read the response:

```
PERIOD?
```

Record the measured value in Table 9-4 and verify that it is within the listed specification.

F. Repeat steps C and D for timebases in Table 9-4 from 250E-12 to 5E-5.

G. Send these commands to the VX4250:

```
CH1:STOP
CH2:STOP
CH2:RANGE 1.6
CH2:COUPLING AC
CH2:TRIGGER:SOURCE INT
CH2:TRIGGER:LEVEL 0
CH2:OFFSET 0
WINDOW:LOC 2
CH2:STEP:EXIT NEVER
```

H. Move the cable and 50 Ω Terminator from the TIME MARK GENERATOR to the VX4250 CHANNEL 2 input.

I. Repeat steps D through F using each set of settings and values listed in Table 9-4, substituting `CH2` for `CH1` where necessary.

J. Move the cable and 50 Ω Terminator from the TIME MARK GENERATOR back to the VX4250 CHANNEL 1 input.

K. Send this command to the VX4250:

```
WINDOW:LOC 1
CH1:COUPLING DC
CH1:TRIGGER:LEVEL 0.5
```

L. Set the TIME MARK GENERATOR to 10 µs Markers.

M. Send these commands to the VX4250:

```
CH1:STOP
CH1:SAMPLE:INTERVAL 10E-9
CH1:START
```

N. Send this query to the VX4250 and read the response:

```
PERIOD?
```

Record the measured value in Table 9-5 and verify that it is within the limits listed.

D. Send this query to the VX4250 and read the response:

```
MEAN?
```

Record the measurement in Table 9-2 and verify that it is specification limits listed.

Table 9-2. DC Gain Accuracy Verification – Attenuator G

Full Scale Range	Measure Mean Value		Max V
	CH1	CH2	
.08 V			± 2.6
.16 V			± 3.3
.4 V			± 5.2
.8 V			± 8.4
1.6 V			± 14.8
4 V			± 34
8 V			± 66
16 V			± 130
40 V			± 322

E. Repeat steps C and D for each voltage range in Table 9-2.

F. Send these commands to the VX4250:

```
CH2:STOP
CH2:TRIGGER:SOURCE FREERUN
WINDOW:LOC 2
```

G. Move the 50 Ω Terminator to the CHANNEL 2 input.

H. Repeat steps C and D for each voltage range in Table 9-2, CH2 for CH1 where necessary.

Sample Rate (sec)	S
100E-12	
250E-12	
500E-12	
1E-9	
2.5E-9	
5E-9	

Sample Rate (sec)	
10E-9	
500E-6	
1.0E-3	

4. Trigger Sensit

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Section 10
Replaceable Parts List of Field Replaceable Units

Introduction

This section provides lists of replaceable mechanical and electrical parts, standard accessories, a cross index linking manufacturer code numbers to manufacturers' names and addresses, and an exploded view drawing of the VX4250.

Replaceable Parts

Replaceable parts are available from or through your local Tektronix, Inc. field office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give users the benefit of the latest circuit improvements developed at Tektronix. When ordering parts it is important to include the part number, serial number, and modification number (if applicable) of your instrument with your order.

If a part you order has been replaced with a new or improved part, Tektronix automatically will ship you the latest version of the part, along with installation instructions. Also, your local Tektronix, Inc. field office or representative may contact you concerning part number changes.

Change information, if any, is located at the rear of this manual.

The figure and index numbers on the Mechanical Parts list on the next page refer to Figure 10-1. The number on Figure 10-1 for each replaceable part indicates the part in the parts list; e.g., 10-1-1 in the Mechanical Parts List, means the part with the encircled 1 in Figure 10-1.

Mechanical Parts List

Fig. & Index	Tektronix Part No.	Serial/Model No. Effective Dscont	Qty	Name and Description	Mfr. Code	Mfr Part Number
1-1	200-3957-00		1	COVER (RIGHT) ("**ATTACHINGPARTS**")	80009	200-3957-00
-2	211-0105-00		11	SCREW 4-40 X .188 FLAT 100 DEG ------**------	83385	OBD
-3	671-2112-00		1	CIRCUIT BD ASSY - L-SHAPED INTERFACE BOARD ("**ATTACHINGPARTS**")	80009	671-2112-00
-4	129-1398-00		5	SPACER POST .188 HEX 4-40 ENDS 0.997" LONG	80009	129-1398-00
-5	210-1307-00		5	#4 LOCK WASHER, 0.155 ID; SPLIT; 0.025 THICK ------**------	86928	A384-25N
-6	671-2128-00		1	CIRCUIT BD ASSY - DIGITAL ACQUISITION BOARD	80009	671-2128-00
-7	407-4122-00		1	ECB MOUNTING BRACKET - SHIELD	80009	407-4122-00
-8	211-0008-00		7	4-40 x .25" MACHINE SCREW	93907	OBD
-9	344-0132-00		6	PLASTIC ECB CLIP ("**ATTACHINGPARTS**")	80009	344-0132-00
-10	213-0138-00		6	SCREW; SELF TAP; 4-24 x 0.188 TYPE B; PAN HEAD ------**------	83385	OBD
-11	200-3958-00		1	COVER (LEFT)	80009	200-3958-00
-12	129-1400-00		6	SPACER POST .188 HEX 4-40 ENDS 0.764" LONG ("**ATTACHINGPARTS**")	80009	129-1400-00
-13	210-1307-00		6	#4 LOCK WASHER; 0.155 ID; SPLIT; 0.025 THICK	86928	A384-25N
-14	211-0105-00		6	SCREW 4-40 X .188 FLAT 100 DEG ------**------	83385	OBD
-15	333-3734-00		1	PANEL FRONT ASSY ("**ATTACHINGPARTS**")	80009	333-3734-00
-16	211-0105-00		3	SCREW 4-40 X .188 FLAT 100 DEG ------**------	83385	OBD
-17	367-0410-00		1	HANDLE; EJECTOR; BOTTOM; W/HARDWARE ("**ATTACHINGPARTS**")	62559	20817-327
-18	213-1040-00		1	SCREW; MACHINE m2.5 x 10; FLAT HD; NI PLT	62559	2110-500
-19	213-1036-00		1	SCREW; MACHINE m2.5 x 10; STEEL/ZINC PLT	62559	2110-138
-20	334-7519-00		1	LABEL; VXI; HANDLE; EJECTOR ------**------	80009	334-7519-00
-21	367-0411-00		1	HANDLE; EJECTOR; TOP; W/HARDWARE ("**ATTACHINGPARTS**")	62559	20817-328
-22	213-1040-00		1	SCREW; MACHINE m2.5 x 10; FLAT HD; NI PLT	62559	2110-500
-23	213-1036-00		1	SCREW; MACHINE m2.5 x 10; STEEL/ZINC PLT	62559	2110-138
-24	334-7685-00		1	MARKER; IDENT; TEK VX4250 ------**------	80009	334-7685-00

Mechanical Parts List (continued)

Fig. & Index	Tektronix Part No.	Serial/Model No. Effective Dscont	Qty	Name and Description	Mfr. Code	Mfr Part Number
-25	131-1315-01		4	BNC CONN; FEM; REAR PELTOLA; W/HARDWARE	24931	28JR306-1
-26	213-1035-00		2	MACHINE SCREW M2.5x11 W/ COLLAR; SLOT	62559	21100-379
-27	198-5781-00		1	WIRE KIT	80009	198-5781-00

Electrical Parts List

Ckt No.	Tektronix Part No.	Serial/Model No. Effective Dscont	Name and Description	Mfr. Code	Mfr. Part Number
F940	159-0153-00		FUSE, WIRE LEAD 1.5A, 125V, FAST BLOW	71400	TRA1 1/2
F941	159-0153-00		FUSE, WIRE LEAD 1.5A, 125V, FAST BLOW	71400	TRA1 1/2
F942	159-0146-00		FUSE, WIRE LEAD 7A, 125V, FAST BLOW	71400	A-7
F960	159-0153-00		FUSE, WIRE LEAD 1.5A, 125V, FAST BLOW	71400	TRA1 1/2

Standard Accessories List

	Tektronix Part No.	Serial/Model No. Effective Dscont	Name and Description
	070-8340-01		VX4250 INSTRUCTION MANUAL
	063-0825-01		3.5 IN. DISKETTE, VX4250 ISD FOR TekTMS™
	063-0826-01		5.25 IN. DISKETTE, VX4250 ISD FOR TekTMS™

Cross Index: Mfr Code Number to Manufacurer

Mfr Code	Manufacturer	Address	City, State, Zip
24931	Specialty Connector Co., Inc.	2620 Endress Place	Greenwood, IN 46142
62559	Schroff Inc.	170 Commerce Dr.	Warwick, RI 02886-2430
71400	Bussman Division of Cooper Industries, Inc.	114 Old State Rd., P.O. Box 14460	St. Louis, Mo 63178
80009	Tektronix, Inc.	P.O. Box 500	Beaverton, OR 97077
83385	Central Screw Co.	2530 Crescent Dr.	Broadview, IL 60153
86928	Seastrom Mfg. Company, Inc.	701 Sonora Avenue	Glendale, CA 91201
93907	Tektron, Inc.	600 18th Avenue	Rockford, IL 61108

VX4250 Exploded View Drawing

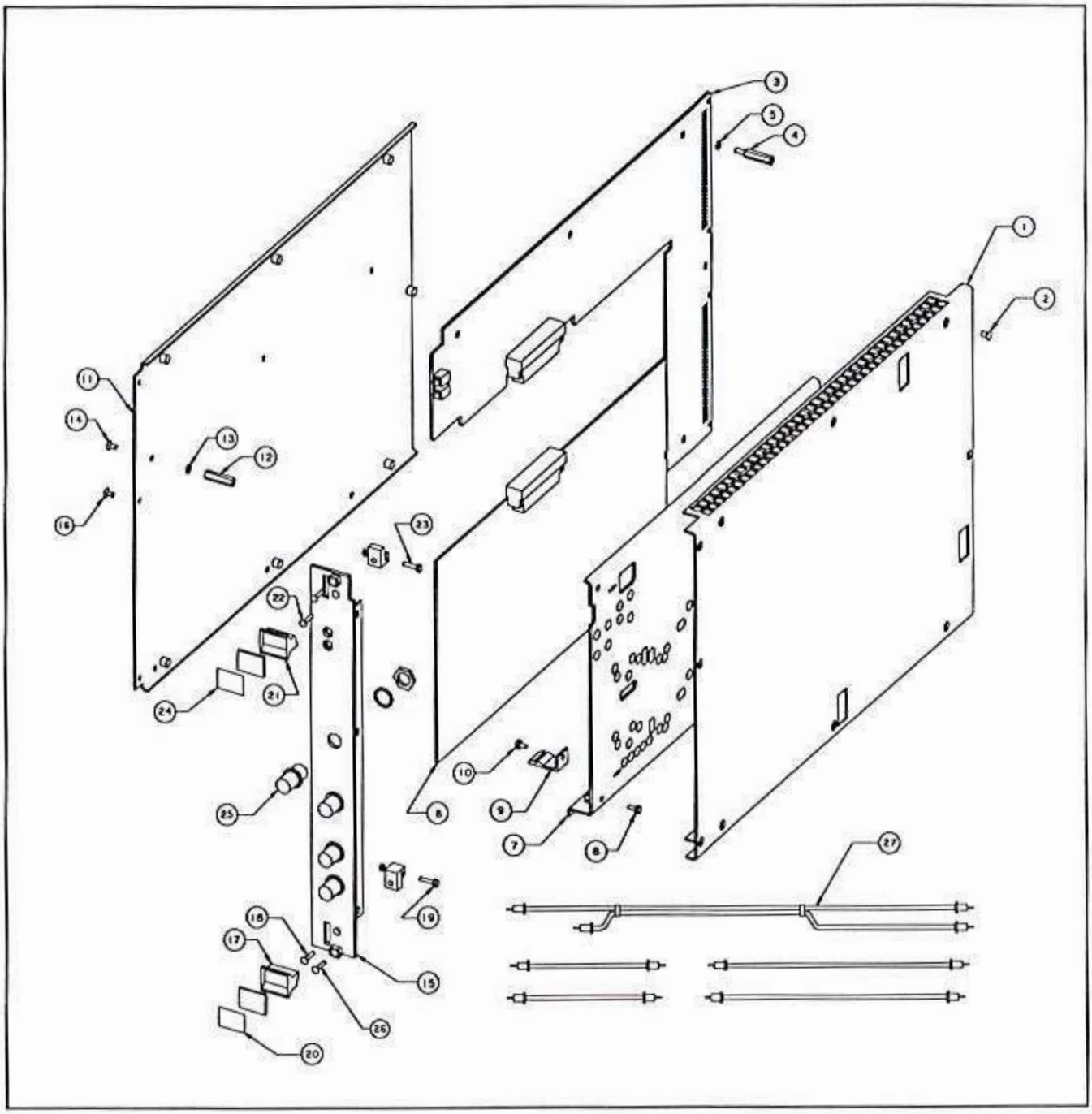


Figure 10-1. VX4250 Exploded View Drawing.

Appendix A
IEEE Standard 488.2 Reference

Command Header Tree Structure

The VX4250 uses compound commands throughout the command set. When attempting to understand how a compound command works, it is useful to look at the command as a tree structure or hierarchy. This is an example of a compound command:

```
:CH1:RANGE 4;COUPLING AC;OFFSET 1.4;TRIGGER:LEVEL 0.0;:CH2:RANGE 8
```

This is the equivalent non-compound command:

```
:CH1:RANGE 4
:CH1:COUPLING AC
:CH1:OFFSET 1.4
:CH1:TRIGGER:LEVEL 0.0
:CH2:RANGE 8
```

The colon (:) operator applies RANGE to the CH1 command. The subsequent COUPLING, OFFSET, and TRIGGER commands are applied to CH1 by the semi-colon (;) operator. The (;:) operator takes the compound command to the top of the tree. Graphically, the above command string looks like the diagram in Figure A-1.

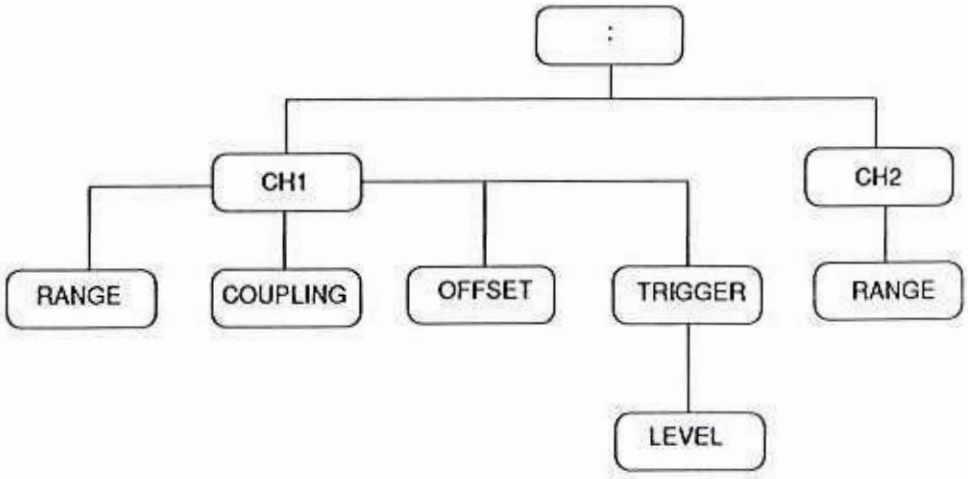


Figure A-1. Compound command string diagram.

CH1 and **CH2** are at the root of the VX4250's command tree. Commands under a common tree element are semicolon separated. In order to pop up to the top level of the tree, that is, to use a new root level command, the (;:) notation is used.

Non-Decimal Numeric Program Data

The IEEE Standard 488.2-1987 describes the use of non-decimal numeric data; that is, numbers that are in hexadecimal, octal, and binary. Any time numeric data is required, the data can optionally be sent in hex, octal, binary, or decimal.

Hexadecimal - #Hd..d where d..d is any collection of hexadecimal digits. For example, CH1:RANGE 1,#H10 will set the full-scale range of channel one to 16 volts.

Octal - #Qd..d where d..d is any collection of octal digits. For example, CH1:RANGE 1,#Q10 will set the full-scale range of channel one to 8 volts.

Binary - #Bd..d where d..d is any collection of binary digits. For example, CH1:RANGE 1,#B100 will set the full-scale range of channel one to 4 volts.

Appendix B
Pulse Measurement Definitions

Overview

This appendix defines the terms used in pulse measurement. The names and commands used in pulse measurement with the VX4250, along with a description of each, are listed in Table B-1.

Table B-1. Pulse Measurement Names and Commands

Pulse Measurement		
Name	**Command**	**Description**
Maximum Magnitude	MAX?	*Most positive voltage of a waveform*
Minimum Magnitude	MIN?	*Most negative voltage of a waveform*
Middle Magnitude	MID?	*Midpoint voltage of a waveform*
Top Magnitude	TOP?	*Topline voltage representing the nominal top of the waveform*
Base Magnitude	BASE?	*Baseline voltage representing the nominal base of the waveform*
Amplitude	AMPLITUDE?	*The top – base amplitude (top minus base)*
Top Overshoot	TOVER?	*Percentage of top overshoot*
Base Overshoot	BOVER?	*Percentage of base overshoot*
Proximal Magnitude	PROXIMAL?	*Typically the 10% magnitude point*
Mesial Magnitude	MESIAL?	*Typically the 50% magnitude point*
Distal Magnitude	DISTAL?	*Typically the 90% magnitude point*
Rising Proximal	RPROXIMAL?	*Sample point of the proximal value on a rising edge*
Rising Mesial	RMESIAL?	*Sample point of the mesial value on a rising edge*
Rising Distal	RDISTAL?	*Sample point of the distal value on a rising edge*
Falling Proximal	RPROXIMAL?	*Sample point of the proximal value on a falling edge*
Falling Mesial	RMESIAL?	*Sample point of the mesial value on a falling edge*
Falling Distal	RDISTAL?	*Sample point of the distal value on a falling edge*
Period Mesial	PMESIAL?	*Sample point of the mesial value used to define a period*
Period	PERIOD?	*Time between the first and third qualified mesial points*
Width	WIDTH?	*The width of the waveform segment*
Frequency	FREQUENCY?	*The inverse of the period*
Duty Cycle	DUTY?	*The percentage of time the waveform exceeds its mesial value*
Rise Time	RISE?	*The time between the rising proximal and distal points*

Pulse Measurement		
Name	**Command**	**Description**
Fall Time	FALL?	*The time between the falling proximal and distal points*
Mean Magnitude	MEAN?	*The average magnitude*
Waveform Area	AREA?	*The area contained under a waveform*
RMS	RMS?	*The root-mean-squared of the waveform*
Waveform Energy	ENERGY?	*The energy contained within a waveform*
Gain	GAIN?	*Amplitude gain between two waveforms*
Phase	PHASE?	*Phase angle difference between two waveforms*

The names and commands for pulse measurement setup, along with their descriptions, are shown in Table B-2.

Table B-2. VX4250 Pulse Measurement Setup

Pulse Measurement Setup		
Name	**Command**	**Description**
Waveform Window	WINDOW	*Selects waveform location and waveform segment to apply pulse analysis computations*
Base Determination	BMODE	*Selects algorithm used for calculating base*
Top Determination	TMODE	*Selects algorithm used for calculating top*
Proximal Reference	REFLINES:PROXIMAL	*Value of the proximal reference point (typically 10%)*
Mesial Reference	REFLINES:MESIAL	*Value of the mesial reference point (typically 50%)*
Distal Reference	REFLINES:DISTAL	*Value of the distal reference point (typically 10%)*
Reference Units	REFUNTS	*Allows reflines to be described in percent of amplitude or in absolute magnitude*
Extended Mode	EXTMODE	*Mean, Area, RMS, and Energy can be computed over a period or window*

VX4250 pulse analysis is divided into three categories: magnitude, time, and extended, as shown in Table B-3.

Table B-3. VX4250 Pulse Analysis Categories

Magnitude Parameters	Time Parameters	Integrated Parameters	Other Parameters
Top	Rise Time	Mean	Gain*
Base	Fall Time	RMS	Phase*
Maximum	Width	Area	
Minimum	Period	Energy	
Top Overshoot	Frequency		
Base Overshoot	Duty Cycle		
Mid-Point			
Peak-to-Peak			
Proximal			
Mesial			
Distal			
Amplitude			

*Gain and Phase are dual port measurements.

Method of Computation – Magnitude Parameters

Maximum (Minimum) Magnitude — The waveform within the bounds specified by the WINDOW command is scanned for the most positive (negative) sample. The value is returned in volts.

Middle Magnitude — The waveform within the bounds specified by the WINDOW command is scanned for the most positive and negative samples and the mid-point is derived. The value is returned in volts.

Peak-to-Peak — The waveform within the bounds specified by the WINDOW command is scanned for the most positive and negative samples. The peak-to-peak value is the difference between the maximum and minimum values. The value is returned in volts.

Top (Base) Magnitude — This value can be computed in one of three ways. The simplest method is to set Top (Base) equal to Max (Min). A more useful method is to use the algorithm described in *ANSI/IEEE Std 181-1977* where a probability density histogram is generated on the selected waveform (please refer to Figure B-1). The default Top (Base) determination method finds the level of the greatest number of occurrences and scales to a voltage level. Alternately, a weighted mean of the histogram is used to set the Top (Base). See the TMODE (BMODE) commands for selecting Top (Base) determination methods.

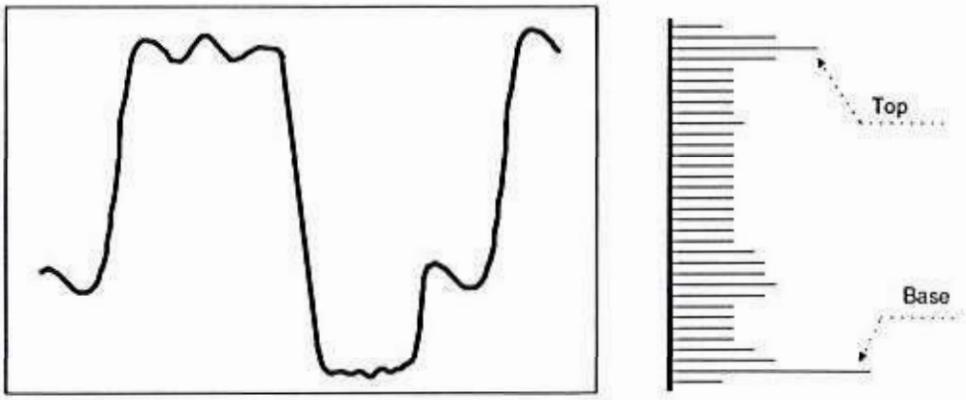


Figure B-1. Top-Base Determination Using Histogram Mode.

Selecting Top (Base) mode determination requires some knowledge of the waveform to be measured. A perfect triangle waveform will have an even distribution of samples. Therefore, the histogram methods will generate erroneous readings. The histogram methods are best suited for square-waves and most sinusoids, as shown in Figure B-1.

Amplitude — The difference between the top and base values expressed in volts.

Proximal, Mesial, and Distal Magnitude — Typically referred to as the 10-50-90 percent reference points, the proximal, mesial and distal measurements return the magnitude at the specified reference point. The reference points are computed as a percentage of the Top-Base magnitude, as shown in Figure B-2.

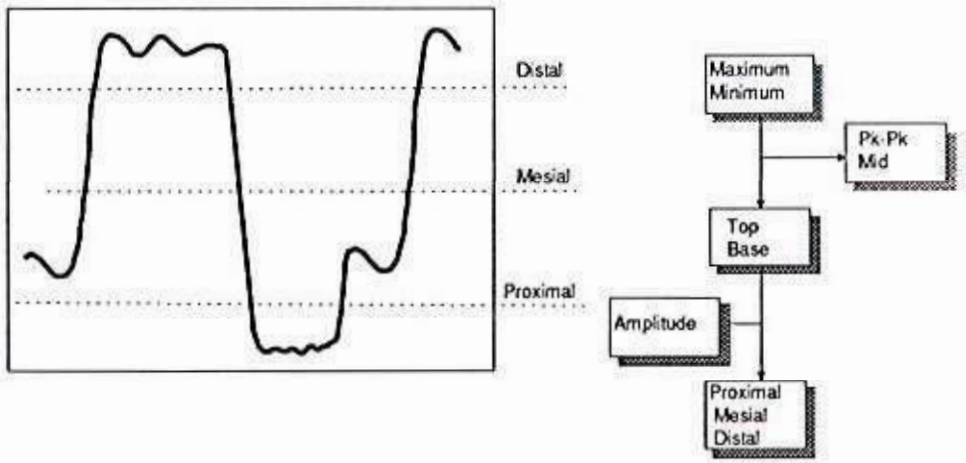


Figure B-2. 10-50-90 Reference Points.

Pulse Magnitude Summary

It is important to note that maximum and minimum are the root of the pulse analysis functions (as shown in Figure B-3). For any pulse measurement, maximum and minimum are always calculated.

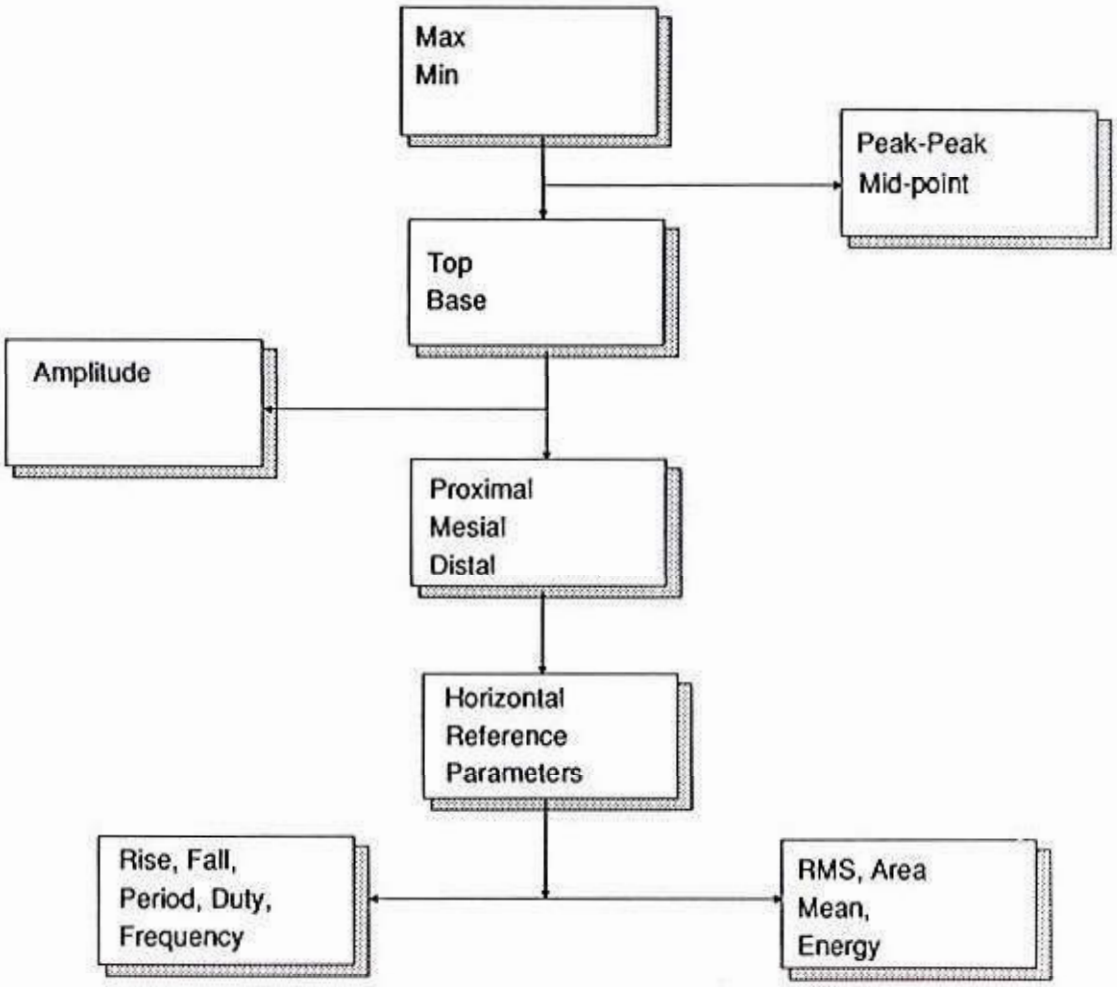


Figure B-3. Pulse Flow Diagram.

Further, note that proximal, mesial, distal, time parameters, and extended parameters are dependent on the top and base values. The proper selection of the base and top determination method is critical for the above mentioned pulse parameters to be calculated correctly.

Reference Locations (RPROXIMAL, RMESIAL, RDISTAL, FPROXIMAL, FMESIAL, FDISTAL, PMESIAL) — Reference locations are the basis for determining time related parameters. Each edge is qualified such that the edge contains a unique proximal, mesial, and distal value. The reference location commands return a linearly interpolated value that indicates the sample location of a given reference location (see Figure B-4).

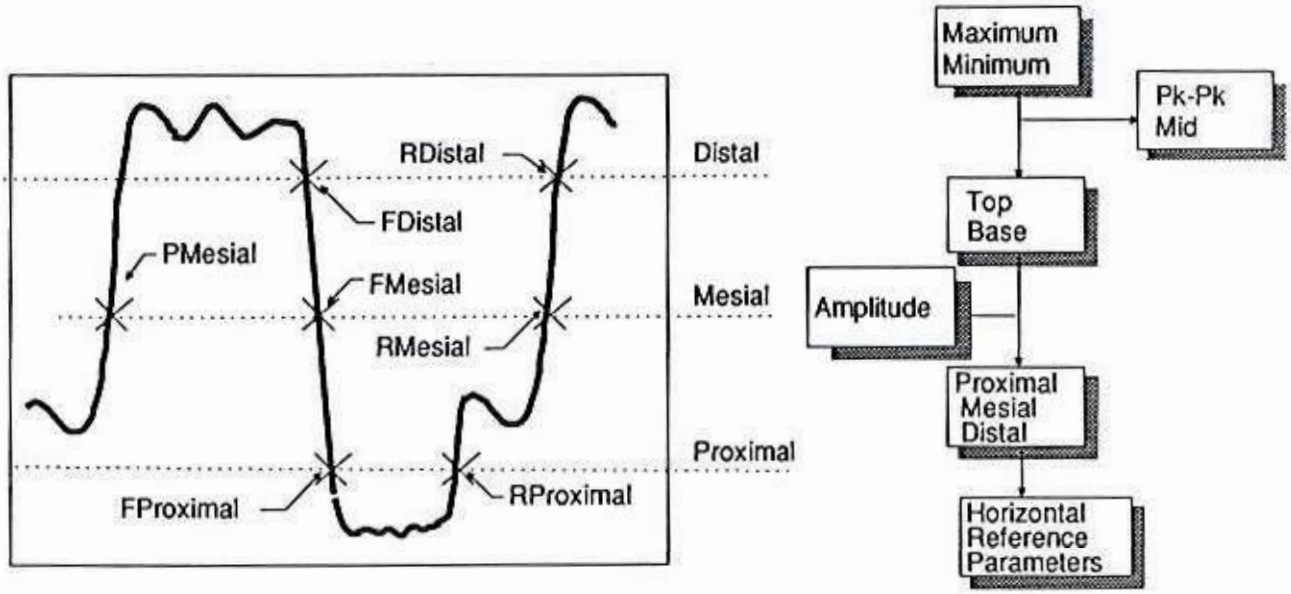


Figure B-4. Horizontal References.

Period and Frequency — Period is the time period between the first and third qualified mesial points. Frequency is simply the inverse of period.

Duty Cycle — The percentage of time a waveform is greater than the mesial value. Duty Cycle is calculated as $\frac{Width}{Period} \cdot 100$.

Rise (Fall) Time — The difference between the rising (falling) proximal and distal points.

Mean — The algebraic mean of the waveform over a period (or optionally over a window; see the EXTMODE command).

Mean is calculated as: $\frac{1}{n}\sum_{i=1}^{n} W_i$.

Area — Area under the waveform over a period (or optionally over a window; see the EXTMODE command). Samples above ground add area, while samples below ground subtract area.

Area is computed as: $\frac{SI}{2} \cdot \sum_{i=1}^{n-1}\left(W_i + W_{i+1}\right)$.

RMS — The root-mean-square of the waveform over a period (or optionally over a window; see the EXTMODE command).

RMS is calculated as: $\frac{1}{2n}\sum_{i=1}^{n-1}\left(W_i^{\,2} + W_{i+1}^{\,2}\right)$.

Energy — The energy of the waveform over a period (or optionally over a window; see the EXTMODE command).

Energy is calculated as: $\frac{SI^2}{2}\sum_{i=1}^{n-1}\left(W_{i+1}^{2} + W_i^{\,2}\right)$

Where: *SI* is the sample interval
W is the waveform element and
i is the sample point index

Pulse Analysis Setup Commands

WINDOW — The VX4250 has eight waveform locations. Any of these waveform locations can be selected for pulse parameter measurement by the WINDOW:LOC command. For example, WINDOW:LOC 2 directs the pulse analysis commands to waveform location 2.

Pulse analysis can be performed on a portion of the selected waveform with the WINDOW:START and WINDOW:STOP commands. For example, the WINDOW:START 100;STOP 1024 command restricts pulse analysis to waveform samples 100 through 1024.

TMODE (BMODE) Top (Base) determination selection — TMODE (BMODE) commands are used to select the Top (Base) determination method. Three methods are provided, MINMAX, HISTOGRAM:MODE, and HISTOGRAM:MEAN.

Reflines (Proximal, Mesial, Distal) — Normally the proximal, mesial, and distal values are set to 10, 50, and 90 percent of the amplitude. The reference values are user programmable through the REFLINES command. For example, to measure rise and fall times between the 20% and 80% points: REFLINES:PROXIMAL 0.2;DISTAL 0.8.

ExtMode — This command allows greater flexibility with the RMS, Area, Mean, and Energy calculations. Normally these measurements are made over a single period. Optionally, the measurements can be made based on the WINDOW:START and WINDOW:STOP parameters. The EXTMODE WINDOW command will direct RMS, Area, Mean and Energy calculations to be made based on the WINDOW information.

Pulse Measurement Calculation within the VX4250

It is important to understand some of the interdependencies of the pulse analysis. Figure B-3 shows the progression of pulse analysis calculations.

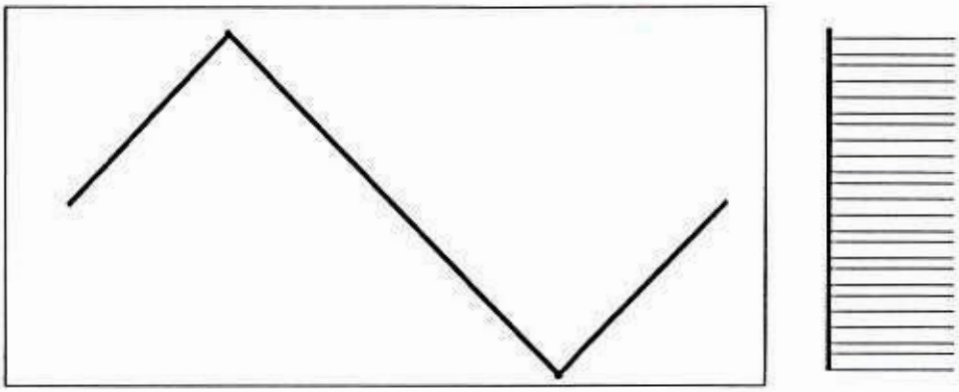


Figure B-5. Triangle Waveform and Associated Histogram.

The pulse analysis routines always start by calculating the maximum and minimum values of the waveform. The maximum and minimum values are saved in memory to save recalculations.

From the maximum and minimum values, peak-to-peak and midpoint values are easily derived.

Next, top and base are calculated based on the Base-Top determination mode selected by the user. Base and Top values are also saved in memory to eliminate the need for recalculations.

Note:

An important note, all remaining pulse parameters depend on the proper calculation of top and base. If the top and base values are incorrect, the proximal, mesial, and distal points will also be incorrect. Since all reference crossings are derived from the proximal, mesial, and distal magnitudes, any time-dependent measurement will be in error.

In most cases, either of the histogram modes for base-top determination will be adequate. Again, waveforms such as a triangle waveform will not work well with histograms (refer to Figure B-5). In this case, setting the base-top determination mode to MINMAX would be appropriate.

Common Problems and Errors

Pulse Values are wrong — Check the parameters to the *WINDOW* command to insure that waveform location and start/stop points are correct. Also, insure that the desired waveform was acquired and placed in the proper location.

Top/Base are wrong — In addition to the above, insure that the base/top determination method is correct. Note in Figure B-5 how the histogram methods can be fooled.

Time and/or Extended Parameter are wrong or not found — In addition to the above, insure that three mesial crossings are present. If three mesial crossings are not available, check the sample rate used to acquire the waveform.

Extended Parameters are Incorrect — The extended parameters (Area, RMS, Mean and Energy) are calculated over a single period of the waveform, if a period exists. Otherwise, the extended parameters are calculated over the bounds set by the WINDOW command. This behavior can be overridden by the EXTMODE command.

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Appendix C
VXI Rear-Panel Interface

Introduction

The VX4250 rear-panel interface consists of VXIbus connectors P1 and P2. The pins used by the VX4250 on P1 and the inner row (Row B) on P2 are configured as defined in the *VMEbus Specification, IEEE Standard 1014.* The pins used by the VX4250 on the outer rows of P2 (Rows A and C) and P3 are configured as defined in the *VXIbus System Specification, Revision 1.3, dated July 14, 1988.* The pin assignments used by the VX4250 on these two connectors are listed in Tables C-1 and C-2. For detailed information regarding the signals on the pins, refer to the *VMEbus Standard* and the *VXIbus Specification* referenced above.

The VX4250 does not use any VXI Local Bus lines on the P2 connector.

Active Signal States

An asterisk (*) following a signal mnemonic (as in ACFAIL*) denotes the signal is active when in its low state.

A signal mnemonic without an asterisk (*) denotes the signal is active when in its high state.

The FDC buffers can be read and written from both the instrument processor and the VXIbus. This means when you access this memory from the VXIbus, it is important to know the impact this has on instrument operation.

When the channel is running, acquired waveforms will be written into the waveform buffer. Only completed waveforms will appear here—for example, an averaged waveform is written when all acquisitions have been accumulated and divided. When the channel is stopped, the waveform scaling information will be added to that buffer. Also, whenever SAVE or *SAV commands are issued, the stored setting area is written.

FDC Commands

There are four word serial commands associated with FDC access:

- FDCBASE?
- FDCSIZE?
- FDCLOAD and FDCLOAD?

In this implementation of FDC, FDCSIZE? and FDCBASE? provide useful information about the location and size of the whole FDC memory or individual buffers. The FDCLOAD and FDCLOAD? commands are provided for compatibility with controller software that may need to handshake multiple buffers through the FDC in other instruments. In the VX4250, you may access the contents of the buffers without the FDCLOAD and FDCLOAD? commands.

Please refer to Section 6, *Command Dictionary*, for a detailed description of FDCSIZE? and FDCBASE? queries and the valid arguments.

FDC Access

As stated earlier, FDCSIZE and FDCBASE provide valuable information about the size and location of the physical buffer. You will need to use this information when accessing the FDC memory.

The following procedure should be used when accessing the individual buffers or the whole FDC memory:

1. Determine the buffer location and size using FDCBASE and FDCSIZE.
2. Stop channel acquisition with "CH1:STOP;:CH2:STOP;"
3. Perform a VXIbus read or VXIbus write to the shared memory, using the base address and size information (this step is controller-dependent; therefore, see the system controller manual for directions on how to do this.)

Note that step 2 is optional. This insures that data is not changing in any of the buffers when the FDC memory is accessed. There may be applications when it is desirable to access waveform information during acquisition of a repetitive signal.

CAUTION

Do not attempt to alter the contents of the FDC buffers. This corrupts the essential data structures that drive the instrument. If this happens, the results are unpredictable.

The intended use of the FDC is to allow the instrument to manipulate the data through buffers, through interpretation of commands and the acquisition process, and to allow users to fast data access for fast unloading and reloading.

The information in Figure D-2 provides a detailed description of the location, size, and structure of the FDC buffers.

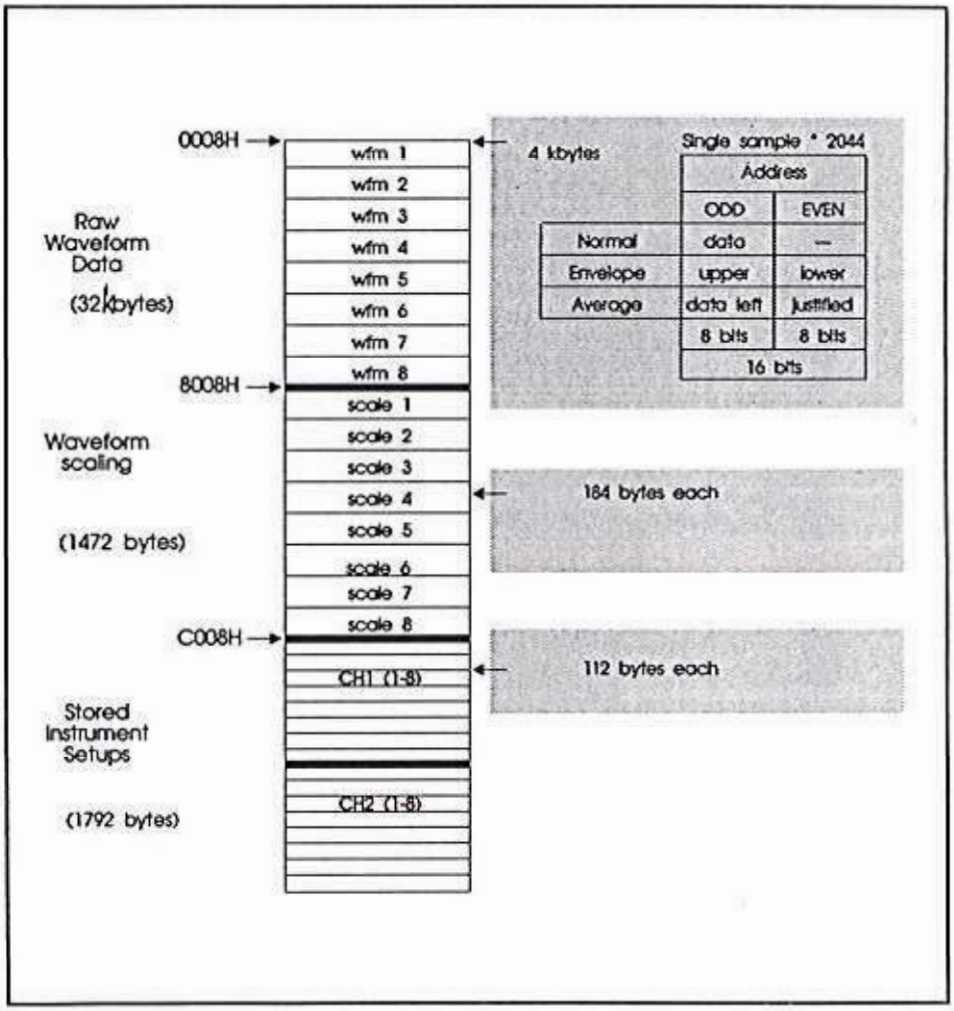


Figure D-2. Detailed FDC Memory Map.

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