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TEK User Reference Supplement

Part No. 070-6119-01
Product Group 47

11A33 Differential Comparator

Serial Number_____

Please check for CHANGE INFORMATION at the rear of this manual.

Second Edition SEP 1988

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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

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100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
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11A33 Features and Functions

The 11A33 Differential Comparator is designed to operate in the plug-in compartments of 11000-series Oscilloscopes. Some 11A33 features and functions are listed below:

Features

- Differential inputs.
- 150 MHz bandwidth.
- Calibrated sensitivities from 1 mV to 10 V/division.
- Selectable input impedances: 50 Ω, 1 MΩ, 1 GΩ.
- Offset voltages can be applied internally to tips of active probes.

Functions

Signals applied to the + or – input connectors can be displayed or removed from the display by pressing the CH 1 display on/off button, which is adjacent to the input connectors.

Other 11A33 functions are controlled through the host mainframe. Such mainframe-controlled functions are:

- Sensitivity, Coarse and Fine, from 1 mV to 10 V/division.
- Vertical Offset.
- Coupling: AC, DC, VC, or Off.
- Impedance (input termination): 50 Ω, 1 MΩ, or 1 GΩ.
- Bandwidth Limit: 100 MHz or 20 MHz.
- Display Polarity: normal or inverted.
- Trigger Polarity: normal or inverted.

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Section 1
General Information

This section describes the content of the 11A33 Supplement to the 11301, 11301A, 11302, 11302A, 11401 and 11402 User Reference manuals. For information on related documentation see Appendix B.

Contents of this Supplement

This Supplement contains the following four sections:

Section 1—GENERAL INFORMATION, describes mainframe to plug-in unit compatibility, explains how to install and remove the 11A33 from a mainframe, outlines any options available for the 11A33, and gives details about packaging for shipment.

Most 11A33 functions, and their use, are described in the *Operating Information* section of the mainframe User Reference manuals. These functions are those common to all amplifier plug-in units. Examples of common functions are offset, sensitivity, input impedance (where selectable), coupling, and bandwidth limit. Only functions unique to the 11A33-11300-series or 11A33-11400-series combinations are explained in the following sections.

Section 2—OPERATING THE 11A33 IN 11300-SERIES MAINFRAMES, explains how to operate those 11A33 functions not covered in the *11301 and 11302 User Reference Manual*, or the *11301A and 11302A User Reference Manual.*

Section 3—OPERATING THE 11A33 IN 11400-SERIES MAINFRAMES, explains how to operate those 11A33 functions not covered in the *11401 and 11402 User Reference Manual.*

Section 4—SPECIFICATION, gives detailed specifications of all 11A33-mainframe oscilloscope combinations.

Plug-in to Mainframe Compatibility

The 11A33 is designed for use in the 11301, 11301A, 11302, 11302A, 11401, 11402 and future 11000-series plug-in mainframes. Refer to the Tektronix Corporate Catalog for complete compatibility information.

Compatibility between mainframe and plug-in firmware versions is described in Appendix C.

CAUTION

Certain installed firmware versions in the mainframe and plug-in may not be compatible. To ensure that the 11A33 firmware version is compatible with the host mainframe, refer to Appendix C, Firmware Compatibility.

Initial Inspection

This instrument was inspected mechanically and electrically before shipment, and should meet all electrical specifications. First, inspect the 11A33 for physical damage incurred in transit. Secondly, to verify that the instrument is functioning properly, perform the *Functional Test Procedure*, shipped with the instrument. This brief procedure verifies most instrument functions and checks the internal auto-calibration references. If you find instrument damage or deficiency, contact your local Tektronix Field Office or representative.

Operating Temperature

The 11A33 can be operated where the ambient air temperature is between 0° and +50° C and can be stored in ambient temperatures from –40° to +75° C. After storage at temperatures outside the operating limits, allow the chassis to reach operating temperature limits before applying power.

Installing and Removing the 11A33

CAUTION

To avoid instrument damage set the mainframe ON/STANDBY switch to STANDBY before installing or removing the 11A33.

If the green indicator light remains ON, when the STANDBY position is selected, the switch has been internally disabled.

To remove or reinstall plug-in units, use the PRINCIPAL POWER SWITCH (rear panel) to shut OFF the power. This will prevent damage to either the plug-in or the mainframe.

To once again enable the ON/STANDBY switch, refer the instrument to qualified service personnel.

When installed in any 11401 or 11402 plug-in compartment, or in the 11301, 11301A, 11302 or 11302A left or center plug-in compartment, the 11A33 will provide a conventional display.

When installed in the center or right plug-in compartment of the 11301, 11301A, 11302 or 11302A the 11A33 will provide the X part of an X-Y display, or provide a trigger signal for the mainframe time bases.

To install the 11A33 in any 11000-series oscilloscope mainframe set the mainframe ON/STANDBY switch to STANDBY. Align the grooves in the top and bottom of the 11A33 with the guides in the mainframe plug-in compartment, then insert the 11A33 into the mainframe until its front panel is flush with the front panel of the mainframe.

To remove the 11A33 from a mainframe, set the mainframe ON/STANDBY switch to STANDBY. Then pull the release latch (see Figure 1-1) to disengage the unit from the mainframe, and pull the 11A33 straight out of the plug-in compartment.

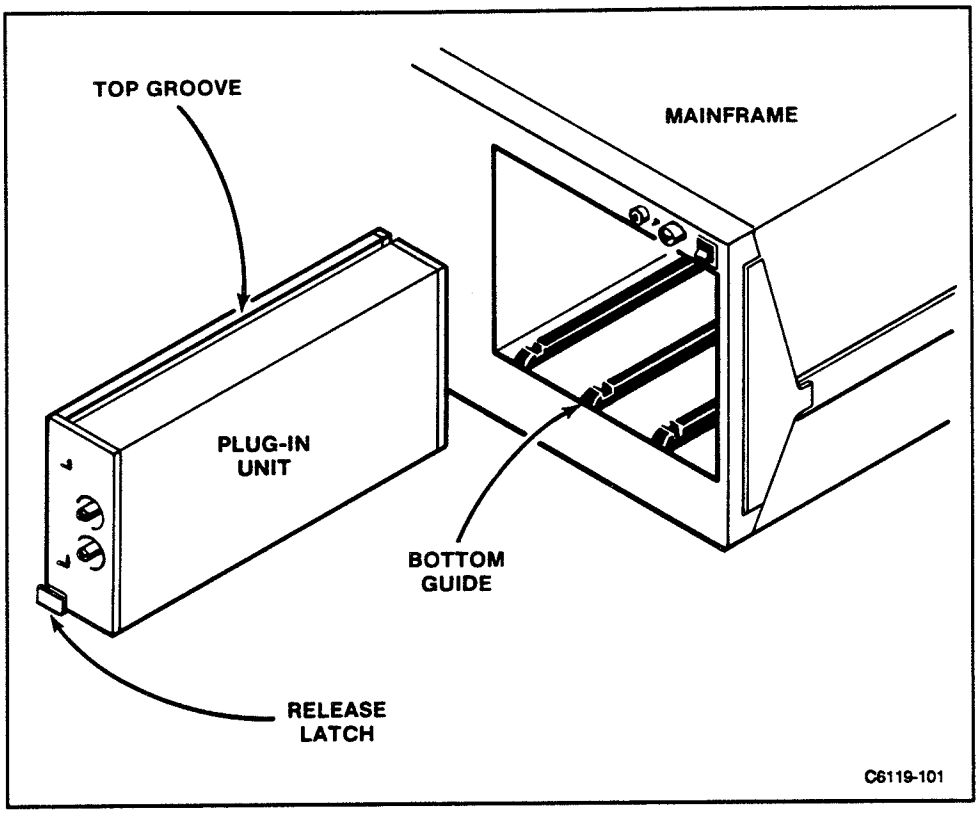


Figure 1-1. Installing a plug-in unit in a mainframe oscilloscope.

Instrument Options

Option 24 includes a P6135 probe pair.

Packaging for Shipment

If this instrument is to be shipped by commercial transportation, we recommend that it be packaged in the original manner. The original carton and packaging material should be saved and reused for this purpose.

NOTE

Package and ship plug-in units and mainframes separately.

If the 11A33 is to be shipped to a Tektronix Service Center for service or repair, attach a tag to the instrument. On the tag, include the following information:

- Name and address of the instrument owner;
- Name of a person at your firm who can be contacted about the instrument;
- Complete instrument type and serial number; and
- A description of the service required.

If the original package is not available or is not fit for use, package the 11A33 as follows:

1. Obtain a corrugated cardboard carton with inside dimensions at least six inches greater than the instrument dimensions. Use a carton with a test strength of at least 200 pounds.
2. Fully wrap the 11A33 with polyethylene sheeting, or its equivalent, to protect the finish.
3. Cushion the 11A33 on all sides by tightly packing dunnage or urethane foam between the carton and the instrument. Allow three inches of packing on each side.
4. Seal the carton with shipping tape or with industrial staples.
5. Mark the address of the Tektronix Service Center and your return address. on the carton in one or more prominent places.

Section 2
Operating the 11A33 in 11300-series Mainframes

The 11A33 Differential Comparator is a high-gain differential comparator for use in Tektronix 11000-series plug-in oscilloscope mainframes. A brief list of 11A33 characteristics follows.

TABLE 2-1
11A33 Characteristics

Calibrated Deflection Factors:	
Zin = 50 Ω or 1 MΩ	1 mV to 10 V/division.
Zin = 1 GΩ	1 mV to 99.5 mV/division.
Input Impedance	50 Ω, 1 MΩ, 1 GΩ.
Comparison Voltage (Vc)	8 V, 80 V, or 500 V, depending on deflection factor (see Section 4, *Specification*).
Bandwidth	DC to 150 MHz.
HF Limit	20 MHz, 100 MHz.
Input Coupling	AC, DC, Vc, Off.

Although the 11A33's principal feature is its differential comparator function, the 11A33 can also be used as a differential amplifier and as a conventional amplifier.

When used as a differential comparator, a DC comparison voltage, Vc, is added differentially (this means Vc is applied to the input to which the input signal is **not** applied) to the input signal. The accuracy of Vc enables precise DC voltage measurements. Comparing Vc with a signal on the other input effectively cancels the displacement created by the DC level of the input signal, and permits the user to observe any small AC components of the signal.

When used as a differential amplifier, signals up to ±8 V can can be applied to the 11A33 (with size set from 1 mV to 99.5 mV and Zin set to 1 MΩ or 1 GΩ). Deflection factors from 100 mV to 10 V/division are not available when the input impedance is set to 1 GΩ. This combination of sensitivity and common-mode rejection permits measuring signals as small as 1 mV, even when superimposed on DC levels of much greater magnitude.

Display On/Off

The display on/off button designates Channel 1 for display, or removes the channel from the display. When the channel is displayed, its label (CH 1) will be illuminated.

Selecting Coupling, HF Limit, and Impedance

To select the desired setting for Coupling, HF Limit, or Impedance, proceed as follows:

1a. If no trace is displayed, press the plug-in display on/off button to create a trace.

1b. If several traces are displayed, select a channel by touching the desired trace description at the top of the CRT.

2. On the 11301 and 11302 oscilloscopes press any VERTICAL button once—OFFSET, SIZE, or POS. On the 11301A and 11302A oscilloscopes press any VERTICAL button twice. This will cause the Control Menu to be displayed.

3. Touch the desired function's label. Successive touches will change its state.

Other Functions

Other 11A33 functions are controlled within the 11300-series mainframe, and their operation is described in detail in Section 2, *Operating Information,* of the *11301 and 11302 User Reference Manual* and the *11301A and 11302A User Reference Manual.* Table 2-2 shows where to find information about operating the 11A33.

TABLE 2-2
Functions and Where They are Described

Function	Described Under Heading
Size (deflection factor)	Waveform Acquisition: Vertical Menu; or for X-Y Display: Horizontal Menu.
Display Select ±Ch 1	Waveform Acquisition: Vertical Menu; or for X-Y Display: Horizontal Menu.
Polarity	Waveform Menu.
Trigger Selection and Polarity	Trigger Source Major Menu.

Position and Offset

All 11300-series oscilloscopes assign position control to the Left Control knob by pressing the VERTICAL POSition button once. The Vertical Position control moves the trace as a user convenience. For example, when displaying multiple channels it may be desirable to set ground references for each trace on separate graticule lines. Position is a screen-related function; its units are divisions.

The offset function, accessed by pressing the VERTICAL OFFSET button, subtracts a precision voltage from the input signal. Changing offset moves the trace just as does the position control. However, if the deflection factor is subsequently changed, the effect is different.

Changing the sensitivity will increase or decrease the size of the display around some screen level (e.g., two divisions above graticule center) set by the Position control. When using a sensitivity that makes the displayed waveform larger than the screen, the Offset control is used to bring the waveform area of interest to the screen location established by the Position control.

The Position control has a range of plus and minus four divisions from graticule center, but the Offset control has a range defined in volts. Offset can be as much as 1000 divisions at 1 mV/division. The amplifier Offset control range is one volt for all sensitivities from 1 mV to 99.5 mV/division, but increases to 10 volts for sensitivities from 100 mV to 995 mV/division. For sensitivities from 1 volt to 10 volts/division, Offset control range increases to 100 volts.

The 11A33 attempts to maintain the user-selected offset even though the offset range changes due to a change in sensitivity. An offset voltage of less than one volt will be maintained as the sensitivity is changed over the entire range of 1 mV/division to 10 V/division. A selected offset of greater than one volt is beyond the offset range for the most sensitive settings and will be reset to one volt when the sensitivity is increased to any value between 99.5 mV/division and 1 mV/division.

For more details about the 11A33 and offset, see *Offset in Four Places*, below.

Offset in Four Places

The 11A33 stores four offset values. These offset values, which provide offset control for the 11A33, are called Vc_offset, amp_offset, plus_offset, and minus_offset. When an input's coupling is set to Vc, Vc_offset becomes the input signal. Amp_offset is subtracted from the signal path after the two inputs have been subtracted. Plus_offset is subtracted from the plus input through the probe; minus_offset is subtracted from the minus input through the probe. When an input does not have an offset probe connected to it, the corresponding probe offset (plus_offset or minus_offset) does not affect the signal.

Stored offset values are modified only by explicit commands; they are not initially set to zero.

Probe offset values are expressed as volts at the probe tip.

The 11A33 has four hardware offset controls that are operated by the software. These hardware offset controls, which determine the offset values, are labeled the same as the offset values, namely amp offset, Vc offset, plus offset, and minus offset. Only one hardware control can be connected at one time. Figure 2-1 shows the signal path and where the offset values are applied.

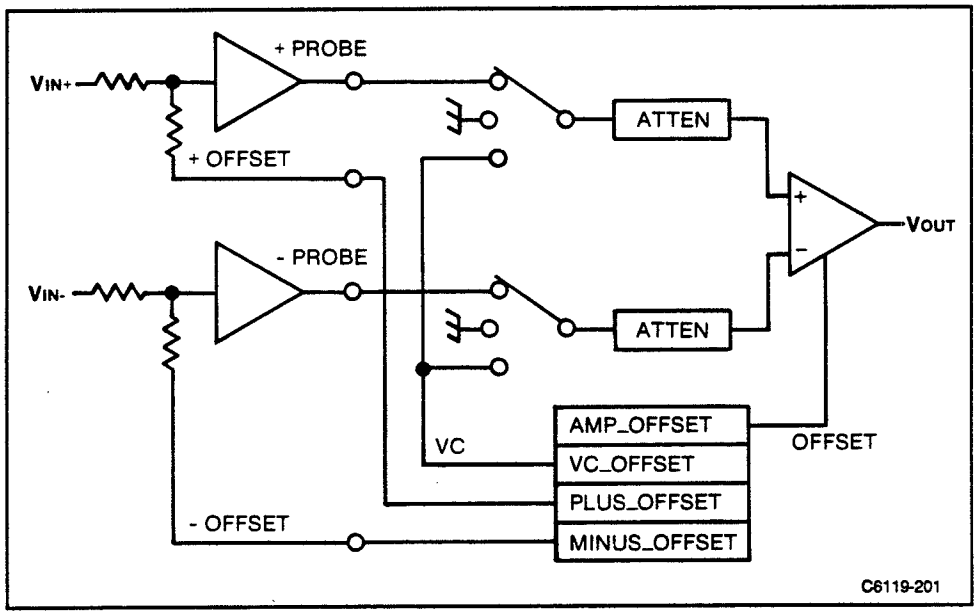


Figure 2-1. Simplified block diagram of 11A33 and 2 Active Probes, with offsets.

Hardware controls can be connected to, or disconnected from, the offset values without changing the stored offset values. For example, if the offset control is disconnected from the amp_offset value based on conditions, the offset control will be set to zero and the amp_offset value will not change. When the offset control is again connected, the offset control will be set to the stored amp_offset value.

Tables 2-4, 2-5, 2-6, and 2-7 each list offset access, applied offset values, and stored offset values for 16 combinations of input coupling. The four tables pertain to various combinations of active and passive probes connected to 11A33 inputs, as follows:

TABLE 2-3
Probe Table List

Table	Probe Connected to Input	
	+	–
2-4	P	P
2-5	A	A
2-6	A	P
2-7	P	A

P=passive
A=active

NOTE

An Active Probe is any Level 2 TEKPROBE with offset driven by the 11A33.

A Passive Probe can be: any Level 2 TEKPROBE without offset, any Level 1 TEKPROBE, any Tektronix probe with single-pin coding, any probe or cable without probe-coding connector, or nothing connected.

Probe Selections

Operation with Passive Probes on one or both inputs is the most common case, and the simplest. See Table 2-4.

Operation with Active Probes of identical types on both inputs is another common case. See Table 2-5.

Operation with an Active Probe on the + input and no probe on the - input is a less common case. See Table 2-6.

Operation with an Active Probe on the – input and no probe on the + input results in a situation that is the mirror image of the previous case. The user could obtain similar results by inverting the displayed waveform. See Table 2-7.

Principles of Probe Operation

Loading on the User circuit will not be changed unless the user directly causes the change. This requires that the offset applied to a probe not be changed unless the user changes it directly.

AC coupling is not allowed when an active probe is installed.

Disconnecting and reconnecting a probe will result in no instrument setup changes, provided no controls were touched while the probe was absent.

Connecting and immediately disconnecting a probe will result in instrument setup changes.

Change of coupling selection and immediate return to previous coupling selection will result in no instrument setup changes, provided no controls were touched while the second coupling state existed.

For cases of one Active Probe and one Passive Probe, availability of Vc is denied to the input with the Passive Probe.

Similarly, when the input with a Passive Probe is DC or AC coupled, offset control, not amplifier offset, remains assigned to the Active Probe.

Input Impedance

When two Passive Probes are connected, choices are available in the impedance menu. Both inputs will have the same impedance.

When two Active Probes are connected both impedances will be 50 Ω, and only 50 Ω will be available in the impedance menu.When one Active Probe is disconnected, that input's impedance is set to 1 MΩ, and choices become available in that input's impedance menu. The input with the Active Probe stays set to 50 Ω.

When one Active Probe and one Passive Probe are connected, the input with the Active Probe will be set to 50 Ω, but choices will remain available in the impedance menu for the input with the Passive Probe. The inputs may have different impedances, but only the impedance with the Passive Probe is reported. When the Active Probe is removed, the impedance for that input will be set the same as the other input.

Probe Attenuation Factor

If an input coupling is set to Vc or Off, the 11A33 ignores the attenuation factor of any probe connected to that input.

If probes with equal attenuation factors are connected to both inputs, that factor is used to determine overall deflection factor.

If probes with different attenuation factors are connected and both input couplings are set to AC or DC, the higher of the two factors is used to determine overall deflection factor.

Offset Tables and How to Use Them

The offset tables list nine items (offset access, which is the function controlled by the Human Interface "Offset" function or the ASCII port offset control; the four applied offset values; and the four stored offset values) as functions of the two input coupling settings.

A glossary defines the terms used in Tables 2-4, 2-5, 2-6, and 2-7. The glossary follows Table 2-7.

Three examples illustrate the use of the tables to find offset access, the four applied values, and the four stored values. Example 1 includes passive probes on both inputs, + coupling set to DC, and - coupling set to vc. Example 2 includes active probes on both inputs, + coupling set to DC, and – coupling set to DC. Example 3 includes an active probe on the + input, a passive probe on the – input, + coupling set to AC, and – coupling set to off.

Table 2-4
Offset Access, Applied and Stored Values
Passive Probes on Both Inputs

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
off	off	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
off	DC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
DC	DC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
off	vc	vc-in	zero	crnt	nu	nu	prev	crnt	prev	prev
vc	off	vc+in	zero	crnt	nu	nu	prev	crnt	prev	prev
DC	vc	vc-in	zero	crnt	nu	nu	prev	crnt	prev	prev
vc	DC	vc+in	zero	crnt	nu	nu	prev	crnt	prev	prev
AC	off	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
off	AC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
AC	AC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
AC	DC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
DC	AC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
AC	vc	vc-in	zero	crnt	nu	nu	prev	crnt	prev	prev
vc	AC	vc+in	zero	crnt	nu	nu	prev	crnt	prev	prev
vc	vc	vc±in	zero	crnt	nu	nu	prev	crnt	prev	prev

Table 2-5
Offset Access, Applied and Stores Values
Active Probe on + Input, Active Probe on – Input

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	+prb	zero	nu	crnt	strd	prev	prev	crnt	prev
off	off	amp	crnt	nu	strd	strd	crnt	prev	prev	prev
off	DC	–prb	zero	nu	strd	crnt	prev	prev	prev	crnt
DC	DC	amp	crnt	nu	strd	strd	crnt	prev	prev	prev
off	vc	——————> DC-off (Note 2)								
vc	off	——————> off-DC (Note 2)								
DC	vc	——————> DC-off (Note 2)								
vc	DC	——————> off-DC (Note 2)								
AC	off	——————> DC-off (Note 1)								
off	AC	——————> off-DC (Note 1)								
AC	AC	——————> DC-DC (Note 1)								
AC	DC	——————> DC-DC (Note 1)								
DC	AC	——————> DC-DC (Note 1)								
AC	vc	——————> DC-off (Notes 1 & 2)								
vc	AC	——————> off-DC (Notes 1 & 2)								
vc	vc	——————> DC-DC (Note 3)								

Table 2-6
Offset Access, Applied and Stored Values
Active Probe on + Input, Passive Probe on – Input

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	+prb	zero	nu	crnt	nu	prev	prev	crnt	prev
off	off	amp	crnt	nu	strd	nu	crnt	prev	prev	prev
off	DC	amp	crnt	nu	strd	nu	crnt	prev	prev	prev
DC	DC	+prb	zero	nu	crnt	nu	prev	prev	crnt	prev
off	vc	——————> DC-off (Note 2)								
vc	off	vc+in	zero	crnt	strd	nu	prev	crnt	prev	prev
DC	vc	——————> DC-off (Note 2)								
vc	DC	vc+in	zero	crnt	strd	nu	prev	crnt	prev	prev
AC	off	——————> DC-off (Note 1)								
off	AC	amp	crnt	nu	strd	nu	crnt	prev	prev	prev
AC	AC	——————> DC-AC (Note 1)								
AC	DC	——————> DC-DC (Note 1)								
DC	AC	+prb	zero	nu	crnt	nu	prev	prev	crnt	prev
AC	vc	——————> DC-off (Notes 1 & 2)								
vc	AC	vc+in	zero	crnt	strd	nu	prev	crnt	prev	prev
vc	vc	——————> DC-off (Note 3)								

Table 2-7
Offset Access, Applied and Stored Values
Passive Probe on + Input, Active Probe on – Input

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	amp	crnt	nu	nu	strd	crnt	prev	prev	prev
off	off	amp	crnt	nu	nu	strd	crnt	prev	prev	prev
off	DC	–prb	zero	nu	nu	crnt	prev	prev	prev	crnt
DC	DC	–prb	zero	nu	nu	crnt	prev	prev	prev	crnt
off	vc	vc-in	zero	crnt	nu	strd	prev	crnt	prev	prev
vc	off	——————> off-DC (Note 2)								
DC	vc	vc-in	zero	crnt	nu	strd	prev	crnt	prev	prev
vc	DC	——————> off-DC (Note 2)								
AC	off	amp	crnt	nu	nu	strd	crnt	prev	prev	prev
off	AC	——————> off-DC (Note 1)								
AC	AC	——————> AC-DC (Note 1)								
AC	DC	–prb	zero	nu	nu	crnt	prev	prev	prev	crnt
DC	AC	——————> DC-DC (Note 1)								
AC	vc	vc-in	zero	crnt	nu	strd	prev	crnt	prev	prev
vc	AC	——————> off-DC (Notes 1 & 2)								
vc	vc	——————> off-DC (Note 3)								

Note 1: AC coupling is not available if Active Probe is connected. If AC coupling exists when a probe is connected, coupling is changed as indicated. Subsequent removal of the probe does not cause reversion to the previous coupling even if no other changes are made while the probe is connected.

Note 2: Vc coupling is not available if two Active Probes are connected. If one Active Probe is connected, Vc coupling is not available for the other input. If Vc coupling exists when a probe is connected, coupling is changed as indicated. Removing a probe does not cause reversion to the previous coupling, even if no other changes are made while the probe is connected.

Note 3: Vc-Vc coupling is not available if an Active Probe is connected. If Vc-Vc coupling exists when a probe is connected, coupling is changed as indicated. Removing a probe does not cause reversion to the previous coupling even if no other changes are made while the probe is connected.

Example 1:

Passive probes on both inputs; + coupling = DC; – coupling = Vc. First we locate Table 2-4, which contains the desired probe combination. Next, locate the DC, vc combination in the two columns headed "Coupling." The desired information is given on the "DC, vc" line. In this example, the line is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	vc	vc-in	zero	crnt	nu	nu	prev	crnt	prev	prev

The "DC, vc" line shows that Vc offset is applied to the – in connector, that vc is the current offset value, that the amplifier has zero offset applied, and that + probe and – probe offsets are not used (passive probes do not apply offset). What values are stored? The Stored Values information shows that the current vc value and the previous amplifier, + probe, and – probe values are stored.

Example 2:

Active probes on both inputs; + coupling = DC; – coupling = DC. This example includes the following four input coupling situations:

1. DC, off input coupling allows the user to choose offset to probe on + input.
2. Off, off input coupling is an intermediate step.
3. Off, DC input coupling allows the user to choose offset to probe on – input.
4. DC, DC is the desired coupling situation.

Locate Table 2-5, which contains the desired probe combination. The top four lines contain the information we seek. For "DC, off" coupling, the top line of Table 2-5 is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	+prb	zero	nu	crnt	strd	prev	prev	crnt	prev

The "DC, off" line shows that offset is applied to the + probe. The Applied Values information shows that the current offset value is applied to the + probe, that the amplifier offset is zero, that Vc offset is not used, and that the applied – probe offset is the stored value. The Stored Values information shows that the current + probe value and the previous amplifier, vc, and – probe values are stored.

For "off, off" coupling, the second line of Table 2-5 is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
off	off	amp	crnt	nu	strd	strd	crnt	prev	prev	prev

The "off, off" line shows that offset is applied to the 11A33 amplifier. The Applied Values information shows that the current offset value is applied to the amplifier, that vc offset is not used, and that the + probe and – probe offsets are stored values. The Stored Values information shows that the current amplifier offset value and previous vc, + probe, and – probe offset values are stored.

For "off, DC" coupling, the third line of Table 2-5 is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
off	DC	–prb	zero	nu	strd	crnt	prev	prev	prev	crnt

The "off, DC" line shows that offset is being applied to the – probe. The Applied Values information shows that the current offset value is applied to the – probe, that zero offset is applied to the amplifier, that vc is not used, and that the applied + probe offset is the stored value. The Stored Values information shows that the current – probe offset and previous amplifier, vc, and + probe offset values are stored.

Finally, for "DC, DC" coupling, line four of Table 2-5 is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	DC	amp	crnt	nu	strd	strd	crnt	prev	prev	prev

The "DC, DC" line shows that offset is being applied to the 11A33 amplifier. The Applied Values information shows that the current offset value is being applied to the amplifier, that vc offset is not used, and that the + probe and – probe offsets are the stored values. The Stored Values information shows that the current amplifier offset and the previous vc, + probe, and – probe offset values are stored.

Example 3:

Active probe on + input; passive probe on – input; + coupling = AC; – coupling = off. First locate Table 2-6, which contains the desired probe combination. Next, locate the AC, off combination in the two columns headed "Coupling." The desired information is given on the "AC, off" line. In this example, the line is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
AC	off	——————————> DC-off (Note 1)								

The "AC, off" line refers to Note 1, which explains that AC coupling is not available with an Active Probe connected. AC coupling eliminates the availability of DC offset at the probe tip. Use DC coupling or a passive probe.

Consequences of Signal Inversion at – Input

Absolute voltages indicated by cursors require special interpretation when a signal is applied to the 11A33 – input, and no signal is applied to the + input, or if + coupling is set to Off or VC.

If the + input coupling is Off, or is AC or DC but no signal is connected, the voltage readout number must be multiplied by –1 to yield the correct answer. For example, a voltage reading on screen of –7 V corresponds to **positive** 7 V Signal amplitude.

If the + input coupling is VC, the voltage readout number must be subtracted from twice the VC value to yield the correct answer. For example, with VC=100 mV a voltage reading on screen of 400 mV corresponds to **negative** 200 mV Signal amplitude.

The preferred measurement method is to connect the signal to the + input of the 11A33 and select VC at the – input, so that voltage readout numbers are correct as displayed without possibility of misinterpretation.

Glossary

Active Probe	Any Level 2 TEKPROBE with offset driven by the 11A33.
amp	Voltage applied to preamplifier offset terminal.
Applied Value	The value applied to the voltage-generating hardware.
crnt	Current—value now being supplied by the human interface Offset knob and numeric entry. Also may be written by ASCII port. Only one voltage at a time may be assigned crnt status. When moving from one status to another, prev of the earlier state becomes the initial value of crnt for the later state.
nu	Not used.
Offset Access	The function controlled by the human interface Offset function (knob and numeric entry).
Passive Probe	Possible inputs are: any Level 2 TEKPROBE without offset, any Level 1 TEKPROBE, any Tektronix probe with single-pin coding, any probe or cable without probe-coding connector, or nothing connected.
– prb	Voltage applied at – input TEKPROBE connector.
+ prb	Voltage applied at + input TEKPROBE connector.
prev	Previous. The last value that existed in a state for which this variable was "crnt," or the last value written from the ASCII port.
Stored Value	An auxiliary set of values. The human interface can access only those values marked "crnt." The ASCII port can write all four values for the presently selected coupling.
strd	Stored. Use the value given in the "stored value" column.
vc-in	Comparison voltage applied to – input connector.
vc+in	Comparison voltage applied to + input connector.
zero	Zero volts.

HF Limit

Two four-pole (24 dB/octave) bandwidth limit (low-pass) filters are available. The purpose of these filters is to reduce the amplitude of unwanted noise or interference occurring at frequencies above the frequency of the signal of interest. The user has a choice of cut-off (–3 dB) frequencies, either 20 MHz or 100 MHz. The trigger, auxiliary trigger, and display signal bandwidths are always the same. The auxiliary trigger is the signal sent to the right plug-in compartment.

DC Circuit Loading

AC Coupling capacitors are connected differently in the 11A52 and 11A71 than the 11A32, 11A33 and 11A34. Figure 2-2 shows this difference.

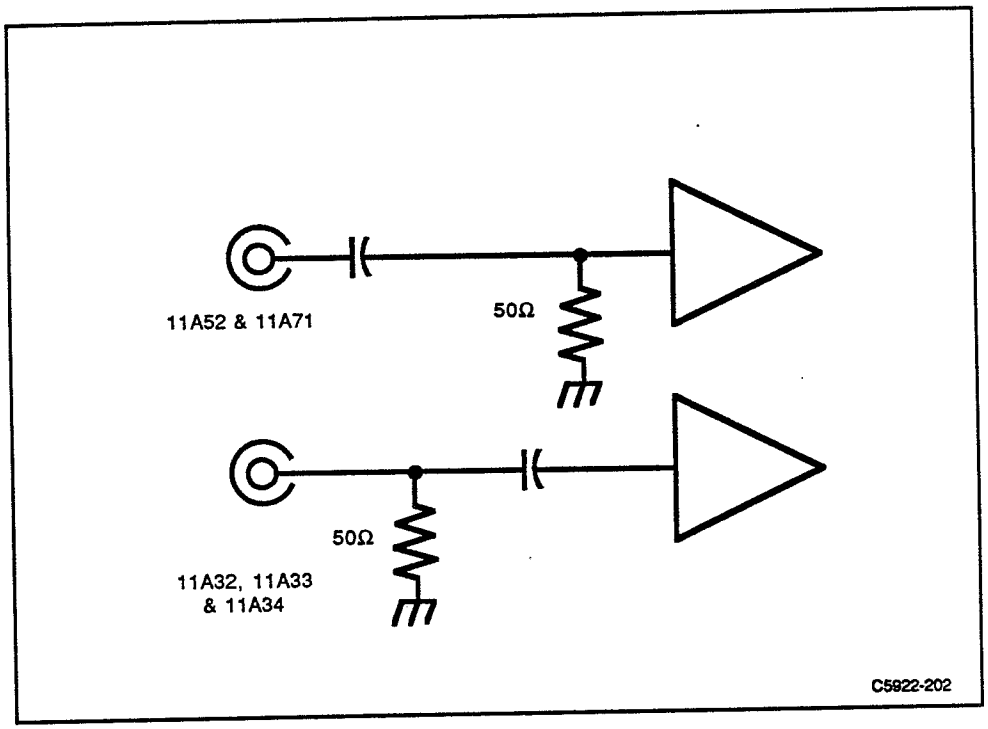


Figure 2-2. Location of AC coupling capacitors in plug-in amplifiers.

In the 11A52 and 11A71, the coupling capacitor isolates both the input termination and the amplifier from external DC voltages. However, the coupling capacitor in the 11A32, 11A33 and 11A34 does not.

CAUTION

Always use caution when working with voltages in excess of 25 volts.

When 50 Ω Impedance mode is selected and input coupling is set to AC or DC, a 50 Ω termination resistance is connected directly from the 11A33 input connector to ground. Take care that the circuit connected to the 11A33 input will not be damaged by the 50 Ω load.

Switching from 1 MΩ to 50 Ω Impedance mode when more than 25 V DC is presented at the 11A33 input will exceed the peak input voltage specification and may damage the 11A33 input relay. A damaged relay could cause an error in calibration.

Adding and Subtracting Waveforms

NOTE

Before adding or subtracting waveforms, check that each channel's waveform is independently on screen.

The 11300-series allow the addition or subtraction of any two channels. Two channels within one plug-in unit may be added, or one channel may be added to a channel from another plug-in unit. A simple restriction applies: each channel must be in its linear operating range. This is assured if each channel separately is within the screen area before addition or subtraction.

These portions of a trace which are off screen will not be valid when brought back on screen using another channel's input signal or Offset control. This general restriction applies to any dual-channel oscilloscope.

Overdriven Waveforms

The 11A33 has an unusual capability to make accurate measurements on signals that overscan the display by large amounts.

Signals that overscan the screen vertically may actually overdrive the input amplifier, which can no longer respond to the input signal. The overdrive recovery specification tells how accurately the displayed trace represents the input signal when it returns on-screen. This is what is meant by Overdrive Recovery time.

The 11A33 will recover extremely fast from overdrives that do not exceed the specified limit on slew rate. Specifically, it will recover from an 8-volt step to less than 0.25% within 40 ns.

Remaining within the slew rate limits allows the amplifier to recover completely and deliver its full accuracy. However, DC level shifts can occur when the slew rate is excessive.

For accurate measurements, therefore, it is important that this be verified when acquiring waveforms that are partially off screen.

One way of making this verification is to change the Vertical Size until everything is on screen. The cursors provide a convenient aid for checking *dV/dt* on the transitions. Once maximum slew rate has been verified to be less than 0.5 V/ns, the Vertical Size can be set to any appropriate value for measurement.

Probe ID

The Probe ID section of the Utility Menu is the means of selecting how the 11300-series oscilloscopes responds to the ID button of recommended probes. All, or some combination of the following operations may be set to start in response to probe ID buttons. To display the Utility Menu, press the front-panel UTILITY button (once on 11301 or 11302 oscilloscopes, twice on 11301A or 11302A oscilloscopes). For details, see the *Probe ID* section of the *Waveform Acquisition* subsection in the *11301 and 11302 User Reference Manual* or the *11301A and 11302A User Reference Manual.*

Pressing the probe ID button can initiate one of the following operations:

1. **A new display can be presented or a trace using the channel will be selected.** Pressing the ID button of a probe connected to an undisplayed left or center compartment channel will always cause that channel to be displayed, unless doing so would exceed the maximum number of traces. Unlike the 11A33 display on/off button, pressing the probe ID button a second time will not remove the trace. Probe ID button-presses for displayed channels will do two things: a) select the trace(s) using this channel, and b) momentarily brighten all traces using this channel.

2. **Stored settings can be sequentially recalled.** Pressing the probe ID button can cause a sequential recall of stored settings. The Stored Settings feature must be enabled using the Probe ID Utility menu. Settings must be stored as explained under *Stored Settings Major Menu* in the *11301 and 11302 User Reference manual* or *11301A and 11302A User Reference Manual.*

3. **The mainframe can "Autoset" to accommodate the input signal introduced by the probe.** The Autoset feature can be enabled or disabled using the Probe ID Utility menu. Autoset provides automatic setup of vertical deflection factor, triggering, and sweep speed to produce a meaningful display, e.g., two to five divisions of vertical deflection and two to five repetitions of the input signal. For more information, refer to *Autoset* in the *11301 and 11302 User Reference manual* or *11301A and 11302A User Reference Manual.*

4. **The mainframe can automatically measure the selected trace.** Automatic measurements of the selected trace can be initiated by pressing a probe ID button. The Automatic Measurements option can be enabled or disabled using the Probe ID Utility menu. Such measurements are peak-to-peak, maximum, middle, and minimum voltages; frequency, period, pulse width, and duty cycle. For full information about automatic measurements, see *Measure* in the *11301 and 11302 User Reference Manual* or *11301A and 11302A User Reference Manual.*

5. **An interrupt to the GPIB and RS-232-C can be generated.** Pressing a probe ID button will cause the mainframe to produce an SRQ to the GPIB and RS-232-C. For more information, refer to the *GPIB/RS-232-C* section of the *11301 and 11302 User Reference Manual* or *11301A and 11302A User Reference Manual.*

Front-Panel Error Messages

Message: Internal DAC overflow on channel 1 of LEFT, CENTER, or RIGHT plug-in unit.

Cause: A plug-in unit detected that a requested setting overflowed an internal DAC. Such overflow usually indicates defective hardware. In this situation, the plug-in unit sets the DAC to the limit nearer the requested setting.

Message: Bad Level 2 probe checksum on channel 1 of LEFT, CENTER, or RIGHT plug-in unit.

Cause: A plug-in unit detected that a Level 2 TEKPROBE had failed or been improperly connected.

50 Ω Overload

When the input impedance is set to 50 Ω and the 11A33 senses voltage at either input substantially exceeding 5 Vrms, the input impedance will be changed to 1 MΩ, and the message:

Input channel 1 overload on LEFT/CENTER/RIGHT plug-in

will be sent to the mainframe. The Impedance menu will show 1 MΩ.

To reset the input impedance to 50 Ω, first correct the overload condition, then select 50 Ω from the Impedance menu.

Maximum Input Voltage

The maximum input voltage is 50 V when Size is set in the range of 1 mV/ div to 99.5 mV/div. The maximum input voltage is 500 V when Size is set in the range of 0.1 V/div to 10 V/div. See Figure 2-3.

This is the maximum instantaneous voltage, and applies to both AC and DC waveform components, regardless of AC or DC coupling.

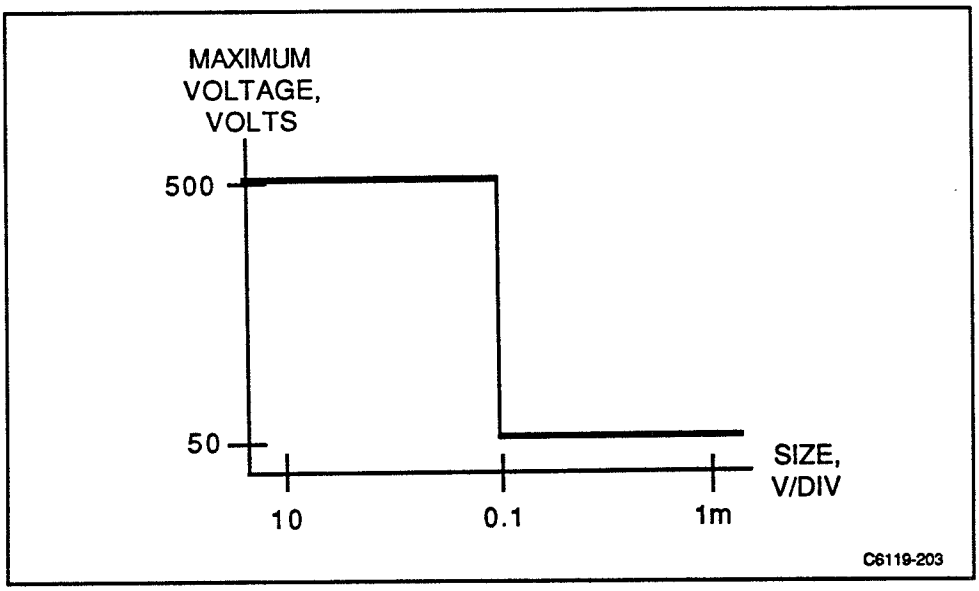


Figure 2-3. Maximum input voltage as a function of Size.

Maximum Voltage Indicators and Range Selector

When using a differential amplifier, the user might increase the Size of the displayed differential signal, while forgetting that large amplitude common mode voltages which may be present at the inputs would exceed the 50 V maximum rating at more sensitive Size settings. Instrument damage may result.

A set of maximum voltage indicators and a range selection switch are provided in the 11A33 to assist the user in adhering to these limits. When all Size settings (1 mV/div to 10 V/div) are available, the '50 V' indicator is on. When the '500 V' indicator is on, only the less sensitive deflection factors (0.1 V/div to 10 V/div) are available. Before changing the range and increasing Size beyond 0.1 V/div it might be wise to look at each input signal independently (+ coupling = DC and – coupling = off; then + coupling = off and – coupling = DC) to verify that each is less than 50 V.

Regardless of the indication, when 50 Ω impedance is selected, maximum input voltage is 5 V rms or 25 V peak.

If 500 volts maximum input mode is requested, and the deflection factor is in the range of 1 mV/div to 99.5 mV/div, deflection factor will be changed to 0.1 V/div. If Impedance was set to 1 GΩ, it will be changed to 1 MΩ.

Probe Calibration

Probe calibration requires use of deflection factors in the range of 1 mV/div to 99.5 mV/div, which are available only with maximum input voltage selection of 50 V.

If Probe Calibration is initiated while 500 V maximum input voltage is selected, the process will fail. An error message will be displayed on screen.

When executing Probe Calibration, first disconnect BOTH probe tips from circuits being measured. Then select 50 V maximum input voltage. Then follow the instructions in the probe calibration menu. After completion of probe calibration, probe tips may again be connected to circuits being measured. If signals over 50 V are present, be sure to select 500 V maximum input voltage before connecting the probes.

Charge on the AC Coupling Capacitor

When AC coupling is used, the AC coupling capacitor charges to the DC (average) value of the signal, which must be less than the rated maximum input described above.

Special care must be used when increasing the sensitivity (Size). Charge on the AC Coupling capacitor must be removed, or reduced to within the rated maximum input of the next most sensitive Size step **before** increasing the Size. The discharge path for the capacitor is through the 1 MΩ input resistance of the 11A33 and the externally connected circuit.

AC Coupling with Probes

When a 10 MΩ 10X probe is used, only AC components of the signal at frequencies higher than 10 Hz are fully attenuated. There is no attenuation of DC or very low AC frequencies. Thus the DC or low frequency amplitude present at the probe tip is also present at the plug-in input.

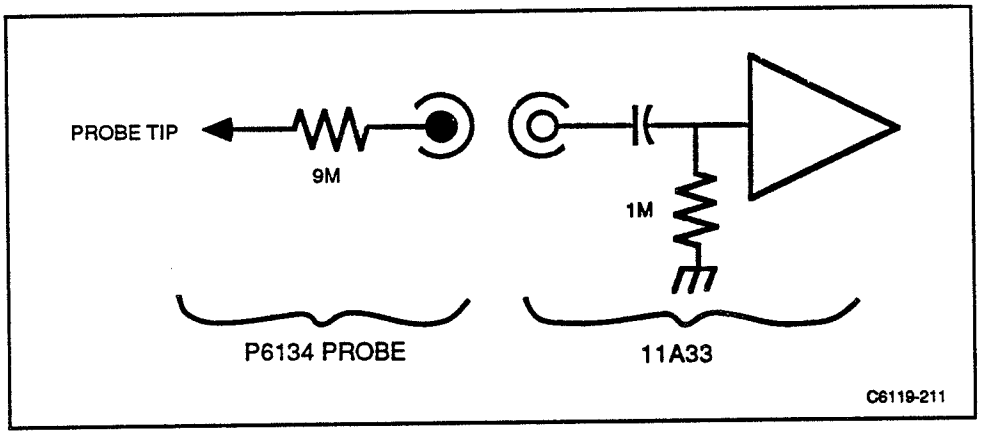


Figure 2-4. P6134 simplified schematic.

With a probe such as the P6134, the maximum voltage allowable at the probe tip is shown in Figure 2-5.

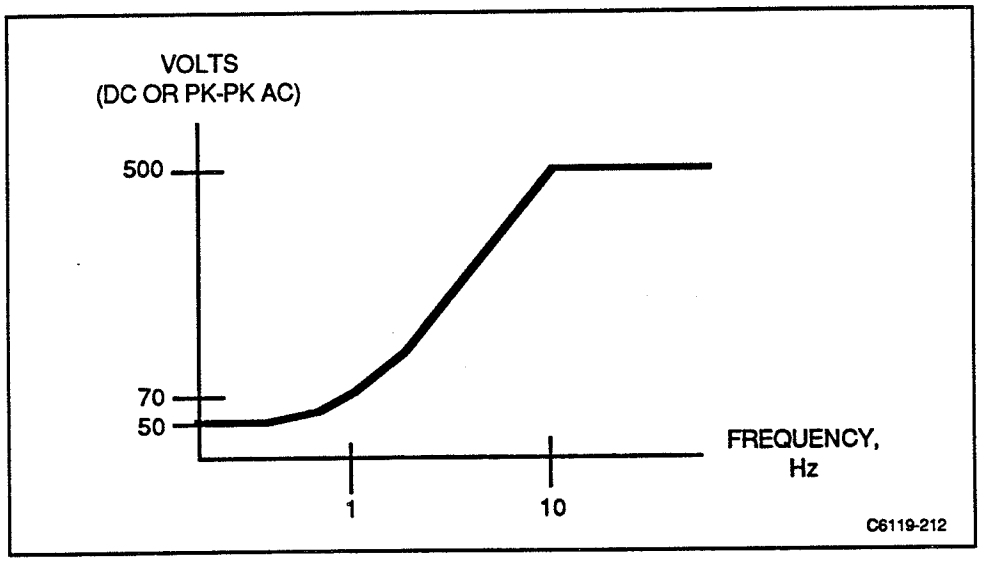


Figure 2-5. Maximum amplitude of signal components vs. frequency at P6134 probe tip. For 10 mV/div to 995 mV/div sensitivity at probe tip.

When the P6135 10X probe set is used, AC components of the signal at frequencies higher than 10 Hz are fully attenuated (by a factor of 10). DC or very low AC frequencies are attenuated by a factor of 9.

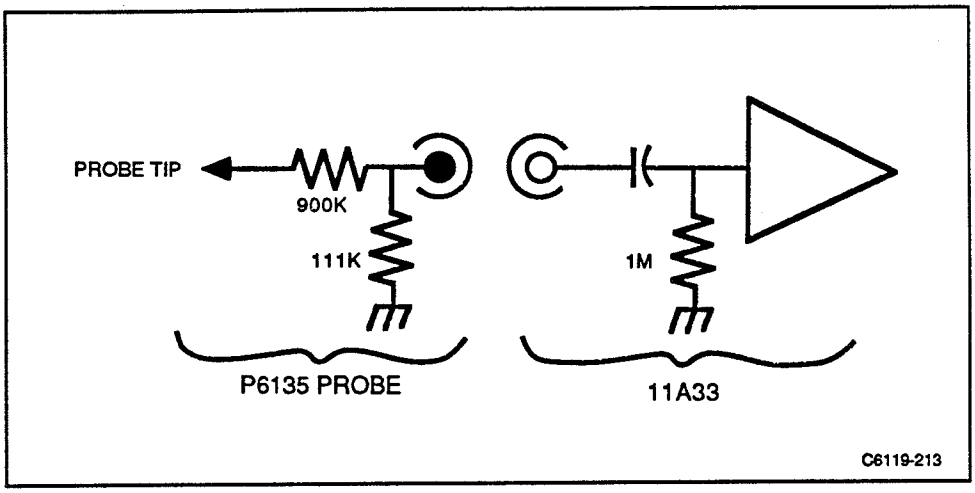


Figure 2-6. P6135 simplified schematic.

With the P6135 probe, the maximum voltage allowable at the probe tip is shown in Figure 2-7.

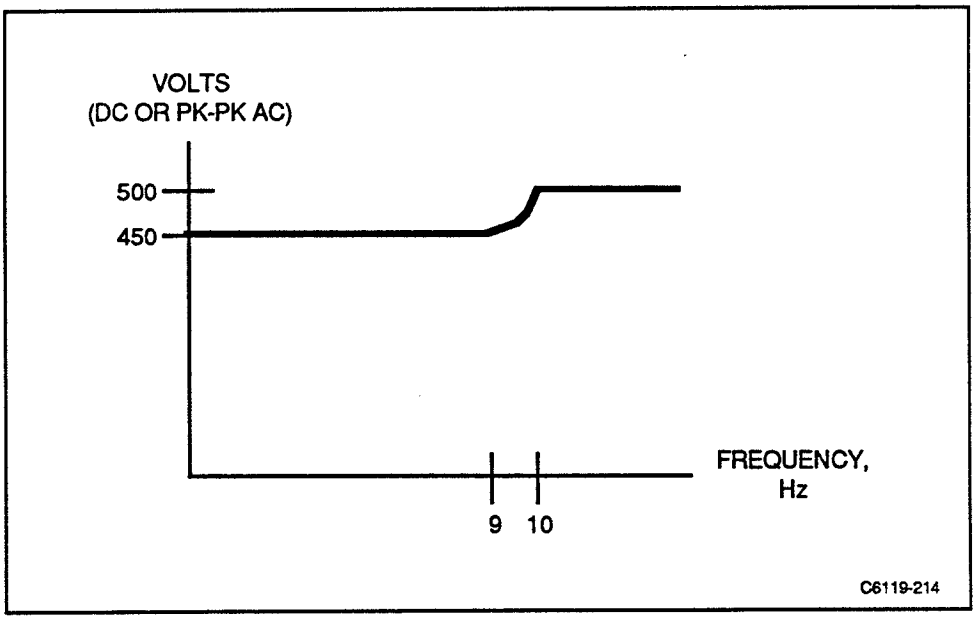


Figure 2-7. Maximum amplitude of signal components vs. frequency at P6135 probe tip. For 10 mV/div to 995 mV/div sensitivity at probe tip.

GPIB and RS-232-C Commands and Syntax

The following commands set parameters of a specified channel.

TABLE 2-8
GPIB and RS-232-C Commands and Syntax

Header	Link	Argument		
CH<L1, C1, R1>	PLSCOUPLING:	AC|DC|OFF|VC	AC coupling not available when Zin = 1 GΩ	
	MNSCOUPLING:	AC|DC|OFF|VC		
	OFFSET:	<NRx>[3]		
	AMPOFFSET:[1]	<NRx>		
		Volts/div	Offset Range	Resolution via RS-232-C, GPIB or Numeric Entry
		1 mV to 99.5 mV 100 mV to 995 mV 1 V to 10 V	±1 V ±10 V ±100 V	25E-6 250E-6 2.5E-3
	MNSOFFSET:[2]	<NRx>		
		Volts/div	Offset Range	Resolution via RS-232-C, GPIB or Numeric Entry
		All	±1 V	25E-6
	PLSOFFSET:[2]	<NRx>		
		Volts/div	Offset Range	Resolution via RS-232-C, GPIB or Numeric Entry
		All	±1 V	25E-6
	VCOFFSET:[1]	<NRx>		
		Volts/div	Offset Range	Resolution via RS-232-C, GPIB or Numeric Entry
		1 mV to 99.5 mV 100 mV to 995 mV 1 V to 10 V	±8 V ±80 V ±500 V	25E-6 250E-6 2.5E-3

[1] The numbers listed refer to the input connectors. Connecting an attenuating probe will change the value by the probe attenuating factor (e.g., a 10X probe will change the value ±8 to ±80).

[2] Scaled by probe.

[3]Number determined by probes connected to inputs and type of coupling selected, see Tables 2-4, 2-5, 2-6, and 2-7.

TABLE 2-8 (cont.)
GPIB and RS-232-C Commands and Syntax

Header	Link	Argument	
CH<L1,C1,R1> (cont)	BWHI:	<NRx> ≤24E6 >24E6 to ≤120E6 ≥120E6	HF Limit 20E6 100E6 150E6, 11301 150E6, 11302
	IMPEDANCE:	<NRx> <1E3 1E3 to 1E7 >1E7	Impedance 50 1E6 1E9
	SENSITIVITY:[1] Sensitivities from 1E-3 to 99. 5E-3 are not available when maximum input voltage selection is 500 V.	Sensitivity 1E-3 to 1.99E-3 2E-3 to 4.98E-3 5E-3 to 9.95E-3 10E-3 to 19.9E-3 20E-3 to 49.8E-3 50E-3 to 99.5E-3	Resolution (step size) 10E-6 20E-6 50E-6 100E-6 200E-6 500E-6
	Sensitivities from 100E-3 to 10 are not available when input impedance is set to 1E9 (1 GΩ)	100E-3 to 199E-3 200E-3 to 498E-3 500E-3 to 995E-3 1 to 1.99 2 to 4.98 5 to 10	1E-3 2E-3 5E-3 10E-3 20E-3 50E-3
	UNITS:	<qstring> (query only) The 11A33 answers a Units query with a units status message, which indicates the units of conversion of a probe connected to its input.	
	MNSPROBE:	<qstring> (query only) This query-only link returns a quoted string indicating what type of probe is connected to the – input. If a Level 1 TEKPROBE is connected, the query response is "Level 1." If a Level 2 TEKPROBE is connected, the query response is "Level 2/<probe_type>/<serial_number>." When neither Level 1 nor 2 TEKPROBE is connected, the query response is "NONE."	

[1] The numbers listed refer to the input connectors. Connecting an attenuating probe will change the value by the probe attenuating factor (e.g., a 10X probe will change the value ±8 to ±80).

TABLE 2-8 (cont.)
GPIB and RS-232-C Commands and Syntax

Header	Link	Argument
CH1<L1,C1,R1> (cont)	PLSPROBE:	<qstring> (query only) This query-only link returns a quoted string indicating what type of probe is connected to the + input. If a Level 1 TEKPROBE is connected, the query response is "Level 1." If a Level 2 TEKPROBE is connected, the query response is "Level 2/<probe_type>/<serial_number>." When neither Level 1 nor 2 TEKPROBE is connected, the query response is "NONE."
	PROTECT	ON | OFF

Legend:

CH<L1, C1, R1>	L, C, and R mean Left, Center, and Right; 1 means Channel 1.
PLSCOUPLING	Sets the plus input coupling to the selected argument.
MNSCOUPLING	Sets the minus input coupling to the selected argument.
OFFSET	Sets offset according to offset access entry in Tables 2-4 through 2-7, which appear earlier in this section.
AMPOFFSET	Sets the 11A33 amplifier offset to the value set by the argument.
MNSOFFSET	Sets offset for probe connected to the minus input.
PLSOFFSET	Sets offset for probe connected to the plus input.
VCOFFSET	Sets comparison voltage to value specified by the argument.
BWHI	Sets the HF Limit (bandwidth) to the value set by the argument.
NRx	Numeric representation.
IMPEDANCE	Sets the input impedance of the specified channel to the value set by the argument.
SENSITIVITY	Sets the input sensitivity to the Volts value indicated by the argument. Sensitivity is a channel-specific command which does not apply to compound waveforms.
qstring	Quoted string data.
PROTECT	ON sets the Maximum Voltage Range Selector to 500 V, and restricts Sensitivity to the range of 100E-3 to 10. OFF sets the Maximum Voltage Range Selector to 50 V. Sensitivity is unrestricted. Refer to Appendix C.

Section 3
Operating the 11A33 in 11400-series Mainframes

The 11A33 Differential Comparator is a high-gain differential comparator for use in Tektronix 11000-series plug-in oscilloscope mainframes. A brief list of 11A33 characteristics follows.

Table 3-1
11A33 Characteristics

Calibrated Deflection Factors Zin = 50 Ω or 1 MΩ Zin = 1 GΩ	 1 mV to 10 V/division. 1 mV to 99.5 mV/division.
Input Impedance	50 Ω, 1 MΩ, 1 GΩ.
Comparison Voltage (Vc) deflection factor (see Section 4, Specification).	8 V, 80 V, or 500 V, depending on
Bandwidth	DC to 150 MHz.
Bandwidth Limit	20 MHz, 100 MHz.
Input Coupling	AC, DC, Off, VC.

Although the 11A33's principal feature is its differential comparator function, the 11A33 can also be used as a differential amplifier and as a conventional amplifier.

When used as a differential comparator, a DC comparison voltage, Vc, is added differentially (this means Vc is applied to the input to which the input signal is not applied) to the input signal. The accuracy of Vc enables precise DC voltage measurements. Comparing Vc with a signal on the other input effectively cancels the displacement created by the DC level of the input signal, and permits the user to observe any small AC components of the signal.

When used as a differential amplifier, signals up to ±8 V can be applied to the 11A33 (with Size set from 1 mV to 99.5 mV and Zin set to 1 MΩ or 1 GΩ. Deflection factors from 100 mV to 10 V/division are not available when the input impedance is set to 1 GΩ). The combination of sensitivity and common-mode rejection permits measuring signals as small as 1 mV, even when superimposed on DC levels of much greater magnitude.

Display On/Off

The display on/off button designates Channel 1 for display, or removes the channel from the display. When the channel is displayed, its label (CH 1) will be illuminated.

Other Functions

All other 11A33 functions are controlled within the 11400-series oscilloscope, and their operation is described in the *11401 and 11402 User Reference Manual.* Table 3-2 shows where to find information about operating the 11A33.

TABLE 3-2
Functions and Where They are Described

Function	Described under Heading[1]
Vertical Offset	Vertical Size and Position.
Vertical Size (sensitivity)	Vertical Size and Position.
Input Coupling (AC, DC, VC, Off)	Selecting Channel Coupling, under Waveform Control.
Select 11A33 Channel	Waveform Control (this is an alternative to pressing the 11A33 display on/off button).
Input Impedance	Selecting Channel Input Impedance.
Offset	Vertical Position.
BW Limit	Selecting Channel Bandwidth Limit.
Display Polarity	Vertical Description.

[1] Under Waveform Control in Section 2, Operating Information.

Vertical Offset

The 11401 and 11402 oscilloscopes use offset to position the trace on the screen. In YT (signal vs. time) mode offset determines vertical position, but when a plug-in unit provides the X component of an XY display, offset controls horizontal position.

Offset is an input-signal-related control, and its units are those of the input signal, usually volts.

Offset subtracts a precision DC voltage from the input signal. To access the offset function, touch the double-ended arrow at the left edge of the screen. Control of offset is then assigned to the lower front panel Control knob.

In the 11401 and 11402, changing the vertical deflection factor magnifies or compresses the displayed signal about screen center. Therefore, to examine a portion of the input signal in greater detail, use Vert Offset (the Lower Control knob) to position the area of interest to center screen. Next, use the Vert Size (the Upper Control knob) to adjust the display to the size needed for closer examination. For more detail about the 11A33 and its offset, see *Offset in Four Places*, which follows.

Offset in Four Places

The 11A33 stores four offset values. These offset values, which provide offset control for the 11A33, are called Vc_offset, amp_offset, plus_offset, and minus_offset. When an input's coupling is set to Vc, Vc_offset becomes the input signal. Amp_offset is subtracted from the signal path after the two inputs have been subtracted. Plus_offset is subtracted from the plus input via the probe; minus_offset is subtracted from the minus input via the probe. When an input does not have an offset probe connected to it, the corresponding probe offset (plus_offset or minus_offset) does not affect the signal.

Stored offset values are modified only by explicit commands; they are not initially set to zero.

Probe offset values are expressed as volts at the probe tip.

The 11A33 has four hardware offset controls that are operated by the software. These hardware offset controls, which determine the offset values, are labeled the same as the offset values, namely amp offset, Vc offset, plus offset, and minus offset. Only one hardware control can be connected at one time. Figure 3-1 shows the signal path and where the offset values are applied.

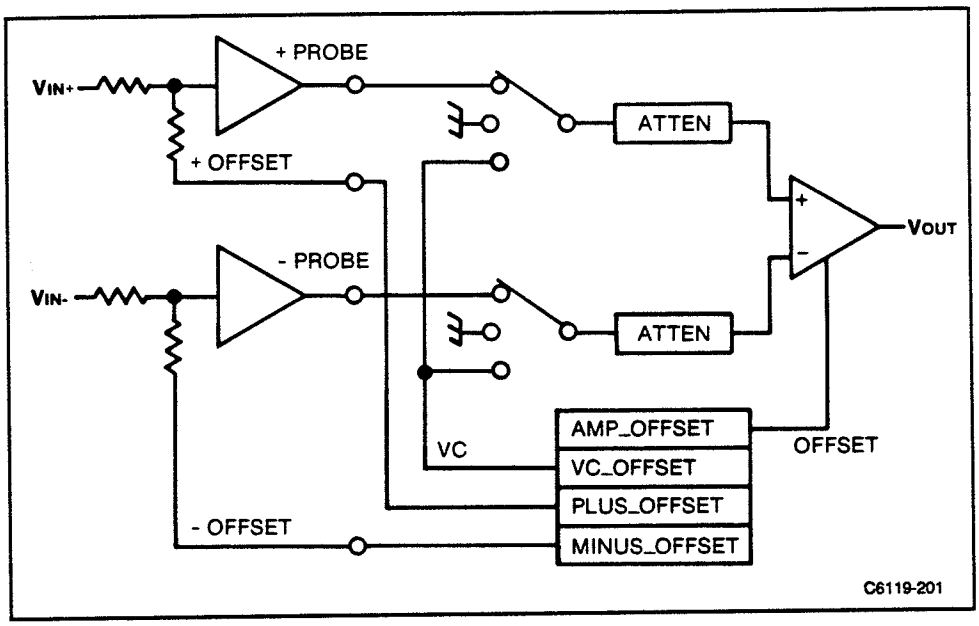


Figure 3-1. Simplified block diagram of 11A33 and active probes with offsets.

Hardware controls can be connected to, or disconnected from, the offset values without changing the stored offset values. For example, if the offset control is disconnected from the amp_offset value based on conditions, the offset control will be set to zero and the amp_offset value will not change. When the offset control is again connected, the offset control will be set to the stored amp_offset value.

Tables 3-4, 3-5, 3-6 and 3-7 each list offset access, applied offset values, and stored offset values for 16 combinations of input coupling. The four tables pertain to various combinations of active and passive probes connected to 11A33 inputs, as follows:

Table 3-3
Probe Table List

Table	Probe Connected to Input	
	+	-
3-4	P	P
3-5	A	A
3-6	A	P
3-7	P	A

P=Passive
A=Active

NOTE

Active Probe means any Level 2 TEKPROBE with offset driven by the 11A33.

Passive Probe means any Level 2 TEKPROBE without offset, any Level 1 TEKPROBE, any Tektronix probe with single-pin coding, any probe or cable without a probe-coding connector, or nothing connected.

Probe Selections

Operation with Passive Probes on one or both inputs is the most common case, and the simplest. See Table 3-4.

Operation with Active Probes of identical types on both inputs is another common case. See Table 3-5.

Operation with an Active Probe on the + input and no probe on the – input is a less common case. See Table 3-6.

Operation with an Active Probe on the – input and no probe on the + input results in a situation that is the mirror image of the previous case. The user could obtain similar results by inverting the displayed waveform. See Table 3-7.

Principles of Probe Operation

Loading on the User circuit will not be changed unless the user directly causes the change. This requires that the offset applied to a probe not be changed unless the user changes it directly.

AC coupling is not allowed when an active probe is installed.

Disconnecting and reconnecting a probe will result in no instrument setup changes, provided no controls were touched while the probe was absent.

Connecting and immediately disconnecting a probe can cause instrument setup changes. For example, suppose + and – coupling are set to AC, DC, and no probes are connected. If an active probe is then connected to the + input the 11A33 will change the coupling for its + input to DC, as shown in Table 3-6. (AC coupling is not allowed with active probes.) Result: DC, DC coupling. Disconnecting the active probe will not change the setup. The 11A33 will remain at DC, DC coupling.

Change of coupling selection and immediate return to previous coupling selection will result in no instrument setup changes, provided no controls were touched while the second coupling state existed.

For cases of one Active Probe and one Passive Probe, availability of Vc is denied to the input with the Passive Probe.

Similarly, when the input with a Passive Probe is DC or AC coupled, offset control, not amplifier offset, remains assigned to the Active Probe.

Input Impedance

When two Passive Probes are connected, choices are available in the impedance menu. Both inputs will have the same impedance.

When two Active Probes are connected both impedances will be 50 Ω, and only 50 Ω will be available in the impedance menu. When one Active Probe is disconnected, that input's impedance is set to 1 MΩ, and choices become available in that input's impedance menu. The input with the Active Probe stays set to 50 Ω.

When one Active Probe and one Passive Probe are connected, the input with the Active Probe will be set to 50 Ω, but choices will remain available in the impedance menu for the input with the Passive Probe. The inputs may have different impedances, but only the impedance with the Passive Probe is reported. When the Active Probe is removed, the impedance for that input will be set the same as the other input.

Probe Attenuation Factor

If an input coupling is set to Vc or Off, the 11A33 ignores the attenuation factor of any probe connected to that input.

If probes with equal attenuation factors are connected to both inputs, that factor is used to determine overall deflection factor.

If probes with different attenuation factors are connected and both input couplings are set to AC or DC, the higher of the two factors is used to determine overall deflection factor.

Offset Tables and How to Use Them

The offset tables (Tables 3-4, 3-5, 3-6, and 3-7) list nine items (offset access, which is the function controlled by the Human Interface "Offset" function or the ASCII port offset control; the four applied offset values; and the four stored offset values) as functions of the two input coupling settings.

A glossary defines the terms used in Tables 3-4, 3-5, 3-6, and 3-7. The glossary follows Table 3-7.

Three examples illustrate the use of the tables to find offset access, the four applied values, and the four stored values. These examples are located after Table 3-7. Example 1 includes passive probes on both inputs, + coupling set to DC, and – coupling set to vc. Example 2 includes active probes on both inputs, + coupling set to DC, and – coupling set to DC. Example 3 includes an active probe on the + input, a passive probe on the – input, + coupling set to AC, and – coupling set to off.

Table 3-4
Offset Access, Applied and Stored Values
Passive Probes on Both Inputs

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
off	off	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
off	DC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
DC	DC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
off	vc	vc-in	zero	crnt	nu	nu	prev	crnt	prev	prev
vc	off	vc+in	zero	crnt	nu	nu	prev	crnt	prev	prev
DC	vc	vc-in	zero	crnt	nu	nu	prev	crnt	prev	prev
vc	DC	vc+in	zero	crnt	nu	nu	prev	crnt	prev	prev
AC	off	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
off	AC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
AC	AC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
AC	DC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
DC	AC	amp	crnt	nu	nu	nu	crnt	prev	prev	prev
AC	vc	vc-in	zero	crnt	nu	nu	prev	crnt	prev	prev
vc	AC	vc+in	zero	crnt	nu	nu	prev	crnt	prev	prev
vc	vc	vc±in	zero	crnt	nu	nu	prev	crnt	prev	prev

Table 3-5
Offset Access, Applied and Stores Values
Active Probe on + Input, Active Probe on – Input

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	+prb	zero	nu	crnt	strd	prev	prev	crnt	prev
off	off	amp	crnt	nu	strd	strd	crnt	prev	prev	prev
off	DC	–prb	zero	nu	strd	crnt	prev	prev	prev	crnt
DC	DC	amp	crnt	nu	strd	strd	crnt	prev	prev	prev
off	vc	——————> DC-off (Note 2)								
vc	off	——————> off-DC (Note 2)								
DC	vc	——————> DC-off (Note 2)								
vc	DC	——————> off-DC (Note 2)								
AC	off	——————> DC-off (Note 1)								
off	AC	——————> off-DC (Note 1)								
AC	AC	——————> DC-DC (Note 1)								
AC	DC	——————> DC-DC (Note 1)								
DC	AC	——————> DC-DC (Note 1)								
AC	vc	——————> DC-off (Notes 1 & 2)								
vc	AC	——————> off-DC (Notes 1 & 2)								
vc	vc	——————> DC-DC (Note 3)								

Table 3-6
Offset Access, Applied and Stored Values
Active Probe on + Input, Passive Probe on – Input

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	+prb	zero	nu	crnt	nu	prev	prev	crnt	prev
off	off	amp	crnt	nu	strd	nu	crnt	prev	prev	prev
off	DC	amp	crnt	nu	strd	nu	crnt	prev	prev	prev
DC	DC	+prb	zero	nu	crnt	nu	prev	prev	crnt	prev
off	vc	——————> DC-off (Note 2)								
vc	off	vc+in	zero	crnt	strd	nu	prev	crnt	prev	prev
DC	vc	——————> DC-off (Note 2)								
vc		vc+in	zero	crnt	strd	nu	prev	crnt	prev	prev
AC	off	——————> DC-off (Note 1)								
off	AC	amp	crnt	nu	strd	nu	crnt	prev	prev	prev
AC	AC	——————> DC-AC (Note 1)								
AC	DC	——————> DC-DC (Note 1)								
DC	AC	+prb	zero	nu	crnt	nu	prev	prev	crnt	prev
AC	vc	——————> DC-off (Notes 1 & 2)								
vc	AC	vc+in	zero	crnt	strd	nu	prev	crnt	prev	prev
vc	vc	——————> DC-off (Note 3)								

Table 3-7
Offset Access, Applied and Stored Values
Passive Probe on + Input, Active Probe on – Input

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	amp	crnt	nu	nu	strd	crnt	prev	prev	prev
off	off	amp	crnt	nu	nu	strd	crnt	prev	prev	prev
off	DC	–prb	zero	nu	nu	crnt	prev	prev	prev	crnt
DC	DC	–prb	zero	nu	nu	crnt	prev	prev	prev	crnt
off	vc	vc-in	zero	crnt	nu	strd	prev	crnt	prev	prev
vc	off	——————> off-DC (Note 2)								
DC	vc	vc-in	zero	crnt	nu	strd	prev	crnt	prev	prev
vc	DC	——————> off-DC (Note 2)								
AC	off	amp	crnt	nu	nu	strd	crnt	prev	prev	prev
off	AC	——————> off-DC (Note 1)								
AC	AC	——————> AC-DC (Note 1)								
AC	DC	–prb	zero	nu	nu	crnt	prev	prev	prev	crnt
DC	AC	——————> DC-DC (Note 1)								
AC	vc	vc-in	zero	crnt	nu	strd	prev	crnt	prev	prev
vc	AC	——————> off-DC (Notes 1 & 2)								
vc	vc	——————> off-DC (Note 3)								

Note 1: AC coupling is not available if an Active Probe is connected. If AC coupling exists when a probe is connected, coupling is changed as indicated. Subsequent removal of the probe does not cause reversion to the previous coupling even if no other changes are made while the probe is connected.

Note 2: Vc coupling is not available if two Active Probes are connected. If one Active Probe is connected, Vc coupling is not available for the other input. If Vc coupling exists when a probe is connected, coupling is changed as indicated. Removing a probe does not cause reversion to the previous coupling, even if no other changes are made while the probe is connected.

Note 3: Vc-Vc coupling is not available if an Active Probe is connected. If Vc-Vc coupling exists when a probe is connected, coupling is changed as indicated. Removing a probe does not cause reversion to the previous coupling even if no other changes are made while the probe is connected.

Example 1:

Passive probes on both inputs; + coupling = DC; – coupling = Vc. First we locate Table 3-4, which contains the desired probe combination. Next, locate the DC, vc combination in the two columns headed "Coupling." The desired information is given on the "DC, vc" line. In this example, the line is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	vc	vc-in	zero	crnt	nu	nu	prev	crnt	prev	prev

The "DC, vc" line shows that Vc offset is applied to the – in connector, that vc is the current offset value, that the amplifier has zero offset applied, and that + probe and – probe offsets are not used (passive probes do not apply offset). What values are stored? The Stored Values information shows that the current vc value and the previous amplifier, + probe, and – probe values are stored.

Example 2:

Active probes on both inputs; + coupling = DC; – coupling = DC. This example includes the following four input coupling situations:

1. DC, off input coupling allows the user to choose offset to probe on + input.
2. Off, off input coupling is an intermediate step.
3. Off, DC input coupling allows the user to choose offset to probe on – input.
4. DC, DC is the desired coupling situation.

Locate Table 3-5, which contains the desired probe combination. The top four lines contain the information we seek. For "DC, off" coupling, the top line of Table 3-5 is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	off	+prb	zero	nu	crnt	strd	prev	prev	crnt	prev

The "DC, off" line shows that offset is applied to the + probe. The Applied Values information shows that the current offset value is applied to the + probe, that the amplifier offset is zero, that Vc offset is not used, and that the applied – probe offset is the stored value. The Stored Values information shows that the current + probe value and the previous amplifier, vc, and – probe values are stored.

For "off, off" coupling, the second line of Table 3-5 is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
off	off	amp	crnt	nu	strd	strd	crnt	prev	prev	prev

The "off, off" line shows that offset is applied to the 11A33 amplifier. The Applied Values information shows that the current offset value is applied to the amplifier, that vc offset is not used, and that the + probe and – probe offsets are stored values. The Stored Values information shows that the current amplifier offset value and previous vc, + probe, and – probe offset values are stored.

For "off, DC" coupling, the third line of Table 3-5 is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
off	DC	–prb	zero	nu	strd	crnt	prev	prev	prev	crnt

The "off, DC" line shows that offset is being applied to the – probe. The Applied Values information shows that the current offset value is applied to the – probe, that zero offset is applied to the amplifier, that vc is not used, and that the applied + probe offset is the stored value. The Stored Values information shows that the current – probe offset and previous amplifier, vc, and + probe offset values are stored.

Finally, for "DC, DC" coupling, line four of Table 3-5 is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
DC	DC	amp	crnt	nu	strd	strd	crnt	prev	prev	prev

The "DC, DC" line shows that offset is being applied to the 11A33 amplifier. The Applied Values information shows that the current offset value is being applied to the amplifier, that vc offset is not used, and that the + probe and – probe offsets are the stored values. The Stored Values information shows that the current amplifier offset and the previous vc, + probe, and – probe offset values are stored.

Example 3:

Active probe on + input; passive probe on – input; + coupling = AC; –coupling = off. First locate Table 3-6, which contains the desired probe combination. Next, locate the AC, off combination in the two columns headed "Coupling." The desired information is given on the "AC, off" line. In this example, the line is:

Coupling		Offset Access	Applied Values				Stored Values			
+in	-in		ampl	vc	+prb	-prb	ampl	vc	+prb	-prb
AC	off	——————————> DC-off (Note 1)								

The "AC, off" line refers to Note 1, which explains that AC coupling is not available with an Active Probe connected. AC coupling eliminates the availability of DC offset at the probe tip. Use DC coupling or a passive probe.

Consequences of Signal Inversion at – Input

Absolute voltages indicated by cursors or the graticule axis labels require special interpretation when a signal is applied to the 11A33 – input, and no signal is applied to the + input, or if + coupling is set to Off or VC.

If the + input coupling is Off, or is AC or DC but no signal is connected, the voltage readout number must be multiplied by –1 to yield the correct answer. For example, a voltage reading on screen of –7 V corresponds to positive 7 V Signal amplitude.

If the + input coupling is VC, the voltage readout number must be subtracted from twice the VC value to yield the correct answer. For example, with VC=100 mV a voltage reading on screen of 400 mV corresponds to negative 200 mV Signal amplitude.

The preferred measurement method is to connect the signal to the + input of the 11A33 and select VC at the – input, so that voltage readout numbers are correct as displayed without possibility of misinterpretation.

Glossary

Active Probe	Any Level 2 TEKPROBE with offset driven by the 11A33.
amp	Voltage applied to preamplifier offset terminal.
Applied Value	The value applied to the voltage-generating hardware.
crnt	Current – value now being supplied by the human interface Offset knob and numeric entry. Also may be written by ASCII port. Only one voltage at a time may be assigned crnt status. When moving from one status to another, prev of the earlier state becomes the initial value of crnt for the later state.
nu	Not used.
Offset Access	The function controlled by the human interface Offset function (knob and numeric entry).
Passive Probe	Possible inputs are: any Level 2 TEKPROBE without offset, any Level 1 TEKPROBE, any Tektronix probe with single-pin coding, any probe or cable without probe-coding connector, or nothing connected.
– prb	Voltage applied at – input TEKPROBE connector.
+ prb	Voltage applied at + input TEKPROBE connector.
prev	Previous. The last value that existed in a state for which this variable was "crnt," or the last value written from the ASCII port.
Stored Value	An auxiliary set of values. The human interface can access only those values marked "crnt." The ASCII port can write all four values for the presently selected coupling.
strd	Stored. Use the value given in the "stored value" column.
vc-in	Comparison voltage applied to – input connector.
vc+in	Comparison voltage applied to + input connector.
zero	Zero volts.

BW Limit

Two four-pole (24 dB/octave) bandwidth limit (low-pass) filters are available. The purpose of these filters is to reduce the amplitude of unwanted noise or interference occurring at frequencies above the frequency of the signal of interest. The user has a choice of cut-off (–3 dB) frequencies, either 20 MHz or 100 MHz. The trigger, auxiliary trigger, and display signal bandwidths are always the same. The auxiliary trigger is the signal sent to the right plug-in compartment.

DC Circuit Loading

AC coupling capacitors are connected differently in the 11A52 and 11A71 than in the 11A32, 11A33 and 11A34. Figure 3-2 shows this difference.

In the 11A52 and 11A71, the coupling capacitor isolates both the input termination and the amplifier from external DC voltages. However, the coupling capacitor in the 11A32, 11A33 and 11A34 does not.

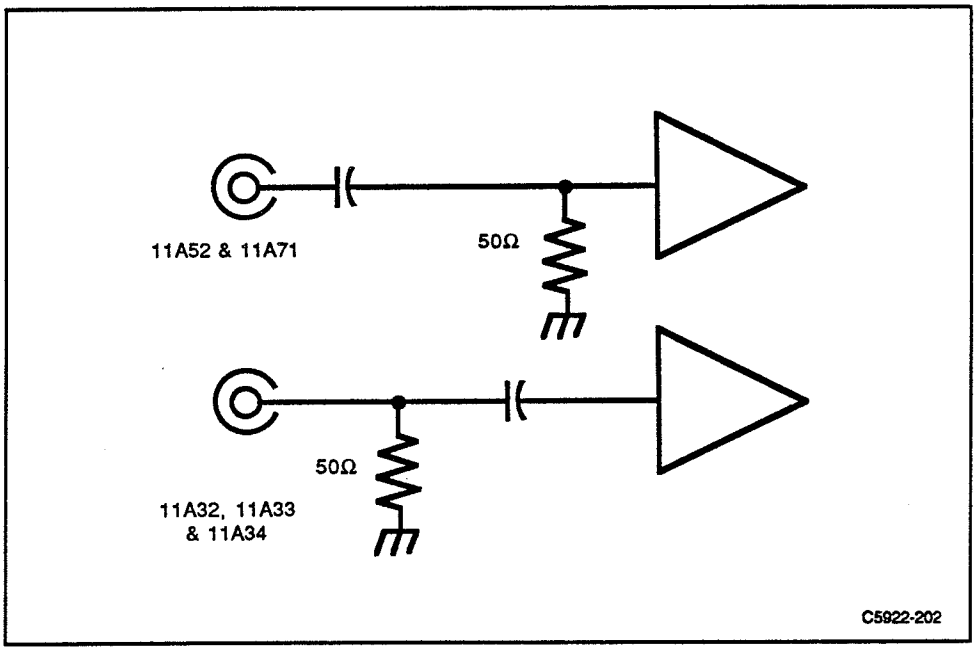


Figure 3-2. Location of AC coupling capacitors in plug-in amplifiers.

CAUTION

Always use caution when working with voltages in excess of 25 volts.

When 50 Ω Impedance mode is selected and input coupling is set to AC or DC, a 50 Ω termination resistance is connected directly from the 11A33 input connector to ground. Take care that the circuit connected to the 11A33 input will not be damaged by the 50 Ω load.

Switching from 1 MΩ to 50 Ω Impedance mode when more than 25 V DC is present at the 11A33 input will exceed the peak input voltage specification and may damage the 11A33 input relay. A damaged relay could cause an error in calibration.

Adding and Subtracting Waveforms

The 11401 and 11402 mainframes do not allow the addition or subtraction of live waveforms without restriction. The reason for this lies in the manner in which samples are taken and used by the mainframe. Each plug-in compartment has an associated sampler in the 11401 or 11402. Samples are taken simultaneously by each sampler. A channel from one plug-in unit may be added to or subtracted from that of another plug-in unit accurately by virtue of this simultaneity. Thus noise and other signals unrelated to the trigger will be canceled when channels in different plug-in units are subtracted.

Signals from different channels within a plug-in unit are sampled at different times. Signals that are entirely repetitive and related to the trigger signal may be successfully added or subtracted in spite of this. However, signals that are not repetitive or related to the trigger will not be sampled at the same time, and may not be displayed correctly. Therefore it is preferable that signals to be added or subtracted be selected from different plug-in compartments.

The 11A33 offers the best common-mode rejection because its hardware subtracts the signals at its two inputs, and passes only the result to the mainframe.

Even when using channels from different plug-in compartments, the following restrictions limit the accuracy of sums or differences:

1. Each waveform in memory is constantly being updated, and therefore consists of some points that are older than others. Although samples may be taken simultaneously, there is a chance that a correct sample may be replaced in memory with a newer value before the waveform is processed and displayed.

2. Delay differences between channels of different plug-in units due to probe cable length differences are normally removed by deskewing the probes and the associated amplifier channel. Samples are still taken simultaneously, but the display is manipulated to remove time differences. Signals correlated to the trigger signal are correctly restored to their proper time relationship, but there is no way for signals unrelated to the trigger to be corrected with this deskewing technique. High-frequency rejection of signals unrelated to the trigger is not improved by deskewing.

The solution to both problems is to invoke averaging. The averaging process suppresses all signals and noise unrelated to the trigger.

Overdriven Waveforms

The 11A33 has an unusual capability to make accurate measurements on signals that overscan the display by large amounts.

Signals that overscan the screen vertically may actually overdrive the input amplifier, which can no longer respond to the input signal. The overdrive recovery specification tells how accurately the displayed trace represents the input signal when it returns on-screen. This is what is meant by Overdrive Recovery time.

The 11A33 will recover extremely fast from overdrives that do not exceed the specified limit on slew rate. Specifically, it will recover from an 8-volt step to less than 0.25% within 40 ns.

Remaining within the slew rate limits allows the amplifier to recover completely and deliver its full accuracy. However, DC level shifts can occur when the slew rate is excessive.

For accurate measurements, therefore, it is important that this be verified when acquiring waveforms that are partially off screen.

One way of making this verification is to change the Vertical Size until everything is on screen. The cursors provide a convenient aid for checking dV/dt on the transitions. Once maximum slew rate has been verified to be less than 1 V/ns, the Vertical Size can be set to any appropriate value for measurement.

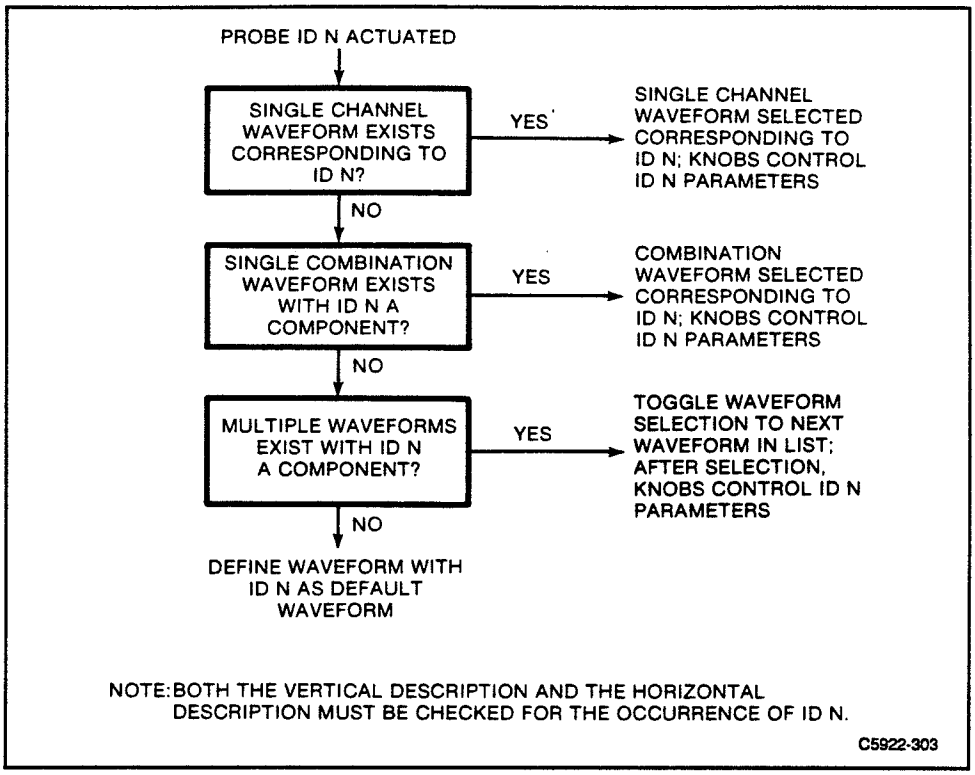


Figure 3-3. Sequence of decisions used to select a new waveform in response to probe ID button.

Probe ID

The **Probe ID Function** is the means of selecting how the 11401 or 11402 responds to an ID button-push of recommended probes. (The **Probe ID Function** is part of the **Probes** pop-up menu, which is selected from the Utilities major menu.) All, or some combination of the following operations may be set to start in response to probe ID button(s). To display the Utility Menu, press the front-panel UTILITY button. For details, see the *Probe Calibration and ID Function* section of the *Utilities* subsection in the *11401 and 11402 User Reference Manual.*

Pressing the probe ID button can initiate one of the following operations:

1. If the **Probe ID Function** (in the **Probes** pop-up menu of the Utility major menu) is set to **Sequence Settings**, the next front-panel setting will be recalled. If the **Probe ID Function** is not set to **Sequence Settings**, then operation 2 or 3, which involve a new waveform and waveform selection, will occur.

If the **Sequence Settings** option is enabled, front-panel settings can be sequentially recalled via the **Probe ID Function**. The settings must be stored as explained under *Storing and Recalling Waveforms* in the *11401 and 11402 User Reference Manual*.

2. If the **Probe ID Function** (in the **Probes** pop-up menu of the Utility major menu) is set to **Waveform Select/New Wfm**, a waveform will be selected. Figure 3-3 shows the sequence of decisions used to select a new waveform.

3. If the Probe ID Function is set to **Wfm Select/New Wfm & AutoSet**, then the decisions shown in Figure 3-3 will be made, and the resulting selected waveform is autoset.

Events 1, 2, and 3 are mutually exclusive. Event 4 may be combined with any one of them.

4. If the IDPROBE SRQMASK is enabled, an appropriate event will be returned to the GPIB and RS-232-C ports.

50 Ω Overload

When the input impedance is set to 50 Ω and the 11A33 senses voltage at either input substantially exceeding 5 Vrms, the input impedance will be changed to 1 MΩ, and the mainframe will display the message:

Input channel 1 overload on LEFT/CENTER/RIGHT plug-in

The impedance menu will show 1 MΩ.

To reset the input impedance to 50 Ω, first correct the overload condition, then select 50 Ω from the Impedance menu.

Front-Panel Error Messages

Message: Internal DAC overflow on channel 1 of LEFT, CENTER, or RIGHT plug-in unit.

Cause: A plug-in unit detected that a requested setting overflowed an internal DAC. Such overflow usually indicates defective hardware. In this situation, the plug-in unit sets the DAC to the limit nearer the requested setting.

Message: Bad Level 2 probe checksum on channel 1 of LEFT, CENTER, or RIGHT plug-in unit.

Cause: A plug-in unit detected that a Level 2 TEKPROBE had failed or been improperly connected.

Maximum Input Voltage

The maximum input voltage is 50 V when Size is set in the range of 1 mV/div to 99.5 mV/div. The maximum input voltage is 500 V when Size is set in the range of 0.1 V/div to 10 V/div. See Figure 3-4.

This is the maximum instantaneous voltage, and applies to both AC and DC waveform components, regardless of AC or DC coupling.

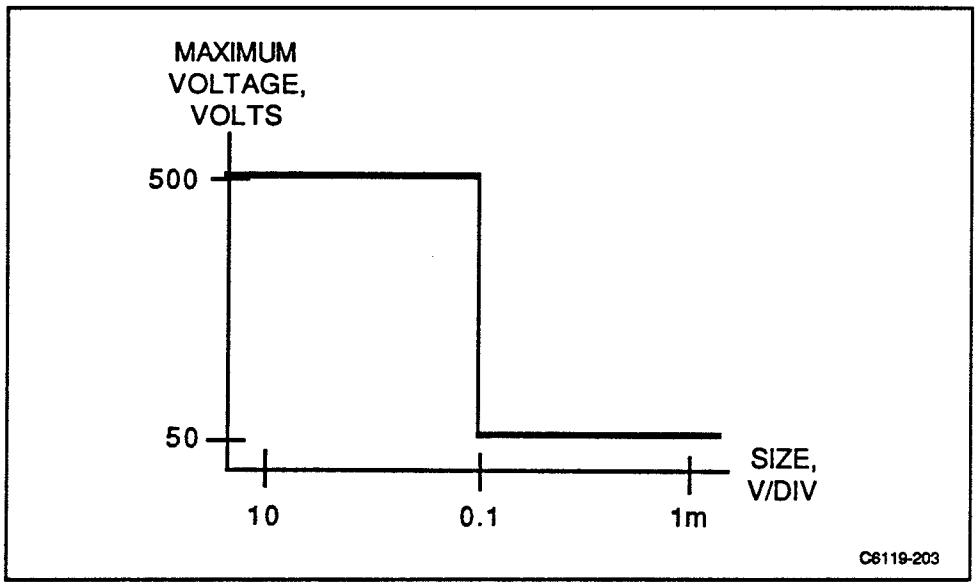


Figure 3-4. Maximum input voltage as a function of Size.

Maximum Voltage Indicators and Range Selector

When using a differential amplifier, the user might increase the Size of the displayed differential signal, while forgetting that large amplitude common mode voltages which may be present at the inputs would exceed the 50 V maximum rating at more sensitive Size settings. Instrument damage may result.

A set of maximum voltage indicators and a range selection switch are provided in the 11A33 to assist the user in adhering to these limits. When all Size settings (1 mV/div to 10 V/div) are available, the '50 V' indicator is on. When the '500 V' indicator is on, only the less sensitive deflection factors (0.1 V/div to 10 V/div) are available. Before changing the range and increasing Size beyond 0.1 V/div it might be wise to look at each input signal independently (+ coupling = DC and – coupling = off; then + coupling = off and – coupling = DC) to verify that each is less than 50 V.

Regardless of the indication, when 50 Ω impedance is selected, maximum input voltage is 5 V rms or 25 V peak.

If 500 volts maximum input mode is requested, and the deflection factor is in the range of 1 mV/div to 99.5 mV/div, deflection factor will be changed to 0.1 V/div. If Impedance was set to 1 GΩ, it will be changed to 1 MΩ.

Probe Calibration

Probe calibration and deskewing require use of deflection factors in the range of 1 mV/div to 99.5 mV/div, which are available only with maximum input voltage selection of 50 V.

If Probe Calibration is initiated while 500 V maximum input voltage is selected, the process will fail. An error message will be displayed on screen.

When executing Probe Calibration, first disconnect BOTH probe tips from circuits being measured. Then select 50 V maximum input range. Then follow the instructions in the probe calibration menu. After completion of probe calibration, probe tips may again be connected to circuits being measured. If signals over 50 volts are present, be sure to select 500 V maximum input range before connecting the probes.

Charge on the AC Coupling Capacitor

When AC coupling is used, the AC coupling capacitor charges to the DC (average) value of the signal, which must be less than the rated maximum input described above.

Special care must be used when increasing the sensitivity (Size). Charge on the AC Coupling capacitor must be removed, or reduced to within the rated maximum input of the next most sensitive Size step before increasing the Size. The discharge path for the capacitor is through the 1 MΩ input resistance of the 11A33 and the externally connected circuit.

AC Coupling with Probes

When a 10 MΩ 10X probe is used, only AC components of the signal at frequencies higher than 10 Hz are fully attenuated. There is no attenuation of DC or very low AC frequencies. Thus the DC or low frequency amplitude present at the probe tip is also present at the plug-in input.

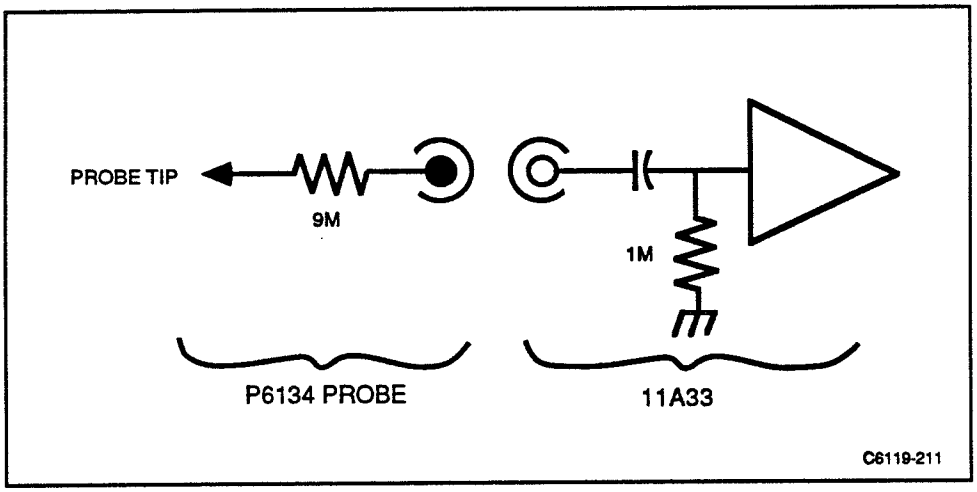


Figure 3-5. P6134 simplified schematic.

With a probe such as the P6134, the maximum voltage allowable at the probe tip is shown in Figure 3-6.

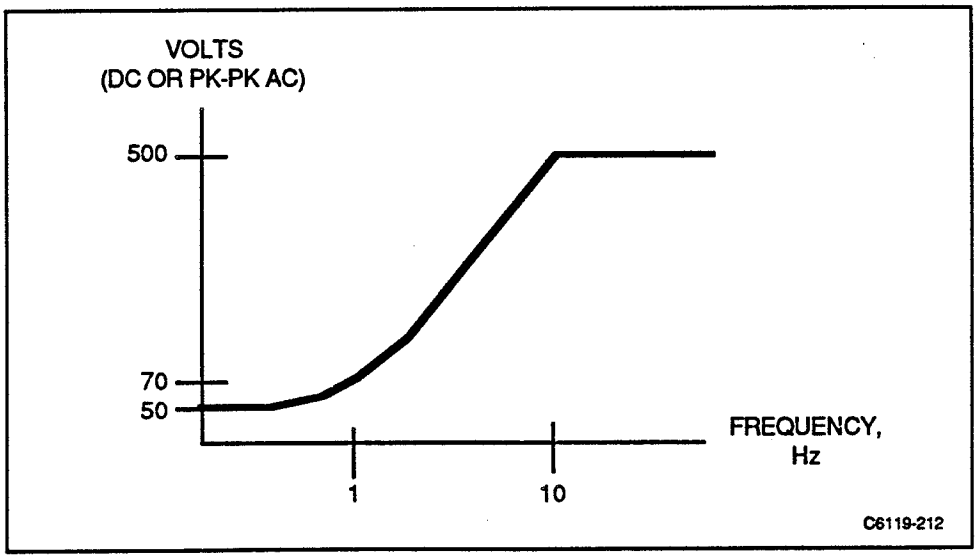


Figure 3-6. Maximum amplitude of signal components vs. frequency at P6134 probe tip. For 10 mV/div to 995 mV/div sensitivity at probe tip.

When the P6135 10X probe set is used, AC components of the signal at frequencies higher than 10 Hz are fully attenuated (by a factor of 10). DC or very low AC frequencies are attenuated by a factor of 9.

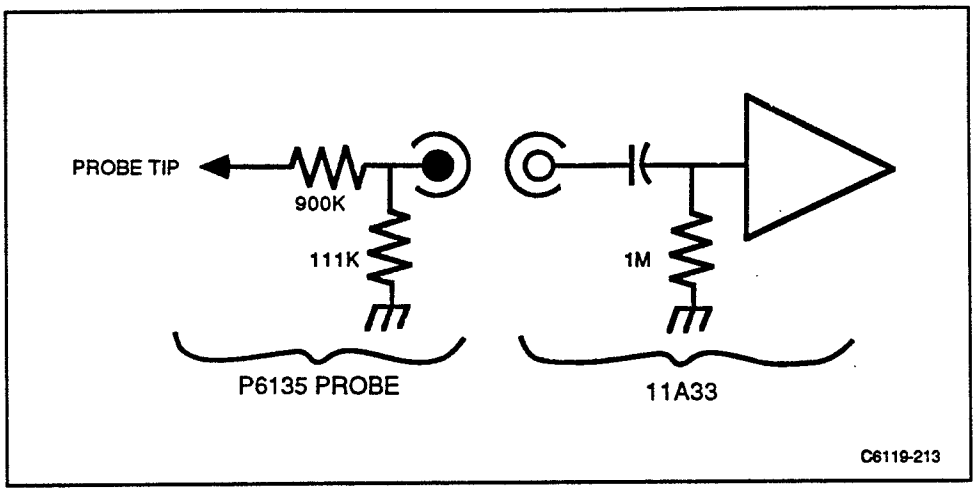


Figure 3-7. P6135 simplified schematic.

With the P6135 probe, the maximum voltage allowable at the probe tip is shown in Figure 3-8.

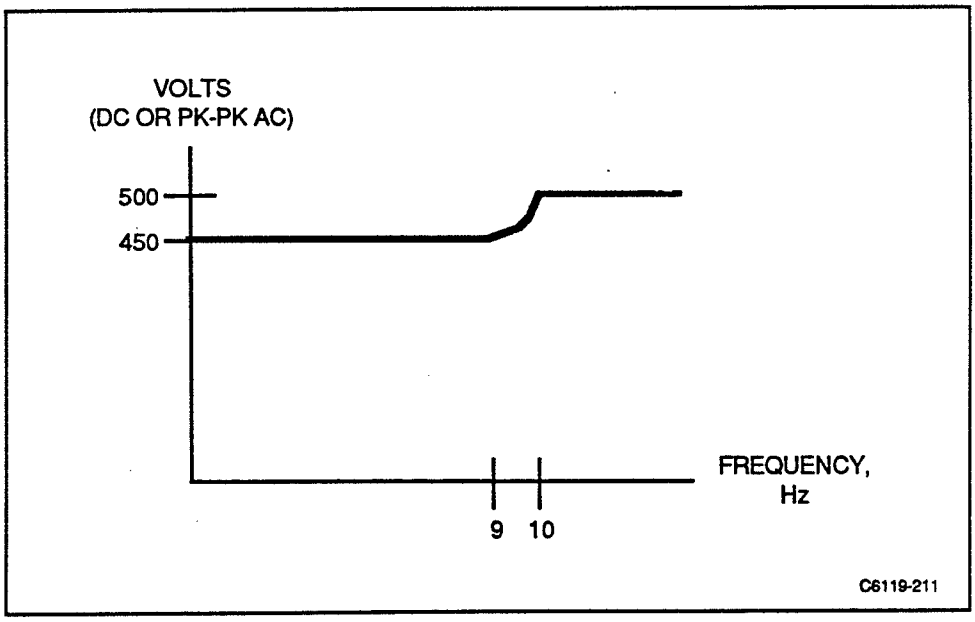


Figure 3-8. Maximum amplitude of signal components vs. frequency at P6135 probe tip. For 10 mV/div to 995 mV/div sensitivity at probe tip.

GPIB and RS-232-C Commands and Syntax

The following commands set parameters of a specified channel.

Table 3-8
GPIB and RS-232-C Commands and Syntax

Header	Link	Argument		
CH<L1, C1, R1>	PLSCOUPLING:	AC|DC|OFF|VC		AC coupling not available when Zin = 1 GΩ
	MNSCOUPLING:	AC|DC|OFF|VC		
	OFFSET:	<NRx>[3]		
	AMPOFFSET:[1]	<NRx>		
		Volts/div	Offset Range	Resolution via RS-232-C, GPIB or Numeric Entry
		1 mV to 99.5 mV 100 mV to 995 mV 1 V to 10 V	±1 V ±10 V ±100 V	25E-6 250E-6 2.5E-3
	MNSOFFSET:[2]	<NRx>		
		Volts/div	Offset Range	Resolution via RS-232-C, GPIB or Numeric Entry
		All	±1 V	25E-6
	PLSOFFSET:[2]	<NRx>		
		Volts/div	Offset Range	Resolution via RS-232-C, GPIB or Numeric Entry
		All	±1 V	25E-6

[1] The numbers listed refer to the input connectors. Connecting an attenuating probe will change the value by the probe attenuating factor (e.g., a 10X probe will change the value ±8 to ±80).

[2] Scaled by probe.

[3]Number determined by probes connected to inputs and type of coupling selected, see Table 2-4, 2-5, 2-6, and 2-7.

Table 3-8 (cont.)
GPIB and RS-232-C Commands and Syntax

Header	Link	Argument		
CH<L1, C1, R1> (cont)	VCOFFSET:[1]	<NRx>		
		Volts/div	Offset Range	Resolution via RS-232-C, GPIB or Numeric Entry
		1 mV to 99.5 mV 100 mV to 995 mV 1 V to 10 V	±8 V ±80 V ±500 V	25E-6 250E-6 2.5E-3
	BW:	<NRx> ≤24E6 >24E6 to ≤120E6 ≥120E6	Bandwidth 20E6 100E6 150E6, 11401 150E6, 11402	
	IMPEDANCE:	<NRx> <1E3 1E3 to 1E7 >1E7	Impedance 50 1E6 1E9	
	SENSITIVITY:[1] Sensitivities from 1E-3 to 99.5E-3 are not available when maximum input voltage selection is 500 V. Sensitivities from 100E-3 to 10 are not available when input impedance is set to 1E9 (1 GΩ)	Sensitivity 1E-3 to 1.99E-3 2E-3 to 4.98E-3 5E-3 to 9.95E-3 10E-3 to 19.9E-3 20E-3 to 49.8E-3 50E-3 to 99.5E-3 100E-3 to 199E-3 200E-3 to 498E-3 500E-3 to 995E-3 1 to 1.99 2 to 4.98 5 to 10	Resolution (step size) 10E-6 20E-6 50E-6 100E-6 200E-6 500E-6 1E-3 2E-3 5E-3 10E-3 20E-3 50E-3	
	UNITS:	<qstring> (query only) The 11A33 answers a Units query with a units status message, which indicates the units of conversion of a probe connected to its input.		

[1] **The numbers listed refer to the input connectors. Connecting an attenuating probe will change the value by the probe attenuating factor (e.g., a 10X probe will change the value ±8 to ±80).**

Table 3-8 (cont.)
GPIB and RS-232-C Commands and Syntax

Header	Link	Argument
CH<L1, C1, R1> (cont)	MNSPROBE:	<qstring> (query only) This query-only link returns a quoted string indicating what type of probe is connected to the – input. If a Level 1 TEKPROBE is connected, the query response is "Level 1." If a Level 2 TEKPROBE is connected, the query response is "Level 2/<probe_type>/<serial_number>." When neither Level 1 nor 2 TEKPROBE is connected, the query response is "NONE."
	PLSPROBE:	<qstring> (query only) This query-only link returns a quoted string indicating what type of probe is connected to the + input. If a Level 1 TEKPROBE is connected, the query response is "Level 1." If a Level 2 TEKPROBE is connected, the query response is "Level 2/<probe_type>/<serial_number>." When neither Level 1 nor 2 TEKPROBE is connected, the query response is "NONE."
	PROTECT	ON | OFF

Legend

CH<L1, C1, R1>	L, C, and R mean Left, Center, and Right; 1 means Channel 1.
PLSCOUPLING	Sets the plus input coupling to the selected argument.
MNSCOUPLING	Sets the minus input coupling to the selected argument.
OFFSET	Sets offset according to offset access entry in Tables 3-4 through 3-7, which appear earlier in this section.
AMPOFFSET	Sets the 11A33 amplifier offset to the value set by the argument.
MNSOFFSET	Sets offset for probe connected to the minus input.
PLSOFFSET	Sets offset for probe connected to the plus input.
VCOFFSET	Sets comparison voltage to value specified by the argument.
BW	Sets the upper bandwidth to the value set by the argument.
NRx	Numeric representation.
IMPEDANCE	Sets the input impedance of the specified channel to the value set by the argument.
SENSITIVITY	Sets the input sensitivity to the Volts value indicated by the argument. Sensitivity is a channel-specific command which does not apply to compound waveforms.
qstring	Quoted string data.
PROTECT	ON sets the Maximum Voltage Range Selector to 500 V, and restricts Sensitivity to the range of 100E-3 to 10. OFF sets the Maximum Voltage Range Selector to 50 V. Sensitivity is unrestricted. Refer to Appendix C.

Section 4
Specification

Performance Conditions

The specifications that follow apply when the instrument is in the condition of Enhanced Accuracy. Enhanced Accuracy is initiated by pushing the **EA** button on the specific host mainframe after the system has reached thermal equilibrium, which requires 20 minutes warmup. Enhanced Accuracy is indicated on the CRT display and remains in effect as long as the mainframe internal temperature change is less than 5° C from the temperature at which the calibration was performed. When the 5° C change does occur the accuracy condition becomes Not-Enhanced. In the Not-Enhanced condition those Characteristics that are temperature sensitive may not remain within the limits of these specifications.

TABLE 4-1
Electrical Characteristics

Circuit	Characteristic	Performance Requirement
Display Deflection Factor (Sensitivity)	Calibrated Range	1 mV to 10 V/div.

Enhanced DC Accuracy[1] of 11A33 in 11300-series Mainframes, with on-screen cursors.

Without Probes

Volts/Div	ΔV DC Acc.	DC Balance	DC Offset Acc.	Vc Acc.
1 mV to 99.5 mV	±(1.0% + 0.04 div)	±(0.5 mV + 0.13 div)	±(0.25% + 0.70 mV)	±(0.15% + 0.6 mV)
100 mV to 995 mV	±(1.0% + 0.04 div)	±(5 mV + 0.13 div)	±(0.30% + 7 mV)	±(0.20% + 6 mV)
1 V to 10 V	±(1.0% + 0.04 div)	±(50 mV + 0.13 div)	±(0.30% + 70 mV)	±(0.20% + 60 mV)

With P6135 Probe Set calibrated from 11300-series Calibrator output

Volts/Div	ΔV DC Acc.	DC Balance	DC Offset Acc.	Vc Acc.
10 mV to 995 mV	±(1.0% + 0.04 div)	±(5.0 mV + 0.13 div)	±(0.30% + 7 mV)	±(0.20% + 6 mV)
1 V to 9.95 V	±(1.0% + 0.04 div)	±(50 mV + 0.13 div)	±(0.30% + 70 mV)	±(0.20% + 60 mV)
10 V to 100 V	±(1.0% + 0.04 div)	±(0.5 V + 0.13 div)	±(0.30% + 0.7 V)	±(0.20% + 0.6 V)
Probe tip TC term	100 ppm/°C	na	na	na

[1]For absolute DC accuracy of single-point measurements using Offset, add the DC Offset Accuracy, DC Balance and ΔV DC Accuracy terms. Apply the ΔV DC Accuracy only to the difference between the Vertical Position setting and the measurement point.

TABLE 4-1 (cont)
Electrical Characteristics
Display Deflection Factor (cont.)

With One P6231 Probe calibrated from 11300-series Calibrator output.

Volts/Div	ΔV DC Acc.	DC Balance	DC Offset Acc.	Vc Acc.	Probe Offset Acc.
10 mV to 995 mV	±(1.1% + 0.04 div)	±(5 mV + 0.13 div)	±(0.30% + 7 mV)	±(0.20% + 6 mV)	±(0.2% + 2.0 mV)
≥1 V	±(1.1% + 0.04 div)	±(50 mV + 0.13 div)	±(0.30% + 70 mV)	±(0.20% + 60 mV	±(0.2% +2.0 mV)
Probe Tip TC term	100 ppm/° C				

Enhanced DC Accuracy[1] of 11A33 in 11401 and 11402 Mainframes.

Without Probes

Volts/Div	ΔV DC Acc.	DC Balance	DC Offset Acc.	Vc Acc.
1 mV to 99.5 mV	±(0.9% + 0.01 div)	±(0.5 mV + 0.10 div)	±(0.25% + 0.7 mV)	±(0.15% + 0.6 mV)
100 mV to 995 mV	±(0.9% + 0.01 div)	±(5 mV + 0.10 div)	±(0.30% + 7 mV)	±(0.20% + 6 mV)
1 V to 10 V	±(0.9% + 0.01 div)	±(50 mV + 0.10 div)	±(0.30% + 70 mV)	±(0.20% + 60 mV)

With P6135 Probe Set calibrated from 11401 and 11402 Calibrator output

Volts/Div	ΔV DC Acc.	DC Balance	DC Offset Acc.	Vc Acc.
10 mV to 995 mV	±(0.9% + 0.01 div)	±(5.0 mV + 0.10 div)	±(0.30% + 7 mV)	±(0.20% + 6 mV)
1 V to 9.95 V	±(0.9% + 0.01 div)	±(50 mV + 0.10 div)	±(0.30% + 70 mV)	±(0.20% + 60 mV)
10 V to 100 V	±(0.9% + 0.01 div)	±(0.5 V + 0.10 div)	±(0.30% + 0.7 V)	±(0.20% + 0.6 V)
Probe tip TC term	100 ppm/° C	na	na	na

With one P6231 Probe calibrated from 11401 and 11402 Calibrator outputs

Volts/Div	ΔV DC Acc.	DC Balance	DC Offset Acc.	Vc Acc.	Probe Offset Acc.
10 mV to 995 mV	±(1.0% + 0.01 div)	±(5 mV + 0.10 div)	±(0.30% + 7 mV)	±(0.20% + 6 mV)	±(0.20% + 2.0 mV)
≥1 V	±(1.0% + 0.01 div)	±(50 mV + 0.10 div)	±(0.30% + 70 mV)	±(0.20% + 60 mV)	±(0.20% +2.0 mV)
Probe Tip TC term	100 ppm/° C				

TABLE 4-1 (cont)
Electrical Characteristics

Circuit	Characteristic	Performance Requirement
Display **Deflection Factor** (Sensitivity) (cont)	Coarse Resolution	1, 2, 5 sequence.
	Fine Resolution	Depends on Deflection Factor, as follows: Rotating the Fine control one increment will change the Deflection Factor by 1% of the next more-sensitive Coarse setting. For example, with deflection factor set to 198 mV, rotating the Fine control counter-clockwise will cause this sequence of sensitivities: 199 mV, 200 mV, 202 mV, etc. Rotating the Fine control clockwise from 204 mV/div will cause the reverse sequence (202 mV, 200 mV, 199 mV, etc.).
Display **Offset**	Comparison Voltage	
	Range	
	with Deflection Factor set between 1 mV and 99.5 mV/div	±8 V.
	with Deflection Factor set between 0.1 V and 0.995 V/div	±80 V.
	with Deflection Factor set between 1.0 V and 10.0 V/div	±500 V.
	Resolution	
	Coarse	0.25 division.
	Fine 0.025 division.	
	Accuracy	See *Deflection Factor Accuracy*, which precedes this characteristic.

TABLE 4-1 (cont)
Electrical Characteristics

Circuit	Characteristic	Performance Requirement
Display **Offset** (cont)	Amplifier Offset	
	Range	
	With Deflection Factor between 1 mV and 99.5 mV/div	±1 V.
	With Deflection Factor between 0.1 V and 0.995 V/div	±10 V.
	With Deflection Factor between 1 V and 10.0 V/div	±100 V.
	Resolution	
	Coarse	0.25 division.
	Fine 0.025 division.	
	Accuracy	See *Deflection Factor Accuracy*, which precedes this characteristic.
	Probe Offset (+OS, –OS)	
	Range of voltage supplied to probe	±1.0 V. Probe-tip offset depends on type of probe used. See *Recommended Probes*, in this manual, or any probe manual.
	Resolution	
	Coarse	0.25 division.
	Fine	0.025 division.
	Accuracy	See *Deflection Factor Accuracy*, which precedes this characteristic.

TABLE 4-1 (cont)
Electrical Characteristics

Circuit	Characteristic	Performance Requirement
Common Mode Rejection Ratio (measured with sine wave)	With Deflection Factor set between 1 mV and 99.5 mV/div (DC coupled)	Test signal ±4 V (8 V p-p) 10,000:1 DC to 1 MHz 2,000:1 at 5 MHz. Test signal ±8 V (16 V p-p) 5,000:1 DC to 1 MHz 2,500:1 at 2 MHz. Test signal ±0.5 V (1 V p-p) 1,000:1 at 10 MHz 500:1 at 20 MHz.
	With Deflection Factor set between 0.1 V and 0.995 V/div (DC coupled)	Test signal ±15 V (30 V p-p) 1,000:1 DC to 1 MHz 100:1 10 MHz to 20 MHz.
	With Deflection Factor set between 1 V and 10 V/div (DC coupled)	Test signal ±50 V (100 V p-p) 500:1 DC to 250 kHz.
	AC Coupled; 60 Hz	At least 50:1.
Display **Frequency Response**	High Frequency Limit (–3 dB) and Calculated Rise Time of Display, Auxiliary, and Trigger signals, Zin=1 MΩ or 50 Ω	**Type of Mainframe**
	Volts/Division	11301(A) / 11302(A) / 11401 / 11402
	1 mV - 1.99 mV	120 MHz 2.9 ns / 120 MHz 2.9 ns / 120 MHz 2.9 ns / 12 MHz 2.9 ns
	2 mV - 10 V	150 MHz 2.3 ns / 150 MHz 2.3 ns / 150 MHz 2.3 ns / 150 MHz 2.3 ns
	Low Frequency –3 dB point, AC coupled	10 Hz or less.

TABLE 4-1 (cont)
Electrical Characteristics

Circuit	Characteristic	Performance Requirement
Step Response	Overdrive recovery time; deflection factor set between 1 mV and 99.5 mV/div. (DC coupled) 1 mV within 300 µs.	Recovery to 0 V from overdrive up to ±8 V, slew rate less than 0.5 V/ns. 0.25% within 40 ns, 2 mV within 100 µs,
Input Impedance	50 Ω, DC or AC Coupled	50 Ω ±0.5% in parallel with approx. 15 pF.
	1 MΩ DC Coupled	1 MΩ ±0.30% in parallel with approx. 15 pF.
	AC Coupled	0.022 µF in series with 1 MΩ ±0.30% and in parallel with approx. 15 pF.
	1 GΩ, DC Coupled	Greater than 1 GΩ in parallel with approx. 15 pF.
	Power-Down Condition	Inputs disconnected.
Maximum Input Voltages	50 Ω DC or AC Coupled	5 Vrms (0.5 watt); 0.5 watt-second pulses not exceeding 25 V peak.
	1 MΩ or 1 GΩ, DC or AC Coupled	
	1 mV to 99.5 mV/division	
	Absolute Maximum	±50 V DC+peak AC. 50 V peak-to-peak AC up to 3 MHz, decreasing 20 dB/decade to 0.5 V at 300 MHz.
	Operating Range	±8 V DC + peak AC.
	100 mV to 995 mV/division	
	Absolute Maximum	±500 V DC + peak AC. 500 V peak-to-peak AC up to 300 kHz, decreasing 20 dB/ decade to 0.5 V at 300 MHz.
	Operating Range	±80 V DC + peak AC.
	1 V to 10 V/division	
	Absolute Maximum	±500 V DC + peak AC. 500 V peak-to-peak AC up to 300 kHz, decreasing 20 dB/ decade to 0.5 V at 300 MHz.

TABLE 4-2
Environmental Characteristics

Characteristic	Information
Ambient temperature (External to main frame)	
Operating within specs.	0° to +50°C., mainframe ambient.
Nonoperating	–40° to +75°C.
Humidity, Operating and Nonoperating	Five days, per MIL-T-28800C. Type III, class 5 as described in 3.9.2.2 and 4.5.5.1.2.2.
Altitude	
Operating	To 4,570 m (15,000 ft.).
Nonoperating	To 15,200 m (50,000 ft.).
Vibration	
Operating, installed on Flexible Extender	MIL-T-28800C, Sec. 4.5.5.3.1, type III, class 5.
Shock, Nonoperating (not installed in mainframe)	MIL-T-28800C, Sec. 4.5.5.4.1, type III, class 5.
Bench Handling (operating and nonoperating)	MIL-T-28800C, Sec. 4.5.5.4.3, type III, class 5.
Packaged Product Vibration and Shock	
Vibration and Bounce of Packaged Product	Meets ASTM D999-75, Method A (NSTA Project 1A-B-1).
Drop of Packaged Product	Meets ASTM D775-61, Paragraph 5 (NSTA Project 1A-B-2).
Electromagnetic Compatibility	MIL. STD. 461B. FCC Part 15, Subpart J, Class A. VDE 0871/6.78, Class B.

TABLE 4-3
Physical Characteristics

Characteristic	Information
Weight (max)	2 lbs. 2 oz. (964 grams).
Weight of Packaged Product (max)	5 lbs. 0 oz. (2.3 kg).
Dimensions	Refer to Figure 4-1.

Recommended Probes

The 11A33 is compatible with Level 1 and 2 TEKPROBES.

TEKPROBE is Tektronix' name for the interface used with probes designed for the 11000-series of oscilloscopes and plug-in units. TEKPROBES have output connectors with one or more spring-loaded coding pins.

A Level 1 probe uses analog encoding to indicate the probe's scale factor to the plug-in unit.

A Level 2 probe uses an EEPROM to store data about the probe's transfer units, scale factor, and output voltage scale factor. Such data is serially encoded, then stored in the EEPROM. The probe data is intended to be read once at instrument power-up or when the probe is first connected to a plug-in unit (that is, at probe power-up).

Tektronix recommends these probes for use with the 11A33:

P6134 Subminiature 10X Passive Probe with ID. With 1 MΩ inputs, the P6134's input impedance is 10 MΩ in parallel with 10.5 pF. The P6134 is a Level 1 probe.

P6135 Subminiature 10X Passive Probe Set. The P6135's input impedance is 1 MΩ in parallel with 15 pF. Attenuation of probe is adjustable to permit matching the two attenuation factors. The P6135 is a Level 1 probe.

P6231 Low Impedance Subminiature 10X Active Probe. The P6231 has a bandwidth of 1.5 GHz, input impedance of 450 Ω, and DC offset of ±5 V controlled by the 11A33. Probe scaling is 5:1 for PLSOFFSET and MNSOFFSET. The P6231 is a Level 2 probe.

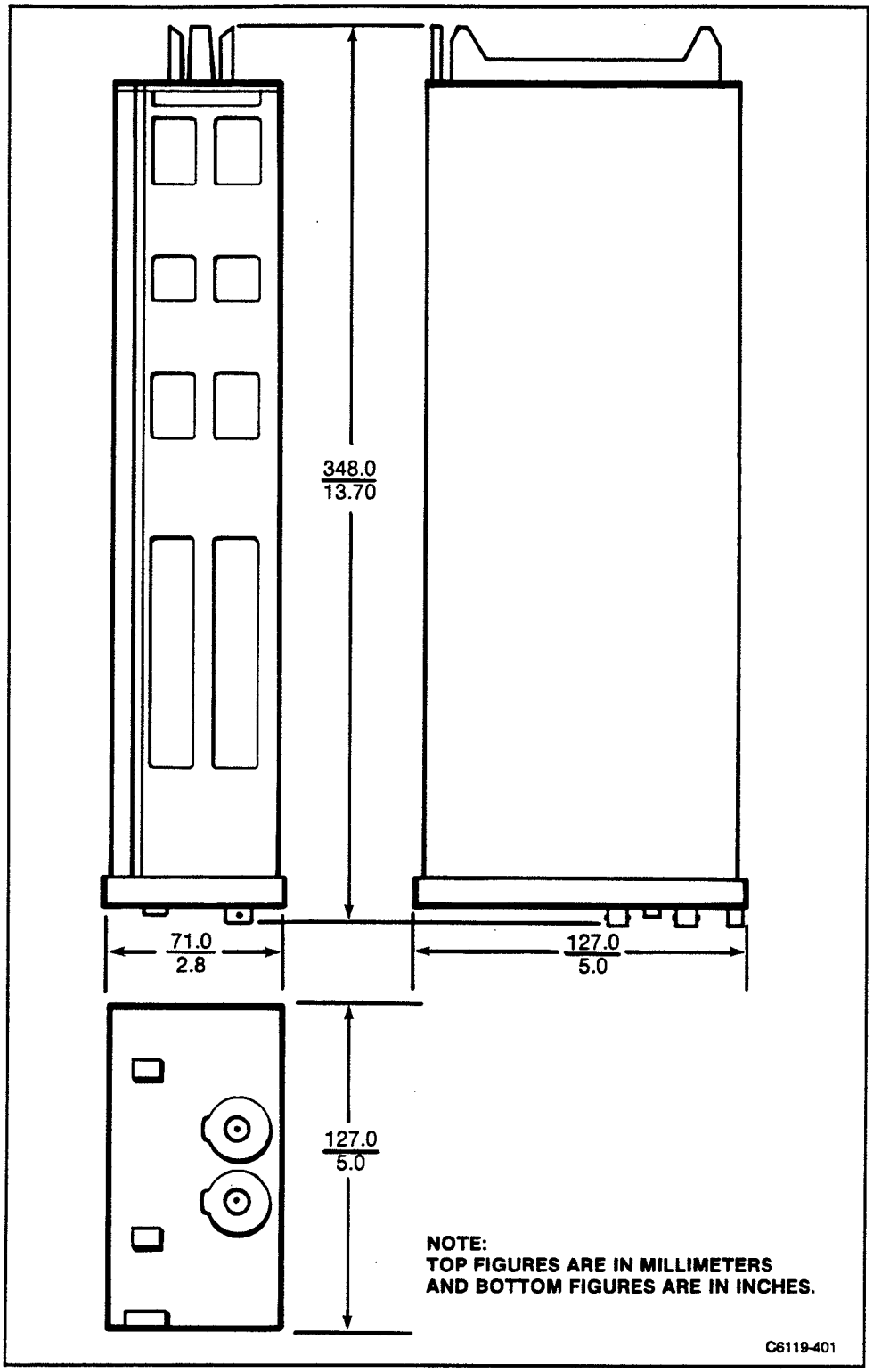


Figure 4-1. Dimensions of 11A33

Appendix A—Glossary

Deflection factor	The ratio of input signal to response in the 11000 system. The reciprocal of sensitivity.
Display on/off button	The front-panel, plug-in button that designates a channel for display, or removes a channel from the display.
Mainframe	Any 11000-series oscilloscope exclusive of plug-in units.
Offset	A control that allows the user to subtract a precision voltage from the input signal to vary the position of the displayed signal.
ON/STANDBY	The front-panel power control on 11000-series mainframes. When set to ON, applies operating power to all circuits. When set to STANDBY, the mainframe DC power supply supplies power to the counter-timer crystal oven (Option 1T).
Sensitivity	The ratio of input signal to response in the 11000 system. In the 11A33, Volts per division. Also called size, vertical size, and deflection factor in this manual.
Size	See Sensitivity.
Toggle	To switch alternately between two functions (e.g., on and off).
Vertical size	See Sensitivity.

Appendix B—Instrument Documentation

- *Introducing the 11301 and 11302 Programmable Oscilloscopes.* This book helps the new user learn the concepts and operation of the 11301 and 11302 programmable oscilloscopes.

  or

  Introducing the 11301A and 11302A Counter/Timer Oscilloscopes. This book helps the new user learn the concepts and operation of the 11301A and 11302A counter/timer oscilloscopes.

- *Introducing the 11401 and 11402 Digitizing Oscilloscopes.* Intended for new users, this book explains the concepts and operation of the 11401 and 11402 digitizing oscilloscopes.

- The *11301 and 11302 User Reference Manual* contains detailed information about measurements the instruments can make, and instructions about how to set the oscilloscope to perform such measurements. Also, installation instructions, specifications, description of options, and details about using the 11301 and 11302 with the GPIB and RS-232-C interfaces are included here.

  or

  The *11301A and 11302A User Reference Manual* contains detailed information about measurements the instruments can make, and instructions about how to set the oscilloscope to perform such measurements. Also, installation instructions, specifications, description of options, and details about using the 11301A and 11302A with the GPIB and RS-232-C interfaces are included here.

- The *11401 and 11402 User Reference Manual* contains detailed information about measurements the instruments can make, and instructions about how to set the oscilloscope to perform such measurements. Also, installation instructions, specifications, description of options, and details about using the 11401 and 11402 with the GPIB and RS-232-C interfaces are included here.

- The *11301 and 11302 Pocket Reference* is a short-form reference. The Pocket Reference gives menus and a brief description of functions selected. External interface commands are listed with their basic syntax, and a list of error and warning messages is included.

  or

  The *11301A and 11302A Pocket Reference* is a short-form reference. The Pocket Reference gives menus and a brief description of functions selected. External interface commands are listed with their basic syntax, and a list of error and warning messages is included.

- The *11A33 Service Manual* includes information needed to check and adjust, perform diagnostic troubleshooting, repair, and otherwise service your instrument.

- The *11A33 Functional Test Procedure* manual verifies that the instrument is functioning properly.

Appendix C —Firmware Compatibility

The PROTECT command is implemented only in higher firmware versions of 11A33 and Mainframes. This appendix describes the functionality and compatibility of 11A33 and Mainframe firmware versions.

Mainframes and 11A33's may be upgraded with higher firmware versions.

For determination of firmware version installed in mainframe and plug-in, refer to instructions in the mainframe user's reference manual.

CAUTION

Replacement of firmware and installation or removal of jumper at J520 in the 11A33 must be done only by qualified service personnel.

TABLE C-1
11A33 Compatibility with Mainframe Firmware Versions

Mainframe (module)		Firmware Versions	
11301		2.2 or lower	2.3 or higher
11302		2.2 or lower	2.3 or higher
11401 (EXP)		1.40 or lower	2.0 or higher
11402 (EXP)		1.40 or lower	2.0 or higher
11A33 Firmware Version	2.0 or higher	Compatible if jumper is installed at J520 in 11A33	Compatible if jumper is removed from J520 in 11A33
	D1.9 or lower	Compatible	Incompatible

When an 11A33 is used with a mainframe equipped with a lower firmware version (left column of Table C-1) the PROTECT command is not recognized by the mainframe, so the function cannot be set or queried by a controller. Maximum input voltage selection is controlled only by the 11A33's front panel button. The maximum voltage indicator will show "50 V" after an Initialize operation.

When an 11A33 is used with a mainframe equipped with a higher firmware version (right column of Table C-1) the PROTECT command is recognized by the mainframe and 11A33, so the function can be set or queried by a controller, as well as by the 11A33's front panel button. The maximum voltage indicator will show "500 V" after an Initialize operation.

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