

PeakTech®



PeakTech® 1145 - 1170

Operation Manual

Digital Oscilloscopes

Monochrom-Display:

Modell 1145 (80 MHz)

Modell 1150 (150 MHz)

Modell 1155 (250 MHz)

Colour Display:

Modell 1160 (80 MHz)

Modell 1165 (150 MHz)

Modell 1170 (250 MHz)



Spitzentechnologie, die überzeugt

CONTENTS:

Oscilloscope:

- 1 set

Supplied accessories

- Operation manual
- Power cord
- Test probes
 - 100MHz probes x1/x10 (**PeakTech**[®] 1145 / 1160)
 - 250MHz probes x1/x10 (**PeakTech**[®] 1150 / 1155 / 1165 / 1170)
- PC Software kit(RS-232C Cable, USB Cable, PC interface Program)
- Interface Card Type A (RS-232C, Centronics, USB)

Optional accessories

- RS-232C thermal printer (Printy2 with RS-232C Cable)

1. Safety precautions

This product complies with the requirements of the following European Community Directives: 89/336/EC (Electromagnetic Compatibility) and 73/23/EC (Low Voltage) as amended by 93/68/EC (CE-Marking). Overvoltage category II; pollution degree 2.

CAT I:	For signal level, telecommunication, electronic with small transient over voltage
CAT II:	For local level, appliances, main wall outlets, portable equipment
CAT III:	Distribution level, fixed installation, with smaller transient overvoltages than CAT IV.
CAT IV:	Units and installations, which are supplied overhead lines, which are stand in a risk of persuade of a lightning, i.e. main-switches on current input, overvoltage-diverter, current use counter.

To ensure safe operation of the equipment and eliminate the danger of serious injury due to short-circuits (arcing), the following safety precautions must be observed.

Damages resulting from failure to observe these safety precautions are exempt from any legal claims whatever.

- * Do not use this instrument for high-energy industrial installation measurement. This instrument is intended for use in installation overvoltage category II according to IEC 664. For measuring circuit not exceeding 400V DC/AC.
- * Do not exceed the maximum permissible input ratings (danger of serious injury and/or destruction of the equipment).
- * The meter is designed to withstand the stated max voltages. If it is not possible to exclude without that impulses, transients, disturbance or for other reasons, these voltages are exceeded a suitable prescale (10:1) must be used.
- * Replace a defective fuse only with a fuse of the original rating. Never short-circuit fuse or fuse holding.
- * Disconnect test leads or probe from the measuring circuit before switching modes or functions.
- * Check test leads and probes for faulty insulation or bare wires before connection to the equipment.
- * To avoid electric shock, do not operate this product in wet or damp conditions. Conduct measuring works only in dry clothing and rubber shoes, i. e. on isolating mats.
- * Never touch the tips of the test leads or probe.
- * Comply with the warning labels and other info on the equipment.
- * Do not subject the equipment to direct sunlight or extreme temperatures, humidity or dampness.
- * Do not subject the equipment to shocks or strong vibrations.
- * Do not operate the equipment near strong magnetic fields (motors, transformers etc.).
- * Keep hot soldering irons or guns away from the equipment.
- * Allow the equipment to stabilize at room temperature before taking up measurement (important for exact measurements).
- * Do not input values over the maximum range of each measurement to avoid damages of the meter.
- * Do not turn the rotary function switch during voltage or current measurement, otherwise the meter could be damaged.
- * Use caution when working with voltages above 35V DC or 25V AC. These Voltages pose shock hazard.
- * Replace the battery as soon as the battery indicator "BAT" appears. With a low battery, the meter might produce false reading that can lead to electric shock and personal injury.
- * Fetch out the battery when the meter will not be used for long period.
- * Periodically wipe the cabinet with a damp cloth and mild detergent. Do not use abrasives or solvents.
- * The meter is suitable for indoor use only
- * Do not operate the meter before the cabinet has been closed and screwed safely as terminal can carry voltage.
- * Do not store the meter in a place of explosive, inflammable substances.
- * Do not modify the equipment in any way
- * Opening the equipment and service – and repair work must only be performed by qualified service personnel
- * **Measuring instruments don't belong to children hands.**

Cleaning the cabinet

Prior to cleaning the cabinet, withdraw the mains plug from the power outlet. Clean only with a damp, soft cloth and a commercially available mild household cleanser. Ensure that no water gets inside the equipment to prevent possible shorts and damage to the equipment.

2. Introduction

2.1. Key Features

The 16bit high speed microprocessor adoption enables the scope to acquire a typical 100,000 points per second and quickly update the picture on the screen.

Basic memory length is 32kB. Captured waveforms can be zoomed in and analyzed in detail. Also its built-in 10ns peak detection circuit enables it to capture high frequency noise even at a low speed time/div and magnify and analyze it using the zoom-in function.

In addition, it can save up to 10 waveforms and provide diversified analysis function like FFT which is available on high priced products.

Models **PeakTech**® 1160/1165/1170 have a 15 cm width LCD-Colour-Display with 320x240 Pixel, models **PeakTech**® 1145/1150/1155 have a Monochrome-Display.

2.2. General Features

- 80MHz bandwidth(**PeakTech**® 1145/1160), 2 CH dual digitizer
- 150MHz bandwidth(**PeakTech**® 1150/1165), 2 CH dual digitizer
- 250MHz bandwidth(**PeakTech**® 1155/1170), 2 CH dual digitizer
- 100MS/s simultaneous maximum sampling rate per channel, 200MS/s sampling rate for one channel only
- 25GS/s equivalent sampling rate per channel
- 10ns peak detection for glitch capture even in ROLL mode
- Max. 400Vpp input voltage into all channels

2.3. Convenient Functions

- Direct single trigger capture function using a hot-key
- Simultaneous 5 waveform information auto measurement and FFT analysis
- Auto trigger level setting to 50%
- Saving 10 waveforms & 10 setup parameters

2.4. Operating Environment

This instrument will operate to its specifications if the environment is maintained within the following conditions.

- Indoor use
- Altitude up to 2000m use
- Operating temperature 0 ~ 40°C
- Relative humidity ≤ 80%
- Main supply voltage fluctuations not exceed 10% of the nominal voltage.
- After turning on the instrument, please allow a pre-heating period of as long as some 15 minutes.

2.5. Safety Symbols



Refer to accompanying documents for Safety-related information. Wherever the symbol is present, see "NOTES FOR A SAFETY OPERATION" part in this manual.



Ground

WARNING max. Input Voltage 400 Vp

WARNING:

Risk of hazard which may cause injury to human body or danger to life. If a WARNING appears on the instrument, and in this manual, do not proceed until its suitable conditions are understood and met.

CAUTION

Risk of hazard which causes fire or serious damage to the instrument or other equipment. Do not proceed until its suitable conditions are met.

2.6. Power Source-related warnings

Protection of Power Cord and Unplugging

Power-supply cords should be routed so that they are not likely to be waked on or pinched by items placed upon or against them, paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the instrument. For added protection for this instrument during a lightening storm, when it is left unattended and unused for long periods of time, unplug it from the power source. This will prevent damage to the instrument due to lightening and power-line surges.

Overloading

Do not OVERLOAD power source and extension cords as this can result in a risk of fire or electric shock.

2.7. Place-related warnings

Object and Liquid Entry

Never push objects of any kind into this instrument through openings as they may touch dangerous voltage points or short out parts that could result in a fire or electric shock. Never spill liquid of any kind on the instrument. Do not use this instrument near water- for example, near a bath tub wash bowl, kitchen sink, or laundry tub, in a wet basement, or near a swimming pool, and the like. Keep the instrument away from damp air, water and dust. Unexpected trouble may be caused when the instrument is placed in a damp or dusty place.

FLAMMABLE AND EXPLOSIVE SUBSTANCE

Avoid using this instrument where there are gases, and where there are flammable and explosive substances in the immediate vicinity.

Unstable Location

Do not place this instrument on an unstable cart, stand, tripod, bracket, or table. The instrument may fall, causing serious injury to a person, and serous damage to the instrument. Do not place or use the instrument in a place subject to ventilation.

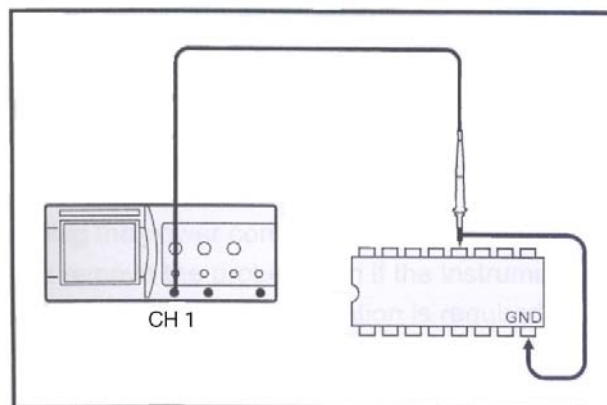
2.8. Operation-related warnings

Power Switch

Before plugging the power cord in be sure to check that the power switch is set to off for protection of the instrument.

Ground Connection

When connecting a probe , connect the ground side of the probe to the ground of the signal source. At a floating status, a potential might be produced with respect to other devices or ground, resulting in damaging the instrument, probe, other measuring instruments, etc.



Excessive Input Voltage

In order to avoid electric shock or fire, the input voltages to the probes, BNC connectors are specified as follows. Do not apply higher voltages. Before using probe, check the rated voltage with the naked eye. Remove the unused probe not to contact with ambient high voltage parts. If you apply a higher voltage more than 400Vpk , remove the probe out of BNC terminals to ensure against accidental danger

Maximum Input Voltage - CH1, CH2 all 400 V _p

2.9. Service-related warning

Damage Requiring Service

Do not attempt to service this instrument yourself as opening or removing covers may expose you to dangerous voltage or other hazards. Unplug this instrument from the power source and after servicing to qualified service personal under the following conditions

- When the AC power cord or plug is damaged.
- When the LCD is damaged.
- If liquid has been spilled, or objects have fallen into the instrument.
- If the instrument does not operate normally by following the operating instructions. Adjust only those controls that are covered by the operating instructions as an improper adjustment of other controls may result in damage and will open require extensive work by a qualified technician to restore the instrument to instrument to its normal operation.

Unplug the power cord from the power source before opening the cover, and then remove the probe. Even if the instrument is disconnected from all the power sources, special attention is required in service as the inside capacity might be in charged condition. When replacement of fuses or other parts is required, be sure the service technician has used replacements parts specified by the manufacturer or have the same characteristics as the original part. Unauthorized substitutions may result in fire, electric shock or other hazards.

There is a risk of electric shock. No user serviceable parts inside. Leave repair to qualified personnel.

Safety Check

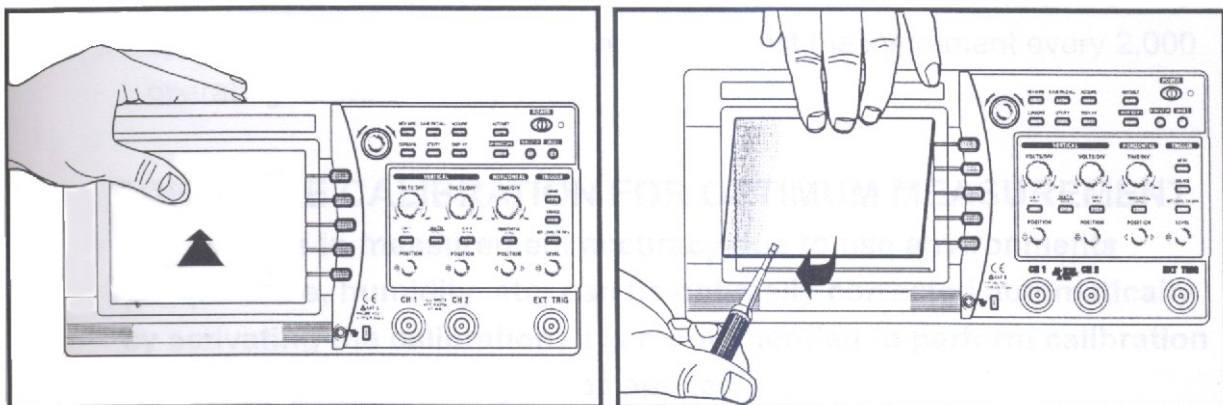
Upon completion of any service or repairs to this instrument, ask the service technician to perform safety checks to determine that the instrument is proper operating condition.

2.10. Cleaning and Maintenance

Maintenance routines performable by the operator are listed in this section. More advanced routines (i.e., Procedures involving repairs or adjustments within the instrument) should be referred to service personnel.

Cleaning

If the outside of the case becomes dirty or stained, carefully wipe the surface with a cloth moistened with detergent, then wipe the cleaned surface with a dry cloth. In case of severe stain, try cleaning with a cloth moistened with alcohol. Do not use powerful hydrocarbons such as benzene or paint thinner. Dust and/or smudges can be removed from the LCD screen. First remove the front case and filter. Clean the filter (and the LCD face, if necessary) by wiping carefully with a soft cloth or commercial wiping tissue moistened with a mild cleaning agent. Take care not to scratch them. Do not use abrasive cleanser or strong solvents. Let the cleaned parts dry thoroughly before reinstalling the filter and front case. If it is installed wet, dew may form and blur the waveforms. Be particularly careful not to get fingerprints on the filter or LCD face.



Maintenance

This instrument should never be placed in a built-in installation such as a bookcase or rack unless proper ventilation is provided. Ideal ambient temperature and relative humidity for storing the instrument are 23°C and 60% RH.

3. Notes to users

3.1. Notice for proper measurement

It is recommended to allow about 15 minutes after power on as warm up time before starting measurement. Traces may drift a little just after power on. When measuring a signal with high accuracy trace declination, you can correct the trace position using the automatic calibration function. Before starting up this function, allow enough warm-up time. The calibration is classified into software calibration for resorting to the automatic calibration function in the menu, and hardware calibration for optimizing the internal circuitry in a wide range.

1. The software calibration is recommended when the ambient temperature has excessively changed (5) or when 1000 operating hours or 6 months has been attained. If the trace is displayed excessively or when it is desired to optimize the measurement, execute it referring to the automatic calibration. Before calibration, disconnect all inputs for accurate adjustment.
2. The hardware calibration is necessary to keep the instrument to a stable operation status. It is recommended to adjust the instrument every 2,000 operating hours or every year.

SOFTWARE CALIBRATION FOR OPTIMUM MEASUREMENT

The changes in measurement accuracy due to use environments (temperature, humidity, etc) can be optimally corrected automatically by activating the calibration. It is recommended to perform calibration when any of the following cases applies.

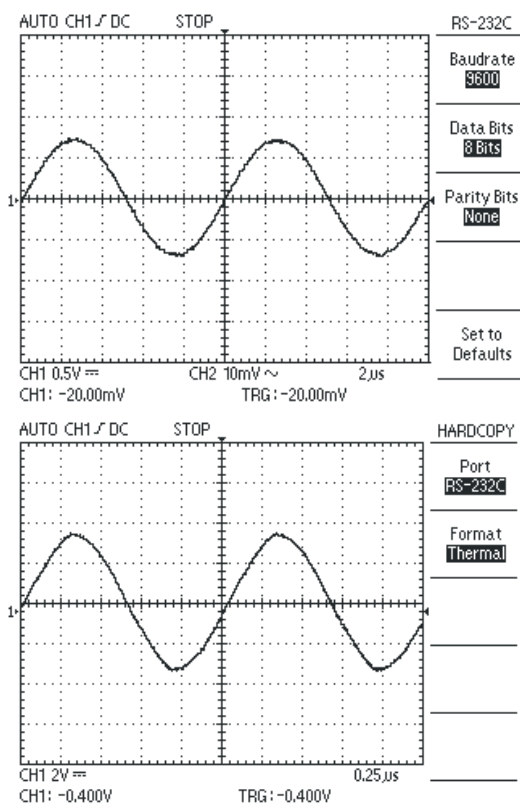
- Before a customer starts to use this instrument first
- When an ambient temperature changes more than 5, compared with that at the time of the previous calibration.
- Every 6 months or 1000 operating hours
- Optimization of measurement accuracy is required

3.2. WHEN CONNECTING PERIPHERAL DEVICES

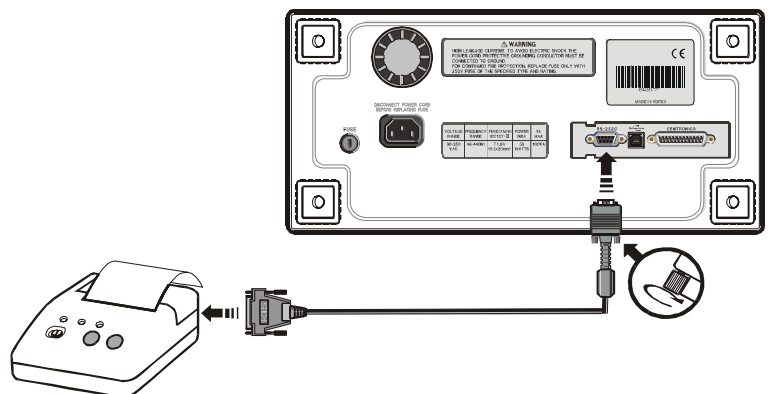
When connecting a printer and a personal computer to the oscilloscope, be sure that the oscilloscope, the printer and the personal computer are all off, and then connect them. Pay attention to the direction of the cables and the ports of the peripheral devices. Before operation, be sure to carry out the setting necessary for the printer and the personal computer. (For the setting of the printer and the personal computer, refer to the operation manual for each) If you operate the printer and the personal computer which are improperly set, abnormal operation will occur. In this case, turn off the instrument, the printer and the personal computer at once, and set them properly again and operate them.

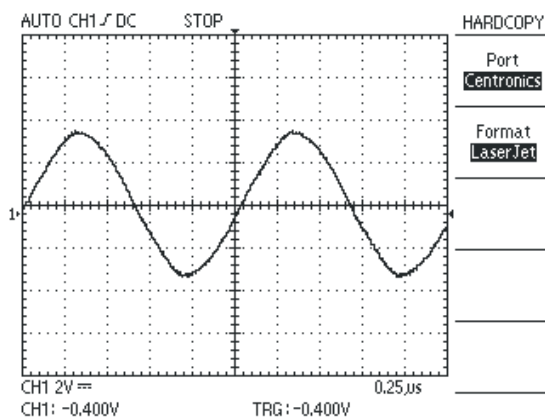
Note:

Before using peripheral devices, Interface card should be installed in this instrument.

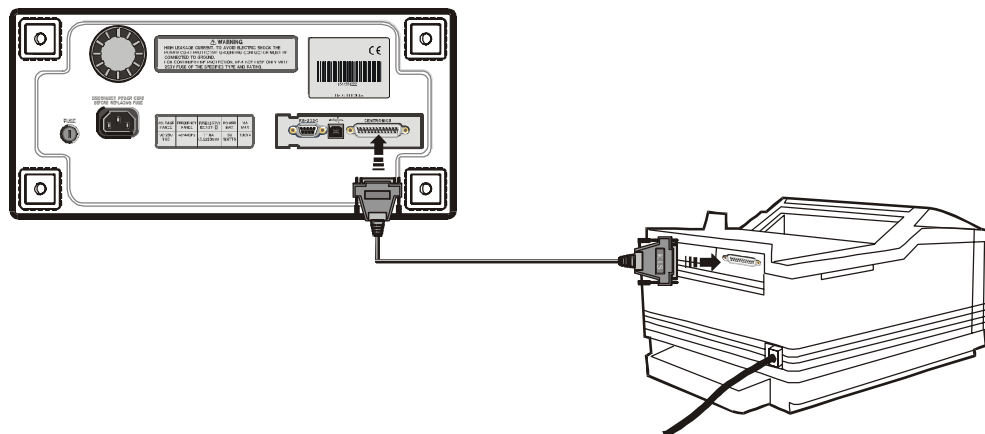


- BAUD RATE : 9600 bps
- PARITY BIT : None
- DATA BIT : 8 bit
- * RS-232C Serial cable is 9pin (male) to 25pin(male) null cable.
- * RS-232C thermal printer is



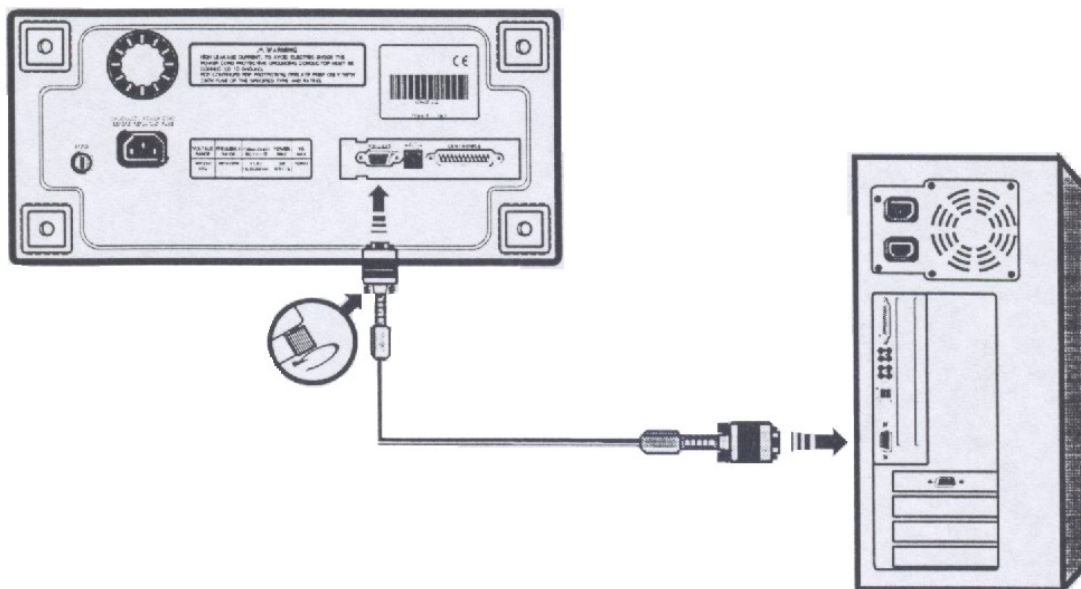


- * This instrument supports DeskJet and LaserJet with PCL level 3
- * DeskJet , LaserJet is registered trade mark of HP.



When using PC communication operation, RS-232C settings are as follows

Before communicating with a PC, the PC software kit(option) should be installed in your PC. If you want to have more detailed information, refer to the PC software kit manual.

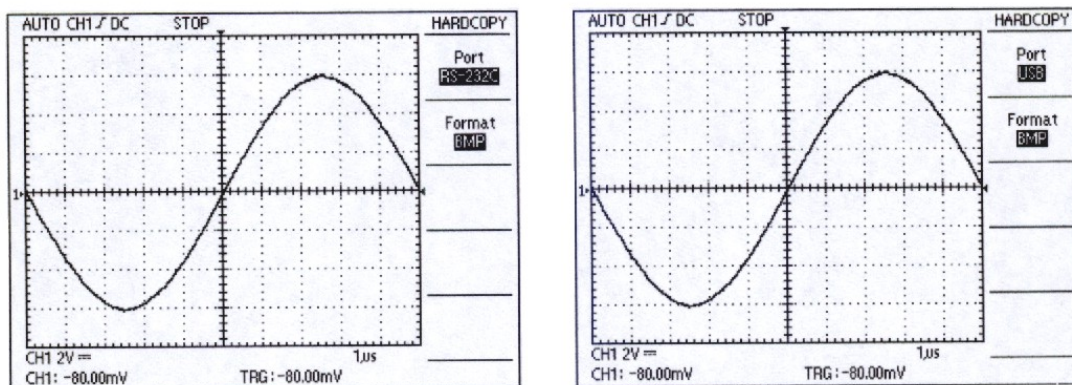
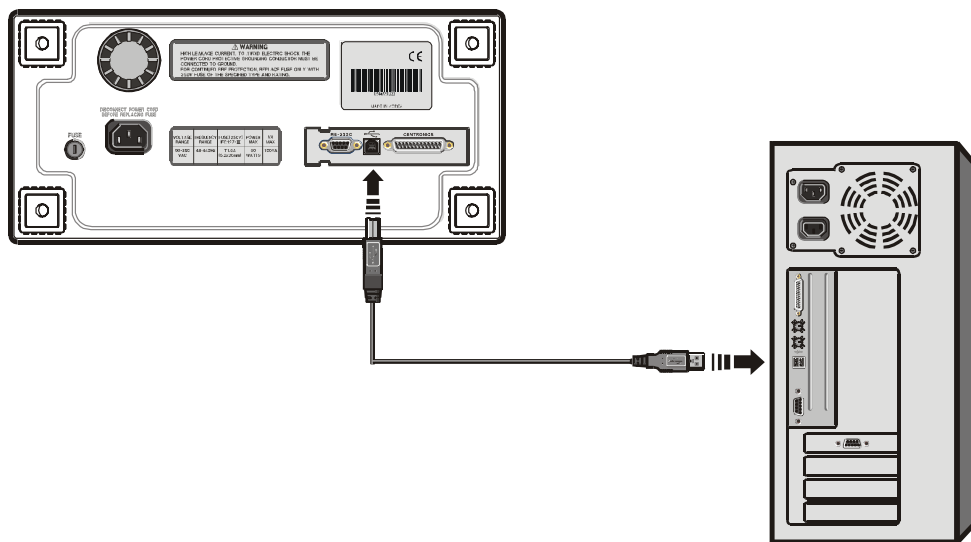


When using PC communication operation, the USB settings are as follows

Before communicating with a PC, the PC software kit (optional) should be installed in your PC, and the interface card with USB should be installed in your instrument. The USB protocol is spec V1.1.

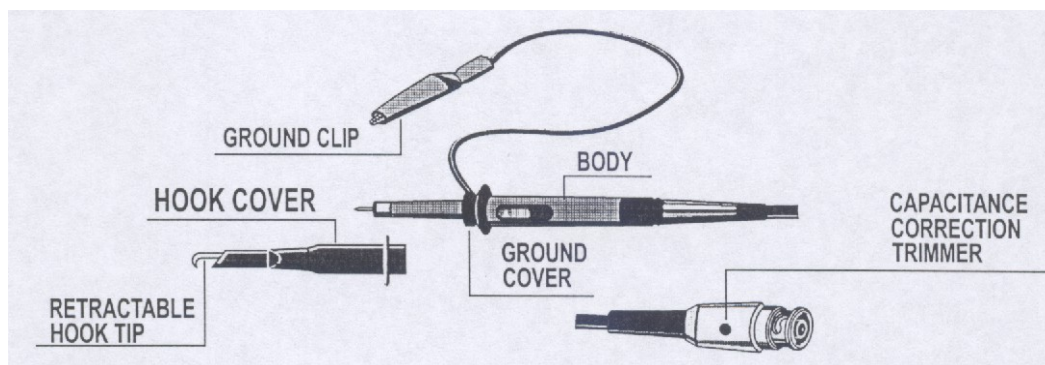
For more detailed information, refer to the PC software kit manual.

If users want to connect the instrument with the computer and use it, the port needs to be set to the connection format between them and the transmission format needs to be set to the BMP format.



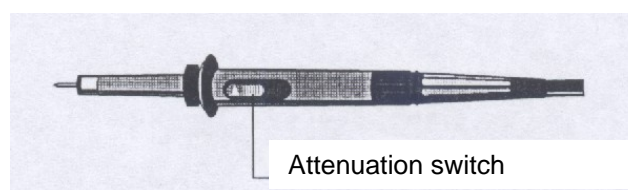
3.3. Probe

The first step of measurement is to connect the signals to the instrument properly.



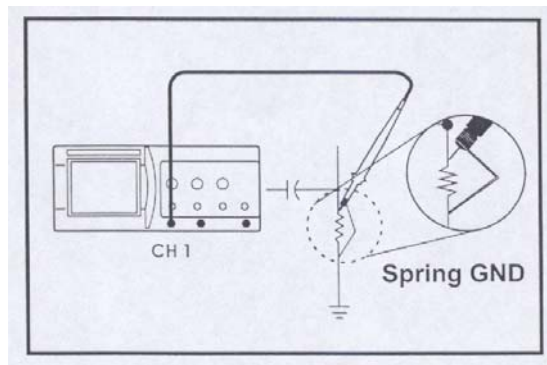
Probe attenuation setting

When the optional probe is used with the x10 / x1 select switch set to x10, the input signal to the instrument is attenuated to 1/10. When a signal is too small to be measured with x10, use the mode x1. In this case, note that the input impedance of x1 is different from that of x10, and the measurable frequency band becomes very low.

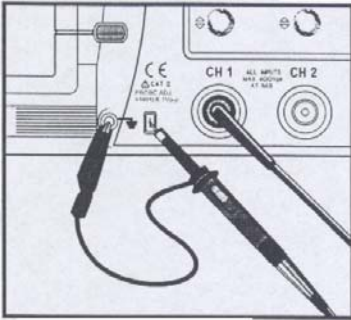


Probe Grounding

Connect the probe ground lead as close as possible to the point being measured especially when measuring a signal with a fast rise time or a high frequency signal. Long probe ground leads may cause waveform distortions, such as ringing and overshoot.

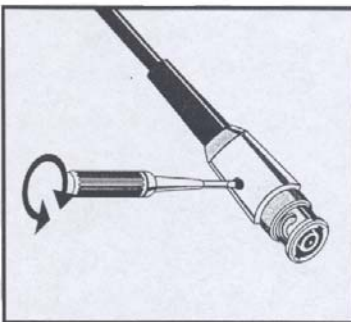


Probe-compensation



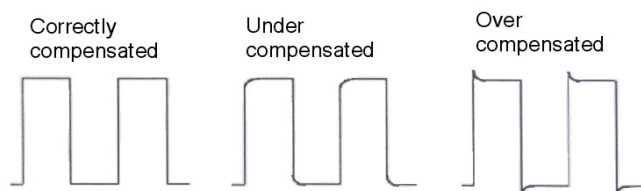
The probe switch setting is 10X. To avoid a measurement error, probe compensation must be done. Especially when the probe is changed. Connect the probe tip to the CAL 1V output terminal.

A 1 kHz square wave should be displayed with flat tops. Any distortion in the left presentation is caused by incorrect probe compensation.



If overshoot or undershoot is present, turn the screwdriver adjustment in the probe for a flat-top presentation.

Be sure that the attenuation switch on the probe is set to match with the probe menu selection in the oscilloscope. This adjustment remains in effect until changed again.

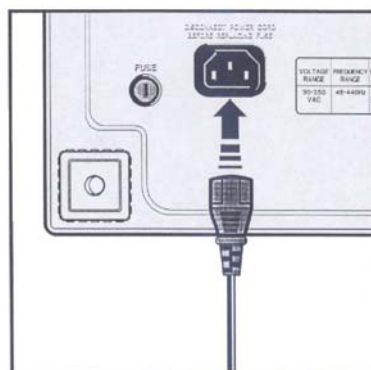


Probe compensation by correction square-wave

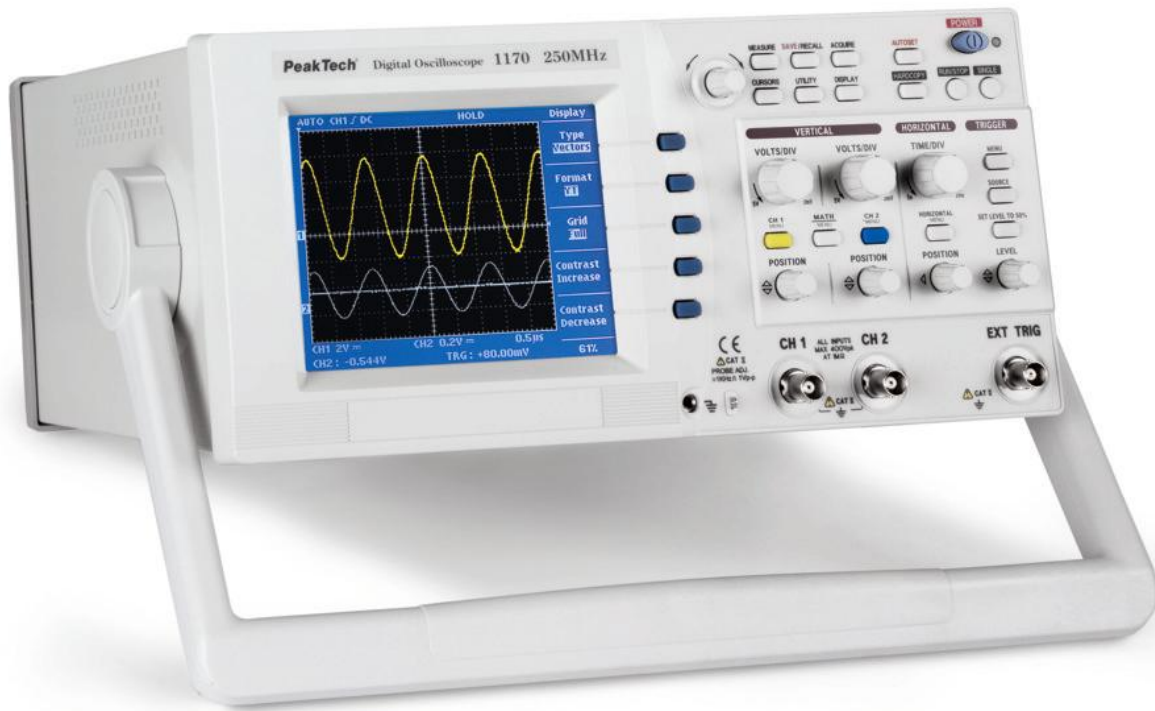
3.3.1. Power Cord

Caution !

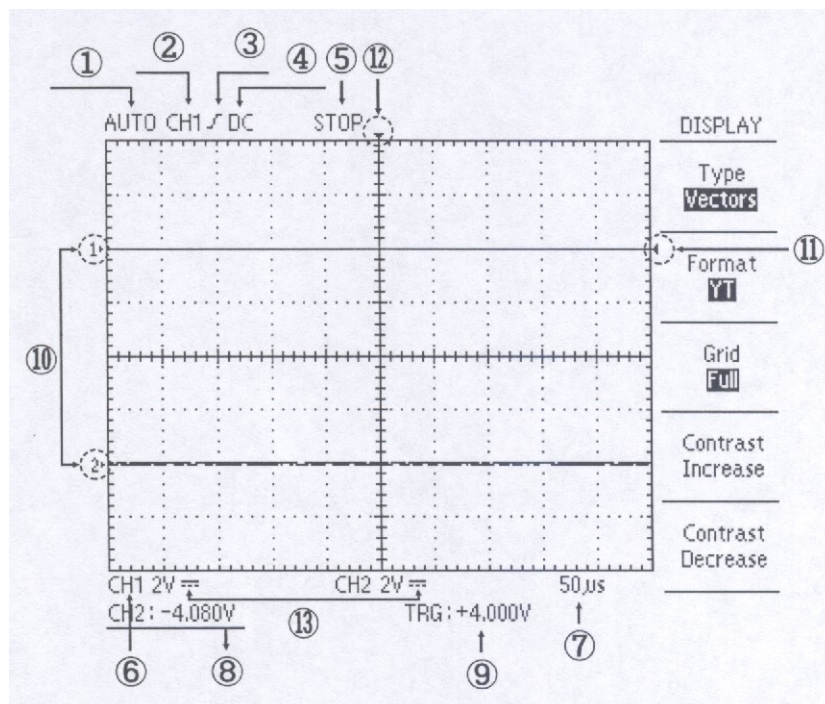
Use only power cords designed for your oscilloscope. Use a power source that delivers 90 to 250 V AC_{rms}, 48 to 440 Hz.



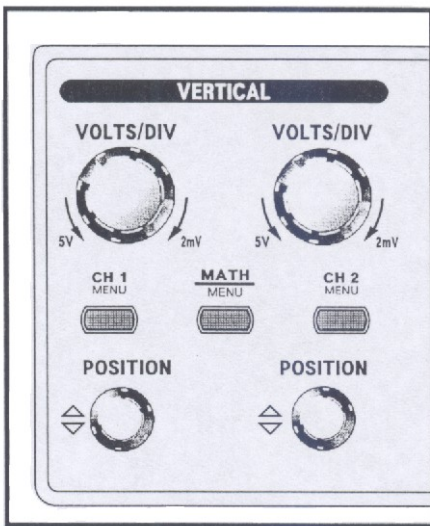
4. Description



4.1. Display Overview



4.2. Vertical axis operation



VOLTS/DIV (CH1, CH 2)

Adjusts vertical scale factor of the scope waveform.

CH 1, CH 2 MENU

Shows the channel function and channel waveform display on and off.

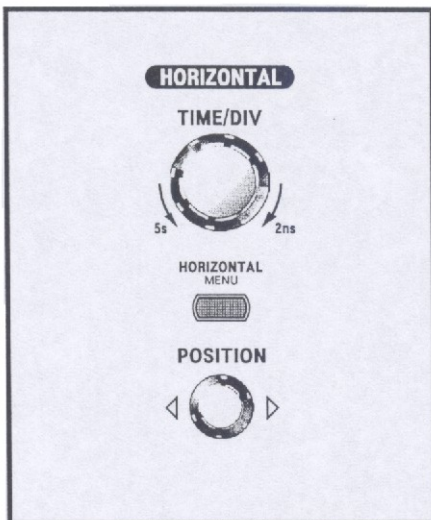
MATH MENU

Shows the math function.

CH 1, 2 POSITION

Adjusts vertical position of the scope waveform.

4.3. Horizontal axis operation



TIME/DIV

Adjusts horizontal axis scale factor of the scope.

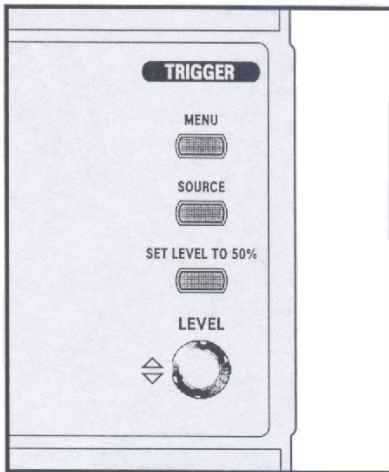
HORIZONTAL MENU

Shows the horizontal function.

POSITION

Moves horizontal axis position of the scope.

4.4. Trigger



TRIGGER MENU

Adjust the trigger mode.

TRIGGER SOURCE

Select the trigger signal source.

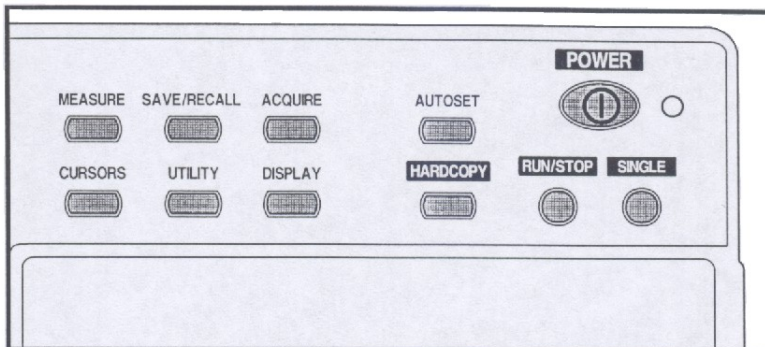
SET LEVEL TO 50%

Set the trigger level to the middle of the scope waveform.

TRIGGER LEVEL

Selects a starting point of triggered signal.

4.5. Menus



MEASURE

Controls the measurement functions.

SAVE/RECALL

Controls the save/recall functions.

ACQUIRE

Controls the acquire mode.

Cursors

Controls the cursor functions.

UTILITY

Sets the utility functions.

DISPLAY

Sets the display mode.

AUTOSET

Automatically displays the optimum waveform of input signals.

HARDCOPY

Prints the waveform.

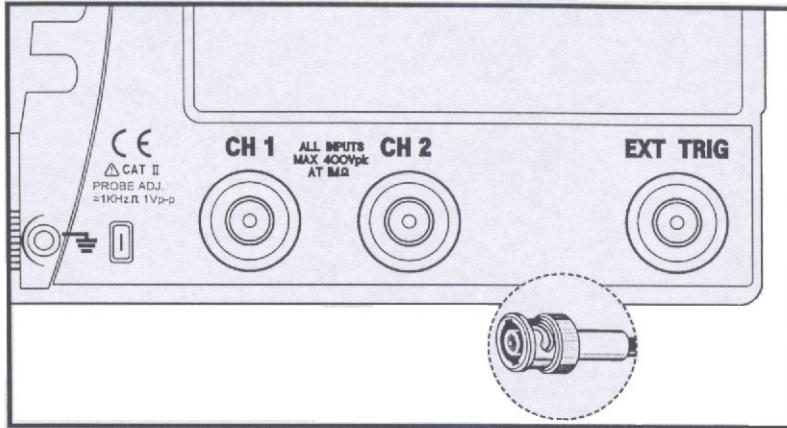
RUN/STOP

Controls the waveform acquisition.

SINGLE

Captures a non-periodic signal and a long-periodic signal.

4.6. Connectors



Probe adjustment

This outputs square wave(1V, 1kHz) for the probe compensation.

CH 1, CH 2.

Connects input signal to the channel vertical amplifier. CH1 becomes a signal of X -axis during X-Y operation and CH2 becomes a signal of Y-axis during X-Y operation.

EXT TRIG.

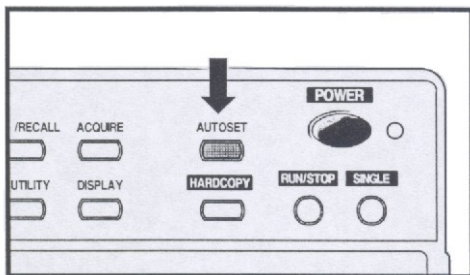
Connects a external trigger signal to the trigger circuit.

4.7. The menu box button and function knob

When you press a menu button on the front panel, the associated menu title displays at the top right screen. There can be up to five menu boxes below the menu title. To the right of the each menu box is bezel button you can use to change the menu setting.

5. Menus

5.1. Autoset



The front panel setting are automatically performed so that the optimum waveform is displayed for an input signal and changes itself in succession. With this function, the following items can be automatically set according to the characteristics of an input signal.

Function Setting	Setting
Vertical coupling	AC
Trigger type	Edge
Trigger coupling	Adjusted to DC
Trigger slope	Rising
Trigger mode	Auto

Condition

The autoset function is available only for a stable, repetitive input signal. For a stable operation, an input signal is essential to meet the following conditions.

a) Frequency : 50Hz ~ maximum bandwidth, typical

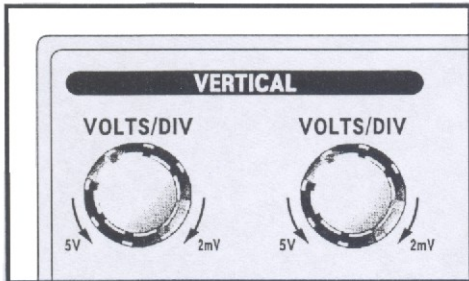
b) Amplitude : more than 60mV

Note

If these conditions are not satisfied, the following message is displayed below the screen : " Unable to autosetup "

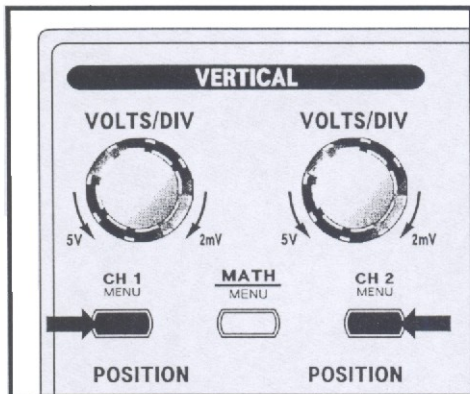
5.2. Vertical

Following description on switches are applied to both CH1 And CH2 equally.



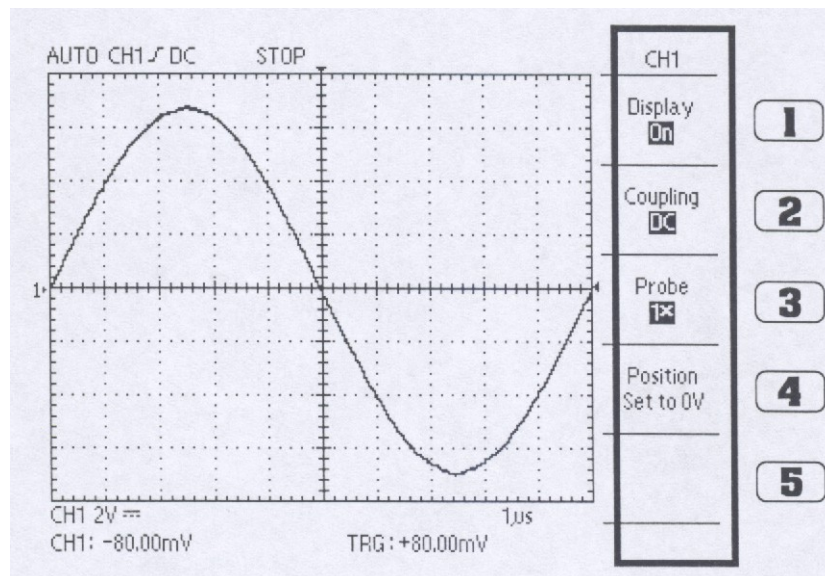
VOLTS/DIV

The vertical axis sensitivity can be set by the VOLTS/DIV switch of the CH1 and CH2.



Menu

There is a separate vertical menu for each channel. Each item is set individually for each channel.



1) Display. (On/Off)

CH1 or CH2 is selected and displayed by pressing this switch, and both channels can be selected and displayed at the same time. Whenever this switch is pressed, channel display function is operated repeatedly.

2) Coupling. (AC/DC/Ground)

Three input coupling modes are available. Select the desired coupling mode by the DC/AC/GND switch. The selected coupling mode is displayed at the bottom left of the screen. Whenever the switch is pressed, coupling of input signal is operated in the sequence of AC, DC and Ground.

AC: Displayed on the screen in the form of "~". An input signal is connected to the amplifier via a capacitor. Its DC component is cut and only AC component is displayed.

DC : Displayed on the screen in the form of "—". An input is directly connected to the amplifier, and the signal including a DC component is displayed.

Ground : Displayed on the screen in the form of "⏏". An input signal is separated and the input of the vertical amplifier is grounded.

3) Probe . (X1 / x10 / x100 / x1000)

Set this to match your probe attenuation factor to make the vertical scale readout correct

x1 : when 1:1 probe is used or signal is directly connected to the coaxial cable, x1 is selected

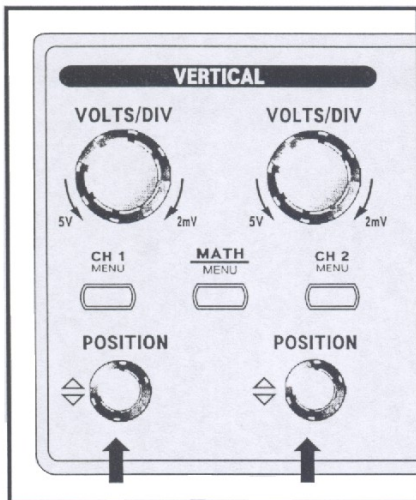
x10 : when 10:1 probe is used , x10 is selected.

x100 : when 100:1 probe is used, x100 is selected.

x1000 : when 1000:1 probe is used , x1000 is selected.

4) Position Set To 0

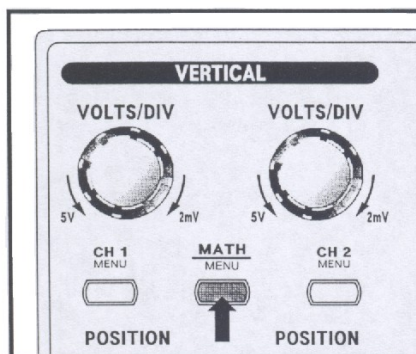
Set the offset to 0V. Offset performs a function similar to the vertical position knob.



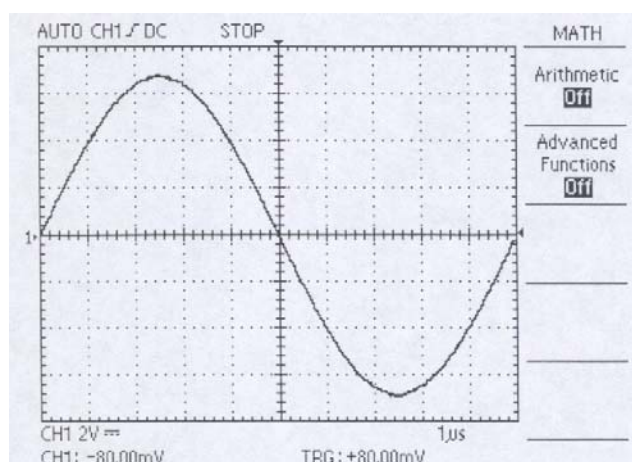
POSITION

The displayed waveform can be moved up and down by the position knob. When the knob moves to right, waveform moves down and when the knob moves to left, waveform moves up.

5.3. MATH

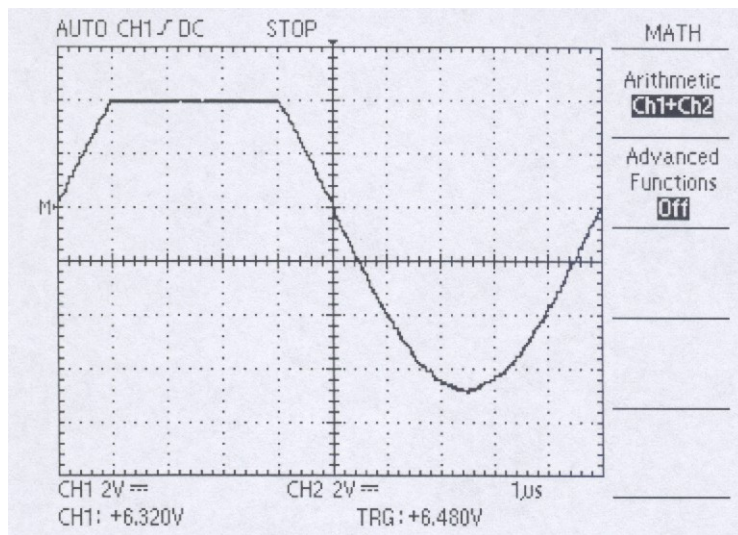


When this switch is pressed, arithmetic and advanced function are displayed.



1) Arithmetic

(Off/CH1+CH2/CH1-CH2/CH2-CH1/CH1 Invert/CH2 Invert)

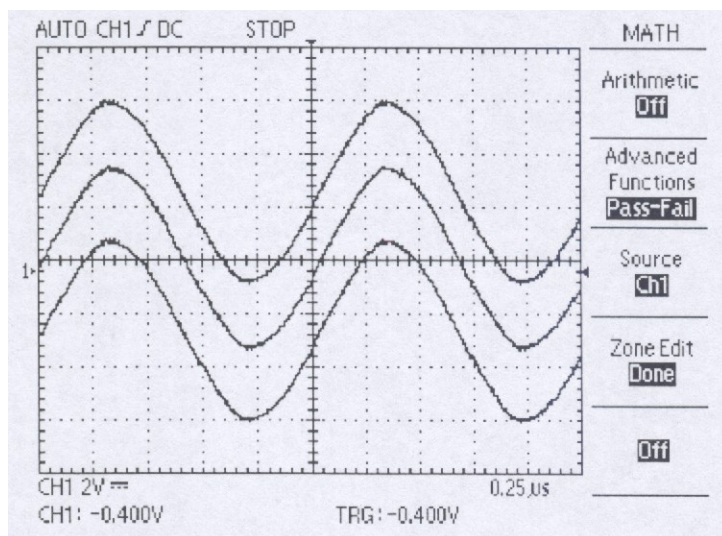


Addition, subtraction and inversion arithmetic of the two channels are able to be carried out to Ch1 or Ch2 by Arithmetic.

- Off :** This cancels the arithmetic function.
- Ch1 + Ch2 :** This displays a waveform which adds signals of two channels.
- Ch1 - Ch2 :** This displays a waveform which subtracts Ch2 from Ch1.
- Ch2 - Ch1 :** This displays a waveform which subtracts Ch1 from Ch2.
- Ch1 Invert :** This displays an inversed waveform signal of Ch1.
- Ch2 Invert :** This displays an inversed waveform signal of Ch2.

Displaying a math waveform automatically removes the display of channels used to create the math waveform. Math operations are turned off if a channel used in the operation is turned on.

2) Advanced Functions (Off/Pass-Fail/FFT)



- Off :** This cancels the Advanced functions.
- Pass-Fail :** User sets the judgement range of Pass-Fail displayed on the screen and compares it with acquired waveforms. When this menu is selected, submenu On, Off, Ch1, Ch2 and Edit are displayed. This function is automatically canceled when XY format display is operated, AUTOSET is operated, Measure menu is operated, ROLL mode is operated, Arithmetic function is operated or Cursor function is operated.

Source (Ch1/Ch2)

- CH1 :** Be selected judgement area as "to be edited signal source" and "to be compared signal source".
- CH2 :** Be selected judgement area as "to be edited signal source" and "to be compared signal source".

Zone Edit (Off/Upper Side/Lower Side/Done)

- Off :** This clears all judgement area currently set on the screen and cancels comparing function. But the data in the memory are not cleared.
- Upper Side :** This decides to be edited portion from upper portion of the waveform. The edited portion be adjusted to use function knob. And it only moves to the upper side of the reference waveform. This mode don't use the others menu except the function knob.

Lower Side : This decides to be edited portion from lower portion of the waveform. The edited portion be adjusted to use function knob. And it only moves to the lower side of the reference waveform. This mode don't use the others menu except the function knob.

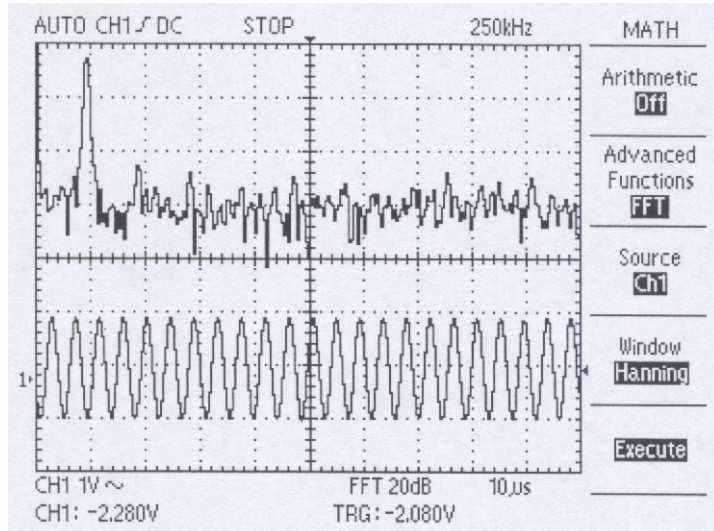
Done : This performs a operation of comparing judgement area set by user with acquired waveform. When acquired waveform is in judgement area, RUN is maintained, and when acquired waveform is get out of the judgement area, STOP is displayed and waveform is stopped. When comparing function is necessary again, maintain RUN by pressing RUN/STOP switch. The waveform is regenerated when selecting On after setting Off

Off/On

Off : Selects not to activate PASS-FAIL function.

On : Selects to activate PASS-FAIL function.

FFT



This allows acquired waveforms to be converted into frequency-domain traces, revealing valuable spectral information that would otherwise be impossible to detect on a time-domain record.

Source (CH1/CH2)

CH1 : CH1 is selected source as to be transformed FFT.

CH2 : CH2 is selected source as to be transformed FFT.

Window (Rectangle/Hamming/Hanning)

Rectangle : Transforms to rectangular mode.

Hamming : Transforms to hamming mode.

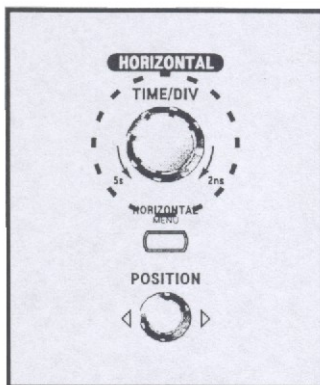
Hanning : Transforms to hanning mode.

Execute/Calculating

Execute : Calculates the FFT. After calculate, display of the waveform is stopped.

Calculating : Displays the status of calculating.

5.4. Horizontal

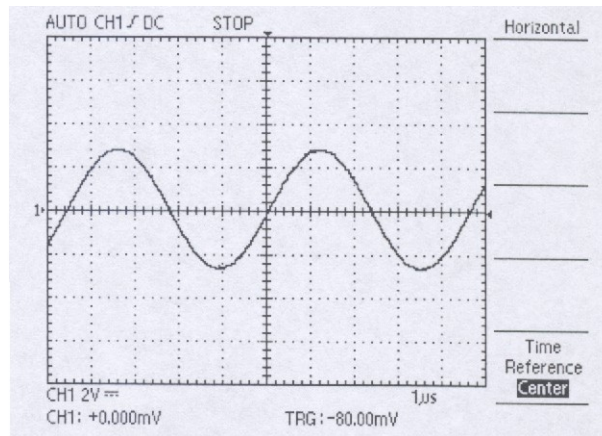
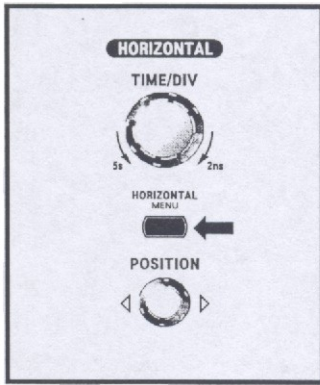


TIME/DIV.

A time axis range can be set by the TIME/DIV knob. When the knob turn to 5s, TIME/DIV is slow in and turn to 2ns, TIME/DIV is fast in.

MENU

Set the horizontal menu.

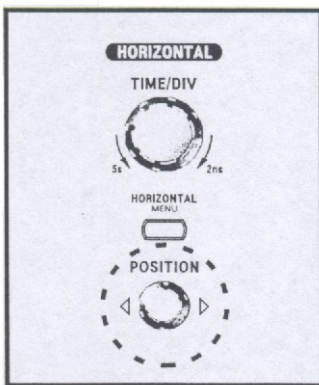


Time Reference (Centre/Right/Left)

Control position of horizontal trigger.

- Centre :** Set the position of horizontal trigger to the centre of screen.
Right : Set the position of horizontal trigger to the right of screen.
Left : Set the position of horizontal trigger to the left of screen.

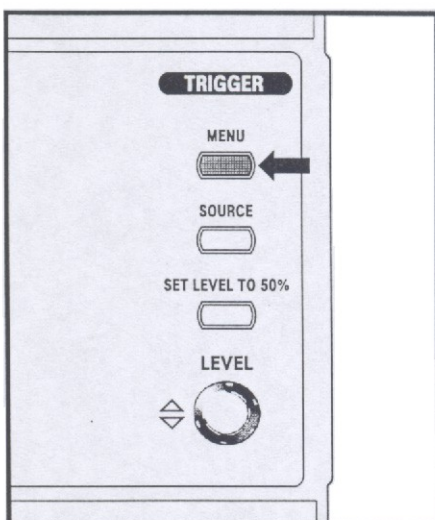
POSITION



Displayed waveform can be moved left and right.

5.5. Trigger

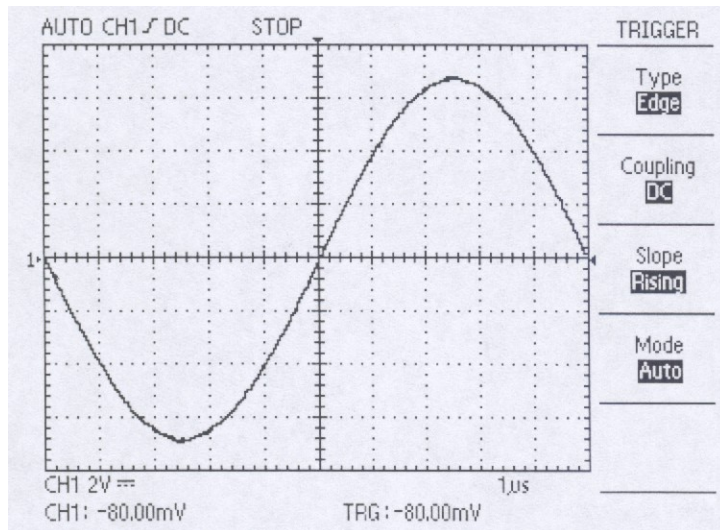
MENU



Two types of triggering are available: Edge and TV. A different set of menus display for each trigger type.

1) Type (Edge/TV): Edge

Use edge triggering to trigger on the edge of the input signal at the trigger threshold.



Coupling(AC/DC/HF Reject/LF Reject) :

This function decides which part of the signal is transferred to the trigger circuit. That is, desired coupling type is selected between trigger source signal and trigger circuit by this switch. When coupling switch is pressed, AC, DC, HF Reject and LF Reject are displayed in sequence.

AC :

Only AC component is passed through in the signal and DC component is removed from the trigger signal.

DC :

Trigger signal which includes DC signal is coupled. Trigger is applied when DC level of signal intersects with setting trigger level.

HF Reject (High frequency rejection) :

This function interrupts a high frequency component of triggering signal. So, only the low frequency component is passed through triggering system and then captured. Interruption of high frequency reduces a signal with 300kHz or more.

LF Reject (Low frequency rejection) :

This function interrupts low frequency component of triggering signal. Interruption of low frequency reduces a signal with 1kHz or less.

Slope(Rising/Falling) :

This function decides at which place the trigger point is found out, rising edge or falling edge. This function displays a status of slope setting behind "coupling". Screen display of rising edge is " " and falling edge is " "

Mode(Auto/Normal/Single) :

When MODE function is pressed, AUTO, NORM and SINGLE are displayed in sequence. Setting of trigger mode is displayed at the top left of the screen.

Auto :

Without trigger, waveform is able to be captured by this function. When AUTO mode is triggered forcibly without triggering, note that it is not synchronized with the waveform of display. In other words, successive capture is not triggered at same point on display. Therefore, waveform seems to cross and roll on the screen.

Normal :

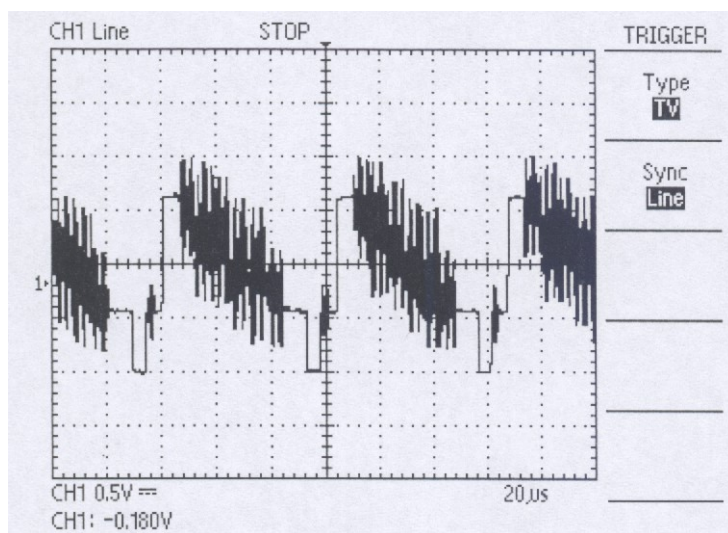
When Trigger is operated, oscilloscope is able to capture the waveform by this function. Without trigger, oscilloscope does not capture the waveform.

Single :

Trigger is able to be operated with NORM mode. However, when trigger is operated in long period or non-periodic signal, it is in the status of STOP, and when trigger is not operated, oscilloscope is in stand-by status until the trigger is restarted.

2) Type (Edge/TV): TV

Use TV triggering to trigger on the TV signal.



Sync (Line/Field)

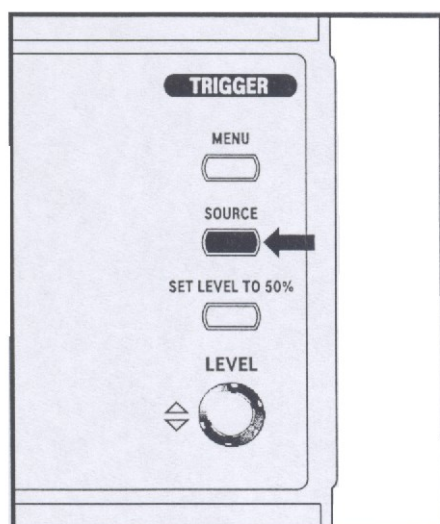
Line :

This function is solely used in the observation of TV signal and trigger is applied to horizontal synchronization signal.

Field :

Trigger is applied to vertical synchronization signal.

SOURCE



With this function, Trigger is able to be selected from the source such as CH1, CH2, EXT or LINE. The channel which is selected as trigger source performs a function of trigger source without connections with display. After the display of "mode setting", source setting is displayed on screen.

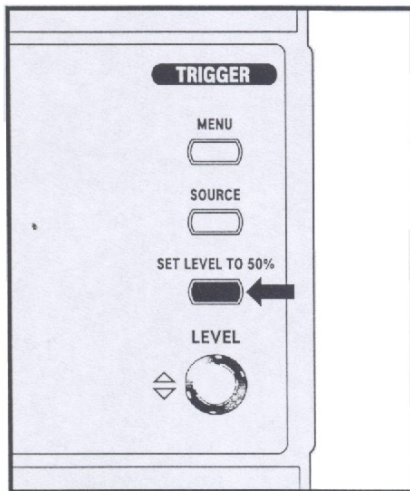
CH1 : Input signal of CH1 is used as trigger source.

CH2 : Input signal of CH2 is used as trigger source.

EXT : When trigger is operated with signals from external clock or other parts of the circuit, or in case an auxiliary trigger is used, connect the external trigger signal to the EXT terminal.

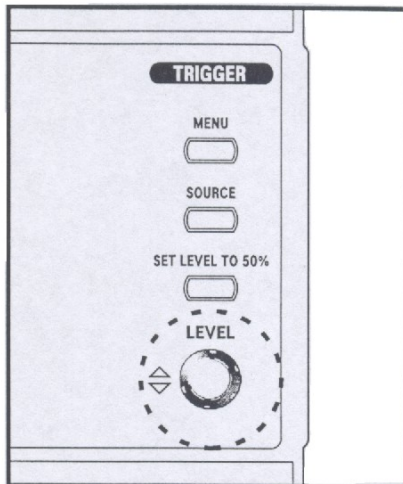
LINE : The LINE trigger source uses the line voltage signal as the trigger source.

SET LEVEL TO 50%



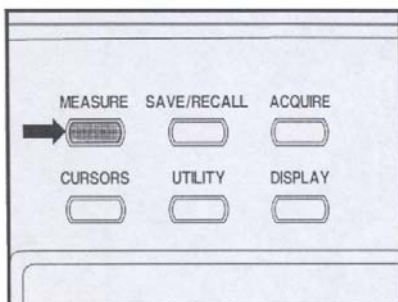
This function automatically sets a trigger source signal within the 50% of trigger level range. When trigger coupling is AC or LF Reject, the 50% of trigger level is set at the centre of GRID vertical axis. When trigger coupling is DC or HF Reject, it is set at the 50% of trigger source signal amplitude.

LEVEL

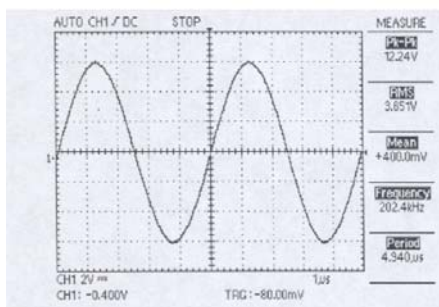


With this function, trigger level is adjusted to the signal level before entering into triggering. Trigger point decides a occurring point on edge. When the knob turn to the right, edge level moves up and turn to the left, edge level moves down.

5.6. Measure



Push the MEASURE button to access the automated measurement capabilities. It has the ability to display up to five parameters at a time. When this menu is selected, submenu NONE, Pk-Pk, RMS, Mean, Frequency, Rising Time, Falling Time, Period, +Width, -Width and Duty are displayed.



NONE: This cancels the measuring functions of parameter.

Pk-Pk :

This displays a Peak to Peak value of the waveforms of the currently displayed channels. That is, absolute gap between maximum and minimum amplitude is displayed with volt. When input signal is out of the ADC input range, "?" is displayed. Maximum value and minimum value are equal, "Invalid" is displayed.

RMS :

This displays a Root Mean Square value of 1 cycle of the waveforms of currently displayed channels. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of 1 cycle is less than 0.4 division on display, "?" is displayed. When 1 cycle is not captured, "Invalid" is displayed.

Mean :

This displays a mean value of 1 cycle of currently displayed waveforms. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of cycle is less than 0.4 division on display, "?" is displayed. When 1 cycle is not captured, "Invalid" is displayed.

Frequency :

This displays a frequency value of 1 cycle of currently displayed waveforms. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of 1 cycle is less than 0.4 division on display, "?" is displayed. When 1 cycle is not captured, "Invalid" is displayed.

NONE :

This cancels the measuring functions of parameter.

Rising Time :

This displays a rising time of currently displayed waveforms. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of 1 cycle is less than 0.4 division on display, "?" is displayed. when 1 cycle is not captured, "invalid" is displayed.

Falling Time :

This displays a falling time of currently displayed waveforms. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of 1 cycle is less than 0.4 division on display, "?" is displayed. When 1 cycle is not captured, "Invalid" is displayed.

Period :

This displays a period of 1 cycle of currently displayed waveforms. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of 1 cycle is less than 0.4 division on display. When 1 cycle is not captured, "Invalid" is displayed.

+ Width :

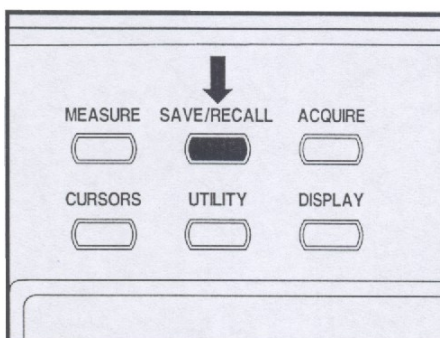
This displays a positive width of 1 cycle of currently displayed waveforms. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of 1 cycle is less than 0.4 division on display, "?" is displayed. When 1 cycle is not captured, "Invalid" is displayed.

- Width :

This displays a negative width of 1 cycle of currently displayed waveforms of channel. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of 1 cycle is not captured, "Invalid" is displayed.

Duty :

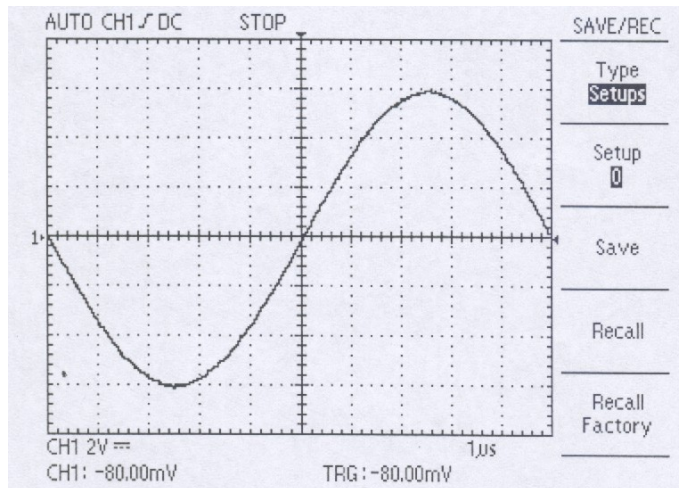
This displays a duty ratio of 1 cycle of currently displayed waveforms of channel. When range of input signal is out of the ADC input range, peak to peak value is less than 2 division, or width of 1 cycle is less than 0.4 division on display, "?" is displayed. When 1 cycle is not captured, "Invalid" is displayed.

5.7. SAVE/RECALL

This function is able to save waveforms and setup conditions of present working environment and they can be recalled by the user. It is used in setting simple working environment and for waveform comparison. The saved information could be preserved for a time even if the inside battery is completely discharged or disconnected from the main body.

1) Type (Setups/Waveform): Setups

This operates the function to save present working condition into memory space.



Setup (0/1/2/3/4/5/6/7/8/9):

The menu displays the memory space to save information, and it is able to save up to 10 setup conditions. They don't overlap with memory space for waveforms.

Save:

The saved setup information includes the conditions of input coupling, display, volts division, trigger mode, trigger coupling, trigger source, trigger slope, trigger level, cursor information, probe factor, LCD brightness, display format, display type, acquisition type and interface card setup.

Recall:

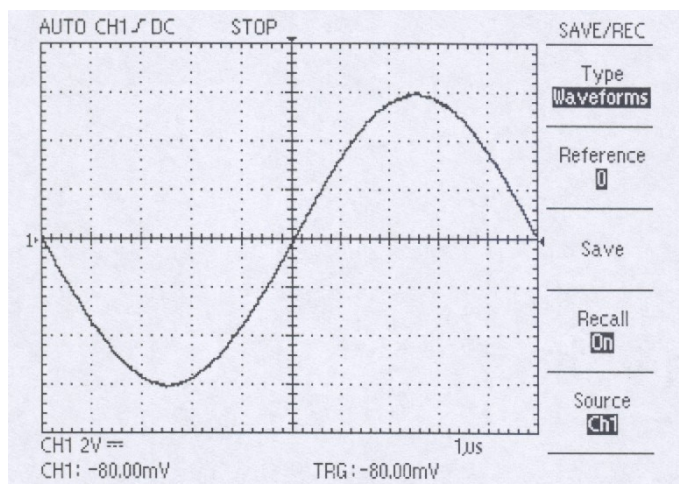
Recalls the instrument settings stored in the location chosen in the setup space.

Recall Factory:

You can recall the default Factory Setup to initialize the instrument to a known setup.

2) Type /Setups/Waveform): Waveforms

This operates the function to save waveform being displayed at present into memory space.



Reference (0/1/2/3/4/5/6/7/8/9)

This function displays the memory space to save waveforms, and it is able to save 10 waveforms. The memory space doesn't overlap with that for setup condition.

Save:

Stores the source waveform to the chosen reference location.

Recall:

Turns the reference waveform display on or off.

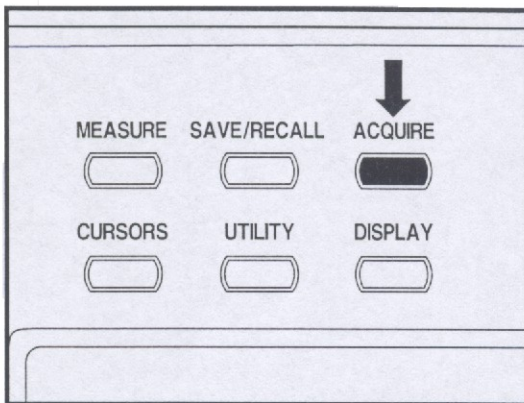
On : you will be in the mode from which the waveform was saved.

Off: This menu operates to cancel present displayed waveforms and to return to the former waveforms.

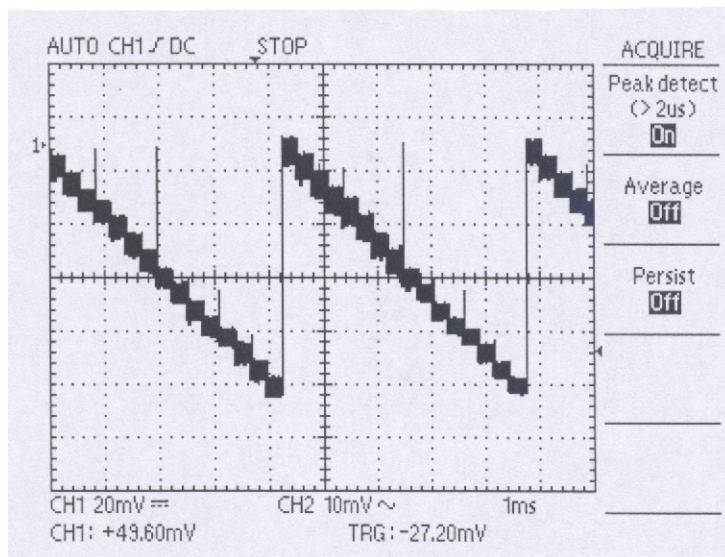
Source (CH 1/CH 2):

Choose the waveform source to store.

5.8. Acquire



Push the ACQUIRE button to set acquisition parameters.



1) Peak detect (On/Off)

Off : Cancels the peak detect mode.

On : Acquires the peak value of the input signal. This mode is able to detect glitches.

2) Average (Off/2/4/8/16/32/64/128)

In this mode, next signal is doubled as much as the reciprocal number of average frequency from the current signal. This mode is used to reduce a distortion of display resulting from noise in signal. The numbers next to Avg are weighted value.

3) Persist (Off/On)

Refresh or overwrite mode is able to be selected by Persist.

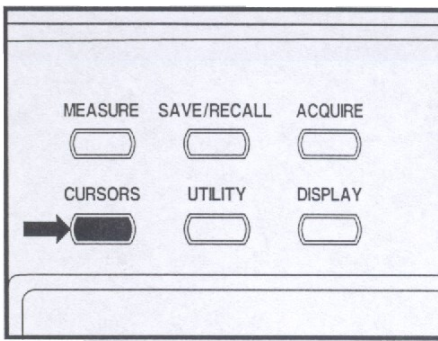
Off :

This selects refresh display mode. In this mode, only the newly acquired data are displayed.

On :

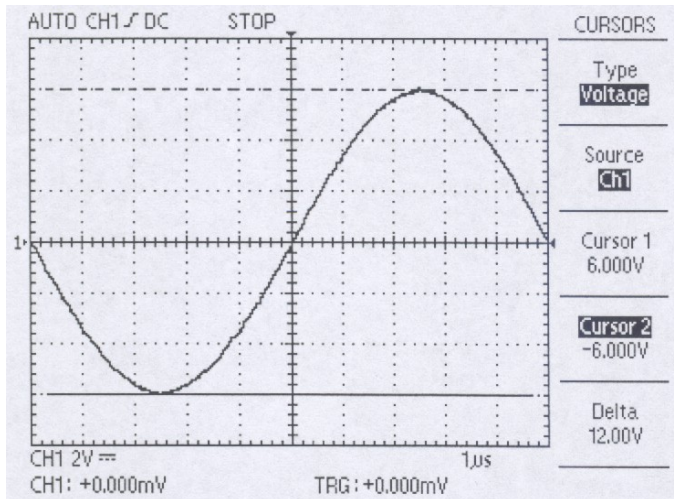
This selects overwrite display mode. In this mode, newly acquired data are displayed upon previously acquired data. This mode is used to observe noise of signal, etc.

5.9. Cursors



The user can operate the cursor by himself and measure the voltage or time of displayed waveform. These functions can be stopped or canceled automatically in the modes of MEASURE, PASS-FAIL setting, XY format.

1) Type (Off/Voltage/Time)



This is used to set the type and on/off mode of cursor. Pressing this button, OFF, Voltage and Time are changed in sequence. At every time, present measuring value is showed up at the menu display.

Off :

This cancels the cursor mode

Voltage :

Measuring the voltage of vertical parameter. Two horizontal cursors show up.

Time :

Measuring the time of horizontal parameter. Two vertical cursors show up.

2) Source (CH 1/CH 2)

Choose the waveform on which to take the cursor measurement.

3) Cursor 1

Displays cursor 1 location.

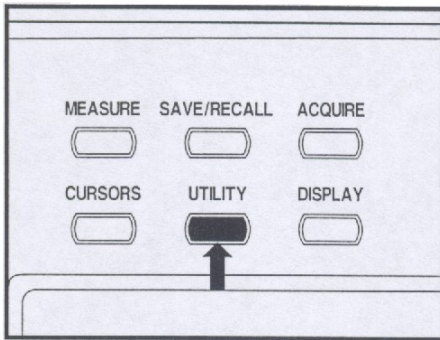
4) Cursor 2

Displays cursor 2 location.

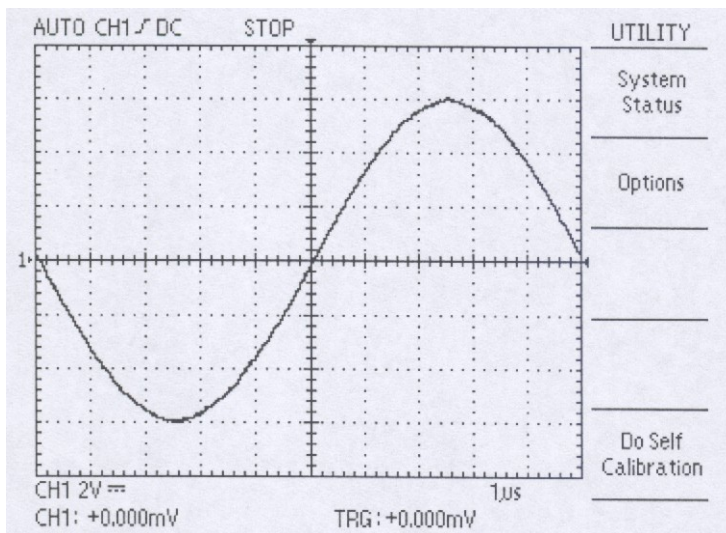
5) Delta

Display the gap between cursors .Use the function knob to move the cursors. You can move the cursors only while the cursor menu is displayed.

5.10. Utility

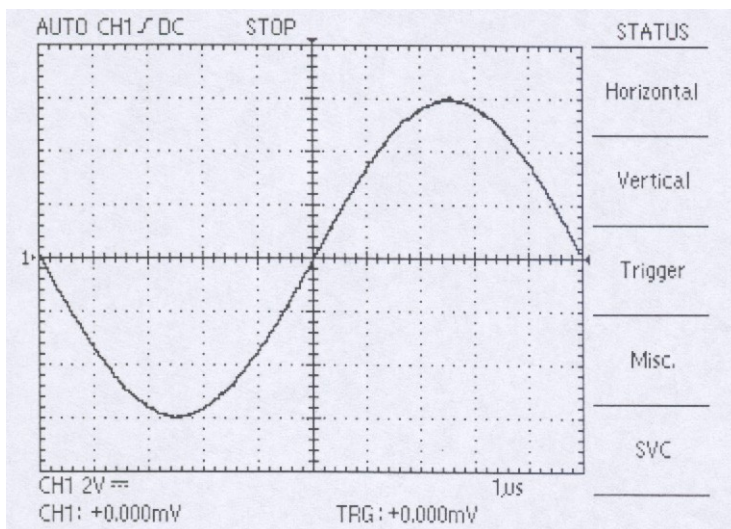


Push the UTILITY button to display the UTILITY menu. The UTILITY menu is changed with the addition of interface modules. The menu explained here relates to the product without module installed. Refer to the manual supplied with your interface module for items not discussed here.



1) System Status

Selecting System Status from the utility menu displays the menus available for obtaining a list of control settings for each group of instrument controls.



Vertical : Lists vertical parameters of channels.

Horizontal : Lists horizontal parameters of channels.

Trigger : Lists trigger parameters

Misc : Shows the information. That is the software version and processor release level. If the option module is installed, the setting of RS-232C and the setting of hardcopy are add.

SVC : This menu is only used for the service engineer.

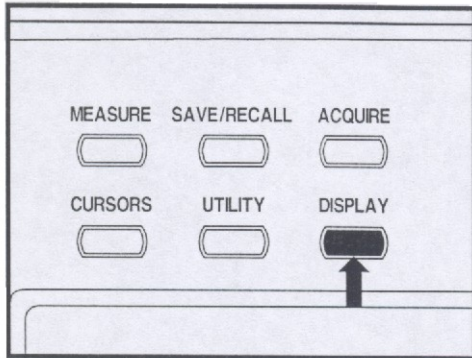
2) Options:

This menu changes with the addition of option modules. The menus explained here relate to the product with no modules installed. Refer to the manual supplied with your option module for items not discussed here.

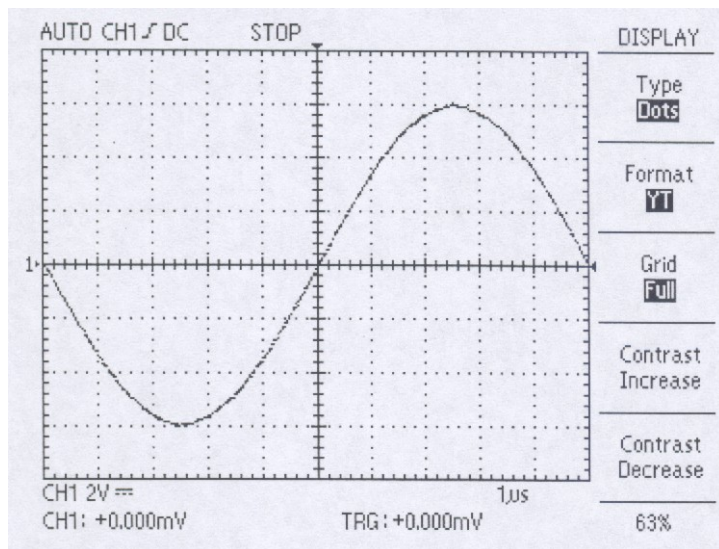
3) Do Self Calibration:

To operate calibration, " Do Self Calibration" is selected. In order to perform proper correction, be sure to remove all the input signals and probe of input connector before carry out above function.

5.11. Display



Push the DISPLAY button to choose how waveforms are presented and to change the appearance of the entire display.



1) Type (Dots/Vectors)

This selects connection mode of acquired waveform data.

Dots : Acquired waveform data are displayed on the screen only in the form of dots.

Vectors : Dots of the acquired waveform data form a line and are displayed on the screen. As dots form a line, square waveform signal or rising edge of pulse is able to be easily observed. This is not operated in XY format mode.

2) Format (YT/XY)

Display mode of waveform is selected by format.

YT : This is a normal type of display and shows a change of signal with the lapse of time.

XY : User compares waveforms of two channels by dots and is able to get phase difference between the signals. Using this menu.

3) Grid (Full/Cross/Board)

This menu sets the type of measuring grid.

Full : Frame, axis and grid are all displayed. By using this scale, adjust waveform to the scale and then measure the value of the waveform data.

Cross : Frame and axis are displayed. Cross measures a waveform by moving a waveform to the center of the screen.

Board : Only the frame is displayed. When scale is not necessary in measuring the data value of the waveform, or when cursor or field display is not necessary, this mode is selected.

4) Contrast Increase

Brightness of LCD is brightened by the stage of 5%.

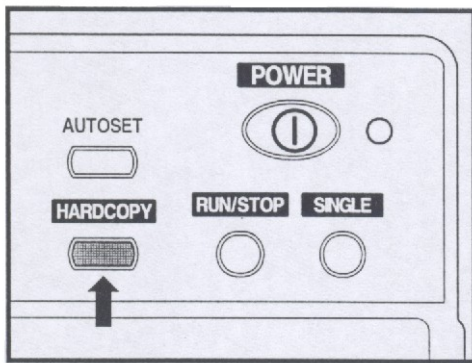
5) Contrast Decrease

Brightness of LCD is darkened by the stage of 5%.

6) Function Knob

Brightness of LCD is changed by the stage of 1%.

5.12. Hardcopy



Push the HARDCOPY button to print a hard copy of the display. The hardcopy function requires that an interface card with Centronics or RS-232C be installed and connected to a printer. Refer to the manual supplied with your interface card for instructions on connecting and using the interface card.

To use Hardcopy, the instrument needs to be set appropriately. The setting can be adjusted under "Options" in the "Utility"-menu. Detailed information about setting the menu can be referred to "NOTES TO USERS".

Hardcopy supports 3 types: BMP, Centronics, Thermal.

BMP

BMP type is enabled only when used to interface with the PC. To use BMP as a Hardcopy, required are additional programs that enables the PC to receive and save the BMP format. Using PeakTech's Softview will facilitate saving in the BMP format with ease and convenience. RS232C and USB are both supported, but USB is faster in saving. Softview operates under Windows 98/2000.

Centronics

Centronics type is needed to send the screen data to a printer directly. Centronics type supports HP's PCL level 3 Deskjet and Laserjet printers in general. Even if the brand differs, if the printer has a mode compatible with the PCL level 3 or lower, it's possible to use. Most printers support this format. However, printers that provide the PCL format only through software on PCs and the HP 700 printer series are not supported. Concerning detailed information for PCL format availability, refer to the printer user's manual or visit the printer maker's homepage

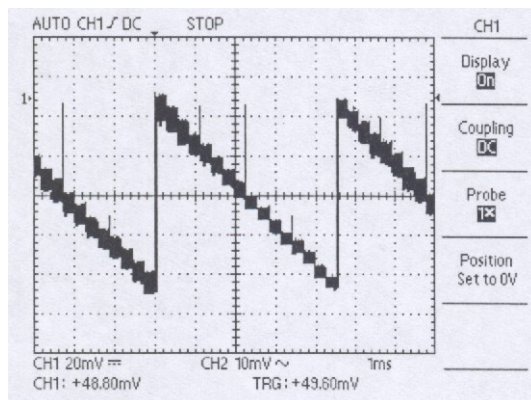
Thermal

Thermal type is enabled only by using SANEI's Printy2 thermal printer that supports RS-232C interface.

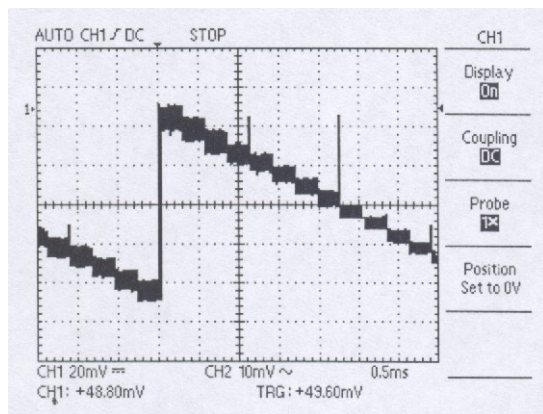
6. Using the functions effectively

6.1. Using the Zoom-function

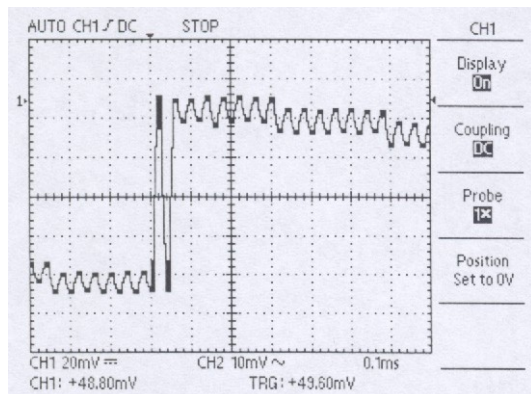
First of all, set oscilloscope to be in stop status by using RUN/STOP button. When you change time/div rotary switch in stop status, waveform is zoomed in. Following figures show zoom function.



When Oscilloscope is RUN status, Push RUN/STOP button. Oscilloscope will be in STOP status.



Use TIME/DIV switch to magnify a waveform. Move TIME/DIV switch to lower time division and you will see a magnified waveform.



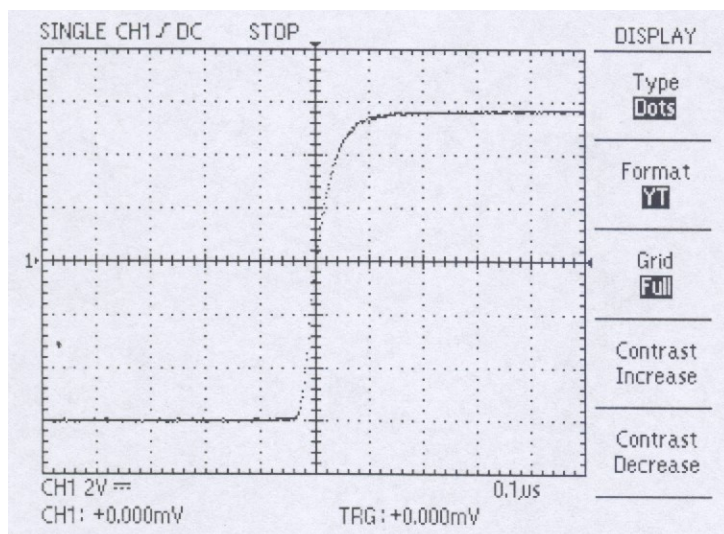
If you want to have more magnified waveform. Move TIME/DIV switch to the next lower time division.

6.2. Using the Single-function

To capture a single waveform or a noise effectively, do the following steps

1. Adjust the VOLTS/DIV and TIME/DIV to proper ranges.
2. Push the ACQUIRE button and choose Peak Detect On if you want to see the peak value or Peak Detect Off if not.
3. Push the TRIGGER MENU button and select the signal slope.
4. Adjust the trigger level by using the TRIGGER LEVEL knob.
5. Push the SINGLE button on the top of the panel or select single mode in the trigger mode menu. Then, you can see the single ready condition on the top of the screen. "RUN" means ready condition, "STOP" means the end of single capture.

If you want to set single ready condition again, only push the **SINGLE** button or the **RUN/STOP** button.



6.3. Using FFT (Fast Fourier Transformation)

With Fast Fourier Transform (FFT), you can transform a waveform from a displayed value of its amplitude against time to one that plots the amplitudes of the several discrete frequencies the waveform has. Use FFT in the following applications:

- Analyzing impulse response of filters and Amplifier
- Analyzing noise in DC power source
- Measuring harmonic content and distortion in systems
- Analyzing harmonics in 50 and 60 Hz power lines
- Analyzing vibration frequency

The FFT computes and displays the frequency content of a waveform you acquire as an FFT math waveform. This frequency domain waveform is based on the following equation:

$$X(k) = \frac{1}{N} \sum_{n=0}^{N-1} x(n) e^{-j2\pi kn/N}$$

Where: $x(n)$ is a point in the time domain record data array
 $X(k)$ is a point in the frequency domain record data array
 n is the index to the time domain data array
 k is the index to the frequency domain data array
 N is the FFT length
 j is the square root of -1

Procedure of using FFT:

1. Push the math menu button
2. Push the menu button of the advanced function to select FFT.
3. Select FFT source channel
4. Select FFT window (Rectangular, Hamming, Hanning)
5. Push the menu button of stop

Rectangular

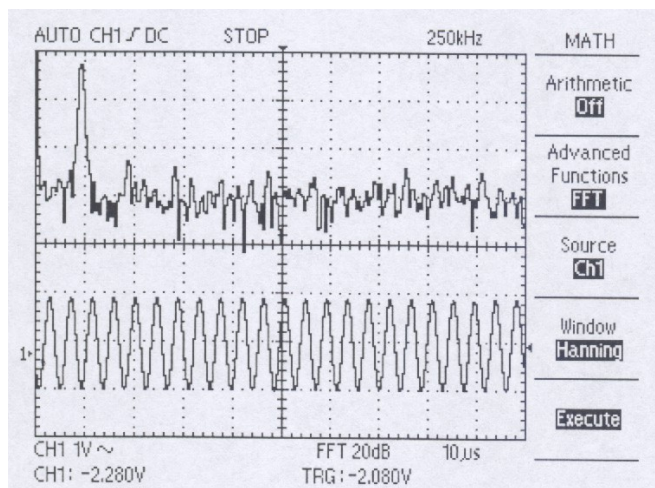
Best window for resolving frequencies but worst for accurately measuring the amplitude of those frequencies. Best window for measuring the frequency spectrum of non-repetitive signals and measuring frequency components near DC.

Hamming

Very good type for resolving frequencies with somewhat improved amplitude accuracy over the rectangular window.

Hanning

Very good for window measuring amplitude accuracy but degraded for resolving frequencies.



Note:

The FFT math waveform vertical scale is dBVRMS, which is dB relative to 1 VRMS (0 dB = 1 VRMS).

7. Application examples

7.1. Understanding Major-Functions

7.1.1. Using "Utility" for Calibration

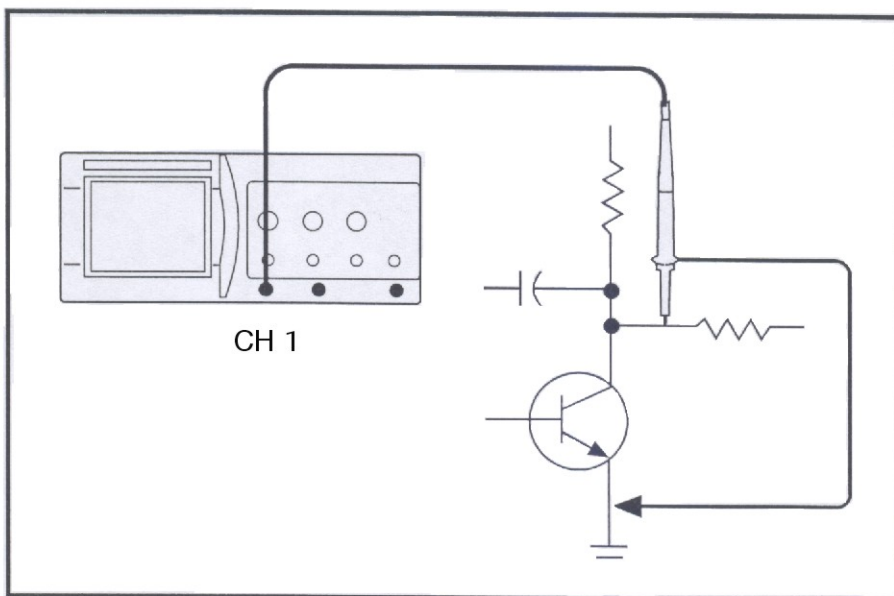
Before you start making any measurements, it might be useful to use UTILITY function and to choose Self-calibration to prepare the oscilloscope. This process may take a few minutes.

7.1.2. Using "AUTOSET"

Suppose you set up the oscilloscope, put the probe to some target, and want to see the signal rapidly with no detailed information of the signal like the frequency and amplitude. You can do this with AUTOSET function. Using this is simple:

1. Set the probe attenuation to 10X and connect to the circuit.
2. Press AUTOSET next to the POWER button. The oscilloscope will automatically display the waveform with certain amplitude and frequency.

Consider the simple setup below:



7.1.3. Using "HORIZONTAL" and "VERTICAL" knobs to adjust display

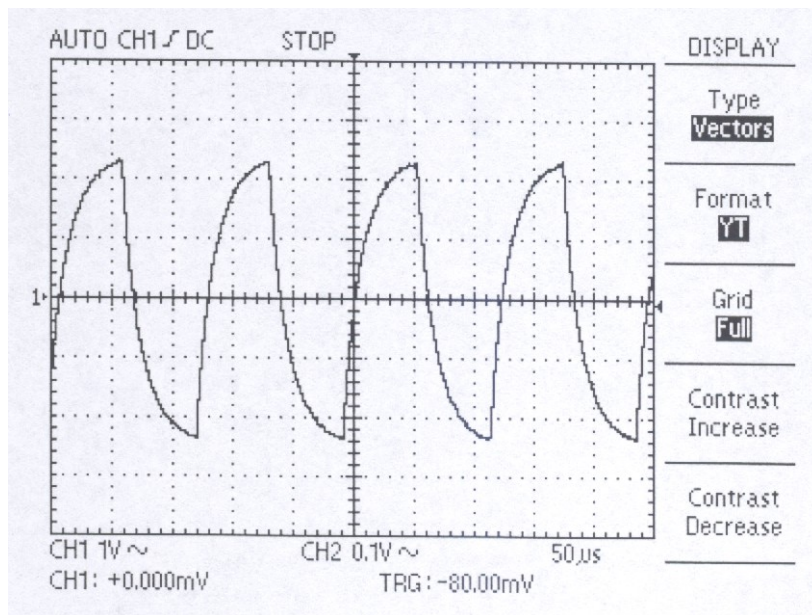
Suppose once you see the signal, you want to adjust the display and several ways including zooming into the signal. To do this,

1. Change the POSITION knob in VERTICAL to adjust the signal's vertical level.
2. Turn VOLTS/DIV to zoom vertically.
3. Turn TIME/DIV to zoom horizontally.
4. Change the POSITION knob in HORIZONTAL to adjust the horizontal position.

7.1.4. Using "DISPLAY" to adjust viewing

Once you see the signal, you may want to modify the display to suit your needs. You will see five submenus that can be used to adjust the display.

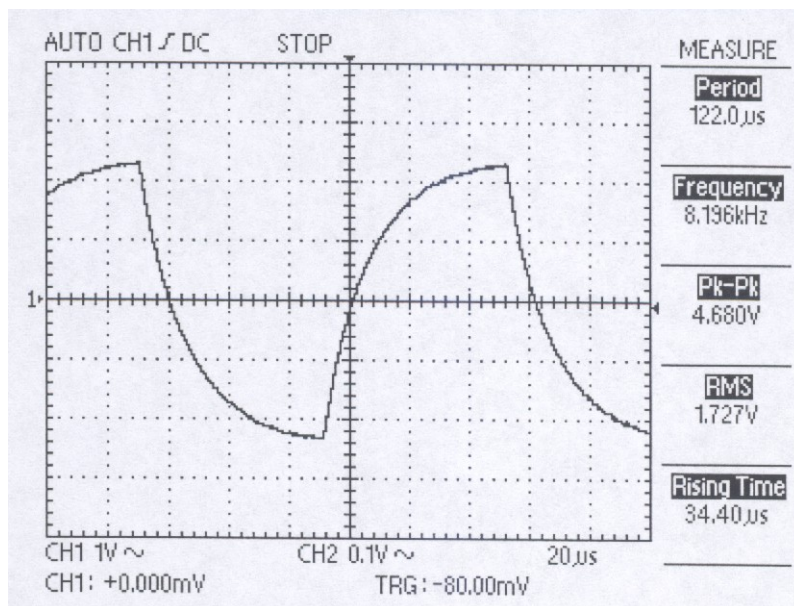
1. Press on the blue button next to Type to switch displaying the waveform display between Vectors and Dots.
2. Format (YT/XY) is irrelevant for now, but XY is used when there are two channel inputs.
3. Grid options can be used for switching between different grid styles.



7.1.5. Using "MEASURE" for quick measurements

Suppose once you see the signal, you want to quickly measure certain fundamental quantities. Quantities like frequency, period, peak-to-peak amplitude, root mean squared, mean, signal frequency, rise time, positive and negative widths can be measured using this function.

1. Connect the probe to the source.
2. Press the MEASURE button to see the submenus.
3. Pressing the bezel buttons will yield the quantities listed above in sequence.

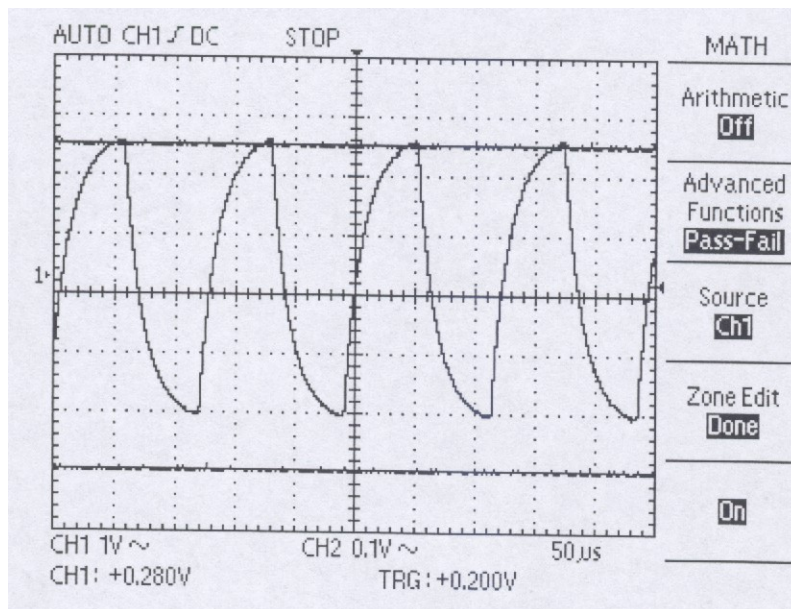


7.1.6. Using "MATHS"-Menus

Math menu provides several functions. Arithmetic is not relevant for the time being. Under Advanced Functions you get Pass-Fail and FFT options. Let's go over these.

Zone Edit

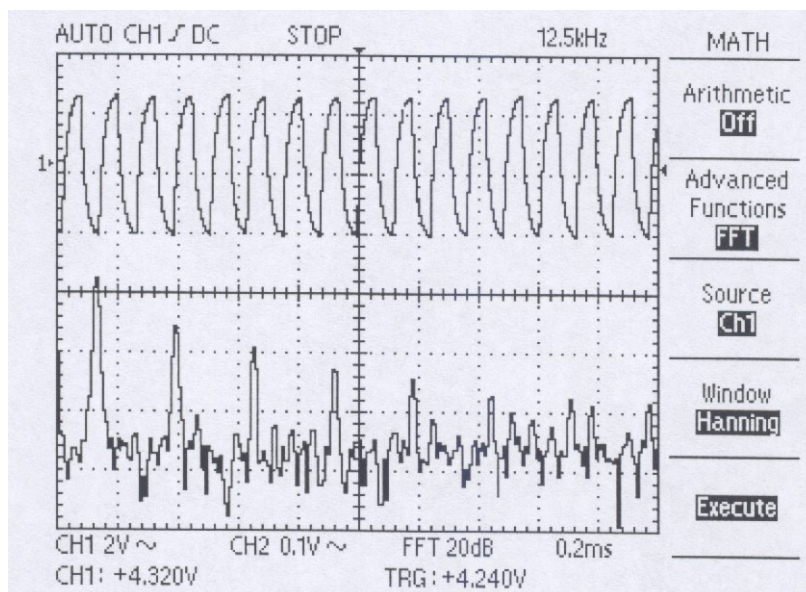
1. Press on the blue bezel button next to Pass-Fail.
2. Press the bezel button next to Zone Edit once to get Upper Side.
3. Use the knob above the buttons to adjust the vertical level.
4. Press once more to get Lower Side and repeat the above.
5. Pressing one more time yields Done.
6. The bezel button next to Off toggles to On to turn on this function.



Fast Fourier Transform

Detailed discussions of FFT will be provided in later sections. Our purpose now is to try out several examples and to get a feel for working with this function. FFT is a widely-used technique that converts a time-domain signal into the frequency components. It is useful for analyzing vibrations, measuring noise in power supplies, measuring harmonics in systems, among many. To try this out,

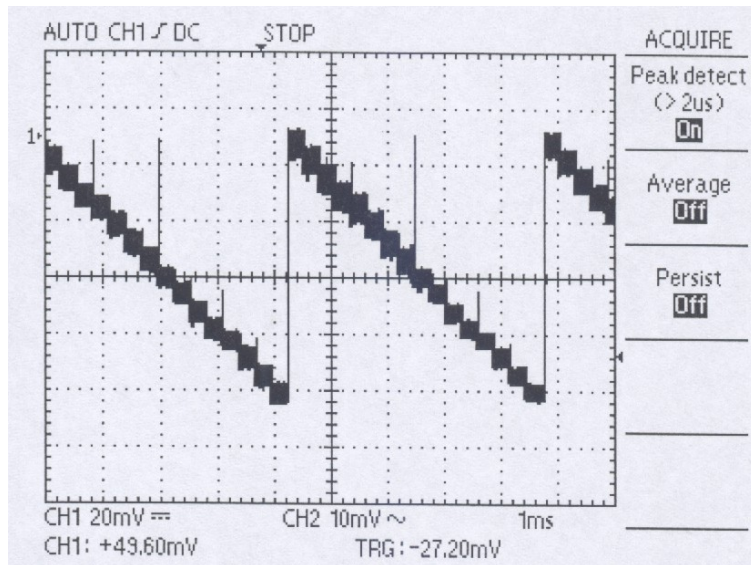
1. Press on the blue bezel button next to Advanced Functions to get to FFT.
2. Make sure that Source is Ch1.
3. Use the knob above the buttons to adjust the vertical level.
4. Under Window there are three options: Rectangle, Hamming, Hanning. Each window is well-suited for a particular purpose, and the detailed discussions are given at later sections. For now, choose Rectangle.
5. Press Execute. The resulting transform will be displayed at the bottom of the screen.
6. Pressing RUN/STOP can get you out of the frozen mode.



7.1.7. Using "ACQUIRE"-Function

1) Noisy Signals And Acquisition Mode

Often you will need to deal with a noisy signal displayed on the oscilloscope and you need to know more about it. The signal might contain more detail than you can now see in the display.



The signal appears noisy and you suspect that noise is causing problems in your circuit. It is helpful to see the peaks which detect and emphasize noise spikes and glitches in your signal.

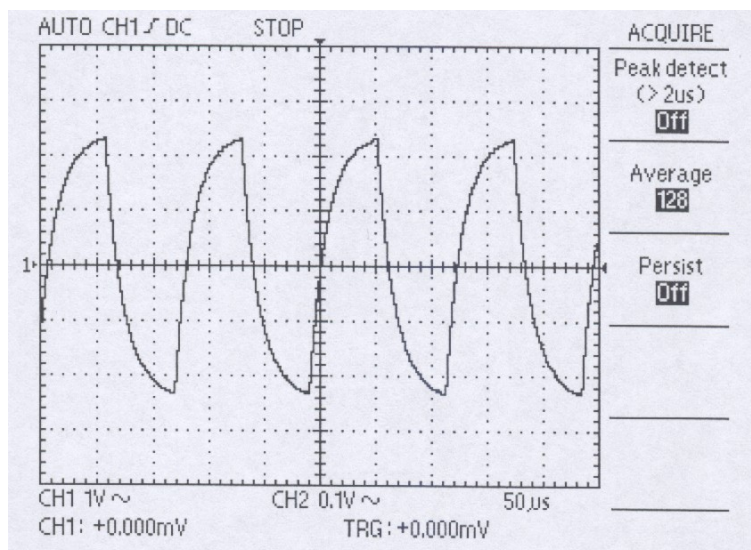
To better analyze the noise and to see the peaks, follow these steps:

1. Push the ACQUIRE button to see the Acquire Menu.
2. Push the Peak Detect option button and set to On.
3. If necessary, push the DISPLAY button to see the Display Menu.
4. Use the Contrast Increase and Contrast Decrease option buttons to adjust the contrast to see the noise more easily.

2) Dealing With Noisy Signals And Using Acquisition Mode Continued

Many signals contain unwanted noises. It is often necessary to analyze the signal shape and filter the unwanted noise. To reduce the unwanted noise in the signal displayed on the screen, follow these steps:

1. Push the ACQUIRE button to see the Acquire Menu.
2. Push the Average option button.
3. Push the Averages option button to see the effects of varying the number of running averages on the waveform display. There are 2-128 waveforms over which to take the resulting average. Averaging reduces random noise and makes it easier to see the actual signal.



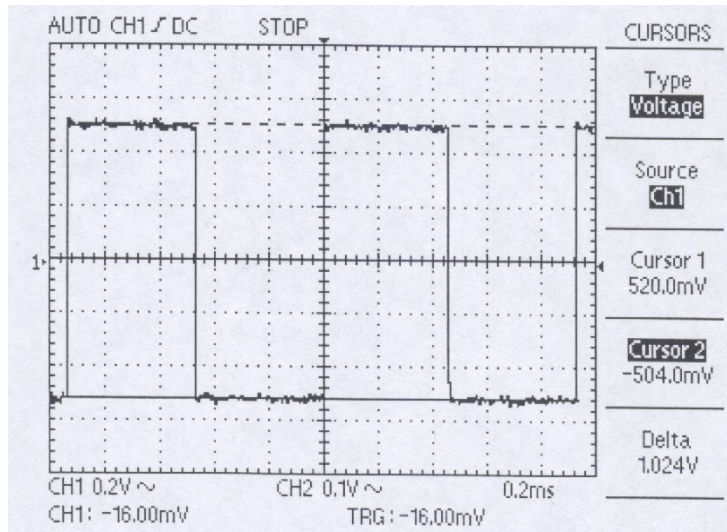
7.2. Taking Cursor - Measurements

You can use the cursors to take time and voltage measurements on a waveform.

7.2.1. Measuring the amplitude of a region

Suppose you want to measure the amplitude of a particular region within a Waveform, follow these steps:

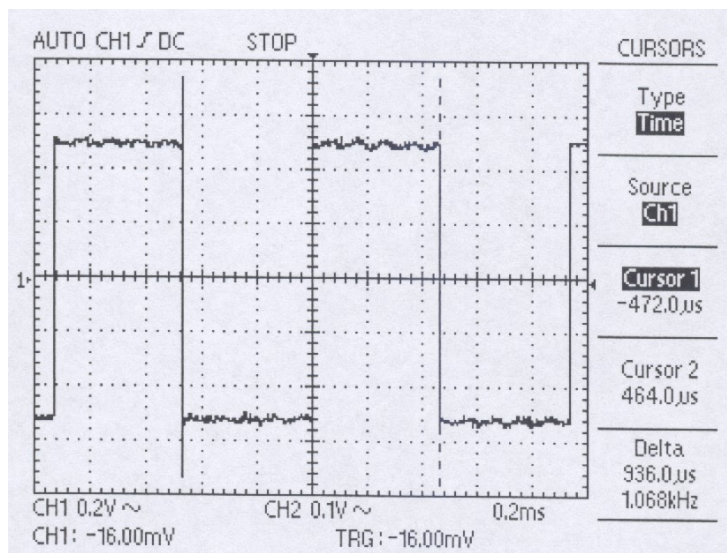
1. Push the CURSOR button to see the Cursor Menu.
2. Push the Type option button and select Voltage.
3. Push the Source option button and select CH1.
4. Press Cursor 1 button and turn the top knob to place the cursor to the desired position.
5. Press Cursor 2 button and repeat the process.
6. Press on Delta and turn the knob and observe that the two lines are moving in parallel. This is the voltage difference between the two peaks designated by the two lines.



7.2.2. Measuring the frequency of a region

Suppose you want to measure the frequency of a particular region within a Waveform. The procedure is similar to those for measuring the amplitude:

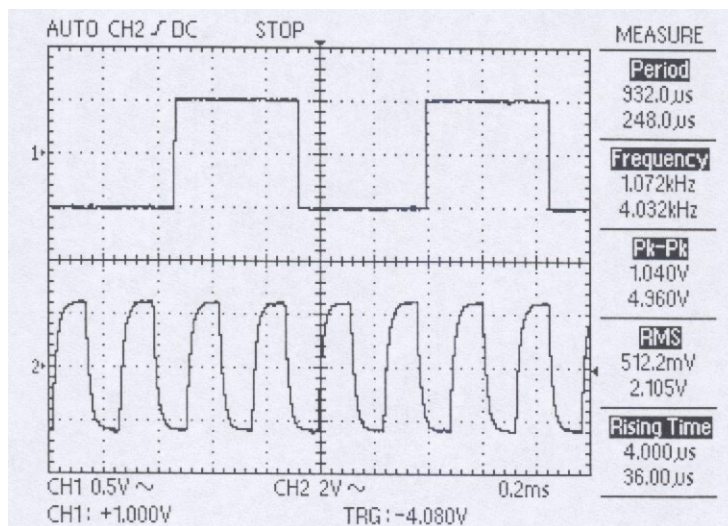
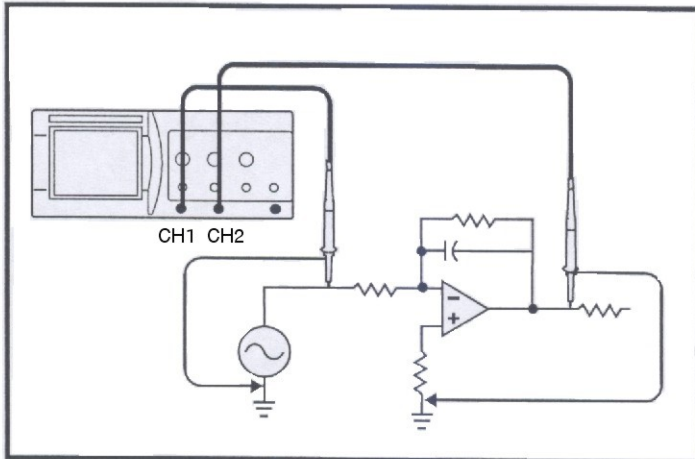
1. Push the CURSOR button to see the Cursor Menu.
2. Push the Type option button and select Time.
3. Push the Source option button and select CH1.
4. Press Cursor 1 button and turn the top knob to place the cursor to the desired horizontal position.
5. Press Cursor 2 button and repeat the process.
6. Press on Delta and turn the knob and observe that the two lines are moving in parallel. This is the frequency difference between the two peaks designated by the two lines.



7.3. Taking 2-Channel Measurements

Suppose you need to measure both channel 1 and 2 at the same time. Measuring the gain of the audio amplifier would be a similar problem. To do this, follow these steps:

1. Connect the probes. Push the CH 1 MENU and CH 2 MENU buttons until they are switched on.
2. Push the AUTOSET button.
3. Push the CH1 MENU button to turn on the channel 1 display.
4. Using the VOLTS/DIV, POSITION knobs, adjust the display.
5. Push the CH 2 MENU button to turn on the channel 2 display.
6. Repeat 4.
7. Read the displayed resulting waveforms for both channels.



8. Specifications

Vertical System	Specifications		
	P 1145 / 1160	P 1150 / 1165	P 1155 / 1170
Bandwidth CH1 and CH 2	DC~80 MHz (40 MHz at 2 mV/div)	DC~150 MHz (40 MHz at 2 mV/div)	DC~250 MHz (60 MHz at 2 mV/div)
Input R & C	1 M Ω \pm 1,5%, approx. 16 pF		
Dynamic Range	More than 8 div. at maximum bandwidth		
Sensitivity (per division) CH1 and CH 2	2 mV/div ~ 5 V/div		
Accuracy	\pm 3%		
Input coupling	AC, DC, GND		
Max. input	400 V (DC/ACp) (AC<1 kHz)		
Square waveform rising time	approx. 4,3 ns	approx. 2,3 ns	approx. 1,4 ns
Input coupling offset	\pm 0,2 div at 5 mV/div ~ 5 V/div \pm 0,5 div at 2 mV/div		
Cross talk (channel isolation)	0,3 div // 50 MHz		
CH1, CH2 Balance (ATT BAL)	\pm 0,2 div at 5 mV/div ~ 5 V/div \pm 0,5 div at 2 mV/div		
Drift	\pm 0,3 div/h		

Horizontal System	Specifications
Resolution	approx. 80 ps
Time / div	Equivalent: 2 ns/div ~ 0,1 μ s/div Real time: 0,25 μ s/div ~ 0,1 s/div Roll-Mode: 0,2 s/div ~ 5 s/div
Pre Trigger	Max. 10 div
Position movement	10 div
Accuracy	0,01%
Magnification	Zoom In/Out

Acquisition System	Specifications
Max. Sample Rate	200 MS/s for one channel 100 MS/s per channel 25 GS/s per channel in equivalent sampling range
Sampling resolution	8 bit
Single shot BW	Max. 20 MHz
Peak detect	10 ns (5 μ s/div ~ 5 s/div)
Record length	Max. 32 kBytes / ch
Average	Number of averages selectable / 2 ~ 128

Trigger System	Specifications		
Sensitivity CH 1 and CH 2	Freq.	5 mV ~ 5 V/div	2 mV/div
	DC ~ 10 MHz	0,5 div	0,5 div
	10 MHz ~ 80 MHz	1,5 div	1,5 div
	80 MHz ~ Max. BW	2,0 div	(at 10 MHz ~ 60 MHz)
Trigger Type	Edge, TV		
Trigger Mode	AUTO, NORM, SINGLE		
Trigger Slope	Positive Edge, Negative Edge		
Trigger Source	CH1, CH2, EXT, Line		
Trigger Couple	AC, DC, LF-RJ, HF-RJ		
Trigger Sync	Line, Field		
Trigger Level Extent	INT: ± 3 div, EXT: $\pm 35\%$ of 4 Vp		
Set Level to 50%	$\pm 0,2$ div		
External trigger sensitivity	0,2 Vss (DC~150 MHz); 0,5 Vss (150 MHz ~ 250 MHz)		
External trigger input max. input	400 V (DC+ACp) (AC < 1 kHz)		
External trigger input R	approx. 1 M Ω		

Display System	Specifications
Display	5,7 inch LCD with CCFL Backlight
Resolution	320 x 240 pixel
Controls	Front-panel intensity control

Probe ADJ	Specifications
Frequency	1 kHz $\pm 20\%$
Voltage	1 V $\pm 4\%$

Advanced Functions	Specifications
Automatic measurements	Amplitude (pp, EFF, Mean) Frequency, Rise time, Falling time, Period Pulse width (+/-), Duty ratio
FFT	Rectangular, Hanning, Hanning, Hamming window
Utility	System condition Self calibration
Save / Recall	10 Waveforms 10 Front-Panel Setups
Math (CH1, CH2)	Addition, Subtraction, Inversion
Auto Setup	50 Hz ~ max. BW at more than 60 mVpp, typical
External I/O (option)	RS-232 C, SPP ¹ , USB
Hard Copy	Hard Copy through SPP or RS-232 C
Supported Printer	Desk Jet TM , Laser Jet ^{TM2} with PCL Level 3, RS-232 Thermal printer)

1. SPP = Standard Parallel Port

2. Desk Jet TM, Laser Jet ^{TM2} = Trademark of HP Hewlett Packard

General	Specifications
Power Requirements	90 V AC ~ 250 V AC 48 Hz ~ 440 Hz
Power Consumption	max. 35 W
Ambient temperature Specifications guaranteed Operating Storage	10°C ~ 35°C (when automatic calibration is performed in the range of $25 \pm 5^\circ\text{C}$) 0°C ~ 40°C -10°C ~ 60°C
Humidity Operating Storage	45 ~ 80% RH 35 ~ 85% RH
EMC	CE (EN 61326)
Dimensions	370 x 167 x 338 mm
Weight	5,5 kg
Warranty	3 years
Safety	CE (EN 61010-1), C-UL (UL 311-1/CSA 1010-1) CAT II, Pollution degree II

Features	Factory settings
CH 1 Display	ON
CH 1 Input coupling	DC Coupling
CH1 Volts/div	20 mV
CH 1 Vertical position	+ 2 div
CH 1 Probe attenuation setting	1 x
CH 2 Display	ON
CH 2 Input coupling	DC Coupling
CH 2 Volts/div	20 mV
CH 2 Vertical Position	-2 div
CH 2 Probe attenuation setting	1 x
Time Base	0,1 ms
Trigger Mode	AUTO
Trigger Source	CH 1
Trigger Coupling	DC
Trigger Slope	Rising Slope
Trigger Level	0 div
Run / Stop	RUN
Cursor Mode	OFF
Display Grid	Full
Display Format	YT
Display Type	Vector
Display Persistence	OFF
Acquire Average	OFF
Acquire Peak Detect	OFF
LCD Contrast	50%
RS-232 C Baud Rate	19200
RS-232 C Parity	None
RS-232 C Data Bit	8 bit
Measure	OFF
Math Display	OFF
Recall Display	OFF

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This manual is according the latest technical knowing. Technical changings which are in the interest of progress, reserved.

We herewith confirm that the units are calibrated by the factory according to the specifications as per the technical specifications.

We recommend to calibrate the unit again, after 1 year.

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