Digital Storage Oscilloscope

Model No. 72-7615, 72-7620, 72-7625 72-7635 and 72-7640

When using electrical appliances, basic safety precautions should always be followed to reduce the risk of fire, electric shock and injury to persons or property.

Read all instructions before using the appliance and retain for future reference.
- This meter is designed to meet IEC61010-1, 61010-2-032, and 61010-2-033 in Pollution Degree 2, Measurement Category (CAT II 150V when switched to 1X and 300V CAT II when switched to 10X) and double Insulation.
- Check that the voltage indicated on the rating plate corresponds with that of the local network before connecting the product to the mains power supply.
- Do not operate this product with a damaged plug or cord, after a malfunction or after being dropped or damaged in any way.
- Check the product before use for any damage. Should you notice any damage on the cable or casing, do not use.
- This product contains no user-serviceable parts. All repairs should only be carried out by a qualified engineer. Improper repairs may place the user at risk of harm.
- Take caution when voltages are above 60V DC and 30V ACrms.
- The earth probe must only be used to connect to ground, never connect to a voltage source.
- This product must be earthed using the mains power cord ground connection.
- Do not disconnect from the mains supply and it's ground connection when any item is connected to this product for measurement.
- Children should be supervised to ensure that they do not play with the product.
- Always disconnect from the mains when the product is not in use or before cleaning.
- Do not use the product for any purpose other than that for which it is designed.
- Do not operate or store in an environment of high humidity or where moisture may enter the product as this can reduce insulation and lead to electric shock.

PRODUCT OVERVIEW

Main Features
- Dual analogue channels with 800x480 7" colour LCD display
- 6 digital trigger frequency counter
- Automatic measurement of 24 waveform parameters plus 2 advanced
- Edge, video, pulse width and alternate trigger functions
- Supports plug and play USB storage devices
- Print screen feature
- Unique waveform recording and replay function

WHAT'S INCLUDED

- Digital Oscilloscope Unit
- Mains power lead
- User Manual
- Communications software CD
- USB lead
- 2 x selectable 1:1/10:1 passive voltage probes

OPERATING PARAMETERS

- The oscilloscope also has high performance index and powerful functions required for faster measurements. Faster signals can be observed with the oscilloscope via 500MS/s (or 1GS/s) real-time sampling and 25GS/s (or 50GS/s) equivalent sampling.
- Powerful trigger and analysis ability make it easier to capture and analyse waveforms.
- Clear LCD and mathematical operating functions make it easy to use to observe and analyse signal problems in a faster and clearer way.

CONTROLS AND CONNECTIONS
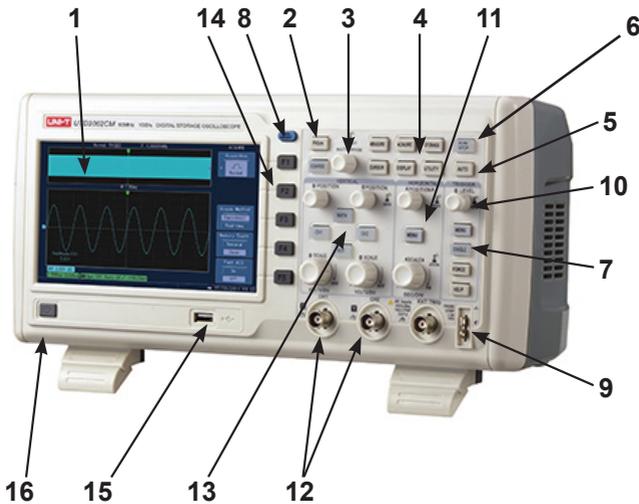
1. Screen display area	9. Calibration and ground terminal
2. Copy/print screen	10. Trigger control area
3. Multifunctional control	11. Horizontal control area
4. Function control area	12. Analogue channel inputs
5. Automatic setting	13. Vertical control area
6. Run/stop	14. Control menu area
7. Single trigger control	15. USB HOST Interface
8. All clear	16. Power on/off

OPERATION

- **Boot check**
- Power on the unit at the rear followed by the soft power button on the front panel.
- The oscilloscope then run through a set on self test functions followed by the display screen showing.
- Take the probe and connect its BNC header to the BNC terminal of the oscilloscope. Connect the probe's main alligator clip to the "Calibration terminal" and the ground clip also connected to the "Ground terminal".
- Press UTILITY button then F1 and the screen will display DEFAULT SETUP.
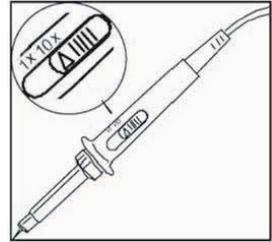
Note: The meter has dual input channels plus one external trigger input channel.

- Press CH1 to enter channel 1 menu.
- Connect the probe to the CH1 input.
- Set the probe attenuation switch to 10X position.

Note: The oscilloscope attenuation has to be set as well.

- Press F4 until 10X displays. This changes the vertical range multiple to ensure the measurement result correctly reflects the amplitude of the measured signal.
- Connect both probe and ground clamp to the corresponding signal terminals.
- Press AUTO and a square wave of about 3V at 1kHz is displayed.
- Press OFF then CH2 and repeat for channel 2.

Probe compensation
- Perform this adjustment when connecting the probes to any input channel for the first time or errors in the measurement may result.
- Connect the probe tip to the probe compensator's signal output connector and connect the ground clamp to the earth wire of the probe compensator.
- Enable CH1 and press AUTO.
- Observe the shape of the displayed waveform.
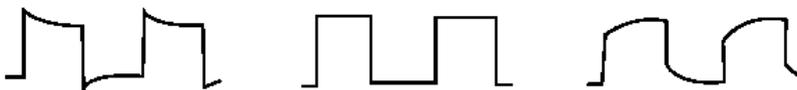
Overcompensation   Correct Compensation   Undercompensation

- Adjust the variable capacitor on the probe with an insulated screwdriver until a correct waveform is achieved.

AUTOSET WAVEFORM DISPLAY

- The oscilloscope features an AUTOSET function which automatically adjusts the vertical deflection factor, scanning time base and trigger mode based on the input signal until the most appropriate waveform is displayed.
- This function only operates when the signal to be measured is 50Hz or above and the duty ratio is larger than 1%.

Using the AUTOSET function
- Connect the signal to be measured to the signal input channel.
- Press AUTO and the oscilloscope will scan the time base and trigger mode and set the vertical deflection factor. You can manually adjust further after this process to get the optimum display.

DISPLAY SETTING CONTROLS

Vertical control panel
- Vertical position control centres the waveform display.
- Press CH1, CH2 to turn on or off each channel.
- As you adjust the POSITION control the ground channel indicator moves in line with the waveform.
- Pressing the position control resets the display to the centre point.
- Adjusting the VERTICAL SCALE control adjusts the VOLT/DIV range. The current status display changes accordingly.
- Press MATH or REFERENCE and the screen shows the corresponding operation menu, sign, waveform and range status information.

Horizontal control panel
- HORIZONTAL POSITION control adjusts the position of the waveform window by adjusting the trigger shift of the signal.
- Pressing HORIZONTAL POSITION resets the display to the centre point.
- The HORIZONTAL SCALE adjustment changes the SEC/DIV time base range and the current status indicator will change accordingly.
- The horizontal scanning rate range is 5ns - 50ns in steps of 1-2-5-10.
- Pressing HORIZONTAL SCALE resets the zoom to default.

Zoom display option
- Press MENU to display the ZOOM options.
- Press F3 to display further options including WINDOW EXPANSION and HOLDOFF.
- Rotate the MULTI FUNCTION rotary control to make adjustments.
- Press F1 to quit the option and return to MAIN TIME BASE.

Trigger system
- The TRIGGER LEVEL rotary control adjusts the trigger level. The display value changes on the display as you make adjustment.
- Press MENU to select the trigger options. Press multi-function control to confirm all selections.
- Press F1 to select TRIGGER TYPE
- Press F2 to select TRIGGER SOURCE to CH1 or CH2
- Press F3 selects EDGE TYPE options
- Press F4 selects TRIGGER MODE options
- Press F5 selects TRIGGER COUPLING options
- Press TRIGGER LEVEL CONTROL 50% to set trigger level at the range amplitude centre point (trigger zero - highest sensitivity setting)
- FORCE: Press to generate a trigger event once.

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Vertical system setup

- Each channel CH1 or CH2 has it's own vertical menu. Each channel should be set up individually.
- Press CH1 or CH2 and the system will display the operation menu for that channel.

Functions Menu	Setup	Notes
Coupling	AC	Intercepts the DC quantities of the input signal.
	DC	Pass AC and DC quantities of input signal
	GROUND	Disconnect input signal
Bandwidth Limit	On	Limit bandwidth to 20MHz to reduce noise display.
	Off	Full bandwidth
Volts / DIV	Coarse tune	Coarse tune in steps of 1-2-5 to set up the deflection factor of the vertical system.
	Fine tune	Fine tune is further tuning within the coarse tune set up to improve the vertical resolution.
Probe	1X, 10X, 100X and 1000X	Select either value based on the probe attenuation factor to keep the vertical deflection factor reading correct.
Invert	On	Waveform invert function on.
	Off	Normal waveform display.

Channel coupling setup

- If for example a signal is applied to CH1 which has a sine signal that contains DC quantities.
- Press F1 to select AC and set up as AC coupling. Any DC quantities in the signal are now intercepted.

- Press F1 to select DC.
- Both AC and DC quantities of the signal being measured can now pass through.
- The waveform displays both AC and DC quantities of the signal.

- Press F1 to select GROUND.
  Both AC and DC quantities of the signal being m
- The waveform is not displayed in this mode but channel circuit.
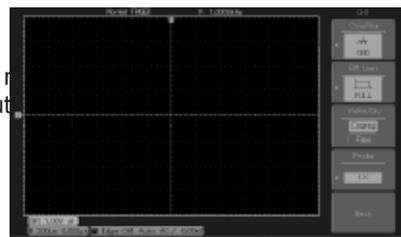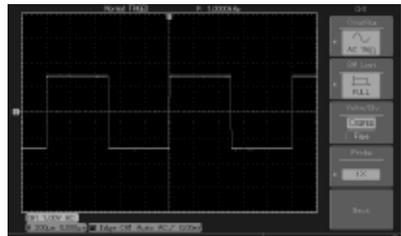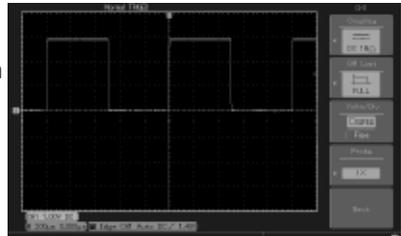
Channel bandwidth setup
- If for example a signal is applied to CH1 which is a pulse signal that contains high frequency oscillation.
- Press CH1 to select Channel1.
- Press F2 to set the BANDWIDTH LIMIT OFF so it is set up as full bandwidth.
- The signal being measured can now pass through even if it contains high frequency quantities.

- Press F2 to set BANDWIDTH LIMIT ON so that frequency quantities higher than 20MHz in the signal being measured will be limited.
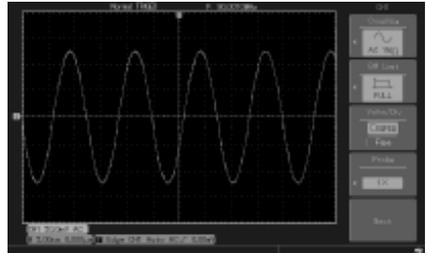
Vertical Volts/Div adjustment setup
- The VOLTS/DIV range of the vertical deflection factor can be adjusted either in coarse or fine tune mode.
- In COARSE TUNE the VOLTS/DIV range is 2mV/div~5V/div. Tuning is in steps of 1-2-5.
- In FINE TUNE mode the deflection factor can be adjusted in smaller steps allowing continuous adjustment within the range 2mV/div~5V/div without interruption.
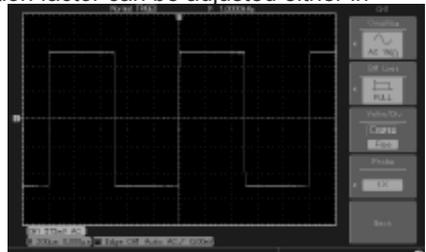
Probe rate setup
- To match the probe attenuation factor setup, it is necessary to set up the probe attenuation factor in the channel operation menu accordingly.
- For example when the probe attenuation factor is 10:1, set the probe attenuation factor at 10X in the menu. This principle applies to other values to ensure the voltage reading is correct.
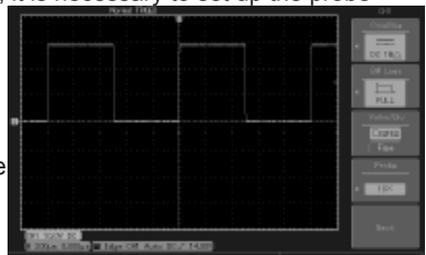
Waveform inversion setup
- The displayed signal is inverted 180 degrees with respect to the ground level.

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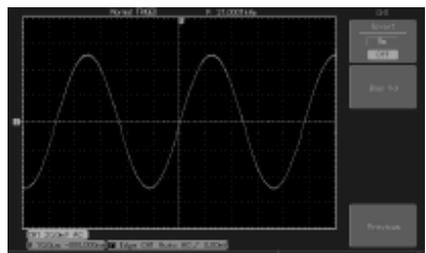
Operating Math functions
- Math functions are displays of +, -, x, ÷ and FFT mathematical results of CH1 and CH2. The menu options are:-
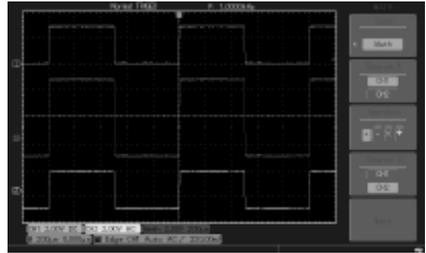
Functions Menu	Setup	Notes
Type	Math	To carry out +, -, x, ÷ functions
Signal source 1	Ch1 Ch2	Set signal source 1 as CH1 waveform Set signal source 1 as CH2 waveform
Operator	+ - x ÷	Signal source 1+ Signal source 2 Signal source 1- Signal source 2 Signal source 1x Signal source 1 Signal source 1÷ Signal source 2
Signal source 2	Ch1 Ch2	Set signal source 2 as CH1 waveform Set signal source 2 as CH2 waveform
Scaling ratio	1/1 1/10 1/100 1/1000	Scaling the waveform according to the four ratio options

FFT spectrum analysis
- Using FFT algorithm you can convert the domain signals (YT) into frequency domain signals.
- With FFT you can observe the following types of signals:
  1. Measure the harmonic wave composition and distortion of the system.
  2. Demonstrate the noise characteristics of the DC power.
  3. Analyse oscillation.
- Signals with DC quantities or DC offset will cause error or offset FFT waveform quantities. To reduce DC quantities select AC coupling.
- To reduce random noise and frequency aliasing as a result of repeated or single pulse event, set the acquired mode of the oscilloscope to average acquisition.

Functions Menu	Setup	Notes
Type	FFT	To carry out FFT algorithm functions
Signal source	Ch1 Ch2	Set CH1 as math waveform Set CH2 as math waveform
Window	Hanning Hamming Blackman Rectangle	Set Hanning window function Set Hamming window function Set Blackman window function Set Rectangle window function
Vertical coordinate	Linear/dbv	Sets vertical coordinate

Select the FFT window
- Assuming the YT waveform is constantly repeating itself, the oscilloscope will carry out FFT conversion of time record of a limited length. When this cycle is a whole number, the YT waveform will have the same amplitude at the start and finish. There is no waveform interruption.
- If the YT waveform cycle is not a whole number there will be different amplitudes at the start and finish, resulting in transient interruption of high frequency at the connection point. In frequency domain this is known as leakage.
- To avoid leakage multiply the original waveform by one window function to set the value at 0 for start and finish compulsively. See the following table:

FFT Window	Feature	Most suitable measurement item
Rectangle	The best frequency resolution, the worst amplitude resolution. Basically similar to a status without adding window.	Temporary or fast pulse. Signal level is generally the same before and after. Equal sine wave of very similar frequency. There is broad-band random noise with slow moving wave spectrum.
Hanning	Frequency resolution is better than the rectangle window but amplitude resolution is poorer.	Sine, cyclical and narrow-band random noise.
Hamming	Frequency resolution is marginally better than Hanning window.	Temporary or fast pulse. Signal level varies greatly before and after.
Blackman	The best amplitude resolution and the poorest frequency resolution.	Mainly for single frequency signals to search for higher-order harmonic wave.

Note: FFT resolution means the quotient of the sampling and math points. When the math point value is fixed, the sampling rate should be as low as possible relative to the FFT resolution.
- Nyquist frequency: To rebuild the original waveform, at least 2f sampling rate should be used for waveform with a maximum frequency of f.
- This is known as Nyquist stability criterion, where f is the Nyquist frequency and 2f is the Nyquist sampling rate.

Digital Filtering Menu

Functions Menu	Setup	Notes
Type	Digital Filtering	Digital Filtering
Information source	Ch1 or Ch2	Set CH1 or CH2 as filtering object
Filtering types	Lowpass Highpass Bandpass	Set filter type

Reference waveform
- Displays of the saved reference waveforms can be set on or off in thee REF menu.
- The waveforms are saved in non-volatile memory and identified with the following names: Ref A, Ref B.
- To display (recall) or hide the reference waveforms use the following method:
1. Press REF menu button on the front panel.
2. Press F2 to call back.
3. Select the signal source and the position of the signal source 1~10 by use of the multi-function rotary control.
4. Press REF to display the waveform stored in that location.

Note: If the stored waveform is on external disk press F5 to select between DSO and USB and select USB having inserted the drive into the USB port.
5. The recalled waveform will be displayed on the screen.
6. Press CANCEL to go back to the previous menu.
7. Press REF B and select the second signal source for the math function repeating step 3

Note: To measure and observe such waveforms you can compare the current waveform with the reference waveform for analysis.
8. Press REF to display the reference waveform menu. See following table:

Functions Menu	Setup	Notes
Reference waveform	REF A REF B	Set reference waveforms as REF A or REF B
Callback	-------	To call our 10 storage positions selected using the multi-function control and press to confirm
Introduce	USB connected USB not connected	Press F5 to select the file stored in root of USB Select using multi function control and press to confirm.

• To store to a selected location choose between 1 and 10. To use external USB, plug in the U disk and press F5 to select the USB memory.
• To save a waveform press SAVE menu.

Horizontal system setup
• The horizontal rotary control is used to change the graticule (time base) and trigger the horizontal position of the memory (triggering position).
• The vertical centre point above the horizontal orientation of the screen is the time reference point of the waveform. Changing the graticule will cause the waveform to increase or decrease in size relative to screen centre. When the horizontal position changes, the position in respect to the waveform triggering point is also changed.

Horizontal position
• Adjust the horizontal positions of the channel waveforms (including math waveforms). Resolution of this control changes with the time base.

Horizontal scaling
• Adjusting the main time base i.e. sec/div. When time base extension is on you can use the horizontal scaling control to change the delay scanning time base and change the window width.

Functions Menu	Setup	Notes
Main time base	--	1 - enable main time base 2 - if window extension is enabled, press main time base to disable window extension
Window extension	--	Enable time base
Holdoff	--	Adjust Holdoff time

Icon definitions
1. Represents the memory position of the current waveform.
2. Represents the memory position of the triggering point.
3. Represents the position of the triggering point in the current waveform window.
4. Horizontal time base (main time base) ie: sec/div.
5. Horizontal distance between the triggering position and the window centre point.

Definitions
• **YT Mode:** in this mode the y axis indicates voltage and the x axis indicates time.
• **X-Y Mode:** in this mode the X axis indicates CH1 voltage and the Y axis indicates the CH2 voltage.
• **Slow Scanning Mode:** When the horizontal time base control is set at 50ms/div or slower, the unit will operate in the slow scan sampling mode. When observing low frequency signals in slow scanning mode, it is advised to set the channel coupling as DC.
• **Sec/Div:** a horizontal scaling (time base) unit. If waveform sampling is stopped (by pressing the RUN/STOP button) time base control can expand or compress the waveform.

Window Extension
• Window extension can be use to zoom in or zoom out a band of waveform to check image details. The window extension setting must not be slower than that of the main time base.
• In the time base extension mode, the display is divided into two zones as shown.
• The upper part displays the original waveform. You can move this zone left or right by turning the horizontal POSITION control, or increase and decrease the selected zone in size by turning the horizontal SCALE control.
• The lower part is the horizontally extended waveform zone.
• Please note that the resolution of extended time base relative to the main time base is now higher as shown.
• Since the waveform shown in the entire lower part corresponds to the selected zone in the upper part, you can increase the extended time base by turning the horizontal SCALE control to decrease the size of the selected zone (increase the multiple of waveform extension).
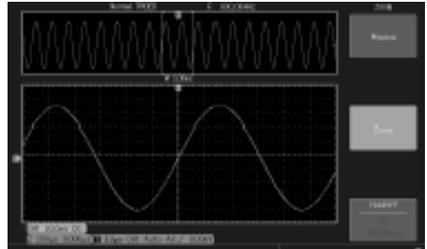
XY Mode
• This mode is suitable for CH1 and CH2 only. After selecting the X-Y display mode, the horizontal axis will display CH1 voltage, while the vertical axis will display CH2 voltage.
Note: in the normal X-Y mode the oscilloscope can cause the random sampling rate to acquire waveforms. To adjust sampling rate and channel vertical range in the X-Y mode, the omitted sampling rate is 100MS/s.
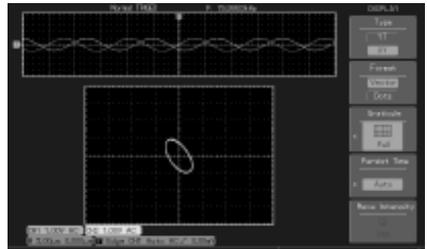
- Generally adjusting the time base lower will result in appropriately Lissajous figures of better display quality.
1. Auto measurement mode
2. Cursor measurement mode
3. Reference or math waveform

Setting up the Trigger system
- Triggering decides when the oscilloscope collects data and displays waveforms. Once the trigger is correctly set up, it can convert unstable display into significant waveforms.
- When beginning to collect data the oscilloscope first collects sufficient data to draw a waveform on the left of the triggering point.
- While waiting for the triggering condition to occur it will continuously collect data. When sufficient data to draw a waveform on the right of the triggering point.
- The trigger control zone on the operation panel comprises a trigger level adjustment control, a trigger MENU button, 50% button for setting up the trigger level at the vertical centre point of the signal, and a SINGLE trigger button.
- Trigger level sets the signal voltage with respect to the triggering point.
- 50% sets the trigger level at the vertical centre point of the trigger signal amplitude.
- FORCE is used to generate an immediate trigger signal, mainly used in the trigger mode and normal and single mode to conduct a test.
- Menu button enables the trigger set up modes.

Trigger Control Mode
- Trigger modes: Edge, Pulse, Video and Alternate.

Edge Trigger:
- When selecting edge trigger, you are triggering at the rising and falling edges of the input signal.

Functions Menu	Setup	Notes
Type	Edge	
Signal source selection	CH1 CH2 EXT EXT/5	Set Ch1 as the signal source trigger signal Set CH2 as the signal source trigger signal Set the external trigger input channel as the signal source trigger signal Set the external trigger source divided by 5 to extend the external trigger level range
Inclination	Rising Falling Rise & Fall	Set to trigger on the signals rising edge Set to trigger on the signals falling edge Set to trigger on rising and falling edge
Trigger Mode	Auto Normal Single	Set to sample waveform only if no trigger condition is detected Set to sample waveform only if trigger condition is satisfied Set to sample waveform once when detecting one trigger and then stop
Trigger coupling	DC AC H/F reject L/F reject	Intercept DC quantities of the input signal Allow AC and DC quantities of the input signal to pass Reject high frequency quantities above 80kHz of the signal Reject low frequency quantities below 80kHz of the signal

Pulse Trigger
- Pulse trigger means determining the triggering time based on the pulse width. You can acquire abnormal pulse by setting the pulse width condition.
- Adjust the pulse width from 2ns~10s by turning the control on the upper front panel.

Functions Menu	Setup	Notes
Type	Pulse	
Trigger source	CH1 CH2 EXT/EXT5 AC line Alter	Set Ch1 as the signal source trigger signal Set CH2 as the signal source trigger signal Set the external trigger input channel as the signal source trigger signal or divided by 5 Set up as AC grid trigger Ch1, CH2 trigger their own signals alternately
Trigger coupling	DC AC Low frequency restriction High frequency restriction	Accept AC and DC signal components Prevents DC signal components Restricts low frequency component lower than 80kHz within the signal source Restricts high frequency component higher than 80kHz within the signal source
Trigger polarity	Pos pulse width Neg pulse width	Set positive pulse as the trigger signal Set negative pulse width as the trigger signal
Trigger mode	Auto Normal Single	The system automatically samples waveform data when there is no trigger signal input. The scan baseline is shown on the display. When the trigger signal is generated it automatically turns to trigger scan. The system stops acquiring data when there is no trigger signal. When the trigger signal is generated trigger scan occurs. One trigger will occur when there is an input trigger signal. Then trigger will stop.
Pulse width setting	------	Enter the pulse width options

Pulse Width Setting

Functions Menu	Setup	Notes
Pulse width polarity	Positive pulse width Negative pulse width	Set to positive pulse width as trigger information source Set to negative pulse width as trigger information source
Pulse width conditions	< > =	To trigger when the input signal pulse width is smaller than the set value of pulse time To trigger when the input signal pulse width is larger than the set value of pulse time To trigger when the input signal pulse width is equal to the set value of pulse time
Pulse width time	20ns~10.0s	Set to trigger on the signals rising edge Set to trigger on the signals falling edge Set to trigger on rising and falling edge
Back	-------	Return to pulse trigger menu

Video Trigger
- By selecting video trigger you can carry out field or line trigger with NTSC or PAL standard video signals. Default trigger coupling is DC.

Functions Menu	Setup	Notes
Type	Video	
Trigger source	CH1 CH2 EXT EXT/5	Set Ch1 as the trigger signal Set CH2 as the trigger signal Set the external trigger input channel as the trigger signal Attenuate the external trigger source 5 times as the trigger signal
Standard	PAL NTSC	Suitable for video signals of low black level Suitable for video signals of high black level
Synchronisation	All lines Specified lines Odd field Even field	Set the TV line to synchronise with trigger Set synchronised trigger on the specified line and adjust by turning the control on the front panel Set video odd field to synchronised trigger Set video even field to synchronised trigger

- When PAL is selected for STANDARD format and SYNCHRONISATION mode is LINE you will see a screen display similar to this:-

- When SYNCHRONISATION mode is FIELD you will see a screen display similar to this:-

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Adjusting the Holdoff time

- You can adjust the Holdoff time to observe complicated waveforms. Holdoff time means the waiting time for the trigger to be ready for use again. During this time the oscilloscope will not trigger until the Holdoff is complete.
- Follow the normal signal synchronisation procedure and select the edge, trigger source and inclination in the trigger menu.
- Adjust the trigger level to make the waveform display as stable as possible.
- Press the key in the horizontal MENU to display the horizontal menu.
- Adjust the multi-function control in the upper front panel. The hold-off time will change accordingly until the waveform display is stable.
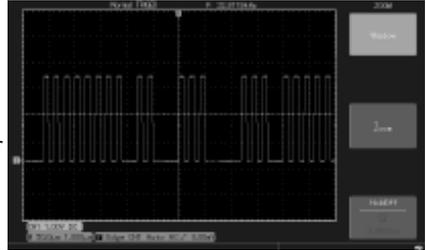
Functions Menu	Setup	Notes
Type	Edge	Set trigger mode to EDGE
Trigger source	Alternate	Set CH1 and Ch2 to alternate trigger
Inclination	Rising	Set trigger inclination as rising edge
Trigger mode	Auto	Set trigger mode to automatic
Trigger coupling	AC	Set trigger coupling mode to AC

Run/Stop
- When the RUN/STOP key is pressed, a green light will be on, indicating the RUN status.
- When the key is pressed again and a red light appears, it indicates the STOP status.
- The RUN state enables the oscilloscope to be in continuous acquisition.
- During the STOP state, the oscilloscope stops collecting data.

Trigger Source - Trigger can be obtained from various sources: Input channel (CH1 or CH2), external trigger (EXT, EXT/5) or grid.
1. **Input channel** - the most common trigger source is input channel. The selected trigger source can operate normally whether the input is displayed or not.
2. **External trigger** - this type of trigger source can trigger in a third channel while acquiring data in two other channels. Both EXT and EXT/5 trigger sources use external trigger signals from the EXT TRIG jack. EXT can use the signals directly. You can use EXT within the trigger level range of -0.8V and +0.8V. EXT/5 divides the trigger by 5. As a result trigger range is extended to -4V to +4V enabling the oscilloscope to trigger at a large signal.

Trigger Mode - determines the action of the oscilloscope when there is no trigger. There are three trigger modes - auto, normal and single.
1. **Auto Trigger** - samples the waveform data when there is no trigger signal input. The scan base is shown on the display. When the trigger signal is generated it automatically turns to trigger scan for signal synchronisation.
Note: when the time base of the scan waveform is set to 50ms/div or slower, the auto mode allows a rolling waveform when there is no trigger signal.
2. **Normal Trigger** - In this mode waveforms are only sampled when triggering conditions are met. The system stops acquiring data and waits when there is no trigger signal. When a trigger is generated, trigger scan occurs.
3. **Single Trigger** - In this mode press RUN button once and the oscilloscope will wait for trigger. When one trigger is detected, it will sample and display the acquired waveform, then stop.

Trigger coupling - determines which quantities of the signal are transmitted to the trigger circuit. Coupling modes are DC, AC, low frequency reject and high frequency reject.
1. **DC** - allowing all quantities to pass.
2. **AC** - intercepting DC quantities and attenuating signals under 10Hz.
3. **Low Frequency Reject** - Intercepting DC quantities and attenuating low frequency quantities under 80kHz.
4. **High Frequency Reject** - Attenuating high frequency quantities over 80kHz.
Pre-Trigger/Delayed Trigger - data sampled before/after triggering. The trigger position is typically set at the horizontal centre of the screen. You are able to view five divisions of pre-trigger and delayed trigger information. Use the horizontal position control to adjust the horizontal shift of the waveform to see more pre-trigger information. By observing pre-trigger data you can see the waveform before trigger occurs. You can detect the glitch that occurs when the circuitry starts. Observing this data can help identify the cause of this glitch.

Setting up the Sampling System

- The ACQUIRE button on the control panel is the function key for the sampling system.

Functions Menu	Setup	Notes
Acquisition Mode	Sample Peak detect Average	Turn on the ordinary sampling mode Turn on the peak detect mode Set the average sampling and display the average number of times
Sampling mode	Real time Equivalent	Set sampling to real time Set sampling to equivalent at a time base range of 5ns~100ns/div.
Memory Depth	Normal Deep	Normal: 6kpts Deep: 8Mpts or 16Mpts
Fast Acquire	ON or OFF	The oscilloscope only acquires enough points for Min memory depth needed to display so as to maintain super waveform capture rate.
Average number of times	2-256	Set the average number of times in multiples of 2 ie: 2, 4, 8, 16, 32, 64, 128, 256 To change the average number of times use the multi-function control on the front panel.

- By changing acquisition setup you can observe the consequent changes in waveform display. If the signal contains considerable noise, you will see this waveform displays when average sampling is not selected.

-
-
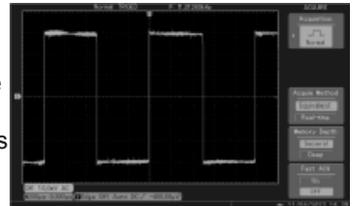
- When 32 time average sampling is selected you will see this.
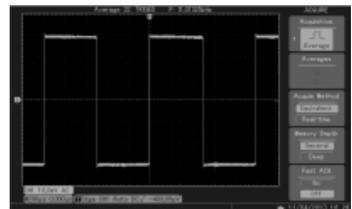
Note: Use **Real Time Sampling** to observe single signals. In this mode the system makes full acquisition to fill the memory. Maximum sampling rate is 500MS/s. At a setting of 50ns or faster, the oscilloscope will automatically carry out interpolation ie: inserting a sampling point between other sampling points.

Use **Equivalent Sampling** to observe high frequency cyclical signals. This is a repeated sampling mode that allows detailed observation of repeated cyclical signals. In the equivalent sampling mode, the horizontal resolution is 40ps higher than the real time mode ie: 25GS/s equivalent.

Sampling Mode is when the oscilloscope reconstructs the waveform by sampling signals at regular intervals.

To avoid mixed envelope, select **Peak Detect**. In this mode the oscilloscope identifies the maximum and minimum values of the input signals at each sampling interval and use these values to display the waveform.

Average Mode is when the oscilloscope acquires several waveforms and take the average value to display the final waveform. You can use this mode to reduce random noise. To reduce random noise of the displayed signal, select average sampling and increase the average number of times in multiples of 2 ie: selecting from 2 to 256.

Memory Depth

Deep memory is required in order to view more waveform detail, and with help of Zoom function, waveform detail is show clearly on the screen, which prevent waveform details becoming too compressed to observe clearly when signal frequency gets higher.

Deep Memory allows 10000 x amplification compared to 10 x for normal memory.

Waveform Display after Zoom-in under Normal Mode
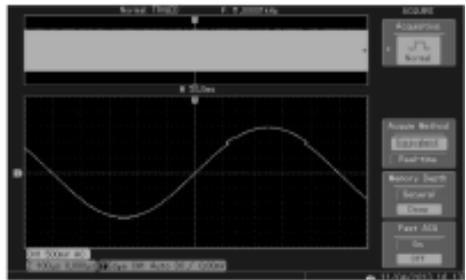
Waveform Display after Zoom-in under Deep Memory

Note:

Please select Peak Detect mode if you want to observe signal envelope and also to avoid noise. If the timebase is greater than 100ms/div and deep memory is used, please set trigger mode to Single or Normal.

Deep memory and fast acquisition cannot apply at the same time.

Fast Acquisition

Fast acquisition helps capture waveforms at high speed and up to 150,000wfms/s. With this function, the operator can view any glitches or other transient signal just in a few seconds.
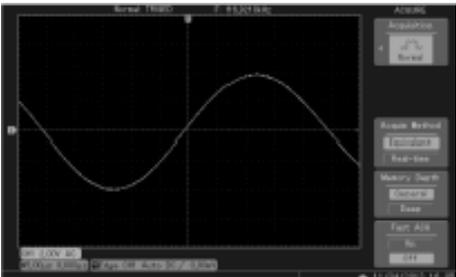
Waveform Display not using fast acquisition mode
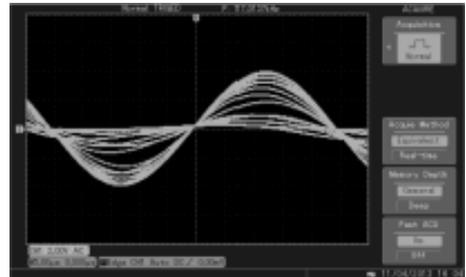
Waveform Display using fast acquisition mode

Note:

Please use deep memory if you want to view more waveform details.

Fast Acquisition is recommended in order to capture certain abnormal signal. Fast Acquisition is valid only within 1 ms/div~1 O0ns/div for single channel and 1 ms/div~200ns/div for dual channels.

Setting up the Display System

- The DISPLAY button on the control panel is the function key for the display system.

Functions Menu	Setup	Notes
Types	YT XY	Operating mode of the oscilloscope X-Y is the display mode CH1 is X input CH2 is Y input.
Format	Vector Dots	Sampling points are linked for display Sampling points are directly displayed
Grid	Full Grid Cross Hair Frame	Set grid display mode of waveform display area
Continuous	Off Infinite	The waveform on the screen is refreshed at higher speed The original waveform on the screen remains on display. New data will be added continuously until this function is disabled.

X-Y Mode

Under the mode, CH1 voltage will be shown on the horizontal (x) axis, and CH2 voltage will be shown on the vertical (y) axis.

Note: under X-Y Mode, to shift the waveform display horizontally with CH1 POSITION control and shift it vertically with CH2 POSITION control. It is possible to regulate size and shape of X-Y display with the SCALE control with two channels and it will display effective Lissajous waveform by changing the time base.

The following functions can be displayed:

1. Automatic measuring function
2. Cursor measuring function
3. Reference or mathematical function

Note: Window extension and horizontal position control are not available in X-Y Mode.

Storage System: pressing the STORAGE button displays the setup menu from where you can save or recall waveforms and setup documents stored in memory both internal and in USB storage devices.

Operating procedure

- Press STORAGE to go to the type menu. There are three types to select from:
1. WAVEFORM to go to the waveform save menu.

2. SETUP to enter the setup save menu.
3. BITMAP to enter the position save menu

Note: this feature can only be recalled after connecting USB ram.

Storage Menu	Setup	Notes
Types	Waveform	Select the waveform save and recall menu
Information source	CH1 CH2	Select the waveform from CH1 Select the waveform from CH2
Store	1~10	Set and select the position in which the waveform is saved in the internal memory. Adjust using the multi-function control
Output	----	Enter into USB menu

USB Menu	Setup	Notes
Disk	DSO USB	Select the internal memory Select external USB memory
Depth	Normal Lengthy	Set normal saving depth of 250 dots Set lengthy saving of 2.5k

Output Menu	Setup	Notes
Filename	----	Select using the multi-function control and F1 key
Format	CSV Inner Bitmap	Selects the type of file to be saved and enter setting storage menu
Confirmation	----	Save graphic data

Note: inner or CSV format can be chosen in Outputting Reference Waveform into USB.
The inner format only displays on the oscilloscope under REF on other interface.
CSV format can be opened using EXCEL on a computer and is data reflecting relation between voltage and time.

Settings Menu	Setup	Notes
Types	Setting	To store the present status of the oscilloscope
Store	1~10	Maximum 10 front panel setups can be saved. Select with the multi-function control on front panel
Fetch	1~10	Recall the setting 1~10 selected using the multi-function control then press to confirm
Input	----	Displays USB file list after connecting USB drive
Output	----	Returns to the output menu

Print Screen Function
• Plug in a USB memory stick into oscilloscope and press PR SCRN key, the screen picture would be stored into the USB instantly with default file name: DSO***· BMP.

Setting up Auto Measurement

• The AUTO button on the control panel is the function key for auto measurement.

The oscilloscope is capable of measuring 20 waveform parameters.
• Press MEASURE to enter the parameter measurement display menu which has five zones for simultaneous display of measurement values assigned to function keys F1 to F5 respectively. When selecting the measurement type of any zone, press the corresponding function key to enter the type option menu.
• The measurement type option menu lets you choose voltage or time. You can enter the voltage or time measurement by pressing F1~F5 for the corresponding type and then return to the measurement display menu.
• Pressing F5 and select ALL PARAMETERS to show all measured parameters of both voltage and time. Press F2 to select the channel (has to be enabled to take measurements).
• Press F1 to return to the parameter measurement menu.

Automatic measurement of voltage parameters

• The DSO series oscilloscope can automatically measure the following voltage parameters.
• Peak to peak value (Vpp) - the voltage value from the highest point to lowest point of the waveform.
• Maximum value (Vmax) - the voltage value from the highest point to ground of the waveform.
• Minimum value (Vmin) - the voltage value from the highest point to ground of the waveform.
• Amplitude value (Vamp) - the voltage value from top to base of the waveform.
• Top value (Vtop) - the voltage value from the level top to ground of the waveform.
• Base value (Vbase) - the voltage value from the level base to ground of the waveform.
• Overshoot - the ratio value of the difference between maximum value and top value of the waveform to the amplitude value.
• Pre-shoot - the ratio value of the difference between minimum value and base value of the waveform to the amplitude value.
• Average value - average amplitude of signals within 1 cycle.
• RMS value - the effective value. Energy generated by AC signal conversion during one cycle with respect to the DC voltage that produces equivalent energy.

Automatic measurement of time parameters

• The DSO series oscilloscope can automatically measure the following parameters.
• Rise time - the time taken by the waveform to rise from10% to 90%.
• Fall time - the time taken for the waveform to fall from 90% to 10%.
• Positive pulse (+width) - pulse width of positive pulse at 50% amplitude.
• Negative pulse (-width) - pulse width of negative pulse at 50% amplitude.
• Delay 1→2 (Rising Edge) - delayed time of the rising edge of CH1, Ch2.
• Delay 1→2 (Falling Edge) - delayed time of the falling edge of CH1, Ch2.
• Positive duty ratio (+Duty) - ratio of positive pulse width to cycle.
• Negative duty ratio (-Duty) - ratio of negative pulse width to cycle.

Functions Menu	Setup	Notes
All parameters	-----	Display/close all parameters - F5 closes
Parameter Setting	-----	Press F2 and select parameters required using multi-function control, press to confirm (4 parameters max)
Indicator	-----	Select the Indicator for parameter measurement
Delete		Deletes all parameter settings
Next		Enter the measurement menu

Functions/Measurement	Notes
Close	Return to the previous menu
Max / Min	
High / Low	
Middle	
Pk - Pk	
Amplitude	
Mean	
RMS	
Cycle Mean	
Cycle RMS	
Area	
Cycle Area	Select to return to the parameter measurement display menu and replace the original parameter in that position
Frequency	
Period	
Rising	
Falling	
+Pulsewidth	
-Pulsewidth	
Burstwidth	
Overshoot	
+Duty cycle	
-Duty cycle	
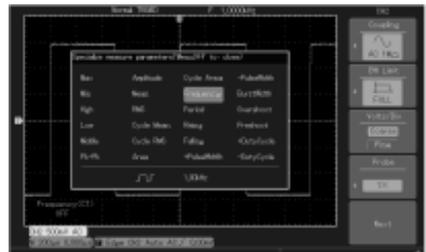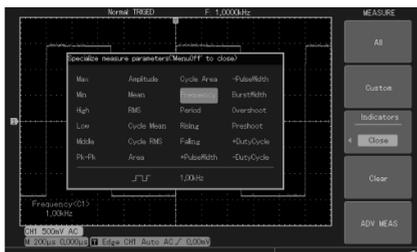
Voltage Parameters

- The following parameters can be measured automatically:
    1. Vmax: Voltage at the highest point with respect to GND
    2. Vmin: Voltage at the lowest point with respect to GND
    3. Vtop: Highest stable voltage
    4. Vbase: Lowest stable voltage
    5. Middle: Midpoint between highest and lowest stable voltage
    6. Vpp: Vmax – Vmin
    7. Vamp: Vtop – Vbase
    8. Mean: Average amplitude of the waveform on screen
    9. CycMean: Average amplitude of a waveform in one period
    10. RMS: The effective value. According to the energy produced by the AC signal in the conversion, the equivalent energy that the DC voltage corresponds to
    11. CycRMS: The RMS of one period
    12. Overshoot: The ratio of the difference between Vmax and Vtop
    13. Preshoot: The ratio of the difference between Vmin and Vbase
    14. Area: The product of time and voltage for all points on the screen
    15. CycArea: The product of time and voltage for all points in one period
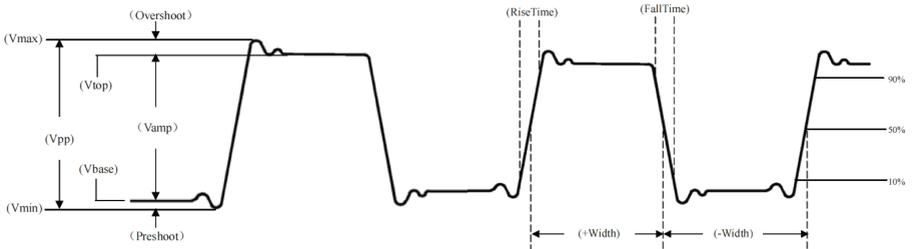
Timing Parameters

- The following parameters can be measured automatically:
    1. Period: The duration of one cycle of a repetitive waveform
    2. Frequency: The reciprocal of the period
    3. Rise time: The time it takes the waveform amplitude to increase from 10% to 90%
    4. Fall time: The time it takes the waveform amplitude to decrease from 90% to 10%
    5. +Width: The width of a positive pulse at 50% amplitude
    6. -Width: The width of a negative pulse at 50% amplitude
    7. +Duty: The ratio of positive pulse width to period
    8. -Duty: The ratio of negative pulse width to period

Cursor Measurement
- The CURSOR button on the control panel is the function key for cursor measurement.
- Adjust the cursor position by turning the multi-function control.

Functions Menu	Setup	Notes
Types	Time	Select the time measurement cursor
Modes	Modes	Independently shift any one of the two cursors. Simultaneously shift the two cursors while maintaining the $\triangle$t.
Vertical Unit	Second Hz Ratio Phase	Select to return to the parameter measurement display menu

Functions Menu	Setup	Notes
Types	Voltage	Select the Voltage measurement cursor
Modes	Independent Tracking	Independently shift any one of the two cursors. Simultaneously shift the two cursors while maintaining the $\triangle$V.
Horizontal Unit	Base Ratio	Measurement parameter is voltage Measurement parameter is percentage

Setting up Auxiliary Functions
- The UTILITY button on the control panel is the function key for alternative functions.

Functions Menu	Setup	Notes
System Configuration	Self-tuning System information Delete information Time setting Factory reset Contrast	Implement self-tuning Display information such as machine mode, version and serial number Delete the stored reference waveform and setting Enter into date and time setting menu Restore the factory reset Regulate contrast of the screen.
Recording waveform	-----	Enter setup for recording waveform
By detecting	on / off	Detect if the input signal is within the stipulated scope

Recording Menu	Setup	Notes
Record	CH1 CH2	Select CH1 as the recording signal source Select CH2 as the recording signal source
Cancel		Quit the current record menu and return to previous menu
■ (F3)		Stop recording
▶ (F4)		Playback button - the system plays back and displays the position reference in the lower RH corner. Use the multi-function control to select the waveform to be displayed repeatedly.
● (F5)		Record button - use to record. The position reference is displayed in the bottom of the screen

PASS TEST

• The pass (fail) test is by using a template to detect whether the input signal satisfies the template requirements.

Function Introduction

• Press UTILITY button then F5 to enter the secondary menu then press F2 to enter the test menu.

Functions	Options	Description
Allow test	Close Open	Close Pass Test Open Pass Test
Output	Fail Pass	Set the Pass/Fail interface on the rear panel to a "failure" pulse and sound a buzzer Set the Pass/Fail interface on the rear panel to a "pass" pulse and sound a buzzer
Source	CH1 to CH4	Set the source channel for the Pass Test
Display info	Close Open	Turn off the display information Turn on the display information
Next Page		Enter Pass Test menu (2)

Functions	Options	Description
Operation	Close Open	Disable Pass Test Enable Pass Test
Stop setting		Enters Stop Settings Menu
Template setting	CH1 to CH4	Enters Template Settings Menu
Back		Back to Pass Test menu

• After opening the pass test, you are required to set the stop settings and template settings before you can perform the test function. Otherwise you'll be prompted "Function is Disabled".

- Stop settings menu.

Functions	Options	Description
Stop type	Pass count	The test function stops after it reaches a specified pass count number
	Fail count	The test function stops after it reaches a specified fail count number
Condition	>=,<=	Stop condition setting
Threshold	1~10000	Use the multi-purpose control to select the stop condition threshold
Return	-----	Return to previous menu

- Template settings menu.

Functions	Options	Description
Reference waveform	CH1 to CH4	Select a channel CH1~CH4 with horizontal and vertical tolerance as template
Horizontal tolerance	1~100	Use the multi-purpose control to select the horizontal tolerance
Vertical tolerance	1~10000	Use the multi-purpose control to select the vertical tolerance
Create template	------	Create template with above conditions
Return		Return to previous menu

Time Setup
- Use multi-function control to make adjustment and confirm by pressing the control after pressing required function button to select the option.

Functions	Options	Description
Display Time	On or OFF	Open time display and select if the time shall display if the frequency meter is on
Minute and hour	-----	Press F2 to select then use multi-function control to adjust
Date and Month	-----	Press F3 to select then use multi-function control to adjust
Year	------	Press F4 to select then use multi-function control to adjust
Confirm		Set and return to Auxiliary menu

AUTO SETTING

Auto Setup
- Auto setup simplifies the operation. Press AUTO and the oscilloscope can automatically adjust the vertical deflection factor and horizontal time base range according to the amplitude and frequency of the waveform, and also ensure a stable display of the waveform.
- When the oscilloscope is in auto mode the setup is as follows:

Functions Menu	Setup
Bandwidth restriction	Full bandwidth or 20MHz to keep the present setting.
Vertical scale coefficency	Based on signal amplitude
VOLTS/DIV	Coarse tuning
Opposite phase	Open or close to keep present setting.
Horizontal position	Automatic tuning
SEC/DIV	To regulate based on signal frequency
Acquisition mode	Setting: normal sampling, peak value, average
Sampling mode	Equivalence or real time present setting
Fast collecting	Off
Trigger type	Setting: edge, pulse width, video or slope
Trigger info source	Setting: CH1, CH2, EXT, EXT/5 or AC Line.
Trigger coupling	Setting: DC, AC, low or high frequency restriction
Trigger modes	Automatic
Load off time	Minimum value
Trigger level	Set to 50%
Slope type	Rise
Signal recognition	Open the required channel if there is a signal

Note: Regulations of trigger information source under AUTO are based on:
1. The signal input channel shall be used as the trigger source when only one channel has an input signal.
2. In using multi-channels, automatic setting function shall set the vertical control of each channel and to set the horizontal and trigger control by using activity channel with smallest number.
3. CH1 shall be used as trigger source when there is no signal in all channels.

System prompts
• **Adjustment at ultimate limit** - this informs you that the control adjustment has reached it's limit in the current status. No further adjustment is possible. When the vertical deflection factor ON/OFF, time base ON/OFF, X shift, vertical shift and trigger level adjustments have reached their ultimate limits, this prompt will appear.
• **USB Drive Connected** - after a USB drive is plugged in this prompt appears when the connection is valid.
• **USB Drive Disconnected** - after a USB drive is unplugged from the oscilloscope this prompt appears.
• **Saving** - when the oscilloscope is saving a waveform, this prompt will show on screen. A progress bar appears at the bottom.
• **Loading** - when recalling a waveform, this prompt shows on screen. A progress bar appears at the bottom.

SPECIFICATION

Sampling		
Sampling modes	Real time	Equivalence
Sampling rates	72-7615	
	72-7620 1GS/s	50GS/s
	72-7625	
	72-7635 2GS/s	25GS/s
	72-7640	
Average value	All channels reach N times of sampling Average value and N should be chosen among 2, 4, 8,16, 32, 64, 128, 256 and 512	
Input		
Input coupling	AC, DC, Ground	
Input impedance	<100MHz	Parallel 1±2%MΩ with 24pF±3pF
	>100MHz	Parallel 1±2%MΩ with 18pF±3pF
Probe attenuation	1 X , 10 X , 100 X , 1000 X	
Maximum input voltage	400V (DC+AC peak value, input impedance 1MΩ)	
Time delay between channels (typical)	50ps	
Horizontal		
Waveform interpolation	sin (x) /x	
Storage depth	Normal 6kpts, depth 8Mpts Normal 6kpts, depth 4Mpts	
Waveform capturing rate	>150000wfms/s	
Scanning scope (s/div)	2ns/div~50s/div under 1-2-5 system	
Sampling rate and delay time	±50ppm (any time interval >1 ms)	
Time interval (△T) measure accuracy (full bandwidth)	Single: ±(1 sampling time interval + 50ppm x reading + 0. 6ns) > 16 average value: ± (1 sampling time interval + 50ppm x reading + 0. 6ns)	

Vertical		
A/D converter	8-bit resolution	
Deflection factor VOLTS/DIV Range at input BNC	72-7640 72-7635 72-7625	2mV/div~5V/div
	72-7620 72-7615	2mV/div~10V/div (at the input BNC port)
Shift Scope	±8div	
Analogue bandwidth	72-7640	200MHZ
	72-7635	300MHZ
	72-7625	200Mhz
	72-7620	100MHz
	72-7615	60MHz
Single bandwidth	72-7640	100MHz
	72-7635	200MHz
	72-7625	200MHz
	72-7620	100MHz
	72-7615	60MHz
Analogue bandwidth restrictions for choice (typical)	20MHz	
Low frequency response (AC coupling, -3dB)	≤10Hz at BNC	
Rise time	72-7635	1.2ns
	72-7640 72-7625	1.8ns
	72-7620	3.5ns
	72-7615	5.8ns
DC gain accuracy	Vertical sensitivity is 2mV/div: ±4% (sampling or average value sampling mode); Vertical sensitivity is 5mV/div~10V/div: ±3% (sampling or average value sampling mode)	
DC measurement accuracy (average sampling mode)	Vertical shift is zero and N>16: ±(5% x reading+0.1 grid+1mV) and select 2mV/div; ±(3% x reading+0.1 grid+ 1mV) and select 5mV/div~5V/div. Vertical shift is not zero, N>16:± [3% X (reading+vertical shift reading)]+ 5% x vertical shift reading)] +0. 2div) set from 5mV/div to 200mV/div+2mV; set value >200mV / div to 5V/div+50mV.	
Voltage difference (△V) measurement accuracy (average sampling mode)	Under identical setup and environmental conditions, the voltage difference (△V) between two points of the waveform after the average of ≥16 waveforms acquired waveforms is taken: ±(3% x reading + 0.05 div)	

Trigger		
Trigger sensitivity	Internal	≤1 div
	EXT	≥60mV
	EXT/5	≤300mV
Trigger level scope	Internal	±8 div from the centre of the screen
	EXT	±800mV
	EXT/5	±4.0V
Trigger level accuracy (Typical) applied on signals of ≥20ns rise or fall time	Internal	± (0.3 div x V/div) within ± 4 div from the centre of the screen)
	EXT EXT/5	± (6% default value + 40mV) ± (6% default value + 200mV)
Trigger capability	Normal mode/scanning mode, pre-trigger/delayed trigger Pre-trigger depth is adjustable	
Load-off scope	100ns ~ 1.5s	
Set level to 50% (Typical)	Input signal frequency ≥50Hz	
Edge Trigger		
Edge type	Rise, Fall, Rise & Fall	
Pulse Trigger		
Trigger mode	(Less than, greater than or equal) positive pulse; (Less than, greater than or equal) negative pulse	
Pulse width	20ns ~ 10ns	
Video Trigger		
Trigger sensitivity (Video trigger, Typical)	Internal	2 div
	EXT	400mV
	EXT/5	2.0V
Signal format and line/field frequency (video trigger type)	Supports standard NTSC and PAL Line range: 1-525 (NTSC) and 1-625 (PAL)	
Slope Trigger		
Trigger mode	>, < , = positive slope, >, < = negative slope	
Time Setting	20ns-10s, pulse, video	
Trigger accuracy	≤3%	
Trigger Frequency		
Resolution	6 bit	
Accuracy	±51ppm	
Frequency scope	When AC coupling from 10Hz to full bandwidth	
Trigger type	Pulse, edge or width	

Measurement		
Cursor	Manual Mode	Voltage difference (△V) between cursors, time difference (△T) between cursors, △T countdown (Hz)(1/△T)
	Tracking mode	Voltage or time value of waveform points
	Auto measurement mode	Allows cursor or display during auto measurement
Auto measurement	Maximum value,minimum value,top value,bottom value,medium value, peak peak value, amplitude value,average value,mean square root value, period average value, period mean square root value, area, period area, frequency, period, rising edge, falling edge, positive pulse width, negative pulse width,accidental pulse width,overshoot impulse,preshoot, +duty, -duty, delay (advanced measurement) and phase (advance measurement)	
Math functions	+, -, x, ÷, and opposite phase	
Saving waveforms	10 groups and 10 setups	
FFT	Window	Hanning, Hamming, Blackman, Rectangle
	Sampling points	1024 points
Lissajous diagram	Bandwidth	100MHz
	Phase difference	±3 degrees
Display		
Display type	178mm (7") TFT LED	
Display resolution	800x480 RGB	
Display	64k Colour	
Waveform displaying	12 grids, each 50 dots; vertical 8 grids, each 50 dots	
Interface Function		
Standard Configuration	1 USB (D) \ 1 USB (H) \ Pass/Fail	
Select fittings	LAN\GPIB\RS232	

Power Source	
Mains voltage	100-240V AC rms 45-440Hz, CAT II
Power consumption	Less than 40VA
Fuse	F1.6AL 250V
Environmental	
Temperature	Operating: 0°C - 40°C (32°F - 104°F) Storage -20°C - 60°C (4°F - 140°F)
Cooling	Forced fan cooling
Humidity	<35°C: ≤90%RH (<95°F ≤90%RH) +35°C~40°C: ≤60%RH (<95°F~104°F ≤60%RH)
Altitude	Operating: under 3000m Non-operating: under 15,000m

Dimensions		
Size	WIDTH	330mm
	HEIGHT	155mm
	DEPTH	130mm
Weight	Exc Packaging	2.9kg
	Inc Packaging	5.0kg
IP rating	IP20	
Adjustment interval	Recommended calibration interval is one year	

MAINTENANCE

Cleaning
- Periodically wipe the case with damp cloth and mild detergent. Do not use abrasives or solvents for cleaning. Disconnect from the mains first.
- Clean the measurement probe tips occasionally, as dirt on the probes can affect reading accuracy.
- Take care to avoid scratching the glass display when cleaning the LCD.
- Do not leave the oscilloscope where the LCD screen will be exposed to strong direct sunlight for long periods.