

# Service Manual

Model: 6502/04/06

20MHz/40MHz/60MHz 4Trace

Oscilloscope

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## 1. Features

This compact, light weight model 6500 series oscilloscope has a frequency range of DC-60MHz, [DC-40MHz] or (DC-20MHz), and offers the following features:

Wide frequency range : Frequencies up to DC-60MHz, [DC-40MHz] or (DC-20MHz).

High sensitivity : 1mV/div

Large size CRT : Waveforms are easy to read, on the large 6-inch CRT with an internal graticule scale.

Scale : Waveforms are parallax-free with the CRT's internal graticule scale.

Alt Mag : The normal( $\times 1$ ) and the  $\times 10$ ( $\times 5$ ) magnified waveforms can be displayed simultaneously.

Alt Trig : Stabilized triggering is accomplished even with two unrelated signals.

TV synchronization : Stable TV signals are displayed using new circuitry.

Auto focus : Focus deviation is automatically corrected.

## 2. Configuration

The Standard accessories supplied are as follows:

(1) Oscilloscope .....	1
(2) Probe .....	2
(3) Power cord .....	1
(4) User's manual .....	1

### **3. Precautions to be taken to ensure long life**

#### 1. Storage and operation

##### 1-1 Avoid extremes of heat or cold

Do not place oscilloscope in direct sun light for long periods; Store in a closed, unventilated vehicle in hot summer weather, or near heating equipment, such as stoves.

##### 1-2 Do not use outdoors in cold weather. Optimum operating temperature range is 0°C to 40°C.

##### 1-3 Movement from warm location to cold one, and vice versa

Do not move oscilloscope abruptly from warm location to cold location, or vice versa. This could result in condensation forming inside the instrument.

##### 1-4 Avoid humidity, moisture and dust

If oscilloscope is left in a humid or dusty location, this could result in instrument failure. Ideal operating relative humidity range is 35% to 85%. Never place containers of liquid such as cups of coffee on top of oscilloscope, as this could result in spilling in the instrument, inducing failure.

##### 1-5 Avoid areas subject to severe vibration

Avoid places where severe vibration can occur, this may result in machine failure, this is a precision measuring instrument.

##### 1-6 Beware of places where magnets and magnetic fields are present

An oscilloscope is an instrument which operates using electromagnetic properties. Never place magnets near your oscilloscope, or operate oscilloscope in the vicinity of equipment which produces strong magnetic fields.

#### 2. Handling

##### 2-1 Do not place objects on top of oscilloscope, and take care not to block the ventilation holes.

##### 2-2 Do not subject oscilloscope to severe impact

##### 2-3 Do not insert wires or pins into the ventilation holes.

##### 2-4 Do not pull equipment by the probes

##### 2-5 Push both ends of carrying handle to release the locking device to deploy the handle.

2-6 Never place a soldering iron on the oscilloscope frame, or on surface of the CRT tube.

2-7 Do not sit the oscilloscope upside down

3. Sitting the oscilloscope upside down may damage the handle or other parts.

Do not use oscilloscope with BNC cable connected to Ext input terminal on rear panel.

4. If the oscilloscope does not operate normally

Recheck operating procedures and, if the symptoms indicate equipment failure, contact your nearest dealer or store for service.

## 5. Repairs

5-1 To clean the case

- To clean stained casing, lightly rub the stained area with a soft cloth dipped in a neutral detergent.
- If the surface of the panel is dirty, use the same method to clean. If the panel is heavily stained, rub the affected area lightly with a soft cloth soaked in light neutral detergent or alcohol.
- Never use highly volatile material such as benzene or paint thinner.

## 6. Precautions prior to use

6-1 Verify the line voltage.

Refer to the following table for the correct operating voltage ranges for this oscilloscope. Check line voltage prior to connecting to the power source, and verify it is within a voltage range listed below.

Rating	Operating Voltage Range
AC 100V	AC 90V to 110V
AC 120V	AC 108V to 132V
AC 220V	AC 198V to 242V
AC 240V	AC 216V to 250V

This oscilloscope has been set to 120V AC prior to delivery.

If the oscilloscope is to be used at a voltage other than the 120V AC the operating voltage may be changed by the following procedure:

- ① Remove power cable from AC Input.
- ② Insert flat-blade screwdriver into the slot located on right side of the fuse holder cap, remove cap by pressing and then pulling up the screw driver.
- ③ Rotate cap on fuse holder to set voltage to the desired level.
- ④ Connect power cable to the AC Input.  
If voltage higher than AC 220V is required, power cable and fuse may need to be changed. In such case, contact your nearest dealer for appropriate service.

6-2 In sure that the fuse used is an authorized product.

In order to prevent circuit damage resulting from overcurrent, use the correct fuse value for the primary circuit.

	20MHz, 40MHz, 60MHz
For AC 100V, AC 120V	2A
For AC 220V, AC 240V	1A

If the fuse blows, check for the cause. Replace the fuse with the correct one after repair has been made.

If other than the correct fuse is used, not only does this create conditions for failure, but is also dangerous. Therefore, always use the correct fuse value (In particular, never use any component which does not meet current ratings)

The fuse ratings are as follows:

	(Shape) (Diameter × length)mm	SPEC
2A	5.2 φ × 20	250V 2A UL
1A	5.2 φ × 20	250V 1A UL

6-3. Do not turn the intensity too bright.

Do not excessively brighten the dot or trace, this not only tires the eyes but, if allowed for long periods of time, could burn the fluorescent side of the CRT.

6-4. Exercise caution to prevent excessive voltage from being applied directly to the scope inputs or to the probe input. Do not apply voltages higher than these limits:

Vertical Inputs (Direct)	300V	(At DC + AC peak 1kHz)
When probes are used	400V	(At DC + AC peak 1kHz)
EXT TRIG INPUT	300V	(At DC + AC peak 1kHz)
Z-Axis Input	30V	(DC + AC peak)

## 4. How to display a trace

Check input line voltage prior to turning on the power switch. If the voltage selector switch has been set to 120V AC, verify that input power voltage is within the range of 108V-132V. Refer to rear panel illustrations for selection of input line voltage. Insert the power cord into the rear panel AC receptacle, and set each control as follows:

Power	Off (I)
Intensity	Turn all the way counterclockwise.
Focus	Center
AC-GND-DC	GND
Vertical position	Center ( X5MAG is in the off (I) position)
Mode	CH1
Trig mode	Auto
Trig source	INT
Trig level	Center
Time/Div	0.5ms/div
Horizontal position	Center (×10MAG)(×5 MAG) are turned Off (I)

After the controls have been set as above, turn on the power switch. The trace will appear when the Inten Knob is turned clockwise, in approximately 15 seconds. Adjust focus knob until the traces are at their clearest. If the oscilloscope is not being used while the power is on, turn INTEN Knob counter clockwise to reduce brightness.

### Caution

For normal operation, set the following variable controls to the "CAL" position.

V/DIV VAR.	The volts/div is calibrated to the indicated values on the V/Div switch when turned fully clockwise.
SWP VAR	The time/div is calibrated to the indicated values on the Time/DIV switch when turned fully clockwise.

Set the trace to the horizontal graticule scale on the center of the screen, by varying the CH1 position control.

If the trace is slanted with respect to the horizontal scale adjust the front panel trace rotation control until the trace is coincident with the horizontal scale.

- General Check -

### **(1) Displaying 1 waveform on the CRT**

If using channel 1, set the switches as follows:

Vertical axis mode switch ..... CH1  
Trig mode switch ..... Auto  
Trig source switch ..... INT

When these settings have been completed, most repetitive signals of a frequency greater than approximately 25Hz will become synchronized by adjusting the trig level control and can be measured. Since the trigger mode is in Auto, the trace appears even when there is no signal, applied or when the AC-GND-DC switch is set to GND, a DC voltage can also be displayed if the AC-GND-DC switch is set to DC. If low-frequency signals less than 25Hz are applied to CH1, the following changes are required

Trig mode switch ..... Norm

Adjust the trigger level control to synchronize the trace.

If using CH2 input, set these switches:

Vertical axis mode switch to ..... CH2  
Trig source switch to ..... CH2

All other settings and steps are the same as for displaying a waveform on CH1.

### **(2) When 2 waveforms are to be observed**

Set the vertical axis mode switch to Dual, both waveforms now can be easily displayed; If the time/div range is changed, the scope will automatically select ALT or CHOP.



If a phase difference is being measured, the signal with a leading phase must be the trigger signal.

### **(3) Displaying an X-Y pattern**

When the X-Y switch is pressed, the oscilloscope will be an X-Y display with the signal applied to the CH1 input, as the X-Axis and the signal applied to CH2 as the Y-Axis. Set the vertical axis  $\times 10\text{MAG}$  ( $\times 5\text{ MAG}$ ) switch to off (pulled-out state.)

### **(4) Use of ADD**

When the vertical mode switch is set to ADD, the algebraic sum of 2 waveforms can be displayed.

## 5. Specifications

### 1. Vertical Axi

	20MHz	40MHz	60MHz	Remarks
CH1 and CH2 sensitivity	5mV/ div to 5V/div 1-2-5 step, 10 calibrated steps (1mV/div to 1V/div at x5 MAG)			
Accuracy	$\pm 3\%$ $\pm 5\%$ (at x5 MAG)                 } +10°C to +35°C			Vertical knob is set to CAL position
Variable vertical sensitivity	To less than 1/2.5 times indicated sensitivity value			
Frequency band width	DC: DC to 20MHz AC: 10Hz to 20MHz	DC: DC to 40MHz AC: 10Hz to 40MHz	DC: DC to 60MHz AC: 10Hz to 60MHz	
x5MAG	DC: DC to 7MHz AC: 10Hz to 7MHz	DC: DC to 7MHz AC: 10Hz to 7MHz	DC: DC to 7MHz AC: 10Hz to 7MHz	
Rise time	Approximately 17.5ns	Approximately 8.7ns	Approximately 5.8ns	
Input impedance	1M $\Omega$ $\pm 2\%$ , 25pF $\pm 3$ pF			
Maximum input voltage	300V (DC+AC peak)			
Input coupling system	AC - GND - DC			
Operating systems	CH1: Only Channel 1 operates CH2: Only Channel 2 operates ADD: Algebraic sum of 2 signals (CH1 + CH2) Dual: Channels 1 and 2 simultaneously displayed			
Invert	Only CH2 signal is inverted			
Overshoot	maximum 8%			

## 2. CH1 Input Amplifier

	20MHz	40MHz	60MHz	Remarks
Output voltage	minimum 20mV/div			
Output impedance	Approximately 50 $\Omega$			
Band width	50Hz to 5MHz (-3dB)			

## 3. Time axis

	20MHz	40MHz	60MHz	Remarks
Sweep mode	A,XY,ALT.MAG, $\times$ 5MAG	A,XY,ALT.MAG $\times$ 10MAG		
Sweep time	0.1 $\mu$ s to 0.2s/div $\pm$ 3%, in 20calibrated steps (1-2-5 seq)			
Sweep expansion	20ns/div to 40ms/div (20ns/div,40ns/div : Uncal)	10ns/div to 20ms/div (10ns/div : Uncal)		
Alt. MAG TRACE	Maximum 4 traces			
Trace Sep. Var	minimum 1.5 div			

#### 4. Triggering

		20MHz			40MHz			60MHz		
Trigger mode		AUTO, NORM, TV-V, TV-H								
Trigger signal source		INT, CH2, LINE, EXT								
Polarity		+, --								
Coupling system		AC coupling								
sensitivity										
	Frequency	INT	EXT	Frequency	INT	EXT	Frequency	INT	EXT	
NORM	DC to 2MHz	3div	200mV	DC to 5MHz	3div	200mV	DC to 5MHz	3div	200mV	
	2MHz to 20MHz	3div	300mV	5MHz to 40MHz	3div	800mV	5MHz to 40MHz	3div	800mV	
							40MHz to 60MHz	3div	1 V	
AUTO	DC to 2MHz	3div	200mV	DC to 5MHz	3div	200mV	DC to 5MHz	3div	200mV	
	2MHz to 20MHz	3div	300mV	5MHz to 40MHz	3div	800mV	5MHz to 40MHz	3div	800mV	
							40MHz to 60MHz	3div	1 V	
TV synchronization		INT	minimum 1 div							
		EXT	minimum 1 Vp-p							

#### 5. XY operation

		20MHz	40MHz	60MHz	Remarks
Operating mode		CH1, X-axis and CH2, Y-axis; when in X-Y operation mode			
Sensitivity		As vertical axis			
Input impedance		1M $\Omega$ 2% approximately 25pF			
X-axis band width		X-axis band width			
Phase difference		maximum 3° (DC-50kHz)			

6. Z axis

	20MHz	40MHz	60MHz	Remarks
Input impedance	33k $\Omega$			
Maximum input voltage	30V ( DC + AC peak), MAX AC 1kHz			
Band width	DC to 2MHz			
Input signal	$\pm 5V$ (NEGATIVE INCREASES INTENSITY)			

7. CAL

	20MHz	40MHz	60MHz	Remarks
Frequency	1kHz (20%)			
Output level	0.5V ( $\pm 3\%$ )			
Duty	minimum 48 : 52			

8. Power supply

	20MHz	40MHz	60MHz	Remarks
Voltage	AC 100V/120V/220V/240V $\pm 10\%$			
Frequency	50Hz to 60Hz			
Power consumption	35W	35W	55W	

9. CRT

	20MHz	40MHz	60MHz	Remarks
Type	6inch square internal scale			
Acceleration voltage	-1.9kV	12K	12K	
Effective screen	8div(vertical direction) $\times$ 10div(horizontal direction)			

10. Environmental conditions

	20MHz	40MHz	60MHz	Remarks
Operating temperature	0°C to 40°C			
Operating humidity	35% to 85%			
Guaranteed operating temperature	10°C to 35°C			
Guaranteed operating humidity	45% to 85%			
Guaranteed maintained temperature	-20°C to 70°C			
Guaranteed maintained humidity	35% to 85% (Less than 70% at temperatures exceeding 50°C).			

11. Mechanical specifications

	20MHz/40MHz/60MHz			Remarks
Physical dimensions	Height	Width	Length	
	140 (H)	335 (W)	375 (D)	mm
Weight	Approximately 7.3kg			