ESCORT

OSCILLOSCOPE INSTRUCTION MANUAL

EAS-1001
EAS-1000
EAS-601
EAS-600
EAS-401
EAS-400
EAS-201
EAS-200
EAS-200S

TABLE OF CONTENTS

TEST INSTRUMENT SAFETY

1 Inspect the shipping carton for shipping damage. If you notice damage, notify the carrier immediately.

2. Before you apply power to the Oscilloscope, make certain that the voltage selector plug on the rear panel has been inserted with the arrow head at the proper line voltage, Also check the fuse to be sure it is of the proper rating.

3. Do not leave a bright beam on the CRT screen for long periods. This can permanently damage to the screen phosphor.

4. This instrument is convection cooled. Do not block cooling vents when you are operating it.

5. To insure stable operation over long periods of time, do not subject the Oscilloscope to vibration, direct sunlight, extreme temperature variations, high humidity, dust, or electromagnetic fields.

6. Replace the line cord with only a properly rated, 3-wire cord.

7 The GND (ground) terminal and outer ring of all front panel BNC connectors are connected to chassis (earth) ground. & this symbol indicates chassis ground.

8. This front and rear panel warning symbol indicates there are limits that must not be exceeded at these inputs. Refer to "Specifications".

SECTION I
INTRODUCTION

The Oscilloscope is a portable, triggered, dual trace, laboratory-grade instrument. Outstanding features such as the fast vertical rise time, good trace brightness, and the high input sensitivity make the Oscilloscope ideal for the wide range of measurements. The dual-trace capability of the Oscilloscope allows two different signals to be displayed on a conventional CRT (cathode ray tube) that has only one set of vertical deflection plates. Two identical vertical preamplifier circuits, a switching circuit, and a vertical deflection amplifier make this possible. Each vertical preamplifier circuit attenuates its input signal by a known factor, amplifies it to a usable level, and provides the necessary positioning bias.

Each of the two identical input channels provides a maximum signal sensitivity of 1 millivolt/centimeter. Their attenuator networks can be switched through calibrated ranges to set the deflection factor from 1 millivolt/centimeter to 5 volts/centimeter. Several modes of signal display are selected by each channel's position control and the Time Base switch. Either or both channels can be displayed as a function of time or as a function of each other.

Calibrated time-base-ranges are readily switched in a 1, 2, 5 steps sequence. A control on the Time Base switch provides variable sweep speeds between switch positions. Any sweep speed can be expanded 5 times when the x 5 speed control is pulled out. The Trigger Select switch and Level control allow the time base to be precisely triggered at any point along the positive or negative slope of the trigger signal. Various trigger signals can be selected. The Trigger Mode switch controls the trigger input bandpass, cutting off unwanted low frequency trigger signals.

A calibrated square were signal is provided through a front panel connector, allowing easy probe compensation, vertical amplifier calibration, and comparison. Front panel display controls include Intensity, Focus, Vertical and Horizontal position.

The Oscilloscope combines the most desirable features required for precise measurement and display, while its solid-state circuitry provides the ultimate in sensitivity, stability, and versatility.

SECTION II
SPECIFICATIONS

MODEL / SPECIFICATIONS		100 MHz Oscilloscope with Delayed Sweep			
VERTICAL SYSTEM	Sensitivity	1mV/div-1V/div(±3%) at ×5 gain selected. 5mV/div-5V/div(±3%) at normal , 10 steps in 1-2-5 sequence, continuously variable between V/div steps			
	Bandwidth	DC- 100 MHz(-3dB) at Normal DC- 25 MHz(-3dB) when ×5 gain selected			
	Rise Time	5mV/div-5V/div:3.5nS 1mV/div:14nS			
	Input Impedance	1MΩ± 2%,25pF ± 10pF			
	Max. Input Voltage	400V(DC+AC peak)			
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP), CH1+CH2, CH1-CH2, CH2(Invert)			
HORIZONTAL SYSTEM	Sweep Time	2nS/div - 50mS/div at×10Mag, 20nS/div-0.5S/div(± 3%), 23steps in 1-2-5 sequence, continuously variable between S/div steps			
	Sweep Mode	Main, Mix, Delay, X-Y			
	Hold Off Time	5:1,continously variable (0.1 μS/div)			
TRIGGER SYSTEM	Trigger Source	CH1,CH2,LINE,EXT			
	Trigger Mode	AC, TV-V(DC), TV-H, LINE			
	Trigger Sensitivity	Coupling	Bandwidth	INT	EXT
		TV-V(DC)	DC-1kHz	1.0div	0.1Vp-p
		TV-H	1 kHz -100kHz	1.0div	0.1Vp-p
		AUTO	100Hz-100MHz	2.0div	0.2Vp-p
		NORM	100Hz-100MHz	2.0div	0.2Vp-p
	Trigger Slope	"+" or "-"			
X-Y OPERATION	Sensitivity	Same as the vertical system			
	Accuracy	Y-Axis ± 3% X-Axis ± 6%			
	Bandwidth	DC - 1MHz(-3dB)			
	Phase Difference	Approximately 3° at 50kHz			
CRT	Type	Rectangular with internal graticule			
	Display Area	8×10 div (1div=1cm)			
	Accelerating Voltage	14kV			
	Controls	Intensity, Focus, Trace Rotation			
OTHER	Calibrator	Square wave 1KHz±10%,0.5Vp-p (±3%)			
	Power Requirement	115V,230VAC±10%,,50/60Hz. Approx. 60W			
	Accessories	Probes×2, Instruction Manual, Power Cord			
	Dimensions (W×H×D)	324×132×398 mm			
	Weight	Approx. 8.5kg			
	Limits of operation	0℃-50℃, 10-80% R.H			
	Rated Range of Use	10℃-35℃, 10-80% R.H			
	Storage Environment	-30℃-70℃, 10-90% R.H			
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity			

SECTION II
SPECIFICATIONS

MODEL / SPECIFICATIONS		100 MHz Oscilloscope
VERTICAL SYSTEM	Sensitivity	1mV/div-1V/div(±3%) at ×5 gain selected. 5mV/div-5V/div(±3%) at normal , 10 steps in 1-2-5 sequence, continuously variable between V/div steps
	Bandwidth	DC- 100 MHz(-3dB) at Normal DC- 25 MHz(-3dB) when ×5 gain selected
	Rise Time	Approx. 3.5nS
	Input Impedance	1MΩ± 2%,25pF ± 10pF
	Max. Input Voltage	400V(DC+AC peak)
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP), CH1+CH2, CH2(Invert)
HORIZONTAL SYSTEM	Sweep Time	2nS/div - 50mS/div at×10Mag, 20nS/div-0.5S/div(± 3%), 23steps in 1-2-5 sequence, continuously variable between S/div steps
	Sweep Mode	X-Y
	Hold Off Time	5:1,continously variable (0.1 μS/div)
TRIGGER SYSTEM	Trigger Source	CH1,CH2,ALT,EXT
	Trigger Mode	AC, TV-V(DC), TV-H, LINE
	Trigger Sensitivity	Internal: 0.5div External: 500mV
	Trigger Slope	"+" or "-"
X-Y OPERATION	Sensitivity	Same as the vertical system
	Accuracy	Y-Axis ± 3% X-Axis ± 6%
	Bandwidth	DC - 1MHz(-3dB)
	Phase Difference	Approximately 3° at 50kHz
CRT	Type	Rectangular with internal graticule
	Display Area	8×10 div (1div=1cm)
	Accelerating Voltage	14kV
	Controls	Intensity, Focus, Trace Rotation
OTHER	Calibrator	Square Wave 1kHz(nominal) ,0.5Vp-p (±3%)
	Power Requirement	110,125,220,240V±10%,50/60Hz, Approx. 60W
	Accessories	Probes×2, Instruction Manual, Power Cord
	Dimensions (W×H×D)	324×132×398mm
	Weight	Approx. 8.5kg
	Limits of operation	0℃-50℃, 10-80% R.H
	Rated Range of Use	10℃-35℃, 10-80% R.H
	Storage Environment	-30℃-70℃, 10-90% R.H
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity

SECTION II
SPECIFICATIONS

SPECIFICATIONS \ MODEL		60 MHz Oscilloscope with Delayed Sweep			
VERTICAL SYSTEM	**Sensitivity**	1mV/div-1V/div(±3%) at ×5 gain selected. 5mV/div-5V/div(±3%) at normal , 10 steps in 1-2-5 sequence ,continuously variable between V/div steps			
	Bandwidth	DC-60 MHz(-3dB) at Normal DC- 20 MHz(-3dB) when ×5 gain selected			
	Rise Time	5mV/div-5V/div:5.8nS 1mV/div:17.5nS			
	Input Impedance	1MΩ+/- 2%,25pF ± 10pF			
	Max. Input Voltage	400V(DC+AC peak)			
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP), CH1+CH2, CH1-CH2, CH2(Invert)			
HORIZONTAL SYSTEM	**Sweep Time**	0.01 μS/div-20mS/div at×10Mag, , 0.1 μS/div-0.2S/div (± 3%), 20steps in 1-2-5 sequence, continuously variable between S/div steps			
	Sweep Mode	Main, Mix, Delay, X-Y			
	Hold Off Time	5:1,continously variable (0.1 μS/div)			
TRIGGER SYSTEM	**Trigger Source**	CH1,CH2,LINE,EXT			
	Trigger Mode	AUTO,NORM,TV-V,TV-H			
	Trigger Sensitivity	Coupling	Bandwidth	INT	EXT
		TV-V(DC)	DC-1kHz	1.0div	0.1Vp-p
		TV-H	1 kHz -100kHz	1.0div	0.1Vp-p
		AUTO	100Hz-60MHz	1.5div	0.1Vp-p
		NORM	100Hz-60MHz	1.5div	0.1Vp-p
	Trigger Slope	"+" or "-"			
X-Y OPERATION	**Sensitivity**	Same as the vertical system			
	Accuracy	Y-Axis ± 3% X-Axis ± 6%			
	Bandwidth	DC - 2MHz(-3dB)			
	Phase Difference	Approximately 3° at 50kHz			
CRT	**Type**	Rectangular with internal graticule			
	Display Area	8×10 div (1div=1cm)			
	Accelerating Voltage	12kV			
	Controls	Intensity, Focus, Trace Rotation			
COMPONENT TEST	**Test Voltage**	Max. 6Vrms(open circuit)			
	Test Current	Max. 11mA(shorted)			
	Test Frequency	Line Frequency			
	Components	Capacitor, Inductor, Diode, Transistor, Zener etc.			
OTHER	**Calibrator**	Square Wave 1kHz(nominal) ,0.5Vp-p (±3%)			
	Power Requirement	110V,125V,220V,240VAC±10%,50/60Hz, Approx. 40W			
	Accessories	Probes×2, Instruction Manual, Power Cord			
	Dimensions	324×132×398mm			
	Weight	Approx.7.8kg			
	Limits of operation	0℃-50℃, 10-80% R.H			
	Rated Range of Use	10℃-35℃, 10-80% R.H			
	Storage Environment	-30℃-70℃, 10-90% R.H			
	Z-Modulation	Positive TTL signal, low level blank intensity at any intensity, high level unblank intensity			
	Y Output	Yes			
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity			

SECTION II
SPECIFICATIONS

SPECIFICATIONS \ MODEL		60 MHz Oscilloscope
VERTICAL SYSTEM	Sensitivity	1mV/div-1V/div(±3%) at ×5 gain selected. 5mV/div-5V/div(±3%) at normal , 10 steps in 1-2-5 sequence ,continuously variable between V/div steps
	Bandwidth	DC-60 MHz(-3dB) at Normal DC- 20 MHz(-3dB) when ×5 gain selected
	Rise Time	Approx. 5.8nS
	Input Impedance	1MΩ+/- 2%,25pF ± 10pF
	Max. Input Voltage	400V(DC+AC peak)
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP), CH1+CH2, CH2(Invert)
HORIZONTAL SYSTEM	Sweep Time	0.01 μS/div-20mS/div at×10Mag, , 0.1 μS/div-0.2S/div (± 3%), 20steps in 1-2-5 sequence, continuously variable between S/div steps
	Sweep Mode	X-Y
	Hold Off Time	5:1,continously variable (0.1 μS/div)
TRIGGER SYSTEM	Trigger Source	CH1,CH2, LINE,EXT
	Trigger Mode	AUTO,NORM,TV-V,TV-H
	Trigger Sensitivity	Internal: 0.5div External: 500mV
	Trigger Slope	"+" or "-"
X-Y OPERATION	Sensitivity	Same as the vertical system
	Accuracy	Y-Axis ± 3% X-Axis ± 6%
	Bandwidth	DC - 1MHz(-3dB)
	Phase Difference	Approximately 3° at 100kHz
CRT	Type	Rectangular with internal graticule
	Display Area	8×10 div (1div=1cm)
	Accelerating Voltage	12kV
	Controls	Intensity, Focus, Trace Rotation
COMPONENT TEST	Test Voltage	
	Test Current	
	Test Frequency	
	Components	
OTHER	Calibrator	Square Wave 1kHz(nominal) ,0.5Vp-p (±3%)
	Power Requirement	110,125,220,240V±10%,50/60Hz, Approx. 40W
	Accessories	Probes×2, Instruction Manual, Power Cord
	Dimensions	324×132×398mm
	Weight	Approx.7.8kg
	Limits of operation	0℃-50℃, 10-80% R.H
	Rated Range of Use	10℃-35℃, 10-80% R.H
	Storage Environment	-30℃-70℃, 10-90% R.H
	Z-Modulation	
	Y Output	
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity

SECTION II
SPECIFICATIONS

SPECIFICATIONS \ MODEL		40 MHz Oscilloscope with Delayed Sweep			
VERTICAL SYSTEM	Sensitivity	1mV/div-1V/div(±3%) at ×5 gain selected. 5mV/div-5V/div(±3%) at normal , 10 steps in 1-2-5 sequence ,continuously variable between V/div steps			
	Bandwidth	DC- 40 MHz(-3dB) at Normal DC- 15 MHz(-3dB) when ×5 gain selected			
	Rise Time	Less than 8.8nS			
	Input Impedance	1MΩ+/- 2%,25pF ± 10pF			
	Max. Input Voltage	400V(DC+AC peak)			
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP), CH1+CH2, CH1-CH2, CH2(Invert)			
HORIZONTAL SYSTEM	Sweep Time	0.01 μS/div-20mS/div at×10Mag, 0.1 μS/div-2.0S/div (± 3%),23steps in 1-2-5 sequence, continuously variable between S/div steps			
	Sweep Mode	Main, Mix, Delay, X-Y			
	Hold Off Time	5:1,continously variable (0.1 μS/div)			
TRIGGER SYSTEM	Trigger Source	CH1,CH2, LINE,EXT			
	Trigger Mode	AUTO,NORM,TV-V,TV-H			
	Trigger Sensitivity	Coupling	Bandwidth	INT	EXT
		TV-V(DC)	DC-1kHz	1.0div	0.1Vp-p
		TV-H	1 kHz -100kHz	1.0div	0.1Vp-p
		AUTO	100Hz-40MHz	1.5div	0.1Vp-p
		NORM	100Hz-40MHz	1.5div	0.1Vp-p
	Trigger Slope	"+" or "-"			
X-Y OPERATION	Sensitivity	Same as the vertical system			
	Accuracy	Y-Axis ± 3% X-Axis ± 6%			
	Bandwidth	DC - 1MHz(-3dB)			
	Phase Difference	Approximately 3° at 100kHz			
CRT	Type	Rectangular with internal graticule			
	Display Area	8×10 div (1div=1cm)			
	Accelerating Voltage	2.1kV			
	Controls	Intensity, Focus, Trace Rotation			
COMPONENT TEST	Test Voltage	Max. 6Vrms(open circuit)			
	Test Current	Max. 11mA(shorted)			
	Test Frequency	Line Frequency			
	Components	Capacitor, Inductor, Diode, Transistor, Zener etc.			
OTHER	Calibrator	Square Wave 1kHz(nominal) ,0.5Vp-p (±3%)			
	Power Requirement	115V,230VAC±10%,,50/60Hz. Approx. 38W			
	Accessories	Probes×2, Instruction Manual, Power Cord			
	Dimensions	324×132×398mm			
	Weight	Approx.7.6kg			
	Limits of operation	0℃-50℃, 10-80% R.H			
	Rated Range of Use	10℃-35℃, 10-80% R.H			
	Storage Environment	-30℃-70℃, 10-90% R.H			
	Z-Modulation	Positive TTL signal, low level blank intensity at any intensity, high level unblank intensity			
	Y Output	Yes			
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity			

SECTION II
SPECIFICATIONS

SPECIFICATIONS \ MODEL		40 MHz Oscilloscope
VERTICAL SYSTEM	Sensitivity	1mV/div-1V/div(±3%) at ×5 gain selected. 5mV/div-5V/div(±3%) at normal , 10 steps in 1-2-5 sequence, continuously variable between V/div steps
	Bandwidth	DC- 40 MHz(-3dB) at Normal DC- 15 MHz(-3dB) when ×5 gain selected
	Rise Time	Approx. 8.8nS
	Input Impedance	1MΩ+/- 2%,25pF ± 10pF
	Max. Input Voltage	400V(DC+AC peak)
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP), CH1+CH2, CH2(Invert)
HORIZONTAL SYSTEM	Sweep Time	0.01 μS/div-20mS/div at×10Mag, 0.1 μS/div-2.0S/div (± 3%),20steps in 1-2-5 sequence, continuously variable between S/div steps
	Sweep Mode	X-Y
	Hold Off Time	5:1,continously variable (0.1 μS/div)
TRIGGER SYSTEM	Trigger Source	CH1,CH2, LINE,EXT
	Trigger Mode	AUTO,NORM,TV-V,TV-H
	Trigger Sensitivity	Internal: 0.5div External: 500mV
	Trigger Slope	"+" or "-"
X-Y OPERATION	Sensitivity	Same as the vertical system
	Accuracy	Y-Axis ± 3% X-Axis ± 6%
	Bandwidth	DC - 1MHz(-3dB)
	Phase Difference	Approximately 3° at 50kHz
CRT	Type	Rectangular with internal graticule
	Display Area	8×10 div (1div=1cm)
	Accelerating Voltage	2.1kV
	Controls	Intensity, Focus, Trace Rotation
COMPONENT TEST	Test Voltage	
	Test Current	
	Test Frequency	
	Components	
OTHER	Calibrator	Square 1kHz(nominal) Wave ,2.0Vp-p (±3%)
	Power Requirement	115V,230VAC±10%,,50/60Hz. Approx. 40W
	Accessories	Probes×2, Instruction Manual, Power Cord
	Dimensions	324×132×398mm
	Weight	Approx.7.8kg
	Limits of operation	0℃-50℃, 10-80% R.H
	Rated Range of Use	10℃-35℃, 10-80% R.H
	Storage Environment	-30℃-70℃, 10-90% R.H
	Z-Modulation	
	Y Output	
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity

SECTION II
SPECIFICATIONS

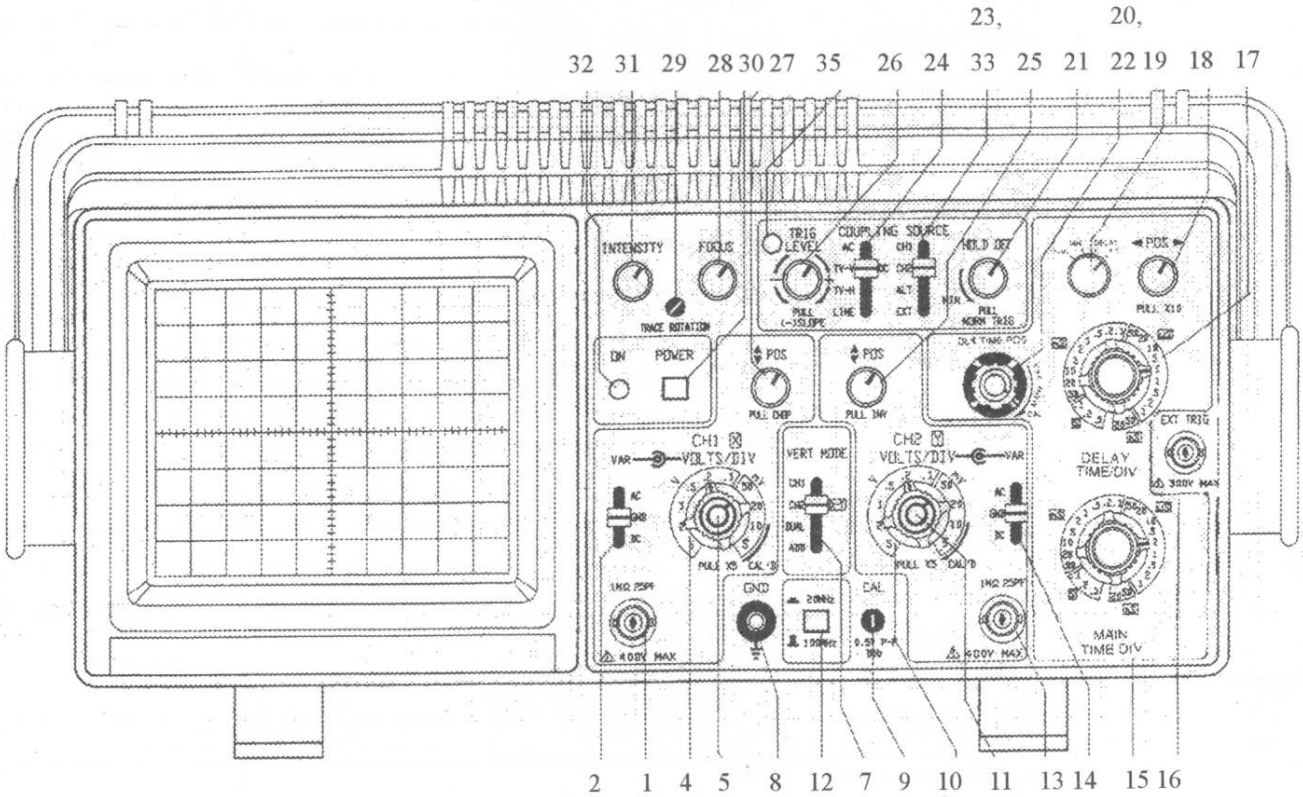
SPECIFICATIONS / MODEL		20 MHz Oscilloscope with Delayed Sweep			
VERTICAL SYSTEM	Sensitivity	1mV/div-1V/div(±3%) at ×5 gain selected. 5mV/div-5V/div(±3%) at normal , 10 steps in 1-2-5 sequence, continuously variable between V/div steps			
	Bandwidth	DC- 20 MHz(-3dB) at Normal DC- 10 MHz(-3dB) when ×5 gain selected			
	Rise Time	Less than 17.5nS			
	Input Impedance	1MΩ+/- 2%, 25pF ± 10pF			
	Max. Input Voltage	400V(DC+AC peak)			
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP), CH1+CH2, CH1-CH2, CH2(Invert)			
HORIZONTAL SYSTEM	Sweep Time	0.01 μS/div-20mS/div at×10Mag, continuously variable between S/div steps,0.1 μS/div-2.0S/div (± 3%),20steps in 1-2-5 sequence			
	Sweep Mode	Main, Mix, Delay, X-Y			
	Hold Off Time	5:1,continously variable (0.1 μS/div)			
TRIGGER SYSTEM	Trigger Source	CH1,CH2, LINE,EXT			
	Trigger Mode	AUTO,NORM,TV-V,TV-H			
	Trigger Sensitivity	Coupling	Bandwidth	INT	EXT
		TV-V(DC)	DC-1kHz	1.0div	0.1Vp-p
		TV-H	1 kHz -100kHz	1.0div	0.1Vp-p
		AUTO	100Hz-20MHz	1.5div	0.1Vp-p
		NORM	100Hz-20MHz	1.5div	0.1Vp-p
	Trigger Slope	"+" or "-"			
X-Y OPERATION	Sensitivity	Same as the vertical system			
	Accuracy	Y-Axis ± 3% X-Axis ± 6%			
	Bandwidth	DC - 1MHz(-3dB)			
	Phase Difference	Approximately 3° at 50kHz			
CRT	Type	Rectangular with internal graticule			
	Display Area	8×10 div (1div=1cm)			
	Accelerating Voltage	2.1kV			
	Controls	Intensity, Focus, Trace Rotation			
COMPONENT TEST	Test Voltage	Max. 6Vrms(open circuit)			
	Test Current	Max. 11mA(shorted)			
	Test Frequency	Line Frequency			
	Components	Capacitor, Inductor, Diode, Transistor, Zener etc.			
OTHER	CALIBRATOR	Square wave 1KHz±10%,2Vp-p (±3%)			
	Power Requirement	110V,125V,220V,240VAC±10%,50/60Hz, Approx. 38W			
	Accessories	Probes×2, Instruction Manual, Power Cord			
	Dimensions	324×132×398mm			
	Weight	Approx.7.6kg			
	Limits of operation	0℃-50℃, 10-80% R.H			
	Rated Range of Use	10℃-35℃, 10-80% R.H			
	Storage Environment	-30℃-70℃, 10-90% R.H			
	Z-Modulation	Positive TTL signal, low level blank intensity at any intensity, high level unblank intensity			
	Y Output	Yes			
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity			

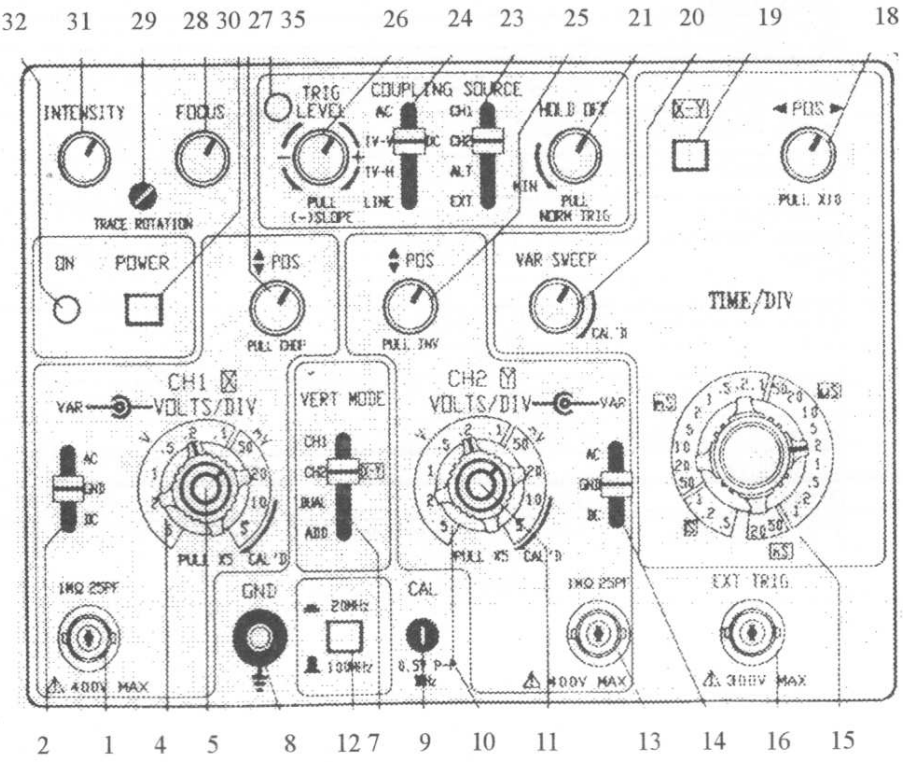
SECTION II
SPECIFICATIONS

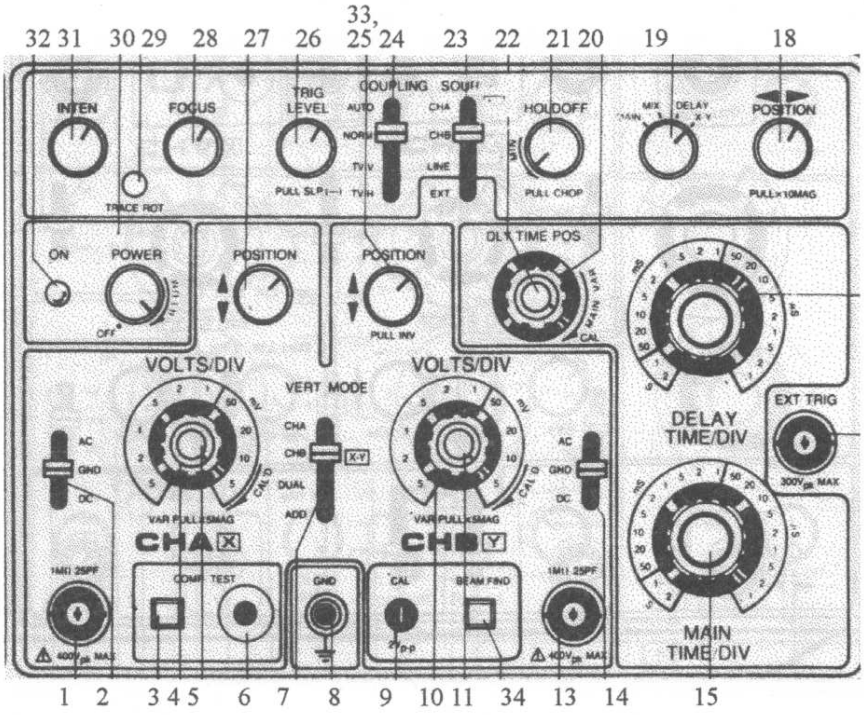
MODEL / SPECIFICATIONS		20 MHz Oscilloscope
VERTICAL SYSTEM	Sensitivity	1mV/div-1V/div(±3%) at ×5 gain selected. 5mV/div-5V/div(±3%) at normal , 10 steps in 1-2-5 sequence ,continuously variable between V/div steps
	Bandwidth	DC- 20 MHz(-3dB) at Normal DC- 10 MHz(-3dB) when ×5 gain selected
	Rise Time	Approx. 17.5nS
	Input Impedance	1MΩ+/- 2%, 25pF ± 10pF
	Max. Input Voltage	400V(DC+AC peak)
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP), CH1+CH2, CH2(Invert)
HORIZONTAL SYSTEM	Sweep Time	0.01 μS/div-20mS/div at×10Mag, continuously variable between S/div steps,0.1 μS/div-2.0S/div (± 3%),20steps in 1-2-5 sequence
	Sweep Mode	X-Y
	Hold Off Time	5:1,continously variable (0.1 μS/div)
TRIGGER SYSTEM	Trigger Source	CH1,CH2, LINE,EXT
	Trigger Mode	AUTO,NORM,TV-V,TV-H
	Trigger Sensitivity	Internal: 0.5div External: 500mV
	Trigger Slope	"+" or "-"
X-Y OPERATION	Sensitivity	Same as the vertical system
	Accuracy	Y-Axis ± 3% X-Axis ± 6%
	Bandwidth	DC - 1MHz(-3dB)
	Phase Difference	Approximately 3° at 50kHz
CRT	Type	Rectangular with internal graticule
	Display Area	8×10 div (1div=1cm)
	Accelerating Voltage	2.1kV
	Controls	Intensity, Focus, Trace Rotation
COMPONENT TEST	Test Voltage	
	Test Current	
	Test Frequency	
	Components	
OTHER	CALIBRATOR	Square Wave 1kHz(nominal) ,2.0Vp-p (±3%)
	Power Requirement	110V,125V,220V,240V±10%,50/60Hz, Approx. 40W
	Accessories	Probes×2, Instruction Manual, Power Cord
	Dimensions	324×132×398mm
	Weight	Approx.7.6kg
	Limits of operation	0℃-50℃, 10-80% R.H
	Rated Range of Use	10℃-35℃, 10-80% R.H
	Storage Environment	-30℃-70℃, 10-90% R.H
	Z-Modulation	
	Y Output	
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity

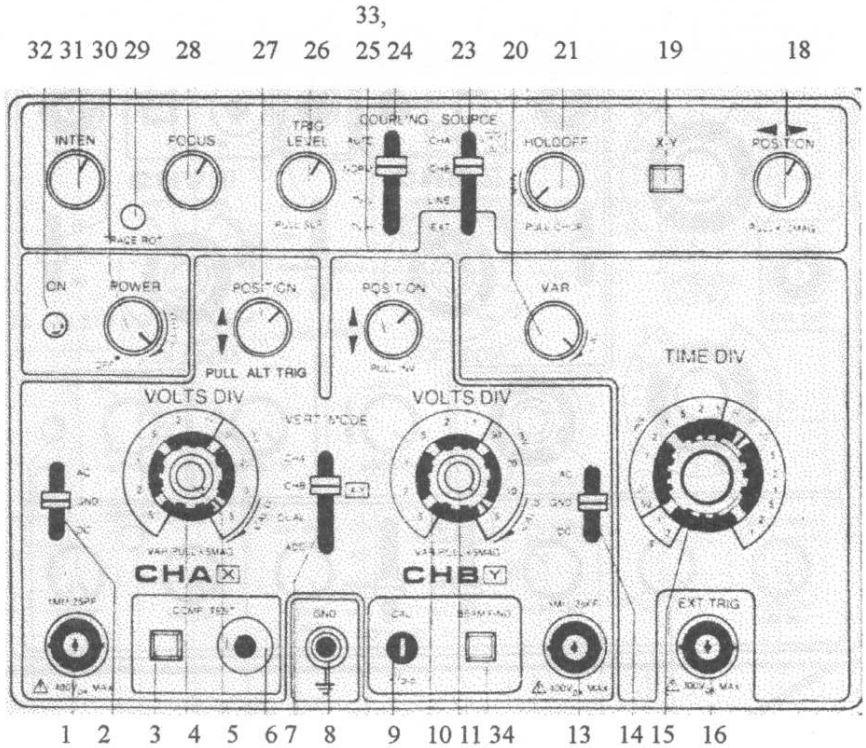
SPECIFICATIONS \ MODEL		20 MHz Oscilloscope			
VERTICAL SYSTEM	Sensitivity	1mV/div-2mV/div(±6%). 5mV/div-5V/div(±3%) , 12 steps in 1-2-5 sequence continuously variable between V/div steps			
	Bandwidth	DC- 20 MHz(-3dB)			
	Rise Time	17.5nS(20MHz). 70nS(5MHz).			
	Input Impedance	1MΩ+/- 3%,32pF +/- 5pF			
	Max. Input Voltage	400V(DC+AC peak)			
	Operating Mode	CH1,CH2,DUAL(ALT,CHOP),CH1+CH2, CH1(invert)			
HORIZONTAL SYSTEM	Sweep Time	20nS/div - 50mS/div at×10Mag, continuously variable between S/div steps, 200nS/div-0.5S/div(± 3%), 20steps in 1-2-5 sequence			
	Sweep Mode	X-Y			
	Hold Off Time	5:1,continously variable (0.1 μS/div)			
TRIGGER SYSTEM	Trigger Source	CH1,CH2,LINE,EXT			
	Trigger Mode	AUTO,NORM,TV-H,TV-V			
	Trigger Sensitivity	Bandwidth	Coupling	INT	EXT
		10Hz-1.5kHz	TV-V	1.5div	0.5Vp-p
		3KHz -30MHz	TV-H	1.5div	0.5Vp-p
		30Hz-5MHz	AUTO	0.5div	0.3Vp-p
		5MHz-30MHz	NORM	1.5div	0.5Vp-p
	Trigger Slope	"+" or "-"			
X-Y OPERATION	Sensitivity	Same as the vertical system			
	Accuracy	Y-Axis ± 3% X-Axis ± 3%			
	Bandwidth	0 ~ 2.0MHz(-3dB)			
	Phase Difference	Less than 3° ,below 50kHz			
CRT	Type	Rectangular with internal graticule			
	Display Area	8×10 div (1div=1cm)			
	Accelerating Voltage	2.1kV			
	Controls	Intensity, Focus, Trace Rotation			
COMPONENT TEST	Test Voltage				
	Test Current				
	Test Frequency				
	Components				
OTHER	CALIBRATOR	Square wave 1KHz±20%,1.0Vp-p±3%			
	Power Requirement	110,120,220,240VAC±10%,,50/60Hz. Approx. 30W			
	Accessories	Probes×2(1:10,1:1), Instruction Manual, Power Cord			
	Dimensions	320×130×361 mm			
	Weight	Approx. 6.5kg			
	Limits of operation	0℃-40℃, 10-80% R.H			
	Rated Range of Use	10℃-35℃, 10-80% R.H			
	Storage Environment	-30℃-70℃, 10-90% R.H			
	Z-Modulation				
	Y Output	Yes			
	C E STANDARD	E.M.C. Regulations-1992(E.C.Directive 89/336/EEC) EN 50081-1 Emissions EN 50082-1 Immunity			

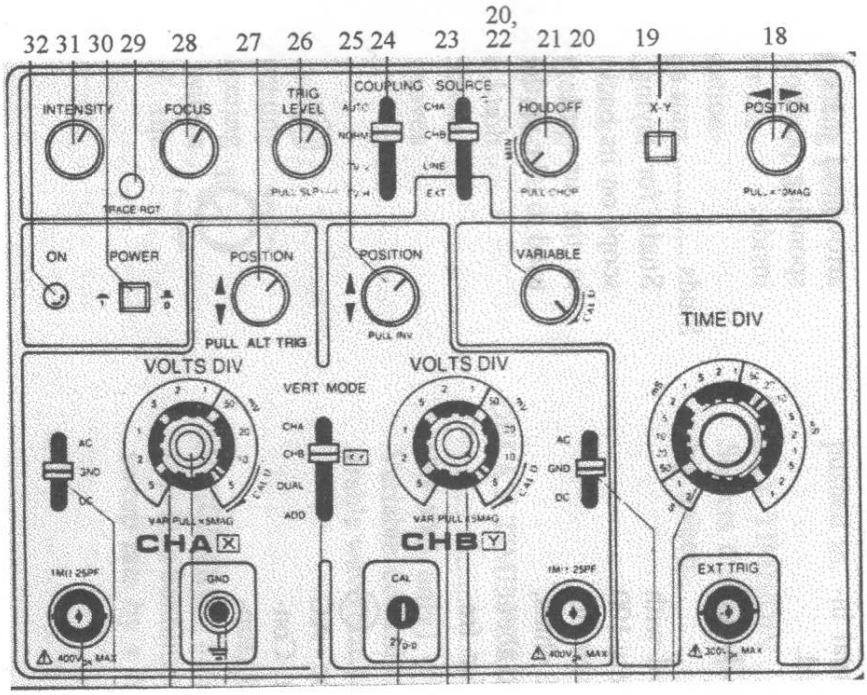
SECTION III
CONTROLS AND INDICATORS

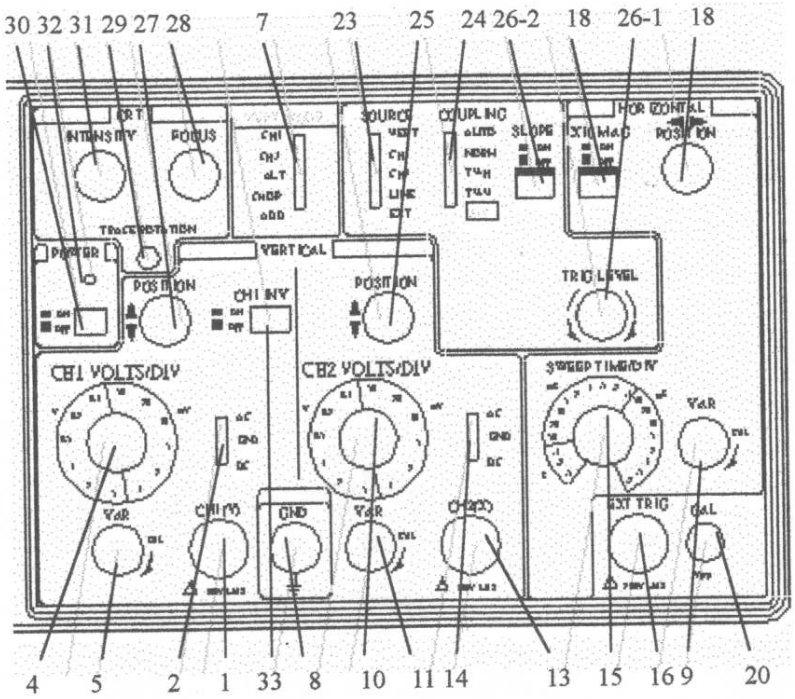


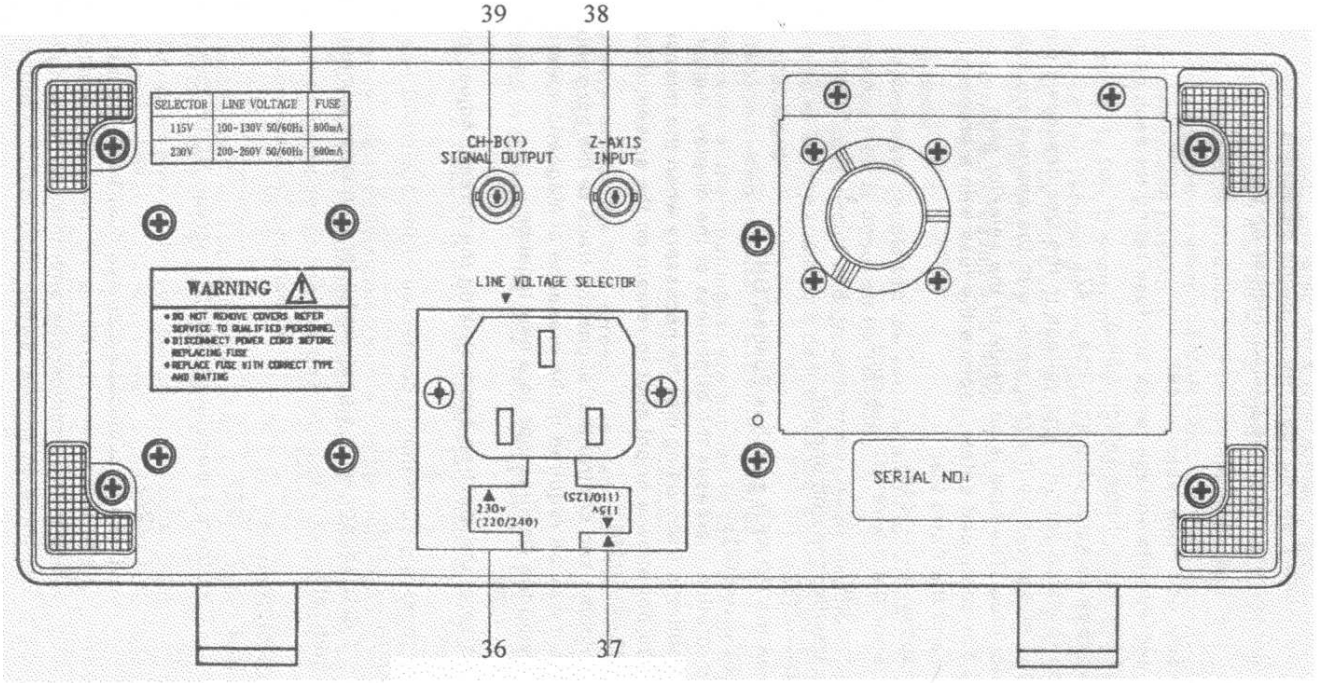


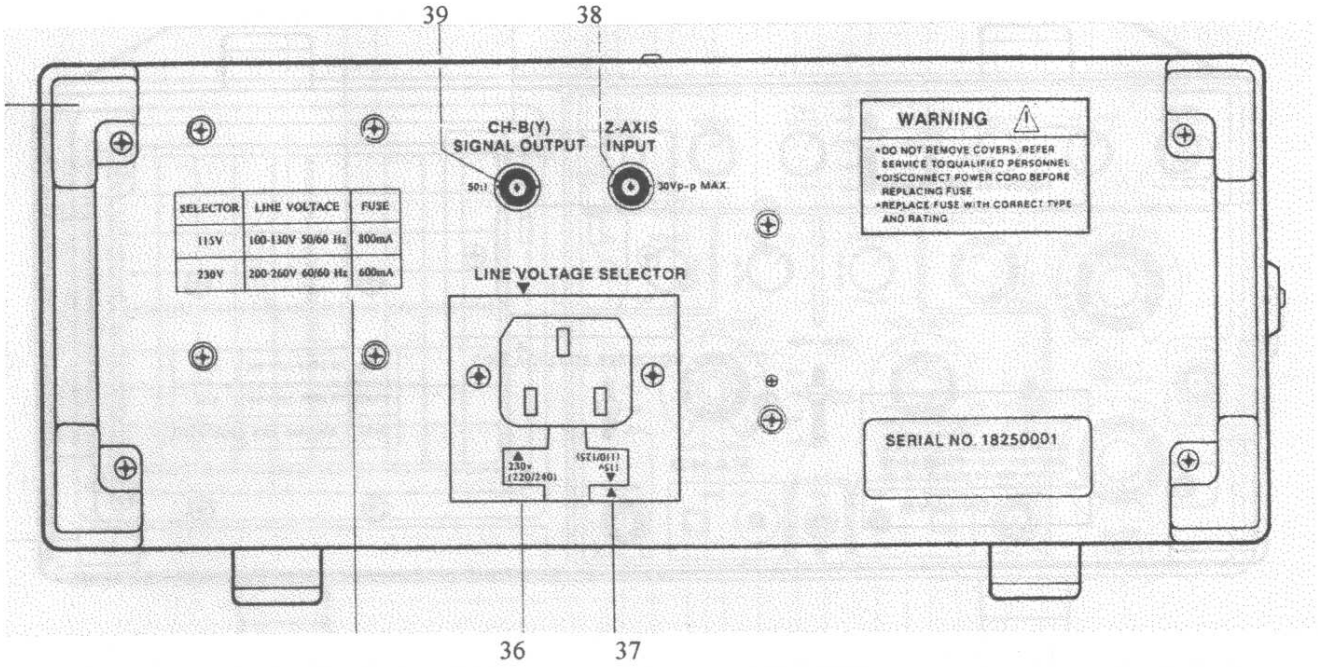

33,
32 31 30 29 28 27 26 25 24 23 22 21 20 19 18
INTEN
FOCUS
TRIG LEVEL
COUPLING
SOURCE
HOLDOFF
POSITION
TRACE ROT
PULL SLP
PULL CHOP
PULL×10MAG
ON
POWER
POSITION
POSITION
PULL INV
DLY TIME POS
VOLTS/DIV
VERT MODE
VOLTS/DIV
DELAY TIME/DIV
EXT TRIG
AC
GND
DC
CHA
CHB
X-Y
DUAL
ADD
CHA X
CHB Y
COMP TEST
GND
CAL
BEAM FIND
MAIN TIME/DIV
1 2 3 4 5 6 7 8 9 10 11 34 13 14 15

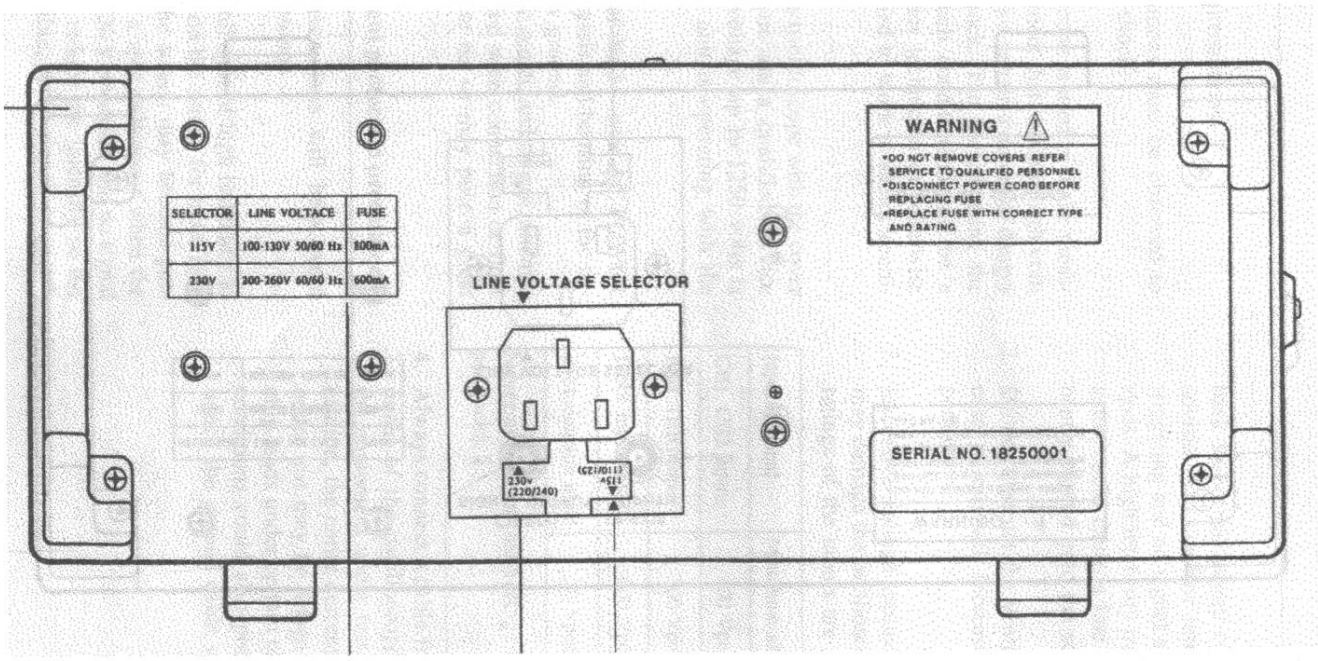

33,
32 31 30 29 28 27 26 25 24 23 20 21 19 18
INTEN
FOCUS
TRIG LEVEL
COUPLING
SOURCE
HOLDOFF
X-Y
POSITION
TRACE ROT
ON
POWER
POSITION
PULL ALT TRIG
POSITION
VAR
TIME DIV
VOLTS DIV
VERT MODE
VOLTS DIV
CHA X
CHB Y
COMP TEST
GND
CAL
BEAM FIND
EXT TRIG
1 2 3 4 5 6 7 8 9 10 11 34 13 14 15 16


32 31 30 29 28 27 26 25 24 23 20, 22 21 20 19 18
INTENSITY
FOCUS
TRACE ROT
TRIG LEVEL
COUPLING
SOURCE
HOLDOFF
X-Y
POSITION
ON
POWER
POSITION
PULL ALT TRIG
POSITION
PULL INV
VARIABLE
TIME DIV
VOLTS DIV
VERT MODE
CHA
CHB
DUAL
ADD
VOLTS DIV
AC
GND
DC
CHA X
CHB Y
GND
CAL
EXT TRIG
1 2 4 5 8 7 9 10 11 13 14 15 16


30 32 31 29 27 28 7 23 25 24 26-2 18 26-1 18
INTENSITY
FOCUS
TRACE ROTATION
POWER
VERTICAL
POSITION
CH1 INV
POSITION
HORIZONTAL
POSITION
TRIG LEVEL
CH1 VOLTS/DIV
CH2 VOLTS/DIV
SWEEP TIME/DIV
VAR
VAR
GND
VAR
EXT TRIG
CAL
4 5 2 1 33 8 10 11 14 13 15 16 9 20


39
38
SELECTOR
LINE VOLTAGE
FUSE
115V
100~130V 50/60Hz
800mA
230V
200~260V 50/60Hz
600mA
CH-B(Y)
SIGNAL OUTPUT
Z-AXIS
INPUT
WARNING
• DO NOT REMOVE COVERS REFER SERVICE TO QUALIFIED PERSONNEL
• DISCONNECT POWER CORD BEFORE REPLACING FUSE
• REPLACE FUSE WITH CORRECT TYPE AND RATING
LINE VOLTAGE SELECTOR
230v
(220/240)
SERIAL NO:
36
37


39
38
CH-B(Y)
SIGNAL OUTPUT
50Ω
Z-AXIS
INPUT
30Vp-p MAX.
WARNING
•DO NOT REMOVE COVERS. REFER SERVICE TO QUALIFIED PERSONNEL
•DISCONNECT POWER CORD BEFORE REPLACING FUSE
•REPLACE FUSE WITH CORRECT TYPE AND RATING
SELECTOR
LINE VOLTAGE
FUSE
115V
100-130V 50/60 Hz
800mA
230V
200-260V 60/60 Hz
600mA
LINE VOLTAGE SELECTOR
230v
(220/240)
SERIAL NO. 18250001
36
37


SELECTOR
LINE VOLTAGE
FUSE
115V
100-130V 50/60 Hz
800mA
230V
200-260V 60/60 Hz
600mA
LINE VOLTAGE SELECTOR
230V
(220/240)
WARNING
•DO NOT REMOVE COVERS REFER SERVICE TO QUALIFIED PERSONNEL
•DISCONNECT POWER CORD BEFORE REPLACING FUSE
•REPLACE FUSE WITH CORRECT TYPE AND RATING
SERIAL NO. 18250001
36
37

1. **CH 1 (CH A) INPUT**

This BNC connector is the CH 1 (CH A) input.

2. **CH 1 (CH A) AC-GND-DC SWITCH**

This switch has three positions:

AC: The input signal is capacitively coupled to the vertical amplifier and DC component is blocked. The low frequency limit is about 10 Hz (at -3dB).

GND: Disconnects (opens) the input circuit and grounds the vertical amplifier input. Use this position when you wish to set the trace to a desired reference baseline without disconnecting the input signal.

DC: Both DC & AC components of the input signal are applied to the vertical amplifier input.

3. **COMP TEST SWITCH**

To operate Component Test function when pushed in.

4. **CH 1 (CH A) VOLTS/DIV CONTROL**

Each position of this attenuator switch marked with a number that indicates the peak-to-peak input voltage required to produce a peak-to-peak deflection of one major division (1 cm) on the screen's graticule when the VAR control is set to its CAL'D (fully clockwise) position.

5. **CH 1 (CH A) VARIABLE CONTROL**

This control is normally set to its CAL'D position (fully clockwise), where the VOLTS/DIV switch position are calibrated. The vertical gain decreases as the control is turned counterclockwise, permitting the size of the vertical pattern to be adjusted in a continuous manner between the selected range and the next higher range.

6. **COMP TEST JACK**

Input banana jack of component test function.

7. **VERT MODE**

CH 1 (CH A): Displays the Channel 1 (Channel A) trace only.

CH 2 (CH B): Displays the Channel 2 (Channel B) trace only.

DUAL: Displays both the CH 1 and CH 2 traces. The traces are normally alternating.

ALT: In ALT mode, CH 2 is swept at the end of the CH 1 sweep.

CHOP: In chopping mode, the trace is quickly switched between the CH 1 and CH 2 inputs (at 500KHz rate) to enhance the viewing of signals with low sweep rates and to verify timing relationships between signals at low and medium sweep rates.

ADD: Displays the algebraic sum of the CH 1 and CH2 signals or the algebraic difference between the CH 1 and CH 2 signals.

8. **GND**

Provides a chassis ground that is connected to the 3-wire AC line cord (earth) ground.

9. **CAL**

Provides a square wave signal useful for frequency compensation of probes, calibrate verttical amplifier gain, etc.

10. **CH 2 (CH B)VOLTS/DIV CONTROL**

Each position o7888888uiif this attenuator switch is marked with a number that indicates the peak-to-peak input voltage required to produce a peak-to-peak deflection of one major division (1 cm) on the screen's graticule when the VAR control is set to its CAL'D position (fully clockwise).

11. **CH 2 (CH B) VARIABLE CONTROL**

This control is normally set to its CAL'D position (fully clockwise), where the VOLTS/DIV switch positions are calibrated. The vertical gain decreases as

the control is turned counterclockwise, permitting the size. of the vertical pattern to be adjusted in a continuous manner between the selected range and the next higher range.

12. **LIMIT SWITCH**

The feature is provided in 100MHz models. With this switch pushed in bandwidth of the oscilloscope will be limited to 20MHz.

13. **CH 2 (CH B) INPUT**

This BNC connector is the CH 2 (CH B) of the oscilloscope input

14. **CH 2 (CH B) AC-GND-DC SWITCH**

This switch has three positions:

AC: The input signal is capacitively coupled to the vertical amplifier and DC component is blocked. The low frequency limit is about 30 Hz (at -3dB)

GND: Disconnects (opens) the input circuit and grounds the vertical amplifier input. Use this position when you wish to set trace to a desired reference baseline without disconnecting the input signal.

DC: Both DC & AC components of the input signal are applied to the vertical amplifier input.

15. **TIME/DIV CONTROL**

Selects the sweep time setting.

16. **EXT TRIG INPUT**

External triggering signal input terminal.

17. **DELAY TIME/DIV CONTROL**

Selects the sweep time for the delayed sweep.

18. **HORIZONTAL POSITION**

Positions the trace horizontally on the CRT screen. It is also the X (horizontal) position control in the X-Y mode.

The horizontal trace is expanded by a factor of ten when x 10 MAG is selected

19. **MAIN-MIX-DELAY-XY**

Selects the type of sweep as follows:

MAIN: For normal sweep operation.

MIX: Allows a continuously variable mixing of main and delayed sweep at any point on the signal waveform.

DELAY: Allows the horizontal sweep to be started at any point on the signal waveform.

X-Y : With the switch set to X Y, the instrument operates as an X-Y oscilloscope.

20. **VAR SWEEP TIME**

Permitting the sweep time to be adjusted continuously between the steps of sweep time/DIV.

21. **HOLD OFF**

Use this control if the measured signal waveform is made up of complex repetative cycles and attain a stable waveform display is not sufficient by TRIG LEVEL control.

22. **DELAY TIME POSITION**

Provides a continuous adjustment of the delayed sweep between the selected range and the next slower range.

MAIN VAR - Provides a continuous adjustment of the sweep rate by a factor of 5. The control is calibrated with the knob set to its CAL position (fully clockwise)

23. **TRIG SOURCE**

Selects the triggering source signal as follows:

CHI: Channel 1 signal.

CH 2: Channel 2 signal.

ALT: For dual trace signals selects the triggering mode in which each sweep alternates between

channel 1 and channel 2 signals as separate triggering sources.

EXT: The signal applied to the EXT TRIG connector.

LINE: The AC line voltage frequency is used as the triggering signal

24. **TRIG COUPLING**

Selects the triggering mode as follows:

AC: The input signal is capacitively coupled to the vertical amplifier and any DC frequency limit is about 30 Hz (at- 3dB).

TV-V: Rejects high frequency sync signals in a composite video signal.

TV-H: Rejects DC and low frequency sync signals in a composite video signal.

NORM: Sweep signal is provided only if trigger signal available.

AUTO: Sweep signal is provided internally if trigger signal is not available, sweep signal changed to NORM trigger automatically while trigger signal is available.

25. **CH 2 (CH B) VERTICAL POSITION**

Positions the CH 2 (CH B) trace vertically on the CRT screen.

26. **TRIG LEVEL AND SLOPE**

Adjust TRIG Level to select the starting point at which the sweep is triggered.

Selects triggering slope "+" or "-" when trigger signal crosses trigger level in a positive-going direction or negative going direction.

27. **CH 1 (CH A) POSITION**

Positions the CH 1 (CH A) trace vertically on the CRT screen.

28. **FOCUS CONTROL**

Varies the size of the electron beam striking the screen. Adjust for the sharpest display.

29. **TRACE ROTATION**

Semi-fixed potentiometer for aligning the horizontal trace in parallel with graticule lines

30. **POWER SWITCH**

Turns the Oscilloscope on and off.

31. **INTENSITY CONTROL**

Clockwise rotation increases the brightness of the display. Adjust the brightness for your lighting conditions. Refocusing may be necessary when the intensity is changed.

CAUTION: Do not allow a bright spot to remain on the screen; it could damage the CRT.

32. **"ON" LED**

Lights when the POWER switch is turned on.

33. **INV**

The trace is inverted when INV operated.

34. **BEAM FIND**

Bring beam to the center of the screen while the trace is not found.

35. **TRIG INDICATOR**

Lights when the input signal is triggered.

36. **AC VOLTAGE SELECTOR PLUG AND FUSE**

For selecting the AC voltage of the instrument by aligning its arrowhead mark in the corresponding position and fuse is inside.

37. **AC POWER INPUT CONNECTOR**

Input connector of the AC power of the instrument. Connect the AC power cord (supplied) to this connector.

38. **Z AXIS INPUT**

Input terminal for external intensity modulation signal.

39. **SIGNAL OUTPUT.**

Delivers the Y signal to be used for frequency counting, etc.

SECTION IV
SAFETY PRECAUTIONS

WARNING

⚠ *The following precautions must be observed to help prevent electric shock*

1. When the oscilloscope is used to make measurements in equipment that contains high voltage. there is always a certain amount of danger from electrical shock. The person using the oscilloscope in such conditions should be a qualified electronics technician or other wise trained and qualified to work in such circumstances. Observe the TEST INSTRUMENT SAFETY recommendations listed on the inside front cover of this manual.

2. Do not operate this oscilloscope with the case removed unless you are a qualified service technician. High voltage up to 1800 volts is present when the unit is operating with the case removed.

3. The ground wire of the 3-wire ac power plug places the chassis and housing of the oscilloscope at earth ground. Use only a 3-wire outlet, and do not attempt to defeat the ground wire connection or float the oscilloscope, to do so may pose a great safety hazard.

4. Special precautions are required to measure or observe line voltage waveforms with any oscilloscope. Use the following procedure:

   a. Do not connect the ground clip of the probe to either side of the line. The clip is already at earth ground and touching it to the hot side of the line may "weld" or "disintegrate" the probe tip and cause possible injury plus possible damage to the scope or probe.

   b. Insert the probe tip into one side of the line voltage receptacle, then the other. One side of the receptacle should be "hot" and produce the waveform. The other side of the receptacle is the ac return and no waveform should result.

CAUTION

⚠ *The following precautions will help avoid damage to the oscilloscope.*

1. Never allow a small spot of high brilliance to remain stationary on the screen for more than a few seconds. The screen may become permanently burned. A spot will occur when the scope is set up for X-Y operation and no signal is applied. Either reduce the intensity so the spot is barely visible apply signal, or switch back to normal sweep operation. It is also advisable to use low intensity with AUTO triggering and no signal applied for long periods. A high intensity trace at the same position could cause a line to become permanently burned onto the screen.

2. Do not obstruct the ventilating holes in the case, as this will increase the internal temperature.

3. Excessive voltage applied to the input jacks may damage the oscilloscope. The maximum ratings of the input are as follows:

   CH1 and CH2: 400V dc + ac peak
   EXT TRIG: 200V dc + ac peak.

CAUTION

⚠ *Never apply external voltage to oscilloscope output jacks.*

4. Always connect a cable from the ground terminal of the oscilloscope to the chassis of the equipment under test. Without this precaution, the entire current for the equipment under test may be drawn through the probe clip leads under certain circumstances. Such conditions could also pose safety hazard, which the ground cable will prevent.

5. The probe ground clips are at oscilloscope and earth ground and should be connected only to the earth ground or isolated common of the equipment under test. To measure with respect to any point other than the common, use subtract operation (ADD mode and INV1), with the channel 2 probe to the point of measurement and the channel 1 probe to the point of reference. Use this method even if the reference point is a de voltage with no signal.

SECTION V
OPERATING INTRUCTIONS

CHECKING AND ADJUSTMENT PRIOR TO MEASUREMENT

In order to operate the oscilloscope at its optimum performance level, carry out the following checks and adjustment before doing your measurements. The instructions which follow concerning basic operation techniques and applications assume that the checks and adjustment described here have been completed.

1. Adjust the control panel to the following settings.

MODE ----------AUTO
SOURCE ----------VERT MODE
VERTICAL MODE----- ALT (DUAL)
SLOPE---------- (+)
LEVEL----------CENTER
CH1 (CH A); CH2 (CH B)
POSITION----------CENTER
VARLABLE----------CAL
VOLTS/DIV----------5V/DIV
AC-GND-DC----------GND
HORIZONTAL
POSITABLE----------CENTER
VARLABLE----------CAL
SWEEP TIME/DIV------1 ms/DIV
x 10MAG----------OFF

After checking the power source voltage ratings, switch the POWER on. The power on indicator will light up and a trace line will appear in 10 to 15 seconds. Check to see that rotating the INTENSITY control clockwise to the right increases trace brightness and counter clockwise it to the left decreases brightness. Then rotate the INTENSITY control all way to left and extinguish the trace line to being preheating. For the most accurate measurement results, it is necessary to preheat the oscilloscope for about 30 minutes. However, preheating is not necessary if you intend only to display waveforms.

2. After preheating, adjust the INTENSITY control so that the trace line is easy to see and adjust the FOCUS control to attain the clearest display image possible. Then, use the TRACE ROTA control to bring the trace line parallel with the horizontal graduation lines.

3. Plug the probe into the INPUT BNC jacks of each channel. Set the AC-GND-DC control at DC and the VERTICAL MODE control at CH1. Plug the CH1 probe to the CAL terminal and set the VOLTS/DIV control at 20mV/DIV. Adjust the VERTICAL POSITION control so that all of the waveform in can be seen. With the waveform in this position, carry out probe compensation adjustment.
After Set the VERTICAL MODE control to CH2 and carry out compensating the channel probes, use the CH1 probe exclusively in channel 1, and the CH2 probe exclusively in channel 2. This is necessary because there is a slight capacitance variation between the two channels, and confusing probes will cause changes in compensation adjustments.

4. Return the VERTICAL MODE control to CH1, each channel's AC-GND-DC control to the AC setting, each channel's VOLTS/DIV control to 5V/DIV POSITION and horizontal POSITION controls to center.
This is what we refer to as the "initial setting" condition.

SINGLE TRACE OPERATION

ALTERNATING CURRENT DISPLAY

With the oscilloscope in the initial setting condition display on the CRT screen the signal applied to the CH1 INPUT terminal. Adjust the signal amplitude to an easy to measure size by changing the VOLTS/DIV control setting. The CH1 VARIABLE control may be rotated to change the

amplitude in continuous fashion. However, if this is not necessary leave the setting at CAL.

Next, adjust the horizontal SWEEP TIME/DIV control to attain an easy to measure display. Make sure to leave the VARIABLE control setting at CAL.

Whenever the waveform begins to destabilize, it is necessary to use the triggering operation. Rotating the trigger LEVEL control left or right will stabilize the waveform.

Depending on the type of signal, switching the SLOPE control will also give you clearer displays. These kinds of operations using the trigger LEVEL and SLOPE control are referred to as setting the Trigger Point. The oscilloscope begins sweeping from preset trigger points.

When inputting low frequency signals or slow occurrence rate signals, switch the TRIGGERING MODE control to the NORM setting. Even though the waveform display may disappear from the CRT screen when signal amplitudes are relatively small or the trigger point setting is inappropriate. The NORM setting will allow more stable triggering than can be attained in the AUTO setting.

COMPOSITE VIDEO SIGNAL DISPLAY

When inputting composite video signals, set the TRIGGERING MODE to either TV-H or TV-V. Also switch the SLOPE control in accordance with signal polarity.

DUAL TRACE DISPLAY

In observing simultaneous waveforms on channel 1 and 2, the waveforms are usually related in frequency. or one of the waveforms is synchronized to the other although the basic frequencies are different. If the two waveforms have no phase or frequency relationship, there is seldom reason to observe both waveforms simultaneously. However, when the trigger SOURCE switch is set to the ALT position, two waveforms not related in frequency or period can be simultaneously viewed.

1. Connect probes to both the CH 1 (CH A) and CH 2 (CH B) input BNC jacks.
2. Connect the ground clips of the probes to the chassis or common of the equipment under test. Connect the tips of the probes to the two points in the circuit where waveforms are to be measured.
3. When the VERTICAL MODE control is set at CH1 the CRT screen will display the signal applied to the channel 1 INPUT terminal. The amplitude can be altered using the channel 1 VOLTS/DIV control.
4. When the VERTICAL MODE control is set at CH2, the CRT screen will display the signal applied to the channel 2 INPUT terminal. The amplitude can be altered using the channel 2 VOLTS/DIV control.
5. When the VERTICAL MODE control is set at ALT, the CH1 and CH2 signals are displayed one after the other for each sweep.
6. When the VERTICAL MODE control is set at CHOP, the CH1 and CH2 signals are sub-divided according to time and displayed on the screen.
7. When the VERTICAL MODE control is set at ADD, CH1 and CH2 signals will be combined (CH1 +CH2) on the CRT display screen. If the INV control is operated in this condition the differential of the two channels will be displayed. In order to measure displayed waveforms at the ADD setting, it is necessary that the VOLTS/DIV control settings be the same for both channels.

SWITCHING TRIGGER SOURCE

When the VERTICAL MODE control is set at CH1, ALT, CHOP, or ADD and the SOURCE control is set at VERT MODE, the signal source for the trigger becomes channel 1. At this time, if the CH1 signal is too complicated, making the trigger point too difficult, switch the SOURCE control to the CH2 setting. The CH2 signal will be simple enough

for a stable trigger point setting. However, when the waveforms of both channels are too complicated, use an external source to set the trigger point.

If different frequencies are input to CH1 and CH2, set the VERTICAL MODE selector to ALT and SOURCE selector to VERT MODE. Input signals to CH1 and CH2 are used as the trigger signal sources, which alternate in every sweeping. Thus, both signals are triggered.

EXTERNAL TRIGGER

Set the Source control at EXT and apply a signal to the EXT TRIG terminal. It is necessary that this signal have a fixed timing relationship to either CH1 or CH2.

Also, in order to simplify the trigger point setting process, you should use as simple an external signal as possible.

LINE TRIGGER

When the CH1 or CH2 signal is synchronized with a commercial-use power source frequency, setting the SOURCE control at LINE will stabilize the trigger.

SWEEP MAGNIFICATION OPERATION

When carrying out measurement by magnifying a portion of the displayed wave form in terms of time, increasing sweep speed may cause the waveform portion to be measured to disappear from the screen. When this happens, waveform measurement can still be done by magnifying the sweep.

Work the HORIZONTAL POSITION control to move the waveform portion to be magnified to the middle of the CRT display screen. Then press the x 10MAG control to magnify the waveforrn 10 times in the horizontal direction.

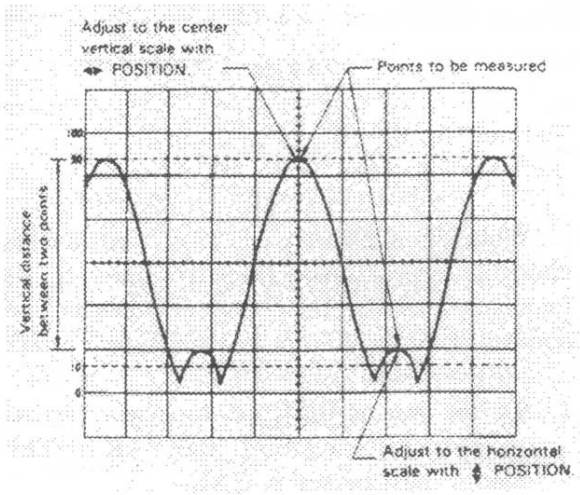
X-Y OPERATION

The oscilloscope not only has all the functions of a conventional oscilloscope, but may also be operated as an X-Y oscilloscope. With X-Y operation, signals applied to the CH1 INPUT and CH2 INPUT terminal are deflected on the X-Y axis, and Lissajous patterns makes it possible to find out phase differences between the two signals and find out their relative frequency proportion.

SECTION VI
APPLICATIONS

Because both the vertical and horizontal axis of the oscilloscope are calibrated, the oscilloscope is capable of not on displaying waveforms but can also quantitatively measuring voltage or time. When performing these latter measurements rotate the three VARIABLE controls (CH1, CH2, and horizontal) all the way in the clockwise direction to the CAL setting. All the oscilloscope's VARIABLE controls will click when rotated into their CAL settings.

In addition, the oscilloscope comes with probes. These probes should all be plugged into their proper jacks in order to assure a minimum of interference to the signals you want to measure.



MEASURING VOLTAGE BETWEEN TWO POINT ON WAVEFORM

Use the following procedures for measuring voltage, etc. between two points or from peak to peak on a waveform.

1. Apply a signal to the INPUT terminal, adjust the VOLTS/DIV and SWEEP TIME/DIV controls. Also reset the trigger point if necessary. Set the AC-GND-DC control at AC.

2. Work the VERTICAL POSITION control so that one of the point (A) to be measured falls on one of the horizontal graduation lines, while the other point (B) can still be observed on the CRT screen.

3. Work the horizontal POSITION control so that point B falls the vertical scale at the center of the CRT screen.

4. Measure the vertical distance between the two points are multiply that value by the VOLTS/DIV setting. When using a probe, also multiply the value by the probe's attenuation rate.

EXAMPLE

The vertical distance between the two points is 4.4 div. If the VOLTS/DIV control is set at 0.2V/div and a probe (xl0 setting) is used, the voltage is calculated as follows:

Voltage between 2 points = 4.4 (div) x 0.2 (V/div) x 10 = 8.8V

COMMON-MODE REJECTION By using the VERTICAL MODE control's ADD setting, unnecessary signal components can be eliminated allowing only desired components to be displayed.

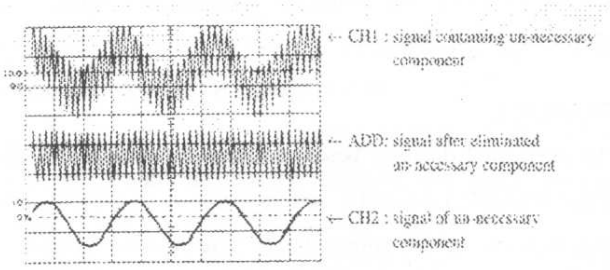
1. Apply the whole signal (including its unnecessary components) to the CH1 INPUT terminal. Now apply the component you want eliminated to the CH2 INPUT terminal.

2. Set the VERTICAL MODE control to ALT or CHOP. Set the control at CH2. Set the trigger point at the CH2 signal, and verify that CH2 SOURCE contains the unnecessary component of CH1.

3. Operate the INV control and verify that the vertical signal represents the unnecessary component in reverse polarity. When the VERTICAL MODE control is set at ADD under these conditions, only the necessary signal components will be displayed on the CRT screen.

Note: Elimination capabilities vary with the size of the unnecessary component.

In order to attain the best results display the vertical input signal with a slightly higher VOLTS/DIV setting. After enable the INV control, and activating the ADD function, adjust the VARIABLE control of CH1, CH2 to get a good waveform. Also, after pressing the INV control and switching to the ADD setting, the displayed waveform may move up or down. Move it back to the display position using the POSITION control.



MEASURING DIRECT CURRENT (DC) VOLTAGE

The oscilloscope's vertical amplification is provided by a excellent stability direct current amplifier circuit. By switching the AC-GND-DC control to the DC setting direct current voltage can be measured.

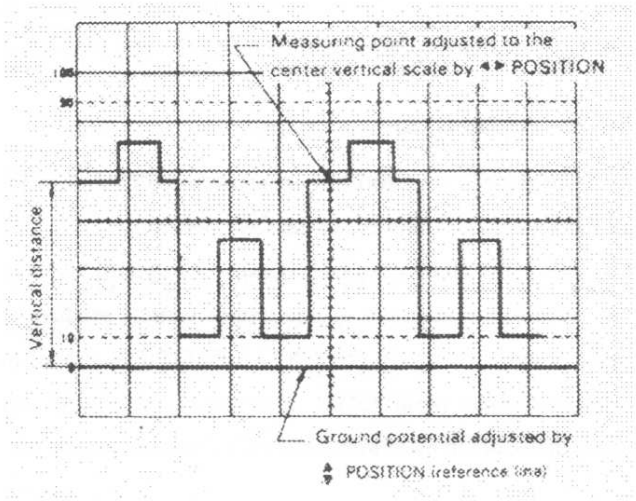
1. Apply the signal to the INPUT terminal. Work the VOLTS/DIV and SWEEP TIME/DIV controls to display the waveform at an easy to see size. Also adjust the LEVEL control if necessary.

2. Set the TRIGGERING MODE control to AUTO, and then set AC-GND-DC to GND. The trace will be displayed on the CRT screen. This trace will become the ground potential. Work the VERTICAL POSITION control to bring the trace in line with one of the horizontal graduation lines. Usually, signals with positive potential are lined up at the 0% graduation and signals of negative potential at the 100% graduation. Once lined up the trace's position will become the reference potential, so do not touch the VERTICAL POSITION control during the measurement process.

3. Set the AC-GND-DC control at DC. The signal will be displayed on the CRT screen with the direct current component intact. If in this case either the VOLTS/DIV or reference potential setting is inappropriate, the waveform may disappear from the display screen. Make sure to check these settings.

4. Measure the potential voltage between two points. The potential sign will be plus if above the reference and minus if below the reference.

5. If there is only one signal to be measured, apply it to CH1, and work the CH2 VERTICAL POSITION control so that CH2 displays the ground potential. If the MODE control is set at either ALT or CHOP after this adjustment is made, you will be sure of the ground potential throughout the procedure. However, make certain that the ground potentials of both channels are always the same.

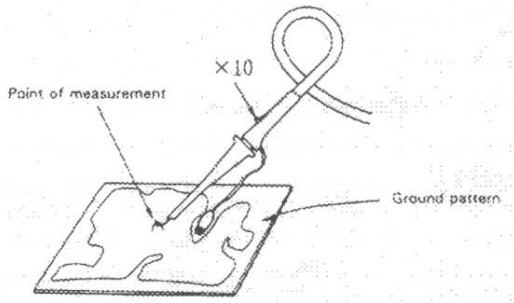


MEASURING SIGNAL WITH LOW FREQUENCY COMPONENT

When the oscilloscope's AC-GND-DC control is set at AC, there is a chance that errors may occur in the voltage measurement. This inaccuracy is caused by low range cut-off frequencies. With AC coupling setting, the most accurate frequency measurements are realized above the 40 to 50Hz range. Therefore, when measuring frequencies below this range, switch the AC-GND-DC control to the DC setting.

MEASURING SIGNAL WITH HIGH FREQUENCY COMPONENT

Always use a probe (x l0 position) when measuring pulses or signals of a few hundred kHz or above. This is because distortion will occur in the waveform's high frequency component due to the use of long leads. This makes it difficult to conduct accurate measurement waveforms.
This is also true for probes with long ground lead clip to the ground potential lying closest to the signal to be measured.

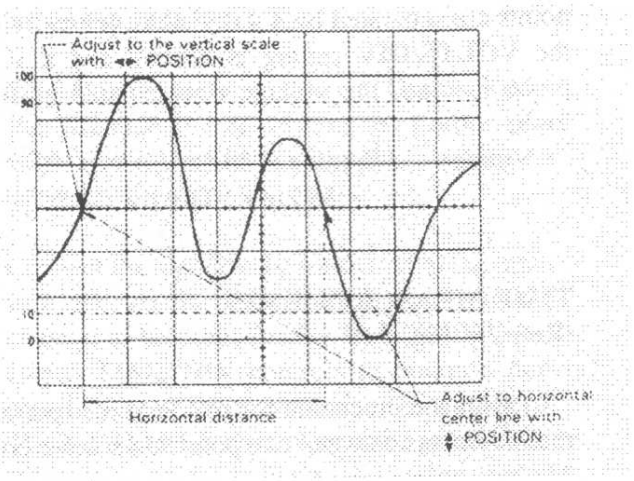


MEASURING TIME BETWEEN TWO POINTS

When measuring time between two points, measurements can be determined from SWEEP TIME/DIV and horizontal distance.

1. Display the waveform by adjusting each control. Set all the VARIABLE controls to the CAL position.
2. Work the HORIZONTAL POSITION control to bring one point to be measured in line with a vertical graduation line. Then work the HORIZONTAL POSITION control to bring the other point to be measured in line with the horizontal scale in the middle of the CRT display screen.

3. Measure the horizontal distance between the two points. Multiply this value by the SWEEP TIME/DIV setting value. If the x 10MAG function has been activated, multiply the value by 1/10.



EXAMPLE:

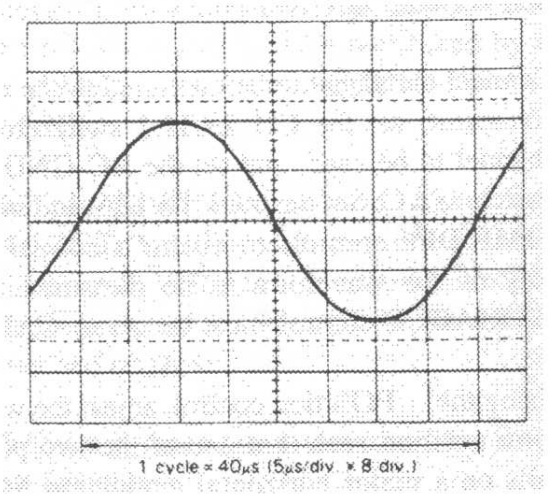
The horizontal distance between the two points is 5.4 div. If the SWEEP TIME/DIV setting value is 0.2 ms/div, the time between the two points may be calculated as follows.

Time between two points = 5.4 div x 0.2 ms/div = 1.08 ms
If the x10MAG function is in use:
Time between two points = 5.4 div x 0.2 ms/div x 1/10
= 0. 108 ms = 108 μs

MEASURING FREQUENCY

Since the frequency is caculated as a reciprocal of a period, measure time (period) of one cycle and calculate its reciprocal valve.

1. Measure the time of one cycle.
2. Calculate the frequency of the period found.



EXAMPLE:

In the case of Figure 14, the period found comes to 40 μs

This frequency is calculated as follows:

Frequency = 1/ (40×10^{-6}) = 25 x 10^{3} = 25 kHz

MEASURING PULSE RISE AND FALL TIMES

Rise (Fall) time is found by measuring the time between 10% and 90% of the peak value.

1. Apply the signal. Adjust the VOLTS/DIV and VARIABLE control so that the amplitude is 5 div. Set the horizontal VARIABLE control at CAL.
2. Rotate the SWEEP TIME/DIV control as fast a setting as possible until the section showing rise (fall) becomes visible. Use the x 10MAG control if necessary.
3. Work the VERTICAL POSITION control to move the waveform between 0% and 100%. Then work the POSITION control to move the starting point of rise to the 10% graduation with a vertical graduation line. Measure the horizontal distance to the 90% graduation. The time is found from this distance measurement.

Note: When measuring high speed rise (fall) times, you must use the following correction formula to calculate the true rise time, "*to*" since there is rise time inherent to the oscilloscope itself.

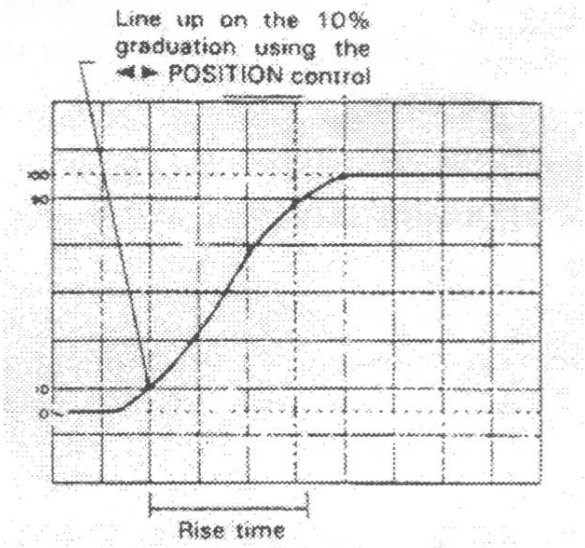
$$to = \sqrt{t^2 m - t^2 r}$$

Where *tm* is the actually measured value, and *tr* is the oscilloscope's inherent rise time.

Since the rise time of the oscilloscope itself is 17.5 ns, if the value actually measured is 50 ns, the ture rise time comes to:

$$to = \sqrt{50^2 - 17.5^2} = 46.8ns$$

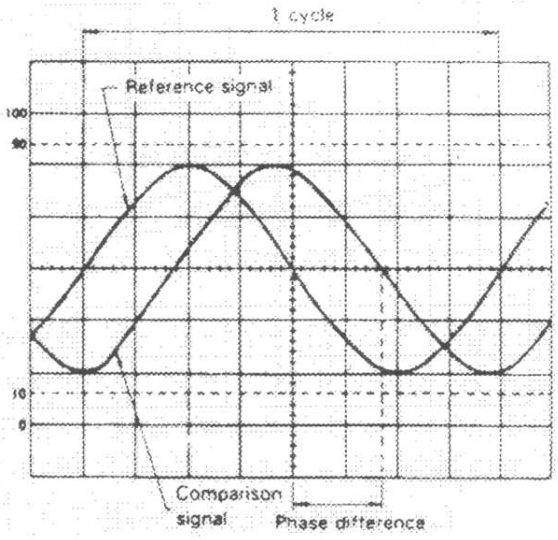
However, this correction factor is not significant when the actually measured value *tm* is above 200 ns.



MEASURING PHASE DIFFERENCE

When carrying out dual trace operation, phase difference can be measured between two since wave signals of identical frequency.

1. Apply the two signals to their respective INPUT terminals. Adjust the VOLTS/DIV and VARIABLE control so that the two signals are at identical amplitude.
2. Adjust the SWEEP TIME/DIV and VARIABLE controls so that one period of the waveforms is 8 div.
3. Work the VERTICAL POSITION control of both channels to bring the waveforms to the center of the CRT display screen.



4. Measure the horizontal distance between corresponding points on the two signals. There is phase difference of 45 degrees for every 1 division of horizontal distance.

DISPLAY LISSAJOUS PATTERNS

When operating the oscilloscope in the X-Y mode, Lissajous patterns can be displayed. With Lissajous patterns, it is possible to find even the slightest phase difference or signal distortion and also find relative frequency proportions.

1. Apply the signal to be measured to the Y INPUT terminal and a reference signal to the X INPUT terminal.

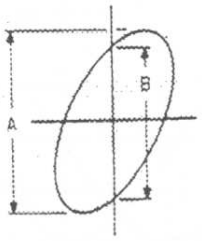
2. Press the X-Y oscilloscope selector switch. In the phase difference measuring process using Lissajous patterns the value will not change even if the VARIABLE controls are rotated. Therefore carry out the measurement at the clearest display possible.

3. Adjust the VOLTS/DIV and VARIABLE controls of both channels to attain an acceptable display.

Phase difference can be measure with Lissajous patterns in the following manner.

The following represent Lissajous patterns indicating the presence of signal distortion or phase difference.

The following represent Lissajous patterns when frequency proportions are altered.

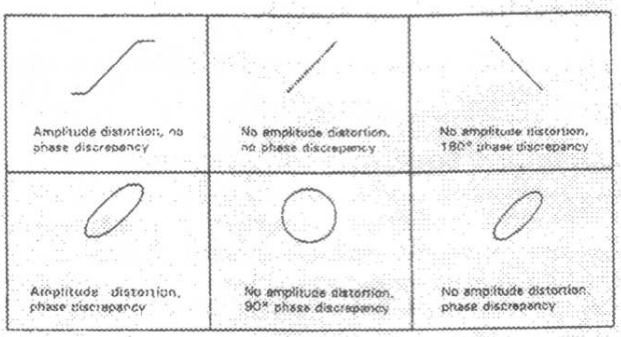


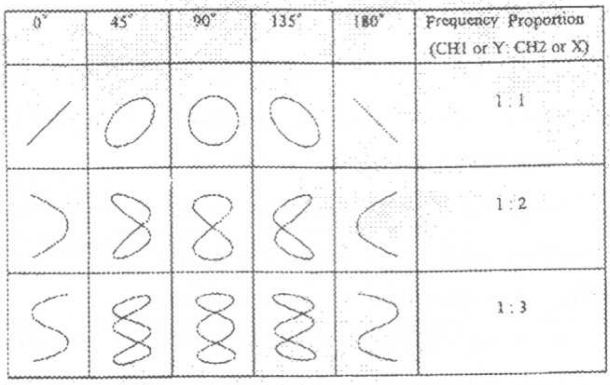
$$\phi = \sin^{-1}\frac{B}{A}$$

or

$$\sin\phi = \frac{B}{A}$$

where ϕ is the phase difference





EXPANDING THE WAVEFORM

If you need to expand a certain portion of the displayed waveform, you may use a faster sweep. However, if the desired portion is far away from the starting point of the sweep, the desired portion may run off the CRT screen. If it does select a slower sweep speed and pull the PULL x 10 MAG switch out. The displayed waveform will then be expanded by 10 times to the right and left, with the center of the screen at the expansion.

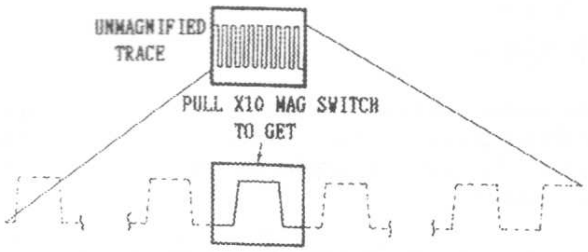
You can determine the sweep time for the magnification process by multiplying the TIME/DIV switch setting by 1/10.

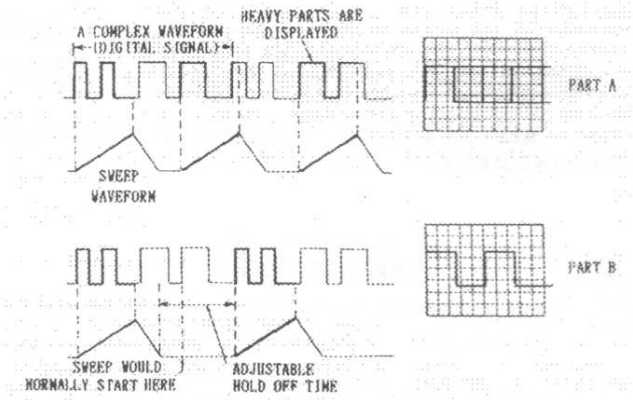
Example:

The TIME/DIV switch setting for a square wave is 0.2us /division. Therefore, this unmagnified maximum sweep speed can be made faster with magnification as follows:

Magnified Sweep Speed = 0.2us/div x 1/10 = 20 ns/div

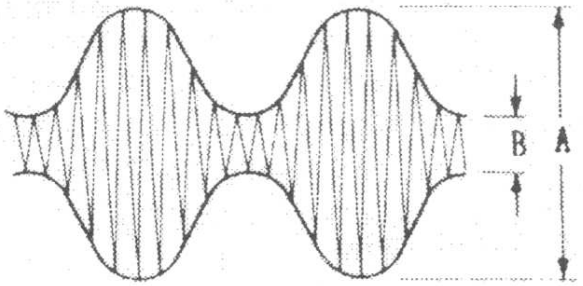
NOTE : When the sweep is magnified as the result of a faster sweep speed, the trace may become faint.





AM MODULATION MEASUREMENT

There are many methods of measuring AM modulation, but here the envelope method is shown. This method is applicable only if the carrier frequency is within the bandwidth of this instrument. The display of a modulated wave. Measure the peak-to-peak values at "A" and "B" to compute modulation.



TRIGGERING AN APERIODIC SIGNAL

A typical low duty cycle, repetitive, complex waveform as shown, viewed with normal triggering, the various portions of the waveform overlap on the screen, making signal observation very difficult. In Part A, there is no hold off time delay between the sweeps, and the sweep waveform is triggered at the first available rising transition after each sweep is completed.

In Part B, the waveform displayed on the screen is shown without the confusing overlap because triggering of the signal is held off as required by turning the HOLD OFF control. In such a case, you can easily synchronize the sweep repetition rate to the measured signal waveform rate by adjusting the "pause" time between sweeps.

SECTION VII
MAINTENANCE

FUSE REPLACEMENT, CHANGING VOLTAGE REQUIREMENTS

WARNING

⚠ Before performing the following procedures, always unplug the power cord.

FUSE REPLACEMENT

If the fuse blows, the oscilloscope will not operate. Locate the cause first. If the oscilloscope is not defective, remove the cap from the fuse holder on the rear panel with a standard type screwdriver, then replace the fuse with a new fuse.

CHANGING VOLTAGE REQUIREMENTS

.Remove the fuse holder and voltage selector from the rear panel with a standard type screwdriver. Fit the line voltage selector to match the supply voltage rating

PERIODIC ADJUSTMENTS

Screwdriver adjustments only need to be checked and adjusted periodically. Probe compensation and trace rotation adjustments are included in this category. Procedures are given below.

Probe Compensation

1. Connect probes to CH 1 to CH 2 input jacks.
2. Touch top of probe to CAL terminal.
3. Adjust oscilloscope controls to display 3 or 4 cycles of CAL square wave at 5 or 6 divisions amplitude.

Trace Rotation Adjustment

1. Set oscilloscope controls for a single trace display in CH1 mode, and with the channel 1 AC-GND-DC switch set to GND.
2. Use the channel 1 POSITION control to position the trace over the center horizontal line on the graticule scale. The trace should be exactly parallel with the orizontal line.
3. Use the TRACE ROTATION adjustment on the front panel to eliminate any trace tilt.

CALIBRATION CHECK

A general check of calibration accuracy may be made by displaying the output of the CAL terminal on the screen. The terminal provides a square wave. This signal should produce a displayed waveform amplitude for both channel 1 and 2. The Variable controls must be set to CAL during this check.

The CAL signal may be used only as a general check of calibration accuracy, not as a signal source for performing recalibration adjustments.

ESCORT

3F, No.6, Alley 6, Lane 45, Pao-Hsin Road, Shin-Tien, Taipei Hsien, Taiwan

TEL : 886-2-2913-1325 FAX : 886-2-2918-3929

Printed in Taiwan R.O.C.

91-25171-1