

# SECTION 1

## CHARACTERISTICS

### Introduction

The Tektronix Type 647A Oscilloscope is a general purpose, high-performance oscilloscope designed to operate in a wide range of environmental conditions. A Tektronix 10-series vertical plug-in unit is required in the left compartment and a Tektronix 11-series horizontal plug-in unit in the right compartment to form a complete measurement system. The following characteristics apply to the Type 647A only. Refer to the plug-in unit Instruction Manuals for characteristics of the complete system.

The electrical characteristics which follow are divided into two categories. Characteristics listed in the Performance

Requirement column are checked in the Performance Check and Calibration sections of this manual. Items listed in the Supplemental Information column are provided for reference use and do not directly reflect the measurement capabilities of this instrument. The Performance Check procedure given in Section 5 of this manual provides a convenient method of checking the Performance Requirements listed in this section. The following electrical characteristics apply over a calibration interval of 1000 hours at an ambient temperature range of  $-30^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$ , except as otherwise indicated. Warm-up time for given accuracy is 20 minutes.

### ELECTRICAL CHARACTERISTICS

#### VERTICAL AMPLIFIER

Characteristics	Performance Requirement	Supplemental Information
Deflection Factor	300 millivolts/centimeter of CRT deflection	Open circuit voltage of 186-ohm source generator
Deflection Accuracy	Within $\pm 1\%$ at $25^{\circ}\text{C}$ when driven from a 186 ohm push-pull source	
Bandwidth (at $-3\text{ dB}$ point)	DC to 120 MHz or greater	Measured with Tektronix calibration fixture 067-0544-00
Risetime (calculated)	2.9 nanoseconds or less	
Low-Frequency Linearity	0.15 centimeter or less total amplitude variation of two-centimeter display when positioned over entire vertical display area.	Includes CRT linearity. Measured at center screen horizontally.
Delay Line		Approximately 140 nanoseconds

#### HORIZONTAL AMPLIFIER

Deflection Factor	0.347 milliampere/centimeter of CRT deflection, per side, push-pull	Short circuit current of source generator
Deflection Accuracy	Within $\pm 1\%$ at $25^{\circ}\text{C}$ when driven from a 20-kilohm push-pull source	Measured over middle eight centimeters of graticule
Calibrated Sweep Deflection Rate	See 11-series time-base instruction manual	Type 647A capable of DC to 10 nanosecond/centimeter sweep deflection rate
Bandwidth	See 11-series time-base instruction manual for combined bandwidth of Type 647A and time-base unit	
Remote Single-Sweep Reset		Pin F of J101 (on rear panel) provides input for remote single-sweep reset to 11-series time-base units with compatible features

#### Z AXIS INPUT

Input to CRT GRID Binding Post Sensitivity	Four volt, or less, peak-to-peak signal produces noticeable modulation at normal intensity	
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**Characteristics—Type 647A**

**Z-AXIS INPUT (Cont)**

Characteristics	Performance Requirement	Supplemental Information
Polarity of operation	Positive-going input signal decreases trace intensity	
Usable frequency range	DC to 10MHz or greater	
Input resistance		Approximately 22 kilohms
Input to CRT CATHODE Binding Post Sensitivity	Five volt, or less, peak-to-peak signal produces noticeable modulation at normal intensity	
Polarity of operation	Positive-going input signal decreases trace intensity	
Usable frequency range	500HZ to 100MHz or greater	
Input time constant		Approximately 330 microseconds (0.015 $\mu$ F and 22 k $\Omega$ )

**CALIBRATOR**

Waveshape	Square wave		
Polarity			Positive going with baseline at zero volts
Output Voltages	0.2-millivolt to 100-volt square waves in 18 steps, and 100 volts DC		Steps in 1-2-5 sequence
Output Current	Five milliamperes through current loop		With one megohm or greater load
Repetition Rate	One kilohertz		
Accuracy	0° C to +40° C	-30° C to +65° C	
Voltage			
100 mV and 100 V	Within $\pm 1\%$	Within $\pm 1.5\%$	
All other voltages	Within $\pm 2\%$	Within $\pm 3\%$	
Current (Calculated)	Within $\pm 1.5\%$		
Repetition rate	Within $\pm 0.1\%$		
Risetime	One microsecond or less		With 20 pF or less load
Duty Cycle	49.9% to 50.1%		
Output Resistance (0° C to +40° C)			50 ohms, $\pm 0.4\%$
0.2 mV to 100 mV			50 ohms, $\pm 1.5\%$
200 mV			
0.5 V to 100 V			Varies with switch position to a maximum of approximately four kilohms

**POWER SUPPLY**

Line Voltage	115 volts nominal or 230 volts nominal		Line voltage and range selected by Line Voltage Selector assembly on rear panel. Voltage ranges apply for waveform distortion which reduces the peak line voltage 5% or less below the true sine-wave peak values.
Voltage Ranges (AC, RMS)			
115 volts nominal	90 to 110 volts 104 to 126 volts 112 to 136 volts		
230-volts nominal	180 to 220 volts 208 to 252 volts 224 to 272 volts		
Line Frequency	45 to 440 hertz		
Power Consumption at 115 volts and 60 hertz			190 watts maximum. 2.0 amps maximum (includes plug-ins).

**CATHODE-RAY TUBE (CRT)**

Tube Type		Tektronix T6470 31-1 rectangular
Phosphor		P31 standard. Others available on special order

**CATHODE-RAY TUBE (Cont)**

Characteristics	Performance Requirement	Supplemental Information
Accelerating Potential		Approximately 14kv total (cathode potential -2.2 kv)
Graticule Type	Internal	
Area	Six divisions vertical by 10 divisions horizontal. Each division equals one centimeter	
Illumination	Variable edge lighting	
Unblanking	Bias-type, DC coupled to CRT grid	
Raster Distortion	0.1 division or less	
Beam Finder	Limits display within viewing area	

**ENVIRONMENTAL CHARACTERISTICS**

The following environmental test limits apply when tested in accordance with the recommended test procedure. This instrument will meet the electrical performance requirements given in this section following environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from Tektronix, Inc. Contact your local Tektronix Field Office or representative.

Characteristics	Performance Requirement	Supplemental Information
Temperature Operating	-30° C to +65° C	Automatic resetting thermal cutout protects instrument from overheating. Limit applies when instrument is not tipped more than 20° in any direction from level. Maximum operating temperature when operated on rear feet is +55° C.
Non-operating	-55° C to +75° C	
Altitude Operating	15,000 feet maximum	Derate maximum operating temperature by 1°/1000 feet change in altitude above 5000 feet
Non-operating	50,000 feet maximum	May be tested during non-operating temperature test
Humidity Non-operating	Five cycles (120 hours) of Mil Std-202C, Method 106B	Exclude freezing and vibration
Vibration Operating and Non-operating	15 minutes vibration along each of the three major axes at a total displacement of 0.025-inch peak to peak (4 g at 55 c/s) from 10-55-10 c/s in one-minute cycles. Hold at 55 c/s for three minutes on each axis.	Instrument secured to vibration platform during test. Total vibration time, about 55 minutes.
Shock Operating and non-operating	Two shocks of 20 g, one-half sine, 11 milli-second duration along each major axis	Guillotine - type shocks. Total of 12 shocks
Transportation	Meets National Safe Transit type of test when packaged as shipped from Tektronix, Inc.	
Package vibration	One hour vibration slightly in excess of 1 g	Package should just leave vibration surface
Package drop	30 inch drop on any corner, edge or flat surface	

## Characteristics—Type 647A

### MECHANICAL CHARACTERISTICS

Characteristics	Information
Construction	
Chassis	Aluminum alloy
Panel	Aluminum alloy with anodized finish
Cabinet	Aluminum alloy with painted finish
Circuit board	Glass-epoxy laminate
Overall Dimensions measured at maximum points)	
Height	14 $\frac{5}{8}$ inches
Width	9 $\frac{7}{8}$ inches
Length	22 inches including rear-panel feet

Weight (without plug-ins or accessories)	Approximately 40 pounds
Connectors	
CAL OUT	BNC
CRT GRID, CRT CATHODE and GND	Binding post
J101	10-terminal connector. Mates with Cinch No. KPT06F12-10P

### STANDARD ACCESSORIES

Standard accessories supplied with the Type 647A are listed on the last pullout page at the rear of this manual. For optional accessories available for use with this instrument, see the current Tektronix, Inc. catalog.