

Figure 1-1.  
LBO-516 Oscilloscope

## 1. GENERAL INFORMATION

### 1-1. INTRODUCTION

The LBO-516, shown in Figure 1-1, is a 100 MHz oscilloscope with all of the features normally found on a lab-grade scope: high-fidelity pulse response, stable operation, dual timebase with calibrated sweep delay, flexible triggering facilities, and a bright CRT display with illuminated internal graticule. Moreover, it also has a very unusual feature found on few scopes in any price class: it can simultaneously display up to eight traces from three different input signals! In addition to the two vertical-input channels and their difference signal, the signal used to externally trigger the main timebase can also appear on the CRT display. The alternate sweep mode, which allows the main and delayed timebases to simultaneously sweep the CRT, effectively doubles this four-trace display to an eight-trace display.

The comprehensive triggering facilities of the LBO-516 include several features that ease the problem of triggering on complex signals: a variety of frequency-selective coupling filters, a trigger holdoff-control, and a trigger pickoff that alternates between the two vertical channels.

### 1-2. SPECIFICATIONS

Specifications for the model LBO-516 oscilloscope are given in Table 1-1.

Table 1-1  
SPECIFICATIONS

#### Vertical Amplifiers (Ch. 1 & 2)

Bandwidth (-3 dB)	
DC coupled	DC - 100 MHz
AC coupled	10 Hz - 100 MHz
Rise Time	3.5 ns
Deflection Coefficients	
Accuracy	5 mV/div to 5 V/div in 10 calibrated steps, 1-2-5 sequence. Continuously variable between steps. X10 magnification adds 0.5, 1, and 2 mV/div steps for frequencies below 5 MHz
Input Impedance	+3%; +5% with X10 magnification 1 megohm +2%, 25 pF +3 pF
Maximum Input Voltage	400 V (DC plus AC peak)

Signal Delay Leading edge displayed.  
 Leading edge displayed.  
 CH-1 only, CH-2 only,  
 CH-1 & CH-2 displayed alternately,  
 CH-1 & CH-2 chopped (at 250 kHz rate),  
 CH-1 & CH-2 added, CH-1 & CH-2 subtracted,  
 CH-1 & CH-2 & CH-3 displayed alternately,  
 CH-1 & CH-2 & CH-3 chopped,  
 CH-1 & CH-2 & CH-3 & CH-1 + CH-2 alternated,  
 CH-1 & CH-2 & CH-3 & CH-1 + CH-2 chopped,  
 CH-1 & CH-2 & CH-3 & CH-1 - CH-2 alternated,  
 CH-1 & CH-2 & CH-3 & CH-1 - CH-2 chopped.

Common Mode Rejection 20dB at 20MHz  
 CH- 1 Output 25 mV/div into 50 ohms

**Horizontal Amplifier (X-Y Mode)**

Bandwidth (- 3 dB)  
 DC coupled DC - 3 MHz  
 AC coupled 10Hz - 3MHz  
 Rise Time 120 ns  
 Phase Shift <3° at 100 kHz  
 Deflection Coefficients 0.5 mV/div to 5 V/div in 13 calibrated steps, 1-2-5 sequence, continuously variable between steps  
 Accuracy +3% for 5 mV/div to 5 V/div, +5% for 0.5 mV/div to 2 mV/div  
 Input Impedance 1 megohm -+2%, 25 pF +3 pF  
 Maximum Input Voltage 400 V (DC plus AC peak)

**Time-Base Generators**

Display Modes Main timebase (TB) only,  
 Main TB intensified by delayed TB,  
 Delayed timebase,  
 Main TB alternated with delayed TB.  
 Main (A) Time Base 0.02 ns/div to 0.5 S/div in 23 calibrated steps, 1-2-5 sequence. Continuously variable between steps.  
 Delayed (B) Time Base 0.2 μS/div to 50 mS/div in 20 calibrated steps, 1-2-5 sequence.  
 Magnifier X10 deflection increase at any TB setting extends sweep speeds of main and delayed TB's to 2 ns/div.  
 Accuracy +- 3% unmagnified  
 +- 5% magnified  
 Delay Time Continuously variable multiplier with 1000 divisions.  
 Delayed TB Jitter 1/20,000

**Trigger Circuits**

Sources CH-1, CH-2, Alternate, Line, External

Modes Auto, Normal, Single-shot  
 Coupling AC, DC, HF reject, TV vertical, TV horizontal  
 Slope + or-  
 Holdoff Normal, Variable (to greater than one sweep), B ends A  
 Sensitivity  
 Internal Trigger DC - 10 MHz: 0.4div  
 10 - 100 MHz: 1.5 divs  
 External Trigger DC - 10MHz: 100mV  
 10 - 100 MHz: 400mV

**External Trigger Amplifier (Ch. 3)**

Bandwidth (-3 dB)  
 DC coupled DC - 100 MHz  
 AC coupled 10Hz- 100 MHz  
 Rise Time 3.5 ns  
 Deflection Coefficients 0.2 V/div and 2 V/div  
 Accuracy +-3%  
 Input Impedance 1 megohm +2%, 30 pF  
 Maximum Input Voltage 400 V (DC plus AC peak)

**Z-Axis Modulation**

Level for Blanking Standard TTL high (+ 2 to + 5V)  
 Coupling DC  
 Maximum Input Voltage 50 Vp-p  
 Input Impedance 10kΩ  
 Bandwidth DC-5 MHz

**Calibrator**

Output Voltage 500 m Vp-p--+ 2%, positive-going, ground referenced  
 Frequency 1 kHz nominal  
 Waveform Fast-rise rectangular wave

**CRT Display**

Phosphor P31 (P39 optional)  
 Accelerating Potential 20 kV/2kV  
 Graticule Internal 1 cm square divisions, 8 div high, 10 div wide.  
 Central axis subdivided into 0.2 cm graduations.  
 Continuously variable  
 Trace Adjustments on Front Panel Rotation, focus, intensity, B intensity

**Other Features**

"Out-of-Calibration" Indicator Main timebase  
 Other Indicators Main timebase triggered  
 Single-shot ready  
 Power on

**Power Requirements**

Line Voltage 100/120/200 VAC 220/240 VAC  
 Line Frequency 50-60 Hz  
 Power Consumption 55W

**Physical & Environmental Data**

Case Size (WxHxD) 12.3 x 5.8 x 16 inches  
 305 x 145 x 400 mm  
 Overall Size (WxHxD), handle folded back 13.75 x 7.25 x 18.5 inches  
 350 x 185 x 470 mm

Weight	20.9 lbs, 9.5 kg
Ambient Operating Temperature	0-40°C (32-104°F) maximum 15-35°C (60-95°F) for guaranteed specs
Vibration Tolerance	2 mmp-p displacement at 12-33 Hz and 33-35 Hz
Shock Tolerance	30g
<b>Accessories Supplied</b>	Instruction Manual Two (2) LP- 100X probes Two (2) BNC-to-post adaptors
<b>Optional</b>	LP-2017 Probe Pouch LC-2016 Protective Front Cover LR-2402 Rack Mount Adaptor LH-2015 Hood

Specifications for the model LP-100X scope probe are given in Table 1-2.

**Table 1-2  
LP-100X SPECIFICATIONS**

Attenuation Ratio	10:1 +2% and 1:1, switch selectable
Input Impedance	10 megohms, 12 pF ±10%
1X attenuation	Scope input Z plus < 150 pF
Rise Time (10X atten.)	3.5 ns nominal
Overshoot & Ringing (10X atten.)	<10%
Bandwidth	
10X attenuation	DC- 100MHz
1X attenuation	DC - 6 MHz
Maximum Input Voltage	600 V (DC plus AC peak)
Ambient Operating Temperature	
Maximum	- 10 to + 55°C
For guaranteed Specifications	+5 to +35°C
Ambient Humidity	
Maximum	40 to 90%
For guaranteed Specifications	45 to 85%

## 2. OPERATING INSTRUCTIONS

This section contains the information needed to operate the LBO-516 and utilize it in a variety of basic and advanced measurement procedures. Included are the identification and function of controls, connectors, and indicators, initial startup procedures, basic operating routines, and selected measurement applications.

### 2-1. FUNCTION OF CONTROLS, CONNECTORS, AND INDICATORS

**Before turning on** this instrument, familiarize yourself with the controls, connectors, indicators, and other features described in this section. The descriptions given below are keyed to the items called out in Figures 2-1 to 2-4.

#### 2-1-1 Display Block

Refer to Figure 2-1 for reference (1) to (9).

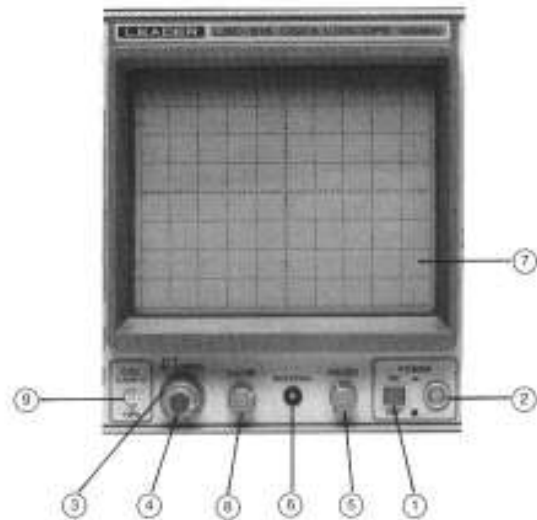
- 1** POWER switch      Push in to turn instrument power on and off
- 2** POWER lamp      Lamp lights when power is on
- 3** A INTEN control    To adjust the overall brightness of the CRT display. Clockwise rotation increases brightness
- 4** B INTEN control    Provides adjustment of CRT brightness during INTEN BY B interval and B timebase sweeps
- 5** FOCUS control      To attain maximum trace sharpness. Astigmatism is automatically adjusted.
- 6** ROTATION control    Provides screwdriver adjustment of horizontal trace alignment with regard to the CRT graticule lines

**7** CRT

**8** ILLUM control

**9** CAL connector

Display device having 1 cm square graticule lines inscribed on the inner CRT surface for parallax-free measurements. Blue filter provides good contrast and pleasing display. To adjust graticule illumination. Clockwise rotation increases brightness  
Provides fast-rise waveform of precise amplitude for probe adjustment and vertical amplifier calibration.



**Figure 2-1.  
Display Block**