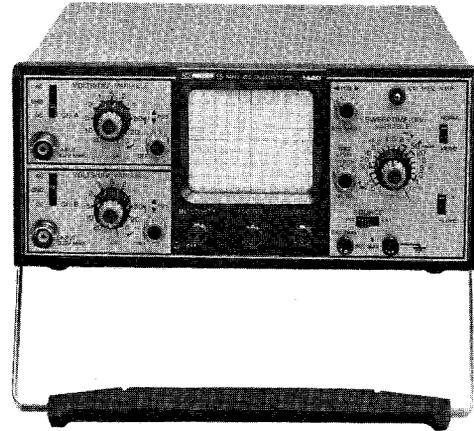


**INSTRUCTION
MANUAL**

BK PRECISION

1420

15MHz, AC/DC/Battery
Dual-Trace
MINI-SCOPE



BK PRECISION DYNASCAN
CORPORATION

TABLE OF CONTENTS

Test Instrument Safety	Inside front cover
Introduction	3
Features	4
Specifications	6
Optional Accessories	10
Controls and Indicators	11
Operating Instructions	15
Precautions	15
Operating Tips	16
Battery Installation	16
Battery Powered Operation	18
AC Powered Operation	18
External DC Powered Operation	19
Initial Starting Procedure	19
Single Trace Waveform Observation	20
Calibrated Voltage Measurement	21
Calibrated Time Measurement	23
Dual-Trace Waveform Observation	25
External Horizontal Input (X-Y Operation)	27
Operator Maintenance	
Periodic Adjustments	27
Calibration Check	29
Servicing	
Removing the Case	29
Fuse Replacement	31
Calibration Adjustments	31
Instrument Repair Service	35
Additional Servicing Information	35
Appendix—External Power Pack Considerations	36
Warranty Information	37

The B & K-Precision Model 1420 Dual-Trace Mini-Scope is a miniature, lightweight instrument for observing and measuring waveforms in electronic circuits. In addition to its portability it offers the high performance features usually found only in laboratory-quality scopes.

The compact Model 1420 will fit easily into a standard attache case with plenty of room left over for the probes and other accessories and tools, even a digital multimeter. The instrument weighs only 8 pounds with battery installed. This is a major convenience when the mini-scope must be carried to an equipment site. For full versatility in its field service role, the unit operates from almost any power source. For operation from ac power, a 120-volt, 60 Hz ac adapter (or 220-volt, 50/60 Hz ac adapter) is supplied. An external dc power jack allows the mini-scope to operate from an external dc power source of 10 to 16 volts. This permits operation in a vehicle, or from the dc power source of the equipment being serviced. The power drain is only 16 watts. If neither of these power sources is readily accessible, an internal battery supplies the power (optional accessory). As a standard feature, the battery charger circuit is built in, and recharging starts when reconnected to an ac source with the scope turned off.

Performance features of the Model 1420 include high accuracy of both amplitude and time measurements ($\pm 5\%$), high sensitivity (10 mV/division), 15 MHz bandwidth, and 24 ns rise time. Accuracy is enhanced by a rectangular CRT with a domed faceplate and matching graticle.

Naturally, the Model 1420 includes operational features you expect of a high quality, laboratory oscilloscope. Dual-trace operation permits two waveforms to be viewed simultaneously, or each may be viewed independently. The chop method of dual-trace operation is automatically selected at sweep times of 1 ms/division and slower, alternate sweep at all faster sweep speeds. The matched, dual vertical amplifiers can be switched to provide vertical

and horizontal deflections in X-Y operation, at the same calibrated sensitivities.

With internal triggering, any signal that produces at least 1 division of vertical deflection is adequate for sweep triggering. A variable trigger threshold level and choice of negative or positive slope permits triggering at any desired point on a waveform. In internal triggered dual-trace operation, the channel A signal is the trigger source. An AUTO mode generates a sweep without an input trigger. For viewing video waveforms, a selectable built-in sync separator permits triggering from vertical or horizontal sync pulses. Vertical or horizontal sync pulse triggering is automatically selected by the sweep time control at sweep speeds appropriate for viewing frames or lines of video.

Convenience features include a built-in square wave generator for probe compensation adjustment, and a sturdy carrying handle that also serves as a tilt stand with a choice of several angles of tilt. The conveniently grouped and well identified controls contribute to ease of operation, and the styling is clean, modern, and attractive. Solid state, integrated construction contributes to reliability and dependability, as well as the low power consumption of 16 watts.

The 1420 Mini-Scope is ideal for applications where portability and performance are both important, such as field engineering and field service of high technology products. In many cases, the performance characteristics of this mini-scope also meet the requirements for laboratory and bench service diagnostics. Typical applications include field engineering and service of mini-computers, computer terminals, microprocessor controlled products, CCTV systems, cable television networks, computer CRT displays, and mobile and studio broadcast and recording equipment. The mini-scope is well suited to installation, maintenance, and adjustment of communications systems, including mobile units, dispatching base stations, remote site equipment, and tower mounted equipment.

PORTABILITY

MINISIZE

Its compact size, light weight, rugged construction, and convenient carrying handle enhance portability. Designed to fit easily in an attache case. Weighs only 8 pounds with battery.

AC/DC/BATTERY OPERATION

The mini-scope operates anywhere from 120 V, 60 Hz ac, 220 V, 50/60 Hz ac, 10-16 VDC, or internal battery.

VOLTAGE REGULATION

Maintains calibration accuracy over entire 105 to 130 VAC or 210 to 260 VAC or 10 to 25 VDC range.

LOW BATTERY INDICATION

Pilot light flashes to warn of low battery.

AUTOMATIC CHARGING

Battery automatically recharges whenever the oscilloscope is connected to ac, and scope is turned off. Will not overcharge.

PERFORMANCE

DUAL TRACE

Two input waveforms can be viewed either singly or simultaneously, as desired. Individual vertical sensitivity and positioning controls are provided for completely independent adjustment of the two signal amplitudes.

24ns RISE TIME

Assures distortion-free, high-resolution presentation at high frequencies, and at fast switching rates.

HIGH SENSITIVITY (10 mV/div)

Permits the low-capacitance, high-impedance, 10:1 attenuation probes to be used for virtually all measurements, thus assuring minimum circuit loading.

15 MHz BANDWIDTH

Guaranteed dc to 15 MHz bandwidth at -3dB. Smooth roll-off makes scope usable well above 15 MHz. Triggers to at least 20 MHz.

TRIGGERED SWEEP

Fully adjustable trigger threshold allows the desired portion of the waveforms to be used for triggering. In dual-trace operation, can be synchronized to the signal

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to 25 VDC

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VIDEO SYNC

displayed on Channel A or to an external sync trigger. Selectable automatic triggering mode provides sweep in absence of triggering signal.

A selectable built-in sync separator circuit is included specifically for viewing composite video signals. A sync separator is needed for observing waveforms in computer terminal displays, CCTV, cable TV, television circuits, etc. Horizontal sync pulses are automatically selected for triggering at sweep times of 50 μ s/div to 1 μ s/div for viewing horizontal lines of video. At sweep times of .1ms/div and slower, vertical sync pulses are selected for viewing vertical frames.

11 CALIBRATED VOLTAGE SCALES

Accurate measurement of the instantaneous voltages on 11 different attenuator ranges for both channel A and channel B (10 mV/div to 20 V/div).

18 CALIBRATED SWEEP SPEEDS

Accurate time measurements on 18 sweep speed ranges of 1.0 μ s/div to 0.5 s/div in a 1, 2, 5 sequence. Provides every speed necessary for viewing waveforms from dc to 15 MHz.

X10 SWEEP MAGNIFICATION

A ten times (10X) magnification of the horizontal sweep allows close-up examination of any portion of the waveform. In addition, the 10X magnification provides a maximum sweep speed of 0.1 μ s/div (100 ns/div).

X-Y OPERATION

Selectable from front panel without changing input connections. Channel A becomes vertical (Y axis) and channel B becomes horizontal (X axis) deflection. The dual matched channel A and B amplifiers provide the same calibration accuracy for both vertical and horizontal deflection.

CALIBRATION SOURCE

A built-in, calibrated, 1 volt-peak-to-peak square wave permits probe compensation adjustment and a general check of calibration accuracy.

SIMPLIFIED OPERATION

All controls are front panel mounted. Controls are logically grouped and labelled for ease of operation. Dual-trace chop-alternate and video frame-line selection is automatic with sweep time selection, which speeds and simplifies set-up.

SPECIFICATIONS

VERTICAL AMPLIFIERS (CH A and CH B)

Deflection Factor	10 mV/div to 20 V/div, $\pm 5\%$, in 11 ranges, each with vernier adjustment.
Frequency Response	DC: dc to 15 MHz (-3 dB). AC: 10 Hz to 15 MHz (-3 dB).
Risetime	24 nanoseconds or less.
Overshoot	3% or less.
Input Impedance	1 megohm $\pm 5\%$, shunted by approx. 26 pF.
Max. Input Voltage	300 V(dc + ac peak) or 600 Vp-p.
Operating Modes	Channel A only. Channel B only. Dual: Trace automatically chopped at all sweep times of 1 ms/div and slower; alternate trace automatically selected for all faster sweep times.
Chop Frequency	100 kHz $\pm 20\%$.
Channel Separation	Better than 60 dB@1 kHz.

SWEEP CIRCUITS (Common to CH A and CH B)

Sweep System	Triggered and automatic. In automatic mode, sweep is obtained without input signal.
Sweep Time	1 μ s/div to 0.5 s/div $\pm 5\%$ in 18 ranges, in 1-2-5 sequence. Each overlapping range provides for fine adjustment.
Magnifier	X10 $\pm 10\%$. Extends maximum sweep rate to 100 ns/div.
Linearity	3% or less distortion, $\pm 5\%$ for X10 magnification.

TRIGGERING

Source	INTernal. Channel A trigger in CH A mode. Channel B trigger in CH B mode. Channel A trigger in DUAL mode. EXTernal.
Type	Normal, automatic. In automatic mode, the sweep triggers automatically without an input signal.
Coupling	AC, 20 Hz-20 MHz.
Slope	Positive or negative.

SPECIFICATIONS (CONT.)

Level	Continuously variable, pull for AUTO.	Frequency Response	DC: dc to 1 MHz (-3 dB). AC: 10 Hz to 1 MHz (-3 dB).
VIDEO Sync	Vertical and horizontal sync separator circuit provided so that any portion of composite video waveform can be synchronized and expanded for viewing. LINE (horiz) and FRAME (vert) sync switched automatically by SWEEP TIME/DIV switch. Frame 0.5 s/div to 0.1 ms/div; line 50 μs/div to 1.0 μs/div.	Input Impedance	1 megohm ± 5%, shunted by 22 pF (± 3 pF).
Trigger Sensitivity	INT: 20 Hz to 15 MHz—1 division EXT: 20 Hz to 15 MHz—1.0 V p-p.	Input Protection	300 V (dc + ac peak) or 600 V p-p.
External Trigger Input	Maximum input voltage: 50V p-p max or 24 V dc + ac peak. Input Impedance: 100 kΩ nominal, 35 pF nominal.	X-Y Operation	With SWEEP TIME/ DIV switch in X-Y position, the CH A input becomes the Y input (vertical) and the CH B input becomes the X input (horizontal). The CH B position control becomes the horizontal position control.

CALIBRATION VOLTAGE

Internal 1 V p-p ± 3% square wave @ 1 kHz ± 5%.

POWER REQUIREMENTS

AC	120 VAC, 60 Hz or 220 VAC, 50/60-Hz, 18 watts. 120 VAC or 220 VAC adapter supplied.
External DC	10-16 VDC, 16 watts. Reverse polarity protection.
Internal Battery (Not Supplied)	12 V lead-acid rechargeable battery. Battery drain, 16 watts.

HORIZONTAL AMPLIFIER (Horizontal input thru CH B input)

Deflection Factor	10 mV/div to 20V/div ± 5%.
--------------------------	----------------------------

with handle.
without handle.
optional
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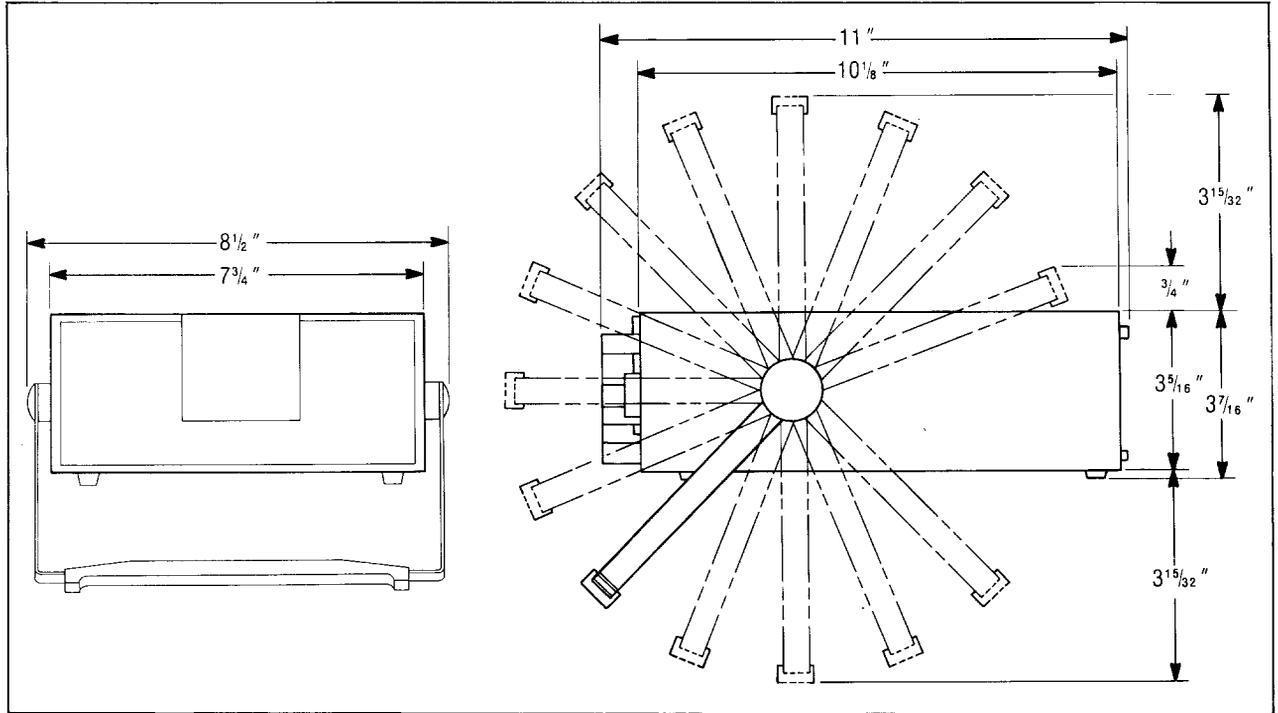


Figure 1. Dimensional Detail.

OPTIONAL ACCESSORIES

MODEL BP-14 BATTERY PACK

This rechargeable battery pack provides operation in field locations where ac or external dc power is not readily available. Battery pack mounts totally inside oscilloscope case. Provides at least 1 hour continuous operation; up to a full day of typical intermittent field service use. Battery charger (standard feature built into Model 1420 Mini-Scope) automatically recharges battery whenever scope is connected to ac power source. Battery is fully charged overnight (16 hours), and charger automatically tapers to trickle charge as needed.

MODEL CC-20 DC POWER CABLE

Adapts scope for operation from 12-volt negative ground vehicle electrical system. Terminated in cigar lighter plug.

MODEL LC-20 DELUXE CARRYING CASE

Rugged man-made leather carrying case affords protection and convenience for field service applications. Front panel protector folds open to permit use of scope without removal from case. Shoulder strap included, but may also be carried by scope handle.

MODEL LC-21 PROBE POUCH

Heavy man-made leather pouch attaches securely to top of scope. Holds two probes and instruction manual.

INSTRUMENT CONNECTING CABLES

The following B & K-Precision cables, which may be purchased separately, may be useful for connecting your oscilloscope directly to other equipment:

Model CC-41. 36" RG/58U with a BNC connector on each end.
Model CC-42. 36" RG/58U with a BNC connector and UHF connector (PL-259).

Model CC-43. 36" RG/58U with BNC connector and banana plugs.

Model CC-44. 36" RG/58U with BNC connector and coaxial microphone connector.

Model CC-45. 36" RG58U with BNC connector and type N connector.

MODEL PR-32 RF DEMODULATOR PROBE

This probe permits display and analysis of the modulation envelope of RF signals to 250 MHz (-6 dB @ 250 MHz). Input impedance is 30 K Ω minimum, shunted by 4.5 pF maximum. Internal shielding protects against stray RF pickup.

MODEL PR-37 DELUXE PROBE

The B & K-PRECISION Model PR-37 deluxe probe is designed for use with wideband oscilloscopes to 100 MHz. The PR-37 is a slim-body probe of precision lightweight construction. A three-position switch select 10:1 or direct modes, or a reference position that grounds the tip through a 9M resistor. The 52" coaxial cable is extremely flexible. Accessories included with the PR-37 are a spring-loaded retractable tip cover, insulating tip BNC tip adapter, IC tip and an insulated compensation capacitor adjustment tool. The insulating tip is designed for probing dense solid-state circuitry with little danger of shorting nearby components.

The BNC adapter tip converts the probe tip into a push-on BNC fitting, ideal for interface with test points or output jacks. The IC tip guides the probe contact into any pin of a standard DIP, making it almost impossible to short two pins of an IC. The PR-37 is available in both grey and red colors. Probes of different colors are particularly useful with a dual-trace scope for instant identification of the channel to which a probe is connected. The PR-37 and accessories come in convenient zippered vinyl case. Model PR-37G is grey and PR-37R is red.

1. **Cathode Ray Tube (CRT).** This is the screen on which the waveforms are viewed. This rectangular CRT has a domed face for greatest precision. An 8x10 division graticule is used.
2. **Pilot Light.** Glows when oscilloscope is turned on. When operating from battery, flashes when battery needs recharging (10V).
3. **INTENSITY Control.** Fully counterclockwise rotation of this control (OFF position) turns off oscilloscope. Clockwise rotation turns on oscilloscope. Further clockwise rotation of the control increases the brightness of the trace.
4. **FOCUS Control.**
5. **ASTIG Adjustment.** Astigmatism adjustment provides optimum spot roundness when used in conjunction with FOCUS and INTENSITY controls. Very little readjustment of this control is required after initial adjustment.
6. **Terminal.** Chassis ground.
7. **CAL 1 kHz 1V p-p Terminal.** Provides 1 kHz, 1-volt peak-to-peak square wave signal. This is useful for probe compensation adjustment and a general check of oscilloscope calibration accuracy.

CHANNEL A CONTROLS (8-12)

8. **POS Control.** Rotation adjusts vertical position of channel A trace. In X-Y operation, rotation adjusts vertical position of display. OFF position disables channel A (fully counterclockwise). Dual-trace operation is enabled when both channel A and B are turned on.

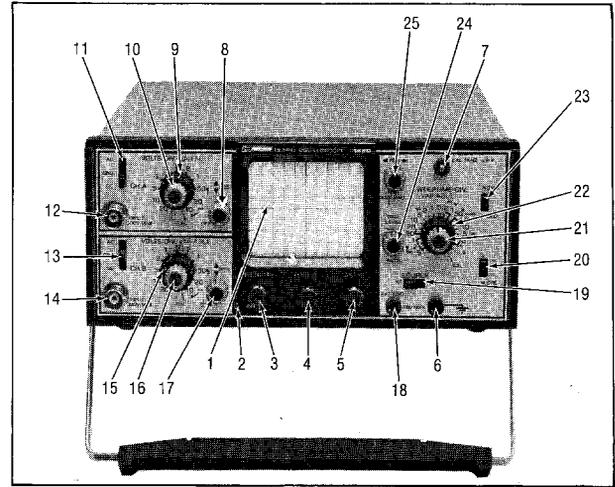


Figure 2. Front Panel Controls.

9. **VOLTS/DIV Switch.** Vertical attenuator for channel A; provides step adjustment of vertical sensitivity. When VARIABLE control (10) is set to CAL, vertical sensitivity is calibrated in 11 steps from 10 mV/div to 20 V/div.
10. **VARIABLE Control.** Rotation provides fine control of channel A vertical sensitivity. In the fully clockwise (CAL) position, the vertical attenuator is calibrated.

CONTROLS AND INDICATORS (CONT.)

11. **AC-GND-DC Switch.** Three-position slide switch which operates as follows:
- | | |
|-----|---|
| AC | Blocks dc component of channel A input signal. |
| GND | Opens signal path and grounds input to vertical amplifier. This provides a zero-signal base line, the position of which can be used as a reference when performing dc measurements. |
| DC | Direct coupled input of ac and dc component of channel A input signal. |
12. **INPUT Jack.** Vertical input for channel A trace. Vertical input for X-Y operation. Maximum input rating 300 volts dc + ac peak or 600 volts peak-to-peak.

CHANNEL B CONTROLS (13-17)

13. **AC-GND-DC Switch.** Three-position slide switch which operates as follows:
- | | |
|-----|---|
| AC | Blocks dc component of channel B input signal. |
| GND | Opens signal path and grounds input to vertical amplifier. This provides a zero-signal base line, the position of which can be used as a reference when performing dc measurements. |
| DC | Direct coupled input of ac and dc component of channel B input signal. |
14. **INPUT Jack.** Vertical input for channel B trace in normal sweep operation. External horizontal input in X-Y operation. Maximum input rating 300 volts dc + ac peak or 600 volts peak-to-peak.

15. **VOLTS/DIV Switch.** Vertical attenuator for channel B; provides step adjustment of vertical sensitivity. When **VARIABLE** control is set to **CAL**, vertical sensitivity is calibrated in 11 steps from 10 mV/div to 20 V/div. In X-Y operation, this control provides step adjustment of horizontal sensitivity.
16. **VARIABLE Control.** Rotation provides fine control of channel B vertical sensitivity. In the fully clockwise (**CAL**) position, the vertical attenuator is calibrated. In X-Y operation, this control becomes the fine horizontal gain control.
17. **▲▼ POS Control.** Rotation adjusts vertical position of channel B trace. In X-Y operation, rotation adjusts horizontal position of display. **OFF** position disables channel B (fully counterclockwise). Dual-trace operation is enabled when both channels A and B are on.

SWEEP AND TRIGGERING CONTROLS (18-25)

18. **EXT TRIG Jack.** Input terminal for external trigger signal. Maximum input rating is 50 volts dc + ac peak.
19. **SOURCE Switch.** Two-position slide switch selects triggering source for sweep.
- | | |
|-----|---|
| INT | Internal sync. Waveform being observed triggers sweep. Channel A signal triggers sweep in dual-trace operation. Any signal of at least 1 division amplitude is capable of triggering the sweep. |
| EXT | External sync. Sweep is triggered by signal applied at EXT TRIG jack. |

20. **SLOPE Switch.** Two-position slide switch with the following positions:

- (+) Sweep is triggered on positive-going slope of waveform, or with positive sync pulse of composite video waveform.
- (-) Sweep is triggered on negative-going slope of waveform, or negative sync pulse of composite video waveform.

21. **SWEEP TIME/DIV Switch.** Horizontal coarse sweep time selector. Selects calibrated sweep times of $1\mu\text{s}/\text{div}$ (microsecond per division) to $0.5\text{ s}/\text{div}$ in 18 steps when sweep time **VARIABLE** control is set to **CAL** position (fully clockwise). In the **CH B** position, this switch disables the internal sweep generator and permits the **CH B** input to provide horizontal deflection (**X-Y** operation).

22. **Sweep Time VARIABLE Control.** Fine sweep time adjustment. In the extreme clockwise (**CAL**) position the sweep time is calibrated.

23. **NORM-VIDEO Switch.** Two-position slide switch selects type of trigger signal.

NORM Used for viewing all waveforms except composite video signals.

VIDEO Used for viewing composite video signals. Interconnects video sync separator to permit the sync pulses to trigger the sweep. Vertical sync pulses automatically selected at sweep times appropriate for viewing **FRAMES**, $.5\text{ s}/\text{div}$ to $.1\text{ ms}/\text{div}$. Horizontal sync pulses automatically selected at sweep times appropriate for viewing **LINES**, $50\mu\text{s}/\text{div}$ to $1\mu\text{s}/\text{div}$.

24. **TRIG LEVEL Control.** Trigger level adjustment, determines point on waveform where sweep starts. "0" (center of rotation) selects zero-crossover, or average, of waveform, and is the most sensitive setting. Rotation in (-) direction selects more negative point of triggering, and rotation in (+) direction selects more positive point of triggering. Push-pull switch selects automatic triggering when pulled out (**PULL AUTO**). With automatic triggering, a sweep is generated automatically (free runs) in the absence of trigger signal; reverts to triggered sweep operation in the presence of adequate trigger signal.

25. **◀POS▶ Control.** Rotation adjusts horizontal position of trace (both traces in dual-trace operation). Alternate action (push-push) switch selects **X10** sweep magnification when knob is released (**PUSH X10 MAG**). Rotation selects portion of sweep to be viewed, ccw to view left end of trace, cw to view right end of trace. **X10** magnification increases sweep rate 10 times, to $100\text{ ns}/\text{div}$ maximum. Push again to latch knob in for standard non-magnified sweep.

ADDITIONAL FACILITIES (FIGS. 3, 4)

26. **Combination Carrying Handle and Tilt Stand.** When the handle is folded upward, the oscilloscope rests on rubber feet. When the handle is folded downward, it elevates the front of the oscilloscope to a convenient viewing angle. Pull out both pivot points to unlock and rotate the handle. Handle locks at each $22\frac{1}{2}^\circ$ angle of rotation.

27. **AC Input Connector.** Accepts output from 120 VAC or 220 VAC adapter.

28. **DC Input Connector.** Accepts input from external dc source of 10 to 16 volts. Center pin is positive.

CONTROLS AND INDICATORS (CONT.)

29. **AC Adapter.** Converts 120 VAC (Model BE-20) or 220 VAC (Model BE-21) input to 16 VAC rms for connection to ac input connector.

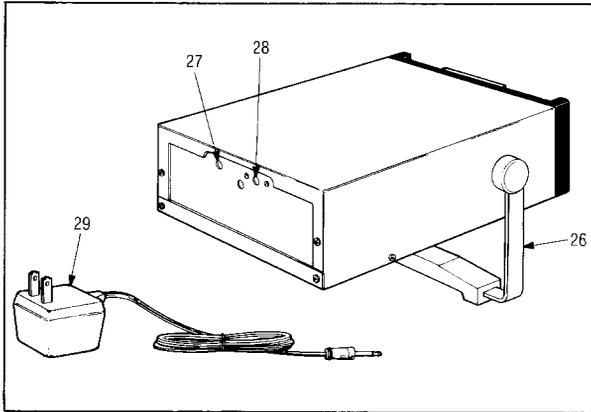


Figure 3. Rear Panel and Miscellaneous Controls.

30. **Viewing Hood.** Reduces ambient light level on CRT to improve viewing.

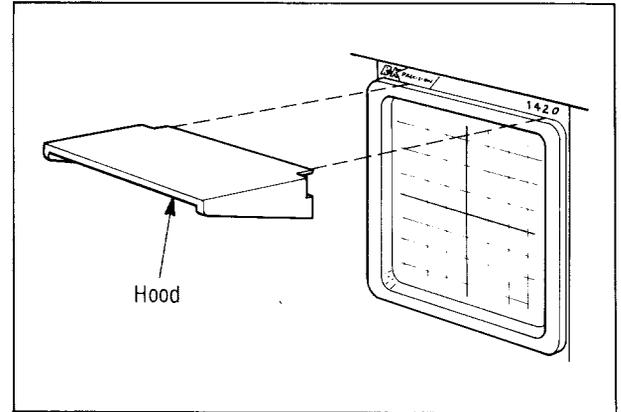


Figure 4. Installation of Viewing Hood.

CONTROLS AND INDICATORS (CONT.)

29. **AC Adapter.** Converts 120 VAC (Model BE-20) or 220 VAC (Model BE-21) input to 16 VAC rms for connection to ac input connector.

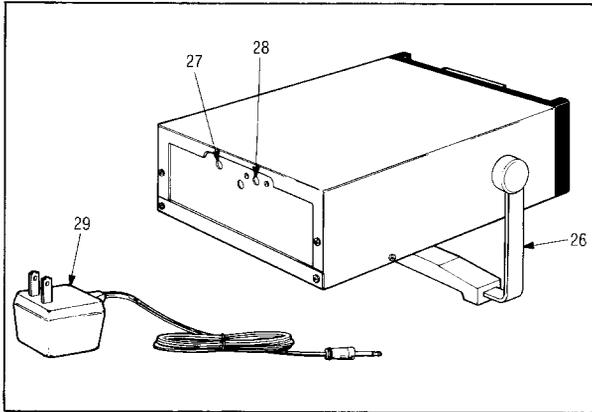


Figure 3. Rear Panel and Miscellaneous Controls.

30. **Viewing Hood.** Reduces ambient light level on CRT to improve viewing.

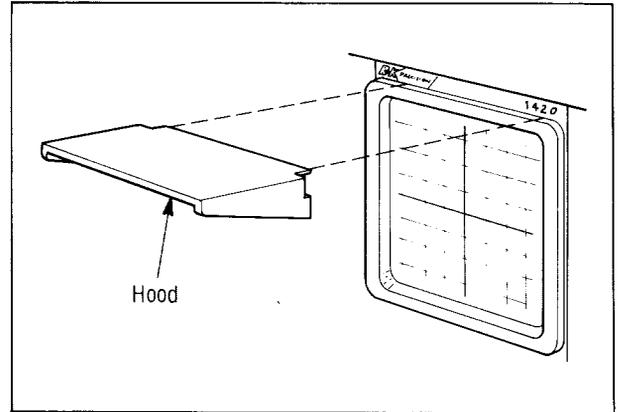


Figure 4. Installation of Viewing Hood.

OPERATING INSTRUCTIONS

PRECAUTIONS

Safety

WARNING

The following precautions must be observed to prevent electric shock.

1. When this oscilloscope is used to make measurements in equipment that contains high voltage, there is always a certain amount of danger from electric shock. The person using the oscilloscope in such conditions should be a qualified electronics technician or otherwise trained and qualified to work in such circumstances. Observe the "Test Instrument Safety" recommendations listed on the inside front cover of this manual.
2. When operated from ac power or internal battery, the chassis and housing of the Model 1420 Mini-Scope is floating (isolated from earth ground). Always connect a cable from the \perp terminal of the mini-scope to a good earth ground before making any other connections to the equipment under test. See item 6 on the inside cover of this manual for a full explanation of the hazard.
3. One of the most commonly encountered shock hazards is testing of "hot chassis" transformerless ac-powered equipment (see item 5 on the inside front cover for a full explanation of the hazard). Never attempt to make oscilloscope measurements in such equipment without first connecting an isolation transformer between the ac power line and the equipment under test. To be on the safe side, treat all equipment as "hot chassis" unless you are sure it has an isolated chassis or earth ground chassis.

4. Special precautions are required to measure or observe line voltage waveforms with any oscilloscope. Use the following procedure:
 - a. First, connect the ground clip of the probe to earth ground. Do not connect the ground clip of the probe to either side of the line. If the "hot" side is contacted, the chassis and case of the scope also become "hot" and pose a serious electrical shock hazard. If the chassis is already grounded, touching the "hot" side of the line may "weld" or "disintegrate" the probe ground clip and cause possible injury, plus possible damage to the scope and 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 should be grounded and no waveform will result.

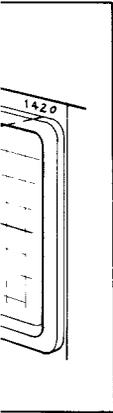
Equipment Protection

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 only 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, or switch back to normal sweep operation when no signal is applied.
2. Never apply more than the rated 300 volts dc + ac peak or 600 volts peak-to-peak (212 volts rms for sine wave) to the

CRT to im-



OPERATING INSTRUCTIONS (CONT.)

oscilloscope inputs. When using 10:1 attenuation probes, the voltage at the scope input is only 1/10 of that at the point of measurement, however, do not exceed the probe rating of 500 volts dc + ac peak at the point of measurement.

3. When operated from external dc power, the chassis and housing of the mini-scope is common with the negative polarity of the power source. Make sure the ground cable for the mini-scope and the ground clips of the probes are also connected to points that are common with the negative polarity of the power source. Without this precaution, the equipment under test may be shorted through the probe clip leads or ground cable, resulting in possible damage to the equipment under test or the mini-scope.

OPERATING TIPS

The following recommendations will help obtain the best performance from the oscilloscope.

1. Always use the probe ground clips for best results. Do not use an external ground wire in lieu of the probe ground clips, as undesired signals may be introduced.
2. Operation adjacent to equipment which produces strong ac magnetic fields should be avoided where possible. This includes such devices as large power supplies, transformers, electric motors, etc., that are often found in an industrial environment. Strong magnetic fields can exceed the practical CRT magnetic shielding limits and result in interference and distortion.
3. Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation of both probes should be adjusted initially, then the same probe always used with channel A and channel B respectively. Probe compensation should be readjusted whenever a probe from a different scope is used, or the channel A and B probes are interchanged. Adjust the compensation trimmer on each probe for the best quality waveshape (minimum overshoot, rounding off, and tilt), while observing the calibration square wave from the CAL 1 kHz 1.0 V p-p terminal.
4. Occasionally check trace rotation, dc balance, astigmatism, and calibration accuracy of the scope using the procedures found in the OPERATOR MAINTENANCE section of this manual.

BATTERY INSTALLATION (refer to Fig. 5)

The Model 1420 Mini-Scope is shipped without a battery. The Model BP-14 Battery Pack is available as an optional accessory for users desiring the convenience of a rechargeable battery that mounts inside the unit. This reduces instrument cost for those users not requiring battery operation. For those requiring the accessory, it assures a fresh battery when you are ready to use the mini-scope as a battery-powered instrument.

1. To prevent electric shock, disconnect all external power and set INTENSITY control to full counterclockwise (OFF) position.
2. Remove six screws securing top cover; two on each side and two at rear panel.
3. Lift off top cover.
4. Remove long screw, washer and spacer.
5. Remove right screw from external dc power jack. Loosen left screw and tilt up right edge of connector body to allow battery to easily slide into the battery compartment.

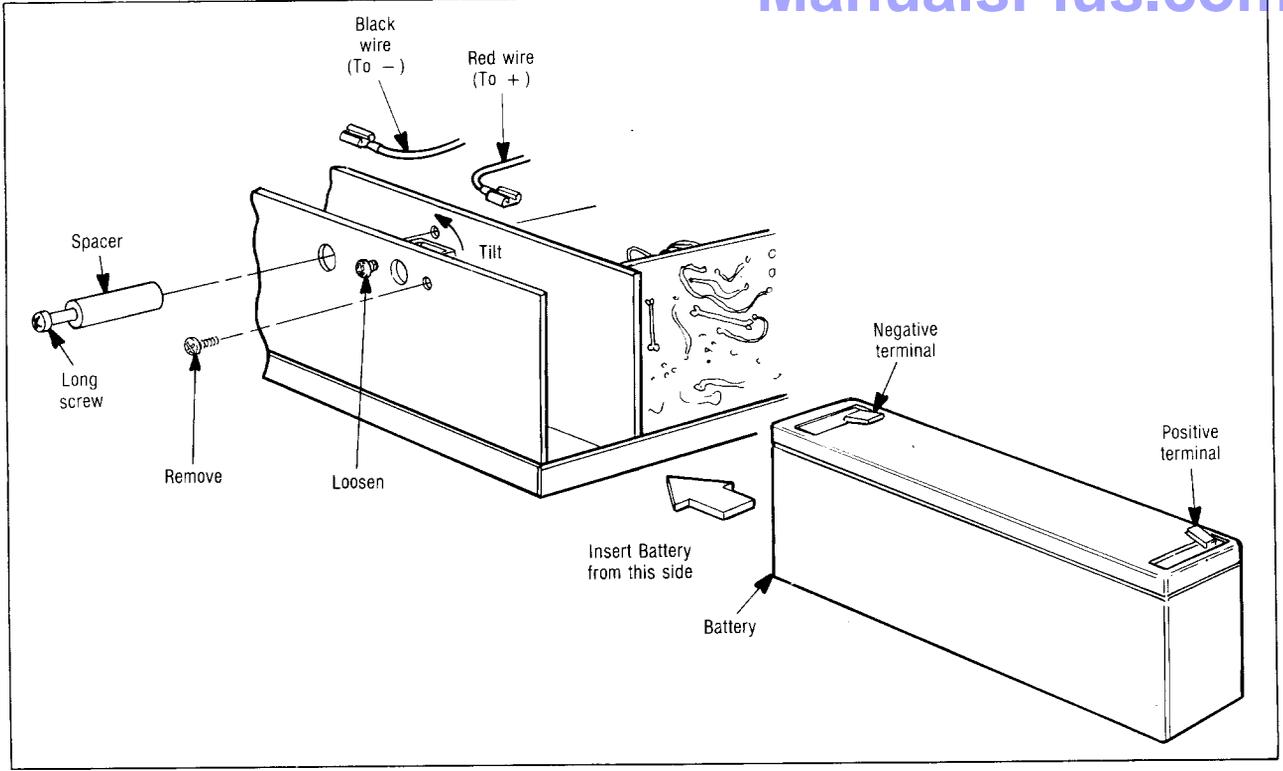


Figure 5. Battery Installation.

OPERATING INSTRUCTIONS (CONT.)

6. Slide battery into position under connectors so that positive (red) terminal is located to the right as shown in Fig. 5. Be sure not to damage any wires.
7. Connect red wire to positive terminal and black wire to negative terminal.
8. Insert long screw and spacer through rear panel and tighten to secure battery in position.
NOTE: Screw is part of Mini-Scope.
9. Replace and tighten mounting screws into external dc power jack.
10. Reinstall top cover.

BATTERY POWERED OPERATION

Initially, the oscilloscope should be operated from ac power to verify the battery is fully charged. Allow up to 16 hours to fully recharge a battery that has discharged to the point of 10 volts. This point is indicated by the flashing pilot light.

1. Turn on oscilloscope with INTENSITY Control (3).
2. If pilot light (2) glows brightly, the battery is charged and the mini-scope is ready to use. A fully charged battery will give at least one hour of continuous operation. To extend battery life, turn off the mini-scope when not actually making measurements.
3. If pilot light (2) flashes, the battery is discharged to 10 volts. Calibration accuracy is sharply degraded below 10 volts. To

continue operation, the scope must be connected to ac or external dc power. If possible, recharge the battery.

4. The battery is recharged when ac power is applied and the scope is turned off. The battery does not recharge at the full charging rate while the mini-scope is operating; a trickle charge is supplied. Recharging also occurs when external dc power is applied, and only if the scope is turned off, but only if the external dc voltage is at least 3 volts higher than the battery voltage. A minimum voltage of 17.5 volts is required to fully charge the battery.
5. If you anticipate the need for prolonged battery operation, you may wish to carry a fully charged spare battery. Another alternative is to carry a heavy duty external battery. The considerations for selecting and using such a battery pack are fully explored in Appendix I.
6. At sites without ac power, a source of external dc power is often available for powering the equipment being serviced. Any dc power source of 10 to 16 volts (up to 25 volts peak) and 16 watts of reserve capacity will power the mini-scope and conserve the battery.

AC POWERED OPERATION

1. Connect ac power adapter (29) to ac input receptacle (27) and to an ac power outlet.
2. Turn oscilloscope on with INTENSITY control (3).
3. Pilot light (2) should glow, indicating the mini-scope is ready for use.

- If the optional battery is installed, it will charge when INTENSITY control (3) is turned OFF (fully counterclockwise), so long as the mini-scope is connected to the ac power source.

EXTERNAL DC POWERED OPERATION

CAUTION

- For use with negative-ground electrical systems only.
- Never connect an external dc power source and the ac adapter at the same time. Possible damage may result.

The 1420 is guaranteed to operate from external dc power sources of 10 to 16 volts. However, it will withstand and operate from voltage as high as 25 volts peak or continuous. We do not recommend operation from nominal 24-volt dc power sources; peak voltage in such systems is usually 28 to 32 volts. If external dc power is taken from the equipment under test, make sure its power supply can furnish 16 watts of additional drain for powering the mini-scope without performance degradation of the equipment being tested.

- Connect a dc power cord from dc receptacle (28) to a negative-ground 12-volt dc power source (10 to 25 VDC), such as a vehicle cigarette lighter, or an external marine type battery. Observe proper polarity; the oscilloscope is protected against reverse polarity damage, but will not operate if polarity is reversed.
- Turn on oscilloscope with INTENSITY control (3).
- Pilot light (2) should glow, and the scope is ready for use. The pilot light will flash if the external dc voltage drops to 10 volts or less.

- If the optional battery is installed, the battery is charging during the time the mini-scope is connected to the external dc source and voltage exceeds the internal battery voltage.

INITIAL STARTING PROCEDURE (refer to Fig. 6)

- Prepare oscilloscope for ac-powered, external dc-powered, or battery-powered operation as previously described.
- Set CH A \blacktriangleleft POS control (8), CH B \blacktriangleright POS control (17), and \blacktriangleleft POS \blacktriangleright (25) to the centers of their ranges.
- Pull TRIG LEVEL control (24) to the AUTO position.
- Set CH A AC-GND-DC switch (11) and CH B AC-GND-DC switch (13) to the GND positions.

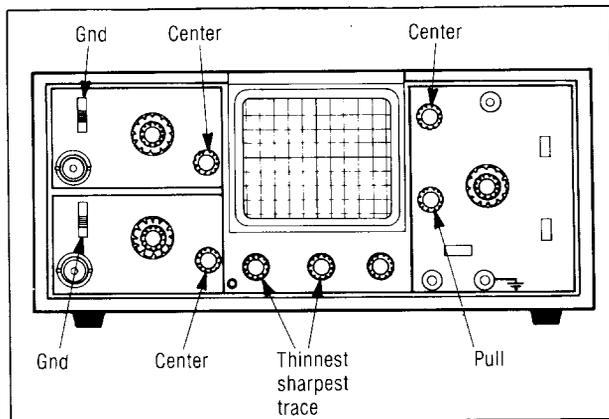


Figure 6. Initial Control Settings.

OPERATING INSTRUCTIONS (CONT.)

6. Wait a few seconds for the cathode ray tube (CRT) to warm up. Two traces should appear on the face of the CRT.
7. If no trace appears, increase (clockwise) the INTENSITY control (3) setting until the trace is easily observed. If a spot appears, select any SWEEP TIME/DIV setting except CH B.
8. Adjust FOCUS control (4) and INTENSITY control (3) for the thinnest, sharpest trace.
9. Readjust position controls (8, 17 and 25) if necessary, to center the traces.
10. Check for proper adjustment of ASTIG control (5).

The oscilloscope is now ready for making waveform measurements.

CAUTION

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. Reduce intensity or keep the spot in motion by causing it to sweep.

SINGLE-TRACE WAVEFORM OBSERVATION

Either channel A or channel B can be used for single-trace operation. Channel A is used in the following instruction.

1. Perform the steps of the "Initial Starting Procedure" with the CH B \blacklozenge POS Control set to OFF. Then connect the probe cable to the CH A INPUT jack (12).

2. Set CH A AC-GND-DC switch (11) to AC for measuring only the ac component (this is the normal position for most measurements and must be used if the point being measured includes a large dc component). Use the DC position for measuring both the ac component and the dc reference, and any time a very low frequency waveform (below 10 Hz) is to be observed. The GND position is required only when a zero-signal ground reference is required, such as for dc voltage readings.
3. Connect ground clip of probe to chassis ground of the equipment under test. Connect the tip of the probe to the point in the circuit where the waveform is to be measured.

WARNING

- a. If the equipment under test is a transformerless ac-powered item, use an isolation transformer to prevent dangerous electrical shock.
 - b. The peak-to-peak voltage at the point of measurement should not exceed 600 volts, and the dc plus signal peak voltage should not exceed 300 volts.
4. Set CH A VOLTS/DIV switch (9) and the VARIABLE control (10) to a position that gives 2 to 6 divisions of vertical deflection. The display on the screen will probably be unsynchronized. The remaining steps are concerned with adjusting synchronization and sweep speed, which presents a stable display showing the desired number of waveforms. Any signal that produces at least 1 division vertical deflection develops sufficient trigger signal to synchronize the sweep.

5. Set SOURCE switch (19) to the INT position. This provides internal sync so that the waveform being observed is also used to trigger the sweep. Most waveforms should be viewed using internal sync. When an external sync source is required, the SOURCE switch should be placed in the EXT position and a cable should be connected from the EXT TRIG jack (18) to the external sync source.
6. Set NORM-VIDEO switch (23) to the VIDEO position for observing television composite video waveforms or to the NORM position for all other types of waveforms.
7. Set SLOPE switch (20) to the (+) position if the sweep is to be triggered by a positive-going wave, or to the (-) position if the sweep is to be triggered by a negative-going wave. If the type of waveform is unknown, the (+) position may be used.
8. Readjust TRIG LEVEL control (24) to obtain a synchronized display without jitter. As a starting point, the control may be pushed in and rotated to any point that will produce a sweep, which is usually somewhere in the center of its range. The trace will disappear if there is inadequate signal to trigger the sweep, such as when measuring dc or extremely low amplitude waveforms. If no sweep can be obtained, pull the control out (PULL AUTO) for automatic triggering.
9. Set SWEEP TIME/DIV switch (21) and VARIABLE control (22) for the desired number of waveforms. These controls may be set for viewing only a portion of a waveform, but the trace becomes progressively dimmer as a smaller portion is displayed. This is because the sweep speed increases but the sweep repetition rate does not change.

10. After obtaining the desired number of waveforms, as in step 10, it is sometimes desirable to make a final adjustment of the TRIG LEVEL control (24). The (-) direction selects the most negative point on the waveform at which sweep triggering will occur and the (+) direction selects the most positive point on the waveform at which sweep triggering will occur. The control may be adjusted to start the sweep on any desired portion of the waveform.
11. For a close-up view of a portion of the waveform, push to release ◀POS▶ control (25). This expands the sweep by a factor of ten (10x magnification) and displays only the center portion of the sweep. To view a portion to the left of center, turn the ◀POS▶ control counterclockwise. To view a portion to the right of center, turn the control clockwise. Push again on the control to latch control in and return the sweep to the normal, non-magnified condition.

CALIBRATED VOLTAGE MEASUREMENT

(See Fig. 7)

Peak voltages, peak-to-peak voltages, dc voltages and voltages of a specific portion of a complex waveform are easily and accurately measured on the Model 1420 Mini-Scope.

1. Adjust controls as previously instructed to display the waveform to be measured.
2. Be sure the CH A VARIABLE control (10) is set fully clockwise to the CAL position.
3. Set CH A VOLTS/DIV switch (9) for the maximum vertical deflection possible without exceeding the limits of the vertical scale.

OPERATING INSTRUCTIONS (CONT.)

4. Read the amount of vertical deflection (in divisions) from the scale. The CH A \updownarrow POS control (8) may be readjusted to shift the reference point for easier scale reading if desired. When measuring a dc voltage, adjust the CH A \updownarrow POS control to a convenient reference with the CHA AC-GND-DC

switch (11) in the GND position, then note the amount the trace is deflected when the switch is placed in the DC position. The trace deflects upward for a positive voltage input and downward for a negative voltage input.

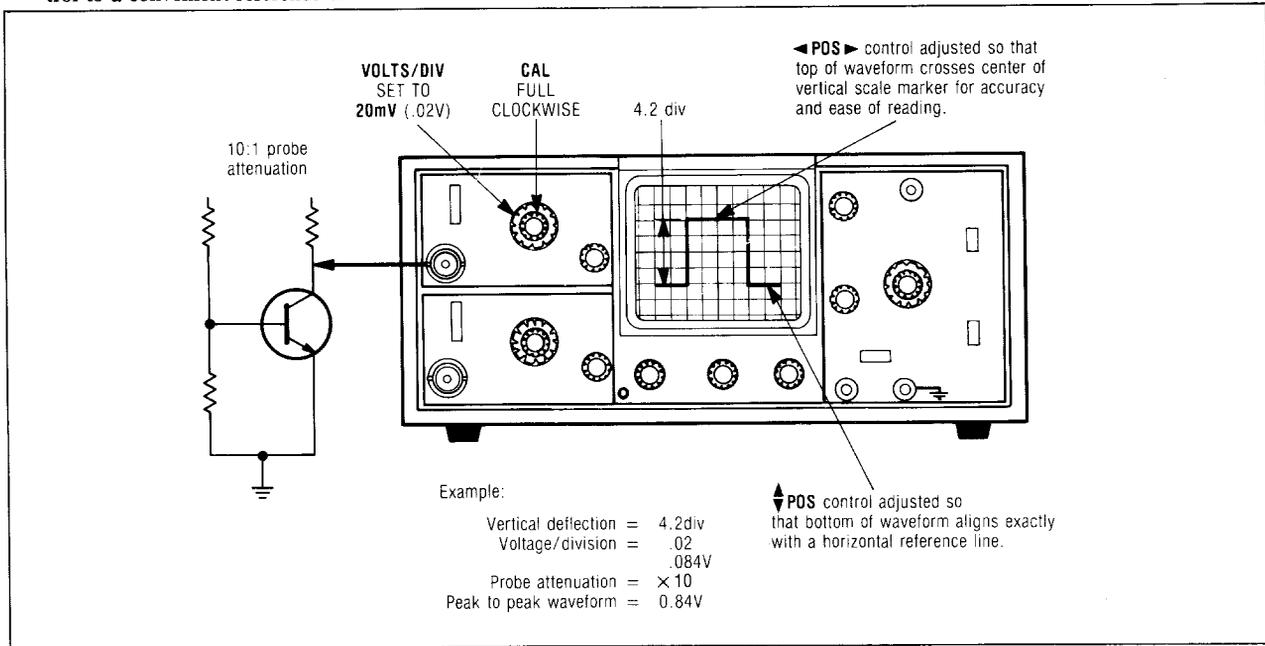


Figure 7. Voltage Measurement.

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the DC posi-
voltage input

5. Calculate the voltage reading as follows: Multiply the vertical deflection (in divisions) by the VOLTS/DIV control (9) setting (see example Fig. 6). Remember that the voltage reading displayed on the oscilloscope is only 1/10th the actual voltage being measured with the 10:1 probe.
6. Calibration accuracy of this oscilloscope may be occasionally checked by observing the 1-volt peak-to-peak square wave signal available at the CAL 1 kHz 1 V p-p terminal (7). This calibrated source should read exactly 1 volt peak-to-peak (0.1 volt when measured with 10:1 probe). If a need for recalibration is indicated, see the "SERVICING" section of the manual for complete procedures.

CALIBRATED TIME MEASUREMENT

(See Fig. 8)

Pulse width, waveform periods, circuit delays and all other waveform time durations are easily and accurately measured on this oscilloscope. Calibrated time measurements from .5 second down to 0.1 microsecond are possible. At low sweep speeds, the entire waveform is not visible at one time. However, the bright spot can be seen moving from left to right across the screen, which makes the beginning and ending points of the measurement easy to spot.

1. Adjust controls as previously described for a stable display of the desired waveform.
2. Be sure the sweep time VARIABLE control (22) is fully clockwise to the CAL position.
3. Set the SWEEP TIME/DIV control (21) for the largest possible display of the waveform segment to be measured, usually one cycle.

4. If necessary, readjust the TRIG LEVEL control (24) for the most stable display.
5. Read the amount of horizontal deflection (in divisions) between the points of measurement. The ◀POS▶ control (25) may be readjusted to align one of the measurement points with a vertical scale marker for easier reading.
6. Calculate the time duration as follows: Multiply the horizontal deflection (in divisions) by the SWEEP TIME/DIV switch (21) setting (see example in Fig. 7). Remember, when the 10X magnification is used, the result must be divided by 10 to obtain the actual time duration.
7. Time measurements often require external sync. This is especially true when measuring delays. The sweep is started by a sync pulse from one circuit and the waveform measured in a subsequent circuit. This allows measurement of the display between the sync pulse and the subsequent waveform. To perform such measurements using external sync, use the following steps:
 - a. Set the SOURCE switch (19) to the EXT position.
 - b. Connect a cable from the EXT TRIG jack (18) to the source of sync signal. Use a short shielded cable. The external sync signal should be at least 1 volt peak-to-peak. Maximum input voltage is 50 volts peak-to-peak or 24 volts dc + ac peak. A higher input voltage may damage the scope.
 - c. Set the SLOPE switch (20) to the (+) or (-) position for the proper polarity for the sync signal.

OPERATING INSTRUCTIONS (CONT.)

- d. Readjust the TRIG LEVEL control (24) if necessary for a stable waveform.
- e. If measuring a delay, measure the time from the start of the sweep to the start of the waveform.
- 8. Another excellent method for measuring time delays is with dual-trace operation. The procedures are given in the "DUAL-TRACE WAVEFORM OBSERVATION" paragraph.

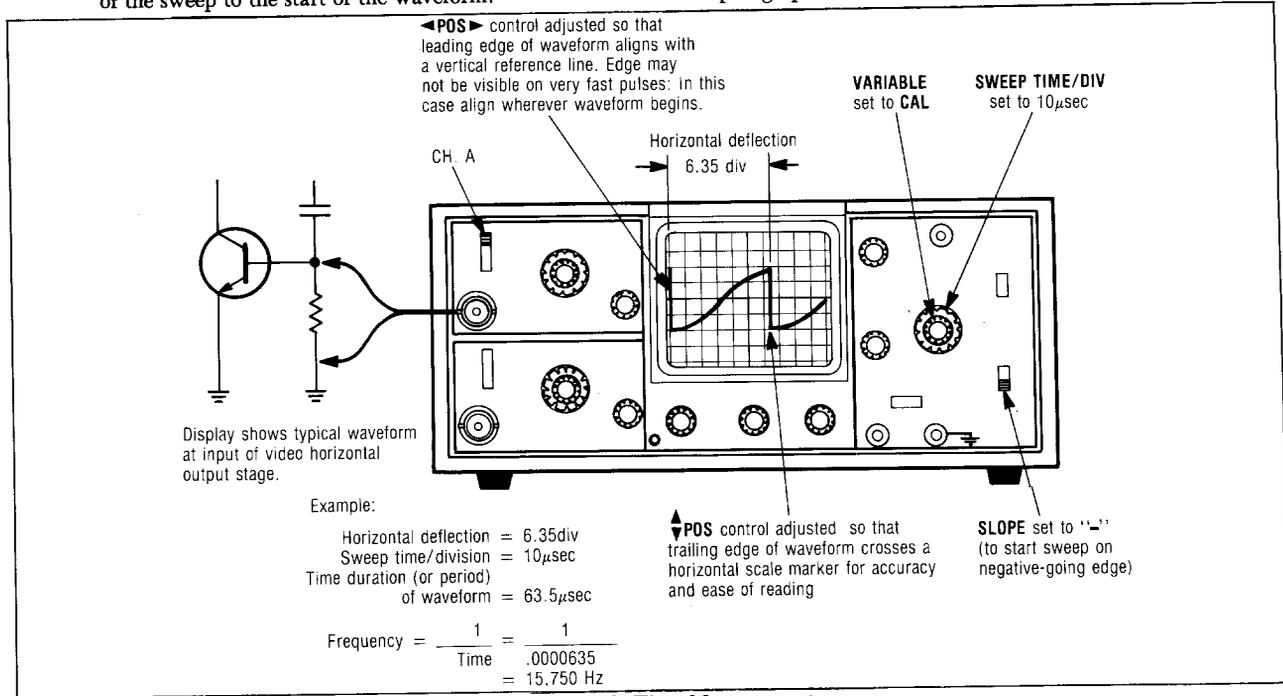


Figure 8. Time Measurement.

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OBSERVATION"

DUAL-TRACE WAVEFORM OBSERVATION (Refer to Fig. 9)

In observing simultaneous waveforms on channels A and B, it is necessary that the waveforms be related in frequency or that one of the waveforms be synchronized to the other, although the basic frequencies may be different. Example: checking a frequency divider or multiplier. The reference, or "clock" frequency can be used on channel A, for example, and the multiple or sub-multiple of this reference frequency will be displayed on channel B. In this way, when the waveform display of channel A is synchronized, the display on channel B also will be in sync with the channel A display. If two waveforms having no phase or frequency relationships to each other are displayed simultaneously, it will be difficult if not impossible to lock both waveforms in sync for any useful observations.

To display two waveforms simultaneously for observation, use the following procedure:

1. Perform the steps of the "Initial Starting Procedure."
2. Connect oscilloscope probe cables to both the CH A and CH B INPUT jacks (12 and 14)
3. Rotate both CH A and CH B \blacktriangle POS control (8 and 17) clockwise out of the off position. Two traces should appear on the screen.
4. Adjust CH A and CH B \blacktriangle POS controls to place the channel A trace above the channel B trace, and adjust both traces to a convenient reference mark on the scale.
5. Set both the CH A and CH B AC-GND-DC switch (11 and 13) to the AC position. This is the position used for most

measurements and must be used if the points being measured include a large dc component.

6. Connect the ground clips of the probes to the chassis ground of the equipment under test. Connect the tips of the probes to points in the circuit where the waveforms are to be measured. The signal to which the waveform will be synchronized must be applied to the channel A input.
7. Set the VOLTS/DIV controls (9 and 15) for channels A and B to a position that gives 2 to 3 divisions of vertical deflection. The displays on the screen will probably be unsynchronized. The remaining steps, although similar to those outlined for single-trace operation, describe the procedure for obtaining stable, synchronized displays.
8. Set the SOURCE switch (19) to the INT position. This provides internal sync so that the channel A waveform being observed is also used to trigger the sweep. Often in dual-trace operation, a sync source other than the measurement point for channel A is required. In this case set the SOURCE switch to the EXT (external) position and connect a cable from the EXT TRIG jack (18) to the sync source.
9. Set the NORM-VIDEO switch (23) to the VIDEO position for observing television composite video waveforms, or to the NORM position for observing all other types of waveforms.
10. Set SLOPE switch (20) to the (+) position if the sweep is to be triggered by a positive-going wave, or to the (-) position if the sweep is to be triggered by a negative-going wave.

OPERATING INSTRUCTIONS (CONT.)

11. Adjust TRIG LEVEL control (24) to obtain a stable, synchronized sweep. As a starting point, the control may be pushed in and rotated to any point that will produce a sweep, which is usually somewhere in the center portion of its range. The trace will disappear if there is inadequate signal to trigger the sweep, such as when measuring extremely low amplitude signals. If no sweep can be obtained, pull out the control (PULL AUTO) for automatic triggering.
12. Set SWEEP TIME/DIV switch (21) and VARIABLE control (22) for the desired number of waveforms. These controls may be set for viewing only a portion of a waveform, but the trace becomes progressively dimmer as a smaller portion is displayed.
13. After obtaining the desired number of waveforms as in step

12, it is sometimes desirable to make a final adjustment of the TRIG LEVEL control (24). The (-) direction of rotation selects the most negative point on the sync waveform at which sweep triggering will occur and the (+) direction selects the most positive point on the sync waveform at which sweep triggering will occur. The control may be adjusted to start the sweep on any desired portion of the sync waveform.

14. The observed waveforms of channels A and B can be expanded by a factor of 10 by pushing to release the ◀POS▶ control (25). This control can then be rotated clockwise or counterclockwise to view the left and right extremes of the waveform displays as desired. Push again to latch the knob in to return the sweep to the normal, non-magnified condition.

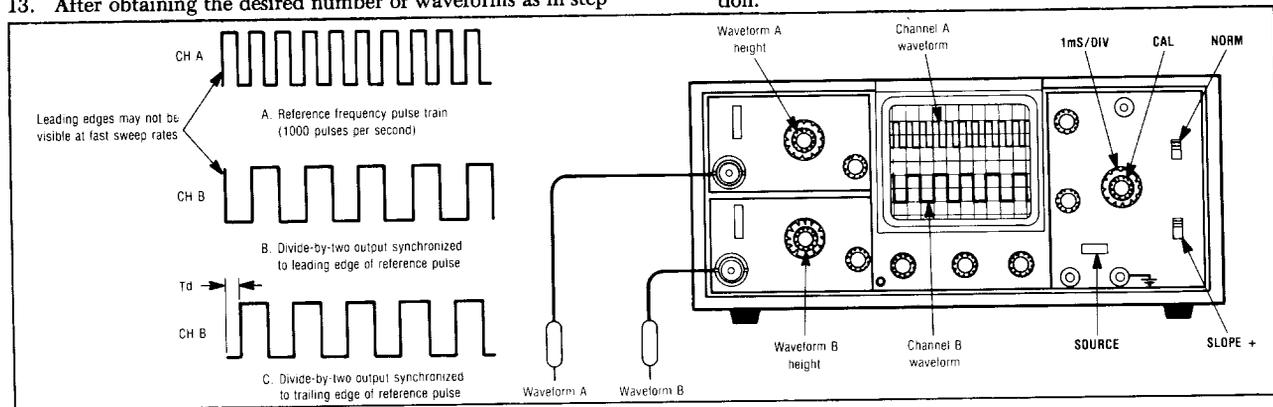
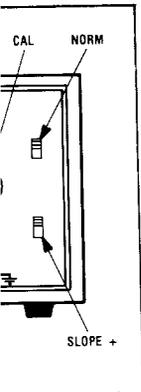


Figure 9. Dual-Trace Measurement in Divide-by-two Circuit.

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15. Calibrated voltage measurements and calibrated time measurements are identical to those previously described for single-trace operation. Either the channel A or channel B vertical adjustment controls can be used as required in conjunction with the horizontal sweep controls to obtain the required amplitude or time interval measurements. This can be done either by using the dual display facilities or by reverting to single-trace operation.

EXTERNAL HORIZONTAL INPUT (X-Y OPERATION)

For some measurements, an external horizontal deflection signal is required. This is also referred to as an X-Y measurement, where the Y input (CH A) provides vertical deflection and the X input (CH B) provides horizontal deflection. X-Y operation permits the oscilloscope to perform many types of measurements not possible with conventional sweep operation. The CRT display becomes an electronic graph of two instantaneous voltages. The display may be a direct comparison of the two voltages such as during phase measurement, frequency measurement with Lissajous waveforms, and vectorscope display of video color bar patterns. However, the X-Y mode can be used to graph almost any dynamic characteristics if a transducer is used to change the

characteristic (frequency, temperature, velocity, etc., etc., etc.) into a voltage. For example, the horizontal deflection voltage during frequency response measurements is proportional to frequency; thus X axis corresponds to frequency. This input must be 10 mV per division of deflection or greater; thus any voltage of 100 mV or greater is sufficient for satisfactory operation. To use an external horizontal input, use the following procedure:

1. Set the SWEEP TIME/DIV switch (21) fully clockwise to the CH B position.
2. Use the channel A probe for the vertical input and the channel B probe for the horizontal input.
3. Adjust the amount of horizontal deflection with the CH B VOLTS/DIV and VARIABLE controls (15 and 16).
4. The CH B (vertical) POS control now serves as the horizontal position control, and the ◀POS▶ control is disabled. *Do not* use the PUSH 10X MAG control during X-Y operation. Use the CH B VARIABLE and VOLTS/DIV controls to adjust horizontal gain.
5. All sync controls are disconnected and have no effect.

OPERATOR MAINTENANCE

WARNING

To prevent electric shock, do not perform servicing that requires removal of the covers unless you are qualified to do so. Exposed high voltage, up to 1,000 volts is present when covers are removed.

PERIODIC ADJUSTMENTS

All adjustments which require removal of the top cover or bottom plate are described in the SERVICING section of this manual and should be performed by qualified personnel only.

OPERATOR MAINTENANCE (CONT.)

The following operator adjustments only need to be checked and adjusted occasionally. The ASTIG and TRACE ROTATION controls are accessible without removing the top cover or bottom plate.

Trace Rotation

If the trace is not exactly parallel with the horizontal lines of the graticule scale, it may be readjusted with the trace rotation adjustment, R40. The trace rotation adjustment is accessible through a hole in the bottom plate of the mini-scope.

1. Set oscilloscope controls to produce a horizontal trace with no input signal (PULL AUTO position of TRIG LEVEL switch).
2. Use Position controls as required to position the trace along a horizontal line of the graticule scale.
3. Adjust Trace Rotation (R40) with a small, thin flat blade screwdriver so trace is parallel with the reference line on the graticule scale.

Astigmatism

1. Set SWEEP TIME/DIV switch to CH B position and channel A and channel B AC-GND-DC switches to GND position. This will produce a spot on the screen.
2. With INTENSITY control set about mid-range, adjust both the ASTIG and FOCUS controls for the sharpest, roundest spot. Do not readjust ASTIG control after this step. If the normal setting for the front panel ASTIG control approaches

its limit, an internal adjustment can be set to re-center the range of adjustment. Refer to the SERVICING section for adjustment procedure.

CAUTION

Never allow a small spot of high brilliance to remain stationary on the screen for more than a few seconds. The screen may be permanently burned.

Probe Compensation

Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation of both probes should be adjusted initially, then the same probe always used with channel A and channel B respectively. Probe compensation should be readjusted whenever a probe from a different oscilloscope is used, or the channel A and B probes are interchanged.

1. Connect probes to both INPUT jacks. Connect ground clip of probes to oscilloscope ground terminal and touch tips of both probes to CAL 1 kHz 1 V p-p terminal.
2. Select single trace operation of channel A, then channel B, for steps 3 and 4.
3. Set oscilloscope controls to display 3 or 4 cycles of CAL square wave at 5 or 6 divisions amplitude.
4. Adjust compensation trimmer on probe for optimum square wave (minimum overshoot, rounding off, and tilt).

CALIBRATION CHECK

A general check of calibration accuracy may be made by displaying the output of the CAL 1 kHz 1 V p-p terminal on the screen. This test signal has been factory adjusted to provide a square wave of 1.0 volt peak-to-peak amplitude ($\pm 3\%$) and 1 millisecond time duration per cycle ($\pm 5\%$). However, a calibration signal of 0.5% accuracy is required for recalibration adjustment of the instrument.

At 20 mV/div (using 10:1 probes) this should produce five divisions of vertical deflection on channel A or channel B, or five divisions of horizontal deflection in X-Y operation when the VARIABLE controls are set to CAL.

With a .1 ms/div sweep time and VARIABLE set to CAL, one cycle of the waveform should occupy 10 divisions. At 1 ms/div sweep time, 10 cycles should span the 10 divisions, while 1 cycle should cover the 10 divisions using 10X magnification.

SERVICING

WARNING

1. The following instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the OPERATOR MAINTENANCE section unless you are qualified to do so.
2. High voltage up to 1000 volts dc is present on the CRT and high voltage power supply when the oscilloscope is operating. Always observe caution when the top cover or

bottom plate is removed from the unit. Contacting exposed high voltage could result in fatal electric shock.

REMOVING THE CASE

The case is removed in two sections as shown in Fig. 10. The top cover can be lifted off after removing six Phillips-head screws from the top and sides of the case. The bottom plate can be lifted off after removing eight Phillips-head screws from the bottom of the case.

SERVICING (CONT.)

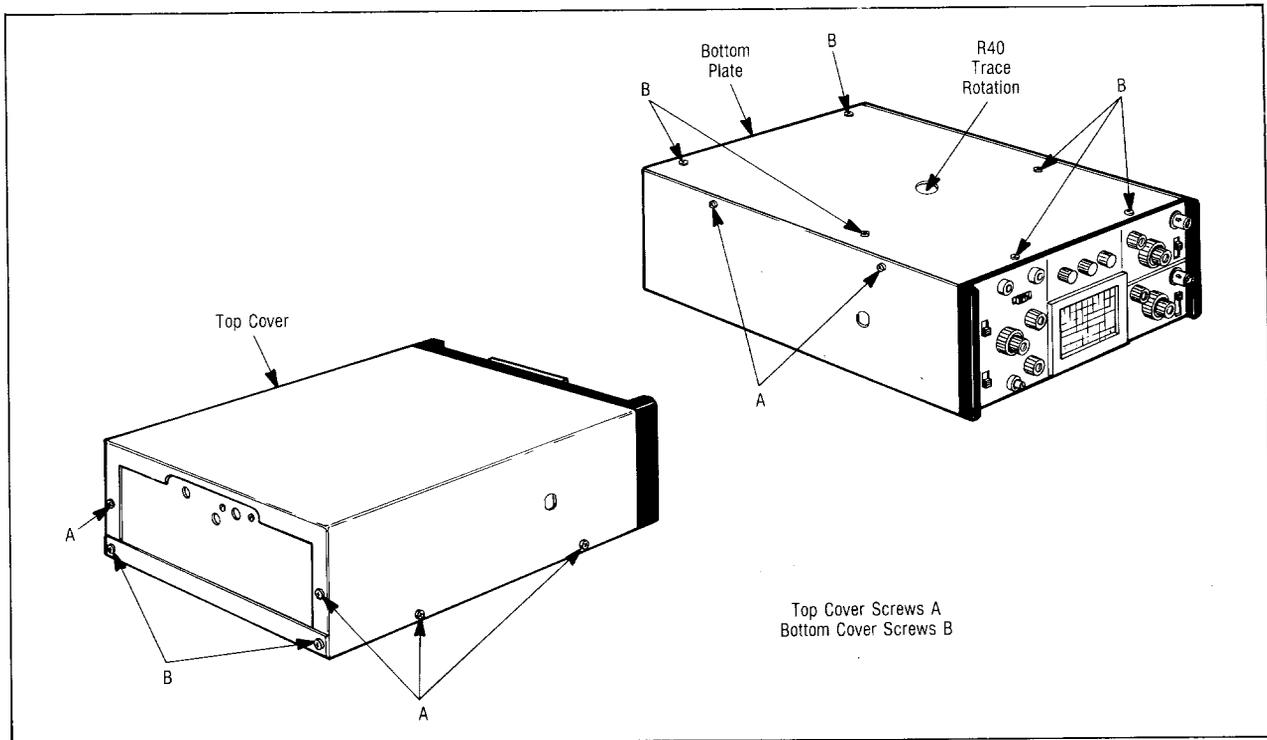


Figure 10. Removing the Case.

FUSE REPLACEMENT (Refer to Fig. 11)

Fuse F1 is in series with the ac input at P1 and dc input at P2. Fuse F2 is in series with the internal battery. If fuse F1 blows when operating on ac or dc, or fuse F2 blows when operating on the internal battery, the pilot light will go out and the oscilloscope will not operate. The fuses should not normally open unless a problem has developed in the unit. Try to determine and correct the cause of the blown fuse, then replace only with a fast blow fuse of the proper current rating and type; 2 amp, 7AG for both fuses. The fuses are located on the power supply circuit board. When operating on external ac or dc the F2 fuse can be used as a spare. When operating on internal battery the F1 fuse can be used as a spare.

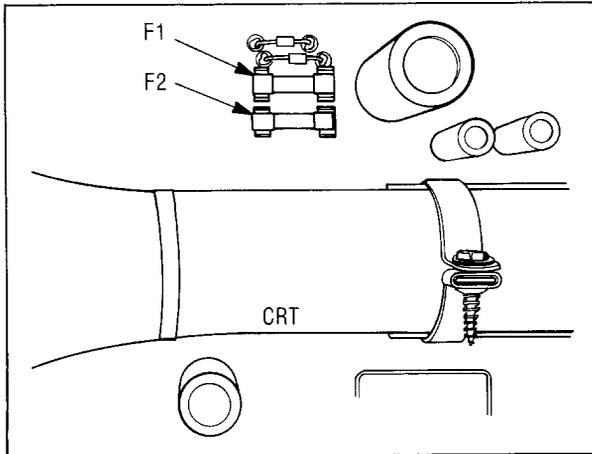


Figure 11. Fuse Locations.

1. Disconnect external power source from unit if used.
2. Remove six screws holding top cover and lift off cover.
3. Pull out the fuse from the fuse clip. The fuse fits very tightly into the clips, and it may be necessary to hold the circuit board in place while pulling.
4. Replace with a fuse of the correct voltage and current rating and type; 2 amp, 32 volt, 7 AG.

CALIBRATION ADJUSTMENTS

The following procedures include only those not requiring specialized skills and test equipment. Sweep time compensation, frequency compensation, and input capacity should be adjusted only by experienced, skilled personnel with the proper test equipment. Complete calibration procedures are available in the Model 1420 Service Manual.

Initial Preparation

All adjustment should be performed in the sequence listed in this manual. Touch-up adjustment of unrelated adjustments can be performed independently. All adjustments are affected by the 8 V reference; if 8 V is readjusted, complete calibration must be performed.

1. Disconnect any external power source.
2. Set INTENSITY to the full counterclockwise (OFF) position.
3. Remove top cover and bottom plate.
4. Place mini-scope bottom side up on workbench.

SERVICING (CONT.)

- Use an external ac or dc power source to assure accuracy and connect to appropriate rear panel connector.
- Set front panel controls to initial positions in following chart.

<u>SWITCH CONTROL</u>	<u>POSITION</u>
<u>SWEEP TIME/DIV</u>	1 mS
Sweep Time	CAL
VARIABLE	
◀POS▶/PUSH	Mechanical Center/released
10X MAG	
INTENSITY	3 o'clock
FOCUS	Optimum Focus
NORM/VIDEO	NORM
SLOPE	+
TRIG LEVEL/ PULL AUTO	Mechanical Center/pull out
SOURCE	INT
CH A POS	Mechanical Center
CH A AC-GND-DC	AC
CH A VOLTS/DIV	10 mV
CH A VARIABLE	CAL
CH B POS	Mechanical Center
CH B AC-GND-DC	AC
CH B VOLTS/DIV	10 mV
CH B VARIABLE	CAL

Table 1. Initial control settings for calibration adjustment.

Test Equipment Required

DC voltmeter: 1% or better accuracy, 1V to 100V, 10 M Ω input impedance. (B&K-Precision Model 2845 or equivalent).

High voltage multiplier probe: 100 M Ω input impedance or greater (B&K-Precision Model PR-28 or equivalent).

AC voltmeter: 0.5% or better accuracy at 200 Hz, 10 M Ω input impedance (B&K-Precision Model 2845 or equivalent).

Frequency counter: 0.5% or better accuracy, 10 Hz to 10 MHz (any B&K-Precision Frequency Counter).

Sine wave generator: 1% or less distortion at 200 Hz.

8V Adjustment

The 8 volt adjustment R27 is located on the power supply as shown in Fig. 12.

- Set voltmeter to measure dc.
- Connect voltmeter between 8 volt bus and ground.
- Set 8V adjust (R27) for a reading of 8.00 volts dc.

DC-DC Converter Frequency Adjustment

The dc-to-dc converter frequency adjustment (R11) is located on the power supply board as shown in Fig. 12.

- Connect frequency counter to IC3 pin 10.
- Adjust frequency adjust (R11) for a reading of 20.0 kHz.

High Voltage Adjust (R48)

The high voltage adjustment is located on power supply board Fig 12.

- Turn INTENSITY control to OFF position.

2. Set dc voltmeter with minimum 100 MΩ input impedance for 1000 volt range (with 1000:1 multiplier, use 1 volt range).
3. Connect (+) to CRT Cathode (pin 4) and (-) to chassis ground.
4. Turn INTENSITY control clockwise to turn on mini-scope.
5. Adjust H.V. Adjust (R48) for 1000 volts (1.000 volts with 1000:1 multiplier).

Charge Voltage Adjustment

The charge voltage adjustment R2 is located on the power supply board Fig. 12. This adjustment sets the maximum charge voltage for the rechargeable battery. This adjustment does not need to be performed on units not using the rechargeable battery pack.

1. Disconnect leads from terminals of rechargeable battery.
2. Connect a 1KΩ, ½ W resistor between the + and - leads disconnected in step 1.
3. Connect a dc voltmeter across the resistor.
4. Adjust Charge Voltage Adjust (R2) for a reading of 14.4 volts dc.

Astigmatism Range Adjust

The astigmatism range adjustment (R69) is located on the power supply board Fig. 12. This adjustment is set so that the front panel ASTIG control is approximately centered for proper astigmatism setting.

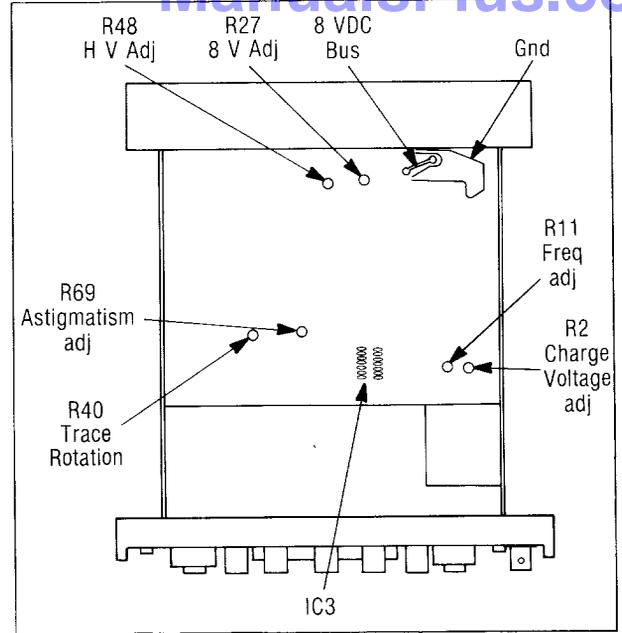


Figure 12. Calibration Adjustments, Bottom of Scope.

1. Set SWEEP TIME/DIV switch to CH B position and channel A and B AC-GND-DC switches to GND. This will produce a spot on the screen.

SERVICING (CONT.)

2. With INTENSITY control and front panel ASTIG control set about mid-range. Adjust FOCUS control and astigmatism range control (R69) for the sharpest, roundest spot. Leave front panel ASTIG control centered while performing this adjustment.

CAUTION

Never allow a small spot of high brilliance to remain stationary on the screen for more than a few second. The screen may be permanently burned.

DC Balance

The dc balance controls (R235 for channel A, R237 for channel B) are located on the vertical board, Fig. 13.

1. Set scope controls for a single horizontal trace on channel A with the channel A AC-GND-DC switch set to GND position.
2. Rotate the Channel A VARIABLE control from maximum clockwise to maximum counterclockwise, while observing the trace.
3. If the trace moves vertically, adjust R235 for minimum or zero movement when performing step 2.
4. Repeat the entire procedure for Channel B, adjusting R237.

Vertical Amplitude Adjustment

The vertical amplitude adjustments (R218 for channel A, R219 for channel B) are located on the vertical board, Fig. 13.

1. Set VOLTS/DIV for both channel A and B to 1V position.
2. Set VARIABLE Controls for both channel A and B fully clockwise to CAL.
3. Set AC-GND-DC Controls for both channel A and B to AC position.
4. Use a sine wave generator (1% or less distortion at 200 Hz) and connect directly to channel A input, without 10:1 attenuation probes.
5. Set \blacklozenge POS Control for channel B to OFF position.
6. Measure level of sine wave signal with an ac voltmeter. Meter must be accurate (0.5% at 200 Hz). Adjust signal generator for a 1.77V rms output.
7. Adjust R218 for a peak-to-peak output of exactly 5 divisions (5V p-p).
8. Rotate channel A \blacklozenge POS control counterclockwise to OFF and channel B POS control clockwise out of the OFF position.
9. Connect signal generator to channel B input.
10. Adjust R219 for a peak-to-peak output of exactly 5 divisions (5V p-p).

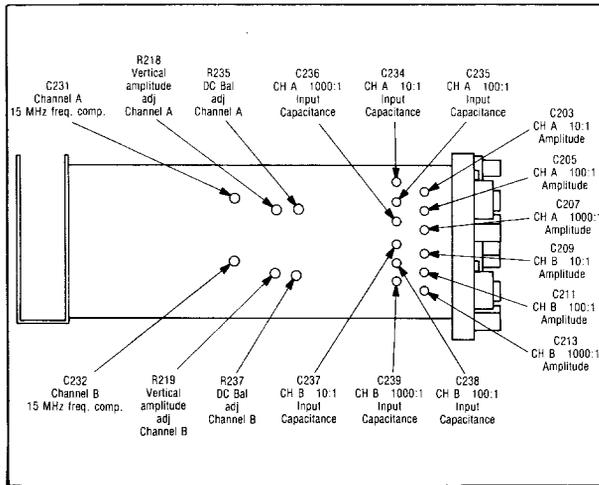


Figure 13. Calibration Adjustments, Left Side of Scope.

CAL Adjustment

The CAL adjustment (R163) is located on the horizontal board, Fig. 14.

1. Immediately after performing vertical amplifier calibration, connect the output of the CAL 1 KHz, 1V p-p terminal to the channel A input (probe set to DIRECT).
2. Using .2V/div sensitivity, adjust R163 for exactly 5 divisions amplitude on the CRT.

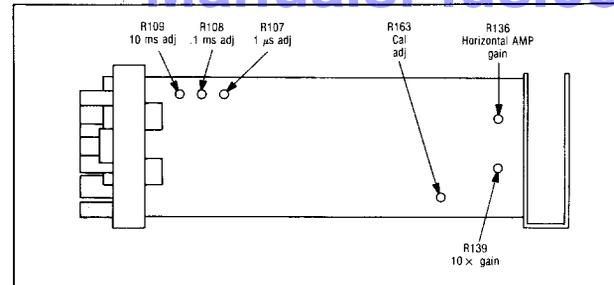


Figure 14. Calibration Adjustments, Right Side of Scope.

INSTRUMENT REPAIR SERVICE

Because of the specialized skills and test equipment required for instrument repair and calibration, many customers prefer to rely upon B & K-Precision for this service, if it is ever needed. We maintain a network of B & K-Precision authorized service agencies for this purpose. To use this service, even if the scope is no longer under warranty, follow the instruction given in the WARRANTY SERVICE INSTRUCTIONS portion of this manual. There is a nominal charge for instruments out of warranty.

ADDITIONAL SERVICING INFORMATION

A complete service manual for this scope will soon be available. Preparation was under way while this manual was being printed, and it is probably now available. Requests for the service manual should be sent to the B & K-Precision Service Department address listed in the WARRANTY SERVICE INSTRUCTIONS. Be sure to specify Model 1420.

APPENDIX

External Power Pack Considerations

The BP-14 Battery Pack gives at least one hour of continuous operation for the Model 1420 Mini-Scope. It also offers the convenience of being fully enclosed and carried inside the scope housing. Compactness and light weight are additional advantages. However, where longer battery operation may be required occasionally, some users prefer to also carry an external power pack. This usually consists of a moderate to heavy duty 12-volt rechargeable battery, such as a marine type, and an adapter cable for connecting the battery to the mini-scope. A carrying case or pouch may be added for convenience. The pilot light on the mini-scope still warns of low voltage conditions by flashing, just as when the BP-14 Battery Pack is used. The external power pack may be connected at the external dc jack on the rear panel of the scope. Several factors should be considered for selecting and using an external battery pack, including the following items.

1. To protect against spillage of battery acid, a dry type is recommended. Ni-cad or lead-acid gel-cell types are preferred.
2. For selecting a specific battery, the most important factor is the maximum number of hours of operation to be expected from a fully charged battery. For the greatest portability, compactness and weight are still important and excess battery capacity is to be avoided. Normally, recharging is possible at the end of each day. A battery giving 8 to 12 hours continuous operation should more than meet the most rigorous requirements. The required battery capacity can be readily calculated as follows:

The scope dissipates about 16 watts. Therefore, at 16 volts, current drain is 1 ampere. At 10 volts, current drain is 1.6 ampere. The average current drain on a 12-volt battery is about 1.3 ampere.

Multiply the maximum number of hours of operation expected times the average current drain of 1.3 amp to determine the required battery capacity. For example, 10 hours of operation times 1.3 amps equals 13 ampere-hours battery capacity. Check the battery derating specification at a current drain of greater than 1 amp; it may significantly affect the total hours of operation per charge.

3. If the internal battery is used until the pilot light flashes before connecting the external battery pack, some of the external battery power will be used to recharge the internal battery. If desired, the internal battery may be disconnected to prevent this drain on the external battery.
4. The external battery *will not* be automatically recharged if the mini-scope is connected to ac power. In fact, serious damage may result since there is only diode isolation between the ac input and external dc input jacks. *Never connect external dc power and ac power at the same time.*
5. Use an external battery charger for the external battery. Use the battery manufacturer's recommendation for selecting the battery charger. It will limit current and voltage to values that give the longest battery life, and with reasonable recharge time.
6. Do not attempt to wire the battery charger circuit of the 1420 to recharge the external battery. This charger is designed for the BP-14 Battery Pack and does not have adequate capacity for a larger external battery pack.