Ballantine

MODEL 6127B PROGRAMMABLE OSCILLOSCOPE CALIBRATOR VOL. 1

INSTRUCTION MANUAL

MODEL 6127B PROGRAMMABLE OSCILLOSCOPE CALIBRATOR VOL. 1

Applicable To Units With
Serial No. Prefix 100— and Below

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90-10310-5B

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WARRANTY

This Ballantine Laboratories, Inc. product is warranted against defects in materials and workmanship for a period of one year from the date of shipment, except for batteries, electron tubes, vacuum thermal elements, and certain other components, if any, listed in this manual. Ballantine Laboratories, Inc. will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Ballantine Laboratories, Inc. prepaid, and provided the proper preventive maintenance and calibration procedures as listed in this manual have been followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BALLANTINE LABORATORIES, INC. IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

CERTIFICATION

Ballantine Laboratories, Inc. certifies that this equipment meets all applicable Ballantine specifications at time of shipment from the factory as determined by thorough testing and inspection. Ballantine further certifies that its measurements are traceable to the United States National Bureau of Standards. All instruments used in calibrating Ballantine products are standardized by systematic reference to NBS-traceable standards as described in the validation procedures shown below.

REFERENCE STANDARDS

DC	10mV-750V	0.002-0.003%
20Hz-50kHz	0.5V-500V	0.004%
20Hz-10MHz	0.5V-100V	0.05%
DC-30MHz	0.5V-100V	0.35%
DC-700MHz	10uV-0.5V	1%-NBS
10MHz-1000MHz	1V-300V	1%-NBS

WORKING STANDARDS

THERMAL VOLTAGE CONVERTERS, BALLANTINE 1397A
TRANSFER STANDARD, BALLANTINE 1605A
MICROPOTENTIOMETERS, BALLANTINE 440
RATIO TRANSFORMERS, GERTSCH

Ballantine's Quality Assurance program satisfied the requirements of MIL-I-45208

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NOTE

The following sections and information are contained in Volume 2 of this Manual.

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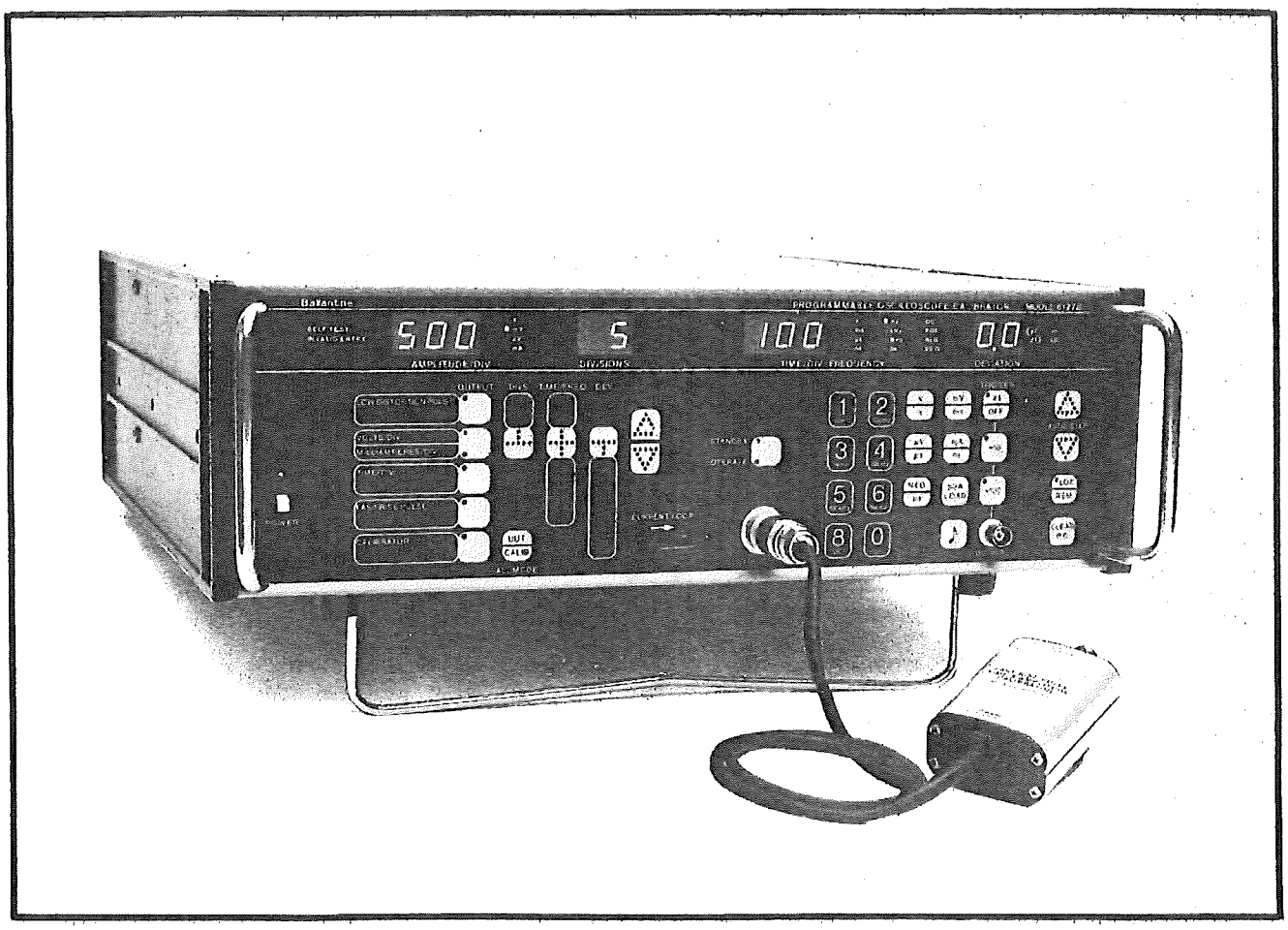


Figure 1-1. Model 6127B Programmable Oscilloscope Calibrator

SECTION 1

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. The Ballantine Model 6127B Programmable Oscilloscope Calibrator is a compact Test Set intended for calibration and maintenance of oscilloscopes. It may be operated in both Manual mode (Local) or Programmable mode (Remote) being compatible with IEEE 488 Standard bus. The 6127B embodies the concept of a Modularly Equipped and Configured Calibrator/Analyzer (MECCA) and features a Touch-plate front panel. The Oscilloscope Calibrator provides the following functions:

Standard Amplitude - VOLTS/DIV

± dc and square wave 40uV to 220 volts.

Used for calibrating amplifier gain and compensating attenuators.

Standard Time - TIME/DIV

0.5 ns to 5 sec.

Used for calibrating the time base of oscilloscopes.

Standard Current - Milliamperes/DIV

1 mA to 100 mA, dc and square wave.

Used for calibrating current probes.

Low Distortion Pulse

20 mV to 1 V peak-to-peak, terminated in 50Ω.

1.2 V to 100 V peak-to-peak, unterminated into ≥ 1 MΩ.

Used for compensating oscilloscope input attenuators and checking the step response of amplifiers.

Fast Risetime Pulse

≤200 psec risetime.

Used for calibrating the step response of fast oscilloscope amplifiers.

Standard Calibrator

Calibrates internal calibrator signal of oscilloscope under test.

1-3. INSTRUMENT AND MANUAL IDENTIFICATION

1-4. The 6127B Instruction Manual contains information fully defining operation, theory, troubleshooting, maintenance and calibration. Complete schematics, replaceable parts lists and location of components are included in this manual.

1-5. The Ballantine Model 6127B has a serial number nameplate on the rear panel. The first three digits of the serial number identify the configuration. Any change affecting configuration will result in a change in the configuration code listed on the serial number plate and the front page of this manual. Addendum sheets supplied with the manual will identify the changes.

1-6. SPECIFICATIONS

1-7. Table 1-1 lists the specifications for the Model 6127B.

TABLE 1-1. PERFORMANCE SPECIFICATIONS

VOLTS/DIV MODE

Used for calibration of vertical display accuracy and attenuator compensation.

HIGH IMPEDANCE OUTPUT (into 1 Megohm):

Range: 40 uV to 200 Volts in 1, 2, 5 steps with multiplier

LOW IMPEDANCE OUTPUT (into 50 Ohms):

Range: 40 uV to 5 Volts in 1, 2, 5 steps with multiplier

MULTIPLIER:

1, 2, 3, 4, 5, 6, 8, 10 divisions.

AMPLITUDE ACCURACY:

± 0.25% of reading ± 1 uV.

VARIABLE AMPLITUDE DEVIATION:

Variable range of ± 9.9%.
Digital deviation meter provides resolution of 0.1%.

WAVEFORMS:

Selectable outputs for all output levels.
Square wave of 10 Hz, 100 Hz, 1 kHz, and 10 kHz.
DC positive polarity.
DC negative polarity.

TRIGGER OUTPUT:

Slaved to select frequency.
Modes: OFF, X1, ÷ 10, ÷ 100.
Amplitude: ≥ 1 Volt into 50 Ohms.

TIME/DIV MODE

Real Time Markers for calibration of oscilloscope timebase accuracies and checking high frequency triggering.

OUTPUT MARKERS:

500 picoseconds to 5 sec in 1, 2, 5 sequence

MARKER AMPLITUDE:

≥ 1 Volt peak into 50 Ohms. 2 ns to 5 sec.
> 350 mV peak-to-peak at 1 ns (1 GHz).*
> 100 mV peak-to-peak at 500 ps (2 GHz).*

ACCURACY:

± 0.005% of reading ± 10 psec (2 ns to 5 sec).
± 0.005% of reading ± 20 psec (0.5 ns and 1 ns).

TRIGGER OUTPUT:

Slaved to marker outputs from 100 ns to 5 sec and fixed at 100 ns for faster markers.
Modes: OFF, X1, ÷ 10, ÷ 100.
Amplitude: ≥ 1 Volt into 50 Ohms.

VARIABLE TIME DEVIATION:

Variable deviation range of ± 9.9% for marker and trigger period.
Digital deviation meter provides resolution of 0.1%.

*Requires use of Model 61274A optional Direct Output Cable.

TABLE 1-1. PERFORMANCE SPECIFICATIONS - Cont'd.

TIMING REFERENCE

INTERNAL TIME BASE:

An internal temperature compensated 10 MHz crystal oscillator provides accuracy of ± 0.002% and long term stability to better than 1 part in 10^{-5} per month after 72 hours and temperature stability of better than 1 part in 10^{-5} from + 4°C to + 40°C after a one hour warmup.

EXTERNAL TIMING REFERENCE:

Input:	10 MHz to ± 0.002%
Input Amplitude:	1 V to 3 V rms
Source Impedance:	50 Ohms

MILLIAMPERES/DIVISION (Current Amplitude Mode)

Used to test current probe accuracy through front panel current loop.

CURRENT RANGES:

1 mA to 100 mA in 1, 2, 5 steps with multiplier.

MULTIPLIER:

1, 2, 3, 4, 5, 6, 8, 10 divisions.

ACCURACY:

± 0.25% of reading ± 2 uA.

FREQUENCY:

± DC; Squarewave to 10 Hz, 100 Hz, 1 kHz, and 10 kHz.

TRIGGER OUTPUT:

Slaved to selected frequency.
Modes: OFF, X1, ÷ 10, ÷ 100.
Amplitude: ≥ 1 Volt into 50 Ohms.

CALIBRATOR MODE

For use with 61272C Amplitude Comparator Head to test accuracy of oscilloscope's internal calibrator signal.

AMPLITUDE RANGE:

High Impedance: ± 40 uV to ± 200 V in 1, 2, 5 sequence.
Low Impedance: (50 Ohm): ± 40 uV to ± 5 V in 1, 2, 5 sequence.

ACCURACY (Amplitude):

± 0.25% of reading ± 1 uV.

ACCURACY OF 50Ω IMPEDANCE:

± 1%

FREQUENCY OF UUT CALIBRATOR WAVEFORM:

DC to >2 MHz

FREQUENCY OF CALIBRATION WAVEFORM:

1 kHz squarewave

TRIGGER OUTPUT:

Slaved to 1 kHz frequency.
Modes: OFF, X1, ÷ 10, ÷ 100.
Amplitude: ≥ 1 Volt into 50 Ohms.

COMPARISON MODE:

Compares output of VOLTS/DIV generator and calibrator of scope under test.
Comparison is switched automatically at 100 Hz or alternate on command.

TABLE 1-1. PERFORMANCE SPECIFICATIONS - Cont'd.

LOW DISTORTION PULSE MODE

Used to test oscilloscope attenuator compensation and input amplifier response.

LOW EDGE (Amplitude Mode)

RANGE:

20 mV to 1 V peak-to-peak in 1, 2, 5 steps.

MULTIPLIER:

1, 2, 3, 4, 5, 6, 8, 10 divisions.

RISETIME:

≤ 1.3 ns from 100 mV to 1 V into 50 Ohms.
≤ 1.6 ns at 20 mV and 50 mV into 50 Ohms.

POLARITY:

Positive transition from negative voltage to ground.

OUTPUT IMPEDANCE:

50 Ohms ± 1%.

WAVESHAPE:

Squarewave with 50% duty cycle.

ABERRATIONS:

± 2% of squarewave amplitude after first 1.5 ns.

LONG TERM FLATNESS:

Droop and Tilt within ± 1%.

FREQUENCY:

10 Hz to 1 MHz to 6 decade steps.

TRIGGER OUTPUT:

Slaved to frequency selected.
Modes: OFF, X1, ÷ 10, ÷ 100.
Amplitude: ≥ 1 V into 50 Ohms

HIGH EDGE (Amplitude Mode)

RANGE:

1.2 V to 100 V peak-to-peak in 1, 2, 5 steps.

MULTIPLIER:

1, 2, 3, 4, 5, 6, 8, 10 divisions.

RISETIME:

< 100 ns.

LOAD RESISTANCE:

≥ 1 Megohm load shunted by less than 18 pF.

POLARITY:

Positive transition from negative voltage to ground.

WAVESHAPE:

Squarewave with 50% duty cycle. Leading edge aberrations within 2% of peak-to-peak amplitude.

LOW DISTORTION PULSE MODE - Cont'd.

ABERRATIONS:

± 2% of squarewave amplitude.

LONG TERM FLATNESS:

Droop and tilt within ± 0.5% after first 500 ns.

FREQUENCY:

10 Hz to 100 kHz in 5 decade steps.

TRIGGER OUTPUT:

Slaved to frequency selected.
Modes: OFF, X1, ÷ 10, ÷ 100.
Amplitude: ≥ 1 Volt into 50 Ohms.

FAST RISE PULSE

The Fast Rise Pulse Head provides a fast rise, low distortion pulse used for testing high bandwidth vertical amplifiers.

AMPLITUDE:

1.1 V peak-to-peak, ± 5% into 50 Ohms.

ADJUSTABLE AMPLITUDE RANGE:

± 10%

RISETIME:

≤ 200 ps into 50 Ohms.

WAVESHAPE:

Output is positive squarewave with 50% duty cycle. Leading edge aberrations are less than ± 3% of amplitude not exceeding 4% peak-to-peak.

FREQUENCY:

10 Hz to 1 MHz in 6 decade steps.

TRIGGER OUTPUT:

Slaved to frequency selected.
Modes: OFF, X1, ÷ 10, ÷ 100 (X1 with Option 81).
Amplitude: ≥ 1 Volt into 50 Ohms.

GENERAL SPECIFICATIONS

OPERATION:

Remote with full compatibility to IEEE-488-1978 Interface Bus. Local operation through touch key panel. Audio tone annunciator provides local command response.

LEARN MODE:

Allows the user to set functions and ranges using the 6127B manual front controls and have these entries automatically transferred to the controller for use in creating a test program.

AUTO STEP:

Two front panel key pads increment or decrement range settings in 1, 2, 5 sequence. Permits single touch change of calibrator output for VOLTS/DIV, TIME/DIV, MILLIAMPERES/DIV, and Low Distortion Pulse amplitude to speed calibration of scopes when 6127B is used in manual mode.

TABLE 1-1. PERFORMANCE SPECIFICATIONS - Cont'd.

BUILT-IN SELF TEST:

Calibration includes full self test capability for all digital command and latch circuits, keyboard touch switches, displays and indicators, analog controls of master clock, VCO and deviation. Internal voltmeter may be used to measure deviation limits for calibration and performance verification. Current Mode performance may be verified at the output BNC of the 61272C Pulse Head.

BUS ADDRESS:

Selected by switch accessible on rear panel. Address setting may be displayed after built-in self test cycle when CLEAR is depressed.

AUTOMATIC TERMINATION:

The calibrator automatically inserts a 50 Ohm terminating resistor whenever a 50 Ohm termination is required in the LOW DISTORTION PULSE, TIME/DIV, and CALIBRATOR Modes. The 6127B may be instructed that its external load is 50 OHms and the internal termination will be automatically disconnected. Automatic termination reduces operator interaction and conveniently speeds the calibration of oscilloscopes.

AC MAINS VOLTAGE:

100/120/220/240 V ac, ± 10%, 50 to 400 Hz, single phase sinusoidal, one lead at ground potential.

POWER:

Approximately 80 watts.

WEIGHT:

15.2 Kg (33.5 lbs.) with covers, accessories, and 61271C and 61272C.

SHIPPING WEIGHT:

17.7 Kg (39 lbs.)

HEIGHT:

133 mm (5.22 inches)

WIDTH:

Bench Mount:	425 mm (16.75 inches)
Rack Mount:	482 mm (19 inches)

DEPTH:

Overall (Unit only)	484 mm (19.05 inches)
Overall with covers	506 mm (19.95 inches)
Behind Panel	438 mm (17.25 inches)

ENVIRONMENTAL

Meets or exceeds MIL-T-28800C, TYpe III, Class 5 requirements, including Reliability and Maintainability.

Temperature	-	Operating:	0 to 50°C
	-	Storage:	-55°C to +75°C
Humidity	-	Operating:	0 to 95% R.H. to +40°C non-condensing
	-	Storage:	0 to 95% R.H. to +50°C for 5 days (non-condensing)
Altitude	-	Operating:	3 km (10,000 feet)
	-	Storage:	15 km (50,000 feet)
Vibration	-	Operating:	0.015 inch p-p, 10 Hz to 55 Hz, one hour and 15 minutes total in three planes
Shock	-	Non-operating:	30 G, 1/2 sine, 11 ms duration. 3 shocks in each direction along the 3 major axes for total of 18 shocks.
Bench Handling	-	Operating:	4 inch drop
EMI	-	Per MIL-STD-461 procedures CE-03, CS-01, CS-02, CS-06, RE-2, RE-03 (limits reduced 15 dB above 20 MHz) and RS-03.	

1-8. SUPPLIED ACCESSORIES

1-9. Model 61271C

Model 61271C Fast Rise Pulse Head Accessory is supplied with the Model 6127B. It connects to the main output connector and is required for:

VOLTS/DIV, TIME/DIV, FAST RISE PULSE, LOW DISTORTION PULSE operation.

1-10. Model 61272C

Model 61272C Amplitude Comparator Accessory Head is supplied with the Model 6127B. It connects to the main output connector and is required for CALIBRATOR mode operation.

1-11. AVAILABLE ACCESSORIES

1-12. Optional accessories available for use with the Model 6127B are listed in Table 1-2.

TABLE 1-2. AVAILABLE ACCESSORIES

MODEL	DESCRIPTION
10650A	Input Capacitance Standardizer
12249D	Cable, 50 ohm, 48 inches, BNC/BNC
12630A	50 ohm Termination, BNC/BNC
	Spare Parts Module Kit for 6127A and 61271A
	Spare Parts Module Kit for 6127B and 61271C
61274A	Cable, Direct Output; 40 inches to BNC.
89-10753-1	Rack Mount Adapter Kit with 2 brackets and slides (Option 15)

1-13. AVAILABLE OPTIONS

1-14. 6127B-Opt.15 Rack Mount. This unit is supplied ready for 19 inch rack mount installation with rack mount bracket and rack slides. Front and rear covers are not supplied with Option 15.

SECTION 2

PREPARATION FOR USE AND SHIPMENT

2-1. GENERAL

2-2. This section contains information and instructions necessary for the installation and reshipment of the Model 6127B Oscilloscope Calibrator. Details are provided for initial inspection, performance checks, power connections, grounding safety requirements, installation information and repacking instructions for storage or shipment.

2-3. UNPACKING AND INITIAL INSPECTION

2-4. Unpacking and initial inspection of the calibrator require only the normal precautions and procedures applicable to the handling of sensitive electronic equipment. The contents of all shipping containers should be checked for included accessories and certified against the packing slip to ascertain that the shipment is complete.

2-5. PERFORMANCE CHECKS

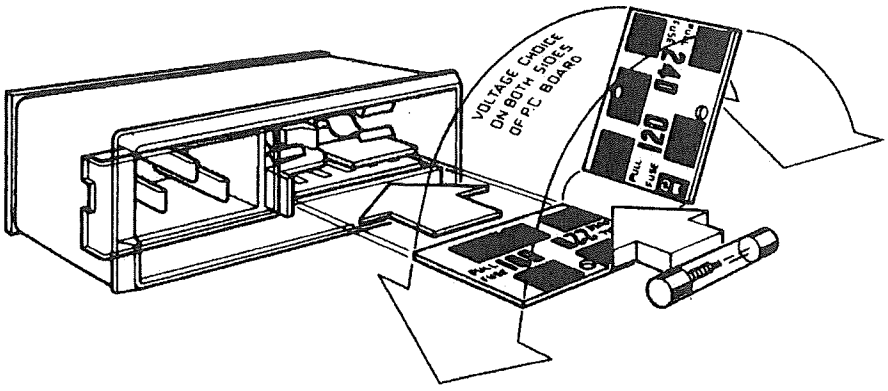
2-6. This instrument was carefully inspected for mechanical and electrical performance before shipment from the factory. It should be free of physical defects and in acceptable operating condition upon receipt. Check the instrument for possible damage incurred while in transit. Complete the performance checks beginning with paragraph 5-3. If there is any indication of damage or improper operation, refer to the warranty included in this manual and notify Ballantine or your local Ballantine field representative.

2-7. POWER REQUIREMENTS

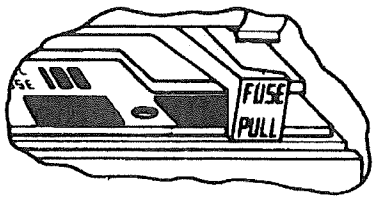
2-8. The instrument may be operated from an ac voltage source rated at 100, 120, 220 or 240 volts rms at 50 to 400 Hz. The orientation of the printed circuit board in the ac power connector on the rear panel of the instrument matches the instrument to the ac voltage source. See Figure 2-1.

CAUTION

Failure to orient the printed circuit board properly will damage the instrument and void the warranty.



Operating voltage is shown in module window.



SELECTION OF OPERATING VOLTAGE

1. Open cover door and rotate fuse-pull to left.
2. Select operating voltage by orienting PC board to position desired voltage on top-left side. Push board firmly into module slot.
3. Rotate fuse-pull back into normal position and re-insert fuse in holders, using caution to select correct fuse value.

Figure 2-1. Voltage Selection and Fused Receptacle

2-9. The instrument should be operated from a power source with its neutral at or near ground (earth) potential. The instrument is not intended for operation from two phases of a multiphase ac system or across the legs of a single-phase, three-wire ac power system. Crest factor (ratio of peak voltage to rms) should be typically within the range of 1.3 to 1.6 at ±10% of the nominal line voltage. Use a true rms responding voltmeter, such as the Ballantine Model 3620A, to measure the power line voltage.

2-10. GROUNDING REQUIREMENTS

2-11. To insure the safety of operating personnel, the U.S. Occupational Safety and Health Act (OSHA) and good engineering practice require that the instrument enclosure be "earth" grounded. All Ballantine instruments are provided with a three-conductor power cable assembly which, when plugged into an appropriate power receptacle, grounds the instrument. The offset pin on the male end of the power cable is the ground wire connection to the connector on the rear panel of the instrument. The Model 6127B is supplied with a shielded power mains cable. Always use this cable to minimize the radiated EMI.

2-12. To preserve the safety protection feature when operating the instrument from a two-contact power outlet, use a three-prong to two-prong adapter and connect the green lead or terminal on the adapter to "earth" ground.

NOTE

In addition to the two methods of grounding stated, the instrument also incorporates a case ground lug on the rear panel.

2-13. INSTALLATION AND MOUNTING

2-14. GENERAL. The calibrator is fully solid state and dissipates minimal heat. No special cooling is required; however, the instrument should not be operated where the ambient temperature exceeds 50°C (122°F) or when condensation due to high humidity appears anywhere on the instrument.

2-15. PORTABLE. The calibrator is shipped with rubber bumper-feet and metal tilt-stand in place, ready for use as a bench instrument. Outline dimensions are shown in Figure 2-2. The instrument is supplied with a side mounted carry handle.

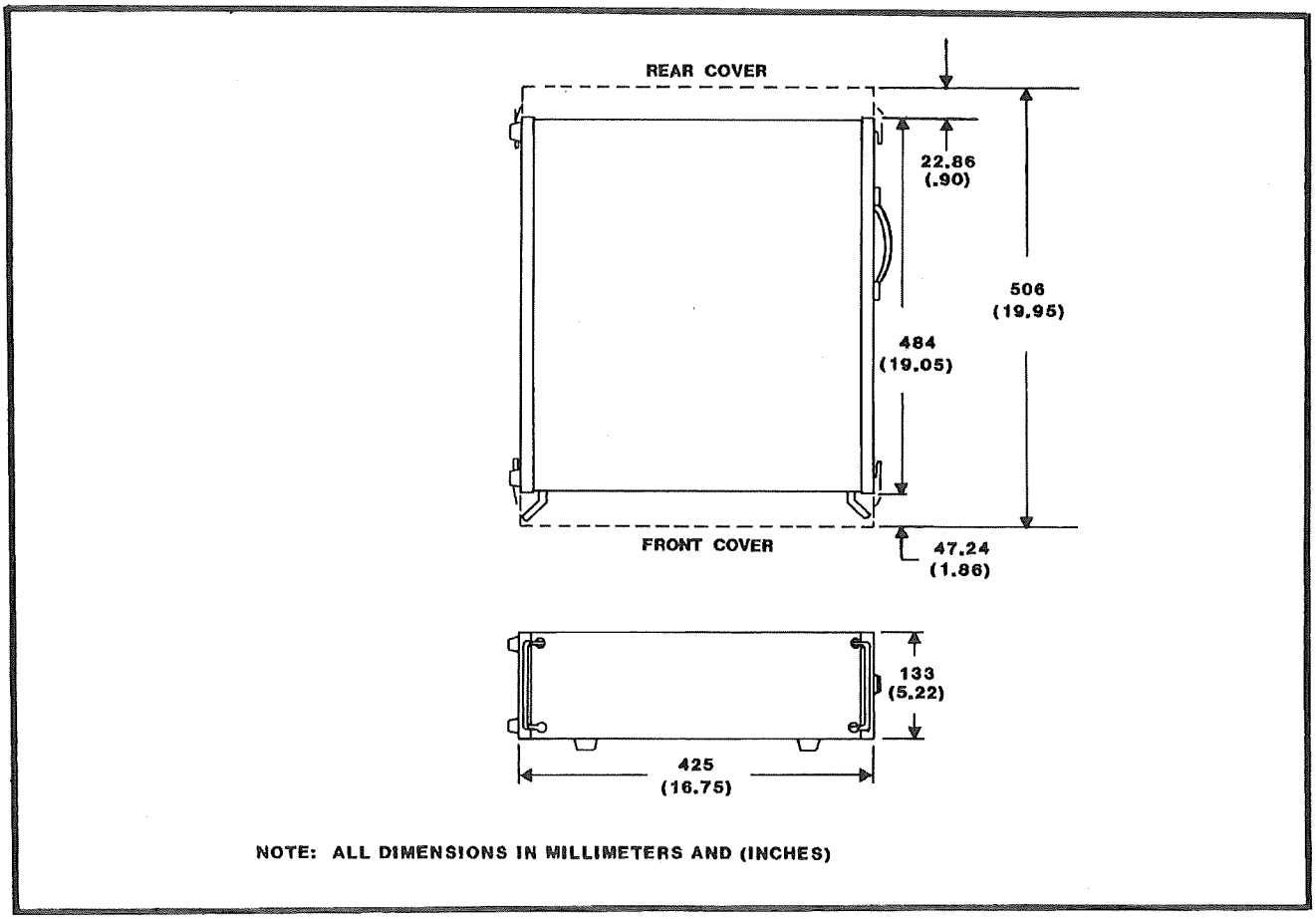


Figure 2-2. Portable Outline Dimensions

2-16. RACK MOUNTING. The calibrator is readily adapted for installation in a standard 19-inch wide equipment rack by use of the rack mount kit (P/N: 89-10753-1). Outline dimensions are shown in figure 2-3.

CAUTION

When rack mounting the instrument, always assure sufficient clearance for ventilation to avoid overheating. When adjacent unit temperatures exceed 35°C, forced air fan ventilation of the rack is recommended. Do not mount the 6127B near instruments which have large external magnetic fields or other electromagnetic emissions.

2-17. The following instructions detail the procedure for installing the Model 6127B in a rack mount configuration using the rack mount kit (P/N: 89-10753-1).

a. Remove the Calibrator bottom dust cover as detailed in paragraph 5-19.

b. Remove the two rear feet from the dust cover.

c. Remove the two front feet and tilt bail stand from the dust cover.

d. Re-assemble the bottom dust cover to the Calibrator.

e. Unfasten the screws securing the front cover clip and feet (2) to the right side casting. Remove both the clip and feet and then re-install the screws.

f. Unfasten the screws securing the rear cover clip and feet (2) to the right side casting. Remove both the clip and feet and then re-install the screws.

g. Remove the two No. 8 screws located on the right side casting near the front of the Calibrator. These empty threaded holes will be used in step (h).

h. Mount one of the angle brackets to the right front side of the Calibrator by fastening it with the new No. 8 screws supplied with the kit.

i. Unfasten the screws securing the front cover clip to the left side casting. Remove the clip and then re-install the screws.

j. Unfasten the screws securing the rear cover clip to the left side casting. Remove the clip and then re-install the screws.

k. Unfasten the screws securing the handle to the left side casting and remove the handle. Do not re-install these screws.

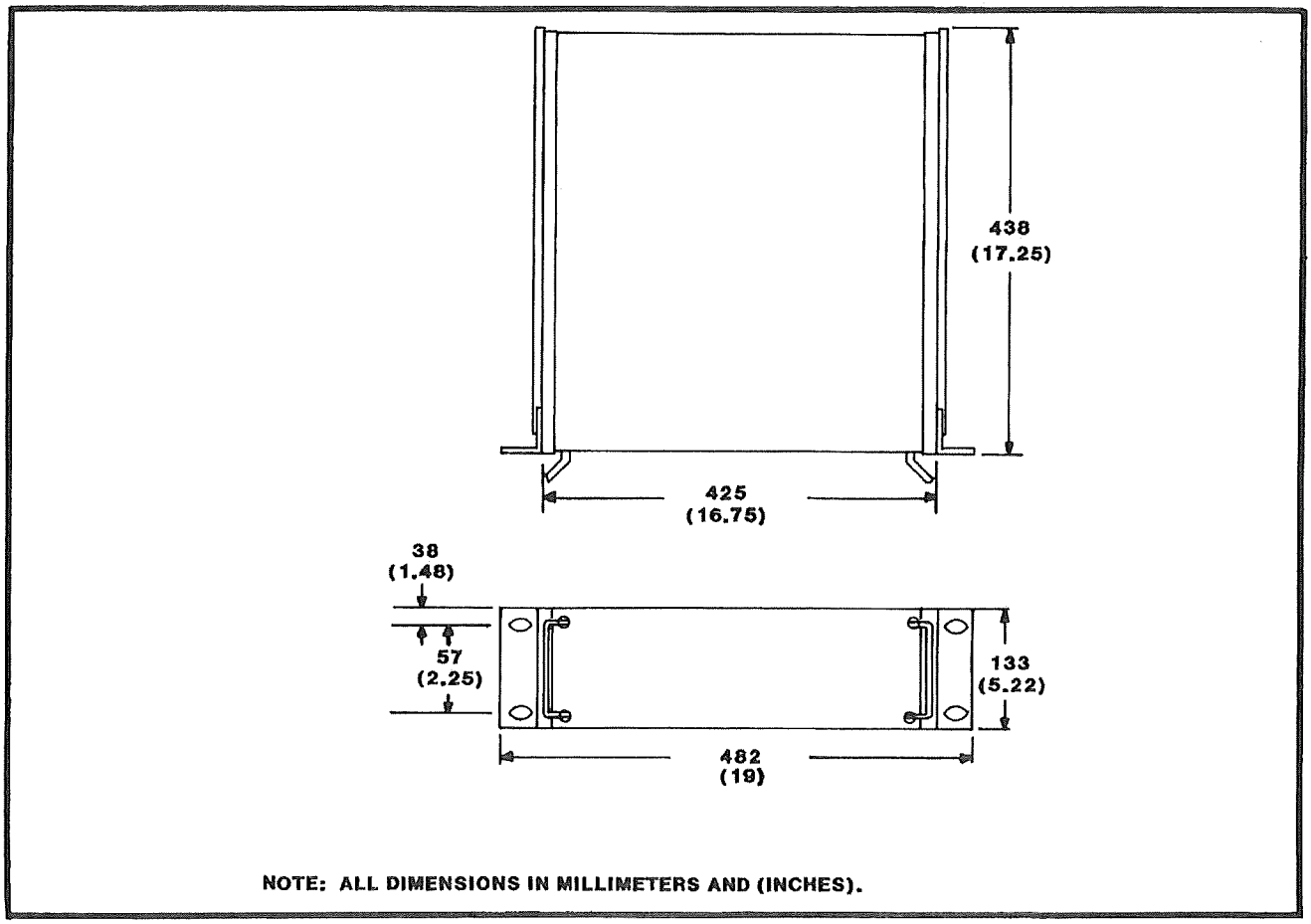


Figure 2-3. Rack Mount Outline Dimensions

l. Remove the two No. 8 screws located on the left side casting near the front of the Calibrator.

m. Attach the other angle bracket to the left front side of the Calibrator by securing it with the new No. 8 screws supplied with the kit.

n. To attach the right chassis-slide assembly, first unlatch and separate the inner slide from the two outer slide sections.

o. Orient the inner slide so that the scalloped corner faces the upper front corner of the Calibrator right side.

p. Fasten this inner slide to the right side of the Calibrator with the three No. 8 screws supplied. (There are three threaded holes provided on the right side of the Model 6127B.)

q. Install the outer right slide assembly inside the right wall of the equipment rack frame.

r. To attach the left chassis-slide assembly repeat steps (n) through (q) except orient the scalloped corner of the inner left slide so that it faces the upper front corner of the Calibrator left side.

s. Install the outer left slide assembly inside the left wall of the equipment rack frame.

t. Position the instrument in the equipment rack and attach in place. It will be necessary to trip the latches on both the right and left Calibrator slide members to permit inserting the instrument completely into the equipment rack.

2-18. SHORT TERM STORAGE

2-19. If the instrument is to be stored for a short period of time (less than three months), place cardboard over the panel and cover the instrument with a suitable protective covering, such as a plastic bag or strong, kraft paper. Place power cable and other accessories with the instrument. Store the covered instrument in a clean, dry area that is not subject to extreme temperature variations or conditions which may cause moisture to condense on the instrument.

2-20. LONG TERM STORAGE OR REPACKAGING FOR SHIPMENT

2-21. If the instrument is to be stored for a period longer than three months, or if it is to be repackaged for shipment, as a general guide, repackage the instrument as described in the following procedure and shown in figure 2-4. Use either the original packing material, if available, or material similar to that specified. Proceed as follows:

a. Store the ac power cord in the rear cover and store the Model 61271C and 61272C Heads in the recesses provided for them in this front cover.

b. For long distance shipping only, use U.S. Government packaging method IIC and tape a two-unit bag of dissicant (MIL-D-3464) on the rear cover.

c. Enclose the instrument in a plastic bag and seal the bag.

d. Wrap the bagged instrument in a 1-inch thick, flexible, cellular plastic-film, cushioning material (PPP-B-795) and place in a barrier bag (MIL-B-131). Extract the air from the bag and then heat seal the bag.

e. Place the wrapped instrument into a fiberboard box (PPP-B-636) of a suitable size. Fill spaces with rubberized hair or cellular plastic cushioning material. Close the box in accordance with container specifications. Seal with sturdy, water-resistant tape or with metal straps.

f. Mark container "FRAGILE," "HANDLE WITH CARE" or similar precautionary notice. Affix shipping labels as required or mark in accordance with MIL-STD-129.

NOTE

If the instrument is to be returned to Ballantine Laboratories, Inc. for calibration or repair; attach a tag to the instrument identifying the problem, symptoms and service or repair desired. List the model and serial number of the instrument. Ship the instrument prepaid to Ballantine Laboratories, Inc., 90 Fanny Road, Boonton, NJ 07005, U.S.A. In any correspondence, identify the instrument by model number, serial number, work authorization order; and date and method of shipment.

2-22. SAFETY

2-23. Table 2-1 and 2-2 delineate the safety aspects of this instrument.

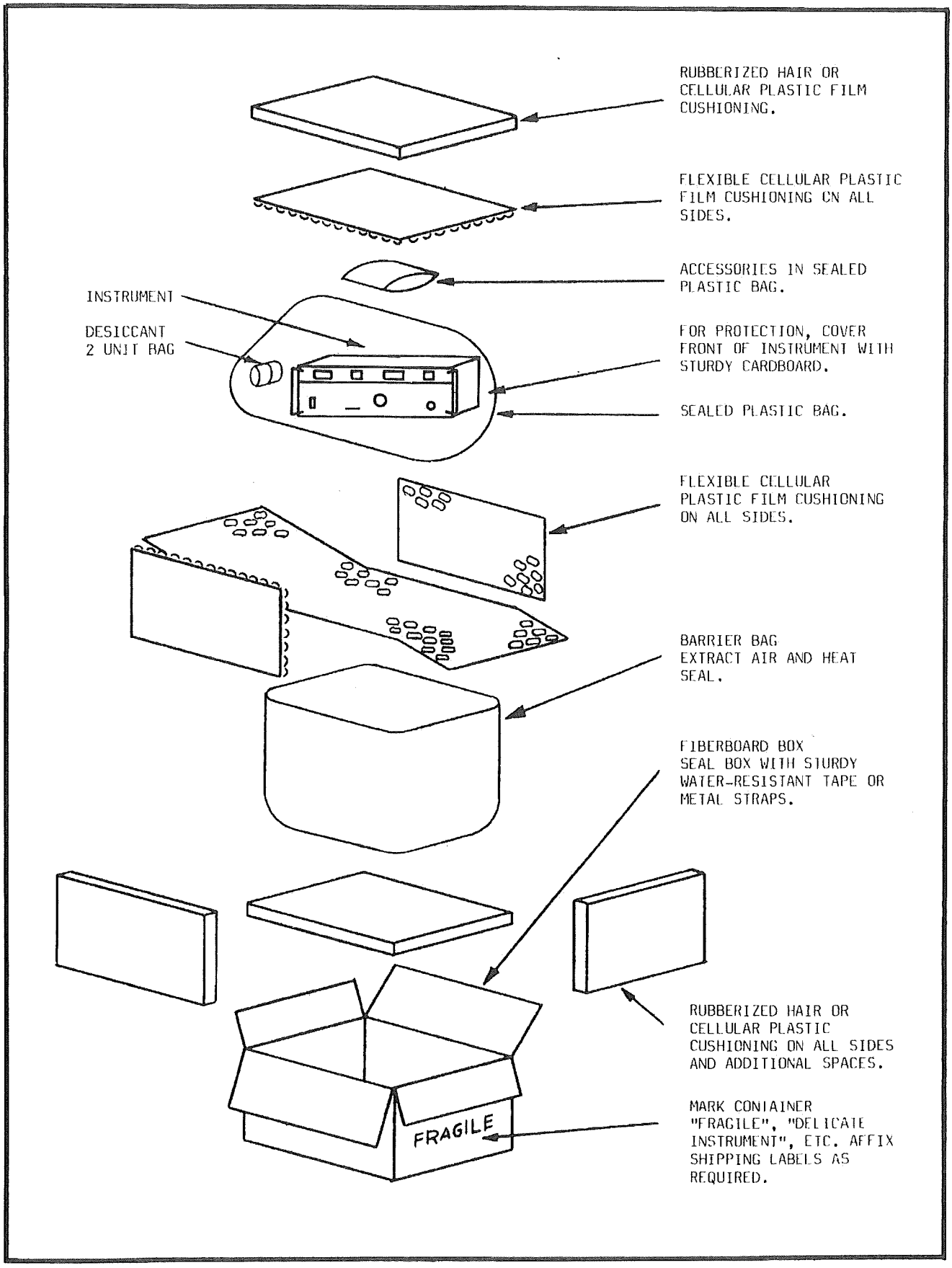


Figure 2-4. Model 6127B Packing Diagram

TABLE 2-1. SAFETY CONSIDERATIONS

SAFETY CONSIDERATIONS

GENERAL

This is a Safety Class I instrument. This instrument has been designed considering IEC Publication 348 and ANSCI C39.5, "Safety Requirements for Electronic Measuring Apparatus".

This manual contains information, cautions, and warnings which must be followed by the service person to ensure safe operation and to retain the instrument in safe condition.

WARNINGS

SAFETY

If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THIS INSTRUMENT, the protective earth terminals of this instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding).

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

GROUNDING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal is likely to make this instrument dangerous. Intentional interruption is prohibited.

HIGH VOLTAGE

Warning – These servicing instructions are for use by qualified personnel only. To avoid dangerous electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

CAUTIONS

LINE VOLTAGE SELECTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the instrument is set to the voltage of the power source. Verify that the power transformer primary is matched to the available line voltage. Verify that the correct fuse is installed.

GROUNDING

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that all devices connected to this instrument are connected to the protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

ATTENTION

This symbol:  , which appears on the instrument means: Read the instruction manual before operating the instrument. If the instrument is operated without reading the instructions, it may not operate correctly.

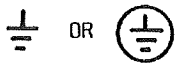
TABLE 2-2

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals

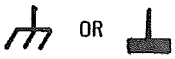
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating instrument.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE

The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

SECTION 3

OPERATION

3-1. INTRODUCTION

3-2. This section contains instructions and information required for the operation of the Model 6127B Programmable Oscilloscope Calibrator. Included are identification of controls, connectors and indicators as well as remote programming information.

3-3. POWER REQUIREMENTS

3-4. See paragraphs 2-7 through 2-9. For grounding and safety earth connections, see paragraphs 2-10 through 2-12. Always check rear panel voltage selector card in the power receptacle.

CAUTION

Failure to apply the correct ac mains power voltage will cause serious damage to the instrument and will void the warranty.

3-5. OPERATING INSTRUCTIONS (LOCAL MODE)

3-6. In the LOC (Local) mode, the Model 6127B is operated manually by touching the appropriate "Touch-plate" controls on the front panel. The respective annunciator lamps illuminate for each touch-plate command.

3-7. Refer to Figure 3-1 and Table 3-1 for identification and explanation of the Model 6127B front panel controls, indicators and connectors. See Figure 3-2 and Table 3-2 for identification and explanation of the Model 61271C connectors and Figure 3-3 and Table 3-3 for the Model 61272C indicators and connectors. Refer to Figure 3-4 and Table 3-4 for identification and explanation of the Model 6127B rear panel controls and connectors. Refer to figure 3-5 for operation of the "Key Pad" switches located on the front panel.

NOTE

Additional operating information is provided, starting with paragraph 3-27. This includes: expanded operating instructions, helpful hints, and application information.

3-8. INITIAL TURN-ON. Push the POWER switch to the "in" position. Both the green POWER lamp and the red SELF TEST lamp will illuminate. The 6127B will then run rapidly through a series of "self tests". At the completion of these self tests, all segments of all displays will illuminate for about 10 seconds. If all of the checks are passed, the instrument will indicate this by displaying "prompt" lines in all of the displays and extinguish the SELF TEST lamp. If any of the "self test" checks fail, the Calibrator will indicate a failure by displaying one of the number codes listed in the following table in the AMPLITUDE/DIV display.

NOTE

To check the setting of the Calibrator's IEEE-488 bus address selector switch A50-S1/S8 wait for the prompt lines to appear in every display window and press the CLEAR touch key. The two digits of bus address to which the 6127B is set, will appear in the DEVIATION display window. Be sure the 6127B bus address matches the command program address from the bus controller. Refer to paragraph 3-25 for bus address switch setting. The bus address display capability is active only after a SELF TEST cycle.

6127B SELF TEST ERROR CODES

CODE	ERROR MESSAGE
001	Fail -9.9% DEV volts
002	Fail +9.9% DEV volts
003	Fail 0% DEV volts
004	Fail -9.9% DEV time
005	Fail +9.9% DEV time
006	Fail 0% DEV time
007	Fail RAM test
008	Fail Keyboard test
090	Fail Phase lock loop malfunction
091	Fail DVM malfunction in first digit (MSD)
092	Fail DVM malfunction in second digit
093	Fail DVM malfunction in third digit
094	Fail DVM malfunction in last digit (LSD)

3-9. VOLTS/DIV MODE. To use the Model 6127B Calibrator in the VOLTS/DIV Mode, proceed as follows:

a. Connect the equipment as shown in figure 3-6. (Refer also to Table 3-5.)

b. Touch the VOLTS/DIV, MILLIAMPERES/DIV OUTPUT Mode key pad. "Prompt" lines will appear in the AMPLITUDE/DIV display.

NOTE

Initially both mode annunciators will illuminate.

c. Enter the desired AMPLITUDE/DIV number (Any number in a 1,2,5 sequence or multiple thereof is a valid entry) by touching, in sequence, the respective key pads; 1,2,5 or 0.

NOTE

If an invalid numerical entry is made subsequent to a valid one, the Calibrator will indicate an "invalid entry" and return to the last valid number after momentarily illuminating the INVALID ENTRY lamp.

d. Select the desired AMPLITUDE/DIV terminator by touching the respective key pad; V, mV or uV. At this time, the instrument will go into the VOLTS/DIV Mode and the MILLIAMPERES/DIV annunciator lamp will extinguish. The annunciator lamp adjacent to the VOLTS/DIV terminator selected will illuminate. (To change the entry, re-touch the VOLTS/DIV OUTPUT key pad. The "prompt" lines will re-appear; then enter the new value and terminator.)

e. Touch the DIVS key pad. "Prompt" lines will appear in the DIVISIONS display.

f. Enter the desired (multiplier) DIVISIONS value (1,2,3,4,5,6,8 or 10) by touching the respective key pads. (To change the entry, re-touch the DIVS key pad. The "prompt" lines will re-appear, then enter the new number.)

g. Touch the TIME/FREQ key pad. "Prompt" lines will appear in the TIME/DIV-FREQUENCY display.

h. Enter the desired frequency (DC, 10Hz, 100Hz, 1kHz or 10kHz) by touching the respective key pad. The display and annunciator will indicate the frequency chosen.

i. If DC is initially selected, it will be positive (POS). To change it to negative, touch the NEG key pad.

NOTE

To change back to positive dc, it will be necessary to first re-touch the TIME/FREQ key pad and then the 0/DC key pad.

j. If a trigger output is required for external triggering of the UUT, touch one of the TRIGGER key pads depending on the trigger frequency desired; X1, ÷10 or ÷100. The respective annunciator lamp will illuminate.

k. When the VOLTS/DIV signal in the range of 5 Volts (1 V x 5 DIV) or less is to be used to calibrate amplifiers with 50Ω input impedance, touch the 50Ω load key pad.

l. Touch the STANDBY/OPERATE key pad to "output" the VOLTS/DIV signal to the UUT. The OPERATE annunciator will illuminate.

m. To activate % DEVIATION, touch the DEV key pad. The DEVIATION display will be 0.0 and neither the HI nor LO lamp will be lit initially.

NOTE

% DEVIATION can only be activated in the OPERATE condition.

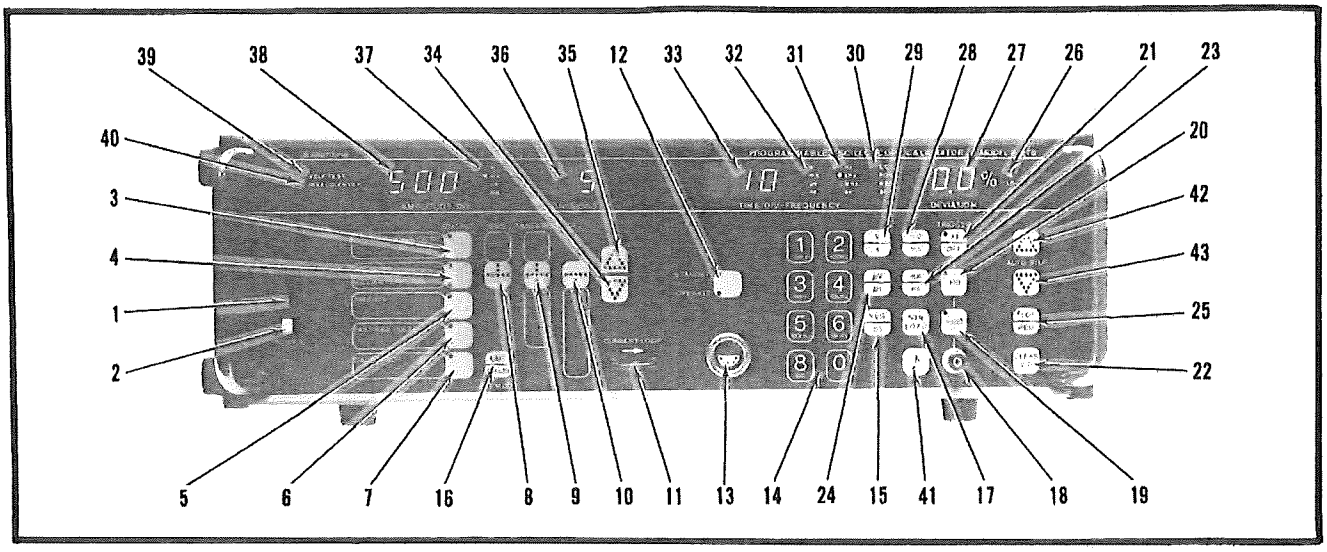


Figure 3-1. Model 6127B Front Panel Controls, Indicators, and Connectors

TABLE 3-1. MODEL 6127B FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS

INDEX NO.	CONTROL, INDICATOR OR CONNECTOR	REF. DESIG.	FUNCTION
1	POWER Lamp	A25-DS1	Illuminates when ac mains power is applied to instrument.
2	POWER Switch	A52-S1	Push-push switch that when pushed to the "in" position applies ac mains power to the instrument.
3	OUTPUT, LOW DISTORTION PULSE Key Pad	A25-DS2	When touched, puts the 6127B in the Low Distortion Pulse Mode. AMPLITUDE/DIV "prompt" lines will appear and the annunciator lamp will illuminate.
4	OUTPUT, VOLTS/DIV, MILLIAMPERES/DIV Key Pad	A25-DS3, DS4	When touched, puts the 6127B in either the VOLTS/DIV or MILLI-AMPERES/DIV Mode; depending on the next instruction. Both annunci-ator lamps will initially illu-minate and AMPLITUDE/DIV "prompt" lines will appear. The next in-struction will determine which one remains illuminated.
5	OUTPUT, TIME/DIV Key Pad	A25-DS5	When touched, puts the 6127B in the TIME/DIV Mode. Annunciator lamp will illuminate but no "prompt" lines will appear until TIME/FREQ touch key is pressed.
6	OUTPUT, FAST RISE PULSE Key Pad	A25-DS6	When touched, puts the 6127B in the FAST RISE PULSE Mode. Annun-ciator lamp and AMPLITUDE/DIV "prompt" lines will illuminate.
7	OUTPUT, CALIBRATOR, Key Pad	A25-DS7	When touched, puts the 6127B in the CALIBRATOR Mode. AMPLITUDE/-DIV "prompt" lines will appear and annunciator lamp will illuminate.
8	DIVS Key Pad	A25	When touched, sets up the 6127B for next instruction (a numerical entry of 1, 2, 3, 4, 5, 6, 8 or 10) and DIV "prompt" lines will appear. This applies to LOW DISTORTION PULSE, VOLTS/DIV, MILLIAMPERES/DIV and CALIBRATOR Modes.
9	TIME/FREQ Key Pad	A25	When touched, sets up the 6127B for next instruction (depending upon which mode has been selected) and TIME/FREQ "prompt" lines will appear. This will be either a numerical entry in a 1, 2, 5 sequence for TIME/DIV Mode; or in decade steps for LOW DISTORTION PULSE, VOLTS/DIV, and FAST RISE PULSE Modes (FREQUENCY).
10	DEV Key Pad	A25	When touched, sets up the 6127B for % DEVIATION, from calibrated time or amplitude, by up to ± 9.9%. Not valid for LOW DISTOR-TION PULSE mode. Initially dis-plays 0.0% DEVIATION. Can only be activated in OPERATE state.

TABLE 3-1. MODEL 6127B FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

INDEX NO.	CONTROL, INDICATOR OR CONNECTOR	REF. DESIG.	FUNCTION
11	CURRENT LOOP →	A25	Milliampere current output terminal when in MILLIAMPERES/DIV Mode.
12	STANDBY/OPERATE Key PAD	A25-DS8, DS9	Will change from STANDBY (Output off) to OPERATE (Output on) when touched, providing all instructions for a particular operating mode have been entered. Annunciator lamps indicate status (STANDBY or OPERATE). Whenever there is an OUTPUT Mode change, instrument reverts back to STANDBY.
13	Output Connector	A24-J4	Main output connector for all signals except current and trigger. Connects Model 61271C for LOW DISTORTION PULSE, VOLTS/DIV, TIME/DIV, FAST RISE PULSE operation. Connects Model 61272C for CALIBRATOR operation.
14	1/10Hz, 2/100Hz, 3/1kHz, 4/10kHz, 5/100kHz, 6/1MHz, 8/DC, 0 Key Pads	A25	When touched, enters a numerical value in a 1, 2, 5 sequence (TIME/DIV and AMPLITUDE/DIV) or a fixed frequency, plus dc, in decade steps (FREQUENCY).
15	NEG/ps Key Pad	A25	Dual function key pad that when touched, changes dc voltage output polarity to minus (NEG) or sets the TIME/DIV value to picoseconds (ps) depending on prior instruction set. Respective annunciator lamp will illuminate.
16	UUT/CALIB - ALT MODE Key Pad	A25	Dual function key pad that when touched, changes the CALIBRATOR Mode from (initially) 100 Hz chopped mode to ALT MODE. Successive touches cause the signal to alternate between that from the UUT (Unit Under Test) and CALIB (6127B) signal. Used with Model 61272C connected. In ALT MODE, the lamp on the Model 61272C is illuminated.
17	50Ω LOAD Key Pad (Applies only to LOW DISTORTION PULSE, TIME/DIV, and CALIBRATOR Modes)	A25	When touched, the 50Ω LOAD Key Pad tells the 6127B that a 50Ω load is to be driven by the 6127B. Otherwise the 6127B automatically provides an internal 50Ω termination when a high impedance input UUT is connected and the 50Ω termination is required by the 6127B. When in CALIBRATOR Mode, and the 50Ω LOAD keypad is activated, a 50Ω termination is presented at the 61272C UUT calibrator input.

TABLE 3-1. MODEL 6127B FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

INDEX NO.	CONTROL, INDICATOR OR CONNECTOR	REF. DESIG.	FUNCTION
18	OUTPUT BNC Connector	A24-J30	Output connector for trigger signal.
19	÷ 100 Key Pad	A25-DS12	When touched, divides the frequency of the trigger signal by 100 and presents trigger signal at OUTPUT BNC connector. Annunciator lamp will illuminate.
20	÷ 10 Key Pad	A25-DS11	When touched, divides the frequency of the trigger signal by 10 and presents trigger signal at OUTPUT BNC connector. Annunciator lamp will illuminate.
21	X1/OFF	A25-DS10	Dual function key pad that when touched for the first time, causes a trigger signal to be present at the OUTPUT BNC connector at X1 (Normal) frequency. The annunciator lamp will illuminate. When key pad is retouched, trigger signal is turned OFF (not present at OUTPUT BNC connector).
22	CLEAR Key Pad	A25	Dual function key pad that prompts the Bus address to be displayed in the DEVIATION display after a reset. When touched twice, resets Calibrator to "Power On" condition and performs "self-test" sequence.
23	mA/ns Key Pad	A25	Dual function key pad that when touched, puts the 6127B in the MILLIAMPERES/DIV Mode (providing the VOLTS/DIV, MILLIAMPERES/DIV OUTPUT Mode was previously selected) or sets the TIME/DIV to ns (nanoseconds) if the instrument is in the TIME/DIV Mode. Respective annunciator lamp will illuminate.
24	uV/us Key Pad	A25	Dual function key pad that when touched, sets the VOLTS/DIV value to uV (microvolts) if the instrument is in the VOLTS/DIV Mode or sets the TIME/DIV value to us (microseconds) if the instrument is in the TIME/DIV Mode. Respective annunciator lamp will illuminate.
25	LOC/REM Key Pad	A25-DS13	When touched, puts the 6127B into the Local (manual) mode of operation if the Local Lockout (LLO) has not been set from the bus. The annunciator lamp will illuminate. If the instrument is connected to a controller, Remote overrides Local and the Calibrator must be manually re-keyed from Remote back to Local.

TABLE 3-1. MODEL 6127B FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

INDEX NO.	CONTROL, INDICATOR OR CONNECTOR	REF. DESIG.	FUNCTION
26	HI/LO Annunciators	A23-DS19, DS20	Lamps that indicate whether the % DEVIATION of the UUT is HI (above standard value) or LO (below standard value).
27	DEVIATION Display	A23-DS29, DS30	Two digit display of % DEVIATION.
28	mV/ms Key Pad	A25	Dual function key pad that when touched, sets the VOLTS/DIV value to mV (millivolts) if the instrument is in the VOLTS/DIV Mode or sets the TIME/DIV value to ms (milliseconds) if the instrument is in the TIME/DIV Mode. Respective annunciator lamp will illuminate.
29	V/s Key Pad	A25	Dual function key pad that when touched, sets the VOLTS/DIV value to V (volts) if the instrument is in the VOLTS/DIV Mode or sets the TIME/DIV value to s (seconds) if the instrument is in the TIME/DIV Mode. Respective annunciator will illuminate.
30	DC, POS, NEG, 50Ω Annunciators	A23-DS15, DS16,DS17, DS18	Lamps that indicate a state of AMPLITUDE/DIV voltage: DC POS or NEG and whether high or low source impedance has been selected.
31	Hz, kHz, MHz, ps Annunciators	A23-DS11, DS12,DS13, DS14	Lamps that indicate value of FREQUENCY being displayed: Hz, kHz, MHz or a range of TIME/DIV displayed: ps.
32	s, ms, us, ns Annunciators	A23-DS7,DS8, DS9,DS10	Lamps that indicate TIME/DIV range displayed: s, ms, us or ns.
33	TIME/DIV-FREQUENCY Display	A23-DS26, DS27,DS28	Three digit display of TIME/DIV when in TIME/DIV Mode or FREQUENCY when in any other mode.
34	▽ Key Pad	A25	If the instrument is in Deviation mode, momentary touching of this key pad decrements the % DEVIATION one step (0.1% decrease) for each time the pad is touched. Maintaining pressure on key pad causes % DEVIATION value to slew in 0.5% steps until pressure is released, to a maximum of +9.9%. (Decreases output voltage in VOLTS/DIV Mode and increases marker repetition rate in TIME/DIV Mode.)

TABLE 3-1. MODEL 6127B FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

INDEX NO.	CONTROL, INDICATOR OR CONNECTOR	REF. DESIG.	FUNCTION
35	△ Key Pad	A25	If the instrument is in Deviation mode, momentary touching of this key pad increments the % DEVIATION one step (0.1% increase) for each time the pad is touched. Maintaining pressure on key pad causes % DEVIATION value to slew in 0.5% steps until pressure is released, to a maximum of -9.9%. (Increases output voltage in VOLTS/DIV Mode and decreases marker repetition rate in TIME/DIV Mode.)
36	DIVISIONS Display	A23-DS24, DS25	Two digit display of number that multiplies AMPLITUDE/DIV value when the instrument is in VOLTS/-DIV, MILLIAMPERES/DIV, CALIBRATOR or LOW DISTORTION PULSE Mode.
37	V, mV, uV, mA Annunciators	A23-DS3,DS4, DS5,DS6	Lamps that indicate VOLTS/DIV range displayed: V, mV, uV; LOW DISTORTION PULSE range displayed: V, mV; or MILLIAMPERES/DIV displayed: mA.
38	AMPLITUDE/DIV Display	A23-DS21, DS22,DS23	Three digit display of VOLTS/DIV (not including multiplier) when in VOLTS/DIV, CALIBRATOR and LOW DISTORTION PULSE Modes; and MILLI-AMPERES/DIV (not including multi-plier) when in MILLIAMPERES/DIV Mode.
39	SELF TEST Annunciator	A23-DS1	Lamp that illuminates during the time that the 6127B is performing a self check (immediately follow-ing a "Power On" condition or double entry of CLEAR key pad).
40	INVALID ENTRY Annunciator	A23-DS2	Lamp that illuminates when an invalid Entry has been made.
41			Key pad switch which shuts off or reactivates audio tone keypad Annunciator.
42	Δ AUTO STEP		When touched, this keypad switch increments VOLTS/DIV, MILLI-AMPERES/DIV, or TIME/DIV output setting to the next higher step.
43	▽ AUTO STEP		When touched, this keypad switch decrements the VOLTS/DIV, MILLI-AMPERES/DIV, or TIME/DIV output setting to the next lower output step.

TABLE 3-2. MODEL 61271C CONNECTORS

INDEX NO.	CONNECTOR	REF. DESIG.	FUNCTION
1	OUTPUT	A40-P1	Connects to Unit Under Test (UUT) vertical input and provides either Fast Rise Pulse, Time Markers or Amplitude signal; depending on Mode selected.
2		A40-P100A	Multipin connector that couples Model 61271C cable to Model 6127B Calibrator.

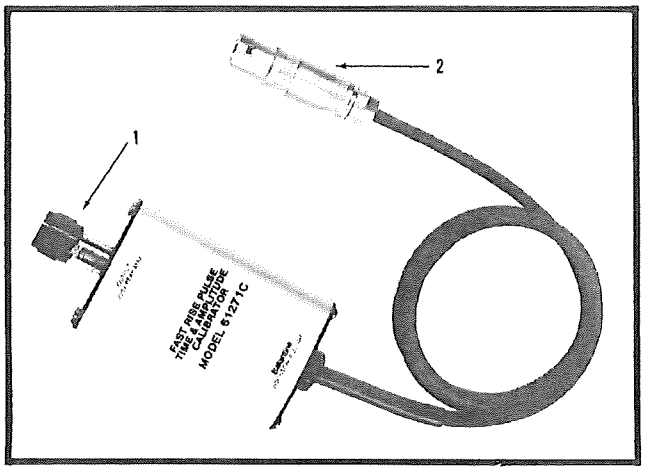


Figure 3-2. Model 61271C Connectors

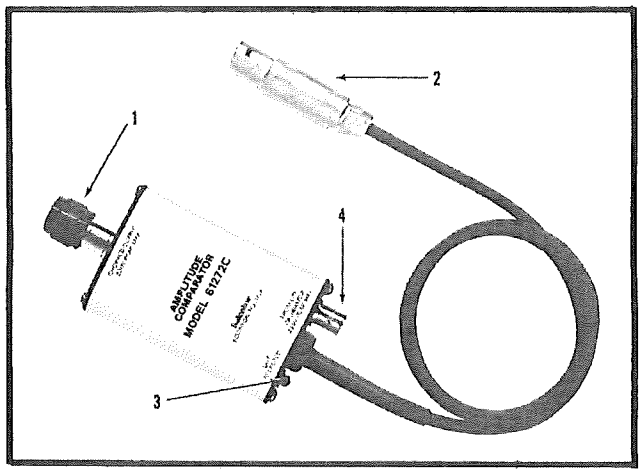


Figure 3-3. Model 61272C Indicators & Connectors

TABLE 3-3. MODEL 61272C INDICATORS AND CONNECTORS

INDEX NO.	CONNECTORS AND INDICATORS	REF. DESIG.	FUNCTION
1	CHOPPED OUTPUT	A42-P1	Output signal from Model 61272B Amplitude Comparator. Initially is switched at 100 Hz rate (chopped) between UUT's calibrator output and VOLT/DIV output of the Model 6127B. Normally connected to UUT vertical input.
2		A42-P100B	Multipin connector that couples Model 61272C cable to Model 6127B Calibrator.
3	UUT SELECTED	A42-CR2	Lamp that illuminates when signal from UUT calibrator has been selected.
4	FROM UUT CALIBRATOR	A42-J1	Input connector for connection of UUT calibration signal to Model 61272C. When UUT is selected, this signal is connected to oscilloscope vertical input.

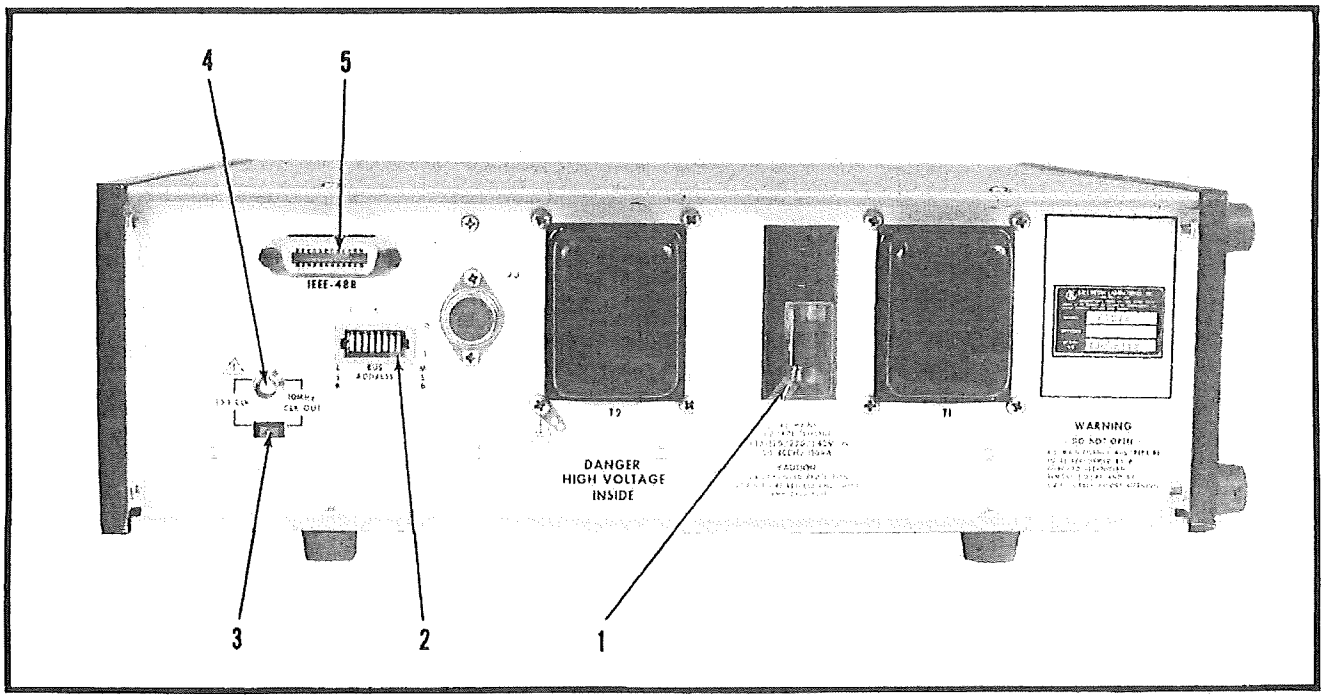
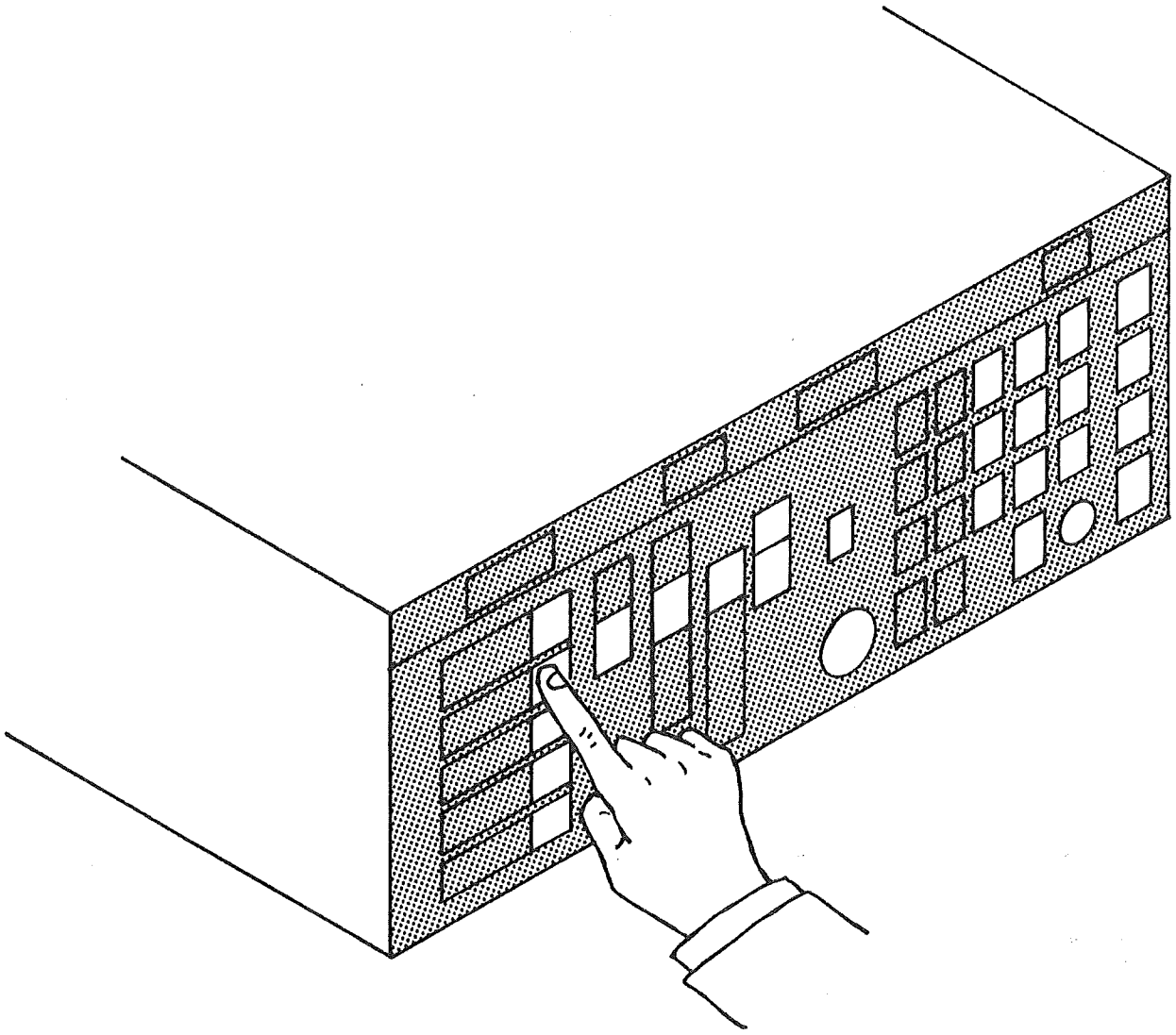


Figure 3-4. Model 6127B Rear Panel Controls and Connectors

TABLE 3-4. MODEL 6127B REAR PANEL CONTROLS AND CONNECTORS

INDEX NO.	CONTROL OR CONNECTOR	REF. DESIG.	FUNCTION
1	Ac Power Receptacle	A50-J1	Ac power input connector that incorporates an ac mains voltage selector printed circuit board (100, 120, 220 or 240 volts) and fuse.
2	BUS ADDRESS Switch	A50-S1-S8	Set the Model 6127B interface address. (Only the first five rocker switches are used.)
3	EXT CLK/IN 10 MHz CLK OUT	A27-S9	Slide switch that selects either external 10 MHz clock input or internal 10 MHz clock output.
4		A50-J30	BNC connector for applying external 10 MHz clock input or provides output from Model 6127B 10 MHz clock.
5	IEEE-488	A50-J2	24 pin connector that permits remote programming of Model 6127B via IEEE-488 Bus.



USE PAD OF INDEX FINGER OR THUMB TO DEPRESS PADS OF TOUCH PANEL SWITCHES

Figure 3-5. Key Pad Switch Operation

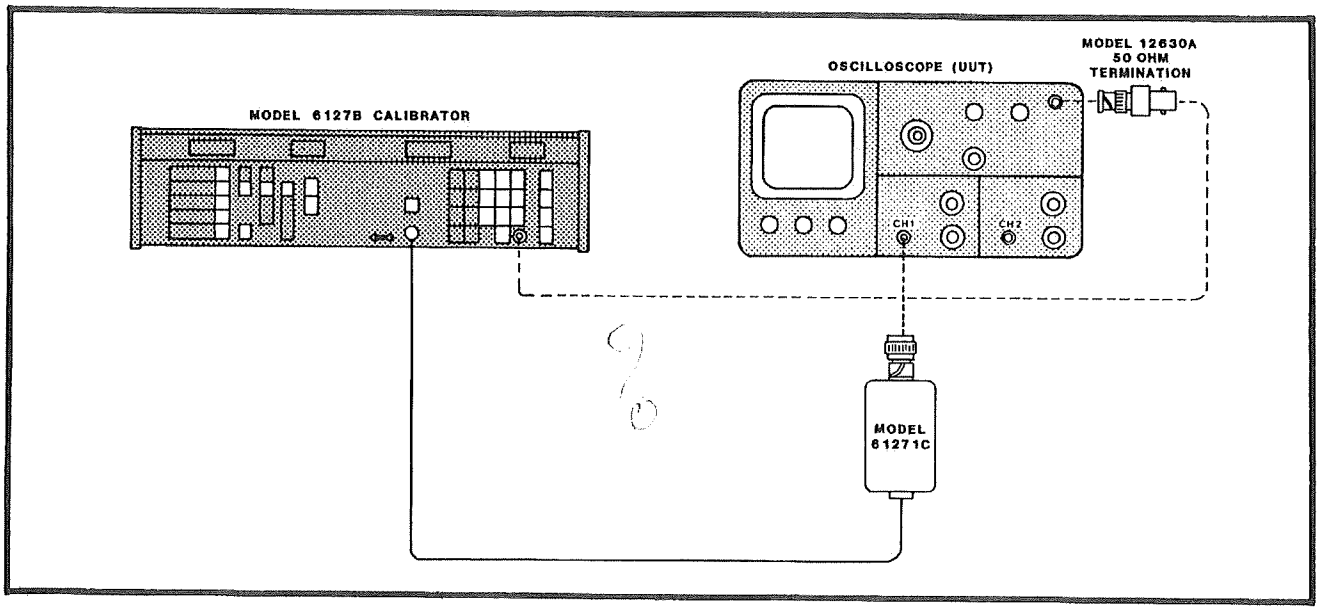


Figure 3-6. Volts/Div Measurement, Equipment Set-Up

TABLE 3-5. 6127B VOLTS/DIV MODE VALID ENTRIES

AMPLITUDE/DIV	DIVISIONS (HI Z) 1	2	3	4	5	6	8	10	DIVISIONS (50Ω) 1	2	3	4	5	6	8	10
50 V																
20 V																
10 V																
5 V																
2 V																
1 V																
500mV																
200mV																
100mV																
50mV																
20mV																
10mV	VALID ENTRY REGION								VALID ENTRY REGION							
5mV																
2mV																
1mV																
500uV																
200uV																
100uV																
50uV																
20uV																
10uV																

n. If the signal displayed on the oscilloscope does not agree with the Calibrator value, increment or decrement the % DEVIATION by touching the respective key pad until the displayed signal is coincident with the proper horizontal graticule line. The number indicated on the display represents the error of the UUT (oscilloscope). If the HI annunciator lamp illuminates, the calibration error of the UUT is high; if the LO annunciator lamp illuminates, the calibration error of the UUT is low.

o. Touch the AUTOSTEP Δ key pad to increment the VOLTS/DIV range to the next higher range in 1, 2, 5 sequence.

p. Touch the AUTOSTEP key pad to decrement the VOLTS/DIV range to the next lower range in 5, 2, 1 sequence.

3-10. MILLIAMPERES/DIV Mode. To use the Model 6127B Calibrator in the MILLIAMPERES/DIV Mode, proceed as follows:

a. Connect the equipment as shown in Figure 3-7. (Refer also to Table 3-6.)

b. Touch the VOLTS/DIV, MILLIAMPERES/DIV OUTPUT Mode key pad. "Prompt" lines will appear in the AMPLITUDE/DIV display.

NOTE

Initially both VOLTS/DIV and MILLIAMPERES/DIV annunciators will illuminate unless instrument was previously in VOLTS/DIV Mode.

c. Enter the desired AMPLITUDE/DIV number (any number in a 1,2,5 sequence or multiple thereof is a valid entry) by touching, in sequence, the respective key pads; 1,2,5 or 0 and press the mA key pad. At this time MILLIAMPERES/DIV will remain lit and VOLTS/DIV will extinguish. The mA annunciator will also illuminate. (To change the entry, re-touch the MILLIAMPERES/DIV OUTPUT key pad. The "Prompt" lines will re-appear; then enter the new value and terminator.)

NOTE

If an invalid entry is made subsequent to a valid one, the Calibrator will indicate an "invalid entry" by displaying the last valid number and momentarily illuminating the INVALID ENTRY lamp.

d. Touch the DIVS key pad. "Prompt" lines will appear in the DIVISIONS display.

e. Enter the desired (multiplier) DIVISIONS value (1,2,3,4,5,6,8 or 10) by touching the respective key pads. To change the entry, re-touch the DIVS key pad. "Prompt" lines will re-appear; then enter the new number.

f. Touch the TIME/FREQ key pad to change the frequency. "Prompt" lines will reappear in the TIME/DIV-FREQUENCY display. Then enter a new frequency.

g. Enter the desired frequency (DC, 10Hz, 100Hz, 1kHz or 10kHz) by touching the respective key pad. The display and annunciator will indicate the frequency chosen.

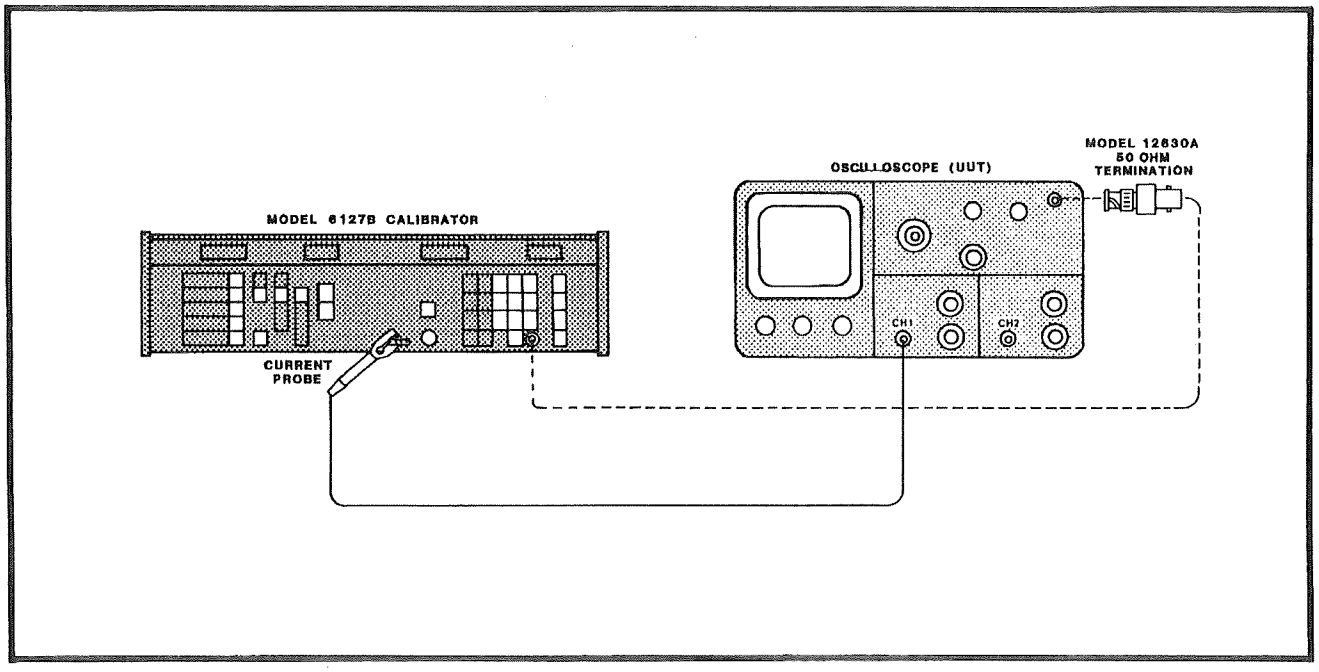


Figure 3-7. Milliamperes/Div Mode, Equipment Set-Up

TABLE 3-6. 6127B MILLIAMPERES/DIV MODE VALID ENTRIES

AMPLITUDE/DIV	DIVISIONS 1	2	3	4	5	6	8	10
10mA 5mA 2mA 1mA	VALID ENTRY REGION							

h. When DC is initially selected, the current flow will be in the direction of the arrow. To reverse the direction of current flow, touch the NEG key pad.

NOTE

To change the flow of current back to the direction indicated by the arrow, it will be necessary to first re-touch the TIME/FREQ key pad and then the 8/DC key pad.

i. If a trigger output is required for external triggering of the UUT, touch one of the TRIGGER key pads depending on the trigger frequency desired; X1, ÷10 or ÷100. The respective annunciator lamp will illuminate.

j. Touch the STANDBY/OPERATE key pad to "output" the MILLIAMPERES/DIV signal to the UUT. The OPERATE annunciator will illuminate.

k. To activate % DEVIATION, touch the DEV key pad. The DEVIATION display will be 0.0 and neither the HI nor LO lamp will be lit initially.

NOTE

% DEVIATION can only be activated in the OPERATE condition.

l. If the current sensed by the UUT does not agree with the Calibrator value, increment or decrement the % DEVIATION by touching the respective key pad until the current value displayed falls on the correct mark. The number indicated on the display represents the error of the UUT. If the HI annunciator lamp illuminates, the calibration error of the UUT is high; if the LO annunciator lamp illuminates, the calibration error of the UUT is low.

m. Touch the AUTOSTEP Δ key pad to increment the MILLIAMPERES/DIV range to the next higher range in 1, 2, 5 sequence.

n. Touch the AUTOSTEP ∇ key pad to decrement the MILLIAMPERES/DIV range to the next lower range in 5, 2, 1 sequence.

3-11. TIME/DIV Mode. To use the Model 6127B Calibrator in the TIME/DIV Mode, proceed as follows:

a. Connect the equipment as shown in Figure 3-6.

b. Touch the TIME/DIV OUTPUT Mode key pad. The annunciator lamp will illuminate indicating that the Calibrator is in the TIME/DIV Mode.

c. Touch the TIME/FREQ key pad. "Prompt" lines will appear in the TIME/DIV-FREQUENCY display.

d. Enter the desired TIME/DIV number (Any number in a 1, 2, 5 sequence or multiple thereof is a valid entry) by touching, in sequence, the respective key pads; 1, 2, 5 or 0. (To change the entry, re-touch the TIME/DIV key pad. The "prompt" lines will re-appear; then enter the new value and terminator.)

e. Select the desired TIME/DIV terminator by touching the respective key pad; s, ms, us, ns or ps. The annunciator lamp adjacent to the terminator selected will illuminate.

f. If the UUT has a 50Ω input impedance, then touch the 50Ω key to remove internal termination. The 50Ω annunciator lamp will illuminate.

g. If a trigger output is required for external triggering of the UUT, touch one of the TRIGGER key pads. The annunciator lamp of the selected TRIGGER key pad will illuminate.

h. Touch the STANDBY/OPERATE key pad to "output" the TIME/DIV signal to the UUT. The OPERATE annunciator will illuminate.

i. To activate % DEVIATION, touch the DEV key pad. The DEVIATION display will be 0.0 and neither the HI nor LO lamp will be lit initally.

NOTE

% DEVIATION can only be activated in the OPERATE condition.

j. If the time markers displayed on the oscilloscope do not agree with the Calibrator value, increment or decrement the % DEVIATION by touching the respective key pad until the displayed markers are coincident with the proper vertical graticule lines. If the HI annunciator illuminates, the calibration error of the UUT is high; if the LO annunciator illuminates, the error of the UUT is low.

k. Touch the AUTOSTEP Δ key pad to increment the TIME/DIV range to the next faster range in 1, 2, 5 sequence.

l. Touch the AUTOSTEP ∇ key pad to decrement the TIME/DIV range to the next slower range in 5, 2, 1 sequence.

3-12. FAST RISE PULSE Mode. To use the 6127B Calibrator in the FAST RISE PULSE Mode, proceed as follows:

a. Connect the equipment as shown in Figure 3-6.

b. A 50Ω termination must always be used when in the FAST RISE PULSE Mode. An oscilloscope with built in 50Ω termination provides the best waveshape. Use a 50Ω wideband termination directly at the input of the UUT with high input impedance. For best performance connect the 61271 Fast Rise Pulse Head accessory through a 6 dB 50Ω attenuator and a 30 cm 50Ω air line or low loss coax cable.

c. Touch the FAST RISE PULSE Mode key pad. The annunciator for that mode will illuminate.

d. Touch the TIME/FREQ key pad. "Prompt" lines will appear in the TIME/DIV-FREQUENCY display.

e. Select a frequency of 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, or 1 MHz by touching the respective key pad. The display and annunciator will indicate the frequency chosen.

f. If a trigger output is required for external triggering of the UUT, touch the desired TRIGGER key pad. The annunciator lamp of the selected key pad (X1, ÷10 or ÷100) will illuminate.

g. Touch the STANDBY/OPERATE key pad to "output" the FAST RISE PULSE to the UUT. The OPERATE annunciator will illuminate.

NOTE

The amplitude of the FAST RISE PULSE may be varied by ± 9.9% from the 1.1 volt peak-to-peak level. Refer to step g.

h. To vary the amplitude of the Fast Risetime Pulse, first touch the DEV key pad. The % DEVIATION display will be 0.0. To increase the amplitude, up to a maximum of +9.9%, touch the increment (deviation) key pad. To decrease the amplitude, to a maximum of -9.9%, touch the decrement (deviation) key pad.

NOTE

% DEVIATION cannot be activated in the STANDBY condition.

3-13. LOW DISTORTION PULSE Mode. To use the 6127B Calibrator in the LOW DISTORTION PULSE Mode, proceed as follows:

a. Connect the equipment as shown in Figure 3-6. (Refer also to Table 3-7.)

b. Touch the LOW DISTORTION PULSE OUTPUT Mode key pad. The annunciator lamp will illuminate indicating that the Calibrator is in the Low Distortion Pulse Mode and "prompt" lines will appear in the AMPLITUDE/DIV display.

c. Enter the desired AMPLITUDE/DIV number (Any number in a 1, 2, 5 sequence or multiple thereof is a valid entry) by touching, in sequence, the respective key pads; 1, 2, 5 or 0 and then select the desired terminator; V or mV. To change the entry, re-touch the LOW DISTORTION PULSE OUTPUT key pad.

NOTE

When the LOW DISTORTION PULSE output is terminated in 50Ω, the selected AMPLITUDE/DIV voltage range is from 20 mV to 1 V peak-to-peak. A 50Ω termination in the 61271C head is automatically provided for use with high input impedance amplifiers. Touch the 50Ω LOAD key pad to disconnect the 50Ω termination in the 61271C head when the amplifier under test has 50Ω input impedance. When the output amplitude is set for 1.2 V to 100 V peak-to-peak, the unterminated mode is automatically selected and the 50Ω termination in the 61271C head is disconnected.

d. Touch the DIVS key pad. "Prompt" lines will appear in the DIVISIONS display.

e. Enter the desired (multiplier) DIVISIONS value (1,2,3,4,5,6,8 or 10) by touching the respective key pads. To change the entry, re-touch the DIVS key pad. The "Prompt" lines will re-appear, then enter the new number.

f. Touch the TIME/FREQ key pad. "Prompt" lines will appear in the TIME/DIV-FREQUENCY display.

g. Enter the desired frequency (10Hz, 100Hz, 1kHz, 10kHz, 100kHz or 1 MHz) by touching the respective key pad. The display and annunciator will indicate the frequency chosen.

NOTE

If the LOW DISTORTION PULSE output has amplitudes of 1.2 Volts and above selected, then the frequency range selection is restricted to 10 Hz, 100 Hz, 1 kHz, 10 kHz and 100 kHz.

h. If a trigger output is required for external triggering of the UUT, touch one of the TRIGGER key pads depending on the trigger frequency desired; X1, ÷ 10 or ÷ 100. The respective annunciator lamp will illuminate.

i. Touch the STANDBY/OPERATE key pad to "output" the LOW DISTORTION PULSE to the UUT. The OPERATE annunciator will illuminate.

NOTE

% DEVIATION function is not available in the LOW DISTORTION PULSE Mode.

j. Touch the AUTOSTEP Δ key pad to increment the LOW DISTORTION PULSE amplitude per DIV range to the next higher amplitude range in 1, 2, 5 sequence.

k. Touch the AUTOSTEP ∇ key pad to decrement the LOW DISTORTION PULSE amplitude per DIV range to the next lower amplitude range in 5, 2, 1 sequence.

NOTE

The 50Ω termination in the 61271C head is automatically programmed to be removed for output amplitudes of 1.2 V and above. When decrementing from higher outputs to amplitudes below 1.2 V, the 50Ω termination in the 61271C head is automatically connected. Since only an amplifier with high input impedance can be used to display amplitudes of of 1.2 V and above, the pre-programmed 50Ω termination in the 61271C head will provide convenient AUTOSTEP automatic operation.

3-14. CALIBRATOR Mode. To use the Model 6127B Calibrator in the CALIBRATOR Mode, proceed as follows:

a. Connect the equipment as shown in Figure 3-8.

b. Touch the CALIBRATOR OUPUT Mode key pad. The VOLTS/DIV and CALIBRATOR annunciator lamps will illuminate and a TIME/DIV-FREQUENCY of 1 kHz will be displayed, indicating that the Calibrator is in the CALIBRATOR Mode. "Prompt" lines will appear in the AMPLITUDE/DIV display.

c. Enter the desired AMPLITUDE/DIV number and terminator (Any number in a 1, 2, 5 sequence or multiple thereof is a valid entry.) by touching, in sequence, the respective key pads; 1, 2, 5 or 0. (To change the entry, re-touch the CALIBRATOR OUTPUT key pad. The "prompt" lines will re-appear, then enter the new value and terminator.)

d. Touch the DIVS key pad. The "prompt" lines will appear in the DIVISIONS display.

e. Enter the desired (multiplier) DIVISIONS value (1, 2, 3, 4, 5, 6, 8 or 10) by touching the respective key pads. (To change the entry, re-touch the DIVS key pad. The "prompt" lines will re-appear; then enter the new number.)

NOTE

The TIME/FREQ key pad is not used in the CALIBRATOR Mode. The frequency of the Calibrator signal is fixed at 1 kHz.

TABLE 3-7. LOW DISTORTION PULSE MODE VALID ENTRIES

AMPLITUDE/DIV	DIVISIONS 1	2	3	4	5	6	8	10
50 V								
20 V								
10 V								
5 V				(HI Z)				
1 V								
500mV								
200mV								
100mV				(50 Ω)				
50mV								
20mV								

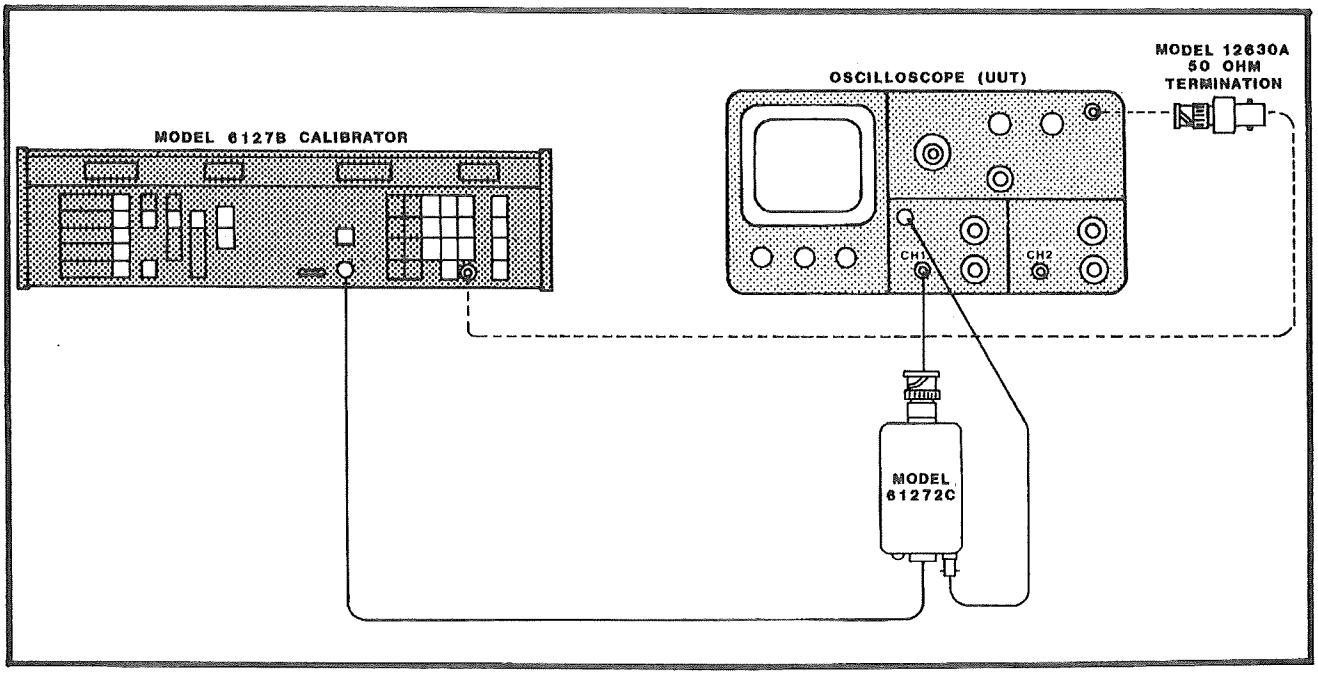


Figure 3-8. Calibrator Mode, Equipment Set-Up

f. External triggering of the UUT is not recommended since a free-running non-synchronous display will provide the best amplitude comparison pattern. If a trigger output should be required for external triggering of the UUT, touch one of the TRIGGER key pads. The annunciator lamp of the selected TRIGGER key pad will illuminate. The trigger is slaved to the 100 Hz chopped rate but disappears once the ALTERNATE Command Mode has been selected.

g. Touch the STANDBY/OPERATE key pad to "output" the CALIBRATOR signal to the UUT. The OPERATE annunciator will illuminate.

NOTE

Until the UUT/CALIB key pad is touched, the signal appearing at the UUT vertical input is both the Model 6127B signal and the UUT calibrator signal; alternately present at a 100 Hz chopped rate.

h. To put the CALIBRATOR into the ALT MODE, touch the UUT/CALIB key pad. The initial touch presents the Model 6127B Calibrator signal (CALIB) to the oscilloscope. The second time the UUT/CALIB key pad is touched, the signal present is the oscilloscope's own internal calibration signal (UUT). This will be indicated by the lamp on the Model 61272C Amplitude Comparator illuminating. Subsequent touches of the UUT/CALIB key pad "toggle" the signal from CALIB to UUT.

i. To change back to the automatic (100 Hz chopped) mode, it will be necessary to re-touch the CALIBRATOR OUTPUT key pad and re-enter an AMPLITUDE/DIV value.

j. To activate % DEVIATION, touch the DEV key pad. The DEVIATION display will be 0.0 and neither the HI nor the LO lamp will be lit initially.

k. If the oscilloscope internal "calibration" signal does not agree with the Calibrator value, increment or decrement the % DEVIATION by touching the respective key pad until the signals coincide. The number indicated on the display represents the error of the UUT (oscilloscope). If the HI annunciator lamp illuminates, the calibration error of the UUT is high; if the LO annunciator lamp illuminates, the calibration error of the UUT is low.

l. If the UUT calibrator requires a 50 ohm load, touch the 50Ω LOAD key pad and a 50 termination in the 61271C will be automatically connected to the FROM UUT CALIBRATOR BNC (A42-J1).

m. The AUTOSTEP operation described for the VOLT/DIV mode in paragraph 3-9 m and o is applicable to the CALIBRATOR mode.

3-15. REMOTE OPERATION

3-16. In the REM (Remote) Mode, the Model 6127B is remotely programmable by an IEEE Standard 488 Bus. In this mode, all of the front panel touch controls are disabled except the LOC/REM key pad. The POWER switch also remains under manual control.

3-17. Programming

3-18. GENERAL. The Model 6127B is programmable in the REM (Remote) Mode through a digital interface that is specified and described in IEEE Standard 488-1978, "Standard Digital Interface for Programmable Instrumentation". This digital interface is referred to as General Purpose Interface Bus (GPIB) throughout this manual. Connector A50-J2, located at the rear of the instrument, is a standard 24 pin connector that permits remote programming of the Model 6127B via the GPIB. Table 3-8 lists the pin assignments of A50-J2.

Table 3-8.
6127B IEEE-488 Interface Connector (A50-J2)

PIN NO.	SIGNAL	PIN NO.	SIGNAL
1	D103	13	NDAC
2	D104	14	IFC
3	D101	15	SRQ
4	D102	16	REN
5	D108	17	NRFD
6	D107	18	DAV
7	D105	19	ATN
8	Ground	20	EOI
9	D106	21	Not Used
10	Ground	22	Not Used
11	Ground	23	Not Used
12	Ground	24	Not Used

3-19. The GPIB consists of 16 signal lines that are functionally divided into three component busses. They are: an eight-line data bus (ASCII), a three-line transfer control (handshake) bus and a five-line management bus. The following is a definition of these signals:

a. Data Bus Lines consist of eight bidirectional signal lines; D101 through D108 inclusive. Information in the form of data bytes (eight bits at a time) is transferred over this bus during a handshake sequence. These data bytes are sent and received in a byte-serial, bit-parallel fashion.

b. Transfer Bus Every time a data byte is transmitted over the data bus a "handshake" sequence is executed between the enabled talker and all enabled listeners. These signal lines are:

1. DAV (Data Valid) Indicates to acceptor that data is available when asserted low by the talker.

2. NRFD (Not Ready For Data) Device(s) not ready to accept data. When all asserted listeners for a particular data byte transfer release NRFD, the NRFD line becomes unasserted (high).

3. NDAC (Not Data Accepted) indicates acceptance of all devices when NDAC line becomes unasserted (high).

c. Management Bus is a group of five signal lines used to control the operation of the GPIB and are defined as follows:

1. ATN (Attention) - When ATN (controller generated) is asserted (high), data lines carry addresses or commands; when unasserted (low), they carry data (controller driven).

2. IFC (Interface Clear) - Puts talkers and listeners into their idle states; and places interface system in a known quiescent state.

3. SRQ (Service Request) - Used by a device to indicate a need for service and to request an interrupt of the current events sequence.

4. REN (Remote Enable) - Selects between two alternate sources of device programming data; front panel control or interface control (controller driven).

5. EOI (End Of Identify) - Used to indicate end of multiple byte transfer sequences or with ATN to perform a parallel polling.

3-20. TYPICAL GPIB SYSTEM

3-21. A typical GPIB system is shown in Figure 3-9. It includes a controller, the Model 6127B Oscilloscope Calibrator and the Unit Under Test (UUT). In this case; an oscilloscope.

3-22. Functions

3-23. The following are definitions of the functions performed by instruments connected to the GPIB.

a. CONTROLLER - Software controlled device that determines which instruments will talk and which will listen during any given time interval. May also designate itself as a talker or listener, as required by the program routine, or send special codes and commands (interface messages) to either selected or all instruments on GPIB.

b. TALKER/LISTENER - Instrument on GPIB that may be designated alternately by the controller as a talker (sends data) or listener (receives data) over the data bus.

c. TALKER - Instrument connected to GPIB that can be addressed by an interface message from the controller to send device dependent messages over the data line.

d. LISTENER - Instrument connected to GPIB that can be addressed by an interface message from the controller to receive device dependent messages over the data line.

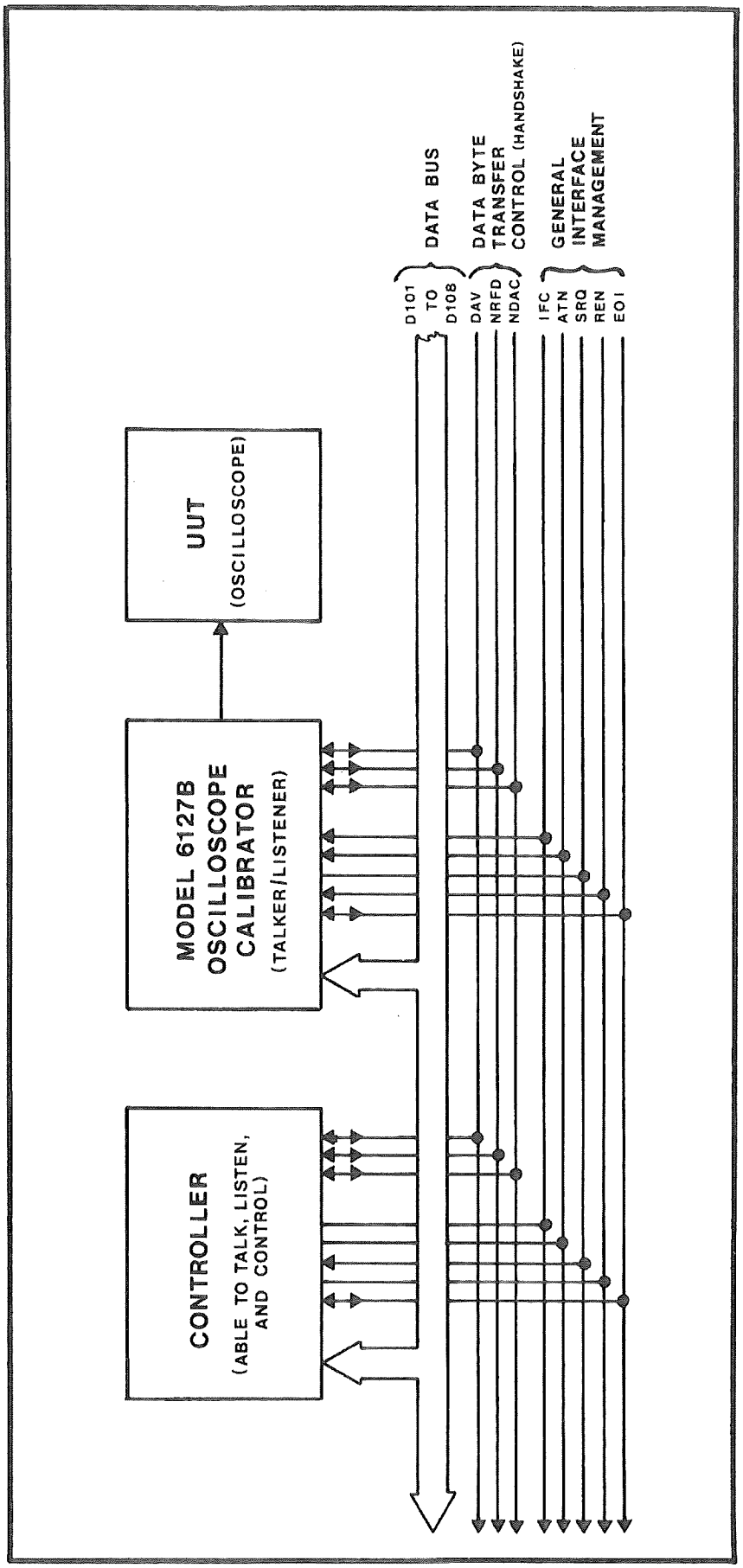


Figure 3-9. Typical GPIB System

3-24. Messages

a. INTERFACE MESSAGES - These messages perform some direct function (address or control) within the interface which may or may not affect the operation of the interconnected devices. These messages include:

(1) Primary talk address

(2) Primary listen address

(3) Addressed commands

(4) Universal commands

Interface messages are specified by the IEEE-488 Standards and are sent exclusively by a controller device. All such messages are transmitted with the ATN line asserted (in the true state).

b. DEVICE DEPENDENT MESSAGES - These messages are specifically constructed to affect some action directly on the device that message is sent to. An example would be a string of characters sent to the 6127B to select the LOW DISTORTION PULSE Mode. Device dependent messages are defined by the instrument (in this case the 6127B) interface designer. Device dependent messages may be programming data sent to an instrument to set up a measurement, or it may be numerical data returning from the instrument that results from the measurement. All such messages are transmitted with the ATN line unasserted (in the false state).

3-25. Address Switch

3-26. The bank of eight rocker switches located at the rear of the Model 6127B (See Figure 3-10) is the bus address switch A50-S1-S8. The first five switches in the bank are used to set the address. To do this, pick an unused bus address between 0 and 30 decimal. Convert the address to binary (refer to table 3-9) and write it left to right, putting the Least Significant Bit (LSB) on the left. Set the five address switches, using a soft-pointed instrument such as a pencil, to the binary value. As an example, the address switch depicted in Figure 3-10 is set to an address of 09 decimal. For instruments with serial prefix 053- and below the IEEE-488 Bus Address Switch should only be changed when POWER is OFF, or prior to a CLEAR/CLEAR command.

NOTE

The 6127B is used as both a listener and talker. The last three switches of the Address Switch (6, 7, 8) are not used and therefore these switches do not need to be set. This permits the controller program to decide when to make the 6127B a Listener or Talker.

Table 3-9. Address Switch Conversion Table

DECIMAL NUMBER	ADDRESS SWITCH 1	2	3	4	5	DECIMAL NUMBER	ADDRESS SWITCH 1	2	3	4	5
01	1	0	0	0	0	16	0	0	0	0	1
02	0	1	0	0	0	17	1	0	0	0	1
03	1	1	0	0	0	18	0	1	0	0	1
04	0	0	1	0	0	19	1	1	0	0	1
05	1	0	1	0	0	20	0	0	1	0	1
06	0	1	1	0	0	21	1	0	1	0	1
07	1	1	1	0	0	22	0	1	1	0	1
08	0	0	0	1	0	23	1	1	1	0	1
09	1	0	0	1	0	24	0	0	0	1	1
10	0	1	0	1	0	25	1	0	0	1	1
11	1	1	0	1	0	26	0	1	0	1	1
12	0	0	1	1	0	27	1	1	0	1	1
13	1	0	1	1	0	28	0	0	1	1	1
14	0	1	1	1	0	29	1	0	1	1	1
15	1	1	1	1	0	30	0	1	1	1	1

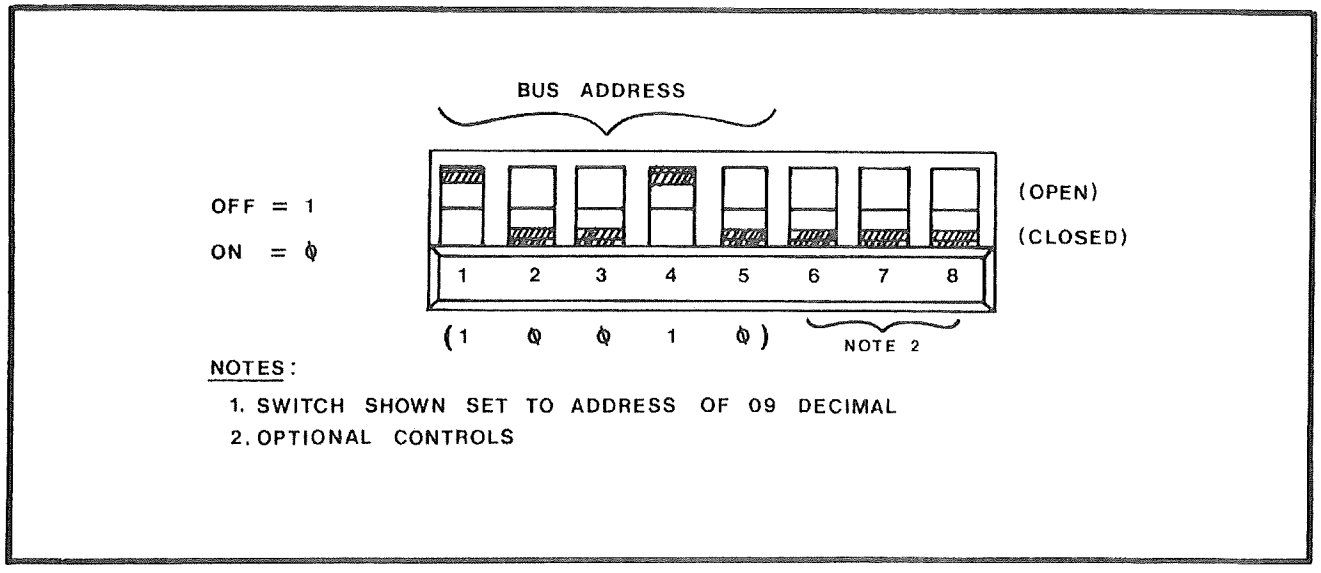


Figure 3-10. Model 6127B Address Switch

TABLE 3-10. 6127B PROGRAMMING INFORMATION

COMMAND		DEFINITION
TYPE	MNEMONIC	
State	DT ON	Set up next command string and await group execute trigger
	DT OFF	Execute command string immediately
	LLO	Disables local operation of front panel
	GTL	Enables local operation of front panel
Mode	MODE V	Selects STANDARD AMPLITUDE Mode
	MODE MK	Selects STANDARD TIME Mode
	MODE CU	Selects STANDARD CURRENT Mode
	MODE CA	Selects STANDARD CALIBRATOR Mode
	MODE ED	Selects LOW DISTORTION PULSE Mode
	MODE FA or FE	Selects FAST RISETIME PULSE Mode
	F$/D G$H$	Selects Unit/Div Output Valid G$ = Numeric value from 0.001 to 500 in a 1,2,5 sequence Valid H$ = NS (nsec), US (usec), MS (msec), S (sec), UV (uV), V (volts), MA (mA) Valid F$ = U (Remain in present Mode) S (Standard Time Mode) V (Standard Amplitude Mode) A (Standard Current Mode)
Modifier	FR A$	Selects frequency for: STANDARD AMPLITUDE, STANDARD CURRENT, FAST RISETIME PULSE, and LOW DISTORTION PULSE Valid A$ = DC, 10HZ, 100HZ, 1KHZ, 10KHZ, 100KHZ, 1MHZ
	MU I$	Selects Multiplier Valid I$ = 1,2,3,4,5,6,8,10
	PO	Selects POSITIVE Voltage/Current
	NE	Selects NEGATIVE Voltage/Current
	LD B$	Selects either high impedance (unterminated) or low impedance (50 ohms) output of STANDARD AMPLITUDE and STANDARD CALIBRATOR Modes Selects internal 50 Ohm Termination in STANDARD TIME, LOW DISTORTION PULSE, and FAST RISETIME Modes. Valid B$ = HI or 50
	TR C$	Selects Trigger Output Mode Valid C$ = NORM (÷ 1), X.1 (÷ 10), X.01 (÷ 100), OFF (Disable), ON (Return to last valid state)
	OU D$	Controls OUTPUT Valid D$ = OFF (Standby) or ON (Operate)
	LO E$	Controls CURRENT Loop Output Valid E$ = ON or OFF

TABLE 3-10. 6127B PROGRAMMING INFORMATION - Cont'd

COMMAND		DEFINITION
TYPE	MNEMONIC	
Special	VA	DEVIATION on [Valid in ON (Operate) condition only]
	FX	DEVIATION off
	PC J$	% DEVIATION (Valid only in VA state) Valid J$ = Numeric value from -9.9 to +9.9
	IN	Increment DEVIATION one step (0.1% increase) (Valid only in VA state)
	DE	Decrement DEVIATION one step (0.1% decrease) (Valid only in VA State)
	CH Z$	Selects Mode when in STANDARD CALIBRATOR Mode Valid Z$ = AUTO (100 Hz chopping rate), DUT (Device Under Test), CG (Calibrator)
		CONTROLLER REQUESTING INFORMATION
	PCT?	Sets up 6127B (CG) to respond with a transmission of the Deviation data in the form: PCT Y$, ... (CR) (LF-EOI) Where Y$ = Numeric value between -9.9 and +9.9
	ID?	Sets up the Model 6127B (CG) to respond in the form: BALLANTINE 6127B (Prom Version XX) Where XX is the revision level.
	CSET?	Sets up the 6127B to respond with the command code string equivalent to the Instrument's correct setting.
	ERR?	Sets up 6127B (CG) to respond with a message in the form: ERR X$, ... (CR) (LF-EOI) Where X$, ... = Numeric error codes if no error pending X$ should = 00

NOTES: 1. All letters transmitted on bus are to be as upper case ASCII characters.
2. Only the first two characters of each COMMAND word are required by the 6127B.

6127B IEEE SRQ ERROR CODES		
SERIAL POLL HEXADECIMAL CODE	ERR? RESPONSE DECIMAL CODE	ERROR MESSAGE
--	00	No Error
43	03	IEEE Output Buffer Not Accepted
44	04	IEEE Buffer OVERFLOW
50	10	Alternate Command Not Legal in the present Mode
51	11	Deviation Command Not Ok
52	12	No Mode Selected
53	13	Multiplier Command Not Ok
54	14	Frequency Command Not Ok
55	15	Multiplier Command Not Ok
57	17	Amplitude Command Not Correct
58	18	No Space in String
60	20	Illegal Command in String
61	21	Amplitude Setting Out of Range
62	22	Terminator Not Ok
63	23	Deviation Not on during Inc, Dec, or PCT Command
64	24	Illegal Trigger Setting
66	26	Time Terminator Command Not Ok in this Mode
67	27	Get Not Legal due to DT OFF Command

NOTE

To obtain the error code, a serial poll sequence must be initiated. The byte received in the serial poll sequence is the error code.

3-27. LEARN MODE The LEARN MODE feature on the 6127B enables the programmer/user to set up an operating condition on the 6127B in LOCAL or REMOTE and then interrogate the instrument over the bus. The response returned from the 6127B is the command set required to initiate the current operating status.

3-28. EXPANDED OPERATING INSTRUCTIONS

3-29. Output Heads. Two accessory output heads are provided with the Model 6127B Calibrator. These heads connect to the instrument at the front panel OUTPUT receptacle, A24-J100. Either of these accessories, when attached, connect directly to the Unit Under Test (UUT).

3-30. MODEL 61271C HEAD (Fast Rise Pulse)

a. VOLTS/DIV

Provides accurate, positive-going square waves of 10 Hz, 100 Hz, 1 kHz, and 10 kHz as well as positive and negative dc. The amplitude of this signal may be varied from 40 uV up to 200 V in a 1, 2, 5 sequence. See table 3-5 for valid entries. Amplitude deviation capability of up to ± 9.9% (high or low in terms of UUT error) is also provided.

This output signal may be used to check an oscilloscope's amplitude accuracy, vertical input attenuator compensation, and low frequency compensation. Other applications are to check the response of both high and low pass filters and to check the accuracy of dc and true rms voltmeters. The VOLTS/DIV output signal drives a high impedance (1 Megohm) load for all voltage levels and 50 ohms for voltage levels up to five volts.

b. TIME/DIV

Provides accurate time markers from five seconds to 0.5 nanoseconds (2 GHz) into a 50 ohm load, in a 1, 2, 5 sequence. Time deviation capability to ± 9.9% (high or low in terms of UUT error) is also provided.

The timing markers are crystal controlled and may be used to calibrate the time base (including delayed time base) of oscilloscopes; and to verify the performance of frequency counters, spectrum analyzers and general timing circuits.

There are five command types that can be sent across the bus to the 6127B. These are defined in the following table.

TYPE	STRING EXAMPLE	WHEN USED
State	DT OFF DT ON LLO GTL	Prior to selecting an output mode. Required only once if not to be changed.
Mode	MODE V;V/D 1MV MODE CU;A/D 5MA MODE MK;S/D 2MS MODE FE MODE ED;V/D 5V MODE CAL;V/D 2V	Anytime a change of mode is selected this entire string must be sent as a group.
Modifier	FREQ 10KHZ MULT 4 LDZ HI TRIG X1 OUT ON LOOP OFF U/D 1V	May be sent any time after Mode Select while in Standby or Operate state. Some commands apply only to particular Modes.
Special	VAR FXD PCT -8.8 INC CHOP AUTO	These commands may only be used while the 6127B is in the Operate State.

The following examples are typical strings to select output signals for each mode of operation.

STANDARD AMPLITUDE:	3 mV @ 1 kHz & Operate into High Z MO V;V/D 1MV;MU 3;FR 1KHZ;OU ON
STANDARD CURRENT:	10 mA @ 10 kHz & Operate MO CU;A/D 5MA;MU 2;FR 10KHZ;LO ON
STANDARD TIME:	10 uS time marks MO MK;S/D 10US;OU ON
STANDARD CALIBRATION:	4 mV @ 100 Hz & Operate Chopped @ 100 Hz MO CA;V/D 1V;MU 4;FR 100HZ;OU ON
FAST RISETIME PULSE:	1 V into 50 ohms @ 100 kHz & Operate MO FE;FR 100KHZ;OU ON
LOW DISTORTION PULSE:	30 mV @ 1 MHz & Operate into 50 ohm load MO ED;V/D 10MV;MU 3;FR 1MHZ;OU ON

NOTE

All SPACES indicated in strings and command mnemonics are part of the program and MUST be included.

Figure 3-11. General Talker/Listener Program For The 6127B

c. FAST RISE PULSE

Provides a clean, flat-topped, positive-going, fast-rise step from a negative base to ground with a repetition frequency of 10 Hz, 100 Hz, 1 kHz, 10 kHz or 1 MHz into a 50 ohm load.

The fast rise pulse is nominally 1.1 volt peak-to-peak when terminated in a 50 ohm load. It may be varied in amplitude from 0.99 to 1.21 volts by activating % DEVIATION. When -9.9% Deviation is selected, the fast rise amplitude is about 0.99 volts and when +9.9% Deviation is selected, the fast rise amplitude is about 1.21 volts.

The 200 picosecond rise time is used for checking step response of oscilloscope amplifiers (as well as other amplifiers) and for verifying overshoot, ringing, and pulse shape of the oscilloscope display. It may also be used to trigger logic elements and to check their propagation and delay times. Still other applications (made possible because the FAST RISE signal repetition rate is crystal controlled and very rich in harmonics) include comb markers to check sweep generators and a frequency standard for checking spectrum analyzers beyond 12 GHz.

d. LOW DISTORTION PULSE

Provides a clean, flat-topped, 100 nanosecond rise time squarewave, variable in amplitude from 1 volt to 100 volts, into a high impedance (1 MΩ shunted by less than 35 pF); and a 1.6 nanosecond rise time squarewave, variable from 20 millivolts to 1 volt, into 50 ohms. Repetition rates of 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz and 1 MHz are selectable for the low impedance (50Ω) output and 10 Hz, 100 Hz, 1 kHz, 10 kHz and 100 kHz for the high impedance output. No % Deviation in time or amplitude is provided for this mode.

The low distortion pulse may be used to check the frequency compensation of oscilloscope input attenuators and will find application wherever a clean, fast rise, squarewave is required.

3-31. MODEL 61272C HEAD (Amplitude Comparator)

Permits comparison of the Model 6127B VOLTS/DIV output to the internal calibrator signal available on most oscilloscopes. When initially activated, the two signals are alternately displayed at a 100 Hz chopped rate. The selected output from the 61272C is applied to the oscilloscope vertical input as shown in figure 3-23. The first time the UUT/CALIB key pad is touched, the output from the 61272C Head is the VOLTS/DIV signal from the Model 6127B. The second touch of the key pad changes the output to that of the oscilloscope (UUT) calibrator signal and is indicated by the lamp on the Model 61272C. Successive touches cause the output from the 61272C Head to alternate between the VOLTS/DIV signal and the UUT calibrator signal. To change operation back to the chopped mode, the CALIBRATOR OUTPUT key pad is pressed and then a new AMPLITUDE/DIV entry is made.

In the chopped mode, the 61272C serves as a high resolution amplitude coincidence detector. The % Deviation feature is activated and then varied to create a "nulled" display on the oscilloscope. This indicates that the oscilloscope (UUT) internal calibrator peak-to-peak amplitude is equal to the VOLTS/DIV output from the 6127B. By reading the displayed 6127B % DEVIATION the calibration error of the UUT calibrator may be determined. (See paragraph 3-55.)

NOTE

A 50Ω load may be presented to the UUT internal calibrator by pressing the 50Ω LOAD touch key on the Model 6127B Calibrator. The comparator oscilloscope still retains its normal 1 MΩ input impedance under this condition.

3-32. Trigger Output. The 6127B TRIGGER OUTPUT BNC connector provides a squarewave output for externally triggering the oscilloscope under test. The choice of trigger outputs are:

OFF (no trigger output), X1 (the normal mode) or ÷ 10 and ÷ 100. The X1 trigger output is locked to the TIME/DIV markers or to the VOLTS/DIV, FAST RISE PULSE, or LOW DISTORTION PULSE squarewave. When ÷ 10 or ÷ 100 is selected, the trigger output squarewave repeats once for every ten or one-hundred transitions of the time marker or amplitude squarewave outputs. The frequency of the TRIGGER OUTPUT is limited to a maximum of 10 MHz (100 ns) and a minimum of 0.002 Hz (500 seconds). For time markers above 10 MHz, the trigger frequency remains at 10 MHz. For time marker and trigger coincidence always trigger on the positive going TRIGGER OUTPUT edge.

3-33. The TRIGGER OUTPUT BNC shell is connected to circuit ground (isolated from the enclosure of the Model 6127B) to minimize noise in the low level VOLTS/DIV amplitude calibration signals. The difference in potential between the enclosure ground and the TRIGGER OUTPUT BNC connector ground never exceeds more than a few millivolts across the 50 ohm 1/2 W resistor connecting the BNC connector shell to the enclosure.

CAUTION

Never apply any voltage or current between the TRIGGER OUTPUT ground and the 6127B enclosure. The TRIGGER OUTPUT cable should always be terminated in 50 ohms at the trigger input of the UUT.

3-34. MILLIAMPERES/DIV CURRENT LOOP. The MILLIAMPERES/DIV CURRENT LOOP provides for the calibration of clamp-on type ac and dc current probes. The output is a squarewave current that may be varied from 1 to 100 mA in a 1, 2, 5 sequence. A choice of frequencies of 10 Hz, 100 Hz, 1 kHz and 10 kHz are offered as well as positive direct current and negative direct current. The arrow above the CURRENT LOOP indicates the direction of current flow when DC POS is selected.

3-35. The MILLIAMPERES/DIV CURRENT LOOP may be used to verify the current amplitude calibration of both ac and dc current probes. Deviation capability of ± 9.9% is provided for the current probe under test.

3-36. Operating Hints. Refer to table 3-11 for a list of helpful operating hints.

3-37. Verifying UUT Amplitude Accuracy and Input Attenuator Compensation.

a. Select the VOLTS/DIV OUTPUT mode to provide squarewaves having extremely flat tops and bottoms, a precisely known peak-to-peak amplitude and a crystal controlled frequency. Attach the Model 61271C Accessory Head to connect the Calibrator signal to the oscilloscope amplifier (UUT). (Refer to figure 3-12 for test equipment set-up.)

b. Set the Model 6127B controls as follows for testing scopes having 1 Megohm amplifier input resistance:

OUTPUT Mode	VOLTS/DIV
AMPLITUDE/DIV	Same as the UUT Volts/Div range to be checked
DIVS	5
TIME/DIV-FREQUENCY	1 kHz
DEV	OFF
STANDBY/OPERATE	OPERATE

c. Set the oscilloscope (UUT) controls as follows:

Volts/Div	1
Input Coupling	DC
Trigger Source	Internal, + Slope
Trigger Coupling	AC
Time/Div	0.5 milliseconds

d. Observe that the UUT displays a squarewave signal of approximately 5 divisions peak-to-peak. The signal should have flat tops and sharp corners to verify proper oscilloscope vertical amplifier alignment. (See figure 3-13.)

NOTE

It is desirable to check for a constant input capacitance, on all UUT ranges tested, by inserting an Input Capacitance Standardizer (such as the Ballantine Model 10650A) between the UUT input and the 61271C output. Constant input capacitance on all ranges is required on a scope to assure proper frequency compensation of scope probes when VOLTS/DIV ranges are switched. Most scopes provide capacitance trimming to standardize input capacitance between ranges.

e. If an Input Capacitance Standardizer is used, it will be necessary to change the DIVS on the 6127B from 5 to 10 to maintain the same display of 5 divisions on the UUT since the Capacitance Standardizer attenuates the signal by a factor of 2:1. Adjust the Input Capacitance Standardizer compensation, using an insulated alignment tool, until a flat topped squarewave with sharp corners is displayed on the UUT. Do not readjust the standardizer when switching VOLTS/DIV ranges on the oscilloscope.

f. Select % DEVIATION on the 6127B by pressing the DEV key pad and observe that 0.0% is indicated by the DEVIATION display.

g. Position the bottom of the displayed squarewave on the next lower horizontal graticule line of the UUT.

h. Increment the % DEVIATION by pressing the △ key pad (this will cause the amplitude of the squarewave to increase). Decrement the % DEVIATION by pressing the ▽ key pad (this will cause the squarewave amplitude to decrease). By incrementing or decrementing, adjust the squarewave amplitude until it is exactly 5 divisions peak-to-peak as indicated by the UUT. Read the % DEVIATION displayed on the Model 6127B. It is the amplitude range calibration error of the UUT.

NOTE

If it was necessary to increment the % DEVIATION to obtain a display of exactly 5 divisions, the Calibrator will indicate a LO % DEVIATION reading. This means the UUT has low sensitivity. A HI % DEVIATION reading (the result of decrementing) means the UUT has high sensitivity.

i. If the % DEVIATION reading exceeds the allowable calibration error of the UUT, note the reading and recalibrate the oscilloscope.

j. Check each VOLT/DIV range of the UUT. Set the Model 6127B Calibrator VOLT/DIV to match the UUT. Check all ranges for amplitude and flatness of waveshape. For dual trace oscilloscopes repeat the procedure for the second channel.

k. If the % DEVIATION reading exceeds the accuracy limits of the UUT or waveshape abberation errors occur, the UUT will require maintenance and recalibration of vertical amplifier sensitivity, attenuator frequency compensation and/or input capacitance adjustment (if using an Input Capacitance Standardizer).

TABLE 3-11. MODEL 6127B OPERATING HINTS

HINT	REASON
1. Always connect the UUT and 6127B Calibrator to adjacent power mains receptacles on the same branch line.	To minimize any potential (noise) between the 6127B and the UUT when using low level calibrating signals and when checking wide bandwidth scope amplifiers.
2. Always set the 6127B STANDBY/OPERATE to OPERATE after changing operating modes.	Because STANDBY mode disconnects the 6127B OUTPUT signal as a safety precaution to protect the operator. OPERATE connects the OUTPUT signal to the UUT. % DEVIATION may only be called for in the OPERATE mode.
3. Always make a 6127B TRIGGER selection when externally triggering the UUT.	The 6127B TRIGGER OUTPUT initializes to OFF and the UUT will not have a display unless a 6127B trigger is requested.
4. When checking a UUT having a 50 ohm input impedance, push 50Ω LOAD key pad on the 6127B in: VOLTS/DIV LOW DISTORTION PULSE FAST RISE PULSE TIME/DIV	Because then the Model 6127B will automatically set proper voltage levels for 50 ohm loads.
5. Don't be surprised when you make a selection if the previous selection is displayed.	The 6127B intelligently returns to the last valid entry made if you enter an invalid request.
6. If the Model 6127B reacts strangely, with blinking indicators or invalid indications, simply turn the POWER off for 10 seconds and then turn it back on.	The Model 6127B microprocessor lost program control. Turning the POWER off for ten seconds resets the 6127B digital logic and properly re-starts the Calibrator, beginning with a SELF TEST.
7. Press the CLEAR key pad twice to reset the digital control circuits and initiate the Self Test sequence.	Use if Model 6127B appears to lose program control or use to clear the calibrator setting by calling for the SELF TEST.
8. When using the TIME/DIV mode, avoid the apparent base line shift prior to the first pulse by selecting positive slope, external triggering on the UUT.	Because the Time Markers are coincident with the faster (positive going) edge of the TRIGGER OUT square wave.
9. When externally triggering a UUT from the 6127B TRIGGER OUTPUT always select positive triggering slope on the UUT.	The positive edge of the 6127B TRIGGER OUTPUT squarewave is time coincident with the TIME/DIV markers, the VOLTS/DIV calibrating squarewave, FAST RISE PULSE, and LOW DISTORTION PULSE Modes.
10. Unit self test checks okay after SELF TEST cycle, but will not respond to the bus controller.	6127B bus address may not match controller program. Determine controller program address requirement for the 6127B. Then SELF TEST again and wait for all prompt lines to appear. Press CLEAR touch key and observe 6127B bus address display in DEVIATION window. If 6127B and controller bus address do not coincide, reset 6127B address.

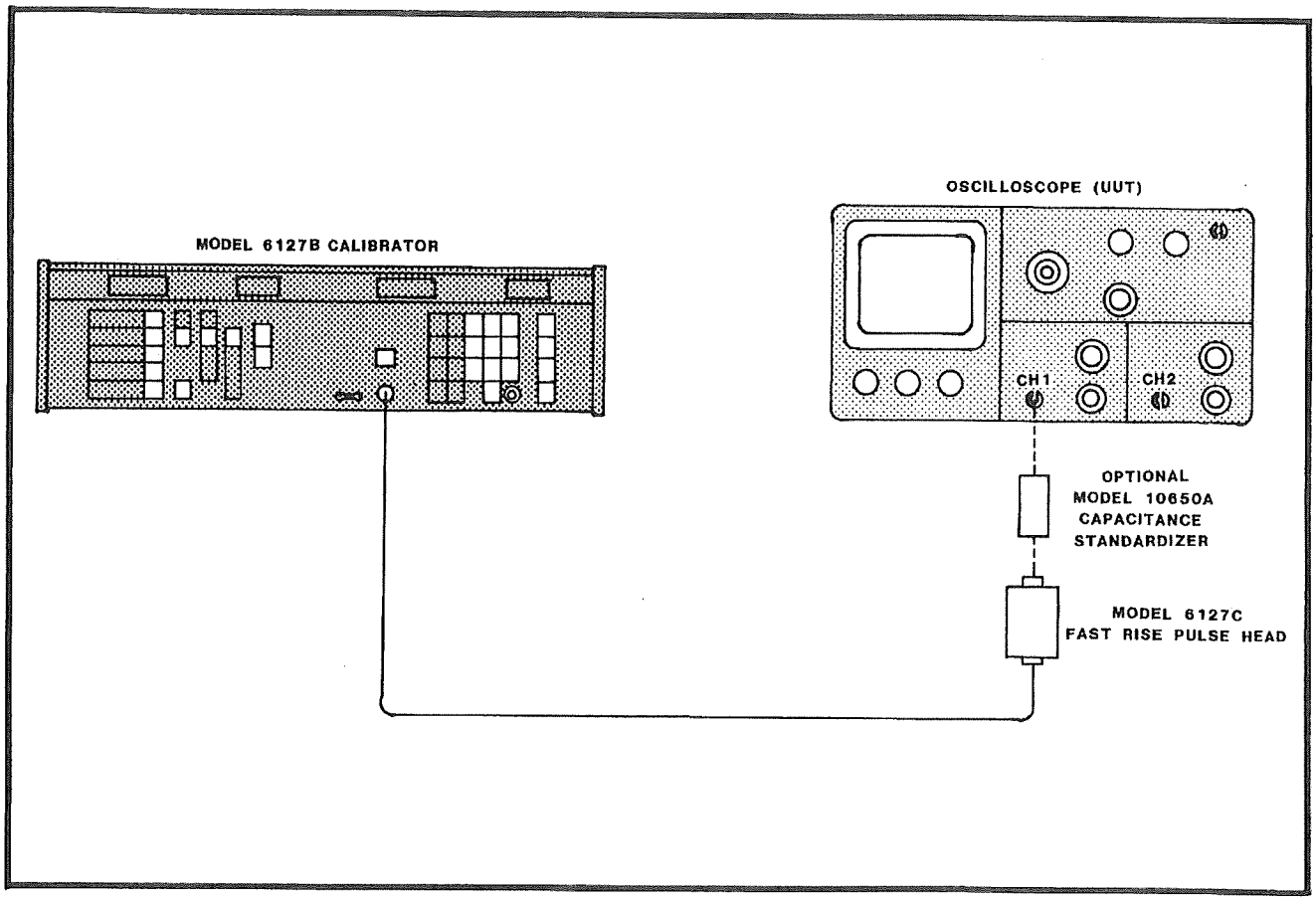


Figure 3-12. Volts/Div Mode, Equipment Set-Up

3-38. Possible Errors When Using VOLTS/DIV Mode.

3-39. LOADING ERRORS (HI Z LOAD). The VOLTS/DIV OUTPUT amplitude accuracy is specified for a 1 Megohm load. Because the output impedance of the 6127B VOLTS/DIV attenuator is very low, the errors caused by loads of less than 100 kΩ are small. Changing the DIVISIONS multiplier does not change the output impedance or the loading errors. Refer to table 3-12 for a summary of these loading errors. The 1 megohm input impedance found on most oscilloscope vertical amplifiers causes negligible loading errors and the 0.25% calibration accuracy of the Model 6127B is maintained. However, even severe loading errors may be corrected by applying the following formula:

1. Determine the load resistance. (R_L).
2. Find the 6127B source resistance (R_S) on the VOLTS/DIV range selected by referring to table 3-12.
3. Calculate the loading error (E_L), in percent, by:

$$E_L = 0.25 - \frac{R_S}{R_S + R_L} \times 100$$

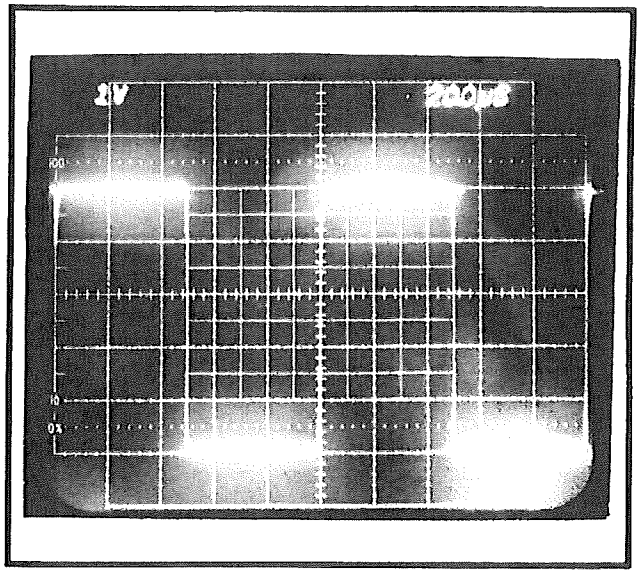


Figure 3-13. Volts/Div Display; 1 V, 5 Div

3-40. LOADING ERRORS (50Ω LOAD). When the 50Ω LOAD touch key is pressed, the 6127B is advised that it must drive a 50Ω load. For this condition, the amplitude accuracy specification of the 6127B is only valid on accurate 50Ω loads.

Voltage calibration errors will result when the load is not precisely 50 ohms. Refer to figure 3-14a. When the 50 Ω LOAD mode is selected, but a high load impedance is used, then the VOLTS/DIV OUTPUT amplitude will be approximately twice the value displayed by the 6127B Calibrator. Refer to figure 3-14b.

3-41. DC OFFSET ERRORS. For VOLTS/DIV OUTPUT amplitudes above 50 mV, the 6127B output attenuator resistors must dissipate sufficient power to heat the precision resistors. Although ultra-stable precision resistors are used, the offset errors caused by self heating may be noticeable when either DC POS or DC NEG is selected. In these modes, the attenuator resistors dissipate twice the power they would for any of the squarewave modes. Thermo-electric potentials are generated as a result of attenuator heating. These thermo-electric potentials cause offsets of a few microvolts on the lower level ranges of VOLTS/DIV OUTPUT.

3-42. Always allow a few minutes waiting period when selecting low VOLTS/DIV OUTPUT amplitudes (below 50 mV) after having used the higher output amplitudes. This assures temperature equalization in the precision attenuators and relays and minimizes thermo-electric offset potentials in low level VOLTS/DIV OUTPUT signals.

TABLE 3-12.
MODEL 6127B VOLTS/DIV OUTPUT RESISTANCE AND LOADING ERROR

VOLTS/DIV	6127B SOURCE RESISTANCE IN OHMS (R_S)		% LOADING ERROR		
			1 MΩ LOAD	10 MΩ LOAD	
20 V	2.5 k		0%	+ .23%	
10 V	2.5 k		0%	+ .23%	
	≤ 5V	≥ 5V		≤ 5V	≥ 5V
5 V	51.6	2.5 k	0%	0%	+ .23%
2 V	51.6	2.5 k	0%	0%	+ .23%
1 V	51.6	2.5 k	0%	0%	+ .23%
.5 V	51.6		NEGLIGIBLE	NEGLIGIBLE	
.2 V					
.1 V					
50 mV					
20 mV					
10 mV					
5 mV					
2 mV					
1 mV					
.5 mV					
.2 mV					
.1 mV					
50 uV					
20 uV					
10 uV					

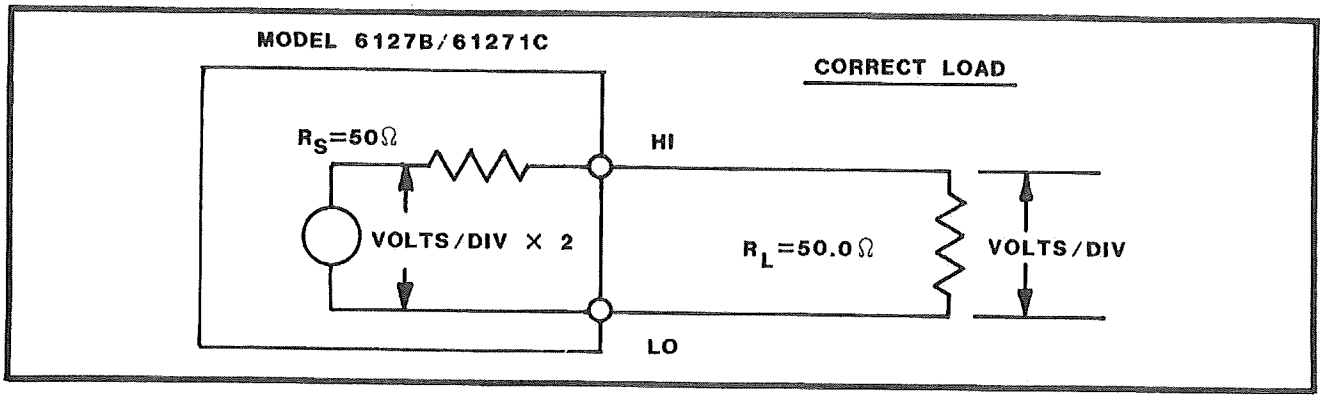


Figure 3-14a. 50Ω Source/50Ω Load Condition

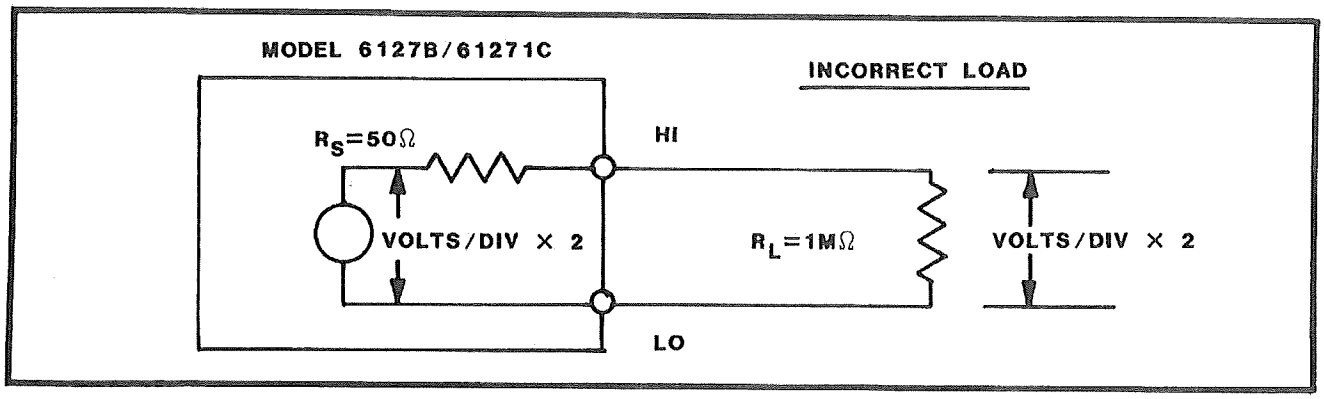


Figure 3-14b. 50Ω Source/High Impedance Load Condition

3-43. Do not use the GND position of the oscilloscope (UUT) input coupling switch or short the input terminals of the voltmeter (UUT) to establish a zero voltage reference. Instead, select the Model 6127B STANDBY mode. This eliminates the effect of most of the thermo-electric offset potentials in the Calibrator. The voltage offset sensed by the UUT when the Model 6127B is in the STANDBY mode is the minimum error voltage of the total calibration system. This voltage should be measured whenever using low dc mode amplitude levels (below 50 mV) of VOLTS/DIV OUTPUT and the correction applied to the calibration measurement. Thermo-electric potentials are offset voltages from reference zero and do not affect the basic accuracy of squarewave amplitude calibration.

3-44. Ground Current Errors

3-45. Always ground the Model 6127B Calibrator, the Bus Controller and the UUT to earth ground. Use adjacent power mains receptacles on the same power outlet branch to avoid potentials between the various earth grounds and between power line low and earth ground. This is especially important for minimizing noise interference when using low amplitude levels of the VOLTS/DIV OUTPUT.

3-46. The VOLTS/DIV circuitry floats within the 6127B and is grounded only at the 61271C Head OUTPUT BNC. Always connect the 61271C Head directly to the UUT input and not through additional connecting cables. This avoids circulating ground loop noise problems between the 6127B/61271C output and the UUT input. When using VOLTS/DIV OUTPUT signals below 100 mV and the calibration of the UUT is suspect or displays either digital noise or amplitude distortion at power mains frequency, carefully check all of the instruments for power mains circuit leakage problems. If the instruments are found safe, it is recommended that one or more of these instruments be temporarily isolated from the power mains earth ground. Well shielded isolation transformers may also be used to connect each of the instruments separately to the power mains. These measures will reduce or eliminate circulating ground currents and thus reduce the noise content of low level VOLTS/DIV calibration signals. See figure 3-15 for a typical 10 microvolt, 5 div, 1 kHz VOLTS/DIV signal displayed with dc to 30 kHz bandwidth.

WARNING

Disconnecting earth grounds may result in a personnel safety hazard. Use extreme caution to avoid shock. One instrument should remain grounded at all times. If in doubt, measure the potential between the enclosures of all instruments in the test set-up using a high impedance voltmeter. Always restore earth ground connections to all instruments once low amplitude VOLTS/DIV calibration is completed.

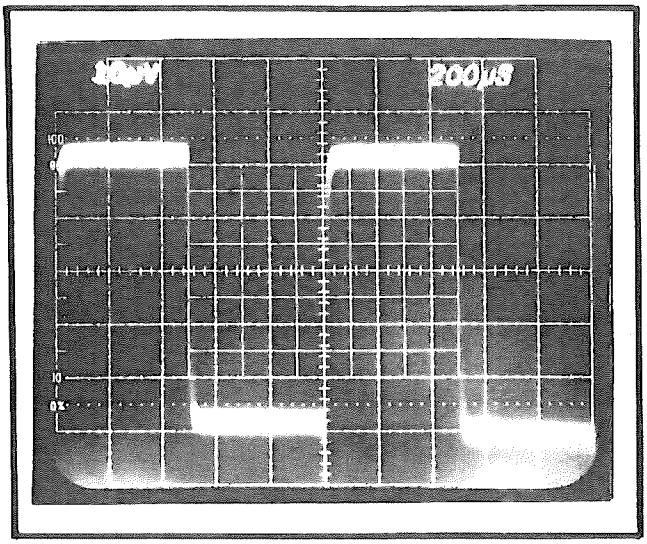


Figure 3-15. Volts/Div Display; 10 uV, 5 Div

3-47. Warmup Errors.

3-48. The Model 6127B is fully operational within one minute after the power has been turned on. The amplitude calibration drift during the first 20 minutes of operation in a laboratory environment, where the ambient is held constant, is less than ± 0.2 percent.

3-49. Verifying Oscilloscope Time Base Accuracy

a. Select the TIME/DIV OUTPUT mode to provide time markers, having well defined peaks (figure 3-16) for periods slower than 10 nanoseconds and sinewaves for 1 and 0.5 nano-seconds (figure 3-17 and 3-18). All timing signals are locked to the 6127B precision crystal controlled clock. Attach the Model 61271C FAST RISE PULSE Head to connect the TIME/DIV markers to the oscilloscope (UUT). Refer to figure 3-19 for test equipment set-up. The 6127B automatically switches a 50Ω termination located in the 61271C FAST RISE PULSE Head to properly load the TIME/DIV circuits. When a UUT having 50Ω input system is being tested, then press the 50Ω LOAD key pad to have the 6127B automatically remove the internal 50Ω termination within the 61271C head.

b. Set the Model 6127B controls as follows:

OUTPUT Mode	TIME/DIV
TIME/FREQ	Same as the UUT Time/Div range to be checked
DEV	Off
TRIGGER	÷ 10
STANDBY/OPERATE	OPERATE

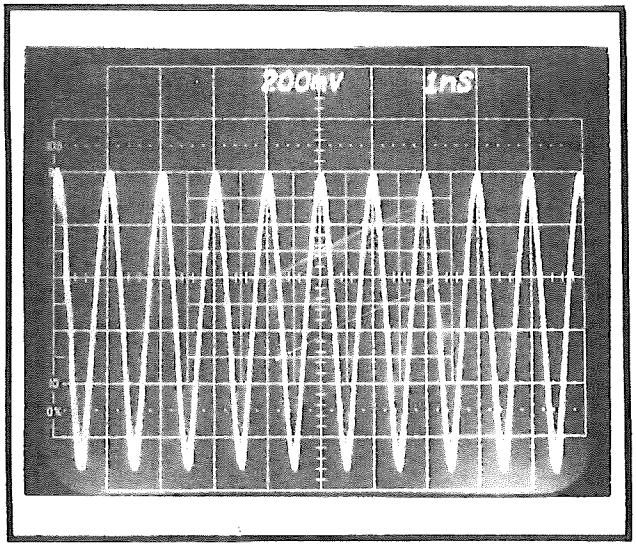


Figure 3-17. Time/Div Display 1 ns Markers

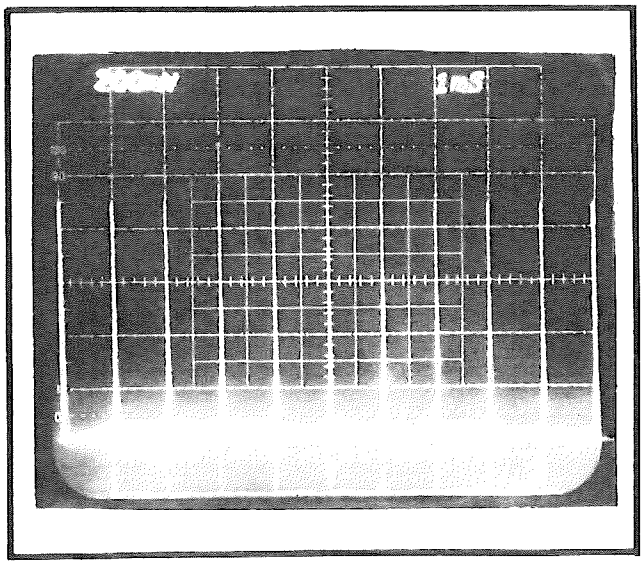


Figure 3-16. Time/Div Display, 1 ms Markers

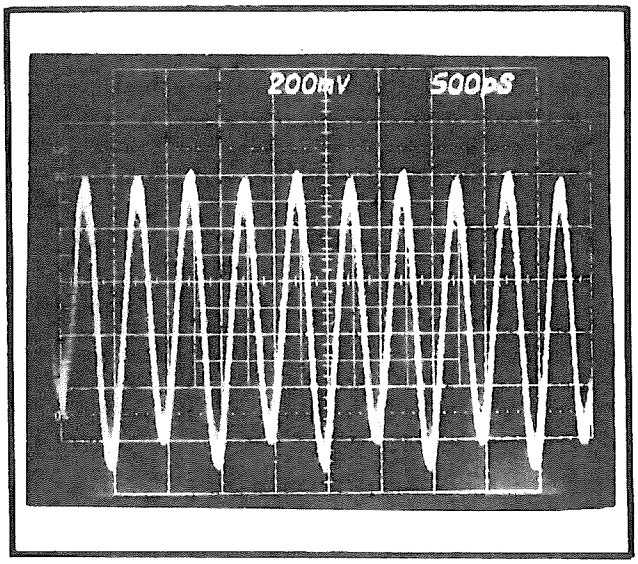


Figure 3-18. Time/Div Display, 500 ps Markers

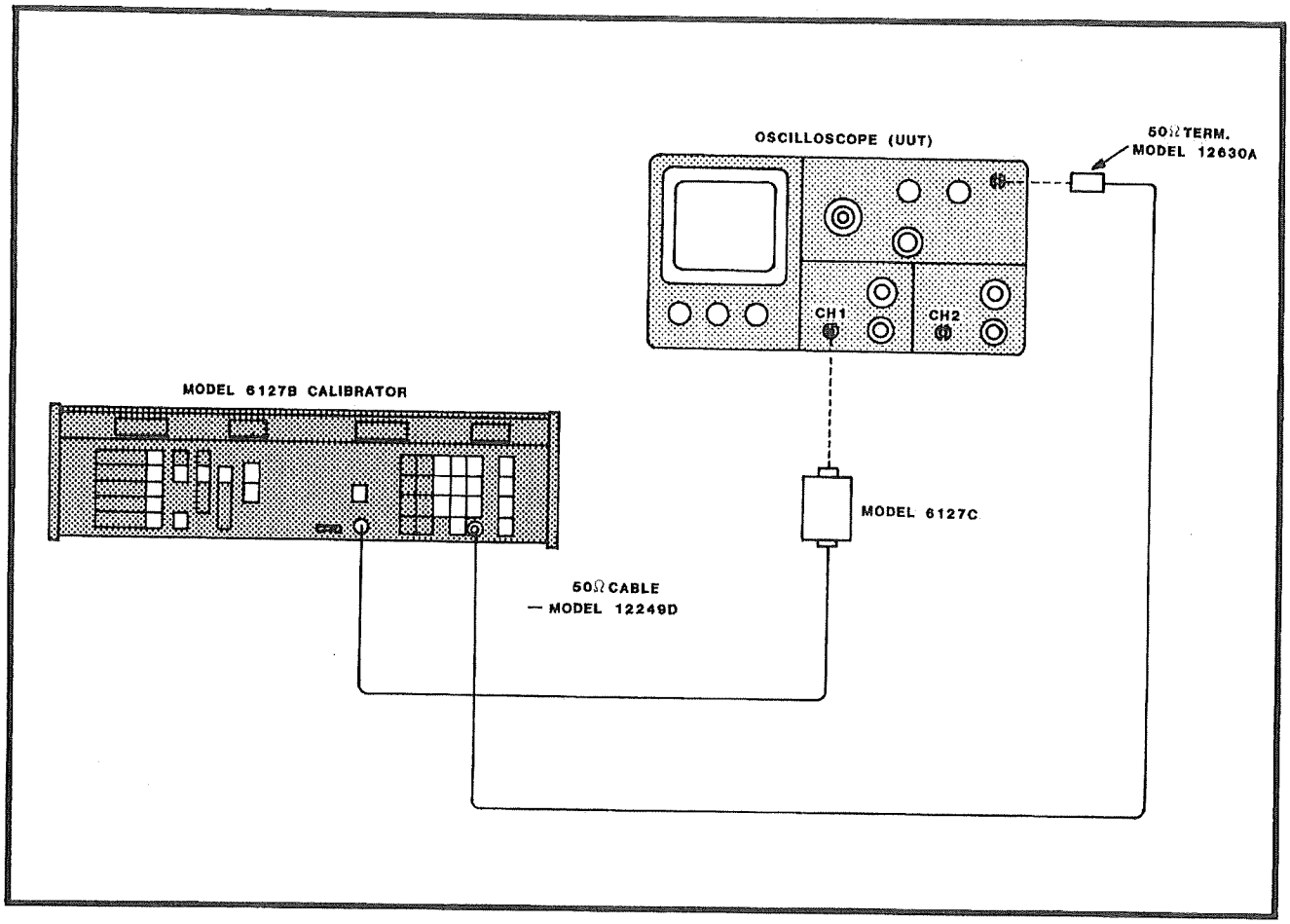


Figure 3-19. Time/Div Mode, Test Set-Up

c. Set the oscilloscope (UUT) controls as follows:

Volts/Div	0.2 V
Input Coupling	DC
Trigger Source	External, - Slope
Trigger Coupling	AC
Time/Div	To UUT range that is to be checked. (Rotate the Time/-Div Variable control to the CALIBRATE position.)

d. Adjust the oscilloscope trigger controls to obtain a stable display. Observe that the peak-to-peak amplitude of the time markers is about 5 divisions.

NOTE

Use triggered sweep synchronization for all TIME/DIV settings of the UUT to avoid unstable triggering and to optimize left hand time marker alignment with the vertical graticule line.

e. Adjust the oscilloscope horizontal position control to place the second marker pulse on the second vertical graticule line from the left.

f. Select % DEVIATION on the 6127B by pressing the DEV key pad and observe that 0.0% is indicated by the DEVIATION display.

g. Increment the % DEVIATION by pressing the △ key pad (this will cause the distance between the time markers to increase) or decrement by pressing the ▽ key pad (this will cause the distance to decrease). By incrementing or decrementing, adjust the time markers so that they are coincident with the vertical graticule lines. (See figure 3-17.) The second and tenth time marks should exactly align with the vertical graticule lines. Read the % DEVIATION displayed on the Model 6127B. It is the time base range calibration error of the UUT.

NOTE

If it was necessary to increment the % DEVIATION to align the time markers, the Calibrator will indicate a LO % DEVIATION reading. This means the UUT time base calibration is slow. A HI % DEVIATION reading (the result of decrementing) means the UUT calibration is fast.

h. If the % DEVIATION reading exceeds the allowable time base calibration error of the UUT, note the reading and any obvious sweep non-linearity before recalibrating the oscilloscope.

i. Check each TIME/DIV range of the UUT. Set the Model 6127B Calibrator TIME/DIV to match that of the UUT.

NOTE

When using the higher TIME/DIV ranges of the 6127B, oscilloscopes with insufficient bandwidth will show a decrease in vertical sensitivity and some on-screen distortion. In this case, it may be necessary to switch to a more sensitive VOLTS/DIV range of the UUT.

3-50. To calibrate fast sweeps of oscilloscopes having low bandwidths, do not select the same TIME/DIV setting on the Model 6127B as the range being checked on the UUT. Instead, select a 6127B TIME/DIV range that is ten times slower than that of the oscilloscope. This will produce two markers on the UUT display, one at the left vertical graticule line and one at the right; still adequate for time base calibration. For example: to calibrate a 1 ns/div sweep range on an oscilloscope having only a 150 MHz bandwidth, select the 10 ns TIME/DIV range of the 6127B Calibrator. The oscilloscope vertical amplifier is then required to pass only the 100 MHz content of the 10 ns time markers and will readily display them for UUT time base accuracy verification.

3-51. Fast Rise Pulse Measurements. The Model 6127B provides a fast rise time signal from a generator located within the Model 61271C Head. The FAST RISE PULSE OUTPUT features a clean 200 ps rise time pulse that is ideal for checking high frequency alignment of both real time and sampling oscilloscopes. (See figure 3-20.) It permits verification of scope bandwidth by relating the risetime to frequency through use of the following formula:

$$\text{Bandwidth (MHz)} = \frac{350}{\text{Risetime (nanoseconds)}}$$

3-52. To check the risetime of an oscilloscope proceed as follows:

a. Connect the Model 6127B Head to the input of the UUT vertical amplifier. (Refer to figure 3-21 for test equipment set-up.) The 50 ohm termination is automatically switched in to properly terminate the FAST RISE PULSE generator. When the UUT has a 50 ohm input, touch the 50Ω LOAD key pad which will disconnect the internal 50Ω termination in the 61271C.

NOTE

It is recommended that the risetime of a real time oscilloscope be measured with the scope vertical input attenuator set to maximum sensitivity. The Model 6127B Fast Rise Pulse delivers 1 Volt peak-to-peak into 50Ω and requires a 50Ω attenuator between the 61271C OUTPUT connector and the UUT. Use an attenuator that connects directly. Use only a 30 cm air line (or 6 inch low loss 50Ω coax) to delay any input impedance mismatch reflections away from the leading edge displayed on the UUT. For example: 30 dB of attenuation will be required to display the fast rise pulse on the UUT with the scope Volt/Div set to 5 mV. With this amount of attenuation, the amplitude of the displayed signal will be about 6 divisions high.

b. Use internal triggering on the oscilloscope under test. Obtain a stable rise time display with the oscilloscope set to its highest sweep speed.

c. Activate the DEVIATION controls by pressing the DEV touch key. By either incrementing (△) or decrementing (▽) DEVIATION, the amplitude of the Fast Rise Pulse may be adjusted to exactly 6 divisions peak-to-peak (0% and 100% horizontal reference lines) on the oscilloscope graticule.

NOTE

Before measuring the displayed risetime of the oscilloscope vertical amplifier, the time base accuracy of the oscilloscope should be checked in the graticule area to be used. For best accuracy of the risetime measurement, check at the fastest magnified sweep speed and position the risetime pulse so that it starts at least 10 percent from the beginning of the sweep. This assures that it is in the linear and best calibrated portion of the sweep.

d. Measure the time required for the pulse to rise from the 10% to the 90% level. This is the displayed risetime.

3-53. The 200 picosecond risetime of the 6127B FAST RISE PULSE checks the performance of oscilloscopes having bandwidths exceeding 1 GHz. For a 300 MHz oscilloscope with a 1.2 ns risetime amplifier, the 200 picosecond FAST RISE PULSE will increase the displayed risetime by only 1%. For slower oscilloscopes, the displayed risetime may

be taken as the true risetime of the UUT amplifier. For oscilloscopes having faster risetimes, the true risetime of the UUT amplifier may be calculated from the following formula:

$$\text{True Risetime} = \sqrt{\left(\frac{\text{Displayed}}{\text{Risetime}}\right)^2 + \left(\frac{\text{Input Rise-}}{\text{time}}\right)^2}$$

Where: Input Risetime (of 61271C) = 0.2 ns, and the true and displayed risetimes are also in nanoseconds.

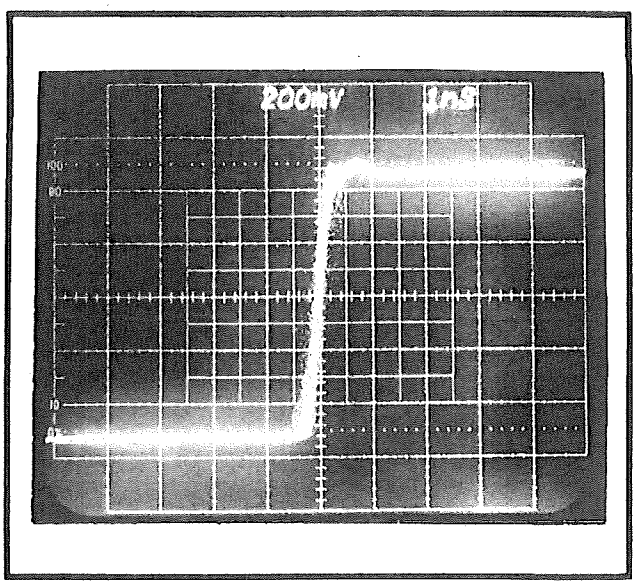


Figure 3-20. Fast Rise Pulse Display, 200 ps Rise Time

3-54. Oscilloscope (UUT) Calibrator Amplitude Accuracy Check

3-55. Chopped Mode. To verify the amplitude accuracy of the oscilloscope's own internal amplitude calibrator, attach the Model 61272C Head to the Model 6127B and proceed as follows:

a. Connect the FROM UUT CALIBRATOR BNC of the Model 61272C COMPARATOR to the oscilloscope (UUT) internal amplitude calibrator, using a short length of coaxial cable. (See figure 3-22.) If the UUT internal calibrator has a range of output voltages, start with the highest amplitude range.

b. Connect the 61272C CHOPPED OUTPUT BNC to the vertical input of the UUT (or other scope having a 1 MΩ input impedance). This will serve as the comparator/coincidence detector.

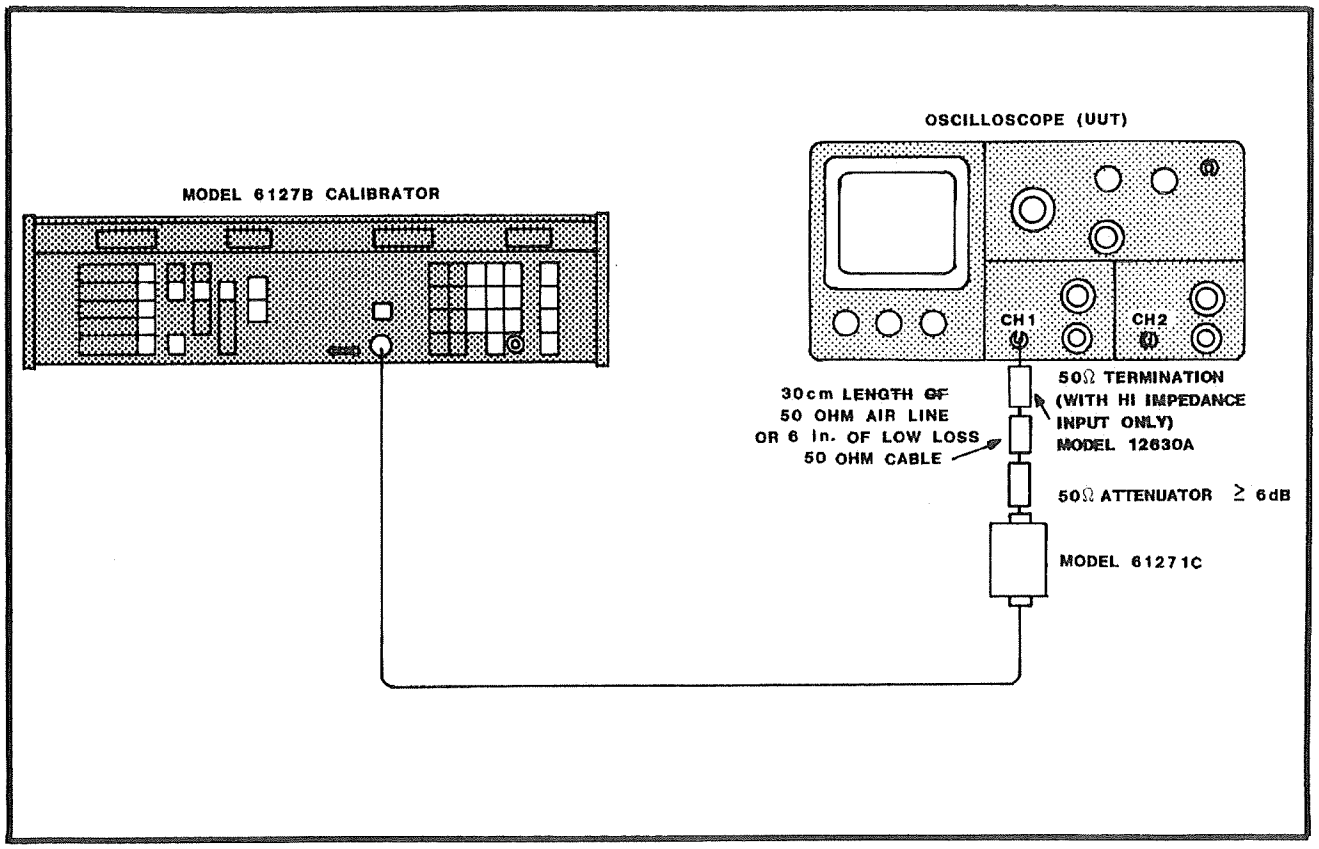


Figure 3-21. Fast Rise Pulse Checks, Equipment Set-Up

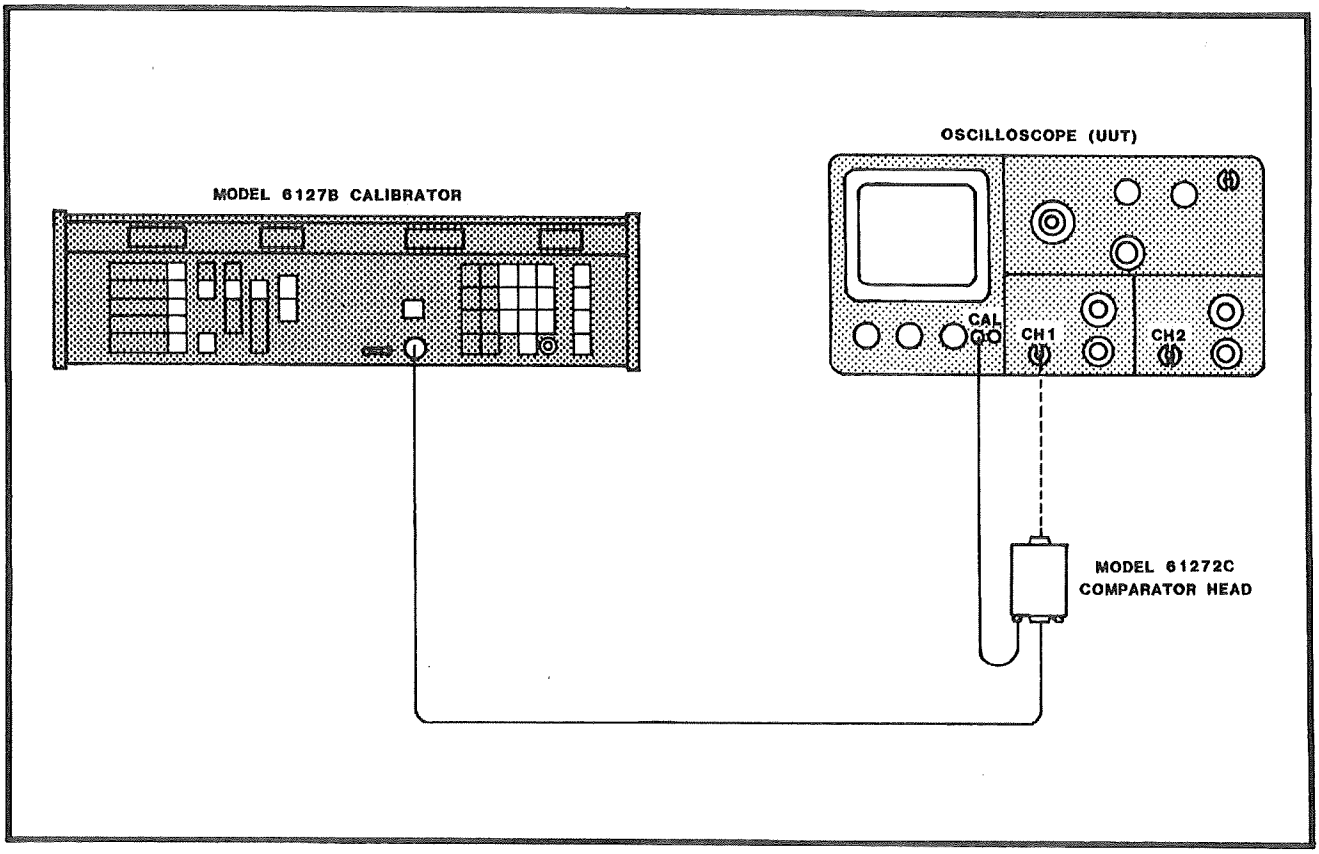


Figure 3-22. Amplitude Comparator Equipment Set-Up

c. Set the Model 6127B controls as follows:

OUTPUT Mode CALIBRATOR

(Note that both the CALIBRATOR and VOLTS/-DIV annunciators light, the TIME/DIV-FREQUENCY display is 1 kHz and the AMPLITUDE/DIV displays prompt lines.)

d. Set the oscilloscope (UUT) controls as follows:

Volts/Div	One-tenth amplitude of UUT internal calibrator
Input Coupling	DC
Trigger	(EXT) Free running or Auto, (No Sync)
Time/Div	50 us

NOTE

If the oscilloscope (UUT) calibrator output amplitude is 50 volts or lower, select the appropriate VOLTS/DIV value and a DIVS (multiplier) value of 1. If the UUT calibrator output amplitude is above 50 volts, select a VOLTS/DIV value of 1/10 the amplitude of the UUT calibrator and then use a DIVS value of 10.

e. Press the STANDBY/OPERATE touch key to put the Model 6127B in the OPERATE mode.

f. Observe the oscilloscope display. It will be a wide band having a single base line along the bottom edge of the sweep and; either a double line (out of calibration) or single line (within calibration) along the top edge.

NOTE

If the oscilloscope (UUT) display appears chopped or torn, select a different TIME/DIV range on the UUT.

g. Press the DEV key pad to activate % DEVIATION.

h. If necessary, press either the △ (increment) or ▽ (decrement) key pad until the top edge of the displayed sweep is a single thin line (similar to the bottom edge). This indicates that the peak-to-peak amplitude of the Model 6127B Calibrator and the Oscilloscope (UUT) internal voltage calibrator are identical.

i. If increased resolution of the coincidence (top) line of the sweep is desired, increase the UUT VOLTS/DIV sensitivity.

j. Observe the % DEVIATION displayed on the Model 6127B. This is the calibration error of the UUT internal calibrator.

3-56. Alternate Mode. Follow the same procedure outlined in the previous paragraph up to step f, and then proceed as follows:

a. Press the UUT/CALIB key pad.

NOTE

Pressing this key pad changes the 61272C chop switch from automatic to manual. Subsequent touches will cause the 61272C chop switch to alternate between the Model 6127B output and the UUT internal calibrator output. A red lamp on the Model 61272C will illuminate each time transfer is made to the UUT output.

b. Press the DEV key pad to activate % DEVIATION.

c. Press either the △ (increment) or ▽ (decrement) key pads until the amplitude of the 6127B Calibrator is identical to that of the UUT internal calibrator, as observed on the oscilloscope.

d. Observe the % DEVIATION displayed on the Model 6127B. This is not the calibration error of the UUT internal calibrator. (See Table 3-13.) To determine the calibration error, apply the following formula:

$$\text{True UUT Error} = \frac{-X}{1+X}$$

$$\text{Where: } X = \frac{\text{Displayed \% DEVIATION}}{100}$$

Example (1):

If the displayed % DEVIATION is 5.0% HI, then:

$$X = \frac{+5.0}{100} = +0.05$$

and

$$\text{True UUT Error} = \frac{-0.05}{1.05} = -0.0476$$

or **-4.76%**

Example (2):

If the displayed % DEVIATION is 3.5% LO, then:

$$X = \frac{-3.5}{100} = -0.035$$

and

$$\text{True UUT Error} = \frac{-(-0.035)}{1+(-0.035)} = \frac{0.035}{0.965} = 0.0362$$

or **+3.62%**

3-57. With the 61272C Comparator Head attached, the Model 6127B has the capability of presenting a 50Ω load to the UUT internal calibrator for signals having an amplitude of 5 volts or less. If the source impedance of the UUT internal calibrator is 50 ohms, press the 50Ω LOAD touch key on the Model 6127B. This will cause the 61272C Comparator Head to terminate the UUT output in a 50 ohm load, indicated by the 50Ω annunciator on the 6127B lighting.

3-58. The Model 6127B will not permit selection of amplitudes greater than 5 volts in the CALIBRATOR mode with 50Ω LOAD selected. However, the 50 ohm load resistance for the calibrator under test in the Model 61272C is not protected from voltage in excess of 5 volts or any voltage that would cause more than 1/2 watt to be dissipated in the 61272C 50 ohm load. When signal inputs to the Model 61272C Comparator BNC input exceed either 5 volts or 1/2 watt, do not select the 50Ω LOAD mode.

WARNING

The maximum power capability of the source connected to the Model 61272C COMPARATOR input from UUT BNC must be limited to 1/2 watt when using the 50Ω LOAD mode. Input power must not exceed 10 watts peak under any operating condition.

Table 3-13. Representative True Offset of UUT Internal Calibrator

% DEVIATION DISPLAY OF MODEL 6127B		TRUE OFFSET OF UUT INTERNAL CALIBRATOR
1.0%	HI	-0.99%
1.0%	LO	+1.01%
2.0%	HI	-1.96%
2.0%	LO	+2.04%
3.0%	HI	-2.91%
3.0%	LO	+3.09%
4.0%	HI	-3.85%
4.0%	LO	+4.17%
5.0%	HI	-4.76%
5.0%	LO	+5.26%
9.9%	HI	-9.00%
9.9%	LO	+10.99%

Ballantine

ADDENDUM

TO INSTRUCTION MANUAL:

MODEL No. 6127B

Applies to all units
#2 (90-10311-5B)

Page 5-4.

TABLE 5-2. TEST EQUIPMENT (Cont'd)

Change to read: Tektronix 7000 Series with 7S14, 7S11, 7T11, 7M11, and S2 Sampling Heads

Page 5-10.

Figure 5-5

Change to: Change to attached Figure 5-5.

Add: Add attached Figure 5-5a.

Page 5-11.

Paragraph 5-15g

Add: Add the following to the end of paragraph 5-15g

The 61271C FAST RISE pulse aberrations are specified as measured with a 1 GHz sampling scope.

Paragraph 5-15

Add:

k. The preferred test set-up uses a Tektronix 4.6 GHz sampling scope (7M11/7T11/7S11/S2)with a 7M11 delay line providing signal delay and an external trigger for the TTL (See Figure 5-5a). This set-up provides a faster display change scope sweep time to 100 ps/div. Observe that the displayed 10% to 90% rise time of the positive going edge is less than 276 ps. Measure the displayed rise time ($T_{display}$)and correct for the 7M11 delay line rise time ($T_{delay\ line}$ = 175 ps) and the 7S11/S2 rise time (T_{scope} = 75 ps) by using the following formula

$$T_{display} = \sqrt{(T_{delay\ line})^2 + (T_{sampler})^2 + (T_{pulse})^2} =$$

$$\sqrt{(175\ ps)^2 + (75\ ps)^2 + (200\ ps)^2} =$$

$$\sqrt{30625 + 5625 + 40000} = \sqrt{76250} = 276\ ps$$

Page 5-11.

Paragraph 5-15k - Cont'd

For the 4.6 GHz sampling scope with signal delay line the net risetime is 190 ps (equivalent bandwidth of 1.84 GHz). The risetime measured on the sampling scope should, therefore, be no slower than 276 ps to verify the 200 ps risetime of the 61271C FAST RISE PULSE. The verification Polaroid oscillogram provided by Ballantine uses this test system and displays a risetime of approximately 276 ps to verify 200 ps 61271C FAST RISE time. To obtain aberration amplitude deconvolute against tunnel diode reference pulse shown in the oscillogram. The tunnel diode reference is 'clean' so that its displayed aberrations are caused by the sampler and the test set-up. The 61271C FAST RISE pulse aberrations are specified when measured with a 1 GHz bandwidth sampling scope (see paragraph g above) and aberrations will be slightly greater when measured with the faster test set-up described in this paragraph.

Page 5-19.

Paragraph 5-49A

Add:

5-49A. 200 ps Fast Rise Adj. (A41-R4, A41-R18, A41-R31, A41-C5, A41-C9) Preferred Method Using 4.6 GHz Sampling Scope With External Signal Delay Line

a. Remove the two upper screws at the front of the Model 61271C Head and the two upper screws at the rear. Lift off the top (labeled) half of the enclosure.

b. Connect the 61271C OUTPUT BNC to the input of the Tektronix Model 7M11 delay line plug in. Connect the output of the delay line to the 4.6 GHz Model 7S11/S2 sampling head. Connect the delay line trigger output to the EXT TRIG input of the Model 7T11 sampling time base. Connect a 6 dB (X2) 50 ohm attenuator and 30 cm of GR874 50 ohm air line between the input of the 7M11 delay line and the 61271C to delay reflections away from the fast rise pulse and upper corner. See Figure 5-5a.

NOTE

Use only good quality connectors with unworn plating. If possible use gold plated connectors to avoid intermittents or pulse shape aberrations.

c. Push the 6127B POWER switch in to the ON position.

d. Select FAST RISE PULSE, 100 kHz TIME/DIV-FREQUENCY.

e. Press the STANDBY/OPERATE touch key pad and set the 6127B to OPERATE.

f. Refer to Figure 5-12 for location of adjustments in the 61271C Head. See Figure 5-13 for pulse shape.

g. Use paragraph 5-49g from page 5-19 of instruction manual Volume 2.

h through l. Use the procedure from pages 5-20 and 5-21 of the manual noting the change in 5-49 l below.

Page 5-20. Figure 5-13

Change to read: Figure 5-13. Fast Rise Pulse Display, 200 ps Rise Time Displayed As 407 ps Using a 1 GHz Sampling Scope

Page 5-21. Paragraph 5-49 1

Change to read: 1. Replace the top cover and again check pulse aberrations to be within ±3%, rise time display to be no slower than 276 ps (when measured with the 7M11 delay line and 7S11/S2 sampler) and best flatness of the pulse top, or 407 ps (when measured with a 1 GHz Sampler Tek 7S14) and best flatness of the pulse top.

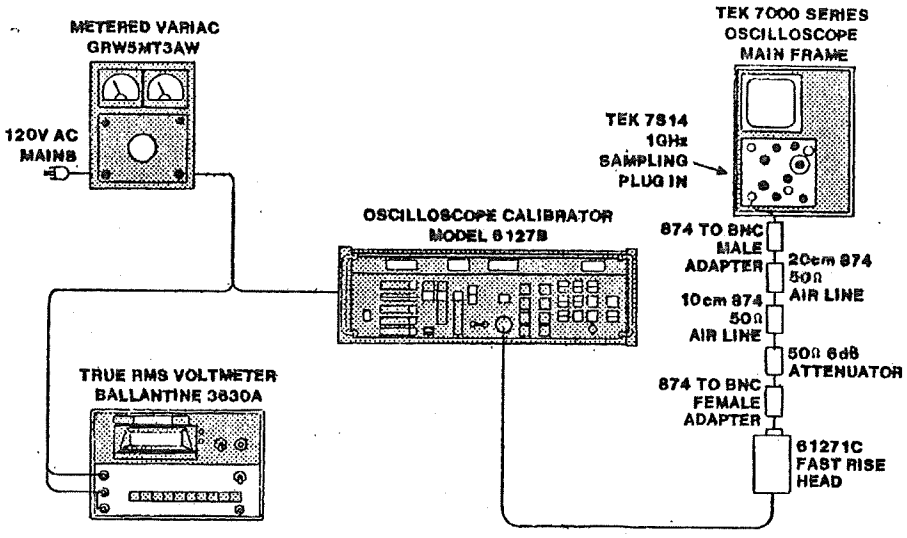


Figure 5-5. FAST RISE PULSE Output Check, Test Set-Up

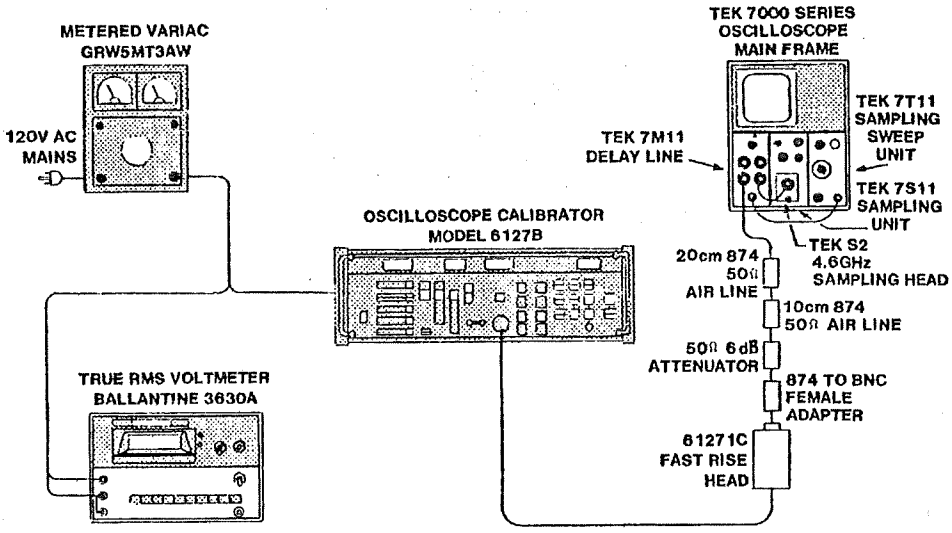


Figure 5-5a. FAST RISE PULSE Output Check, Test Set-Up (Preferred Test Set-Up)

Ballantine

ADDENDUM

TO INSTRUCTION MANUAL:

MODEL No. 6127B

Applies to all units
#1 (90-10311-5B)

Page 5-11.

Paragraph 5-16 i.

Change: 5mV/DIV to .5mV/DIV

Paragraph 5-16 j.

Change to read: j. Select MILLIAMPERES/DIV mode, 5 mA, 10 DIVISIONS, 1 kHz FREQUENCY, and OPERATE. Depress UUT/CALIB keypad.

Paragraph 5-16 l.

Change: 8 div peak to peak to 5 div peak to peak
1 mV/mA to 50 mV/mA

Page 5-16.

Paragraph 5-36 a.

Delete: Delete paragraph 5-36 a.

Paragraph 5-36 b.

Change to read: b. Connect the differential voltmeter as shown in figure 5-10.

Paragraph 5-36 c.

Delete: Delete paragraph 5-36 c.

Paragraph 5-36 d.

Change: 5 DIVISIONS to 10 DIVISIONS

Figure 5-10. Current Calibration, Test Set-Up

Delete: Delete the word 'A26-R5' from the figure. The test set-up does not change.

Page 5-17.

Paragraph 5-36 g.

Change to read:

g. Press the STANDBY/OPERATE touch key. Press the UUT/CALIB touch key.

Paragraph 5-36 i.

Delete:

Delete paragraph 5-36 i.

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