INSTRUCTION MANUAL

MODEL 1625A
Active AC / DC
Current Shunt

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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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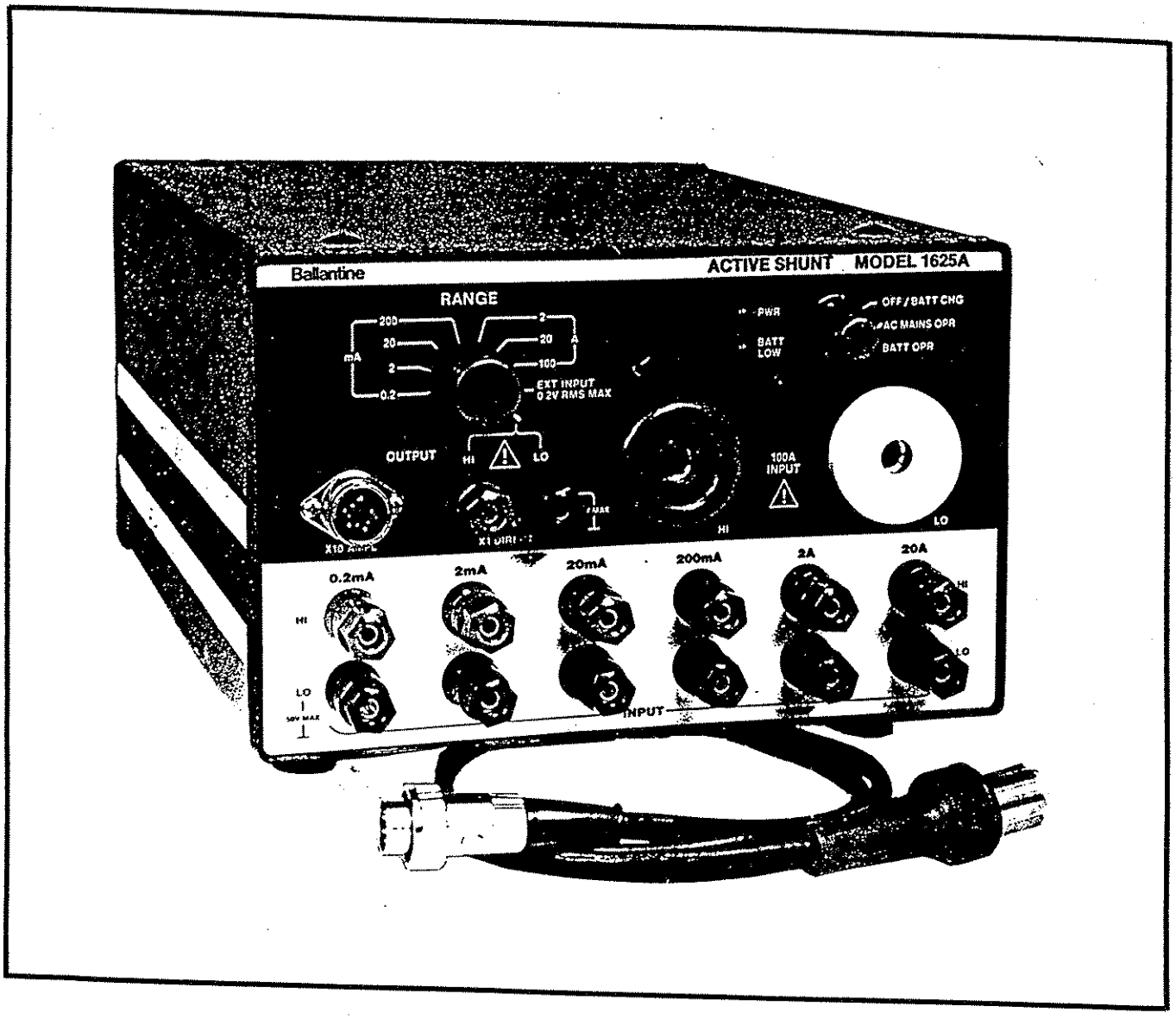


Figure 1-1. Model 1625A Active AC/DC Current Shunt

SECTION 1
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. The Model 1625A Active Current Shunt is a precision AC/DC shunt. It incorporates seven decade shunt ranges from 200 uA full scale to 100 Amperes. Each shunt range has its own current input terminals and a selector switch provides access to the voltage output terminals of each shunt resistor. A single set of binding posts conveniently provides output voltage to the measuring voltmeter. The performance of the shunt resistors permits using the 1625A as a laboratory standard as well as a general purpose measuring instrument.

1-3. A stable precision low noise instrumentation amplifier is incorporated to buffer the voltage output terminals of the shunt resistors. The amplifier has a precisely adjustable gain of 10 so that the output potential from each current shunt may be used to drive a 200 ohms per volt AC/DC transfer device. Sensed output leads from the precision amplifier to the thermal transfer standard maintain accuracy and measuring integrity from dc to well beyond 100 kHz although ac flatness and accuracy is specified to 10 kHz. The precision amplifier permits the shunts to operate at lowest power and also drive an AC/DC transfer device. Internal rechargeable Nicad batteries assure low noise and permit off ground operation.

1-4. The availability of a precision amplifier permits all the current input to the shunt resistors to flow without bypassing measured current to the AC/DC transfer device. This avoids the otherwise limiting condition which restricts passive shunts to a low current of 2.5 mA when used with thermal transfer standards.

1-5. The compliance voltage of the shunts is less than 0.25 volts at full scale for each range except the 100 Ampere range which has a compliance voltage of only 125 mV. Each shunt is a highly stable ac/dc resistor connected in a four terminal configuration. A compensated adjustable network controls voltage output to a precise dc and ac current to voltage conversion. The 20 A and 100 A ranges each incorporate a non-inductive shunt resistor made of a specially heat treated alloy developed by Ballantine. These shunts are highly stable with a low temperature coefficient of resistance of nominally ±10 ppm per degree centigrade. This assures rapid settling time with best accuracy and minimum measurement time.

1-6. Forced air cooling is provided by a fan mounted on the rear panel. Outside air is pulled in by the fan, passed over the shunt resistors, and exhausted at the rear panel. DC power is provided for the fan. The fan is operable when using 100, 120, 220, and 240 volts 50 to 400 Hz ac mains power. The internal batteries will provide fan power when operating the 1625A off line.

1-7. The 1625A is housed in a rugged all aluminum enclosure which is fully shielded for EMI considerations. The instrument has sturdy die cast end frames, side extrusions, and vinyl clad covers. The enclosure conforms to EIA half rack 5.25 inch high standards and may be rack mounted or used on the lab bench or in portable applications.

1-8. SPECIFICATIONS

1-9. Specifications for the 1625A Active Current Shunt are listed in Table 1-1.

1-10. AVAILABLE ACCESSORIES

1-11. Table 1-2 lists the available accessories.

TABLE 1-2. AVAILABLE ACCESSORIES

BALLANTINE PART NO.	DESCRIPTION
31-10338-0	100 Ampere plug (Red)
31-10339-0	100 Ampere plug (White)
88-10120-1	2 meter cable, #2 gauge, 100 Ampere plug (white) and spring clip
88-10121-1	2 meter cable, #2 gauge, 100 Ampere plug (red) and spring clip
88-10122-1	1 meter cable, #2 gauge, 100 Ampere plug (red) at each end
88-10123-1	1 meter cable, #2 gauge, 100 Ampere plug (white) at each end
800-06	Rack mount kit for 2 half rack units 5.25-inch rack height
38-10037-1	Half rack cover plate for 800-06

SHUNTS

Type: 4 terminal networks with calibration adjustments for each network.

RANGE	NOMINAL SHUNT VALUE	DC ACCURACY	AC ACCURACY (1 kHz	AC ACCURACY 10 kHz	MAX. INPUT (DC + AC rms)
100 A	0.001 Ω	±0.015%	±0.1%	-	100 A
20 A	0.01 Ω	±0.01%	±0.1%	±0.5% (5 kHz)	20 A
2 A	0.1 Ω	±0.01%	±0.1%	±0.10%	2 A
200 mA	1 Ω	±0.01%	±0.1%	±0.10%	200 mA
20 mA	10 Ω	±0.01%	±0.1%	±0.10%	20 mA
2 mA	100 Ω	±0.01%	±0.1%	±0.15%	2 mA
0.2 mA	1000 Ω	±0.01%	±0.1%	±0.2%	200 uA

Accuracy: Stated for 1 year at 23°C ±2°C. Expressed accuaracy of volts output to current input add ±10 uV to all percentage limits.

Shunt Output Voltage: 200 mV full scale on all ranges, except 100 mV full scale on the 100 A range.

Shunt Output Loading: 1 Megohm shunted by less than 100 pF.

AMPLIFIER

Gain: 10.000

Accuracy: ±50 ppm ±10 uV at dc. Adjustable with rear panel accessible control.

Offset Voltage: Less than 10 uV. Adjustable to ZERO with rear panel accessible control.

Frequency Response: ±0.01% to 1 kHz
±0.025% to 10 kHz

Input Resistance: 10 Megohms across input binding posts. Differential, balanced to output common.

Input Overvoltage Protection: 300 V rms (440 V ac peak) applied continuously.

Output Resistance: Less than 0.01 Ohms when using sense leads.

Output Voltage (rms): 2 V rms or ±4 V peak.

Maximum Output Current: ±75 mA (dc or ac peak). Protected against damage with continuous short circuits.

Load Resistance: 20 ohms or greater for full rms output.

Common Mode Rejection: 90 dB (dc to 60 Hz).

Common Mode Voltage: ±10 Volts max.

Distortion and Noise: >70 dB below full scale rms output over a bandwidth of dc to 10 kHz.

Power Source: AC mains or internal rechargeable battery.

Amplifier Output: Four wire output through 5 pin female DIN connector. Uses Model 16251A 4 wire sense cable accessory with 874 output connector.

GENERAL SPECIFICATIONS

Input Terminals: Gold plated universal binding posts on all ranges, except 100 A range which uses Superior Model RS100G high current female terminals.

Output Terminals: Gold plated universal binding posts.

ENVIRONMENTAL CHARACTERISTICS:

Temperature: 0 to 50°C operating
-40 to +65°C storage with NiCad batteries

Humidity: 95% R.H. to 40°C (no condensation)
90% R.H. to 50°C

Shock and Vibration: MIL-T-28800, Class 5

Altitude: 3 km (10,000 feet) operating
15 km (15,000 feet) storage

Ventilation: Forced air (fan) cooled.

Off Ground Operation: ±50 Volts (dc or ac peak)

GENERAL

Size:

Height: 133.4 mm (5.25 in.)

Width: 216 mm (8.5 in.)

Depth: 304.8 mm (12 in.)

Weight: 4.32 kg (9.5 lbs.)

Shipping: 6 kg (15 lbs.)

Power: 100/120/220/240 Volts ±10% 50 to 60 Hz; 10 W

Internal rechargeable NiCad batteries operate amplifier "off line" for 8 hours.

Recharge batteries in 14 hours with mains power switch set to OFF.

ACCESSORIES PROVIDED

AC Mains Power Cable
External sense cable 60 cm (25 inches) 5 pin DIN connector to 874 output connector, Model 16251A.
Instruction Manual

ACCESSORIES AVAILABLE

Model 1620A 100 A Transconductance Amplifier
88-10120-1 2 meter cable, #2 gauge, 100 A plug (white) with spring tip termination.
88-10121-1 2 meter cable, #2 gauge, 100 A plug (red) with spring tip termination.

1-12. INSTRUMENT AND MANUAL IDENTIFICATION

1-13. These Ballantine instruments are identified by a two section serial number. The first three digit section identifies the configuration control code. The configuration control code number also appears on the front page of this manual and must coincide with the first three digits of the serial number of your instrument. Addendum sheets attached to this manual will define technical corrections or differences between your instrument which may have a higher configuration code and the unit described in this manual. If applicable, back dating information for instruments having lower configuration control code numbers is located at the end of this manual.

SECTION 2

INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information and instructions necessary for the 1625A Active Current Shunt. Details are provided for initial inspection, ac mains power connection, grounding safety requirements, installation, and repacking for storage or shipment.

2-3. UNPACKING AND INITIAL INSPECTION

2-4. Unpacking and handling of the instrument requires 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 perfect electrical order upon receipt. Check the instrument for damage in transit and perform the electrical performance verification procedure outlined in section 5. If there is indication of damage or deficiency, see the warranty in this manual and notify your local Ballantine field engineering representative or the factory.

CAUTION

It is recommended that the operator be fully familiar with the specifications and all sections of this manual. Failure to do so may compromise the warranty and the accuracy which Ballantine has engineered into your instrument.

2-7. POWER REQUIREMENTS

2-8. The instrument may be operated from any one of the following ac sources:

a. 90 to 110 volts (100 volts nominal)

b. 108 to 132 volts (120 volts nominal)

c. 198 to 242 volts (220 volts nominal)

d. 216 to 264 volts (240 volts nominal)

All instruments operate over the power frequency range of 50 to 400 Hz. Always verify that the ac mains voltage selector is set to the proper voltage as shown in Figure 2-1.

CAUTION

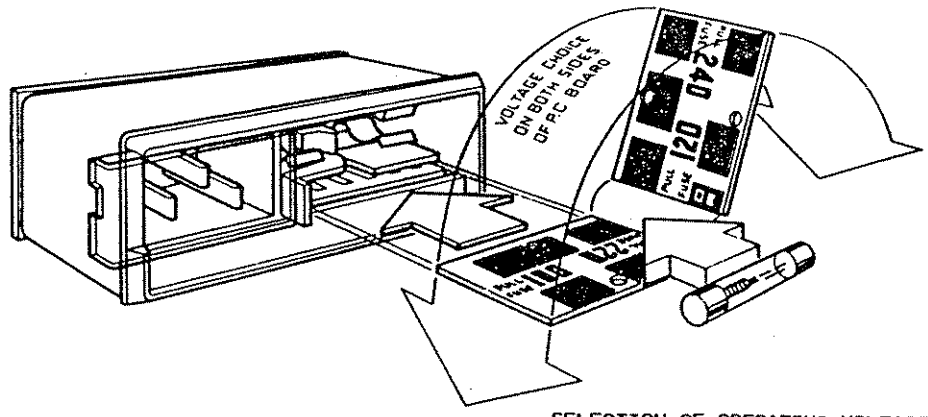
Failure to connect the instrument to match the operating line voltage will damage the instrument and may void the warranty.

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%/+8% of the nominal rms mains voltage. Use a true rms responding voltmeter, such as the Ballantine Model 3630A, to measure the ac mains power voltage.

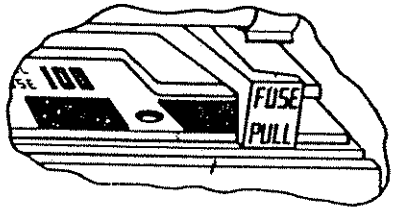
2-9. The instrument may also be operated from internal rechargeable Nickel Cadmium batteries. Battery operation may be selected with ac mains power connected or fully disconnected for off ground floating operation. Fully charged batteries will operate the amplifier and fan for 8 hours. With ac mains power connected, the batteries may be fully charged within 14 hours when the POWER Selector switch is set to OFF/BAT CHG. Upon receipt of the instrument, or after extended storage, the batteries should be charged for at least 14 hours prior to use.

2-10. GROUNDING REQUIREMENTS

2-11. To assure the safety of operating personnel, the U.S. O.S.H.A. (Occupational Safety and Health) requirement and good engineering practice mandate that the instrument panel and enclosure be "earth" grounded. All Ballantine instruments are provided with an Underwriters Laboratories (U.L. and C.S.A.) listed three conductor



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 Selecting and Fused Receptacle Printed Circuit Board Location and Orientation

power cable, which when plugged into an appropriate power receptacle, grounds the instrument. The long offset pin on the male end of the power cable carries the ground wire to the enclosure of the instrument.

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

WARNING

Always earth ground the enclosure of the instrument using the ac mains power cable or through the case ground binding post on the rear panel. This will avoid personnel shock hazard to the operator when using the instrument in off ground floating operation.

2-13. INSTALLATION AND MOUNTING

2-14. The instrument is fully solid state and the shunt resistors dissipate considerable power. Forced air cooling is incorporated. However, the instrument should not be operated where the ambient temperature exceeds 50°C (122°F), when the relative humidity exceeds 95% or condensation appears anywhere on the instrument.

2-15. BENCH MOUNTING

2-16. The instrument is shipped with plastic feet and tilt bail in place ready for use as a bench instrument. A side carry handle is provided for easy portability. See Figure 2-2 for outline dimensions.

2-17. RACK MOUNTING

2-18. The instrument may be rack mounted in a standard 19 inch EIA rack using the Model 800-06 rack mount kit. One or two instruments may be mounted in the rack. If only one instrument is to be mounted, use of cover plate 38-10037-1 is required. See Figure 2-3 for outline dimensions.

2-19. To rack mount, remove the handle as well as the feet and tilt stand from the bottom cover. Set the instrument with its bottom cover attached into the rack mount frame and fasten it to the rack mount shelf. Use four screws to attach the bottom cover to the rack mount shelf.

2-20. Do not mount the 1625A into a rack where high temperatures or large temperature variations occur. Do not locate the instrument near large magnetic or electrostatic fields so as to avoid measurement error.

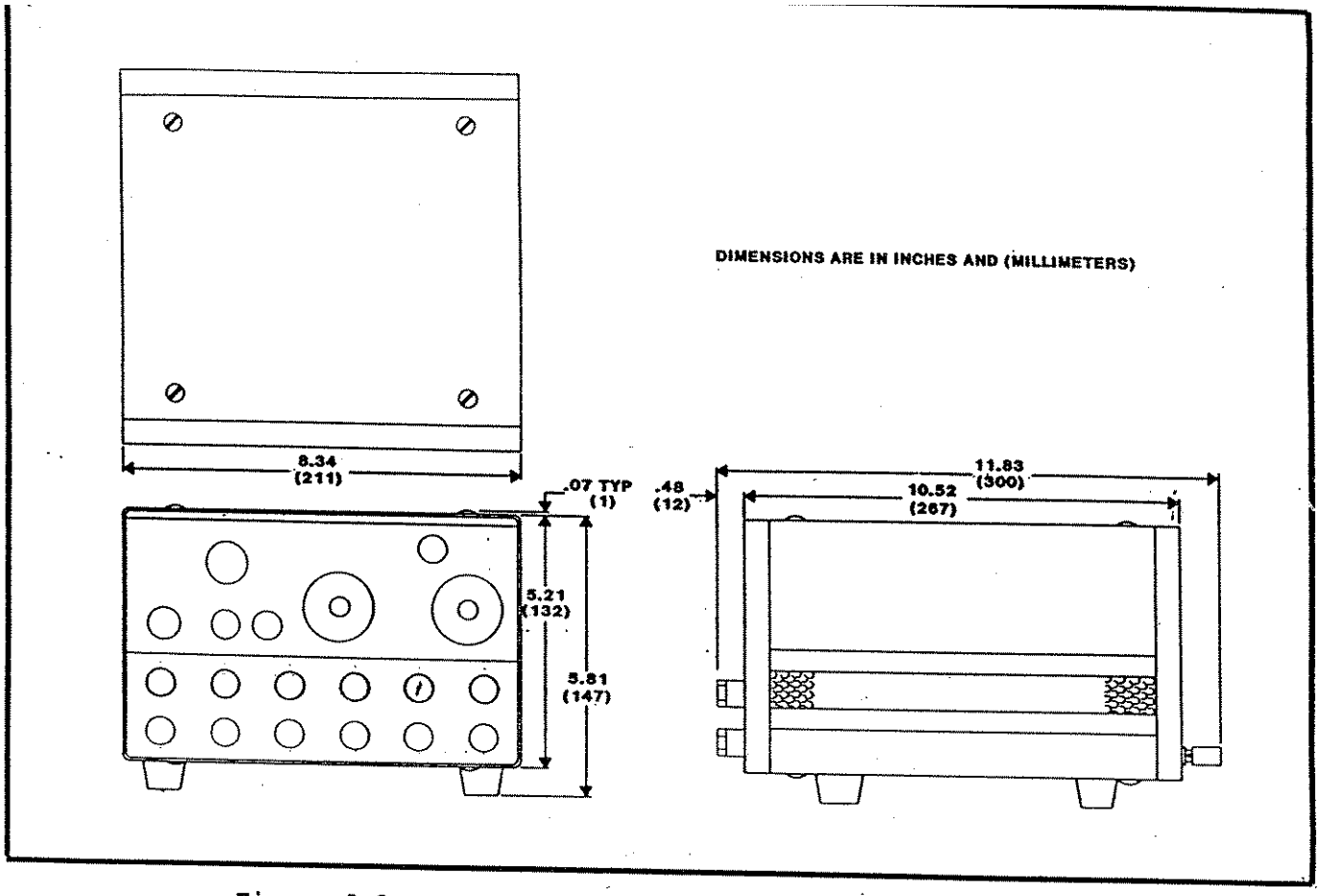


Figure 2-2. Model 1625A Outline Dimensions Bench Mount

2-21. SHORT TERM STORAGE

2-22. 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 suitable protective covering such as a plastic bag or strong kraft paper. Place accessories with the instrument. Store the covered unit in a clean dry area that is not subject to extreme temperature variations or conditions which may cause moisture to condense on the instrument.

2-23. LONG TERM STORAGE OR REPACKAGING FOR SHIPMENT

2-24. If the instrument is to be stored for a long period or shipped, proceed as directed below. If you have any questions, contact your local Ballantine field engineering representative or the Ballantine Service Department at the factory.

2-25. If the original Ballantine supplied packing is to be used, proceed as follows:

a. If the original wrappings, packing material, and container have been saved, repack the instrument and accessories originally shipped to you. If the original container is not available, one may be purchased through the Ballantine Service Department at the factory.

b. Be certain the carton is well sealed with strong tape or metal straps.

c. Mark the carton with the model number and serial number with indelible marking. If it is to be shipped, show sending address and return address on two sides of the box and cover all previous shipping labels.

2-26. If the original container is not available, proceed as follows:

a. Before packing the unit, place all accessories into a plastic bag and seal the bag.

b. For extended storage or long shipping only, use U.S. Government Packaging Method II C and tape a two unit bag of desiccant (per MIL-D-3464) on the rear cover.

c. Place a 13 cm (5 inch) by 20 cm (8 inch) piece of sturdy cardboard over the front panel for protection.

d. Place the instrument into a plastic bag and seal the bag.

e. Wrap the bagged instrument and accessories in one inch thick flexible cellular plastic film cushioning material (per PPP-C-795) and place in a barrier bag (per MIL-B-131). Extract air from bag and heat seal.

f. Place bagged instrument and accessories into a 250 mm (10 inch) x 200 mm (8 inch) x 310 mm (12 inch) fiber board box (per PPP-B-363 type CF, class WR, variety SW, grade V3C). Fill additional spaces with rubberized hair or cellular plastic cushioning material. Close box in accordance with container specifications. Seal with sturdy water resistant tape or metal straps.

g. Mark container "DELICATE INSTRUMENT", "FRAGILE", etc. Mark instrument model and serial number and date of packaging. Affix shipping labels as required or mark according to MIL-STD-129.

NOTE

If the instrument is to be shipped to Ballantine for calibration or repair, attach a tag to the instrument fully identifying the owner (with contact, company name, address, telephone number) and complete details indicating the problem, symptoms, test method used, and service or repair to be performed. Always include the model and serial number of the instrument on the tag. If possible ship by air freight. In any correspondence, identify the instrument by model number, complete serial number, work authorization order, and date and method of shipment to Ballantine.

2-27. Always contact factory for authorization and a control number BEFORE shipping to Ballantine.

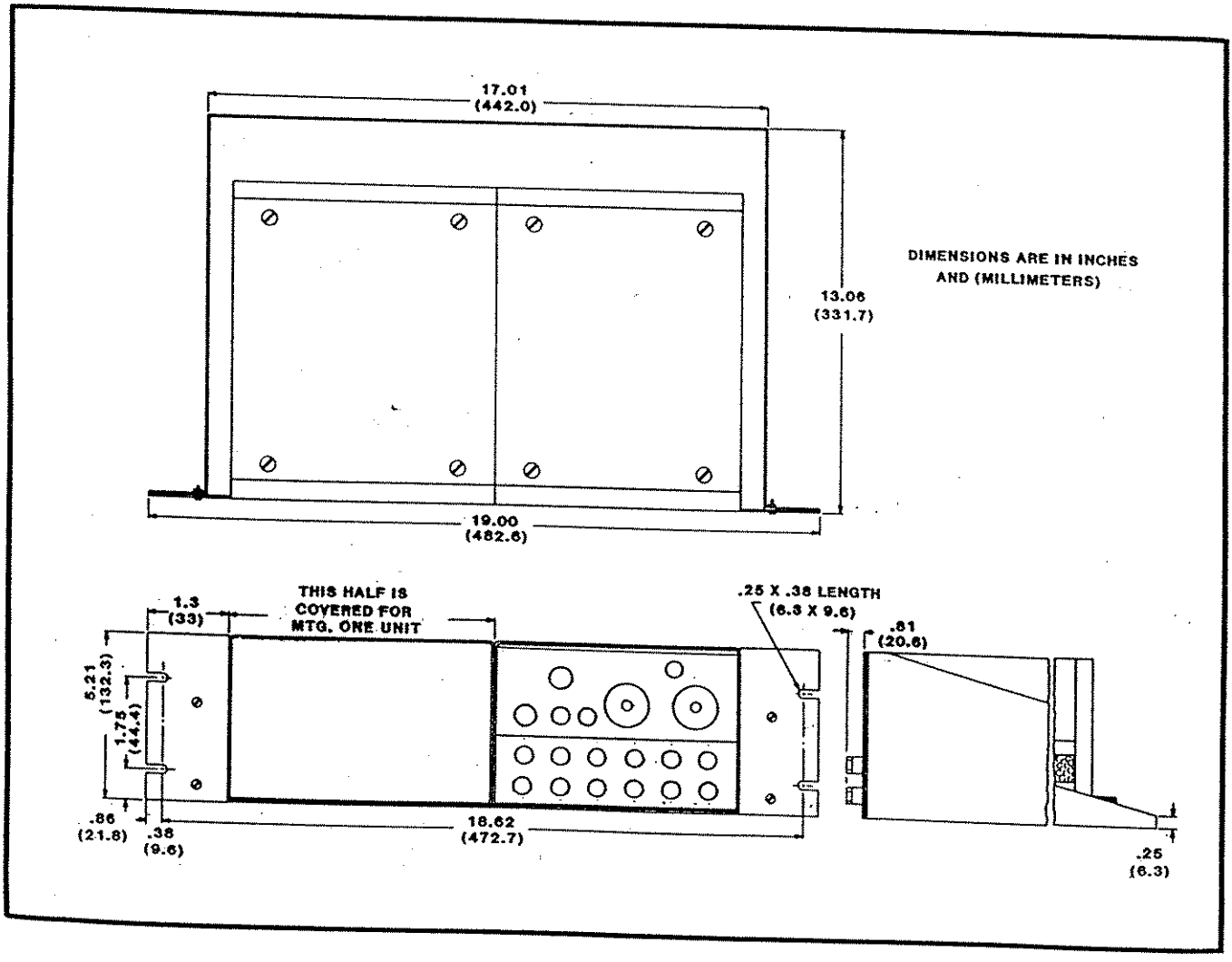


Figure 2-3. Model 1625A Outline Dimensions Rack Mount

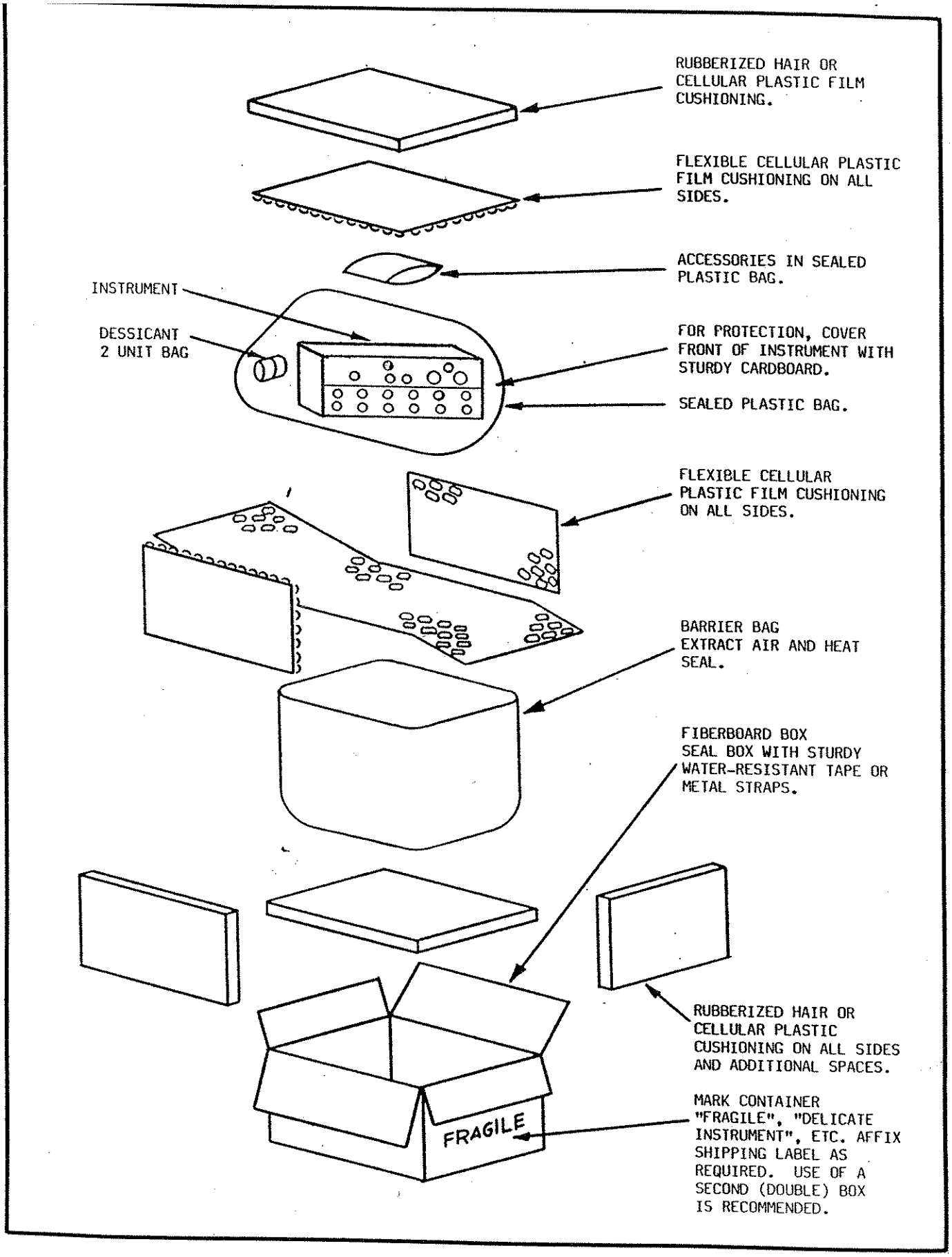


Figure 2-4. Model 1625A Packing Diagram

TABLE 2-1. SAFETY CONSIDERATIONS

SAFETY CONSIDERATIONS

GENERAL

This is a Safety Class 1 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 THE 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. ntentional 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 and adhere to all lockout/tagout requirements.

CAUTION

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.

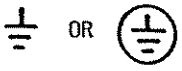
TABLE 2-2

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals

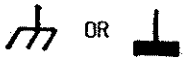
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

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.

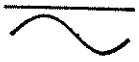
Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating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

OPERATING INSTRUCTIONS

3-1. INTRODUCTION

3-2. This section contains instructions and information required for the operation of the Ballantine Model 1625A Active AC/DC Current Shunt. Included are identification of controls, connectors, and indicators as well as turn on procedures and operating instructions.

3-3. CONTROLS, INDICATORS, AND CONNECTORS

3-4. The instrument controls, indicators, and connectors are identified in Figure 3-1 and 3-2, and in Table 3-1.

3-5. POWER REQUIRMENTS

3-6. For AC mains power and internal battery operation see paragraph 2-7 and see paragraph 2-10 for grounding safety requirement. See Figure 2-1 for fuse replacement instructions. Use only a 0.25 A, 250 V fuse for continued protection against fire and accidental overload.

3-7. FORCED AIR COOLING

3-8. The 1625A is provided with an internal cooling fan to assure the stability and accuracy of the shunts. It is especially important for the high current ranges of 2 A, 20 A, and 100 A. The fan pulls in air, passes it over the shunts, and exhausts it through openings in the rear panel. The fan uses dc power and may be operated from the internal battery when the instrument is operated off-line without ac mains connections.

NOTE

To assure shunt accuracy specifications do not apply input current to the shunts unless the fan is energized. Do not obstruct the air intake and exhaust openings.

3-9. CURRENT MEASUREMENTS

3-10. The 1625A uses a four terminal current shunt configuration. Two terminals (CURRENT INPUT) are used to conduct the current to be measured. The RANGE selector switch is used to select the voltage sense terminals (VOLTAGE OUTPUT) and are not intended to provide any measurement current or output current. The VOLTAGE OUTPUT sense terminals are connected directly across the calibration adjustment divider of the shunt resistor selected by the RANGE switch.

3-11. Each shunt resistor is paralleled by an adjustable resistive voltage divider which provides absolute calibration of 100 mV output for half scale input. This is applicable to dc as well as ac input currents. The output is "direct reading" and no calculations involving shunt resistance are required to determine the dc or rms value of the measured current.

3-12. Output voltage for dc must be measured with a 6.5 digit precision dc voltmeter having 10 Megohm input resistance and an accuracy of nominally ±0.005%.

3-13. When current is passed through a shunt, the voltage (E=IR) developed across the shunt voltage output does not include the voltage drop of the connections leading to the shunt. There are no paralleling loads such as the thermal element in an AC/DC transfer voltmeter. The output voltage from sensing terminals of each shunt network is adjustable to provide absolute values and provides an accurate indication of the current flowing through the shunt. Each shunt resistor is usable from 0 current to full scale current and is linear and stable over the rated range.

3-14. Table 3-2 shows the parameters of the 1625A shunt range.

3-15. CERTIFICATION

3-16. The shunt resistors in the 1625A are certified at dc by connecting the shunt in series with a certified resistor. A stable dc current is passed through both the reference shunt and the 1625A under test. The current is established precisely at the reference shunt by measuring its voltage drop with a high resolution voltmeter. Once the measuring current is known, the voltage drop is measured at the 1625A VOLTAGE OUTPUT terminals and compared to the full scale RANGE value. As an example, a precise 1 ampere current in the 2 A RANGE will provide precisely 100 mV output.

TABLE 3-1. CONTROLS, INDICATORS, AND CONNECTORS

INDEX NO.	CONTROL, INDICATOR, OR CONNECTOR	REFERENCE DESIGNATOR	FUNCTION
1	POWER ON-OFF/BAT CHG	A2-S2	Turns AC mains power ON or OFF. Allows battery recharge in OFF position.
2	100A CURRENT INPUT LO	A2-J19	Lo terminal for 100 A range current input
3	100 A CURRENT INPUT HI	A2-J18	Hi terminal for 100 A range current input.
4	20A HI AND LO CURRENT INPUT	A2-J16 A2-J17	Hi and Lo terminals for 20 A range current input.
5	2 A HI AND LO CURRENT INPUT	A2-J14 A2-J15	Hi and LO terminals for 2 A range current input.
6	200 mA HI AND LO CURRENT INPUT	A2-J12 A2-J13	Hi and Lo terminals for 200 mA range current input.
7	20 mA HI AND LO CURRENT INPUT	A2-J10 A2-J11	Hi and Lo terminals for 20 mA range current input.
8	2 mA HI AND LO CURRENT INPUT	A2-J8 A2-J9	Hi and Lo terminals for 2 mA range current input.
9	0.2 mA HI AND LO CURRENT INPUT	A2-J6 A2-J7	Hi and Lo terminals for 0.2 mA range current input.
10	VOLTAGE OUTPUT LO	A2-J21	Shunt voltage Lo output terminal and precision amplifier external voltage Lo input connector.
11	VOLTAGE OUTPUT HI	A2-J20	Shunt voltage Hi output terminal and precision amplifier external voltage Hi input connector.
12	OUTPUT	A2-J2	Precision amplifier current output and sense access 5 pin connector.
13	RANGE	A2-S1	8 position RANGE selector rotary switch. Selects VOLTAGE OUTPUT from one of 7 current shunt resitors or selects precision amplifier external voltage input.
14	BAT LO	A2-DS1	Red indicator lamp illuminates when internal battery voltage is low and requires recharging.
15	AMPL PWR	A2-S2	3 position switch selects Amplifier OFF, Amplifier with ac mains power, or Amplifier with internal battery (off-line) operation.
16		A3-J2	Case earth ground terminal.
17	AMPL GAIN Adj	A1-R5	10 turn control adjusts amplifier X10 gain.

TABLE 3-1. CONTROLS, INDICATORS, AND CONNECTORS - Cont'd

INDEX NO.	CONTROL, INDICATOR, OR CONNECTOR	REFERENCE DESIGNATOR	FUNCTION
18	AMPL OFFSET Adj	A1-R6	10 turn control permits zero adjustment of amplifier output dc offset voltage.
19	AC Mains Voltage Selector	A3-S1	PC card switch may be inserted 4 ways to select 100, 120, 220, and 240 volts ac mains.
20	Fuse	A3-F1	0.25 A, 250 V fuse to provide protection against fire and ac mains shorts.
21	AC Mains Power Receptacle	A3-J1	AC mains power receptacle.
22	Fan Air Intake Port		Air intake port for cooling fan.
23	Fan Air Exhaust Port		Air exhaust port for cooling fan.

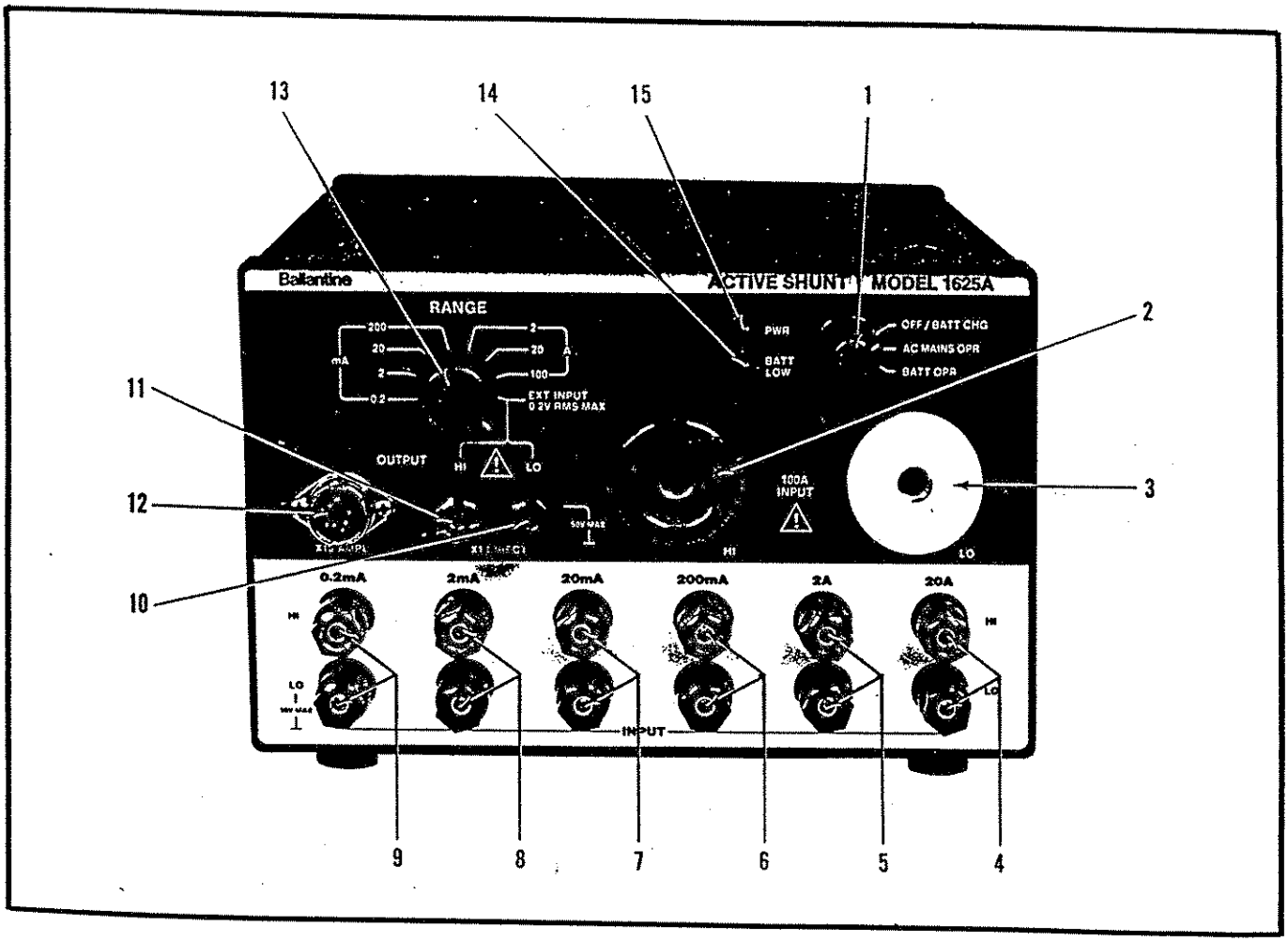


Figure 3-1. Front Panel Controls, Indicators, and Connectors

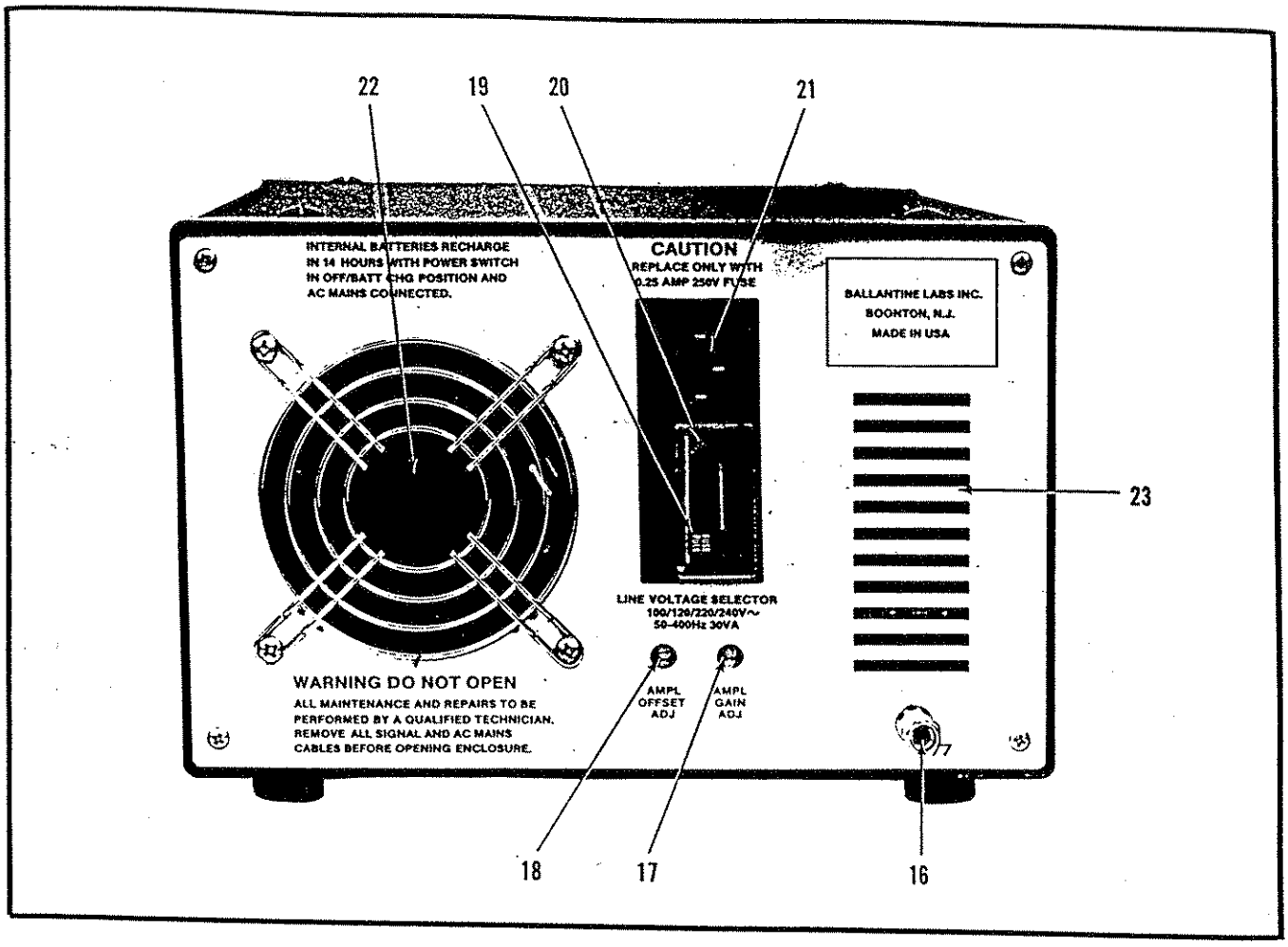


Figure 3-2. Rear Panel Controls, Indicators, and Connectors

TABLE 3-2. SHUNT PARAMETERS

RANGE	FULL SCALE VOLTAGE OUTPUT	NOMINAL RESISTANCE	COMPLIANCE VOLTAGE AT FULL SCALE INPUT	POWER DISSIPATION AT FULL SCALE
100 A	100 mV	0.0011 Ω	125 mV	11 W
20 A	200 mV	0.011 Ω	250 mV	4.4 W
2 A	200 mV	0.11 Ω	250 mV	0.44 W
200 mA	200 mV	1.1 Ω	250 mV	4.4 mW
20 mA	200 mV	11 Ω	250 mV	4.4 mW
2 mA	200 mV	105 Ω	250 mV	420 uW
0.2 mA	200 mV	1050 Ω	250 mV	42 uW

3-17. Once the dc calibration is verified, ac may be substituted for dc and certification repeated using an AC/DC transfer standard to establish AC/DC difference correction with frequency for the 1625A. The 1625A precision amplifier is always recommended for use when performing ac verifications with AC/DC transfer standards since the VOLTAGE OUTPUT of the 1625A is not intended for loads below 1 Megohm. Always apply the known ac/dc difference corrections listed on the calibration certificate of the reference shunt when performing these measurements to assure NBS traceability.

3-18. USING THE PRECISION AMPLIFIER

3-19. The Precision Amplifier is used to buffer the VOLTAGE OUTPUT from the shunt resistors. The amplifier has very high input impedance and does not load the shunt. The amplifier does not bypass any measuring current from the shunt resistor and thereby assures maintenance of the precision calibration of the shunt. The Precision Amplifier may be adjusted for an exact gain of ten by means of the AMPL OFFSET and AMPL GAIN screwdriver adjustment accessible from the rear panel of the instrument. A power output stage provides 50 Ω drive capability for output current levels beyond 60 mA. Sensing of the output leads provides lowest output impedance and assures integrity of the X10 gain setting even when driving the thermal elements of ac/dc transfer standards and other loads with high current demands. For best results use the Model 16251A sensed output cable provided with the instrument.

3-20. The Precision Amplifier operates from ac mains or internal battery power. For best results choose internal battery power. Keep the battery fully charged. Recharge batteries overnight when the red LED BATT LOW indicator is illuminated.

3-21. OPERATION

3-22. Reference the previous paragraphs and use the following procedure to operate your 1625A. A 1.5 A dc current is used as an example.

a. Set the 1625A controls as follows:

AMPL POWER	INT BAT
RANGE	2A

b. Connect a 6.5 digit voltmeter with 1 uV resolution to the VOLTAGE OUTPUT terminals. The HP 3456A DVM is an appropriate voltmeter.

c. Select 200 mV range on the DVM.

d. Remove power from the dc circuit to be measured and connect the 1625A into the circuit to be measured using the CURRENT INPUT terminals of the 2 A RANGE. Consider the 1625A as if it were an ammeter. Observe polarity by connecting the positive lead to the red 2 A circuit input terminal.

e. Energize the circuit under test and derive the measured current by using the following formula:

$$I_m = S \times E_{dvm}$$

I_m = Measured current
S = The full scale shunt range
E_{dvm} = The DVM reading in volts

NOTE

For this example, 1.5 A dc input current yields a 150 mV reading on the DVM.

3-23. To measure an ac current proceed as follows. A 175 uA current measurement at 400 Hz is given as an example.

a. Connect the Amplifier Voltage output cable to the LO INPUT connector of a Ballantine Model 1605A Autobalancing AC/DC Transfer Standard. Connect an HP 3456A DVM (or equivalent) to the 1605A DC OUTPUT terminals to serve as auxiliary dc output voltmeter for the transfer standard.

b. Set the 1625A controls as follows:

AMPL. POWER	INT BAT
RANGE	0.2 mA

c. Zero the AMPL OFFSET by connecting the DC DVM to the amplifier output cable 874 connector by adjusting the AMPL OFFSET control for zero ±1 uV as indicated by the DVM.

d. Set the 1605A transfer standard controls as follows:

LOCAL/REMOTE	LOCAL
RANGE	1 to 2 V
MODE	AUTO NORM
AUTO RECYCLE	OFF

e. Set the controls of the auxiliary 6.5 digit DVM connected to the 1605A to DC VOLTS, AUTO RANGE, FILTER, TRIGGERED. Average 10 readings over 10 seconds after the DVM is triggered.

f. Remove power from the ac circuit to be measured and connect the 1625A into the circuit to be

measured using the CURRENT INPUT terminals of the 0.2 mA RANGE.

g. Energize the circuit under test and operate the 1605A transfer standard. Trigger the auxiliary DC DVM when the 1605A READ light illuminates and take a 10 reading average over 10 seconds with the DVM. Read the auxiliary DVM and derive the measured current using the formula

$$I_m = S \times E_{dvm}$$

I_m = Measured current
S = The full scale shunt range
E_{dvm} = The auxiliary DVM reading in volts averaged for ≥10 readings in ten seconds

NOTE

A simple one range thermal converter such as the Ballantine 1394A, 1397A, or the Fluke 540B may also be used as the ac/dc transfer device.

ACCEPTANCE TEST PROCEDURE

TEST EQUIPMENT LIST FOR MODEL 1625A

Ballantine 1620A	Transconductance Amplifier
Fluke 5200A	AC Calibrator
Keithley Nanovoltmeter #191	Digital Voltmeter
Fluke 931AB	AC Voltmeter
HP 333A	Distortion Analyzer
General Resistance DAV460	Dial-A-Volt Voltage Reference
Ballantine 1625A	Reference unit - calibrated against the in-house standard
Ballantine 3028B	Digital Multimeter
Test Cables	(1) Double Banana both ends
	(1) Single Banana both ends
	(3) RS 100G Superior Electric male terminals both ends
Sprague Goodman JFD 5284	Calibration Tool
Ballantine 12-12600-0A	1 MΩ resistor

1.0 CURRENT SHUNT ASSEMBLY (89-11368-1)

1.1 Equipment Set-Up

a. 1620A Transconductance Amplifier

Power Switch	ON
Standby/Operate	Standby
Range	200 uA
Output Connectors	See Figure 1
Input Terminals	Connect Dial-A-Volt set to 1.0 volt out

b. 1625A Unit Under Test and reference unit shunts - see Figure 1

Sense Outputs (X1) - Connect the DVM to the X1 direct output. Install a 1 MΩ termination resistor to the input (Ballantine P/N 12-12600-0A) of the DVM.

Range Switch - set to 200 uA position

c. After the equipment is set up as shown in Figure 1, proceed with the dc calibration.

NOTE

Be aware of the equipment set-up, and that the 1620 is driving the correct current shunt.

1.2 DC Calibration - Current Shunts

NOTE

Instrument must be in Line Operate or Battery Operate for calibration.

a. After equipment is set up, start on the 200 uA range. Depress the Operate button on the 1620, then read the voltage on the voltmeter. Make note of the reading, then transfer the sense cable from the reference unit to the Unit Under Test (UUT). Read the voltage level. Adjust potentiometer R2 until the reading is the same as the reference unit. Recheck reference unit reading against UUT reading and repeat if necessary. Place 1620 in standby when finished, and record check mark on Test Data Sheet Section 1.

b. Proceed to the next shunt - 2 mA. Transfer cables and change range selection switch to 2 mA. Connect DVM with 1 MΩ termination to the reference unit, then place the 1620A in Operate mode. Read the DVM and transfer to the UUT. Read the DVM and adjust potentiometer R6 for the same reading as the reference unit. Repeat if necessary. Place the 1620A in standby when finished and record check mark on Test Data Sheet Section 1.

c. Proceed to the next shunt - 20 mA. Follow step b, adjusting potentiometer R10. Also repeat for 200 mA, 2 A, and 20 A adjusting potentiometers R14, R18, and R23 respectively. Also check polarity for 20 A range. It must be positive. Record on the Test Data Sheet Section 1.

NOTE

For 20 A range, change to the 1620A 20A terminal output.

d. For the 100 A shunt, use the Superior RS 100G high current male terminals. Set the range switch to 100 A and put the 1620A in Operate mode. Take a reading of the reference unit and then transfer to the UUT. Take a reading and adjust R27 if required. Recheck and repeat if necessary. Place 1620A in Standby mode (NOTE: operate fan on unit), record on Test Data Chart.

1.3 AC Response

a. Disconnect the Dial-A-Volt and connect the Fluke 5200A AC Calibrator set up for approximately 1 V rms output, and frequency of 50 Hz. Connect the Fluke 931AB AC Voltmeter to the reference unit X1 direct output, change the range switch to 0.2 mA for the 1620A and 1625A units. Depress the Operate button on the 1620A, read the 1625A output level on the Fluke differential voltmeter, operate the ACVM in the differential null mode at maximum sensitivity. Note the reading at 50 Hz, then transfer the sense cable to the UUT and take a reading. Enter as a % reading from the ACVM and record on the Test Data Sheet Section 2 AC Response. Transfer the sense cable back to the reference

unit, change the frequency to 1 kHz. Read the level on the ACVM. Maintain the same level output as read for 50 Hz, adjust the Fluke 5200 AC Calibrator if required. Transfer the sense cable to the UUT, take a reading, and record on Test Data Sheet Section 2 AC Response. Transfer the sense cable back to the reference unit, change the frequency to 10 kHz. Read the output level. Adjust the level to the same reading as what was read for 50 Hz. Now transfer the sense cable back to the UUT, take a reading, and record it on the Test Data Sheet Section 2 AC Response.

b. Perform the same test for the 2 mA, 20 mA, 200 mA, 2 A, 20 A, and 100 A shunts. Note that for the 20 A shunt, test the upper frequency limit at 5 kHz and for the 100 A shunt, test only at 1 kHz. Record the information on the Test Data Sheet Section 2 AC Response.

c. Check the test data sheet for any out of spec ranges on the shunts which are:

200 uA to 2 A (≤ 10 kHz) = 0.1%
20 A (≤ 5 kHz) = 0.5%
100 A (5 kHz) = .5%

Test at 50 Hz for a reference level and at 10 kHz for 200 uA to 2 A range, 5 kHz to 20 A range, and 100 A range at 5 kHz driven at 20 A from the 1620. Then determine a value of compensating capacitor to be added across R1 for the .2 uA. Use the capacitor substitution box Model CDA-5 by Cornell Dubilier to determine the value. There are terminal posts provided for this, to wrap the capacitor leads around and solder.

NOTE

For the 20 A and 100 A shunt, the frequency response could be compensated for by adjusting the sense wire's position on the shunt. The sense wires give a flatter frequency response when they are laid close to the edge surface on both sides and travel down the edge to the end of the shunt, then are twisted together going to the PC board.

1.4 20 dB Amplifier Assembly (89-11367-1)

a. Amplitude Zero Adjust

Turn range switch on 1625A to external input. Connect unit to ac line, turn the front panel switch to mains position. Place a short across the input terminals, connect the output from the 5 pin Din Jack via the 16251A accessory cable to the DCVM. Adjust the rear panel zero offset adjustment for a reading of 0 V ±50 uV. Remove short when completed and leave voltmeter connected. Use a 1 MΩ termination. Record on the Test Data Sheet when completed.

b. Amplifier Gain Adjust

With range switch on external, insert a +100 mV reference from the Dial-A-Volt. Set the rear panel adjustment to mid range (9 turns), adjust R4 Gain Coarse Adjustment located inside for 1 V ± .1 mV dc (1 MΩ termination). Then adjust the rear panel gain adjustment of the 1625A for a reading of 1.00000 ±100 uV into a 1 MΩ load. Record on the Test Data Sheet when completed.

c. Short Circuit Test

Connect the output of the ampl via the 16251A cable to an ammeter. Use a 3028B set on 200 mA range. Connect +100 mV dc to the input. Read the current. It must be more than 56, less than 150 mA. Change polarity of input to -100 mV dc. Check current. It must be more than 56, less than 150 mA. Record on the Test Data Sheet when completed. Disregard LOW BATT light if on.

d. Distortion Test

Insert a 100 mV ac signal at 10 kHz from the Fluke 5200A to the external input of the 1625A. Connect to a HP 333A Distortion Analyzer via the 16251A output cable. Output must be greater than -66 dB distortion. Check battery operate mode also; turn front panel switch to battery operate. Read distortion must meet -66 dB. Record on the Test Data Sheet when completed.

e. Frequency Response Test

Insert a 100 mV signal from the Fluke 5200A to the external input of the 1625A. Connect the output 5 pin Din Jack via the 16251A cable to a Fluke 931AB Differential Voltmeter. Check at 50 Hz, 1 kHz, and 10 kHz. The response must be within ± .01% from dc to 1 kHz and .025% from dc to 10 kHz. Record on the Test Data Sheet when completed.

1.5 Low Battery Indicator

Operate the 1625A with the switch in the battery operate position. Check that the Battery Low LED is out. This indicates a charged battery. To test the circuit and LED, hold a 51 kΩ resistor across resistor R25 located on the 20 dB amplifier PCB located in upper left corner of the PC Board (front bottom view of board). The LED must illuminate with this operation. Record on the Test Data Sheet Section 4.

1.6 Battery Charge Circuit

Set 1625A to OFF BATT CHARGE mode. Install line cord to rear of 1625A. Connect a 3028B in ammeter mode, 200 mA range negative to the cathode of CR-10, positive to anode. Charge current should read between 120 and 180 mA.

1.7 Fan

Turn power switch to AC Mains position with unit plugged into ac line. Fan must operate blowing air inside of unit.

1.2 DC Calibration Current Shunts:

a. 0.2 mA	_____	( )
b. 2 mA	_____	( )
c. 20 mA	_____	( )
d. 200 mA	_____	( )
e. 2 A	_____	( )
f. 20 A	_____	( )
g. 100 A	_____	( )

1.3 AC RESPONSE

	50 Hz	1 kHz	5 kHz	10 kHz
a. 0.2 mA	0%			_____ %
b. 2 mA	0%			_____ %
c. 20 mA	0%			_____ %
d. 200 mA	0%			_____ %
e. 2 A	0%			_____ %
f. 20 A	0%		_____ %	----
g. 100 A	0%		_____ %	----

1.4 20 dB AMPLIFIER

a. amplitude zero adjust	_____	( )
b. amplifier gain adjust	_____	( )
c. short circuit test	_____	( )
d. distortion test	_____	( )
e. frequency response test	_____	( )

1.5 LOW BATTERY INDICATOR _____ ( )

1.6 BATTERY CHARGE CIRCUIT _____ ( )

1.7 FAN _____ ( )

1.8 MECHANICAL (loose hardware, etc.) _____ ( )

PARTS LIST, MODEL 1625A FRAME ASSY (89-11364-1)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NUMBER
P...1	88-10153-1A	CAA 1625A 7 CON J1	050423	BLI
P...2	88-10154-1A	CAA 1625A 5 CON J2	050423	BLI
P...3	88-10155-1A	CAA 1625A 2 CON J4	050423	BLI
P...4	88-10155-1A	CAA 1625A 2 CON J4	050423	BLI

PARTS LIST, MODEL 1625A 20 dB AMPL ASSY A1 (89-11367-1)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NUMBER
C...1	07-10252-0A	CEA 330.0UF 63.0 V -10+50%	073445	AMPEREX ET331X063AD3
C...2	07-10252-0A	CEA 330.0UF 63.0 V -10+50%	073445	AMPEREX ET331X063AD3
C...5	07-10235-0A	CEA 100.0UF 25.0 VT	080031	MEPCO 3073EE101T025JPA
C...6	07-10235-0A	CEA 100.0UF 25.0 VT	080031	MEPCO 3073EE101T025JPA
C...8	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	004222	AVX CERAMICS MD015E104MAA
C..10	07-20004-0A	CCD 27.0PF 500.0 VK +-10%	071590	CTL DD-270
C..11	07-20004-0A	CCD 27.0PF 500.0 VK +-10%	071590	CTL DD-270
C..17	07-10324-0A	CMU 27.0PF 500.0 VF+- 2%	053201	SANGAMO CM05ED270G03 OR EQ
CR..1	05-10006-0A	DGP W04M 400V 1.5A	005828	GI W04M
CR..2	05-10017-0A	DGP 1N746A 3.3 20M .4	012954	DIC SI
CR..3	05-07920-0A	DGP 1N4148 75 10M	007263	FCH SI D035 1N4148
CR..4	05-07920-0A	DGP 1N4148 75 10M	007263	FCH SI D035 1N4148
CR..5	05-07920-0A	DGP 1N4148 75 10M	007263	FCH SI D035 1N4148
CR..6	05-10124-0A	DGP 1N458A LO LEAKAGE	007263	FAIRCHILD
CR..7	05-10124-0A	DGP 1N458A LO LEAKAGE	007263	FAIRCHILD
CR..8	05-10124-0A	DGP 1N458A LO LEAKAGE	007263	FAIRCHILD
CR..9	05-10124-0A	DGP 1N458A LO LEAKAGE	007263	FAIRCHILD
CR.10	05-09472-0A	DGP 1N4002 100 1A	004713	MOT SI D041 CASE 59
J...1	31-10256-0A	CON MTA-100 POST 7 PIN	000779	AMP 640098-7
J...2	31-10253-0A	CON MTA-100 POST 5 PIN	000779	AMP 640098-5
J...3	31-10247-0A	PLG 2PIN 24GA .1" IN LINE	000779	AMP MTA-100 640441-2
J...4	31-10254-0A	CON MTA-100 POST 2 PIN	000779	AMP 640098-2
J...5	31-10254-0A	CON MTA-100 POST 2 PIN	000779	AMP 640098-2
Q...1	10-10004-0A	TRQ MJE520 NPN 1 30 P77-03	004713	MOT MJE520
Q...2	10-10225-0A	TRQ MPSW14 NPN DARL 30V 1W	004713	MOTOROLA
Q...3	10-10226-0A	TRQ MPSW64 PNP DARL 30V 1W	004713	MOTOROLA
Q...4	10-10099-0A	TRQ E507 J-FET 1.8MA	017856	SILICONIX J507
Q...5	10-09473-0A	TRQ 2N3906 PNP 1 40 PTO-92	004713	MOT 2N3906
Q...6	10-10099-0A	TRQ E507 J-FET 1.8MA	017856	SILICONIX J507
Q...7	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	004713	MOT 2N3904
Q...8	10-10087-0A	TRQ 2N5193 PNP 1 40 P77-03	004713	MOT 40 2M 10
Q...9	10-10004-0A	TRQ MJE520 NPN 1 30 P77-03	004713	MOT MJE520
R...1	12-12938-0A	RFF 15.0 1.0 W 2%	016299	CGW FP1
R...2	12-01268-0A	RFC 1.3 K 1 W J 5%	001121	A-B TYP GB
R...3	12-13109-0A	RFF 16.2 500.0MW F	016299	CGW NA60
R...4	09-10214-0A	RVF 500.0 500MW K 18T	073138	HELIPOT 68W R500 VERT ADJ

PARTS LIST, MODEL 1625A 20 dB AMPL ASSY A1 (89-11367-1) - Cont'd

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NUMBER
R...5	09-10300-0A	RVF 100.0 500MW 20T	080053	BECKMAN 89PR100
R...6	09-10299-0A	RVF 10.0K 500 MW 20T	080053	BECKMAN 89PR10K
R...7	12-12363-0A	RFF 4.53K 250.0MW F+- 1%	016299	CGW RN55D 4531 F
R...8	12-12429-0A	RFF 20.0 K 250.0MW F+- 1%	016299	CGW RN55D 2002 F
R...9	12-12429-0A	RFF 20.0 K 250.0MW F+- 1%	016299	CGW RN55D 2002 F
R..10	12-13401-0A	RFF 19.0K 5 W 1.0%	016299	CORNING 19000 1% FP67
R..11	12-13401-0A	RFF 19.0K 5 W 1.0%	016299	CORNING 19000 1% FP67
R..12	12-01003-0A	RFC 5.1 M 500 MW J 5%	001121	A-B TYP EB
R..13	12-01003-0A	RFC 5.1 M 500 MW J 5%	001121	A-B TYP EB
R..14	12-12116-0A	RFF 14.7 250.0MW F+- 1%	016299	CGW RN55D 14R7 F
R..15	12-12319-0A	RFF 1.58K 250 MW F+- 1%	016299	CGW RN55D 1581 F
R..16	12-12116-0A	RFF 14.7 250.0MW F+- 1%	016299	CGW RN55D 14R7 F
R..17	12-12319-0A	RFF 1.58K 250 MW F+- 1%	016299	CGW RN55D 1581 F
R..18	12-12300-0A	RFF 1.0 K 250 MW F+- 1%	016299	CGW RN55D 1001 F
R..19	12-12392-0A	RFF 9.09K 250.0MW F+- 1%	016299	CGW RN55D 9091 F
R..21	12-12100-0A	RFF 10.0 250.0MW F+- 1%	016299	CGW RN55D 10R0 F
R..22	12-12100-0A	RFF 10.0 250.0MW F+- 1%	016299	CGW RN55D 10R0 F
R..23	12-12240-0A	RFF 261.0 250.0MW F+- 1%	016299	CGW RN55D 2610 F
R..24	12-12502-0A	RFF 105.0 K 250.0MW F+- 1%	016299	CGW RN55D 1053 F
R..25	12-12404-0A	RFF 11.0 K 250.0MW F+- 1%	016299	CGW RN55D 1102 F
R..26	12-13387-0A	RFC 39 M 250 MW 5%	001121	ALLEN BRADLEY TYPE CB
R..27	12-12268-0A	RFF 511.0 250.0MW F+- 1%	016299	CGW RN55D 5110 F
R..28	12-12268-0A	RFF 511.0 250.0MW F+- 1%	016299	CGW RN55D 5110 F
R..29	09-10004-0A	RVF 100.0 0.5 W M	073138	HEL TYP 72PM
R..30	12-13402-0A	RFF 2.87K 500 MW 1.0%	016299	CGW 2.87K 1% RN60D OR N20
R..31	12-12100-0A	RFF 10.0 250.0MW F+- 1%	016299	CGW RN55D 10R0 F
R..32	12-12100-0A	RFF 10.0 250.0MW F+- 1%	016299	CGW RN55D 10R0 F
T...1	20-10082-1L	TRX 3045 SERIES POWER XFER	050423	BLI
U...1	24-10437-0A	ICL AD625A PROG GAIN AMPL	024355	ANALOG DEVICES AD 625AD
U...2	24-10391-0A	ICP OP-16-6J LO DRIFT 8MHZ		PRECISION MONO OP-16-6J
U...3	24-10215-0A	ICP ICL8211CPA U POWER V DET		INT ICL8211CPA 8 PIN DIP

PARTS LIST, MODEL 1625A FRONT PANEL ASSY A3 (89-11366-1)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NUMBER
CR.11	05-09472-0A	DGP 1N4002 100 1A	004713	MOT SI D041 CASE 59
CR.12	05-09472-0A	DGP 1N4002 100 1A	004713	MOT SI D041 CASE 59
DS..1	16-10028-0A	LMP LED RED WIDE ANGLE	028480	HP HLMP-3301 RED
DS..2	05-10060-0A	GREEN LED	028480	HP HLMP 3502
J...1	31-10170-0A	REC 5 PIN BLKHD MT LOCK	082389	SWITCHCRAFT 61HA5F
J...6	31-10057-0A	BPS INS. NYL 2KV RED	083330	H.H. SMITH 257-102
J...7	31-10058-0A	BPS INS. NYL 2KV BLACK	083330	H.H. SMITH 257-103
J...8	31-10057-0A	BPS INS. NYL 2KV RED	083330	H.H. SMITH 257-102
J...9	31-10058-0A	BPS INS. NYL 2KV BLACK	083330	H.H. SMITH 257-103

PARTS LIST, MODEL 1625A FRONT PANEL ASSY A3 (89-11366-1) - Cont'd

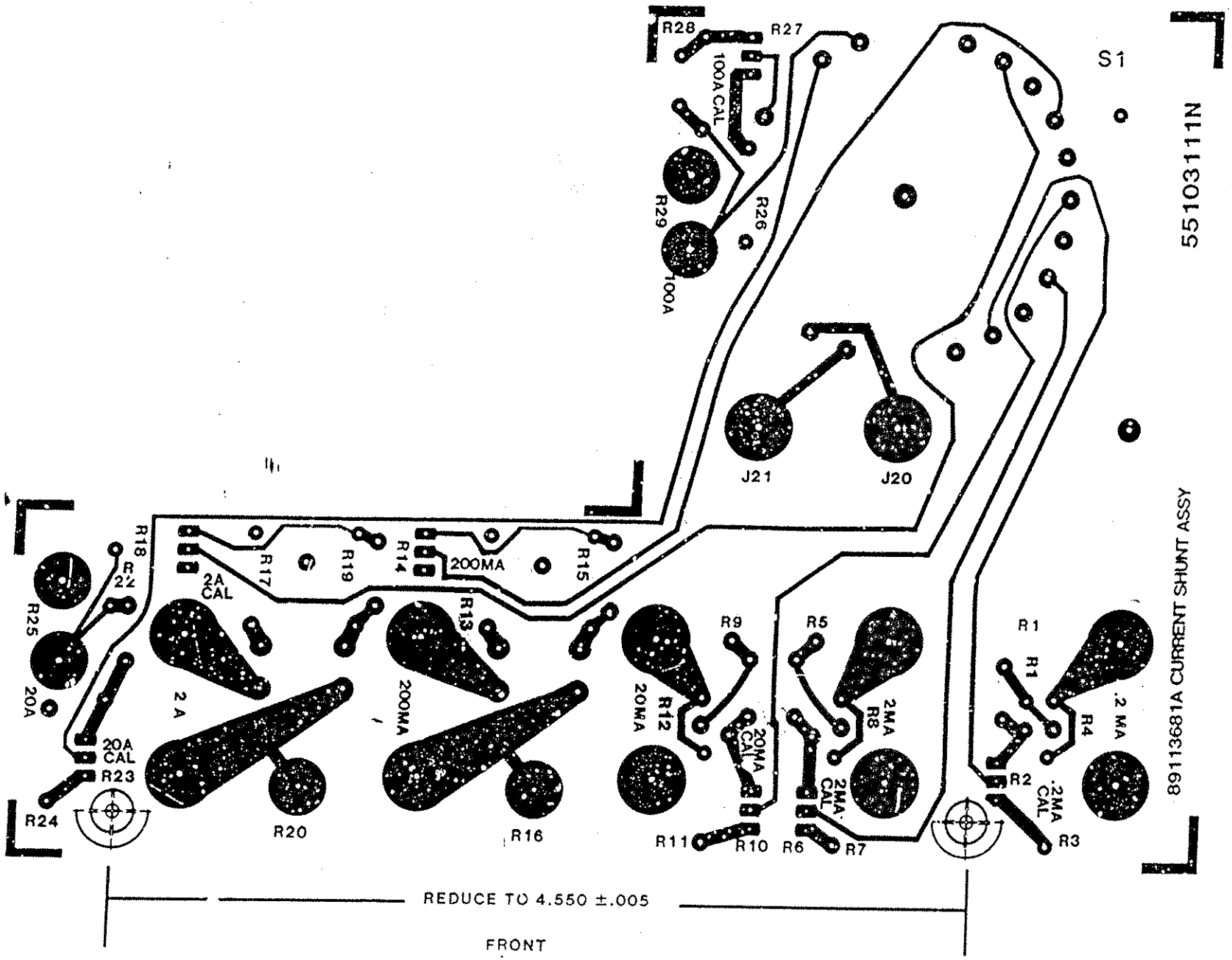
SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NUMBER
J..10	31-10057-0A	BPS INS. NYL 2KV RED	083330	H.H. SMITH 257-102
J..11	31-10058-0A	BPS INS. NYL 2KV BLACK	083330	H.H. SMITH 257-103
J..12	31-10057-0A	BPS INS. NYL 2KV RED	083330	H.H. SMITH 257-102
J..13	31-10058-0A	BPS INS. NYL 2KV BLACK	083330	H.H. SMITH 257-103
J..14	31-10057-0A	BPS INS. NYL 2KV RED	083330	H.H. SMITH 257-102
J..15	31-10058-0A	BPS INS. NYL 2KV BLACK	083330	H.H. SMITH 257-103
J..16	31-10057-0A	BPS INS. NYL 2KV RED	083330	H.H. SMITH 257-102
J..17	31-10058-0A	BPS INS. NYL 2KV BLACK	083330	H.H. SMITH 257-103
J..18	31-10333-0A	CON RED 100A SOCKET RECEPT.	058474	SUPERIOR ELEC RS100GR
J..19	31-10334-0A	CON WHITE 100A SOCKET RECEPT	058474	SUPERIOR ELEC RS100GWT
J..20	31-10057-0A	BPS INS. NYL 2KV RED	083330	H.H. SMITH 257-102
J..21	31-10058-0A	BPS INS. NYL 2KV BLACK	083330	H.H. SMITH 257-103
R..25	12-13357-1G	RFW 1625A 20A CURRENT SHUNT	050423	BLI
R..29	12-13358-1G	RFW 1625A 100A CURRENT SHUNT	050423	BLI
S...2	25-10240-0A	SWC 3POS 4POLE ROTARY	078488	STACKPOLE 73-8261 1/4 SHFT LGT

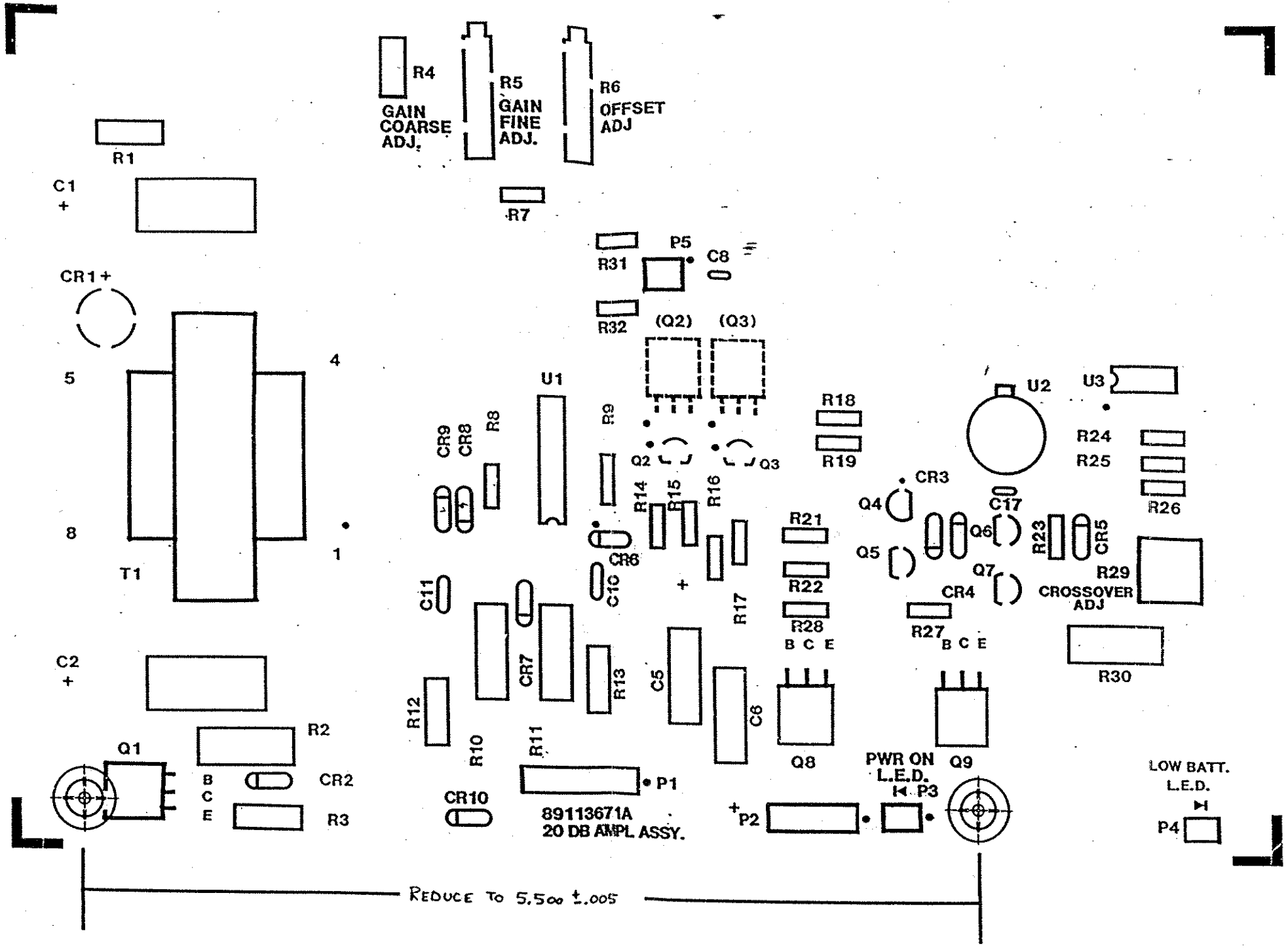
PARTS LIST, MODEL 1625A CURRENT SHUNT ASSY A2 (89-11368-1)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NUMBER
R...1	12-13403-0A	RFF 5.0K 0.1% 300 MW 10PPM	018612	VISHAY S102K
R...2	09-10256-0A	RVF 50.0 500MW 18 TURN	073138	HELIPOT 68W R50
R...3	12-12136-0A	RFF 23.7 250.0MW F+- 1%	016299	CGW RN55D 23R7 F
R...4	12-13382-0A	RFP 1262 0.3W +-0.1% 1.5PPM	018612	VISHAY S102K
R...5	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	016299	CGW RN55D 4641 F
R...6	09-10256-0A	RVF 50.0 500MW 18 TURN	073138	HELIPOT 68W R50
R...7	12-12136-0A	RFF 23.7 250.0MW F+- 1%	016299	CGW RN55D 23R7 F
R...8	12-13383-0A	RFP 103.0 0.3W +-0.1% 1PPM	018612	VISHAY S102K
R...9	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	016299	CGW RN55D 4641 F
R..10	09-10256-0A	RVF 50.0 500MW 18 TURN	073138	HELIPOT 68W R50
R..11	12-12136-0A	RFF 23.7 250.0MW F+- 1%	016299	CGW RN55D 23R7 F
R..12	12-13384-0A	RFP 10.1 0.3W +-0.1% 5PPM	018612	VISHAY S102K
R..13	12-12136-0A	RFF 23.7 250.0MW F+- 1%	016299	CGW RN55D 23R7 F
R..14	09-10256-0A	RVF 50.0 500MW 18 TURN	073138	HELIPOT 68W R50
R..15	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	016299	CGW RN55D 4641 F
R..16	12-13385-1B	RFP 1.01 SHUNT 4 WIRE +-7PPM	050423	BLI
R..17	12-12136-0A	RFF 23.7 250.0MW F+- 1%	016299	CGW RN55D 23R7 F
R..18	09-10256-0A	RVF 50.0 500MW 18 TURN	073138	HELIPOT 68W R50
R..19	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	016299	CGW RN55D 4641 F
R..20	12-13386-1B	RFP 0.101 SHNT 4WIRE +-15PPM	050423	BLI
R..22	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	016299	CGW RN55D 4641 F
R..23	09-10256-0A	RVF 50.0 500MW 18 TURN	073138	HELIPOT 68W R50
R..24	12-12136-0A	RFF 23.7 250.0MW F+- 1%	016299	CGW RN55D 23R7 F
R..26	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	016299	CGW RN55D 4641 F
R..27	09-10256-0A	RVF 50.0 500MW 18 TURN	073138	HELIPOT 68W R50
R..28	12-12136-0A	RFF 23.7 250.0MW F+- 1%	016299	CGW RN55D 23R7 F
S...1	25-10235-1B	SWC 1625A 8POS 2POLE	050423	BLI

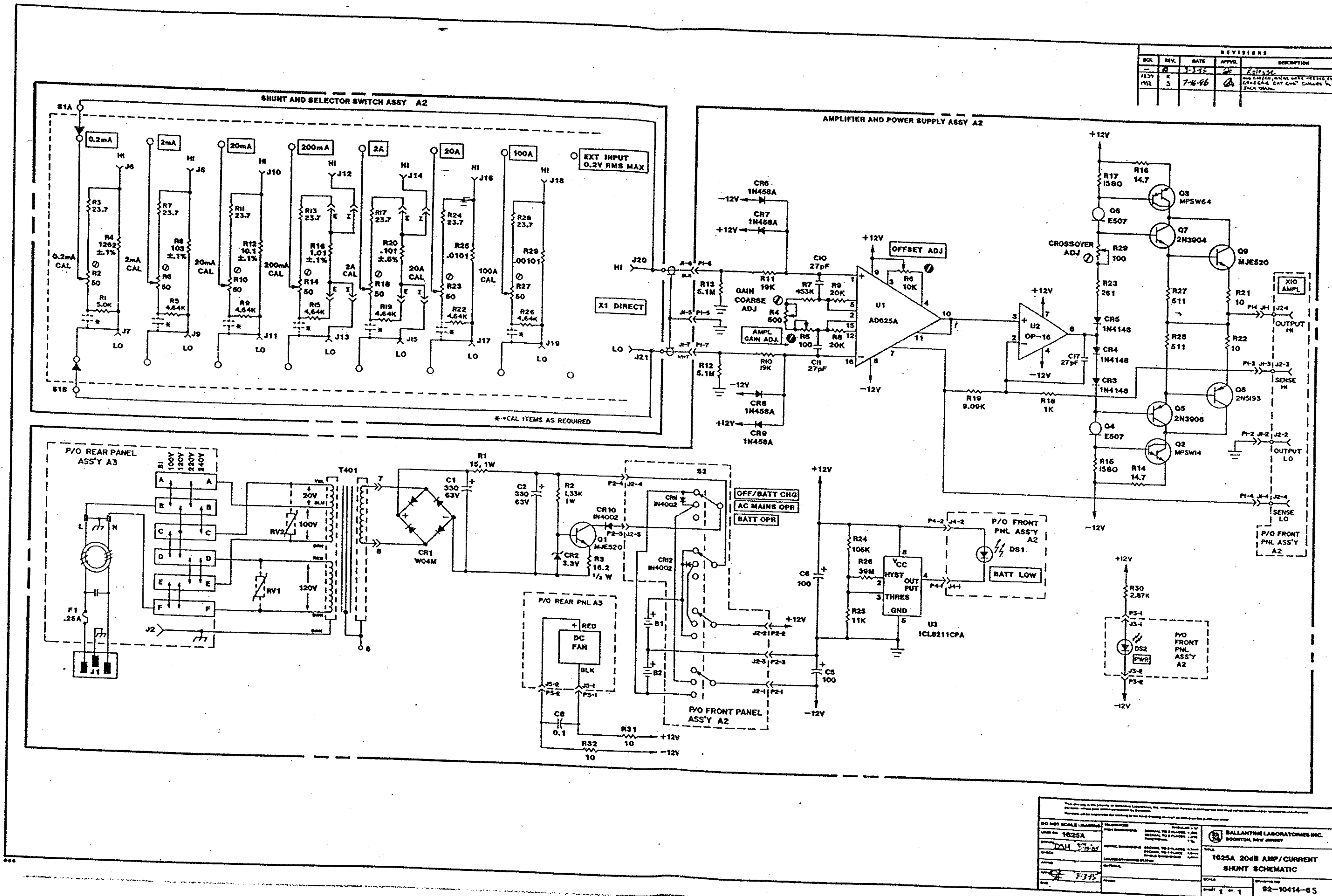
PARTS LIST, MODEL 1625A REAR PANEL ASSY A4 (89-11365-1)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR. CODE	MFR. PART NUMBER
RV..1	14-10000-0A	REG LINE SURGE SUPPRESSOR	024446	GE V150LA10A
RV..2	14-10000-0A	REG LINE SURGE SUPPRESSOR	024446	GE V150LA10A


R28
R27
100A CAL
R29
R26
100A
S1
5510311 1N
J21
J20
R18
R22
R17
R19
R14
200MA
R15
2A CAL
R13
R25
20A
2 A
200MA
R9
R5
R1
R1
20MA R12
20MA CAL
2MA R8
.2 MA R4
20A CAL
R23
R24
R20
R16
R11
R10
R6
R7
R2
.2MA CAL
R3
8911368 1A CURRENT SHUNT ASSY
REDUCE TO 4.550 ±.005
FRONT



DO NOT SCALE DRAWING	TOLERANCES ANGULAR ± ½° INCH DIMENSIONS DECIMAL TO 3 PLACES ± .005 DECIMAL TO 2 PLACES ± .010 FRACTIONAL ± 1/64 METRIC DIMENSIONS DECIMAL TO 2 PLACES ± 1mm DECIMAL TO 1 PLACE ± 2mm WHOLE DIMENSIONS ± 4mm UNLESS OTHERWISE STATED	BALLANTINE LABORATORIES INC. BOONTON, NEW JERSEY
USED ON 1625A		
DRAWN KR DATE 2-1-85		TITLE 20 DB AMPLIFIER PCB MARKING DWG COMPONENT SIDE
CHECK		
APPVD	MATERIAL	



SHUNT AND SELECTOR SWITCH ASSY A2
AMPLIFIER AND POWER SUPPLY ASSY A2
P/O REAR PANEL ASS'Y A3
P/O FRONT PANEL ASS'Y A2
EXT INPUT 0.2V RMS MAX
X1 DIRECT
*-CAL ITEMS AS REQUIRED
REVISIONS
BALLANTINE LABORATORIES INC.
BOONTON, NEW JERSEY
1625A 20dB AMP/CURRENT
SHUNT SCHEMATIC
92-10414-6S