OPERATOR'S MANUAL
FOR
BROADBAND LINEAR POWER AMPLIFIERS
MODELS 5020B, 2060, 3552B, 15100B

AUGUST 1991

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CERTIFICATION:

American Microwave Technology, Inc., (AMT) certifies that this product was tested and is in full compliance with its published specifications at the time of shipment from the factory. AMT further certifies that its calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by the Institute's Calibration Facility.

WARRANTY:

This AMT product is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, AMT will, at its option, either repair or replace the products which prove to be defective.

REPAIR WARRANTY:

Products returned to AMT for repair that have exceeded the initial one year warranty period will incur charges for necessary repairs. All replaced components, material and workmanship will be warranted for one year from the date of shipment of the repaired unit.

LIMITATION:

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance. Furthermore, if the AMT warranty seal is disturbed without the direct written consent of AMT, this warranty shall be void. Customers returning products which are not covered under warranty shall be charged an evaluation fee.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. AMT SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

SERVICE:

Additional service information can be made available by writing:

American Microwave Technology, Inc.
3080 Enterprise Street
Brea, CA 92621
Phone: (714) 993-0802
Fax: (714) 993-1619

Users are advised to be aware of potential hazards to personnel and equipment and of the steps necessary to prevent their occurrence. **WARNINGS** describe conditions that, if not avoided, can cause injury or death to personnel.

WARNING #1

AMT power amplifiers operate at radio frequencies up to 1000 MHz and at power levels up to 50 watts. Severe radiation burns can occur if recommended safety precautions are not strictly observed. The human eye is particularly susceptible to cataracts when exposed to high levels of RF radiation. Do not operate exposed circuitry or radiating elements with personnel in close proximity to the radiation source (particularly when close to the human head). Always replace covers and shields during any operation.

WARNING #2

Maintenance personnel must observe all safety precautions at all times. Make sure that electrical power to the system is disconnected before proceeding with any maintenance action. Failure to comply may cause injury or death to personnel. Do not replace components inside the equipment with the power on. Under no circumstances should any person reach into an enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who can render aid. Remove power from the system for all procedures that do not require power. For those procedures that do require power, be extremely cautious in handling test leads, tools, and equipment in the proximity of live circuitry. Always follow AMT's recommended procedures during any powered operation.

Personnel are warned that although no radiation hazard exists with the primary power line, physical contact with such voltages can be lethal. Primary line voltages (up to 300 volts peak) exist in the power supply section. Avoid physical contact with these voltages to avoid injury.

WARNING #3

The amplifier weighs approximately 50 pounds. Make sure that sufficient personnel are present to support the amplifier. Do not try to move the amplifier alone. Failure to comply may result in injury to personnel.

GLOSSARY

AC	Alternating Current
ADJ	Adjustment
ALC	Automatic Level Control
AMT	American Microwave Technology, Inc.
ASSY	Assembly
CAL	Calibration
dB	Decibels
dBc	Decibels with respect to main signal level
DC	Direct Current
EXT	External
FWD	Forward (power)
Hz	Hertz (cycle per second)
LED	Light emitting diode
MHz	Megahertz
MW	Megawatt
mW	Milliwatt
RF	Radio Frequency
RFL	Reflected (power)
SENS	Sensitivity
VAC	Volts, Alternating Current
VSWR	Voltage Standing Wave Ratio
W	Watts

SECTION 1.0

INTRODUCTION AND DESCRIPTION

1.1 INTRODUCTION

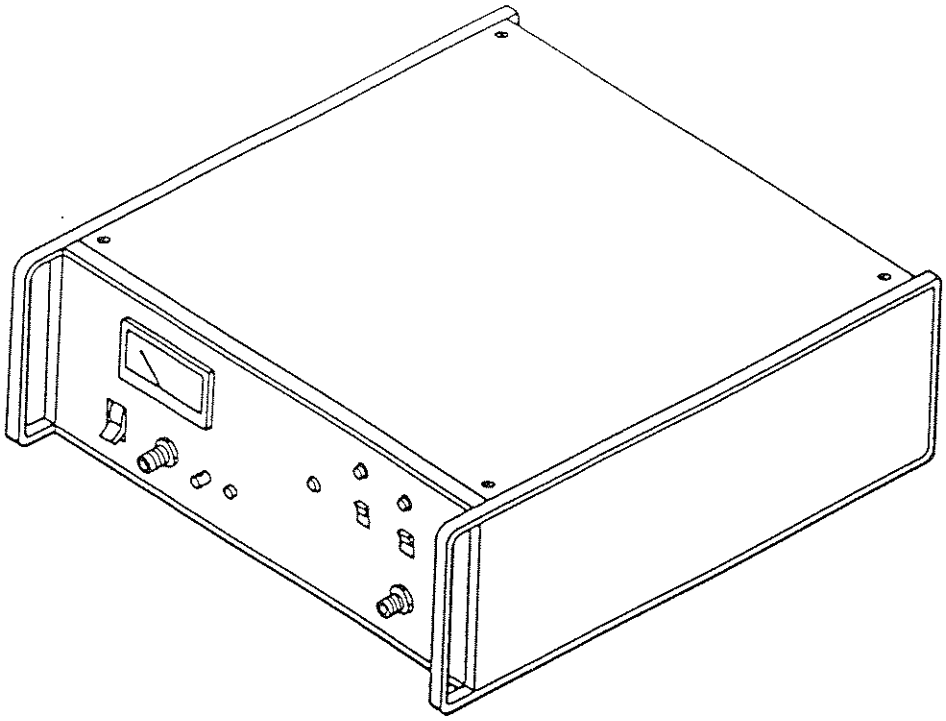
This manual contains operation and maintenance instructions for the AMT broadband linear power amplifier Models 5020B, 2060, 3552B and 15100B.

The principal function of this manual is to provide the user with information and guidance for general operation of the amplifiers, performance verification testing and preventive maintenance, and replacement of repairable modules. Drawings in the Appendix provide additional information.

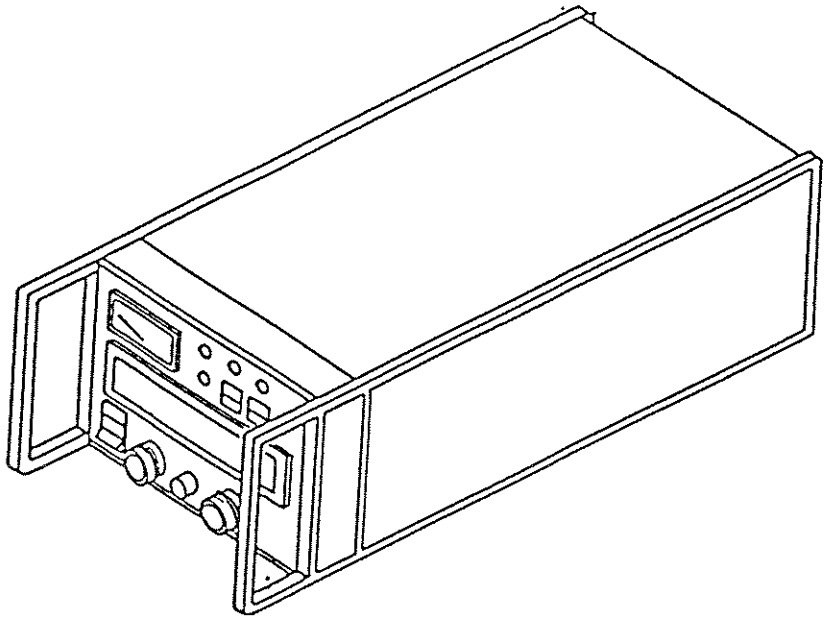
1.2 GENERAL DESCRIPTION

AMT solid-state broadband linear amplifiers (Figure 1-1) are designed to be driven by signal sources such as milliwatt sweepers and frequency synthesizers and to provide high power RF at frequencies from 1 MHz TO 1000 MHz, depending on the model. Table 1-1 gives the specifications of each amplifier.

The AMT amplifiers feature a true directional wattmeter to measure forward and reflected power delivered to the load. Additionally, an output sample DC voltage from the directional coupler, proportional to the forward power, is made available to the front panel for external leveling. Leveling the amplifier output increases the flatness typically by a factor of two, and improves the effective output impedance. In order to accomplish the above operation, it is necessary to use a source with external leveling capability and a negative input voltage requirement.



(A) MODELS 5020B, 3552B, 15100B



(B) MODEL 2060

FIGURE 1-1. TYPICAL BROADBAND LINEAR AMPLIFIERS

TABLE 1-1 EQUIPMENT SPECIFICATIONS

Item	Characteristics	
Model No.	5020B	2060
Frequency Range	1-200 MHz	20-200 MHz
Power Output (50 ohms load)	50 W	20 W
Compression	1 dB max. @ 40 W	1 dB max. @ 15 W
Gain/Sensitivity (max mW in for W out)	47 dB min. (1 mW for 50 W)	46 dB min. (1 mW for 50 W)
Gain Variation	±1.5 dB	±1 dB
Total Harmonics Distortion	-25 dBc at 1 dB comp.	-25 dBc at 1 dB comp.
Input VSWR	1.5:1	1.5:1
Spurious Response	-60 dBc max.	-65 dBc max.
Noise Figure	11 dB	5 dB max.
VSWR Protection (All phase Angles)	Yes	Yes
Over Temperature (Shutdown)	Auto Restart	Auto Restart
Operating Ambient	0 to 50°C	+10 to 40°C
Output Meter (50 ohms load)		
High Range	±1 dB @ 80 W	±1 dB @ 30 W
Low Range	±1 dB @ 20 W	±1 dB @ 5 W
Size	7x17x17.25 in. (17.78x43.18x 43.81cm)	7x8.5x17in (17.78x21.59x 43.18cm)
Weight	43 lbs (19.5kg)	22lbs (10 kg)
Required AC Power	115/230 VAC ±10%, 50-60Hz, 500 W	120/240 VAC ±10%, 50-60Hz 150 W

Table 1-1. EQUIPMENT SPECIFICATIONS (Continued)

Item	Characteristic	
Model No.	3552B	15100B
Frequency Range	100-512MHz	500-1000MHz
Power Output (50 ohms load)	50 W	25 W
Compression	1 dB max. @ 30 W	1 dB max. @ 15 W
Gain Sensitivity (max mW in for W out)	47 dB min. (1 mW for 50 W)	43 dB min. (1 mW for 20 W)
Gain Variation	± 2 dB	± 2 dB
Total Harmonics Distortion	-25 dB at 1 dB comp.	-25 dB at 1 dB comp.
Input VSWR	2:1	3:1
Spurious Response	-60 dBc min.	-60 dBc min.
Noise Figure	14 dB	14 dB
Active VSWR Protection (All phase angles)	Yes	Yes
Over Temperature (Shutdown)	Auto Restart	Auto Restart
Operating Ambient	0-50° C	0-50° C
Output Meter (50 ohms load)		
High Range	±1 dB at 80 W	±1 dB at 80 W
Low Range	±1 dB at 20 W	±1 dB at 10 W
Size	7x17x17.25 in (17.78x43.18x 43.81 cm)	7x17x17.25 in (17.78x43.18x 43.81 cm)
Weight	43 lbs (19.5kg)	43 lbs (19.5kg)
Required AC Power	115/230 VAC ±10%, 50-60 Hz, 500 W	115/230 VAC ±10%, 50-60 Hz, 400 W

SECTION 2.0

PERFORMANCE VERIFICATION

2.1 INTRODUCTION

This section of the manual describes Performance Verification Tests that can be used to verify that an amplifier is functioning in accordance with the specifications listed in Table 1-1. These tests can be used after a repair or when the performance of an amplifier is suspect.

2.2 REQUIRED TEST EQUIPMENT

TYPE:	MODEL (OR EQUIVALENT):
Source	Wavetek 2001
Step Attenuator	HP 355D and 355C
Power Attenuator	NARDA 771-20
Spectrum Analyzer	AILTECH 707
Power Meter	Hewlett-Packard

2.3 PERFORMANCE VERIFICATION TESTS

The following tests should be conducted to verify the performance of an amplifier using the test setups shown in the referenced figures.

a. Performance Check Performance of AMT linear amplifiers can be verified by using a power meter rated over the frequency range, a high-power attenuator, and a high power step attenuator with 10.0 and 0.1 dB steps.

1. Connect the amplifier, attenuators, and power meter as shown in Figure 2-1.

2. Set the attenuator initially to 10 dB.

3. Increase power at the frequency source to the rated power of the amplifier.

4. Manually tune the frequency source over the amplifier's frequency range.

5. The step attenuator should not have to be varied more than the flatness specification to maintain a constant output power.

NOTE: This test assumes that the output of the sweeper is constant over the measurement range. If it is not, add the sweeper uncertainty to the above flatness specification.

b. Compression Check To test for the 1dB compression point, perform the following:

1. Connect the amplifier shown in Figure 2-1.

2. With the attenuator set in the 20 dB position, adjust the source to drive the amplifier to an output level at 10 dB below the specified 1dB compression point.

3. Reduce the attenuation until the power increases to the 1dB compression point.

4. The attenuation should not have to be decreased by more than 11 dB in this test.

c. Harmonic Level Check To check the harmonic level, use a frequency source with harmonics and spurious signals 10 dB below the rated specification for the amplifier.

1. Connect the amplifier as shown in Figure 2-2.

2. Check the harmonic content at the lowest, center and highest frequencies.

3. Adjust the input drive to achieve rated output power (check on power meter).

4. Adjust the spectrum analyzer display to a convenient reference level. Make sure the analyzer is not over loaded.

5. Adjust the spectrum analyzer to the harmonic frequency.

6. The difference between the level in step 4 and step 5 will be the harmonic content referenced to the fundamental signal.

7. Re-do steps 3 through 6 for any other desired frequency.

d. Internal Directional Flatness Check The internal directional flatness may be checked as follows:

1. Connect the amplifier as shown in Figure 2-3.

2. Adjust the source for an output of 3 dB below the rated power level for the amplifier. Without changing the level, vary the frequency over the bandwidth of the amplifier.

3. Under level conditions, the output power should not vary more than the rated specification (See Table 1-1).

NOTE: If a sweeper with leveling is not available, it is still possible to check whether or not voltage is present at the ALC connector. Operate the amplifier as shown in Figure 2-1. With the output set to full power, measure the ALC voltage with the adjustment potentiometer fully clockwise. The voltage should be greater than the rated specification (see Table 1-1).

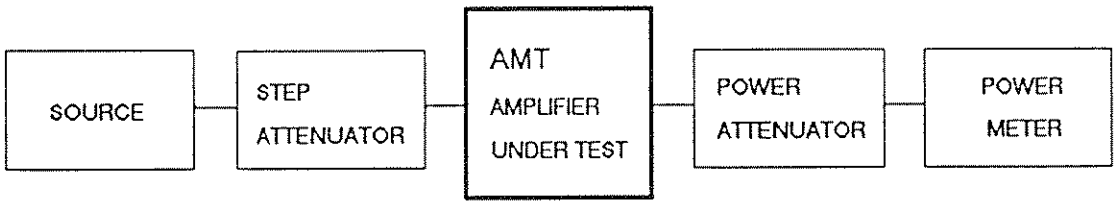


FIGURE 2-1. SETUP FOR PERFORMANCE CHECK OF AMPLIFIER

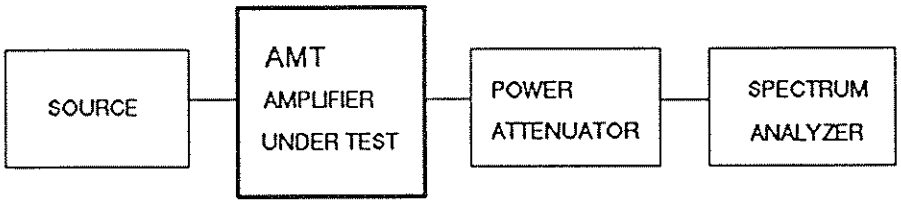


FIGURE 2-2. SETUP FOR HARMONIC LEVEL CHECK

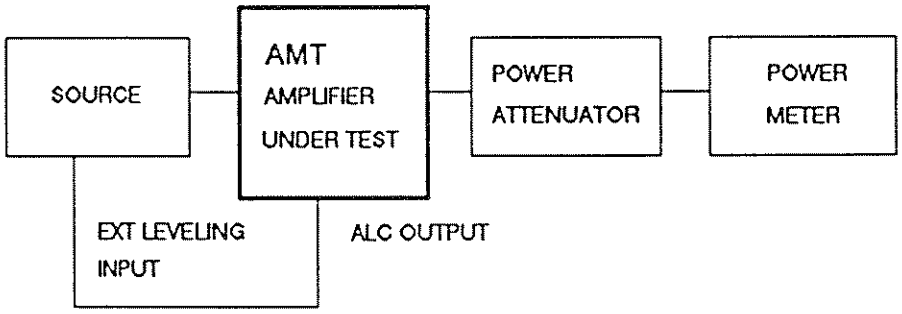


FIGURE 2-3. SETUP FOR INTERNAL DIRECTIONAL FLATNESS

SECTION 3.0

INSTALLATION AND OPERATION

3.1 GENERAL INFORMATION

To protect operating personnel, the National Electrical Manufacturers Association (NEMA) recommends that the instrument panel and cabinet be grounded. All AMT instruments are equipped with a three-conductor power cable which, when connected appropriately, grounds the instrument. The offset pin on the three-prong power cable is the ground wire.

To preserve the protection feature when operating the instrument from a two-connector outlet, use a three-prong to two-prong adapter, and connect the green pigtail on the adapter to ground.

Only fuses with the required rated current, voltage, and specified type (slow blow, time delay, etc.) should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out by a skilled person who is aware of the hazard involved. Do not work on the high voltage while alone.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

NOTE: Unauthorized entry into the instrument or submodules will void the warranty.

3.2 INITIAL INSPECTION

If damage to the shipping carton is evident, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for signs of mechanical damage. Also check the packing material for evidence of severe stress.

3.3 DAMAGE CLAIMS

If the instrument is mechanically damaged in transit, notify the carrier and AMT immediately. Retain the shipping carton and padding material for the carrier's inspection. AMT will arrange for replacement or repair for your instrument without waiting for claim settlement against the carrier.

3.4 SAFETY CONSIDERATIONS

Before applying power, verify that the AC input voltage selector is matched to the available line voltage and the correct fuse is installed.

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electrical shock, do not perform any servicing unless qualified to do so.

3.5 PERFORMING CHECKS

Before shipment, this instrument was inspected and found free of mechanical and electrical defects. The electrical performance of the instrument should be verified upon receipt. Acceptance procedures suitable for incoming inspection are given in the performance verification section of this manual.

If there is any deficiency, or if electrical performance is not within specifications, notify your factory representative or AMT directly.

3.6 GENERAL OPERATION

Connect the AMT linear amplifier to a suitable source of line power. **Use only AMT supplied power cords when operating AMT equipment.** The RF input is a signal within the frequency range of the amplifier with an output level of 1 milliwatt or less. Connect the amplifier as shown in Figure 3-1. If leveled operation is desired, connect the ALC as shown in Figure 3-2.

NOTE: The metering/protection circuit buffers the dual-directional coupler output so that different circuit loading (different meter ranges, calibration settings, etc.) will not cause the coupler output to change. The forward and reflected power is summed and compared with a set reference to establish a safe output operating area. If the output load is a low VSWR (little reflected power), the amplifier will be allowed to deliver its maximum power. However, if the load has a moderate to high VSWR, the amplifier is allowed to deliver less than its maximum power. As the VSWR increases, the available output power decreases to the point where the amplifier will safely drive into an infinite VSWR. To lessen the possibility of damage by sudden high VSWR (for example, a cable failure), a high speed (approximately 10 microseconds) comparator is used to sense this condition and set the pin diode module at its maximum attenuation level for approximately 1 millisecond. This allows the lower speed protective loop time to react to the overload condition.

Set the amplifier's POWER switch to ON and monitor the amplifier's forward (FWD) and reflected (RFL) power while slowly increasing the input drive level until the output power is at the desired level (meter sensitivity may be increased by a factor of 4 by switching the amplifier's HIGH/LOW switch to LOW position). Output power level may be adjusted by varying the signal source output level.

NOTE: Excessive VSWR, caused by a poor load, causes the amplifier's output to be reduced by the protective circuitry and causes the amplifier's OVERLOAD indicator to light (a signal to the operator). The OVERLOAD indicator also lights if the amplifier is being driven beyond its safe output power level.

3.7 CONTROL AND INDICATORS

Primary controls and indicators required to operate and monitor an amplifier are located on the front panel. Figure 3-3 illustrates front-panel controls and indicators and Table 3-1, cross-referenced to Figure 3-3, provides a functional description of these controls.

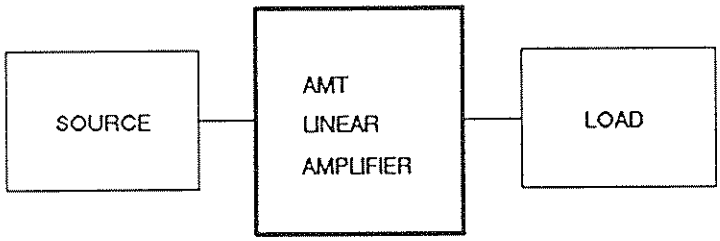


FIGURE 3-1. TYPICAL OPERATIONAL HOOK-UP

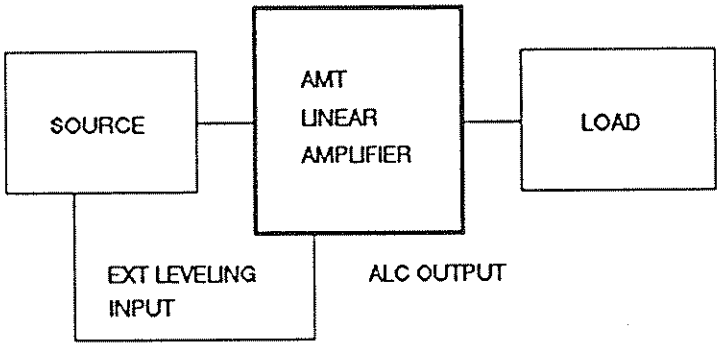
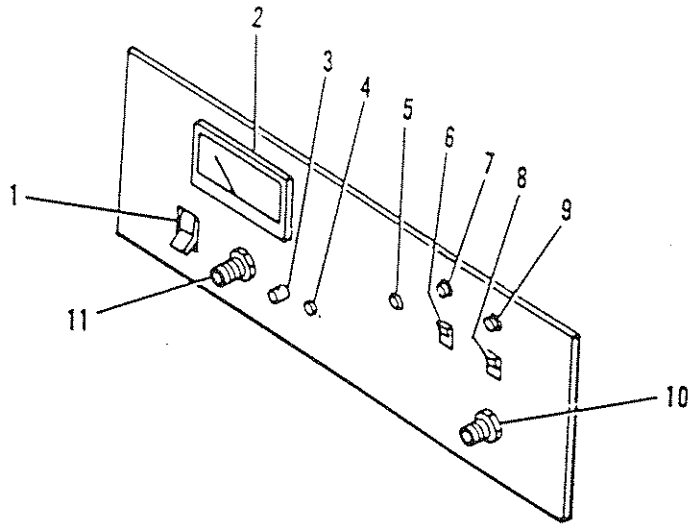
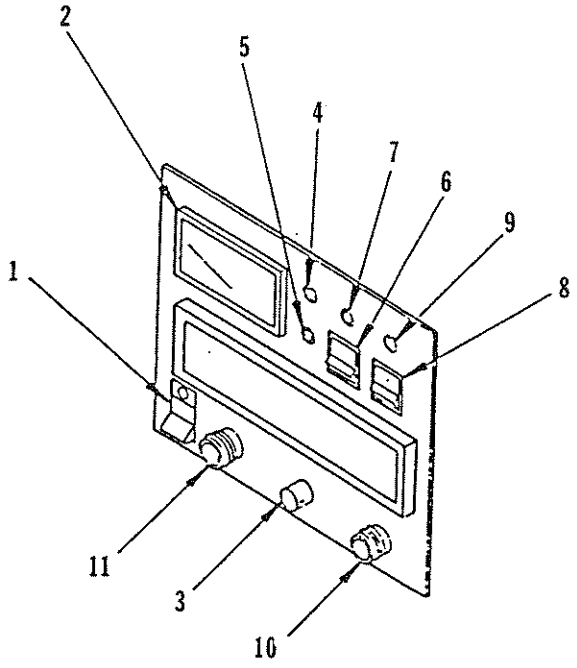


FIGURE 3-2. TYPICAL LEVELING OPERATIONAL HOOK-UP



(A) MODELS 5020B, 3552B, 15100B



(B) MODEL 2060

NOTE: Call-out numbers are cross-reference index numbers for descriptions found in Table 3-1.

FIGURE 3-3. OPERATORS CONTROLS, INDICATORS, AND CONNECTORS AMPLIFIER PANEL

TABLE 3-1. OPERATOR CONTROLS, INDICATORS, AND CONNECTORS ON AMPLIFIER PANEL

Index No. (Fig. 3-3)	Control Indicator or Connector Name	Function
1	POWER/ON	Two-position toggle circuit breaker switch: Used to control power to amplifier.
2	No panel placarding (wattmeter)	RF power meter scaled in watts: High and low scales are selected by panel switch (item 6) and measure either forward or reflected power as selected by panel switch (item 8). Full scale ranges depend upon the amplifier as follows: Model / Low Full Scale / High Full Scale 5020B: 20 W / 80 W 2060: 5 W / 30 W 3552B: 20 W / 80 W 15100B: 10 W / 40 W
3	ALC OUT	Type BNC connector: Used for supplying the forward voltage produced by the directional coupler, for external leveling purposes. Measured DC voltage is an analog of the output power level.
4	ALC OUT ADJ	Trim potentiometer, screwdriver adjustment: Used to adjust DC-voltage scaling of ALC measured at panel connector (item 3).
5	OVER LOAD	LED indicator (red): When lighted, indicates that the amplifier is being driven to its safe limits of operation.

TABLE 3-1. OPERATOR CONTROLS, INDICATORS, AND CONNECTORS ON AMPLIFIER PANEL (Continued)

Index No. (Fig. 3-3)	Control, Indicator or Connector Name	Function
6	HIGH/LOW	Two-position switch: Used to set full-scale range of wattmeter (refer to item 2) to either high or low wattage scale
7	HIGH (METER CAL)	Trim potentiometer, screwdriver adjustment: Used to adjust calibration of the high scale of the wattmeter (item 2).
8	FWD/RFL	Two-position switch: Used to select wattmeter (item 2) input to read either forward (FWD) RF power or reflected (RFL) RF power as measured at the amplifier output.
9	LOW (METER CAL)	Trim potentiometer, screwdriver adjustment: Used to adjust calibration of the low scale of the wattmeter (item 2).
10	RF OUTPUT	Type N RF connector: Coaxial RF signal that is nominally -50 dB of the amplifier output.
11	RF INPUT	Type N RF connector: Coaxial signal-input for driving the amplifier.