EC Declaration of Conformity

We; Amplifier Research
160 School House Road
Souderton, Pa. 18964

declare that our product;

the Model 1S1G4A RF amplifiers

to which this declaration relates is in compliance with the requirements of the EEC EMC Directive (89/336/EEC) in accordance with the relative standards listed below:

EN 50082-2 : 1995
   Electromagnetic compatibility - Generic immunity standard
   Part 2: Industrial environment

EN 55011 : 1991
   Electromagnetic emmissions requirements for Industrial, Scientific and Medical (ISM) Equipment
   Group 1, Class A

The CE marking is affixed on the device according to article 10 of the EC Directive 89/336/EEC.

Donald R. Shepherd
President
INSTRUCTIONS FOR SAFE OPERATION

BEFORE APPLYING POWER
Review this manual and become familiar with all safety markings and instructions.

Verify that the equipment line voltage selection is compatible with the main power source.

Protection provided by the equipment may be impaired if used in a manner not specified by Amplifier Research.

SAFETY SYMBOLS

⚠️ This symbol is marked on the equipment when it is necessary for the user to refer to the manual for important safety information. This symbol is indicated in the Table of Contents to assist in locating pertinent information.

⚠️ Dangerous voltages are present. Use extreme care.

CAUTION: The caution symbol denotes a potential hazard. Attention must be given to the statement to prevent damage, destruction or harm.

接地符号: 该符号表示安全地线端子。当设备接地端子不正常时，必须立即更换防雷器。

SAFETY GROUND
This equipment is provided with a protective earth terminal. The main power source to the equipment must supply an uninterrupted safety ground to input wiring terminals, power cord, or supplied power cord set. The equipment MUST NOT BE USED if this protection is impaired.

CAUTION:
Adjustment, maintenance, or repair of the equipment must be performed only by qualified personnel.

Hazardous energy may be present while protective covers are removed from the equipment even if disconnected from the power source. Contact may result in personal injury.

Replacement fuses are required to be of specific type and current rating.
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SECTION I

GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Model 1S1G4A is a self-contained, broadband Amplifier designed for laboratory applications where instantaneous bandwidth, high gain and moderate power output are required. A gain control, located on the front panel, can be used to decrease the amplifier gain by 10dB or more. Solid state technology is used exclusively to offer significant advantages in reliability and cost. A Model 1S1G4A, used with a frequency swept signal source, will provide 1.0 watt of swept power output from 0.8 to 4.2GHz. Typical applications include antenna and component testing, wattmeter calibration, EMI susceptibility testing, use as a driver for frequency multipliers and high power amplifiers.

1.2 POWER SUPPLIES

The 1S1G4A contains a switching Power Supply. The input voltage range to this supply is 90-132 or 180-264 VAC, 50/60Hz, selected automatically. The operator does not have to switch or change anything on the 1S1G4A when changing the AC input voltage. The AC power consumption is 15 watts nominal. Primary AC circuit fusing is provided. The switching Power Supply also has an internal AC fuse.

1.3 SPECIFICATIONS

Refer to the "Amplifier Research Data Sheet" on the following page for detailed specifications.
SECTION II

OPERATING INSTRUCTIONS

2.1 GENERAL

Operation of the Model 1S1G4A broadband amplifier is simple. The input signal, whether swept or fixed in frequency, is fed into the jack marked "INPUT" and the amplifier output signal is taken from the jack labeled "OUTPUT". The unit is turned ON by activating the power switch. In the event of a unit malfunction, protection is provided by fusing located in the AC input receptacle. A polarized, three (3) wire AC power cord is also included with the unit to provide cabinet and chassis grounding to the power mains.

⚠️ CAUTION:

THE MODEL 1S1G4A AMPLIFIER IS NOT CRITICAL IN REGARDS TO SOURCE AND LOAD VSWR AND WILL REMAIN UNCONDITIONALLY STABLE WITH ANY MAGNITUDE AND PHASE OF SOURCE AND LOAD VSWR. IT ALSO HAS BEEN DESIGNED TO WITHSTAND, WITHOUT DAMAGE, RF INPUT POWER UP TO TWENTY (20) TIMES ITS RATED INPUT OF 1mW. HOWEVER, SIGNAL LEVELS HIGHER THAN 20mW OR TRANSIENTS WITH HIGH PEAK VOLTAGES CAN DAMAGE THE AMPLIFIER. ALSO, ACCIDENTAL CONNECTION OF THE 1S1G4A OUTPUT TO THE INPUT CAUSES OSCILLATIONS WHICH WILL PERMANENTLY DAMAGE THE INPUT CIRCUITRY.

NOTE:

ALTHOUGH DESIGNED FOR OVERDRIVE AND LOAD TOLERANCE DESCRIBED ABOVE, SUBJECTING THE AMPLIFIER TO THESE CONDITIONS SIMULTANEOUSLY CAN CAUSE FAILURE OF THE OUTPUT TRANSISTOR. REPEATED FAILURES OF THIS NATURE WILL NOT BE COVERED UNDER WARRANTY.

The 1S1G4A Amplifier is protected from input overdrive by an automatic level control circuit which will limit the maximum RF level to the first gain stage (U1) of the RF Amplifier to approximately 0dBm. The 1S1G4A RF power transistors are protected from over temperature, by sensing the heat sink temperature near the RF output transistors. In the event of a cooling fan failure or an air flow blockage the DC voltage will be removed from the RF stages, when the heat sink temperature reaches approximately 70°C.

Normal operation can be resumed after the heat sink temperature drops below 70° C.
2.2 AMPLIFIER OPERATION

Figure 2-1 shows the Model 1S1G4A Amplifier in pictorial form.

Turn On Sequence:

1. Connect input signal to "INPUT" connector. The input signal level should be 0dBm maximum.
2. Connect load to "OUTPUT" connector.
3. Activate power switch to ON (1) position. A green indicator light located next to the power switch will light when power is applied.
SECTION III
THEORY OF OPERATION

3.1 INTRODUCTION

The Model 1S1G4A RF amplifier consists of a 0.8-4.2GHz RF amplifier, Bias Control and a Power Supply circuit on the chassis opposite of the RF Amplifier. The RF assembly is accessible thru the top of the unit, the Power Supply and Bias Control are accessible thru the bottom of the unit.

The RF section consists of a variable gain amplifier, a splitter/detector, a linearizer/control circuit, a one (1) watt amplifier and a bias control circuit.

The Power Supply section consists of an AC input filter with fusing, AC Power Switch, and a switching Power Supply.

3.2 RF AMPLIFIER OPERATION

3.2.1 A1 Variable Gain Amp (Schematic No. 1012338 Part of Schematic 1012408)

The RF input signal is fed to the A1 Variable Gain Amplifier, RF attenuator U1. U1 is a Gallium Arsenide (GaAs) Field-Effect Transistor (FET) Attenuator. DC signals between approximately –0.5V to –2.0V are used to control the shunt and series legs of the RF Attenuator. This Attenuator is used for manual gain control using the front panel GAIN control for remote gain control, and to attenuate RF input signals above 0dBm, by utilizing internal voltages.

LC networks C2, L1, C3 and L2 form high pass filters used to attenuate low frequency signals.

Transistor Q1 is a GaAs FET transistor and is the first stage of gain in the amplifier. Transistor A3Q1 in the A3 Linearizer Control Circuit controls the drain current thru FET Q1. The output of the A1 is fed to the input of the Wilkinson Two-Way Splitter.

The Wilkinson Two-Way Splitter splits the signal into two paths: one output is fed to the input of the A3 One (1)-Watt Amplifier, the other output is fed to a detector that is terminated in 50Ω. The detected output is fed to the A2 Linearizer Control Circuit.

3.2.3 A3 Linearizer Control Circuit (Schematic 1012335 Part of Schematic 1012408)

I.C. U1A provides a DC signal to the series element of the A1U1 attenuator. The A1U1 has minimum attenuation when the control signal is at approximately -12.5VDC with maximum attenuation (minimum gain) occurring with 0VDC on the control input.
3.2.3 A3 Linearizer Control Circuit (Continued)

NPN transistors Q2, Q3 and A4 are used to provide break points in the series control voltage input to the A1U1 RF attenuator, providing a more linear gain control/attenuation characteristic.

PNP transistor Q1 is used to control the drain current of GaAs A1Q1 by varying the A1Q1 gate voltage. A reference voltage is provided at the base of Q1 by voltage dividers R25 and R26. The drain current of the RF FET (A1Q1) flows thru R27 (220Ω 1 watt). PNP transistor Q1 varies the gate voltage to the RF FET A1Q1 to maintain the correct drain current.

I.C. U2A amplifiers the detected signal from A2CR1. I.C. U2B is a comparator, its normal output is approximately -12.5 VDC. When the RF input signal to the A1 variable gain amplifier is increased above approximately 1mw (0dBm), the voltage output from U2B will become less negative. This voltage is fed to the gain control on the front panel of the amplifier. The wiper of the gain control is connected to the control input of U1A of the Linearizer/Control Circuit. The amplifier has maximum gain at approximately -12.5 VDC control input. Minimum gain occurs at 0 VDC. The attenuation of A1U1 will increase as the output of A3U2B varies from -12.5V toward 0 volts. This will help to protect the unit in the event of input overdrive.

3.2.4 A4 One (1) Watt Amplifier (Schematic 1010591 Part of Schematic 1010903)

The one (1) watt amplifier is assembled on a teflon/glass P.C. board using microstrip techniques. The one (1) watt amp has three (3) GaAs FET gain stages. Each stage is input and output DC isolated from the other stage with coupling capacitors. Resistive feedback is used from the drain to the gate of the GaAs FET to decrease the low frequency gain. Shunt capacitive stubs are used to tune the amplifier. The drain of Q3 is matched to the output.

The GaAs FET transistors are operated in a depletion mode. They will conduct the maximum DC current with 0VDC bias on their gates and are normally operated with between approximately -1 to -4 VDC on their gates.

3.2.5 A5 Bias Control (Schematic 1010901 Part of Schematic 1010903)

The bias control circuit controls the DC drain current of the three (3) FET stages in the A4 one (1) watt amplifier by varying the gate voltage of the RF stages.
3.2.5  A5 Bias Control (Continued)

The bias control has a -5 VDC input and a +15 VDC input from the power supply.

All of the bias control stages operate in a similar manner therefore only the operation of Q4 will be described.

PNP transistor Q4 (2N3906) is used to control the DC current thru A4Q3 FET in the one (1) watt amplifier. A reference voltage of 9.5 VDC is established on the base of Q4 with the voltage divider network R7 (2.0K) and R12 (3.57K). There is a 18Ω resistor from the 15VDC line to the emitter of Q4 and also to the drain of A4Q4 in the one (1) watt amplifier. Q4 will operate normally with approximately 8.8V on the emitter, this will occur with approximately 270ma thru the 18Ω resistor R8. If the current thru A4Q3 decreases the drop across R8 will decrease increasing the emitter voltage of Q4, this will cause Q4 to conduct more which will cause the gate voltage of A4Q3 to go more positive, which will cause A4Q3 to conduct more returning the voltage at the emitter of Q4 to 10.2V.

3.3  Power Supply

3.3.1

Power supply PS1 supplies +15VDC, −15VDC, and +5VDC. PS1 is a switching regulator which automatically sets the AC input circuits to the correct connections for the line voltage in use either the 90-132 or the 180-264 VAC input ranges 50 to 60Hz.

Auxillary Board A6 (Schematic 1011211) filters the +15VDC and −15VDC and has a regulator which supplies −5VDC to the A5 Bias Control Board.
SECTION IV
MAINTENANCE

4.1 GENERAL MAINTENANCE INFORMATION

The Model 1S1G4A should require very little maintenance since it is a relatively simple instrument. It is built with etched circuit wiring and solid state devices which should ensure long, trouble free life. However, should trouble occur special care must be taken in servicing to avoid damage to the devices or the etched circuit board.

Since the components are soldered in place, substitution of components should not be resorted to unless there is some indication that they are faulty. In addition, take care when troubleshooting, not to short voltages across the amplifier. Small bias changes may ruin the amplifier due to excessive dissipation or transients.

Components in Amplifier Research instruments are conservatively operated to provide maximum instrument reliability. In spite of this, parts within an instrument may fail. Usually, the instrument must be immediately repaired with a minimum of "down time". A systematic approach can greatly simplify and thereby speed up the repair.

However, due to the importance of the amplifier's alignment, it is recommended that when failure is caused by breakdown of any of the components in the signal circuits, the amplifier be returned to the factory for part replacement and amplifier realignment. Shipping instructions are as follows.

Ship PREPAID via United Parcel Service to:

Amplifier Research Corporation
160 School House Road
Souderton, Pa. 18964

4.2 DISASSEMBLY PROCEDURE

⚠️ CAUTION:

EXTREME CAUTION SHOULD BE EXERCISED WHEN TROUBLESHOOTING THIS UNIT. PARTICULARLY WHEN MEASURING VOLTAGES IN THE POWER SUPPLY SECTION OF THE UNIT AS HAZARDOUS VOLTAGES DO EXIST IN THE UNIT WHICH COULD CAUSE SERIOUS INJURY TO ANY PERSONNEL PERFORMING THE MEASUREMENTS.

The amplifier can be removed from the housing by removing 4 screws from the front panel. The amplifier can then be slid from the housing. The top cover can be removed to gain access to the RF assemblies. The bottom cover can be removed to gain access to the power supply, and A3 and A5 Bias Control.
4.3 TROUBLESHOOTING

CAUTION

THE RF TRANSISTORS USED IN THE 1S1G4A AMPLIFIER ARE GaAs FET'S. THESE DEVICES ARE VERY RELIABLE WHEN INSTALLED IN A SUITABLE CIRCUIT BUT CAN BE EASILY DAMAGED WITH IMPROPER TROUBLESHOOTING OR HANDLING TECHNIQUES. THE GATE JUNCTIONS OF THE GaAs FET'S HAVE A HIGH INPUT IMPEDANCE AND ARE SUSCEPTIBLE TO STATIC DAMAGE OR DAMAGE DUE TO AN UNGROUNDED SOLDERING IRON. DO NOT TRY TO CHECK FET'S WITH AN OHMMETER. USE CAUTION WHEN TROUBLESHOOTING, DO NOT SHORT THE GATE TO GROUND OR TO THE DRAINS.

CAUTION

USE CARE WHEN UNPACKING NEW FET'S. THE FET PACKAGING SHOULD ONLY BE OPENED AT STATIC APPROVED WORK STATIONS, BY INDIVIDUALS FAMILIAR WITH THE HANDLING OF STATIC SENSITIVE RF GaAs FET'S.

Troubleshooting the 1S1G4A in a logical manner can speed the solution to a problem. The settings of pots, capacitors or other variables should not be disturbed until other problems have been eliminated. Many problems can be solved by comparing the measured DC voltage to those shown on the schematics. Before measuring circuit voltages, first verify that the voltage to the circuits are correct.

1S1G4A Troubleshooting Categories

Paragraph 4.4 Power Indicator LED Doesn't Light
Paragraph 4.5 Thermal Fault
Paragraph 4.6 Low or No RF Power Output

4.4 Green Power Indicator LED Doesn't Light

Refer to Schematic Number (1010905)

4.4.1 Is the cooling fan running?

If the fan is not running, check to see that the 1S1G4A is plugged into a live outlet. Check the line cord, is the line cord plugged into the 1S1G4A completely?

4.4.3 Check the AC fuse located in the AC receptacle on the rear panel.

4.4.4 Check the output voltage from PS1, there should be +15VDC, -15VDC and +5VDC.
4.4 Green Power Indicator LED Doesn't Light (Continued)

If there is no output:

(1) Check the AC input to PS1. The AC input should be equal to the AC Line Voltage. If there isn't any AC input, the power switch could be defective or there could be an open in the wiring or other component.

(2) Check the fuse on the AC input located in PS1, if okay, remove the output connector from PS2, recheck the D.C. output voltage, if voltage is present without load, there may be a short on the output of PS1. If the 2 amp fuse located in PS1 is blown, replace it with the spare fuse in the shipping kit.

4.5 Thermal Fault

S2 is a temperature sensing switch, switch is mounted on the top side of the chassis located between the A1 Variable Gain Amp and the A4-1Watt Amp.

If the operating temperature of the chassis rises above 70°C, the switch will open and remove the 15VDC going to the A3 and A5 Bias Control Circuits. This will remove the voltage to the drain leads of the GaAs Fets.

When the operating temperature drops below 70°C, S2 will close and normal operation can resume.

4.5.1 Check for blockage of the air inlet on the bottom of the unit.

4.5.2 Check for blockage of the air inlet on the top of the unit.

4.5.3 Is the fan running? There should be airflow from the top panel.

4.5.4 If the above are okay and the unit is not overheated, check S2, the Thermal sensing, the switch should be closed below 70°C.

4.5.5 Check for continuity between P6-1 and P7-1.
4.6 Low or No RF power output

If the power indicator is lit (green):

4.6.1 Check the position of the RF gain control.

4.6.2 Check the RF input power to the 1S1G4A, is it the correct frequency range and amplitude.

4.6.3 Check the RF output connections, is it correctly connected to the load? Is the coax cable defective?

4.6.4 Check the following voltages on the Power Supply. If any of the voltages are out of tolerance, correct the problem before further troubleshooting.

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<table>
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<tbody>
<tr>
<td>P6-1</td>
<td>+15V</td>
<td>±0.4V</td>
</tr>
<tr>
<td>P6-2</td>
<td>+5V</td>
<td>±0.3V</td>
</tr>
<tr>
<td>P6-6</td>
<td>-15V</td>
<td>±0.4V</td>
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4.6.5 If the voltages in Paragraph 4.6.4 are correct, check the voltage to the Linearizer/Control Circuit (A1A3). Troubleshoot any incorrect voltages.

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<table>
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<tbody>
<tr>
<td>J1 Pin 4</td>
<td>-15V</td>
<td>±0.4V</td>
</tr>
<tr>
<td>J1 Pin 5</td>
<td>+15V</td>
<td>±0.4V</td>
</tr>
<tr>
<td>J1 Pin 6</td>
<td>-12.5V</td>
<td>±1.5V (Gain control at maximum gain. Input signal less than -5dBm)</td>
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4.6.6 Check the voltage supplied to the A1A5 Bias Control Circuit. Troubleshoot any incorrect voltage.

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<tbody>
<tr>
<td>J1 Pin 1</td>
<td>-5V</td>
<td>±0.2V</td>
</tr>
<tr>
<td>J1 Pin 3</td>
<td>+15V</td>
<td>±0.5V</td>
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4.6.7 Check the voltage on the feedthru caps of the A4 one (1) watt amplifier. Troubleshoot any incorrect voltage.

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<tbody>
<tr>
<td>C3, C5 C7</td>
<td>-0.7V to -3.5V</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>+7.0</td>
<td>±0.5V</td>
</tr>
<tr>
<td>C6</td>
<td>+10V</td>
<td>±0.5V</td>
</tr>
<tr>
<td>C8</td>
<td>+10V</td>
<td>±0.5V</td>
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4.6.8 Check the voltage on the feedthru caps of the A1A1 variable gain amplifier, with the RF gain control at maximum gain. Troubleshoot any incorrect voltages.

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<tbody>
<tr>
<td>C12</td>
<td>-0.7V to -3.5V</td>
<td></td>
</tr>
<tr>
<td>C13</td>
<td>+4.3V</td>
<td>±0.5V</td>
</tr>
<tr>
<td>C11</td>
<td>-0.1V</td>
<td></td>
</tr>
<tr>
<td>C10</td>
<td>-1.5V</td>
<td>±0.5V</td>
</tr>
<tr>
<td>C9</td>
<td>-4.0V</td>
<td>±1.0V</td>
</tr>
</tbody>
</table>
4.6 Low or no RF power output (Continued)

4.6.9 The gain can be checked by disconnecting the output of the A1 Variable Gain Amp from the input of the A4 one (1) watt amplifier.

4.6.10 Check the RF Gain from the RF input on the front panel to the output of A1 Variable Gain Amp. The gain should be approximately 1-2dB with the Gain Control at maximum gain. If the gain is normal, go to Paragraph 4.6.14.

4.6.11 If the RF gain is low, check the input coaxial cable.

4.6.12 Check the gain from the input of the Variable gain amplifier to the output.

4.6.13 If the gain is not approximately 1-2dB, check for broken coupling caps, open input or output connections.

4.6.14 Check the gain from the input of the one (1) watt amplifier A4 to the RF output on the front panel. The gain should be 27dB minimum.

4.6.15 Check the gain from the input connector to the output connector of the one (1) watt amplifier, the gain should be 27dB minimum. If the gain is low, check for broken coupling caps, bad connections at the input and output of the amplifier.