SGC

SG-500

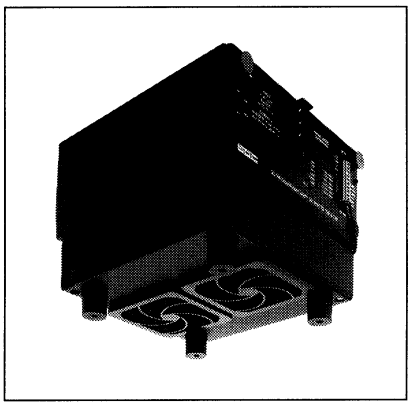
SmartPowerCube™

500 Watt HF Linear Amplifier

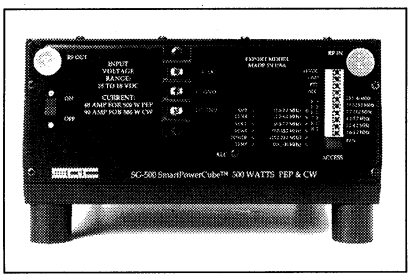
OPERATION/MAINTENANCE MANUAL

POWER TOOLS

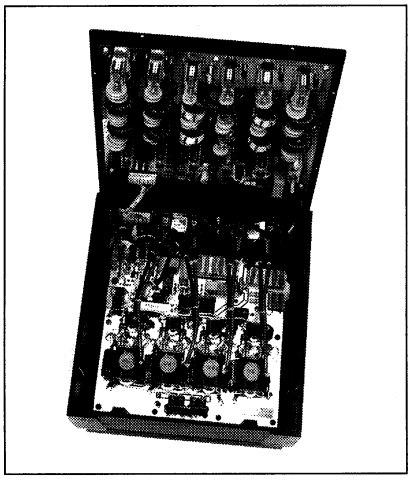
Getting the most from every watt of HF-SSB Power



Heavy duty cooling fan option for continuous CW use.



SG-500 features microprocessor controlled LED bank fault indicators and extra heavy-duty input/output connections.



Only premium components and assembly techniques are utilized. The SG-500 is engineered and built to reliably function, essentially unattended, in the most demanding conditions.

Full 500 watt output.

- The SG-500 produces enough power to be within 1 "S" unit (3 dB) of a 1 kW amplifier.

Microprocessor Controlled:

- Automatically adjusts amplifier input sensitivity.
- Monitors all parameters for faults (Heat, high VSWR, under voltage, etc.).
- Automatically selects the correct filter band.
- Export versions control transmit/receive switching.

Fully compatible with most HF equipment produced by most HF manufacturers.

Important Installation Tips:

- The SmartPowerCube™ should be located as close as possible to the antenna or coupler.
- When installing the SmartPowerCube,™ be absolutely certain that your antenna will handle the power output.
- Since some antennas are over-rated, plan on using an antenna system which is designed for at least 1 kW of power. Antennas rated at 500 watts or less are likely to fail.
- Avoid corona discharge by using "corona dope" to coat pointed metal parts on your antenna.
- Antenna wire should be at least AWG #8.
- Feedline should be at least RG-8, with larger cable for runs over 25 feet.

SGC

NO COMPROMISE COMMUNICATIONS

The SGC Building
13737 S.E. 26th Street, Bellevue, WA 98005 USA
(206) 746-6310 Fax: (206) 746-6384

1-800-259-7331

SG-500 SmartPowerCube™ Specifications:

Power Output:	
SSB:	500 watts PEP
CW:	500 watts 10 Min. (no fan) 500 watts Unlimited with fan
AM:	250 watts Carrier max.
Frequency Range:	1.6-24 MHz (U.S.) (For marine and ham use pending FCC approval) 1.6-30 MHz (Export)
Power Input:	50-90 watts(Automatic or present) 90-150 watts
Band Switching:	Fully Automatic
Input Voltage:	14.0 VDC
Input Range:	10.0-18.0 VDC
Input Current:	40 amps average (SSB) 90 amps peak, or for CW
Cooling:	Convection standard
Optional Cooling:	Cooling fans
T/R Switching Time:	10 mS nominal
Band Switch Time:	15 mS nominal
Keying:	Via PTT line (U.S. version) PTT or RF Sense (Export)
Protection:	Input overdrive Under voltage (adjustable): Factory default 10.0 VDC Amplifier module current imbalance VSWR faults Frequency out of specified range Over current Over temperature
Built-In Test Equipment:	Microprocessor controlled LED bank fault indicator
Modes Supported:	SSB, CW, RTTY, SITOR, ALE, SSTV, AM at 250 watts
Dimensions:	6 H x 12.25 D x 11.4 W inches
With Optional Cooling Fans:	Changes H to 9.75 inches
Color:	Matte black
Case:	Special aluminum casting
Weight:	21 lb. (9.5 Kg)

AMERICAN TECHNOLOGICAL LEADERSHIP
MADE IN USA

SG-500

SmartPowerCube™

500 Watt HF Linear Amplifier

Installation and Operations Manual
Revised: October, 1996

Caution: Carefully read the information presented in this manual prior to operating your *SmartPowerCube* ™ amplifier. This unit will provide years of outstanding service if you follow the detailed recommendations in this manual.

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WARNING!

Safety First!

The SG-500 *SmartPowerCube,*™ is a high power amplifier capable of producing output power levels which can cause serious RF burns to anyone coming in contact with exposed antenna or feedline during transmission. These RF power levels can also cause fire, explosion, injury or even death resulting from improper and unsafe operation or installation. Observe all rules and precautions of electrical safety and adhere to the operating and installation guidance provided in this manual.

Never operate the unit with its protective cover removed, nor attempt to modify its original circuit design and construction. Doing so may cause malfunctions and void the warranty. Ensure that any work performed on the unit be done in the presence of another person who is thoroughly trained in first aid techniques including specifically CPR.

Power Supply Warning!

SGC strongly advises against the use of any switched-mode or analog regulated power supply with the SG-500 amplifier, and doing so may void the warranty. Regulated analog supplies not designed for use in high RF fields may experience regulator circuit instability, producing damaging over-voltage conditions, or oscillation between supply and amplifier.

To remedy the power supply issue, SGC offers a conservative and safe solution with our PS-50 unregulated 14 VDC, 50 amp supply. While slightly more expensive than some of it regulated counterparts, it is extremely reliable *and safe* in the high RF fields encountered with amplifier operation. A lower-cost alternative is to use a 100-Ah lead-acid automotive/RV battery floated with a low-cost charger.

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SGC Inc. SGC Building, 13737 SE. 26th St. Bellevue, WA. 98005 USA
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1.0 Introduction

The SGC SG-500 *SmartPowerCube* ™is a professional-grade HF amplifier designed to provide a maximum of 500 watts PEP RF output when driven from virtually any HF transceiver — up to 150 W PEP input. This provides on-the-air signal levels within 3 dB of a full kW amplifier at much less the cost! An operational frequency range of 1.8-24 MHz is available in domestic versions, with full 1.6-30 MHz coverage in export units. This amplifier is the result of extensive research and design to create an affordable unit which provides dependable operation with a minimum of controls and operator interface.

SGC SG-500 SmartPowerCube™

The SG-500 is "bullet-proof" - fully protected by microprocessor control. This circuitry dynamically monitors all amplifier parameters, and provides adjustments and protection against high VSWR, under-voltage, over-current, and high-temperature conditions. Amplifier status is visible from a row of LED indicators on the front panel. Professional-grade design and construction is utilized throughout the unit, with all circuit assemblies encased within the massive die-cast alloy chassis/heatsink.

PTT Keying Mode and Band Input Filter Selection can be enabled automatically, or by manual control. Band switching time is typically 15 msec or less. This automated capability is ideal for remote or unattended operating site applications. SGC's conservatively rated amplifier design uses 8 x MRF454 final power transistors for full power output with minimal component stress. The small case dimensions (less than 1 cubic foot!) and footprint size allow convenient desktop, mobile, and maritime installation. When used with the matching SGC-235 antenna coupler, it forms the heart of an automatic all-band 500-watt HF system.

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2.0 About SGC – The Company

SGC has been in the HF communications business for over 25 years, and started with the manufacture of HF SSB transceivers for the maritime and commercial (para-military, government) markets. Since then our product line has expanded to cover an entire range of station equipment and accessories - antenna couplers, amplifiers, DSP units, and power supplies. SGC products are proudly made in the USA, and all are backed by a no-nonsense ***5-year limited warranty***.

In the unlikely event that you ever have difficulties with your SGC equipment, we encourage you to call our technical support staff and let us assist you in resolving the problem. We value every one of our customers, and our commitment to outstanding service and support provided after the sale is just one of the reasons SGC has maintained its reputation as a leader in the HF communications industry.

SGC believes that each piece of HF equipment should be "intelligent" enough to provide fully automatic operation, and that it should be compatible with other manufacturer's equipment. This is in stark contrast when compared to other HF radio manufacturers who warranty their equipment only when used with *their* own equipment brand. To expand and better serve the end-users choices and desires we offer an alternative: SGC *Smart* equipment.

You now have total freedom to use whatever equipment you want with SGC products. This approach insures that your investment continues to work well into the future. It makes your purchase a long-term investment which never becomes obsolete.

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3.0 Specifications:

3.1 Electrical

Power Output:	500 W PEP SSB, 500 W CW 10 min. maximum w/o fan 500 W CW no time limit w/fan (at 50% duty cycle) 250 W AM carrier max.
Frequency Range:	1.8 - 24 MHz (1.6 - 30 MHz in export version)
Power Input:	30 to 60 watts (automatic or preset) 60 - 150 watts
Band Switching	Manual (automatic in export version)
Input Voltage:	14.0 VDC (input range 10.0 - 18.0 VDC)
Input Current:	40 A average (SSB), 90 A peak
Cooling:	Natural air convection (optional cooling fan available)
T/R Switching:	10 msec. nominal
Keying:	PTT line (manual) or RF sensed (automatic)
Protection:	Input overdrive Under voltage (adjustable -factory default 10.0 VDC) Out-of-band frequency input Amplifier module current imbalance Over-current High temperature High VSWR
Built In Test Equip:	Microprocessor controlled LED fault indicators
Operating Modes:	SSB, CW, RTTY, SITOR, ALE, SSTV, AM at 250 W.

3.2 Mechanical

Dimensions:	4.9" H x 12.0" D x 10.8" W Body only 6.1" H x 13.2" D x 10.8" W w/feet 9.75" H w/optional fan
Case:	Special metal casting, matte black finish
Weight:	21 Pounds (9.5 Kg)

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5.0 Cautions and Safety Considerations

Although you are probably anxious to get your SG-500 amplifier installed into your station and operating, we highly recommend first taking a few moments to review the information presented in this manual. It will help familiarize you with the proper preparation, installation, and operation of your new equipment. The few minutes spent now will save you much time later when you begin the more involved process of installation and getting on the air.

5.1 DC Power Supply Considerations

This amplifier is designed to be powered only from a high-quality 14.0 VDC power supply providing adequate reserve current capability for the desired operational application. At the 500-watts RF power, high RF and DC current level are present in and around equipment. We only recommend the use of high-quality linear power supplies designed for RF applications, such as the SGC PS-50. *We strongly advise against the use of a switched-mode power supply for high RF applications. Permanent damage to the power supply or other station equipment may occur if a improperly-designed switched-mode supply is used!* It is best to use a separate, dedicated power supply for the exciter (transceiver), such as the SGC PS-30.

A minimum of 50A, 14VDC is needed for SSB operation (PS-50), and 90A or better for carrier modes (AM, FM, RTTY) or high duty cycle operation (2 x PS-50). In many cases, a battery can be paralleled or "floated" with a charger or power supply for extended current reserve. However, please check with the manufacturer of the power supply, because high-current diodes are sometimes needed to accomplish this. SGC recommends that only a 100-Ah, deep-cycle marine/RV battery be used for this application. For commercial or high duty-cycle operation, we recommend installing the optional SGC cooling fan kit for continuous operation.

5.2 Safety Considerations

While all SGC equipment is designed with safety and ease-of-operation in mind, all safety and protective considerations needed to be adhered to. Follow the recommended installation instructions outlined later in this manual. The 500 watt RF energy can cause a painful burn to anyone coming into contact with a radiating antenna element, whip or open transmission line. Ensure that no person or animal comes into direct contact with the antenna or transmission line of your station.

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6.0 Antenna and Feedline Tips:

The quality of your transmission is directly related to how *efficiently* you transfer the power from amplifier to antenna (via the transmission line), and how *effectively* your antenna radiates your signal into space. Keeping those two facts in mind, we offer the following advice for your station installation.

6.1 Antenna Characteristics

Connect your station antenna to the coaxial connector marked **RF OUT** on the SG-500. Ensure that your antenna is rated to handle a minimum RF power level of 500 watts PEP or greater, and is resonant at the intended band or frequencies of operation.

The output impedance of the SG-500 is 50 ohms. Your antennas characteristic impedance should present a VSWR (Voltage Standing Wave ratio) of 2.0:1 *or less* at all desired operating frequencies. If not, an automatic antenna coupler (such as the SG-235) or manual matching network must be used. When using manual tuning networks, first tune for resonance with the amplifier off, to prevent a high VSWR trip from occurring.

When installing the *SmartPowerCube,*™ you should be absolutely certain that your antenna will handle the power. Because some antenna manufacturers over-rate their antennas, ensure your antenna system is designed for at least 1 kW of power. Small antennas which are rated at 500 watts or less are likely to fail. Also, small antenna systems are subject to component overheating. If this occurs when using the SmartPowerCube™, immediately investigate and resolve the problem.

The antenna system used should have no sharp edges to reduce the possibility of corona discharge, a condition which causes the area around the antenna to glow with a bluish-white light. Corona is a very dangerous condition and may lead to fire, destruction of the antenna and damage to the *SmartPowerCube.* ™ When using a wire or metal antenna which has pointed metal parts, please take the time to coat the portions with "corona dope" which is frequently used in the high voltage section of televisions where similar high voltages can occur.

The antenna (radiating) wire used with the *SmartPowerCube* ™ should be AWG #8 *or heavier*. because during transmission high currents exist at certain points on the antenna. These currents may exceed 20 amps (depending upon the impedance at a particular point on the antenna). Electrical theory states if you try to force 20 amps through smaller diameter wire, such as AWG # 14, the wire will heat. Heat translates into lost power. We strongly emphasize that if you have any component heating, you must resolve that issue in order to have the best possible signal. *Heat loss = signal loss!*

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6.2 Transmission Feed Lines

You will need to construct or purchase a coaxial jumper cable to connect the transceiver output to the SG-500 RF Input. Use high quality 50-ohm foam dielectric cable such as RG-8, RG-8X, or their equivalent. Standard UHF connectors (known as PL-259 plugs) need to be installed at each end. Small diameter RG-58 can be used if *very short* (less than 3 feet) cable runs are encountered. Never use 75-ohm RG-59 (CATV) cable for this purpose.

Use feedline having the lowest loss (per foot) for your application. Although you may use RG-58 type coax for short runs, you should use large coax for lengths over 25 feet. The smaller type of coax cable *should not be used* because it is subject to the same heating losses as described above.

6.21 Coaxial cable selection and routing tips:

A. Transmission line loss varies according cable age, length, and the frequency of operation.

Cables "age" due to time, weather, and UV exposure — all of which may cause the dielectric quality of the insulation between the center conductor and the outer conductor to degrade. Therefore, always select the highest quality coax cable. Review cable specifications and compare outer braid shielding (%), dielectric material, and dB loss per foot across the 1-30 MHz range.

In general, the higher the percentage, the better the quality of the outer shield. Two common dielectric materials are polyethylene and foam, with the foam type usually offering better specifications. Transmission line power loss is usually stated in dB per foot, and is proportional to the operating frequency range. The cable offering the lowest loss at 30 MHz or below is best for your HF installation.

B. Route coax cable as straight as possible, avoid "kinks" in bends, and coiling excess cable length. Try to distance cable from AC power wiring that may be a source of noise.

C. Because high power is involved, all feedline terminations at the transceiver and antenna should be securely fastened. Use solder-type coaxial plugs (sometimes known as PL-259 or UHF connectors) and avoid the crimp or "push-on" solderless type plugs.

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7.0 Power Supplies

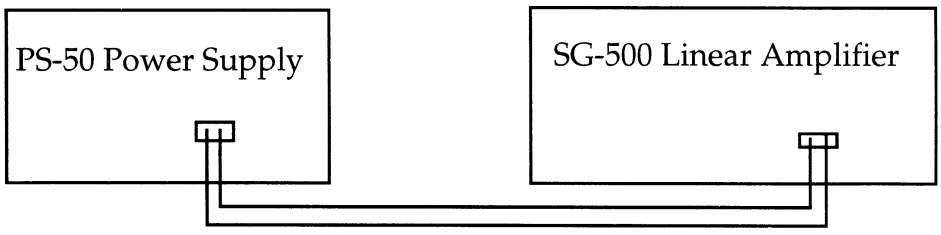
The SG-500 is designed to be powered from a high-quality 14.0 VDC power supply providing adequate reserve current capability for the desired operational application. At 500-watts, high DC and RF current levels are present in and around equipment. We only recommend the use of high-quality linear power supplies designed for RF applications, such as the SGC PS-50. *We strongly advise against the use of any switched-mode power supply for high-power RF applications.* Permanent damage to the power supply or other station equipment may occur if a switched-mode or regulated analog supply is used! *Please read the warning box on the inside cover of the manual.* It is best to use a separate, dedicated power supply for the transceiver, such as the SGC PS-30.

SGC PS-50 DC Power Supply

A minimum of 50A, 14VDC is needed for SSB operation (PS-50), and 90A or better for carrier modes (AM, FM, RTTY) or high duty cycle operation (2 x PS-50). For commercial or high duty-cycle operation, we recommend installing the optional SGC cooling fan kit for continuous operation.

7.1 Single Power Supply

If you are operating only on SSB and CW in intermittent service, you may use one PS-50 power supply, as shown below. This is adequate for 500 watt PEP SSB operation.



Caution: Use at least AWG #6 wire - Very heavy Current Drain of up to 90 Amps peak will be encountered in use.

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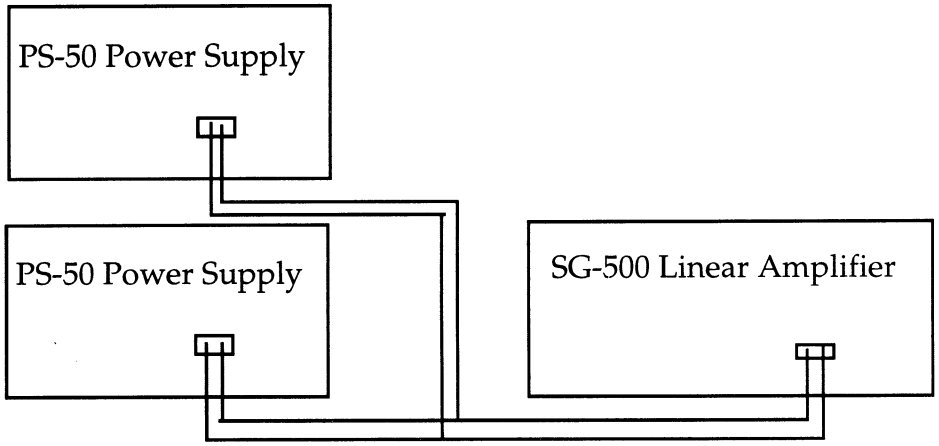
7.2 Multiple Power Supplies

For high duty-cycle, or continuous transmission such as RTTY, SSTV or other digital modes (key-down longer than 1-2 mins), we advise using *two* PS-50 power supplies connected in parallel, as shown below.



Caution: Use at least AWG #6 wire - Very heavy Current Drain of up to 90 Amps peak will be encountered in use.

7.3 Battery "Float" Power Supply

In some cases, a battery can be paralleled or "floated" with a charger or power supply for extended current reserve. However, please check with the manufacturer of the power supply, as high-current diodes in series are sometimes needed to do this.

SGC recommends that only a 100-Ah, deep-cycle marine/RV type battery be used for this application. Note that the power supply may over-charge the battery if left connected when the SG-500 is not in use. Also, if an internal bleeder resistor is used in the power supply, the battery will discharge through it. To prevent either of these situations, remove the positive (+) battery lead when not in use.

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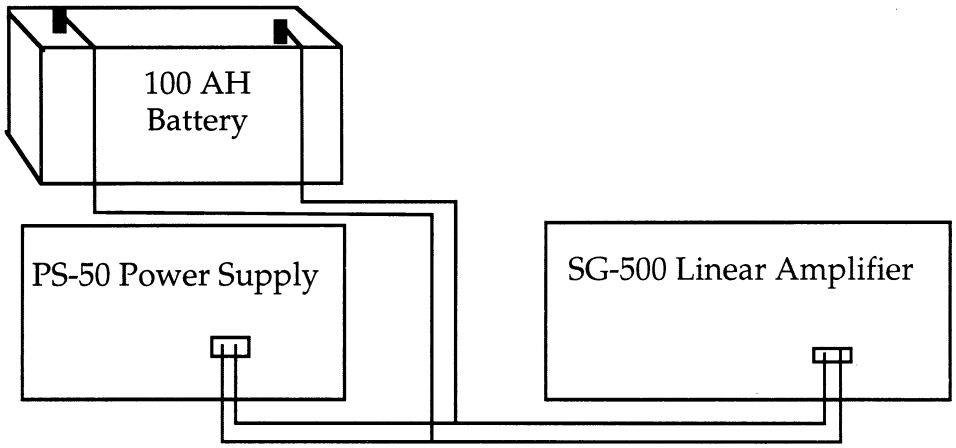

Caution: Use at least AWG #6 wire - Very heavy Current Drain of up to 90 Amps peak will be encountered in use.

7.4 Alternative Power Sources

The SG-500 *SmartPowerCube* ™ may be used with other 14 VDC sources, such as solar and wind power units. However, please ensure that the power source can supply the necessary voltage level and current capacity under load. The amplifier is designed to operate at voltages down to 11 VDC - below this voltage the SG-500 automatically drops "off-line" and is bypassed for "barefoot" transceiver operation.

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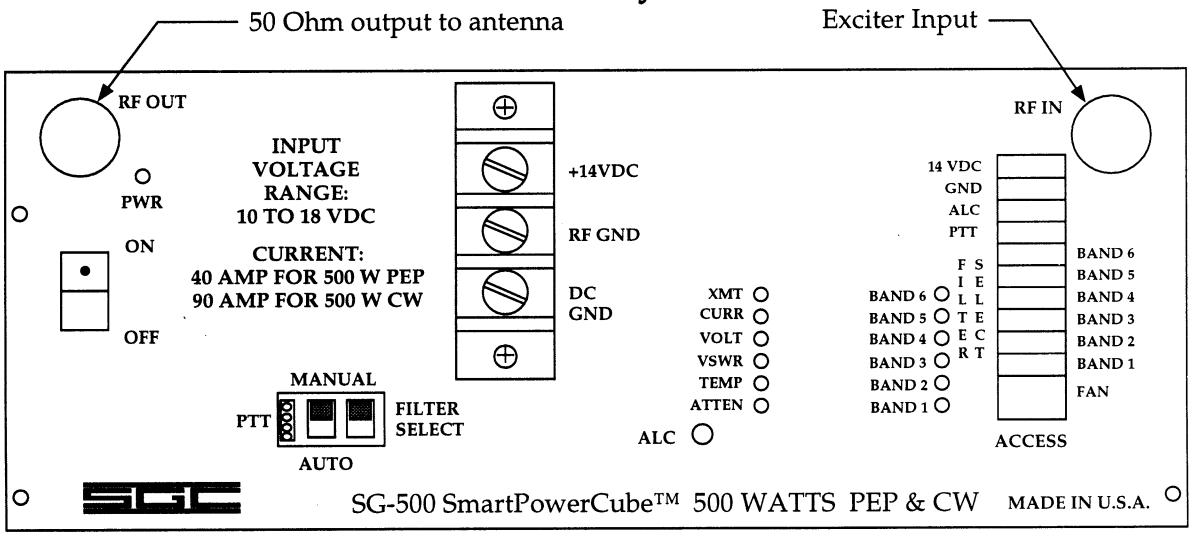
8.0 Front Panel Description

This section describes the front panel controls and ports of the SG-500. These are described from left to right.

SG-500 Front Panel Layout and Connections



Refer to the drawing above when reviewing the following descriptions.

8.1 RF OUT & RF IN Jacks

Connect your station antenna, SG-235, or manual matching network to the **RF OUT** jack, and the coax jumper from the exciter (transceiver) to the **RF IN** jack.

WARNING: Do Not Operate the SG-500 without an Antenna or suitable dummy load connected. If you are uncertain of the antenna being used, test it at low power before applying 500 watts to it. The *SmartPowerCube*™ tests VSWR before bringing the amplifier on-line. A high VSWR may prevent amplifier operation.

8.2 POWER ON/OFF Switch

This powers the SmartPowerCube™ on/off. When the power switch is in the off position, the amplifier is bypassed allowing "barefoot" operation.

8.3 POWER LED

This LED indicates when 14 VDC power is supplied to the SG-500.

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8.4 Power Connector

This barrier strip with screw terminals allow DC power and RF ground connections.

The **TOP** screw terminal is for +14 VDC.
The **MIDDLE** screw terminal is for RF ground.
The **BOTTOM** screw terminal is for DC ground (return).

Wiring Tips

• The +14 VDC wiring should be #6 AWG diameter or larger, and kept as short as possible to avoid excessive voltage drop.

• The RF ground should be connected to a suitable ground system. See other SGC publications for specific antenna ground and counterpoise suggestions.

• The DC ground/return should also be #6 AWG wire diameter or larger.

8.5 Status LED Description

The status LEDs indicate the various amplifier parameters and any fault conditions that may exist. There are two vertical columns of six LEDs. The left column indicates faults and transmit status. The right column indicates the active selected filter band. The function of the various LED indicators are as follows:

XMT — When this indicator is on, the amplifier is keyed for transmission. Normally this LED is on only when push-to-talk (PTT) is engaged.

CURR — Warns that a over-current condition (exceeding 100 amps) exists, or if the current imbalance between amplifier modules exceeds 20%. When illuminated, the amplifier has tripped off-line. To reset the amplifier, power down and restart the unit.

VOLT — Warns that an under-voltage condition (less than 10 VDC) exists. When illuminated, the amplifier has tripped off-line. To reset the amplifier, power down and restart the unit.

IMPORTANT!

A common cause of an under-voltage condition is that the power supply does not have sufficient capacity for the power level or duty cycle. A larger power supply or battery-float should be employed. Voltage "droop" under high current demands will not damage the SG-500, but may result in reduced output power.

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VSWR — Warns that the sampled VSWR (Voltage Standing Wave Ratio) has exceeded 4:1, and the power reflected back to the SG-500 is higher than acceptable. When illuminated, the amplifier has tripped off-line. To reset the amplifier, power down and restart the unit.

TEMP — Warns that an over-temperature condition (greater than 55° C) exists. This LED starts flashing slowly at 55° C, and increases in rate until it is on continuously - *at which time the amplifier trips off-line.* When this occurs, the amplifier has not been damaged and may be operated again as soon as the indicator resumes flashing. Occasional flashing of this indicator may occur during normal operation as the temperature of the *SmartPowerCube* ™ rises.

KEEP IT COOL!

To avoid a high temperature condition, ensure adequate air flow around the unit. Keep the cooling fins unobstructed, and do not stack other station components on the SG-500. If the optional fan is installed, ensure it is plugged in and operating. Also check the VSWR of the antenna system since a high VSWR increases the heat dissipation by the amplifier, causing faster temperature rise.

ATTEN — This LED indicates the input attenuator circuit is engaged. As input RF power level increases beyond 60-70 watts, the attenuation increases automatically. The attentuator remains engaged until the input drops to 30 watts. If this happens, reduce exciter output slightly. The LED may flash during voice peaks in SSB mode.

ALC control— provides adjustable ALC feedback voltage available via pin #3 (**ALC**) of the ACCESS connector. This provides a *positive* ALC voltage range of approximately 1-5 VDC and should *not* be used with transceivers utilizing negative ALC control.

LOW DRIVE FOR MAX POWER

An illuminated **ATTEN** LED does not necessarily indicate the amplifier has tripped, or that a faulty condition exists. The SG-500 is designed to be driven to maximum output across either a low (10-60 W) or high (60-150W) input range. This is convenient for transceivers without continuously adjustable output power control. Maximum efficiency occurs when the SG-500 is driven across the "low" input range, *just below the point* where the attenuator circuit is activated.

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BAND FILTER SELECT — These LEDs indicate which of the input band-pass filters are active, as selected via manual or automatic control (see section 9.2 on page 16).

BAND 6 LED is on when the **1.6 - 2.2 MHz** filter is selected
BAND 5 LED is on when the **2.2 - 4.2 MHz** filter is selected
BAND 4 LED is on when the **4.2 - 7.7 MHz** filter is selected
BAND 3 LED is on when the **7.7 - 13.2 MHz** filter is selected
BAND 2 LED is on when the **13.2 - 23.3 MHz** filter is selected
BAND 1 LED is on when the **23.3 - 30.0 MHz** filter is selected

***Note - BAND 1** selection is disabled on US domestic version amplifiers. Licensed amateur and commercial station operators may restore full coverage by following the procedure outlined in section 9.6 on page 20.

8.6 ACCESS Connector

Inserted into the **ACCESS** connector is the supplied 10 pin vertical plug which permits interfacing to certain amplifier functions. Below this a three pin horizontal connector controls the optional cooling fan unit (SGC PN #51-82).

Access connector pins (from top to bottom) are described below:

14 VDC — Switched 14 VDC via the **ON/OFF** switch is present on this line (maximum 5A). Not to be used for powering station components drawing greater than 5A. See the box on page 19 regarding remote control via this port.

GND — Chassis ground for control purposes available on this line.

PTT — Push-To-Talk control. This keys the amplifier circuitry when this line is grounded, *and the PTT control switch is set to manual.*

ALC — Automatic Level Control. A positive-going voltage is present on this line for use with transceivers equipped for ALC input control. See the ALC control description on the previous page.

BAND 1~BAND 6 — Bringing the appropriate line low (to ground) selects the desired input filter for domestic operation when the front-panel **FILTER SELECT** switch is set to **MANUAL**. A simple rotary switch box can be constructed for this purpose. With the **FILTER SELECT** switch set to **AUTO** (for export use), input filters are selected automatically each time you key the exciter.

FAN — The optional cooling fan (SGC PN #51-82) cable plug inserts into this connector for power and fan control.

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9.0 Amplifier Operation

This section intends to get you on the air using your new amplifier with maximum ease. Before starting, check the following items:

• Ensure you are using an SGC PS-50 power supply, or other DC source capable of providing at least 14 VDC at 50A or greater. Do not run the amplifier and transceiver from the same supply.

• Check that the power cables are firmly terminated at the power strip on both the amplifier and power supply. The screws should be firmly tightened so that the cable lug terminals are flat against the strip for best mechanical and electrical contact.

• Ensure the amplifier, transceiver (and any other station components such as the SG-235, or manual antenna coupler) are connected to a proper RF ground.

9.1 Test Transmission

Start by testing into a 50-ohm RF dummy load connected into the **RF OUT** jack on the SG-500. We recommend installing a RF power meter in-line to monitor your transmitted output power

a. Set the **PTT** and **FILTER** select switches on the front panel to **AUTO**, and turn the power on. The red LED should light.

b. Select CW mode on your transceiver, and reduce the power output control to minimum. **Note** — other carrier modes (AM or FM) can be used if your transceiver does not have CW capability.

c. Press the PTT or CW key to transmit, then slowly advance the power control and observe the indicated output power. Continue advancing the power level until the **ATTEN** LED just comes on and note the input power level at which this occurs (approximately 50-60 watts). Un-key the transceiver.

d. Re-adjust the power output control just below the "break-point" (the top of the input range before the **ATTEN** circuit activates). You have now found the "sweet spot" at which you can drive the amplifier to maximum output with minimum drive. *This is the recommended drive method to be used whenever practical.*

e. Now switch the transceiver to SSB, and transmit in a normal voice. The **ATTEN** circuit should not activate, except on occasional voice peaks.

This concludes the test transmission, you can now connect your station antenna and any other interconnections.

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INPUT DRIVE LEVELS

The amplifier reduces power when the **ATTEN** circuit activates, and then must be driven *through a higher input range* to derive maximum output. Some 100-watt class amateur transceivers may not be capable of producing sufficient output levels to drive the SG-500 for maximum output. Therefore, as stated before, we recommend using the *low input range* (10-50 watts) for normal operation.

9.2 PTT KEYING: AUTO vs. MANUAL

The amplifier can be keyed either manually or automatically - the best method will depend on your preference or application.

Manual Keying - This requires a wire connection to your transceiver; the **PTT** line (on the **ACCESS** connector) needs to be pulled low (to ground) when your transceiver is keyed to transmit. This is the *preferred configuration* to be used. Check with the documentation provided with your particular transceiver for details on where to access this connection.

Automatic Keying - This uses *RF Sensing* to detect when you transmit, and then brings the amplifier on-line. Although automatic keying requires no control line, a small associated delay may be encountered in SSB mode due to the "rise time" characteristic of SSB modulation.

9.3 AMPLIFIER OPERATION WITH THE SG-2000 TRANSCEIVER

If you own an SGC SG-2000 or SG-2000 Powertalk transceiver, please review the following notes regarding use of the SG-500 SmartPowerCube:

- We recommend setting the SG-2000 to 60 watts high power and 20-25 watts low power operation, as detailed on the next page.

- The PTT line needed for manual amplifier keying can be connected from the rear panel (J301, pin 4, or J503, pin 3) to the **ACCESS** jack (pin 3 - **PTT**) on the SG-500.

- We recommend driving the amplifier in the *low* input power range (10-50 watts). Select low power operation by pressing keypad button **9** "**PWR HI/LO**" so that "**LO**" appears in the transceiver display. This should reduce carrier power to approximately 50 watts.

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SG-2000 PRESET POWER LEVEL ADJUSTMENT PROCEDURE

If the amplifier **ATTEN** circuit engages even with low power selected, you can adjust the SG-2000 output power levels individually (high and low settings) by performing the following steps:

- Attach a calibrated wattmeter and 50-ohm dummy load to the SG-2000. Select a test frequency of 8.420 MHz, CW mode, and high power output.

- Adjust **R41** & **R42** on the LPA board fully clockwise for maximum output. Press the PTT to transmit and adjust **R121** on the exciter PCB for 100 watts output.

- Transmit and adjust **R42** for 60 watts. Un-key the radio, select low power, then transmit and adjust **R41** for 20-25 watts.

This should adjust the high power output level approximately to the "sweet spot" just below where the **ATTEN** circuit activates. With the levels properly adjusted, the SG-2000 should provide four power selections: 25/60 watts (low/high) "barefoot", and 250/500 watts with the SG-500 engaged.

This concludes the power adjustment procedure for the SG-2000 radio.

9.4 Mobile Installation of the SG-500

If you are operating the amplifier mobile, please remember that the minimum size wire to be used from the battery to the amplifier is #6. Heavier wire is preferred. The recommended way to install the amplifier in mobile installations is to install a second battery next to the amplifier. This is shown in the diagram on the following page:

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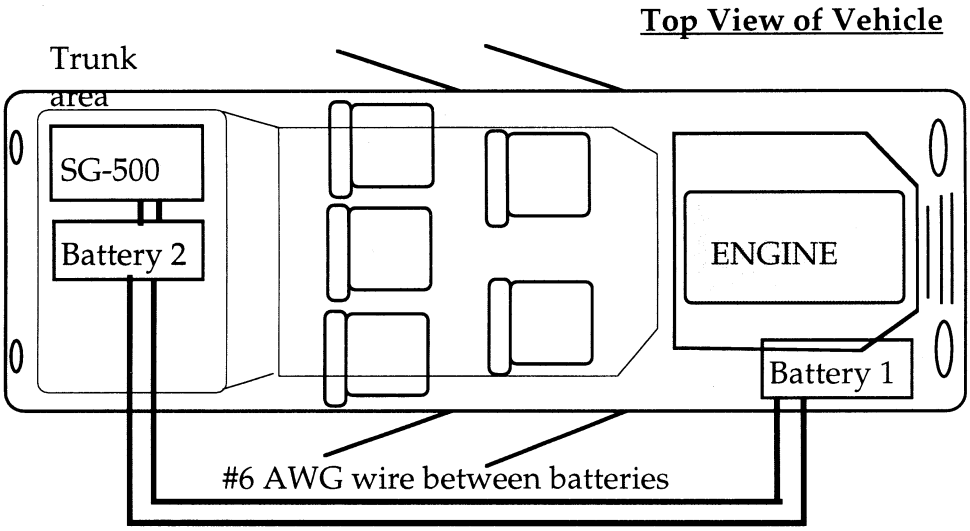

Intallation of a second battery next to the SG-500 Amplifier

Operating HF mobile at the 500 watt level requires careful planning and understanding of RF and automotive systems. The information needed regarding this is too expansive to be adequately dealt with here in this manual.

In response to customer inquiries, and from invaluable knowledge gained in this area by SGC research staff, SGC offers a highly informative publication called "GO MOBILE AT 500 WATTS" which outlines the complete installation of the SG-500, SG-2000 and the famous QMS antenna system in a variety of vehicles.

For anyone considering installing and using their SG-500 in a mobile application, we highly recommend requesting this free publications by calling SGC at 1-800-259-7331 betwen 8AM - 5PM PST.

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9.5 SG-500, SG-2000 and SG-235 Interconnections

When the SG-500 is mated with the SG-2000 transceiver and SG-235 Smartuner, they form an outstanding 500 watt automatically-tuned HF system. Interconnections between the SG-500 and SG-235 permit amplifier keying only when a proper antenna impedance match has been found. Only a few connections need to be made between these components, as outlined below:

SG-235	— to —>	**SG-500**
COAX CABLE PLUG		RF OUT jack
BROWN WIRE		PTT line (pin#4)
		SG-2000
RED WIRE		J502, pin 2
BLACK WIRE		J502, pin 1
BLACK/YELLOW WIRE		J502, pin 1
GREEN WIRE		J502, pin 3
GRAY WIRE		J301, pin 4
		SMARTLOCK PRO
BLUE WIRE		BLUE WIRE
WHITE WIRE		WHITE WIRE

Please refer to the SG-235 and SG-2000 operating manuals for further details.

Remote ON/OFF Power Control

The SG-500 can be turned on/off remotely via a connector provided for this purpose. To the left of the front panel PTT selection switch is a vertical 4-pin header. A jumper comes installed across the top two pins, which are in series with the front-panel **ON/OFF** switch line. The bottom two pins provide indicator output for a LED, and are in parallel with the front panel **PWR** LED.

To install a remote on/off switch, *remove the upper jumper* and connect your switch leads in its place using a push-on connector. Likewise, a remote LED can be connected to the lower two pins if desired (LED ground connection on the lower pin). Leave the front panel on/off switch in the **ON** position to enable your remoted line in this configuration.

Note—An alternate method for on/off control is to connect a switched 12-volt line to the **14VDC** port of the **ACCESS** connector. Wire a series 5A fuse on this line for safety. With the power switch in the **OFF** position, applying line DC voltage to the 14VDC port will turn the amplifier on. The line must be held high for as long as the amplifier is to remain on. Removing the +14VDC turns the amplifier off.

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9.6 DOMESTIC vs. EXPORT Amplifier Versions

Amplifiers manufactured for US domestic sales are disabled to operate above 24.5 MHz. Export versions of the SG-500 do not have this restriction.

Amateur radio, MARS, or CAP operators holding valid, current FCC station licenses may operate the SG-500 on US amateur bands above 24.5 MHz or other frequencies, limited to the operating priveledges authorized in their license (see the warning and disclaimer below). This requires performing the following equipment modification :

Early-Type Amplifier Versions

- Disconnect all power and coaxial connections, then remove the ten screws affixing the top cover. Lift the top cover slightly and note the ribbon cable connecting the Filter and MCU boards.

- On the Filter board side, locate connector J7 and note that the wire leading to pin #6 is removed and insulated with tubing. Remove the tubing to expose the wire end, and reconnect this wire to pin #6 of J7. Reassemble the top cover.

Later-Type Amplifier Versions

- Disconnect all power and coaxial connections, then remove the ten screws affixing the top cover. Lift the top cover slightly and locate the MCU board.

On the MCU board locate two 4-pin jumpered headers labeled J13 and J14. Move the jumper from "D" to "E" on both headers. Reassemble the top cover.

This completes the extended-coverage modification (see the warning below).

Modification Warning and Disclaimer!

Intentional modification and use of this amplifier for operation in domestic radio services not authorizing output power levels for which this amplifier is designed or type-approved may be in violation of FCC regulations. Furthermore, operators convicted of such violations may be subject to legal fines, forfeiture/revocation of station license, and or equipment confiscation.

SGC assumes no responsibility nor liability for any unapproved or unauthorized circuit modification to the amplifier. Any such modifications are performed against the manufacturers recommendations solely at the users risk, and will void the limited warranty.

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10.0 Troubleshooting Guide

The information presented in this manual attempts to cover the most commonly encountered questions and difficulties in HF station installations. However, conditions may arise when one or more components in your station may not function properly, causing the amplifier to not operate.

10.1 Fault Analysis

A solid understanding station interconnections and equipment specifications helps in resolving the problem. The following table analyzes common faults and their correction:

FAULT	ADVICE
CURR trip off-line **VOLT** trip off-line	Ensure power supply maintains voltage greater than 11.0VDC *under load*. Check DC cable connections. Use only #6AWG wire or heavier and make cable lengths as short as practical. Check battery charge state and voltage droop under load. Use separate supplies for amp and transceiver. Reduce input drive level.
VSWR trip off-line	Check integrity of antenna and feedline connections. Check for evidence of arc-over or dielectric breakdown of feedline. Ensure antenna is resonant (<2:1 SWR) at the desired operating frequency. Check proper interconnection and operation of SG-235 or manual matching network.
TEMP LED flashing	Reduce drive level or duty cycle. Ensure fan unit is operating by checking **FAN** plug on front panel **ACCESS** connector, or supply forced cooling to lower heatsink temperature.
No PTT Keying	Ensure transceiver, amplifier and DC supply all utilize a common ground return. Use externally-switched relay for PTT line control.

Please note that the SG-500 represents the latest in microprocessor control technology, and the amplifier is designed to shut off in the event that any critical parameter is outside pre-determined values. This insures that the amplifier will give many years of maintenance-free service and optimum performance. This also means that particular attention must be given to the amplifiers environment and associated systems. Most particular, the power supply and antenna. The next section addresses specific troubleshooting steps to isolate a fault experienced with the amplifier.

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10.2 Troubleshooting Guideline

SGC has determined that many reports of amplifier "difficulties" actually stem from problem relating to the power supply voltage, interconnection cables, and antenna installations. If a quick review of your installation and the above table does not provide some solution, we advise making the following checks before contacting SGC for technical support:

TEST PROCEDURE

1 - Connect a 50-ohm RF dummy load (1 KW rating) to the amplifier output jack, and a in-line wattmeter (0-200 watt range) between the transceiver and amplifier.

2 - Connect an in-line wattmeter (0-1000 watt range) between the amplifier output jack and RF dummy load.

3 - Select CW mode, and adjust the transmitter output power level to 40 watts.

4 - Turn on the SG-500, and transmit. Confirm that a CURR/VOLT fault does_____ does not _____ occur.

5 - If a fault occurs, use an analog DC voltmeter to measure the voltage at the amplifier DC terminal under load (TX) and idle (RX):

TX_____ VDC RX_____VDC

6 - Confirm that a VSWR fault does_____ does not_____ occur under these conditions. If no VSWR fault occurs

7- If a fault occurs, discontinue testing and contact SGC.

8 - If no fault occurs, check your antenna, antenna coupler interconnections, transmission line, and measure overall system SWR:

SWR_____: 1___ @ Freq._____MHz

9 - If the SWR 2.0:1 or less, you may test your system on the air.

SGC can be called between 8AM -5PM PST for technical support, however, please be prepared to have all of the above data available to help us assist you further.

SGC TECHNICAL ASSISTANCE
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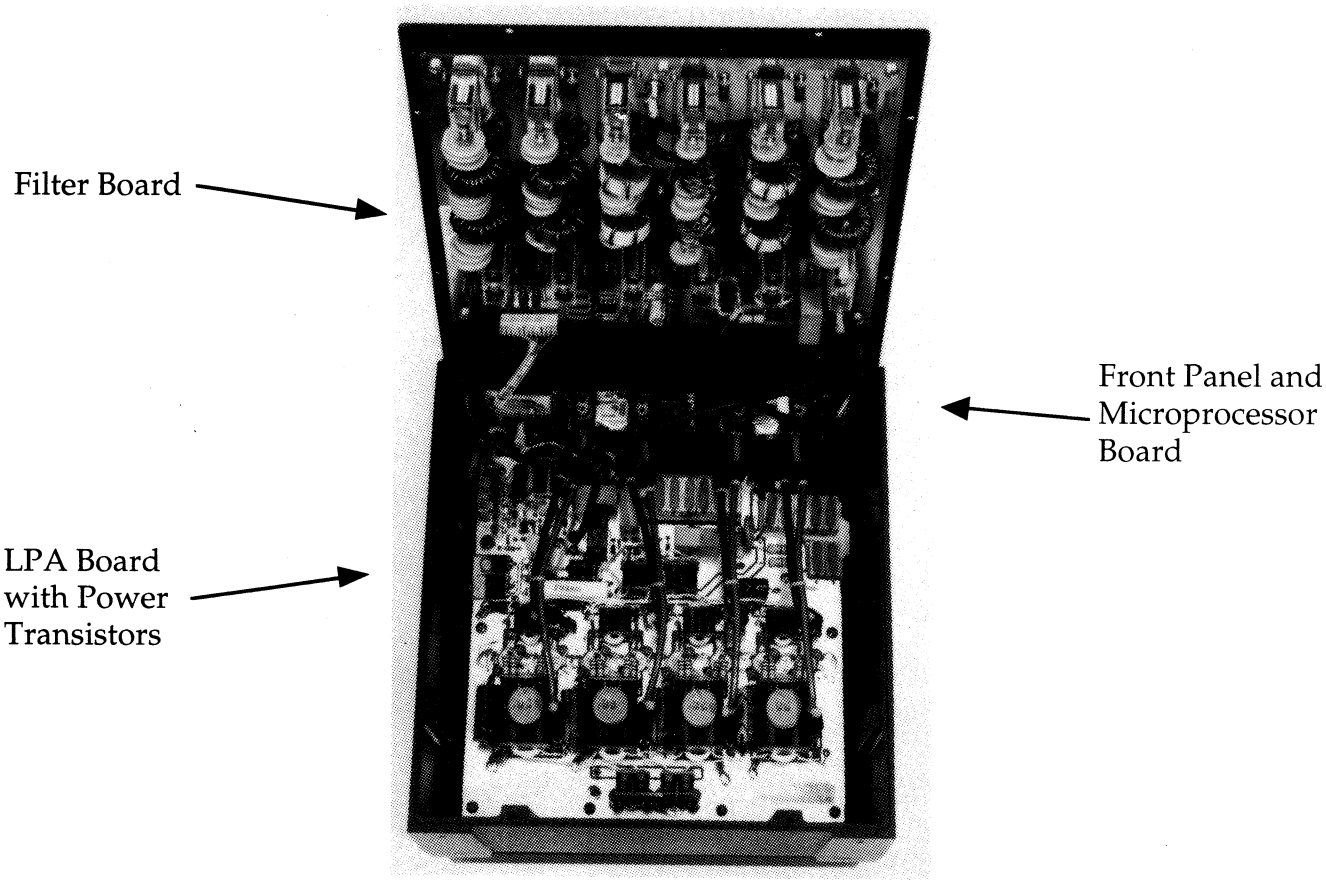
11.0 Pictorial Overview



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12.0 Circuit Theory of Operation

The circuit theory of operation behind the SG-500 is detailed as follows:

12.1 RF Circuits

The RF signal flow can take one of two paths through the SG-500 depending on whether the amplifier is bypassed or engaged:

- **Bypass Mode** — RF enters J103 on the LPA assembly, goes through (de-energized) relays K102, K101 to J3 on the Filter Assembly, through T1 VSWR sensing circuit and via J5 to the antenna.

- **Amplifier Engaged** — RF enters J103 on the LPA Assembly, through (energized) relay K102 to input splitter T201. There it splits into four signals, each of which is applied to an RF push-pull amplifier. The four amplified signals then re-combine in the output combiner T211. Next, J201 routes the signal to J2 of the Filter Assembly where one of five filters is selected to remove harmonics. The filtered output then passes through K13 and VSWR transformer T1 and exits J5 to the antenna.

12.2 Control Circuits

Linear Power Amplifier (LPA) T101 and its associated circuitry measure the RF input level ,which is used by the Micro Controller Unit (MCU) to test if the input drive is too low or too high. In either case the MCU switches the amplifier into bypass mode.

IC102 and its associated circuitry conditions the RF input signal so that the MCU can measure the RF frequency. If the frequency is outside of allowable limits, the MCU places the amplifier into bypass mode.

RT201 and its associated circuitry allows the MCU to monitor the amplifier's internal temperature. If the temperature exceeds 65°C, optional fans activate until the temperature drops below 50°C. If the temperature exceeds 75°C, the attenuator is engaged until the temperature drops below 60°C. If the temperature exceeds 85°C, the amplifier is put into bypass mode until the temperature drops below 60°C.

Filter T1 and its associated circuitry sample forward and reverse RF currents supplied to the antenna. This information is used by the MCU to calculate the VSWR. If the VSWR exceeds 4:1, the MCU places the amplifier into the bypass mode.

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Micro Controller Unit (MCU). IC3A and its associated circuitry monitor the DC supply voltage and alert the MCU if it drops below a preset value (factory set at 10 VDC). If this happens, the MCU places the amplifier into the bypass mode. R7 is used to adjust the shutdown voltage level.

IC3B and associated circuitry develop a positive ALC voltage which is available at the access connector J4.

IC21 and its associated circuitry generate a wake-up signal to the MCU 2 - 3 minutes after each time the amplifier is put into the bypass mode. When the MCU is awakened, information on the status of the amplifier is updated and any actions that needed (such as turning off fans because the amplifier has cooled) are done and the MCU returns to sleep (unless the amplifier is in transmit).

IC5 and its associated circuitry form one of four current-sensing circuits, the outputs of which are sent to the MCU. IC6, IC7, and IC8 along with their associated parts form the other three circuits. If one or more of the sensors alerts the MCU that the current is too high, the MCU places the amplifier into the bypass mode. The MCU also continuously compares all four current values and will put the amplifier into the bypass mode if any one current value is not within 20% of the average of all four current values.

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13.0 Description of Operation

When DC power is not applied, the amplifier is bypassed and RF input is bridged to the output connector. Conversely, with power is applied, the MCU performs a series of self checks and initializes various circuitry including the input attenuator and T/R relays for both input and output. Note that the amplifier is bypassed at all times except when keyed (PTT line is grounded).

13.1 TX (Input) Signal Amplification

When a signal is transmitted, the following series of events takes place.

A. The MCU checks internal temperature sensors to determine that the temperature does not exceed programmed limits.

B. The MCU then confirms proper operating voltage. The amplifier will not operate with less than 10 VDC present.

C. The MCU confirms that the VSWR on the antenna is within tolerance. If the VSWR exceeds 4:1, the amplifier will not operate.

D. The MCU checks the value of the incoming signal from the exciter to confirm that the amplifier will not be overdriven.

E. The MCU confirms that the frequency of operation is within preset limits. The amplifier will not operate if the frequency is not within specification.

F. The input attenuator is activated, if necessary then the amplifier is engaged in the transmit mode.

G. The amplifier then continues to operate and the MCU continues checking the following parameters on a continuous basis:

- Current imbalance
- Overdrive
- Absence of drive
- Temperature
- Under voltage
- VSWR
- Over current

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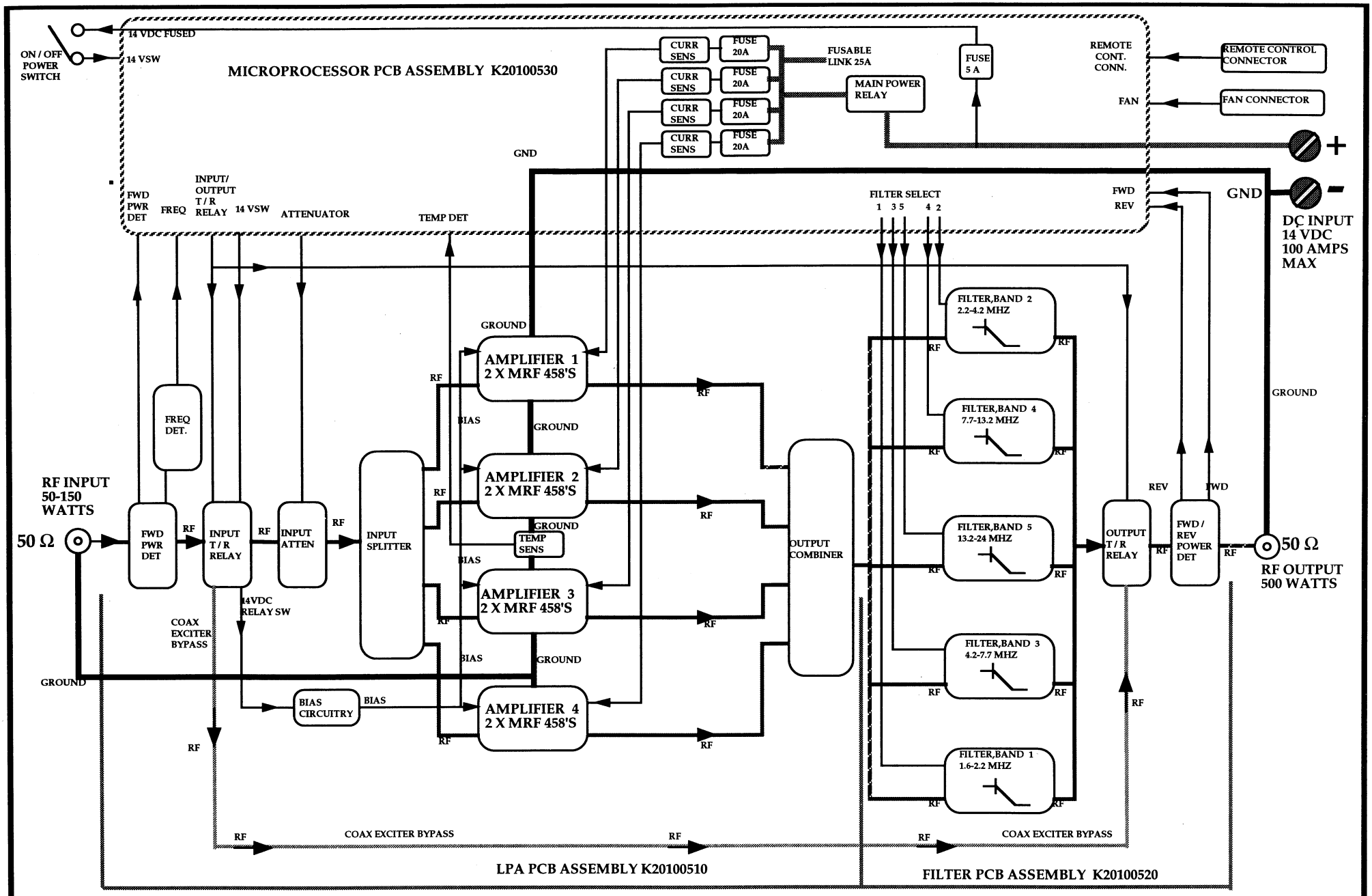

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SG 500
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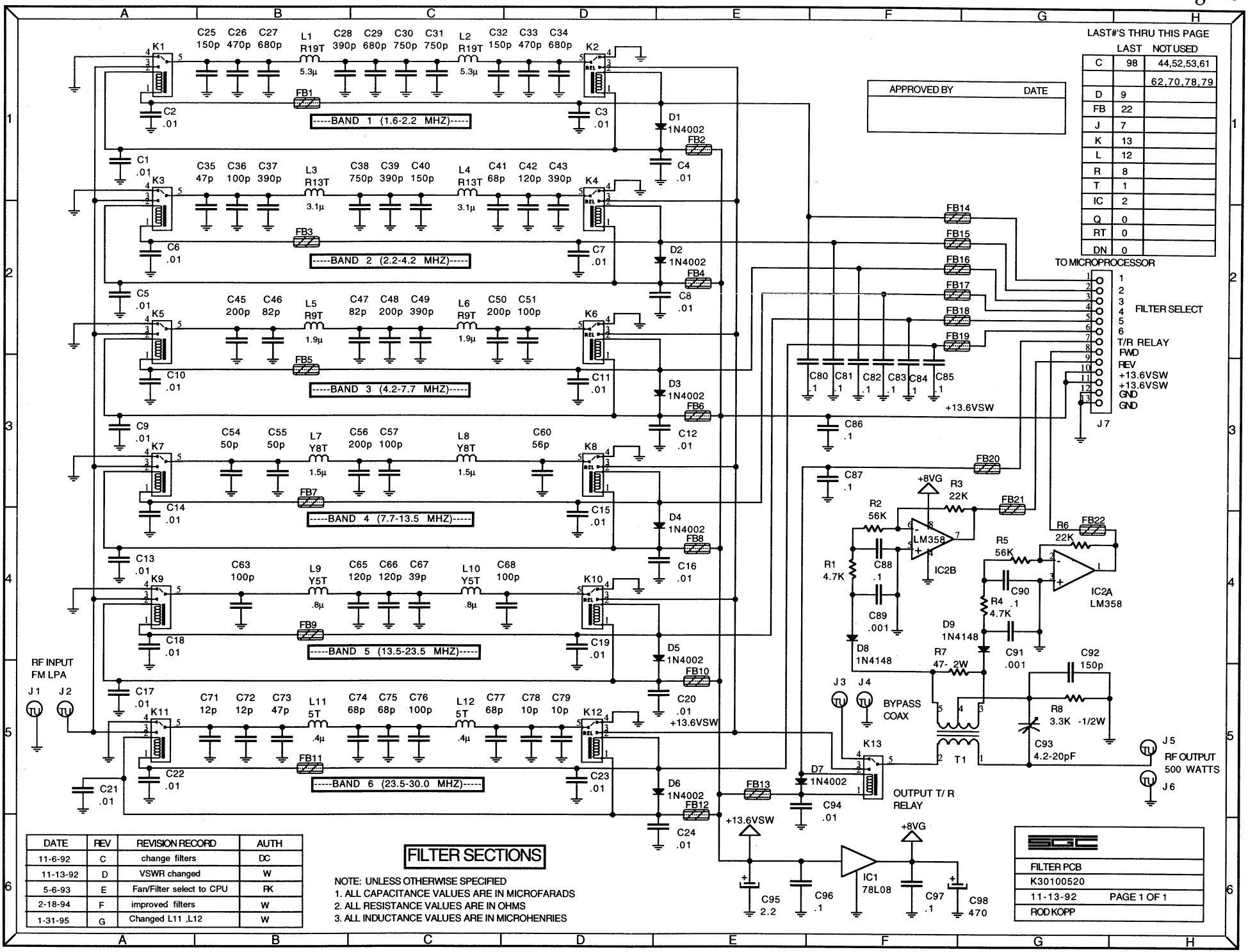
K40100510 B
DOC 08-07-91



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11-13-92	D	VSWR changed	W
5-6-93	E	Fan/Filter select to CPU	RK
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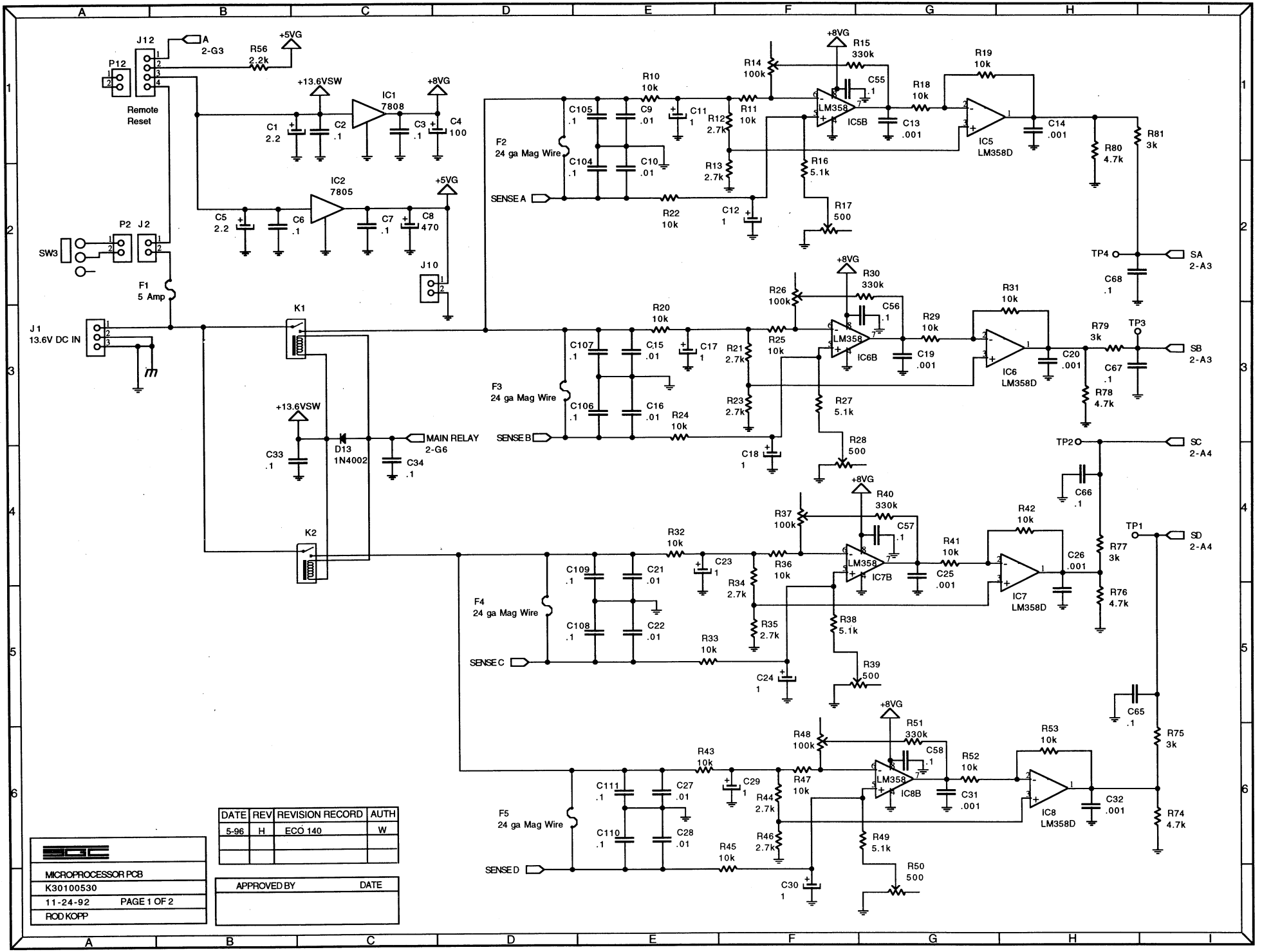
1-31-95	G	Changed L11 ,L12	W



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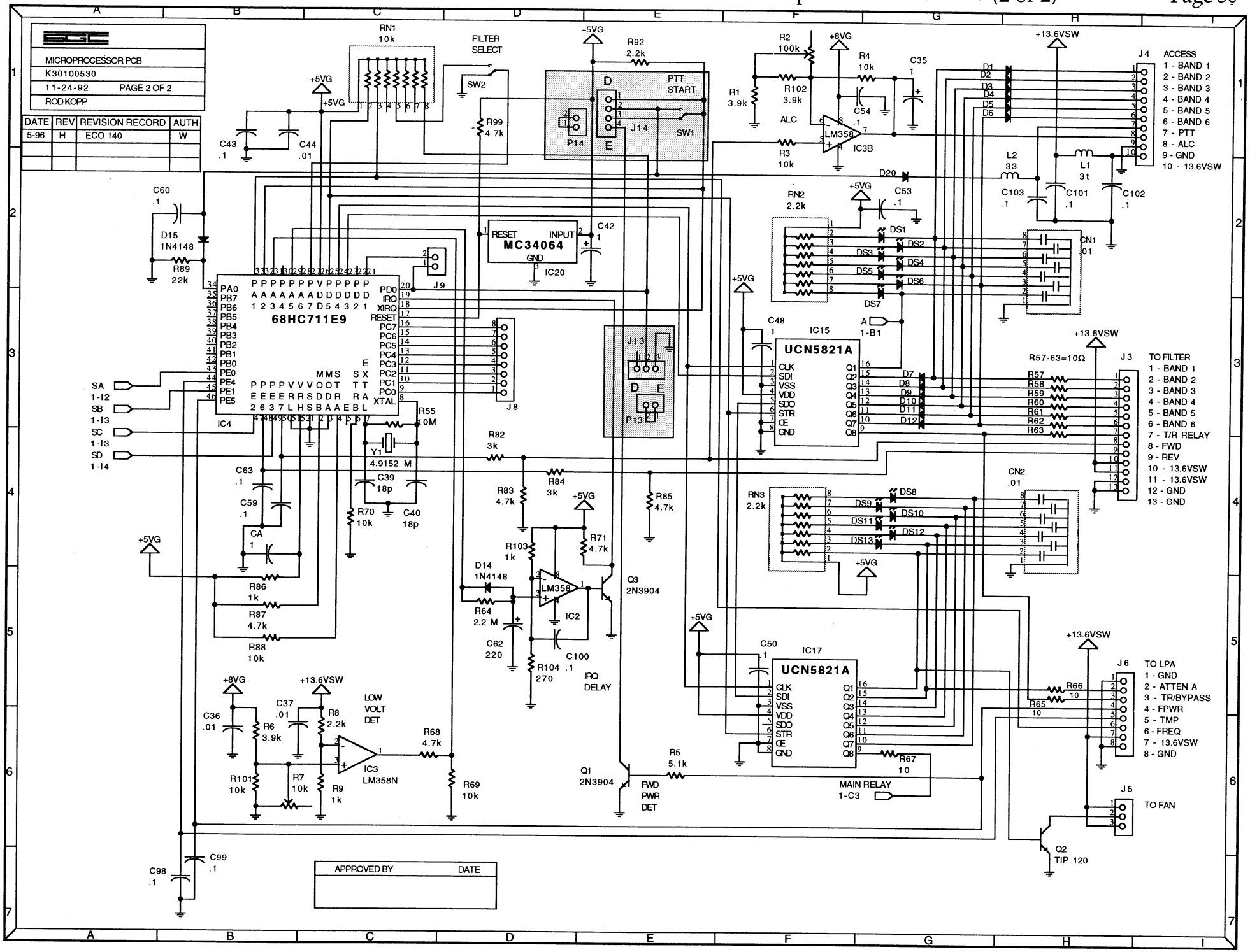
K30100530
11-24-92 PAGE 1 OF 2
ROD KOPP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K30100530
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68HC711E9
IC4
MC34064
IC20
UCN5821A
IC15
UCN5821A
IC17
LM358
IC2
LM358
IC3
LM358N
IC3B
FILTER SELECT
PTT START
ACCESS
1 - BAND 1
2 - BAND 2
3 - BAND 3
4 - BAND 4
5 - BAND 5
6 - BAND 6
7 - PTT
8 - ALC
9 - GND
10 - 13.6VSW
TO FILTER
1 - BAND 1
2 - BAND 2
3 - BAND 3
4 - BAND 4
5 - BAND 5
6 - BAND 6
7 - T/R RELAY
8 - FWD
9 - REV
10 - 13.6VSW
11 - 13.6VSW
12 - GND
13 - GND
TO LPA
1 - GND
2 - ATTEN A
3 - TR/BYPASS
4 - FPWR
5 - TMP
6 - FREQ
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TO FAN
LOW VOLT DET
IRQ DELAY
FWD PWR DET
MAIN RELAY
TIP 120
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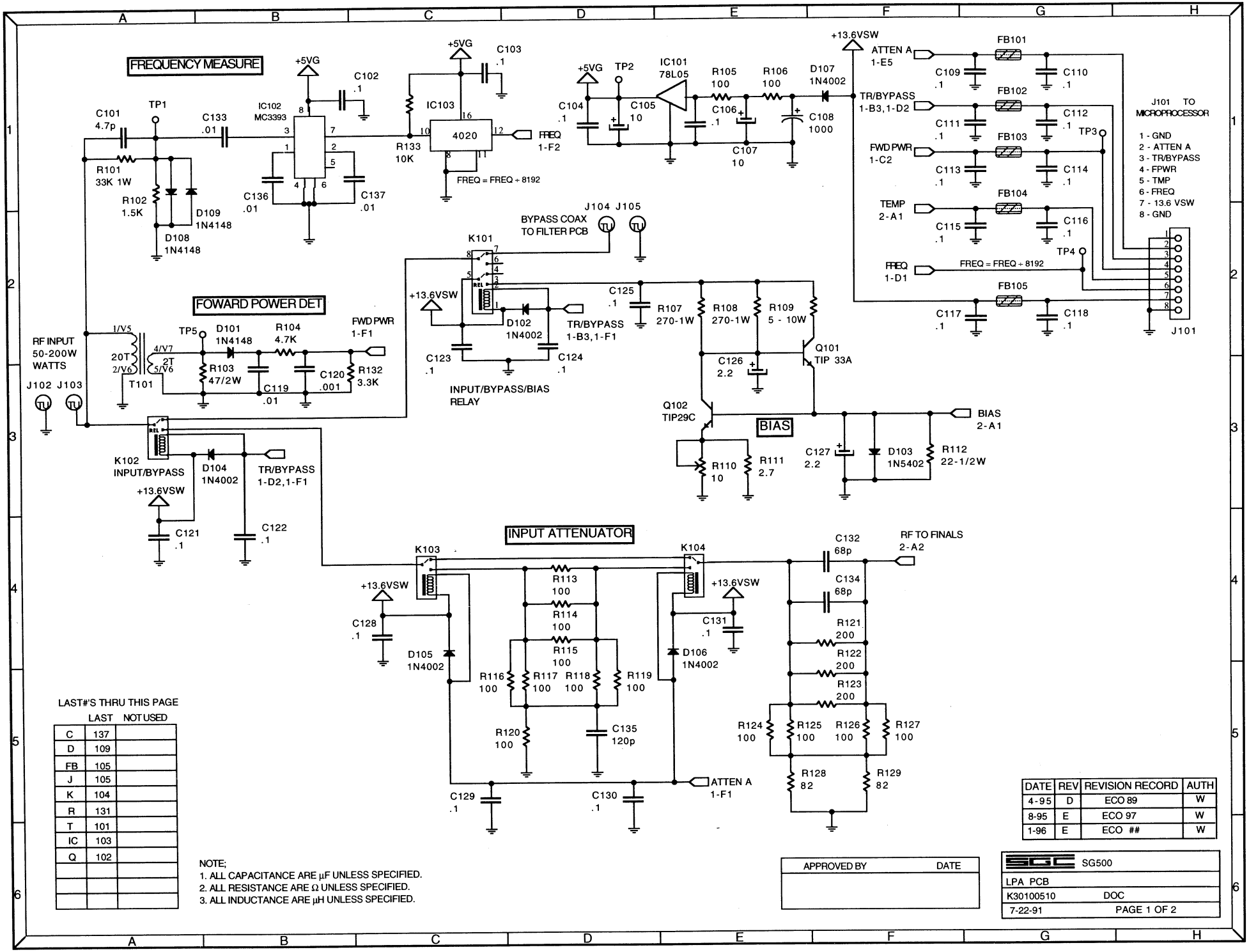

LAST#'S THRU THIS PAGE

	LAST	NOT USED
C	137	
D	109	
FB	105	
J	105	
K	104	
R	131	
T	101	
IC	103	
Q	102	

NOTE;
1. ALL CAPACITANCE ARE µF UNLESS SPECIFIED.
2. ALL RESISTANCE ARE Ω UNLESS SPECIFIED.
3. ALL INDUCTANCE ARE µH UNLESS SPECIFIED.

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SGC	SG500
LPA PCB	
K30100510	DOC
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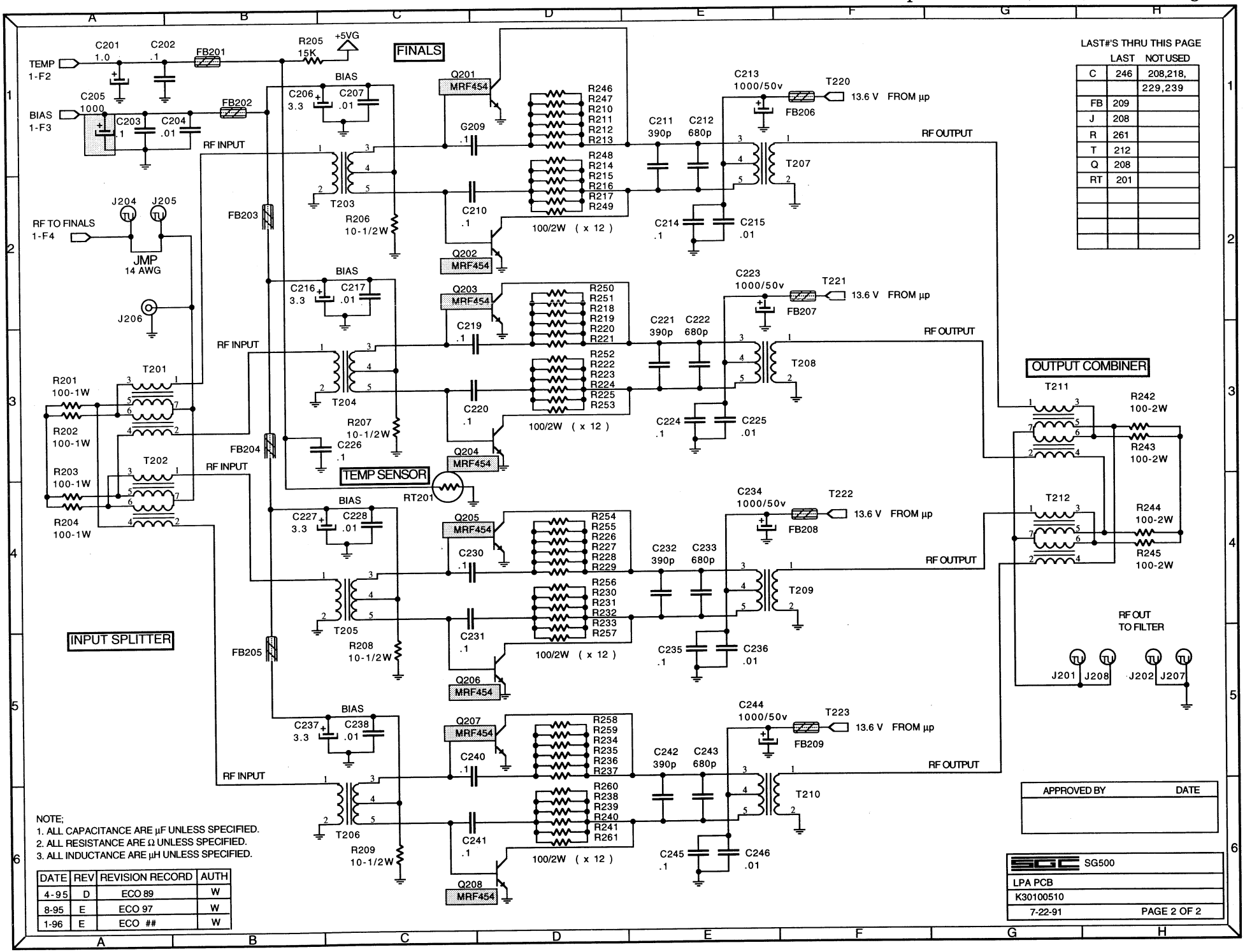

NOTE;
1. ALL CAPACITANCE ARE µF UNLESS SPECIFIED.
2. ALL RESISTANCE ARE Ω UNLESS SPECIFIED.
3. ALL INDUCTANCE ARE µH UNLESS SPECIFIED.

DATE	REV	REVISION RECORD	AUTH
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8-95	E	ECO 97	W
1-96	E	ECO ##	W

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SGC

"No Compromise Communications"

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When you need an HF radio, please call or fax SGC for a quotation.

Our toll-free telephone number in the U.S. is **1-800-259-7331.** Outside the U.S. call **(206) 746-6310** or use the convenient fax form below.

-Thank you!

SGC Quotation Request

Your Name: _____ Telephone: _____

Company: _____ Fax Number: _____

1. Primary use: Marine: ☐ Amateur: ☐ Commercial: ☐ Aircraft: ☐ Mobile: ☐

   For installation as: Base station: ☐ Shipboard: ☐ Mobile: ☐ Aircraft: ☐

2. Is a remote head desired? Yes ☐ No ☐

3. Do you need additional control heads? Yes ☐ No ☐ If "yes", number: _____

4. Do you need an A.C. power supply? Yes ☐ No ☐

5. Do you need an antenna? Yes ☐ No ☐

   If yes, type desired: Longwire: ☐ Dipole: ☐ 8 ft. Whip: ☐ 28 ft. Whip: ☐

6. How many units do you need? _____

7. How soon do you need delivery? _____ days

8. Do you need a SITOR modem? Yes ☐ No ☐

9. Do you have special requirements? Yes ☐ No ☐

   Specify:

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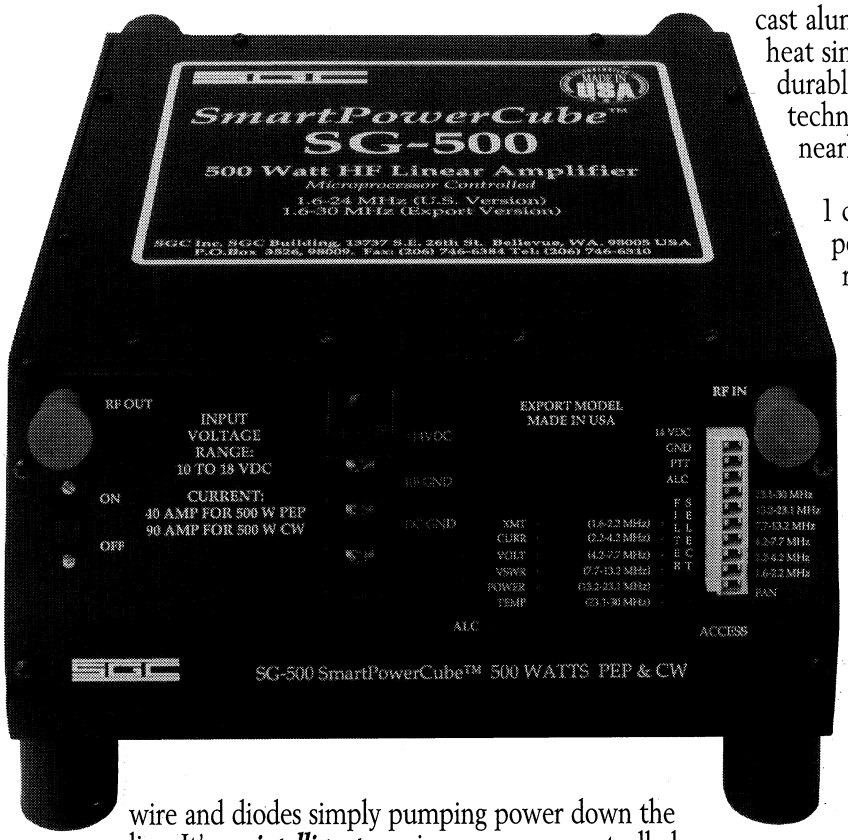
SG 500

SmartPowerCube™

Microprocessor Controlled Linear Amplifier

DRAMATICALLY BOOST YOUR POWER, AT LOW COST.

When evaluating the 12 volt SG-500 SmartPowerCube™, the key word is "smart." Because the SG-500 is not just another mindless mass of wire and diodes simply pumping power down the line. It's an ***intelligent*** —microprocessor controlled—high powered linear amplifier. It constantly monitors your HF-SSB's activities, power needs and antenna condition, and automatically—in less than 15 milliseconds—selects the right broadband filter.



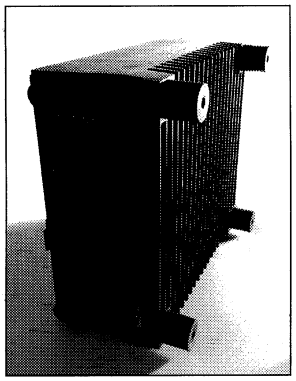
A bank of status LED's on the front panel of the SmartPowerCube™ functions as built-in test equipment (BITE) and allows the operator to quickly determine any fault which has occurred. Backing up this user-friendly visual system, the SG-500's microprocessor protects the SmartPowerCube™ from faults with preprogrammed shutdown procedures; in the event of a microprocessor fault, the unit shuts down automatically.

The SG-500 is designed to do exceptional service in fixed, mobile, and marine applications. It's an exceptionally rugged power source with a cast aluminum enclosure and extra heavy duty heat sinks, powder coat finish, and only the most durable electronic components and assembly techniques. In real world applications, it's nearly indestructible.

It's also very compact, taking up less than 1 cubic foot of space. Considering how much power it produces, the SmartPowerCube™ is remarkably light, around 21 lb. (9.5 Kg.). So, it may be a heavyweight in performance, but it's slim and trim for installation.

Most significantly, the SG-500 is specifically designed to operate in an unattended manner. In other words, it's ideal for installations where access to the amplifier is limited.

The SG-500 SmartPowerCube™. It's high power, that's intelligent, at low cost.



The SmartPowerCube™ produces tremendous power—nearly as much as a 1 kW amplifier. Ample heat sinks help it reliably do the job.

SGC

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