MX Series - 1 Watt UHF AMPLIFIER

Section **Title** **Page**

NOTICES, ETC. 2

SAFETY AND HEALTH WARNINGS........ 3&4

GENERAL SERVICE INFORMATION

1) Parts Lists Explained 4
2) Interpreting LARCAN Drawing Numbers 4
3) The LARCAN Assembly Prefix Numbering System........ 5
4) List of Prefix Numbers for the 1W Amplifier 6
5) Production Changes 6

GENERAL DESCRIPTION

INTRODUCTION........ 7

SPECIFICATIONS 8

ABOUT THIS MANUAL........ 9

ON SITE: First Time Start-up 10

PUBLICATION LIST for MX series 1W UHF Amplifier:

PUB99-92 1W UHF Amplifier Assembly:

Section		Page
1.	Amplifier Chassis Description	92-1
2.	Pre-Amp Module	92-2
3.	PA Module	92-2
4.	Directional Coupler	92-3
5.	RF Metering Board	92-3
6.	Power Supply	92-4
7.	Basic Maintenance/Replacement Parts	92-5
8.	Parts List	92-12

LIST OF FIGURES: see PUB99-92, **page 92-1** for the drawing listing.

MX Series - 1 Watt UHF AMPLIFIER

NOTICES, ETC.:

THIS EQUIPMENT USES STATIC-SENSITIVE CMOS INTEGRATED CIRCUITS. Observe proper handling precautions (indicated in Maintenance Sections) at all times when working with this equipment.

TOXIC MATERIALS NOTICE... *IMPORTANT*...

Effective thermal management in certain semiconductor devices in this equipment is possible only through the use of Beryllium Oxide ceramic materials. This equipment contains devices made with Beryllium Oxide!

Beryllium and its compounds is a POISON if taken into the body in any manner.

To reduce your risk, remember: In case of accidental breakage of any kind of semiconductor device, DO NOT INHALE THE DUST, and AVOID GETTING DUST IN YOUR MOUTH; *it could contain Beryllium.* DO NOT LET BERYLLIUM DUST INTO YOUR BLOODSTREAM THROUGH CUTS OR OPEN WOUNDS!

Seek and obtain IMMEDIATE medical attention if the dust enters your body in any manner.

Avoid cuts by wearing gloves while picking up the pieces. Wash your hands thoroughly after replacing devices. Dispose of defective devices only through approved toxic waste disposal facilities.

Remember too, after cleaning up an accidental breakage, avoid inhaling the dust while replacing or emptying vacuum cleaner filter bags, and wash your hands well after servicing the vacuum cleaner.

Although the following pages contain as much information about the 1W UHF Amplifier as it is reasonably possible to provide, nevertheless we must state that these instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with its installation, operation, or maintenance. It is assumed that fully competent technical personnel will be responsible for the maintenance and repair of the equipment that is described in this manual. Should further information be desired, or should particular problems arise which are not covered sufficiently herein for the purchaser's purposes, or should replacement parts be required, the matter should be referred to us.

LARCAN INC.
228 Ambassador Drive,
Mississauga, Ontario, Canada L5T-2J2.
Telephone (905) 564-9222, FAX (905) 564-9244

MX Series - 1 Watt UHF AMPLIFIER

TRANSMITTER SAFETY PRECAUTIONS:

AC VOLTAGES USED FOR THE OPERATION OF THIS EQUIPMENT ARE DANGEROUS TO HUMAN LIFE!

This instruction manual has been written for the general guidance and information of operation, maintenance and service personnel who are aware of, and are familiar with, the hazards of working with high powered electronic circuits.

This manual does not purport to detail all of the safety precautions that should be observed when servicing this or any other electronic equipment. Servicing by inadequately trained or inexperienced personnel may expose such personnel to serious risks that could result in personal injury or death, and/or damage to this equipment. All personnel concerned with the servicing of this equipment should be thoroughly familiar with standard first aid procedures for the treatment of electrical burns and shock.

The equipment has been designed to protect operating personnel from accidental contact with voltages dangerous to human life, either by means of distance (where it is necessary to deliberately reach to make contact with live terminals) or with shielding. It is therefore of prime importance that any protective covering devices are kept in place at all times.

While all practical safety precautions have been adopted to safeguard personnel from possible injury, in times of off-air emergency there is often a strong tendency to act without due regard for normal caution; for this reason, both supervisory and operating personnel are urged to **ENSURE THAT THE SAFETY RULES DETAILED BELOW ARE FOLLOWED AS AN ESTABLISHED ROUTINE** at all times.

1. *KILL THE AC POWER BEFORE IT KILLS YOU*

Under no circumstance should any person reach within the cabinets for the purpose of servicing or adjusting the equipment without first disconnecting the AC power, or without the immediate presence of another person capable of rendering aid. Use of the buddy system is encouraged for transmitter work.

2. *DO NOT TAMPER WITH INTERLOCKS OR SAFETY SHIELDS*

Under normal circumstances no safety shield should be removed.

3. *REMOVE PERSONAL JEWELRY WHEN WORKING ON THE EQUIPMENT*

The 48 volt power supply in this transmitter, although overload protected, is able to deliver currents capable of heating metallic tools or personal jewellery such as a watchband, bracelet, or ring. Accidental short circuits from such metallic objects can cause them to heat sufficiently to result in serious personal injury.

4. *KNOW FIRST AID, AND KEEP FIRST AID SUPPLIES AVAILABLE*

Illustrated first aid instructions for the treatment of electrical shock and burns should be displayed in a prominent location adjacent to the equipment. In rendering first aid, the timeliness and effectiveness of the treatment are vitally important to the recovery of the injured person.

Without exception, all personnel should thoroughly familiarize themselves with the procedures involved. One person, whose regular duties place him or her at the transmitter site often, should be delegated and given the complete responsibility and authority to ensure that first aid supplies are kept on site and maintained fresh and up to date.

Prominently display a list of emergency telephone numbers. This list should include the telephone numbers of the nearest ambulance, hospital, doctor, and fire department paramedics; and the public works (highways or county roads) department in case the former persons need access to the site during inclement weather.

MX Series - 1 Watt UHF AMPLIFIER

HEALTH WARNINGS:

1. Non-metallic coverings of some coaxial cables used in this equipment are **FLAMMABLE** and may transmit fire when ignited. Other wire coverings are not capable of supporting combustion, but any non-metallic covering when heated sufficiently may emit dense smoke and acid gases which can be highly **TOXIC** and often **CORROSIVE.**

2. Be careful when replacing RF power transistors. Thermal transfer properties in these devices are achievable only by the use of Beryllium Oxide ceramics. We stated it earlier but we will emphatically repeat it again and again, ***Beryllium Oxide is a TOXIC substance.*** If the ceramic or other encapsulation is opened, crushed, broken or abraded, the Beryllium Oxide dust can be hazardous if taken into the body in any manner. Use caution in replacing these devices.

3. Solvents such as alcohol, ketones, aliphatic or aromatic hydrocarbons, halogenated hydrocarbons, etc. as found in glues, paints, paint thinners, paint removers, and/or cleaning fluids, may emit **TOXIC VAPOURS** and some may be **FLAMMABLE.** Read and understand the directions on their containers, and ensure that they are used only in well-ventilated locations.

GENERAL SERVICE INFORMATION

1. Parts List Layout - EXPLAINED

Parts lists for manuals are computer-generated out of the LARCAN materials management database. They are presented in hierarchical or family tree order.

The computer is input with the parent parts list number, in this case the amplifier model 40D2180G3 which it designates as level 0. The computer first checks the parent list for major subassemblies, then each subassembly list for more subassemblies, etc., and arranges these lists in order of hierarchy beginning with level 0, then 1, then 2, etc., then prints each in the order in which they were found. In these booklets which together describe the PARTS of the amplifier, we have used the computer's electronic data output to allow us to more easily integrate the relevant parts list with the text.

The line of text immediately above the horizontal line on the first page of each list provides the number and name of the relevant assembly that the list represents.

An "R" followed by a dash and a number indicates revision status. This information is meaningful to our Renewal Parts and/or Customer Service people, and in order that these people can be most helpful, they should be advised of this revision number especially if renewal parts are needed.

2. Interpreting LARCAN Drawing Numbers

Engineering drawings at LARCAN are based on the concept that an assembly or subassembly is simply a GROUP of component parts, thus when a **G** appears on a list, it means an "assembly". Thus a circuit board loaded with parts may be referenced in this manual as "21B1389G1". In this example, G1 is the amplifier used in the IPA2 stage while G2 is the amplifier used in the PA stage. Furthermore, the \`P' in 21B1389P1 indicates that this is a part in itself (a printed circuit board) with no parts in it. In this case this part is called up in 21B1389G1 parts list. The \`S' in 21B1389S indicates that this is a schematic diagram. In some cases the schematic diagram may be a completely different number.

GENERAL SERVICE INFORMATION

2. Interpreting LARCAN Drawing Numbers (continued).

Other assemblies may be shown as a number of separate assemblies (Parts 1, 2, 3, 4, or 5), on several sheets of a single drawing. The drawing "parts" all are assembled the same way, but vary in quantity and type of components.

For vendor components such as resistors and capacitors, often a generic drawing describing basic specifications, but having many "parts", will be used.

As an example, Drawing 3R152: Resistor, composition, ¼ watt. Drawing 3R152 describes a ¼ W resistor, but the drawing PART number calls for the value and tolerance of the resistor wanted. The first two digits after the "P" are the first two significant figures of the resistance, the third digit is the number of following zeroes in the resistance value, and a J is 5% tolerance, or K is 10% tolerance. Some example part numbers are: 47 Ω, ±10%, ¼W, is "3R152P470K"; and "3R152P243J" specifies 24 kΩ, ±5%, ¼W. For resistance values between 1 Ω and 10 Ω, a letter "R" will appear in the part number to indicate the decimal place; for instance a 5.6 Ω, ±5%, ¼W resistor will be designated as "3R152P5R6J".

Often the letter "R" appears on schematics or in parts lists where it specifies the decimal place when referring to resistances, such as "51R" or "75R" or "5R6", and sometimes the letter "k" will appear in the same context, such as "3k3". This practice is deplored by old-timers in our midst who attended North American tech schools and therefore learned about component values that are specified with the use of decimal notation, but schematics drawn this way are common in other parts of the world. In a parts list, moreover, an R followed by a dash and a number indicates a revision, but you will be able to recognize the difference from the layout framework of the list.

3. The LARCAN Assembly Prefix Numbering System

Because a transmitter is a complex device, a referencing system for unique identification of component parts reduces the chaotic situation that would otherwise result from the natural numbering system found in every parts list, in which the first capacitor is designated C1 and the first resistor is likewise designated R1, but when several assemblies using capacitors or resistors appear together, the entire question then becomes "*which* C1 or R1 are we talking about?"

The LARCAN prefixing system and its "undocumented features" represent a beginning and evolving solution to some of these problems. It begins by assigning a distinct assembly prefix number to each subassembly.

Prefix 1, the amplifier chassis assembly, has other subassemblies, which are uniquely prefixed such as the metering board, which is prefixed 5. This sub assembly could have a C1, an R1, etc. Identification of each component in full is done by simply adding the prefix number to the component designator, thus 5C1, 5R1, etc.

Prefix designation is great for written communications such as letter or FAX, but when talking about it during a phone conversation, it is probably more natural to simply say "C1 in the preamp board" or "R7 in the output amplifier" than to go through the routine of looking up the prefix number.

GENERAL SERVICE INFORMATION

4. List of Assembly Prefixes

	Prefix	1	Main Amplifier Chassis Assembly
Sub-assembly	Prefix	2	Line Filter
"	"	3	Power Supply
"	"	4	Pre-Amplifier
"	"	5	Metering Board
"	"	6	Not Used
"	"	7	Directional Coupler
Sub-assembly	Prefix	8	Power Amplifier (PA)

5. Production Changes

From time to time, it may become necessary that changes be made in the equipment described in this manual. Such changes are usually made either to provide improved performance, or to accommodate component substitutions necessitated by vendor product availability. A revision letter or number may follow the model or group number marked on the nameplate, chassis, or circuit board; or on the parts list (where it is an "R" followed by a dash and a number). Whenever a revision letter or number appears, it should be quoted in any correspondence or communication regarding the equipment.

MX Series - 1 Watt UHF AMPLIFIER

GENERAL DESCRIPTION

INTRODUCTION

This manual describes the LARCAN 1Watt UHF amplifier which is designed to operate on channels 14 through 69. This solid state 1W UHF amplifier was designed to operate conservatively at 1W peak sync visual RF power, and 0.1W average aural carrier RF power, with superb performance, reliability and operating economy. This amplifier accepts an on-channel internally diplexed (in a 10:1 ratio Vis to Aur) composite driving signal of about 1mW peak visual RF as input to its RF chain.

The 1W amplifier and channel processor chassis' are designed to fit in a single 19" customer-provided cabinet rack, and require 5.25" (3RU) of vertical panel space for a complete transmitter or translator system. Alternatively, a 19" customer-provided tabletop cabinet could be substituted if the site requires it.

The RF amplifier and other sub-assemblies are all convection cooled. The simplicity of design, the deployment of all modular and other subassemblies, and the use of standard readily available components, also enhances serviceability.

Peak forward and reflected power are displayed on an analog percent power meter located on the front panel of the amplifier unit.

AMPLIFIER CHAIN

The amplifier chain consists of two stages of amplification. These are the Pre-amplifier and PA stages. Both stages operate in class A. The system has a minimum gain of 30dB.

The internally diplexed composite RF output of the channel processor or exciter is fed to a conservatively designed broadband solid-state Pre-amplifier. This amplifier requires no tuning or adjustment. Simplicity of operation, reduced maintenance costs and increased reliability are a few of the major benefits derived from this module.

This first stage is a broadband pre-amplifier module which delivers about 40mW to the PA stage to achieved overall 1W sync peak at the output. The gain of the pre-amplifier is about 18 dB.

The 1W PA module also operates in class A mode, and has a gain of about 15dB. This amplifier is also wideband and does not require retuning even if it has to operate on another channel.

TRANSMITTER CONTROL

Because of its simple and rugged design, this amplifier does not require any special control, interlocking, nor protection circuitry. The amplifier can operate safely over ambient temperature of over 45°C, and will tolerate extremely high VSWR.

The control is simply a front panel switch which applies 117VAC to the power supply.

MX Series - 1 Watt UHF AMPLIFIER

GENERAL DESCRIPTION
ELECTRICAL AND MECHANICAL SPECIFICATIONS

NTSC

Power Output: .... Visual 1 W peak, Aural 0.1W
Diplexing: .... internally diplexed, 10:1 V to A
Frequency Range: .... 470-806 MHz (channels 14 thru 69)
Amplifier Output Impedance: .... 50 Ω
Output Connector: .... type BNC
Amplifier Input Impedance: .... 50 Ω
Output Regulation: .... 3% (black-white picture)
Output Variation: .... 2% (over 1 frame)
Amplitude/Frequency Response
-0.75 MHz to +4.75 MHz (Relative to Visual Carrier) .... +0.5/-1.0 dB
Harmonic Radiation: .... -60 dB
Spurious Emission (fv-4.5MHz, fv+9.0 MHz) .... -40 dB
Intermodulation Distortion: .... -50 dB

ELECTRICAL

AC Line Input: 117VAC
Power Consumption: .... 40VA (typical)

ENVIRONMENTAL

Ambient Temperature: .... 0°C to +45°C
Humidity: .... 0% to 90%
Altitude: .... 7500 ft.

COOLING

Convection.

DIMENSIONS

The amplifier and standard channel processor chassis' are standard 19" rack wide units;
Amplifier height is 3.5" (2RU); channel processor is 1.75" (1RU); for a TOTAL HEIGHT of 5.25" (3RU).
Depth is 15" including an allowance for connectors.

The MX1U series amplifier is marketed on the assumption that the customer prefers to provide the cabinet or enclosure for it.

SHIPPING WEIGHT

Amplifier only: Approximately 6 lbs.

MX Series - 1 Watt UHF AMPLIFIER

GENERAL DESCRIPTION
ABOUT THIS MANUAL

It will be observed that this manual consists of a collection of separate publications, each one of which describes its own module or section of the equipment. Parts lists, applicable alignment instructions, and illustrations which generally consist of assembly diagrams and schematics are included in each of these booklets, which are identified by a "PUB" number and revision.

These mini-publications represent our attempt to assure quality of our documentation and at the same time maintain the material as current as possible. In the usual large manual or handbook, a change made to a single module might require a sentence or even several paragraphs be added, with the result that all text following the change will shift, consequently requiring renumbering of all pages and subsequent reprinting. These operations create an undesirable delay between the release of the revision to the equipment and the re-issue of its manual, despite our extensive use of computers. It is our hope that this republication delay will be reduced because revisions are nearly always done on one module at a time, and a few pages pertinent to one module are obviously simpler to revise and reprint than the many pages of a handbook.

Each section or module of the equipment is described in its own booklet. For each booklet, the format generally consists of a block diagram where applicable, then the relevant specifications, then the circuits are described, then test/alignment procedures are defined, and then the parts list is presented. Finally, the Figures (illustration drawings in 11" x 17" size) complete the booklet.

The Parts Lists in all booklets have been compiled by, and then extracted from, the LARCAN materials management computer system, and are current as of the date of issue of the booklet.

We have attempted to present our circuit descriptions in such a way that they would be meaningful to the competent technician whose main objective is to look after the equipment. We have therefore minimized the inclusion of material usually found in engineering textbooks, professional papers, and doctoral theses, because much of the information from such sources, although meaningful to the EE, can be too heavy and overdone for the beleaguered technician who is desperately trying to put a transmitter back on the air.

3-ring binders are used for LARCAN manuals as a courtesy to our customers because a 3-ring binder enables assembly drawings and/or equipment schematics to be temporarily extracted and used in a more convenient place when necessary. (Before their joining LARCAN, several of our staff technical people were previously broadcast station engineering technicians, whose custom was to temporarily tape their schematics to the transmitter cabinet doors for convenient reference when working inside the equipment).

Drawings whose numbers begin with 30C, 31C, 40D, 41D, 50E, or 51E may have been reduced in size or even split into several sheets to fit into the booklet's 11" x 17" format. Should any reduced drawings as presented in our manuals be found difficult to read, full size engineering blueprints are available at no charge by simply writing, calling or FAXing our Customer Service department and requesting the referenced drawing and revision wanted.

LARCAN INC.

228 Ambassador Drive,

Mississauga, Ontario, Canada L5T 2J2

Phone (905)-564-9222; FAX (905)-564-9244.

MX Series - 1 Watt UHF AMPLIFIER

GENERAL DESCRIPTION

FIRST-TIME, ON-SITE TRANSMITTER START-UP PROCEDURE:

Please take the time to read and understand the technical Sections of this manual, which contain information that you might want or need when you first start your newly installed transmitter.

The amplifier meter was calibrated at the factory to read 100% at 1W sync peak and at the channel specified by the customer. The point is that if the amplifier is to operate at a channel other than that of the factory test channel, the metering requires re-calibration. In other words, a meter indication of 100% on channel 47 at 1Wsp may only read, say, 80% on the meter on channel 40 for the same 1Wsp output. In other words, the power meter setting is a channel dependent calibration.

1. Connect the transmitter output to a 50 ohm dummy load or the antenna. The transmitter uses a 50 Ω type BNC connector for its output. An inline wattmeter or spectrum analyzer can be used for power measurements. 1W sync peak is equal to +30dBm.

2. Transmitters only: Apply 117VAC to the exciter. Connect a 1 V peak-to-peak video signal to the exciter video input jack. Connect an audio signal to the exciter audio input. Connect the RF output of the exciter to the RF input of the amplifier. Be sure to adjust the RF output level control at minimum for the time being.

   Translator only: Apply 117VAC to the channel processor. Apply the input channel signal to the input of the channel processor, and its RF output to the input of the amplifier. Ensure that the RF level control is at minimum for the time being.

3. Connect the 117VAC mains input to the amplifier. This AC circuit should be supplied through a slow-tripping breaker or time delay fuse with at least 2A rating.

4. Push the switch to the `ON' position. The power supply should be ON indicated by the lit green LED above the switch.

5. Adjust the RF level control on the exciter/channel processor until the front panel power meter reads 100%. The meter was calibrated at the factory at a specific channel which means that if the current operating channel is other than that of the factory test channel the meter reading will be incorrect.

   WARNING : If the amplifier is to operate on a channel other than the channel set at the factory, the front panel power meter must be re-calibrated.

GENERAL DESCRIPTION

Notes:

1W UHF AMPLIFIER ASSEMBLY

Contents:

Part	Topic	Page
1	Amplifier Chassis Description	92-1
2	Pre-Amplifier Module	92-2
3	PA Module	92-2
4	Directional Coupler	92-3
5	Metering Board	92-3
6	Power Supply	92-4
7	Basic Maintenance/Replacement Parts	92-5
8	Parts List	92-12

List of Figures:

Figure	Title	Drawing Reference
92-1	Chassis Assembly Diagram	40D2180G3
92-2	Wiring and Block Diagram	20B2482
92-3	Pre-Amp Module Assembly and Schematic Diagrams	10A1453G7 10A1453sheet13
92-4	PA Module Assembly	21B1324G2
92-5	PA PCB Assembly	21B1334G1
92-6	PA Module Schematic	21B1334S
92-7	Directional Coupler Assembly	10A2086G1
92-8	Metering Board Assembly	20B1235G5
92-9	Metering Board Schematic	20B2448

1.0 Amplifier Chassis Assembly 40D2180G3: Figure 92-1.

The Amplifier Chassis consists of a standard 19" rack mounted 3.5", 2RU enclosure containing a line filter, power supply, two amplifier module assemblies, a directional coupler, metering board, and a metering panel. Its basic part number is 40D2180.

The amplifier modules are broadband, thus covering the entire UHF television spectrum ranging from 470MHz to 860MHz.

117VAC to the amplifier chassis comes in via a fused line filter, 2LF1. Pressing the ON/OFF switch to the ON position (UP) applies AC to the primary of the power supply transformer, thus, applying DC power to the amplifier stages.

Metering is achieved using a directional coupler which samples the RF signal. It is fed to a peak detection metering board which then displays the corresponding power level on the front panel analog meter.

The chassis is wired according to the wiring diagram, 20B2482, shown on Figure 92-2.

Chassis parts lists are provided on the last pages of this manual. The circled numbers seen on the assembly drawing correspond to the "symbol" item numbers on the parts list.

2.0 Pre-amplifier 10A1453G7 : Figures 92-3

The Pre-amplifier module is a conservatively designed broadband amplifier which can operate on frequencies between 470MHz to 860MHz with a excellent gain of about 18dB. It also has a very good return loss and DC current stability with temperature.
The RF output of the channel processor or exciter is fed to this amplifier which raises the level to about 40mW to achieve 1W at the output of the final amplifier. This module requires no tuning nor bias adjustments. The Pre-amp DC supply voltage is 24V, and it draws about 200mA (class A).

3.0 PA Module 21B1324G2: Figures 92-4, 92-5, 92-6

Power Amplifier 21B1324G2 is a dual device amplifier module. Adequate length RF cables are part of, and attached to, each board assembly 21B1334G1; input cable simply plug in to the output of the corresponding side of the pre-amp assembly, and output cable plugs in to the input of the directional coupler.

The power amplifier (schematic, Figure 92-6) consists of two FET amplifiers type MRF181 paralleled in RF phase quadrature, and operated in class A. Amplifier operating bias and over-current protection is provided by an industry-standard type µA723 regulator IC.

After the quadrature hybrid splitter HY1, each MRF181 amplifier input is matched with the equivalent of an L network followed by a π network. The input circuit begins with a short section of 50 ohm microstrip line then a coupling capacitor (C100 or C110) then a short section of lower impedance microstrip which provides some inductance, then an adjustable capacitor (C101 or C111) to ground, then a considerable length of the same impedance (which behaves as a larger inductance), then the input of the FET whose gate capacitance forms the output side of the π matching network. This matching arrangement is good for operation from 470 through 860 MHz, and minor tweaking of the adjustable capacitors C101 and/or C111 provides flat response over the range.
The output circuit is similar except it uses narrower (higher impedance) microstrip lines because the output impedance of the FET is higher than its input impedance. The output match consists of the equivalent of a Tee followed by an L; the input of the L is adjustable with variable capacitor C103 or C113. This capacitor is adjusted to provide flat response over the range. An output coupling capacitor C104 or C114 completes the match to 50 ohms; two outputs are combined in a quadrature hybrid HY2.

Bias to the gates of the FETs passes through R100 or R110 from balance controls RV100 or RV110.

The bias regulator U1 uses an µA723 (MC1723CD) to provide approximately 6½ volts to the gate bias controls RV100 & RV110. Voltage divider R5, R6 provides the inverting input of the regulator error amplifier with a sample of the output voltage, and the wiper of RV3 provides the non inverting input with its reference signal which is an adjustable fraction of the 7.15V built-in reference of the µA723. The adjustment of RV3 therefore should be able to give us an output within the range from zero to approximately 9 volts. R4 and C2 are a phase-lead network; C1 together with the internal collector impedance of the error amplifier provides a phase-lag network; and R3, C4 provide another phase-lag. All are there to frequency-compensate the feedback system and maintain regulator stability.

Drain current of the two FETs is sampled by the voltage drop across R7, R8, and R9. When this voltage exceeds approximately 0.5V at normal operating temperature (about 1.5 amps total FET current), Q3 begins conduction and feeds voltage to pin 2 of the regulator to start its current foldback limiter circuit. The regulator reduces its output voltage, which in turn reduces the bias on the FETs, they decrease their drain currents, reducing the voltage drop across R7, R8, R9 and over-current protection is achieved. CR1 protects Q3 emitter-base junction from current inrush to C3 and C107 charging during start-up.

Setting up is performed during initial factory testing by first setting RV110 to its maximum CCW position so that Q2 receives no bias voltage, therefore should not conduct, then setting RV3 for regulator output at U1 pin 10 to +6.5 ± 0.2 volts. An ammeter is connected in series with the +24V supply lead. Then, RV100 is set for 300 mA reading on the ammeter due to Q1 conduction. Next, RV110 is set for Q2 also 300 mA so that we read Q1 + Q2 = twice as much current = 600mA.

Another (final) check is made before applying RF: gate voltages at C102 and C112 are measured. With good FETs, both voltages should be approximately equal and in the range +3.5 to +5.5VDC.

Current limiting is checked by increasing the setting of RV3; the current will increase to a threshold of, and must not exceed, 1.6 amperes. RV3 is then reset to obtain the original +6.5 volts at U1-10.

When RF sweep is applied, C101, C111, C103 and C113 are adjusted for flat response over the range. The overall gain of the Intermediate Amplifier is a nominal 15dB over the band.

4.0 UHF Directional Coupler Assembly: Figure 92-7

The main function of the directional coupler is to supply RF sample to the metering board such that the forward power can be monitored for the purpose of metering. The sample signal is about 24 dB below 1W which amounts to about 4mW. The FWD sample connects to the metering board forward input, 5J1.

5.0 RF Metering Board Assembly 20B1235G5: Figures 92-8, 92-9

The function of this board is to monitor the forward power. A 100% reading on the front panel meter indicates that the amplifier output is at 1W sync peak. Keep in mind, however, that this reading is not true if the operating channel is changed. It must be re-calibrated.

a) RF Detectors:

The forward RF power sample is applied to J1 and is terminated by R2 . A small amount of forward bias is applied to CR1 via R1 and R5 to overcome the threshold voltage of the diode and enhance its detection linearity at low signal levels. The opposing connection of CR1 diode junction and Q1 emitter-base junction provides temperature compensation.

Q1 buffer amplifier provides a low impedance source to drive the trap C3, C4, and L1, through R9. This trap is broadly resonant to 4.3 MHz, and significantly attenuates 3.58 MHz NTSC colour subcarrier as well as any 4.5 MHz intercarrier that may be generated in CR1 or CR2 due to the presence of visual and aural RF signals together in the system. Removal of these subcarrier components before the signal is peak detected, enables the circuit to be responsive to sync peak power only (for visual) or just CW (aural) power, and relatively immune to undesired carriers.

CR3 is a peak detector with a time constant set by C7 and R11. The signal from this peak detector is fed to op-amp U1pin 5 and the gain of this stage is 0.5x, and its output on pin 7 feeds the meter which is located on the front panel of the amplifier.

U1 output pin 7 zero-offset voltage is controlled by R18. This pot should be set with no RF input, so that while you watch the voltage on TP1 as you are setting the pot, you will observe the decrease of the voltage towards zero. When it ceases decreasing, stop adjusting. Expect about 50 mV offset voltage when the op-amp output is almost touching ground. If the pot is turned beyond this point, the output stage of the op-amp will be driven into saturation thus unable to respond to low power levels.

The output of U1-7 drives the RF power meter through R32 which set the meter deflection with a known RF signal. U1-7 drives. Forward calibration is done with full rated power and a forward RF sample from the directional coupler applied to J1. R32 is adjusted for a 100% reading on the forward power meter position.

2. RF Metering Board Test and Calibration:

a) Forward Power Meter Calibration - Zero Adjust

With no RF input connected, measure the DC voltage at U1-7 (or TP1) and adjust R18 until the output voltage at U1-7 (TP1) drops to a minimum, approximately 10 to 50 mVDC. A DC coupled scope will make the adjustment easier to see; the objective is to place the U1 output as near the op-amp ground rail as possible without the op-amp going into saturation. Turning the pot farther will decrease the sensitivity of the system for small signals. Once this minimum voltage has been reached, do not re-adjust R18.

b) Forward Power calibration

Set the exciter/processor RF output for the transmitter to run at its operating power, i.e., *1W sync peak. Adjust R32 for a forward power meter reading of 100% (top scale).

Measuring power using the `average' power meter method:
*1W sync peak: A **mod-ramp** 80 video signal plus the **aural carrier switched `ON'** set at 10dB below visual would normally read about **0.59W** on an `AVERAGE power meter'.
or
*1W sync peak: **Black** video signal (no setup) with **no aural** carrier present would also read 0.59W on the average power meter according to the formula: Pav=Psp/1.685.

Measuring power using the spectrum analyzer method:
Connect the output of the amplifier to the spectrum analyzer using a short low loss cable. To protect the spectrum analyzer from overdrive, a 10, 20 or 30dB attenuator must be used in line with the cable.
*1W sync peak is equal to **+30dBm**.
or
Use a directional coupler with a known coupling level. Connect the output of the amplifier to a load thru this coupler. If the coupling is –20db then the reading on the analyzer should be +10dbm.

6.0. Power Supply:

The power supply used in the amplifier is an International Series Linear, single output power supply. The part number is HB24-1.2-A which is an adjustable 24VDC with a 1.2A rating. The range of the adjustment is about ±10%. It is adaptable to various AC voltage inputs by changing the jumpering on the primary side of the transformer. The choices are: 110/120/220/230/240 VAC. In this application, its default setting is 120VAC.

7.0 BASIC MAINTENANCE

Please note that the following are basic maintenance guidelines and general information and not all may be applicable to your particular equipment.

7.1 GENERAL

When the transmitter was installed and commissioned it was in proper operating condition. During final tests, all circuits were checked for optimum adjustment to ensure both peak performance and conservative operation of components, and test results were recorded for future reference.

Given reasonable care and attention the transmitter will provide efficient and reliable service for many years.

Experience indicates that equipment which is regularly and carefully maintained is far less likely to be subject to sudden failure than that which is operated continuously without regard to basic maintenance requirements. It is therefore desirable that a detailed preventive maintenance program be established to ensure that the original efficiency and picture quality is maintained throughout the life of the equipment.

Preventive maintenance techniques do not necessarily involve extensive dismantling of the various assemblies; on the contrary, this practice is to be discouraged unless a valid reason exists for doing so. Preventive maintenance is more concerned with detailed physical inspection and the general observation of the equipment during and after operation, to detect the presence of any abnormality which if not corrected might later develop more serious proportions, resulting in operational failure.

In preparing any maintenance program, the frequency and scope of the inspections must be determined, and to a great degree will be influenced by site location and the station's market parameters consequently its hours of operation, equipment configuration, and technical personnel deployment. For example, is the station on the air for 24 hours a day, are there main/standby transmitters, and are they attended or unattended? In general, the following routines should form the basis of any maintenance program.

7.2 DAILY

At an attended site, the operator is afforded the opportunity to make daily or more frequent checks on the equipment and thereby increase his/her familiarity with its operation. The "transmitter log" entries made during these checks would include all meter readings, also any irregularity in performance, or in picture quality, for later analysis. An unattended site where equipment is operated by remote control, and monitored by telemetry and a high quality off-air receiver or demodulator located within the primary coverage area at the studio site, can also be continuously checked for performance by studio technical personnel, using VITS or VBI test signals encoded into the video signal vertical blanking interval.

7.3 WEEKLY

If the site is unattended, and VITS or VBI test equipment is not available, many broadcasters schedule their operational tests and transmitter inspections to be performed once a week during weekend hours, such as from midnight Sunday to six AM Monday, depending on their market conditions.

If there is an emergency alternator, it should be checked out completely, and run for at least an hour under full load. The checking of this unit should include the condition of its battery, its ease of starting (and its Winter starting enhancers such as block heater, battery warmer, fuel antifreeze), its engine oil level and condition (see "Monthly" below), its radiator coolant condition and level; and its fuel tank should be topped up. This simple check will serve as a reminder to order more fuel if necessary.

7.4 MONTHLY

In addition to the normal operational tests, thorough physical inspection of every piece of equipment should be made, with all power turned off. All surfaces should be dusted off or wiped down, terminal boards checked for loose connections, and all components examined for any evidence of overheating. Air filter media should be inspected and replaced if necessary. High pressure air, not over 20 psi, may be used with discretion to dislodge dust from inaccessible places.

Change the engine oil and oil filter in the emergency alternator, if it has been operated longer than its manufacturer's recommended time since this was last done. In the absence of recommendations, don't let it run more than about 100 hours between oil changes. When put into perspective, 100 hours is the time logged by a vehicle running 6000 miles at 60 mph. Oil is cheap, when compared with engine parts.

7.5 SEMI-ANNUALLY and ANNUALLY

Check all external RF connections for tightness. Test the antenna and transmission line with a transmission test set or network analyzer if one is available, to identify any potential problems with the antenna or line. Inspect and clean contacts on all switches and contactors; carefully redress contact surfaces if pitted.

Change the engine oil in the emergency alternator to summer or winter grade, depending on the season. Also inspect and if necessary replace, its fuel filter and air filters.

Inspection and maintenance (tighten all bolts, replace obstruction light bulbs) of the tower, antenna, and grounding system, should be conducted annually.

7.6 TRANSMITTER COOLING SYSTEM

Air filter material supplied with some transmitter cabinets has been impregnated with a polyester coating, which is designed to attract and hold very fine particles that may be in the air flow. This air filter material should be inspected every month or oftener, and replaced when dirty. Frequency of inspection and replacement, of course, will depend on your particular local environmental conditions.

All cooling fans in the transmitter are Rotron™or equivalent, and all are fitted with sealed bearings requiring no lubrication during the lifetime of the motor.

7.7 STATIC 1, EQUIPMENT 0: Static vs. Sensitive devices...

Care must be taken at all times because this equipment contains static-sensitive CMOS and FET devices. Here is a brief tutorial on static, particularly pertinent to CMOS and other MOS device handling:

1. It is important to avoid surroundings or situations in which static can be generated. The building floor should have grounded conductive floor coverings, or a grounded conductive mat placed on the floor in front of the bench. Then, the bench itself should also have a grounded conductive mat on which the equipment is placed. Anybody working on the equipment should wear either a grounded wrist strap (preferably) or conductive overshoes. Vacuum cleaner tools should all be conductive and grounded to avoid static from air motion. (Vacuum cleaners made for computer servicing would be suitable). Soldering iron tips must be grounded. Use properly maintained soldering equipment that has a three wire, grounding plug, verifying low path resistance between ground and the tip with an ohmmeter every time this equipment is used.

2. The average person wearing rubber-soled shoes and walking across a woollen or synthetic carpet or untreated vinyl tiled floor is able to generate voltages in excess of 15 to 20 kV. Most MOS devices will suffer puncture of the oxide insulating their gates, at 20 to 40 V. Many CMOS devices are fabricated with built-in zeners which will clamp foreign voltages, but the amount of energy that must be dissipated may easily exceed the rating of this protection. It is therefore prudent to assume that little or no static protection exists in a CMOS device and therefore you must provide your own.

3. A typical unprotected gate of a CMOS logic IC has an input capacitance of about 5 pF and can self-immolate at 20 V, so the energy to destroy the IC is given by the expression $W = CV^2/2$ where W is in watt-seconds, C is in farads, and V is in volts. One watt-second is also known as a Joule. Substituting numeric quantities results in W = 5 x 10^{-12} x 20 x 20 ¸ 2 = 1 x 10^{-9} Joule per gate. Stored energy in the approximately 100 pF capacitance of the human body charged to 15 kV, becomes W = 100 x 10^{-12} x 15000 x 15000 ¸ 2 = 11.25 x 10^{-3} Joule. *Eleven and a quarter **million** times more energy than is needed to destroy one gate input!* Some of us may therefore be led to conclude that a body can annihilate more than eleven million CMOS gate oxides all at once.

4. This is serious stuff. To avoid destroying CMOS devices, the human body must be grounded first. That is the reason for all the "grounded surroundings" we suggest in paragraph 1. Don't forget, though, that a circuit board has conductive metallic paths connecting into the CMOS parts, which makes them all susceptible to mass devastation as easily as would be the destruction of any one CMOS chip all by itself. Always ground yourself first, then the board.

5. Avoidance of static exposure of boards and CMOS devices is easier. Ensure that boards are always kept in conductive bags or boxes when not in place in the equipment, and that spare CMOS ICs are in conductive chip carriers or plugged into conductive foam. Be careful about this point; many plastic foams can be coloured black, but may still be an insulator. Use your ohmmeter to be sure.

   Don't accept any devices whose pins are punched through aluminum foil into foam plastic. People who don't know better have used this method for shipment and storage of devices, but it cannot be depended upon, because many times the holes made in the foil by the device pins become enlarged simply from the motion of pressing the pins into the foam, and won't make contact any longer. When the device is withdrawn from the foam, the friction of the plastic against the pin can generate enough charge to cause puncture and consequent failure of the CMOS gate insulation.

6. Identical statements to those made in the above paragraphs apply to RF power MOSFETs, and although the gates of these devices might appear to be considerably more robust than those of the average CMOS logic device, this is due only to the much greater gate area and consequently greater input capacitance. The same order of magnitude of gate oxide breakdown voltage exists for RF power FETs as for small CMOS devices, therefore use the same order of care in handling.

7. Believe it or not, ordinary analog meters can also be affected by static. Years ago, meters were made with glass faceplates and had movements that were relatively insensitive, so were affected little by stray static charges accumulating on the glass. Today, almost all meters are made with clear plastic faceplates and many of these, such as the sensitive 50 µA ones we use, have extremely compliant moving parts, thus can be easily caused to read incorrectly from a static charge on their front surfaces. This charge can be readily generated by simply cleaning the meter face.

   It is important that meter accuracy be maintained within reasonable tolerances, because you as a broadcaster are responsible for ensuring that the transmitter complies with all regulations pertinent to its operation, and the easiest way of tracking its performance is from its meter readings.

It is recommended for better accuracy that meter faces be given an anti-static treatment, either by cleaning with an antistatic cleaning agent, or sprayed with an antistatic coating, or both.

Suitable antistatic chemicals should be available through your nearest electronics parts distributor, and typically carry such names as *"Zero Charge"* from Tech Spray™, *"Destaticizing Lens Cleaner"* from G-C™, and *"420 Antistatic Screen Cleaner"* from M.G. Chemicals™. Check them out. Similar brands should also be available in most reputable computer shops or office supply stores.

CAUTION: Antistatic cleaners or treatment chemicals must not contain organic solvents such as acetone, MEK, methyl isobutyl ketone, benzene, toluene, xylene, ethyl cellosolve acetate, or many of the chlorinated hydrocarbons including ethylene dichloride and 1,1,1 trichloroethane, as these solvents will etch or even dissolve most of the plastics used for meter faceplates.

Our meter supplier recommends and uses a harmless coating treatment which it keeps in stock under its catalog number FS 681. This coating is otherwise known to the trade as *ANSTAC 2-M*.

ANSTAC 2-M is made by *Chemical Development Corp.*
22 Portsmouth Rd.
Amesbury MA 01913 U.S.A.
Phone (508) 388-2221.

7.8 FIELD REPLACEMENT OF FETs and SURFACE MOUNT COMPONENTS:

TOXIC MATERIALS WARNING... Thermal management in certain RF devices in this equipment is accomplished through the use of Beryllium Oxide ceramic material. Beryllium Oxide is a hard white ceramic used as insulation for heatsinking of RF power semiconductors. *Beryllium Oxide is a POISON if taken into the body. In case of accidental breakage, DO NOT INHALE THE RESULTING BERYLLIUM DUST and AVOID GETTING BERYLLIUM DUST IN YOUR MOUTH. DO NOT LET BERYLLIUM DUST INTO YOUR BLOOD STREAM THROUGH CUTS OR OPEN WOUNDS !! Seek and get IMMEDIATE medical attention if the dust enters your body in any manner.* Avoid cuts by wearing gloves while picking up the broken pieces. Be careful - do not inhale dust while replacing or emptying vacuum cleaner filter bags, and wash your hands thoroughly afterward. Wash your hands thoroughly after replacing RF power devices. Dispose of defective RF power devices only through approved toxic waste facilities.

If for any reason it should become necessary to change a FET in the field, we strongly recommend following the handling precautions outlined on the next few pages:
Any FET can be damaged by static discharge. It is therefore mandatory that static-free handling techniques as discussed in the foregoing "static 1, equipment 0" tutorial should be routine, and that soldering equipment must be suitable for insulated gate MOSFET work, and must be properly maintained.

a) Keep FETs in their anti-static containers until ready to install. The module and the technician should both be earthed/grounded. Observe the handling procedures discussed in Part 7 above, including the use of antistatic bench coverings, conductive overshoes, grounded wrist straps, etc.

b) The soldering iron tip MUST be at earth/ground potential at all times, that is, absolutely no AC voltage must be available on the tip. Test with an ohmmeter each time the iron is used; the test must indicate continuity from tip to ground. Special battery operated soldering irons are also available to avoid any chance of AC voltage being present on the tip, but these are not satisfactory for RF FET work as they do not heat to sufficiently high temperatures. Use an accurately controlled temperature regulated low voltage soldering iron, and set it for about 700° to 750°F.

7.9 FET Replacement Hints and Advice:

a) Remove the screws bolting the transistor to the heatsink. Some transistors are mounted on the heatsink using clamping bridges to improve the devices' thermal transfer. In the PA module remove the nuts holding the clamping bridge and FET to the heatsink, then salvage the clamping bridge, nuts, and spring lockwashers for later use.

b To minimize board damage, use a sharp "screwdriver" tip on the soldering iron, and carefully help it along with a solder pick tool, working it under one tab first, then once that tab is free and FET mounting screws have been removed, the FET can be rocked gently, allowing other tabs to be easily unsoldered in turn. The defective FET can now be lifted out. Remove excess solder with "no clean" fluxed copper braid wick.

c) Clean the FET heatsink area thoroughly with alcohol ***(CAUTION:- ALCOHOL VAPOUR IS TOXIC)***, and inspect to ***ensure that there are no defects nor debris present and that all old thermal compound has been completely removed***. The board solder areas should be lightly and uniformly pre-tinned.

d) Apply only enough heatsink thermal compound (supplied with the transmitter) to the new FET base and to the heatsink, that will result in a thin uniform coating on the FET base and heatsink. The metal should be faintly visible through the coating on both surfaces. Apply it sparingly; too much compound is every bit as bad for thermal transfer as an insufficient amount would be. To refresh your memory: thermal compound fills the tiny little tool marks left by the milling machine on the heatsink surface, but only enough that no microscopic air spaces remain between FET and heatsink. Heat transfer depends partly on the distance through which the heat must travel from the FET to the heatsink; too much compound effectively adds more distance, which could result in overheating.

e) Lightly pre-tin and gently bend the FET tabs upward slightly, so that the tabs and the circuit board do not prevent the FET from making proper thermal contact with the heatsink.

f) Torque the screws evenly to 4.5 inch-pounds. This amount is recommended by the FET manufacturer to allow for thermal expansion of the device. 4.5 inch-pounds also will avoid the possibility of stripping the threads in the heatsink, or breaking the screws

g) Solder each tab to the board in turn, using a solder-pick tool to hold each tab in contact with the board while soldering; apply enough heat to ensure that the pre-tin solder on the boards flows, and apply just enough new solder to give a "butt" free joint. Set the bias resistances at their highest values to get minimum start-up current (see step "l" below), and then set the stage bias currents as described in the applicable PA module, IPA2 (driver), or IPA1 section of this manual.

h) Use eutectic tin-lead 63/37 solder (preferred, but if 63/37 is not available, 60/40 is acceptable). Current manufacturing process at LARCAN uses AIM™ (American Iron & Metal Company Inc.) 63/37 solder containing a "no clean" flux which becomes inert during soldering, therefore does not require subsequent board cleaning. Other good brands are Kester and Ersin Multicore; equivalent 63/37 or 60/40 "no clean" tin-lead solders also should be available from other vendors. If "no-clean" is unavailable, "RMA" (Resin Mildly Activated) core solder can be used; carefully clean the flux residue from the board with an environmentally friendly board cleaning solvent, applied sparingly.

Most commercially available alcohols are reasonable flux solvents that are harmless to circuit boards, and are CFC free and environment-friendly. Proprietary circuit board cleaning solvents are available that also meet these objectives; check with your local electronics parts dealer.

Inexpensive cotton swabs (available in drug stores or supermarkets) can be used for wiping the solvent over the area to be cleaned, then a stiff bristle brush (an old toothbrush) can be used to scrub if necessary. Use the swabs for mopping up the residue. Clean the board thoroughly, then inspect and clean it again; don't merely rearrange the residue. *Be careful - do not allow solvent to run under power transistors where it can dilute the heatsink compound.*

> ***CAUTION: VAPOURS FROM ALCOHOLS AND OTHER SOLVENTS ARE TOXIC AND FLAMMABLE... DO NOT INHALE! IF YOU ARE A SMOKER, DO NOT SMOKE WHILE USING FLAMMABLE SOLVENTS! USE ALL SOLVENTS ONLY IN A PROPERLY VENTILATED LOCATION!***

i) Finally, if you have not already done so, set the bias potentiometers for the stage to maximum resistance so that when power is applied, the FET will start at its lowest current. Then set the bias as described in the RF PA, Visual/Vision Driver, and IPA RF amplifier sections of this manual. We mentioned this procedure during step "j" above as well, because some circumstances may make it simpler to set the bias in a High Band PA before replacing L9. When L9 is in place, each half of the stage will need to be adjusted concurrently with a bias short on the opposite side (to turn off the side not being set), otherwise the DC path through L9 makes the procedure impossible. This is explained in the applicable PA, Visual Driver, or IPA section of the manual

7.1.1 Surface-mount Components Hints and Advice:

Failures of small surface mounted resistors on boards where they were companion to other components having leads, were traced to mechanical overstress of their end caps as a result of the soldering procedure to the component. Our manufacturing procedure has since been altered to fix this problem, and despite our embarrassment, we think it is important that you should know about it. For your information:

1. It is critical that surface mount components are soldered onto a clean flat surface. Use a suction device followed by fluxed braid wick material to ensure that all old solder is removed from pads of the board.

2. If this is not possible due to the presence of other components, try to clean at least one of the pads so it is flat (don't solder this end yet), then solder the other (solder-laden) pad FIRST, pressing the component down into the puddle of solder. (Plain wooden toothpicks will serve well as tools to apply pressure to components while soldering them). The remaining flat pad then can be soldered.

   To ensure minimum stress on any SM component, always be certain that the component is laying flat in contact with the board before soldering except as above when it is necessary to melt the solder on a pad first, and *never force it unless both ends of the component are free to move.*

3. If all the pads are loaded with solder, it will be necessary to heat all terminals of the component simultaneously. Check with your local electronic parts dealer for special soldering iron tips and/or other attachments (in addition to toothpicks) that will aid in surface-mount work.

4. Always keep the tip of your iron clean and freshly tinned (wetted), for maximum heat transfer.

7.1.2 REPLACEMENT PARTS

All component parts in the transmitter are available from:

LARCAN Inc., 228 Ambassador Drive, Mississauga, Ontario, Canada L5T 2J2;
Phone (905)-564-9222, or FAX (905)-564-9244, during and after normal working hours.

To expedite delivery of your order, especially if you call after hours and get our answering service, please leave a number where we can return your call, and please identify the parts requested as specifically and completely as possible.

Our Renewal Parts Department may be able to more quickly identify your requirement if the assembly name and number where the part is used, and any applicable revision number for that assembly, are stated in addition to the part's symbol number, description, and its drawing and part number as listed.

Although LARCAN can supply any part when required, in many instances it may be more conveniently obtained from a local source. Part numbers of replaceable components used in LARCAN equipment are almost always the catalog numbers of the various parts manufacturers, with the rare exception of proprietary items such as tightly specified RF power FETs, crystals, or analog 50 μA meters. If your local dealer or distributor should encounter problems and you require further information, please feel free to call upon anyone in our customer service department at the telephone number given above. We have assumed that reliable dealers of electronic components are located in or near your station market area, and that they maintain adequate stocks of "commodity" items such as resistors and capacitors. We have further assumed that you prefer to obtain most non-proprietary replacement parts from your local dealer, therefore we have listed very few such commodity items here, but we believe the following information might be useful to you during your spares requirements planning:

Capacitors: Generally, most ceramic or film capacitors are reliable, and "5% spares" (1 spare for each 20 identical parts, and 1 each if less than 20) will be found to be a satisfactory inventory level. This includes ceramic, polystyrene, polyester, polycarbonate, polypropylene, and (usually) solid electrolyte tantalums.

Reliability notwithstanding, it is worth the trouble to know exactly what is inside your replacement capacitors. Use a bridge if available, to measure their capacitance (especially for electrolytics), stray inductance, and ESR (equivalent series resistance). Measure leakage current at rated voltage.

Aluminum electrolytics require further consideration. When you consider aluminum electrolytics, usually you will need to consider their operating temperature as well:

The transmitter cooling system was designed to provide worst-case internal temperatures no higher than 60°C, in all modules of the transmitter. This cooling is based on 45°C maximum ambient air temperature and normal air flow through the intakes of the transmitter cabinet.

Most capacitor vendors state that 60°C or lower operating temperatures can be expected to give service lifetimes for their aluminum electrolytic capacitors of ten years or longer, but as their operating temperature increases to the specified maximum of 85°C, the specified service lifetime decreases to a mere 1000 hours.

You may therefore wish to increase your spares level for aluminum electrolytic capacitors if site ambient temperatures are consistently higher than 40°C, because if cooling air flow becomes restricted due to filter saturation, it is entirely possible for on-board temperatures to reach or exceed 85°C. This is why your maintenance program MUST include the regular inspection and replacement of filter media.

1W UHF AMPLIFIER ASSEMBLY

Resistors: Experience has shown that a spares stock to the 5% spares level (1 spare for each 20 of the same thing, and 1 of each when less than 20) for each value and size of resistor, is usually sufficient. Incidentally, when a molded carbon composition resistor (as specified on LARCAN drawings 3R152, 3R77, 3R78, or 3R79) such as those made by Ohmite™ or Allen-Bradley™, is used in an RF circuit, it is not necessarily good practice to make substitution without knowing exactly what the replacement resistor is; in the past, certain makes of FILM resistors have been touted as replacements for molded composition, but unless the resistors are specifically made to be non-inductive, they may be unsuitable because some film resistors are laser-trimmed on a lathe to final value. The resulting helix has significant inductance which can make the resistor unsatisfactory for use in VHF circuits.

It is worth the trouble to know exactly what is inside your replacement components. Use an RF bridge if available, to measure any stray inductance and/or capacitance associated with your replacement resistors.

Spare Parts: The list on the following pages began as computer output listings "STS10B, STS50B, etc." from our database used to compile the parts list data for each Section of the manual, and the computer has classified recommended spare parts and suggested their quantities, by part number. Because the manual is written to apply to the entire low powered basic series of transmitters, we have made a composite suggested spares list by simply combining the computer's Low Band and High Band recommendations.

We suggest that the parts lists in each Section booklet comprising the manual should be thoroughly and rigorously scrutinized, with the intention of taking your specific local conditions, and your usual dealers or suppliers inventories and order turnaround times into account, before commitment to a sizable inventory of replacement parts.

7.1.3 SPARE PARTS RECOMMENDATIONS:

Although it is our sincere hope that they will never be found necessary, it is recommended that a minimum spares stock of the following items be kept on hand.

Assembly No.	Description
40D2180G3	1W UHF AMPLIFIER

Where used	Part No.	Description	Quantity
40D2180G3	MDL-1	FUSE 1A, 250VAC, SLOW BLOW	2 EA
21B1324G2	MRF 181	TRANSISTOR RF POWER FET	1 EA
10A1453G7	MHW9182	IC AMP	1 EA