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FIGURES

1 THE MXI1503-2004 TRANSMITTER

This publication describes the operation and maintenance of both the MXi1503 and MXi2004. These transmitters are very similar, only differing in the number of amplifier and power supply modules. The MXi1503 is comprised of 3 Amplifier and 3 Power Supply modules where as the MXi2004 is comprised of 4 Amplifier and 4 Power Supplies. In both cases each power supply is connected to an individual amplifier.

In addition to the Amplifiers and Power Supplies both transmitters consist of a Main Control Chassis, Driver/Splitter Assembly (either 3-way or 4-way), Combiner and Reject Load Assembly (either 3-way or 4 –way combiner) and Front End (this could be a modulator, exciter or channel processor depending on the application).

2 MXi AMPLIFIER ASSEMBLY

Each MXi Power Amplifier Assembly consists of a control board, fan-cooled heatsink and ten printed circuit board sub-assemblies. The first module is a pre-amplifier, known as the Front-End Module. Next is the Driver pallet, which is biased so as to pre-correct for the non-linearity in the final amplifier stage. The next stage is a five-way splitter that splits the RF power so it can be fed to the PA pallets. The final amplifier stage is the PA pallets. After the pallets is the five-way combiner which combines the output power from the PA pallets. The last sub-assembly on the heatsink is the directional coupler which detects the forward and reflected power and provides samples to the control board and a RF test point on the rear panel. Also mounted on the heatsink is a thermal switch, which protects the amplifiers from over-temperature conditions such as the absent of cooling or amplifier over dissipation. Figure 1 below shows the layout of this assembly.

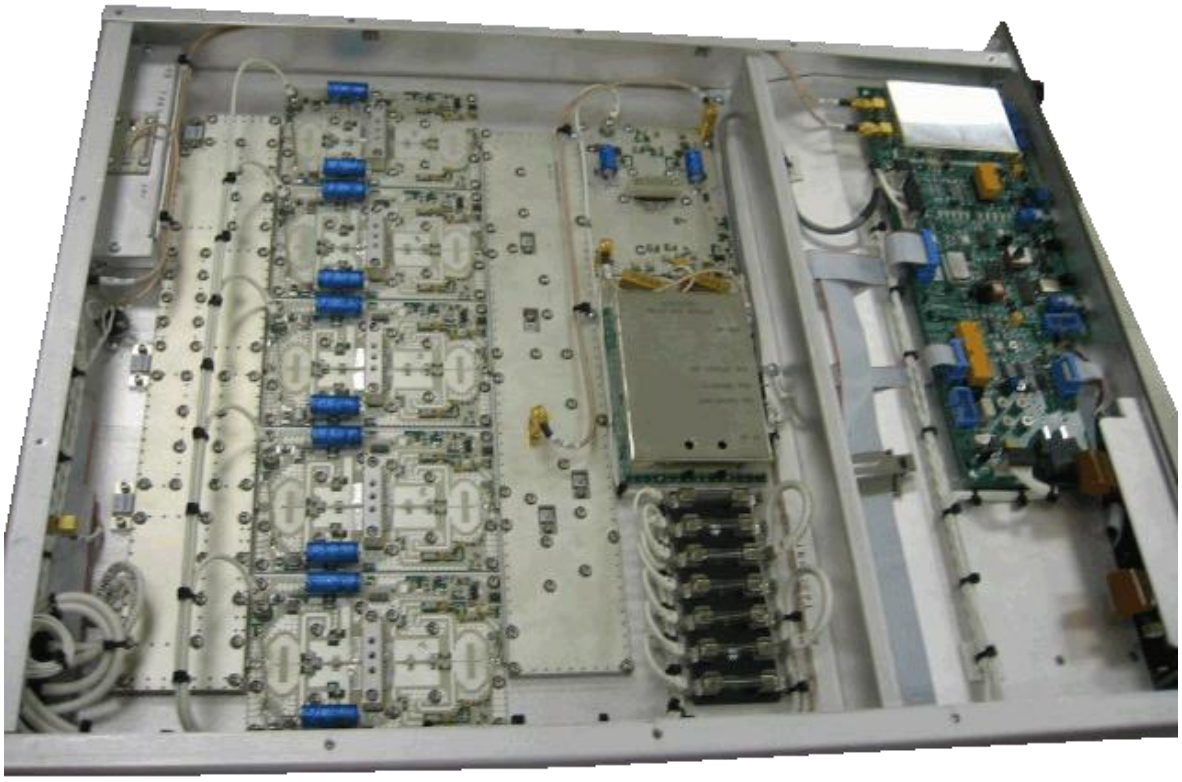

Figure 1 MXi Amplifier Heatsink Assembly

Cooling for the heatsink is provided by a fan array assembly consisting of four 4-inch axial flow +12VDC muffin fans. This array is situated near the front section of the MXi housing underneath the MXi Amplifier Controller PC board. The fans blow air into the finned portion of the heatsink, which exhausts through the rear.

3 MXi AMPLIFIER CONTROLLER

The MXi amplifier control board (Assembly 31C1897) is a single-circuit assembly that provides all of the control functions required for the MXi series amplifier on a single circuit board. This board can be configured for a number of different amplifier types, power levels, transmission standards and options.

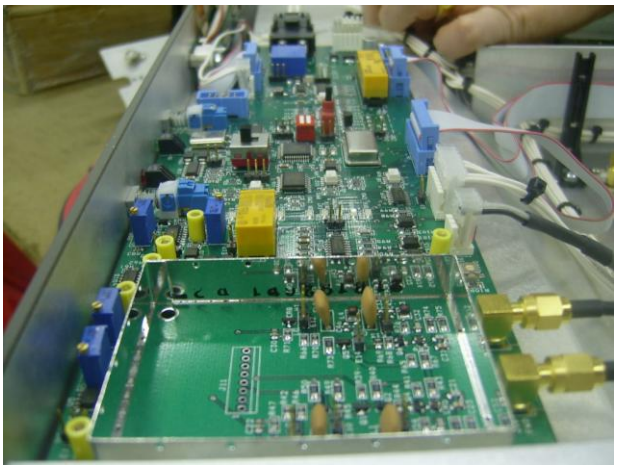

Figure 2 MXi Controller

The board implements status/telemetry for remote monitoring through a rear panel connector that will interface to a typical remote control systems (such as Moseley or Gentner). An RS232 serial port is also provided to allow communication with the main controller located inside the main control chassis. The MXi control board has RF detectors for forward and reflected power and all the circuitry to support AGC/VSWR/Cutback functions.

For complete documentation regarding the Amplifier Controller, see the publication *Amplifier Controller Board*.

4 MAIN CONTROL CHASSIS

The main control chassis located above the RF Amplifiers contains the main control board, LCD touch screen and RF splitter.

The main control board (Assembly 31C1972) is a single-circuit assembly that provides all of the communications and controls to the MXi Amplifiers on a single circuit board. The controller uses a RS-232 connection to communicate with the Amplifiers. The board implements status/telemetry for remote monitoring through a rear panel connector that will interface to a typical remote control systems (such as Moseley or Gentner). An RS-232 serial port as well as a RJ45 Ethernet connection is also provided to allow remote monitoring using our In-SiNC Remote Monitoring Software. The MXi control board has RF detectors for forward and reflected power and all the circuitry to support AGC/VSWR/Cutback functions. For complete documentation regarding the Main Control Board, see the publication *Main Transmitter Controller Board*.

On the front panel is the LCD touchscreen. This provides status and telemetry readings for the transmitter. From the LCD you have the ability to raise or lower the power using AGC controls. You can also enable or disable the remote controls and setup your Ethernet address or serial stream communications.

5 AMPLIFIER INSTALLATION AND STARTUP

The MXi Amplifier was fully tested at LARCAN before it was delivered. Under normal circumstances, the transmitter can be fully operational with minimal setup when turned ON. However, a good practice is to take the "start from scratch" approach, which means that one should take precautionary measures before the amplifier is allowed to run at full rated power. These important steps will avoid any catastrophic failures at start-up. The procedure described is essentially the same approach taken at the factory with a new and untested transmitter. This also applies if there is a need to completely replace a major sub-assembly in the transmitter.

5.1 BEFORE APPLYING AC TO THE UNIT

Pay careful attention to items 1 to 3 before applying AC to the amplifier. These are initial steps that **must** be observed and followed for proper and safe operation of the amplifier.

1. Termination

   - Ensure that the amplifier is properly terminated with a suitable load. This can be into a dummy load or into the transmitter output system. A 50 Ohm, 1kW load with at least –20dB return loss (1.2 VSWR) is recommended. Preferably, directional couplers with known coupling levels at the frequency of interest should be connected at the input and output of the band-pass filter. These points are very useful in determining absolute power levels and losses, and also for use as an RF sample for monitoring purposes. See Figure 10 for a typical transmitter test equipment setup.

2. Interlocks

   Interlocks must be connected to the amplifier to avoid damage to the equipment and to the output section. The overall interlock is located on the rear panel of the Main Control chassis and it is labeled INT'K. If this interlock is open, the +50V to each Amplifier will shut down, including the cooling fans.

3. Power At Minimum

   - Initially, the modulator's output should be at minimum level.

5.2 APPLYING AC TO THE UNIT

- Check that the AC going into Main AC Breaker ranges from 190-264VAC. If this is so, proceed to applying power, otherwise, investigate the source of the problem.
- Usually, once the AC is applied to the breakers and the breakers are in the on position, the Control Power Supply turns ON and applies +12V to the Main Controller and the controller in each amplifier.
- The Power-Up screen will be displayed on the LCD, followed immediately by the Main Menu.

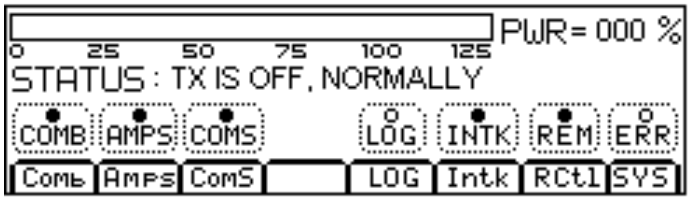

Figure 3 Main Menu

5.3 BEFORE TURNING THE AMPLIFIER ON

From the Main Menu, the status of the amplifier is displayed and shows if the amplifier is ready for operation. Status legends, when lit, such as the INTK (INTERLOCK), usually signify OK conditions and that the transmitter is ready to be switched ON.

Check that all of the following conditions are met:

1. Modulator and up-converter, or Channel Processor is ready.

- Usually in the application of AC, the modulator goes through its warm-up sequence and may take a few seconds before it is ready.

2. POWER METERING is at Zero.

- On the LCD (see Main Menu display in Figure 6), the PWR should be at 000% and the STATUS should be TX IS OFF, NORMALLY.

3. MAIN CONTROLLER is ready.

- If there were prior faults, clear them by pushing the RESET button on the power supply chassis front panel.

4. INTERLOCKS are closed or OK.

- Interlocks and Status are OK.

Figure 4 Interlocks Status

5. The Amplifier is in LOCAL mode.

- Push the REM button so that it is NOT lit.

6. The TX is OFF.

- Push the Front Panel ON/OFF button so that it is NOT pushed in.

5.4 AMPLIFIER ON SEQUENCE

Upon depressing the ON button, the fans start and at the same time the +50V power supply is enabled, thus applying DC power to the amplifies. Since the modulator/up-converter or Channel Processor are on hot standby (RF is always applied), the amplifiers will ramp up to 100% output power quickly. The reason there is a ramp up is incase there is a problem with the output system resulting in a large reflection of power. As the amplifier ramps up it will see the reflection and start cutting back. For first time installations, it is recommended that the level of the modulator be set to minimum initially and then increase in steps until 100% power is attained. This is done so that catastrophic failure is avoided. Keep in mind that in a newly installed transmitter that loose or bad connections in the output, as an example, are possible particularly when the output system is not swept for proper matching or VSWR. Hence, as the power is increased, by observing the combined, single amplifier, reflected, and reject power metering one will be able to assess if everything is in proper order.

5.4.1 Turning ON the Transmitter

1. Enable amplifier LOCAL operation by pressing the REM touch button such that the REM legend is NOT lit.

- Push the front panel ON button.
- The Transmitter should now be ON (if you did not turn the output level of the modulator all the way down before turning the transmitter on the unit will come up to 100% power. If the modulators output was reduced the output power will be 0 the status message will read “TX IS ON WITH NO RF DRIVE”)

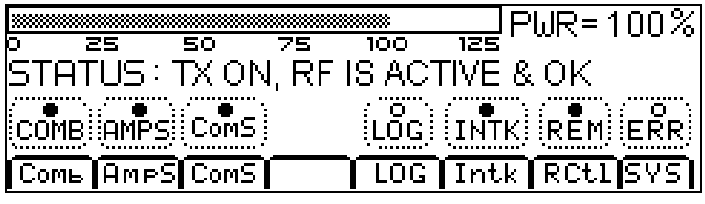

Figure 5 Transmitter ON with Full Drive

2. Monitor the +50V power supply voltage and currents on the LCD. Check that the power supplies are operating by pressing the P/S touch button. The voltage readings should be about 50V and the currents should be about 45-50 Amps per module under full power.

ALLOW THE AMPLIFIER SOME WARM-UP TIME!

Only after the transmitter has been ON for approximately 15 minutes should you perform the fine adjustments. The amplifiers must be allowed to reach their operating temperature for stable operation. The Power Amplifiers in the MXi transmitter are equipped with thermal compensation circuits, which reduce the output power when the temperature rises. Therefore, the operating temperature must be reached before adjusting the RF level to its proper level, i.e. 100%. The amplifiers are also equipped with Automatic Gain Control, primarily designed to prevent the transmitter from overpower or overdrive condition.

3. Increase the RF output by slowly turning the Modulator/Exciter or Channel Processor output level control. Stop at about 25% output power indicated on the LCD. At this level, the current should be around than 20 Amps per amplifier. Current will vary with channel.

4. If the current is not drastically higher, increase the power to 50%. Again, make note of the PS current readings. The current should be around 26 Amps per amplifier. Proceed to the next step if this condition is met.

5. Increase the RF output to 100%. The current should be about 45A-50A per amplifier normal video signal.

6. AGC SETTING: The AGC is setup at the factory for each amplifier. You can raise and lower the AGC level on the touchscreen under the Comb (combined) submenu. When you select the button to raise or lower the AGC a command is sent to each amplifier to raise or lower the level the same amount.

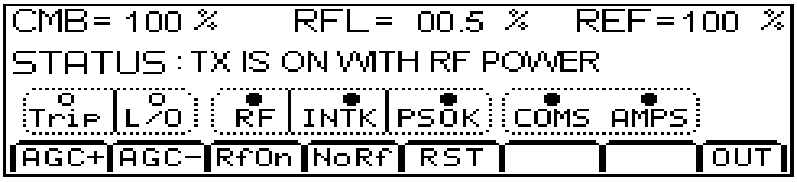

Figure 6 AGC Adjustment

The AGC setup of each amplifier should not be adjusted under normal operating conditions. It should only be change if you are changing channels. For instructions on AGC setup of the amplifiers see Section 6.1.5

7. With the amplifiers fully functional and adjusted to final settings, record keeping becomes very important. Record the current, voltage, power, etc. This data can be used as a very valuable troubleshooting tool later. Below is typical test data pertaining to the Revive amplifiers at 100% output power.

5.4.2 TYPICAL DATA read on the LCD

Combined

COMB	***100%***	***AMP1***	***100%***	***AMP3***	***100%***
RFL	***0.5%***	***AMP2***	***100%***	***AMP4***	***100% (In the case of a MXi2004)***

Amplifier

FWD	***100%***	***RFL***	***1.0%***
AGC	***1.0V***	***CUTB***	***0.0V***

Power Supply

PS VOLTS	***50.0V***	***PS CURR***	***47A***

6 TEST AND TROUBLESHOOTING

6.1 BENCH TEST PROCEDURES

The following procedures are test instructions for the amplifier modules comprising the MXi amplifier.

6.1.1 Front-End Module, *21B2860G7*, Bench Test Procedure

- Connect +32V to TP2. Limit the power supply current 1A. Check that the current consumption is about 0.30A.
- Apply a 0dBm (1mW) RF input to the amplifier.
- Turn RV2 fully clockwise. The Front-End module should have a gain of about 14dB. Adjusting RV2 from one extreme to the other should vary the gain by 25dB. Set RV2 fully clockwise after checking the range (maximum Gain)
- Set phasing adjustment, RV1, fully clockwise (Phasing not required in this model).
- RF Mute Check: Connect a variable power supply to TP1. Gradually increase the voltage until the gain drops by 20dB or more. The applied voltage should be about 7.0 volts in this condition.
- Telemetry (not used on all models): Monitor TP3. Note that the voltage on TP3 decreases to 0.0V when RF output has been muted.

6.1.2 Driver Pallet, *21B2708G3*, Bench Test Procedure

- BIAS SETTING: Connect a 50-Ohm load to the output of the Driver pallet.
  - Before applying +50V to the module, adjust R11 fully counter-clockwise (CCW). Limit the power supply current to 1.0A.
  - Apply +50V to the B+ terminal. Monitor the Drain current and adjust R11 clockwise (CW) for a current of **0.35A ± 0.05A**.
  - Proceed to the next step if a network analyzer or similar equipment is available.
- RF SWEEP: Check that the gain of the Driver pallet, in the frequency range of 470MHz to 806 MHz. is between 20 to 22dB.

6.1.3 PA Pallet 21B2729G1 Bench Test Procedure

- BIAS SETTING: Connect a 50-Ohm load to the output of the PA pallet.
  - Before applying +50V to the module, adjust R11 fully counter-clockwise (CCW). Limit the power supply current to 2.0A.
  - Apply +50V to the B+ terminal. Monitor the Drain current and adjust R11 clockwise (CW) for a current of **1.45A ± 0.05A**.
  - Proceed to the next step if a network analyzer or similar equipment is available
- RF SWEEP: Check that the Gain of the PA pallet, in the frequency range of 470MHz to 806MHz, is between 20 to 22 dB.

6.1.4 Amplifier AGC Setup

- Start With Amplifier OFF
- Remove the AGC jumper, E16, from the control board to disable the AGC

- Turn the Amplifier ON with the drive level from the Modulator and up-converter, or Channel Processor turned all the way down
- Increase the output power to 110%, using the output level control in the Exciter or Channel processor. Enable the AGC by inserting the AGC jumper, E16, on the control board. Use the LOWER button on the LCD to set the power to 100%

6.2 BASIC TROUBLESHOOTING TECHNIQUES

One of the best tools in troubleshooting is knowing what the nominal figures or typical values of the MXi amplifier are when it is at its normal performance. If a fault condition occurs, then you can compare the data taken previously with the present conditions and come up with a reasonable conclusion about what is at fault.

The following describes some fault conditions and possible solutions.

6.2.1 No RF Output

- Check for the presence of a valid input stream to the modulator
- Check for outputs from the Driver
- Check for proper power supply voltage and current
- Check for potential connector problems causing either no drive to a module pallet (input connector) or VSWR (output connector) problems.
- Check the fuses on the driver stages.
- Check to insure each amplifiers interlock is closed.

6.2.2 Output Reduced by 45% (for MXi1503) or 60% (for MXi2004)

If the output is by approximately 45% for an MXi1503 or to 60% for an MXi2004 a possible cause is a total loss of power from one of the amplifiers. Check the power connections to insure the amplifier is receiving the necessary +12VDC and +50VDC supply voltages needed for operation. Next check that input and output cables are fully tightened. Than check the interlock connection to see that it is in fact being shorted by the main controller. A review of the Main Controllers touchscreen will also help trouble shot the problem by reviewing the logs as well as the amplifiers status screen.

7 MAINTENANCE

Equipment which is regularly and carefully maintained is far less likely to be subject to sudden failure than that which is operated without regard to basic maintenance requirements. A detailed preventive maintenance program should be established to ensure that the original efficiency and picture quality is maintained throughout the life of the equipment. Given reasonable care and attention, the transmitter will provide efficient and reliable service for many years.

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 directed at 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 result 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 and 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.

7.1 DAILY

At an attended site, the operator is afforded the opportunity to make 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 can also be continuously checked for performance by studio technical personnel.

7.2 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. High-pressure air, not over 20psi, can be used with discretion to dislodge dust from inaccessible places.

7.3 SEMI-ANNUALLY AND ANNUALLY

Check all external RF connections for tightness, looking specifically for any discoloration, which might indicate a loose inner connector, flange or sleeve coupling. Test the passive RF system 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.

Check the operation of all interlocks including patch panel, dummy load, air and thermal switches and emergency interlocks (if applicable).

7.4 TRANSMITTER COOLING SYSTEM

All cooling fans in the transmitter are fitted with sealed bearings requiring no lubrication during the lifetime of the motor. Access to the fan assembly is via the bottom of the amplifiers.

8 SERVICE

The MXi contains few user-serviceable parts; the modular surface-mount design makes module replacement and/or factory repair the most efficient repair method.

The service most likely to be performed by users is the replacement of the fan array.

8.1 REMOVING THE FAN ARRAY

The MXi fan array consists of four 4" muffin-type fans which are attached to the mounting plate. The mounting plate is secured to the bottom of the MXi chassis with three Phillips head screws.

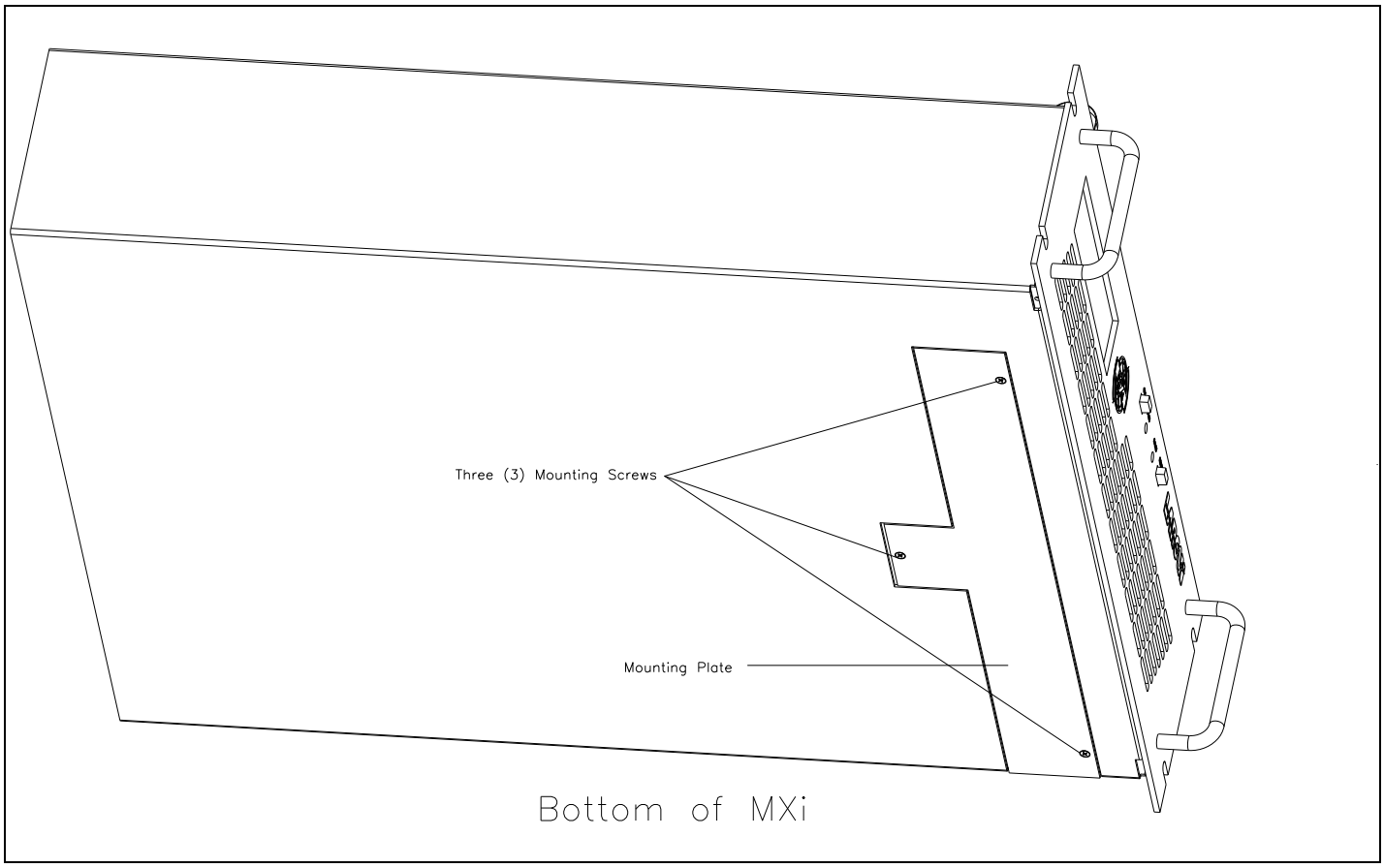

Figure 7 Bottom View of MXi

1. Turn the MXi OFF.
2. Disconnect the AC power from the MXi.
3. Slide the MXi partially out from the mounting rack. **Important**: Ensure that the weight of the MXi is fully supported.
4. With a Phillips screwdriver, remove the three mounting screws on the underside of the MXi. When removing the last screw, be sure to hold the mounting plate in place.
5. Remove the mounting plate. The fan array is attached to the mounting plate and comes out with the plate.

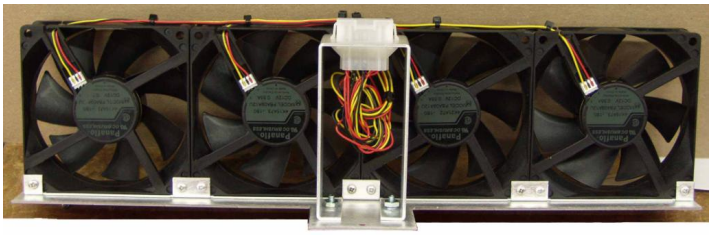

Figure 8 Fan Array

8.2 Replacing the Entire Fan Array

In the event of a fan failure, LARCAN recommends replacing the entire array, as all fans have a similar lifespan.

1. Remove the fan array as described in Section 8.1.
2. Slide the new fan array into the MXi. The power connection is aligned so that it connects when the mounting plate is fully in place.
3. Insert and tighten the three mounting screws. **Note**: Screws only need to be snug; do not over tighten.

8.3 Replacing a Single Fan

1. Remove the fan array as described in Section 8.1.
2. Each of the four fans is attached to the mounting plate via two screw-and-nut assemblies. Remove the screws and nuts and set aside.

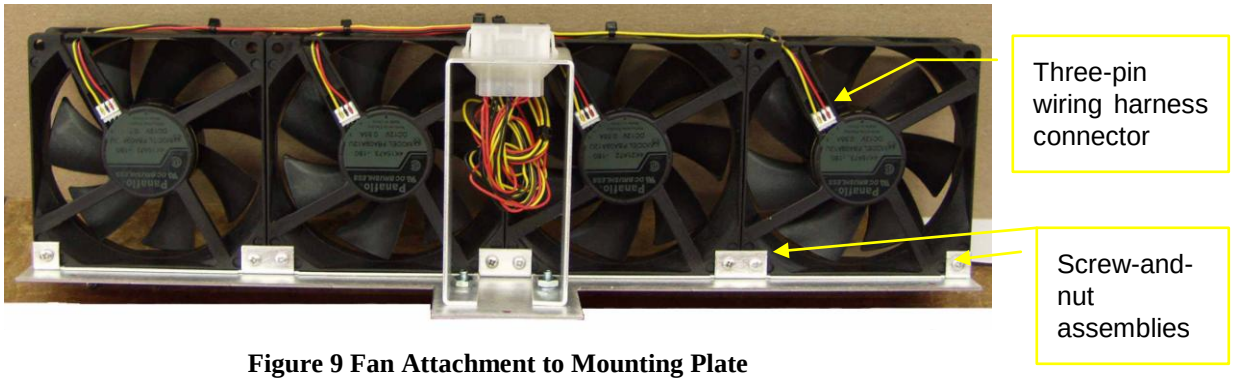

Figure 9 Fan Attachment to Mounting Plate

3. Disconnect the three-pin wiring harness connection by *gently* sliding it back with a fingernail or small plastic tool.
4. If necessary, carefully cut and remove the zip tie holding the wires to the fan frame.
5. Remove the defective fan and replace with a known good fan of *exactly* the same dimensions and specifications.
6. Re-connect the three-pin wiring harness connection.
7. Re-fasten the two screw-and-nut assemblies holding the fan to the mounting plate.
8. If necessary, replace the zip tie holding the wires to the fan frame.
9. Replace fan array into MXi as described in Section 8.1.

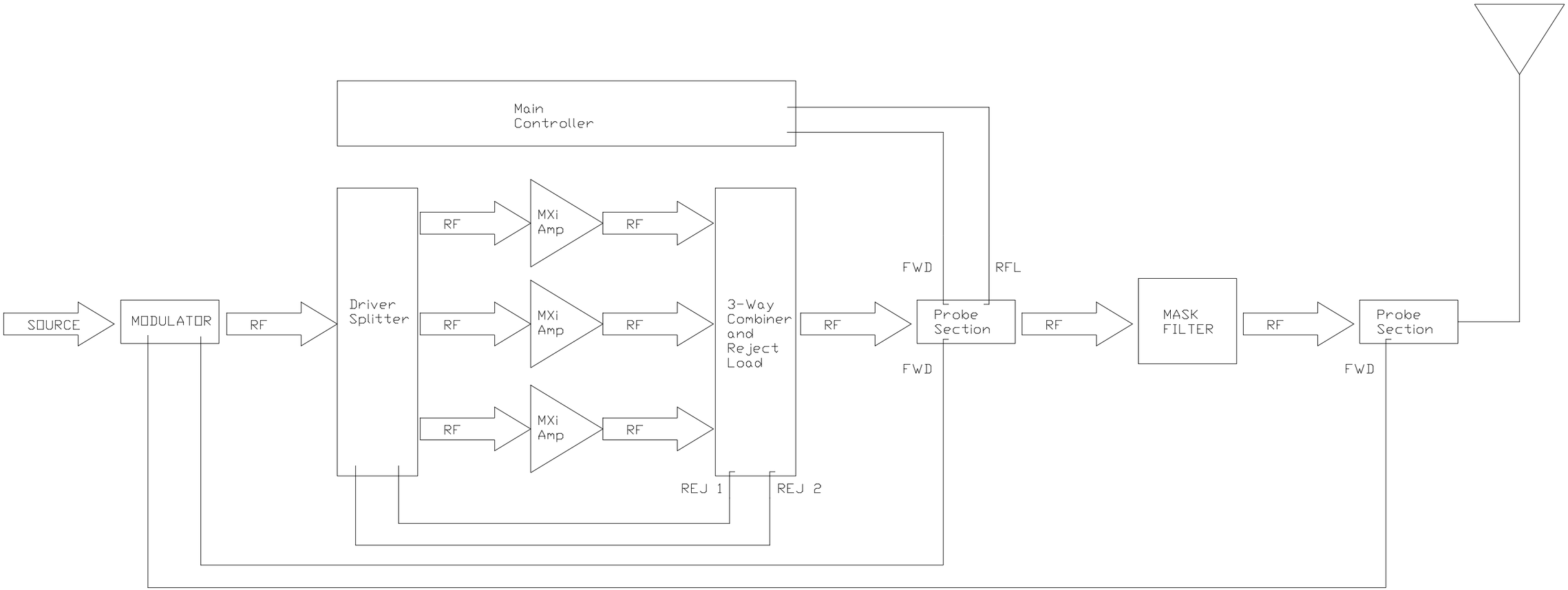

Figure 10 RF Flow for MXi1503

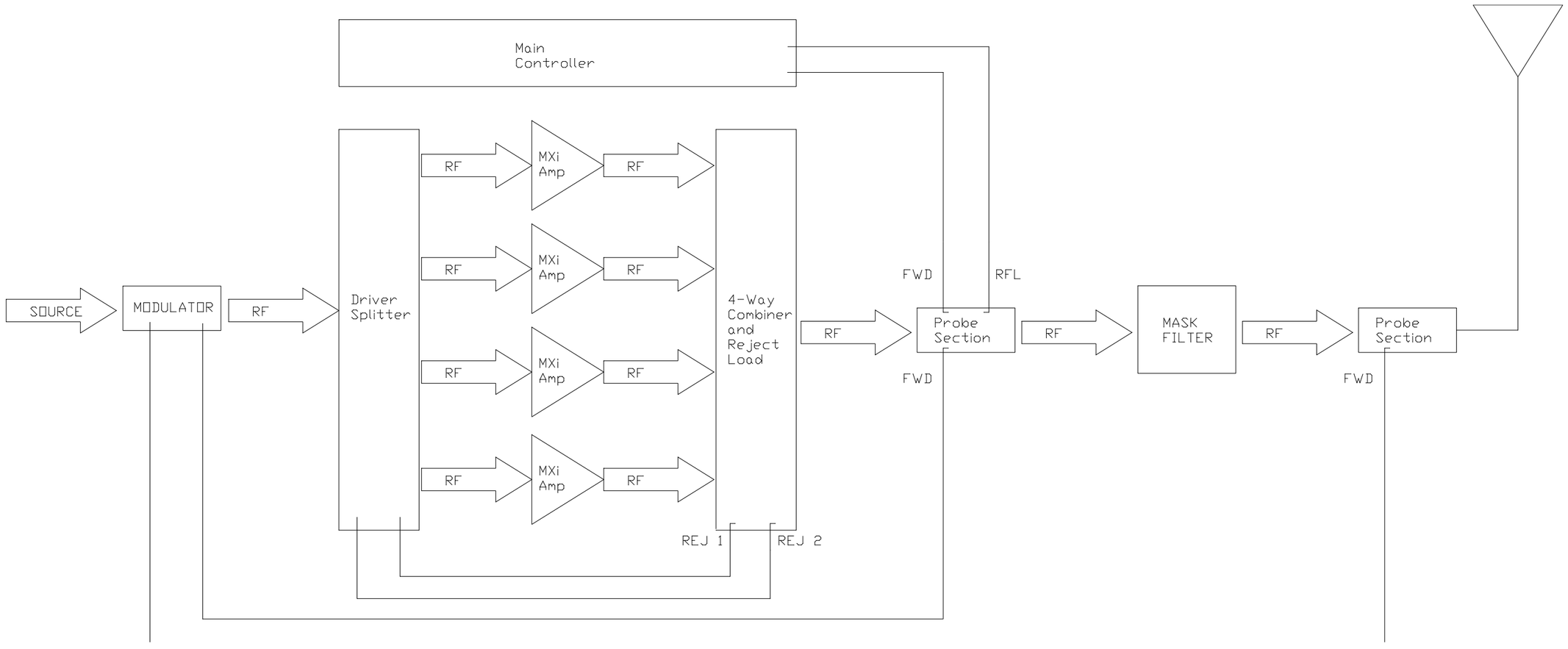

Figure 11 RF Flow for MXi2004

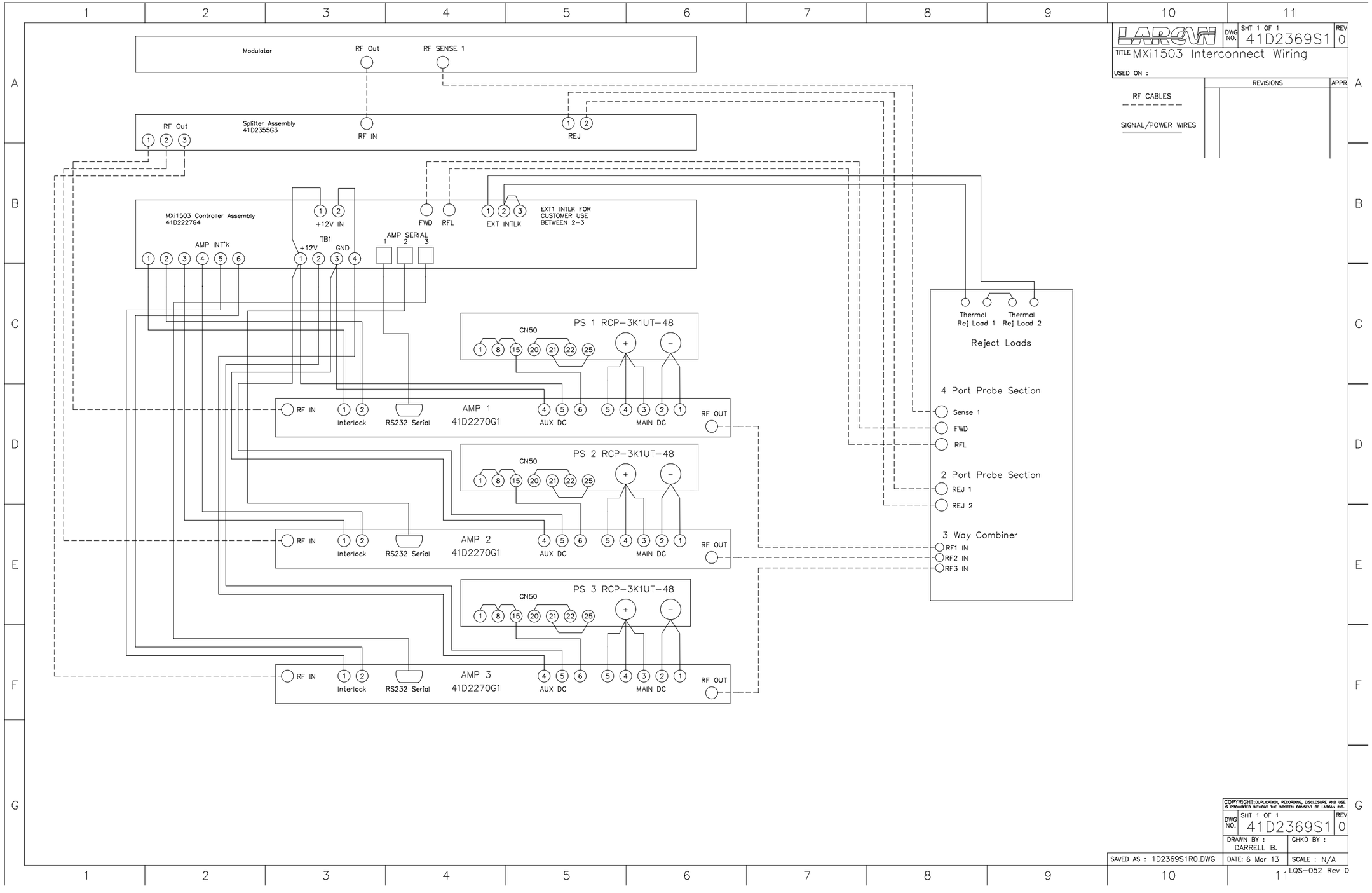

Figure 12 MXi1503 Interconnect Diagram

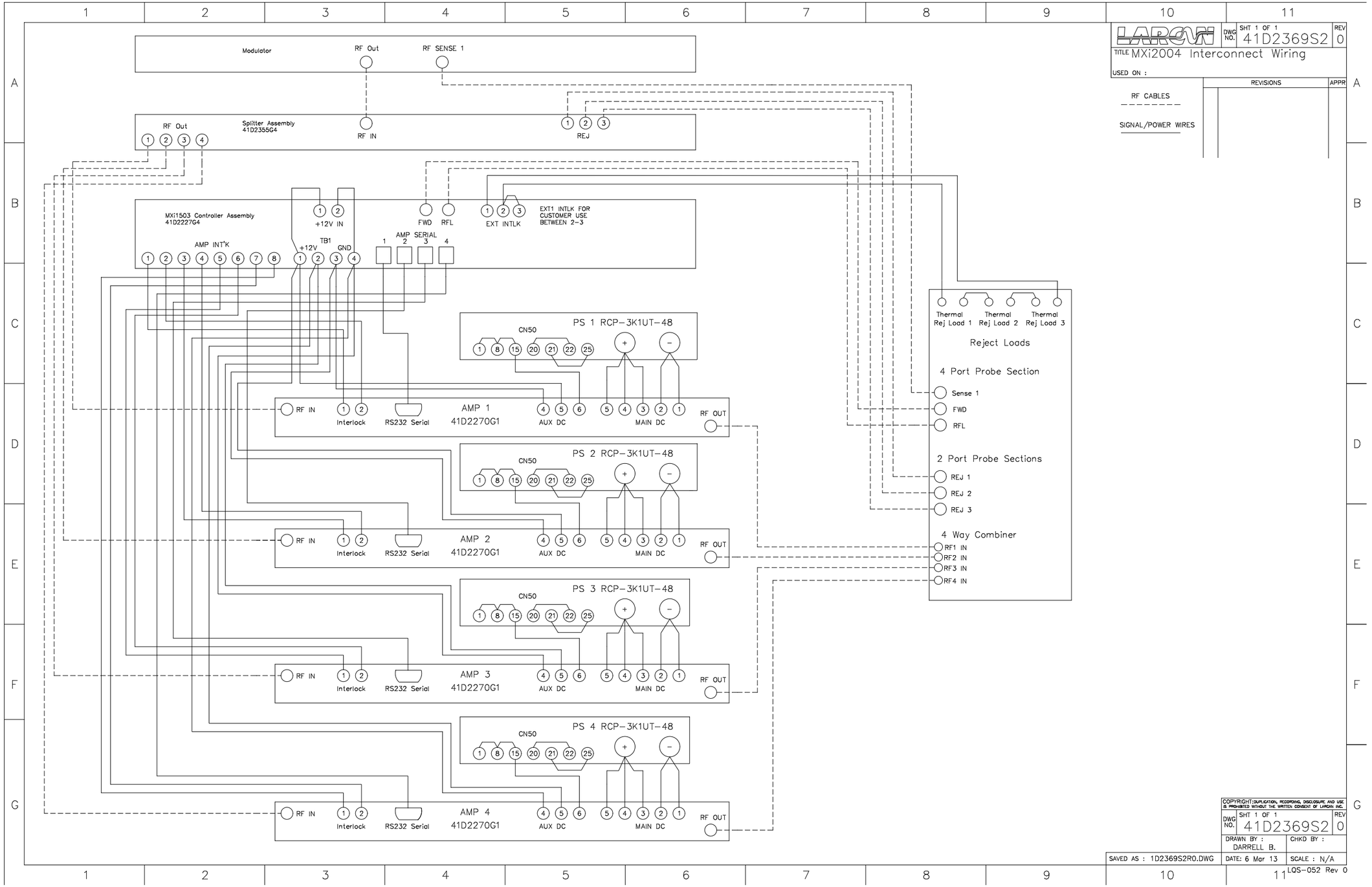

Figure 13 MXi2004 Interconnect Diagram

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