



MXi005U AMPLIFIER TECHNICAL SERVICE MANUAL



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MXi005U OPERATIONS AND MAINTENANCE

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1 MXi005U AMPLIFIER

The RF section of the MXi005U Amplifier consists of a heatsink assembly that includes three cascaded broadband amplifier modules and a directional coupler. Figure 1 shows the layout of this assembly.

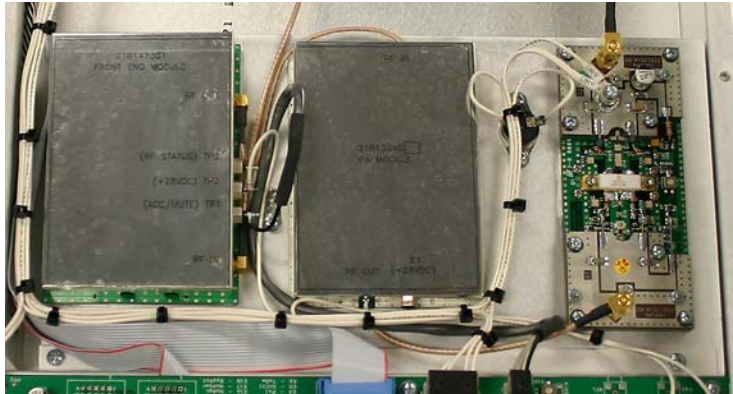


Figure 1 MXi005U Amplifier Heatsink Assembly

Also mounted on the heatsink is a thermal switch that protects the amplifier from over temperature conditions.

2 MXi CONTROLLER

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

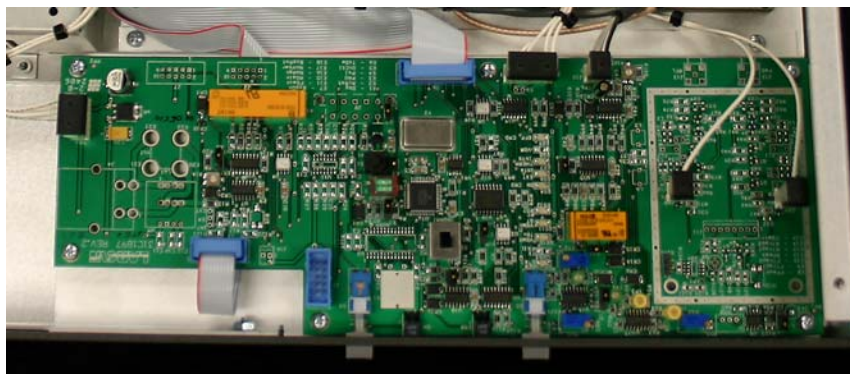


Figure 2 MXi Controller

The MXi control board provides local front panel interface via ON/OFF and RESET buttons. The board implements controls/status/telemetry for remote control 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 the operator to access the MXi through an external computer (with the appropriate software). The MXi control board has RF detectors for forward and reflected power and all the circuitry to support AGC/VSWR/Cutback functions. Circuitry to control and monitor the +28V power supply is also included on this board.



Figure 3 MXi Front Panel

2.1 MXi005U CONTROL BOARD ASSEMBLY AND JUMPER SETTINGS

Figure 9 shows the assembly diagram for the control board (Part No 31C1897A2) that is used in the MXi005U transmitter. There is only a single control board in this transmitter that performs all the control, monitoring, RF detection and communication functions.

There are a number of jumpers on this board that are factory set and should not be altered in the field without consulting Larcan Technical Services first. Changing the jumper settings may result in improper operation of the transmitter.

The factory jumper settings are given here in the case that either a jumper is dislodged during shipping or has been removed for any other reason.

Note: This circuit board is used for a number of transmitter models and a number of components and jumpers are not installed or used for the MXi005U application. We will only detail the jumpers that are used in this application.

E1 BDM Enable

Allows connection of the BDM program cable to the board

Setting = NORM for all MXi005U transmitters

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E2 Not used in the MXi005U transmitter

Setting = no jumper installed

E3 Not used in the MXi005U transmitter

Setting = no jumper installed

E4 Not installed in this assembly

E5 Front Panel ON/OFF button Mode

This jumper determines the function of the Front Panel ON/OFF button

If E5 is in the 'INT' position, Remote ON/OFF Controls are disabled, Local Controls Only

If E5 is in the 'EXT' position, Remote ON/OFF Controls are enabled, Local OFF Control Only

More detail on this function is given in Section XX of this manual

Setting = EXT for all MXi005U transmitters

E6 Transmitter Switching Interlock

This may have either a two pin header or may be permanently jumpered with bus wire

If there is a two pin header, then it requires a shorting jumper

If this is not shorted, then the transmitter will not turn ON.

Setting = Jumper installed

E7 Not used in the MXi005U transmitter

Setting = no jumper installed

E8 Not installed in this assembly

E9 Not installed in this assembly

E10 Not installed in this assembly

E11 Forward Power Sample Gain

Sets either High or Low gain from the DC sample received from the RF coupler

Set to obtain a voltage between 4.5 and 8V at TP2 for full power RF output

Can be either in the HI or LO position depending on channel and RF coupler

Typical Setting = LO for most MXi005U transmitters

E12 Not installed in this assembly

E13 Not installed in this assembly

E14 Not installed in this assembly

E15 Reflected Power Sample Gain

Sets either High or Low gain from the DC sample received from the RF coupler

Set to obtain a voltage between 4.5 and 8.0V at TP4 for 10% reflected power

Can be either in the HI or LO position depending on channel and RF coupler

Typical Setting = HI for most MXi005U transmitters

E16 AGC Disable

This jumper disables the AGC circuitry

DO not install this jumper. It is meant for factory setup

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Setting = not Installed for all MXi005U transmitters

E18 Direct Vswr Relay reset from the Remote Reset Command

This jumper allows the Remote Reset Command to directly clear the VSWR trip relay

Setting = Installed for all MXi005U transmitters

E19 Forward Power Detection Type

Setting = PK for all MXi005U transmitters

2.2 REMOTE CONTROLS AND THE MXi005U FRONT PANEL ON/OFF BUTTON

The Front Panel ON/OFF button on the MXi transmitter can function in two distinct modes which depends on the position of jumper E5 on the 31C1897 control board located inside the MXi transmitter chassis. E5 that can be placed in either of two positions, one labeled 'INT' and the other position EXT.

When the jumper E5 is in position INT, then the transmitter will ignore any ON or OFF remote controls. This remote controls can either come from the serial communication program or from the external remote control connector on the rear of the MXi transmitter chassis. Please note that only the ON and OFF remote controls are disabled and the AGC raise/lower and Vswr reset commands will still be operational. In this mode the transmitter can only be turned ON or OFF via the front panel button. This is mostly for maintenance purposes when the technician is working on the transmitter and doesn't want anyone to remotely turn it ON or OFF.

When jumper E5 is in the EXT position then remote controls are enabled, this is the normal factory setting as shipped. Even when E5 is in the 'EXT' position, the front panel button will still shut the transmitter OFF if it is placed in the OFF position but when the front panel button is pressed in then the remote ON/OFF controls are enabled. The MXi transmitter records the last known requested ON/OFF state from the remote control and will cause the transmitter to enter into that state. If the operator last issued a remote OFF command then the remote state of the transmitter would be OFF and if the operator last issued an ON command then the remote state of the transmitter would be OFF. This is done to insure that when remote control is enabled and an AC power failure occurs, then upon restoration of AC power the transmitter will return to the ON/OFF state is was in prior to the AC power failure. This is necessary since the remote ON/OFF commands are momentary closures and are not present all the time.

2.3 EXTERNAL REMOTE CONTROL CONNECTIONS

External remote controls are intended to interfacing to a third party remote control vendor such as Moseley or Gentner if such systems are installed or available at the transmitter site. These external controls function in parallel with the serial remote commands implemented with the Larcan supplied remote control program.

These remote signals are available on the 15-pin D-connector labeled Telemetry on the rear panel of the MXi005U transmitter. The remote controls can be broken down into four categories, control inputs, status outputs, telemetry outputs and interlock as follows:

2.3.1 Remote Command Inputs

There are only three remote commands available to the operator, these being TX ON, TX OFF and VSWR Reset. In the table of remote signals, all remote commands have an RC_prefix.

All remote controls are active low, opto-isolated inputs configured as shown at left, all of which require a GROUND for assertion and the activator to be able to sink 15mA or more for at least 200ms to accomplish reliable keying. Each of these is current-limited by an individual resistor. A ground reference pin is provided at pin 12 to ease the interface task since all these remote commands are active low and require a short to ground.

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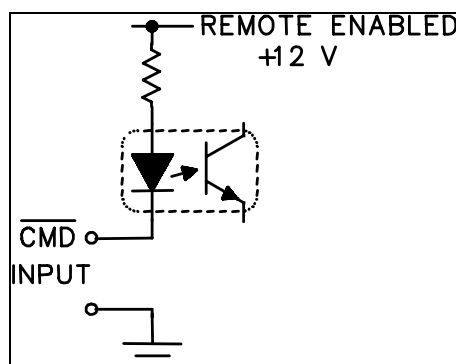


Figure 4 Remote Command Inputs

2.3.2 Remote Telemetry Outputs

There are only four remote telemetries available to the operator, these being RF forward power, RF reflected power, AGC voltage and Cutback voltage. In the table of remote signals, all remote commands have a RT_ prefix.

The only further note on the telemetry outputs concern the AGC and Cutback telemetry levels. These levels are normally sent to the PreAmp attenuator and range from 0V to about 10V. The circuit that generates these telemetries for the remote interface only has a range of 0V to 5V and so the values of these two telemetries are actually half of their true value. That is an AGC telemetry reading of 2.3V actually represents an AGC voltage level to the PreAmp attenuator of 4.6V.

All telemetry outputs of the transmitter are designed to operate between zero and +5V, referenced to ground. Where possible and practical, factory calibration is standardised on 100% normal power or 100% normal voltage as applicable, and adjusted to deliver +4V to the appropriate telemetry output. All come from op-amps that can supply only a few mA. A ground reference pin is provided at pin 12 to ease the interface task since all these remote commands are active low and require a short to ground.

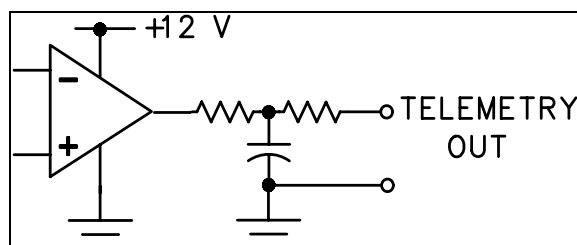


Figure 5 Remote Telemetry Outputs

2.3.3 Remote Status Outputs

There are only two remote statuses available to the operator, these being transmitter ON and an Error status. In the table of remote signals, all remote status have a RS_ prefix.

The transmitter ON status is a relay contact that with one side of the contact connected to ground. When the transmitter is in the ON state, this relay closes providing a path to ground to the RS_TXON signal. Thus when this status sinks current to ground, it indicates that the transmitter is ON.

The transmitter Error status is also an active low current sink to ground, but is implemented with the output transistor of an opto-isolator as shown in the diagram below. When the transistor sinks current to ground, it indicates that there is some fault condition with the transmitter. This fault is an indication to the operator that there is some problem with the transmitter (such as a VSWR trip, Interlock open or Power supply problem) that needs some attention. A ground reference pin is provided at pin 12 to ease the interface task since all these remote commands are active low and require a short to ground.

The Error status is a current sinking open collector output that comes directly from the NPN transistor outputs of the opto-isolator devices. The available output sink current is dependent on the opto-isolator transfer ratio. Generally, one can expect at least 20mA of sinking current for each output listed here. Because these are open collector, they

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can be connected to maximum 30 VDC output. The active (true) condition whether high or low will depend on the specific status output.

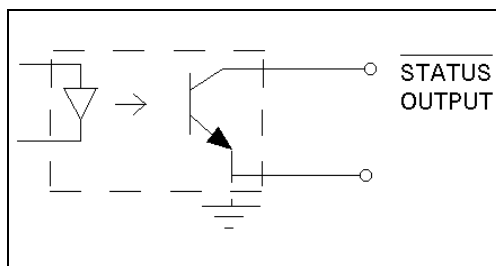


Figure 6 Remote Status Outputs

2.3.4 External1 Interlock

There is a pair of terminals on the D-connector that is used for an external interlock to interface to any site alarms or shutdown conditions. These pins would expect a dry contact that is closed when there is no error condition. This External #1 interlock is in parallel with the two pin terminal block on the rear of the MXi transmitter chassis. The MXi applied its own +12V to one side of this interlock (the Ext1+ line) and will sense this +12V on the other interlock side (the Ext1- line).

REMOTE SIGNAL	PIN#	DESCRIPTION
RC_TXON	1	Control, Transmitter ON
RC_VSWRrst	2	Control, VSWR Reset
RS_TXON	3	Status, Transmitter ON
Spare [Unused]	4	
RT_FwdPwr	5	Telemetry, Forward Power
Spare [Unused]	6	
RT_CutBack	7	Telemetry, Cutback Voltage (1/2 Scale)
Ext1-	8	External Interlock, Normally Open
RC_TXOFF	9	Control, Transmitter OFF
Spare [Unused]	10	
RS_TXErr	11	Status, Transmitter Error
Ground Reference	12	Ground Reference
RT_RflPwr	13	Telemetry, Reflected Power
RT_AGC	14	Telemetry, AGC Voltage (1/2 Scale)
Ext1+	15	External Interlock, (+12V Armed)

2.4 EXTERNAL TRANSMITTER INTERLOCK

The MXi transmitter provides the customer a set of contacts where an external interlock can be applied to control the ON state of the transmitter. The purpose of this interlock is to shut down the transmitter if there is sensed an emergency condition (such as a building fire or smoke alarm) or if there is some RF output switch that is going to be moved and the RF output of the transmitter needs to be shut off temporarily when the switch is in transit. If there is no application for this interlock then the customer must insure that it is shorted out (i.e., closed) so that the transmitter is enabled to be turned ON.

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The external1 interlock contacts are available in two separate locations. The first location is on the two pin terminal block on the rear of the MXi transmitter chassis. This is the more likely and convenient place for the External1 interlock to be connected. A second parallel set of contacts is located on the 15-pin Telemetry D-connector on the rear of the MXi transmitter chassis. Only one set of these contacts need to be closed to enable the transmitter since they are in parallel.

These pins would expect a dry contact that is closed when there is no error condition. This External #1 interlock is in parallel with the two pin terminal block on the rear of the MXi transmitter chassis. The MXi applied its own +12V to one side of this interlock (the Ext1+ line) and will sense this +12V on the other interlock side (the Ext1- line).

3 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 you 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.

3.1 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, 20W 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 for use as an RF sample for monitoring purposes. An RF sample test point is provided below the RF out on the rear panel. Its coupling is approximately 24dB and it is not calibrated for exact measurements.

2. Interlocks

- Interlocks are employed by the amplifier to avoid damage to the equipment and to the output section. For instance an internal interlock for over-temperature exists to shut down the Transmitter if the temperature of the amplifier heatsink exceeds a certain critical level. An Interlock which is external to the transmitter can be used through the INTK terminal block located on the rear panel. This may be used in cases where external transmitter switching is desired. If no system external to the transmitter requires the use of the interlock contact terminals, replace this interlock connection with a jumper across the terminals.



Figure 7 Rear Panel Showing Interlock Terminal Board

3. Power At Minimum

- Initially, the Exciter or Channel Processor’s RF output should be at minimum level. Adjust the OUTPUT LEVEL control for a minimum output. Adjustment of the RF output power is performed through the remote interface.

3.2 APPLYING AC TO THE UNIT

- Check that the AC voltage available to the amplifier ranges from 90-264VAC. If so, proceed to applying the power to the AC INPUT of the amplifier
- Once the AC is applied to the unit, the Control Power Supply turns ON and applies +12V to the MXi Controller. This will be evident by the cooling fan turning on.

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3.3 BEFORE TURNING THE AMPLIFIER ON

Check that all of the following conditions are met:

1. Modulator is Ready.
 - Usually in the application of AC, the Modulator goes through its warm-up sequence. Ensure that it has done so.
2. MXi CONTROLLER is ready.
 - If there were prior faults, clear them by pushing the RESET button.
3. INTERLOCKS are closed or OK.
 - Interlocks and Status are OK.
4. The TX is OFF.
 - Push the Front Panel ON/OFF button so that it is NOT pushed in.
5. The Fan is working.
 - As soon as AC is applied to the amplifier the Fan should startup.

3.4 AMPLIFIER ON SEQUENCE

Upon depressing the ON button, the +28V power supply is enabled, thus applying B+ to the MXi Amplifier. Since the Modulator is on hot standby (RF is always applied), the amplifier normally produces output power immediately.

3.4.1 Turning ON MXi Amplifier

6. Push the front panel ON button. The MXi Amplifier should now be ON.
7. Monitor the +28V power supply voltage and current on the LCD screen. With the user interface program check that the power supply is operating by observing the voltage and power supply status indicator. The voltage reading should be about 28V and the power supply status indicator should be green.

ALLOW THE AMPLIFIER SOME WARM-UP TIME!

Only after the transmitter has been ON for approximately 15 minutes should you perform fine adjustments. The amplifier must be allowed to reach its operating temperature for stable and consistent operation. The Power Amplifier in the MXi transmitter is 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. The amplifier is also equipped with Automatic Gain Control, primarily designed to prevent the transmitter from overpower or overdrive condition.

8. Increase the RF output by slowly adjusting the Modulator output level control. Increase the power to 100%. At this time the proper warm-up period begins.
9. With the amplifier fully functional and adjusted to its final setting, 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 MXi amplifier at 100% output power.

TYPICAL DATA read on the User Interface Program

FWD	100%
RFL	00.1%
AGC	1.0V
CUTB	0.1V
PS VOLTS	28.0V

4 TEST AND TROUBLESHOOTING

4.1 BENCH TEST PROCEDURES

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

4.1.1 Front-End Module Bench Test Procedure

- Connect a +28V (1A current limit) power supply to TP2.
- Apply a 0dBm (1mW) RF input to the amplifier.
- Turn RV2 fully clockwise. The front-end should have a gain of 13dB. Adjusting RV2 from one extreme to the other should vary the gain by a minimum of 20dB. Set RV2 fully clockwise.
- RF Mute Check: Connect a variable supply to TP1. Gradually increase the voltage until the gain drops by 20dB or more. The applied voltage should be approximately 7 volts.
- Telemetry: Monitor TP3. Note voltage decrease to 0V DC when RF output has been muted.

4.1.2 IPA1 Bench Test Procedure

This amplifier must be mounted on a properly sized heatsink for testing.

- Connect a suitable load to the output of the Pre Amplifier.
- On the unit under test, set RV200 fully clockwise and set RV110 fully counter-clockwise.
- Set variable power supply to 28.0V and set its current limit to 1 ampere.
- Apply the +28V to the feed through capacitor of the pre-amp shield box.
- Adjust RV3 to achieve $6.5 \pm 0.2V$ at the junction of R5 and RV100.
- Adjust RV200 to achieve total current draw of $300 \pm 20mA$.
- Check that the junction of R100 and CR100 measures between 3.5 and 5.5 volts.
- Adjust RV110 to raise total current draw to $600 \pm 50mA$.
- Check that the junction of R110 and CR110 measures between 3.5 and 5.5 volts.
- Increase the power supply current limiting to 2.2A.
- Increase RV3 clockwise slowly and check that the maximum current limits itself at 1.6 ± 0.1 Amp but do not allow current to go above 2A while performing this test.
- Reset RV3 to achieve $6.5 \pm 0.2V$ measured at the junction of R5 and RV100.
- Check balance of the two transistors with a voltmeter connected between the hot sides of C105 and C115; the difference in voltage should be less than 3mV.
- Apply RF drive (max. +18dBm from a pre-amp) and adjust C101, C103, C111, and C113 for minimum frequency response ripple and flat response. Gain should be a minimum of 15dB with maximum variation less than 0.5dB over the frequency range 470 MHz through 860 MHz (Note: output will then be about +33dBm or 2 Watts for an input of +18dBm, so make sure you properly protect your test equipment).
- If roll off at the higher frequencies prevents meeting this gain-bandwidth specification, it may be necessary to replace either C103 or C113 or both with a higher value; use variable capacitor made by Johanson, part # 16E2320-2, which is 2.5 to 10pF.

4.1.3 Pallet 21B1751 Bench Test Procedure

- **BIAS SETTING:** Connect a 50-Ohm load to the output of the pallet.
 - Before applying +28V to the module, adjust R12 fully clockwise. Limit the power supply current to 3.0A.

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- Apply +28V to the B+ terminal. Monitor the current and adjust R12 counter clockwise (CCW) for a total current of about **0.6A ± 0.05A**.
- Proceed to the next step if a network analyzer or similar equipment is available.
- RF SWEEP: Adjust C7 for best frequency response. With the bias set at 0.6A, the gain in the range of 470MHz to 860 MHz should be 15 to 16dB.

4.2 BASIC TROUBLESHOOTING TECHNIQUES

As mentioned earlier, one of the best tools in troubleshooting is knowing what the nominal figures or typical values of the MXi amplifier 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.

4.2.1 Amplifier Completely OFF

The MXi amplifier is equipped with a fused AC line filter. Although it rarely happens, abnormal conditions such as power surges may cause the fuse to blow. Blown AC fuses will completely shutdown the amplifier. In this case, replacing the fuse will rectify the problem.

4.2.2 No RF Output

- Check for proper power supply voltage.
- Check for potential connector problems causing either no drive to a module pallet (input connector) or VSWR (output connector) problems.

4.2.3 Output Reduced to 25%

If the output is approximately 25%, a possible cause is a failure of one of the devices in the IPA. This stage has dual devices so that if one fails the output of that stage will be reduced to quarter power (25%). A measurement of the current drawn by the amplifier will determine if this condition exists. The IPA usually draws 0.6A. If the current is 0.3A, then this is the case.

5 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.

5.1 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.

5.2 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. Air filter media should be inspected and replaced if necessary. High-pressure air, not over 20psi, can be used with discretion to dislodge dust from inaccessible places.

5.3 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).

5.4 TRANSMITTER COOLING SYSTEM

The air filter supplied with the transmitter is a pleated filter with a medium ASHREA efficiency rating. These filters have special polyester coatings, designed to attract and hold very fine particles that may be in the airflow. This filter should be inspected every month or more often, and replaced when dirty. Frequency of inspection and replacement depends on the particular local environmental conditions.

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

6 TEST EQUIPMENT SETUP

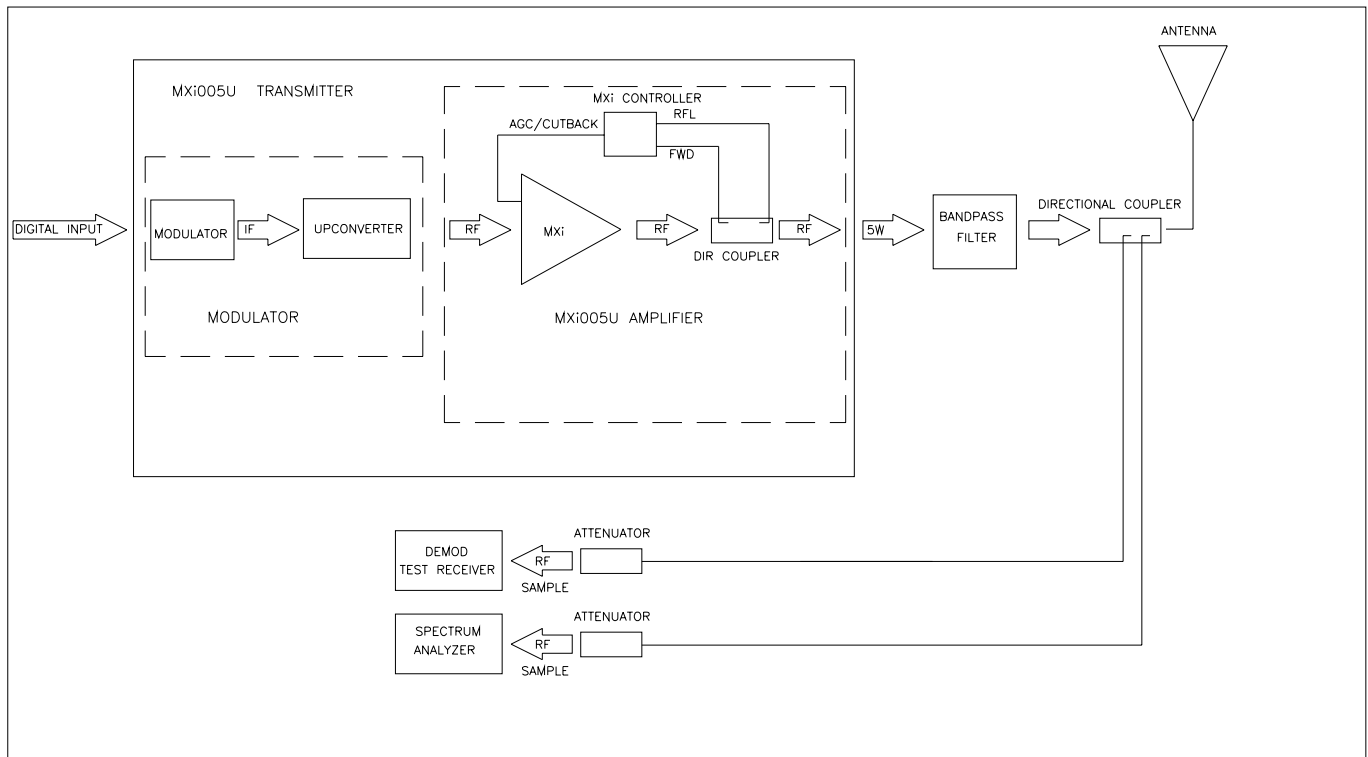


Figure 8 Test Equipment Setup

7 SPECIFICATIONS

Specifications are subject to change without notice.

7.1 ELECTRICAL

AC Line Input90 to 264VAC, 50 to 60Hz

Power Consumption, black picture + 10% aural 120VA (typical)

7.2 ENVIRONMENTAL

Ambient Temperature0°C to +45°C (0°F to 113°F)

Humidity 95%

Altitude3500m

7.3 COOLING

1 muffin fan pulls air through the front panel and heatsink, and out through the rear panel.

7.4 DIMENSIONS

The Amplifier and Modulator chassis are standard 19" rack wide units.

Height

Amplifier.....3.5" (2RU)

Modulator.....1.75" (1RU)

Total Height5.25" (3RU)

7.5 SHIPPING WEIGHT

WeightApproximately 6.5kg (14lbs)

MXi005U OPERATIONS AND MAINTENANCE

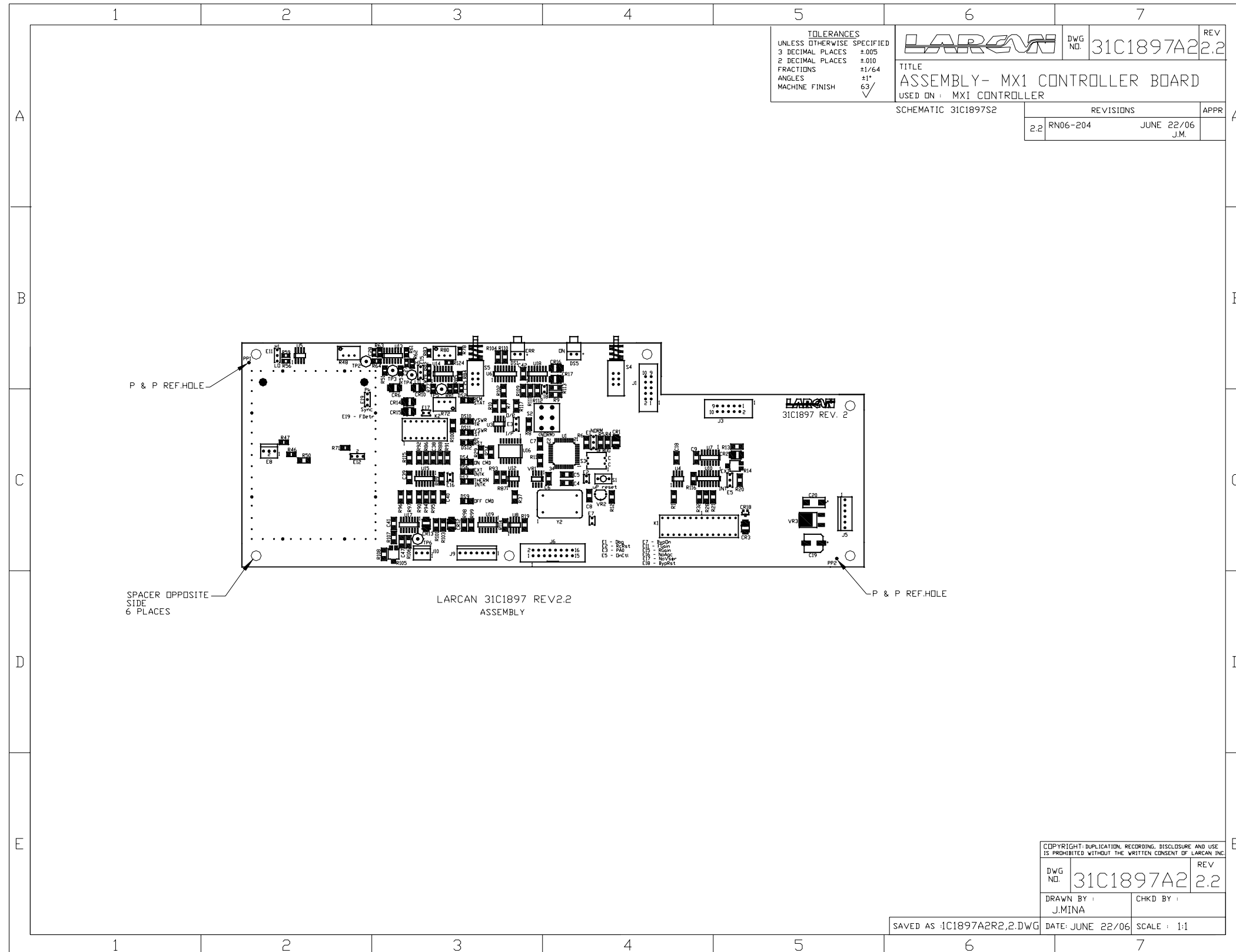


Figure 9 MXi005U Controller Board Assembly

