# Repeater Tests

## Overview

This chapter describes how to test the RF-11000E repeater, to set levels and to verify that it is operating properly.

## Test Equipment Required

Table 10, in Chapter 2, lists test equipment and tools required for testing the RF-11000E repeater. Equivalent equipment may be substituted.

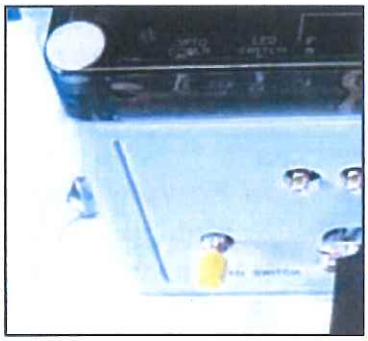
## Applying Power to the Repeater

1. Confirm the repeater is connected to the antenna feedlines, is grounded and that the power system has been installed and tested. Confirm that all fuses are removed, amplifiers are unplugged, and RMAS-120 is switched off.
2. Apply primary DC power to Battery A and B terminal blocks TB1 and TB2 on the repeater main panel.
3. Measure the DC voltage at TB1 and TB2.

   Make sure that the voltage is within the operating parameters of the repeater:

   - +24 Volts DC: +19 ~ +30 VDC. Nominal lead acid battery voltage is +25.2 VDC when fully charged and +27.0 VDC when being charged. Correct as necessary
4. If the RMAS-120 alarm equipment is provisioned and installed, switch ON the alarm transmitter. Press the yellow LED switch on the lower left to observe all LEDs illuminate and then report current alarm conditions. To make testing easier, set the LED Switch jumper to DIS. This will allow the LEDs to report without pressing the LED switch.

   - When finished testing, the LED Switch jumper is returned to the ENB position to conserve power by only displaying alarm LEDs when the button is pressed.



5. If the DC power is correct, all the LEDs will light briefly, then these alarm conditions should be present:

| Alarm | Condition |
|---|---|
| Battery A Low | **Clear** |
| Battery B Low | **Clear** |
| Door | Alarm when door is open |
| W/G | Either |
| PWR F1 ~ F8 | Clear (amplifiers unplugged) |
| AMP 1 ~ 8 | Clear (amplifiers unplugged) |
| UNCOM SUM (UC1 ~ 7) | Either, clear if not used |

6. Insert all fuses. Plug in all amplifier power plugs. Alarm conditions may change.

| Alarm | Condition |
|---|---|
| Battery A Low | **Clear** |
| Battery B Low | **Clear** |
| Door | Alarm when door is open |
| W/G | Either |
| PWR F1 | Either |
| PWR F2 | Either |
| PWR F3 | Either if equipped, otherwise Clear |
| PWR F4 | Either if equipped, otherwise Clear |
| PWR F5 ~ F8 | Clear |
| AMP 1 ~ 8 | Clear. Any AMP alarm is a concern and potential amplifier failure. |
| UNCOM SUM (UC1 ~ 7) | Either, Clear if not used. |

7. Once the Battery A and B alarms clear or TB1 and TB2 are between +19 and +30 VDC and when measured voltage at TB3 shows +8.5 ~ +9 VDC, then the repeater is powered and ready for testing.
8. Current Test: Measure the Battery A and B current flowing into TB1 and TB2. Repeaters with equal numbers of amplifiers will have the two battery inputs close to equal and approximately half of the total current listed in Table 1. If either battery input has a low or zero current, check the battery source and distribution system. Record currents for reference.
9. The repeater can operate on a single A or B battery input when needed. Each amplifier can draw power from both DC/DC converters and thus either battery input. When one battery source is removed or failed, all the current per Table 1 will flow into the remaining working battery feed.

## *Transmit Power Adjustment*

At this point, the antennas should be mounted, feeders swept, antennas aligned and isolation confirmed. The repeater's power amplifiers have been factory set to the specified output power levels per the system modulation, when known. Fine adjustments are recommended for best performance. Greater than recommended power levels can result in amplitude distortion, radio, and line errors (BER). Less than recommended power levels may have been selected by transmission engineering (e.g. short hops). Refer to system path calculations and path data sheets for details.

### To measure and adjust output power:

1. Calibrate the RF Power Meter for 11 GHz operating frequencies.
2. The far end transmitter operating on repeater frequency F1 must be transmitting at this time.
3. Connect the power meter to the RF MON test port on the side of Amplifier A1 (F1 PA). This is an SMA-female connector. A right-angle adapter with a between series (e.g. SMA to N) adapter (if needed) to fit the power meter sensor are needed to access the test port.
4. Measure and record the power meter reading. Typically, this reading will be between -15 and +15 dBm at RF MON.
5. Add the Cal Loss marked near the RF MON (see Figure 35) to the power meter reading, the result is the Power Amplifier Output Power.

6. Compare the Power Amplifier Output Power reading to Table 4, using the listing for the radio modulation type used.
7. Adjust the AGC/ALC potentiometer as required to set the power amplifier output level equal to the listing in Table 4.
   - Note: Lower levels may have been selected by transmission engineering, please refer to system path calculations and path data sheets for details.
8. Once the power levels have been set, confirm the RMAS Alarm Transmitter PWR alarm is clear for each frequency equipped. If the PWR alarm remains active and the transmit power is correct, then the RMAS Alarm Transmitter alarm point must be adjusted. Please refer to the alarm equipment documentation for adjustment details. The alarm point is normally 5 dB below normal operating power level.

| Alarm | Condition | Alarm Point |
|---|---|---|
| Battery A Low | Clear | < 23 VDC |
| Battery B Low | Clear | < 23 VDC |
| Door | Alarm | Door Open |
| W/G | Either | Pressurization Low, < 1 PSI |
| PWR F1 | Clear | 5 dB below normal operating power |
| PWR F2 | Clear | " " |
| PWR F3 | Clear | " " |
| PWR F4 | Clear | " " |
| PWR F5 ~ F8 | Clear | " " not available for RF-11000 |
| AMP 1 ~ 8 | Clear | Current out of range, high or low |
| UNCOM SUM (UC1 ~ 7) | Either, Clear if not used. | Closure on UC# position |

9. To determine the Antenna Port Output Power Level, subtract the TX Branch Loss from the Power Amplifier Output Level. The TX Branch Loss is marked on the repeater panel near the PA. Include any transmit attenuator pad loss if equipped.

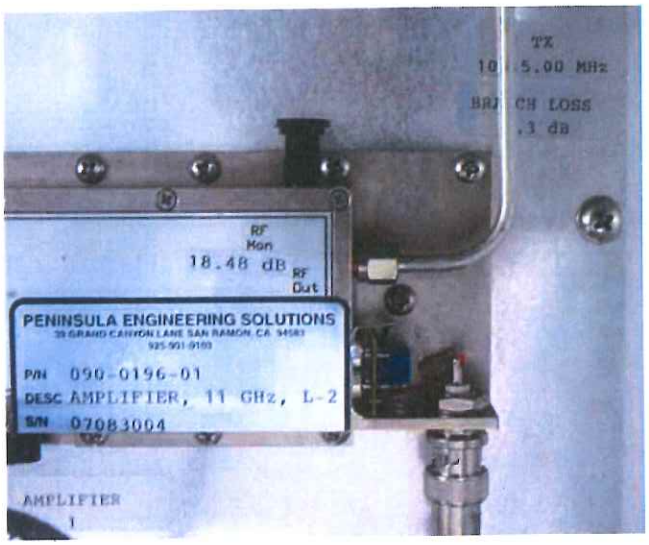



*Figure 35 Power Amplifier RF MON and TX Branch Loss*

## Receive and Transmit Attenuator Pads

Receive, RX, pads attenuate input signals that are greater than can be compensated by the repeater amplifier's AGC/ALC circuits. Receive pads are installed on the amplifier input (RF IN) jack.

Transmit, TX, pads attenuate output signals. Transmit signals can also be reduced by adjusting the AGC/ALC potentiometer. In cases of very short hops, more power reduction may be needed. In these cases a TX Pad is normally installed. Transmit pads are installed on the amplifier output (RF OUT) jack.

### Pad Installation:

1. If required in the field, the RX/TX attenuator pads should be installed at the RF input or output of the amplifiers.
2. To install the pad, turn OFF the DC power supply first.
3. Disconnect the input or output semi-rigid coax cable from the amplifier.
4. Connect the SMA male end of the pad to the amplifier's SMA female input or output; and then connect input or output cable to the female end of the pad.
5. Check all coaxial connections for tightness (8 in-lbs).
6. Turn ON the DC power supply.
7. Set output power level by adjusting AGC/ALC.

## Radio Link Tests

Once the repeater levels have been set and confirmed and antenna alignment is accepted, then, confirm microwave signals are received at each terminal radio. Observe and record the receiver AGC or RSL indications for reference.

End to end link tests can now be run. These tests may typically include un-faded BER, radio errors, system thermal and intermodulation noise. Refer to the radio terminal equipment documentation and system engineering requirements for the link test plan.

## Completion

When setup and tests are complete, set the RMAS Transmit Alarm LED SWITCH jumper to the ENB position to conserve power by only displaying alarm LEDs when the yellow test button is pressed.

Refer to the RMAS-120 manual for alarm system tests.

*Table 4 Transmit Power Backoff[10] per Modulation Type*

| Modulation Type[11] | Backoff | Level 2 PA Output |
|---|---|---|
| BPSK | 1.0 | 31.0 |
| QPSK, OQPSK, 4PSK, 4QAM | 2.0 | 30.0 |
| 8PSK | 4.0 | 28.0 |
| 16QAM | 6.0 | 26.0 |
| 32QAM | 8.0 | 24.0 |
| 64QAM | 10.0 | 22.0 |
| 128QAM | 12.0 | 20.0 |
| 256QAM | 13.0 | 19.0 |
| 512QAM | 14.0 | 18.0 |
| 1024QAM | 15.0 | 17.0 |
| 32TCM | 9.0 | 23.0 |
| 64TCM | 10.0 | 22.0 |
| 128TCM | 12.0 | 20.0 |
| 256TCM | 14.0 | 18.0 |
| OFDM QPSK | 11.0 | 21.0 |
| OFDM 16QAM | 15.0 | 17.0 |
| OFDM 64QAM | 19.0 | 13.0 |
| COFDM QPSK | 6.0 | 26.0 |
| COFDM 16QAM | 9.0 | 23.0 |
| COFDM 64QAM | 13.0 | 19.0 |
| 9QPRS/QPR3 | 5.0 | 27.0 |
| 25QPRS/QPR5 | 5.5 | 26.5 |
| 49QPRS/QPR7 | 6.0 | 26.0 |
| 81QPRS/QPR9 | 7.0 | 25.0 |
| 225QPRS/QPR15 | 9.0 | 23.0 |

*Note: Peninsula Engineering Solutions may change performance specifications where necessary to meet industry requirements.*

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[10] Transmit power set point is reduced as the modulation becomes more complex. This power "backoff" provides adequate linearity as required by the system performance objectives. The ALC adjustment on each amplifier is used to set the output power level. To calculate the repeater's output power at the antenna port flange, take the amplifier power output without backoff, reduce that level by the backoff listed in this table, then subtract the transmit branch loss for the specific configuration from Tables 2 or 3.

For Example: Level 2 Amplifier Power Output = +32 dBm without backoff reduction, Modulation is 256QAM, therefore backoff = 13.0 dB, RF-11000E-041 Tx Branch Loss = 2.8 dB,. Output power at antenna port flange = +32.0 – 13.0 – 2.8 = +16.2 dBm.

[11] Modulations listed are the most popular types. List is not exclusive. If a modulation is not listed, contact the company for specific details.