RMAS-120 Trouble Shooting Guide

Introduction

The RMAS-120 Repeater Monitor and Alarm System provides supervision of microwave RF repeaters. Alarm and status information is encoded into a serial data stream that is then amplitude modulated on the microwave carriers being amplified by the RF repeater. In some cases, this serial data stream (telemetry) is carried by an auxiliary UHF radio link.

The telemetry signal and RMAS-120 are designed to be compatible with a wide range of microwave radio terminal equipment.

With the wide range in equipment and circumstances of the applications, there are times when the data recovery may be difficult to setup. This trouble-shooting guide is intended to assist in diagnosing and resolving many common problems.

The telemetry data is sent at a very slow rate in order to be compatible with most radio Automatic Gain Control, AGC circuits. The data timing fits within the frequency range of natural fast fading (100 dB/second or 1dB/10 msec).

Common Problems

1. Receiver does not synchronize

1.1. The most common reasons the receiver will not synchronize are:

- No or Weak Signal
- Interference
- Inverted Data
- Incompatible AGC

2. Basic Checks

2.1. Check RMAS-120 Transmitter for the following:

2.1.1. DC Power is applied and main switch is ON.

2.1.2. Modulation switches are set for the intended direction of transmission. Note: 2-switches per modulated frequency.

2.1.3. Microwave carriers are present and setup properly.

2.2. Check RMAS-120 Receiver for the following:

2.2.1. Receiver shelf is grounded to the equipment rack. Use power connector ground. The chassis ground is not enough. The chassis is isolated from the circuit board ground. Proper grounding is very important.

2.2.2. DC Power is applied and main switch is ON.

2.2.3. AGC + and AGC – wiring is using shielded twisted pair from the RMAS receiver to the microwave radio AGC or RSL voltage points. The shield must be grounded at the RMAS receiver end, minimum. Grounding the shield to the rack is normal. Refer to figure 3.2 in the manual.

2.3. Check the polarity of the AGC + and AGC – inputs. Try reversing the polarity. The data is polarity sensitive, one direction will synchronize and the other will not.

3. Signal Measurements

3.1. Signal measurements are important to determine if all equipment and connections are in working order. Refer to the table of reference waveforms.

3.2. Start at the RMAS-120 receiver unit. Measure the waveform at the RCVR DATA test point on the front panel. Waveform #7 should be found. Waveform #8 shows the RX input signal and RCVR DATA signals. A quick test can be made with a DVM set to AC. Signal presence normally measures 2.3 ~ 3.0 VAC. This quick test does not distinguish between signal and AC Line noise.

3.2.1. To confirm the measured signal actually comes from the RMAS transmitter, have another person go to the RF repeater site and turn off the RMAS-120 transmitter power switch. If the signal goes away when the transmitter is OFF and comes back when the transmitter is ON, then the alarm telemetry data is really getting to the receiver.

3.2.2. If the signal is present, look at the signal on the oscilloscope. Look for signs of interfering signals such as AC power line hum and noise. Power line frequencies, 50 Hz, 60 Hz, are close to the frequency range of the telemetry data and will often cause synchronization problems. Grounding and shielding are the best ways to reduce AC interference. Waveform #9 shows strong 60Hz AC interference.

3.3. RF. The next place to measure the telemetry signal is at the RF repeater's output. The complete test requires a spectrum analyzer that covers the radio carrier frequencies. A quick test can be made using an RF power meter.

3.3.1. Quick test. Connect the RF power meter to the RF MON SMA test port on the amplifier being modulated by the alarm telemetry signal. This is the same point used to set the RF output level.

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3.3.2. If the alarm telemetry signal is modulating the carrier, the power meter needle or digital display will wiggle or show a few tenths of dB change.

3.3.3. Turn OFF the RMAS-120 transmitter and then ON again to see the change in pattern. If no change is seen, check modulation switch settings and wiring harness connections.

3.3.4. Complete test. Connect the spectrum analyzer to the RF MON SMA test port on the amplifier being modulated by the alarm telemetry signal. Tune the analyzer to the microwave carrier frequency.

3.3.5. When the carrier frequency is found, reduce the frequency span to 0 (Zero) Span. This puts the spectrum analyzer into time-base mode much like an oscilloscope. Set the time-base to 10 msec/div if possible. Waveform #6 should be displayed. Again, turn the RMAS-120 transmitter OFF, then ON to see the difference. If no change is seen, check modulation switch settings and wiring harness connections.

3.3.6. Make sure the correct microwave carrier frequency is being modulated. If in doubt, switch ON all frequencies equipped.

3.3.6.1. Note: in the case of tandem RF repeaters, turning ON all frequencies can cause telemetry interference with other RF repeaters if two or more data streams are modulated on the same carrier frequency.

3.4. Modulation. If the microwave carrier is not modulated when it should be, check the telemetry signal at the amplifier's power connector or feed-thru connections. Waveforms #3, 4 or 5 should be observed.

3.4.1. Amplifier power connector pins.

Pin	Signal/Feed-Thru	Color
8	DIFF +	VIO
7	DIFF -	BRN

3.4.2. If the correct telemetry signal is present at the amplifier power connector and RF carrier modulation is not present, the amplifier must be replaced.

3.5. RMAS-120 Transmitter. If the correct telemetry signal is not observed at the amplifier connector per 2.4, then measure the output of the RMAS-120 transmitter unit.

3.5.1. Two locations can be used to confirm the RMAS-120 transmitter alarm telemetry signal. J3, the User Output connector on the lower side of the RMAS-120 transmitter unit and TP1 and TP2 internal to the unit.

J3 is easily accessible but requires a thin probe or wire to fit the DB37-pin female connector.

J3-25, DIFF +
J3-26, DIFF -
J3-37, GND

TP1 and TP2 are located on the PCB under the black cover panel. The black cover panel is removed by un-snapping it from 4 posts. Look for TP1 and TP2 in the upper right corner above the A and B Battery long test points, T19, T20.

TP2, DIFF +
TP1, DIFF -
T1, GND

Waveforms #3, 4 and 5 should be observed.

3.5.1.1. Note: These points have a DC bias between +2.5 ~ +4.0V. The RMAS-120 transmitter output is DC coupled to the amplifier modulation inputs.

3.5.2. If the alarm telemetry signal is present but not at the correct level, it is permissible to adjust pot R58 for the correct level. Note the setting before making an adjustment in case something goes wrong!

4. Fading

4.1. Fading of the microwave path can cause interruption in the detection of the alarm telemetry signal. Because the alarm telemetry signal occupies the same frequencies as natural fast fading, when deep fades or rapid fades occur, the receive can loose frame synchronization. When fading subsides, the receiver re-acquires frame sync and alarm telemetry is received again.

4.1.1. Some microwave paths experience nearly constant fading. These paths may be near coastal or ocean areas where a strong maritime layer is often present. In these cases, contact Peninsula Engineering Solutions for alternate alarm transmission equipment (UHF Radio Link).

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5. Interference

5.1. Interference from AC Power Lines, hum and noise, can be severe causing total loss of frame synchronization or partial causing data errors. Section 2.2 covers the severe case.

5.1.1. When the interference is partial, it is possible to have frame sync (SYNC LOSS LED is clear) and not correctly receive alarms and telemetry. The RMAS-120 receiver incorporates a data redundancy check where each alarm must have the same data bit for three frames before a change of state is recognized. Partial interference can prevent three (3) good data bits from being received thus preventing a change of alarm state. Normally improvements to the grounding and wiring between the RMAS-120 receiver and the radio receivers will correct this problem.

6. Incompatible AGC

6.1. Radios with incompatible AGC normally are in these categories:

- AGC time constant is too slow
  - < 100dB/Sec
- AGC sensitivity (V/dB) is too low
  - < 20mV/dB
- AGC bandwidth is too low
  - < 100 Hz
- AGC voltage is not accessible

6.2. Since radios are designed differently, the concepts used are not within the control of Peninsula Engineering Solutions. Radios that have a digitized AGC or derive the RSL monitor from a digitized AGC typically are in one or more of these categories.

6.3. Alternative alarm transmission equipment has been designed by Peninsula for these cases. The alternate method uses a separate radio channel, typically UHF, to transport the alarm telemetry data. This method is completely independent from the main microwave radio equipment.

7. Telemetry Inoperative, Receiver Unit

7.1. If the telemetry outputs of the RMAS-120 receiver are not reading correctly, where Battery A shows nearly 0 volts and Battery B shows a steady 4 volts ±, there may be a physical problem in the receiver unit.

7.2. Turn off the receiver, and remove the wires connecting to all the connectors on the rear panel. Remove the faceplate by unscrewing the 2 thumbscrews.

7.3. Observe the small D/A “daughter board” mounted behind the Battery Voltage test jacks. It should be oriented with the notch facing forward and around the plastic spacer.

7.4. If this daughter board is reversed (notch to the back and overhanging the MCU) then it will not function correctly.

7.5. If the board is reversed, slide out the receiver PCB and then pull out the D/A daughter board from its socket. Orient the board so the notch is forward and re-insert into the socket. See the picture in Figure 1 below.

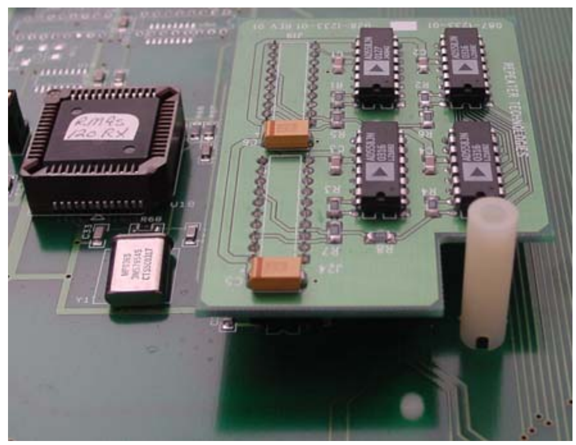

Figure 1 D/A Daughter Board, correctly installed

7.6. We have found that reversing the D/A board normally does not damage it. Expectations are that once correctly installed, the telemetry outputs will function correctly. Should this not be the case, and the receiver does not function correctly after correctly installing the D/A board, contact Peninsula Engineering Solutions for RMA support.

7.7. Slide the main receiver PCB inside the shelf housing, attach the front panel and reconnect the wires and connections to the rear panel connectors.

7.8. Apply power, turn on the receiver and check out the telemetry outputs by measuring the voltages at the front panel test jacks.

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8. Temperature Sensor

8.1. The battery temperature sensor or transducer is used to measure the site storage battery temperature to better estimate its state of charge. The temperature sensor must be located near or in contact with the site batteries. Typically, the sensor is wedged between two batteries or supported with a piece of foam insulation.

8.2. If the temperature reading disagrees with the actual temperature (use a thermometer, don't guess!) or if the sensor has been replaced, it may be necessary to re-calibrate the sensor.

8.2.1. Adjust pot R73 to calibrate the sensor. Measure the voltage at T18. Use the following table as a guide.

Temperature, °C/°F	T18 Voltage
30C / 86F	3.50
29C / 84F	3.45
28C / 82F	3.40
27C / 81F	3.35
26C / 79F	3.30
25C / 77F	3.25
24C / 75F	3.20
23C / 73F	3.15
22C / 72F	3.10
21C / 70F	3.05
20C / 68F	3.00
19C / 66F	2.95
18C / 64F	2.90
17C / 63F	2.85
16C / 61F	2.80
15C / 59F	2.75
10C / 50F	2.50

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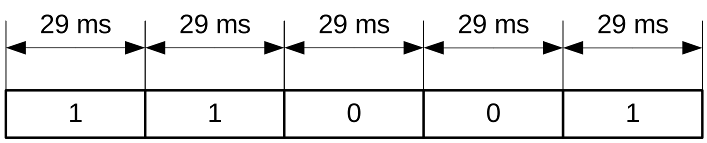
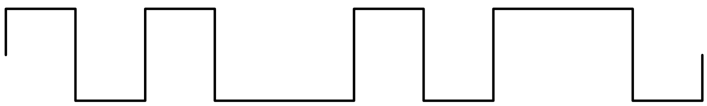
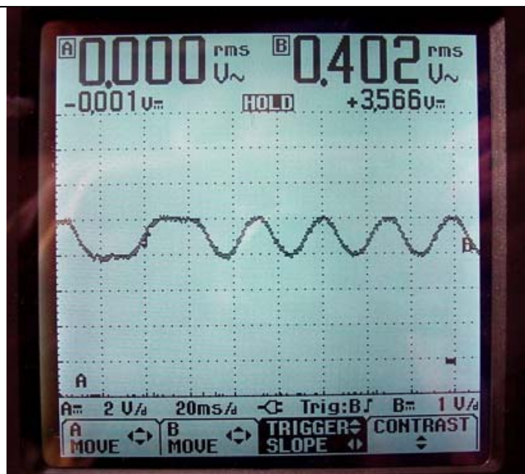
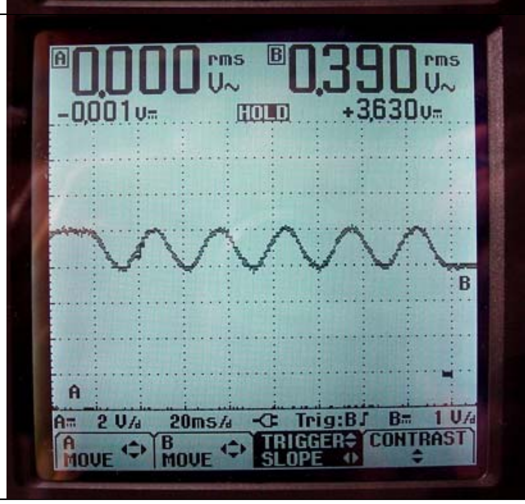
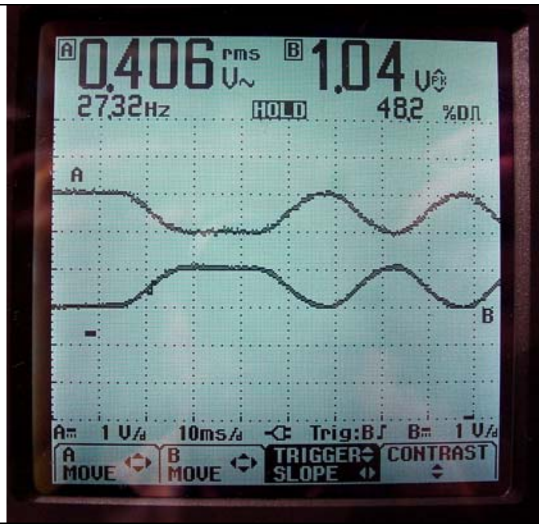
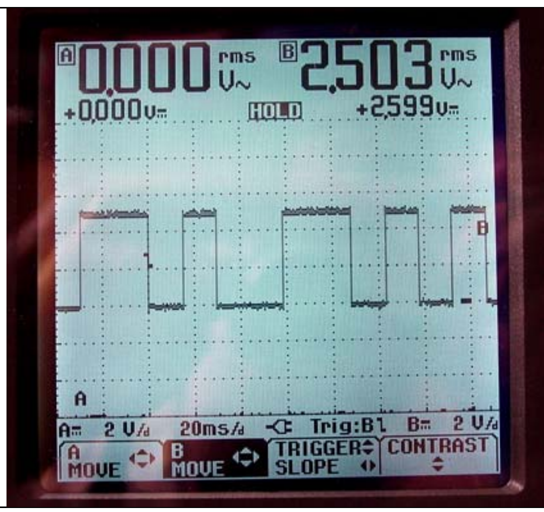
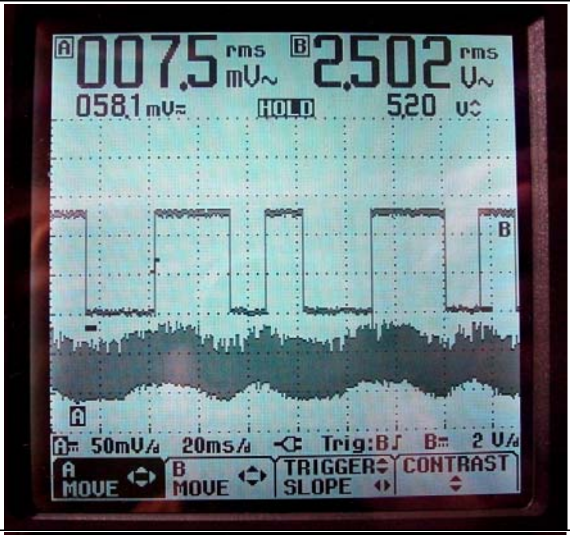
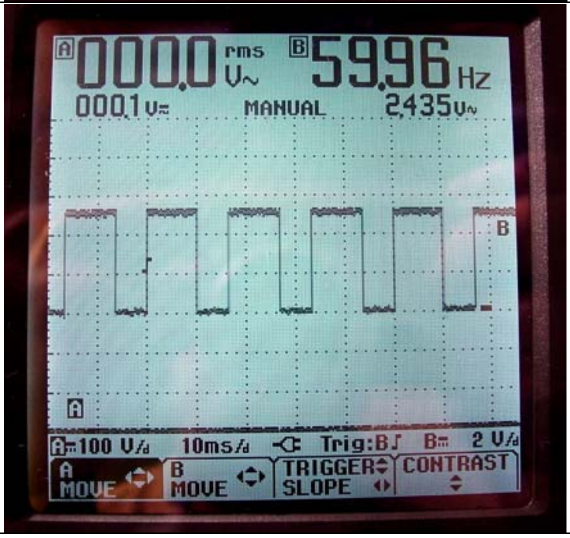
Technical Note

Reference Waveforms

Use an oscilloscope to observe the data waveforms. Set the time-base to 10ms/div or 20ms/div. An oscilloscope with 2-channels operating in A-B differential mode can be very useful in certain measurements. Signal bandwidths are quite low, ranging from DC to 1 kHz. Waveform #6 requires a spectrum analyzer.

#	Location	Waveform Note: all drawn waveforms have the same time scale	
1	RMAS-120 Transmitter Data Timing 96b/frame 34b/s		29 msec per bit 5 data bits
2	RMAS-120 Transmitter Manchester Coded Digital Data		29 msec per bit 5 data bits
3	RMAS-120 Transmitter LP Filtered Data + TP-2 to Ground 2.5 ~ 4.0 V DC Bias		Oscilloscope B Channel 20 msec/div, 1 V/div DC Coupled 1.0 V P-P
4	RMAS-120 Transmitter LP Filtered Data - TP-1 to Ground 2.5 ~ 4.0 V DC Bias		Oscilloscope B Channel 20 msec/div, 1 V/div DC Coupled 1.0 V P-P

5	RMAS-120 Transmitter LP Filtered Data TP-2 & TP-1 Amplifier DIFF + & DIFF - Differential Signal		A Channel = Data +, (DIFF +) B Channel = Data –, (DIFF -) 10 msec/div, 1 V/div DC Coupled 1.0 V P-P each, 2.0 V P-P Differential
6	Microwave Amplifier RF MON, Amplitude Modulated		1.0 ± 0.3 dB P-P
7	RMAS-120 Receiver RCVD DATA TP to GND		Oscilloscope B Channel 20 msec/div, 2 V/div DC Coupled 5.0 V P-P

8	RMAS-120 Receiver Input Data to Receiver RCVD DATA TP to GND		A Channel = Input Signal and Noise 50 mV/div, 20 msec/div B Channel = RCVD DATA TP to GND 2 V/div, 20 msec/div
9	RMAS-120 Receiver 60Hz AC Interference on RCVD DATA TP to GND		Oscilloscope B Channel 10 ms/div, 2 V/div 5.0 V P-P Note the shorter waveform period of AC 60Hz = 16.7 msec. 50Hz = 20.0 msec period.