Date: August 22, 2008

Subject: Tune-up Procedure

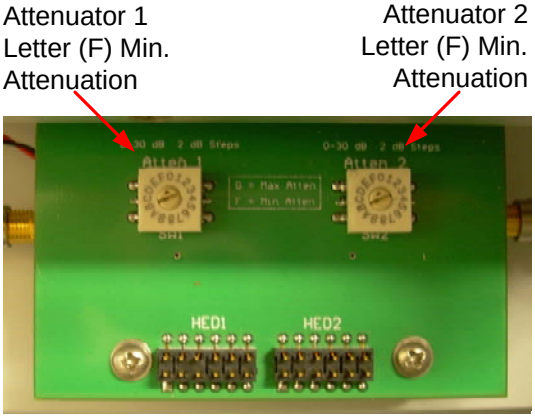
Product Category: FS31H
Model Number: FS31H-4
Description: UHF RF Bi-Directional Repeater (RFBDA)

Tools required:

1. Precision flat head screwdriver

The RF Bi-Directional Amplifier has 2 main sections for tuning, the RF gain adjustment located between the Low Noise Amplifier (LNA) and the Power Amplifier (PA) called Digital Attenuator (DATTN). The second section is composed of the RF Automatic Level Control (ALC) and the Power Alarm of the PA features located in the Alarm pc board.

Digital Attenuator Section:
The Digital Attenuator has a total of 60 dB range at 2 dB steps per range.
Attenuator 1 controls 30 dB range and the Attenuator 2 controls 30 dB range.
The Uplink has 1 Digital Attenuator Board between the (LNA) Low Noise Amp and the (PA) Power Amp.
The Downlink has 1 Digital Attenuator Board between the (LNA) Low Noise Amp and the (PA) Power Amp.



Digital Attenuator Board
2dB/ Step. Position 0 Max. Attenuation
Clockwise decreases attenuation.

Figure 1

Dial Indicator	Attenuation
0	30 dB
1	28 dB
2	26 dB
3	24 dB
4	22 dB
5	20 dB
6	18 dB
7	16 dB
8	14 dB
9	12 dB
A	10 dB
B	8 dB
C	6 dB
D	4 dB
E	2 dB
F	0 dB

Table 1

Calculation to determine Dial Indicator position.

The RF gain of the amplifier chain is 70 dB which the user can adjust.
The basic formula is:

RF Out (dBm) =RF Gain (dB) + RF In (dBm) - Attn1 (dB) - Attn2 (dB)

Re-arranging the formula to isolate the Attn1 and Attn2 variable,

RF Gain (dB) - RF Out (dBm) = RF In (dBm) - Attn1 (dB) - Attn2 (dB)

RF Gain (dB) - RF Out (dBm) + RF In (dBm) = - Attn1 (dB) - Attn2 (dB)

Results:

RF Gain (dB)	=	RF Out (dBm)	-	Attn 2 (dB)	-	Attn 1 (dB)	+	RF In (dBm)
70	=	36	-	0	-	14	+	-20

In this example Attn 1 dial would be set to “8” and Attn 2 would be set to “F”.
See Table 1

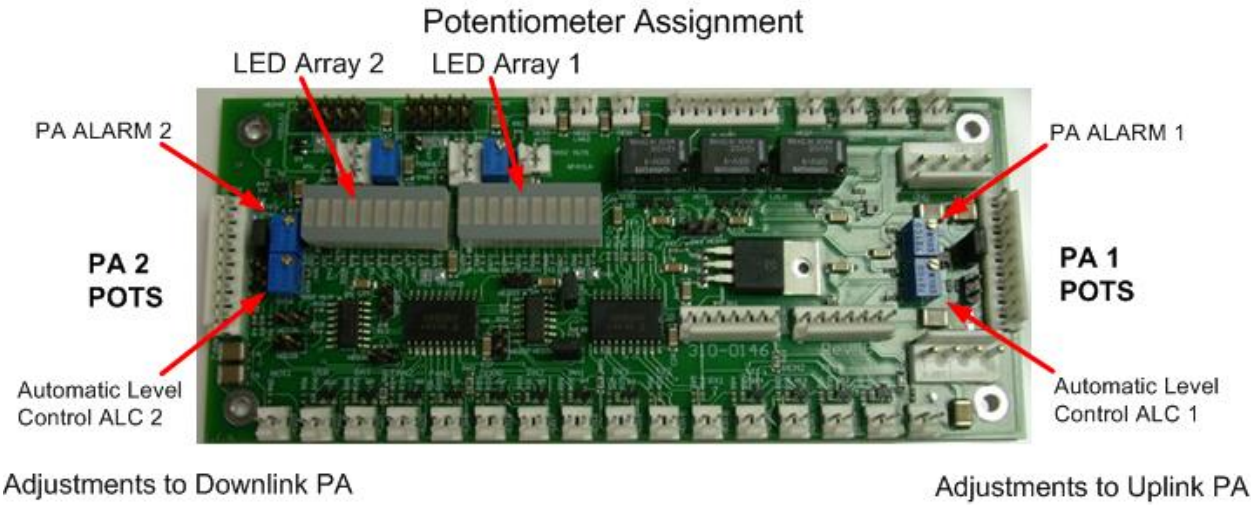


Figure 2

RF Automatic Level Control (ALC) and the Power Alarm Section:

To set the Automatic Level Control (ALC) Clockwise (CW) will increase the RF dBm level. Counter Clock Wise (CCW) will decrease the RF dBm level. See Figure 2 to view the location of the potentiometers (pots). In the left section of the alarm PCB are the pots to adjust power amplifier (PA Alarm 2) for the downlink path. In the right section of the alarm PCB are the pots to adjust power amplifier (PA Alarm 1) for the uplink path.

PA1 Automatic Level Control (ALC) feature:
ALC feature is used to control the RF output composite level. When the RF output composite level reaches this threshold the RF levels will stay "Lock" and maintain the RF composite output constant when the RF input level continues to rise. The output level "Lock Range" as a function of the input level increasing is 10 to 12 dB.

See figure 3 to setup the equipment and Device Under Test (DUT) for the uplink path. DUT is the RF BDA.

ALC tuning:

1. Connect the spectrum analyzer input to the DUT Antenna port. Set the center frequency to 466 MHz. Set the Reference level to 40 dBm. Set the Span to 10 Mhz. Once equipment is setup search for the source frequency and center it on the screen.
2. Set the signal generator frequency to 466 Mhz. Adjust the RF level to -70 dBm. Turn Off.
3. Connect the signal generator output to the DUT DAS port.

4. Turn On the spectrum analyzer.
5. Turn On the DUT.
6. Turn On the signal generator.
7. When you have centered the frequency and is visible on the screen increase the signal input 3 times in 10 dB steps this will bring the output level to around 30 dBm which is closer to the desired range.
8. If output signal is lower than 30 dBm increase clockwise the ALC pot until it has reach the desired level.
9. Increase the input signal in 1 dB steps until it has reach 1 dB above the desired level. If the desired level is 36 dBm increase to 37 dBm.
10. While viewing the spectrum analyzer screen lower the 37 dBm output level to 36 dBm with the ALC pot. This is accomplished by turning the pot counter clock wise.
11. ALC tuning is complete. DUT is the RF BDA.

PA2 Automatic Level Control (ALC) feature:
ALC feature is used to control the RF output composite level. When the RF output composite level reaches this threshold the RF levels will stay "Lock" and maintain the RF composite output constant when the RF input level continues to rise. The output level "Lock Range" as a function of the input level increasing is 10 to 12 dB.

See figure 3 to setup the equipment and Device Under Test (DUT) for the downlink path.

ALC tuning:
1. Connect the spectrum analyzer input to the DUT Antenna port. Set the center frequency to 459 MHz. Set the Reference level to 40 dBm. Set the Span to 10 Mhz. Once equipment is setup search for the source frequency and center it on the screen.
2. Set the signal generator frequency to 459 Mhz. Adjust the RF level to -70 dBm. Turn Off.
3. Connect the signal generator output to the DUT DAS port.
4. Turn On the spectrum analyzer.
5. Turn On the DUT.
6. Turn On the signal generator.
7. When you have centered the frequency and is visible on the screen increase the signal input 3 times in 10 dB steps this will bring the output level to around 30 dBm which is closer to the desired range.
8. If output signal is lower than 30 dBm increase clockwise the ALC pot until it has reach the desired level.
9. Increase the input signal in 1 dB steps until it has reach 1 dB above the desired level. If the desired level is 36 dBm increase to 37 dBm.
10. While viewing the spectrum analyzer screen lower the 37 dBm output level to 36 dBm with the ALC pot. This is accomplished by turning the pot counter clock wise.
11. ALC tuning is complete.

PA Alarm 1 feature:

The feature is used as an “Alarm Threshold Indicator”. When the power amplifier RF output composite level reaches the alarm threshold LED array 2 position 1 will illuminate.

PA Alarm tuning:

1. Connect the spectrum analyzer input to the Device Under Test (DUT) Antenna port. Set the center frequency to 466 MHz. Set the Reference level to 40 dBm. Set the Span to 10 MHz. After the equipment is setup search the source frequency and center it on the screen.
2. Set the signal generator frequency to 466 MHz. Adjust the RF level to -70. Turn Off.
3. Set the signal generator frequency output to the DUT DAS port.
4. Turn On the spectrum analyzer.
5. Turn On the DUT.
6. Turn On the signal generator.
7. Increase the input signal in 1 dB steps until it has reach 3 dB above the desired set level. If the desired level is 33 dBm increase level to 36 dBm.
8. While viewing the LED for PA1 lower the PA Alarm pot counter clockwise until the LED is illuminating.
9. You can now back down the ALC level 3 dB. The LED will turn off.
10. PA Alarm tuning is complete.

PA Alarm 2 feature:

The feature is used as an “Alarm Threshold Indicator”. When the power amplifier RF output composite level reaches the alarm threshold LED array 2 position 1 will illuminate.

PA Alarm tuning:

1. Connect the spectrum analyzer input to the Device Under Test (DUT) Antenna port. Set the center frequency to 466 MHz. Set the Reference level to 40 dBm. Set the Span to 10 MHz. After the equipment is setup search the source frequency and center it on the screen.
2. Set the signal generator frequency to 466 MHz. Adjust the RF level to -70. Turn Off.
3. Set the signal generator frequency output to the DUT DAS port.
4. Turn On the spectrum analyzer.
5. Turn On the DUT.
6. Turn On the signal generator.
7. Increase the input signal in 1 dB steps until it has reach 3 dB above the desired set level. If the desired level is 33 dBm increase level to 36 dBm.
8. While viewing the LED for PA1 lower the PA Alarm pot counter clockwise until the LED is illuminating.
9. You can now back down the ALC level 3 dB. The LED will turn off.

PA Alarm tuning is complete.

Test Equipment Required:

- 1- HP Signal Generator or equivalent, frequency range 450 – 470 MHz.
- 1 - HP Spectrum Analyzer or equivalent.

- 2- RF Cables N-male to N-male, 1 meter length.
- 2- 50 Ohm 20 Watt Load, used to terminate unused ports.

Equipment Setup to set ALC and PA Alarm for Power Amplifier # 1 uplink path.

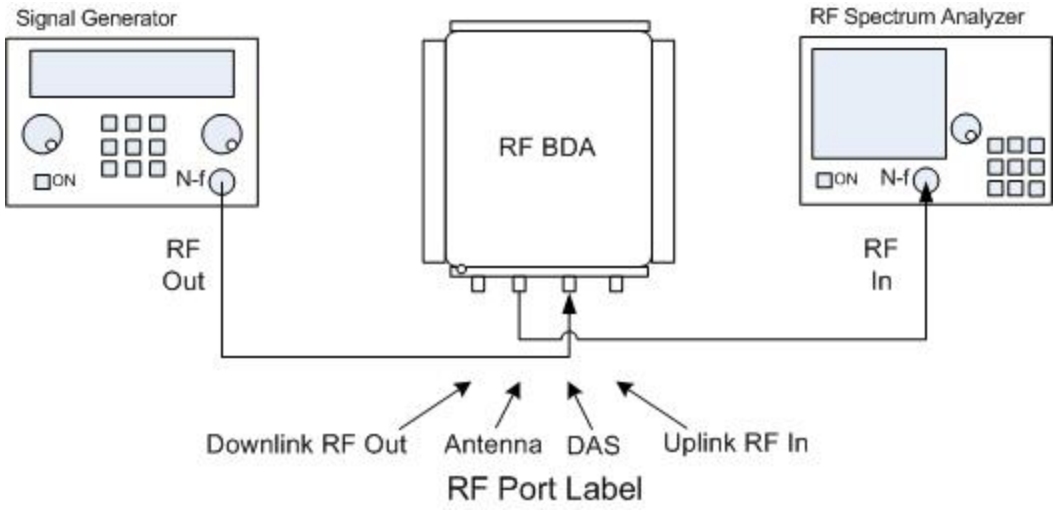


Figure 3

Equipment Setup to set ALC and PA Alarm for Power Amplifier # 2 downlink path.

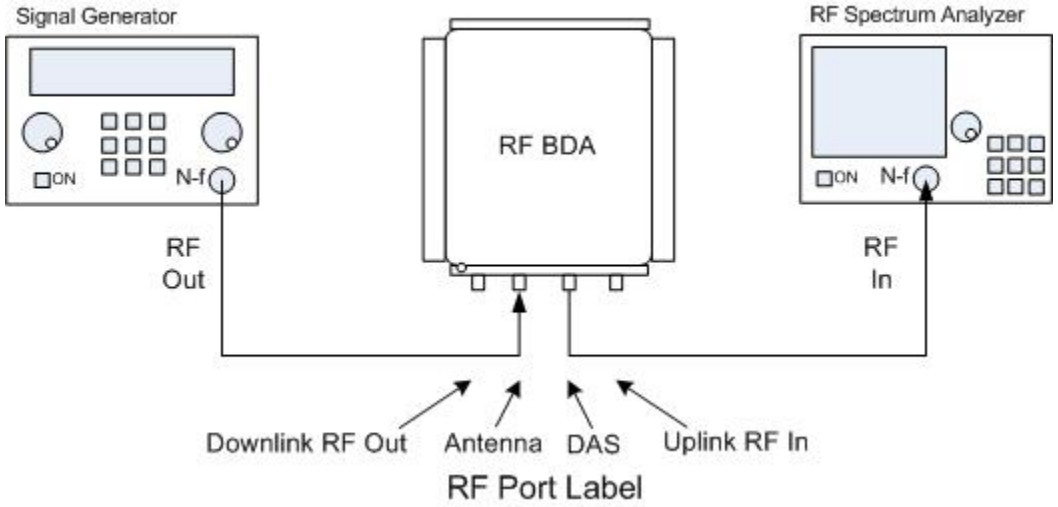


Figure 4

Warning! Terminate all unused ports with 50 Ohm 20 Watt Load.