

display which does require a button press to exit. The main status display shows the uplink and downlink gain in dB as well as the uplink and downlink output level in dBm.

The last line of the main status display gives a summary status message for the entire signal booster. In this example “Status OK” is being displayed. Pressing the “ENTER” button will move you from the main status display into the menu selections and will permit interaction with the system. There are two main functions available within the software menus including configuration settings and detailed status displays.

Configuration Settings

In most cases, the factory default settings are the optimum values for adjustable parameters. The most common setting to be changed by the system’s technician is the gain setting. This is normally done to compensate for varying values of antenna isolation as outlined earlier in this manual or to reduce excessive OLC action resulting from excessive gain.

Please thoroughly study this section before making any adjustments to the configuration values. Each configured item is discussed in detail.

RESTORE ORIG CONFIG

This command will restore all configured settings to their original factory default values. SB II ships from the factory preset to the lowest gain possible.

CALIBRATE CURRENTS

Use this command when replacing an RF amplifier. This function automatically calibrates the current alarm “trip” point of each amplifier in the system. Due to manufacturing tolerances there are small differences in current draw between amplifier assemblies. This software function matches the alarm sensing circuit to the respective amplifier assembly and should be repeated whenever an amplifier assembly is replaced.

SET GAIN

This function allows the user to electronically set the gain of the booster in 0.5 dB increments over a range of 30 dB. Gain can be adjusted independently for both the uplink and downlink channels but in most cases both uplink and downlink should be set to the same gain value.

Know your antenna isolation before making this adjustment. We recommend that you temporarily disconnect both the uplink and downlink antennas when setting the gain to avoid the possibility of causing the unit to oscillate. After changing the setting, power the unit down, reconnect the antennas and power-up the booster.



Note: A reduction in system gain will also result in an equal reduction in the OLC dynamic range, refer to the section titled “OLC” on page 11.

SET OUTPUT LEVEL

Allows the output power for the uplink and downlink channels to be independently adjusted in .5 dB increments up to +31 dBm. Note that the OLC circuitry will maintain the systems output level at the values you have selected in this menu.

Use this function **ONLY** if your system is causing some form of interference to another radio system. You can only reduce the booster’s output power with this command.

CHANGE GAIN CONFIGURATION

Insures proper gain readings when changing basic booster gain by changing the type of plug-in card assemblies.

Use of this menu is **ONLY** needed when converting your stock SB II to a different gain level by changing the low level, mid-level plug-in amplifier card or the addition of an attenuator card. It actually is a change to the characteristics of another model. Don’t confuse this with simple amplifier bypassing to reduce gain. Uplink and down link can be set independently. Choices for gain are Full, Mid or Low and the Enter key toggles the gain setting. The corresponding gain level is displayed. Select Done using the arrow keys and press enter to return to the menu. Use the Cancel button to return to the Status Display.

Detailed Status Screens

These items allow a detailed examination of system components including; all amplifiers (current draw and temperature), the power supply (voltage level), and the OLC function (present status and historical archive). Each item is discussed below in detail.

AMPLIFIERS

A separate status screen is available for each amplifier in the system. When an amplifier is selected this function will display the present current draw of that amp as well as its present operating temperature in degrees Celsius. In addition, a status message will indicate if the amplifier is connected and whether the amplifier is bypassed or not bypassed. This menu selection also provides the option of placing an amplifier in bypass or taking an amplifier out of bypass.

The current draw will be blank if an amplifier is not connected, will display BYP if the amplifier is bypassed, and will display ATTEN if an attenuator card is being used in place of the amplifier card.



The power amplifier currents will normally fluctuate up to 850 ma when signals are present.

POWER SUPPLY

This function displays the real time power supply voltages for both 24 volt and 12 volt supplies.

OLC

This screen shows the amount of attenuation presently being used by the OLC for both the uplink and downlink channels. In addition, the percentage of OLC presently being used is also shown.



The amount of OLC currently being used in either the uplink or downlink channels is also indicated by LED bar graph displays located on the display panel. Each segment represents 2 to 4 dB of attenuation depending on the gain setting of the booster. The OLC bars should only be active occasionally and no more than 3 or 4 segments briefly lit. Constant light bar activity means the booster gain needs to be reduced for optimum performance.



The system has 60 dB of OLC dynamic range. However, the dynamic range of the OLC is reduced when the user selectable gain is reduced. The reduction will be an equal amount. For instance, if the user selectable gain is reduced by 20 dB then the OLC dynamic range will also be reduced by 20 dB.

OLC DATALOG

This screen displays an OLC Datalog which is the OLC data over the past 100 days for both uplink and downlink branches of the system. This is a rolling 100 day log with day 101 overlapping day 1 and so forth. Day zero represents the current day while day one represents yesterday and so on. The logged data is stored in non-volatile memory and will not be erased when the unit is powered down.

The average OLC attenuation used when the OLC was active is given both for individual days and over the entire past 100 days. The percentage of time the OLC was active is also given for both individual days and over the past 100 days. This archived information will permit the creation of a user signal profile to facilitate optimum system configuration and performance.

This archive feature will allow you to see if the gain of the unit is set too high or if there are transient episodes of strong signals perhaps desensitizing other channels being amplified by the booster.

Alarms

The system continuously monitors the current draw and operating temperature of each amplifier as well as the voltage level of the +12 and +24 VDC supplies. If any of these parameters exceed normal operating levels by a factory preset percentage the system enters an alarm condition. Notification of an alarm condition is provided by LED indicators and Form-C contacts available via the alarm terminal screws.

LED INDICATORS

There are LED indicators for each amplifier in the system as well as the +12 and +24 VDC power supply voltages. The LED indicators for the low, mid, and low gain amplifiers are located on the individual plug-in module. These are tri-color LEDs with green representing NORMAL operation, orange representing a WARNING condition, and red indicating a FAULT. A warning condition occurs when the current draw of the amplifier exceeds nominal by +/- 20%. Fault conditions occur when the current draw exceeds +/- 30% or the amplifiers operating temperature exceeds 80° Celsius. The LED for the attenuator card is green only and indicates DC power applied to the card.

The LED indicators for the power amplifiers are located on the display panel next to the menu select buttons and are dual color LED's. Green represents NORMAL operation while red indicates a FAULT condition. Fault conditions occur when the current draw exceeds 900 ma or falls below 200 ma. Also, whenever the amplifiers operating temperature exceeds 95° Celsius. The power amplifiers do not have a warning state.

The power supply LED indicators are located on display panel next to the menu selection buttons and are also dual color. Green representing normal operation and red a fault condition. A fault condition for the +24 VDC supply occurs whenever the voltage potential drops below +16 VDC (30% below nominal). Likewise, a fault for the +12 VDC supply occurs when the potential is below +8 VDC (30% below nominal).

FORM-C CONTACTS

Form-C contacts are available inside the cabinet next to the power supply assembly, see figure 2. These screw terminals are intended for connection to the customers supervisory alarm or data acquisition system. One set of terminals supplies notifi-

cation of any alarm condition occurring and the second set of contacts indicate the system is operating on battery backup power.

PERFORMANCE SURVEY

It is a good idea to document the performance of the system after installation so that a reference exists for future comparisons. This information can make troubleshooting an interference problem or investigation of a complaint about system performance much easier. If there are coverage problems with a system, this survey will usually reveal them allowing corrective measures to be taken before the system is put into routine use. The following is an outline of how to do such a survey. Because the nature of each installation can be quite different, only a broad outline is given.

- 1) Measure the gain of the signal booster being careful not to exceed the maximum input level. **Figure 8** shows this being done using a signal generator and spectrum analyzer. Record the measured values for each passband. We recommend that a 50 ohm load be connected to the unused RF port on the bottom of the cabinet during the gain test.

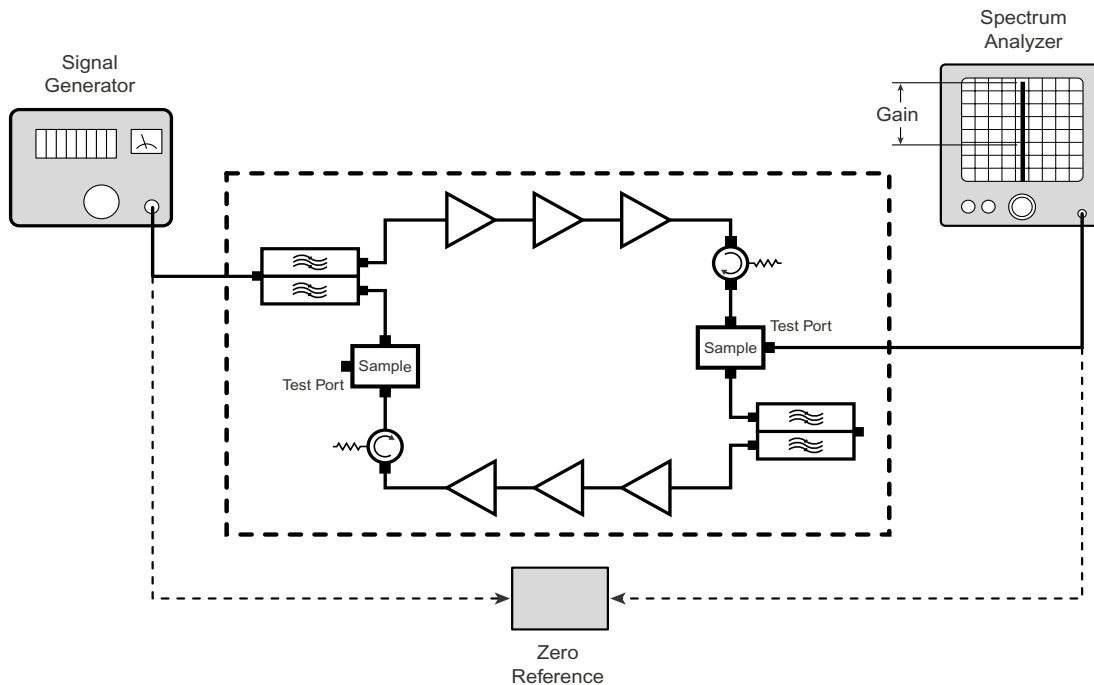


Figure 8: Measuring signal booster gain.

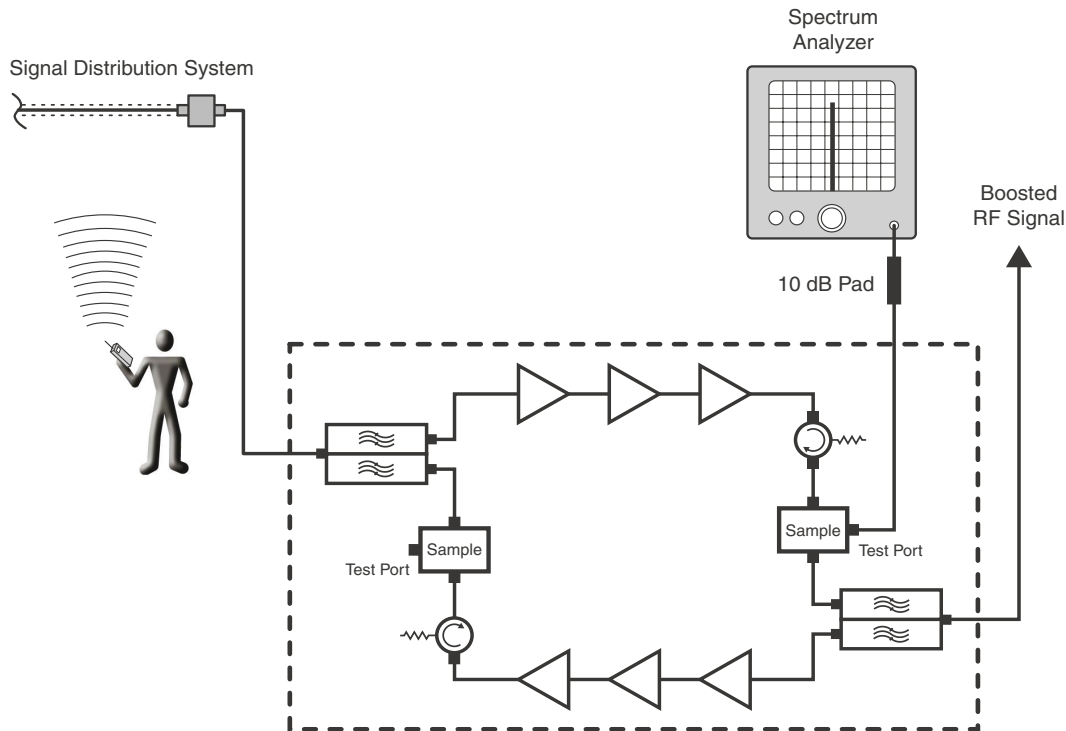


Figure 9: Methodology for doing a performance survey of the signal distribution system.

- 2) The spectrum analyzer is connected to the -30 dB signal sampler port following the final output amp. This port will allow the observation of the amplifier output at a considerably reduced output level. This decoupling value (-30 dB) needs to be added to any measured signal value in order to arrive at the actual signal level.
- 3) With a spectrum analyzer connected to the signal sampler port (see **Figure 9**), have personnel with handheld radios move to several predetermined points and key their radios. Record the level of these signals as observed on the analyzer and also record the location of the person transmitting. In this way, a map of the systems performance can be generated.
- 4) For signals coming from a fixed antenna or station, record the level of all the desired incoming signals for future reference.

MAINTENANCE AND REPAIR

Signal boosters manufactured by TX RX Systems, Inc. can perform for years with little maintenance and repair. However, if the amplifiers are subjected to excessively high signal levels, power surges or lightning strikes, failures may occur. The following procedures may be followed for detecting a malfunctioning unit or as part of a periodic maintenance program.

- 1) The heatsink area should be cleared of dust and debris.
- 2) Inspect the unit to see that the two power supply LED DC indicators are lit (remove any dust or debris that may obscure the LEDs). This will verify that DC power is flowing properly. Check all hardware for tightness.
- 3) Compare system performance to initial performance levels measured when the system was first installed. The lack of signal can be traced to a malfunctioning amplifier by progressive signal monitoring from the output (far end) to the input end of the system noting the area where the

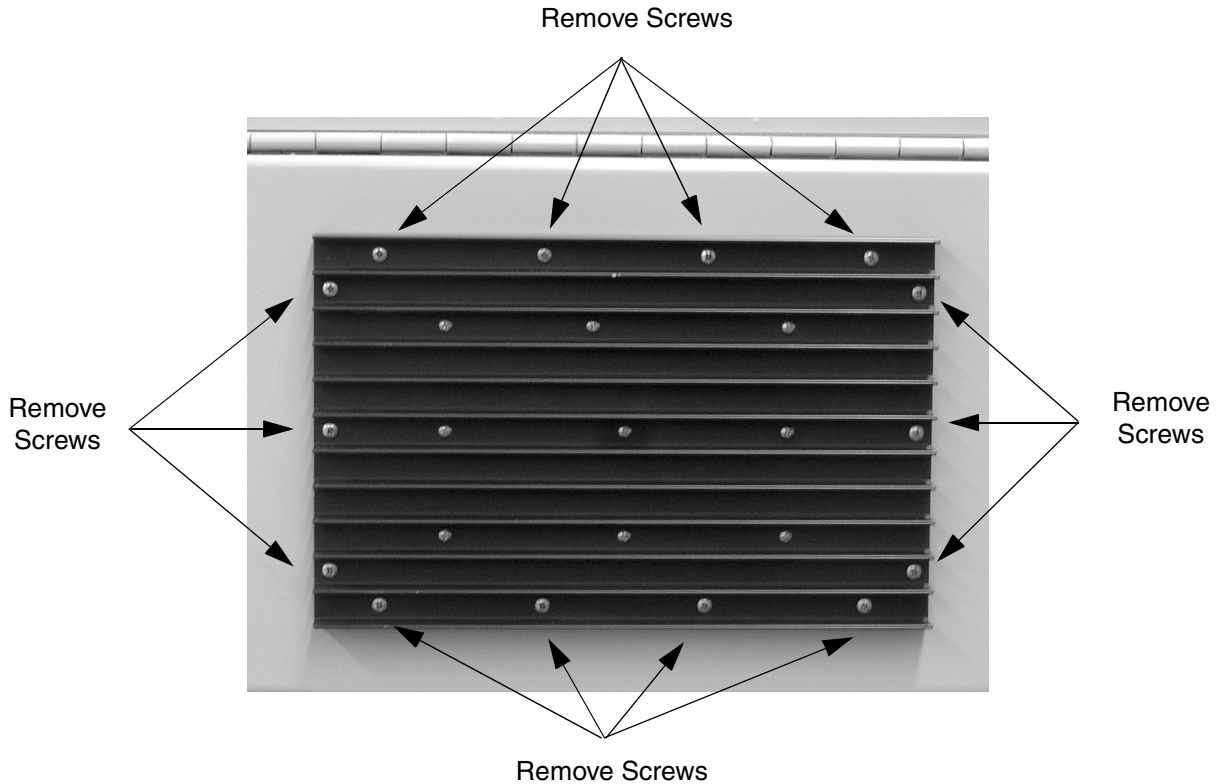


Figure 10: Remove 14 mounting screws to detach amplifier assembly from cabinet.

signal returns to normal level. The next amplifier toward the output end of the system will probably be the one that failed.

or

Measure the gain at any convenient frequency in the working frequency band to verify that the performance is still within specifications.

Power Amplifier Replacement

The SB II power amplifiers are field replaceable. Follow the steps listed below in sequential order. The required tools are a #1 Phillips screwdriver and a 5/16" open-ended wrench.



Note: Power to the SB II cabinet must be turned OFF during the power amplifier replacement process.

- 1) Remove the Phillips screws which hold the amplifier into place, refer to **Figure 10**. The nuts holding the screws are pressed into the cabinet



Figure 11: Slide amplifier towards bottom of cabinet to remove upper cable.



Figure 12: Slide amplifier towards top of cabinet to remove lower cables.

and will remain in place when the screws are removed.

- 2) Slide the amplifier towards the bottom of the cabinet as far as it will go. This will allow the top RF connector to clear the opening. Tilt the top of the amplifier outwards and remove the top RF cable at the SMA connector using the 5/16" wrench. See **Figure 11**.
- 3) Slide the amplifier assembly towards the top of the cabinet as far as it will go. This will allow the bottom RF connector and grey control cable to clear the opening. Tilt the bottom of the amplifier outwards and remove the bottom RF cable at the SMA connector and the grey control cable. To remove the grey cable from the socket on the amplifier it is necessary to squeeze the top and bottom of the connector together to release a hold down tab. When properly squeezed the grey cable will disconnect easily from the amplifier. Refer to **Figure 12**.
- 4) To replace the amplifier assembly repeat steps 1 through 3 in reverse order. When replacing the RF cables do not overtighten the SMA connectors. They should be tightened just slightly more than hand tight or to the specification of 7 in/lbs. The replacement amplifier comes with an attached gasket which must press up against the outside of the cabinet firmly and squarely in order to provide a correct moisture seal.

Module Replacement

The SB II modules are field replaceable. Follow the steps listed below in sequential order. The required tools are a #1 Phillips screwdriver. Two thumb screws hold each module into place.



Note: Power to the SB II cabinet must be turned OFF during the module replacement process except for the amplifier modules which are "HOT" switchable.

- 1) Loosen the two thumb screws which hold the module into place. Phillips screws are incorporated into the thumbscrews and they made need to be loosened first.
- 2) Grasping the two loosened thumb screws pull the module straight out of the card cage.
- 3) To install the replacement module place the module into the guide-rails of the slot and press down firmly into place. Each type of module is keyed uniquely to fit in only one slot within the card cage. Once the card is seated into place properly tighten the thumb screws.

The SB II low level and mid level amplifier stages are field replaceable by simply removing the module and plugging in a replacement. These modules are HOT switchable meaning they can be swapped without powering down the system. RF cables attached to the modules must be removed (5/16" wrench) prior to swapping the modules and must be re-attached after the new module is in place. when replacing the RF cables do not overtighten the SMA connectors. They should be tightened just slightly more than hand tight or to the specification of 7 in/lbs.

Modules can be swapped between the uplink and downlink branches for troubleshooting purposes. If a problem exists in one branch and the problem moves to the other branch when modules are swapped around this indicates a defective module.



Note: After an amplifier module is replaced use the Calibrate Currents software function to properly set the amplifiers alarm trip point, see page 9. Due to slight differences in component tolerances the trip point must be reset for any new amplifier assemblies introduced into the system.

Display/User Interface Assembly Replacement

The SB II Display/User Interface assembly is field replaceable. Follow the steps listed below in sequential order. No tools are required.



Note: Power to the SB II cabinet must be turned OFF during the display/user interface replacement process.

- 1) Loosen the two thumb-nuts which hold the display/user interface assembly to the card cage.
- 2) Gently tilt only the top of the assembly up from the card cage. Keep the bottom of the assembly in place. The bottom mounting plate (part of the card cage) has an overhang on it to support the display/user interface board. If the assembly is lifted straight out the overhang it could possibly damage the interface circuit board.
- 3) With the display/user interface board standing up straight gently move it upwards while lifting it

out about an inch or two. This should allow the overhang to clear the interface circuit board without damage.

- 4) Remove the ribbon cable that connects the display/user interface assembly to the card cage, see **Figure 13**.
- 5) To replace the display/user interface assembly repeat steps 1 through 4 in reverse order.

Power Supply Replacement

The SB II power supply assembly is field replaceable. Follow the steps listed below in sequential order. The required tools are a #1 Phillips screwdriver.

- 1) Turn off AC power at the junction box.
- 2) Disconnect the 3 conductor cable that brings AC power to the supply from the junction box.

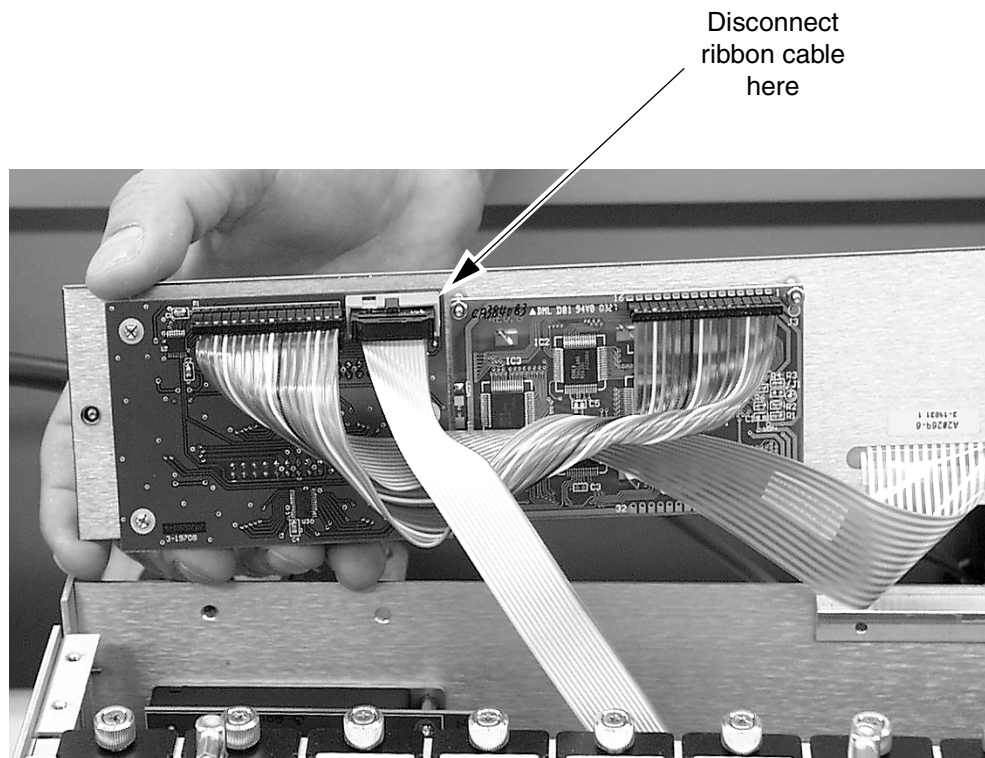


Figure 13: Disconnecting the display/user interface assembly from the card cage.

- 3) Disconnect the red and black leads from the power supply that connect to the card cage.
- 4) Remove the Phillips screws that hold the power supply mount bracket to the back plate and remove the assembly from the cabinet.
- 5) Reverse steps 4 through 2 to install the replacement power supply.
- 3) Remove the row of Phillips screws which hold the card cage to the back plate. There is a row of screws at the top and bottom of the cage.
- 4) To install a replacement cage perform steps 3 through 1 in reverse order.

RECOMMENDED SPARES

It is recommended that one spare of each of the following assemblies be kept on hand for emergency repair purposes; Power Supply 8-19938, Uplink Power Amplifier 3-19787, Downlink Power Amplifier 3-20028, Mid Level Amplifier Card 3-19576, Low Level Amplifier Card 3-19575, Low Gain Amplifier Card 3-20294, Attenuator Card 3-20208, Power Distribution Card 3-19833, Controller Card 3-19832, and the Display/User Interface Assembly 3-19831.

Filter Replacement

The filter assemblies are field replaceable. Follow the steps listed below in sequential order. The required tools are a #1 Phillips screwdriver with an extended shaft to reach down far enough into the unit to loosen the mounting screws.



Note: Power to the SB II cabinet must be turned OFF during the filter replacement process.

- 1) All RF cables attached to the assembly must be removed (5/16" wrench).
- 2) Remove the Phillips screws that hold the assembly mount brackets to the back plate and remove the assembly from the cabinet.
- 3) Reverse steps 2 and 1 to install the replacement filter. When replacing the RF cables do not overtighten the SMA connectors. They should be tightened just slightly more than hand tight or to the specification of 7 in/lbs.

Card Cage Replacement

To replace the card cage follow the steps listed below in sequential order. The required tools are a #1 Phillips screwdriver with an extended shaft to reach down far enough into the unit to loosen the mounting screws.



Note: Power to the SB II cabinet must be turned OFF during the card cage replacement process.

- 1) Disconnect the display/user interface assembly.
- 2) Disconnect 4 cables at the backplane of the card cage which are assessable with the display/user interface board out of the way.

Model 61-88-50 Signal Booster Specifications

	61-88-50-A06-G1	61-88-50-B06-G1	61-88-50-C06-G1
Part Number:			
Electrical			
Frequency Range:	896 - 941 MHz	896 - 941 MHz	896 - 941 MHz
FCC Identification Number:	EZZ5P1618850	EZZ5P1618850	EZZ5P1618850
Industry Canada Identification Number	1940A-PI618850	1940A-PI618850	1940A-PI618850
Number of Passbands:	2	2	2
Passband Frequencies:	896-902 / 935-941 MHz	896-902 / 935-941 MHz	896-902 / 935-941 MHz
Minimum Passband Separation:	45 MHz	45 MHz	45 MHz
Pass Bandwidth:	6 MHz	6 MHz	6 MHz
Maximum RF Power Output/Passband*:	+35 dBm (3 Watts)	+35 dBm (3 Watts)	+35 dBm (3 Watts)
Gain:	+80 dB	+60 dB	+45 dB
Guardband:	33 MHz	33 MHz	33 MHz
Output Level Control Range**:	60 dB	60 dB	60 dB
System Noise Figure at Maximum Gain:	3.5 dB maximum	6.5 dB maximum	6.5 dB maximum
Third Order Output Intercept Point:	+55 dBm	+55 dBm	+55 dBm
Primary Supply Voltage:	100-240 VAC; 50-60 Hz	100-240 VAC; 50-60 Hz	100-240 VAC; 50-60 Hz
Automatic Battery Backup Option:	+24 to +30 VDC	+24 to +30 VDC	+24 to +30 VDC
Mechanical			
Height:	24"	24"	24"
Width:	24"	24"	24"
Depth:	8"	8"	8"
Weight	85 lbs.	85 lbs.	85 lbs.
Housing Type:	Painted Steel	Painted Steel	Painted Steel
Enclosure Type:	NEMA 4 Standard	NEMA 4 Standard	NEMA 4 Standard

* Maximum total power

** Output control range at maximum gain setting

Table 3, Signal Booster ii specifications

CELCIUS TO FARENHEIT CONVERSION TABLE

CELCIUS	FARENHEIT
105	221.0
104	219.2
103	217.4
102	215.6
101	213.8
100	212.0
99	210.2
98	208.4
97	206.6
96	204.8
95	203.0
94	201.2
93	199.4
92	197.6
91	195.8
90	194.0
89	192.2
88	190.4
87	188.6
86	186.8
85	185.0
84	183.2
83	181.4
82	179.6
81	177.8
80	176.0
79	174.2
78	172.4
77	170.6
76	168.8
75	167.0
74	165.2
73	163.4
72	161.6
71	159.8
70	158.0
69	156.2
68	154.4
67	152.6

CELCIUS	FARENHEIT
66	150.8
65	149.0
64	147.2
63	145.4
62	143.6
61	141.8
60	140.0
59	138.2
58	136.4
57	134.6
56	132.8
55	131.0
54	129.2
53	127.4
52	125.6
51	123.8
50	122.0
49	120.2
48	118.4
47	116.6
46	114.8
45	113.0
44	111.2
43	109.4
42	107.6
41	105.8
40	104.0
39	102.2
38	100.4
37	98.6
36	96.8
35	95.0
34	93.2
33	91.4
32	89.6
31	87.8
30	86.0
29	84.2
28	82.4

CELCIUS	FARENHEIT
27	80.6
26	78.8
25	77.0
24	75.2
23	73.4
22	71.6
21	69.8
20	68.0
19	66.2
18	64.4
17	62.6
16	60.8
15	59.0
14	57.2
13	55.4
12	53.6
11	51.8
10	50.0
9	48.2
8	46.4
7	44.6
6	42.8
5	41.0
4	39.2
3	37.4
2	35.6
1	33.8
0	32.0
-1	30.2
-2	28.4
-3	26.6
-4	24.8
-5	23.0
-6	21.2
-7	19.4
-8	17.6
-9	15.8
-10	14.0
-11	12.2

CELCIUS	FARENHEIT
-12	10.4
-13	8.6
-14	6.8
-15	5.0
-16	3.2
-17	1.4
-18	-0.4
-19	-2.2
-20	-4.0
-21	-5.8
-22	-7.6
-23	-9.4
-24	-11.2
-25	-13.0
-26	-14.8
-27	-16.6
-28	-18.4
-29	-20.2
-30	-22.0
-31	-23.8
-32	-25.6
-33	-27.4
-34	-29.2
-35	-31.0
-36	-32.8
-37	-34.6
-38	-36.4
-39	-38.2
-40	-40.0
-41	-41.8
-42	-43.6
-43	-45.4
-44	-47.2
-45	-49.0
-46	-50.8
-47	-52.6
-48	-54.4
-49	-56.2
-50	-58.0