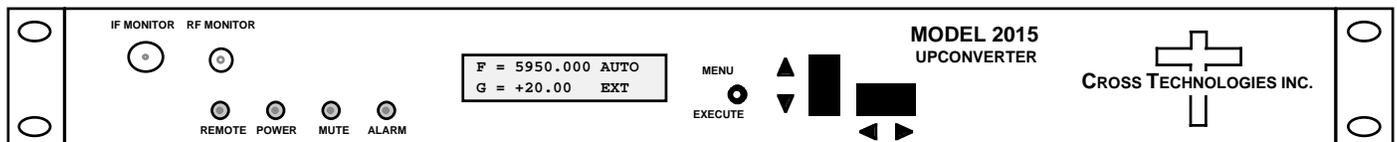


Instruction Manual

Model 2015-61 Upconverter

November 2009 Rev. A



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INSTRUCTION MANUAL
MODEL 2015-61 Upconverter

<u>TABLE OF CONTENTS</u>	<u>PAGE</u>
Warranty	2
1.0 General	3
1.1 Equipment Description	3
1.2 Technical Characteristics	4
1.3 Monitor & Control Interface	5
2.0 Installation	7
2.1 Mechanical	7
2.2 Rear Inputs & Outputs	8
2.3 Front Panel Controls & Indicators	8
2.4 Operation	9
2.5 Menu Settings	10

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MODEL 2015-61 Upconverter

1.0 General

1.1 Equipment Description

The 2015-61 Upconverter converts 70 ± 18 MHz to 5.85 to 6.425 GHz in 1kHz, 10kHz, 100kHz, or 125kHz steps (user selectable) with low group delay and flat frequency response. Push button switches select the RF frequency, gain, and other parameters. Front panel connectors provide -20 dB monitors of the IF and RF signals. Front panel LEDs provide indication of DC power (green), remote operation (yellow), PLL alarm (red), or the TX carrier is muted (yellow). Variable attenuators for the IF input and RF output provide a gain range of +10 to +30 dB as adjusted by the front panel pushbutton switches. Remote operation allows selection of frequency and gain. Parameter selection and frequency, gain and 10MHz reference source settings appear on the LCD display. Connectors are BNC for IF input, IF monitor, and 10MHz reference input and output, and Type N for the RF output and SMA for the RF monitor. The 2015-61 is powered by a 100-240 $\pm 10\%$ VAC power supply; and housed in a 1.75" X 19" X 16" rack mount chassis. The unit is powered by a 100-240 $\pm 10\%$ VAC power supply, and housed in a 1.75" X 19" X 16" 1RU chassis.

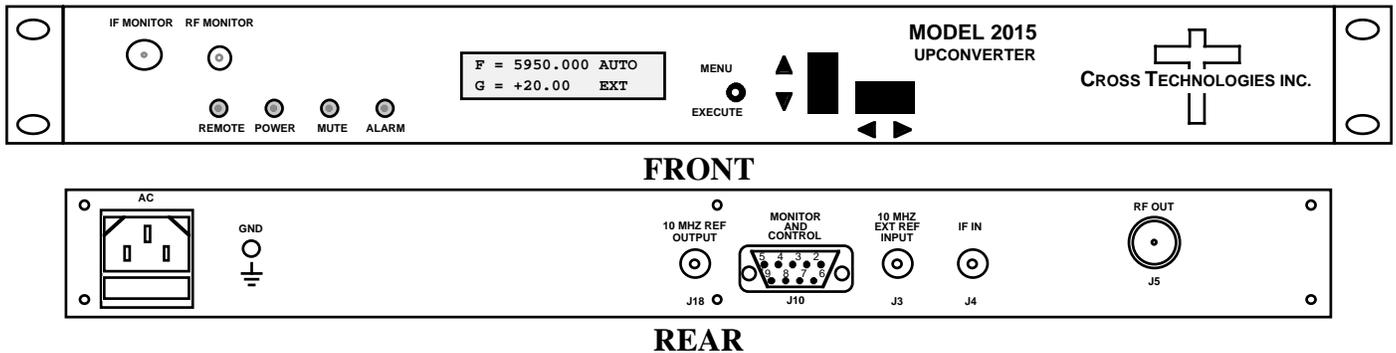


FIGURE 1.1 Model 2015-61 Front and Rear Panels

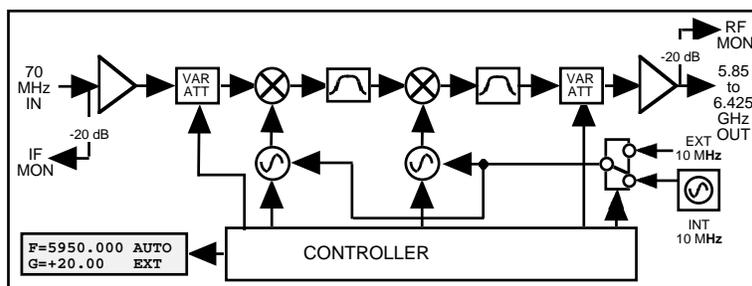


FIGURE 1.2 Model 2015-61 Upconverter Block Diagram

1.2 Technical Characteristics

TABLE 1.1 2015-61 Upconverter Specifications*

Input Characteristics (IF)

Impedance	50Ω
Return Loss	18 dB
Frequency	70 ± 18 MHz
Level	-40 to -20 dBm

Output Characteristics (RF)

Impedance	50Ω
Return Loss	14 dB
Frequency	5.85 to 6.425 GHz
Level	-20 to 0 dBm
1dB compression	+9 dBm
Carrier Mute	-60 dBc

Channel Characteristics

Gain range	+10 to +30 dB (adjustable in 0.25 dB steps)
Spurious Response	< -55dBc @ 0dBm output
Intermodulation	<-38 dBc for two carriers each at 0 dBm output
Frequency Response	±1.5 dB, 5.85-6.425 GHz ; ± 0.5 dB, 36 MHz BW
AM/PM Conversion:	0.1 deg/dB max @ -5 dBm output
Gain Stability	± 0.25 dB/day
Gain Slope	0.1 dB/MHz
Group Delay, max	0.01 ns/MHz ² , parabolic, 0.03 ns/MHz, linear, 1 ns ripple peak-to-peak
Frequency Sense	Non-inverting

Synthesizer Characteristics

Frequency Accuracy	±0.01 ppm internal reference; Auto locks to external reference at 0 ± 3 dBm input
Frequency Step	1kHz, 10kHz, 100kHz, 125kHz (selectable)
10 MHz In/Out Level	3 dBm ± 3 dB

Phase Noise @ Freq	100 Hz	1kHz	10kHz	100kHz	1MHz
dBc/Hz	-65	-75	-85	-95	-105

Controls, Indicators

Freq/Gain Selection	direct readout LCD; pushbutton switches or remote selection
Power	Green LED
Alarm	Red LED
Mute	Yellow LED
Remote	Yellow LED
Remote	RS232C, 9600 baud
Monitors (-20±2dB)	IF: -20dB of input, 50Ω BNC, female / RF: -20dB of output, 50Ω SMA, female

Other

RF / RF Mon Connector	Type N (female) / SMA (female)
IF / IF Mon Connector	BNC (female) / BNC (female)
10 MHz Connectors	BNC (female), 75Ω; works for 50 or 75 ohm impedance
Alarm/Remote Conn.	DB9 - NO or NC contact closure on Alarm
Size	19 inch, 1RU standard chassis 1.75"high X 16.0" deep
Power	100-240 ±10% VAC, 47-63 Hz, 45 watts max

Options

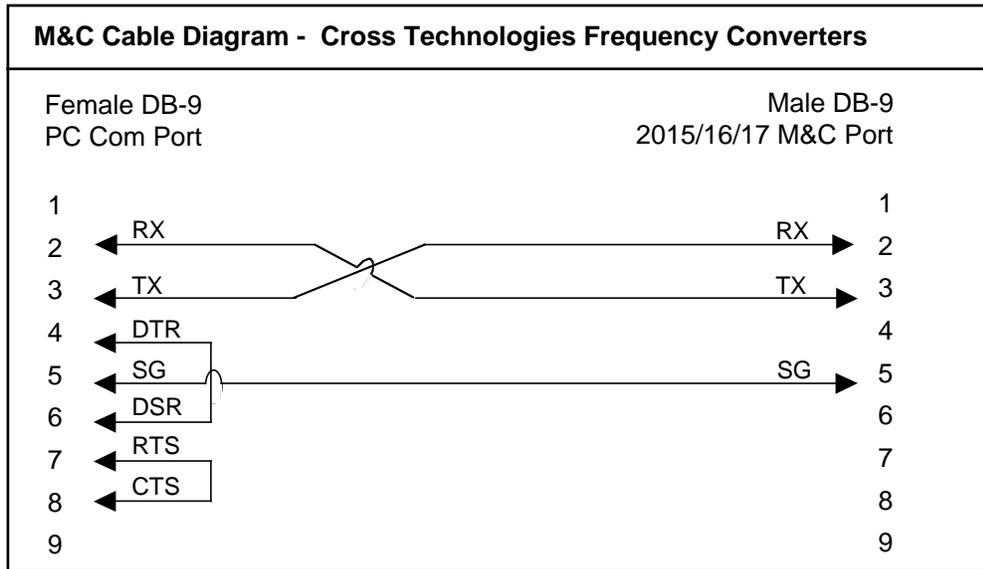
Q	RS485 Remote Interface
---	------------------------

*+0°C to +50°C; Specifications subject to change without notice

1.3 Monitor and Control Interface

A) Remote Serial Interface

Protocol: RS-232C, 9600 baud rate, no parity, 8 data bits, 1 start bit, and 1 stop bit.
(RS-232C, RS-422, or **RS-485 - option -Q**)



Connector - Rear panel, DB-9 female

Pinouts (RS-485/422/232C)

Pin	Description
1	Rx-
2	Rx+ (RS-232C)
3	Tx+ (RS-232C)
4	Tx-
5	Ground
6	Alarm Relay - Common
7	Alarm Relay - Normally Open
8	Not Used
9	Alarm Relay - Normally Closed

B) Status Requests -

Table 13 lists the status requests for the 2015-02 and briefly describes them.

* PLEASE NOTE: The two character {aa}(00-31) prefix, in the table below, should be used ONLY when RS-485, (OPTION-Q), is selected.

Table 1.3 2015-61 Status Requests		
Command	Syntax	Description
Command Status	{aaS1}*	Returns {aaS1bbbbbbccdddEFAM} where:
		• bbbbbbb = Tx frequency
		• cc = Input Level
		• dddd = Tx Gain
		• E = 10MHz Ref Status (0 = Internal, 1 = External)
		• F = 10MHz Ref Mode (0=Internal, 1=External, 2=Auto)
		• A = Alarm Status (0 = NO Alarm, 1 = Alarm)
		• M = Tx RF Status (1 = Normal, 0 = Muted)

C) Commands -

Table 1.2 lists the commands for the 2015-60 and briefly describes them. After a command is sent the 2015-60 sends a return ">" indicating the command has been received and executed.

General Command Format - The general command format is {aaCND...}, where:

- { = start byte
- aa = Address (**RS-485 only**)
- C = 1 character, either C (command) or S (status)
- N = 1 character command or status request
- D = 1 character or more of data (depends on command)
- } = stop byte

* PLEASE NOTE: The two character {aa}(00-31) prefix, in the table below, should be used ONLY when RS-485, (OPTION-Q), is selected.

Table 1.2 2015-61 Commands		
Command	Syntax	Description
Set Transmitter Frequency	{aaC1xxxxxxx}* 	where: • xxxxxxx = 7 characters • Range: 5850000 to 6425000 kHz, 1kHz steps min.
Set Input Level	{aaClxx}* 	where: • xx = 2 characters • Range: 20 to 40 (-20 dB to -40 dB, in 1 dB steps)
Set Transmit Gain	{aaC3xxxx}* 	where: • xxxx = 4 characters • Range: 1000 to 3000 (10.00 to 30.00 dB, 0.25 dB steps)
Enable Tx	{aaCAx}* 	where x =: • 0 to disable Tx signal • 1 to enable Tx signal
External 10MHz Mode	{aaCEx}* 	where x =: • 0 = Internal 10MHz ref signal • 1 = External 10MHz ref signal • 2 = Auto 10MHz ref signal
Enable Remote	#	Just # sign
Disable Remote	{aaCRO}* 	{CR and zero}

2.0 Installation

2.1 Mechanical - The 2015-61 consists of one RF/Controller PCB, RF components and synthesizer assembly housed in a 1 RU (1 3/4 inch high) by 16 inch deep chassis. A switching, ± 12 , +24, +5 VDC power supply provides power for the assembly. The 2015-61 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 2015-61 is assembled.



FIGURE 2.1 2015-61 Mechanical Assembly

2.2 Rear Panel Input / Output Signals - Figure 2.2 shows the input and output connectors on the rear panel.

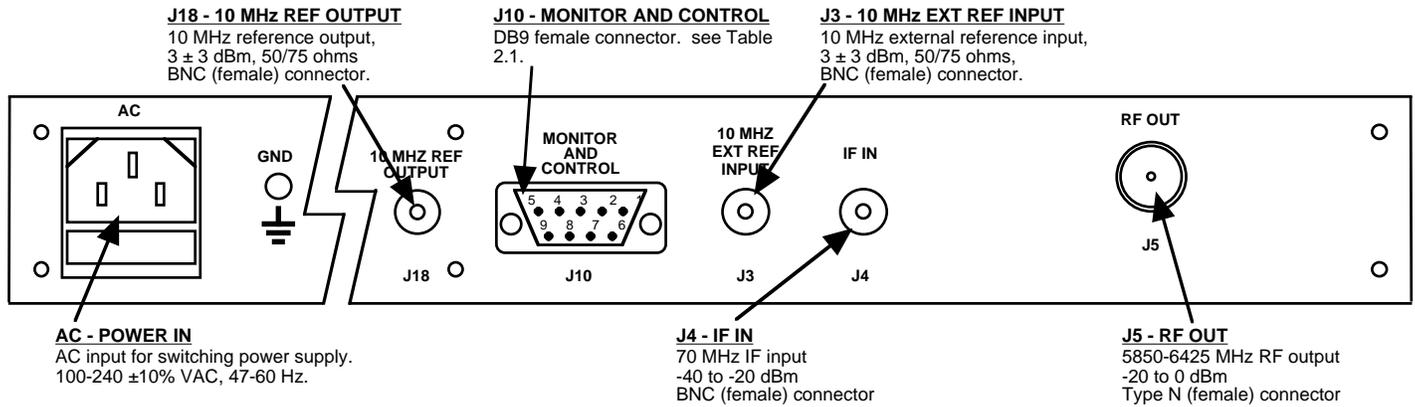


FIGURE 2.2 2015-61 Rear Panel Inputs and Outputs

Pin	Description
1	Rx-
2	Rx+ (RS-232C)
3	Tx+ (RS-232C)
4	Tx-
5	Ground
6	Alarm Relay - Common
7	Alarm Relay - Normally Open
8	Not Used
9	Alarm Relay - Normally Closed

***Interface:** DB-9 Female; **Protocol:** RS-485, RS-422, or RS-232C (selectable), 9600 baud rate, no parity, 8 data bits, 1 start bit, 1 stop bit

2.3 Front Panel Controls and Indicators -The following are the front panel controls and indicators.

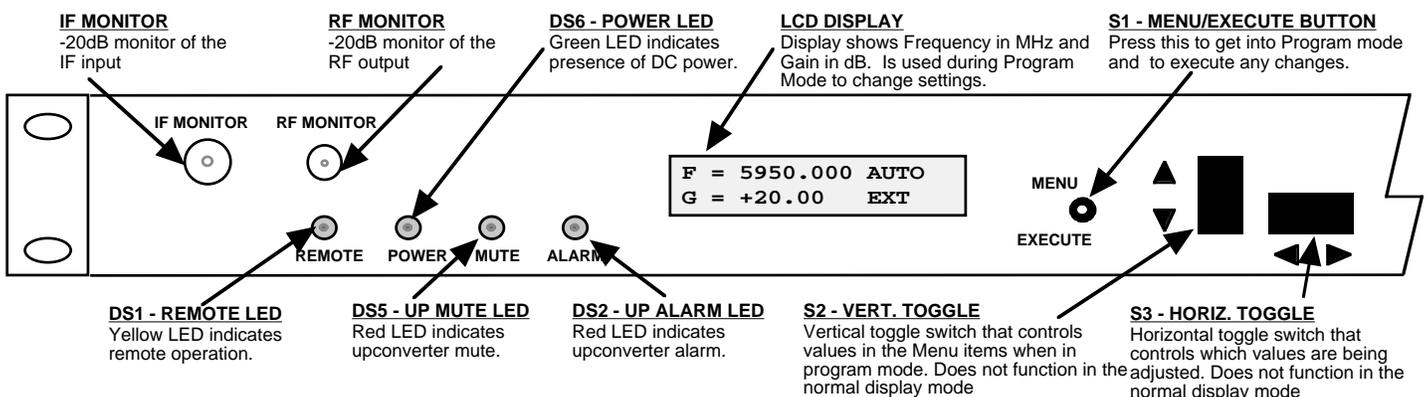


FIGURE 2.3 2015-61 Front Panel Controls and Indicators

2.4 Installation / Operation

2.4.1 Installing and Operating the 2015-61 Upconverter

1. Connect a -40 dBm to -20 dBm, 70MHz signal to IF IN, J4 (Figure 2.2)
2. Connect the RF OUT, J5, to the external equipment.
3. Connect 100-240 \pm 10% VAC, 47 - 63 Hz to AC input on the back panel.
4. Select 10 MHz Reference Mode EXT, INT, AUTO (automatically locks to external reference at 0 ± 3 dBm in) (See Section 2.5 Menu Settings).
5. Set the desired output frequency (See Section 2.5 Menu Settings).
6. Set the input level (See Section 2.5 Menu Settings).
7. Set the gain for +10 to +30 dB. Make sure the output stays within -20 to 0 dBm with the gain selected and the input level provided. The firmware will prevent setting gain and input level outside this range. (See Section 2.5 Menu Settings).
8. Set the 10 MHz reference operating mode as desired for AUTO, EXTERNAL, or INTERNAL (See Section 2.5 Menu Settings).
9. Be sure DS6 (green, DC Power) is on and DS2 (red, Alarm) is off (Figure 2.3).
10. AC Fuse - The fuse is a 5 mm X 20 mm, 2 amp slow blow (Type T) and is inserted in the far slot in the drawer below the AC input as shown in Figure 2.4. There is a spare fuse in the near slot. If a fuse continues to open, the power supply is most likely defective.

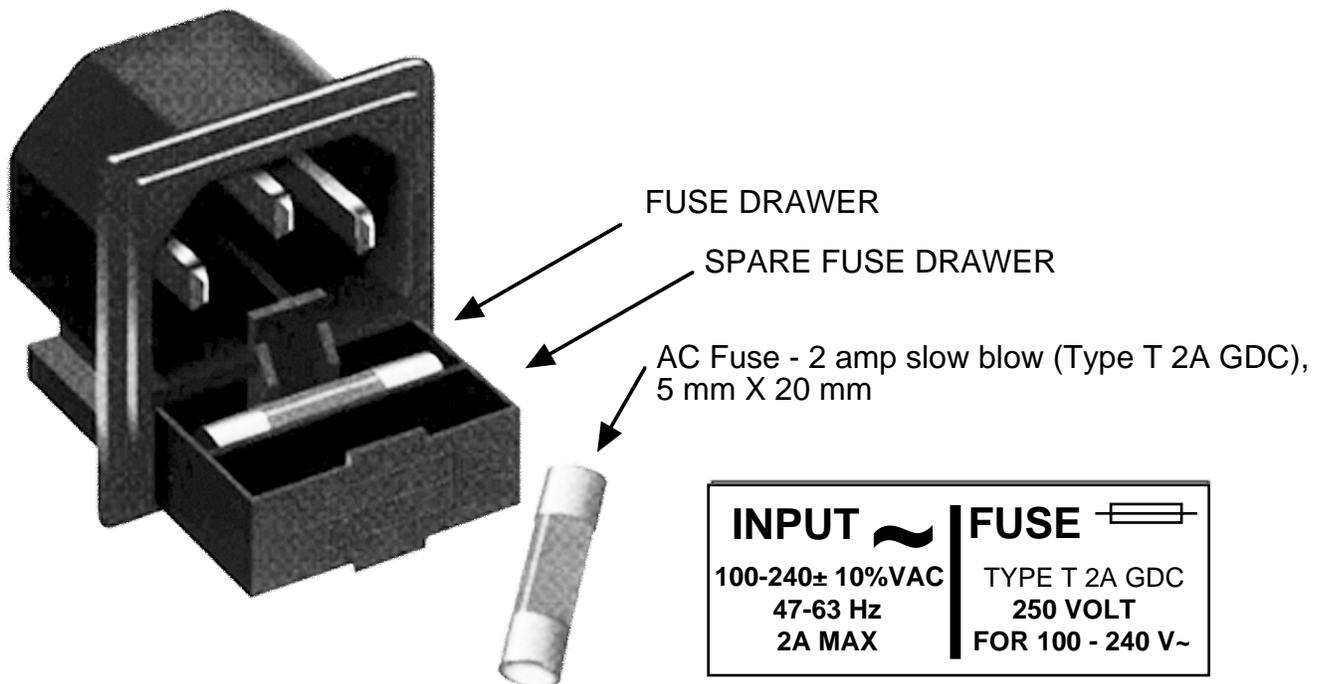


FIGURE 2.4 Fuse Location and Spare Fuse

2.5 Menu Settings

2.5.1 Functions - This section describes operation of the front panel controls. There are three operator switches, the LCD display and alarm indicator LEDs. All functions for the equipment are controlled by these components. The functions are (see Figure 2.5):

Power Up

Normal Display

Menu 1	Frequency in MHz
Menu 2	Input Level in dBm (-40 to -20)
Menu 3	Gain in dB (0 to +20)
Menu 4	Mute TX Signal
Menu 5	Set Unit to Remote Operation
Menu 6	Select Frequency Step Size (1kHz, 10kHz, 100kHz, or 125kHz)
Menu 7	Select Reference Mode EXT, INT, AUTO (locks to external reference at 0 ± 3 dBm in)
Menu 8	Select RS232, RS422, or RS485 Remote Operation (option Q)
Menu 9	Select RS485 Remote Address for Unit (option Q)

Save Menu When go to end

Alarm indications appear on the LEDs (see figure 2.2).

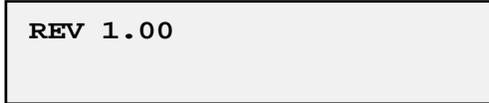
All program changes must start with the operation of the Menu/Execute switch and must also end with the operation of the Menu/Execute switch verified by the "Save Settings?" Menu. If this sequence is not followed, none of the changes will take effect. If programming is initiated and no operator action takes place for approximately 12 seconds (before the final press of the Menu/Execute switch) the display will revert to its previous status and you will need to start over.

2.5.2. Power On Settings

NOTE: The last status of a unit is retained even when power is removed. When power is restored, the unit will return to its previous settings.

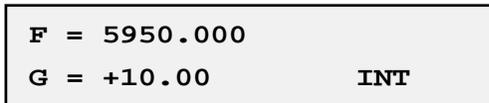
When power is first applied, the LCD display goes through three steps.

1. The LCD goes black to show all segments are functioning.
2. The software version will be displayed.



REV 1.00

3. The present frequency, gain, and selected 10 MHz Reference mode of the upconverter is shown.



F = 5950.000
G = +10.00 INT

The unit is now operational and ready for any changes the operator may desire.

2.5.3 Control Switches

1. Menu/Execute - Any change to the programming of the unit must be initiated by pressing the Menu/Execute switch and completed by pressing the Menu/Execute switch.
2. Horizontal Switch - This switch is mounted so its movement is horizontal and moves the cursor left or right.
3. Vertical Switch - This switch is mounted so its movement is vertical and has two functions:
 - A) During frequency, gain changes, the vertical movement will raise or lower the number in the direction of the arrows.
 - B) For other functions such Mute on/off, the vertical switch will alternately turn the function on or off regardless of the direction operated.

2.5.4 Frequency Changes

At any time during the modification process, if you have made a mistake and do not wish to save the changes you have made, **do not press the Menu/Execute switch**; simply do nothing for approximately 12 seconds, and the system will return to the normal operating mode or scroll to “**R**” and push the menu/Execute switch and select “**NO**” in the “**SAVE SETTINGS?**” window.

To change the FREQUENCY:

1. Operate the Menu/Execute switch until you get to the menu item you want to change see Figure 2.5 for the sequence of menu options. The following display is for changing the upconverter frequency:

```
F = 5950.000      R
```

Pressing the Up/Down switch down will toggle the display to:

```
F = 5850.000      R
```

By using the horizontal rocker switch the cursor can be moved left or right .

```
F = 5850.000      R
```

NOTE: STEP SIZE IS FACTORY SET TO 1 KHZ STEPS SO YOU CAN ADJUST 1, 10, OR 100 KHZ BY SCROLLING TO THAT DIGIT. THE UNIT WILL ONLY INCREMENT AS LOW AS THE STEP IT IS SET TO INCREMENT IN.

NOTE: CHANGES DO NOT TAKE PLACE ON FREQUENCY UNTIL YOU GO TO THE SAVE MENU AND INDICATE YOU WANT TO SAVE THE CHANGES. THE CARRIER IS MUTED WHEN FREQUENCY IS CHANGED.

When the display indicates the value desired you can push the Menu/Execute switch to the next item:

```
INLVL = -20      R
```

OR you can scroll to “R”, push the Menu/Execute switch to get to:

```
SAVE SETTINGS?  Y N
```

Selecting **Y** will save the new settings. Selecting **N** will revert to the previous settings.

Pushing the Menu/Execute switch then takes you to the default display:

```
F = 5950.000
G = +10.00      INT
```

Figure 2.5 shows all the menu items and how to make changes.

2.5.5 Gain Changes

When you get to this menu note that the gain changes will be made as you make them but if you do not wish to save the changes you have made, scroll to “R” and push the menu/Execute switch and select “NO” in the “SAVE SETTINGS?” window or **do not press the Menu/Execute switch**; simply do nothing for approximately 12 seconds, and the system will return to the normal operating mode.

To change the GAIN, first push the Menu/Execute switch to get to the gain setting:

Operate the Menu/Execute switch until you get to the menu item you want to change (see Figure 2.5 for the sequence of menu options). The following display is for changing the upconverter input level. This is an important setting to optimize spurious and should be made as accurately as possible:

```
INLVL = -20           R
```

NOTE: CHANGES TAKE PLACE ON LEVEL AND GAIN IMMEDIATELY BUT DO NOT GET SAVED UNTIL YOU GO TO THE SAVE MENU AND INDICATE YOU WANT TO SAVE THE CHANGES.

Press the Up/Down switch to change the level in 1 dB steps and then push the Menu/Execute switch to get to the Gain setting:

```
G = +10.00           R
```

Press the Up/Down switch to change the gain in 0.25, 1 or 10 dB steps:

```
G = +20.00           R
```

By using the horizontal rocker switch the cursor can be moved left or right. Pressing the Up/Down switch down will toggle the display digit selected until you have the desired gain.

NOTE: THE GAIN WILL BE CHANGED AS YOU ADJUST THE NUMBERS. HOWEVER, THE VALUE WILL NOT BE STORED UNTIL YOU INDICATE YES IN THE SAVE SETTINGS WINDOW. DO NOT SET A GAIN THAT WOULD EXCEED 0 dBm OR HAVE LESS THAN -20 dBm OUTPUT LEVEL. THE FIRMWARE PREVENTS YOU FROM THIS.

When the display indicates the value desired you can push the Menu/Execute switch to the next item OR you can scroll to “R”, push the Menu/Execute switch to get to:

```
SAVE SETTINGS?   Y N
```

Selecting Y will save the new settings. Selecting N will revert to the previous settings.

Pushing the Menu/Execute switch then takes you to:

```
F = 5850.000
G = +20.00       INT
```

Figure 2.5 gives the menu items and how to make changes

2.5.6 10 MHz Reference Mode Changes

At any time during the modification process, if you have made a mistake and do not wish to save the changes you have made, **do not press the Menu/Execute switch**; simply do nothing for approximately 12 seconds, and the system will return to the normal operating mode or scroll to “**R**” and push the menu/Execute switch and select “**NO**” in the “**SAVE SETTINGS?**” window.

To change the 10 MHz REF:

1. Operate the Menu/Execute switch until you get to the menu item you want to change see Figure 2.5 for the sequence of menu options. The following display is for changing the 10 MHz Reference Mode:

```
REF MODE = INT      R
```

Pressing the Up/Down switch down will toggle the display to:

```
REF MODE = AUTO      R
```

By using the horizontal rocker switch the cursor can be moved left or right .

```
REF MODE = EXT      R
```

NOTE: CHANGES DO NOT TAKE PLACE ON FREQUENCY UNTIL YOU GO TO THE SAVE MENU AND INDICATE YOU WANT TO SAVE THE CHANGES. THE CARRIER IS MUTED WHEN REFERENCE IS CHANGED IF PLL LOCK IS IN ALARM.

When the display indicates the value desired you can push the Menu/Execute switch to the next item:

OR you can scroll to “**R**”, push the Menu/Execute switch to get to:

```
SAVE SETTINGS?  Y N
```

Selecting **Y** will save the new settings. Selecting **N** will revert to the previous settings.

Pushing the Menu/Execute switch then takes you to the default display:

```
F = 5950.000
G = +10.00      INT
```

If you have selected **AUTO**, the display will show **AUTO** and whether you have **INT** or **EXT** automatically selected.

```
F = 5950.000      AUTO
G = +10.00      INT
```

Figure 2.5 shows all the menu items and how to make changes.

2.5.7 Alarm Indications

An alarm condition will occur if the local oscillator phase lock loop (PLL) comes out of lock. The Mute LED will light if you select to mute the Tx Signal and the Remote LED will light when you select the Remote mode.

ON POWER UP			
Power Up	REV 1.00		
NORMAL DISPLAY			
Normal Display	F = 5950.000 AUTO G = +10.00 INT		PUSH BUTTON
PUSHING MENU/EXECUTE SEQUENCE			
Menu 1 Set Frequency	F = <u>5950.000</u> R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 2 Set Input Level (from -40 to -20)	INLVL = <u>-20</u> R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 3 Set Gain (+10 to +30)	G = <u>+10.00</u> R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 4 Mute TX signal	MUTE <u>OFF</u> R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 5 Set Unit to Remote Operation	REMOTE <u>OFF</u> R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 6 Set Frequency Step Size (1kHz, 10kHz, 100kHz, or 125kHz)	STEP = <u>1</u> KHZ R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 7 Select External 10 MHz Reference Mode	REF MODE = AUTO R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 8 Set Remote Mode (option -Q)	<u>RS485</u> R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 9 Set RS-485 Address (option -Q)	ADDRESS = <u>00</u> R	SCROLL <> SCROLL ⬇	PUSH BUTTON
Menu 10 View PCB Temperature (option -T)	TEMP = 35 DEG R	SCROLL <>	PUSH BUTTON
Save Settings? At the end or when "R" is selected from any of the above menus	SAVE SETTINGS? <u>Y</u> N	SCROLL <>	PUSH BUTTON

FIGURE 2.5 Menu Display and Sequence



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