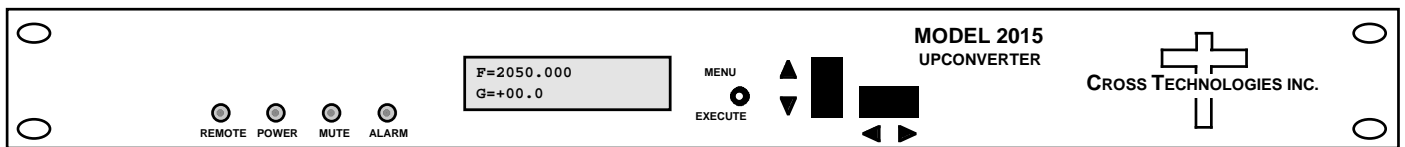


# Instruction Manual

# Model 2015-225 Upconverter

August 2007 Rev. A



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**INSTRUCTION MANUAL**  
**MODEL 2015-225 Upconverter**

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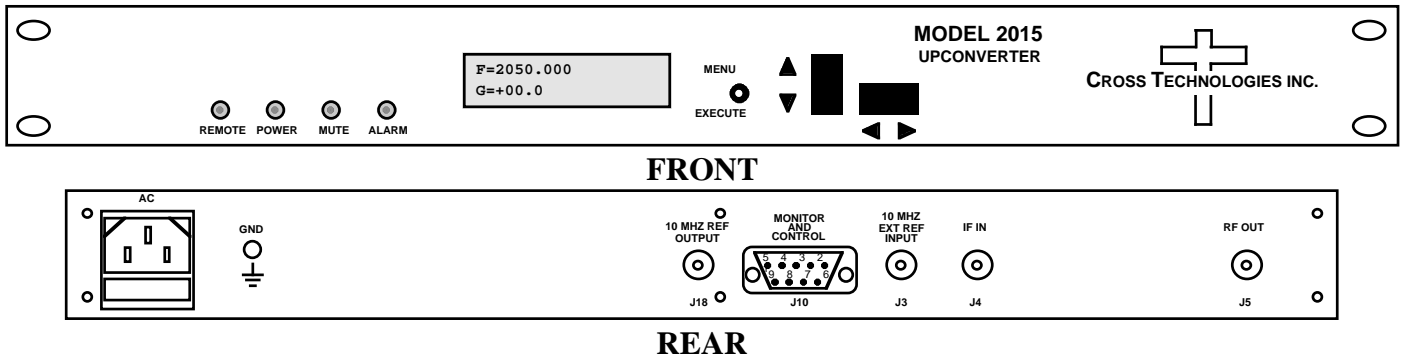
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# MODEL 2015-225 Upconverter

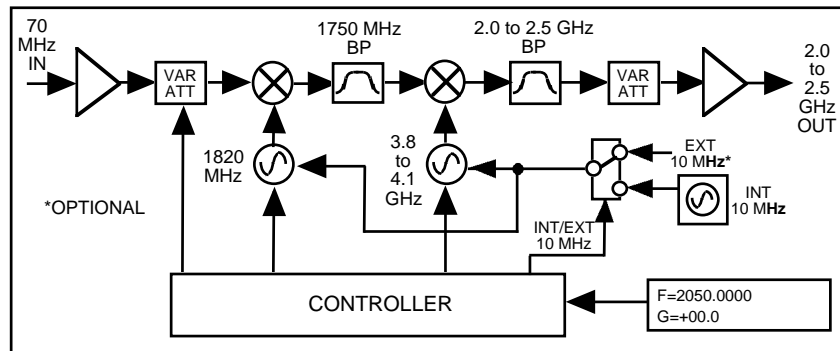
## 1.0 General

### 1.1 Equipment Description

The 2015-225 Upconverter converts  $70 \pm 18$  MHz to 2000 to 2500 MHz in 1kHz, 10kHz, or 125kHz steps (user selectable) with low group delay and flat frequency response. Synthesized local oscillators (LO) provide very low phase noise and  $\pm 0.01$  ppm stability frequency selection. Multi-function push button switches select the RF frequency, gain, and other parameters. Front panel LEDs provide indication of DC power (green), PLL alarm (red), remote operation (yellow) or the TX carrier is muted (yellow). Variable attenuators for the IF input and output provide a gain range of -10 to +30 dB as adjusted by the front panel multi-function push-button switches. Remote operation allows selection of frequency and gain. Parameter selection and frequency and gain settings appear on the LCD display. Connectors are BNC female for IF Input, RF outputs and the 10MHz external reference input and 10MHz reference output. The unit is powered by a 100-240  $\pm 10\%$  VAC power supply, and is housed in a 1 3/4" X 19" X 16" rack mount chassis.



**FIGURE 1.1 Model 2015-225 Front and Rear Panels**



**FIGURE 1.2 Model 2015-225 Upconverter Block Diagram**

## 1.2 Technical Characteristics

**TABLE 1.1 2015-225 Upconverter Specifications\***

### Input Characteristics

Impedance/Return Loss	50 $\Omega$ /18 dB
Frequency	70 $\pm$ 18 MHz
Input Level	-40 to -10 dBm

### Output Characteristics

Impedance/Return Loss	50 $\Omega$ /12 dB
Frequency	2000 to 2500 MHz
Output level	0 to -20 dBm
Output level/1 dB	+5 dBm

### Channel Characteristics

Gain range (adjustable)	-10.0 to +30.0 dB
Frequency Response	$\pm$ 1.5 dB, 2000 to 2500 MHz; $\pm$ 0.5 dB, 36 MHz BW
Spurious Response	< -50 dBC
Group Delay, max	0.01 ns/MHz <sup>2</sup> parabolic; 0.03 ns/MHz linear; 1 ns ripple
Frequency Sense	Non-inverting

### Synthesizer Characteristics

Frequency Accuracy	$\pm$ 0.01 ppm max over temp internal reference
Frequency Step	1 kHz, 10 kHz, 100 kHz, or 125 kHz (selectable)
10 MHz Level (In or Out)	+3 dBm, $\pm$ 3 dB, 75 ohms

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

### Controls, Indicators

Frequency Selection	direct readout LCD; pushbutton switches or remote selection
Gain Selection	direct readout LCD; pushbutton switches or remote selection
Power	Green LED
Alarm	Red LED
Mute	Yellow LED
Remote	Yellow LED, RS232C, 9600 baud

### Other

RF Connector	BNC (female), 50 $\Omega$
IF Connector	BNC (female), 50 $\Omega$
10 MHz Connectors	BNC (female), 50 $\Omega$ /75 $\Omega$
Alarm/Remote Connector	DB9 (female), NO or NC contact closure on Alarm
Size	19 inch, 1RU standard chassis 1.75" high X 16.0" deep
Power	100-240 $\pm$ 10% VAC, 47-63 Hz, 45 W max

### Options

E	External 10MHz Ref Input and 10MHz Output
Q	RS485 Remote Control
Z	0.1 dB steps on Attenuator
SW	Switchable dual RF outputs

\*+10°C to +40°C; Specifications subject to change without notice

### 1.3 Monitor and Control Interface

#### A) Remote Serial Interface

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

**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 1.2 lists the status requests for the 2015-225 and briefly describes them.

Table 1.2 2015-225 Status Requests		
Command	Syntax *	Description
Command Status	{aaS1}	Returns {aaS1bbbbbbccdddAMR} where: <ul style="list-style-type: none"> <li>• bbbbbbb = Tx frequency</li> <li>• cc = Input Level</li> <li>• dddd = Tx Gain</li> <li>• A = Alarm Status (0 = NO Alarm, 1 = Alarm)</li> <li>• M = Tx RF Status (1 = Normal, 0 = Muted)</li> <li>• R = RF Output Status (0 = RF Out A, 1 = RF Out B)</li> </ul> on units with option SW
	{aaS2}	Returns {aaS2E} where: <ul style="list-style-type: none"> <li>• E= external 10MHz status (1=on, 0=off)</li> </ul>
* PLEASE NOTE: The Address (aa) should only be used when RS-485 is selected.		

**C) Commands** - Table 1.3 lists the commands for the 2015-225 and briefly describes them. After a command is sent the 2015-225 sends a return “>” indicating the command has been received and executed.

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

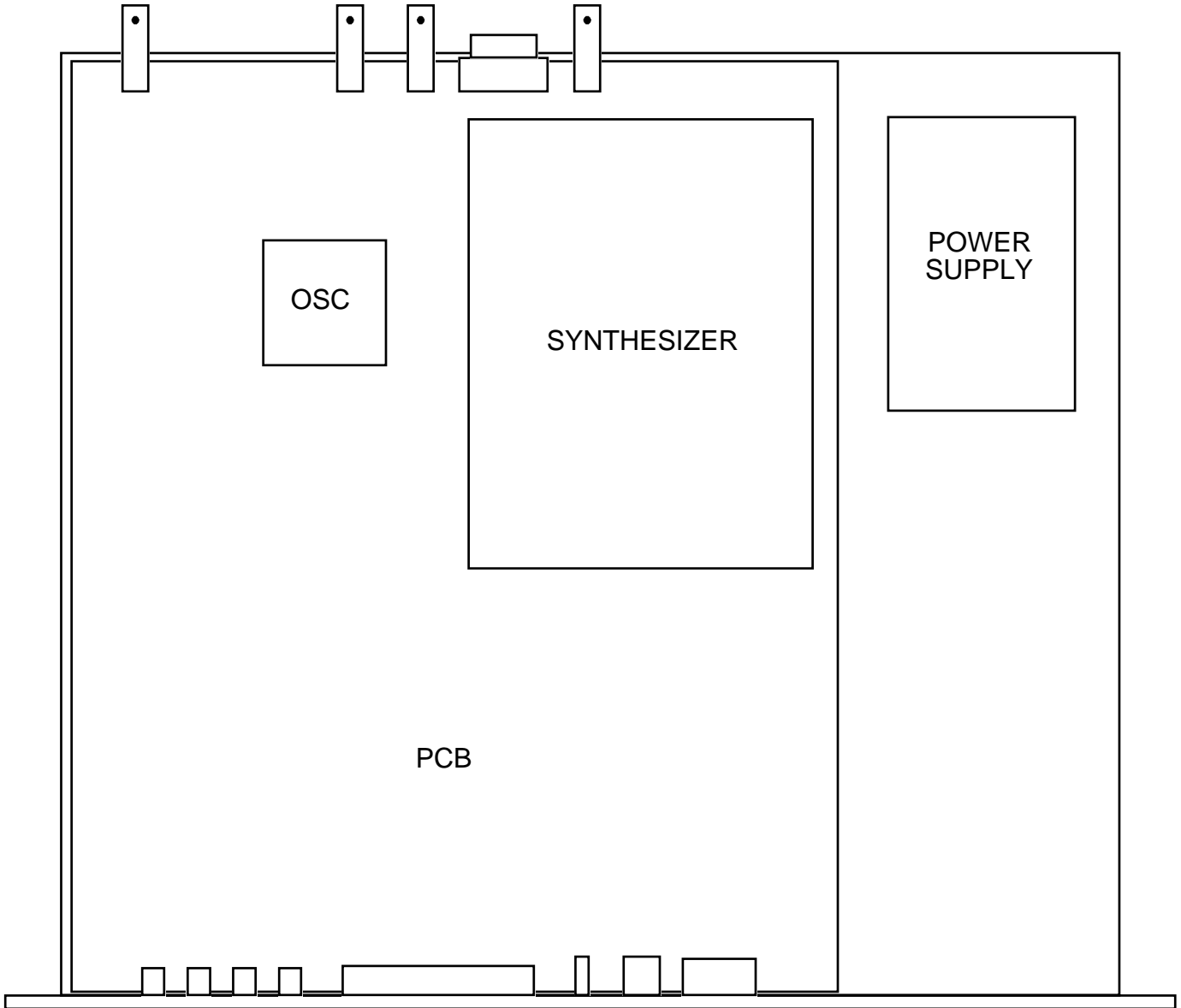
- { = start byte
- aa = Address (**RS-485 only**)
- C = 1 character, either C (command) or S (status)
- N = 1-digit command or status number, 1 through 9
- D = 1 character or more of data (depends on command)
- } = stop byte

<b>Table 1.3 2015-225 Commands</b>		
<b>Command</b>	<b>Syntax</b>	<b>Description</b>
Set Transmitter Frequency	{aaC1xxxxxxx}* 	where: • xxxxxxx = 7 characters • Range: 2000000 to 2500000 kHz, 1kHz steps
Set Input Level	{aaClxx}* 	where: • xx = 2 characters • Range: 10 to 40 (-10 dB to -40 dB, in 1 dB steps)
Set Transmit Gain	{aaC3xxx}* 	where: • xxx = 3 characters • Range: -10 to +30 (-10 dB to 30 dB, 1 dB steps)
Set Transmit Gain <b>(option Z)</b>	{aaC3xxxx}* 	where: • xxxx = 4 characters • Range: -100 to +300 (-10.0 dB to 30.0 dB, 0.1 dB steps)
Set RF Output <b>(option SW only)</b>	{aaC7x}* 	where x =: • 0 for RF Out = A • 1 for RF Out = B
Enable Tx	{aaCAx}* 	where x =: • 0 to disable Tx signal • 1 to enable Tx signal
Enable External 10MHz <b>(option E only)</b>	{aaCEx}* 	where x =: • 0 to disable External 10MHz ref signal • 1 to enable External 10MHz ref signal
Enable Remote	#	Just # sign
Disable Remote	{aaCRO}* 	{CR and zero}
<b>* PLEASE NOTE: The Address (aa) should only be used when RS-485 is selected.</b>		

## 2.0 Installation

### 2.1 Mechanical

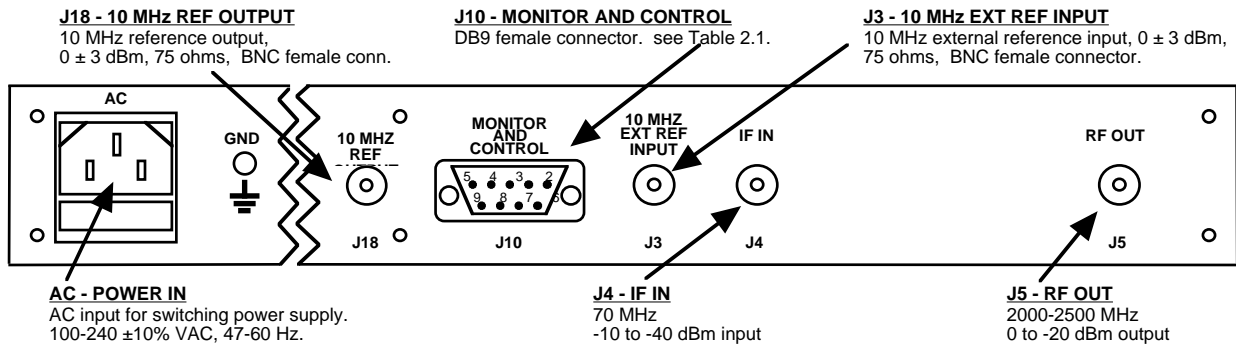
The 2015-225 consists of one RF/Controller PCB which is housed in a 1 RU (1 3/4 inch high) by 16 inch deep chassis. A switching,  $\pm 12$ , +24, +5 VDC power supply provides power for the assembly. The 2015-225 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 2015-225 is assembled.



**FIGURE 2.1 Mechanical Assembly**

## 2.2 Rear Panel Input / Output Signals

Figure 2.2 shows the input and output connectors on the rear panel.



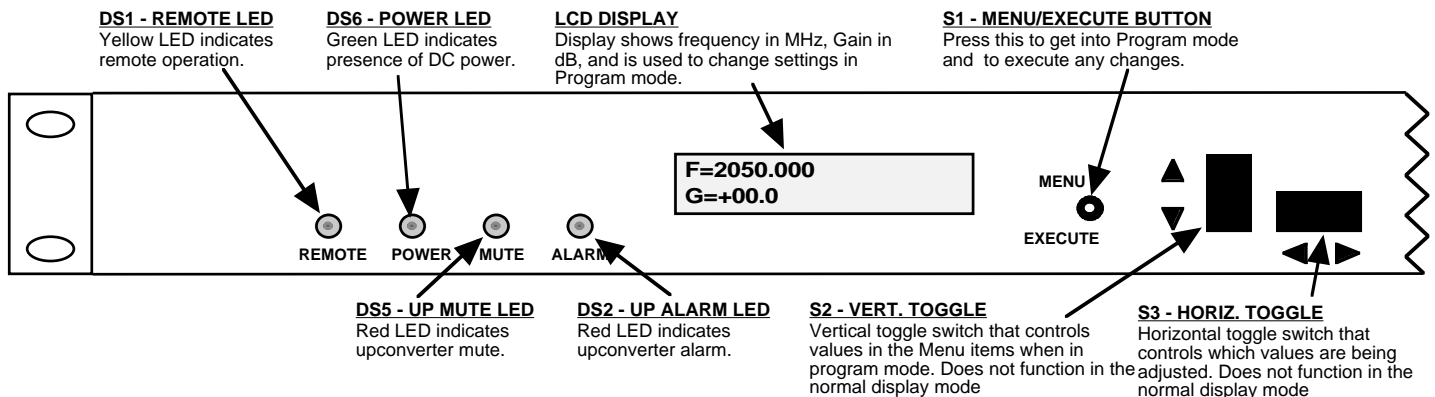
**FIGURE 2.2 Rear Panel Inputs and Outputs**

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-232C (RS-485, RS-422, option Q), 9600 baud rate, no parity, 8 data bits, 1 start bit, 1 stop bit

## 2.3 Front Panel Controls and Indicators

Figure 2.3 shows the front panel controls and indicators.

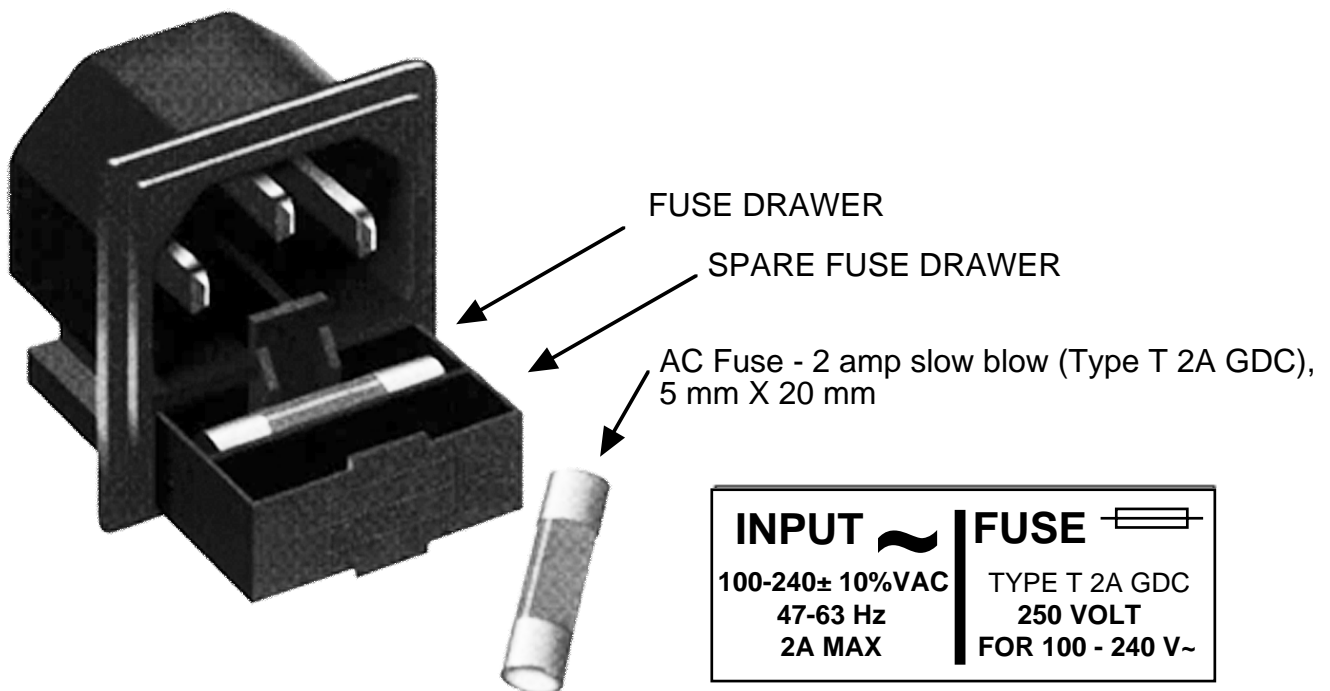


## **FIGURE 2.3 Front Panel Controls and Indicators**

### **2.4 Installation / Operation**

#### **2.4.1 Installing and Operating the 2015-225 Upconverter**

1. Connect a -10 dBm to -40 dBm, 70 MHz signal to IF IN, J4 (Figure 2.2)
2. Connect 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. Set the desired output frequency (See Section 2.5 Menu Settings).
5. Set the input level (See Section 2.5 Menu Settings).
6. 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).
7. Be sure DS6 (green, DC Power) is on and DS2 (red, Alarm) is off (Figure 2.3).
8. 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

<b>Menu 1</b>	Frequency in MHz
<b>Menu 2</b>	Input Level (-40 to -10)
<b>Menu 3</b>	Gain (-10.0 to +30.0)
<b>Menu 4</b>	Mute
<b>Menu 5</b>	Select RF Output (option SW only)
<b>Menu 6</b>	Set Unit to Remote Operation (Note: the local controls still function when in REMOTE)
<b>Menu 7</b>	Select Frequency Step Size (1kHz, 10kHz, 100 kHz, or 125kHz)
<b>Menu 8</b>	Select External 10 MHz Ref (option E only)
<b>Menu 9</b>	Select RS232, RS422, or RS 485 Remote Operation (option Q only)
<b>Menu 10</b>	Select Remote RS485 Address for Unit (option Q only)

**Save Menu** When “R” is selected or at the end of the menus

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 it's 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 RF output of the upconverter is shown.

F = 2050.000
G = +00.0

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 = 2050.000	R
--------------	---

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

F = 2150.000	R
--------------	---

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

F = 21 <u>5</u> 0.000	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 FREQUENCY IS CHANGED.**

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

UP INLVL = -20	R
----------------	---

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

SAVE SETTINGS? <u>Y</u> 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 = 2150.000
G = +00.0

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:

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 input level. This is an important setting to optimize spurious and should be made as accurately as possible:

UP INLVL = -2 <u>0</u>	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 = + <u>00</u> .0	R
--------------------	---

Press the Up/Down switch to change the gain in 0.1, 1 or 10 dB steps:

G = + <u>10</u> .0	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? <u>Y</u> N
---------------------------

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

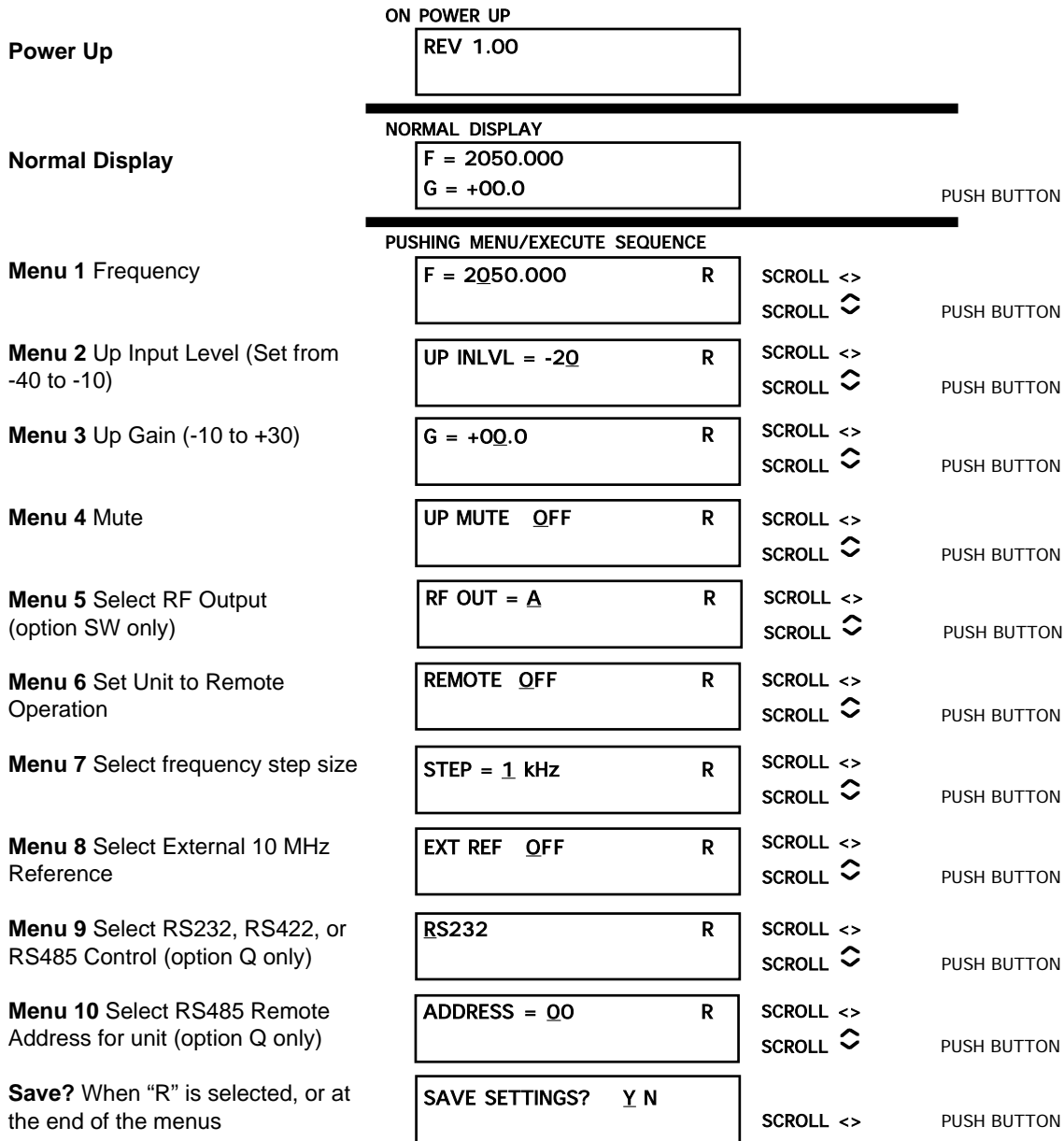
Pushing the Menu/Execute switch then takes you to:

F = 2150.000
G = +10.0

Figure 2.5 gives the menu items and how to make changes

### 2.5.5 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.



**FIGURE 2.5 Menu Display and Sequence**



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