INSTRUCTION MANUAL

MODEL 2016-123 Downconverter

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MODEL 2016-123 Downconverter

1.0 General

1.1 Equipment Description

The 2016-123 Downconverter converts 2025 to 2300 MHz (in 1 kHz, 10 kHz, or 125 kHz steps - user selectable) to 70 ± 18 MHz with low group delay and flat frequency response. Synthesized local oscillators (LO) provide very low phase noise and ±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), and remote operation (yellow). Gain is adjustable manually over a 0 to +50 dB range 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 RF Input, IF outputs and the 10MHz external reference input and 10MHz reference output. The 10MHz reference signal (internal or external) can be sent to the 10MHz reference output connector and/or to the RF IN connector. The IF signal is split into two signals (A and B). The unit is powered by a 90-260 VAC power supply, and housed in a 1 3/4" X 19 " X 16" rack mount chassis.
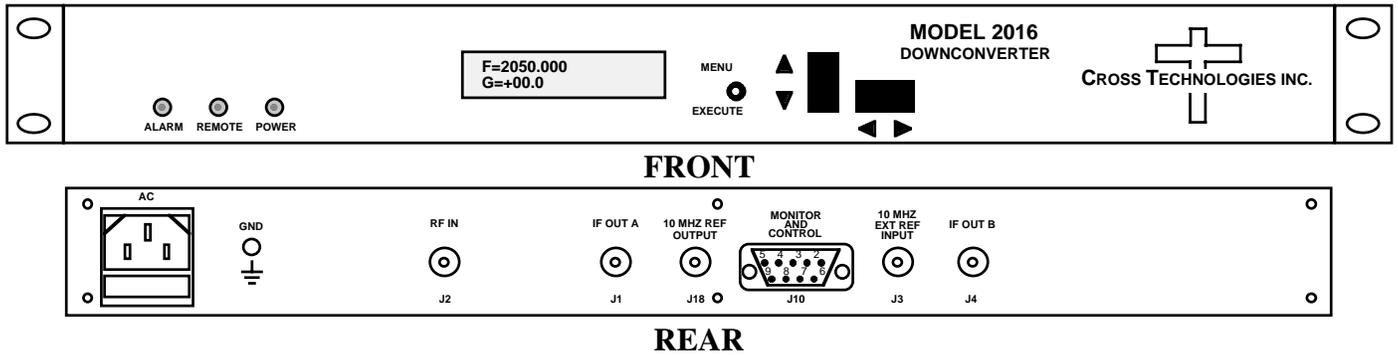

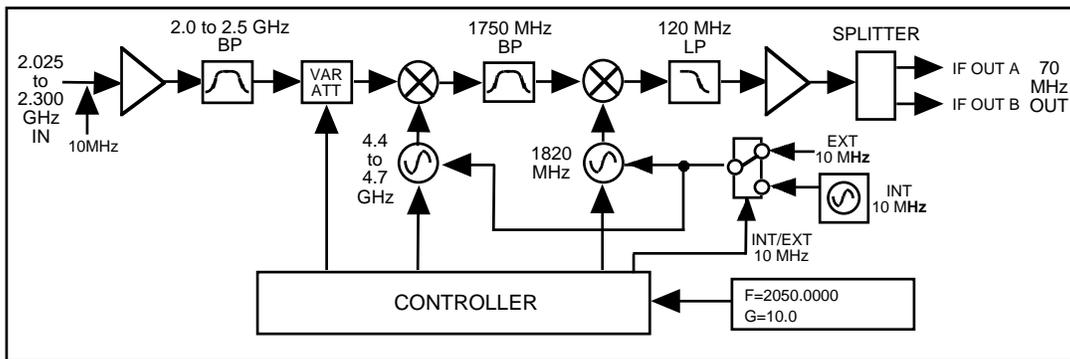**FIGURE 1.1 Model 2016-123 Front and Rear Panels**

FIGURE 1.2 Model 2016-123 Downconverter Block Diagram

1.2 Technical Characteristics

TABLE 1.1 2016-123 Downconverter Specifications*

Input Characteristics

Impedance/Return Loss	50 Ω /10 dB
Frequency	2025 to 2300 MHz
Noise Figure, max.	15 dB (max gain)
Input Level	-70 to -20 dBm
Input 1dB compression	-15 dBm (min gain)

Output Characteristics

Impedance/Return Loss	50 Ω/18 dB
Frequency	70 ± 18 MHZ
Output level/max linear	-20 dBm / -10 dBm
Output 1dB compression	-5 dBm

Channel Characteristics

Gain range (adjustable)	0 to +50 dB (1 dB steps)
Image Rejection	> 50 dB
Spurious Response	<-50 dBC in band
Frequency Response	±1.5 dB, 2025 to 2300 MHz; ± 0.5 dB, 36 MHz BW
Group Delay, max	3 ns, 30 MHz, 5 ns, 36 MHz BW
Frequency Sense	Non-inverting

Synthesizer Characteristics

Frequency Accuracy	± 0.01 ppm max over temp internal reference; external ref. input
Frequency Step	1 kHz, 10 kHz, or 125 kHz (selectable)

Phase Noise (Freq)	100Hz	1kHz	10kHz	100kHz	1MHz
(dBC/Hz)	<-75	<-90	<-97	<-107	<-117

10 MHz Level (In or Out)	0 dBm, ± 3 dB, 75 ohms

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
Remote	Yellow LED, RS232C/RS422/RS485 (selectable), 9600 baud

Other

RF Connectors	BNC (female), 50 Ω
IF Connector	BNC (female), 50 Ω
10 MHz Connectors	BNC (female), 75 Ω
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	90-260 VAC, 47-63 Hz, 45 W max

---

*+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) Commands - Table 1.2 lists the commands for the 2016-123 and briefly describes them. After a command is sent the 2016-123 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

Table 1.2 2016-123 Commands		
Command	Syntax	Description
Set Frequency	{aaC2xxxxxxx}*	where:
		• xxxxxxx = 7 characters
		• Range: 2000000 to 2500000 kHz, 1kHz steps
Set Gain	{aaC4xx}*	where:
		• xx = 2 characters
		• Range: 00 to 50 (0 dB to 50 dB, in 1 dB steps)
Enable 10MHz insertion/out	{aaC5x}*	where x =:
		• 0 to disable reference out
		• 1 to enable reference out
Enable External 10MHz	{aaCEx}*	where x =:
		• 0 to disable External 10MHz ref signal
		• 1 to enable External 10MHz ref signal
Enable Remote	#	Just # sign
Disable Remote	{aaCR0}*	{CR and zero}
* PLEASE NOTE: The Address (aa) should only be used when RS-485 is selected.		

C) Status Requests - Table 1.3 lists the status requests for the 2016-123 and briefly describes them.

Table 1.3 2016-123 Status Requests		
Command	Syntax	Description
Command Status	{aaS1}*	Returns {aaS1bbbbbbbccIEA} where:
		• bbbbbbb = Frequency
		• cc = Gain
		• I = Ref Insertion Status (1 = Ref On, 0 = Ref Off)
		• E = External Ref Status (1 = Ext Off, 0 = Ext On)
		• A = Alarm Status (0 = NO Alarm, 1 = Alarm)
* PLEASE NOTE: The Address (aa) should only be		used when RS-485 is selected.

2.0 Installation

2.1 Mechanical - The 2016-123 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, ± 12, +24, +5 VDC power supply provides power for the assembly. The 2016-123 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 2016-123 is assembled.
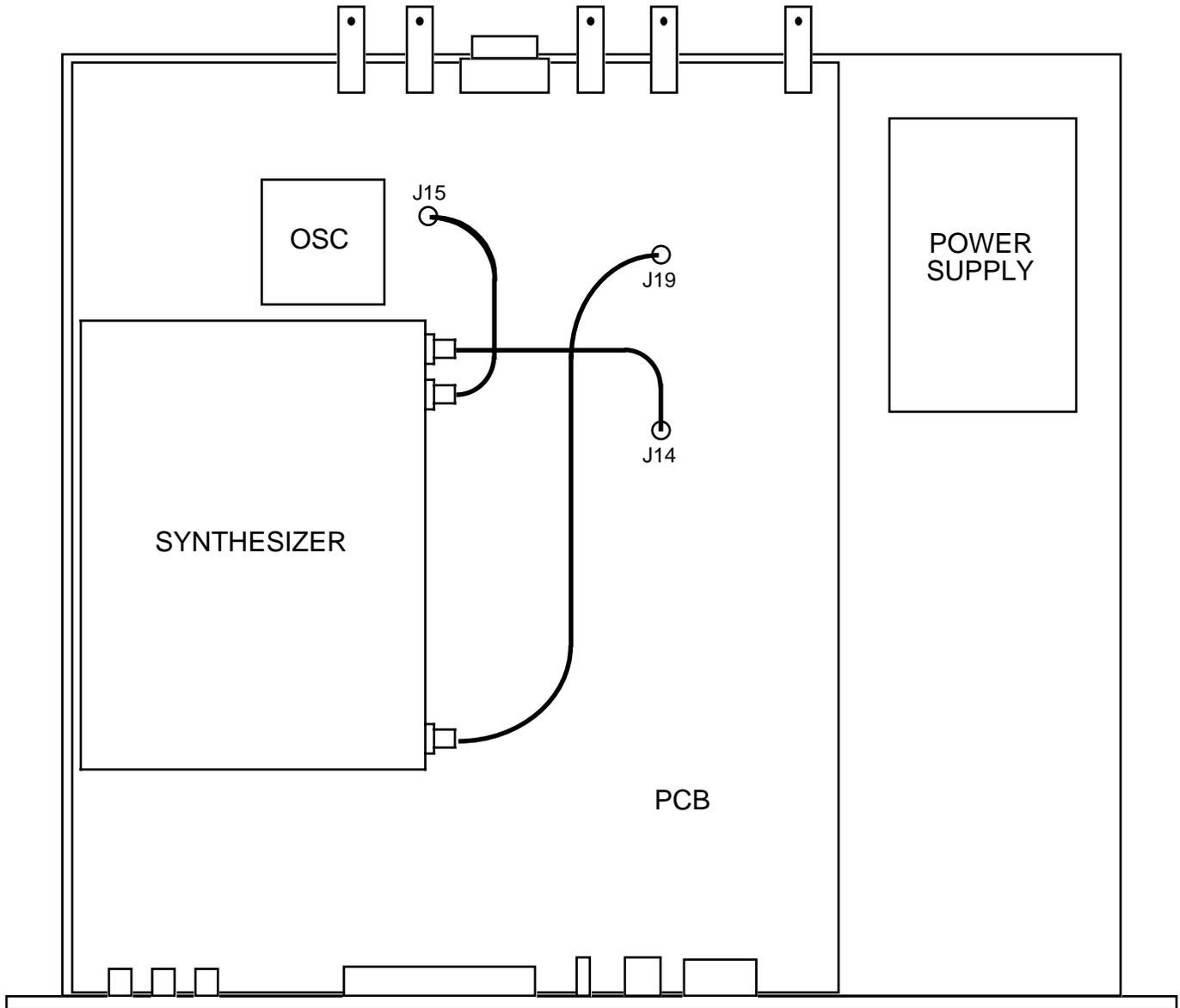

FIGURE 2.1 2016-123 Mechanical Assembly

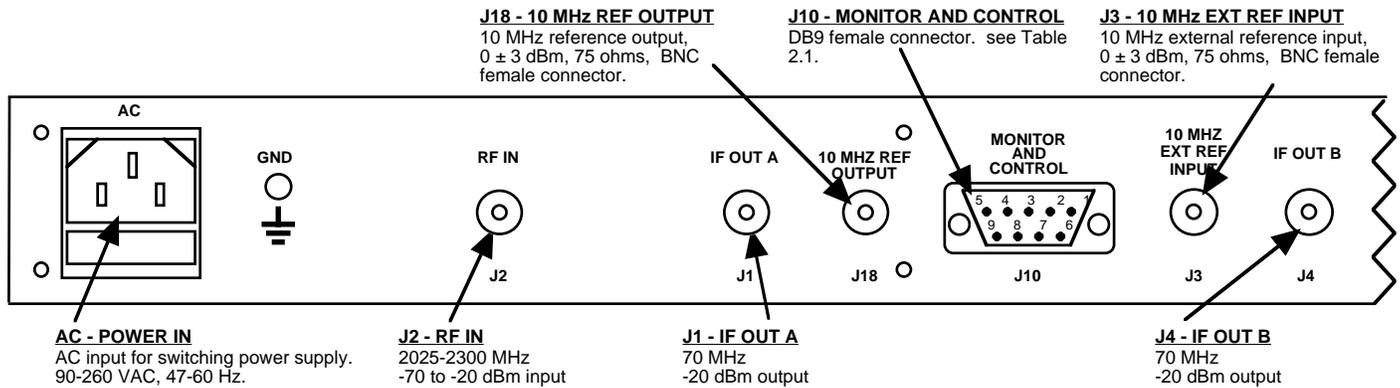## 2.2 Rear Panel Input / Output Signals - Figure 2.2 shows the input and output connectors on the rear panel.

J18 - 10 MHz REF OUTPUT
10 MHz reference output, 0 ± 3 dBm, 75 ohms, BNC female connector.

J10 - MONITOR AND CONTROL
DB9 female connector. see Table 2.1.

J3 - 10 MHz EXT REF INPUT
10 MHz external reference input, 0 ± 3 dBm, 75 ohms, BNC female connector.

AC - POWER IN
AC input for switching power supply. 90-260 VAC, 47-60 Hz.

J2 - RF IN
2025-2300 MHz
-70 to -20 dBm input

J1 - IF OUT A
70 MHz
-20 dBm output

J4 - IF OUT B
70 MHz
-20 dBm output

FIGURE 2.2 2016-123 Rear Panel Inputs and Outputs

Table 2.1 J10 Pinouts (RS-485/RS-422/RS-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

*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

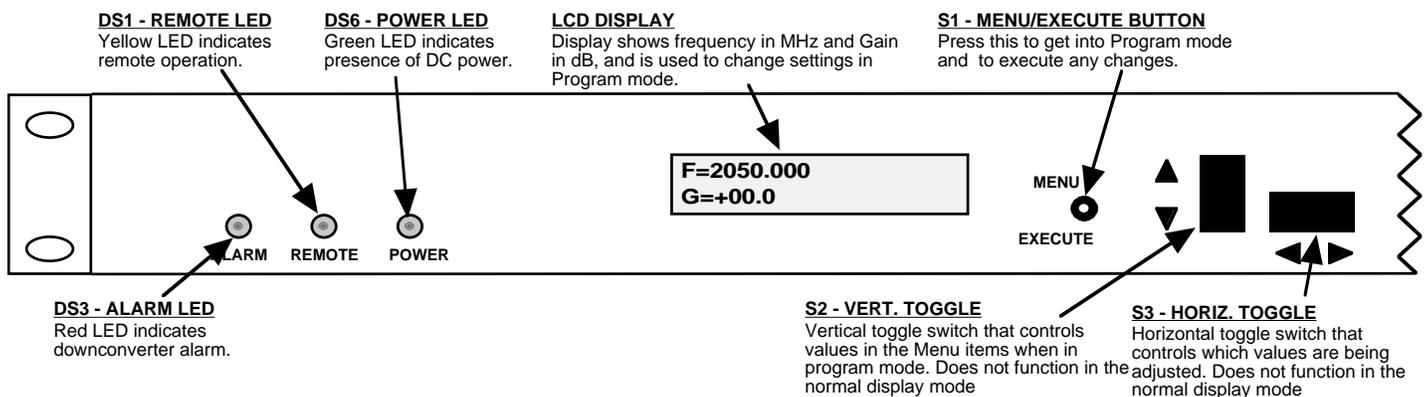## 2.3 Front Panel Controls and Indicators - The following are the front panel controls and indicators.

DS1 - REMOTE LED
Yellow LED indicates remote operation.

DS6 - POWER LED
Green LED indicates presence of DC power.

LCD DISPLAY
Display shows frequency in MHz and Gain in dB, and is used to change settings in Program mode.

S1 - MENU/EXECUTE BUTTON
Press this to get into Program mode and to execute any changes.

F=2050.000
G=+00.0

DS3 - ALARM LED
Red LED indicates downconverter alarm.

S2 - VERT. TOGGLE
Vertical toggle switch that controls values in the Menu items when in program mode. Does not function in the normal display mode

S3 - HORIZ. TOGGLE
Horizontal toggle switch that controls which values are being adjusted. Does not function in the normal display mode

FIGURE 2.3 2016-123 Front Panel Controls and Indicators

2.4 Installation / Operation

2.4.1 Installing and Operating the 2016-123 Downconverter

1.) Connect a -70 dBm to -20 dBm, 2025-2300 MHz signal to RF IN, J4 (Figure 2.2)

2.) Connect the IF OUT A, J1, and IF OUT B, J4, to the external equipment.

3.) Connect 90- 260 VAC, 47 - 63 Hz to AC input on the back panel.

4.) Set the desired input frequency (See Section 2.5 Menu Settings).

5.) Set the gain for 0 to +50 dB (See Section 2.5 Menu Settings).

6.) Be sure DS6 (green, DC Power) is on and DS2 (red, Alarm) is off (Figure 2.3).

7.) **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.
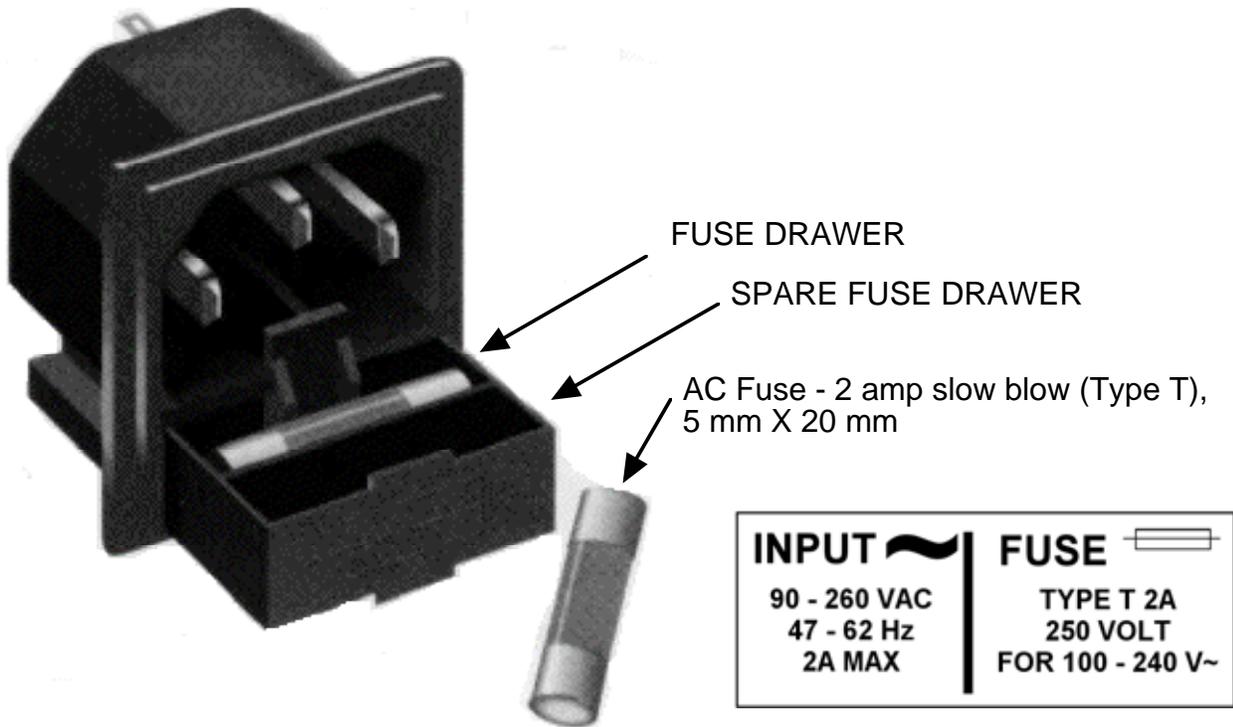

FUSE DRAWER

SPARE FUSE DRAWER

AC Fuse - 2 amp slow blow (Type T), 5 mm X 20 mm

INPUT 〰	FUSE ▭
90 - 260 VAC	TYPE T 2A
47 - 62 Hz	250 VOLT
2A MAX	FOR 100 - 240 V~

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**   Gain (0 to +50 dB)
> **Menu 3**   For Other Settings (see below)
> **Save Menu** When go to "R" or at end
>
> **IF OTHER = Y**
> **Menu 4**   Set Unit to Remote Operation (Note: the local controls still function when in REMOTE)
> **Menu 5**   Select Frequency Step Size (1kHz, 10kHz, 100kHz, or 125kHz)
> **Menu 6**   Select External 10 MHz Ref
> **Menu 7**   Select 10 MHz Output
> **Menu 8**   Select RS232, RS422, or RS 485 Remote Operation
> **Menu 9**   Select Remote Address for Unit (RS485 only)
>
> **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 it's previous settings.
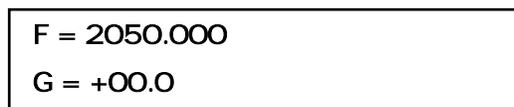
When power is first applied, the LCD display goes through three steps.

> 1.The LCD goes black to show all segments are functioning.
> 2.The software version will be displayed.
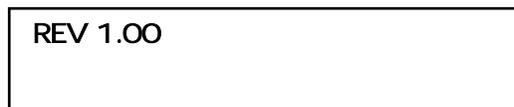
```
REV 1.00


```

> 3.The present frequency and gain of the downconverter 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. <u>Menu/Execute</u> - 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. <u>Horizontal Switch</u> - This switch is mounted so its movement is horizontal and moves the cursor left or right.

3. <u>Vertical Switch</u> - 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 downconverter 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 = 2150.000              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:

```
 G = +00.0                 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 = 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).

NOTE: CHANGES TAKE PLACE ON 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 = +00.0                    R
```

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

```
G = +10.0                    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?      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 = 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 for 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.

Power Up

ON POWER UP

REV 1.OO

Normal Display

NORMAL DISPLAY

F = 2050.OOO

G = +00.0

PUSH BUTTON

PUSHING MENU/EXECUTE SEQUENCE

Menu 1 Up Frequency

F = 2050.OOO   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Menu 2 Down Gain (0 to +50)

G = +00.0   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Menu 3 For Other Settings (below)

OTHER? Y N   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Save? When go to "R" or at end

SAVE SETTINGS?   Y N

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

IF OTHER = Y

Menu 4 Set Unit to Remote Operation

REMOTE OFF   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Menu 5 Select frequency step size

STEP = 1 kHz   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Menu 6 Select External 10 MHz Reference

EXT REF   OFF   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Menu 7 Select 10MHz Output

DN REF OUT   OFF   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Menu 8 Select RS232, RS422, or RS485 remote control

RS232   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Menu 9 Select remote address for unit (RS485 only)

ADDRESS = OO   R

SCROLL <>

SCROLL ⌃⌄   PUSH BUTTON

Save? When go to end

SAVE SETTINGS?   Y N

SCROLL <>   PUSH BUTTON

FIGURE 2.5 Menu Display and Sequence

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