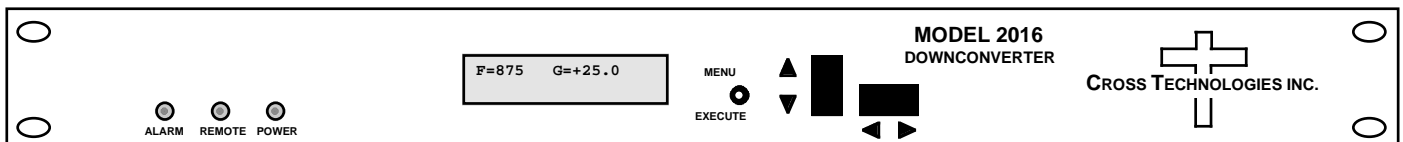


# Instruction Manual

# Model 2016-10 Downconverter

March 2007 Rev 0



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**INSTRUCTION MANUAL**

# MODEL 2016-10 Downconverter

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

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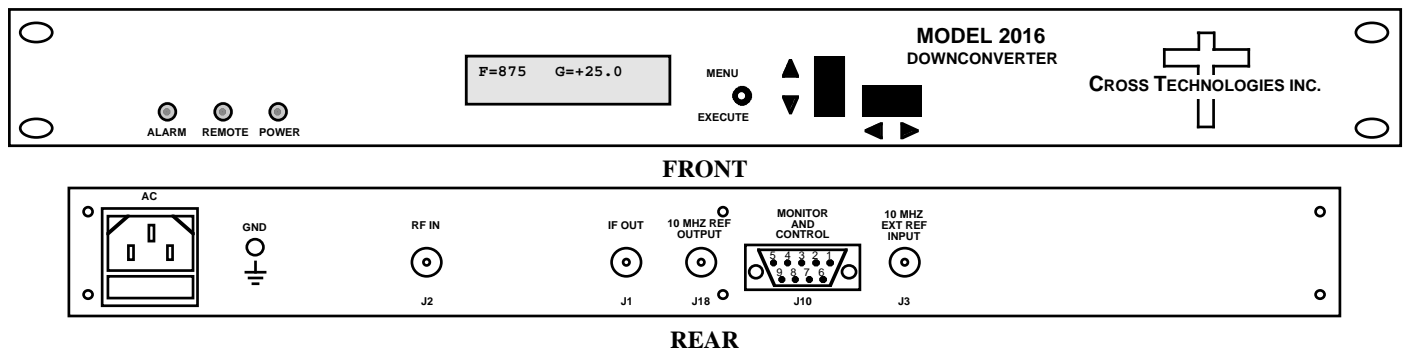
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**MODEL 2016-10 Downconverter**

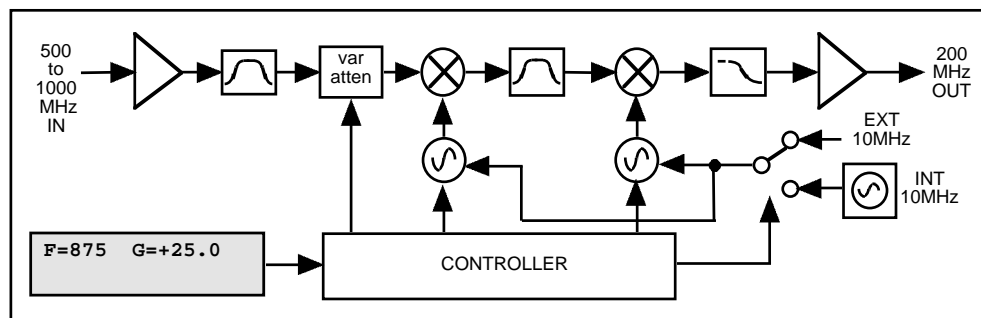
## 1.0 General

## 1.1 Equipment Description

The 2016-10 Downconverter converts 500 to 1000 MHz to  $200 \pm 55$  MHz in 1 MHz steps with low group delay and flat frequency response. Synthesized local oscillators (LO) provide frequency selection. Multi-function push button switches select the input frequency, gain, and other parameters. Front panel LEDs provide indication of DC power, PLL alarm or Remote operation. Gain is adjustable manually (MGC) over a 0 to 50 dB range. The frequency and gain are remotely selectable. Parameter selection and frequency and gain settings appear on the LCD display. Connectors are BNC female for the RF, and BNC female for the IF and optional external 10 MHz reference input and output (option E). Other connector options are available. The 2016-10 is powered by a 100-240  $\pm 10\%$  VAC power supply, and is contained in a 1 3/4" X 19" X 16" rack mount chassis.



**FIGURE 1.1 Front and Rear Panels**



**FIGURE 1.2 Block Diagram**

## 1.2 Technical Characteristics

**TABLE 1.0 2016-10 Downconverter Specifications\***

### Input Characteristics

Impedance	50 $\Omega$ (see TABLE 2.2 for connector options)
Return Loss	14 dB
Frequency	500 to 1000 MHz
Level range	-55 to -5 dBm
1dB compression	0 dBm, 0 dB gain

### Output Characteristics

Impedance	50 $\Omega$ (see TABLE 2.2 for connector options)
Return Loss	18 dB
Frequency	200 $\pm$ 55 MHz
Level	-25 to -5 dBm
1dB compression	+5 dBm

### Channel Characteristics

Gain range (adjustable)	0 to +50 dB, 1 dB steps
Image Rejection	> 50 dB, min
Spurious Response	< -50 dBC in band ( $\pm$ 18 MHz)
Frequency Response	$\pm$ 1.5 dB, 500-1000 MHz; $\pm$ 0.5 dB, 100 MHz BW; $\pm$ 0.5 dB, 110 MHz BW
Group Delay, max	0.0015 ns/MHz <sup>2</sup> parabolic; 0.025 ns/MHz linear; 1 ns ripple
Spectrum Sense	Inverting or Non-inverting (selectable)

### Synthesizer Characteristics

Frequency Accuracy	$\pm$ 1.0 ppm internal reference ( $\pm$ 0.01 ppm, <b>option H</b> )					
Frequency Step	1 MHz minimum					
10 MHz level (In & Out)	3 dBm $\pm$ 3 dB ( <b>option E</b> )					
Phase Noise	@ Freq	100Hz	1kHz	10kHz	100kHz	1MHz
	dBC/Hz	< -70	< -70	< -80	< -90	< -100

### 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 , 9600 baud (RS485, <b>option Q</b> )

### Other

RF Connector	BNC (female) (see TABLE 2.2 for other options)
IF Connector	BNC (female) (see TABLE 2.2 for other options)
10 MHz Connectors	BNC (female), 50 $\Omega$ /75 $\Omega$
Alarm/Remote Connector	DB9 (female) - NO or NC contact closure on Alarm
Size	19 inch standard chassis 1.75"high X 16.0" deep
Power	100-240 $\pm$ 10% VAC, 47 - 63 Hz, 45 watts max.

### Options

E	External 10 MHz Reference Input and Output
H	High Stability ( $\pm$ 0.01 ppm) Internal Reference
Q	RS-422/RS-485 Remote capability
Connector options	see TABLE 2.2

\*+10°C to +40°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.

**Connector:** Rear panel, DB-9 female

J10 Pinouts (RS-232C/422/485)	
Pin	Function
1	Rx-
2	Rx+ (RS-232C)
3	Tx+ (RS-232C)
4	Tx-
5	GND
6	Alarm Relay: Common
7	Alarm Relay: Normally Open
8	Not Used
9	Alarm Relay: Normally Closed

#### B) Status Requests

Table 1.1 lists the status requests for the 2016-10 and briefly describes them.

TABLE 1.1 2016-10 Status Requests		
Command	Syntax*	Description
Command Status	{aaS1}	Returns {S1bbbbbbccA} where: <ul style="list-style-type: none"> <li>• bbbbbbb = Rx frequency (in kHz)</li> <li>• cc = Rx gain</li> <li>• A = summary alarm; 1=alarmed, 0=normal</li> </ul>
10MHz Ref Status	{aaS2}	Returns {S2E} where: <ul style="list-style-type: none"> <li>• E = 1 - external 10 MHz switched in</li> </ul>

\* PLEASE NOTE: The Address (aa) should only be used when RS-485 is selected (option Q).

## C) Commands

Table 1.2 lists the commands for the 2016-10 and briefly describes them. After a command is sent the 2016-10 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 - option Q**)
- 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

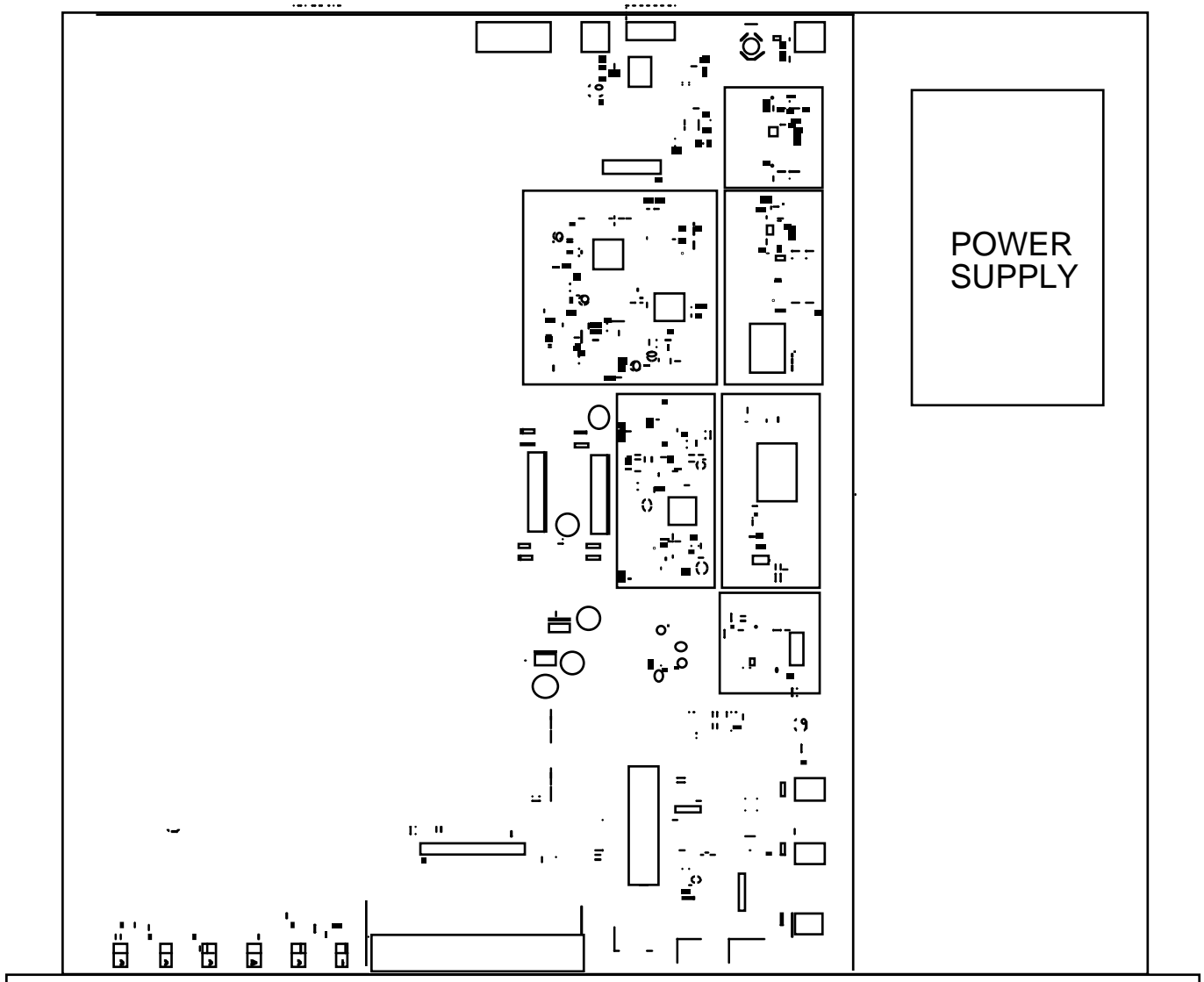
<b>Table 1.2 2016-10 Commands</b>		
<b>Command</b>	<b>Syntax*</b>	<b>Description</b>
Set Receiver Frequency	{aaC2xxxxxxx}	where: <ul style="list-style-type: none"> <li>• xxxx = 4 characters</li> <li>• Range: 0500 to 1000 MHz, in 1MHz steps</li> </ul>
Set Receiver Gain	{aaC4xx}	where: <ul style="list-style-type: none"> <li>• xx = 2 characters</li> <li>• Range: 00 to 50 (0 dB to +50 dB, in 1 dB steps)</li> </ul>
Enable External 10MHz IN	{aaCEx}	where x =: <ul style="list-style-type: none"> <li>• 0 to disable External 10MHz ref signal</li> <li>• 1 to enable External 10MHz ref signal</li> </ul>
Enable Remote	#	Just # sign
Disable Remote	{aaCRO}	{CR and zero}

\* PLEASE NOTE: The Address (aa) should only be used when RS-485 is selected (option Q).

## 2.0 Installation

### 2.1 Mechanical

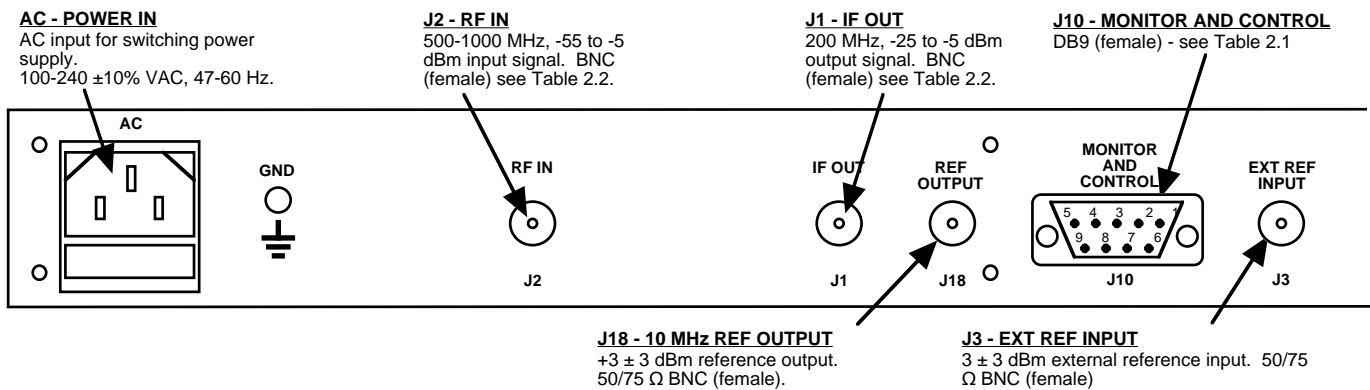
The 2016-10 consists of one RF/Controller PCB housed in a 1 RU (1 3/4 inch high) by 16 inch deep chassis. A switching,  $\pm 12$ , +24, +5 VDC power supply provides power for the assemblies. The 2016-10 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 2016-10 is 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 2016-10 Rear Panel I/Os**

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

Option	IF	RF
STD	BNC, 50 $\Omega$	BNC, 50 $\Omega$
B	BNC, 75 $\Omega$	BNC, 75 $\Omega$
C	BNC, 75 $\Omega$	BNC, 50 $\Omega$
N	BNC, 75 $\Omega$	Type N, 50 $\Omega$
M	BNC, 50 $\Omega$	Type N, 50 $\Omega$
S	BNC, 50 $\Omega$	SMA, 50 $\Omega$

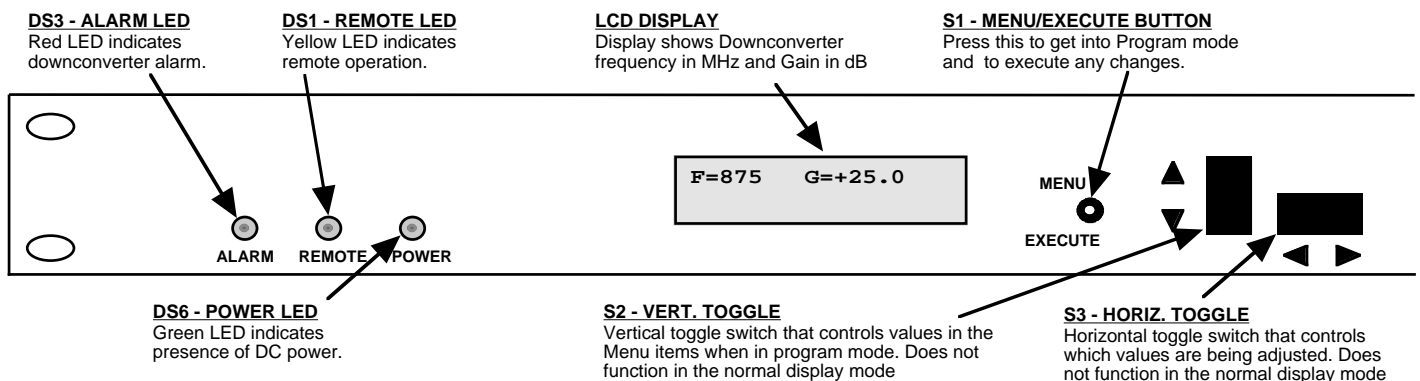
### \*Remote Serial Interface

Interface: DB-9 Female

Protocol: RS-232C, 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.

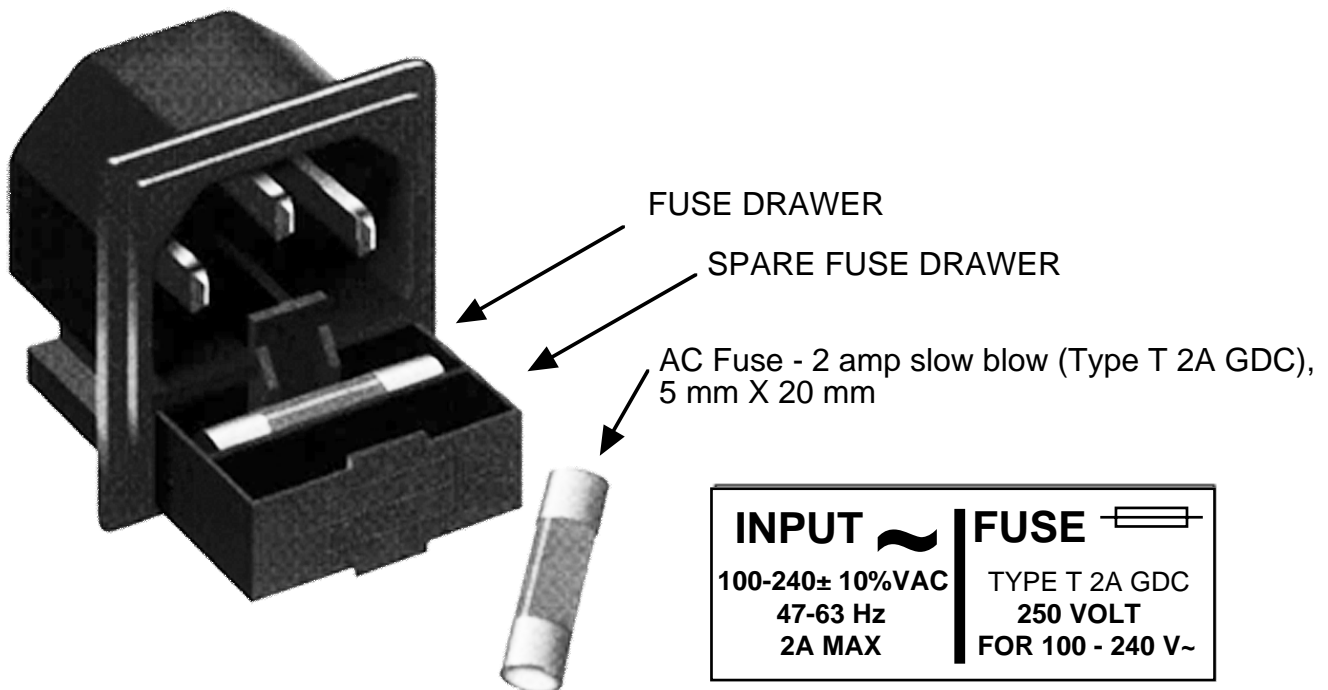


**FIGURE 2.3 2016-10 Front Panel Controls and Indicators**

## 2.4 Operation

### 2.4.1 Installing and Operating the 2016-10 Downconverter

1. Connect a -55 dBm to -5 dBm signal to RF IN, J2 (Figure 2.2)
2. Connect the IF OUT, J1, to the external equipment
3. Connect 100-240  $\pm$ 10% VAC, 47 - 63 Hz to AC on the back panel.
4. Set the 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 DS3 (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.



**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)

**Menu 3** Set Unit to Remote Operation

**Menu 4** Select External 10 MHz Ref

**Menu 5** Set Remote mode (**option Q**)

**Menu 6** Set RS-485 address (**option Q**)

**Save Menu** When “R” is selected in any above menu or at the end of the menu options

Alarm indications appear on the LEDs (see figure 2.3).

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 30 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.**

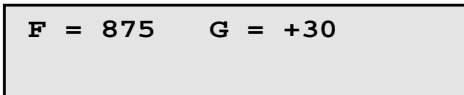
When power is first applied, the LCD display goes through three steps.

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 and gain of the downconverter is shown.



F = 875 G = +30

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 30 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:

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 = 875           R
```

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

```
F = 885           R
```

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

```
F = 885           R
```

**NOTE: CHANGES DO NOT TAKE PLACE ON FREQUENCY UNTIL YOU GO TO THE SAVE MENU AND INDICATE YOU WANT TO SAVE THE CHANGES.**

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

```
G = +30          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 this:

```
F = 885    G = +30
```

Figure 2.5 gives 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 30 seconds, and the system will return to the normal operating mode.

To change the GAIN:

Push the Menu/Execute switch to get to the gain setting (See Figure 2.5 for the sequence of menu options):

G = + <u>3</u> 0	R
------------------	---

Pressing the Up/Down switch will change the gain in 1 or 10 dB steps depending on the cursor location:

G = + <u>4</u> 0	R
------------------	---

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

G = +4 <u>0</u>	R
-----------------	---

**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.**

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

REMOTE <u>O</u> FF	R
--------------------	---

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

SAVE SETTINGS? <u>Y</u> N
---------------------------

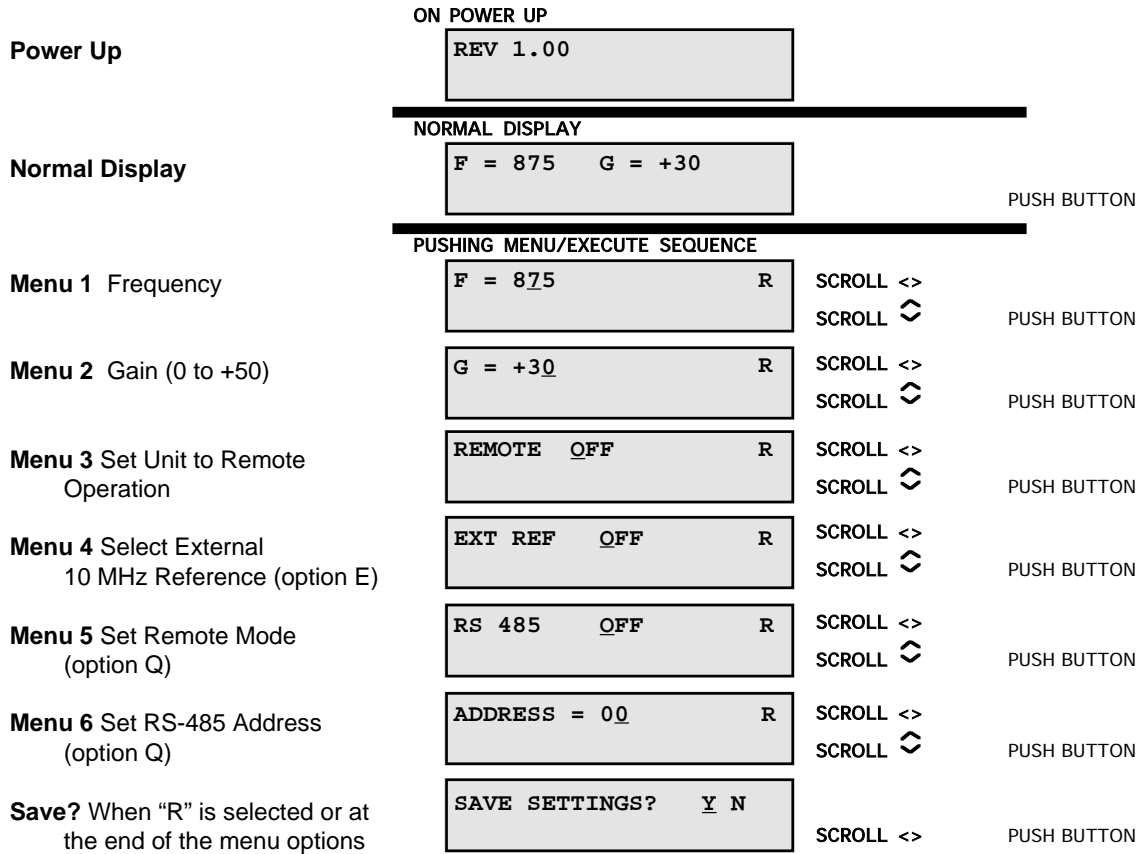
Selecting **Y** will save the new settings. Selecting **N** will revert to the previous settings. Pushing the Menu/Execute switch then takes you to this:

F = 885    G = +40
--------------------

Figure 2.5 gives the menu items and how to make changes.

## 2.5.5 Alarm Indications

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



**FIGURE 2.5 Menu Display and Sequence**



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