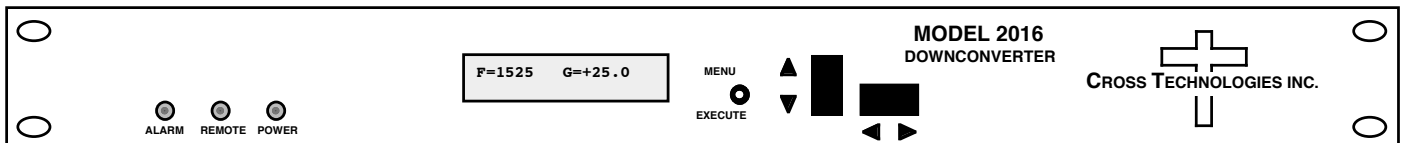


# Instruction Manual

# Model 2016-02-500 Downconverter

January 2017, Rev D



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# INSTRUCTION MANUAL

## MODEL 2016-02-500 Downconverter

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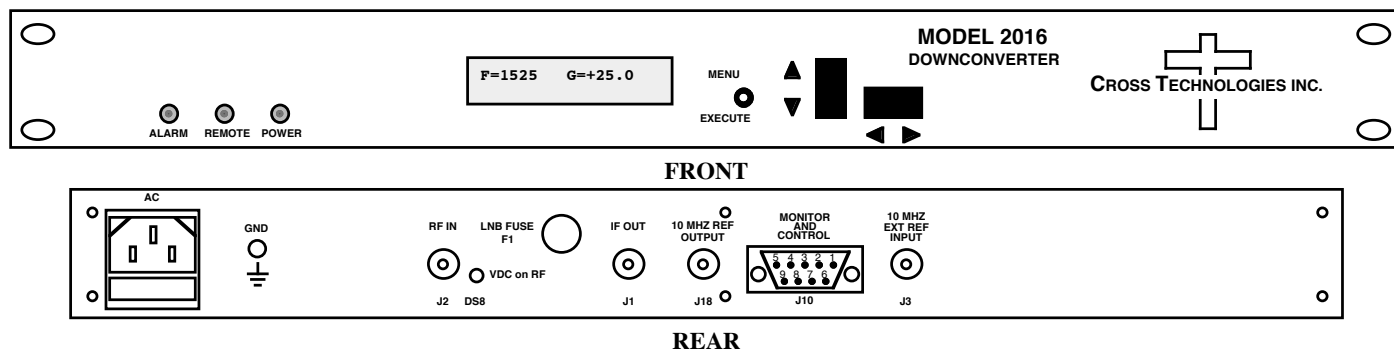
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# MODEL 2016-02-500 Downconverter

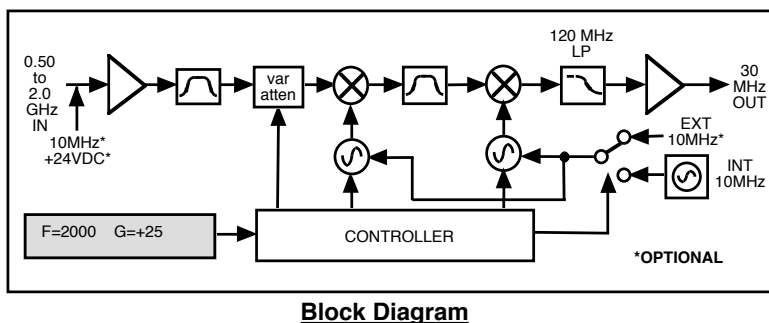
## 1.0 General

### 1.1 Equipment Description

The 2016-02-500 Downconverter converts 500 to 2000 MHz to 30 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 +30 dB range. The frequency and gain are remotely selectable. Parameter selection and frequency and gain settings appear on the LCD display. Connectors are Type F 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 2016-02-500 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 Model 2016-02-500 Front and Rear Panels**



**FIGURE 1.2 Model 2016-02-500 Downconverter Block Diagram**

## 1.2 Technical Characteristics

**TABLE 1.0 2016-02-500 Downconverter Specifications\***

### Input Characteristics (RF)

Impedance/Return Loss	75Ω/10 dB (see TABLE 2.2 for connector options)
Frequency	500 to 2000 MHz
Noise Figure, Max.	15 dB max gain
Input Level range	-35 to -5 dBm
Input 1 dB compression	+5 dBm

### Output Characteristics (IF)

Impedance/Return Loss	75 Ω /18 dB (see TABLE 2.2 for connector options)
Frequency	30 ± 5 MHz
Output Level/max linear	-10/0 dBm
Output 1 dB compression	+10 dBm

### Channel Characteristics

Gain Range	0 to +30.0 dB, 1 dB steps (manually adjustable)
Image Rejection	> 50 dB, min
Spurious Response	<-50 dBC in band (± 5 MHz)
Frequency Response	±2.0 dB, 500 - 2000 MHz; ± 0.5 dB, 10 MHz BW
Group Delay, max	4 ns Parabolic; 4 ns linear; 1 ns ripple
Frequency Sense	Non-inverting

### Synthesizer Characteristics

Frequency Accuracy	±1.0ppm max over temp (±0.01ppm <b>option H</b> ) internal reference
Frequency Step	1.0 MHz minimum
10 MHz level (In & Out)	+3 dBm, ± 3 dB, ( <b>option E</b> )

Phase Noise @ Freq	100 Hz	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, Remote	Red LED, Yellow LED
Remote	RS232C, 9600 baud (RS485 <b>option Q</b> ; Ethernet, option W8)

### Other

RF/IF Connectors	Type F (female), BNC (female), 75Ω (see TABLE 2.2 for other options)
10 MHz Connectors	BNC (female) works with 50 or 75 ohm impedance ( <b>option E</b> )
M&C 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 ±10% VAC, 47 - 63 Hz, 45 watts max.

### Options

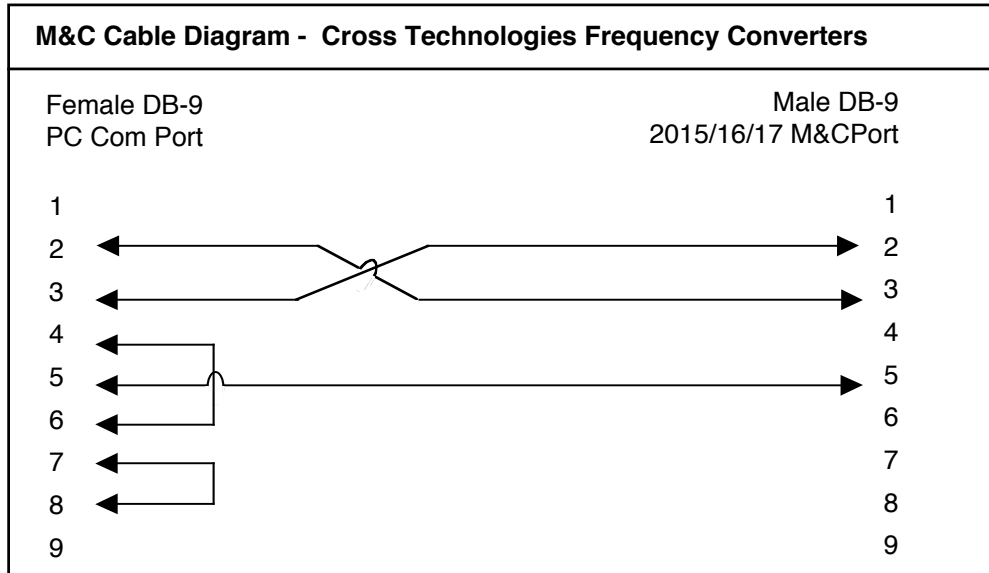
-E	Allows ext. 10 MHz ref input, 10 MHz ref can be inserted on the RF in
-H	High Stability (± 0.01 ppm) internal reference
-Q	RS-422/RS-485 Remote capability
-T	Temperature Sensor
-W8	Ethernet M&C Remote Interface
Connector options	See TABLE 2.2

\*+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.  
(RS-232C, RS-422, or **RS-485 - option -Q**)



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

<b>J10 Pinouts (RS-232C/422/485)</b>	
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 2016-02-500 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.

<b>TABLE 1.1 2016-02-500 Status Requests</b>		
<b>Command</b>	<b>Syntax*</b>	<b>Description</b>
Command Status	{aaS1}	Returns {aaS1bbbbccA} where:
		<ul style="list-style-type: none"> <li>• bbbb = Rx frequency</li> </ul>
		4 characters - standard (7 characters - Option-X)
		<ul style="list-style-type: none"> <li>• cc = Rx gain</li> </ul>
		<ul style="list-style-type: none"> <li>• A = summary alarm; 1=alarmed, 0=normal</li> </ul>
10MHz Ref Status (option -E only)	{aaS2}	Returns {aaS2ER} where:
		<ul style="list-style-type: none"> <li>• E = 1 - external 10 MHz switched in</li> </ul>
		<ul style="list-style-type: none"> <li>• R = 1 - 10 MHz ref inserted on RF input connector</li> </ul>
LNB Current (option -L only)	{aaS3}	Returns {aaS3eee} where:
		<ul style="list-style-type: none"> <li>• eee = LNB current (000 to 500 = 0 to .500 A)</li> </ul>

## C) Commands

Table 1.2 lists the commands for the 2016-02-500 and briefly describes them. After a command is sent the 2016-02-500 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 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 2016-02-500 Commands		
Command	Syntax*	Description
Set Receiver Frequency	{aaC2xxxx}	where:
		• xxx = 4 characters standard (7 characters -Option-X)
		• Range: 0500 to 2000, in 1 MHz steps
		0500.000 to 2000.000 in 1 kHz steps (option-X)
Set Receiver Gain	{aaC4xx}	where:
		• xx = 2 characters
		• Range: 00 to 30 (0 dB to +30 dB, in 1 dB steps)
Enable 10MHz Ref Insertion (option -E only)	{aaC6x}	where x =:
		• 0 to disable 10MHz insertion on RF input connector
		• 1 to enable 10MHz insertion on RF input connector
Enable External 10MHz IN (option -E only)	{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}

## 1.4 Environmental Use Information

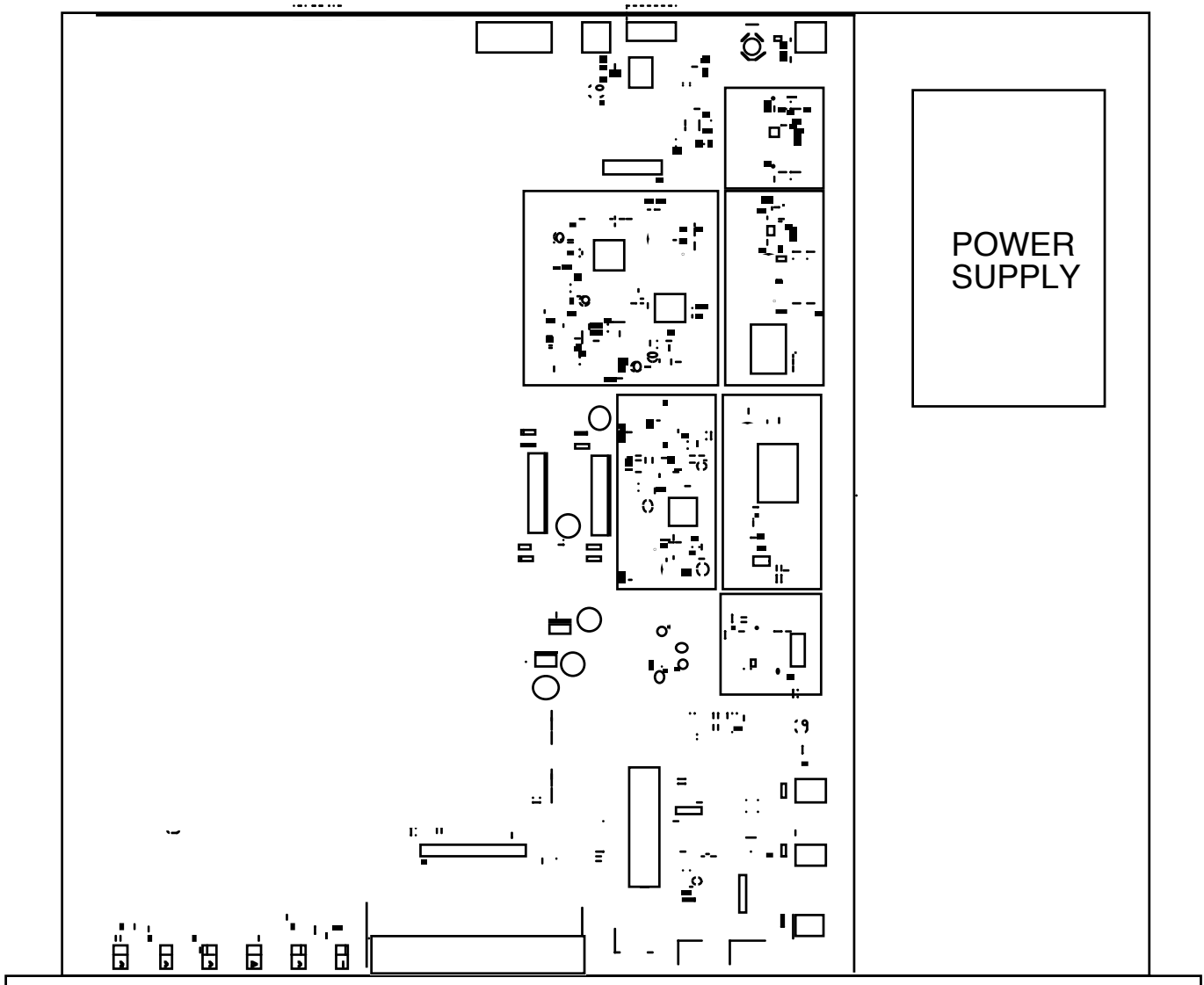
- A. Elevated operating ambient temperature** - if installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack may be greater than room ambient temperature. Therefore, consideration should be given to  $T_{mra}$ .
- B. Reduced air flow** - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised. Additional space between unit may be required.
- C. Mechanical loading** - Mounting of equipment in a rack should be such that a hazardous condition does not exist due to uneven weight distribution.
- D. Circuit Overloading** - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of circuits could have on over current protection and supply wiring. Appropriate consideration of equipment name plate rating should be used, when addressing this concern.
- E. Reliable Earthing** - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connection to the Branch (use of power strips).
- F. Top Cover** - There are no servicable parts inside the product so, the Top Cover should not be removed. If the Top Cover is removed the ground strap and associated screw **MUST BE RE-INSTALLED** prior to Top Cover screw replacement. **FAILURE TO DO** this may cause **INGRESS** and/or **EGRESS** emission problems.



## 2.0 Installation

### 2.1 Mechanical

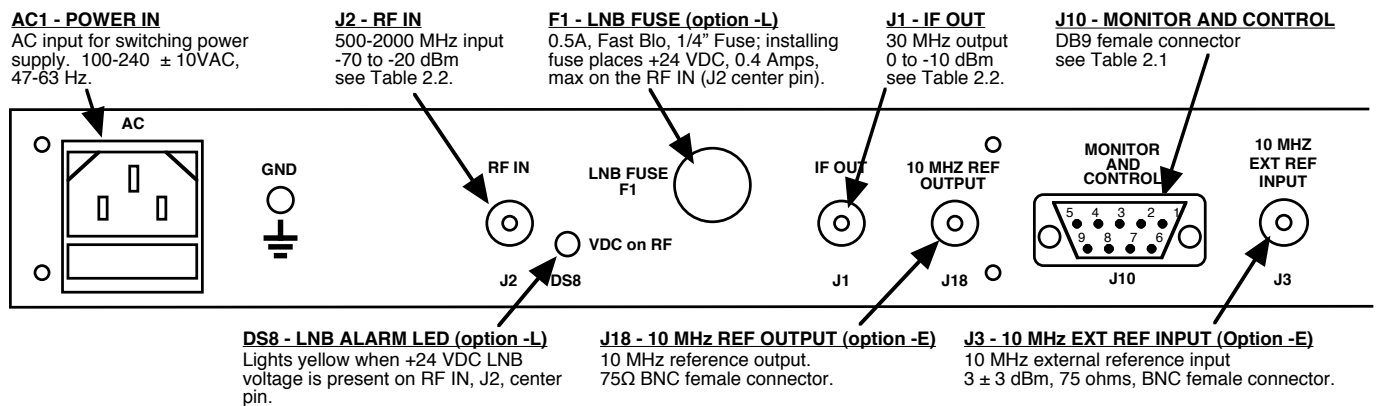
The 2016-02-500 consists of one RF/Controller PCB housed in a 1 RU (1 3/4 inch high) by 16 inch deep chassis. A switching,  $\pm 12$ , +24, +5 VDC power supply provides power for the assemblies. The 2016-02-500 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 2016-02-500 is assembled.



**FIGURE 2.1 2016-02-500 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 2016-02-500 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

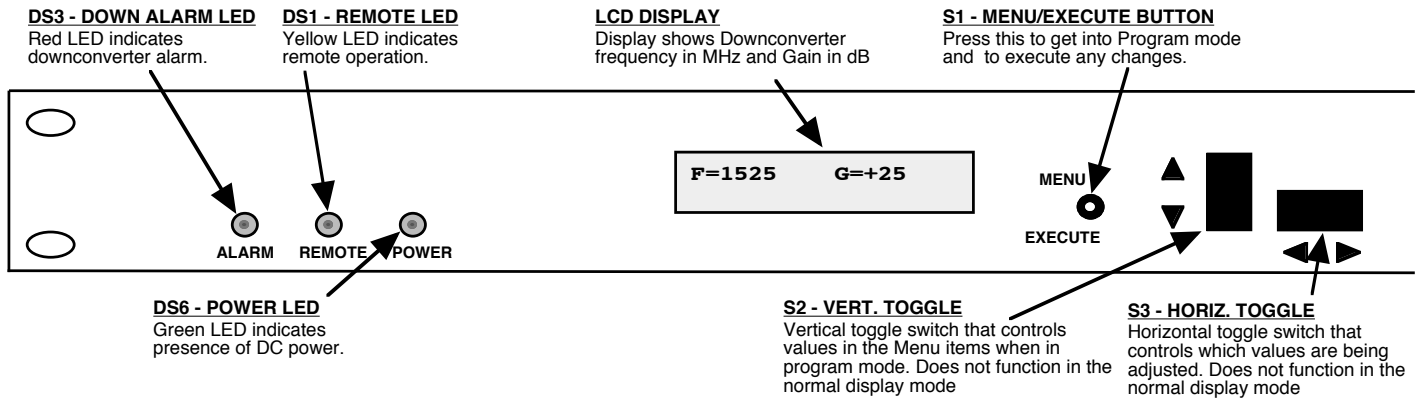
### \*Remote Serial Interface

Interface: DB-9 Male

Protocol: RS-232C, 9600 baud rate, no parity, 8 data bits, 1 start bit, 1 stop bit

Option	IF	RF
STD	BNC, 75Ω	Type F, 75Ω
B	BNC, 75Ω	BNC, 75Ω
C	BNC, 75Ω	BNC, 50Ω
D	BNC, 50Ω	BNC, 50Ω
F	Type F, 75 Ω	Type F, 75 Ω
FN	Type F, 75 Ω	Type N, 50 Ω
J	BNC, 50Ω	Type F, 75 Ω
K	BNC, 50Ω	BNC, 75 Ω
M	BNC, 50Ω	Type N, 50Ω
N	BNC, 75Ω	Type N, 50Ω
S	BNC, 50Ω	SMA, 50Ω

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

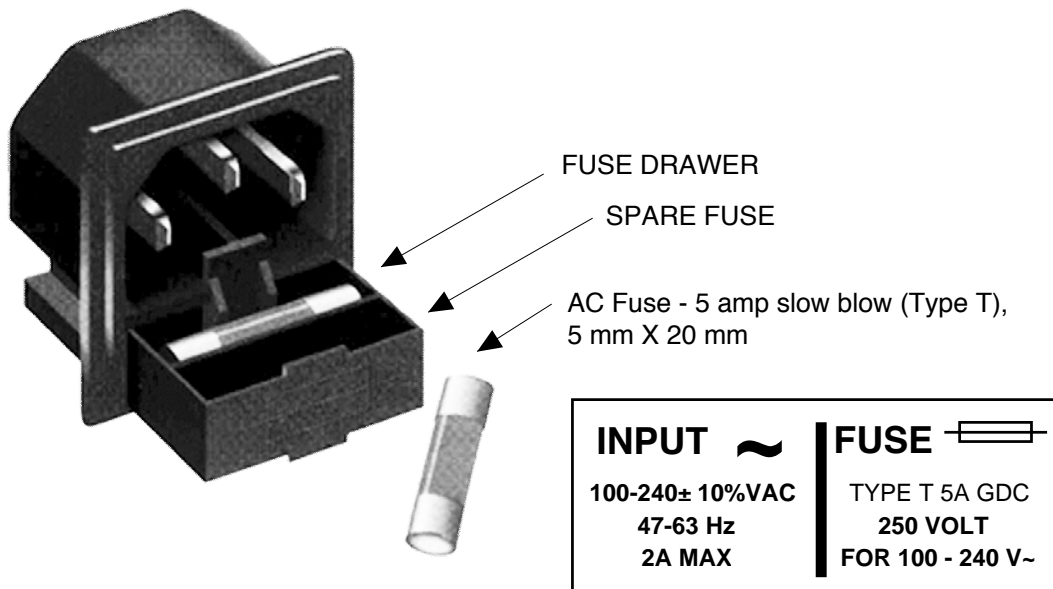


**FIGURE 2.3 2016-02-500 Front Panel Controls and Indicators**

## 2.4 Operation

### 2.4.1 Installing and Operating the 2016-02-500 Downconverter

1. Connect a -5 dBm to -35 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 +00.0 to +30.0 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. Option -L only - To insert LNB +24 VDC on the RF center pin install 0.5A fast blo fuse in F1 and check that DS8 lights yellow (Figure 2.1)
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**

**Menu 1** Frequency in MHz

**Menu 2** Gain (0 to +30)

**Menu 3** Set Unit to Remote Operation

**Menu 4** Select External 10 MHz Ref (option -E)

**Menu 5** Select Reference Out (option -E)

**Menu 6** Set Remote Interface

**Menu 7** Set RS-485 address (option -Q)

**Menu 8** View LNB Current (option -L)

**Save Menu** When go to end

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 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=1350 G=+10

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 = 1 <u>3</u> 50	R
-------------------	---

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

F = 1 <u>4</u> 50	R
-------------------	---

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

F = 14 <u>5</u> 0	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 = + <u>1</u> 0	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 this:

F=1450    G=+10
-----------------

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 DOWNCONVERTER GAIN:

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

G = + <u>1</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>2</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 = +2 <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:

OTHER? <u>Y</u> N	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:

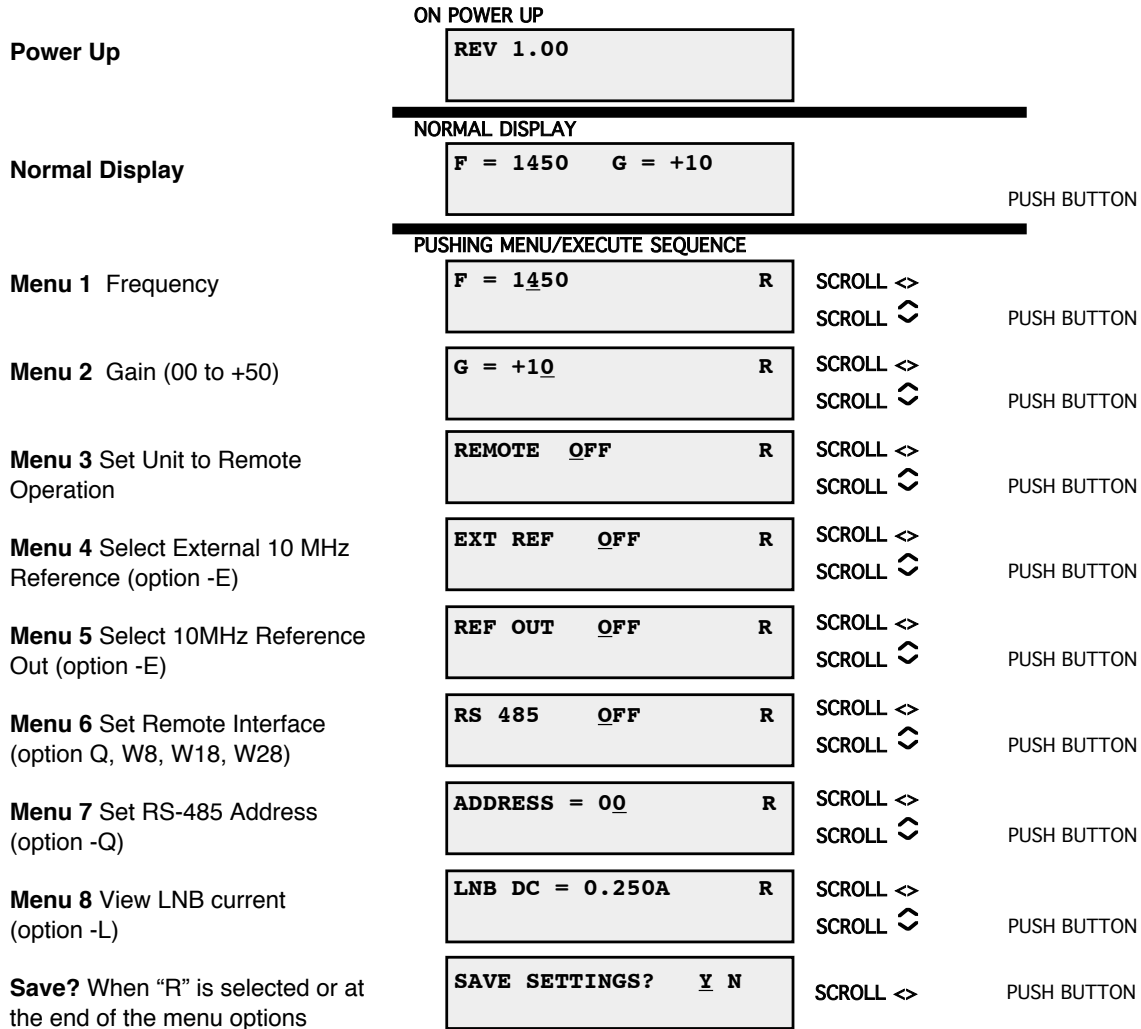
F=1450 G=+20
--------------

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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