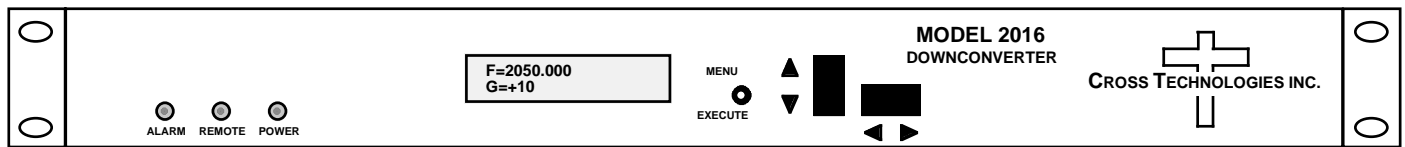


Instruction Manual

Model 2016-12 Downconverter

July 2009 Rev A



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INSTRUCTION MANUAL
MODEL 2016-12 Downconverter

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MODEL 2016-12 Downconverter

1.0 General

1.1 Equipment Description

The 2016-12 Downconverter converts 950 to 2150 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 unit is powered by a $100\text{-}240 \pm 10\%$ VAC power supply, and housed in a 1.75" X 19" X 16" rack mount chassis.

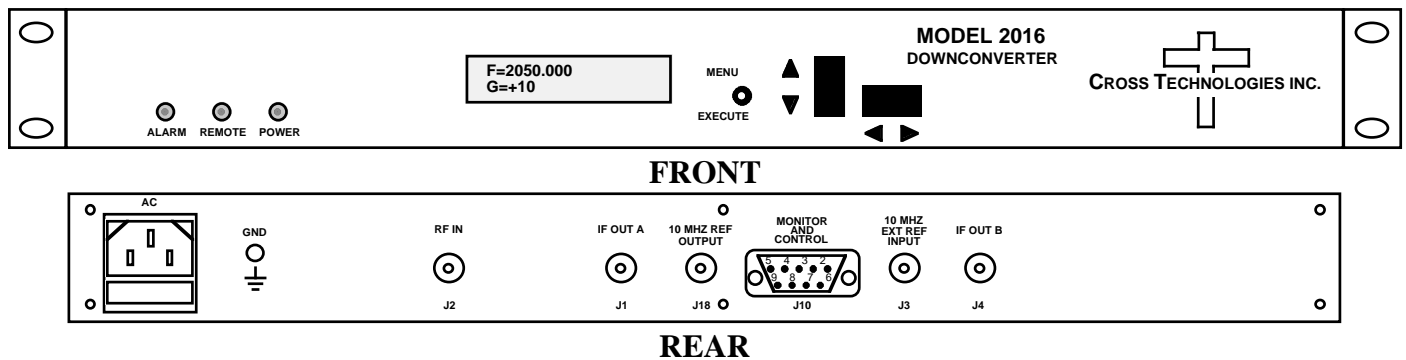


FIGURE 1.1 Model 2016-12 Front and Rear Panels

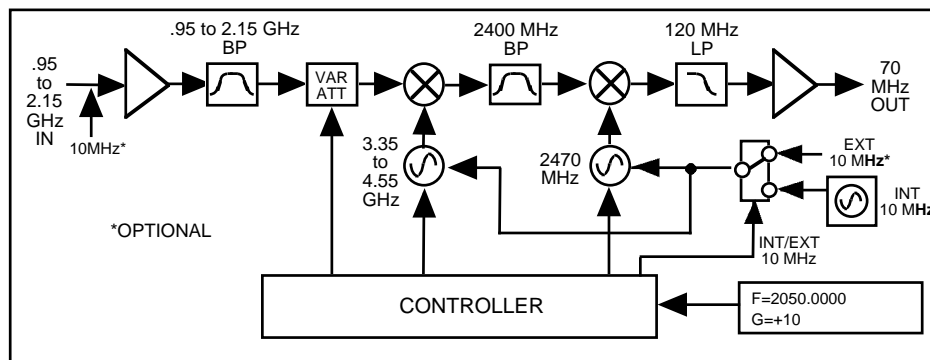


FIGURE 1.2 Model 2016-12 Downconverter Block Diagram

1.2 Technical Characteristics

TABLE 1.1 2016-12 Downconverter Specifications*

Input Characteristics

| | |
|-----------------------|--------------------|
| Impedance/Return Loss | 75 Ω /12 dB |
| Frequency | 950 to 2150 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 | 75 Ω /18 dB |
| Frequency | 70 \pm 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 | \pm 1.5 dB, 950 to 2150 MHz; \pm 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 | \pm 0.01 ppm max over temp internal reference; external ref. input |
| Frequency Step | 1 kHz, 10 kHz, or 125 kHz (selectable) |

| Phase Noise @ Freq | 100 MHz | 1kHz | 10kHz | 100kHz | 1MHz |
|--------------------|---------|------|-------|--------|------|
| dBC/Hz | -75 | -90 | -97 | -107 | -117 |

10 MHz Level (In or Out) 0 dBm, \pm 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

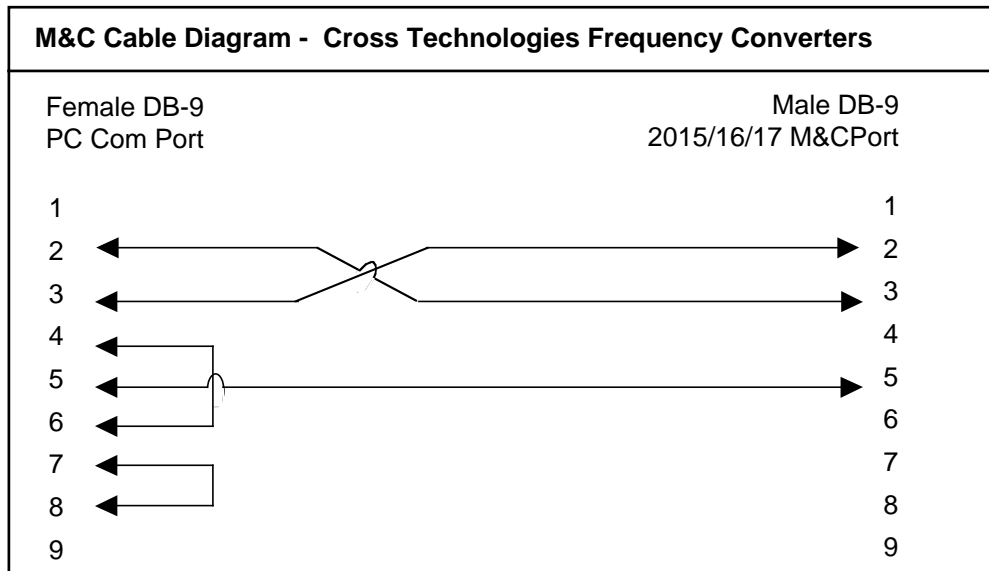
| | |
|------------------------|--|
| RF Connectors | Type F (female), 75 Ω |
| IF Connector | BNC (female), 75 Ω |
| 10 MHz Connectors | BNC (female), 75 Ω |
| Alarm/Remote Connector | DB9 (female), NO or NC contact closure on Alarm |
| Size | 19 inch, 1RU standard chassis 1.75"high X 16.0" deep |
| Power | 100-240 \pm 10% 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# | Function |
|------|-------------------------------|
| 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 1.3 lists the status requests for the 2016-12 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 2016-12 Status Requests | | |
|-----------------------------------|---------------------------|--|
| Command | Syntax | Description |
| Command Status | {aaS1}* option -E ONLY | Returns {aaS1bbbbbbccA} where: <ul style="list-style-type: none"> • bbbbbbb = Frequency • cc = Gain • A = Alarm Status (0 = NO Alarm, 1 = Alarm) |
| Ext 10MHz Status | {aaS2}* option -E ONLY | Returns {aaS2bc} where: <ul style="list-style-type: none"> • b = 0 (internal), 1 (external) • c = 1 (10MHz inserted on downconverter RF) |
| LNB Current Readout | {aaS3}* option -L ONLY | Returns {aaS2bb} where: <ul style="list-style-type: none"> • bbb = LNB current, range 00 to 50 (0 to 500 ma) |

C) Commands - Table 1.2 lists the commands for the 2016-12 and briefly describes them. After a command is sent the 2016-12 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 2016-12 Commands | | |
|-----------------------------------|----------------------------------|---|
| Command | Syntax | Description |
| Set Frequency | {aaC2xxxxxxx}* option -E ONLY | where: <ul style="list-style-type: none"> • xxxxxxx = 7 characters • Range: 0950000 to 2150000 kHz, 1kHz steps |
| Set Gain | {aaC4xx}* option -E ONLY | where: <ul style="list-style-type: none"> • xx = 2 characters • Range: 00 to 50 (0 dB to 50 dB, in 1 dB steps) |
| Enable 10MHz insertion/out | {aaC5x}* option -E ONLY | where x =: <ul style="list-style-type: none"> • 0 to disable reference out • 1 to enable reference out |
| Enable External 10MHz | {aaCEx}* option -E ONLY | where x =: <ul style="list-style-type: none"> • 0 to disable External 10MHz ref signal • 1 to enable External 10MHz ref signal |
| Enable Remote | # | Just # sign |
| Disable Remote | {aaCRO}* option -E ONLY | {CR and zero} |

2.0 Installation

2.1 Mechanical - The 2016-12 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 2016-12 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 2016-12 is assembled.

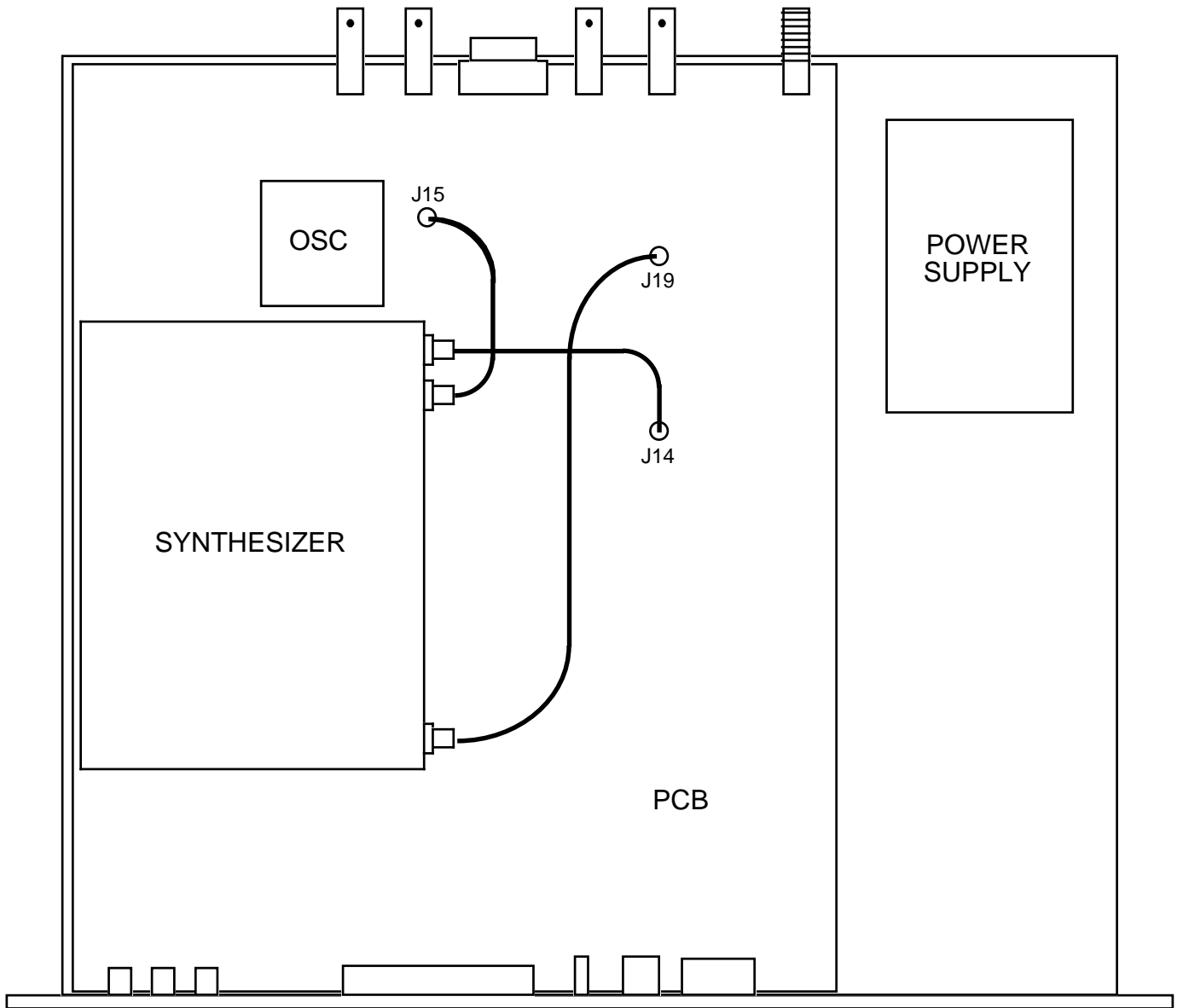


FIGURE 2.1 2016-12 Mechanical Assembly

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

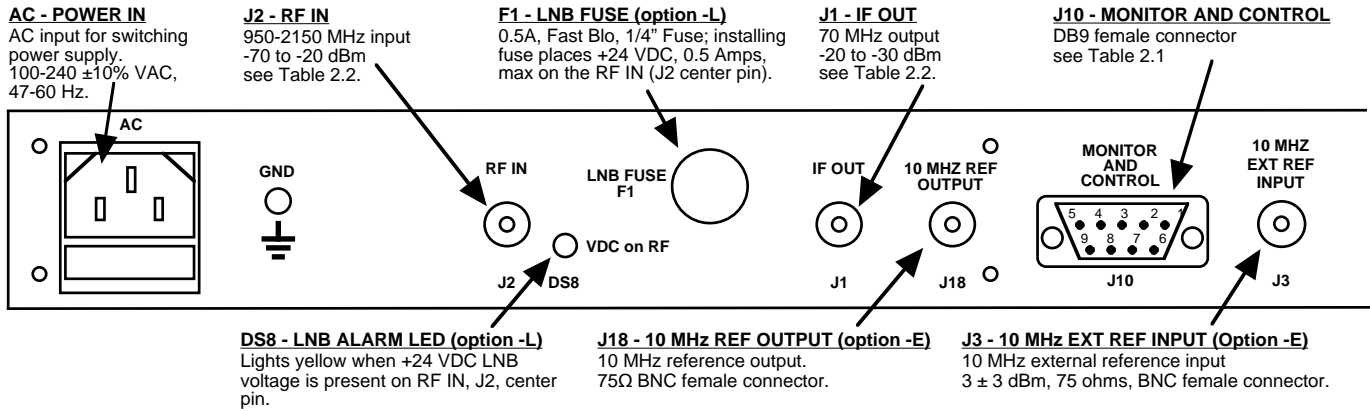


FIGURE 2.2 2016-12 Rear Panel Inputs and Outputs

| 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

| Option | IF | RF |
|--------|------------------|---------------------|
| STD | BNC, 75 Ω | Type F, 75 Ω |
| -B | BNC, 75 Ω | BNC, 75 Ω |
| -C | BNC, 75 Ω | BNC, 50 Ω |
| -D | BNC, 50 Ω | BNC, 50 Ω |
| -N | BNC, 75 Ω | Type N, 50 Ω |
| -M | BNC, 50 Ω | Type N, 50 Ω |

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

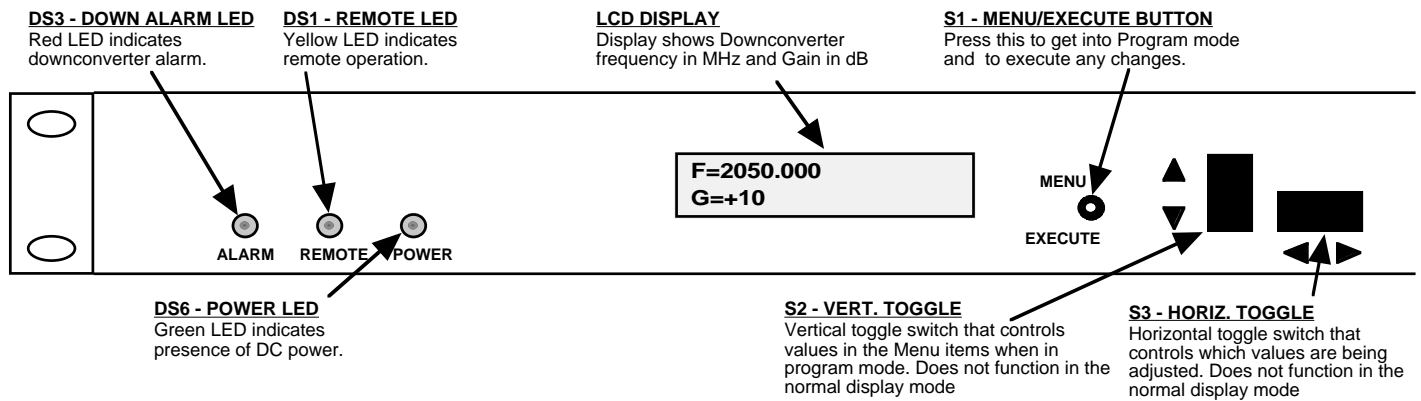


FIGURE 2.3 2016-12 Front Panel Controls and Indicators

2.4 Installation / Operation

2.4.1 Installing and Operating the 2016-12 Downconverter

- 1.) Connect a -70 dBm to -20 dBm, 950-2150 MHz signal to RF IN, J4 (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 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.

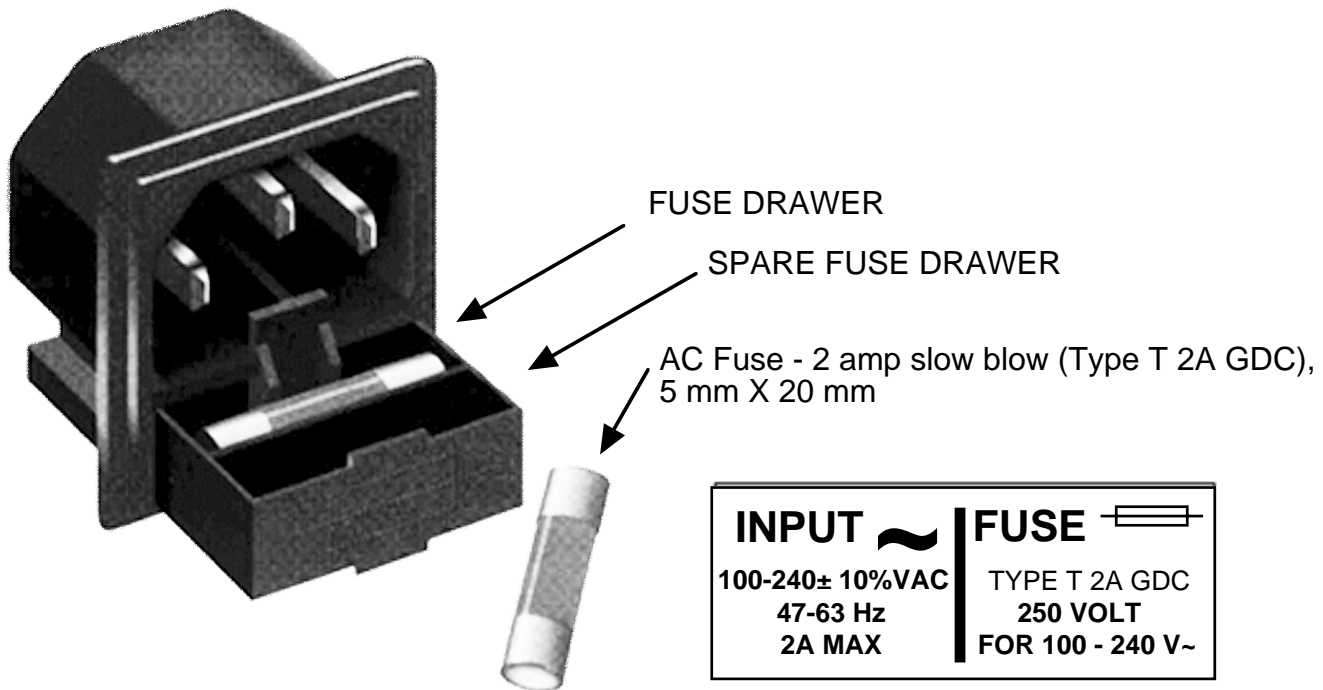


FIGURE 2.4 Fuse Location and Spare Fuse

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 | Set Unit to Remote Operation (Note: the local controls still function when in REMOTE) |
| Menu 4 | Select Frequency Step Size (1kHz, 10kHz, 100kHz, or 125kHz) |
| Menu 5 | Select External 10 MHz Ref (option -E ONLY) |
| Menu 6 | Select 10 MHz Output (option -E ONLY) |
| Menu 7 | LNB Current (option -L ONLY) |
| Menu 8 | Select RS232, RS422, or RS 485 Remote Operation (option -Q ONLY) |
| Menu 9 | Select RS485 Remote Address for Unit (option -Q 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 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 = 2050.000 |
| 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 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 = 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.

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

| | |
|-----------|---|
| G = +10.0 | 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 the default display:

| |
|--------------|
| F = 2150.000 |
| G = +10 |

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 30 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 = + <u>1</u> 0 | R |
|------------------|---|

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

| | |
|------------------|---|
| 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 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.

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 = +20 |

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 Remote LED will light when you select the Remote mode.

| | | | |
|--|---|-----------------------|-------------|
| Power Up | ON POWER UP REV 1.00 | | |
| Normal Display | NORMAL DISPLAY F = 2050.000 G = +10 | | PUSH BUTTON |
| Menu 1 Up Frequency | PUSHING MENU/EXECUTE SEQUENCE F = 2050.000 R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Menu 2 Down Gain (0 to +50) | G = +10 R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Menu 3 Set Unit to Remote Operation | REMOTE OFF R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Menu 4 Select frequency step size | STEP = 1 kHz R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Menu 5 Select External 10 MHz Reference (option -E) | EXT REF OFF R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Menu 6 Select 10MHz Output (option -E) | DN REF OUT OFF R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Menu 7 LNB Current readout (option -L) | LNB DC = 0.250 A R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Menu 8 Select RS232, RS422, or RS485 remote control (option -Q) | RS232 R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Menu 9 Select remote address for unit (RS485 only) (option -Q) | ADDRESS = 00 R | SCROLL <> SCROLL ↕ | PUSH BUTTON |
| Save? When go to end | SAVE SETTINGS? Y N | SCROLL <> | PUSH BUTTON |

FIGURE 2.5 Menu Display and Sequence

3.0 Environmental Use Information

- A. Rack-Mounting** - To mount this equipment in a rack, please refer to the installation instructions located in the user manual furnished by the manufacturer of your equipment rack.
- B. Mechanical Loading** - Mounting of equipment in a rack should be such that a hazardous condition does not exist due to uneven weight distribution.
- C. 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 Tmra.
- D. 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.
- E. 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.
- F. 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).
- G. Top Cover** - There are no serviceable 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 REINSTALLED** prior to Top Cover screw replacement. **FAILURE TO DO** this may cause **INGRESS** and/or **EGRESS** emission problems.



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