Instruction Manual

Model 2016-24
Downconverter

January 2012,   Rev. B

```
F=1450.000              MENU        ▲   ██     MODEL 2016
G=+25.0                  O                     DOWNCONVERTER
                       EXECUTE      ▼   ██
ALARM  REMOTE  POWER                    ◄ ►    CROSS TECHNOLOGIES INC.
```

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INSTRUCTION MANUAL

MODEL 2016-24 Downconverter

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MODEL 2016-24 Downconverter

1.0 General

1.1 Equipment Description

The 2016-24 L-band Downconverter converts 950 to 2150 MHz in 1 kHz, 10 kHz, 100kHz, or 125 kHz steps (user selectable) to 140 ± 36 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. Multifunction 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 multifunction 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 output and the optional external reference input and output, and Type F female for the RF input. LNB +24 VDC, 0.4 Amps and 10 MHz reference can be inserted on the RF line as added options. The 10 MHz option also includes a 10 MHz output connector, which contains either the internal or external 10 MHz reference signal. The unit is powered by 100-240 ±10% VAC power supply, and housed in a 1 3/4" X 19" X 16" rack mount chassis.

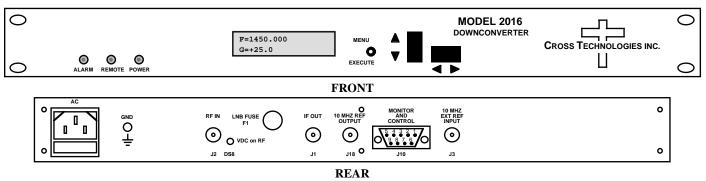**FIGURE 1.1 Front and Rear Panels**
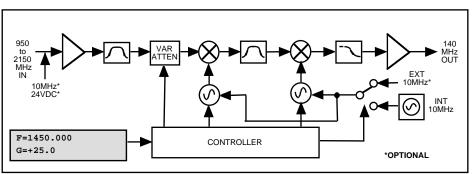

FIGURE 1.2   Block Diagram

1.2 Technical Characteristics

TABLE 1.0 2016-24 Downconverter Specifications*

Input Characteristics

Impedance	75 Ω (see TABLE 2.2 for connector options)
Return Loss	12 dB
Frequency	950 to 2150 MHz
Level range	-70 to -20 dBm
1dB compression	-15 dBm

Output Characteristics

Impedance	75 Ω (see TABLE 2.2 for connector options)
Return Loss	18 dB
Frequency	140 ± 36 MHz
Output Level/Max linear	-20 dBm / -10 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 (± 18 MHz)
Frequency Response	±1.5 dB, 950-2150 MHz; ±0.5 dB, 100 MHz BW; ±0.5 dB, 72 MHz BW
Group Delay, max	0.0035 ns/MHz^2 parabolic; 0.035 ns/MHz linear; 1 ns ripple
Spectrum Sense	Inverting or Non-inverting (selectable)

Synthesizer Characteristics

Frequency Accuracy	±0.01 ppm internal reference
Frequency Step	1, 10, 100, or 125 kHz (user selectable)
10 MHz level (In & Out)	+3 dBm ± 3 dB (**option E**)

Phase Noise @ Freq	100 Hz	1kHz	10kHz	100kHz	1MHz
dBC/Hz	-72	-85	-88	-110	-120

Controls, Indicators

Frequency Selection	direct readout LCD; push-button switches or remote selection
Gain Selection	direct readout LCD; push-button switches or remote selection
Power	Green LED
Alarm	Red LED
Remote	Yellow LED; RS232C , 9600 baud (RS485, **option Q**)

Other

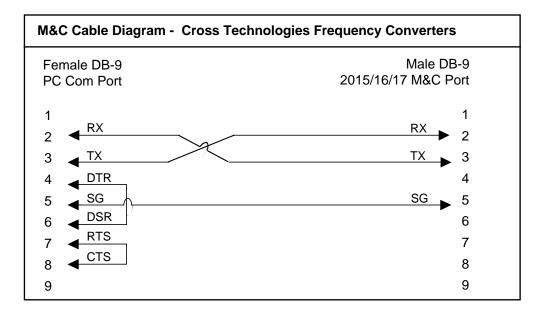|	
RF Connector	Type F (female) (see TABLE 2.2 for other options)
IF Connector	BNC (female) (see TABLE 2.2 for other options)
10 MHz Connectors	BNC (female), 50Ω/75Ω
Alarm/Remote Connector	DB9 (female) - NO or NC contact closure on Alarm
Size	19 inch standard chassis 1.75" high X 16.0" deep
Power	100-240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

Options

E	External 10 MHz Reference Input and Output with RF insertion
L	LNB voltage insertion on RF IN; +24VDC, 0.4A max
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.
(RS-232C, RS-422, or **RS-485** - **option -Q**)

```
┌──────────────────────────────────────────────────────────────┐
│  M&C Cable Diagram -  Cross Technologies Frequency Converters  │
├──────────────────────────────────────────────────────────────┤
│                                                                │
│  Female DB-9                                      Male DB-9    │
│  PC Com Port                              2015/16/17 M&C Port   │
│                                                                │
│   1                                                     1      │
│         RX                                    RX               │
│   2  ◄───────┐                           ┌───────►   2         │
│         TX    ╲                         ╱     TX               │
│   3  ◄───────  ╳───────────────────────      ───────►  3       │
│         DTR                                             4      │
│   4  ◄────┐                                                    │
│         SG │                                 SG               │
│   5  ◄───┐ ├──────────────────────────────────────►  5        │
│         DSR│                                                   │
│   6  ◄────┘                                             6      │
│         RTS                                                    │
│   7  ◄────┐                                             7      │
│         CTS│                                                   │
│   8  ◄────┘                                             8      │
│   9                                                     9      │
│                                                                │
└──────────────────────────────────────────────────────────────┘
```

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 2016-04 and briefly describes them.

* PLEASE NOTE: The two character {aa}(OO-31) prefix, in the table below, should be used ONLY when RS-485, (OPTION-Q), is selected.

TABLE 1.1 2016-24 Status Requests		
Command	**Syntax***	**Description**
Command Status	{aaS1}	Returns {S1bbbbbbbccIA} where:
		• bbbbbb = Rx frequency (in kHz)
		• cc = Rx gain
		• I = 1 - spectrum invert enabled
		• A = summary alarm; 1=alarmed, 0=normal
10MHz Ref Status	{aaS2}	Returns {S2ER} where:
(option E ONLY)		• E = 1 - external 10 MHz switched in
		• R = 1 - 10 MHz reference inserted on RF IN connector
LNB Current	{aaS3}	Returns {S3eee} where:
(option L ONLY)		• eee = LNB current (OOO to 5OO = 0 to .5OO A)

C) Commands - Table 1.1 lists the commands for the 2016-04 and briefly describes them. After a command is sent the 2016-04 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}(OO-31) prefix, in the table below, should be used ONLY when RS-485, (OPTION-Q), is selected.

Table 1.2 2016-24 Commands		
Command	**Syntax***	**Description**
Set Receiver Frequency	{aaC2xxxxxxx}	where:
		• xxxxxxx = 7 characters
		• Range: 0950000 to 2150000 kHz, in 1kHz steps min.
Set Receiver Gain	{aaC4xx}	where:
		• xx = 2 characters
		• Range: 00 to 50 (0 dB to +50 dB, in 1 dB steps)
Enable 10MHz Ref Insertion	{aaC6x}	where x =:
(option E ONLY)		• 0 to disable 10MHz insertion on RF input connector
		• 1 to enable 10MHz insertion on RF input connector
Enable Spectrum Invert	{aaC7x}	where x =:
		• 0 to disable spectrum invert
		• 1 to enable spectrum invert
Enable External 10MHz IN	{aaCEx}	where x =:
(option E ONLY)		• 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. **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.

2.0 Installation

2.1 Mechanical

The 2016-24 consists of one RF/Controller PCB 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 assemblies. The 2016-24 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 2016-24 is assembled.
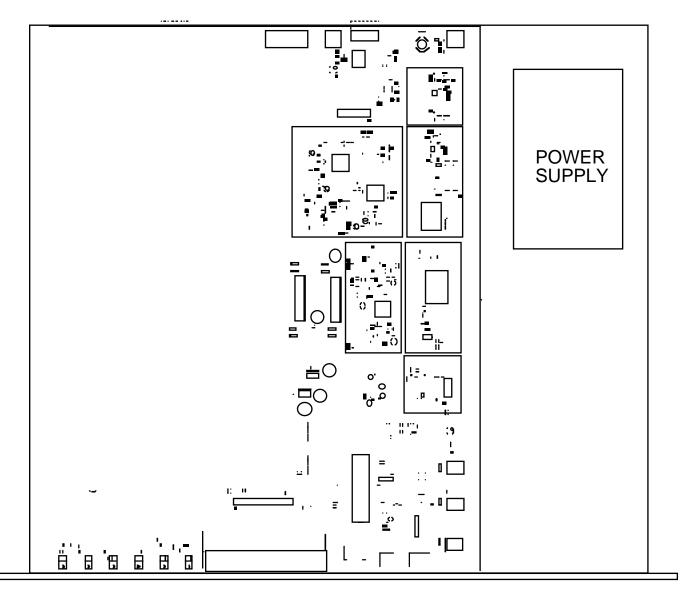

POWER
SUPPLY

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.

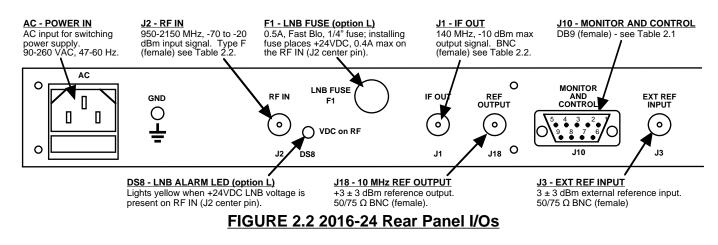**AC - POWER IN**
AC input for switching power supply.
90-260 VAC, 47-60 Hz.

J2 - RF IN
950-2150 MHz, -70 to -20 dBm input signal. Type F (female) see Table 2.2.

F1 - LNB FUSE (option L)
0.5A, Fast Blo, 1/4" fuse; installing fuse places +24VDC, 0.4A max on the RF IN (J2 center pin).

J1 - IF OUT
140 MHz, -10 dBm max output signal. BNC (female) see Table 2.2.

J10 - MONITOR AND CONTROL
DB9 (female) - see Table 2.1

DS8 - LNB ALARM LED (option L)
Lights yellow when +24VDC LNB voltage is present on RF IN (J2 center pin).

J18 - 10 MHz REF OUTPUT
+3 ± 3 dBm reference output. 50/75 Ω BNC (female).

J3 - EXT REF INPUT
3 ± 3 dBm external reference input. 50/75 Ω BNC (female)

FIGURE 2.2 2016-24 Rear Panel I/Os

TABLE 2.1 J10 Pinouts (RS-232C*)

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

TABLE 2.2 IF/RF Connector Options

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

*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

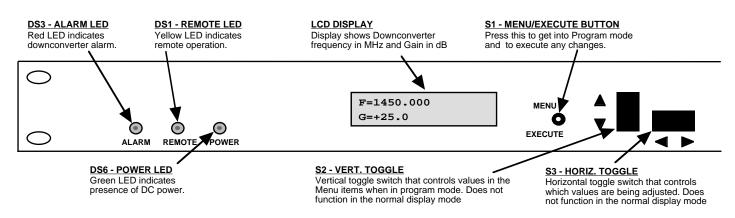Figure 2.3 shows the front panel controls and indicators.

DS3 - ALARM LED
Red LED indicates downconverter alarm.

DS1 - REMOTE LED
Yellow LED indicates remote operation.

LCD DISPLAY
Display shows Downconverter frequency in MHz and Gain in dB

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

```
F=1450.000
G=+25.0
```

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

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 2016-24 Front Panel Controls and Indicators

2.4 Operation

2.4.1 Installing and Operating the 2016-24 Downconverter

1. Connect a -70 dBm to -20 dBm signal to RF IN, J2 (Figure 2.2)
2. Connect the IF OUT, J1, to the external equipment
3. Connect 100-240 ±10% VAC, 47 - 63 Hz to AC on the back panel (Figure 2.2).
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. Option L ONLY - To insert LNB +24 VDC on the RF center pin install 0.5A fast blo fuse (included) in F1 and check that DS8 lights yellow (Figure 2.2)
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.
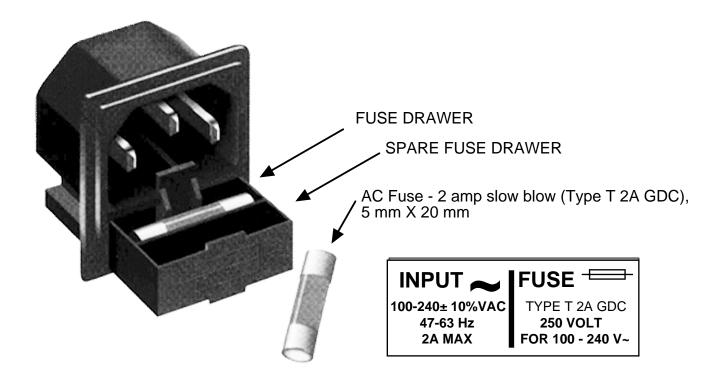
FUSE DRAWER

SPARE FUSE DRAWER

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

INPUT ~	FUSE
100-240± 10%VAC	TYPE T 2A GDC
47-63 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)
Menu 3 Set Unit to Remote Operation
Menu 4 Select Non-inverting or Inverting Spectrum
Menu 5 Select Frequency Step Size (1kHz, 10kHz, 100kHz, or 125kHz)
Menu 6 Select External 10 MHz Ref (option E)
Menu 7 Select 10 MHz Reference Insertion (option E)
Menu 8 Set Remote mode (option Q)
Menu 9 Set RS-485 address (option Q)
Menu 10 View LNB Current (option L)

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 = 1450.000
G = +30
```

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 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 = 1450.000          R
```

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

```
F = 1550.000          R
```

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

```
F = 1550.000          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 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 = 1550.000
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 = +30                 R
```

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

```
G = +40                 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 = +40                 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    OFF           R
```

OR you can scroll to "R" and 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 = 1550.000
G = +40
```

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

2.5.5 Alarm Indications

An alarm condition for 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.

Power Up

ON POWER UP

```
REV 1.00
```

Normal Display

NORMAL DISPLAY

```
F = 1450.000
G = +30
```
PUSH BUTTON

PUSHING MENU/EXECUTE SEQUENCE

Menu 1 Frequency
```
F = 1450.000          R
```
SCROLL <>
SCROLL ⌄⌃   PUSH BUTTON

Menu 2 Gain (0 to +50)
```
G = +30               R
```
SCROLL <>
SCROLL ⌄⌃   PUSH BUTTON

Menu 3 Set Unit to Remote Operation
```
REMOTE   OFF          R
```
SCROLL <>
SCROLL ⌄⌃   PUSH BUTTON

Menu 4 Select Non-Inverting or Inverting Spectrum
```
DNSPECTRUM   NON      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 (option E)
```
EXT REF   OFF         R
```
SCROLL <>
SCROLL ⌄⌃   PUSH BUTTON

Menu 7 Select 10 MHz Reference Insertion (option E)
```
REF OUT   OFF         R
```
SCROLL <>
SCROLL ⌄⌃   PUSH BUTTON

Menu 8 Set Remote Mode (option Q)
```
RS 485    OFF         R
```
SCROLL <>
SCROLL ⌄⌃   PUSH BUTTON

Menu 9 Set RS-485 Address (option Q)
```
ADDRESS = 00          R
```
SCROLL <>
SCROLL ⌄⌃   PUSH BUTTON

Menu 10 View LNB current (option L)
```
LNB DC = 0.150        R
```
SCROLL <>   PUSH BUTTON

Save? When "R" is selected or at the end of the menu options
```
SAVE SETTINGS?    Y N
```
SCROLL <>   PUSH BUTTON

FIGURE 2.5 Menu Display and Sequence

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