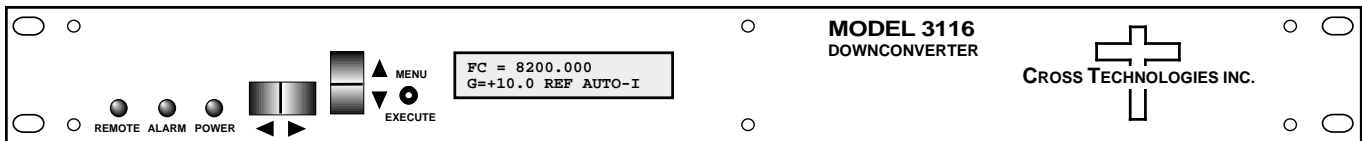


## Instruction Manual

# Model 3116-7786-1200

## Block Downconverter

February 2020, Rev. 0



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# INSTRUCTION MANUAL

## MODEL 3116-7786-1200 Downconverter

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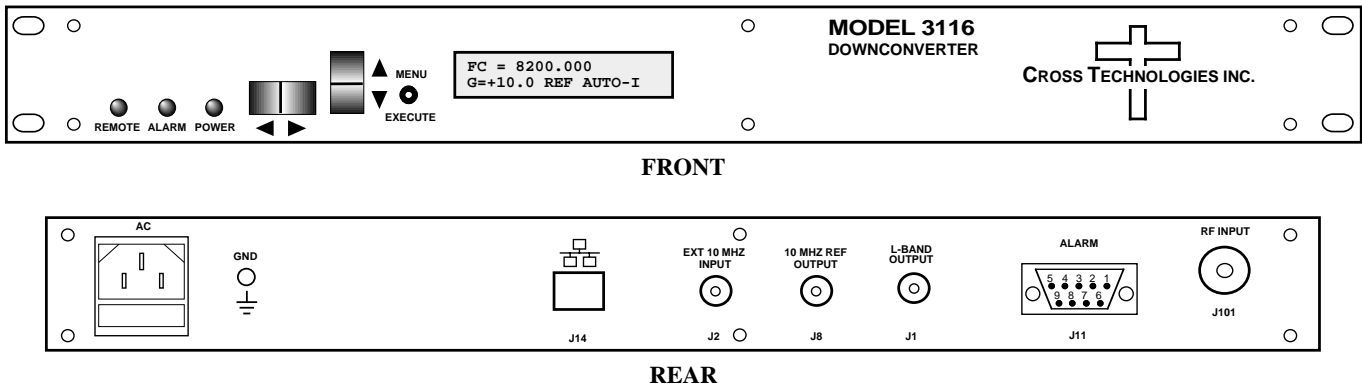
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# MODEL 3116-7786-1200 Downconverter

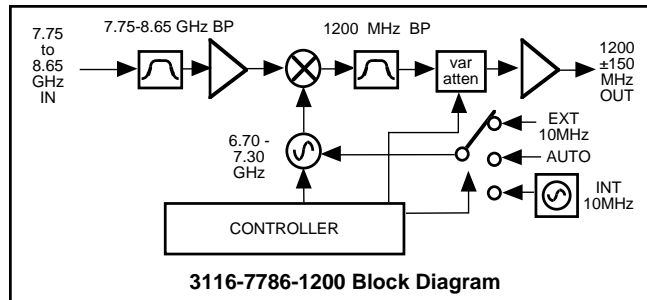
## 1.0 General

### 1.1 Equipment Description

The 3116-7786-1200 Downconverter converts 7.75 - 8.65 GHz ( $F_c = 7.9 - 8.5$  GHz) to  $1200 \pm 150$  MHz (non-inverted) in 1 MHz steps (100 kHz, 125 kHz steps optional) with a 6.70 - 7.30 GHz local oscillator. The gain is +35 dB maximum with a 30 dB adjustment in  $0.5 \pm 0.5$  dB steps. Front panel LEDs provide indication of Remote operation, PLL Alarm and DC Power. Frequency and internal/external/Auto reference mode selection are controlled by front panel switches or remote selection (via RS-232C/485, standard; Ethernet Optional) and are viewable on the LCD Display. Connectors are Type N female for the RF and BNC female for the L-Band and external reference input and reference output. In AUTO, the 10 MHz reference stays in external if the external level is +3 dBm,  $\pm 3$  dB. The 3116 is powered by a  $100-240 \pm 10\%$  VAC power supply, and housed in a 1 3/4" X 19" X 12" rack mount chassis.



**FIGURE 1.1 Model 3116-7786-1200 Front and Rear Panels**



**FIGURE 1.2 Model 3116-7786-1200 Downconverter Block Diagram**

## 1.2 Technical Characteristics

**TABLE 1.0 3116-7786-1200 Downconverter Specifications\***

Input Characteristics (RF)						
Impedance / Return Loss	50Ω / 14 dB					
Frequency	7.75 to 8.65 GHz (Fc = 7.9 - 8.5 GHz)					
Nosie Figure, maximum	12 dB, max. gain					
Input Level Range	-55 to -35 dBm					
Input 1 dB Compression	-25 dBm					
Output Characteristics (L-Band)						
Impedance / Return Loss	50Ω / 14 dB					
Frequency	1200 ±150 MHz					
Output Level Range	-20 to 0 dBm					
Output 1dB Compression	+10 dBm at maximum gain					
Channel Characteristics						
Gain at Fc, Max.; adjustable	+35 dB ±2 dB, max. gain; 30 dB adjustment in 0.5± 0.5 dB Steps (Fc = 7.9 - 8.5 GHz)					
Image Rejection	> 60 dB, minimum					
Spurious, In Band	SIGNAL RELATED <-45 dBC, 0 dBm out; SIGNAL INDEPENDENT, <-55 dBm (1200 ±325 MHz Out)					
Spurious, Out of Band	<-50 dBm (0.3-1.04 and 1.36-2.0 GHz Out)					
Intermodulation	<-50 dBC for two carriers at 4 MHz spacing, each at -10 dBm out, at Gmax.					
Frequency Response	±2.0 dB over the band, ± 1.0 dB 1200 ± 150 MHz out;					
Frequency Sense	Non-inverting					
LO Characteristics						
LO Frequency	6.70 - 7.30 GHz, 1 MHz steps; 100 kHz, 125 kHz steps opt.					
Frequency Accuracy	±0.01 ppm internal reference; External reference input					
10 MHz Level (In / Out)	3 ± 3 dBm, with Auto-detect					
Phase Noise @ F(Hz) >	10	100	1K	10K	100K	1M
Standard dBC/Hz	-55	-75	-80	-80	-100	-120
Controls, Indicators						
Frequency/Ext. Ref. Selection	Direct readout LCD, pushbutton switches or remote					
Power/Alarm/Remote/Mute	Green LED; Red LED; Yellow LED; Yellow LED					
Remote	RS232C/RC485/422, 9600 baud Ethernet Optional					
Other						
RF Connector	N-Type (female), 50Ω					
L-Band Connector	BNC (female), 50Ω					
10 MHz Connectors	BNC (female), 75Ω, works with 50 or 75 ohms					
Alarm/Remote Connector	DB9 - NO or NC Contact Closure on Alarm					
Size	19 inch, 1 RU Standard Chassis 1.75" high X 14.0" deep					
Power	100-24 ±10% VAC, 47-63 Hz, 30 watts maximum					

\*10°C to 40°C; Specifications subject to change without notice

**Technical Characteristics continued on page 5...**

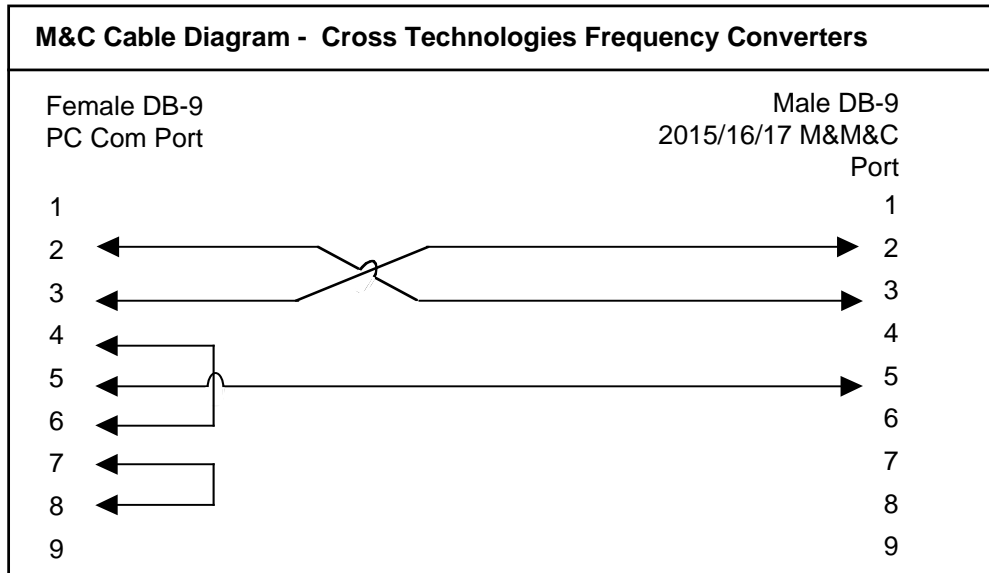
## Technical Characteristics continued from page 4...

Available Options	
<b>Remote M&amp;C Ethernet Options</b>	
- W8	Ethernet with Web Browser Interface
- W18	Ethernet with SNMP (and MIB) Interface
- W28	Ethernet with TCP/IP, Telnet®
- W116	Output Select
- X	125 KHz Steps
- X1	100 KHz Steps
<b>Connectors Options</b>	
- N	50Ω N-type N-type (RF), 75Ω BNC (L-Band)
- NN	50Ω N-type (RF), 50Ω N-type (L-BAND)
- NS	50Ω N-type (RF), 50Ω SMA (L-BAND)
- S7	50Ω SMA (RF), 75Ω BNC (L-BAND)
- SN	50Ω SMA (RF), 50Ω N-type (L-BAND)
- SS	50Ω SMA (RF), 50Ω SMA (L-BAND)
Contact Cross for other options.	
*10°C to 40°C; Specifications subject to change without notice	
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### 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 female

J11 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) M&C Commands -

Table 1.1 lists the status requests for the 3116-7786-1200 and briefly describes them. After a command is sent the 3116-7786-1200 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 character command or status byte

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 1.1 3116-7786-1200 Status Requests		
Command	Syntax *	Description
Get Frequency	{aaSF}	returns: {aaSFxxxx}
		where:
		• xxxx = 4 characters standard, 7 characters options x, x1
		• xxxx = Frequency in MHz, xxxxxxx = Frequency in kHz
Get Gain	{aaSG}	returns {aaSGxxx} where:
		• xxx = Converter gain in 0.5 dB steps.
Get Internal 10 MHz Reference Offs	{aaSO}	Returns {aaSOxxxxx} where:
		• xxxxxx = Internal 10 MHz reference frequency offset.
Get 10 MHz Reference Mode	{aaSE}	Returns {aaSEx} where:
		• x = 0 if the converter's 10 MHz reference mode is set to Internal
		• x = 1 if the converter's 10 MHz reference mode is set to External
		• x = 2 if the converter's 10 MHz reference mode is set to Auto
Get Mute	{aaSM}	Returns {aaSMx} where:
		• x = 0 if the converter's RF output is NOT muted (RF output is ON)
		• x = 1 if the converter's RF output is muted (RF output is OFF)
Get 10 MHz Reference Status	{aaSB}	Returns {aaSBx} where:
		• x = 0 if the currently selected 10 MHz reference is Internal
		• x = 1 if the currently selected 10 MHz reference is External
Get IP Address	{Si}	Returns {Sixxx.xxx.xxx.xxx} where:
(Options W8, W18, W28 only)		• xxx.xxx.xxx.xxx = IP address
Get Subnet Mask	{Ss}	Returns {Ssxxx.xxx.xxx.xxx} where:
(Options W8, W18, W28 only)		• xxx.xxx.xxx.xxx = subnet mask
Get Product/Model info	{SV}	Returns {Sv3116-xxy..yverZZZZ} where:
		• 3116-xx is the product model number
		• y..y = list of options, if any
		• "ver" = separates model & options from firmware version
		• ZZZZ = firmware version (e.g., 4.00)
Get Alarm Status	{aaSA}	Returns {aaSAx}where:
		• x = 0 if alarm is off
		• x = 1 if alarm is on
Get Output Path	{aaSD}	Returns {aaSDx}where:
(option W116)		• x = 0 if selected output path is A.

## B) Status Requests

TABLE 1.2 3116-7786-1200 Commands		
Command	Syntax *	Description
Set Frequency	{aaCFxxxx}	where: <ul style="list-style-type: none"> <li>• aa = unit address, range = 00 to 31,</li> <li>only used if interface is RS485, otherwise omit.</li> <li>• F = command code</li> <li>• xxxx=frequency in MHz, range = 7900-8500,</li> <li>xxxxxxx = frequency in kHz if option - X, X1 (7900 to 8500 MHz, 1 MHz steps)</li> <li>• example: {CF8250}</li> </ul> Will set the unit's frequency to 8250 MHz The unit will reply with the '>' character if the command is successfully processed.
Set Gain	{aaCGxxx}	where: <ul style="list-style-type: none"> <li>• xxx = Converter gain in 0.5 dB steps</li> <li>Range: 050 to 350 where 300 = 30.0 dB</li> <li>Example: {CG355} sets the converter's gain to +35.5 dB</li> </ul>
Set Internal 10 MHz Reference Offset	{aaCOxxxxx}	where: <ul style="list-style-type: none"> <li>• xxxxxx = Internal 10 MHz reference frequency offset.</li> <li>Range: -2000 to +2000</li> </ul>
Set 10 MHz Reference Mode	{aaCEx}	where: <ul style="list-style-type: none"> <li>• x = 0 if the converter's 10 MHz reference mode is set to Internal</li> <li>• x = 1 if the converter's 10 MHz reference mode is set to External</li> <li>• x = 2 if the converter's 10 MHz reference mode is set to Auto</li> </ul>
Set Mute	{aaCMx}	where: <ul style="list-style-type: none"> <li>• x = 0 if the converter's RF output is NOT muted (RF output is ON)</li> <li>• x = 1 if the converter's RF output is muted (RF output is OFF)</li> </ul>
Set Output Path (option W116)	{aaCDx}	Returns {aaSDx}where: <ul style="list-style-type: none"> <li>• x = 0 if selected output path is A.</li> </ul>



## 1.4 Environmental Use Information

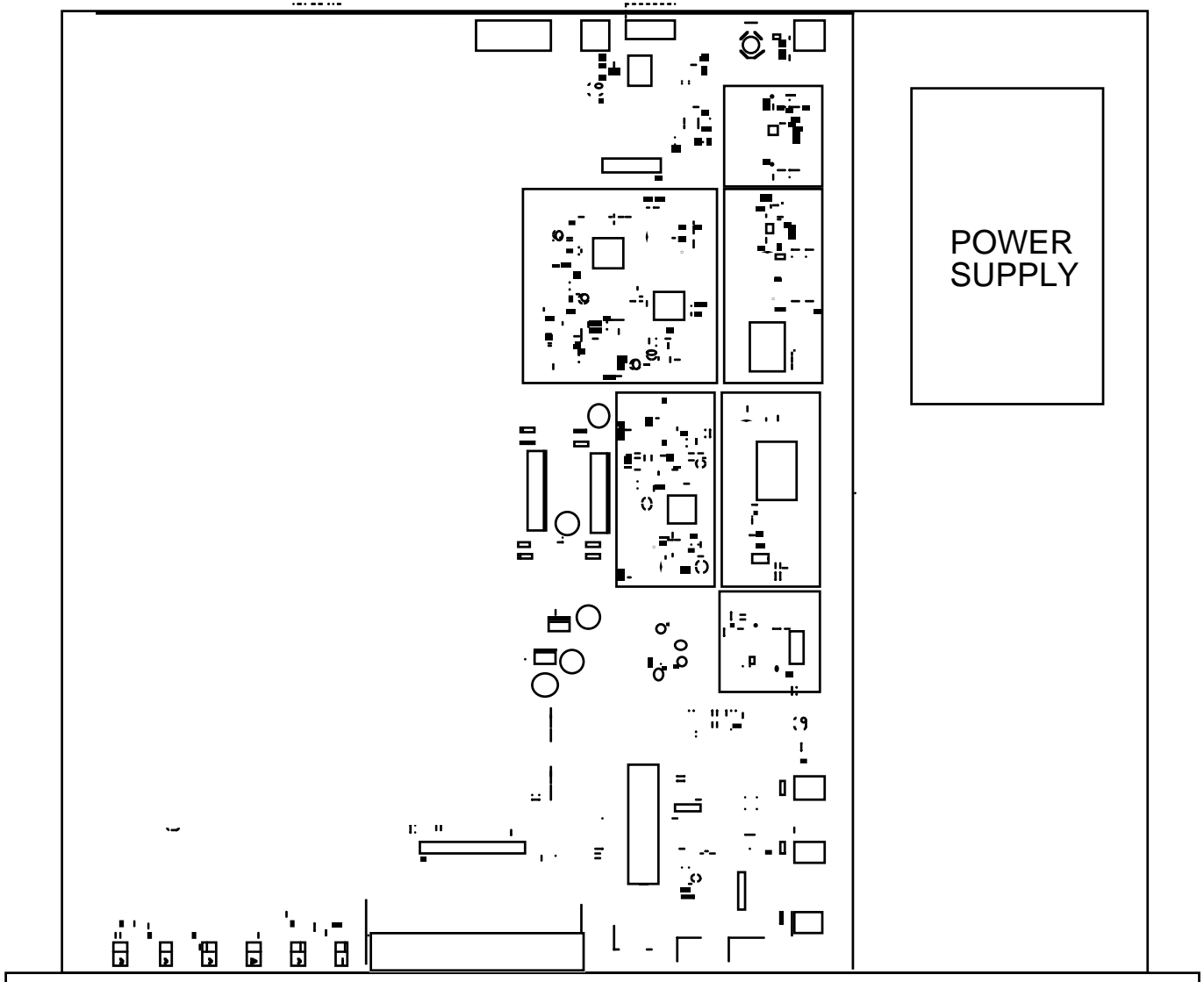
- A. Rack-Mounting** - To mount this equipment in a rack, please refer to the installation instructions located in the user manual furnished by the manufacturer of your equipment rack.
- B. Mechanical loading** - Mounting of equipment in a rack should be such that a hazardous condition does not exist due to uneven weight distribution.
- C. Elevated operating ambient temperature** - If installed in a closed or multiunit rack assembly, the operating ambient temperature of the rack may be greater than room ambient temperature. Therefore, consideration should be given to Tmra (Maximum Recommended Ambient Temperature).
- 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 units 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 3116-7786-1200 consists of one RF/Controller PCB housed in a 1 RU (1 3/4 inch high) by 12 inch deep chassis. A switching,  $\pm 12$ , +24, +5 VDC power supply provides power for the assemblies.

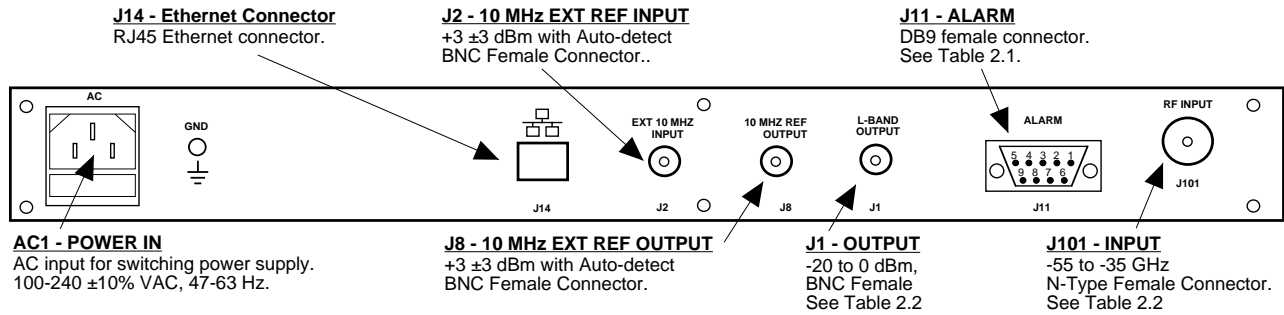
The 3116-7786-1200 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 3116-7786-1200 is assembled.



**FIGURE 2.1 3116-7786-1200 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 3116-7786-1200 Rear Panel I/Os**

TABLE 2.1 J11 Pinouts (RS-232C*)	
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

TABLE 2.2 Connector Options		
Option	RF	L-Band
N	50Ω N-type	75Ω BNC
NN	50Ω N-type	50Ω N-type
NS	50Ω N-type	50Ω SMA
S7	50Ω SMA	75Ω BNC
SN	50Ω SMA	50Ω N-type
SS	50Ω SMA	50Ω SMA

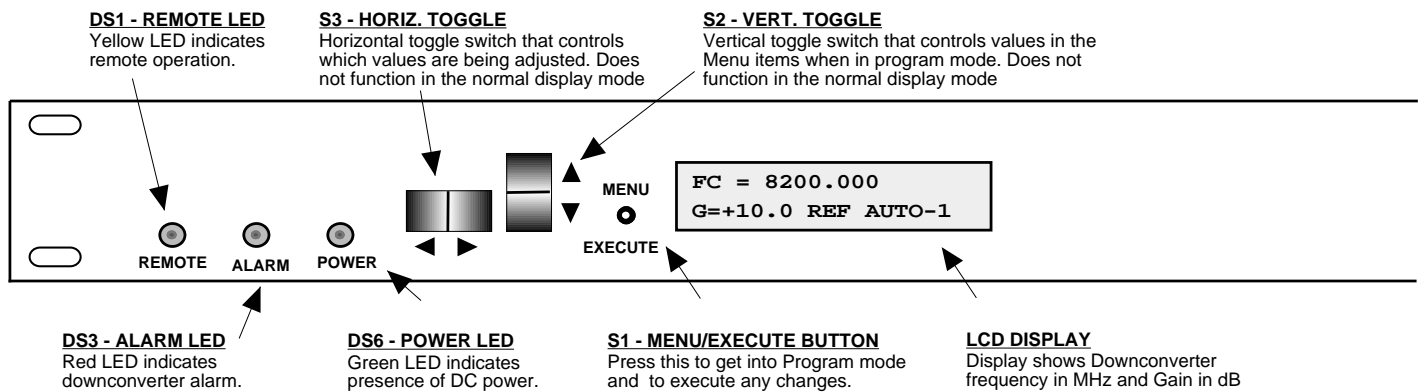
### \*Remote Serial Interface

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.

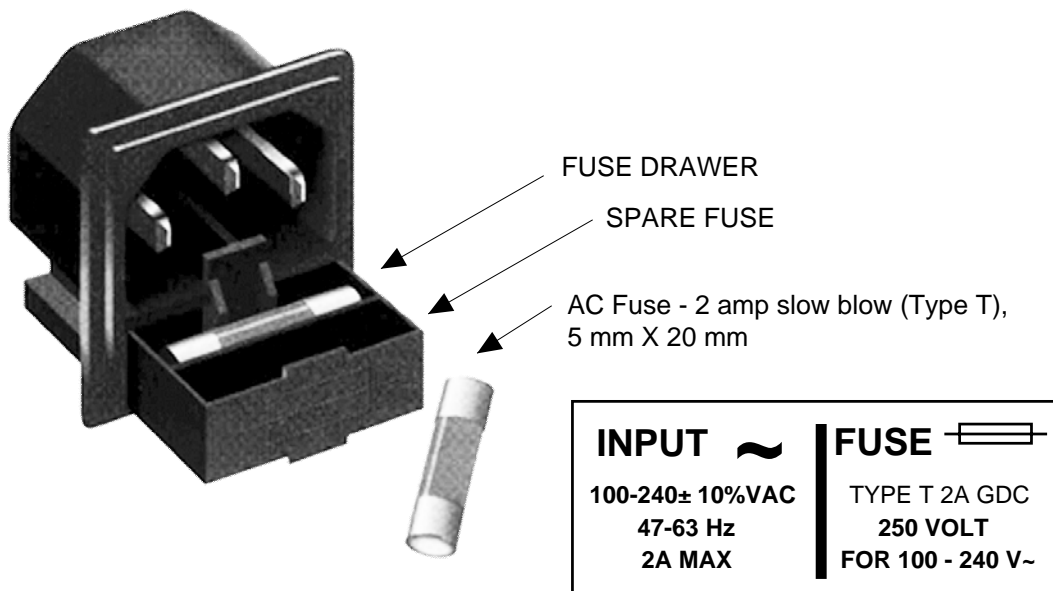


**FIGURE 2.3 3116-7786-1200 Front Panel Controls and Indicators**

## 2.4 Operation

### 2.4.1 Installing and Operating the 3116-7786-1200 Downconverter

1. Connect a -55 dBm to -35 dBm signal to RF IN, J101 (Figure 2.2).
2. Connect the RF 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 +35 dB max. with 30 dB adjustment (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** Output Select OPT W116
- Menu 2** Frequency in MHz
- Menu 3** Gain +35 dB maximum with 30 dB adjustment
- Menu 4** Set Unit to Remote Operation
- Menu 5** Select External 10 MHz Ref
- Menu 6** Set Remote Mode
- Menu 7** Set RS-485 Address

**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.**

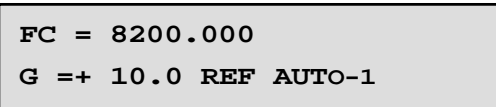
When power is first applied, the LCD display goes through three steps.

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.



FC = 8200.000  
G =+ 10.0 REF AUTO-1

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 = 8100.000      R
```

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

```
F = 8200.000      R
```

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

```
F = 8200.000      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 = +30.0        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 this:

```
FC = 8200.000  
G =+ 10.0 REF AUTO-1
```

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 = +30.0      R
```

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

```
G = +40.0      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 = +40.0      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:

```
FC = 8200.000
G =+ 10.0 REF AUTO-1
```

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



## 2.5.6 Alarm Indications

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

## 2.5.7 10 MHz Reference Mode Operation

**Internal Mode:** The unit uses its own built-in 10 MHz OCXO. The Internal Reference is present on the Reference Output Connector, J8. REF = INT appears on the front panel display.

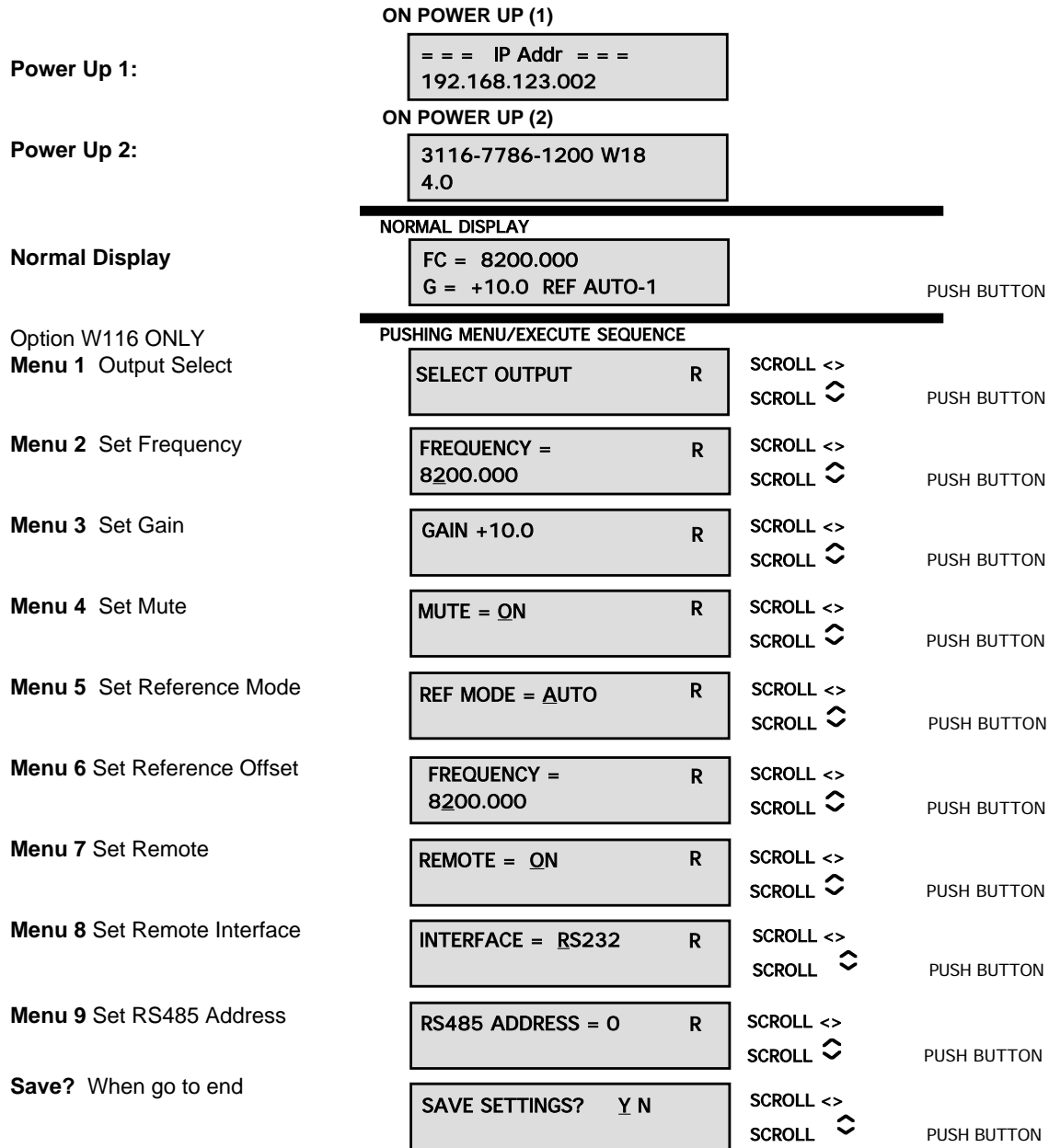
**External Mode:** The unit uses a 10 MHz Reference that is connected to the External Reference Input, J2. REF = EXT appears on the front panel display. The External 10 MHz Reference level must be +3dBm,  $\pm 3$ dB. If the External 10 MHz signal does not meet the unit's specified parameters then the unit will not function properly. The External Reference is present on the Reference Output connector, J8.

**Auto Mode:** The unit defaults to the External 10 MHz Reference as long as the level meets the +3dBm,  $\pm 3$ dB specification. REF = AUTO - E appears on the front panel display where the -E indicates that the unit is using the External 10 MHz Reference. The External Reference is present on the Reference Output connector, J8.

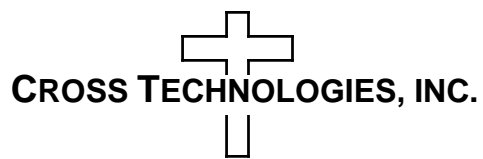
If the external 10 MHz Reference signal level is less than -1dBm, the unit switches to Internal 10 MHz Reference. REF = AUTO -I appears on the front panel display where -I indicates that the unit is using the Internal 10 MHz Reference. The Internal 10 MHz Reference is present on the reference output connector, J8.

## 2.5.8 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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