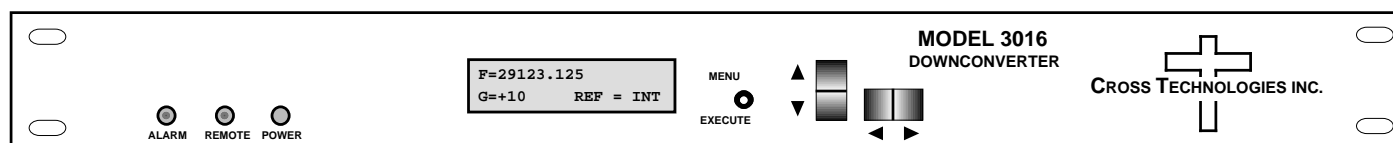


# Instruction Manual

# Model 3016-2830 Downconverter

March 2018, Rev. 0



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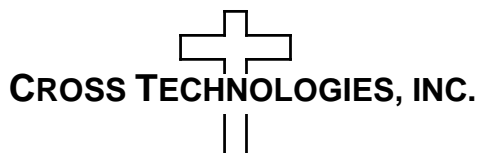
# INSTRUCTION MANUAL

## MODEL 3016-2830 Downconverter

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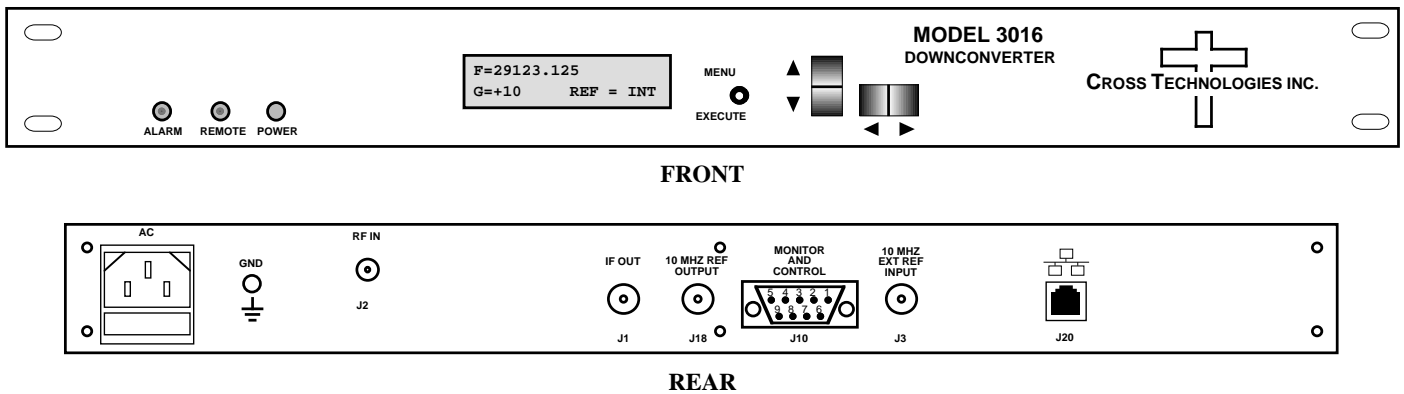
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# MODEL 3016-2830 Downconverter

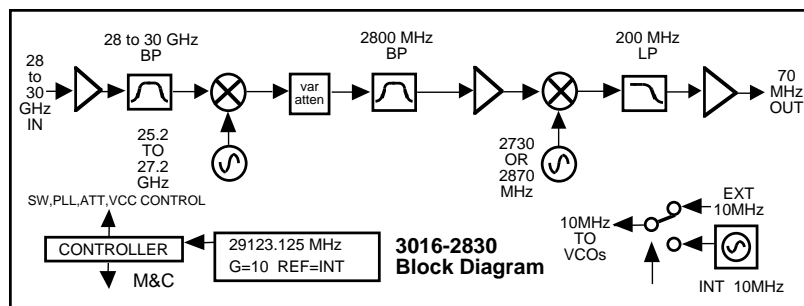
## 1.0 General

### 1.1 Equipment Description

The 3016-2830 Downconverter converts 28 to 30 GHz to  $70 \pm 18$  MHz in 125 kHz steps (1 kHz opt- X1008). This unit combines an agile block downconverter with a 2.8 GHz to 70 MHz downconverter to obtain the wide tuning range. Synthesized local oscillators (LO) provide frequency selection. Multi-function 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 +10 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 2.92 mm female for the RF, and BNC female for the IF and external 10 MHz reference input and output. Other connector options are available. It is powered by a 100-240  $\pm 10\%$  VAC power supply, and is in a 1 3/4" X 19" X 18" rack mount chassis.



**FIGURE 1.1 Model 3016-2830 - Front & Rear Panels**



**FIGURE 1.2 Model 3016-2830 Downconverter Block Diagram**

## 1.2 Technical Characteristics

**TABLE 1.1 3016-2830 Downconverter Specifications\***

<b>Input Characteristics (RF)</b>					
Impedance / Return Loss	50Ω / 18 dB Typical				
Frequency	28.0 to 30.0 GHz				
Noise Figure, Maximum	20 dB (maximum gain)				
Input Level Range	-50 to -30 dBm				
<b>Output Characteristics (IF)</b>					
Impedance / Return Loss	75Ω / 18 dB				
Frequency	70± 18 MHz				
Output Level	-20 to 0 dBm				
Output 1 dB Compression	+10 dBm				
<b>Channel Characteristics</b>					
Gain Max./Range (adjustable)	30 ± 3 dB Maximum/ +10.0 to +30.0 dB, 0.5 dB ± 0.5 dB steps				
Image Rejection	50 dBC minimum				
Frequency Response	±3.0 dB, 28 - 30 GHz; ±1.5 dB, any 1 GHz band; ±1.0 dB, 36 MHz BW				
Spurious Response	<-50 dBC, in band, 28 to 30 GHz				
Intermod	<-50 dBC for two carriers each at -5 dBm out				
Group Delay, max.	0.02 ns/MHz <sup>2</sup> parabolic; 0.05ns/MHz linear; 1 ns ripple, 36 MHz BW				
Frequency Sense	Inverting or Non-inverting (user selectable)				
<b>Synthesizer Characteristics</b>					
Frequency Accuracy	± 0.01 ppm max. over temp internal reference; external reference input				
Frequency Step	125 kHz minimum (1 kHz option - X1008)				
External 10 MHz Level	3 dBm ± 3 dB				
Phase Noise @ Frequency	100 Hz	1 kHz	10kHz	100kHz	1MHz
dBC/Hz	-60	-70	-80	-90	-100
<b>Controls, Indicators</b>					
Frequency / Gain Selection	Direct readout LCD; manual or remote selection				
Power, Alarm, Remote	Green LED, Red LED, Yellow LED				
Remote	RS232C, 9600 baud (RS422/485/option -Q, Ethernet/option -W8, -W18, -W28)				
<b>Other</b>					
RF, IF Connectors	2.92 mm (female), BNC, 75Ω (female), (50Ω IF opt - S29)				
10 MHz Connectors	BNC (female) 50Ω works for 50 or 75 ohms				
Alarm/Remote Connector	DB9 (female) - NO or NC contact closure on Alarm				
Size	19 inch, 1RU Standard Chassis 1.75" high X 18.0" deep				
Power	100-24 ±10% VAC, 47-63 Hz, 60 watts maximum				

See next page for available options...

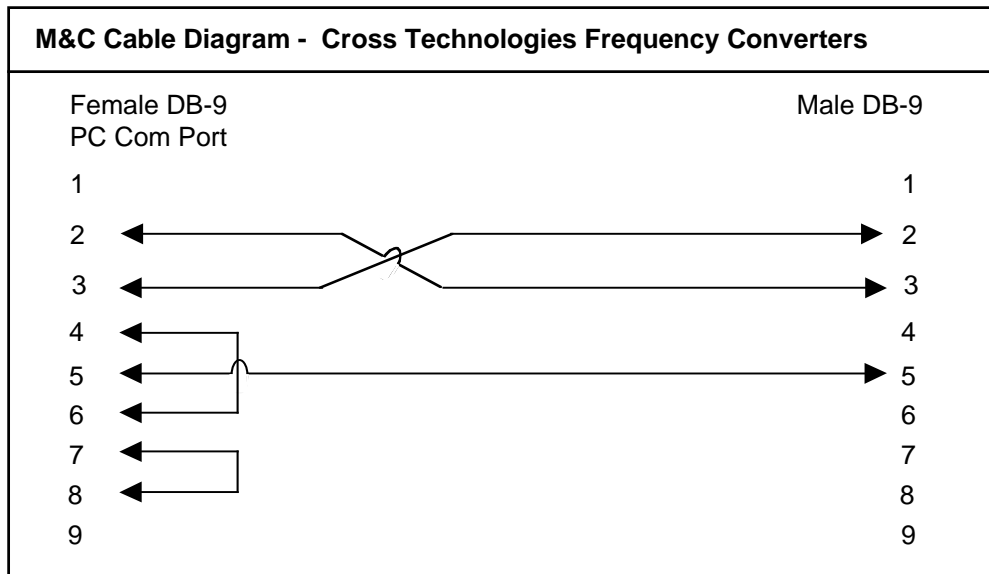
## 1.2 Technical Characteristics (continued from page 4)

Available Options (contact Cross for other available options)		Bundled Options
- W16	Test Data	-01
- W71	IF Mon., -20 dB, 50 ohm	S29
- W73	RF Mon., -3 ± 3dB, 50 ohm	W8
- X1008	1 KHz steps	W16
<b>Remote M&amp;C Interfaces</b>		W70
- Q	RS485 Remote Interface	X1008
- W8	Ethernet with Web Browser (WB)	
- W18	Ethernet with Web Browser & SNMP	
- W28	Ethernet with TCP/IP, Telnet®	
<b>Connectors / Impedance</b>		
S29	2.92mm (RF), 50Ω BNC (IF)	
SS29	2.92mm (RF), SMA (IF)	
*+0 to +50 degrees 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 - J10	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

**B) Commands** - Table 1.2 lists the commands for the 3016-2830 and briefly describes them. After a command is sent the 3016-2830 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 of 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 3016-2830 Commands		
Command	Syntax	Description
Set Frequency	{aaCFxxxxxxx}	where: aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit F = command code xxxxxxx=frequency in kHz, range=28000000 to 30000000 (28000.000 to 30000.000 MHz, 125 kHz steps, 1kHz steps option X1008) 125 kHz steps, 1kHz steps option X1008) example: {CF28250425} Will set the unit's frequency to 28250.425 MHz. The unit will reply with the '>' character if the command is sucessfully processed.
Set Gain	{aaCGxxx}	where: aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit xxx = gain, range: 100 to +300 (+10.0 to +30.0) in 0.5 dB steps example: {CG255} Will set the unit's gain to 25.5 dB. The unit will reply with the '>' character if the command is sucessfully processed.
Set Spectrum Invert	{aaC7x}	where: aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit 7 = command code x = 0 to set to spectrum non-invert, x = 1 to set to spectrum invert example: {C71} Will set the spectrum to invert. The unit will reply with the '>' character if the command is sucessfully processed.

**Table 1.2 3016-2830 Commands Continued...**

Command	Syntax	Description
Set Frequency	{aaCFxxxxxxx}	where: aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit F = command code xxxxxxx=frequency in kHz, range=28000000 to 30000000 (28000.000 to 30000.000 MHz, 125 kHz steps, 1kHz steps option X1008) 125 kHz steps, 1kHz steps option X1008) example: {CF28250425} Will set the unit's frequency to 28250.425 MHz. The unit will reply with the '>' character if the command is sucessfully processed.
Set Gain	{aaCGxxx}	where: aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit xxx = gain, range: 100 to +300 (+10.0 to +30.0) in 0.5 dB steps example: {CG255} Will set the unit's gain to 25.5 dB. The unit will reply with the '>' character if the command is sucessfully processed.
Set Spectrum Invert	{aaC7x}	where: aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit 7 = command code x = 0 to set to spectrum non-invert, x = 1 to set to spectrum invert example: {C71} Will set the spectrum to invert. The unit will reply with the '>' character if the command is sucessfully processed. sucessfully processed.
Set Reference Mode	{aaCEx}	where: aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit E = command code x = 0 to set to internal reference, x = 1 to set to external reference, x = 2 to set to auto reference example: {CE2} Will set the reference mode to Auto. The unit will reply with the '>' character if the command is sucessfully processed.



Table 1.2 3016-2830 Commands Continued...		
Set Remote Off	{aaCRO}	where:
		aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit
		R = command code
		O, ascii number zero.
		example: {CRO}
		Will disable the unit's serial M&C port.
		The unit will reply with the '>' character if the command is successfully processed.
		(Note: this command only affects the serial M&C port, the ethernet port is always on and will not be affected)
Set Remote On	#	Just the ascii pound sign, (0x23)
		Will enable the unit's serial M&C port.
		The unit will reply with the '>' character if the command is successfully processed.
		(Note: this command only affects the serial M&C port, the ethernet port is always on and will not be affected)

C) **Status Requests** - Table 1.3 lists the status requests for the 3016-2830 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 1.3 3016-2830 Status Requests/Inquires</b>		
<b>Command</b>	<b>Syntax</b>	<b>Description</b>
Frequency Inquiry	{aaSF}	returns: {aaSFxxxxxx}
		where:
		aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit
		F = command code
		xxxxxxx = frequency in kHz
		The unit will append the '>' character if the command is sucessfully processed.
Gain Inquiry	{aaSG}	returns: {aaS7x}
		where:
		aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit
		G = command code
		xxxxx = gain in dB
		The unit will append the '>' character if the command is sucessfully processed.
Spectrum Invert Inquiry	{aaS7}	returns: {aaS7x}
		where:
		aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit
		7 = command code
		x = 1 if the spectrum is inverted, x = 0 if the spectrum is not inverted
		The unit will append the '>' character if the command is sucessfully processed.
Reference Mode Inquiry	{aaSE}	returns: {aaSEx}
		where:
		aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit
		E = command code
		x = 0 if reference mode is internal, x = 1 if external,
		x = 2 if auto
		The unit will append the '>' character if the command is sucessfully processed.

**Table 1.3 3016-2830 Status Requests/Inquires Continued...**

Command	Syntax	Description
Reference Status Inquiry	{aaSB}	returns: {aaSBx}
		where:
		aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit
		B = command code
		x = 1 if the unit is using the external reference, x = 0 if the unit is using the internal reference
		note: this inquiry is useful if the reference mode is auto the user wants to know if the unit has switched to the internal reference.
		The unit will append the '>' character if the command is sucessfully processed.
Alarm Inquiry	{aaSA}	returns: {aaSAx}
		where:
		aa = unit address, range = 00 to 31, only used if interface is RS485, otherwise omit
		A = command code
		x = 0 if alarm is off, x = 1 if alarm is on.
		The unit will append the '>' character if the command is sucessfully processed.
Product/Model Info Inquiry	{aaSV}	returns {aaSV3016-2830-xxxver5.00}
		where 3016-2830 = product model
		xxx = list of options, if any
		"ver" = separates model & options from firmware version
		5.00 = firmware version

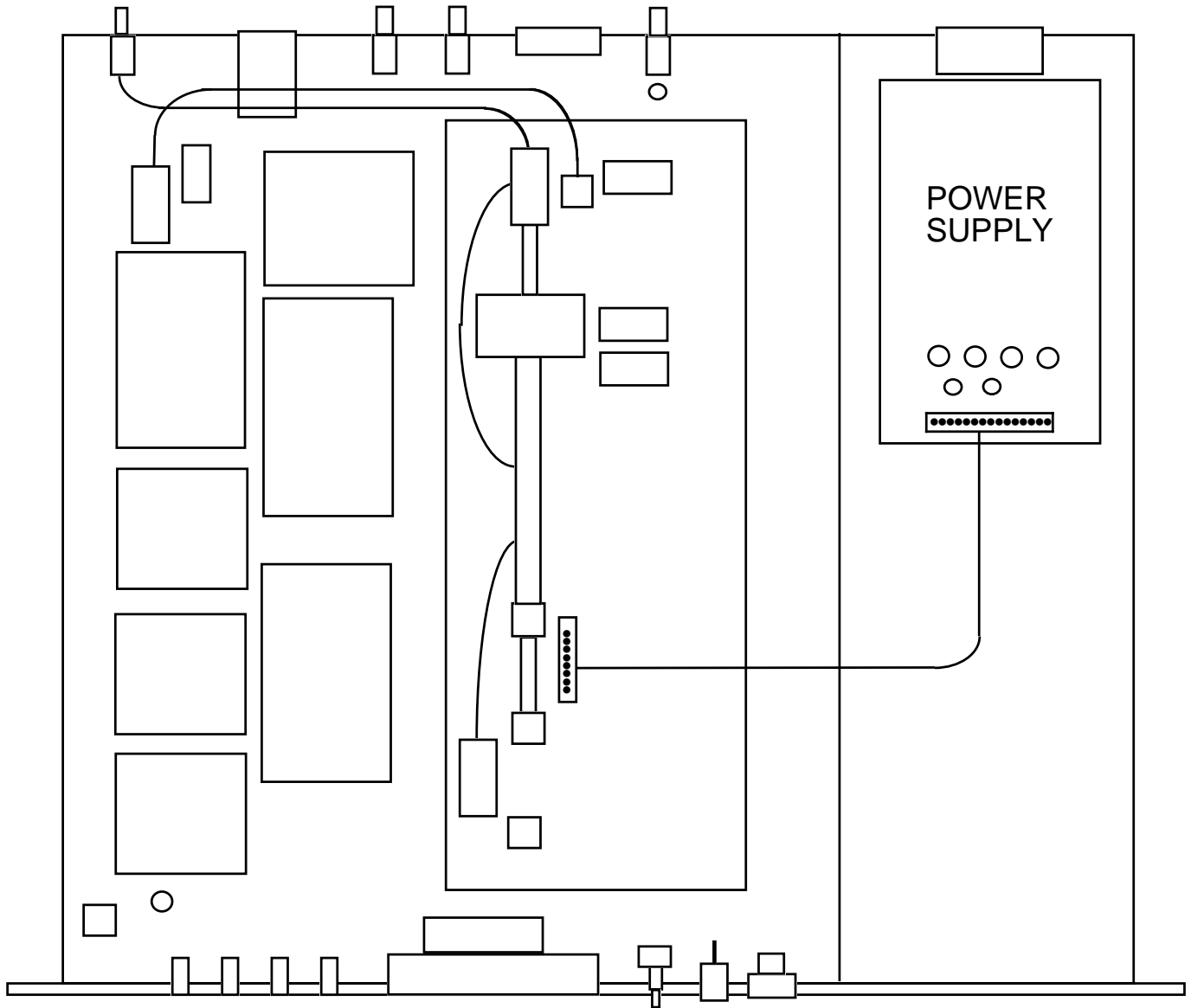
## 1.4 Environmental Use Information

- 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 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 3016-2830 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,  $\pm 12$ , +24, +5 VDC power supply provides power for the assembly. The 3016-2830 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 3016-2830 is assembled.



**FIGURE 2.1 3016-2830 Mechanical Assembly**

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

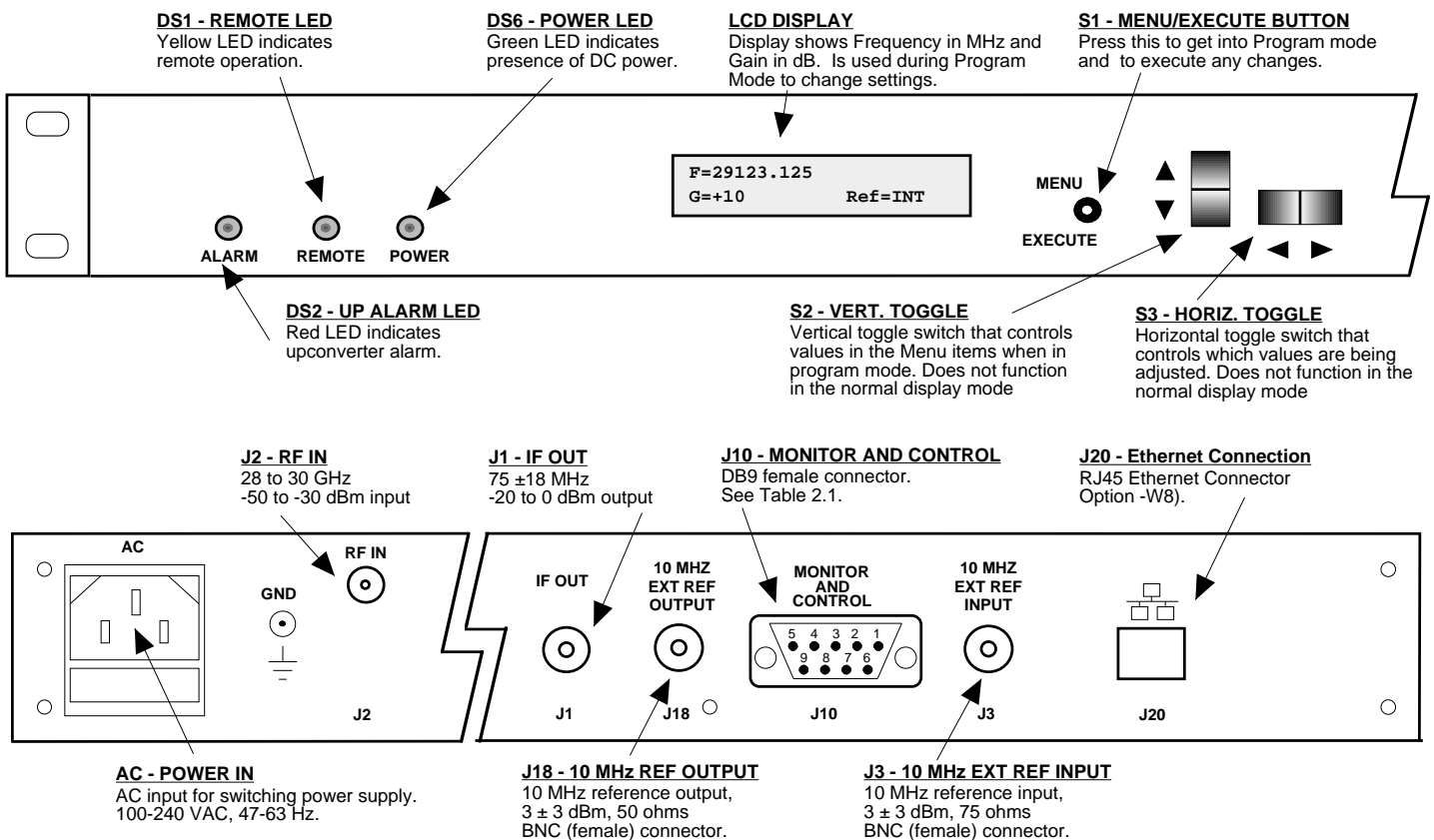
**FIGURE 2.2 3016-2830 Rear Panel Inputs and Outputs**

Table 2.1 J10 Pinouts (RS-485/RS-422/RS-232C)*	
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

Table 2.2 Connectors/Impedance	
S29	2.92mm (RF), 50Ω BNC (IF)
SS29	2.92mm (RF), SMA (IF)

## 2.3 Front & Rear Panel Controls and Indicators - Figure 2.3 shows the front and rear panel controls and indicators.

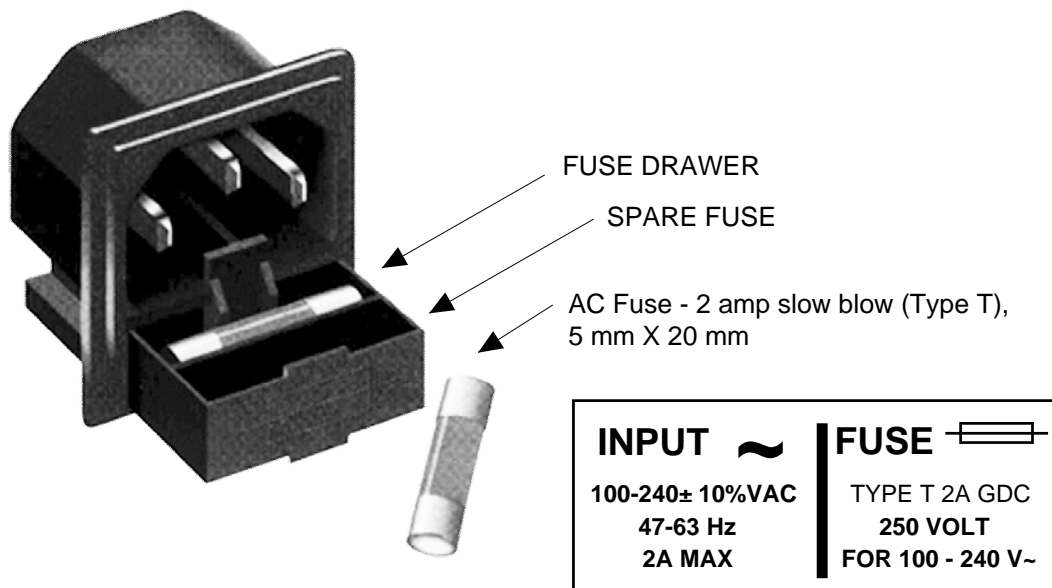


**Figure 2.3 Front & Rear Panel Controls & Indicators**

## 2.4 Installation / Operation

### 2.4.1 Installing and Operating the 3016-2830 Upconverter

1. Connect a -50 dBm to -30 dBm, 50MHz signal to RF IN, J2 (Figure 2.3, page 9)
2. Connect 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 output frequency (See Section 2.5 Menu Settings, page 13).
5. Set the gain for +10.0 to +30.0 dB. Make sure the output stays within -20 to 0 dBm with the gain selected. (See Section 2.5 Menu Settings, page 15).
6. Be sure DS6 (green, DC Power) is on and DS2 (red, Alarm) is off (Figure 2.3, page 9).
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, page 10. 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, page 15):

### Power Up

### Normal Display

- Menu 1**      Frequency in MHz
- Menu 2**      Gain in dB (+10.0 to +30.0)
- Menu 3**      Set Unit to Remote Operation
- Menu 4**      Select Frequency Step Size -1 kHz minimum (**option X1008**)
- Menu 5**      Select External 10 MHz Reference
- Menu 6**      Select RS232, RS422, or RS485 Remote Operation (**option Q**)
- Menu 7**      Select RS485 Remote Address for Unit (**option Q**)

**Save Menu**    When “R” is selected in any of the above menus or when operator reaches the end

Alarm indications appear on the LEDs (see figure 2.2, page 9).

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 12 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.

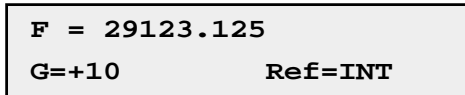
When power is first applied, the LCD display goes through three steps.

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, gain, and selected RF output of the upconverter is shown.



F = 29123.125  
G=+10                      Ref=INT

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 as 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:

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 upconverter frequency:

```
F = 29123.125
G=+10      Ref=INT
```

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

```
F = 29123.125
G=+10      Ref=INT
```

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

```
F = 29123.125      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:

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 the default display:

```
F = 29123.125
G=+10      Ref=INT
```

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 12 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:

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 LEVEL AND 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 = +10.0      R
```

Press the Up/Down switch to change the gain in 0.1, 1 or 10 dB steps:

```
G = +20.0      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. DO NOT SET A GAIN THAT WOULD EXCEED 0 dBm OR HAVE LESS THAN -20 dBm OUTPUT LEVEL.**

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?  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:

```
F = 29123.125
G=+10      Ref=INT
```

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

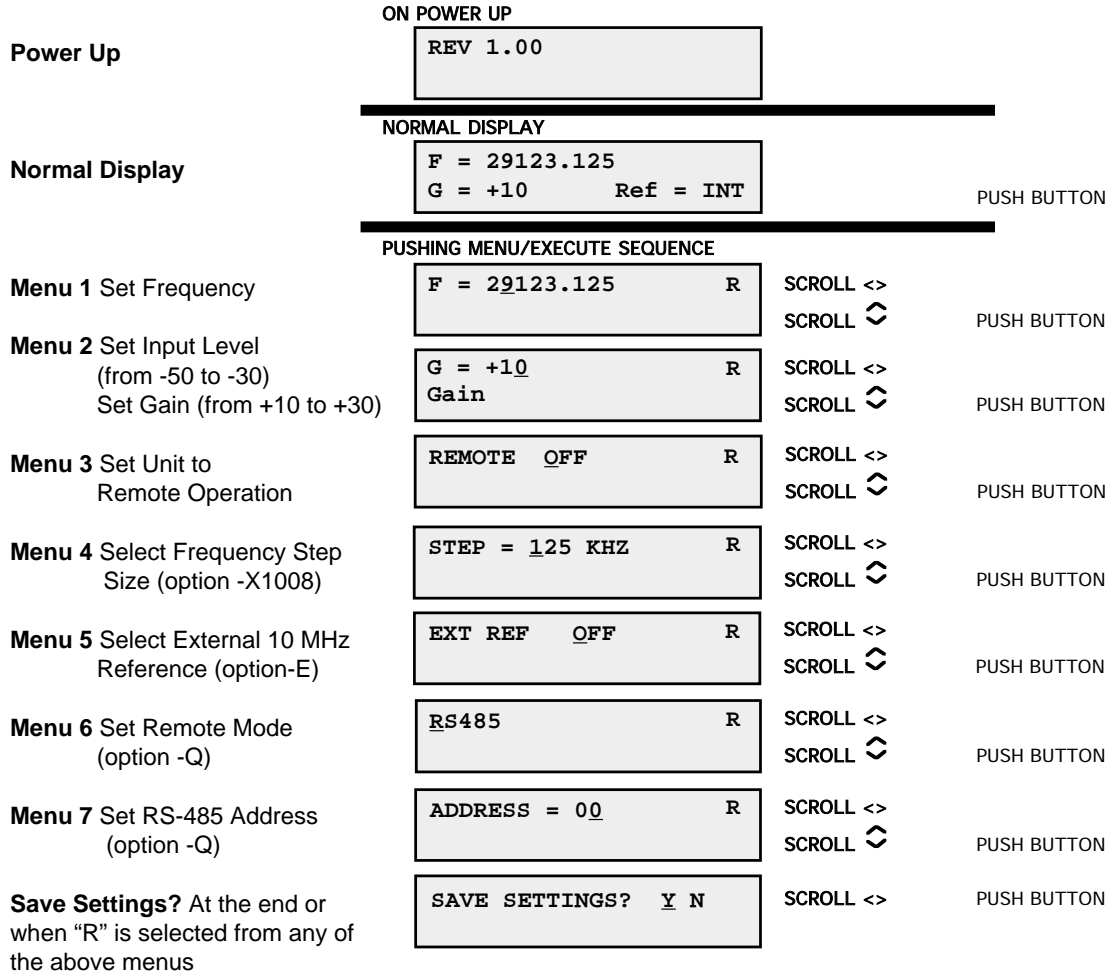
### **2.5.5 Alarm Indications**

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

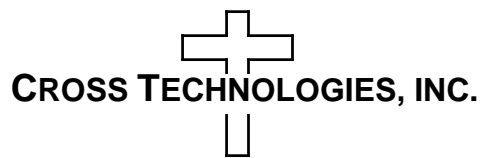
### **2.5.6 10 MHz Reference Mode Operation**

Internal Mode: The unit uses its own built-in 10 MHz OCXO. The Internal Reference is present on the Reference Output Connector, J18. 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, J3. 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, J18.



**FIGURE 2.5    Menu Display and Sequence**



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