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1.0 General

1.1 Equipment Description
The 2016-05 Downconverter converts 950 to 1525 MHz to 140 ± 36 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 50 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). Table 2.2 shows other connector options. LNB +24 VDC (option L) and 10 MHz reference (option E) can be inserted on the RF lines. The 2016-05 is powered by a 100-240 ±10% VAC power supply, and is contained in a 1 3/4” X 19 “ X 16” rack mount chassis.
1.2 Technical Characteristics

**TABLE 1.0  2016-05 Downconverter Specifications***

**Input Characteristics**
- Impedance/Return Loss: 75Ω/12 dB (see TABLE 2.2 for connector options)
- Frequency: 950 to 1525 MHz
- Noise Figure, Max.: 15 dB max gain
- Input Level range: -70 to -20 dBm
- Input 1 dB compression: -15 dBm

**Output Characteristics**
- Impedance/Return Loss: 75Ω/18 dB (see TABLE 2.2 for connector options)
- Frequency: 140 ± 36 MHZ
- Output Level/max linear: -20/-10 dBm
- Output 1 dB compression: -5 dBm

**Channel Characteristics**
- Gain: 0.0 to 50.0 dB, 1 dB steps (manually adjustable)
- Image Rejection: > 50 dB, min
- Spurious Response: <-40 dBC in band (± 36 MHZ)
- Frequency Response: ±1.5 dB, 950 - 1525 MHz; ± 0.5 dB, 72 MHz BW
- Group Delay, max: 0.0035 ns/MHz² parabolic; 0.025 ns/MHz linear; 1 ns ripple
- Frequency Sense: Non-inverting or Inverting (selectable)

**Synthesizer Characteristics**
- Frequency Accuracy: ±1.0ppm max over temp (±0.01ppm option H) internal reference
- Frequency Step: 1.0 MHz minimum
- 10 MHz level (In & Out): 3 dBm, ± 3 dB (option E)

<table>
<thead>
<tr>
<th>Phase Noise @ Freq</th>
<th>100 Hz</th>
<th>1kHz</th>
<th>10kHz</th>
<th>100kHz</th>
<th>1MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>dBC/Hz</td>
<td>-70</td>
<td>-70</td>
<td>-80</td>
<td>-95</td>
<td>-105</td>
</tr>
</tbody>
</table>

**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 (RS485 option Q), 9600 baud

**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), 50/75 Ω (option E)
- Connector, Alarm, Remote: DB9 - 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
- L: LNB +24 VDC, 0.4 Amps with readout of current
- O: 10 MHz Reference Adjust capability
- Q: RS-422/RS-485 Remote capability
- R: Redundant Power Supplies
- T: Temperature Sensor
- X: 125 kHz Frequency Steps
- 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)

<table>
<thead>
<tr>
<th>M&amp;C Cable Diagram - Cross Technologies Frequency Converters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female DB-9 PC Com Port</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>

Connector: Rear panel, DB-9 male

<table>
<thead>
<tr>
<th>J10 Pinouts (RS-232C/422/485)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>
B) Commands - Table 1.1 lists the commands for the 2016-05 and briefly describes them. After a command is sent the 2016-05 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-digit command or status number, 1 through 9
- 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>
<thead>
<tr>
<th>Table 1.1 2016-05 Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command</td>
</tr>
</tbody>
</table>
| Set Receiver Frequency | \{aaC2xxxx\} | where:
  - xxxx = 4 characters (7 characters, option X)
  - Range: 0950 to 1525 MHz |
| Set Receiver Gain | \{aaC4xx\} | where:
  - xxx = 3 characters
  - Range: 000 to 500 (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 | \{aaCR0\} | {CR and zero} |

C) Status Requests

Table 1.1 lists the status requests for the 2016-05 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>
<thead>
<tr>
<th>TABLE 1.2 2016-05 Status Requests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command</td>
</tr>
</tbody>
</table>
| Command Status | \{aaS1\} | Returns \{S1bbbbcccclA\} where:
  - bbbb = Rx frequency (bbbbbbbb, option X)
  - ccc = Rx gain
  - l = 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 ref inserted on RF input connector |
| LNB Current | \{aaS3\} | Returns \{S3eee\} where:
  - (option L only)
  - eee = LNB current (000 to 500 = 0 to .500 A) |
2.0 Installation

2.1 Mechanical
The 2016-05 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 2016-05 can be secured to a rack using the 4 holes on the front panel. Figure 2.1 shows how the 2016-05 is assembled.

FIGURE 2.1 2016-05 Mechanical Assembly
2.2 Rear Panel Input/Output Signals - Figure 2.2 shows the input and output connectors on the rear panel.

**TABLE 2.1 J10 Pinouts (RS-232C*)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not Used</td>
</tr>
<tr>
<td>2</td>
<td>Rx+ (RS-232C)</td>
</tr>
<tr>
<td>3</td>
<td>Tx+ (RS-232C)</td>
</tr>
<tr>
<td>4</td>
<td>Not Used</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>Alarm Relay: Common</td>
</tr>
<tr>
<td>7</td>
<td>Alarm Relay: Normally Closed</td>
</tr>
<tr>
<td>8</td>
<td>Not Used</td>
</tr>
<tr>
<td>9</td>
<td>Alarm Relay: Normally Open</td>
</tr>
</tbody>
</table>

*Remote Serial Interface

Interface: DB-9 Male
Protocol: RS-232C, 9600 baud rate, no parity, 8 data bits, 1 start bit, 1 stop bit

**TABLE 2.2 IF/RF Connector Options**

<table>
<thead>
<tr>
<th>Option</th>
<th>IF</th>
<th>RF</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD</td>
<td>BNC, 75Ω</td>
<td>Type F, 75Ω</td>
</tr>
<tr>
<td>B</td>
<td>BNC, 75Ω</td>
<td>BNC, 75Ω</td>
</tr>
<tr>
<td>C</td>
<td>BNC, 75Ω</td>
<td>BNC, 50Ω</td>
</tr>
<tr>
<td>D</td>
<td>BNC, 50Ω</td>
<td>BNC, 50Ω</td>
</tr>
<tr>
<td>F</td>
<td>Type F, 75Ω</td>
<td>Type F, 75Ω</td>
</tr>
<tr>
<td>J</td>
<td>BNC, 50Ω</td>
<td>Type F, 75Ω</td>
</tr>
<tr>
<td>K</td>
<td>BNC, 50Ω</td>
<td>BNC, 75Ω</td>
</tr>
<tr>
<td>M</td>
<td>BNC, 50Ω</td>
<td>Type N, 50Ω</td>
</tr>
<tr>
<td>N</td>
<td>BNC, 75Ω</td>
<td>Type N, 50Ω</td>
</tr>
</tbody>
</table>
2.3 Front Panel Controls and Indicators - The following are the front panel controls and indicators.

- **DS3 - DOWN 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.
- **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 2016-05 Front Panel Controls and Indicators**
2.4 Operation

2.4.1 Installing and Operating the 2016-05 Downconverter

1. Connect a -20 dBm to -70 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.
4. Set the input frequency (See Section 2.5 Menu Settings).
5. Set the gain for +00.0 to +50.0 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.

![Fuse Location and Spare Fuse](image)
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, 1dB steps)
  - **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 mode (option Q)
  - **Menu 7** Set RS-485 address (option Q)
  - **Menu 8** View PCB Temperature (option T)
  - **Menu 9** 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 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 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=+25.0 |

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:

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 = 1350

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

F = 1450

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

F = 1450

NOTE: CHANGES DO NOT TAKE PLACE ON FREQUENCY UNTIL YOU GO TO THE SAVE MENU AND INDICATE YOU WANT TO SAVE THE CHANGES. THE CARRIER IS MUTED WHEN FREQUENCY IS CHANGED.

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

G = +25.0

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=1450 G=+25.0

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 12 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):

\[ G = +25.0 \]

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

\[ G = +15.0 \]

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.

\[ G = +15.0 \]

**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:

\[ \text{OTHER? Y N} \]

OR you can scroll to “R” and push the Menu/Execute switch to get to:

\[ \text{SAVE SETTINGS? Y N} \]

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:

\[ F = 1450 \quad G = +15.0 \]

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.

![Figure 2.5 Menu Display and Sequence]

**ON POWER UP**

**REV 1.00**

**NORMAL DISPLAY**

**F = 1450  G = +10.0**

**PUSH BUTTON**

**PUSHING MENU/EXECUTE SEQUENCE**

**Menu 1** Frequency

**F = 1450  R**

**Menu 2** Gain (00.0 to +50.0)

**G = +10.0  R**

**Menu 3** Set Unit to Remote Operation

**REMOTE OFF  R**

**Menu 4** Select External 10 MHz Reference (option E)

**EXT REF OFF  R**

**Menu 5** Select 10MHz Reference Out (option E)

**REF OUT OFF  R**

**Menu 6** Set Remote Mode (option Q)

**RS 485 OFF  R**

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

**ADDRESS = 00  R**

**Menu 8** View PCB temperature (option T)

**TEMP = 35 DEG  R**

**Menu 9** View LNB current (option L)

**LNB DC = 0.36 A  R**

**Save?** When “R” is selected or when the end of the menus is reached

**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.