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2019-4x Upconverter, Four Output Frequencies

1.0 General

1.1 Equipment Description

The 2019-4x Upconverter converts one 70 ±18 MHz input signal to four individual frequencies (combined to one output). The output frequency ranges are: 250 to 750 MHz for Model 2019-41; 1650 to 2150 MHz for Model 2019-42 and 950 to 2150 MHz for Model 2009-43. All outputs are tunable in 1 MHz steps. Synthesized local oscillators (LO) provide frequency selection. Multi-function switches select the RF frequencies, gain, and other parameters. Front panel LEDs provide indication of DC power (green), Unit alarm (red), and remote operation (yellow). Variable attenuators for each channel provide a gain range of -10 to +10 dB as adjusted by the front panel multi-function switches. Remote operation allows selection of frequency, mute, and gain of each signal. The LCD will display parameter selection during setup and frequency and gain/mute settings during operation. Connectors are 75 ohm BNC female for IF and the optional external reference input and SMA for the combined four-frequency output. The unit is powered by a 100-240 ±10% VAC power supply, and housed in a 1 3/4” X 19” X 16” rack mount chassis.

FIGURE 1.1   Model 2019-4x Front and Rear Panels

FIGURE 1.2   Model 2019-4x Upconverter, Block Diagram
1.2 Technical Characteristics

**TABLE 1.0 2019-4x Upconverter Specifications**

**Input Characteristics (IF)**
- Impedance/Return Loss: 75 Ω/18 dB (see TABLE 2.2 for connector options)
- Frequency: 70 ± 18 MHz
- Input Level: -25 to -15 dBm

**Output Characteristics (RF)**
- Impedance/Return Loss: 50 Ω/12 dB (see TABLE 2.2 for connector options)
- Frequency:
  - Model 2019-41: 250 to 750 MHz
  - Model 2019-42: 1650 to 2150 MHz
  - Model 2019-43: 950 to 1450 MHz
- Output level/carrier: -30 to -10 dBm
- Output 1 dB compression: +5 dBm
- Carrier Intermod: <-40 dBc, 3 ON, 1 OFF
- Carrier Level Variation: ±1.5 dB, 0.25 to 0.75 GHz
- Mute Level: -40 dBc min, -45 dBc typical

**Channel Characteristics**
- Gain range (adjustable): -10 to +10, 1 dB steps
- Spurious Response: <-40 dBc, 0.25 to 0.75 GHz (non-intermod related)
- Frequency Response: ±0.7 dB, 36 MHz BW
- Group Delay, max: 0.015 ns/MHz² parabolic; 0.03 ns/MHz linear; 1 ns ripple
- Frequency Sense: All Four Frequencies Non-inverting

**Synthesizer Characteristics**
- Frequency Accuracy: ± 1.0 ppm internal reference; external reference optional
- Frequency Step: 1.0 MHz minimum
- 10 MHz level: 3 dBm, ± 3 dB (for 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>-110</td>
</tr>
</tbody>
</table>

**Controls, Indicators**
- Power; Alarm; Rem; Mute: Green LED; Red LED; Yellow LED; “OFF” on LCD
- Remote: RS232C, 9600 baud
- Freq/Gain Selection: Direct readout LCD; multi-function switches or remote selection

**Other**
- IF & 10 MHz/RF Conn.: 75 ohm BNC (female) SMA
- Alarm/Remote Connector: DB9 - NO or NC contact closure on Alarm
- Size: 19 inch, 1RU 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
- -Q: RS-422/RS-485 Remote capability
- -W8: Ethernet M&C Remote Interface
- 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>J10 Pinouts (RS-232C/422/485)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pin</strong></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
**B) Status Requests** Table 1.1 lists the status requests for the 2019-4x 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>Command</th>
<th>Syntax *</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Frequency</td>
<td>{aaSFn}</td>
<td>Returns {aaSFn;xxxx} where:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n = 1,2,3, or 4 to select Carrier 1,2,3, or 4 respectively</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xxxx = Frequency of Carrier n</td>
</tr>
<tr>
<td>Query Gain</td>
<td>{aaSGn}</td>
<td>Returns {aaSGn;xxx} where:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n = 1,2,3, or 4 to select Carrier 1,2,3, or 4 respectively</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xxx = Gain of Carrier n</td>
</tr>
<tr>
<td>Mute Status</td>
<td>{aaSMn}</td>
<td>Returns {aaSMn;x} where:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n = 1,2,3, or 4 to select Carrier 1,2,3, or 4 respectively</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x = 0 if Carrier n is not muted, x = 1 if Carrier n is muted</td>
</tr>
<tr>
<td>Alarm Status</td>
<td>{aaSA}</td>
<td>Returns {aaSAx} where:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x = 1 if the unit's alarm is on, x = 0 if the unit's alarm is off</td>
</tr>
<tr>
<td>Product Information</td>
<td>{aaSV}</td>
<td>Returns {aaSVxxxx-xxxy,yy} where:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xxxx-xx is the model number, yy is the firmware revision</td>
</tr>
</tbody>
</table>
## Commands

Table 1.2 lists the commands for the 2019-4x and briefly describes them. After a command is sent the 2019-4x sends a return “>” indicating the command has been received and executed.

### General Command Format

The general command format is \{CND...\}, where:

- \{ = start byte
- 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>
<thead>
<tr>
<th>Command</th>
<th>Syntax*</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Frequency</td>
<td>{aaCFn;xxxx}</td>
<td>n = 1,2,3, or 4 to select Carrier 1, 2, 3, or 4 respectively</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(xxxx = ) desired frequency in MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency Range: 2019-41 : 250-750 MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency Range: 2019-42 : 1650-2150 MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency Range: 2019-43 : 950-1450 MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>example: Set Frequency command for model 2019-41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>{CF2;0742} Set Carrier 2’s frequency to 0742 MHz</td>
</tr>
<tr>
<td>Set Gain</td>
<td>{aaCGn;xxx}</td>
<td>n = 1,2,3, or 4 to select Carrier 1, 2, 3, or 4 respectively</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(xxx = ) desired gain in dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All 2019-4x models have a gain range of -10 to +10 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>example: Set Gain command:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>{CG3;-10} Set Carrier 3’s gain to -10 dB</td>
</tr>
<tr>
<td>Set Mute</td>
<td>{aaCMn;x}</td>
<td>n = 1,2,3, or 4 to select Carrier 1, 2, 3, or 4 respectively</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(x = ) 1 to mute carrier (N), (x = 0) to un-mute carrier (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>example: Set Mute command:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>{CM4;1} Mute (disable) carrier 4</td>
</tr>
<tr>
<td>Disable Remote</td>
<td>{aaCR0}</td>
<td>{CR and zero}</td>
</tr>
<tr>
<td>Enable Remote</td>
<td>#</td>
<td>Just # sign</td>
</tr>
</tbody>
</table>
2.0 Installation

2.1 Mechanical - The 2019-4x consists of an RF/Controller PCB and a splitter/combiner 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 2019-4x can be secured to a rack using the 4 holes on the front panel. Figure 2.0 shows how the 2019-4x is assembled.

![Figure 2.0: 2019-4x Mechanical Assembly](image)
2.2 Rear Panel Input/Output Signals  - Figure 2.1 shows the input and output connectors on the rear panel.

**FIGURE 2.1  2019-4x Rear Panel I/O's**

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

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rx-</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>Tx-</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 Open</td>
</tr>
<tr>
<td>8</td>
<td>Not Used</td>
</tr>
<tr>
<td>9</td>
<td>Alarm Relay: Normally Closed</td>
</tr>
</tbody>
</table>

*Remote Serial Interface*

Interface: DB-9 Male
Protocol: RS-232C (RS-232C/422/485 option -Q), 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>-N</td>
<td>BNC, 75Ω</td>
<td>Type N, 50Ω</td>
</tr>
<tr>
<td>-M</td>
<td>BNC, 50Ω</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.

<table>
<thead>
<tr>
<th>Control</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS2 - Up Alarm LED</td>
<td>Red LED indicates upconverter alarm.</td>
</tr>
<tr>
<td>DS1 - Remote LED</td>
<td>Yellow LED indicates remote operation.</td>
</tr>
<tr>
<td>LED Front Panel Display</td>
<td>Display shows Frequency in MHz and Gain in dB</td>
</tr>
<tr>
<td>S1 - Menu/Execute Button</td>
<td>Press this to get into Program mode and to execute any changes.</td>
</tr>
<tr>
<td>DS6 - Power LED</td>
<td>Green LED indicates presence of DC power.</td>
</tr>
<tr>
<td>S2 - Multi-Function Switch</td>
<td>Vertical toggle switch that controls values in the Menu items when in program mode. Does not function in the normal display mode.</td>
</tr>
<tr>
<td>S3 - Multi-Function Switch</td>
<td>Horizontal toggle switch that controls which values are being adjusted. Does not function in the normal display mode.</td>
</tr>
</tbody>
</table>

**FIGURE 2.2** 2019-4x Front Panel Controls and Indicators
2.4 Installation / Operation

2.4.1 Installing and Operating the 2019-4x, Upconverter Section

1. Connect -25 dBm to -15 dBm signal to IF In, J4 (Figure 2.1)
2. Connect the RF OUT, J5, to the external equipment
3. Connect 100-240 ±10% VAC, 47 - 63 Hz to AC1 on the back panel.
4. Set the desired output frequency (See Section 2.5 Menu Settings).
5. Set the gain for -10 to +10 dB. Make sure the output stays within -30 to -10 dBm with the gain selected and the input level provided.
6. Be sure DS6 (green, DC Power) is on and DS2 (red, Alarm) is off (Figure 2.2).
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 2.3. 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 2.4):

<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Frequency of carrier 1</td>
</tr>
<tr>
<td>2</td>
<td>Frequency of carrier 2</td>
</tr>
<tr>
<td>3</td>
<td>Frequency of carrier 3</td>
</tr>
<tr>
<td>4</td>
<td>Frequency of carrier 4</td>
</tr>
<tr>
<td>5</td>
<td>Gain of carrier 1</td>
</tr>
<tr>
<td>6</td>
<td>Gain of carrier 2</td>
</tr>
<tr>
<td>7</td>
<td>Gain of carrier 3</td>
</tr>
<tr>
<td>8</td>
<td>Gain of carrier 4</td>
</tr>
<tr>
<td>9</td>
<td>Mute carrier 1</td>
</tr>
<tr>
<td>10</td>
<td>Mute carrier 2</td>
</tr>
<tr>
<td>11</td>
<td>Mute carrier 3</td>
</tr>
<tr>
<td>12</td>
<td>Mute carrier 4</td>
</tr>
<tr>
<td>13</td>
<td>Set unit to Remote Operation</td>
</tr>
<tr>
<td>14</td>
<td>Set Remote Mode (option -Q)</td>
</tr>
<tr>
<td>15</td>
<td>Set RS-485 address</td>
</tr>
</tbody>
</table>

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 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.
   
   2019-41  
   4.02

3. The present frequency and gain of the upconverter is shown.

   274 354 514 682  
   -07 OFF +08 +09

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 2.4 for the sequence of menu options. The following display is for changing the upconverter frequency:

```
F R E Q  C1 = 0 4 5 0  R
```

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

```
F R E Q  C1 = 0 3 5 0  R
```

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

```
F R E Q  C1 = 0 3 5 0  R
```

**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 the next item:

```
F R E Q  C2 = 0 2 5 0  R
```

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

```
S A V E  S E T T I N G S ?  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:

```
274  354  514  682
-07  OFF  +08  +09
```

Figure 2.4 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.

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 A I N  = - 2 0  
```

Use the horizontal rocker switch to move 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? 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:

```
274 354 514 682
-07 OFF +08 +09
```

Figure 2.4 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

2019-41
4.02

Normal Display

PUSHING MENU/EXECUTE SEQUENCE

Menu 1 Set Frequency C1
FREQ C1 = 0450 R
PUSH BUTTON

Menu 2 Set Frequency C2
FREQ C2 = 0250 R
PUSH BUTTON

Menu 3 Set Frequency C3
FREQ C3 = 0350 R
PUSH BUTTON

Menu 4 Set Frequency C4
FREQ C4 = 0350 R
PUSH BUTTON

Menu 5 Set Gain C1
GAIN C1 = -10 R
PUSH BUTTON

Menu 6 Set Gain C2
GAIN C2 = -10 R
PUSH BUTTON

Menu 7 Set Gain C3
GAIN C3 = -10 R
PUSH BUTTON

Menu 8 Set Gain C4
GAIN C4 = -10 R
PUSH BUTTON

Menu 9 Mute C1
MUTE C1 OFF R
PUSH BUTTON

Menu 10 Mute C2
MUTE C2 OFF R
PUSH BUTTON

Menu 11 Mute C3
MUTE C3 OFF R
PUSH BUTTON

Menu 12 Mute C4
MUTE C4 OFF
PUSH BUTTON

Menu 13 Set Unit to Remote Operation
REMOTE OFF R
PUSH BUTTON

Menu 14 Set Remote Interface
INTERFACE 485 R
PUSH BUTTON

Menu 15 Mute C1
RS485 ADDR R
PUSH BUTTON

Save? When “R” is selected from any above menu or at the end
SAVE SETTINGS? Y N
PUSH BUTTON

FIGURE 2.4 Menu Display and Sequences
1.4 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.