INSTRUCTION MANUAL

MODEL 2002-32, 2002-33 AGILE TEST UPCONVERTER

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MODEL 2002-32, 2002-33 AGILE TEST 199 - 319 MHz UPCONVERTER

SECTION 1 GENERAL

1.1 Equipment Description- The Model 2002-32,-33 Agile Test 199 - 319 MHz Upconverter takes a 36 MHz IF signal and upconverts it to 199 - 319 MHz in 1.0 MHz steps. The IF carrier input is mixed with a synthesized 163 - 283 MHz local oscillator signal. The output frequency is selected using up and down tune push button switches which command the microprocessor to control the synthesized oscillator. A red LED lights when the PLL is unlocked and this alarm signal goes to an open drain FET output. A yellow LED indicates remote operation. The output of the mixer is applied to the output amplifier providing output levels of nominally -12dBm with -15 dBm in. The **2002-32** includes a wall power supply.The **2002-32R** is the rack mount version of the 2002-32 and the **2002-33R** is the rack mount version of the 2002-33.

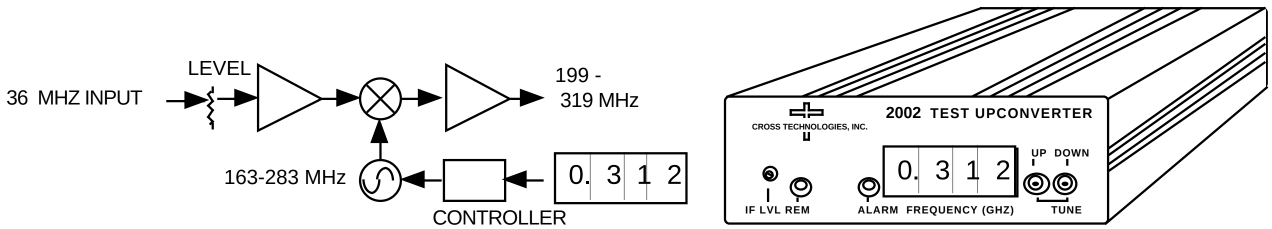


FIGURE 1.1 2002-32, -33 Agile Test Upconverter Block Diagram and Front Panel

1.2 Technical Characteristics

TABLE 1.0 2002-32,-33 UPCONVERTER SPECIFICATIONS

Characteristics	Specifications*
Input Characteristics	
Impedance	75 ohms unbalanced
Return Loss	15dB, minimum
Frequency	36 MHz center
Input Level	-10 to -20 dBm
Input 1dB Compression	+0 dBm
Input 3rd order Intercept	+10 dBm
Output Characteristics	
Impedance	50 ohms unbalanced
Return Loss	10dB, minimum
Frequency Band	199 - 319 MHz
Level	-12 dBm with -15 dBm in
Channel Characteristics	
Gain	+3 dB ±2 dB
Spurious Response	NA; output not filtered
Frequency Response	±2 dB, 199 - 319 MHz
	±0.5 dB, any 10 MHz increment
Synthesizer Characteristics	
Frequency Accuracy	± 10 kHz
Frequency Step	1.0 MHz minimum
Phase Noise	Suitable for 64 kB/s QPSK with rate 1/2 FEC
Controls	
Frequency Selection	Push button switches with direct frequency readout
Output Level	Potentiometer and Toggle switch
Indicators	
PLL Alarm	Red LED (with FET open drain)
Remote	Yellow LED
Frequency	Four digit displays show the desired output frequency in GHz
Other	
DC Power, max.	+15VDC, 300ma; -15VDC, 50ma; via wall power supply for 2002-32
RF, IF Connectors	BNC, female

*Specifications subject to change without notice

2.0 Installation

2.1 Mechanical - The 2002-32 and 2002-33 are packaged in an aluminum extrusion. The 2002-32R and 2002-33R are mounted on a 1 3/4” X 19” panel that can be mounted to a rack using the 4 holes at the ends. The 2002-32 derives ± 15V from the wall power supply and the 2003-33 derives ± 15V from the model 2000-01 power supply. See Figure 2.1.

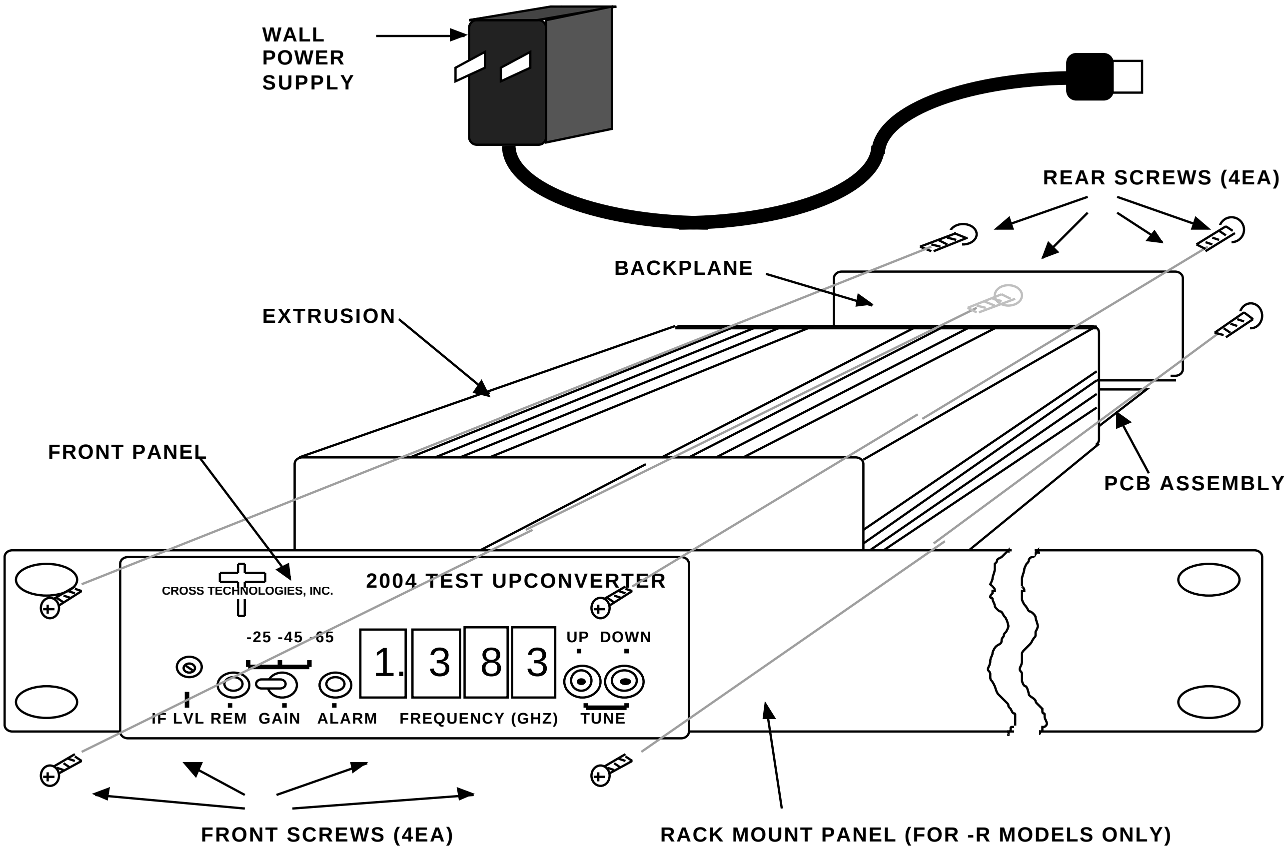


FIGURE 2.1 SERIES 2000 ASSEMBLY DRAWING

2.2 Controls and Indicators - Figure 2.2 shows front panel controls and indicators.

2.3 Input / Output Signals - Figure 2.3 shows the input and output signals to the 2002-32,-33.

2.4 Accessing and Changing On-Card Jumpers and Controls - Figure 2.4 shows jumpers (with factory settings) and other on-card controls. To remove the printed circuit board (PCB) from the extrusion for access to the jumpers and controls:

1.) Remove four (4) **rear panel screws** (see Figure 2.1).

2.) **Gently** pull the backplane and PCB assembly completely out of the extrusion.

3.) With the **power supply disconnected**, move jumpers to the desired positions (Figure 2.4).

4.) **To set Channel frequencies** apply power via power supply and program frequencies (see Section 2.5.4).

5.) **Always remove power** when installing the PCB in to the extrusion. Make sure the shield goes in the lower channel and the PCB in the next channel above that in the extrusion.

6.) **Gently** push the backplane and PCB assembly completely in to the extrusion so the front panel controls go through the front panel.

7.) Install four (4) **rear panel screws**.

2.5 Installation / Operation -

2.5.1 Local Operation -

1.) If required, check that on-card jumpers are set to the desired positions (Figure 2.4)

2.) Connect the wall power supply to the 2002-32 and the wall power supply to 115 VAC, 60 Hz (Figure 2.1). For the 2033-33 be sure the ± 15 VDC inputs are connected to the 2000-01 Power Supply and the 2000-01 to 90-260 VAC, 47-60 Hz.

3.) Connect a -15 dBm signal to IF In (Figure 2.1, Figure 2.3)

4.) Set the desired frequency by pushing SW3 or SW4. If numbers 0 to 9 appear when pushing SW3 or SW4, the 2002-32,-33 is set for the channel mode (with on-card jumper JP4, Figure 2.4). See section 2.5.2 for frequency setting information.

5.) Be sure DS1 and DS6 are off (Figure 2.2).

6.) If needed, R52 can be adjusted (Figure 2.2) for input signals that are different than -15 dBm (-10 to -20 dBm). Note that this adjusts the level of IF In and uncalibrates the 2002-32,-33 from its -15 dBm input setting

2.5.2 Frequency Setting, Frequency Mode - In this mode, the frequency is selected by pushing the up and down switches (SW3, SW4) on the front panel until the desired frequency is indicated on the front on the display. The frequency displayed is the desired output frequency with the IF center frequency input. EEROM U3 stores the last frequency set so in the event of power failure the upconverter will go to the frequency it was set to prior to the power outage. The front panel frequency setting switches increment or decrement the frequency in 1.0 MHz steps at approximately a 5 step per second rate. If the switch remains depressed for approximately ten steps, the rate increases by a factor of ten. There is no muting of the output carrier during frequency selection.

2.5.3 Low Side LO, 36 MHz Input - The 2002-32,-33 operates over it's full 199 to 319 MHz range with low side LO and 36 MHz input. Also, note that there will be no spectrum inversion of the input IF modulation with the low side LO. The 2002-32,-33 operates over it's full 199 to 319 MHz range with low side LO and 36 MHz input as the following table shows.

TABLE 2.0 2002-32,-33 TEST UPCONVERTER FREQUENCY INFORMATION

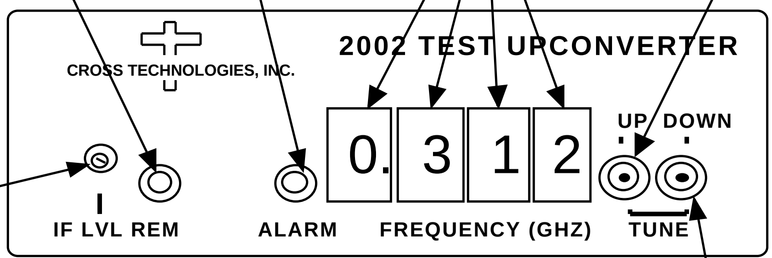
LO-Side	IF (MHz)	LO Range (MHz)	Output Frequency Range (MHz)
LOW	36	163-286	199-319

DS1 - Remote LED - Lights yellow when jumper JP3 is set to REMOTE. When this LED is on, SW3 and SW4 on the front panel are disabled and these functions are controlled remotely

DS6 - Alarm LED - Lights red when PLL comes out of lock

DS2, DS3, DS4, DS5 - Frequency Displays - Display the desired output frequency which is the Local Oscillator frequency +36 MHz in GHz.

SW3 - UP Frequency Control Pushbutton Switch - When in FREQUENCY mode (as set by jumper JP2), when pushed will increment frequency in 1.0 MHz steps at about a 0.2 second rate. If held in for about 10 steps, will increment frequency in 10 MHz steps at about a 0.2 second rate. When in CHANNEL mode (as set by jumper JP2), when pushed momentarily will display the channel number it's on. If held in will increment channel number and when released will display the frequency of the selected channel.



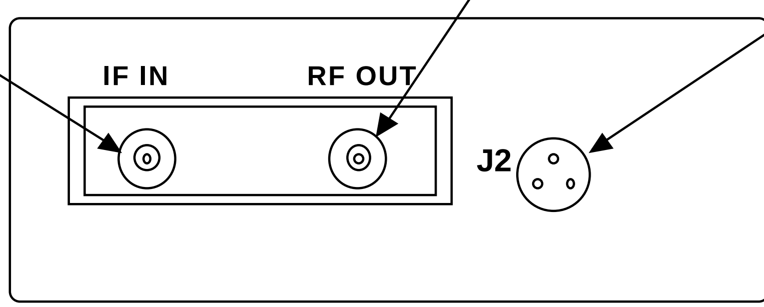
R52 - IF IN Level Adjustment - Ten turn potentiometer that adjusts the level of IF In. Set for +3dB gain and can be adjusted for --6 to +6 dB gain

SW4 - DOWN Frequency Control Pushbutton Switch - Same as SW3 except decreases frequency or channel

FIGURE 2.2 2002-33 Front Panel Controls and Indicators

J6 - 1-2 GHZ RF OUT - The mixed LO + IF RF output. This is an unfiltered output and will also contain the LO, LO - IF, and other mixer products. This is a 50Ω, BNC output at normally -12 dBm level.

J4 - IF #1 Input - The main IF 36 MHz input . This is a 75Ω, BNC input at normally -10 to -20 dBm levels. The RF output of -12 dBm occurs with -15 dBm in as set at the factory and this gain can be adjusted by front panel pot R52.



J2 - DC IN - The +15 VDC AND -15 VDC regulated DC voltage from the wall power supply

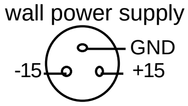


FIGURE 2.3 2002-32, -33 Inputs and Outputs

2.5.4 Frequency Setting, Channel Mode - A second tuning mechanism is channel selection. This is accomplished when the on board three-pin jumper (JP2) (Figure 2.4) is set to the "channel" position. Ten preset channels (0-9) can be selected as follows:

1. The 2002-32,-33 PCB is removed from the extrusion (see section 2.4 for instructions) to access the channel selecting decimal switch (SW5) and the push to program switch (SW2) (Figure 2.4). With the display mode jumper (JP2) set in the frequency mode, the frequency set switches (SW3,SW4) are pushed to the frequency desired (Figure 2.2).

2. The decimal switch (SW5) is set to the channel number desired to be programmed (Figure 2.4).

3. Push programming button (SW2) to program the displayed frequency into that channel number (Figure 2.4).

4. The above steps are repeated for any additional channels that are desired to be programmed.

5. When finished, set JP2 (Figure 2.4) in the "Channel" position if this tuning mechanism is desired.

At the factory, channels zero through nine are programmed from 200 to 290 MHz in 10 MHz steps (0 = 200, 1 =210, 2 = 220, etc.). When in the remote mode, either frequencies or channel numbers can be provided, but programming of the channels can only be done locally. The frequency display (DS2, DS3, DS4, DS5) in the channel mode displays the current channel number selected when SW3 or SW4 is pushed, and, if the switch is held for more than 2 seconds, the channel numbers are incremented or decremented depending on which button is pushed. The display indicates zero through nine for channel number, and, when the desired channel is selected and the button is released for one to two seconds, the frequency of that channel is shown on the frequency display and this frequency display remains until switch SW3 or SW4 is pushed again.

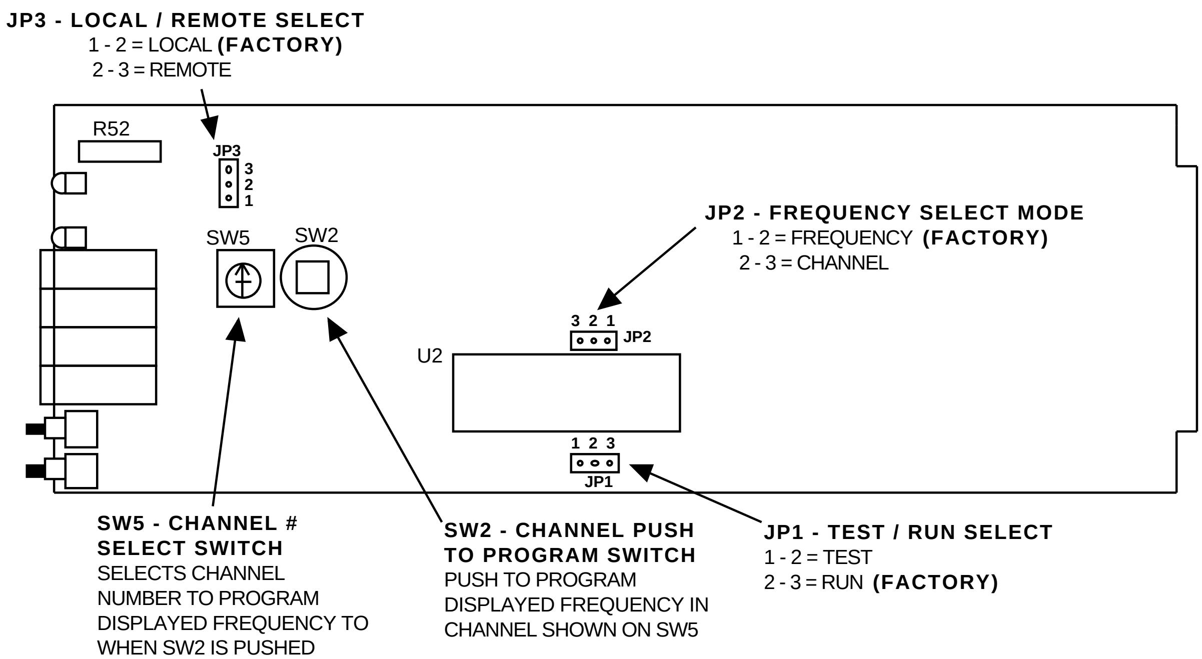


FIGURE 2.4 2002-32, -33 On-Card Jumpers and Controls (See Section 2.4 for instructions on removing the PCB from the extrusion)

2.5.5 Remote Operation - Frequency control can be remotely commanded from an external (not supplied) PC using a simple DOS program. To place the 2002-32,-33 in the Remote mode, place on-card jumper JP3 in the REMOTE (pins 2-3) position (Figure 2.4) and observe yellow LED DS1 (Figure 2.2) is on. Serial ASYNC (8N1) data is received via RS232C receiver U4 and sent via RS232C transmitter U13 at a 9.6kB/s data rate. When in the remote mode, either frequencies or channel numbers can be provided, but programming the frequencies of the channels can only be done locally.

2.5.6 Remote Control DOS Program - The 2002-32,-33 remote control program (REMOTE.EXE, diskette supplied with the 2002-32,-33) runs on an IBM compatible computer under DOS. The user is prompted to select one of three possible functions, which are:

1. Set Frequency
2. Set Channel

When Set Frequency is selected, the up arrow and down arrow keys are used to increase or decrease the 2002-32,-33's output frequency in 1.0 MHz increments.

When Set Channel is selected, the up arrow and down arrow keys are used to select one of ten possible channels. The frequency of each channel must be programmed locally, as described in section 2.5.4.

The remote control program sends commands to the 2002-32,-33 through pin 3 of the DB9 connector, J3 (Figure 2.3). Pin 3 is an RS-232 serial port set to accept 8N1 formatted data. Each command sent to the 2002-32,-33 consists of an instruction byte followed by one or two bytes of data. The 2002-32,-33 acknowledges receiving and successfully executing each remote control command by sending an **acknowledge byte** (9600 baud, 8N1 format) through pin 2 of the DB9 connector, J3.

The instruction byte to set output frequency is 0A (hex). This byte must be followed by two data bytes of the desired output frequency in BCD format. The following list shows examples of this.

Output Frequency	Control Bytes (Acknowledge byte = 06 (hex))
210 MHz	0A (hex), 02 (hex), 10 (hex)
237 MHz	0A (hex), 02 (hex), 37 (hex)
.	.
.	.
319 MHz	0A (hex), 03 (hex), 19 (hex)

The instruction byte to set channel is 0B (hex). This byte must be followed by a data byte that selects one of 10 possible channels. The following list shows examples of this.

Channel	Control Bytes (Acknowledge byte = 07 (hex))
0	0B (hex), 00 (hex)
1	0B (hex), 01 (hex)
.	.
.	.
9	0B(hex), 09 (hex)

3.0 Circuit Description

3.1 Block Diagram Description - 2002-32,-33 (Figure 3.1) - The 36 MHz input (J4) carrier first goes through a resistive summing network (R49, R50, R51). The signal then goes through a lowpass filter consisting of L1, C33 and C34 which cuts off at approximately 200 MHz. The signal next goes to a variable attenuator, R52, R53, R54, which is adjusted to provide for level input variations of -20 to -10 dBm in. Amplifier U15 provides +20 dB gain. The signal then goes to mixer A1 which receives the LO generated by VCO A2 and provides the LO ± IF and LO unfiltered output.

This signal next goes through to output buffer amplifier U25 which provides +10 dB gain and to the output BNC connector J6. IF input connector J4 is also BNC.

Commands for the phase lock loop IC, U18, are provided serially from microprocessor U2 which receives serial RS232C commands from an external (not supplied) PC via RS232C receiver IC, U4. Microprocessor U2 can send serial RS232C commands to an external PC via RS232C transmitter IC, U13.Frequency control is provided by microprocessor U2 and can be remotely commanded from an external (not supplied) PC using a simple DOS program.

Microprocessor U2 uses its internal oscillator controlled by the 4.9152 MHz crystal Y1.Crystal oscillator A3 provides the 25 MHz reference frequency for the synthesizer U18. U23, Q4, and associated circuitry generate an open collector alarm when phase lock is lost. U19 provides +30 VDC for the loop amplifier U22. Q2 and Q3 provide low noise regulated voltages for A2 and U18. U1 is a watch dog timer for microprocessor U2. IC's U7, U8, U9, U10, U11, U14 provide multiplexing and strobing of displays DS2, DS3, DS4, DS5.

3.2 Controller Operation for 2002-32,-33 Upconverter

3.2.1 General - The controller consists of a microprocessor and associated circuitry which receives inputs from

a) the front panel frequency set switches (SW3, SW4),
b) the on card display mode jumper (JP2),
c) the on card channel programming decimal switch (SW5),
d) the on card channel programming "push to program" switch (SW2), and
e) the on card local / remote control mode jumper (JP3)

The controller provides command signals to the

a) phase lock loop IC (U18), and
b) the front panel frequency display (DS2, DS3, DS4, DS5).

In addition, when in the remote control mode, the microprocessor U2 accepts a serial data stream which is generated by a simple DOS program (by an external, not provided, PC) that selects the frequency and the gain. Serial data is received via RS232C receiver U4 and sent via RS232C transmitter U13. The following provides additional detail.

3.2.2 Frequency Setting, Frequency Mode - The frequency is selected either by pushing the up and down switches (SW3, SW4) on the front panel until the desired frequency is indicated on the front on the display or, if set to the channel mode, the up and down switches select one of ten preset channels that have been programmed in. The frequency displayed is the desired output frequency which is factory set as the local oscillator (LO) plus the 36 MHz input frequency. EEROM U3 stores the last frequency set so in the event of power failure the upconverter will go to the frequency it was set to prior to the power outage. The front panel frequency setting switches increment or decrement the frequency in 1.0 MHz steps at approximately a 5 steps per second rate. If the switch remains depressed for approximately ten steps, the rate increases by a factor of ten. There is no muting of the output carrier during frequency selection.

3.2.3 Frequency Setting, Channel Mode - A second tuning mechanism is channel selection. This is accomplished when the on board, but not front panel accessible, three-pin jumper (JP2) (Figure 2.4) is set to the "channel" position. Ten preset channels (0-9) can be selected as follows:

1. The 2002-32,-33 PCB is removed from the extrusion (see section 2.4 for instructions) to access the channel selecting decimal switch (SW5) and the push to program switch (SW2) (Figure 2.4). With the display mode jumper (JP2) set in the frequency mode, the frequency set switches (SW3,SW4) are pushed to the frequency desired (Figure 2.2).

2. The decimal switch (SW5) is set to the channel number desired to be programmed (Figure 2.4).

3. Push programming button (SW2) to program the displayed frequency into that channel number (Figure 2.4).

4. The above steps are repeated for any additional channels that are desired to be programmed.

5. When finished, set JP2 (Figure 2.4) in the "Channel" position if this tuning mechanism is desired.

At the factory, channels zero through nine are programmed from 200 to 290 MHz in 10 MHz steps. When in the remote mode, either frequencies or channel numbers can be provided, but programming of the channels can only be done locally.

The frequency display (DS2, DS3, DS4, DS5) in the channel mode displays the current channel number selected when SW3 or SW4 is pushed, and, if the switch is held for more than 2 seconds, the channel numbers are incremented or decremented depending on which button is pushed. The display indicates zero through nine for channel number, and, when the desired channel is selected and the button is released for one to two seconds, the frequency of that channel is shown on the frequency display and this frequency display remains until switches SW3 or SW4 are pushed again.

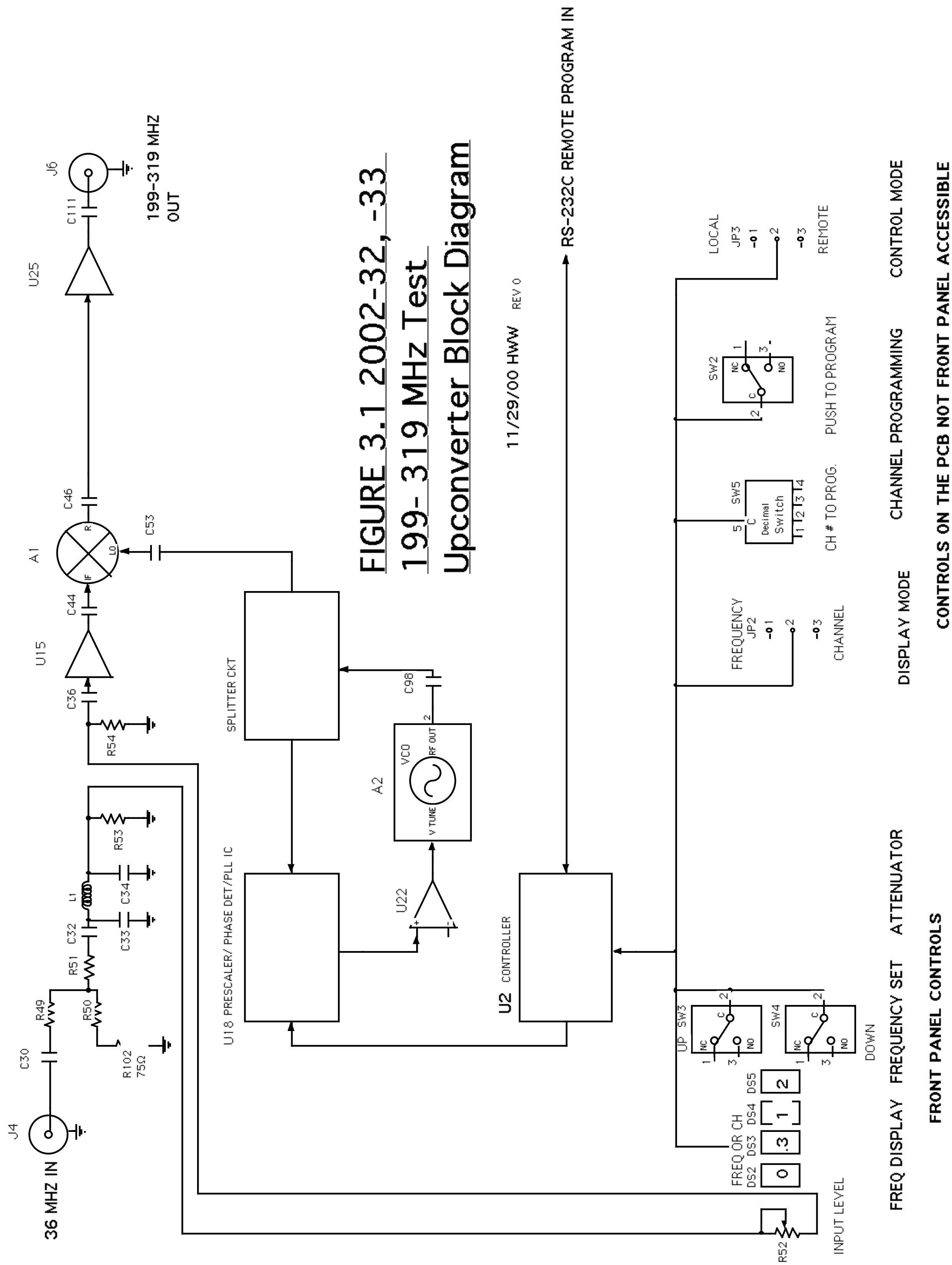


FIGURE 3.1 2002-32, -33
199- 319 MHz Test
Upconverter Block Diagram
11/29/00 HWW
REV 0
36 MHZ IN
J4
C30
R49
R50
R51
R102
75Ω
C32
C33
L1
C34
R53
R54
C36
U15
C44
A1
IF
LO
R
C46
C53
U25
C111
J6
199-319 MHZ
OUT
SPLITTER CKT
U18 PRESCALER/ PHASE DET/PLL IC
A2
VCO
V TUNE
RF OUT
C98
U22
U2
CONTROLLER
RS-232C REMOTE PROGRAM IN
R52
INPUT LEVEL
FREQ OR CH
DS2
DS3
DS4
DS5
UP
SW3
SW4
DOWN
NC
NO
FREQUENCY
JP2
CHANNEL
SW5
Decimal
Switch
CH # TO PROG.
SW2
PUSH TO PROGRAM
LOCAL
JP3
REMOTE
FREQ DISPLAY
FREQUENCY SET
ATTENUATOR
DISPLAY MODE
CHANNEL PROGRAMMING
CONTROL MODE
FRONT PANEL CONTROLS
CONTROLS ON THE PCB NOT FRONT PANEL ACCESSIBLE