Experimental Translators, and Microwave Technology to Provide 8VSB Television Signals to Rural Communities Outside the Coverage Areas of a Primary Television Station

- **By: R. Kent Parsons**

•Federal Communications Commission
•Larcan-USA

•Zenith Electronics Corporation

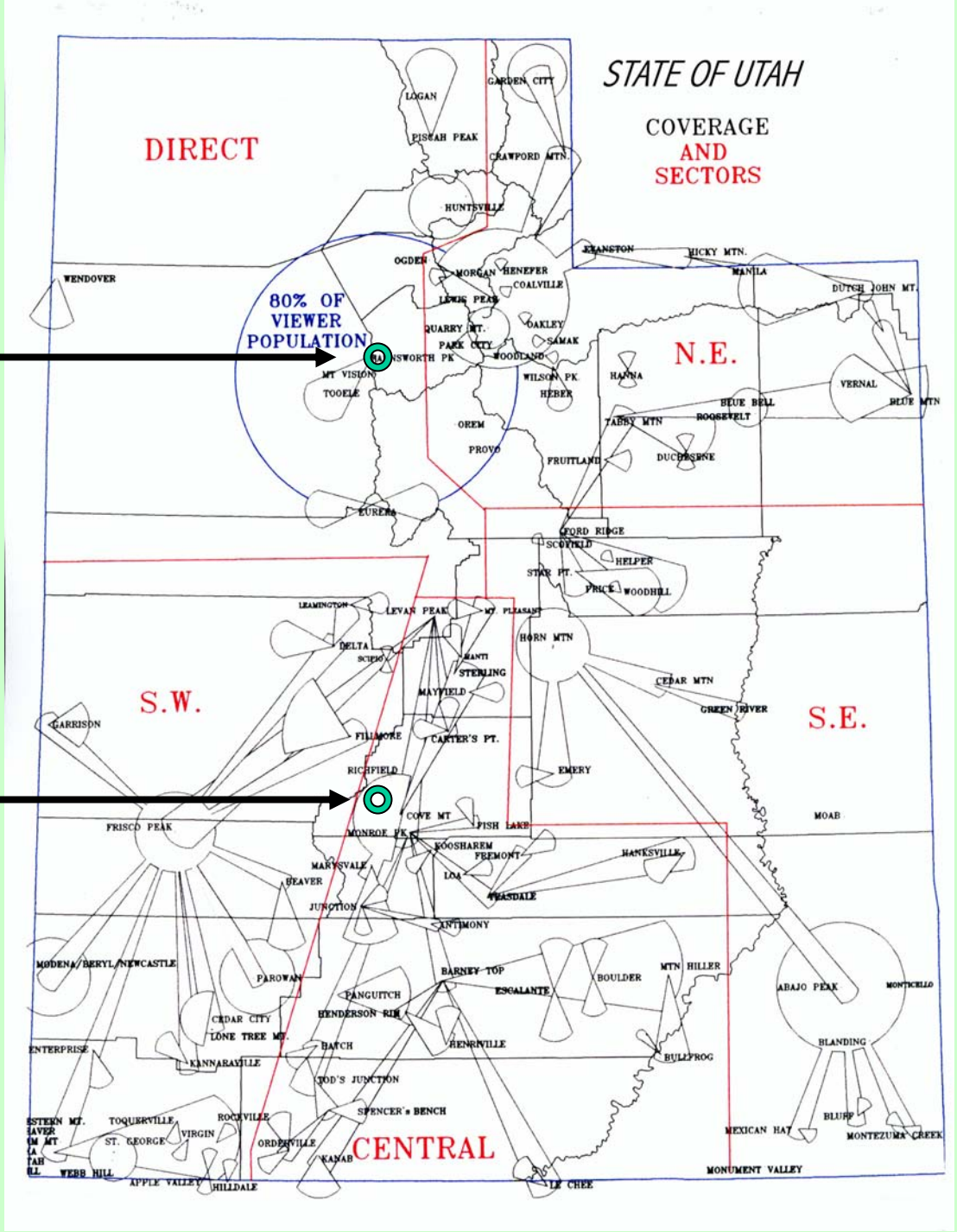
THE GOOD

THE BAD

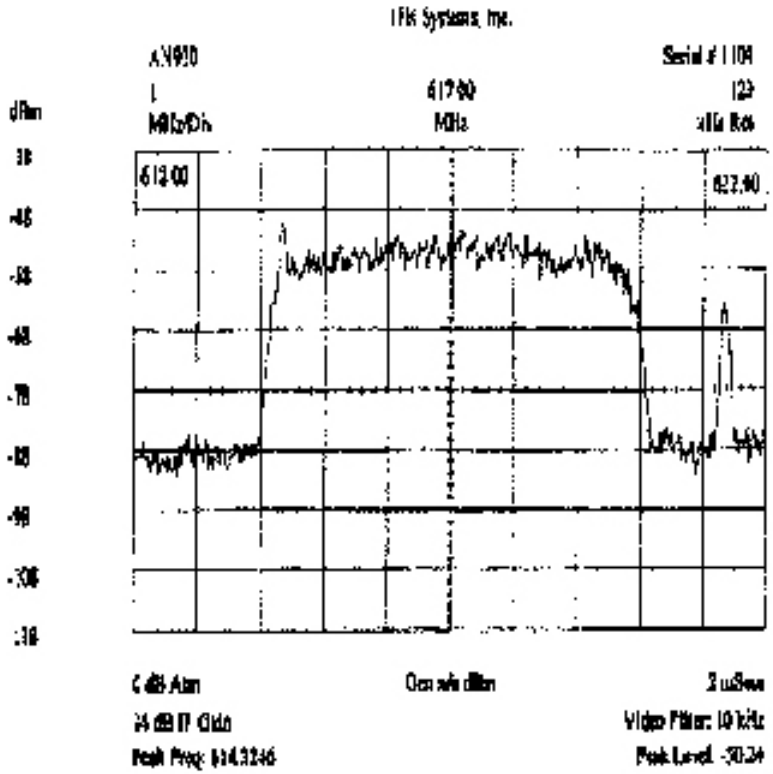
AND THE UGLY

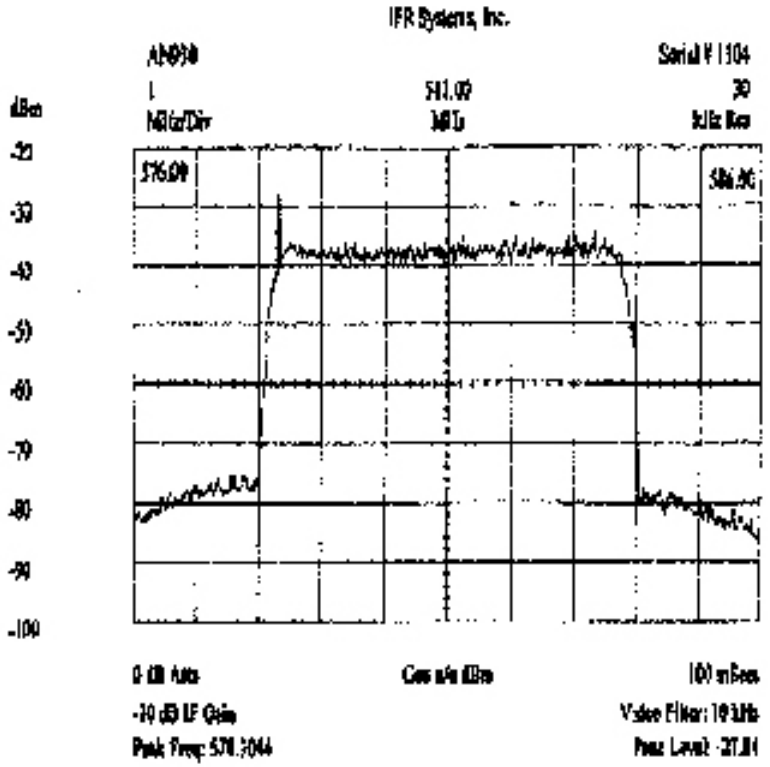
Farnsworth

Monroe



LEVAN SITE 1995





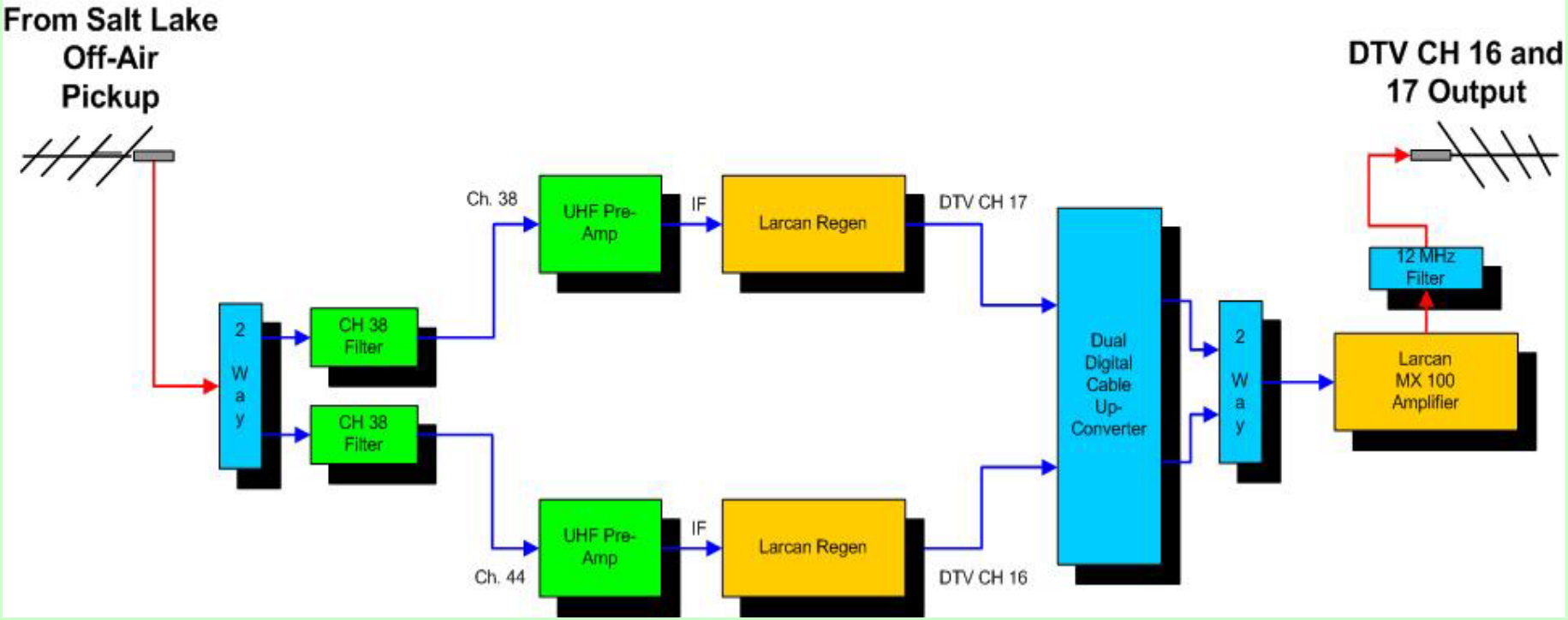
CH17 transmitted 67 miles to COVE

LEVAN SITE
K17FJ
No Input Filter or Pre-Amp
CH38 *Input*, 83 miles from Salt Lake City

→

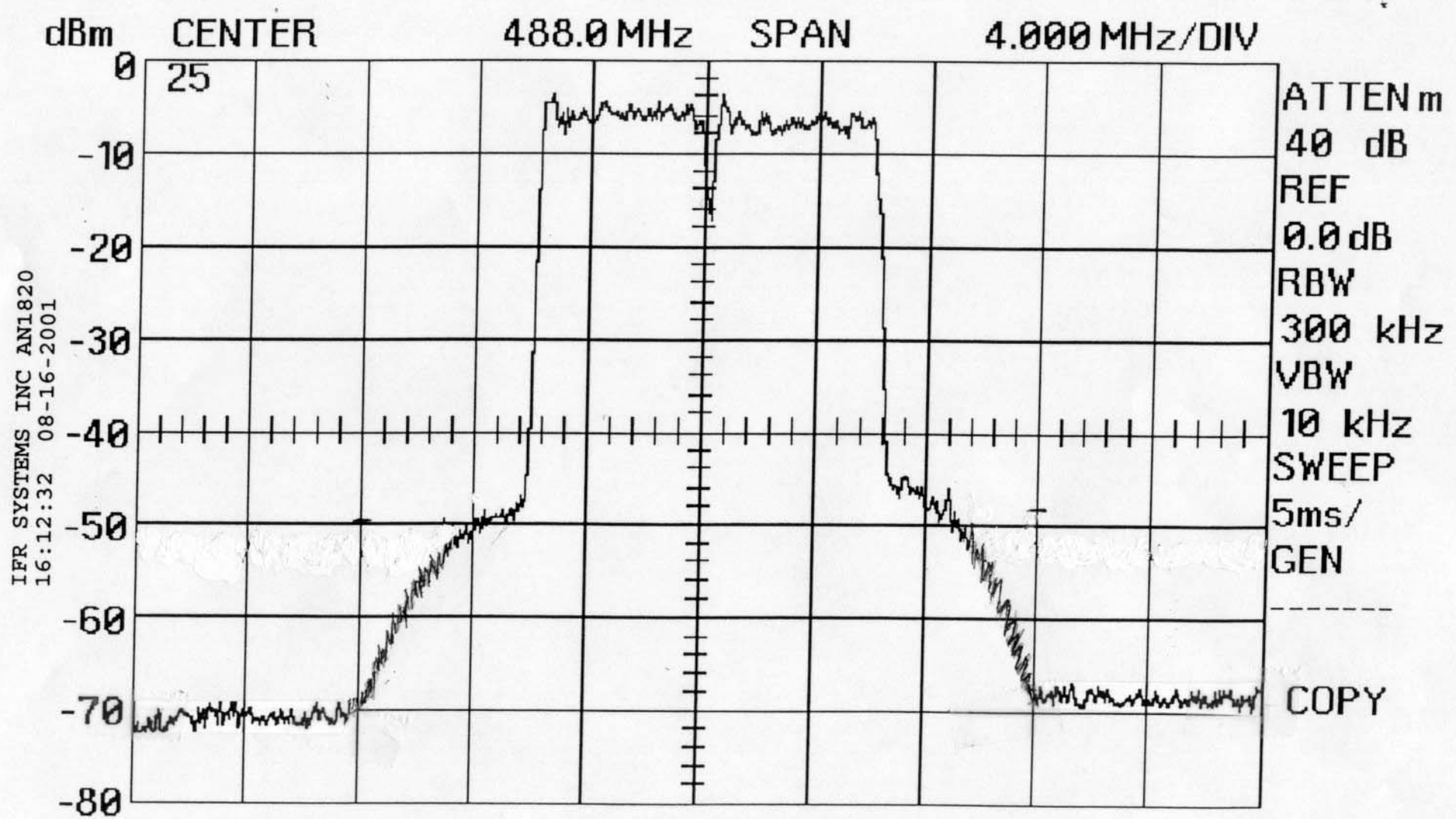
COVE SITE
K32PO
CH32 *Output* to Monroe

Levan Mountain, Block Diagram, Adjacent 8VSB, DTV Translator

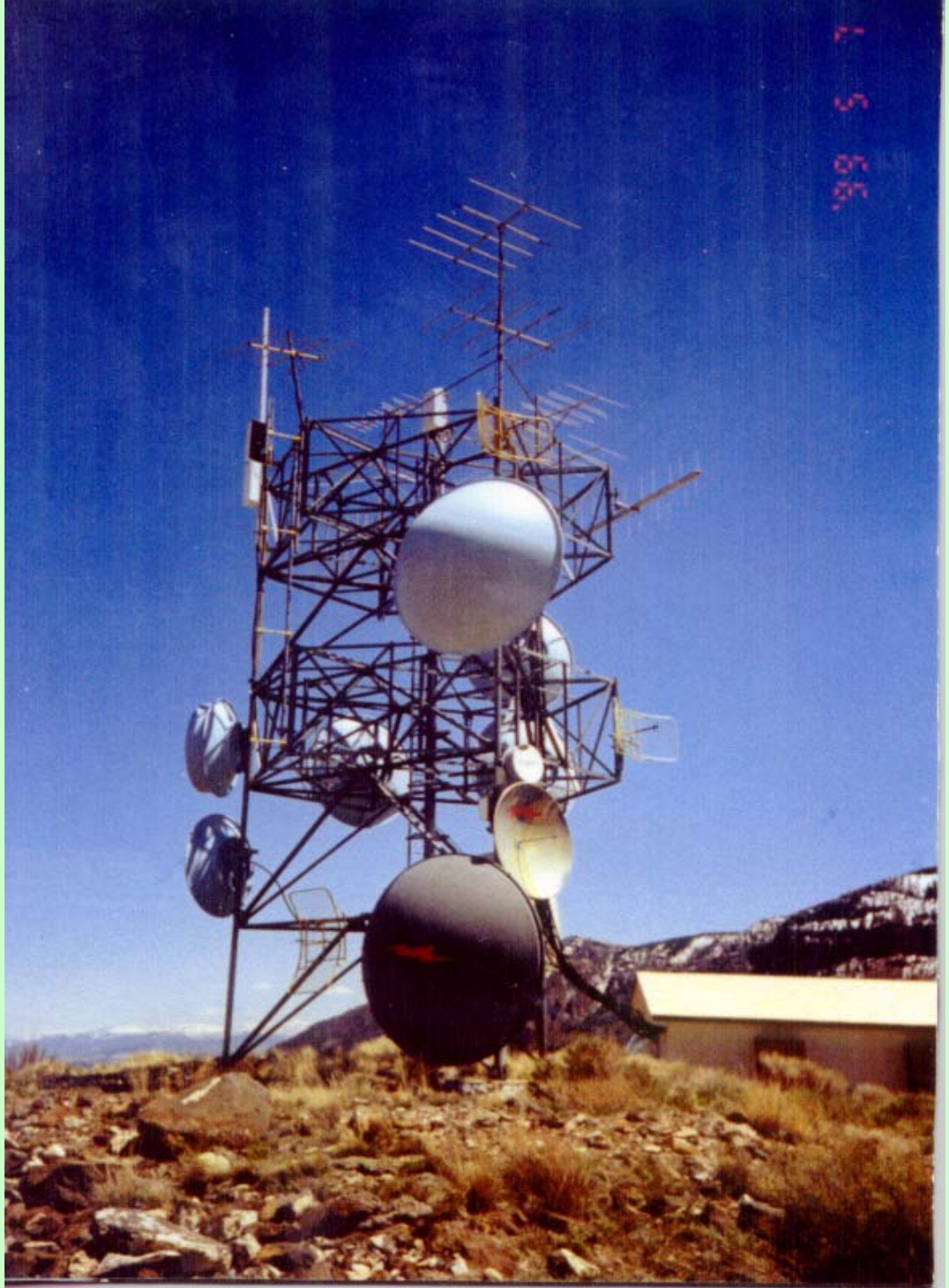


LARCAN/TTC TV TRANSLATOR
MODEL MX100/u

TWO CHANNELS - ONE TRANSLATOR....WITH OUTPUT FILTER
CHANNELS 16 & 17

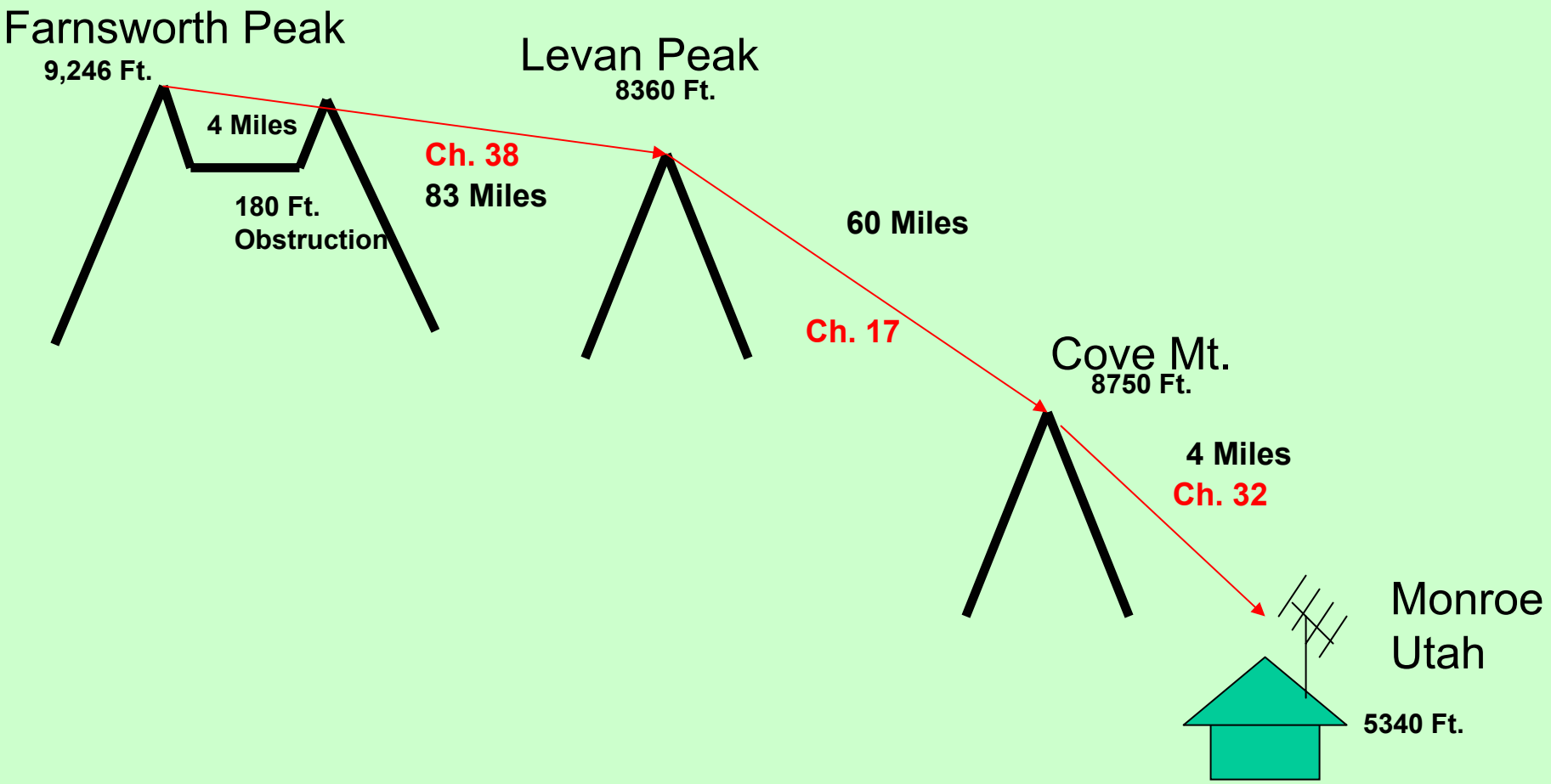


PRINT PLOT



DTV

Salt Lake City to Monroe Utah

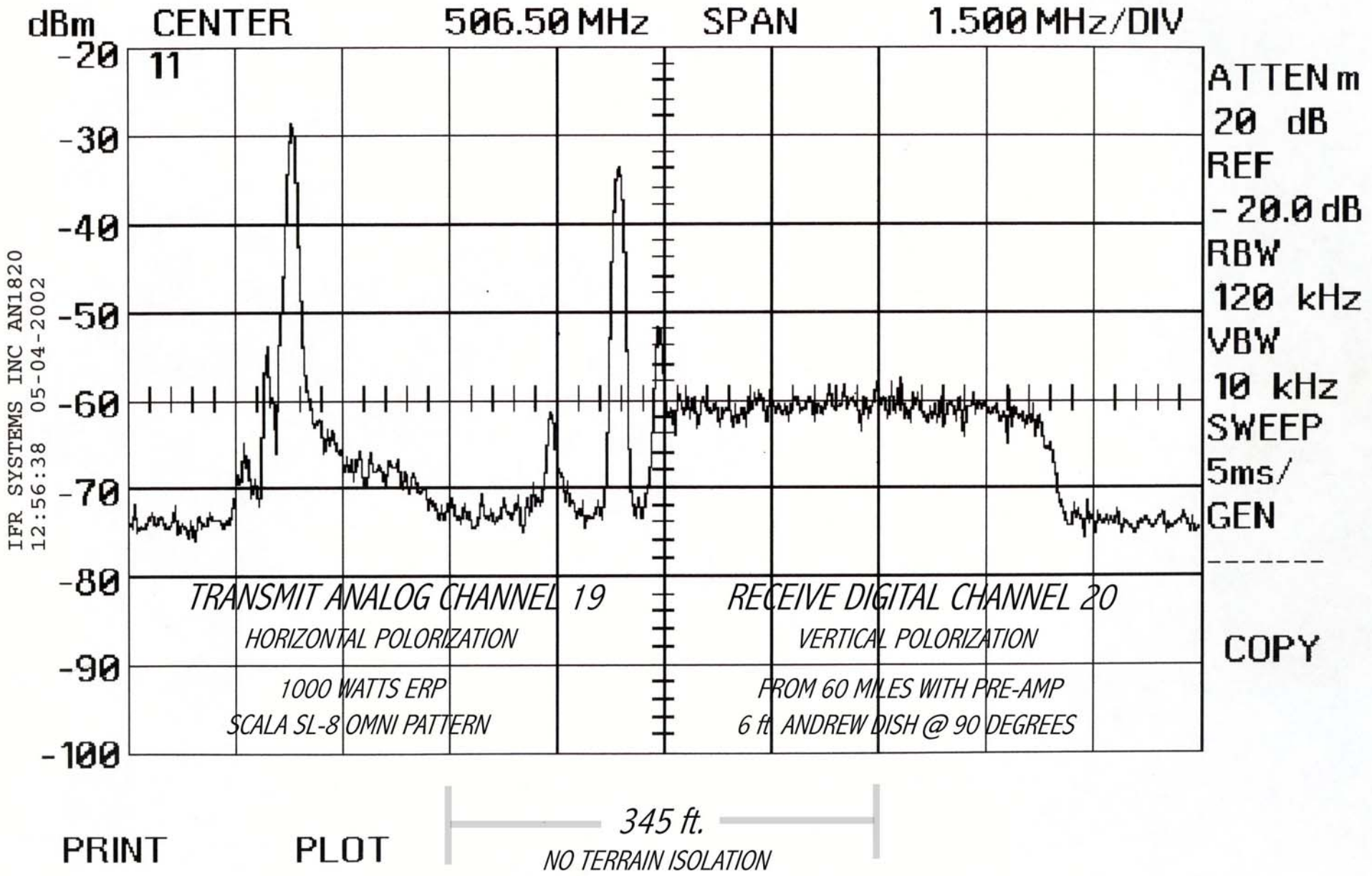


Cove
Site

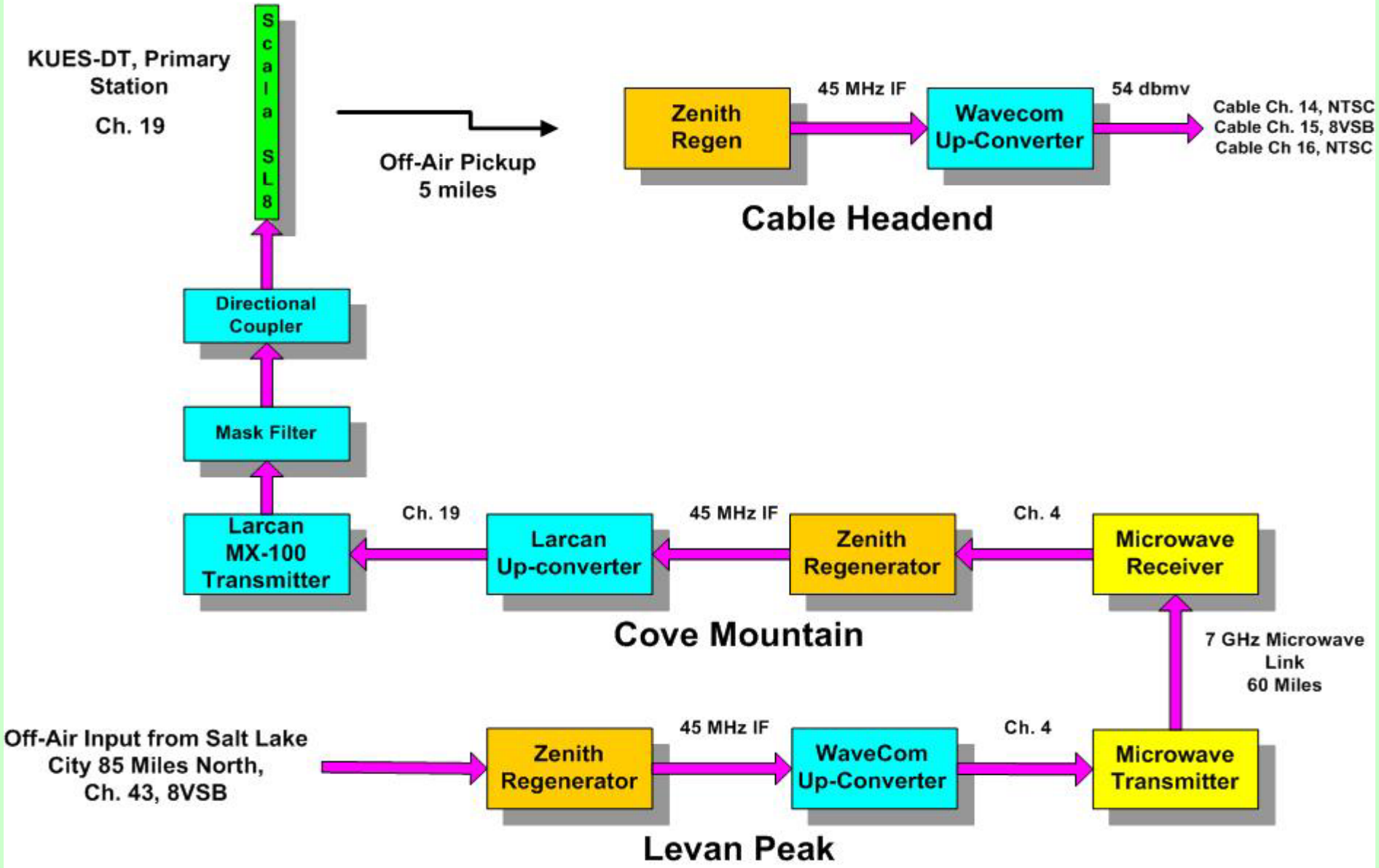
CHANGING A MX100/U TV TRANSLATOR

TO A DIGITAL

PART 73 PRIMARY STATION


dBm
CENTER
506.50 MHz
SPAN
1.500 MHz/DIV
-20
-30
-40
-50
-60
-70
-80
-90
-100
11
ATTEN m
20 dB
REF
-20.0 dB
RBW
120 kHz
VBW
10 kHz
SWEEP
5ms/
GEN
COPY
IFR SYSTEMS INC AN1820
12:56:38 05-04-2002
TRANSMIT ANALOG CHANNEL 19
HORIZONTAL POLORIZATION
1000 WATTS ERP
SCALA SL-8 OMNI PATTERN
RECEIVE DIGITAL CHANNEL 20
VERTICAL POLORIZATION
FROM 60 MILES WITH PRE-AMP
6 ft ANDREW DISH @ 90 DEGREES
345 ft.
NO TERRAIN ISOLATION
PRINT
PLOT

8VSB from Salt Lake to Cable System, 150 Miles Distance



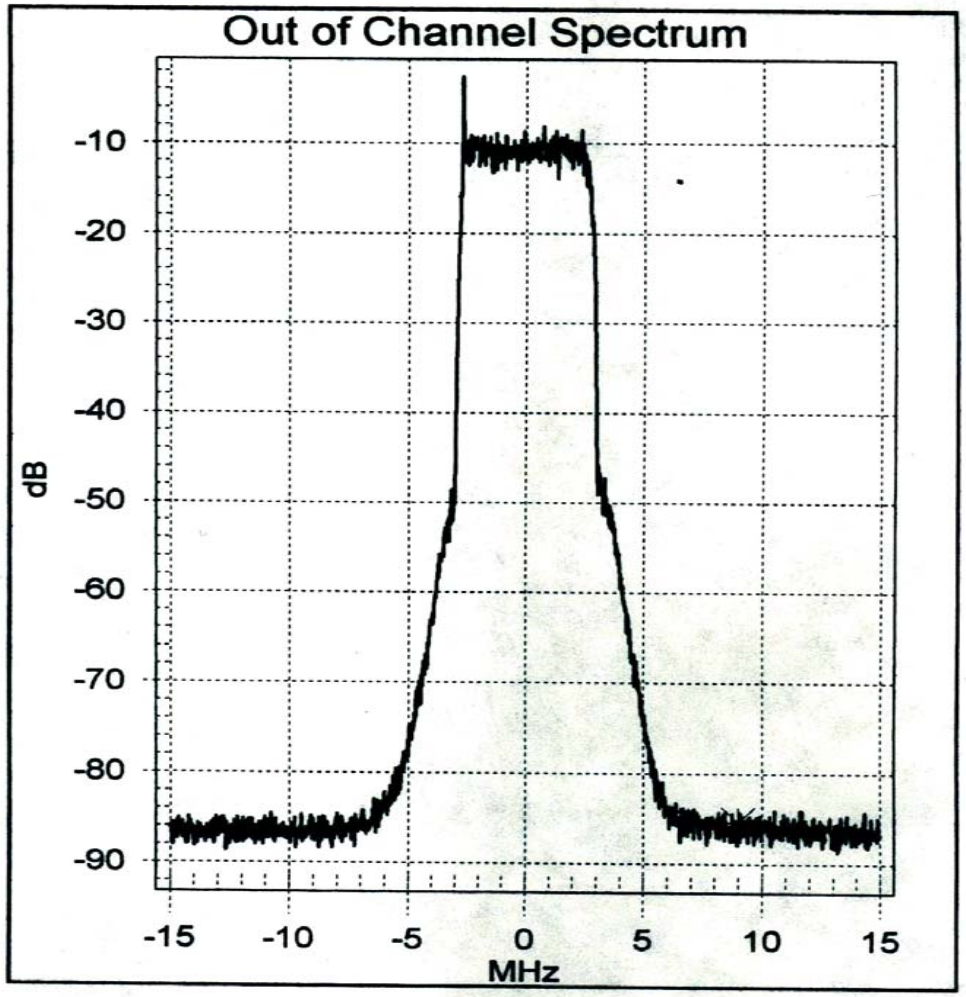
Measurement: Out of Channel Emissions
Smoothing: Low
Frequency: 500.31 MHz

Out of Channel Power to Average Power
Lower Channel -50.0 dB
Upper Channel -47.0 dB

Adjacent Channel Mask Test: Off

5 Channels
Enhanced Accuracy

	Amplitude (dB)	Freq (MHz)
+	-85.34	8.98
×	-85.34	8.98
△	0.00	0.00

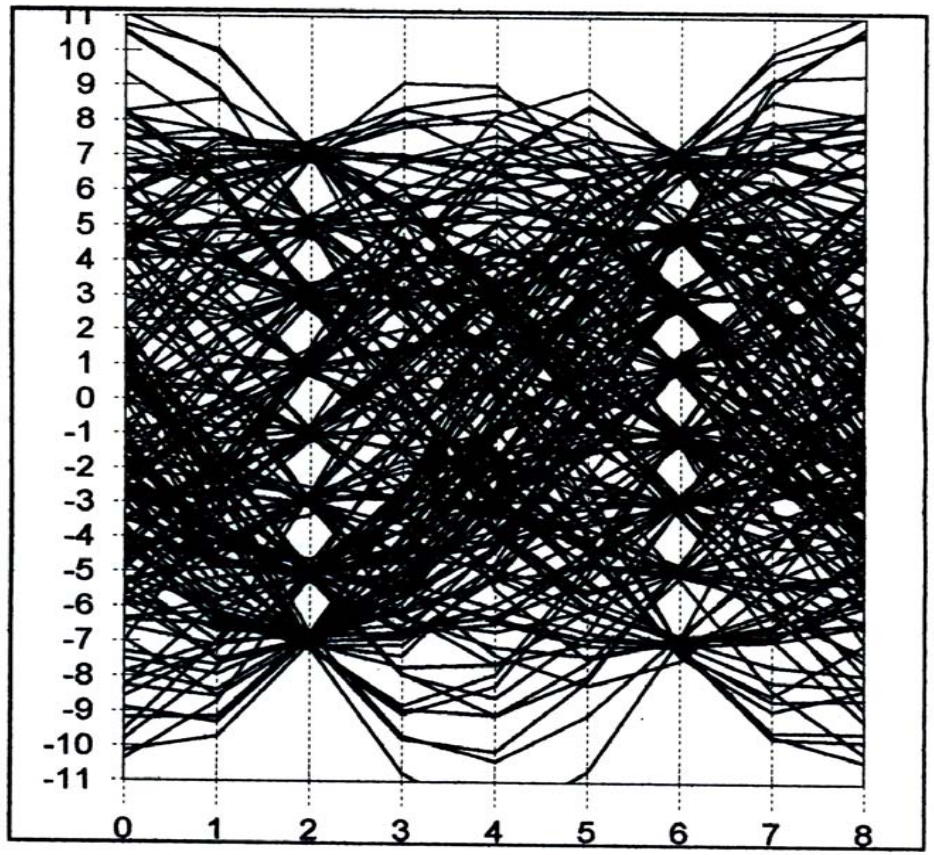


Printed: Monday, March 31, 2003 1:40:11PM

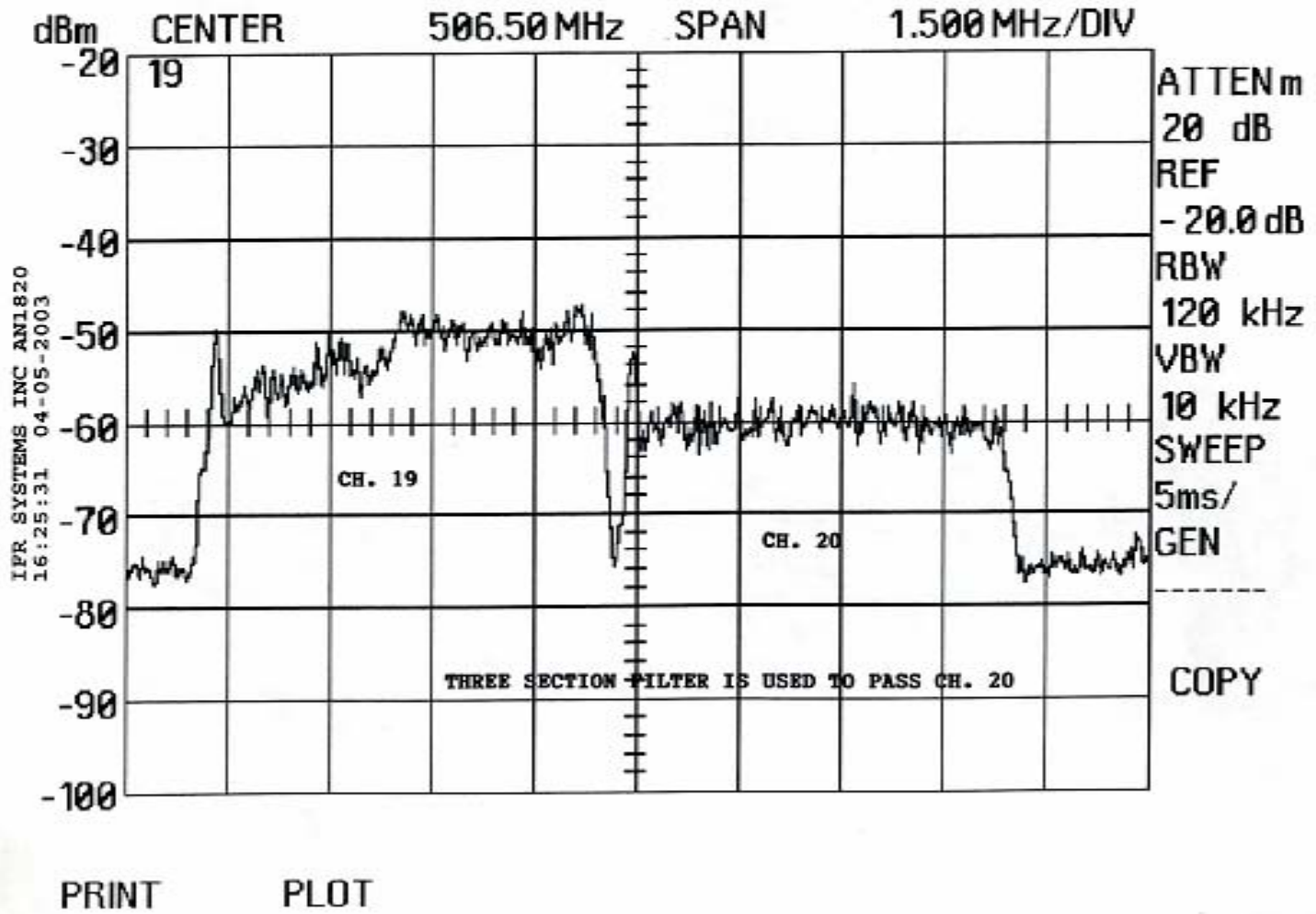
Measurement: Signal/Noise & EVM
Smoothing: Off
Frequency: 500.31 MHz

Signal/Noise	27.7 dB
EVM	3.9 %
Complex MER	27.4 dB
Pilot Amplitude Error	-0.42 dB

Use Equalizer	Off
Subtract Pilot Offset from Symbol axis	On



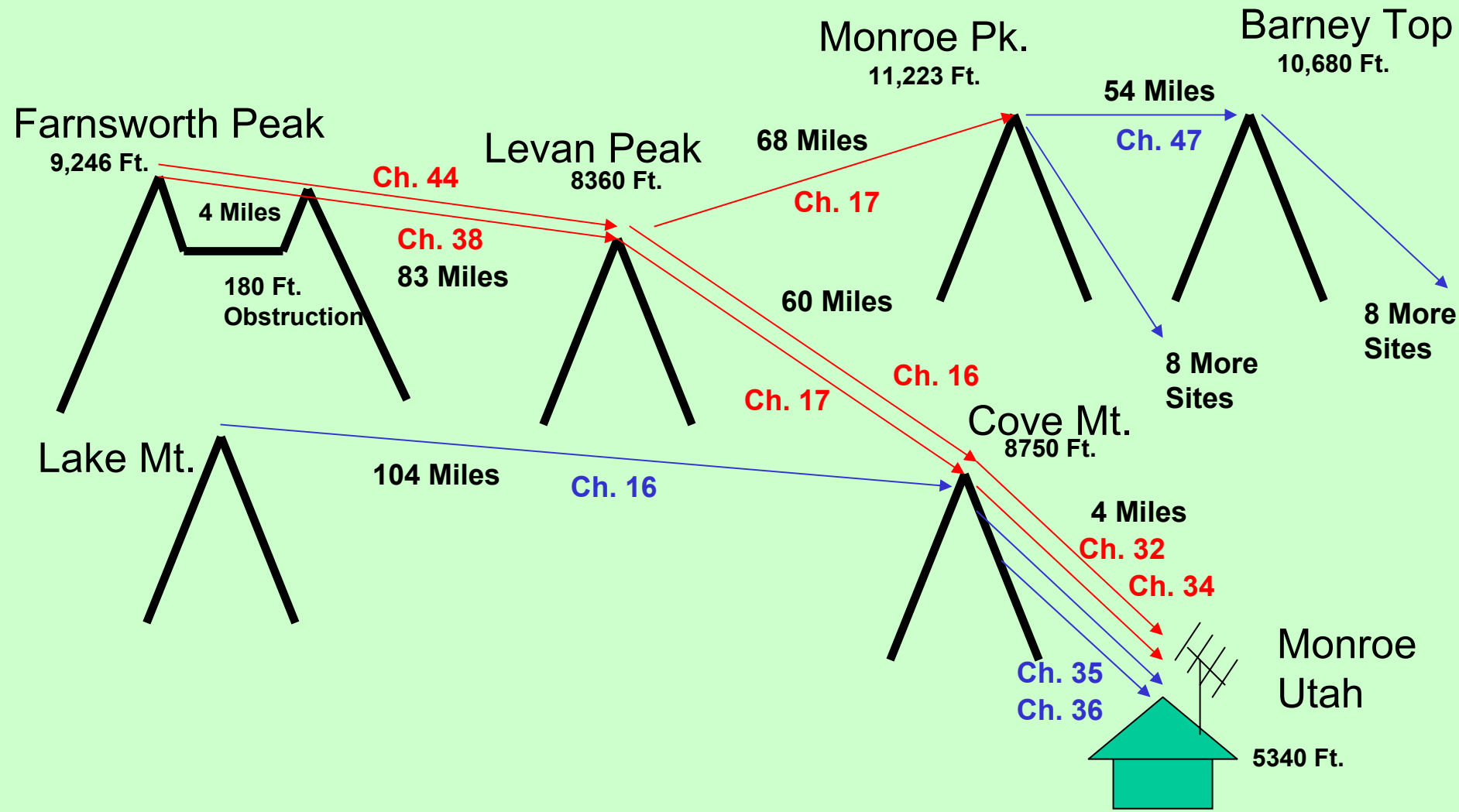
RECEIVED DIGITAL CHANNEL 20 FROM LEVAN SITE WHILE
TRANSMITTING DIGITAL CHANNEL 19
WITH TPO OF 25 WATTS AND
330 WATTS ERP ON OMNI SL-8 ANTENNA



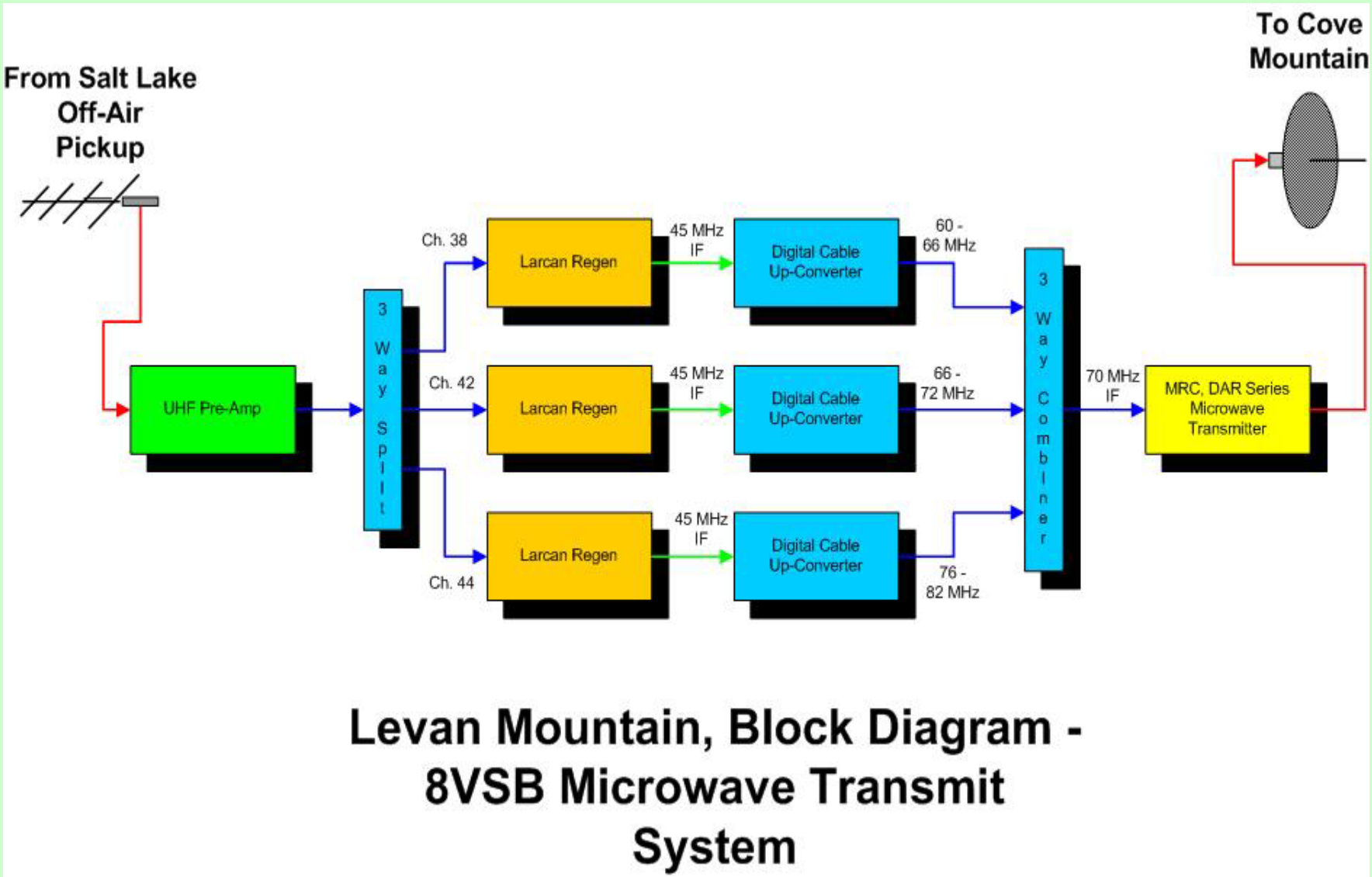
DTV

Salt Lake City to Monroe Utah

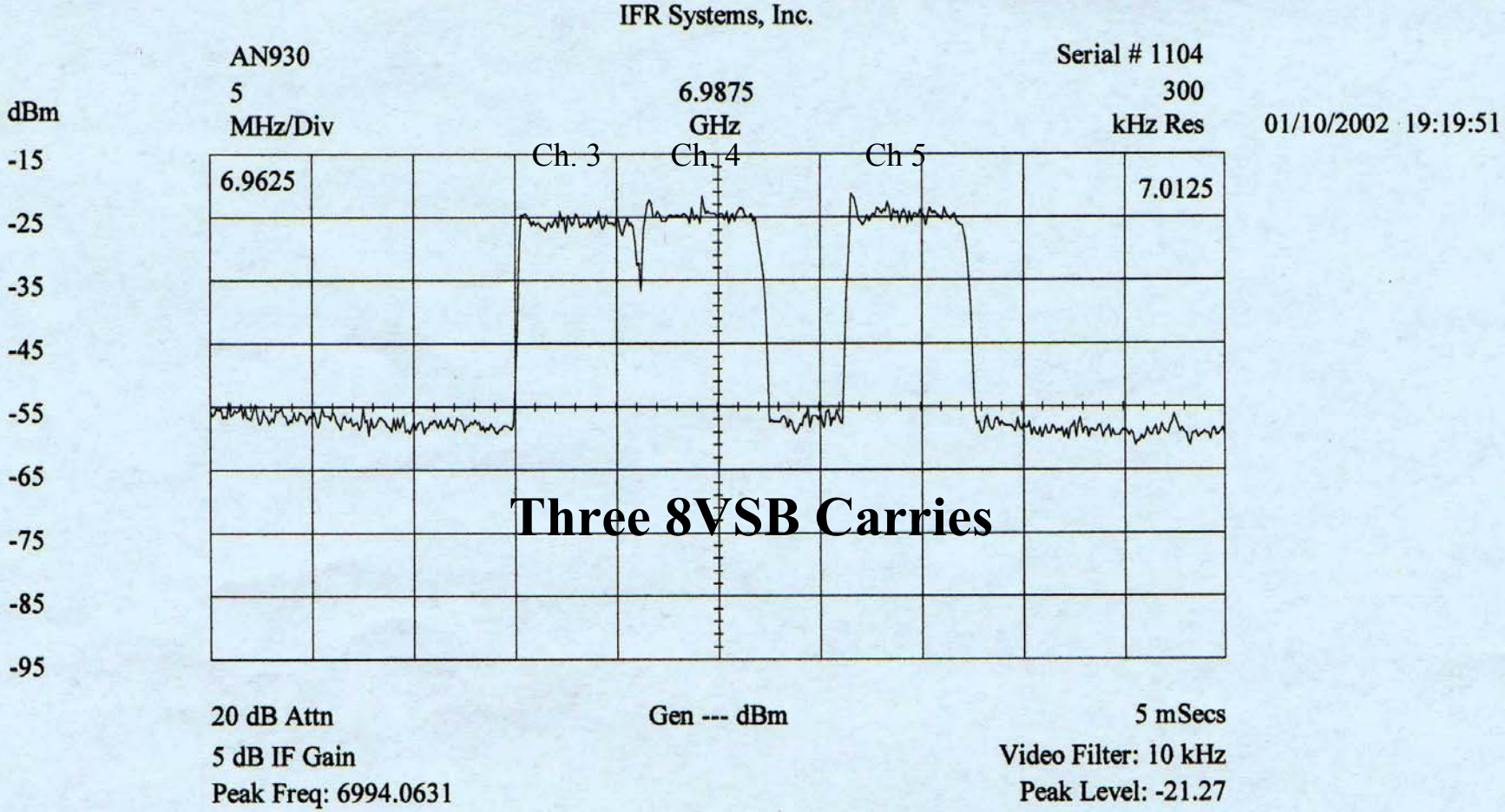
Improve Reception to Rural Viewers



Microwave



Levan Mountain, Block Diagram - 8VSB Microwave Transmit System



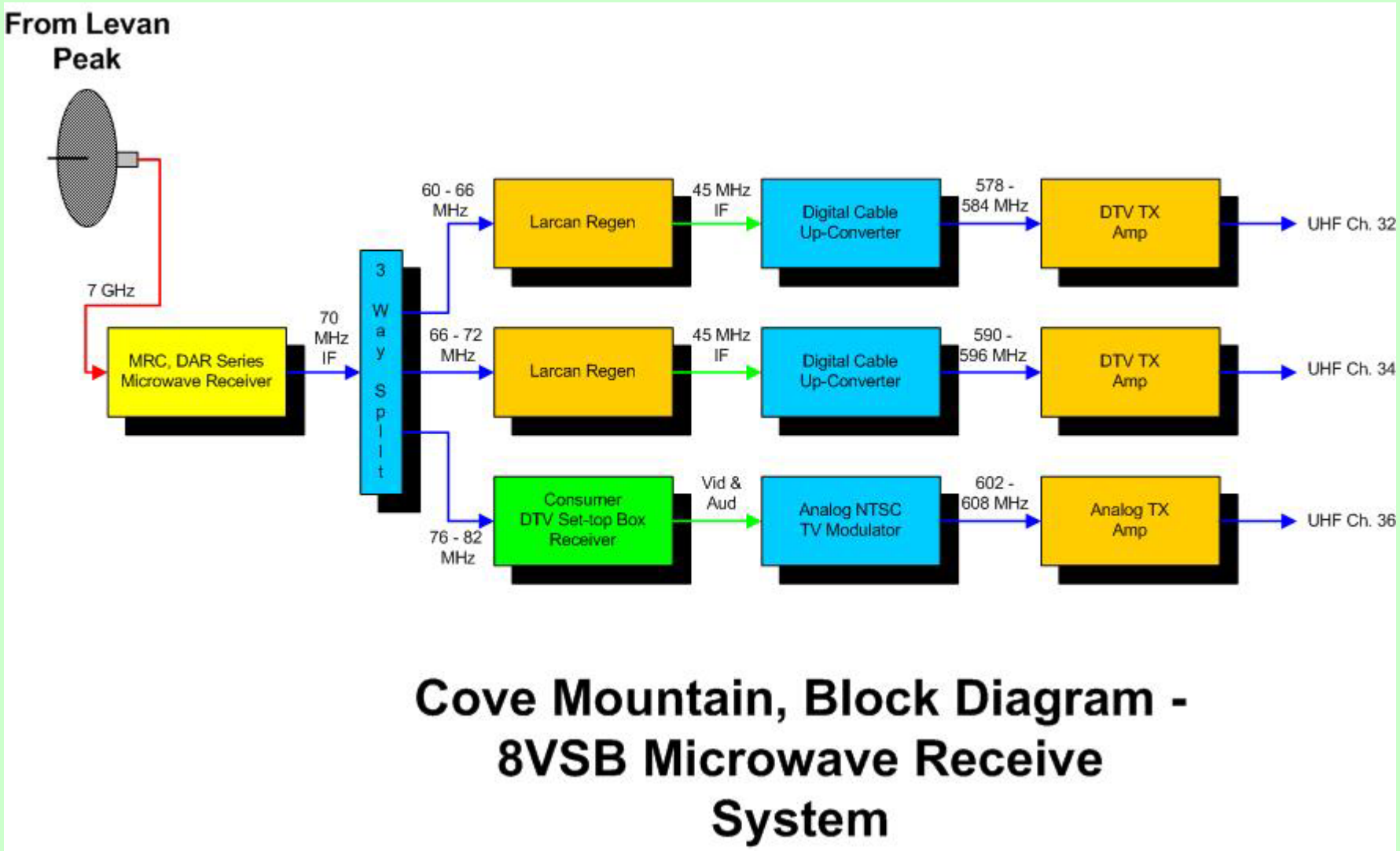
DAR Transmitter, Output Test Point

Better than 30dB C/N and 23MHz of Bandwidth

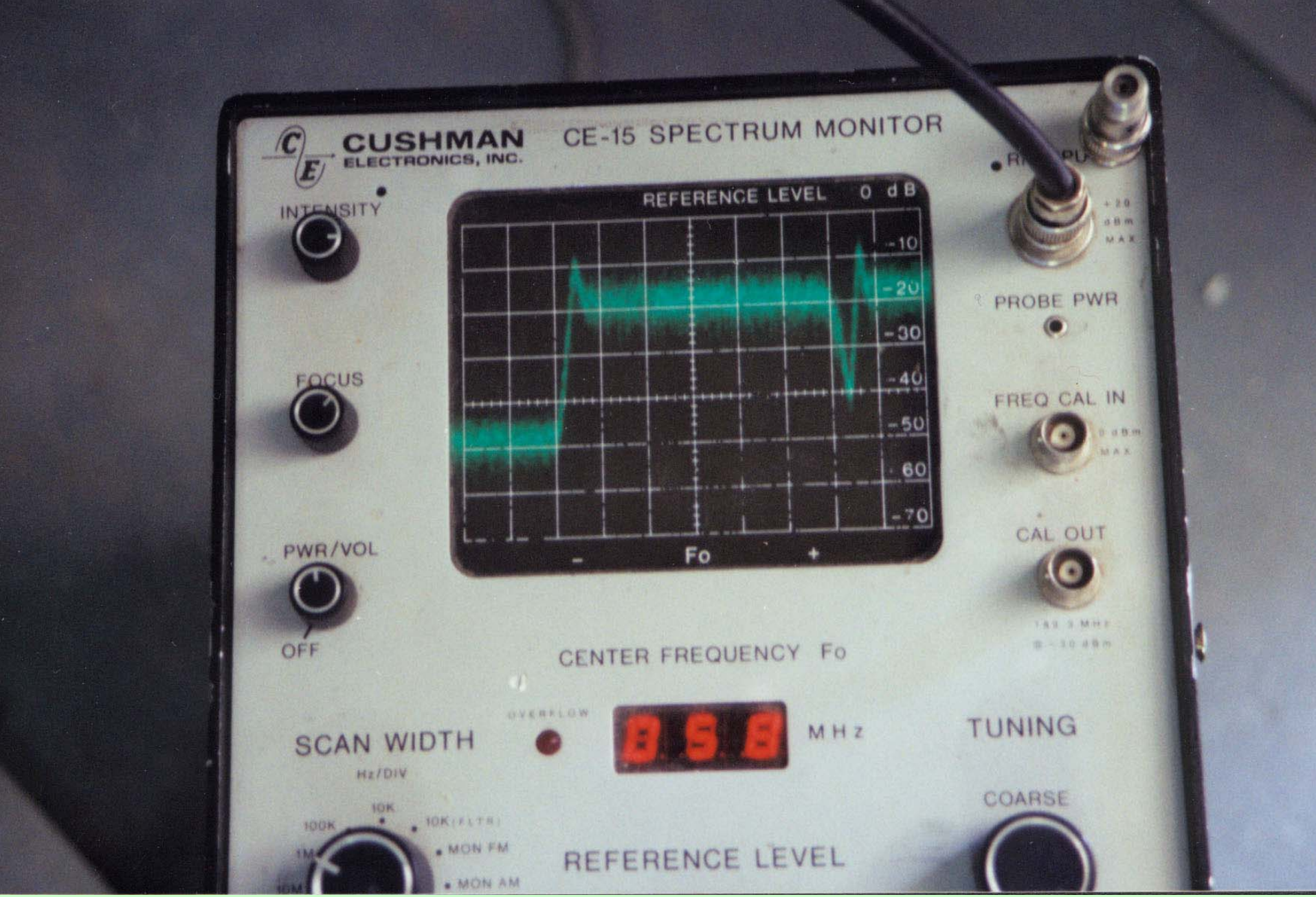
Ch. 3, 60-66 Mhz

Ch. 4, 66-72 Mhz

Ch. 5, 76-82 Mhz

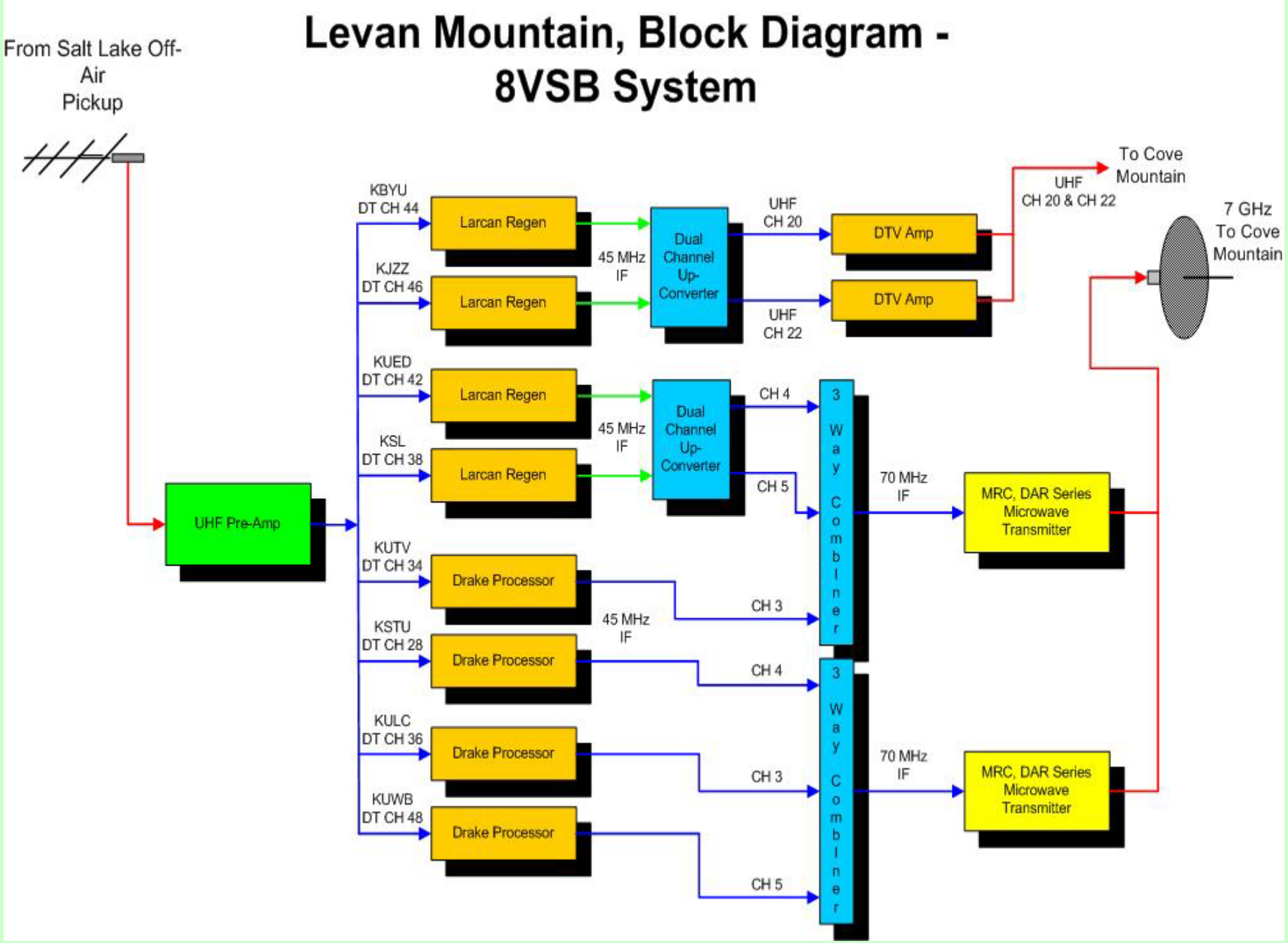


Cove Mountain, Block Diagram - 8VSB Microwave Receive System

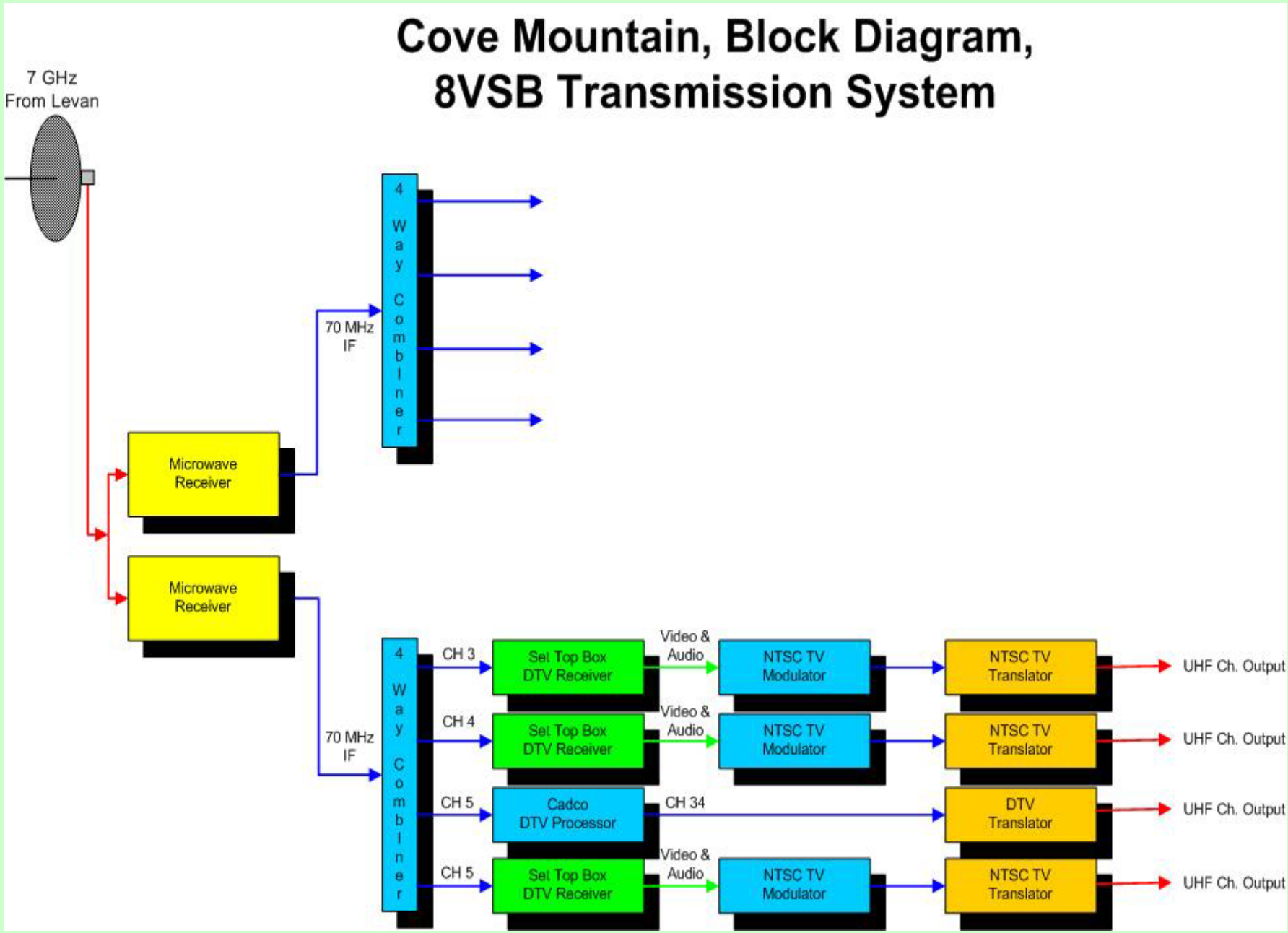


Microwave Receiver Output

Levan Mountain, Block Diagram - 8VSB System



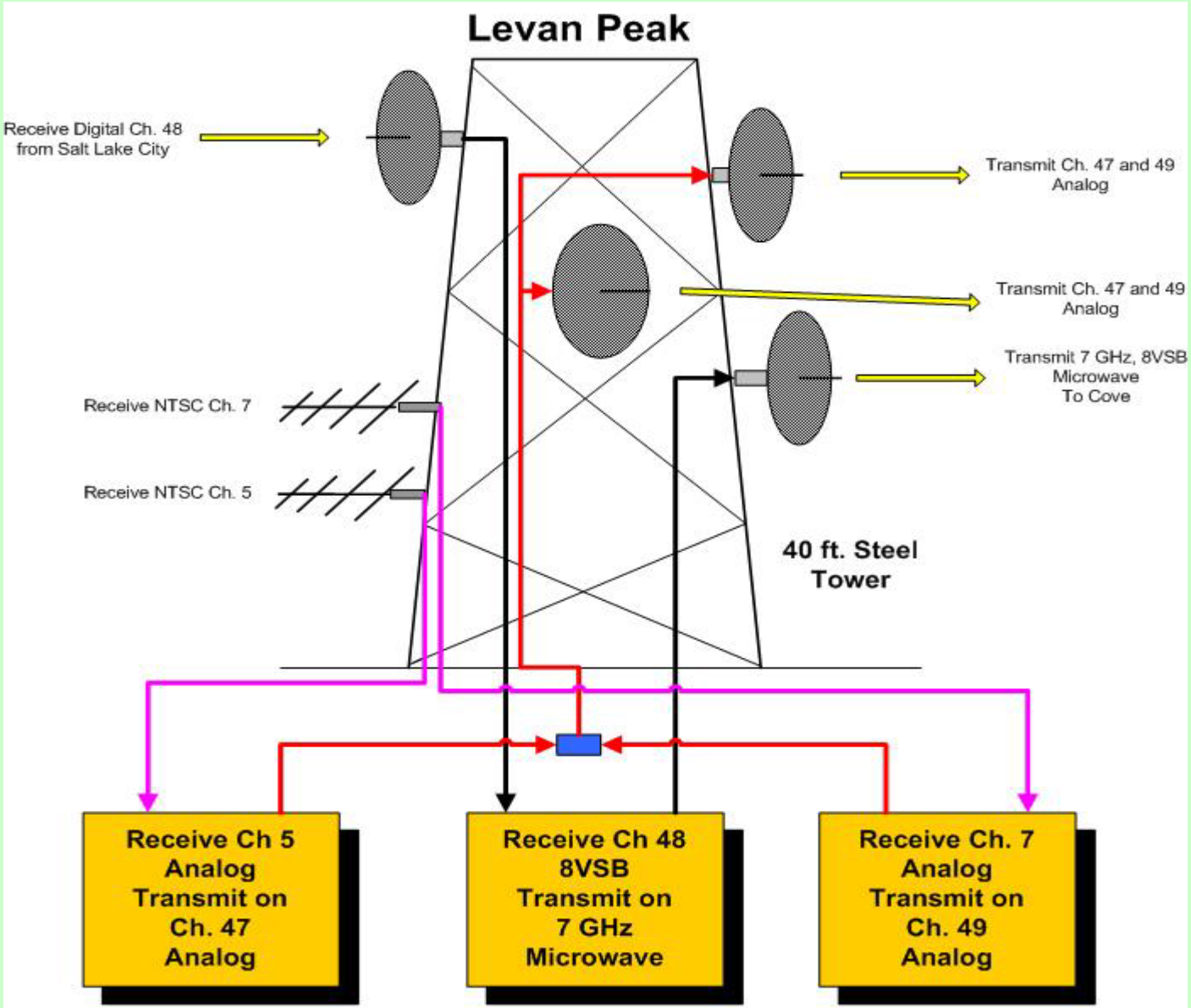
Cove Mountain, Block Diagram, 8VSB Transmission System



ADJACENT CHANNEL

8VSB TRANSMISSION

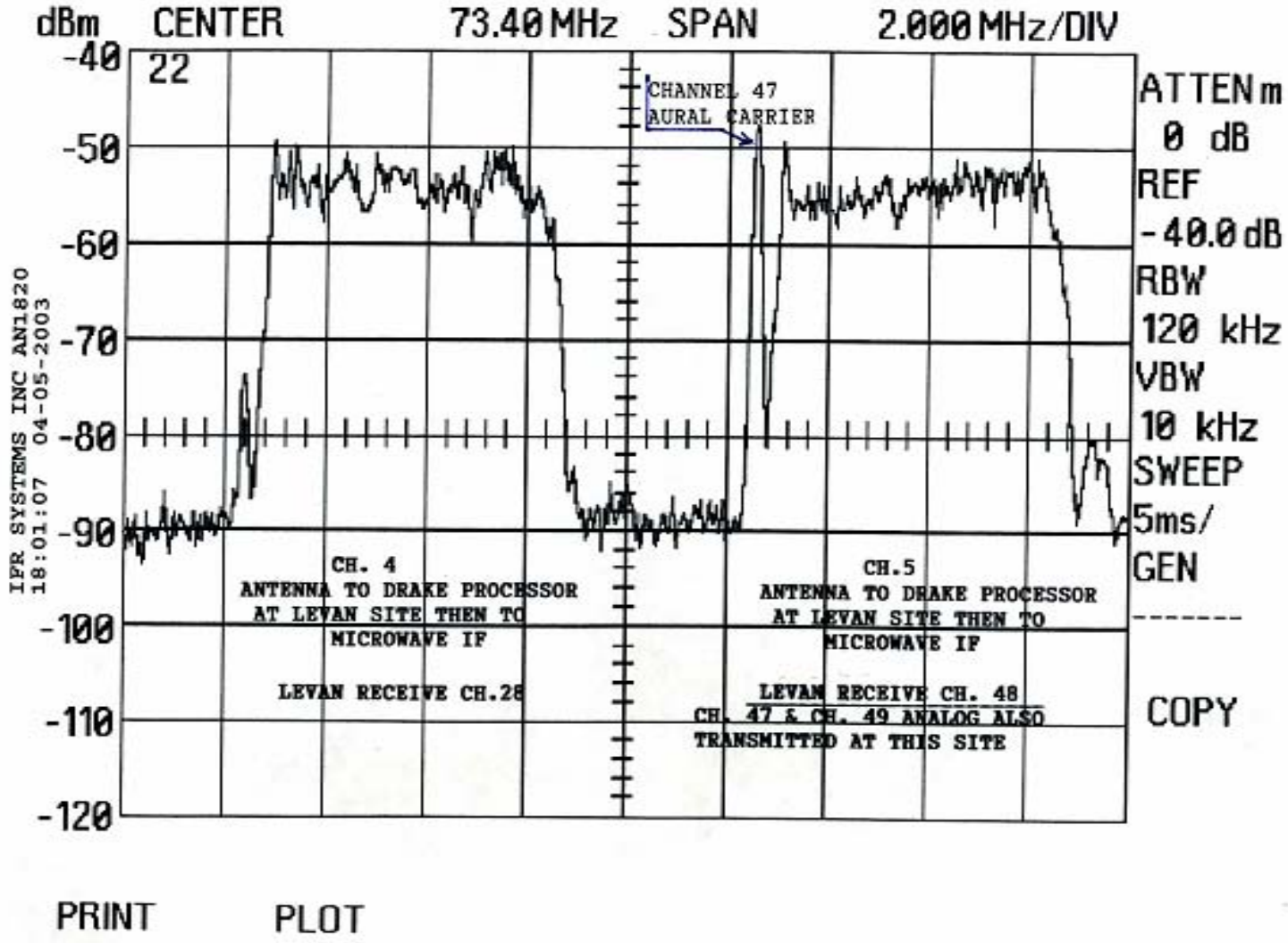
FROM THE SAME TOWER



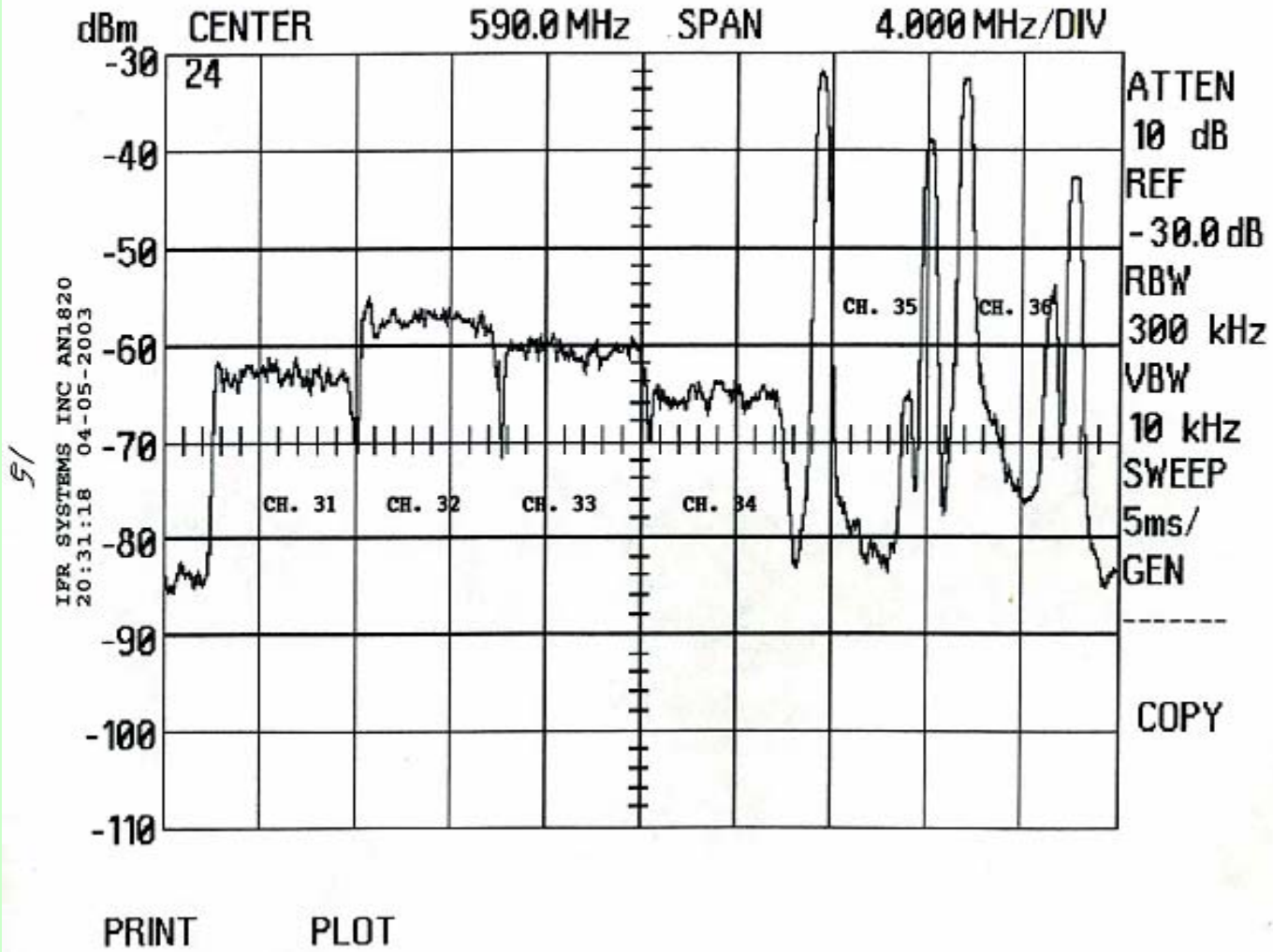
Off Air 8VSB low level channel 48 received from Salt Lake City, at the same time, transmitting an analog channel 47 and 49 with 100 watt translators.

Drake heterodyne processor was used for the channel change to provide a channel 5 input to the microwave 70 MHz IF.

70 mhz OUTPUT OF MICROWAVE RECEIVER AT COVE SITE



DIGITAL AND ANALOG SIGNALS RECEIVED AT MY TV SET
IN MONROE, UTAH

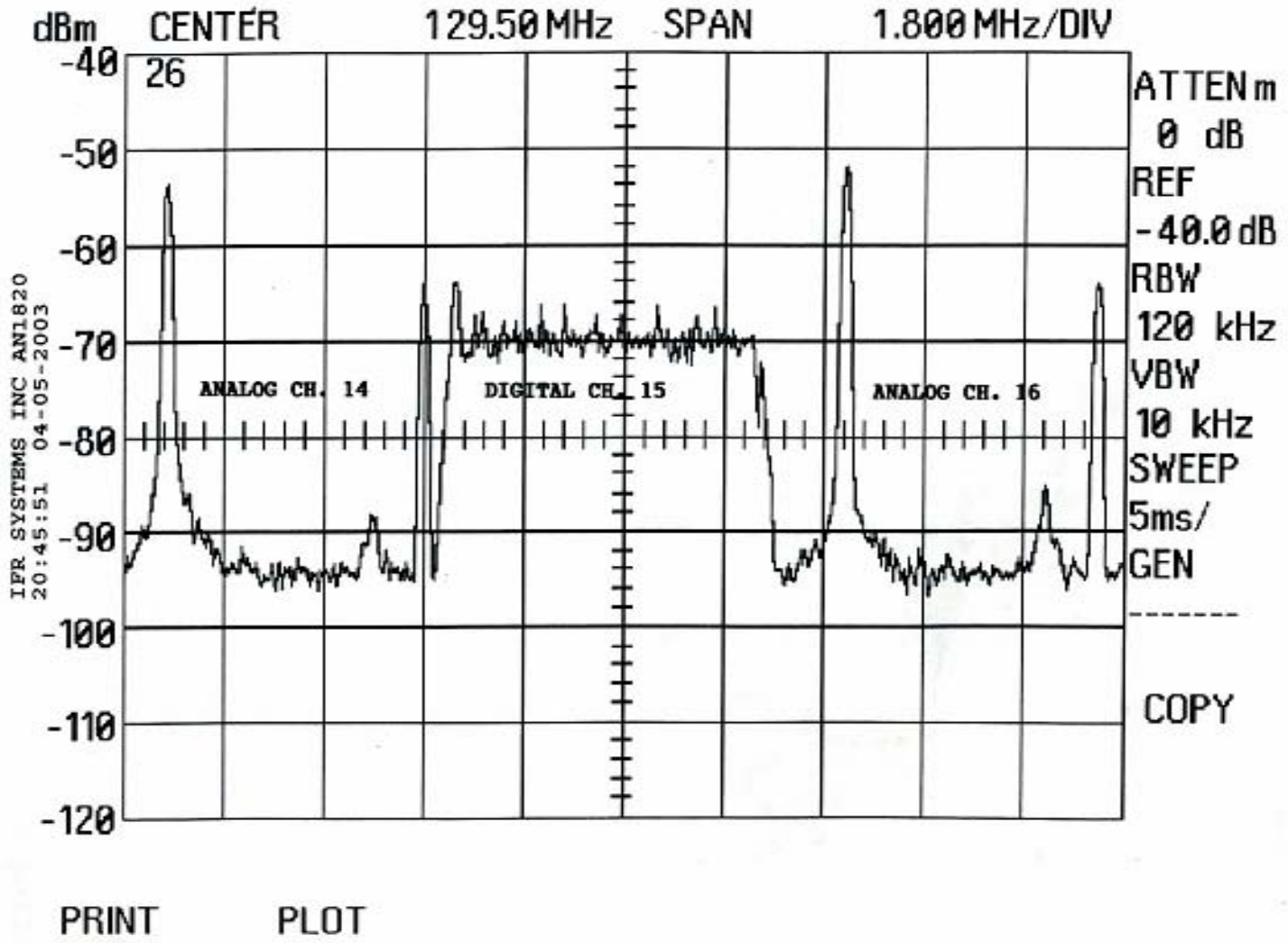


8VSB TELEVISION

ON LOCAL

CABLE SYSTEM

CABLE DIGITAL CHANNEL 15 RECEIVED AT MY HOME
IN MONROE, UTAH

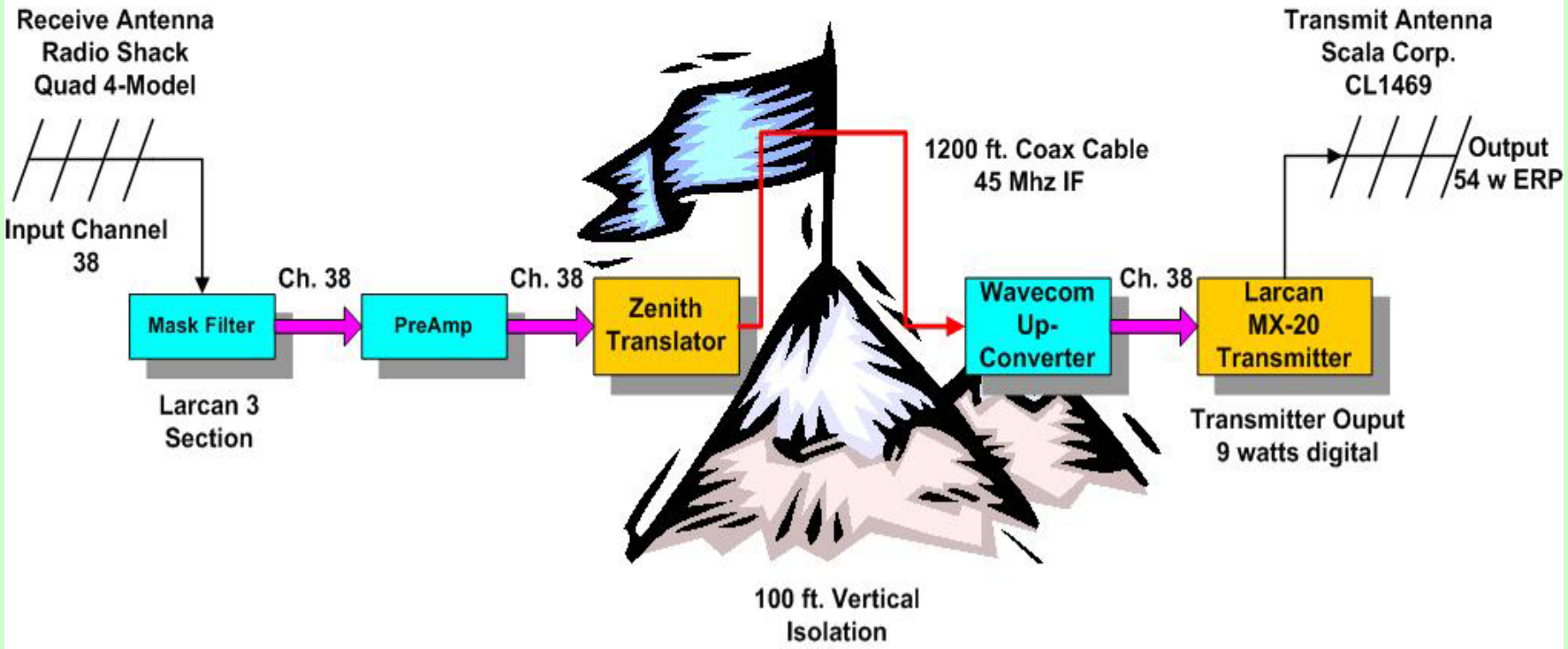


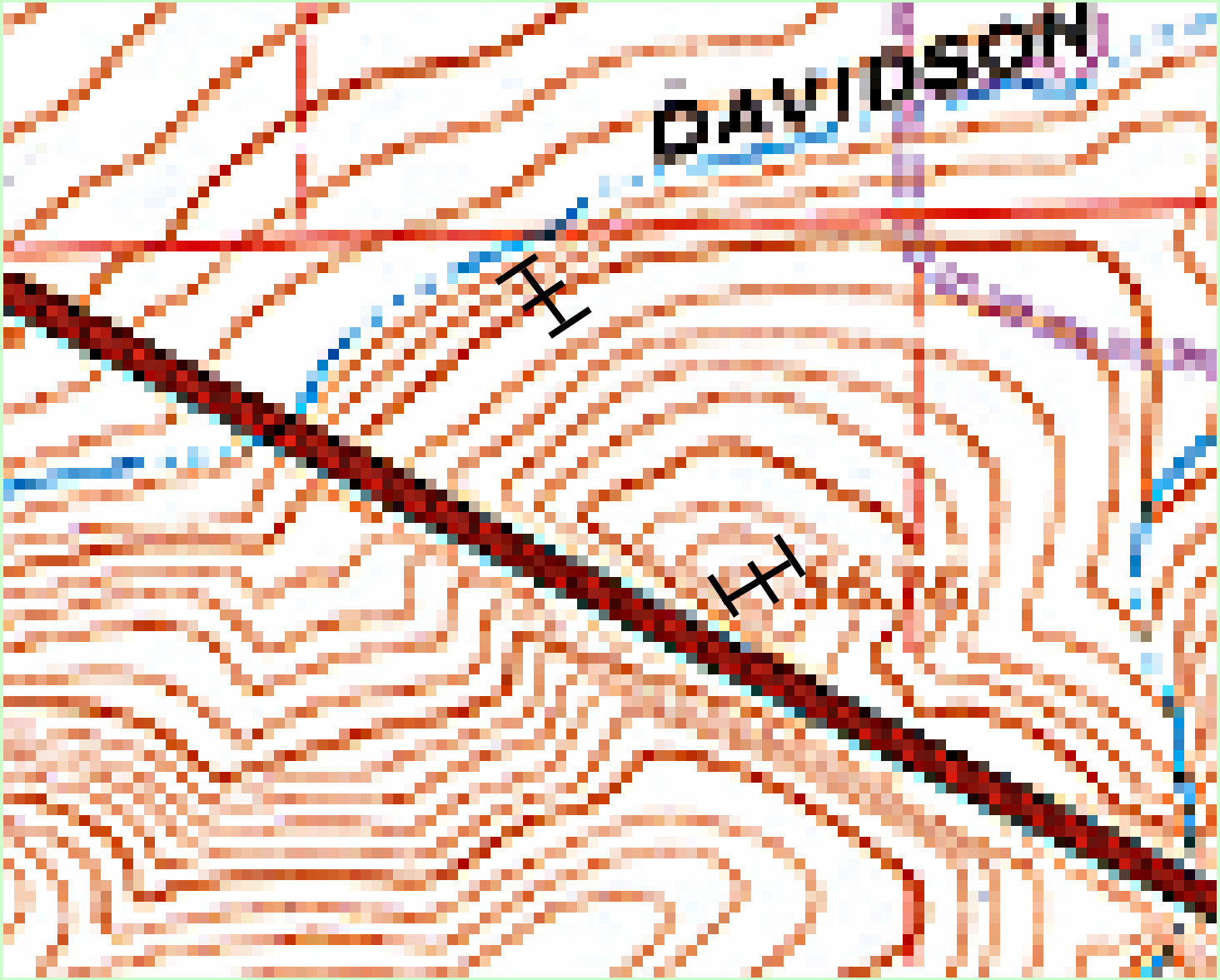
BARE BONES
ON CHANNEL
8VSB BOOSTER TEST

BOULDER, COLORADO

SEPT. 30 & OCT. 1, 2002

Boulder, Co
On Channel Booster Test
Sept. 30 & Oct. 1, 2002




DAVIDSON
H
H

4x4

THE DOUBLE L's

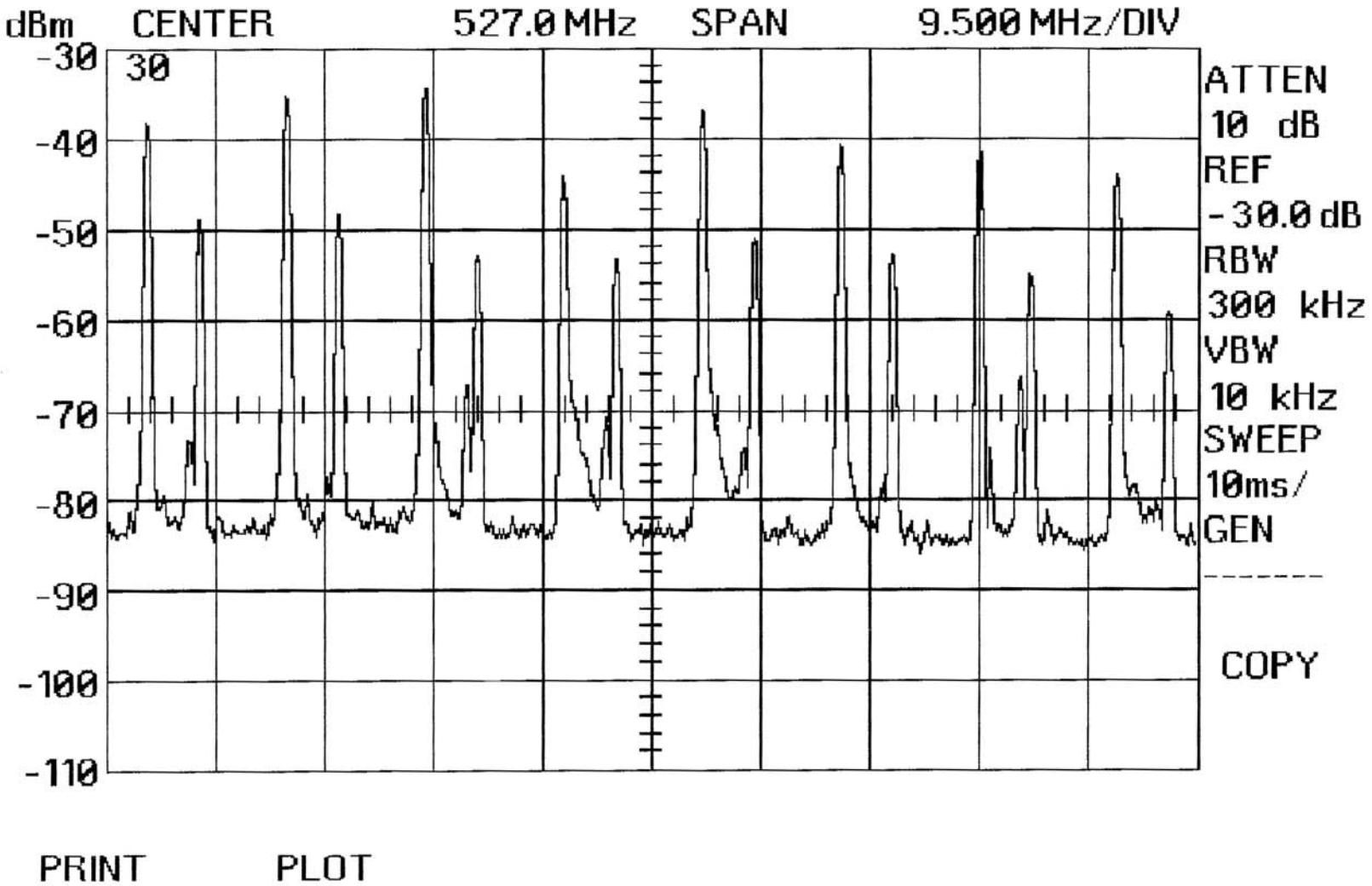
Levels

Linearity

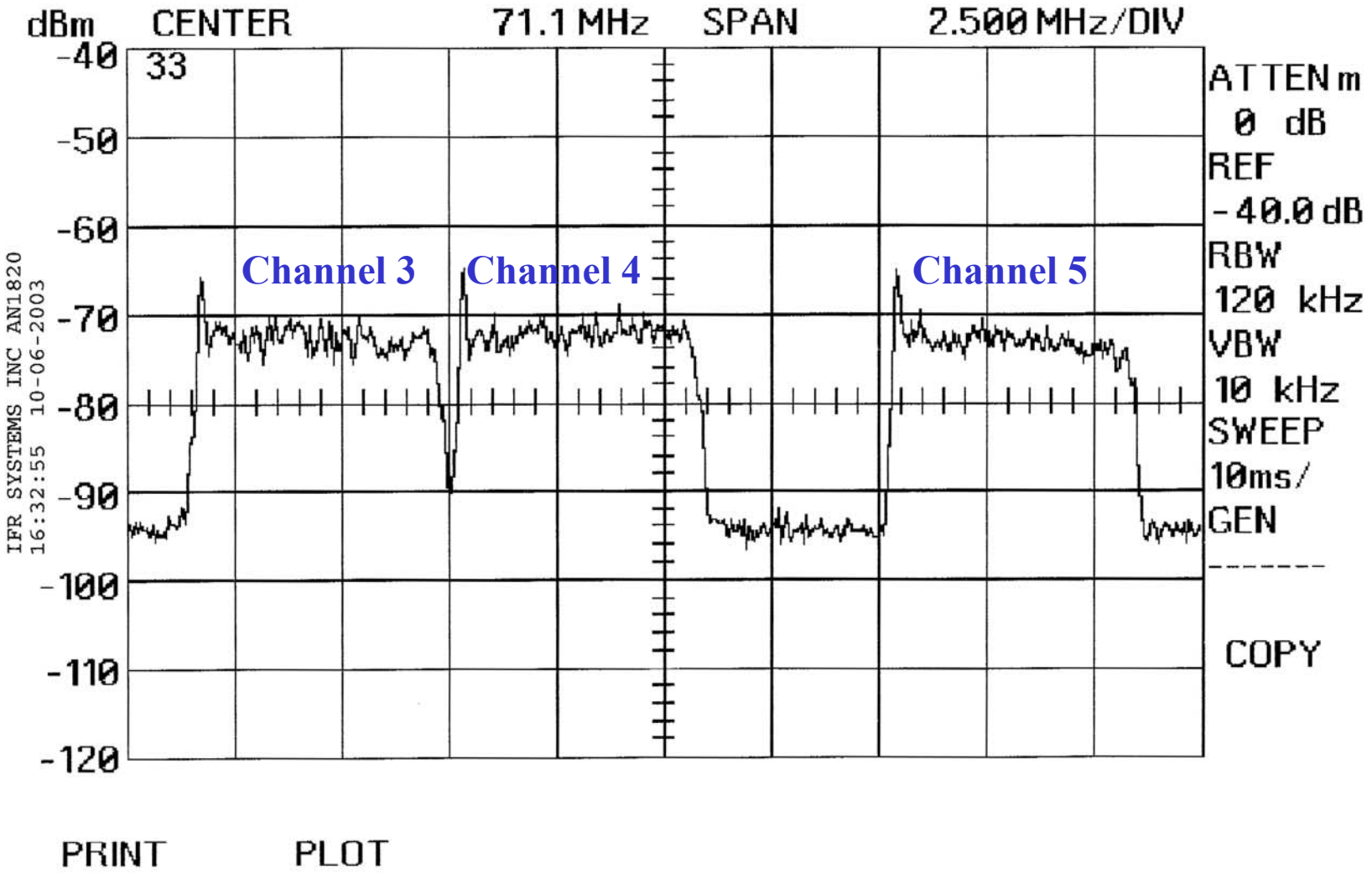
Monroe Peak

Analog & Digital Signals

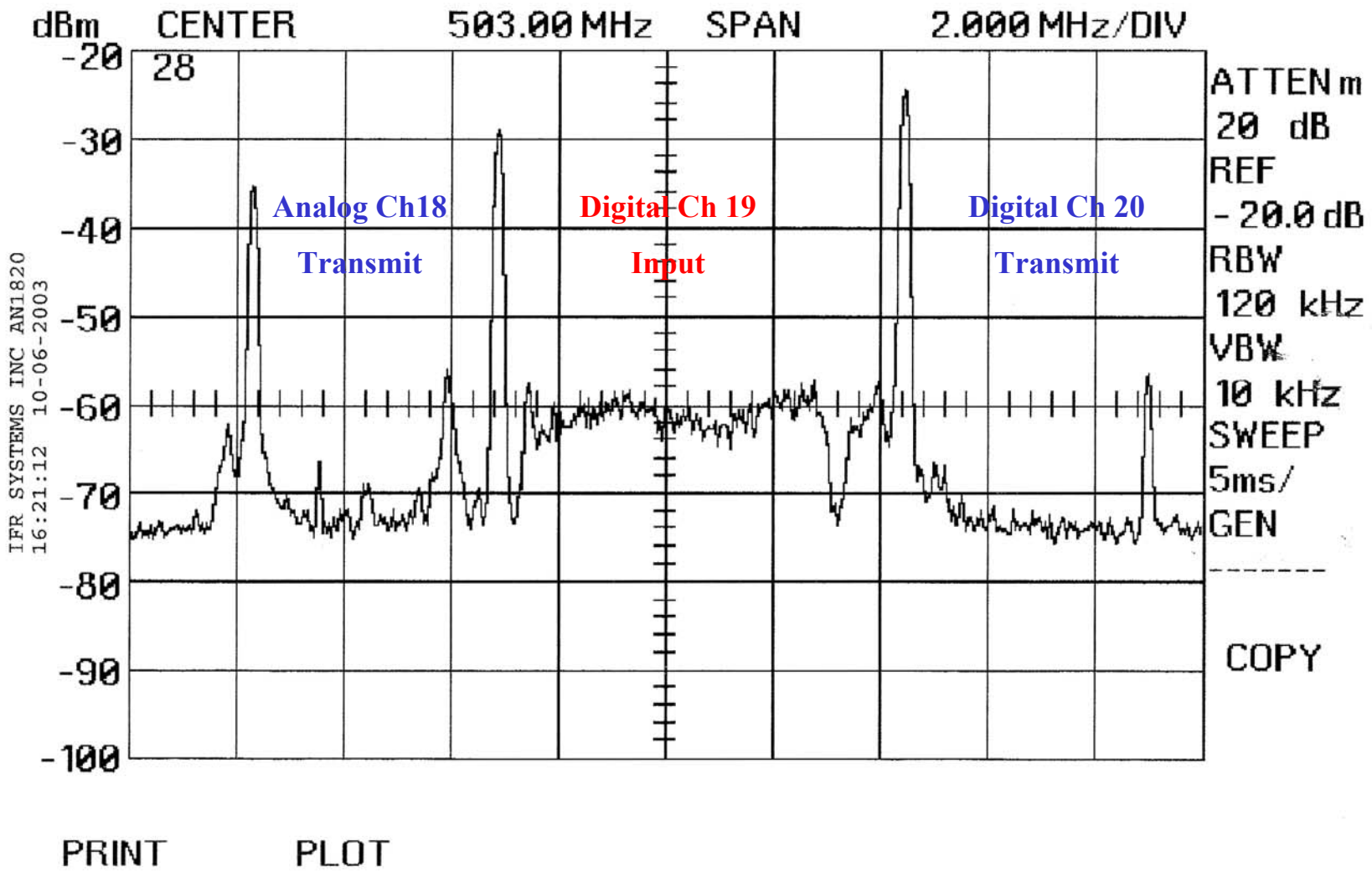
8 Analog Receive Channels



Output of Microwave

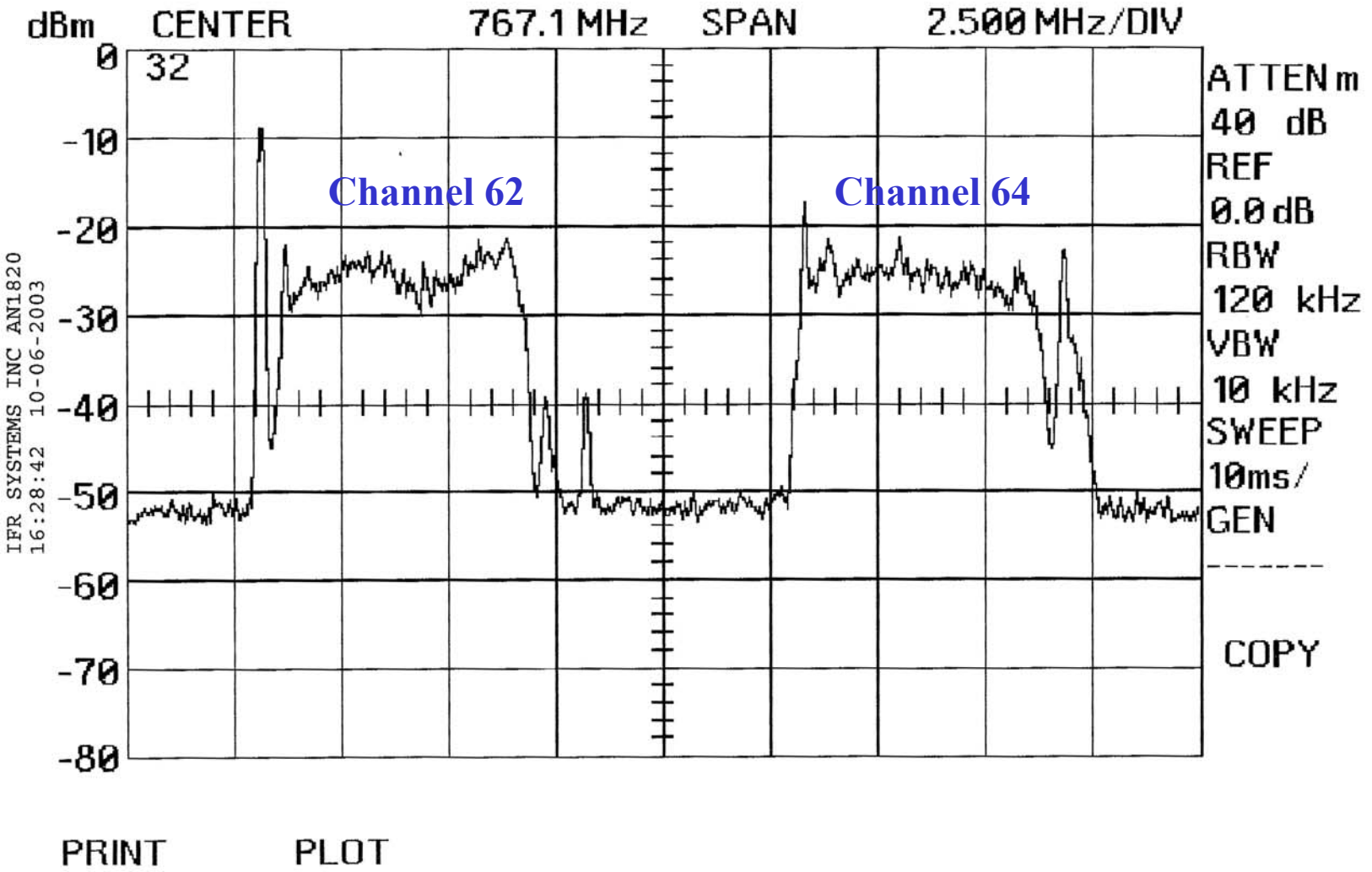


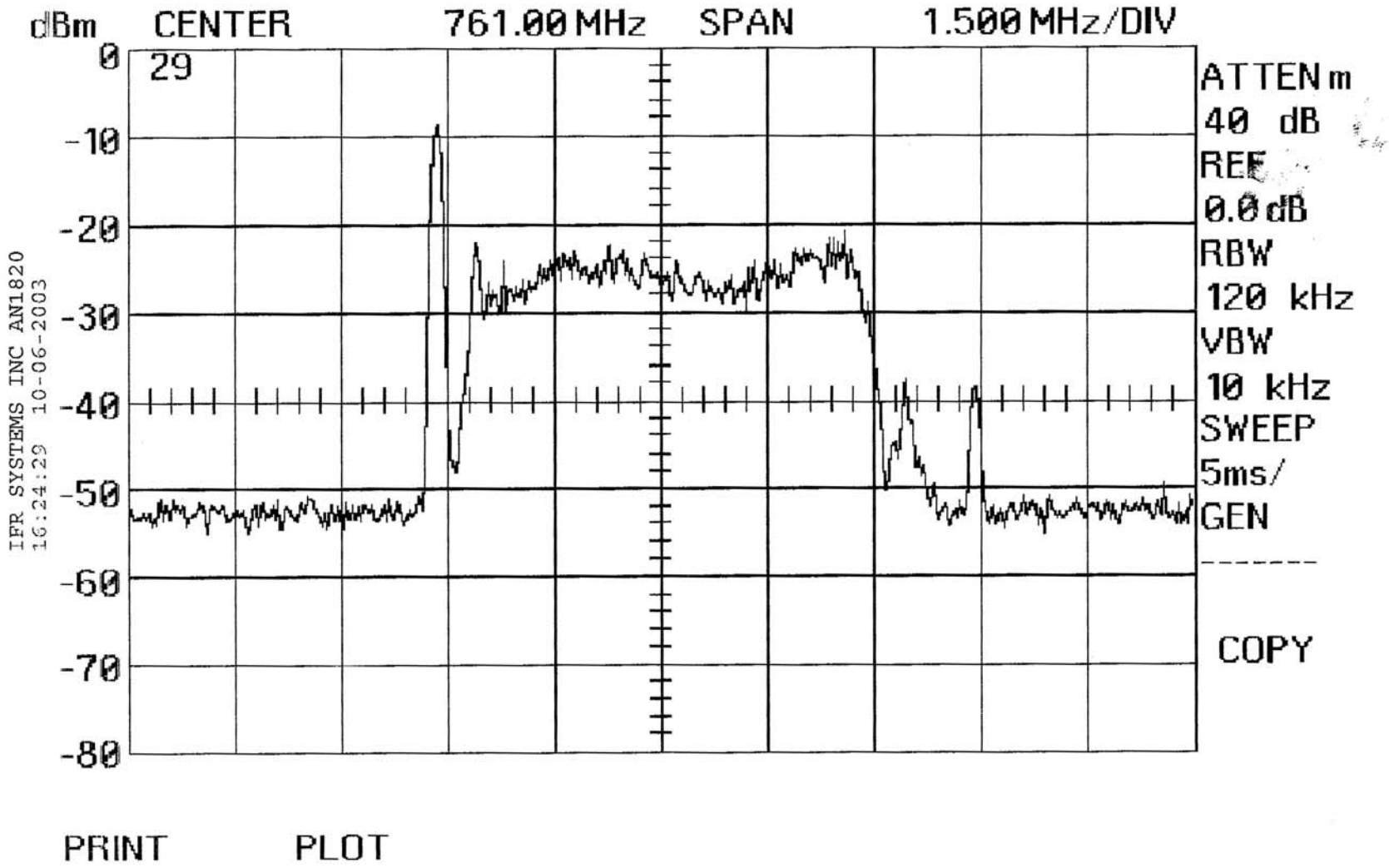
Recovery of Digital Channel 19



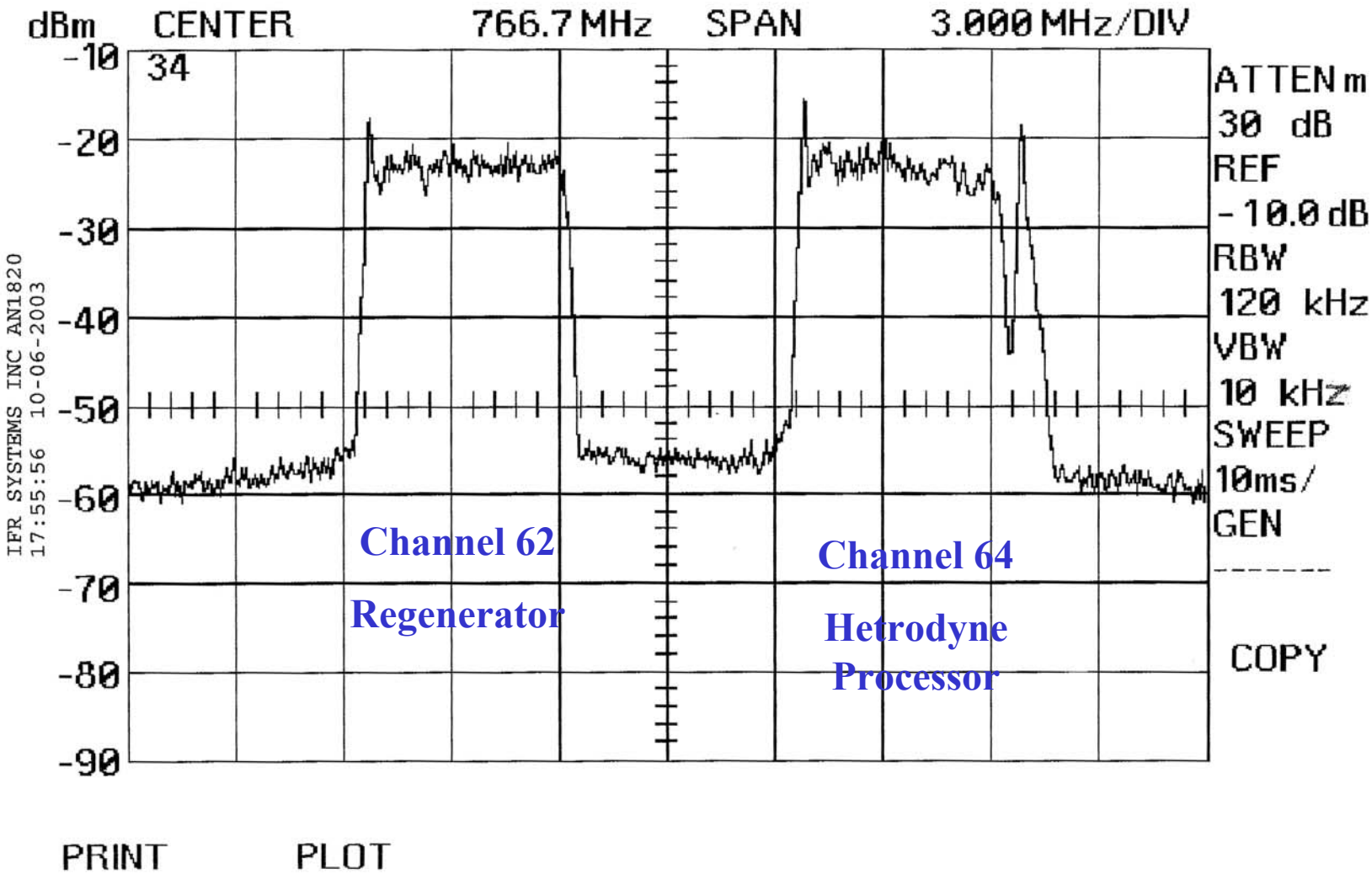
Adjacent Channel Splatter

with Hetrodyne Processors

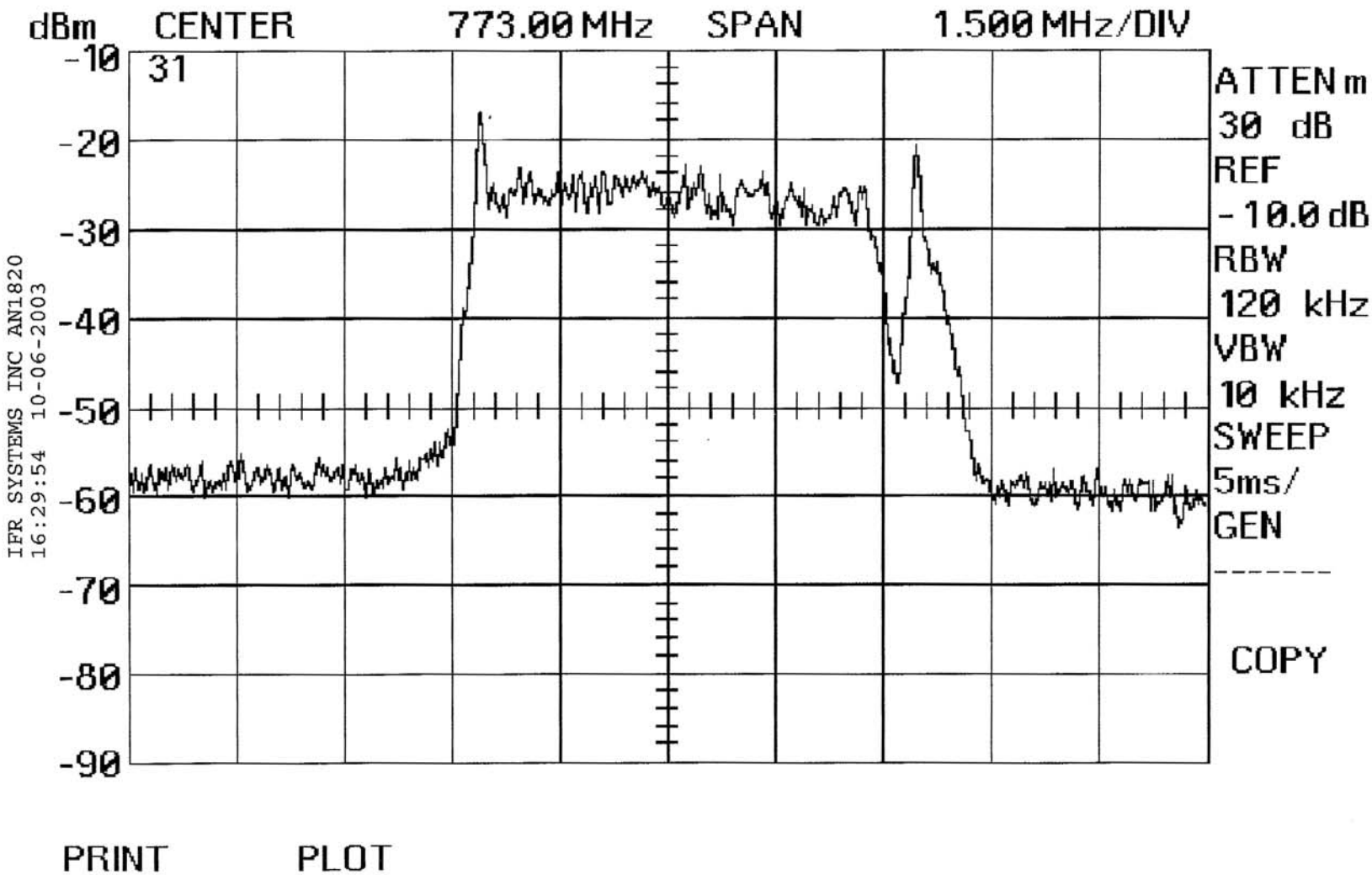



dBm
CENTER
761.00 MHz
SPAN
1.500 MHz/DIV
0
-10
-20
-30
-40
-50
-60
-70
-80
29
ATTEN m
40 dB
REF
0.0 dB
RBW
120 kHz
VBW
10 kHz
SWEEP
5ms/
GEN
COPY
IFR SYSTEMS INC AN1820
16:24:29 10-06-2003
PRINT
PLOT

Regenerator & Channel Processor

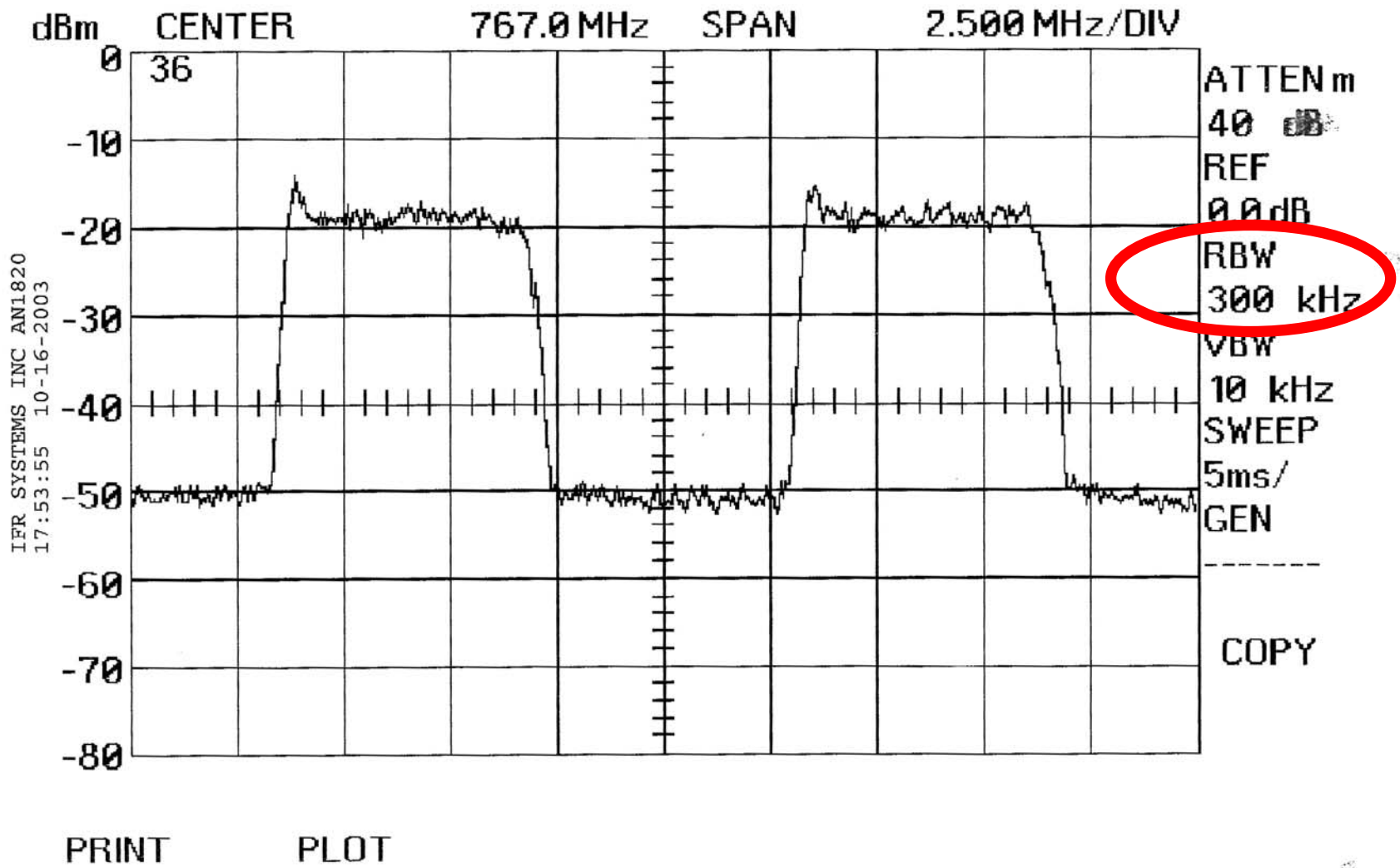


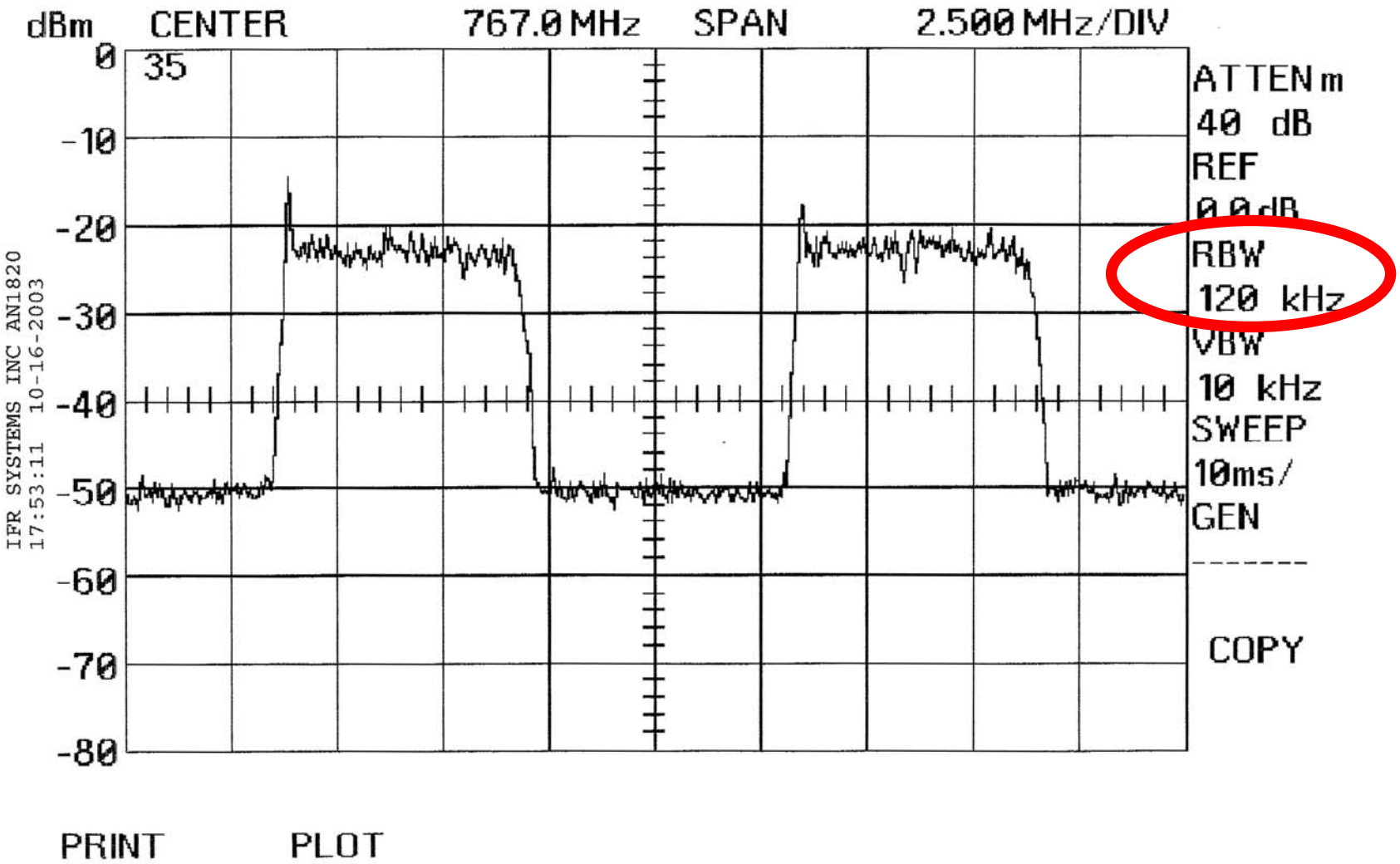
Expanded view of Ch 64 processed.

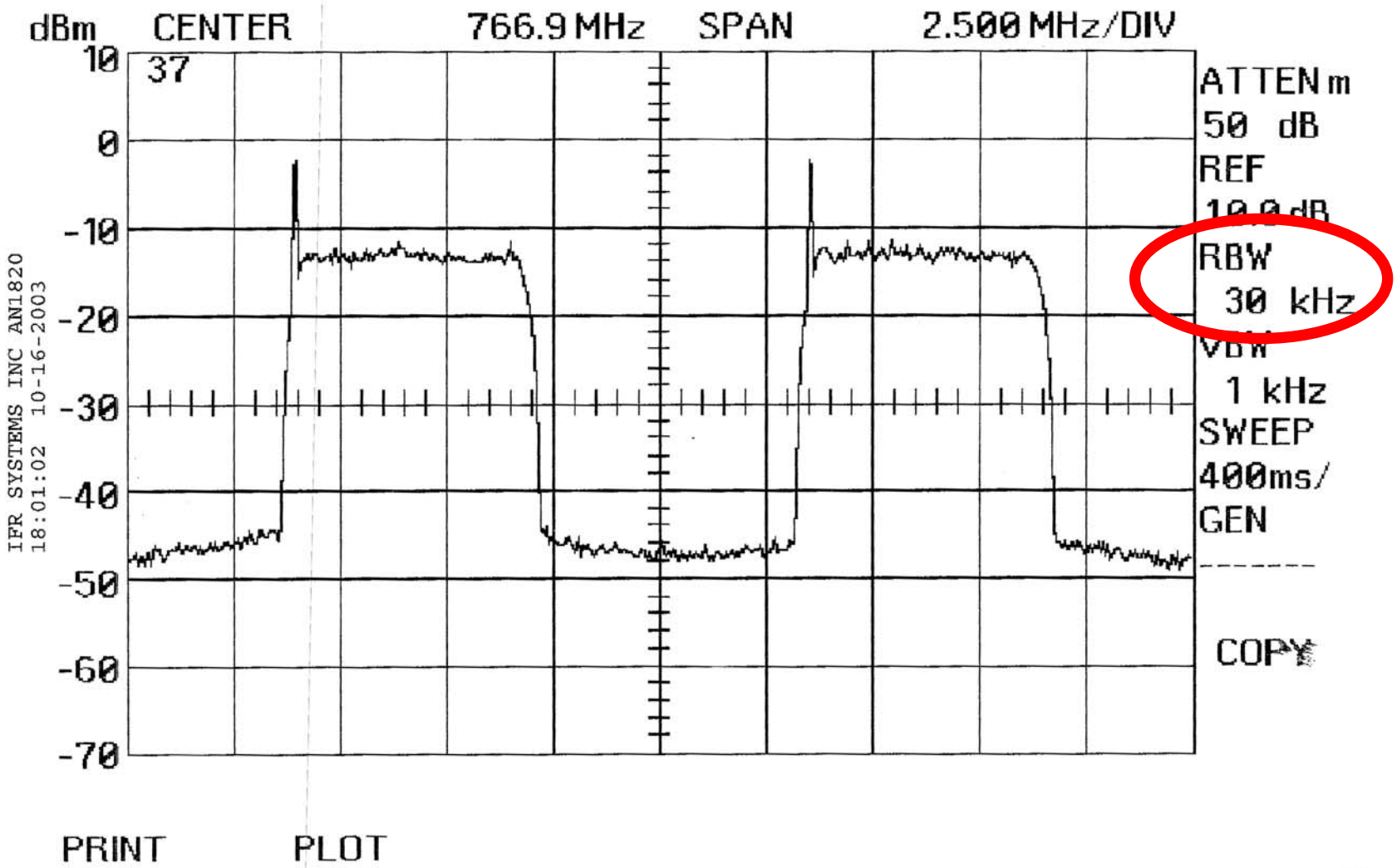


Both channels using Zenith

Transcoder Regenerators.




dBm
CENTER
767.0 MHz
SPAN
2.500 MHz/DIV
0
-10
-20
-30
-40
-50
-60
-70
-80
35
IFR SYSTEMS INC AN1820
17:53:11 10-16-2003
ATTEN m
40 dB
REF
0.0 dB
RBW
120 kHz
VBW
10 kHz
SWEEP
10ms/
GEN
COPY
PRINT
PLOT


dBm
CENTER
766.9 MHz
SPAN
2.500 MHz/DIV
37
10
0
-10
-20
-30
-40
-50
-60
-70
ATTEN m
50 dB
REF
RBW
30 kHz
VBW
1 kHz
SWEEP
400ms/
GEN
COPY
IFR SYSTEMS INC AN1820
18:01:02 10-16-2003
PRINT
PLOT

Measuring Digital Power

BIRD WATT METER – THERMO POWER METER – SPECTRUM ANALYZER

MEASURING TRANSLATOR
OUTPUT FREQUENCY
PILOT – 309.441 kHz FROM LOWER BAND EDGE

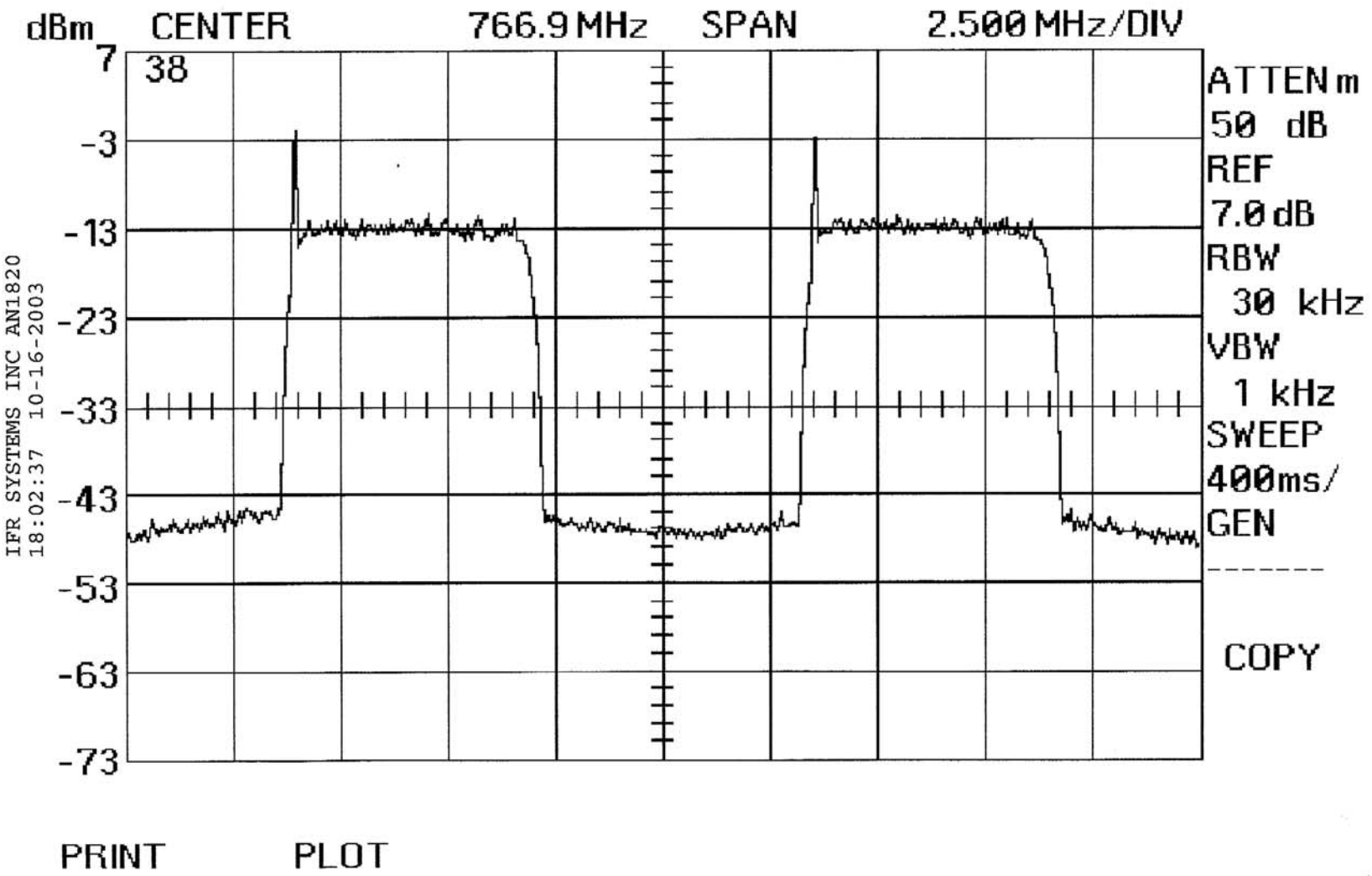
ENCODING SIGNALS INTO
A TRANSLATOR

WHAT TEST EQUIPMENT
IS NEEDED?

WE NEED FCC AUTHORIZATION
TO USE TRANSLATORS FOR
DIGITAL OPERATION **NOW**

USING TRANSLATORS AS
STUDIO TRANSMITTER LINKS

Calculating Transmit Power



DTV Power Measurement

Resolution Bandwidth Conversion

Res BW	NBWRBW=1 Correction Factor	NBW/RBW=1.2 Correction Factor
1 Hz	67.6 dB	----
30 kHz	22.8 dB	22.0 dB
100kHz	17.6 dB	16.8 dB
300 kHz	12.8 dB	12.0 dB
1 MHz	7.6 dB	6.8 dB

C.F. = 10 *log {5.38 MHz/NBW} + 0.3dB

some spectrum analyzers need an additional +2.5dB correction factor

due to envelop detection & logarithmic amplification

Adjacent Channel Interference Ratios

VSB Lab Test Results

Adjacent Channel Interference

- **Adjacent channel tests performed with 50+ dB DTV splatter**
- **NTSC sets' TOV varied betweeen 24-30dB**
- **Upper Adjacent:**

  D-into-N: D/U = -2 dB or better @ medium (TOV)

  D-into-N: D/U = -13 dB or better @ medium (CCIR-3)*

  N-into-D: D/U = -49 dB or better @ weak (TOV)

  D-into-D: D/U = -39 dB or better @ medium (TOV)

- **Lower Adjacent:**

  D-into-N: D/U = -1 dB or better @ medium (TOV)

  D-into-N: D/U = -12 dB or better @ medium (CCIR-3)

  N-into-D: D/U = -48 dB or better @ weak (TOV)

  D-into-D: D/U = -39 dB or better @ medium (TOV)

*** Note that color beat was seen NTSC picture during panning**

Experimental Translators, and Microwave Technology to Provide 8VSB Television Signals to Rural Communities Outside the Coverage Areas of a Primary Television Station

- **By: R. Kent Parsons**

SPECIAL THANKS TO

- **Federal Communications Commission**
- **Larcan-USA**
- **Zenith Electronics Corporation**

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LARCAN- USA

This workshop/seminar was presented by LARCAN-USA in association with

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