



FCC CFR47 PART 22 (PUBLIC MOBILE SERVICES) CERTIFICATION

TEST REPORT

FOR

WIRELESS IP (CDPD) MODEM FOR OEMs

MODEL: TPRM 130C

FCC ID: NZ6T8130C

REPORT NUMBER: 99U0284

ISSUE DATE: JUNE 08, 1999

Prepared for
TELLUS TECHNOLOGY
40990 ENCYCLOPEDIA CIRCLE
FREMONT, CA 94538-2470

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ATTACHMENT

1. EUT PHOTOGRAPHS
2. RF TRANSCEIVER DESCRIPTION
3. RF MICRO DEVICES (RF2402) AND TQS (TQ9142B)
4. SCHEMATICS
- 5.. BLOCK DIAGRAM
6. USERS MANUAL
- 7.. WIRELESS P.O.S. ANTENNA SPECIFICATION

EXHIBITS

1. FCC 731 FORM
2. AUTHORIZATION LETTER
3. PROPOSED FCC ID LABEL FORMAT

1. VERIFICATION OF COMPLIANCE

COMPANY NAME: TELLUS TECHNOLOGY, INC.
40990 ENCYCLOPEDIA CIRCLE
FREMONT, CA 94538-2470

CONTACT PERSON: MIHN DAO / SR. RF ENGINEER

TELEPHONE NO: 510-498-8500 EXT. 140

MODEL NO/NAME: TPRM 130C

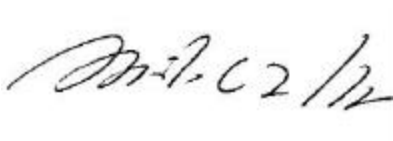
SERIAL NO: N/A

DATE TESTED: May 21, 1999

TYPE OF EQUIPMENT:	Wireless IP (CDPD) Modem For OEMs
MEASUREMENT DISTANCE:	3 METER
TECHNICAL LIMIT:	FCC 22.359, 22.917
FCC RULES:	PART 15, PART 22
EQUIPMENT AUTHORIZATION PROCEDURE	CERTIFICATION
MODIFICATIONS MADE ON EUT	YES (X)NO

The above equipment was tested by Compliance Consulting Services for compliance with the requirements set forth in the FCC CFR 47, PART 15 AND 22. The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved By



MIKE KUO / VICE PRESIDENT
COMPLIANCE CERTIFICATION SERVICES

2. PRODUCT DESCRIPTION

The transmitter for the TPRM 130C is a single conversion design employing direct IQ modulation. A phase locked loop controlled oscillator operating at a fixed frequency of 90MHz is mixed with the signal from the main synthesizer to provide the output carrier frequency. High-side injection is used for this frequency conversion process. A high selectivity SAW filter selects the desired mixing product.

The carrier is modulated with I and Q signals from the baseband ASIC. The modulated signal passes through a driver amplifier, and another SAW filter, and then is boosted to a nominal level of +30dBm by the power amplifier. The signal from the power amplifier is routed through a frequency diplexer and out to the antenna.

Data from the modem is transmitted in bursts. Each transmit burst includes a ramp-up and ramp-down sequence to limit the frequency bandwidth occupied. The transmit power-level that the modem uses for each burst is calculated based on a parameter broadcast by the CDPD base station and the actual RSSI reading at the modem. The TPRM 130C conforms to power class 3 devices, so it transmits at nominal power levels from -22dBW to -2dBW

3. TEST FACILITY

The open area test sites and conducted measurement facilities used to collect the radiated and conducted data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

4. ACCREDITATION AND LISTING

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code:200065-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (reference no: 31040/SIT (1300B3) and 31040/SIT(1300F2))

5. MEASUREMENT INSTRUMENTATION

Radiated emissions were measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, ridged waveguide, liner horn. EMI receivers were used for line conducted readings, spectrum analyzers with pre-selectors and quasi-peak detectors were used to perform radiated measurements. Receiving

equipment (i.e., receiver, analyzer, quasi-peak adapter, pre-selector) and LISNs conform to CISPR specification for "Radio Interference Measuring Apparatus and Measurement

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

6. MEASURING INSTRUMENT CALIBRATION

The measuring equipment which was utilized in performing the tests documented herein has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment which is traceable to recognized national standards.

7. UNITS OF MEASUREMENT

Measurements of radiated interference are reported in terms of dB(uV/m) at a specified distance. The indicated readings on the spectrum analyzer were converted to dB(uV/m) by use of appropriate conversion factors. Measurements of conducted interference are reported in terms of dB(uV).

The field strength is calculated by adding the Antenna Factor and Cable Factors, then by subtracting the Amplifier Gain from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

Assume a receiver reading of 52.5 dBuV is obtained. The Antenna Factor of 7.4dB/m and a Cable Factor of 1.1dB is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/m. The 32 dBuV/m value was mathematically converted to its corresponding level in uV/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dBuV/m}$$

$$\text{Level in uV/m} = \text{Common Antilogarithm} [(32 \text{ dBuV/m})/20] = 39.8 \text{ uV/m}$$

8. CLASSIFICATION OF DIGITAL DEVICE

Class A includes digital devices that are marketed for use in commercial, industrial or business environments, excluding devices which are marketed for use by the general public or are intended to be used in the home.

Class B includes digital devices that are marketed for use in residential environments, notwithstanding use in commercial, business and industrial environments.

Note: The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as Class B device, and in fact is encouraged to do so provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

9. RADIATED EMISSION LIMITS

FCC PART 15 CLASS A

MEASURING DISTANCE OF 10 METER		
FREQUENCY RANGE (MHz)	FIELD STRENGTH (Microvolts/m)	FIELD STRENGTH (dBuV/m)
30-88	90	39.1
88-216	150	43.5
216-960	210	46.4
Above 960	300	49.5

FCC PART 15 CLASS B

MEASURING DISTANCE OF 3 METER		
FREQUENCY RANGE (MHz)	FIELD STRENGTH (Microvolts/m)	FIELD STRENGTH (dBuV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

10. RADIATED EMISSION TEST PROCEDURE

The EUT and all other support equipment are placed on a wooden table 80 cm above the ground screen. Antenna to EUT distance is 3 meters. During the test, the table is rotated 360 degrees to maximize emissions and the antenna is positioned from 1 to 4 meters above the ground screen to further maximize emissions. The antenna is polarized in both vertical and horizontal positions.

EUT test configuration is according to Section 8 of ANSI C63.4/1992.

Monitor the frequency range of interest at a fixed antenna height and EUT azimuth. Frequency span should be small enough to easily differentiate between broadcast stations and intermittent ambients. Rotate EUT 360 degrees to maximize emissions received from EUT. If emission increases by more than 1 dB, or if another emission appears that is greater by 1 dB, return to azimuth where maximum occurred and perform additional cable manipulation to further maximize received emission.

Move antenna up and down to further maximize suspected highest amplitude signal. If emission increased by 1 dB or more, or if another emission appears that is greater by 1dB or more, return to antenna height where maximum signal was observed and manipulate cables to produce highest emissions, noting frequency and amplitude.

11. AMBIENT CONDITIONS

The ambient conditions at the time of final tests were as follows:

	Radiated Emission	Conducted Emission
Temperature	18°C	19°C
Humidity	60%	62%

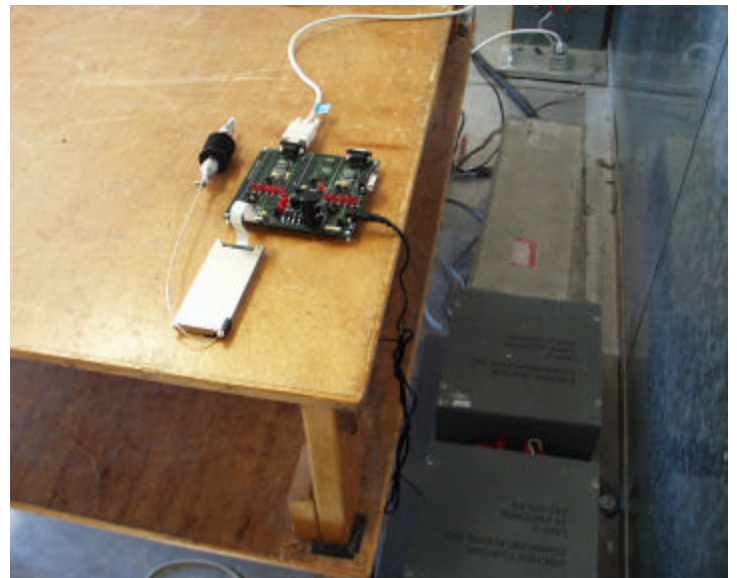
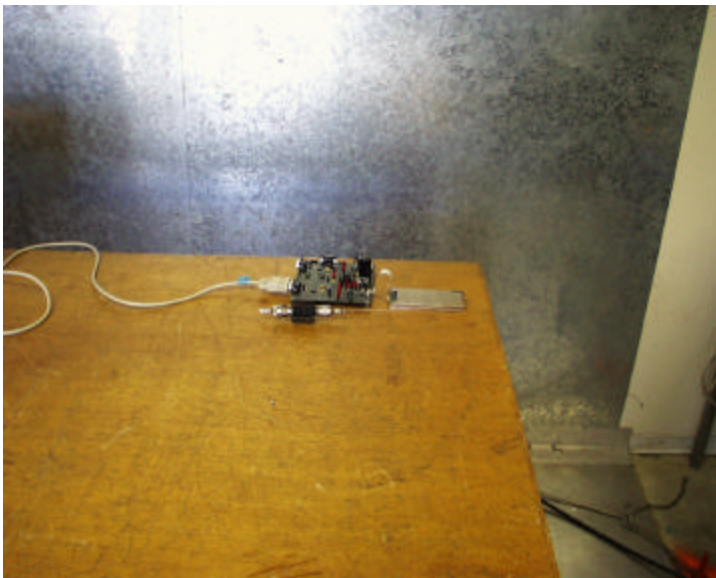
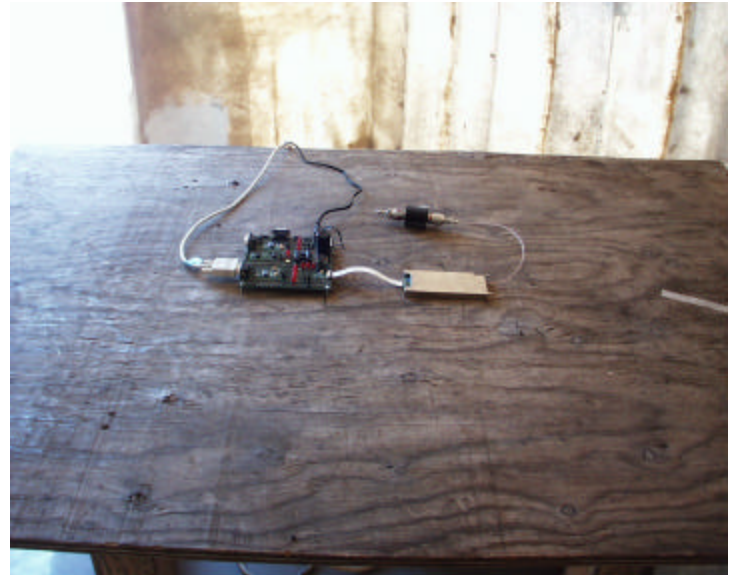
12. TEST EQUIPMENT LIST

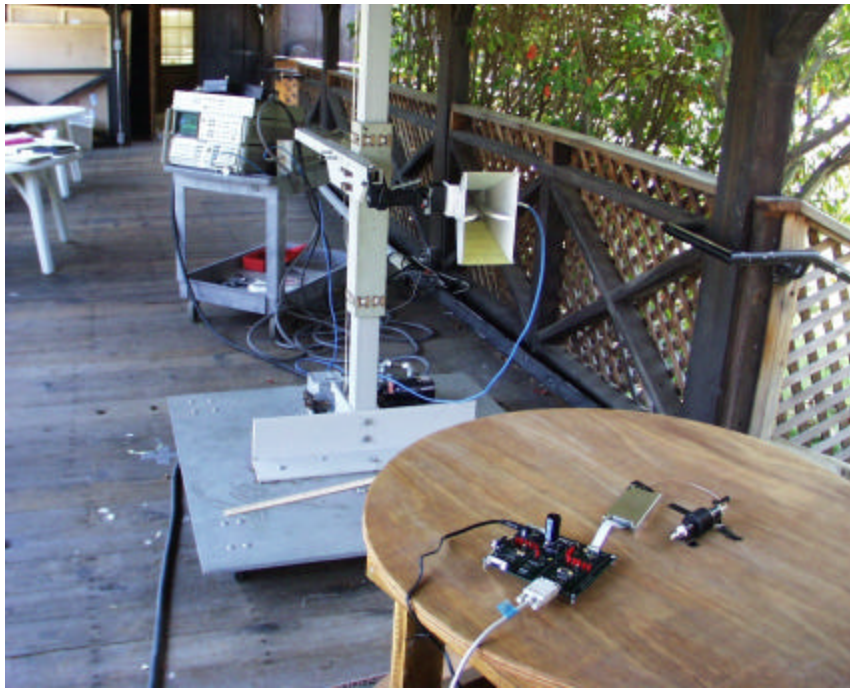
Equipment	Manufacturer	Model No.	Serial No.	Site	Cal Date	Due Date
Spectrum Analyzer	H.P.	8593EM	3710A00205	A	05/28/99	05/27/00
Antenna	EMCO	3146	NSN=X100	A/F	08/15/99	08/14/00
Antenna	ARA	DRG-118/A	104	A/F	01/23/99	01/22/00
Pre-Amp	H.P.(P2)	8447D	2944A06265	A/F	09/04/98	09/03/99
Pre-Amp	H.P.	8449B	3008A00369	A/F	04/05/99	04/04/00
Antenna	Emco	3110	8908-1079	A/F	03/15/99	03/14/00

13. SUPPORT EQUIPMENT

Device Type	Manufacturer	Model Number	Serial No.	FCC ID / DoC
PC	Toshiba	PA1240U VCD	978273928-3	DOC
Transceiver	Tellus	130C	N/A	N/A

14. EUT SETUP PHOTOS





15. TEST RESULT SUMMARY

FCC Part 15 Final Radiated Emission Test							
OATS No:A F / 3 meter		Data Report No. 990521F1		Date 5/21/99		Tested By: PETE KREBILL	
Six Highest Radiated Emission Readings							
Frequency Range Investigated				30 MHz TO 9000 MHz			
Freq (MHz)	Meter Reading (dBuV)	C.F. (dB/m)	Corrected Reading (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Reading Type (P/Q/A)	Polar (H/V)
356.40	44.20	-8.75	35.45	46.00	-10.55	P	H
240.60	53.40	-14.51	38.89	46.00	-7.11	Q	H
280.60	50.00	-11.51	38.49	46.00	-7.51	P	H
315.00	52.30	-9.62	42.68	46.00	-3.32	Q	H
356.40	46.20	-9.9	36.30	46.00	-9.70	P	V
314.90	53.80	-9.8	44.00	46.00	-2.00	Q	V

C.F.(Correction Factor)=Antenna Factor+Cable Loss-Amplifier Gain

Corrected Reading = Metering Reading + C.F. Margin=Corrected Reading - Limits

P=Peak Reading

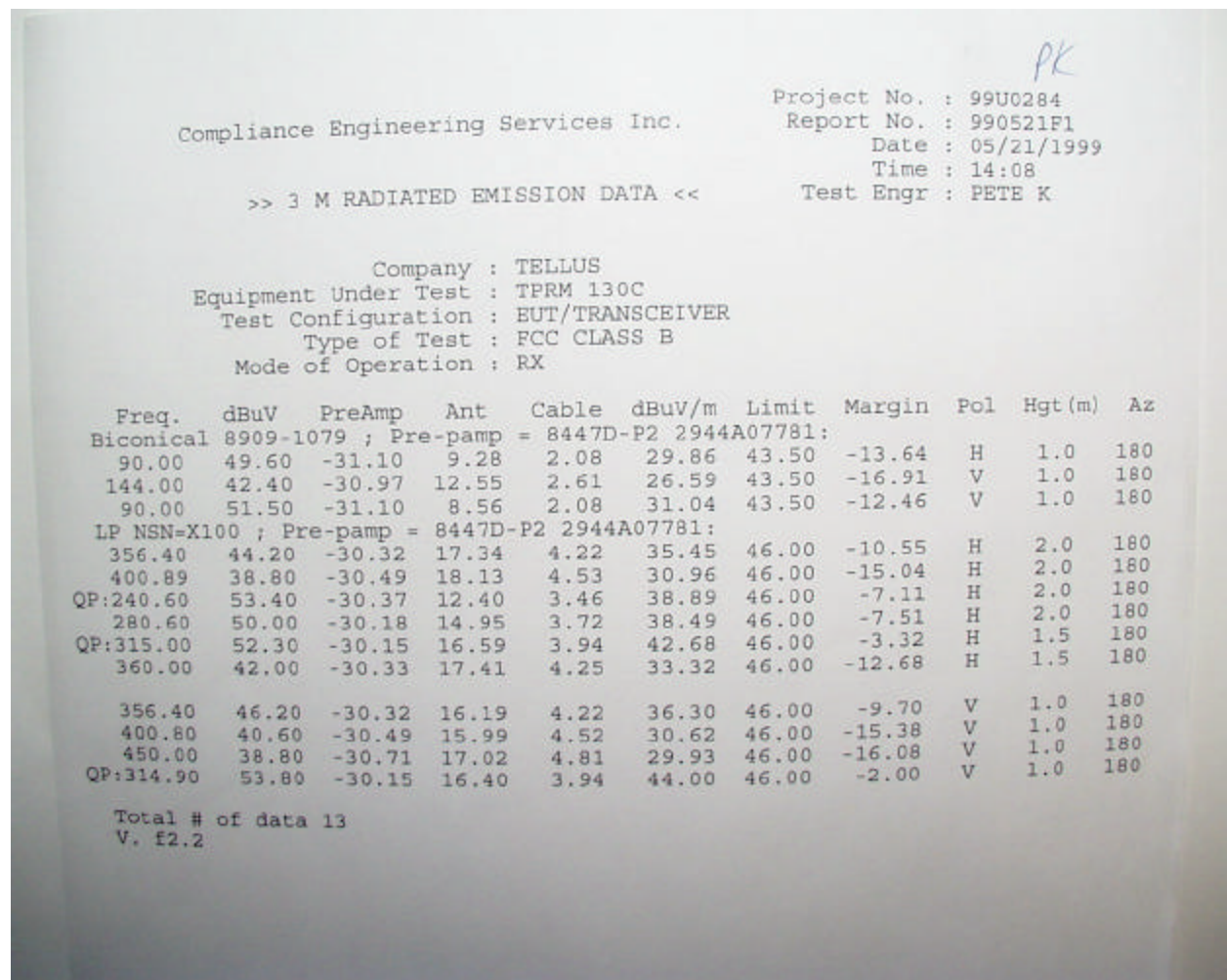
H=Horizontal Polarization/Antenna

Q=Quasi-peak

V=Vertical Polarization/Antenna

A=Average Reading

Comments:N/A



Final Conducted Emission Test

Conducted Room		Plot No. 99U0284		Date 5/21/99		Tested By: PETE KREBILL	
Six Highest Conducted Emission Readings							
Frequency Range Investigated				150 kHz TO 30 MHz			
Freq (MHz)	Meter Reading (dBuV)	C.F. (dB)	Corrected Reading (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Reading Type (P/Q/A)	Line (L1/L2)
0.450	25.83	0	25.83	48	-22.17	P	1
0.506	24.29	0	24.29	48	-23.71	P	1
0.560	23.02	0	23.02	48	-24.98	P	1
0.450	25.71	0	25.71	48	-22.29	P	2
0.506	24.35	0	24.35	48	-23.65	P	2
0.539	23.48	0	23.48	48	-24.52	P	2

C.F.(Correction Factor)=Insertion Loss + Cable Loss

Corrected Reading = Metering Reading + C.F.

Margin=Corrected Reading - Limits

P=Peak Reading

L1=Hot

Q=Quasi-peak

L2=Neutral

A=Average Reading

FCC Rule 2.983

- 2.983 (a) Name of Applicant: TELLUS TECHNOLOGY
40990 ENCYCLOPEDIA CIRCLE
FREMONT, CA 94538-2470
- 2.983 (b) Equipment Identification: NZ6T8130C
- 2.983 (c) Planned for quantity production.

2.983 (d) Technical description:

- (1) GMSK 30KHz B/W using direct IQ modulation scheme
- (2) TX Band: 824-849MHz RX Band: 869-894MHz
- (3) Power controlled through software
 - Level 0-2: 28+2/-4dBm
 - Level 3: 24+2/-4dBm
 - Level 4: 20+2/-4dBm
 - Level 5: 16+2/-4dBm
 - Level 6: 12+2/-4dBm
 - Level 7: 8+2/-4dBm
- (4) 1Watt (30dBm)
- (5) The power amplifier is dual supply voltage and high efficiency is selected for this design. It is three stages MESFET operates from 3V to 5V. The negative voltage generator is external and concerted positive supply to negative and feed into PA Vgate terminals. The power control for the transmitter is from the baseband and with other control line to toggle the PA on/off. The maximum output power is +31.1dBm.
- (6) see RF Transceiver description(attachment 2) pgs. 5-8
- (7) see attachment 4 (Schematic Diagram and Block Diagram)
- (8) see attachment 6 (User manual)
- (9) The transmitter adjustment is a two-step process. The first step is to adjust the TCXO reference frequency (using a mechanical tuning screw) for the dual phase-locked loop. This sets the output frequency of the transmit signal, since it determines both the 90MHz offset frequency and the main synthesizer signal frequency. The second step is to adjust the IQ output spectrum for carrier and sideband suppression, by alternately adjusting two tuning resistors in the IQ modulator circuitry. This ensures that the output will meet the adjacent channel emission requirements.

(10) see RF Transceiver description(attachment 2) pg. 7-8

(11) Limitation of Spurious Radiation

The TPRM 130C contains two SAW filters in the transmit chain to suppress unwanted mixing products and harmonics before reaching the antenna. Also, the transmit arm of the diplexer has a band stop characteristic with rejection in the cellular mobile receive band.

The CDPD system employs Gaussian-filtered Minimum Shift Keying (GMSK) modulation with BT=0.5. The pre-modulation Gaussian low pass filter results in increased spectral efficiency. A ramp-up and ramp-down are performed at the beginning and end of each transmit burst to limit the emission spectrum spill over into adjacent channels.

Limitation of Modulation

The TPRM 130C uses IQ modulation in the transmitter which results in high modulation accuracy. I and Q signals from the baseband are combined with the carrier frequency in a quadrature modulator circuit to create the transmit signal. With this implementation, no frequency related adjustment of the modulator is required.

Limitation of Transmit Power

The power amplifier in the TPRM 130C is a three stage GaAsFET amplifier operating with a drain voltage of 4.8V for stages 1 and 3. Power control for the transmitter is accomplished by varying the stage 2 drain voltage. The gate bias circuit for the power amplifier regulates the gate voltages for each stage to set the operating point consistently from unit to unit. The maximum output power of the amplifier is less than +32dBm over temperature at 4.8V. This, along with the minimum diplexer insertion loss, ensures that the maximum specified transmitter power of 1W will not be exceeded.

(12) see RF Micro Devices(attachment 3)

FCC PART 2 .985 through 2.997 TEST REQUIREMENT:

SECTION 2.985 RF POWER OUTPUT

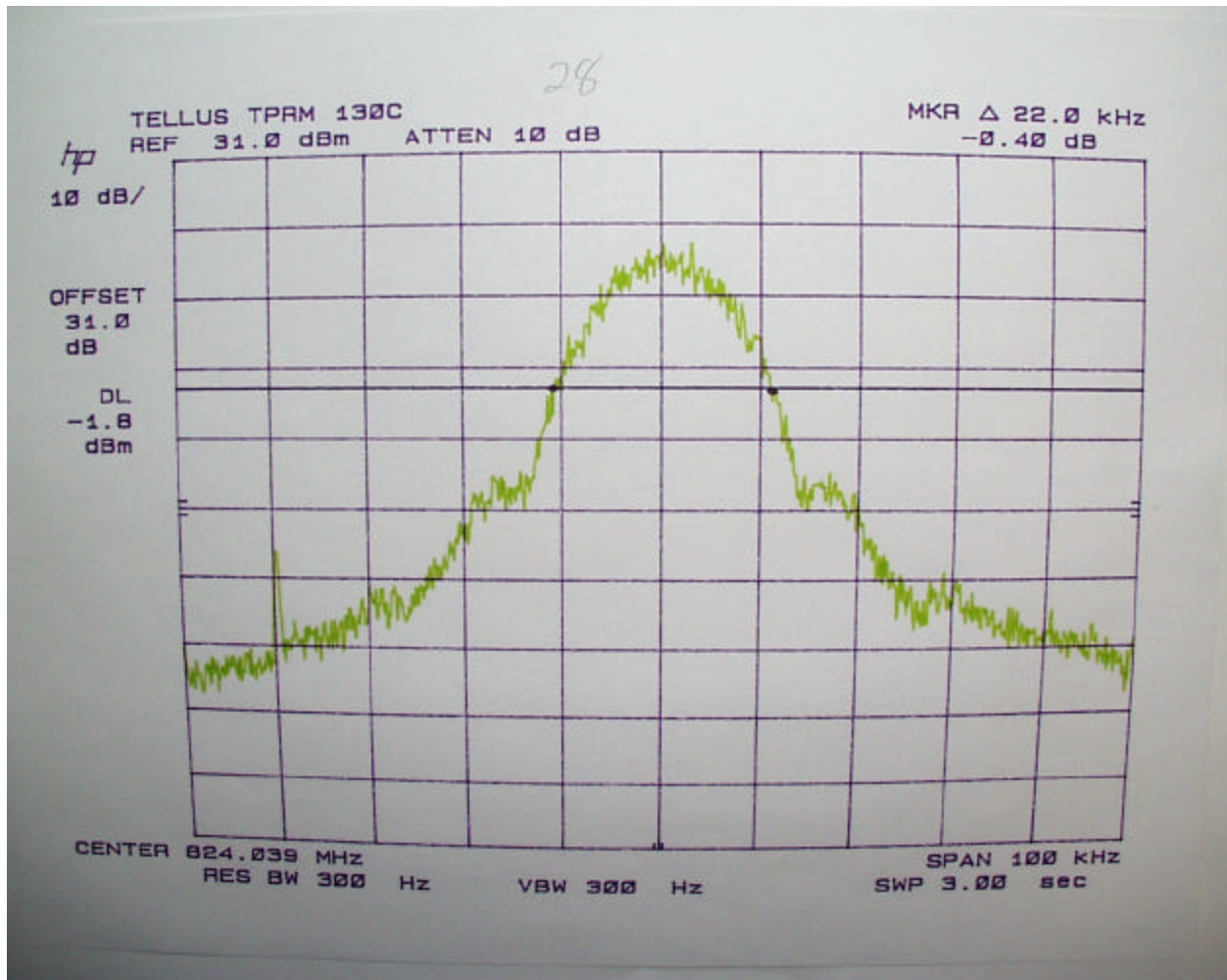
	MEASURED RF POWER OUTPUT
	0.529 WATTS

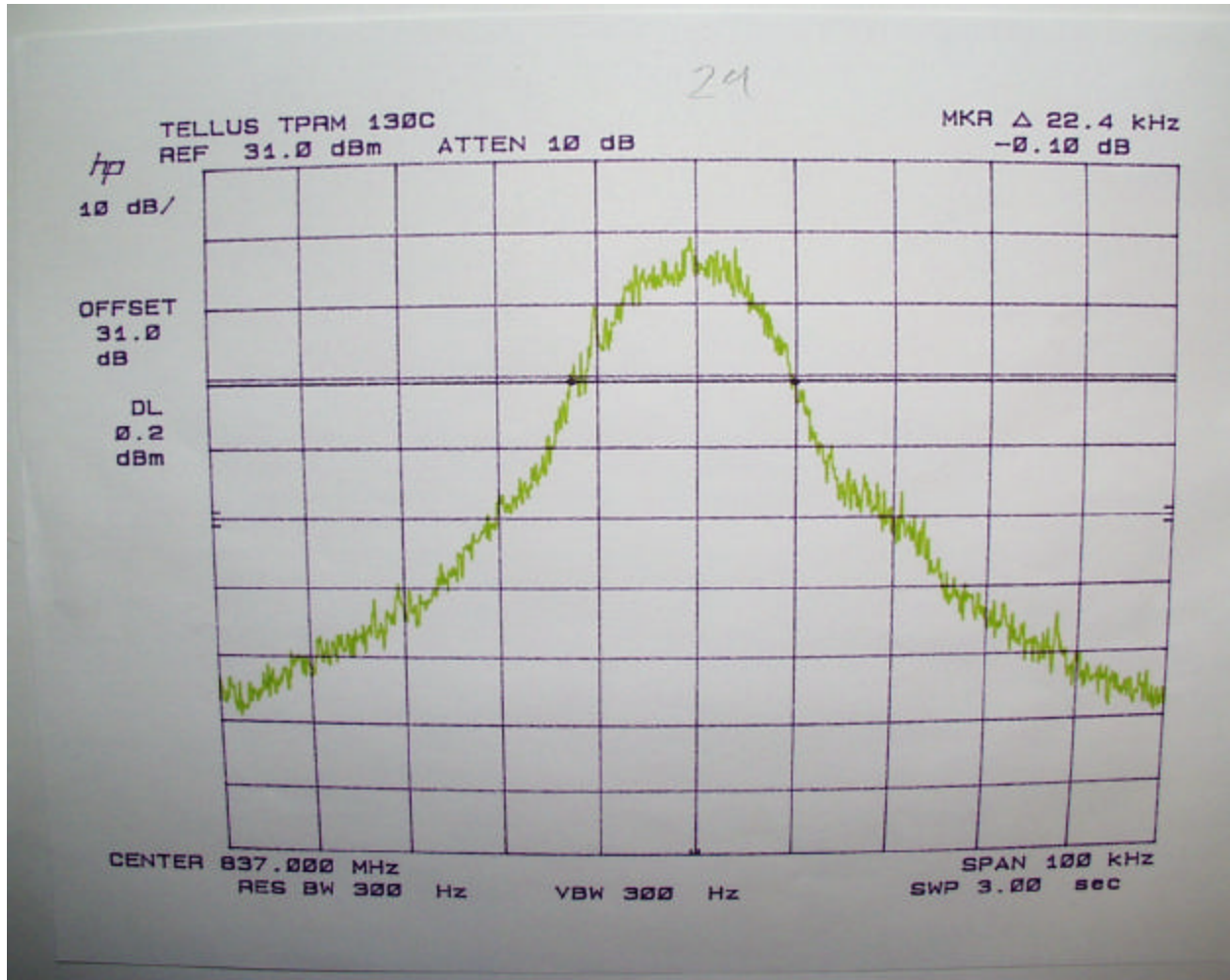
SECTION 2.987 MODULATION CHARACTERISTICS

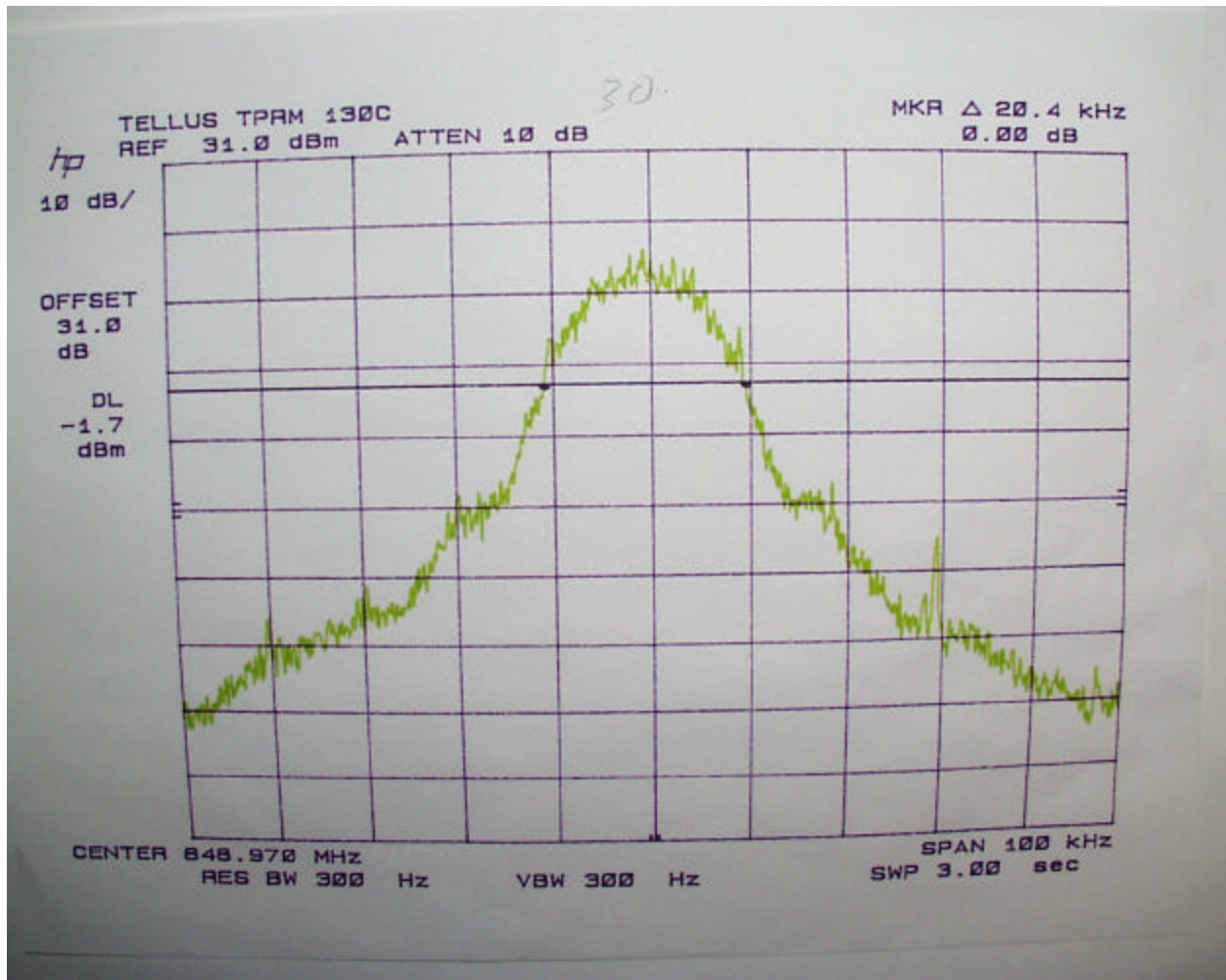
GMSK See attachment 3 (RF Micro Device)

SECTION 2.989 OCCUPIED BANDWIDTH

CHANNEL/ FREQUENCY	PLOT #
991/824.039MHz	28
400/837MHz	29
799/848.97MHz	30





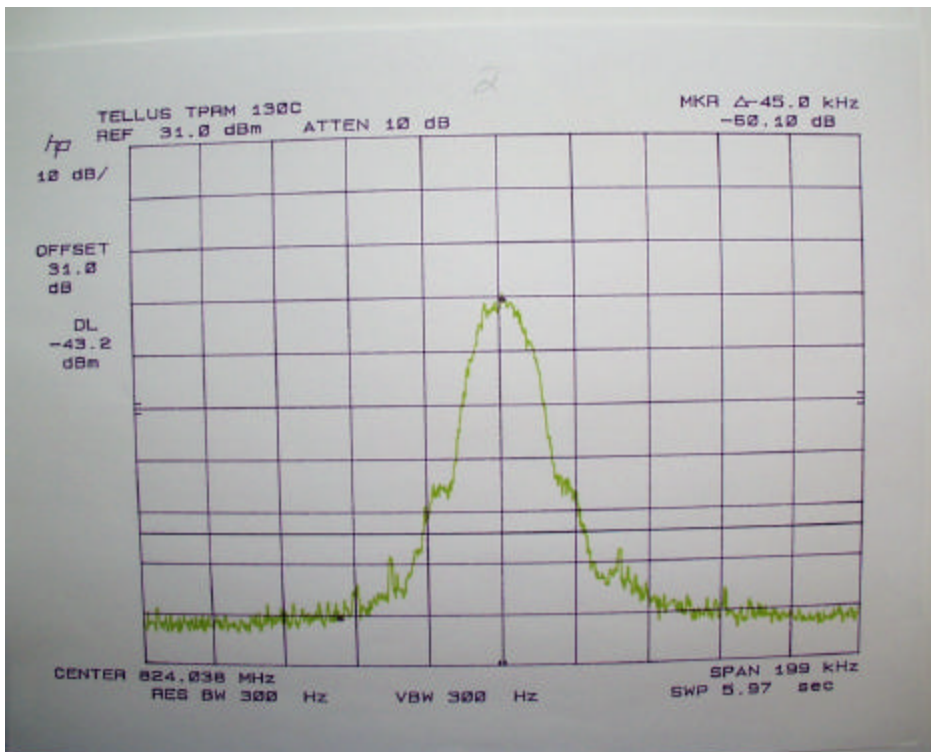
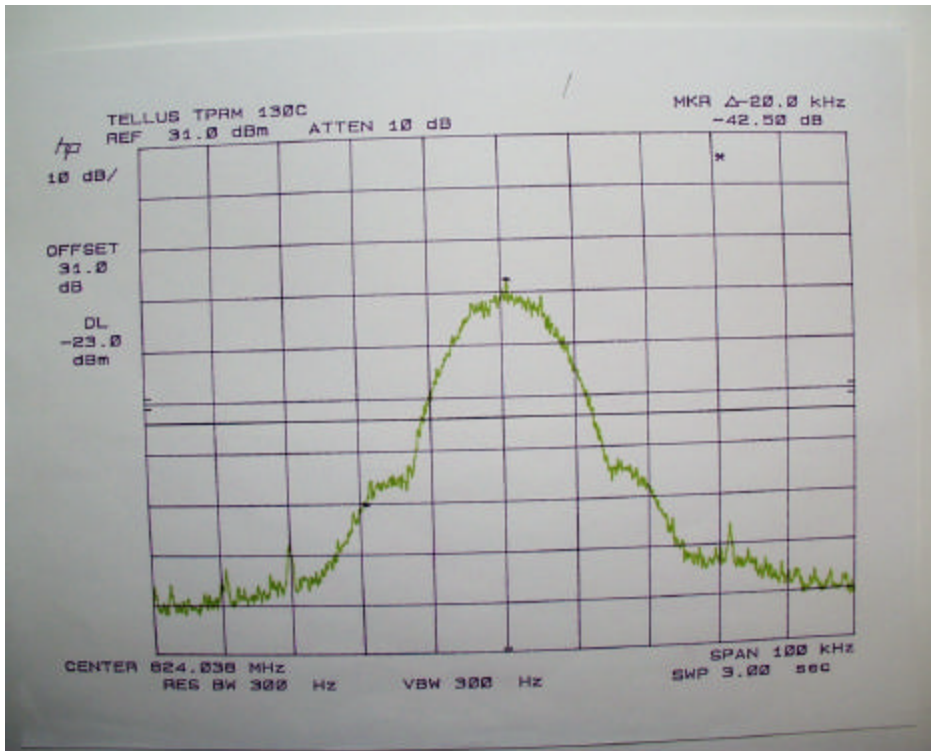


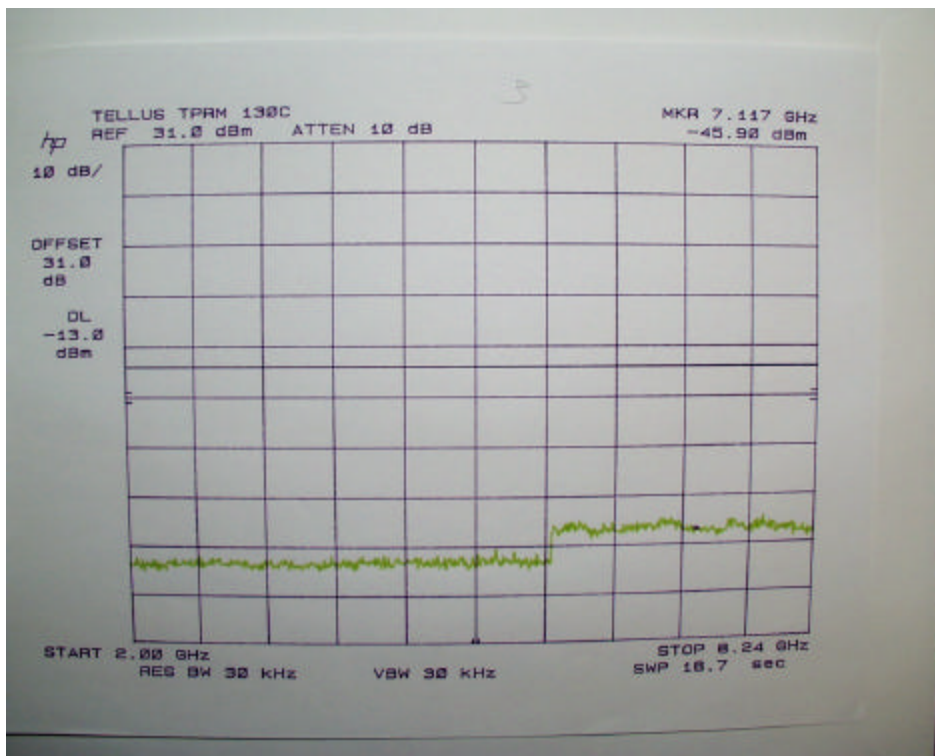
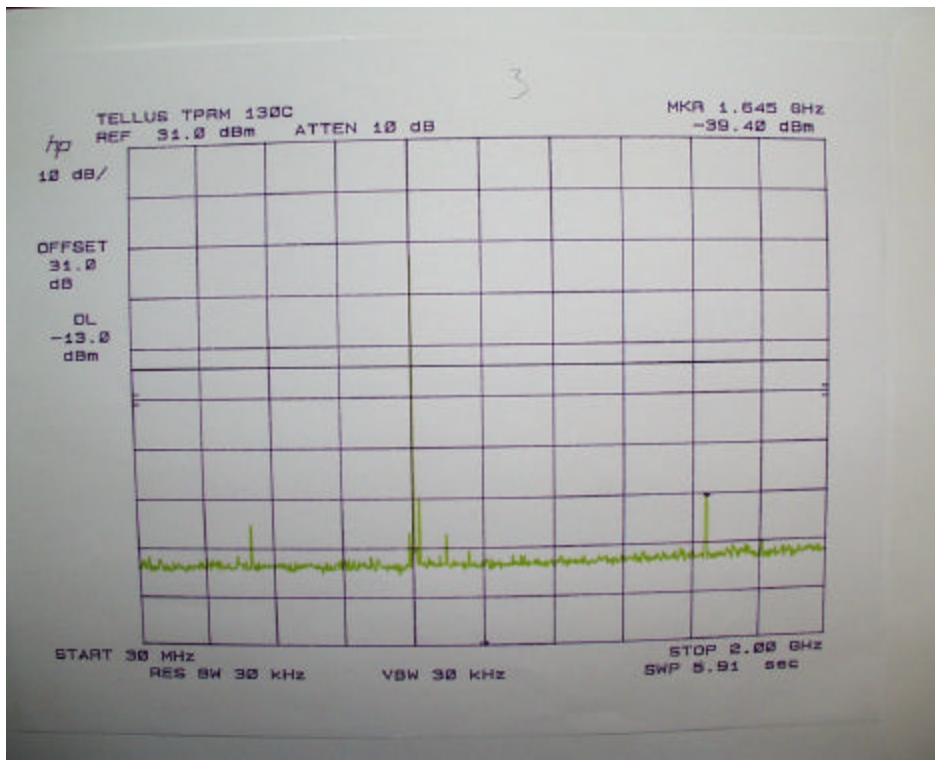
SECTION 2.991 SPURIOUS EMISSION AT ANTENNA TERMINALS

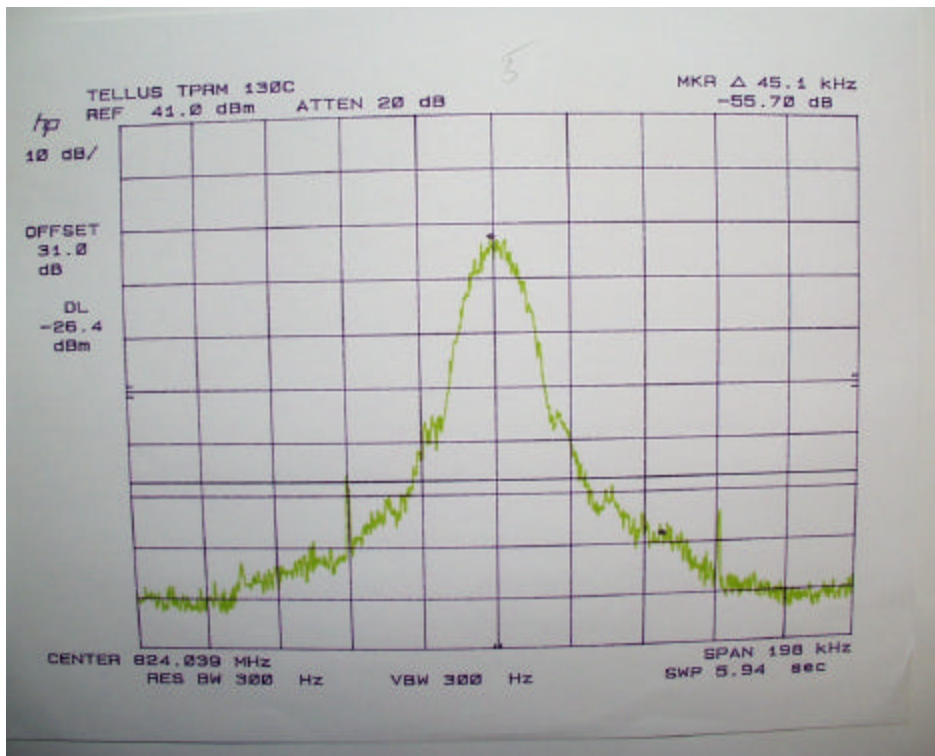
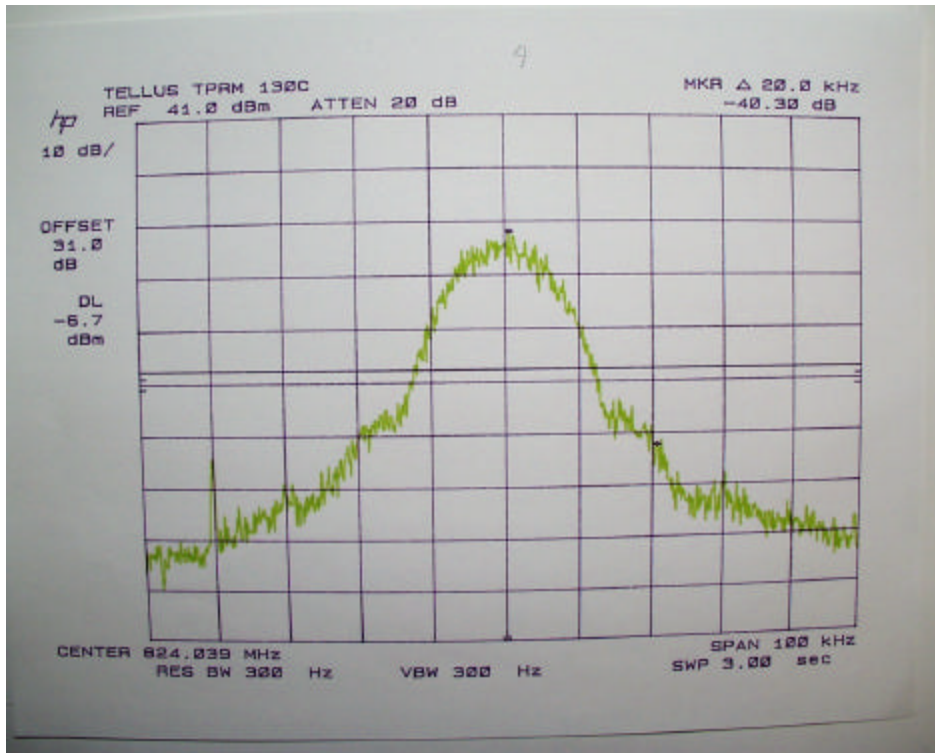
Out of band emission plots are from 30MHz to 8940MHz with 30k RES B/W as specified in 22.917(f). In band emission plots show compliance with 22.917(d)(1) & (2). 1ST in band plot shows emission removed 20KHz with limit of 26dBc, with 300Hz RES B/W as specified in 22.917(h). 2ND in band plot shows emissions removed 45KHz with limit of 45dBc, with 300Hz RES B/W as specified in 22.917(h). Mobile emissions in base band plots show compliance with FCC 22.917(f).

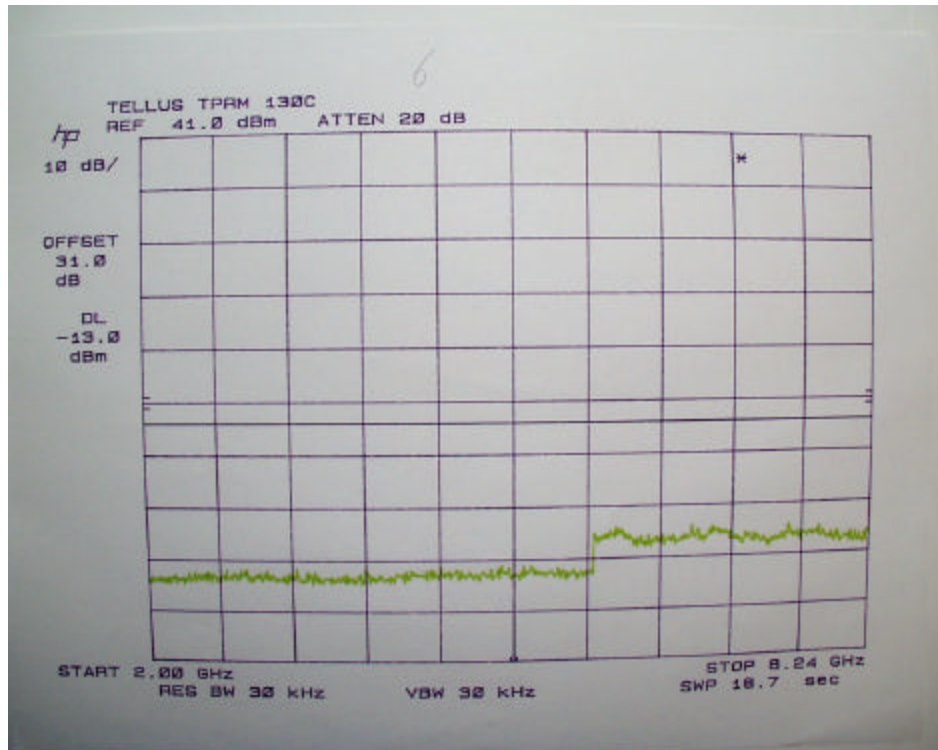
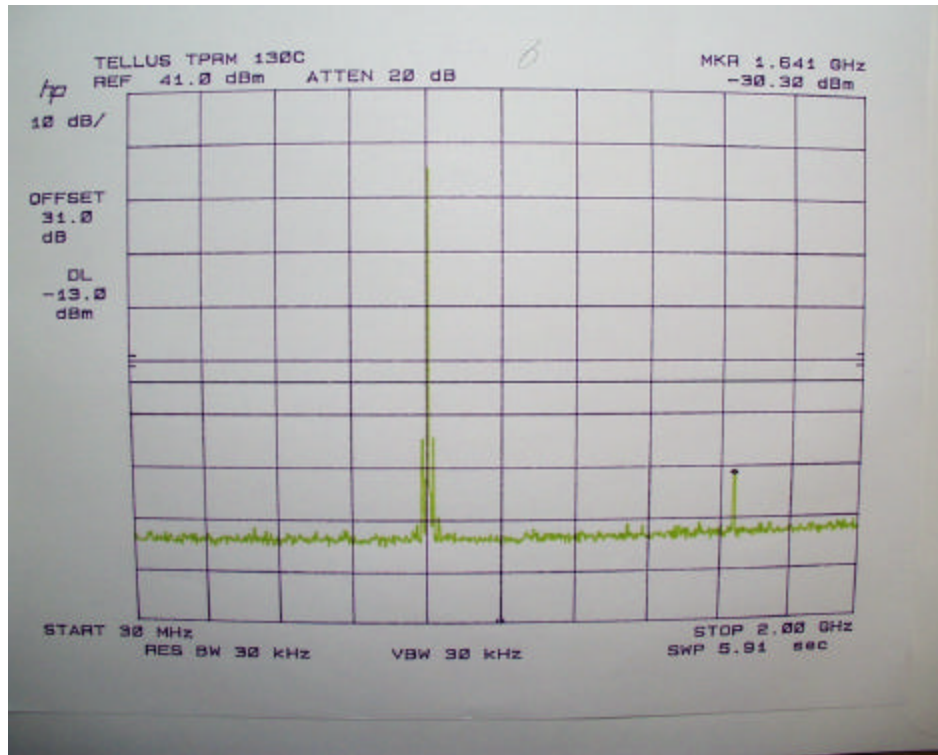
CHANNEL/POWER LEVEL	PLOT DESCRIPTION	PLOT#
991/LEVEL7	1 ST IN BAND	1
991/LEVEL 7	2 ND IN BAND	2
991/LEVEL 7	OUT OF BAND	3,3
991/LEVEL0-2	1 ST IN BAND	4
991/LEVEL 0-2	2 ND IN BAND	5
991/LEVEL 0-2	OUT OF BAND	6,6
991/LEVEL 4	1 ST IN BAND	7
991/LEVEL 4	2 ND IN BAND	8
400/LEVEL 4	OUT OF BAND	9,9
400/LEVEL7	1 ST IN BAND	10
400/LEVEL 7	2 ND IN BAND	11
400/LEVEL 7	OUT OF BAND	12,12
400/LEVEL 0-2	1 ST IN BAND	13
400/LEVEL 0-2	2 ND IN BAND	14
400/LEVEL 0-2	OUT OF BAND	15,15
400/LEVEL 4	1 ST IN BAND	16
400/LEVEL 4	2 ND IN BAND	17
400/LEVEL 4	OUT OF BAND	18,18
799/LEVEL 7	1 ST IN BAND	19

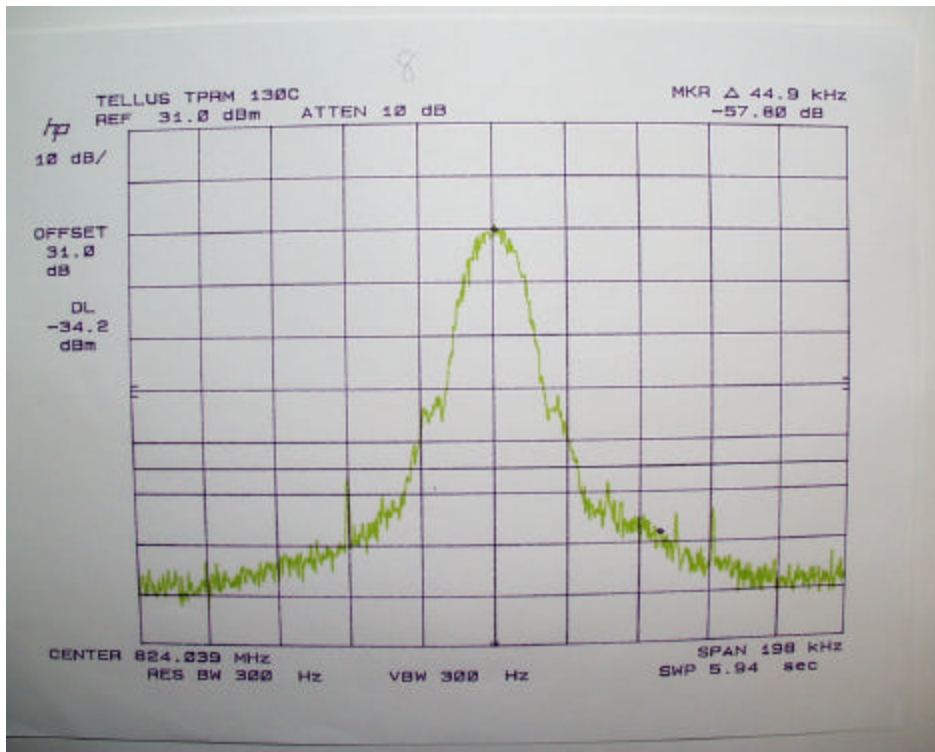
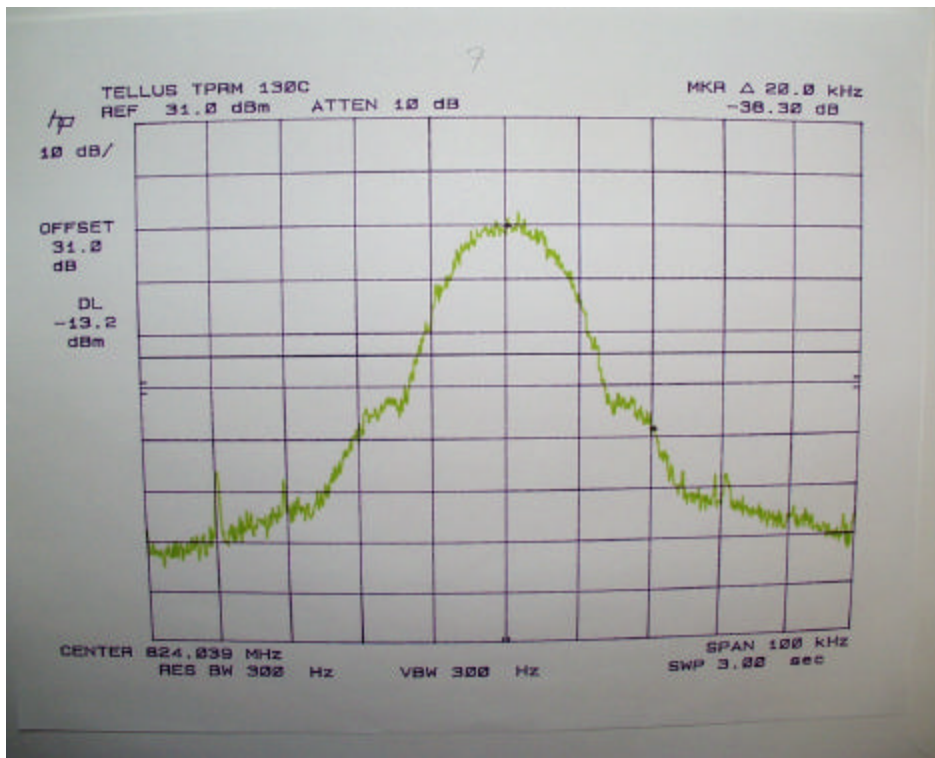
799/LEVEL 7	2 ND IN BAND	20
799/LEVEL 7	OUT OF BAND	21,21
799/LEVEL 0-2	1 ST IN BAND	22
799/LEVEL 0-2	2 ND IN BAND	23
799/LEVEL 0-2	OUT OF BAND	24,24
799/LEVEL 4	1 ST IN BAND	25
799/LEVEL 4	2 ND IN BAND	26
799/LEVEL 4	OUT OF BAND	27,27
799/LEVEL 0-2	MOBILE IN BASE BAND	31

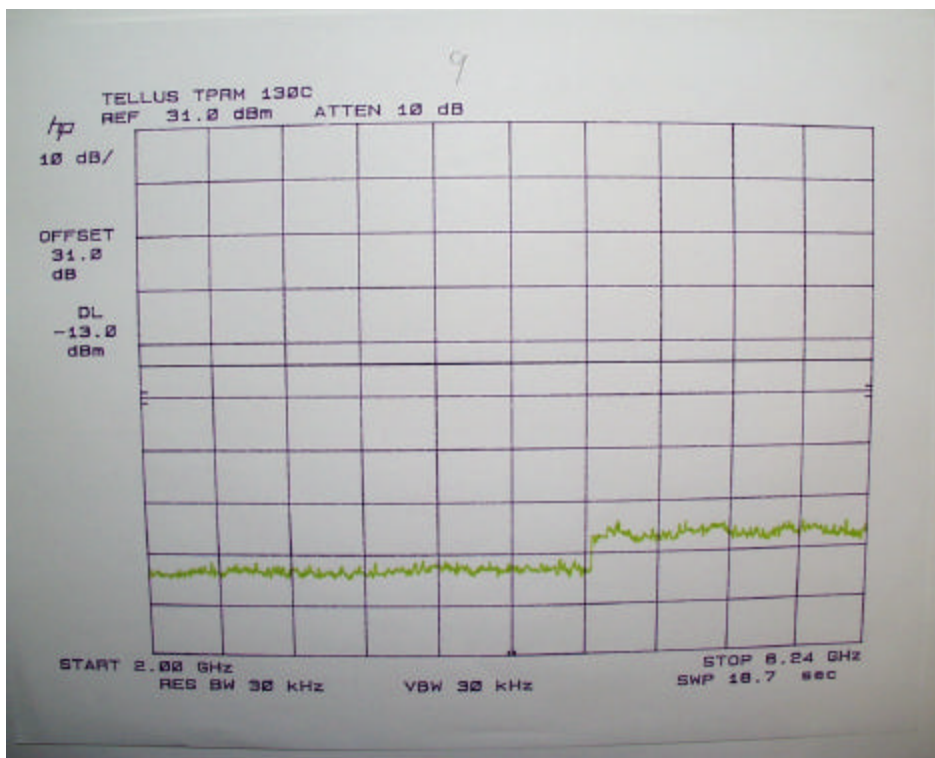
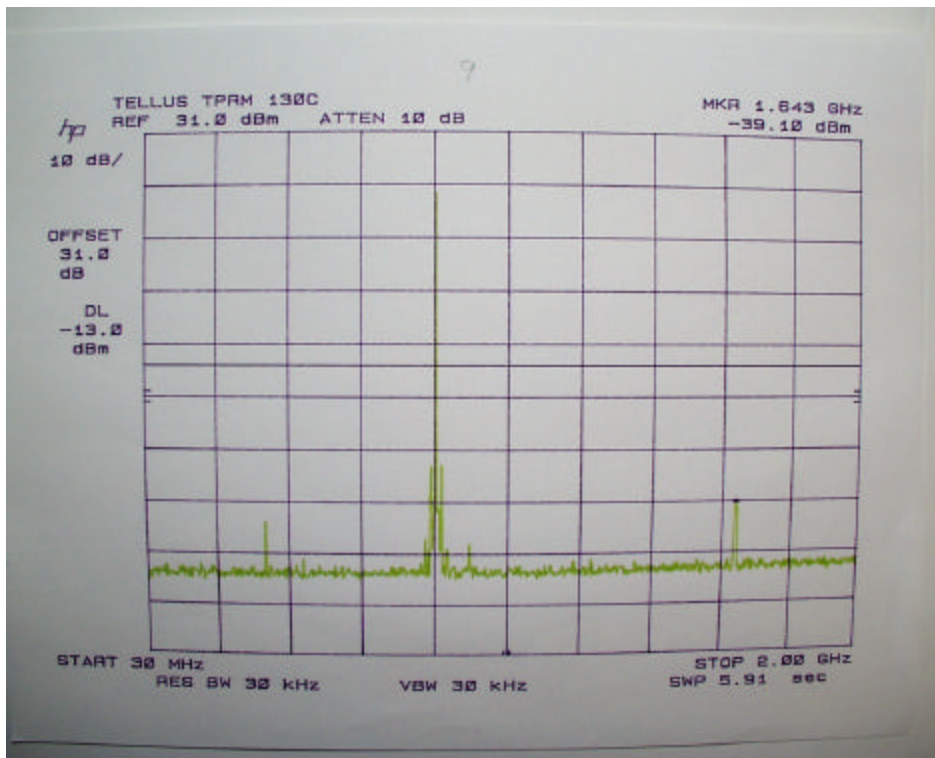


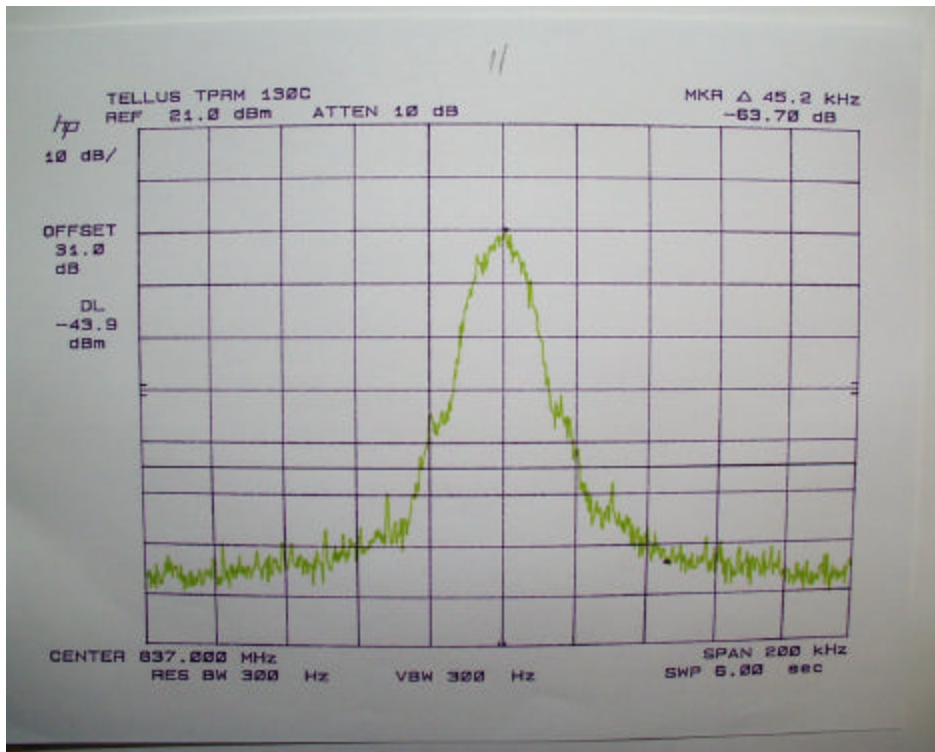
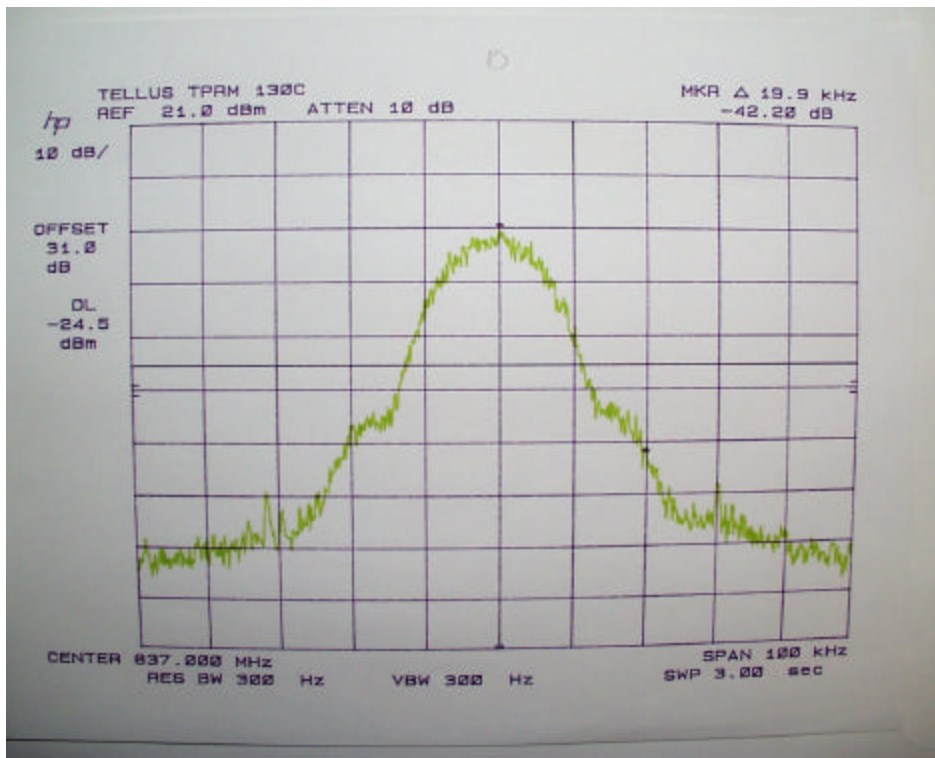


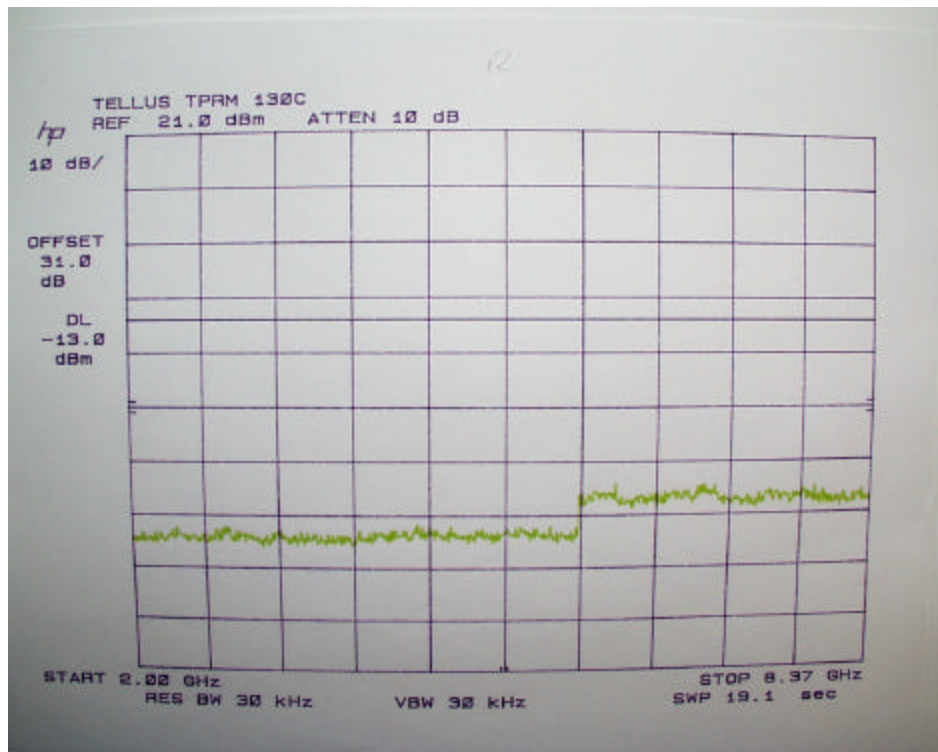
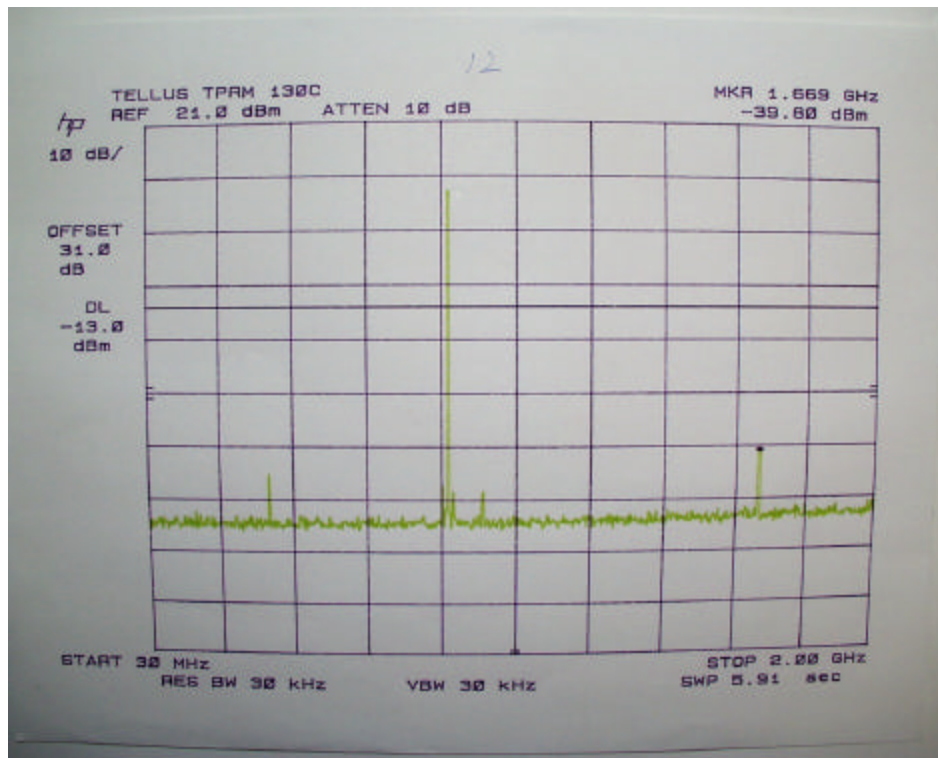


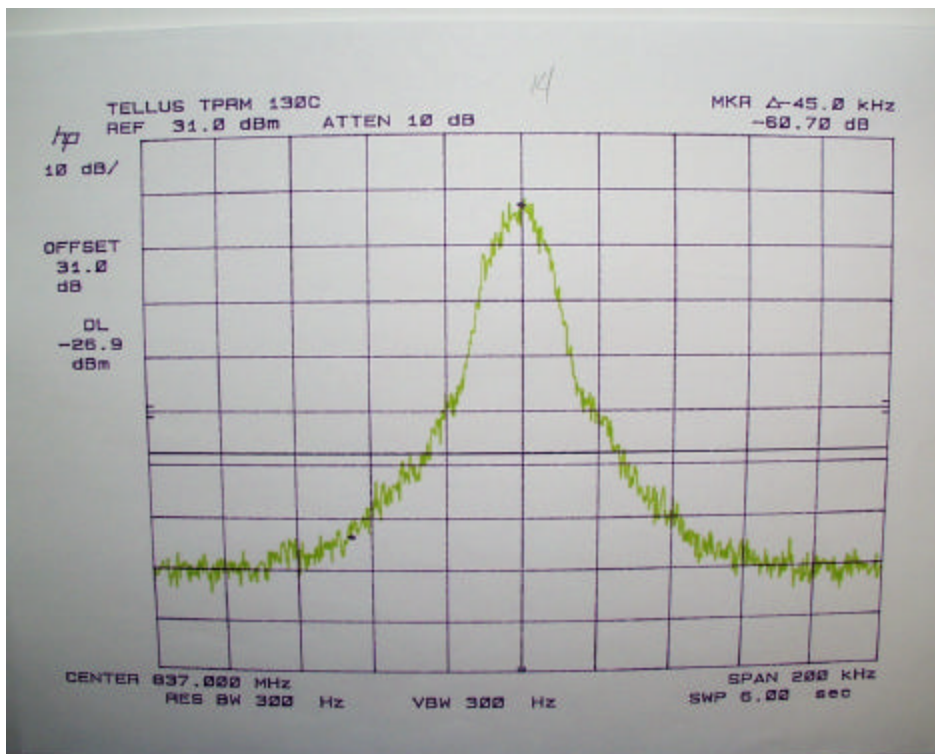
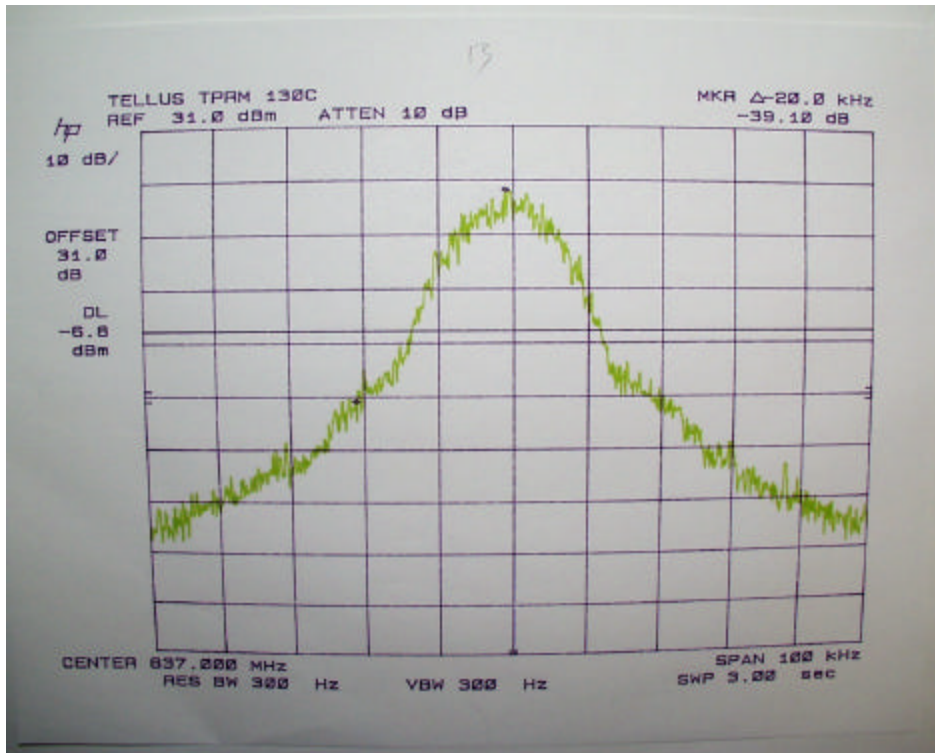


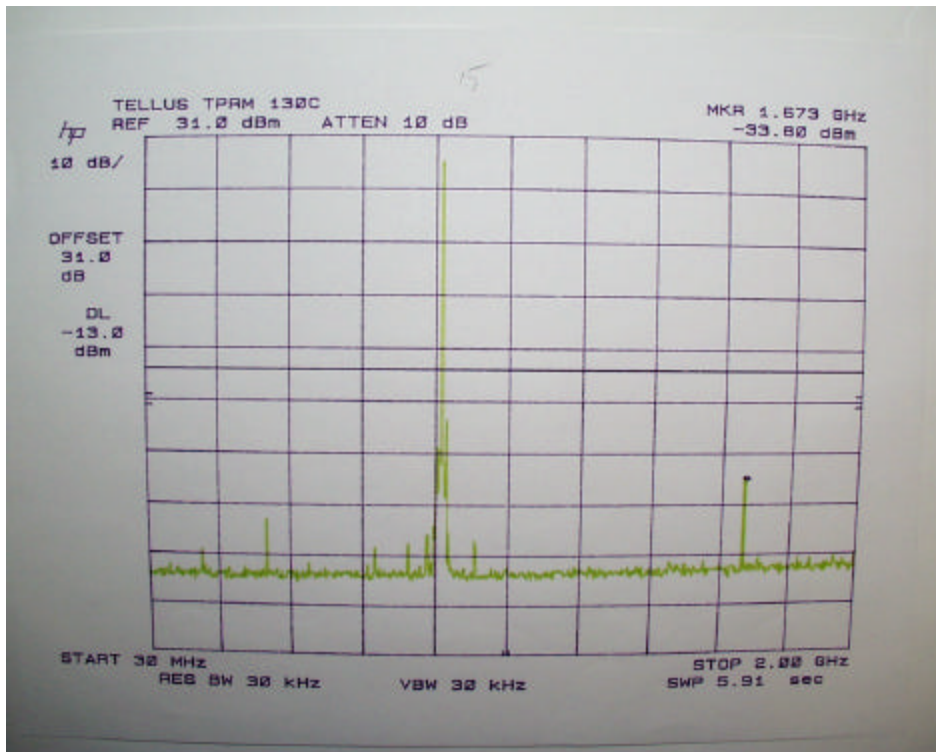
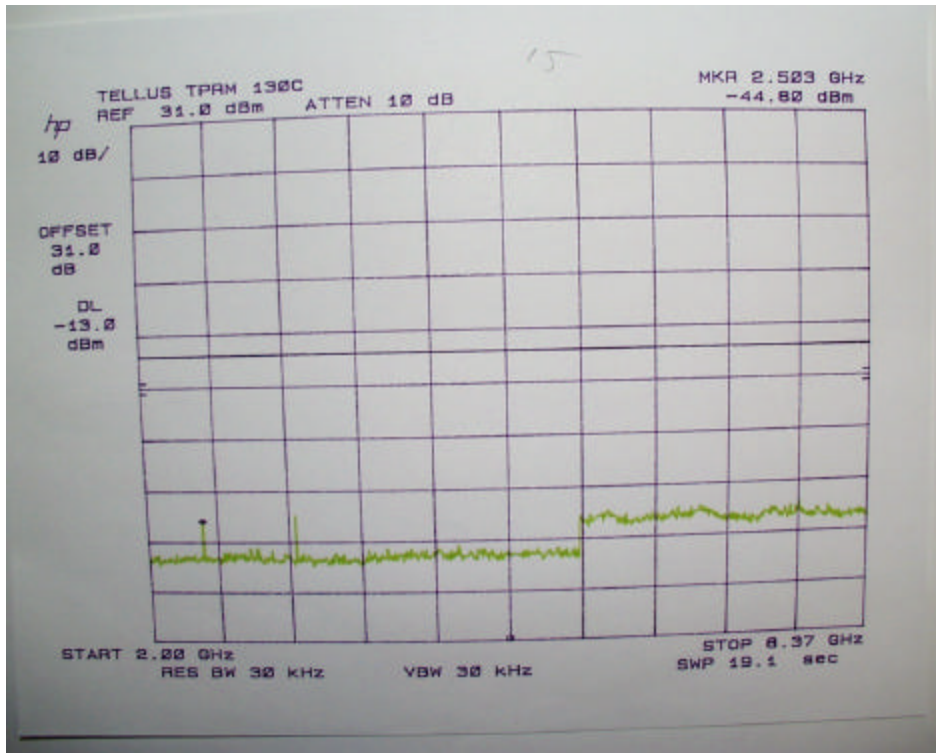


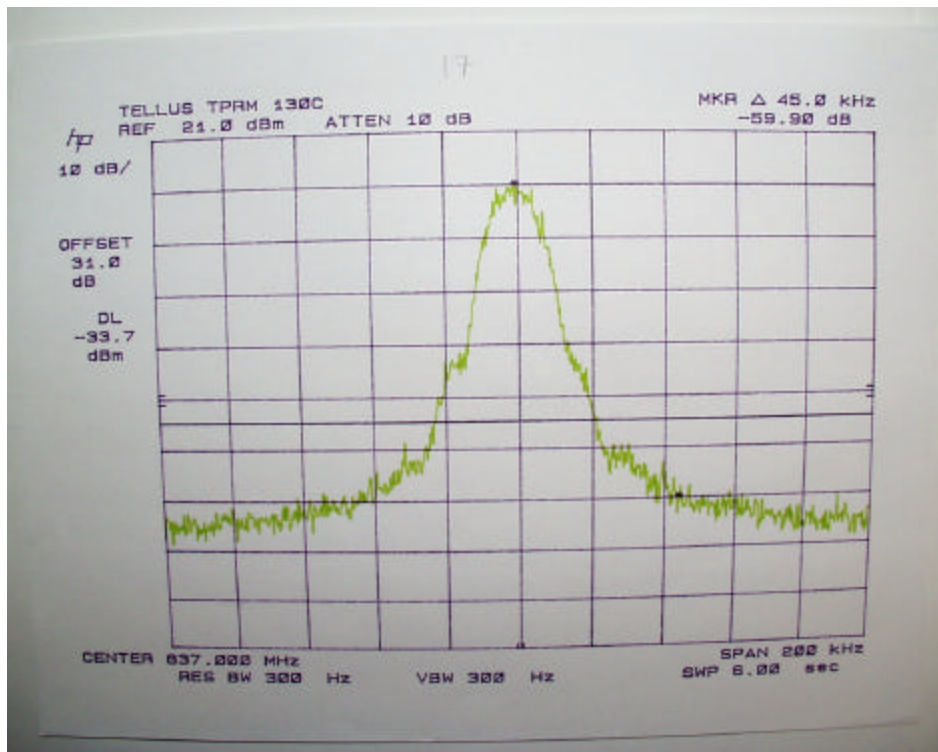
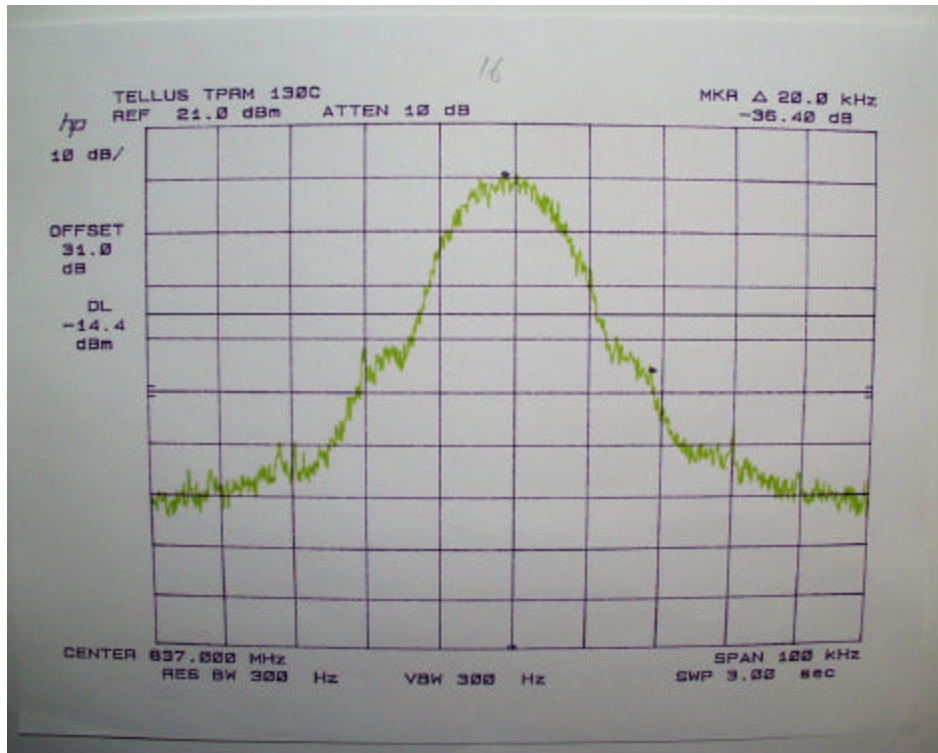


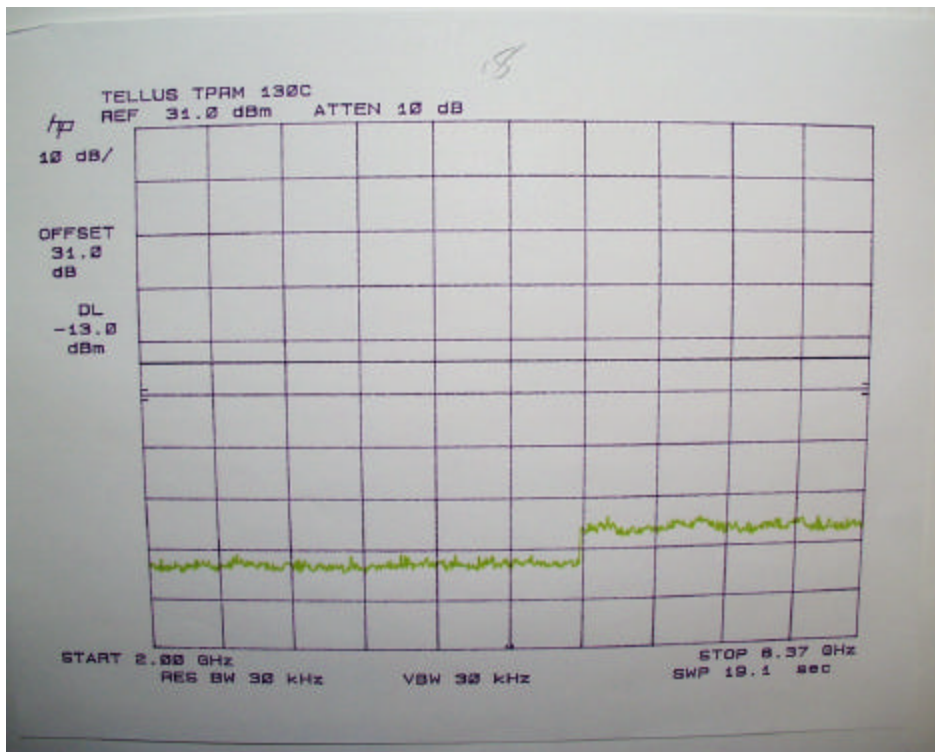
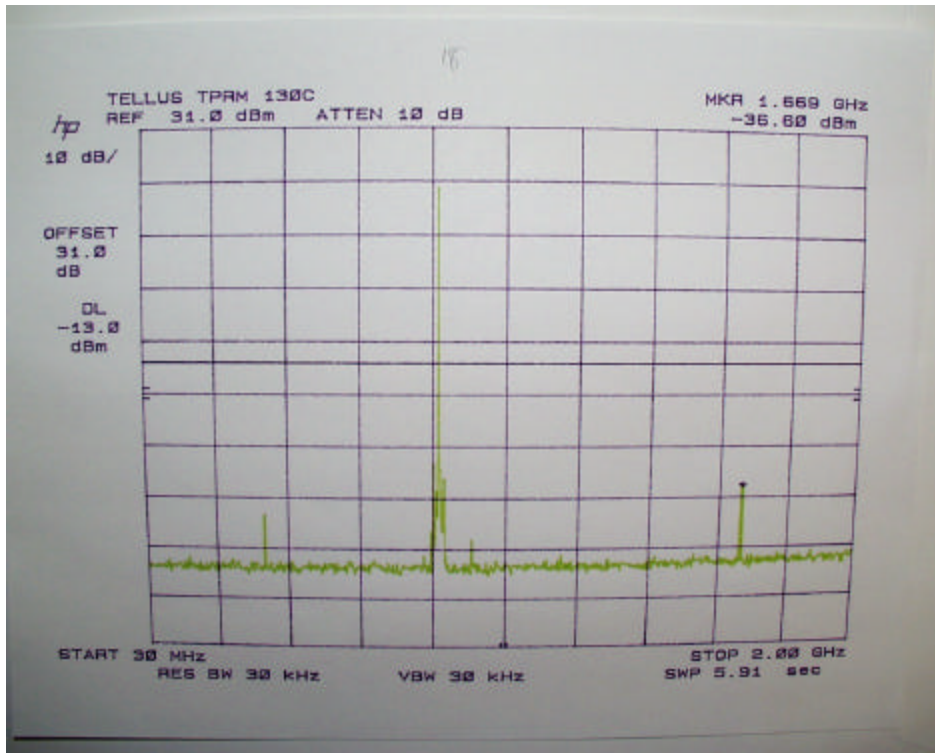


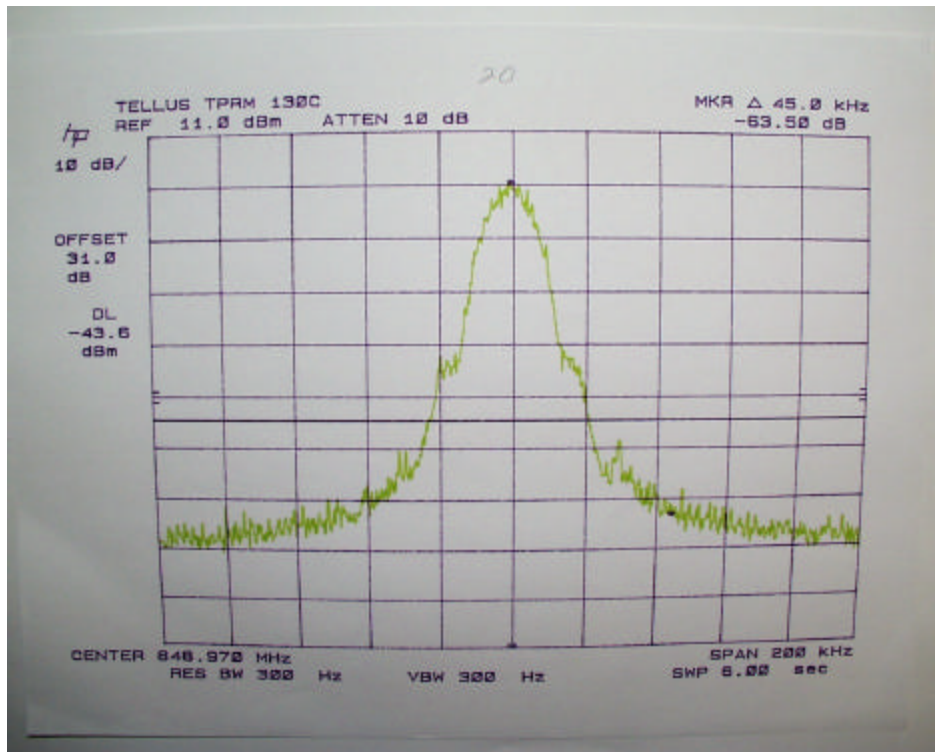
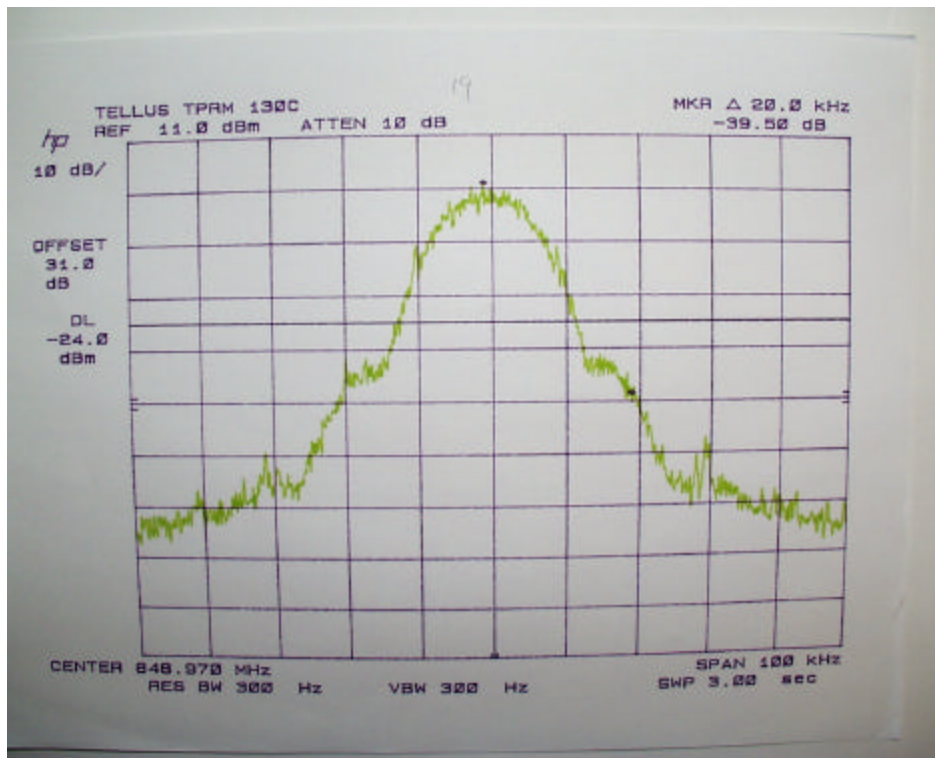


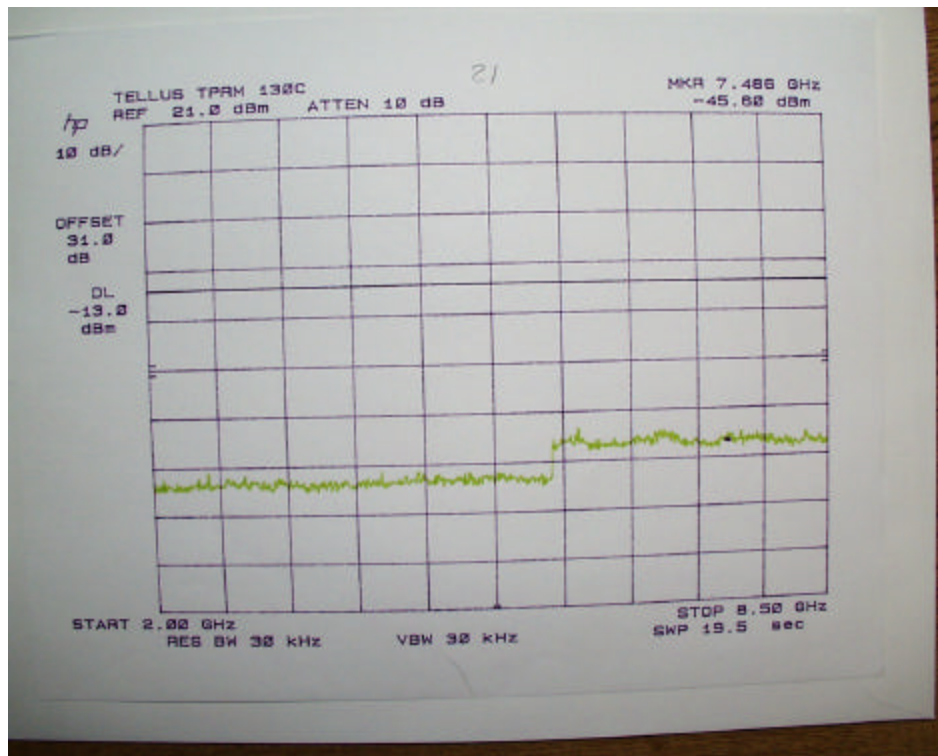
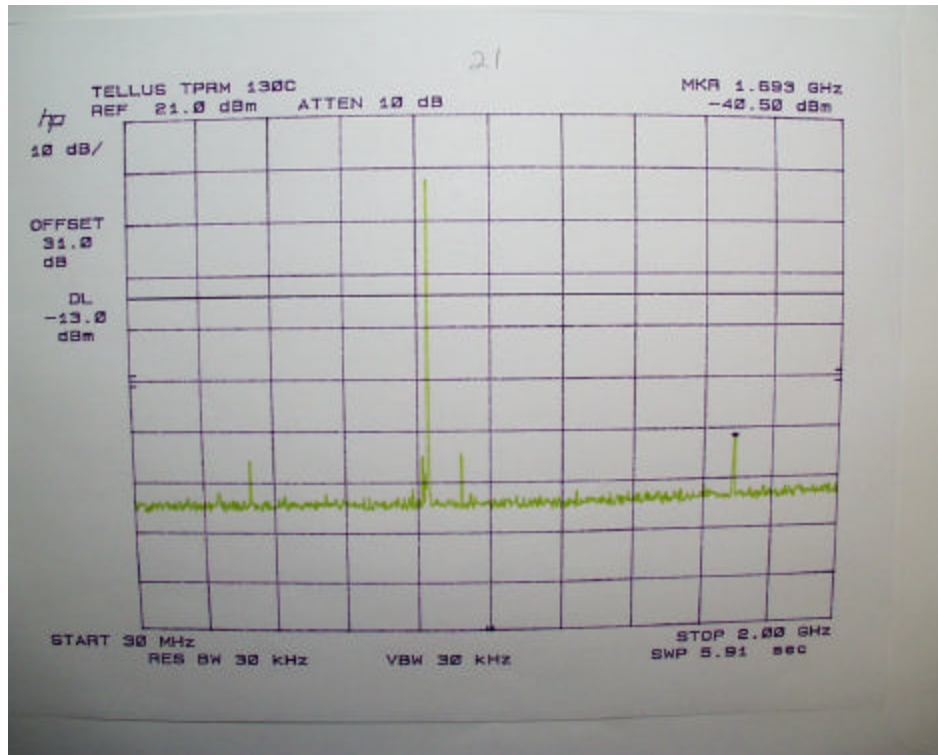


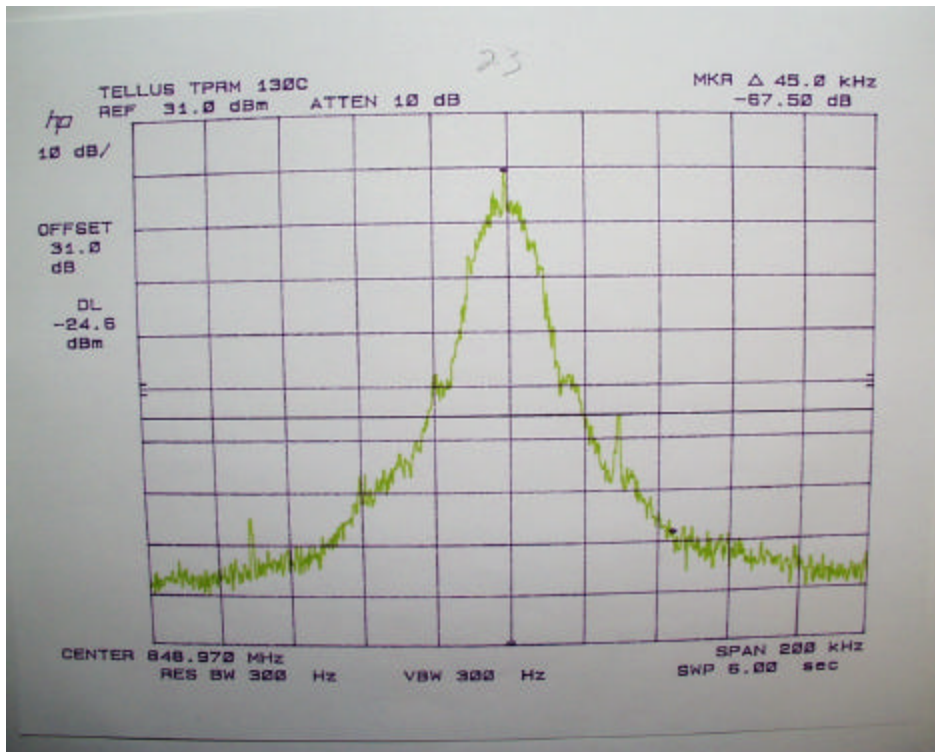
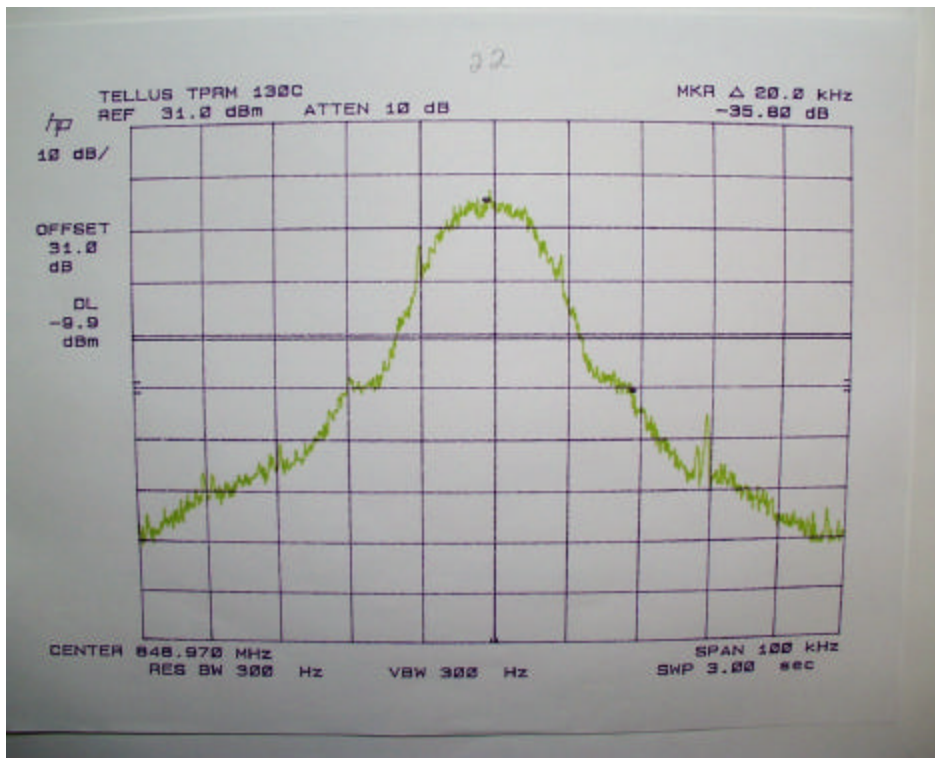


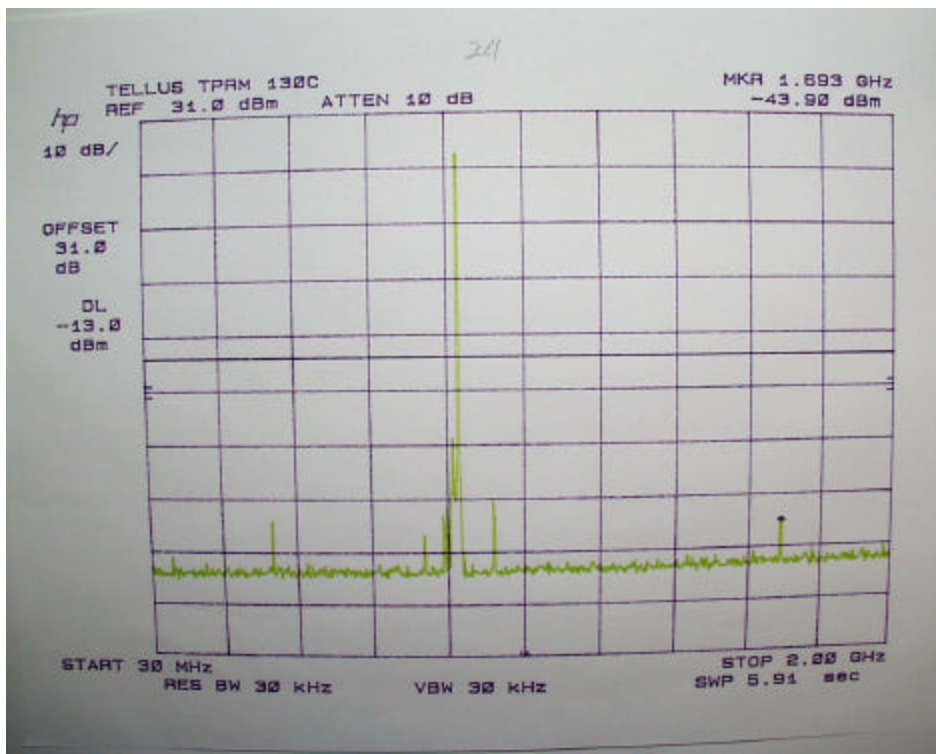
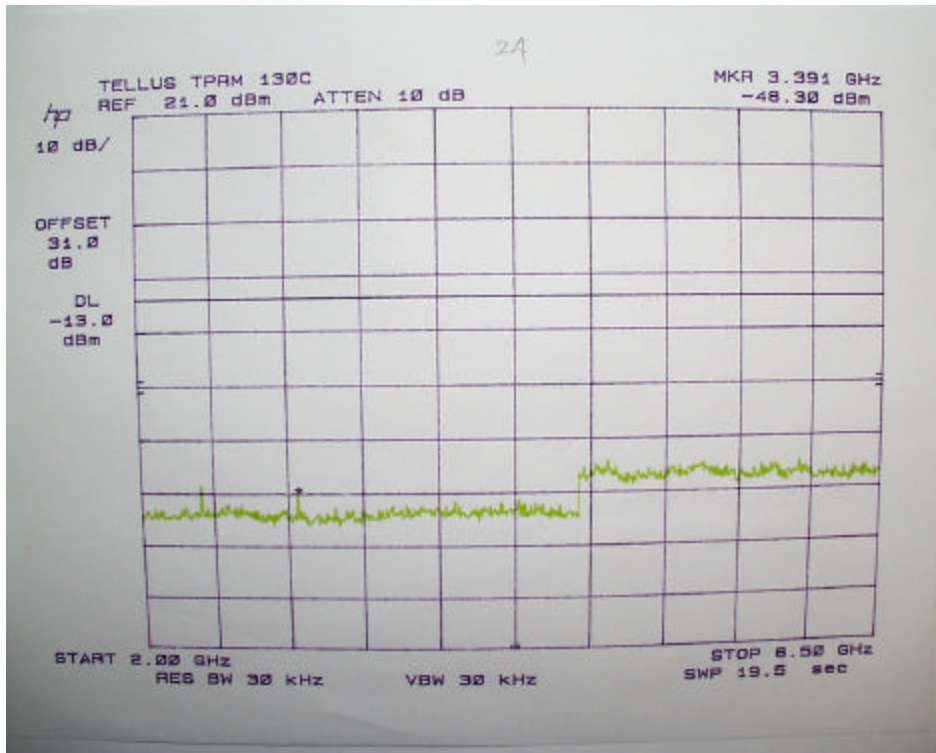


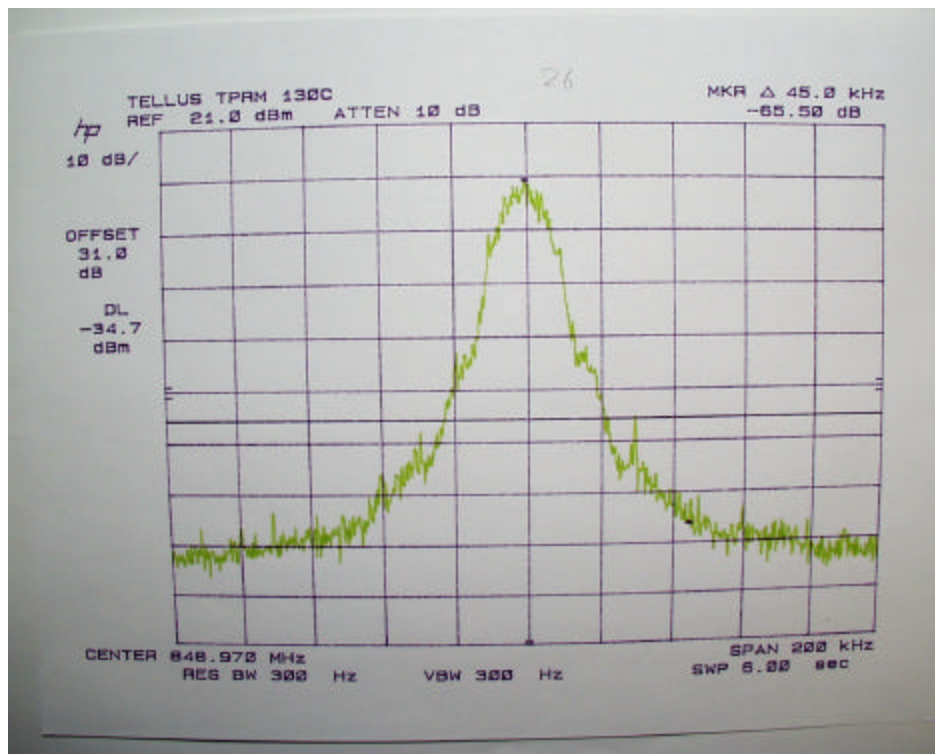
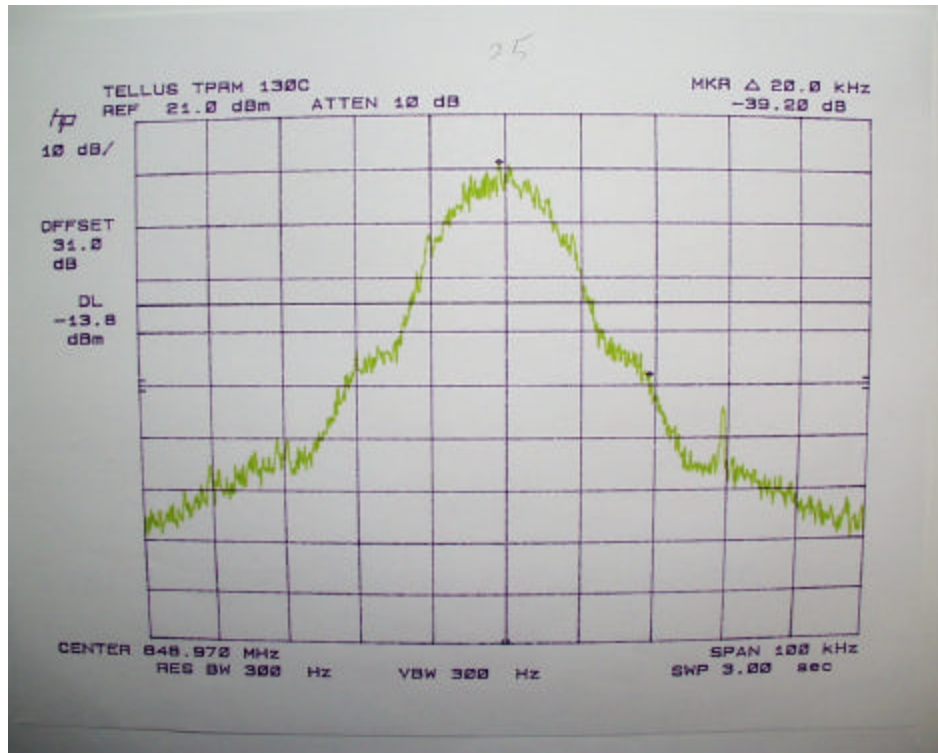


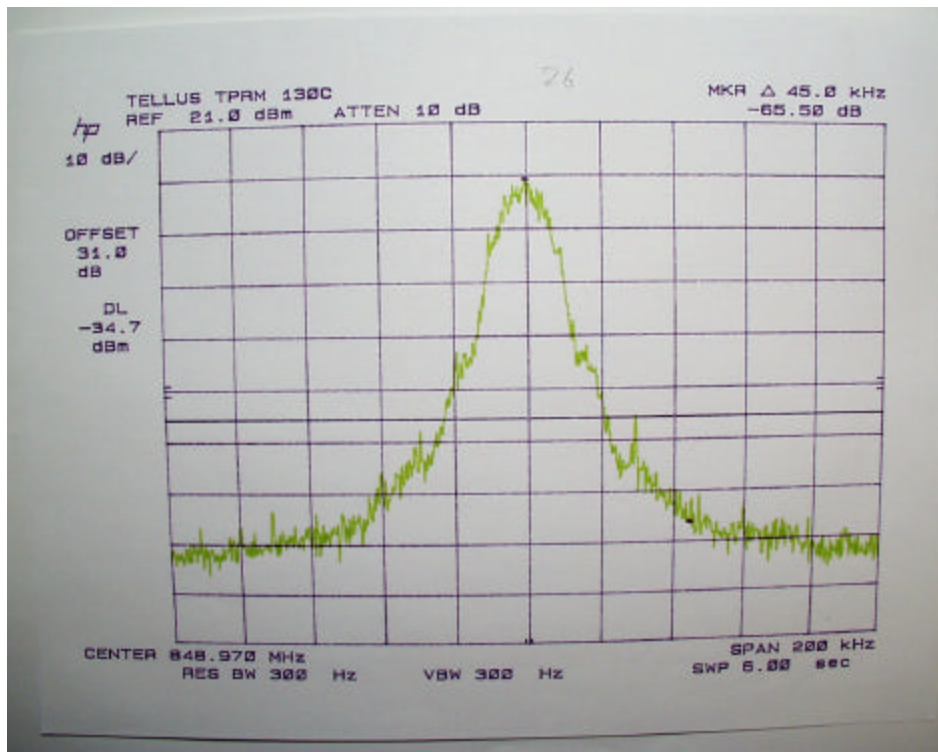
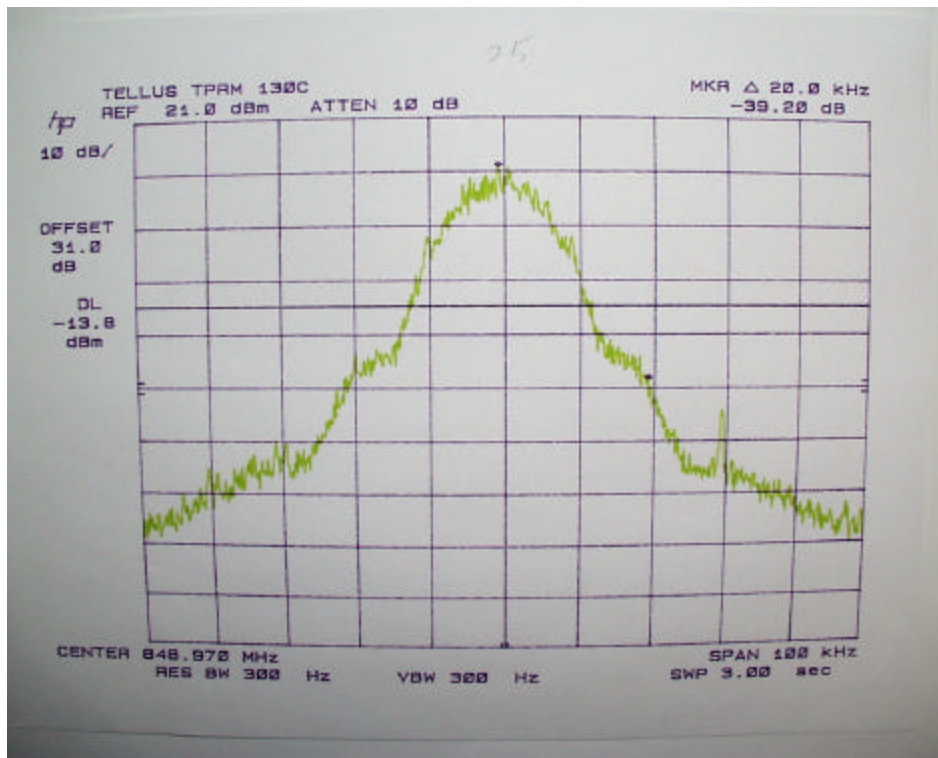


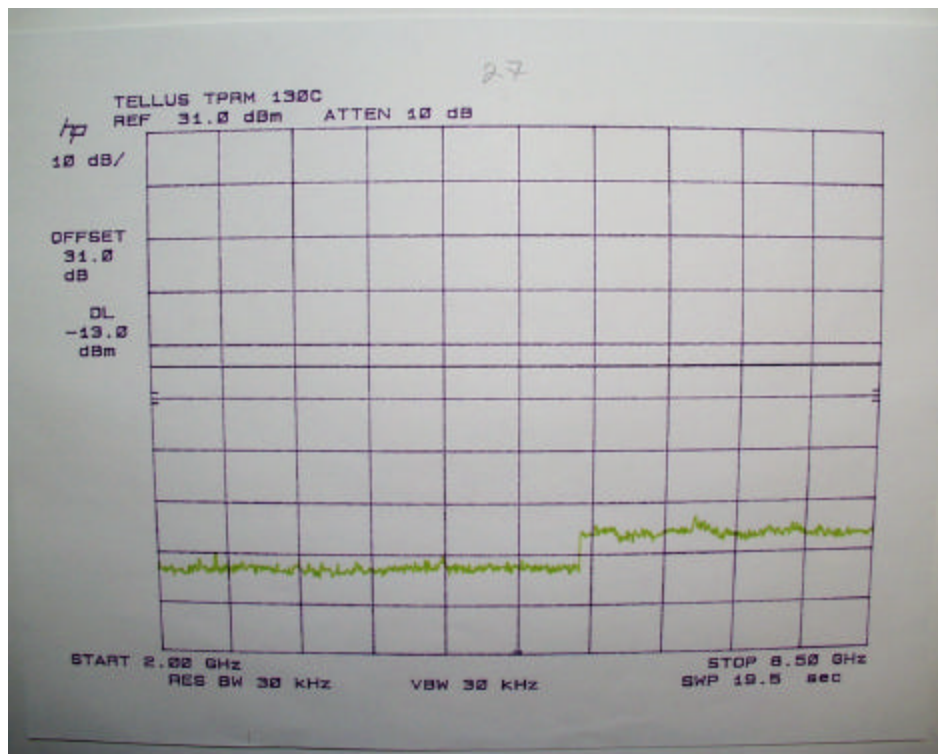
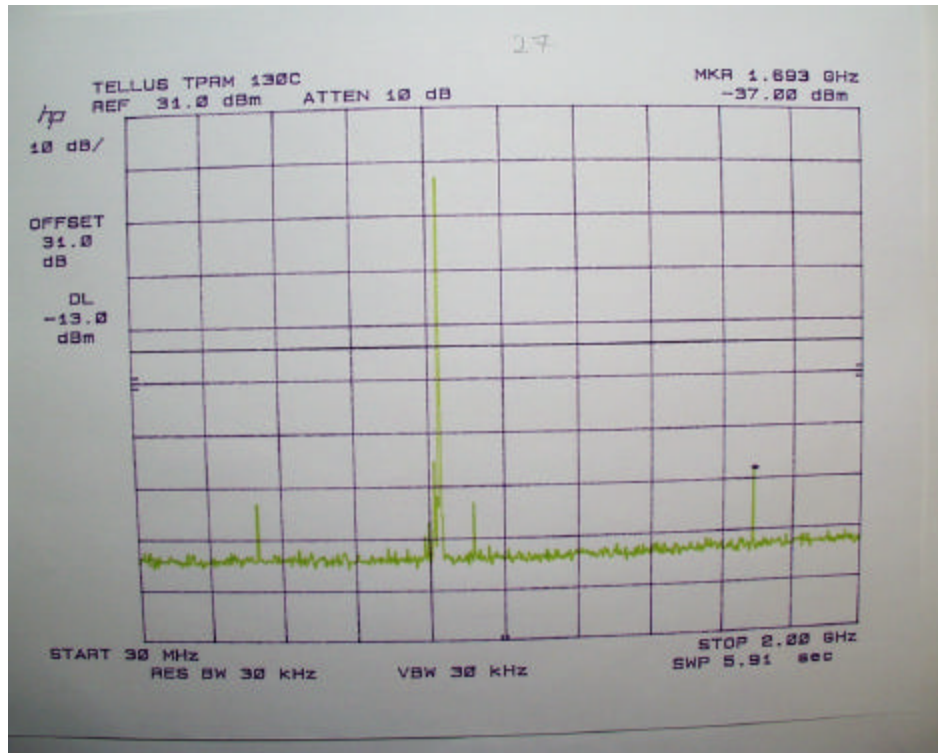


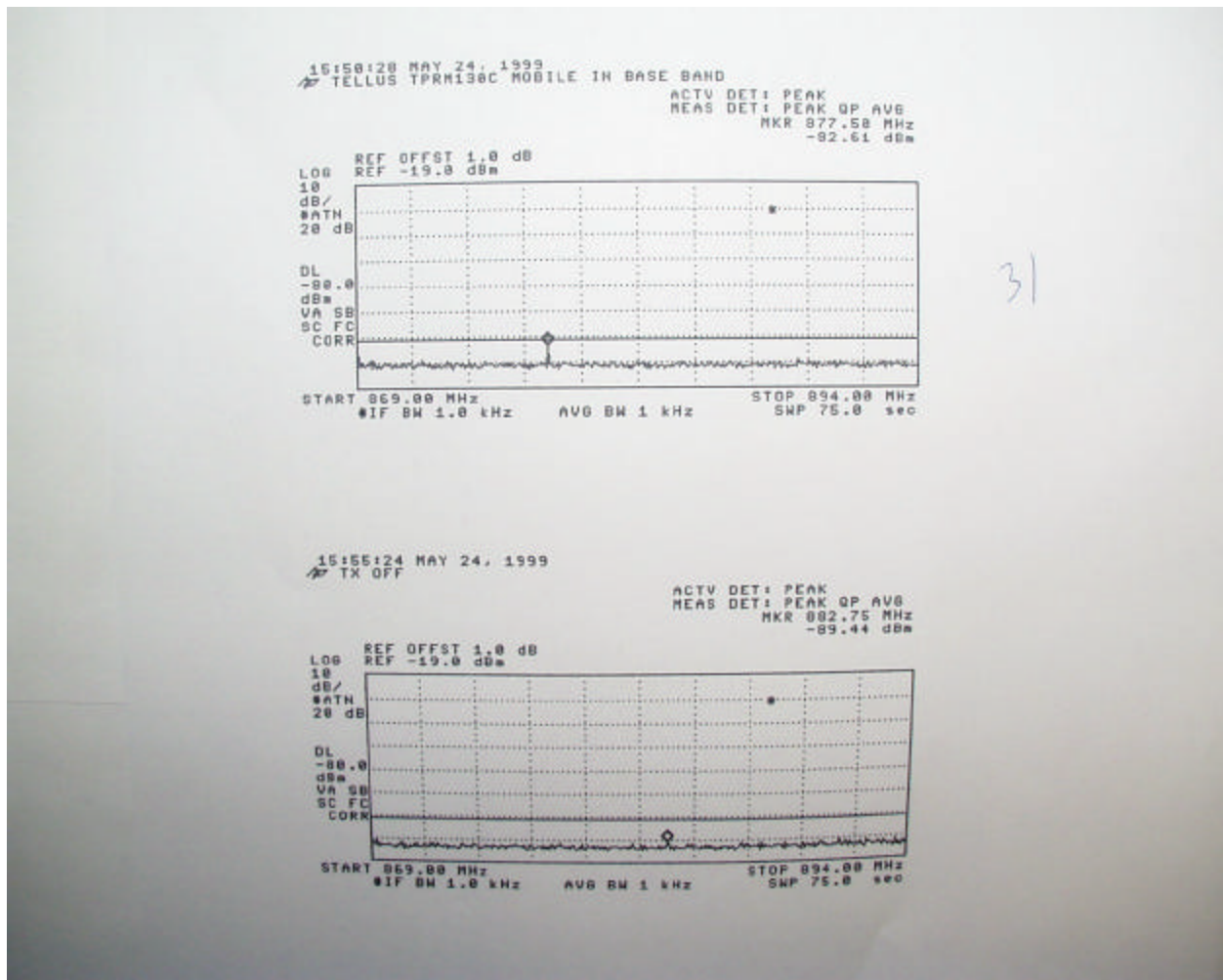












SECTION 2.993 FIELD STRENGTH OF SPURIOUS RADIATION

Technical Limits applied :Section, 22.917 emission masks

See attached chart

5/21/99

PETE KREBILL

TELLUS
TPRM 130C

ALL READINGS ARE PEAK

F(MHz)	Level (dBuV)	AF (dB)	CL (dB)	AMP (dB)	FILTER (dB)	DIST (dB)	Total (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Vertical									
1697.94	56	25.2	2.34	-35.5	10	-10.5	47.54	82	-34.46
2546.91	47.9	29.2	2.79	-35.5	1	-10.5	34.89	82	-47.11
3395.88	48.5	32.8	4.1	-35.5	1	-10.5	40.4	82	-41.6
4244.87	46.1	32.3	5	-35.5	1	-10.5	38.4	82	-43.6
5093.84	42.9	34.3	5.4	-35.5	1	-10.5	37.6	82	-44.4
5942.79	35.8	35.2	5.7	-35.5	1	-10.5	31.7	82	-50.3
6791.76	33	36	6	-35.5	1	-10.5	30	82	-52
7640.73	43.6	36.9	6.4	-35.5	1	-10.5	41.9	82	-40.1
8489.7	44.6	37.5	6.7	-35.5	1	-10.5	43.8	82	-38.2
Horizontal									
1697.94	45.2	25.2	2.34	-35.5	10	-10.5	36.74	82	-45.26
2546.91	43.4	29.2	2.79	-35.5	1	-10.5	30.39	82	-51.61
3395.88	46.5	32.8	4.1	-35.5	1	-10.5	38.4	82	-43.6
4244.87	44.2	32.3	5	-35.5	1	-10.5	36.5	82	-45.5
5093.84	36.2	34.3	5.4	-35.5	1	-10.5	30.9	82	-51.1
5942.79	37.3	35.2	5.7	-35.5	1	-10.5	33.2	82	-48.8
6791.76	32.6	36	6	-35.5	1	-10.5	29.6	82	-52.4
7640.73	37	36.9	6.4	-35.5	1	-10.5	35.3	82	-46.7
8489.7	40.1	37.5	6.7	-35.5	1	-10.5	39.3	82	-42.7

AF= ANTENNA FACTOR
CL=CABLE LOSS
AMP= AMPLIFIER GAIN

FILTER=HP FILTER INSERTION LOSS
DIST=DISTANCE CORRECTION TO 3 METERS

RES & VIDEO BW=1MHZ

16. EXTERNAL I/O CABLE CONSTRUCTION DESCRIPTION

CABLE NO: 1	
I/O Port: SERIAL	Number of I/O ports of this type:1
Number of Conductors:9	Connector Type:DB9
Capture Type: SCREW-IN	Type of Cable used:UN-SHIELDED
Cable Connector Type: PLASTIC	Cable Length: 2M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

CABLE NO: 2	
I/O Port: RF	Number of I/O ports of this type:1
Number of Conductors:2	Connector Type:SMA
Capture Type: SCREW-IN	Type of Cable used: SHIELDED
Cable Connector Type: METAL	Cable Length: 0.25M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

CABLE NO: 3	
I/O Port: DATA	Number of I/O ports of this type:1
Number of Conductors: 16	Connector Type: 16 PIN RIBBON
Capture Type: SNAP-IN	Type of Cable used: UNSHIELDED
Cable Connector Type: MOLDED	Cable Length:0.25M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

CABLE NO: 4	
I/O Port: DC POWER	Number of I/O ports of this type:1
Number of Conductors: 2	Connector Type: DC
Capture Type: SNAP IN	Type of Cable used: UNSHIELDED
Cable Connector Type: MOLDING	Cable Length:2M
Bundled During Tests: NO	Data Traffic Generated: NO
Remark: N/A	

SETUP BLOCK DIAGRAM

