Modulation characteristics measurement test results

TEST SPECIFICATION: FCC part 2, §2.987 (b), part 22, §22.915(c)
COMPANY: Telrad
EUT: CET-10
DATE: September 28, 1998
RELATIVE HUMIDITY: 51%
AMBIENT TEMPERATURE: 22°C

Carrier Frequency MHz	Microphone		RJ11		Deviation Required ±10% KHZ
	Level Volt	Deviation KHz	Level Volt	Deviation KHz	
825.03	2.79	11.0	3.28	11.15	± 12
836.49	2.79	11.0	2.76	11.4	± 12
848.97	2.79	11.0	3.2	10.95	± 12

Test Equipment

Equipment Description	Manufacturer	Model Number	Serial Number
Stabilock	Wavetek	4032	1488 250
Signal Generator	HP Tims	4036A	2210 0U00119
PC	Twinhead	SLIMNOTE-5	63-000608-02

Test performed by:
Mrs. Eleonora Pitt, test engineer

Hermon Labs

Table 3.4.3 Modulation characteristics measurement test results

TEST SPECIFICATION:	FCC part 2, §2.987 (b), part 22, §22.915(c)
COMPANY:	Telrad
EUT:	CET-10
DATE:	July 16, 1998
RELATIVE HUMIDITY:	48%
AMBIENT TEMPERATURE:	23°C

Carrier frequency 836.49 MHz

Modulating frequency, kHz	Initial		Increased	
	Nominal level, mV	Deviation, kHz	By 20 dB level, mV	Deviation, kHz
0.5	45	3.7	450	4.1
1	45	7.6	450	8.3
1			2000	7.1
3	45	6.6	450	6.6

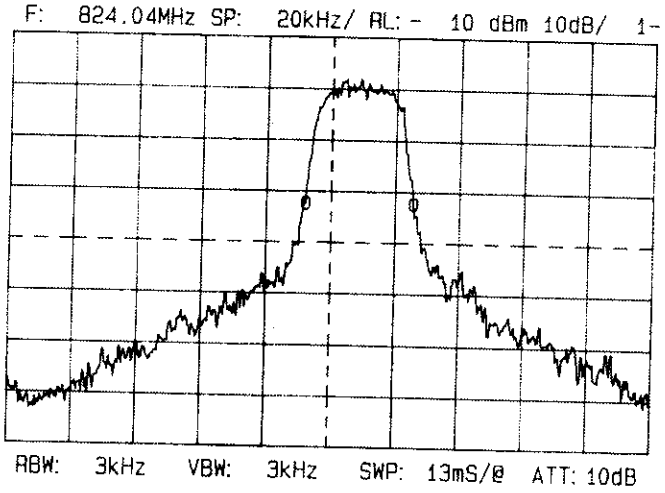
Test performed by:
Mr. Michael Nikishin, test engineer

Hermon Labs

Attachment #1

15.02.98 # 2663 Tirad CET-10 FCC p 22
mode : digital Voice pi /4DQPSK mask according to FID
Occupied bandwidth at maximum output power.

dM: + 33.60kHz + 0.0dB < 40 kHz limit EXT ATT=Y1dB



FRANK please look at this. This is the original of page 7-2 of our test report dated April 1998.

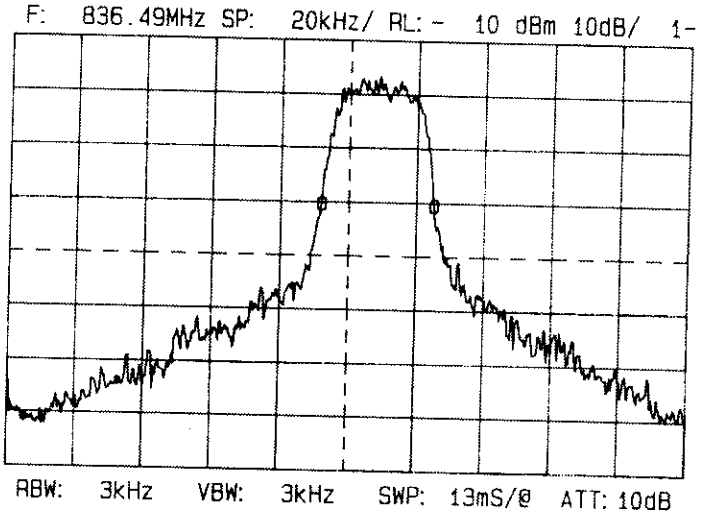
BH

HERMON חרמון

16.02.98 # 12663 Tetrad CET-10 FCC p 22

Mode digital voice pi/4DQPSK mask according to FID
Occupied bandwidth at maximum output power

dM: + 33.20kHz - 0.2dB < 40 kHz limit

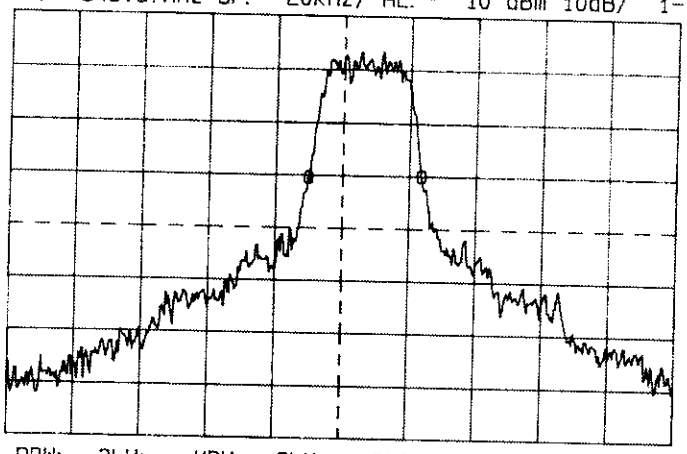


16 02 98. # 2663 Telrad CE7-10 FCC p 22

mode digital ~~$\pi/4$~~ / 4DQPSK mask according to FID
Occupied Bandwidth at maximum output power

dM: + 34.00kHz + 0.4dB < 40 kHz limit

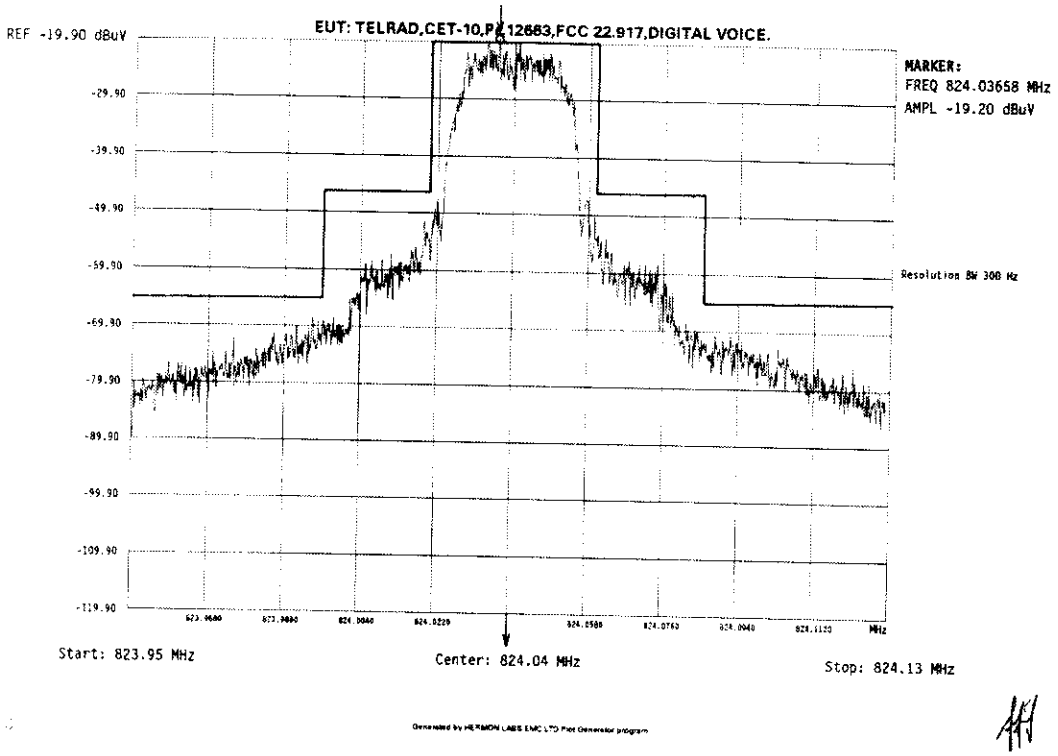
F: 848.97MHz SP: 20kHz/ RL: - 10 dBm 10dB/ 1-



Emission mask

Hermon Labs EMC LTD

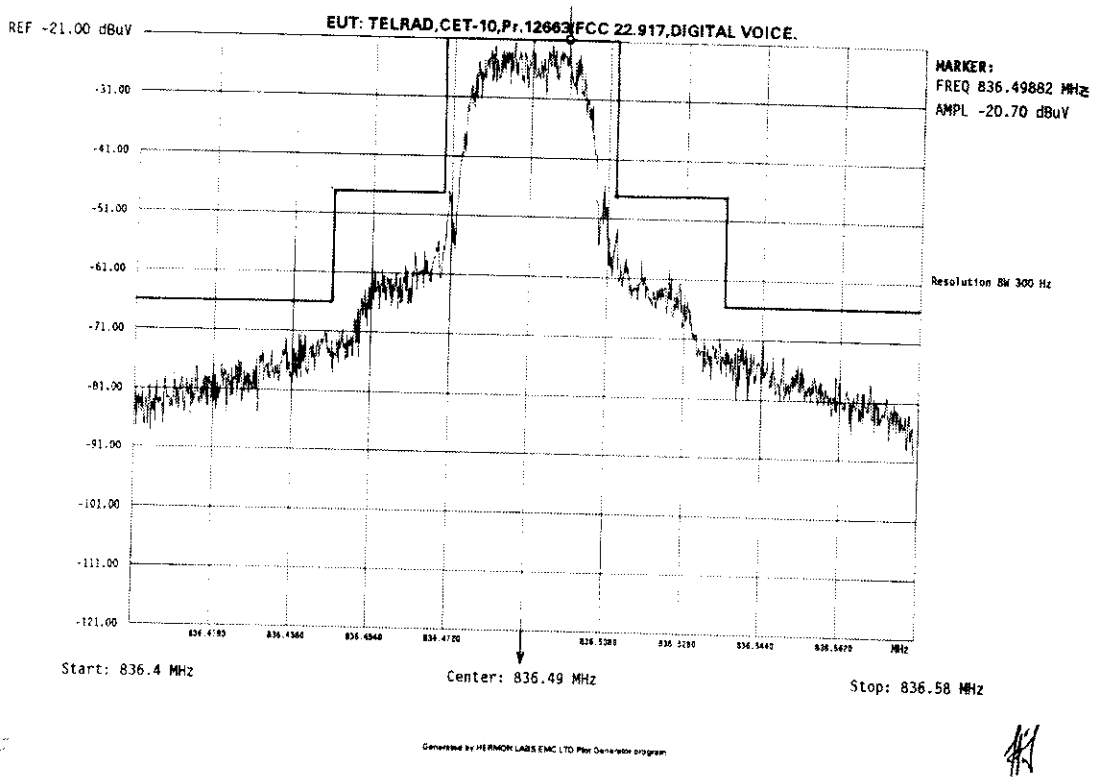
Thursday, 6/8/1998
Time: 19:32:40



Emission mask

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 19:49:44

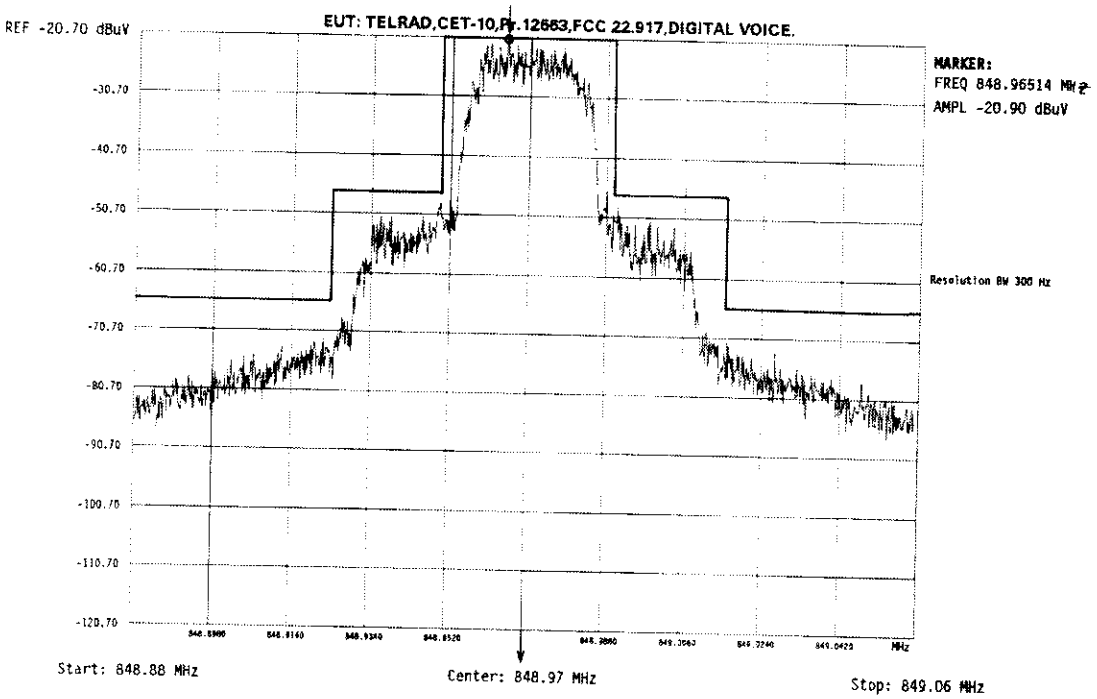


Generated by HERMON LABS EMC LTD Plot Generator program

Emission mask

Hermon Labs EMC LTD

Thursday, 6/8/199
Time: 19:39:27



Generated by HERMON LABS EMC ; TD Plot Generator program

Table 3.2.1
Frequency stability test results

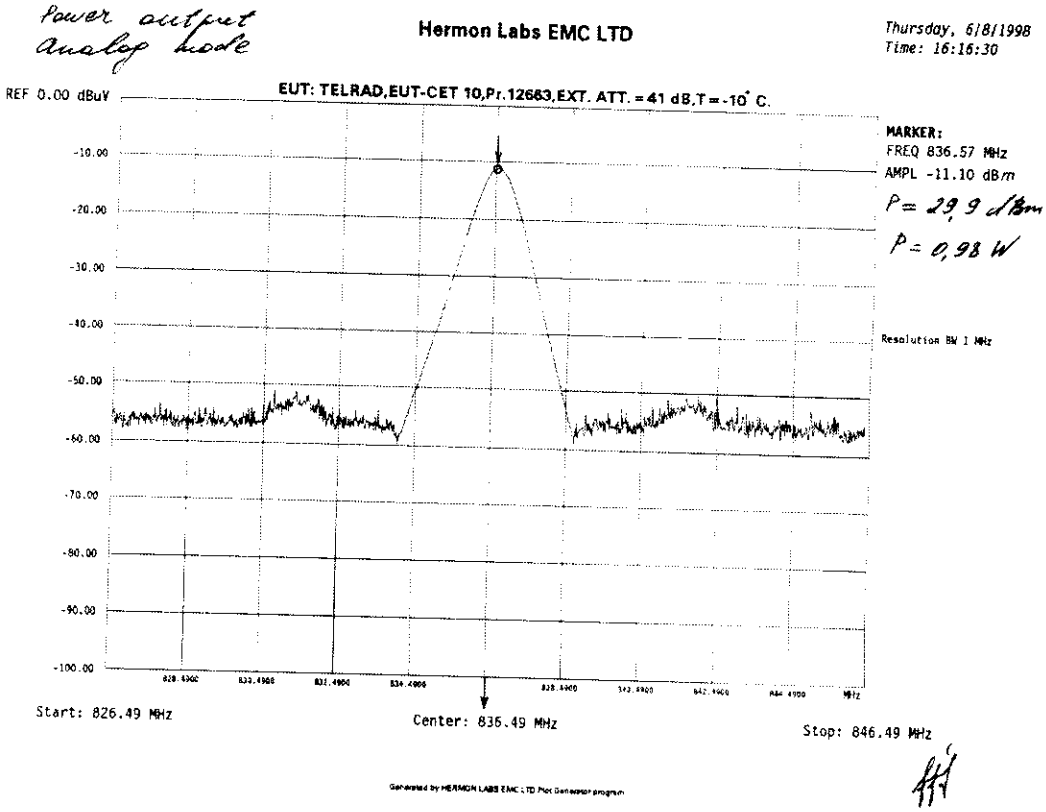
Carrier frequency, MHz	Frequency stability limit, ±Hz	Measured frequency tolerance, ±Hz vs temperature, ºC								Pass/ Fail
		-30	-20	-10	0	10	20	30	40	
824.04	2060	-840	-1200	-1160	-1160	-1240	-1360	-1400	-1440	Pass
836.49	2091	-920	-1240	-1200	-1200	-1280	-1320	-1400	-1400	Pass
848.97	2122	-1000	-1200	-1160	-1160	-1240	-1360	-1400	-1400	Pass

Table 3.2.2
Frequency stability test results

Carrier frequency, MHz	Frequency stability limit, ±Hz	Measured frequency tolerance, ±Hz vs primary supply voltage		Pass/ Fail
		102 V AC	138 V AC	
824.04	2060	140	120	Pass
836.49	2091	360	240	Pass
848.97	2122	80	-20	Pass

Attachment #3

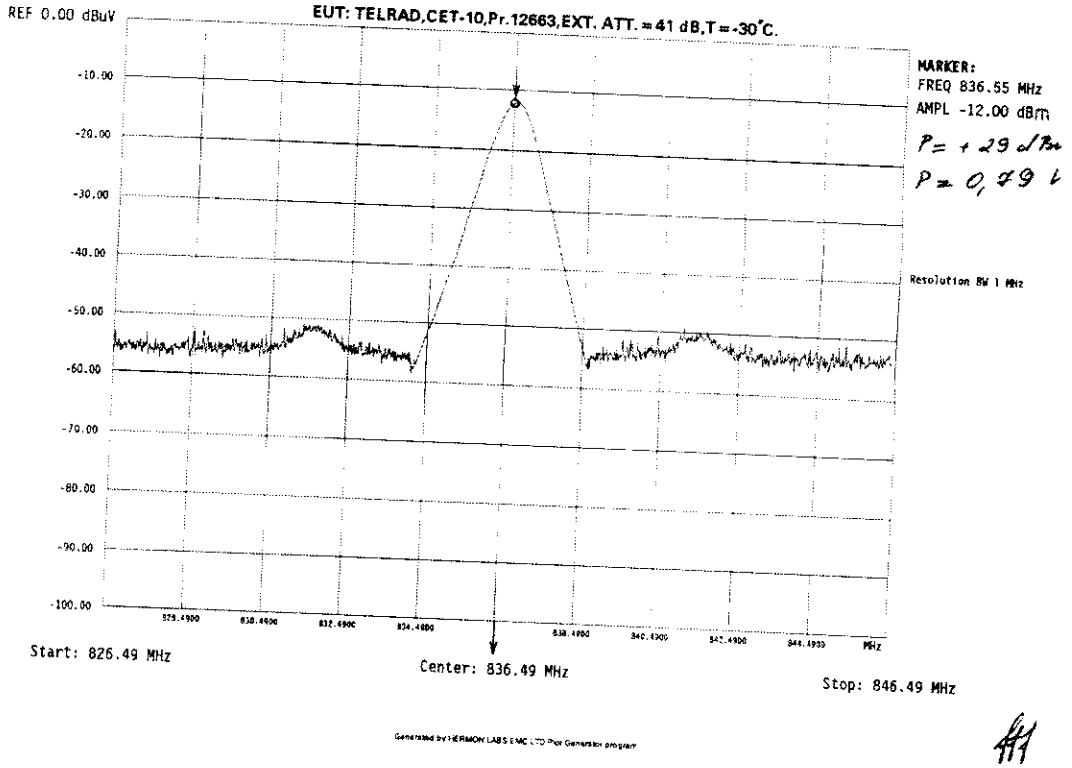
Power output
analog mode



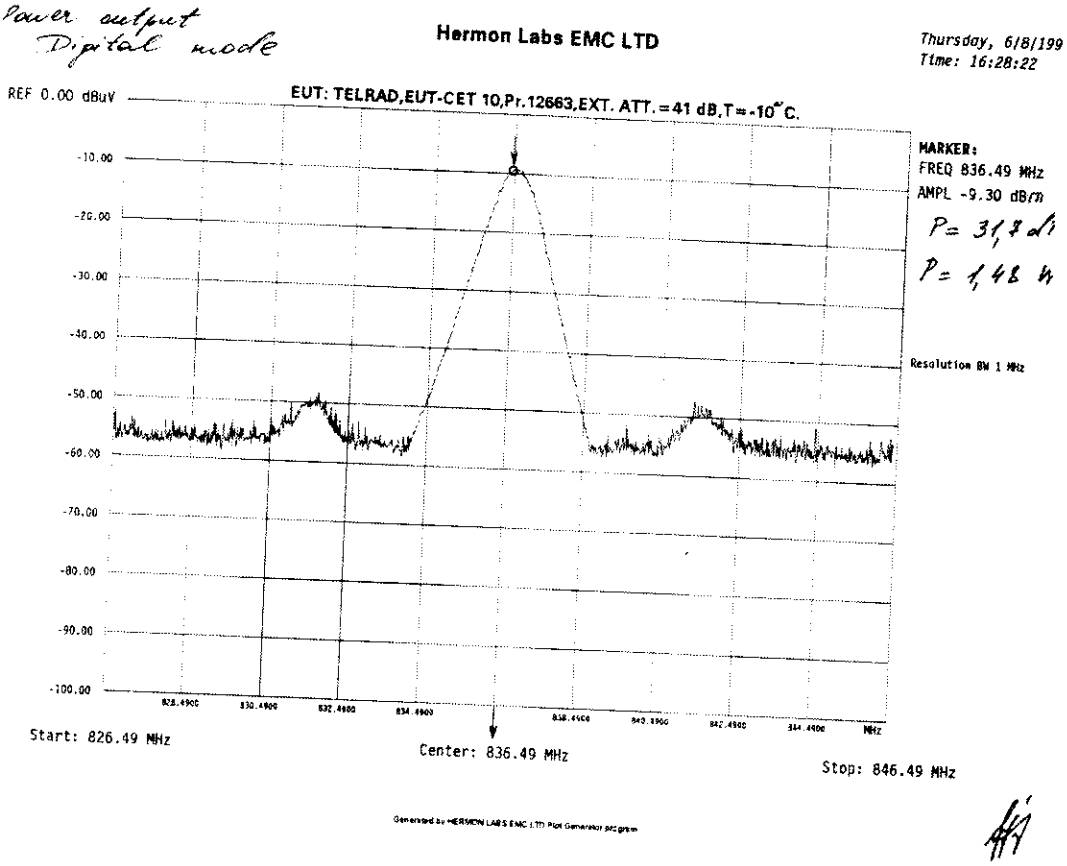
Power output
analog mode

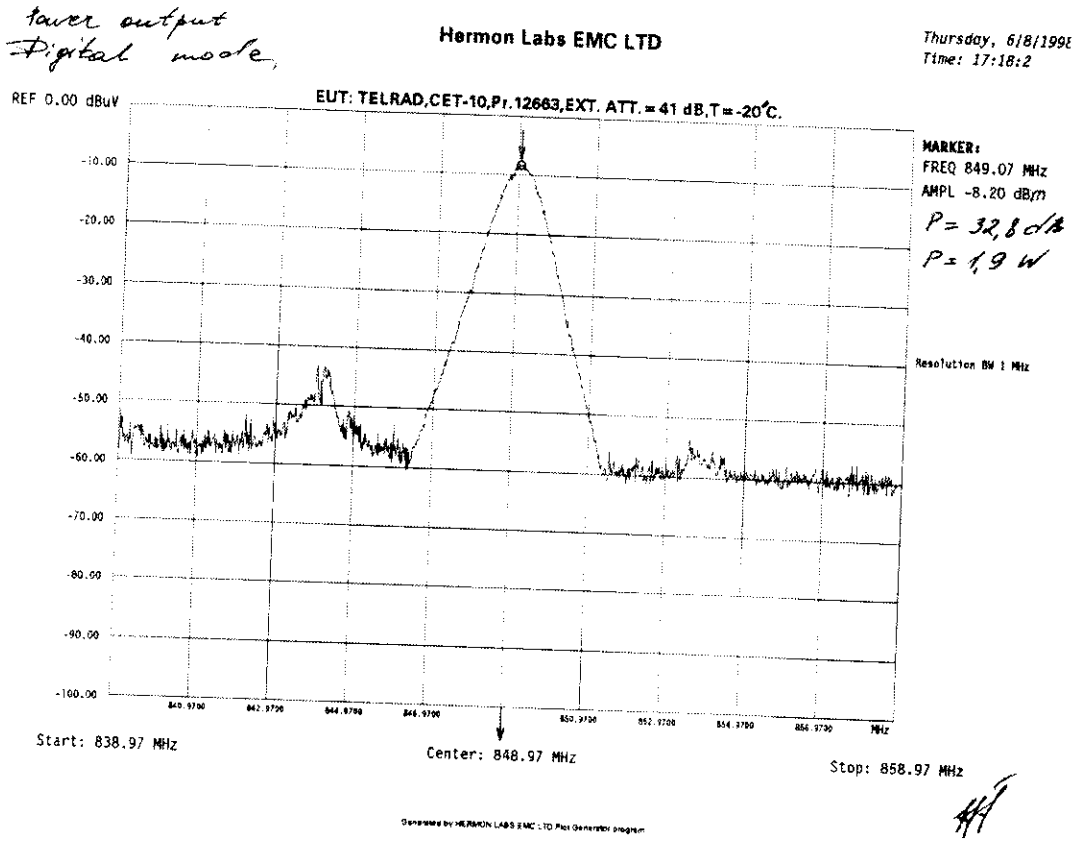
Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 17:57:52

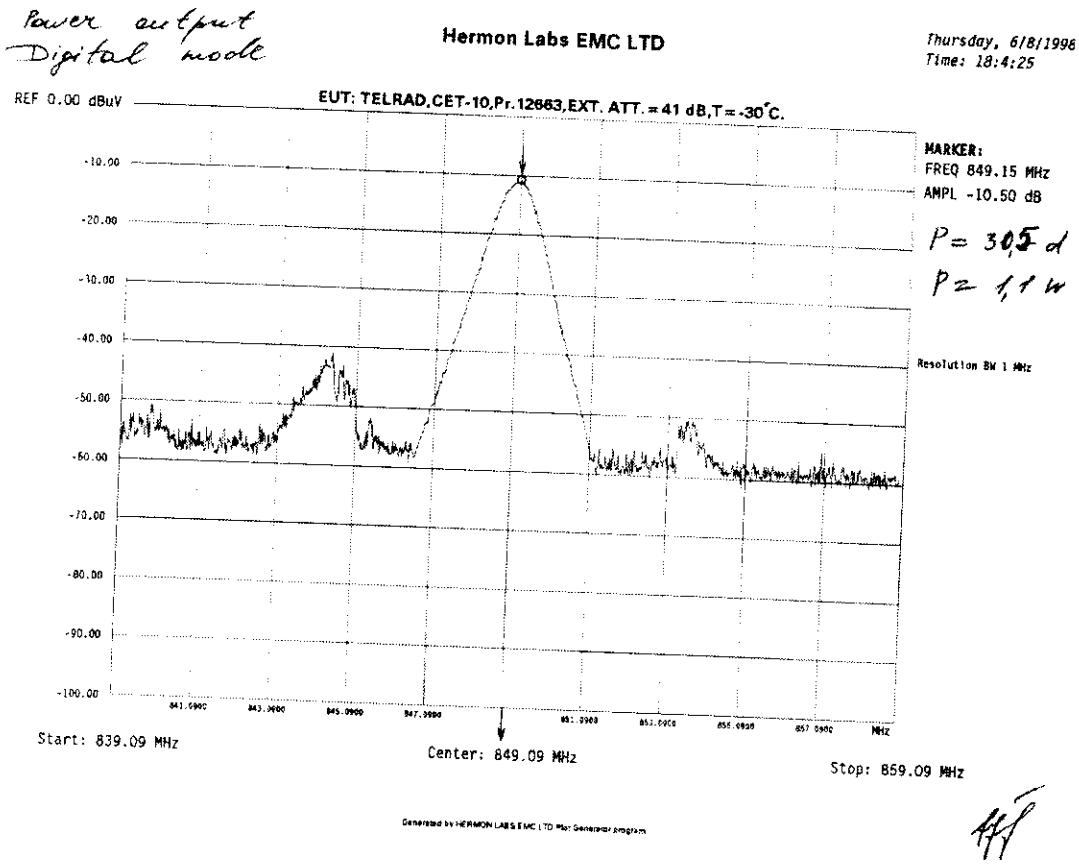


Power output
Digital mode




tower output
Digital mode,
Hermon Labs EMC LTD
Thursday, 6/8/199
Time: 17:18:2
REF 0.00 dBuV
EUT: TELRAD,CET-10,Pr.12663,EXT. ATT.=41 dB,T=-20°C.
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
-80.00
-90.00
-100.00
MARKER:
FREQ 849.07 MHz
AMPL -8.20 dBm
P= 32,8 dB
P= 1,9 W
Resolution BW 1 MHz
840.9700
842.9700
844.9700
846.9700
850.9700
852.9700
854.9700
856.9730
MHz
Start: 838.97 MHz
Center: 848.97 MHz
Stop: 858.97 MHz

Power output
Digital mode

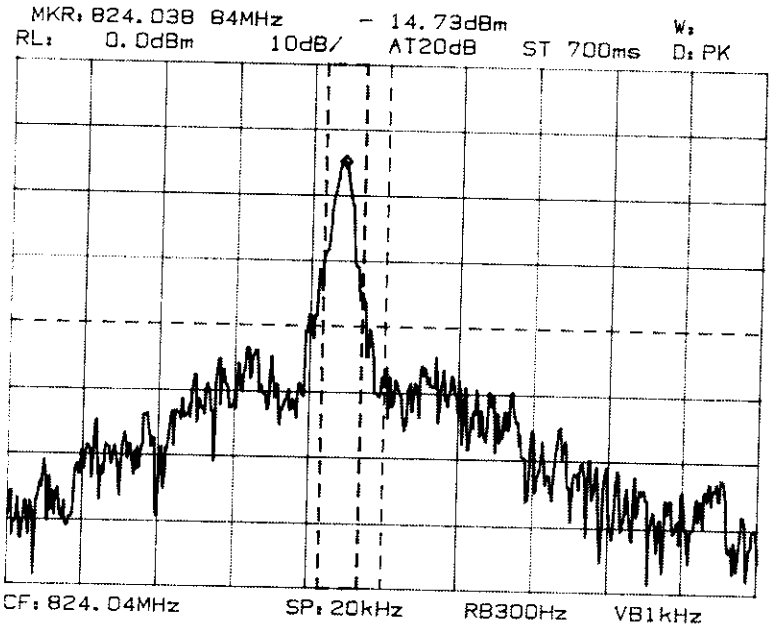


16.08.98 Tetrad CET-10 T=-10°C

Pt. 12665

ΔF = -1.16 kHz

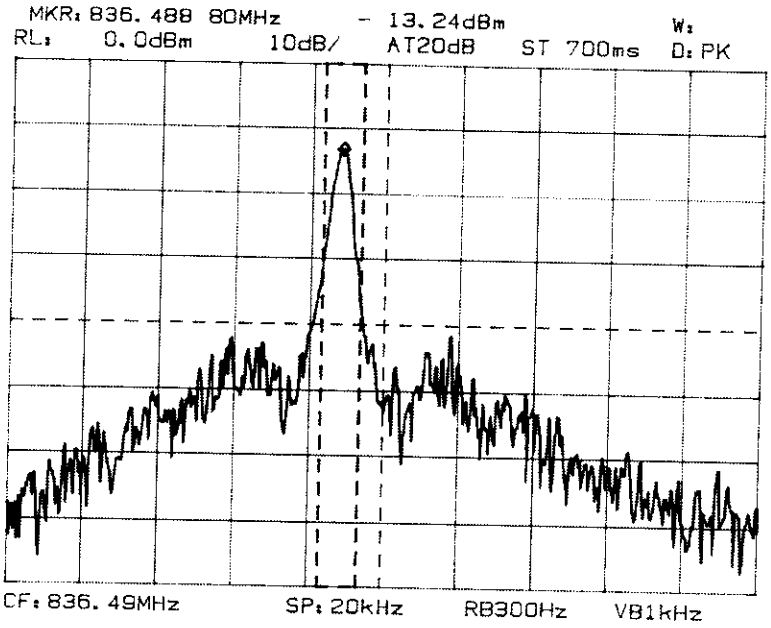
EXT ATT = 41 dB



HERMON

25.09.98 Tetrad CCT-10 Ta=10°C
12663

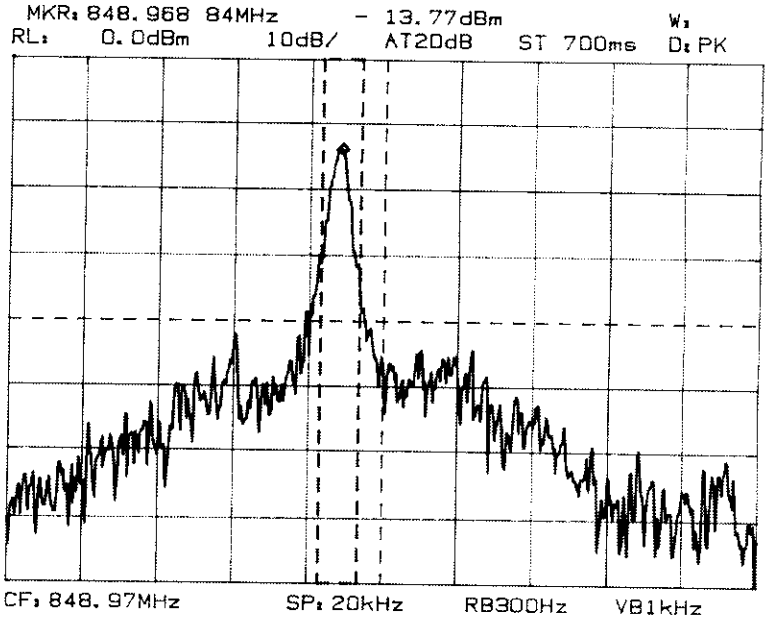
Δf = -1.2 kHz EXT ATT: 41 dB



AK

25.02.98 Tetrad CET-10 T=-10°C

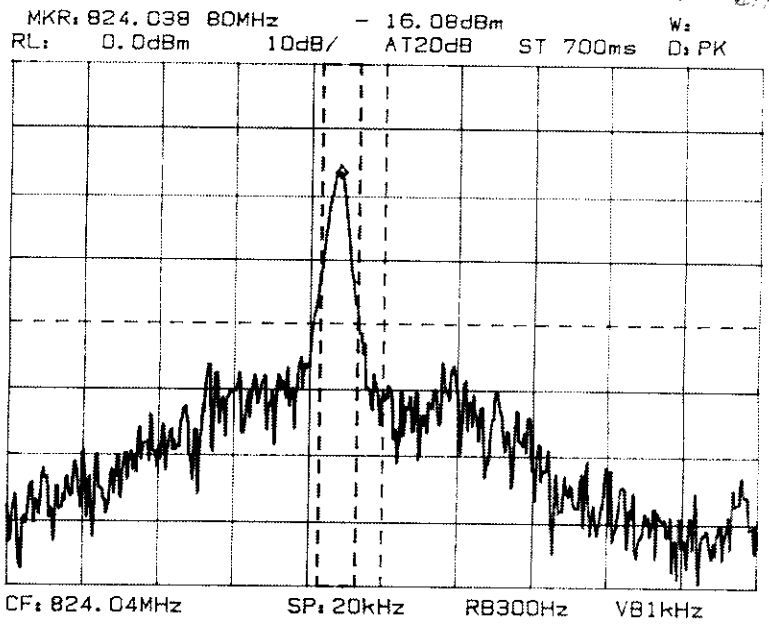
A. 1265 $\Delta f = -1.16$ kHz Ext $\Delta T = 11$ dB



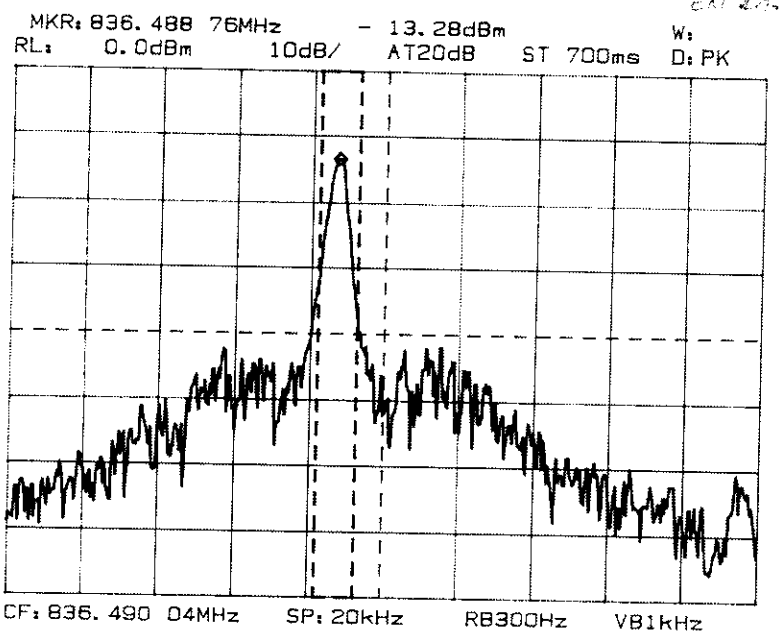
25.08.98
A.1266

Telrad CET-10 T = -20°C

Δf = -12 kHz



25.02.98 Telfad CET-10 T=-20°C

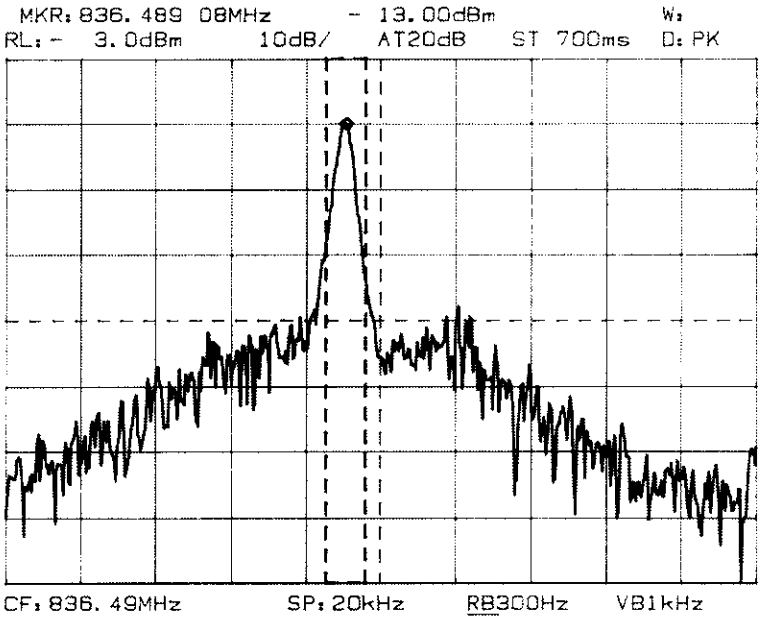


28.08.98
R. 12663

Tetrad CET-40 T=-20°C

Frequency stability Δf=-920 Hz

EUT ΔF=-41dB



Frequency Stability Over Temp. Range

The transceiver reference freq (14.4 MHz). is generated from a VCTCXO component (enclosed data sheet).

The temp. stability is +-2 ppm over 0 to +65 C.
In order to improve temp. stability we have compensated the original VCTCXO control voltage by addition of negative temp. coefficient (NTC) resistor in serial to R386 in the voltage divider. (see enclosed scheme).

The NTC resistor has an opposite behavior graph to the VCTCXO.
The result is a significant improvement . Enclosed is the result with the compensation over the temp. range: -30 to +40 C.

Bakalnick J

DETAIL SPECIFICATION FOR:
Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz

1. SCOPE:

THIS SPECIFICATION DEFINES THE REQUIREMENTS FOR:

Metal package , SMT , PCB mounting , Voltage Controlled Temperature Compensated Crystal Oscillator (VCTCXO), with internal trimmer, frequency 14.4MHz and Clipped Sine output.

2. APPLICABLE DOCUMENTS:

* TELRAD Quality Assurance Requirements(QAR) # 20-201-6302

3. REQUIREMENTS:

REQUIREMENTS SHALL BE AS SPECIFIED IN THE APPLICABLE DOCUMENT AND HEREIN.

3.1 Absolute Maximum Rating

The devices shall be capable of operation or storage through the full range of absolute maximum condition listed in Table 1 without damage. The devices need not necessary meet all of the electrical requirements of this specification under these condition.

						DRAWN			
						DESIGN	PODRIADCHIK BENY		01.05.96
						CHECKED	BOKALCHUK IOSY		
						APPROVED	SHPITZ ZVI		
REV	ECR No.	DESC. OF CHANGE	NAME	SIGN	DATE		NAME	SIGN	DATE
TITLE:		Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz				All dimensions are in mm unless otherwise specified.			Telrad
NUMBER:		27-201-1033/1			A4	Sheet: 1/8		W116-24	

Table 1

Symbols	Parameters	Min.	Max.	Unit
Vs	Supply voltage	-0.05	+7.0	V
Ts	Storage temperature	-40	+85	oC
	Terminal temperature (see Fig 2)		+220	oC

Note: All voltages referenced to ground.

3.2 Operating Range

The devices shall start up and operate under any combinations of supply voltage , and ambient temperature specified in Table 2. The devices shall meet all of the electrical parameters of this specification under these conditions.

Table 2

Symbols	Parameters	Min.	Max.	Unit
Vs	Supply voltage	+4.75	+5.25	V
Ta	Operating temperature	0	+65	oC
R_L	Output load R_L// C_L		10±10%	KΩ
C_L			10±10%	pF
Tst	Start-up time		7	mS

Note: All voltages referenced to ground.

						DRAWN			
						DESIGN	PODRIADCHIK BENY		01.05.96
						CHECKED	BOKALCHUK IOSY		
						APPROVED	SHPITZ ZVI		
REV	ECR No.	DESC. OF CHANGE	NAME	SIGN	DATE		NAME	SIGN	DATE

TITLE:	Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz		All dimensions are in mm unless otherwise specified.		Telrad
NUMBER:	27-201-1033/1	A4	Sheet: 2/8	W116-24	

3.3 Electrical Characteristic

Table 3

Symbols	Parameters	Test Condition	Min.	Max.	Unit
f	*Nominal Frequency*			14.4	MHz
	Frequency Adjustment Range	With internal trimmer	±3		ppm
$\Delta f/f$	*Initial Frequency Accuracy*	Ta = 25oC V_c=2.2V		±1	ppm
$\Delta f_a/f$	*Stability over temperature from 0 to 65oC*	Referenced to frequency at Ta = 25oC (Note 2)		±2	ppm
$\Delta f_a/v_s$	*Stability over v_s changes*	Supply Voltage ± 3%		±1	ppm
Δf_a/Load	*Stability over load changes*	Maximum load changes		±0.5	ppm
	Shock and vibration			±0.5	ppm
$\Delta f_a/f$	*Aging (first year)*			±1	ppm
$\Delta f_a/f$	*Aging (10 years)*	Including first year		±5	ppm
$\Delta f/f$	*Total stability*	Note 1		±8	ppm
VOL	*Output voltage*	Clipped Sine (ptp)	1		V
	Phase Noise(SSB)	1KHz		-130	dBc/Hz
	Phase Noise(SSB)	10KHz		-135	dBc/Hz
	Linearity			±10	%
V_c	*Control Voltage Range*		0.2	4.2	V
	Frequency Control Range	Positive Polarity. Centered at V_c=2.2V	±8	±14	ppm
Is	*Supply current*	Output not connected		8	mA

Note: 1. - The worst case deviation limit from the device nominal frequency may be encountered over the device working life(10 years) when operated over the entire range of operating condition as per Table 2. includes

REV	ECR No.	DESC. OF CHANGE	NAME	SIGN	DATE

DRAWN			
DESIGN	PODRIADCHIK BENY		01.05.96
CHECKED	BOKALCHUK IOSY		
APPROVED	SHPITZ ZVI		
	NAME	SIGN	DATE

TITLE: Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz

All dimensions are in mm unless otherwise specified.

NUMBER: 27-201-1033/1 | A4 | Sheet: 3/8 | WI16-24

Telrad

For manufacturers and part numbers see Telrad database.

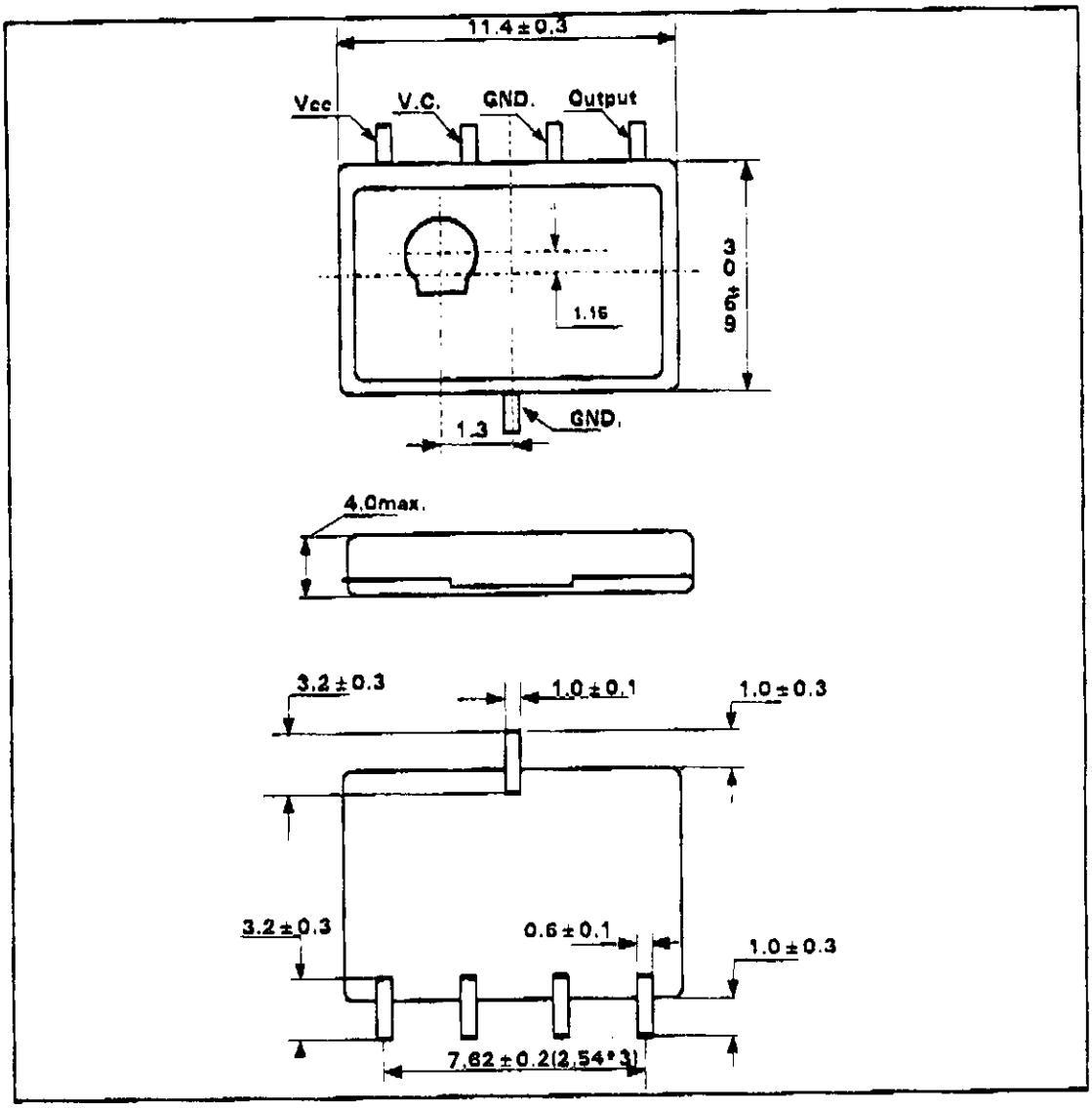


FIGURE 1(A)

						DRAWN			
						DESIGN	POORIADCHIK BENY		01.06.96
						CHECKED	BOKALCHUK IOSY		
						APPROVED	SHPITZ ZVI		
REV	ECR No.	DESC. OF CHANGE	NAME	SIGN	DATE		NAME	SIGN	DATE
TITLE:		Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz				All dimensions are in mm unless otherwise specified.			
NUMBER:		27-201-1033/1			A4	Sheet: 6/8	W116-24		

Telrad

Temperature Measurement

SMD

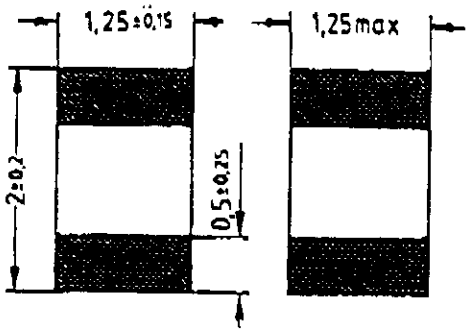
B 57620
C 620

Applications

- Temperature compensation in hybrid circuits, especially in data plus telecom systems and in automotive electronics
- Example: LCD compensation

Features

- Small dimensions, EIA size 0805
- Silver palladium terminations
- Cost-effective thermistor for automatic placement
- Suitable for wave and reflow soldering
- Also available in bulk



Dimensions in mm
Approx. weight 13 mg

Options

Resistance tolerance < 5% available

Climatic category (IEC 68-1)		55/125/21	
Max. power at 25 °C (on PCB)	P_{25}	210	mW
Resistance tolerance	$\Delta R/R_N$	± 5 %, ± 10 %, ± 20 %	
Rated temperature	T_N	25	°C
B value tolerance	$\Delta B/B$	± 3 %	
Dissipation factor (on PCB)	δ_{th} ')	approx. 3.5	mW/K
Thermal cooling time constant (on PCB)	τ_c ')	approx. 10	s
Heat capacity	C_{th} ')	approx. 35	mJ/K

Type	R_{25} Ω	No. of R/T characteristic	$B_{25/100}$ K	Ordering code (Tape & reel)
C 620/220/+	220	3207	3100	B57620-C221-+62
C 620/330/+	330	3204	3250	B57620-C331-+62
C 620/470/+	470	3205	3300	B57620-C471-+62
→ C 620/680/+	680	3206	3450	B57620-C681-+62
C 620/1 k/+	1 k	3206	3450	B57620-C102-+62
C 620/2.2 k/+	2.2 k	1304	3300	B57620-C222-+62
C 620/4.7 k/+	4.7 k	1307	3560	B57620-C472-+62
C 620/10 k/+	10 k	1011	3730	B57620-C103-+62
C 620/22 k/+	22 k	2003	3980	B57620-C223-+62
C 620/47 k/+	47 k	2101	4100	B57620-C473-+62
C 620/100 k/+	100 k	2004	4100	B57620-C104-+62
C 620/220 k/+	220 k	2904	4300	B57620-C224-+62

+: J for $\Delta R/R_N = \pm$ 5 %
K for $\Delta R/R_N = \pm$ 10 %

HERMON LABORATORIES

P.O.Box 23 Binyamina 30500 Israel
Tel. +972-6-6286001
Fax +972-6-6286277
Email: *hermon@Netvision.net.il*

August 26, 1998

Federal Communication Commission
Equipment Authorization Division
Application Processing Branch
7435 Oakland Mills Road
Columbia MD 21046,
USA
Att: Mr. Frank Coperich

RE: Your E-mail dated August 4, 1998; correspondence ID: 2429

Subject: FCC ID: ARACET-10, Application for type acceptance of digital radio telephone, applicant Telrad Telecommunication and Electronic Industries Ltd.
731 Confirmation Number: EA89412

Dear Frank,

Many thanks for your response. Please find below Hermon Labs answers in reference to your message.

1. Please find the test results according to F1D basic characteristics (Attachment #1, 6 plots).

2. Still I do not understand the FCC requirements for the deviation. From my point of view (plus see EIA IS55, para. 3.3.1.2.3.3, our Attachment #2) this is the maximum but not minimum requirements. Please find below the modified our Table 3.4.3, which clearly shows increasing of deviation by increased (+ 20 dB) input signal, where 45 mV is the customer defined nominal signal. The quality of the communication link is also provided by our customer (Telrad) product.

3. Please find the frequency stability test data down to -30°C (corrected page 44 of Test Report TLRFCC.12663, Attachment #3, 9 plots – frequency stability, 6 plots – output power).

4. The ERP value is 1.07 W, which is less than 1.5 W, the device complies with the MPE limits and a warning label is not required.

Yours most sincerely,

Dr. E. Usoskin,CEO

Hermon Laboratories

Attachements: 1) your message dated August 4, 1998

2) corrected table 3.4.3 (page 237 of the test Report TLDFCC.12663)

3) Attachments #1 and #3 (plots of measurements)

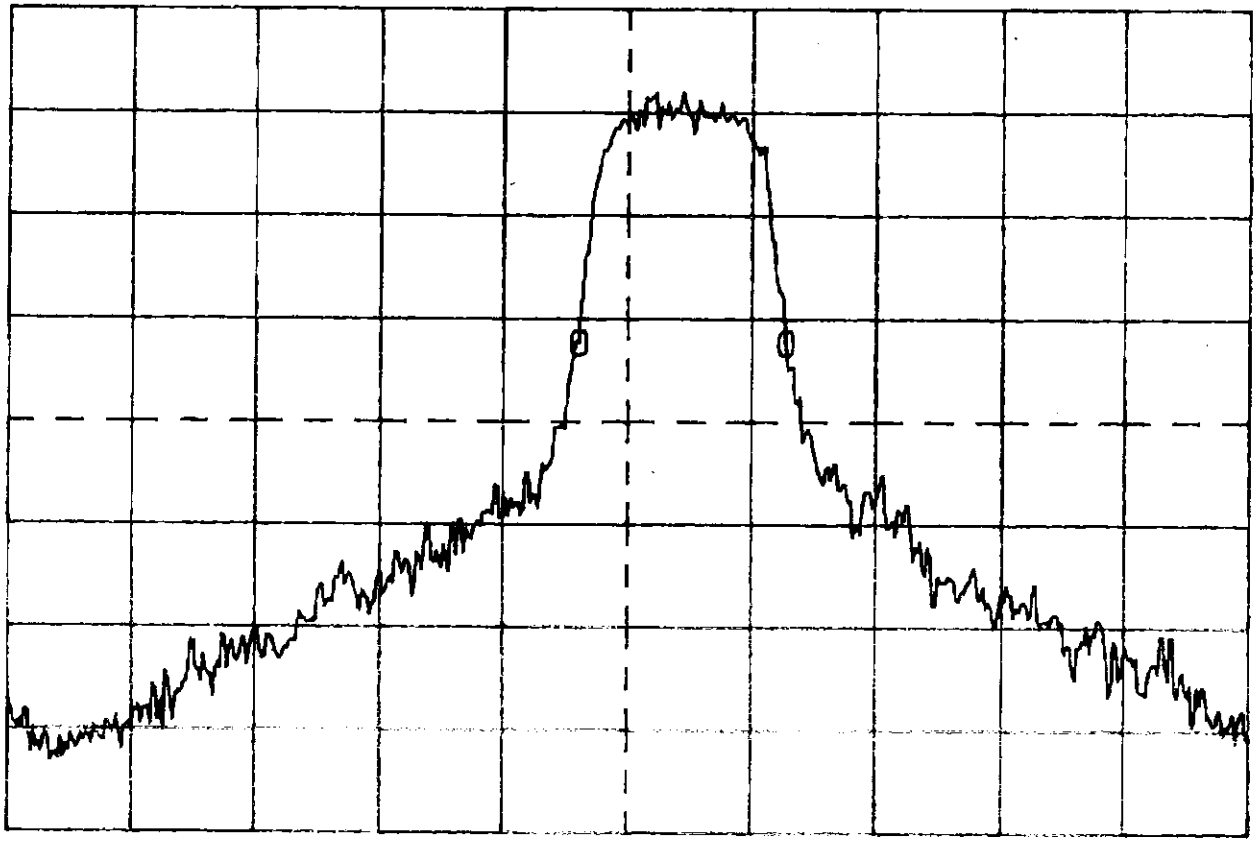
16.02.98 Pt. 12663 Telrad CET-10 FCC p. 22

mode : digital voice pi/4DQPSK mask according to F1D

Occupied bandwidth at maximum output power

EXT ATT = 41 dB

dM: + 33.60kHz + 0.0dB < 40 kHz limit



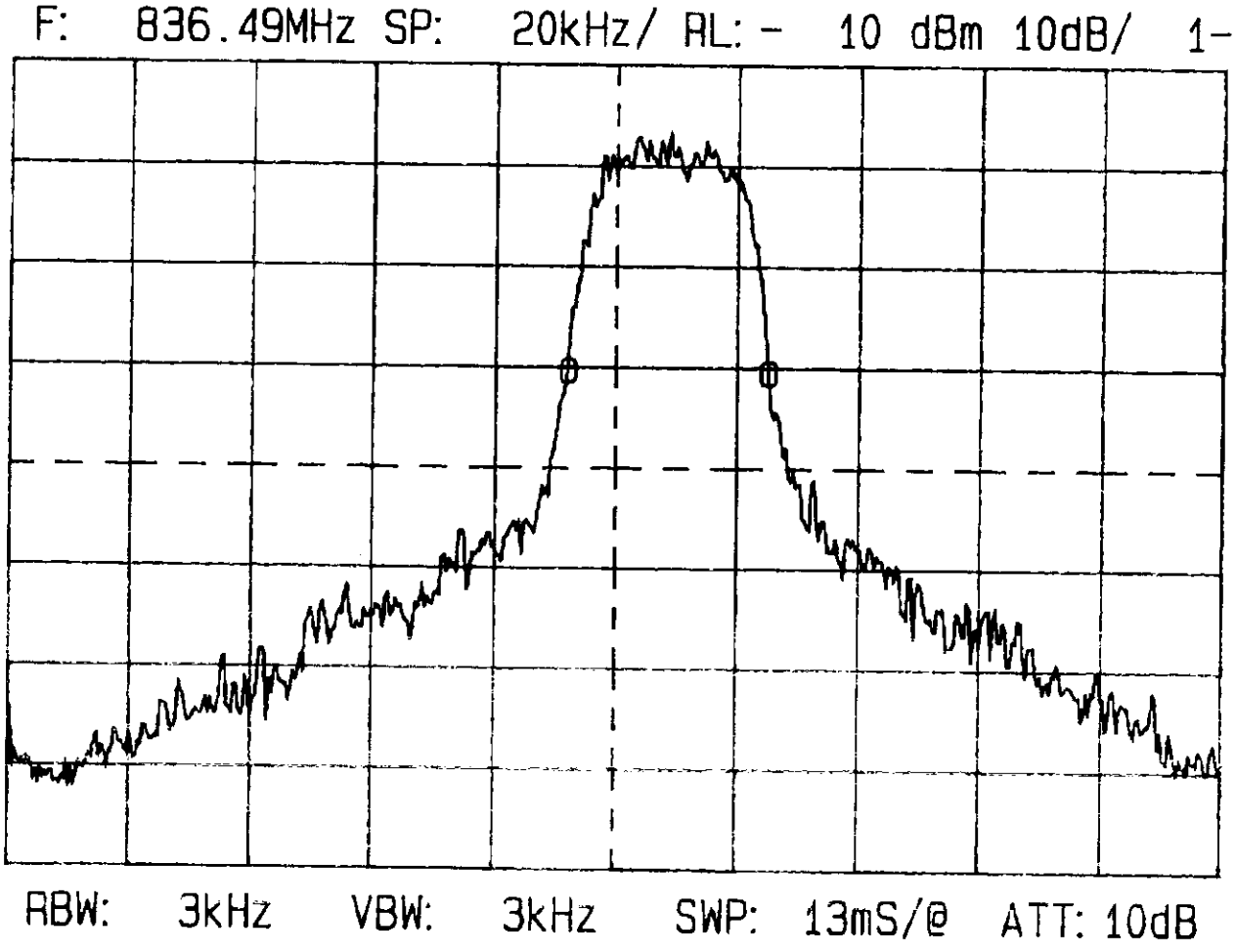
FRANK please look at this. This is the original of page 72 of our test report dated april 1998

Attachment #1, plot No. 1

16.02.98 Nr. 12663 Telrad CET-10 FCC p. 22

Mode: digital Voice pi/4DQPSK mask according to FID
Occupied bandwidth at maximum output power

dM: + 33.20kHz - 0.2dB < 40 kHz limit



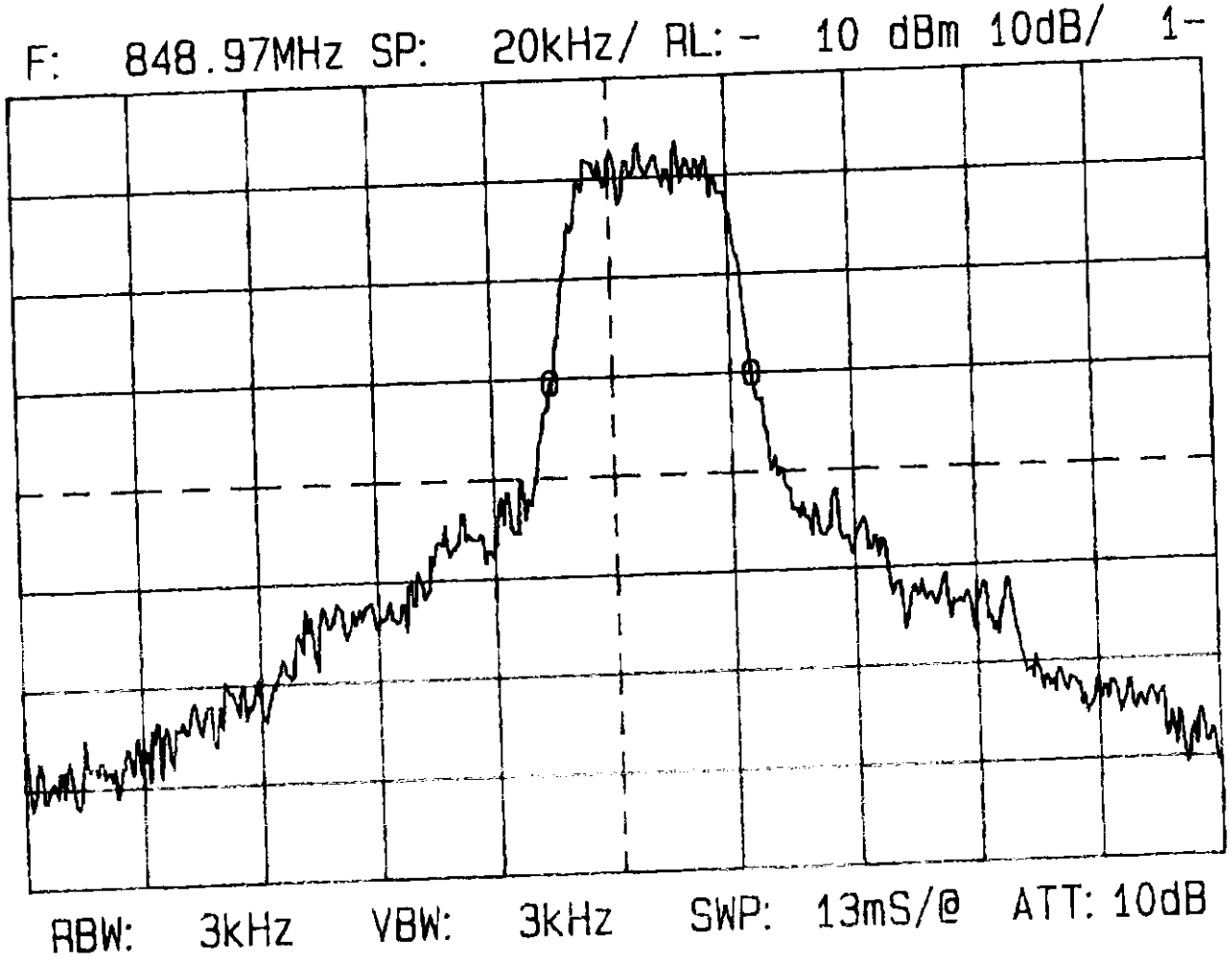
Plot No. 2

16.02.98. Ref. 12663 Telrad CET-10 FCC p. 22

Mode: digital via pi/4DQPSK mask according to F1D

Occupied Bandwidth at maximum output power

dM: + 34.00kHz + 0.4dB < 40 kHz limit



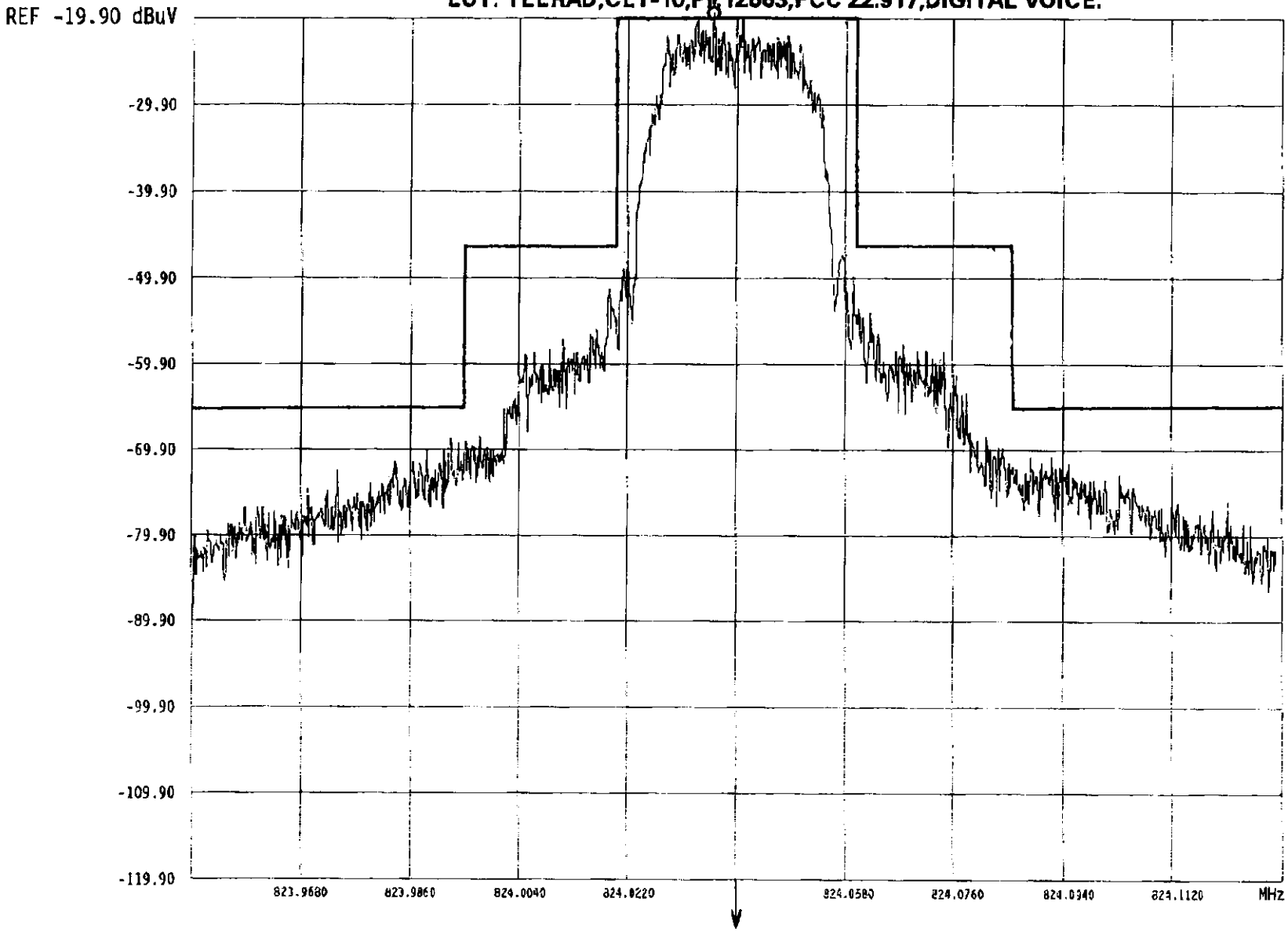
Plot No. 3

Emission mask

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 19:32:40

EUT: TELRAD,CET-10,P/N 12663,FCC 22.917,DIGITAL VOICE.



Start: 823.95 MHz Center: 824.04 MHz Stop: 824.13 MHz

Plot No. 4

Generated by HERMON LABS EMC LTD Plot Generator program

AUG 26 '98 16:32 HERMON LABS

P.6

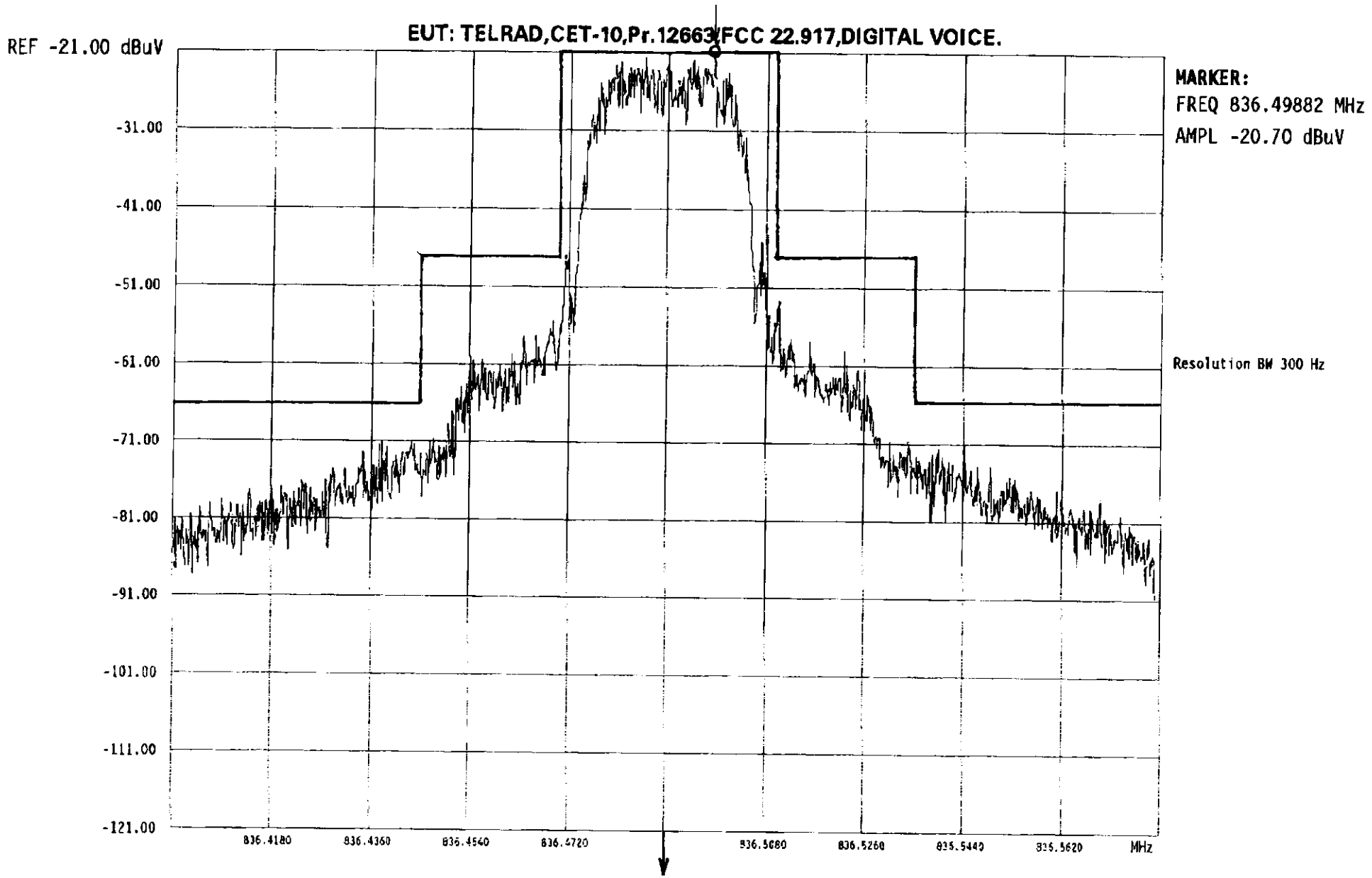
4

Emission mask

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 19:49:44

EUT: TELRAD,CET-10,Pr.12663,FCC 22.917,DIGITAL VOICE.



Start: 836.4 MHz

Center: 836.49 MHz

Stop: 836.58 MHz

Plot No.5

Generated by HERMON LABS EMC LTD Plot Generator program

AUG 26 '98 16:32 HERMON LABS

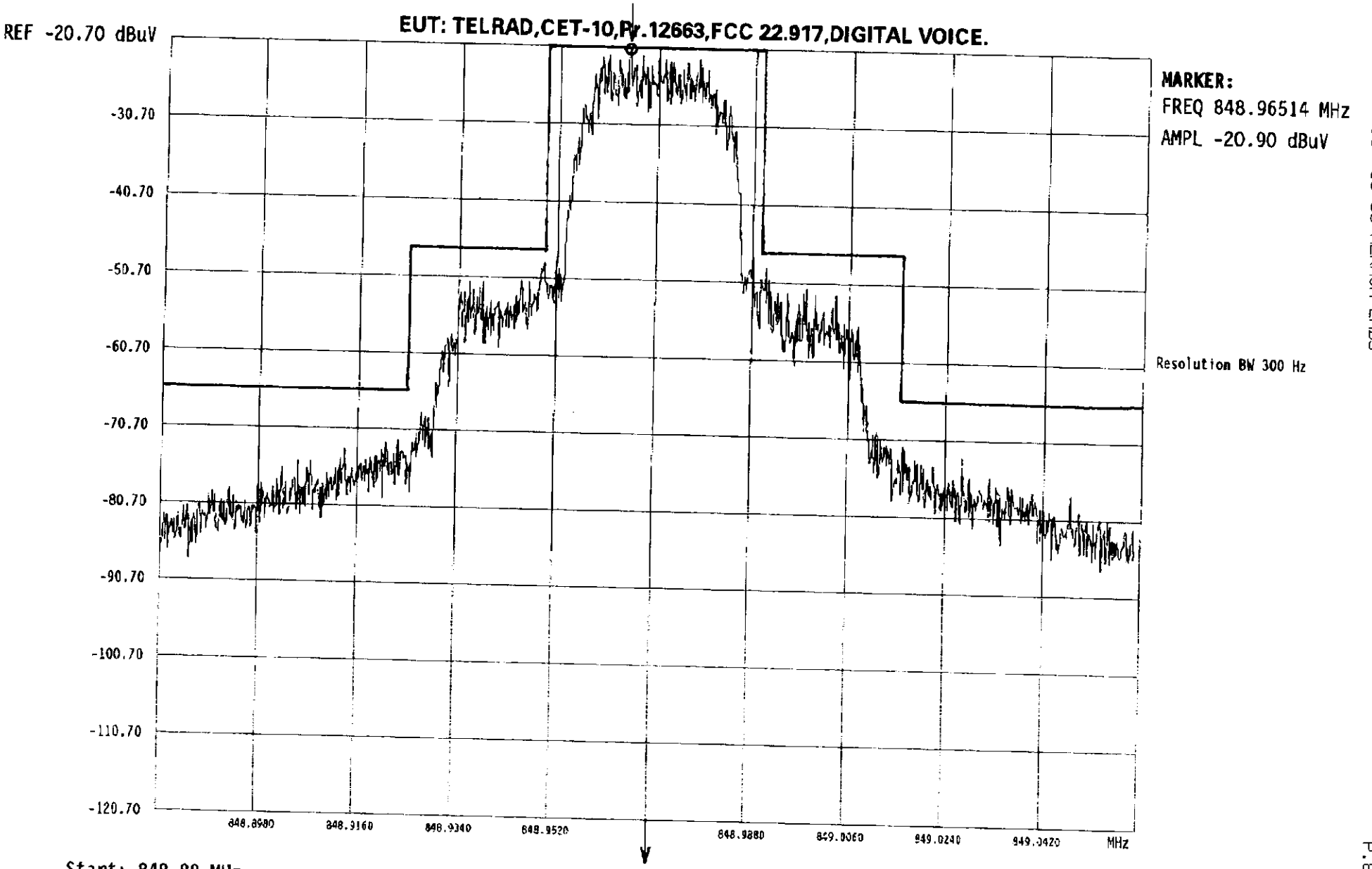
P.7

5

Emission mask

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 19:39:27



AUG 26 '98 16:33 HERMON LABS

P.8

Plot No. 6

Generated by HERMON LABS EMC LTD Plot Generator program

6

§ 2

Table 3.4.3 Modulation characteristics measurement test results

TEST SPECIFICATION:	FCC part 2, §2.987 (b), part 22, §22.915(c)
COMPANY:	Telrad
EUT:	CET-10
DATE:	July 16, 1998
RELATIVE HUMIDITY:	48%
AMBIENT TEMPERATURE:	23°C

Carrier frequency 836.49 MHz

Modulating frequency, kHz	Initial		Increased	
	Nominal level, mV	Deviation, kHz	By 20 dB level, mV	Deviation, kHz
0.5	45	3.7	450	4.1
1	45	7.6	450	8.3
1			2000	7.1
3	45	6.6	450	6.6

Test performed by:
Mr. Michael Nikishin, test engineer

Hermon Labs

EIA IS54B

PN3304
July 13, 1994 EIA 1555

Attachment #2

3.3.1.2.3 **Modulation Deviation Limiting**

3.3.1.2.3.1 **Definition**

Modulation limiting refers to the ability of the transmitter circuits to prevent the transmitter from producing deviation in excess of rated system deviation.

3.3.1.2.3.2 **Method of Measurement**

The transmitter shall be set to a channel near the center of the band and adjusted per the manufacturer's procedures and instructions for full rated system deviation. With the compressor enabled and the SAT disabled, adjust the audio input for ±8 kHz peak frequency deviation at 1004 Hz. Increase the audio input level by 20 dB in one step (rise time between the 10% and 90% points shall be 0.1 second maximum). Both the instantaneous peak and the steady-state deviations at and after the time of increasing the signal level shall be observed.

With the input level held constant at the 20 dB level, vary the frequency and observe the deviation for all frequencies between 300 and 3000 Hz.

Repeat with the transmitter set on channel 991 and then to channel 799, and then repeat over the environmental conditions described in 4.

3.3.1.2.3.3 **Minimum Standard**

X The instantaneous peak and steady-state deviations shall not exceed the rated system peak frequency deviation of ±12 kHz at any audio frequency or reasonable change in input level while operating on any channel under the environmental test conditions described in 4. This requirement excludes SAT and 10 kilobit/second wideband data signals.

3.3.1.2.4 **Audio Voice-Path Muting**

3.3.1.2.4.1 **Definition**

Audio muting under control of the logic circuitry shall be provided during wideband data transmission periods.

3.3.1.2.4.2 **Method of Measurement**

Operate the transmitter under standard test conditions with the compressor enabled and a 1004 Hz modulating tone adjusted for ±8 kHz peak frequency deviation. Monitor the transmitter carrier demodulated level using a C-message weighted filter.

Enable the voice mute circuit and measure the attenuation of the 1004 Hz test tone.

HERMON LABORATORIES

Table 3.2.1
Frequency stability test results

Carrier frequency, MHz	Frequency stability limit, ±Hz	Measured frequency tolerance, ±Hz vs temperature, °C								Pass/ Fail
		-30	-20	-10	0	10	20	30	40	
824.04	2060	-840	-1200	-1160	-1160	-1240	-1360	-1400	-1440	Pass
836.49	2091	-920	-1240	-1200	-1200	-1280	-1320	-1400	-1400	Pass
848.97	2122	-1000	-1200	-1160	-1160	-1240	-1360	-1400	-1400	Pass

Table 3.2.2
Frequency stability test results

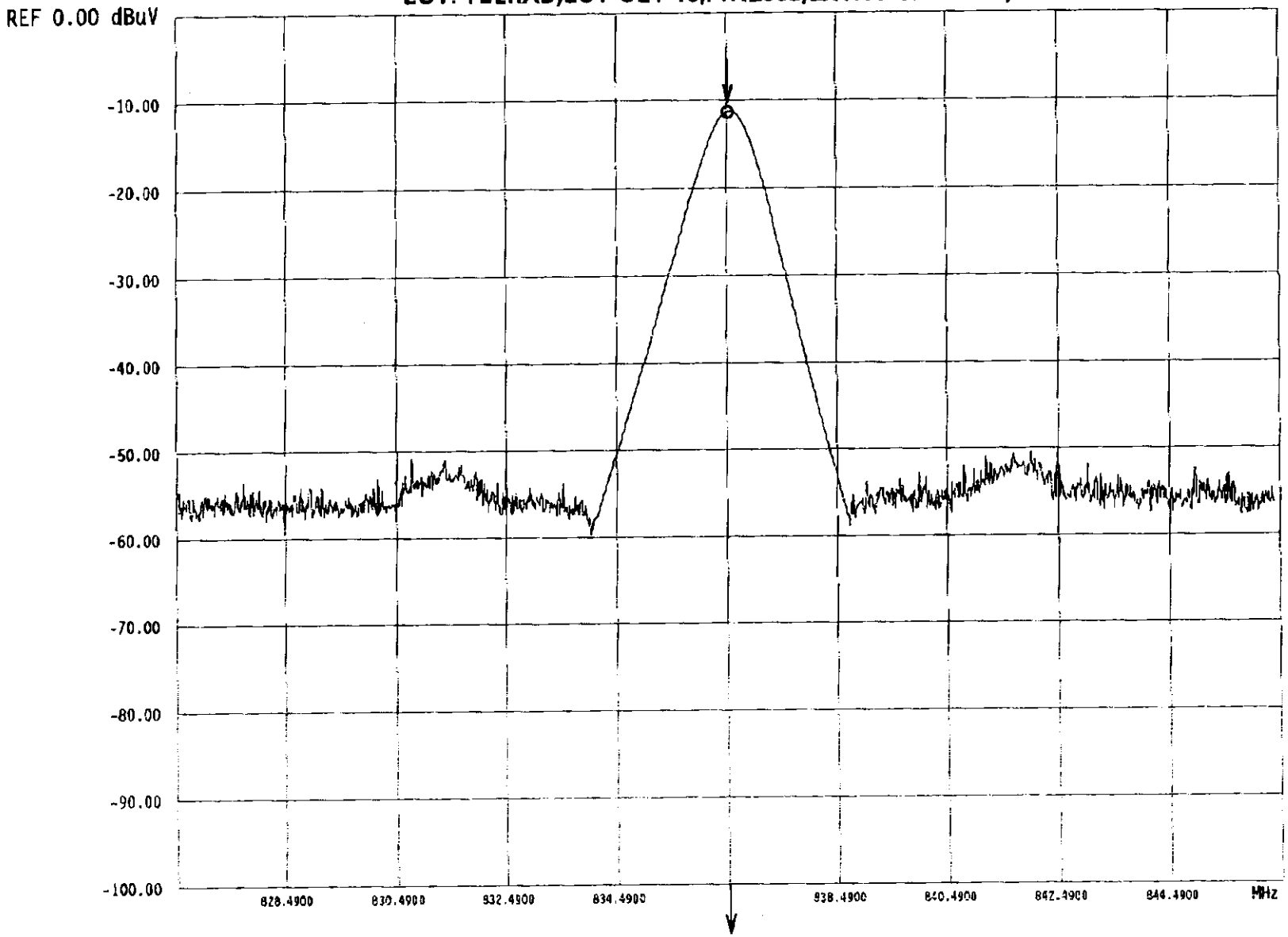
Carrier frequency, MHz	Frequency stability limit, ±Hz	Measured frequency tolerance, ±Hz vs primary supply voltage		Pass/ Fail
		102 V AC	138 V AC	
824.04	2060	140	120	Pass
836.49	2091	360	240	Pass
848.97	2122	80	-20	Pass

Power output
Analog mode

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 16:16:30

EUT: TELRAD,EUT-CET 10,Pr.12663,EXT. ATT.=41 dB,T=-10° C.



Start: 826.49 MHz Center: 836.49 MHz Stop: 846.49 MHz

AUG 26 '98 16:34 HERMON LABS

P.12

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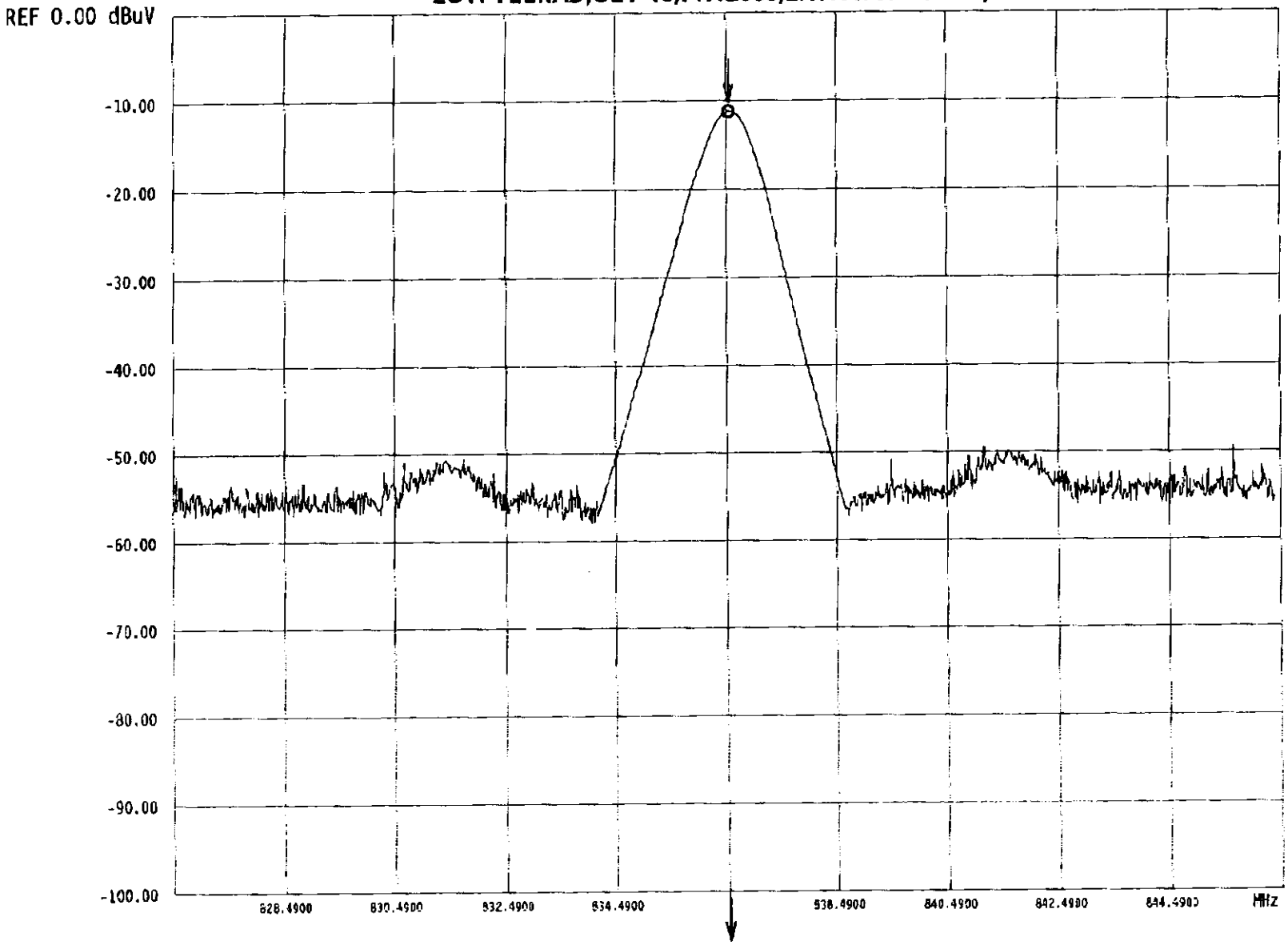
Power output
Analog mode

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 17:12:28

EUT: TELRAD,CET-10,Pr.12663,EXT. ATT.=41 dB,T=-20°C.



Start: 826.49 MHz Center: 836.49 MHz Stop: 846.49 MHz

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AUG 26 '98 16:35 HERMON LABS

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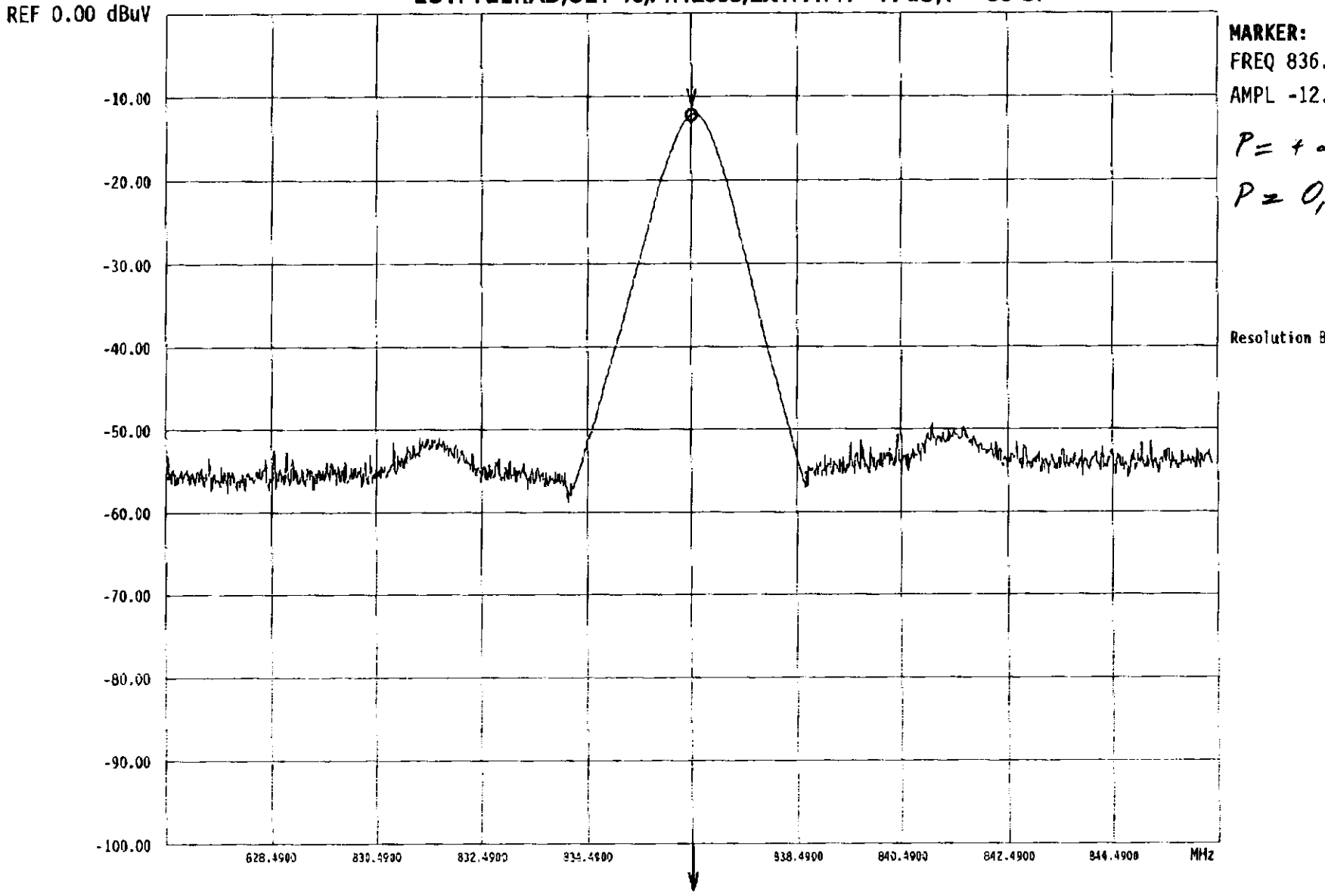
8

power output analog mode

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 17:57:52

EUT: TELRAD,CET-10,Pr.12663,EXT. ATT.=41 dB,T=-30°C.



Start: 826.49 MHz Center: 836.49 MHz Stop: 846.49 MHz

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P.14

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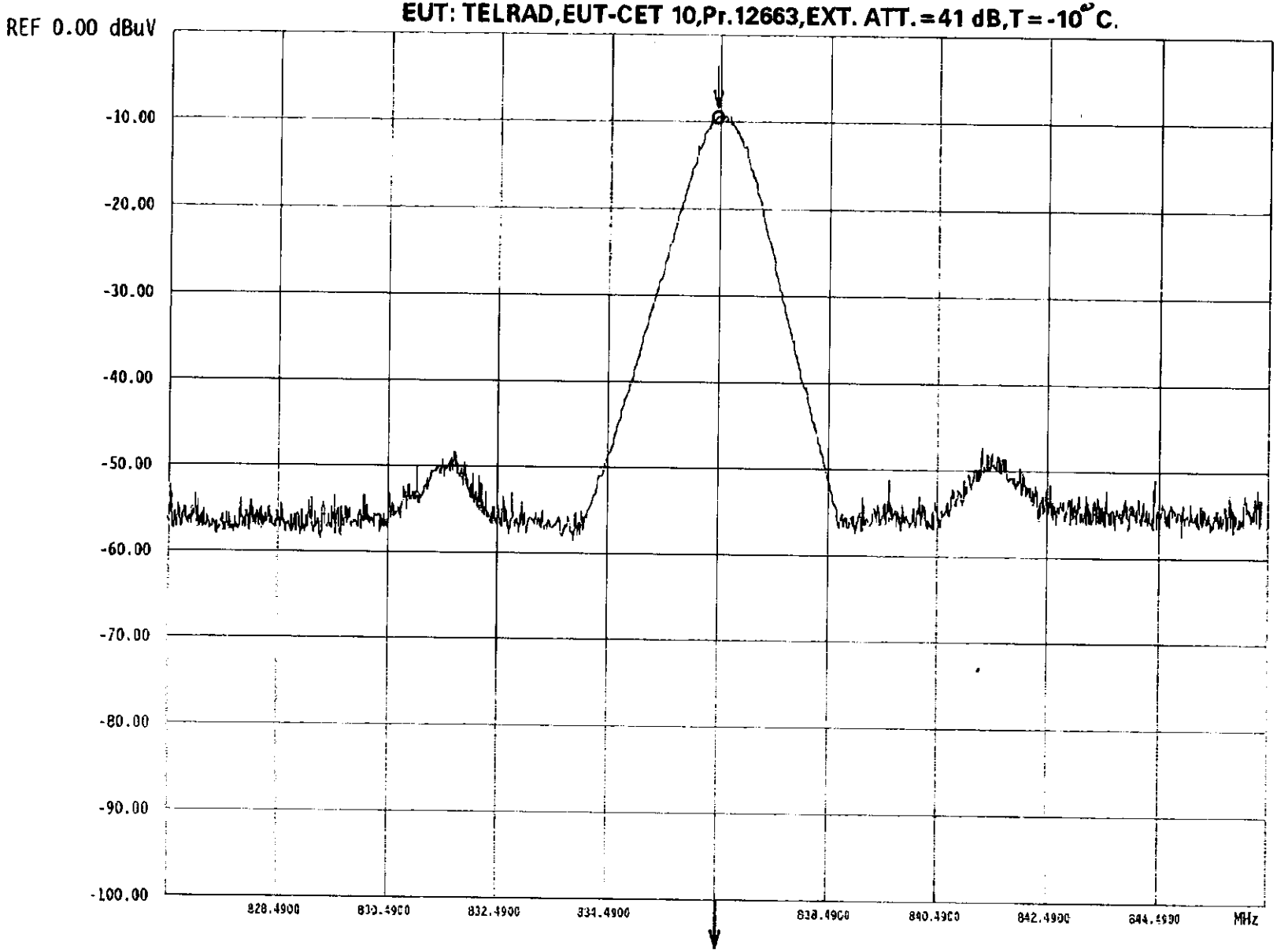
9

Power output
Dipital mode

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 16:28:22

EUT: TELRAD,EUT-CET 10,Pr.12663,EXT. ATT.=41 dB,T=-10°C.



AUG 26 '98 16:35 HERMON LABS

P.15

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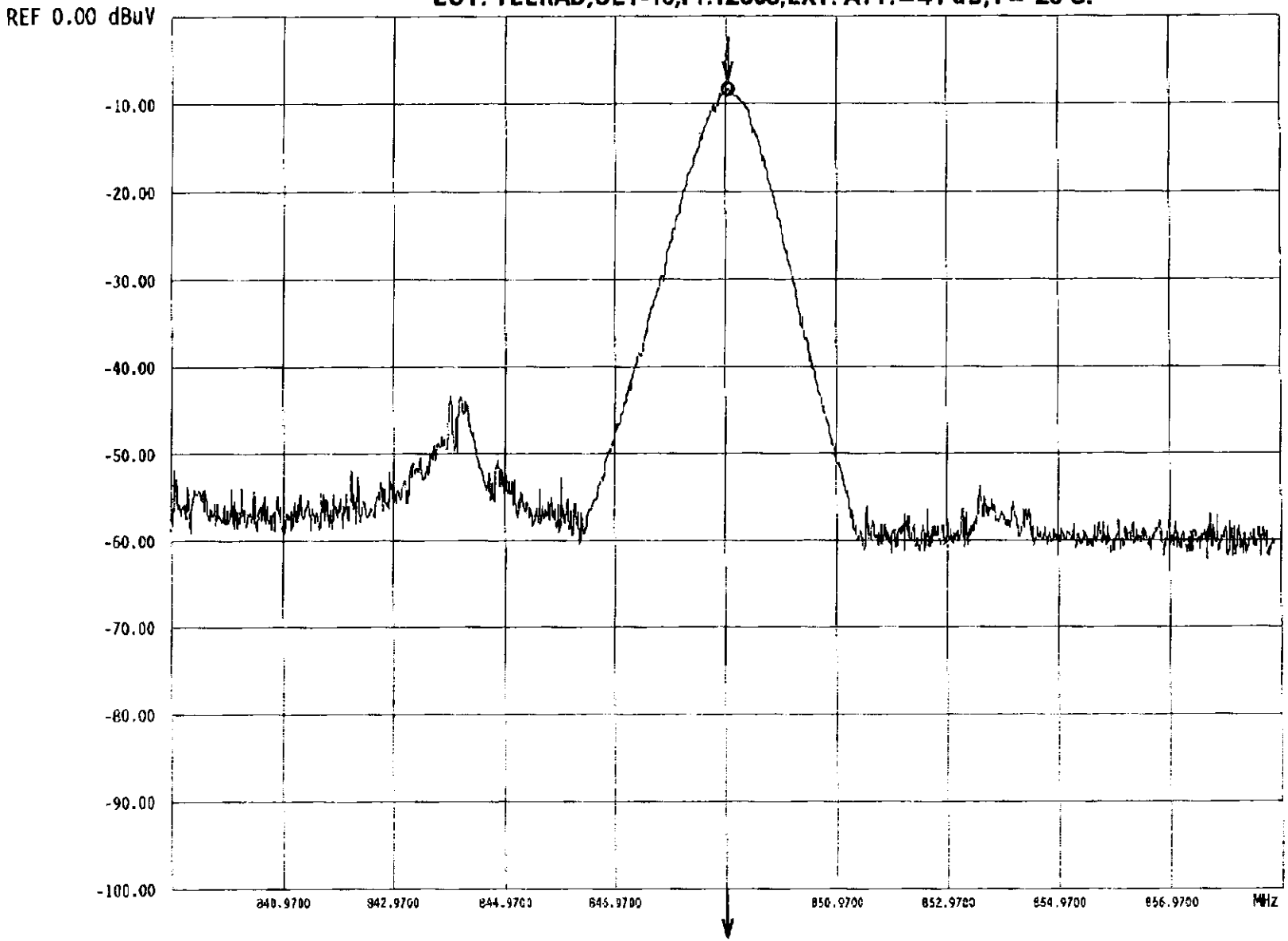
10

tower output
Digital mode

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 17:18:2

EUT: TELRAD,CET-10,Pr.12663,EXT. ATT.=41 dB,T=-20°C.



Start: 838.97 MHz Center: 848.97 MHz Stop: 858.97 MHz

AUG 26 '98 16:36 HERMON LABS

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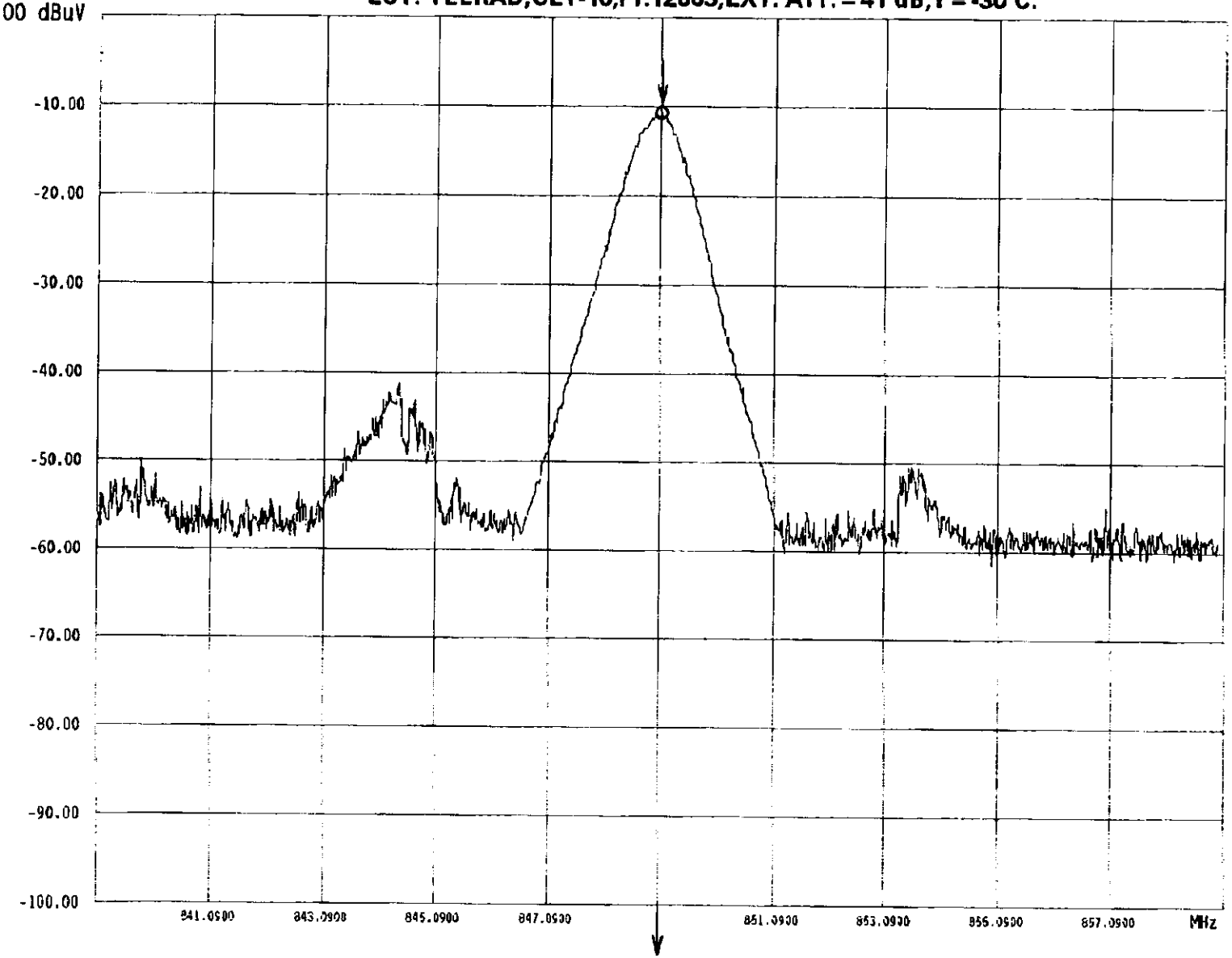
11

Power output
Digital mode

Hermon Labs EMC LTD

Thursday, 6/8/1998
Time: 18:4:25

EUT: TELRAD,CET-10,Pr.12663,EXT. ATT. = 41 dB,T = -30°C.



P = 30,5 dBu
P = 1,1 W

Start: 839.09 MHz
Center: 849.09 MHz
Stop: 859.09 MHz

AUG 26 '98 16:36 HERMON LABS

P.17

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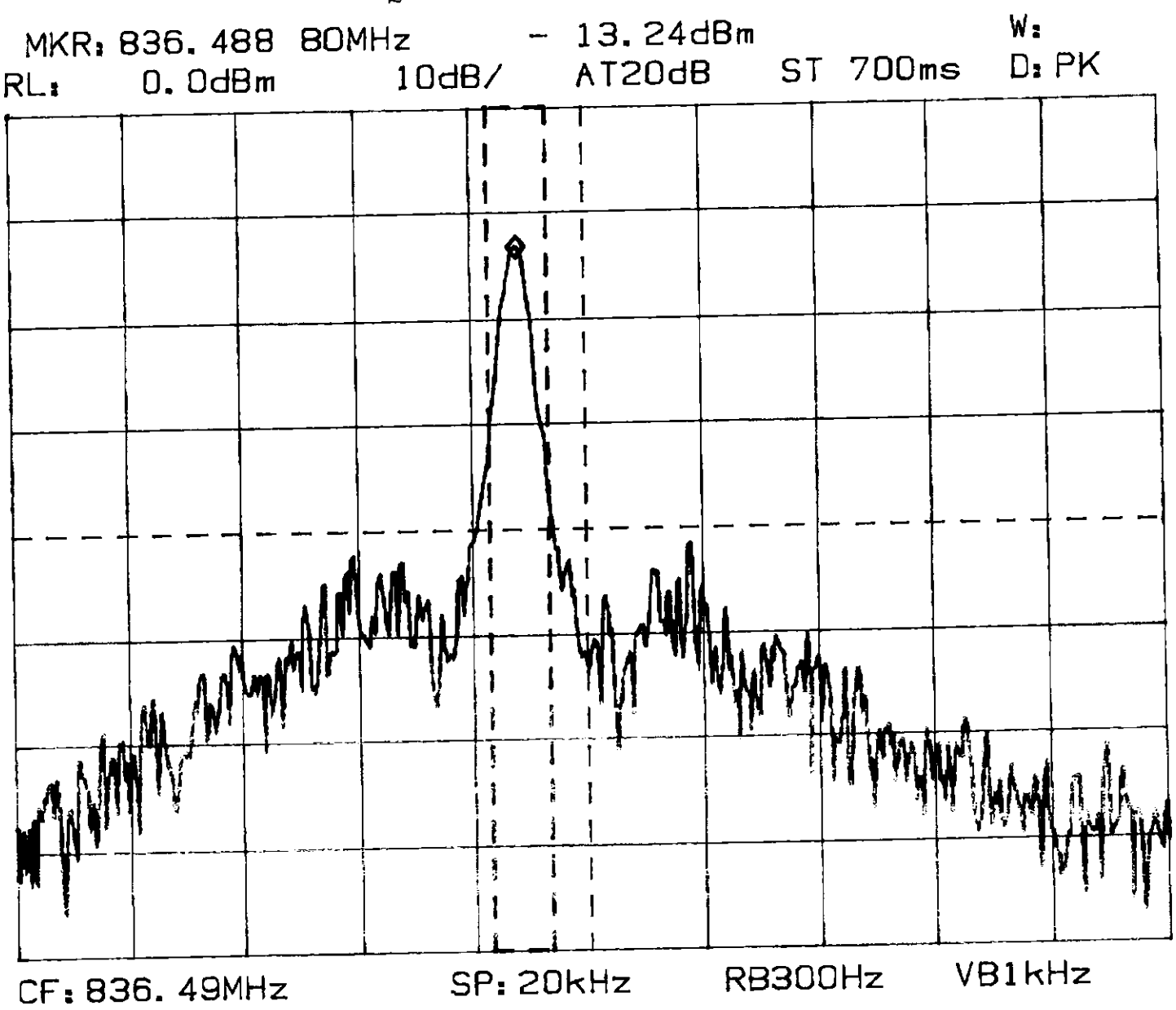
25.08.98
Pr. 12663

Telrad CET-10 Tz -10°C

ΔFz -1.2 kHz

EXT ATTz Y1 dB



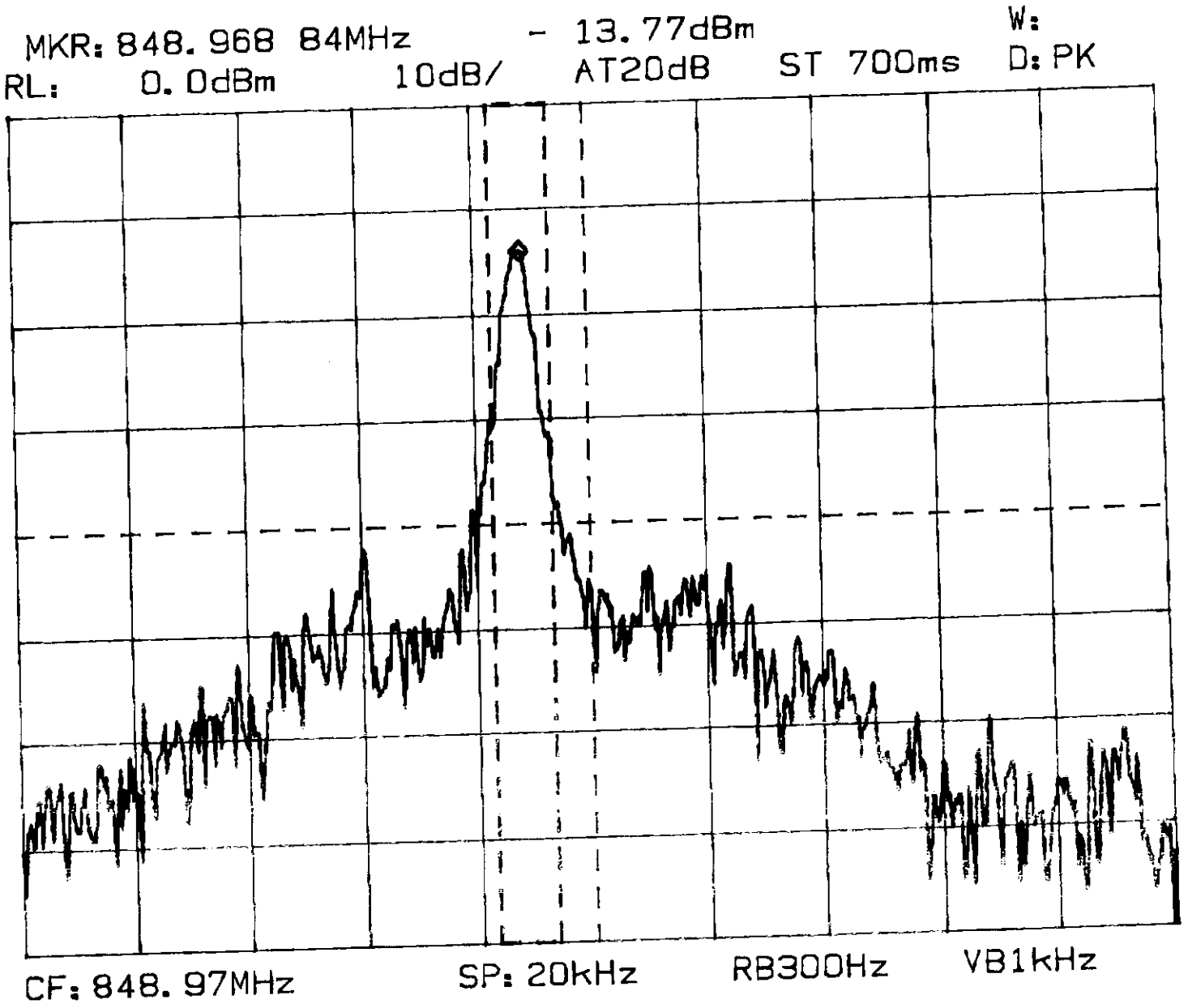
25.08.98

A. 12665

Telrad CET-10 T = -10°C

ΔF = -1.16 kHz

Ext ATT = 41 dB

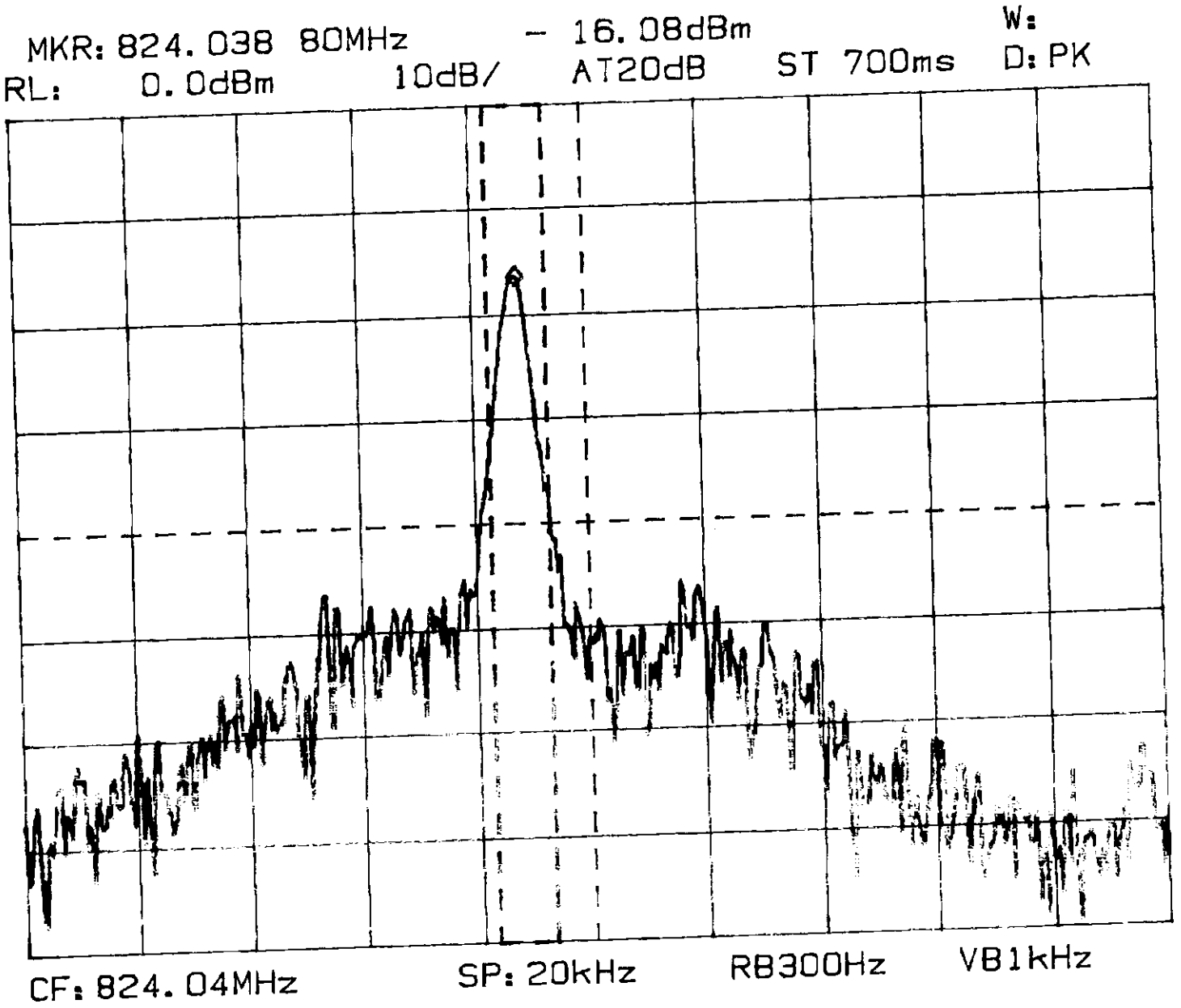


25.08.98.
Pt. 1266

Telrad CET-10 T = -20°C

Δ F = -1.2 kHz

EXT ATT = 41 dB

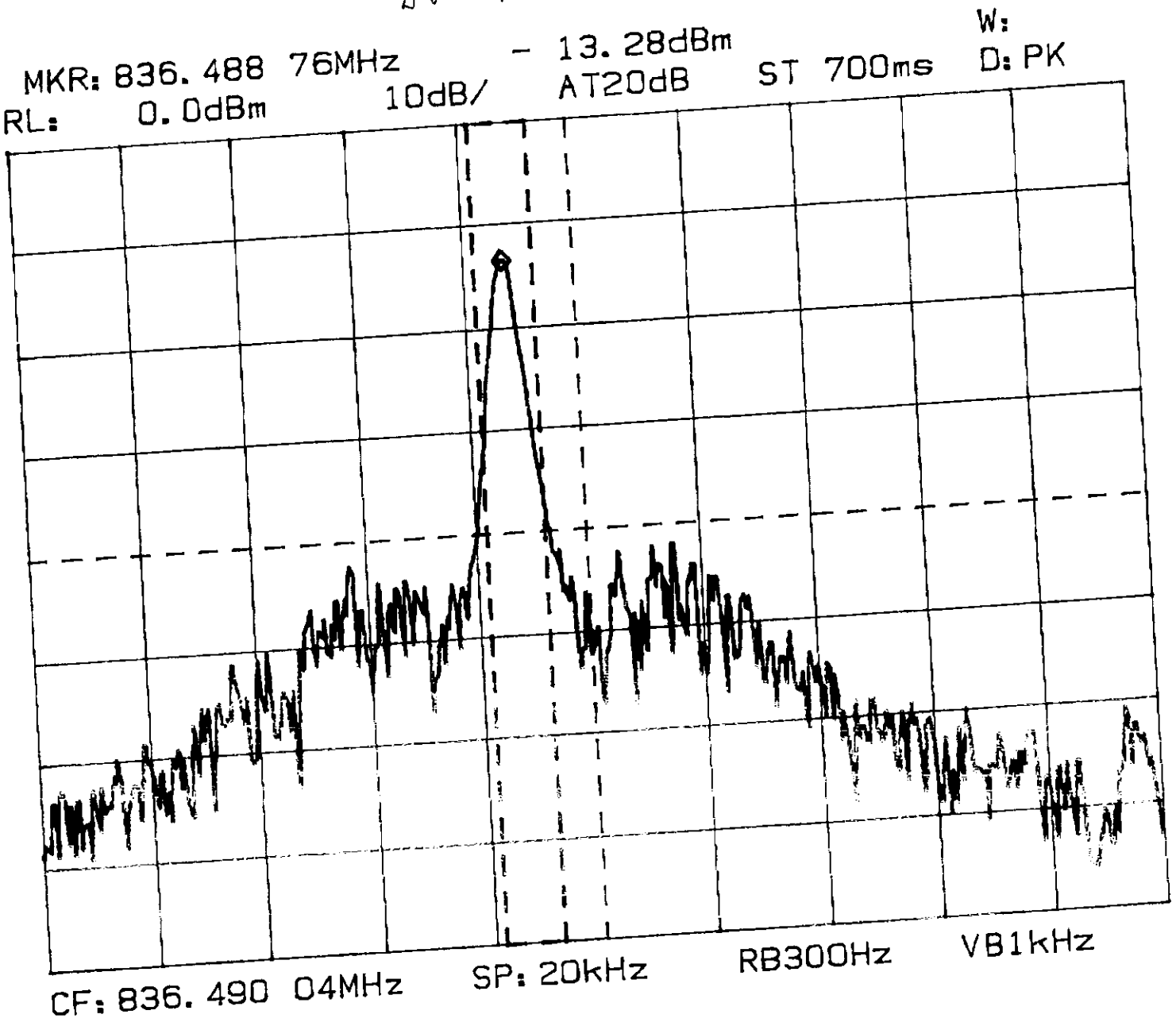


25.08.98
R. 1266

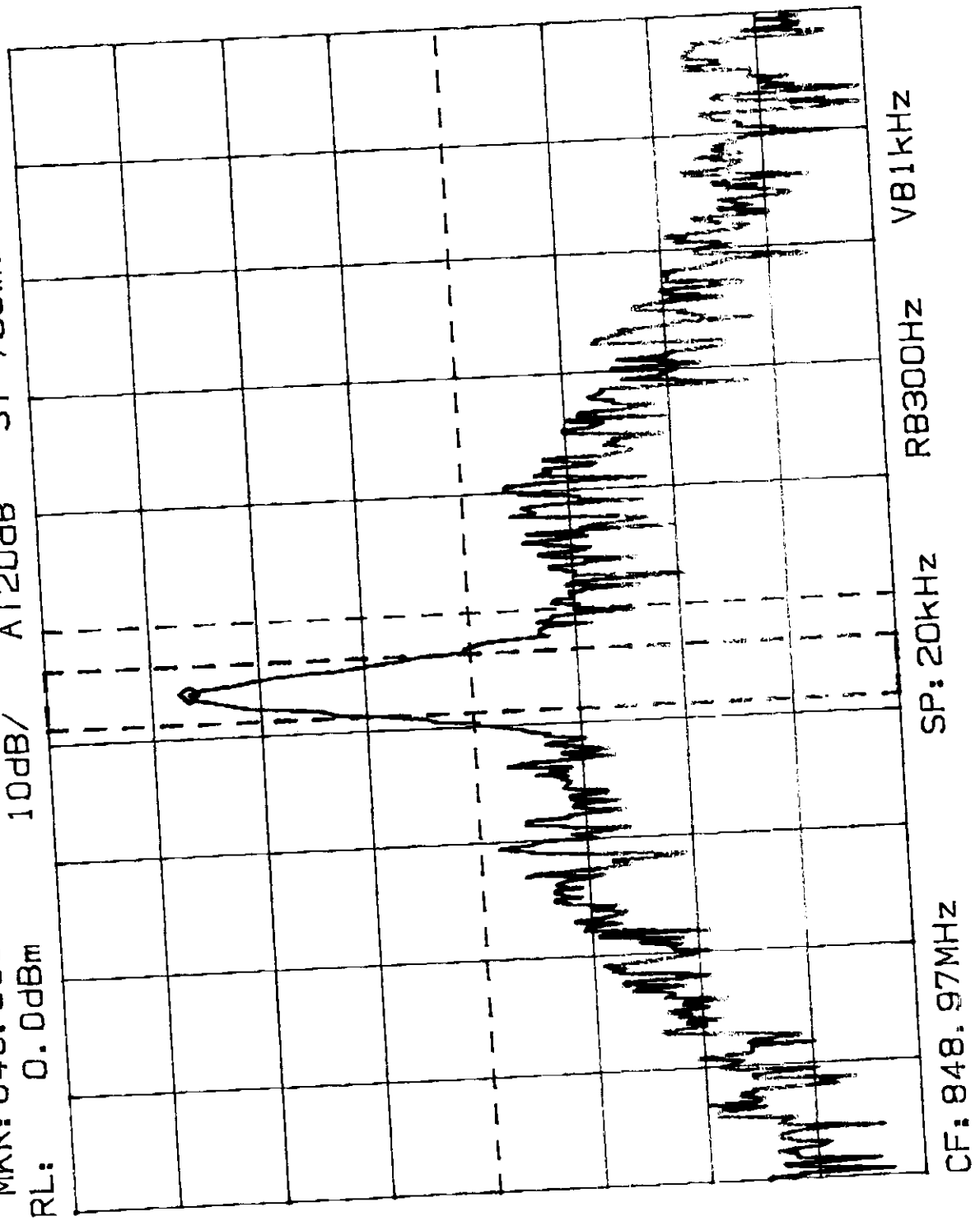
Tetrad CET-10 T = -20°C

ΔF = -1.24 kHz

EXT ATT = 41 dB



EXT ATT = 41 dB

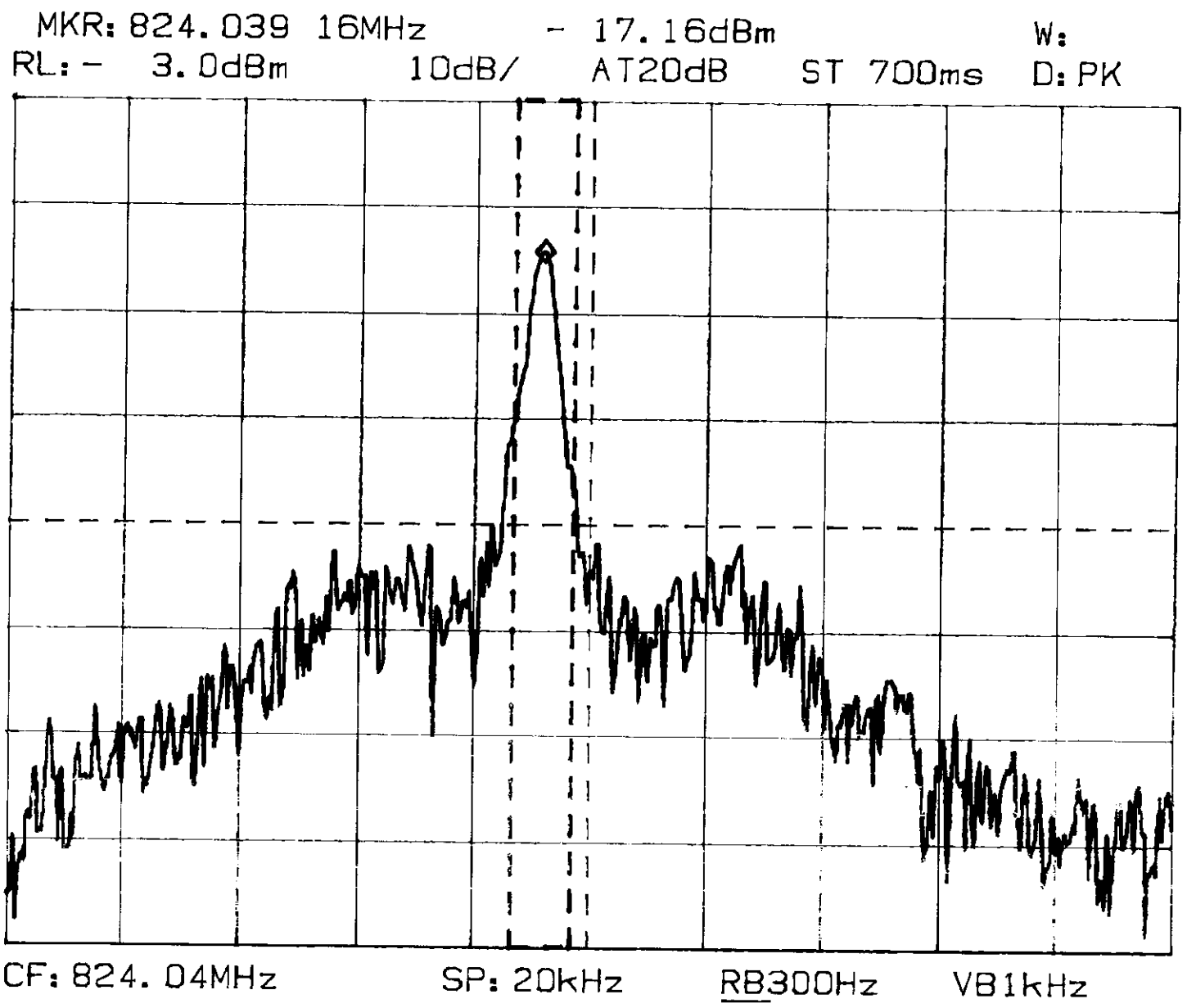


Telrad CET-10 T=-20°C
ΔF=-1.2 kHz

25.08.98
12663

25.08.98 Tetrad CET-10 T=-30°C

Pr.1266 Frequency stability ΔF=-840 Hz EXT ATT=41 dB



AUG 26 '98 16:39 HERMON LABS

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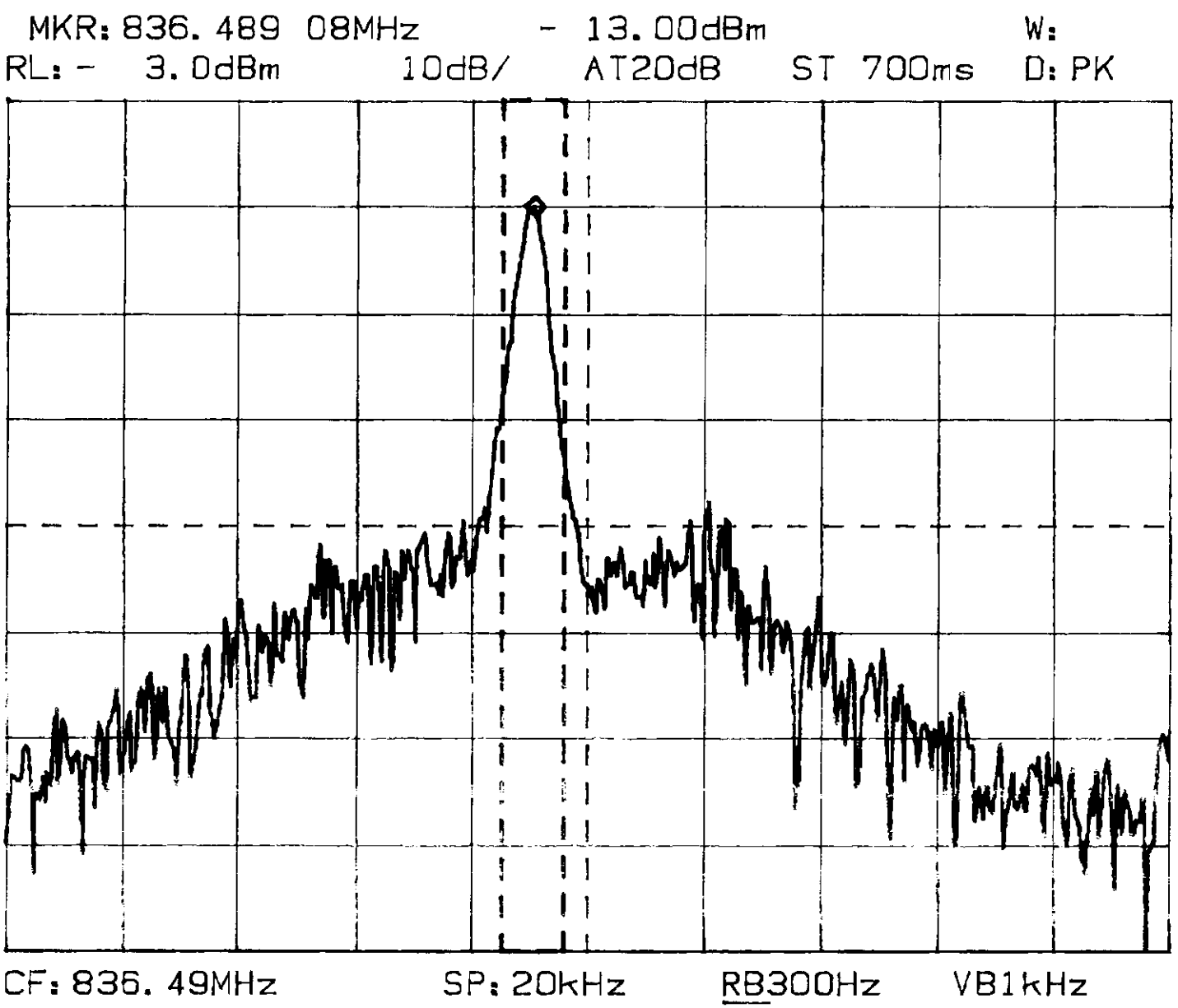
25.08.98
Pr. 12663

Telrad CET-10 T = -30°C

Frequency stability ΔF = -920 Hz

EXT ATT = 41 dB



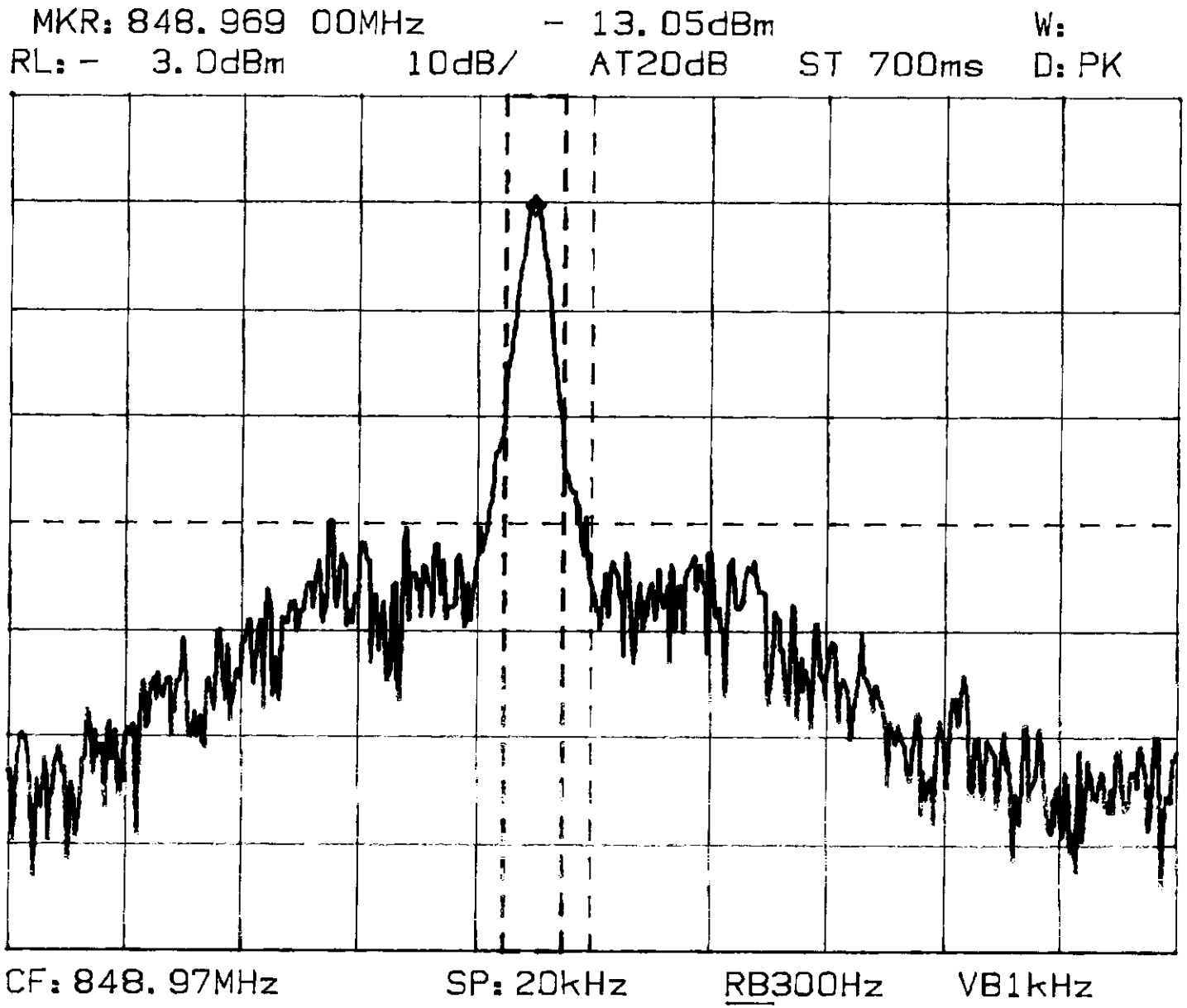
AUG 26 '98 16:40 HERMON LABS

P.25

25.08.98 Telrad CET-10 T = -30°C

Frequency stability ΔF = -1 kHz

EXT ATT = 41 dB



AUG 26 '98 16:40 HERMON LABS

P.26

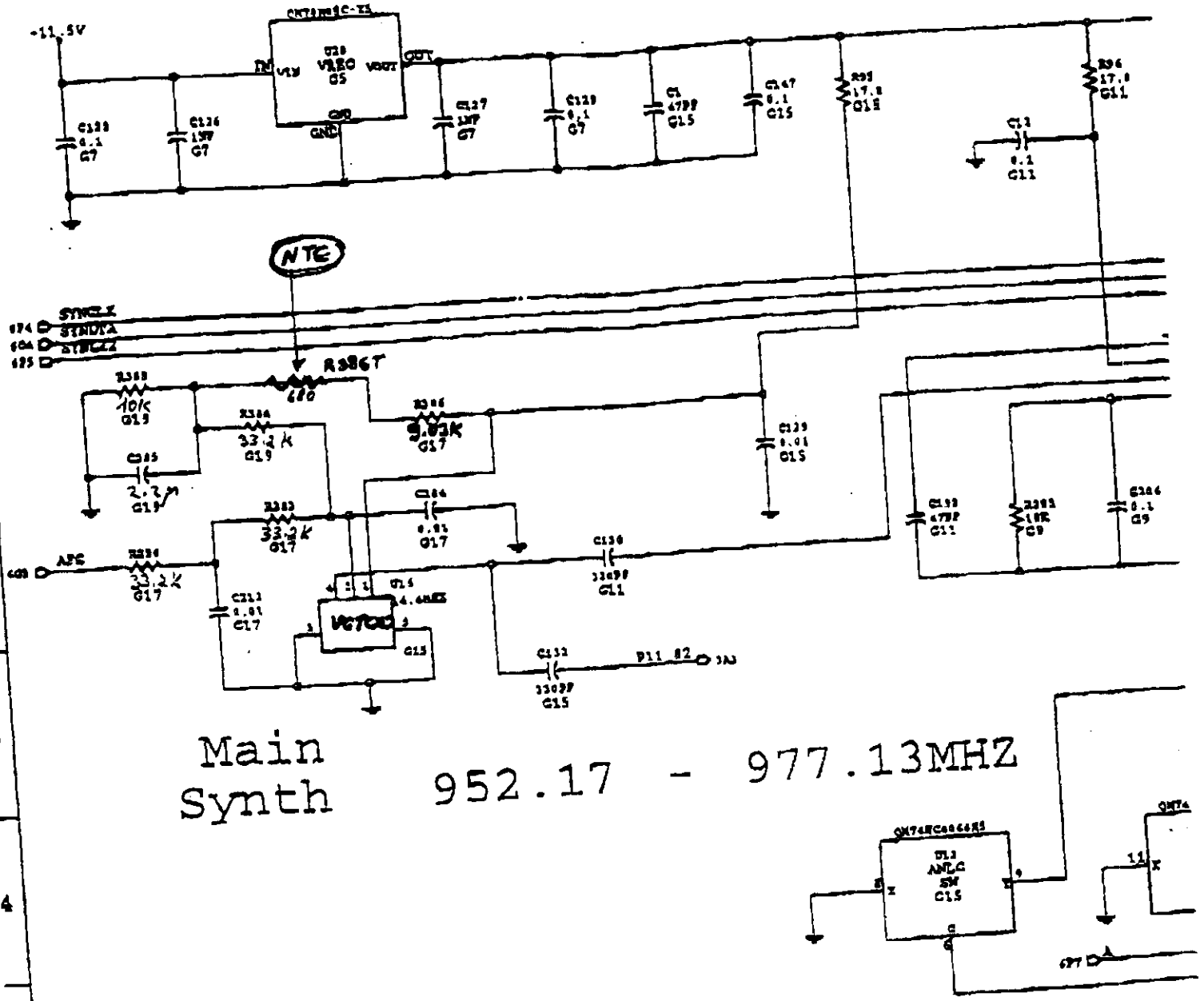
Frequency Stability Over Temp. Range

The transceiver reference freq (14.4 MHz). is generated from a VCTCXO component (enclosed data sheet).

The temp. stability is +-2 ppm over 0 to +65 C.
In order to improve temp. stability we have compensated the original VCTCXO control voltage by addition of negative temp. coefficient (NTC) resistor in serial to R386 in the voltage divider. (see enclosed scheme).

The NTC resistor has an opposite behavior graph to the VCTCXO.
The result is a significant improvement . Enclosed is the result with the compensation over the temp. range: -30 to +40 C.

Bakalnick


-11.5V
NTC
R386T
SYNCLK
SYNDTA
STBCLK
APC
VCTCXO
Main
Synth
952.17 - 977.13MHZ
128.16MHZ

For manufacturers and part numbers see Telrad database.

DETAIL SPECIFICATION FOR: Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz

1. SCOPE:

THIS SPECIFICATION DEFINES THE REQUIREMENTS FOR:

Metal package , SMT , PCB mounting , Voltage Controlled Temperature Compensated Crystal Oscillator (VCTCXO), with internal trimmer, frequency 14.4MHz and Clipped Sine output.

2. APPLICABLE DOCUMENTS:

* TELRAD Quality Assurance Requirements(QAR) # 20-201-6302

3. REQUIREMENTS:

REQUIREMENTS SHALL BE AS SPECIFIED IN THE APPLICABLE DOCUMENT AND HEREIN.

3.1 Absolute Maximum Rating

The devices shall be capable of operation or storage through the full range of absolute maximum condition listed in Table 1 without damage. The devices need not necessary meet all of the electrical requirements of this specification under these condition.

REV	ECR No.	DESC. OF CHANGE	NAME	SIGN	DATE

DRAWN	FOBRIADCHIK BENY		01.08.96
DESIGN	SOKALCHUK IOSY		
CHECKED	SHPITZ ZVI		
APPROVED	NAME	SIGN	DATE

All dimensions are in mm unless otherwise specified.

TITLE: Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz

NUMBER: 27-201-1033/1 A4 Sheet: 1/8 W116-24

Telrad

For manufacturers and part numbers see Telrad database.

Table 1

Symbols	Parameters	Min.	Max.	Unit
Vs	Supply voltage	-0.05	+7.0	V
Ts	Storage temperature	-40	+85	oC
	Terminal temperature (see Fig 2)		+220	oC

Note: All voltages referenced to ground.

3.2 Operating Range

The devices shall start up and operate under any combinations of supply voltage , and ambient temperature specified in Table 2. The devices shall meet all of the electrical parameters of this specification under these conditions.

Table 2

Symbols	Parameters	Min.	Max.	Unit
Vs	Supply voltage	+4.75	+5.25	V
Ta	Operating temperature	0	+65	oC
R_L	Output load R_L// C_L		10±10%	KΩ
C_L			10±10%	pF
Tst	Start-up time		7	mS

Note: All voltages referenced to ground.

REV	ECR No.	DESC. OF CHANGE	NAME	SIGN	DATE

DRAWN			
DESIGN	PODRIADCHIK BENY		01.05.94
CHECKED	BOKALCHUK IOSY		
APPROVED	SHPITZ LVI		
	NAME	SIGN	DATE

TITLE: Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz

All dimensions are in mm unless otherwise specified.

NUMBER: 27-201-1033/1 | A4 | Sheet: 2/8 | W16-24

Telrad

For manufacturers and part numbers see Telrad database.

3.3 Electrical Characteristic

Table 3

Symbols	Parameters	Test Condition	Min.	Max.	Unit
f	*Nominal Frequency*			14.4	MHz
	Frequency Adjustment Range	With internal trimmer	±3		ppm
$\Delta f/f$	*Initial Frequency Accuracy*	Ta = 25oC V_c=2.2V		±1	ppm
$\Delta f_s/f$	*Stability over temperature from 0 to 65oC*	Referenced to frequency at Ta = 25oC (Note 2)		±2	ppm
$\Delta f_s/V_s$	*Stability over v_s changes*	Supply Voltage ± 3%		±1	ppm
Δf_s/Load	*Stability over load changes*	Maximum load changes		±0.5	ppm
	Shock and vibration			±0.5	ppm
$\Delta f_a/f$	*Aging (first year)*			±1	ppm
$\Delta f_a/f$	*Aging (10 years)*	Including first year		±5	ppm
$\Delta f/f$	*Total stability*	Note 1		±8	ppm
VOL	*Output voltage*	Clipped Sine (ptp)	1		V
	Phase Noise(SSB)	1KHz		-130	dBc/Hz
	Phase Noise(SSB)	10KHz		-135	dBc/Hz
	Liniarity			±10	%
V_c	*Control Voltage Range*		0.2	4.2	V
	Frequency Control Range	Positive Polarity. Centered at V_c=2.2V	±8	±14	ppm
Is	*Supply current*	Output not connected		8	mA

Note: 1. - The worst case deviation limit from the device nominal frequency may be encountered over the device working life(10 years) when operated over the entire range of operating condition as per Table 2. includes

REV	ECR No.	DESC. OF CHANGE	NAME	SIGN	DATE

DRAWN
DESIGN FOGRIADCHIK BENY 01.08.96
CHECKED BOKALCHUK IOSY
APPROVED SHPITZ ZVI

NAME SIGN DATE

TITLE: Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz

All dimensions are in mm unless otherwise specified.

NUMBER: 27-201-1033/1 A4 Sheet: 3/8 W116-24

Telrad

For manufacturers and part numbers see Telrad database.

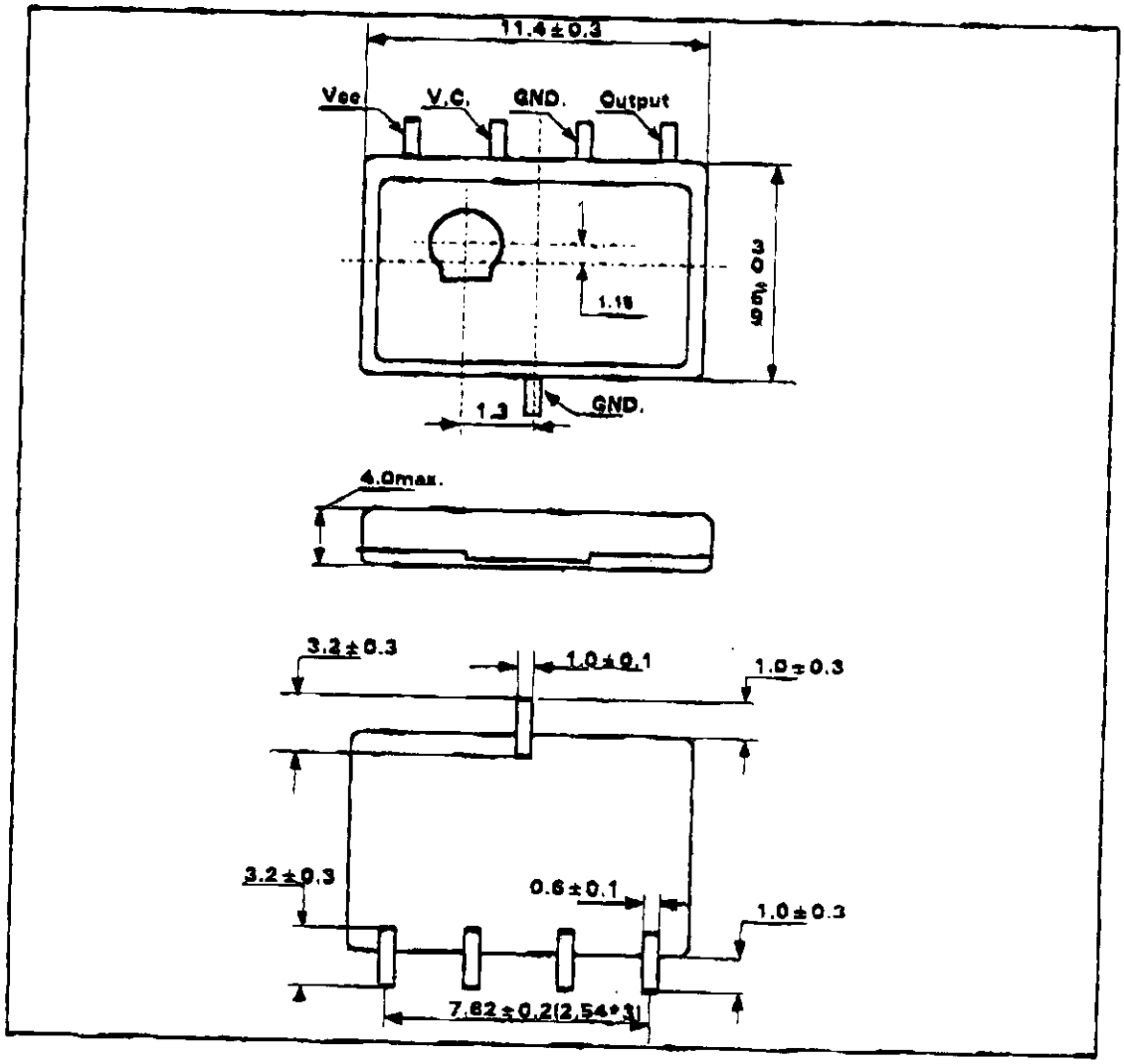


FIGURE 1(A)

REV	ECR No.	DESC. OF CHANGE	NAME	SIGN	DATE

DRAWN				
DESIGN	RODRIGOCHIK BENY			01.06.98
CHECKED	SOKALCHUK IOSY			
APPROVED	SHPITZ ZVI			
	NAME	SIGN	DATE	

TITLE: Voltage Controlled Temperature Compensated Crystal Oscillator 14.4MHz

All dimensions are in mm unless otherwise specified.

NUMBER: 27-201-1033/1 | A4 | Sheet: 6/8 | W116-24

Telrad

Temperature Measurement

SMD

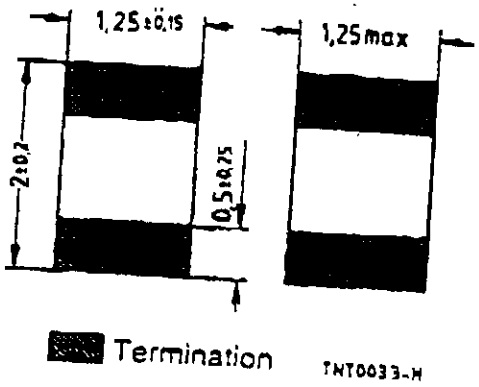
B 57620
C 620

Applications

- Temperature compensation in hybrid circuits, especially in data plus telecom systems and in automotive electronics
- Example: LCD compensation

Features

- Small dimensions, EIA size 0805
- Silver palladium terminations
- Cost-effective thermistor for automatic placement
- Suitable for wave and reflow soldering
- Also available in bulk



Dimensions in mm
Approx. weight 13 mg

Options

Resistance tolerance < 5% available

Climatic category (IEC 68-1)		55/125/21	
Max. power at 25 °C (on PCB)	P_{25}	210	mW
Resistance tolerance	$\Delta R/R_N$	± 5 %, ± 10 %, ± 20 %	
Rated temperature	T_N	25	°C
B value tolerance	$\Delta B/B$	± 3 %	
Dissipation factor (on PCB)	δ_{th} ')	approx. 3.5	mW/K
Thermal cooling time constant (on PCB)	τ_c ')	approx. 10	s
Heat capacity	C_{th} ')	approx. 35	mJ/K

Type	R_{25} Ω	No. of R/T characteristic	$B_{25/100}$ K	Ordering code (Tape & reel)
C 620/220/+	220	3207	3100	B57620-C221-+62
C 620/330/+	330	3204	3250	B57620-C331-+62
C 620/470/+	470	3205	3300	B57620-C471-+62
C 620/680/+	680	3206	3450	B57620-C681-+62
C 620/1 k/+	1 k	3206	3450	B57620-C102-+62
C 620/2.2 k/+	2.2 k	1304	3300	B57620-C222-+62
C 620/4.7 k/+	4.7 k	1307	3560	B57620-C472-+62
C 620/10 k/+	10 k	1011	3730	B57620-C103-+62
C 620/22 k/+	22 k	2003	3980	B57620-C223-+62
C 620/47 k/+	47 k	2101	4100	B57620-C473-+62
C 620/100 k/+	100 k	2004	4100	B57620-C104-+62
C 620/220 k/+	220 k	2904	4300	B57620-C224-+62

+: J for $\Delta R/R_N = \pm$ 5 %
K for $\Delta R/R_N = \pm$ 10 %

To: Edward Usoskin (Telrad Telecommunication & Electronic Ind Ltd)
From: Frank Coperich FCC Application Processing Branch
Date: August 4, 1998
FCC ID: ARACET-10

Applicant Name: Edward Usoskin

Subject: Telrad FCC ID: ARACET-10

The items indicated below must be submitted before processing can continue on the above referenced application. Failure to provide the requested information within 60 days may result in application dismissal pursuant to Section 2.917(c) and forfeiture of the filing fee pursuant to Section 1.1106

This is in response to your supplemental reply dated July 30, 1998.

1.) Your selection of the character "3" as the second emission symbol is inappropriate. Notice that "3" represents an analog process. In general, pi/4DQPSK would use the "1" character. Additionally, we notice that occupied bandwidth and emissions mask plots for digital voice, FAX and modem operation have not been submitted.

2.) As previously indicated, the modulation deviation tolerance in FCC Section 22.915(b)(1) is 12 kHz +/- 10%. The test you referenced has the initial setting at 8 kHz before the input level is increased by 20 dB. The results from that process should show an increasing level of modulation deviation as the input signal level increases. This data to demonstrate compliance is again requested.

3.) As previously requested, frequency stability measurement data for operation down to - 30 degrees C must be submitted.There are no exceptions under FCC Section 2.995(a)(1). Note that it is permissible for a unit not to function at lower temperatures. In that case, a temperature sensor / cut - off circuit would be inluded in the device.

4.) Please note that units used within 20 cm of the body are defined as "portable" under Section 2.1093 and must satisfy the SAR limits. If you want to categorize this unit as a "Mobile" then the minimum spacing to the user should be greater than 20 cm and the instruction manual should provide direction for the use and installation of the unit to ensure such spacing to the user and bystanders.

DO NOT Reply to this email by using the 'Reply' button. In order for your response to be processed expeditiously, you must upload your response via the Internet at https://dettifoss.fcc.gov/beta/oet/index.html

Replies to this letter MUST contain the Reference Number: 2429

3.3.1.2.3 Modulation Deviation Limiting

3.3.1.2.3.1 Definition

Modulation limiting refers to the ability of the transmitter circuits to prevent the transmitter from producing deviation in excess of rated system deviation.

3.3.1.2.3.2 Method of Measurement

The transmitter shall be set to a channel near the center of the band and adjusted per the manufacturer's procedures and instructions for full rated system deviation. With the compressor enabled and the SAT disabled, adjust the audio input for ±8 kHz peak frequency deviation at 1004 Hz. Increase the audio input level by 20 dB in one step (rise time between the 10% and 90% points shall be 0.1 second maximum). Both the instantaneous peak and the steady state deviations at and after the time of increasing the signal level shall be observed.

With the input level held constant at the 20 dB level, vary the frequency and observe the deviation for all frequencies between 300 and 3000 Hz.

Repeat with the transmitter set to channel 991 and then to channel 799, and then repeat over the environmental conditions described in 4.

3.3.1.2.3.3 Minimum Standard

The instantaneous peak and steady-state deviations shall not exceed the rated system peak frequency deviation of ±12 kHz at any audio frequency or reasonable change in input level while operating on any channel under the environmental test conditions described in 4. This requirement excludes SAT and 10 kilobit/second wideband data signals.

3.3.1.2.4 Audio Voice-Path Muting

3.3.1.2.4.1 Definition

Audio muting under control of the logic circuitry shall be provided during wideband data transmission periods.

3.3.1.2.4.2 Method of Measurement

Operate the transmitter under standard test conditions with the compressor enabled and a 1004 Hz modulating tone adjusted for ±8 kHz peak frequency deviation. Monitor the transmitter carrier demodulated level using a C-message weighted filter.

Enable the voice mute circuit and measure the attenuation of the 1004 Hz test tone.

Attachment #3

[2] keep the transmission power stable in the assigned level over the : frequency, temperature and supply voltage. An automatic level control (ALC) mechanism changes its value to keep the transmission power stable .

3.1 Automatic level control (ALC) mechanism

The ALC mechanism is implemented by software . It detects the actual transmitted power at output and changes the "PWRCTRL" to achieve the required transmission power.

The actual transmitted power is sampled by semi lumped directional coupler into a power detector.The power detector is composed of the dual Shotky diode D5 (BAT62) and active low pass filter composed of U7 (MC3324D). The power detector produces the "PWRIND" indication as a measurement of the transmitted power. Detailed description of the electrical scheme of this portion is introduced in page No.11.

The production process includes a calibration procedure that sets measures and saves the values of the "PWRIND" signal for each power level.

The ALC mechanism enables transmitted power of ±2 dB from its maximum transmitted level over the frequency band , over the operating temperature and voltage supply range. The maximum transmitted power can be 2.5 W.

3.2 Protection against false transmission

The power indication is used for protection against false transmission mechanism..This mechanism is implemented in software and reads the "PWRIND" value while the power amplifier is turned off and resets the subscriber if it senses power when the power amplifier has been set off .

4 **Frequency stability**

The radio module includes four signals sources that are used as local oscillators for up or down conversion in the transmitter and receiver circuits. Three sources are fixed frequencies of 128.16 MHz , 82.71 MHz and 900 kHz. The fourth is a frequency synthesizer for 952.17÷977.13 MHz.

All the signal sources are phase locked oscillators that are locked on reference of 14.4 MHz oscillator . Figure 2 describes the block diagram of signal sources section.

The reference oscillator is a VCTCO (NDK's END3190A voltage controlled temperature compensated crystal oscillator) . The VCTXO provides nominal frequency of 14.4 MHz and output voltage 1 V peak to peak. The VCTXO is used to achieve temperature stability of ±2 ppm over 0°C to 65°C operating temperature range.

The nominal frequency is tuned during the production process to achieve frequency accuracy of ±200 Hz of the RF frequency of the assigned channel.

The VCTXO's frequency is tuned by setting a proper voltage to the V tune port of the VCTCXO. The voltage to the V tune port is supplied from the "AFC" control signal of the control card via a low pass filter network composed of R266, C212,R381,R384,R385,R386. Detailed description of the electrical scheme of this portion is given in page No.7.

3.6 Effective radiated power test according to Part 2, §22.913 and field strength of spurious radiation test according to Part 2, § 2.993 and Part 22, § 22.917 (e)

3.6.1 Effective radiated power test

3.6.1.1 Definition of the test

This test was performed to demonstrate that the EUT maximum effective radiated power (ERP) of mobile transmitter is not more than 7 W.

3.6.1.2 The test set-up configuration

The radiated emissions measurements were performed with the Biconilog antenna, installed on the variable height antenna mast in the Hermon Laboratories anechoic chamber at 3 meters measuring distance as shown in Photographs 3.6.1, 3.6.2.

The EUT was installed on the 0.8 m high wooden table which was on the top of the metal turntable flush mounted with the ground plane. To find the maximum radiation measuring antenna height was changed from 1 to 4 m, the turntable was rotated 360° and the antennas polarization was changed from vertical to horizontal.

3.6.1.3 Test results

The EUT was tested according to the substitution method with dipole antenna. The field strength generated by the EUT was measured at 3 unmodulated carrier frequencies (824.04, 836.49, 848.97 MHz) in analog and pulse modulated frequencies in digital mode of operation.
The transmitting antenna was installed in the position where approximately the center of the EUT was to be placed. The transmitting antenna was fed by the generator signal with enough power ($P_{out\ gen}$) to give a suitable reading on the measuring set for each test frequency.
The maximum measured field strength result in analog mode was 128.9 dB(μV/m) at frequency of 836.49 MHz that corresponds to 30.9 dBm output power of the signal generator. Maximum ERP was calculated from equation:

$$ERP_{max} = P_{out\ gen} - \text{Cable loss} + \text{Antenna gain} =$$
$$= 30.9\ \text{dBm} - 2.03\ \text{dB} + 1.41\ \text{dB} = 30.28\ \text{dBm} = 1.07\ \text{W}$$

The test results are shown in table 3.6.1 and plots 3.6.1.1 to 3.6.1.6.

3.6.1.4 Exposure limit according to part 1, §1.1310

Limit for power density for general population/uncontrolled exposure is

$$f/1500 = 824/1500 = 0.55 \text{ mW/cm}^2 = 5.5 \text{ W/m}^2 .$$

this is equal to the field strength E_{lim}=45.5 V/m = 153.2 dB (μV/m).

The maximum measured field strength result was E_{max}=128.9 dB (μV/m) at 3 meter distance in analog mode. In digital mode of operation the average factor of 4.8 dB was taken into account (due to pulse modulation, refer to plot 3.6.1.7). Therefore the maximum measured radiated emission in digital mode 131.1 dB(μV/m), shown in Table 3.6.1, was reduced by the 4.8 dB average factor and the result was 126.3 dB(μV/m).

Thus the distance where the public will not be exposed to RF level in excess of the FCC requirements is 0.18 m - from the following equation:

$$E_{lim} = E_{max} + 20 \log D_1/D_2,$$

where D_1=3 m, D_2 is the minimal allowed distance.

Reference numbers of test equipment used

HL 0026	HL 0378	HL 0465	HL 0521	HL 0604	HL 0614	HL 0661

Full description is given in Appendix A.

Amendment to the Test Report TLRFCC.12663

Table 3.6.1 Effective Radiated Power measurement test results

TEST SPECIFICATION: FCC part 22, §22.913
COMPANY: Telrad
EUT: CET-10
DATE: July 20, 1998
RELATIVE HUMIDITY: 48%
AMBIENT TEMPERATURE: 23°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Freq. MHz	Radiated Emission measured result dB (µV/m)	Antenna Gain dB	Cable Loss dB	Generator P out dBm	ERP dBm	ERP W	Spec. Limit dBm	Spec. Margin dB	Pass/ Fail
Analog	**mode**								
824.04	127.7	1.36	1.92	28.6	28.04	0.64	38.45	10.01	Pass
836.49	128.9	1.41	2.03	30.9	30.28	1.07	38.45	8.17	Pass
848.97	128.2	1.47	2.04	29.5	28.93	0.78	38.45	9.52	Pass
Digital	**mode**								
824.04	130.6	1.36	1.92	31.4	30.84	1.2	38.45	7.61	Pass
836.49	131.1	1.41	2.03	32.2	31.58	1.4	38.45	6.87	Pass
848.97	130.8	1.47	2.04	31.0	30.43	1.1	38.45	8.02	Pass

Test parameters:
Detector type = peak
Resolution bandwidth = 120 kHz
Antenna type - dipole.
Antenna polarization - vertical

Table calculations and abbreviations:
ERP (dBm) = P_{out} (dBm) – Cable Loss (dB) + Antenna Gain (dB)
Spec. margin = specification margins = dB below (negative if above) specification limit.

Test performed by:
Mr. Michael Nikishin, test engineer

Hermon Labs

Table 3.4.3 Modulation characteristics measurement test results

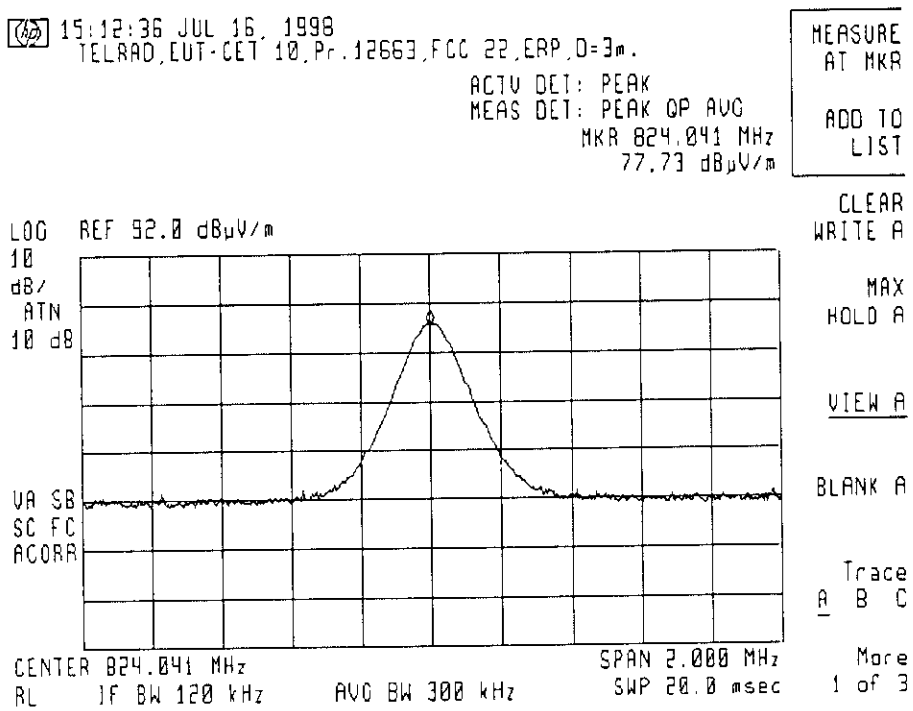
TEST SPECIFICATION: FCC part 2, §2.987 (b), part 22, §22.915(c)
COMPANY: Telrad
EUT: CET-10
DATE: July 16, 1998
RELATIVE HUMIDITY: 48%
AMBIENT TEMPERATURE: 23°C

Modulating frequency, kHz	Input signal, mV	Measured deviation, kHz	Carrier frequency, MHz
0.5	45	3.7	836.49
0.5	1000	4.2	836.49
1	45	7.6	836.49
1	500	8.3	836.49
1	1000	8.1	836.49
1	1500	7.7	836.49
1	2000	7.1	836.49
3	45	6.6	836.49
3	1000	6.6	836.49

Test performed by:
Mr. Michael Nikishin, test engineer

Hermon Labs

Screen Capture - captured on 7/16/98 3:12:35 PM



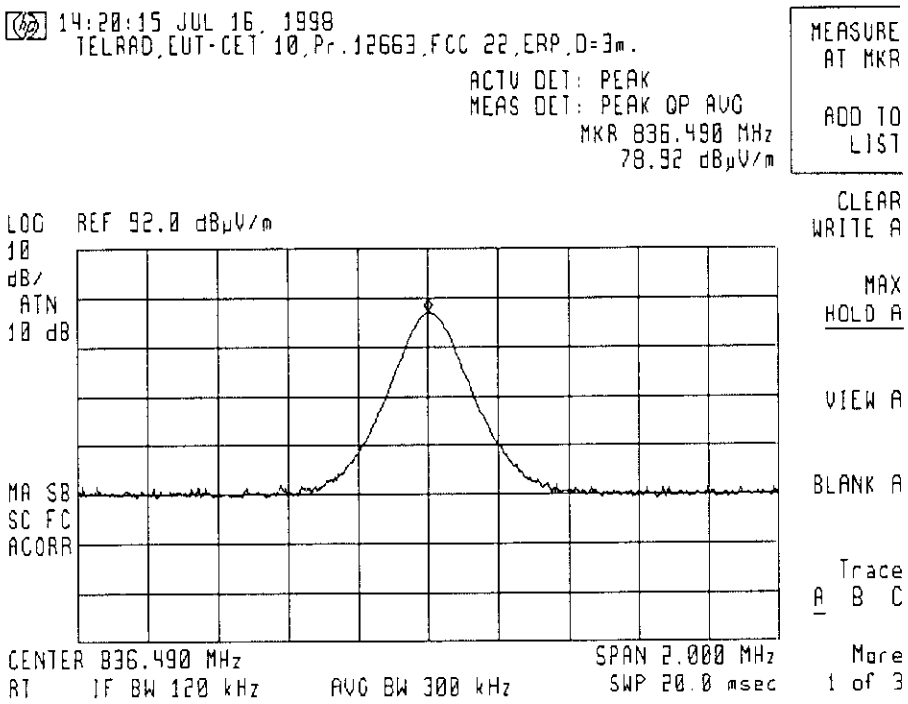
Plot 3.6.1.1

external attenuator 50 dB

77,73 + 50 = 127,73 dBµV/m

Analog mode

Screen Capture - captured on 7/16/98 2:20:14 PM



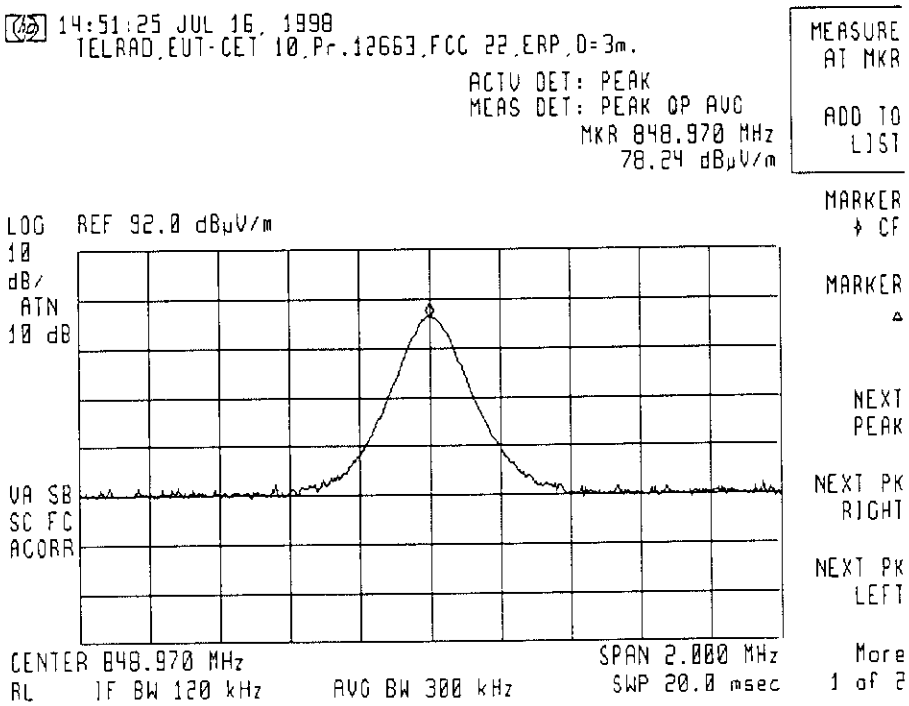
Plot 3.6.1.2

external attenuator 50dB

78,92 + 50 = 128,92 dBµV/m

Analog mode

Screen Capture - captured on 7/16/98 2:51:24 PM



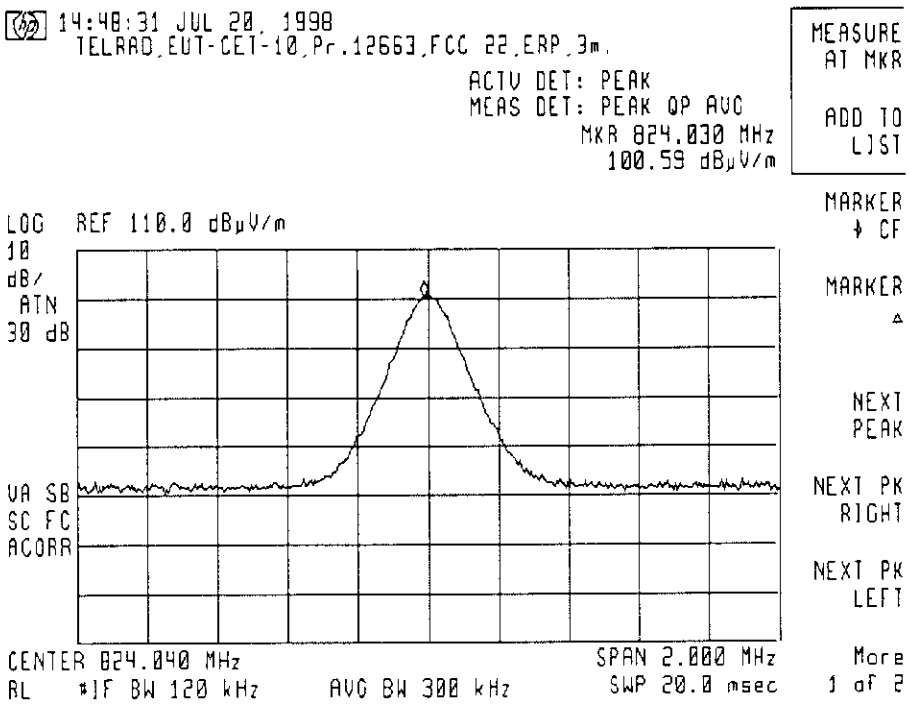
Plot 3.6.1.3

external attenuator 50 dB

78,24 + 50 = 128,24 (dBµV/m)

Analog mode

Screen Capture - captured on 7/20/98 2:48:30 PM



plot 3.6.1.4

$U_{GEN} = -48,6 + 80 = 31,4$ dBm Ext. att = 30 dB

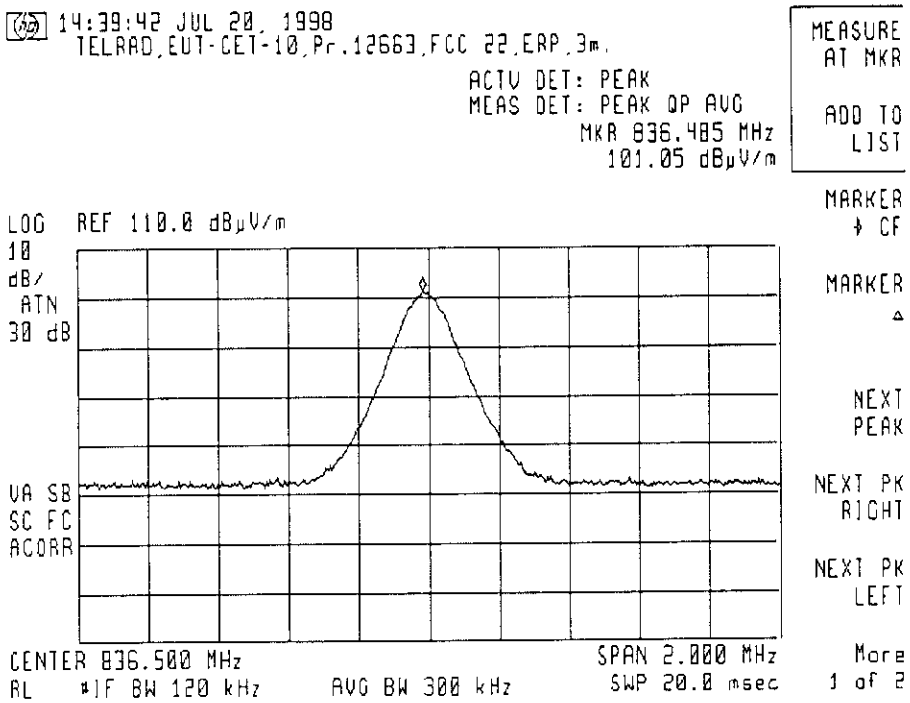
Digital mode

fft

$ERP = U_{GEN} + AG - CL = 31,4 + 1,36 - 1,92 = 30,3$ (dBm)

$ERP = 1,2$ W

Screen Capture - captured on 7/20/98 2:39:41 PM



plot 3.6.1.5

ext. att = 30 dB

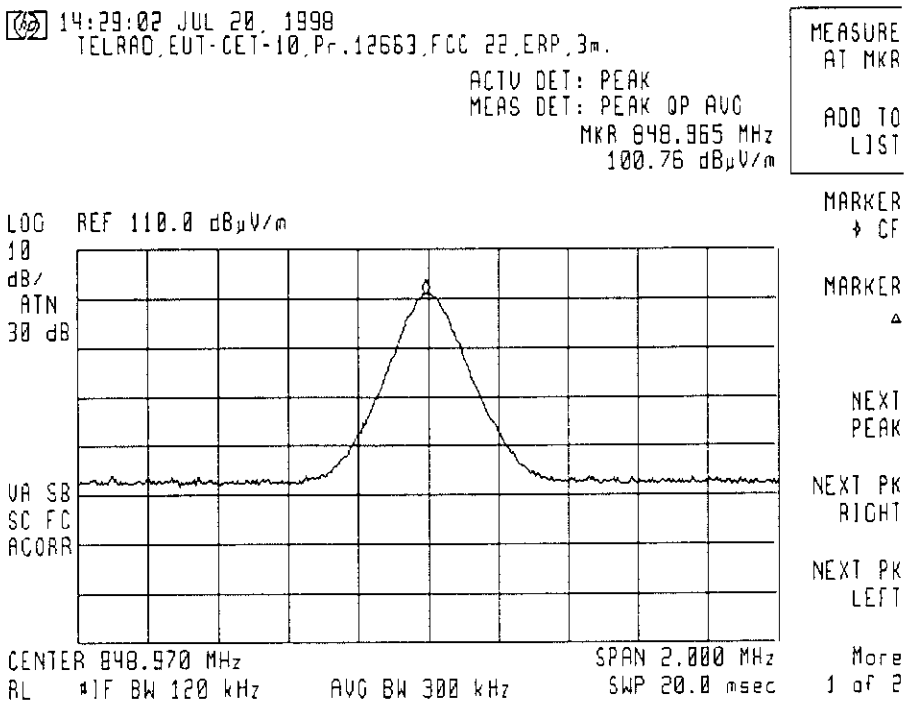
Digital mode

$U_{GEN} = -47,8 + 80 = 32,2$ dBm

$ERP = U_{GEN} + AG - CL = 32,2 + 1,41 - 2,03 = 31,6$ (dBm)

$ERP = 1,4$ W

Screen Capture - captured on 7/20/98 2:29:01 PM



Plot 3.6.1.6

ext. att. = 30 dB

Digital mode

$U_{GEN} = -49,0 + 80 = 31,0$ dBm

$ERP = U_{GEN} + AG - CL = 31,0 + 1,47 - 2,04 = 30,4$ (dBm)

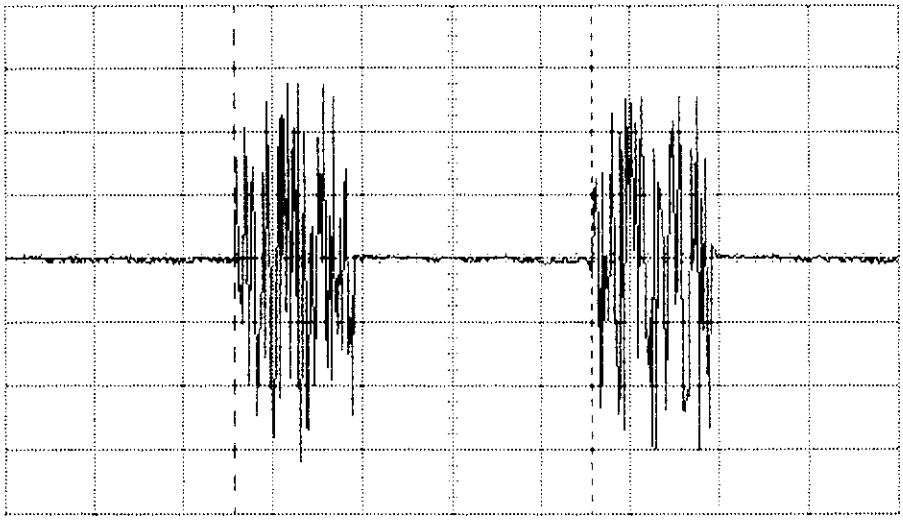
$ERP = 1,1$ W

24/07/98 Tetrad, CET-10, Pr. 12663, RF hazard.

Duty cycle = 1/3

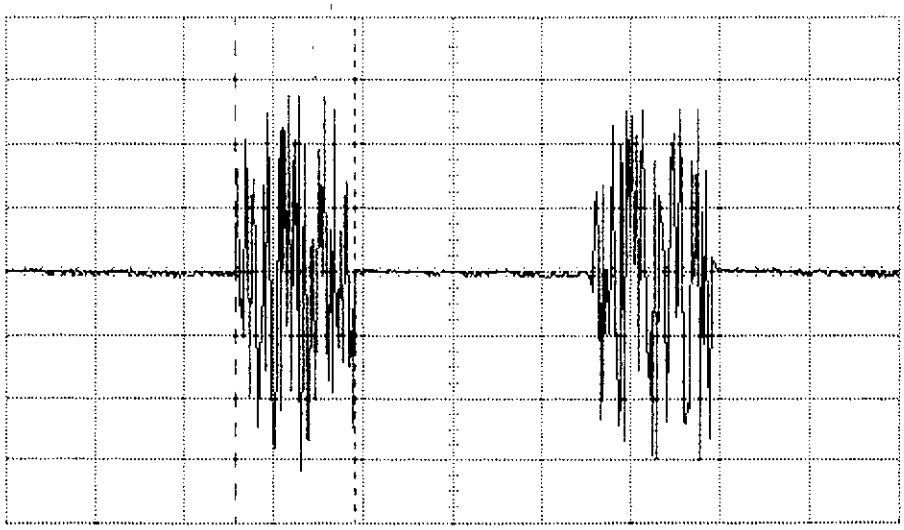
Average factor = 10 log $\frac{3}{1}$ = 4,8

hp stopped

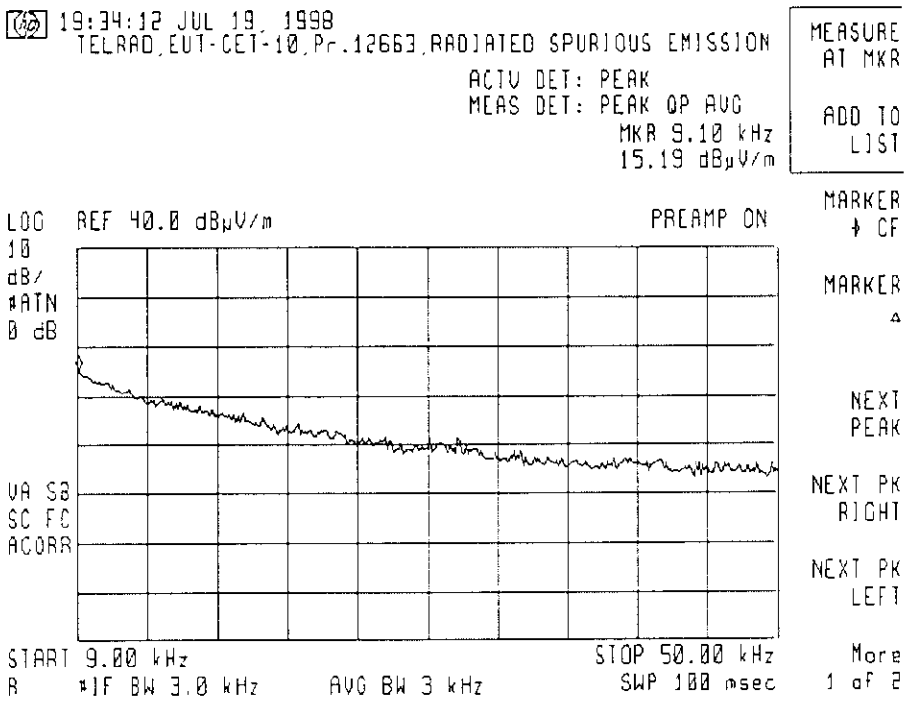


plot 3.6.1.7

hp stopped



Screen Capture - captured on 7/19/98 7:34:11 PM



Plot No. 1

824 MHz

ext. att. = 30 dB

Analog mode

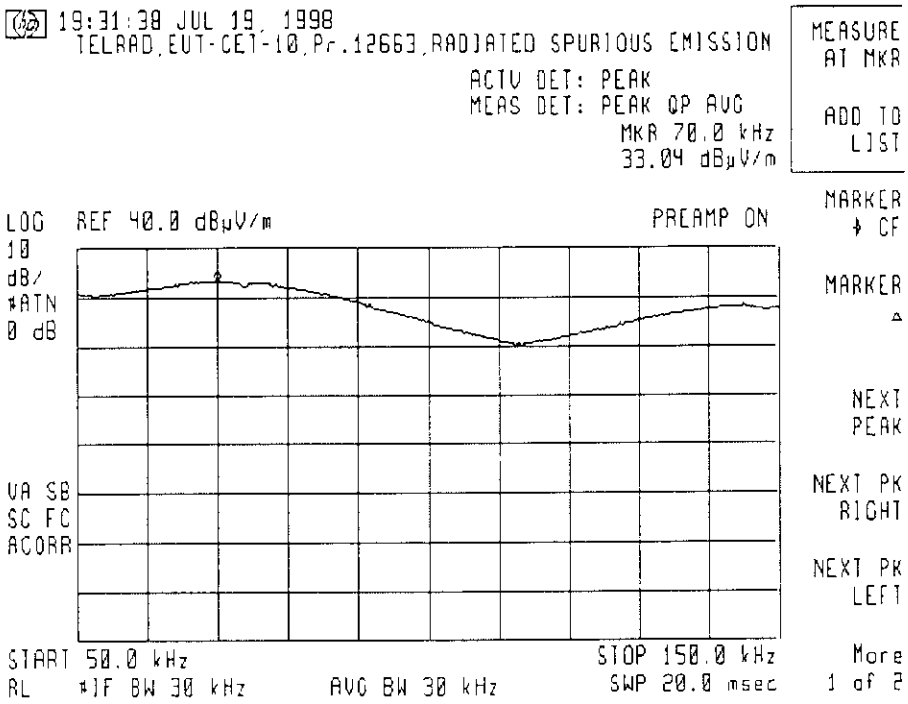
~~f~~ $-20 \log \frac{RBW}{RBW_m}$

Attenuation = 97.47 − 15.19 = 82.3 dB − $20 \log \frac{30}{3}$ =

= 62,3 dB

Lim = 43 + $10 \log P$ = 43 + $10 \log 0{,}64$ = 41,1 dB

Screen Capture - captured on 7/19/98 7:31:38 PM



Plot No. 2

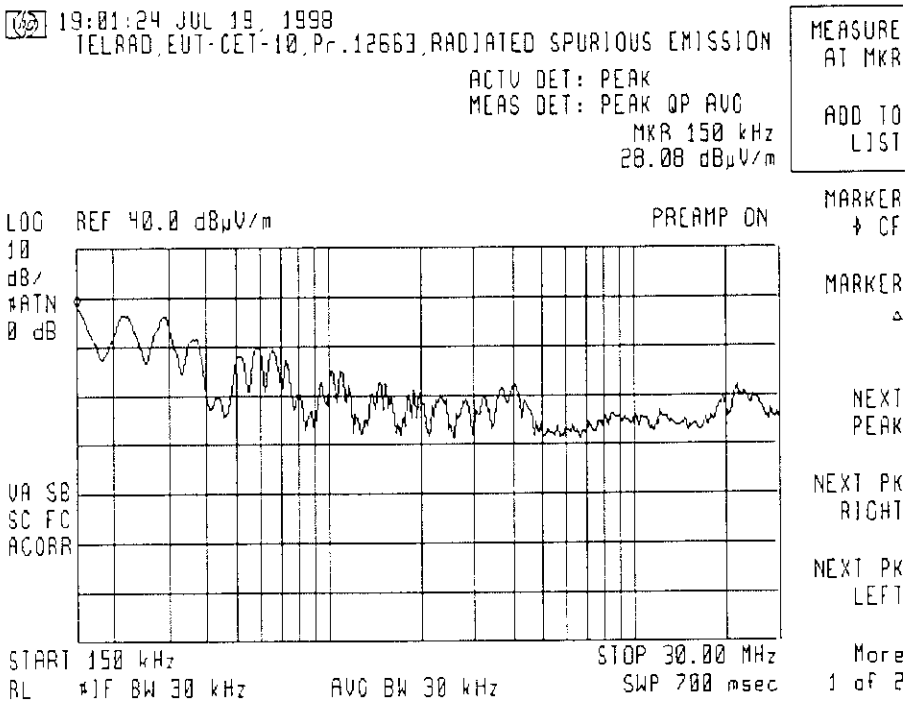
Ext. att = 30 dB

Analog mode

Attenuation = 97,47 - 33,04 = 64,4 dB

Lim = 41,1 dB

Screen Capture - captured on 7/19/98 7:01:23 PM



Plot No. 3

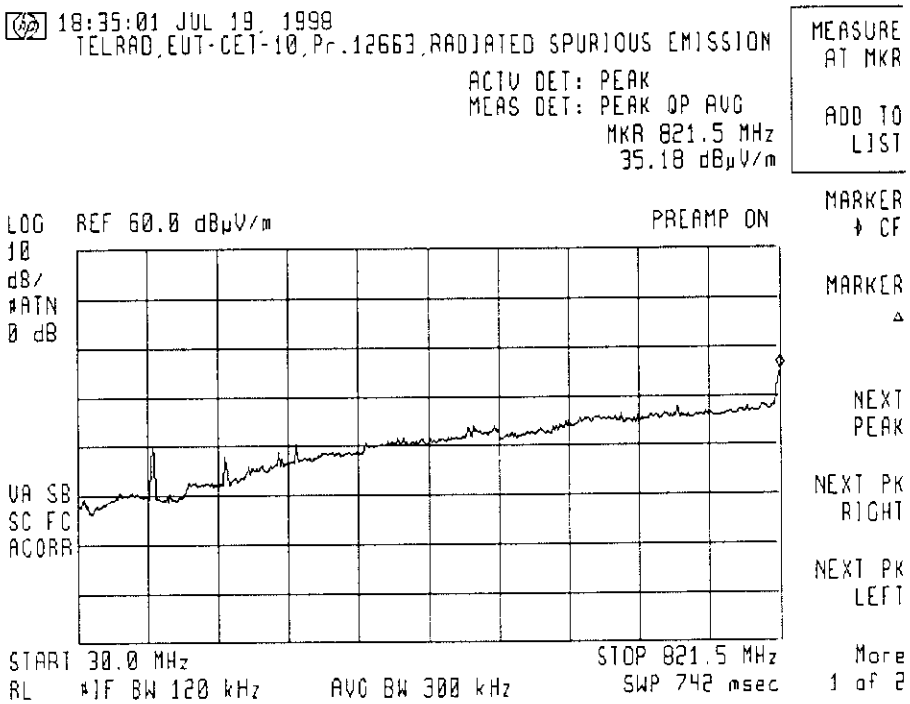
ext. att. = 30 dB

Analog mode

Attenuation = 97.47 - 28.09 = 69.4 dB

Lim = 43 + 10log P = 41.1 dB

Screen Capture - captured on 7/19/98 6:35:00 PM



Plot No.4

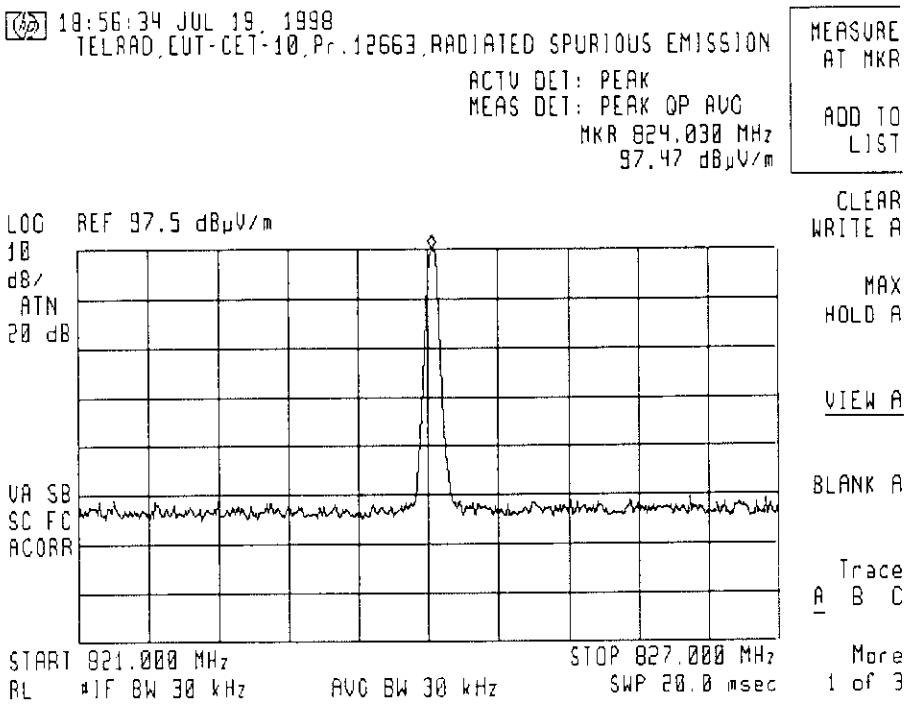
ext. att = 30 dB

Analop mode = fft

Attenuation = 97,47 - 35,18 = 62,3 dB

Lim = 43 + 10 lg P = 41,1 dB

Screen Capture - captured on 7/19/98 6:56:33 PM



Plot No. 5

ext. att = 30 dB

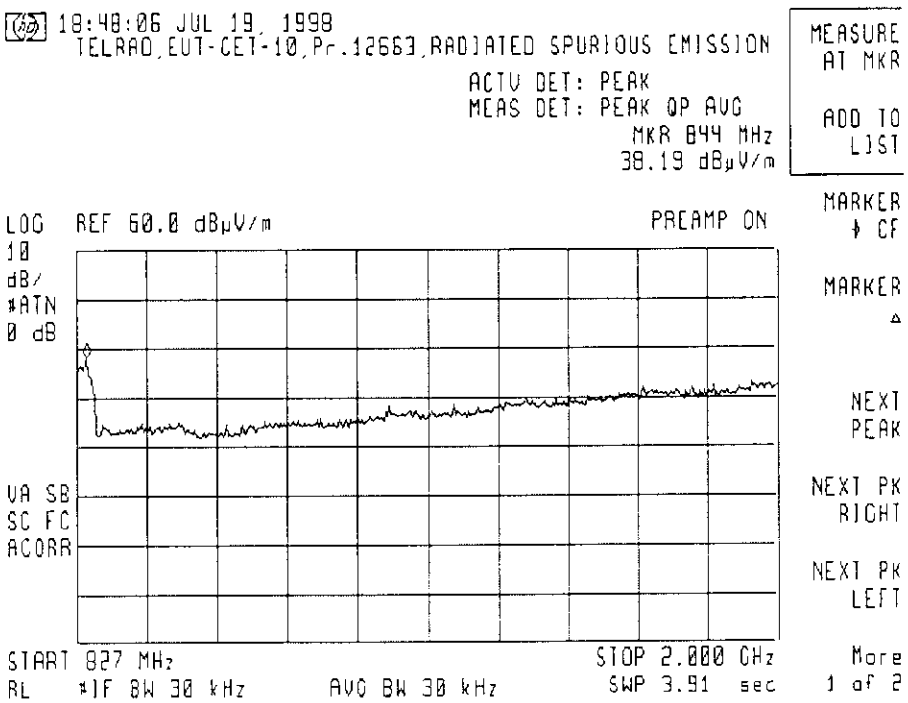
Analog mode

fff

Attenuation more than 50 dB

Lim = 43 + 10 lg P = 41,1 dB

Screen Capture - captured on 7/19/98 6:48:05 PM



Plot No.6

ext. att. = 30 dB

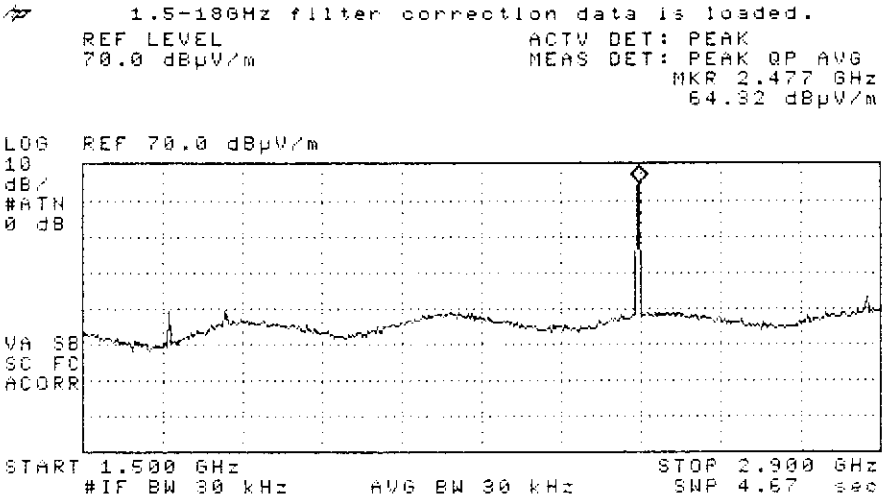
Analog mode

Attenuation = 97,47 - 38,19 = 59,3 dB

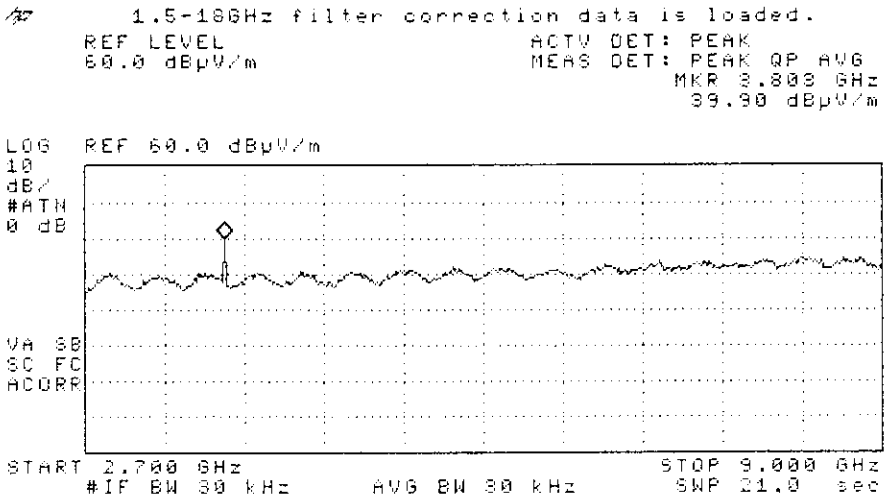
Lim = 43 + 10 lg P = 41,1 dB

20/07/93 Telrad, EUT - CET 10 Pc. 12663

F_{tx} = 824.04 MHz, Analog mode



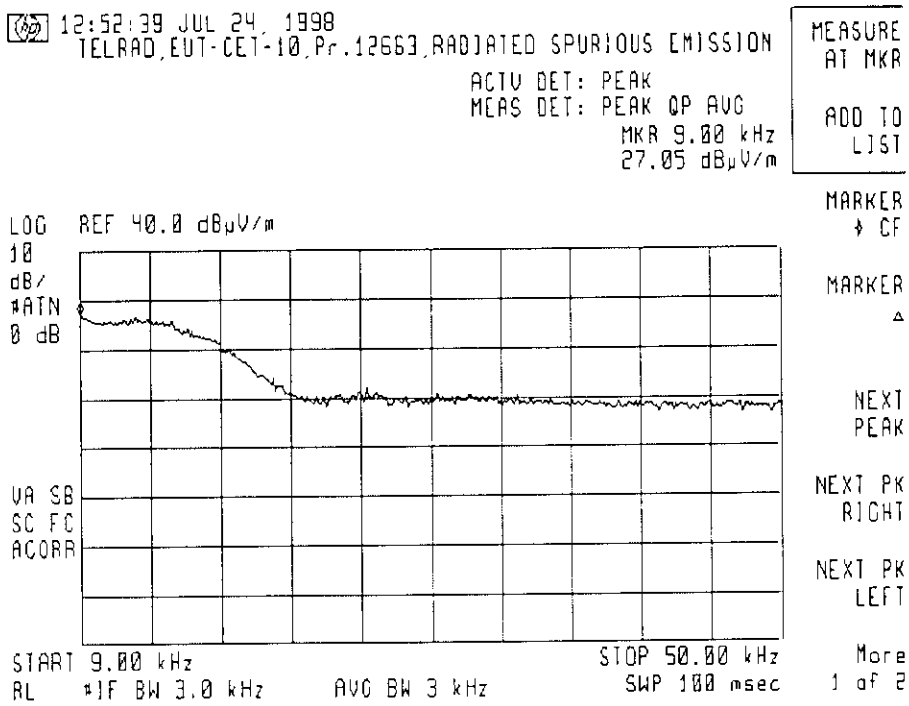
Plot No. 7



Attenuation = 127,47 - 64,32 = 63,2* dB

Limit = 43 + 10 lg P = 41,1 dB

Screen Capture - captured on 7/24/98 12:52:39 PM



Plot No.8

ext. att. = 30 dB

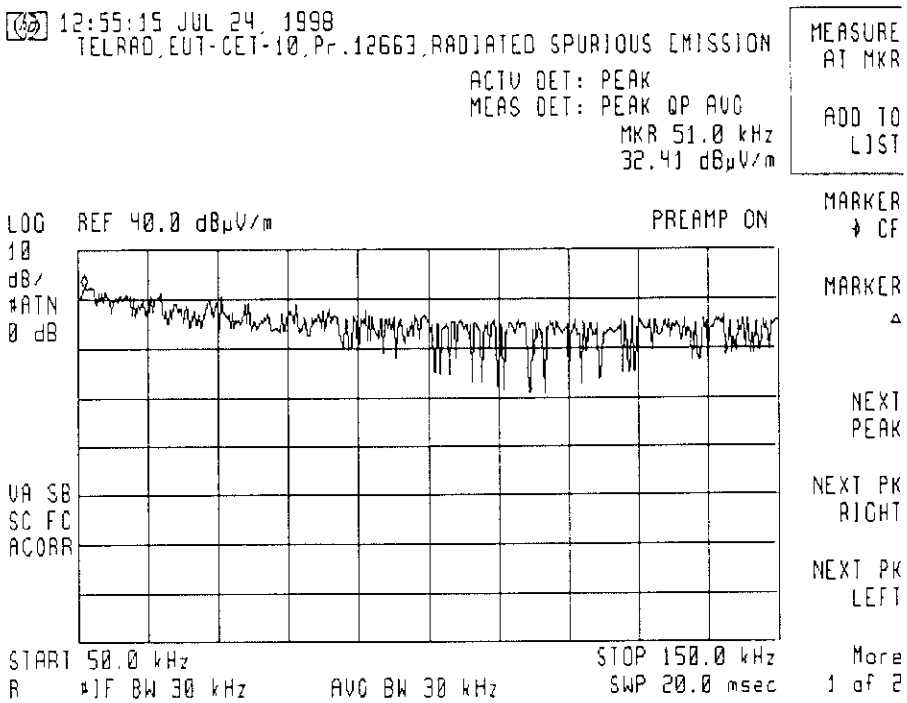
Digital mode

$$Attenuation = 130,1 - \left(57,05 + 20 \lg \frac{30}{3}\right) =$$

$$= 53 \text{ dB}$$

$$Lim = 43 + 10 \lg P = 43,8 \text{ dB}$$

Screen Capture - captured on 7/24/98 12:55:14 PM



Plot No. 9

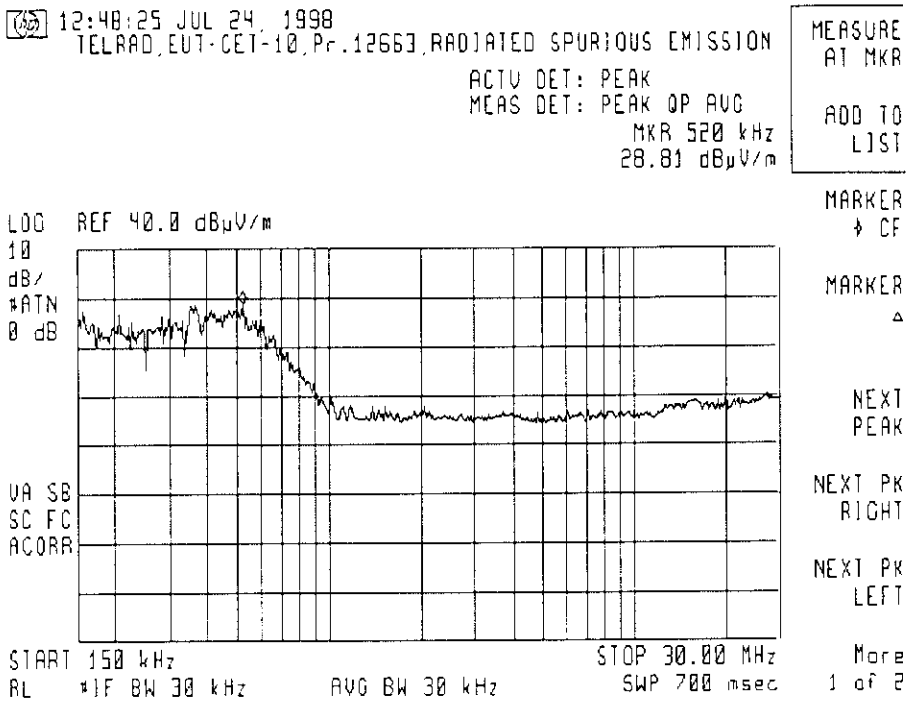
ext. att. = 30 dB

Digital mode

Att. = 130,1 - 62,41 = 67,7 dB

Lim = 43,8

Screen Capture - captured on 7/24/98 12:48:24 PM



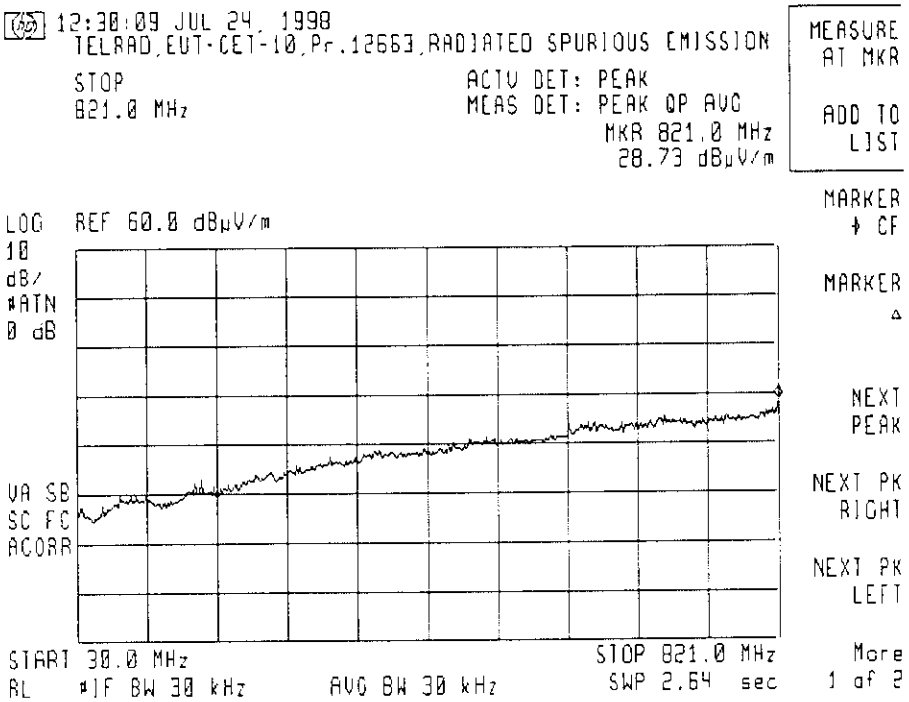
Plot No. 10

ext. att. = 30 dB

Dijital mode

Att = 130,1 - 58,8 = 71,3

Screen Capture - captured on 7/24/98 12:30:08 PM



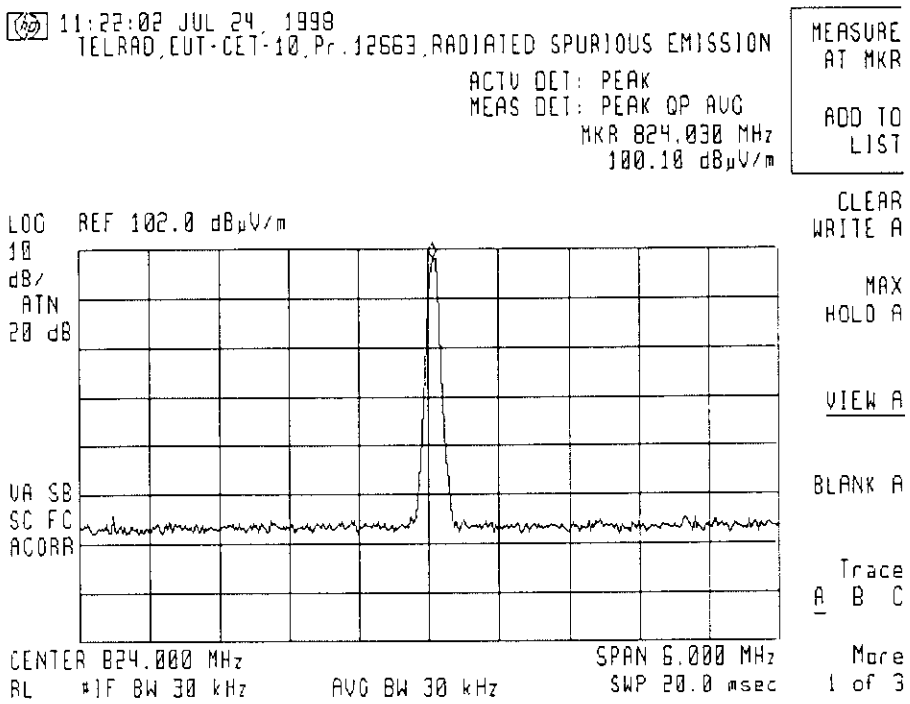
Plot No. 11

ext. att = 30 dB

Digital mode

Att. = 130.1 - 58.7 = 71.4 dB

Screen Capture - captured on 7/24/98 11:22:01 AM



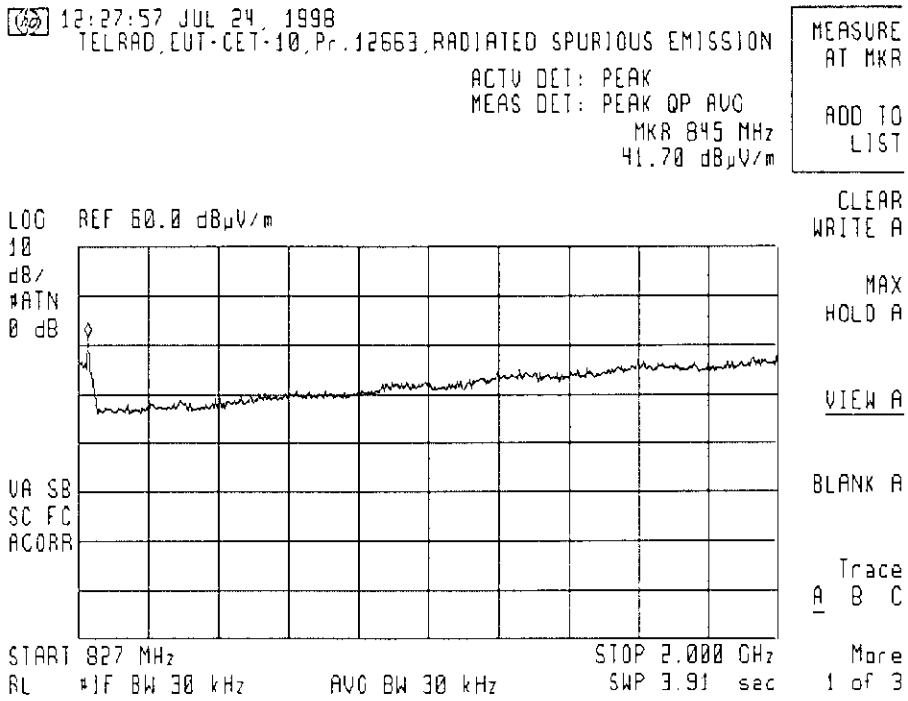
Plot No. 12

ext. att. = 30 dB

Digital mode

Attenuation more than 50 dB

Screen Capture - captured on 7/24/98 12:27:56 PM



Plot No. 13

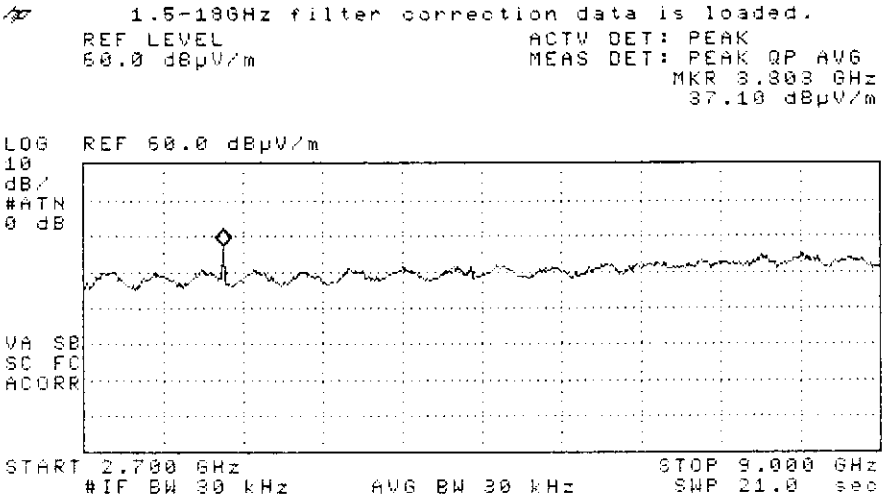
ext. att. = 30 dB

Digital mode

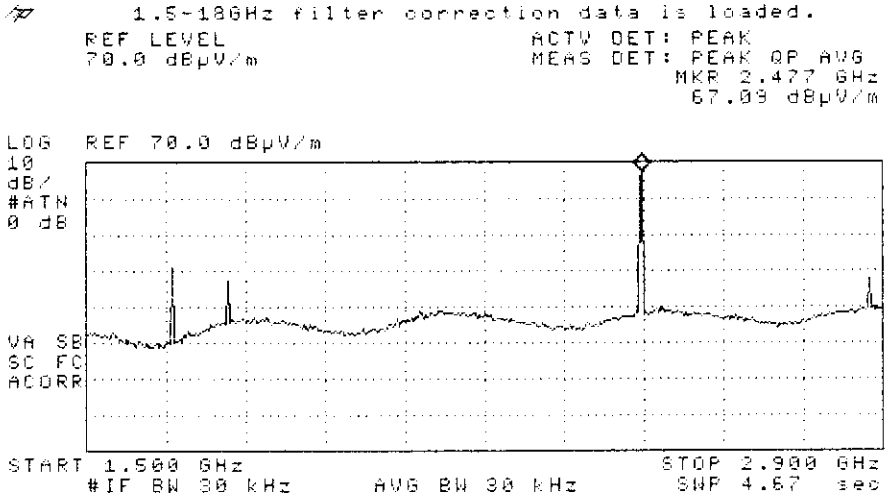
Att. = 130,1 − 41,7 = 88,4 dB

20/07/98 Telrad, EMT-CET 10, P.N. 12663

f_{tx} = 824,04 MHz, Digital mode



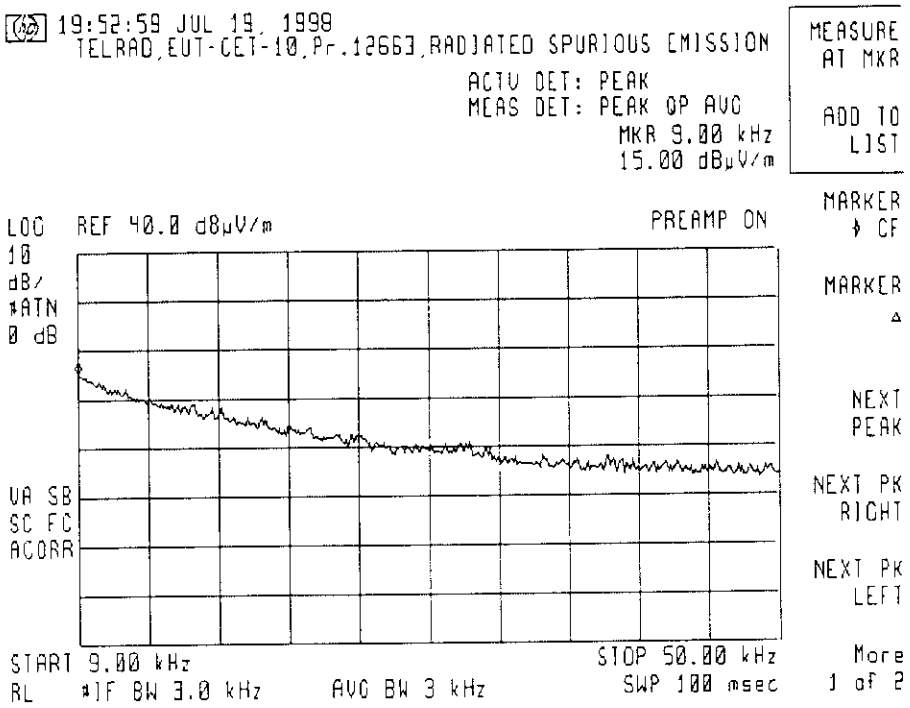
Plot No. 14



Attenuation = $130,58^{10} - 67,09 = 63,0$ dB

Limit = $43 + 10 \log P = 43,8$

Screen Capture - captured on 7/19/98 7:52:58 PM



Plot No. 15

$f = 836.49$ MHz

ext. att. = 30 dB

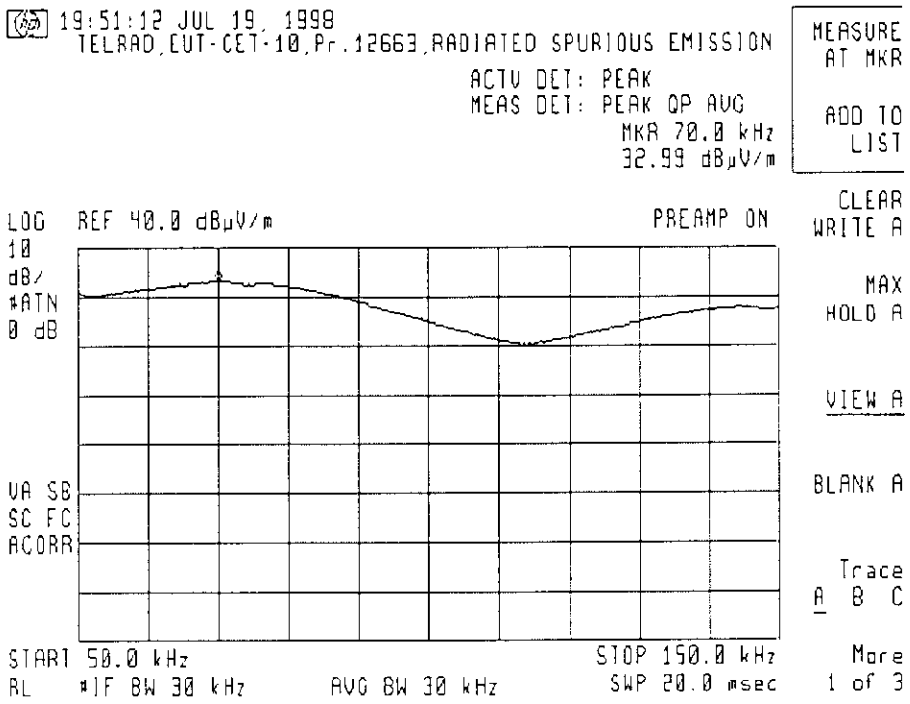
Analog mode

$-20 \lg \frac{RBW_o}{RBW_m}$

Attenuation = 98,07 − 15,00 = 83,07 (dB) − 20 = 62,07 dB

Lim = 43 + 10 lg P = 43,3 dB

Screen Capture - captured on 7/19/98 7:51:12 PM



Plot No.16

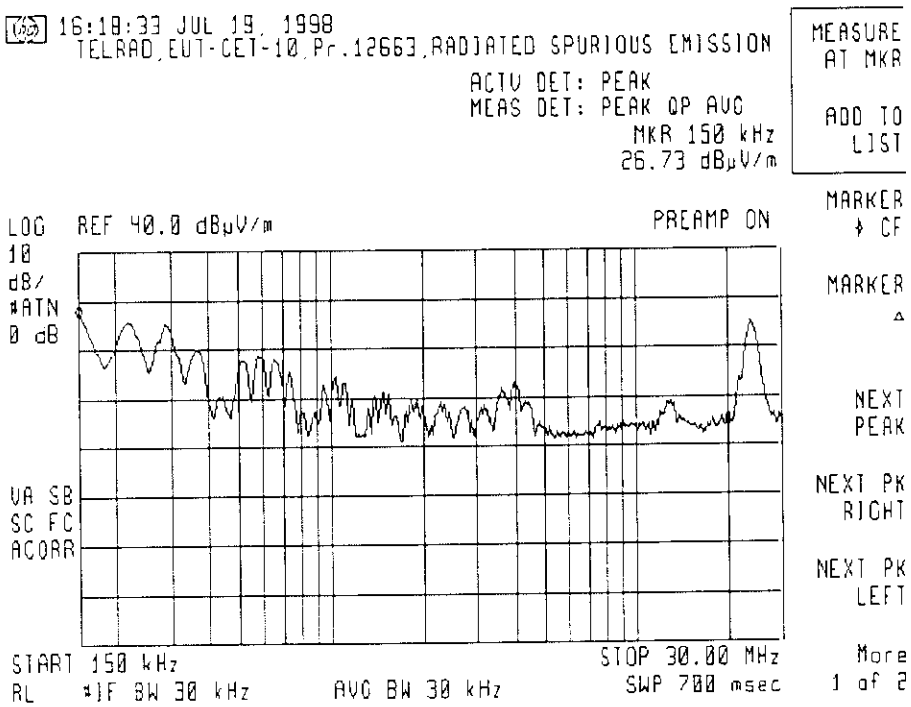
ext. att. = 30 dB

Analog mode

Attenuation = 98.07 - 32,99 = 65,1 dB

Lim = 43 + 10 lg P = 43,3 dB

Screen Capture - captured on 7/19/98 4:18:32 PM



Plot No. 17

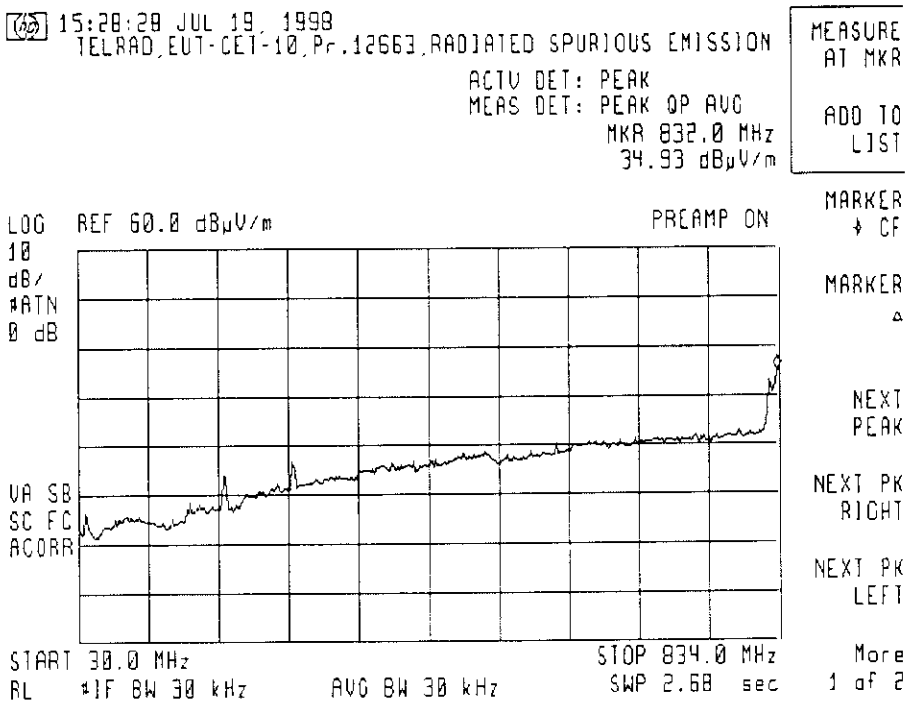
ext. att = 30 dB

Analog mode

Attenuation = 98,07 - 26,73 = 71,34 dB

Lim = 43 + 10 lg P = 43,3 (dB)

Screen Capture - captured on 7/19/98 3:28:27 PM



Plot No. 18

ext. att. = 30 dB

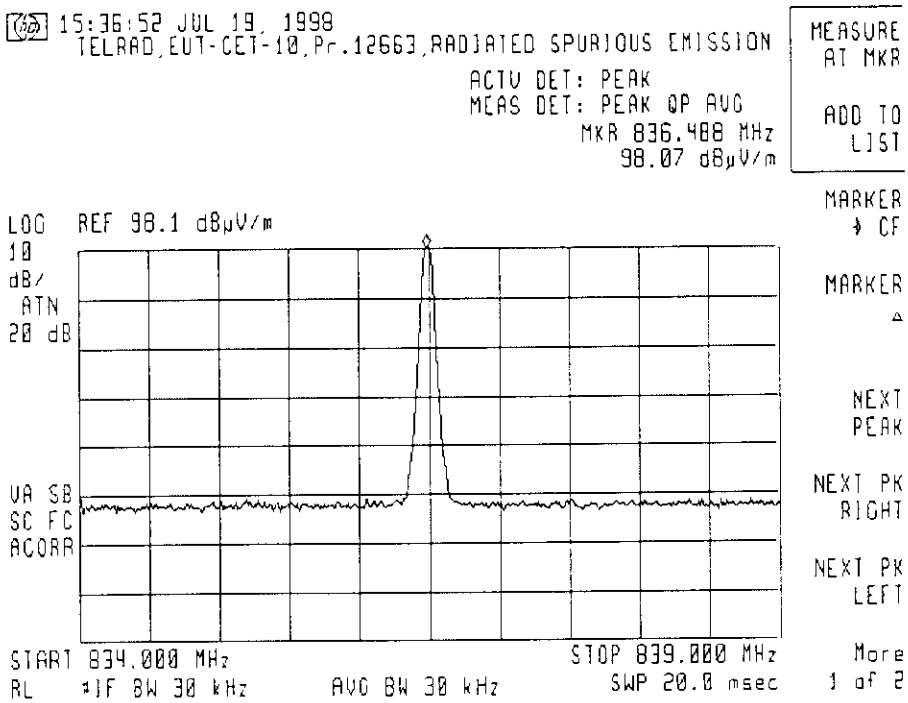
Analog mode

fff

Attenuation = 98,07 − 34,93 = 63,1 dB

Lim = 43 + 10 lg P = 45,3 dB

Screen Capture - captured on 7/19/98 3:36:51 PM



Plot No. 19

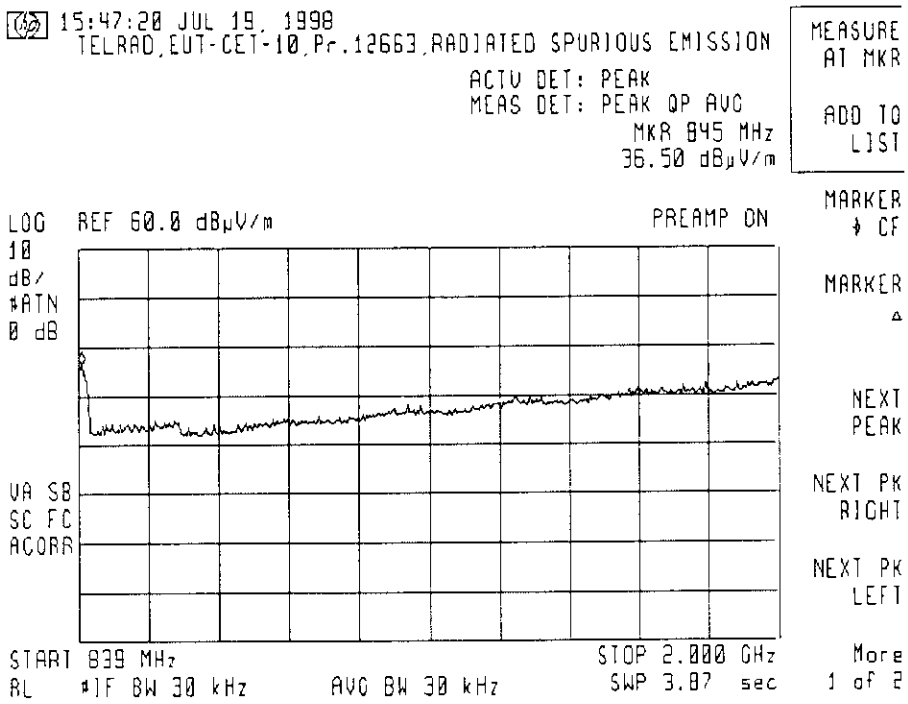
ext. att = 30 dB

analog mode

Attenuation more than 50 dB

Lim = 43.3 dB

Screen Capture - captured on 7/19/98 3:47:19 PM



Plot No. 20

ext. att. = 30 dB

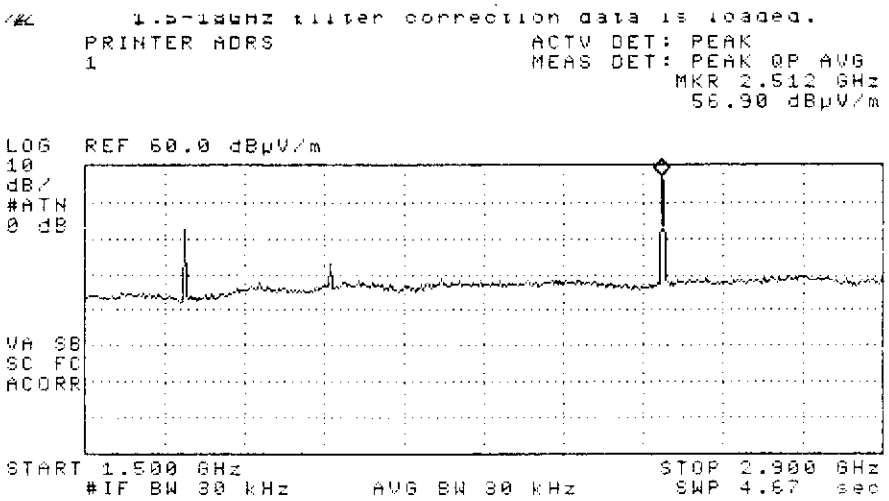
Analog mode

Attenuation = 98.07 - 36.5 = 61.6 dB

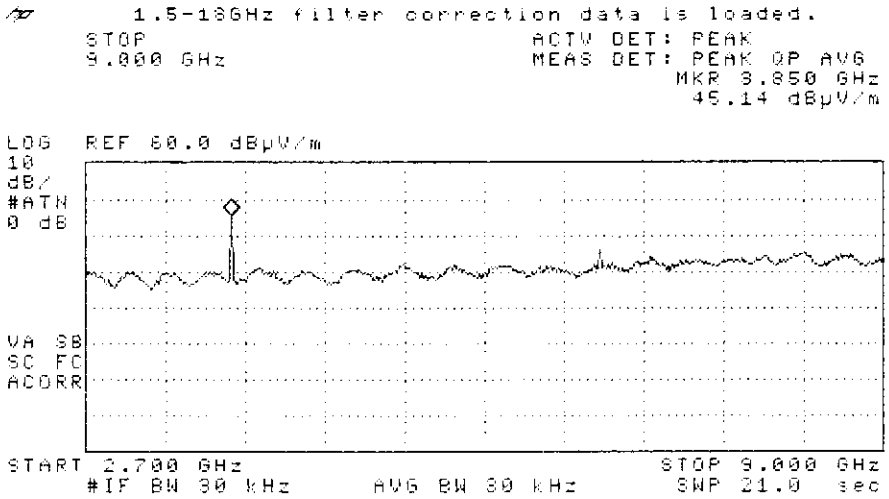
Lim = 43.3 dB

20/07/98 ~~Tekelec~~ Telecom, EUT - CET 10, Pr. 12663

F_{tx} = 836,49 MHz, Analog mode



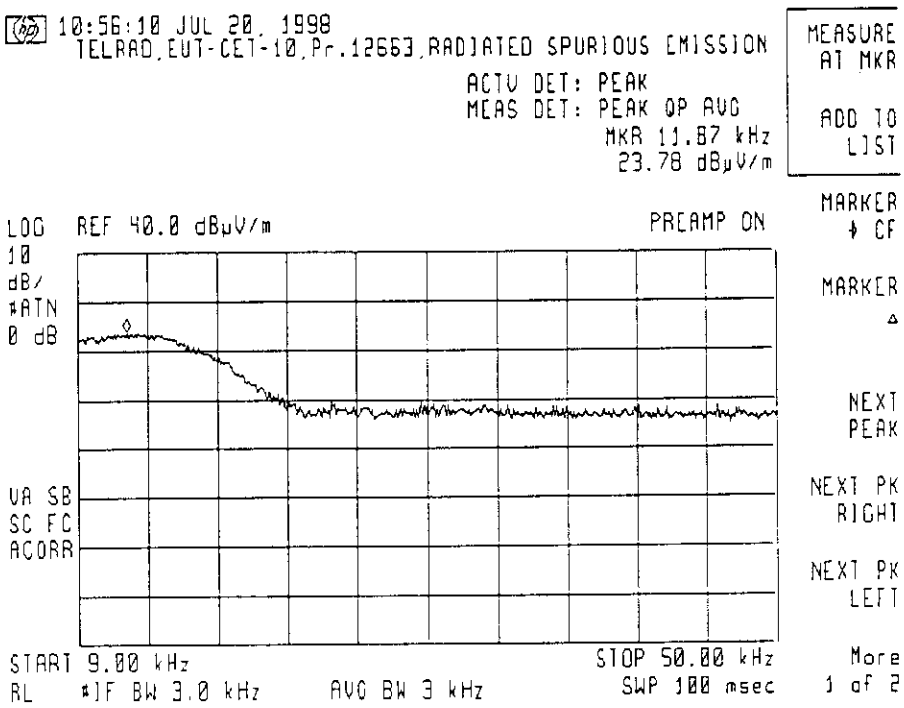
Plot No. 21



Attenuation = 128,~~92~~ 07 - 56,9 = ~~72~~ 71,2 dB

Lim = 43,3 dB = 10 lg P + 43

Screen Capture - captured on 7/20/98 10:56:09 AM



Plot No. 22

ext. att = 30 dB

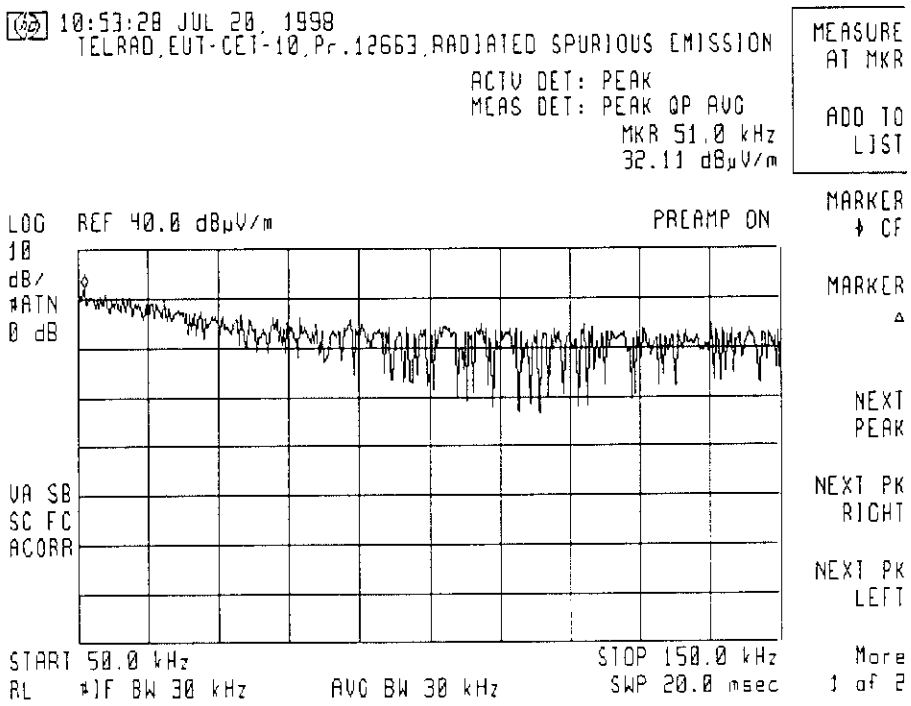
Digital mode

$Lim = 44,5\ dB$

$Lim = 43 + 10 \log = 43 + 20 \log 1,4 = 44,5\ dB$

$Attenuation = 130,46 - \left(5,378 + 20 \log \frac{30}{3}\right) = 56,68\ dB$

Screen Capture - captured on 7/20/98 10:53:28 AM



Plot No. 23

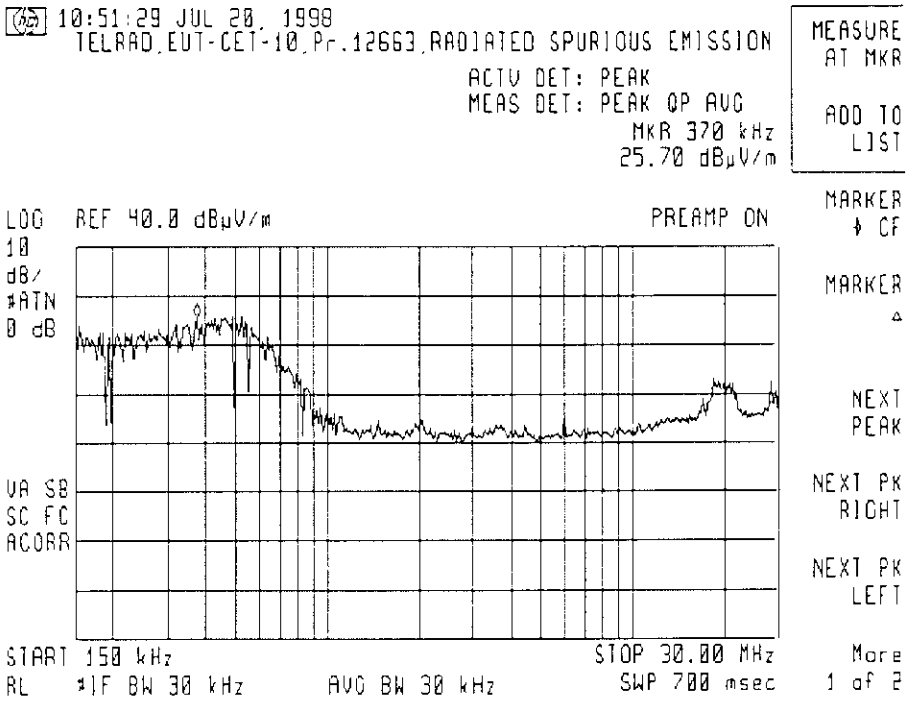
ext. att = 30 dB

Digital mode

fff

Attenuation = 130,46 - 62,11 = 68,35 dB

Screen Capture - captured on 7/20/98 10:51:28 AM



Plot No. 24

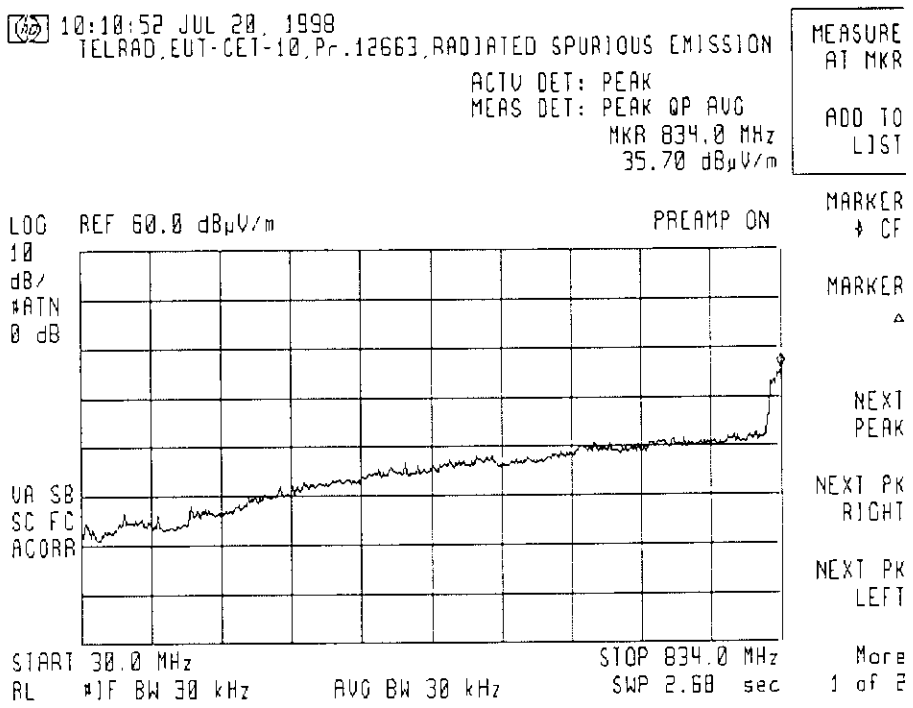
ext. att. = 30 dB

Digital mode

fff

Attenuation = 130,46 - 55,7 = 74,76 dB

Screen Capture - captured on 7/20/98 10:10:51 AM



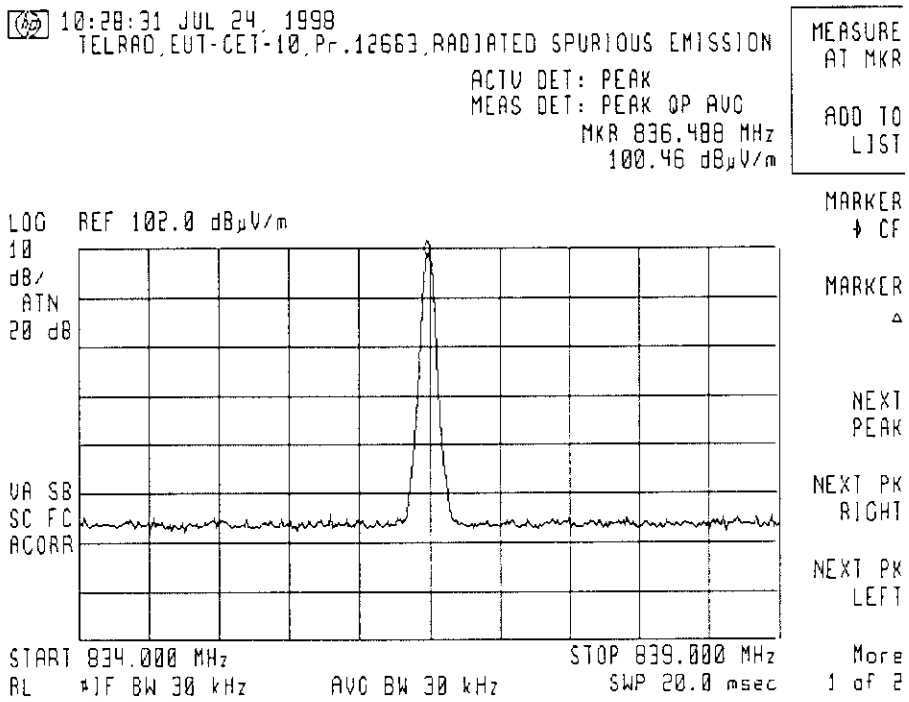
Plot N. 25

ext. att. = 30dB

Digital mode

Attenuation = 130,46 - 65,70 = 64,76 dB

Screen Capture - captured on 7/24/98 10:28:30 AM



Plot No. 26

ext att = 30dB

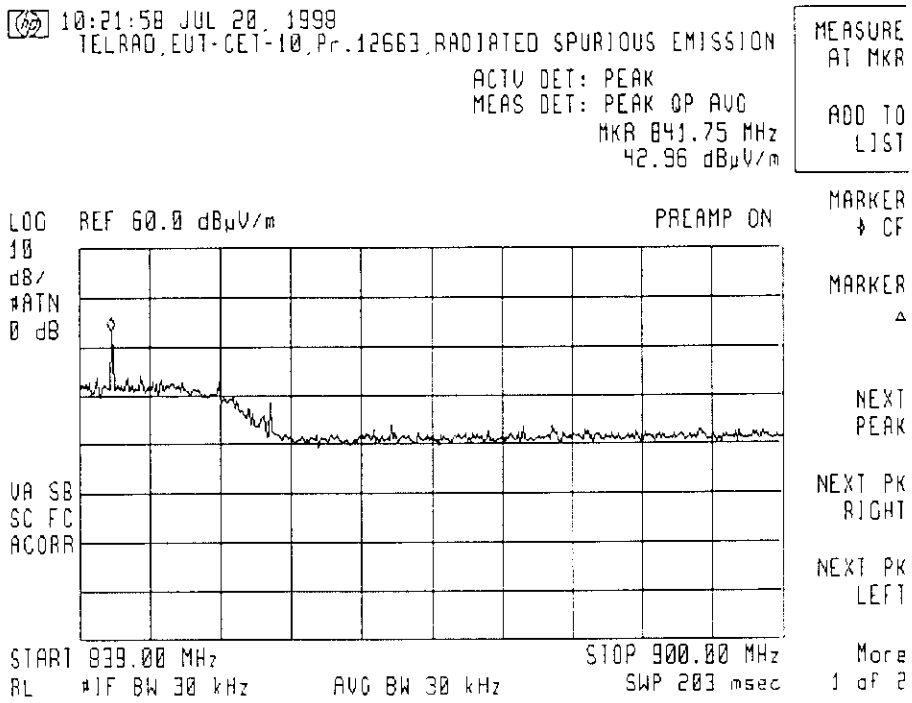
Digital mode

Attenuation more than 50dB

Limit = 43 + 10 lg 1,4 = 44,5 dB

fff

Screen Capture - captured on 7/20/98 10:21:57 AM



Plot No. 27

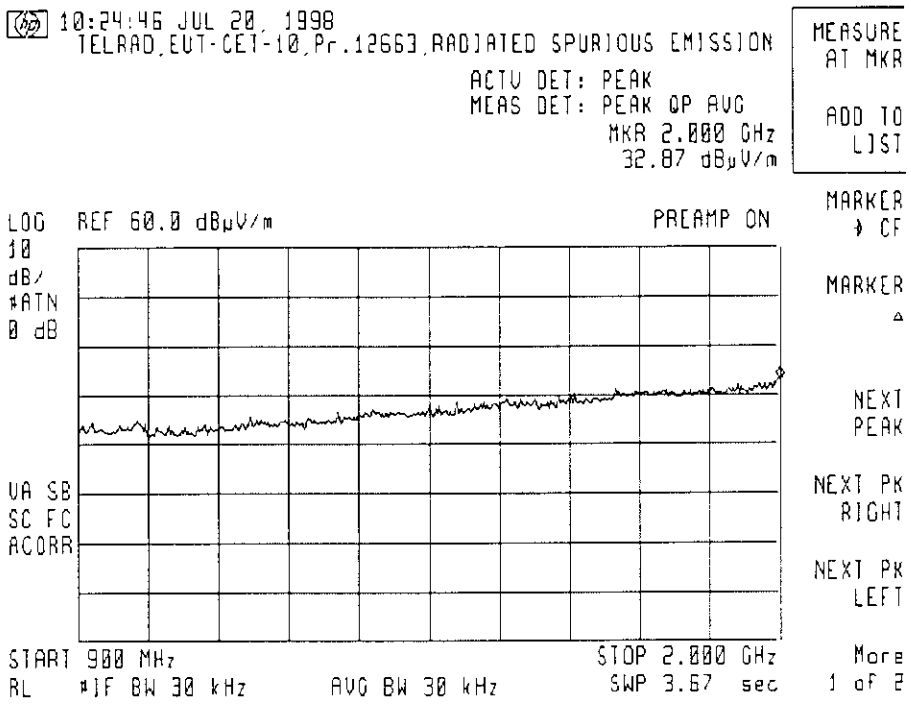
ext. att = 30db

Digital mode

fff

Att = 130,46 - 72.96 = 57,5 db

Screen Capture - captured on 7/20/98 10:24:45 AM



Plot No. 28

ext. att.

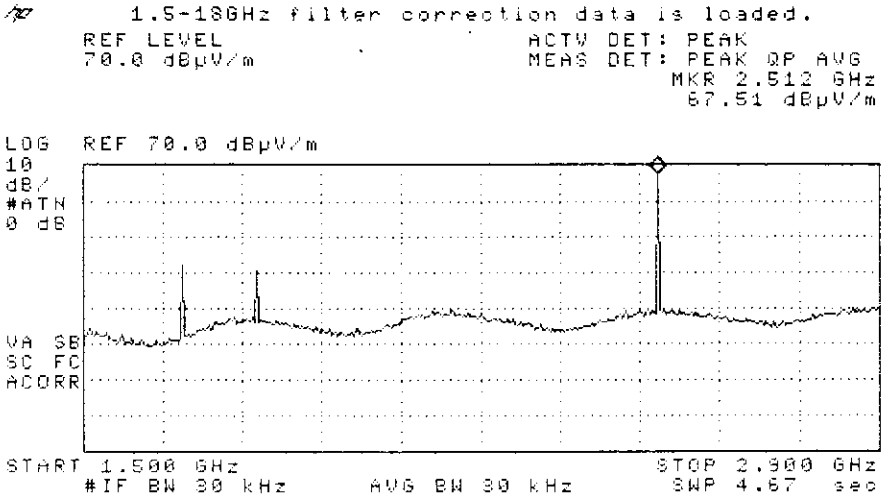
Digital mode

fff

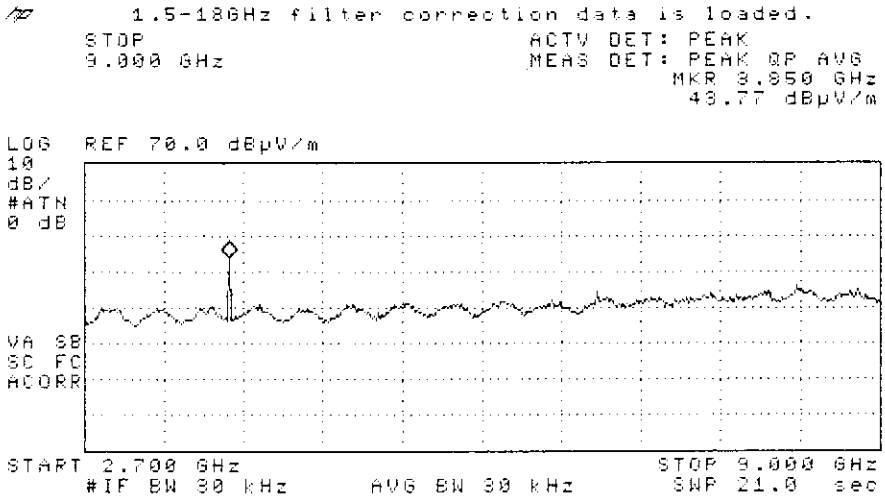
Att = 130,46 - 62,87 = 67,59 dB

20/07/98 Telrad, EUT - CET 10, Pz. 12663

F_{tx} = 836,49 MHz, Digital mode



Plot No. 29

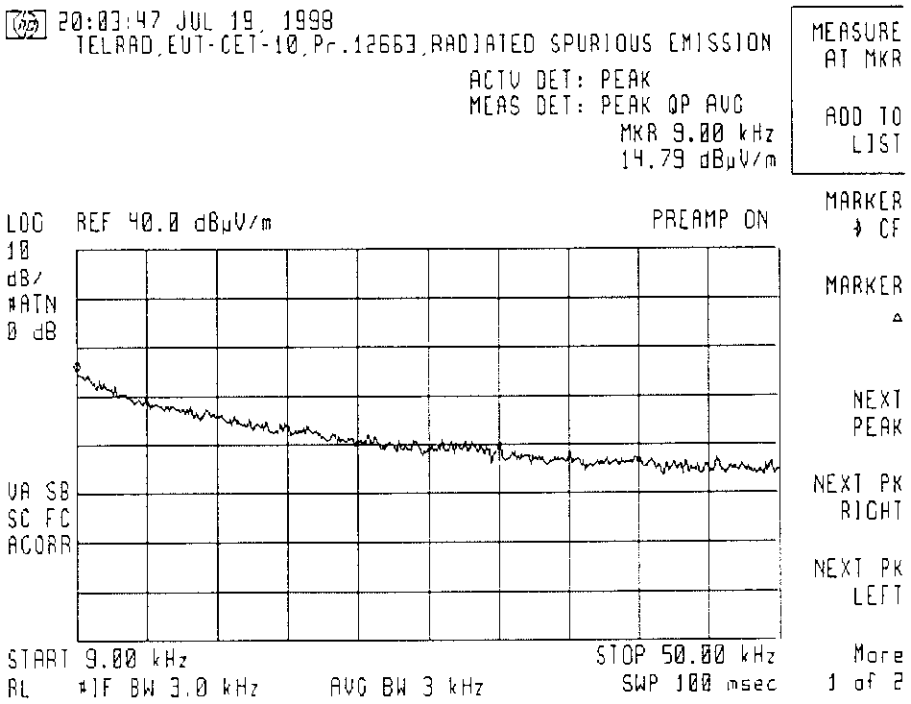


attenuation = 130,~~05~~ 46 − 67,51 = 62,95 dB

Limit = 10 lg P + 43 = 44,5 dB

fff

Screen Capture - captured on 7/19/98 8:03:47 PM



Plot No. 30

f = 848.97 MHz

ext. att = 30 dB

Analog mode

fff

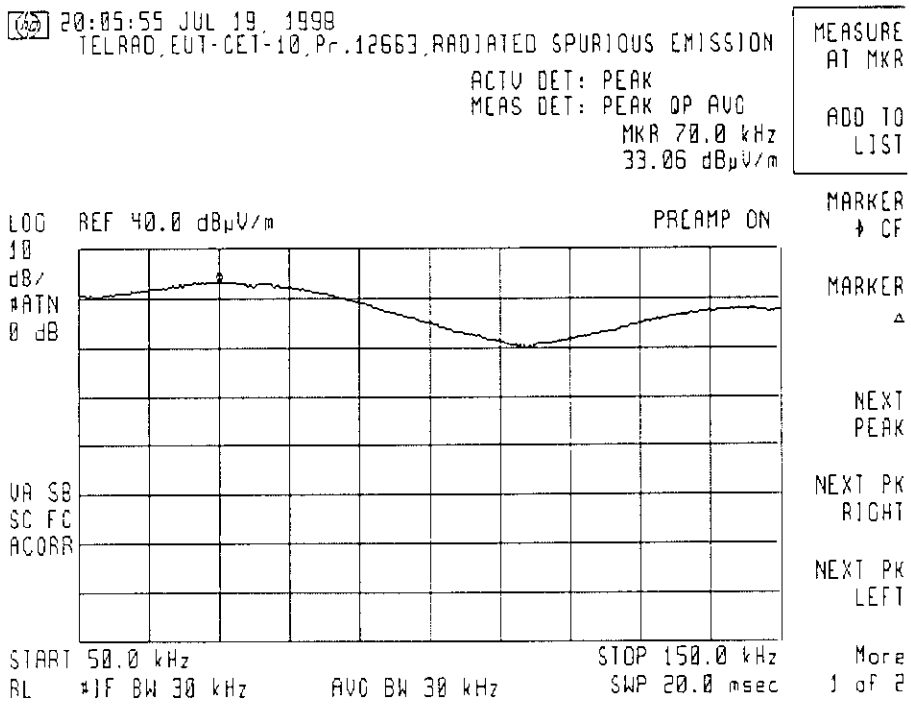
$$Attenuation = 98,51 - \left(14,79 + 20 \lg \frac{RBW_o}{RBW_m}\right) =$$

$$= 98,51 - \left(14,79 + 20 \lg \frac{30}{3}\right) = 63,7 \text{ dB}$$

$$Lim = 43 + 10 \lg P = 43 + 10 \lg 0,78 =$$

$$= 41,9 \text{ dB}$$

Screen Capture - captured on 7/19/98 8:05:54 PM



Plot No. 31

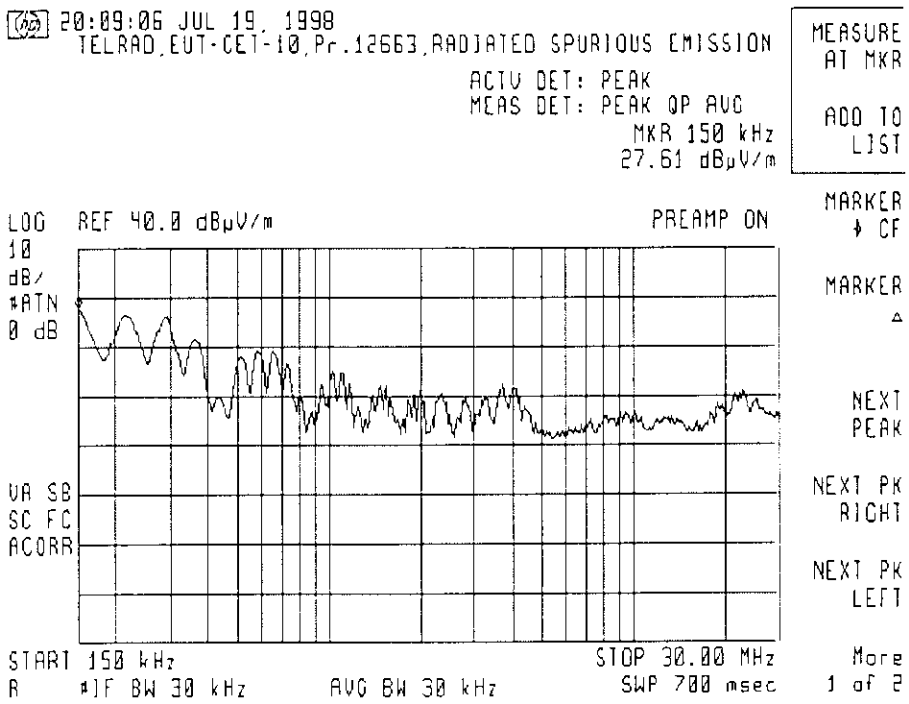
ext. att. = 30 dB

Analog mode

Attenuation = 98,51 − 33,06 = 65,5 dB

Lim = 41,9 dB

Screen Capture - captured on 7/19/98 8:09:05 PM



Plot No. 32

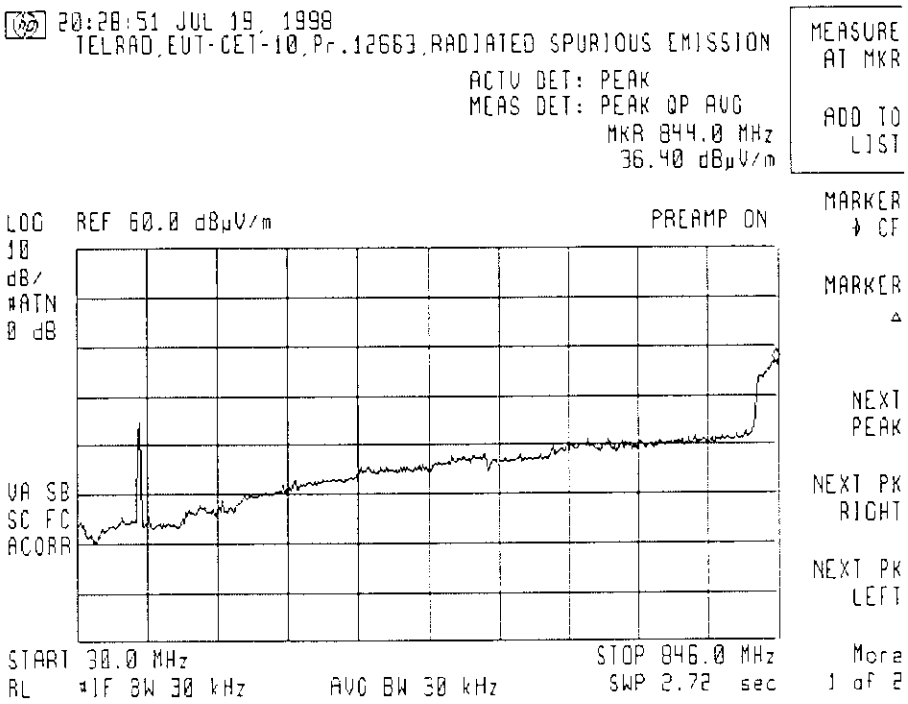
ext. att = 30 dB

Analog mode

Attenuation = 98.51 - 27.61 = 70.9 dB

Lim = 41.9 dB

Screen Capture - captured on 7/19/98 8:28:50 PM



Plot No. 33

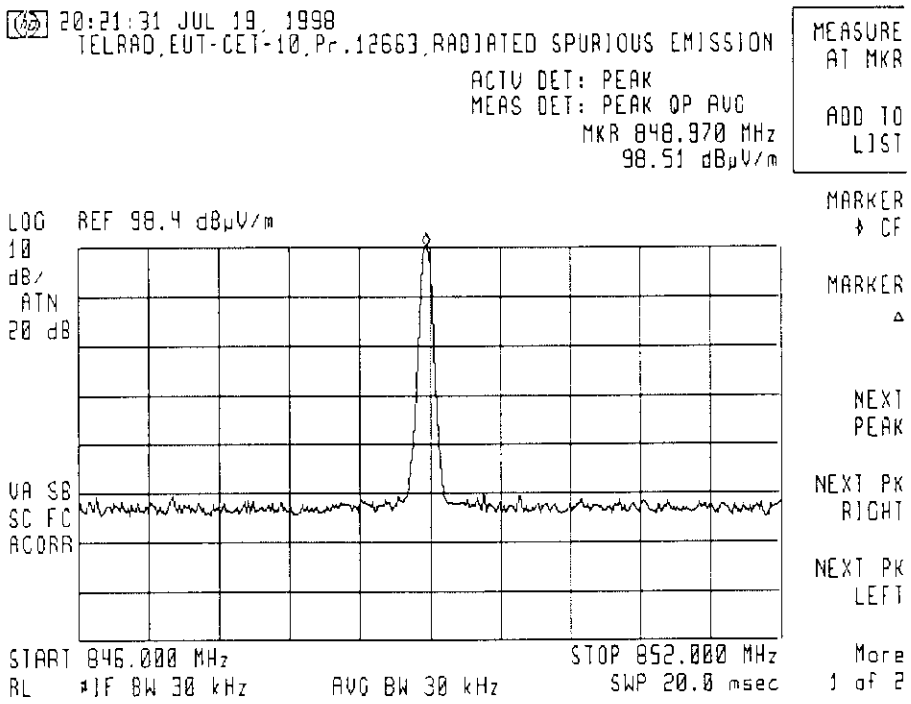
ext. att = 30 dB

Analog mode

Attenuation = 98,51 - 36,4 = 62,1 dB

Lim = 41,9 dB

Screen Capture - captured on 7/19/98 8:21:30 PM



Plot No. 34

ext. att = 30 dB

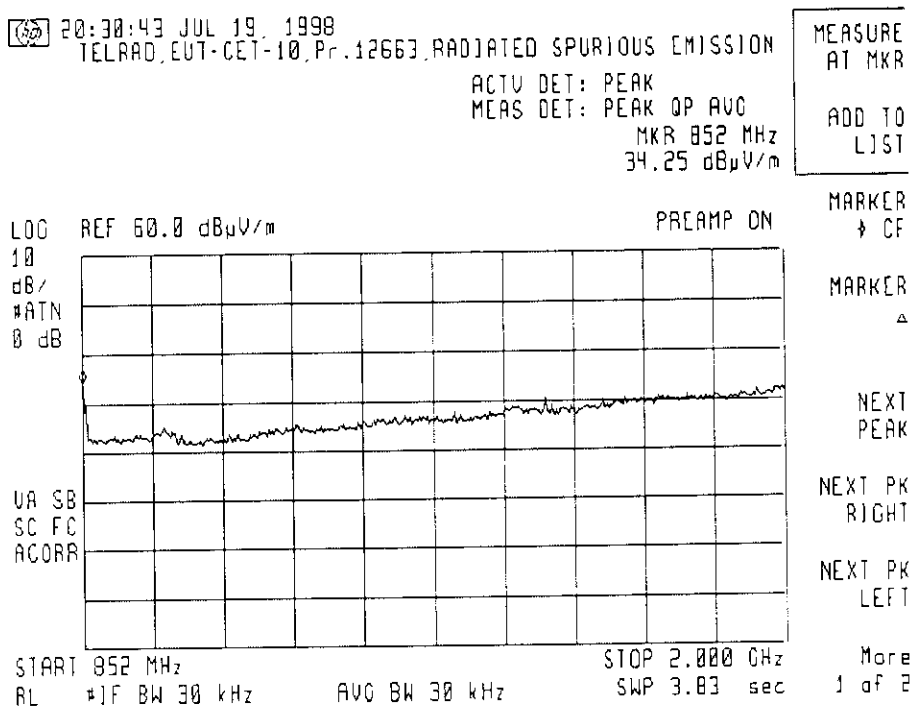
Analog mode

~~QP~~

Attenuation more than 50 dB

Lim = 43 + 10 lg P = 41,9 dB

Screen Capture - captured on 7/19/98 8:30:42 PM



Plot No. 35

ext. att – 30 dB

Analog mode

Attenuation = 98,51 - 34,52 = 64 dB

Lim = 43 + 10 log P = 41,9 dB

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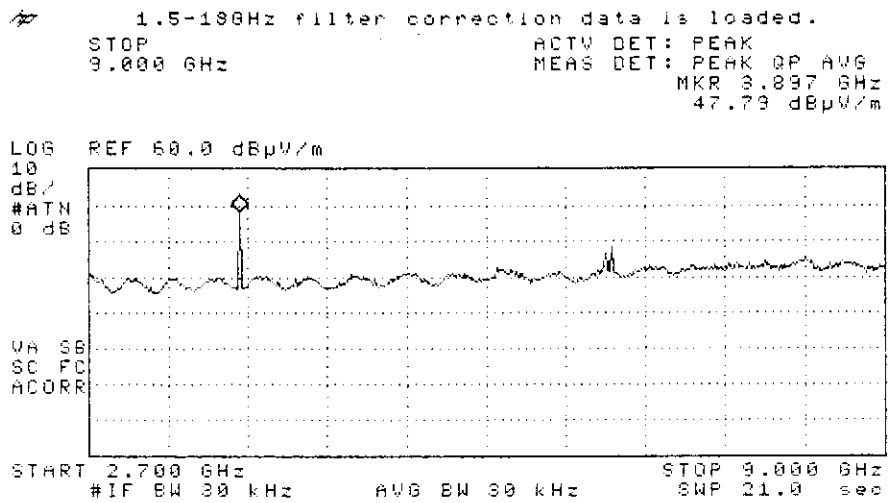
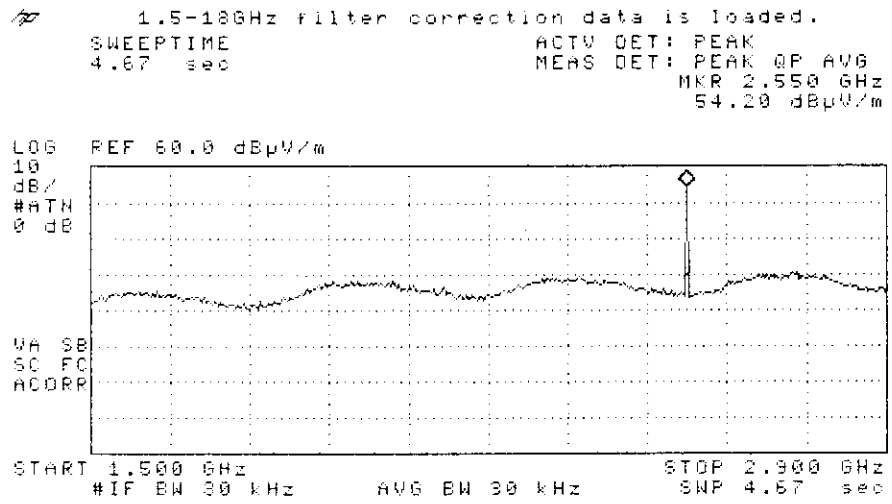
F_{tx} = 848,97 MHz, analog mode



Plot No. 36

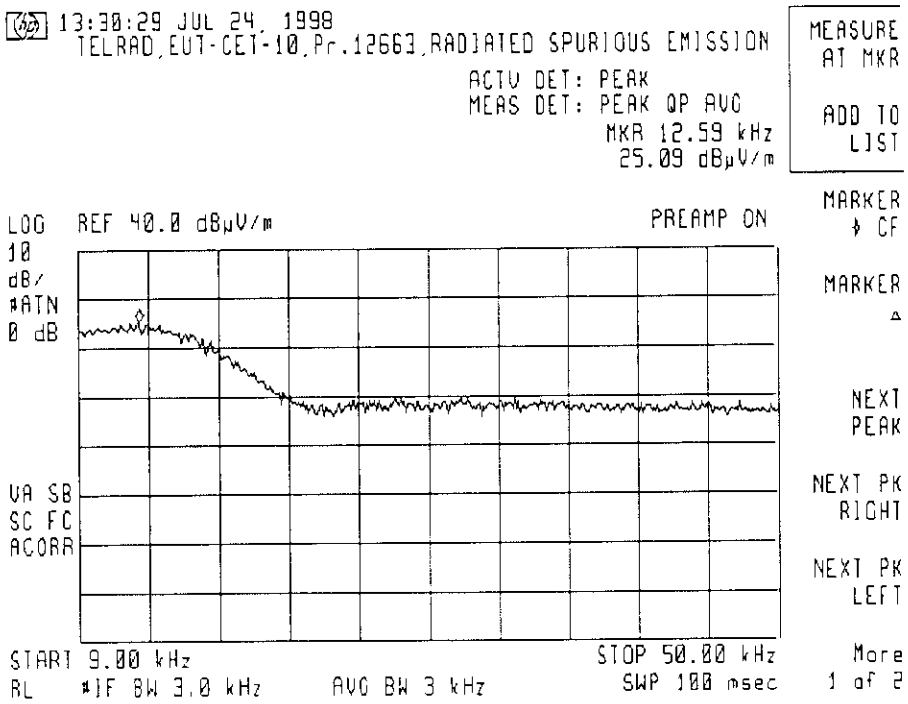


Attenuation = 128,~~54~~ 51 - 54,2 = 74,30 dB

Lim = 10 lg P + 43 = 41,9 dB

ff

Screen Capture - captured on 7/24/98 1:30:28 PM



Plot No. 37

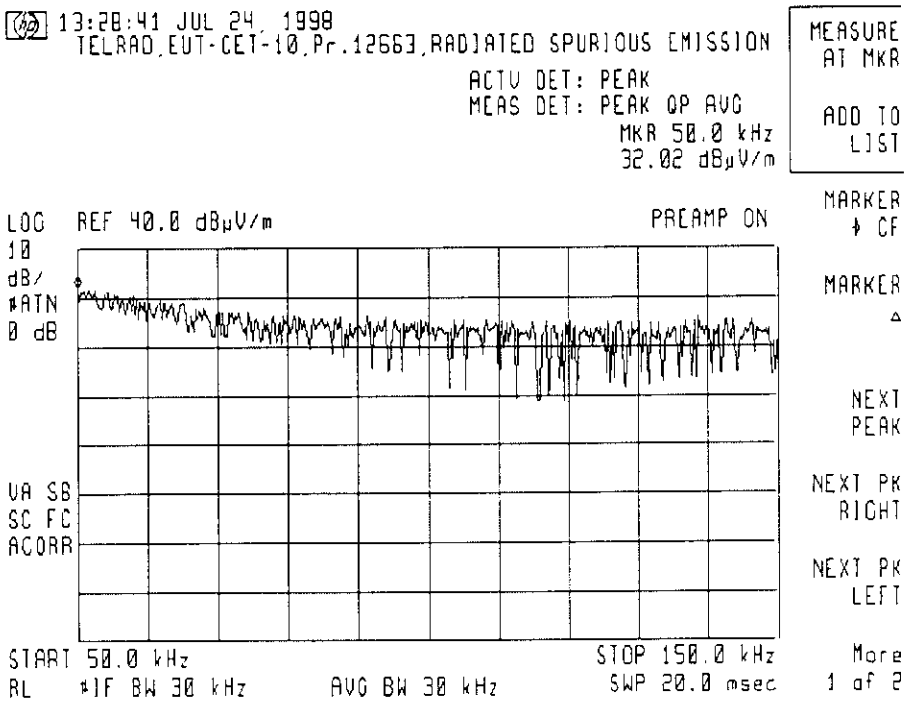
ext. att. = 30 dB

Digital mode

$att. = 129,58 - \left(55.09 + 20 \log \frac{30}{3}\right) = 54,5$ dB

lim = 43,4 dB

Screen Capture - captured on 7/24/98 1:28:40 PM



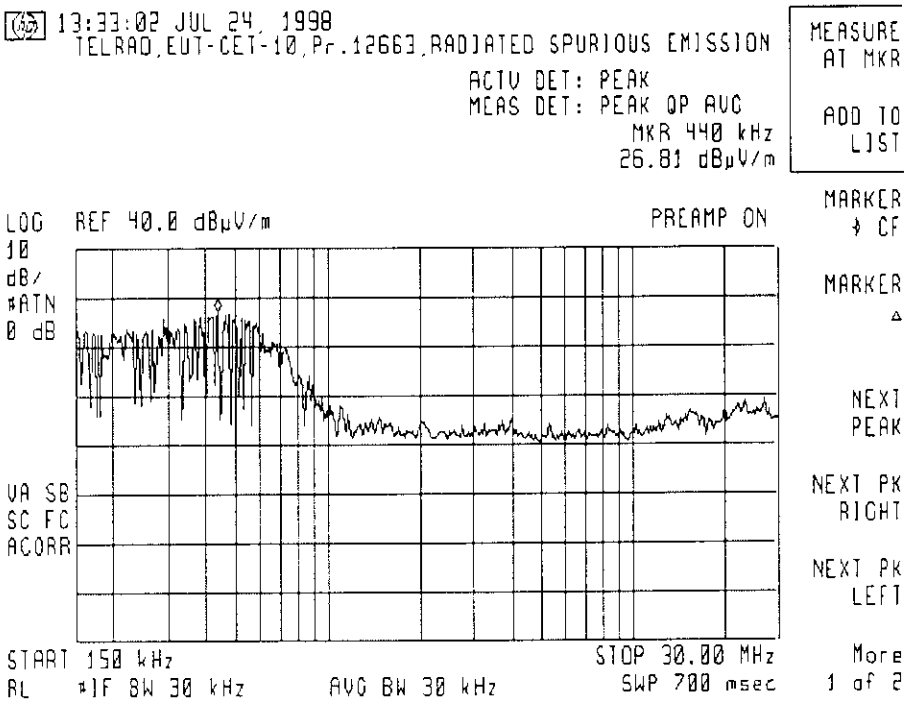
Plot No. 38

ext. att = 20 dB

Dip. mode

Att. = 129.58 - 32.02 = 97.56 dB

Screen Capture - captured on 7/24/98 1:33:02 PM



Plot No. 39

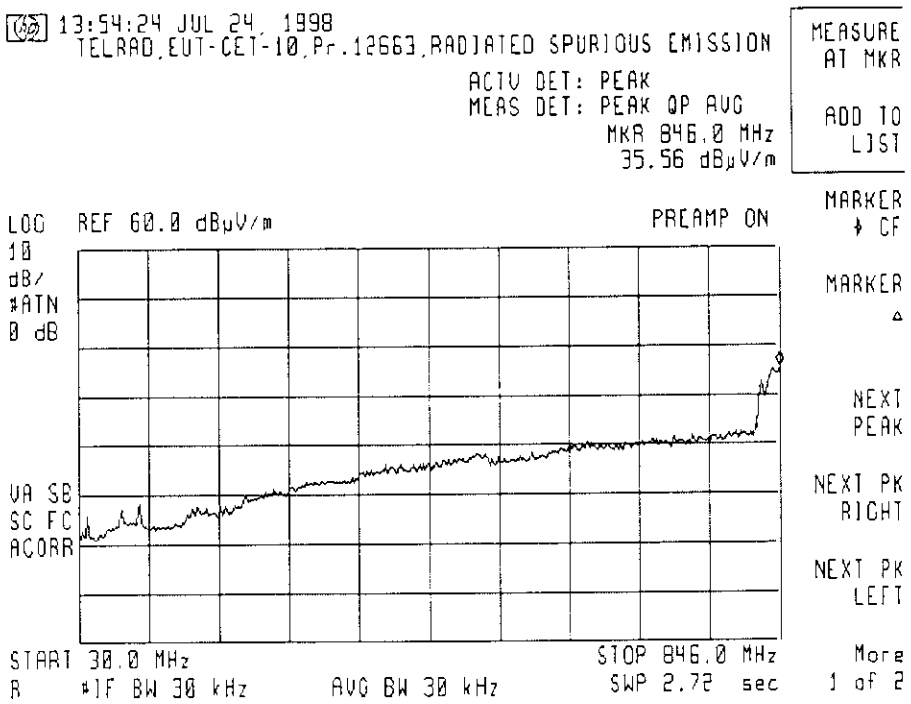
ext. att = 30 dB

Dip. mode

Att. = 129.58 - 46.81 = 82.77 dB

FF

Screen Capture - captured on 7/24/98 1:54:23 PM



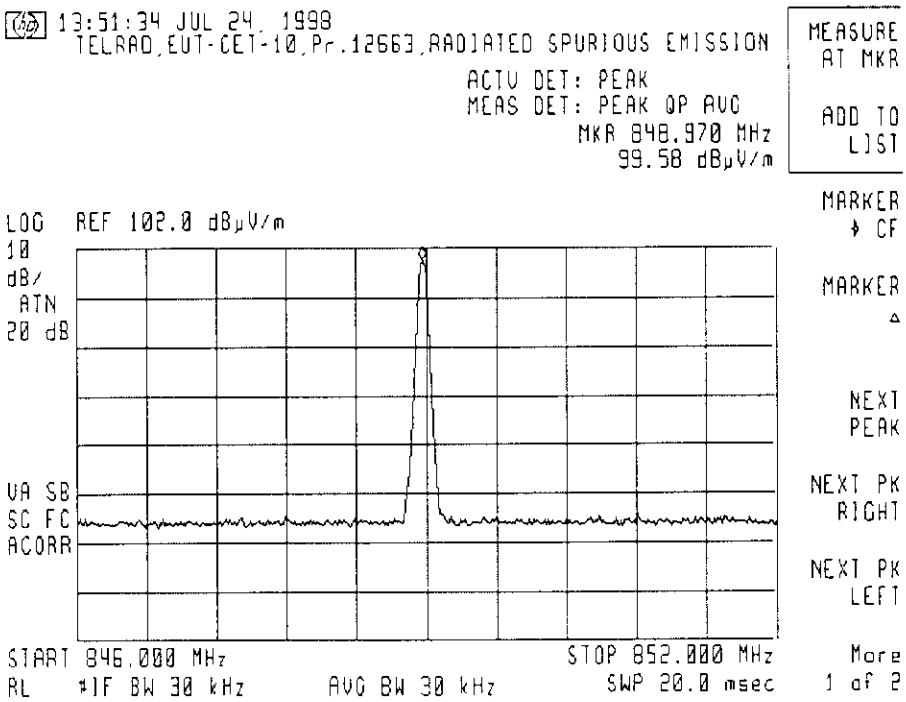
Plot No. 40

ext. att. = 30 dB

Dip. mode

Att. = 129.58 − 65,56 = 64,02 dB

Screen Capture - captured on 7/24/98 1:51:33 PM



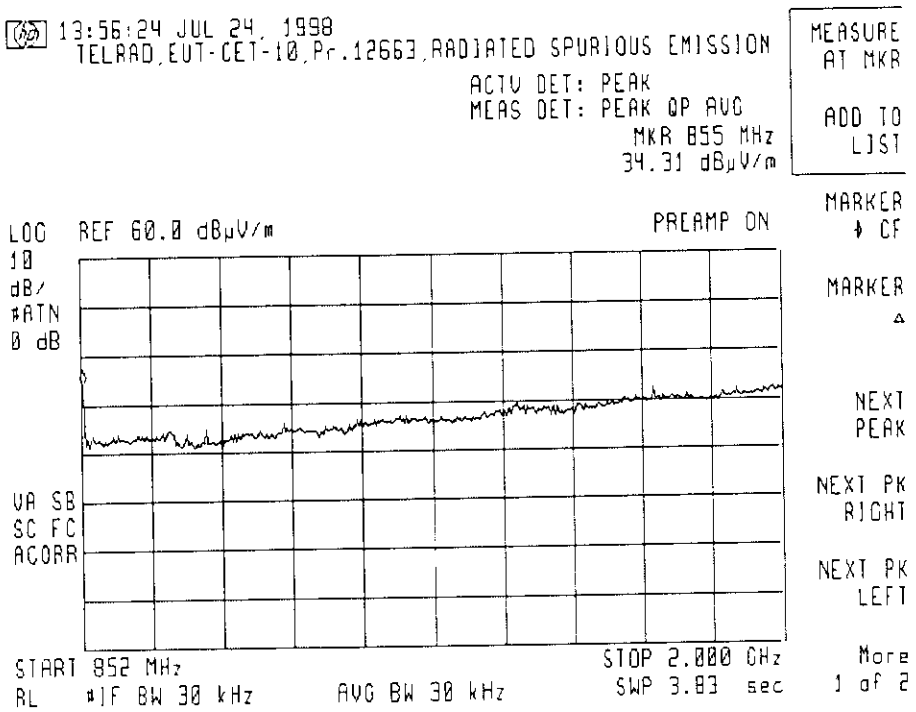
Plot No. 41

ext. att = 30 dB

Dig. mode,

Att. more than 50 dB

Screen Capture - captured on 7/24/98 1:56:23 PM



Plot No. 42

ext. att. = 30 dB

D.g. mode

att. = 129.58 - 64.31 = 65.27

20/07/98 Telrad, EUT-CET 10, Pr. 12663

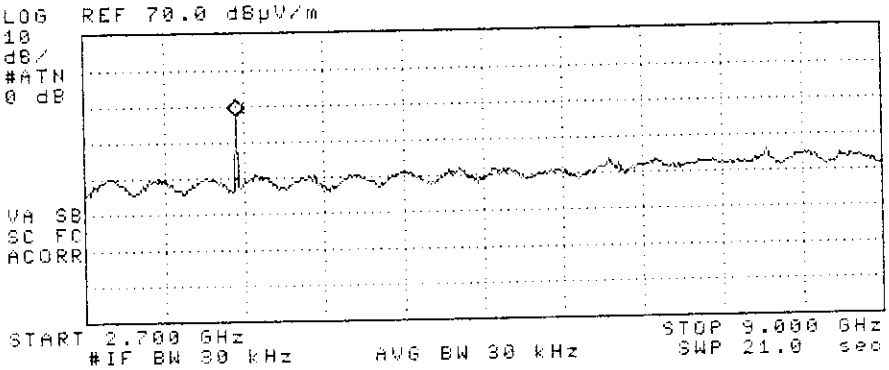
F_{tx} - 848,97 MHz, Dipital mode

1.5-18GHz filter correction data is loaded.

STOP
9.000 GHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 3.937 GHz
46.38 dBµV/m

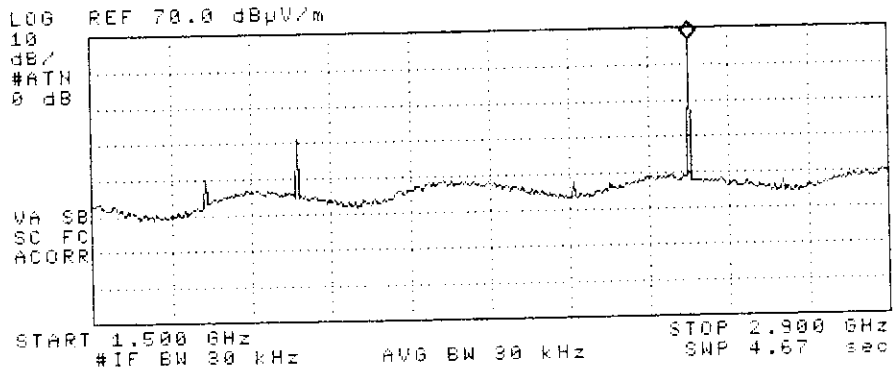
Plot No. 43



1.5-18GHz filter correction data is loaded.

STOP
2.900 GHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.550 GHz
66.53 dBµV/m



129,58

Attenuation = ~~130,76~~ - 66,53 = ~~63,23~~ dB

Limit = 43 + 10 lg P = 43,4 dB

Applicant: Telrad Telecommunication and Electronic Industries Ltd.

Application for: Type acceptance of digital radio telephone CET-10

FCC requirements §2.983 (a)

The manufacturer and the applicant are the same organization:
Telrad Telecommunication and Electronic Industries Ltd.
P.O.Box 50, Lod 71100, Israel

Responsible person is Mr. Josef Bakalzuk, Department Manager.
Tel: +972 8913 3716
Fax: +972 8913 3164

FCC requirements §2.983 (b)

Identification of the equipment for which acceptance is sought:

The equipment is a digital radio telephone (fixed cellular terminal), model CET-10, provides voice, facsimile and data services, accessing all wired equipment. The CET-10 supports any type of tone dialing feature phones, modem, fax, answering machine. The CET-10 cellular transceiver transmit frequency range is 824-849 MHz, with maximum authorized occupied bandwidth 40 kHz, receive frequency range is 869-894 MHz. Maximum RF output power is 1.6 W (ERP). The EUT is supplied by 120 V AC/12 V DC external power supply unit.

The equipment is identified by the following label:
"FCC ID:ARACET-10".

FCC requirements §2.983 (c)

The digital radio telephone CET-10 is manufactured in mass production (thousands) quantities.

FCC requirements §2.983 (d)

The equipment technical description.

FCC requirements §2.983 (d) (1), (2)

The CET-10 cellular transceiver transmit frequency range is 824-849 MHz, with maximum authorized occupied bandwidth 40 kHz, 40K0F3D/F3E type emission, receive frequency range is 869-894 MHz.

FCC requirements §2.983 (d) (3)-(7), (9)-(11)

The device does not contain any elements (potentiometers, variable capacitors or adjustable inductors) accessible to operator to influence or to change RF output power. The Telrad product description (original pages 3 to 18) follows this page covers all the FCC above mentioned requirements.

1. **General**

This document describes the means implemented to ensure modulation stability, transmitted power stability, frequency stability, and spuriouses attenuation. The transmitter provides transmission of FM and π/4DQPSK modulated RF signals in 824 to 849 MHz frequency band. Figure 1 describes the block diagram of the transmitter.

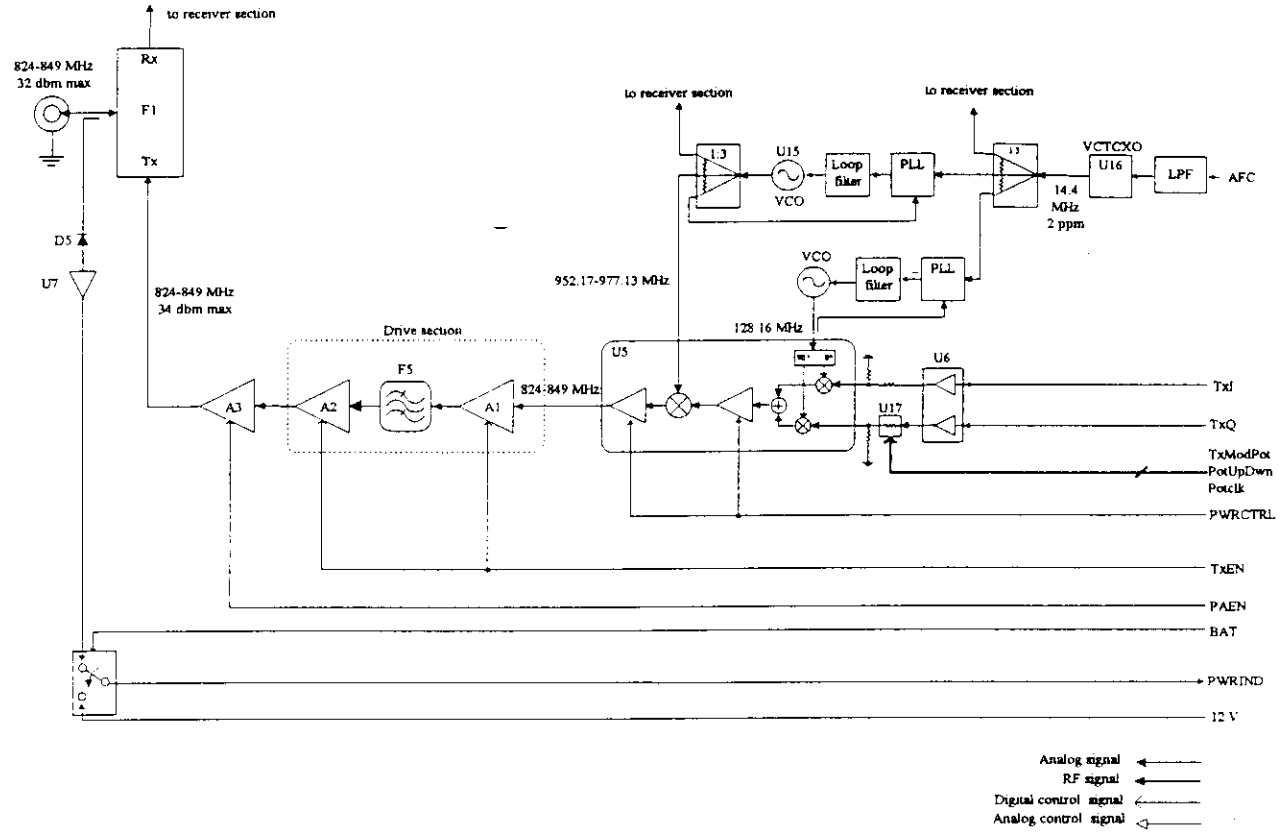


Figure 1: Transmitter section

2. **Modulation stability**

The modulated signal is generated in the TCS320IS54B- a baseband interface chipset. It generates π/4DQPSK and frequency modulations using baseband in-phase and quadrature signals. It produces differential baseband signals "TxI" for the in-phase and "TxQ" for the quadrature. The baseband waveforms are generated according to the modulation technique in use.

2.1 Analog mode

The voice signal produced by the microphone is amplified in the audio circuits, then is processed by the TCS320IS54B chip set.The processing includes:

[1] compression that is provided by a 2:1 syllabic compander. It converts every 2 dB change in input level to 1 dB at compressor's output.

[2] modulation deviation limiting that enables to limit the instantaneous frequency deviation to ±12 kHz maximum.

[3] Preemphasis filter with 6 dB /octave characteristics within the 300 Hz ÷3000 Hz.
[4] Postdeviation limmiter filtering that attenuates frequency components above 3 kHz . In frequency range among 3 kHz to 5.9 kHz and 6.1 kHz to 15 kHz the attenuation relative to 1 kHz is minimum $40\log[f_{[Hz]}/3000_{[Hz]}]$. Among 5.9 kHz to 6.1 kHz the attenuation relative to 1 kHz is 35 dB minimum . For frequencies higher than 15 kHz the attenuation is 28 dB minimum.
[5] Generation of frequency modulated signal.

The processing is performed in the chip set.

2.2 Digital mode

The voice signal produced by the microphone is amplified at the audio circuits and then is processed by the TCS320IS54B chip set.The processing includes:
[1] Voice coding
[2] Channel coding .
[3] π/4DQPSK modulation
[4] Generation of 24.3 ksymbol/sec baseband signals shaped by a squared root raised cosine (SQRRC) filter with roll of factor α=0.35.

The processing is performed in the chip set.

The TxQ signal (quadrature branch) goes to the digitally controlled potentiometer U17 (XICOR's X9313WS).U17 is used to change TxQ signal's voltage to reduce the amplitude imbalance between the TxI (in-phase branch) and TxQ rails. The required resistance is programmed during the production of the telephone. Programming of the potentiometer is achieved by the "PotClck", "PotUpDwn" and "TxModPot" signals. Detailed description of the electrical scheme of this portion is given in page No.10.

3 **Transmission Power stability**

The TxI and TxQ baseband signals go to a quadrature modulator that generates a modulated RF signal within the 824 ÷849 MHz frequency band at the assigned channel frequency.

The subscriber is get of eight distinctive power levels . The highest level is +32 dbm (1.6W) and the lowest level is +8 dbm (6 mW).
The power level can be changed by controlling the gain of the voltage controlled amplifiers in the modulator U5 (AT&T's W2013CBY) by the "PWRCTRL" a control signal supplied from the control card. Detailed description of the electrical scheme of this portion is given in page No.10.

The "PWRCTRL" signal is generated to:
[1] set the transmission power to the required power level (one of eight). The production process includes a calibration procedure that sets initial value to the "PWRCTRL" signal for each power level.

[2] keep the transmission power stable in the assigned level over the : frequency, temperature and supply voltage. An automatic level control (ALC) mechanism changes its value to keep the transmission power stable .

3.1 Automatic level control (ALC) mechanism

The ALC mechanism is implemented by software . It detects the actual transmitted power at output and changes the "PWRCTRL" to achieve the required transmission power.

The actual transmitted power is sampled by semi lumped directional coupler into a power detector.The power detector is composed of the dual Shotky diode D5 (BAT62) and active low pass filter composed of U7 (MC3324D). The power detector produces the "PWRIND" indication as a measurement of the transmitted power. Detailed description of the electrical scheme of this portion is introduced in page No.11.

The production process includes a calibration procedure that sets measures and saves the values of the "PWRIND" signal for each power level.

The ALC mechanism enables transmitted power of ±2 dB from its maximum transmitted level over the frequency band , over the operating temperature and voltage supply range. The maximum transmitted power can be 2.5 W.

3.2 Protection against false transmission

The power indication is used for protection against false transmission mechanism..This mechanism is implemented in software and reads the "PWRIND" value while the power amplifier is turned off and resets the subscriber if it senses power when the power amplifier has been set off .

4 Frequency stability

The radio module includes four signals sources that are used as local oscillators for up or down conversion in the transmitter and receiver circuits. Three sources are fixed frequencies of 128.16 MHz , 82.71 MHz and 900 kHz. The fourth is a frequency synthesizer for 952.17÷977.13 MHz.

All the signal sources are phase locked oscillators that are locked on reference of 14.4 MHz oscillator . Figure 2 describes the block diagram of signal sources section.

The reference oscillator is a VCTCO (NDK's END3190A voltage controlled temperature compensated crystal oscillator) . The VCTXO provides nominal frequency of 14.4 MHz and output voltage 1 V peak to peak. The VCTXO is used to achieve temperature stability of ±2 ppm over 0°C to 65°C operating temperature range.

The nominal frequency is tuned during the production process to achieve frequency accuracy of ±200 Hz of the RF frequency of the assigned channel.

The VCTXO's frequency is tuned by setting a proper voltage to the V tune port of the VCTCXO. The voltage to the V tune port is supplied from the "AFC" control signal of the control card via a low pass filter network composed of R266, C212,R381,R384,R385,R386. Detailed description of the electrical scheme of this portion is given in page No.7.

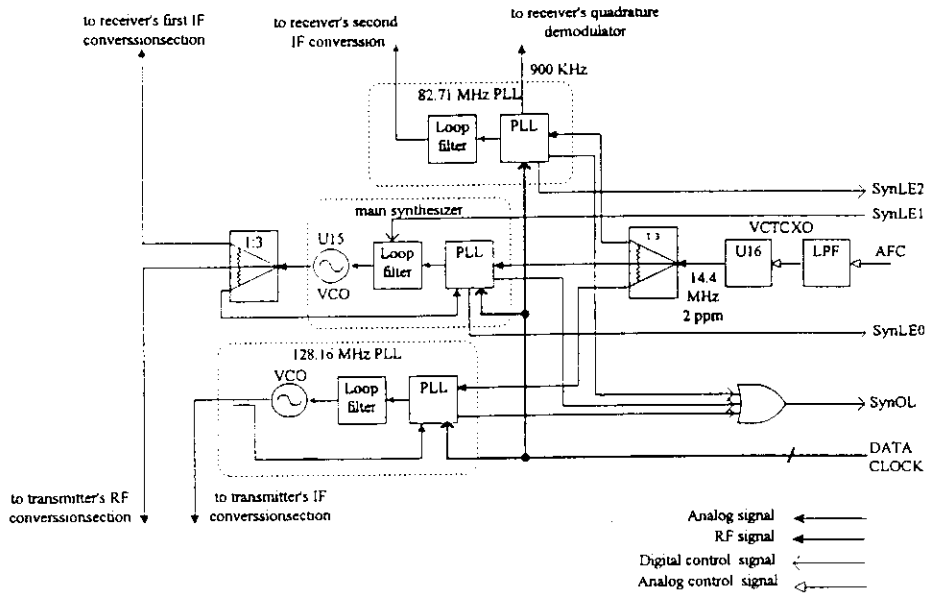


Figure 2: signal sources section

5. Spurious reduction

5.1 Synthesizer spurious reduction

The main synthesizer is composed of U10 - a dual fractional N synthesizer (Philips SA7025, VCO U15 (FDK's IF066) and a filter network. The filter consists of the loop filter and spurious reject filter. The loop filter determines the dynamics of the synthesizer (attack time,release time and RMS phase error) and composed of R2, R3, C3,C4.The spurious reject filter attenuates spuriouses generated by the synthesizer (by its charge-pump phase detector). It is a low pass filter composed of R4,C5,C6. Detailed description of the electrical scheme of this portion is given in page No.17.

5.2 Second harmonic and signal source leakage reduction

The high power RF signal from the power amplifier A3 (MITSUBISHI's M68761) goes to the Tx port of the duplexer F1 (Motorola's KFF-6382A ceramic filter) through a matching network. The duplexer attenuates the out of band emissions (such as the second harmonics and other signal source leakage) . Detailed description of the electrical scheme of this portion is performed in page no.11.

6. Electrical schemes

look at the the following pages.

FCC requirements §2.983 (d) (8)

Instruction book.

This page is followed by Telrad Digital radio-telephone User Manual book, which contains 24 pages and all the necessary information required for user and service personnel.

FCC requirements §2.983 (e), §2.985 - §2.999

Test Measurement Report TLRFCC.12663 according to FCC Parts 2 and 22, total 233 pages, follows this page.

FCC requirements §2.983 (g)

The eight photographs of the CET-10digital radio telephone follow this page: external and internal view, radio module and digital part PCBs.