EXHIBIT I

California State Polytechnic University
Department of Electrical and Computer Engineering

Analysis of the Potential for Interference to Television Reception of Channel 13 by Base Station Transmitters in the Automated Maritime Telecommunications System (AMTS)

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Overview

This study presents empirical testing, performed in the Department of Electrical and Computer Engineering, California State Polytechnic University, on behalf of Regionet Wireless. All measurements were made by University staff, working as independent investigators.

This study examines the performance of approximately 50 television receivers in relation to co-channel signals, as may be received from the Automated Maritime Telecommunications System (AMTS).

Channel 13 television broadcasters are assigned a spectrum allocation from 210-216 MHz. The AMTS broadcast spectrum is from 217-218 MHz and 219-220 MHz. In order to assess any possible negative effect of AMTS transmissions on channel 13 television reception, the University staff tested frequencies from 216-220 MHz in 0.5 MHz steps. It should be noted that while tests were performed over the entire four megahertz range, only the two regions, from 217-218 and 219-220 Mhz, are of particular interest, as the remaining spectrum is used by other services.

In general, it can be assumed that as the frequency of the potential interfering signal approaches the frequency band of the channel 13 Broadcaster interference to reception is more likely to occur. Of principal interest is the level of energy required to produce "just perceptible" interference to the reception of the channel 13 broadcasts.

Sample Selection

In choosing a sample set of television receivers to be tested, the University staff chose television receivers in private homes, in residential communities in Los Angeles, Orange, and San Bernardino Counties, CA. All of the receivers tested were located within the B-grade contour of KCOP Channel 13, the local Los Angeles area broadcaster. The make, model, serial number, and approximate age of the receivers were recorded as part of the testing criteria. This random selection of television receivers represents a reasonably accurate cross-section of the television receivers to be found in the general population.

Test Set-Up

In the past, other tests [1,2,3] have been performed using a small number of television receivers using over-the-air reception and a "test" AMTS transmitter. In this study the University staff opted for a methodology more closely corresponding to the real world.

By definition, the University staff considered "just perceptible" interference to occur when the visual signal of channel 13 appeared minimally degraded from a normal viewing distance of 10-12 feet.

To determine at what power level "just perceptible" interference might occur for a channel 13 signal, the broadcast signal was combined with an interfering 1 kHz FM modulated AMTS signal. As used in previous studies [1,2,3], the University staff assumed –65 dBm as the minimum signal required for acceptable TV reception. This level is well below the signal level that would normally be expected from cable companies.

The received television signals, off-the-air or from a cable, were converted from 75 ohms to 50 ohms using a Matching Pad (JFW Model 57ZT) designed to operate over a frequency range of 0.5 - 300 MHz with a maximum insertion loss of 0.75 dB.

The received signal was then fed through a 50 ohm step Attenuator (Kay Elemetrics Corp. Model 839) designed to operate from DC to 2GHz. The attenuator was used to reduce the signal to –65 dBm, the minimum power level suggested by the FCC for acceptable television viewing.

From the output of the step attenuator the signal was connected to one input of a Combiner (Mini-Circuits Model ZFSZ-2-1) designed to operate in the frequency range of 5-500 MHz. The other input to the combiner was connected to a WaveTek (Model 3006) signal generator. The insertion loss through this combiner was 0.8dB above the 3dB due to the division of the signal.

The WaveTek signal generator was used to produce the interfering signal, modulated with a 1kHz tone. This signal generator was tested with a calibrated Hewlett-Packard Spectrum Analyzer (Model 8591EM), and it was found to be linear over the frequency ranges of interest and the second harmonic was below the fundamental by 35dB.

Another JFW Model 57ZT Matching Pad was placed on the output of the combiner so as to convert the combined signal back to 75 ohms. This output was connected to a coaxial switch capable of switching between two outputs.

Output A of the AB Switch, as shown in figure 1, was connected to a Sadelco (Model Minimax 800, Serial No. LT2163) frequency selective signal meter. The Sadelco meter was configured to measure the average power level of channel 13 (210-216 MHz). The meter was supplied with an active certificate of calibration showing compliance with National Standards (HP Power Sensor Model 8484A, Serial No. 1528A00225 and HP Digital Power Meter Model 436A, Serial No. 1611A00620).

Output B, as shown in figure 1, was connected to the television test under test.

Test Procedure

When testing a television receiver, the incoming signal was connected to the Sadelco frequency selective signal level meter. With the step attenuator, the signal was adjusted to –65 dBm which corresponds to –16.2 dBmv (the meter reads average voltage in the 4MHz Bandwith of channel 13). Once that power level had been acquired, taking into account all system and impedance conversion losses, the signal was directed to the television receiver via the AB switch. At this point, the WaveTek generator (interfering signal) is presented to the television receiver and the test to determine interference was performed in 0.5 MHz increments over a frequency range from 216MHz to 220 MHz .

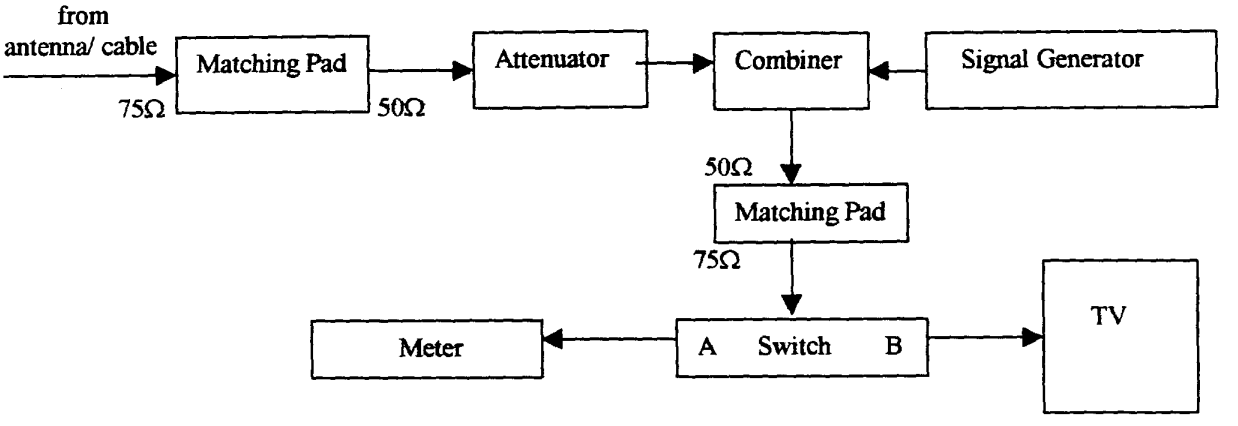


Figure 1. Test Set-Up

The interfering signal power level is increased until the viewer at a viewing distance of 10-12 feet notes "just perceptible" interference. This test is repeated at each frequency under test.

Data Collection

The data collected in this study is graphically represented as the maximum undesired signal level possible versus frequency of interfering signal. The undesired signal level is that necessary to produce "just perceptible" interference with the channel 13 video at various frequencies.

It was observed that relatively high power signal levels are required to produce perceptible Channel 13 video image deterioration at the interfering frequencies of 216 Mhz to 216.5 MHz. The average of all television receivers tested is presented in figure 2. The vertical axis of Figure 2 represents the signal level at which interference was just perceptible.

The data for each television receiver tested is presented graphically in Appendix A, figures A3 through A47.

While some television receivers were tested with off-the-air reception, the preponderance of television receives tested were served by commercial cable systems. Had it not been that various cable television providers delivered a sub-standard signal level, a significantly higher number of TV sets would have been tested in the time allowed. The power measured on some homes in the Placentia, Fullerton, Arcadia, and Irvine areas ranged between –68 and –78 dBm. Even then, the televisions tested at this low signal level produced results no worse than when the broadcast input power was at –65 dBm, as it shows in the tabulated data in appendix A for televisions 48 through 51.

Data Interpretation

Modern television receivers, in general, perform very well even in the presence of relatively strong, adjacent channel interfering signals. AMTS signals in the frequency range from 217 to 218 MHz (those designated for high power base stations installations) can exhibit power levels, at a minimum, some 25 dB higher than -65 dBm, before just perceptible interference may occur. At frequencies above 217.5 MHz this "headroom" rises to over 30 dB, or a power factor of 1000 times. In the frequency range from 219 to 220 MHz this number increases even more and approaches 38 dB.

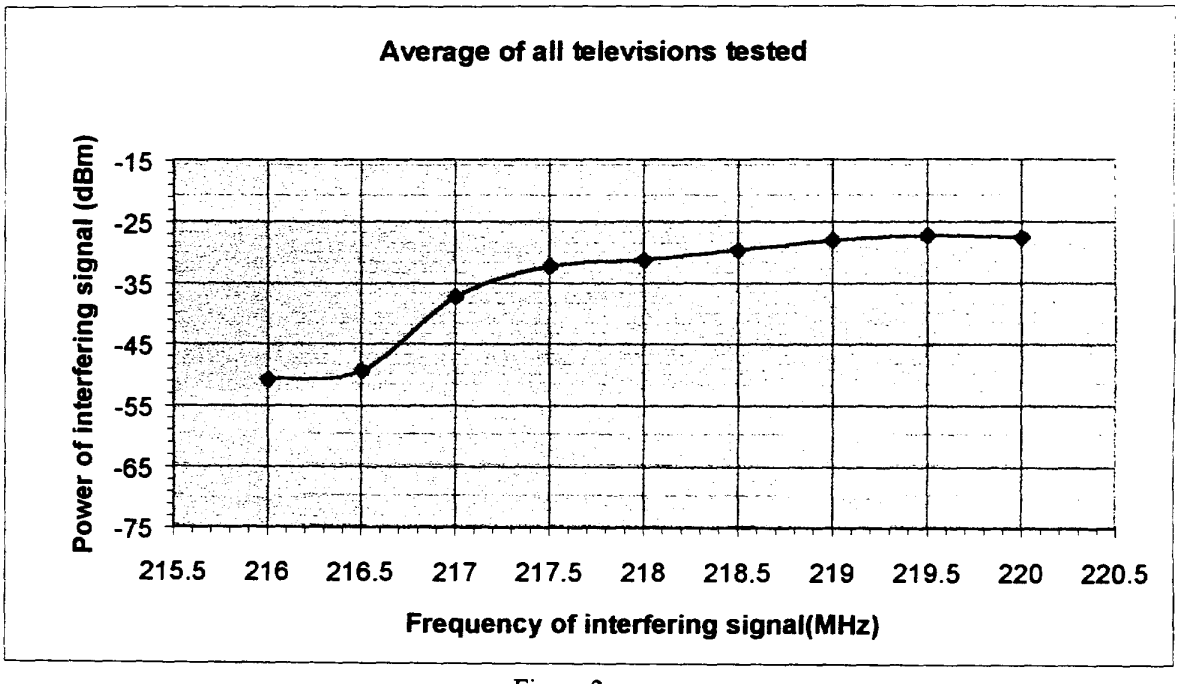


Figure 2

Conclusions

The following observations can be made:

- It would appear, from the tests performed in this study, that the average television receiver has significantly increased performance over those tested in earlier studies conducted by Middlekamp & Davis, Eckert and H. Davis. This change in performance is something between 25 to 38 dB better, depending on the frequency under consideration.

- Only eleven television receivers, out of the 53 tested, were actually receiving broadcast material off-the-air, either because they did not have cable going to their homes or they did not want to pay the high cable fees. The majority of households receive television broadcast signals via cable, where the possibility of interference from AMTS systems is virtually nonexistent. When deregulation of cable companies occurs, the number of television receivers using cable will increase. The actual number of television receivers, that will continue to receive broadcast television off-the-air, that could potentially be adversely affected by AMTS signals, would appear to be very small indeed.

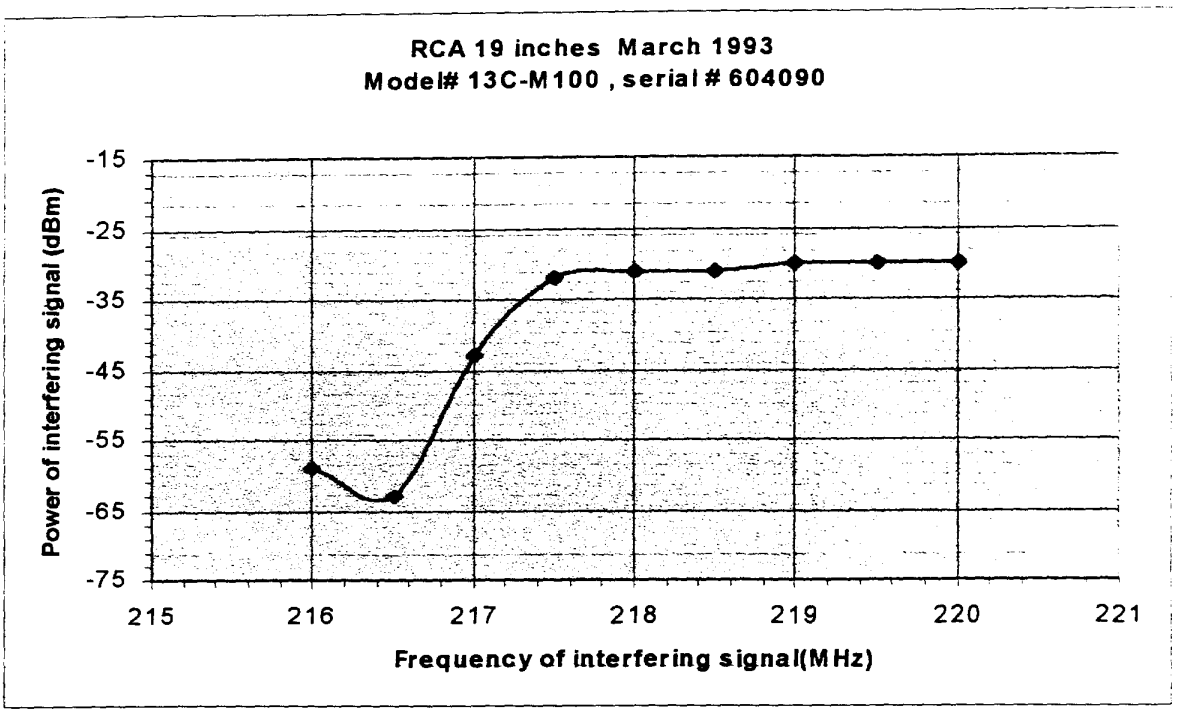
References

1. L. Middlekamp, H. Davis, Interference to TV channels 11 and 13 from Transmitters Operating at 216-225 MHz, FCC Lab Division Report, Project No. 2229-71, Oct. 1975

2. H. Davis, Field Tests of 216 to 220 MHz transmitters for Compatibility with TV Channels 13 and 10. OST Technical Memorandum, FCC/OST TM82-4, July 1982

3. R. Eckert, Guidance for Evaluating the Potential for Interference to TV from Stations in the Inland Waterways Communications Systems, OST Technical Memorandum FCC/OST TM82-5, July 1982

Appendix A



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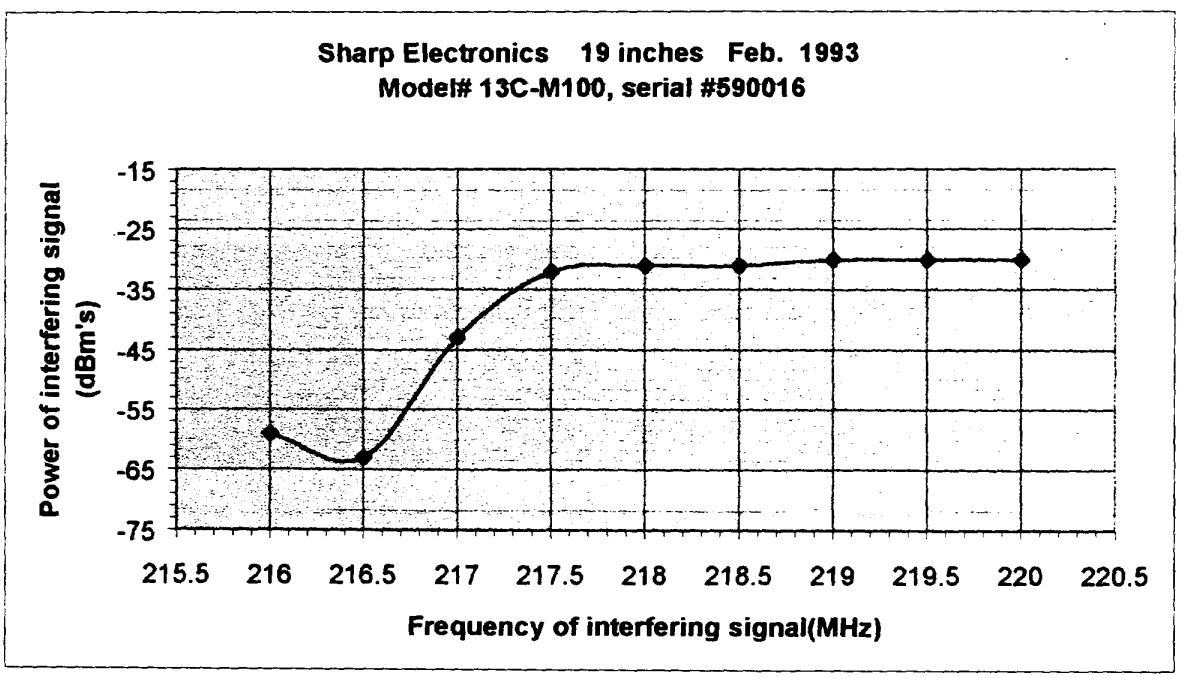

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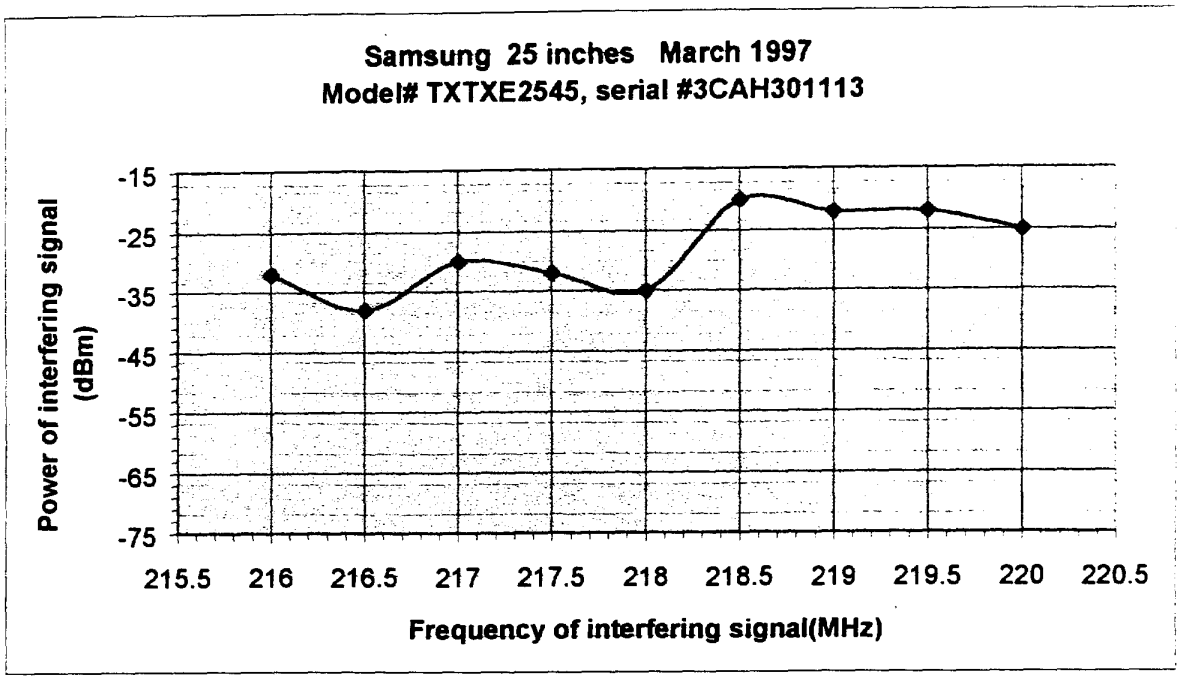

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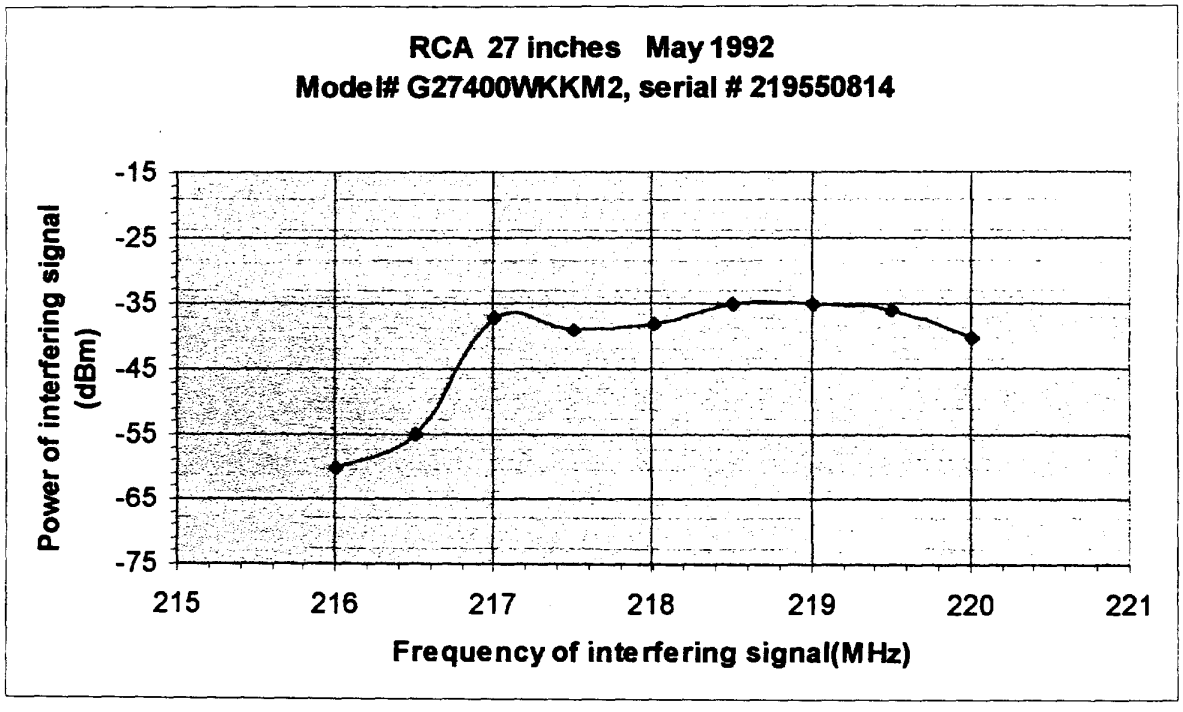

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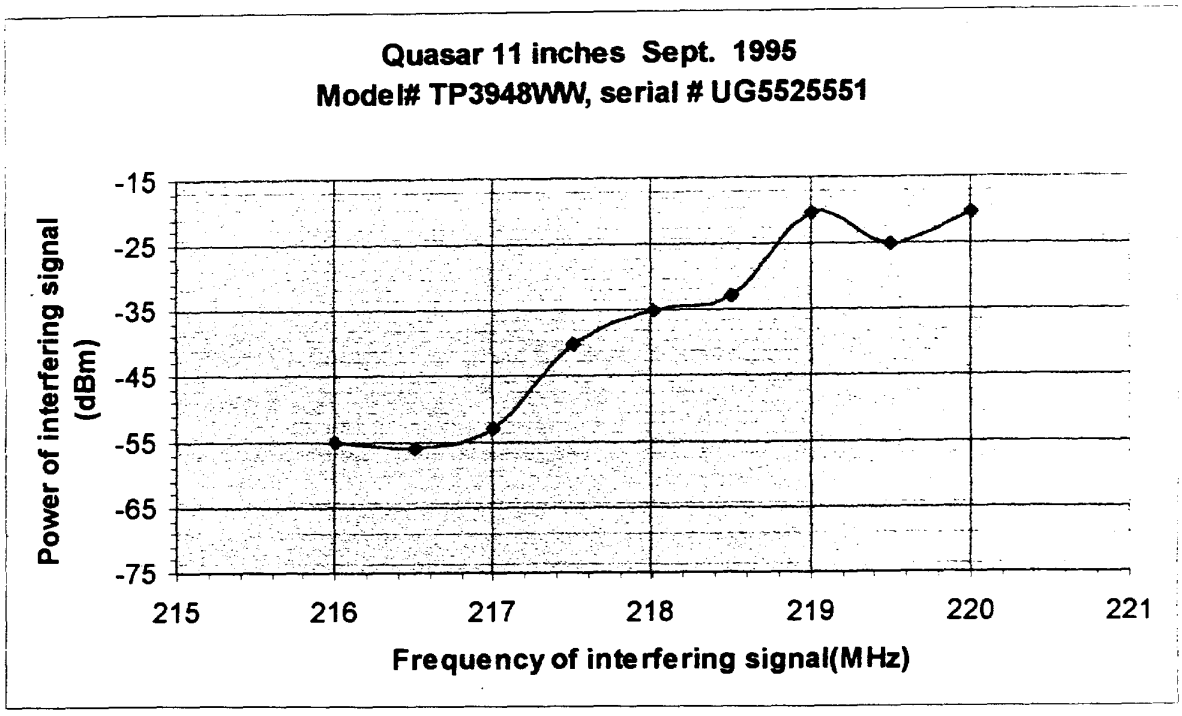

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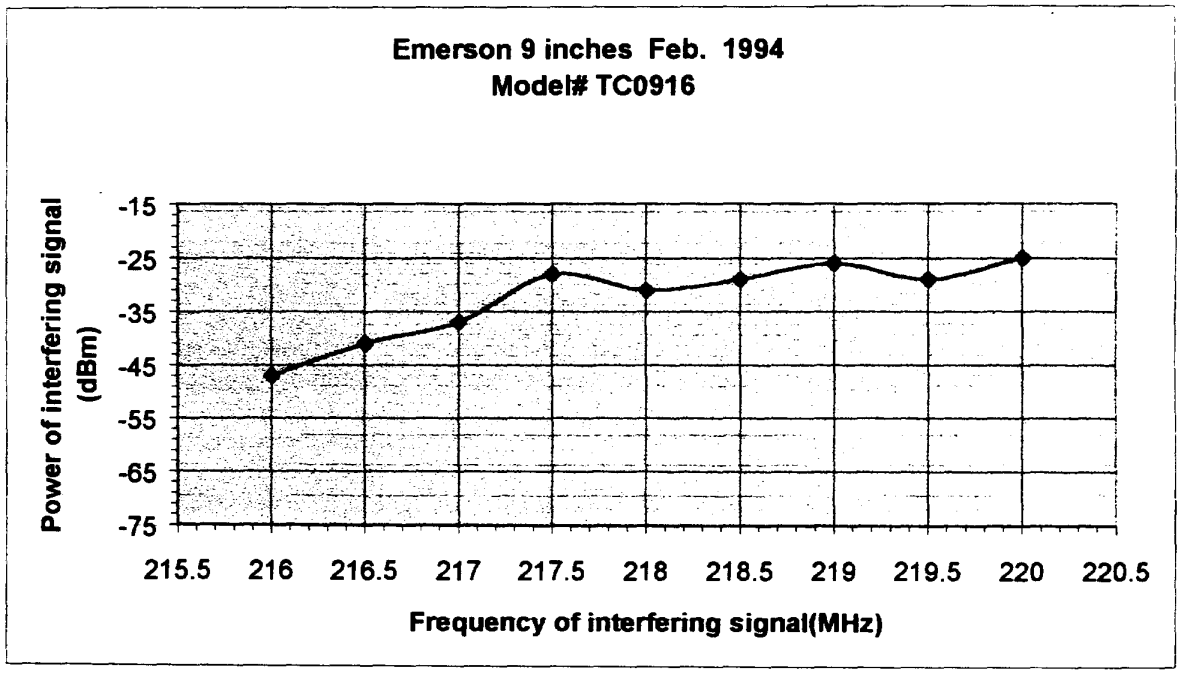

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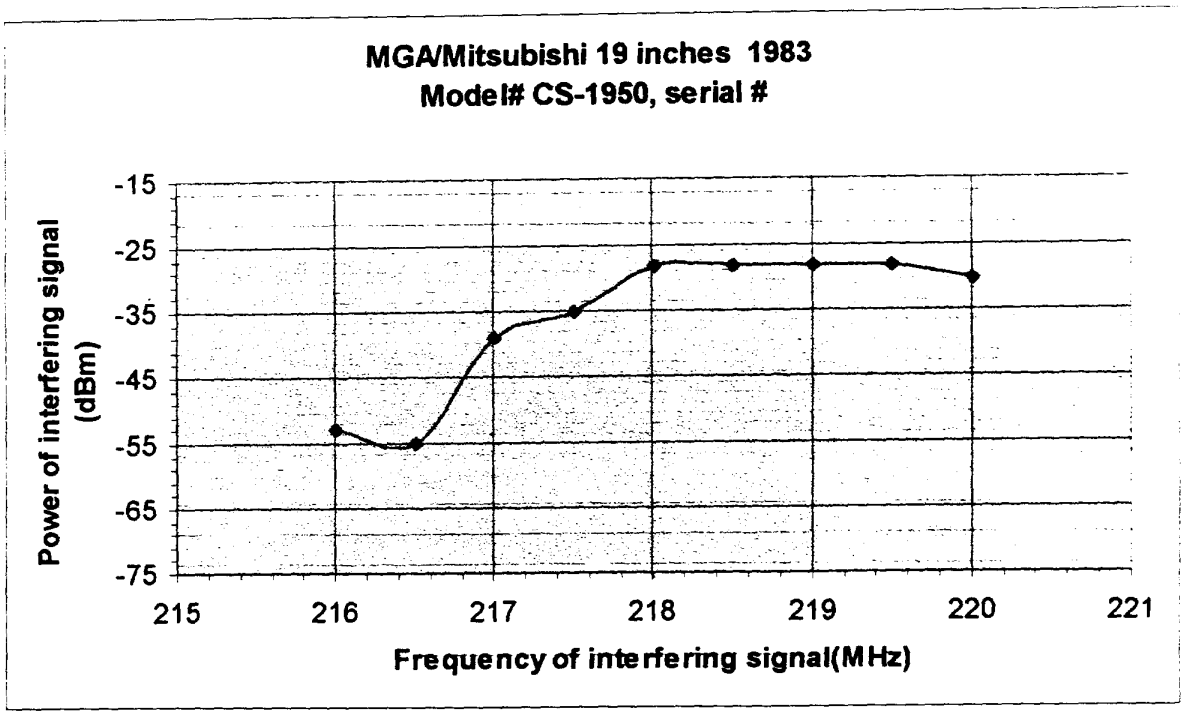

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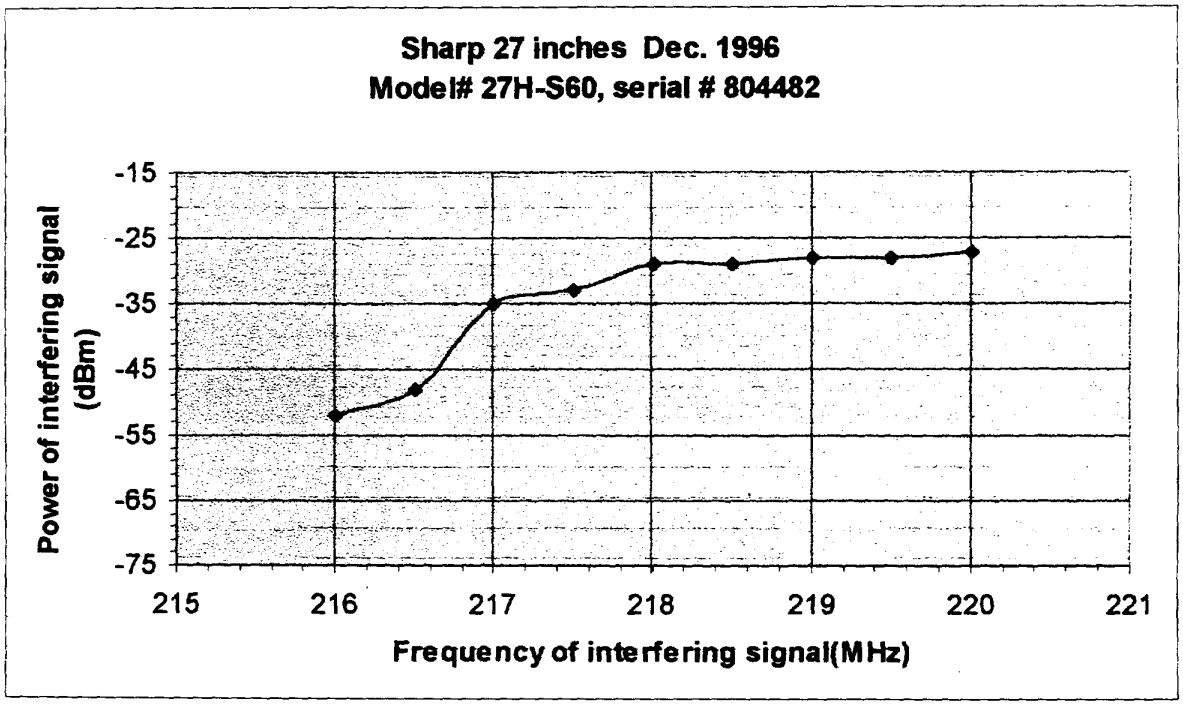

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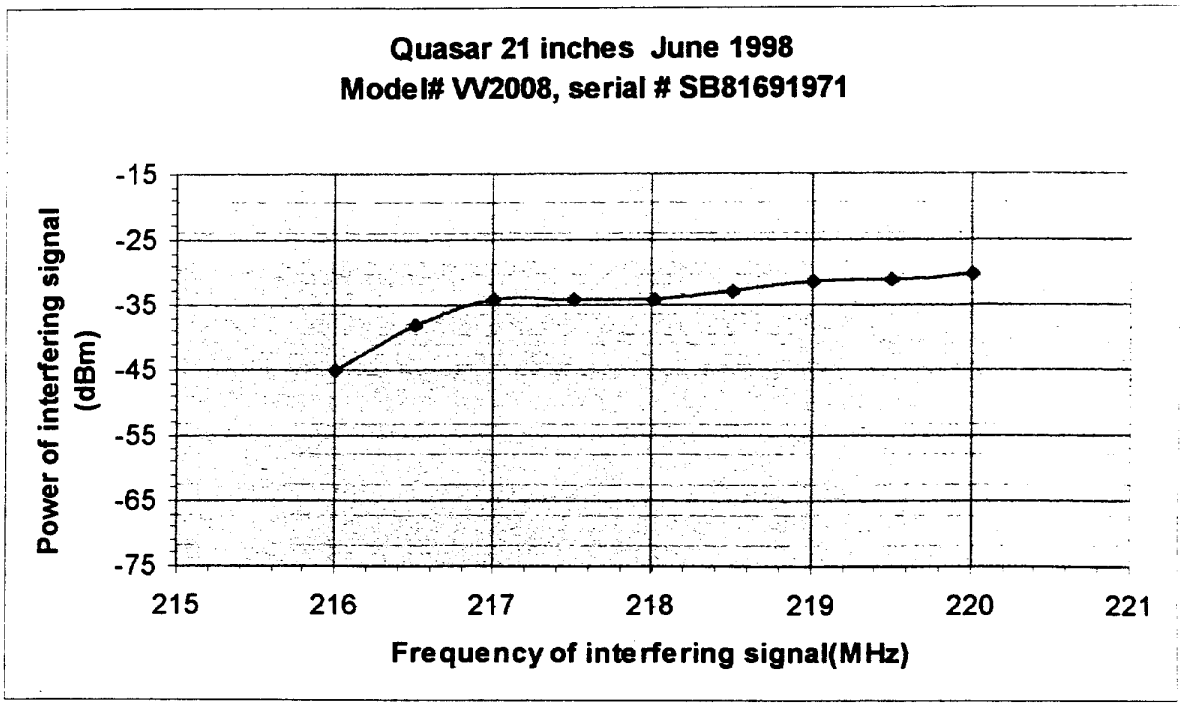

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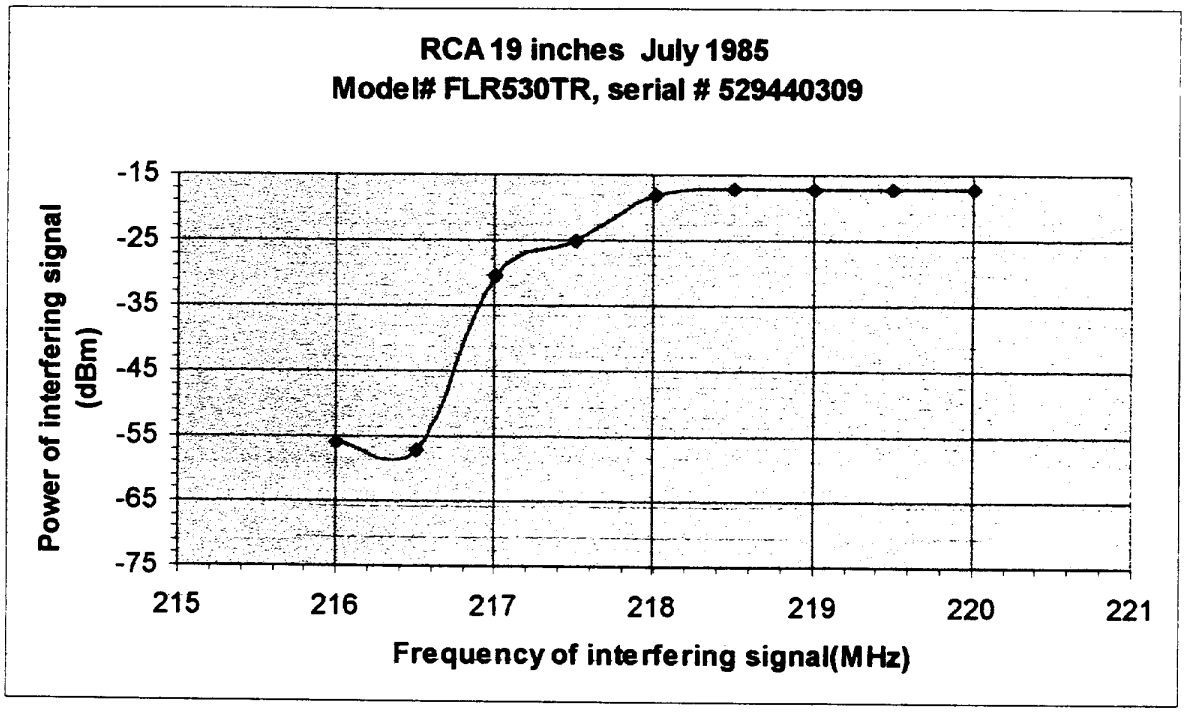

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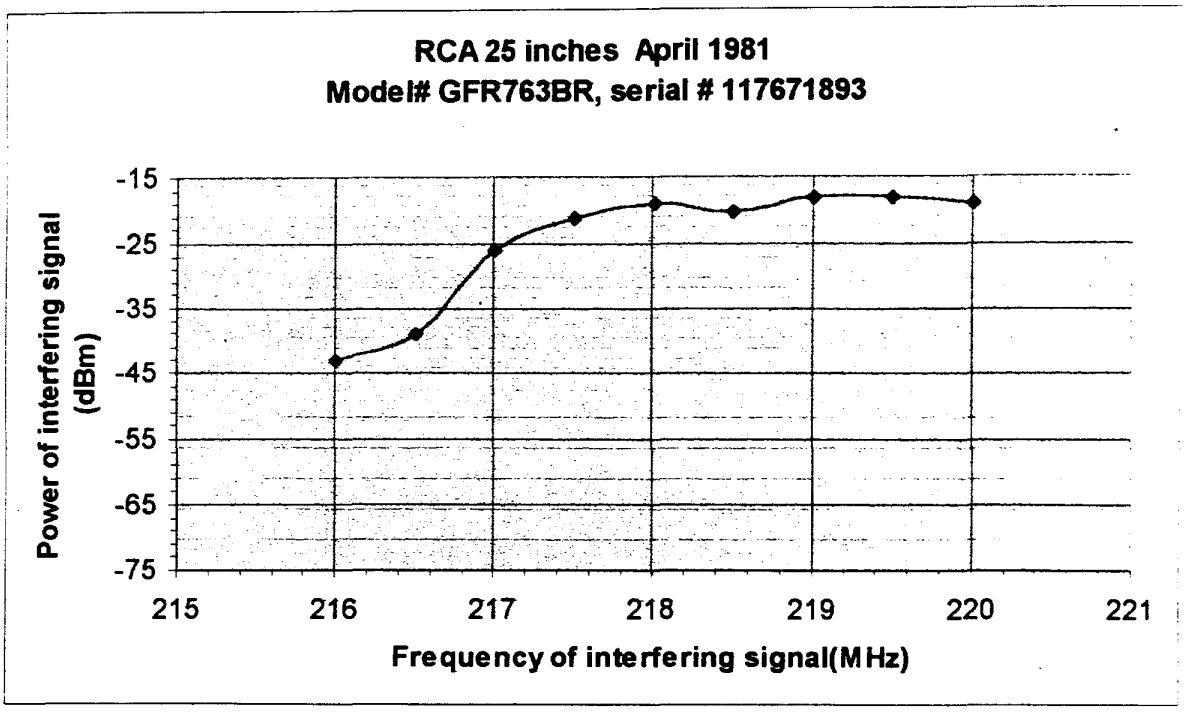

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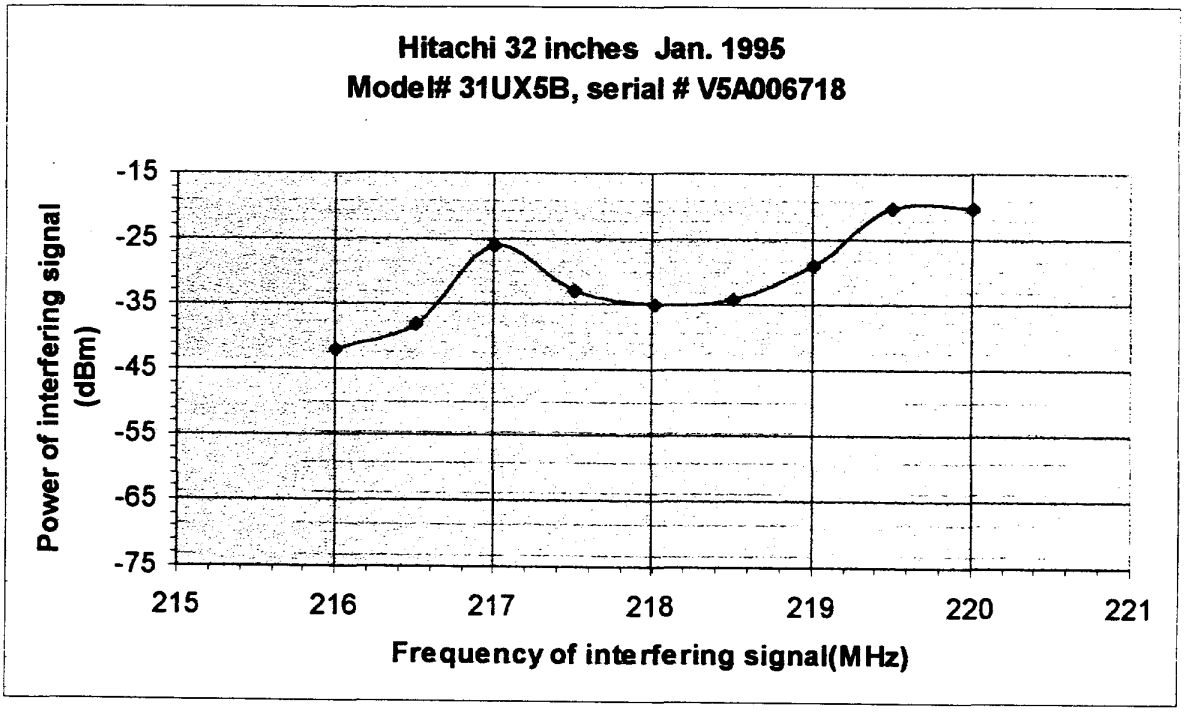

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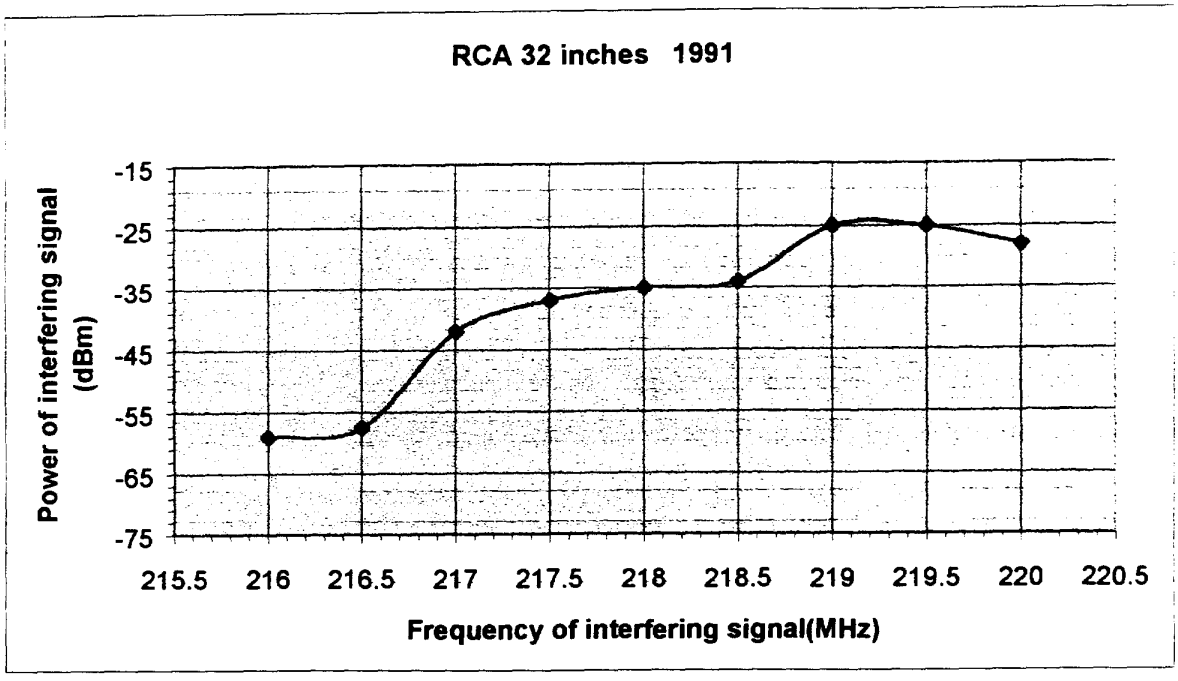

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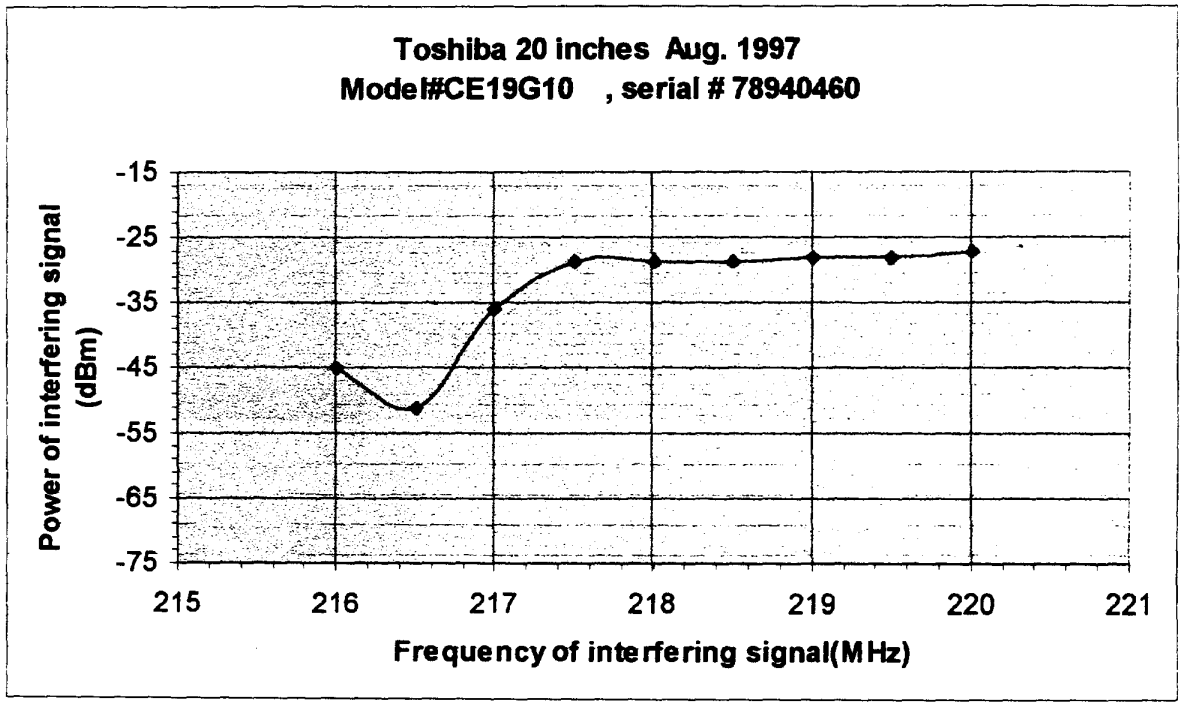

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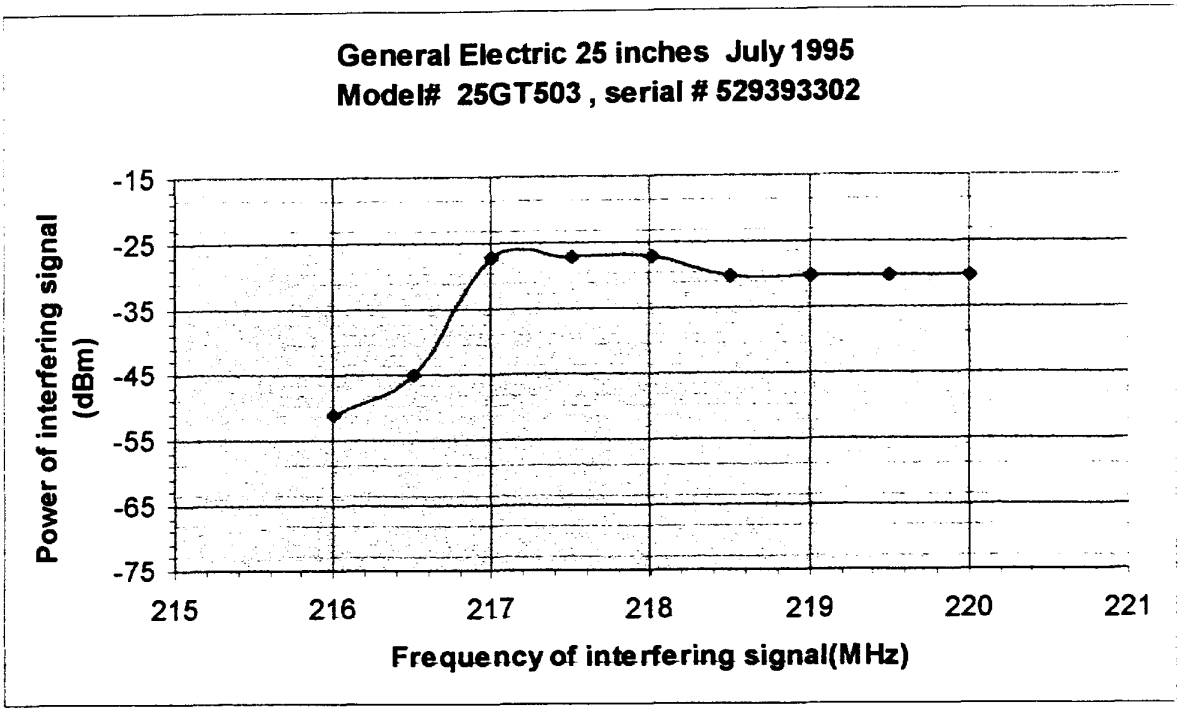

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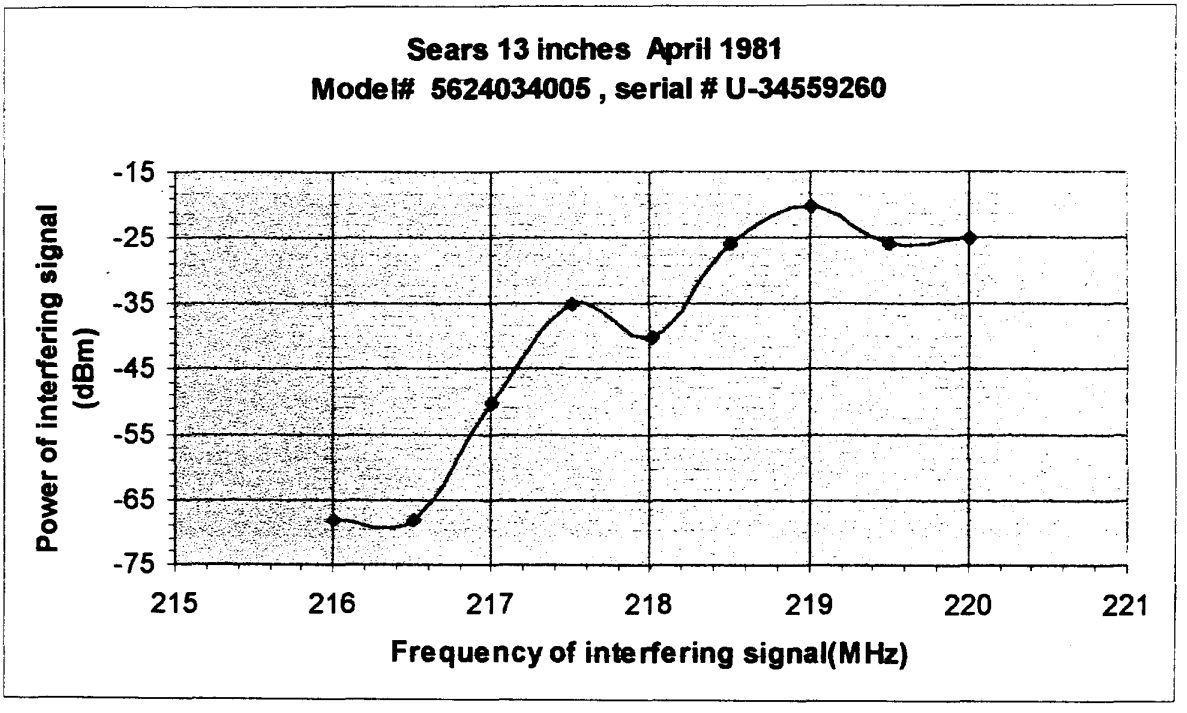

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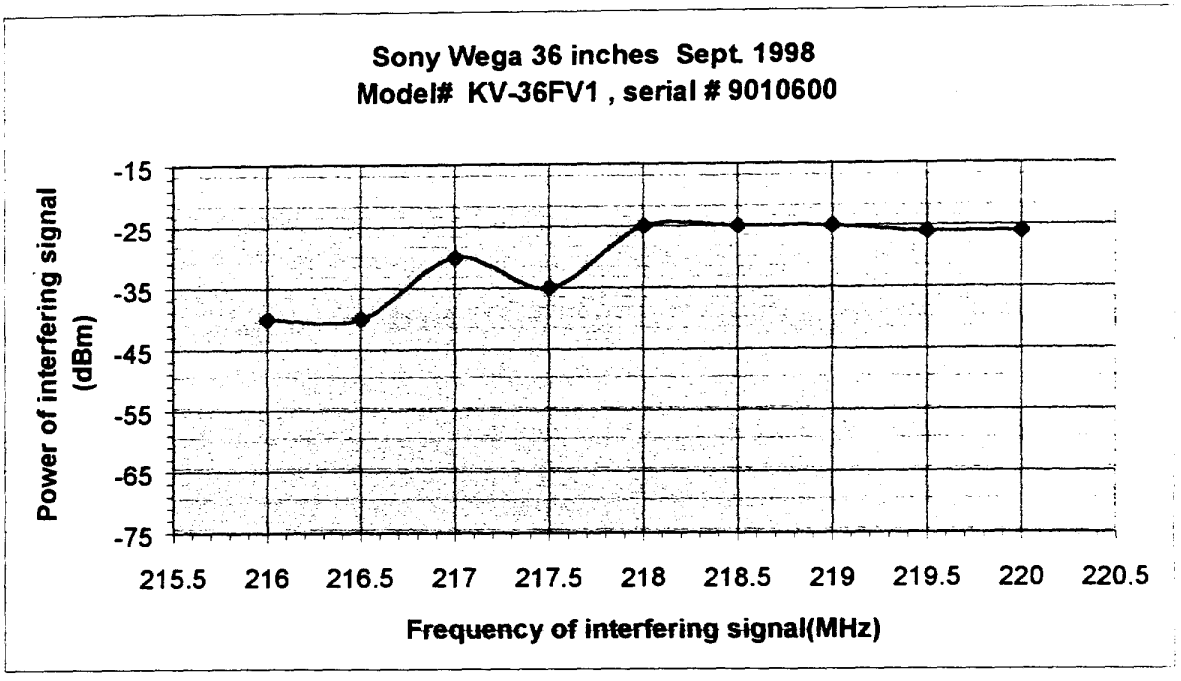

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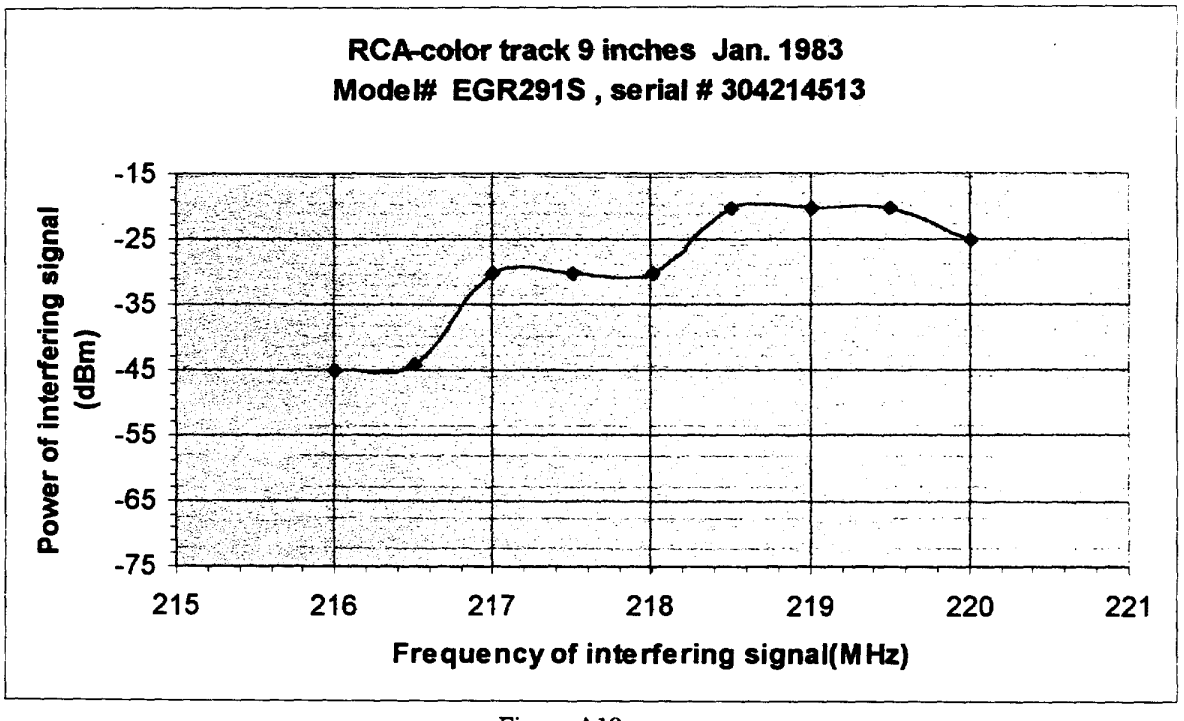

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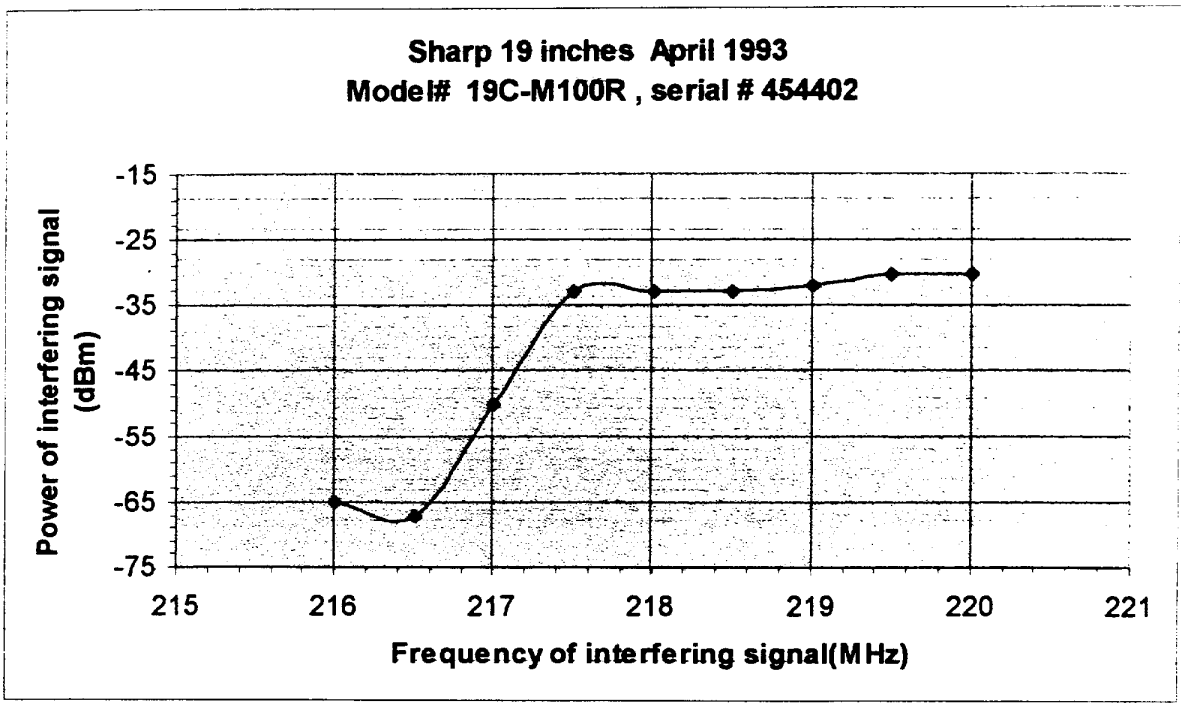

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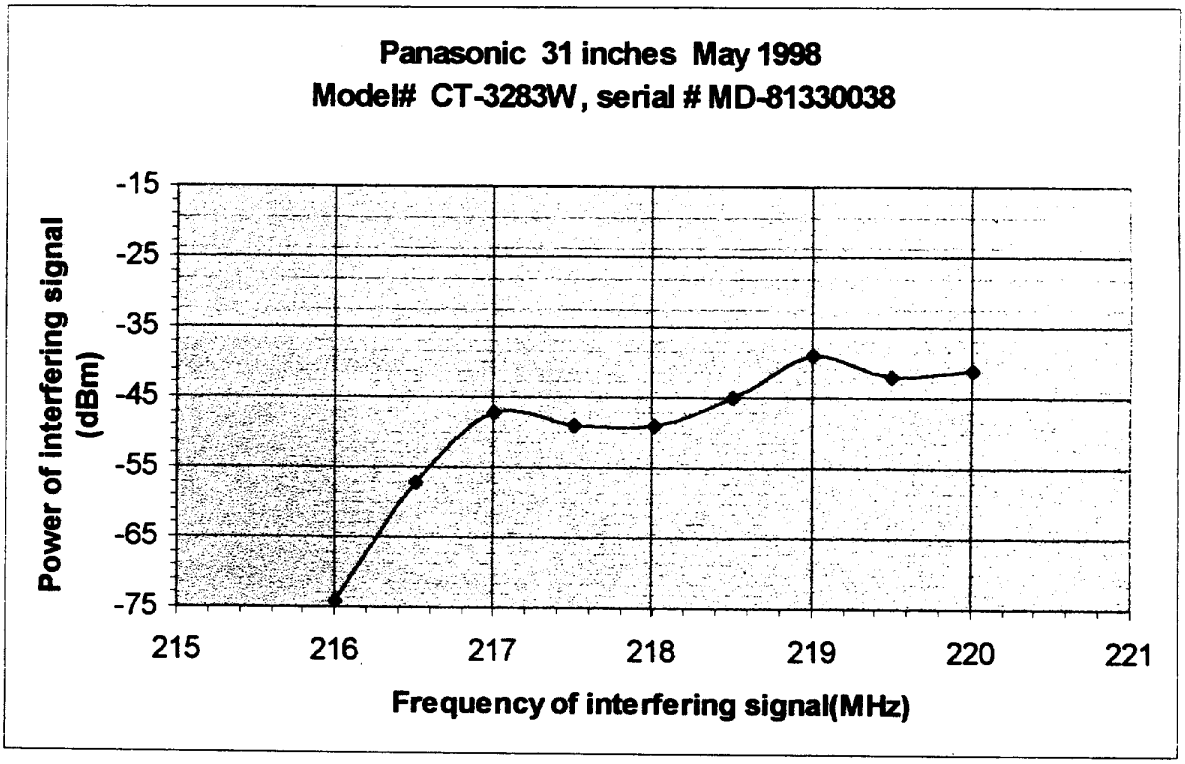

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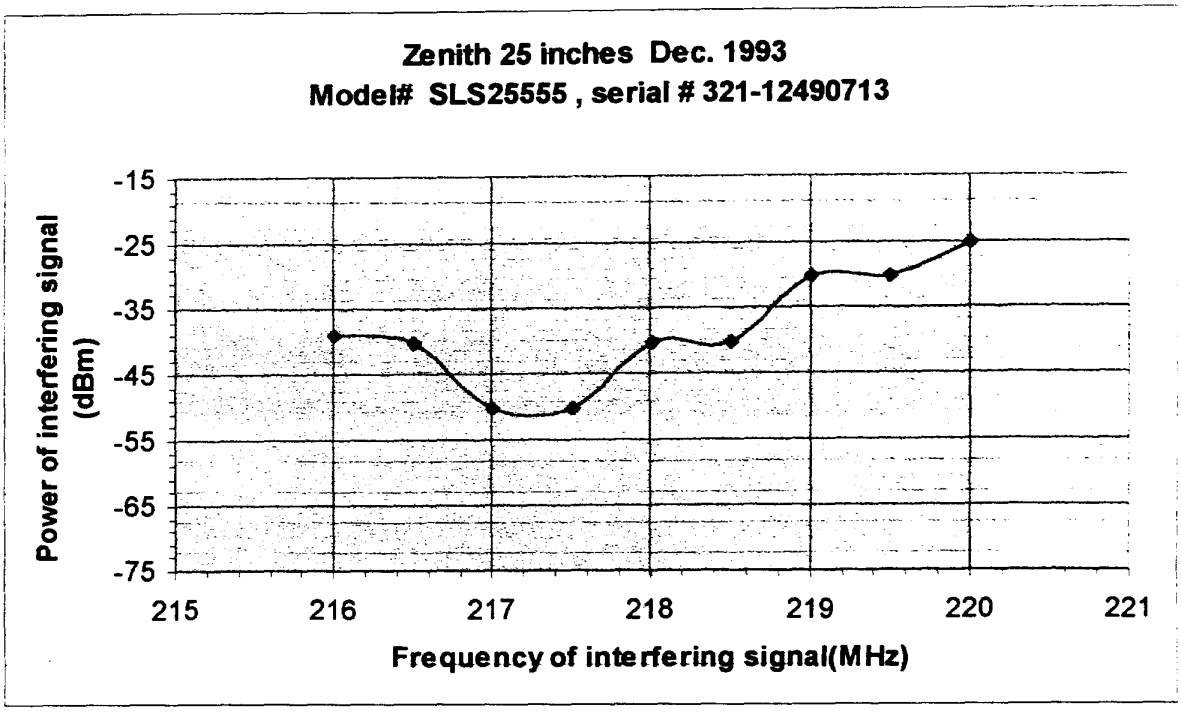

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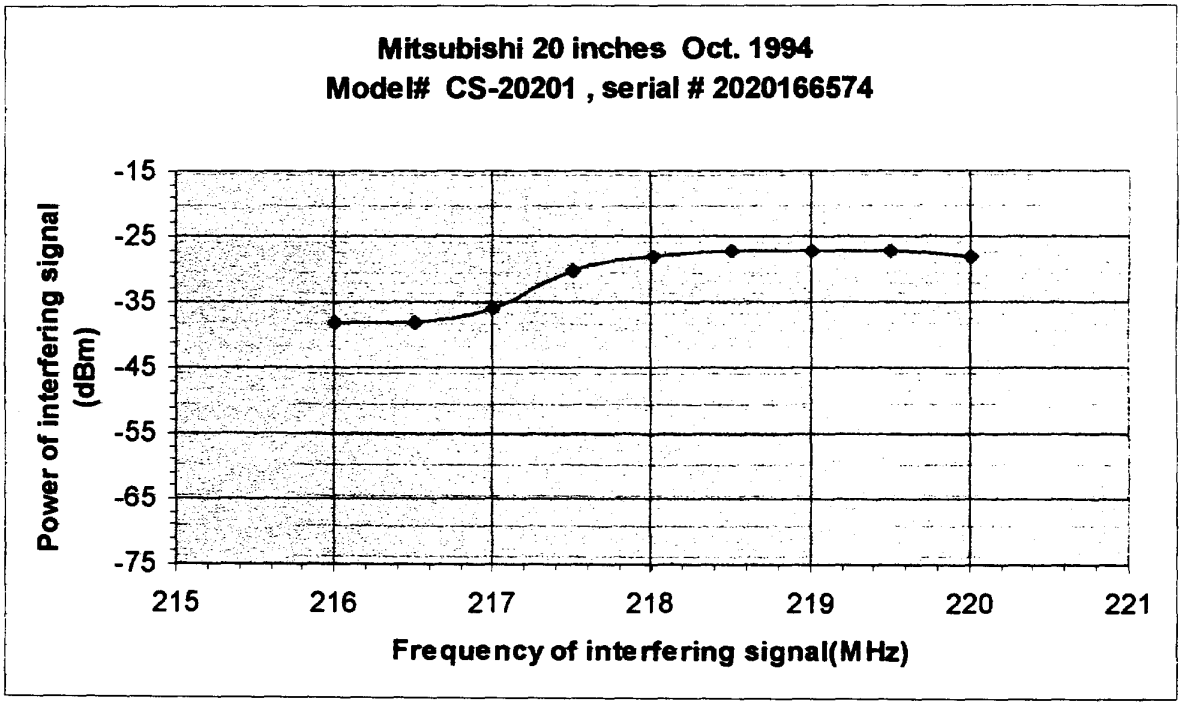

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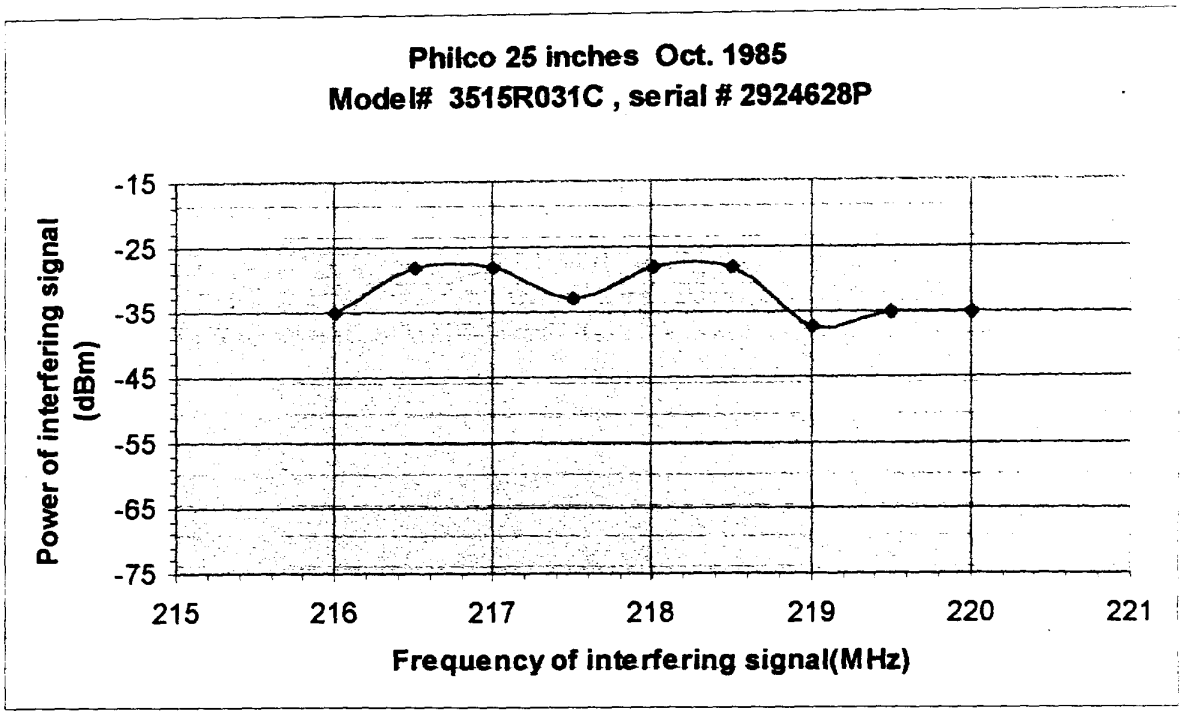

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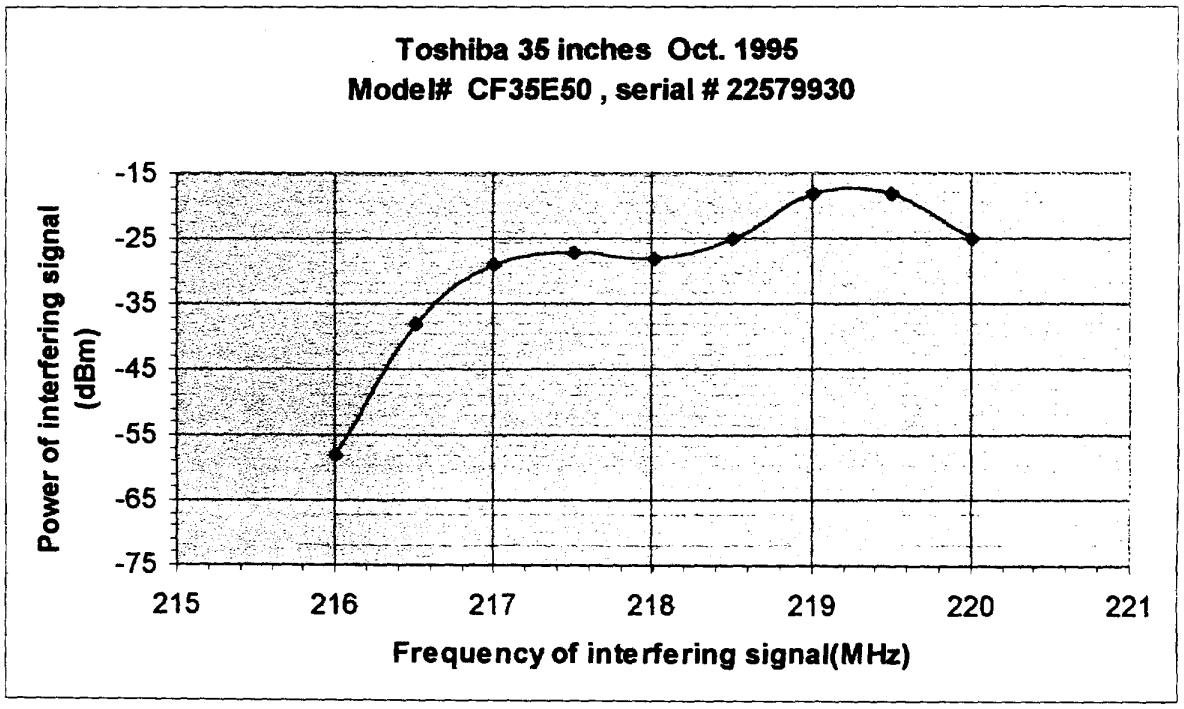

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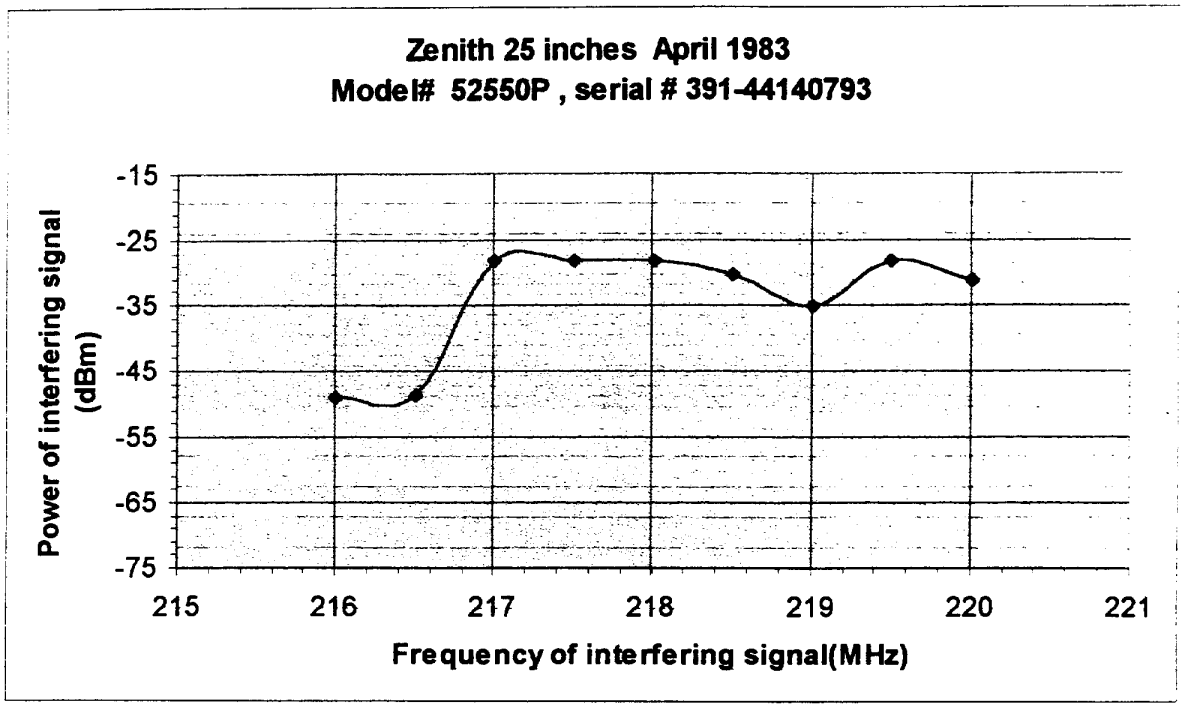

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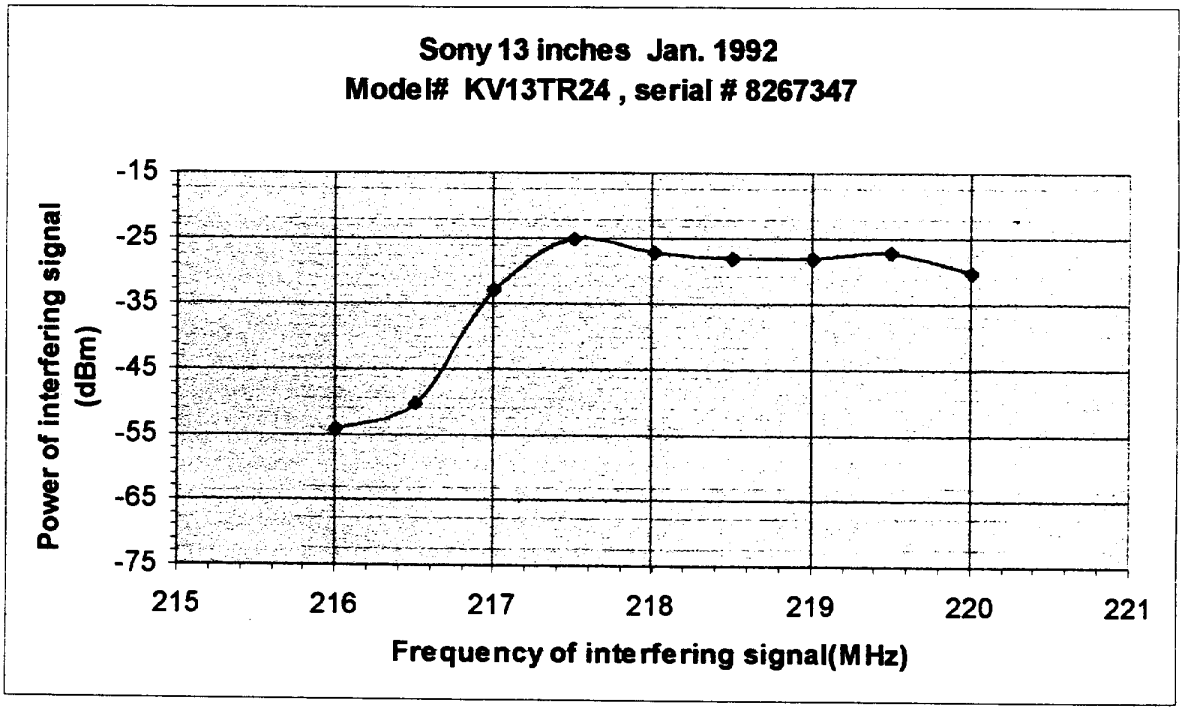

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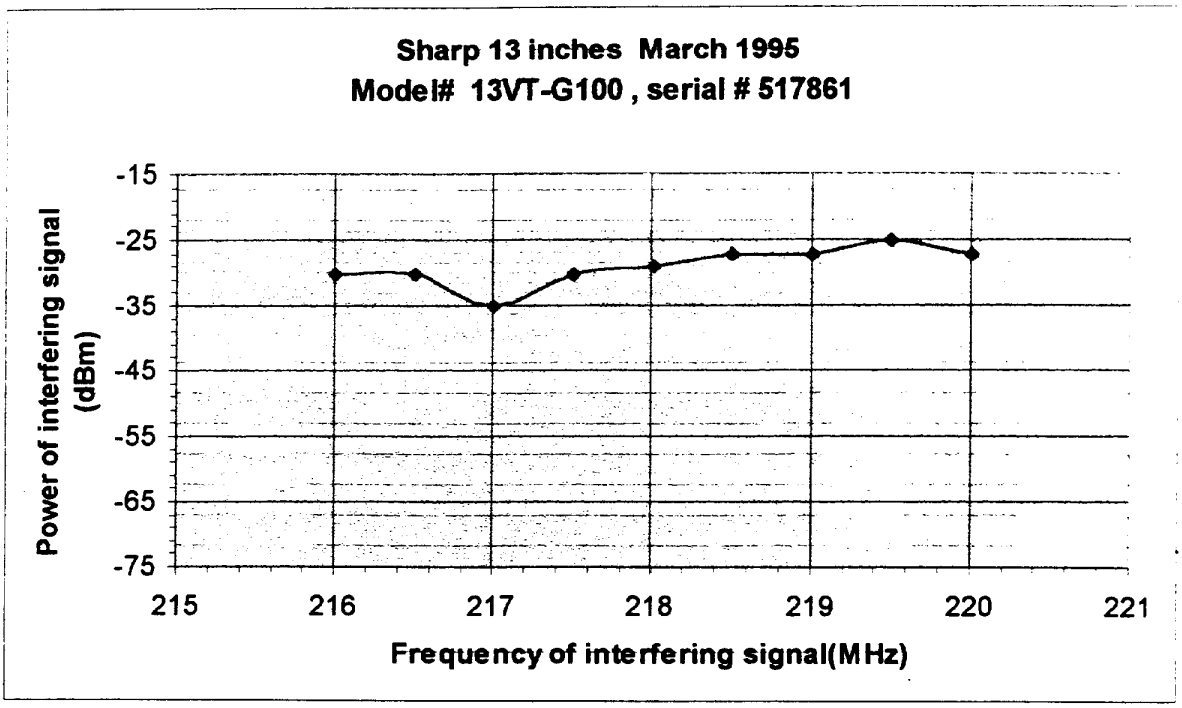

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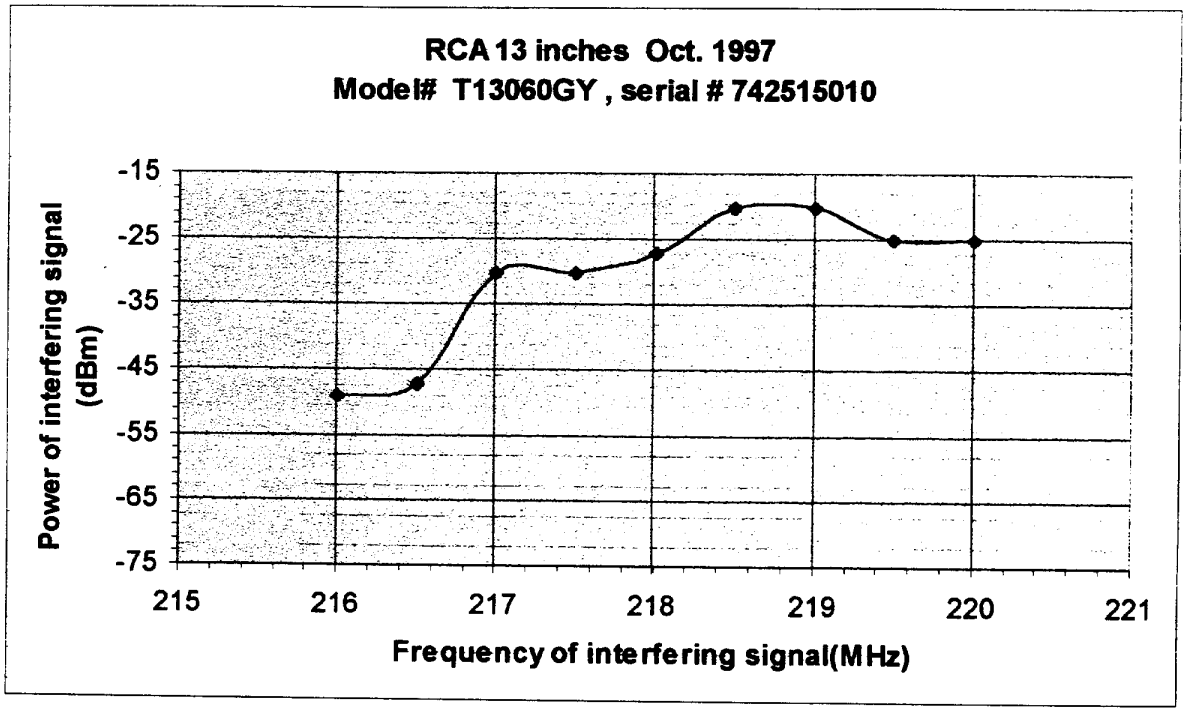

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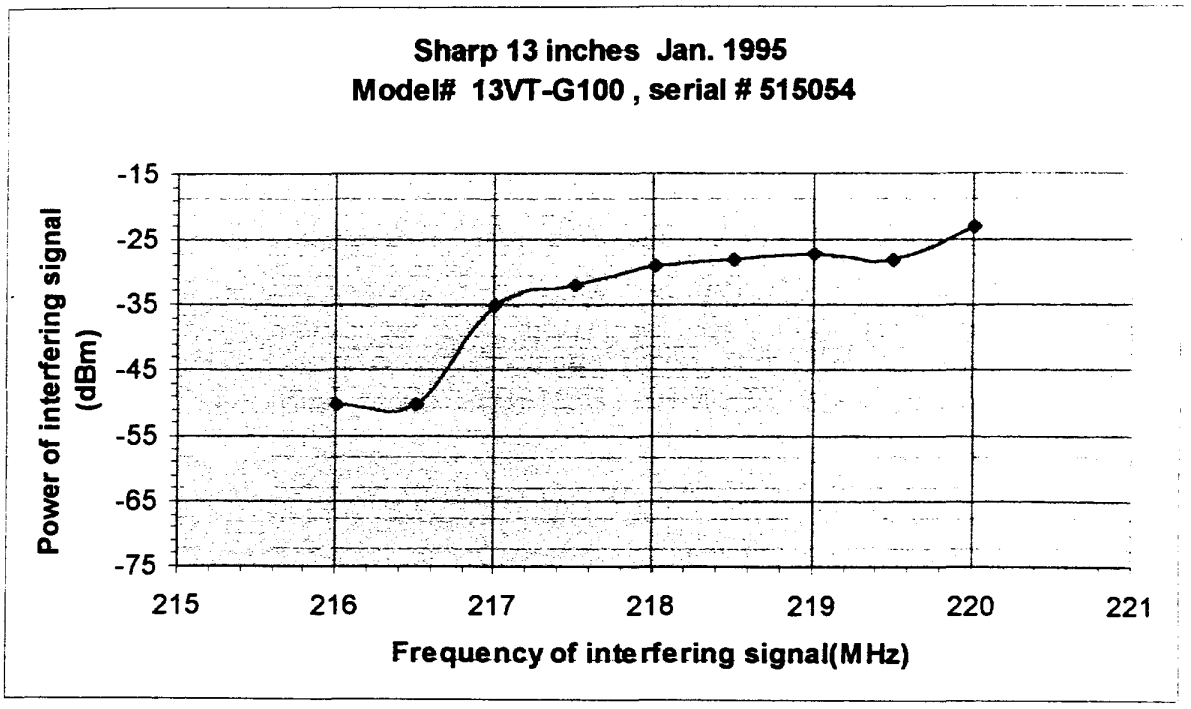

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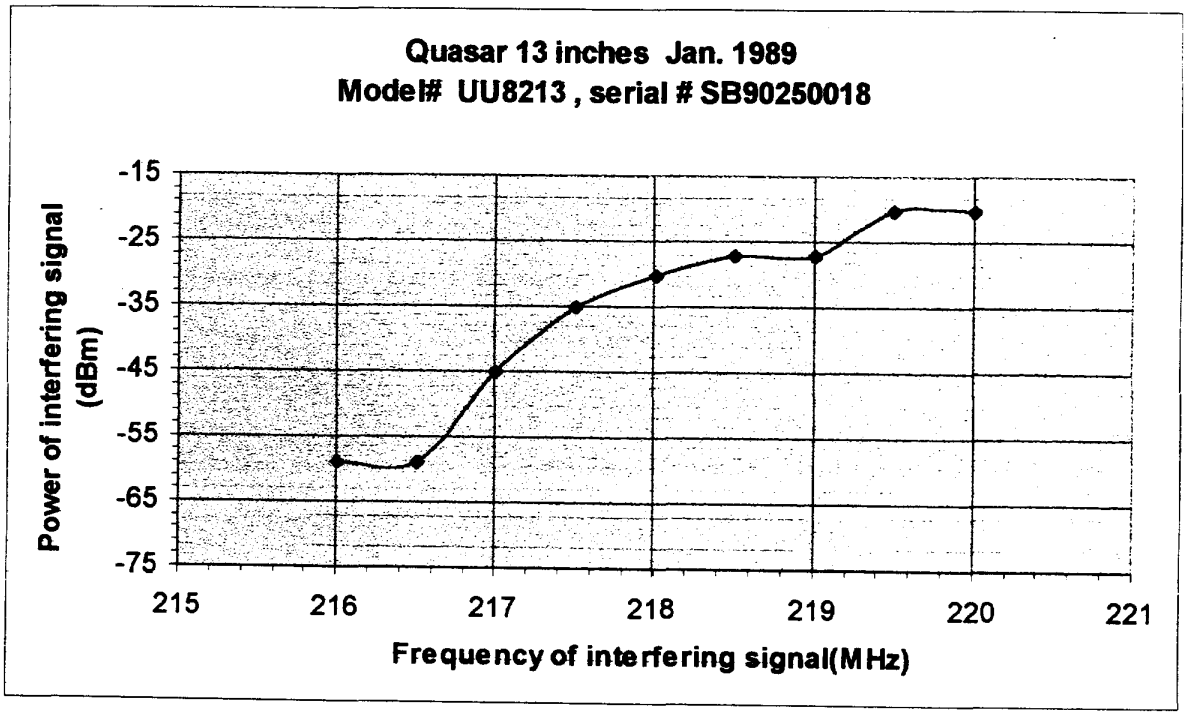

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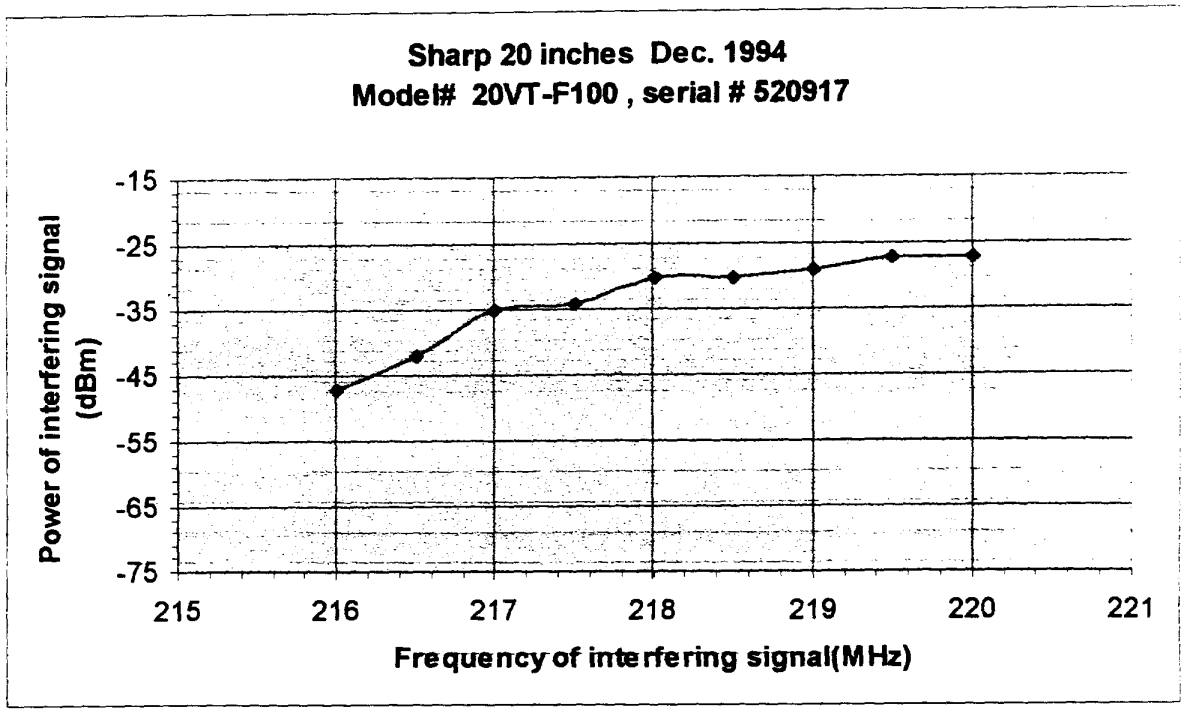

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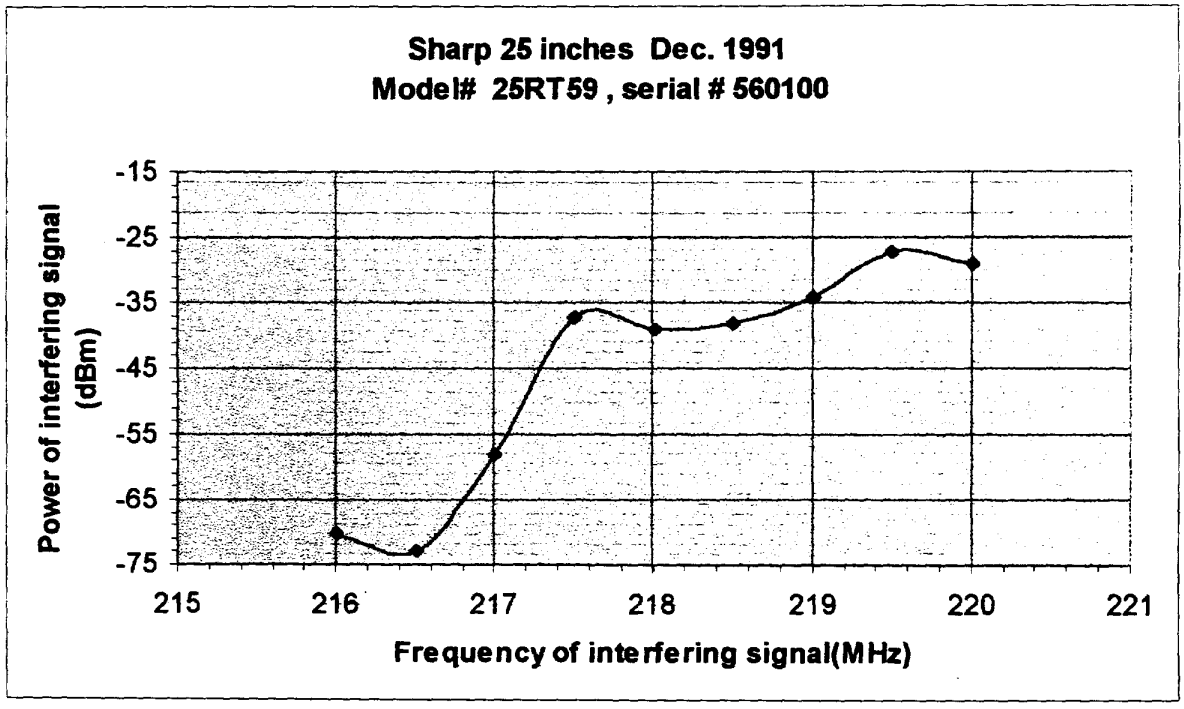

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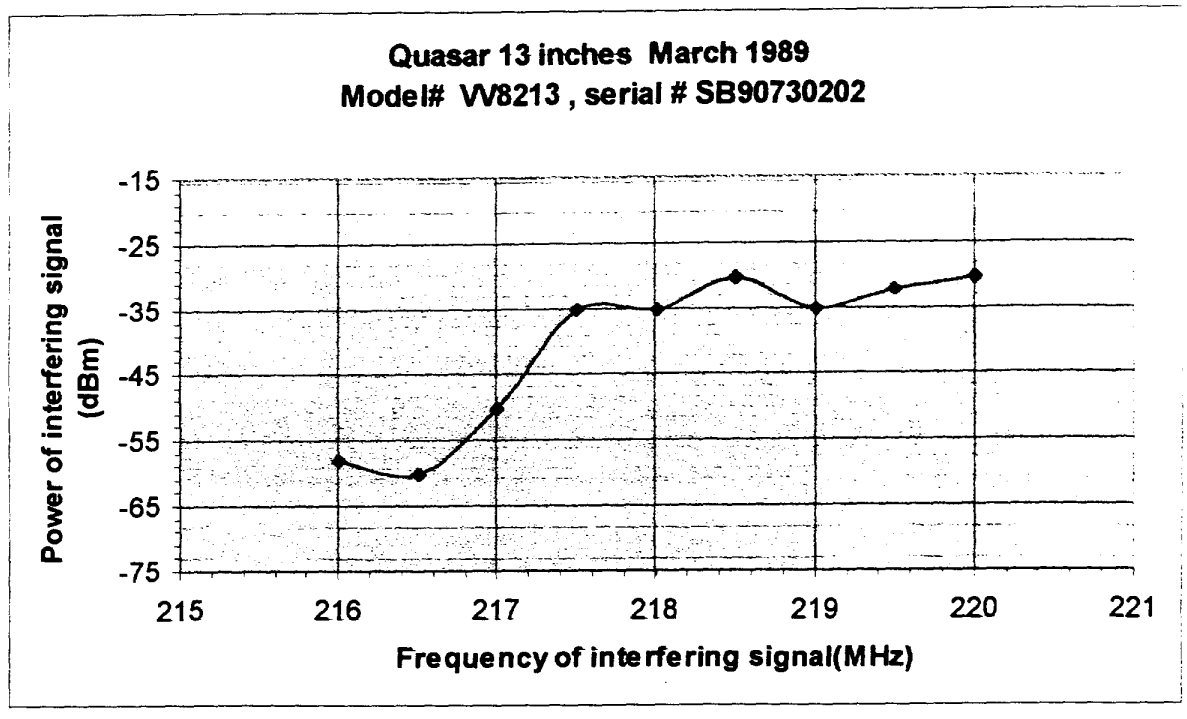

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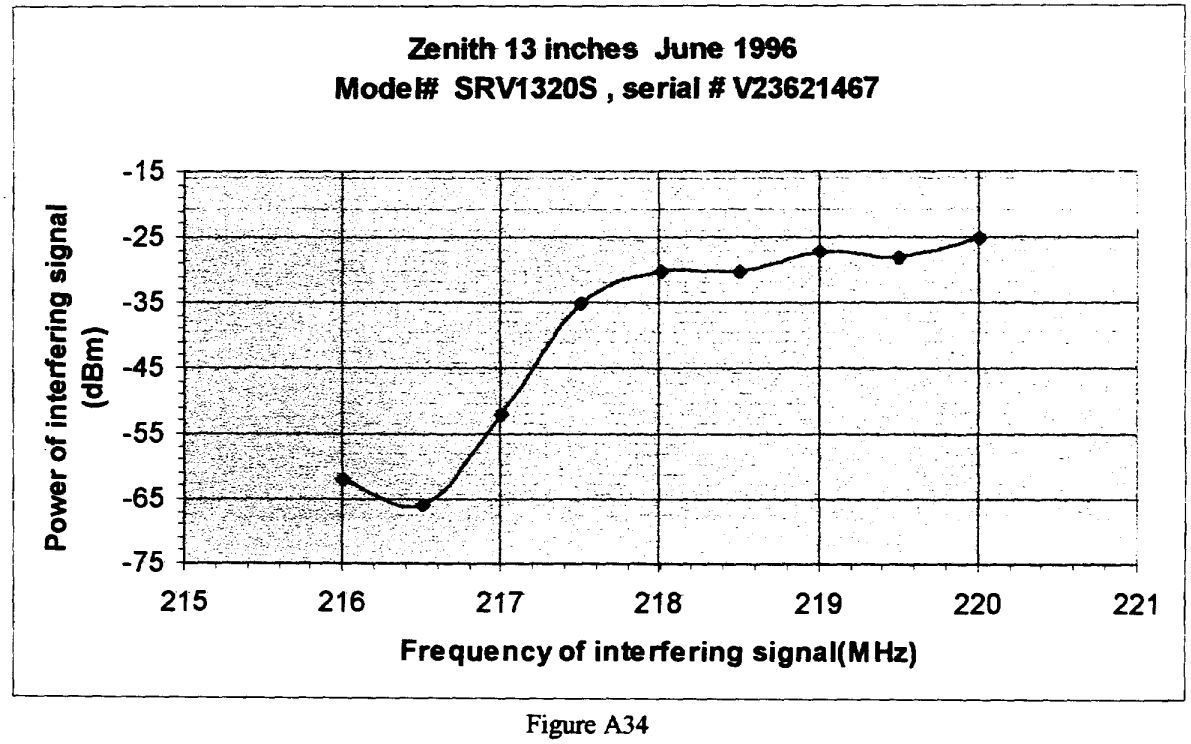

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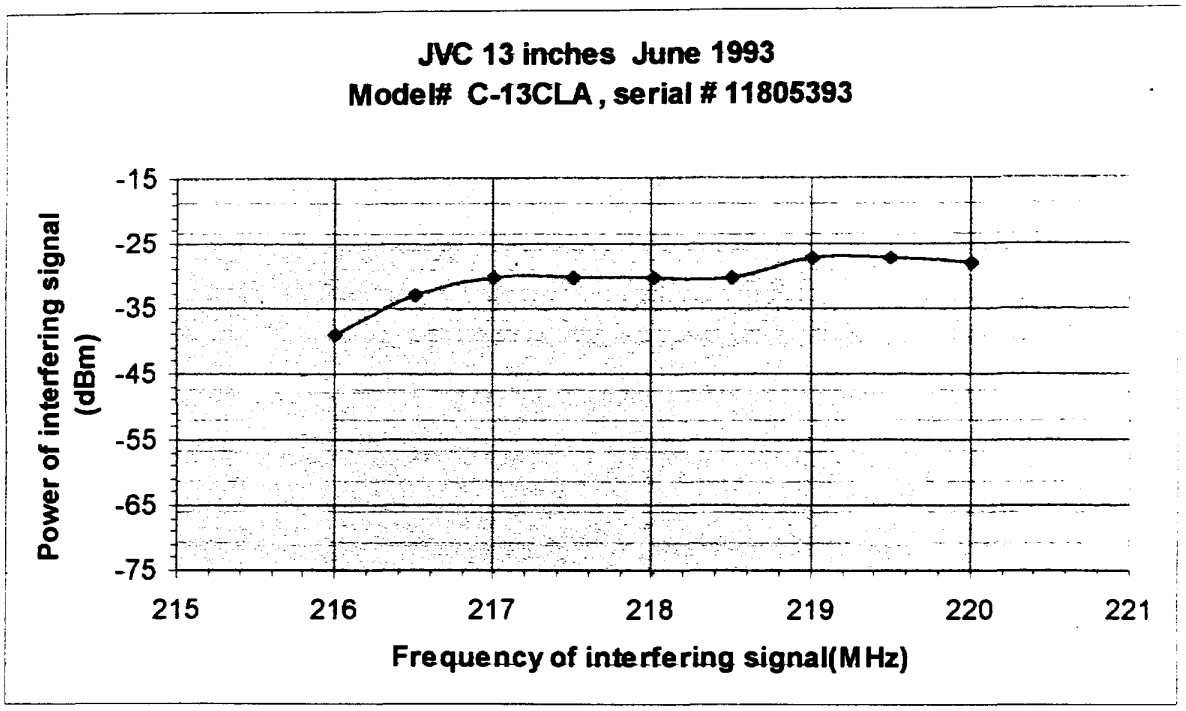

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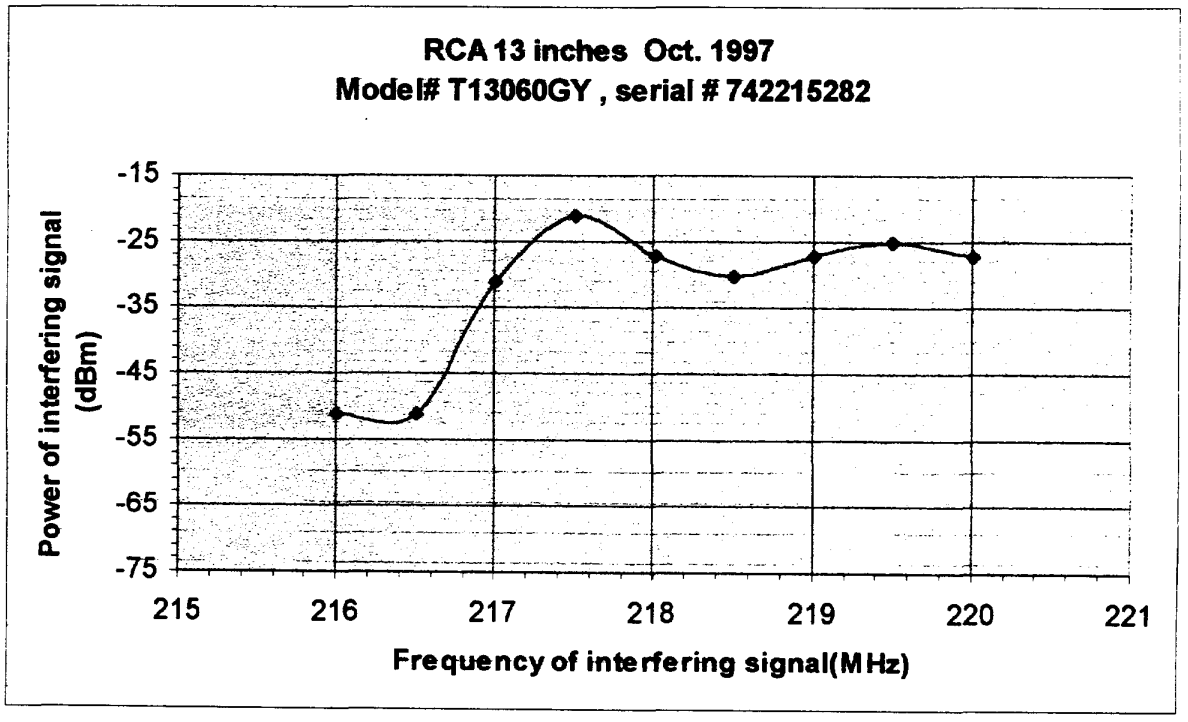

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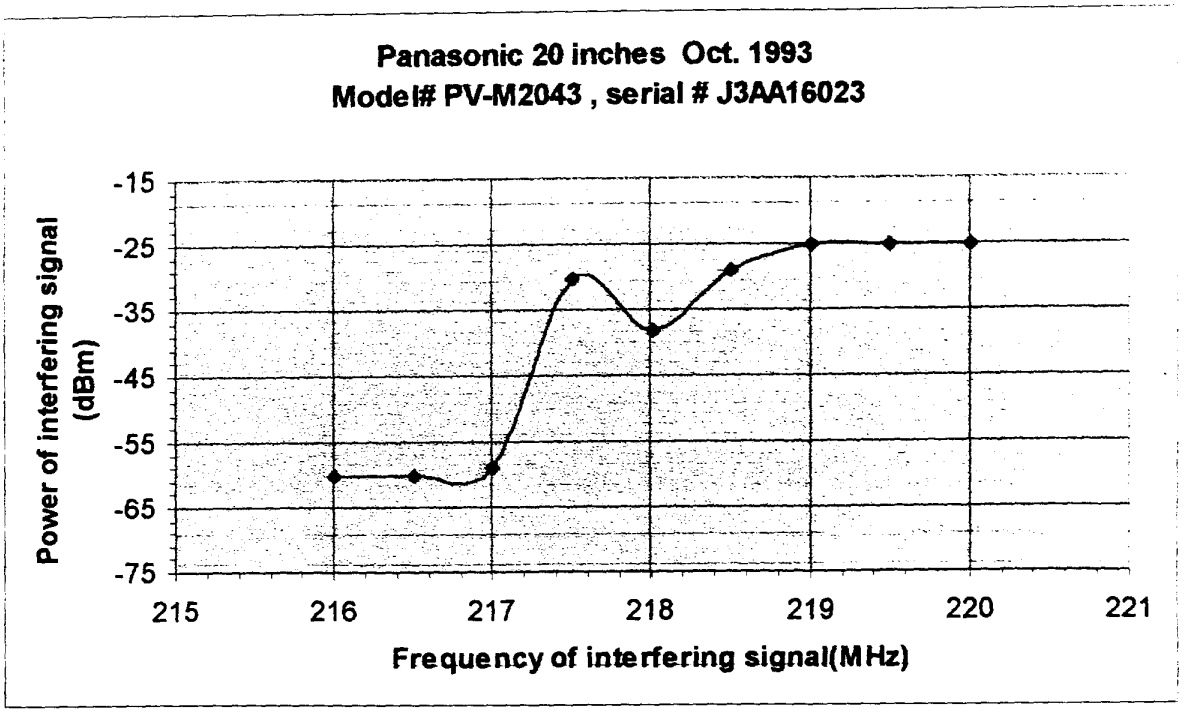

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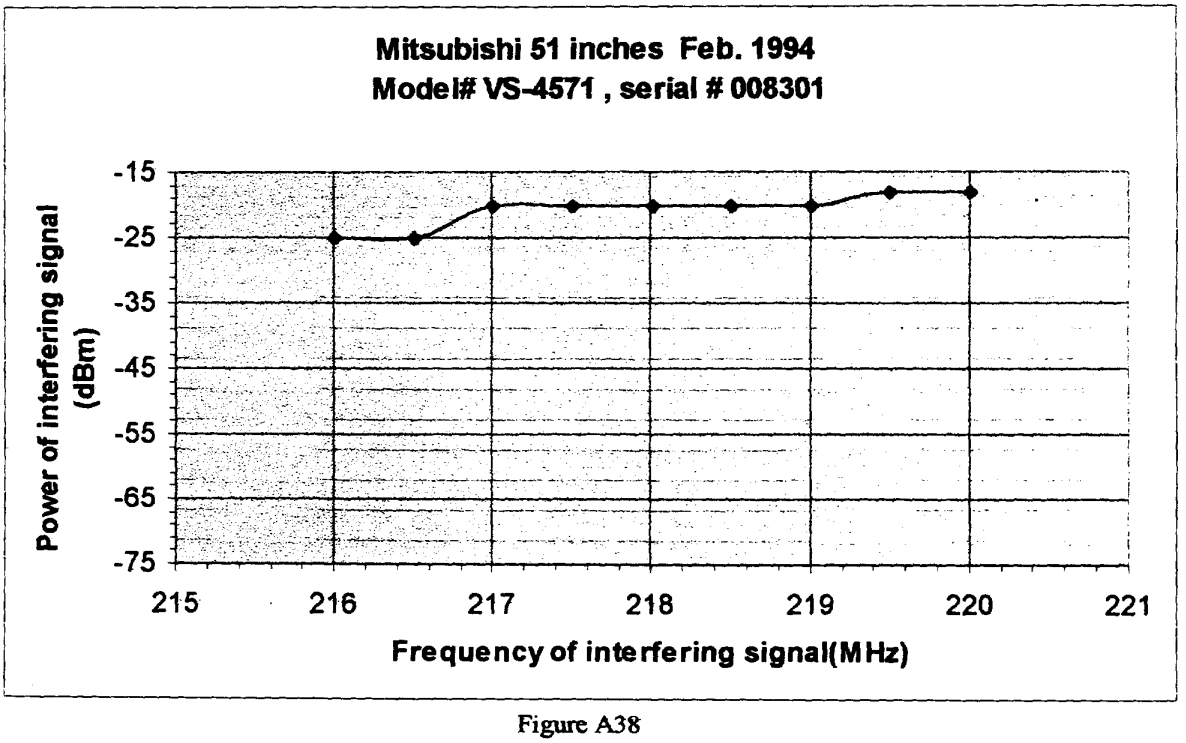

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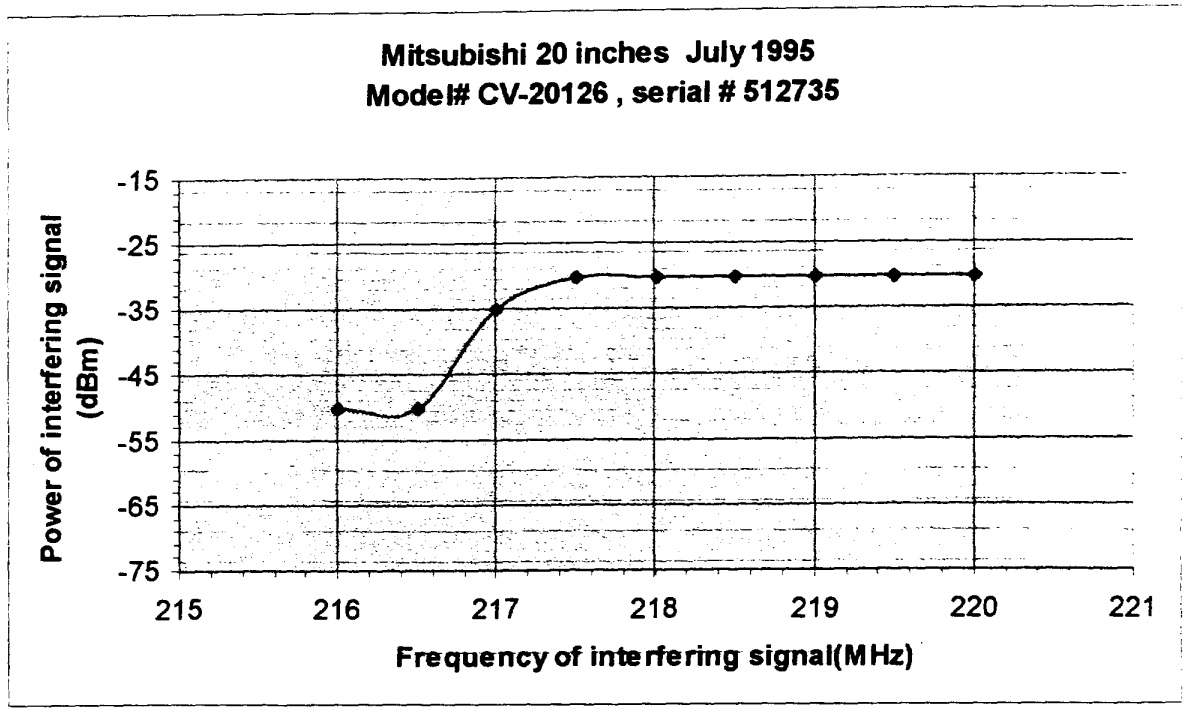

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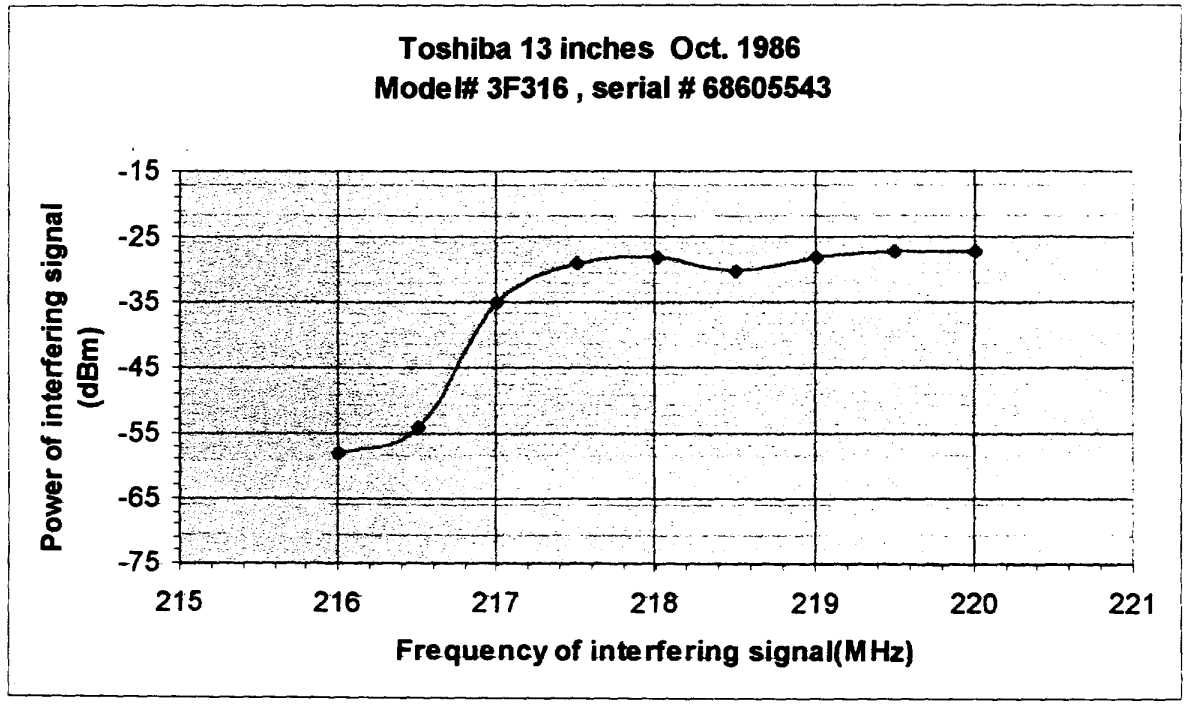

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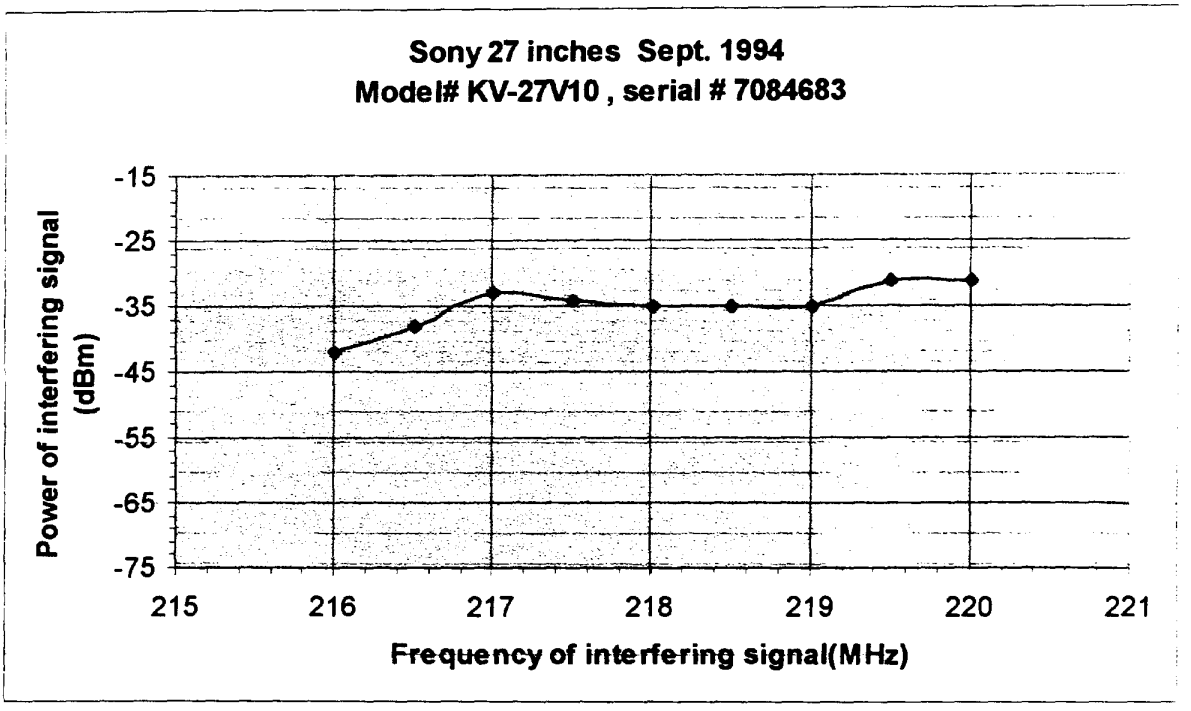

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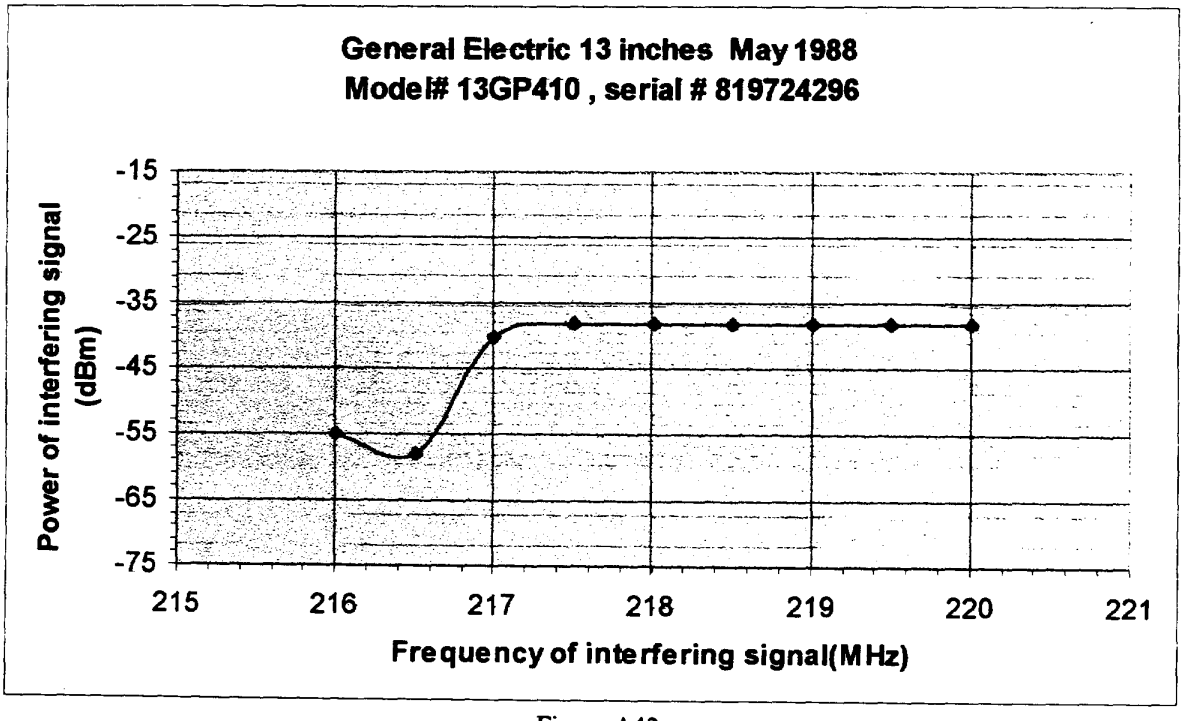

Figure A42

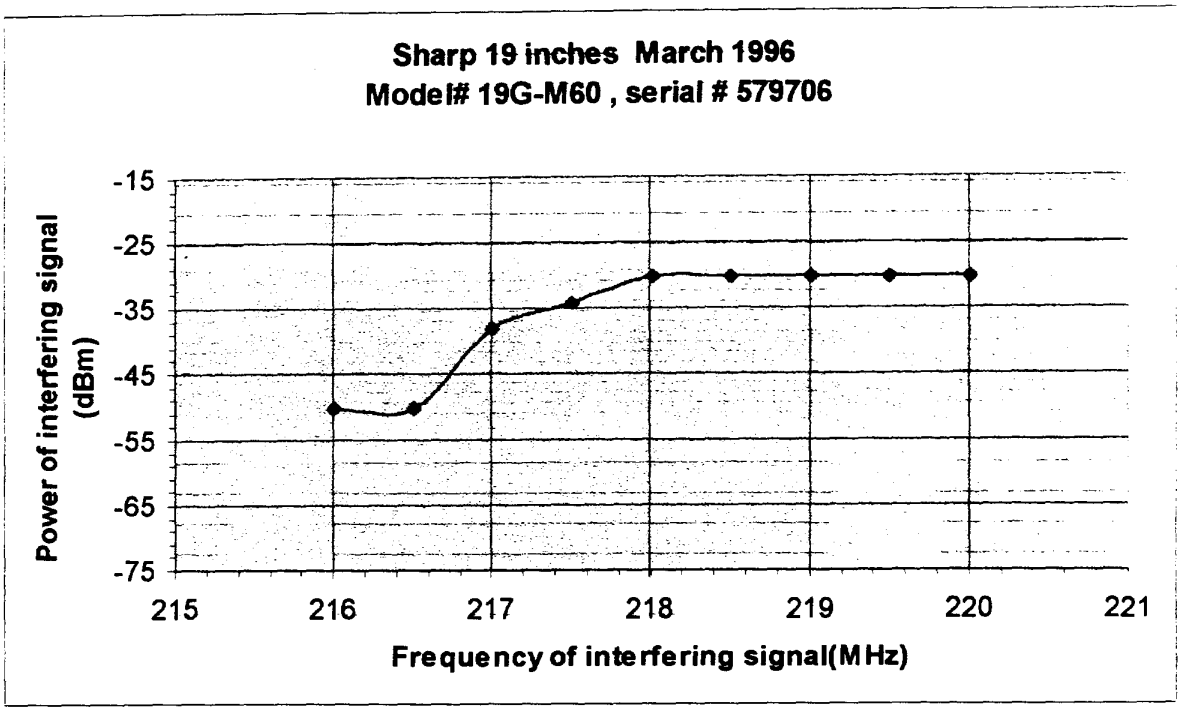

Figure A43

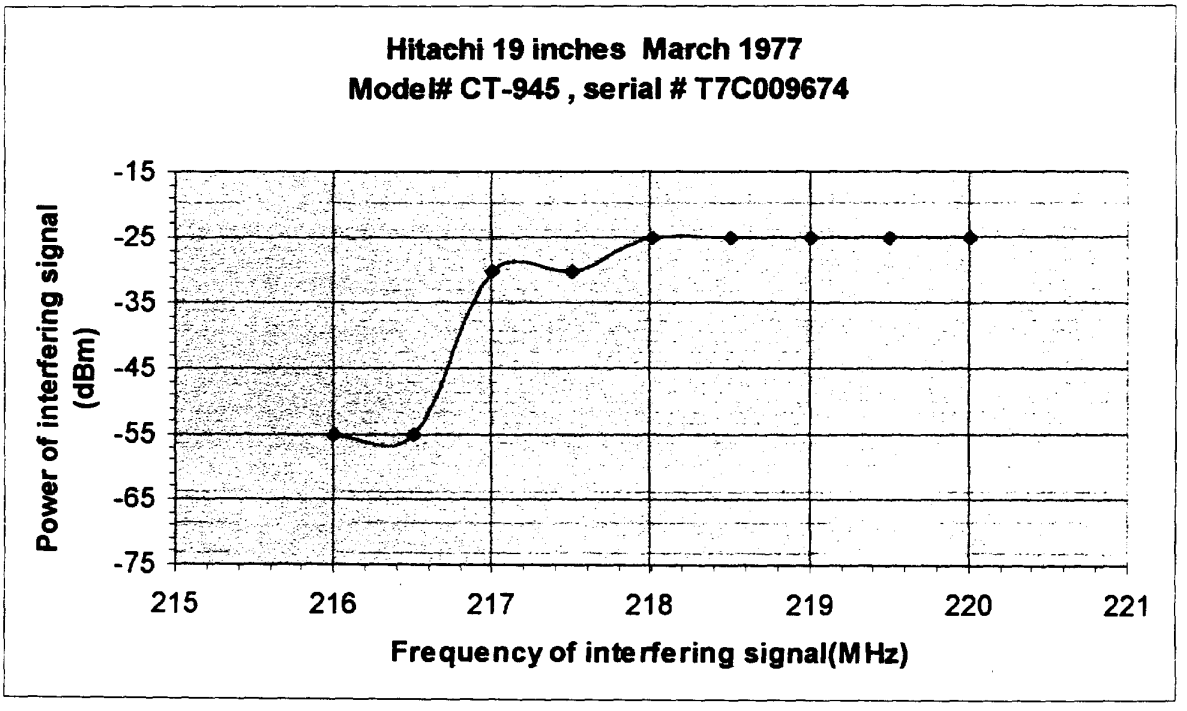

Figure A44

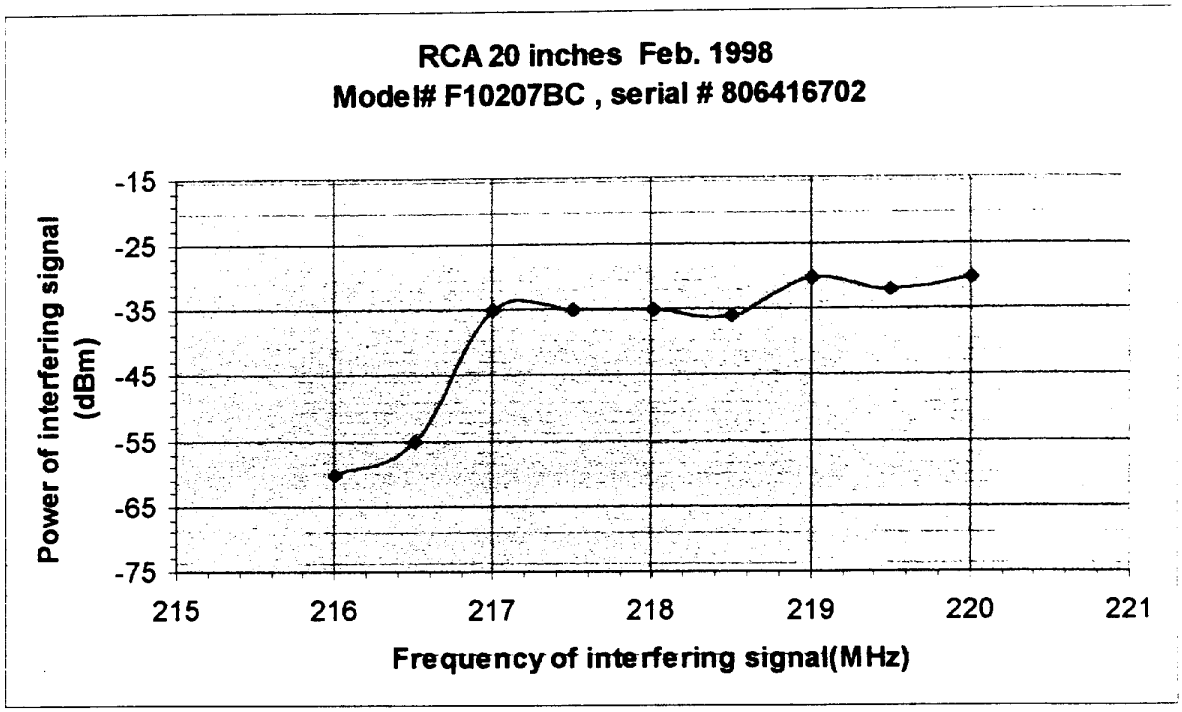

Figure A45

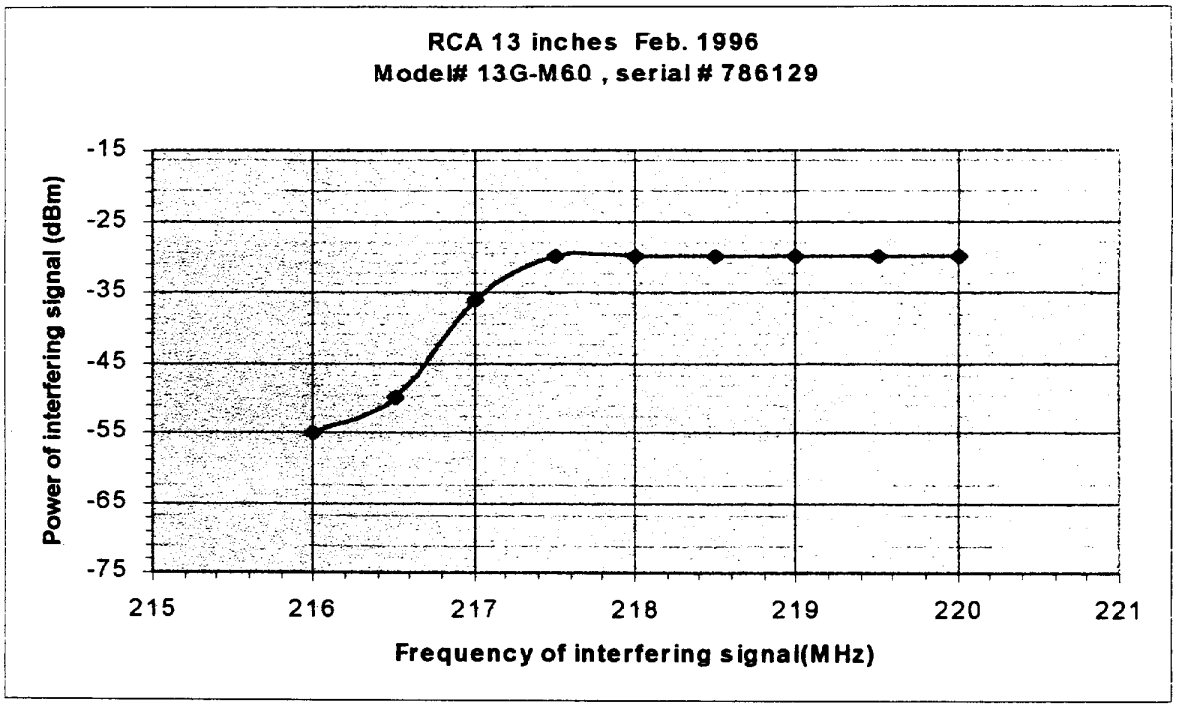

Figure A46

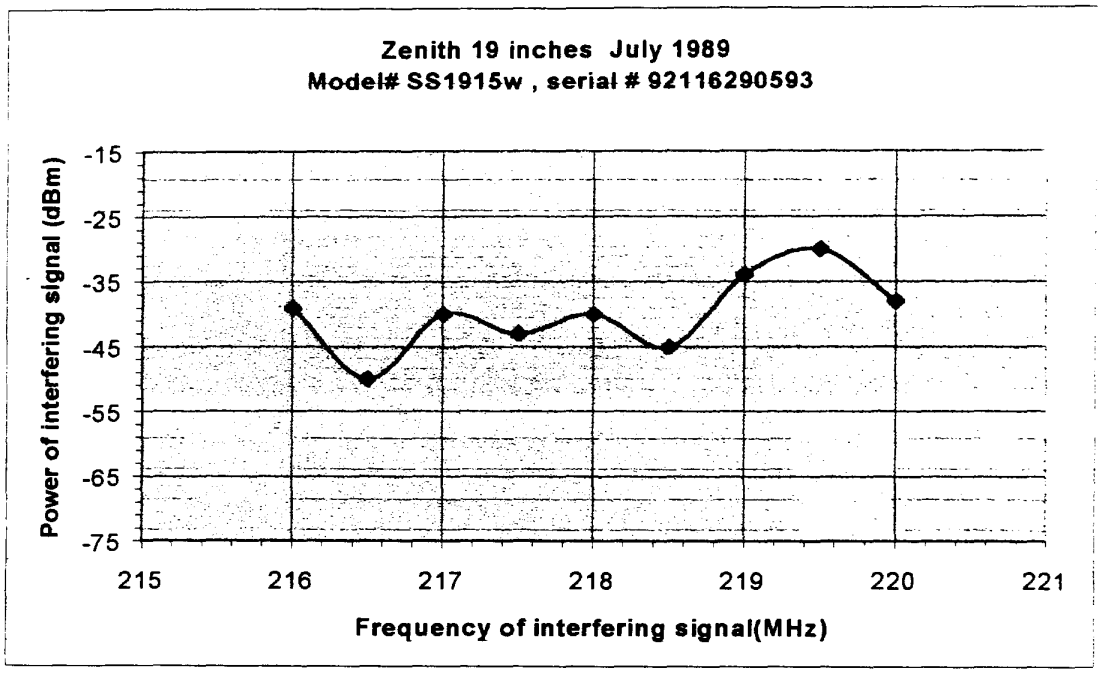
Zenith 19 inches July 1989
Model# SS1915w , serial # 92116290593
Power of interfering signal (dBm)
-15
-25
-35
-45
-55
-65
-75
215
216
217
218
219
220
221
Frequency of interfering signal(MHz)

Figure A47

Appendix B

TV#	Chanel Power (dBmv)	TV manufacturer size & date	Model #	Serial #	216	216.5	217	217.5	218	218.5	219	219.5	220	cable or antenna Location/
					Power level(dBm) of the interfering signal (MHz) at the moment of interference									
1	-16.3	Sharp electronics(19"), March 1993	13C-M100	604090	-59	-63	-43	-32	-31	-31	-30	-30	-30	Pomona/cable
2	-16.3	Sharp electronics(19"), Feb. 1993	13C-M100	590016	-61	-64	-44	-28	-32.5	-28	-30	-23	-21	Pomona/cable
3	-16.8	Samsung(25"), March 1997	TXTXE2545	3CAH301113	-32	-38	-30	-32	-35	-20	-22	-22	-25	Yorba Linda/cable
4	-16.3	RCA(27"),May 1992	G27400WKKM2	219550814	-60	-55	-37	-39	-38	-35	-35	-36	-40	Yorba Linda/cable
5	-16.2	Quasar(11"), Spt. 1985	TP3948WW	UG5525551	-55	-56	-53	-40	-35	-33	-20	-25	-20	Yorba Linda/cable
6	-16.8	Emerson(9"), Feb. 1994	TC0916		-47	-41	-37	-28	-31	-29	-26	-29	-25	Yorba Linda/cable
7	-16.2	MGA/Mitsubishi(19"), 1983	CS-1950		-53	-55	-39	-35	-28	-28	-28	-28	-30	Yorba Linda/cable
8	-16.2	Sharp(27"), Dec. 1996	27H-S60	804482	-52	-48	-35	-33	-29	-29	-28	-28	-27	Yorba Linda/cable
9	-16.5	Quasar(21"), June 1998	VV2008	SB81691971	-45	-38	-34	-34	-34	-33	-31.5	-31	-30	Placentia/antenna
10	-16.2	RCA(19"), July 1985	FLR530TR	529440309	-56	-57	-30.5	-25	-18	-17	-17	-17	-17	Anaheim/antenna
11	-16.2	RCA(25"), April 1981	GFR763BR	117671893	-43	-39	-26	-21	-19	-20	-18	-18	-19	Anaheim/antenna
12	-16.2	Hitachi(32"), Jan. 1995	31UX5B	V5A006718	-42	-38	-26	-33	-35	-34	-29	-20	-20	Placentia/antenna **
13	-16.2	RCA(32"), 1991			-59	-57.5	-42	-37	-35	-34	-25	-25	-28	Irvine/cable
14	-16.7	Toshiba(20"), Aug.1997	CE19G10	78940460	-45	-51	-36	-28.5	-28.5	-28.5	-28	-28	-27	Irvine/cable
15	-16.2	General Electric(25"), July 1995	25GT503	529393302	-51	-45	-27	-27	-27	-30	-30	-30	-30	Yorba Linda/antenna
16	-16.7	Sears(13"), April 1981	562.4034005	U-34559260	-68	-68	-50	-35	-40	-26	-20	-26	-25	Yorba Linda/antenna
17	-16.2	Sony WEGA(36"), Sept1998	KV-36FV1	9010600	-40	-40	-30	-35	-25	-25	-25	-26	-26	Irvine/cable
18	-16.2	RCA-color track(9"), Jan.1983	EGR291S	304214513	-45	-44	-30	-30	-30	-20	-20	-20	-25	Irvine/cable
19	-16.7	Sharp(19"), April 1993	19C-M100R	454402	-65	-67	-50	-33	-33	-33	-32	-30	-30	Irvine/cable
20	-16.9	Panasonic(31"), May 1998	CT-3283W	MD-81330038	-74	-57	-47	-49	-49	-45	-39	-42	-41	Arcadia/antenna **
21	-16.8	Zenith(25"), Dec. 1993	SLS25555	321-1249071	-39	-40	-50	-50	-40	-40	-30	-30	-25	Arcadia/antenna **
22	-16.8	Mitsubishi(20"), Oct 1994	CS-20201	2020166574	-38	-38	-36	-30	-28	-27	-27	-27	-28	Arcadia/antenna **
23	-16.2	Philco(25")>Oct 1995	3515R031C	2924628P	-35	-28	-28	-33	-28	-28	-37	-35	-35	Arcadia/antenna **
24	-16.3	Toshiba(35"), Oct. 1995	CF35E50	22579930	-58	-38	-29	-27	-28	-25	-18	-18	-25	Arcadia/antenna **
25	-16.3	Zenith(25"), April 1983	52550P	391-44140793	-49	-48.5	-28	-28	-28	-30	-35	-28	-31	Arcadia/antenna **
26	-16.2	Sony(13"), Jan. 1992	KV13TR24	8267347	-54	-50	-33	-25	-27	-28	-28	-27	-30	Arcadia/antenna
27	-16.5	Sharp(13"), March 1995	13VT-G100	517861	-30	-30	-35	-30	-29	-27	-27	-25	-27	Arcadia/antenna
28	-16.3	RCA(13"), Oct. 1997	T13060GY	742515010	-49	-47	-30	-30	-27	-20	-20	-25	-25	Pomona/cable
29	-16.3	Sharp(13"), Jan.1995	13VT-G100	515054	-50	-50	-35	-32	-29	-28	-27	-28	-23	Pomona/cable

TV	Power to channel 13 (dBmv)	TV manufacturer size & date	Model #	Serial #	Power level(dBm) of the interfering signal (MHz) at the moment of interference									Location/ cable or antenna
					216	216.5	217	217.5	218	218.5	219	219.5	220	
30	-16.3	Quasar(13"), Jan. 1989	UU8213	SB90250018	-59	-59	-45	-35	-30	-27	-27	-20	-20	Pomona/cable
31	-16.4	Sharp(20"), Dec. 1994	20VT-F100	520917	-47	-42	-35	-34	-30	-30	-29	-27	-27	Pomona/cable
32	-16.4	Sharp(25"), Dec. 1991	25RT59	560100	-70	-73	-58	-37	-39	-38	-34	-27	-29	Pomona/cable
33	-16.2	Quasar(13"), March 1989	VV8213	SB90730202	-58	-60	-50	-35	-35	-30	-35	-32	-30	Pomona/cable
34	-16.6	Zenith(13"), June 1996	SRV1320S	V23621467	-62	-66	-52	-35	-30	-30	-27	-28	-25	Pomona/cable
35	-16.4	JVC (13"), June 1993	C-13CLA	11805393	-39	-33	-30	-30	-30	-30	-27	-27	-28	Pomona/cable
36	-16.6	RCA(13"), Oct. 1997	T13060GY	742215282	-51	-51	-31	-21	-27	-30	-27	-25	-27	Pomona/cable
37	-16.2	Panasonic(20"), Oct. 1993	PV-M2043	J3AA16023	-60	-60	-59	-30	-38	-29	-25	-25	-25	Downey/antenna
38	-16.2	Mitsubishi(51"), Feb. 1994	VS-4571	OO8301	-25	-25	-20	-20	-20	-20	-20	-18	-18	Buena Park/antenna **
39	-16.8	Mitsubishi(20"), July 1995	CV-20126	512735	-50	-50	-35	-30	-30	-30	-30	-30	-30	Buena Park/antenna **
40	-16.2	Toshiba(13"), Oct. 1986	3F316	68605543	-58	-54	-35	-29	-28	-30	-28	-27	-27	Buena Park/antenna
41	-16.2	Sony(27"), Sept. 1994	KV-27V10	7084683	-42	-38	-33	-34	-35	-35	-35	-31	-31	Irvine/cable
42	-16.2	General Electric(13"), May 1988	13GP410	819724296	-55	-58	-40	-38	-38	-38	-38	-38	-38	Irvine/cable
43	-16.2	Sharp(19"), March 1996	19G-M60	579706	-50	-50	-38	-34	-30	-30	-30	-30	-30	S.Antonio Heights/cable
44	-16.2	Hitachi(19"), March 1977	CT-945	T7C009674	-55	-55	-30	-30	-25	-25	-25	-25	-25	Placentia/antenna
45	-16.2	RCA (20"), Feb. 1998	F10207BC	806416702	-60	-55	-35	-35	-35	-36	-30	-32	-30	Placentia/antenna
46	-16.2	Sharp (13"), Feb. 1996	13G-M60	786129	-55	-50	-36	-30	-30	-30	-30	-30	-30	S.antonio Heights/cable
47	-16.8	Zenith(19"), July 1989	SS1915W	92116290593	-39	-50	-40	-43	-40	-45	-34	-30	-38	Arcadia/Antenna **
48	-26	Philco(25"), Jan. 1993	P2505RP205	23199247	-25	-25	-15	-15	-15	-15	-15	-15	-16	Placentia/cable
49	-29	Toshiba(27"), March 1997	CE27F15	67518388	-27	-26	-25	-23	-22	-21.5	-18.5	-18.5	-18	Placentia/cable
50	-24.5	Magnavox(19"), Jan. 1998	RH4250WA02	58457223	-37	-35	-30	-27	-26	-20	-23	-19	-20	Placentia/cable
51	-28	Zenith(26"), 1994	SM2767W9	421-04410233	-24	-25	-19	-17.5	-19	-20	-21	-22	-23	Placentia/cable

** cable was available but antenna was used beacause the power level from cable company was too low