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AIRTOUCH™
Communications

The new name for PacTel

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June 23, 1994

RECEIVED

JUN 23 1994

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

EX PARTE OR LATE FILED

EX PARTE

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW, Room 222
Washington, DC 20554

RE: PR Docket 93-61, Automatic Vehicle Monitoring Systems

Dear Mr. Caton:

The attached letter dated June 23, 1994 was forwarded to the Commission. Please associate this material with the above-referenced proceeding.

Two copies of this notice were submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's Rules.

Please stamp and return the provided copy to confirm your receipt. Please contact me at 202-293-4960 should you have any questions or require additional information concerning this matter.

Sincerely,

Kathleen Q. Abernathy

Kathleen Q. Abernathy

Attachments

No. of Copies rec'd 0+2
List ABCDE

June 23, 1994

Ralph Haller
Chief, Private Radio Bureau
Room 5002
2025 M Street, N.W.
Washington, D.C. 20054

Re: PR Docket No. 93-61: Automatic
Vehicle Monitoring Systems

Dear Mr. Haller:

The undersigned entities are parties to Federal Communications Commission PR Docket No. 93-61, an NPRM released on April 9, 1993, proposing permanent rules for vehicle monitoring systems. We represent a majority of those entities that are either operating or developing wideband, location monitoring systems (known currently as wideband LMS systems). We have attached a Consensus Paper on Part 15 inteference. In addition, we offer the following compromise proposal in an effort to alleviate Part 15 concerns about the potential for interference from Part 15 devices to receivers used by wideband LMS systems in the 902-928 MHz band. We have verbally discussed this proposal with representatives of the Part 15 industry and are forwarding them copies of this written proposal.

Most of the Part 15 community have expressed concern over the licensing of wideband LMS systems in the 902-928 MHz band because of the perceived potential that LMS providers could force Part 15 equipment owners, who are unlicensed and must operate on a non-interfering basis under the band hierarchy, to cease operation in the LMS band. The compromise proposal set forth below responds to this concern by overlaying interference negotiation obligations on the band hierarchy. The proposed interference negotiation obligations would be imposed on the 902-928 MHz band because of the unique characteristics of the band, including the potential congestion of the band and the need to accommodate multiple users. The specifics of the proposal are as follows:

1) Since wideband LMS systems and Part 15 devices both provide valuable services to the public, the Commission would impose an obligation on both groups of providers to negotiate in good faith to eliminate harmful interference caused by Part 15 equipment to wideband LMS service providers. If such negotiations are unsuccessful, then the parties

can either mutually agree to submit to binding arbitration or they have the option of seeking relief from the FCC.

2) Whenever the FCC is asked to adjudicate LMS/Part 15 interference disputes, the Commission, possibly using its Alternative Dispute Resolution procedures, would examine the equities of the case and the potential engineering solutions available and resolve the matter. We believe, however, that in the vast majority of instances, the parties will resolve the dispute prior to seeking FCC involvement since business necessity will require speedy resolution of interference problems.

3) The FCC would adopt a threshold interference level below which wideband AVM systems cannot complain about "harmful interference" from Part 15 devices. This threshold level can be based on the attached technical report. This report presents an overview of the experience of LMS system operators with interference from Part 15 devices. It includes a proposed threshold interference level based on field measurements of interference levels, estimates of potential interference levels under various scenarios, and interference levels that most LMS systems should be able to tolerate without significant adverse degradation.

The proposed interference rules will require the LMS industry and the Part 15 industry to work out acceptable engineering solutions, thus preserving the ability of Part 15 users to deploy systems in the 902-928 MHz band. In addition, since this solution does not require a revision of the band hierarchy, but rather simply layers on top of the hierarchy interference rules, no further round of notice and comment is necessary.

We look forward to discussing this proposal with you and to continued discussions with the Part 15 community.

Sincerely,

AirTouch Teletrac

By Kathleen Q. Abernathy

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AirTouch Communications
1818 N Street, N.W.
Washington, D.C. 20036

MobileVision, L.P.

By_____

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Pinpoint Communications, Inc.
Inc.

By David E. Hilliard

David E. Hilliard
Wiley, Rein & Fielding
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Washington, D.C. 20006

Uniplex

By_____

Mac Bryan
President
2905 Country Drive
St. Paul, MN 55117

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LMS Consensus Position on Part 15 Interference

I. Introduction.

A group of companies representing a majority of those involved in developing or providing AVM services (LMS)[1] have joined to present a common position concerning the issues of interference from Part 15 equipment. This group of LMS companies consisting of AirTouch Teletrac, MobileVision, Pinpoint Communications, and Uniplex (the authors) provides this consensus document as evidence of their ability to operate within the 902 to 928 MHz frequency band in the presence of interference from Part 15 devices. This document presents a summary of LMS experience with actual cases of interference and field measurements of interference levels at LMS receive sites.

Concerns have been expressed over the potential consequences to Part 15 users from harmful interference they may cause to LMS systems. Many parties that have commented on this issue have had no direct experience with LMS systems on which to base these concerns. The authors believe that a review of their experience with interference from Part 15 equipment will help to alleviate these concerns. This experience comes from:

- designing, testing and operating systems in the spectrum shared with Part 15 equipment,
- encountering real world cases of interference from Part 15 devices,
- numerous measurements of interference levels at LMS receive sites, and
- the designed tolerance of LMS systems to interference.

In a show of good faith, the authors offer to take action to underscore the fact that substantial interference from Part 15 equipment can be tolerated by their systems and that harmful interference can be resolved reasonably and equitably in the limited situations that it occurs. First, the authors recommend that the LMS rules include an interference threshold below which interference from Part 15 devices may not be considered harmful by an LMS operator. This is not a level at which interference from a Part 15 device would automatically be considered harmful but rather, it is a level above which LMS systems could seek to negotiate a resolution to interference in the event that it is harmful. The proposed definition of this threshold level is as follows:

> *An LMS receiver shall be capable of tolerating interference from a Part 15 device if the total field strength of the interfering signal at an LMS receive site, across the licensed LMS sub-band, is below 59 μV/m (equivalent to -101 dBm at an isotropic antenna), or in the case when the Part 15 device is transmitting less than 10% of the time, in any 10 second period, below 186 μV/m (equivalent to -91 dBm at an isotropic antenna).*

This interference level is based on historical operating experience and would ensure adequate performance of all LMS systems while generating relatively few instances of harmful

[1] The Notice of Proposed Rulemaking includes renaming Automatic Vehicle Monitoring (AVM) to Location Monitoring Services (LMS).

interference. Nevertheless, it is known that some LMS systems will tolerate significantly higher levels of interference, making it far less likely that a Part 15 device will cause interference requiring resolution than the proposed levels might suggest.

The authors further recommend that in those cases when interference exceeds the proposed threshold the rules should require LMS operators and Part 15 providers to negotiate in good faith to resolve the interference. The details of the negotiation mechanism are proposed separately.

II. Summary of Findings.

The combined experience of the authors makes it clear that fears of widespread interference to LMS systems from Part 15 equipment are unfounded. The results of their years of testing and operating systems in the 902 to 928 MHz frequency band plus detailed analysis of potential interference effects of large populations of Part 15 devices demonstrate that LMS systems can co-exist with Part 15 users. Experience shows that:

- The actual cases of harmful interference experienced to date represent only 0.007% of the more than 795,000 Part 15 devices co-existing in the 902 to 928 MHz frequency band with LMS receivers.
- Most cases of harmful interference to date have been caused by only 2 types of Part 15 devices used in commercial/industrial applications: field disturbance sensors and long range point-to-point video links.
- The devices that have caused interference have continued to operate after migrating to frequencies outside the passband of LMS receivers and in no case has a user of a Part 15 device ever been required to cease operation.
- Every case of interference to date has been resolved cooperatively with Part 15 manufacturers or users without the need for FCC intervention.
- Migrating the few Part 15 devices that cause harmful interference has virtually no impact on other Part 15 users of the 902 to 928 MHz frequency band.
- The levels of interference from Part 15 devices measured at LMS receive sites only exceed the proposed LMS tolerance level in very limited circumstances making it a reasonable threshold for interference above which LMS operators may seek resolution.
- Analysis shows that LMS systems can tolerate extremely large numbers of Part 15 devices under a wide range of scenarios without significant degradation in service.
- Consumer uses of Part 15 devices have very little likelihood of harmfully interfering with LMS systems.

III. LMS Experience Base.

As a group, the authors have over 5 years of experience in designing, testing and operating LMS systems intended to co-exist with Part 15 equipment in the 902 to 928 MHz frequency band. Teletrac systems have been commercially operating in six major metropolitan areas:

Los Angeles for 3 1/2 years, Chicago and Detroit for 3 years, Dallas and Miami for 2 1/2 years, and Houston for 2 years. Teletrac also has a test system operating in San Diego. This coverage is achieved with about 190 fixed site receiving stations that share the spectrum with hundreds of thousands of Part 15 devices. Teletrac provides reliable and useful services for over 35,000 subscriber units 24 hours a day, 365 days a year. Many of Teletrac's customers (including utilities and retailers) use Part 15 equipment that operates in the 902 to 928 MHz frequency band in their daily operations without degradation to either Teletrac or the Part 15 equipment. MobileVision, and Pinpoint have further experience in South Florida, Washington DC, Dallas and Chicago that includes testing and operating more than 30 LMS receive sites. In total, the authors have systems in development, test or operation in urban and suburban areas estimated to include almost 13% of the U.S. population (based on 1990 census data).[2]

IV. LMS Experience with Cases of Part 15 Interference.

With LMS receivers covering about 13% of the U.S. population in 9 metropolitan areas, Table I shows that nearly 800,000 Part 15 devices are estimated to be co-existing with LMS systems.[3] This is probably a low estimate given that Part 15 devices are heavily deployed in metropolitan areas such as those covered by LMS systems. Table II shows that only 0.007% of these devices have caused harmful interference to LMS receivers.

Table I. Estimated Number of Part 15 Devices in LMS Coverage Areas.

City	Estimated U.S. Population Covered by LMS Systems	Estimated Number of Part 15 Devices in Coverage Areas
Boca Raton	0.1%	6,163
Chicago	2.2%	135,586
Dallas	1.4%	86,282
Detroit	1.3%	80,120
Houston	1.2%	73,956
Los Angeles	4.8%	295,824
Miami	1.4%	86,282
San Diego	0.3%	18,489
Washington DC	0.2%	12,326
Total	**12.9%**	**795,028**

Each case of harmful interference shown in Table II represents an individual Part 15 device which, due to its deployment and/or proximity to a LMS receive site, has caused degradation in system performance. In each case, the interference has been resolved cooperatively by the

[2] Interference to LMS receive sites depends on the number of sites, the number of Part 15 devices and the area of coverage and does not depend on the number of LMS subscriber units. Therefore, subscriber unit growth will not increase the incidence of interference.

[3] Estimates of Part 15 devices operating in the 902 to 928 MHz frequency band nation-wide and a method for estimating the number operating in LMS coverage areas are provided in the Teletrac report entitled "Experience with Part 15 Interference", dated June 21, 1994.

LMS company and the Part 15 manufacturer (or in a very few cases, the user). In almost all cases the interference has been resolved by changing the operating frequency of the Part 15 device with the LMS company paying the cost.

Table II. Incidence of Harmful Interference from Part 15 Devices.[4]

Equipment Type / Use	Part 15 Devices Within LMS Coverage Areas (a)	Total Cases of Interference (b)	Active Cases of Interference (c)	Cases of Interference Involving FCC (d)
Spread Spectrum	13,739	3	1	0
Wireless Stereo/Video	38,700	18	2	0
Cordless Telephones	193,500	1	0	0
Wireless Security Alarms - Residential	18,576	0	0	0
Wireless Security Alarms - Commercial	10,643	0	0	0
Field Disturbance Sensors	3,870	33	0	0
Wireless Bar-code Readers and Portable Computers	129,000	0	0	0
Meter Reading Transponders	387,000	0	0	0
Total	**795,028**	**55**	**3**	**0**
Percent	**100%**	**0.007%**	**0.0004%**	**0.0%**

Definitions: (a) = (Total number of devices in U.S.) * (Percent of US Population covered by LMS)
(b) = Total number of Harmful Interference cases in all LMS coverage areas.
(c) = Total number of Harmful Interference cases awaiting resolution today.
(d) = Total number of Harmful Interference cases referred to FCC for resolution.

Table II highlights the fact that no case of harmful interference experienced to date has required FCC intervention or involvement. Also, in no case has a user been required to discontinue use of a device other than for the time required to make the necessary modifications or adjustments. In most cases this is an adjustment or modification that can be completed in a few minutes at the customer's premises by the manufacturer or a qualified technician. In some cases it is accomplished through a user selectable frequency option.

V. Typical Part 15 Signals that Cause Harmful Interference to LMS Systems.

The incidence of harmful interference encountered by the authors has been almost entirely due to industrial or commercial uses of Part 15 equipment. Of the dozens of applications for Part 15 equipment, only two types of equipment have caused over 90% of these cases. These primary causes have been field disturbance sensors used as anti-shoplifting sentries that operate under Part 15.245 and long range video links that operate under Part 15.249. Even

[4] Teletrac report "Experience with Part 15 Interference" includes estimates of the number of Part 15 devices of each type operating nation-wide based on Part 15 manufacturer data. The numbers in column (a) of Table II represent 12.9% of those quantities.

within these two applications, only about 51 individual devices have caused harmful interference to LMS receivers during as many as 5 years of LMS testing and operation in 9 cities. These cases have consisted of 33 field disturbance sensors and 18 long range point-to-point video links. The other four cases of harmful interference were caused by a cordless telephone and 3 long range point-to-point data links operating under Part 15.247. In all cases, the users were able to continue operating at frequencies outside of LMS operating bands.

As stated previously, harmful interference to LMS receivers has been caused almost exclusively by two types of equipment:

- long-range point-to-point links (primarily video links)
- field disturbance sensors used in anti-shoplifting applications

The signals from these devices can be harmful to LMS receivers under limited circumstances for two principal reasons: they either transmit continuous signals (narrowband or wideband) and/or they transmit from antennas placed at relatively high elevations. However, it should be noted that even these particular devices have only been harmful when deployed in close proximity to an LMS receiver, at relatively high antenna elevations, or when directional antennas are directed toward receive sites.

The kinds of isolated cases of interference that have been experienced by LMS operators were anticipated when the Part 15 rules were developed. The Part 15 rules indicate that no rules, no matter how comprehensive, can prevent interference under all circumstances.[5] Therefore, the rules include guidance to Part 15 providers and users to take precautions beyond the rule limits to reduce the potential for interference. Such precautions include transmitting less than the maximum power allowed if less is sufficient for proper operation, using the lowest necessary antenna height for proper operation, and using directional antennas or redirecting them wherever practical. Although the isolated cases of interference are easily resolved when they occur, the use of simple and inexpensive preventive measures such as these would reduce the potential for interference to LMS systems to an even lower level.

A factor that may make the occurrence of interference to LMS systems even lower than that experienced to date is the trend for long range applications to operate in the 2.4 and 5.7 GHz frequency bands. Some manufacturers that have caused interference in the past are tending to migrate existing equipment and deploy new equipment to the 2.4 GHz frequency band. Additionally, proposed rules that would remove antenna gain restrictions on Part 15 equipment operating in the 2.4 and 5.7 GHz frequency bands will probably accelerate this trend, thus reducing the incidence of interference even further. However, even without these factors it is clear from the LMS experience that the overall occurrence of interference from even these devices is limited.

[5] Part 15.15(c) and Part 15.105(b) of the Federal Communications Commission rules.

It is important to note that LMS systems have not experienced a single case of harmful interference from meter reading transponders, metropolitan area network devices, indoor video links, wireless security systems, wireless bar-code readers, or wireless portable computers. In fact, the authors have seen harmful interference from the equipment of only 5 manufacturers out of the dozens of Part 15 manufacturers that have commented in the LMS rulemaking. This experience provides a high degree of confidence that LMS systems can continue to co-exist with Part 15 equipment without risk of significant interference.

VI. Resolving Harmful Interference.

Every case of harmful interference to date has been resolved cooperatively between LMS operators and Part 15 manufacturers or users and in no case has there been a need for FCC intervention nor has any Part 15 device been required to cease operation. Interference has typically been resolved by changing the operating frequency of the Part 15 device for about $200 including parts and labor which the LMS company has paid in most cases. In no case did a Part 15 user ever have to cease operation of equipment for longer than the time required to change the equipment to another frequency (typically on the order of 15 to 30 minutes). Given the limited number of units that have had to shift frequency there has been virtually no impact to other users of the band. Many, if not most, Part 15 devices have a selectable operating frequency to mitigate the potential for interference between each other and other users of the spectrum: some do this automatically while others require manual selection. This capability is employed by Part 15 devices to mitigate interference between each other on a routine basis. Co-existence with LMS requires no more than this existing capability from Part 15 equipment and it is only in very isolated cases that it becomes necessary. In those cases where frequency selection is not a designed-in capability, only very simple and inexpensive modifications to the equipment are necessary (typically replacement of a crystal oscillator costing a few dollars).[6]

VII. Typical Interference Levels at LMS Receive Sites.

LMS system operators have conducted extensive field measurements of interference levels at their receive sites in the course of testing, deploying and/or operating their systems. These measurements and actual experience with Part 15 interference have shown that only a small percentage of interfering signals are of sufficient strength at receive sites to cause substantial degradation to LMS systems.

Typical interference levels measured by the providers at their receive sites are shown in the figures at the end of this document. These levels represent the combined interference from the various other users of the band including Part 15 devices, narrowband AVI/RF tag systems, ISM equipment, amateurs and government systems. The levels shown represent the range of interference levels that have been measured at a number of LMS sites including those times when harmful interference has been present. The measurements demonstrate that only a few interferers are present above the ambient noise levels at any site and only a very few approach or exceed the tolerance threshold that has been proposed.

[6] Teletrac report "Experience with Part 15 Interference" includes a summary of steps Teletrac takes in resolving interference when it occurs. Similar steps have been taken by other LMS operators.

VIII. Conclusion.

Experience shows that LMS systems can and do co-exist in the 902 to 928 MHz frequency band with Part 15 devices. The types of Part 15 devices that have caused harmful interference have been primarily limited to two applications (anti-shoplifting and long range point-to-point links) and within these applications to only a small fraction of the units deployed. The total number of incidents of harmful interference encountered by LMS systems over the past several years represents only 0.007% of the installed base of Part 15 equipment that operates in LMS coverage areas. This experience and further analysis of the interference potential to LMS systems from Part 15 devices shows that LMS systems can tolerate substantially large numbers of Part 15 devices.[7] Continued deployment of LMS systems will not have a significant impact on the number of Part 15 devices that can be deployed and it is likely that Part 15 devices will be primarily limited by their ability to co-exist with each other.

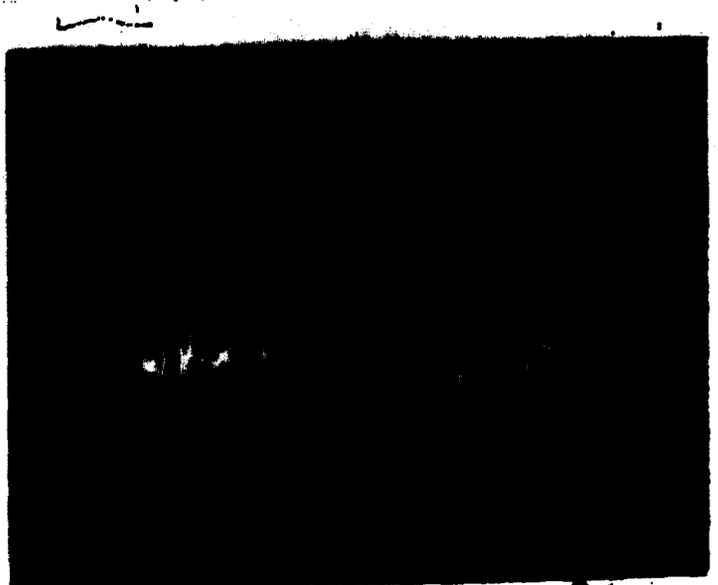
The hierarchy of use in the 902-928 MHz frequency band offers LMS operators the structure within which the isolated cases of interference can be quickly resolved in cooperation with Part 15 manufacturers. Overlaying the proposed LMS interference threshold and good faith negotiation provisions onto the existing hierarchy will improve this relationship. These steps will protect Part 15 users from frivolous claims of harmful interference yet ensure that Part 15 providers will continue to limit the potential for interference and LMS operators will continue to tolerate interference.

The authors have shown that LMS systems if properly designed and operated can co-exist in the 902 to 928 MHz frequency band without adverse affects on Part 15 users. The authors have also shown that Part 15 manufacturers may continue to develop equipment for this band without fear of disruption from LMS operations. Therefore the FCC should ensure that LMS systems can continue to develop and operate under permanent rules.

[7] MobileVision report "Further Analysis of Interference of Part 15 Devices and LMS Wideband Systems - Probability of Interference", June 1994.

Figure 1. Interference Measurement at LMS Receive Site.

GARLAND 6 11 92



GARLAND 11-4-92

Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 2. Interference Measurement at LMS Receive Site.

AIRCALL 10-15-92

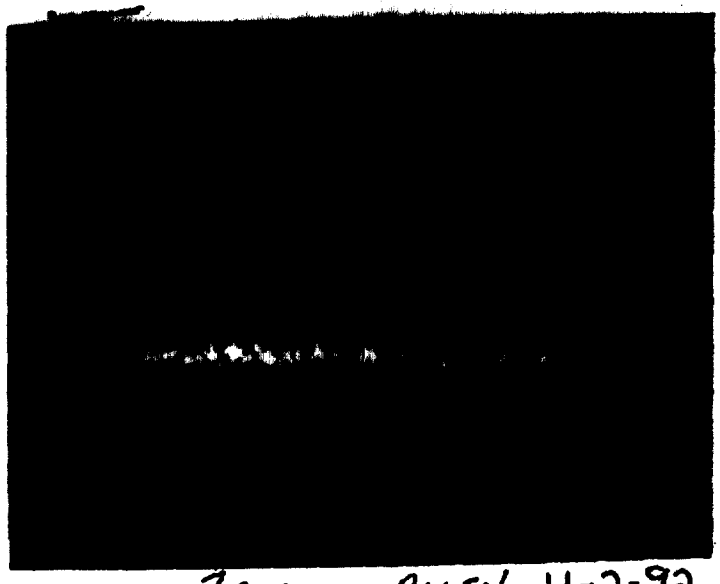
AIRCALL 5-26-93

Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 3. Interference Measurement at LMS Receive Site.

FRISCO - ALLEN BASE 6-9-92

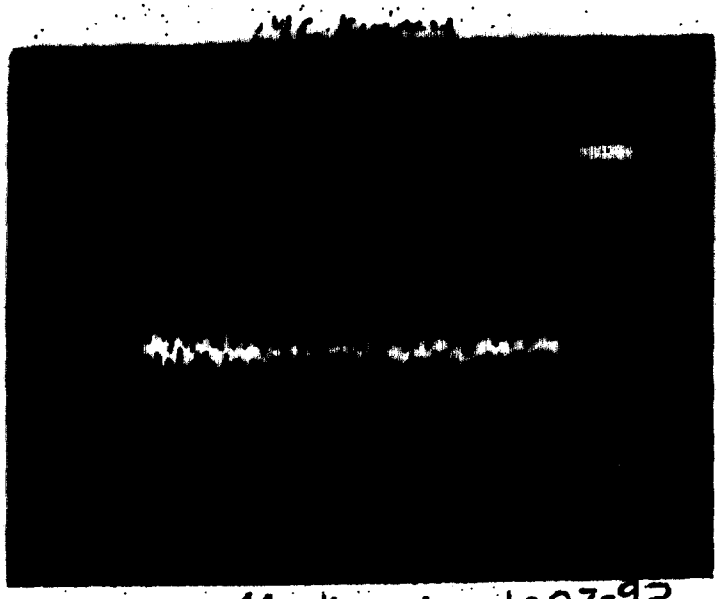


FRISCO - ALLEN 11-2-92

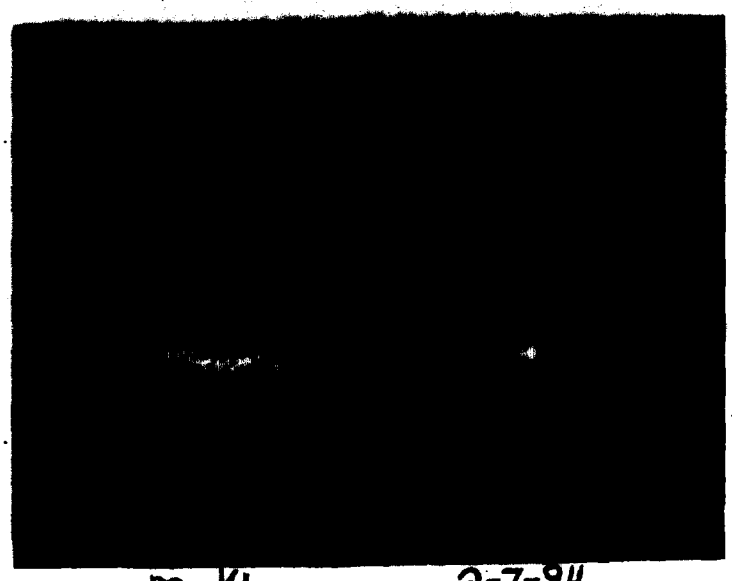
Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 4. Interference Measurement at LMS Receive Site.



Mc Kinney 1-07-92



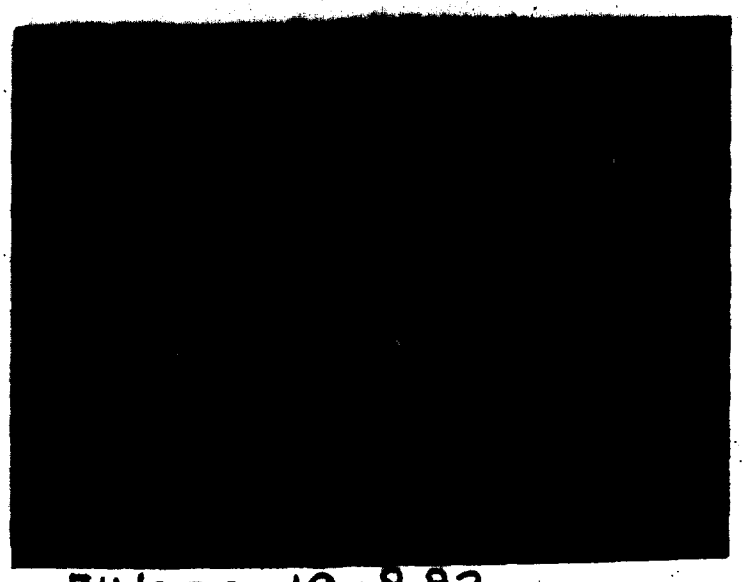
McKinney 2-7-94

Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 5. Interference Measurement at LMS Receive Site.

EULESS 6-15-92

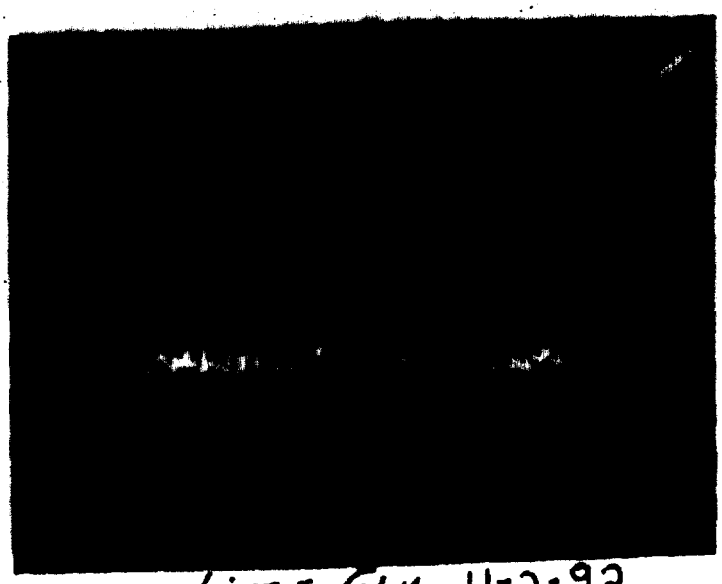


Euless 12-9-93

Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 6. Interference Measurement at LMS Receive Site.



LITTLE ELM 11-2-92

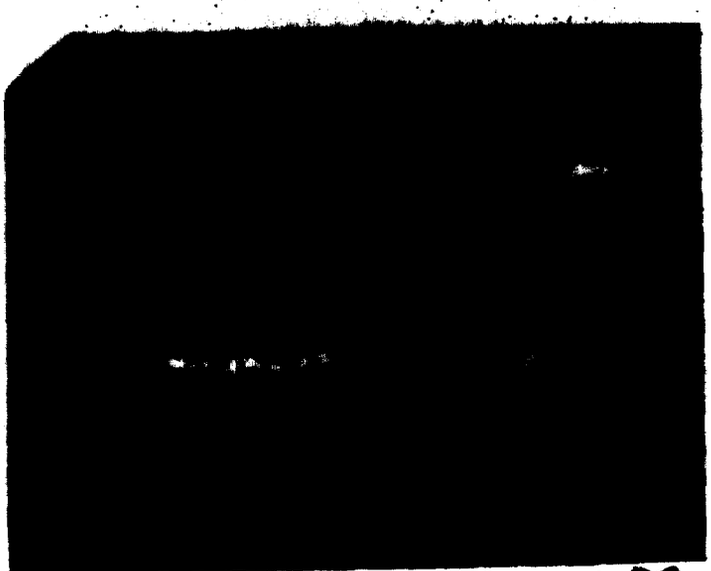
Little Elm 3-3-94

Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 7. Interference Measurement at LMS Receive Site.

RENAISSANCE 6-12-92



EN AISSANCE 5-27-93

Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 8. Interference Measurement at LMS Receive Site.

ALLIANCE 6-1-93

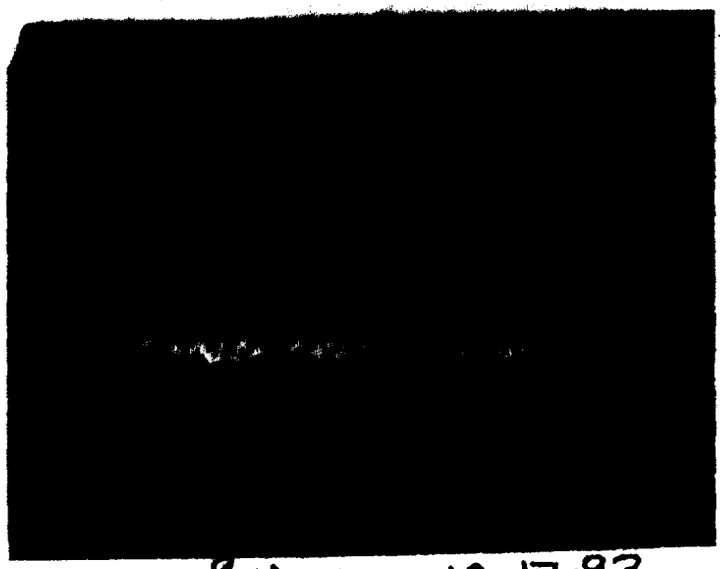
ALLIANCE-8 3-3-94

Parameters:	**Center:** 908 MHz	**Span:** 5 MHz
	Resolution BW: 30 kHz	**Video BW:** 30 kHz
	Reference Level: -77 dBm	**Scale:** 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 9. Interference Measurement at LMS Receive Site.

BURLESON 6-1-93

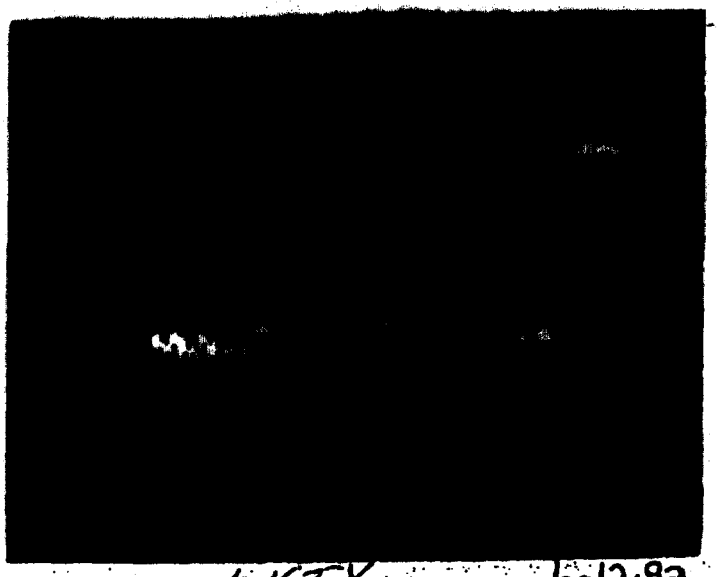


Burleson 12-17-93

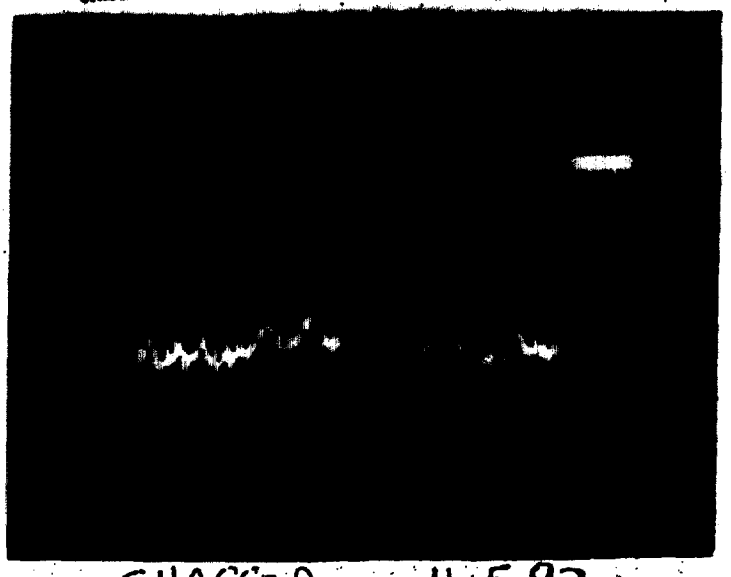
Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 10. Interference Measurement at LMS Receive Site.



KXTX 6-12-92



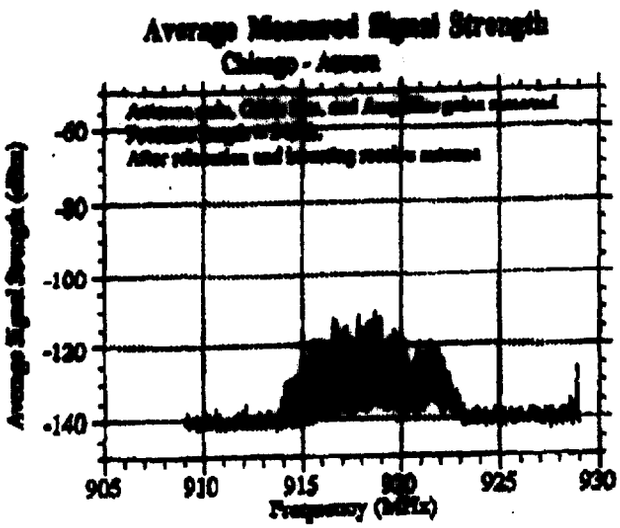
SHAEFER 11-5-92

Parameters:	Center: 908 MHz	Span: 5 MHz
	Resolution BW: 30 kHz	Video BW: 30 kHz
	Reference Level: -77 dBm	Scale: 10 dB / division
	Sweep Time: 20 msec	

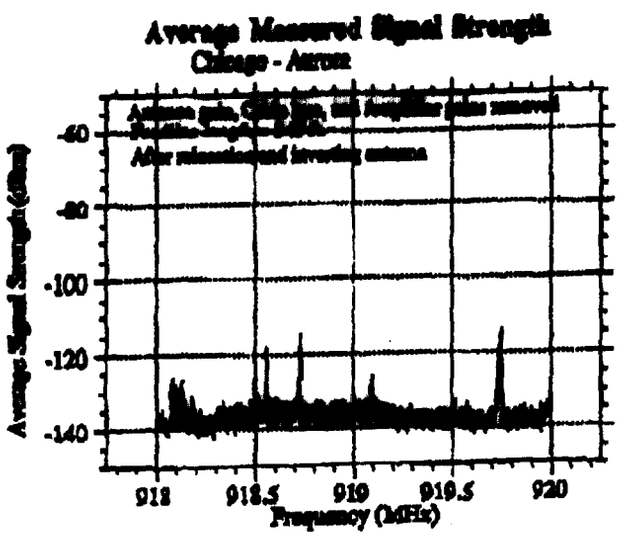
Reference level adjusted for antenna gain, preamplifier gain and line losses.

Figure 11. Interference Measurement at LMS Receive Site.

[redacted]



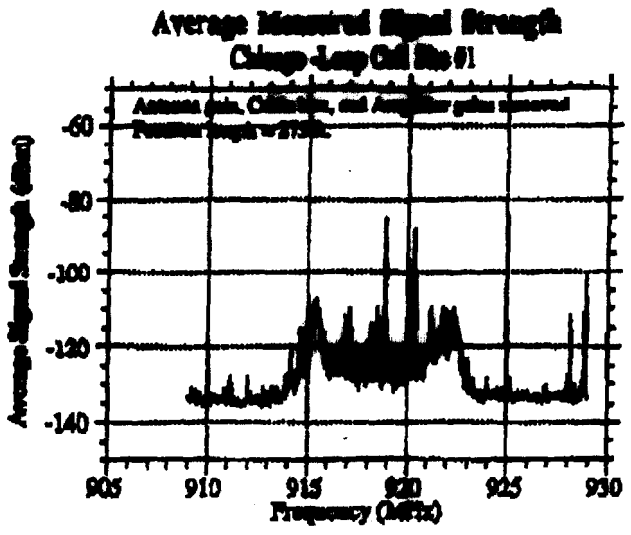
[redacted]



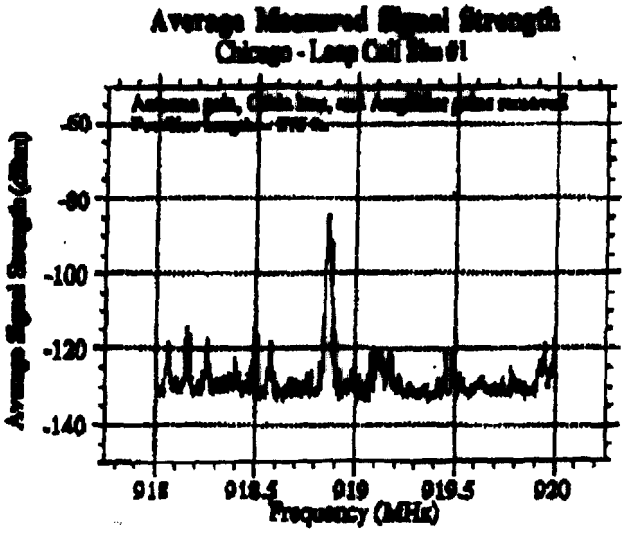
Parameters: Resolution BW: 10 kHz Video BW: 3 kHz

Figure 12. Interference Measurement at LMS Receive Site.

[redacted]



[redacted]



Parameters: Resolution BW: 10 kHz Video BW: 3 kHz