Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C., 20554

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In the Matter of	)	
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The Development of Operational,	)	
Technical and Spectrum Requirements	)	WT Docket No. 96-86
For Meeting Federal, State and Local	)	
Public Safety Agency Communication	)	
Requirements Through the Year 2010	)	
	)	
Establishment of Rules and Requirements	)	
For Priority Access Service	)	

COMMENTS OF MOTOROLA
THIRD NOTICE OF PROPOSED RULE MAKING

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January 19, 1999

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SUMMARY

The FCC's Third Notice of Proposed Rule Making in WT Docket No. 96-86 seeks comments on several ancillary issues surrounding the recent allocation of public safety spectrum at 746-806 MHz.

The proposal with the most potential to affect the near term use of the 700 MHz public safety band is the out-of-band emission restrictions intended to protect Global Orbiting Navigation Satellite System (GNSS) receivers. At this time, Motorola is unsure whether it can achieve these very stringent standards without imposing extreme additional costs on users. If adopted, these emission restrictions will clearly delay public safety's ability to access this band.

Fortunately, the impact of these proposed standards can be minimized because only a small portion of the 700 MHz public safety allocation has a direct second harmonic relationship with the GNSS band. In fact, the specific allocations render it unnecessary to impose any additional out-of-band emission restrictions on any 746-806 MHz ***narrowband*** public safety equipment. The FCC must ensure that any new out-of-band emission standards should apply only to that portion of the public safety spectrum that could cause harmful second harmonic emissions to operational GNSS systems.

Given the potential costs to public safety, the FCC must proceed cautiously before imposing such severe restrictions even in this limited fashion. While rejected by the *Third NPRM,* Motorola continues to believe that a technical summit involving all potential parties may be beneficial in narrowing any negative impact.

Motorola supports the proposals to identify additional spectrum alternatives to foster interoperability among users operating below 512 MHz but is concerned that the specific channels identified by the Commission are not immediately available on a nationwide basis due to incumbent users and adjacent channel conditions. In addition, the channels identified in the UHF band are 6.25 kHz wide channels which is inconsistent with the PSWAC recommendation for 12.5 kHz wide interoperability channels.

The difficulty of identifying clear VHF and UHF channels for interoperability highlights the importance of allocating some portion of the 138-144 MHz band for public safety. Not only could this band be used to establish new interoperability options, it would provide spectrum "green space" needed to help clear channels in other bands.

Turning to the 8.8 MHz of reserve spectrum, Motorola is not convinced that the FCC has the luxury to withhold any portion of the 24 MHz public safety allocation pending additional analysis on alternative licensing methods. Immediate spectrum relief is now needed for land mobile voice and data operations in major cities. Making the entire 24 MHz immediately available to public safety, including the 8.8 MHz reserve band, increases the possibility that users in all markets will be able to find channels that are unencumbered by existing television broadcast signals.

In summary, Motorola urges the FCC to take action to ensure that the entire 24 MHz of public safety spectrum in the 700 MHz band is available to that community as quickly as possible. Only in this way, can the American public begin to realize the promise of this allocation.

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COMMENTS OF MOTOROLA
THIRD NOTICE OF PROPOSED RULE MAKING

Motorola hereby responds to the FCC's Third Notice of Proposed Rule Making in the above-captioned proceeding.[1] The *Third NPRM* seeks comments on several ancillary issues surrounding the recent allocation of public safety spectrum at 746-806 MHz including: 1) coordinating the use of 8.8 MHz of spectrum now held in reserve, 2) promoting interoperability below 512 MHz, 3) preventing interference to global navigation satellite systems, and 4) assessing public safety Y-2K readiness.

Many of the remaining issues raised in this proceeding are more appropriately discussed by the user community. To that end, Motorola will limit its initial comments to a manufacturer's perspective on the potential interference to GPS and GLONASS satellite systems, the possibility for improving interoperability below 512 MHz, and the availability of the 8.8 MHz of reserved spectrum. As reflected in its pending petition for

reconsideration, Motorola supports FCC decisions that expedite public safety use of the new 746-806 MHz allocation to the fullest extent possible.[2]

I. The Emission Limitations Proposed to Protect Satellite Navigation Systems are Unnecessarily Stringent.

The proposal with the greatest potential to affect the near term use of the 746-806 MHz public safety band is the out-of-band emission restrictions intended to protect Global Orbiting Navigation Satellite System (GNSS) receivers.[3] In accordance with the recommendations of the FAA and the NTIA, the *Third NPRM* proposes to reduce second harmonic emissions of certain 746-806 MHz radios to unprecedented levels in order to provide protection to GNSS receivers. The proposed rule reads as follows:

> §90.553 **GNSS Protection**. In order to provide adequate protection to receivers of the Global Navigation Satellite System (GNSS) which will utilize the Radionavigation-Satellite Service (space to earth) band, mobile units must meet a minimum second harmonic suppression standard in the frequency range of 1559-1605 MHz of 90 dB down from the maximum effective radiated power of the carrier and handhelds and portable units must meet a minimum second harmonic suppression standard in the frequency range of 1559-1605 MHz of 80 dB down from the maximum effective radiated power of the carrier. This standard applies only to equipment operating in the frequency band 779.5-802.5 MHz.

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[1] *See First Report and Order and Third Notice of Proposed Rule Making*, WT Docket No. 96-86, FCC No. 98-191, released September 29, 1998, 63 Fed. Reg. 58685 (November 2, 1998) [*Hereinafter Third NPRM.*]

[2] *Motorola Petition for Reconsideration and Clarification,* WT Docket No. 96-86, filed December 2, 1998.

[3] *See Third NPRM* at ¶196. The GNSS embodies two existing satellite navigation systems; the Global Positioning Satellite (GPS) system operated and maintained by the United States and GLONASS which is operated and maintained by the Russian Federation. These two satellite systems utilize portions of the 1559-1610 MHz band allocated to the Aeronautical Radionavigation-Satellite Service (space to earth).

Recognizing the potential impact that these proposed standards would impose upon manufacturers, the *Third NPRM* seeks comment on the appropriateness of the assumptions used by the aeronautical community to develop these attenuation figures.[4] Further, the FCC attempts to limit the scope of this proposal by applying the stringent emission restrictions only to that portion of the public safety spectrum that would cause second harmonic emissions in the GNSS band.[5]

The FCC's concern on the impact of these proposals is warranted. The proposed limitations impose a significant challenge in the design of 700 MHz public safety radios. Currently, FCC rules require that out-of-band emissions be reduced to a level of -13 dBm.[6] To ensure compliance with more stringent European requirements, some of Motorola's two-way radio products are designed to reduce emissions to approximately -30 dBm. To achieve compliance with the proposed rules, Motorola will need to reduce emissions by an additional 20-40 dB. At this time, Motorola is unsure whether it can achieve this objective without imposing extreme additional costs on users.[7] To be very

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[4] *Third NPRM* at ¶199.

[5] *Id.*

[6] *See, e.g.,* Section 90.210 of the Commission's Rules.

[7] This is particularly true if the FCC adopts compliance methods that require measurement of "radiated" emissions as implied by the standards adopted by the aeronautical community. The emission restrictions supported by the NTIA and the FAA are based on 30 meter separation between the transmitting device and the GPS or GLONASS receiver. Measurements to show compliance with such standards require the use of a certified radiation range or R.F. anechoic chamber for portable devices and highly qualified personnel. In contrast, existing FCC rules for out-of-band emissions require measurement of "conducted" emissions that are most commonly done by connecting a spectrum analyzer to the output of the radio. While the proposed rules are unclear about measurement technique, it would appear that Appendix G and proposed Section 90.553 are attempting to relate this new proposed standard to the existing out-of-

clear, Motorola believes that the proposed emission standards will delay the manufacturing of compliant 700 MHz public safety radios and even have the potential to completely negate public safety's ability to utilize this band at any time in the near future.

Fortunately, the impact of these proposed standards can be minimized because, as recognized by the *Third NPRM*, only a small portion of the 700 MHz public safety allocation has a direct second harmonic relationship with the GNSS band.[8] Thus, it will not be possible for the vast majority of the 700 public safety radios to have any adverse effect on satellite-based navigation.

As allocated by the FCC, public safety will use two band segments; 764-776 MHz and 794-806 MHz. The first band holds no interference potential to GNSS because its second harmonic frequencies fall outside of the GNSS band entirely. Accordingly, radios operating in this band are not implicated in the proposed rule which instead limits its scope to "equipment operating in the frequency range of 779.5-802.5 MHz."[9]

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band emission requirements. This would imply the measurement of conducted emissions. Motorola strongly recommends that the FCC do this and avoid imposing huge costs on manufacturers to conduct radiated measurements.

[8] Out-of-band emissions that are not harmonically related to the fundamental carrier of the 700 MHz public safety transmitters do not pose interference threats to GNSS receivers. *See, e.g.,* RTCA Inc. Special Committee No. 159, Assessment of Radio Frequency Interference Relevant to the GNSS, Document No., RTCA/DO-235, January 27, 1997 at Section 8.2 [*hereinafter RTCA/DO-235*].

[9] *See* Proposed Rule Section 90.553. Even as currently drafted, the rule is inappropriately wide in its scope. The sub-band 779.5-794 MHz is not part of the public safety allocation yet is covered by the auspices of the proposed rule. Application of the proposed emission restrictions to this frequency band is premature and beyond the scope of this proceeding. Motorola urges the FCC to defer consideration of any new emission restrictions on non-public safety frequencies in the 746-806 MHz band until the service rules for those frequencies are specifically addressed.

Only a narrow portion of the second public safety sub-band (794-806 MHz) has a direct second harmonic relationship with frequencies used by GLONASS.[10] According to the *Third NPRM,* however, GLONASS "will use the 1598-1605 MHz portion of the Radionavigation-Satellite Service (space to earth) allocation at 1559-1610 MHz."[11] Thus, the only public safety frequencies with a direct second harmonic relationship to the GLONASS allocation fall between 799-802.5 MHz. As shown in Attachment A, that sub-band is assigned by the FCC for wideband public safety applications. Therefore, it is unnecessary to impose any additional out-of-band emission restrictions on any 746-806 MHz ***narrowband*** public safety equipment. The FCC must ensure that any new out-of-band emission standards should apply only to that portion of the public safety spectrum that could cause harmful second harmonic emissions to operational GNSS systems.

It is unclear to Motorola why GLONASS should require any additional interference protection. The entire premise of protecting GNSS receivers arises from the requirement that these systems will be available for precision approach and landings when used in aircraft. However, the RTCA report did not consider that GLONASS would be used by itself to perform Category I precision landings in the US but, rather, would only be used (at best) to augment GPS receivers for such critical applications.[12]

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[10] *See Third NPRM* at n.553 ("GPS will not be impacted by public safety systems operating in 794-806 MHz (TV Channels 68-69) portion of the band.")

[11] *Id.* at n. 514.

[12] *See RTCA/DO-235* at Section 2.2.4.

Thus, it is not clear why GLONASS should receive exorbitant protection from terrestrial public safety communications in the U.S.[13]

Motorola urges the FCC and the aeronautical community to devote equal attention to the other side of the interference issue and investigate whether better receivers may promote better spectrum sharing between the services. As shown in the attached Appendix, interference suppression technology for GNSS receivers already exists and offers impressive rejection capabilities of interfering signals -- between 30 - 60 dB of improvement for both wideband and narrowband signals. Thus, a potential alternative to onerous emission limits would be to outfit GNSS receivers that require greater protection, such as those use for precision aircraft landings, with this or similar technology.[14] This would avoid a "broad-brush" solution that would require all 700 MHz equipment to protect every class of GNSS receivers.

Given the costs imposed on public safety radio systems, the FCC must proceed cautiously before imposing such severe restrictions even in this limited fashion. Indeed, the Commission must adopt common sense regulations and fully consider all mitigating factors affecting the interference relationship between 700 MHz land mobile systems and the GNSS systems. While rejected by the *Third NPRM,* Motorola continues to believe

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[13] This question is particularly relevant considering that the emission restrictions are based on protecting GNSS receivers during a confluence of independent "worst-case" events that are extremely unlikely to ever occur. Appendix E of *RTCA/DO-235* contains a table of events that will need to occur simultaneously before RF interference can disrupt a precision landing. In the case of public safety, these scenarios are rendered even more unlikely given that GLONASS will not be used independently for precision landings.

[14] Certainly, not all GPS/GNSS applications are safety related that require such unprecedented levels of considerations.

that a technical summit involving all potential parties may be beneficial in narrowing the impact of any new significant emission limitations.

II. Motorola Supports the FCC's Efforts to Provide Additional Spectrum Below 512 MHz for Interoperability.

The *Third NPRM* builds upon the 700 MHz public safety allocation by proposing additional spectrum alternatives to foster interoperability among users operating below 512 MHz. Motorola commends the Commission for these proposals which are consistent with the recommendations of the PSWAC Interoperability Subcommittee.[15]

Motorola is concerned, however, that the specific channels identified by the Commission are not immediately available on a nationwide basis due to incumbent users and adjacent channel conditions. In addition, the channels identified in the UHF band (450-512 MHz) are 6.25 kHz wide channels which is inconsistent with the PSWAC recommendation that VHF/UHF interoperability channels bands be 12.5 kHz wide.[16]

Motorola recognizes that many of the FCC's recommendations for specific channel pairs for interoperability are consistent with the recommendations of the PSWAC interoperability subcommittee. Motorola questions, however, whether those recommendations are now dated due to the progress of the Refarming process. The need for such interoperability channels remains, however, and Motorola stands ready to work with the public safety community to identify channels that may be more appropriate.

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[15] *See PSWAC Final Report,* Appendix C: Interoperability Subcommittee Report at 68.
[16] *Id.* at 81.

The difficulty of identifying existing VHF and UHF interoperability channels due to the high level of incumbency elevates the importance of allocating some portion of the 138-144 MHz band for public safety.[17] Not only could this band be used to establish new interoperability options, it would provide spectrum "green space" for relocating existing users from other bands in order to clear new interoperability channels.[18] Therefore, Motorola suggests that the spectrum available in the 138-144 MHz band be allocated to public safety uses and that preliminary licensing of the band be restricted to either interoperability use or to systems relocating from other frequency bands to clear newly assigned interoperability channels.

In response to the Commission's request for comment on the "practicality of providers of public safety services acquiring small, inexpensive radios that are capable of communicating in the 138-144 MHz frequency band"[19], Motorola wishes to point out that it already manufactures small, inexpensive radios for the 150 MHz and 450 MHz bands, and sees no technical barriers to producing such radios for the 138 MHz band. However, public safety users typically demand feature rich radios with a high degree of durability. It will be a significant manufacturing challenge to incorporate the traditional set of features for

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[17] In accordance with the provisions of the Balanced Budget Act of 1997, the NTIA has identified approximately 20 MHz of spectrum for transfer to non-government uses including 3 MHz in the 138-144 MHz band.

[18] Some incumbent VHF and UHF public safety users may strongly prefer to relocate to the 138-144 MHz band because of propagation issues or better compatibility with their imbedded infrastructure.

[19] *Third NPRM* at ¶193.

new VHF public safety radios and achieve a price point of $100-$200 per radio as discussed by the FCC.[20]

III. The FCC Should Expedite the Availability of the 8.8 MHz Reserve Spectrum.

In the *Third NPRM*, the FCC is seeking comment on a number of issues regarding the use and licensing of the 2.6 MHz of interoperability and the use and licensing of the 8.8 MHz of reserve spectrum. The issues range from whether coordination should be managed by the existing Regional Planning Committees (RPCs), amended RPCs, or the States, to whether the Commission should hold the 8.8 MHz of spectrum in reserve for future uses.[21]

All of these issues, either directly or indirectly, can delay public safety access to the 700 MHz spectrum. Motorola is not convinced that the FCC has the luxury to withhold this spectrum pending additional analysis on alternative licensing methods. The recommendation of PSWAC's Spectrum Requirements subcommittee was quite clear that immediate spectrum relief was needed for land mobile voice and data operations in major cities. In the short-term, voice and data operations require 25 MHz of new public safety allocations. By the year 2010, an additional 70 MHz will be needed for these applications, plus image and video requirements, for a total of 95 MHz.[22]

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[20] This is particularly true if the FCC adopts its proposal to create 6.25 kHz wide interoperability channels.

[21] *Third NPRM* at ¶169.

[22] *See PSWAC Final Report,* Appendix D, Spectrum Requirements Subcommittee Report at 14.

The 24 MHz of spectrum allocated to public safety uses by this proceeding is a direct response to the PSWAC concern that 25 MHz of spectrum is needed in the short term. Since in many major markets, the availability of the 700 MHz allocation is compromised by incumbent broadcast facilities, the entire allocation should be made available immediately to maximize deployment opportunities during the DTV transition period. As is well known, there is no mandatory date at which the broadcast stations must relinquish their NTSC channel after the initiation of DTV broadcasting.[23] Making the entire 24 MHz immediately available to public safety, including that in the 8.8 MHz reserve band, increases the possibility that public safety users in all markets will be able to find channels that are unencumbered by existing television broadcast signals.

While Motorola chooses not, at this time, to comment on whether the interoperability spectrum should be licensed pursuant to the RPC process or by some other means, we wish to emphasize again that the Commission should expedite its decision making process. Consistent with Motorola's recommendations that the entire 700 MHz allocation be available to enhance deployment options, the Commission should commit to a schedule that would initiate licensing in the reserved band no later than

[23] While the Balanced Budget Act of 1997 specifies December 31, 2006, as the end of the DTV transition, it also allows incumbent broadcast licensees to retain their NTSC channel assignments if more than 15% of the households in a digital television service market are not capable of receiving the digital television transmissions. *See* 47 U.S.C. 309(j).

September of 1999 which is one year after the congressionally mandated deadline for the commencement of licensing in the 700 MHz band.[24]

Motorola holds similar concerns about the issue of whether the 8.8 MHz reserve band should contain the same channeling specifications as the remainder of the 24 MHz. This, too, has the potential "chilling effect" on product development for 700 MHz equipment. Motorola believes that it would eliminate many of the manufacturing economies of scale if the FCC were to fragment the public safety allocations into differing technical characteristics beyond the existing narrowband and wideband distinctions. Further fragmentation would result in artificially higher costs for public safety radios.

In summary, Motorola urges the FCC to take action to ensure that the entire 24 MHz of public safety spectrum in the 700 MHz band is available to that community as quickly as possible. This includes treating the reserve spectrum in the same manner as the general use spectrum in terms of licensing and bandplan characteristics and by expediting the resolution of any remaining licensing issues for the interoperability spectrum.

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[24] To this end, Motorola remains deeply concerned that some of the FCC's decisions and proposals in this proceeding will cause significant delays in public safety utilization of the 700 MHz band. *See, e.g.,* Motorola Petition for Reconsideration and Clarification.

IV. Conclusion

The public safety 700 MHz allocation promises great benefits to the American people. To realize its promise, the FCC must resolve the pending regulatory issues in a most expeditious fashion so that manufacturers and users can proceed with the task of deploying new systems to ease spectrum overcrowding and to promote more efficient interoperability communications.

Respectfully Submitted,

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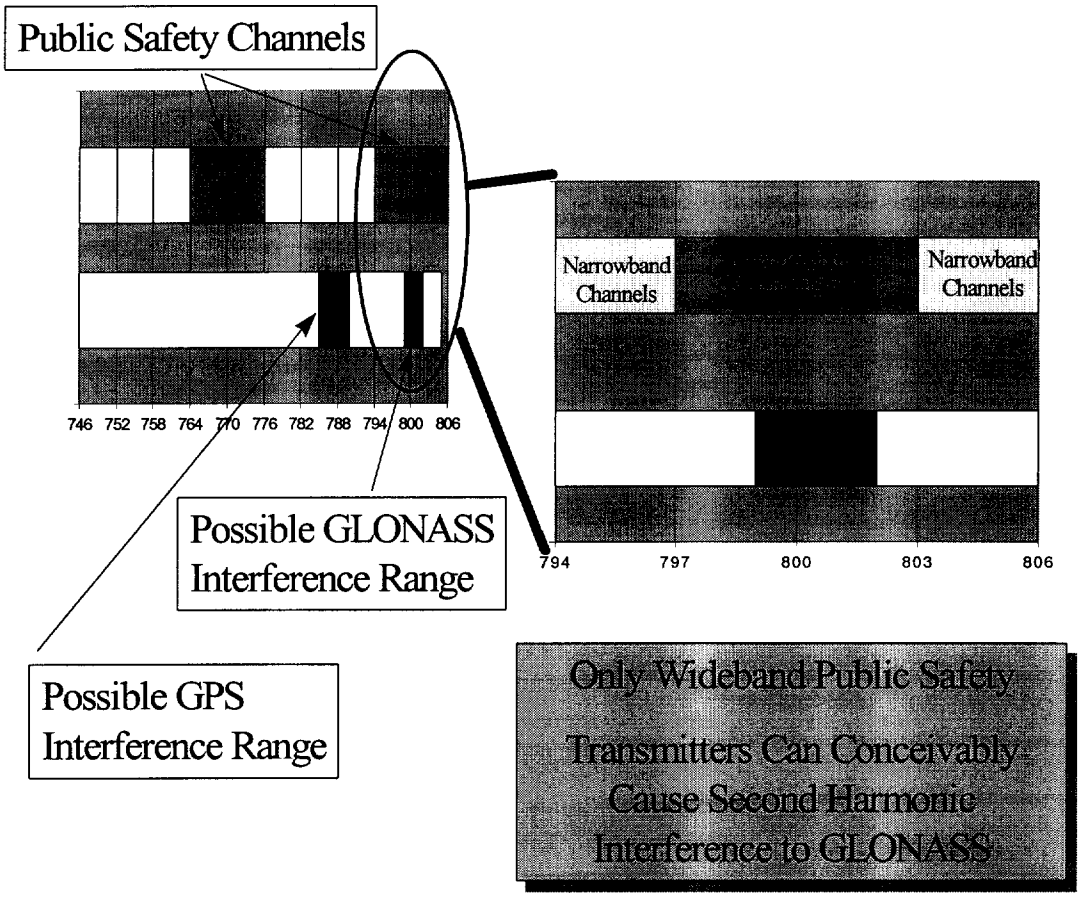
January 19, 1999

ATTACHMENT A

SPECTRUM RELATIONSHIP BETWEEN 746-806 MHz AND THE GNSS ALLOCATION

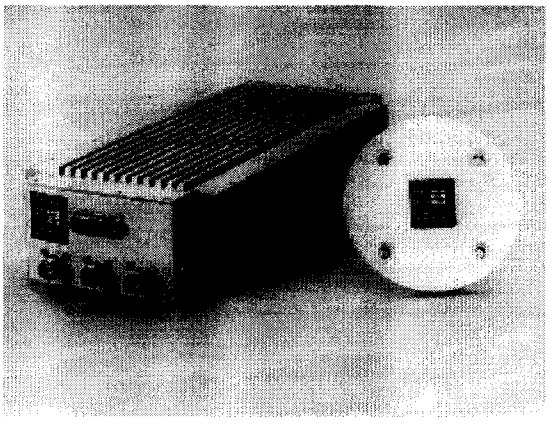


ATTACHMENT B
GNSS RECEIVER SUPPRESSION TECHNOLOGY

Global Positioning System (GPS) Interference Suppression Unit (ISU)

Electro-Radiation Inc., 39 Plymouth Street, Fairfield NJ 07004-1615
973-808-9033

Model No. ISU/LRU2000L1

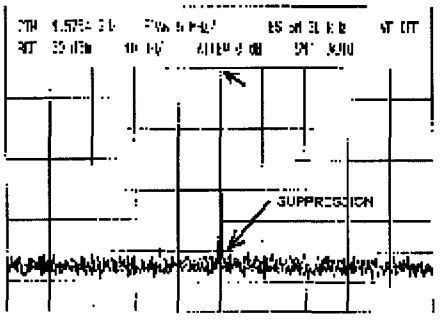


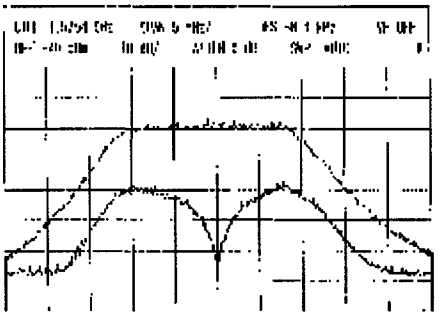
The Global Positioning System (GPS) provides precision navigation and position data essential for aircraft, surface ships, ground vehicles and hand held equipment. The dependence on GPS for precision data also raises the requirement of GPS signal availability. Interference either intentional or unintentional, reduces GPS availability. ERI's ISU was developed to address the national and international need to mitigate (anti-jam) narrow band and wide band interference.

Description

The ISU consists of a modified fixed reception pattern antenna (MFRPA) and an electronics unit (EU). The system provides suppression of interfering signals while allowing the GPS Signals to pass with minimal attenuation. The system is configured for C/A Code or P(y) Code as an option and with or without an external preamplifier.

Below: ISU test results against CW and Wide Band Gaussian Noise Interference





The ISU operates at RF enabling its use with any GPS receiver and can be easily retrofit into platforms which already have GPS receivers installed. ERI's ISU Model No. 2000L1 was specifically designed to replace the existing FRPA antenna and AE-4 electronics and, thus, greatly enhance GPS availability during electro magnetic interference. The ISU will typically provide 35dB and 45dB of interference suppression when subjected to additive white gaussian noise and CW, respectively. When closely coupled (ISU, GPS, and INS) with an inexpensive onboard INS, the overall system interference suppression capability can exceed 100dB.

The ISU uses a proprietary cancellation technique which does not utilize null steering or beam steering electronics. The system is configured to operate using only one antenna (operative). Extensive use of commercial-of-the-shelf (COTS) technology permits an affordable solution in today's environment. Circuit card (CCA) in SEM-E configuration and chip set version will be

available in the near future to achieve smaller size and lower costs needed for hand held and weapons applications.

System Characteristics

System Inputs

DC Power	+5VDC @ 800mA, ±15VDC @ 5mA 18-36 VDC or 115 VAC optional
Frequency Range	1575.42 ± 2.5 MHZ 1575.42 ± 10.2 MHZ (optional) 1227.6 ± 10.2 MHZ (optional)
Interference Dynamic Range	-100dBm to -50dBm @ 0dBi Antenna (-100dBm to -30 dBm, optional)
Interference Waveform	Tone (CW), Pulse (PRF > 500 KHZ, Duty Cycle 20-80%), AM (3-10 KHZ, 60% Modulation), FM (1-2 MHZ @ 10KHZ), AWGN (additive White Gaussian Noise)
Inhibit Function	ISU in standby

System Outputs

GPS Signal Gain	16 ± 3dB (30dB optional)
Noise Figure	< 6.0 dB (<3dB optional)
Frequency Range	1575.42 ± 2.5 MHz 1575.42 ± 10.2 MHz (optional) 1227.6 ± 10.2 MHz (optional) 173 MHz IF (optional)
Interference Suppression	> 35dB Tone (typically > 45dB) > 35 dB Pulse (typically >40dB) > 35 dB AM (typically >40dB) > 35 dB FM (typically >40dB) > 25 dB AWGN (typically >35dB)
Interference Detection	> - 105 dBM @ 0dBi Antenna

System Operation

Interference Signal Acquisition	500 msec typical (<250 msec optional)
Interference Signal Tracking	50 msec typical (<25 msec optional)
Antenna Gain Cancellation Technique	Proprietary - Patented -3dBi (± 60 from Zenith)

Physical Characteristics

Electronics	LRU (AE-4 Configuration, 9.5" x 4.4" x 2.3") CCA (36 sq. in. optional) Chip set (4 cu. in. optional)
Antenna	3 ½ Dia. x ¼ think (L1) FRPA configuration (L1 & L2, optional)
Weight	<6 lbs. (electronics) <3 oz. (Antenna)

Environmental

Cooling	Convection
Operating Temperature	-10° C to + 55° C
Storage Temperature	-25° C to + 90° C
Relative Humidity	90%, non condensing
Altitude	40,000 Feet (higher altitude, optional)
Random Vibration	0.008 g2 /Hz
Note	Extended environmental performance (optional)

Connectors

RF Electronics	TNC (Quantity of 3)
RF Preamp (optional)	SMA (TNC, optional)
Power & Control	9 Pin Male DE-9P (Quantity 1)

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