Teresa D. Baer
Direct Dial: +202.637.2226
teresa.baer@lw.com

555 Eleventh Street, N.W., Suite 1000
Washington, D.C. 20004-1304
Tel: (202) 637-2200 Fax: (202) 637-2201
www.lw.com

LATHAM & WATKINS LLP

FIRM / AFFILIATE OFFICES

Barcelona	New Jersey
Brussels	New York
Chicago	Northern Virginia
Frankfurt	Orange County
Hamburg	Paris
Hong Kong	San Diego
London	San Francisco
Los Angeles	Shanghai
Madrid	Silicon Valley
Milan	Singapore
Moscow	Tokyo
Munich	Washington, D.C.

February 22, 2007

VIA ELECTRONIC FILING

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: Investigation of the Spectrum Requirements for Advanced Medical Technologies, ET Docket No. 06-135, RM 11271, ET Docket No. 05-213, ET Docket No. 03-92

In the Matter of Boston Scientific Corporation, Petition for Waiver of Section 15.205 of the Commission's Rules, ET Docket No. 05-331

Ex Parte Presentation

Dear Ms. Dortch:

On February 21, 2007, representatives of Boston Scientific Corporation ("BSC") met with Chairman Martin and Fred Campbell to discuss the above-referenced proceedings. Specifically, Paul A. LaViolette (Chief Operating Officer), Brenda Becker (Senior Vice President, Global Government Affairs), Ron Reimann (Manager, Engineering Compliance) and Teresa D. Baer (outside counsel, Latham & Watkins LLP) attended the meeting on behalf of Boston Scientific. At the meeting, consistent with its filings in these proceedings, BSC urged the adoption of a rule authorizing the operation of cardiac implants in the 90-110 kHz band or, alternatively, the extension of the temporary waiver previously granted to BSC. Copies of the attached paper were distributed at the meeting

Please direct any questions to the undersigned.

Very truly yours,

Teresa D. Baer

Teresa D. Baer

Attachment

cc: Chairman Kevin J. Martin
Fred Campbell

LICENSING OF INDUCTIVE TELEMETRY DEVICES IN THE 90-110 KHZ FREQUENCY BAND

(ET Docket No. 06-135, RM-11271, ET Docket No. 05-213, ET Docket No. 03-92)

Implantable cardiac devices, such as pacemakers, defibrillators, and cardiac resynchronization therapy devices, deliver enormous public health benefits, and the Commission appropriately understands and has embraced medical use of electromagnetic-based telemetry systems in such devices. The Commission should continue on this path by licensing by rule implantable cardiac devices that emit low levels of radio frequency ("RF") energy in the 90-110 kHz band as a byproduct of inductive telemetry. Under the Commission's rules, the 90-110 kHz band is restricted to the Radionavigation Service ("LORAN-C") for Federal and non-Federal users.[1] However, there is simply no reason to prohibit the use of cardiac devices on a non-interfering basis. Indeed, in none of the Commission's rulemaking proceedings relating to medical devices has either the federal government or any other party objected to licensing the use of cardiac devices or other medical therapy implants at 90-110 kHz. In fact, commenters in this proceeding strongly support the use of medical devices that produce low-level radiation in this band.[2]

This paper provides an overview of the overwhelming public interest benefits of authorizing cardiac devices that use inductive telemetry in or across the 90-110 kHz frequency band, either by licensing such devices on a non-interfering basis or some other permanent

---

[1] 47 C.F.R. § 2.106. The term "LORAN" refers to LOng Range Aids to Navigation.

[2] *See e.g*, Partners Healthcare System, Inc., ET Docket No. 06-135, RM-11271, ET Docket No. 05-213, ET Docket No. 03-92 at 9 (filed Oct. 31, 2006). Partners Healthcare System, Inc. ("Partners") is a not-for-profit health care organization founded by Brigham and Women's Hospital and Massachusetts General Hospital.

means.[3] Additionally, the attached Technical Report demonstrates that the risk of interference from inductive telemetry devices into LORAN-C communications in the 90-110 kHz band is nonexistent.[4]

I. LICENSING INDUCTIVE TELEMETRY DEVICES IN THE 90-110 KHZ BAND WILL STRONGLY PROMOTE THE PUBLIC INTEREST

Implantable medical devices deliver critical, life-saving treatment options for a wide range of diseases and health conditions, offering benefits to hundreds of thousands of patients in the United States.[5] Such devices have produced important advances in therapeutic treatment options and improvements in the quality of life for patients suffering from debilitating medical conditions. The Commission has broadly acknowledged the need to allocate additional spectrum for medical devices and properly seeks to adapt its rules to accommodate the fast pace of development of newer and more sophisticated medical devices that use RF spectrum.[6] Additionally, commenters in this proceeding uniformly recognize the benefits of implantable devices that use RF technologies.[7]

---

[3] In the NPRM, the Commission sought comment on whether inductive telemetry operations should be licensed by rule or authorized under an exception to the restricted band spurious emission limits for unlicensed medical devices that use inductive coupling in the 90-110 kHz band. *Investigation of the Spectrum Requirements for Advanced Medical Technologies*, ET Docket No. 06-135, *Amendment of Parts 2 and 95 of the Commission's Rules to Establish the Medical Device Radio Communications Service at 401-402 and 405-406 MHz*, RM-11271, *DexCom, Inc. Request for Waiver of the Frequency Monitoring Requirements of the Medical Implant Communications Service Rules*, ET Docket No. 05-213, *Biotronic, Inc., Request for Waiver of the Frequency Monitoring Requirements for the Medical Implant Communications Service Rules*, ET Docket No. 03-92, Notice of Proposed Rulemaking Notice of Inquiry and Order, FCC 06-103 ¶ 34 (rel. July 18, 2006) ("NPRM"). As discussed further below, while licensing by rule appears to be the most straightforward option, permanent authorization by whatever means the Commission deems appropriate will advance the public interest. *See infra* § I.C.

[4] *See* Dr. J. Neil Birch, DEE, *Analysis of the Potential for Adverse Interference with LORAN-C From Implantable Medical Devices* (Feb. 21, 2007) ("Technical Report"), attached hereto.

[5] NPRM ¶ 1.

[6] *Id.* ¶ 2.

[7] *See e.g.*, Comments of Partners Healthcare System, Inc., ET Docket No. 06-135, RM-11271, ET Docket No. 05-213, ET Docket No. 03-92 at 2 (filed Oct. 31, 2006) (observing the increasing need to

By increasing flexibility in the spectrum available for use by implantable medical devices, the Commission would help ensure the availability of the broadest range of treatments that medical technology has to offer. The Commission should adopt a rule affording medical devices flexibility to emit low levels of RF energy on a non-interfering basis in the 90-110 kHz band. Cardiac devices using inductive telemetry offer life-saving benefits without any risks of harmful interference to or from LORAN-C communications. Granting clear, long-term authority for low-level emissions in this band will maintain the availability of a range of cardiac and other medical devices for the treatment of cardiovascular and other diseases and will promote the development of new medical devices that use inductive telemetry.

A. The Commission Properly Has Recognized the Need for Additional Spectrum for Medical Devices

In launching this proceeding, the Commission correctly recognized that "the pace and nature of development of newer, more capable, and more sophisticated devices may be inadequately accommodated by" the current rules governing wireless medical radiocommunication technologies.[8] As Commissioner McDowell stated, this proceeding seeks "to create an environment that fosters continuing improvements in medical devices through flexible spectrum allocations and minimum regulatory requirements."[9] Indeed, the Commission broadly recognized the need to expand spectrum available for use by medical devices by seeking

---

integrate wireless communications systems within medical devices); Dr. Richard Mellish, Medicines and Healthcare Products Regulatory Agency, United Kingdom, ET Docket No. 06-135 (filed Aug. 1, 2006) (supporting flexibility for cochlear implants, implanted pacemakers and other medical devices using short range inductive coupling); Comment of Biotronik, Inc., RM No. 11271 at 1-2 (filed Sept. 23, 2005) (describing benefits of cardiac implant devices); Comments of Medtronic, Inc., ET Docket No. 06-135, RM-11271 at 2-3 (filed Oct. 31, 2006) (describing new therapeutic and diagnostic capabilities of a wide range of implanted radio devices).

[8] NPRM ¶ 2.

[9] NPRM, Statement of Commissioner Robert M. McDowell.

comment on whether to open the 401-402 MHz and 405-406 MHz bands for medical devices, as well as the 90-110 kHz band.[10]

Any new rules that the Commission adopts in this proceeding must accommodate future generations of devices. The Commission appropriately sought information on evolving trends in medical radio devices, which is vital to identifying suitable additional spectrum for the operation of future devices.[11] As Commissioner Tate recognized, the Commission must ensure that it "properly facilitate[s] the promises of biomedical engineering in a manner that protects patients while still giving doctors and innovators the flexibility they need to continue to make even more stunning advances in the future."[12] The need for additional spectrum will continue to grow as physicians demand higher-speed delivery of increasing amounts of information from implanted devices. As the population of implant patients expands and other medical therapies rely on implantable devices, spectrum availability and interference among devices will become pressing regulatory concerns. Authorizing the use of medical implants at 90-110 kHz will advance all of these important objectives.

It will also be critical for the Commission to enhance collaborative efforts with the U.S. Food and Drug Administration ("FDA"). As the Commission proposes, the agencies should reach out to the medical device manufacturing and RF wireless technology industries regarding the compatibility and coexistence of medical radio devices in an RF environment.[13] As Chairman Martin noted, "[a]s demand for more advanced medical devices increases, [the Commission] should also be prepared to facilitate next-generation solutions and to work with the

---

[10] NPRM ¶¶ 20, 23, 34.

[11] *Id.* ¶¶ 2, 36-7.

[12] NPRM, Statement of Commissioner Deborah Taylor Tate.

[13] NPRM ¶¶ 4, 47.

Food and Drug Administration and other agencies that play a role in their evolution."[14] The Commission and the FDA presently work together concerning various aspects of medical radio device issues, including coordination of spectrum use and interference immunity issues.[15] Furthermore, the FDA has recognized that implantable wireless medical devices perform critical public health functions and that wireless technology will be a mainstay in the development of future medical devices. Accordingly, the FDA has issued draft guidance for device manufacturers regarding product design and the implementation of RF technology in medical devices.[16] With complementary safeguards in place from the Commission and the FDA, allowing medical devices to operate in the 90-110 kHz band will deliver enormous public health benefits without any countervailing harms.

B. Authorizing Use of Inductive Telemetry Devices at 90-110 kHz Will Deliver Critical Benefits to Cardiac Patients

Implantable cardiac devices have revolutionized medical care for patients with cardiovascular disease, which is the leading cause of death in the United States. These devices—including pacemakers, defibrillators, and cardiac resynchronization therapy devices—can save the lives of patients by delivering electrical stimuli to manage and resynchronize abnormal heart rhythms. Such devices have prolonged the lives of hundreds of thousands of Americans. And they are more critical today than ever: With the aging baby boomer population, the already-substantial use of implantable cardiac devices will continue to increase. Medical professionals can better control a patient's cardiac disease using implantable cardiac devices, reducing the

---

[14] NPRM, Statement of Kevin J. Martin.

[15] NPRM ¶ 46.

[16] *See generally*, Draft Guidance for Industry and FDA Staff, "Radio Frequency Wireless Technology in Medical Devices," FOOD AND DRUG ADMIN. (rel. Jan 3, 2007) (available at http://www.fda.gov/cdrh/osel/guidance/1618.pdf).

need for emergency care, and thereby reducing health care costs.[17] Therefore, cardiac patients and the public more generally will experience substantial benefits from the adoption of rules that increase the availability and the range of choices of cardiac devices.

Implanted medical devices rely on electromagnetic telemetry systems for monitoring and therapy changes. Certain implantable cardiac devices, including Boston Scientific's leading products, use inductive telemetry to communicate with heart monitoring equipment. A physician can monitor a patient's heart function by downloading from the implanted device information regarding a patient's cardiac events as well as the functioning of the device. Inductive telemetry has been a cost-effective solution for implantable devices because the low energy requirements of this technology preserve the battery energy and prolong the useful life of the device. While the newest generation of implantable cardiac devices use Ultra High Frequency ("UHF") RF communications for these critical aspects of their functionality, all devices still produce Low Frequency ("LF") emissions as a byproduct of their legacy inductive telemetry transmission.

Although inductive cardiac devices emit incidental signals in various bands, some implantable cardiac devices on the market today employ inductive telemetry that emits low-level RF energy in the range of 50-200 kHz, including the restricted 90-110 kHz frequencies. Approximately 600,000 people in the United States currently rely on these devices, with thousands more expected to use them in coming years.

---

[17] *See* NPRM, Statement of Commissioner Robert M. McDowell ("facilitating competition in the medical device market is particularly important given the ageing [sic] U.S. population . . . and the corresponding need for an increased number of our citizens to participate in more frequent health monitoring. I am hopeful that a proliferation of devices will lead to decreased health care prices and improved quality of care, while also allowing patients the ability to lead more independent lives.").

Inductive telemetry in the 90-110 kHz band has been incorporated into several cardiac device models. Authorizing their use in this band well into the future will enable continued use of cardiac device models that have a history of proven benefits. Therefore, licensing the use of such devices in the 90-110 kHz band will provide cardiac device manufacturers with a broader LF spectrum to develop higher bandwidth devices and support systems without avoiding this gap in the spectrum. As a result, patients and their physicians will be afforded maximum flexibility to choose the cardiac device best suited to their needs. When selecting the most appropriate course of treatment, cardiac patients and their physicians may take into account the various functionalities and price points of different cardiac devices, as well as other crucial factors. Ultimately, the selection of a cardiac implant should be a *medical* decision that is unaffected by the frequency band in which the device happens to emit RF energy, as long as the emissions produce no harmful interference—as is indisputably the case here.[18] Certain devices should not be precluded as an option merely due to the limitation in the frequency band in which the device emits ultra-low levels of RF energy.

C. Precluding Use of the 90-110 kHz Band by Cardiac and Other Medical Devices Would Be Detrimental to Patients and the Public Generally

The benefits to the public interest discussed above would not be realized if medical devices are precluded from emitting low levels of RF energy in the 90-110 kHz band. Furthermore, maintaining the restriction in this band would diminish treatment options and choices for patients at a time when a growing segment of the population would benefit from implantable devices and as new applications for such devices are proliferating. The inductive telemetry technology that emits in the 90-110 kHz band was developed based on a good-faith interpretation of the rules regarding incidental emissions from induction devices in the restricted

---

[18] *See infra* § I.D.

band. In the absence of a rule authorizing cardiac devices to emit low levels of RF energy in the 90-110 kHz band, however, leading cardiac device models could be phased out of use prematurely.

Curtailing use of such devices would needlessly remove an invaluable tool from cardiac physicians' arsenal and would diminish patient choices. A reduction in the treatment options available to cardiac patients could weaken market competition in cardiac devices, resulting in harm to public health. Unfortunately, device manufacturers cannot easily or quickly introduce into the marketplace alternative cardiac devices emitting in different bands due to a long product development cycle, rigorous testing, and the intensive approval process of the FDA, to which medical devices are subject.

The development of next-generation cardiac devices can cost into the hundreds of millions of dollars, and as the device technologies become more complex, design and testing can extend over a period of years, thus creating relatively long product cycles. Implantable medical devices undergo design and testing cycles that can last over five years. Any changes to products in the development stage can significantly delay completion of design and testing. These products are extremely complex and must meet extraordinary reliability standards. Each device contains a number of subsystems that must interact precisely and that are packaged into a remarkably small unit. After completion of testing to verify design reliability, the FDA must review and approve the device. FDA approval typically requires at least six months and can run considerably longer if the device implements new or novel design features. Due to the lengthy product development and testing cycle and the FDA approval process, device manufacturers require the certainty of a rule authorizing low-level emissions in the 90-110 kHz band. A limited waiver therefore is not sufficient to justify continued use of these inductive telemetry devices.

As a technical matter, cardiac device models cannot simply be redesigned to emit in alternative bands. Redesigning the inductive telemetry technology would subject device manufacturers to the high level of scrutiny to which novel designs are subject, as mentioned above, and would also necessitate changes to other systems within the device, potentially requiring redesign and retesting of those systems. Additionally, all of the external monitoring and support equipment used for patient care would need to be redesigned. Moreover, because the incidental induced emissions occur on a bandwidth wider than the 90-110 kHz band, unless the induced emissions are shifted significantly away from the restricted band, the signals from these devices cannot easily avoid the 90-110 kHz band. As a result, the restricted portion of the bandwidth into which these devices radiate RF impedes the continuing use of this inductive telemetry technology.

Licensing inductive cardiac devices emitting in the 90-110 kHz band would allow device manufacturers to bring such devices currently in the design and approval process to market and to ensure that such devices could remain available to patients in the long term. Further, permanent authority to emit low-power emissions in this band would enable medical device manufacturers to incorporate existing inductive telemetry technology into future product designs and use a broader spectrum of the LF band, thereby reducing costs and the time period it takes to bring these products to market. Thus, permitting incidental RF emissions from inductive telemetry devices in this band would expand the treatment alternatives available to cardiac patients and their physicians. Such a licensing rule is fully consistent with the Commission's goal in this proceeding "to better accommodate new medical devices *immediately* and *imminently* available."[19] Therefore, the Commission should take expedited action to adopt a rule

---

[19] NPRM ¶ 3 (emphasis added).

authorizing inductive telemetry devices in the 90-110 kHz band in order to ensure access to inductive telemetry devices that will enter the marketplace in the near future.

D. Licensing Inductive Telemetry Devices by Rule Poses No Threat of Harmful Interference or Any Other Costs

Based on their inherent characteristics, inductive telemetry devices pose no threat of causing harmful interference to LORAN-C receivers, for which the 90-110 kHz band is currently allocated.[20] The primary users of LORAN-C frequencies include the U.S. Coast Guard and non-federal aviation[21] and Private Land Mobile services.[22] In general, inductive telemetry inherently produces extremely low levels of byproduct RF emissions in various frequency bands. For instance, the field strength of the cardiac devices at issue is typically 50-70 dB below the Commission's power limit for spurious emissions in the 90-110 kHz band.[23] Emissions from the device are further attenuated by the device's titanium casing and the surrounding human tissue. Therefore, the physician's monitoring device must be located within close proximity (*e.g.*, within six inches) to inductively couple with the implanted device and to receive the low-power magnetic signal.

---

[20] The Department of Homeland Security and Department of Transportation have sought comment on the potential elimination of the LORAN-C Radionavigation System, as a result of new GPS services and other alternatives. *See Long Range Aids to Navigation (LORAN) Program; Office of Navigation and Spectrum Management*, Notice, 72 Fed. Reg. 796 (Jan. 8, 2007). If the LORAN-C program is decommissioned, there would plainly be no reason to exclude medical devices from operating at 90-110 kHz. But, in any event, cardiac devices can coexist with the LORAN-C service without any adverse effects, as the attached Technical Report by Dr. J. Neil Birch shows. Laboratory tests establish that the Boston Scientific implantable device and its programmer will not adversely affect the LORAN-C navigation accuracies for E field or H field equipped receivers. The inductively based implant transmission is simply too low to cause any adverse interference in the LORAN-C band given any reasonable use scenario.

[21] 47 C.F.R. Part 87.

[22] 47 C.F.R. Part 90.

[23] *See* 47 C.F.R. § 15.209; Technical Report at 11.

Additionally, inductive cardiac devices emit signals in the 90-110 kHz band only under very limited circumstances and for very short periods of time. The inductive signals generated by these cardiac devices can only be received from a distance of a few inches, and the communication function of these devices operates in controlled environments such as a hospital or doctor's office. By contrast, LORAN-C receivers operate on mobile air, land, and marine platforms, far from the vicinity of any medical office.[24] Older cardiac implants typically use inductive coupling to communicate with a monitoring device for a total of only a few minutes a year. Newer generations of cardiac devices with UHF telemetry subsystems only use inductive coupling to *initiate* a communications session, and thus will operate for even shorter periods of time—approximately two seconds per device per year.

The history of inductive telemetry devices confirms that they pose no threat of harmful interference to licensed users of adjacent spectrum bands or to unlicensed devices. There have been no reported instances of interference from cardiac devices into LORAN-C receivers. Neither the Coast Guard, which operates LORAN-C receivers, nor any of the commenters in this proceeding, opposes the use of inductive telemetry devices at low power levels in the 90-110 kHz band. Moreover, in related proceedings, the National Telecommunications and Information Administration ("NTIA") has made clear that it does not object to the use of inductive devices that emit in the 90-110 kHz band.[25] In fact, comments in this proceeding fully support the authorization of low-level radiation in this band.[26]

---

[24] *See* Technical Report at 7-8.

[25] *See* Boston Scientific Corporation, Petition for a Limited Waiver of Section 15.205 of the Commission's Rules, ET Docket No. 05-331 at 11, n.18 (filed June 6, 2006).

[26] *See e.g.,* Partners Healthcare System, Inc., ET Docket No. 06-135, RM-11271, ET Docket No. 05-213, ET Docket No. 03-92 at 9 (filed Oct. 31, 2006).

Furthermore, there are no identifiable risks of interference to implantable devices from LORAN-C operations. Implantable medical devices are designed to tolerate electromagnetic interference, and there is no realistic prospect that LORAN-C transmitters (or any other 90-110 kHz spectrum usage) could interfere with the proper functioning of cardiac implants. Typically, an external cardiac monitoring device (*e.g.*, a "programmer") queries the implanted device using an induced signal before a communications session is initiated. The implanted device must receive the appropriate "keying pattern" in the initiating signal before responding to any communication signals. The keying pattern establishes a "handshake" between the implanted device and the programmer. The initiation handshake is important to assure the security of patient information, and transmissions between the device and the programmer must be within six inches to guarantee that the responding implant is the intended target of the communications. Additionally, the keying patterns required to initiate communications with a cardiac device are much more complex than LORAN-C timing signals. Therefore, impulses from a LORAN-C transmitter could not inadvertently trigger a communications session with a cardiac implant device.

As a result of these factors, there has never been a reported instance in which an implanted cardiac device experienced interference from a LORAN-C signal. These devices have been used for years to provide effective medical treatment without any adverse implications for the LORAN-C service. The general exclusion of cardiac devices from the 90-110 kHz band is wholly unnecessary due to the ability of these devices to operate without interference to primary LORAN-C users. There are no harms to weigh against the public interest benefits in connection with secondary use of the LORAN-C band by inductive cardiac devices. Therefore, authorizing

inductive telemetry devices to operate in the 90-110 kHz band on a secondary basis unquestionably promotes the public interest.

II. LICENSING INDUCTIVE TELEMETRY DEVICES IN THE 90-110 KHZ BAND ENJOYS STRONG SUPPORT FROM THE COMMISSION'S SPECTRUM POLICY

Authorizing inductive telemetry devices in the 90-110 kHz band would advance the Commission's overarching policy of promoting greater spectrum sharing and flexibility. In this proceeding, the Commission recognizes the need to open more bandwidth for medical devices and proposes to authorize the use of low-power, low duty-cycle devices in the Medical Device Radiocommunication Service ("MedRadio") frequencies of 401-402 MHz and 405-406 MHz ("wing bands").[27] Adoption of a similar rule for inductive telemetry devices in the 90-110 kHz band would be consistent with the MedRadio proposal and would further the Commission's spectrum policy goals. Allowing non-interfering services to share spectrum with existing uses would help satisfy the growing demand for RF spectrum suitable for implantable devices. As demonstrated herein, inductive telemetry devices can coexist in this band with the primary users without any interference concerns. Thus, authorizing these devices on a secondary basis in the LORAN-C band will promote efficient use of the spectrum and maximize the benefits from this spectrum resource.

A. The Commission's Promotion of Spectrum Sharing and Flexible Use Supports Secondary Use of Medical Devices in the 90-110 kHz Band

Authorizing use of medical devices in the 90-110 kHz band would directly advance the Commission's interest in promoting increased sharing of spectrum and more flexible allocations. In recent years, the Commission has abandoned the rigid allocations of spectrum

---

[27] NPRM ¶ 20.

that it adopted under the command-and-control model. Instead, the Commission has embraced more flexible allocations and encouraged spectrum sharing to promote greater efficiency. As Chairman Martin has explained, "promoting spectrum sharing is a fundamental part of encouraging efficient spectrum usage" and "is a crucial means to get more mileage out of this important resource."[28] Indeed, the Commission has made spectrum sharing and increased flexibility more generally overarching principles in its spectrum-related proceedings.[29] While recognizing the importance of protecting existing services from interference, the Commission seeks to maximize the potential benefits of radio communications by allowing secondary uses of spectrum, both licensed and unlicensed.[30]

The Commission has added allocations or approved new uses of spectrum where it found that services have the capability to coexist without harmful interference. In recent years, the Commission has adopted and proposed rules for shared use of spectrum in a variety of communications services that expand the uses of bands beyond historical allocations.[31] The

---

[28] Separate Statement of Commissioner Kevin J. Martin, *Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies; Authorization and Use of Software Defined Radios* (ET Docket Nos. 00-47, 03-108), Notice of Proposed Rulemaking and Order, FCC 03-322 (rel. Dec. 30, 2003); *see also* U.S. Spectrum Policy: Convergence or Co-Existence?, Remarks by Kevin J. Martin to the FCBA Policy Summit & CLE (Mar. 5, 2002).

[29] *See, e.g., Spectrum Policy Task Force Report,* ET Docket No. 02-135, at 16 (Nov. 2002) (calling for "grant[ing] both licensed and unlicensed device operators the maximum possible autonomy to determine the highest valued use of their spectrum, subject only to those rules that are necessary to afford reasonable opportunities for access by other spectrum users and to prevent or limit interference among multiple spectrum users"); *see also*, Letter from Kevin J. Martin, Chairman, FCC, to the Honorable John D. Dingell, Chairman, Committee on Energy and Commerce, and the Honorable Edward J. Markey, Chairman, Subcommittee on Telecommunications and the Internet, Committee on Energy and Commerce 10-12 (Feb. 7, 2007) (regarding response to pre-hearing question relating to the Commission's spectrum management policies).

[30] *See, e.g., Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies; Authorization and Use of Software Defined Radios,* Report and Order, 20 FCC Rcd 5486 ¶ 18 (2005).

[31] *See e.g., Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Notice of Proposed

Commission has recognized that different uses of spectrum can coexist on the same frequencies, either through advances in technology, or because the nature of the use and the characteristics of the signals are such that users can adequately manage any interference potential.

That precedent and the Commission's spectrum sharing principles provide strong support for licensing low-power, low-duty-cycle medical devices to operate on a secondary, non-interfering basis at 90-110 kHz. In the case of inductive telemetry devices in the 90-110 kHz band, as demonstrated above, there is no potential for harmful interference due to the nature of LORAN-C and inductive telemetry signals and operations. Therefore, the Commission would continue on its path of advancing flexible and efficient spectrum usage by adopting this proposed secondary use of the 90-110 kHz band.

In addition to the public benefits cited above, opening the LORAN-C band to low-power inductive devices would diminish congestion in other bands currently available for medical devices, such as the 900 MHz band. Authorizing new uses of the 90-110 kHz band will encourage the development of new technologies that will allow the realization of increased potential benefits of the spectrum. The Commission's goal in the MedRadio proceeding is "to create an environment that fosters continuing advances in medical devices through flexible RF spectrum allocations with the minimum FCC regulatory requirements that are necessary for

---

Rulemaking, 20 FCC Rcd 2906 ¶¶ 1-2 (2005) (proposing to allow mobile operations in the fixed satellite service bands to promote more efficient use of the spectrum to meet growing demand for broadband communications); *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Report and Order, 18 FC Rcd 1962 ¶¶ 1-2 (2003) (permitting flexibility to use spectrum allocated to mobile satellite service to integrate ancillary terrestrial components, thus "balancing the traditional goals of effective and efficient use of spectrum with preserving the optimal amount of spectrum from the provision of international satellite services"); *Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, First Report and Order, 17 FCC Rcd 7435 ¶ 1 (2002) ("UWB devices can operate using spectrum occupied by existing radio services without causing interference, thereby permitting scarce spectrum resources to be used more efficiently").

efficient use of the spectrum and to ensure patient safety."[32] Commenters in this proceeding broadly recognize the value in promoting increased flexibility.[33] As Biotronik notes, for example, "[b]y permitting flexible but non-interfering spectrum use . . . the Commission would let the medical device manufacturers decide which technology or technologies are better suited for their devices and give them the flexibility they need to design a variety of devices that meet important medical and therapeutic needs."[34] Thus, in keeping with the Commission's spectrum sharing policy, the Commission should eliminate the exclusive allocation of the 90-110 kHz band for LORAN-C services, which was adopted under an obsolete model of spectrum allocation.

B. Allowing Secondary Use of the 90-110 kHz Band by Inductive Cardiac Devices Is Consistent With the Commission's Proposal to Expand MedRadio Bands in This Proceeding

In launching the MedRadio proceeding, the Commission recognized the high demand for medical devices that rely on radiocommunications.[35] To address these growing needs, the Commission in this proceeding proposes to allow low-power, low-duty-cycle operations by medical implants and body-worn devices in the MedRadio wing bands (401-402 MHz and 405-406 MHz). In that context, the Commission proposes to authorize such non-interfering uses by rule on a secondary basis. Just as allowing operation subject to reasonable

---

[32] NPRM ¶ 4.

[33] *See e.g.*, Reply Comments of Intel Corporation, RM-11271 at 4 (filed Oct. 11, 2005) (supporting MEDS radio allocation in spectrum currently designated for meteorological weather balloons); Comments of Dr. Richard Mellish, Medicines and Healthcare Products Regulatory Agency, United Kingdom, ET Docket No. 06-135 (filed Aug. 1, 2006) (commenting that implanted devices using short range inductive coupling should be permitted to operate in any band and with any bandwidth suitable for intended medical purposes, subject only to limits for incidental emissions); Comment of Biotronik, Inc., RM No. 11271 at 1, 3 (filed Sept. 23, 2005) (supporting the authorization of "a wider range of devices that may operate on MICS frequencies").

[34] Comments of Biotronik, Inc. ET Docket No. 06-135, RM-11271, ET Docket No. 05-213, ET Docket No. 03-92 at 4 (filed Oct. 31, 2006).

[35] NPRM ¶ 1.

power and duty-cycle limits in those bands would "reflect a reasonable balance between the operational capabilities needed for devices to function properly and the need to minimize the risk of interference to other devices in the band,"[36] so too would such usage at 90-110 kHz promote the Commission's goals.

Today, there are numerous medical devices using frequencies available for licensing under Part 95, as well as on an unlicensed basis under Part 15 (including the 900 MHz frequencies). In addition to opening the MedRadio frequencies for medical devices, opening the 90-110 kHz band for secondary licensing of such devices would be appropriately responsive to the increasing use of spectrum by health practitioners and would help diminish congestion in other bands as the use of medical devices continues to grow. Further, inductive cardiac devices have proven capable of sharing these frequencies with LORAN-C services with no ill effects. Because the risk of interference with LORAN-C devices is nonexistent as a practical matter, and hundreds of thousands of patients already rely on implants that emit at 90-110 kHz, the case for permitting the use of implants at 90-110 kHz is considerably *stronger* than the proposal regarding the MedRadio wing bands.

III. CONCLUSION

The Commission should move promptly to authorize the use of inductive cardiac devices in the 90-110 kHz on a long-term basis. Neither the federal government nor any other party has objected to licensing the use of cardiac devices or other implants in these frequencies. Granting permanent authorization for induced emissions in the band will provide flexibility in treatment options for cardiac patients without posing a risk of harmful interference to LORAN-C services. The selection of a cardiac implant should be a medical decision that is unaffected by

---

[36] *Id.* ¶ 25.

the frequency band in which the implant happens to emit ultra-low levels of RF energy. Adopting the proposed secondary use of the LORAN-C band is consistent with the Commission's aims in the MedRadio proceeding and would advance the Commission's overarching policy goals of greater spectrum sharing and flexibility. In light of the substantial benefits and the complete absence of countervailing harm, the public interest overwhelmingly favors licensing inductive telemetry devices by rule or by authorizing such use through other long-term means.

ANALYSIS OF THE POTENTIAL FOR ADVERSE INTERFERENCE WITH LORAN-C FROM IMPLANTABLE MEDICAL DEVICES

Dr. J. Neil Birch, DEE

February 21, 2007

I. Introduction

This report assesses the potential for adverse interference effects on LORAN-C navigation performance from an inductive telemetry system used by implantable medical devices. As examples, this report considers implants from Boston Scientific Corporation that operate within the body to monitor heart functions and treat arrhythmias, as well as an external programmer device used to interrogate and retrieve information from the implanted device.

Technical analysis provided herein demonstrates that the inductive telemetry system in implantable devices will not interfere with the LORAN-C system. Independently-directed laboratory measurements of Boston Scientific devices also demonstrate that the in-band electric field emissions from an implantable device are significantly below the in-band spurious emissions produced by the programmer and will not affect LORAN-C performance. The actual implant signal levels are presented in this report. Because the Commission has approved the use of the programmer as meeting its spurious in-band specification and the implant in-band signals are far below the in-band spurious levels from the programmer, and since the implant and programmer are used in a time division duplex manner and in close proximity, it follows that the use of the implant will not cause any adverse effects.

This report concludes that inductive telemetry systems within the implantable medical devices in question will not affect the LORAN-C system, which operates at 90-110 kHz.

II. Expert Qualifications

I am J. Neil Birch and I reside at 8831 Mustang Island Circle, Naples, FL 34113. I have a Doctorate in Electrical Engineering from the Catholic University of America (1965) and was selected in 1986 to be a Fellow of the Institute of Electronic and Electrical Engineers for Contributions to Military Communications. My complete resume is attached to this document in Exhibit C.

My association with LORAN-C dates back to 1967 when I joined the Magnavox Co. in their Washington, D.C. facilities. Magnavox proposed to the U.S. Navy a scheme by which binary encrypted data would be imposed on LORAN-C pulses to affect a one-way (simplex) communication link to vessels within the LORAN-C coverage areas. The data was to be imposed by phase shifting LORAN-C pulses $\pm$ 45 degrees. My principal task was to assess the effects of atmospheric noise on the data transmission. Magnavox was able to demonstrate that its approach did not degrade the navigation performance of LORAN-C. The data transmission technique works as a result of the sampling and averaging process within the LORAN-C receiver. That is, random low-level phase perturbations around the zero crossing designated for sampling are averaged out. This early proposal by Magnavox is similar to the two-pulse communication mode found in LORAN-C.

Shortly after arriving at Magnavox I established their Advanced Systems Analysis Office, where I conducted research on the effects of continuous wave (CW) interference on a variety of digital modulation techniques such as amplitude shift keying, binary phase shift keying, quadri-phase shift keying and continuous phase binary frequency modulation. I was able to show that low-level CW interference 20 dB below the desired signal power levels, with Gaussian noise,

had minimal effect on the error probabilities, e.g. .5 dB. Furthermore, at -30 dB, there were no discernable adverse effects.

I joined the U.S. Navy, Chief of Naval Operations in 1973, at the Pentagon, as Chief Scientist for Naval Communications and Command and Control. LORAN-C and other navigation systems were within my technical oversight. In 1975, I became the Chief Scientist for the office of the Secretary of Defense (Telecommunications) and subsequently, the Deputy Assistant Secretary of Defense for Command Control, Communications and Intelligence (C^3I.) As such, I was responsible for the well-being of LORAN-C and new navigation programs such as the Global Positioning Satellite System. Subsequent to the Deputy Assistant Secretary of Defense position in the Pentagon, I formed my own company in 1979. As part of my consulting activities for U.S. Industry I researched the effect of jamming on GPS and recommended solutions.

III. The LORAN-C Signal

The LORAN-C system employs a large number of groups of antennae to propagate LORAN-C pulses so that a receiver can measure the time difference of arrival of at least three of the pulses from a group of antennas (stations) to obtain a position fix. One of the stations within a grouping of stations serves as the master station. There are also two or more secondary stations within a group of stations used to obtain a position fix.

The latitude and longitude of the station are precisely known and individual groups of stations are identified via the phase coding of designated LORAN-C pulses. The master station is identified through a particular phase coding of LORAN-C pulses and has a distinctive arrangement of eight pulses within each transmission cycle. The master station's transmission is followed by the time ordered non-overlapping transmissions from the secondary station, each transmission consisting of eight LORAN-C pulses. A transmission cycle is complete when the master station and all secondary stations have transmitted and the master station begins to transmit again.

By observing the time of arrival of the master signal followed by a similar observation of the arrival of the secondary signals, a LORAN-C receiver can compute the location of the receiving equipment and display it in latitude and longitude.

The LORAN-C pulse is precisely time generated so that a designated zero crossing of the 100 kHz carrier within the pulse envelope can serve as the time measurement point (sampling point) for subsequent time difference of arrival observations and calculations. The ideal LORAN-C radio frequency pulse is shown below in Figure 1.

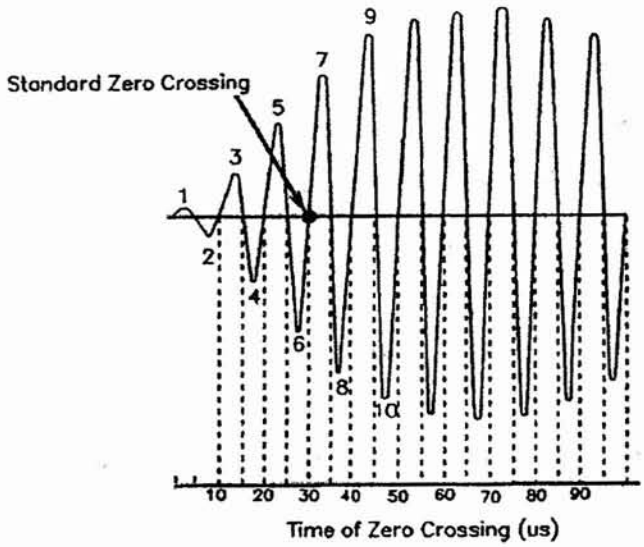


Figure 1 – LORAN-C Signal (Source: COMDINST 16562.4A p. 2-5)

The LORAN-C pulse is described mathematically as

$$i(t) = 0\ ;\ \text{for } t < \tau$$

$$i(t) = A(t-\tau)^2 \exp\left[\frac{-2(t-\tau)}{65}\right] \ \text{SIN}\,(0.2\pi t + PC)\ ;\ \text{for } \tau \le t \le 65 + \tau$$

where:
A is a normalization constant related to the magnitude of the peak antenna current in amperes.
t is time measured in microseconds.
tau is the envelope-to-cycle difference (ECD) in microseconds. The range is $-5 \le \text{tau} \le +5$ usec.
PC is the phase-code parameter (in radians) which is 0 for positive phase code and pi for negative phase code.

Source: COMDINST 16562.4A

The LORAN-C pulses can be sampled and averaged over many pulses to reduce the time jitter resulting from ambient noise and other sources of interference. The LORAN-C pulse shape is designed to ensure that 99% of the power is contained in the 90-110 kHz band. Typical peak

power levels for LORAN-C pulse depend on station capabilities and are a few hundred kilowatts to over 1 mega watt.

LORAN-C coverage is described for each group of stations by means of contours which indicate locations around the group of stations where position accuracies of 500', 1000' and 1500' can be anticipated. LORAN-C receivers are designed to acquire and track a master station when the received signal to noise ratios is 0 dB to -10 dB. This is accomplished by averaging over many pulses, and a maximum acquisition time should be equal to or less than 7.5 minutes at the lowest SNR values.

The range of LORAN-C signal levels anticipated at a LORAN-C receiving site is expected to be 17.8 microvolt/meter to 316 millivolt/meter, or 25dB microvolt/meter to 110dB microvolt/meter above a 1 microvolt/meter reference.

A limiting factor to LORAN-C coverage is the ambient noise levels present at a LORAN-C receiving site. The well-known CCIR-322 report and other sources provide us with a range of expected noise levels that vary diurnally, over the year and with latitude. These noise levels are generally measured in a one kHz band and presented as xxdB above one microvolt/meter. The published noise levels for typical LORAN-C coverage contours varies from 43 to 58 dB microvolts/meter depending on location. The lower latitudes generally experience the higher noise levels resulting from frequent and intense thunderstorms.

Annual noise level variation can be 20 dB, again depending on the time of day and latitude. Again, any in-band interference should be kept well below the minimum expected ambient noise levels so as not to decrease the LORAN-C coverage.

IV. Inductive Telemetry Systems in Implantable Devices

It is my understanding that inductive telemetry circuits in implantable devices are designed to magnetically couple with an external, non-implanted coil that is attached to an external monitoring device, such as a programmer. The telemetry system in an implantable device consists of a circuit that drives a low current through a small inductive coil that is a few centimeters in diameter and is encased in the titanium housing of the implanted device. The inductive system is typically designed to operate using very low power levels so as to limit the drain on the battery in the implanted device.

It is also my understanding that the telemetry system is in use only when interrogated by the external device such as a programmer, and then for only a short period of time.[1] These interrogations are very infrequent, e.g. days and or months apart, thus resulting in an extremely low duty factor transmission from any given implant.

Furthermore, it is my understanding that the combination of the programmer and an implantable device employ inductively coupled magnetic loops which are in close proximity, e.g. < 20 cm, during the interrogation/data retrieval cycle. The programmer/implanted device combination will typically be employed by a physician or a highly trained medical technician such as a physician's assistant.

The close proximity to an external device and the need for trained personnel necessary to operate the system severely restrict, in my opinion, the use scenarios for this medical instrumentation. For example, the programmer/device combination could be used in a medical land-based mobile van facility, or perhaps on board a large vessel with medical facilities. In

---

[1] The programmer/implant combination operates in a time division duplex mode or "ping-pong" mode. The programmer interrogates for a short period of time followed by the implant's transmission. The typical interrogate response cycle time is about 150 bytes every 100 milliseconds.

either case, the device combination would be remote from and shielded from any LORAN-C receiving antenna where any significant fields from the implant could be of concern. Perhaps a large VIP aircraft is another option – however, the LORAN-C antenna would be external to the aircraft, remote from and shielded from any conceivable on-board medical facility.

Boston Scientific has informed me that its programmer, which utilizes interrogation/programming transmissions outside the 90-110 kHz LORAN-C band, has been approved by the Commission since spurious emissions in the 90-110 kHz band from the programmer are below the prescribed limits. Thus, the remaining technical issue is whether or not the transmission within the LORAN-C band from an implanted device can possibly degrade the navigation performance of the LORAN-C signal given realistic use scenarios of the implant. It is shown in this report that there is no possibility of this happening.

V. Analysis

I understand that a medical device inductive telemetry signal is generated by passing a modulated current through a small coil associated with the implant. Since the coil represents an inductive or magnetic antenna, the fields about a magnetic loop antenna can be shown to have the following form:

$$\vec{E}(r) = \hat{\phi}\left(\frac{\mu_r \mu_0 m f_{carrier}}{2r^2}\right)[\beta r - j]Sin(\theta)e^{-j\beta r} \quad \text{V/m}$$

$$\vec{H}(r) = \left(\frac{m}{4\pi r^3}\right)e^{-j\beta r}\left\{\hat{\theta}\left[1 + j(\beta r) - (\beta r)^2\right]Sin(\theta) + \hat{r}2[1 + j(\beta r)]Cos(\theta)\right\} \quad \text{A/m}$$

The wave number $\beta = \frac{2\pi}{\lambda} = 2\pi f_{carrier}\sqrt{\mu_r \mu_0 \varepsilon_r \varepsilon_0}$ radians/m, where μ_r and ε_r are the relative permeability and permittivity respectively; the permeability of free space $\mu_0 = 4\pi x 10^{-7}$ H/m; $\varepsilon_0 = 8.85x10^{-12}$ F/m is the permittivity of free space; $f_{carrier}$ is the modulation carrier frequency, and

λ is the wavelength in the propagating medium. The spherical coordinate system referenced by the unit vectorsϕ, θ and r is illustrated in Figure 2.

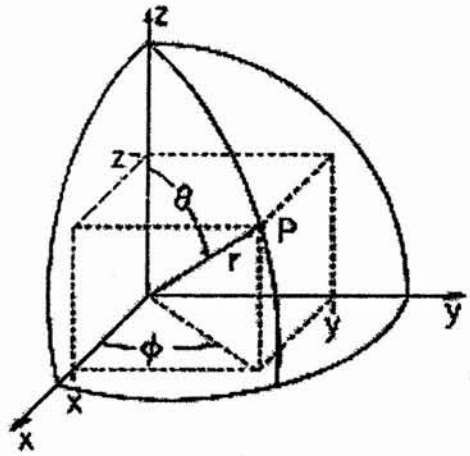


Fig. 2 Spherical coordinate system used for field equations

For a single turn loop of radius R, the dipole moment is defined as m=IA where I is the AC current flowing at frequency $f_{carrier}$ and A is the cross sectional area of the circular loop, or πR^2. In more general terms, it can be shown for an antenna circumferences less than ~1/5 of a wavelength (or about ½ Km for 100 kHz in air), A can be replaced with the actual cross sectional area of the magnetic field antenna, whether it is a perfect circle or not. This is typically the case for the small implantable devices.

Unlike the LORAN-C's transverse electromagnetic wave, in the far field, where a vertical electric (E) fields and horizontal magnetic (H) fields are present, the equations above for the small implant coil is an H field in the near field, and is a non-propagating closed inductive H field.

An implanted device's telemetry link performance is typically quantified as axial distance normal to its housing surface — therefore θ is at or near 0 degrees and the E_ϕ & H_θ field

components go to zero. Under this assumption, the RF field magnitude reduces to only the axial field component:

$$H_r = \left(\frac{m}{2\pi r^3}\right)\sqrt{1+(\beta r)^2} \text{ A/m} \approx \left(\frac{m}{2\pi r^3}\right) \text{ A/m for small values of } (\beta r)$$

Note this is not the typical transverse (TEM) wave found in the far field of LORAN-C, e.g. there is no orthogonal electric and magnetic field perpendicular to its propagation direction. In general this near field is best described as a non-propagating or "static" induction field set up by the current flowing in the small implant antenna coil.

In sum, for any reasonable use scenario, the likelihood that the implant would induce unacceptable signal levels in a LORAN-C E-field antenna is very remote for any reasonable distance from the implant, e.g. > 1 meter. The magnetic inductive field decreases rapidly with distance from the implant (see Figure 3), and while the field can be detected by the programmer in close proximity to the implant, the rapid decrease in the H field with added distance mitigates against inducing signals into even H field sensors not near the implant, as shown in later in the report. For any reasonable distance from the implant, e.g. > 1 meter, emissions from the implant are virtually undetectable. In other words, for any reasonable use scenario, the implant will not induce unacceptable signal levels in a LORAN-C E-field antenna.

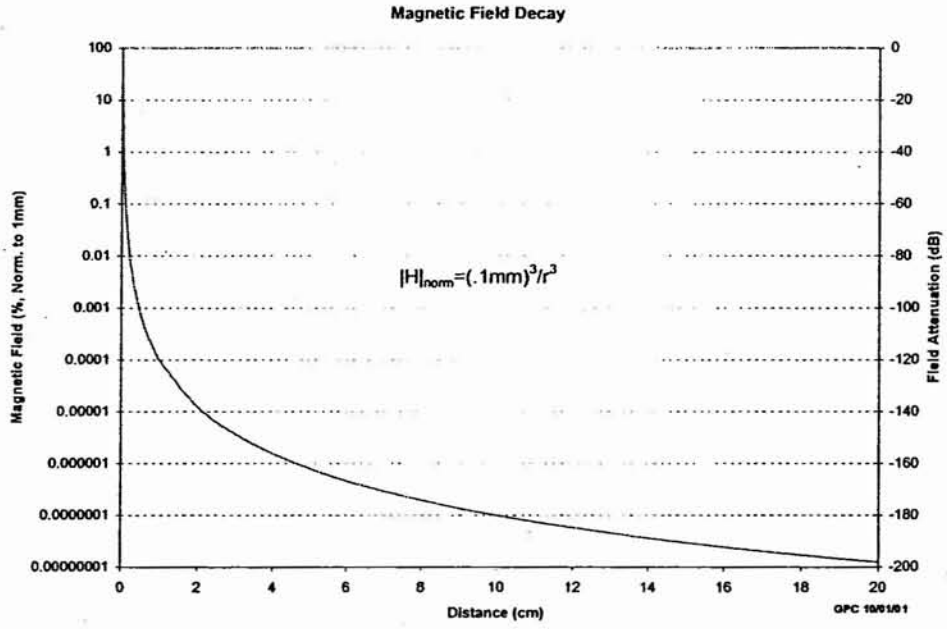


Figure 3 – Magnetic (H) Field relative propagation loss in air

Comparison of actual emissions from implanted devices to the ambient noise in the 90-110 kHz band yields a similar conclusion: In any realistic use scenarios, electric field emissions from a medical implant inductive system are well below the ambient noise in the LORAN-C band and far below out-of-band spurious emissions thresholds for the LORAN-C band established by FCC rules.

As described above, the ambient noise in the LORAN-C band is on average 43 dB microvolts/meter in a one-kilohertz bandwidth and under extreme conditions 23 dB above one microvolt/meter. At a distance of 300 meters, the measurement distance prescribed by the FCC rule governing in-band spurious emissions, the electric field from an implanted device is approximately -50 dB microvolts/meter, i.e. totally undetectable by a LORAN-C receiver. Test data is shown later in this report to substantiate that the emissions from a programmer/implant combination produce minimal or inconsequential interference within the 90-110 kHz LORAN-C band at the prescribed measurement distance. Likewise, as expected from theory, a LORAN-C

field antenna is essentially non-responsive to an implant transmission at distances of one meter or more.

Transmissions from Boston Scientific's Implantable Device

I understand that for one of Boston Scientific's products, the implant transmission takes the form of a quadriphase signal. The data rate is 102.4 kbps and the carrier frequency is also 102.4 kHz. Since the signal is quadriphase the symbol rate is 51.2 kilosymbols/sec and results in power frequency spectrum as shown below.

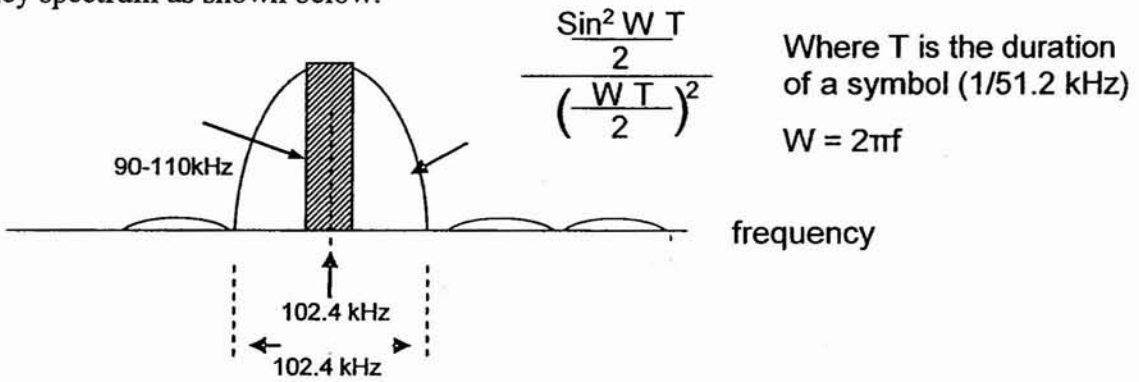


Figure 4 – Implant spectrum with in-band emissions identified

Much of the implant power is concentrated within the main lobe of the spectrum centered on 102.4 kHz. The measured power spectrum is shown in Exhibit B of this report as verification of the spectrum shape.

If one assumes that the implant transmission is somehow induced into a Loran-C antenna at some very low level, only a portion of the implants power spectrum is contained in the 90-110 kHz band. Thus, a significant portion of the potential interference from the implant can be rejected by the Loran-C receiver.

VI. Test Configuration and Results

Boston Scientific, through an independent laboratory, had emission measurements made of the implant operating alone and of the implant/programmer operating in the time division duplex mode. The complete test document is included in this report as Exhibit A. To quote the individual conducting the tests, Mr. Jonathon Peng, "Emission levels were very low, therefore testing was done at one meter and two meter antenna to EUT [device] distance."

The tests were conducted using an H-field loop antenna whose orientation could be changed to ensure that the maximum H-field emission would be measured at 1 and 2 meters. Using FCC recommended procedures, the test results at 1 and 2 meters were extrapolated to find the field strengths at 300 meters, the distance which conforms to the specifications in section 15.209 of the Commission's rules.

Scan test results are shown in figures on pages 14 to 29 of the document in Exhibit A, covering the spectrum 85 kHz to 115 kHz. The last three right-most columns on these pages reflect the distance-adjusted fields, the section 15.209 specification limits and the net comparison of the adjusted fields to the specification limits. As can be seen in the right-most column, the fields are 80 to 105 dB below the specification.

In anticipation that there may be questions concerning the effects of the implant and the programmer on a LORAN-C receiver equipped with an E-field antenna, I developed a test and directed Boston Scientific engineers to conduct a series of measurements. Boston Scientific procured a standard eight foot-long LORAN-C E-field antenna made by Shakespeare, Inc., and with a highly sensitive spectrum analyzer made by Rhode & Schwartz, a world-class instrument, made scan measurements over a 160 kHz band centered at 102.4 kHz with a resolution bandwidth of 1 kHz.

Like the tests conducted by the independent laboratory, the Boston Scientific tests were conducted in an anechoic chamber. These test results, which are included in this report as Exhibit B, show that the implant transmits at a level that is 40 dB lower than the programmer, which is already approved by the FCC. The fields picked up by the LORAN-C E-field antenna are virtually at the spectrum analyzer's noise floor when implant fields are measured at three feet (approx 1 meter) and six feet (approx 2 meters) from the device.

Also shown in the test results (Exhibit B) is the time domain operation of the programmer and the implant illustrating the time division duplex or "ping-pong" operation. Finally, the tests show the spectrum of the implant with its characteristic $\sin^2 x/x^2$ power spectrum and how much of its spectrum would fall within the 90-110 kHz band.

In sum, the data demonstrate that even in the extremely unlikely event that the telemetry system in an implanted device is operating in close proximity to a LORAN-C receiver, the extremely low-level E-fields picked up by the LORAN-C antenna cannot possibly interfere with LORAN-C navigation.

VII. Conclusions

Thus, it has been established through independent laboratory tests and through recent outside directed tests that the Boston Scientific implantable device and its programmer will not adversely affect the LORAN-C navigation accuracies for E field or H field equipped receivers. The inductively based implant transmission is simply too low to cause any adverse interference in the LORAN-C band given any reasonable use scenario. The programmer operates outside the LORAN-C band and meets or exceeds the spurious emission level tolerated within the LORAN-C band.

Given that the implantable device transmit power level is far below that of the programmer and near the 90-110 kHz noise floor, it is recommended that the implantable devices be allowed to operate in the LORAN-C band.

J. Neil Birch

Dr. J. Neil Birch

EXHIBIT A

Frontier I Inductive Telemetry Analysis

Introduction

Guidant's new Frontier is an implantable medical device. Generically referred to as a PG (Pulse Generator), its' different configurations can contain both pacing and defibrillation functions. Programming of this device will be accomplished using two different methods. One method uses the ISM band at 902-928 MHz, that method of communication will be certified under 15.249. The other method, referred to as inductive telemetry, is the focus of the discussion. The wireless telemetry is designed to operate at a nominal frequency of 102.5 kHz. The rule part most applicable for the approval of this type of device is 15.201(a):

> ***Intentional radiators operated as carrier current systems, devices operated under the provisions of §§ 15.211, 15.213 and 15.221, and devices operating below 490 kHz in which all emissions are at least 40 dB below the limits in Section 15.209 shall be verified pursuant to the procedures in Subpart J of Part 2 of this Chapter prior to marketing.***

In the present configuration, the PG requires a Programmer to be within a very close proximity to operate, it **cannot** transmit continuously without a programmer. The programmer has much higher emission levels and will not meet the requirements above as a verified device, (and hence it will be certified under 15.209). To measure the emissions from just the PG, a test unit was configured. This special "Test PG" (QPSK-driven PG) has the antenna coil connected to an external generator. That generator was set up to provide the same signal to the PG antenna, as it would normally receive from the internal radio.

The attached data was all acquired using a 10-meter semi-anechoic chamber. The chamber meets the ANSI C63.4 volumetric site attenuation requirements for an alternate test site. The chamber is listed with the FCC as an acceptable radiated emissions test facility.

The data is broken up into different sections, for ease of review. The first section is broadband scans. These broadband scans were performed to characterize the devices. That characterization allowed determination of worst-case antenna and EUT position as well as placement for the balance of the testing. Emission levels were very low, in order to actually measure the low levels of emissions, the antenna was placed at a two meter antenna to EUT distance. Data for the broad band scans has been extrapolated as specified in 15.31(f)(1):

> **Measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).**

Section 15,205 Restricted bands of operation; (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

.090 - .110 MHz

With the device operating in this restricted band, further scan data was acquired focusing on the restricted band of 90 – 110 kHz. Scans were made at both 1 meter and 2 meter antenna to EUT distances. The results were extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade) specified in 15.31 below 30 MHz.

The maximized data is used to show precise values compared to the limits. For the maximized data, measurements were made at 2 distances to determine the correct extrapolation factor, as specified in 15.31. Final data was acquired using a Quasi Peak detector as specified for the restricted band. This final maximized data demonstrates the equipment meets the 15.201 verification requirements of having margins greater than 40 dB below the 15.209 specification limits.

Next data is shown with the Programmer and the PG as one system. In **normal** operation, the PG must have a Programmer there to continuously communicate. That data, as may be referenced, demonstrates the entire system meets the requirements of 15.209.

The following data (pages 4 - 12) represents broadband scans of the entire 10 kHz - 30 MHz frequency band. These broadband scans were performed to characterize the devices. That characterization allowed determination of worst-case antenna and EUT position as well as placement for the balance of the testing. Emission levels were very low, in order to actually measure the low levels of emissions, the antenna was placed at a two meter antenna to EUT distance. Data for the broad band scans has been extrapolated as specified in 15.31(f)(1):

Measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005.1.4
EMI 2005.4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guldant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis; Actual test distance 2m.

EUT OPERATING MODES

PG Transmitting Telemetry

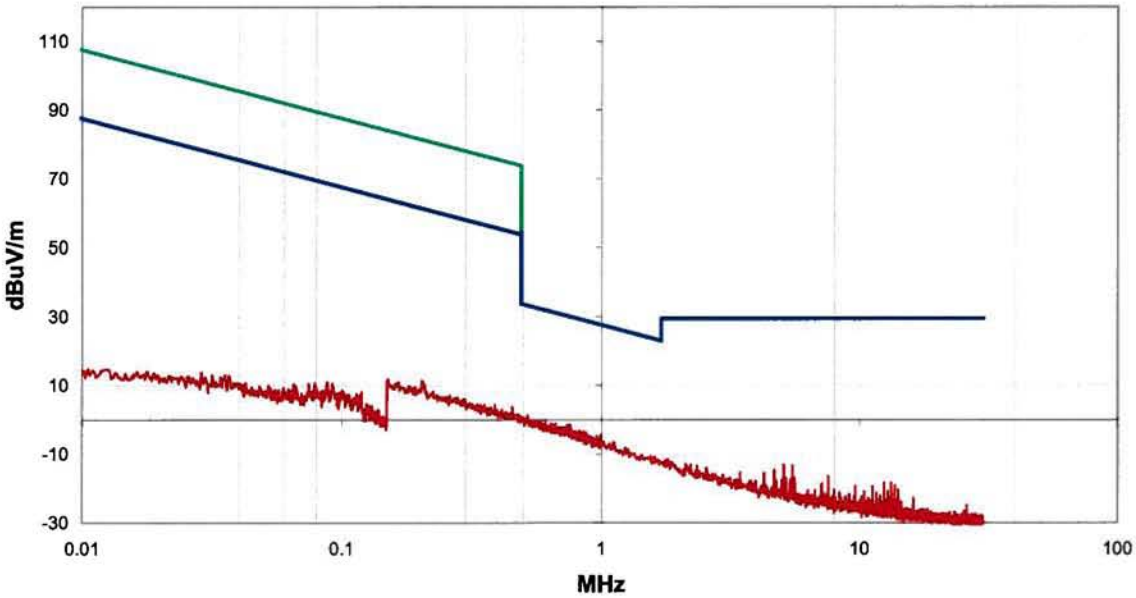
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	1

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.754	35.2	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.3	30.1	-31.4
0.737	35.0	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.5	30.3	-31.7
0.518	37.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	1.4	33.3	-32.0
0.606	36.5	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.1	32.0	-32.0
0.988	32.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-4.4	27.7	-32.1
0.664	35.4	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.1	31.2	-32.2
0.866	33.2	0.0	0.0	10.1	0.2	0.0	V		-47.0	-3.5	28.9	-32.3
0.585	36.4	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.2	32.3	-32.4
0.822	33.5	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.1	29.3	-32.4
0.847	33.2	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.4	29.1	-32.5
0.637	35.5	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.0	31.5	-32.5
0.648	35.3	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.2	31.4	-32.6
0.956	31.9	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.7	28.0	-32.7
0.709	34.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.1	30.6	-32.7
0.829	33.1	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.5	29.2	-32.8
0.701	34.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.1	30.7	-32.8
0.795	33.3	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.3	29.6	-32.9
0.686	34.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.0	30.9	-32.9
0.879	32.4	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.3	28.7	-33.0

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005.1.4
EMI 2005.4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Y-Axis; Actual test distance 2m.

EUT OPERATING MODES

PG Transmitting Telemetry

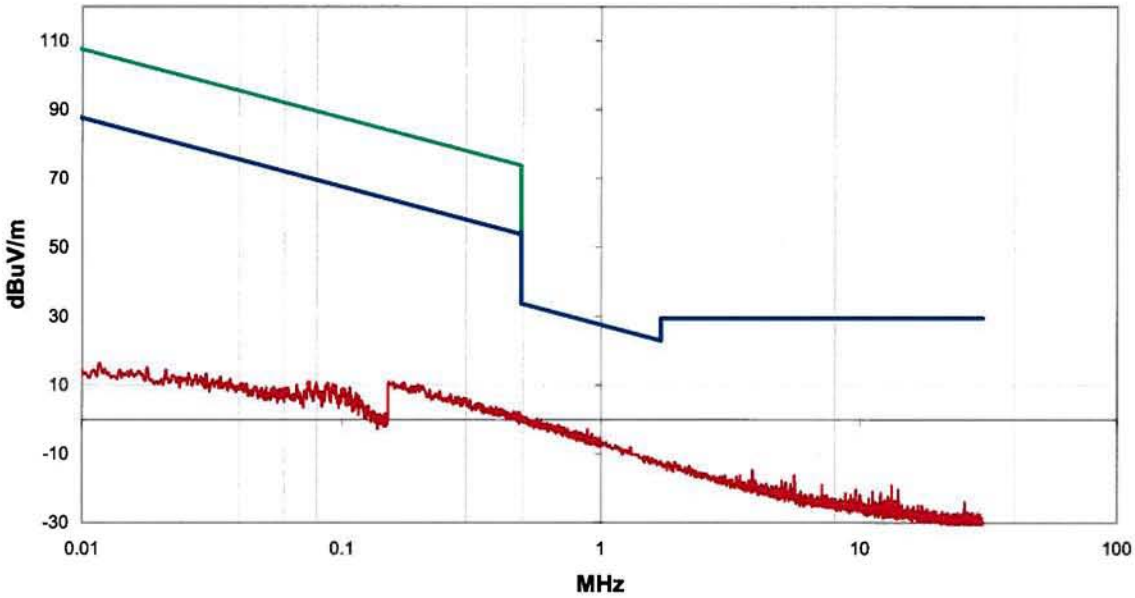
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	2

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.884	34.0	0.0	0.0	10.1	0.2	0.0	V		-47.0	-2.7	28.7	-31.4
0.586	36.7	0.0	0.0	10.2	0.2	0.0	V		-47.0	0.1	32.2	-32.1
0.565	36.9	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.4	32.6	-32.2
0.922	32.6	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.1	28.3	-32.4
0.680	34.9	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.5	31.0	-32.5
0.741	34.0	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.5	30.2	-32.7
0.718	34.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.2	30.5	-32.7
0.708	34.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.1	30.6	-32.7
0.802	33.4	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.2	29.5	-32.7
0.994	31.4	0.0	0.0	10.3	0.2	0.0	V		-47.0	-5.1	27.7	-32.8
0.640	35.2	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.3	31.5	-32.8
0.832	32.9	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.7	29.2	-32.9
0.912	32.0	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.7	28.4	-33.1
0.823	32.8	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.8	29.3	-33.1
0.868	32.2	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.5	28.8	-33.3
0.987	30.8	0.0	0.0	10.3	0.2	0.0	V		-47.0	-5.7	27.7	-33.5
1.819	24.4	0.0	0.0	10.2	0.2	0.0	V		-47.0	-12.2	29.5	-41.7
1.927	24.4	0.0	0.0	10.2	0.2	0.0	V		-47.0	-12.2	29.5	-41.7
2.197	23.2	0.0	0.0	10.2	0.2	0.0	V		-47.0	-13.4	29.5	-42.9

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1.4
EMI 2005 4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG X-Axis; Actual test distance 2m.

EUT OPERATING MODES

PG Transmitting Telemetry

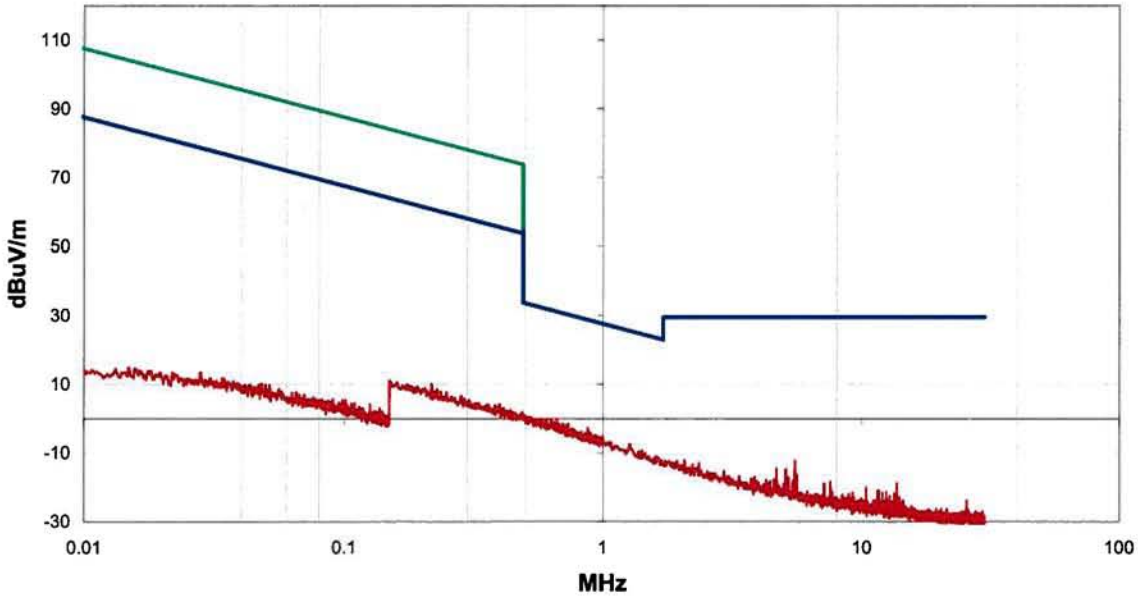
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	3

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.662	36.3	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.2	31.2	-31.4
0.872	34.0	0.0	0.0	10.1	0.2	0.0	V		-47.0	-2.7	28.8	-31.5
0.732	35.0	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.5	30.3	-31.8
0.626	36.4	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.1	31.7	-31.8
0.698	35.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.4	30.7	-32.1
0.606	36.3	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.3	32.0	-32.3
0.719	34.6	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.8	30.5	-32.3
0.672	35.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.4	31.1	-32.4
0.600	36.2	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.4	32.1	-32.4
0.726	34.3	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.1	30.4	-32.5
0.584	36.3	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.3	32.3	-32.6
0.561	36.5	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.0	32.6	-32.6
0.893	32.6	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.1	28.6	-32.7
0.935	32.0	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.6	28.2	-32.8
0.771	33.5	0.0	0.0	10.3	0.2	0.0	V		-47.0	-3.0	29.9	-32.9
1.261	29.2	0.0	0.0	10.3	0.2	0.0	V		-47.0	-7.3	25.6	-32.9
0.543	36.4	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.1	32.9	-33.0
0.824	32.9	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.7	29.3	-33.0
0.997	31.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-5.4	27.7	-33.1

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1-4
EMI 2005 4-13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG X-Axis; Actual test distance 2m.

EUT OPERATING MODES

PG Transmitting Telemetry

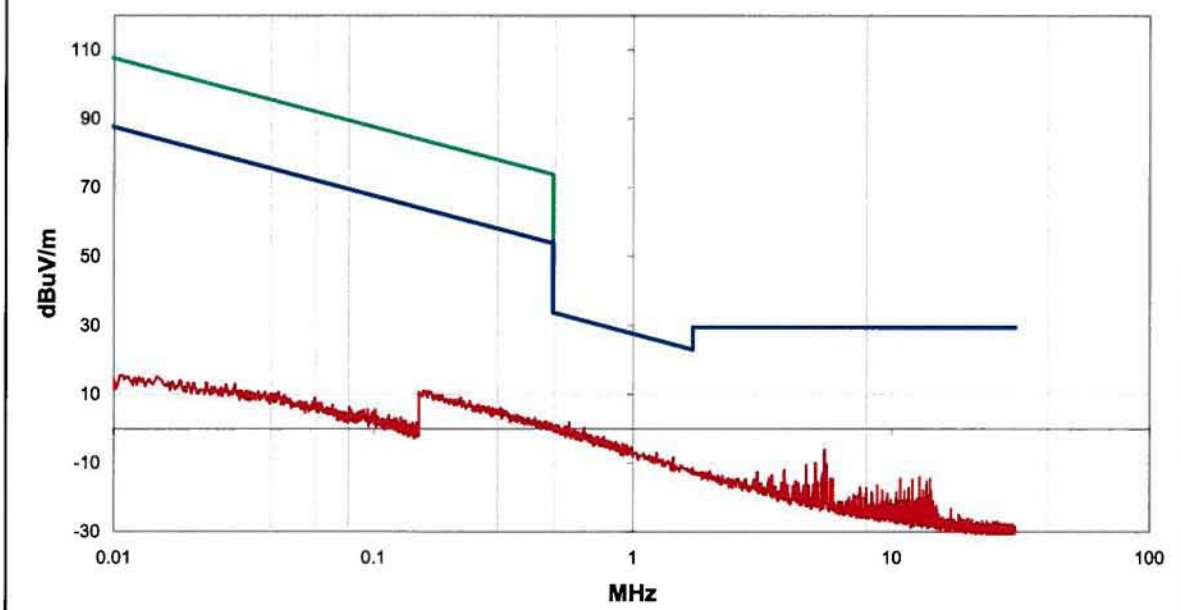
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	4

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.566	38.3	0.0	0.0	10.3	0.2	0.0	V		-47.0	1.8	32.6	-30.8
0.647	36.8	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.3	31.4	-31.1
0.554	37.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.6	32.7	-32.1
0.544	37.2	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.7	32.9	-32.2
0.768	34.2	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.3	29.9	-32.2
0.593	36.1	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.5	32.1	-32.6
0.731	34.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.4	30.3	-32.7
0.856	32.9	0.0	0.0	10.1	0.2	0.0	V		-47.0	-3.8	29.0	-32.7
1.234	29.6	0.0	0.0	10.3	0.2	0.0	V		-47.0	-6.9	25.8	-32.7
0.680	34.6	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.8	31.0	-32.8
0.687	34.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.9	30.9	-32.8
0.910	32.3	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.4	28.4	-32.8
1.432	28.2	0.0	0.0	10.3	0.2	0.0	V		-47.0	-8.3	24.5	-32.8
0.611	35.6	0.0	0.0	10.2	0.2	0.0	V		-47.0	-1.0	31.9	-32.9
0.614	35.5	0.0	0.0	10.2	0.2	0.0	V		-47.0	-1.1	31.8	-32.9
0.941	31.8	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.8	28.2	-33.0
0.754	33.6	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.9	30.1	-33.0
0.946	31.7	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.9	28.1	-33.0
0.927	31.9	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.7	28.3	-33.0

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Y-Axis; Actual test distance 2m.

EUT OPERATING MODES

PG Transmitting Telemetry

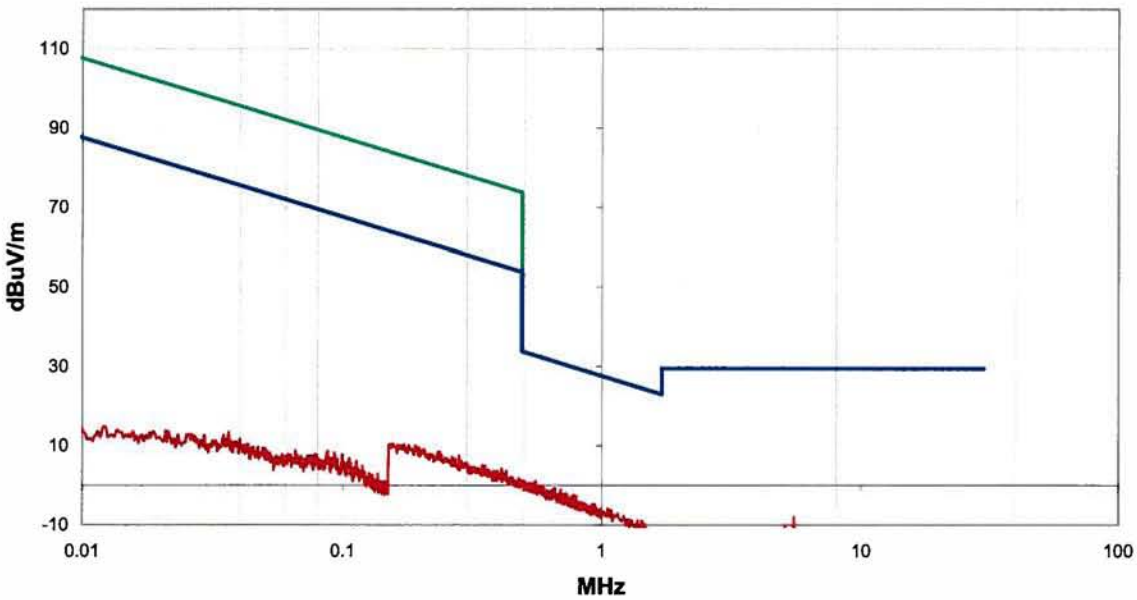
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	5

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.553	37.7	0.0	0.0	10.3	0.2	0.0	V		-47.0	1.2	32.8	-31.6
0.692	35.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.0	30.8	-31.8
0.658	35.9	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.6	31.2	-31.8
0.777	34.3	0.0	0.0	10.2	0.2	0.0	V		-47.0	-2.2	29.8	-32.1
0.794	34.1	0.0	0.0	10.2	0.2	0.0	V		-47.0	-2.5	29.6	-32.1
0.649	35.7	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.8	31.4	-32.2
0.501	37.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	1.3	33.6	-32.3
0.586	36.5	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.1	32.2	-32.3
0.726	34.5	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.9	30.4	-32.3
0.538	37.0	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.5	33.0	-32.5
0.527	37.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.6	33.2	-32.5
0.766	33.8	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.7	29.9	-32.7
0.732	34.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.4	30.3	-32.7
0.705	34.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.1	30.6	-32.8
0.635	35.3	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.2	31.6	-32.8
0.936	32.0	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.6	28.2	-32.8
0.684	34.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.9	30.9	-32.8
0.941	31.9	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.7	28.1	-32.9
0.774	33.5	0.0	0.0	10.3	0.2	0.0	V		-47.0	-3.0	29.8	-32.9

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005.1.4
EMI 2005.4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Z-Axis; Actual test distance 2m.

EUT OPERATING MODES

PG Transmitting Telemetry

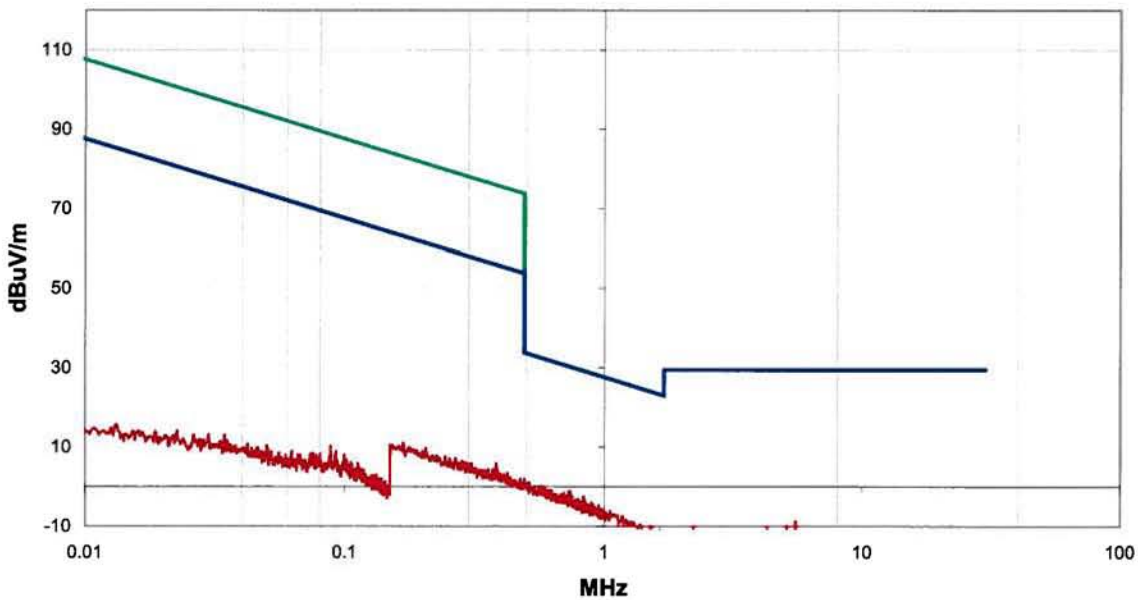
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	6

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.737	35.5	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.0	30.3	-31.2
0.725	35.3	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.1	30.4	-31.5
0.831	34.3	0.0	0.0	10.2	0.2	0.0	V		-47.0	-2.3	29.2	-31.6
0.491	38.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	2.1	33.8	-31.7
0.573	36.8	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.3	32.4	-32.2
0.698	34.9	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.5	30.7	-32.2
0.514	37.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	1.1	33.4	-32.3
0.840	33.4	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.2	29.1	-32.4
0.750	34.2	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.3	30.1	-32.4
0.623	35.8	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.7	31.7	-32.5
0.559	36.7	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.2	32.7	-32.5
0.890	32.8	0.0	0.0	10.1	0.2	0.0	V		-47.0	-3.9	28.6	-32.5
0.951	32.1	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.5	28.1	-32.6
0.793	33.5	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.1	29.6	-32.7
0.605	35.8	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.8	32.0	-32.8
0.681	34.6	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.8	30.9	-32.8
0.904	32.4	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.3	28.5	-32.8
0.538	36.6	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.1	33.0	-32.9
0.776	33.3	0.0	0.0	10.2	0.2	0.0	V		-47.0	-3.2	29.8	-33.1

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop X-Axis, PG Z-Axis; Actual test distance 2m

EUT OPERATING MODES

PG Transmitting Telemetry

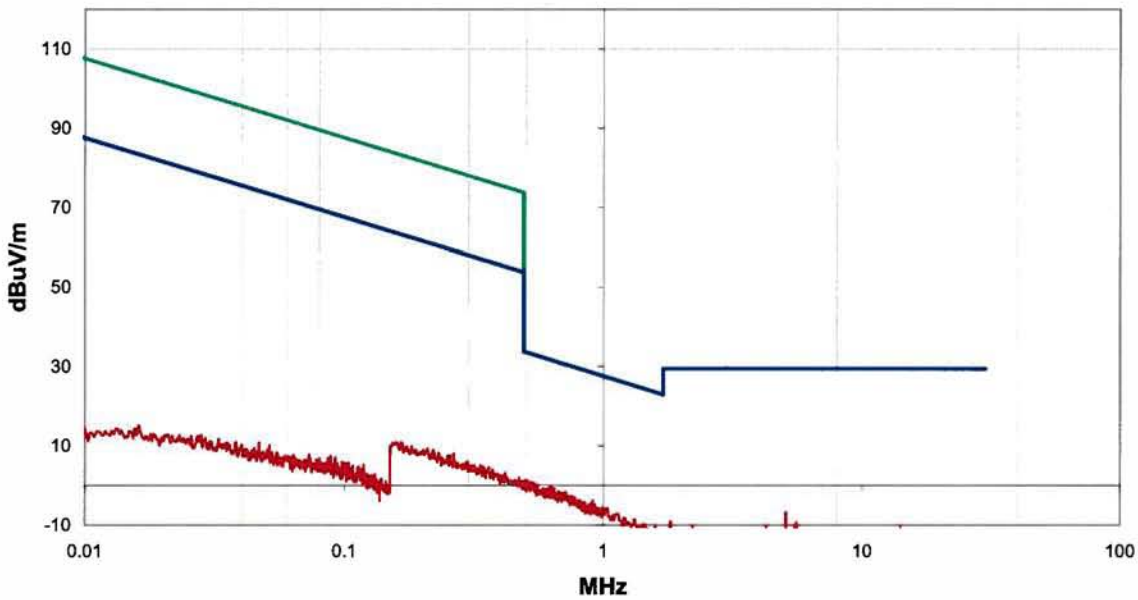
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	7

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.619	36.4	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.2	31.8	-31.9
0.644	35.9	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.6	31.4	-32.0
0.712	34.9	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.5	30.6	-32.1
0.631	36.0	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.5	31.6	-32.1
0.504	37.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	1.4	33.6	-32.2
0.499	37.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	1.4	33.6	-32.2
0.908	32.9	0.0	0.0	10.1	0.2	0.0	V		-47.0	-3.8	28.5	-32.2
0.520	37.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	1.0	33.3	-32.3
0.555	36.8	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.3	32.7	-32.4
0.668	35.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.4	31.1	-32.5
0.686	34.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.7	30.9	-32.6
0.607	35.9	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.7	31.9	-32.6
0.748	33.9	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.6	30.1	-32.7
0.895	32.4	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.3	28.6	-32.9
0.924	31.9	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.7	28.3	-33.0
0.994	31.0	0.0	0.0	10.3	0.2	0.0	V		-47.0	-5.5	27.7	-33.2
0.846	32.5	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.1	29.1	-33.2
0.878	31.9	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.8	28.7	-33.5
1.585	26.3	0.0	0.0	10.2	0.2	0.0	V		-47.0	-10.2	23.6	-33.9

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop X-Axis, PG Y-Axis; Actual test distance 2m.

EUT OPERATING MODES

PG Transmitting Telemetry

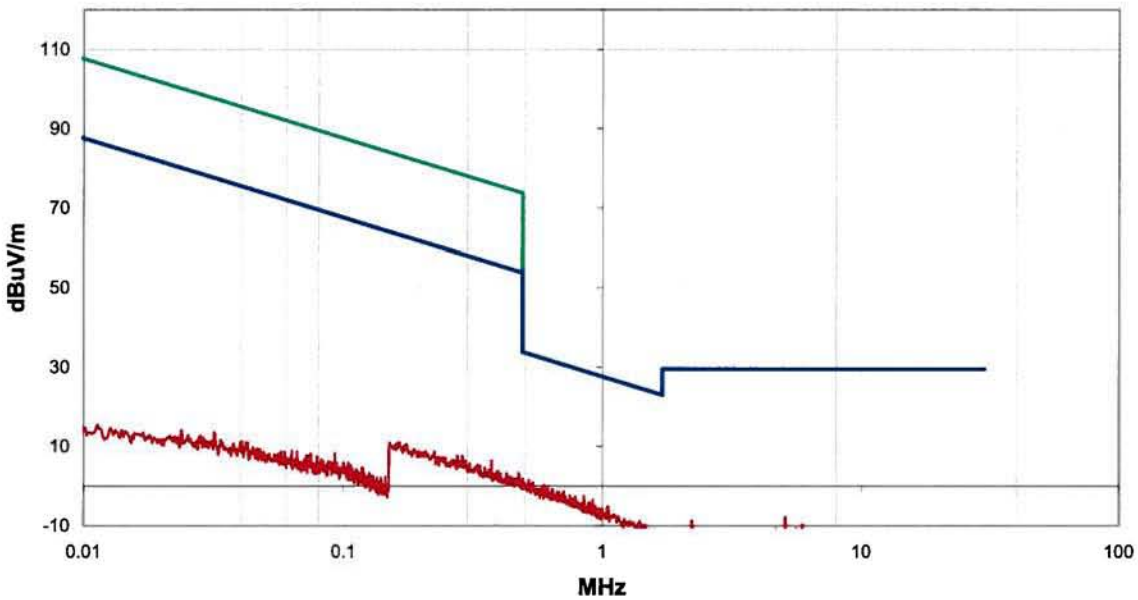
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	8

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.849	34.2	0.0	0.0	10.2	0.2	0.0	V		-47.0	-2.4	29.0	-31.5
0.595	37.0	0.0	0.0	10.2	0.2	0.0	V		-47.0	0.4	32.1	-31.7
0.918	33.3	0.0	0.0	10.1	0.2	0.0	V		-47.0	-3.4	28.4	-31.7
0.518	38.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	1.6	33.3	-31.8
0.711	35.1	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.3	30.6	-31.9
0.538	37.4	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.9	33.0	-32.1
0.639	35.9	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.6	31.5	-32.1
0.614	36.2	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.4	31.8	-32.2
0.785	34.0	0.0	0.0	10.2	0.2	0.0	V		-47.0	-2.6	29.7	-32.3
1.045	31.4	0.0	0.0	10.3	0.2	0.0	V		-47.0	-5.1	27.2	-32.3
0.702	34.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.7	30.7	-32.4
0.680	35.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.4	31.0	-32.4
0.669	35.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.4	31.1	-32.5
0.746	34.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.4	30.2	-32.5
0.890	32.6	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.1	28.6	-32.7
0.583	36.1	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.5	32.3	-32.8
0.998	30.8	0.0	0.0	10.3	0.2	0.0	V		-47.0	-5.7	27.6	-33.3
0.960	31.0	0.0	0.0	10.2	0.2	0.0	V		-47.0	-5.6	28.0	-33.5
0.983	30.7	0.0	0.0	10.3	0.2	0.0	V		-47.0	-5.8	27.8	-33.6

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop X-Axis, PG X-Axis; Actual test distance 2m.

EUT OPERATING MODES

PG Transmitting Telemetry

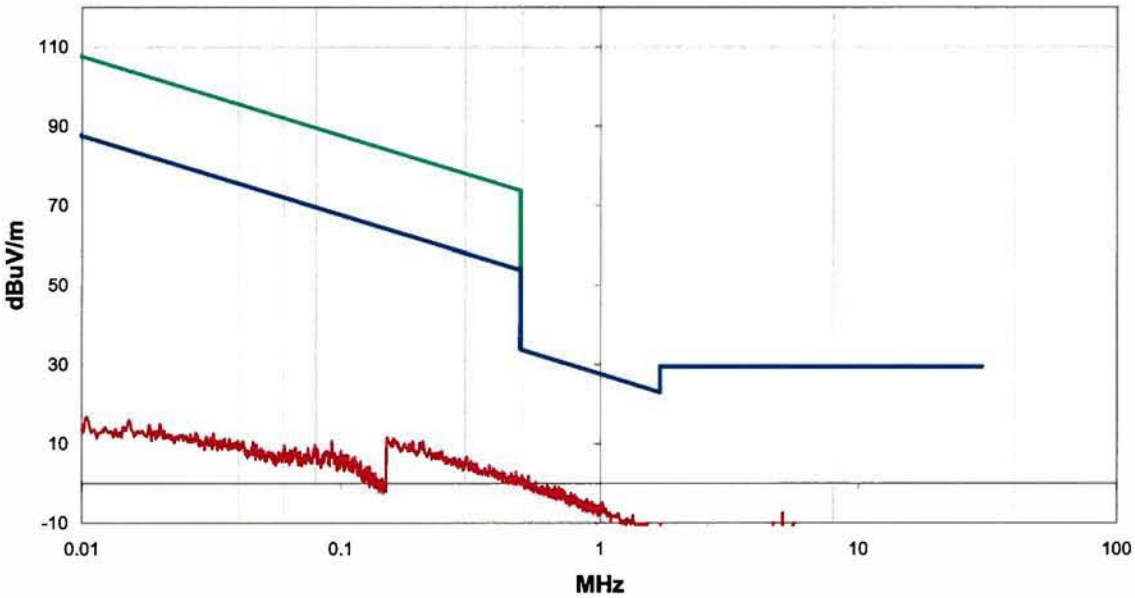
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	9

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.527	38.4	0.0	0.0	10.3	0.2	0.0	V		-47.0	1.9	33.2	-31.2
0.498	38.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	2.1	33.7	-31.6
0.692	35.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-0.9	30.8	-31.7
0.669	35.7	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.8	31.1	-31.9
0.708	35.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.4	30.6	-32.0
0.720	34.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.6	30.5	-32.1
0.563	37.0	0.0	0.0	10.3	0.2	0.0	V		-47.0	0.5	32.6	-32.1
0.624	36.1	0.0	0.0	10.2	0.2	0.0	V		-47.0	-0.4	31.7	-32.1
0.770	34.2	0.0	0.0	10.3	0.2	0.0	V		-47.0	-2.3	29.9	-32.2
1.018	31.7	0.0	0.0	10.3	0.2	0.0	V		-47.0	-4.8	27.5	-32.3
0.799	33.8	0.0	0.0	10.2	0.2	0.0	V		-47.0	-2.8	29.6	-32.4
0.674	35.0	0.0	0.0	10.3	0.2	0.0	V		-47.0	-1.4	31.0	-32.5
0.634	35.6	0.0	0.0	10.3	0.2	0.0	V		-47.0	-0.9	31.6	-32.5
0.887	32.8	0.0	0.0	10.1	0.2	0.0	V		-47.0	-3.9	28.7	-32.5
0.930	32.0	0.0	0.0	10.2	0.2	0.0	V		-47.0	-4.6	28.2	-32.9
1.342	28.6	0.0	0.0	10.3	0.2	0.0	V		-47.0	-7.9	25.1	-33.0
0.992	31.1	0.0	0.0	10.3	0.2	0.0	V		-47.0	-5.4	27.7	-33.1
0.882	32.2	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.5	28.7	-33.2
0.918	31.8	0.0	0.0	10.1	0.2	0.0	V		-47.0	-4.9	28.4	-33.2

The data provided (pages 14 - 29) is preliminary scan data. It was used to characterize the device, such that maximum positions of the EUT and the antennas could be determined. The transmit frequency is at 102 kHz, so the scans were focused on the Restricted Band, 90 kHz - 110 kHz. Emissions levels were very low, therefore testing was done at a 1 meter and 2 meter antenna to EUT distance. As specified in 47 CFR 15.31 (f)(2), for the scan data, the 40 dB/decade exptrapolation was used for comparing the emissions to the limits. The information acquired here was used to determine test positions for the maximized data.

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1-4
EMI 2005 4-13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop X-Axis, PG X-Axis

EUT OPERATING MODES

PG Transmitting Telemetry

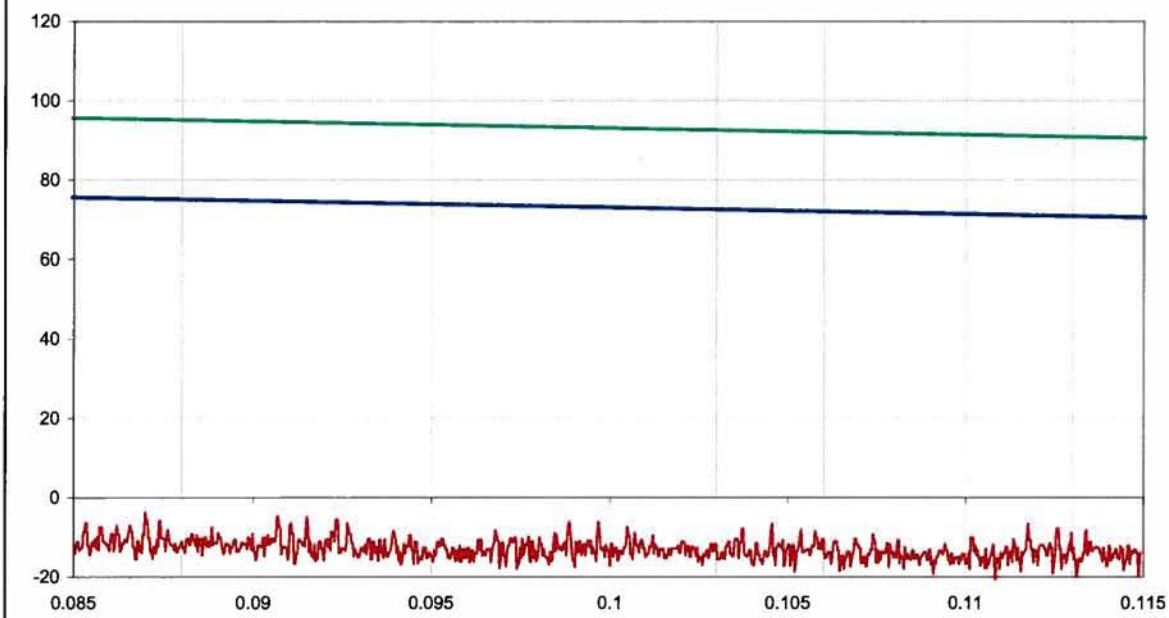
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	18

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.087	32.4	0.0	0.0	10.6	0.2	0.0	V		-47.0	-3.8	88.8	-92.6
0.091	31.5	0.0	0.0	10.7	0.2	0.0	V		-47.0	-4.6	88.4	-93.1
0.092	31.3	0.0	0.0	10.7	0.2	0.0	V		-47.0	-4.8	88.4	-93.2
0.112	29.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.6	86.6	-93.2
0.100	30.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.1	87.6	-93.7
0.092	30.7	0.0	0.0	10.6	0.2	0.0	V		-47.0	-5.5	88.3	-93.8
0.099	30.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.1	87.7	-93.8
0.105	29.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.6	87.2	-93.8
0.113	28.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.7	86.6	-94.3
0.087	30.3	0.0	0.0	10.6	0.2	0.0	V		-47.0	-5.9	88.8	-94.6
0.113	28.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-8.2	86.5	-94.7
0.093	29.7	0.0	0.0	10.6	0.2	0.0	V		-47.0	-6.5	88.3	-94.7
0.100	29.1	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.3	87.6	-94.9
0.091	29.6	0.0	0.0	10.7	0.2	0.0	V		-47.0	-6.5	88.4	-94.9
0.104	28.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.7	87.3	-95.0
0.105	28.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-8.1	87.1	-95.2
0.085	29.8	0.0	0.0	10.6	0.2	0.0	V		-47.0	-6.4	89.0	-95.4
0.113	27.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-8.9	86.5	-95.4
0.106	28.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-8.4	87.1	-95.5

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1-4
EMI 2005 4-13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop X-Axis, PG X-Axis

EUT OPERATING MODES

PG Transmitting Telemetry

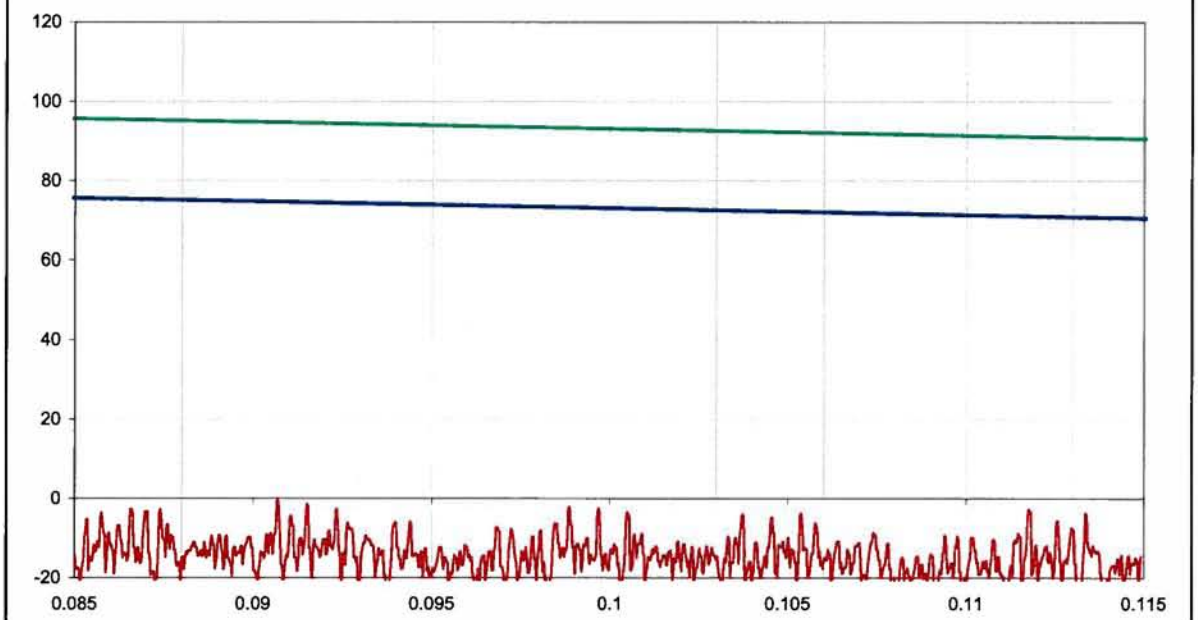
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	1	21

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	48.2	0.0	0.0	10.7	0.2	0.0	V		-59.0	0.1	88.4	-88.4
0.112	46.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.1	86.6	-88.7
0.099	46.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.5	87.7	-89.2
0.092	47.2	0.0	0.0	10.7	0.2	0.0	V		-59.0	-0.9	88.4	-89.3
0.100	46.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.0	87.6	-89.6
0.113	45.2	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.2	86.5	-89.7
0.105	45.2	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.2	87.1	-90.3
0.100	45.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.9	87.6	-90.5
0.092	46.0	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.2	88.3	-90.5
0.104	45.0	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.4	87.3	-90.7
0.087	46.0	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.2	88.8	-90.9
0.087	46.0	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.2	88.8	-91.0
0.105	44.2	0.0	0.0	10.4	0.2	0.0	V		-59.0	-4.2	87.2	-91.4
0.087	45.5	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.7	88.8	-91.5
0.113	43.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-5.0	86.6	-91.6
0.086	45.2	0.0	0.0	10.6	0.2	0.0	V		-59.0	-3.0	88.9	-91.9
0.091	44.3	0.0	0.0	10.7	0.2	0.0	V		-59.0	-3.8	88.4	-92.2
0.106	42.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-5.7	87.1	-92.8
0.094	43.0	0.0	0.0	10.6	0.2	0.0	V		-59.0	-5.2	88.1	-93.3

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005.1.4
EMI 2005.4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Y-Axis vertical

EUT OPERATING MODES

PG Transmitting Telemetry

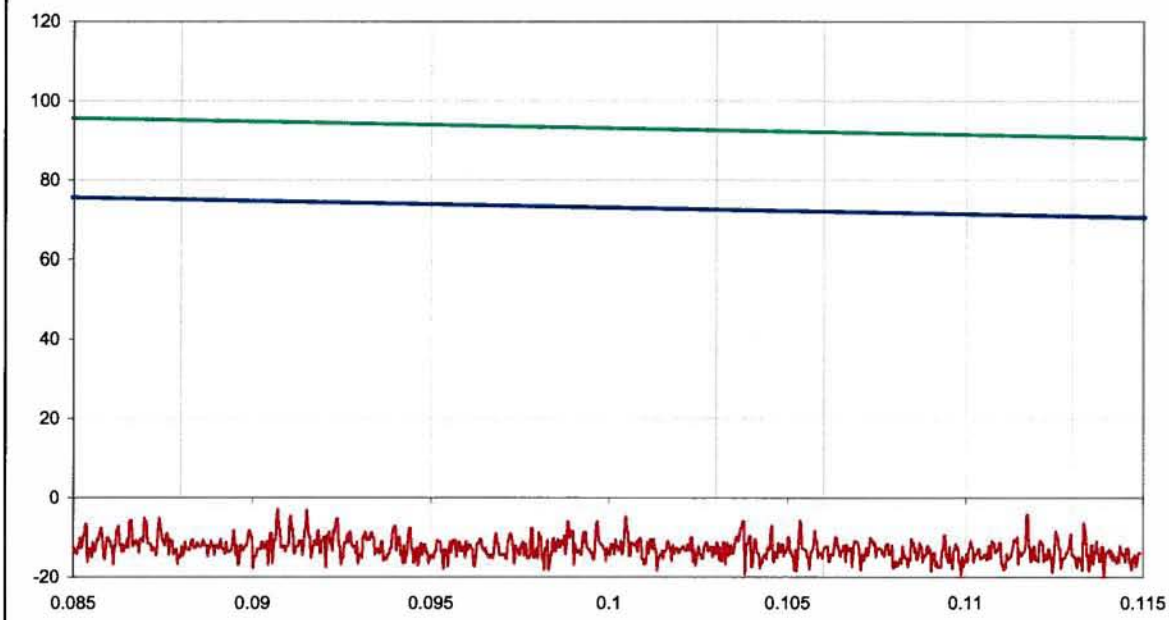
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	22

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.112	32.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-4.2	86.6	-90.8
0.091	33.2	0.0	0.0	10.7	0.2	0.0	V		-47.0	-2.9	88.4	-91.4
0.092	33.1	0.0	0.0	10.7	0.2	0.0	V		-47.0	-3.0	88.4	-91.4
0.100	31.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-4.7	87.6	-92.3
0.105	30.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.7	87.1	-92.8
0.113	30.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.4	86.5	-92.9
0.091	31.6	0.0	0.0	10.7	0.2	0.0	V		-47.0	-4.5	88.4	-92.9
0.104	30.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.9	87.3	-93.2
0.100	30.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.9	87.6	-93.5
0.092	30.9	0.0	0.0	10.6	0.2	0.0	V		-47.0	-5.3	88.3	-93.6
0.099	30.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.0	87.7	-93.7
0.087	31.1	0.0	0.0	10.6	0.2	0.0	V		-47.0	-5.1	88.8	-93.8
0.087	31.1	0.0	0.0	10.6	0.2	0.0	V		-47.0	-5.1	88.8	-93.9
0.105	29.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.0	87.2	-94.2
0.087	30.5	0.0	0.0	10.6	0.2	0.0	V		-47.0	-5.7	88.8	-94.5
0.113	28.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-8.4	86.6	-95.0
0.094	29.1	0.0	0.0	10.6	0.2	0.0	V		-47.0	-7.1	88.1	-95.3
0.106	28.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-8.2	87.1	-95.3
0.098	28.8	0.0	0.0	10.5	0.2	0.0	V		-47.0	-7.5	87.8	-95.3

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005.1.4
EMI 2005.4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Y-Axis vertical

EUT OPERATING MODES

PG Transmitting Telemetry

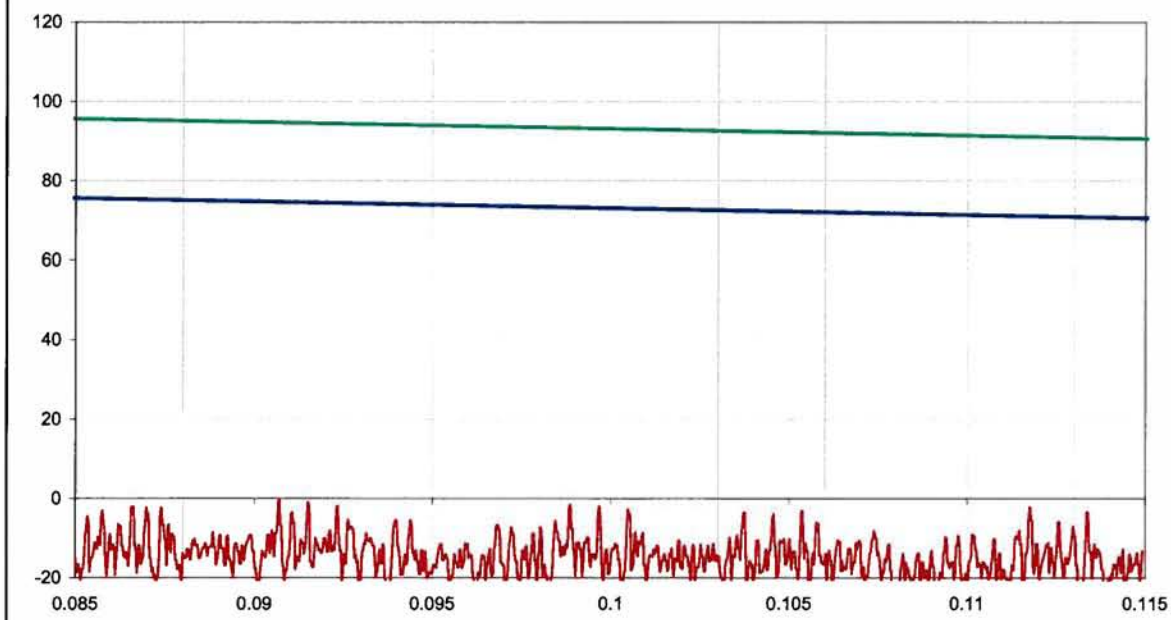
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	1	33

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank: equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	48.5	0.0	0.0	10.7	0.2	0.0	V		-59.0	0.4	88.4	-88.1
0.112	46.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.6	86.6	-88.2
0.092	47.8	0.0	0.0	10.7	0.2	0.0	V		-59.0	-0.3	88.4	-88.7
0.099	47.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.1	87.7	-88.8
0.100	47.0	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.4	87.6	-89.0
0.113	45.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.9	86.5	-89.4
0.105	45.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.5	87.1	-89.6
0.092	46.8	0.0	0.0	10.6	0.2	0.0	V		-59.0	-1.4	88.3	-89.7
0.100	46.2	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.2	87.6	-89.8
0.104	45.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.9	87.3	-90.2
0.087	46.6	0.0	0.0	10.6	0.2	0.0	V		-59.0	-1.6	88.8	-90.4
0.087	46.4	0.0	0.0	10.6	0.2	0.0	V		-59.0	-1.8	88.8	-90.5
0.087	46.4	0.0	0.0	10.6	0.2	0.0	V		-59.0	-1.8	88.8	-90.6
0.105	45.0	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.4	87.2	-90.6
0.091	45.2	0.0	0.0	10.7	0.2	0.0	V		-59.0	-2.9	88.4	-91.3
0.086	45.7	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.5	88.9	-91.4
0.113	43.1	0.0	0.0	10.4	0.2	0.0	V		-59.0	-5.3	86.6	-91.9
0.106	42.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	-5.5	87.1	-92.6
0.098	43.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-5.1	87.7	-92.8

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Y-Axis horizontal;

EUT OPERATING MODES

PG Transmitting Telemetry

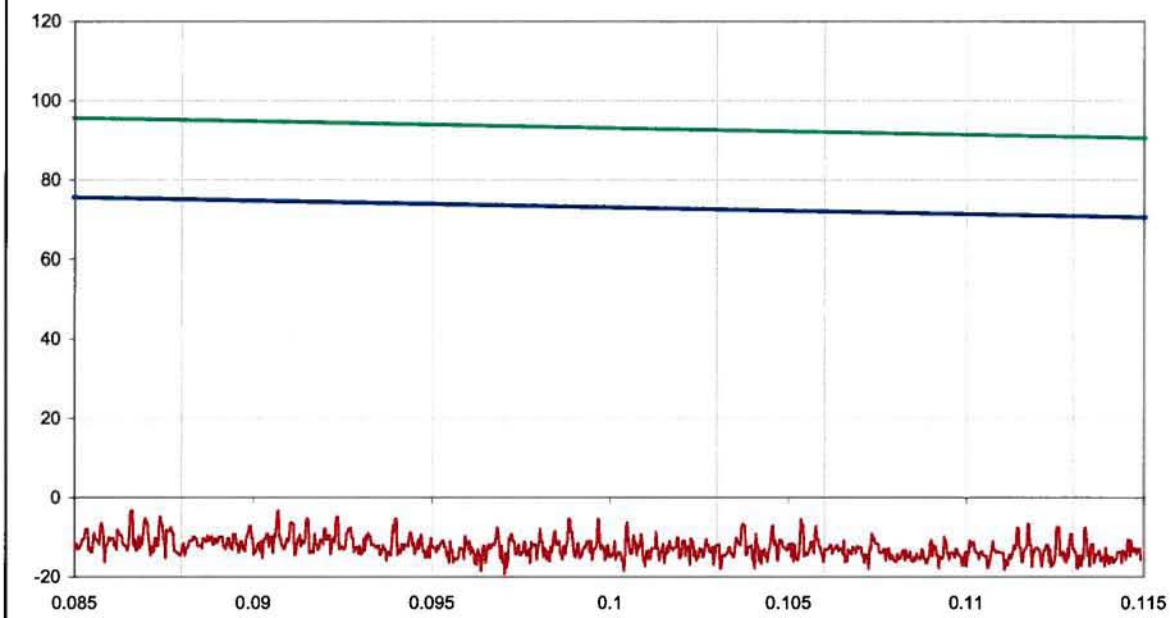
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	23

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peak [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	32.8	0.0	0.0	10.7	0.2	0.0	V		-47.0	-3.3	88.4	-91.8
0.087	32.9	0.0	0.0	10.6	0.2	0.0	V		-47.0	-3.3	88.8	-92.1
0.105	31.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.4	87.1	-92.5
0.100	31.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.4	87.6	-93.0
0.099	31.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.4	87.7	-93.1
0.092	31.3	0.0	0.0	10.6	0.2	0.0	V		-47.0	-4.9	88.3	-93.2
0.112	29.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.6	86.6	-93.2
0.094	30.9	0.0	0.0	10.6	0.2	0.0	V		-47.0	-5.3	88.1	-93.5
0.087	31.4	0.0	0.0	10.6	0.2	0.0	V		-47.0	-4.8	88.8	-93.5
0.092	30.9	0.0	0.0	10.7	0.2	0.0	V		-47.0	-5.2	88.4	-93.6
0.100	30.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.2	87.6	-93.8
0.104	29.9	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.5	87.3	-93.8
0.113	29.1	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.3	86.6	-93.9
0.087	31.0	0.0	0.0	10.6	0.2	0.0	V		-47.0	-5.2	88.8	-94.0
0.113	28.9	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.5	86.5	-94.0
0.105	29.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.0	87.2	-94.2
0.106	29.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.1	87.1	-94.2
0.111	28.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-7.6	86.7	-94.3
0.091	29.9	0.0	0.0	10.7	0.2	0.0	V		-47.0	-6.2	88.4	-94.6

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005.1.4
EMI 2005.4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Y-Axis horizontal; Actual test distance 2m, adjusted data reflects incorrected distance factors

EUT OPERATING MODES

PG Transmitting Telemetry

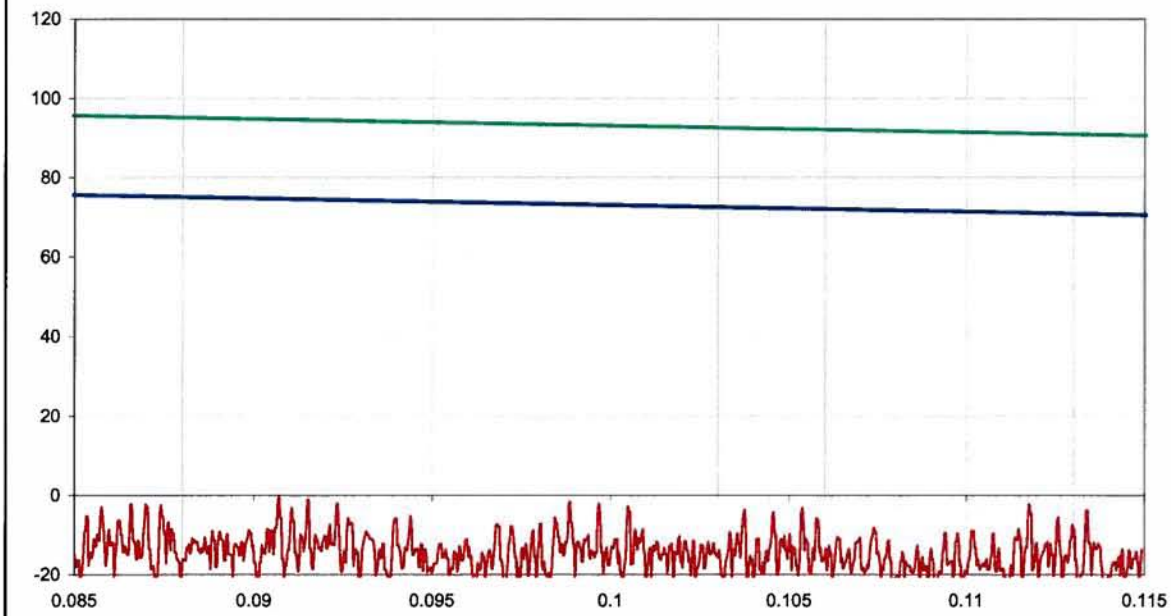
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	1	32

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	48.3	0.0	0.0	10.7	0.2	0.0	V		-59.0	0.2	88.4	-88.3
0.112	46.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.7	86.6	-88.3
0.099	47.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.0	87.7	-88.7
0.092	47.6	0.0	0.0	10.7	0.2	0.0	V		-59.0	-0.5	88.4	-88.9
0.100	46.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.6	87.6	-89.2
0.105	45.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.6	87.1	-89.7
0.100	46.2	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.2	87.6	-89.8
0.092	46.7	0.0	0.0	10.6	0.2	0.0	V		-59.0	-1.5	88.3	-89.8
0.113	45.1	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.3	86.5	-89.8
0.104	45.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.1	87.3	-90.4
0.087	46.5	0.0	0.0	10.6	0.2	0.0	V		-59.0	-1.7	88.8	-90.5
0.087	46.4	0.0	0.0	10.6	0.2	0.0	V		-59.0	-1.8	88.8	-90.6
0.087	46.2	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.0	88.8	-90.7
0.105	44.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.7	87.2	-90.9
0.091	45.5	0.0	0.0	10.7	0.2	0.0	V		-59.0	-2.6	88.4	-91.0
0.086	45.8	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.4	88.9	-91.3
0.113	43.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-5.0	86.6	-91.6
0.106	43.1	0.0	0.0	10.4	0.2	0.0	V		-59.0	-5.3	87.1	-92.4
0.098	43.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-5.1	87.7	-92.8

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005-1-4
EMI 2005-4-13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Z-Axis horizontal;

EUT OPERATING MODES

PG Transmitting Telemetry

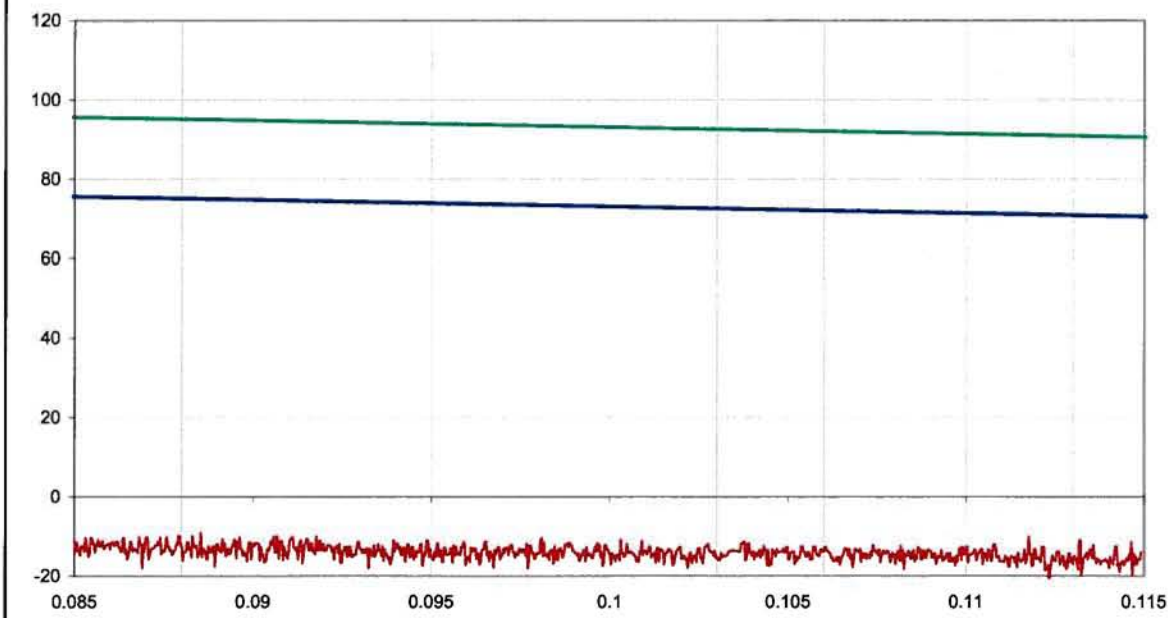
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	24

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.112	26.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-10.1	86.6	-96.7
0.113	25.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-11.0	86.5	-97.5
0.089	27.0	0.0	0.0	10.7	0.2	0.0	V		-47.0	-9.1	88.7	-97.8
0.115	25.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-11.4	86.4	-97.8
0.098	25.9	0.0	0.0	10.5	0.2	0.0	V		-47.0	-10.4	87.8	-98.2
0.091	26.2	0.0	0.0	10.7	0.2	0.0	V		-47.0	-9.9	88.4	-98.4
0.092	26.1	0.0	0.0	10.6	0.2	0.0	V		-47.0	-10.1	88.3	-98.4
0.100	25.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-10.9	87.6	-98.5
0.088	26.3	0.0	0.0	10.7	0.2	0.0	V		-47.0	-9.8	88.7	-98.5
0.091	26.0	0.0	0.0	10.7	0.2	0.0	V		-47.0	-10.1	88.4	-98.5
0.088	26.3	0.0	0.0	10.7	0.2	0.0	V		-47.0	-9.8	88.7	-98.6
0.091	26.0	0.0	0.0	10.7	0.2	0.0	V		-47.0	-10.1	88.5	-98.6
0.101	25.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-11.1	87.5	-98.6
0.104	25.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-11.4	87.3	-98.7
0.114	24.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-12.2	86.5	-98.7
0.111	24.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-12.0	86.7	-98.7
0.090	25.9	0.0	0.0	10.7	0.2	0.0	V		-47.0	-10.2	88.5	-98.8
0.088	26.0	0.0	0.0	10.7	0.2	0.0	V		-47.0	-10.1	88.7	-98.9
0.114	23.9	0.0	0.0	10.4	0.2	0.0	V		-47.0	-12.5	86.4	-98.9

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification: FCC 15.209:2003 | Method: ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Z-Axis horizontal

EUT OPERATING MODES

PG Transmitting Telemetry

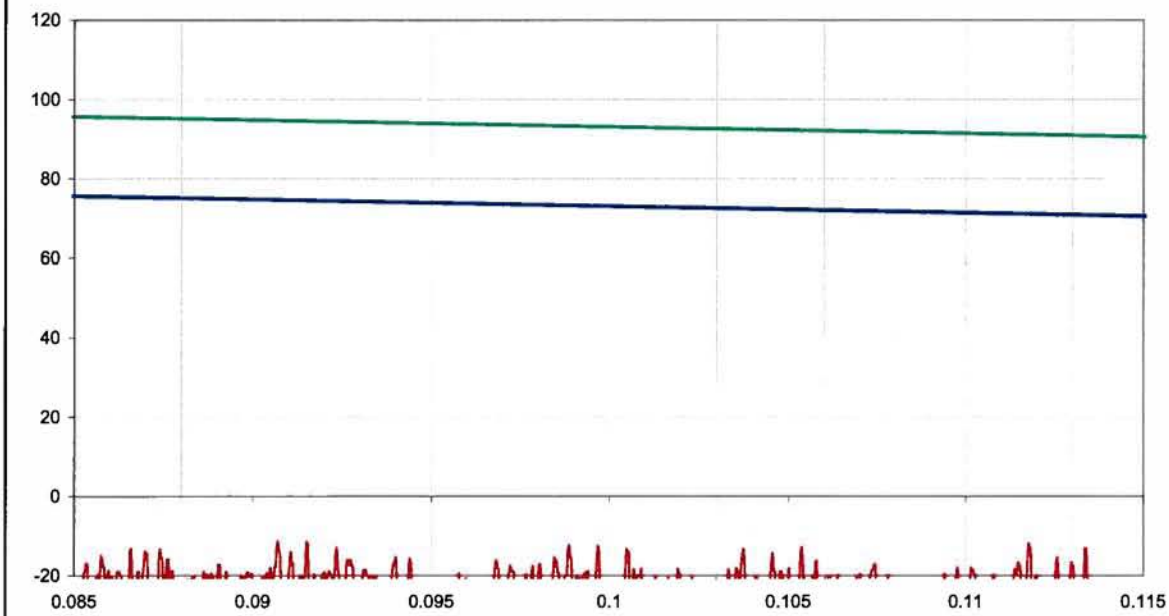
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	1	31

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.112	37.1	0.0	0.0	10.4	0.2	0.0	V		-59.0	-11.3	86.6	-97.9
0.113	35.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-12.6	86.5	-99.1
0.091	37.4	0.0	0.0	10.7	0.2	0.0	V		-59.0	-10.7	88.4	-99.2
0.092	37.2	0.0	0.0	10.7	0.2	0.0	V		-59.0	-10.9	88.4	-99.3
0.105	36.2	0.0	0.0	10.4	0.2	0.0	V		-59.0	-12.2	87.1	-99.3
0.099	36.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-11.7	87.7	-99.4
0.100	36.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-11.9	87.6	-99.5
0.104	35.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-12.7	87.3	-100.0
0.100	35.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-12.7	87.6	-100.3
0.092	35.8	0.0	0.0	10.6	0.2	0.0	V		-59.0	-12.4	88.3	-100.7
0.105	34.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-13.7	87.2	-100.9
0.113	33.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-14.9	86.6	-101.5
0.087	35.5	0.0	0.0	10.6	0.2	0.0	V		-59.0	-12.7	88.8	-101.5
0.087	35.4	0.0	0.0	10.6	0.2	0.0	V		-59.0	-12.8	88.8	-101.5
0.091	34.7	0.0	0.0	10.7	0.2	0.0	V		-59.0	-13.4	88.4	-101.8
0.087	34.8	0.0	0.0	10.6	0.2	0.0	V		-59.0	-13.4	88.8	-102.2
0.098	33.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-14.9	87.7	-102.6
0.113	32.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-16.1	86.5	-102.6
0.111	32.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-16.0	86.7	-102.7

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005.1.4
EMI 2005.4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Z-Axis vertical;

EUT OPERATING MODES

PG Transmitting Telemetry

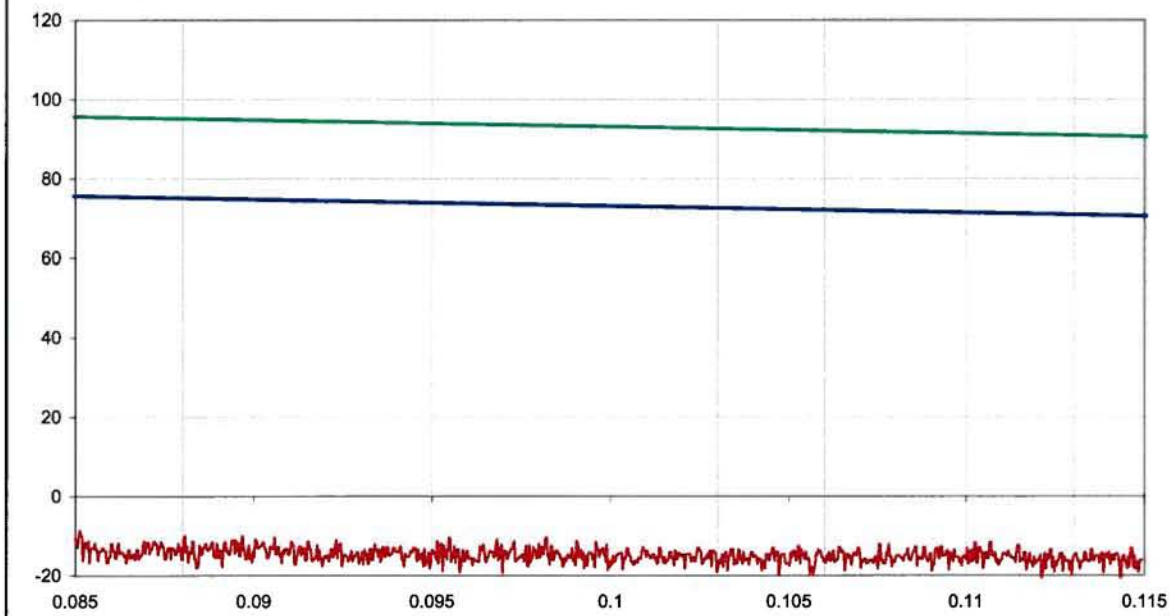
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	25

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.085	27.6	0.0	0.0	10.6	0.2	0.0	V		-47.0	-8.6	89.0	-97.6
0.098	25.9	0.0	0.0	10.5	0.2	0.0	V		-47.0	-10.4	87.8	-98.2
0.111	24.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-11.6	86.7	-98.3
0.110	24.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-11.7	86.8	-98.4
0.095	25.8	0.0	0.0	10.5	0.2	0.0	V		-47.0	-10.5	88.0	-98.5
0.090	26.1	0.0	0.0	10.7	0.2	0.0	V		-47.0	-10.0	88.5	-98.5
0.088	26.2	0.0	0.0	10.7	0.2	0.0	V		-47.0	-9.9	88.7	-98.6
0.091	25.9	0.0	0.0	10.7	0.2	0.0	V		-47.0	-10.2	88.5	-98.7
0.097	25.4	0.0	0.0	10.5	0.2	0.0	V		-47.0	-10.9	87.9	-98.8
0.099	25.1	0.0	0.0	10.4	0.2	0.0	V		-47.0	-11.3	87.7	-99.0
0.111	24.1	0.0	0.0	10.4	0.2	0.0	V		-47.0	-12.3	86.7	-99.0
0.108	24.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-12.1	86.9	-99.0
0.108	24.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-12.1	87.0	-99.1
0.097	25.0	0.0	0.0	10.5	0.2	0.0	V		-47.0	-11.3	87.8	-99.2
0.100	24.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-11.6	87.6	-99.2
0.092	25.2	0.0	0.0	10.6	0.2	0.0	V		-47.0	-11.0	88.3	-99.3
0.095	25.0	0.0	0.0	10.5	0.2	0.0	V		-47.0	-11.3	88.0	-99.3
0.115	23.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-13.0	86.4	-99.4
0.085	25.7	0.0	0.0	10.6	0.2	0.0	V		-47.0	-10.5	89.0	-99.5

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Z-Axis vertical

EUT OPERATING MODES

PG Transmitting Telemetry

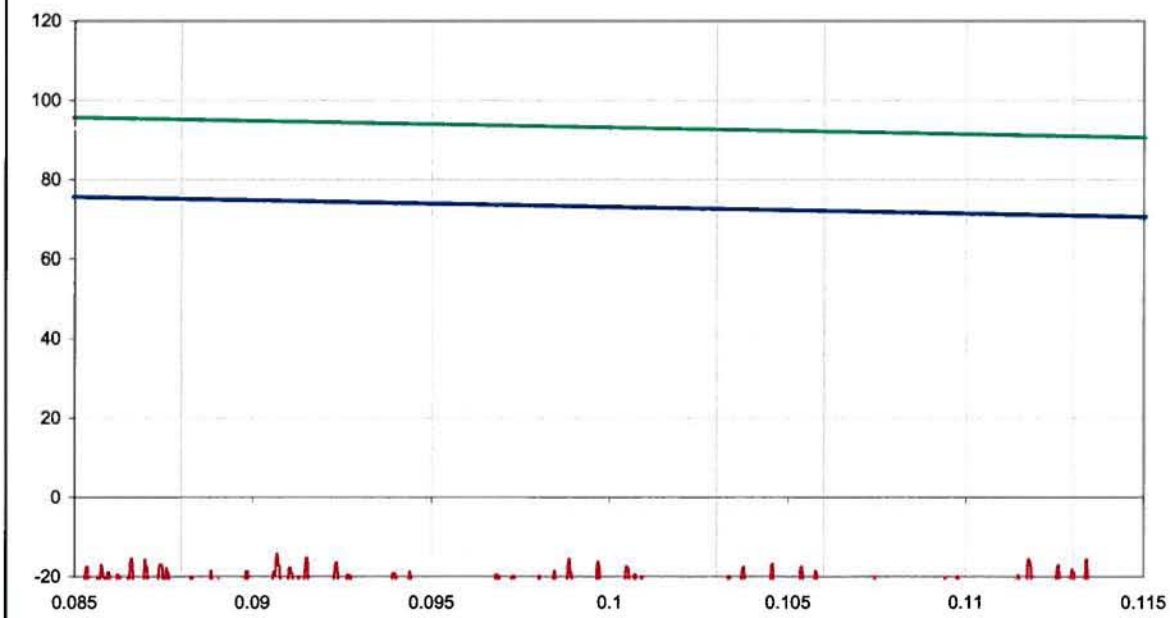
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	1	30

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.113	33.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-15.1	86.5	-101.6
0.112	33.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-15.0	86.6	-101.6
0.091	34.5	0.0	0.0	10.7	0.2	0.0	V		-59.0	-13.6	88.4	-102.1
0.099	33.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-14.9	87.7	-102.6
0.092	33.5	0.0	0.0	10.7	0.2	0.0	V		-59.0	-14.6	88.4	-103.0
0.113	31.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-16.6	86.6	-103.2
0.100	32.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-15.7	87.6	-103.3
0.105	32.2	0.0	0.0	10.4	0.2	0.0	V		-59.0	-16.2	87.2	-103.4
0.087	33.3	0.0	0.0	10.6	0.2	0.0	V		-59.0	-14.9	88.8	-103.7
0.087	33.0	0.0	0.0	10.6	0.2	0.0	V		-59.0	-15.2	88.8	-104.0
0.105	31.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-16.9	87.1	-104.0
0.113	30.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-17.6	86.5	-104.1
0.092	32.3	0.0	0.0	10.6	0.2	0.0	V		-59.0	-15.9	88.3	-104.2
0.104	31.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-17.0	87.3	-104.3
0.100	31.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-16.9	87.6	-104.5
0.106	30.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-18.0	87.1	-105.1
0.087	31.8	0.0	0.0	10.6	0.2	0.0	V		-59.0	-16.4	88.8	-105.1
0.086	31.7	0.0	0.0	10.6	0.2	0.0	V		-59.0	-16.5	88.9	-105.4
0.091	31.0	0.0	0.0	10.7	0.2	0.0	V		-59.0	-17.1	88.4	-105.5

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1 4
EMI 2005 4 13

EUT:	NGP / Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis vertical;

EUT OPERATING MODES

PG Transmitting Telemetry

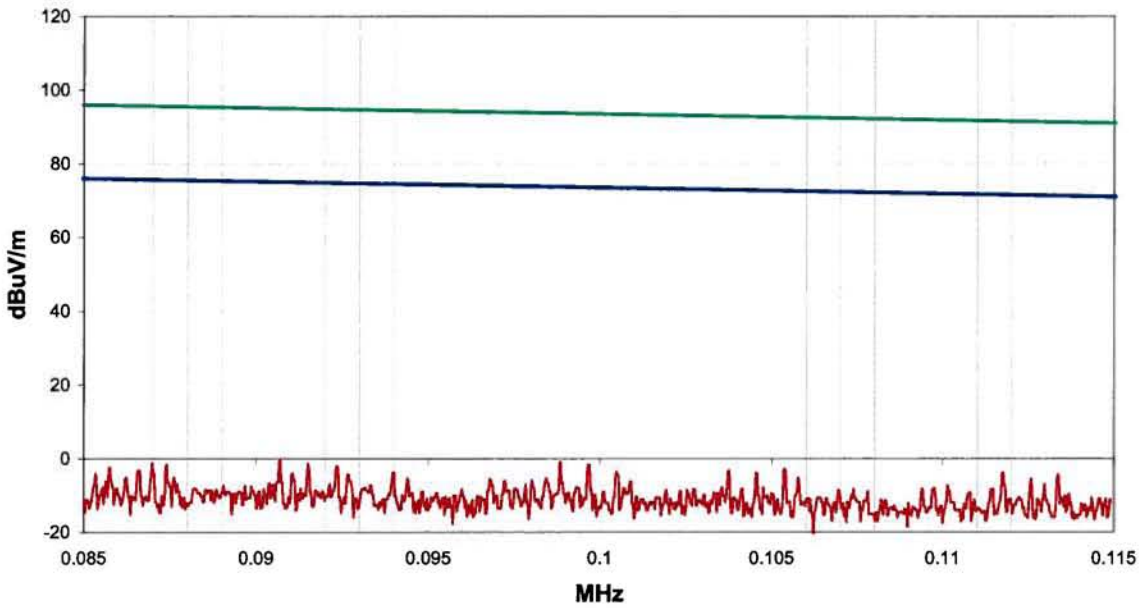
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	26

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.099	35.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-0.9	87.7	-88.6
0.091	35.7	0.0	0.0	10.7	0.2	0.0	V		-47.0	-0.4	88.4	-88.9
0.100	34.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.7	87.6	-89.3
0.092	34.7	0.0	0.0	10.7	0.2	0.0	V		-47.0	-1.4	88.4	-89.8
0.105	33.6	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.8	87.1	-89.9
0.087	35.0	0.0	0.0	10.6	0.2	0.0	V		-47.0	-1.2	88.8	-90.0
0.087	34.6	0.0	0.0	10.6	0.2	0.0	V		-47.0	-1.6	88.8	-90.3
0.112	32.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-3.7	86.6	-90.3
0.092	34.1	0.0	0.0	10.6	0.2	0.0	V		-47.0	-2.1	88.3	-90.4
0.104	33.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-3.2	87.3	-90.5
0.113	32.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-4.4	86.5	-90.9
0.105	32.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-3.9	87.2	-91.1
0.100	32.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-3.6	87.6	-91.2
0.086	33.8	0.0	0.0	10.6	0.2	0.0	V		-47.0	-2.4	88.9	-91.3
0.094	32.4	0.0	0.0	10.6	0.2	0.0	V		-47.0	-3.8	88.1	-92.0
0.087	33.0	0.0	0.0	10.6	0.2	0.0	V		-47.0	-3.2	88.8	-92.0
0.113	30.9	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.5	86.6	-92.1
0.106	31.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.2	87.1	-92.3
0.091	32.2	0.0	0.0	10.7	0.2	0.0	V		-47.0	-3.9	88.4	-92.3

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis vertical

EUT OPERATING MODES

PG Transmitting Telemetry

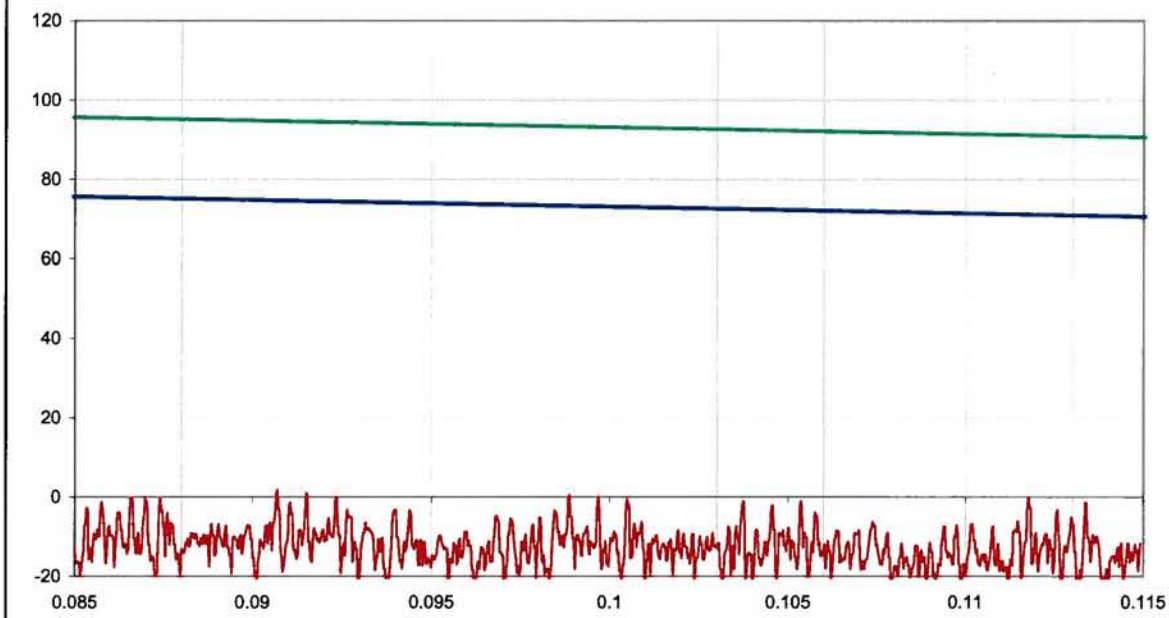
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	1	29

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.112	48.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	0.5	86.6	-86.1
0.091	50.4	0.0	0.0	10.7	0.2	0.0	V		-59.0	2.3	88.4	-86.2
0.099	49.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	1.0	87.7	-86.7
0.092	49.7	0.0	0.0	10.7	0.2	0.0	V		-59.0	1.6	88.4	-86.8
0.100	49.0	0.0	0.0	10.4	0.2	0.0	V		-59.0	0.6	87.6	-87.0
0.113	47.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-0.9	86.5	-87.4
0.105	47.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	-0.5	87.1	-87.6
0.100	48.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-0.1	87.6	-87.7
0.092	48.7	0.0	0.0	10.6	0.2	0.0	V		-59.0	0.5	88.3	-87.8
0.104	47.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	-0.5	87.3	-87.8
0.087	48.5	0.0	0.0	10.6	0.2	0.0	V		-59.0	0.3	88.8	-88.4
0.087	48.5	0.0	0.0	10.6	0.2	0.0	V		-59.0	0.3	88.8	-88.5
0.087	48.2	0.0	0.0	10.6	0.2	0.0	V		-59.0	0.0	88.8	-88.8
0.105	46.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.6	87.2	-88.8
0.091	47.2	0.0	0.0	10.7	0.2	0.0	V		-59.0	-0.9	88.4	-89.3
0.113	45.6	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.8	86.6	-89.4
0.086	47.5	0.0	0.0	10.6	0.2	0.0	V		-59.0	-0.7	88.9	-89.6
0.106	45.0	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.4	87.1	-90.5
0.098	45.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.0	87.7	-90.7

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis horizontal

EUT OPERATING MODES

PG Transmitting Telemetry

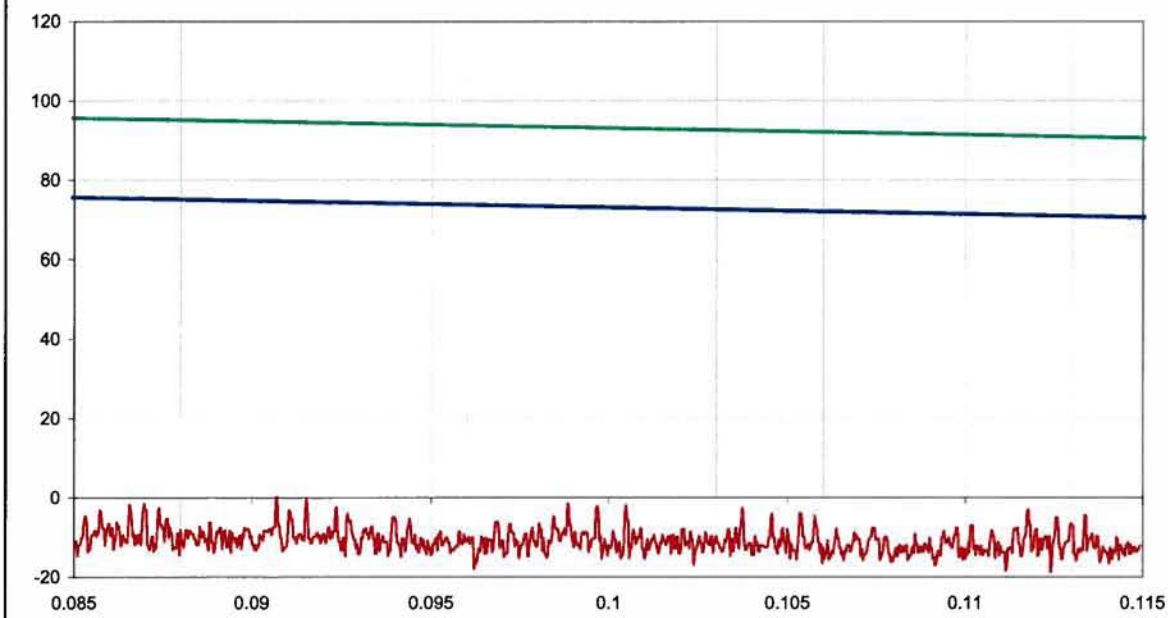
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	27

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks [PK] from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	36.4	0.0	0.0	10.7	0.2	0.0	V		-47.0	0.3	88.4	-88.2
0.092	35.8	0.0	0.0	10.7	0.2	0.0	V		-47.0	-0.3	88.4	-88.7
0.099	34.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-1.6	87.7	-89.3
0.100	34.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.0	87.6	-89.6
0.112	33.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-3.0	86.6	-89.6
0.100	34.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.2	87.6	-89.8
0.104	33.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.6	87.3	-89.9
0.087	34.6	0.0	0.0	10.6	0.2	0.0	V		-47.0	-1.6	88.8	-90.4
0.087	34.4	0.0	0.0	10.6	0.2	0.0	V		-47.0	-1.8	88.8	-90.6
0.092	33.8	0.0	0.0	10.6	0.2	0.0	V		-47.0	-2.4	88.3	-90.7
0.113	32.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-4.4	86.5	-90.9
0.105	32.5	0.0	0.0	10.4	0.2	0.0	V		-47.0	-3.9	87.1	-91.0
0.105	32.3	0.0	0.0	10.4	0.2	0.0	V		-47.0	-4.1	87.2	-91.3
0.087	33.6	0.0	0.0	10.6	0.2	0.0	V		-47.0	-2.6	88.8	-91.3
0.113	31.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.0	86.6	-91.6
0.091	32.9	0.0	0.0	10.7	0.2	0.0	V		-47.0	-3.2	88.4	-91.6
0.106	31.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-4.6	87.1	-91.7
0.086	33.0	0.0	0.0	10.6	0.2	0.0	V		-47.0	-3.2	88.9	-92.1
0.093	32.1	0.0	0.0	10.6	0.2	0.0	V		-47.0	-4.1	88.3	-92.3

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1.4
EMI 2005 4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guldant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis horizontal

EUT OPERATING MODES

PG Transmitting Telemetry

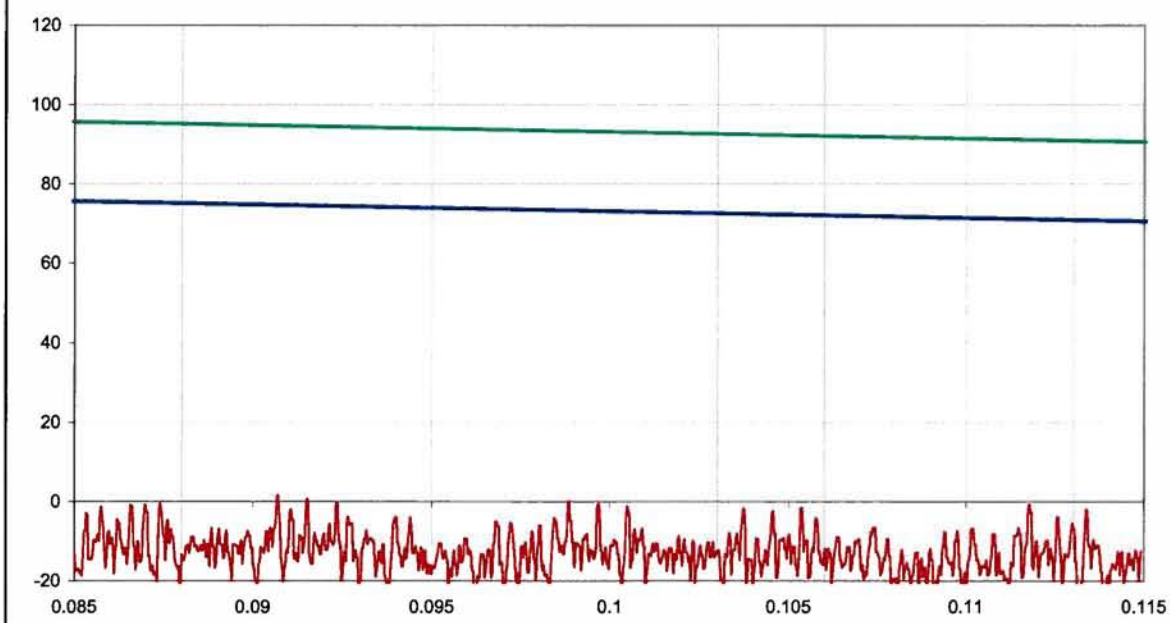
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	1	28

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peak) (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	50.3	0.0	0.0	10.7	0.2	0.0	V		-59.0	2.2	88.4	-86.3
0.112	48.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-0.1	86.6	-86.7
0.099	49.0	0.0	0.0	10.4	0.2	0.0	V		-59.0	0.6	87.7	-87.1
0.092	49.4	0.0	0.0	10.7	0.2	0.0	V		-59.0	1.3	88.4	-87.1
0.100	48.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	0.0	87.6	-87.6
0.113	46.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.5	86.5	-88.0
0.092	48.4	0.0	0.0	10.6	0.2	0.0	V		-59.0	0.2	88.3	-88.1
0.105	47.4	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.0	87.1	-88.1
0.100	47.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-0.7	87.6	-88.3
0.104	47.1	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.3	87.3	-88.6
0.087	48.2	0.0	0.0	10.6	0.2	0.0	V		-59.0	0.0	88.8	-88.7
0.087	48.0	0.0	0.0	10.6	0.2	0.0	V		-59.0	-0.2	88.8	-89.0
0.105	46.6	0.0	0.0	10.4	0.2	0.0	V		-59.0	-1.8	87.2	-89.0
0.087	47.8	0.0	0.0	10.6	0.2	0.0	V		-59.0	-0.4	88.8	-89.2
0.086	47.4	0.0	0.0	10.6	0.2	0.0	V		-59.0	-0.8	88.9	-89.7
0.091	46.7	0.0	0.0	10.7	0.2	0.0	V		-59.0	-1.4	88.4	-89.8
0.113	45.0	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.4	86.6	-90.0
0.106	44.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.6	87.1	-90.7
0.085	45.9	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.3	89.0	-91.3

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005.1.4
EMI 2005.5.05

EUT:	Frontier HE Model	Work Order:	GDMN0075
Serial Number:	N/A	Date:	05/12/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis vertical; HE Model;

EUT OPERATING MODES

PG Transmitting Telemetry

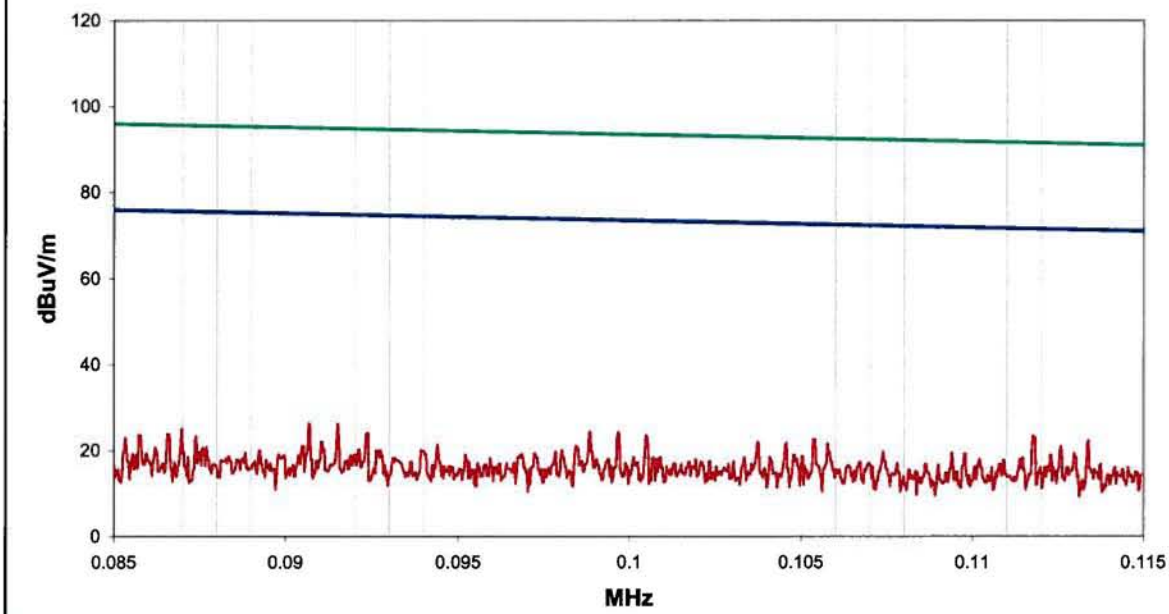
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	2	12

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.092	35.4	0.0	0.0	10.7	0.2	0.0	V		-47.0	-0.7	88.4	-89.1
0.091	35.4	0.0	0.0	10.7	0.2	0.0	V		-47.0	-0.7	88.4	-89.2
0.112	32.8	0.0	0.0	10.4	0.2	0.0	V		-47.0	-3.6	86.6	-90.2
0.100	33.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.7	87.6	-90.3
0.099	33.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-2.7	87.7	-90.4
0.087	34.2	0.0	0.0	10.6	0.2	0.0	V		-47.0	-2.0	88.8	-90.8
0.100	33.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-3.4	87.6	-91.0
0.092	33.3	0.0	0.0	10.6	0.2	0.0	V		-47.0	-2.9	88.3	-91.2
0.113	31.7	0.0	0.0	10.4	0.2	0.0	V		-47.0	-4.7	86.5	-91.2
0.105	32.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-4.4	87.1	-91.5
0.087	33.1	0.0	0.0	10.6	0.2	0.0	V		-47.0	-3.1	88.8	-91.9
0.104	31.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.0	87.3	-92.3
0.086	32.8	0.0	0.0	10.6	0.2	0.0	V		-47.0	-3.4	88.9	-92.3
0.105	31.2	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.2	87.2	-92.4
0.087	32.5	0.0	0.0	10.6	0.2	0.0	V		-47.0	-3.7	88.8	-92.4
0.106	31.0	0.0	0.0	10.4	0.2	0.0	V		-47.0	-5.4	87.1	-92.5
0.113	30.4	0.0	0.0	10.4	0.2	0.0	V		-47.0	-6.0	86.6	-92.6
0.085	32.2	0.0	0.0	10.6	0.2	0.0	V		-47.0	-4.0	89.0	-93.0
0.091	31.2	0.0	0.0	10.7	0.2	0.0	V		-47.0	-4.9	88.4	-93.3

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005.1.4
EMI 2005.5.05

EUT:	Frontier HE Model	Work Order:	GDMN0075
Serial Number:	HE Model	Date:	05/12/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis vertical; HE Model

EUT OPERATING MODES

PG Transmitting Telemetry

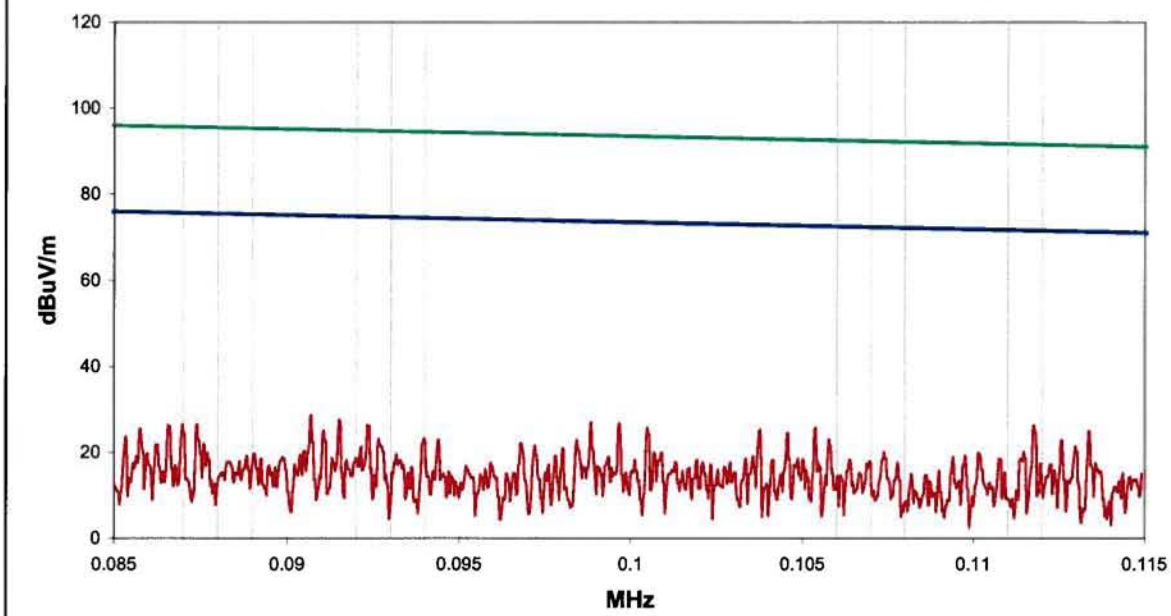
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Test Distance (m)	Run #
Evaluation	1	11

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Preamp (dB)	Chamber (dB)	Transducer (dB)	Cable (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector (blank equal peaks (PK) from scan)	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	47.3	0.0	0.0	10.7	0.2	0.0	V		-59.0	-0.8	88.4	-89.3
0.112	45.3	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.1	86.6	-89.7
0.092	46.4	0.0	0.0	10.7	0.2	0.0	V		-59.0	-1.7	88.4	-90.1
0.099	45.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.5	87.7	-90.2
0.100	45.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-2.7	87.6	-90.3
0.105	44.7	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.7	87.1	-90.8
0.113	43.9	0.0	0.0	10.4	0.2	0.0	V		-59.0	-4.5	86.5	-91.0
0.100	44.6	0.0	0.0	10.4	0.2	0.0	V		-59.0	-3.8	87.6	-91.4
0.092	45.1	0.0	0.0	10.6	0.2	0.0	V		-59.0	-3.1	88.3	-91.4
0.104	44.2	0.0	0.0	10.4	0.2	0.0	V		-59.0	-4.2	87.3	-91.5
0.087	45.3	0.0	0.0	10.6	0.2	0.0	V		-59.0	-2.9	88.8	-91.7
0.087	45.2	0.0	0.0	10.6	0.2	0.0	V		-59.0	-3.0	88.8	-91.7
0.087	45.1	0.0	0.0	10.6	0.2	0.0	V		-59.0	-3.1	88.8	-91.9
0.105	43.5	0.0	0.0	10.4	0.2	0.0	V		-59.0	-4.9	87.2	-92.1
0.091	43.8	0.0	0.0	10.7	0.2	0.0	V		-59.0	-4.3	88.4	-92.7
0.086	44.3	0.0	0.0	10.6	0.2	0.0	V		-59.0	-3.9	88.9	-92.8
0.113	41.8	0.0	0.0	10.4	0.2	0.0	V		-59.0	-6.6	86.6	-93.2
0.106	42.0	0.0	0.0	10.4	0.2	0.0	V		-59.0	-6.4	87.1	-93.5
0.094	42.0	0.0	0.0	10.6	0.2	0.0	V		-59.0	-6.2	88.1	-94.4

The following maximized data (pages 31 - 42) is used to show precise values compared to the limits. For the maximized data, measurements were made at 2 distances to determine the correct extrapolation factor, as specified in 15.31. Final data was acquired using a Quasi Peak detector as specified for the restricted band. This final maximized data demonstrates the equipment meets the 15.201 verification requirements being greater than 40 dB below the 15.209 specification limits.

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2004	Method:	ANSI C63.4:2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop X-Axis, PG X-Axis;

EUT OPERATING MODES

PG Transmitting Telemetry

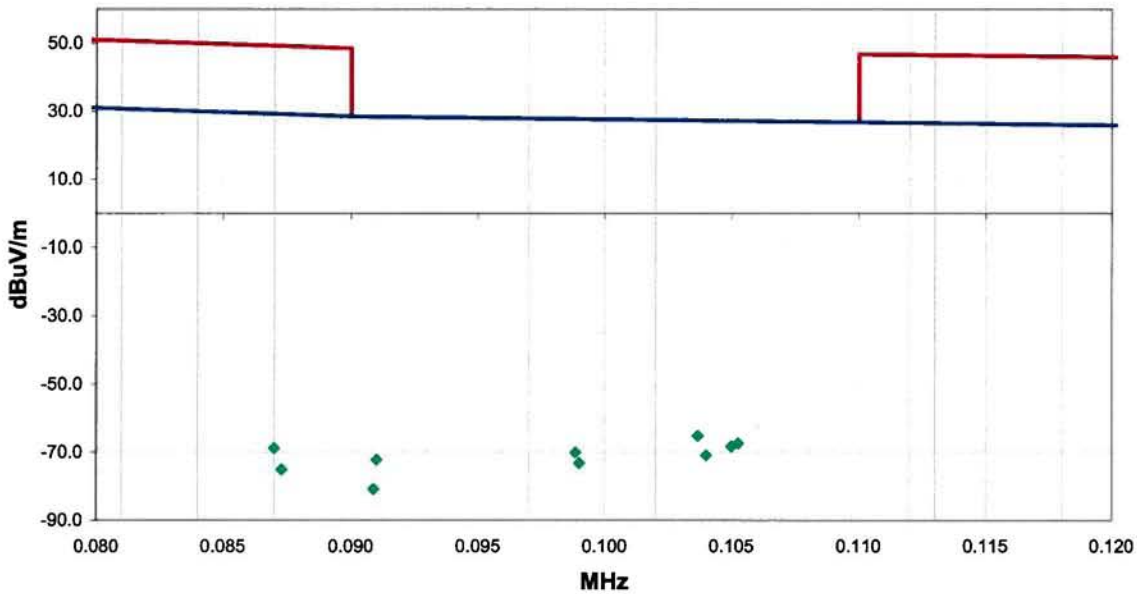
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	1

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.087	29.7	10.9	0.0	1.0	2.0	0.0	Loop	PK	-115.7	-75.1	48.8	-123.9
0.091	31.2	10.9	0.0	1.0	2.0	0.0	Loop	PK	-122.9	-80.8	28.4	-109.2
0.099	31.4	10.6	0.0	1.0	2.0	0.0	Loop	PK	-112.0	-70.0	27.7	-97.7
0.104	30.5	10.6	0.0	1.0	2.0	0.0	Loop	PK	-106.3	-65.2	27.3	-92.5
0.105	30.4	10.6	0.0	1.0	2.0	0.0	Loop	PK	-108.4	-67.4	27.2	-94.6
0.087	32.4	10.8	0.0	1.0	2.0	0.0	Loop	QP	-112.0	-68.8	28.8	-97.6
0.091	33.3	10.9	0.0	1.0	2.0	0.0	Loop	QP	-116.4	-72.2	28.4	-100.6
0.099	32.6	10.6	0.0	1.0	2.0	0.0	Loop	QP	-116.4	-73.2	27.7	-100.9
0.104	31.3	10.6	0.0	1.0	2.0	0.0	Loop	QP	-112.8	-70.9	27.3	-98.2
0.105	31.7	10.6	0.0	1.0	2.0	0.0	Loop	QP	-110.6	-68.3	27.2	-95.5

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1-4
EMI 2005 4-13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	04/29/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2004	Method:	ANSI C63.4:2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop X-Axis, PG X-Axis

EUT OPERATING MODES

PG Transmitting Telemetry

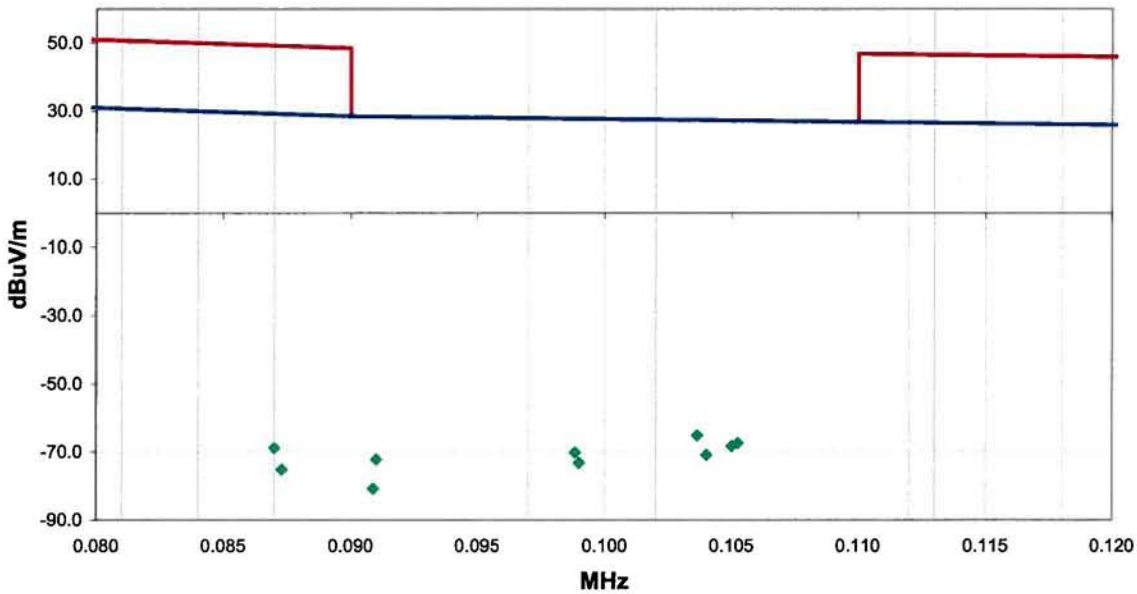
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	1

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.087	45.7	10.8	0.0	1.0	1.0	0.0	Loop	PK	-131.7	-75.2	48.8	-124.0
0.091	48.2	10.9	0.0	1.0	1.0	0.0	Loop	PK	-139.9	-80.8	28.4	-109.2
0.099	46.7	10.6	0.0	1.0	1.0	0.0	Loop	PK	-127.5	-70.2	27.7	-97.9
0.104	45.2	10.6	0.0	1.0	1.0	0.0	Loop	PK	-121.0	-65.2	27.3	-92.5
0.105	45.4	10.6	0.0	1.0	1.0	0.0	Loop	PK	-123.4	-67.4	27.2	-94.6
0.087	47.9	10.8	0.0	1.0	1.0	0.0	Loop	QP	-127.5	-68.8	28.8	-97.6
0.091	49.4	10.9	0.0	1.0	1.0	0.0	Loop	QP	-132.5	-72.2	28.4	-100.6
0.099	48.7	10.6	0.0	1.0	1.0	0.0	Loop	QP	-132.5	-73.2	27.7	-100.9
0.104	46.9	10.6	0.0	1.0	1.0	0.0	Loop	QP	-128.4	-70.9	27.3	-98.2
0.105	47.0	10.6	0.0	1.0	1.0	0.0	Loop	QP	-125.9	-68.3	27.2	-95.5

Distance Adjustment Factor for Radiated Emissions below 30 MHz

Method: Per 47 CFR 15.31(f)(2), the data was extrapolated based upon a the measured fall-off (at each frequency / polarity).

EUT: Frontier
S/N:
Date: 5/2/2005
Job Number: GDMN0070

Frequency (MHz)	Loop Antenna Polarity	Detector	Test Distance (meters)	Adjusted Level (dBuV/m)	Fall-Off from 1 to 2 m (dB)	Extrapolation Factor for Specification Limit (dB / decade)	Test Distance of Spec. Limit (meters)	Distance Adjustment Factor (dB)
0.087	Maximum Position	PK	2	29.7	-16.0	53.2	300.0	115.7
			1	45.7				131.7
0.091	Maximum Position	PK	2	31.2	-17.0	56.5	300.0	122.9
			1	48.2				139.9
0.099	Maximum Position	PK	2	31.2	-15.5	51.5	300.0	112.0
			1	46.7				127.5
0.104	Maximum Position	PK	2	30.5	-14.7	48.8	300.0	106.3
			1	45.2				121.0
0.105	Maximum Position	PK	2	30.4	-15.0	49.8	300.0	108.4
			1	45.4				123.4
0.087	Maximum Position	QP	2	32.4	-15.5	51.5	300.0	112.0
			1	47.9				127.5
0.091	Maximum Position	QP	2	33.3	-16.1	53.5	300.0	116.4
			1	49.4				132.5
0.099	Maximum Position	QP	2	32.6	-16.1	53.5	300.0	116.4
			1	48.7				132.5
0.104	Maximum Position	QP	2	31.3	-15.6	51.8	300.0	112.8
			1	46.9				128.4
0.105	Maximum Position	QP	2	31.7	-15.3	50.8	300.0	110.6
			1	47.0				125.9

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005.1.4
EMI 2005.4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2004	Method:	ANSI C63.4:2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Y-Axis vertical;

EUT OPERATING MODES

PG Transmitting Telemetry

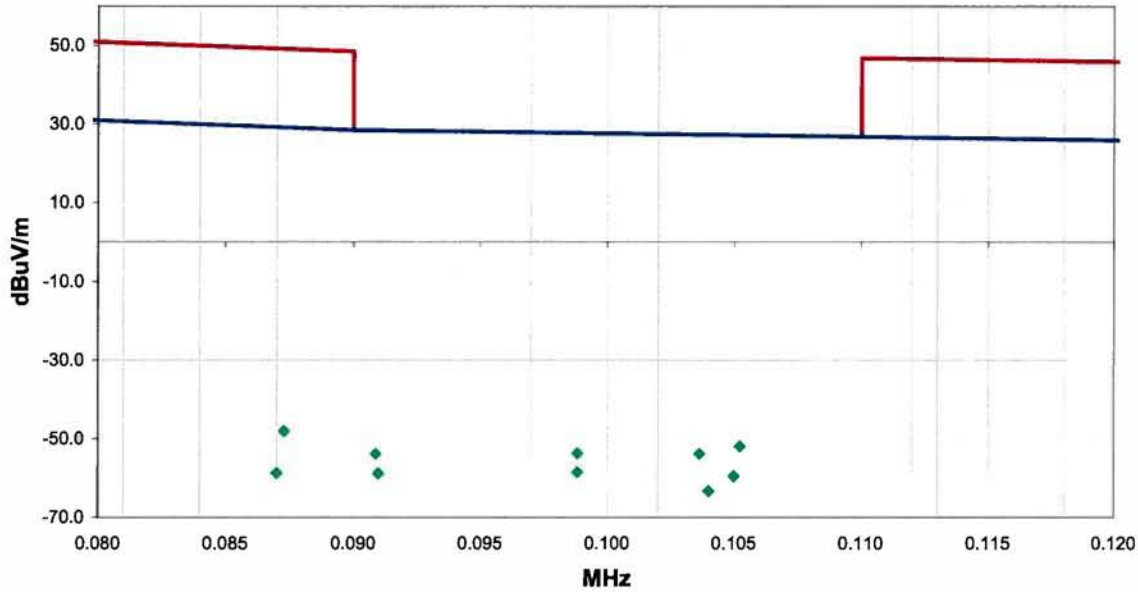
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	3

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.105	32.9	10.6	0.0	1.0	2.0	0.0	Loop	PK	-95.4	-51.9	27.2	-79.1
0.104	32.5	10.6	0.0	1.0	2.0	0.0	Loop	PK	-96.9	-53.8	27.3	-81.1
0.099	34.0	10.6	0.0	1.0	2.0	0.0	Loop	PK	-98.3	-53.7	27.7	-81.4
0.091	35.1	10.9	0.0	1.0	2.0	0.0	Loop	PK	-99.8	-53.8	28.4	-82.2
0.099	35.0	10.6	0.0	1.0	2.0	0.0	Loop	QP	-104.1	-58.5	27.7	-86.2
0.105	33.3	10.6	0.0	1.0	2.0	0.0	Loop	QP	-103.4	-59.5	27.2	-86.7
0.091	35.8	10.9	0.0	1.0	2.0	0.0	Loop	QP	-105.5	-58.8	28.4	-87.2
0.087	34.6	10.8	0.0	1.0	2.0	0.0	Loop	QP	-104.1	-58.7	28.8	-87.5
0.104	33.1	10.6	0.0	1.0	2.0	0.0	Loop	QP	-107.0	-63.3	27.3	-90.6
0.087	33.7	10.8	0.0	1.0	2.0	0.0	Loop	PK	-92.5	-48.0	48.8	-96.8

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1-3
EMI 2005 4.13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2004	Method:	ANSI C63.4:2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Y-Axis, PG Y-Axis vertical

EUT OPERATING MODES

PG Transmitting Telemetry

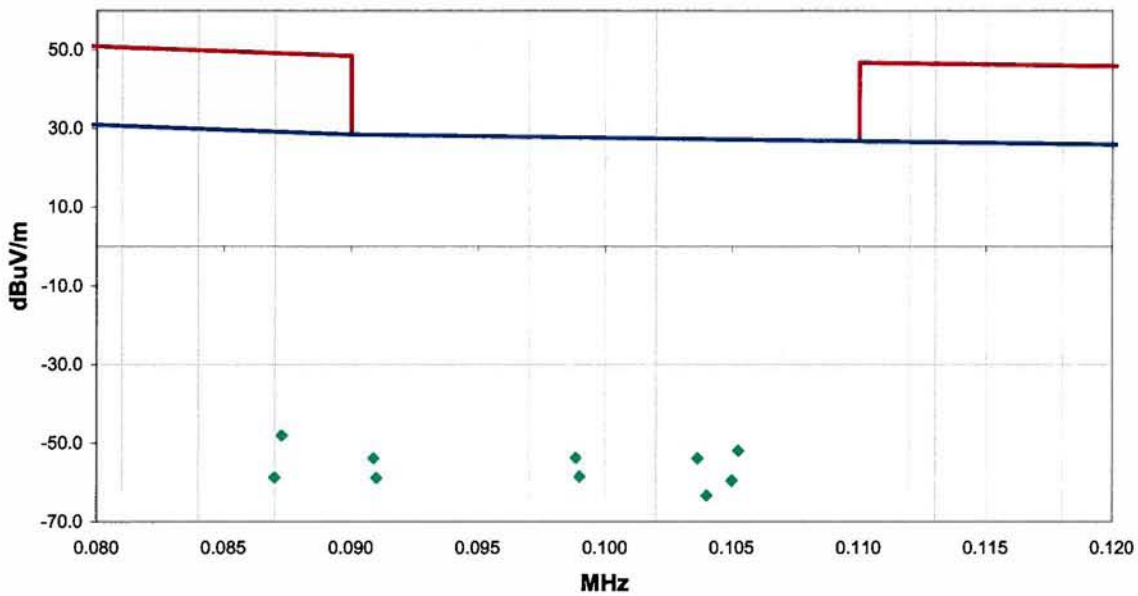
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	3

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.105	46.1	10.6	0.0	1.0	1.0	0.0	Loop	PK	-108.6	-51.9	27.2	-79.1
0.104	45.9	10.6	0.0	1.0	1.0	0.0	Loop	PK	-110.3	-53.8	27.3	-81.1
0.099	47.6	10.6	0.0	1.0	1.0	0.0	Loop	PK	-111.9	-53.7	27.7	-81.4
0.091	48.9	10.9	0.0	1.0	1.0	0.0	Loop	PK	-113.6	-53.8	28.4	-82.2
0.099	49.4	10.6	0.0	1.0	1.0	0.0	Loop	QP	-118.5	-58.5	27.7	-86.2
0.105	47.6	10.6	0.0	1.0	1.0	0.0	Loop	QP	-117.7	-59.5	27.2	-86.7
0.091	50.4	10.9	0.0	1.0	1.0	0.0	Loop	QP	-120.1	-58.8	28.4	-87.2
0.087	49.0	10.8	0.0	1.0	1.0	0.0	Loop	QP	-118.5	-58.7	28.8	-87.5
0.104	47.9	10.6	0.0	1.0	1.0	0.0	Loop	QP	-121.8	-63.3	27.3	-90.6
0.087	46.5	10.8	0.0	1.0	1.0	0.0	Loop	PK	-105.3	-48.0	48.8	-96.8

Distance Adjustment Factor for Radiated Emissions below 30 MHz

Method: Per 47 CFR 15.31(f)(2), the data was extrapolated based upon a the measured fall-off (at each frequency / polarity).

EUT: Frontier
S/N:
Date: 5/2/2005
Job Number: GDMN0070

Frequency (MHz)	Loop Antenna Polarity	Detector	Test Distance (meters)	Adjusted Level (dBuV/m)	Fall-Off from 1 to 2 m (dB)	Extrapolation Factor for Specification Limit (dB / decade)	Test Distance of Spec. Limit (meters)	Distance Adjustment Factor (dB)
0.087	Maximum Position	PK	2	33.7	-12.8	42.5	300.0	92.5
			1	46.5				105.3
0.091	Maximum Position	PK	2	35.1	-13.8	45.8	300.0	99.8
			1	48.9				113.6
0.099	Maximum Position	PK	2	34.0	-13.6	45.2	300.0	98.3
			1	47.6				111.9
0.104	Maximum Position	PK	2	32.5	-13.4	44.5	300.0	96.9
			1	45.9				110.3
0.105	Maximum Position	PK	2	32.9	-13.2	43.8	300.0	95.4
			1	46.1				108.6
0.087	Maximum Position	QP	2	34.6	-14.4	47.8	300.0	104.1
			1	49.0				118.5
0.091	Maximum Position	QP	2	35.8	-14.6	48.5	300.0	105.5
			1	50.4				120.1
0.099	Maximum Position	QP	2	35.0	-14.4	47.8	300.0	104.1
			1	49.4				118.5
0.104	Maximum Position	QP	2	33.1	-14.8	49.2	300.0	107.0
			1	47.9				121.8
0.105	Maximum Position	QP	2	33.3	-14.3	47.5	300.0	103.4
			1	47.6				117.7

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005 1 4
EMI 2005 4 13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2004	Method:	ANSI C63.4:2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis vertical;

EUT OPERATING MODES

PG Transmitting Telemetry

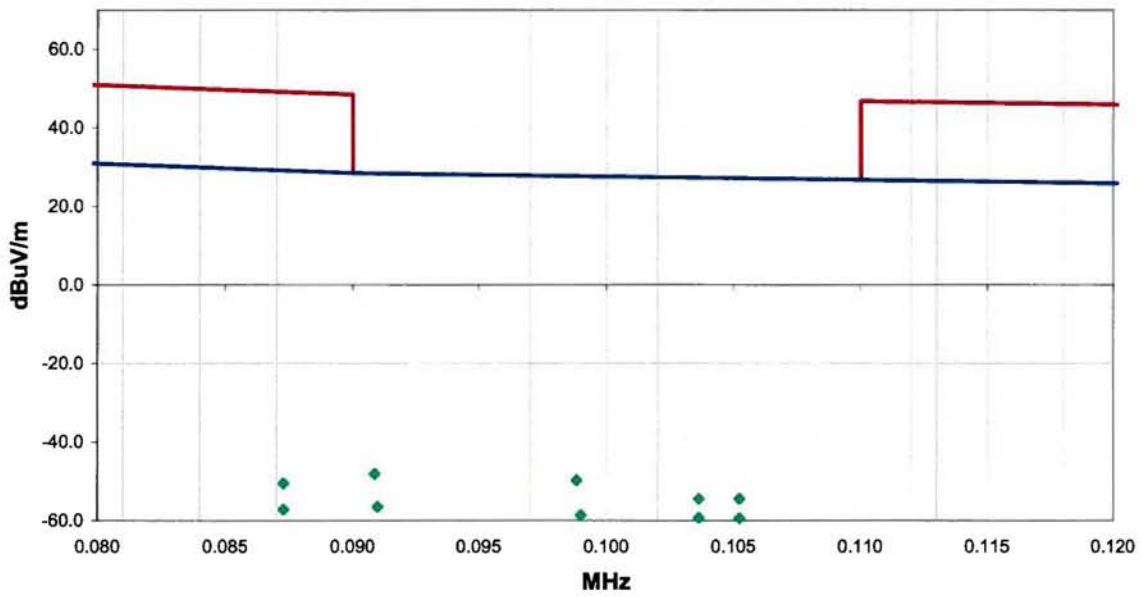
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	4

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	37.9	10.9	0.0	1.0	2.0	0.0	Loop	PK	-96.9	-48.1	28.4	-76.5
0.099	36.6	10.6	0.0	1.0	2.0	0.0	Loop	PK	-96.9	-49.7	27.7	-77.4
0.105	34.8	10.6	0.0	1.0	2.0	0.0	Loop	PK	-99.8	-54.4	27.2	-81.6
0.104	34.7	10.6	0.0	1.0	2.0	0.0	Loop	PK	-99.8	-54.5	27.3	-81.8
0.091	38.1	10.9	0.0	1.0	2.0	0.0	Loop	QP	-105.5	-56.5	28.4	-84.9
0.087	36.8	10.8	0.0	1.0	2.0	0.0	Loop	QP	-104.8	-57.2	28.8	-86.0
0.099	37.1	10.6	0.0	1.0	2.0	0.0	Loop	QP	-106.3	-58.6	27.7	-86.3
0.105	35.5	10.6	0.0	1.0	2.0	0.0	Loop	QP	-105.5	-59.4	27.2	-86.6
0.104	35.6	10.6	0.0	1.0	2.0	0.0	Loop	QP	-105.5	-59.3	27.3	-86.6
0.087	35.6	10.8	0.0	1.0	2.0	0.0	Loop	PK	-96.9	-50.5	48.8	-99.3

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1-4
EMI 2005 4-13

EUT:	Frontier	Work Order:	GDMN0070
Serial Number:	N/A	Date:	05/02/05
Customer:	Guldant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2004	Method:	ANSI C63.4:2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis vertical

EUT OPERATING MODES

PG Transmitting Telemetry

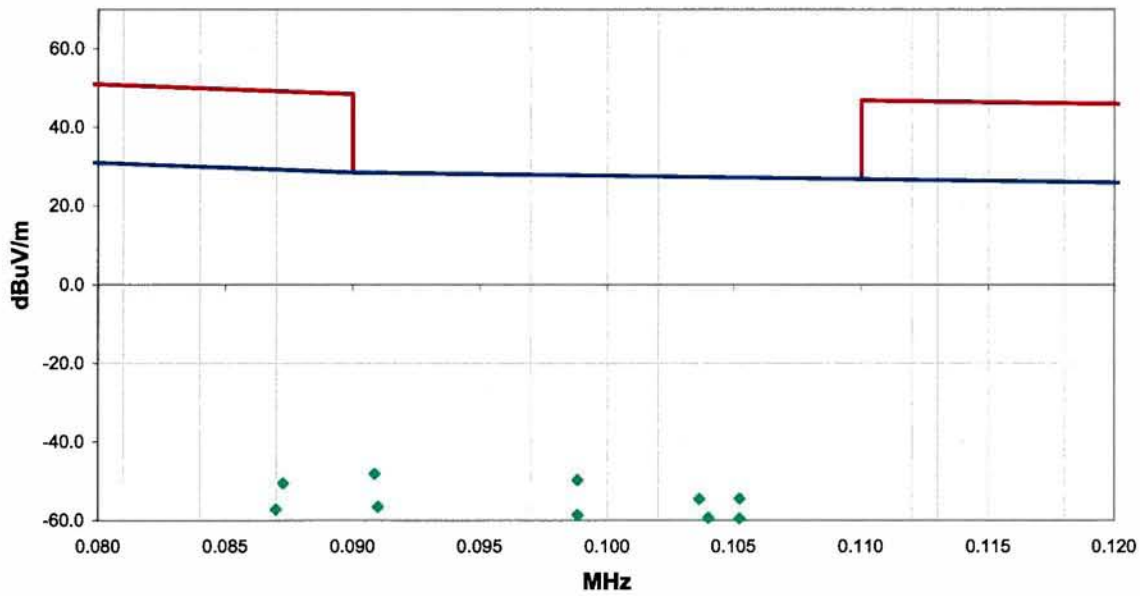
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	4

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.091	51.3	10.9	0.0	1.0	1.0	0.0	Loop	PK	-110.3	-48.1	28.4	-76.5
0.099	50.0	10.6	0.0	1.0	1.0	0.0	Loop	PK	-110.3	-49.7	27.7	-77.4
0.105	48.6	10.6	0.0	1.0	1.0	0.0	Loop	PK	-113.6	-54.4	27.2	-81.6
0.104	48.5	10.6	0.0	1.0	1.0	0.0	Loop	PK	-113.6	-54.5	27.3	-81.8
0.091	52.7	10.9	0.0	1.0	1.0	0.0	Loop	QP	-120.1	-56.5	28.4	-84.9
0.087	51.3	10.8	0.0	1.0	1.0	0.0	Loop	QP	-119.3	-57.2	28.8	-86.0
0.099	51.8	10.6	0.0	1.0	1.0	0.0	Loop	QP	-121.0	-58.6	27.7	-86.3
0.105	50.1	10.6	0.0	1.0	1.0	0.0	Loop	QP	-120.1	-59.4	27.2	-86.6
0.104	50.2	10.6	0.0	1.0	1.0	0.0	Loop	QP	-120.1	-59.3	27.3	-86.6
0.087	49.0	10.8	0.0	1.0	1.0	0.0	Loop	PK	-110.3	-50.5	48.8	-99.3

Distance Adjustment Factor for Radiated Emissions below 30 MHz

Method: Per 47 CFR 15.31(f)(2), the data was extrapolated based upon a the measured fall-off (at each frequency / polarity).

EUT: Frontier
S/N:
Date: 5/2/2005
Job Number: GDMN0070

Frequency (MHz)	Loop Antenna Polarity	Detector	Test Distance (meters)	Adjusted Level (dBuV/m)	Fall-Off from 1 to 2 m (dB)	Extrapolation Factor for Specification Limit (dB / decade)	Test Distance of Spec. Limit (meters)	Distance Adjustment Factor (dB)
0.087	Maximum Position	PK	2	35.6	-13.4	44.5	300.0	96.9
			1	49.0				110.3
0.091	Maximum Position	PK	2	37.9	-13.4	44.5	300.0	96.9
			1	51.3				110.3
0.099	Maximum Position	PK	2	36.6	-13.4	44.5	300.0	96.9
			1	50.0				110.3
0.104	Maximum Position	PK	2	34.7	-13.8	45.8	300.0	99.8
			1	48.5				113.6
0.105	Maximum Position	PK	2	34.8	-13.8	45.8	300.0	99.8
			1	48.6				113.6
0.087	Maximum Position	QP	2	36.8	-14.5	48.2	300.0	104.8
			1	51.3				119.3
0.091	Maximum Position	QP	2	38.1	-14.6	48.5	300.0	105.5
			1	52.7				120.1
0.099	Maximum Position	QP	2	37.1	-14.7	48.8	300.0	106.3
			1	51.8				121.0
0.104	Maximum Position	QP	2	35.6	-14.6	48.5	300.0	105.5
			1	50.2				120.1
0.105	Maximum Position	QP	2	35.5	-14.6	48.5	300.0	105.5
			1	50.1				120.1

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1.4
EMI 2005 5.05

EUT:	Frontier - HE Model	Work Order:	GDMN0075
Serial Number:	N/A	Date:	05/12/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2004	Method:	ANSI C63.4:2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis vertical; HE Model;

EUT OPERATING MODES

PG Transmitting Telemetry

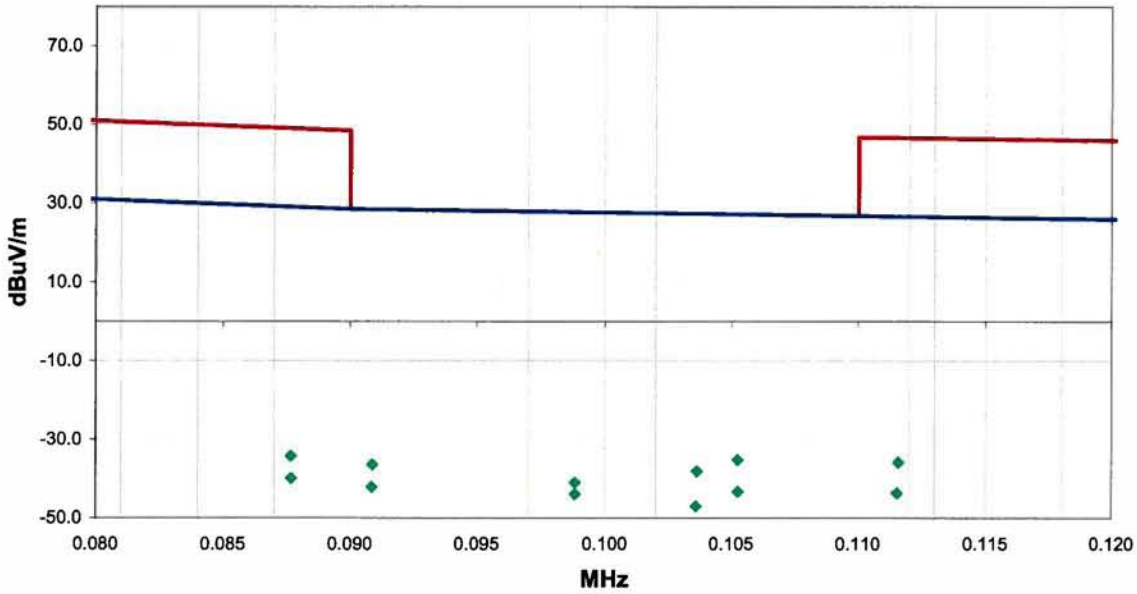
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	5

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.105	33.7	10.6	0.0	1.0	2.0	0.0	Loop	PK	-79.5	-35.2	27.2	-62.4
0.091	35.8	10.9	0.0	1.0	2.0	0.0	Loop	PK	-83.1	-36.4	28.4	-64.8
0.104	33.0	10.6	0.0	1.0	2.0	0.0	Loop	PK	-81.7	-38.1	27.3	-65.4
0.088	34.5	10.9	0.0	1.0	2.0	0.0	Loop	QP	-85.3	-39.9	28.7	-68.6
0.099	34.4	10.6	0.0	1.0	2.0	0.0	Loop	PK	-86.0	-41.0	27.7	-68.7
0.112	34.0	10.6	0.0	1.0	2.0	0.0	Loop	QP	-88.2	-43.6	26.7	-70.3
0.105	33.6	10.6	0.0	1.0	2.0	0.0	Loop	QP	-87.5	-43.3	27.2	-70.5
0.091	36.6	10.9	0.0	1.0	2.0	0.0	Loop	QP	-89.6	-42.1	28.4	-70.5
0.099	35.1	10.6	0.0	1.0	2.0	0.0	Loop	QP	-89.6	-43.9	27.7	-71.6
0.104	34.2	10.6	0.0	1.0	2.0	0.0	Loop	QP	-91.8	-47.0	27.3	-74.3
0.112	34.6	10.6	0.0	1.0	2.0	0.0	Loop	PK	-81.0	-35.8	46.7	-82.5
0.088	34.4	10.9	0.0	1.0	2.0	0.0	Loop	PK	-79.5	-34.2	48.7	-82.9

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005.1.4
EMI 2005.5.05

EUT:	Frontier - HE Model	Work Order:	GDMN0075
Serial Number:	N/A	Date:	05/12/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2004	Method:	ANSI C63.4:2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using QPSK waveform directly connected to Frontier 1 PG to induce transmission; Loop Z-Axis, PG Z-Axis vertical; HE Model

EUT OPERATING MODES

PG Transmitting Telemetry

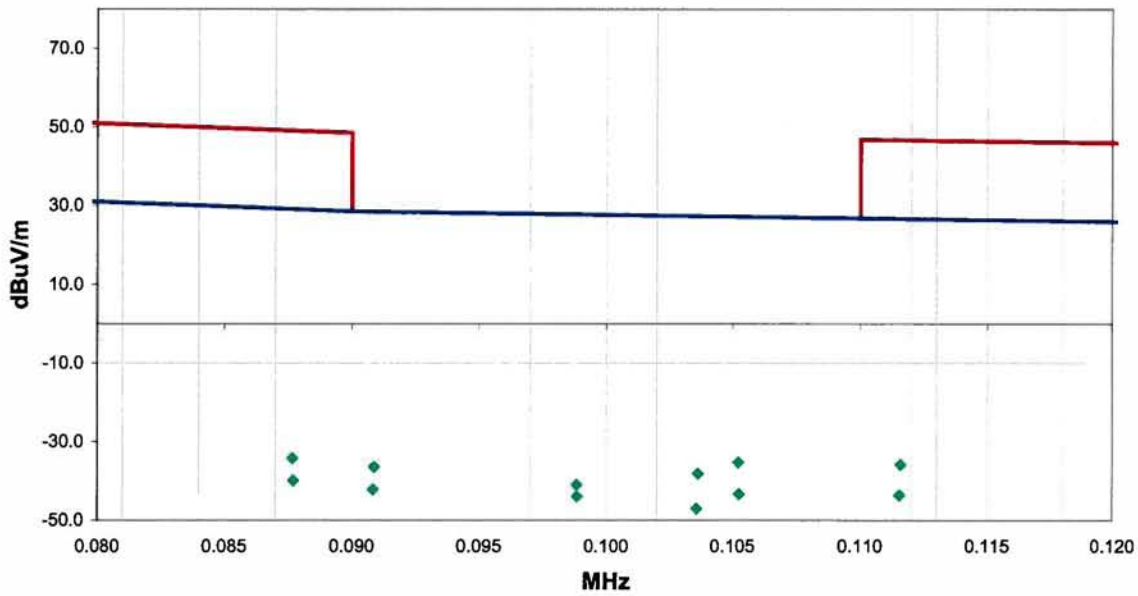
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	4

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.105	44.7	10.6	0.0	1.0	1.0	0.0	Loop	PK	-90.5	-35.2	27.2	-62.4
0.091	47.3	10.9	0.0	1.0	1.0	0.0	Loop	PK	-94.6	-36.4	28.4	-64.8
0.104	44.3	10.6	0.0	1.0	1.0	0.0	Loop	PK	-93.0	-38.1	27.3	-65.4
0.088	46.3	10.9	0.0	1.0	1.0	0.0	Loop	QP	-97.1	-39.9	28.7	-68.6
0.099	46.3	10.6	0.0	1.0	1.0	0.0	Loop	PK	-97.9	-41.0	27.7	-68.7
0.112	46.2	10.6	0.0	1.0	1.0	0.0	Loop	QP	-100.4	-43.6	26.7	-70.3
0.105	45.7	10.6	0.0	1.0	1.0	0.0	Loop	QP	-99.6	-43.3	27.2	-70.5
0.091	49.0	10.9	0.0	1.0	1.0	0.0	Loop	QP	-102.0	-42.1	28.4	-70.5
0.099	47.5	10.6	0.0	1.0	1.0	0.0	Loop	QP	-102.0	-43.9	27.7	-71.6
0.104	46.9	10.6	0.0	1.0	1.0	0.0	Loop	QP	-104.5	-47.0	27.3	-74.3
0.112	45.8	10.6	0.0	1.0	1.0	0.0	Loop	PK	-92.2	-35.8	46.7	-82.5
0.088	45.4	10.9	0.0	1.0	1.0	0.0	Loop	PK	-90.5	-34.2	48.7	-82.9

Distance Adjustment Factor for Radiated Emissions below 30 MHz

Method: Per 47 CFR 15.31(f)(2), the data was extrapolated based upon a the measured fall-off (at each frequency / polarity).

EUT: Frontier
S/N:
Date: 5/2/2005
Job Number: GDMN0070

Frequency (MHz)	Loop Antenna Polarity	Detector	Test Distance (meters)	Adjusted Level (dBuV/m)	Fall-Off from 1 to 2 m (dB)	Extrapolation Factor for Specification Limit (dB / decade)	Test Distance of Spec. Limit (meters)	Distance Adjustment Factor (dB)
0.087	Maximum Position	PK	2	34.4	-11.0	36.5	300.0	79.5
			1	45.4				90.5
0.091	Maximum Position	PK	2	35.8	-11.5	38.2	300.0	83.1
			1	47.3				94.6
0.099	Maximum Position	PK	2	34.4	-11.9	39.5	300.0	86.0
			1	46.3				97.9
0.104	Maximum Position	PK	2	33.0	-11.3	37.5	300.0	81.7
			1	44.3				93.0
0.105	Maximum Position	PK	2	33.7	-11.0	36.5	300.0	79.5
			1	44.7				90.5
0.112	Maximum Position	PK	2	34.6	-11.2	37.2	300.0	81.0
			1	45.8				92.2
0.087	Maximum Position	QP	2	34.5	-11.8	39.2	300.0	85.3
			1	46.3				97.1
0.091	Maximum Position	QP	2	36.6	-12.4	41.2	300.0	89.6
			1	49.0				102.0
0.099	Maximum Position	QP	2	35.1	-12.4	41.2	300.0	89.6
			1	47.5				102.0
0.104	Maximum Position	QP	2	34.2	-12.7	42.2	300.0	91.8
			1	46.9				104.5
0.105	Maximum Position	QP	2	33.6	-12.1	40.2	300.0	87.5
			1	45.7				99.6
0.112	Maximum Position	QP	2	34.0	-12.2	40.5	300.0	88.2
			1	46.2				100.4

The following data (pages 43 - 49) demostrates the emissions profile of the Programmer and the PG as one system. In normal operation, the PG must have a Programmer there to continuously communicate. That data, as may be referenced, demonstrates the entire system meets the requirements of 15.209. For the maximized data, measurements were made at 2 distances to determine the correct extrapolation factor, as specified in 15.31.

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACO 2005.1.4
EMI 2005.4.13

EUT:	NGP / Frontier	Work Order:	GDMN0070
Serial Number:	610502 H303	Date:	05/04/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	49%
Cust. Ref. No.:		Barometric Pressure	30.15
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using Red Hat Linux Inductive Link Session; Loop antenna - Z-Axis, PG Z-Axis vertical; SE Model (H/17861718); 3m distance

EUT OPERATING MODES

PG Transmitting Telemetry

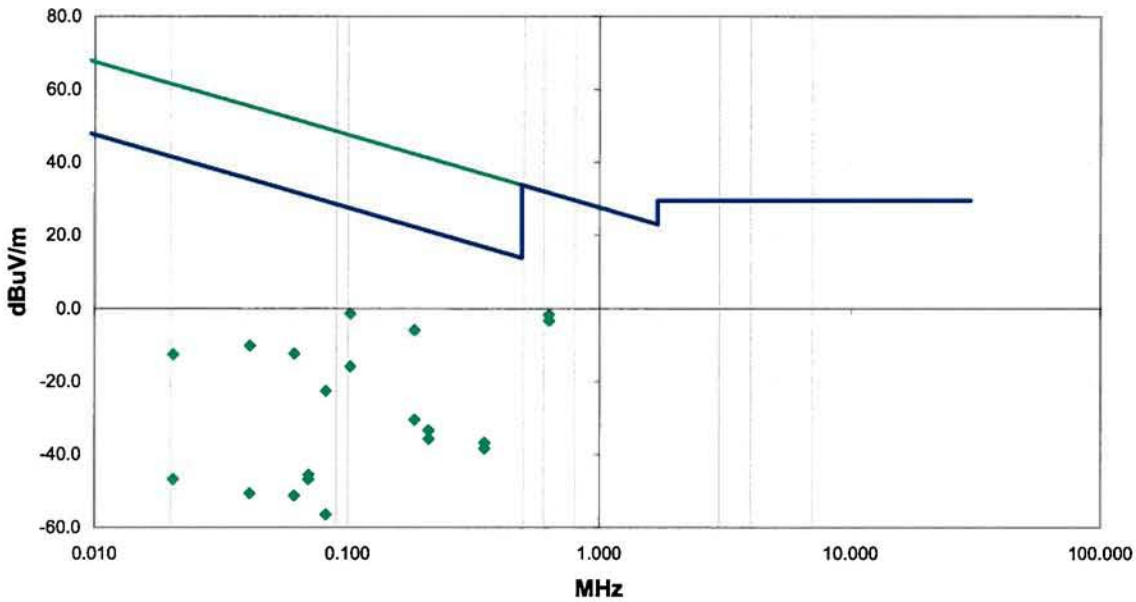
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	6

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.629	50.5	10.5	268.0	1.0	3.0	0.0	Loop	PK	62.7	-1.7	31.6	-33.3
0.629	48.9	10.5	268.0	1.0	3.0	0.0	Loop	QP	62.7	-3.3	31.6	-34.9
0.184	62.8	10.6	360.0	1.0	3.0	0.0	Loop	PK	79.3	-5.9	42.3	-48.2
0.102	48.5	10.6	190.0	1.0	3.0	0.0	Loop	PK	60.4	-1.3	47.4	-48.7
0.184	38.3	10.6	360.0	1.0	3.0	0.0	Loop	AV	79.3	-30.4	22.3	-52.7
0.349	59.3	10.6	259.0	1.0	3.0	0.0	Loop	AV	108.2	-38.3	16.7	-55.0
0.210	63.7	10.6	260.0	1.0	3.0	0.0	Loop	AV	110.0	-35.7	21.1	-56.8
0.103	34.0	10.6	190.0	1.0	3.0	0.0	Loop	QP	60.4	-15.8	47.4	-63.2
0.061	79.5	11.0	360.0	1.0	3.0	0.0	Loop	PK	102.8	-12.3	51.8	-64.1
0.041	83.6	11.8	360.0	1.0	3.0	0.0	Loop	PK	105.5	-10.1	55.3	-65.4
0.082	71.4	10.7	0.0	1.0	3.0	0.0	Loop	PK	104.6	-22.5	49.3	-71.8
0.349	60.8	10.6	259.0	1.0	3.0	0.0	Loop	PK	108.2	-36.8	36.7	-73.5
0.021	76.4	13.9	0.0	1.0	3.0	0.0	Loop	PK	102.8	-12.5	61.4	-73.9
0.210	66.1	10.6	260.0	1.0	3.0	0.0	Loop	PK	110.0	-33.3	41.1	-74.4
0.070	74.1	10.8	256.0	1.0	3.0	0.0	Loop	AV	131.6	-46.7	30.7	-77.4
0.061	40.6	11.0	360.0	1.0	3.0	0.0	Loop	AV	102.8	-51.2	31.8	-83.0
0.082	37.5	10.7	0.0	1.0	3.0	0.0	Loop	AV	104.6	-56.4	29.3	-85.7
0.041	43.1	11.8	360.0	1.0	3.0	0.0	Loop	AV	105.5	-50.6	35.3	-85.9
0.021	42.2	13.9	0.0	1.0	3.0	0.0	Loop	AV	102.8	-46.7	41.4	-88.1
0.070	75.3	10.8	256.0	1.0	3.0	0.0	Loop	PK	131.6	-45.5	50.7	-96.2

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1.4
EMI 2005.5.05

EUT:	NGP / Frontier	Work Order:	GDMN0075
Serial Number:	610502 H303	Date:	05/09/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	53%
Cust. Ref. No.:		Barometric Pressure	30
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using Red Hat Linux Inductive Link Session; Loop antenna - Z-Axis, PG Z-Axis vertical; SE Model (H/17861718); 5m distance

EUT OPERATING MODES

PG Transmitting Telemetry

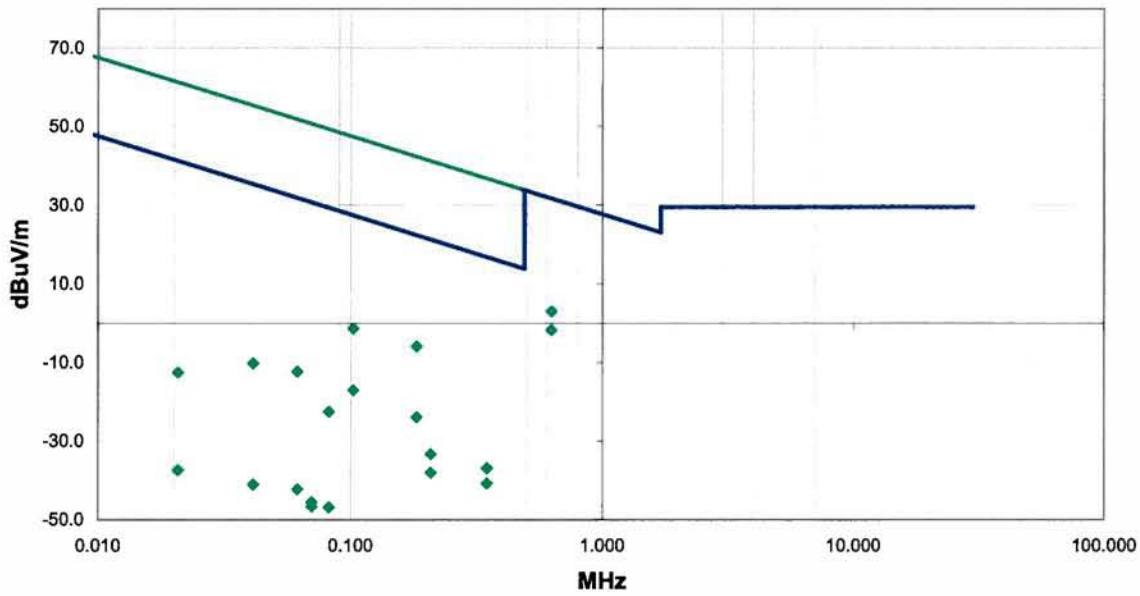
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	4

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.629	41.4	10.5	268.0	1.0	5.0	0.0	Loop	PK	48.8	3.1	31.6	-28.5
0.629	36.6	10.5	268.0	1.0	5.0	0.0	Loop	QP	48.8	-1.7	31.6	-33.3
0.184	36.0	10.6	360.0	1.0	5.0	0.0	Loop	AV	70.5	-23.9	22.3	-46.2
0.184	54.0	10.6	360.0	1.0	5.0	0.0	Loop	PK	70.5	-5.9	42.3	-48.2
0.103	41.8	10.6	190.0	1.0	5.0	0.0	Loop	PK	53.7	-1.3	47.4	-48.7
0.349	44.9	10.6	259.0	1.0	5.0	0.0	Loop	AV	96.2	-40.7	16.7	-57.4
0.210	49.2	10.6	260.0	1.0	5.0	0.0	Loop	AV	97.8	-38.0	21.2	-59.2
0.061	68.1	11.0	360.0	1.0	5.0	0.0	Loop	PK	91.4	-12.3	51.8	-64.1
0.103	26.1	10.6	190.0	1.0	5.0	0.0	Loop	QP	53.7	-17.0	47.4	-64.4
0.041	71.9	11.8	360.0	1.0	5.0	0.0	Loop	PK	93.8	-10.1	55.3	-65.4
0.082	59.8	10.7	0.0	1.0	5.0	0.0	Loop	PK	93.0	-22.5	49.3	-71.8
0.349	48.8	10.6	259.0	1.0	5.0	0.0	Loop	PK	96.2	-36.8	36.7	-73.5
0.021	65.0	13.9	0.0	1.0	5.0	0.0	Loop	PK	91.4	-12.5	61.3	-73.8
0.061	38.2	11.0	360.0	1.0	5.0	0.0	Loop	AV	91.4	-42.2	31.8	-74.0
0.210	53.9	10.6	260.0	1.0	5.0	0.0	Loop	PK	97.8	-33.3	41.2	-74.5
0.082	35.5	10.7	0.0	1.0	5.0	0.0	Loop	AV	93.0	-46.8	29.3	-76.1
0.041	41.0	11.8	360.0	1.0	5.0	0.0	Loop	AV	93.8	-41.0	35.3	-76.3
0.070	59.6	10.8	256.0	1.0	5.0	0.0	Loop	AV	117.0	-46.6	30.7	-77.3
0.021	40.2	13.9	0.0	1.0	5.0	0.0	Loop	AV	91.4	-37.3	41.3	-78.6
0.070	60.7	10.8	256.0	1.0	5.0	0.0	Loop	PK	117.0	-45.5	50.7	-96.2

Distance Adjustment Factor for Radiated Emissions below 30 MHz

Method: Per 47 CFR 15.31(f)(2), the data was extrapolated based upon a the measured fall-off (at each frequency / polarity).

EUT: Frontier/NGP
S/N: 610502 H303
Date: 5/2/2005
Job Number: GDMN0070

Frequency (MHz)	Loop Antenna Polarity	Detector	Test Distance (meters)	Measured Level (dBuV/m)	Fall-Off from 3 to 5 m (dB)	Extrapolation Factor for Specification Limit (dB / decade)	Test Distance of Spec. Limit (meters)	Distance Adjustment Factor (dB)
0.021	Maximum Position	PK	3	76.4	11.4	51.4	300.0	102.8
			5	65.0				91.4
0.041	Maximum Position	PK	3	83.6	11.7	52.7	300.0	105.5
			5	71.9				93.8
0.061	Maximum Position	PK	3	79.5	11.4	51.4	300.0	102.8
			5	68.1				91.4
0.070	Maximum Position	PK	3	75.3	14.6	65.8	300.0	131.6
			5	60.7				117.0
0.082	Maximum Position	PK	3	71.4	11.6	52.3	300.0	104.6
			5	59.8				93.0
0.102	Maximum Position	PK	3	48.5	6.7	30.2	300.0	60.4
			5	41.8				53.7
0.184	Maximum Position	PK	3	62.8	8.8	39.7	300.0	79.3
			5	54.0				70.5
0.210	Maximum Position	PK	3	66.1	12.2	55.0	300.0	110.0
			5	53.9				97.8
0.349	Maximum Position	PK	3	60.8	12.0	54.1	300.0	108.2
			5	48.8				96.2
0.629	Maximum Position	PK	3	50.5	13.9	62.7	30.0	62.7
			5	36.6				48.8

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005.1.4
EMI 2005.5.05

EUT:	NGP / Frontier	Work Order:	GDMN0075
Serial Number:	900705 H309	Date:	05/06/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	53%
Cust. Ref. No.:		Barometric Pressure	30
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using Red Hat Linux Inductive Link Session; Loop antenna - Z-Axis, PG Z-Axis vertical; HE Model (H/17861777); 3m distance

EUT OPERATING MODES

PG Transmitting Telemetry

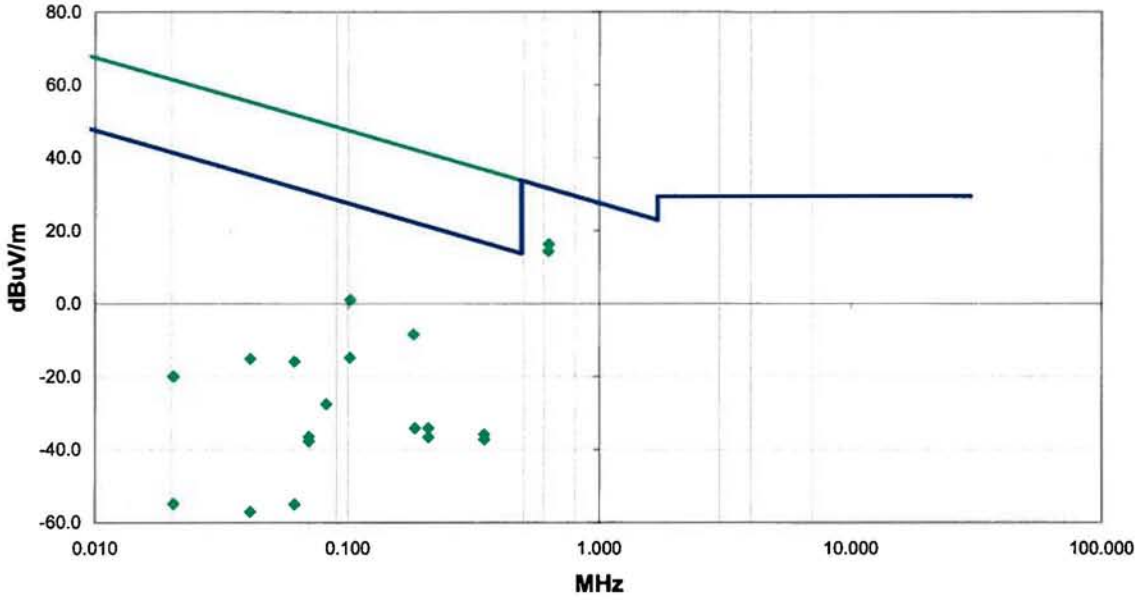
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	1

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.629	50.9	10.5	264.0	1.0	3.0	0.0	Loop	PK	45.1	16.3	31.6	-15.3
0.627	49.0	10.5	264.0	1.0	3.0	0.0	Loop	QP	45.1	14.4	31.7	-17.3
0.102	49.1	10.6	171.0	1.0	3.0	0.0	Loop	PK	58.6	1.1	47.4	-46.3
0.183	63.0	10.6	360.0	1.0	3.0	0.0	Loop	PK	82.0	-8.4	42.3	-50.7
0.349	59.5	10.6	256.0	1.0	3.0	0.0	Loop	AV	107.3	-37.2	16.7	-53.9
0.186	37.3	10.6	360.0	1.0	3.0	0.0	Loop	AV	82.0	-34.1	22.2	-56.3
0.210	63.7	10.6	257.0	1.0	3.0	0.0	Loop	AV	110.9	-36.6	21.2	-57.8
0.102	33.2	10.6	171.0	1.0	3.0	0.0	Loop	QP	58.6	-14.8	47.4	-62.2
0.061	79.6	11.0	360.0	1.0	3.0	0.0	Loop	PK	106.4	-15.8	51.8	-67.6
0.070	74.1	10.8	254.0	1.0	3.0	0.0	Loop	AV	122.6	-37.7	30.7	-68.4
0.041	84.0	11.8	360.0	1.0	3.0	0.0	Loop	PK	110.9	-15.1	55.3	-70.4
0.349	60.9	10.6	256.0	1.0	3.0	0.0	Loop	PK	107.3	-35.8	36.7	-72.5
0.210	66.2	10.6	257.0	1.0	3.0	0.0	Loop	PK	110.9	-34.1	41.2	-75.3
0.082	71.8	10.7	0.0	1.0	3.0	0.0	Loop	PK	110.0	-27.5	49.3	-76.8
0.020	77.1	13.9	0.0	1.0	3.0	0.0	Loop	PK	110.9	-19.9	61.4	-81.3
0.061	40.4	11.0	360.0	1.0	3.0	0.0	Loop	AV	106.4	-55.0	31.8	-86.8
0.070	75.3	10.8	254.0	1.0	3.0	0.0	Loop	PK	122.6	-36.5	50.7	-87.2
0.082	37.8	10.7	0.0	1.0	3.0	0.0	Loop	AV	110.0	-61.5	29.3	-90.8
0.041	42.1	11.8	360.0	1.0	3.0	0.0	Loop	AV	110.9	-57.0	35.3	-92.3
0.020	42.2	13.9	0.0	1.0	3.0	0.0	Loop	AV	110.9	-54.8	41.4	-96.2

NORTHWEST EMC

RADIATED EMISSIONS DATA SHEET

ACQ 2005 1.4
EMI 2005.5.05

EUT:	NGP / Frontier	Work Order:	GDMN0075
Serial Number:	900705 H309	Date:	05/09/05
Customer:	Guidant Inc.	Temperature:	20
Attendees:	Yogendra Shah	Humidity:	53%
Cust. Ref. No.:		Barometric Pressure	30
Tested by:	Jonathan Peng	Power: Internal Battery	Job Site: OC08

TEST SPECIFICATIONS

Specification:	FCC 15.209:2003	Method:	ANSI C63.4:2001

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

COMMENTS

Telemetry operating using Red Hat Linux Inductive Link Session; Loop antenna - Z-Axis, PG Z-Axis vertical; HE Model (H/17861777); 5m distance

EUT OPERATING MODES

PG Transmitting Telemetry

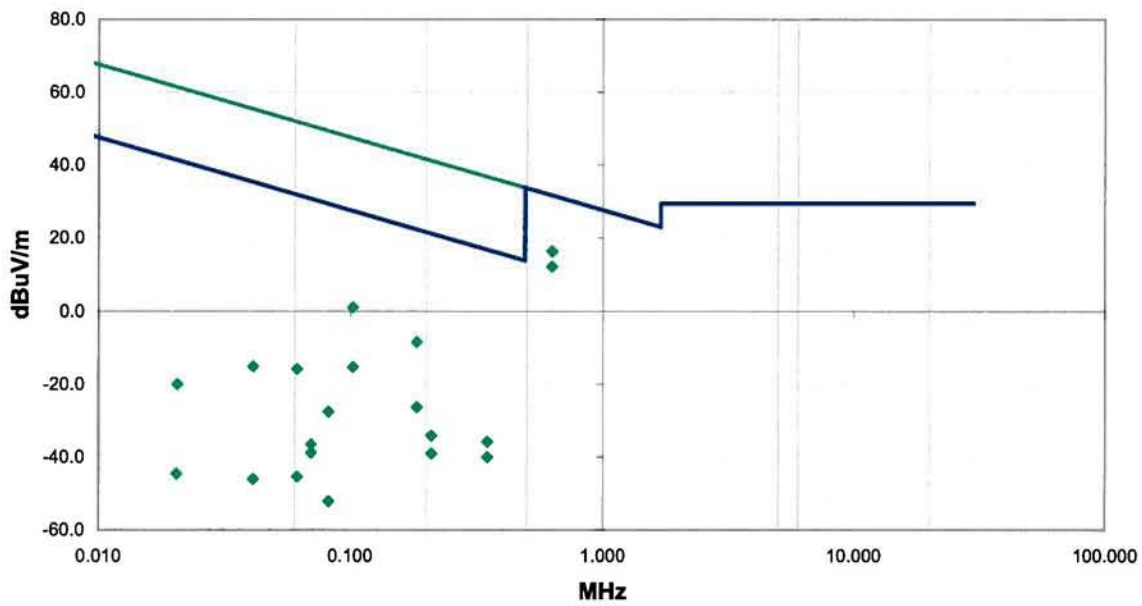
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Evaluation	2

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
0.629	40.9	10.5	264.0	1.0	5.0	0.0	Loop	PK	35.1	16.3	31.6	-15.3
0.628	36.7	10.5	264.0	1.0	5.0	0.0	Loop	QP	35.1	12.1	31.6	-19.5
0.103	42.6	10.6	171.0	1.0	5.0	0.0	Loop	PK	52.1	1.1	47.4	-46.3
0.184	36.0	10.6	360.0	1.0	5.0	0.0	Loop	AV	72.9	-26.3	22.3	-48.6
0.184	53.9	10.6	360.0	1.0	5.0	0.0	Loop	PK	72.9	-8.4	42.3	-50.7
0.349	44.8	10.6	256.0	1.0	5.0	0.0	Loop	AV	95.4	-40.0	16.7	-56.7
0.210	49.0	10.6	257.0	1.0	5.0	0.0	Loop	AV	98.6	-39.0	21.2	-60.2
0.103	26.2	10.6	171.0	1.0	5.0	0.0	Loop	QP	52.1	-15.3	47.4	-62.7
0.061	67.8	11.0	360.0	1.0	5.0	0.0	Loop	PK	94.6	-15.8	51.8	-67.6
0.070	59.4	10.8	254.0	1.0	5.0	0.0	Loop	AV	109.0	-38.8	30.7	-69.5
0.041	71.7	11.8	360.0	1.0	5.0	0.0	Loop	PK	98.6	-15.1	55.3	-70.4
0.349	49.0	10.6	256.0	1.0	5.0	0.0	Loop	PK	95.4	-35.8	36.7	-72.5
0.210	53.9	10.6	257.0	1.0	5.0	0.0	Loop	PK	98.6	-34.1	41.2	-75.3
0.082	59.6	10.7	0.0	1.0	5.0	0.0	Loop	PK	97.8	-27.5	49.3	-76.8
0.061	38.3	11.0	360.0	1.0	5.0	0.0	Loop	AV	94.6	-45.3	31.8	-77.1
0.021	64.8	13.9	0.0	1.0	5.0	0.0	Loop	PK	98.6	-19.9	61.3	-81.2
0.041	40.8	11.8	360.0	1.0	5.0	0.0	Loop	AV	98.6	-46.0	35.3	-81.3
0.082	35.0	10.7	0.0	1.0	5.0	0.0	Loop	AV	97.8	-52.1	29.3	-81.4
0.020	40.2	13.9	0.0	1.0	5.0	0.0	Loop	AV	98.6	-44.5	41.4	-85.9
0.070	61.7	10.8	254.0	1.0	5.0	0.0	Loop	PK	109.0	-36.5	50.7	-87.2

Distance Adjustment Factor for Radiated Emissions below 30 MHz

Method: Per 47 CFR 15.31(f)(2), the data was extrapolated based upon a the measured fall-off (at each frequency / polarity).

EUT: Frontier/NGP
S/N: 900705 H309
Date: 5/2/2005
Job Number: GDMN0070

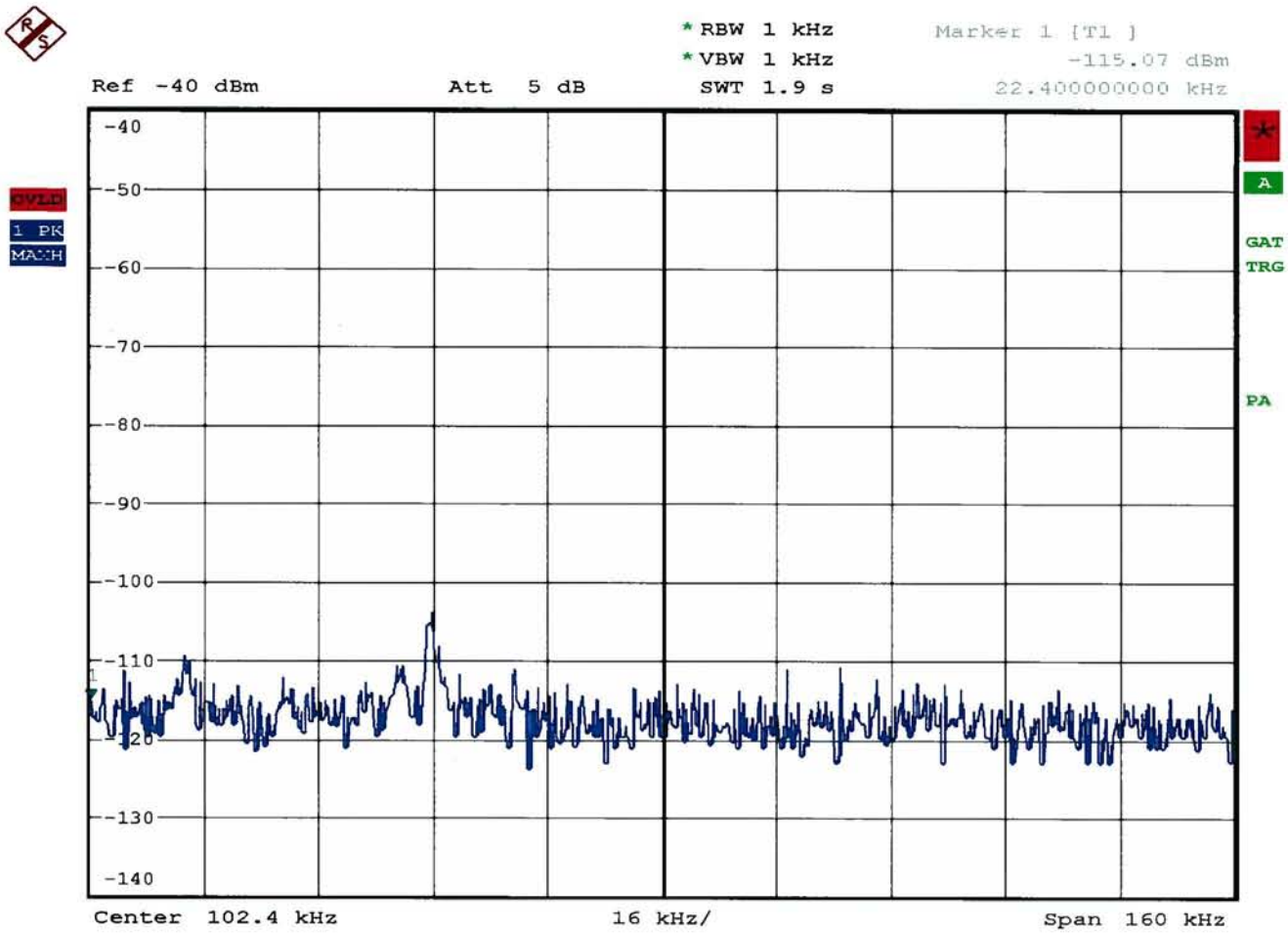
Frequency (MHz)	Loop Antenna Polarity	Detector	Test Distance (meters)	Measured Level (dBuV/m)	Fall-Off from 3 to 5 m (dB)	Extrapolation Factor for Specification Limit (dB / decade)	Test Distance of Spec. Limit (meters)	Distance Adjustment Factor (dB)
0.021	Maximum Position	PK	3	77.1	12.3	55.4	300.0	110.9
			5	64.8				98.6
0.041	Maximum Position	PK	3	84.0	12.3	55.4	300.0	110.9
			5	71.7				98.6
0.061	Maximum Position	PK	3	79.6	11.8	53.2	300.0	106.4
			5	67.8				94.6
0.070	Maximum Position	PK	3	75.3	13.6	61.3	300.0	122.6
			5	61.7				109.0
0.082	Maximum Position	PK	3	71.8	12.2	55.0	300.0	110.0
			5	59.6				97.8
0.102	Maximum Position	PK	3	49.1	6.5	29.3	300.0	58.6
			5	42.6				52.1
0.184	Maximum Position	PK	3	63.0	9.1	41.0	300.0	82.0
			5	53.9				72.9
0.210	Maximum Position	PK	3	66.2	12.3	55.4	300.0	110.9
			5	53.9				98.6
0.349	Maximum Position	PK	3	60.9	11.9	53.6	300.0	107.3
			5	49.0				95.4
0.629	Maximum Position	PK	3	50.9	10.0	45.1	30.0	45.1
			5	40.9				35.1

EXHIBIT B

Test Setup Information:

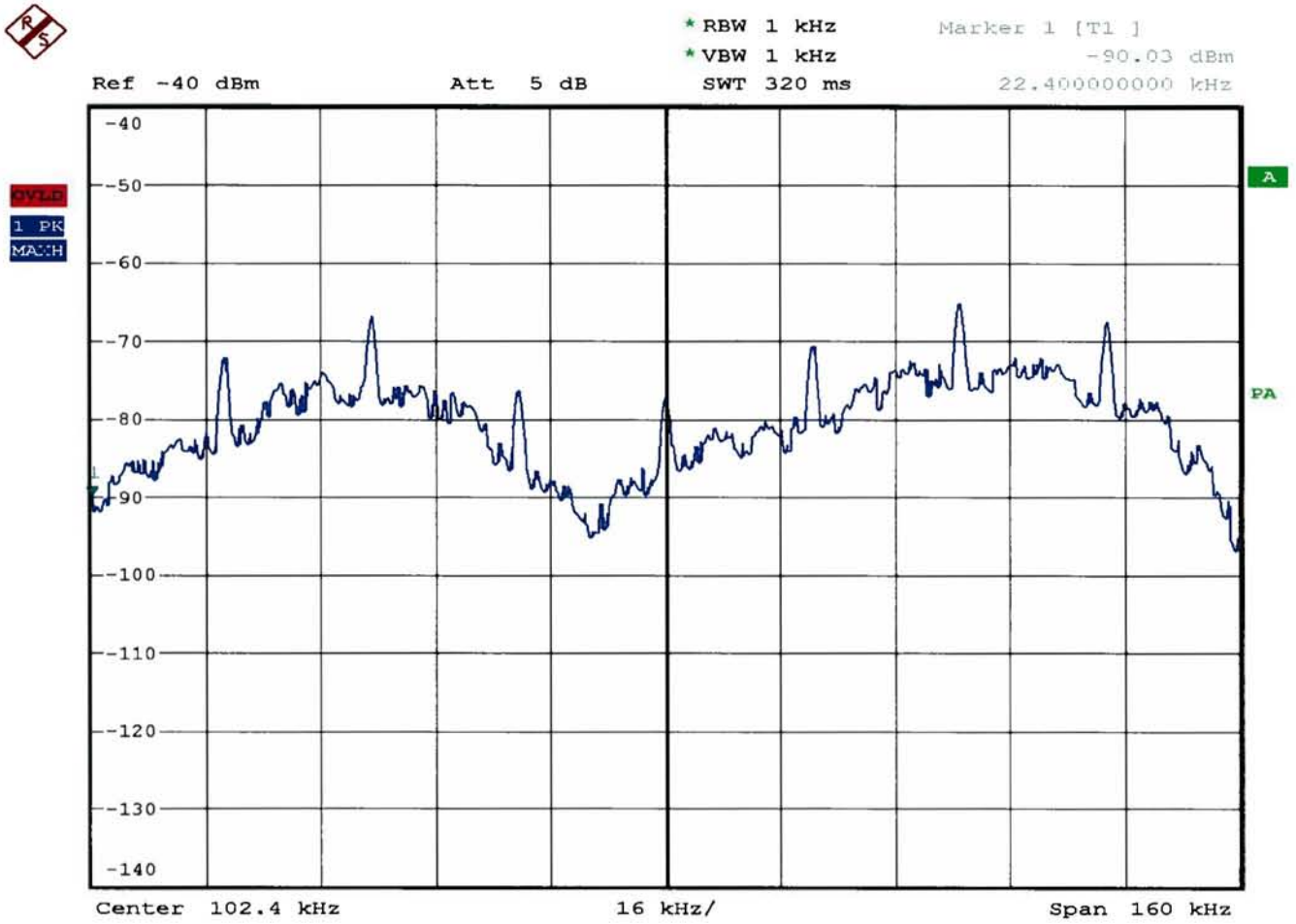
- The following plots were acquired with an 8ft. long Loran antenna from Shakespeare model number 4208 connected to a Rohde & Schwarz FSU spectrum analyzer.
- The measurements were acquired in Boston Scientific's anechoic chamber.
- The Programmer was in a typical telemetry session with the PG using only inductive telemetry.
- The spectrum plots for the telemetry wand were acquired with the spectrum analyzer in free run mode.
- The spectrum plots for the Cognis (Frontier) implantable device were acquired by gating the spectrum analyzer sweep so the sweep only occurred during the inductive telemetry response from the implant.
- Typical spectrum analyzer settings: center frequency = 102.4KHz
  span = 160KHz
  RBW = 1KHz
  maximum hold
- The OVLD marker was caused by out of span emissions picked up by LORAN antenna.
- Implantable device tested in air (not implanted) as worst-case emissions scenario.

Cognis implantable device at 1 foot from Loran antenna



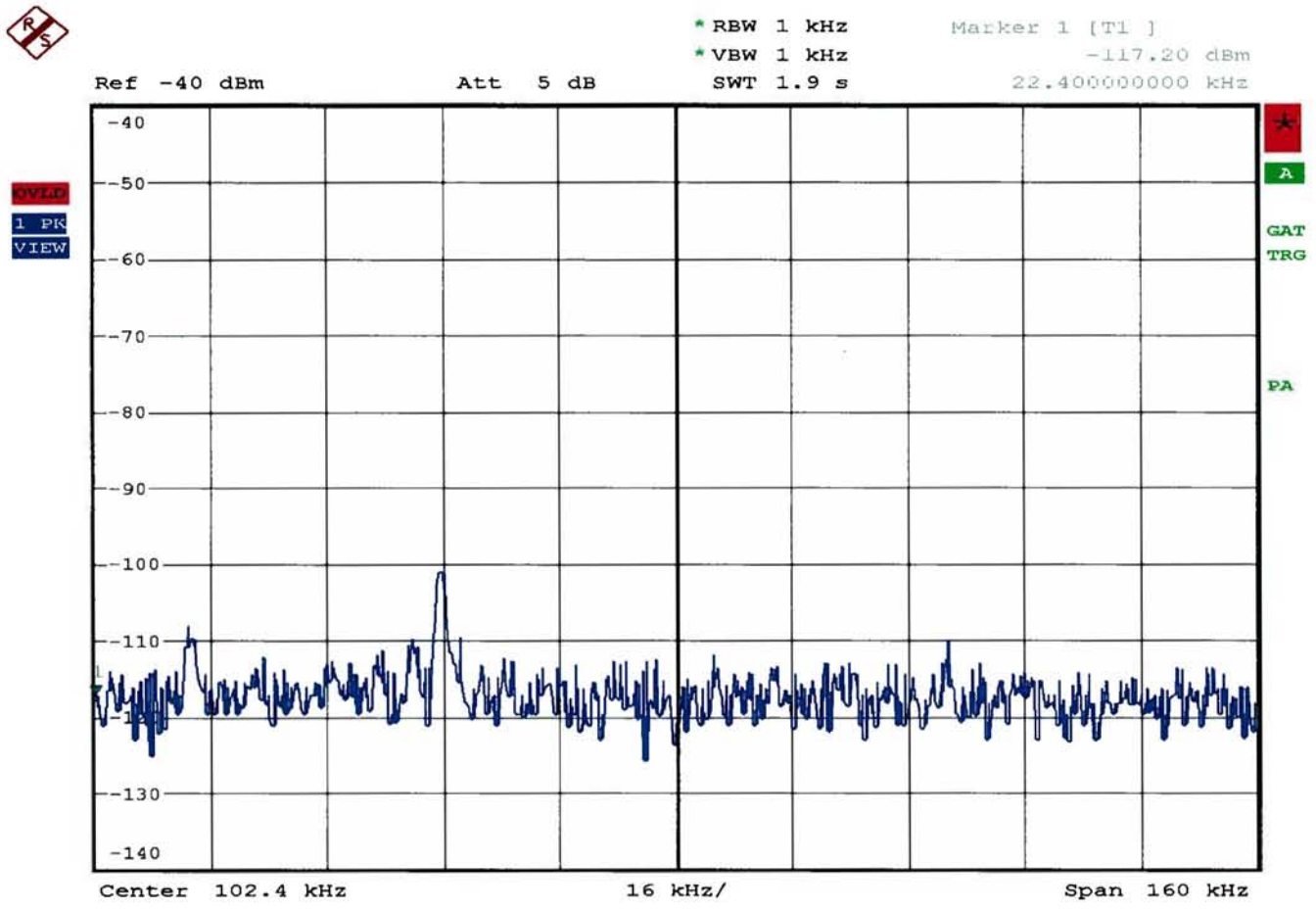
Date: 15.FEB.2007 14:12:03

Programmer telemetry wand at 1 foot from Loran antenna



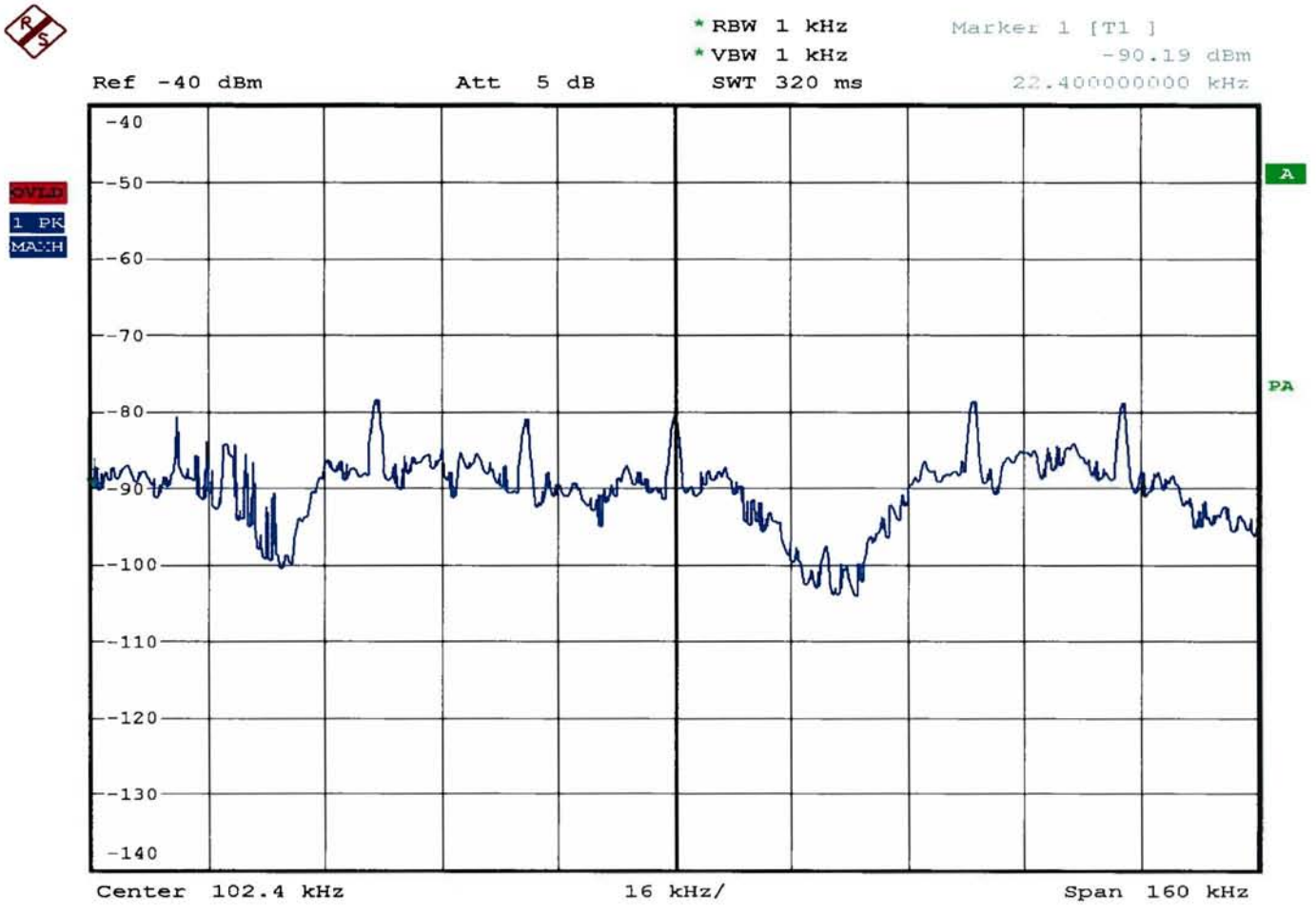
Date: 15.FEB.2007 14:08:40

Cognis implantable device at 3 feet from Loran antenna



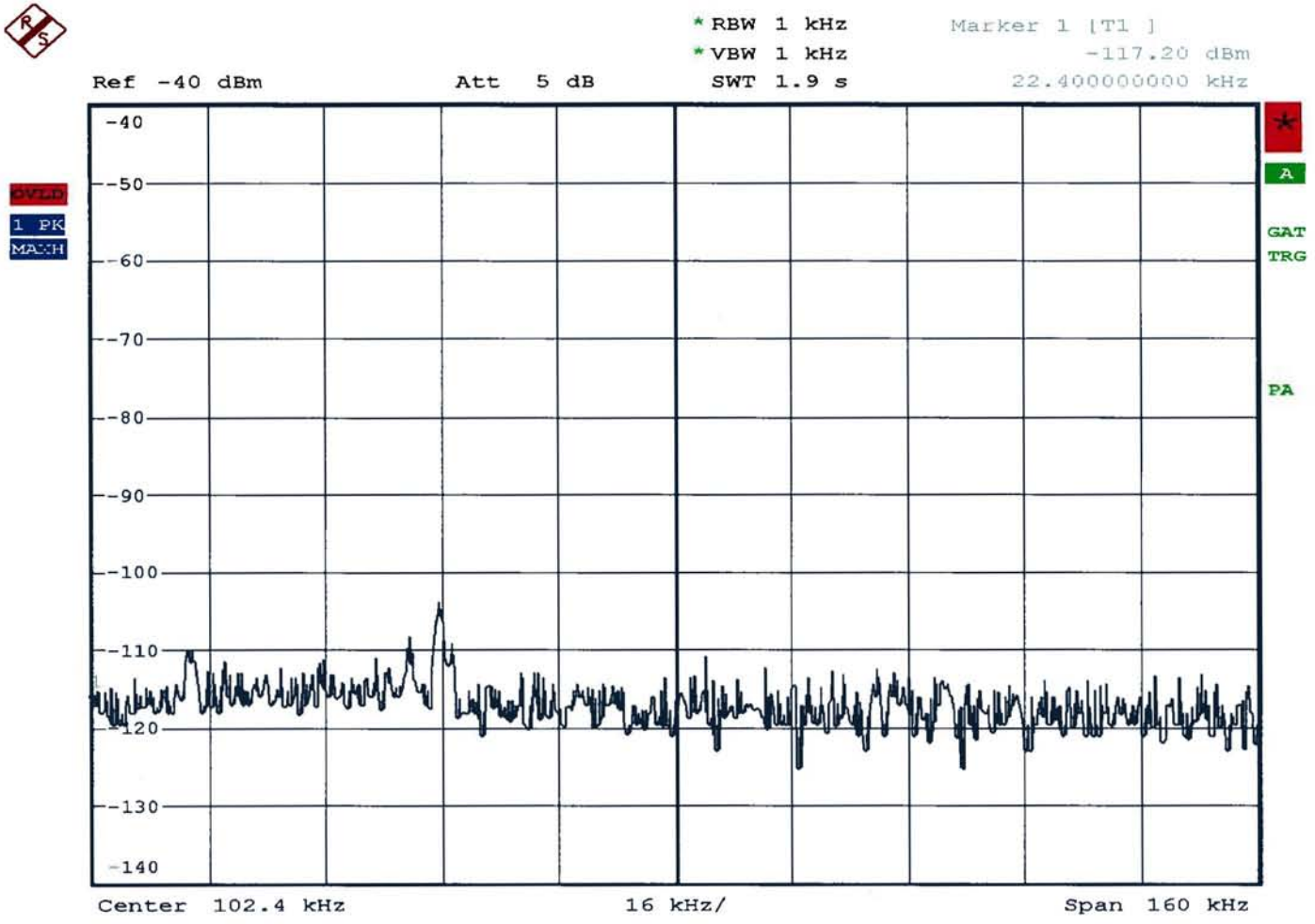
Date: 16.FEB.2007 07:12:47

Programmer telemetry wand at 3 feet from Loran antenna



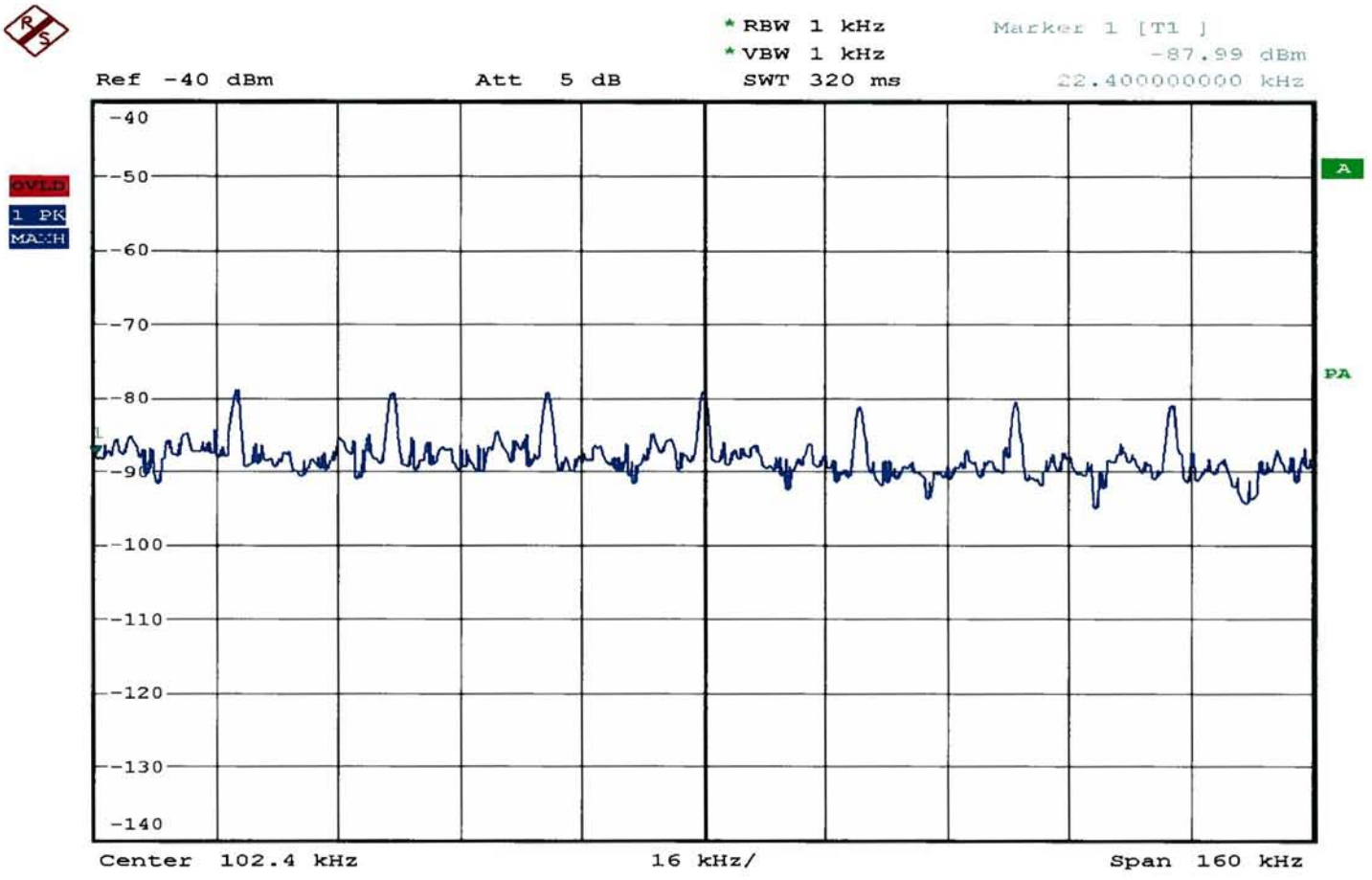
Date: 15.FEB.2007 14:17:47

Cognis implantable device at 6 feet from Loran antenna



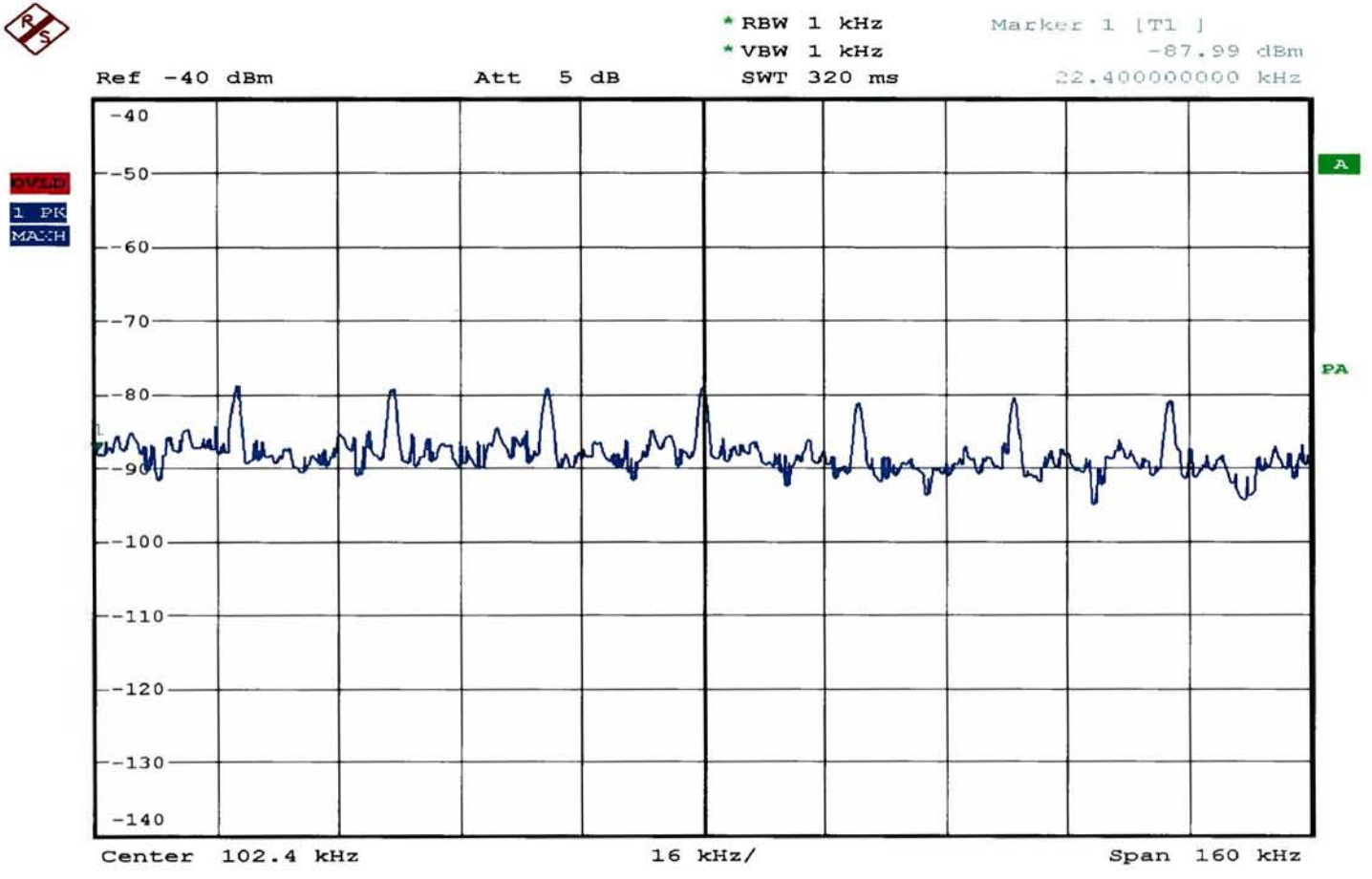
Date: 15.FEB.2007 14:26:53

Programmer telemetry wand at 6 feet from Loran antenna



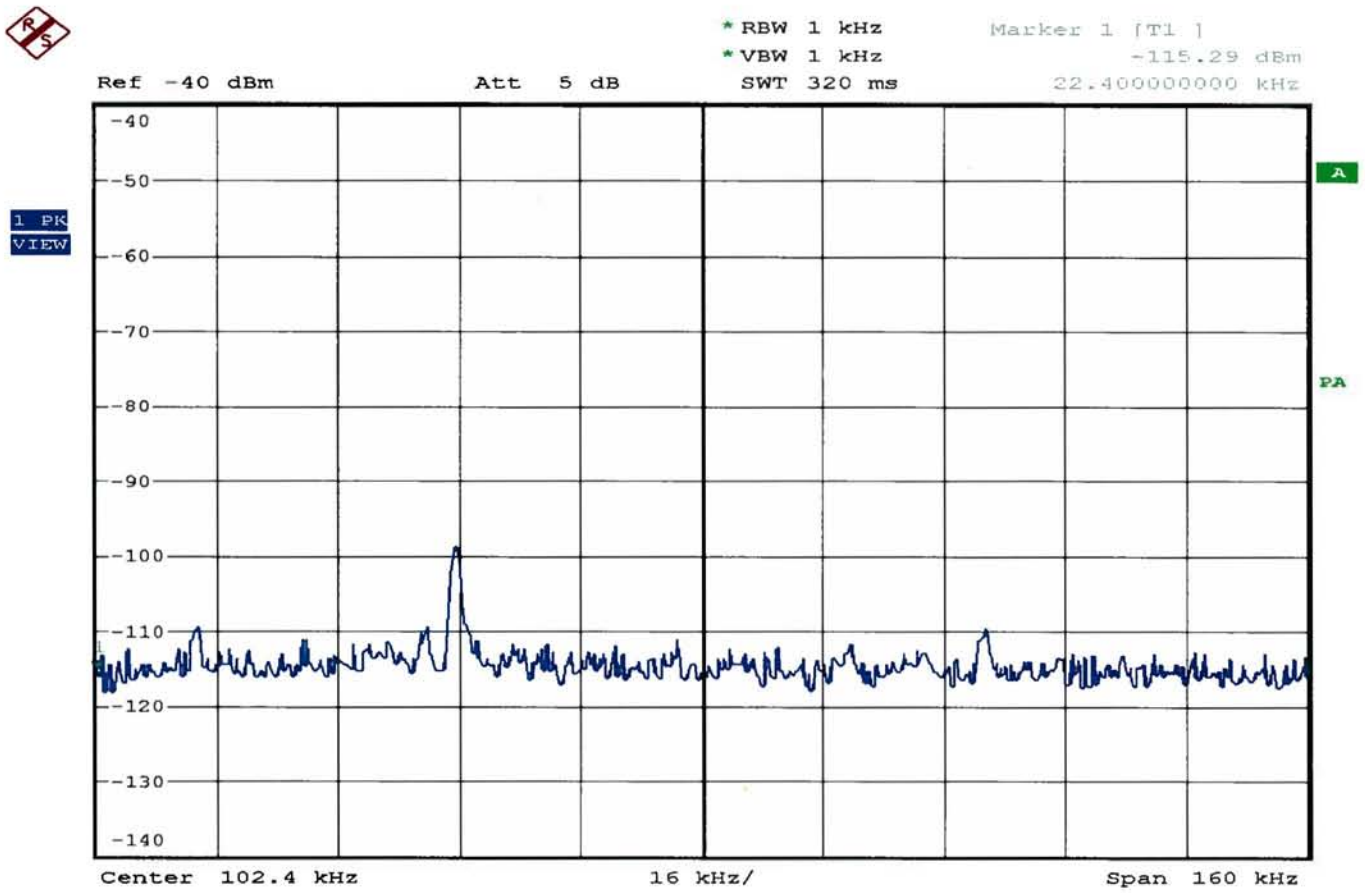
Date: 15.FEB.2007 14:28:39

Programmer telemetry wand at 6 feet from Loran antenna



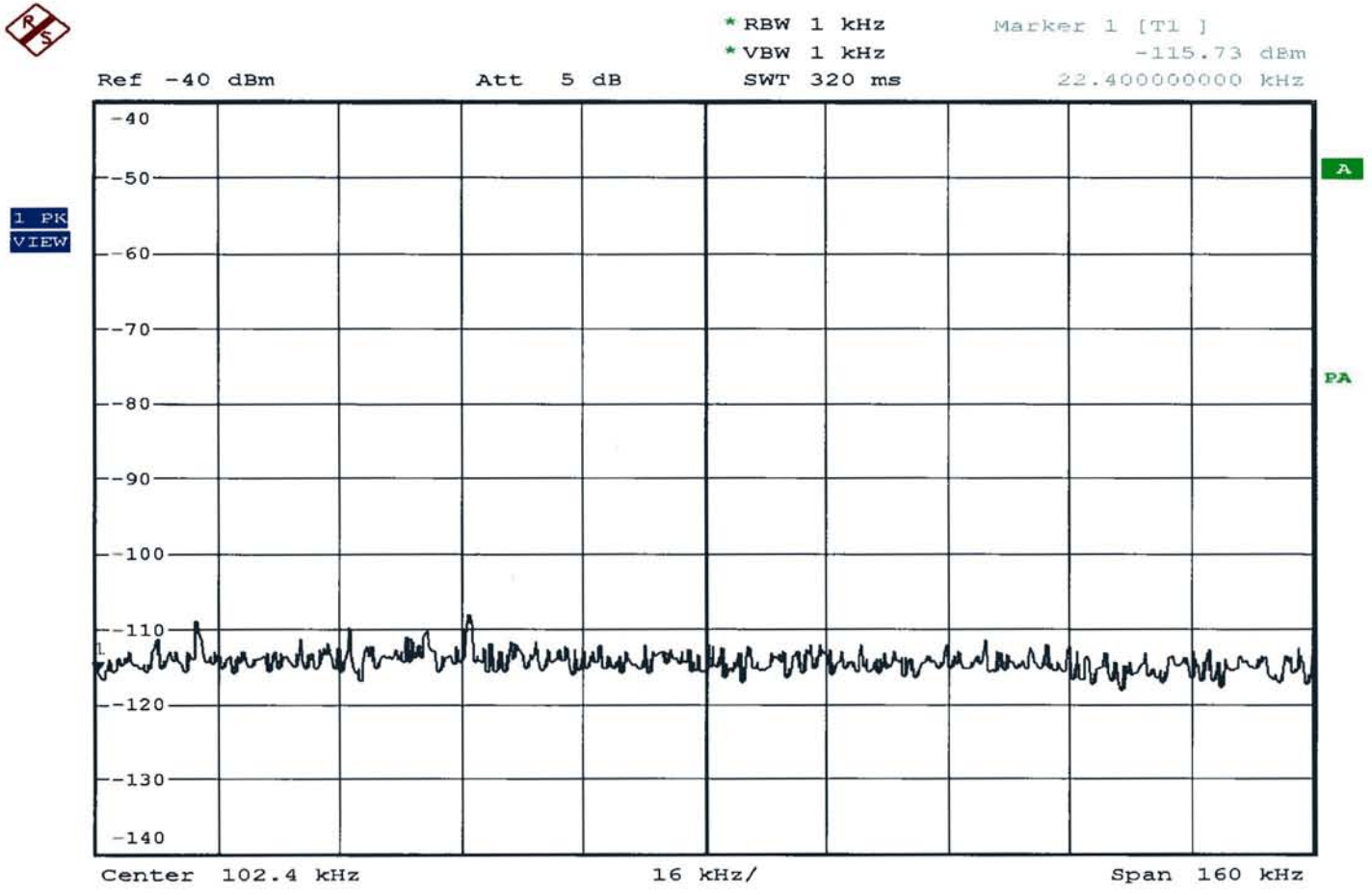
Date: 15.FEB.2007 14:28:39

Background noise with the antenna connected and the telemetry session ended



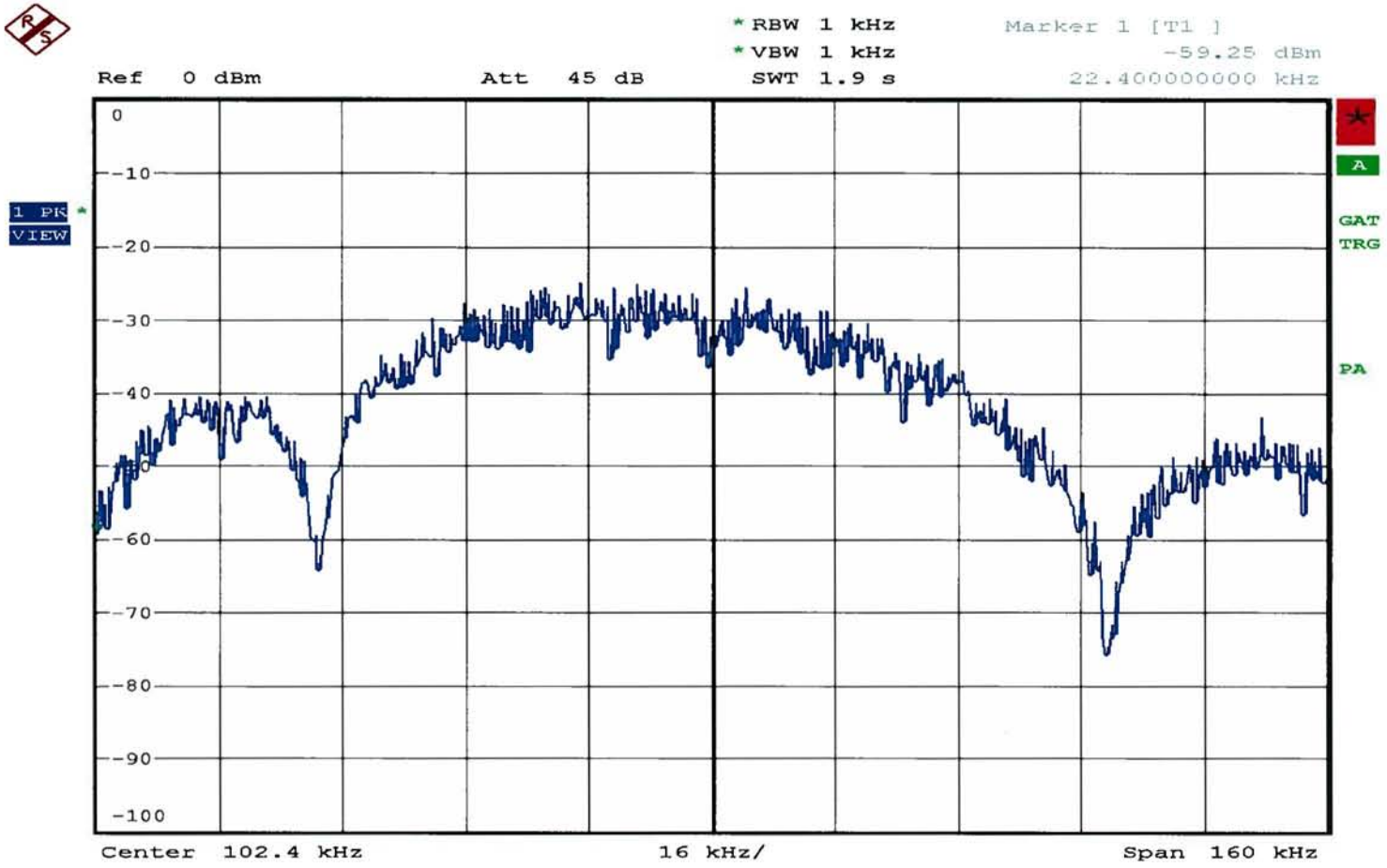
Date: 15.FEB.2007 15:46:06

Spectrum analyzer noise level with no antenna connected



Date: 15.FEB.2007 15:47:08

Telemetry spectrum from Cognis implantable device as measured with a nearby magnetic pickup coil (not LORAN antenna)



Date: 15.FEB.2007 15:26:16

Example timing from a BSC Cognis implantable device telemetry session (both implant and programmer) using a nearby magnetic pickup coil

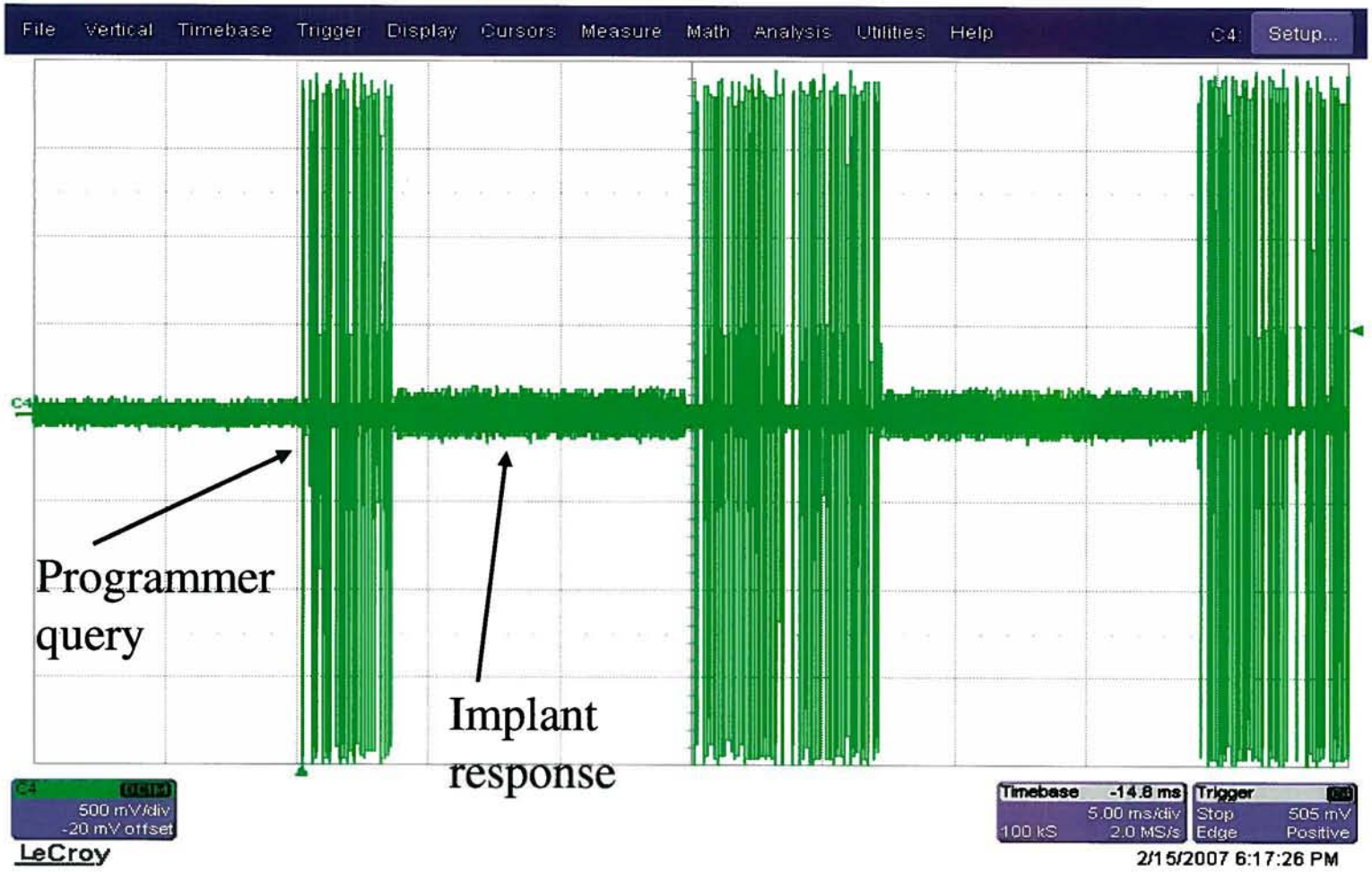


EXHIBIT C

DR. NEIL BIRCH

Dr. Birch holds Ph.D. and M.S. degrees In Electrical Engineering from the Catholic University of America and a B.S. degree in Electrical Engineering from North Carolina State University. Dr. Birch is President of Birch Associates, Inc. which specializes in the field of Communications, Command, Control and Intelligence (C3I).

Previous positions held by Dr. Birch have included: Principle Director and Deputy Assistant Secretary of Defense, Office of the Assistant Secretary Advisor to the Director, Telecommunications and Command and Control Systems (DTACCS), Office of the Secretary of Defense and Assistant Director for Systems and Advance Technology; Chief Scientist, U.S. Navy command, control and Communications Programs, Office of the Chief of Naval Operations; Director of Advanced Systems Analysis Office, Magnavox Company; Division Chief, National Security Agency; Staff Engineer, Western Electrical Company.

Dr. Birch has experience in the following areas: World Wide Military Command and Control System; European Command and Control; Tactical Command and Control Systems and TRI-TAC; Defense Communication System; Military and Domestic Systems; Digital voice Coding; Secure and Privacy Communications; Spread Spectrum and Error Control Coding; Navigation Aids; HF and Meteor Burst; Advanced Tactical Communications and Interfaces, Communications Channel Modeling; Remote Monitoring; Telecommunications Technology Forecasting; Maritime, Aeronautical and Meteorological Satellite Systems; and Intelligence and Intelligence Related Program.

Dr. Birch is the author of numerous publications and is active on a number of DOD panels.

PERSONAL DATA

Born: Birmingham, Alabama, 19 November 1936 Residence:
8831 Mustang Island Circle; Maples, Fl 34113 Marital Status:
Married with three children Telephone:
Home (239) 793-3055

EDUCATION

Doctor of Electrical Engineering - Catholic University. 1965
Master of Science of Electrical Engineering - Catholic University. 1951

PROFESSIONAL AFFILIATIONS

Institute of Electrical Engineers (IEEE)
Professional Group of Aerospace & Electronics Systems (IEEE) to 1975
Communications Society (IEEE)
Sigma XI, CUA Chapter
Association of Old Crows
Armed Forces Communications & Electronics Association
Elected Fellow of IEEE (January, 1986)

Dr. Birch graduated with a B.S. In Electrical Engineering from North Carolina State in 1958 and after working for Western Electric for a short period of time was assigned to the National Security Agency as an engineering officer in the U.S. Air Force. During this period of time he worked on advanced H.F. intercept equipment, microwave amplifiers and receivers and interpretation of new and unusual signals. Also, during this period of time he obtained his M.S. in Electrical Engineering from Catholic University and began working on the doctoral degree. He taught a microwave measurements laboratory and a course in electromagnetism to undergraduate students at CUA.

He received his Doctorate in Electrical Engineering from CUA during the fall of 1965 with formal graduation in the spring of 1966. Meanwhile, he continued teaching at CUA, developing a course in analog and digital communications, which he taught at the graduate level. At NSA he continued research in voice processing and the effects of time perturbations on voice quality and intelligibility.

He was promoted to branch chief responsible for spread spectrum communications and conventional military tactical communications. He was responsible for the commissioning and oversight of the first definitive widely distributed document on spread spectrum communications. He was also responsible for the establishment of certain U.S. and Allied communications standards which ensure radio interoperability among military allies and near optimum radio performance. He performed fundamental research into the performance of electronic timing circuits in digital secure radio equipment.

After his promotion to division chief at NSA, he left government service to join the Magnavox Co. in 1967. He created and was placed in charge of the Magnavox Advanced Systems Analysis Office, a Washington based research facility that worked for NASA, the Department of Defense, and the Advanced Research Project Agency. While at Magnavox, Dr. Birch led new business activities in the areas of spread spectrum communications, satellite transponder designs, voice coding and intelligibility testing, time varying multi-path communications channel modeling and communications packages for environmental sensor systems. Operational NASA satellite employ modulation and transponders based on this design work. He continued to teach a communications course at CUA and developed a course in space communications which he taught internationally.

In 1973 he returned to government service as Chief Scientist for the U.S. Navy for Telecommunications, Command and Control Systems. His duties within the Chief of Naval Operations included the coordination research and development programs in Telecommunications within the U.S. Navy and joint satellite programs, submarine communications and task force communications.

He accepted the position as Chief Scientist with the Office of the Secretary of Defense for Telecommunications, Command and Control Systems in 1975 and subsequently became the Deputy Assistant Secretary of Defense for Communication, Command and Control of Intelligence programs for the U.S. Military Services. He was responsible for technical guidance and budget matters for all electronic U.S. Department of Defense activities that supported strategic, theater and tactical forces. He was instrumental in bringing to fruition a number of electronic systems that were subsequently used by U.S. forces in "Desert Storm".

In 1979, Dr. Birch left the Pentagon to form Birch Associates Inc., a Washington based consulting firm dealing in Command Control, Communications and Intelligence matters. The company assisted U.S. and foreign corporations and governmental operations in activities relating to electronic communications, security and surveillance. He served on a number of U.S. Government defense oriented committees and participated as a member of the board of directors for several high technology firms. Dr. Birch is also a Senior Vice President and the Chief Technical Officer for Samanco International Ltd., a company that provides telecommunications and security products, systems and

services to governments and industry in Africa, the Middle East and the Far East.

He is an active member of the Armed Forces Communication Electronic Association for which he has developed a number of continuing engineering education courses. He has assisted the Catholic University of America over the past several years by conducting seminars, consulting on electrical engineering curriculum, obtaining summer jobs for engineering students and by recommending ways to equalize enrollment in engineering at CUA.

In addition to receiving two distinguished civilian service awards while in the U.S. Government, Dr. Neil Birch was elected Fellow of the Institute of Electronic and Electrical Engineers in 1986 for his contributions to U.S. Military Communications.

He has been an expert witness on several communications legal cases, some of which involved advanced digital wireless technologies. He is co-inventor and patent holder for a technique to counter cellular telephone fraud.

Dr. Birch developed and taught a number of courses in telecommunication which he has presented in the U.S. and abroad over the past twenty-five years. These include "Advanced Communications," "High Frequency Radio," "Spread Spectrum Communications," "Military Command, Control, Communications, and Intelligence," "Space Communications," "Integrated Services Digital Networks," "Data Links," and 'Voice Coding".

PUBLICATIONS

"Intelligibility of Frequency Modulated Speech," NASA 1964
"Bipolar Coding and Baseband Recovery," NSA Technical Journal 1967
'Caribbean Tropo Test Results," NSA Publication
"Design Consideration for PCM and Delia Mod Systems," TP68-2147 Magnavox
"Error Rates for DPSK and FSK over a Rayleigh Channel with Optimum Frequency Selection," TP69-2166 Magnavox
"Analysis of Conventional Clock Recovery Circuit," TP68-215 Magnavox
"Evaluation of the Probability of Binary Error for a Phase Reversal Keyed Signal in the Presence of Exponentially Distributed Nose and Rayleigh Fading." TP68-2167 Magnavox
"Voice Coding for Maritime Satellite System," U.S. MARSAT 2/29
"Modems for Maritime Communication," U.S. MARSAT 2/27
"Survey of Navigation System," U.S. MARSAT 2/29
"U.S. MARSAT Access Control," 2/28
"Comparison of Coherent and Non-Coherent Detection of Binary FM," NTC-1972
"Comparison of Voice Coding Techniques for ATC," AFCRL Speech Conference 1972
"Binary Error Probabilities for FSK over Rayleigh Fading Channel with Unequal Gains in the Receiver," TP68-2176 Magnavox
"Amplitude Shift Keying," Magnavox Technical Memorandum
"An Alternative Derivation of Voelcker's Equation for DPSK Error Probability over a Rayleigh Channel," TP68-2024 Magnavox
"Performance of Coherent Phase Reversal Keyed System in the Presence of VW Interference," Magnavox Technical Memorandum
"Multi-path/Modulation Study for TDRS," prepared by Magnavox for NASA/GSFC, January 1970
"Voice Coding and Intelligibility Testing for a Satellite Based Air Traffic Control System," Prepared by Magnavox for NASA/GSFC, January 1970
"HEAO Modulation Report," ASAO-PR 20026-4 "
A Pseudo-Noise Transponder Design for Low Data Rate Users of the Tracking and Data Relay Satellite System," ASAO-PR 20026-4
"Definition of Multi-Path/RFI Experiments for Orbital Testing with a Small Applications Technology

Satellite," ASAO-PR 20041-8, December 1,1972 prepared by Magnavox for NASA/MSC (co-authored with R.H, French).

"A Comparison of Voice Coding Techniques." EASCON Record 1974

"Spread Spectrum Applications and Technology," AFCEA Conference, 1975 Signal Magazine 1975

"Trends in Digital Communications and Switching," AFCEA 1980 Signal Magazine

"Future MilSatCom Architecture for the DOD," ITC 1981 Conference Record

"Survey of Correct and Future DOD Spread Spectrum Communications," MILCOM 1982

"JTIDS Technology Application to Trophospherio Scatter and Satellite Communication," MILCOM 1985

PUBLICATIONS FOR GOVERNMENT AND INDUSTRY

Photonics Market Assessment for N.T.I.
Principal architect for Phase I Aviation Satellite System for Arino
Team leader and Principal advisor on Large Air Defense C3 program for Saudi Arabia
Tactical Communications Study for Kollsman Instruments
DOD - Wide Communications Study for Westinghouse
Telecom Futures Study for NSA
Navy Datalink Study for Hughes
Surveillance Direction System Connectivity Study for IBM
Data Relay Satellite Study
Submarine Laser Comm Study for Allied Signal
SDI Link Study for Cubic Corporation
Intelligence Business Plan for Hughes
Market Assessment of Mobile C2 Centers for Loral
Space Laser Comm Study for MDAC
Business Plan for AIL
Intelligence Plan for Motorola
Study of Digital Avionics Technologies for Honeywell