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October 10, 2001

Ms. Magalie Salas, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

Re: ET Docket No. 98-153, Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems
Ex parte Communication

On behalf of Peter Annan, President, Sensors & Software Inc., and as an accommodation to Alan Schutz, Engineering Manager, Geophysical Surveys Systems, Inc., and pursuant to Section 1.1206(b)(1) of the Commission's Rules, I am electronically filing the attached written *ex parte* communication for inclusion in the above-referenced docket.

If there are any questions about this filing, please call me at the number above.

Respectfully submitted,

Mitchell Lazarus
Counsel for Sensors & Software Inc.,
and filing as an accommodation to
Alan Schutz

cc: Service list

Follow-up Submission to the Oct 2, 2001, Meeting with OET

On Ground Penetrating Radar (GPR)

ET Docket No. 98-153

1. Highlights of this submission are as follows:

    a. A proposed variance to Section 15.209 to recognize the reduced emission of GPRs, with reduced PRFs for GPR operating frequencies below 500 MHz.

    b. A cost sensitive means for test site fabrication to minimize variability in emissions testing of GPRs.

    c. Discussion of the different requirements of in-wall imaging GPRs and through-the-wall imaging radars, stressing the need to recognize the in-wall imaging application for GPR.

    d. Discussion on limiting GPR PRFs to 500 kHz and lower, plus comment on possibly limiting GPRs with PRFs above 200 kHz to vehicle mounted operation.

    e. Efficacy of procedures to limit GPR operation when left unattended, and a solution based on motion sensing.

2. Following our meeting with the FCC Oct 2, 2001, the major concerns expressed with the use of Section 15.209 limits as the emission limits for GPR systems are as follows:

    a. GPR system power spectral density generally increases as the GPR center operating frequency decreases, while the limits in Section 15.209 decrease with decreasing frequency, making these limits very onerous on low frequency GPRs.

    b. The quasi-peak measurement approach specified in Section 15.209 is insensitive to the PRF rate in the 1 to 100 kHz range where the vast majority of GPRs operate, thus giving no recognition to the reduction in power spectral density that occurs with reducing PRF. Again this is particularly onerous on the lower frequency GPRs as PRF is normally reduced as GPR center frequency is decreased.

    c. The measurement site constraints and approach must reflect those of GPR usage and be reproducible.

    Additional concerns were expressed about the following.

d. There is a need to distinguish between through-the-wall imaging radars and in-wall GPR measurement devices.

e. The Commission's and NTIA's desire that the upper PRF rate for GPRs should be kept as low as possible.

f. The need for a GPR self-terminate feature if left unattended.

3. With respect to concern a), current GPR technology readily complies with Section 15.209 limits for GPRs with center frequencies above 500 MHz. Existing GPRs operating above this frequency will satisfy Section 15.209 limits. GPRs operating with a center frequency below this range face decreasing performance if these limits are to be met. In fact, GPRs with center frequencies below 200 MHz become progressively less effective as the center frequency is reduced. Our previous suggestion of Class A limits was driven by this concern.

   The depth of exploration and resolution length both increase as the frequency of a GPR system is reduced. There are numerous uses for low frequency GPR systems, as has been pointed out in prior comments. We are very concerned that these uses be recognized and accommodated in the rulemaking.

   The GPR applications most severely affected are those normally carried on in non-urban areas in outdoor settings such as geological investigations, environmental site assessments, agricultural non-point pollution, bridge pier scour monitoring, groundwater studies, nuclear waste disposal, glaciology and polar ice cap studies, dam safety and a host of geotechnical site assessments for new road construction, pipeline routing, etc. Other applications are affected to the degree that the spatial scale approaches and exceeds about 1m (the wavelength of a 100 MHz signal in typical soil or rock). A rather small number of such devices are being created and used world-wide per year.

4. With respect to concerns a) and b), we endorse the use of Section 15.209 limits for GPR with measurements as defined in CISPR16, combined with the maximum limit of 500 kHz on PRF (as we discuss in item 7 below) subject to the following variance to accommodate lower frequency GPRs with reduced PRF. Below 500 MHz, a GPR system may exceed the Section 15.209 by an amount dependent on its PRF expressed as

   20 log10 (500 kHz/PRF in kHz) dBuV/m

   subject to a maximum limit which depends on the testing frequency below 500 MHz expressed as

   20 log10 (500 MHz/ Testing Frequency in MHz) dBuV/m

   This variance approach has many features that respect the goals of regulating spurious GPR emissions into the ether, yet accommodate the reality of lower frequency GPR systems. All GPRs with a PRF of 500 kHz must meet Section

15.209 with no variance. All GPRs must satisfy Section 15.209 limits above 500 MHz. Only lower PRF GPRs can exceed Section 15.209, and the amount of this variance is constrained in a smooth manner with frequency such that the variance tapers to zero as frequency approaches 500 MHz.

We feel that a ruling with this type of variance will be least onerous to the GPR user community at large and still address the FCC's concerns. Existing GPRs have operated benignly with these general emission characteristics for 30 years

5. With respect to c), we had recommended in our submission that a concrete pad at least twice the size of the GPR transducer and a thickness of 1 wavelength or 1m, whichever is the lesser, be used for testing. We recognize the concerns that may be caused in constructing such a facility. As a compromise, we would suggest a concrete pad of the same lateral dimensions but with a thickness of 8 in (0.2m) and installed laid over at least 12 in (0.3m) of gravel, again with the proviso of no reinforcing bar or use of fiberglass (non-electrical conducting) bar in the concrete. The most critical issue is get to a repeatable test facility with readily available inexpensive construction material that is representative of typical 'ground' electrical properties.

6. With respect to d), the need for using GPR on retaining walls, tunnel walls, and in similar in-wall function is clear. In-wall measuring GPRs are very different from through-wall imaging radars. First, the walls of interest for GPR are most-often concrete structures typically several inches thick. GPRs designed to inspect such walls image into the concrete and little energy will get through the concrete. Such GPRs are normally quite high frequency (in excess of 500 MHz) and are very low power. The maximum penetration of GPR signals in concrete is 12 to 24 inches depending on the concrete. This means that most of the available energy is dissipated in this thickness of concrete.

   Second, instrument design, deployment, and control functionality are totally distinct for a concrete imaging GPR versus a through-the-wall GPR. The through-the-wall unit is normally placed in a fixed location and changes of response measured with time. In other words, the unit is deployed in a static fashion. For GPR concrete imaging, the transducer must be moved over the surface in a regular fashion to obtain an image. The use of a motion sensing on-off constraint could help differentiate operations and uses.

   If there is concern about mis-use, then label warnings stating that the GPR must only be used on walls of concrete or similar absorbing materials with adequate thickness to absorb the energy and cite examples of acceptable situations. (At least 4 inches of concrete if there is no backing material between the far wall and the outside world containing victim receivers.)

   Although the applications may seem similar at first glance, in reality the needs, system design, deployment method and operator control are sufficiently distinct that common sense says there will be little likelihood of mis-use.

7. With respect to item e) regarding an upper limit on PRF, we recommend that the upper limit be 500 kHz. Most existing GPRs operate in the 1 to 500 kHz PRF range. The upper limit is critical to high speed vehicle mounted systems. Such systems are used for road and bridge deck inspection where PRFs of 500 kHz are needed to enable measurements at highway speeds of 55 mph. Limiting PRFs to lower rates results in a concomitant reduction in driving speed that poses a major traffic hazard. For example, a PRF of 100 kHz could constrain driving speed to 10 mph.

   A suggestion for alleviating concerns about PRF rates above a value of 200 kHz could be to limit use of such rates to vehicle mounted systems employed in surveys which require rapid system movement (see comments on motion also in item 8). Since many of the higher PRF requirements need higher frequency GPRs, a further constraint for these systems could be to apply an emissions limit similar to that posed in item 4 above for vehicle mounted systems with PRF in excess of 200 kHz and operating frequencies above 500 MHz.

8. With respect to item f), the use of a feature which senses system motion could be a practical means of resolving the issue of unattended operation for many GPR applications. If the GPR system has not moved for a period of time, say 120 seconds, an internal capability to have the unit automatically stop itself could be triggered. In fact, many modern GPRs already have this capability in some form or other. Suggestions such as a dead-man switch or orientation-based shut-off switch are not practical for many reasons as indicated in our prior submissions. Further, a deadman switch is more susceptible to being defeated by the operator.

9. As a last note, we would like to reiterate that we encourage the Commission to include a very clear definition of what a GPR system is and does. The goal is to recognize legitimate use of the technology in scientific and engineering form, and not some misuse of the rule's intent. The wording that this group submitted in earlier comment is reproduced here for reference.

   Ground Penetrating Radar (GPR)

   Ground penetrating radar (GPR) is a device thatexploits the forward or back scattering of electromagnetic energy to locate and measure the spatial distribution of physical properties within soil, rock, water, ice, wood, concrete, and similar materials, or locates or images objects buried in such materials. GPR devices intentionally radiate into such materials with only unintentional radiation into the air.

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