

April 14, 2015

**VIA E-MAIL**

Mr. Stephen M. Mackey  
Electronics Engineer  
Aircraft Wakes and Weather Division (V-345)  
Volpe, The National Transportation Systems Center  
U.S. Department of Transportation  
55 Broadway, Kendall Square  
Cambridge, MA 02142

**Re: Adjacent Band Compatibility Proposed Testing Requirements**

Dear Mr. Mackey:

At the recent Adjacent Band Compatibility Workshop, the Department of Transportation (“DoT”) outlined, in a presentation by Mr. Hadi Wassaf, the tests it expects to conduct to determine the protection that Global Positioning System (“GPS”) and other space-based Global Navigation Satellite System (“GNSS”) receivers may require from adjacent channel operations. According to that presentation at the recent workshop, DoT is in the process of developing a test plan on which it likely will seek public comment next month.

Garmin International, Inc., Trimble Navigation Limited and Deere & Company, all members of the GPS Innovation Alliance (“GPSIA”) appreciate DoT’s efforts and look forward to continuing to work with DoT in this important area. They have prepared and are submitting with this letter comments on Mr. Wassaf’s presentation and ask that DoT take those comments into consideration as DoT finalizes its proposed test plan on which it will seek public comment.

If there are any questions regarding the attached comments, please contact the undersigned directly.

Very truly yours,

/s/ M. Anne Swanson

M. Anne Swanson  
Cooley, LLP  
1299 Pennsylvania Ave., NW  
Suite 700  
Washington, DC 20004  
[aswanson@cooley.com](mailto:aswanson@cooley.com)

Counsel for Garmin International, Inc.

/s/ Russell H. Fox

Russell H. Fox  
Mintz, Levin, Cohn, Ferris, Glovsky  
and Popeo, PC  
701 Pennsylvania Ave, NW  
Suite 900  
Washington, DC 20004  
[rfox@mintz.com](mailto:rfox@mintz.com)

Counsel for Trimble Navigation Limited

/s/ Catherine Wang

Catherine Wang  
Morgan, Lewis & Bockius LLP  
2020 K Street, N.W.  
Washington, DC 20006  
[catherine.wang@morganlewis.com](mailto:catherine.wang@morganlewis.com)

Counsel for Deere & Company

cc: Karen Van Dyke

Attachment

# GPSIA Comments on DOT Proposed Testing Requirements Workshop III

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April 14, 2015

## Introduction

GPSIA supports DOT's efforts to create a framework for determining adjacent-band aggregate transmitter power limits necessary to protect GNSS signals and services in the RNSS L1 band (1559 – 1610 MHz) and its proposal to develop an adjacent band interference mask as a function of offset frequency.

GPSIA offers the following comments on the *Testing Requirements Discussion*, presented at the Adjacent Band Compatibility Workshop III, held at Aerospace Corp. on March 12, 2015.

## Test Frequencies <Slides 2-4>

- GPSIA agrees with DOT's proposal to test adjacent band frequencies from 1525 – 1675 MHz, but recommends extending the frequency range to 1680 MHz.
- For clarification, GPSIA recommends specifying the frequency ranges of 1525 – 1559 MHz and 1610 – 1680 MHz.
- Since this is an adjacent band test, data should not be collected within the RNSS band in order to reduce test time and save cost.

## Conducted vs. Radiated Testing <Slides 5-7>

- GPSIA recommends using standardized language of *conducted* and *radiated* testing rather than *wired* and *wireless* testing in order to avoid confusion with the wireless industry.
- GPSIA agrees with DOT's approach to utilize both conducted and radiated testing as part of its study.
- Primarily, data used for the development of an interference mask should be based on radiated testing, whereas conducted testing should be used to vet the test plan (as was done in the NPEF tests) and corroborate radiated test results.<sup>1</sup>
- Additionally, many receiver models are tightly integrated with their antenna, which would not allow for conducted testing without modification of a production unit. Further, many antennas do not allow access to the LNA without modification.

## Antenna Pattern Characterization <Slides 8, 23>

- GPSIA recommends using a standardized antenna model as a way to reduce test burdens and uncertainty. Manufacturers may note any major deviations from the standardized antenna model.
- Further, GPSIA suggests that all radiated tests be conducted with both the interference antenna and RNSS antenna aimed at boresight. Manufacturers will indicate the boresight orientation on devices submitted for testing.

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<sup>1</sup> See NPEF test report, *Follow-on Assessment of LightSquared Ancillary Terrestrial Component Effects on GPS Receivers*, Section 2, <http://www.gps.gov/news/2012/02/lightsquared/NPEF-report.pdf> (accessed 4/1/15).

## Interference Protection Criteria (“IPC”) <Slides 10-11>

- GPSIA agrees that a 1 dB reduction in  $C/N_0$  is the most appropriate interference metric.
- Developing a frequency and bandwidth dependent mask is ideal; however, DOT’s suggestion to test a variety of signal types and bandwidths may lead to significant increases in test time and cost without producing any probative results.

## IPC Test Procedure (Slide 14)

- GPSIA is concerned that DOT’s proposed test regime with multiple test cycles for each frequency point will lead to significant increases in test time and cost.
- DOT’s proposed criteria that  $C/N_0$  be monotonically increasing/decreasing in order for a given measurement to be accepted should not be required as a test criteria. This can be handled in post-analysis.

## Interfering Signal Specification (Slides 12, 19)

- GPSIA notes that a technology-agnostic test signal could make the test results more robust and applicable to future technologies that may arise.
- Using LTE modulation for the interfering test signal has already been done in the past and raises a number of issues, as DOT notes on Slide 19.
  - Which LTE modes, modulation, and configuration to use?
  - Will the test cover MIMO, Carrier Aggregation, or address intermodulation concerns?
- GPSIA recommends establishing a baseline mask with a swept CW signal using an initial step size of 5 MHz. This could be adjusted based on a variety of factors, such as distance from the band edge, etc.
- If time permits, additional tests should be conducted using Band-limited AWGN measured in discrete steps.
- GPSIA recommends limiting  $P_{\max 2}$  to -10 dBm (at the LNA) in order to limit any permanent damage to receivers. (Consistent with NPEF testing.)
- GPSIA recommends using a  $T_{\text{step}}$  consistent with what was used in previous NPEF tests.<sup>2</sup>

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<sup>2</sup> See NPEF test report, *Follow-on Assessment of LightSquared Ancillary Terrestrial Component Effects on GPS Receivers*, Section 3.4.3.2, <http://www.gps.gov/news/2012/02/lightsquared/NPEF-report.pdf> (accessed 4/1/15).

### **RNSS Signal Specification (Slide 13)**

- GPSIA suggests the following technical parameters for the RNSS Signals
  - Simulate 12 GPS Satellites with full almanac and uniform power levels in order to allow averaging of all channels
  - Both L1 and L2 should be transmitted to ensure proper performance of HPN receivers
  - Utilize a single transmit antenna

### **GPSIA also recommends adding simulated GLONASS signals, if possible, in order to fully test the RNSS band.Acquisition Test (Slide 15)**

- GPSIA believes that an Acquisition Test would significantly increase test time; in fact, the logistics of a radiated acquisition test for multiple DUT's would be practically infeasible.

### **Data Collection and Analysis (Slides 16-18)**

- GPSIA is concerned that a simulated environment does not lend itself to collection of the secondary data DOT proposes to collect. Further, these data are not required to create a 1 dB mask.
- Consequently, the test should rely on DOT's primary recommendation, the collection of  $C/N_0$  data.
- GPSIA notes that its proposed uniform RNSS signal power levels will facilitate DOT's suggestion to average satellite power levels for data analysis.
- GPSIA recommends that DOT not discard  $C/N_0$  data that is not monotonically increasing/decreasing. Rather, a procedure should be implemented to govern how such data is interpreted.