ET Docket No. 10-27; ET Docket No. 10-23

Comments in response to Request for Waiver submitted by Ohmart/Vega on December 3, 2009.

First, please excuse the late filing of this comment. I only recently noticed the posting of the waiver request. However, I see that Ohmart/Vega filed information in this proceeding in the past few days.[1] Because the measurements procedures requested by Ohmart/Vega are similar to those requested in ET Docket No. 10-23, these comments also should be associated with that docket.

It appears that the authorized radio services operating in the affected frequency bands would not be susceptible at the low level peak emission limits permitted under Section 15.252(b)(4) of the Commission's rules. Thus, I doubt that anyone will have a problem granting Ohmart/Vega a waiver of the limit on peak emissions. It makes no difference whether a waiver is granted for Section 15.35(b), retaining operation of the transmitter under Section 15.209, or a waiver is granted to the operational restrictions in Section 15.252(a). The effect is the same – other than the tighter unwanted emission limits specified under Section 15.252.

The problems with this waiver request do not involve the peak level emissions from the transmitter. The problems are with the measurement procedure Ohmart/Vega proposes in Appendix B to its petition, the higher emission levels these measurement procedures will permit and the resulting potential for harmful interference to the authorized radio services.

1. Measurement of a reflected emission:

The proposal to measure the reflected emissions, instead of the emissions from the transmitter, will set a precedence that the Commission may later regret. All other radar devices, regardless of the operating rule Part, are subject to limits based on the energy directed from the antenna, not from a reflected source.[2] Allowing the measurement from a reflected source for Ohmart/Vega could result in requests from other radar manufacturers for similar consideration. Should radar systems operating under Section 15.245 of your rules now be measured based on the level of the reflected signal? What should be used as the reflecting source? There are several possible reflection sources, all of which will provide different reflection levels and different angles of reflection making it next to impossible to determine the direction and level of the maximum emissions that could be expected from the transmitter.

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[1] See the Ohmart/Vega test report filed in ET Docket No. 10-27 on April 2, 2010.

[2] While some may argue that ground penetrating radars (GPRs) are measured based on the level of their reflected signals, this is not quite correct. GPRs are unique in that they always operate in immediate proximity to the ground with their signals directed into the ground. The close proximity of the GPR to the ground minimizes propagation distance for any radiated emissions resulting in a low interference potential. Consequently, they are tested with the emissions directed into dry sand which tends to absorb the fundamental emissions rather than reflect them.

Ignoring the precedence, you should at least consider specifying that the reflective surface should be a ground plane. Not only does this allow repeatable test results, it also removes any future arguments as to what material and what dielectric value should be employed when a reflected measurement is performed. A smooth water surface may also be feasible for test purposes provided the reflected emissions can be measured, as discussed in the following section. Specifying a dry sand surface at a 30 degree angle can cause inconsistencies depending on the granule size and composition of the sand, but this is not the major problem. Dry sand, with a dielectric value of only 3-6, would be less reflective than other target materials employed with the Ohmart/Vega equipment and will result in a very low reflected emission level.

2. Measurement setup.

The measurement proposal from Ohmart/Vega could enable the manufacturer to produce a transmitter at almost any power level and still demonstrate compliance with the rules. Under this proposal, effectively all that will be measured is the signal leakage from the transmitter enclosure, as I'll explain.

Ohmart/Vega, in its waiver, requests that the transmitters be tested with the transmitter operating at a height above the reflecting surface "…corresponding to the smallest distance in an application." Ohmart/Vega requests that the measurement antenna be located 3 m horizontally from the vertical center line from the antenna to the test surface. The height of the measurement antenna would range from 1 m to 4 m above the ground plane.

According to to Ohmart/Vega's product information literature, its models VEGAPULS 61, 62 and 63 have minimum operating distances of 50 mm with antenna beamwidths ranging from 4 degrees to 22 degrees. The VEGAPULS 64 and 65 have minimum separation distances of 100 mm with antenna beamwidths ranging from 13 degrees to 38 degrees.[3] Even so, the test data submitted by Ohmart/Vega to the Commission on April 2, 2010, employed a test distance of 1 m above the reflective surface using a system with an antenna beamwidth of 3.7 degrees and with the measurement antenna located at a test distance of 0.25-1 m, adding that the worst case measurement occurred at a measurement distance of 0.45 m from the vertical center line from the transmitter's antenna to the measurement antenna.[4] My calculations below are based on the system employed to

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[3] The VEGAPULS 67 has a minimum separation distance of 50 mm and the VEGAPULS 68 has a minimum separation distance of 400 mm but I did not find a specification for antenna beamwidth in Ohmart/Vega's literature. However, I did not that the VEGAPULS 68 has a parabolic antenna available for its operation.

[4] Ohmart/Vega indicted that the worst case measurement occurred at a slant distance of 1m, at a horizontal measurement distance of 0.45 m, and at a measurement height of 0.90 m. Ohmart/Vega indicated that its calculations for determining the resulting emission level at 3 m were based on this measurement and its assumption that the measured distance to be employed was the 1 m slant distance instead of the 0.45 m horizontal distance. Based on the wording in Section 15.31(f), the measurement distance used for the calculations should have been 0.45 m horizontal distance and not 1 m. However, this is a unique case where Ohmart/Vega is requesting that you permit a transmitter to direct its emissions away from the measurement antenna so the actual transmission distance may need to be applied. This would be

obtain this test data. These calculations should also apply to Ohmart/Vega's proposed in-tank testing method unless the tanks are sealed metal or concrete structures.

Measurement based on a smooth water surface:
For this measurement, a transmitter using a 3.7 degree beamwidth antenna is pointed down to a smooth water surface that is 0.6 m above the ground plane and the transmitter is located 1 m above the water surface. The measurement antenna is varied in height from 1 m to 4 m above the ground plane. The radius of the surface area of the water illuminated by the radar is 1xtan(3.7/2) m = 0.03 m. The radius of the area illuminated by the reflected signal at the maximum measurement height of 4 m is 1xtan(3.7/2) + (4-0.6)xtan(3.7/2) m = 0.142 m. Thus, the measurement antenna must be located no further than 0.142 m from the centerline of the transmitter to see the reflected signal. The Ohmart/Vega equipment was tested with the measurement antenna located 0.45 m from the center. Accordingly, the measurement antenna was outside of the reflections from the water surface.[5] In other words, the reflections are in the vertical direction, not horizontally towards where the measurement antenna is placed. The only signals being emitted in the direction of the measurement antenna will be those leaked from the transmitter's enclosure and those much weaker emissions that are well outside of the specified antenna beamwidth. Using its proposed test procedure, Ohmart/Vega could produce a high power transmitter, with an ERP in the kW range, and still show compliance with the emission limits in Section 15.209 provided the transmitter enclosure is sufficiently shielded and a narrow antenna beamwidth is employed.

Measurement based on a dry sand surface at 30 degrees from the horizontal:
For this measurement, a transmitter using an antenna with a 3.7 degree beamwidth is pointed 1 m away from a dry sand surface that is sloped at a 30 degree angle. The contact point is in the center of this 1 m wide surface so that the center point of contact is 0.26 m above the ground plane. Again, the measurement antenna is varied from 1 m to 4 m above the ground plane.

The use of a reflection surface angled at 30 degrees results in an angle of incidence of (60-3.7/2 =) 58.15 degrees. The height above the sand surface for the reflected signal has increased from 1 m (at the centerline) to 1.02 m (at the edge of the antenna's beamwidth closest to the measurement antenna) and the height above the ground plane at this edge of contact (3.7/2 =) 1.85 degrees from the centerline has decreased to 0.24 m. At a measurement height of 4 m above the ground plane, the illuminated area in the direction of the measurement antenna is 1xtan(3.7/2) + (4-0.24)xtan(180-58.15-58.15-3.7/2) m = 7.06 m. Thus, the measurement antenna can see an actual reflected signal using this test

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the 1 m distance from the transmitter plus the 1 m slant distance back to the measurement antenna resulting in a total transmission distance of 2 m, not 1 m.

[5] If the test procedures requested by Ohmart/Vega were followed, using a 100 mm height above the water surface and a 38 degree antenna beamwidth would have resulted in an illuminated radius of only 1.21 m at a measurement height of 4 m above the ground plane. The measurement antenna would need to be no further than 1.21 m from the transmitter centerline to see the reflected signal. This is the widest reflected signal produced by any of the VEGAPULS 61-65 systems. However, the wider antenna beamwidth will also result in a lower emission level compared to the other antenna configurations.

procedure.[6] However, this reflected signal will not necessarily be representative of the signal levels that may be reflected under actual operating conditions.

Dry sand has a dielectric value of only 3 to 6. It is an extremely poor reflector. Most materials will produce a much higher level reflected signal than that from dry sand.[7] The higher level reflected signal using another medium would have been apparent in the measurement employing a smooth water surface if the measurement antenna had been located within the area of the reflected signal rather than off to the side.

General considerations:
If the Ohmart/Vega system was used only to measure smooth surfaces and was always mounted in the vertical position, the emissions emitted by the transmitter would be directed towards the ground and the reflected emissions would be directed upwards. If the Ohmart/Vega system was used only to measure materials that had extremely low dielectric values and was always mounted in the vertical position, the levels of the reflected emissions would be low. In these specific cases, the reflected emissions may not be of much concern for interference purposes. However, these are not the normal operating conditions. The reflecting surfaces will be irregular with varying slopes, the measured materials may have high dielectric values, and the transmitters may be mounted at skewed angles. Thus, it is impossible to predict the directions in which the emissions will be reflected during actual operation of the equipment or the levels of those emissions. For these reasons, it is important that measurements be performed either on the actual emission emitted from the transmitter's antenna or on the emissions reflected by a flat target surface with a high dielectric value. In other words, the manufacturer should be required to demonstrate that the equipment complies with the appropriate emission limits in all directions under all possible conditions of operation.

If the Commission permits the measurement of the reflected signals instead of the emissions directly from the antenna, obviously the measurement antenna must be positioned within the area illuminated by the reflected signal. This may be difficult. As previously shown, this measurement antenna would need to be placed less than 14 cm from the center of the Ohmart/Vega transmission antenna. The size of the Ohmart/Vega transmission system, the size of the measurement antenna, and the directionality of the measurement antenna must be considered in such a setup. It may be simpler to perform a direct measurement from the Ohmart/Vega transmitter's antenna and to calculate the signal level that would occur should a reflected measurement have been performed. This is a simple task as you will know the total measurement distance and the dielectric value of the reflective surface is readily available, especially if you base the reflection on a ground plane or on water. The use of a ground plane for the reflecting surface ensures that the reflected emissions never exceed the prescribed limits, regardless of the type of material being detected by the radar signal.

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[6] Using the test conditions requested by Ohmart/Vega with the transmitter located 50 mm above the sand and employing an antenna with a 4 degree beamwidth results in an illuminated area 4 m above the ground plane that extends towards the measurement antenna by a distance of 0.05xtan(2) + 3.76xtan(180-58-58-2) m = 7.07 m.

[7] For example, the dielectric value of water is about 81.

One remaining problem in using a reflective measurement is that, based on the operating frequency and the size of the antenna, all of these measurements are being performed in the near field. I leave it up to the Commission on how this problem can be resolved absent making far field measurements directly from the transmitter's antenna with subsequent calculations to determine the radiated signal levels.

Thank you for your consideration of my comments.

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