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

In the Matter of	)	
	)	
Revision of Part 15 of the Commission's	)	ET Docket No. 98-153
Rules Regarding Ultra-Wideband	)	
Transmission Systems	)	

REPLY COMMENTS OF
SIEMENS VDO AUTOMOTIVE AG

Siemens VDO Automotive AG ("Siemens VDO") submits these Reply Comments primarily in response to the comments filed by the National Academy of Sciences' Committee on Radio Frequencies ("CORF") in the above-referenced proceeding.[1] CORF was the only commenter to oppose the proposal, contained in the Commission's Further Notice of Proposed Rulemaking ("*Further Notice*"),[2] to permit the operation under the Commission's UWB rules of Siemens VDO's pulsed frequency hopping ("FH") vehicular short range radar ("SRR") systems currently under development. CORF's opposition to allowing the operation of Siemens VDO's SRRs in the 22–29 GHz band is based entirely on its concern that such devices are more likely than pure pulsed devices to cause harmful interference to earth exploration satellite service ("EESS") sensors operating in the 23.6–24 GHz band.[3]

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1 *See* Comments of the National Academy of Sciences' Committee on Radio Frequencies, filed in ET Docket 98-153 (July 16, 2003) ("CORF Comments").

2 *See* Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, ET Docket 98-193, *Memorandum Opinion and Order and Further Notice of Proposed Rulemaking,* FCC 03-33 (rel. Mar. 12, 2003) ("*Further Notice*").

3 *See* CORF Comments at 5.

In its Comments,[4] Siemens VDO explained in detail why its devices are *not* more likely to cause harmful interference to EESS or any other service. In these Reply Comments, Siemens VDO refutes CORF's specific assertions and proposals, and re-emphasizes its principal arguments relating to this matter.

I. The Commission Should Reject CORF's Proposals

In its Petition for Reconsideration, Siemens VDO asked the Commission to permit the use of a 10 ms integration time when conducting average power measurements of the Siemens VDO devices, in order to obtain more accurate root mean square ("RMS") readings.[5] In its Comments, Siemens VDO stated that, while a 1 ms period would produce inaccurately high power readings, it could nevertheless accept the application of the 1 ms integration time for measurements in the 23.6–24 GHz passive band.[6] CORF, in its comments, asked the Commission to impose an integration time of 0.1 ms on the Siemens VDO devices, a time period dramatically shorter than the existing 1 ms period established by the Commission's *UWB Order*.[7] CORF's request was based on a simplistic and inaccurate conclusion that the measurement integration time must be less than the integration time of the EESS sensor in order to equate the interference potential of pulsed FH devices with pure

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[4] *See* Comments of Siemens VDO Automotive AG, filed in ET Docket 98-153 (July 21, 2003) ("Comments").

[5] *See* Petition for Reconsideration at 9.

[6] *See* Comments at 10.

[7] *See* CORF Comments at 5 (suggesting the 0.1 ms integration time as an alternative to outright prohibition on the operation of pulsed FH devices); *see* Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, ET Docket 98-153, *First Report and Order,* FCC 02-48 (rel. Apr. 22, 2002) ("*UWB Order*").

pulsed devices.[8] CORF also proposed that measurements be taken using a fast-response power detector.[9] The Commission should reject CORF's proposals for the following reasons:

- Siemens VDO's pulsed FH devices will not pose any greater threat of interference to EESS or any other service, compared to pure pulsed systems. Interference potential is defined primarily by a victim receiver's bandwidth and by the characteristics of the emissions. Pure pulsed devices generate instantaneously a single line power ("SLP") spectrum that is discrete in the frequency domain. The Siemens VDO pulsed FH device produces the same emissions characteristics. Both the level of each SLP and the distribution of the SLP within the victim receiver bandwidth are identical, thereby making it impossible for a victim receiver (with a bandwidth of up to 50 MHz) to differentiate between the two modulation types.[10]

- Siemens VDO has already indicated that it would be willing to accept a 1 ms integration time for measuring average emissions in the passive 23.6–24 GHz band. As evident from the *Further Notice* and from CORF's own comments, this integration period is less than the integration time of any EESS sensor in existence. The fact that Siemens VDO is willing to accept a 1 ms integration time should be sufficient to moot CORF's concern.[11] The Commission should not base any change in its rules on what CORF speculates regarding the integration times of future EESS sensors.[12] CORF presents nothing more than unsupported conjecture in this regard.

- CORF fails to acknowledge that any threat of future interference to EESS will be reduced due to existing rules that, starting in 2010, require all UWB vehicular radar devices to sharply attenuate emissions appearing 30° or more above the horizontal plane.[13]

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8 *See* CORF Comments at 5.

9 *See id*. at 7.

10 *See* Comments at 3-7.

11 *See Further Notice* at ¶ 157; CORF Comments at 5-6. CORF evidently proposes the use of the shorter integration time for measurements made throughout the entire 22–29 GHz band, but never explains why this would be necessary given that the EESS allocation is limited to the 23.6–24 GHz passive band.

12 *See* CORF Comments at 6.

13 *See* 47 C.F.R. § 15.515(c) (requiring a 30 dB attenuation in 2010 and a 35 dB attenuation in 2014).

- CORF's comments also ignore the fact that as EESS sensor integration times decrease, the sensors' sensitivity to interference also decreases. This point is demonstrated by the equation contained in Recommendation ITU-R SA.1029 ("Interference Criteria for Satellite Passive Remote Sensing"), which indicates that the sensitivity of passive radiometers is inversely proportional to the square root of the integration time.[14] Based on these equations, it can be shown that, if the integration time of an EESS sensor is reduced, for example, from 1 ms to 0.1 ms, its sensitivity will be decreased by 5 dB (*i.e.*, 10 log(sqrt(10))). Thus, assuming compliance with the Commission's vehicular radar average power limit of –41.3 dBm in the main beam, it is evident that an EESS with a 1 ms integration time will be 5 dB more sensitive than the same EESS sensor with only a 0.1 ms integration time, leading to a power interference level of –36.3 dBm/MHz. Therefore, by proposing an integration time of 0.1 ms, CORF is effectively seeking a "back door" means to reduce the average power limit that the Commission has already determined to be sufficient to protect EESS from harmful interference.

- As explained in the Comments, in demonstrating that its devices will not cause harmful interference to EESS sensors, Siemens VDO relies primarily on the effects of spatial integration, rather than on the relative length of the integration time.[15] With spatial integration, the aggregated power from multiple transmitters received at the victim receiver is averaged over a large geographic area (*i.e.*, the EESS sensor's antenna footprint), resulting in a smoothing of individual pulses and making it impossible for the sensor to distinguish individual modulation techniques.

- The issue of the proper integration time to employ in taking the average power measurement of the Siemens VDO device is important in achieving an

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[14] Specifically, Recommendation SA.1029 states that sensitivity is generally expressed as a temperature differential, ΔT_e, expressed as $\Delta T_e = \alpha T_s / \sqrt{Bt}$, where a is a receiver system constant, T_s is the operating noise temperature (K), B is the receiver bandwidth (Hz) and t is the total time of observation (s). The radiometric threshold, or minimum discernible power change of a radiometric passive sensor is given by $\Delta P = k \Delta T_e B$, where k is Boltzmann's constant. Thus, the sensitivity is inversely proportional to the square root of the integration time. *See also,* Recommendation ITU-R RA.769 at Annex 1 (indicating that the sensitivity of passive sensors in the radio astronomy service is likewise inversely proportional to the square root of the integration time).

[15] *See* Comments at 12-13.

accurate RMS measurement.[16] However, in the final analysis the resolution of this issue – which is at the heart of CORF's comments and is discussed prominently in the *Further Notice* – will have less to do with the potential of the Siemens VDO pulsed FH devices to cause harmful interference than the fact that low pulse repetition frequency ("PRF") devices (such as the proposed Siemens VDO SRRs) are inherently peak power limited.[17] The attached Annex provides examples that help illustrate that devices operating pursuant to the UWB rules are average power limited where the PRF is high and are peak power limited where the PRF is low.

- CORF's proposal to use a fast response (*i.e.*, 0.1 ms or faster) power detector instead of a spectrum analyzer is not practical, as Siemens VDO is not aware that any such highly sensitive, fast response time measurement device is commercially available.

- Finally, CORF appears to confuse average and peak power measurement procedures. For example, when purportedly discussing average power measurement techniques,[18] CORF suggests taking measurements over several seconds, at 0.1 ms per sample, to "ensure that the estimate of the 'maximum' value is accurate . . . ."[19] Such a technique is normally used to determine peak power values. To the extent CORF intends this procedure to apply to RMS measurements, the Commission should ignore this illogical proposal.

Thus, as shown above, the Commission should not adopt any of CORF's proposals.

II. The Commission Should Adopt the Proposals in the Further Notice that Will Permit the Operation of Siemens VDO's SRR Devices

In its Comments, Siemens VDO responded to specific questions posed in the *Further Notice* and identified specific rule changes the Commission should make to create a competitively neutral regulatory environment that will ensure that the

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[16] The most accurate RMS readings are achieved when the integration time is equal to the frame time of the emitting device. RMS integration times exceeding the frame time produce negligible reading errors, but RMS integration times that are significantly shorter than the frame time can result in significant measurement artifacts. *See* Comments at 8-11.

[17] *See* Comments at 8, 11-12.

[18] *See* CORF Comments at 6-7 (responding to ¶ 161 of the *Further Notice*).

[19] *See id.*

safety benefits of the Siemens VDO SRR devices can become available to the public.

Those suggestions are briefly recapped below:

- The Commission should enact its proposal to eliminate the definition of ultra-wideband transmitter containing the requirement that UWB devices must occupy 500 MHz of bandwidth "at any point in time." In addition to the fact that *no* pulsed device employing some quiescent periods can satisfy a literal reading of this requirement, the rule also creates a perverse incentive for manufacturers to design devices that instantaneously occupy more bandwidth than is necessary.[20]

- Should the Commission decide not to eliminate the minimum bandwidth requirement, the Commission should adopt one or both of the measurement methods proposed by Siemens VDO for confirming the UWB bandwidth of its pulsed FH system within a 10 ms time period. The Commission should not, however, adopt its proposal to measure the -10 dB bandwidth of a single hopping channel and multiply it by the number of non-overlapping hops that occur within a 10 ms time period. [21] Siemens VDO believes that such a measurement procedure would be difficult, if not impossible, to perform with a standard spectrum analyzer.[22]

- Siemens VDO believes that the Commission's proposal to limit the RBW to one-tenth of the –10 dB bandwidth for measurements of non-UWB wideband Part 15 transmitters would not result in accurate peak power measurements, but would, instead, penalize some systems by as much as 6 dB. Accordingly, the full –10 dB bandwidth should be used.[23]

- Siemens VDO generally supports the Commission's proposal to change the UWB peak power limit to the same limit it proposed in paragraph 164 of the *Further Notice* for non-UWB, wideband Part 15 systems. However, Siemens VDO proposes that the more stringent one-tenth of the –10 dB bandwidth peak measurement requirement be applied only to the passive band at 23.6–24 GHz. For the rest of the 22–29 GHz UWB vehicular radar band, the full –10 dB bandwidth should be allowed for the peak measurement, with the caveat that the total EIRP power must be reduced by 20 log (50 MHz/instantaneous occupied BW).[24]

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[20] *See Further Notice* at ¶ 166; Comments at 15, 22 and 31.

[21] *See Further Notice* at ¶ 161.

[22] *See* Comments at 17-22.

[23] *See Further Notice* at ¶¶ 163-64; Comments at 27-29.

[24] *See Further Notice* at ¶ 166; Comments at 15-16.

- Measurements of peak power may be taken either with the frequency hopping active or stopped.[25] Average power measurements, however, must be taken with the frequency hopping active to obtain an accurate RMS reading.[26] This conclusion is supported by recent joint Commission-NTIA measurement tests in which NTIA concluded that "the radiated emissions from a pulsed FH radar prototype can be accurately measured in frequency hopping mode." [27]

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[25] *See* Comments at 23-24 (providing detailed suggestions regarding peak power measurement procedures).

[26] *See* Comments at 25-26.

[27] NTIA, "Measurements of Siemens Pulsed Frequency Hopping Vehicular Radar Prototype," Mar. 20, 2003 at 37.

CONCLUSION

For the foregoing reasons, Siemens VDO urges the Commission to reject the proposals proffered by CORF and instead to adopt the rule changes proposed in the *Further Notice* that will permit Siemens VDO's pulsed FH vehicular radar devices to operate as UWB devices.

Respectfully submitted,

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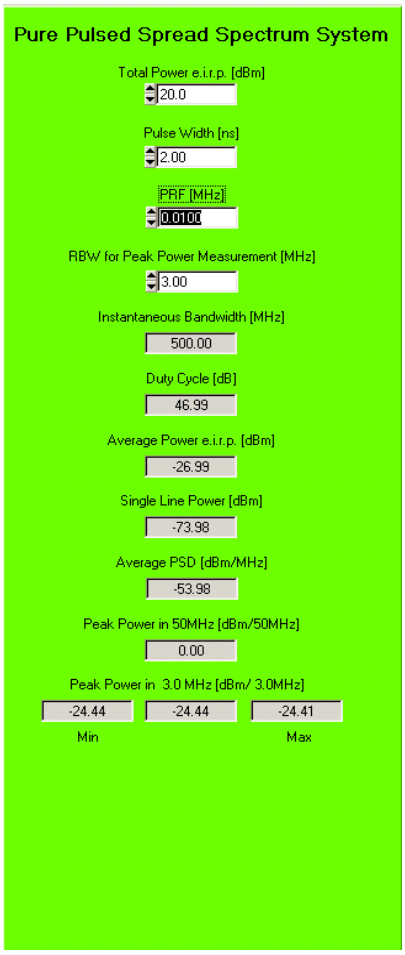
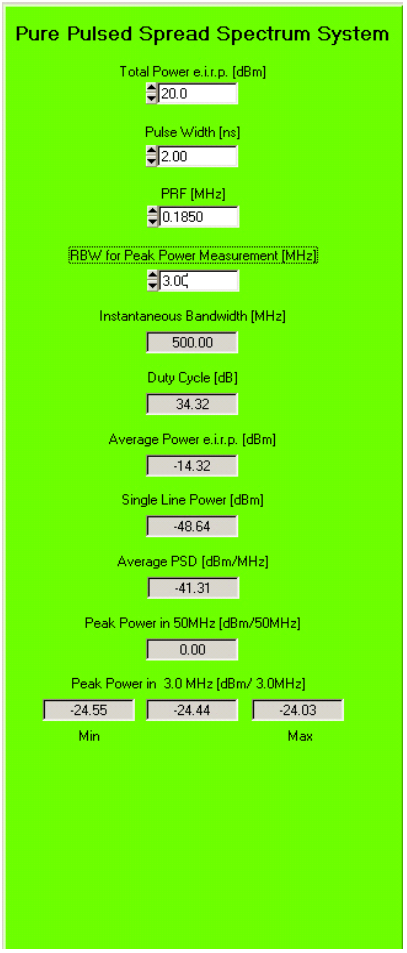
ANNEX

The screen prints[1] shown below help to illustrate the operational parameters that would cause a UWB device to be limited by its peak power, average power or both.





All three parameter sets above have a pulse width of 2ns, which results in an instantaneous occupied bandwidth of 500 MHz, as required by the *UWB Order* to qualify as a UWB device. The peak power, measured in a 50 MHz RBW, is 0 dBm. Thus, all three parameter sets are limited by the peak power limit of 0 dBm/50 MHz contained in the rules.

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[1] The screen prints come from the UWB Power Calculator, a software program developed by Siemens VDO containing mathematical formulas used to analyze both pure pulsed and pulsed FH radar devices. A copy of this program was submitted as a CD-ROM attachment to the Comments and will be made available upon request to any party.

The PRF for the first two cases (*i.e.*, 0.001 MHz which is equivalent to 1 ms, and 0.01 MHz which is equivalent 0.1 ms) is so low that the average power is far below the -41.3 dBm/MHz criterion (*i.e.*, -63.98 dBm/MHz and -53.98 dBm/MHz, respectively). For the third case with a PRF of 0.185 MHz (equivalent to 5.4 μs) the parameter set becomes both peak and average limited.

For higher PRFs (above 0.185 MHz), the UWB device becomes automatically average power limited. By adjusting either the total EIRP power, the pulse width or a combination of both, the average power limit criterion can be achieved. This is demonstrated in the parameter sets shown below.

Thus, all three parameter sets above are limited only by the -41.3 dBm/MHz average power criterion.