

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

**In re Application of** )  
 )  
**CURTISS-WRIGHT CONTROLS, INC.** ) **ET Docket No. 10-167**  
**Request for Waiver of Part 15 of the** )  
**Commission’s Rules Applicable to Ultra-** )  
**Wideband Devices for a Stepped-Frequency** )  
**Ground Penetrating Radar System** )

**To: The Office of the Secretary**

**EX PARTE COMMENTS OF ROBERT BOSCH, GmbH**

Robert Bosch, GmbH (Bosch), by and through counsel and pursuant to the Public Notice, DA 10-1551, released in this proceeding August 19, 2010, hereby submits its comments on an *ex parte* basis<sup>1</sup> in support of the waiver requested by Curtiss-Wright Controls, Inc. (CWCI) of Sections 15.503(d) and 15.521(d) of the Commission’s rules. In support of the relief requested by CWCI in its June 10, 2010 waiver request, and more generally with respect to the need for clarity and flexibility in the application of the Commission’s requirement that ultra-wideband (UWB) devices meet a fractional

---

<sup>1</sup> These comments are submitted out of time. The Public Notice, DA 10-1551 called for comments to be filed by September 20, 2010 and reply comments to be filed not later than October 4, 2010. The reason why Bosch did not participate earlier in this proceeding is that, since July 9, 2010, Bosch has had pending in the Office of Engineering and Technology a letter *Request for Interpretation of Section 15.503(d) of the Commission’s Rules*. This letter request relates to the determination of the minimum bandwidth of UWB devices depending on the emission mode and the measurement process used. The letter request is still pending as of this writing. At the suggestion of a member of the Commission’s staff in January of 2011, Bosch filed on January 26, 2011 an essentially similar interpretation request in the form of a Knowledge Database (KDB) request with the OET Laboratory (Inquiry Tracking Number 598295). Though the KDB request was responded to by the Commission on a timely basis, Bosch was subsequently informed on February 18, 2011 that the KDB response was being vacated and the subject revisited in view of the fact that the issues raised by Bosch in the KDB request were similar in part to the issues being adjudicated in the instant proceeding, and that it was important that the issues raised with respect to determination of the minimum bandwidth of UWB devices be resolved in a consistent manner. Bosch was informed by Commission staff that Bosch was “welcome to add [its] comments on the docket.” It is therefore hoped that these *ex parte* comments will be deemed timely under the circumstances and considered substantively in the instant proceeding.

bandwidth minimum of 0.20 or 500 megahertz “at any point in time,” Bosch states as follows:

1. Bosch is a multinational corporation which manufactures many different types of high-quality products for numerous industries, including vehicular radar systems and construction tools. Bosch conducts extensive research and development and is interested in UWB technology for current and future product development worldwide. Bosch’s development of products for use in the United States, however, is inhibited by the lack of a clear understanding of the Commission’s minimum bandwidth rule for UWB devices. Of particular concern is Section 15.503(d) of the Commission’s Rules governing the operation of UWB devices. This rule contains the requirement that UWB devices meet a fractional bandwidth minimum of 0.20 or 500 megahertz “at any point in time.” This absolute requirement is particularly confusing and the application of it is unclear. A clear understanding of this rule is important in order that Bosch and other companies can develop UWB products using various emission modes. The minimum bandwidth requirement set forth in the rules is complicated, because it does not appear possible to comply with it using any practical emission mode. As it cannot be the Commission’s intent to have a rule that precludes all UWB emissions, this proceeding offers the opportunity to provide a flexible and practical construction of Section 15.503(d), not only for CWCI but for other manufacturers and those interested in UWB applications as well.

2. CWCI’s product, called the 3d-Radar System, operates between 100 MHz and 3 GHz. With an almost 3 GHz bandwidth, the device would be considered a UWB device but for the fact that it is configured with a series of antennas (in order to generate a three-dimensional image) and transmits in sequential, 2 MHz steps, with a scan/cycle rate of

2.8 mS each. The Commission's staff has told CWCI that, for an intentional radiator to meet the requirements of Section 15.503(d) of the Rules, the device must have an instantaneous bandwidth of at least 500 MHz. The rules, CWCI says, do not define what period of time constitutes an instantaneous measurement interval. However, the prevailing interpretation is that, for the stepped frequency emission that the CWCI device uses, each step is the instantaneous bandwidth of the device, and therefore, since each step is less than 500 MHz, the device does not meet the UWB definition. CWCI asserts, *and Bosch agrees*, that that UWB test procedures should accommodate non-impulse transmitters by permitting measurements to be made with any hopped, stepped or gating functions active.

3. CWCI notes that the Commission did grant a waiver for a UWB stepped frequency OFDM device in 2005. However, the First Report and Order in the UWB docket specifically stated that measurements on a stepped frequency or frequency hopping modulated system are performed with the stepping sequence or frequency hop *stopped*. The Commission further noted that with the sweep, step function or hopping stopped, it is *unlikely* that swept frequency (linear FM or FMCW) or stepped frequency modulated emissions would comply with the fractional bandwidth or minimum bandwidth requirements.

4. Bosch's concerns are similar to those of CWCI. Bosch has requested of the Commission an interpretation of Section 15.503(d) of the Rules governing the operation of UWB devices relative to the requirement that UWB devices meet a fractional bandwidth minimum of 0.20 or 500 megahertz "at any point in time." *The words "at any*

*point in time” are in this context not clear. No emission can fulfill this requirement, if literally applied.*

5. The definition of UWB relative to minimum bandwidth requirements adopted in the UWB *First Report and Order* reads as follows:

Section 15.503 Definitions.

(a) UWB Bandwidth. For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated  $f_H$  and the lower boundary is designated  $f_L$ . The frequency at which the highest radiated emission occurs is designated  $f_M$ .

(b) Center frequency. The center frequency,  $f_C$ , equals  $(f_H + f_L)/2$ .

(c) Fractional bandwidth. The fractional bandwidth equals  $2(f_H - f_L)/(f_H + f_L)$ .

(d) Ultra-wideband (UWB) transmitter. An intentional radiator that, **at any point in time**, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

(emphasis added)

6. The Commission decided in that proceeding that the -10 dB fractional bandwidth should be 0.20, and that the minimum bandwidth limit would be 500 megahertz for UWB devices. The Commission noted, “*as long as the transmission system complies with the fractional bandwidth or minimum bandwidth requirements at all times during its transmission, we agree that it should be permitted to operate under the UWB regulations.*” The rule therefore seems to require without exception that the minimum bandwidth requirement be achieved at all times (*i.e. in all possible operation modes of the device*) during the transmission, regardless of modulation or emission type.

7. This requirement, that the minimum bandwidth must be met “at all times,” precludes the use of essentially all modulation schemes, except a continuous-wave signal of at least 500 MHz bandwidth. Pulsed emissions, frequency-hopping emissions, swept frequency (*e.g.*, FMCW), and stepped frequency systems are all precluded by this requirement, if the requirement is strictly construed. The requirement that the minimum 500 MHz bandwidth be achieved “at any point in time,” in combination with the requirement that the signal must be measured *with and without modulation*<sup>2</sup> makes any UWB device impossible of compliance. For some UWB applications, emissions other than pulse or OFDM are more appropriate. Examples are frequency hopping, frequency stepping, FMCW, or pseudo-noise coding. *In “normal” operation* each of these emissions is capable of meeting or exceeding a 500 MHz bandwidth. For most of these applications it makes no sense to switch off the modulation, as that would leave only the signal basic form. As an example of the problem, with FMCW, the signal is only usable with modulation. Without modulation, there is only a carrier. To send out only the carrier makes no sense, and it is not efficient.

8. An alternative interpretation, which would make sense, is to prohibit UWB sensors or other devices which are capable of switching off the modulation or which could change to an *operating mode* in which the emission is than less than 500 MHz. Alternatively, a requirement could be implemented that would provide that in all modes of operation of the UWB device, the necessary or occupied bandwidth must be greater

---

<sup>2</sup> The term “modulation” in this context further detracts from the clarity of the rule. What the modulation is in this case is determinative but unclear. Is it the step sequence for the frequency hopped signal, or for FMCW, the ramp? If so, then the absence of modulation leaves only the carrier. If, however, the modulation is on the basic signal, then the rule is far more permissive. If the hopping or the ramp is the modulation, then even pulsed signals will fail to meet the minimum bandwidth test, because in that case, the PRF generation of the signal is comparable to the modulation of the FMCW or the frequency hopping emission.

than 500 MHz. To have to switch off the modulation for compliance testing makes UWB products unworkable, absent a waiver for each one.

9. An additional issue, and one directly encountered in the instant proceeding, is the measurement time of the measurement receiver (such as a spectrum analyzer) during which the minimum bandwidth requirement must be met (e.g., one millisecond). It is clear that the requirement cannot be fulfilled in no time or during an unspecified time, but within a certain time delta. Measurement procedures now require that measurements of swept frequency devices be made with the frequency sweep stopped. 47 C.F.R. §15.31(c). This requirement was enacted apparently because the measurement procedures for swept frequency devices were undetermined at the time of the first UWB Report and Order. Likewise, interference aspects of swept frequency devices were undetermined due to the fact that measurement results obtained from measurements taken with the sweep active would differ from those with the sweep stopped. Similarly, measurements on a stepped frequency or frequency hopping modulated system are performed with the stepping sequence or frequency hop stopped. With the sweep, step function or hopping stopped, it is unlikely that swept frequency (linear FM or FMCW) or stepped frequency modulated emissions would comply with the fractional bandwidth or minimum bandwidth requirements. The Commission admitted in the UWB *First Report and Order* that it is “unlikely that frequency hopping systems would comply unless an extremely wide bandwidth hopping channel is employed.” It did not, however, indicate how the “at any point in time” condition could possibly be literally complied with by any modulation scheme.

10. In 2003, the Commission issued a *Memorandum Opinion and Order and Further Notice of Proposed Rule Making* in the UWB docket, which made no change in the minimum bandwidth requirement but did state: “The rules adopted in the *R&O* also permit UWB devices to comply with the minimum bandwidth requirement due to the use of a high speed data rate or the use of other modulation techniques instead of the width of the pulse or impulse signal.”

11. In December of 2004, the Commission issued a *Second Report and Order and Second Memorandum Opinion and Order*, which addressed proposed changes in operational standards for unlicensed devices that may apply simply due to the bandwidth of the transmission system. The Commission said that its standards for unlicensed devices must reflect emission limits that reduce the potential for causing harmful interference to authorized radio services. The emission limits applied to UWB ensure a low probability of causing harmful interference, *and the minimum bandwidth requirement could have the opposite effect than what is intended: it could cause a manufacturer to design transmitters that occupy more bandwidth than is operationally necessary or transmitters that inject noise in order to increase the occupied bandwidth simply to permit operation under the UWB regulations. This would place greater energy in frequency bands where operation is not necessary for the system to function and increase the interference potential.* So, the Commission realized that a minimum bandwidth standard (and, obviously, the measurement procedure for determining the minimum bandwidth) could be counterproductive to reducing whatever minimal potential there might be for harmful interference, and it proposed to eliminate the definition of an ultra-wideband transmitter in 47 C.F.R. § 15.503(d). The Commission recognized that it

is the limit on emission levels (and particularly the limit on spectral power density) that primarily controls interference potential, not whether or not the minimum bandwidth is met “at all times.” The Commission proposed to permit the operation of any transmission system, regardless of its bandwidth, as long as it complies with the standards for UWB operation set forth in Subpart F of 47 C.F.R. Part 15 and based the resolution bandwidth used for the peak power measurement to 10 percent of the -10 dB bandwidth of the emission. NTIA opposed eliminating the bandwidth requirements, stating that the supporting comments offered no technical support and expressing concern that such a change would permit operation in the restricted bands regardless of the bandwidth of the unlicensed emission. Ultimately, the Commission said it found “no necessity at this time to eliminate the UWB minimum bandwidth requirements.” It said that such changes “could be disruptive and could further delay the introduction of UWB devices” and that any operation in the restricted bands should be subject to the additional technical standards and operational parameters specified in the UWB regulations. Changes to the minimum bandwidth requirements for UWB devices were deferred “until additional experience has been gained with this equipment.”

12. It is not clear from that discussion that the Commission recognized that its requirement that the minimum bandwidth of a UWB device must be achieved “at all times” during a transmission constituted a preclusive limit on UWB deployment and would preclude some or all UWB products (since none, including pulsed emission UWB devices, can meet this absolute restriction). The rule is not at all clear, and on its face is completely preclusive, *unless* a common-sense interpretation is applied. The “at any point in time” regulation, in order to make sense, must mean “at any point in time in the normal

operating mode of the device.” Absent such an interpretation, every UWB device that would not, at all times during its transmit cycle, meet the minimum bandwidth requirement (which Bosch suggests is every UWB device) would require a waiver from the Commission. Instead, a practical interpretation of the Section 15.503(d) definition of minimum bandwidth is called for, focusing on the - 10 dB requirement and the fractional bandwidth requirement, and applying the “at any point in time” provision to mean that the minimum bandwidth must be complied with at all times during the normal operating cycle of the emission being utilized.

13. Bosch supports the grant of the CWCI waiver. But more broadly than this, Bosch requests that the Commission provide, for all UWB manufacturers, the opportunity to apply a practical interpretation of the Section 15.503(d) definition of minimum bandwidth, focusing on the - 10 dB requirement and the fractional bandwidth requirement, and to apply the “at all times” provision to mean that the minimum bandwidth must be complied with at all times during the normal operating cycle of the emission being utilized by a UWB device.

Therefore, the foregoing considered, Robert Bosch, GmbH, respectfully requests

that the Commission grant the requested waiver and in addition provide the broader relief requested herein.

Respectfully submitted,

**ROBERT BOSCH, GmbH**

By: \_\_\_\_\_  
Christopher D. Imlay  
Its Attorney

Booth, Freret, Imlay & Tepper, P.C.  
14356 Cape May Road  
Silver Spring, MD 20904-6011  
(301) 384-5525

March 2, 2011