Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Ultra-Wideband	)	ET Docket No. 98-153
Transmission Systems	)	

To: The Commission

Comments of Endress + Hauser GmbH & Co.

Endress + Hauser GmbH & Co. ("Endress Hauser"), by its attorneys and pursuant to section 1.419 of the rules and regulations of the Federal Communications Commission ("FCC" or "Commission"), 47 C.F.R. § 1.419 (1997), hereby submits its comments in response to the *Notice of Inquiry* ("*Notice*"), released on September 1, 1998, in the above-captioned proceeding. As set forth more fully below, Endress Hauser urges the Commission to revise Part 15 of its rules to permit the rapid and full deployment of advanced ultra-wideband devices ("UWB devices").

I. **Background**. Endress Hauser is a leading manufacturer of Part 15, unlicensed radar level measurement systems. The company's state-of-the-art radiofrequency ("RF") products are employed at industrial sites throughout the United States. Endress Hauser is concerned that the FCC's Part 15 rules, adopted and revised in a piecemeal fashion in delayed response to the advent of new technologies (*e.g.*, cordless telephones), are lagging behind certain advanced UWB technologies. In some instances, the FCC's rules are prohibiting advanced products from reaching the market, despite the fact that these products do not represent an interference concern. Accordingly, Endress Hauser is pleased to submit these comments and urges the Commission to revise its rules in the manner indicated herein.

II. **Radar Level Measurement Systems**. Over the past several years, new Radar Level Measurement Systems have been developed as unlicensed low power devices, allowing the measurement of stored fluids or solids with high accuracy under rough ambient conditions (*e.g.*, under very high temperatures or pressure). Conventional level measurement systems, such as ultrasonic systems, often fail in these conditions because of the incompatibility of the sensor materials and because of the strong temperature dependence of the velocity of sound waves in air. Because the velocity of light waves is nearly independent of temperature, pressure, and humidity, these new radar technologies offer new applications for level measurement under the rough ambient conditions in the industry. In extreme applications with very toxic or aggressive chemicals, the systems can even measure through glass windows and prevent any contamination of the environment. Hence, the deployment of Radar Level Measurement Systems not only produces industrial benefits for the users, it also increases the safety of production processes with aggressive or toxic chemicals, and decreases environmental hazards.

Thus, based on the foregoing, Radar Level Measurement Systems are in the public interest and should be promoted by the FCC to the fullest extent possible. Part 15 regulations that impair the user's ability to deploy these advanced systems should be reconsidered where feasible.

III. **Technical Background**. For Radar Level Measurement Systems, two modulation principals are generally employed: Frequency Modulated Continuous Wave Systems (FMCW, swept frequency modulation) or Pulsed Systems (narrow pulse modulation). For a very high measurement accuracy of a few centimeters or millimeters, short

signals with a pulse length of the order of a few Nanoseconds are required. The corresponding frequency bandwidth ranges up to a few gigahertz and may include frequency bands that are FCC-restricted or safety-related. 47 C.F.R. § 15.205 (1997). However, harmful interference to other users of the spectrum is completely avoided due to the low transmission power of these UWB systems. *Because the pulsed signal energy is spread over an ultra-wide bandwidth, the spectral power density is extremely low and is equivalent to background noise.* Thus, these critically important UWB devices have an extremely low potential to cause a harmful interference to other users of the radio spectrum.

IV. **Existing and Future Radar Systems.** Radar Level Measurement Systems from several manufacturers exist on the market. Endress Hauser produces and is developing in the future pulsed UWB systems with following technical specifications:

Center frequency:	5,8 GHz, 6,3 GHz, 24 GHz, 76 GHz
pulse length:	0,2-3 ns
bandwidth:	0,7 - 10 GHz
pulse repetition frequency:	1-10 MHz
pulse noise generation frequency:	10 - 100 kHz
transmitter power peak level:	0,1 ...1 mW
transmitter power average level:	0,1 ...1 μW
field strength peak level [1) 3)]:	50 mV/m.....800 mV/m (94 ... 118 dBμV/m)
field strength average level[1)]:	200 μV/m ....2500 μV/m (44 ... 68 dBμV/m)
spectral power density [1)]:	0,01 ... 2 μW/MHz (EIRP[2)])
operation distance:	20 m ...100 m

[1)] measured at 3 m distance from the antenna using 1 MHz Bandwidth
[2)] Equivalent isotropic radiated power density
[3)] applying the pulse desensitization method according to FCC rule 15.35

V. **Regulatory Treatment.** Because of their the low duty cycle, the average power levels of existing UWB systems are much lower than the peak levels and do not exceed the limits specified in FCC rule section 15.209 (500 μV/m or 54 dBμV/m). However, under the

FCC's current policies, application of the "pulse desensitization" method for the measured *average* levels results in the UWB device far exceeding the FCC limits specified in rule sections 15.209 and 15.35(b) (5000 μV/m or 74 dBμV/m). *Notice* at ¶ 5. Based on the foregoing, Endress Hauser believes that the pulse desensitization method was developed for narrow band systems with continuous emissions. *Id.* It is illogical to apply the pulse desensitization method to UWB pulsed radio systems, because the spectral energy is the critical factor when evaluating the potential for harmful interference. Receivers are sensitive only for a limited bandwidth and the peak energy is only relevant for theoretical considerations. Additionally, because of the extremely short range of Radar Level Measuring Systems (100 meters), the potential for harmful interference to other spectrum users is negligible. Therefore, UWB technologies should be treated differently in part 15 of the FCC's rules.

VI. Specific Proposals. UWB Radar Level Measurement Systems should be defined as non-licensed intentional radiators under Part 15 with the following restrictions:

A. Emission Limits. The field strength limits specified in FCC rule section 15.209 are acceptable for existing devices, provided the pulse desensitization method is not applied and only the *average* levels are considered. In the future, UWB devices should be limited in terms of the spectral power density which accommodates the technical specifications of UWB devices. See Section IV, *supra*. Further, as specified in FCC rule section 15.35(b), a resolution bandwidth of 1 MHz is recommended. The limit should be defined in terms of Equivalent Isotropic Radiation Power Density ("EIRP"), see FCC OET Bulletin No. 65, which is an equivalent to the emitted field strength and can easily be calculated by the product of the

measured transmitter spectral power density and the antenna gain. This limit could be implemented in the existing Part 15 rules.

The specification of a "peak" power spectral density is not appropriate, because when measuring a pulsed signal with a pulse repetition frequency higher than 1 MHz and using a bandfilter of 1 MHz, a continuous signal will be observed.

A cumulative effect of a large proliferation of UWB level measurement devices is not to be expected, because the range of such systems is limited to 100 meters. Because these UWB systems employ antennas with a directivity of better then 10° beam angle, a cumulative effect would only result in the unlikely event that such systems were artificially aligned. Additionally, as these pulsed systems have a low duty cycle of 1:100 to 1:1000, the probability of a simultaneous emission of a short pulse of only 1...3 nanoseconds is negligible. Using FMCW-systems with continuous emission, a cumulative impact resulting in an increase of the background noise is possible. Hence, a restriction on FMCW systems is recommended.

The existing FCC limits on the amount of energy permitted to be conducted back onto the AC power lines are appropriate for Radar Level Measurement Devices. 47 C.F.R. § 15.207 (1997). No additional limits are required.

If the Radar Level Measurement device meets the FCC's field strength or spectral power density levels, no additional operational restrictions are required. Endress Hauser's existing UWB systems are currently unfairly restricted to operation within a tank or storage vessel. These restrictions should be eliminated to permit the flexible and safe use of UWB

devices, such as installation in an open tank or in a free field. These types of installations are often highly desired by end users.

B. Restricted Bands. As the bandwidth of Pulsed Radar Level Measurement Systems is extremely wide, emissions into restricted bands can generally not be avoided. *Notice* at ¶ 11. Although these emissions are not required for the functionality of the UWB system, it is impossible to suppress them by employing filtering techniques. However, the spectral power density of pulsed Radar Level Measurement Systems is extremely low and the signal should be considered similar to spurious emissions, which are permitted under the current rules. 47 C.F.R. § 15.205 (1997). Additionally, some UWB systems use a pseudo-random generator, causing the RF signal to appear like a spurious broadband noise signal. Under these conditions, pulsed Radar Level Measurement Systems should be permitted to operate in the whole frequency spectrum including the restricted bands, provided their average signal strength or spectral power density meet the requirements outlined above.

C. Measurements. Measurement procedures should be applied to pulsed Radar Level Measurement Devices in a manner that only considers the average emitted power or the spectral power density. Hence, as indicated in FCC rule section 15.35(b), for frequencies above 1 GHz measurement instrumentation the use of an average detector function is appropriate. To measure the spectral power density, a resolution bandwidth of 1 MHz as specified in FCC rule section 15.35(b) is recommended. The total peak output level is not a useful measurement, because the pulsed systems have a very low duty cycle emitting only a very low energy in the time-interval between two pulses. Thus, the pulse desensitization method is not appropriate for such UWB systems and should not be applied. Instead, the

average detector function is more indicative of the harmful interference potential of such UWB devices.

A center frequency band is readily discernible in the spectrum measured with a standard spectrum analyzer. Hence, the current frequency measurement ranges, which are specified in FCC rule section 15.33, are appropriate for pulsed Radar Level Measurement Systems.

D. Class B Damped Wave Emission And Other Matters. The prohibition against class B damped wave emission is irrelevant for pulsed Radar Level Measuring devices, because of the relatively low power of such devices. *Notice* at ¶ 14. Due to the low power and typical range of less than 100 meters, Radar Level Measuring Systems are not similar to Class B Damped Wave Emissions.

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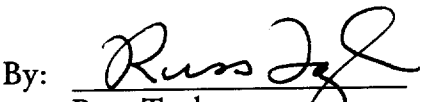
Based on the foregoing, Endress Hauser requests that the agency amend its rules in a manner consistent with the views express herein.

Respectfully submitted,

Endress + Hauser GmbH & Co.

By: 

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