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

In the Matter of	)	
	)	
Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band.	)	ET Docket No. 11-90 RM-11555
	)	
Amendment of Section 15.253 of the Commission's Rules to Permit Fixed Use of Radar in the 76-77 GHz Band.	)	ET Docket No. 10-28

Comments of the Measurement, Control & Automation Association

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July 18, 2011

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Comments of the Measurement, Control & Automation Association

The Measurement, Control & Automation Association (MCAA) files these comments in response to the Commission's Notice of Proposed Rulemaking in the above-captioned docket.[1]

MCAA is filing to point out the need for an additional rulemaking to accommodate level probing radars (LPRs) in the 80 GHz region, among other parts of the spectrum.

A. ABOUT MCAA

MCAA is the national trade association representing leading manufacturers and distributors of instrumentation, systems, and software used in industrial process control and factory automation around the world. Members include the leading multi-national companies, together with a range of niche-oriented providers.

The association was founded in the 1940s as Recorder-Controller, Inc. and subsequently became associated with the Scientific Apparatus Makers Association (also known as the SAMA Group of Associations). MCAA was incorporated under its current name in 1994.

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[1] *Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band*, Notice of Proposed Rulemaking, 26 FCC Rcd 8107 (2011).

A list of members appears in Appendix A.

B. About Level Probing Radars

A level probing radar (LPR) is an electronic radar device, usually aimed downward, that measures the level of a liquid or solid substance, either within a closed tank (or similar structure) or in the open.

There are two main LPR technologies in use today.

Pulse radars, as the name suggests, emit a train of pulses that reflect from the surface being measured and return to the unit. The time needed for the round trip gives the distance between the unit and the surface.

The second type, called frequency modulated continuous wave (FMCW) radars, transmit a signal whose frequency changes at a known rate. When the return signal arrives back at the unit, the transmit signal has moved on to a slightly different frequency. The difference between the two frequencies at that instant gives the duration of the round trip and, again, the distance between the unit and the surface.

1. Applications

LPRs are used to measure outdoor water levels in natural basins, rivers and streams, navigable waterways, lakes, bodies of water adjacent to dams, storm-water at lift stations, water in open channels at sewage treatment facilities, tide levels at coast lines, water intake facilities at power plants, and any other open site, especially those subject to adverse weather conditions. These applications help to minimize loss of life and property due to floods and droughts and to manage water resources for domestic, agricultural, commercial, industrial, and recreational uses. The technology is suitable for use in remote locations, thanks to inherently high reliability and output in a form that provides for easy data transmission.

Power plants use LPRs to maintain safe levels in cooling systems. In some kinds of plants, particularly nuclear facilities, failure to track these levels accurately can be extremely dangerous. A related application continuously confirms the level of water used to shield and cool spent fuel rods at nuclear power plants.

Other outdoor measurement applications include piles of solid or granulate substances stored in open warehousing environments. LPRs can increase the reliability of operation in quarries, electric power plants, paper mills, cement plants, concrete mixing facilities, mining facilities, ore refineries, wood processing plants, and other similar facilities. Alternative technologies, particularly those that entail physical contact with the substance or rely on moving mechanical parts, have difficulty coping with everyday conditions such as wind, dust, steam, fog, condensation, and frost. Optical and ultrasonic methods are unduly sensitive to environmental conditions such as temperature, humidity, and dust. Technologies that rely on electrical or physical properties of the substance being measured are prone to error and inflexible in application.

Failures in measurement have real consequences. Overfilling of plant equipment can damage machinery, threaten worker safety, and cause environmental harm from overflows. Underfilling that results in machinery running empty can be catastrophic. Rock crushers, for example, that are operated without product suffer severe damage. Preventing these occurrences helps to limit collateral worker injury. LPRs also promote worker safety more directly, by eliminating the need for in-person checks of level measurements and repairs in hazardous areas.

2. Advantages

LPRs offer important advantages over other measurement technologies. These include:

- high absolute accuracy;
- high repeatability;

- high long-term stability;
- robust performance in a variety of applications and processes;
- unaffected by vapor or dust (at appropriate frequencies);
- unaffected by materials deposited on the measuring device;
- no danger of igniting explosive materials (with appropriate design);
- minimum maintenance (no moving parts);
- measurement independent of medium (permits a wide range of applications);
- low power drain—can use solar cells in remote locations;
- easy installation;
- no contact with surface being measured (no risk of device corrosion or substance contamination); and
- efficient detection of alarm conditions (such as imminent overflows).

C. 76-77 GHz Will Not Suffice for LPRs.

MCAA has no objection to the Commission's adoption of its proposed rules at 76-77 GHz. We file only to explain that those rules will not support LPR operation. Although the proposal to allow fixed radar would accommodate LPRs, and the proposed power levels are more than adequate, the proposed 1 GHz of bandwidth is insufficient for LPRs.

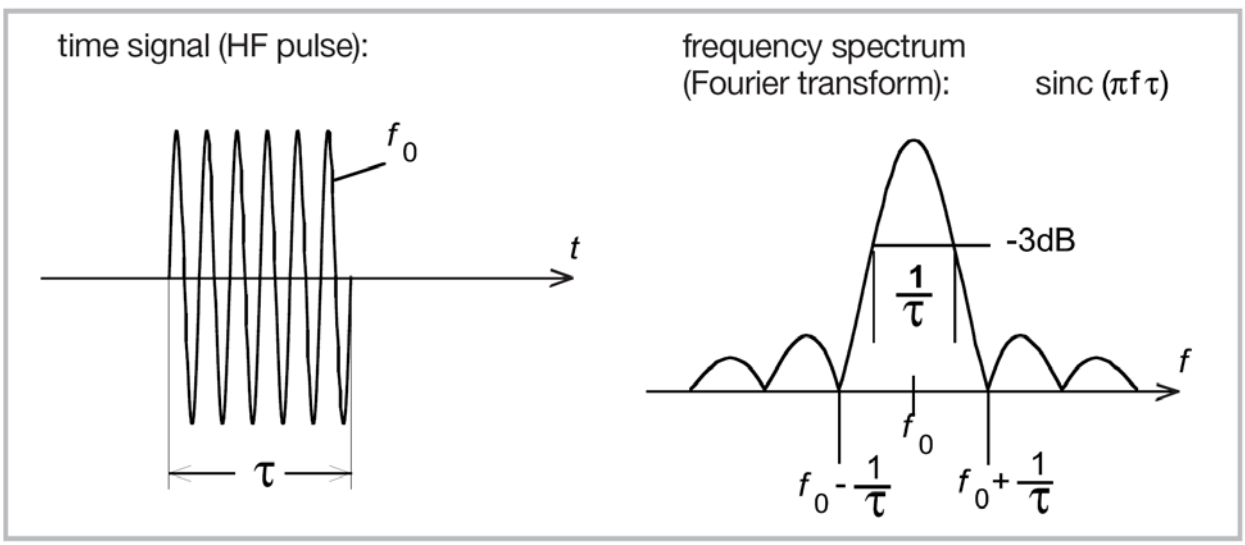
In order to provide adequate range resolution in the short range applications typical for LPRs, more bandwidth is required. As shown below, there is a direct relationship between range resolution and bandwidth in both pulse radars and FMCW radars.

For a pulse radar, the pulse duration limits the resolution of two adjacent echoes. That is, shorter pulses allow the discrimination of two echoes that are more closely spaced. The minimum separation at which two objects can be discriminated is:[2]

$$\Delta a = \frac{c \cdot \tau}{2}$$

Where τ is the pulse duration and *c* is the speed of light. Solving this equation for a one nanosecond pulse shows that two targets 15 cm apart may be distinguished.

The relationship between pulse duration and bandwidth appears in the following diagram:[3]



The bandwidth for a given pulse duration is:

$$BW_{-3dB} = \frac{1}{\tau}$$

$$BW_{null-null} = \frac{2}{\tau}$$

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2 DR.-ING. DETLEF BRUMBI, FUNDAMENTALS OF RADAR TECHNOLOGY FOR LEVEL GAUGING 46 (2003), *available at* http://www.krohne.com/html/dlc/BR_LEVELRADAR_en_72.pdf

3 *Id*. at 13.

Thus, a pulse radar with a 1 nanosecond pulse has a null-to-null bandwidth of 2 GHz but, as noted, is only capable of resolving two targets 15 cm apart.

The relationship between pulse duration and bandwidth dictates the following relationship between bandwidth and object discrimination for both pulse and FMCW radar systems:[4]

$$\Delta a = \frac{c}{2 \cdot BW_{-3dB}}$$

A 3 dB bandwidth of 1 GHz allows 15 cm resolution. LPRs are used in many short range applications between 2 and 5 meters, where 15 cm is a very significant fraction of the measurement distance.

It follows that the 1 GHz of bandwidth in the 76-77 GHz band is not sufficient for LPRs.[5]

MCAA urges the Commission to initiate a parallel proceeding that would accommodate LPRs with adequate spectrum not only in the 80 GHz region, but also at 6, 28, and 60 GHz. MCAA stands ready to assist with technical and industry expertise.

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4 *Id*.

5 The Commission generally measures the bandwidth of a wideband system at the –10 dB points, rather than the –3 dB points used in the analysis here. This limits the effective bandwidth even further.

CONCLUSION

The Commission should not attempt to shoehorn LPRs into the present proceeding, but should issue a separate Notice of Proposed Rulemaking devoted to LPRs specifically, in several regions of the spectrum.

Respectfully submitted,

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July 18, 2011

APPENDIX A– MCAA Members

Manufacturers

ABB Instrumentation Division
Acromag Inc.
Adaptive Wireless Solutions, LLC
Ametek Measurement & Calibration Technologies
Ashcroft, Inc.
Automation Products Group, Inc.
Azbil North America
Berthold Technologies USA LLC
Burkert Fluid Control Systems
Burns Engineering Inc.
Cameron Measurement Systems
ControlAir, Inc.
Control Microsystems
Cosa Instrument Corp.
Danaher
Dwyer Instrument, Inc.
Emerson Power & Water Solutions
Emerson Process Management
Emerson Process Systems Business
Endress + Hauser, Inc.
Extrel CMS
FasTest, Inc
Festo Corporation
Fluid Components International
Gems Sensors & Controls
Georg Fischer Signet LLC
GF Piping Systems
Great Plains Industries, Inc.
Hach Corporation
Ham-Let USA
Hawk Measurement America
Hoffer Flow Controls, Inc.
Invensys Process Systems
Kessler Ellis Products
Krohne, Inc.
Magnetrol International
Martel Electronics Corporation
McCrometer
Meriam Process Technologies
Metso Automation
Micro Motion, Inc.
Mid-West Instruments
Monitor Technologies LLC
Moore Industries International, Inc.
Palmer Wahl
Pepperl + Fuchs
Phoenix Contact Inc.
Practical Instrument Electronics
Precision Digital Corporation
Pyragon, Inc.
Pyromation, Inc.
Racine Federated, Inc.
Red Lion Controls
RJ Global WIKA, LLC
Rockwell Automation
Rosemount Analytical Liquid Division
Rosemount, Inc.
Siemens Industry Inc.
Sierra Instruments, Inc.
Sierra Monitor Corporation
Smart Sensors Inc.
SpectraSensors, Inc.
StoneL
Tel-Tru Manufacturing Co.
Ultra Electronics, NSPI
UWT Level Controls, LLC
VEGA Americas
Venture Measurement
WIKA Instrument Corporation

Channel Partners

AWC-Inc.
Branom Instrument Company
BurnsCascade
Centro, Inc.
Compass Controls & Instrumentation Inc.
Controls West, Inc.
Cross Company
Daitron Inc.
DynaTech Control-Solutions
Engineered Sales Co.
Fluid Flow Products, Inc.
Forberg Scientific
George Instrument
Gilson Engineering Sales, Inc.
Heartland Controls
Hile Controls of Alabama, Inc.
Instrument Specialties, Inc.
Instruments Direct
Ives Equipment Corporation
Jasper Engineering & Equipment Co.
Lesman Instrument Co.
Miller Energy, Inc.
Miller Mechanical Specialties, Inc.
Mueller Sales Corp.
Petro-Chem Equipment
Precision Fitting and Gauge Company
Process Controls Corp.
Regal-Brown, Inc.
Ritec Enterprises Incorporated
Robert S. Hudgins Company, Inc.
Rust Automation and Controls, Inc.
R. STAHL Inc.
Transcat
Wilson-Mohr, Inc.

Associates

CSA International
Flow Research, Inc.
Intertek Testing Services NA
ISA
MET Laboratories
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RB Marketing Communications
SELLTiS LLC
Spitzer & Boyes
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