RESPONSE TO NOTICE OF ENQUIRY FCC 98-208

The following document is in response to an FCC Notice of Inquiry, relating to revision of the Commission's rules regarding Ultra Wideband Transmission Systems.

Introduction

Milltronics is a company based in Peterborough, Ontario, Canada. The company designs and manufactures industrial process measuring equipment. Our interest in Ultra Wideband Transmission systems is due to the fact that we have recently introduced a microwave pulse radar system, intended for use in process industries to measure the level of liquids in storage tanks and process vessels. The equipment consists of an electronic system couple to an antenna. The equipment is mounted at the top of the tank or vessel, and directs a pulse of microwave energy towards the surface of the liquid contained in the vessel. The time taken before a reflected pulse is received is measured and used to determine the amount of liquid present in the vessel.

Due to the short distances involved (10 to 20 meters) it is necessary that the pulse width be kept as short as possible, and this leads to the wideband nature of the emission.

Our first product of this type has been tested and found to meet the standards of several European countries for unlicensed operation.

In the US market, the product has been approved under Part 15 for unlicensed operation under the restriction that:

- The frequency of operation be set at 6.3 GHz instead of 5.8 GHz, and filtering applied in order to prevent emissions in the restricted bands
- Application of the product is restricted to metallic tanks.

The product was approved under FCC ID NJA-IQ160.

We would naturally like to see these restrictions removed, especially since some of our competitors with similar equipment have been allowed unrestricted, unlicensed operation.

We therefore welcome this NOI as an attempt to clarify the rules and test procedures for UWB devices and would like to answer the questions posed in the NOI as follows:

What type of UWB devices can we expect to be developed?

As a manufacturer of industrial level measurement equipment, we expect to continue to develop microwave pulse radar systems for use in process industries. In this type of equipment, the wide bandwidth is a result of the narrow pulse width.

We also expect in the future to develop and market FMCW radar systems. While the bandwidth is not as wide as a pulse radar system, the average signal levels are higher due to the continuous nature of the signal.

- **What are the frequency ranges and bandwidths expected to be used by UWB devices?**
  We expect to continue to develop products whose fundamental frequency is placed in one of the designated ISM bands. For example:
  5.800 GHz ± 75 MHz
  24.125 GHz ± 125 MHz
  The maximum bandwidth that may be achieved with current technology is a result of a pulse width in the region of 1.5 nS. Based on footnote 2, this represents a bandwidth of approximately 4.24 GHz. However we can expect that in the future the trend will be towards even shorter pulse widths, since 1.5 nS represents a distance of 450 mm which is excessive in a pulse radar system designed to operate over a distance of 10 to 20 meters.
  We may expect to see pulse widths in the sub nanosecond range in the future.

- **What are the expected total power levels and spectral power densities, peak and average, of UWB devices?**
  We may expect to see pulse radar devices developed having peak power of under 50 mW EIRP.
  In order to assess average power levels, we must consider the typical duty cycle of these devices. Pulse widths may be expected to range from 0.5 nS to 2 nS. Repetition rates can range from 2 microseconds to as high as 0.2 microseconds. Therefore duty cycles could vary from 0.01 to 0.00025.

- **What are the expected or desired operating distances**
  In our industry, we normal operate in tanks or vessels which are less than 20 meters in height. Tanks and vessels of 30 meters in height may be encountered on occasion.
  Future development may extend operation of these devices to solids storage bins - in this case it is possible though rare to encounter storage bins up to 70 meters in height.
- **Are there certain types of UWB devices or applications that should be regulated on a licensed basis under some other rule part? If so, which rule part?**
  No comment on this.
- **If provisions are made for UWB technology under Part 15, how should we define UWB technology?**
  For our purposes we would consider UWB technology to comprise a pulse transmission system using a burst of controlled or stabilized carrier frequency, where the burst length is less than 3 nS and the repetition rate could be up to 5 MHz.

- **Should the rules generally continue to prohibit operation of UWB systems within the restricted bands and the TV broadcast bands?**
  We are not able to comment on this.
- **Are there certain restricted bands where operation could be permitted, but not others? If so which bands and what is the justification?**
  An equitable solution may be to allow emissions in the restricted bands up to the general emission limits. After all, spurious emissions are permitted in the restricted bands, as long as they do not exceed the general emission limits. A victim receiver is not able to distinguish between a spurious emission and one which forms part of the fundamental signal - therefore why treat spurious and fundamental emissions in the same way when evaluating their impact on signal levels in the restricted bands.
- **If certain restricted bands were retained, what impact would this have on the viability of UWB technology?**
  The proximity of some of the restricted bands to the designated ISM bands makes it difficult or impossible to continue to develop UWB devices for application at these frequencies. For example the restricted bands at 5.35-5.46 GHz and 7.25-7.75 GHz are close to the designated ISM band of 5.8 GHz $\pm$ 75 MHz. The restricted band at 23.6 to 24 GHz is very close to the designated ISM band of 24.125 GHz.

  Unfortunately, it is mandatory for our type of product to operate at these frequencies in order to be permitted to operate in many markets outside of North America (for example in Europe). This leads to the unfortunate situation where a manufacturer is required to produce two versions of a product, one for sale in North America and another for sale in Europe and the rest of the world. This results in higher cost to the manufacturer and the customer.
- **Are the existing general emission limits sufficient to protect other users of the spectrum, especially radio operations in the restricted bands, from harmful interference?**
  Since the general emission limits apply to spurious emissions in the restricted bands, it seems that these limits are sufficient. A decrease in the permitted emission limit in these bands would impose and unfair restriction on designers of equipment which operates close to these bands.
- **Should different limits be applied to UWB systems?**
  We would like to see these limits increased for UWB systems. Because of the nature of the UWB systems, the low duty cycle makes the emission appear as wideband noise to most victim receivers. A higher emission limit could apply for this type of device.
- **Should we specify a different standard for UWB devices based on spectral power density? Should these standards be designed to ensure that the emissions appear to be broadband noise?**
  We would favor a standard based on spectral power density. This would recognize that fact that while the bandwidth of the device is high, signal levels are low and difficult to measure even with sophisticated laboratory equipment.

  Although the emission levels are low and broadband in nature, for our type of product it is not easy to make the emission appear as broadband noise. The characteristic emission

from a pulse radar system is (sin x)/x in nature. It would be difficult or impossible to modulate the carrier frequency in such a way as to make it appear as broadband noise.

- **What is the potential for harmful interference due to the cumulative impact of emissions if there is a large proliferation of UWB devices? Could the cumulative impact result in an unacceptably high increase in the background noise level? Should the Commission limit proliferation by restricting the types of products or should the rules permit manufacturers to design products for any application as long as the equipment meets the standards?**
  For our type of product (pulse radar for process level measurement) the cumulative impact would be very small. The duty cycle of transmission is extremely low and the range of transmission is short.
- **Should a limit on the total peak level apply to UWB devices?**
  Part 15.35b limits the peak emissions to 20 dB above the average radiated emission limits. This is quite onerous for a pulse system where the duty cycle factor may be in the 80 dB range or higher. We would like to see this restriction increased.
- **Can emissions below or above a certain frequency range be further filtered to reduce the potential for interference to other users of the radio spectrum without affecting the performance of the UWB systems?**
  While this can be done (and indeed has been done in our product to allow operation in restricted circumstances), it always has a negative impact on performance. Filtering in the frequency domain must have an effect on the time domain performance of our type of product, by modifying the pulse shape and hence the accuracy of our system.
- **Are the existing limits on the amount of energy permitted to be conducted back onto the AC power lines appropriate for UWB devices?**
  For our type of product, we have not found the existing limits to be onerous. We would not like to see the limits decreased, but have no trouble complying with the existing limits.
- **What operational restrictions, if any, should be required to protect existing users?**
  For our type of device, average emissions are low. The product is invariably installed facing straight down and the emissions are very directional by design. This will tend to decrease the potential for interference with a victim receiver. Therefore, we feel no operational restrictions are necessary.
- **Is the use of UWB modulation techniques necessary for certain types of communication systems; if so, for what purposes?**
  Not able to comment.
- **Is a pulse desensitization correction factor appropriate for measuring emissions from a UWB device? Should any modifications be made to this measurement procedure for UWB devices?**
  For the type of equipment we manufacture, the pulse desensitization factors applied to the measurement become rather high. For example, a 1nS pulse width measured with a 3 MHz RBW requires a pulse desensitization factor of 45 dB. The presence of victim receivers which would be likely to respond to emission having this characteristic is highly unlikely, as the victim receiver would require a very wide bandwidth response. Therefore we would like to see this procedure modified.
- **Would another measurement procedure that does not apply a pulse desensitization correction factor be more appropriate for determining the interference potential of an UWB device?**
  A spectrum analyzer connected to a receiving antenna placed 3 meters from the device should be set to the maximum resolution bandwidth (typically 3 MHz). Recognizing that the spectrum analyzer represents a very high quality receiver which is likely to have a wider bandwidth response than typical victim receivers, we do not believe it is necessary to apply a pulse correction factor to this measurement.
- **The frequency range over which measurements are required to be made depends on the frequency of the fundamental emission. Is the frequency of the fundamental emission readily discernible for UWB devices? Are the current frequency measurement ranges specified in the rules appropriate for UWB devices or should these ranges be modified?**
  For the specific type of UWB device we manufacture (pulse radar systems) the frequency of the fundamental emission is readily discernible and part of the design specification.
- **Are the measurement detector functions and bandwidths appropriate for UWB devices? Should these standards be modified and, if so, how?**
- **Are there any other changes to the measurement procedures that should be applied to UWB devices?**

- **Should the prohibition against Class B, damped wave emissions apply to UWB systems or is the prohibition irrelevant, especially in light of the relatively low power levels employed by UWB devices?**
  We believe the prohibition is irrelevant. The power levels employed by our type of device are low. Also, operation of the equipment depends on maintaining good control of the amplitude and duration of the pulsed transmission. For this reason we strive by design to produce a pulse which does not have the characteristics of damped wave oscillation.

- **Comments are invited on any other matters or issues that may be pertinent to the operation of UWB systems.**