July 21, 2000

Federal Communications Commission
Equipment Authorization Division
7435 Oakland Mills Road
Columbia, Maryland 20146

Re: Amtech Systems Division of Intermec Technologies Corp.
        Amendment to Application for Equipment Authorization
        Proposed FCC I.D. No. FIH-F4-06476-LP
        Correspondence Reference Number: 15174
        731 Confirmation Number: EA97485

To the Commission:

In response to your e-mail transmitted to Amtech on 7/18/00 from Mr. Errol Chang (Ref. No. 15174), concerning the pending grant of certification of the F4 printer (operating as a frequency hopping radio in the 2400-2483.5 MHz band), we are submitting the following amendments and clarifications to our application as described herein:

The antenna and RFID module are enclosed in the printer cabinet that is made out of conducting material (magnesium) that provides shielding in off angle measurements (reference the emission measurements from Rogers Labs). Furthermore, the antenna is not pointed at the paper feed point (the only entry/exit point in the printer), but at approximately 45° from the paper feed point. The antenna is a single patch with a measured gain 2.0 dBi (i.e. 1.6 linear) at normal and approximately -1.75 dBi (i.e. 0.67 linear) at 45°. The antenna measurement was performed at the Physical Science Laboratory at New Mexico State University on May 25, 2000. The polar plot of the antenna measurement is included under separate cover. In this configuration with the shielding, the support structure of the printer, and the distances involved, we cannot foresee that the actual gain of the antenna will be close to that which was measured in free space on a calibrated range. (We estimate that the antenna is in a "near field" condition such that the gain is not well defined.)

We have re-evaluated the antenna placement in the printer and have arrived at the minimum separation distance between the antenna and the paper feed point. The minimum separation distance is 2.8" (7.1 cm). A diagram of the internal placement of the antenna showing the paper feed path is included under separate cover.

Additionally, the transmitter duty cycle is software limited to a maximum of 50%. The duty cycle limitation is imposed by the operating software in the RFID module to meet various timing requirements of the frequency hopping algorithms as required under §15.247(a)(1)(i). Although we expect the actual duty cycle to be on the order of 10%, we have used the maximum duty cycle of 50% in our calculations. The use of time-averaging in this case is appropriate because it is based on an inherent property of the device. See § 2.1091(d)(2) of the Commission's Rules.

The F4 printer is only marketed for commercial applications and is to be used by trained personnel; it is not intended for use by the general public. Hence, when we performed the initial assessment, we purposefully chose the MPE limits as for Occupation/Controlled Exposure of 5 mW/cm^2. However, as explained below, the MPE is well below the General Population/ Uncontrolled Exposure as well.

The EIRP chosen was based on the rated power as specified on the application form. Although the measured power was 656 mW, that is only 1 dB more than the 500 mW as used in our calculations. Since manufacturing variances will occur, we chose the rated power as a representative value for the output power. Further calculations will use the measured value of 656 mW.

For reference purposes, we have re-calculated the time averaged exposure using the well-known formula to convert emitted power into the time averaged power density:

$$P_D = EIRP/(4\pi R^2) \times Duty\ Cycle$$

Using the measured transmitter power, antenna gain, distance, and duty cycle as given below:

P_T = 656 mW
G_T = 0.67 (@ 45°)
R = 7.1 cm (2.8")
EIRP = P_T x G_T
Duty Cycle = 50% (maximum)

Given the parameters specified above, the calculated radiation from the RFID printer is found to be: P_D = 0.35 mW/cm^2. This value is below the maximum allowed power density (P_D) limit of 1.0 mW/cm^2 for the General Population/Uncontrolled Exposure.

Therefore, the limits of §1.1310 are met with margin.

Although the F4 printer is capable of operating with the door removed, warnings in the current user manual caution the user not to operate the unit with the door open (page 8). We have added additional warnings in the user manual to highlight the need to keep the door and printer plate closed while operating. A copy of the revised user manual page is included under separate cover.

We encourage the Commission to expeditiously process our responses to your queries in order that this application can be granted the authorization in a timely fashion. We hope that these answers suffice. Please contact me if there are any additional questions. I may be reached by email at wmays@asctmd.com or by phone at (505) 856-8054.

Sincerely,

Wes Mays
Engineering Manager

enclosures: Antenna Data Plot
Internal Diagram of F4 Printer
Addendum to User's Manual