LIST OF EXHIBITS

1. Cover Letter
   Request for Confidentiality
   Previous Type Acceptance of Similar Device
2. Exhibit A ID Label Photo
3. Exhibit B Circuit Board Photos
4. Exhibit C Block Diagram, Schematic
5. Exhibit D Description of Operation
6. Exhibit E Test Reports
7. Exhibit F Instruction Manual

Sept. 24, 1999

Federal Communications Commission
Office of Engineering and Technology
Equipment Approval Services

RE: Request for Confidentiality
Attached Form 731 – Application for Equipment Authorization
FCC ID: LLB6327

Dear Sir or Madam:

Hexagram, Inc. does not wish to publicly disclose certain technical information which is enclosed with this application. This material contains critical trade secrets and we request that the Commission withhold this information from public inspection pursuant to the provisions of Section 0.457(d) of the Rules.

MATERIAL TO BE HELD CONFIDENTIAL:

Exhibit B	Circuit Board Photos	Two pages
Exhibit C	Block Diagram, Schematics	Four pages
Exhibit D	Description of Operation	Two pages

This material is confidential and is not available to the public or end user.

Sincerely,

Lawrence M. Sears
Director of Technology

LS/sd

Enclosure

PREVIOUS TYPE ACCEPTANCE OF SIMILAR DEVICE

The radio transmitter submitted (LLB6327) herein is used as a telemetry device for the reading of utility meters.

An operationally identical device (LLB6082) was previously submitted for Type Acceptance and received a Grant of Type Acceptance on March 4, 1998. This earlier version has been in field service since the grant was issued.

The product described in this application (LLB6327) is a modified version of LLB6082. The Block Diagram and basic circuit configuration of the new product is identical to that of the original LLB6082.

As detailed in Exhibit D: Description of Operation, the semiconductor lineup has been changed from the LLB6082 device in order to improve efficiency, reduce component count, and reduce manufacturing cost. Specific changes are shown below.

- RF power amp – higher efficiency, higher output power
- Voltage controlled Oscillator – miniaturization, cost
- Data filter – miniaturization
- RF preamp – higher efficiency, higher output power
- 3.3 vdc regulator – miniaturization, cost
- Rectifier diodes – miniaturization, cost
- Digital Transistors – miniaturization, cost

Also attached is a "Statement Concerning Compliance with Section 90.203 (j) (3)." The identical statement was submitted with the application for Type Acceptance of the earlier LLB6082 device.

Please Note:

An essentially identical transmitter (LLB6717) was submitted for Type Acceptance at the same time as this application. The same Statement Concerning Compliance was enclosed with that application.

STATEMENT CONCERNING COMPLIANCE WITH SECTION 90.203(j)(3)

Introduction

Section 90.203(j)(3) of the Commission's Rules on transmitters provides, in pertinent part:

> If the equipment [in the 150-174 and 421-512 MHz bands] is capable of transmitting data and has an overall bandwidth of 6.25 kHz or more, the equipment must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of bandwidth.[1]

Three parties interested in remote utility metering sought reconsideration of this provision to allow alternative showings of spectrum efficiency for low power frequency reuse systems.[2] The Commission replied:

> [W]e will provide manufacturers with additional flexibility to design spectrally efficient transmitters. **The Commission's Equipment Authorization Division may, on a case by case basis, grant type acceptance to equipment with slower bit rates than specified in Sections 90.203(j)(3) and 90.203(j)(5)** of our rules, provided that an acceptable technical analysis is submitted with the application which demonstrates that the slower data rate will provide more spectral efficiency than the standard data rate.[3]

The present application is for automatic remote meter reading equipment, and falls squarely within the scope of this exception. When considered as part of a system, the device in question provides spectrum efficiency and channel utilization far in excess of 4800 bits/sec per 6.25 kHz.

Technical Analysis

The device submitted for type acceptance is a Meter Transmitter Unit (MTU). When the system is implemented, an MTU is attached to each utility meter. The MTU periodically transmits meter readings omnidirectionally in transmissions lasting under one-tenth second each. Transmissions from different MTUs are independent and uncorrelated.

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[1] 47 C.F.R. para. 90.203(j)(3). This provision governs Part 90 type acceptance applications filed from August 1, 1996, through December 31, 2004.

[2] Replacement of Part 90 by Part 88 to Revise the Private Land Mobile Radio Services, 11 FCC Rcd 17676, 17686 (1996).

[3] *Id*., 11 FCC Rcd at 17687 (emphasis added).

Data Collection Units (DCUs) are mounted on a nominal one mile grid. A DCU receives and stores the transmissions from all the MTUs in its range. Once daily, each DCU transfers the accumulated data to a central computer at the utility office via a cellular phone mounted on the DCU.

MTU bandwidth is 12.5 kHz, so a strict application of Section 90.203(j)(3) would require the equipment to support a data rate of 9600 bits/sec. In fact, to minimize component cost and bit error rate, an individual MTU transmits at the rate of 1200 bits/sec. The system achieves spectrum efficiency not through a high bit rate in each individual MTU, but through a high level of frequency re-use achieved by deploying a large number of low-power short range transmitters.

As detailed in the attached Appendix, a typical large installation of MTUs on a single 12.5 kHz channel can support data rates exceeding 100,000 bits/sec. This performance represents spectrum efficiency far in excess of that required under Section 90.203(j)(3). Where a typical commercial user of private land mobile radio spectrum, such as a delivery service, requires a pair of channels to provide two-way communication with dozens of trucks at most, the MTU is part of a system that uses a single channel to service millions of users and to carry data representing billions of dollars in annual revenue. This is an extremely efficient use of the spectrum, and is completely consistent with the Commission's purposes underlying Section 90.203(j)(3).

An operationally identical MTU (LLB6082) received a Grant of Type Acceptance on March 4, 1998. Automatic Meter Reading Systems incorporating this technology have been in service since March 1998 and have incorporated tens of thousands of transmitters. The MTU described in this application for Certification represents an improved product.

An earlier product (LLB5155) operating under the Commission rules then in effect has been in service at hundreds of locations since May of 1996.

Public Interest Considerations

Public interest considerations support the deployment of Automatic Meter Reading equipment, such as the device in question. Automatic Meter Reading equipment directly helps to keep consumer rates down in an era of rapidly increasing labor costs. The alternative, traditional door-to-door meter reading, is not only much more expensive, but dangerous for the meter readers, and necessarily exposes consumers to potential security risks in their homes.

Equally important in a pro-competitive regulatory environment, Automatic Meter Reading equipment makes possible time-of-use billing, under which a customer's utility rate varies with time of day or day of the week. Electric time-of-use billing, for example, typically requires a meter read every 15 minutes, which is not feasible without Automatic Meter Reading equipment. Frequent meter-reading is an important component of utility deregulation, because it enables new competitors to tailor service and rates to particular niche markets, profiles of demand, and competitive situations. It also makes possible negotiated rates and requirements for particular clusters of customers. Furthermore, by maximizing the efficient use of existing utility plants, time-of-use billing furthers both economic and conservation goals.

The capability for automatic meter reading has other advantages as well. It permits detection of water leaks though the prompt recognition of abnormal consumption patterns. And once a system is installed for utility metering, it can also be used to transmit alarm data for such emergencies as fire, smoke, gas leak, water accumulation, and unauthorized intrusion. The same system can also be used to remotely monitor utility distribution equipment such as valves and sensors.

Conclusion

We respectfully submit that both Commission spectrum policy and the public interest are well served by calculating the spectrum efficiency of this equipment in terms of an integrated system that incorporates a large number of MTUs.

Lawrence M. Sears
Director of Technology
September 27, 1999

PLEASE NOTE:

A second product, LLB6717, has been submitted for Certification at the same time as this application. This product (LLB6327) is essentially identical to LLB6717.

APPENDIX

CALCULATION OF SYSTEM SPECTRUM EFFICIENCY

Assumptions

1. Large urban area (5-10 million people) containing five million meters. This assumes 2-3 meters per average household of 2-4 individuals, and covers an area approximately equal to that served by a conventional Part 90 base station.

1. 5 million MTUs and 1,000 DCUs.

2. 24 meter-readings (transmissions) per day. This includes more frequent readings for time-of-use billing averaged into less frequent readings for other services.

3. Each transmission contains 92 bits and has duration of 77 milliseconds.

Calculations (all first order approximations)

1. Determine probability of collision:

$$\underset{\text{(per one DCU)}}{5{,}000 \text{ MTUs}} \times \frac{0.077 \text{ seconds}}{\text{transmission}} \times \frac{24 \text{ transmissions}}{24 \text{ hours}} \times \frac{24 \text{ hours}}{8.6 \times 10^4 \text{ sec}} = 0.11$$

   0.11 is the ratio of time that some MTU **in range of a given DCU** is actively transmitting. To a first approximation, 0.11 is also the probability that the channel is occupied in the vicinity of the local DCU when a given MTU attempts to transmit. Note, however, that because the DCU's are distributed over a wide area, many MTU's can transmit simultaneously without collision. Thus the channel can support very large data loads without collision. This is a result of the MTU's having a short transmission range compared to the area served by the channel.

2. Determine overall system bandwidth:

$$5 \times 10^6 \text{ MTUs} \times \frac{92 \text{ bits}}{\text{transmission}} \times \frac{24 \text{ transmissions}}{24 \text{ hours}} \times \frac{24 \text{ hours}}{8.6 \times 10^4 \text{ sec}} = 128 \text{ Kbps}$$

3. Reduce baud rate by expected collision percentage:

   128 Kbps x (1 - 0.11) = 114 Kbps

4. **Overall supportable system bandwidth = 114 Kbps. This is the data load handled by this system covering an area comparable to that served by a** conventional base station