Exhibit 15.0 : Module & Antenna Requirements

Table of Contents

15.1 Summary Of 15.247 Compliance

15.1.1 47 CFR 15.247 (a)(1)

The OS2400 uses carrier frequencies separated by 1.0 MHz. The 20 dB bandwidth of the transmitted MSK signal is approximately 400 kHz.

The system uses a table of pseudorandomly ordered hop frequencies. The transmitter goes through the list in order before starting over, which ensures that each frequency is used equally on average.

The receiver has 500 kHz wide second IF filters which matches the 400 kHz 20 dB bandwidth of the transmitter signal. The remotes track the transmitted hop sequence from the Master and synchronize their hopping to it.

15.1.2 47 CFR 15.247 (a)(1)(ii)

The OS2400 uses 79 hopping frequencies. The 20 dB bandwidth of the hopping channel is approximately 400 kHz. The 79 frequencies are used equally on average which gives the average time of occupancy of 30 / 79 = 0.38 = 0.38 seconds in a 30 second period.

15.1.3 47 CFR 15.247(b)(1)

The output power is limited to 250 mW under the rules for a radio module. The maximum output power of the OS2400 is factory calibrated to be less than or equal to 250 mW.

15.1.4 47 CFR 15.247(b)(3)

The output power of the radio is 250 mW, 6.0 dB less than the maximum limit of 1.0 W. For point multi-point operation the antenna gain is limited to 6.0 dBi plus the reduction in power below 1 W. The result is a maximum antenna gain of 12.0 dBi. The radio module users manual specifies the maximum allowable antenna gain for point multipoint operation.

15.1.5 47 CFR 15.247(b)(3)(i)

The output power of the radio is 250 mW, 6.0 dB less than the maximum limit of 1.0 W. For point to point operation the antenna gain may be increased by 3.0 dB for every 1.0 dB in output power reduction below one Watt which gives an increase of 6 dB * 3 dB = 18 dB. This increase is the amount above a 6.0 dBi antenna gain, which gives a maximum allowable antenna gain of 24.0 dBi The radio module users manual specifies the maximum allowable antenna gain for point to point operation.

15.1.6 47 CFR 15.247(b)(3)(iii)

Directions for installation of a point to point system are included in the OS2400 instruction manual.

15.1.7 47 CFR 15.247(b)(4)

To insure safety, calculations were done to show safety for the OS2400 radio module for antenna to body distances greater than 20cm per FCC parts 2.1091, 1.1310 and 1.1307. The antennas must be kept the greater of 20cm or the distance at which the radiated power density drops below $1mW/cm^2$. The radio transmit power is 250 mW maximum. The maximum transmit duty cycle is 50 % which gives and average power of 125 mW. Assuming an isotropic radiator, the transmitted power density is Pd = Pxmit / (4 * ? * d^2). Solving for d with Pd = 1.0 mW /cm^2 gives d = 3.15 cm (1.24 inches). Since this is less than 20cm, the minimum safe distance is specified as 20cm. A table of exposure limits for an omni-directional, and other antennas is given in the OS2400 instruction manual. Safe exposure distance for each antenna gain is listed. Operation at antenna to body spacings less than 20cm falls under 2.1093 and will be dealt with on an application by application basis as noted in the manual.

15.1.8 47 CFR 15.247(c)

The lab that submits the FCC application has verified that the radio meets this and other applicable emissions requirements.

15.1.9 47 CFR 15.247(g)

The Master radio transmits on each frequency hop. It uses each entry in the hop table once and in order, (before starting over) which guarantees all hop frequencies are used equally.

Remote radios transmit only when they have data to send to the Master. If presented with a continuous data stream, remotes will transmit on the same frequency hops as the Master (equally on all frequencies in the table).

15.2 Summary Of Module Compliance

The OS2400 was designed to meet the following conditions for approval as a module so that it may be installed in various enclosures without the need for additional Certification.

15.2.1 Shielding

A module must have its own shielding. Shielding of the RF components of the module is required.

The OS2400 radio module has a shield covering the entire RF section and the entire digital section. In addition, the VCO and Power amp sections have their own shields. Emissions tests of the module are done with no other shielding.

15.2.2 Power Supply Regulation

A module must have its own power supply regulation

The module specifications list a 5v +/-5% supply. The module has a 3.3v linear regulator, and also overvoltage and undervoltage detection on the 5v input. Because the power amplifier is connected to the 5.0 V input, the transmitter is shut down in over or under voltage conditions. The output power can not be increased by increasing the supply voltage. Power output is calibrated in production and tested to guarantee output power below 250mW at the maximum input voltage before the transmitter is shutdown.

15.2.3 Data-Line Buffering

A module must have its own input data-line buffering (input signal changes must not affect compliance) if such inputs are provided.

Input data-lines are for serial communication and status indication. No access to the transmitter through the input data-lines (or any other I/O lines) is possible. Input data is stored in a buffer, and formatted by the Digital Signal Processor (DSP) before it is transmitted. The transmit parameters (such as data rate, modulation, transmit power, etc.) are not affected by the signals on the data or I/O lines.

15.2.4 I/O Cables and Modes of Operation

The module must be tested in all of the typical modes of operation and configurations. Therefore, applicable I/O cables must be attached and if I/F boards are needed for operation, they too should be connected.

To test the radio, an interface board is attached which has an integrated circuit that converts RS232 serial levels to the logic levels needed by the radio. Attached to the interface board are a power cable and the RS232 serial cable. Please see the interface board documentation for a full schematic, parts list, and picture of the interface board. The RS232 cable allows control of the radio by a computer. Two special test modes not available to the end user are invoked for testing. This allows testing the radio at fixed (non-hopping) transmit frequencies, fixed receive mode, and normal hopping mode. Also, the transmit power level is adjustable.

15.2.5 Test Requirement – Transmitting Data

The module must be tested while transmitting data.

A pseudo random data pattern is transmitted in both the normal hopping mode and special fixed frequency test modes. The pattern is a standard 127 bit pseudo random maximal length sequence that is repeated continuously. It is a 7 bit shift register with taps at locations 1 and 7.

15.2.6 Label Requirements

A module must be labeled with its own FCC ID number, and if the FCC ID is not visible when the module is installed in another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. The exterior label can use wording such as the following: " Transmitter Module FCC ID: xyz1234" or " This device Contains Transmitter Module FCC ID: xyz1234." The exact wording is not specified in our Rules (since modules are not specifically addressed), so you may use similar wording which expresses the same meaning.

Please see the artwork for the FCC label and notice that the manual for the module includes instructions about the exterior label requirement.

15.2.7 Receiver Verification

The receiver must be tested but is subject to Verification.

Radiated measurements from the module in receive mode were made to verify compliance. The receiver also meets requirements for part 15.247(a)(1).

15.2.8 Antenna Requirements

Each antenna must be tested with the module and must comply with §15.203.

The test lab evaluation of the radio included testing with the antennas listed in the operator's manual. For antennas of the same type, only the highest gain version was tested. The module has MMCX (nonstandard) style RF connectors that were specifically chosen for compliance with Section 15.203.

15.2.9 Antenna Safety Documentation

The Certification application should list all antennas, the antenna gains, the output power for each antenna, the total EIRP and how each antenna complies with the RF Safety requirements. The RF safety requirements should take into account the use of each antenna/tx combination.

Below is a list of the antennas that are to be used with the radio module. Compliance with RF safety requirements for a mobile transmitter according to FCC parts 2.1019 and 1.1310 is being insured by specifying the minimum safe distance the antenna must be kept from the user for each antenna in the user's guide. Compliance with RF safety requirements for applications with less than 20cm from the antenna to the users body are governed by FCC 2.1093 and will be approved

on a case by case basis when integrated in the final product. This is also covered in the user's manual.

The minimum safe distance per FCC part 2.1091 was calculated using the power density of $1mW/cm^2$ limit for maximum permissible exposure in an uncontrolled environment per FCC Part 1, section 1310 (b). The minimum safe distance is the larger of this calculated distance or 20cm.

The radio has a maximum peak output power of 250mW. By design, the maximum inherent duty cycle for the transmitter is less than 50%. There is no way to operate the radio with the transmitter on more than 50% so the source-based time-averaging duty cycle factor of 50% can be used in the MPE calculations.

Example:
For an Isotropic radiator the surface area of a sphere can be used to determine the area over which the transmitter energy is radiated.

Surface area of a sphere = $4*? *radius^2$

In the case where there is antenna gain,the worst case energy density is increased by the antenna gain. The exposure level can be calculated as follows, accounting for the antenna gain:

$$Distance := \sqrt{\frac{OutputPower \cdot DutyCycle \cdot 10^{\left(\frac{Gain}{10}\right)}}{4 \cdot ? \cdot ExposureLimit}}$$

For the 2 dBi Whip Antenna

MPE distance = $(250\ mW*50\%*1.58/(4*3.14*1))^{1/2}$

= 4.0 cm

Since this is less than 20cm, 20cm is the safe distance. The safe distance to adhere to permissible exposure limits was calculated in the same manner for each antenna.

Antenna Type	Manufacturer	Manufacturer Part Number	Connector Type	Gain	Output Power	EIRP	1mW/cm^2 Distance	Safe Distance
½? whip – articulating	NCC	N24ARSMA1	Reverse polarity SMA	2 dBi	250mW	395mW	4.0cm	20cm
½ ? whip – articulating	NCC	NOV2400SMA	Reverse thread SMA	2 dBi	250mW	395mW	4.0cm	20cm
½ ? whip – articulating	Centurion	WCR2400SMRP	Reverse polarity SMA	2 dBi	250mW	395mW	4.0cm	20cm
½ ? whip – straight	NCC	N2400SM8	Reverse polarity SMA	2 dBi	250mW	395mW	4.0cm	20cm
Collinear array	Mobile Mark	OD9-2400	Reverse polarity N	9 dBi	250mW	2 W	9 cm	20cm
Collinear array	Maxrad	MFB-24008	Reverse polarity N	8 dBi	250mW	1.6 W	8 cm	20cm
Collinear array	Maxrad	MFB-24006	Reverse polarity N	6 dBi	250mW	1 W	6.5 cm	20cm
Collinear array – articulating	NCC	N24HGASM1B	Reverse polarity SMA	5 dBi	250mW	800mW	6 cm	20cm
Collinear array – articulating	NCC	NOV24HEARSMA 2B	Reverse thread SMA	5 dBi	250mW	800mW	6 cm	20cm
Patch	Maxrad	MP24013FSMA	Reverse thread SMA	13dBi	250mW	5W	15 cm	20cm
Patch	Maxrad	MP24011FSMA	Reverse thread SMA	11dBi	250mW	3.2 W	12 cm	20cm
Patch	Maxrad	MP24008FSMA	Reverse thread SMA	8dBi	250mW	1.6 W	8 cm	20cm
Yagi	Astron	P-2415	Reverse polarity N	15dBi	250mW	8 W	18 cm	20cm
Parabolic Grid	Pacific Wireless	PMANT25	Reverse polarity N	24dBi	250mW	63W	50 cm	50cm

The Yagi and Parabolic antennas can only be used for point-to-point networks per 15.247(b)(3) and will be so noted in the user's manual.