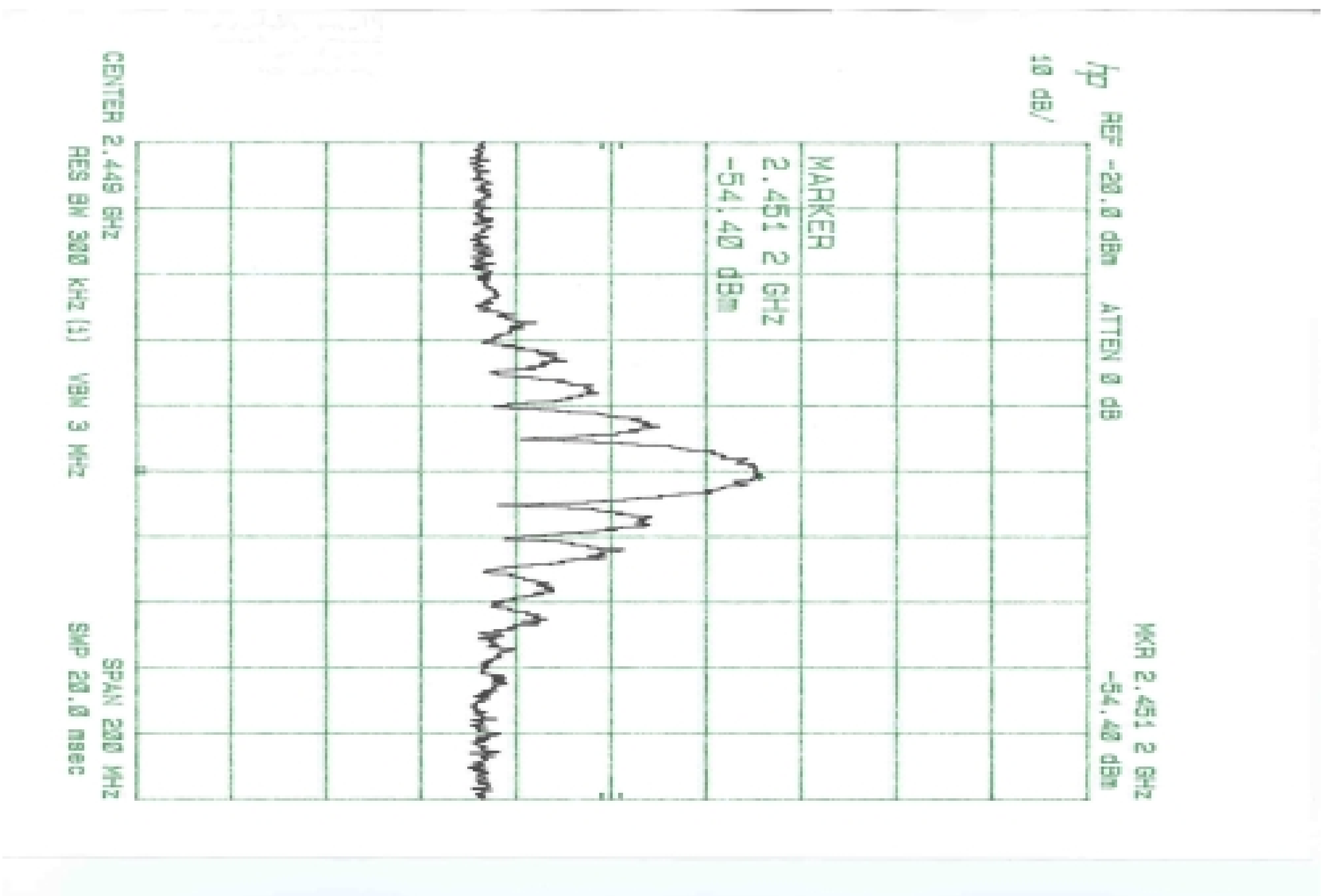
To: PATRICIA TERILLI, CHOMERICS TEST SERVICES
From: Joe Dichoso
jdichoso@fcc.gov
FCC Application Processing Branch

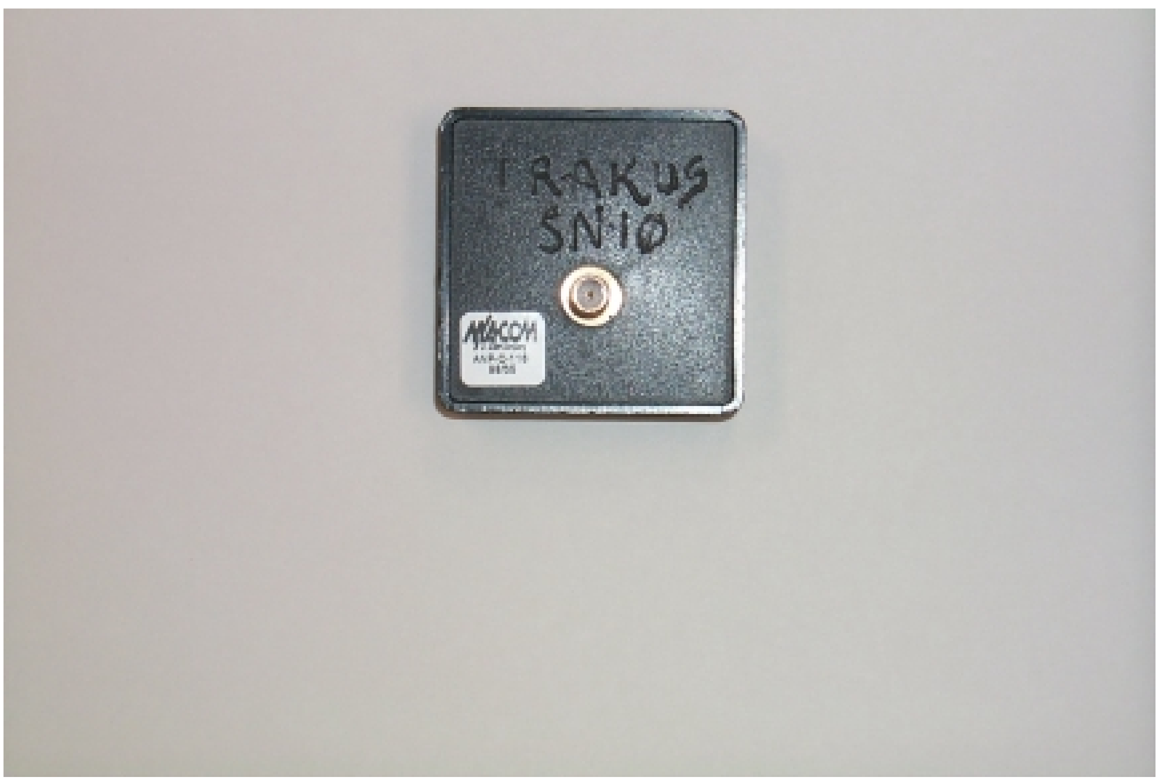
Re: FCC ID PEH-TMS-TT-V0700
Applicant: Trakus, Inc.
Correspondence Reference Number: 19609
731 Confirmation Number: EA100923

1) Verify that the only operating frequency is 2450 Mhz. Otherwise submit additional test data as appropriate or the operating frequency range.

The output of the Tower Transceiver is 2.45GHz. Below is a graph of the output of the Tower Transceiver.



2) Provide photo's of the antenna and list the antenna gain.



2.4 GHz Patch Antenna for ISM Band

ANP-C-116

V3.00

Features

- Hemispherical/Omnidirectional
- Flat Configuration
- Rugged/Durable
- Low VSWR
- Circular Polarization Minimizes Multipath Effects
- Various Types of Input Connectors Available
- Variety of ISM Applications

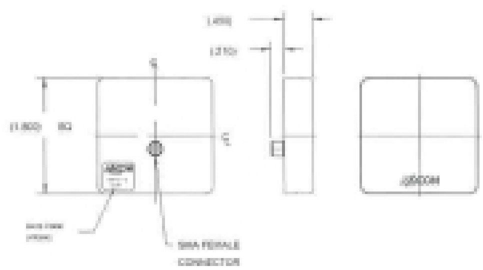
Description

The ANP-C-116 patch antenna is a hemispherical/ omnidirectional antenna. It is circularly polarized to maximize immunity to fading in high multipath environments.

This durable antenna has a flat configuration that makes it suitable for surface mount applications. It can be used for a variety of ISM applications such as bar code scanning, auto toll collection, wireless LAN and medical monitoring devices.

Specifications

Frequency Range	2400-2485 MHz
Peak Gain	+4 dBic Min
Polarization	Right Hand Circular
Nominal Impedance	50 Ohms
VSWR	2.0:1 Max
R. F. Power Handling	1 W Avg. Max 3 W Peak Max
Connector Type	SMA Female
Weight	1.5 oz Max



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3) Provide information on the antenna cable used for testing. What type? length? attenuation in dB?

The antenna attached to the Tower Transceiver is , being fed through a 50’ low-loss coaxial cable. The cable has 8 dB of loss at 2.45 GHz, or 0.16 dB/ft. The connectors on the cable are SMA style.

4) Indicate compliance with Section 15.203.

The Trakus Tower Transceiver and Player Patch are part of a system that are used to track NHL hockey players during a game. The Tower Transceiver and Player Patch are not sold to the general public. A trained employee from Trakus will install the Tower Transceiver and Player Patch.

Below is a description of the system.

The Tower Transceiver (TT) and Player Patch (PP) were developed as part of a microwave radio link operating in the Industrial, Scientific, & Medical (ISM) band for spread spectrum transmissions at 2.4 GHz to 2.485 GHz. The transceivers were developed for an Electronic Local Area Positioning System (ELAPS) which uses pairs of TT’s as delta time of arrival (ΔTOA) sensors to determine exact locations of multiple PP’s within a defined viewing area. Multiple PP locations are determined based on TOA correlation data called Digital Signal Processing Records (DSPR’s). Location, Velocity, and Acceleration (LVA) calculations are made from DSPR’s and then grouped for each PP and used as statistics for real-time display and amassed in a database. The Trakus system will be owned and operated by Trakus personnel and will not be for sale to the consumer market. However, the digital data that is collected by the Trakus system will be sold to interested consumer markets (i.e. Television/Sports networks, gaming and internet companies etc.).

Current Applications

The immediate application is for the televised sports industry, starting in the National Hockey League. The Tower Transceivers are deployed around an ice rink to determine the LVA’s of all athletes during an entire game. Eight to sixteen TT’s are used to cover the area confined by the rink boards. TT’s will be located as close to the boards as possible, positioned at a predetermined height above the ice. All skaters in the game will be equipped with a PP affixed in their helmets. PP’s will be worn at all times by the athletes throughout the game and will periodically transmit signals back to the TT’s so that TOA correlation data may be obtained. LVA’s can then be produced by the Trakus system to determine the locations and speeds of the hockey players at all times during the game, total distances skated by hockey players, the force of a hit between two or more hockey players (such as in checking), as well as many other insightful statistics.

5) Provide peak conducted output power measurements with a peak power meter.

The output of the Tower Transceiver was measured with a H/P Power Meter 437B. The measurement was made at the output of the Tower Transceiver. Two measurements were made, the normal mode of operation, which is TDMA, and a full power constant transmission mode.

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TDMA Mode  = 5.3dBm  = 112.3dBuV  = 412mV/m
Full Power = 22.6dBm = 129.6dBuV  = 3.01V/m
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6) Provide Processing gain measurements, data and test procedure description.

The processing gain was provided by Trakus**.**

Processing Gain

The processing gain of a spread spectrum system is often determined by:

$$G_p := 10 \cdot \log\left(\frac{R_c}{R_b}\right)$$

Where Rc is the code rate and Rb is the desired data rate. The Trakus system was designed to use PRN code inversion as a method of determining what logic value was transmitted. An inverted code would correspond to a logic “1” and a logic “0” would correspond to a non-inverted code. Therefore, the maximum data rate of the system is determined by the length of the PRN code and the number of epochs transmitted per time slot. As mentioned previously, the PP and the TT’s use different PRN code lengths. However, both systems use a maximum chip rate of 10Mcps. The table below shows the PRN code length, the number of epochs transmitted per time slot, the maximum allowable data rate per given slot, and the processing gain for each receiver.

System Type	RX Code Length	Epochs per Slot	Max Data Rate	Processing Gain
Player Patch	31	160	322kbps	14.92dB
Tower Transceiver	127	39	78kbps	21.07dB

7) Indicate compliance with the RF safety requirements. Provide calculations taking into account the output power, antenna gain to determine the RF safety distances. Provide installation instructions to ensure that distances are met and ensure that the intructions indicate what they are for. e.g...."To comply with FCC RF safety requirements, mount the antenna to maintain a distance of XXXX m from the antenna and nearby persons."

The antenna for the Tower Transceiver will be placed a minimum of 12 feet or 3.65 meters above the ice with the antenna facing the ice.

The calculations for the RF Safety are as follows.

For a worst case condition the equation of $S= PG/4(3.14)R^2$ will be used.
S= Power Density mW/cm^2
P= Input Power to antenna mW
R= Distance from antenna cm
G= Gain relative to an isotropic radiator

The input power used for the equation will be the worst case full power mode (22.6dBm or 185mW).

The distance from the antenna is the 12 feet or 365.76cm which is the minimum distance from the antenna to the ice per the Trakus manual.

The gain of the antenna is 4dBi from the data provided by Trakus.

$S= 185 (4)/4(3.14)365.76^2$
$S= 740/(12.56)(133780)$
$S= 740/1680276.8$
$S=0.00044mW/cm^2$
$S=0.04uW/cm^2$

The MPE at 3.65 Meters is $0.04uW/cm^2$

Per Trakus manual the antennas will be installed by trained Trakus personal. The system is not sold to the public.

The items indicated above must be submitted before processing can continue on the above referenced application. Failure to provide the requested information within 60 days of the original e-mail date may result in application dismissal pursuant to Section 2.917 (c) and forfeiture of the filing fee pursuant to section 1.1108.

DO NOT reply to this e-mail by using the Reply button. In order for your response to be processed expeditiously, you must upload your response via the Internet at www.fcc.gov, Electronic Filing, OET Equipment Authorization Electronic Filing. If the response is submitted through Add Attachments, in order to expedite processing, a message which informs the processing staff that a new exhibit has been submitted must also be submitted via Submit Correspondence. Also, please note that partial responses increase processing time and should not be submitted.

Any questions about the content of this correspondence should be directed to the e-mail address listed below the name of the sender.


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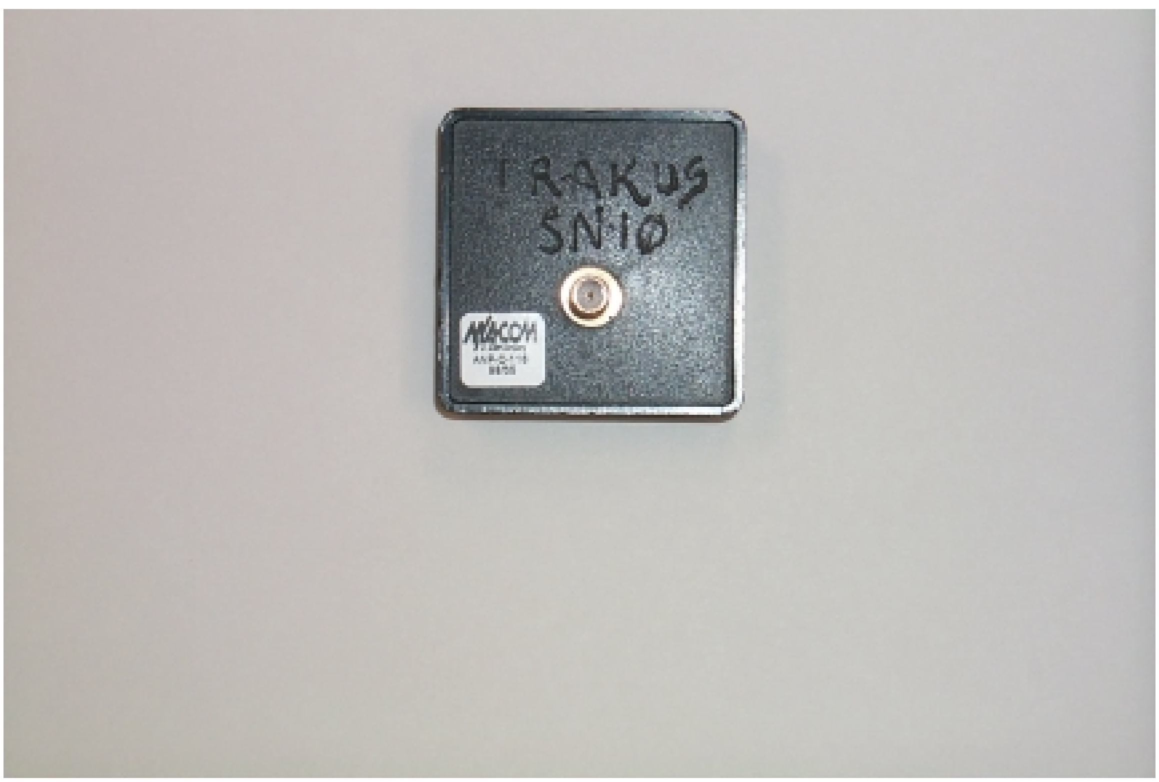
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