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Regarding: Processing gain of the AirMax 240 and the AirMAX 2400
FCC ID: QGQ-AM241

This letter addresses the processing gain requirement of FCC Part 15.247 for Direct Sequence Spread Spectrum devices. Recall that the Malibu AirMAX units utilize a Cisco systems IEEE 802.11 module.

Attached is the processing gain data from the original Cisco FCC grant (LDK-102040, uploaded to the FCC on 5 June 2000). This file was submitted during the initial application. Though there have been several permissive changes to this grant, they have all been for additional antennas, therefore the processing gain characteristics of the device have not changed.

If there are any additional questions or I can be of further help, please let me know.

David Waitt, on behalf of Malibu Networks.

CISCO SYSTEMS

PRODUCT NAME: Cisco Merucry Radio

NAME OF TEST: The Processing Gain of a Direct Sequence System.

FCC Part 15.247 (e) specifies:

The processing gain of a direct sequence system shall be at least 10 dB.

Guidance on measurement by FCC

The processing gain may be measured using the CW jamming margin method. The test consists of stepping a signal generator in 50khz increments across the passband of the system. At each point, the generator level required to the produce the recommended Bit Error Rate (10-5) is recorded. This is the jammer level. The output power of the transmitting unit is measured at the same point. The Jammer to Signal (J/S) ratio is then calculated. Discard the worst 20% of the J/S data points. Total losses in a system including transmitter and receiver, should be assumed to be no more than 2 dB.

therefore, processing gain = S/N + Mj + Lsys

Where :
S/N = Signal to noise ratio required at the receiver output for 10-5 error rate of a ideal receiver for your demodulation scheme

Mj = Jammer to signal ratio
Lsys = System losses (2dB max)

Test results :

for 1 mb data rate:

S/N = 13 dB ; taken from Wireless Information Networks by Pahlavan & Levesque
Mj = - 4.2 dB ; worst case jamming margin from tests in lab
Lsys = 2.0 dB ; system losses

therefore the processing gain at 1mb is 13 dB - 4.2 dB + 2.0 dB = 10.8 dB

for 2 mb data rate:

S/N = 13 dB ; taken from Wireless Information Networks by Pahlavan & Levesque
Mj = - 4.2 dB ; worst case jamming margin from tests in lab
Lsys = 2.0 dB ; system losses

therefore the processing gain at 2mb is 13 dB – 4.2 dB + 2.0 dB = 10.8 dB

for 5.5 mb data rate:

S/N = 13.6 dB ; taken from Harris CCK encoding modulation

Mj = - 4.4 dB ; worst case jamming margin from tests in lab (after 20% discard)

Lsys = 2.0 dB ; system losses

therefore the processing gain at 5.5mb is 13.6 dB - 4.4 dB + 2.0 dB = 11.2 dB

for 11 mb data rate:

S/N = 16.0 dB ; taken from Harris CCK encoding modulation

Mj = - 7.4 dB ; worst case jamming margin from tests in lab (after 20% discarded)

Lsys = 2.0 dB ; system losses

therefore the processing gain at 11mb is 16.0 dB - 7.4 dB + 2.0 dB = 10.6 dB