

# Application Note



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Provisions to Combat Interference

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Nova Engineering's NovaRoam 900 is a complete 902 to 928MHz FCC Part 15 direct sequence spread spectrum (DSSS) wireless transceiver that may be used for multiple access networking, point to point, or broadcast operation. The channels may be configured using any of seven DSSS modes with burst data rates spanning 21kbps to 1.008Mbps. This broad range of nearly 50:1 enables users to select the best combination of throughput and range to establish a robust link. The DSSS waveform results in enhanced immunity to interference, yielding increased link reliability, especially in congested areas. In addition, the NovaRoam 900 has been specifically tailored to survive levels of external interference that would disable most Part 15 transceivers, enabling it to deliver reliable wireless links under extremely adverse conditions.

#### **1.0 Summary**

The FCC restricts the transmitter power of all 902 to 928MHz Part 15 spread spectrum transceivers to 1 watt, making interference from adjacent frequency bands potentially devastating. For instance, pager transmitters are licensed to operate over frequencies ranging from 928 to 932MHz and radiate effective power levels as high as 3500W. This has led some wireless LAN link designers to conclude that 902 to 928MHz direct sequence Part 15 equipment is inherently ill equipped to deal with such high interference levels. The NovaRoam 900 has overcome these limitations by virtue of an extremely high dynamic range receiver front end that incorporates high selectivity RF filters to block much of this interference. The technical features that enable the NovaRoam 900 to survive in this hostile interference environment are described below.

## 2.0 Interference Survey

Field tests have been conducted in order to assess the levels of pager interference that could be encountered. The magnetic mount collinear antenna that is supplied with the NovaRoam 900 was mounted to the roof of a vehicle. The antenna cable was attached to a spectrum analyzer in order to monitor the incident signal level as the car was driven along routes that came as close as 50 feet from the base of several pager transmitter towers. The most severe interference levels were encountered in a location that had 5 cellular/pager towers within ¼ mile of the vehicle. The resulting signal spectrum is plotted in the attached figure and is representative of a worst case situation. Note that the maximum incident signal level exceeds -19dBm.

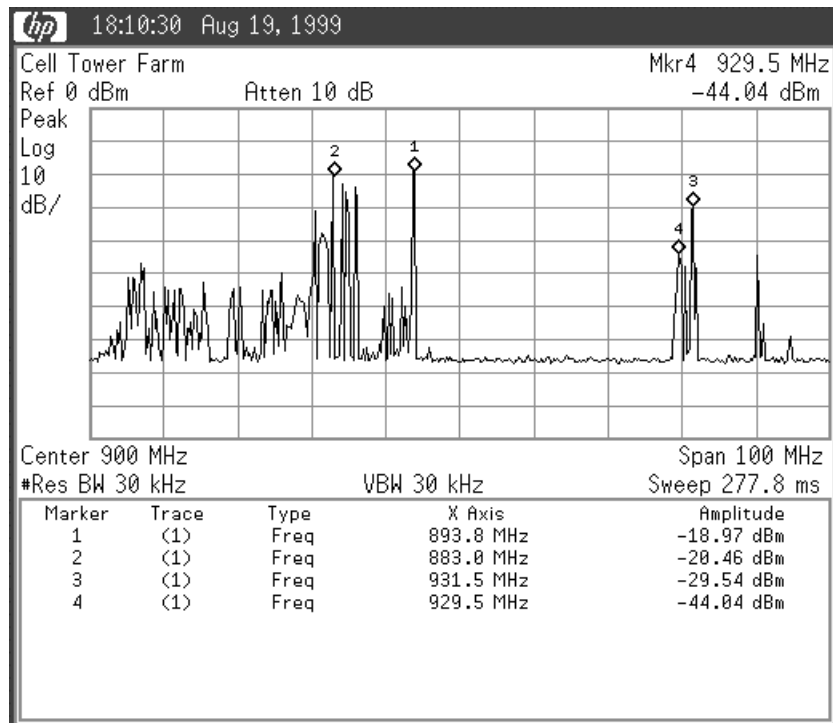


Figure 1



receiver module in order to yield the highest  $IP^3$  levels that are practical for Part 15 transceivers. The predominant culprits producing these 3<sup>rd</sup> order IM products are amplifiers and mixers. The NovaRoam 900 includes highly selective front-end bandpass filters that effectively mute the interference before it reaches these critical stages and thereby diminish its effect on the sensitive portions of the receiver circuitry. The following plot, at a vertical scale of 5dB per division, displays the superior amount of selectivity available from the NovaRoam 900 front end by comparing its performance to a conventional Part 15 bandpass filter. Note that the NovaRoam 900 filter yields roughly 10 to 15dB more selectivity in the filter skirts than competing products. Remarkably, this improvement is achieved along with enhanced receiver sensitivity since the NovaRoam 900 also has better passband insertion loss.

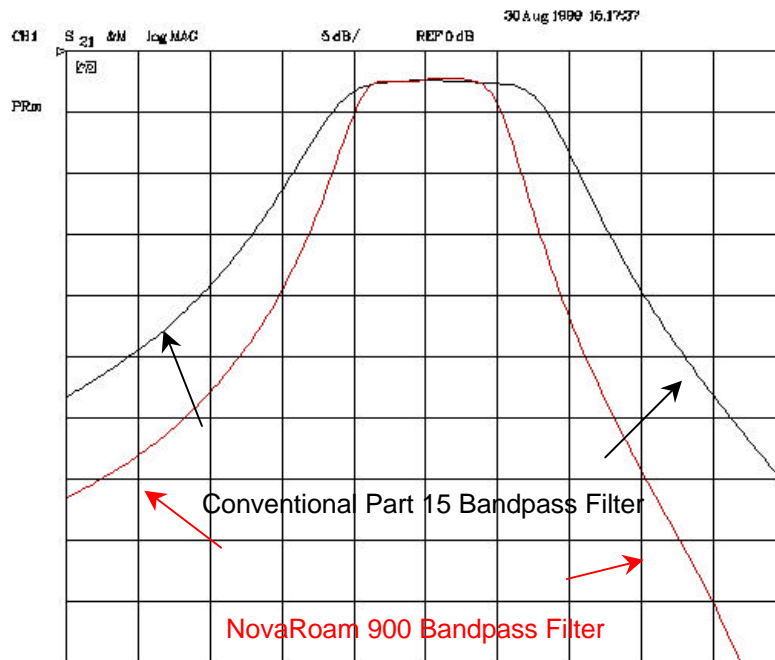


Figure 2

The features inherent in the NovaRoam 900 to minimize nonlinear distortion can be assessed by analyzing the unit's performance against the severe interference environment plotted earlier. The maximum effective 3<sup>rd</sup> order IM distortion product generated in the NovaRoam 900 hardware by

this collection of interferers is only  $-167\text{dBm}$ . This falls more than 50dB below the NovaRoam 900 minimum receiver sensitivity and therefore does not affect any of its 7 operating modes.

Now consider the more stringent case of pager interference in the 928 to 932MHz band. This case is even more challenging since the interferers are closer to the NovaRoam 900 channels and there is less front end filter selectivity available to block these undesired signals. The analysis reveals that all operating modes of the NovaRoam 900 are able to tolerate a maximum interference level of  $-22\text{dBm}$  without any adverse effects. Therefore, the NovaRoam 900 receiver performance remains solid even under these extreme circumstances.

In fact, the NovaRoam 900 continues to deliver outstanding performance when installed on antenna towers that are equipped with high power pager transmitters. In this case it becomes necessary to include a cavity bandpass filter between the NovaRoam 900 and its antenna in order to adequately attenuate the interference. This strategy translates into a tremendous deployment advantage by allowing the NovaRoam 900 to be installed on towers that are already equipped with pager transmitters. In this way, the user can obtain substantial base station antenna height at a preferred location by leasing space on an existing tower. The expense of adding a cavity bandpass filter is generally far less than the price of purchasing and erecting a new tower.

## About Nova Engineering

Nova Engineering, a 100% employee owned digital and wireless communication systems company, designs, develops and manufactures high speed data processing and transmission equipment. In ten years of operation, Nova Engineering, Inc. has pioneered a variety of leading edge projects in both the commercial and government sectors.

Designs include miniature, low power RF communications equipment, waveform development software, high performance modems, ultra-low phase noise synthesizers, embedded real-time signal processing systems and communication products development tools.

Nova supports the total development cycle from systems engineering, analysis and computer simulation to printed circuit board design, prototyping, production, and automated testing.

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