

Introduction

This resource document is designed to give the reader a basic understanding of the technical and legal issues that apply to the operation of RF devices in the 902Mhz to 928Mhz band. Since the allowed use of frequencies varies considerably worldwide, it should be recognized that this resource document is intended for designers planning to operate in the United States under the rules of CFR47 Part 15.

When working with RF, a clear distinction must always be made between what is technically possible and what is legally acceptable. Since consideration of technical issues serves little purpose if the chosen frequency cannot be legally used for your intended purpose, let us consider issues of legality first.

Legal considerations

In the United States, the FCC (Federal Communications Commission) is responsible for the regulation of all RF devices. These regulations are contained in the Code of Federal Regulations (CFR), Title 47. Title 47 is made up of numerous volumes; however, all regulations applicable to operation in the 902 MHz to 928MHz bands are contained in volume 0-19. It is strongly recommended that a copy be obtained and reviewed in its entirety. You may download a copy from the Linx web site at www.linxtechnologies.com or obtain a hard copy from your local government bookstore or the Government Printing Office in Washington.

What is unlicensed operation

Here in the United States, the FCC requires any device that intentionally radiates RF energy to be tested for compliance with FCC rules. Certain bands within the RF spectrum are available for "unlicensed" operation. The term "Unlicensed" is often misunderstood. The manufacturer of a product designed for "Unlicensed" operation is not exempt from the

certification procedure. Indeed, both the transmitter and receiver must be tested by a qualified testing laboratory and an FCC ID number obtained before the product can be legally sold. Once this has been done, however, the end user of the product can operate it without obtaining a license for its use.

The frequencies from 902Mhz to 928Mhz are allocated for a wide variety of unlicensed applications. Under Part 15 and Part 18 a wide variety of narrow band, spread spectrum and industrial/scientific/-medical(ISM) devices are allowed legal operation. In most instances, users of modules manufactured by Linx will seek certification under Part 15.249.

What must I do to to be unlicensed?

Part 15 requirements for many bands are somewhat obscure and difficult to interpret. Thankfully, the regulations of Part 15.249 are very straightforward.

Comply with allowed power output, harmonic and spurious requirements

Devices operating under Part 15.249 are allowed a maximum fundamental field strength of 50,000 microvolts and harmonics of 500 microvolts measured at three meters. All spurious radiation shall be attenuated to the lesser of 50 dB below the fundamental or to 200 microvolts below 960 MHz or 500 microvolts above. Linx modules are inherently designed to meet these requirements, but it is important to note that external factors can affect the modules' compliance. The RF level radiated into free space is dependent not only on raw output power but also on the type of antenna employed. Most transmitter modules, including those manufactured by Linx, have an output level that is sufficient to produce a radiated RF level that is non-compliant. The transmitter is purposely set high because many designers may wish to utilize inefficient antenna styles for

cost or cosmetic reasons. If the module is matched to a highly efficient antenna or one which exhibits gain characteristics such as a full whip or yagi, the output power may need to be reduced externally by an attenuation pad. (For further details, review Linx application note 00150).

On the other hand, a badly matched antenna can be equally damaging. Consider, for example, an antenna which has a high SWR at the fundamental frequency and a low SWR at a harmonic frequency. This misplaced antenna efficiency may cause the harmonic power to rise to an unacceptable level. Harmonics can also be affected by noise present in the transmitter power supply. This noise can cause oscillator instability and subsequent spurs and harmonic events.

While these issues of legality may appear formidable, they are generally not. By choosing a correct operational and using a pre-made RF module, a product designer's burden is greatly reduced. With proper attention to such basics as good layout, clean supply lines, and a properly matched antenna, RF success is a nearly painless process.

Now that you have a basic overview of legal issues, let us consider the actual technical issues of operation in these frequencies.

Benefits of operation within the 902-928 MHz Band

First is freedom. The band is free of the tight FCC restrictions which limit the applications for which other bands can be used. In the 902-928 MHz band virtually any analog or data signal can be sent without restrictions on content or duration.

Second: higher legal output power yields longer transmission distances than many other bands.

Third: the propagation of frequencies in the 900Mhz range is better than at higher frequencies, 2.4GHz. Therefore, lower output power is

needed to attain any particular distance. Since less output power is needed, transmitter power consumption is reduced.

Fourth: antenna compactness. A useful by-product of higher frequency is shorter wavelength. This allows a 1/4-wave antenna in the 900 MHz range to be typically less than 3.25 inches in length, allowing for easy concealment in compact portable products.

Drawbacks to the 902-928 band

The lack of restriction on the band has caused it to become increasingly popular and thus congested. Many products that transmit continuous data at high rates are now migrating to higher frequencies but the popularity of the band makes it likely to remain crowded.

Higher level interferers: in addition to its allocation for narrow-band devices the 902 to 928 MHz frequency range is also allocated for and surrounded by potentially higher-level interferers such as spread spectrum devices. Linx modules employ a variety of techniques including SAW filtration, uncommon frequency allocation, channel qualification and constant carrier modulation techniques to minimize the possible impact to a user from such interference.

Difficulty of export: most countries outside the US do not allow similar operation in the 900MHz band; thus, it is usually impractical to export a device which operates in this range. Fortunately, nearby frequencies are being standardized in large market areas such as Europe. Linx will offer pin- and function-compatible products allowing accommodation of both domestic and export requirements with just a change of modules and antennas.

Summary:

The 902-928 MHz band is ideal for instances where analog or digital signals prohibited in other bands need to be sent. In addition, it should also be given consideration for all applications where high performance analog or digital transmissions are required.