

INTRODUCTION

This application note 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 260 Mhz to 470 Mhz bands. Since the allowed use of these frequency bands varies considerably worldwide, it should be recognized that this application note is intended for designers planning for operation 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 260 MHz to 470 MHz 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.

Unlicensed operation in the frequencies from 260 Mhz to 470 Mhz is governed by Part 15, section 231. Part 15 is what is termed “Living Legislation”. This means it is subject to interpretation on a case-by-case basis. If your application is not clearly in compliance, it is best to consult the FCC directly before proceeding with a design.

WHAT MUST I DO TO BE UNLICENSED?

The regulations of Part 15.231 are rather unusual. In many bands the FCC specifies only fundamental power, harmonic levels, and allowed bandwidth. In the case of the 260-470 MHz band the FCC actually considers what the data being sent originally consisted of and what their intended function is. You will want to review the text of 15.231 in its entirety. (It has been included for your convenience at the end of this applications note.) When reviewing this section, it is critical to realize that paragraphs (A)-(D) are intended to be read as a unit, while paragraph (E) applies only if the rules of paragraph (A) are being violated. Because of the complexity and application-dependent nature of the rules, they are best illustrated in a flowchart style as follows.

Is My Application Legal for Operation Under Part 15.231 A-D

YES

Allowed Transmission Types

Under 15.231 A-D You May:

- Transmit control or command signals
- Transmit ID codes in order to identify a system component
- Transmit radio control signals during emergencies

NO

Banned Transmission Types

Under 15.231 A-D You May Not:

- Transmit voice or video
- Control toys
- Transmit true variable data (time, pressure, temperature, etc.)

Transmitter Activation Method

AUTOMATIC

Transmission must cease within 5 sec. of activation.

MANUAL

Operation must cease within 5 sec. of switch being released after use.

Comply with the output power, bandwidth, and harmonic requirements of paragraphs B-D and the product is suitable for certification.

Is It Legal Under Para. (E)?

Any Operation Is Allowed Under Paragraph E Provided:

1. The output power is halved.
2. Maximum transmission time 1 sec.
3. The minimum period between transmission is 30 times the transmission period but never less than 10 sec.
4. The harmonic and bandwidth requirements of Para. B-D are complied with.

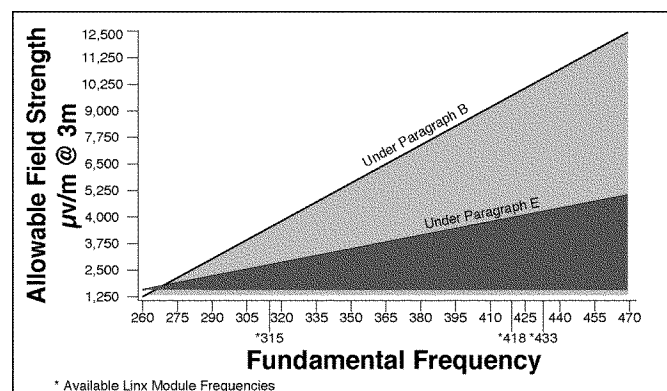
By reviewing Part 15 and the preceding flow chart, you have, hopefully, determined that your application is appropriate for operation in the 260 MHz to 470 MHz band. If you are still uncertain or feel your application falls into a “grey” area, you may wish to consult directly with an FCC engineer. You may do so by contacting the FCC directly at:

Federal Communications Commission
Equipment Authorization Division
Customer Service Branch, MS 1300F2
7435 Oakland Mills Road
Columbia, MD 21046
Tel: (301) 725-1585 / Fax: (301) 344-2050
www.fcc.gov

FUNCTIONAL REQUIREMENTS

Once you are certain your application is allowed in principle you will want to focus on understanding the specific functional requirements that must be met in order for your completed device to receive certification.

DETERMINE AND COMPLY WITH ALLOWED OUTPUT POWER



The above table illustrates the linear relationship between the fundamental frequency of

operation and the allowed output power. Since the output power is allowed to climb as the frequency increases, it might at first appear that selecting the highest frequency would give the best range performance. This is not the case, however, since free space attenuation increases proportionate to frequency. Thus, linear interpolation serves only to equalize the band's propagation characteristics so that range performance is similar across the band.

It is important that 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 such as a loop-trace or helical for cost or cosmetic reasons. If the module is matched to a highly efficient antenna 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).

In addition to the restrictions on fundamental output power, the FCC also regulates allowed harmonic levels and occupied bandwidth. Since this application note is oriented toward users of Linx products, little detail is needed or will be given on these points as our modules are inherently designed to meet these requirements. It is important, however, to note that there are several ways in which a user can adversely affect harmonic content. The most common is the use of a badly matched antenna. Consider, for example, an antenna which has a high SWR at the fundamental frequency and a low SWR at a harmonic frequency. When the transmitter's output power is raised to achieve maximum legal output at the fundamental, the harmonic may rise to an unaccept-

able level by virtue of the antenna's misplaced efficiency. Harmonics can also be affected by noise present in the transmitter 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 your application has, hopefully, survived the legal considerations outlined above, let's consider the actual technical issues of operation in these frequencies.

Benefits of Operation within the 260-470 Band

First, it should be recognized that the unusual restrictions placed on the band by the FCC do more than just make your life miserable. They also help to keep this set of frequencies quite clear of interference. Other Part 15 bands such as the 902-928 MHz band are crowded with continuous transmissions of voice, data, video and hi-level interference from microwave ovens to Spread Spectrum devices.

Second. Longer transmission distances are achieved with less power. The free space propagation of frequencies in this range is significantly better than at higher frequencies, such as 900 or 2.4 GHz. Therefore, lower output power is needed to attain any particular distance. Since less output power is needed, transmitter power consumption is significantly reduced.

Third. Cost effectiveness. The components used at these frequencies are significantly lower in cost than those designed for operation at higher frequencies. This allows an excellent balance between product cost and performance.

Fourth. Ease of export. Many countries worldwide have allocated these frequencies for similar uses. If your product will be sold abroad, this band will provide a wide range of international compatibility.

Common frequencies within the band and their uses

As you review Linx product offerings, you will notice three standard frequencies within the band from 260 MHz to 470 MHz. These frequencies are 315, 418, and 433.92 MHz.

- 315 MHz is commonly used for gate/garage door openers, security and keyless entry systems.
- 418 MHz is a very clean frequency here in the US and also appropriate for operation in the US and UK.
- 433.92 MHz is used throughout all Europe. While it is appropriate for use here in the US, interference from the nearby pager band may sometimes pose a problem.

If you are a high volume user (50K+/yr.), you may wish to further reduce the potential for interference by selecting a custom frequency within the band.

Summary:

The 260-470 MHz band is ideal for instances where control, command or status signals need to be sent. In addition, it should also be given consideration for all applications where periodic short-range analog or digital transmissions are required.

This application note is believed to be accurate as of the date of publication; however, Linx accepts no responsibility for loss or damage resulting from the information contained herein. It is the responsibility of each user to verify that his individual application is appropriate and legal on the frequency chosen for operation.