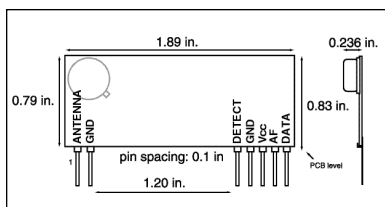# RM SERIES RECEIVER MODULE DATA GUIDE

DESCRIPTION:

The LINX RM Series module incorporates an ultra-sensitive, SAW-based, double-conversion FM superheterodyne receiver. When paired with the LINX RM Series transmitter module the units create a highly reliable RF link capable of transferring analogue or high-speed digital data at distances in excess of 500 ft. Like all Linx modules, the RM Series needs no production

Package Outline

tuning or adjustment and requires no external RF components (except an antenna). Observing simple design rules, the module is easily integrated even by engineers lacking previous RF experience.

FEATURE HIGHLIGHTS:

- Compact SIP-style package
- No production tuning or setup
- Precision SAW-controlled FM reception
- Selective double-conversion superhet design
- High sensitivity for superior range
- Supports high data rates (up to 10 Kbps)
- Wide supply range (3.9-9 vDC)
- Carrier detect & AF outputs
- Low power consumption (14mA)
- Wide temperature range

APPLICATIONS INCLUDE:

- Remote Control / Access Control
- Remote Monitoring / Telemetry
- Medical Alert
- Remote Industrial Process Monitoring
- Periodic Data Transfer
- Lighting Control
- Garage/Gate Openers
- Security / Fire Alarms
- Wire Elimination

ORDERING INFORMATION

PART #	DESCRIPTION
MDEV-418-RM	Evaluation Kit 418 MHz
MDEV-433-RM	Evaluation Kit 433 MHz
TXM-418-RM-**	Transmitter 418 MHz
RXM-418-RM-**	Receiver 418 MHz
TXM-433-RM-**	Transmitter 433 MHz
RXM-433-RM-**	Receiver 433 MHz
** Insert TB for Tube Packaging	

MODULE DESCRIPTION

The RM Series is a SAW-(Surface Acoustic Wave) based double-conversion FM superheterodyne receiver designed to be utilized in combination with a matching RM Series transmitter. The receiver utilizes a data slicer that is driven by the AF output. A carrier detect signal is available to indicate to external circuits that a signal is present. This signal is extremely useful when implementing duty-cycle power-save circuits or to indicate to external logic that a signal is being received. It is internally derived from the degree of noise quieting due to the presence of a receive carrier. By adding a simple antenna, the pair can transfer serial data at distances well in excess of 500 feet.The range of any RF link is widely variable and depends upon many factors, including the type of antenna employed and the operating environment.The 500 ft. quoted range is a typical operating distance over open ground using 1/4-whip antennae at both ends of the link at 5 feet above the ground. Use of a less efficient antenna or adverse environmental factors such as interference, obstacles, or multipath can substantially reduce the link's reliable working range. Slowing the data rate or utilizing a directional antenna (especially on the receiver) can provide increased performance but may not comply with licensing requirements. It is recommended that your individual application be reviewed with Linx prior to entering production or seeking approvals.
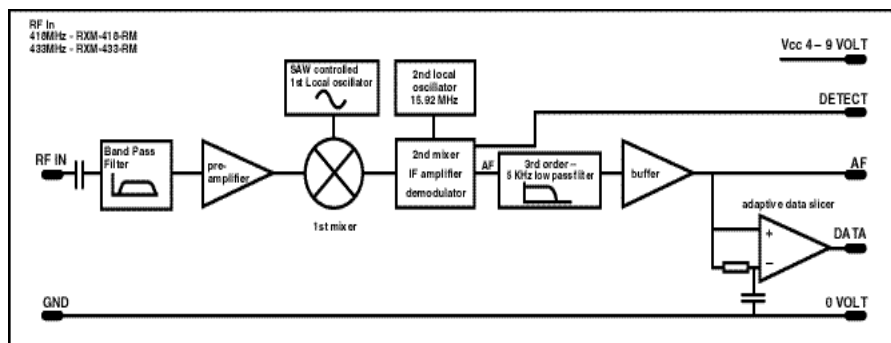

figure 1: Overall block Diagram

THE SAW-BASED DESIGN ADVANTAGE

The SAW (Surface Acoustic Wave) device provides a highly accurate frequency source with excellent immunity to frequency shift due to age or temperature. The use of a SAW device on both the transmitter and receiver modules allows the receiver's pass opening to be quite narrow, resulting in outstanding sensitivity and greater immunity to interfering signals. As an additional benefit, the SAW device is manufactured to resonate at a precise frequency, thus eliminating production tuning and lowering parts count.The SAW device, in combination with advanced design and manufacturing techniques, has made it possible to reduce the size and cost of an RF link, while enhancing its performance to a level rivaling far more complex and costly systems. The end user benefits from improved product range and reliability and the OEM manufacturer from lower cost and simpler manufacturing procedures.

PHYSICAL PACKAGING

The receiver is packaged as a hybrid SIP module with five pins spaced 0.100 in. on center.The SIP package allows easy accommodation of both horizontal and vertical mounting requirements into a highly compact package. Its leaded design allows for easy prototyping and simple integration into through-hole and surface-mount designs. If the module will be bent and laid flush on the circuit board, it is suggested that a pad of silicon or other adhesive be used to hold it in place.
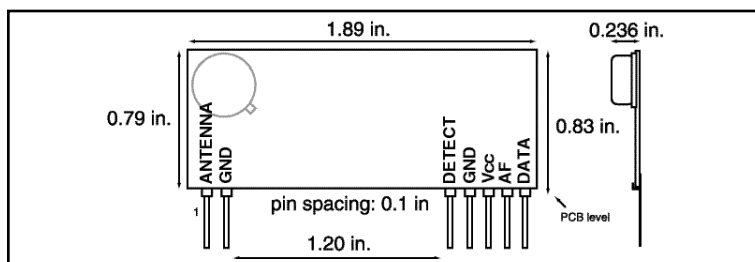

figure 2: mechanical dimensions

PIN DESCRIPTION

Pin 1   RF IN
The receiver antenna connects to this input.It is AC-coupled and has nominal RF impedance of 50   .

Pin 2 & 4   GROUND
This pin should be connected to a common groundplane.

Pin 3   DETECT
This pin may be used as described in this manual to derive an indication of when a signal is being received. In combination with simple external circuits the pin is useful for qualifying data and implementing power-save functions. If the detect function is not being used, a 10 K   pull up to pin 5 (Vcc) should be connected.

Pin 5   Vcc
Positive supply of 4 to 9 volts. The supply must be clean (<20 mV pp) stable and free of high-frequency digital noise. A supply filter is recommended unless the module is driven from its own regulated supply or battery.

Pin 6   AF (ANALOG OUTPUT)
This is the FM demodulator output. It has a standing DC bias of approximately 2 volts and may be used to recover analog signals such as audio or tones. Load impedance as low as 2 K   and up to 100 pF can be driven.

Pin 7   DATA (DIGITAL OUTPUT)
This digital output from the internal data slicer is a squared version of the signal on pin 6 (AF). This signal is used to interface with external digital decoders, or logic devices such as a microprocessor. The output recreates the digital input to the transmitter. Load impedance as low as 1 K   and up to 1 nF can be driven.

PERFORMANCE DATA – LINX RM SERIES

Performance Data Parameters:

Ambient temperature: 20°C
Supply voltage: +5 volt
Test circuit: configured as shown in figure 3

Parameter		Min.	Typical	Max	Units	Notes
Operating voltage range (Vcc)	pin 5	3.9	5.0	9.0	Volts	–
Supply current	pin 5	11	14	17	mA	–
Power-save mode current			150		µA	–
Receive frequency	Available in 418 & 433.92 MHz					
Overall frequency accuracy		-100	0	+100	KHz	1
Sensitivity	pin 1	-95	-100	–	dBm	2
Carrier detect, threshold	pin 1	–	0.5	2.0	µV	–
RF input impedance	pin 1	–	50	–	Ohms	–
IF bandwidth		–	250	–	KHz	3
AF output level	pin 6	–	500	–	mVpp	2, 3
AF bandwidth	pin 6	DC	–	5	KHz	3
Frequency conversion	pin 6	–	10	–	mV/Khz	–
Data output, Logic low	pin 7	0	0.2	0.8	V	4
Logic high	pin 7	4.0	4.5	5	V	5
Data mark-space ratio		20%	–	80%		7
Data settling time	pin 7	–	–	15	mS	8
(minimum preamble duration)						
Enable time	pin 3	–	–	2.5	mS	3, 9
Signal detect time	pin 3	–	–	0.5	mS	3, 9

Notes:

1   over supply and temperature range
2   ± 25 KHz deviation, 1 KHz tone
3   3 µV input
4   1 mA sink
5   1 mA source
7   (time high / time low) * 100%, averaged
      over any 20 mS period

8   time from valid carrier detect to stable
      data output
9   from application of supply to carrier
      detect valid
10 from application of signal to carrier
      detect low

Absolute Maximum Ratings:

Supply voltage Vcc, pin 5 -0.3   to   +10   Volts

Operating temperature   -10°C   to   +50°C
Storage temperature   -40°C   to   +100°C
RF input, pin 1   0 dBm
Any input or output pin   -0.3   to   Vcc Volts   ± 10 mA

NOTE Exceeding any of the limits of this section may lead to permanent damage to the device. Furthermore, extended operation at these maximum ratings may reduce the life of this device.
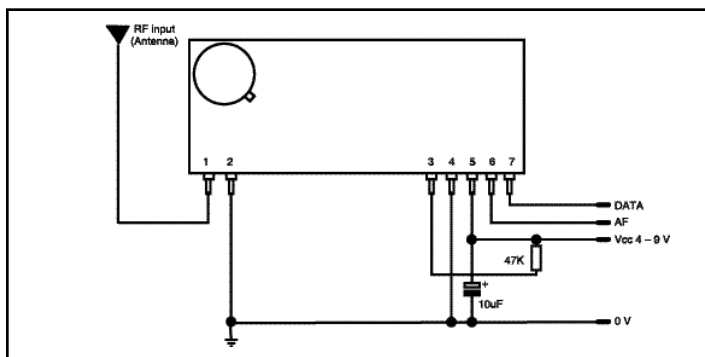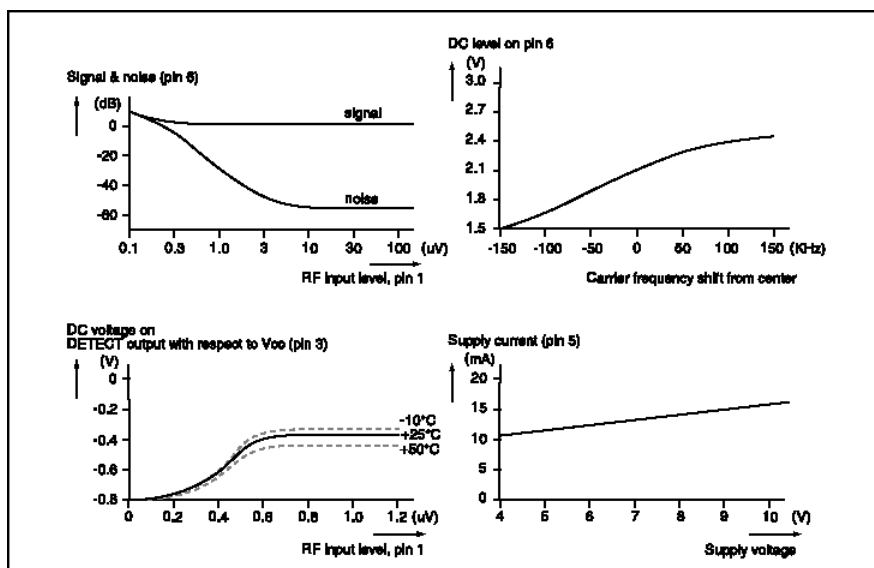
figure 3: Test/Basic application circuit

Signal & noise (pin 6)

(dB)

signal

noise

0.1   0.3   1.0   3   10   30   100   (uV)

RF input level, pin 1

DC level on pin 6

(V)
3.0
2.7
2.4
2.1
1.8
1.5

-150   -100   -50   0   50   100   150   (KHz)

Carrier frequency shift from center

DC voltage on
DETECT output with respect to Vcc (pin 3)

(V)
0
-0.2
-0.4
-0.6
-0.8

0   0.2   0.4   0.6   0.8   1.0   1.2   (uV)

-10°C
+25°C
+50°C

RF input level, pin 1

Supply current (pin 5)

(mA)
20
15
10
5
0

4   5   6   7   8   9   10   (V)

Supply voltage

figure 4: Typical performance curves

DETECT (pin 3)

2mS

5 Volt

0 Volt

DETECT (pin 3)

DETECT stable

no signal

signal present

AF (pin 6)

Audio signal

0 Volt

DATA (pin 7)

Data setting time: < 10mS

TX en

RF signal

2mS

DETECT (pin 3)

DETECT stable

no signal

signal present

white noise

Audio signal

0 Volt

squared noise

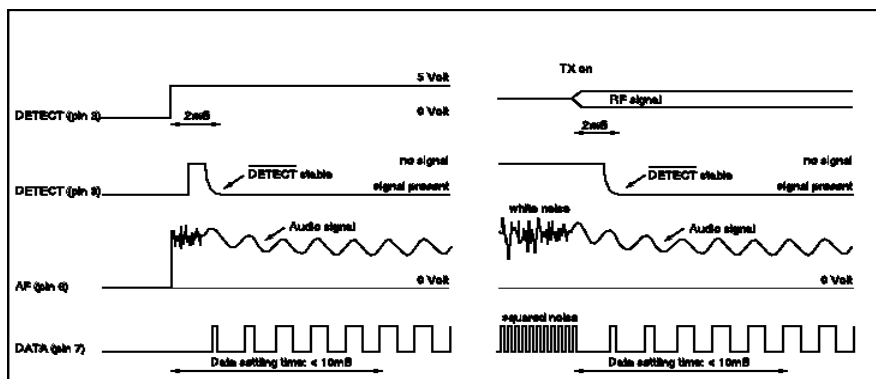Data setting time: < 10mS

figure 5: Timing Charts

POWER SUPPLY REQUIREMENTS

The receiver module requires a clean, well-regulated voltage. While it is preferable to power the unit from a battery, the unit can also be powered from a power supply as long as noise and 'hash' is less than 20mV. A 10µF capacitor to ground on pin 5 (Vcc) and a 10 series resistor will help in cases where the quality of supply power is poor.
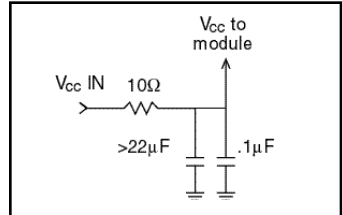

Figure 6: Suggested supply filter

BOARD LAYOUT CONSIDERATIONS

If you are at all familiar with RF devices you may be concerned about specialized layout requirements. Fortunately, because of the care taken in design, integrating an RM receiver into your design is very straightforward. By adhering carefully to a few basic design and layout rules, you can enjoy a trouble-free path to RF success.

Figure 7 shows the suggested PCB footprint for the RM receiver.

1)   A ground-plane (as large as possible) should be placed directly under the RM receiver. This ground-plane can also be critical to the performance of your antenna.
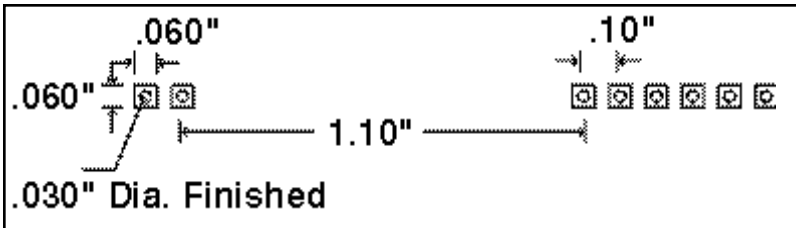

Figure 7: Recommended pad layout

2)   The RM receiver should, as much as reasonably possible, be isolated from all other components on your PCB. Specifically, high-frequency circuitry such as crystal oscillators should be kept as far away as possible from the receiver.

3)   The module may be mounted vertically or bent horizontal to the product's PCB. If the receiver is to be mounted parallel to the board, it should be bent over so that the side without components is closest to the PC board and the component side is facing away from the PC board.

4)   No conductive items should be placed within .25 in. of the module's component side to prevent detuning.

5)   The trace from the receiver to the antenna should be kept as short as possible. A simple trace is suitable for runs up to 1/4 inch for antennas with wide bandwidth characteristics. For longer runs or to avoid detuning a high-Q narrow bandwidth antenna such as a helical, use a 50-ohm coax or 50-ohm microstrip transmission line as shown in the adjoining diagram.

Formula Method
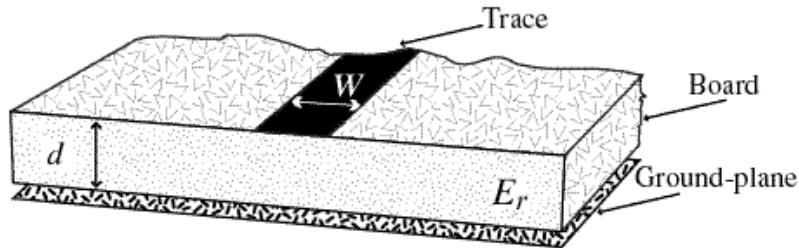
$$E_e = \frac{E_r+1}{2} + \frac{E_r-1}{2} \cdot \frac{1}{\sqrt{1+12d/W}}$$

$$Z_0 = \begin{cases} \dfrac{60}{\sqrt{E_e}} \cdot \ln\left(\dfrac{8d}{W} + \dfrac{W}{4d}\right) & \text{For } r \ \dfrac{W}{d} \le 1 \\[3ex] \dfrac{120\pi}{\sqrt{E_e} \cdot \left(\dfrac{W}{d} + 1.393 + 0.667 \cdot \ln\left(\dfrac{W}{d} + 1.444\right)\right)} & \text{For } \dfrac{W}{d} \ge 1 \end{cases}$$

E_r = Dielectric constant of PCB material

Ratio Method

Dielectric Constant	Width/Height (W/d)	Effective Dielectric Constant	Characteristic Impedance
4.8	1.8	3.59	50.0
4	2	3.07	51.0
2.55	3	2.12	48.0

Figure 8: Microstrip formulas

THE DATA OUTPUT

A CMOS-compatible data output is available on pin 7. This output is normally used to drive a digital decoder IC or a microprocessor which is performing the data decoding.The data slicer in the receiver module is designed to accept data with a wide range of pulse widths and mark:space ratios (see specification table for limiting values).The data slicer has a 10 mS initial settling time. During this settling period the data may be corrupt at the data output.

It is important to recognize that the data output pin is unsqulched and unqualified.This is done to maximize the sensitivity of the receiver and to allow the user complete control over data qualification methods. The designer must take into account that the data output will not hold a DC level in the absence of a transmitted carrier. The output may "hash", that is toggle randomly on noise or other signals present in the environment.

In order to assure a reliable and robust link the designer must understand that a wireless link has issues of timing and error not frequently found in a wired environment. Since these issues are common to any RF link many simple methodologies exist for dealing with them. Common approaches would include preamble qualification, error detection, and carrier detect or squelch implementation.

USING THE DETECT OUTPUT

Pin 3 of the module may be used in several ways:

1.   Pulled up to pin 5 (Vcc) with a 47 K resistor unmutes the AF and DATA output for normal operation.

2.   Pulled down to 0 Volts with a 47 K disables (mutes) the AF and DATA outputs (both go to 0 Volt).

3.   The data output of the receiver is not qualified, therefore "hashing"is present in the absence of a transmitter carrier. Most applications will be unaffected by this condition or the condition can be resolved in software. In instances where it is necessary to qualify the data, the carrier detect output can be used for qualification. The carrier detect pin (pin 3) is not directly suitable for carrier indication as it has a limited swing from Vcc-.8V with no carrier to Vcc-.3 volts with a strong carrier. Therefore some external circuitry is necessary to provide a logic level output.

Many different circuits can be implemented to derive a logic level output from the small available voltage swing. Figure 9 demonstrates one such simple circuit. This circuit works by taking advantage of the BC558 transistor's characteristics. The transistor, as with many PNP transistors, will turn "on"when its base is more than .7V below the collector voltage. When a carrier is present, the base voltage is only .3V below VCC (and the collector voltage) and the transistor is "off" forcing the "detect" output low through the 47K resistor. When a carrier is not present, the base voltage is .8V below VCC, and the transistor will turn "on", causing the "detect" output to go high.

The usefulness of the carrier detect pin is not limited to data qualification.It may also be used for duty-cycle power-saving control in portable equipment where battery life is a problem.Once the designer has added the external components necessary to derive a logic level detect signal the receiver can be periodically turned on and checked for a valid carrier. If a carrier is received the user's

circuitry can latch the receiver on until all data is received;if no carrier is detected it can immediately be put back to "sleep".   By pulsing the receiver on/off, the average supply current may often be reduced by a factor of 20 or more, depending upon the system requirements. The data detect output is valid within 3ms after application of the supply.
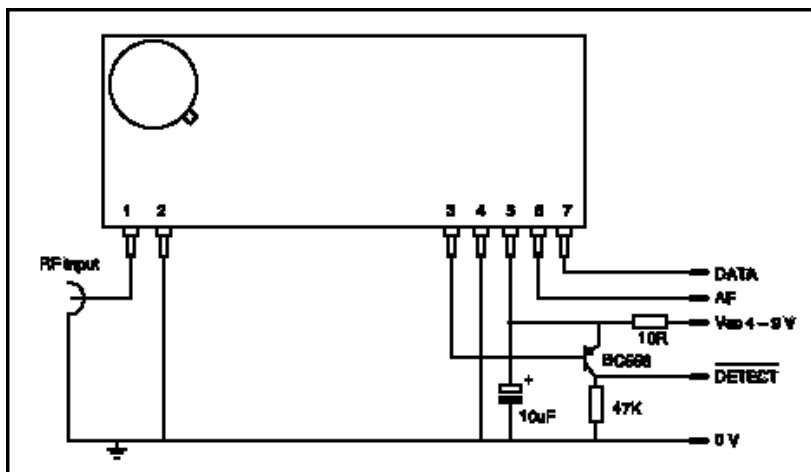

Figure 9: Simple circuit implementing carrier detect

DATA CODING

Once a reliable RF link has been established, the challenge becomes how to most effectively transfer data across it. Since the transmit and receive modules have no internal digital coding/decoding, a user has tremendous flexibility to send many types of analog and digital data. It is important to understand, however, that some intelligent transmission structure must be used.This is true for several reasons. The first and most significant is that there must be some way to distinguish an intended transmission from interferers and ambient noise. In addition, it is generally not possible to hold DC levels across an RF link; therefore, transitions must take place at minimum intervals. The designer must always structure his protocol to take into account such considerations in order to assure a reliable and error-free wireless link. For further information on such issues you may wish to refer to the application note section of the Linx internet site @www.linxtechnologies.com.

Application-specific data encoding and transfer is often accomplished using a microprocessor. Inexpensive micros such as the Microchip PIC series make an excellent choice for this task.They can directly interface to the RM's data output.

If you do not have a microprocessor on-board your product and you want to send control signals such as a key press, switch closing, or low-rate data, consider using an encoder and decoder IC chipset.These chips take care of all encoding, error checking, and decoding functions and are available from a number of manufacturers including Linx.An example of such an application is shown on the following page.

BASIC REMOTE CONTROL EXAMPLE

This is an example of a basic remote control design utilizing Holtek encoder/decoder IC available from Linx. When a key is pressed at the transmitter, a corresponding pin at the receiver goes high. This basic circuit can be easily modified to suit a broad range of applications, and demonstrates the ease of using and interfacing the Linx modules.
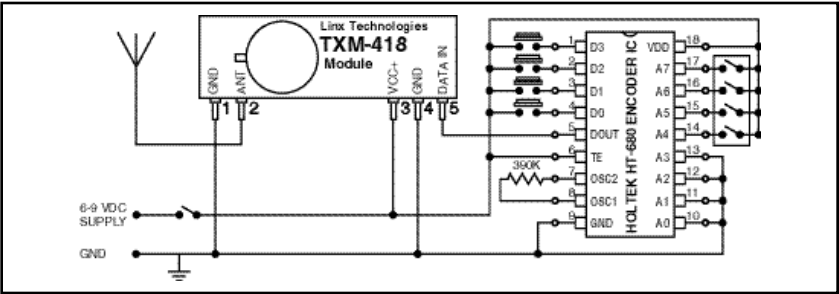
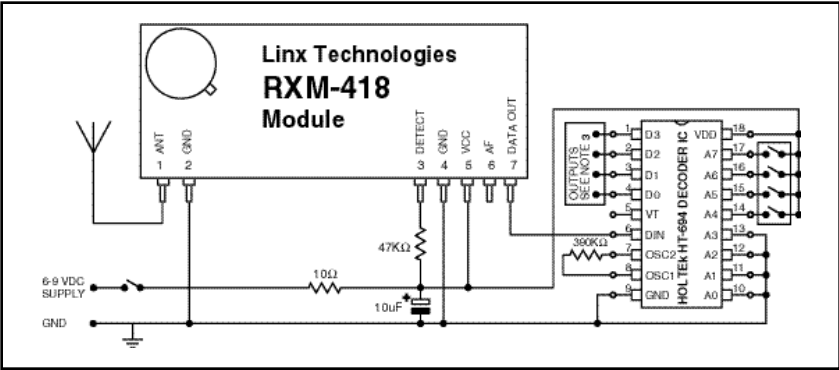

Figure 10: Basic Wireless Encoder circuit

Figure 11: Basic Wireless Decoder circuit

Notes:

1) DIP Switch used to set ID code. A 4-position switch was chosen for this example but all or none of the 8 address bits (A0-A7) may be used. Settings of the Receiver and Transmitter must match for signal to be recognized.

2) VT (valid transmission) pin goes high when incoming signal is recognized and matched.

3) These outputs will go high as the corresponding buttons are pushed at the transmitter. They can be interfaced directly with a microprocessor or used to turn on and off LED's, buzzers, etc., (Holtek chips can only sink/source 1mA on output pins so external components may require a driving transistor.)

ACHIEVING A SUCCESSFUL RF IMPLEMENTATION

Adding wireless capabilities brings an exciting new dimension to any product. It also means that additional effort and commitment will be needed to bring the product successfully to market. By utilizing Linx RF modules the design and approval process will be greatly simplified. It is important, however, to have an objective view of the steps necessary to insure a successful RF integration. Since the capabilities of each customer vary widely it is difficult to recommend one particular design path, but most projects follow steps similar to those shown at the right.

In reviewing this sample design path you may notice that Linx offers a variety of services, such as antenna design, and FCC prequalification, that are unusual for a high-volume component manufacturer. These services, along with an exceptional level of technical support, are offered because we recognize that RF is a complex science requiring the highest caliber of products and support. "Wireless Made Simple" is more than just a motto, it's our commitment. By choosing Linx as your RF partner and taking advantage of the resources we offer, you will not only survive implementing RF, but you may even find the process enjoyable.


```
DECISION TO UTILIZE RF IS MADE
          ▼
    RESEARCH RF OPTIONS
          ▼
   ORDER EVALUATION KIT(S)
          ▼
   TEST MODULE(S) WITH
      BASIC HOOKUP
          ▼
   LINX MODULE IS CHOSEN
          ▼
  INTERFACE TO CHOSEN
    CIRCUIT AND DEBUG
          ▼
  CONSULT LINX REGARDING
ANTENNA OPTIONS AND DESIGN
          ▼
     LAY OUT BOARD
          ▼
 SEND PRODUCTION-READY
    PROTOTYPE TO LINX
  FOR EMC PRESCREENING
          ▼
 OPTIMIZE USING RF SUMMARY
    GENERATED BY LINX
          ▼
   SEND TO PART 15
    TEST FACILITY
          ▼
   RECEIVE FCC ID #
          ▼
COMMENCE SELLING PRODUCT
```

TYPICAL STEPS FOR IMPLEMENTINGRF

HELPFUL APPLICATION NOTES FROM LINX

It is not the intention of this manual to address in depth many of the issues that should be considered to ensure that the modules function correctly and deliver the maximum possible performance. As you proceed with your design you may wish to obtain one or more of the following application notes, which address in depth key areas of RF design and application of Linx products.

NOTE #	LINX APPLICATION NOTE TITLE
00500	Antennas: Design, Application, Performance
00130	Modulation techniques for low-cost RF data links
00125	Considerations for operation in the 260 Mhz to 470 Mhz band
00100	RF 101: Information for the RF challenged
00110	Understanding the performance specifications of receivers
00140	The FCC Road: Part 15 from concept to approval
00150	Use and design of T-Attenuation Pads

ANTENNA CONSIDERATIONS

The range of the RF link is widely variable and depends upon the type of antenna employed and the operating environment.Proper design and matching of an antenna is a complex task requiring sophisticated test equipment and a strong background in principles of RF propagation. While adequate antenna performance can often be obtained by trial and error methods, you may also want to consider utilizing a premade antenna from Linx.Our low-cost antenna line is designed to ensure maximum performance and Part 15 compliance.

It is usually best to utilize a basic quarter-wave whip for your initial concept evaluation.This can easily be made from a piece of wire as shown on the next page. Once the prototype product is operating satisfactorily, a production antenna should be selected to meet the cost, size and cosmetic requirements of the product. It is important to recognize that the antenna plays a significant role in determining the performance and legality of your end product.In order to gain a better understanding of the considerations involved in the design and selection of antennas, please review Linx applications note #00500 "Antennas:Design, Application, Performance".

The following notes should help in achieving optimum antenna performance:

1.   Proximity to objects such as a user's hand or body, or metal objects will cause an antenna to detune. For this reason the antenna shaft and tip should be positioned as far away from such objects as possible.

2.   Optimum performance will be obtained from a 1/4- or 1/2-wave straight whip mounted at a right angle to the ground-plane. In many cases this isn't desirable for practical or ergonomic reasons; thus, an alternative antenna style such as a helical, loop, patch, or base-loaded whip may be utilized.

3.   On the transmitter end it is always a good practice to include a T-attenuation pad as described under "Board Layout Considerations".This allows your product's output power to be adjusted for certification purposes without change or compromise to the antenna.

4.   If an internal antenna is to be used, keep it away from other metal components, particularly large items like transformers, batteries, and PCB tracks and ground-planes. In many cases, the space around the antenna is as important as the antenna itself.

5.   In many antenna designs, particularly 1/4-wave whips, the ground-plane acts as a counterpoise, forming, in essence, a 1/2-wave dipole. For this reason adequate ground-plane area is essential. As a general rule the ground-plane to be used as counterpoise should have a surface area   the overall length of the 1/4-wave radiating element.

6.   Remove the antenna as far as possible from potential internal interference sources. Switching power supplies, oscillators, even relays can also be significant sources of potential interference. The single best weapon against such problems is attention to placement and layout. Filter the module's power supply with a high-frequency bypass capacitor. Place adequate ground-plane under all potential sources of noise. Shield noisy board areas whenever practical.

7.   In some applications it is advantageous to place the transmitter and its antenna away from the main equipment.This avoids interference problems and allows the antenna to be oriented for optimum RF performance. Always use 50   coax such as RG-174 for the remote feed.

Antenna Selection Chart

PARAMETER	LOOP	HELICAL	WHIP
Ultimate performance	●	●●	●●●
Ease of design setup	●	●●	●●●
Size	●●	●●●	●
Immunity to proximity effects	●●●	●●	●
●=FAIR ●●=GOOD ●●●=EXCELLENT			

COMMON ANTENNA STYLES

There are literally hundreds of antennas styles that can be successfully employed with the RM Series. Following is a brief discussion of the three styles most commonly utilized in compact RF designs. Additional antenna information can be found in Linx application notes #00500, #00100, #00126 and #00140.

Whip Style

A whip-style monopole antenna provides outstanding overall performance and stability. A low-cost whip can be easily fabricated from wire or rod, but most product designers opt for the improved performance and cosmetic appeal of a professionally made model. To meet this need, Linx offers a wide variety of straight and reduced-height whip-style antennas in permanent and connectorized mounting styles.

The wavelength of the operational frequency determines an antenna's overall length. Since a full wavelength is often quite long, a partial 1/4-wave antenna is normally employed. Its size and natural radiation resistance make it well matched to Linx modules. The proper length for a 1/4-wave antenna can be easily found using the formula below. It is also possible to reduce the overall height of the antenna by using a helical winding. This decreases the antenna's bandwidth but is an excellent way to minimize the antenna's physical size for compact applications.

1/4-wave wire lengths for RMfrequencies:

418MHz = 6.7"
433MHz = 6.5"

$$L = \frac{234}{F_{MHz}}$$

where:
length in feet of quarter-wave length
operating frequency in megahertz

Helical Style

A helical antenna is precisely formed from wire or rod.A helical antenna is a good choice for low-cost products requiring average range performance and internal concealment. A helical can detune badly in proximity to other objects and its bandwidth is quite narrow so care must be exercised in layout and placement.

Loop Style

A loop- or trace-style antenna is normally printed directly on a product's PCB. This makes it the most cost-effective of antenna styles. There are a variety of shapes and layout styles which can be utilized.The element can be made self-resonant or externally resonated with discrete components. Despite its cost advantages, PCB antenna styles are generally inefficient and useful only for short-range applications. Loop-style antennas are also very sensitive to changes in layout or substrate dielectric which can introduce consistency issues into the production process. In addition, printed styles initially are difficult to engineer, requiring the use of expensive equipment including a network analyzer. An improperly designed loop will have a high SWR at the desired frequency which can introduce substantial instability in the RF stages.

Linx offers a low-cost planar antenna called the "SPLATCH"which is an excellent alternative to the sometimes problematic PCB trace style. This tiny antenna mounts directly to a product's PCB and requires no testing or tuning. Its design is stable even in compact applications and it provides excellent performance in light of its compact size.

LEGAL CONSIDERATIONS

NOTE: RM Series Modules are designed as component devices which require external components to function. The modules are intended to allow for full Part 15 compliance; however, they are not approved by the FCC or any other agency worldwide. The purchaser understands that approvals may be required prior to the sale or operation of the device, and agrees to utilize the component in keeping with all laws governing its operation in the country of operation.

When working with RF, a clear distinction must be made between what is technically possible and what is legally acceptable in the country where operation is intended. Many manufacturers have avoided incorporating RF into their products as a result of uncertainty and even fear of the approval and certification process. Here at Linx our desire is not only to expedite the design process, but also to assist you in achieving a clear idea of what is involved in obtaining the approvals necessary to legally market your completed product.

In the United States the approval process is actually quite straightforward. The regulations governing RF devices and the enforcement of them are the responsibility of the Federal Communications Commission. The 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 this module are contained in volume 0-19. It is strongly recommended that a copy be obtained from the Government Printing Office in Washington, or from your local government book store. Excerpts of applicable sections are included with Linx evaluation kits or may be obtained from the Linx Technologies web site (www.linxtechnologies.com). In brief, these rules require that any device which intentionally radiates RF energy be approved, that is, tested, for compliance and issued a unique identification number. This is a relatively painless process. Linx offers full EMC pre-compliance testing in our HP/Emco-equipped test center. Final compliance testing is then performed by one of the many independent testing laboratories across the country. Many labs can also provide other certifications the product may require at the same time, such as UL, CLASS A/B, etc.Once your completed product has passed, you will be issued an ID number which is then clearly placed on each product manufactured.

Questions regarding interpretations of the Part 2 and Part 15 rules or measurement procedures used to test intentional radiators should be addressed to:

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 E-Mail:labinfo@fcc.gov

International approvals are slightly more complex, although many modules are designed to allow all international standards to be met. If you are considering the export of your product abroad, you should contact Linx Technologies to determine the specific suitability of the module to your application.

All Linx modules are designed with the approval process in mind and thus much of the frustration that is typically experienced with a discrete design is eliminated. Approval is still dependent on many factors such as the choice of antennas, correct use of the frequency selected, and physical packaging. While some extra cost and design effort are required to address these issues, the additional usefulness and profitability added to a product by RF makes the effort more than worthwhile.

MISMATCH CONVERSION TABLE

VSWR	Insertion Loss (dB)	Power Transmitted (%)	Power Reflected (%)
17.391	-6.87	20.57%	79.43%
11.610	-5.35	29.21%	70.79%
8.724	-4.33	36.90%	63.10%
6.997	-3.59	43.77%	56.23%
5.848	-3.02	49.88%	50.12%
5.030	-2.57	55.33%	44.67%
4.419	-2.20	60.19%	39.81%
3.946	-1.90	64.52%	35.48%
3.570	-1.65	68.38%	31.62%
3.010	-1.26	74.88%	25.12%
2.615	-0.97	80.05%	19.95%
2.323	-0.75	84.15%	15.85%
2.100	-0.58	87.41%	12.59%
1.925	-0.46	90.00%	10.00%
1.433	-0.14	96.84%	3.16%
1.222	-0.04	99.00%	1.00%
1.119	-0.01	99.68%	0.32%
1.065	0.00	99.90%	0.10%
1.034	0.00	99.97%	0.03%
1.020	0.00	99.99%	0.01%

NOTES:

U.S. CORPORATE HEADQUARTERS:

LINX TECHNOLOGIES, INC.
575 S.E. ASHLEY PLACE
GRANTS PASS, OR 97526

Phone: (541) 471-6256
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Disclaimer

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