Athena – Pelvic Muscle Trainer
Technical Description – Version S3

April 11th, 2006

Technical Description

The Athena PMT (Pelvic Muscle Trainer) is a device that generates electrical stimulation pulses for the strengthening of female Pelvic muscles to help with various problems caused by general pelvic muscle loss of strength.

The device consists of two separate, battery powered, electronic circuits housed in enclosures manufactured from injection molded plastic that communicate over an RF link:

1) Controller – A hand held device molded in commercial grade ABS plastic and used to house the Trainer when it is not is use, select the frequency of the stimulation pulse, Start and Stop stimulation sessions and adjust the voltage level of the stimulation pulses.

   The circuits are powered by three AAA batteries and are laid out on a single, double sided PCB using standard "off the shelf" SMT components.

   A two color LED is provided to communicate the current status of the PMT.

Critical Component

Component	Part Number	Description
MCU (U1)	P87LPC768	Output Control
U2	TXM-433-L-C	433MHz RF Module
Y1 Oscillator	Y1	6MHz Oscillator
RX1	10K	Voltage Selector

LINX TECHNOLOGIES

WIRELESS MADE SIMPLE

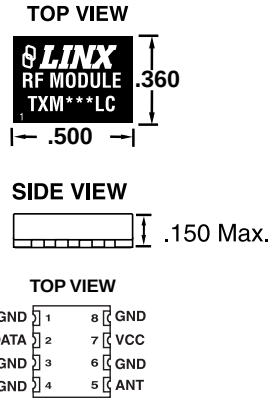
TXM-315-LC
TXM-418-LC
TXM-433-LC

LC-SERIES TRANSMITTER MODULE DATA GUIDE

DESCRIPTION:

The LC Series is ideally suited for volume use in OEM applications such as remote control, security, identification, and periodic data transfer. Packaged in a compact SMD package, the LC transmitter utilizes a highly optimized SAW architecture to achieve an unmatched blend of performance, size, efficiency and cost. When paired with a matching LC-Series receiver, a highly reliable wireless link is formed, capable of transferring serial data at distances in excess of 300 feet. No external RF components, except an antenna, are required, making design integration straightforward, even for engineers lacking previous RF experience.

PHYSICAL DIMENSIONS



PINOUTS

FEATURES:

- Low Cost
- No External RF Components Required
- Ultra-low Power Consumption
- Compact Surface-Mount Package
- Stable SAW-based Architecture
- Supports Data Rates to 5,000 bps
- Wide Supply Range (2.7-5.2 VDC)
- Direct Serial Interface
- Low Harmonics
- No Production Tuning

APPLICATIONS INCLUDE:

- Remote control
- Keyless entry
- Garage / Gate openers
- Lighting control
- Medical monitoring / Call systems
- Remote industrial monitoring
- Periodic data transfer
- Home / Industrial automation
- Fire / Security alarms
- Remote status / Position sensing
- Long-range RFID
- Wire Elimination

ORDERING INFORMATION

PART #	DESCRIPTION
EVAL-***-LC	Basic Evaluation Kit
MDEV-***-LC	Master Development Kit
TXM-315-LC	Transmitter 315 MHZ
TXM-418-LC	Transmitter 418 MHZ
TXM-433-LC	Transmitter 433 MHZ
RXM-315-LC	Receiver 315 MHZ
RXM-418-LC	Receiver 418 MHZ
RXM-433-LC	Receiver 433 MHZ

*** Insert Frequency

Not covered in this manual

LC Transmitters are supplied in tube packaging - 50 pcs. per tube.

Revised 10/3/2

PERFORMANCE DATA– TXM-***-LC

ABOUT THESE MEASUREMENTS

The performance parameters listed below are based on module operation at 25°C from a 3.3VDC supply unless otherwise noted. Figure 1 at the right illustrates the connections necessary for testing and operation. It is recommended that all ground pins be connected to the groundplane.

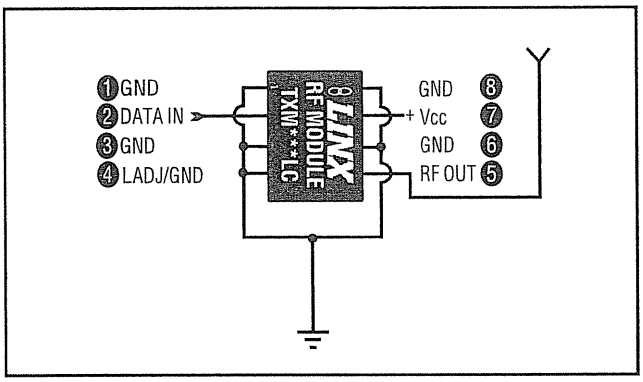


figure 1: Test/Basic application circuit

Parameters LCTX 433, 418, 315MHz	Designation	Min.	Typical	Max.	Units	Notes
Operating Voltage Range	V_{CC}	2.7	–	5.2	Volts	–
Current Continuous	I_{CC}	–	3.0	6.0	mA	1, 5
Current Average	I_{CA}	–	1.5	–	mA	2, 5
Current In Sleep	I_{SLP}	–	–	1.5	µA	3
Data Input Low	V_{IL}	0	–	0.4	Volts	–
Data Input High	V_{IH}	2.5	–	V_{CC}	Volts	–
Oscillator Start-up Time	T_{OSU}	–	–	80	µS	4
Oscillator Ring-down Time	T_{ORD}	–	–	100	nSec	4
Output Power	P_O	-4	0	+4	dBm	4

Parameter LCTX 315MHz	Designation	Min.	Typical	Max.	Units	Notes
Frequency of Carrier	F_C	314.925	315.0	315.075	MHz	–
Harmonic Emissions	P_H	–	–	-40	dBc	4

Parameter LCTX 418MHz	Designation	Min.	Typical	Max.	Units	Notes
Frequency of Carrier	F_C	417.925	418	418.075	MHz	–
Harmonic Emissions	P_H	–	–	-40	dBc	4

Parameter LCTX 433MHz	Designation	Min.	Typical	Max.	Units	Notes
Frequency of Carrier	F_C	433.845	433.92	433.995	MHz	–
Harmonic Emissions	P_H	–	–	-45	dBc	4

Notes:

1. Current draw with data pin held continuously high.
2. Current draw with 50% mark/space ratio.
3. Current draw with data pin low.
4. RF out connected to 50Ω load.
5. Ladj (pin 4) through 430Ω resistor.

Absolute Maximum Ratings:			
Supply voltage V_{CC}, using pin 7	-0.3	to	+6 VDC
Operating temperature	-30°C	to	+70°C
Storage temperature	-45°C	to	+85°C
Soldering temperature	+225°C for 10 sec.		
Any input or output pin	-0.3	to	V_{CC}

***NOTE* Exceeding any of the limits of this section may lead to permanent damage of the device. Furthermore, extended operation at these maximum ratings may reduce the life of this device.**

TYPICAL PERFORMANCE GRAPHS

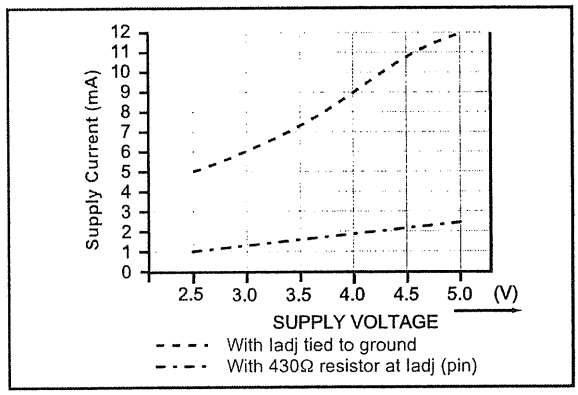


figure 2: Consumption vs. Supply Voltage

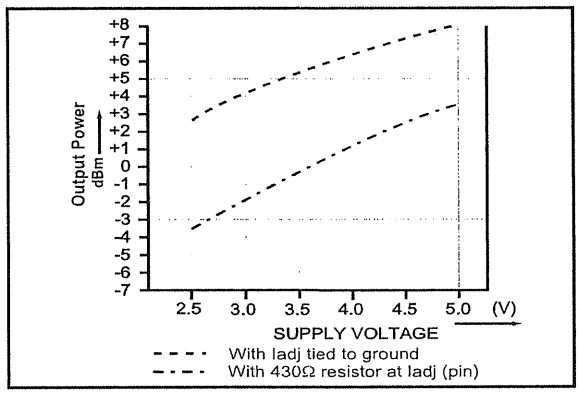


figure 3: Typical RF power into 50Ω

figure 4: Typical Oscillator Turn-On Time

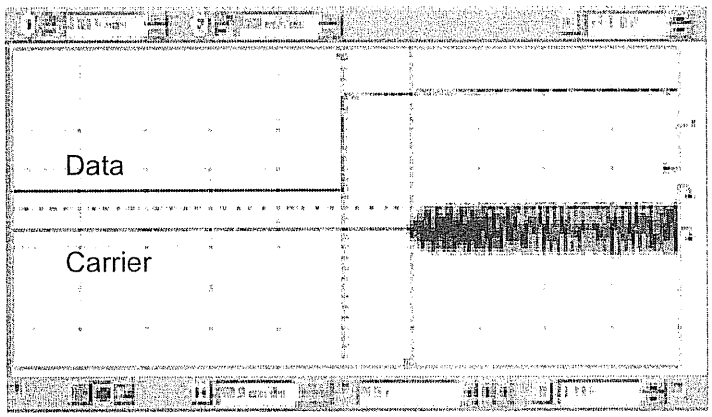
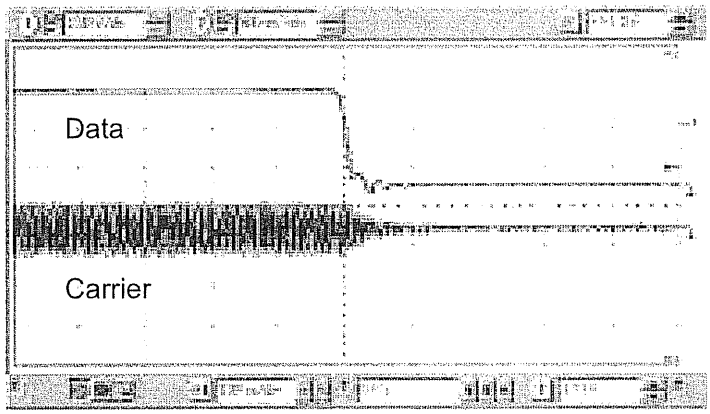


figure 5: Typical Oscillator Turn-Off Time



TRANSMITTER AUTOMATED ASSEMBLY

For high-volume assembly most users will want to auto-place the modules. The modules have been designed to maintain compatibility with most pick-and-place equipment; however, due to the module's hybrid nature certain aspects of the automated assembly process are far more critical than for other component types.

Following are brief discussions of the three primary areas where caution must be observed.

Reflow Temperature Profile

The single most critical stage in the automated assembly process is the reflow process. The reflow profile below should be closely followed since excessive temperatures or transport times during reflow will irreparably damage the modules. Assembly personnel will need to pay careful attention to the oven's profile to insure that it meets the requirements necessary to successfully reflow all components while still meeting the limits mandated by the modules themselves.

Shock During Reflow Transport

Since some internal module components may reflow along with the components placed on the board being assembled, it is imperative that the module not be subjected to shock or vibration during the time solder is liquidus.

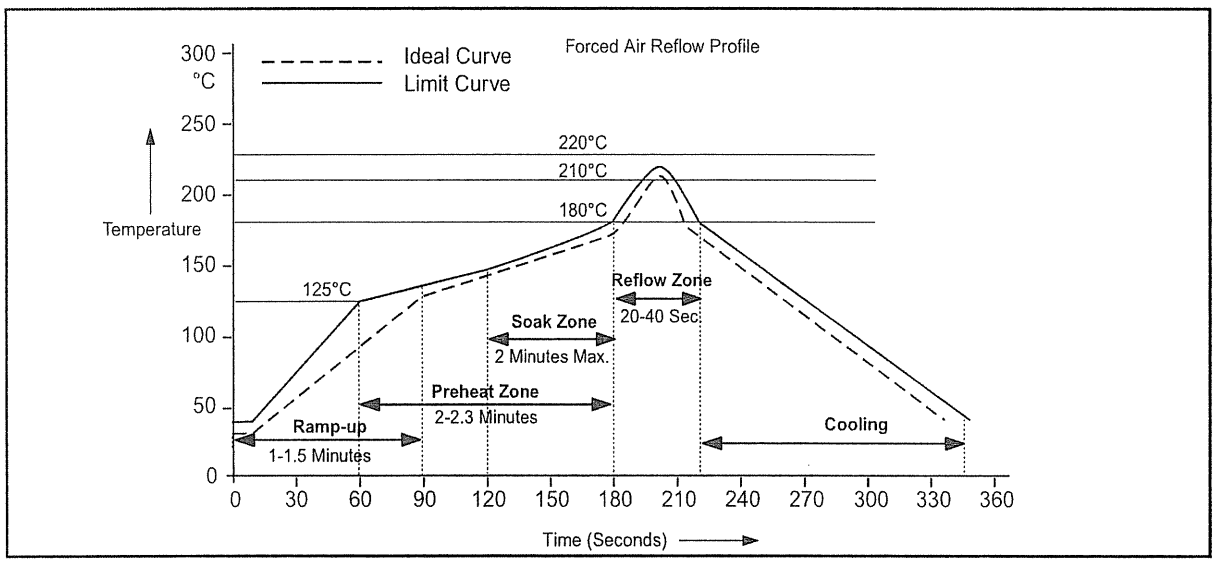


figure 6: Required reflow profile

Washability

The modules are wash resistant, but are not hermetically sealed. They may be subject to a standard wash cycle; however, a twenty-four-hour drying time should be allowed before applying electrical power to the modules. This will allow any moisture that has migrated into the module to evaporate, thus eliminating the potential for shorting during power-up or testing.

PRODUCTION GUIDELINES

The LC modules are packaged in a hybrid SMD package which has been designed to support hand- or automated-assembly techniques. Since LC devices contain discrete components internally, the assembly procedures are critical to insuring the reliable function of the LC product. The following procedures should be reviewed with and practiced by all assembly personnel.

PAD LAYOUT

The following pad layout diagrams are designed to facilitate both hand and automated assembly.

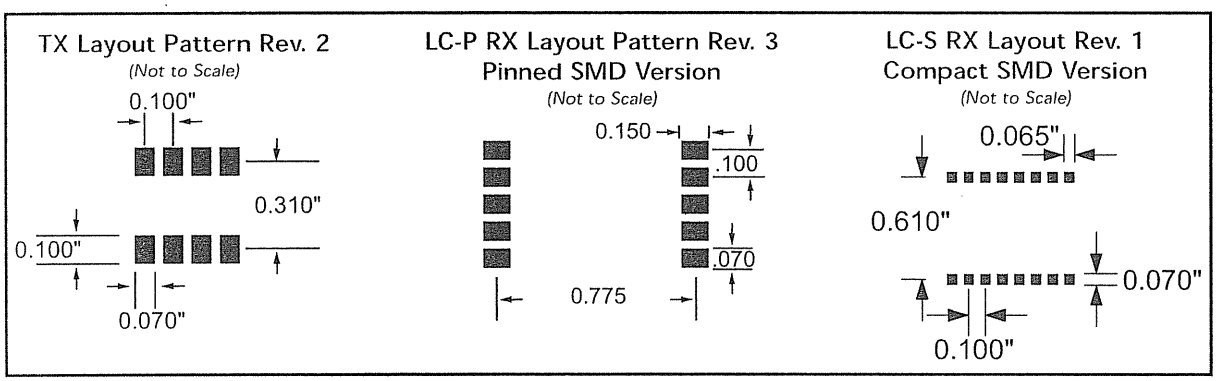


figure 7: Suggested Pad Layout

TRANSMITTER HAND ASSEMBLY

The LC transmitter's primary mounting surface is eight pads located on the bottom of the module. Since these pads are inaccessible during mounting, castellations that run up the side of the module have been provided to facilitate solder wicking to the module's underside. If the recommended pad placement (Rev.2) has been followed, the pad on the board will extend slightly past the edge of the module. Touch both the PCB pad and the module castellation with a fine soldering tip. Tack one module corner first, then work around the remaining attachment points using care not to exceed the solder times listed below.

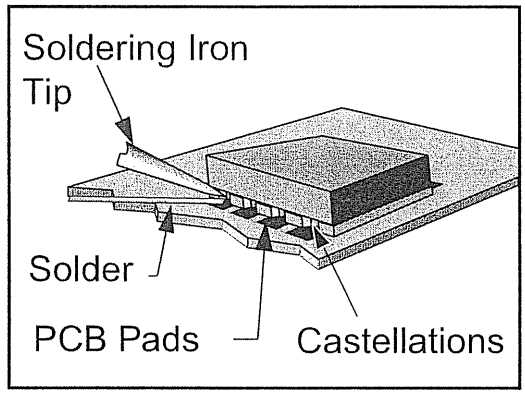


Figure 8: LC-TX Soldering Technique

Absolute Maximum Solder Times

Hand-Solder Temp. TX +225°C for 10 Sec.
Hand-Solder Temp. RX +225°C for 10 Sec.
Recommended Solder Melting Point +180°C
Reflow Oven: +220° Max. (See adjoining diagram)

PHYSICAL PACKAGING

The transmitter is packaged as a hybrid SMD module with eight pads spaced 0.100" apart on center. The SMD package is equipped with castellations which allow for side introduction of solder. This simplifies prototyping or hand assembly while maintaining compatibility with automated pick-and-place equipment. Modules are available in tube or tape-and-reel packaging (see page 1 for ordering information).

PIN DESCRIPTIONS:

Pin 1 GROUND

Connect to groundplane.

Pin 2 DATA IN

Serial data input pin. TTL and CMOS compatible.

Pin 3 GROUND

Connect to groundplane.

Pin 4 LADJ/GND

Output power level adjustment. Connect to ground for 3V operation. Connect to ground through 430 Ohm resistor for 5V operation. (see graph on page 3 and page 10)

Pin 5 RF OUT

Connect to 50Ω matched antenna.

Pin 6 GROUND

Connect to groundplane.

Pin 7 POSITIVE SUPPLY (Vcc 2.7-6 VDC)

The supply must be clean (<20 mV pp), stable and free of high-frequency noise. A supply filter is recommended unless the module is operated from its own regulated supply or battery.

Pin 8 GROUND

Connect to groundplane.

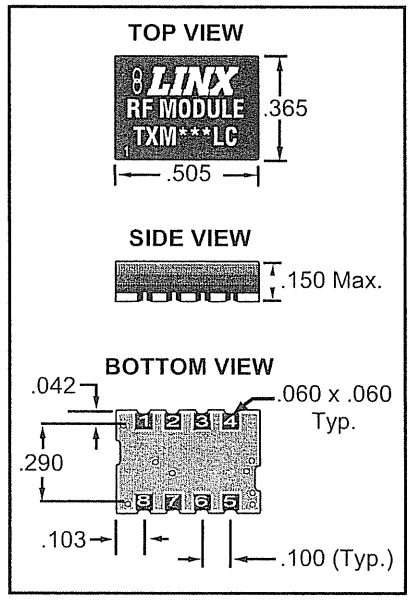


figure 9: LC -TXM Physical Package

POWER SUPPLY REQUIREMENTS

The transmitter module requires a clean, well-regulated power source. While it is preferable to power the unit from a battery, the unit can also be operated from a power supply as long as noise and 'hash' are kept to less than 20 mV. A 10Ω resistor in series with the supply followed by a 10µF tantalum capacitor from Vcc to ground as shown at the right will help in cases where the quality of supply power is poor.

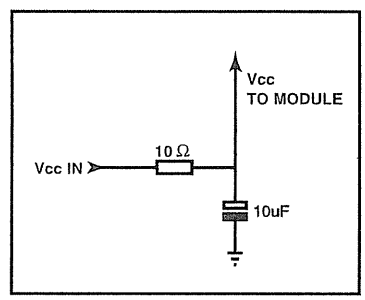


figure 10: Supply Filter

TRANSMITTING DATA

Once a reliable RF link has been established, the challenge becomes how to effectively transfer data across it. While a properly designed RF link provides reliable data transfer under most conditions, there are still distinct differences from a wired link that must be addressed. Since the LC modules do not incorporate internal coding/decoding, a user has tremendous flexibility in how data is formatted and sent.

It is always important to separate what type of transmissions are technically possible from those that are legally allowable in the country of intended operation. You may wish to review application notes #00125 and #00140 along with Part 15 Sec. 231 for further details on acceptable transmission content.

Another consideration is that of data structure or protocol. If you are not familiar with the sending serial data in a wireless environment read Linx application note #00232 (Considerations for sending data with the LC series). This application note details important issues such as the effect of start-up times, pulse stretching and shortening and the relationship between data and output power in a CPCA-based transmitter. These issues should be understood prior to commencing a design effort.

If you want to send simple control or status signals such as button presses or switch closures, consider using an encoder and decoder IC set available from a wide range of manufacturers including: Microchip (Keeloq), Holtek, and Motorola. These IC's take care of all encoding, error checking, and decoding functions and generally provide a number of data pins to which switches can be directly connected. Address bits are usually provided for security and to allow the addressing of multiple receivers independently. Additionally, it is a simple task to interface with inexpensive microprocessors such as the Microchip PIC or one of many IR, remote control, DTMF, and modem IC's.

Shown below is an example of a basic remote control transmitter utilizing a encoder chip from Holtek. When a key is pressed at the transmitter, a corresponding pin at the receiver goes high. A schematic for the receiver/decoder circuit may be found in the LC receiver guide.

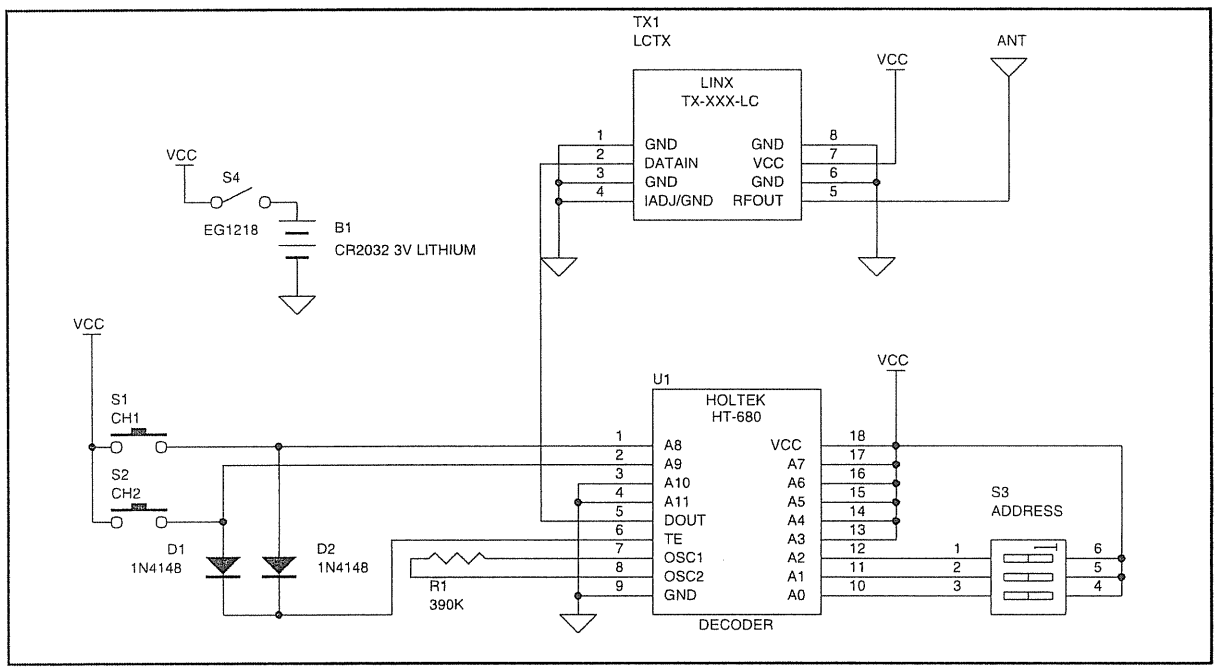


figure 12: Basic Remote Control Transmitter Circuit

Notes:

1) DIP Switch used to set ID code. A 3-position switch was chosen for this example but all or none of the address bits may be used. Settings of the Receiver and Transmitter must match for signal to be recognized.