Texas Instruments Registration and Identification System

TIRIS Technology by Texas Instruments™

Inductance Expansion Module

RI-MOD-LEX1 (discontinued)

Reference Manual

11-06-29-022 20-December-1995

Edition Notice: First Edition - December 1995

This is the first edition of this manual, it describes the following equipment:

TIRIS Inductance Expansion Module RI-MOD-LEX1

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1. Introduction

1.1 General

This document provides information about the TIRIS Series 2000 Reader System Inductance Expansion Module RI-MOD-LEX1. It describes the module and how to install it.

1.2 Reference

This document should be used in conjunction with the RFM Reference Manual:

Radio Frequency Module RI-RFM-114B /-214B
Reference Manual 11-06-29-020

or

Radio Frequency Module RI-RFM-004B
Reference Manual 11-06-29-023

1.3 Product Description

The Inductance Expansion Module is used to expand the antenna inductance tuning range of the TIRIS RF Module.

The Inductance Expansion Module (L-Expansion) is typically connected between the RF Module and the antenna, it can also be used in conjunction with a Multiplexer Module. It enables the use of antennas with a tuning range of 16 µH to 55 µH in place of the standard range of 26.0 µH to 27.9 µH.

The tuning ranges are selected by jumpers on the board. Tuning is done in several ranges in combination with a tuning coil. For inductances less than 26.0 µH, capacitors are connected in parallel, for inductances larger than 27.9 µH, capacitors are connected in series. The RFM tuning coil is then used as normal for fine tuning.

As the RF Module's damping circuit parameters are changed by adding capacitors, the L-Expansion Module also includes resistors to adapt the RF Module’s damping circuit.

1.4 Product Option Coding

For product and ordering numbers of RF Module, Antennas, Control Modules, combinations of these and Accessories, please contact your local TIRIS Application Center.

1.5 Conventions

Certain conventions are used in this document in order to display important information, these conventions are:

WARNING

A warning is used where care must be taken, or a certain procedure must be followed, in order to prevent injury or harm to your health.

CAUTION: This indicates information on conditions which must be met, or a procedure which must be followed, which if not heeded could cause permanent damage to the Module.

***Note**: Indicates conditions which must be met, or procedures which must be followed, to ensure proper functioning of the Module.*

HINT: Indicates information which makes usage of the Module easier.

2. Product Function

2.1 Description

There are seven connections on the L-Expansion Module, these are:

ANT_I1 GNDA_I1	The connection to the RF Module antenna resonator terminals (using M3 screws)
ANT_O1 GNDA_O1	The terminals for connecting the antenna (using M3 screws)
ANT_O2 GNDA_O2	The terminals for connecting the antenna (using M4 screws)
ST1	Used to connect the additional damping resistors of the L-Expansion Module to the RF Module

The L-Expansion Module can be mounted by means of four M3 mounting bolts on the bottom side of the Module.

A layout of the L-Expansion Module viewed from the top is shown in figure 1. A block schematic is shown in figure 2.

Instructions on how to connect and install the L-Expansion Module are given in section 4.

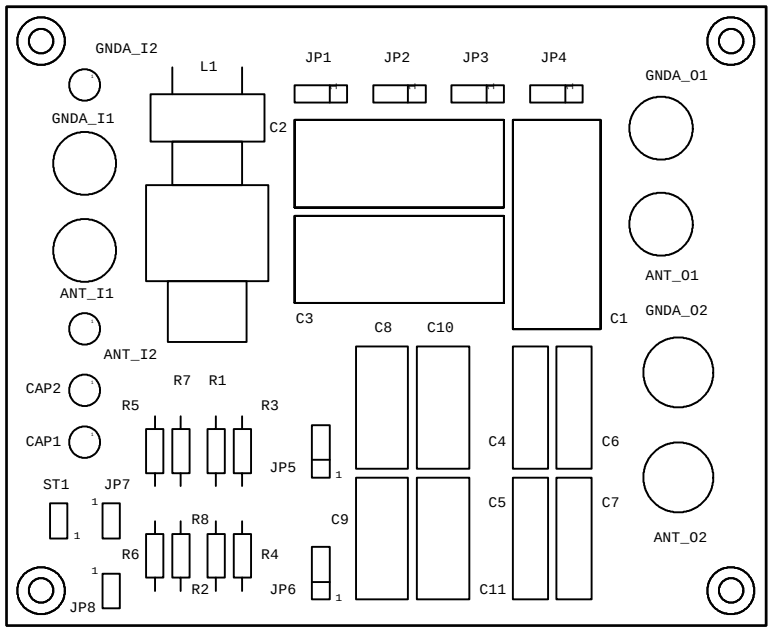

Figure 1: Top View of L-Expansion Module

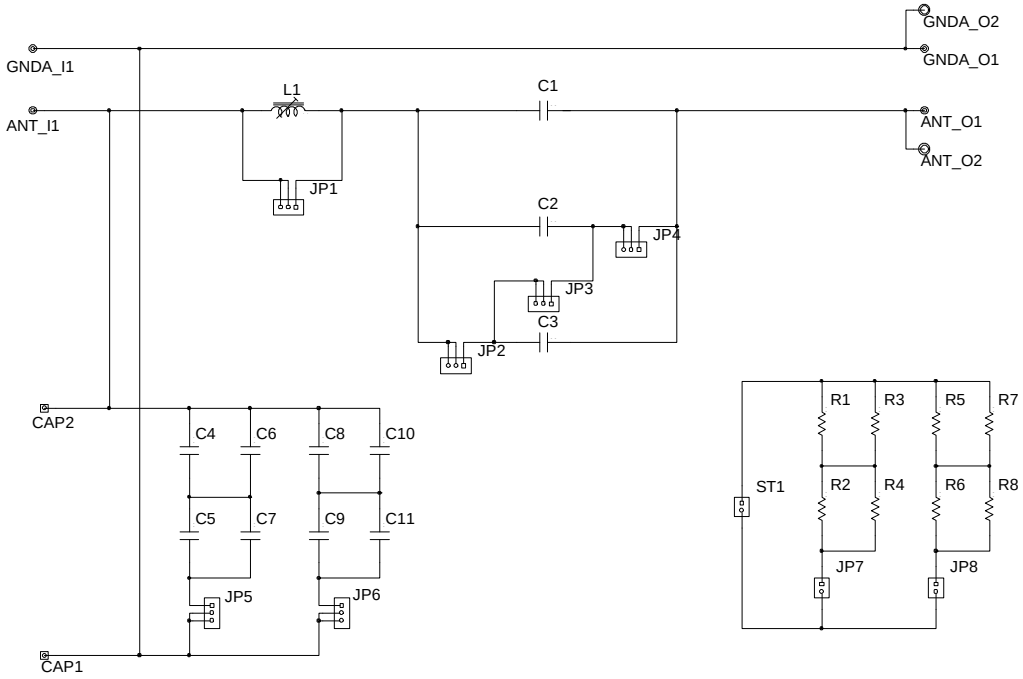

Figure 2: Schematic Diagram of L-Expansion

CAUTION: The RF Module must not be operated in continuous transmit mode.

WARNING

Care must be taken when handling the RF Module and the L-Expansion Module, especially when tuning to resonance. HIGH VOLTAGE across the antenna terminals and all antenna resonator parts could be harmful to your health. If the antenna insulation is damaged the antenna should not be connected to the RF Module.

2.2 L-Expansion Module Connectors and Jumpers

2.2.1 Connectors

Table 1 lists the pin functions for connector ANT-in, the connection is made using M3 screws.

Table 2 lists the pin functions for connector ANT-out1,the connection is made using M3 screws.
Table 3 lists the pin functions for connector ANT-out2, the connection is made using M4 screws.
The difference between ANT-out1 and ANT-out2 is the size of connector, which one you use depends on the size of the connecting wire.

Table 4 lists the pin functions for connector ST1. The connector type is a 2-pin header with 2.54 mm pin spacing.

Table 1: ANT-in Pin Functions

Pin#	Signal	Direction	Description
1	ANT_I1	IN/OUT	Connection to RF Module antenna resonator signal ANT
2	GNDA_I1	IN/OUT	Connection to RF Module antenna resonator ground GNDA

Table 2: ANT-out1 Pin Functions

Pin#	Signal	Direction	Description
1	ANT_O1	IN/OUT	Connection to antenna terminal Connection to RF Module signal ANT
2	GNDA_O1	IN/OUT	Connection to antenna terminal Connection to RF Module signal GNDA

Table 3: ANT-out2 Pin Functions

Pin#	Signal	Direction	Description
1	ANT_O2	IN/OUT	Connection to antenna terminal Connection to RF Module signal ANT
2	GNDA_O2	IN/OUT	Connection to antenna terminal Connection to RF Module signal GNDA

Table 4: ST1 Pin Functions

Pin#	Signal	Direction	Description
1	RES1	IN/OUT	Additional antenna damping resistors terminal 1
2	RES2	IN/OUT	Additional antenna damping resistors terminal 2

2.2.2 Jumpers

There are 8 jumpers on the L-Expansion Module, these jumpers are used to select the tuning ranges as shown in table 5. For location of the jumpers please see figure 1.

JP1

This jumper is used to connect and disconnect the tuning coil on the L-Expansion Module. When the jumper is plugged in, the tuning coil is shorted thus allowing standard TIRIS antennas to be used.

Default: JP1 closed

JP2, JP3, JP4

These jumpers are used to connect and disconnect the serial capacitors on the L-Expansion Module. When the jumpers are plugged in, the serial capacitors are shorted thus allowing standard TIRIS antennas to be used.

Default: JP2, JP3, JP4 closed

JP5, JP6

These jumpers are used to connect and disconnect the parallel capacitors on the L-Expansion Module. When the jumpers are **not** plugged in, the parallel capacitors are **not** connected thus allowing standard TIRIS antennas to be used.

Default: JP5, JP6 open

JP7, JP8

These jumpers are used to connect and disconnect the additional damping resistors on the L-Expansion Module. When the jumpers are **not** plugged in, the additional resistors are **not** connected thus allowing standard TIRIS antennas to be used.

Default: JP7, JP8 open

Table 5 shows how the jumpers need to be connected, in order to get the required antenna inductance tuning range.

Table 5: L-Expansion Module Jumpers

Inductance Range	JP1	JP2	JP3	JP4	JP5	JP6	JP7 Q	JP8 50	Coil
50.0 - 55.0 µH	-	-	-	-	-	-	-	X	Tune
46.0 - 49.9 µH	-	-	-	-	X	-	-	X	Tune
40.0 - 45.9 µH	-	-	X	-	-	-	X	-	Tune
35.0 - 39.9 µH	-	-	X	-	X	-	X	-	Tune
30.0 - 34.9 µH	-	X	-	X	-	-	-	-	Tune
28.0 - 29.9 µH	-	X	-	X	X	-	-	-	Tune
26.0 - 27.9 µH	X	X	X	X	-	-	-	-	-
20.0 - 25.9 µH	-	X	X	X	-	-	-	-	Tune
16.0 - 19.9 µH	-	X	X	X	X	-	X	-	Tune
13.0 - 15.9 µH	-	X	X	X	-	X	-	X	Tune
11.0 - 12.9 µH	-	X	X	X	X	X	X	X	Tune

X means jumper closed - means jumper open

Note: *JP7 and JP8 are used to adapt the damping circuit of the RF Module. In order to do this, the connector ST1 must be connected to the damping circuit of the RF Module. This is only necessary for high Q antennas (Q > 50).*

3. Specifications

3.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)

Antenna resonance voltage	V_RF	350	Vpeak
Antenna resonance current	I_RF	16	Apeak
Operating free-air temperature range	T_oper	-25 to +70	°C
Storage temperature range	T_store	-40 to +85	°C

CAUTION: Exceeding absolute maximum ratings may lead to permanent damage to the Module. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

The RF Module must not be operated in continuous transmit mode.

3.2 Recommended Operating Conditions

at Tamb=25 °C (unless otherwise noted)

Symbol	Parameter	min.	typ.	max.	Unit
V_RF	Antenna resonance voltage			330	Vpeak
I_RF	Antenna resonance current			12	Apeak

Note: *The specification for I_RF is valid for a duty cycle of 50 ms ON and 20 ms OFF. It is not specified for continuous current load.*

3.3 Electrical Characteristics

Symbol	Parameter	min.	typ.	max.	Unit
Rdamp1	Resistance of additional damping resistor connected via JP7	162	180	198	Ohm
Rdamp2	Resistance of additional damping resistor connected via JP8	108	120	132	Ohm
Cserial	Capacitance of serial capacitors connected via JP2, JP3 and JP4	45.8	47.0	48.2	nF
Cparallel1	Capacitance of parallel capacitor connected via JP5	9.7	10	10.3	nF
Cparallel2	Capacitance of parallel capacitor connected via JP6	19.8	22	24.2	nF
Lserial	Inductance of serial coil	2.0		6.0	µH
R_add	Additional series resonance resistance of L-Expansion Module (JP1, JP2, JP3 and JP4 closed)		0.075		Ohm

3.4 Timing Characteristics

Symbol	Parameter	min.	typ.	max.	Unit
f_TX	Operating frequency		134.2		kHz
t_short	Maximum short circuit time of output terminals			10	s

3.5 Mechanical data

The mechanical data is given in the table 6 and figure 3.

Table 6: Mechanical Details

Parameter	Measurement	Unit
Height(including mounting bolts)	37 +/- 2.0	mm
Weight of complete L-Expansion Module	120	Grams

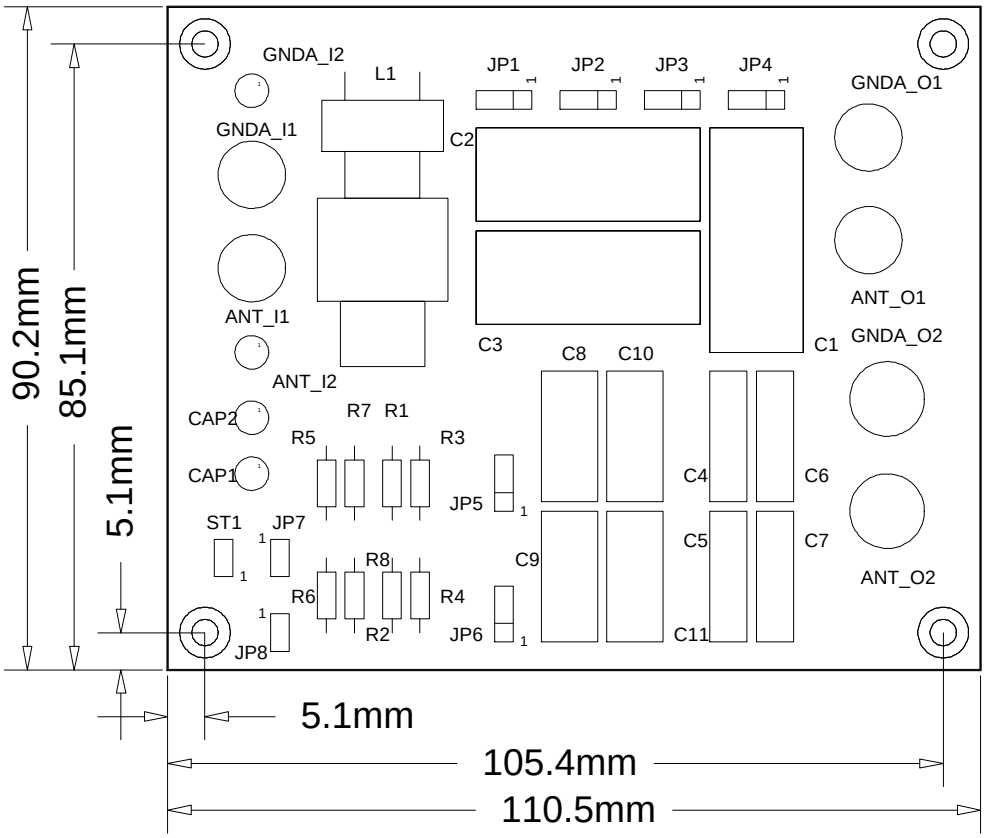

Figure 3: Mechanical Data

4. Installation and use of the Inductance Expansion Module

4.1 Installation

The L-Expansion Module must be connected to the RF Module as shown in figure 4.

It is recommended to do the connection as shown in figure 4 and not to swap the cables to the antenna terminals, in order to guarantee that other additional modules (for example: the TX/RX multiplexer) work together with the L-Expansion Module. The polarity of the antenna connection does not matter.

The connection of the additional antenna damping resistors (connector ST1) is only necessary for antennas, which have a quality factor of more than 50.

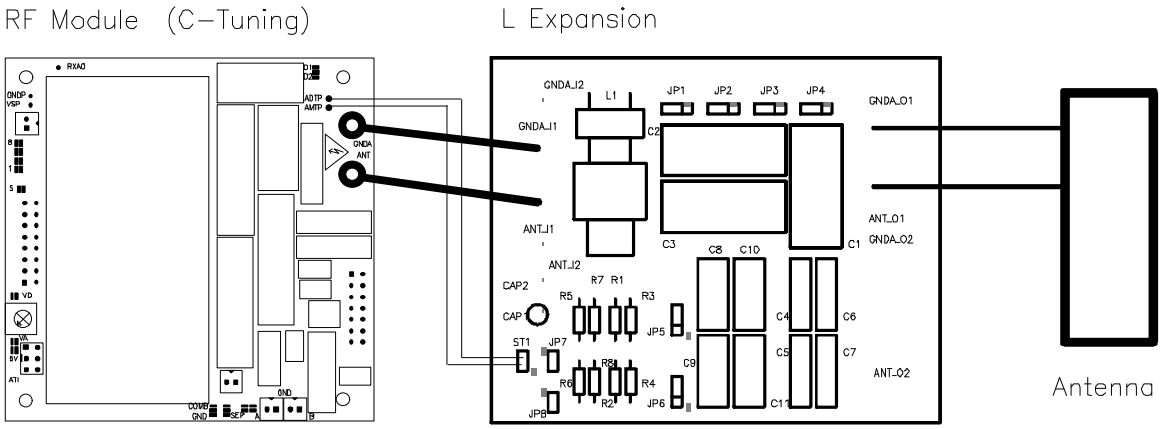

Figure 4: How to connect the L-Expansion Module to an RF Module

Note: *Do not swap the cables to the antenna terminals*

4.2 Tips and Recommendations

The L-Expansion circuit allows antennas with an inductance range from 16.0 to 55.0 µH to be used together with the RF Module.

Using the parallel capacitors which are connected via jumpers JP5 and JP6 has one disadvantage: capacitors parallel to the RF Module's antenna terminals change the coupling of the TX power stage to the antenna circuit of the RF Module. Therefore the generated antenna resonance voltage and the generated field strength is smaller. This is the reason that we only recommend the use of the L-Expansion Module together with antennas where the inductance is in the range 16.0 to 55.0 µH.

Actually inductances down to 11.0 µH can be used. However this reduces the generated field strength, so we therefore only recommend using the L-Expansion Module with such low inductance values when large loop antennas are used, as the generated field strength is still enough for large loop antennas.

If the inductance of a loop antenna with 1 turn is below 11.0 µH, then using two or more turns will bring the antenna inductance value within the tuning range (twice the number of turns gives 4 times the inductance ==> 4 x 10.0 µH = 40.0 µH).

Another advantage is that two TIRIS Standard antennas can be connected in series and still can be tuned to resonance. The inductance value of a Standard TIRIS antenna is 27 µH and thus twice the value (54 µH) is still within the tuning range.