TIAMIS-800 wireless radio transceiver

User Manual

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The Tiamis-800 Wireless Data Transceiver is made in the United States of America.
Printed in the United States of America.

Revision history

Revision	Released	Firmware level covered
1.0	November, 2005	1.06e and prior
1.2	February, 2006	1106.i and prior
1.3	March, 2006	1106.i and prior
1.3a	May, 2006	1106Mi and prior

Notice

Changes or modifications not expressly approved by Lexycom Technologies, Inc. could void the user's authority to operate this equipment.

Any and all product information in this document is subject to change without notice.

General Safety Information

Lexycom Technologies, Inc. does not recommend the use of its products in life support applications where the failure or malfunction of a component may directly threaten life or lead to an injury.

Do not operate radio equipment near electrical blasting caps or in an explosive atmosphere.

Do not operate radio transmitter unless all RF connectors are secure and any open connectors are properly terminated.

Do not allow the antenna to come close to, or touch, the eyes, face, or any exposed body parts while the radio is transmitting.

Be sure that your Tiamis-800 transceiver has been provided with sufficient DC voltage and current.

All equipment should be installed according to the manufacturer's instructions and in accordance with all regulatory agencies.

Electro Static Discharge (ESD)

Static build up can cause serious damage to electronic devices when improperly handled. Appropriate precautions should be taken when handling the transceiver(s).

FCC Notifications

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.

This device must be operated as supplied by Lexycom Technologies, Inc. Any changes or modifications made to the device without the express written approval of Lexycom Technologies may void the user's authority to operate the device.

NOTE: The Tiamis-800 transceivers are sold to be professionally installed only.

WARNING: The Tiamis-800 transceiver has the maximum transmitted output power of 1 Watt. It is required that the transmit antenna be kept at least 23 cm away from nearby persons to satisfy FCC RF exposure requirements.

WHEN INSTALLED INSIDE OF ANOTHER DEVICE: The Tiamis-800 is a modular transmitter. Therefore, in accordance with the FCC rules, when installed inside of another device, the outside of this device must display a label referring to the enclosed module. This exterior label can use wording such as “Contains FCC ID: TKY-TMS800”. Any similar wording that expresses the same meaning may be used.

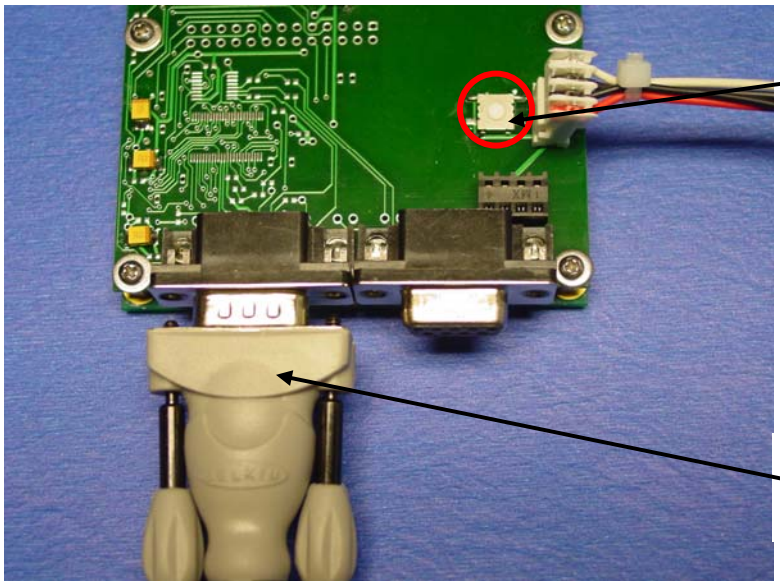
NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in the commercial installations. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Electronic FCC ID

The Tiamis-800 transceiver is a Software Defined Radio transceiver (SDR). Its FCC ID label can be accessed by using a standard terminal program such as Hyper Terminal or similar.

To access transceiver's FCC ID, follow the steps below.

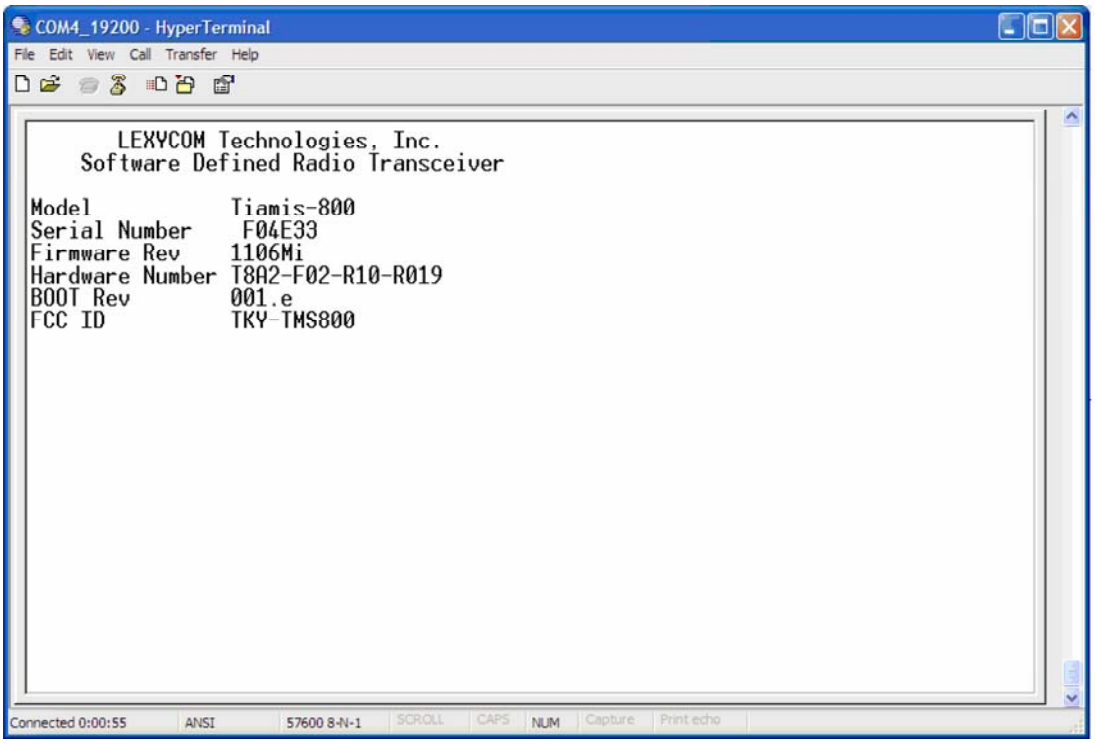
1. Connect one end of the data cable supplied to you by Lexycom to the RS232 diagnostics connector and the other end of the same cable to the programming computer's COM port.



2. Apply power to the transceiver by turning the power source On.

3. On the computer, start the Hyper Terminal or similar terminal program.

4. Push the Reset button on the interface board. The Hyper Terminal's screen will show FCC ID number (shown below).


COM4_19200 - HyperTerminal
File Edit View Call Transfer Help
LEXYCOM Technologies, Inc.
Software Defined Radio Transceiver
Model Tiamis-800
Serial Number F04E33
Firmware Rev 1106Mi
Hardware Number T8A2-F02-R10-R019
BOOT Rev 001.e
FCC ID TKY-TMS800
Connected 0:00:55
ANSI
57600 8-N-1
SCROLL
CAPS
NUM
Capture
Print echo

1. Introduction

The Tiamis-800 is a software-defined radio transceiver. When loaded with firmware 1106.i and prior, it supports frequency hopping spread spectrum operation in the 902-928 MHz license free frequency band.

The Tiamis-800 provides the end user with a flexible, reliable, secure data communication solution. With its fast frequency hopping capability the Tiamis-800 easily avoids interference even in the most complex environments.

The Tiamis-800 transceiver is aimed to be used in applications such as remote data gathering and control, GPS based networks, SCADA systems, remote monitoring, and as a wireless bridge.

2. Quick Start

When purchased, the Lexycom wireless data transceivers are shipped from the factory pre-configured to operate in the Slave mode of operation with the acknowledgement turned off. The settings, however, can be changed by the user at any time by using "Configuration Program" supplied with the transceivers.

Using the same program, if needed, the settings on the transceivers can be changed back to the factory default.

The transceiver's data port is preset for RS232 baud rate of 115.2 kb/s. Its diagnostics port is set to operate at 57.6 kb/s (fixed settings, cannot be changed by the user).

When used for RS232 data transfers, the transceiver functions as a null modem cable. Therefore, if the Tiamis-800 is to be used to replace a straight-through RS232 connection, then a null modem cable must be placed between the transceiver and the DCE instrument to which it is connected.

To establish communications between a pair of Lexycom Wireless Data Transceivers just received from the factory:

1. Set the RS232 baud rate on each transceiver to match the baud rate of the instrument to which it is connected. Please note that the baud rate settings do not have to be the same on each transceiver in the network.

2. Connect one side of the RS232 cable supplied from the factory to the data port of the transceiver. Connect the other end of this cable to your instrument.
3. Connect an antenna to the transceiver's RF connector.

4. Configure the transceiver to operate in the Master mode if necessary.

5. Make sure your power source is capable of supplying a DC voltage in the range between 4.5 and 25 VDC. Also, confirm that your power source is capable of delivering at least 6.5 Watts of power to the transceiver.

6. Connect the power cord from your power source to the transceiver.

7. Turn On your power source.

8. Repeat all of the steps above with the rest of the transceivers, which will be a part of the same network.

9. Shortly after all modems are plugged in they should establish a communications link with each other and your connection is complete!

3. Operating Modes

The version of the firmware 1106.i and prior supports the following network topologies:

- Point-to-Point,
- Point-to-Multipoint,
- TDMA.

3.1. Description of the messages in the network

Generally, there are two types of RF channel messages/packets supported by the transceiver:

- Global_Packet. Means that the packet is sent to all listening transceivers in the network. If a transceiver hears a Global_Packet and if the packet reception was error-free, then the data portion of such packet (if exists) will be sampled out by the transceiver to its data port.

- Local_Packet. Means that the packet is sent to a specific transceiver in the network. In the case of a good packet reception, only the addressed transceiver will deliver the data portion of such packet (if exists) to its data port.

3.2. Point-to-Point network overview

In general, a Point-to-Point network includes a Point-to-Point Master (P2P Master), a Slave, and optional Repeater(s). The network allows two way communications between the P2P Master and the Slave.

The typical Point-to-Point network assumes that all of the messages sent between P2P Master and the Slave required acknowledgement by the receiving site. However, the user can turn the acknowledgement On or Off for one of the radios or for both. It gives added flexibility to the user to adjust the network performance to the application requirements.

All of the packets sent within Point-to-Point network are always Local_Packets addressed either to the P2P Master or to the Slave.

3.2.1. Functionality of the Point-to-Point Master (P2P Master)

A P2P Master radio can send a new packet of data over the RF channel only if the link to the Slave is On.

Each RF packet, which the P2P Master sends out, is addressed to a specific Slave and sent as a Local_Packet.

There are several Master settings, which must be considered when setting up the Slave radio to operate in the same network. Below are **the Master's settings, which need to be matched by the recipient Slave radio in the network:**

- The Slave must have its *Recipient_UnitID* matching the Master's *my_UnitID*.
- The Slave must have its *NetworkID* and their *AddressMask* matching the corresponding Master's settings.
- Selected Master's hopping pattern, *HopTableLength*, and the options selected for each of the hopping channels must be repeated on the Slave unit.

The settings ignored by the Master radio:.

- *BytesThreshold.*
- *FrameToWait*.

3.2.2. Functionality of the Slave in a Point-to-Point network

A Slave radio can send a new packet of data over the RF channel only if the following conditions are met:

- The link is On.
- The number of bytes in the Slave's input buffer is greater than or equal to the *BytesThreshold* settings OR if the Slave did not send RF packets for longer than *FramesToWait* number of frames and its input buffer has at least one byte of the user's data in it.
- The last packet it received from the Master was Global_Packet or Local_Packet addressed to this Slave.

The Slave transceiver will send each RF packet once and will repeat it *PacketRepeat* times. Therefore, when used in Point-to-Point network configuration, the *PacketRepeat* settings must be set to '0'.

The Slave will loose a link to the Master if it does not hear the Master's transmissions for *TimeoutRetries* consecutive frames. Once the link is lost, the Slave will start searching for the Master.

The Slave can link to the P2P Master only if it hears the Master's transmission and only if the Master is transmitting Local_Packet(s) addressed to this Slave.

The Slave's settings, which need to match the Master's settings in the order for the Slave to be able to operate in the network:

- Each Slave in the network must have its *Recipient_UnitID* matching the Master's *my_UnitID*.

- Each Slave in the network must have their *NetworkID* and their *AddressMask* matching the corresponding Master's settings.
- Each Slave in the network must repeat the Master's hopping pattern, *HopTableLength*, and the options selected for each of the hopping channels.

The settings ignored by the Slave radio:

- *MasterSlotBytes* and *SlaveSlotBytes* (these settings are used by the Slave only during the initial network acquiring process). Once the Slave 'finds' its Master, it will use Master's settings instead.

3.3. Point-to-Multipoint network overview

In general, a Point-to-Multipoint network includes a Point-to-Multipoint Master (P2M Master), a Slave, and optional Repeater(s). The network allows two way communications between the P2M Master and the Slaves.

The typical Point-to-Multipoint network assumes that all of the messages sent from the P2M Master to the Slaves do not required acknowledgement by the Slaves. On the other hand, the transmissions sent by the Slaves to the P2M Master need to be acknowledged by the Master. However, if needed, the user can turn the acknowledgement on the Slaves Off. It gives added flexibility to the user to adjust the network performance to the application requirements.

All of the packets sent by the P2M Master within Point-to-Multipoint network are always Global_Packets. The packets sent by the Slaves are always Local_Packets addressed to the P2M Master. Therefore, the direct communication between the Slaves in the Point-to-Multipoint network is not supported.

3.3.1. Functionality of the Point-to-Multipoint Master (P2M Master)

A P2M Master radio can send a new packet of data over the RF channel as soon as at least one byte of the user's data was received from the user's data device.

Each RF packet, which the P2M Master sends out, is broadcasted to all listening Slaves as a Global_Packet.

Each RF packet with or without user's data in it is sent by the P2M Master once and repeated *PacketRepeat* times. If the listening Slave receives such packet from the Master followed by a copy of the same packet, the Slave will discard the additional copies automatically without delivering a copy of the user's data to the data port.

There are several Master settings, which must be repeated or considered when setting up the Slave radios to operate in the same network. Below are **the Master's settings, which need to be matched by the recipient Slave radio(s) in the network:**

- Each Slave in the network must have its *Recipient_UnitID* matching the Master's *my_UnitID*.
- Each Slave in the network must have their *NetworkID* and their *AddressMask* matching the corresponding Master's settings.
- Selected Master's hopping pattern, *HopTableLength*, and the options selected for each of the hopping channels must be repeated on all of the Slave units in the network.

The settings ignored by the Master radio:

- *ACKRequired.*
- *Receipient_UnitID.*
- *BytesThreshold.*
- *FrameToWait*.

3.3.2. Functionality of the Slave in a Point-to-Multipoint network

A Slave radio in Point-to-Multipoint network can send a new packet of data over the RF channel only if ALL of the following conditions are met:

- The link is On.
- The number of bytes in the Slave's input buffer is greater than or equal to the *BytesThreshold* settings OR if the Slave did not send RF packets for longer than *FramesToWait* number of frames and its input buffer has at least one byte of the user's data in it.
- The last packet it received from the Master was Global_Packet or Local_Packet addressed to this Slave.

As soon as the Slave has sent at least one RF packet to the Master, it will not stop until there is no data in its input buffer or until the link to the Master is lost. In other words, the Slave will hold the Master's attention until its input buffer is empty.

For the firmware version 1106.e and prior the *ACKRequired* settings on the Slave should always be "Off". Therefore, with each RF packet sent, the Slave will not expect any acknowledgements back from the Master.

The Slave transceiver will send each RF packet once and will repeat it *PacketRepeat* times. Therefore, when used in Point-to-Multipoint network configuration, the *PacketRepeat* settings on the Slave need to be set to something other than '0'. From our experience, the *PacketRepeat* value of '2' or '3' is usually sufficient.

The Slave will loose the link to the Master if it does not hear the Master's transmissions for *TimeoutRetries* consecutive frames. Once the link is lost, the Slave will start searching for the Master.

The Slave can link to the Master only if it hears the Master's transmission and only if the Master is transmitting Global_Packet(s) or Local_Packet(s) addressed to this Slave.

The Slave's settings, which need to match the Master's settings in order for the Slave to be able to operate in the network:

- Each Slave in the network must have its *Recipient_UnitID* matching the Master's *my_UnitID*.
- Each Slave in the network must have their *NetworkID* and their *AddressMask* matching the corresponding Master's settings.
- Each Slave in the network must repeat the Master's hopping pattern, *HopTableLength*, and the options selected for each of the hopping channels.

The settings ignored by the Slave radio:

- *MasterSlotBytes* and *SlaveSlotBytes* (these settings are only used by the Slave during the initial network acquiring process). Once the Slave 'finds' its Master, it will use Master's settings instead.

3.4. TDMA network overview

In general, a TDMA network includes a Master, one or more Slaves, and optional Repeater(s). The network allows two way communications between the Master and the Slaves. It also allows the direct communication between the Slaves, which can hear each other.

Functionally, the TDMA network is very similar to the Point-to-Multipoint network except that each Slave in the TDMA network is assigned to transmit on a specific frame. Therefore, the chances of RF packet collisions in such network are minimized.

3.4.1. Choosing between TDMA and Point-to-Multipoint networks

In general, the TDMA topology has some advantages when compared to a Point-to-Multipoint topology. But, in some cases the TDMA may not be as efficient as Point-to-Multipoint network.

To allow the user more flexibility in finding the right network configuration for a given application, the Tiamis-800 transceivers supports:

1. Pure TDMA. In this case each radio on the field can be programmed to:
    - Just listen – has no frames to transmit on;

- Listen and transmit – has at least one frame to transmit on;
- Only transmit – has no frames when it receives messages from anybody in the network other than the Master.

2. Pure Point-to-Multipoint. In this case the FrameTable contains only two frames, one of which is the Master's and one other that is shared between all of the Slaves in the network.
3. Hybrid of the Point-to-Multipoint and the TDMA. In this case there is at least one frame in the network dedicated to the Master; there is at least one frame dedicated to one of the Slaves' transmissions; and there is at least one frame to be shared between two or more Slaves. The Slave with the dedicated transmit frame in this case might 'push' its data while the Slaves, who are sharing frames, might be 'polled' by the Master (just like in the Point-to-Multipoint network).

We recommend choosing a TDMA network topology instead of the Point-to-Multipoint if one of the following situations is true:

- If the number of Slaves in the network is relatively high (100 or more).
- If the Slaves are not 'polled' by the Master (Slaves 'push' their data) and each one of them generates near continuous data.
- If the Slave sites will most likely generate their data almost at the same time. For example a network in which the Slave sites are equipped with GPS receivers.

On the other hand, one may find the Point-to-Multipoint network more suitable for an application if each Slave site in the network is polled for its data by the Master.

3.4.2. Functionality of the TDMA Master

The Master in a TDMA network can send a new packet of data over the RF channel as soon as at least one byte of the user's data was received from the user's data device.

Each RF packet, which the TDMA Master sends out, is broadcasted to all listening Slaves as a Global_Packet.

Each RF packetwith or without user's data is sent by the TDMA Master once and repeated *PacketRepeat* times. Each copy of the original packet will be sent during the Master's next transmit frame. If a listening Slave receives such packet from the Master followed by a copy of the same packet, the Slave will discard the additional copies automatically without delivering a copy of the user's data to the data port.

There are several Master settings, which must be repeated or considered when setting up the Slave radios to operate in the same network. Below are **the Master's settings, which need to be matched by the recipient Slave radio(s) in the network:**

- Each Slave in the network must have its *Recipient_UnitID* matching the Master's *my_UnitID*.

- Each Slave in the network must have their *NetworkID* and their *AddressMask* matching the corresponding Master's settings.
- Selected Master's hopping pattern, *HopTableLength*, and the options selected for each of the hopping channels must be repeated on all of the Slave units in the network.

The settings ignored by the Master radio:

- *ACKRequired.*
- *Receipient_UnitID.*
- *BytesThreshold.*
- *FrameToWait*.

3.4.3. Functionality of the Slave in a TDMA network

A Slave radio can send a new packet of data over the RF channel only if the all of the following conditions are met:

- The link is On.
- The number of bytes in the Slave's input buffer is greater than or equal to the *BytesThreshold* settings OR if the Slave did not send RF packets for longer than *FramesToWait* number of frames and its input buffer has at least one byte of the user's data in it.
- The last packet it received from the Master was Global_Packet or Local_Packet addressed to this Slave.

The Slave will transmit only during its transmit frames.

For the firmware version 1106.e and prior the *ACKRequired* settings on the Slave should always be "Off". Therefore, with each RF packet sent, the Slave will not expect any acknowledgements back from the Master.

The Slave transceiver will send each RF packet once and will repeat it *PacketRepeat* times.

The Slave will loose a link to the Master if it does not hear the Master's transmissions for *TimeoutRetries* consecutive receive frames. Once the link is lost, the Slave will start searching for the Master.

The Slave can link to the Master only if it hears the Master's transmission and only if the Master is transmitting Global_Packet(s) or Local_Packet(s) addressed to this Slave.

The Slave's settings, which need to match the Master's settings in the order for the Slave to be able to operate in the network:

- Each Slave in the network must have its *Recipient_UnitID* matching the Master's *my_UnitID*.
- Each Slave in the network must have their *NetworkID* and their *AddressMask* matching the corresponding Master's settings.
- Each Slave in the network must repeat the Master's hopping pattern, *HopTableLength*, and the options selected for each of the hopping channels.

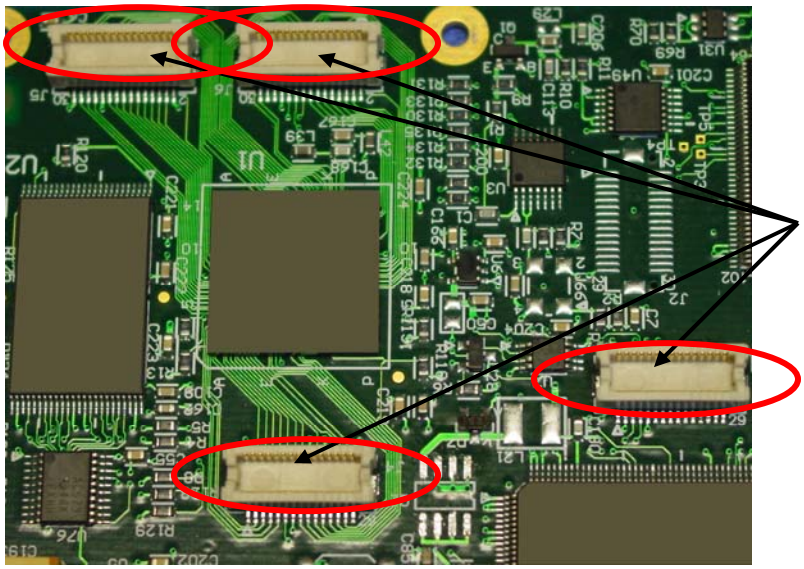
The settings ignored by the Slave radio:

- *MasterSlotBytes* and *SlaveSlotBytes* (these settings are used by the Slave only during the initial network acquiring process). Once the Slave 'finds' its Master, it will use Master's settings instead.

4. Data Interfaces supported

The transceiver's firmware version 1106.i and prior support single RS232 data and single RS232 diagnostic interfaces (options Opt.11xx).

The board level transceiver supports RS232 data interface and provides CMOS logic levels of RS232 signals on its data connectors.



Data Connectors

Contact factory for pin assignment if needed.

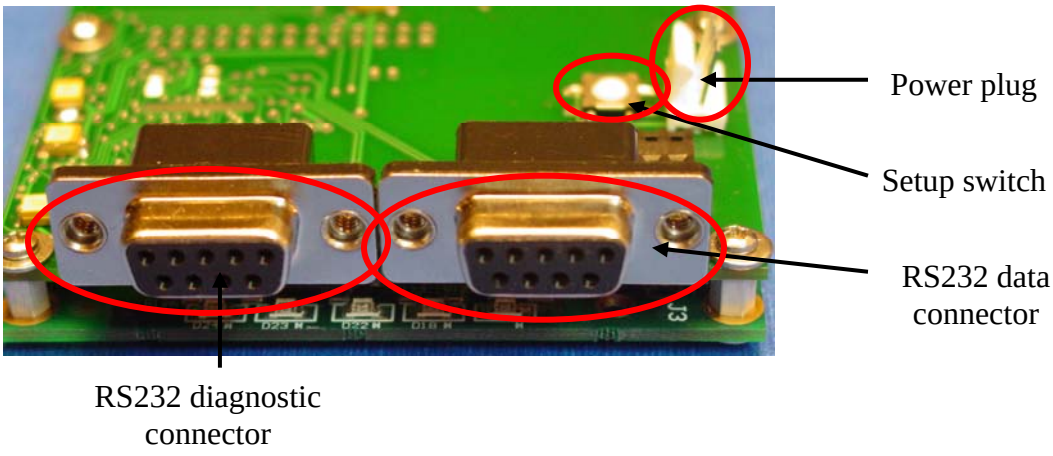
The following RS232 data port configurations are supported:

Parameter	Possible settings
RS232 baud rate [bits/sec]	4800 9600 19200 38400 57600 115200
Parity	None Even Odd
Stop bits	1 1.5 2
Data bits	5 6 7 8

The transceiver's data RS232 port can be forced into different test modes such as local_loop, remote_loop, etc. Not-standard baud rates are also possible. Please, contact the factory for more details.

If true RS232 levels are required for an application, option "Opt.1100" needs to be purchased from Lexycom and installed appropriately (see "Installation instructions for Opt.1100").

The picture below shows the location of the data and diagnostic connectors of a transceiver when it is equipped with the "Opt.1100".



The pin assignment of the RS232 diagnostic and data connectors for the option "Opt.1100" is given in the Table 4-1 below.

Table 4-1. Option "Opt.1100" RS232 data port connector pin assignment

Pin number	Name	Input (I) or output (O)	Notes
1	"CD"- Carrier Detect	O	
2	"Tx" – Transmit	O	
3	"Rx" – Receive	I	
4	"DTR" – Data Terminal Ready	I	
5	Ground		
6	"DSR" – Data Send Ready	I	
7	"RTS" – Request To Send	I	
8	"CTS" - Clear To Send	O	See Note 1 below for timing details
9	Ground		

Note 1. CTS timing. The transceiver asserts its CTS line right after power up. When the transceiver is in the setup mode, its CTS line remains de-asserted. The status of the CTS line while the transceiver is in the normal operating mode depends upon a number of factors and explained in section 4.2 of this document.

4.1. Functionality of the transceiver's RS232 input and output buffers

The transceiver has independent, 512 bytes long RS232 input and output buffers. Both buffers are implemented to be a circular. This means that in the case of an overflow, the newest data placed in the buffer will start replacing the oldest characters in it.

> *For example, if the transceiver received 50 new characters from the user's data device and if the transceiver's input buffer only has room for 20 bytes (the input buffer was already holding 492 bytes), then the total number of bytes received so far would be 492 + 50 = 542 bytes. Then, the oldest 30 bytes in the buffer will be overwritten by the new data.*

4.2. CTS line timing

When the transceiver is not in the setup mode, its CTS line status depends on transceiver's *CTSFlooring* and *CTSCeiling* settings. These two parameters determine CTS line's 'histerisys'.

The status of the CTS line changes in two cases:

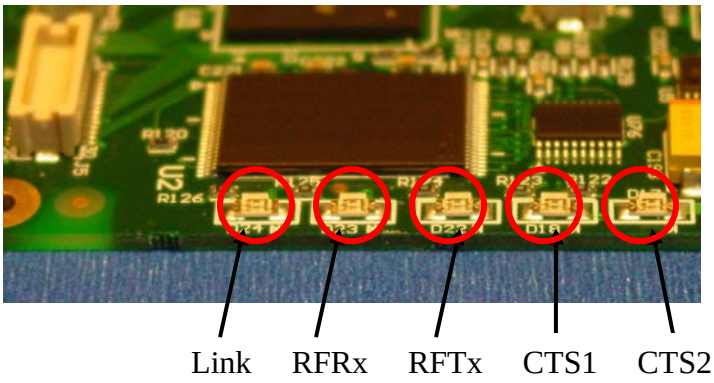
> *Case 1.* When the transceiver receives a new character from user's device.
>
> As soon as a RS232 character is received, the transceiver reads the newly received character into its RS232 input buffer, updates the buffer's byte count and checks the amount of bytes left in it. If the number of bytes left in the transceiver's input buffer is more than {Buffer_Size – *CTSCeiling*} bytes, then the transceiver will de-assert the CTS line indicating to the user's data device to stop sending data.
>
> When a new character is received, the transceiver also checks to see if the number of bytes in its input buffer is less than {Buffer_Size – *CTSFlooring*} bytes. If it is, then the transceiver will assert its CTS line indicating to the user's data device that there is a room left for new data.

Case 2. When the transceiver has a chance to send a new RF packet.

In this case the transceiver checks to see if the number of bytes in its input buffer is less than {Buffer_Size – *CTSFlooring*}. If it is, then the CTS line gets asserted. Otherwise, the CTS line status will remain unchanged.

5. Transceiver's LEDs

The Tiamis-800 transceiver is equipped with total of 5 red color LEDs. The LEDs' position and their 'names' are shown on the picture below.



The functionality of the LEDs for normal modes of transceiver's operation is described in the Table 5-1.

Table 5-1. Description of the LEDs functionality during normal modes of the transceiver's operation

LED 'name'	Functionality
Link	Flashing = the radio is searching for a signal from the Master. The flashing rate depends upon the *HopTableLength* and can vary from about once per second (for the *HopTableLength* settings around 50) to once per two seconds (for the *HopTableLength* settings close to 128). Solid On = the radio has acquired a RF link. Stays solid On until the link to the Master is lost. Always stays solid On when the transceiver is powered and the operating mode is P2M Master.

Table 5-1. Description of the LEDs functionality during normal modes of the transceiver's operation (Continued)

LED 'name'	Functionality
RF Rx	Turns On when the radio is starting an Rx frame. Turns Off when the radio quits an Rx frame. If the radio is programmed to be a Slave and if the RF link is solid, this LED should stay On almost 100% of the time.
RF Tx	Turns On when the radio is starting a Tx frame. Turns Off when the radio quits a Tx frame. Therefore, if radio has been programmed to have at least one Tx frame in its FrameTable, this LED will always turn On at least for a very short period of time even if the radio has nothing to send over the RF channel. The LED stays On for as long as the transceiver stays in the Tx mode.
CTS1	RS232 data port #1 flow control LED. If Off = the buffer is full or near full. The user's data device should stop sending the data.
CTS2	RS232 data port #2 flow control LED. If Off = the buffer is full or near full. The user's data device should stop sending the data.

Additionally, the LEDs indicate different stages of the transceiver's operation while the transceiver is in one of its special operation modes. These cases are explained in the table below.

Table 5-2. Description of LEDs functionality during special modes of transceiver's operation

Which LEDs are On					What does it mean
Link	RF Rx	RF Tx	CTS1	CTS2	
○	●	●	●	●	***Setup Mode*** The transceiver is in the setup mode. Use the "Configuration Program" to view/modify/store transceiver's settings. The transceiver will enter this mode if the Setup switch was pressed OR if the transceiver detected a falling edge on its Setup pin. The transceiver will stay in this mode until the power to it is cycled.
○	●	●	●	○	***Sector0 Erase Mode*** The transceiver is erasing its memory Sector0 so another pre-stored f/w can be copied into it (see the "Firmware Upgrade" software documentation for more details). The transceiver will enter this mode only if the user specified that the f/w in transceiver's main f/w bank is to be updated at the next power up. The time the transceiver will stay in this mode may vary and usually it takes no longer than 5-6 seconds. **WARNING.** It is highly recommended not to disturb power to the transceiver while it is in this mode. If the transceiver stays in this mode for longer than 20 seconds, contact Lexycom Technologies' technical support department.

Table 5-2. Description of LEDs functionality during special modes of transceiver's operation (Continued)

Which LEDs are On					What does it mean
Link	RF Rx	RF Tx	CTS1	CTS2	
○	●	●	○	○	***Program Sector0 Mode*** The transceiver is copying the firmware from one of it's memory Sectors into Sector0 (see the "Firmware Upgrade" software documentation for more details). The transceiver will enter this mode if the user specified that the f/w in the transceiver's main f/w bank is to be updated at the next power up and only if the transceiver already went through the "Sector Erase" phase. The time the transceiver will stay in this mode may vary and usually it takes no longer than 30 seconds. **WARNING.** It is highly recommended not to disturb power to the transceiver while it is in this mode. If the transceiver stays in this mode for longer than 2 minutes, contact Lexycom Technologies' technical support department.

6. Frame Table

The FrameTable of the Tiamis-800 includes total of 96 frames. Each of these frames is executed by the transceiver in sequential order starting from 'Frame0'.

The number of frames that the transceiver will execute from its FrameTable is determined by the *NumberOfFrames* settings. This parameter is user-programmable. Its valid range is from 2 to 96. If the *NumberOfFrames* is set to a value lower than 96, then the remainder of the frames in the transceiver's FrameTable will be ignored.

Additionally, the transceiver starts its FrameTable by running a SystemSlot. The duration of the SystemSlot is never less than ~700 usec and determined by the *SystemSlotBytes* settings. During the SystemSlot the transceiver checks its command buffer for valid commands, executes the first valid command in the queue, and runs some housekeeping routines. The duration of the SystemSlot is made adjustable via *SystemSlotBytes* settings so the FrameTable duration can be adjusted to aparticular application needs.

The content of each frame determines the transceiver's functionality during this frame. As shown on Figure 6-1, each frame in the FrameTable has four sections: *WhatToDo*, *ACKRequired*, *OperatingMode*, and *FrameTiming*.

Frame0	Frame1	Frame2	Frame3	Frame4	Frame5	Frame6	Frame7
Frame8	Frame9	Frame10	Frame11	Frame12	Frame13	Frame14	Frame15
Frame16	Frame17	Frame18	Frame19	Frame20	Frame21	Frame22	Frame23
Frame24	Frame25	Frame26	Frame27	Frame28	Frame29	Frame30	Frame31
Frame32	Frame33	Frame34	Frame35	Frame36	Frame37	Frame38	Frame39
Frame40	Frame41	Frame42	Frame43	Frame44	Frame45	Frame46	Frame47
…							
Frame88	Frame89	Frame90	Frame91	Frame92	Frame93	Frame94	Frame95

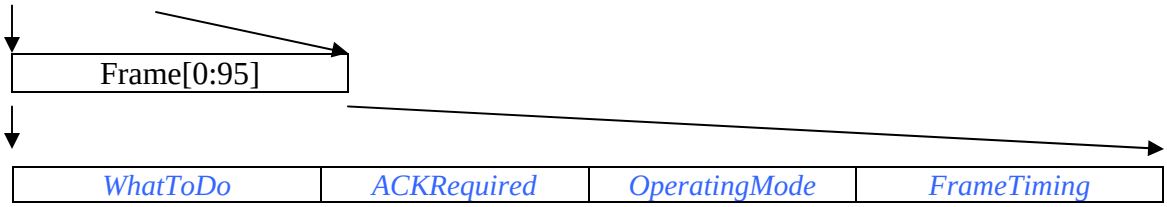


Figure 6-1. FrameTable structure

The meaning and possible settings of each of these sections is provided in the Table 6-1.

Table 6-1. Description of the sections within each frame

Section Name	*Possible values*	Meaning
WhatToDo	*Rx*	The transceiver will be in the receive mode during this frame.
	Tx	The transceiver will be in the transmit mode during this frame.
	Idle	The transceiver will be in the idle mode during this frame.
	Reserved	
ACKRequired	*Yes*	Means each RF packet sent during this frame will have a request for an acknowledgement in it. It will force the receiving site to send an acknowledgement back to the transmitting radio in the case of good packet reception. It also means that the transmitting radio will expect to receive an acknowledgement back and it will be re-sending the same packet for as many as *TimeoutRetries* times if the acknowledgement was not received. If the acknowledgement is not received after that, the transmitting site will consider the RF link lost and it will discard the last packet of data sent from its input buffer. If the transceiver is in the Slave mode, the Slave will then try to reacquire the network connection again.
	No	Means each RF packet sent during this frame will have no request for an acknowledgement in it. The receiving site in this case does not need to send any acknowledgement back to the transmitting radio.

Table 6-1. Description of the sections within each frame (Continued)

Section Name	*Possible values*	Meaning
OperatingMode	*P2PM*	The radio will be operating as a P2P Master during this frame.
	P2MM	The radio will be operating as a P2M Master during this frame.
	Slave	The radio will be operating as a Slave during this frame.
FrameTiming	*MasterSlotBytes*	Means that the duration of the frame determined by the *MasterSlotBytes* settings on the radio. If the radio is configured as a Slave, as soon as it will receive a RF packet from the Master to which it can synch, the Slave will follow the Master's *MasterSlotBytes* settings instead of using its local value.
	SlaveSlotBytes	Means that the duration of the frame is determined by the *SlaveSlotBytes* settings on the radio. If the radio is configured as a Slave, as soon as it will receive a RF packet from the Master to which it can synch, the Slave will follow the Master's *SlaveSlotBytes* settings instead of using its local value.

7. Diagnostics

The transceiver reports several diagnostics parameters to help with proper installation and maintenance of the network.

The parameters reported by the transceiver are:

- Transceiver's *Temperature*;
- The *SignalLevel*;
- The *NoiseLevel*;
- The *HeaderRate*;
- The *ReceiveRate*;
- The *NumberOfDisconnects*;
- The *BytesReceived* count;
- The *BytesSent* count.

The *Temperature* indicates the transceiver's board temperature.

While changing the frequency channels during the frequency hopping, the transceiver measures levels of the signal and the noise on each of these RF channels. The *SignalLevel* and *NoiseLevel* values reported by the transceiver are averaged over the *HopTableLength* number of measurements. Thus, *SignalLevel* and *NoiseLevel* indicate the average levels of signal and noise for the hopping pattern used by the transceiver.

To make sure that a RF link performs as expected, the user needs to take steps to increase the *SignalLevel* and to decrease the *NoiseLevel*. The ratio of the *SignalLevel* to the *NoiseLevel* (signal to noise ratio or *SNR*) is an indicator of how good the RF link is. We suggest maintaining the *SNR* of at least 15 dB or more.

The *HeaderRate* indicates how good the transceiver can hear its neighbors on average. In an ideal case this number would read a 100%. The *HeaderRate* calculated as a percentage of good RF packet headers received by the transceiver during the last 255 consecutive receive frames. The transceiver increments this number every time it receives a RF packet from a radio in its network if the header of this packet was error-free. Please note that even Local_Packet(s) addressed to somebody else in the network count.

The *ReceiveRate* shows how good the transceiver can hear transmissions addressed to it or broadcasted. In an ideal case this number would read a 100%. The *ReceiveRate* is calculated as a percentage of good RF packets received by the transceiver during the last 255 consecutive receive frames. The transceiver increments this number every time it hears a RF packet addressed to it if the header and the data portion of this packet are error-free.

The *NumberOfDisconnects* shows how many times the transceiver lost the synch to its Master. This number is meaningless for Masters. The Slave transceivers increment this number every time they decide that the link is lost. While in the search mode, the Slave does not update its *NumberOfDisconnects*. The maximum value of the *NumberOfDisconnects* is 255. When the maximum value is reached, the transceiver will reset the *NumberOfDisconnects* and continue counting from '0' again. When first time powered up, the Slave radio will show *NumberOfDisconnects* of '1'.

The *BytesReceived* shows the number of bytes received by the transceiver from the RF channel. The *BytesReceived* value is incremented by the transceiver every time it can accept new data received from another radio in the network.

The *BytesSent* shows the number of bytes sent by the transceiver into the RF channel. It includes broadcasted bytes or bytes sent to a specific addressee. If the transceiver is programmed to send each of its RF packets more than once, the copies of the previously sent bytes are not counted.

8. Technical Support

Technical support for Lexycom products is available from 8:00 a.m. to 5:00 p.m. mountain standard time, Monday through Friday, excluding holidays.

Please contact technical support at:
(303) 774-7822 phone
(303) 774-7828 fax

9. Return Authorization and Shipping Information

To obtain product service, please contact Lexycom Technologies for a Return Material Authorization (RMA) number before returning any equipment. All products should be returned to the following address:

Lexycom Technologies Inc.
ATTN: RMA#
1227 Reserve Drive
Longmont CO 80501

For warranty and non-warranty shipments, domestic and International shipments, all shipping costs, including freight charges, insurance, customs clearance, and broker's fees, incurred in returning equipment to Lexycom Technologies Inc must be ***prepaid.***

All product service requests should include the appropriate customer contact information and return shipping information.

10. Warranty

The Lexycom Technologies Wireless Data Transceiver is warranted against defects in materials and manufacturing for a period of 2 years from the date of purchase. In the event of a product failure due to materials or workmanship, Lexycom Technologies will, at its discretion, repair or replace the product. Lexycom Technologies, its suppliers, and its licensors shall in no event be liable for any damages arising from the use of or inability to use this product. This includes business interruption, loss of business information, or other loss which may arise from the use of this product.

Appendix A. Settings used by the transceiver.

All settings used by the transceiver are listed below in the Table A-1.

Table A-1. Settings used by the transceiver

RS232 data port control			
	Parameter	Meaning	Notes
	BaudRate	RS232 baud rate.	
	DataBits	RS232 data bits.	
	Parity	RS232 data parity.	
	StopBits	Number of stop bits for RS232 data protocol.	
	FlowControl	Used to set a desired type of flow control.	Not activated.
	CTSFlooring	Upper limit of the number of bytes left in the RS232 input buffer before CTS line gets de-asserted.	
	CTSCeiling	Lower limit of the number of bytes in the RS232 input buffer before CTS line gets re-asserted again after being de-asserted.	
HoppingTable options			
	Parameter	Meaning	Notes
	FrequencyChannel #	Frequency channel number to be used by the transceiver.	
	Primary HoppingPattern	Selection of the primary hopping pattern to be used by the transceiver.	
	SecondaryHoppingPattern	Selection of the secondary hopping patterns to be used by the transceiver.	
	HopTableLength	The length of the HopTable to be used by the transceiver.	

Table A-1. Settings used by the transceiver (Continued)

FrameTable options			
	Parameter	Meaning	Notes
	WhatToDo	Determines what the transceiver is supposed to do while the transceiver is executing the given frame.	
	ACKRequired	Determines if the acknowledgement request will be sent with each outgoing RF packet while the transceiver is executing the given frame.	
	OperatingMode	Determines the operating mode that the transceiver will be in while executing the given frame.	
	FrameTiming	Determines the duration (in bytes) of the given frame.	
	NumberOfFrames	Number of frames used by the transceiver. The minimum is 2, the maximum is 96.	
Network security control			
	Parameter	Meaning	Notes
	My_UnitID	Transceiver's UnitID.	
	NetworkID	The ID of the network in which the transceiver is operating.	
	AddressMask	The address mask to be used by the transceiver for operation in the network.	
	Recipient_UnitID	The ID of the recipient the transceiver is communicating to.	

Table A-1. Settings used by the transceiver (Continued)

Timing defining parameters			
	Parameter	Meaning	Notes
	MasterSlotBytes	Determines how many bytes will be allocated for an RF packet for transceiver(s) operating in the Master mode.	
	SlaveSlotBytes	Determines how many bytes will be allocated for an RF packet for transceiver(s) operating in the Slave mode.	
	RoundTrip_usec	Used to adjust the round trip timing on the transceiver.	Not activated.
	SystemSloltBytes	The SystemSlot is always added at the beginning of the Frame0 in the Frame Table. The duration of this slot is determined by this parameter.	
Transmission control			
	Parameter	Meaning	Notes
	FramesToWait	Determines how many frames the Slave transceiver will wait before it is allowed to transmit an RF packet.	
	TimeoutRetries	If the transceiver does not receive RF packets from the radio it is communicating to for longer than *TimeoutRetries* consecutive frames, then the transceiver will timeout and it will drop the link.	
	PacketRepeat	It determines a number of additional copies of each RF packet the transceiver will send out.	
	BytesThreshold	It determines the minimum number of bytes the Slave transceiver needs to have in its input data buffer before it is allowed to transmit an RF packet.	

Table A-1. Settings used by the transceiver (Continued)

Encryption control			
	Parameter	Meaning	Notes
	Protocol	Used to select a type of encryption protocol to be used for data transfers in the RF channel.	
	SecurityKey	The security key to be used by transceiver's built-in encryption engine.	