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Datasheet

LT1110 Wireless Module

Version 3.1

REVISION HISTORY

Version	Date	Notes	Approver
3.0	13 Jan 2014	Separated into two separate docs: Hardware Integration Guide and User Guide. Marked as Rev 3.0 to match User Guide.	Sue White
3.1	6 April 2017	Updated to remove PRM210/211/220/221 and PRM241	Jennifer Gibbs

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1 Overview

The LT1110 Frequency Hopping Spread Spectrum Transceiver Module from Laird Technologies is the latest in robust and easy to use radio modules. Supporting both high data rates and long ranges, the LT1110 is a great fit for any number of machine to-machine applications. The LT1110 features an easy to use serial UART with hardware flow control for fast integration into an existing serial infrastructure.

This document contains information about the hardware and software interface between a Laird Technologies LT1110 transceiver and an OEM Host. It is designed to explain how to integrate the LT1110 module into a host device.

For reference, this document also includes a list of Related Documents.

Note: Unless mentioned specifically by name, the LT1110 modules are referred to as *radio* or *transceiver*. Individual naming is used to differentiate product specific features. The host (PC/Microcontroller/Any device to which the LT1110 module is connected) are referred to as *OEM host* or *host*.

2 Key Features

- High power (200 mW) and low power (10mW) versions available
- Retries and acknowledgements
- Configurable network parameters
- Multiple generic I/O
- 280 kbps or 500kbps RF data stream
- Idle current draw of 8mA, sleep current of 0.3uA
- Software selectable interface baud rates from 1200 bps to 460.8 kbps
- Upgradable FW through serial port
- Low cost, low power and small size ideal for high volume, portable and battery powered applications
- All modules are qualified for Industrial temperatures (-40°C to 85°C)
- Advanced configuration available using AT commands
- Easy to use Configuration & Test Utility software

3 Specifications

Table 1: General specifications

Parameter	LT1110
Interface	UART
Frequency	902-928 MHz
RF Data Rate	230 kbps
Serial Interface Options	Logic Level (matches supply voltage)
Serial Interface Data Rate	Up to 460,800 baud
Variable Conducted Output Power	+13 to +23 dBm (200 mW)
Maximum Radiated Power (EIRP)	+29 dBm (800 mW) with a 6 dBi antenna

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Table 2: Current consumption specifications

Parameter	LT1110
Peak Tx	230 mA
Peak Rx	30 mA
Average Idle	8 mA
Sleep	0.3 µA
Channels	52 channels
Sensitivity (BER 10-6)	230 kbps RF rate: -89 dBm
Voltage	2.0 - 3.6 VDC
Approximate Range (Indoor/Outdoor)	800 feet/3.2 miles (with 2 dBi dipole)
Temperature	-40° to +85° C
Dimensions	25 mm x 30 mm x 4 mm (Pluggable U.FL)
Antenna	25 mm x 39 mm x 4 mm (Pluggable Ant)
Approvals	U.FL connector (PRM240)

Table 3: Pin definitions for the LT1110 transceiver

SMT Pin	Pluggable Pin	Type	Signal Name	Functions
1	7	O	GIO_0	Generic Output/Hop_Frame
2	6	O	GIO_1	Generic Output
3	8		DNC	Do not connect.
4	17	O	GIO_2	RS-485 Driver Enable
5	19	O	GIO_3	PWM Output
6	3	I	RXD	Asynchronous serial data input to transceiver
7	2	O	TXD	Asynchronous serial data output from transceiver
8	10	GND	GND	Signal Ground
9	1	PWR	Vcc	3.3 - 3.6 V ±50mV ripple (must be connected)
10	-	PWR	Vpa	No internal connection. Reserved for Vpa on higher power LT1110 modules.
11	-	GND	GND	Signal Ground
12	9	I	$\overline{\text{Force 9600}}$	Force 9600 – When pulled logic low and then applying power or resetting, the transceiver's serial interface is forced to a 9600, 8-N-1 rate. **Note:** Because this mode disables some modes of operation, it should not be permanently pulled low during normal operation.
13	14	I	GIO_4	Generic Input
14	5	I	$\overline{\text{µP_Reset}}$	RESET – Controlled by the LT1110 for power-on reset if left unconnected. After a stable power-on reset, a logic low pulse resets the transceiver.

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SMT Pin	Pluggable Pin	Type	Signal Name	Functions
15	11	I	$\overline{\text{CMD/Data}}$	When logic low, the transceiver interprets incoming OEM Host data as command data. When logic high, the transceiver interprets OEM Host data as transmit data.
16	15	O	$\overline{\text{In Range}}$	When logic low, the client is in range and synchronized with a server. This is always low on a server.
17	16	I	$\overline{\text{RTS}}$	Request to Send. Floats high if left unconnected. When enabled in EEPROM, the module does not transmit data out the serial UART unless the pin is low
18	12	O	$\overline{\text{CTS}}$	Clear to Send - CTS is used for hardware flow control. CTS toggles high when the input buffer reaches the CTS On threshold until the buffer recedes below CTS Off.
19	18		GIO_8	Generic Input
20	13		GIO_5	Reserved for future use. Do not connect.
21	4		GIO_6	Reserved for future use. Do not connect.
22	20	I	GIO_7	Analog to Digital Input

Engineer's Tips:

- All I/O is 3.3V TTL.
- All inputs are weakly pulled high via a 20k Ohm pull-up resistor and may be left floating during normal operation.
- Minimum connections: VCC, BPA, GND, TXD, and RXD.
- Signal direction is with respect to the transceiver.
- Unused pins should be left disconnected.

Table 4: Input characteristics

Signal name	Min. High	Max. High	Min. Low	Max. Low
µP_Reset	.8 V	Vcc	0 V	.6 V
RTS	2.31 V	Vcc	0 V	.99 V
GIO_7 (AD_In)	n/a	Vcc	0 V	n/a
All other inputs	70% Vcc	Vcc	0 V	30% Vcc

Table 5: Output characteristics

Signal name	Min. High	Max. High	Min. Low	Max. Low	Sink Current
GIO_0	2.5 V	3.3 V	0 V	.4 V	20 mA
GIO_1	2.5 V	3.3 V	0 V	.4 V	20 mA
GIO_3 (PWM Output)	N/A	3.3 V	0 V	N/A	4 mA
All other inputs	2.5 V	3.3 V	0 V	.4 V	4 mA

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Table 6: Timing Specifications

Parameter	Server/Client	Min.	Typ.	Max.	Notes
Power on to CTS Low		5 ms	10 ms	N/A	The first boot after a FW upgrade requires more than the typical amount of time for CTS to toggle low.
EEPROM Read		800 µs	1 ms	2 ms	Measured from last byte of command to first byte of response: ▪ 870 us for 1 byte ▪ 1.1 ms for 80 bytes ▪ 1.4 ms for 256 bytes
EEPROM Write		20 ms	30 ms	40 ms	Measured. EEPROM writes cause the radio to resynchronize
Power on to In Range	Client only; server goes in range in <13 ms	13 ms	600 ms	1700 ms*	*Maximum time assuming all beacons are heard; RF interference could extend the maximum time indefinitely
Hop Period In Range			13.19 ms		
Hop Period Out of Range	Client only		38.4 ms		
Reset Pulse		250 ms			
PWM Output Period			315.077 µs		
Restore Default EEPROM Command		10 ms	38 ms		The Restore command initiates a soft reset; monitoring CTS is the best indication of a completed command
Non-Specific AT Command		1 ms	10 ms		Some AT commands could wait indefinitely for a response
Write Flash					For FW upgrade
Read Flash					
Decrypt Image					

3.1 RF Hop Frame

The LT1110 hops every 13.19 milliseconds and can be configured for two different RF data rates to provide options for range or throughput. During each hop, the LT1110 reserves a certain amount of time for overhead, such as the synchronization beacon, internal messaging, and user data transmission. Figure 1 outlines the various transmissions that occur during a hop. These transmissions are transparent to the user sending data, but may be useful for applications that require critical timing. User data is only transmitted during the data slots and after the Interface Timeout or RF Packet Size criteria has been met. Data transmission only begins at the beginning of a data slot. When configured for Full Duplex, data slot 1 is reserved for the server and data slot 2 is shared by all clients for transmissions.

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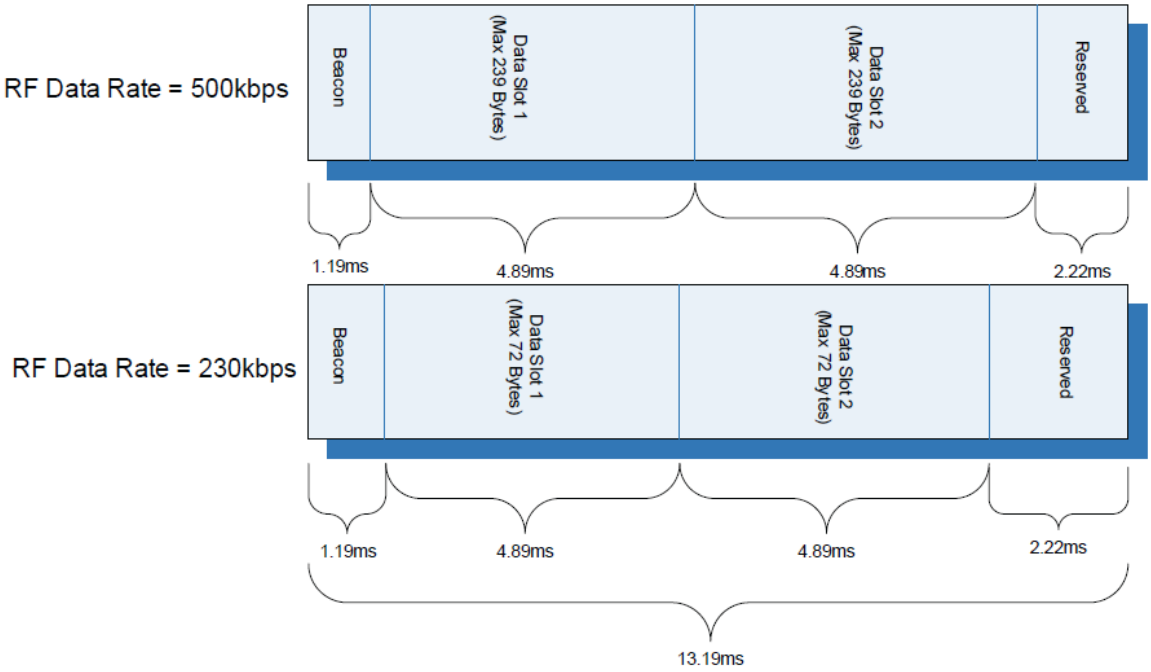

Figure 1: RF hop frame diagram

4 BLOCK DIAGRAM

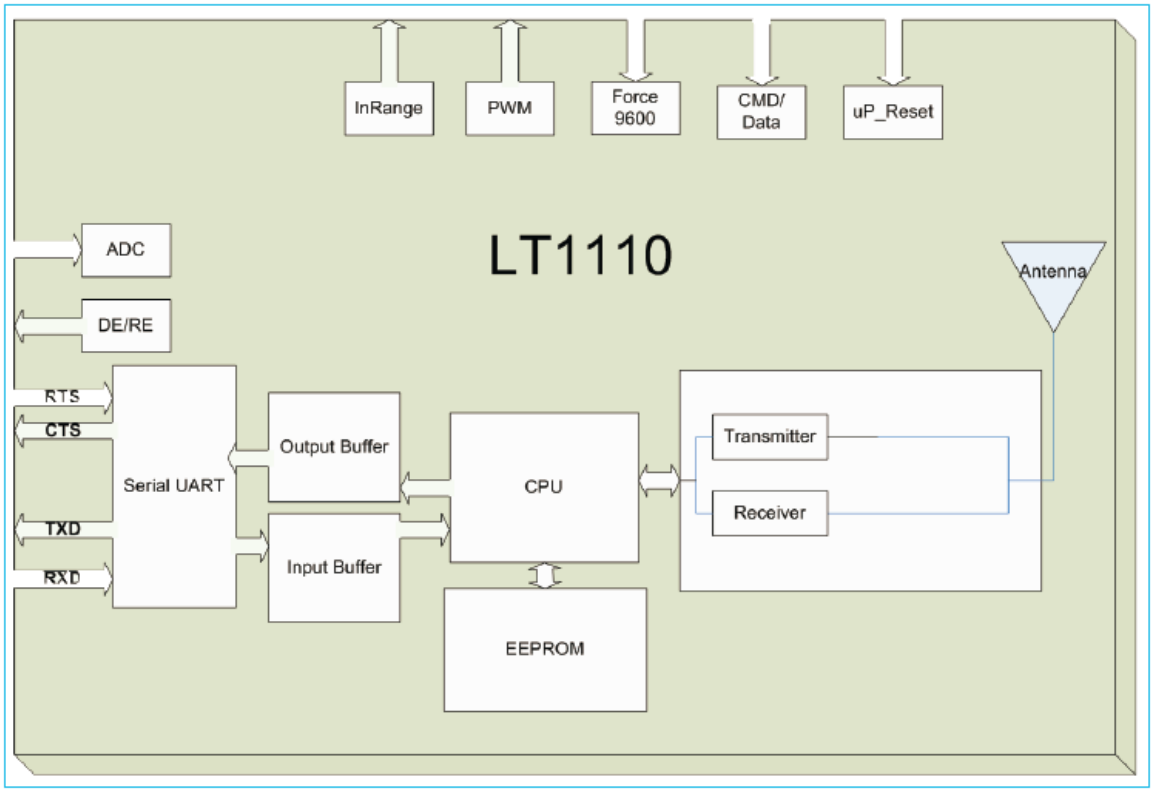

Figure 2: LT1110 functional block diagram

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5 HARDWARE INTERFACE

5.1 Pin Descriptions

5.1.1 RXD and TXD

The LT1110 accepts 3.3 VDC TTL level asynchronous serial data from the OEM host via the RXD pin. Data is sent from the transceiver, at 3.3V levels, to the OEM host via the TXD pin. Pins should be left floating or high when not in use. Leaving the RXD tied low results in the radio transmitting garbage serial data across the RF.

5.1.2 Force 9600

When pulled logic low before applying power or resetting, the transceiver's serial interface is forced to 9600, 8-N-1 (8 data bits, No parity, 1 stop bit), regardless of actual EEPROM setting. The interface timeout is also set to 3 milliseconds and the RF packet size is set to the default size for the selected RF data rate. To exit, the transceiver must be reset or power-cycled with Test pin logic high or disconnected.

When enabled in the EEPROM, 9600 Boot Option causes the 9600 pin to be ignored on cold boot (power-up), command boot (0xCC 0xFF), and brown-out conditions. Therefore, the 9600 pin is only observed on warm boots (reset pin toggled). This helps ensure that brown-out conditions don't cause the baud to change if the 9600 pin happens to be low at the time. When 9600 Boot Option is disabled, the 9600 pin is used for all boot conditions. 9600 Boot Option is enabled by default.

Force 9600 is also used to wake the radio from sleep. When the pin is taken Low, the radio wakes. The transceiver does not sleep if the pin is low when the sleep command is issued.

Note: Because this pin disables some modes of operation, it should not be permanently pulled low during normal operation.

5.1.3 µP_RESET

µP_Reset provides a direct connection to the reset pin on the LT1110 microprocessor and is used to force a hard reset. For a valid reset, reset must be asserted low for an absolute minimum of 250 ns.

5.1.4 Command/Data

When logic high, the transceiver interprets incoming serial data as transmit data to be sent to other transceivers. When logic low, the transceiver interprets incoming serial data as command data. When logic low, data packets from the radio are not transmitted over the RF interface. However, incoming packets from other radios are still received. Enabling CMD/Data RX Disable in the EEPROM causes incoming RF packets to be queued by the receiving radio while CMD/Data is Low. When CMD/Data goes High, the data is sent over the serial interface.

5.1.5 In_Range

The In Range pin is driven low when a client radio's frequency hopping is synchronized with that of a server. In Range is always driven low on a server. Following boot, In Range transitions Low in approximately 12 milliseconds on a server. For a client, the In Range takes an average of 500 milliseconds, depending on the signal strength of the received beacon, the presence and strength of interference, and randomness of the sync function. It can vary from 150 to over 1500 milliseconds.

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5.1.6 GO_0/Hop_Frame

The Hop Frame indicator functionality is disabled by default and controlled by the Control 1, Bit-6 EEPROM setting. When enabled, this pin transitions logic Low at the start of a hop and transition logic High at the completion of a hop. The OEM host is not required to monitor Hop Frame.

5.1.7 $\overline{\text{RTS}}$ Handshaking

With RTS mode disabled, the transceiver sends any received data to the OEM host as soon as it is received. However, some OEM hosts are not always able to accept data from the transceiver. With RTS enabled in EEPROM, the OEM host can prevent the transceiver from sending it data by de-asserting RTS (High). Once RTS is re-asserted (Low), the transceiver sends packets to the OEM host as the packets are received.

Note: Leaving RTS de-asserted for too long can cause data loss once the transceiver's transmit buffer reaches capacity.

5.1.8 $\overline{\text{CTS}}$ Handshaking

If the transceiver buffer fills up and more bytes are sent to it before the buffer can be emptied, data is lost. The transceiver prevents this loss by deasserting CTS High as the buffer fills and asserting CTS Low as the buffer is emptied. CTS should be monitored by the host device and data flow to the radio should be stopped when CTS is High.

5.1.9 DE/RE

When enabled, RS-485 Data Enable uses the DE/RE pin to control the DE pin on external RS-485 circuitry. When the transceiver has data to send to the host, it asserts DE/RE High, send the data to the host, and then take DE/RE Low.

5.1.10 PWM Output

PWM output can be configured to output on any of three pins (SMTP in 5, 6, or 7). The PWM Output can optionally produce a pulse width modulation for RSSI with a period of 315.077 uS.

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6 MECHANICAL CONSIDERATIONS

6.1 Mechanical Drawing: PLUGGABLE U.FL

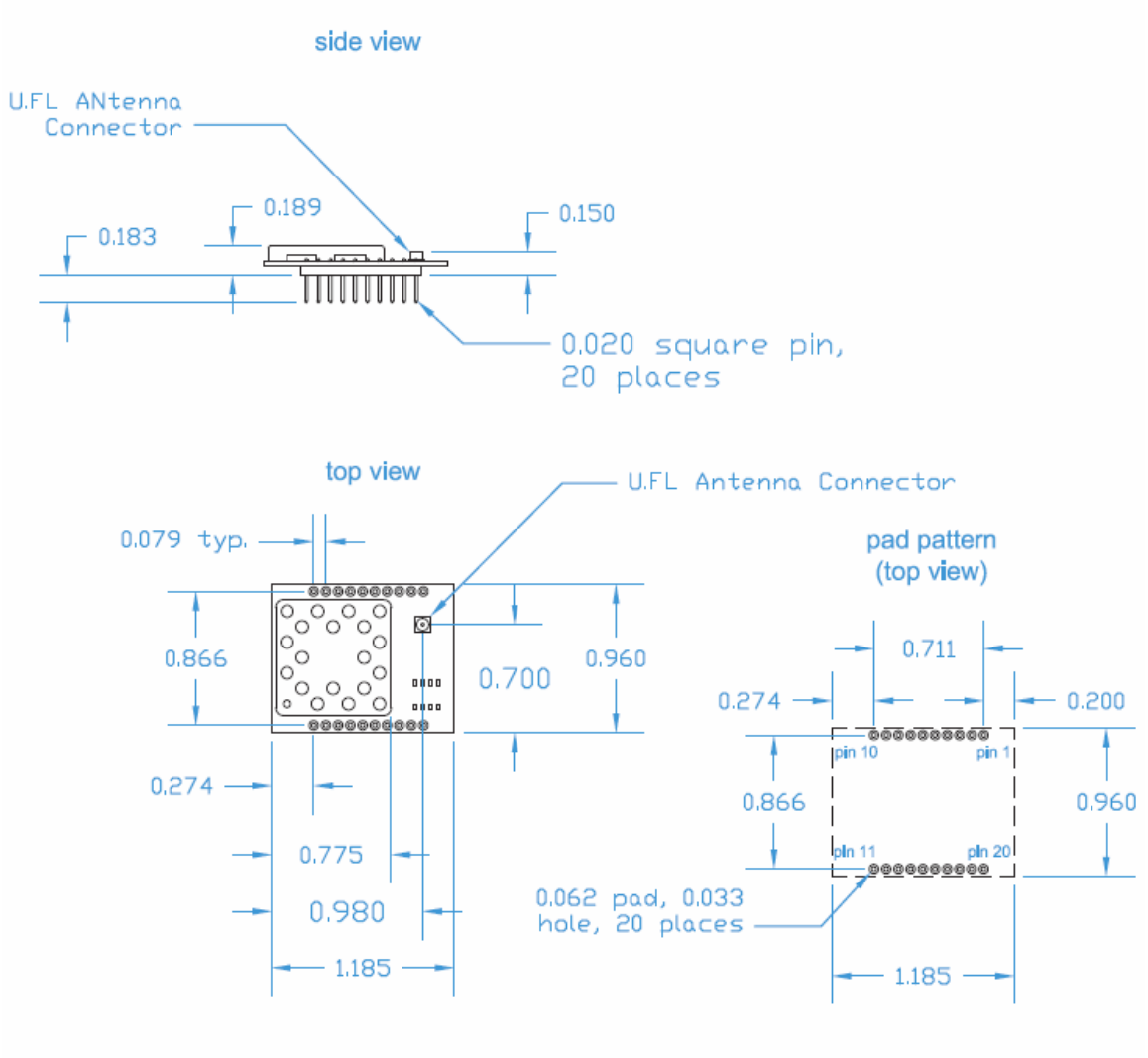

Figure 3: Form factor: pluggable U.FL

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6.2 Moisture Content Warning

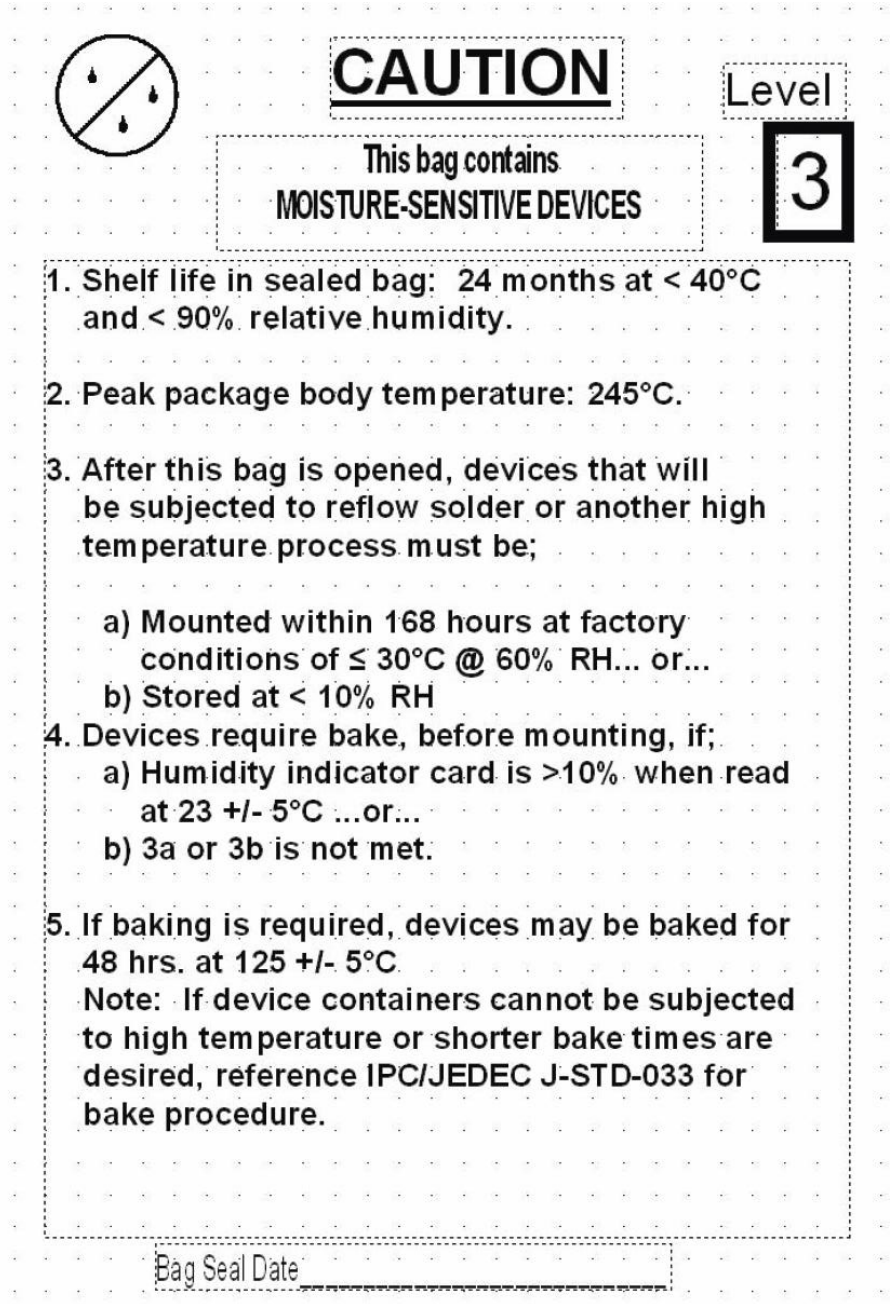

Figure 4: Moisture content warning

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7 Ordering Information

7.1 Product Part Numbers

Table 7: LT1110 Part Numbers

Part #	Description	FCC ID*	IC
PRM240	900 MHz OEM Transceiver, pluggable, 3.3V TTL, 200 mW, u.FL Jack	KQL-1110200	2268C-1110200

8 Compliancy Information

8.1 Agency Identification Numbers

Family	US/FCC	Canada/IC
LT1110-200	KQL-1110200	2268C-1110200

8.2 LT1110-200 Family

Part #	Description	Packaging
PRM240	(+23 dBm), Pluggable with U.FL connector	PLG-U.FL

8.3 LT1110-200 Family Approved Antenna List

Item	Part Number	Mfg.	Type	Gain (dBi)
1	0915AT43A0026	Johanson	Chip	-1
2	YS8963	Laird Technologies	Yagi	6
3	S467FL-6-PX-915S	Nearson	Dipole	2
4	FG9026	Laird Technologies	Omni	6

8.4 FCC/IC Requirements for Modular Approval

In general, there are two agency classifications of wireless applications; portable and mobile.

Portable: Portable is a classification of equipment where the user, in general, will be within 7.87 in (20 cm) of the transmitting antenna. Portable equipment is further broken down into two classes; within .98 in (2.5 cm) of human contact and beyond .98 in (2.5 cm). The LT1110 is not agency approved for portable applications. The OEM is required to have additional testing performed to receive this classification. Contact Laird Technologies for more details.

Mobile: Mobile defines equipment where the user will be 7.87 in (20 cm) or greater from the transmitting equipment. The antenna must be mounted in such a way that it cannot be moved closer to the user with respect to the equipment, though the equipment may be moved.

This equipment has been approved for mobile applications where the equipment should be used at distances greater than 7.87 in (20 cm) from the human body.

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CAUTION: Any changes or modifications not expressly approved by Laird could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. 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. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does not cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

8.5 OEM Equipment Labeling Requirements

WARNING: The OEM must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate Laird Technologies FCC identifier for this product as well as the FCC notice below. The FCC identifiers are listed above.

Contains FCC ID: KQL-111010

The enclosed 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.

Contains FCC ID: KQL-111010200

The enclosed 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.

Label and text information should be in a size of type large enough to be readily legible, consistent with the dimensions of the equipment and the label. However, the type size for the text is not required to be larger than eight point.

8.6 Antenna Requirements

To reduce potential radio interference to other users, the antenna type and gain should be chosen so that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

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8.7 Warnings Required in OEM Manuals

WARNING: This equipment has been approved for mobile applications where the equipment should be used at distances greater than 7.87 in (20 cm) from the human body. Operation at distances of less than 7.87 in (20 cm) is strictly prohibited and requires additional SAR evaluation.

9 Related Documents

The following documents are related to the LT1110/LT1111 wireless modules and are available from the LT1110 product page on the Laird website:

- LI1110/LT1111 Product Brief
- Firmware Release Notes
- LT1110/LT111 User Guide

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