TECHNOLOGY TRAINING & SUPPORT SERVICES

Service Manual for GTECH's AirCon Radio

March 2015

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GTECH

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Revision History

This document describing the AirCon Radio has a revision number. Each time this document is updated, the document revision number is updated. The number below represents the current revision of this manual.

Service Manual for GTECH's AirCon Radio
2-ARC-003-04

For future documentation revisions, the last two digits of the number above will increment by 1 (for example, when revision 01 is revised, the last two digits in the number above will become 02). Revision details are tracked in the table below.

Revision #	Description	Date	Writer
2-ARC-001-01	Preliminary Release	July 2011	S. Lataille
2-ARC-001-02	Document Release; Revision 1.0	May 2012	J. Pearson
2-ARC-001-03 Draft	Draft Document for review	10/10/2012	J. Pearson
2-ARC-003-01	Document Release	11/09/2012	J. Pearson
2-ARC-003-02	Added note for wirelessly connecting to TSP	04/22/2013	J. Pearson
2-ARC-003-03	Update manual to reflect changes by trainer; update to new logo and formatting.	September 2014	J. Pearson
2-ARC-003-04	Updates from trainer Kristi Matos.	March 2015	J. Pearson

No provisions exist for automatic, on-site updates of this manual.

This manual is intended for use as a training guide. Accordingly, although we strive to be as accurate as possible at print time, product information contained in this manual should not be construed as official product specification information or as legally-binding promises of product performance. Each chapter also has a revision level since chapters may be edited before new manuals are published. If you believe your manual is out of date, contact **GTECH Technical Training and Support Services** to obtain the latest edition level

GTECH Technical Training and Support Services, 401-392-7961 or #ttssdocs@gtech.com

To suggest or request updates to this manual, please contact your Field Services Engineering (FSE) Representative or TTSS by email at **#Field Services Engineering** or **#ttssdocs@gtech.com**.

GTECH

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1

ESD Handling Precautions

Exercise Caution

All GTECH Printed Circuit Boards (PCBs) are static-sensitive. In order to prevent damage to electronic components through ESD, please take the precautions presented in this chapter whenever:

- Performing any work on a PCB
- Removing subassemblies or components

What is ESD?

Static is the electrical charge created by the friction of two dissimilar materials moving against each other. ESD, or electrostatic discharge, is the dissipation of the charge by current.

Our bodies can create as much as 25,000 volts of static electricity across our 100 to 250 picofarads of capacitance to ground. In the worst case work environment, voltages on some objects could exceed 50,000 volts. This more than exceeds the static-tolerance threshold of most transistors, resistors, op-amps, and digital computer chips. Some MOS families, for instance, can be damaged by a charge as low as 150 volts.

Usually the damage is such that it goes undetected for some time but eventually creates either an intermittent or hard failure in the field. Insulators, or non-conductors of electricity, pose the greatest static discharge threat to electronic devices because of their inability to bleed their static charges.

Becoming “Static Safe”

Equipment or component failures that result from ESD can be difficult to identify but can be avoided at minimal cost with proper handling techniques.

A static electricity-safe workplace is an environment in which anything that can generate static charges is eliminated or is drained of its charge. Such a workplace employs conductive and static dissipative materials for its table tops, floor surfaces, clothing, and material handling bins, boxes and bags. Machines, tools and test fixtures should be properly grounded. Technicians or anyone handling electronic components should wear wrist straps and ankle straps at all times.

GTECH has created this chapter to help you identify ESD failures and to implement correct handling procedures. Please read the following sections carefully.

ESD-Induced Failure Modes

Radiated Electromagnetic Fields

Radiated electromagnetic fields induce low-level voltages in unshielded signal conductors. These can cause intermittent unit halts from which the operator may recover. Older products are more sensitive to these fields. Products manufactured today are designed with covers and shielded external cables to protect them from most induced voltages.

Conducted Charges

Conducted charges (usually at points where the operator touches the unit) may transfer directly to components and result in either intermittent or permanent failures.

Typical Symptoms of ESD Damage

Hard failures such as blown semiconductor junctions, cracked oxide layers, fused metallization or bond wires can result from ESD.

Intermittent failures are the most common result of ESD. The device becomes temperature sensitive, input thresholds shift, output levels and drive ability degrade, etc.

Increased failure rates are also typical. Normal stresses such as temperature swings, power surges, or another “zap” could permanently disable a device previously exposed to ESD, even if no symptoms existed from the first exposure!

Common False Assumptions Concerning ESD

- **MYTH:** Only MOS devices are ESD sensitive.
  FACT*:* All semiconductor materials are sensitive to ESD. Some devices are just more sensitive than others.

- **MYTH*:*** A component cannot be damaged once it is installed in a board.
  FACT: It may be even more susceptible to induced fields due to the antenna effect of the etch or wire connected to it.

- **MYTH:** If the device works after I replaced it, I got lucky and did not damage it.
  FACT: Most failures are not catastrophic and only reveal themselves as intermittent or latent failures.

- **MYTH:** A grounded metal table top is a good anti-static work surface.
  FACT: A much better way to dissipate electrostatic fields is to use an anti-static mat and a 1-Megohm discharge current limiting resistor so that the charge is drained in a controlled manner.

- **MYTH:** Wrist straps present a personal shock hazard when working on live circuits because they ground your body.
  FACT: As long as the 1-Megohm resistor is connected between the strap and the ground connection the wrist strap does not increase your risk of suffering a shock hazard. The 1-Megohm resistor limits the current to a safe value for low-voltage circuits.

- **MYTH:** We don’t take precautions and we don’t have ESD problems at our depot.
  FACT: You may not realize the damage that you are causing, but it is there. GTECH Engineering can determine if hard and intermittent failures are due to ESD damage by examining individual components, but such damage is not something that a technician can readily identify.

- **MYTH:** The GTECH terminal is not susceptible to static damage.
  FACT: Our terminals can be destroyed by static discharge just like any other electronic device.

ESD Precautions Checklist

Recommended Devices

- Wrist straps at the bench
- Wrist strap tester
- Only tools or parts made out of conducting materials (i.e., no plastic solder vacuums, tweezers, etc.).
- 3M® anti-static vacuum cleaners
- Static-dissipative mats for bench tops and flooring
- Static-dissipative bags, boxes, bins and/or totes for handling PCBs (bags and totes must remain closed during transport - no part of the item can “stick out” of the bag or the bag is useless)
- Static-free floor mats, static-dissipative shelving, and 3M black conductive PCB storage bags used at all times (stockroom)
- Field Service Static Dissipative Grounding Kits

Precautionary Practices

- Minimize handling of components.
- Keep parts in static-dissipative packaging until ready for use.
- Use ESD-protective containers for handling and transporting small components.
- Handle IC’s by the body, not the leads.
- Do not slide static sensitive devices over any surface.
- Eliminate static generators from your work area, for example plastic, vinyl, styrofoam, etc.
- Use a static-free workstation whenever handling parts in the office, in the field or anywhere.

Recommended Handling - Example

A typical scenario for a technician at a bench to properly retrieve parts from a stock area is as follows:

- You, the technician, are seated at a bench, connected to electrical ground via a wrist strap.
- The bench surface has a clean, grounded, static-dissipative bench mat. All tools are conductive.

- When rising from the bench to retrieve a PCB (for example), disconnect the wrist strap.
- Walk across the matting back to the bench, keeping the board in the bag.
- Re-attach the wrist strap, remove the board from the bag, and install it in the terminal, which is sitting on the static-dissipative mat.

After leaving and returning to the static-dissipative area, always touch either the anti-static surface or electrical ground before touching any of the parts.

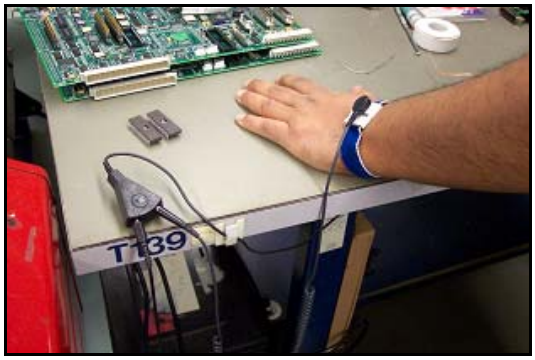
Proper Grounding Technique

Screeners and FSTs must follow proper ESD precautions. This includes the items mentioned throughout this section: wrist straps, anti-static mats, anti static vacuum cleaners, and antistatic bags.

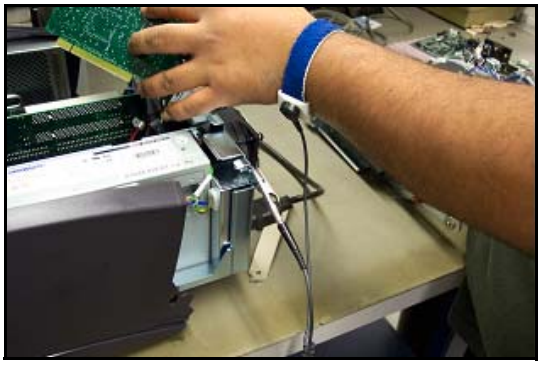
- FSTs must be grounded by a wrist strap connected to the terminal when servicing that terminal and all boards being transported must be stored inside an antistatic bag.
- Screeners must work in a Static-safe environment the workbenches must have antistatic mats and the screener must observe proper ESD precautions.

Vacuum cleaners are generators of static electricity. When purchasing a vacuum cleaner, choose one with an antistatic nozzle (such as the one recommended in the Spare Parts and Tools Chapter). If unable to purchase antistatic vacuum cleaners, the nozzle of the hose must be wrapped with antistatic (conductive) tape from the nozzle to the handle.

The picture below shows a properly grounded technician, notice that the technician is grounded to the antistatic mat and then the mat is grounded to earth ground on the AC outlet.



When servicing the terminal in the field the FST first must ground himself to the terminal chassis, as shown in the picture below.



GTECH Specification

GTECH assemblies comply with IEC 61000-4-2 recommendations for severity typically in excess of level three. IEC stands for International Electrotechnical Commission. The specification is for Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment.

Part two specifies electrostatic discharge requirements and states that our equipment must withstand air discharges and contact discharges. Both positive and negative polarity discharges must comply.

2

Introduction

Overview

GTECH's AirCon Radio is a standalone Radio module communications device with an optional external dipole antenna. It is used for communications between GTECH online lottery terminals and associated peripherals.

Figure 2-1. AirCon Radio

Depending on the online terminal, the Radio module is used in one of two ways:

- Installed into the terminal as a standalone Radio Module (below)

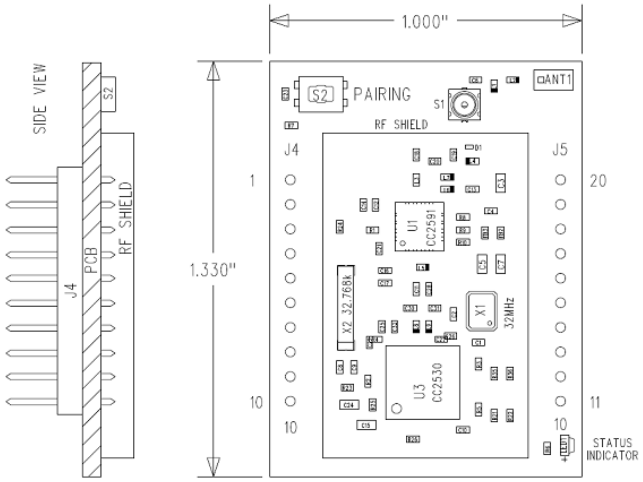


Figure 2-2. Standalone Radio Module

- Mounted to a Host Board via two headers; the two mated boards are enclosed in a plastic housing that comprise what is referred to as the Dongle.

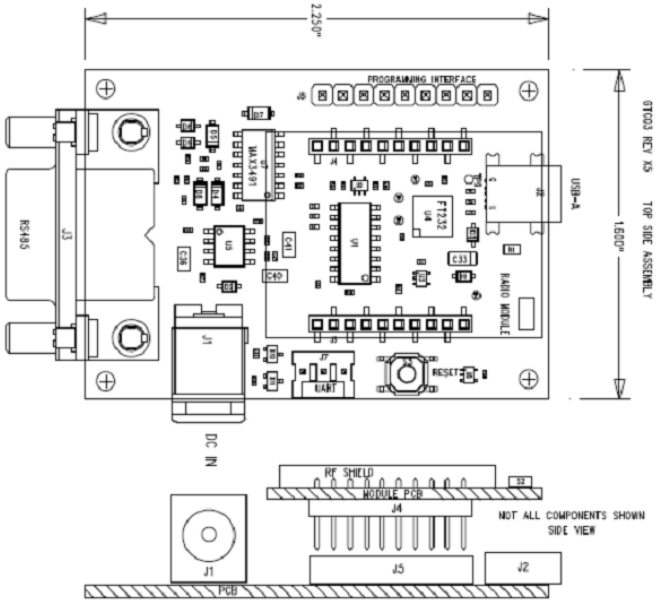


Figure 2-3. Radio Module Mounted to Host Board

Peripheral devices include (but are not limited to) the following:

- TicketScan & TicketScan Plus
- Customer Display Units
- Jackpot Signs

The AirCon Radio consists of the following components:

- Radio Module Board (51-1884-01E)
  - Radio Module Label (14-2027-02E)
  - Optional External Antenna with Cable (55-0121-01E, 32-1751-01E)
- Carrier/Host Board (51-1885-01E) (Optional for Dongle configuration)
- Wall Mount Power Supply (Optional for Dongle configuration)
  - US: 50-0347-01E
  - UK: 50-0347-02E
  - EU: 50-0347-03E
- Cables (Optional for Dongle configuration)
  - USB A to USB mini B Cable (32-1743-01E)
  - RS-485 Straight pinned Cable (32-1344-03E)
  - RS-485 Crossed pinned Cable (32-1744-01E)
- Plastic Enclosure (Optional for Dongle configuration)
  - Plastic Parts (16-2104-502E & 16-2105-502E)
  - Dongle Label (14-2027-01E)

Block Diagram

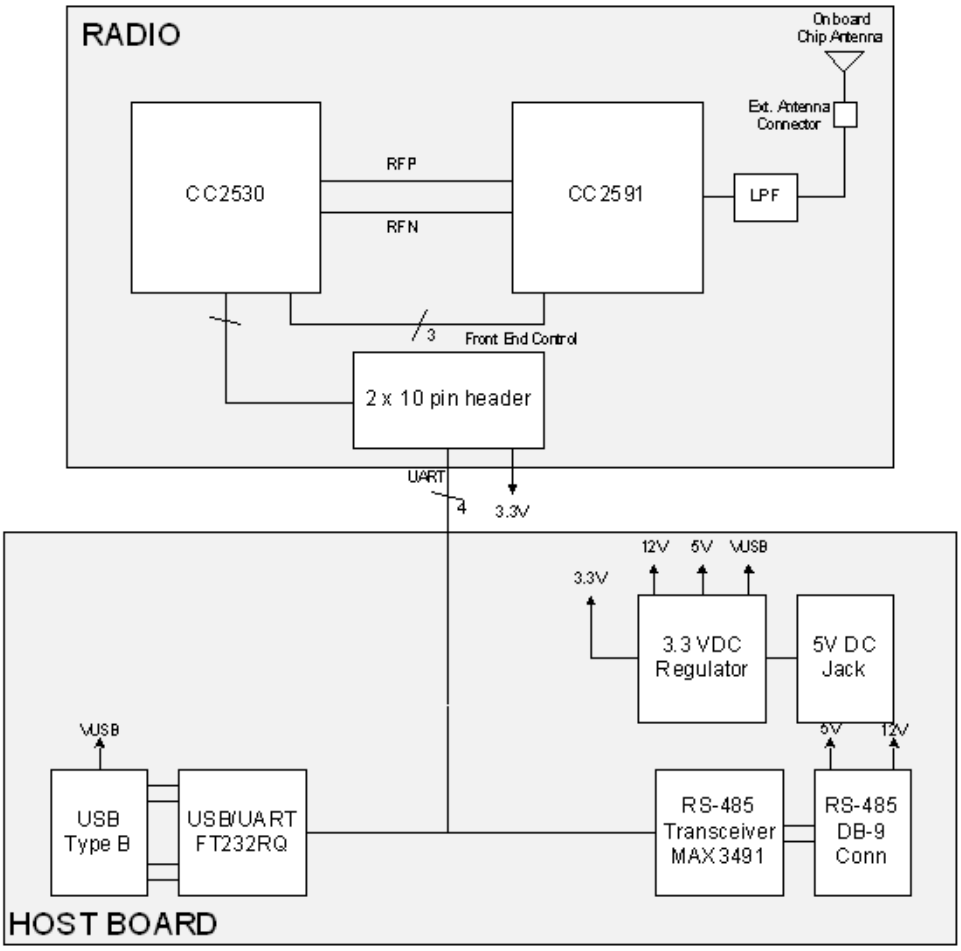


Figure 2-4. AirCon Radio Block Diagram

Radio Module Board (51-1884-01E)

The Radio Module Board is comprised of the following:

- System-on-Chip
- 2.4GHz Front End Module
- 32 MHz Crystal
- Chip Antenna
- RF Connector
- Antenna Switch
- Interface Connectors

- External Antenna with Cable Assembly - U.FL Connector mount
- LS Research - Cable assembly, U.FL to reverse polarity SMA (080-0001)

Electrical and RF Specifications are as follows:

Parameter	*Min*	*Typical*	*Max*	*Unit*
Supply Voltage (VCC)	2.7	3.3	3.6	Volts
Supply Current			250	mA
Operating Temperature	-40		80	°C
Temperature rate of change			10	°C/min
Operating Humidity	10		90	%RH
Voltage on any IO pin	-0.3		VCC+0.3	Volts

Parameter	*Min*	*Typical*	*Max*	*Unit*
RF Frequency	2400		2480	MHz
RF Channels		16		
Radio Baud Rate		250		kbps
Radio Chip Rate		2		Mcps

Pin #	NAME	DESCRIPTION
1	VCC	3.3 Vdc
2	UTX	UART data out from module
3	URX	UART data in to module
4	NC	No Connect. Module option to connect to port P1_5
5	RESET_N	Module Reset
6	NC	No connect. Module option to connect to port P2_0
7	P2_2/DC	CC2530 Debug Clock. For programming and debugging of radio module CC2530
8	P2_1/DD	CC2530 Debug Data. For programming and debugging of radio module CC2530
9	DTR_N	Data Terminal Ready communication line
10	GROUND	Ground
11	NC	No Connect
12	CTS_N	Clear to Send Flow Control
13	SLEEP_N	Module status indicator
14	NC/P1_6/UTX1	No Connect. Module option to connect to alternative UART TXD
15	NC/P1_7/URX1	No Connect. Module option to connect to alternative UART RXD
16	RTS_N	Request to Send Flow Control
17	TX_EN	RS-485 driver enable output line. Disables bus driver during hardware reset
18	NC	No Connect. Module option to connect to port P1_4
19	NC	No Connect. Module option to connect to port P1_2
20	STATUS_LED	No Connect. Module option to connect to port P1_0

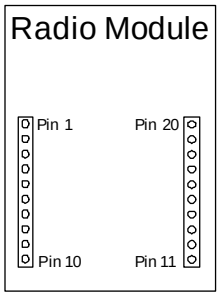


Figure 2-5. Radio Module Interface Pin Numbering and Assignments

Carrier/Host Board (51-1885-01E)

The host board is used to connect to the radio module through the (2) 10-pin headers, provide the RS-485 and USB 2.0 Type B interface options, provide the external power jack, and provide the power supply regulation necessary for the radio module to operate from the various interface power sources.

The Host board is comprised of the following:

- Interface Connectors
- RS-485 Interface (DB-9 Female)
- RS-485 Transceiver
- USB Type B Interface
- USB - UART Transceiver
- DC Jack
- 3.3 V Regulator

Host Board Electrical and RF Specifications are as follows:

Parameter	*Min*	*Typical*	*Max*	*Unit*
Input Voltage	4		16	Volts
Output Current			800	mA
Output Voltage	3	3.3	3.6	Volts

Power Supply

Parameter	*Min*	*Typical*	*Max*	*Unit*
Serial Baud Rate	2.4	19.2	230.4	kbps
Input Supply Power	5		12	Volts
Input Supply Current	300			mA

RS485 Bus

Parameter	*Min*	*Typical*	*Max*	*Unit*
Serial Baud Rate	2.4	19.2	230.4	kbps
Input Supply Power	5		12	Volts
Input Supply Current	300			mA

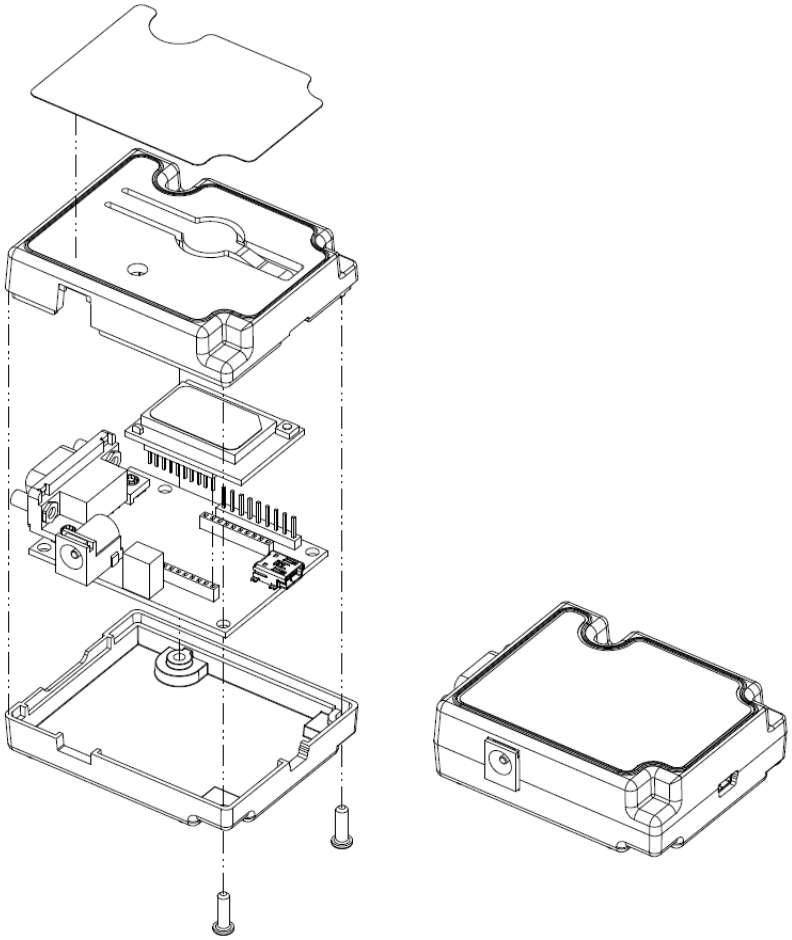
USB Interface

Power Supply

The AirCon radio runs on 3.3V nominal, 3.6V maximum. The host board provides the 3.3V power regulation for the possible external power supplies.

- +12V or +5V via the RS-485
- +5V via the USB Bus
- +5V via the external wall transformer and the DC power jack.

Dongle Assembly



3

Installation

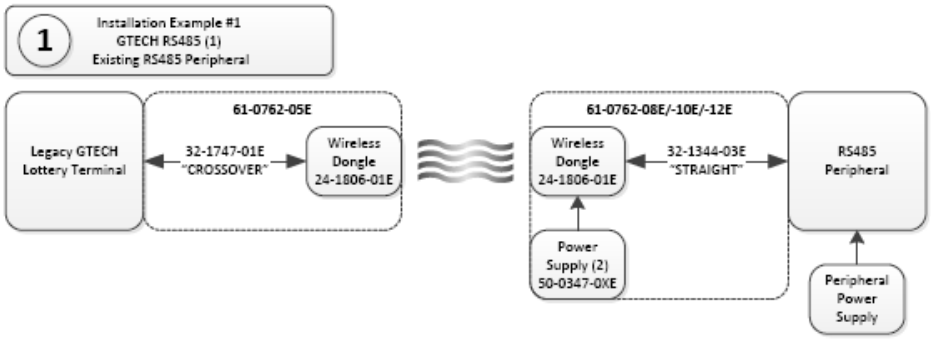
This chapter contains instructions for installing the AirCon Radio to the online lottery terminal and associated peripherals. If the online lottery terminal was manufactured with the GWT154 installed in the chassis, installation instructions do not apply to the terminal, proceed to peripheral installation.

NOTE! Be sure to follow the Product Safety Instructions that are shipped with the terminal and are included in “Product Safety & Approvals” on page B-i.

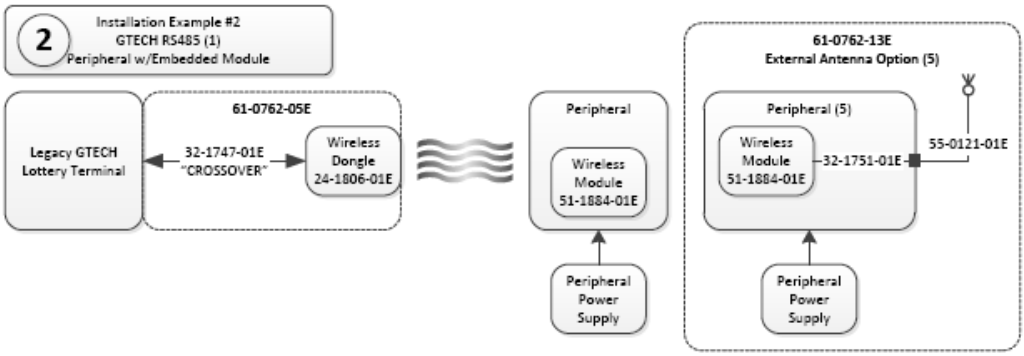
Installation

The following drawings identify typical GTECH installation configurations.

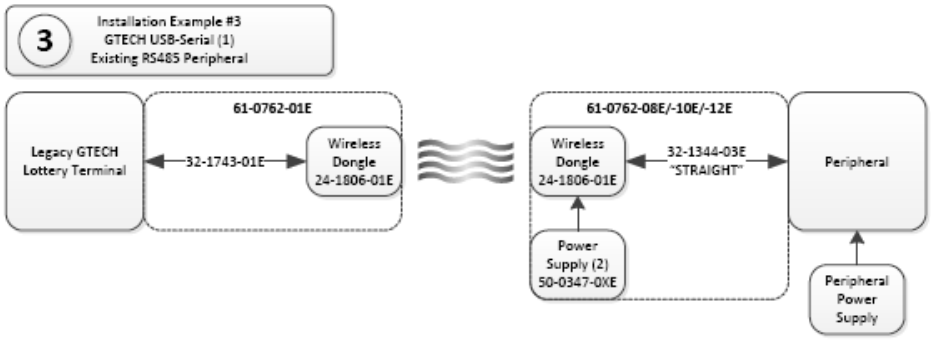
Installation Example 1: GTECH RS485 - Existing RS4875 Peripheral



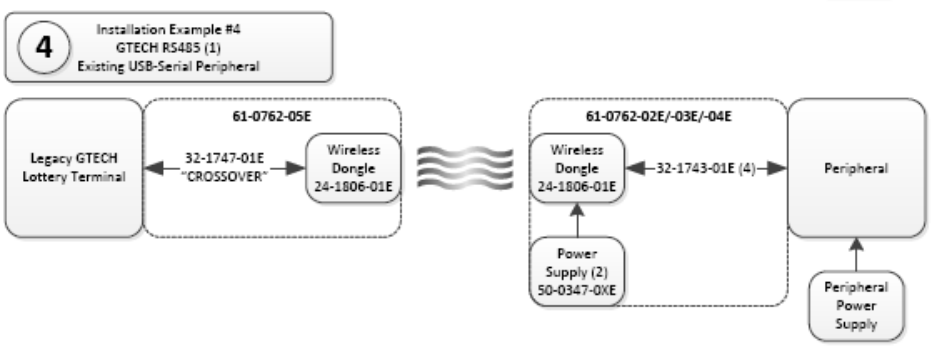
Installation Example 2: GTECH RS485 - Peripheral with Embedded Module



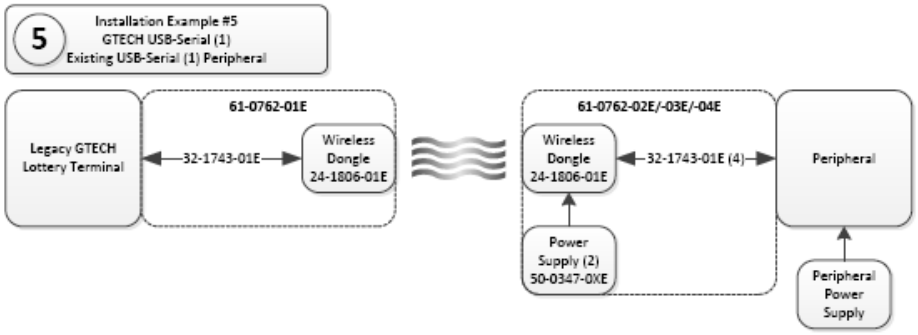
Installation Example 3: GTECH USB-Serial - Existing



Installation Example 4: GTECH RS485 - Existing USB-Serial Peripheral



Installation Example 5: GTECH USB-Serial - Existing USB-Serial Peripheral



4

Troubleshooting

The troubleshooting procedures in this section are a general guide on how to isolate possible faults with the AirCon Radio. Prior to performing the troubleshooting steps in this chapter perform the following:

- Inspect the device for any physical damage, debris or disconnected/loose cables.
- Use terminal diagnostics to further diagnose the problem with the device; this chapter assumes that diagnostic testing has been performed prior to performing the steps that follow.

Troubleshooting Steps

These steps are a general guideline for Field Service Technicians to follow in the event of a specific fault. After each step, the device should be checked to determine whether or not the step cleared the fault. If the fault is not cleared with the first step, the next step is performed in an attempt to clear the fault. Once the fault is cleared, the source of the problem is identified and should be sent for repair.

Table 4-1. Troubleshooting Steps for the AirCon Radio

Module	Problem	FST Action
Wireless Transceiver	**Not Transmitting**	1. Verify that the correct cables are being used. 2. Reset the Radio to the *Uninitialized* Status by holding the reset button for 15 seconds and then release. You will see the LED flash RED once. 3. Get Transceiver Status using the configuration tool. 4. Verify the RS485 address using the terminal diagnostics. 5. Swap the transceiver.

5

Diagnostics

Refer to **Chapter 9, Configuration**.

6

Preventive Maintenance

No preventive maintenance is required for the AirCon radio in the field.

7

Download

In certain instances it may be necessary to update the firmware for the AirCon Radio. This chapter explains how to upload the firmware for the AirCon Radio using the TI Debugger Tool and Smart RF Flash Programmer.

NOTE: The most current version of firmware is “Firmware Ver. 2013_05_29a” as of 9/18/2014. If you have any questions regarding firmware versions please contact Field Service Engineering.

Updating Firmware for the AirCon Radio

Tools needed:

- Latest Radio Firmware; `GTECH485.hex` file
- #1 Phillips head screwdriver
- SmartRF Flash Programmer `http://www.ti.com/tool/flash-programmer`
- Gtech cable P/N 32-1764-01E
- TI Debugger tool (search for `cc-debugger` made by Texas Instruments) P/N 95-0266-01E
- 1-2 mini USB cables – P/N 32-1743-01E
- AC Power cord for dongle
- 9 Pin Straight Header P/N 21-2516-01E

Update GTECH Tool

To update the GTECH tool you must first run the executable file (`GTECH_AirCon_TestTool.exe`) included in the compressed zip file. Any updates to the firmware (`GTECH485.hex` file) and software will generate an ECO, which is sent to the respective sites.

Installing the USB driver

To get the required USB driver for the CC Debugger, it is necessary to install the SmartRF Flash Programmer.

Alternatively, you can download `Cebal – CCxxxx Development Tools USB Driver for Windows x86 and x64,` which is a standalone installer that includes only the device driver.

After downloading the USB driver to your PC:

1. Connect the CC Debugger to the PC. The USB driver will be installed automatically.

2. Check that the debugger has been associated correctly with the USB device driver by opening the Windows Device Manager.

3. The debugger should appear under “Cebal controlled devices” as shown to the right.

4. For further details or troubleshooting the driver installation process, please refer to `http://www.ti.com/lit/an/swra366/swra366.pdf`.
5. Please ensure that the connection between the device and CC Debugger is correct before starting to use the tools.

Installing the SmartRF™ Flash Programmer.

1. Download and unpack the zip file from the TI web page: `http://www.ti.com/tool/flash-programmer`
2. Double click on the file: `Setup_SmartRFProgr_x.x.x.exe` to start the installation.
3. Follow the instructions on the screen.

The installation of SmartRF Flash Programmer must be executed with administrator privileges. For Windows Vista and Windows 7 a “User Access Control” dialog will appear when starting the installer. If the user has administrator privileges, click on the “yes” button to continue installation. If the user doesn’t have administrator privileges, a user id and password with these privileges must be entered.

4. When prompted to install a Shortcut on your Desktop, choose Yes.

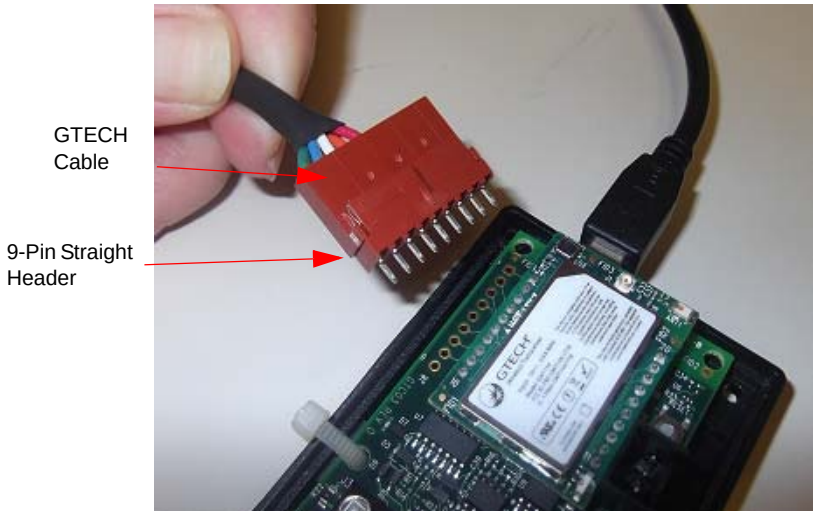
5. Disconnect the AirCon Radio Dongle from power as well as from all data connections.

6. Remove the 3 (three screws) from the back of the dongle using the #1 Phillips head screwdriver.

7. Turn over the dongle and remove the top cover.

8. Connect the GTECH cable (P/N 32-1764-01E) to the CC Debugger.

9. Hold the other end of the GTECH cable equipped with the 9-Pin Straight Header (P/N 21-2516-01E) onto the pins of the AirCon Radio card by angling the header pins to make the connection.



10. NOTE: Contact Pins will need to be held constantly secure during download.

11. Next apply power to AirCon radio via:

    - The Mini USB plug to the PC USB port.

OR

- The AC power port.

Preferred power application.

AC Power Port

Note!

Power to the Radio dongle is always applied PRIOR to applying power to CC Debugger tool.

12. LASTLY apply power to the CC Debugger tool via the Mini USB to PC USB port.

Mini USB Plug

13. Click on the desktop shortcut to start the SmartRF Flash Program.

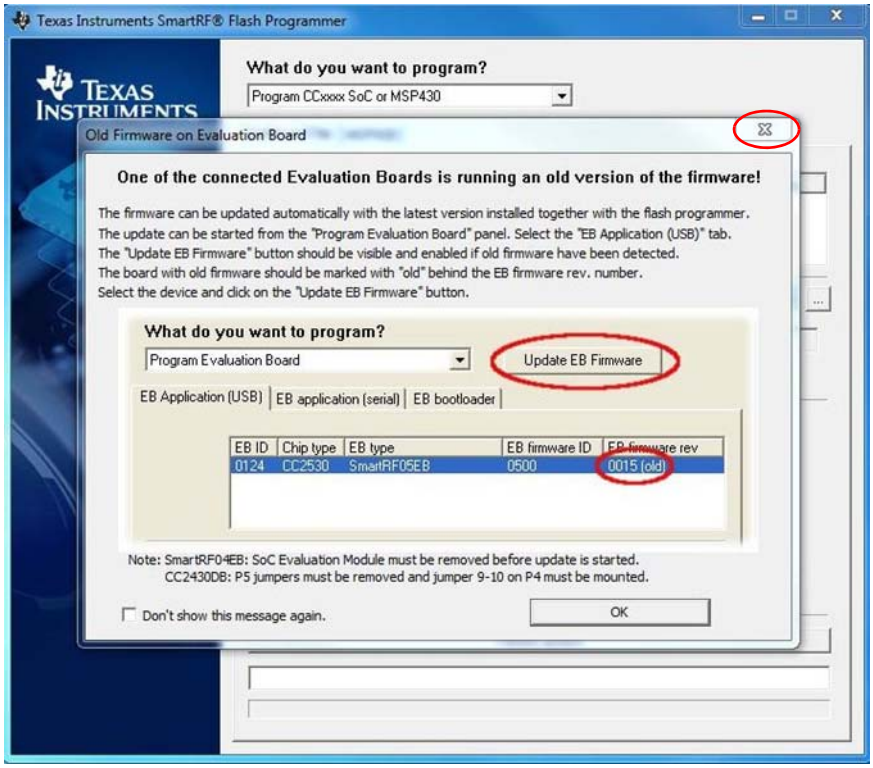
Note!

The Flash Program can be opened at anytime and can be left open during all procedures)

14. Press the reset button on the CC Debugger tool.

    The LED should turn green indicating the connection is correct

15. The following screen may display. Close smaller top window by clicking the X in the upper right hand corner.

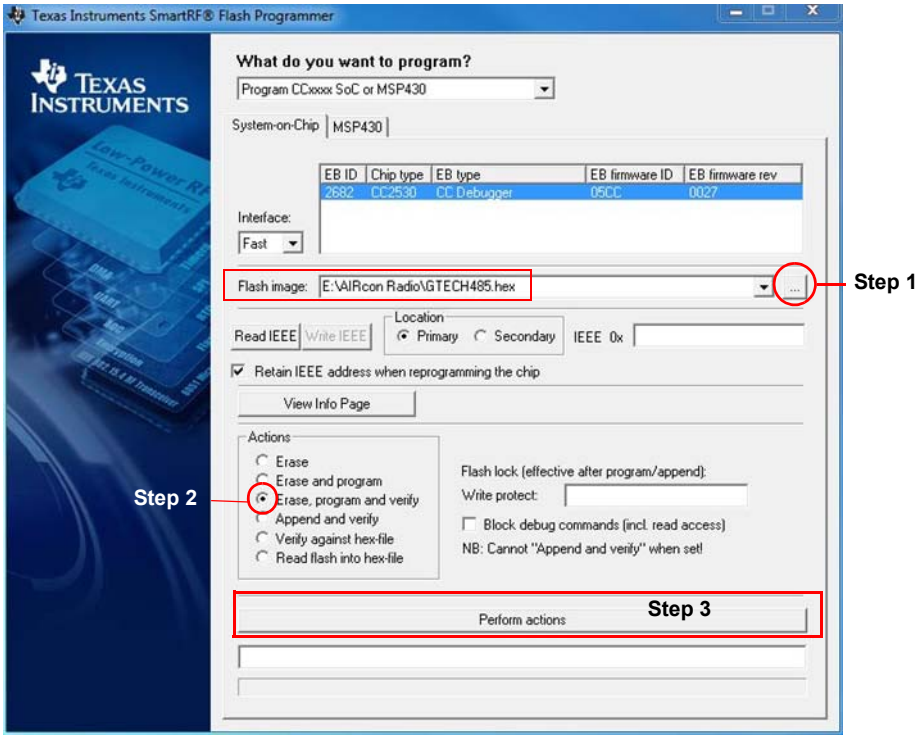

Texas Instruments SmartRF® Flash Programmer
What do you want to program?
Program CCxxxx SoC or MSP430
Old Firmware on Evaluation Board
One of the connected Evaluation Boards is running an old version of the firmware!
The firmware can be updated automatically with the latest version installed together with the flash programmer.
The update can be started from the "Program Evaluation Board" panel. Select the "EB Application (USB)" tab.
The "Update EB Firmware" button should be visible and enabled if old firmware have been detected.
The board with old firmware should be marked with "old" behind the EB firmware rev. number.
Select the device and click on the "Update EB Firmware" button.
What do you want to program?
Program Evaluation Board
Update EB Firmware
EB Application (USB)
EB application (serial)
EB bootloader
EB ID
Chip type
EB type
EB firmware ID
EB firmware rev
0124
CC2530
SmartRF05EB
0500
0015 (old)
Note: SmartRF04EB: SoC Evaluation Module must be removed before update is started.
CC2430DB: P5 jumpers must be removed and jumper 9-10 on P4 must be mounted.
Don't show this message again.
OK

The other screen is the one you use to reprogram the radio module with the new firmware using the following steps:

Step 1 - In the Flash Image field browse to locate and select the GTECH485.hex file

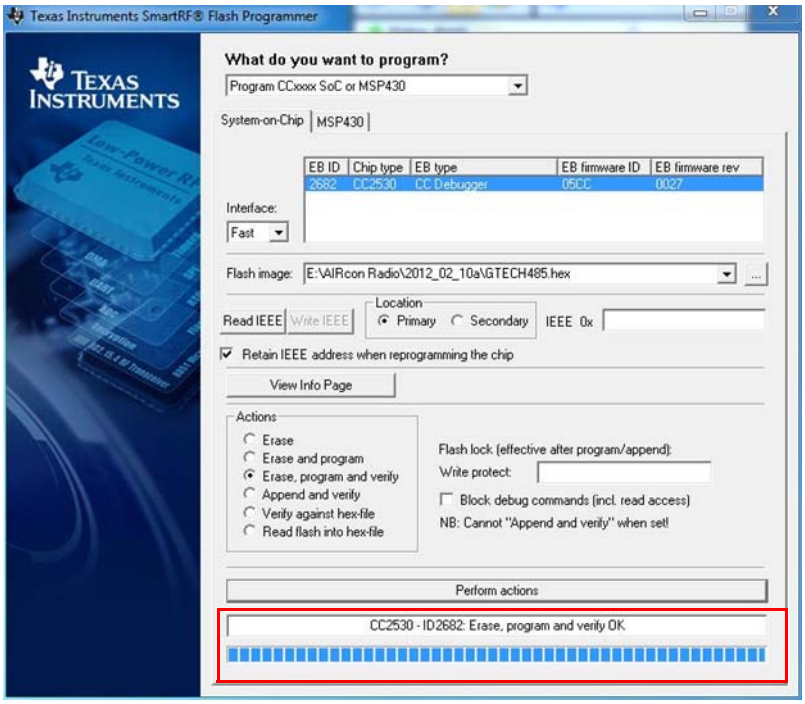
Step 2 - In the Actions section, select the Erase, program and verify radio button.

Step 3 - Click the Perform actions button.



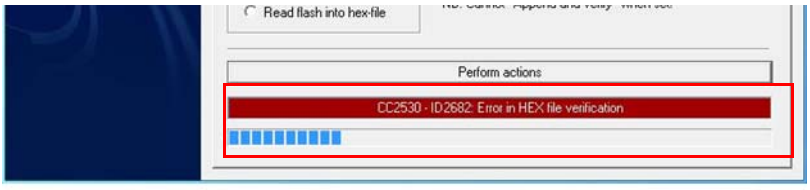
Using the “Erase, program and verify” action completes all necessary actions, therefore saving time.

If the firmware loads correctly, the following message “CC2530 - ID 2682: Erase, program and Verify OK” appears at the bottom of the screen:



If firmware does NOT load correctly, an error message similar to “CC2530 - ID 2682: Error in hex file verification” displays.

If you receive this error, check to be sure contact is being made with the pins on board, and that the green light is on, then perform the actions again.



Once the firmware is successfully downloaded:

1. Disconnect power from Radio dongle.
2. Disengage the GTECH cable from Radio dongle.

The status of the radio will be in “Uninitialized” status and must be configured as Coordinator or End Device prior to being paired.

3. To restart the process, connect all the cables remembering to apply power to Radio dongle PRIOR to applying power to the CC Debugger tool.

Using AC power for the Radio Dongle during this process has proven to be more successful than using the USB power source.

AC Power Port

8

Disassembly

Disassembly is not required in the field.

9

Configuration

The AirCon Radio Module has one user LED status indicator and one momentary contact push button switch input. The following radio modes are initiated and indicated by the following:

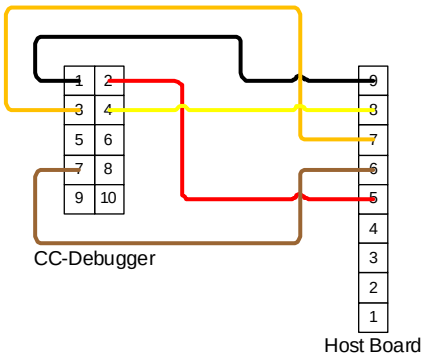
- **Uninstalled Radio:** An un-commissioned radio from the factory defaults to an End Device that has not been joined to a PAN Coordinator. When initially powered the indicator LED may flash Red, then stop.
- **End Device Joining:** Pressing and holding the push button switch on the radio for more than 3 seconds, and UNDER 8 or 9 seconds will place the End Device radio into the network *Join* mode. The radio will attempt to Associate with any nearby PAN Coordinators and indicates this attempt by flashing the LED at a 500ms ON and 500ms OFF cadence.

  If and when the radio receives a beacon from a Coordinator in response to its beacon request while attempting to associate the LED, the LED will exhibit a steady ON indicating it has found a PAN Coordinator.

  If, after 30-seconds, the End Device radio does not successfully negotiate joining a network, the radio will abort the Joining mode and turn the LED OFF.

NOTE! If you hold the push button switch too long (over 10 seconds), when you release the button you will see the LED flash RED once and the Radio returns to the Uninitialized Status.

- **Radio Programming:** The GWT154 Wireless Transceiver is programmed using Texas Instruments (TI) Debugger in-system-debugger/programmer tool for CC2530 and an adapter cable as shown in the following illustration. See **Chapter 7, Download** for instructions on how to load the firmware onto the AirCon Radio.



GTECH485 Test Tool

The GTECH485 Test Tool is a PC application developed for a Windows platform. This tool is to be used by GTECH FSTs to configure and setup the radios.

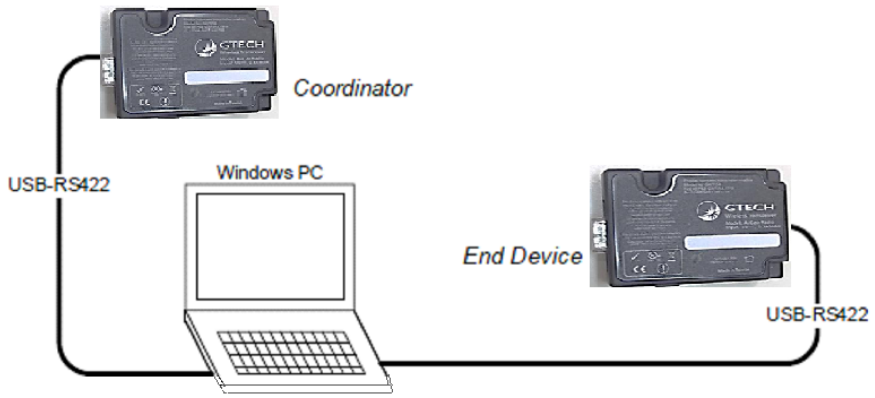
This section describes the equipment required and the test tool setup used to configure and test the AirCon radios.

Equipment Required

Qty.	Description
1	Microsoft Windows PC
-	LSR/GTECH PC Test-Tool Software (GTECH_TestTool.exe v1.6)
2	FTDI USB to EIA422 (or EIA232/Logic-level with adapter cable)
2	GTECH-485 Radio Module and Host Baseboard
1	#2 Phillips Screwdriver
1	*Power Supply for Dongle

* For use with peripherals.

Test Tool Setup



Configuration Procedure

- Both radio modules should be in factory-new condition and both connected to separate instances of the LSR/GTECH PC-Test via USB-RS422 cables.
  - Generally one radio is set up as the Coordinator and the other is set up as the End Device.
  - Both radios must have the same version of the software to pair.
- In Windows:
  - Determine the appropriate COM port (Go to **Start** | **Control Panel** | **System** | **Hardware Tab**).
  - Click **Device Manager** and scroll to Ports (COM & LPT) and expand the view by clicking the plus (+) sign. The COM ports will be displayed for each cable (USB Serial Port (COMx) (where x is the port number).

Setup

1. Install the GTECH AirCon_Test Tool on the PC. (Note that you may want to set up a shortcut on your PC for easier access.)

NOTE: YOU MUST ALWAYS PERFORM THE FOLLOWING STEPS.

2. Connect each radio one at a time by plugging each radio into a USB port on the PC.

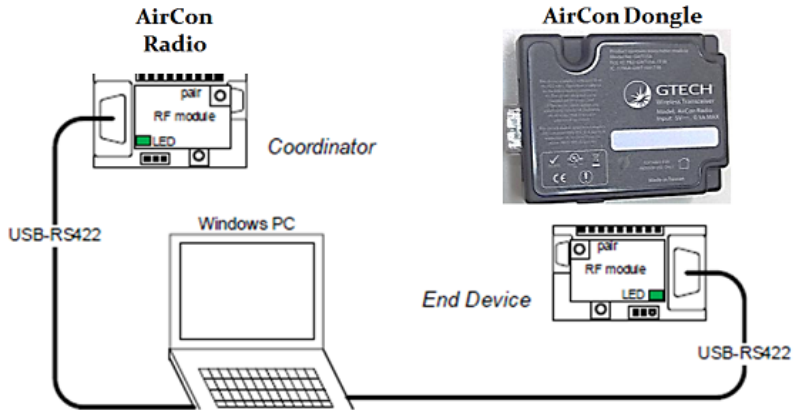


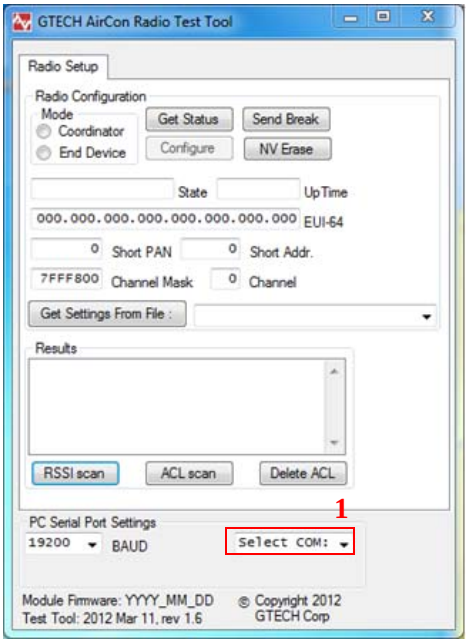
Figure 9-1. AirCon Radio Configuration Setup

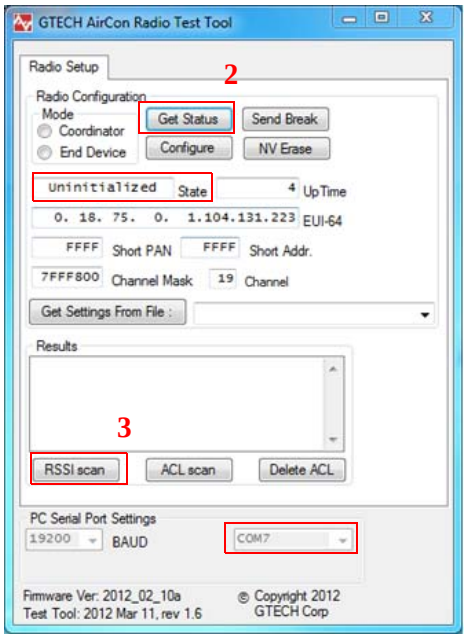
3. Start two instances of the GTECH AirCon Radio Test Tool program. You should see two instances of the test tool running with a **Radio Setup** tab displayed. If both indicate **Coordinator**, click **NV Erase**, then **Get Status**.

Configuring the Coordinator and End Device

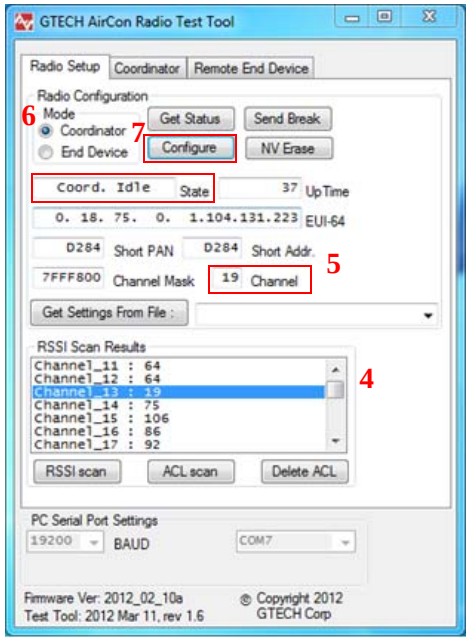
To configure one radio as the Coordinator:

1. Use the **Select COM** drop-down list to select the appropriate COM port in the lower right portion of one of the software test tool instances on the screen.
2. Select **Get Status**. If `Uninitialized`, this status displays in the State field.



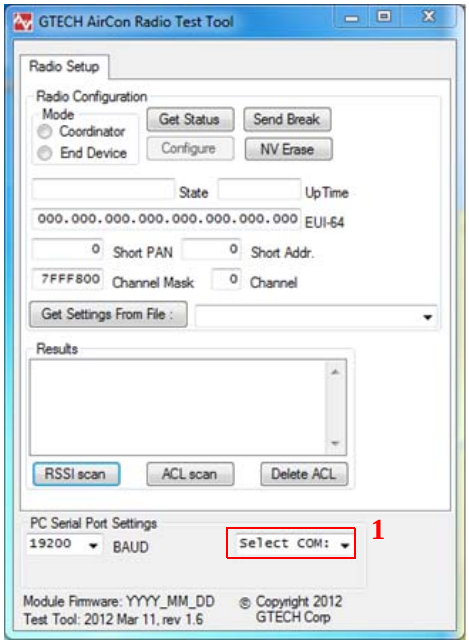


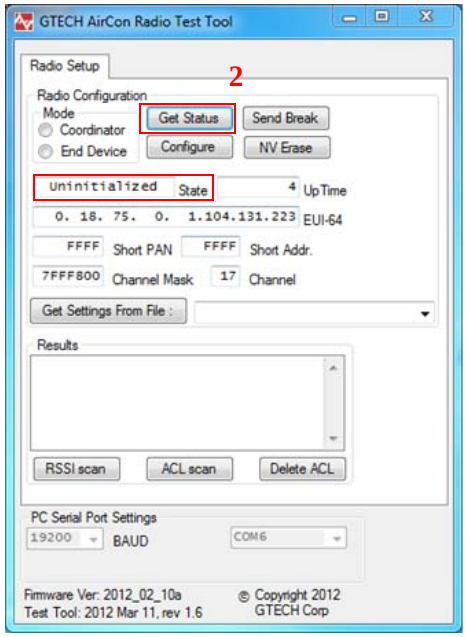
3. Select **RSSI scan**. The RSSI Scan Results text pane lists the results for all the 802.15.4 channels.
4. Scroll to find zero, or the lowest number (minimum interference sensed) on the **Channel** that falls between the Chart of Compliance Limits in the RSSI Scan Results text pane.
5. Enter the **Channel** in the field provided.
6. Under **Radio Configuration**, select the **Coordinator** radio button for the Mode.
7. Click **Configure**. The State should be `Coord. Idle.`



To configure another radio as an End Device:

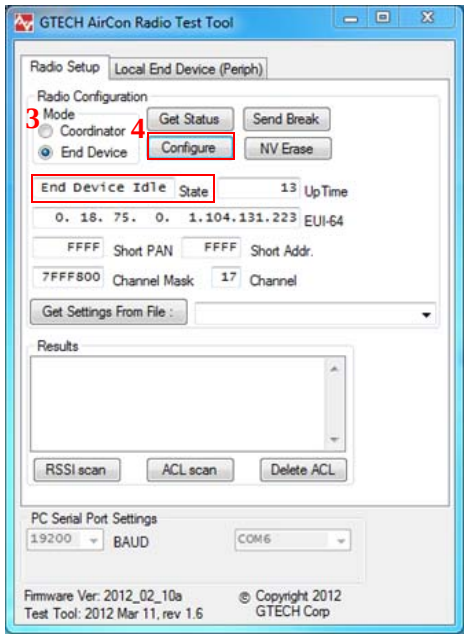
1. In the other instance of the software test tool, use the **Select COM** drop-down list to select the appropriate COM port in the lower right portion of the screen.
2. Select **Get Status**. If the State is `Uninitialized` or `End Device Idle`, then it is OK to pair the radios. If you encounter other States, then you should click **NV Erase** to reset the radio. If you get other States, such as `End Device Started`, you must clear it by disconnecting the radio and waiting at least 10 seconds to give the capacitors a chance to discharge before reconnecting them.





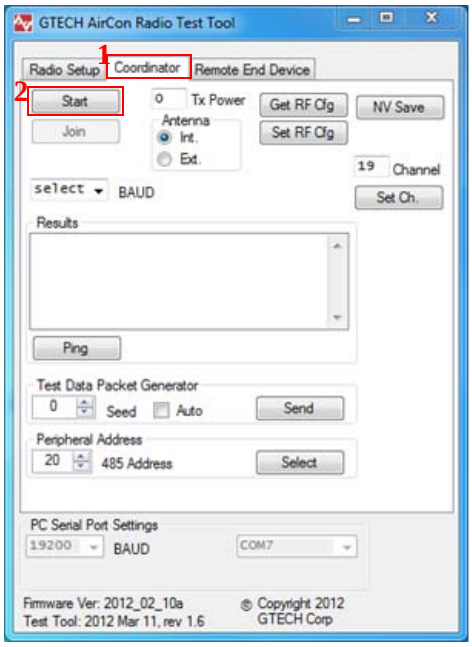
3. Under **Radio Configuration**, select the **End Device** radio button for the Mode.
4. Click **Configure**. The status of the end device should be `End Device Idle`.

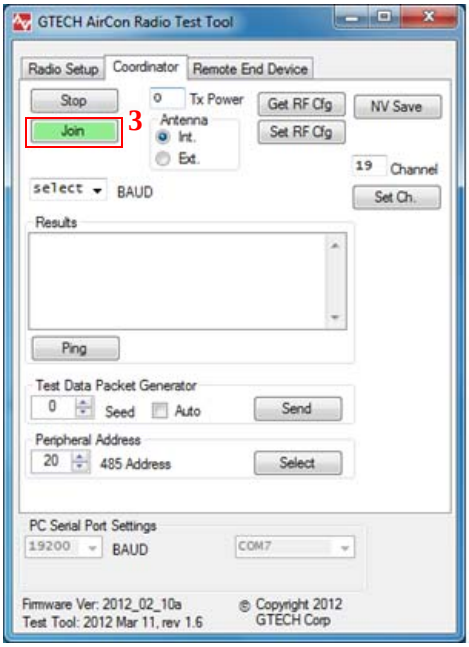
   In addition, there is a new tab for the **Local End Device (Periph).**



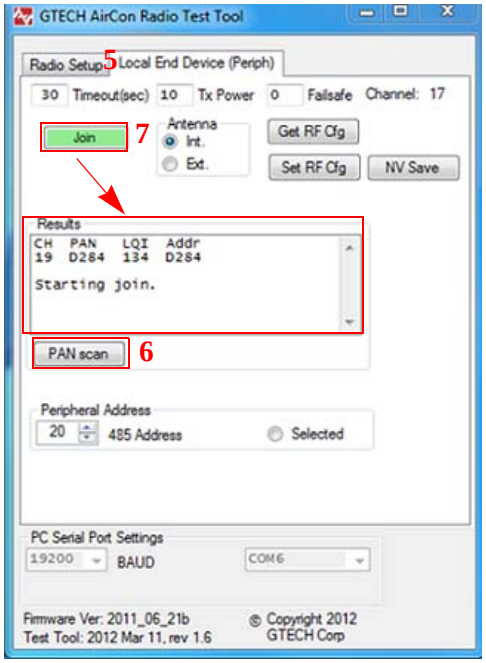
Pairing Both AirCon Radios w/PC

1. On the PC, select the software instance for the **Coordinator** tab from GTECH AirCon Test Tool menu.
2. Select **Start**.
3. Select **Join** to accept the new End Device Association Request. Notice that the **Join** button is now green indicating that the device is working properly.

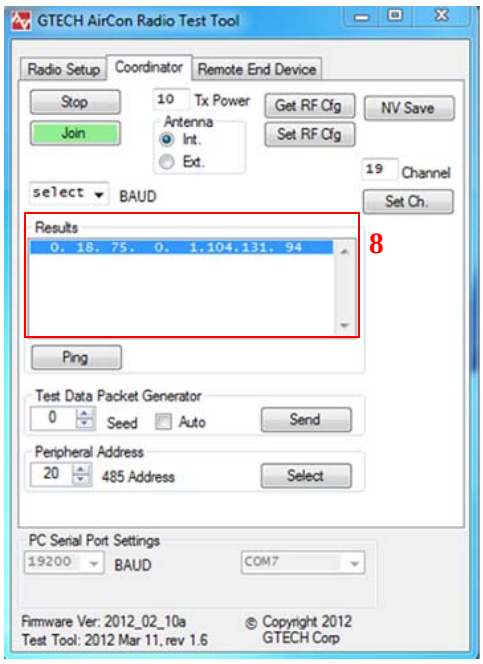


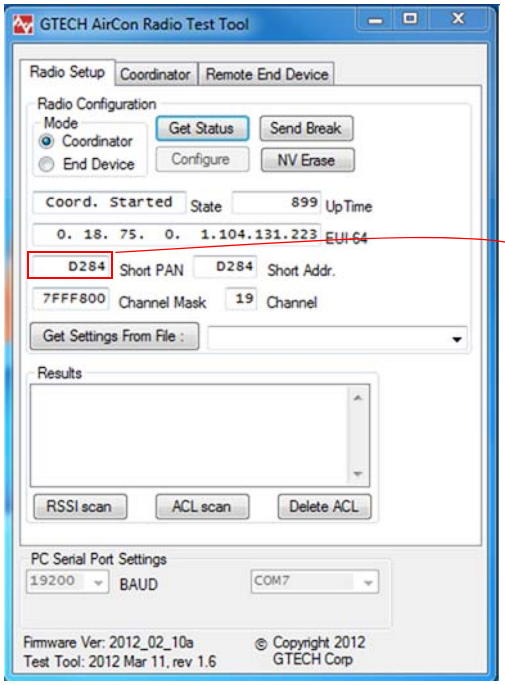


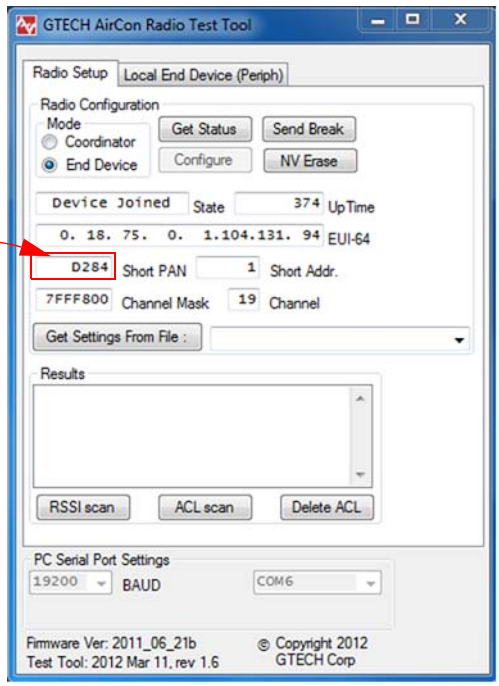
4. Leave the **End Device** radio connected to the COM port and its associated PC Test-Tool instance as Active.
5. On the End Device radio, select the **Local End Device (Periph)** tab.
6. Select **PAN scan**. The Coordinator radio's PAN and Short Address should appear in Results.
7. When the selected channel appears, select **Join** again. The **Join** button turns green and the `Starting Join` message displays.



8. The End Device radio's EUI-64 should now appear in the **Results** text pane on the **Coordinator** tab. When the results display an address in the Results text pane, double-click on this EUI-64 address. After clicking on the EU-64 address, it should disappear from the **Coordinator** Results text pane and on the End Device the **Join** button should return to the background color.
9. On the **Coordinator** radio, select **Radio Setup** tab. The Coordinator Short PAN should match that of the End Device.
10. On the **End Device** radio, select **Radio Setup** tab. The End Device Short PAN should match that of the Coordinator and Short Address should be 1.







11. On the **Coordinator** radio, click **Join** to inhibit polling for any new join requests. The **Join** button should return to the background color.
12. Click **NV Save**.

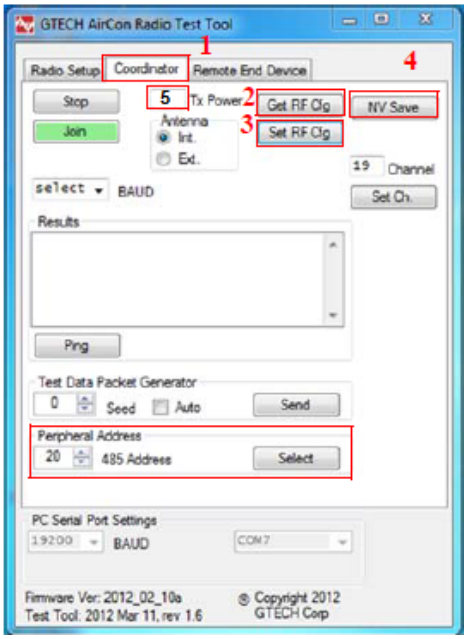
Setting Transmit Power and Failsafe Values and Testing the Joining Pair

Setting the Transmit Power level (EU or US) and Failsafe Values:

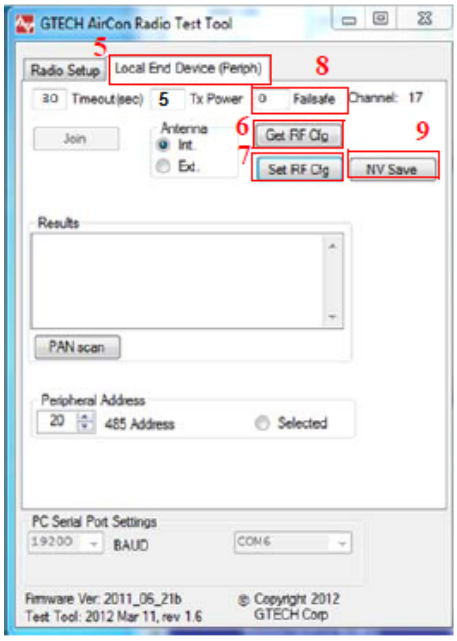
NOTE: Do not set the transmit power level to above TX Power 18 for US and 5 for EU. Refer to “Reference Charts” on page 9-11.

1. On the **Coordinator** radio, select the **Coordinator** tab.
2. Click **Get RF Cfg** in the GTECH AirCon Radio Test Tool.

   The value should read 5 for EU and 18 for US. See the Transmit Power Levels chart provided (Figure 9-2 on page 11).
3. Enter the correct value and then select **Set RF Cfg**.
4. Select **NV Save**.



5. On the **End Device** radio, select the **Local End Device (Periph)** tab.
6. Select **Get RF Cfg**, on the Peripherals tab; the value should read 5 for EU and 18 for US.
7. Enter the correct value and select **Set RF Cfg**.
8. **Failsafe** should read 0 (zero); if any other value is there, replace it with 0 and select **Set RF Cfg**. Note that the end device TX Power and **Failsafe** values can be set at the same time.
9. Select **NV Save**.
10. Close both instances of the PC Test-Tool.
11. Remove the cable from both radios.



Testing the Joined Pair:

This procedure is used to:

- Verify that a factory-new radio module can be configured as an 802.15.4 PAN Coordinator using the LSR/GTECH PC Test-Tool.
- Verify a second factory-new radio is joined (paired) as an End Device to the new Coordinator using a second instance of the LSR/GTECH PC Test-Tool.
- Verify the Coordinator is able to communicate End Device radio joined to its PAN by selecting its GTECH485 Peripheral Address.
- Verify data packet communication and fragmentation/defragmentation by exchanging maximum size test packets between Terminal Coordinator and End Device Peripheral emulators.
- Verify that an End Device radio rejoins its paired PAN Coordinator after experiencing a Power-On or Reset event.
- Verify that an End Device radio rejoins its paired PAN Coordinator after the Coordinator radio experiences a Power-On Reset event.

1. Restart the two instances of the PC Test-Tool.
2. Select one as the **Coordinator** Mode and one as the **End Device** Mode.
3. Select the **COM** ports previously selected for each instance.
4. On both windows, click **Open**.
5. On both windows, click **Get Status** and verify that the Coordinator is identified as the *Coordinator* and the End Device is identified as *Device Joined*.
6. Select the **Local End Device (Periph)** tab on the **End Device** radio and the **Coordinator** tab on the **Coordinator** radio.
7. On the **Coordinator** radio, select the **Coordinator** tab, then the **Select** button.

   On the End Device, the **Local End Device (Periph)** tab should indicate **Selected**, and there should be no Time-out or other error Dialog boxes displayed.

8. Press **Send** on the **Coordinator,** then check that the Results text panes for the **Coordinator** and **End Device** radios have the same information.
9. On the **Coordinator** tab, select **Ping**. Under Ping Results, you should see the TX Power that you set earlier and verify that the Channel is set to what you set earlier.
10. On the **End Device**, ensure that the Channel is also set accurately to what you set earlier.
11. On the **End Device** radio, on the **Local End Device (Periph)** tab, the 485-Address will be set to the default 20(hex) and the **Selected** indicator should be cleared.

12. On the **Coordinator** radio, on the **Coordinator** tab; the 485-Address will also be 20. Click **Select**, the End Device's **Selected** indicator should now be set and there should be no Time-out or other error Dialog boxes displayed.

    Note that the first peripheral address is 20, and that additional peripherals will be numbered from 21 up to 29 allowing for 10 peripherals to be connected to the device.
13. On the **Coordinator** radio, click **Send** to generate a maximum length test data packet to the selected Peripheral Address. The PC Test-Tool instance at the Local End Device will return any data packets it receives from its Coordinator. There should be no error dialogs displayed by either instance of the PC-Test-Tool.

NOTE: Because this procedure sends a maximum length test message over-the-air to the End Device radio and back, it is possible that errors may occur due to external influences. If an error does occur, click Send again to retry.

Reference Charts

RF Channel	Max Host RF Power Value (dBm)		TX_PWR Register Value		RF Output Power (mW)	
	US	EU	US	EU	US	EU
11	18	5	0xC5	0x35	63.1	3.2
12	18	5	0xC5	0x35	63.1	3.2
13	18	5	0xC5	0x35	63.1	3.2
14	18	5	0xC5	0x35	63.1	3.2
15	18	5	0xC5	0x35	63.1	3.2
16	18	5	0xC5	0x35	63.1	3.2
17	18	5	0xC5	0x35	63.1	3.2
18	18	5	0xC5	0x35	63.1	3.2
19	18	5	0xC5	0x35	63.1	3.2
20	18	5	0xC5	0x35	63.1	3.2
21	18	5	0xC5	0x35	63.1	3.2
22	18	5	0xC5	0x35	63.1	3.2
23	18	5	0xC5	0x35	63.1	3.2
24	18	5	0xC5	0x35	63.1	3.2
25	18	5	0xC5	0x35	63.1	3.2
26	13	5	0x85	0x35	20.0	3.2
Note: When using Optional External Dipole Antenna, RF Channel 26 reduces for FCC Compliance:						
26	9	5	0x65	0x35	7.9	3.2

Transmit Power	Characterized	Power	CC2530
18	18.45 dBm	70.0mW	0xD5
17	17.37 dBm	54.6mW	0xB5
16	16.42 dBm	43.9mW	0xA5
15	15.06 dBm	32.1mW	0x95
14	14.08 dBm	25.6mW	0x85
13			0x75
12	12.63 dBm	18.3mW	0x75
11	10.97 dBm	12.5mW	0x65
10			0x55
9			0x55
8	8.94 dBm	7.83mW	0x55
7			0x45
6	6.64 dBm	4.61mW	0x45
5			0x35
4	4.30 dBm	2.70mW	0x35
3			0x25
2	2.71 dBm	1.87mW	0x25
1	0.70 dBm	1.18mW	0x15
0	-0.8 dBm	832uW	0x05

Figure 9-2. Charts of Compliance Limits and Transmit Power Levels

Pairing with an EPP or other Orphan End Device

Prior to pairing radios with another device, the **Coordinator** must be set to *Join* status using the PC application. Then you must press and hold the push button switch on the **End Device** radio for about 3 seconds to place the **End Device** radio into the network *Join* Mode. In *Join* Mode, the radio will attempt to associate with any nearby PAN **Coordinator** indicating this attempt by flashing the LED at a 500ms ON and 500ms OFF cadence.

If and when the radio receives a beacon from a **Coordinator** in response to its beacon request while attempting to associate the LED, the LED will exhibit a steady ON indicating it has found a **Coordinator**.

NOTE If you hold the push button switch too long (over 10 seconds), when you release the button you will see the LED flash RED once and the Radio returns to the Uninitialized Status.

The End Device radio's EUI-64 should now appear in the Results text pane on the Coordinator tab. When the results display an address, double-click on the address. It will disappear indicating a join.

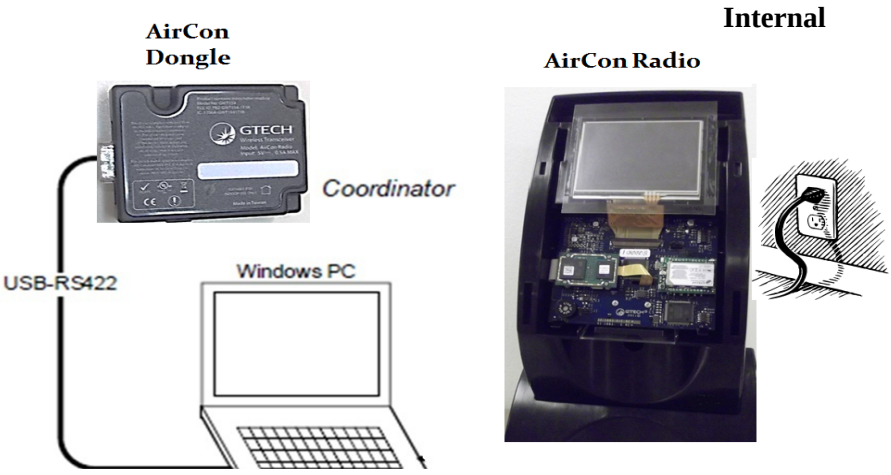
After the End Device has joined with the Coordinator, then the Coordinator will remain in *Join* mode until stopped. To stop any further joins with other devices, on the PC application, click the **Join** button on the **Coordinator** tab to inhibit polling for any new Join requests. The **Join** button should return to the background color indicating it is no longer in Join mode. Click **NV Save** to complete the process.

Configuring and Pairing Radios

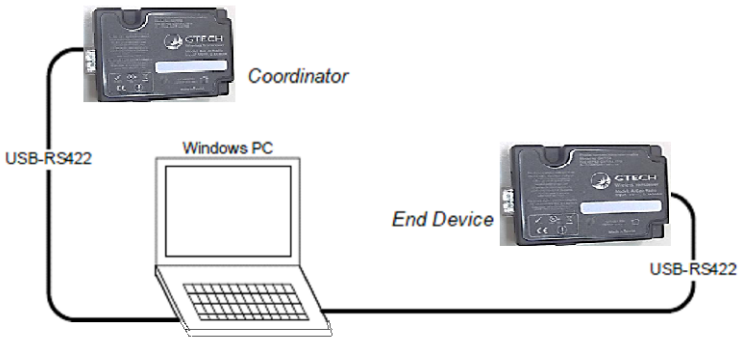
Note the following Configurations for the Pairing of different devices:

Pairing EPP Wireless

Pairing TSP Wireless



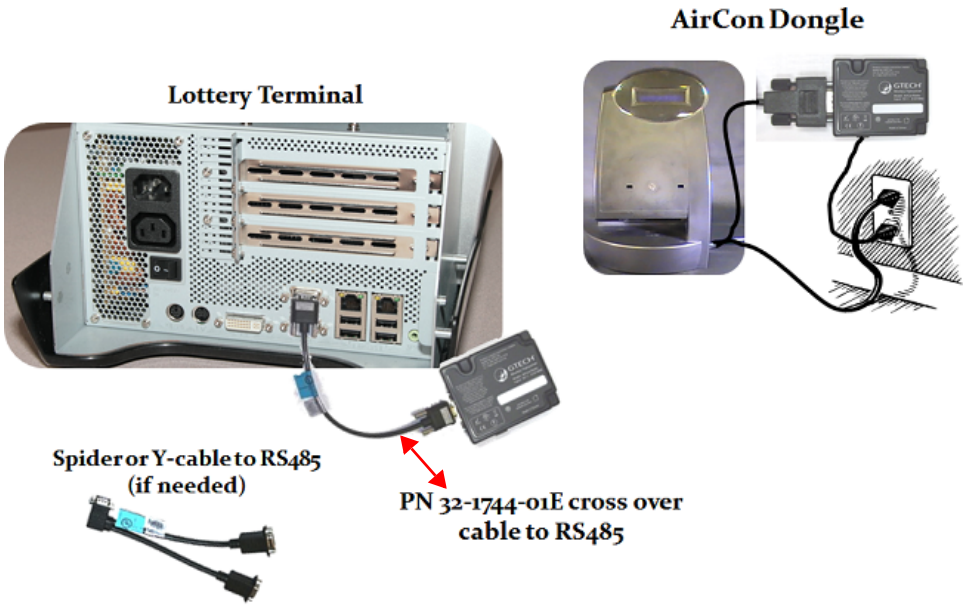
OR



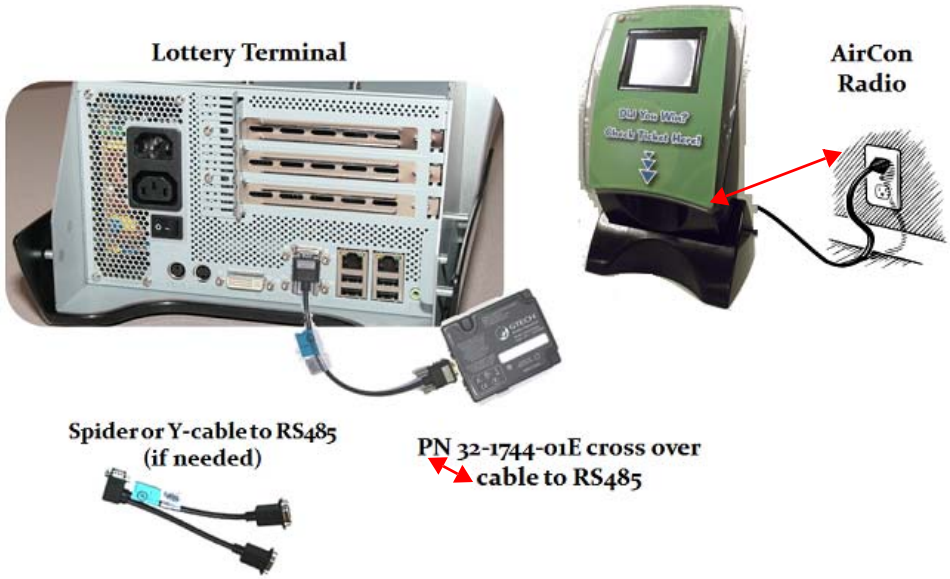
End Device Connections

Note the following example connections for wireless devices:

Connection Wireless EPP



Connections Wireless TSP



IMPORTANT!

For a terminal to be able to recognize the TSP wirelessly, the OFF-SET ADDRESS on the TSP **MUST** be set to “9” prior to connecting and powering on the terminal.

10

Spare Parts and Tools

Contact GTECH Field Service Engineering for spare parts if necessary (#FieldServiceEngineering@GTECH.com).

A

Acronyms & Abbreviations

AC	Alternating Current
ACL	Access Control List
aka	Also known as
AL	Analog Loopback
APB	Analog Processing Board
AT	Advanced Technology
API	Application Programming Interface
App	Application
ARM	Advanced RISC (Reduced Instruction Set Computer) Module
BERT	Bit Error Rate Tester
BIOS	Basic Input Output System
bps	Bits per Second
^{o}C	Degrees (Centigrade) Celsius
CCD	Charge Coupled Device
CCFT	Cold Cathode Fluorescent Tube
CCITT	The International Telegraph and Telephone Consultive Committee
CE	Conformite' Europeene [CE marking w/in the European Union (EU)]
CFR	Code of Federal Regulations
CIS	Contact Image Sensor

CPLD	Complex Programmable Logic Device
CPU	Central Processing Unit
CSA	Canadian Standards Association
CSU/ DSU	A modem that is typically used with AT&T DDS service or a similar service provided by another carrier.
CTR	Common Technical Regulation
CTS	Clear to Send
CTs	Color Touchscreen
dB	Decibels
dBa	Adjusted Decibel
dBm	Decibel referred to 1 mWatt
dBv	Decibel referred to 1 Volt
DC	Direct Current
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DDS	Digital Service is a network service offered by AT&T. This is also an acronym for Digital Data Service.
degrees C	Degrees Centigrade
DFMA	Design for Manufacturability and Assembly
DIMM	Dual In-line Memory Module
DMA	Direct Memory Access
DOC	DiskOnChip
dots/mm	dots per millimeter
DPB	Digital Processing Board
dpi	Dots per Inch
DPST	Double Pole Single Throw
DQA	Design Quality Assurance
DVT	Design Verification Testing
DRAM	Dynamic Random Access Memory
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
DUART	Dual Universal Asynchronous Receiver Transmitter
ECO	Engineering Change Orders
ECP	Enhanced Capabilities Port
EDO	Extended Data Out
EEPROM	Electrically Erasable Programmable Read Only Memory
EEROM	Electronically Erasable Programmable Logic Device
EFT	Electrical Fast Transients
EIDA	Enhanced Integrated Drive Electronics

EIDE	Extended Integrated Drive Electronics
EMC	Electromagnetic Capability
EMI	Electromagnetic Interference
EPA	United States Environmental Protective Agency
EPLD	Electronically Programmable Logic Device
EPP	Enhanced Parallel Port
EPP	Express Point Plus
EPROM	Erasable Programmable Read Only Memory
ESD	Electrostatic Discharge
ETSI	European Telecommunications Standards Institute
EUI	Extended Unique Identifier (aka MAC address)
F	Fahrenheit
FCC	Federal Communications Commission
FCC Part 15	This agency approval ensures that the device does not cause excessive interference with other devices likely to be found in a commercial environment.
FCC Part 68	This agency approval ensures that the device, when connected to the telephone network, will not harm the network or network personnel.
FBBN	Flash Bank (Bit Number)
FDD	Floppy Disk Drive
FFC	Flat Flex Cable
FIFO	First in First out
FPG	Flash Page
FST	Field Service Technician
g	gram
gf	gram force
GRUB	Grand Unified Boot Loader
GTECH 485	Shorthand for the wired serial protocol defined in GTECH 96-0258-01
GUTS	GTECH Universal Tracking System
HDD	Hard Disk Drive
Hz	Hertz (Cycles per Second
I485	Internal 485
IC	Integrated Circuit
ID	Identification
in	Inches
IPC	Institute of Printed Circuits
IPS	Inches per Second
IR	Infrared
ISA	Industry Standard Architecture
ISO	International Standards Organization

ITU	International Telecommunications Union (formerly the CCITT)
KB	Kilobyte
kg	Kilogram
LAN	Local Area Network
lbs.	Pounds
LCD	Liquid Crystal Display
LCS	Loop Current Sense
LED	Light Emitting Diode
LIF	Low Insertion Force
LPS	Limited Power Source
LPT	Line Printer
LVDS	Low Voltage Differential Signal
mA	milli-Amperes
MA	Memory Address
MB	Megabyte
MCBF	Mean Cycles Between Failure
MCU	Micro Controller Unit
MDP	Modem Data Pump
MIDI	Musical Instrument Digital Interface
mm	Micrometer
mm/sec	Millimeter per second
MMX	Multimedia Extensions
ms	Millisecond
MTBF	Meantime Between Failures
MTTR	Mean Time to Replace
ns	Nanosecond
NVRAM	Non-volatile Random Access Memory
OCR	Optical Character Recognition
OEM	Original Equipment Manufactured
OH	Off-Hook
OM	Open Architecture Modular Package
OS	Operating System
OTP	One-Time Programmable
PA	Power Amplifier
PAN	Personal Area Network
PC	Personal Computer
PCB	Printed Circuit Board
PCI	Peripheral Communications Interface
PCMCA	PC Memory Card International Association
PFD	Power Fail Detect (generated by power supply)
PIN	Personal Identification Number

PIT	Paper in Throat
P/N	Part Number
PSTN	Public Switched Telephone Network
PTC	Positive Temperature Coefficient (Type Fuse)
RAM	Random Access Memory
RAP	Read-After-Print
RDCLK	Receive Data Clock
RDL	Remote Digital Loopback
RI	Ring Indicator
RF	Radio Frequency
ROM	Read Only Memory
RS232	EIA RS232 Electrical Standard
RSSI	Received Signal Strength Indication
RTS	Request to Send
RxD	Receive Data
s	second
SA	Stand Alone
SAW	Surface Acoustic Wave
SCC	Serial Communications Controller
SIMM	Single In-Line Memory Module
SO-DIMM	Small outline DIMM
SPDT	Single Pole, Double Throw
SPGA	Staggered Pin Grid Array
SPKR	Speaker
SRAM	Static Random Access Memory
TDCLK	Transmit Data Clock
TFT	Thin Film Transistor
TI	Texas Instruments
TSP	TicketScan Plus
TTL	Transistor-Transistor Logic
TUV	Technischer Uberwachungs Verein
TxD	Transmit Data
UART	Universal Asynchronous Receiver Transmitter
UL	Underwriter’s Laboratory
us	microsecond
USB	Universal Serial Bus
V	Volt
VAC	Voltage Alternating Current
VCC	+5V Supply Voltage
VDC	Voltage Direct Current
VFD	Vacuum Fluorescent Display

VGA	Video Graphics Array
VIRN	Void If Removed Number
Vpen	Voltage Program Enable
Vrms	Voltage root means squared
WAN	Wide Area Network
WE	Western Electric
XPB	Transport Controller Board
XTCLK	External Transmit Clock
ZIF	Zero Insertion Force

B

Product Safety & Approvals

Safety Instructions

- The device may only be installed by qualified, trained personnel.
- Field Service Manuals and for the device are provided at the time of training.
- If the device was stored in a cold environment, condensation can occur. In order to prevent condensation, wait for the terminal to acclimate to the temperature for 3 to 4 hours before opening the package.
- Verify that the device nominal voltage matches the voltage of the local line to which it is being installed.
- Ensure that the power outlet to which the device is being connected is freely accessible.
- Always grip the cable plugs to remove them from outlet, never pull the power or data cables from the sockets by the cables.
- Lay leads and cables so that no one can stand on or trip over them.
- In the case of an emergency (e.g. damaged housing, operating device or power cable, entry of moisture or objects), switch off the terminal, pull out the power cable and contact the responsible customer support department.

- Repairs or modifications to the device may only be carried out by qualified, trained personnel.
- Unauthorized opening of the device and repairs may result in considerable danger, as well as jeopardize the warranty coverage.

FCC

Compliance Statement (Part 15.19)

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.

Warning (Part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement (Part 15.105 (b))

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 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 of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into 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.

RF Exposure (OET Bulletin 65)

To comply with FCC/IC RF exposure requirements for mobile transmitting devices, this transmitter should only be used or installed at locations where there is at least 20cm separation distance between the antenna and all persons.

Industry Canada

Section 7.1.2 of RSS-GEN

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number, or model number if

Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device. This device has been designed to operate with the antenna(s) listed below, and having a maximum gain of {x} dB. Antennas not included in this list or having a gain greater than {x} dB are strictly prohibited for use with this device. The required antenna impedance is {y} ohms.

Section 7.1.3 of RSS-GEN

This Device complies with Industry Canada License-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause interference, and;
2. This device must accept any interference, including interference that may cause undesired operation of the device.

OEM Responsibilities to comply with FCC and Industry Canada Regulations

The AirCon Radio Module has been certified for integration into products only by OEM integrators under the following conditions:

1. The antenna(s) must be installed such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and all persons at all times.
2. The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter.

As long as the two conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

IMPORTANT NOTE: In the event that these conditions cannot be met (for certain configurations or co-location with another transmitter), then the FCC and Industry Canada authorizations are no longer considered valid and the FCC ID and IC Certification Number cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC and Industry Canada authorization.

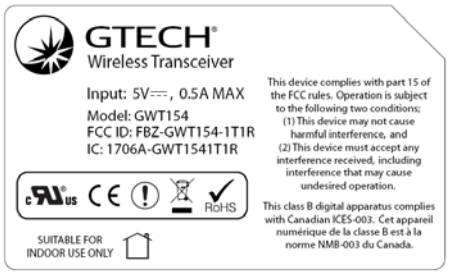
End Product Labelling

The AirCon Radio Module is labeled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. See labels below.

To comply with FCC and Industry Canada RF radiation exposure limits for general population, the antenna(s) used for this transmitter is installed such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and all persons at all times and are not co-located or operating in conjunction with any other antenna or Revision History.

Labels

Dongle Label



Radio Label