
5Connectivity

This section describes how to connect multiple LGCell systems and how to connect specific microcellular base stations (MBSs) to the LGCell.

Please refer to the tables in *Section 2, LGCell Equipment*, for important information on system gains and maximum RF power per carrier.



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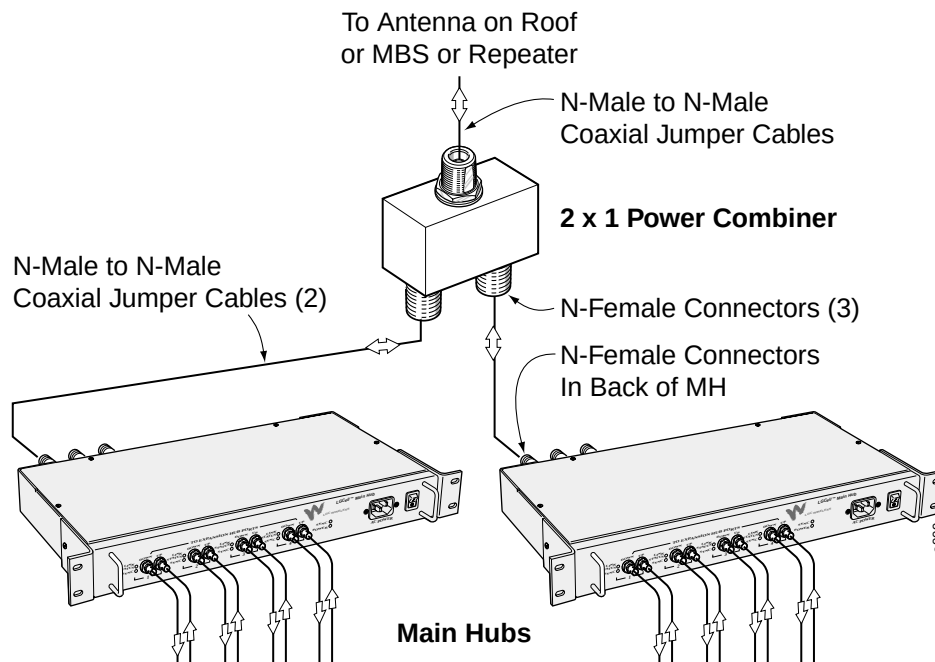
Connecting Multiple LGCell Systems

Connecting multiple LGCell systems increases the total number of Remote Antenna Units (RAUs). Multiple LGCells can be stacked to increase the total number of RAUs through the use of power combiner/dividers.

LGC Wireless provides Integration Modules which may be used with the LGCell to efficiently centralize additional radio capacity inside a facility. These Modules provide the connection between the radios for the facility and the LGCell system. Because the Integration Modules distribute all available radio capacity automatically among all antennas within a cell, available capacity is dynamically allocated throughout the entire coverage area, thus providing an improved grade of service without the need to conduct ongoing traffic monitoring and analysis. Specific installation information on all available Integration Modules may be found in the *Integration Module Installation and Reference Manual*.

Connecting two LGCells

Connecting two LGCells increases the total number of RAUs from 16 to 32. A 2x1 or 2x2 hybrid power combiner/divider is required (see graphic below).



The following are procedures for connecting two LGCells. For Dual Band installations, connect a power combiner/divider for each Main Hub band.

1 **Connect Cables**

From LGCells to Hybrid Power Combiner/Divider	To Roof-Mounted Antenna, Repeater, or MBS
Connect the DUPLEX, FORWARD, or REVERSE connector of one of the Main Hubs to an input/output port on the power combiner/divider using an N-male to N-male coaxial cable jumper.	Connect the combined port of the power combiner/divider to a roof-mounted antenna, repeater, or MBS using an N-male to N-male coaxial cable jumper.
Connect the DUPLEX, FORWARD, or REVERSE connector of the second Main Hub to the second input/output port on the power combiner/divider using an N-male to N-male coaxial cable jumper.	

2 **Check Main Hub LEDs**

After connecting the LGCells, check all Main Hub LEDs to ensure that the system is operating properly.

Connecting More Than Two LGCells

Repeat this procedure to connect any number of LGCell systems. For three systems, use a 3x1 power combiner/divider, and so on.

Connecting LGCell to Base Stations, Microcells, or Picocells

One or more LGCell systems can connect with any base station, microcell, or picocell. Before connecting an LGCell system to one of these, confirm the following items:

- Connector type (LGCell uses N-type connectors)
- Power distribution (LGCell supports either duplex or simplex)
- Maximum power output (dBm) (Do not exceed the maximum input power into the Main Hub. If the input power is too high, an attenuator might be required.)

For more information about connections to microcellular base stations or picocells, including connections to multiple base stations, see the *Integration Module Installation and Reference Manual*.

6 Common Problems, Troubleshooting, and Frequently Asked Questions

This section provides procedures for troubleshooting *LGCell* problems based on the front panel diagnostic LEDs.

LGCell has no user-serviceable parts. Faulty or failed units are fully replaceable through LGC Wireless. U.S. customers, please contact us at 1-800-530-9960. International customers, please contact us at +1-408-487-2400.



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Common Problems and Troubleshooting

The LGCell has three sources of potential problems:

- Malfunction of one or more LGCell component
- Faulty cabling/connector
- Antenna, base station, or repeater problem

By far, most problems discovered have to do with faulty cabling. All CAT 5 cable should be tested to TIA/EIA 568-A specifications.



The diagnostic procedures are based on information in the *Diagnostic Table* on page 9. The table lists all LEDs and indicates what to do under certain circumstances. There is a blank table at the end of this section that you can copy and use to record the LEDs while you troubleshoot an LGCell system.

After following the recommended procedures, if you cannot determine the cause of a problem, call LGC Wireless customer help hotline:

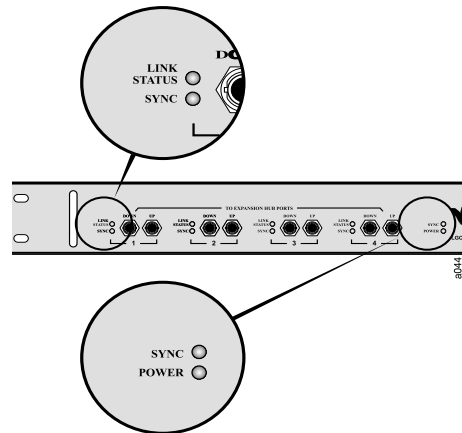
1-800-530-9960

(International customers, please call +1-408-487-2400 for assistance.)

LED Indicator Description

The LGCell Main Hub, Expansion Hubs, and RAUs have front panel LEDs. The LEDs provide diagnostic information and operational status of each unit. Together they provide an efficient diagnostic display system, which help technicians find the fault if there is a malfunction.

Main Hub LEDs



There are two sets of LEDs on the Main Hub front panel:

- Main Hub MMF Ports
- Main Hub Functionality LEDs

- **Main Hub MMF Ports LEDs**

Provides status on each of the Main Hub's four MMF ports.

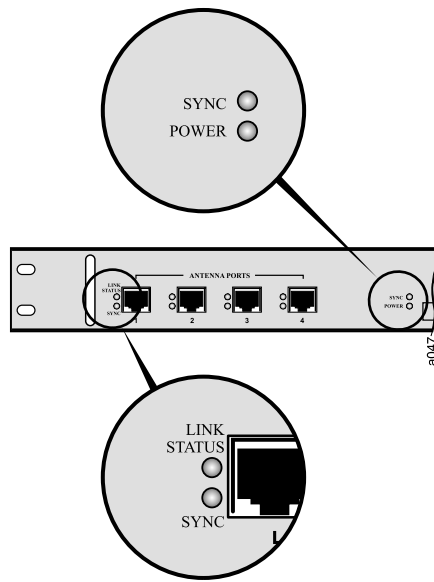
LED	Color	Indication
LINK STATUS	Green	Indicates a good connection to Expansion Hub for that port.
	Red	Connection problem to Expansion Hub.
SYNC	Green	Indicates Expansion Hub and any RAUs connected to it are operating properly.
	Red	Problem with Expansion Hub or one of the RAUs.

- **Main Hub Functionality LEDs**

The LEDs provide diagnostic information on the Main Hub's functionality.

LED	Color	Indication
SYNC	Green	Indicates Main Hub is correctly producing the synchronization signal.
POWER	Green	Turns green when Main Hub has power.

Expansion Hub LEDs



There are two sets of LEDs on the front panel

- Expansion Hub UTP/STP Ports
- Expansion Hub Functionality

- **UTP/STP Ports LEDs**

Provides status on each of the Expansion Hub's four UTP/STP ports.

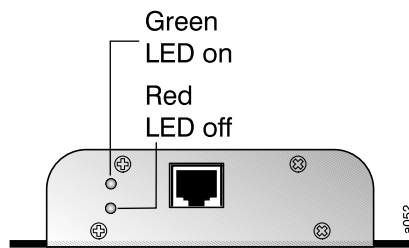
LED	Color	Indication
LINK STATUS	Green	Indicates good connection to the RAU.
	Red	Connection problem between Expansion Hub and the RAU plugged into that port.
SYNC	Green	Indicates RAU connected to it is operating properly.
	Red	Problem with the RAU plugged into that port.

- **Expansion Hub Functionality LEDs**

Provides diagnostic information on the Expansion Hub's functionality.

LED	Color	Indication
SYNC	Green	Indicates Expansion Hub is receiving the synchronization signal from Main Hub.
POWER	Green	Turns green when Expansion Hub has power.

RAU LEDs



RAUs have two LEDs:

- Sync
- Power

LED	Color	Indication
SYNC	Red	Antenna lost sync and has shut down RF power.
POWER	Green	Antenna is plugged in and the connected Expansion Hub is on.

Troubleshooting Guidelines

The LGCell Main Hub, Expansion Hub, and RAUs have front-panel indicator LEDs that provide diagnostic information and the operational status of each unit. Together they provide an efficient diagnostic display system for maintenance and fault location if a malfunction ever exists. The troubleshooting procedures in this section are based on the front panel diagnostic LEDs.

The following table contains supplementary troubleshooting information that the diagnostic LEDs do not cover. Please check the table for a possible cause of a problem. Some simple checks or a minor adjustment might eliminate the problem and restore proper operation.

Problem/Symptoms	Check
No downlink signal output when all diagnostic LEDs are green.	Make sure that there is a reasonable amount of power at the input of the Main Hub. Measure the output power of the coaxial cable using a power meter. The LGCell is intended for a different frequency band. Verify that your system corresponds to the desired frequency spectrum (for example, 800 MHz, 1800 MHz, or 1900 MHz). Check the part number of each unit. The LGCell is factory set for different bands of operation. Please be sure you have the proper band.
The system gain is lower than specification.	The optical fiber connector is dirty. Clean the fiber ST-connector, using the manufacturer's recommended cleaning procedure. There are two types of Multi-Mode Fiber (MMF), 62.5/125 μm and 50/125 μm. Make sure the vertical run MMF is the 62.5/125 μm type of fiber.
Remote Antenna Unit (RAU) power LED (green LED) stays off after you plug in the twisted pair cable.	The Expansion Hub provides power to the RAU. Make sure the Expansion Hub is on. Make sure that the twisted-pair (TP) cable wiring conforms to the TIA/EIA 568-A standard. (For information about the standard, refer to <i>Appendix B – TIA/EIA 568-A Cabling Standard</i>.) Use a standard local area network (LAN) cable tester to perform this test. Possible errors are wrong wiring and/or cable length.
The LGCell performance is intermittent when you use it for the CDMA application.	The uplink and downlink gain is not balanced. A CDMA system performs active power control between the base station and the mobile unit. It is important to maintain a balanced link from the base station ports to the RAU ports (equal uplink and downlink gain) to optimize the performance of the LGCell.

Diagnostic Procedures

Use the following table when diagnosing system problems. While troubleshooting, you can copy the blank table on page 12 and use it to record the LED colors on the Main Hub, the particular Expansion Hub indicating a fault, and the RAUs connected to it. This is necessary because the Main Hub, Expansion Hubs and RAUs might be geographically distributed.

To determine where the fault might be

- 1** Go to the Main Hub and record the LEDs. The Main Hub indicates which Expansion Hub may be faulty by lighting one of its port LEDs red.
- 2** Go to the Expansion Hub attached to the port that has a red LED.
- 3** Record that Expansion Hub's LEDs. The Expansion Hub indicates which RAU(s) may be faulty by lighting its antenna LED red.
- 4** Go to the RAU(s) connected to the Expansion Hub port indicating a fault. Record the error.
- 5** Compare your filled in table to the Diagnostic Table below and begin troubleshooting according to the notes indicated for your situation.

Diagnostic Table

Visual Alarm LEDs										Remote Alarm Contacts	See Note	
RAU		Expansion Hub				Main Hub				DB-9 Connector		
		PORT LEDS		HUB LEDS		PORT LEDS		HUB LEDS				
POWER	SYNC	LINK STATUS	SYNC	SYNC	POWER	LINK STATUS	SYNC	SYNC	POWER	MAJOR ALARM CONTACT	ERROR LATCH CONTACT	
Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Short	Short	1
Off	Off	Off	Off	Off	Off	Red	Red	Green	Green	Open	Open	2
Off	Off	Green	Red	Green	Green	Green	Red	Green	Green	Open*	Open	3
Off	Off	Red	Red	Green	Green	Green	Red	Green	Green	Open*	Open	4
Green	Red	Green	Red	Green	Green	Green	Red	Green	Green	Open	Open	5
Green	Red	Green	Red	Off	Green	Green	Red	Green	Green	Open	Open	6
Green	Red	Green	Red	Red	Green	Red	Red	Green	Green	Open	Open	7
Green	Red	Green	Red	Off	Green	Off	Off	Off	Off	Open	Open	8
Green	Red	Green	Red	Red	Green	Green	Red	Red	Green	Open	Open	9
Green	Off	Green	Green	Green	Green	Red	Red	Green	Green	Open	Open	10
Off	Off	Red	Red	Green	Green	Green	Red	Green	Green	Open*	Open	11

Major and Error Latch contacts indicate an alarm when the contacts go from a short to open state.

* Major Alarm contact will momentarily open for 100 milliseconds.

The following numbers correspond to the “See Note” column of the Diagnostic Table above.

- 1 System is functioning properly.
- 2 The Expansion Hub is off.
Make sure the power cord is connected to a live AC power jack and that the Expansion Hub power switch is in the **1** position.
- 3 Power is being delivered to the RAU but it is not turning on.
 - Check that the UTP/STP cable has been properly crimped and passes a standard CAT 5 compliance test.
 - If that is not the problem, replace RAU.

-
- 4 Power is not being delivered to the RAU.
- Switch the UTP cable to a different Expansion Hub port to see if the same problem occurs.
- If the LEDs on the new port are both green, there is a problem with the Expansion Hub.
- If the problem persists, there is a problem with either the RAU or the UTP/STP cable.
- Check that the UTP/STP cable has been properly crimped and passes a standard TIA/EIA 568-A CAT 5 compliance test.
- If the cable passes the CAT 5 test, replace the RAU.
- 5 RAU has lost synchronization.
- Make sure that the UTP/STP passes CAT 5 testing.
 - If the cable is OK, replace the RAU.
- 6 The Expansion Hub is not properly receiving the synchronization signal from the Main Hub.
- The MMF cable connection might not be good or if system was working, the MMF downlink cable is pulled out or cut. Switch MMF cables.
 - If the problem persists, switch to a different Main Hub port. If this solves the problem, the Main Hub port is malfunctioning.
 - If the problem persists, there is an Expansion Hub problem.
 - If switching MMF cables is not practical, switch the uplink and downlink pairs. (A connection error may have been made when connecting the Main Hub **UP** port to the Expansion Hub **UP** port, and similarly for the **DOWN** ports.)
 - If the Expansion Hub **SYNC** LED turns green, one of the MMF cables was bad or the connection between the Main Hub and Expansion Hub was done incorrectly. If both are bad, this test will not help. Switch to a different Main Hub port.
- 7 The Expansion Hub is not properly receiving the synchronization signal from the Main Hub.
- Too much loss on downlink MMF. Might be due to MMF pairs not attached to the proper connector.
- Check that the “**down**” cable end is in the **DOWN** port connector on both the Main Hub and on the Expansion Hub. Same for the “**up**” cable end and connectors for the **UP** port.
 - If the problem persists, check the integrity of MMF cable using an Optical Time Domain Reflectometer. If the fiber is faulty, replace it.
 - If the MMF cable is OK, try using a different Main Hub port.

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- If the problem persists, replace the Main Hub.
 - If the problem persists, replace the Expansion Hub.
- 8** The Main Hub is off.
Make sure the power cord is connected to a live AC power jack and that the Main Hub power switch is in the **1** position.
- 9** Main Hub is not properly generating the synchronization signal.
Turn off the Main Hub and turn it back on. If the sync LED stays off, the Main Hub might require replacement.
- 10** The Expansion Hub is not properly sending the synchronization signal to the Main Hub.
The MMF cable connection might not be good, or if the system was working, the MMF uplink cable is pulled out or cut.
- 11** The RAU is off.
- Check that the UTP/STP cable is operating properly.
 - If the system was working, the RJ 45 cable is pulled out or cut.

Use the following blank table to record LEDs as you troubleshoot

[illegible]

Frequently Asked Questions

The following list provides answers to some frequently asked questions about LGCell:

1 What is the LGCell Distributed Antenna System?

The LGCell Distributed Antenna System (DAS) contains multiple low-power radiating elements that are deployed around indoor facilities to improve coverage and capacity. The unique, patented architecture of the LGCell DAS provides an inexpensive solution to the cellular and PCS provider for coverage/capacity upgrades and private microcell applications.

2 *What is twisted pair cable? Will it pick up spurious emissions?*

Twisted pair (TP) cable is the standard cable that you find at the back of your computer for the network hookup. TP cable is the most ubiquitous cable in any office building. Furthermore, TP cable is inexpensive and easy to install. The twisting nature of the cable creates a transmission line for efficient signal transfer and rejection of spurious emissions. The LGCell uses a state-of-the-art common-mode rejection device that reduces pickup of spurious emissions on a TP cable by a factor of 10,000.

3 *Can a single LGCell simultaneously support multiple access standards (such as 800 AMPS/TDMA)?*

Yes. The LGCell is a frequency selective product. The LGCell system is transparent to the protocol that the base station and mobile unit use. You can view the entire system with all the cables together as a frequency selective repeater with a specified gain.

4 *What is the bandwidth of the LGCell?*

LGCell selects from the RF bandwidth, which can help prevent amplification of an unwanted signal, such as a competitor's signal. Refer to the data specifications for the RF bandwidth of the system. Another interpretation of bandwidth is the amount of data that the LGCell system can transmit. The microcellular or macrocellular base station to which the LGCell is connected limits the bandwidth or capacity of the LGCell, which is a transparent system. Total, composite output power and spurious emissions are the only constraints that limit the amount of channels that an RAU can radiate. Furthermore, the LGCell system shall not limit the data rate of the modulation transmitted through the system.

5 *Can the LGCell support multiband operation?*

The LGCell provides a wide variety of single-band products, including the U.S. 800 MHz, European GSM 900, DCS 1800, Korean PCS 1800, U.S. PCS 1900 systems, and iDEN. You can use these systems together to provide multiband services. In addition, LGCell has a Dual Band 900/1800 system available.

6 *Can the LGCell system share the same UTP Category 5 Cable with the Ethernet network?*

No. The LGCell system can use the existing unused cabling inside the building; however, you cannot use the same cable to connect an RAU and a computer.

7 *What is the minimum power input to the Main Hub?*

The coverage area of an RAU is directly related to the input down link power at the Main Hub. Therefore, an input power that generates an output power of 0dBm per channel optimizes the coverage area of an RAU.

8 *What is the minimum detectable power of an RAU?*

The minimum detectable power of system with 1 RAU is -114 dBm in a 30 kHz bandwidth, -106 dBm in a 200 kHz bandwidth, and -98 dBm in a 1.25 MHz bandwidth, without taking into account the processing gain of different access standards.

9 *What is the difference between connecting the LGCell to a roof-mounted antenna and to a microcellular base station?*

Connecting the LGCell to a roof-mounted antenna increases the coverage of the indoor environment. Connecting the LGCell to a microcellular base station improves both the coverage and the capacity in the building and might also provide a private wireless office application for the customer.

10 *Does each Main Hub require a separate coaxial feed to the base station?*

A typical RF input power per channel to the Main Hub is 0 dBm. This provides a lot of margin (link budget margin) for interfacing with antennas through a base station that typically has an output power of 20 dBm. Therefore, a power combiner/splitter might be installed between the MH and the base station. This enables one base station to connect to multiple Main Hubs. For details, refer to *Section 2, LGCell Equipment*.