TREBL with Sprint Magic Box User Guide

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About this guide

This guide describes how to use the features of TREBL with Sprint Magic Box, hereafter referred to as TREBL.

It contains the following topic:

- Revision information
Revision information

Table 1: Revision information

<table>
<thead>
<tr>
<th>Document issue and date</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Oct 2019</td>
<td>TREBL</td>
<td>Initial User Guide Created</td>
</tr>
</tbody>
</table>

Note and Attention text

Throughout this guide, there are paragraphs set off by ruled lines above and below the text. These paragraphs provide key information with two levels of importance, as shown below.

Information to help you maximize the benefits of TREBL.

Issues that, if ignored, may seriously affect performance, security, or the operation of TREBL.
Get to know your TREBL

TREBL—A three-in-one device that boosts LTE data signals in your home, provides premium audio via a built-in harman/kardon speaker and provides Alexa voice assistant capabilities.

This chapter contains the following section:

- About TREBL
About TREBL

In a partnership between Sprint and Harman, TREBL was developed to provide new generation Magic Box capabilities for Sprint with integrated harman/kardon premium audio and Alexa capabilities.

This section contains the following topics:

- Capabilities of the device
- Security features of TREBL

Capabilities of the device

TREBL has the following capabilities:

- Communicates visually through light display
- Simple installation
- Works with most smartphones and mobile hotspots
- Premium audio with built-in HK 16W speakers, Bluetooth enabled, and Amazon Alexa Voice Assistant
- IP54 water-resistant device
- Boosts Sprint LTE data network signals
- VoLTE capable and 5G support
- LTE access with 1 sector omni B41 LTE access, 2 x 21dBm, 16 users LTE/ VoLTE
- UE Relay with 4T8R UE-Relay (B41 & B25) with omni antenna for easy install
- Optional Wi-Fi Backhaul feature with 2.4/5 GHz
- Plug and Play with Voice Guided Installation (VGI) sound support
- Easy to install Set Up Assistant app, which is a companion App for TREBL

Security features of TREBL

This section describes security measures that have been taken to secure your TREBL. It contains the following topics:

- Private key
- eSIM
Private key

Each device has a private key and associated certificate which is used to authenticate itself when initiating communications.

This private key is generated in the factory, and so is the corresponding vendor certificate. This capability is necessary to support large scale plug and play deployments.

This device key is stored on the Sprint TREBL to allow it to authenticate to the network. If the private key is compromised, then the device can be masqueraded by an attacker towards the operator’s core network. Therefore, it is stored in an encrypted form.

In later releases a device-specific key will be introduced, this is a random number blown into on-SoC eFuses during manufacture. This offers two points of additional protection namely: the key is not discoverable by decompiling the code (an attacker will need to run code on the device to read the eFuses); and the key can only be used to obtain the private key of a single device (because each encryption key is unique).

eSIM

The system provides an embedded SIM (eSIM) to the board instead of using a removable SIM. This removes the temptation to steal the SIM. Additionally, the operator can ensure that these SIMs can only be used with the Relay APN, which would make them unusable with an ordinary mobile phone (because relay traffic uses nested GTP-U tunnels).
Physical design

**Figure 1: TREBL**

<table>
<thead>
<tr>
<th>HOME 4G * model 1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kit includes TREBL, power supply, and Installation Manual.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Band support—B41 Low (2500MHz-2570MHz) TDD 41—B41 High (2620MHz-2690MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX Power</td>
<td>• B41: 23dBm per chain (Conducted)</td>
</tr>
<tr>
<td></td>
<td>• B25: 20dBm per chain (Conducted)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power requirements</th>
<th>Duplex—TDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tx Total Power at RF Port (dBM)—27 Nominal Power Consumption (W)—55</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>H X W X D = 205.99 mm X 199.87 mm X 199.87 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>4.5 Kgs</td>
</tr>
</tbody>
</table>
Action buttons on TREBL

Following action buttons appear on the TREBL device:

1. Volume down—Press this button to decrease the volume.
2. Mute—Press this button to mute or unmute the microphone.
3. Alexa—Press this button to do the following:
   - Long press this button (for up to 6 seconds) to enable the setup mode to configure the TREBL with the TREBL application. See, Configuring the Sprint TREBL device with the application.
   - Short press this button (a single press) to enable Alexa listening mode if your Alexa account is already configured. See, Logging in to Amazon Alexa.
4. Bluetooth pairing—Long press this button (for up to 6 seconds) to enable Bluetooth and connect to your mobile device. See “Pairing your mobile device with TREBL”.
5. Volume Up—Press this button to increase the volume.
Safety measures

This installation manual contains instructions and warnings that should be followed during installation and operation.

Ensure you follow all operating and safety instructions while handling TREBL:

- Static sensitive components inside—do not remove the lid or base. No user serviceable parts inside.
- Position the power cord to avoid possible damage; do not overload circuits.
- Do not place this product on or near a direct heat source and avoid placing objects on the terminal.
- Use only a damp cloth for cleaning. Do not use liquid or aerosol cleaners. Disconnect the power before cleaning.
- It is the user’s responsibility to install this device in accordance with the local electrical codes.
- Installation of the TREBL unit should be performed using the Set Up Assistant App available on both Play Store and App Store.
- The circuit breaker where connected should be easily accessible in case you have to disconnect the device.
- When installed in the final configuration, the product must comply with the applicable Safety Standards and regulatory requirements of the country in which it is installed. If necessary, consult with the appropriate regulatory agencies and inspection authorities to ensure compliance.

Failure to follow these instructions could cause bodily injury and/or product failure.

Installation

- To install the TREBL, refer to the included Quick Start Guide.
Unboxing and checking the device

- Carefully unpack the TREBL from the box.
- Inspect the unit for any damage and check that all the accessories are in the box.
- Remove the Power Supply (included) from the packaging.
- Follow the instructions on the display to finish the initial setup.
Setting up TREBL

This section describes how to set up TREBL. It contains the following topic:

- Initial set up of TREBL
Initial set up of TREBL

The TREBL turns on automatically when the power supply is connected to the underside of the unit.

To set up the TREBL

1. Plug the included power adapter into TREBL and then into a power outlet. TREBL performs the following:

   I. While TREBL is booting up:

      o Voice Guided Installation (VGI) message—Your Sprint TREBL is being activated.
      o Light pattern—the lights will turn blue and travel back and forth.

   II. When TREBL begins the LTE installation:

      A solid white light appears and the TREBL will start checking for the Sprint network.

      After finding the Sprint network, TREBL performs the following:

      o VGI message—The Sprint TREBL installation is in progress. Please download the Set Up Assistant app on your mobile device.
      o Light pattern—The lights will turn white and will light up progressively.

   III. When TREBL completes the LTE installation:

      o VGI message—Sprint TREBL set up is complete. To configure Alexa, please use the Set Up Assistant App.
      o Light pattern—A solid center white light appears.

   If the LTE installation fails, TREBL performs the following:

   • VGI message—Error detected. Use Set Up Assistant App for troubleshooting.
   • LED pattern—All 5 red lights blinks twice and then a solid center red dot appears.
Managing the Set Up Assistant application

The Set Up Assistant application is a companion to the TREBL device that lets you easily set up all required LTE configurations.

This chapter contains the following topics:

- [Downloading the Set Up Assistant application](#)
- [Configuring the Sprint TREBL device with the application](#)
Downloading the Set Up Assistant application

This section describes the Set Up Assistant application that you will need to download on your mobile device.

It contains the following topics:

- Features of the application
- Download the application
- The Set Up Assistant application icon

Features of the Set Up Assistant application

The TREBL application has the following features:

- Free and easy to download
- Integration with Amazon Alexa
- Easy to switch between network (from Sprint LTE network to Wi-Fi network)
- Regular notifications

Download the Set Up Assistant application

Download the Set Up Assistant application.

- For Android user—Download the TREBL application from the Play Store.
- For iPhone user—Download the TREBL application from the App Store.

The Set Up Assistant application icon

After downloading the Set Up Assistant application on your mobile device, the following icon appears:

![Set Up Assistant icon](image)

Click the icon to begin the configuration of the Set Up Assistant application with the TREBL.
Configuring the TREBL device with the application

You can configure the TREBL device in two ways:

- Using the Sprint network—It is recommended to configure Sprint LTE using the Sprint network.
- Using the Wi-Fi network—If the Sprint LTE installation fails, you can switch to the Wi-Fi network.

This section includes the following topics:

- Configure TREBL using the Sprint network
- Switch to the Wi-Fi network

Configure TREBL using the Sprint network

To connect the TREBL with the Set Up Assistant application

1. Tap the Set Up Assistant icon on your Mobile Phone Dashboard. The following screens will appear to request permission to access the mobile device storage and location.

2. Tap Allow.

The Set Up Assistant application starts loading.
The **Choose your Device** screen appears.

3. Tap the **TREBL**.

The **TREBL tutorial** screens appear.

Use the **Skip** option to exit the tutorial screens (**harman/kardon**, **Integrate with Alexa**, and **Know your device**). After you skip the tutorial screens, the **Terms and Conditions** screen appears. Please move on to **Step 7**.

The **Welcome** screen appears.
4. Tap **Next**.

   The **harman/kardon** screen appears.

5. Tap **Next**.
6. Tap **Next**.

The **Know your device** screen appears that explains the available features.

7. Tap **Get Started**.

The **Terms and Conditions** screen appears.
8. Scroll through the Terms and Conditions and then tap **Accept**.

   The **Connect your Sprint TREBL with your app** screen appears.

9. Tap **Continue**.
The Setup Mode On screen appears.

If the Blue LED light does not appear, ensure you press the Amazon Alexa button on the Sprint TREBL device for upto 5 seconds. See Action buttons on Sprint TREBL.

10. Tap Continue.

The TREBL Connection screen appears.

You must view the Service Set Identifier (SSID) information appears on this screen. This information is required to search your Sprint TREBL in the Wi-Fi list.

11. Tap Continue.
The following **Access Request** message appears.

12. Tap **Continue**. The **Access Request** message appears.

13. Tap **OK**.

   The Wi-Fi list of your Phone appears.

14. Select TREBL from the list.

   When it is successfully connected, the message **TREBL Connected** appears.

---

If the connection fails, tap **Retry** to connect to Wi-Fi again OR see the error code description.

The installation begins, and the LTE Backhaul Setup progress bar appears with a pull up bar, which can begin a slide show of the features that TREBL supports.
When TREBL is successfully installed, the message **Installation complete** appears.
Switch to the Wi-Fi network

If the TREBL installation fails at any point in time, you can switch to the Wi-Fi to continue the installation. The error message appears with its description.

The following is an example of an error that may occur during installation:

To switch to Wi-Fi network

1. On the error message screen, tap Change Backhaul.
   
   The Network Settings screen appears showing a Wi-Fi network list.
2. Select the required network from the list.

3. Type the password and tap Join.

You can also Change the Wi-Fi network.

When it is successfully connected, the Wi-Fi Backhaul installation begins.
When the Sprint TREBL is successfully installed, the following message **Installation complete** appears.
Using the TREBL Dashboard

The TREBL Dashboard is used to monitor the following:

- Connection status of your device
- Network settings
- Login status of your Amazon Alexa account.

This chapter contains the following section:

- About the TREBL Dashboard
About the TREBL Dashboard

The Dashboard appears after you install the SetUp Assistant application on your mobile device. See, Configuring the TREBL device with the application.

The following TREBL Dashboard page appears:

The Dashboard page shows the status of the TREBL, network settings details, and your Amazon Alexa account.

On the Dashboard page, you can do the following:

- Viewing Sprint TREBL menu
- Changing the network settings
- Logging in to Amazon Alexa
- Obtaining technical assistance
- Unpairing the Sprint TREBL
- Retrieving the TREBL logs
- Refreshing the page
Viewing Sprint TREBL menu

The TREBL Menu (🍔) button appears on the title bar of the Sprint TREBL Dashboard.

The following menu items appear on the Dashboard screen:

- **My Sprint TREBL** shows the following information:
  - Serial Number
  - Device Name
  - Sprint TREBL Firmware Version
  - Speaker Firmware Version

- **Settings** show the various device options:
  - Fetch Logs: Retrieve the audio speaker log archive
  - Audio Reset: Reboot the speaker only
  - Check Internet Speed: Check the internet speed being provided to speaker

- **About** shows the version of the Set Up Assistant App and provides a link to the device Tutorial.

- **Help** shows the help contents of TREBL:
  - FAQs
  - Technical Support
  - Troubleshooting
Changing the network settings

By default, TREBL will install using the Sprint LTE backhaul, but you can change the network settings from Sprint LTE to Wi-Fi backhaul.

To change the network settings

1. Tap () > Network Settings, and then tap Change.
2. Select one of the following network button:
   - Sprint
   - Wi-Fi
   The Backhaul confirmation message appears.
3. Tap Continue.
   The status of the network setting is updated on the Dashboard page.

Logging in to Amazon Alexa

TREBL includes access to Amazon Alexa. Connect your Amazon account to access personalized features.

Ensure your mobile device is connected to the internet and paired with TREBL.

To log in to Amazon Alexa

1. Go to the Dashboard and screen below will be displayed.
1. Tap Login.  
   The Sign in page appears.

2. Type your Amazon user name and password.

3. Tap Sign in.  
   When Amazon Alexa is successfully integrated with TREBL, the Amazon Alexa Activated page appears.

Obtaining technical assistance

TREBL offers a variety of technical support programs to help you keep the TREBL up and running. To obtain the information about the TREBL, tap the Help option on the Dashboard.

The Help screen offers a wide range of technical resources that includes:

- FAQs
- Technical Support
- Troubleshooting

If you contact Customer Support, please provide as much of the following information as possible:

- Contact information
- Deployment scenario
- Description of the problem
- Share the log file containing error messages
- Description of conditions under which the error occurred
• Description of troubleshooting activities you have already performed

Unpairing the TREBL

You can unpair the TREBL if it stops responding or does not work properly.

To unpair the TREBL

1. Tap  > My Sprint TREBL.
2. Tap Forget this Device

   The Unpair Confirmation message appears.

   This action deletes TREBL information from the Set Up Assistant app.
Retrieving the TREBL logs

If your TREBL stops responding or does not work properly, you can retrieve the TREBL audio logs and share them for the technical assistance. The logs are downloaded in the zip file and are password protected.

To retrieve the TREBL logs

1. Tap 🔄 > Settings > Fetch Logs.

   The Sharing Confirmation message appears.
2. Tap **Continue**.

The following options appear to share the zip file.

**Refreshing the page**

The **Refresh** button appears on the Dashboard and will work when your mobile device is within range and connected to the TREBL. It updates the page and displays the most recent events.
Pairing your mobile device with TREBL

TREBL also pairs with your mobile device using Bluetooth. After successfully connecting to TREBL, you can enjoy premium audio.

This chapter contains the following topic:

- Pairing your mobile device with TREBL
Pairing your mobile device with TREBL

To set up Bluetooth audio streaming, you must enable Bluetooth on TREBL before you pair with your mobile device.

To pair your Mobile Phone with the Sprint TREBL

1. On TREBL, long press the Bluetooth button for up to 5 seconds to pair with your mobile device. After successful enablement of Bluetooth, the following VGI sound is played:
   - VGI Sound—Bluetooth pairing mode enabled.

2. Activate Bluetooth on your mobile device.
3. Select TREBL on your mobile device to connect.
   After successfully connecting, the following VGI message is played:
   - VGI Sound—Now connected to <Name of your Mobile Device>.
Using Alexa

TREBL is integrated with Amazon Alexa voice assistant, which allows you to interact with your TREBL as well as enjoy Alexa features.

This chapter contains the following topic:

- Things to try with Alexa
Things to try with Alexa

The following is a sample list of Amazon Alexa capabilities:

- Play radio stations
- Stream music from other music services
- Set timers and alarms
- Get customized news reports
- Get weather updates
- Shop with Alexa

For more details please visit below link:

https://www.amazon.com/gp/help/customer/display.html?nodeId=201608460
Resetting your TREBL

You can factory data reset your TREBL if it stops responding or does not work properly.

This chapter contains the following topic:

- [Resetting TREBL to factory settings](#)
Resetting TREBL to factory settings

Your configuration settings are removed after you reset the TREBL to factory settings. You will need to re-configure the settings if you wish to install the TREBL again (see Configure TREBL using the Sprint network). The factory reset button is in a small hole located on the bottom of the TREBL.

Ensure your TREBL is powered on before you reset it.

To reset your TREBL

1. Put a pin in the reset hole located at the bottom of the TREBL.
2. Press and hold the Reset button for 15 seconds.
3. Reboot the Sprint TREBL.

Table 2 indicates the process appears on the Sprint TREBL.

Table 2: Resetting your Sprint TREBL

<table>
<thead>
<tr>
<th>Sr.no</th>
<th>LED Light pattern</th>
<th>LED light Action</th>
<th>Status</th>
<th>VGI sound</th>
<th>What this means...</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A blue LED light appears</td>
<td>Moves back and forth</td>
<td>Connecting Bluetooth/LTE/Wi-Fi</td>
<td>Your TREBL is getting activated.</td>
<td>The process has started.</td>
</tr>
<tr>
<td>2</td>
<td>A blue LED light appears</td>
<td>Two blinks and then solid blue LED light</td>
<td>Connected</td>
<td>N/A</td>
<td>TREBL is activating.</td>
</tr>
<tr>
<td>3</td>
<td>A blue and a white LED light appears</td>
<td>Solid blue light getting covered by solid white light with increasing progress</td>
<td>Installation in progress</td>
<td>TREBL installation is in progress. Please install the companion app on your mobile phone or tablet.</td>
<td>The installation is in progress.</td>
</tr>
<tr>
<td>4</td>
<td>A solid white LED light appears</td>
<td>Solid white LED light</td>
<td>Installation complete</td>
<td>TREBL setup is complete. To configure Alexa, please use the Set Up Assistant app.</td>
<td>The installation has completed.</td>
</tr>
</tbody>
</table>
Warnings and Cautions

This chapter describes safety instructions and warnings that should be followed during installation, and operation.

It contains the following section:

- Warnings and Cautions
Warnings and Cautions

It is advised that you must read all rules, warnings, and follow all operating and safety instructions provided in this section.

It includes the following sections:

- Human Exposure to Radio Frequencies
- Radio Interference
- Modifications
- General instructions
- Service information
- Uplink information

Human Exposure to Radio Frequencies

The TREBL antennas should be installed with a minimum distance of 20 CM from your body.

Radio Interference

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 internal vehicle radio communications.

Please ensure a maximum separation between the TREBL and other antennas.

Modifications

Any physical changes and modifications to this device will void the warranty.

Service information

Refer all repairs to Sprint customer care.

Do not modify any part of this device, as this will void the warranty.

- Disconnect the power to this product and return it for service if the following conditions apply:
- The unit does not function after following the operating instructions outlined in this manual.
- The product has been dropped or the housing is damaged.
- Locate the serial number of the terminal and record this on your registration card for future reference. Also record the MAC address, located on the product sticker.

**Uplink information**

- The circuit where the equipment is connected must be properly grounded according with NEC and other local safety code requirements.

- Reminder to all the BWA system installers—Attention to Section 820-40 of the NEC which provides guidelines for proper grounding and, in particular, specifies that the cable ground shall be connected to the grounding system of the building, as close to the point of cable entry as is practical.
Hardware specifications

This chapter describes hardware specifications of TREBL.

It contains the following section:

- **Hardware specifications**
- **Long Term Evolution (LTE) Femto specifications**
- **Long Term Evolution Relay specifications**
## Hardware specifications

Table 3 describes hardware specification of the TREBL.

**Table 3: TREBL hardware specifications**

<table>
<thead>
<tr>
<th>Category</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buttons</td>
<td>• Volume down</td>
</tr>
<tr>
<td></td>
<td>• Mute</td>
</tr>
<tr>
<td></td>
<td>• Alexa</td>
</tr>
<tr>
<td></td>
<td>• Bluetooth pairing</td>
</tr>
<tr>
<td></td>
<td>• Volume Up</td>
</tr>
<tr>
<td></td>
<td>• Hard Reset</td>
</tr>
<tr>
<td>LED</td>
<td>LED lights used for visual notification</td>
</tr>
<tr>
<td></td>
<td>• Power</td>
</tr>
<tr>
<td></td>
<td>• Femto Cell</td>
</tr>
<tr>
<td></td>
<td>• UE/Relay</td>
</tr>
<tr>
<td></td>
<td>• Wi-Fi backhaul</td>
</tr>
<tr>
<td></td>
<td>• Voice Assistant</td>
</tr>
<tr>
<td>Power</td>
<td>• Input</td>
</tr>
<tr>
<td></td>
<td>o Power Adapter—110V-AC</td>
</tr>
<tr>
<td></td>
<td>o Magic Box+—12V - 7A DC</td>
</tr>
<tr>
<td></td>
<td>o Power Adapter is labeled</td>
</tr>
<tr>
<td></td>
<td>o Power Adapter with LED indication for power status</td>
</tr>
<tr>
<td></td>
<td>• Cord</td>
</tr>
<tr>
<td></td>
<td>o 10 feet long</td>
</tr>
<tr>
<td></td>
<td>o Black color</td>
</tr>
<tr>
<td>Environment</td>
<td>• Operating—Ambient Temperature Range:</td>
</tr>
<tr>
<td></td>
<td>o -5 Degree C to +40 Degree C of operation</td>
</tr>
<tr>
<td></td>
<td>• Storage range is between -10 to +45 Degree C</td>
</tr>
<tr>
<td></td>
<td>• Resistant from External Ice Formation, Ingress of Dust and Ingress of Water—IP 54 rated</td>
</tr>
</tbody>
</table>
| Dimensions       | • Weight of the box—4.5 Kgs (approx.)  
|                 | • Volume of the box—8.24 liters (approx.)  
|                 | H X W X D = 205.99 mm X 199.87 mm X 199.87 mm |
| Antenna         | Magic Box will contain 15 antenna serving various purposes, details can be found in Antenna Specifications |
| Bluetooth       | Bluetooth 4.2 (BLE + Classic) |
| Zigbee          | • No of Antenna—1  
|                 | • Type—PCB  
|                 | • Material—PCB  
|                 | • Frequency range—2400 - 2500 MHz  
|                 | • ZigBee—802.15.4  
|                 | • Hardware ready, but it is disabled |
| SIM Card        | • Production—MFF2 SIM (soldered) |
| MAC Address     | Single MAC address for the complete board |
| Serial Number   | • SN rule—C+XX(Product ID) +YYMM(2 digits Year+2 digits Month)+nnnnn (5 digits incremental hex number)  
|                 | Product ID for MagicBox—C88 for example, C88180612345 |
| System          | MB GPS will process AGPS data from the Sprint provided file server.  
|                 | Device will do Plug and Play and receive new configuration at every Power Cycle, including the case where a device moves between power cycles  
|                 | Device has a System Watchdog Timer  
|                 | Software + Hardware  
|                 | Disabled unused access ports  
|                 | FCC Approved |
Long Term Evolution (LTE) Femto specifications

Table 4 describes Long Term Evolution (LTE) specifications of the Sprint TREBL.

Table 4: Sprint TREBL hardware specifications

<table>
<thead>
<tr>
<th>Category</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chipset Info</td>
<td>FSM9016 + FTR8930 + DDR3L1GB + AR8033</td>
</tr>
<tr>
<td>Transmit Power</td>
<td>2x 21dBm Max Indoor LTE Sector Tx Power</td>
</tr>
<tr>
<td>Antenna Gain (Femto)</td>
<td>Band 41 Indoor Antenna Gain: &gt; 5dBi</td>
</tr>
<tr>
<td>Tx Range</td>
<td>eNB Tx Dynamic Range: &gt;26dB</td>
</tr>
<tr>
<td>Tx Emissions</td>
<td>eNB Spurious Emissions: meet Category B as defined in 3GPP TS36.104</td>
</tr>
<tr>
<td>Rx Sensitivity</td>
<td>eNB Spurious Emissions: meet Category B as defined in 3GPP TS36.104</td>
</tr>
<tr>
<td>Rx Selectivity</td>
<td>eNB Adjacent Channel Selectivity (ACL): as per TS36.104</td>
</tr>
<tr>
<td>Frequency Accuracy</td>
<td>+/-0.1ppm eNB Frequency Accuracy</td>
</tr>
<tr>
<td>UE Category</td>
<td>Support for UE Category up to 4</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Bandwidth support Single channel, B41, 10/15/20MHz</td>
</tr>
<tr>
<td>Transmission Mode</td>
<td>Transmission Mode 3, 4</td>
</tr>
<tr>
<td>Frame Type</td>
<td>TDD Frame Configuration 1 (DL: UL 60:40)</td>
</tr>
<tr>
<td></td>
<td>TDD Frame Configuration 2 (DL: UL 80:20)</td>
</tr>
<tr>
<td></td>
<td>Special Sub-Frame 7</td>
</tr>
<tr>
<td>Error Control</td>
<td>HARQ</td>
</tr>
<tr>
<td>Channel Quality</td>
<td>Enhanced Link Adaptation</td>
</tr>
<tr>
<td>Handover</td>
<td>S1 Seamless Handover</td>
</tr>
<tr>
<td></td>
<td>X2 Seamless Handover</td>
</tr>
<tr>
<td></td>
<td>Lossless Handover (Packet Forwarding)</td>
</tr>
<tr>
<td>RLC Mode</td>
<td>RLC-AM</td>
</tr>
<tr>
<td></td>
<td>RLC-UM</td>
</tr>
<tr>
<td></td>
<td>RLC-TM</td>
</tr>
<tr>
<td>Sync</td>
<td>Sync from GPS</td>
</tr>
<tr>
<td></td>
<td>Sync from</td>
</tr>
<tr>
<td></td>
<td>Network</td>
</tr>
<tr>
<td></td>
<td>Listen</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>LTE Security</strong></td>
<td>AES Integrity Protection</td>
</tr>
<tr>
<td></td>
<td>SNOW3G Integrity Protection</td>
</tr>
<tr>
<td></td>
<td>IPSEC</td>
</tr>
<tr>
<td></td>
<td>CMPv2</td>
</tr>
<tr>
<td><strong>LTE Network Planning</strong></td>
<td>Soft Frequency Reuse (SFR) / Static ICIC</td>
</tr>
<tr>
<td></td>
<td>PLMN Support (up to six)</td>
</tr>
<tr>
<td></td>
<td>Handover Restriction List (HRL)</td>
</tr>
<tr>
<td></td>
<td>Multi Frequency Band Indicator (MFBI)</td>
</tr>
<tr>
<td><strong>Quality of Service</strong></td>
<td>DSCP Marking</td>
</tr>
<tr>
<td><strong>Public Warning System</strong></td>
<td>Public Warning System (PWS) Support</td>
</tr>
<tr>
<td><strong>S1-AP Procedure</strong></td>
<td>S1 Reset</td>
</tr>
<tr>
<td></td>
<td>Location Reporting S1-Flex</td>
</tr>
<tr>
<td>**Internet Protocol (IP)</td>
<td>IPv6</td>
</tr>
<tr>
<td>Addresses**</td>
<td></td>
</tr>
<tr>
<td><strong>Legacy Network Support</strong></td>
<td>CSFB to 1x (R8)</td>
</tr>
<tr>
<td><strong>VoLTE</strong></td>
<td>VoLTE: RoHC</td>
</tr>
<tr>
<td></td>
<td>VoLTE: Signaling Prioritization</td>
</tr>
<tr>
<td></td>
<td>VoLTE: Emergency Call Support</td>
</tr>
<tr>
<td></td>
<td>VoLTE: Short PDCP</td>
</tr>
<tr>
<td><strong>Congestion Control</strong></td>
<td>Access Class Barring</td>
</tr>
<tr>
<td><strong>NS Signaling</strong></td>
<td>NS Signaling NS-01</td>
</tr>
<tr>
<td></td>
<td>NS Signaling NS-04</td>
</tr>
<tr>
<td><strong>Event Type</strong></td>
<td><strong>A1</strong> Events</td>
</tr>
<tr>
<td></td>
<td><strong>A2</strong> Events</td>
</tr>
<tr>
<td></td>
<td><strong>A3</strong> Events</td>
</tr>
<tr>
<td></td>
<td><strong>A4</strong> Events</td>
</tr>
<tr>
<td></td>
<td><strong>A5</strong> Events</td>
</tr>
<tr>
<td>**Internet Protocol (IP)</td>
<td>IPv4 Support</td>
</tr>
<tr>
<td>Support**</td>
<td>IPv6 Support</td>
</tr>
<tr>
<td></td>
<td>Support</td>
</tr>
<tr>
<td><strong>Max UE’s</strong></td>
<td>16 active UEs</td>
</tr>
<tr>
<td>Feature</td>
<td>Specification</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Antenna Gain</td>
<td>Wi-Fi Antenna Gain: &gt;2dBi</td>
</tr>
<tr>
<td></td>
<td>GPS Antenna Gain: &gt;2dBic</td>
</tr>
<tr>
<td>Receiver GPS</td>
<td>GPS Receiver as per spec</td>
</tr>
<tr>
<td>X2 AP Procedure</td>
<td>Load information over X2</td>
</tr>
<tr>
<td>Congestion Control</td>
<td>Load based scheduling</td>
</tr>
</tbody>
</table>
# Long Term Evolution Relay specifications

Table 5 describes Long Term Evolution (LTE) specifications of the Sprint TREBL.

<table>
<thead>
<tr>
<th>Category</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIM Card</td>
<td>Standard SIM Card (3FF) for Lab and MFF2 for production</td>
</tr>
<tr>
<td>Chipset Info</td>
<td>GDM7243A + GRF7243A + QCA8337</td>
</tr>
<tr>
<td>Band Support:</td>
<td>B41 Low (2497MHz-2568MHz)</td>
</tr>
<tr>
<td>TDD: 41</td>
<td>B41 High (2619MHz-2690MHz)</td>
</tr>
<tr>
<td>TX Power</td>
<td>B41:23dBm, B25:24dBm</td>
</tr>
<tr>
<td>Antenna Gain (UE)</td>
<td>B41:4dBi, B25:6dBi</td>
</tr>
<tr>
<td>Modulation</td>
<td>UL: QPSK, 16QAM, 64QAM, DL: QPSK, 16QAM, 64QAM, 256QAM</td>
</tr>
<tr>
<td>CA</td>
<td>2CA, B25 any combination, noncontiguous, 2CA, B41 any combination, contiguous/noncontiguous, 3CA, B25 any combination, noncontiguous, 3CA, B41 any combination, contiguous/noncontiguous, 4CA, B41</td>
</tr>
<tr>
<td>MIMO</td>
<td>4x2 DL MIMO, 4x4 DL MIMO (single carrier support only), 4x8 DL MIMO, SISO UL, 2TX CDD (UL)</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>5/10/15/20Mhz</td>
</tr>
<tr>
<td>UE Category</td>
<td>12</td>
</tr>
<tr>
<td>3GPP Release</td>
<td>R12</td>
</tr>
<tr>
<td>Disabled JTAG Inter. faces</td>
<td>Yes</td>
</tr>
<tr>
<td>Secure Bootable</td>
<td>Yes</td>
</tr>
<tr>
<td>IPv6 Support</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Peak UE DL Throughput</strong></td>
<td>DL=600 Mbit/s (CAT12)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td><strong>DL Transmission Mode</strong></td>
<td>DL Transmission Mode 1-9</td>
</tr>
<tr>
<td><strong>Frame Type</strong></td>
<td>Frame Type 1 FDD</td>
</tr>
<tr>
<td></td>
<td>Frame Type 2 TDD, 5ms periodicity</td>
</tr>
<tr>
<td><strong>Tx/Rx</strong></td>
<td>B41: 4T8R</td>
</tr>
<tr>
<td></td>
<td>B25: 2T8R</td>
</tr>
<tr>
<td><strong>Scanning</strong></td>
<td>DeNB Selection and Ranking</td>
</tr>
<tr>
<td></td>
<td>PDCL --&gt; Donor Selection Algorithm</td>
</tr>
</tbody>
</table>
Appendix

This appendix includes the following sections:

- Federal Communication Commission Notice
- Radiation Exposure Statement
- Proposition65 Warning Statement
Federal Communication Commission Notice

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

This 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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Operations in the 5.15-5.25GHz band are restricted to indoor usage only.

Proposition 65 Warning Statement

This product can expose you to chemicals, including lead, which are known to the State of California to cause cancer, birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
Warning symbols

The following symbols may be encountered during installation or troubleshooting. These warning symbols mean danger. Bodily injury may result if you are not aware of the safety hazards involved in working with electrical equipment and radio transmitters. Familiarize yourself with standard safety practices before continuing.

![Warning symbols]

- Caution, hot surface
- Caution
- Electro-Magnetic Radiation
- DC
Table 6 describes terms used in this guide.

Table 6: Glossary of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3GPP</td>
<td>3rd Generation Partnership Project, responsible for LTE</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel. A logarithmic unit used to describe a ratio (such as power ratio in radio telecommunications)</td>
</tr>
<tr>
<td>dBm</td>
<td>An abbreviation for the power ratio in decibels (dB) of the measured power referenced to one mill watt (mW). It is used as a convenient measure of absolute power because of its capability to express both very large and very small values in a short form</td>
</tr>
<tr>
<td>DL</td>
<td>Downlink</td>
</tr>
<tr>
<td>FDD</td>
<td>Frequency-Division Duplexing. A transceiver mode where the transmitter and receiver operate at different carrier frequencies</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>IPsec</td>
<td>Internet Protocol Security is a protocol suite for securing Internet Protocol (IP) communications by authenticating and encrypting each IP packet of a communication session</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>LTE</td>
<td>Long Term Evolution</td>
</tr>
<tr>
<td>MAC</td>
<td>Medium Access Controller—it is used for several functions, such as Scheduling, Packet (De) Multiplexing</td>
</tr>
<tr>
<td>MIMO</td>
<td>Multiple-Input Multiple-Output</td>
</tr>
<tr>
<td>MTBF</td>
<td>Mean Time Between Failures</td>
</tr>
<tr>
<td>PDCP</td>
<td>Packet Data Convergence Protocol. A Sub-Layer in LTE responsible for Security, IP Header (De) Compression, etc.</td>
</tr>
<tr>
<td>QAM</td>
<td>Quadrature Amplitude Modulation</td>
</tr>
<tr>
<td>QPSK</td>
<td>Quadrature Phase Shift Keying</td>
</tr>
<tr>
<td>RB</td>
<td>Resource Block</td>
</tr>
</tbody>
</table>