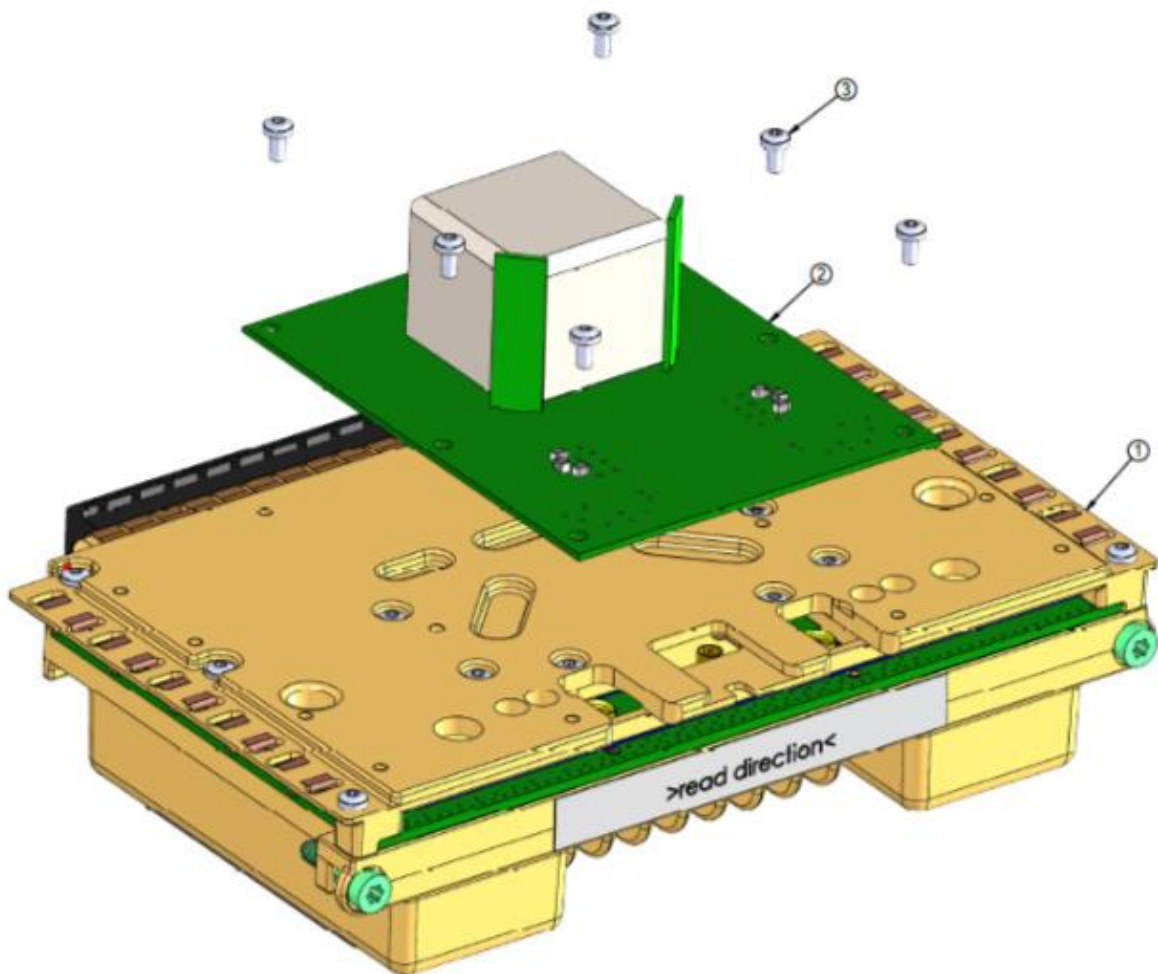


# Module Integration Instructions

## RPM-A61L1-7E

### B12, B13, B14 Radio Module



CommScope®

# 1. INTRODUCTION

This document provides the module integration guidance and instructions for the RPM-A61L1-7E radio module covering the 3GPP Bands 12, 13, and 14. The radio module is a FDD 2x2 MIMO radio module operating in the 700 MHz frequency range.

The radio module has a limited single modular transmitter grant. However, this module is intended for use on CommScope hosts only. The host platform contains proprietary software required to operate the radio module. As such, these integration instructions do not address the detailed design decisions that drive the module locations or module combinations when the host is populated with multiple modules. This is acceptable based on KDB 996369 D03 section 2.1.

The following performance requirements define the required operational parameters and limits when the radio module is integrated into a host platform. The host platform shall ensure that the operation does not exceed the performance limits of these requirements.

*Table 1-.1 Key RF Performance Parameters*

Parameter	Value
DL Frequency/Tuning Range	729 to 768 MHz / 39 MHz
UL Frequency/Tuning Range	699 to 716 MHz / 17 MHz 777 to 798 MHz / 21 MHz
Instantaneous BW	39 MHz
TX Power	+23.5 dBm / antenna @ RF Connectors
TX Power Tolerance	+1 / -3 dB
EVM	2% (3GPP 256QAM requirement)
Receive NF	< 6.5 dB
Technology	LTE & 3GPP NR
Modulations	QPSK, 16QAM, 64QAM, 256QAM
Signal Bandwidths	5, 10 MHz
Applicable Standard	3GPP TS 38.104
MIMO Mode	2x2

## 2. APPLICABLE RULES

The RPM-A61L1-73 radio module is certified to FCC CFR 47 Part 27 for Bands 12 and 13 and CFR 47 Part 90 for Band 14 for operation as a licensed non-broadcast station transmitter. The host manufacturer, CommScope, is responsible for compliance to any other FCC rules not covered by the modular transmitter grant of certification. The CommScope host platform is also tested to be compliant to Part 15 Subpart B.

## 3. OPERATIONAL USE

### 3.1. HOST CONSIDERATIONS

The CommScope RP6100i is the host platform for the RPM-A61L1-7E radio module. The RP6100i is an access point utilized in the CommScope OneCell system. The proprietary software and firmware of the host platform also supports an ORAN based fronthaul. The RP6100i access point (AP) supports up to 4 radio modules. The host platform provides the front haul interface for overall connectivity of the AP to the OneCell system. In addition, it provides control, signal processing, and timing for each of the installed radio modules.

The CommScope RP6100i is designed for indoor and protected environments. It incorporates thermal monitoring and fans to ensure that the temperature of the radio module does not exceed the ratings and cause aberrant behavior. The RP6100i is typically mounted either to a ceiling or on a wall in indoor applications. For protected outdoor applications the unit may be mounted to a ceiling, wall, or other supporting structure. A parking garage is an example of a potential protected outdoor application.

### **3.1.1. HOST VARIANTS**

#### **3.1.1.1. *Single Module Variant***

The host platform may be populated with a single radio module. The RPM-A61L1-7E radio module has been certified under the Limited Modular Approval since the module must be operated with the host, i.e. it cannot be tested in a standalone configuration. Therefore, the Part 27, Part 90 and Part 15 testing was performed with the radio module in the host. As such no additional testing is required.

The primary host consideration in a single module variant i.e. RPM-A61L1-7E radio module only, is to ensure that the module is installed in the designated slot and is secured to the host platform to ensure good grounding contact. See the installation section for more details.

#### **3.1.1.2. *Multiple Module Variant***

The host platform may be populated with up to four radio modules. Each of these radio modules will also be certified as Limited Single Modules. The host manufacturer shall perform a composite investigation test to verify that the host product meets all applicable FCC rules. This verifies that intermixing of emissions with other transmitters does not cause emissions that would be non-compliant to the applicable FCC rules.

As with the single module variant, it is important to ensure that the radio modules are installed in the designated slot of the host platform. The host manufacturer, CommScope, performs both proprietary analysis and testing to verify that the designated slot locations for each radio module ensure that emissions are not degraded. See the installation section for more details.

### **3.1.2. HOST LABELLING**

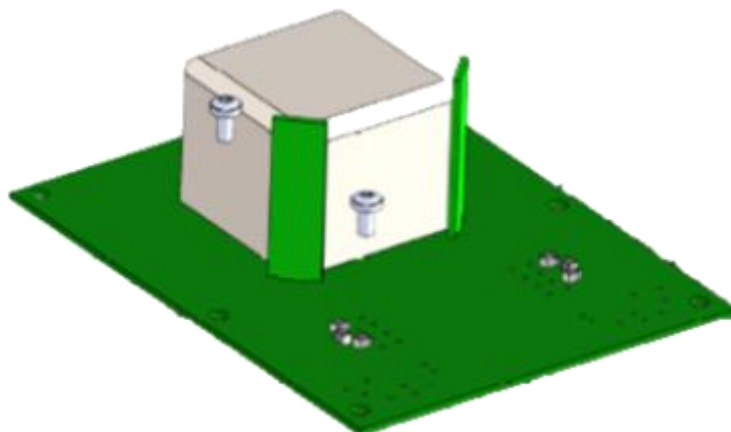
If the FCC labels of the radio module are not visible when installed in the host product, the host product shall provide either a physical label or e-label stating “Contains FCC ID xxx” with the finished product. As the sole host manufacturer, CommScope has this information included with the host product.

### 3.2. ANTENNAS

The radio module uses a unique dielectrically loaded antenna design internally identified with part number no. 7850491-xx. The antenna is installed on the radio module during the final equipment assembling under the responsibility of CommScope Technologies LLC.

An example view of the antenna is shown in the following figure. The antenna consists of vertical elements of the antenna are printed on a PCB structure which is physically placed in proximity to a dielectric block to provide loading of the antenna. This approach provides antenna patterns that are optimized for coverage in a ceiling mounted configuration. Each antenna has an approximately equal circular pattern in the azimuth with nearly constant gain in all directions. The elevation pattern contains a null off the end of the vertical element that reduces the field strength of users that are located directly below the unit.

As can be seen in the figure below, there are two vertical antenna elements on orthogonal corners of the dielectric block. Each element radiates one layer in 2x2 MIMO operation. This approach provides good isolation between the two antennas for MIMO operation. In MIMO operation the precoding is determined by channel characteristics such that the antenna gain in any direction with MIMO operation is optimized for a particular user. As such for MIMO operation, the total gain can be 3 dB greater than the gain of a single element. The table below provides the mean and peak gain for each of the antenna elements.



*Figure 3.1 Radio Module Antenna*

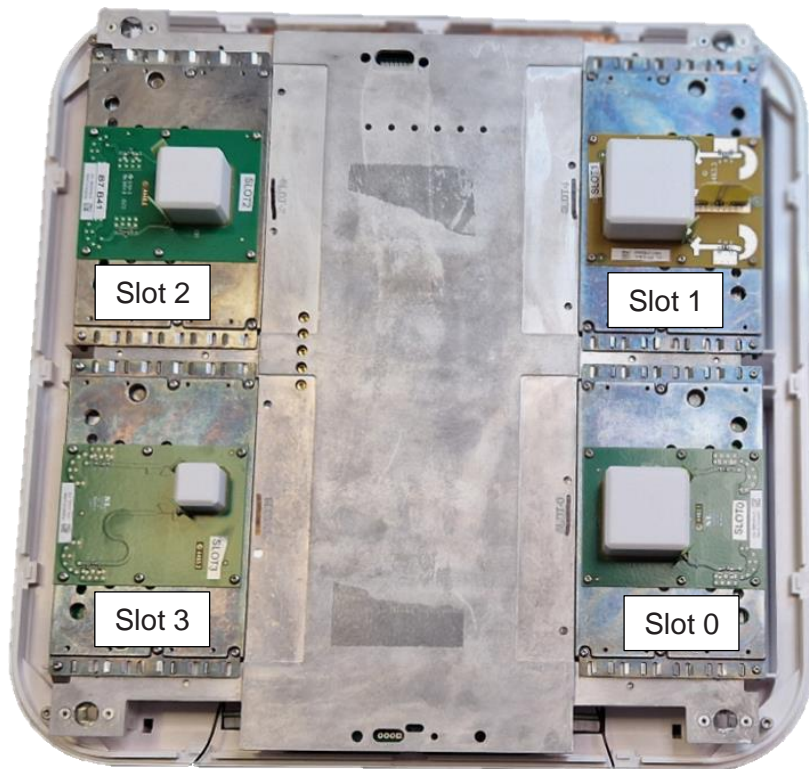
*Table 3- Antenna Gain Specification*

Parameter	Value
Peak Antenna Gain (-45 / +45)	3.7 / 3.2 dBi
Mean Antenna Gain (-45 / +45)	1.8 / 1.7 dBi

### 3.3. INSTALLATION INSTRUCTIONS

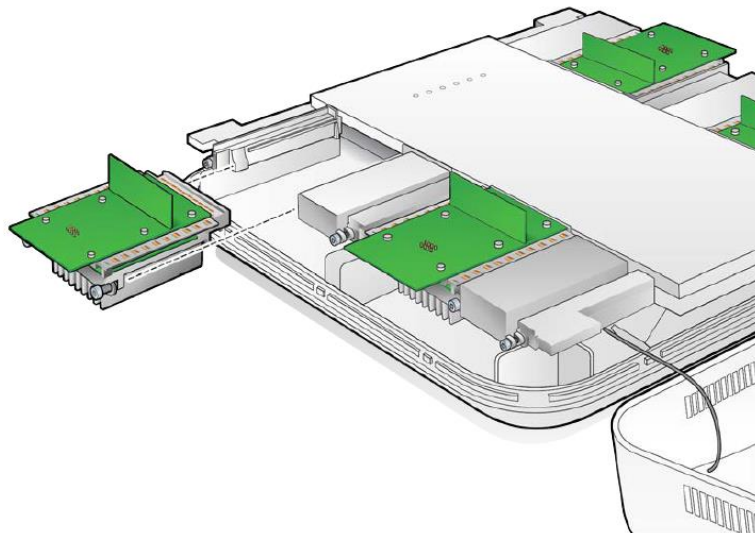
The following figure shows an internal view of the RP6100i host platform. The RP6100i has slots for up to four radio modules. Each slot has grounding fingers that ensure excellent ground connections between the radio module and the host platform frame. In addition, each radio module contains two T-10 Torx screws to secure the radio

module to the host platform frame to provide retention of the radio module and to ensure EMI performance is maintained.



*Figure 3.2- RP6100i Internal View of Slots for Radio Modules*

Installation of a radio module into the host platform involves sliding the radio module into the host platform frame until the connector of the radio module is fully seated in the mating connector on the host platform. Once seated the two T-10 Torx retaining screws are tightened.



*Figure 3.3- RP6100i Radio Module Installation*



### 3.4. RF EXPOSURE CONSIDERATIONS

The following table shows the analysis of the exposure due to the radio module operating at rated power with 2x2 MIMO. As can be seen from the table there is margin to the Maximum Permissible Exposure (MPE) limits at a spacing of 20 cm. This table assumes that the radio module is operated with the approved antenna. If the host supports multiple bands then the host provided must ensure that the MPE limits for the multiple radio configuration are satisfied.

*Table 3.-1 RP6100i n77c Radio Module MPE Calculation*

Parameter	Value
Tx Power (dBm) per antenna	23.5
Tolerance/Margin (dB)	1
Tx Loss (dB)	0
Peak Tx Antenna Gain (dBi)	3.7
Transmitter Duty Cycle %	100
Number of Antennas (MIMO)	2
Contribution due to multiple antennas (dB)	3.0103
Derived Total EIRP (dBm)	31.21
Point Source Total EIRP (mWatts)	1321.39
Power Density (mW/cm <sup>2</sup> ) @ 20cm	0.263
Power Density (mW/cm <sup>2</sup> ) @ 30cm	0.117
MPE Limit (mW/cm <sup>2</sup> )	1.00
MPE Margin @ 20cm (mW/cm <sup>2</sup> )	-0.737
MPE Margin @ 30cm (mW/cm <sup>2</sup> )	-0.883

## 4. REGULATORY

### 4.1. HOST

**Important:** Changes or modifications not expressly approved by CommScope LLC could void your authority to operate the equipment.

The RP6100i host platform has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Installation of this module in other host platforms will require Part 15B testing.

## 4.2. RADIO MODULE

**The RPM-A61L1-05 Radio Module complies with FCC Rule Parts 1.110, 2.1091, 15B, Part 27 and Part 90.**

**Important:** Radio Modules are not standalone components. They need to be assembled in the host system. Radio modules must only be added per the CommScope designated configurations which define the combinations of radio modules and the location (slot) of the radio modules.

The modular transmitter complies with Part 15 requirements under conditions of excessive data rates or over-modulation as the radio module is only connected to a host that is designed or approved by CommScope Technologies LLC, and the host provides the necessary requirements such that the module does not need to have buffered modulation/data inputs. The module has a unique antenna connector to support a bolted on attached antenna PCBA. The antenna is intended for professional installation only during host assembly performed or approved by CommScope Technologies LLC. The final radio equipment embedding this radio module is designed, or approved, by CommScope Technologies LLC. Harmful interference is prevented by adopting good engineering design and manufacturing practice as well as by verifying the possible weakening of radio transmission performance both as a digital device, and in the presence of other intentional sources of transmission (multi-transmission mode).

The radio module was approved under a Limited Modular Approval, and because the module has no buffered modulation/data inputs, each other host which is not identical in construction/material/configuration would have to be added through a Class II Permissive Change. Integration of the module into a non-identical host will require radiated testing including (1) maximum ERP value according to CFR 47, Part 27.50(b) and (c) or Part 90.542(a), (2) radiation pattern for 3 orientations when the host orientation is undefined, and (3) Emission Limits according to CFR 47, Part 27.53(m) or Part 90.543(e).

RF exposure limits conformity is always guaranteed both as single radio module and in the final radio equipment (multi-transmission mode).

For more information, see the publication femtocells and Health at <https://www.smallcellforum.org/> or visit the FCC website at <https://www.fcc.gov/>.

## 4.3. EN55032 EMISSIONS

**WARNING: The host equipment is compliant with Class A of EN55032. In a residential environment, this equipment may cause radio interference.**

#### 4.3.1. Human exposure limits for ONECELL deployments

The human exposure limits for the ONECELL product are calculated by using the Maximum Permissible Exposure (MPE) method associated with fixed-type transmitter devices at a minimum exposure distance of 20 cm.

**WARNING: This equipment is not suitable for use in locations where children are likely to be present.**

#### 4.4. FCC ID

The FCC ID is available on the information labels attached to the radio modules. The FCC ID for each of the installed radio modules is visible when the cover or the radio module is removed from the host. The example below shows the label placement on the side of the radio module.

Example label:

RADIO MODULE, B12+13+14, WB, AC, ANT ID No.: 7847588-00 Rev.: 01 SN: BGRMBG24340053			FCC ID: XS5-RPML2-B121314 MODEL: RPM-A61L1-7E
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Product Placement:

