



Gastonia Fire Department
Fire Marshal's Office
Emergency Responder Communication Coverage

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A Guide for Building Owners/Managers, General Contractors,
Vendors and Installers of ERCC Systems

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**Note the referenced 2018 NC Fire Code reflects the code
amendments adopted on 1/1/2022.**

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1. GENERAL

The North Carolina Fire Code requires that the Public Safety Radio System be fully operable in the interior of new buildings as code permits. Per North Carolina 2018 Fire Code Section 510, approved in-building 2-way emergency responder radio communication coverage shall be provided in all new buildings greater than 7500 square feet, or that do not meet the exceptions listed in the code.

New building owners subject to the NC 2018 Fire Code Section 510 are required to submit a Radio Signal Strength Study that demonstrates that existing Public Safety Radio System signal levels meet the Code or they will be required to install an Emergency Responder Communication Coverage System (also known as a BDA system) to boost the radio signals up to the required levels. Section 510 of the 2018 NC Fire Code for new construction is attached at the end of this document. All owners of new buildings, as well as their general contractors and ERCCS vendors/installers, should be familiar with all provisions of the relevant codes and standards. This guide augments those documents with further clarification as to how the codes and standards are implemented.

2. PRE-PLANNING

Because the Radio Signal Strength study cannot be performed until the building is nearly complete, and because of the lead time in procuring and installing an ERCCS (also known as a BDA) **building owners/managers are well advised to consider having a pre-construction signal strength test study.** This test will be beneficial due to the strong possibility that accommodating an ERCCS installation late in the building process may well delay final building acceptance and add cost beyond what would have been required for a pre-planned ERCCS. Some steps may be taken during building design and early construction that can help alleviate some of the delays and expense should an ERCCS be required. Such steps would include pre-planning a roof penetration and conduits for the coax cable feeding the roof-top donor antenna as well as ceiling conduits for the interior DAS cabling. Building owners are encouraged to make sure their building designers are aware early-on of the possibility of the need for an ERCCS installation and plan accordingly. Documentation regarding the pre-construction signal strength site study shall be emailed to: Fire Marshal Chris Stowe stowe_chris@cityofgastonia.com,

Assistant Fire Marshal Terry Revis revis_terry@cityofgastonia.com, and David Peace davidp@cityofgastonia.com.

3. RADIO SIGNAL STRENGTH STUDIES

Any builder owner wishing to demonstrate that the existing radio signal levels inside the building meet the minimum criteria (as specified in NC 2018 Fire Code Section 510.4.1) will be required to submit a Radio Signal Strength Study.

The Radio Signal Test Study should be done using the following frequencies:

853.4625 MHz (UASI Control Channel)

852.8750 MHz (UASI Backup Control Channel)

Such studies shall be performed by a suitably qualified engineer or technician with an FCC General Radio Operator's License or acceptable alternative qualifications. Acceptance of alternative technical qualifications will be done on a case by case basis by the Fire Marshal's Office.

Signal studies can only be conducted once the building is permanently enclosed, i.e. all windows, doors, dry wall, exterior coatings and roof in place. When tests are conducted all windows and doors in the building should be closed.

Note that even if the test shows the signal is sufficient, when this office conducts a TCO and/or CO inspection of the building and in the event we cannot establish effective communication, we can and will mandate an Emergency Responder Communication Coverage System (BDA) be installed.

Building shall be considered to have acceptable in building 2-way emergency responder communication system coverage when signal strength measurements in 95 percent of all areas on each floor of the building and critical areas shall be provided with 99 percent floor area radio coverage. Critical Areas (as defined in 2013 NFPA 72 Section 24.5.2.2.1) are fire command centers, fire pump rooms, exit stairs, exit passageways, elevator lobbies, sprinkler rooms, riser rooms, standpipe cabinets, sprinkler valve locations, and other areas deemed critical by the AHJ. The signal strength shall meet requirements in sections 510.4.1.1 through 510.4.1.3 of the North Carolina Fire Prevention Code.

All signal measurements will be conducted using an approved professional-grade spectrum analyzer that has been calibrated within 12 months of the date of the study. A copy of the most recent spectrum analyzer calibration certificate shall be included with the Radio Signal Strength Study.

Documentation of the signal strength study shall be emailed to: Fire Marshal Chris Stowe stowe_chris@cityofgastonia.com, Assistant Fire Marshal Terry Revis at: revis_terry@cityofgastonia.com and David Peace davidp@cityofgastonia.com.

After submission of the study the building owner will be notified as to whether the results were accepted or whether an ERCCS (BDA) will be required. The Fire Marshal's Office reserves the right do its own signal level spot checks to verify study results.

Radio Signal Strength Study results do not need to be submitted if the building owner has already determined that an ERCCS will be required.

4. ERCCS INSTALLATION

For buildings that fail to meet the criteria for sufficient radio signal levels, an ERCCS will be required. An ERCCS captures the radio signal at the rooftop level through an outdoor donor antenna and carries that signal to the interior of the building where it can be amplified by a Bi-Directional Amplifier (BDA), also known as a signal booster. The amplified signal output of the BDA will normally be redistributed within the building via a Distributed Antenna System (DAS). In some cases, it may be necessary to distribute the amplified signal by a "leaky" coaxial cable method. The amplified signal distributed inside the building should not radiate beyond the perimeter of the building or generate any interference to any licensed radio service.

Per NC 2018 Fire Code section 510.5.2, amplification systems capable of operating on frequencies licenses to any public safety agency by the FCC or other radio licensing authority shall not be installed without proper coordination and approval of the fire code official and the frequency license holder(s). Upon approval, the building owner/manager will be issued a "Letter of Authorization to Retransmit" the radio frequencies licensed to the Public Safety Agency. (see Section 6-FCC requirements)

As specified in Section 510.3 of the NC 2018 Fire Code, a construction permit is required for any installation or modification of an ERCCS. An ERCCS permit shall be obtained from the Gastonia Fire Marshal's Office once the installation plan has been approved. Fees will apply.

Installation of an ERCCS, to include rooftop antenna components and all required electrical wiring, antenna cables, conduits, bonding, grounding, and lightning protection shall be in compliance with all applicable NC building and fire codes.

5. ALARM SYSTEM INTERFACE

Per NC 2018 Fire Code Section 510.4.2.5 the in-building 2-way emergency responder communication coverage system shall be monitored by a listed fire alarm control unit, or where approved by the *fire code official*, shall sound an audible signal at a constantly attended on-site location. Automatic supervisory signal shall include the following:

1. Loss or normal AC power supply

2. System battery charger(s) failure.
3. Malfunction of the donor antenna(s).
4. Failure of active RF-emitting device(s).
5. Low-battery capacity at 70-percent reduction of operating capacity.
6. Failure of critical system components.
7. The communication link between the fire alarm system and the in-building 2-way emergency responder communication coverage system.
8. Oscillation of active RF-emitting device(s).

EXCEPTION:

1. Systems where all portable devices within the same bank use active power control features.

6. FCC REQUIREMENTS

Per 510.5.5 of the 2018 NC Fire Code, in-building 2-way emergency responder communication coverage system installation and components shall comply with all applicable federal regulations including, but not limited to, FCC 47 CRR Part 90.219.

No ERCCS shall transmit on any public safety frequency until the Letter of Authorization to Retransmit has been issued. Additionally, for any Class B ERCCS, the ERCCS shall not transmit on any frequency until the ERCCS has been registered in the FCC data base and the Booster ID number reported to the Fire Marshal's Office.

7. MINIMUM PERSONNEL QUALIFICATION REQUIREMENTS

Minimum qualification for the ERCC system designer and lead installer are specified in NC 2018 Fire Code Section 510.5.3. and shall include both of the following:

1. A valid FCC-issued general radio operators license.
2. Certification of in-building system training issued by an approved organization or approved school, or a certificate issued by the manufacturer of the equipment being installed.

These qualifications shall not be required where demonstration of adequate skills and experience satisfactory to the fire code official is provided.

8. ACCEPTANCE TESTING

Acceptance testing for all in-building 2-way emergency responder communication coverage systems shall be conducted in accordance with North Carolina Fire Code section 510.5.4. An ERCCS acceptance test can only be conducted once the building is permanently enclosed, i.e. all windows, doors, drywall, roofs, and exterior coatings in place. The building owner can contact the Gastonia Fire Marshal's Office to request an ERCCS acceptance test and final inspection once the installation is complete and all alarm interfaces fully tested. Acceptance testing will also include demonstration of the alarm panel interface, to include simulations of all possible fault modes. Final acceptance testing will also include an electrical inspection to ensure compliance with all electrical codes, to include electrical wiring, conduits, antenna cabling, grounding, bonding, and lightning protection.

9. LABELLING

All ERCC systems should be labelled at the BDA enclosure. The enclosure should be labelled with the words "ERCCS - Emergency Responder Communication Coverage System." In addition, instructions should be posted for how to completely disable the ERCCS in case of radio interference issues.

10. MAINTENANCE & ANNUAL INSPECTIONS

ERCCS shall be maintained operational at all times in accordance with NC 2018 Fire Code

Section 510.6 and is the responsibility of the building owner/manager. Annual testing of all ERCCS shall be conducted annually and be tested per section 510.6.1 of the 2018 NC Fire Code. A testing report verifying the system is in compliance with section 510.5.3 of the 2018 NC Fire Code must be submitted to the fire code official per section 510.6.1 number 5 of the 2018 NC Fire Code.

NC 2018 NORTH CAROLINA FIRE PREVENTION CODE

SECTION 510 - EMERGENCY RESPONDER COMMUNICATION COVERAGE

510.1 Emergency responder radio coverage in new buildings.

Approved in building 2-way emergency responder communication coverage shall be provided in all new buildings. In-building-2-way emergency responder communication coverage shall be based on the existing coverage levels of the public safety communication system utilized by the jurisdiction, measured at the exterior of the building. This section shall not require improvement of the existing public safety communication systems.

Exceptions:

1. Where *approved* by the building official and the *fire code official*, a wired communication system in accordance with Section 907.2.13.2 shall be permitted to be installed or maintained instead of an *approved* communications coverage system.
2. Where it is determined by the *fire code official* that the communications coverage system is not needed.
3. In facilities where emergency responder communications coverage is required and such systems, components or equipment required could have a negative impact on the normal operations of that facility, the *fire code official* shall have the authority to accept an automatically activated emergency responder communications coverage system.
4. New buildings 7,500 square feet or less and not more than 1 story above grade plane.
 - 4.1 This exception does not apply to windowless buildings, underground buildings or buildings with a basement.

510.2 Emergency Responder Communications Coverage in Existing Buildings. Deleted.

510.3 Permit required. A construction permit for the installation of or modification to in-building two way communication coverage systems and related equipment is required as specified in Section 105.7.5. Maintenance performed in accordance with this code is not considered a modification and does not require a permit.

510.4 Technical requirements. Equipment required to provide emergency responder communication coverage shall be listed in accordance with UL 2524. Systems, components and equipment required to provide in-building 2-way emergency responder communication coverage shall comply with Sections 510.4.1 through 510.4.2.8.

510.4.1 Emergency communication coverage system signal strength. The building shall be considered to have acceptable in-building 2-way emergency responder communication system coverage when signal strength measurements in 95 percent of all areas on each floor of the building and critical areas shall be provided with 99 percent floor area radio coverage. Critical areas are fire command centers, fire pump rooms, exit stairs, exit passageways, elevator lobbies, sprinkler rooms, riser rooms, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ. The signal strength shall meet requirements in Sections 510.4.1.1 through 510.4.1.3.

510.4.1.1 Minimum signal strength into the building. The minimum inbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as specified by *the fire code official*. The inbound signal level shall be a minimum -95 dbm throughout the coverage area and sufficient to provide not less than a Delivered Audio Quality (DAQ) of 3.0 or an equivalent Signal-to-Interference-Plus-Noise Ratio (SINR) applicable to the technology for either analog or digital signals.

510.4.1.2 Minimum signal strength out of the building. The minimum outbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as specified by *the fire code official*. The outbound signal level shall be sufficient to provide not less than a DAQ of 3.0 or an equivalent SINR applicable to the technology for either analog or digital signals.

510.4.2 System design. The in-building 2-way emergency responder communication system shall be designed in accordance with Sections 510.4.2.1 through 510.4.2.8 and NFPA 1221.

510.4.2.1 Amplification systems and components. Buildings and structures that cannot support the required level of in building 2-way emergency responder communication coverage shall be equipped with systems and components to enhance the radio signals and achieve the required level of emergency communication coverage specified in Sections 510.4.1 through 510.4.1.3. Emergency communication systems utilizing radio-frequency-emitting devices and cabling shall be approved by the *fire code official*. Prior to installation, all RF-emitting devices shall have the certification of the radio licensing authority and be suitable for public safety use.

510.4.2.2 Technical criteria. The *fire code official* shall maintain a document providing the specific technical information and requirements for the in-building 2-way emergency responder communication coverage system. This document shall contain, but not be limited to, the various frequencies required, the location of radio sites, the effective radiated power of radio sites, the maximum propagation delay in microseconds, the applications being used and other supporting technical information necessary for system design.

510.4.2.3 Standby power. In-building 2-way emergency responder communication coverage systems shall be provided dedicated standby power or provided with 2-hour standby batteries and connected to the facility generator power system in accordance with Section 604. The standby power supply shall be capable of operating the in-building 2-way emergency responder communication coverage system at 100-percent system capacity for a duration of not less than 12 hours.

510.4.2.4 Signal booster requirements. If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be contained in a National Electrical Manufacturer's Association (NEMA) 4-type waterproof cabinet.
2. Battery systems used for the emergency power source shall be contained in a NEMA 3R or higher-rated cabinet.
3. Equipment shall have FCC or other radio licensing authority certification and be suitable for public safety use prior to installation.
4. Where a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas to not less than 20dB greater than the system gain under all operating conditions.
5. Active RF emitting devices used in in-building 2-way emergency responder communication coverage systems have built-in oscillation detection and control circuitry.
6. The installation of amplification systems or systems that operate on or provide the means to cause interference on any in-building 2-way emergency responder communication coverage network shall be coordinated and approved by the *fire code official*.

510.4.2.5 System monitoring. The in-building 2-way emergency responder communication coverage system shall be monitored by a listed fire alarm control unit, or where approved by the fire code official, shall sound an audible signal at a constantly attended on-site location. Automatic supervisory signal shall include the following:

1. Loss of normal AC power supply.
2. System battery charger(s) failure.
3. Malfunction of the donor antenna(s).
4. Failure or active RF-emitting devices(s).
5. Low-battery capacity at 70-percent reduction of operating capacity.
6. Failure of critical system components.
7. The communications link between the fire alarm system and the in-building 2-way emergency responder communication coverage system.

8. Oscillation of active RF-emitting device(s).

510.4.2.6 Additional frequencies and change of frequencies. The in-building 2-way emergency responder communication coverage system shall be capable of modification or expansion in the event frequency changes are required by the FCC or other radio licensing authority, or additional frequencies are made available by the FCC or other radio licensing authority.

510.4.2.7 Design documents. The *fire code official* shall have the authority to require “as-built” design documents and specifications for in-building 2-way emergency responder communication coverage systems. The documents shall be in a format acceptable to the *fire code official*.

510.4.2.8 Radio communication antenna density. Systems shall be engineered to minimize the near-far effect. In-building 2-way emergency responder communication coverage system designs shall include sufficient antenna density to address reduced gain conditions.

Exception:

1. Systems where all portable devices within the same band use active power control features.

510.5 Installation requirements. The installation of in-building 2-way emergency responder communication coverage system shall be in accordance with NFPA 1221 and Sections 510.5.1 through 510.5.5.

510.5.1 Mounting of the donor antenna (s). To maintain proper alignment with the system designed donor site, donor antennas shall be permanently affixed on the building or where approved, mounted on a movable sled with a clearly visible sign stating “Movement or repositioning of this antenna is prohibited without approval from the *fire code official*”. The antenna installation shall be in accordance with the applicable requirements in the *International Building Code* for weather protection of the building envelope.

510.5.2 Approval prior to installation. Amplification systems capable of operating on frequencies licensed to any public safety agency by the FCC or other radio licensing authority shall not be installed without prior coordination and approval of *the fire code official* and the frequency license holder(s).

510.5.3 Minimum qualifications of personnel. The minimum qualifications of the system designer and lead installation personnel shall include both of the following:

1. A valid FCC-issued general radio operator’s license.
2. Certification of in-building system training issued by an approved organization or approved school, or a certificate issued by the manufacturer of the equipment being installed.

These qualifications shall not be required where demonstration of adequate skills and experience satisfactory to the *fire code official* is provided.

510.5.4 Acceptance test procedure. Where an in-building 2-way communication coverage system is required, and upon completion of installation, the building owner shall have the radio system tested to verify that two-way coverage on each floor of the building is not less than 95 percent. The test procedure shall be conducted as follows:

1. Each floor of the building shall be divided into a grid of 20 approximately equal test areas. Where a floor exceeds 128,000 ft² (11,900 m²), the floor shall be subdivided into sectors each having an area less than or equal to 128,000 ft² (11,900 m²), and each sector be tested individually with 20 grid cells in each sector. Signal strength measurements should be taken at the center of each grid and should be performed using standardized parameters as specified by NFPA 1221.
2. The test shall be conducted using a calibrated portable radio of the latest brand and model using by the agency talking through the agency's radio communications system or equipment approved by the *fire code official*.
3. Failure of more than one test area shall result in failure of the test.
4. In the event that two of the test areas fail the test, in order to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. Failure of not more than two nonadjacent test areas shall not result in failure of the test. If the system fails the 40-area test, the system shall be altered to meet the 95-percent coverage requirement.
5. A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system. Once the test location has been selected, that location shall represent the entire test area. Failure in the selected test location shall be considered to be a failure of that test area. Additional test locations shall not be permitted.
6. The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file with the building *owner* so that the measurement can be verified during annual tests. In the event that the measurement results become lost, the building *owner* shall be required to rerun the acceptance test to reestablish the gain values.
7. As part of the installation, a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at the time of installation and at subsequent annual inspections.
8. Systems shall be tested using two portable radios simultaneously conducting subjective voice quality checks. One portable radio shall be positioned not greater than 10 feet (3048 mm) from the indoor antenna. The second portable radio shall be positioned at a distance that represents the farthest distance from any indoor antenna. With both portable radios simultaneously keyed up on different frequencies within the same band, subjective audio testing shall be conducted and comply with DAQ levels as specified in sections 510.4.1.1 and 510.4.1.2

510.5.5 FCC Compliance. The in-building 2-way emergency responder communication coverage system installation and components shall comply with all applicable federal

regulations including, but not limited to, FCC 47 CFR Part 90.219.

510.6 Maintenance. The in-building 2-way emergency responder communication coverage system shall be maintained operational at all times in accordance with Sections 510.6.1 through 510.6.4.

510.6.1 Testing and proof of compliance. The owner of the building or owner's authorized agent shall have the in-building 2-way emergency responder communication coverage system inspected and tested annually or where the structural changes occur including additions or remodels that could materially change the original field performance tests. Testing shall consist of the following:

1. In-building coverage test as described in Section 510.5.3.
2. Signal boosters shall be tested to verify that the gain is the same as it was upon initial installation and acceptance, or set to optimize the performance of the system.
3. Backup batteries and power supplies shall be tested under load of a period of 1 hour to verify that they will properly operate during a power outage. If within the 1-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional 1-hour periods until the integrity of the battery can be determined.
4. All active components shall be checked to verify operation within the manufacturer's specifications.
5. At the conclusion of the testing, a report, which shall verify compliance with Section 510.5.3, shall be submitted to the *fire code official*.

510.6.2 Additional Frequencies. The building *owner* shall modify or expand the in-building 2-way emergency responder communication coverage at his or her expense in the event frequency changes are required by the FCC or other radio licensing authority, or additional frequencies are made available by the FCC or other radio licensing authority. Prior approval of in-building 2-way emergency responder communication system on previous frequencies does not exempt this section.

510.6.3 Nonpublic safety system. Where other nonpublic safety amplification systems installed in buildings reduce the performance or cause interference with the in-building 2-way emergency responder communication coverage system, the nonpublic safety amplification system shall be corrected or removed.

510.6.4 Field testing. Agency personnel shall have the right to enter onto the property at any reasonable time to conduct field testing to verify the required level of radio coverage.

Chapter 80 Referenced Standards

NFPA

NFPA 1221-19 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems.....510.4.2, 510.5, 510.5.4.

UL

UL2524-19 Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems.....510.4

FCC

47 CFR Part 90.219-2007.....510.5.4, 510.5.

