



FLOWER MOUND FIRE DEPARTMENT

FIRE MARSHAL'S OFFICE

3911 SOUTH BROADWAY AVENUE | FLOWER MOUND, TEXAS 75028
PHONE (972) 874.6270 | www.flower-mound.com

IN-BUILDING EMERGENCY RESPONDER RADIO COMMUNICATIONS ENHANCEMENT SYSTEM (B.D.A)

The Flower Mound Fire Department has developed this specification in collaboration with the requirements of Denton County, F.C.C. regulations, and various sources to include, but not limited to:

- International Fire Code, 2021 edition, Section 510
- NFPA 70 - The National Electrical Code, the most recent edition
- NFPA 72 - National Fire Alarm and Signaling Code, the most recent edition.
- NFPA 1221 - Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, the most recent edition, Section 9.6

The installation and operation of a radio-based emergency responder communication system shall comply with this document.

Property owners who maintain compliance with this specification are granted permission to operate the signal boosters on frequencies licensed to Denton County by the Federal Communications Commission. **The radio call signs are Whiskey, November, Juliet, Juliet, Six, Nine, Zero, Whiskey, Quebec, Victor, Victor, Three, Four, and Zero.**

B.D.A. Public Safety Radio Frequencies:

P25 Ch	Repeater TX	Repeater RX	Description
1	859.2875	814.2875	Primary Control Channel
2	773.65625	803.65625	Alternate Control Channel
3	858.2875	813.2875	Alternate Control Channel
4	772.60625	802.60625	Alternate Control Channel
5	857.2875	812.2875	Primary Talk Path
6	771.85625	801.85625	Primary Talk Path
7	856.2875	811.2875	Primary Talk Path
8	771.15625	801.15625	Primary Talk Path
9	854.6125	809.6125	BSI WNJJ690
10	770.53125	800.53125	Primary Talk Path
11	770.10625	800.10625	BSI WQVV340



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Purpose

Denton County operates a digital P25 public safety radio system. The system was designed to provide clear, intelligible, in-building communication for portable radios worn at the hip with an area coverage reliability of 95 percent or greater. This specification describes a Radio Signal Booster System's requirement, also referred to as a D.A.S., B.D.A. This will correct for reducing the radio signal to a level below that required to assure the 95 percent area coverage reliability needed for public safety communications caused by a new building (structure) development. Radio Signal Booster Systems shall be required in any new buildings within the town limits but do not benefit from the radio coverage delivered by Denton County's 700/800 MHz (megahertz) trunked radio system. This system must also provide in-building coverage for the town backup system that utilizes 700/800 MHz P25.

System Design Criteria for Buildings and Structures

The Signal Booster System shall amplify all signals within the required frequency band and provide the necessary radio system coverage into interior portions of the building, including all basement levels and any partially underground building areas. The Signal Booster System shall consist of an exterior antenna, a bi-directional amplifier system with a backup power supply mounted in a suitable location in the building, and an in-building antenna or radiating cable system as necessary to provide the stated signal level. The bi-directional amplifier must have capabilities of channelization to prevent the amplification of unwanted signals. Broadband amplifiers shall not be approved. The Signal Booster must be capable of Phase 1 FDMA and Phase 2 TDMA radio transmissions. The Signal Booster System shall be designed to operate in the 769-765 and 799-806 MHz bands and the 806- 861 MHz bands. The Signal Booster System design shall provide a minimum -109 dBm

R.F. signal level or a transmitted signal BER (bit error rate) not to exceed 5% and 10 dB above the minimum R.F. floor noise at any point within the building.

The Signal Booster System shall employ technology that maintains the maximum required output power while preventing excessive emissions per F.C.C. requirements. All equipment must be F.C.C. type accepted and approved for digital signal amplification. R.F. filtering shall be employed as necessary to reduce the emission of non-desired signals. Signal levels cannot extend beyond the building area, where coverage is insufficient to prevent interference.

The Erection of New Buildings That Affect Radio System Coverage

The effect on radio coverage depends on location, the building height, projected frontal area, and construction materials. (the distance from the radio transmitter and receiver and other buildings in the area). Suppose Flower Mound's analysis indicates a reduction in radio system coverage to a level below that considered acceptable for reliable public safety communications. In that case, corrective action to assure radio system coverage reliability within identified buildings shall be the owner's responsibility. A Radio Signal Booster System will be required, or it may be necessary to install a P25 Micro Site system or a full transmit and receive site in extreme situations.

Emergency responder radio system permits

Before the commencement of installing an Emergency Responder Radio Communications System, the Flower Mound Fire Marshal's Office must issue a permit.

To obtain a permit

A complete design package shall be submitted for review & approval to the Town of Flower Mound Fire Marshal's Office. All related expenses are the responsibility of the contractor, owner, or designated agent.



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As a minimum, the submittal package for review shall consist of the following:

- Drawings shall contain the original B.D.A. signal strength heat map, riser diagram, cable paths, antenna location, equipment locations, codes & standards editions, cable survivability level, system performance narrative, and general notes describing the minimum Scope of Work.
- Equipment technical specifications
- Product certifications (FCC ID, UL Listing, and File Number)
- Battery Calculations
- Plans signed by a person holding a valid FCC GROL License
- Contact information and license number of the installing contractor(s)



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FIRE FIGHTER COMMUNICATION SYSTEM SPECIFICATION

I) GENERAL

- A) New buildings shall have approved radio coverage for emergency responders within the building based on the existing coverage levels of the jurisdiction's public safety communication systems, measured at the building's exterior. This section shall not require improving the current public safety communication systems.

1) Exceptions:

- (a) Where the fire code official determines a radio coverage system is unnecessary.
- (b) In facilities where emergency responder radio coverage could harm that facility's normal operations, the fire code official shall have the authority to accept an automatically activated emergency responder radio coverage system.
- B) Buildings and structures that cannot support the required radio coverage level shall be equipped with a distributed antenna system and FCC-certified and listed signal booster or systems otherwise approved to achieve adequate radio levels coverage.
- C) A construction permit for installing or modifying emergency responder radio coverage systems and related equipment is required, as specified in Section 105.7.6. Maintenance performed as per this code is not considered a modification and does not require a permit.

D) Required Notifications

- 1) The FCC requires that all Class B signal boosters be registered Per FCC Part 90. The link to the registration site is as follows: <https://signalboosters.fcc.gov/signal-boosters/>
- 2) All class-A signal boosters must be licensed with the FCC.
- 3) For all signal boosters: send specifications and installation location to sheriff.tech@dentoncounty.gov, DCSO Radio Shop, phone number 940-349-1501.

II) TECHNICAL REQUIREMENTS:

- A) Systems, components, and equipment needed to provide the emergency responder radio coverage system shall comply with this document.
- B) The building shall have acceptable emergency responder communications enhancement system coverage when signal strength measurements in 95 percent of all areas on each building floor meet the signal strength requirements cited in this document.
- C) Critical Areas such as an emergency command center, a fire pump room, exit stairs, exit passageways, elevator lobbies, and similar critical areas shall be provided with 100% floor area radio coverage.
- D) In-building radio systems required by this document must provide the following signal strengths:
- 1) Downlink – Minimum signal strength of -95dBm throughout the coverage area.
- 2) Uplink - Minimum signal strength of -95 dBm received at the public safety Radio System
- E) The system performance shall be sufficient to meet the requirements of Denton County's digital P25 public safety radio system described above under System Design Criteria for Buildings and Structures.
- F) The system design shall comply with the requirements of Denton County's digital P25 public safety radio system described above under System Design Criteria for Buildings and Structures.



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- G) The fire code official shall maintain a document providing the specific technical information and requirements for the emergency responder communications coverage system. This document shall contain, but not be limited to, the various frequencies required, the location of radio sites, the sufficient radiated power
 - 1) of radio sites, the maximum propagation delay in microseconds, the applications, and other supporting technical information necessary for the system design.
- H) If used, signal boosters shall meet the following requirements:
 - I) All signal booster components shall be contained in a National Electrical Manufacturer's Association (NEMA) 4-type waterproof cabinet.
 - J) Battery systems used for the emergency power source shall be contained in a NEMA 3R or higher-rated cabinet.
 - K) Equipment shall have F.C.C. or other radio licensing authority certification and be suitable for public safety use before installation.
 - L) A donor antenna exists, and isolation shall be maintained between the donor antenna and all inside antennas to less than 20dB greater than the system gain under all operating conditions.
 - M) Bi-Directional Amplifiers (B.D.A.s) used in emergency responder radio coverage systems shall have oscillation prevention circuitry.
 - N) The installation of amplification systems or systems that operate on or provide the means to cause interference on any emergency responder radio coverage networks shall be coordinated and approved by the fire code official.

III) RADIO SIGNAL STRENGTH SURVEY:

- A) The building owner shall have the building radio tested to ensure that two-way radio coverage on each building floor meets or exceeds the required levels. The building must be substantially completed with all walls, windows, roof, and interior partitions completed before the survey.
- B) Each building floor shall be divided into a grid of a minimum of twenty (20) equal areas of no larger than 2,500 SF each. Each critical area shall contain at least one test reading. A maximum of one (1) test point of the general area will be allowed to fail the test per floor. 100% of all critical areas must pass. A spot located approximately in the center of a grid area will be selected for the test. Once the location has been determined, prospecting for a better place within the grid will not be permitted. Field strength testing instruments are to be recently calibrated (1 year) and of the frequency selective type incorporating a flexible antenna like the ones used on the hand-held transceivers.
- C) RF plots indicating the enhanced coverage shall be submitted to the Fire Department after testing.
- D) Critical areas radio coverage 99%: all critical areas such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the authority having jurisdiction shall have a minimum of 99% floor area radio coverage in accordance with NFPA 72.
- E) Non-critical areas radio coverage 90%: shall have a minimum of 90% floor area radio coverage in accordance with NFPA 72.
- F) A minimum inbound signal strength of -95 dBm or other signal strength as required by the authority having
 - 1) jurisdiction is shown throughout the coverage area in accordance with NFPA 72.
- G) A minimum outbound signal strength of -95 dBm at the donor site, or other signal strength as required by the authority having jurisdiction, shall be provided from the coverage area in accordance with NFPA 72.



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IV) TECHNICAL SPECIFICATIONS AND COMPONENT INSTALLATION:

- A) Assembly and installation of all components of the Fire Fighter Communication System shall comply with all applicable sections of:
 - 1) Town of Flower Mound Amendments
 - 2) International Fire Code, 2021 edition, Section 510
 - 3) FCC Regulations
 - 4) NFPA 70 - The National Electrical Code, 2017 edition
 - 5) NFPA 72 – National Fire Alarm and Signaling Code, 2019 edition
 - 6) NFPA 1221 – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, 2019 edition, Section 9.6
- B) Survivability from attack by fire shall meet NFPA 72, National Fire Alarm and Signaling Code, 2019 edition.
- C) The system shall comply with all applicable sections of F.C.C. rules. The Signal booster shall have F.C.C. certification before installation.
- D) The signal booster and all other active components shall be listed for their intended purpose.
- E) External filters or attachments or aftermarket modifications of the original equipment shall not be permitted.
- F) All signal booster components shall be contained in a Type-4 approved waterproof cabinet. All enclosures shall be painted red with a locking mechanism.
- G) The signal booster system shall include built-in automatic alarm malfunctions of the signal booster and battery system as per NFPA 1221, 2019 Edition Section 9.6. Aftermarket equipment add-ons and modifications to comply with this specification will not be accepted.
- H) Maximum Propagation delay of the signal booster system shall be 14us (microseconds) or as otherwise approved by the A.H.J.
- I) Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20dB under all operating conditions.
- J) The signal booster shall be designed to amplify the full 800MHz and 700MHz public safety frequency bands.
- K) Radio Tower Locations:
 - 1) Location 1: 127 N Woodrow Ln, Denton GPS Coord: 33 12 48.3 N, 97 06 49.9 W
 - 2) Location 2: 100 N Magnolia St, Aubrey GPS Coord: 33 18 18.0 N, 96 58 57.0 W
 - 3) Location 3: 4101 Fairway Dr, Grapevine GPS Coord: 32 59 02.9 N, 97 03 55.4 W
 - 4) Location 4: 8400 Thompson Rd, Argyle GPS Coord: 33 06 17.2 N, 97 14 27.5 W
- L) Signal Boosters shall have oscillation prevention circuitry to protect the public safety radio system signal booster from malfunctioning.
- M) To prevent radio interference and degradation of public safety radio systems, signal boosters shall not emit any measurable uplink noise while idle. The signal booster shall contain an automatic uplink noise suppression function.

V) SYSTEM MONITORING:

- A) The In-Building Radio system shall include automatic supervisory and trouble signals for



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malfunctions described in 5.2 and annunciated by the fire alarm system. The building owner shall immediately report all indications to the signal booster provider.

- B) A dedicated, supervised monitoring panel shall be provided to annunciate all signal booster locations' status. The monitoring panel shall provide a visual and labeled indication of the following for each signal booster:
- | | |
|--|--------------------|
| 1) Normal A.C. power | Supervisory Signal |
| 2) Signal booster failure | Supervisory Signal |
| 3) Antenna failure | Supervisory Signal |
| 4) Loss of A.C. power | Supervisory Signal |
| 5) Failure of battery charger | Supervisory Signal |
| 6) Low battery capacity 70% or below | Trouble Signal |
| 7) Failure of active RF emitting device(s) | Supervisory Signal |
| 8) Failure of communication between FACP and BDA | Supervisory Signal |
- C) The integrity of the circuit monitoring the signal boosters and power supplies shall comply with NFPA 72, National Fire Alarm and Signaling Code, 2019 edition.
- D) System and Signal booster supervisory signals shall include Antenna Malfunction and Signal booster failure.
- E) Power supply supervisory signals shall consist of loss of A.C. power, battery charger failure, and low battery capacity (alarming at 70% of battery capacity and 30% of the charge remaining).
- F) A sign will be located at the dedicated monitoring panel with the service provider's name and telephone number.

VI) DISTRIBUTED ANTENNA SYSTEM:

- A) The distributed antenna system may utilize a radiating cable, conventional cable, fixed antennas, or a combination of all three.
- B) The distributed antenna system shall not be shared with commercial cellular systems. Sharing of the passive
- 1) D.A.S. with other commercial in-building radio systems is only allowed if the A.H.J approves. The permit application shall include the Intermodulation study and a list of commercial frequencies.

VII) POWER SUPPLY:

- A) Two independent and reliable power sources shall be provided for all RF-emitting devices and any other active electronic components of the system: one primary and one secondary.
- B) The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA 70, 2017 edition.
- C) The secondary power source shall be provided with dedicated standby batteries or connected to the facility generator power system as per Section 1203. The standby power supply shall be capable of operating at 100- percent system capacity for not less than 12 hours.

VIII) ACCEPTANCE TESTING:

- A) Delivered audio quality (D.A.Q.) testing shall be conducted by F.D. radio personnel to ensure that



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two-way radio coverage on each floor of the building meets the minimum coverage requirements of Section 2.

- B) The signal booster vendor shall certify that the in-building radio system was installed and tested per the current A.H.J. In-Building Radio Specification requirements.
- C) A signal booster service company shall certify that a maintenance contract is in effect that provides a 24-hour, 7-day response within 2 hours of notification of a problem. This contract must be for at least one year.
- D) RF plotting (grid tests) results, gain values of all amplifiers, as-built drawings, including B.D.A. Manufacturer, Model #, Serial #, F.C.C. Certification #, and a link budget must be submitted.

IX) ANNUAL TEST:

- A) The owner shall check all active components of the in-building radio system, including but not limited to the amplifier, power supplies, and backup batteries, once every twelve (12) months.
- B) Amplifiers shall ensure that the gain is the same as upon initial installation and acceptance. The original gain shall be noted, and any change in gain shall be documented.
- C) Back-up batteries and power supplies shall be tested under load to verify that they will operate during an actual power outage.
- D) Active components shall be checked to determine operation within the manufacturer's specifications for their intended purpose.
- E) Documentation of the testing shall be maintained on-site, and a copy forwarded to the Flower Mound Fire Department.

X) FIVE-YEAR TEST:

- A) In addition to the annual test, a radio coverage test shall be conducted once every five (5) years to ensure the radio system continues to meet this ordinance's requirements. The procedure outlined in Section 3 shall apply to such tests.

XI) SIGNAL BOOSTER SERVICE PROVIDER RESPONSIBILITIES:

- A) All tests shall be conducted, documented, and signed by a person possessing an F.C.C. General Radio Telephone Operators License.
- B) All testing personnel shall be certified and authorized by the B.D.A. manufacturer in their equipment's installation and operation.
- C) Must submit reports of annual tests and 5-year tests.
- D) The FD shall be notified in writing at least thirty (30) days before canceling a maintenance contract.
- E) The FD shall be notified in writing upon procuring contractual agreements relating to in-building radios covered by this specification.

XII) MODIFICATIONS:

- A) Any modification of an existing B.D.A. system shall require a written request to the F.D.
- B) After completing any modification to a B.D.A., a full acceptance test shall be conducted and submitted for review as required in this specification.

XIII) FIRE DEPARTMENT INSPECTIONS:

- A) Fire Department Radio personnel shall have the right to enter the property to conduct field testing



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to ensure that the required radio coverage level is present.

XIV) PROPERTY OWNER RESPONSIBILITIES:

- A) Upgrades to the system as directed by the Flower Mound Fire Department.
- B) Maintenance contracts shall include a qualified radio service contractor, who will provide a 24-hour by 7-day emergency response within two (2) hours after notification.