

Ukiah Valley Fire Authority

Fire Prevention Bureau

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Standard for ERRCS

Per Section 510 of the California Fire Code and NFPA 1221



Technical Specifications

(Rev. 08-29-2023)

Mendocino County Public Safety Radio Systems Specifications for In-Building Bi-Directional Amplifiers

There are (7) VHF Radio Channels that are required for Routine and Emergency Communications for First Responders working in buildings.

Channel Name	Downlink	Uplink	Type	Modulation	Power	Donor Site Coordinates	Maximum propagation
Sheriff Blue Central Dispatch	154.755	155.655	Conventional	Analog FM	100 Watts	39' 07' 00.2 N - 123' 13' 58.1 W	25 microseconds
Ukiah Police Dept	154.860	155.370	Conventional	Analog FM	100 Watts	39' 08' 48.0 N - 123' 12' 37.0 W	25 microseconds
XME Red Fire Dispatch	153.950	154.385	Conventional	Analog FM	100 Watts	39' 07' 00.2 N - 123' 13' 58.1 W	25 microseconds
XME Blue Fire Command	151.085	156.195	Conventional	Analog FM	100 Watts	39' 07' 00.2 N - 123' 13' 58.1 W	25 microseconds
V-Fire 23 Fireground	154.950	154.295	Conventional	Analog FM	100 Watts	Direct radio-radio Itinerant	25 microseconds
V-Fire 22 Fireground	154.265	154.265	Conventional	Analog FM	100 Watts	Direct radio-radio Itinerant	25 microseconds
CALCORD All agency Mutual Aid	156.075	156.075	Conventional	Analog FM	100 Watts	Direct radio-radio Itinerant	25 microseconds

Emergency Responder Radio Communication System

PURPOSE

This reference guide is provided to assist with submittal of Grid Survey Reports and DAS/BDA Systems to the Ukiah Valley Fire Authority. It is not intended to serve as a step-by-step checklist for installation and system design. The information herein shall not be used as the sole source criteria for formal plan review design specification and or inspection of systems to be installed.

SCOPE

Any new and/or existing building shall be provided with approved in-building, two-way emergency responder communication coverage for emergency responders as required by the Authority Having Jurisdiction. (AHJ)

In-Building Two-Way Communication systems shall provide the following functions:

1. Communication between the requester and emergency response agencies.
2. Communication within the emergency response agency under emergency and nonemergency conditions.
3. Communication among emergency response agencies

SUBMITTAL REQUIREMENTS

Required Permits:

- A construction permit for the installation of or modification to in-building, two-way emergency responder communication coverage systems and related equipment is required as specified in Section 105.6.4 of the California Fire Code.
- If within the City of Ukiah city limits, file a building permit with the City of Ukiah Building Division.

- If within Mendocino County, file a building permit with the Mendocino County Planning and Building Services.

Submission of System Designs

- Architectural, Electrical, Radio Frequency (RF) Engineering Documents for communications systems shall include the following information, applicable to the project:
 1. Code Data and associated standards for FBC and NFPA
 2. Manufacture Data sheets for all materials to be installed.
 3. System riser diagram for each cabling system.
 4. Civil plan indicating underground location of wiring in relation to other utilities installed.
 5. Equipment legend.
 6. Cabling type and performance data of the transmission.
 7. Design of wiring method and mounting in all applicable areas.
 8. UL assemblies and other structural details.
 9. Device type and locations.
 10. Backup power sources where applicable.
 11. Design of lightning protection.
 12. Installation, identification and testing requirements.
 13. Characteristics and locations of surge protective devices, if included in the engineering design.
 14. New construction installations will require coordination for conduit installations.
 15. Some system designs and backbone riser locations will require a life safety plan.

An integrator who is FCC/GROL licensed must conduct the survey test to verify compliance with required DAQ 3.0 performance of the system.

- **Multiple Buildings, Campus design.** Where there are two or more buildings on a single property each building shall have its own individual Backbone and BDA system.

Licensed or Certification of Installing Contractors

- All system designs, installation, testing, and maintenance should be conducted, documented, and signed by an acceptable manufacturer or person in possession of a current radio licensing authority license, industry certification, and professional electrical engineering license.
- As applicable a valid FCC-issued general radio operator's license.

- Certification of in-building wireless communications system training issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment being installed.

Distributed Antenna Systems (DAS) and Bi-Directional Amplifier (BDA)

When required by the AHJ, in-building two-way radio communications enhancement systems shall be designed, installed, tested, inspected, and maintained in accordance with NFPA 1221.

The public safety system shall be installed for complete full building coverage per the discretion of the AHJ. The system installed is to meet the requirements of inbound and outbound transmissions under hazard and independent of other systems present in the building.

Targeted Antennae Installation. When required, the DAS system shall be installed as a full system per the criteria of NFPA 1221. (Backbone, riser, protection of connections, monitorization, lightning protection and battery backup)

Targeted placement of antennas and or partial coverage is disapproved.

Any request for partial coverage use of a DAS system shall be reviewed for approval by the Fire Prevention Bureau. To request an application for Fire Department Determination email Fireprevention@cityofukiah.com.

Architectural and Electrical Engineered RF (Radio Frequency) design drawings shall be submitted to Building and Fire for formal review and approval prior to installation.

Grid Survey Reports and Radio Coverage

Survey Report. The survey report shall include the following: Type of analyzer and or technology, (DL) download and (UL) upload calculations for inbound and outbound transmission, DAQ and a grid report of frequencies for every floor.

Signal Strength.

- **Inbound.** A minimum inbound signal strength of -95 dBm shall be provided throughout the coverage area. The inbound signal level shall be sufficient to provide a minimum of DAQ 3.0 or equivalent SINR for either analog or digital signals.
- **Outbound.** A minimum outbound signal strength of -95 dBm at the donor site shall be provided from the coverage area. The outbound signal level shall be sufficient to provide a minimum of DAQ 3.0 or equivalent SINR for either analog or digital signals. Isolation shall be maintained between the donor antenna and all inside antennas and shall be a minimum of 20 dB above the signal booster gain under all operating conditions.

Critical areas. Critical areas including fire command centers, fire pump rooms, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ, shall be provided with 99 percent floor area radio coverage.

General building areas. General building areas shall be provided with 95 percent floor area radio coverage.

Technology. A spectrum analyzer and/or other comparable technology shall be used to ensure adequate reception and transmission of signal is not violated by other unauthorized carriers. The choice of technology used shall be identified in the report.

In compliance with NFPA 1.11.10 properties who submitted Grid Reports as proof of coverage will be required to demonstrate minimum radio strength annually or at the request of the AHJ.

Alternative Methods and Newly Developed Products

- Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.
- A formal plan review and official determination shall be received prior to installation and/or implementation of an alternative method of installation and/or use of a newly developed product.
- In all such cases the integrator, owners and/or designer shall submit an application with technical documents included for formal consideration via the equivalency process.

GENERAL REQUIREMENTS

Annual Inspection and Test Requirements

- To obtain an application for renewal of the BDA/DAS system. Contact the Ukiah Valley Fire Authority Fire Prevention Bureau.
- BDA/DAS systems are required to be inspected and tested annually or whenever structural changes occur including additions or remodels that could materially change the original field performance tests.
- The occurrence of any fault in an emergency responder radio coverage system where the system function is decreased shall result in the transmission of a supervisory signal to a supervisory service. Systems that are out-of-service for more than four hours require notification to the fire code official.
- All relevant documentation for the BDA/DAS system, including the acceptance and annual maintenance test reports, must be kept on the building premises and be made available to the UVFA upon request.
- The AHJ should be notified in advance and should direct annual test procedures and requirements. Note: Typically, annual tests require several items to be checked. RF emitting devices and system components should be tested to ensure that the gain is the same as it was at initial installation and acceptance. Backup batteries and power supplies should be tested under load for 1 hour to verify that they will operate properly during a power outage.

Inspection Process

To schedule an inspection, Call (707) 463-6739

- Permitting Services Inspection:** Customers should ensure the following information is available on site for use by the Permitting Services Inspectors (Building or Fire)
1. Locations of the BDA/DAS system control equipment, amplifiers, signal boosters, backup battery systems, and any outdoor antennas.
 2. Grid Report. Diagram for each floor where coverage is provided, divided into a grid of 20 approximately equal test areas, and include pre-test received signal strengths and frequencies for each test area. Indicate all critical areas where 99% coverage is required.
 3. Copies of manufacturer specification sheets for all BDA/DAS systems components, including amplifiers, signal boosters, antennas, coax, couplers, splitters, combiners, filters, or any other passive components proposed. Include data sheets for the backup

battery and charging system (if utilized) and include calculations to ensure the backup power requirements are met.

4. A certification letter stating that the BDA/DAS system has been installed and tested per code and that the system is complete and fully functional.

At the conclusion of successful acceptance testing, the AHJ may require the integrator and or owner to apply for a renewable annual permit. ALL DAS systems installed and approved by the AHJ shall be maintained for the life of the property.

Initial Acceptance Test Requirements

- All systems initial acceptance testing documentation shall include a listing of the following:
 - All system equipment utilized.
 - Manufacturer's data sheets
 - Installation, testing, and maintenance documentation
 - As-built drawings showing all equipment locations.
 - Written documentation acceptable to the AHJ of the initial system testing, including the DAQ measured at all locations in the building or areas covered by the installed system.
 - Secondary power calculation
 - List of assigned frequencies s NFPA 1221.6.4; 1221.11.3.9

Shell Building Requirements

- All new buildings under construction where an in-building system is to be installed proof of minimum radio frequency coverage and functionality shall be provided prior to the issuance of a Certificate of Completion.
- The backbone and/or donor riser arrangement shall be fully installed.
- A grid report indicating minimum coverage shall be provide upon inspection.
- System installers submitting designs post formal plan review must follow the application process detailed under section “**Submission of System Designs.**”

Phased Installation

- In all cases of phased construction, the backbone and/or donor riser shall be fully installed. Only the DAS system may be phased per tenant, floor and/or building section.
- A grid report indicating minimum coverage per phase shall be required prior to starting additional phases of installation.
- The AHJ may require revised plans to be submitted for all in-field modifications and changes during installation under phasing conditions.

Lightning Protection

- Systems shall have lightning protection that complies with NFPA 780 and NFPA 96A
- Where required by NFPA 780, system components shall be listed and labeled.
- The system shall be grounded in accordance with NFPA 70, Chapter 8.

Backbone and Donor Riser Systems

- Backbone.** A communications cable in an in-building radio enhancement system that carries wideband signals important to the entire building, from the donor antenna, through the amplifiers, and to distribution antenna lines. Damage to the backbone will disable the radio enhancement system through much or all of the building, and as a result is should be identified and protected.
- Distribution Antenna.** A radio antenna that is specifically designed to radiate RF energy into a building area. It is typically a coax cable or radiating cable, and it is outside of the heat and fire protection provided by firewalls or other means.
- Donor Antenna Cable.** Antennas used with two-way radio communications enhancement systems that provide the connection between the wide-area communications system of interest and the in-building system.
 - The backbone, antenna distribution, radiating, or any fiber optic cables shall be rated as plenum cables. [1221.9.6.2.1.]
- Underground Routing.** Underground metallic and fiber-optic communication and signal cables in ducts or of the direct burial type shall be permitted to be brought above ground only at locations approved by the AHJ.

- All raceways or ducts entering buildings from underground duct systems shall be effectively sealed with an identified sealing compound or other means acceptable to the AHJ to prevent moisture or gases from the underground duct system from entering the building.
- Cable splices, taps, and terminal connections shall be located only where accessible for maintenance and inspection and where the AHJ has determined that no potential for damage to the cable due to falling structures or building operations exists.

Wiring Inside Buildings

- Pathway survivability.** Where fire survivability is required, a listed electrical circuit protective system or a fire-rated cable that is listed to maintain circuit integrity shall be used.
 - Pathway survivability levels shall be as described in Section 5.10. [1221.6.9.2; 72:24.3.13.1]
 - The installation of all pathway wiring, cable, and equipment shall be in accordance with NFPA 70 and the applicable requirements of NFPA 72.12.2.3.1 through 12.2.3.3.
- Where** installed in buildings, conductors and fiber-optic cables shall be installed in accordance with NFPA 70 in any one of the following wiring methods: [1221.5.5.2]
 - (1) Electrical metallic tubing
 - (2) Intermediate metal conduit
 - (3) Rigid metal conduit
 - (4) Surface metal raceways
 - (5) Reinforced thermosetting resin conduit (RTRC)
 - (6) Metallic cable trays.

Note. Piping shall be identified in a manner that distinguishes DAS system piping from other runs.

- Plenum rated cable.** Plenum rated cable has a special insulation that has smoke and low flame characteristics. It is mandated to be installed in any “air handling” space. For instance, most large office buildings use the ceiling to return air to the AC unit.
- Plenum rated armored cable systems.** Listed incased plenum rated cables are acceptable as a metal raceway alternative, in accordance with NFPA 72 section 12.4.2 and level 1 pathway survivability. **The design and use shall be submitted for formal review and approval prior to installation.**
 - **Use in riser applications.** Shall be protected with a rated enclosure when used as a riser or backbone system. (See wiring survivability and vertical shaft section requirements.)
- Fiber-Optic cables.** Conductors and fiber-optic cables shall be installed as far as possible without splices or joints.

- Splices or joints shall be permitted only in listed junction terminal boxes, enclosures, or other approved termination devices.

Use of Rated Rooms.

1. Design of wiring method shall receive a formal plan review and approval prior to installation.

2. The connections, backbone and/or donor riser shall be provided with protection against physical damage in a method approved by the AHJ.

3. Passage of the antenna distribution cable in and out of the enclosure shall be fire stopped comparable to the building's fire rating.

4. All other conditions of use not detailed will be considered during formal review wherein all details presented.

Wiring and Pathway Survivability

- Where a two-way radio communications enhancement system shall have a pathway survivability of Level 1, Level 2, or Level 3. (72.24.3.13.8.1) See Footnote Commentary*
- The feeder and riser coaxial cables shall be rated as plenum cables. [72.24.3.13.8.1.1]
- The feeder coaxial cables shall be connected to the riser coaxial cable using hybrid coupler devices of a value determined by the overall design. [72:24.3.13.8.1.2]
- Riser coaxial cables shall be rated as riser cables and routed through a 2-hour-rated enclosure. [72.24.3.13.8.3]
 - See the exceptions under vertical shafts.
- The connection between the riser and feeder coaxial cables shall be made within the 2-hour-rated enclosure, and passage of the feeder cable in and out of the 2-hour-rated enclosure shall be fire stopped to 2-hour ratings.
- **Use of listed 2 hr. rated coaxial cables.** When used as the backbone and/or donor riser in lieu of the required 2 hr. rated enclosure, the distribution connections shall be designed with 2 hr. protection. There shall be no installation of the cable prior to formal approval of the design proposed.
- Conditions of installation may require mechanical protection from physical damage. When such is required, it will be communicated by the AHJ.
- All signal booster components shall be protected in NEMA 4-Type waterproof cabinets.

Vertical Shafts

Exit Stair Enclosures and Elevator Shafts in commercial buildings. Shall be enclosed in accordance with the criteria of NFPA 101.7.1.3.2 and protected in accordance NFPA 101.8.6.5.

Enclosures connecting four or more stories in new construction shall be protected with 2 hr. fire barriers.

- The connection between the riser and feeder coaxial cables shall be made within the 2- hour-rated enclosure, and passage of the feeder cable in and out of the 2-hour-rated enclosure shall be fire stopped to 2-hour ratings.
- When two-way radio enhancement is approved in lieu of in-building wired fire fighter phone jacks the design shall be formally reviewed and approved by the AHJ prior to installation. NFPA 72. 24.3.13.3.8.2

Enclosures connecting three or less stories in new construction shall be protected with 1 hr. fire barriers.

- The connection between the riser and feeder coaxial cables shall be made within the 1- hour-rated enclosure, and passage of the feeder cable in and out of the 1-hour-rated enclosure shall be fire stopped to 1-hour ratings.

Note. In cases where allowed, a fire resistance of no less than a minimum of 1-hour shall be provided. There is no provision for installation of a backbone and/or donor riser system without fire resistive protection.

Exception Non-Highrise Residential Buildings. If a lodging and rooming house, new hotel and/or new apartment building is protected throughout by an approved supervised automatic sprinkler system and is not a high-rise building; walls enclosing vertical openings and doors shall be allowed to have a minimum 1-hour fire resistance rating.

Stair Enclosures in non-high rise residential buildings.

Backbone and/or donor riser shall be protected against physical damage in a manner approved by the AHJ. The construction of the physical protection shall not encroach nor obstruct the egress width required. The design of protection proposed shall be submitted for review and approved prior to installation.

The connections, backbone cable and the antenna cables shall be made within the enclosure and passage of the antenna distribution cable in and out of the stair enclosure shall be fire-stopped at fire resistance rating of 1 hr. as applicable to the criteria for residential occupancies. Fire resistance rating shall be 2 hrs. when installed in a high-rise building or as noted when more stringent requirements are applicable in other occupancy chapters of NFPA 101.

Elevator Shafts in non-high rise residential buildings.

The connections, backbone and/or donor riser shall be protected against physical damage in a manner approved by the AHJ. The passage of the antenna distribution cable in and out of the

elevator shaft enclosure shall be fire-stopped at fire resistance rating of 1 hr. as applicable to the criteria for residential occupancies. Fire resistance rating shall be 2 hrs. when installed in a high-rise building or as noted when more stringent requirements are applicable in other occupancy chapters of NFPA 101.

Component Approval and Enclosures

- RF emitting devices and cabling used in the installation of the public safety two-way radio communications enhancement systems shall be approved by the AHJ, and all RF emitting devices shall have the certification of the radio licensing authority and be suitable for public safety use prior to installation.
- All repeater, transmitter, receiver, signal booster components, external filters, and battery system components shall be contained in a NEMA 4- or NEMA 4X-type enclosure(s). (1221.9.6.11.2)
- Batteries that require venting shall be stored in NEMA3R-type enclosures.

Non-Interference and Non-Public Safety System Degradation

- No amplification system capable of operating on frequencies or causing interference on frequencies assigned to the jurisdiction by the FCC shall be installed without prior coordination and approval of Cal-Fire, the UVFA, MCSO, and UPD. (1221.9.6.5.1; 72.24.5.2.1.1)
- The building manager/owner shall suspend and correct equipment installations that degrade the performance of the public safety radio system or public safety radio enhancement system.

Radio Coverage

- Critical areas, including fire command centers, fire pump rooms, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ, shall be provided with 99 percent floor area radio coverage. [1221.9.6.7.3]

- Emergency Command Center(s)
- Exit Stairs o Elevator Lobbies
- Sprinkler Sectional o Fire Pump Rooms (s)
- Exit Passageways o Standpipe Cabinets
- Valve Locations
- Other areas identified by the fire code official.
- General building areas shall be provided with 90 percent floor area radio coverage. [1221.6.9.7.4]

Radio Frequencies

- **BDA/DAS** system owners are required by the FCC to register their BDA/DAS system (which the FCC identifies as 'signal boosters') with the FCC. This applies to those systems already placed in operation, in permitting or under construction. The FCC Rule requiring registration is CFR 47, FCC Part 90.219(d)(5). Additional information may be found at: <http://wireless.fcc.gov/signalboosters/part-90-boosters/index.html>
 - The amplification equipment must be FCC Type Accepted.
 - All uplink signals need to be confirmed with a Spectrum Analyzer for system oscillations and the uplink ERP is 5 watts or below (+37 dbm).
- **The AHJ** shall maintain a list of all inbound/outbound frequency pairs for distribution to system designers. (1221.9.6.10.1) To ensure that BDA/DAS systems do not cause any harmful interference to the public safety radio system, building owners or their designees will be required to provide specific information about their BDA/DAS system and to coordinate system turn-up with Cal-Fire Howard Forest ECC, MCSO and UPD.
 - The determination as to which BDA/DAS system to install in the Ukiah Valley Fire Authorities jurisdiction is the responsibility of an RF engineer and/or installing vendor.

Amplification Components

- **Buildings** and structures that cannot support the required level of radio coverage shall be equipped with a radiating cable system or a distributed antenna system (DAS) with FCC certified signal boosters, or both, or with a system that is otherwise approved, in order to achieve the required adequate radio coverage.

Signal Strength

- Inbound.** A minimum inbound signal strength of -95 dbm at the donor site, or other signal strength sufficient to provide usable voice communications, as specified by the AHJ, shall be provided throughout the coverage area. The inbound signal level shall be sufficient to provide a minimum of Delivered Audio Quality, DAQ 3.0 for either analog or digital signals.
- Outbound.** A minimum outbound strength of -95 dbm at the donor site shall be sufficient to provide usable voice communications, as specified by the AHJ, shall be provided throughout the coverage area. The outbound signal level shall be sufficient to provide a minimum of Delivered Audio Quality, DAQ 3.0 for either analog or digital signals.

Isolation

- If a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas and shall be a minimum of 20 dB above the signal booster gain under all operating conditions.
- If used, signal boosters shall meet the following requirements, as well as any other requirements determined by the authority having jurisdiction:
 - Signal boosters shall have FCC certification prior to installation.
 - All signal boosters shall be compatible with both analog and digital communications simultaneously at the time of installation. The authority having jurisdiction shall provide the maximum acceptable propagation delay standard.

Power Sources

- Primary Power Source.** The primary power source shall be supplied from a dedicated branch circuit and comply with 72.10.6.5.1
 - **Branch Circuit.**
 - The branch circuit supplying the fire alarm equipment(s) or emergency communication system(s) shall supply no other loads and shall be supplied by one of the following:
 1. Commercial light and power

2. An engine-driven generator or equivalent in accordance with 10.6.11.2, where a person specifically trained in its operation is always on duty.

3. An engine-driven generator or equivalent arranged for cogeneration with commercial light and power in accordance with 10.6.11.2, where a person specifically trained in its operation is always on duty.

- At least two independent and reliable power supplies shall be provided for all RF emitting devices and any other electronic components of the system: one primary and one secondary.

Secondary Power Source. The secondary power source shall consist of one of the following:

1. A storage battery dedicated to the system with 12 hours of 100 percent system operation capacity.

2. An automatic-starting, engine-driven generator serving the dedicated branch circuit or the system with at least 12 hours of 100 percent system operation capacity and storage batteries dedicated to the system with at least 2 hours of 100 percent system operation capacity and arranged in accordance with (72.10.6.11.3).

Monitoring. Monitoring the integrity of power sources shall be in accordance [1221.9.1.2.2]

System Monitoring

Fire Alarm System. The system shall include automatic supervisory signals for malfunctions of the two-way radio communications enhancement systems that are annunciated by the fire alarm system in accordance with NFPA 72; 1221.9.6.13.1(2)(a) and shall comply with the following:

(1) Monitoring for integrity of the system shall comply with NFPA 72, Chapter 10.6.9 and Section 12.6

(2) System supervisory signals shall include the following:

- a. Donor antenna malfunction
- b. Active RF emitting device failure.
- c. Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
- d. Active system component failure

(3) Power supply supervisory signals shall include the following for each RF emitting device and system component:

- a. Loss of normal ac power
- b. Failure of battery charger

(4) The communications link between the fire alarm system and the two-way radio communications enhancement system must be monitored for integrity.

Dedicated Annunciation

A dedicated annunciator shall be provided within the fire command center to annunciate the status of all RF-emitting devices and active system component locations. This device shall provide visual and labeled indications of the following for each system component and RF-emitting device:

1. Normal ac power
2. Loss of normal ac power
3. Battery charger failure
4. Low-battery capacity (i.e., to 70 percent depletion)
5. Donor antenna malfunction
6. Active RF-emitting device malfunction
7. Active system component malfunction

The communications link between the dedicated monitoring panel and the two-way radio communications enhancement system must be monitored for integrity.

END OF DOCUMENT