REFERENCE GUIDE

Bi-Directional Amplifier

Codes and Standards Reference Guide

Most current adopted Building Codes and Installation Standards require Emergency Responder Radio Signal strength and coverage to be measured in all new and some existing construction. This Reference Guide summarizes the key requirements in the national consensus model codes and installation standards that govern the installation, testing, and maintenance of in-building emergency responder radio enhancement systems. Always consult with your local fire jurisdiction to determine if other local specifications or ordinances are followed, which could be more stringent than those listed below.

CODE REQUIREMENTS**	NFPA*			IFC		
	NFPA 72 - 2013	NFPA 1221 - 2016	NFPA 1221 - 2019	IFC 510 - 2015	IFC 510 - 2018	IFC 510 - 2021
In-Building Solution Required	Section 24.5.2	Section 9.6	Section 9.6	Section 510.1	Section 510.1	Section 510.1
Pathway Survivability for Coaxial Cable Required	2 Hour for Riser Coaxial Cable Section 24.3.6.8.1	2-Hour for Riser Coaxial Cable Section 9.6.2.1.1	Backbone Cable Routed Through Enclosure Matching Bldgs. Fire Rating Section 9.6.2.3	Not Addressed in Section 510. Referenced in 24.3.6.8.1 of NFPA 72-2013	Yes, Section 510.4.2. Reference to NFPA 1221***	Yes, Section 510.4.2. Reference to NFPA 1221
Plenum Rated Coaxial Cable Required	Yes, Riser & Feeder Coaxial Cable Section 24.3.6.8.1.1	Yes, Riser & Feeder Coaxial Cable Section 9.6.2.1.1.1	Yes, Backbone & Antenna Distribution Cables Section 9.6.2.1	Not Addressed in Section 510. Referenced in 24.3.6.8.1.1 of NFPA 72-2013	Yes, Section 510.4.2. Reference to NFPA 1221	Yes, Section 510.4.2 Reference to NFPA 1221
Lightning Protection Required	Not addressed in Section 24.5.2	Yes, In accordance with NFPA 780 Section 9.6.3	Yes, Section 9.6.3 Installed per NFPA 780	Not Specifically Addressed in Section 510	Yes, Section 510.4.2 Per NFPA 780 as Referenced in NFPA 1221	Yes, Section 510.4.2 Per NFPA 1221 Section 9.6.3 Installed per NFPA 780
Isolation of Donor Antenna Required	Yes, 15 dB Section 24.5.2.3.3	Yes, 20 dB Section 9.6.9	Yes, 20 dB Above System Gain Section 9.6.9	Not Specifically Addressed in Section 510	Yes, 20 dB Section 510.4.2.4 (4)	Yes, 20 dB Section 510.4.2.4 (4)
Battery Backup Required	12 Hours Section 24.5.2.5.5.2	12 Hours Section 9.6.12.2	12 Hours Battery or Generator Section 9.6.12.2	24 Hours Section 510.4.2.3	12 Hours Section 510.4.2.3 or 2-Hours Battery with Emergency Generator	12 Hours Section 510.4.2.3 or 2- Hours Battery with Emergency Generator
Signal Strength and Area Coverage Required	-95 dBm - Section 24.5.2.3 90% General Section 24.5.2.2.2 99% Critical Section 24.5.2.2.1	DAQ 3.0 - Section 9.6.8 90% General Section 9.6.7.5 99% Critical Section 9.6.7.4	DAQ 3.0 - Section 9.6.8 90% General Section 9.6.7.4 99% Critical Section 9.6.7.3	-95 dBm - Section 510.4.1 95% General Section 510.4.1 99% Critical - Not Specifically Addressed in Section 510	DAQ 3.0 - Section 510.4.1.1 95% General Section 510.4.1 99% Critical Section 510.4.2 Ref. to NFPA 1221	DAQ 3.0 Section 510.4.1.1 95% General Section 510.4.1 99% Critical Section 510.4.1
Monitoring by Fire Alarm Required	Yes, Section 24.5.2.6	Yes, Section 9.6.13	Yes, Section 9.6.13 & Chapter 10 of NFPA 72	Yes, Section 24.5.2.6 NFPA 72 -2013	Yes, Section 510.4.2.5	Yes, Section 510.4.2.5
Cabinets for Equipment and Battery Backup Required	Yes, NEMA 4/NEMA 4X Section 24.5.2.5.2	Yes, NEMA 4/NEMA 4X Section 9.6.11.2	Yes, NEMA 4/4X & NEMA 3R for Batteries Section 9.6.11.2	Yes, NEMA 4 Section 510.4.2.4 (1) & (2)	Yes, NEMA 4/NEMA 3R Section 510.4.2.4 (1) & (2)	Yes, NEMA 4/NEMA 3R Section 510.4.2.4 (1) & (2)
Monitor Antenna Malfunction Required	Yes, Donor Antenna Section 24.5.2.6(2)(a)	Yes, Donor Antenna Section 9.6.13.1(2)(a)	Yes, Donor Antenna Section 9.6.13.2.1(5)	Yes, Section 24.5.2.6(2)(a) NFPA 72-2013	Yes, Donor Antenna Section 510.4.2.4(4)	Yes, Donor Antenna Section 510.4.2.4(4)
System Acceptance/Testing	Section 24.5.2.1.2 & 14.4.10	Section 9.6.4, 11.3.9 & 11.3.9.1	Section 9.6.4, 11.3.9 & 11.3.9.1	Section 510.5.3	Section 510.5.3	New Section 510.5.4 Annual Section 510.6.1
Listing of Equipment	Not specifically addressed	Not specifically addressed	Specific Listing Requirement TBD by the AHJ	Not Required by Section 510	Not Required by Section 510	Yes, Section 510.4 (UL2524)
Mounting of Donor Antenna	Not specifically addressed	Not specifically addressed	Not specifically addressed	Not specifically addressed	Not specifically addressed	Section 510.5.1

*** NFPA 1 Section 11.10:** In all new and existing buildings, minimum radio signal strength for emergency services department communications shall be maintained at a level determined by the AHJ. Where required by the AHJ, in-building emergency responder communication enhancement systems shall comply with Section 9.6 of NFPA 1221 and 11.10.3.1 through 11.10.5 of 2021 NFPA 1; Shall be listed and labeled in accordance with UL 2524, In-building 2-Way Emergency Radio Communication Enhancement Systems.

******* Also See NFPA 1221 TIA 16-2



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REFERENCE GUIDE

UL 2524 In-building 2-Way Emergency Radio Communication Enhancement Systems – Technical Requirements

Areas Addressed by UL 2524:

- Safety (risk of fire and risk of shock) requirements –construction and testing
- Compliance with specific performance requirements in accordance with the IFC-2018 and NFPA 1221-2016 (2019)
- Reliability performance requirements applicable for life safety systems – construction and testing
- Product marking and installation documentation

Scope:

- Cover products (e.g. repeater, transmitter, receiver, signal booster components, remote annunciators and operational consoles, power supply, and battery charging system components) used for in-building 2-way radio emergency radio communication enhancement systems installed in a location to improve wireless communication at that location.
- Does not cover passive RF components which are defined in UL 2524 as "any device that RF passes through that does not have an active electronic component that requires external power. This includes, antennas, splitters, couplers, coaxial cable and connectors. Passive components cannot amplify RF signals."

Performance - Operation:

- Normal AC power
- Visual and audible annunciation within 200 secs of fault for Loss of normal AC power, Battery charger failure, Loss of battery capacity (to 70% depletion), Donor antenna disconnection, Active RF emitting device malfunction, System component malfunction other than passive RF component which affects system performance
- Visual & audible annunciation within 24 hours of fault for Donor antenna malfunction

Construction:

- NEMA Type 4 or 4X for all repeater, transmitter, receiver, signal booster components, external filters, and battery system components. Note: Rechargeable standby batteries are permitted to be contained in enclosures that comply with the requirements for a Type 3R.
- The system shall be sufficiently modular to have the capability to support revised and/or additional system frequencies within the same frequency band of the bi-directional amplifier supplied to maintain radio system coverage as it was originally intended without the need to replace the system.

Reliability:

- Variable Voltage Operation Test
- Variable Ambient Temperature and Humidity Tests
- Component Temperatures Test
- Charging Current Test
- Transient Testing

For more information
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