BROWARD COUNTY
BOARD OF RULES AND APPEALS

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To: Members of the Committee to Address Uniform Procedures for Installation of Bi-Directional Amplifiers (BDA)

D. Rice, P.E.	B. Bowers	M. Bray	K. Brown	J. DeZayas	T. DiBernardo
R. Dinello	J. Franklin	K. Grams	B. Higdon	W. Keys	H. Melamed
J. Preston	M. Sheehan	R. Taylor	A. Zackria		

From: Bryan Parks, Chief Fire Code Compliance Officer
Ken Castronovo, Chief Electrical Code Compliance Officer

Date: July 29, 2019

Subj: BDA Committee to Discuss Agenda Items

The Chairman of the BDA Committee, Mr. Dave Rice, P.E., has called for a meeting of the BDA Committee on July 29, 2019 at 1:30pm at the Plantation Fire Station, 550 NW 65th Avenue, Plantation, FL 33317. The latest issues concerning Bi-Directional Amplifiers will be discussed.

Chairman Welcoming Remarks

Roll Call

Acceptance of April 25, 2019 Meeting Minutes

Regular Meeting

Schedule Next Meeting

Adjournment

Sunshine Law Reminder: *Advisory Board members cannot communicate with each other on a possible committee or Board topic outside of a public meeting, per State statute.*

Broward County
Board of Rules and Appeals
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DRAFT

MEETING OF THE COMMITTEE TO ADDRESS UNIFORM PROCEDURES FOR INSTALLATION OF BI-DIRECTIONAL AMPLIFIERS

Minutes
April 25, 2019

Call to order:

Chair David Rice, P.E. called a published meeting of the Broward County Board of Rules and Appeals Committee to Address Uniform Procedures for Installation of Bi-Directional Amplifiers to order at 1:40pm.

Chair Rice welcomed the members of the public who were attending the BDA Committee Meeting for the first time and gave them background information about Broward County Board of Rules and Appeals committees. He suggested that the committee members, Broward County ORCAT and City of Fort Lauderdale employees to introduce themselves as reputable points of contact.

The roll was called, and the following members were present:

Bruce Bowers	Mickey Bray	Kenneth "Sean" Brown
Robert "Bob" Dinello	Johnathan Franklin	Brad Higdon
William "Bill" Keys, CFPE	Howard Melamed	David Rice, P.E.
Robert Taylor		

Staff: Bryan Parks, Chief Fire Code Compliance Officer
Kenneth Castronovo, Chief Electrical Code Compliance Officer

Chair Rice explained the Florida Sunshine law to the public which states that per State statute, Advisory Board members cannot communicate with each other on a possible committee or Board topic outside of a public meeting.

Chair David Rice, P.E., shared a statement that was sent to him via email by Mr. John Foley, Safer Buildings Coalition. Mr. Foley was concerned that he was misinterpreted at the February 26, 2019 BDA Committee Meeting. His email clarified that he believes that, regarding to UL 2524, the statement that inspection process has the potential to be flawed because the box cannot account for the totality of the system, is not a position that can be supported by the Safer Buildings Coalition. Mr. Foley added that the Safer Buildings Coalition is not currently pursuing an initiative to expand the scope of UL 2524.

A MOTION WAS MADE BY MR. FRANKLIN AND SECONDED BY MR. HIGDON TO AMEND THE FEBRUARY 26, 2019 COMMITTEE TO ADDRESS UNIFORM PROCEDURES FOR

Item 1: Discussion on the use of elevator shafts and stairwells as a two-hour fire rated enclosure for riser cables. NFPA 72, 2013

Mr. Kenneth Castronovo, Broward County Board of Rules and Appeals, informed the public that there have been questions about elevator shafts and BDA antennas/wire. As well as, there is a variance that can be completed through the Broward County Elevator Division.

Chair Rice added that this issue came to his attention through NFPA Section 1221 in the Florida Fire Prevention Code which states that the risers have to be in a fire-rated enclosure. However, the appendix goes on to state that the stairwells and the elevator shaft could be used as fire-rated enclosures. Chair Rice said because the statement is in the appendix, it is not technically a part of the code. Also, the term "could" was used rather than shall, which would allow the decision to be made by the Authority Having Jurisdiction (AHJ).

Mr. William Redmond, Broward County Building Code Services Division, said you can't have any foreign equipment in the elevators. There are exceptions for sprinkler plates, heating and cooling. Variances are allowed only when the financial hardship requirement is met. Mr. Redmond suggested obtaining the signals through alternative spaces, in lieu of the hoistways. He noted that the although the process is expensive, it is worth it. A letter from the owner is required stating that the individual who is requesting variances is the same individual who is working on the owner's behalf.

Mr. Redmond shared the location of his office with the public and offered his assistance with the variance process. He added that the variance requires knowledge of the elevator section, knowledge of the intent of the code (to prevent non-elevator personnel from injury in the hoistway and to ensure the safe operation of the elevator) and possess the ability to demonstrate a process to carry out the intent of the code.

It is also required to provide documentation from the owner of the property, from the antenna manufacturer, documentation of the signal strength and documentation from the elevator manufacturer proving that the signal strength will not have adverse effects on the operation of the elevator.

Whoever is working in the hoistway is required, by Florida Statute, to be under the direct supervision of (or in close proximity to) a certified elevator technician.

Mr. Gary Gray, City of Fort Lauderdale, noted that the antenna manufacturer will not know anything about the signal levels coming off the antenna. The design and the signal strength that is being fed to the antenna must be taken into consideration before a solution can be determined.

Mr. Jonathan Franklin, Signal Communications, LLC, asked Mr. Gray for his guidance on the best practice for getting radio signals to reach the elevator shafts. Mr. Gray said that based on his experience, the IE antennas can be placed in the elevator shafts and the BDA systems produce a much less powerful output than the portable radio that will be brought in by public safety personnel. He also recommended that once the system is put in, the antennas should not be disturbed unless there is physical damage to the cables themselves. Although the cables shouldn't be disturbed, there will need to be a way for the elevator shaft to be accessed for routine testing.

Mr. Bryan Parks, Broward County Board of Rules and Appeals, mentioned that most of the calls that he gets are not related to the elevator shafts, but they pertain to having access to running riser cables.

Mr. Bryan Parks, Broward County Board of Rules and Appeals, mentioned that most of the calls that he gets are not related to the elevator shafts, but they pertain to having access to running riser cables.

Mr. Keith Jewett, City of Fort Lauderdale, asked for clarification about the committee's views on risers. He explained that in Fort Lauderdale there are numerous high-rise buildings that take multiple antennas inside of the elevator shaft to reach sufficient coverage (sometimes two or three antennas). He has come in contact with people who ask if the equipment has the propensity to penetrate multiple floors rather than come through the bottom floor and take the signal up through the elevator shaft.

Mr. Redmond said that having multiple antennas is permitted and the signal entry points must match the antenna locations. Mr. Parks asked if a variance was still required in situations like these. Mr. Redmond clarified that a variance will be required.

Chair Rice asked Mr. Redmond what the typical turn-around time for a variance was. Mr. Redmond answered that when all of the proper documentation has been submitted, the variance can be issued within 30 days. He added to make sure that the proper documentation is submitted before the last 90 days of a project, to avoid any potential delays.

Mr. Howard Melamed, Cell Antenna Corporation, asked for clarification about the current discussion. Mr. Redmond said that what all components of the conversation have in common is the mission to provide a signal in the elevator shaft.

Chair Rice reiterated: if an antenna needs to be installed inside of an elevator shaft, a variance can be found through the Broward County Building Code Services Division, but a variance for installing antennas floor to floor using a riser cannot.

Mr. Redmond added that no one is permitted to access the elevator shaft without access given by a certified elevator technician.

Mr. John Dignan, RF FREQS, stated that it is more beneficial to put the antennas in the shaft rather than to force someone to try to get a signal from outside of the shaft because it will cause the signal to be overridden and raise the noise level, resulting in interference.

NO MOTION.

Chair Rice reminded the members of the BDA Committee that the motion needed to be made for the amendments to the February 26, 2019 minutes.

A MOTION WAS MADE BY MR. BROWN AND SECONDED BY MR. KEYS TO APPROVE THE AMENDMENT OF THE FEBRUARY 26, 2019 COMMITTEE TO ADDRESS UNIFORM PROCEDURES FOR INSTALLATION OF BI-DIRECTIONAL AMPLIFIERS MEETING MINUTES. THE MOTION PASSED BY UNANIMOUS VOTE.

Item 2: Review Formal interpretation #20 concerning UL Standard 2524 for Bi-Directional Amplifier Systems

A. Memo to all interested BDA parties concerning UL 2524 (Effective Date: April 19, 2019)

Mr. Castronovo informed the room that Formal Interpretation #20 expired on April 19, 2019. Any plans that are submitted after the expiration date must abide by UL 2524. Chair Rice cited the Florida Statutes adding that the permit application must be date stamped before April 19, 2019 to be able to implement Formal Interpretation #20.

Mr. Melamed said that his company, Cell Antenna Corporation, has researched the market, looking for companies that can meet the UL 2524 standard. Their organization found that there is not a sufficient amount of companies that can meet the standard. He added that the inability to meet the standard, will result in hardship for the companies that provide the service and the consumers will be forced to work with a limited number of vendors.

Mr. Melamed inquired about if there is a requirement for the battery backup unit (BBU) to meet the UL2524 standard.

Chair Rice reiterated that UL 2524 is not the standard. He said the codes that should be referenced vary. For example, an electrical inspection should reference NFPA 100, NFPA 110 or NFPA 72. NFPA 100 states that the equipment must be approved by the authority having jurisdiction (AHJ).

Chair Rice gave his contact information to the audience to share their comments and suggestions with him.

Mr. James DiPietro, Broward County Board of Rules and Appeals, added that the central issue is the fact that the committee cannot override the code.

Mr. Dignan asked Chair Rice for clarification about the extent of the code's authority. Chair Rice answered that UL 2524 is not the only code that can be enforced. Most engineers first look for equipment to be UL listed before having to conduct a third-party inspection.

NO MOTION.

Item 3: Third-Party Field Evaluations, NFPA 790 and NFPA 791

Mr. Ric Caselli, MPBX, Inc., asked the committee why Nationally Recognized Testing Laboratories (NRTLs) are being utilized for third-party inspections, rather than using a company that specializes in BDAs. He added that working with the smaller companies would make the inspection process cheaper and faster.

Chair Rice said that third-party inspections are under NFPA 790 and NFPA 791, which define who is eligible to perform a third-party inspection as well as the components of the inspection.

Ms. Anne McGee, Cobham Wireless, mentioned that rather than requiring a specific listing, the National Electric Code (NEC) only requires a listed assembly. Ms. McGee also suggested the 6-month extension to use equipment that is currently UL listed, rather than only UL 2524, since they have already been inspected for safety.

Chair Rice suggested that Ms. McGee was alluding to UL 60950. Chair Rice explained that UL 60950's purpose is for communications and Information Technology (IT). He added that he has reached out to a few people to learn the differences between UL 60950 and UL 2524. The State of Florida is under the 2014 National Electric Code and none of the code states that UL 2524 is a requirement. It only states the equipment must be approved by AHJ.

Mr. Thomas Sullivan, Mobile Communications, said that he contacted four independent testing labs to have a BDA system inspected and they all told him that they are not currently able to meet the standards of UL 2524.

Mr. Parks reminded the room that they should refrain from using the term "UL listing" exclusively because the code refers to all NTRLs for listings.

Chair Rice added that anyone who is practicing third-party inspections, must meet the requirements of NFPA 790 and NFPA 791.

Mr. Melamed viewed the circumstances as bureaucratic because no other municipality in the United States of America requires an additional organization for the public to go through. He stated that the BDA Committee was created to help simplify complex situations and make the process easier for contractors throughout the county, but the committee has begun to add to the confusion.

Mr. Melamed asked the public if they were clear about what was required of them to get their approvals and what they need to submit. No one raised their hand.

Chair Rice informed the members of the committee that they were welcome to make any motion that they wanted to and if they made a motion they would have to make sure to be present at the next Board Meeting, so that they can represent themselves. He added that it is the BDA Committee only has the authority to recommend things, but it is up to the Board to approve.

Mr. Scott Douglas, City of Miramar, said that he was very happy that the BDA Committee implemented UL 2524. He shared that since the BDA is an emergency standard, he believes UL listed products are more accurate and dependable.

Mr. Robert Dinello, Electrical Plans Examiner, City of Fort Lauderdale, asked why there was such a huge turnout at the April 25, 2019 meeting in comparison to any other meeting held before the April 19, 2019 deadline.

Chair Rice asked all of the manufacturers in the room to contact him to share their ideas about UL 60950. If there is a strong case made for UL 60950, Chair Rice will have a meeting with electrical chiefs to discuss the potential of its implementation.

Mr. Melamed asked if there is a way for a designated authority to approve the BDAs so that the industry will have an established approval process.

Chair Rice asked if there was anyone present representing Miami-Dade County and if Dade County was in the process of establishing their approval practices. Mr. Richard Rodriguez, City of Miami, said that NFPA 72 gives a lot of leeway and many of the Fire Marshals in Miami-Dade County have not begun to push UL 2524.

Chair Rice added that in Miami-Dade County, a few checklists for code compliance have been published. He would like to meet with Dade County to discuss creating a list of Broward County vendors.

Mr. Gray warned the committee about sharing vendor lists with Dade County because the frequencies used from county to county are different.

Mr. Melamed announced that he was interested in possibly making two motions. One, to delay the implementation of UL 2524 equipment due to the lack of diversity of both products and manufacturers currently required as BDAs in the County and allow for the UL approval for the UL 60950. Two, to request funding from the Broward County Board of Rules and Appeals to hire a qualified testing company to provide approvals for BDAs.

Chair Rice said that he would make a commitment by the next meeting to sit down with Jim DiPietro to see what they can do about coming up with product qualification requirements as well as potentially meet with Miami-Dade County. He said that he would look into the use of UL 60950

Mr. Barry Smith, ORCAT, added that everyone in Broward County needs to work together because there is a lot of competition coming to the county from other parts of the state or county and they are interested in working.

NO MOTION.

Item 4: Electrical Contractors Licensing Board specialty licensing option for the Bi-Directional Amplifier profession update

Mr. Castronovo said that he was contacted by the State of Florida Bureau of Education Testing. They informed him that they would be starting the process of finalizing their summer schedule.

Chair Rice added that the only people there are a few people who are presently permitted to sign contracts. Working with the ECLB will lead the charge in creating a new classification for BDA contractors to be able to sign contracts as well. The ECLB also created a committee to develop the exam required for BDA professionals to earn this contracting license.

NO MOTION.

Item 5: Discussion on enforcing the code in effect

Mr. Parks shared that the UL 2524 is very different from the fire code. He added that the code does say the code of NFPA 72 (2013) is what should be used in the State of Florida. The code states that everything supplied in relation to NFPA 72 or two-way enhanced radio systems must be listed. If the product was not listed, the local fire AHJ must be consulted.

NO MOTION.

Item 6: Approved Engineer. FBC 118.1.4

Chair Rice expressed that as an electrical engineer, he knows what is required to sign and seal a document. He gave the room the example of someone bringing in a document to that was not prepared by him or prepared under his direction, it is impermissible for him to sign and seal it.

He reiterated that all engineers that are hired to the project must have an electrical background and experience.

NO MOTION.

Item 7: Lightning Protection, 9.6.3 NFPA 1221, 2016

Chair Rice divulged that while switching to NFPA 1221 can be beneficial, there are disadvantages as well. Most of the new high-rise buildings are equipped with lightning protection systems.

Mr. Melamed asked if it is the contractors' responsibility to ask the owners if their lightning protection system is certified. Chair Rice said that a lightning protection system contractor would have to be hired. He also noted that the installation and certification of the systems has the potential to be very expensive.

NO MOTION.

Item 8: Surge Arrestor, NFPA 70, 2014, 810.6

Chair Rice cited NFPA 70, 2014, 810.6 which states that a surge protector is required to be installed for the antenna. He also advised everyone to follow the system installation recommendations because it is hypersensitive process.

Mr. Melamed added that the surge arrestor is not built to withstand a lightning strike. Chair Rice agreed, explaining the difference between lightning protection and surge arrestors. The lightning protection systems is designed to protect the structure. The surge arrestor is intended to protect equipment, although it has the potential to fail if it is hit directly.

NO MOTION.

Chair Rice informed the public that Broward County is in process of creating a new radio system. Any system that was installed after 2016, will have to meet the requirements of the new radio system. The project does not have a definite completion date yet.

A MOTION WAS MADE BY MR. MELAMED AND SECONDED BY MR. BRAY TO ADJOURN THE MEETING. THE MOTION PASSED BY UNANIMOUS VOTE.

Adjournment

Having no further business to go before the Committee, the meeting adjourned at 4:02pm.

Item 1:
Discuss UL 60950 and UL 2524

BROWARD COUNTY
BOARD OF RULES AND APPEALS

ONE NORTH UNIVERSITY DRIVE
SUITE 3500-B
PLANTATION, FLORIDA 33324

PHONE: 954-765-4500
FAX: 954-765-4504
www.broward.org/codeappeal

Subject: Memo to Support the use of UL 60950 for BDA installations.

Date: May 14, 2019

To: All interested System Installers, System Integrators, and Inspectors

From: Kenneth Castronovo, Chief Electrical Code Compliance Officer, Bryan Parks, Chief Fire Code Compliance Officer.

Findings:

The UL 60950 Standard (Information Technology Equipment) is referenced in NFPA 70 (2014), Annex A, Product Safety Standard, and in NFPA 72 (2013), Chapter 2, Referenced Publications. This UL 60950 Standard, in Section 1.1.1, specifically identifies a repeater (or BDA) as an example of equipment that is in the scope of this standard. Companies have used this UL Standard as their listing in past years.

The UL 2524 Standard (Safety In-Building, 2-Way Emergency Radio Communication Equipment Systems) was issued in 2018. Section 5.6 of this standard states that if a product meets the requirements of the UL 60950 Standard, then the product also meets many of the construction requirements of the UL 2524 Standard.

Summary

The AHJ may approve equipment listed to either UL Standard 60950 or UL 2524, the Standard for Two-Way Radio Communications Enhancement Systems..

Respectfully,

Kenneth Castronovo, CECCO

Bryan Parks, CFCCO

BROWARD COUNTY
BOARD OF RULES AND APPEALS

ONE NORTH UNIVERSITY DRIVE
SUITE 3500-B
PLANTATION, FLORIDA 33324

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Subject: Formal Interpretation # 20 Expiring April 19, 2019

Date: January 31, 2019

To: All Bi-Directional Amplifier Interested Parties

From: Kenneth Castronovo, Chief Electrical Code Compliance Officer

Broward County Formal Interpretation #20 (FI #20) will expire April 19, 2019. FI #20 allows the Engineer of Record to certify BDA Systems equipment for AHJ approvals up to six months after a standard is issued by a Nationally Recognized Testing Laboratory. UL Standard 2524 was issued on October 19, 2018. The extension deadline for FI #20 is rapidly approaching. All specifications submitted for BDA systems for permitting after the above date will be required to be UL 2524 compliant. Any BDA System can still be certified by a third-party field evaluation company using NFPA 790 and 791. Third-Party Field Evaluation companies shall be accepted by the Authority Having Jurisdiction to perform Field Evaluations.

Sincerely,

Kenneth Castronovo

Critical safety and performance requirements found in NFPA 1 and NFPA 1221 that are not addressed by system certification to UL 60950

UL 2524 includes additional critical safety and performance requirements not found in UL 60950. These requirements were adopted to align with similar requirements that have been utilized for fire alarm systems and which the fire alarm industry has found beneficial.

Requirements unique to UL 2524 (i.e., not found in UL 60950) primarily fall into two categories: Performance/Functionality and Construction.

Performance/Functionality Requirements:

- Monitoring for integrity of the indicated faults result in audible and visual trouble annunciation at the dedicated annunciator:
    - Loss of normal AC power*
    - Battery charger failure*
    - Loss of battery capacity (to 70 percent depletion)*
    - Donor antenna disconnection*
    - Active RF emitting device malfunction*
    - System component malfunction, other than passive RF component, which affects system performance*
    - Donor antenna malfunction**

      * = Visual and Audible annunciation within 200 sec of fault

      ** = Visual and Audible annunciation within 24 hrs. of fault
- Additional aspects of the system to be monitored for integrity include:
    - Loss of secondary power
    - Single open and single ground faults on the communication pathway to the dedicated annunciator
- The system meets the requirement for redundant (two independent) power sources.
- Secondary power source tested to operate at 100% capacity for at least 12 hours.
- Capability of the system to be compatible with a fire alarm system to annunciate system supervisory signals for donor antenna malfunction, active RF emitting device failure, loss of battery capacity (to 70 percent depletion), loss of normal AC power, battery charger failure, and system component malfunction, other than passive RF component, which affects system performance
- Maximum time domain interference delay (propagation delay)
- Radio enhancement systems supporting more than one channel or talk path have the capability to support two radios simultaneously transmitting on different talk paths or channels
- The system is 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.
- All repeater, transmitter, receiver, signal booster components, external filters, and battery system components are contained in enclosures which comply with the requirements for a Type 4 or 4X enclosure and batteries requiring venting are contained in enclosures complying with the requirements for a Type 3R enclosure
- Manufacturer’s published product installation instructions, which are referenced on the product marking by drawing number and issue number and/or revision level, delineate the compatible components forming the system.

- In addition, the following performance tests similar to those performed on fire alarm systems are conducted where the efficacy of the product is confirmed:
    - Variable Voltage Operation Test – consistent with NFPA 72;
    - Variable Ambient Temperature and Humidity Tests – consistent with NFPA 72;
    - Component Temperatures Test – to assess component reliability; and
    - Externally induced supply line transient, internally induced transients, and field wiring transients.

Construction Requirements:

- All field-wiring connections shall be contained in either an enclosed field wiring compartment integral with the product or in a separate outlet box to which the product is to be mounted.
- Enclosure covers need to be hinged, sliding, pivoted or similarly attached to provide access to fuses or any other over current-protective device, the intended protective functioning of which requires renewal or resetting, or when it is necessary to open the cover in connection with the normal operation (operation of a switch for testing or for silencing an audible signal appliance) of the unit.
- All subassemblies, modules, and printed-wiring boards are to be held in their intended place in the product by mechanical means.
- Products intended to be connected to the branch circuit supply are to be provided with a means for permanent connection to the branch-circuit supply. A product intended for permanent connection to the branch-circuit supply is to have provision for mechanically protecting the supply conductors.
- The location of a terminal box or compartment, in which branch-circuit connections to a permanently-wired product are to be made, is to be such that the connections can be readily inspected without disturbing the wiring or the product after the product has been installed as intended.
- A means of strain relief is to be provided for the field supply leads of a product to prevent any mechanical stress from being transmitted to internal connections. Inward movement of the leads provided with a ring-type strain relief or means determined to be the equivalent shall not damage internal connections or components, or result in a reduction of electrical spacings. Each lead used for field connections or an internal lead subjected to movement or handling during installation and servicing shall be capable of withstanding for 1 min a pull of 10 lbs. (4.54 kg) without any evidence of damage or of transmitting the stress to internal connections.
- Duplicate terminals or leads, or an equivalent arrangement, are to be provided for circuits of products intended to be connected to initiating-device circuits of a fire alarm control unit.
- Separation of power limited and non-power limited circuits. The installation document of the product is to completely detail cable entry routing of all conductors into the product.
- A wiring lead provided for field connection to a circuit with voltages exceeding 30 V rms or 42.4 V DC is not to be smaller than 18 AWG (0.82 mm^2), and the insulation, when of rubber or thermoplastic, is to be minimum 0.30 in (0.76 mm) minimum average and 0.027 in (0.69 mm) minimum at any point.
- All external circuits intended to be connected to nonpower-limited wire are to contain either current-limiting or overcurrent protection to prevent fault currents in excess of the current rating for the gauge wire size permitted by the National Electrical Code, ANSI/NFPA 70, or as specified in the installation wiring diagram/instructions

Critical safety and performance requirements found in NFPA 1 and NFPA 1221 that are not addressed by system certification to UL 60950

- Construction requirements for end of line devices include insulating the leads of the device. Where the circuit in which the end-of-line device is to be connected is intended for connection by coaxial cable, the device is to be enclosed. The coaxial connections may be internal or external on the enclosure. The enclosure is to be provided with a means for mounting.
- A rechargeable storage-type battery is to be protected against excessive loading or charging current by a fuse or other overcurrent protective device. The mounting arrangement for the batteries is to permit access to the cells for testing and maintenance, or the product is to provide integral meters or readily accessible terminal facilities for the connection of meters for determining battery voltage and charging current.

June 7, 2019

Broward County, Florida
Board of Rules and Appeals
One North University Drive
Suite 3500-8
Plantation, Florida 33324

Subject: Board Memo to Support the use of UL 60950 for BDA Installations

To: Kenneth Castronovo, Chief Electrical; Code Compliance Officer
Bryan Parks, Chief Fire Code Compliance Officer

UL is writing to provide the Broward County Board of Rules and Appeals additional information concerning the use of UL 60950[1] as the sole certification standard for BDAs used as an In-building 2-Way Emergency Radio Communication Enhancement System. Underwriters Laboratories is the standards development organization for UL 60950. On October 19, 2018, UL published ANSI/UL 2524[2] as an American National Standard covering certification of these systems.

UL is a global, independent, safety-science company that has championed progress and safety for 125 years. Guided by our mission, UL's 14,000 professionals promote safe working and living environments for all people. UL uses research, standards, and conformity assessment to continually advance and meet ever-evolving safety challenges, and partners with businesses, manufacturers, retailers, trade associations, and regulatory authorities internationally to provide solutions and to address the risks of increasingly complex global supply chains.

To optimize safety and critical system performance, UL recommends that ***In-building 2-Way Emergency Radio Communication Enhancement Systems*** should be required to comply with both UL 60950 and UL 2524. UL 60950-1 is a general standard for evaluation of risk of shock and fire for electronic equipment less than 600 volts. UL 2524 is a comprehensive electrical shock, fire safety and system performance safety standard specifically written for these critical emergency responder communication systems. UL 2524 incorporates the requirements of UL 60950 and 43 other UL standards by reference. The scope of UL 2524 is defined below:

> **Scope**
> 1.1 These requirements 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 emergency radio communication enhancement systems installed in a location to improve wireless communication at that location.

[1] UL 60950-1, *Information Technology Equipment – Safety – Part 1: General Requirements*
[2] UL 2524, *Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems*

1.2 In the United States – These requirements cover products to be employed in accordance with the following Model Building and Installation Codes:

- Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, NFPA 1221;
- National Electrical Code, NFPA 70;
- Fire Code NFPA 1;
- Life Safety Code, NFPA 101;
- International Fire Code.

1.3 The products covered by this standard are intended to be used in combination with other products and devices to form an in-building 2-way emergency radio communication enhancement system. An installation document(s) provided with the product describes the various products needed to form an inbuilding 2-way emergency radio communication enhancement system and their intended use and installation.

1.4 These requirements address the safety, reliability and operational requirements prior to installation.

There are numerous critical safety and performance requirements found in NFPA 1 and NFPA 1221 that are not addressed by system certification to only UL 60950. The requirements unique to UL 2524 are summarized on the attached document.

The posted decision by the Broward County Board of Rules and Appeals also states that UL 60950 is currently a referenced certification standard in NFPA 72-2013. While that is an accurate statement, we would like to point out that the reference to UL 60950 in Chapter 2 of NFPA 72-2013 is only for specific applications and products. The NFPA 72 language to permit UL 60950 products not assessed for other performance standards does not apply to section 24.9 covering Two-Way Radio Communications Enhancement Systems or other parts of NFPA 72. To clarify a key requirement, Clause 10.3.1 of NFPA 72 states: "Equipment constructed and installed in conformity with this Code shall be listed for the purpose for which it is used." This is why reference to UL 60950 may be included to delineate specific equipment which does not need to be listed for fire alarm or life safety use.

For certification purposes, there is an allowance in Clause 5.6 of UL 2524 which states that products need only be evaluated to the applicable construction requirements of UL 2524, rather than the entirety of the standard, when such products also currently meet all of the requirements of UL 60950-1, UL 62368-1[3] or UL 60065[4].

In summary, the completed 2021 edition of the International Fire Code (IFC) and the first draft version of 2021 NFPA 1 both include specific requirements for these systems to be certified to UL 2524. This requirement was added to these model fire codes by a consensus process to ensure the safety, performance and code compliance of these systems that first responders count on for reliable and critical communication in emergency situations. UL 2524 was not included as a certification requirement

[3] UL 62368-1, *Standard for Audio/Video, Information and Communication Technology Equipment - Part 1: Safety Requirements*
[4] UL 60065, *Standard for Audio, Video, and Similar Electronic Apparatus-Safety Requirements*

in earlier editions of these model fire codes simply because the standard was not published when those codes were published.

UL supports the Broward County Board of Rules and Appeals requiring certification of Two-Way Radio Communication Enhancement Systems as an assurance of safety, but UL further recommends these products be required to comply with both UL 60950 and UL 2524 to optimize safety, critical system performance and compliance with the latest consensus-based model fire codes.

Thank you for your consideration of these comments. Please do not hesitate to contact us if you have any questions regarding UL 60950, UL 2524, or these comments.

Sincerely,

Larry Shudak, P.E.
UL. LLC
Principal Engineer
Life Safety Technologies

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cc: Charles A. Rego, Associate General Counsel, UL LLC
Sarah Owen, Principal Policy Advisor, Underwriters Laboratories

[3] UL 60065, *Standard for Audio, Video, and Similar Electronic Apparatus-Safety Requirements*
[4] UL 62368-1, *Standard for Audio/Video, Information and Communication Technology Equipment - Part 1: Safety Requirements*

Item 2:
Discuss the Compatibility List

Two-Way Radio Communications Enhancement Systems
Product Compatibility
Draft Edition 2019-06-14

Item	Manufacturer	Product Name	Part Number	UL Standard	NRTL Listing
BDA/Repeater					
Power Supply					
Battery/Charger/ Enclosure					
Battery/Enclosure					
Remote Annunciator					
Surge Protection					
Donor Antenna				N/A	-
In-Building Antenna				N/A	-
Couplers				N/A	-
Connectors				N/A	-
Splitters				N/A	-
Ground Kit				-	-
Mast				-	-
Coaxial Cable-Outside				N/A	-
Coaxial Cable-Plenum Rated				N/A	-

The above items are compatible for use with the BDA. This form shall be filled out by the BDA manufacturer.

BDA Mfgr. _____
Address _____
City/State _____
Rep Name _____
Title _____
Date _____

Florida Engineer of Record:
Name _____
PE # _____
Company _____
CA # _____
Date _____

Item 3:
Discuss having a Plan Review Meeting

Item 4:
Discuss the proposed draft edition of the “Guidelines”

Broward County

Two-Way Radio Communications Enhancement Systems

BC RCES Guidelines

Part 1. Overview

Table of Contents

1.1 Purpose

A “Two-Way Radio Communications Enhancement System” (RCES) gives fire departments and law enforcement a reliable in-building communication system without detrimentally impacting the surrounding community’s Public Radio Communication Systems.

The purpose of these guidelines is to provide the designers, manufacturers, installers, inspectors, and FCC License Holders the tools to properly design, permit, install, and inspect a fully functional in-building communication enhancement system that meets the state and local codes for Broward County, Florida.

1.2 Background

Each municipality has a public emergency Two-Way Radio Communications System for use by the fire department and law enforcement. These two-way radio systems generally work in open spaces without problems. However, these two-way radio systems do not always work inside buildings. Most buildings now require a signal repeater system located in the building to amplify the radio signal to allow the two-way radio system to work. These systems are known as “Two-Way Radio Communications Enhancement Systems (RCES)” or “Bi-Directional Amplifier Systems” (BDA).

When these systems are not properly designed, installed, and inspected, then major communication problems can occur inside and outside of the building. One faulty system may take down the radio communication system in a large part of a municipality. This faulty system would prohibit the fire department and law enforcement from communicating through their two-way radio system.

These failures have occurred in Broward County. In 2015, a BDA system was installed in Southeast Florida. The installation contractor did not properly notify the FCC License Holder (AHJ) of the installation and did not notify the FCC License Holder that the system was started up for testing purposes. This BDA System had serious design and installation problems. Every time the system was started up for testing, the Broward County Radio System in the southeastern portion of Broward County failed. The Fire Department and law enforcement lost two-way radio communication. Once the problem was identified, the building system was immediately taken off-line. Broward County then asked Broward County Board of Rules and Appeals (BORA) to investigate the problems associated with the faulty installation and to review the existing codes and procedures to attempt to prevent this problem from occurring again.

BORA started up a temporary committee to address these problems. The committee found the following:

1. The state and local codes, Florida Building Codes (FBC), Florida Fire Prevention Code (FFPC), and NFPA 72, if followed, were sufficient and did not require any changes.
2. The problem was a procedural one. All three (3) codes required that the installation shall be permitted and the AHJ’s be notified. A new code section was added to the Florida Building Code (FBC), Broward County Edition, Chapter 1. This new section 118 set forth procedures requiring AHJ notification, among other requirements.

The temporary committee was made a permanent committee in 2018 to address ongoing Two-Way Radio Communications Enhancement Systems problems. The technology is moving at a faster pace than the codes are able to address.

1.3 Codes and Requirements for Broward County

As of January 1, 2018, the following codes have been in effect:

Florida Statute (FS)633.202(1)

Adopts the FFPC

Florida Statute (FS)633.202(18)

This statute pertains to high-rise buildings.

Florida Building Code (FBC), Broward County Edition, Chapter 1, Sixth Edition (2017)

Section 118	Two-Way Radio Communication Enhanced Public Safety Signal Booster Systems

Florida Fire Prevention Code (FFPC) Sixth Edition (2017)

NFPA 1 Fire Code (2015)

Section 1.4	Equivalencies
Section 2.2	Referenced Publications NFPA 70, NFPA 72, NFPA 780, (NFPA 1221 Not enforceable)
Section 11.10	Two-Way Radio Communications Enhancement System when required by AHJ

NFPA 70 (NEC) (2014)

Section 90.7	
Article 100	Definitions
Section 110.2	Approval (UL, etc.)
Section 100.2(B)	Approval (UL, etc.)

NFPA 72 (Fire Alarm) (2013)

Chapter 10	Fundamentals
Section 12.4	Pathway Survivability
Section 14.4.10	In-Building Emergency Radio Communication System
Section 24.3.6	Pathway Survivability
Section 24.5.2	Two-Way Radio Communications Enhancement Systems
Annex A14.4.10.3	DAQ
Annex A14.4.10.5	DAQ

1.3 Codes and Requirements for Broward County (cont.)

Codes and Standards Available:

NO.	Description	Issue Date								
		2013	2014	2015	2016	2017	2018	2019	2020	2021
NFPA 70	Electric		FL			*				
NFPA 72	Fire Alarm	FL			*			*		
NFPA 780	Lightning Protection Systems		*			*				
NFPA 1221	Em Service Comm System				*			*		
UL 2524	2-way EM Comm						*			
FL – Adopted by Florida * – Code Now Available, but not adopted by Florida										
State of Florida is up to six (6) years behind in adopting codes.										

Other Codes and Standards Available, but not adopted by Florida:

NO.	Description	Issue Date								
		2013	2014	2015	2016	2017	2018	2019	2020	2021
IFC	International Fire Code IFC/ICC			*			*			
IEEE 1692	Institute of Electric and Electronic Engineers	Guide for the Protection of Communication Installations from Lightning Effects 2011								
Motorola R56	Standards and Guidelines 2015 For Communications Sites Chapter 4 Exterior Grounding Chapter 5 Interior Grounding Chapter 7 Surge Protection Devices Chapter 9 Equipment Installation 9.9.8 RF Cabling									

Other Guidelines:

City of Fort Lauderdale	Communications	BDA Guidelines 2019
Broward County	RESC	BDA Guidelines 2019

1.3 Codes and Requirements for Broward County (cont.)

Optional Codes and Dates

The State of Florida, through the FFPC (2017), Chapter 1, Section 1.4, allows the Two-Way Radio Communications Enhancement System Engineer of Record to design the system with present or newer codes, if acceptable by the AHJ, as shown below:

The design engineer shall select one of the following three options:

NFPA 72 (2013)
NFPA 72 (2016 and NFPA 1221 (2016)
NFPA 72 (2019) and NFPA 1221 (2019)

1.3 Codes and Requirements for Broward County (cont.)

Code Comparison

The State of Florida has adopted NFPA (2013). The Engineer of Record (EOR) may select to design the system using NFPA 72 (2016), NFPA 1221 (2016), or NFPA 72 (2019), NFPA 1221 (2016).

Main differences between codes and dates:

	NFPA 72 (2013)	NFPA 72 (2016), NFPA 1221 (2016)
1	Feeder and riser cables are routed through an enclosure rated for 2 hours. (NFPA 72-24)	Feeder and riser cables are routed through an enclosure that matches the building's fire rating. (NFPA 1221-9.6)
2	The antenna mast shall be connected to a Lightning Protection System if a Lightning Protection System is existing. The system shall comply with NFPA 780.	The antenna mast shall be connected to a Lightning Protection System if a Lightning Protection System is existing. A new Lightning Protection System shall be installed if one does not exist. The system shall comply with NFPA 780. (NFPA 1221-9.6.3)

	NFPA 72 (2013)	NFPA 72 (2019), NFPA 1221 (2019)
1	Feeder and riser cables shall be routed through an enclosure rated for 2 hours. (NFPA 72-24)	Backbone cables shall be routed through an enclosure that matches the building's fire rating. (NFPA 1221-9.6)
2	Feeder cables are cables from the donor antenna to the BDA. Riser cables are cables from the BDA to the antenna distribution cables. (NFPA 72-1224)	Feeder and riser cables are now called backbone cables. Cables from the BDA to the distribution antenna are called antenna distribution cables. (NFPA 1221-9.6)
3	A Pathway Survivability of Level 1 allows antenna distribution cables to be installed in metal raceways instead of in a 2-hour-fire rated enclosure. (NFPA 72-24)	The Pathway Survivability has been removed. Antenna distribution cables are not required to be in an enclosure that is fire-rated. Antenna distribution cables are not required to be in conduit. (NFPA 1221-9.6)
4	The antenna mast shall be connected to a Lightning Protection System if a Lightning Protection System is existing. The system shall comply with NFPA 780.	The antenna mast shall be connected to a Lightning Protection System if a Lightning Protection System is existing. A new Lightning Protection System shall be installed if one does not exist. The system shall comply with NFPA 780. (NFPA 1221-9.6.3)

1.4 Authorities Having Jurisdiction (AHJ)

The AHJ is defined as: “An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation or a procedure”.

In Broward County, Florida, the AHJ’s are as follows for the installation of Two-Way Radio Communications Enhancing Systems:

Local Municipalities (City or County)

1. Chief Electrical Inspector
   NFPA 70
2. Fire Official
   NFPA 72
3. Broward County Elevator Inspection
   FBC-30, FS 399, FAC 61C-5, ASME A17-1
4. FCC License Holder
   - A. Broward County (RESC)
   - B. Fort Lauderdale
   - C. Coral Springs (RESC)
   - D. Plantation (RESC)
   - E. Hollywood (RESC)

Note: Work shall not start on any project until a permit has been issued and signed by each of the four (4) AHJ’s:
Electrical, Fire, Elevator, FCC License Holder

The system shall not be energized (including testing) until written authorization is obtained by each of the three (3) AHJ’s:
Electrical, Fire, FCC License Holder

A certificate of completion, or occupancy shall not be issued until the permit work is completed and signed off by each of the three (3) AHJ’s:
Electrical, Fire, FCC License Holder

1.5 Design

The Two-Way Radio Communications Enhancement System shall be designed by a Professional Engineer, licensed in the State of Florida. The Professional Engineer shall follow the Florida Statutes and the Florida Administration code requirements for the system engineering process.

The FBC, Broward County Edition, Section 118 requires that the Professional Engineer have training and experience in Electrical Engineering.

Heat wave map drawings shall be prepared by the Professional Engineer or a designer under the direct supervision of the Professional Engineer in accordance with FS and FAC requirements. Heat wave map drawings shall be prepared by a designer certified by the heat wave map software company. The drawings shall include the designer's name and the name of the heat wave map software company.
The professional Engineer shall show on the drawings all applicable codes with corresponding dates:

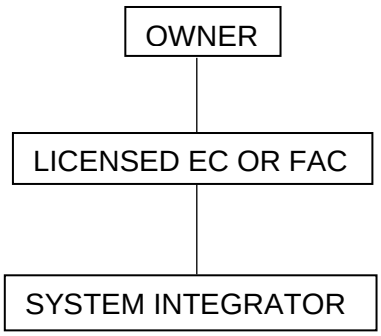
The Professional Engineer should be available for Plan Review and inspections.

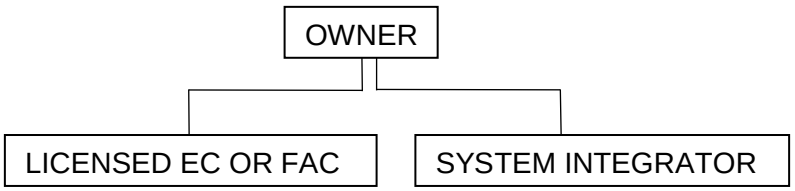
1.6 Installation

The installation shall be completed by a qualified Electrical Contractor or Fire Alarm Contractor. The contracting shall be in compliance with the State of Florida Electrical Contractor's Licensing Board (ECLB).

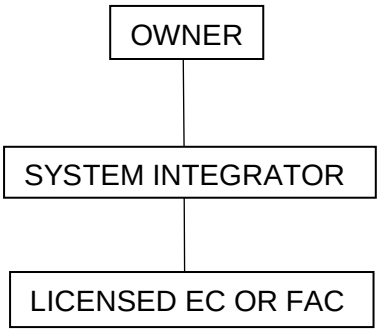
Only a licensed Electrical Contractor, Fire Alarm Contractor, or ESCS Contractor (pending) can contract to install a system. A systems integrator, which is not a licensed EC or FC, cannot contract for the installation. (FAC 61G6)

Allowed





Not Allowed



Note: Never energize the system for any reason without first passing the FCC AHJ's Initial Inspection.

1.7 Permitting

Record drawings, signed and sealed by a qualified Professional Engineer, shall be submitted to each AHJ for plan review and approval. The drawings shall be approved by all AHJ's prior to the start of any work.

Refer to the applicable Code Compliance Plan Review Checklist for the requirements of each AHJ.

1.8 Inspections

The contractor shall coordinate all inspections as required by the AHJ's.

Note: Never energize the system for any reason without first passing the FCC AHJ initial inspection.

Refer to the applicable Code Compliance Inspection Checklist for the requirements of each AHJ.

1.9 Final Acceptance

A Certificate of Occupancy or a Certificate of Completion for a building shall not be given until the Two-Way Radio Communications Enhancement System is approved by the Authority Having Jurisdiction. (Electric, Fire, Elevator and FCC License Holder)

Broward County

Two-Way Radio Communications Enhancement Systems

BC RCES Guidelines

Part 2A. Recommended Checklists for NFPA 72 (2013)

Table of Contents

2A.1.1 NFPA 72 (2013) Plan Review - Fire

Plans shall include the following information:

- ☐ 1. Building owner and address (FAC 61G6)
- ☐ 2. Scope of Work
- ☐ 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. The AHJ may require that the Engineer of Record shall provide evidence of experience and training in Electrical Engineering. (NFPA 72-10.5) (FAC 118.1.4) (61G15-30.003(2))
- ☐ 4. Applicable codes and edition dates (61G15-30.003(1b))
- ☐ 5. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (FAC 61G15)
- ☐ 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. (FBC 118.2.1.4)
- ☐ 7. Riser plans for systems (FBC 714, FBC 1023.5)
- ☐ 8. Specifications with manufacturer's parts numbers (FAC 61G15)
- ☐ 9. Firewall penetration details, etc. (NFPA 1-12.7.5.1 2015)
- ☐ 10. Not Used
- ☐ 11. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number. (FBC 118.2.1.8)
- ☐ 12. Provide an information binder stored next to the BDA. Information shall include:
    - ☐ (1) As-built drawings
    - ☐ (2) Manufacturer's data sheets and specs
    - ☐ (3) Heat map
    - ☐ (4) Final signal strength measurement
    - ☐ (5) Maintenance contract
    - ☐ (6) Broward County Regional Emergency Services and Communications (RESC) approval
    - ☐ (7) Maintenance Repair Log
- ☐ 13. Pathway survivability level shall be 1, 2, or 3. For Level 1, all coaxial cables shall be in metal raceways. (NFPA 72-12.4)
- ☐ 14. The feeder and riser coaxial cables shall be rated as plenum cable. (NFPA 72-24.3.6.8.1.1)
- ☐ 15. Riser coaxial cables shall be routed through a 2-hour-rated enclosure. (NFPA 72-24.3.6.8.3)
- ☐ 16. Radio coverage shall be a minimum of 99% in critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ and 90% in general building areas. (NFPA 72-24.5.2.2)
- ☐ 17. Signal strength inbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3.1)
  Signal strength outbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3.2)
  Note: a signal strength of less than -90 dBm as shown on the plans has a high probability of failing the final inspection of DAQ 3.0 minimum. See NFPA 72-14.4.10.3 Test Procedures; Recommend -90 dBm.
- ☐ 18. Isolation shall be a minimum of 15 dBm above the signal booster gain under all operating conditions. (NFPA 72-24.5.2.3.3)
  Note: NFPA 1221 (2016) requires a minimum of 20 dBm. Any lower value may result in the probability of failing the final inspection.

2A.1.1 NFPA 72 (2013) Plan Review - Fire (cont.)

- ☐ 19. System radio frequencies; system shall be capable of transmitting all public safety radio frequencies used by the AHJ. (NFPA 72-24.5.2.4)
- ☐ 20. Frequency changes. System shall be capable of upgrading. (NFPA 72-24.5.2.4.2)
- ☐ 21. System Components: Components shall be approved and compatible with the local Public Safety Radio System. (NFPA 72-24.5.2.5.1) (NFPA-1.1.4)
- ☐ 22. All repeaters, transmitter receptacles, signal booster components and battery system components shall be in a NEMA 4, 4X enclosure. (NFPA 72-24.5.2.5.2) (NFPA 1-1.4)
- ☐ 23. Power supplies shall have at least two independent sources. (NFPA 72-24.5.5)
- ☐ 24. The primary power source shall be supplied from a dedicated circuit and shall comply with NFPA 72-10.6.5. (NFPA 72-24.5.5.1)
- ☐ 25. The secondary power source shall consist of one of the following (NFPA 72-24.5.5.2):
    - ☐ (1) Battery with at least 12 hours of operation at 100% per NFPA 72-10.6.10
    - ☐ (2) Life Safety generator with at least 12 hours of operation at 100% and a battery with at least 2 hours of operation at 100% per NFPA 10.6.11.3.
- ☐ 26. System Monitoring: The fire alarm system shall monitor the following items as a minimum (NFPA 72-24.5.2.6.1):
    - ☐ (1) Integrity of the circuit monitoring signal booster(s) and power supply(ies) shall comply with NFPA 72-24.10.6.9 and NFPA 72-12.6.
    - ☐ (2) System and signal booster supervisory signals shall include the following:
        - ☐ (a) Antenna malfunction
        - ☐ (b) Signal booster failure
        - ☐ (c) Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
    - ☐ (3) Power supply signals shall include the following for each signal booster:
        - ☐ (a) Loss of normal AC power
        - ☐ (b) Failure of battery charger
- ☐ 27. Dedicated Panel (annunciator panel) shall show (NFPA 72-24.5.2.6.2):
    - ☐ (1) Normal AC power
    - ☐ (2) Signal booster trouble
    - ☐ (3) Loss of normal AC power
    - ☐ (4) Failure of battery charger
    - ☐ (5) Low battery capacity
- ☐ 28. Technical Criteria (NFPA 72-24.5.2.7)
    - ☐ (1) Frequencies required
    - ☐ (2) Location of effective radiated power (ERP) of the FCC AHJ radio site
    - ☐ (3) Maximum propagation delay less than 30 micro-seconds
    - ☐ (4) List of specifically approved components
    - ☐ (5) Other support technical information
- ☐ 29. When an elevator(s) is(are) present in the building, an antenna is typically required to be mounted in the elevator shaft(s) to get coverage inside the elevator car(s). A note on the plan shall be provided: “Contractor shall obtain written approval from the elevator inspector prior to any work inside an elevator shaft or machine room.” (NFPA 72-24.5.4) (ASME A17.1)

Note: This checklist is a minimum checklist. Coordinate with the local Fire AHJ for additional checklist items.

2A.1.2 NFPA 72 (2013) Plan Review - Electrical

Plans shall include the following information:

- ☐ 1. Building owner and address
- ☐ 2. Copy of the contract with the owner or GC (FAC 61G6)
- ☐ 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. (FBC 118.1.4) (61G15-30.003(2))
- ☐ 4. Applicable codes and edition dates (61G15-30.003(1b))
- ☐ 5. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (FAC 61G15)
- ☐ 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, etc. (FBC 118.2.1.4)
- ☐ 7. Riser plans for systems (FAC 61G15)
- ☐ 8. Specifications with manufacturer's parts numbers (FAC 61G15)
- ☐ 9. Details, including firewall penetration, etc. (FAC 61G15; NEC 70-820-26)
- ☐ 10. Antenna, and mast detail drawings shall show mounting and grounding. (FAC 61G15)
- ☐ 11. Antenna NFPA 780 connection (if existing). (FAC 61G15) (NFPA 780)
- ☐ 12. Identify the panel and circuit breaker; show panel location on plan (NFPA 72)
- ☐ 13. Show circuit breaker lock. (NFPA 72)
- ☐ 14. Show how the system components are wired to power (120V). (NFPA 70-110.2(B))
- ☐ 15. Circuit shall have an isolated ground, if required by the manufacturer. (NFPA 70)
- ☐ 16. Listing and labeling requirements (NFPA 70-110.2)
- ☐ 17. Identify minimum conduit sizes and minimum conduit 90-degree bend radiuses. (NFPA 70-110.3)
- ☐ 18. System equipment shall be installed in an air-conditioned and mechanically ventilated room where the manufacturer's installation document requires a temperature limitation and/or ventilation. (NFPA 70-110.3)

Note: This checklist is a minimum checklist. Coordinate with the local Electrical AHJ for additional checklist items.

2A.1.3 NFPA 72 (2013) Plan Review - Elevator

Plans shall include the following information:

A variance shall be obtained from the Broward County Elevator Inspection Services Section at Permitting prior to any work inside an elevator shaft or elevator machine room. The variance shall be to install one or more antenna(s) in the elevator shaft(s). (ASME A17.1)

Note: The elevator code does not allow the elevator shaft to be used for coaxial cable risers. (ASME A17.1.2.8.1)

Note: This checklist is a minimum checklist. Coordinate with the local Elevator AHJ for additional checklist items.

2A.1.4 NFPA 72 (2013) Plan Review - FCC License Holder

Plans shall include the following information:

- ☐ 1. Building owner and address (FAC 61G6)
- ☐ 2. Copy of the contract with the owner or GC (FBC 118.1.4)
- ☐ 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. (NFPA 72-10.5) (FAC 118.1.4) (61G15-30.003(2))
- ☐ 4. Applicable codes and edition dates (61g15-30.003(1b))
- ☐ 5.Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (FAC 61G15)
- ☐ 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. Propagation (heat) map drawings shall include the following (FBC 118.2.1.4):
  - ☐ Indoor Prediction Legend
  - ☐ Materials Legend
  - ☐ Pictogram Legend
  - ☐ Cables Legend
  - ☐ Calculations Legend
  - ☐ Number of Channels
  - ☐ Frequencies
  - ☐ Predictive propagation on floor plans
  - ☐ Name of certified designer and company
- ☐ 7. Riser plans for systems (FAC 61G15)
- ☐ 8. Specifications with manufacturer's parts numbers (FAC 61G15)
- ☐ 9. Details, including firewall penetration, etc. (FAC 61G15)
- ☐ 10. Manufacturer's specifications for equipment (FAC 61G15)
- ☐ 11. Antenna and surge protector detail (FAC 61G15)
- ☐ 12. Notes on plans shall state (FBC 118.4.2.2):
  "The system shall never be energized for testing or operation
  until written, or on site, approval is obtained from the FCC License Holder."
- ☐ 13. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number. (FBC 118.2.1.8)
- ☐ 14. Pathway survivability level shall be 1, 2, or 3. Level 1: All coaxial cables shall be in metal conduit. (NFPA 72-12.4)
- ☐ 15. Radio coverage shall be a minimum of 99% in critical areas and 95% in general building areas. (NFPA 72-24.5.2.2)
- ☐ 16. Signal strength inbound shall be a minimum of -95 dBm.
  Signal strength outbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3)
  Note: a signal strength of less than -90 dBm as shown on the plans
  has a high probability of failing the final inspection of DAQ 3.0 minimum.
  See NFPA 72-14.4.10.3 Test Procedures; Recommend -90 dBm.
- ☐ 17. Isolation shall be a minimum of 15 dBm above the signal booster gain under all operating conditions. (NFPA 72-24.5.2.3.3)
  Note: NFPA 1221 (2016) requires a minimum of 20 dBm. Any lower
  value may result in the probability of failing the final inspection.
- ☐ 18. System radio frequencies: system shall be capable of transmitting all public safety radio frequencies used by the FCC AHJ. (NFPA 72-24.5.2.4)
- ☐ 19. Frequency changes. System shall be capable of upgrading. (NFPA 72-24.5.2.4.2)

2A.1.4 NFPA 72 (2013) Plan Review - FCC License Holder (cont.)

☐ 20. System Components: Components shall be approved and compatible with the Public Safety Radio System. (NFPA 72-24.5.2.5)
Show the propagation delay.
Signal Boosters shall have FCC Certification. Power supplies shall have at least two independent supplies. Battery shall provide twelve (12) hour minimum operational run time.

☐ 21. System Monitoring: (NFPA 72-24.5.2.6.1) The fire alarm system shall monitor the following items as a minimum:

- ☐ (1) Integrity of the circuit monitoring signal booster(s) and power supply(ies) shall comply with NFPA 72-24.10.6.9 and NFPA 72-12.6.
- ☐ (2) System and signal booster supervisory signals shall include the following:
  - ☐ (a) Antenna malfunction
  - ☐ (b) Signal booster failure
  - ☐ (c) Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
- ☐ (3) Power supply signals shall include the following for each signal booster:
  - ☐ (a) Loss of normal AC power
  - ☐ (b) Failure of battery charger

☐ 22. Dedicated Panel (annunciator panel) (NFPA 72-24.5.2.6.2)

- ☐ (1) Normal AC power
- ☐ (2) Signal booster trouble
- ☐ (3) Loss of normal AC power
- ☐ (4) Failure of battery charger
- ☐ (5) Low battery capacity

☐ 23. Technical Criteria (NFPA 72-24.5.2.7)

- ☐ (1) Frequencies required
- ☐ (2) Location of effective radiated power (ERP) of the FCC AHJ radio site
- ☐ (3) Maximum propagation delay (30 microseconds)
- ☐ (4) List of specifically approved components
- ☐ (5) Other support technical information

☐ 24. When an elevator(s) is(are) present in the building, an antenna is typically required to be mounted in the elevator shaft(s) to get coverage inside the elevator car(s). A note on the plan shall be provided: “Contractor shall obtain written approval from the elevator inspector prior to any work inside an elevator shaft or machine room. (NFPA 72-24.5.4) (ASME A17.1)

☐ 25. Antenna mast shall be installed per FBC, Broward County Edition, HVHZ Sections.

☐ 26. Other industry standards include Motorola R56 and IEEE 1692.

Note: This checklist is a minimum checklist. Coordinate with the local FCC License Holder AHJ for additional checklist items.

2A.2.1 NFPA 72 (2013) Inspection - Fire

Final Inspection

Property Information

Property Name: _____ Permit #: _____ Inspection Date: _____

Property Address: _____

Contact Information:

BDA Equipment Provider: _____

BDA Licensed Contractor: _____

Fire Alarm Licensed Contractor: _____

Fire Alarm Monitoring Company: _____

Engineer of Record: _____

☐ 1. The latest approved record drawings, operation manuals, and maintenance manuals are on the site.

☐ 2. The following representatives are on the site for the inspection:

- ☐ Fire Inspector
- ☐ Broward County RESL
- ☐ Ft. Lauderdale TelCom
- ☐ Electrical Inspector
- ☐ BDA Equipment provider
- ☐ BDA Licensed Contractor
- ☐ Fire Alarm Licensed Contractor
- ☐ Engineer of Record
- ☐ Building Owner

☐ 3. Fire Rated Enclosure openings and penetrations are properly sealed. (NFPA 1-12.7.5.1)

☐ 4. The installation complies with the pathway of survivability level as shown on the approved record drawings.

☐ 5. The system components match the approved record drawings for manufacturer and part numbers. (NFPA 72-24.5.2.5.1) (NFPA-1.1.4)

☐ 6. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number. (FBC 118.2.1.8)

☐ 7. Provide an information binder stored next to the BDA. Information shall include (NFPA 72-14.6.1.1) (FBC 118):

- ☐ (1) As-built drawings
- ☐ (2) Manufacturer's data sheets and specs
- ☐ (3) Heat map, final measured readings after commissioning
- ☐ (4) Final signal strength measurement
- ☐ (5) Maintenance contract
- ☐ (6) Broward County Regional Emergency Services and Communications (RESC) approval
- ☐ (7) Maintenance Repair Log

☐ 8. Pathway survivability level shall be 1, 2, or 3. For Level 1, all coaxial cables shall be in metal raceways. (NFPA 72-12.4)

☐ 9. The feeder and riser coaxial cables shall be rated as plenum cables. (NFPA 72-24.3.6.8.1.1)

☐ 10. Riser coaxial cables shall be routed through a 2-hour-rated enclosure. (NFPA 72-24.3.6.8.3)

2A.2.1 NFPA 72 (2013) Inspection - Fire (cont.)

- ☐ 11. Radio coverage shall be a minimum of 99% in critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ and 90% in general building areas. (NFPA 72-24.5.2.2)
- ☐ 12. Signal strength inbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3.1)
  Signal strength outbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3.2)
- ☐ 13. Isolation shall be a minimum of 15 dBm above the signal booster gain under all operating conditions. (NFPA 72-24.5.2.3.3)
- ☐ 14. System radio frequencies; system shall be capable of transmitting all public safety radio frequencies used by the FCC AHJ. (NFPA 72-24.5.2.4)
- ☐ 15. Frequency changes. System shall be capable of upgrading. (NFPA 72-24.5.2.4.2)
- ☐ 16. System Components: Components shall be approved and compatible with the Public Safety Radio System. (NFPA 72-24.5.2.5.1) (NFPA-1.1.4)
- ☐ 17. All repeaters, transmitter receptacles, signal booster components and battery system components shall be in a NEMA 4, 4X enclosure. (NFPA 72-24.5.2.5.2) (NFPA 1-1.4)
- ☐ 18. Power supplies shall have at least two independent sources. (NFPA 72-24.5.5)
- ☐ 19. The primary power source shall be supplied from a dedicated circuit and shall comply with NFPA 72-10.6.5. (NFPA 72-24.5.5.1)
- ☐ 20. The secondary power source shall consist of one of the following (NFPA 72-24.5.5.2):
  - ☐ (1) Battery with at least 12 hours of operation at 100% per NFPA 72-10.6.10
  - ☐ (2) Life Safety generator with at least 12 hours of operation at 100% and a battery with at least 2 hours of operation at 100% per NFPA 10.6.11.3.
- ☐ 21. System Monitoring: The fire alarm system shall monitor the following items as a minimum (NFPA 72-24.5.2.6.1):
  - ☐ (1) Integrity of the circuit monitoring signal booster(s) and power supply(ies) shall comply with NFPA 72-24.10.6.9 and NFPA 72-12.6 (Auto-notification within 3 minutes 20 seconds).
  - ☐ (2) System and signal booster supervisory signals shall include the following:
    - ☐ (a) Antenna malfunction
    - ☐ (b) Signal booster failure
    - ☐ (c) Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
  - ☐ (3) Power supply signals shall include the following for each signal booster:
    - ☐ (a) Loss of normal AC power
    - ☐ (b) Failure of battery charger
- ☐ 22. Dedicated Panel (annunciator panel) shall show (Auto-notification within 3 minutes, 20 seconds) (NFPA 72-24.5.2.6.2):
  - ☐ (1) Normal AC power
  - ☐ (2) Signal booster trouble
  - ☐ (3) Loss of normal AC power
  - ☐ (4) Failure of battery charger
  - ☐ (5) Low battery capacity

2A.2.1 NFPA 72 (2013) Inspection - Fire (cont.)

☐ 23. Signage is provided to locate the BDA.
Fire Department signal booster permit number, service provider, and contact telephone numbers are shown. (FBC 118.2.1.8) (NFPA 72-10.18.3.2)

☐ 24. Completed NFPA documentation specific to this system is provided. [NFPA 72-7.8.2; figure 7.8.2(a) and (b)]

☐ 25. Documentation is provided showing that a maintenance and service agreement has been entered into between the property owner and the provider of the BDA System. (NFPA 72-14.4.10.1; NFPA 72-14.4.10.6; NFPA 72-14.6.1.1)

☐ 26. DAQ, Delivered Audio Quality, for the system is a minimum of DAQ 3.0. Include all floors, critical areas, elevator cabs, and general building areas.

Note: This checklist is a minimum checklist. Coordinate with the local Fire AHJ for additional checklist items.

2A.2.2 NFPA 72 (2013) Inspection - Electrical

☐ 1. **Rough Electrical Inspection** (FBC BC (2017)-1.110.8.5)

- ☐ Conduits
- ☐ Coaxial Cables
- ☐ Panels
- ☐ Antenna and mast
  - Grounding, Lightning Protection System (if installed)
  - Lead-in surge protection
- ☐ Power connection to the BDA
- ☐ Fire-rating of all conduit enclosures

☐ **2.Final Inspection**

- ☐ All electrical components are in place.

Note: This checklist is a minimum checklist. Coordinate with the local Electrical AHJ for additional checklist items.

2A.2.3 NFPA 72 (2013) Inspection - Elevator

☐ **1. Rough System Inspection**

- ☐ Conduit and cable installed in elevator shafts.

☐ **2. Final Inspection**

- ☐ Antenna(s) installed in the elevator shaft.

Note: This checklist is a minimum checklist. Coordinate with the local Elevator AHJ for additional checklist items.

2A.2.4 NFPA 72 (2013) Inspection - FCC License Holder

1. Initial Inspection

☐ 1. The system shall never be energized for testing or operation until written, or onsite approval is obtained from the FCC License Holder.
(FBC BC 1.118.4.2.2)

☐ 2. Prior to the initial inspection, a letter from the Engineer of Record stating that the installation is complete and ready to be energized for testing shall be received by the FCC License Holder. The system settings and pictures of the installed major components shall also be provided to the FCC License Holder. (FBC BC – 1.118.4.2.1)

The following components shall be included in the letter and pictures:

- ☐ (1) BDA with information
  Permit Number; Serviced by _____; Telephone _____
- ☐ (2) Enclosures with battery charger and batteries installed, wired with a label showing the battery installation date.
- ☐ (3) The Dedicated annunciator shall be wired. The system shall be constructed and programmed to the FACP and the annunciator.
- ☐ (4) BDA and FACP rooms shall be fire rated. Doors shall also be fire rated.
- ☐ (5) All equipment shall be properly grounded.
- ☐ (6) Antenna mast shall be grounded and connected to the NFPA 780 Lightning Protection System (if installed).
- ☐ (7) Antenna shall have surge protection installed and wired.
- ☐ (8) Antenna(s), if installed in the elevator shaft, shall have the approval of the Elevator Inspector. Provide a copy of the variance.
- ☐ (9) Junction boxes connected to the riser coaxial cables to the horizontal cables shall be installed and wired.
- ☐ (10) All electrical rough inspections shall be completed.

☐ 3.The contractor shall coordinate the inspection with all responsible parties.
The following shall be present at a minimum:

- ☐ Owners representative
- ☐ Electrical Contractor
- ☐ Fire Alarm Contractor
- ☐ BDA Vendor representative with analyzer
- ☐ FCC AHJ

☐ 4. The Initial Inspection shall include the following:

- ☐ (1) The System shall be energized for the first time.
- ☐ (2) Items B (1) through B (10) shall be inspected for compliance.
- ☐ (3) Acceptable dB levels shall be recorded. Include stairwells and elevator cab.

2A.2.4 NFPA 72 (2013) Inspection - FCC License Holder (cont.)

Final Inspection

This Inspection is a joint effort between the Fire Official and the FCC License Holder. Prior to the final inspection, the contractor shall provide to the Fire Official and to the FCC License Holder the following documentation showing that the building is ready for the final inspection.

After passing the initial inspection, the contractor shall submit to the FCC License Holder a Post Heat Map Study, with the actual measured signal strengths, to show that all areas are covered per the code. A letter from the Engineer of Record shall state that the System is completed, fully operational, and ready for the final inspection.

The contractor shall coordinate the inspection with all responsible parties. The following shall be present at a minimum:

- ☐ Owners representative
- ☐ Electrical Contractor
- ☐ Fire Alarm Contractor
- ☐ BDA Vendor representative with analyzer
- ☐ System Engineer of Record
- ☐ Electrical AHJ
- ☐ Fire Official AHJ
- ☐ FCC AHJ

Final Inspection:

- ☐ (1) Building Radio Coverage Inspection
  - 99% in critical areas
  - 95% in common areas
  - DAQ 3.0 or better
- ☐ (2) All dB levels are acceptable
- ☐ (3) Remote annunciator shall be functional.
- ☐ (4) Connection to the fire alarm shall be functional.
- ☐ (5) Owner shall provide proof of a signed service agreement with the BDA vendor.

Note: This checklist is a minimum checklist. Coordinate with the local FCC License Holder AHJ for additional checklist items.

Broward County

Two-Way Radio Communications Enhancement Systems

BC RCES Guidelines

Part 3. Additional Information Attachments

Table of Contents

Additional Information Attachments

This attachment is for informational and guidance purposes only. Attachments include code requirements and also include good engineering practices. These engineering practices may include items that go beyond the minimum code standards.

These attachments shall be updated and expanded in the future to reflect current technologies and standards.

The interpretation of any code item shall be completed by the specific Authority Having Jurisdiction (AHJ).

Additional Information Attachments (cont.)

3.1 Applicable Codes and Edition Dates

A) The Florida Fire Prevention Code had adopted NFPA 72, 2013.

B) The Florida Fire Prevention Code does allow the Florida Engineer of Record to select a later NFPA code for a specific project (FPPC (2017) 1, 4 Equivalencies…).

C) The Florida Engineer of Record may select one of the following sets of codes:

NFPA 72 (2013)
or
NFPA 72 (2016) and NFPA 1221 (2016)
or
NFPA 72 (2019) and NFPA 1221 (2019)

D) This selection shall be identified on the system drawings for permit and shall be approved by the Fire AHJ.

Additional Information Attachments (cont.)

3.2 FCC License Holder Additional Requirements

The FCC License Holder has additional requirements beyond state and local codes. Those requirements are from industry standards:

IEEE 1692 (2011) Guide for the Protection of Communication Installations from Lightning Effects

TIA/ANSI/EIA 569-C (2012) Telecommunications Pathways and Spaces

TIA/ANSI/EIA 607-B (2011) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

Motorola R56 Standards and Guidelines for Communication Sites

Refer to the following FCC License Holder requirements:

Broward County RESC Communications Requirements dated ___2019____

City of Fort Lauderdale Communications Requirements dated ___2019_____

Additional Information Attachments (cont.)

3.3 UL Standards and NRTL's

A. Equipment with UL Standards:

The conductors and equipment required or permitted by this code shall be acceptable only if approved (NFPA 70-110.2 approval),

Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling (NFPA 70-110.3(B)) manufacturers installation instructions.

Definition of approved: Acceptable to the Authority Having Jurisdiction (AHJ), (NFPA 70-100).

Listed equipment:
Third-party labeling as per NFPA 790, 791

Listing Standards:

UL 60950	For BDA's/Repeaters
UL 2524	For RCES equipment, BDA's/Repeaters, transmitters, Signal Booster components, Remote Annunciators, Power Supply, Battery Charging System components
UL 924	Power Supply
UL 1778	Uninterruptable Power Supply

B. Standards and Nationally Recognized Testing Laboratories (NRTL):

List of companies that are recognized by OSHA to test equipment (NRTL'S):

UL	MET	ARL	ETC.
ETL	TUV	CSA	

UL sets the standards for testing products:

UL 60950
UL 2524

NRTL'S test the products for compliance:

Listed:	A product that is safe for use
Labeled:	A product that is field evaluated by a third-party testing laboratory per NFPA 790, 791. (This may be accepted by the AHJ as an alternate to a listed product.)

Additional Information Attachments (cont.)

3.4 Product Capability

Equipment without UL Standards:

There are many components of an RCES that do not fall into a category having a UL Standard. In these cases, the AHJ should use NFPA 1-1.4 Equivalencies, Alternatives, and Modifications to enable the usage of these components in an RCES.

See the attached product compatibility forms.

3.4 Two-Way Radio Communications Enhancement Systems Product Compatibility

Draft Edition 2019-06-14

Item	Manufacturer	Product Name	Part Number	UL Standard	NRTL Listing
BDA/Repeater				60950 2524	
Power Supply					
Charger					
Battery/Enclosure					
Remote Annunciator					
Surge Protection					
Donor Antenna				N/A	-
In-Building Antenna				N/A	-
Couplers				N/A	-
Connectors				N/A	-
Splitters				N/A	-
Ground Kit				NA	-
Mast				NA	-
Outside Cable					
Plenum Cable					

The above items are compatible for use with the BDA. This form shall be filled out by the BDA manufacturer.

BDA Mfgr. _____
Address _____
City/State _____
Rep Name _____
Title _____
Date _____

Florida Engineer of Record: Name
_____ PE #
_____ Company
_____ CA #
_____ Date

Two-Way Radio Communications Enhancement Systems
Product Compatibility

Item	Manufacturer	Product Name	Part Number	UL Standard	NRTL Listing
BDA/Repeater	BDA Corp.	Repeater	BDA-XXX	60950 2524	UL/ETL
Power Supply UPS	UPS Corp.	UPS	Incl BDA-XXX		
Charger	C Corp.	Charger	Incl BDA-XXX		
Battery/Enclosure	B/E Corp.	Battery Backup	BDA-XXX		
Remote Annunciator	RA Corp.	Annunciator			
Surge Protection	Polyphaser Times Microwave	Surge Protector Times Project	TSX-NFF-BFN-CCK LP-BTR(W)-NFF Mt	NA	
Donor Antenna	Sinclair	800/700 MHZ	SY407-SF2SNM	NA	-
In-Building Antenna	Galtronics	700/800 MHZ	PEAR-S5379	NA	-
Couplers	Micro Lab	2-Way	D2-85FN	NA	-
Connectors	RFS	N-Male	NM-LCF12-D01	NA	-
Splitters	Micro Lab	Power Splitter Fixed Ratio	DN-XXFN	NA	-
Ground Kit	CI Wireless.com	1/2" Ground Kit Tinned	SCGK12	NA	-
Mast	CI Wireless.com	Pipe Wall Mount	BS100-72	NA	-
Outside Cable	RFS	1/2" UV Cable	ICA12-50J		ETL
Plenum Cable	RFS Commscope	1/2" Plenum Cable 1/2" Plenum Cable	LCF12-50JPL HL4-50A		ETL ETL
Busbar	CI Wireless	Tinned Copper Busbar	GB212-NH	NA	

The above items are compatible for use with the BDA. This form shall be filled out by the BDA manufacturer.

BDA Mfgr. BDA Corp
Address Any Street
City/State Any Town, Any State
Rep Name _____
Title _____
Date _____

Florida Engineer of Record:
Name _____
PE # _____
Company _____
CA # _____
Date _____

Additional Information Attachments (cont.)

3.5 Battery Enclosures

The battery enclosure type is determined by the NFPA code and issue date. The following codes apply:

1. NFPA 72.24.5.2.5.2 (2013)
   The battery enclosure shall be a NEMA 4, 4X type.
2. NFPA 1221-9.6.11.2 (2016)
   The battery shall be stored in a NEMA 4, 4X type enclosure.
3. NFPA 1221-9.6.11.2.2 (2019)
   The battery shall be stored in a NEMA 4, 4X type enclosure.
   NFPA 1221-9.6.11.2.2
   Batteries that require ventilation shall be stored in a NEMA 3R type enclosure.

All rechargeable batteries manufactured today, including “sealed” batteries, require ventilation. The 2019 Code addresses this issue and requires a NEMA 3R type enclosure.

When a project is permitted under NFPA 72 (2013) or NFPA 1221 (2016), approval from the Fire AHJ is required to use the NEMA 3R type enclosure. The Fire AHJ may approve the NEMA 3R type enclosure based on NFPA 1-1.4, Equivalencies, Alternatives, and Modifications.

Additional Information Attachments (cont.)

3.6 Drawing Set Numbering Option

Drawing numbers for plans should be set up in a logical sequence. Care should be taken to select the first and second letters to minimize confusion in reviewing drawings.

The following are typical drawing letters:

A:	Architectural
C:	Civil
E:	Electrical
F, FP:	Fire Protection
FA:	Fire Alarm
I:	Interior
M:	Mechanical
P:	Plumbing
Q:	Equipment
T:	Telecommunications

FC should be used for Fire RCES Drawings.

Drawing Number	Description
FC	Fire Communication Drawing Set
FC-1.XX	Title Sheet, Drawing Index, Property Information, Project Team, Applicable Codes with Edition Dates, Scope of Work, Specific Requirements, Legend, Notes, Specifications
FC-2.XX	Floor Plans with Fire Rating of Walls, Equipment Locations, Conduit Runs
FC-3.XX	Conduit Riser, Details
FC-4.XX	Propagation Plan, System Riser Diagrams, Equipment Lists, Link Budgets, Etc.
FC-5.XX	Product Compatibility List Manufacturer's Specs for Equipment

Additional Information Attachments (cont.)

3.7 Conditioned Space for Equipment

Equipment shall be installed in a space that does not exceed the temperature limitations as indicated in the manufacturer's specifications and requirements (NFPA 70-110.3(B)).

The system also has a battery backup system. These systems require mechanical ventilation for operation.

Most, if not all, RCES systems are installed in an air-conditioned space to meet the temperature requirements in the State of Florida.

Additional Information Attachments (cont.)

3.8 Lightning Protection

NFPA 72 (2013); NFPA 1221.9.6.3 (2016, 2019)

A) Systems installed under NFPA 72 (2013) are not required to have a lightning protection system that complies with NFPA 780. NFPA 72 (2013).

However, if the building has a Lightning Protection System that complies with NFPA 780, then the new RCES shall tie into the Lightning Protection System and shall comply with NFPA 780.

B) Systems installed under NFPA 1221 (2016, 2019) shall have a lightning protection system that complies with NFPA 780. (NFPA 1221.9.6.3)

1) This section of NFPA 1221 clearly states that the Two-Way Radio Communications Enhancement shall be connected to an NFPA 780 Compliant Lightning Protection System.
2) In buildings where there is an NFPA 780 Compliant Lightning Protection System, the antenna mast shall be connected to the NFPA 780 Compliant Lightning Protection System and the system shall be re-certified by the Lightning Protection System installer to meet the requirements of NFPA 780.
3) In buildings where there is no NFPA compliant Lightning Protection System, a new NFPA 780 Lightning Protection System shall be installed for the entire building. The antenna mast shall be connected to the new NFPA 780 Compliant Lightning Protection System. The entire system shall be certified by the Lightning Protection System installer. (The cost of a new NFPA 780 Compliant Lightning Protection System could be in excess of $10,000.00 for a 10,000 SF building)

Additional Information Attachments (cont.)

3.9 Coaxial Cables, Conduits, and Pull Boxes

The Manufacturer's recommended minimum bend radius for repeated bends shall be used for all coaxial cables installed in conduits (NFPA 70-110.3B).

A note on the drawing shall specify the minimum conduit size and the minimum bend radius.

Coaxial cables can be easily damaged during the installation. It is recommended that oversized conduits with large radius bends be used to protect the cables during the installation process.

A standard 90-degree elbow for a 2" EMT has a bend radius of 9-1/2". A typical cable spec sheet requires a 10" radius for 1/2" cable with repeated bends.

A bend radius of 9-1/2" does not meet the manufacturer's requirements.

It is good engineering practice to use 2" minimum conduits with large, 24" radius bends for all coaxial cables.

Notes:

1. Conduits are recommended to be a minimum of 2" with large 24" radius bends for all coaxial cables.

2. Junction or pull boxes are recommended to be a minimum of 18" x 18" x 6".

3. The AHJ may require sweep testing at any time. Small conduits, long runs, small junction boxes, or multiple bends could be strong indicators that there might be problems with the installation. This is an expensive process and may cause delays on the project.

Additional Information Attachments (cont.)

3.9 Coaxial Cables, Conduits, and Pull Boxes (cont.)

The Telecommunications Industry Association Standard, TIA/ANSI-569-C, recommends the following guidelines:

9.8.2.1 Length

No section of conduit shall be longer than 100ft. between pull points.

9.8.2.1 Bends

No section of conduit shall contain more than two 90^{o} bends, or equivalent, between pull points.

9.8.2.3 Pull Tension

The pull tension of the cable being installed shall not be exceeded.

9.8.2.4 Pull Boxes

9.8.3.2 Pull Strings

Pull strings shall be placed in installed conduit.

9.9.4 Pathway Fill Factor (Conduits)

For future pathways, the maximum pathway fill shall be 40%.

Additional Information Attachments (cont.)

3.10 Coaxial Cables, Plenum Rated

All coaxial cables shall be plenum rated.
(NFPA 72-24.3.6.8.1.1) (2013)
(NFPA 1221-9.6.2.1.1.1) (2016)
(NFPA 1221-9.6.2.1) (2019)

To understand this requirement, the NFPA 72 Handbook shall be referenced.

24.5 Two-Way, In-Building Emergency Communications Systems

Two-Way communications service within a building provides a reliable method for fire-fighters and other emergency response personnel to communicate with each other during the course of an emergency. The code recognizes two means: two-way telephones and two-way, in-building radio communications enhancement systems.

24.3.6.8 Two-way radio communications enhancement systems shall comply with 24.3.6.8.1 through 24.3.6.8.4

24.3.6.8.1 Where a two-way radio communications enhancement system is used in lieu of a two-way in-building wired emergency communications system, it shall have a pathway survivability of Level 1, Level 2, or Level 3.

24.3.6.8.1.1 The feeder and riser coaxial cables shall be rated as plenum cables

Additional Information Attachments (cont.)

3.11 Cables, Pathway Survivability

NFPA 72 (2013)

Level 1 Feeder cables in conduit

Riser cables in a 2-hour fire-rated enclosure
(Donor antenna to BDA cables are riser cables)

Level 2,3 All cables in a 2-hour fire-rated enclosure

NFPA 72 (2016), NFPA 1221 (2016)

Level 1 Feeder cables in conduits

Riser cables in a fire-rated enclosure to match building fire rating
(Donor antenna to BDA cables are riser cables)

Level 2,3 All cables in a fire-rated enclosure to match building fire rating

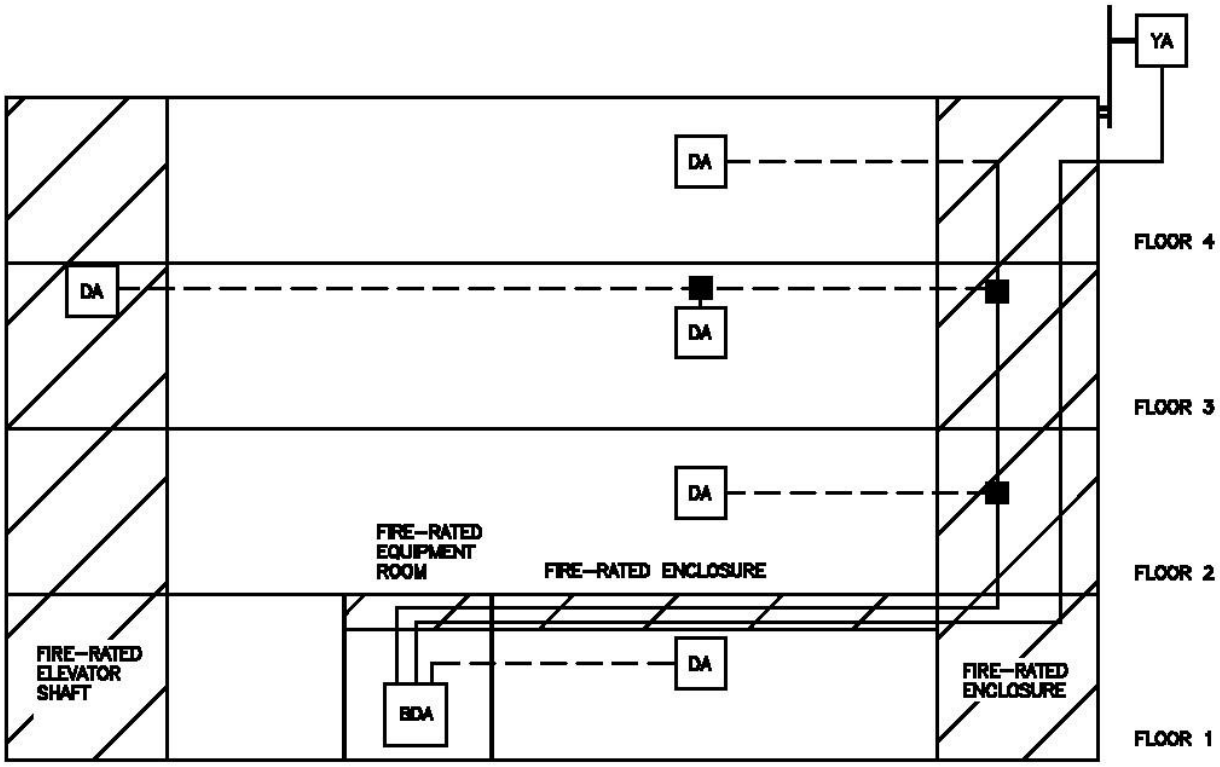
NFPA 72 (2019), NFPA 1221 (2019)

Pathway Survivability removed

Antenna Distribution Cables:	Not in conduit
(Feeder cable)	Not in a fire-rated enclosure
Backbone Cables:	
Donor antenna to BDA cables	Fire-rated enclosure to match building
BDA to riser shaft cables	
Riser cables	

Additional Information Attachments (cont.)

3.12 Cables, Typical Details NFPA 72 (2013)



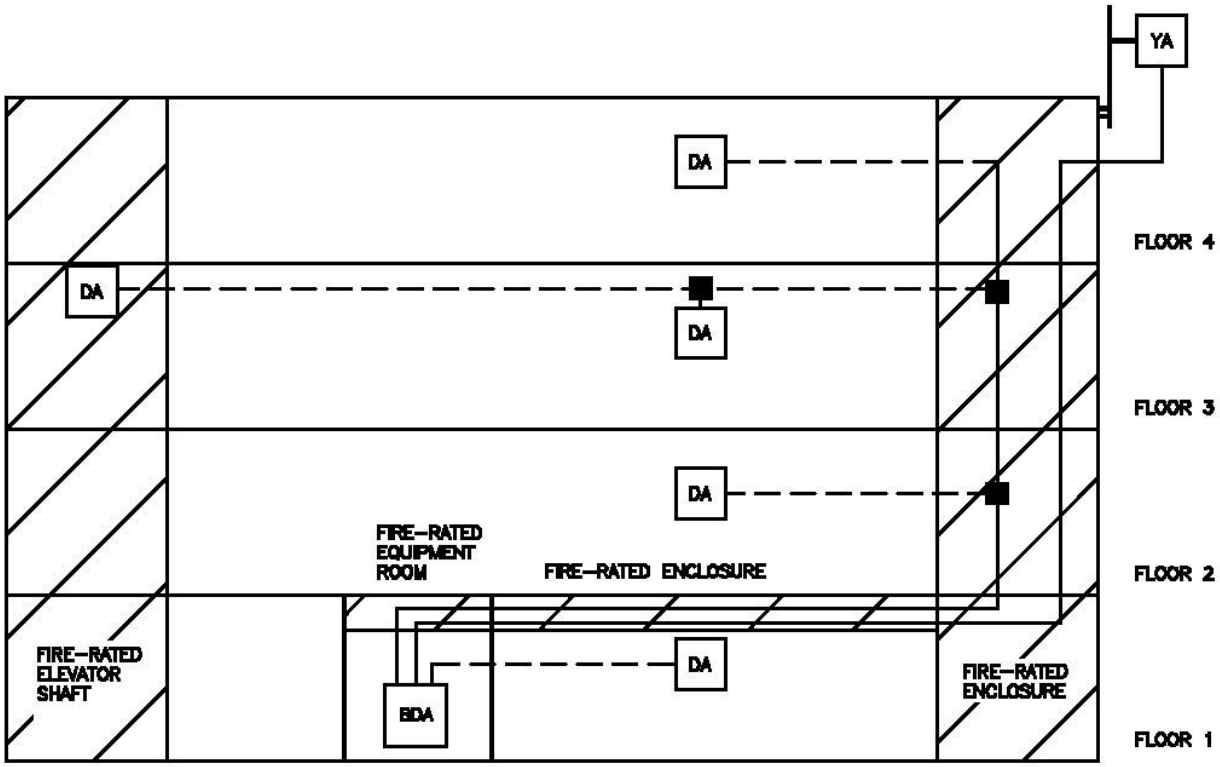
Notes and Legend

Fire-rated enclosures shall have a 2-hour fire-rating
Pathway survivability Levels 1, 2, or 3
All cables shall be plenum rated.
Riser cables (solid): In a fire-rated enclosure
(Backbone cables)
Feeder cables (dashed) Level 1: In a fire-rated enclosure or in metal raceways
(Antenna Distribution cables) Level 2,3: In a fire-rated enclosure
Provide fire stop where cables penetrate fire-rated walls.

YA	Yagi (Donor) Antenna
DA	Distribution Antenna
BDA	Bi-directional amplifier, Public Safety repeater

Additional Information Attachments (cont.)

3.13 Cables, Typical Details NFPA 72 (2016), NFPA 1221 (2016)



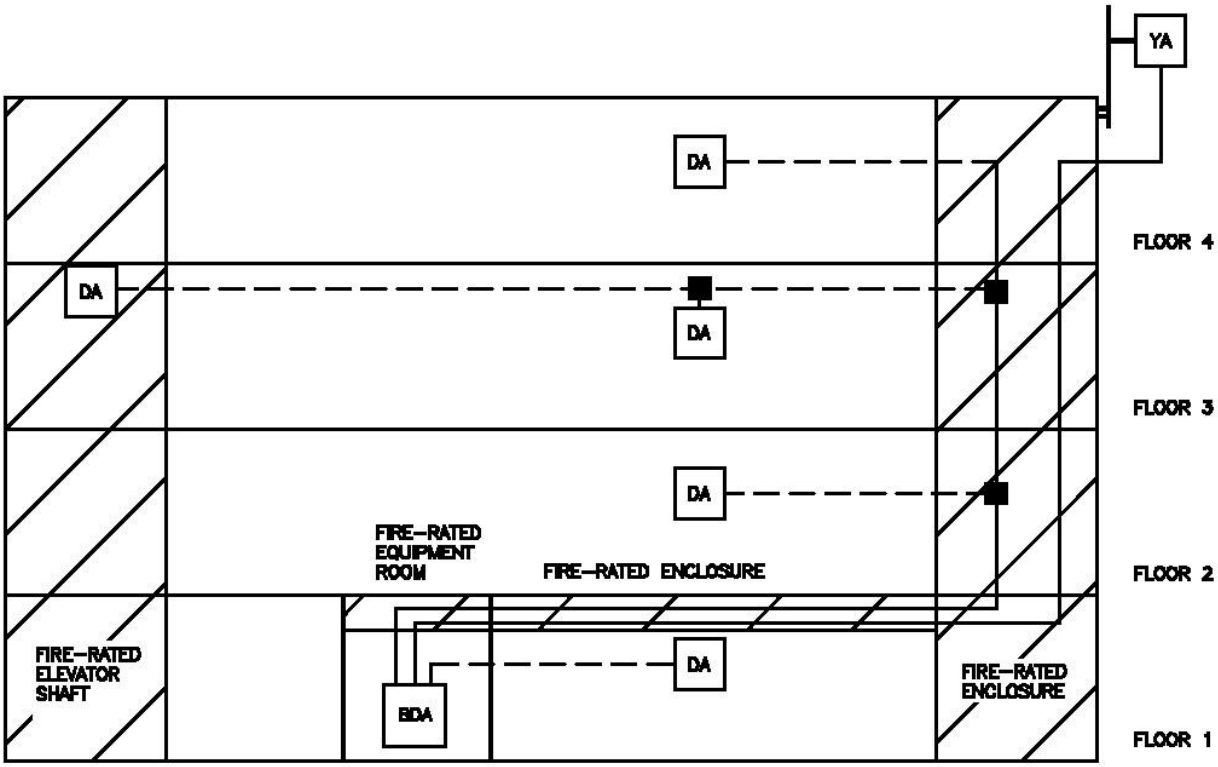
Notes and Legend

Fire-rated enclosures shall match the building's fire-rating.
Pathway survivability Levels 1, 2, or 3
All cables shall be plenum rated.
Riser cables (solid): In a fire-rated enclosure
(Backbone cables)
Feeder cables (dashed) Level 1: In a fire-rated enclosure or in metal raceways
(Antenna Distribution cables) Level 2,3: In a fire-rated enclosure
Provide fire stop where cables penetrate fire-rated walls.

YA	Yagi (Donor) Antenna
DA	Distribution Antenna
BDA	Bi-directional amplifier, Public Safety repeater

Additional Information Attachments (cont.)

3.14 Cables, Typical Details NFPA 72 (2019), NFPA 1221 (2019)



Notes and Legend

Fire-rated enclosures shall match the building's fire-rating
There is no pathway survivability.
All cables shall be plenum rated.
Backbone cables (solid): In a fire-rated enclosure
(Riser cables)
Antenna Distribution Cables (dashed): A fire-rated enclosure is not required.
(Feeder cables) Metal raceways are not required.
Provide fire stop where cables penetrate fire-rated walls.

YA	Yagi (Donor) Antenna
DA	Distribution Antenna
BDA	Bi-directional amplifier, Public Safety repeater

Additional Information Attachments (cont.)

3.15 Engineer of Record

1) State of Florida
Florida Statute FS 471 Engineering
Florida Administrative Code FAC 61G15
Degree in Engineering from an accredited university
Pass the Fundamentals of Engineering Exam
Pass the Professional Engineering Exam
5 years' experience as an engineer under a PE

PE designates Professional Engineer.

Florida does not designate a specific discipline. For example: A civil engineer may design roads, bridges, nuclear power plants, and BDA systems. The State of Florida only states that the engineer shall be qualified. The engineer is qualified until proven differently.

FAC Chapter 61G15-30(4) states:
"Engineering Documents: Engineering documents are designs, plans, specifications, drawings, prints, reports, or similar instruments of service in connection with engineering services or creative work that have been prepared and issued by the professional engineer or under his responsible supervision, direction, or control."

The engineer cannot sign work designed by others unless the engineer was involved during the design process. The engineer cannot sign and seal plans prepared by others with only a quick review. The engineer shall fully understand the signed and sealed drawings.

Engineers typically sign and seal drawings prepared by designers, CADD operators, software specialists, and others who are under the Engineer's responsible supervision.

2) Florida Building Code (FBC)(2017), Broward County Edition, Section 118.1.4 Design
A sealed submittal from an engineer, with training and experience in Electrical Engineering, shall also be required.
As a minimum, this requires a BSEE (Bachelor's Degree in Electrical Engineering). Additional training is also required as Continuing Education. Experience should include at least five (5) years direct experience in Electrical Engineering.

3) NFPA 72 (2013)
Section 10.5.1.4: The system designer shall provide evidence of their qualifications and/or certifications when required by the Authority Having Jurisdiction (AHJ).

Additional Information Attachments (cont.)

3.16 Reserved

Broward County

Two-Way Radio Communications Enhancement Systems

BC RCES Guidelines

For Review and Approval by the

BDA Committee
2019

Draft Edition

Broward County

Two-Way Radio Communications Enhancement Systems

BC RCES Guidelines

Table of Contents

Item 5:
Discuss the proposed draft edition of the “Sample Drawings”

TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
SAMPLE OFFICE BUILDING
BROWARD COUNTY, FLORIDA

INFORMATION PURPOSES
NOT FOR PERMITTING OR CONSTRUCTION

PROPERTY INFORMATION

ADDRESS
1730nw 33rd ST.
POMPANO BEACH, FL 33064

BROWARD COUNTY
PROPERTY ID# 4842 2240 0010

SITE COORDINATES
26.270583 DEG
-80.147414 DEG
(FROM GOOGLE MAPS)

OWNER
XYZ CORP, INC.
12327 WILES RD.
CORAL SPRINGS, FL 33076

TOTAL AREA: _____ SQ.FT.
NUMBER OF FLOORS: _____ FLOORS

SYSTEM INTEGRATOR

BDA INTEGRATION, INC.

FCC# 123456789

SYSTEM INSTALLER

BDA CONTRACTOR, INC.

EC# 123456

SCOPE OF WORK

FURNISH AND INSTALL A COMPLETE OPERATIONAL TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM.

THE SYSTEM SHALL BE IN COMPLIANCE WITH THE APPLICABLE CODES AND WITH THE APPLICABLE FCC LICENSE HOLDER REQUIREMENTS.

TIE INTO THE FIRE ALARM SYSTEM.

INDEX OF DRAWINGS

NFPA 72 (2013) THIS PROJECT

CODE REQUIREMENTS:
- FIRE RATED ENCLOSURES SHALL BE 2-HOUR.
- TIE INTO EXISTING LIGHTNING PROTECTION SYSTEM, IF INSTALLED.

PATHWAY SURVIABILITY SHALL BE A LEVEL 1 FOR DISTRIBUTION:
- COAXIAL CABLES FROM THE DONOR ANTENNA TO THE BDA SHALL BE IN A FIRE-RATED ENCLOSURE.
- COAXIAL CABLES AS RISER CABLES SHALL BE IN A FIRE-RATED ENCLOSURE.
- DISTRIBUTION COAXIAL CABLES FROM THE BDA TO THE DISTRIBUTION ANTENNAS SHALL BE IN A METAL RACEWAY.

OPTIONAL CODE SELECTION BY THE ENGINEER

NFPA 72 (2016), NFPA 1221 (2016)

CODE REQUIREMENTS:
- FIRE RATED ENCLOSURES SHALL MATCH THE BUILDING'S FIRE-RATING.
- TIE INTO EXISTING LIGHTNING PROTECTION SYSTEM, IF INSTALLED.
- TIE INTO A NEW LIGHTNING PROTECTION SYSTEM IF ONE DOES NOT EXIST.

PATHWAY SURVIABILITY SHALL BE A LEVEL 1 FOR DISTRIBUTION:
- COAXIAL CABLES FROM THE DONOR ANTENNA TO THE BDA SHALL BE IN A FIRE-RATED ENCLOSURE.
- COAXIAL CABLES AS RISER CABLES SHALL BE IN A FIRE-RATED ENCLOSURE.
- DISTRIBUTION COAXIAL CABLES FROM THE BDA TO THE DISTRIBUTION ANTENNAS SHALL BE IN A METAL RACEWAY.

NFPA 72 (2019), NFPA 1221 (2019)

CODE REQUIREMENTS:
- FIRE RATED ENCLOSURES SHALL MATCH THE BUILDING'S FIRE-RATING.
- TIE INTO EXISTING LIGHTNING PROTECTION SYSTEM, IF INSTALLED.
- TIE INTO A NEW LIGHTNING PROTECTION SYSTEM IF ONE DOES NOT EXIST.

PATHWAY SURVIVABILITY HAS BEEN REMOVED.
- BACKBONE COAXIAL CABLES SHALL BE INSTALLED IN A FIRE-RATED ENCLOSURE.
- DISTRIBUTION COAXIAL CABLES DO NOT HAVE TO BE IN A FIRE-RATED ENCLOSURE AND DO NOT HAVE TO BE INSTALLED IN CONDUIT.

OTHER APPLICABLE CODES

IEEE 1692 (2011) GUIDE FOR THE PROTECTION OF COMMUNICATION INSTALLATIONS FROM LIGHTNING EFFECTS

TIA/ANSI/EIA 569-C (2012) TELECOMMUNICATIONS PATHWAYS AND SPACES

TIA/ANSI/EIA 607-B (2011) GENERIC TELECOMMUNICATIONS BONDING AND GROUNDING (EARTHING) FOR CUSTOMER PREMISES

MOTOROLA R56 STANDARDS AND GUIDELINES FOR COMMUNICATION SITES

OTHER STANDARDS AND REQUIREMENTS

1. FCC LICENSE HOLDERS
   A. BROWARD COUNTY REGIONAL EMERGENCY SERVICES AND COMMUNICATIONS 2019 REQUIREMENTS
   B. CITY OF FORT LAUDERDALE TELECOMMUNICATIONS SECTION 2019 REQUIREMENTS
2. FREQUENCIES
   A. 800 MHZ
   B. 700 MHZ P25
3. PATHWAY SURVIVABILITY IS A LEVEL 1 (NFPA 12.4)
   BUILDING SPRINKLERED

PLOT PLAN nts

LOCATION OF SITE_____
LOCATION OF FCC TOWER_____

THE DOCUMENT IS FOR TEACHING PURPOSES ONLY AND IS FOR A SAMPLE OFFICE BUILDING, NOT A SPECIFIC BUILDING.

THE DOCUMENT INCLUDES COMPLIANCE WITH THE REQUIRED STATE AND LOCAL CODES, AS WELL AS GOOD ENGINEERING PRACTICES.

THE DOCUMENT IS PRELIMINARY AND IS NOT IN THE FINAL FORM. THE DOCUMENT MAY BE REVISED AT ANY TIME TO RESOLVE ANY ISSUES.

DO NOT COPY OR REPRODUCE WITHOUT PRIOR WRITTEN AUTHORIZATION.

DRAFT EDITION
2019-07-20

THIS DRAWING HAS NOT BEEN APPROVED BY ANY AHJ.

TITLE SHEET, DRAWING INDEX, INFORMATION

SCALE: NTS

RC ENGINEERING INC
5532 NW 106th DRIVE
CORAL SPRINGS, FL 33076
(954)757-7900
CA4755

REVISIONS
BY DESC
DATE

Date: 2019-07-20
Drawn: MAR
Checked: DLR
Scale: NTS
JOB NO. 19005

PROJECT
TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
SAMPLE OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
TITLE SHEET, DRAWING INDEX, INFORMATION

SEAL

DATE _____
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
FC-1.1
of sheets

GENERAL SPECIFICATIONS FBC, SIXTH EDITION (2017)

THE CONTRACTOR SHALL SECURE AND PAY FOR ALL PERMITS, TAXES, AND OTHER FEES AS REQUIRED FOR A COMPLETE JOB. THE COMPLETE INSTALLATION SHALL BE IN ACCORDANCE WITH STATE AND LOCAL AUTHORITIES HAVING JURISDICTION, FBC SIXTH EDITION, FFPC SIXTH EDITION, NFPA 70 (NEC) 2014, AND NFPA 72 (SEE DRAWING FC–1.1).

THE CONTRACT DOCUMENTS INDICATE THE EXTENT AND GENERAL ARRANGEMENT OF EQUIPMENT AND WIRING. ALL ITEMS NOT SPECIFICALLY MENTIONED IN THE DOCUMENTATION BUT WHICH ARE OBVIOUSLY NECESSARY TO MAKE A COMPLETE WORKING INSTALLATION SHALL BE INCLUDED. THE WORK SHALL BE OF FIRST CLASS QUALITY.

THE CONTRACTOR SHALL PROVIDE A GUARANTEE AGAINST DEFECTIVE WORKMANSHIP, MATERIALS, OR EQUIPMENT FOR A MINIMUM OF ONE (1) YEAR FROM THE DATE OF ACCEPTANCE.

THE CONTRACTOR SHALL VISIT THE PROJECT. IF ANY DEPARTURES FROM THE CONTRACT DOCUMENTS ARE DEEMED NECESSARY BY THE CONTRACTOR, DETAIL OF SUCH DEPARTURES AND REASONS THEREFORE SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL. THIS MUST BE DONE AS SOON AS POSSIBLE AND WITHIN TEN (10) DAYS AFTER AWARD OF CONTRACT. NO SUCH DEPARTURES SHALL BE MADE WITHOUT WRITTEN APPROVAL OF THE ENGINEER.

THE CONTRACTOR SHALL VERIFY ALL EQUIPMENT AND SIZES. COORDINATE THESE REQUIREMENTS AND SIZES WITH THE OTHER TRADES AND THE OWNER'S REPRESENTATIVE BEFORE PLACING ORDERS.

THE CONTRACTOR SHALL PROVIDE ALL CUTTING AND PATCHING, ETC. FOR A COMPLETE JOB. ALL MATERIALS SHALL BE NEW, SHALL BEAR THE LABEL OF THE UNDERWRITER'S LABORATORIES OR APPROVED EQUIVALENT, SHALL BE APPROVED BY THE LOCAL CODE ENFORCING AUTHORITIES, AND SHALL BE OF COMMERCIAL GRADE.

ALL CIRCUIT BREAKERS SHALL BE FULL SIZE; NO TANDEM TYPE CIRCUIT BREAKERS. PROVIDE AN ACCURATE PANEL SCHEDULE ON THE INSIDE OF EACH PANEL DOOR.

ALL GUTTER AND WIREWAY SIZES SHALL COMPLY WITH NEC ARTICLE 376.22 AND TABLES 312.6(A) & (B).

ELECTRICAL EQUIPMENT EXPOSED TO THE WEATHER SHALL BE WEATHERPROOF.

PENETRATION OF ALL PIPES AND CONDUITS THROUGH FIRE RATED PARTITIONS SHALL BE IN COMPLIANCE WITH UL ASSEMBLY. PROVIDE 3M FIRE BARRIER CP–25 N/S FIRESTOP CAULKING FOR CONDUITS UP TO 4" IN TWO (2) HOUR (MAX) RATED FIRE PARTITIONS.

THE ROOM WITH THE BDA EQUIPMENT SHALL BE FIRE–RATED. THE ROOM SHALL ALSO BE AIR–CONDITIONED WITH MECHANICAL VENTILATION AT ALL TIMES, AS REQUIRED BY THE MANUFACTURER'S INSTALLATION GUIDELINES.

SHOP DRAWINGS SHALL BE PROVIDED AND SHALL INCLUDE, BUT NOT BE LIMITED TO, BDA'S, REPEATERS, POWER SUPPLIES, BATTERIES, ENCLOSURES, REMOTE ANNUNCIATORS, SURGE PROTECTORS, PASSIVE DEVICES, AND COAXIAL CABLES.

1. PROVIDE A DETAILED LIST OF ANY DEVIATION BETWEEN EACH SPECIFIED ITEM AND THE ITEM SUBMITTED FOR REVIEW. THIS LIST SHALL BE HIGHLIGHTED SUCH THAT ALL DEVIATIONS ARE OBVIOUS AND CLEAR, AND INCLUDE INFORMATION ON DIMENSIONS, FINISH, MATERIAL, ETC.
2. PROVIDE SCALED SHOP DRAWINGS SHOWING THE FIT OF ALL ITEMS WHERE THE DIMENSIONS OF THE SUBMITTED ITEMS ARE DIFFERENT FROM THE SPECIFIED ITEMS.
3. PROVIDE COST SAVINGS INFORMATION TO OWNER, WHERE ANY DEVIATIONS ARE IDENTIFIED IN THE DETAILED LIST ABOVE.

ELECTRICAL LEGEND

⏚	120V – 20A DUPLEX RECEPTACLE – 18" AFF OR AS NOTED (C–CEILING MOUNTED) (A–AUTOMATIC CONTROL)
⌒	CONDUIT RUN, CONCEAL AS POSSIBLE
▬	ELECTRICAL DISTRIBUTION PANEL
EC	ELECTRICAL CONTRACTOR
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
WP	WEATHERPROOF
WR	WEATHER–RESISTANT
BDA	BI–DIRECTIONAL AMPLIFIER/REPEATER
ANN	ANNUNCIATOR
BAT	BATTERY WITH ENCLOSURE
UPS	UNINTERRUPTIBLE POWER SUPPLY
YA	YAGI ANTENNA (DONOR)
ANT	DISTRIBUTION ANTENNA
SP	SPLITTER
(J)	JUNCTION BOX
SPD	SURGE PROTECTION DEVICE
FACP	FIRE ALARM CONTROL PANEL
FAA	FIRE ALARM ANNUNCIATOR

DRAFT EDITION
2019–07–20

THIS DRAWING HAS NOT BEEN APPROVED BY ANY AHJ.

SPECS, LEGEND, ETC.

SCALE: NTS

RC ENGINEERING INC
5532 NW 106th DRIVE
CORAL SPRINGS, FL 33076
(954)757–7900
CA4755

REVISIONS

DATE	BY	DESC

Date: 2019-07-20
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JOB NO. 19005

PROJECT
TWO–WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
SPECS, LEGEND, ETC.

SEAL

DATE
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
FC–1.2
of sheets

FIRE AHJ NOTES

1. THE BDA ENCLOSURE SHALL BE PAINTED RED AND A SIGN SHALL SHOW PERMIT NUMBER, VENDOR NAME AND TELEPHONE NUMBER. (FBC 118.2.1.8)
2. PROVIDE AN INFORMATION BINDER STORED NEXT TO THE BDA. INFORMATION SHALL INCLUDE:
   (1) AS-BUILT DRAWINGS
   (2) MANUFACTURER'S DATA SHEETS AND SPECS
   (3) HEAT MAP
   (4) FINAL SIGNAL STRENGTH MEASUREMENT
   (5) MAINTENANCE CONTRACT
   (6) BROWARD COUNTY REGIONAL EMERGENCY SERVICES AND COMMUNICATIONS (RESC) APPROVAL
   (7) MAINTENANCE REPAIR LOG
3. PATHWAY SURVIVABILITY LEVEL SHALL BE 1, 2, OR 3. FOR LEVEL 1, ALL COAXIAL CABLES SHALL BE IN METAL RACEWAYS. (NFPA 72-12.4)
4. THE FEEDER AND RISER COAXIAL CABLES SHALL BE RATED AS PLENUM CABLE. (NFPA 72-24.3.6.8.1.1)
5. RISER COAXIAL CABLES SHALL BE ROUTED THROUGH A 2-HOUR-RATED ENCLOSURE. (NFPA 72-24.3.6.8.3)
6. RADIO COVERAGE SHALL BE A MINIMUM OF 99% IN CRITICAL AREAS, SUCH AS THE FIRE COMMAND CENTER(S), THE FIRE PUMP ROOM(S), EXIT STAIRS, EXIT PASSAGEWAYS, ELEVATOR LOBBIES, STANDPIPE CABINETS, SPRINKLER SECTIONAL VALVE LOCATIONS, AND OTHER AREAS DEEMED CRITICAL BY THE AHJ AND 90% IN GENERAL BUILDING AREAS. (NFPA 72-24.5.2.2)
7. SIGNAL STRENGTH INBOUND SHALL BE A MINIMUM OF -95 DBM. (DAQ 3.0) (NFPA 72-24.5.2.3.1)
   SIGNAL STRENGTH OUTBOUND SHALL BE A MINIMUM OF -95 DBM. (DAQ 3.0) (NFPA 72-24.5.2.3.2)
   NOTE: A SIGNAL STRENGTH OF LESS THAN -90 DBM AS SHOWN ON THE PLANS HAS A HIGH PROBABILITY OF FAILING THE FINAL INSPECTION OF DAQ 3.0 MINIMUM. SEE NFPA 72-14.4.10.3 TEST PROCEDURES; RECOMMEND -90 DBM.
8. ISOLATION SHALL BE A MINIMUM OF 20 DBM ABOVE THE SIGNAL BOOSTER GAIN UNDER ALL OPERATING CONDITIONS. (NFPA 72-24.5.2.3.3) (NFPA 1221-9.6.9 (2016))
   NOTE: NFPA 1221 (2016) REQUIRES A MINIMUM OF 20 DBM. ANY LOWER VALUE MAY RESULT IN THE PROBABILITY OF FAILING THE FINAL INSPECTION.
9. SYSTEM RADIO FREQUENCIES; SYSTEM SHALL BE CAPABLE OF TRANSMITTING ALL PUBLIC SAFETY RADIO FREQUENCIES USED BY THE AHJ. (NFPA 72-24.5.2.4)
10. FREQUENCY CHANGES. SYSTEM SHALL BE CAPABLE OF UPGRADING. (NFPA 72-24.5.2.4.2)
11. SYSTEM COMPONENTS: COMPONENTS SHALL BE APPROVED AND COMPATIBLE WITH THE LOCAL PUBLIC SAFETY RADIO SYSTEM. (NFPA 72-24.5.2.5.1) (NFPA-1.1.4)
12. ALL REPEATERS, TRANSMITTER RECEPTACLES, SIGNAL BOOSTER COMPONENTS AND BATTERY SYSTEM COMPONENTS SHALL BE IN A NEMA 4, 4X ENCLOSURE. (NFPA 72-24.5.2.5.2) (NFPA 1-1.4)
13. POWER SUPPLIES SHALL HAVE AT LEAST TWO INDEPENDENT SOURCES. (NFPA 72-24.5.5)
14. THE PRIMARY POWER SOURCE SHALL BE SUPPLIED FROM A DEDICATED CIRCUIT AND SHALL COMPLY WITH NFPA 72-10.6.5. (NFPA 72-24.5.5.1)
15. THE SECONDARY POWER SOURCE SHALL CONSIST OF ONE OF THE FOLLOWING (NFPA 72-24.5.5.2):
   (1) BATTERY WITH AT LEAST 12 HOURS OF OPERATION AT 100% PER NFPA 72-10.6.10
   (2) LIFE SAFETY GENERATOR WITH AT LEAST 12 HOURS OF OPERATION AT 100% AND A BATTERY WITH AT LEAST 2 HOURS OF OPERATION AT 100% PER NFPA 10.6.11.3.
16. SYSTEM MONITORING: THE FIRE ALARM SYSTEM SHALL MONITOR THE FOLLOWING ITEMS AS A MINIMUM (NFPA 72-24.5.2.6.1):
   (1) INTEGRITY OF THE CIRCUIT MONITORING SIGNAL BOOSTER(S) AND POWER SUPPLY(IES) SHALL COMPLY WITH NFPA 72-24.10.6.9 AND NFPA 72-12.6.
   (2) SYSTEM AND SIGNAL BOOSTER SUPERVISORY SIGNALS SHALL INCLUDE THE FOLLOWING:
      (a) ANTENNA MALFUNCTION
      (b) SIGNAL BOOSTER FAILURE
      (c) LOW-BATTERY CAPACITY INDICATION WHEN 70 PERCENT OF THE 12-HOUR OPERATING CAPACITY HAS BEEN DEPLETED.
   (3) POWER SUPPLY SIGNALS SHALL INCLUDE THE FOLLOWING FOR EACH SIGNAL BOOSTER:
      (a) LOSS OF NORMAL AC POWER
      (b) FAILURE OF BATTERY CHARGER
17. DEDICATED PANEL (ANNUNCIATOR PANEL) SHALL SHOW (NFPA 72-24.5.2.6.2):
   (1) NORMAL AC POWER
   (2) SIGNAL BOOSTER TROUBLE
   (3) LOSS OF NORMAL AC POWER
   (4) FAILURE OF BATTERY CHARGER
   (5) LOW BATTERY CAPACITY
18. TECHNICAL CRITERIA (NFPA 72-24.5.2.7)
   (1) FREQUENCIES REQUIRED
   (2) LOCATION OF EFFECTIVE RADIATED POWER (ERP) OF THE FCC AHJ RADIO SITE
   (3) MAXIMUM PROPAGATION DELAY LESS THAN 30 MICRO-SECONDS
   (4) LIST OF SPECIFICALLY APPROVED COMPONENTS
   (5) OTHER SUPPORT TECHNICAL INFORMATION
19. A NOTE ON THE PLAN SHALL BE PROVIDED: "CONTRACTOR SHALL OBTAIN WRITTEN APPROVAL FROM THE ELEVATOR INSPECTOR PRIOR TO ANY WORK INSIDE AN ELEVATOR SHAFT OR MACHINE ROOM." (NFPA 72-24.5.4) (ASME A17.1)

ELECTRICAL AHJ NOTES

1. ALL CIRCUIT BREAKERS SHALL BE FULL SIZE; NO TANDEM TYPE CIRCUIT BREAKERS. PROVIDE AN ACCURATE PANEL SCHEDULE ON THE INSIDE OF EACH PANEL DOOR.
2. PROVIDE LOCKABLE CIRCUIT BREAKER FOR ALL SYSTEM CIRCUITS.
3. ALL WIRING SHALL BE COPPER. THE MINIMUM SIZE SHALL BE #12 AWG, EXCEPT AS NOTED. THE INSULATION SHALL BE THHN, THWN. ALL WIRING SHALL BE IN CONDUIT.
4. ALL GUTTER AND WIREWAY SIZES SHALL COMPLY WITH NEC ARTICLE 376.22 AND TABLES 312.6(A) & (B).
5. ELECTRICAL EQUIPMENT EXPOSED TO THE WEATHER SHALL BE WEATHERPROOF.
6. ALL EMPTY CONDUITS SHALL HAVE NYLON PULL CORDS AND SHALL BE IDENTIFIED AT EACH END. ALL CONDUITS THROUGH THE ROOF SHALL PENETRATE THE ROOF USING PROPER, APPROVED FLASHING.
7. PENETRATION OF ALL PIPES AND CONDUITS THROUGH FIRE RATED PARTITIONS SHALL BE IN COMPLIANCE WITH UL ASSEMBLY. PROVIDE 3M FIRE BARRIER CP-25 N/S FIRESTOP CAULKING FOR CONDUITS UP TO 4" IN TWO (2) HOUR (MAX) RATED FIRE PARTITIONS.

EMPTY CONDUITS AND JUNCTION BOXES

METAL RACEWAYS FROM DONOR ANTENNA(S) TO THE BDA SHALL BE A MINIMUM OF 2" EMT WITH LARGE RADIUS SWEEPS (MINIMUM 24" RADIUS).

METAL RACEWAYS FROM BDA TO THE DISTRIBUTION ANTENNA(S) SHALL BE A MINIMUM OF 2" EMT WITH LARGE RADIUS SWEEPS (MINIMUM 24" RADIUS).

METAL RACEWAYS FROM UPS TO 120V POWER PANEL SHALL BE 3/4" MINIMUM.

METAL RACEWAYS FROM BDA TO FIRE ALARM CONTROL PANEL 1" MINIMUM.

A MAXIMUM OF TWO (2) 90° BENDS ARE ALLOWED BETWEEN JUNCTION/PULL BOXES.

A MAXIMUM OF 100 FEET IS ALLOWED BETWEEN JUNCTION/PULL BOXES.

JUNCTION PULL/BOXES SHALL BE A MINIMUM OF 18"x18"x6".

ALL CONDUITS PENETRATING A FIRE-RATED ENCLOSURE SHALL BE FIRE-STOPPED.

JUNCTION BOXES FOR CONDUITS LEAVING A FIRE-RATED ENCLOSURE SHALL BE LOCATED IN THE FIRE-RATED ENCLOSURE.

ELEVATOR AHJ NOTES

FOR ANY DAS ANTENNAS INSTALLED IN AN ELEVATOR SHAFT, A VARIANCE SHALL BE OBTAINED FROM THE BROWARD COUNTY BUILDING CODE SERVICES DIVISION, CHIEF ELEVATOR INSPECTOR, PRIOR TO THE START OF ANY WORK INSIDE AN ELEVATOR SHAFT OR ELEVATOR MACHINE ROOM.

THIS VARIANCE MAY TAKE SIX TO EIGHT WEEKS TO OBTAIN. WORK SHALL NOT START UNTIL THE VARIANCE IS OBTAINED. ALL WORK INSIDE THE ELEVATOR SHAFT SHALL BE COORDINATED WITH THE ELEVATOR INSPECTOR.

SEE FC-2.2 FOR ADDITIONAL INFORMATION.

FCC LICENSE HOLDER AHJ NOTES

1. SEE THE ANTENNA AND SURGE PROTECTOR DETAIL ON DRAWING FC-5.1 (FAC 61G15)
2. THE SYSTEM SHALL NEVER BE ENERGIZED FOR TESTING OR OPERATION UNTIL WRITTEN, OR ON SITE, APPROVAL IS OBTAINED FROM THE FCC LICENSE HOLDER. (FBC 118.4.2.2)
3. THE BDA ENCLOSURE SHALL BE PAINTED RED AND A SIGN SHALL SHOW PERMIT NUMBER, VENDOR NAME AND TELEPHONE NUMBER. (FBC 118.2.1.8)
4. PATHWAY SURVIVABILITY LEVEL SHALL BE 1, 2, OR 3. LEVEL 1: ALL COAXIAL CABLES SHALL BE IN METAL CONDUIT. (NFPA 72-12.4)
5. RADIO COVERAGE SHALL BE A MINIMUM OF 99% IN CRITICAL AREAS AND 95% IN GENERAL BUILDING AREAS. (NFPA 72-24.5.2.2)
6. SIGNAL STRENGTH INBOUND SHALL BE A MINIMUM OF -95 DBM. (DAQ 3.0)
   SIGNAL STRENGTH OUTBOUND SHALL BE A MINIMUM OF -95 DBM. (DAQ 3.0) (NFPA 72-24.5.2.3)
   NOTE: A SIGNAL STRENGTH OF LESS THAN -90 DBM AS SHOWN ON THE PLANS HAS A HIGH PROBABILITY OF FAILING THE FINAL INSPECTION OF DAQ 3.0 MINIMUM. SEE NFPA 72-14.4.10.3 TEST PROCEDURES; RECOMMEND -90 DBM.
7. ISOLATION SHALL BE A MINIMUM OF 15 DBM ABOVE THE SIGNAL BOOSTER GAIN UNDER ALL OPERATING CONDITIONS. (NFPA 72-24.5.2.3.3)
   NOTE: NFPA 1221 (2016) REQUIRES A MINIMUM OF 20 DBM. ANY LOWER VALUE MAY RESULT IN THE PROBABILITY OF FAILING THE FINAL INSPECTION.
8. SYSTEM RADIO FREQUENCIES; SYSTEM SHALL BE CAPABLE OF TRANSMITTING ALL PUBLIC SAFETY RADIO FREQUENCIES USED BY THE FCC AHJ. (NFPA 72-24.5.2.4)
9. FREQUENCY CHANGES. SYSTEM SHALL BE CAPABLE OF UPGRADING. (NFPA 72-24.5.2.4.2)
10. SYSTEM COMPONENTS: COMPONENTS SHALL BE APPROVED AND COMPATIBLE WITH THE PUBLIC SAFETY RADIO SYSTEM. (NFPA 72-24.5.2.5)
    SHOW THE PROPAGATION DELAY.
    SIGNAL BOOSTERS SHALL HAVE FCC CERTIFICATION. POWER SUPPLIES SHALL HAVE AT LEAST TWO INDEPENDENT SUPPLIES. BATTERY SHALL PROVIDE TWELVE (12) HOUR MINIMUM OPERATIONAL RUN TIME.
11. SYSTEM MONITORING: (NFPA 72-24.5.2.6.1) THE FIRE ALARM SYSTEM SHALL MONITOR THE FOLLOWING ITEMS AS A MINIMUM:
   (1) INTEGRITY OF THE CIRCUIT MONITORING SIGNAL BOOSTER(S) AND POWER SUPPLY(IES) SHALL COMPLY WITH NFPA 72-24.10.6.9 AND NFPA 72-12.6.
   (2) SYSTEM AND SIGNAL BOOSTER SUPERVISORY SIGNALS SHALL INCLUDE THE FOLLOWING:
      (a) ANTENNA MALFUNCTION
      (b) SIGNAL BOOSTER FAILURE
      (c) LOW-BATTERY CAPACITY INDICATION WHEN 70 PERCENT OF THE 12-HOUR OPERATING CAPACITY HAS BEEN DEPLETED.
   (3) POWER SUPPLY SIGNALS SHALL INCLUDE THE FOLLOWING FOR EACH SIGNAL BOOSTER:
      (a) LOSS OF NORMAL AC POWER
      (b) FAILURE OF BATTERY CHARGER
12. DEDICATED PANEL (ANNUNCIATOR PANEL) (NFPA 72-24.5.2.6.2)
   (1) NORMAL AC POWER
   (2) SIGNAL BOOSTER TROUBLE
   (3) LOSS OF NORMAL AC POWER
   (4) FAILURE OF BATTERY CHARGER
   (5) LOW BATTERY CAPACITY
13. TECHNICAL CRITERIA (NFPA 72-24.5.2.7)
   (1) FREQUENCIES REQUIRED
   (2) LOCATION OF EFFECTIVE RADIATED POWER (ERP) OF THE FCC AHJ RADIO SITE
   (3) MAXIMUM PROPAGATION DELAY (30 MICROSECONDS)
   (4) LIST OF SPECIFICALLY APPROVED COMPONENTS
   (5) OTHER SUPPORT TECHNICAL INFORMATION
14. WHEN AN ELEVATOR(S) IS(ARE) PRESENT IN THE BUILDING, AN ANTENNA IS TYPICALLY REQUIRED TO BE MOUNTED IN THE ELEVATOR SHAFT(S) TO GET COVERAGE INSIDE THE ELEVATOR CAR(S). A NOTE ON THE PLAN SHALL BE PROVIDED: "CONTRACTOR SHALL OBTAIN WRITTEN APPROVAL FROM THE ELEVATOR INSPECTOR PRIOR TO ANY WORK INSIDE AN ELEVATOR SHAFT OR MACHINE ROOM. (NFPA 72-24.5.4) (ASME A17.1)
16. OTHER INDUSTRY STANDARDS INCLUDE IEEE 1692, TIA/ANSI/EIA 569-C, TIA/ANSI/EIA 607-B, MOTOROLA R56.

DRAFT EDITION
2019-07-20

THIS DRAWING HAS NOT BEEN APPROVED BY ANY AHJ.

AHJ NOTES

SCALE: NTS

RC ENGINEERING INC
5532 NW 106th DRIVE
CORAL SPRINGS, FL 33076
(954)757-7900
CA4755

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TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
AHJ NOTES

SEAL

DATE _____
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
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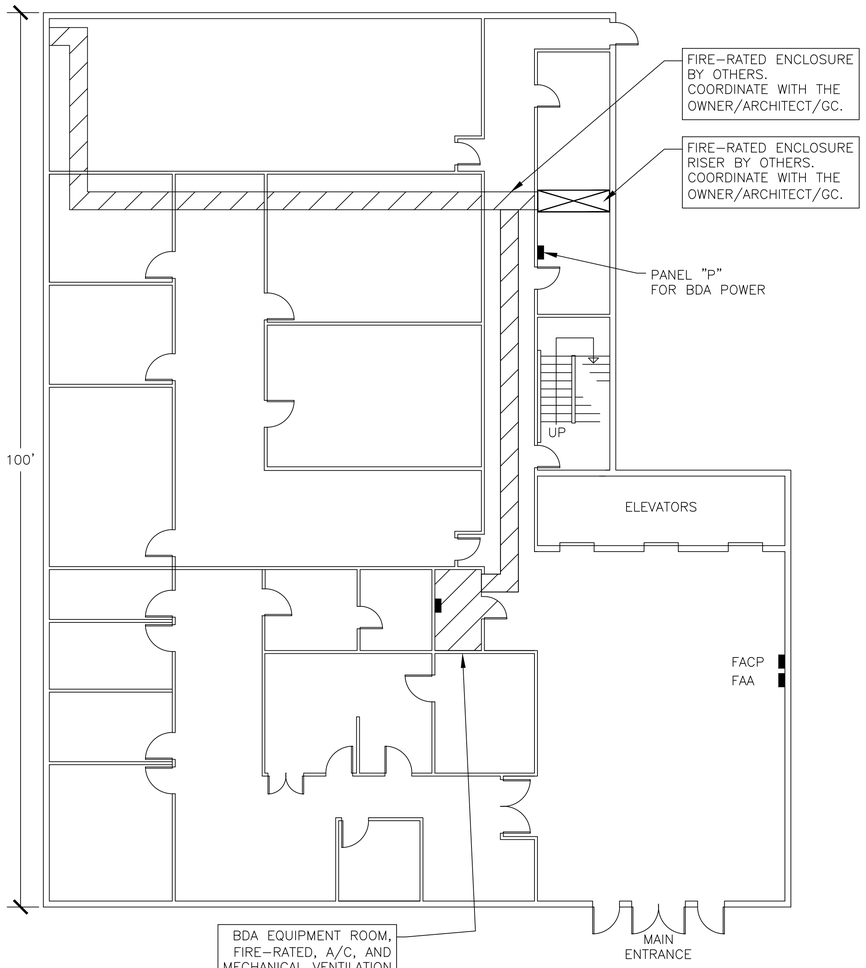
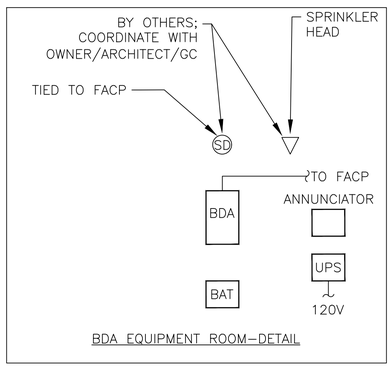




BDA EQUIPMENT ROOM–DETAIL

TIE THE BDA TO THE FACP FOR THE REQUIRED ALARMS.

WIRE THE UPS TO A 120V PANEL WITH A 20A, 1P, LOCKABLE CB. PANEL SHALL BE ON THE EMERGENCY GENERATOR, IF AVAILABLE.
PROVIDE A LOCKABLE SWITCH OR TWIST LOCK RECEPTACLE (UNDER A COVER) NEXT TO THE UPS.

FLOOR TO FLOOR	12'–0"
CEILINGS	9'–0"
WINDOWS (EGLASS)	4'–0" TO 8'–0" AROUND PERIMETER

DRAFT EDITION
2019–07–20

THIS DRAWING HAS NOT BEEN APPROVED BY ANY AHJ.

FIRST FLOOR PLAN

SCALE: 1/8" = 1'-0"

1"

NORTH

RC ENGINEERING INC
5532 NW 106th DRIVE
CORAL SPRINGS, FL 33076
(954)757-7900
CA4755

REVISIONS

DATE	BY	DESC

Date: 2019-07-20
Drawn: MAR
Checked: DLR
Scale: 1/8"=1'-0"
JOB NO. 19005

PROJECT
TWO–WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

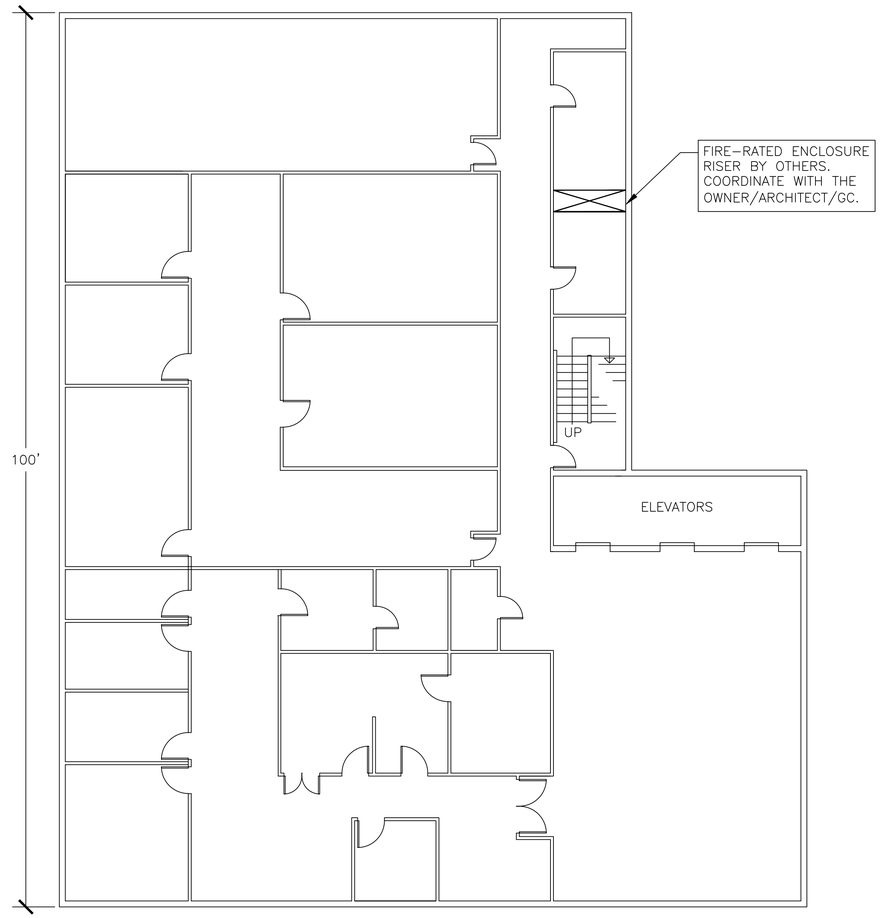
TITLE
FIRST FLOOR PLAN

SEAL

DATE
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
FC–2.1

of sheets



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2019–07–20

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SECOND FLOOR PLAN

SCALE: 1/8" = 1'-0"

1"

NORTH

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TWO–WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
SECOND FLOOR PLAN

SEAL

DATE
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Electrical Engineer
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PE 34343

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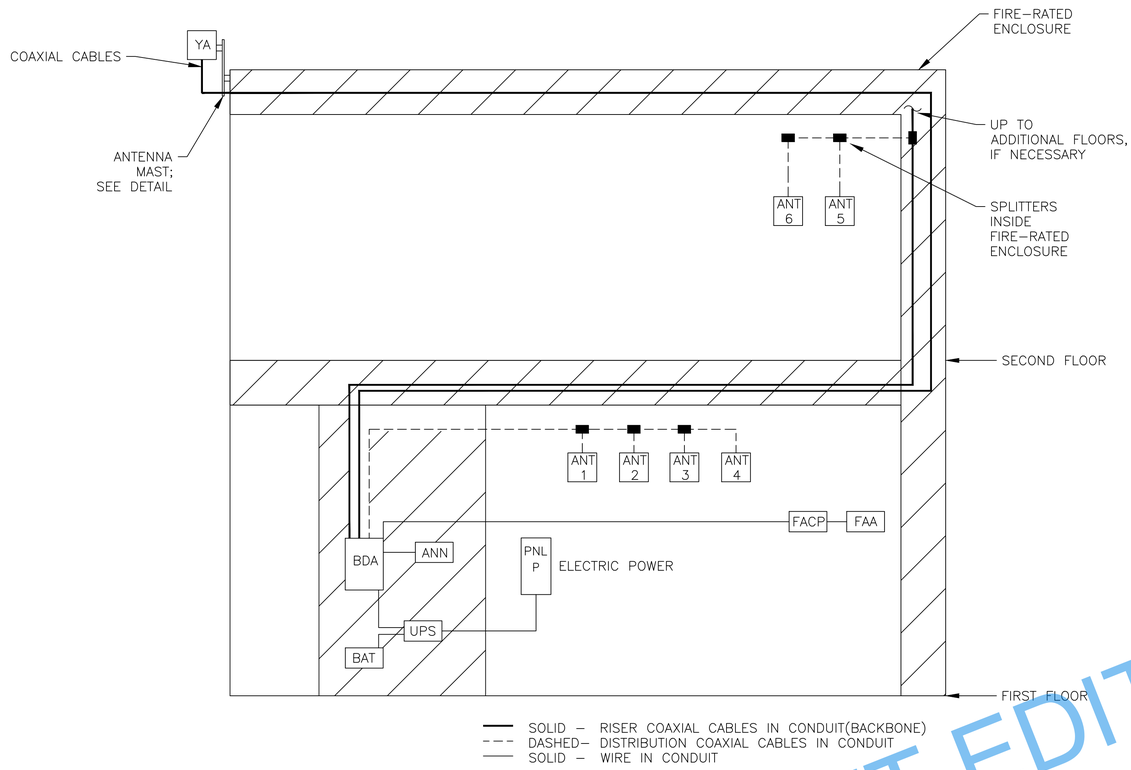

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CONDUIT RISER DIAGRAM

SCALE: NTS

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(954)757-7900
CA4755

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PROJECT
TWO–WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
CONDUIT RISER DIAGRAM

SEAL

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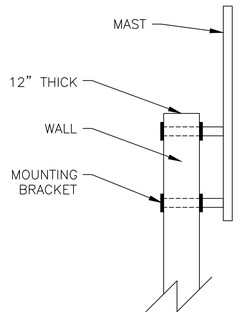


MOUNTING NOTE:

PROVIDE SHOP DRAWINGS FOR REVIEW BY THE ENGINEER OF RECORD (4 COPIES MINIMUM).

SHOP DRAWINGS SHALL BE SIGNED AND SEALED BY A FLORIDA REGISTERED PROFESSIONAL ENGINEER.

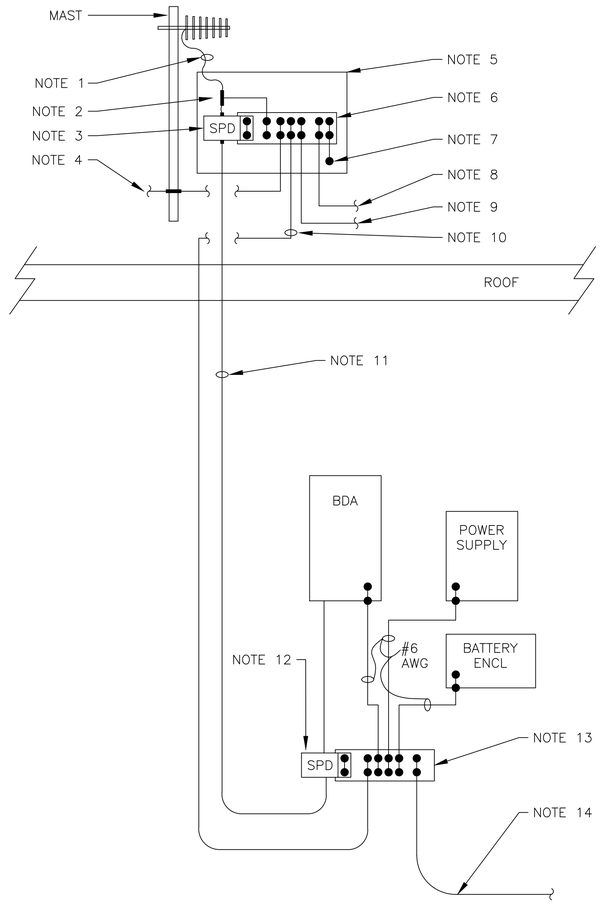
SHOP DRAWINGS SHALL INCLUDE THE COMPLETE ASSEMBLY, INCLUDING MAST, ANTENNA, MOUNTING HARDWARE, AND BUILDING CONSTRUCTION.

SHOP DRAWINGS SHALL BE FOR WORST CASE CONDITIONS.

ALL ASSOCIATED COSTS FOR THE TOTAL INSTALLATION INCLUDING SHOP DRAWINGS AND DESIGN FEES SHALL BE INCLUDED IN THE CONTRACT.

SHOP DRAWINGS SHALL STATE THAT THE COMPLETE ASSEMBLY INSTALLATION COMPLIES WITH THE MINIMUM REQUIREMENTS OF THE HVHZ SECTIONS OF THE FLORIDA BUILDING CODE, BROWARD COUNTY AMENDMENTS, SIXTH EDITION (2017).

ANTENNA AND MAST INSTALLATION DETAIL



NOTES:

1. UV, WP RATED COAXIAL CABLE
2. COAXIAL CABLE GROUND CLAMP (NFPA 70–810.21 2014)
3. SURGE PROTECTOR (SPD) LIGHTNING ARRESTOR MOUNTED TO BUSBAR WITH CORROSION INHIBITOR (NFPA 70–810.6 2014)
4. MAST GROUND CLAMP TO BUSBAR (#6 AWG)
5. NEMA 4X FIBERGLASS JUNCTION BOX 18"x18"x6" WITH HINGED COVER
6. TIN–PLATED COPPER BUSBAR, MINIMUM 1/4"x2"x12' WITH INSULATED MOUNTING AND TWO (2) HOLE LUGS.
7. #6 AWG COPPER WIRE TO EACH RACEWAY ENTERING THE BOX
8. BUS BAR TO A NFPA 780 LIGHTNING PROTECTION SYSTEM, IF EXISTING
9. #2 AWG STRANDED, GREEN INSULATED, COPPER WIRE TO CLOSEST BUILDING GROUND (STEEL STRUCTURE, CWP, ETC). MAY BE BELOW THE ROOF.
10. #2 AWG STRANDED, GREEN INSULATED, COPPER WIRE IN A METAL RACEWAY (BONDED AT BOTH ENDS) TO THE BDA BUSBAR
11. PLENUM RATED COAXIAL CABLE INSTALLED IN A FIRE–RATED ENCLOSURE IN A 2" EMT WITH 24" RADIUS BENDS, BONDED AT BOTH ENDS
12. SURGE PROTECTION DEVICE MOUNTED TO BUSBAR WITH CORROSION INHIBITOR (NFPA 70–810.6 2014)
13. TIN–PLATED COPPER GROUND BUS BAR, MINIMUM 1/4" x 2" x 12" WITH INSULATED MOUNTING AND WITH TWO (2) HOLE LUGS
14. MINIMUM #6 AWG CU TO METAL RACEWAYS ENTERING
15. INSTALLATION SHALL BE IN COMPLIANCE WITH:
    NFPA 70–810 (2014)
    IEEE STD 1692 (2011)
    TIA/ANSI/EIA 569–C (2012)
    TIA/ANSI/EIA 607–B (2011)
    MOTOROLA R–56

ANTENNA AND MAST INSTALLATION DETAIL

MISCELLANEOUS NOTES:

- MINIMUM BEND RADIUS OF 8"
- MINIMUM BENDS SHALL BE 90°
- USE TWO HOLE LUGS.
- USE IRREVERSIBLE COMPRESSION FITTINGS.
- ANTENNA TO GROUND BUS AT BDA SHALL BE AWG #2 STRANDED.
- FINAL CONNECTIONS SHALL BE AWG #6 STRANDED MINIMUM.
- BUSBARS SHALL BE TINNED COPPER WHERE EXPOSED TO THE ELEMENTS.
- ALL GROUND WIRES SHALL BE AS SHORT AS POSSIBLE WITH MINIMUM BENDS.
- WHERE A GROUND WIRE IS INSTALLED IN A METAL CONDUIT, THE CONDUIT SHALL BE BONDED AT BOTH ENDS.
- SURGE SUPPRESSORS SHALL BE COMPATIBLE WITH THE BDA.
- CABLES SHALL BE ATTACHED TO THE MAST WITH LISTED ATTACHMENTS, PER THE MANUFACTURER'S RECOMMENDATION.
- THE TOP OF THE MAST SHALL BE 12" MINIMUM ABOVE THE ANTENNA.

DRAFT EDITION
2019–07–20

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ANTENNA AND GROUNDING DETAILS

SCALE: NTS

RC ENGINEERING INC
5532 NW 106th DRIVE,
CORAL SPRINGS, FL 33076
(954)757-7900
CA4755

REVISIONS

DATE	BY	DESC

Date: 2019-07-20
Drawn: MAR
Checked: DLR
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JOB NO. XXXXX

PROJECT
TWO–WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
ANTENNA AND GROUNDING DETAILS

SEAL

DATE
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
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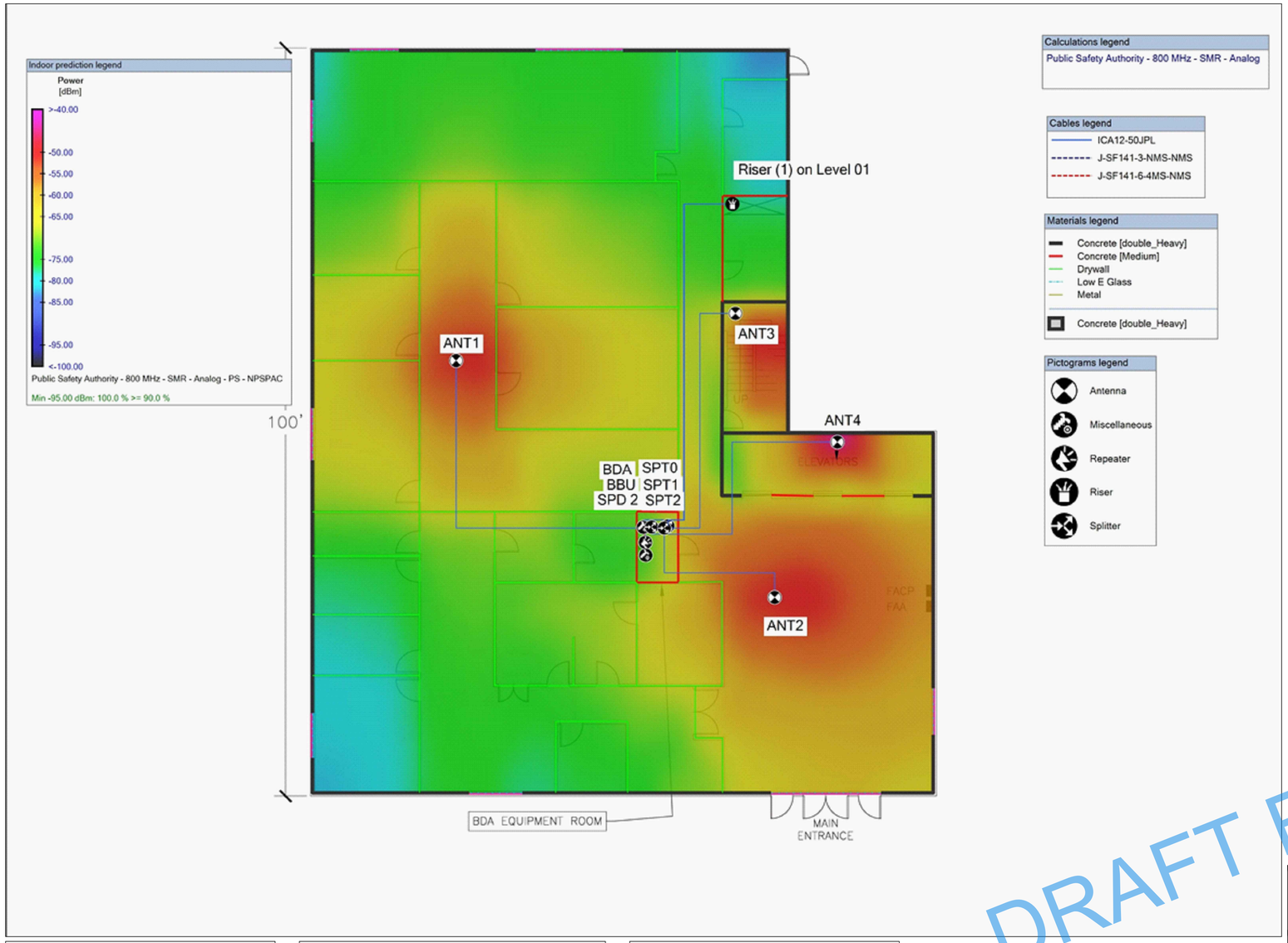
of sheets



DRAFT EDITION

iBwave DESIGNER
CERTIFICATE NUMBER: _____

FLOOR TO FLOOR 12'–0"
CEILINGS 9'–0"
WINDOWS (EGLASS) 4'–0" TO 8'–0" AROUND PERIMETER

THE SYSTEM SHALL NEVER BE ENERGIZED FOR TESTING OR OPERATION UNTIL WRITTEN OR ONSITE APPROVAL IS OBTAINED FROM THE FCC LICENSE HOLDER AHJ.

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2019–07–20
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FIRST FLOOR PROPAGATION PLAN

SCALE: 1/8" = 1'-0"

1"

NORTH

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REVISIONS
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PROJECT
TWO–WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
FIRST FLOOR
PROPAGATION PLAN

SEAL

DATE _____
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

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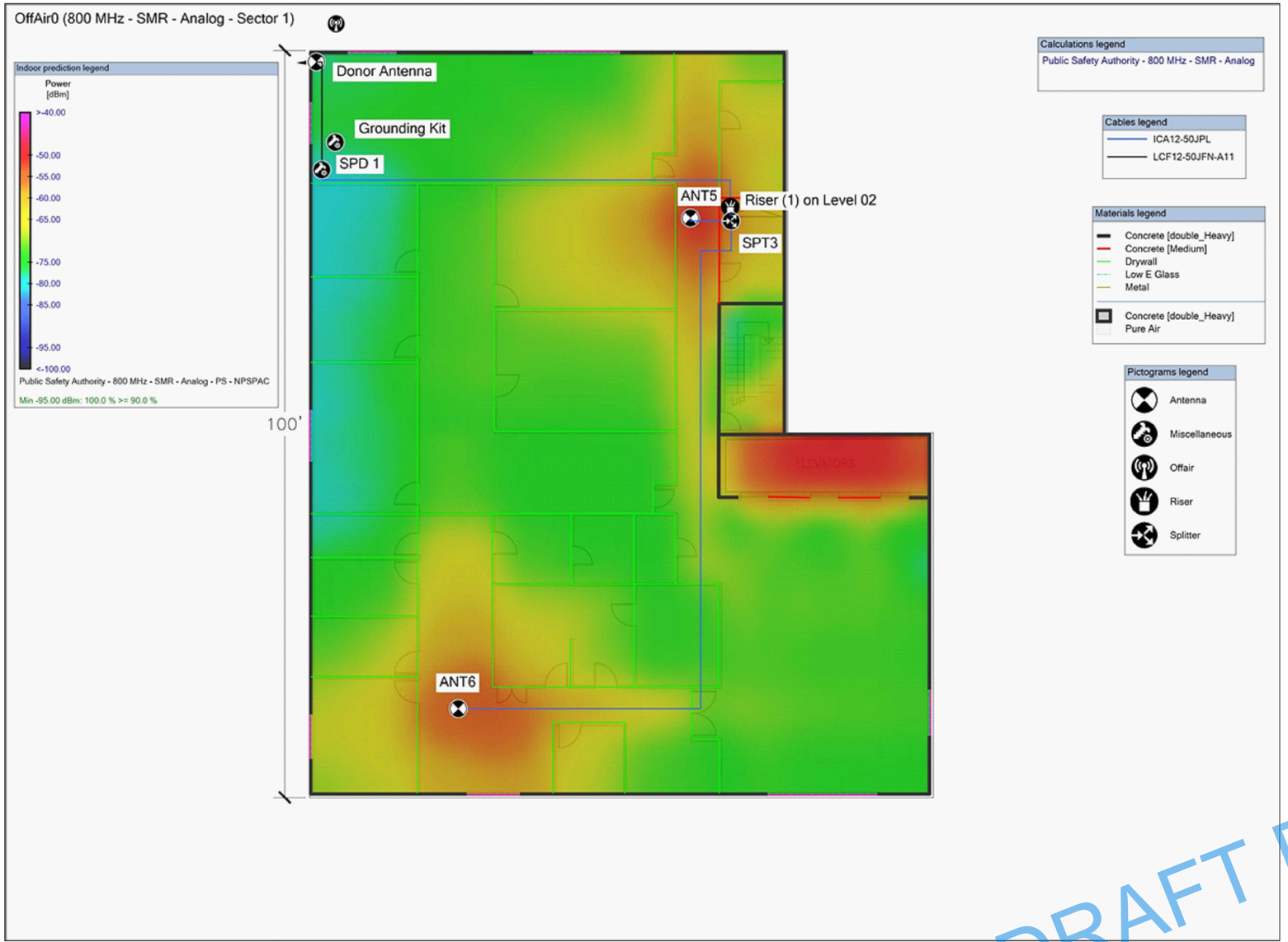

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2019-07-20

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SECOND FLOOR PROPAGATION PLAN

SCALE: 1/8" = 1'-0"

NORTH

1"

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PROJECT
TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
SECOND FLOOR
PROPAGATION PLAN

SEAL

DATE
David L. Rice, P.E.
Electrical Engineer
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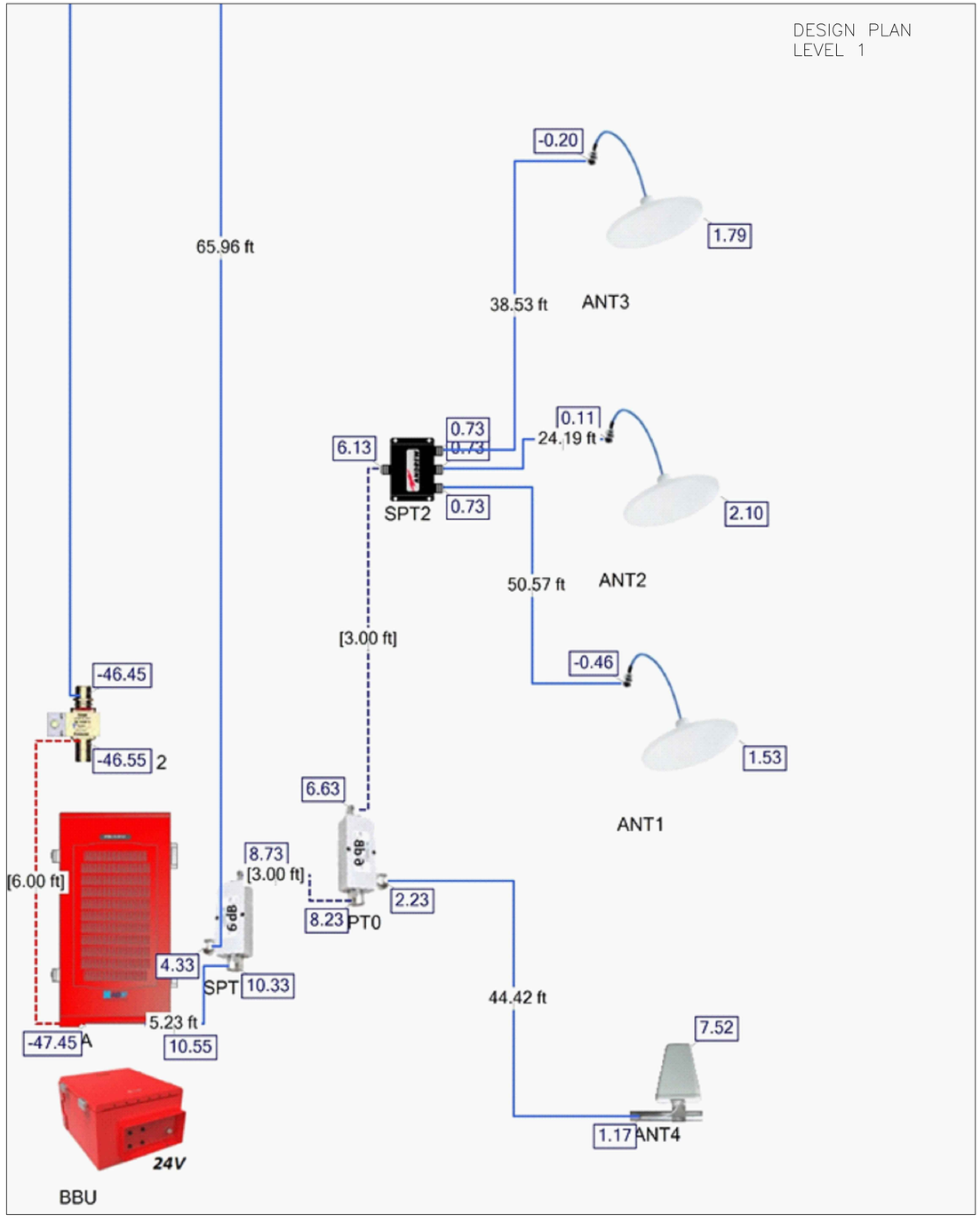
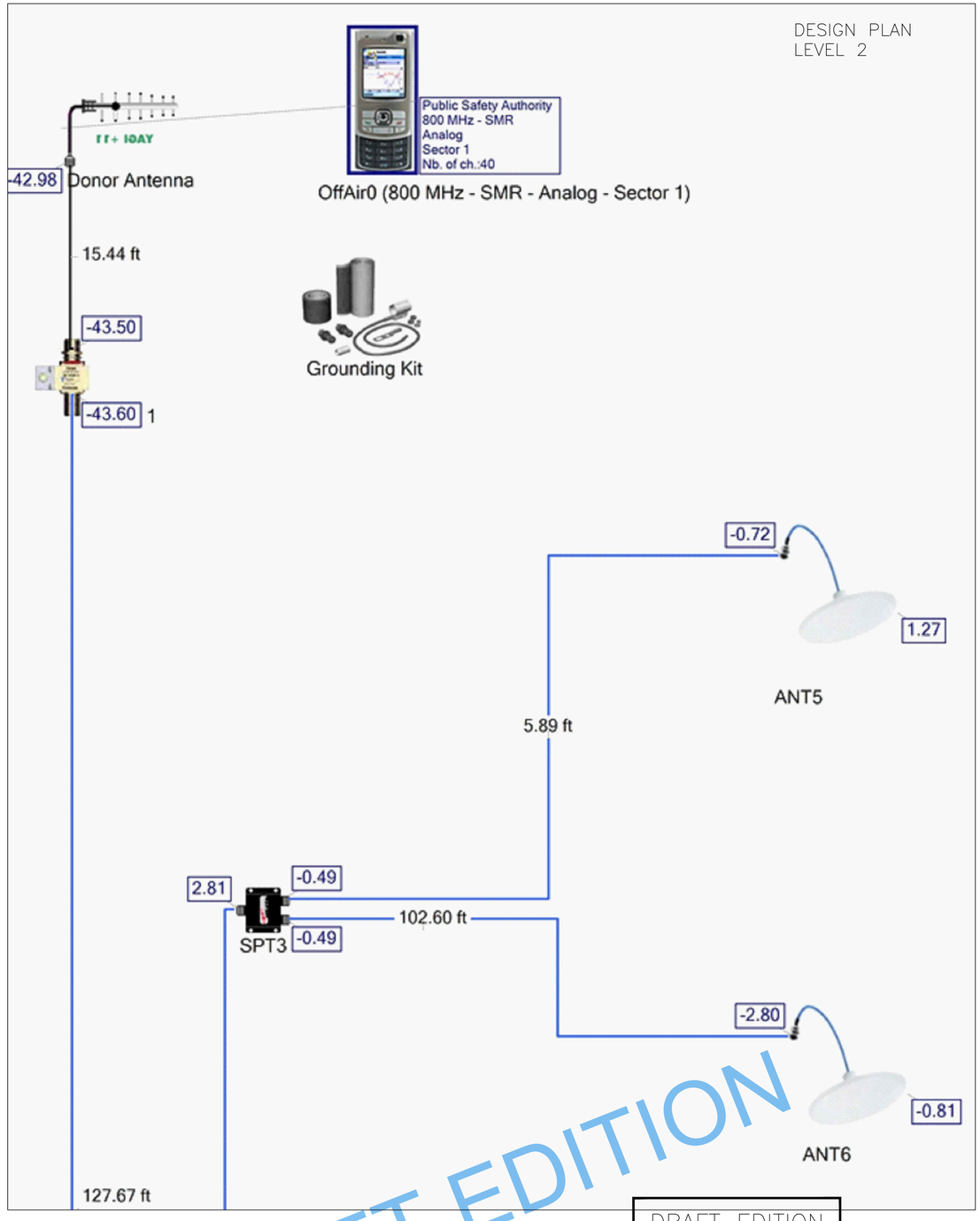
DESIGN PLAN
LEVEL 1



DESIGN PLAN
LEVEL 2



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2019-07-20

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DESIGN PLAN

SCALE: NTS

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PROJECT
TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
DESIGN PLAN

SEAL

DATE
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
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of sheets

Two-Way Radio Communications Enhancement Systems
Product Compatibility

Item	Manufacturer	Product Name	Part Number	UL Standard	NRTL Listing
BDA/Repeater	BDA Corp.	Repeater	BDA-XXX	60950 2524	UL/etl
Power Supply UPS	UPS Corp	UPS	Incl BDA-XXX		
Charger	C Corp	Charger	Incl BDA-XXX		
Battery/Enclosure	B/E Corp.	Battery Backup	BDA-XXX		
Remote Annunciator	RA Corp.	Annunciator			
Surge Protection	Polyphaser Times Microwave	Surge Protector Times Project	TSX-NFF-BFN-CCK LP-BTR(W)-NFF mt	N/A	
Donor Antenna	Sinclair	800/700 MHZ	SY407-SF2SNM	N/A	-
In-Building Antenna	Galtronics	700/800 MHZ	PEAR-S5379	N/A	-
Couplers	Micro Lab	2-Way	D2-85FN	N/A	-
Connectors	RFS	N-Male	NM-LCF12-D01	N/A	-
Splitters	Micro Lab	Power-Splitter Fixed Radio	DN-XXFN	N/A	-
Ground Kit	CI Wireless.com	1/2" Ground Kit Tinned	SCGK12	N/A	-
Mast	CI Wireless.com	Pipe Wall Mount	BS100-72	N/A	-
Outside Cable	RFS	1/2" UV Cable	ICA12-50J		ETL
Plenum Cable	RFS Commscope	1/2" Plenum Cable 1/2" Plenum Cable	LCF12-50JPL HL4-50A		ETL ETL
Busbar	CI Wireless	Tinned Copper Busbar	GB212-NH	NA	

The above items are compatible for use with the BDA. This form shall be filled out by the BDA manufacturer.

BDA Mfgr.	BDA Corp.	Florida Engineer of Record:	
Address	Any Street	Name	
City/State	Any Town, Any State	PE#	
Rep Name		Company	
Title		CA#	
Date		Date	

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2019-07-20

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PRODUCT COMPATIBILITY LIST

SCALE: NTS

RC ENGINEERING INC
5532 NW 106th DRIVE
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CA4755

REVISIONS

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PROJECT
TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
PRODUCT
COMPATIBILITY LIST

SEAL

DATE
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
FC-5.1
of sheets

BDA

POWER SUPPLY

BATTERY AND ENCLOSURE

ANNUNCIATOR

NOTES:
1. ALL SPECS, NOTES, DESCRIPTIONS, ETC. SHALL BE PRINTED ON AN 11x17 DRAWING.
2. THIS DRAWING IS FOR INFORMATION PROVIDED BY THE PRODUCT MANUFACTURER. THE ENGINEER OF RECORD IS NOT RESPONSIBLE FOR THE MANUFACTURER'S CONTENT AS PER FAC-61G15.30.003(3)

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MANUFACTURER'S SUBMITTAL SHEET 1 SCALE: NTS

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TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
MANUFACTURER'S SUBMITTAL SHEET 1

SEAL

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Electrical Engineer
State of Florida
PE 34343

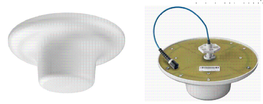
SHEET
FC-5.2
of sheets

DAS ANTENNA

a Bayln technologies Company

Small Form Factor In-Building SISO Antenna [698-960, 1695-2700 and 5200-6000 MHz]

PEAR™ S5379i



698-960, 1695-2700 and 5200-6000 MHz Omni Antenna

Description:

- **Omni directional antenna for in-building applications such as DAS.**
- **The antenna was especially desgined for in-building multi-path environments..**

Electrical Specifications				
Frequency Band [MHz]	698-960	1695-2180	2180-2700	5200-6000
Input Connector Type	1x N-Type DIN (F) or 4.3-10 DIN (F) w/ pigtail (12", 30cm)			
VSWR/Return Loss	<1.7:1 / 11.8 dB	<1.7:1 / 11.8 dB	<1.5:1 / 14.0 dB	< 2.0:1 / 9.5 dB
Impedance	50 Ω			
Polarization	Vertical			
Horizontal Beamwidth	Omni (360°)			
Max. Gain	2.4 dBi	3.1 dBi	4.0 dBi	6.1 dBi
Avg. Gain	1.4 dBi	2.7 dBi	3.4 dBi	4.8 dBi
Max Power / Port	25 Watts at ambient temperature 77°F (25°C)			
PIM @ 2x43 dBm	<-153 dBc for 4.3-10 DIN; <-150 dBc for N-Type			

Mechanical Specifications	
Operating Temperature	-40° to 158°F (-40° to +70°C)
Antenna Weight	0.86 lbs (390g)
Antenna Diameter	8.0" (204 mm)
Antenna Height	3.2" (82 mm)
Radome Material	PC / ABS
Flamibility rating	UL 94-V0
RoHS	Compliant
Radome Color	RAL 9016 (white)*
Ingress Protection	Indoor
Shipping Dimensions - L x W x D	26.18" x 14.17" x 9.8" / 665 x 360 x 250 mm
Shipping Weight (Gross Weight)	14.33 lbs (6.5 Kg)

* Radome can be painted with recommended paint "Krylon fusion for plastic"

Release Date: August 29, 2017| Revision: 5.0 | RFS#5379

Matting Male Connector Torque:
N-Type: 26.6 in-lb (3 Nm)
4.3-10: 44.3 in-lb (5 Nm)

DAS ANTENNA

GALTRONICS
WE'RE MAKING WAVES™

Outdoor/In-Building Directional Antenna [698-960 MHz, 1695-2700 MHz]

PEAR™ S5490i

Description:

- Directional wall mount antenna for outdoor and in-building applications such as DAS.
- The antenna is vertically polarized and operates at 698-2700 MHz covering also the public safety frequency band for TETRA.

698-968 MHz & 1695-2700 MHz Directional Antenna

Electrical Specifications						
Frequency Band [MHz]	698-790	790-960	1695-1820	1820-2180	2180-2380	2380-2700
Input Connector Type	1x N-Type (F) or 1x 4.3-10 (F) with cable (12", 30 cm)					
VSWR/Return Loss	<1.7:1 / 11.8 dB	<1.7:1 / 11.8 dB	<1.5:1 / 14.0 dB	<1.5:1 / 14.0 dB	<1.5:1 / 14.0 dB	<1.5:1 / 14.0 dB
Impedance	50 Ω					
Polarization	Vertical					
Vertical Beamwidth	75°	75°	70°	95°	70°	40°
Horizontal Beamwidth	100°	100°	82°	85°	75°	75°
Max. Gain	6.2 dBi	5.8 dBi	6.5 dBi	6.8 dBi	7.2 dBi	8.0 dBi
Avg. Gain	5.8 dBi	5.1 dBi	6.2 dBi	5.7 dBi	6.9 dBi	7.4 dBi
Max Power / Port	50 Watts at ambient temperature 77°F (25°C)					
PIM @ 2x43 dBm	<-153 dBc (for 4.3-10), <-150 dBc (for N-Type)					

Mechanical Specifications	
Operating Temperature	-40° to 158°F (-40° to +70°C)
Environmental Conditions	Outdoor / Indoor
Antenna Weight	1.32 lbs (600g)
Antenna Dimensions (H x W x D)	10.2" x 8.0" x 2.5" (259 x 203 x 65 mm)
Radome Color	RAL 9016 (white)*
Outdoor Ingress Protection	IP65
Flammability rating	UL 94-V0
RoHS	Compliant
Cable	Plenum Rated
Approved for use in Plenum Space	Listed & tested by Intertek ETL

* Radome can be painted with recommended paint "Krylon fusion for plastic"

S-5490i | Revision: 1.1 | Release Date: June 14, 2019

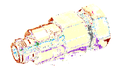
COUPLER

PRODUCT DATASHEET
NF-LCF12-D01

RADIO FREQUENCY SYSTEMS
The Clear Choice®

N Female Connector for 1/2" Coaxial Cable, OMNI FIT™ Premium, Straight, Polymer claw and compression sealing

OMNI FIT™ high performance connectors are designed for use with both CELLFLEX® (copper) and CELLFLEX® Lite (aluminium) cables. They are designed specifically to provide the highest quality connector-cable interface while simplifying and speeding up connector attachment. All RFS connectors are fully tested for mechanical and electrical compliance to industry specifications.
The 7-16 connector is the most rugged RF connection meeting all requirements even under the most severe environmental conditions. Sealing against outer conductor and jacket by means of the polymer claw and 360° compression fit. Multifunctional, self-lubricating HighTech polymer assembly locks on cable corrugation, avoids electrochemical potential differences and compression-fits to the jacket.



OMNI FIT™ Premium Connectors

FEATURES / BENEFITS

- Ultra high PIM performance i.e. reduced interference leading to high customer satisfaction
- Two-piece design i.e. visual inspection of interlocking leads to improved installation security
- OMNI FIT™ concept i.e. streamlined order management and reduced stock level
- Watertight sealing in mated and unmated condition, i.e. reduced efforts during installation and improved security during operation
- Unique NiTin plating i.e. extreme resistance against corrosion even under hardest climatic and environmental circumstances
- Multi-thread (Tristart) design i.e. simplified and accelerated tightening process
- RoHS (EU) and CRoHS (China) compliant i.e. can be used on a global basis

Technical Features

GENERAL SPECIFICATIONS

Transmission Line Type		Coaxial Cable
Cable Size		1/2"
Cable Type		Foam Dielectric
Model Series		LCF12-50 Series, ICA12-50 Series, RCF12-50 Series
Connector Interface		N
Connector Type		OMNI FIT™ PREMIUM Straight
Sealing Method		Polymer claw + 360° Compression
Gender		Female

ELECTRICAL SPECIFICATIONS

Nominal Impedance	Ohm	50
3rd Order IM Product @ 2x20 Watts	dBc	-156 ; typical -162
Maximum Frequency	GHz	3.7
VSWR, Return Loss	VSWR (dB)	0 < f ≤ 1.0 GHz: 1.02 (40.0) 1.0 < f ≤ 2.7 GHz: 1.03 (36.6) 2.7 < f ≤ 3.7 GHz: 1.06 (30.7)

MECHANICAL SPECIFICATIONS

Plating Outer/Inner		NiTin/Silver
Length	mm (in)	57.1 (2.25)
Outer Diameter	mm (in)	26 (1.02)
Weight	kg (lb)	0.1 (0.22)
Inner Contact Attachment		Basket
Outer Contact Attachment		360° clamping

ACCESSORIES

Wrench size front	mm (in)	27 (1-1/16)
Wrench size rear	mm (in)	27 (1-1/16)
Trimming Tool		TRIM-SET-L12-D01 TRIM-LCF12-D01-A

TESTING AND ENVIRONMENTAL

Waterproof Level		IP68

NF-LCF12-D01 REV: F REV DATE: 29.Feb.2016 www.rfsworld.com

COUPLER RFS

PRODUCT DATASHEET
NM-LCF12-D01

RADIO FREQUENCY SYSTEMS
The Clear Choice®

N Male Connector for 1/2" Coaxial Cable, OMNI FIT™ Premium, Straight, Polymer claw and compression sealing

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The 7-16 connector is the most rugged RF connection meeting all requirements even under the most severe environmental conditions. Sealing against outer conductor and jacket by means of the polymer claw and 360° compression fit. Multifunctional, self-lubricating HighTech polymer assembly locks on cable corrugation, avoids electrochemical potential differences and compression-fits to the jacket.

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- Ultra high PIM performance i.e. reduced interference leading to high customer satisfaction
- Two-piece design i.e. visual inspection of interlocking leads to improved installation security
- OMNI FIT™ concept i.e. streamlined order management and reduced stock level
- Watertight sealing in mated and unmated condition, i.e. reduced efforts during installation and improved security during operation
- Unique NiTin plating i.e. extreme resistance against corrosion even under hardest climatic and environmental circumstances
- Multi-thread (Tristart) design i.e. simplified and accelerated tightening process
- RoHS (EU) and CRoHS (China) compliant i.e. can be used on a global basis

Technical Features

GENERAL SPECIFICATIONS

Transmission Line Type		Coaxial Cable
Cable Size		1/2"
Cable Type		Foam Dielectric
Model Series		LCF12-50 Series, ICA12-50 Series, RCF12-50 Series
Connector Interface		N
Connector Type		OMNI FIT™ PREMIUM Straight
Sealing Method		Polymer claw + 360° Compression
Gender		Male

ELECTRICAL SPECIFICATIONS

Nominal Impedance	Ohm	50
3rd Order IM Product @ 2x20 Watts	dBc	-156 ; typical -162
Maximum Frequency	GHz	3.7
VSWR, Return Loss	VSWR (dB)	0 < f ≤ 1.0 GHz: 1.02 (40.0) 1.0 < f ≤ 2.7 GHz: 1.03 (36.6) 2.7 < f ≤ 3.7 GHz: 1.06 (30.7)

MECHANICAL SPECIFICATIONS

Plating Outer/Inner		NiTin/Silver
Length	mm (in)	64.05 (2.52)
Outer Diameter	mm (in)	29 (1.14)
Weight	kg (lb)	0.11 (0.24)
Inner Contact Attachment		Basket
Outer Contact Attachment		360° clamping

ACCESSORIES

Wrench size front	mm (in)	18
Wrench size rear	mm (in)	26
Trimming Tool		TRIM-SET-L12-D01 TRIM-LCF12-D01-A

TESTING AND ENVIRONMENTAL

Waterproof Level		IP68

NM-LCF12-D01 REV: F REV DATE: 29.Feb.2016 www.rfsworld.com

PLENUM CABLE

PRODUCT DATASHEET
ICA12-50JPL

RADIO FREQUENCY SYSTEMS
The Clear Choice®

1/2" ClearFill® Line Plenum-Rated Air-Dielectric Coaxial Cable for In-Building Applications

ClearFill® Line 1/2" low loss air dielectric cable, Plenum-rated, CMP

FEATURES / BENEFITS

- **Supports Multiple RF Signals**
- **Complete Shielding**
  The solid outer conductor of the ClearFill® Line coaxial cable creates a continuous RFI/EMI shield that minimizes system interference.
- **Outstanding Intermodulation Performance**
  RFS coaxial cable's solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory.
- **Wide Range of Applications**
  Typical areas of application are feedlines for plenum-space installations within occupied buildings or structures but also suitable for outdoor use due to jacket UV rating.

1/2" Plenum-Rated In-Building Cable

Technical Features

APPLICATIONS

Applications		Suitable for plenum in-building/public safety or outdoor usage

STRUCTURE

Cable Type		Air-Dielectric, Corrugated
Size		1/2"
Inner Conductor	mm (in)	4.8 (0.19) Copper-Clad Aluminum Wire
Dielectric	mm (in)	11.8 (0.464) Extruded Polyethylene
Outer Conductor	mm (in)	13.8 (0.54) Corrugated Copper
Jacket	mm (in)	15.93 (0.627) Plenum Rated / Color Blue UV rated to ASTM G155

ELECTRICAL SPECIFICATIONS

Impedance	Ω	50 +/- 1
Maximum Frequency	GHz	6.0
Velocity	%	91.0
Capacitance	pF/m (pF/ft)	76 (23.2)
Inductance	µH/m (µH/ft)	0.19 (0.058)
Peak Power Rating	kW	40.0
RF Peak Voltage	Volts	2000.0
Jacket Spark	Volt RMS	8000.0
Inner Conductor dc Resistance	Ω/1000 m (Ω/1000 ft)	1.48 (0.45)
Outer Conductor dc Resistance	Ω/1000 m (Ω/1000 ft)	1.9 (0.58)
Return Loss (VSWR) Performance		24.3 (1.13) @ 698-960 MHz 24.3 (1.13) @ 1700-2155 MHz 18 (1.29) @ 4400-5900 MHz
Maximum Return Loss	dB (VSWR)	19 (1.25) in other specified bands
Temperature & Power		High Power Rating

MECHANICAL SPECIFICATIONS

Cable Weight, Nominal	kg/m (lb/ft)	0.37 (0.25)
Minimum Bending Radius, Single Bend	mm (in)	125 (5)
Minimum Bending Radius, Repeated Bends	mm (in)	254 (10)
Bending Moment	Nm (lb/ft)	4.1
Tensile Strength	N (lb)	1112 (250)
Recommended / Maximum Clamp Spacing	m (ft)	0.5 / 0.9 (1.8 / 3)

ICA12-50JPL REV: I REV DATE: 3.Oct.2017 www.rfsworld.com

OUTSIDE CABLE

PRODUCT DATASHEET
LCF12-50J

RADIO FREQUENCY SYSTEMS
The Clear Choice®

1/2" CELLFLEX® Low-Loss Foam-Dielectric Coaxial Cable

CELLFLEX® 1/2" low loss flexible cable

FEATURES / BENEFITS

- **Low Attenuation**
  The low attenuation of CELLFLEX® coaxial cable results in highly efficient signal transferin your RF system.
- **Complete Shielding**
  The solid outer conductor of CELLFLEX® coaxial cable creates a continuous RFI/EMI shield that minimizes system interference.
- **Low VSWR**
  Special low VSWR versions of CELLFLEX® coaxial cables contribute to low system noise.
- **Outstanding Intermodulation Performance**
  CELLFLEX® coaxial cable□s solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory.
- **High Power Rating**
  Due to their low attenuation, outstanding heat transfer properties and temperature stabilized dielectric materials, CELLFLEX® cable provides safe long-term operating life at high transmit power levels.
- **Wide Range of Application**
  Typical areas of application are: feedlines for broadcast and terrestrial microwave antennas, wireless cellular, PCS and ESMR base stations, cabling of antenna arrays, and radio equipment interconnects.

1/2" CELLFLEX® Low-Loss Foam Dielectric Coaxial Cable

Technical Features

APPLICATIONS

Applications		OEM jumpers, Main feed transitions to equipment, GPS lines, intended for outdoor usage

STRUCTURE

Cable Type		Foam-Dielectric, Corrugated
Size		1/2"
Jacket Option		Black
Inner Conductor	mm (in)	4.8 (0.19) Copper-Clad Aluminum Wire
Dielectric	mm (in)	11.3 (0.44) Foam Polyethylene
Outer Conductor	mm (in)	13.8 (0.54) Corrugated Copper
Jacket	mm (in)	15.8 (0.62) Polyethylene, PE

ELECTRICAL SPECIFICATIONS

Impedance	Ω	50 +/- 1
Maximum Frequency	GHz	6.8
Velocity	%	88.0
Capacitance	pF/m (pF/ft)	76 (23.2)
Inductance	µH/m (µH/ft)	0.19 (0.058)
Peak Power Rating	kW	38.0
RF Peak Voltage	Volts	1950.0
Jacket Spark	Volt RMS	10000.0
Inner Conductor dc Resistance	Ω/1000 m (Ω/1000 ft)	1.61 (0.48)
Outer Conductor dc Resistance	Ω/1000 m (Ω/1000 ft)	3.1 (0.95)
Return Loss (VSWR) Performance		Optimized
Maximum Return Loss	dB (VSWR)	Contact RFS for your VSWR performance specification for your required frequency band.
Phase Stabilized		Phase stabilized and phase matched cables and assemblies are available upon request.
Temperature & Power		Standard

MECHANICAL SPECIFICATIONS

Cable Weight, Nominal	kg/m (lb/ft)	0.187 (0.13)
Minimum Bending Radius, Single Bend	mm (in)	76 (3)
Minimum Bending Radius, Repeated Bends	mm (in)	125 (5)
Bending Moment	Nm (lb ft)	6.5
Tensile Strength	N (lb)	1100 (247)
Recommended / Maximum Clamp Spacing	m (ft)	0.6 / 1 (2 / 3.25)

LCF12-50J REV: H REV DATE: 17. Jun 2019 www.rfsworld.com

NOTES:
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DRAFT EDITION
2019-07-20

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MANUFACTURER'S SUBMITTAL SHEET 2

SCALE: NTS

RC ENGINEERING INC
5532 NW 106th DRIVE
CORAL SPRINGS, FL 33076
(954)757-7900
CA4755

REVISIONS		BY	DESC
DATE			

Date: 2019-07-20
Drawn: MAR
Checked: DLR
Scale: NTS
JOB NO. XXXXX

PROJECT
TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
MANUFACTURER'S SUBMITTAL SHEET 2

SEAL

DATE
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
FC-5.3

of sheets

SPD POLYPHASER

PolyPhaser
an IMPULSE brand

Type N F/F Bulkhead Coaxial RF Surge Protector, 698MHz - 2.7GHz, DC Block, 500W, IP67, .005uJ, 40kA, Filter

TSX-NFF

Features

- Surge current of 40kA
- Max Power 500W
- Frequency range from 698 MHz to 2700 MHz
- Waterproof IP67 rated
- N-type Female connectors
- DC Block
- VSWR <1.1:1
- Low insertion loss
- CE & RoHS compliant
- Bidirectional

Applications

- Cellular communication systems
- Public safety systems
- Emergency response systems
- Industrial Communications

Description

RF surge protector (also known as lightning arrester) TSX-NFF from PolyPhaser utilizing a patented spiral inductor design enables an almost instantaneous response to a lightning surge to protect critical hardware while maintaining the RF performance. This RF surge protector component is manufactured in a coaxial in-line design with wide operating frequency range. All PolyPhaser RF surge protector products are available in stock with same day shipping.

Electrical Specifications

Surge Protector Type: Surge Filter
DC Handling: DC Block

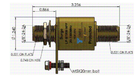
Description	Minimum	Typical	Maximum	Units
Frequency Range	0.698		2.7	GHz
Impedance		50		Ohms
VSWR			1.1:1	
Insertion Loss			0.1	dB
Input Power, CW 500W @ 920MHz 750W @ 50°C			500	Watts
Surge Current IEC 61000-4-5 8/20µs WAVEFORM			40	kA
Throughput Energy FOR 3kA @ 8/20µs WAVEFORM			5	nJ

Click the following link (or enter part number in "SEARCH" on website) to obtain additional part information including price, inventory and certifications:
Type N F/F Bulkhead Coaxial RF Surge Protector, 698MHz - 2.7GHz, DC Block, 500W, IP67, .005uJ, 40kA, Filter TSX-NFF

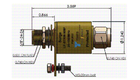
+1 800 882 9110 | PolyPhaser.com

SPD TIMES MICROWAVE

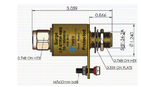
Times-Protect™



• LP-BTRW-NFF
20-1000MHz DC Blocked N Type F/F



• LP-BTRW-NMP
20-1000MHz DC Blocked N Type M on Protected

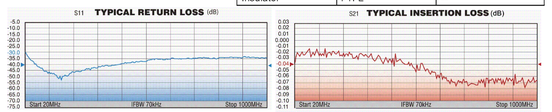


• LP-BTRW-NMS
20-1000MHz DC Blocked N Type M on Surge

*All dimensions shown in inches

Electrical Specifications	
Impedance	50 Ω
Frequency Range	20-1000 MHz
VSWR/Return Loss	<1.1:1 / <-26dB
Insertion Loss	< 0.1dB
Impulse Discharge Current	10KA multiple (8x20µs wave-form)
Turn-on Voltage	600V ± 20%
Turn-on Time	2.5ns for 2kV/ns
Energy Throughput Rating	<200µJ (6kV/3kA 1.2x50/8x20µs wave-form)
Power Handling at Frequency	375W (20-220MHz) 125W (220-700MHz) 50W (700-1000MHz)
Protection Circuit	DC Blocked
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C / -40ºC - +50ºC
Weatherization	IEC 60068 55/155/56 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	7 to 10 in-lb
Unit Weight	0.25kg/pc / 0.55lb

Material Specifications		
Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner ConductorFemale	Phosphor Bronze	Silver
Outer Conductor	Brass	White Bronze
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--



TIMES MICROWAVE SYSTEMS
An Amphenol Company

World Headquarters: 358 Hall Avenue, Wallingford, CT 06492 • Tel: 203 -949-8400, 1-800-867-2629 • Fax: 203 -949-8423
International Sales: 4 School Brae, Dysart, Kirkcaldy, Fife, Scotland KY1 2XB UK • Tel: +44(0)1592655428
China Sales: No. 318 Yuan Shan Road, Shanghai 201108 China • Tel: 86-21-51761234 • Fax: 86-21-64424098
www.timesmicrowave.com
LP-BTR-W 06/13

SPLITTERS

Microlab

Power Splitter, Dx-08 series

2, 3 & 4 way Tube Style, Reactive Power Dividers
Wideband, 380 - 2,700 MHz, N & 7-16
Rev. E

- Standard Frequency band
- Up to 500 W Average Power
- Minimal RF Insertion Loss
- High Reliability, IP67
- Guaranteed Low PIM
- RoHS Compliant
- Low Cost Design

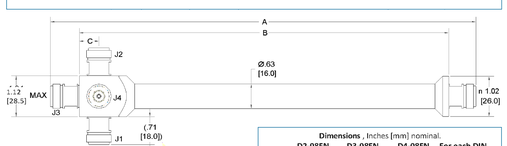
Microlab Model Dx-08 series of 2, 3 and 4 way Power Splitters has been designed to evenly split high power commercial cellular and tetra signals with minimal reflections or loss. All joints are moisture sealed with o-rings to meet IP67. The mechanical shape allows easy attachment to wall using the supplied clips.

The wide frequency range allows use with multiband antennas and leaky cable systems. With few solder joints and an air dielectric, the loss has been minimized and reliability enhanced. Units are available with either N or 7-16 mm connectors. See Dx-08FE for 4.3-10.

Frequency Range:	380 - 2700 MHz
Amplitude Balance:	± 0.3 dB
Impedance:	50Ω nominal
PIM, Passive IM:	<-155 dBc*(-112 dBm) (2 tones at +43 dBm)
Temperature:	-40°C to +85°C
Environment:	IP67, RoHS compliant
Finish:Connectors:	N or 7-16 (f), Triplate
Housing:	Passivated aluminum
Mounting:	2 Clips supplied

*higher PIM performance to order

Model No/Connectors N (f)	7-16 (f)	No. of Ways	Split Loss	Insertion Loss	Input VSWR	Power Rating, Avg. N	7-16	Weight, oz (g) nom. N	7-16
D2-08FN	D2-08FD	2	3 dB	<0.1 dB	<1.25:1	300W	500W	19 (330)	22 (410)
D3-08FN	D3-08FD	3	4.8 dB	<0.1 dB	<1.25:1	300W	500W	20 (370)	24 (480)
D4-08FN	D4-08FD	4	6 dB	<0.1 dB	<1.30:1	300W	500W	21 (400)	26 (540)



Note: 2 way Splitter delete J3 & J4
3 way Splitter delete J4
4 way Splitter as drawn.

This dimension with 7-16 mm connectors is 0.78 [19.7] nom.

Dimensions, Inches [mm] nominal.

	D2-08FN	D3-08FN	D4-08FN	For each DIN
A	11.2 [285]	10.7 [297]	10.7 [297]	+0.067 [1.7]
B	10.5 [267]	10.3 [262]	10.3 [262]	same as N
C	0.56 [14.2]	0.56 [14.2]	0.56 [14.2]	same as N

14627

Note: Specifications are subject to change without prior notice.

06FEB2019

Microlab, A Wireless Telecom Group Company, 25 Eastmans Road, Parsippany, NJ 07054
Tel: (973) 386-9696 • sales@microlabtech.com • www.microlabtech.com • Fax: (973) 386-9191

DONOR ANTENNA SINCLAIR

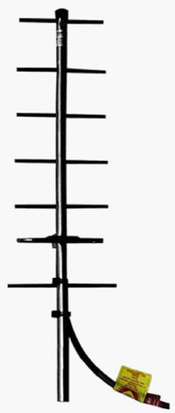
SINCLAIR
Superior then, Superior now.
A Norsat Company | Norsat International Inc.

Antennas
700-1000 MHz Antennas
SY407 Series

SY407-SF2SNM(ABK) Yagi directional antenna, 10 dBd gain, black anodized, 746-869

- Black anodized aluminum for long life
- 360 degree welded elements for durability and reliability
- 10 dBd gain with low VSWR

The SY407 yagi antenna has been developed to meet the need for a high gain, broadband, top quality directional antenna in the 746-869 MHz frequency range. The SY407 provides 10 dBd gain with a low VSWR. Designed for high performance, versatility and ease of installation, the SY407 will fill a wide variety of requirements. All elements are at DC ground potential for lightning protection.



www.sinctech.com

Region	United States	Europe, Middle East and Africa	Caribbean and Latin America	Canada and rest of the world
Telephone	USA: 1 800 263 3275	International: +44 (0) 1487 84 28 19	International: +1 905 726 7676	Canada: 1 800 263 3275 International: +1 905 727 0165
E-mail	salesusa@sinctech.com	salesuk@sinctech.com	salesla@sinctech.com	salescan@sinctech.com

Product Specification Sheet EPR 018191 — SY407-SF2SNM(ABK) — Issue: 3 — Dated: 14-12-16
Customer Tech Manual 005391 — Dated: 02-03-16

Sinclair's commitment to product leadership may result in improvement or change to this product

Page 1/2

DONOR ANTENNA SINCLAIR

SINCLAIR
Superior then, Superior now.
A Norsat Company | Norsat International Inc.

Antennas
700-1000 MHz Antennas
SY407 Series

Electrical Specifications		
Frequency Range	MHz	746 to 869
Bandwidth	MHz	123
Connector		N-Male
Gain (nominal)	dBd (dBi)	10 (12.1)
Input VSWR (max)		1.5:1
Polarization		vertical or horizontal
Pattern		Directional
Horizontal beamwidth (typ)	degrees	52
Vertical beamwidth (typ)	degrees	45
Average Power Input (max)	W	125
Lightning protection		DC ground
Front-to-back ratio (typ)	dB	15 *1

Notes
*1 : 12 dB min.

Mechanical Specifications		
Width	in (mm)	7.75 (197)
Depth	in (mm)	2.88 (73)
Length/ Height	in (mm)	24 (610)
Base pipe diameter	in (mm)	0.75 (19)
Base pipe mounting length	in (mm)	2 (51)
Finish		anodize (black)
Weight	lbs (kg)	2.1 (0.95)
Weight iced (1/2" ice)	lbs (kg)	6.2 (2.81)
Mounting Hardware (included)		Clamp115
Actual shipping weight	lbs (kg)	8.5 (3.86)

Environmental Specifications		
Temperature range	°F (°C)	-40 to +140 (-40 to +60)
Wind Loading Area (Flat Plate Equivalent)	ft² (m²)	0.16 (0.01)
Wind Loading Area (1/2" ice)	ft² (m²)	0.52 (0.05)
Rated wind velocity (no ice)	mph (km/h)	155 (250)
Rated wind velocity (1/2" radial ice)	mph (km/h)	95 (153)
Lateral thrust (100 mph No Ice)	lbs (N)	6.3 (28)
Bending moment (100 mph No Ice)	ft-lbs (Nm)	4.6 (6.2)

SINCLAIR TECHNOLOGIES
MEASURED RADIATION PATTERN
VERTICAL POLARIZATION
Azimuth

SINCLAIR TECHNOLOGIES
MEASURED RADIATION PATTERN
VERTICAL POLARIZATION
Elevation

www.sinctech.com

Region	United States	Europe, Middle East and Africa	Caribbean and Latin America	Canada and rest of the world
Telephone	USA: 1 800 263 3275	International: +44 (0) 1487 84 28 19	International: +1 905 726 7676	Canada: 1 800 263 3275 International: +1 905 727 0165
E-mail	salesusa@sinctech.com	salesuk@sinctech.com	salesla@sinctech.com	salescan@sinctech.com

Product Specification Sheet EPR 018191 — SY407-SF2SNM(ABK) — Issue: 3 — Dated: 14-12-16
Customer Tech Manual 005391 — Dated: 02-03-16

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Page 2/2

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DRAFT EDITION
2019-07-20

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MANUFACTURER'S SUBMITTAL SHEET 3

SCALE: NTS

RC ENGINEERING INC
5532 NW 106th DRIVE
CORAL SPRINGS, FL 33076
(954)757-7900
CA4755

REVISIONS
DATE | BY | DESC

Date: 2019-07-20
Drawn: MAR
Checked: DLR
Scale: NTS
JOB NO. XXXXX

PROJECT
TWO-WAY RADIO COMMUNICATIONS ENHANCEMENT SYSTEM
OFFICE BUILDING
BROWARD COUNTY, FLORIDA

TITLE
MANUFACTURER'S SUBMITTAL SHEET 1

SEAL

DATE
David L. Rice, P.E.
Electrical Engineer
State of Florida
PE 34343

SHEET
FC-5.4

of sheets

Item 6:
Discuss Re-inspections: Should the Engineer of Record be required to attend?

Item 7:
Discuss how many BDA systems have been installed in Broward County and how many will be installed next year?

Item 8:
Discuss the future of the BDA Committee

Item 9:
Discuss General Items