



INTRODUCTION TO EMERGENCY RESPONDER RADIO COMMUNICATION SYSTEMS (ERCES) FOR SCHOOL SAFETY PLANNING



An ERCES system receives outdoor public safety radio signals and retransmits those signals into to all areas of a school or building – especially in stairwells, fire control room, basements, and heavily shielded areas.

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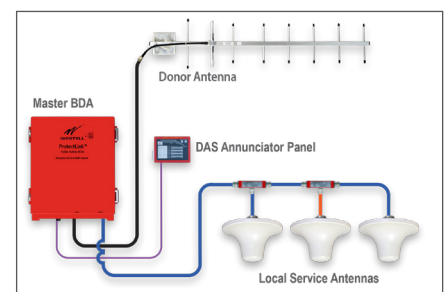
What is ERCES?

The ERCES solution consists of a BDA (bi-directional amplifier) connected to a DAS (distributed antenna system), a network of antennas **distributed throughout the building that receives outdoor public safety radio signals and retransmits those signals into to all areas of a building** – especially in stairwells, fire control room, basements, and heavily shielded areas.

The antennas are connected with splitters and couplers to adjust the power output at each antenna location, ensuring that the entire school maintains consistent radio coverage in case of an emergency.

ERCES is required when your local jurisdiction has adopted a fire code from 2010 or later.

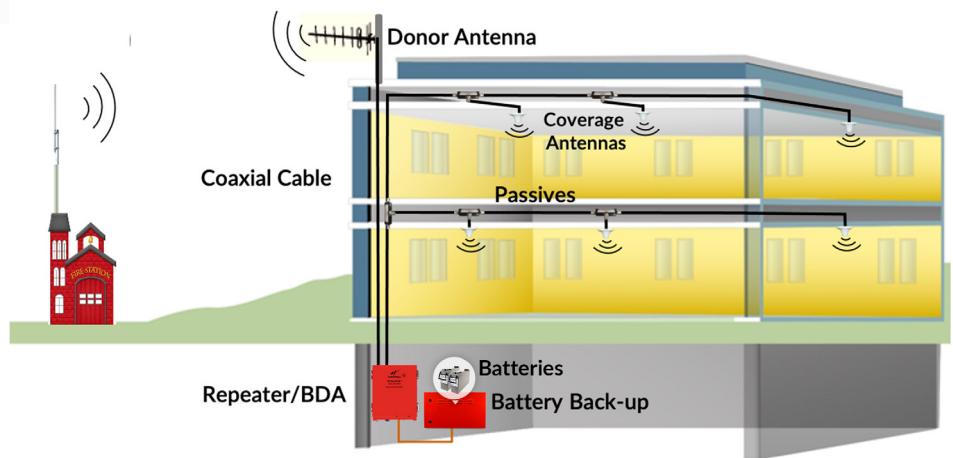
ERCES has proven to be a crucial part of safety plans that can greatly improve safety response success.



Indoor Wireless System Configurations

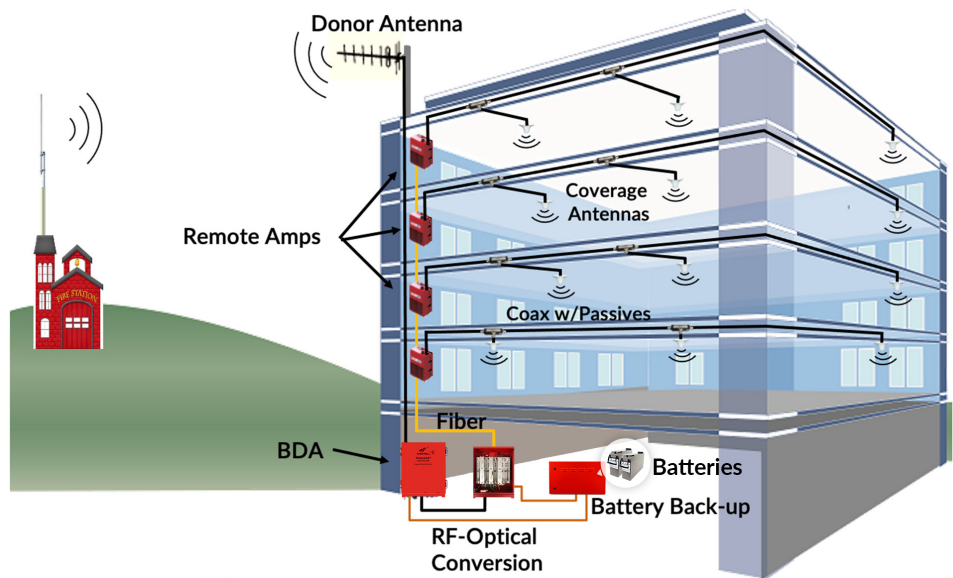
Passive DAS Configuration

- Repeater / BDA is the only active component.
- Ideal solution for smaller venues <500K sq. ft.
- Simplest to install



Active DAS Configuration

- Active Equipment: Repeater / BDA and back-up battery, and DAS
- Ideal solution for larger venues and campuses
- Capability for future growth or expansion



First Responder Frequencies

Frequency Bands Available for Use by Public Safety Agencies:

- **VHF High Band:** 150 MHz to 174 MHz, in use in rural areas and certain fire departments
- **UHF 450 MHz – 470MHz plus 470 – 512 MHz** in 11 major metro cities
- **700 MHz:** Public safety’s largest band with 24 MHz of dedicated spectrum
- **800 MHz:** Most common band used by Public Safety agencies in urban areas

FirstNet®:

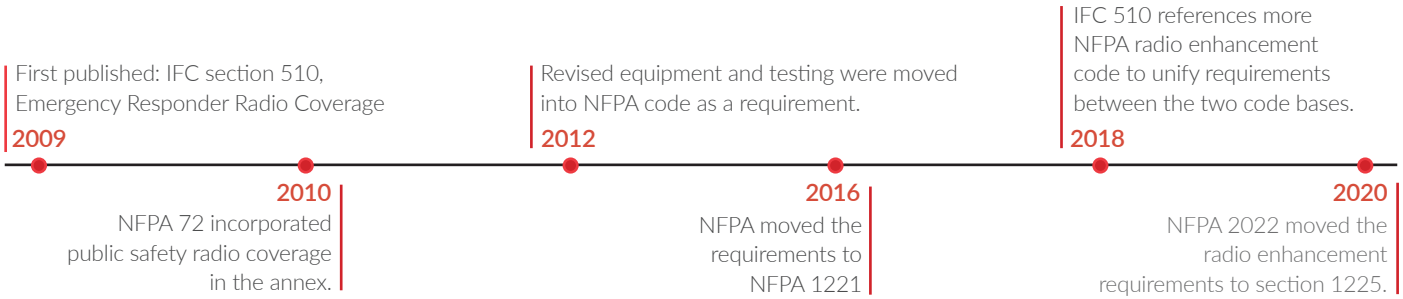
- New nationwide broadband service for first responders
- 20MHz in the 700MHz band
- AT&T operated priority network for first responders; consumers may use it as a secondary user
- So far no AHJ is mandating FirstNet coverage
- Many BDA manufacturers include FirstNet in 700 band BDAs



Fire Code

Fire Code Evolution

Both the National Fire Protection Association (NFPA) the Internal Building Code (IBC) include sections on radio enhancement:



Typical NFPA and IFC Code Requirements

- Either minimum radio signal level or a minimum voice quality included depending on version of the code base.
 - Typically newer code requires voice quality testing.
- 90% to 95% of general floor area must meet the minimum signal level or voice quality level required.
- 99% of critical areas must be covered such as stairwells, exit pathways, fire control room, standpipe locations and such.
- BDAs must have FCC type acceptance.
- BDA alarms are connected to fire alarm panel.
- Battery backup of 12 to 24 hours must be included.
- Coaxial cable pathways must meet certain survivability requirement.

UL 2524 – Standard for Safety, In-Building 2-Way ERCES

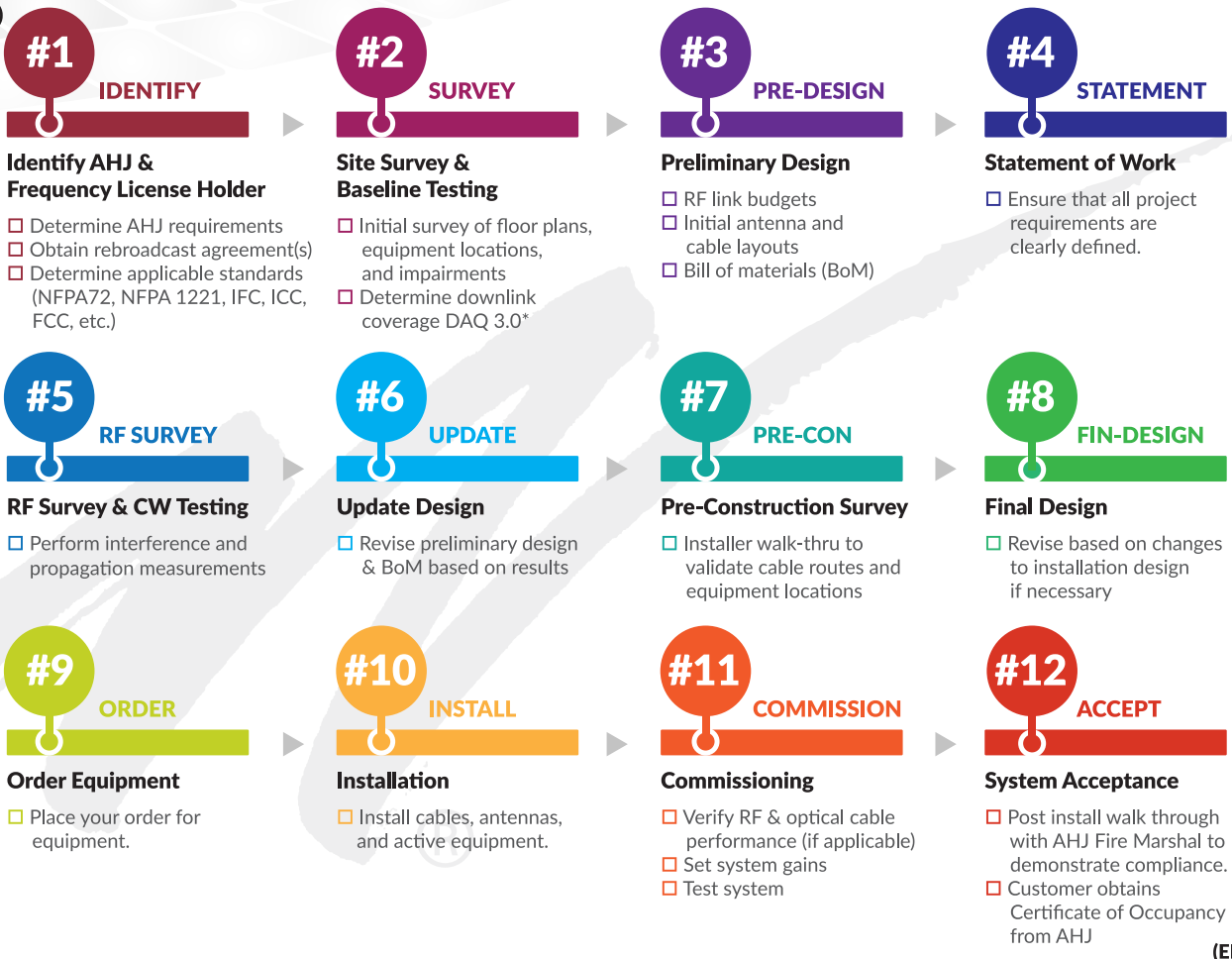
2524 is one of the newest UL Standards. It covers active equipment used in ERCES.

- The code revisions for both NFPA 2022 and IFC 2021 mandate that BDAs and DAS equipment be listed to UL 2524.
- The standard covers only the active products (e.g. repeater, transmitter, receiver, signal booster components, remote annunciators and operational consoles, power supply, and battery charging system components).
- First published in October 2018, 2nd revision January 2019.
- Westell ERCES, UL 2524 products began shipping in June 2020.



Public Safety ERCES: Design, Installation, and Acceptance Process

(START)



(END)

*Delivered Audio Quality (DAQ)

The DAQ scale includes a scale ranging from 1 to 5, with 1 being unusable audio output and 5 being perfect.

DAQ 1:	Unusable. Speech present, but not understandable.	DAQ 3.4:	Speech understandable without repetition. Some noise or distortion present.
DAQ 2:	Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion.	DAQ 4:	Speech easily understandable. Little noise or distortion.
DAQ 3:	Speech or understandable with slight effort. Requires occasional repetition due to noise or distortion.	DAQ 5:	Perfect. No distortion or noise discernible.

The Site Survey

Goals of a Site Survey:

1. Understand scope of building
2. Baseline RF measurements
3. Determine location of BDA and donor antenna

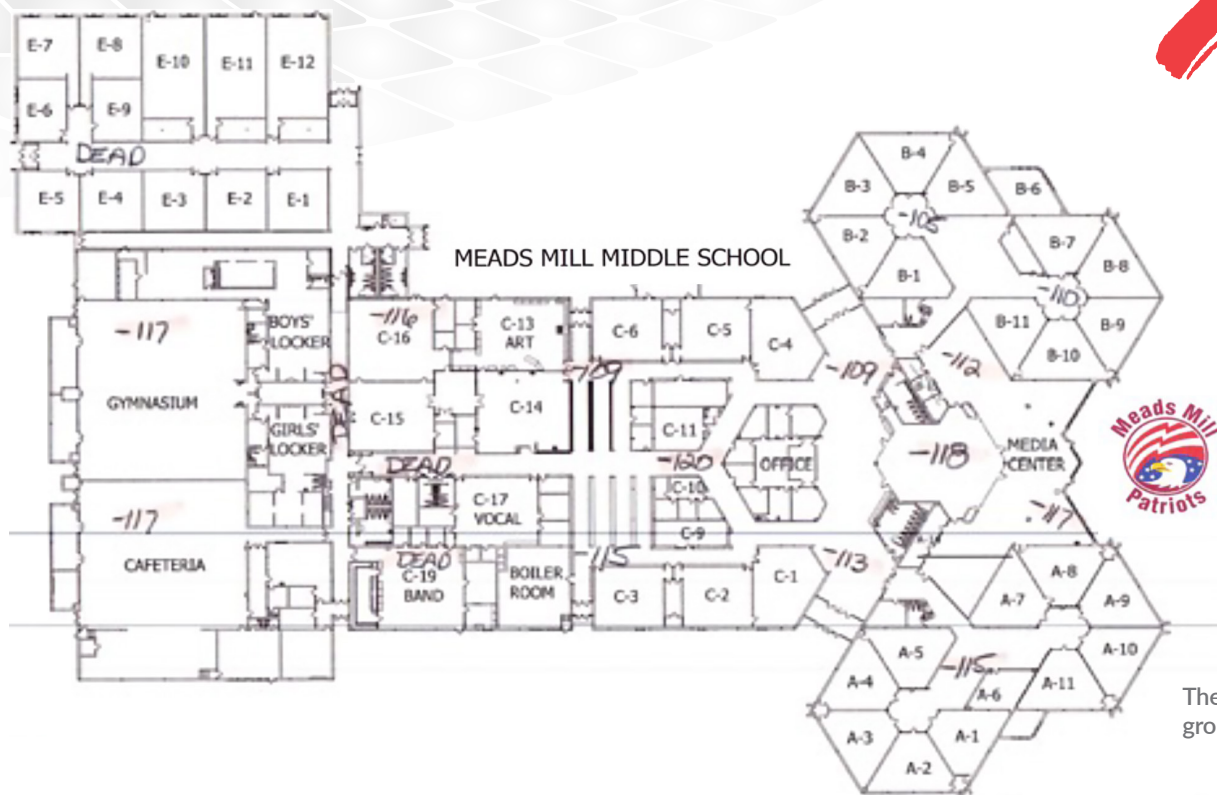
RF Measurement Equipment is Mandatory!

Types of RF survey equipment:

- Spectrum Analyser
- Two-Way radio with RSSI readout
- Specialized RF scanning tool



Example of a Pre-Install Signal Strength Testing



The outside reading ground level: -89 dBm

Designing In-Building Systems

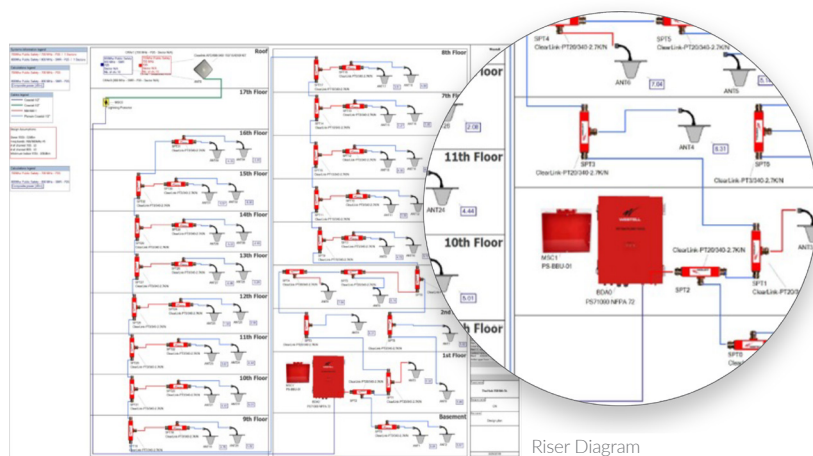
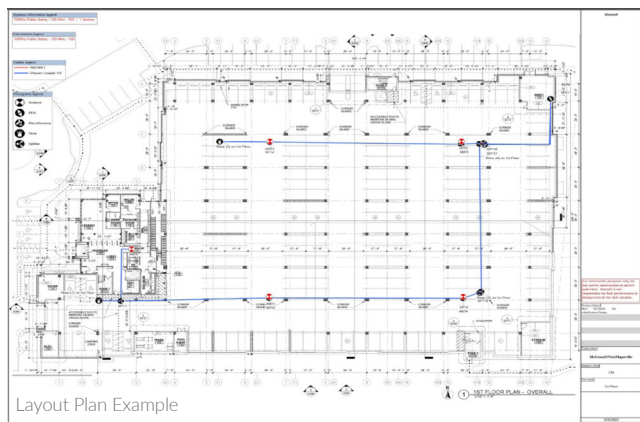
ERCES require a complete design prior to construction to assure proper distribution of radio signal and to manage potential interference or oscillation.

Design work is best done by someone skilled in radio frequency technology and with specialized software (CAD for indoor RF design).

- The designer must understand RF link budgets
- The most common design software is iBwave. This software includes all hardware components and will automatically calculate RF.

- The optional propagation module will calculate signal level throughout building to create a heat map.

Some AHJs also require CAD drawings with construction notes. A few AHJs even require PE stamped drawings.



Equipment List Example

A	B	C	D	E	F	G	H	I
6	Project name: Wilson Hall Exp.				Design company: Westell			
7	Project creation date: 10/14/2020				Designer: CN			
10	Type	Manufacturer	Model	Description	Inventory#	Qty		
11	Antenna	Westell	Ant-O\698-2700/N Econ	Economy Omni Antenna Quad-Band (698-960, 1710-2690MHz), 1/5dBi	CS03-019-429	8		
12	Antenna	Westell	CSI-AY/746-896/11 (11dBi Yagi 746-896MHz)	Yagi Antenna Public Safety 700/800 (746-896MHz) 11 dBi	CS03-003-430	1		
13	BDA	Westell	PS51080E NFPA 72	Enhanced Public Safety 700+FirstNet/800 MHz 1/2 Watt, 80dB gain Signal Booster with front panel annunciator, built-in battery charging and alarms and improved interface for power and alarm connections. Listed to	CS14-720-820	1		
14	Cable	Generic	NM-NM-1	Teflon Jumper Cable 1m RG142 N-Male / N-Male	N/A	6		
15	Cable	Generic	Plenum Coaxial-1/2"	50 ohms - 1/2" plenum rated coaxial cable - air dielectric	N/A	946.67 feet		
16	Cable	Generic	Coaxial-1/2"	50 ohms - 1/2" coaxial cable - foam dielectric	N/A	67.65 feet		
17	Connector	Generic	N-Male	Generic N-Male Coaxial Connector	N/A	22		
18	Miscellaneous	Generic	Lightning Protector	125-1000 MHz Lightning Protector with N femal connectors both ends	N/A	1		
19	Miscellaneous	Westell	CS19-BBC-003	NEMA3R battery cabinet designed to work with PS-Enhanced Series Class B BDA's. Can be combined with CS19-BAT-24-100AH Battery kit for 24 Hour backup OR with the	CS19-BBC-003	1		
20	Miscellaneous	Westell	CS19-BAT-24-45AH	24 VDC, 45AH Battery kit for 12 hour backup of NEW PS Enhanced Series BDA.	CS19-BAT-24-45AH	1		
21	Splitter	Westell	ClearLink-PT3/340-2.7K/N	ClearLink-PT3/340-2.7K/N, POWER TAPPER, 3dB, 500W (340-2700 MHz) N-Type	CS05-494-114	4		
22	Splitter	Westell	ClearLink-PT7/340-2.7K/N	ClearLink-PT7/340-2.7K/N, POWER TAPPER, 7dB, 500W (340-2700 MHz) N	CS05-480-114	2		
23	Splitter	Westell	ClearLink-PT6/340-2.7K/N	ClearLink-PT6/340-2.7K/N, POWER TAPPER, 6dB, 500W (340-2700 MHz) N-Type	CS05-479-114	1		

Installing Passives

Couplers, tappers and splitters are used in the coax lines to break out RF signal.

Splitters evenly split RF energy, typically 2-way, 3-way and 4-way.

Tappers and directional couplers are unequal splitters allowing the designer to balance the RF level at all antennas.



It's vital the installer follows the design exactly and place tappers/couplers in the correct order and direction.

Crossband couplers split or combine RF signals by frequency band.

Construction Considerations

System construction should be undertaken by skilled tradesmen.

Installation of ERCES requires professional installation with fines up to \$100,000 per day for improperly installed systems that cause interference.

Construction must follow NFPA/IFC rules to ensure pathway survivability, fire stopping, reliable power supply, monitoring by fire panel and much more.

Some AHJs require coax be installed in EMT conduit, be aware of AHJ requirements!

Installing Cables and Connectors

The most common cable is 1/2" plenum rated hard-line. Like BX armored cable only not.

Uses specialized tools to prepare for attaching connectors.

This cable can easily be damaged. The spacing between the center conductor and shield is critical.

Minimum bend radius typically 5 inches.

Typically also use flexible coax jumpers where needed.

Highly recommend cable analyser to sweep coax cables.



Commissioning the BDA System

You must have the proper equipment including spectrum analyser, signal generator and portable computer.

We recommend attending the manufacturer installation certification course. Westell offers these webinars at:

www.Westell.com/support/training.

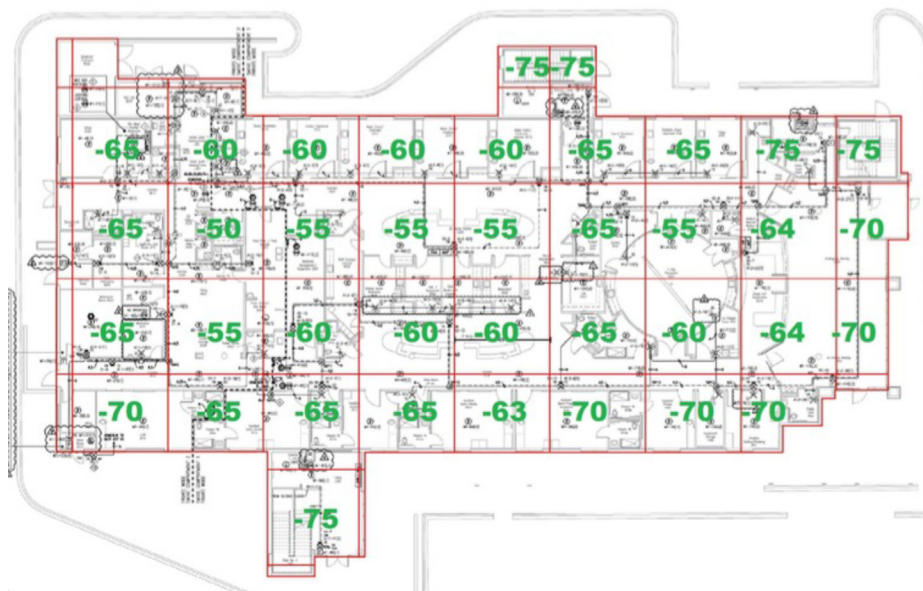
NFPA and IFC code require that installers are certified by the

manufacturer or hold nationally recognized DAS installer certification.

Commissioning is a very critical step. Incorrectly installed BDAs can cause serious interference to public safety tower sites resulting in hefty fines.

An understanding of RF and link budgets is important for the person doing the BDA commissioning.

Post Install Grid Testing Example



Radio Licenses

The installer MUST obtain written permission from the license holder of the radio network prior to turning on a signal booster system.

Often the license holder is not the fire department, but a regional radio authority that manages the radio

network for multiple governmental departments. The fire department should be able to direct you to the radio authority contact.

Some jurisdictions require installers to have a **General Radiotelephone Operators License (GROL)**.

Installation Examples



In-Building Wireless Public Safety / ERCES Products, Partial List

Class A/B and Class B BDAs & Accessories:

Class A/B Fiber DAS:

Donor and Coverage Antennas:



ProtectLink™
Class A/B and B BDAs

Ask About
Software
Upgrades



ProtectLink™
UHF/VHF BDAs



ProtectLink™
Master BDA



Yagi



Yagi



Yagi



ProtectLink™
BDA Kits
Master BDA, Backup Battery
Cabinet, & 2 Batteries



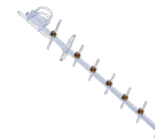
Westell®
Simplified BDA Kits
1 of 3 BDA Options, Backup
Battery Cabinet, & 2 Batteries



Master Chassis & Optical
Radio Module
Supports up to 8 Radio
Modules, RF to Fiber



Panel Donor



Yagi



Directional



Omni, Slim



Directional



Omni Econ



Westell®
Class B BDAs



ProtectLink™
Battery Back Up

NEMA3R Rated
NFPA 1221 Compliant



Single / Dual Band Remotes



Omni



UHF Omni

Public Safety Passives:



Directional
Couplers



Hybrid
Couplers



Power
Splitters



Power
Splitters



Power
Tappers



Universal Remote
Annunciator



BDA Remote
Annunciator
Single Device
Monitoring



DAS Remote
Annunciator
Multiple Device
Monitoring

Visit www.westell.com/solutions/public-safety for our complete public safety product line.

If you have any questions, contact us at: www.westell.com/contact/sales.

