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InLogis News

Whole House / Office Professional Cell Phone / Public Safety / DAS Signal Boosters April 2016

Public Safety Radio Boosters

Reliable cell phone coverage is important for employees and guests in your clients' buildings but it's critical during times of emergency for first responders. In order to ensure coverage for emergency personnel the National Fire Protection Association (NFPA) established codes and standards for Emergency Communications Systems. While adherence to specific NFPA requirements varies based on jurisdiction, we can design a system for you that meets those requirements for your specific location.

In designing a cell phone solution areas that are most frequently used are typically paid the most attention. During an emergency first responders often find themselves in need of communications in less-used areas such as stairwells or basements. The NFPA guidelines require 100% coverage in areas identified as critical by local fire departments and 90% coverage in general use areas. This means that while a design will obviously ensure coverage in the lobby or in offices it is equally important to identify areas in basements, elevators, stairwells and parking structures that are not as well served.

Completing a survey of the signal strengths in different areas of your building allows us to identify weak spots and implement enhancements. (*continued on page 2*)

5 Watt 95 dB gain 700 MHz Public Safety Bi-Directional Booster Amplifier in NEMA Enclosure

Cities Now Require Public Safety Radio Signal Enhancement for First Responders

In This Issue

Federal Communications Commission

FCC General Radio Operators License (GROL)

Our lead engineers involved in systems design are all FCC Licensed in compliance with the most recent edition of the International Fire Code.

Most cities, states and counties in the US have now adopted this fire code and it's a legal requirement. The GROL license certifies that our engineers have passed a very rigorous examination given by the FCC that covers a broad range of legal and highly technical radio and electrical engineering subjects. This ensures they have the required skills and knowledge to implement these systems in compliance with current FCC rules and regulations.

5 Watt 95 dB gain 700 / 800 MHz Public Saftey Bi-Directional Booster Amplifier

Public Safety Radio Boosters (*continued from page 1)*

Frequencies often used by emergency personnel (VHF, UHF, 700 MHz and 800 MHz) must be supported to meet the code in your city.

Determining the right equipment and designing for total coverage is only the beginning. In the event of a disaster the equipment must be capable of withstanding adverse conditions. This is especially important in the event of a fire when equipment may be inundated with water.

The NFPA requires all equipment serving a network be housed in a NEMA-4 compliant water-proof enclosure.

Testing of these enclosures is rigorous and will ensure the equipment is protected from water pressure of at least 65 gallons per minute from a distance of less than 10 feet. Implementing these safeguards not only keeps the network in line with the best safety practices but will also prevent costly damage to your equipment.

Seamless coverage is important for your public safety network and the NFPA specifies minimum signal strengths that must be maintained within your coverage area. The minimum signal strength should be -95 dBm regardless of frequency. Your network may require multiple antennas to meet coverage requirements so we pay close attention to isolation between the indoor and outdoor antennas. A directional antenna may be the optimal solution in some locations to meet requirements for coverage, signal strength and isolation.

A comprehensive network with water-proofed equipment is only useful when it has power. This is why NFPA regulations also require systems to include battery backups and real-time monitoring alarms that alert to any failures and malfunctions. All systems must include alarms that monitor and notify of power or battery failures, antenna malfunctions and low battery capacity. All equipment must be supported by a battery backup that will keep the system running for 8 to 24 hours depending on local regulations.

A reliable DAS network can do more than provide connectivity in public spaces for employees and guests. A well designed Public Safety / DAS network can protect your client's building and provide the peace of mind that comes with preparation.

This low cost meter can detect most cable and connector problems

RigExpert Model IT-24 — Tests VSWR in the 2.3 – 2.6 GHz Band — Price : $260

Cable Testing at High Frequencies Can Save You Time, Trouble and $.......

Most of the problems and troubleshooting issues we run into usually involve cable and connector installation problems which can be easily detected with the proper test equipment. One of the gems we have come across is the RigExpert IT-24 available from several sources for about $260. It measures cable and antenna performance in the 2.3 to 2.6 GHz region. While this is somewhat higher in frequency than most cellular bands, it can provide an excellent way to detect major faults such as a poorly installed connector or a kinked cable. It performs this test by measuring Voltage Standing Wave Ratio (VSWR) which is related to how well the transmission line is matched to its load and how much power is reflected from the load. Wide band VSWR meters covering all of the cellular frequency bands can cost well over $1,000. Since major cable or connector faults will affect virtually all frequencies, it is usually sufficient to test one high frequency band to get an adequate indication if the cable is good or bad. All you need is a dummy load (either 50 or 75 ohms depending on the cable type) to put at the end of the cable. For good cables the VSWR should measure between 1.1 to 1.2. If there is a fault, the VSWR will be orders of magnitude higher and you will know there's a problem (usually a poorly installed connector or a major kink or short in the cable).

Not all Coax Cable is Equal (Typical LMR cable types shown below)

100 Series — Ø.105 in. (2.7mm) Nominal — 50 Ohm Impedance

NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	22.8	74.8
1800	33.2	108.8
2500	39.8	130.6

195 Series — Ø.195 in. (5.0mm) Nominal — 50 Ohm Impedance

NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	11.1	36.5
1800	16.0	52.5
2500	19.0	62.4
5800	29.9	98.1

200 Series — Ø.195 in. (5.0mm) Nominal — 50 Ohm Impedance

NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	9.9	32.6
1800	14.2	46.6
2500	16.9	55.4
5800	26.4	86.5

240 Series — Ø.240 in. (6.1mm) Nominal — 50 Ohm Impedance

NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	7.6	24.8
1800	10.9	35.6
2500	12.9	45.4
5800	20.4	66.8

400 Series — Ø.405 in. (10.3mm) Nominal — 50 Ohm Impedance

NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	3.9	12.8
1800	5.7	18.6
2500	6.8	22.2
5800	10.8	35.5

600 Series — Ø.590 in. (15.0mm) Nominal — 50 Ohm Impedance

NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	2.5	8.2
1800	3.7	12.1
2500	4.4	14.5
5800	7.3	23.8

900 Series — Ø.900 in. (22.9mm) Nominal — 50 Ohm Impedance

NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	1.7	5.6
1800	2.5	8.2
2500	2.9	9.8
5800	4.9	16.0

Loss Characteristics of Typical Materials

Structure / Material	850 MHz	1800 MHz	2.3 GHz
Drywall	2	2.5	3
Plywood	1	2.5	4
Office Cubicals	1	1.5	2
Normal glass Windows	2	2.5	3
Low E Glass Windows	25	30	35
Concrete	18	20	30
Lead	45	50	60

Signal Level Meter

Site Survey Tips:

One of the most important considerations in designing a booster system is understanding the RF environment at the job site. It is critically important to measure the signal levels at the location where the outdoor antenna will be located. You should use a signal level meter like the one we sell that provides measurements in each of the frequency blocks used by the cell phone carriers. We can supply a table based on zip code that specifies which blocks are in use by the carriers in that neighborhood. It is important to know what the outdoor signal strength is for the carrier that supplies service for your client (ATT, Verizon, T-Mobile, Sprint, etc). It is also important to know the signal strength for all of the other carriers. For example your customer may have very weak service on his AT&T phone in his home from a tower that is 7 miles away, but there may be a Verizon tower just a block away that is delivering a signal 1000 times stronger. We need to know all these levels to design a system with the appropriate dynamic range that is not overloaded by strong local signals.

Another factor we take into account is the building materials used in the structure and the layout of each floor. The table above shows typical Radio Frequency signal loss characteristics of various materials usually found in a home, office or commercial/medical building. For example, if there is an indoor antenna located in a central location and the indoor walls are standard drywall construction, we take into account how many walls there are between the indoor booster antenna and where the receiving phone could be located. This helps us to design the optimum plan for recommending where the antennas should be mounted.

Coax Cable Selection.

Not all coax cables are made equal so we consider this carefully when designing your system. We must consider the following:

- Cable length, type, impedance and cost.
- Is this a retro-fit or new construction?
- What is the loss introduced by the cable between the amplifier and its antenna?
- What is the cable distribution strategy for minimum installation labor and materials cost? Should we use a home run design or a trunked system with taps located along the main trunk?
- Where is the best place to locate passive splitters to minimize installation cost?
- Is there existing cable installed and what type of cable is it?
- Should we use fiber optic cable for very long runs to minimize loss and installation costs?
- What are the appropriate connectors to use for the cable type selected?
- Is plenum rated insulation required?
- Is conduit required to meet fire code?
- Where can the amplifiers be located?

Indoor and Outdoor Antenna Selection

We have wide variety of indoor and outdoor antennas available to solve almost any installation problem. Factors that must be considered include required antenna gain, installation easy, cost and the esthetic requirements imposed by the building owner.