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Surge Protection Considerations and Solutions for Citizens Band Radio Service Networks

White Paper

Wireless communication is booming and many users are finding that some types of wireless networks are more effective than others.

For example, many Wi-Fi networks do not offer a coverage area that is large enough for an organization's needs, or the ability to connect a sufficient number of devices, or enough dependability for critical communications. Another option, public cellular networks, might not have the reach your organization needs or offer the local flexibility and control that Wi-Fi can.

In this climate, Citizens Broadband Radio Service (CBRS) networks have emerged with a single platform that meets the diverse needs of countless organizations. It offers a spectrum that can be used exclusively by an organization as well as more coverage, capacity, security, and control.

The first part of this white paper details the traits and main benefits of a CBRS network. The second part explains the importance of protecting a CBRS network from destructive power transients caused by lightning strikes and other sources.

CBRS: Wireless Broadband on Your Own Frequency

The Citizens Broadband Radio Service is a wireless communication spectrum in the United States that allows for shared access between multiple users in the 3.5 GHz frequency band. The Federal Communications Commission (FCC) created the CBRS to increase access to wireless broadband services while also providing opportunities for innovation and growth in wireless technologies.

The CBRS is unique in that it allows for a three-tiered sharing system where incumbent users, such as government agencies and satellite providers, have priority access to the spectrum. However, once these incumbent users have been allocated their required spectrum, the remaining spectrum can be shared among priority access licensees (PALs) and general authorized access (GAA) users.

PALs are licenses that provide exclusive access to a specific frequency band for a set period of time, while GAA users have access to the remaining spectrum on an unlicensed basis. This sharing system allows for multiple users to access the spectrum while also protecting the needs of incumbent users.

The CBRS is expected to lead to increased access to high-speed wireless broadband services, especially in rural and underserved areas, and to enable the development of new and innovative wireless technologies.

Benefits of Using a CBRS Network

A CBRS network offers several solid benefits over other types of wireless connectivity, including:

- **Dedicated spectrum:** Unlike Wi-Fi and public cellular networks, which operate on unlicensed or shared spectrum, the CBRS provides a dedicated spectrum that can be used exclusively by an organization or group of organizations. This dedicated spectrum can provide more reliable and consistent performance than shared spectrum.
- **Better coverage:** The CBRS spectrum operates in the 3.5 GHz band, which provides better propagation characteristics than the higher frequency bands used by many Wi-Fi and cellular networks. This can allow for better coverage, especially indoors and in rural areas.

- **More capacity:** The CBRS provides access to up to 150 MHz of spectrum, which can provide significantly more capacity than Wi-Fi or public cellular networks. This can be especially useful in high-traffic areas or for applications that require high-bandwidth data transfer.
- **Improved security:** The CBRS includes security measures to prevent interference and unauthorized access, which can provide a more secure communication environment than public Wi-Fi or cellular networks.
- **Greater control:** The CBRS provides organizations with greater control over their wireless network, including the ability to allocate spectrum and manage interference. This can mean more flexibility and customization for organizations with specific requirements.

Disruptions from Power Surge

Lightning strikes in the United States about 20 million times a year. CBRS networks, like all systems of electronic connectivity, are vulnerable to being damaged by lightning and other causes of power surges and transients. The disruption, which can be extremely costly, can come in three forms:

- **Physical damage:** Lightning can directly strike a CBRS antenna, damaging the equipment and rendering it useless. Lightning can also generate high-voltage surges on the power and data lines, which can damage a network's electronic components.
- **Induced voltage:** Lightning-induced voltage surges can enter the CBRS through the antenna or data cables, leading to damage to the radio equipment. These voltage surges can generate a significant amount of heat, leading to a short-circuit in the CBRS equipment.
- **EMI/RFI Interference:** Lightning strikes can generate electromagnetic interference (EMI) and radio frequency interference (RFI), causing communication problems in the CBRS. The interference can lead to poor signal quality and reduced transmission range and can also cause errors in data transmission.

SPDs to the Rescue

To prevent lightning strikes and power surges from damaging CBRS equipment, it is important to install surge protection devices (SPDs) such as lightning arrestors and surge protectors at the antenna and power/data connection points. SPDs typically work by providing a low-impedance path to ground for the surge current, effectively shunting the excess energy away from the equipment.

Quarter-Wave Stubs: Faster, Tougher

One type of SPD that is particularly effective for use with CBRS networks is the quarter-wave stub RF surge protector. They stop surges faster than other types of protectors, require no maintenance and can withstand repeated surges without being damaged.

A quarter-wave stub SPD is a type of coaxial cable that is cut to a specific length, typically one-quarter of the wavelength of the frequency being used. The quarter-wave stub works by reflecting any surge voltage that is present back towards the source, preventing it from reaching the equipment. When the surge voltage reaches the quarter-wave stub, it encounters an impedance mismatch that causes the voltage to reflect back down the cable towards the source.

This reflected voltage combines with the original surge voltage, canceling it out and preventing it from reaching the equipment. The quarter-wave stub RF surge protector is sometimes used in conjunction with other surge protection devices such as gas discharge tubes, to provide additional protection against voltage surges.

Quarter-wave stubs offer three advantages over other types of SPDs:

- **Quick response:** A gas discharge tube takes about 100 nanoseconds to become conductive when a surge hits, while a quarter-wave coaxial protector responds instantly. It's all in the design. The stub that shorts the surge is one-fourth the length of the working frequency of the signal in the cable. Also, the quarter-wave stub protector is made of instantly conductive metal.
- **No maintenance:** A gas discharge tube surge protector occasionally needs a tube replacement, requiring money and time to install. A quarter-wave stub surge protector needs no maintenance after it is installed.
- **Longer product life:** While a single surge from a cell tower might destroy a gas discharge tube, a quarter-wave stub surge protector can withstand many surges with no damage.

Extended-Range SPDs for CBRS

PolyPhaser offers a line of quarter-wave stub RF surge protectors with frequency ranges that are well suited for use with CBRS networks. Our QWP series of extended-range SPDs are loaded with useful features for all major cellular bands up to CBRS. They deliver low-PIM performance, an extended-range passband of 555 MHz to 4.5 GHz and quarter-wave stub protection. As the table below shows, one model has 7/16 DIN connectors, one has 2.2-5 connectors, and two models have 4.3-10 connectors.

Following are the common features and applications of Transtector's extended-range quarter-wave stub protectors:

Features:

- Extended-range broadband from 555 MHz to 4.5 GHz
- DC block topology
- Repetitive strike protection
- Low PIM

Applications

- CBRS networks
- Cellular
- Distributed antenna systems (DAS)
- Emergency response systems
- Public safety systems

Transtector Extended-Range Quarter-Wave Stub SPDs

Product No.	Connectors	Max. Power Handling	Pass Band
QWP-22M22F-ER	2.2-5 male to 2.2-5 female	300W	555MHz–4.5GHz
QWP-43F43F-ER	4.3-10 female to 4.3-10 female	500W	555MHz–4.5GHz
QWP-43M43F-ER	4.3-10 male to 4.3-10 female	500W	555MHz–4GHz
QWP-DMDF-ER	7/16 male to 7/16 female	500W	555MHz–4.5GHz

Summary

CBRS networks are a useful wireless alternative, offering a spectrum that can be used exclusively by an organization as well as more coverage, capacity, security, and control. However, like all other modes of electronic connectivity, CBRS can be disrupted by power surges. An excellent solution can be found in quarter-wave stub RF surge protectors with an extended-range pass band. They cover the frequencies used by CBRS and their unique design makes them respond faster and last longer than other types of protectors.

PolyPhaser's line of quarter-wave stub RF surge protectors with extended-range passband are in-stock and available for **same-day** shipping. For more information, contact us at +1 208 635 6400.