

APPLICATION NOTE

Surge Protection for AC Power in Baseband Units



IsoMOV™ / GMOV™
Hybrid Protection Components



Power TVS Products



SinglFuse™ SMD Fuses

BACKGROUND

A Baseband Unit (BBU) processes baseband in a telecom system and transmits it to the remote radio unit in a tower via optical fiber. Since a BBU must be in close proximity to the radio tower, it is usually located in an exposed area such as an outdoor cabinet versus a secure building. Typically, the BBU is AC powered but it can also be DC powered.

Given its outdoor location, the BBU power cables are more exposed to lightning and power induced surges. A direct or induced surge caused by lightning will couple high energy transient voltage and hence, send high current to the power line of a wireless base station. Base stations are designed and expected to run 24/7, having their own reserve backup power sources.

Any lightning or severe power induced surge to the base station power lines can lead to an extended shutdown and even permanent damage. Therefore, it is paramount that any power lines entering or leaving the BBU cabinet are protected from lightning surges.



Figure 1: Typical Wireless Base Station with BBU



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CHALLENGE

BBUs are predominantly powered by AC power versus DC power. Aside from lightning strikes, AC power lines can experience large voltage swells from power stations, which can expose the BBU power system to potentially damaging voltage levels. Thus, protection against harmful voltage swells along with lightning surges should be in considered for the entire application design.

For overvoltage protection (OVP), **Metal Oxide Varistors (MOVs)** are the most common component employed in the primary side of an AC supply.

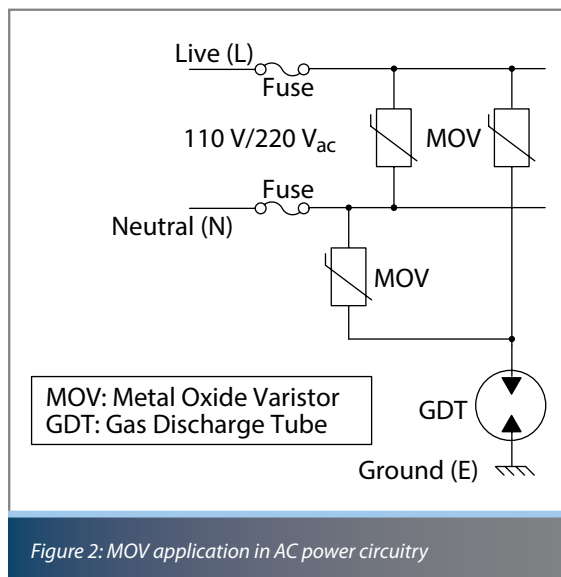


Figure 2: MOV application in AC power circuitry

MOVs are cost-effective but typically do not provide long-term, robust protection against surges. Two factors can make them suboptimal protectors in applications like BBU, where high reliability is a must:

1. Leakage current increases after aging—causing the MOV to heat up (I^2R loss) over time and allow voltage to flow like in Figure 2.
2. Rapid degradation after a few heavy-duty surges—“Dead Man Walking” phenomena, commonly making MOVs the weakest component in the surge protection paths.

The challenge is how to overcome the two key disadvantages of an MOV without making the protection component bulky and costly.

Bourns has developed two hybrid solutions known as **GMOV™** and **IsoMOV™** devices. These components do not suffer the two stated disadvantages of an MOV, while still being cost-effective and retaining the same package size as that of an equivalent rated MOV.



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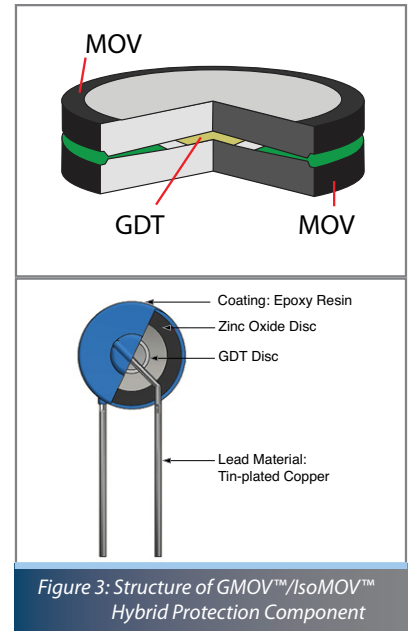


SOLUTION

Bourns® GMOV™ hybrid overvoltage surge protection components deliver enhanced performance and reliability compared to an MOV. The breakthrough GMOV™ component physically joins together a Metal Oxide Varistor (MOV) and a Gas Discharge Tube (GDT) with patented space-saving FLAT® technology. This hybrid design makes GMOV™ products suitable for use in the primary or secondary side of an AC power line.

Benefits

- Low leakage over life (<0.1 μ A), longer MTBF (Mean Time Between Failure).
- Improved survivability after multiple surges.
- Predictable EOL mode when used together with a single blow fuse.



Bourns® IsoMOV™ protectors provide an even more advanced solution than GMOV™ protectors by fully-integrating the GDT isolation structure between two industry-leading EdgMOV™ MOV discs - providing breakthrough surge performance in an even smaller package size than GMOV™ protectors.

By combining MOV and EdgMOV™ technologies with GDTs in a single, space-saving package, GMOV™ and IsoMOV™ hybrid protectors offer best-in-class surge performance, enhanced reliability, and longer life in certain harsh environments.

The circuit shown below is an optimized solution for AC power protection, suitable for small cell or Base Band Unit applications. The schematic illustrates the application protection and does not constitute the complete circuit design. Customers should verify actual device performance in their specific applications.

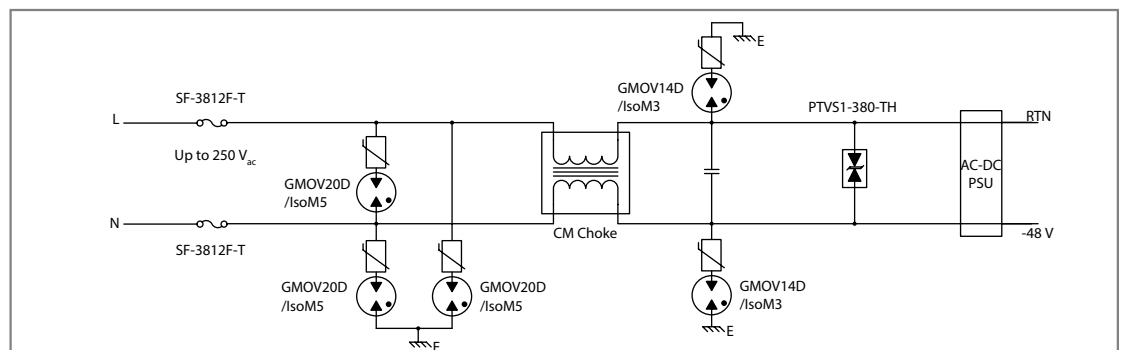


Figure 4: AC protection circuitry for Baseband Unit (BBU)



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Solution (Continued)

The protection circuitry shown in figure 4 can help a protected device to withstand the surge level of 8/20 μ s 5 kA in both the metallic and the longitudinal modes of the surge, which is a common surge level in small cell or BBU designs. These designs can be powered by the AC input voltage of 220 V_{ac} which may increase up to 280 V_{rms} due to the AC swell from the power station. The AC-DC PSU represents an AC-DC conversion circuitry or a module typically adopted in a design. AC-DC PSU is responsible for converting the 220 V_{ac} to conventional 48 V telecom DC power. Because the AC-DC PSU is not ordinarily robust against a high energy surge (the PSU input typically can only withstand an input voltage limit of approximately 800 V), differential surge levels higher than this level may damage the module.

Overvoltage Protection (OVP)

For overvoltage protection, the primary side protector, Model GMOV20/IsoM5, is installed across the L-N, L-E and N-E for both common and differential modes of protection. The GMOV™ /IsoMOV™ component's low leakage characteristic can be utilized to minimize wattage loss. The secondary side of the Model GMOV14/IsoM3 further suppresses the incoming residual surge to a lower clamping voltage.

GMOV Product Family

Product Size	MCOV Ratings	Leakage at MCOV	Max. Capacitance	I _{max} 8/20 μ s	Ring Wave 200 A
14 mm version	45 - 320 V _{rms}	<0.1 μ A	4 pF	6 kA	\pm 250 operations
20 mm version	45 - 320 V _{rms}	<0.1 μ A	4 pF	10 kA	\pm 250 operations

IsoMov Product Family

Product Size	MCOV Ratings	Leakage at MCOV	Max. Capacitance	I _{max} 8/20 μ s	Ring Wave 200 A
10 mm version	175-320 V _{rms}	<10 μ A	30 pF	6 kA	\pm 250 operations
14 mm version	175-555 V _{rms}	<10 μ A	40 pF	10 kA	\pm 250 operations



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Overcurrent Protection (OCP)

In secondary side protection, a precise and low let-through overvoltage protection device is required across the sensitive input port of the AC-DC PSU. Bourns® PTVS1-380C-TH high voltage Power TVS Diode can be utilized to avoid turn on at abnormal fluctuating high AC voltages of 80 VAC, while at the same time clamping the voltage below 520 V when the 1 kA peak surge current is achieved. The PTVS diode exhibits a much lower clamping voltage when compared to conventional varistor protection in this situation. With conventional varistor protection in this special situation, the clamping voltage can be much lower.



Bourns offers a wide assortment of Power TVS Diodes from 1 kA to 15 kA with a variety of package choices for AC and DC protection of small cell, BBU and RRU (remote radio units).

PTVS Diodes Product family

	PTVS1	PTVS3	PTVS6	PTVS10	PTVS15
Product	PTVS1-xxxC-TH	PTVS3-xxxC-TH	PTVS6-xxxC-TH	PTVS10-xxxC-TH	PTVS15-xxxC-TH
Series	TH Series	TH Series SH Series M Series	TH Series SH Series M Series	TH Series SH Series M Series	TH Series SH Series
Peak Pulse Current (8/20 μs) (kA)	1	3	6	10	15
Working Peak Reverse Voltage (V)	380	15/58/76 380/430 66/76	58/76 380/430 58/76	58/76 170/320/430/470 66/76/86	58/76 58/76



The Bourns® SinglFuse™ Model SF-3812F-T SMD Fuse series primary side acts as a failsafe overcurrent protection which will melt and open in case of any abnormal short in any part of the circuitry. These fuses are one-time blow fuses, designed to handle up to a certain level of surge without blowing the fuse. Bourns offers the ceramic SF-3812F-T series with an appropriate I²t range to handle surges without damage to the circuitry.

SinglFuse™ SMD Fuse Ceramic Tube / Ceramic Cube Product Family

Product	Fuse Type	Rated Current	Rated Voltage	Operating Temp. (°C)
SF-2410FP-T	Fast Acting Precision	62 mA - 10 A	125 VAC	-55 – +125
SF-3812F-T	Fast Acting	10 A - 60 A	250 VAC	-55 – +125
SF-2923HC-C	High Current	20 A - 50 A	60 VDC	-55 – +125



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Recommended Products used in AC Power Protection Solution

- GMOV™ Hybrid Protection Components: GMOV14D-321K, GMOV20D-321K
- IsoMOV Hybrid Protection Components: IsoM3-320-R-L2, IsoM5-320-R-L2
- Power TVS Diode for AC: PTVS1-380C-TH
- SinglFuse™ SMD Fuse: SF-3812F-T series

Related Literature

- Bourns® GMOV™ Components Product Brief
- Bourns® GMOV™ Components White Paper
- Surface Mount Power TVS Diodes Deliver Optimal Protection for Power Supplies Application Note
- Bourns® SinglFuse™ Products Technical Library
- Bourns IsoMOV Hybrid Protector Product Brief
- New Surge Protective Device Solves Circuit Protection Design Issues White Paper
- Bourns Surge Protection for DC and AC powered systems Application Note

Additional PortNote Solutions

- Mobile Broadband AC Power Supply Protection
- Mobile Broadband DC Power Supply Protection



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