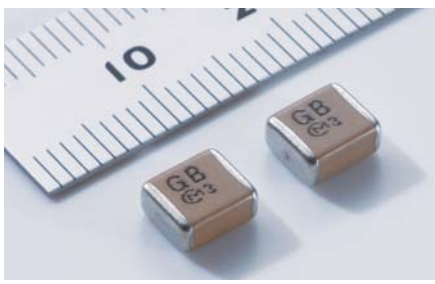
Technology Focus

Wielding Base Metal Yields Cheaper, Stable Class X2 Capacitors

Capacitors directly connected to power supply primary circuits of electronic equipment are at high risk of being exposed to high-voltage surges. Therefore, capacitors are required to obtain safety standards certification. Film capacitors and disc ceramic capacitors are typical products that are awarded with safety standards. The capacitors used in power supply and communication circuits that passed these safety standards are sought to be small in size, low in profile, can be installed using surface-mount method, and can be operated in high temperatures. Such features are demanded in order to meet the requirements of weight, thickness, length, and size reduction of electronic equipment, such as personal computers and information equipment.

In response to these trends, Murata Manufacturing Co., Ltd. has been designing high withstand voltage monolithic ceramic chip capacitors and obtaining safety standards certification for these products. In 1997, Murata introduced safety standards-certified GB Series monolithic ceramic chip capacitor as a Class X2 capacitor for commercial power supply ahead of other manufacturers in the market. The GB Series is being mass produced at present (Photo).



Product outline of the GB Series capacitor

Recently, Murata has developed a new GB Series at relatively lower cost through the use of base metal. It achieves an increased capacitance by means of a new inner electrode design. The features of this new product are introduced below together with the safety standards applied to the GB Series.

Obtaining Safety Standards Certification

Safety standards define the safety criteria of electronic equipment and components. Basically, products are mandated to comply with safety standards in order to protect human life and property from hazards, such as electric shock and fire, when the equipment is being used. To improve the safety of electronic equipment, a capacitor connected to a specific location of the device, for example, between the opposite poles of a power supply primary circuit or between the power lines of a power supply primary circuit and chassis ground, must be certified by safety standards.

To obtain safety standards certification, the product must undergo specific tests and must comply with the required criteria to receive a conformity result. In other words, the process enables a capacitor to obtain a certificate indicating conformance to the necessary standards.

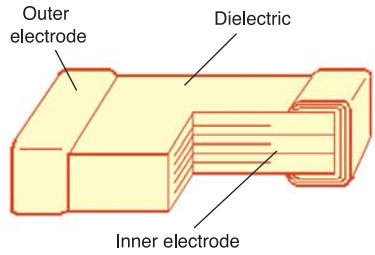
The GB Series is an IEC60834-14 subclass X2 capacitor certified product. It is a monolithic ceramic chip capacitor that can be used for commercial power supply equipment, such as AC adaptors and battery chargers.

Table 1 presents the GB Series product lineup certified by safety standards. As the GB Series capacitors have been awarded with safety standard certificates, they can be used for audio-video equipment, information equipment, and home electronic appliances in major European countries.

Table 1: Safety standard certified products lineup

	Certified standard	Approved for certification	Rated voltage
UL	UL1414	—	AC 250V (r.m.s)
BSI	EN132400	—	
VDE		◎	
ESTI		◎	
SEMKO		◎	
EN132400 class		X2	

— : Not Approved
◎ : Approved



Item		New product material	Existing product material
Dielectric		Ceramic	Ceramic
Inner electrode		Ni	Ag/Pd
Outer electrode	Base layer	Cu	Ag
	2nd layer	Ni	Ni
	Outer layer	Sn	Sn

Fig. 1: Comparison of materials used

Strategy to Reduce Cost

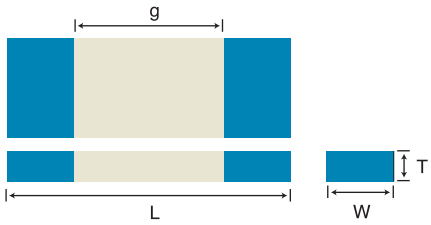
Fig. 1 provides a comparison between the materials used for the new GB Series products and Murata's existing products.

Murata's existing products use electrodes made of precious metals, such as silver and palladium, involving high production costs. In the new GB Series products, the precious metals have been replaced with base metals to reduce the production costs. Here, nickel is used for the inner electrodes and copper is used for the base layer of the outer electrodes.

Furthermore, the new GB Series product can be installed using the surface-mount method with excellent solderability and wettability as the outer electrode surface is tin-plated.

Table 2: Part number

Type	Series	Part No.	Rated voltage (V)	Temperature characteristics (compliance standard)	Capacitance (nF)	Operating temperature range (ºC)
GA355 (5.7 × 5.0)	GB	GA355QR7GB103KW01L	AC 250 (r.m.s)	X7R	10	-55 ~ +125
		GA355QR7GB153KW01L	AC 250 (r.m.s)	X7R	15	-55 ~ +125
		GA355DR7GB223KW01L	AC 250 (r.m.s)	X7R	22	-55 ~ +125
		GA355ER7GB333KW01L	AC 250 (r.m.s)	X7R	33	-55 ~ +125
		GA355ER7GB473KW01L	AC 250 (r.m.s)	X7R	47 (addition)	-55 ~ +125
		GA355XR7GB563KW06L	AC 250 (r.m.s)	X7R	56 (addition)	-55 ~ +125



L×W: 5.7×5.0mm
T: 1.5mm to 2.9mm (varies depending on the part number)
g: 3.0mm

Fig. 2: The product's outside dimensions

To Increase Capacitance

Table 2 provides a list of GB Series part numbers, while Fig. 2 shows the product's outside dimensions.

For the first time in the industry, a new product lineup of Class X2 monolithic ceramic chip capacitors featuring a high capacitance of 56nF become available in the size of 5.7 × 5.0mm. This capacitance level was achieved by adopting a new inner electrode design using base metals in place of precious metals. The highest capacitance of existing products of the same size is 33nF.

The new GB Series products have a wide operating temperature range from -55 to +125ºC. Therefore, the capacitance of these new products has low temperature dependence, for example, X7R characteristic has a capacitance change rate of ±15 percent. One of the advantages of the GB Series capacitors is the stable performance they provide for equipment used in a high-temperature environment. Moreover, the size and profile of these capacitors have been significantly reduced compared with film capacitors.

Conclusion

Murata has achieved both cost reduction and increased capacitance in the company's safety standard-certified new monolithic ceramic chip capacitor, the GB Series, by applying a new inner electrode design using base metal material for the electrodes.

Monolithic ceramic chip capacitors have an advantage over other capacitors because of the products' smaller size and lower profile and also because they can be mounted using the surface-mount method. Monolithic ceramic chip capacitors make the most of these advantages in order to meet the requirements of size and profile reduction of X2 capacitors, something that cannot be achieved by film capacitors and disc ceramic capacitors.

Murata expects that the installation of the GB series in power devices, such as adaptors for notebook personal computers, will expand in the future.

About This Article:

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