Certified Ceramic Capacitors Temper Noise in Power Lines

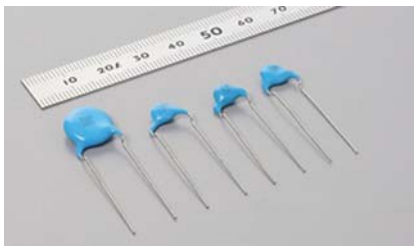

Photo 1: Type RA/Type SA ceramic capacitors

Murata Manufacturing Co., Ltd. has expanded its rated voltage lineup by introducing ceramic capacitors Type RA and Type SA (Photo 1), which are new series of ceramic capacitors certified for the X1/Y1 class and X1/Y2 class safety standards.[*1] The new series consist of a high-performance product and two standard-performance products for each class.

The high-performance products have rated voltages of AC 400V and AC 500V (Y class), and are suitable for use in large equipment requiring high reliability, such as solar power systems and factory automation (FA) equipment, thanks to their high impulse tolerance.

Table 1: Product lineup of the new series Type RA/Type SA

Safety standard class	Product type name	Rated voltage	Capacitance range	Certified for:	Features
X1 / Y1	DE1 Series Type RA	X1: AC500V Y1: AC500V	10 pF to 4700pF	ENEC[*2] (VDE), UL, CQC	High-performance specs/ high-impulse tolerance
		X1: AC440V Y1: AC300V	10pF to 4700pF	ENEC (VDE), UL, CQC	Standard-performance specs/smaller than conventional Type KX (Some have the same size)
		X1: AC440V Y1: AC250V	10pF to 4700pF	ENEC (VDE), UL, CQC, KTC	Standard-performance specs/smaller than conventional Type KX (Some have the same size)
	DE1 Series Type KX	X1: AC440V Y1: AC300V	10pF to 4700pF	VDE, UL, etc. in 11 countries	-
X1 / Y2	DE2 Series Type SA	X1: AC440V Y2: AC400V	10pF to 10000pF	ENEC (VDE), UL, CQC	High-performance specs/ high-impulse tolerance
		X1: AC300V Y2: AC300V	10pF to 10000pF	ENEC (VDE), UL, CQC	Standard-performance specs/smaller than conventional Type KY (Some have the same size)
		X1: AC300V Y2: AC250V	10pF to 10000pF	ENEC (VDE), UL, CQC, KTC	Standard-performance specs/smaller than conventional Type KY (Some have the same size)
	DE2 Series Type KY	X1: AC250V Y2: AC300V	10pF to 10000pF	VDE, UL, etc. in 11 countries	-

Meanwhile, the standard-performance products have rated voltages of AC 250V and AC 300V (Y class), and have equal or smaller external diameters than existing products (Type KX/Type KY). Therefore, they are suitable for small equipment such as chargers for mobile devices. (The external diameter herein means diameter in specifications.)

The safety standard certified capacitors are connected between power lines or between a power line and a chassis, in order to eliminate noise mainly from commercial AC power lines. Capacitors connected between power lines are referred to as X capacitors, and capacitors connected between a power line and chassis are referred to as Y capacitors; these capacitors are certified for safety standards. Ceramic capacitors are mainly used as Y capacitors.

This article describes the product lineup of the new series Type RA and Type SA, and their product specifications, including structures and guaranteed performance, and provides main characteristic data.

Product Specifications of Type RA, Type SA

Table 1 presents the product lineup and respective specifications of Type RA and Type SA Series of ceramic capacitors.

In terms of structure, Murata's safety standard certified ceramic capacitors are disk-type ceramic capacitors with leads that offer high reliability through matching of its original ceramic dielectric material and copper (Cu) electrode material. They are environmentally friendly products; halogen-free flame retardant resin complying with UL94-V0 is used for their external covering (Figure 1).

High-performance products

The guaranteed performance of the high-performance products is expanded compared to the guaranteed performance of conventional products (Type KX (Y1)/ Type KY (Y2)) and of standard-performance products (Table 2). Especially, the impulse voltage tolerance of Type

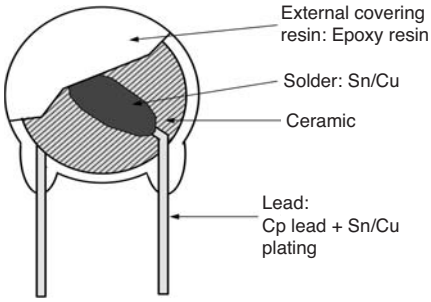

Fig. 1: Internal structure of the products

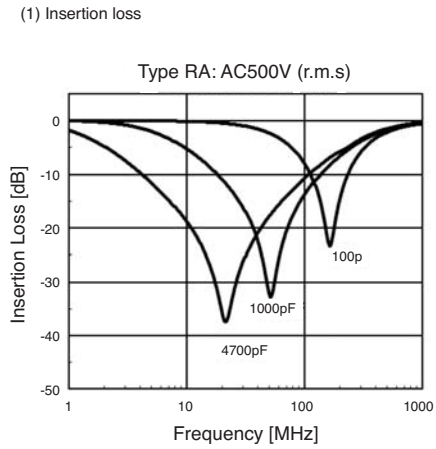

Fig. 2: Insertion loss of Type RA

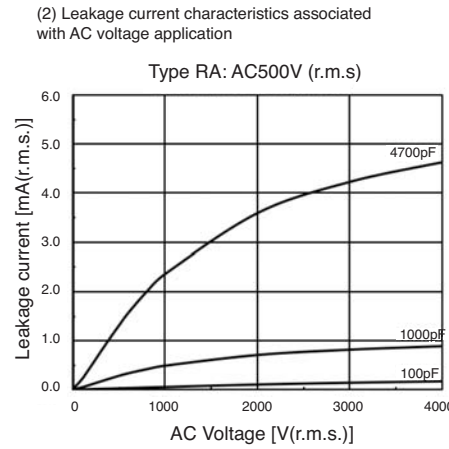

Fig. 3: Leakage current characteristics of Type RA

RA (Y1), is set at 12kVo-p. As some of other manufacturers' products guarantee 10kVo-p, the Type RA high-performance products are superior in withstand voltage performance to other manufacturers' general products.

Also, the high-performance products are aimed at markets for solar power systems, FA equipment, and light-emitting diodes (LEDs), which require high surge resistance and heat-shock resistance. Moreover, as there is a growing demand for products with rated voltages of AC 400V or more and above than DC 300V in these markets, Type RA (Y1) and Type SA (Y2) are designed as products with rated voltages of AC 500V/DC 1.5kV and AC 400V/DC 1kV, respectively. The rated DC voltages herein are voltage values that can be guaranteed by Murata (DC 1.5kV for Type RA and DC 1kV for Type SA).

Standard-performance products

The standard-performance products offer the same guaranteed performance as conventional Type KX (Y1)/Type KY (Y2) while having 1- to 2-mm smaller diameter than the conventional products, although some of them have the same external diameter. Most standard-performance products have diameters equal to or smaller than those of other manufacturers' products, while some are larger by 0.5 to 1mm in diameter.

The standard-performance products can meet demands for miniaturization, and are suitable for small equipment such as chargers for mobile devices.

Main characteristic data

The safety standard certified capacitors are used to eliminate noise mainly from commercial AC power lines. They are required to eliminate noise with a high frequency of several hundred kilohertz to several megahertz, and to have sufficient high-frequency attenuation characteristics. Also, as Y capacitors are connected between a power line and a chassis, AC leakage current flows from the power line to the chassis. If this current is too large, this may cause risk of electrical shock; therefore, equipment safety standards specify the upper limits on leakage current.

Ceramic capacitors have AC voltage characteristics where their capacitance changes depending on the applied voltage. Therefore, in order to determine the upper limit capacitance of Y capacitors, it is necessary to identify the relation between the voltage applied to them and the leakage current through experiments so that the leakage current does not exceed the limits specified by the standards.

Thus, insertion loss associated with frequency (Figure 2) and leakage current associated with AC voltage application (Figure 3) are selected as main characteristic data on capacitors operating in an actual device.

As a typical example, the characteristic data of Type RA high-performance products are provided.

Example of application circuits

Finally, an application circuit is described using a solar power system as an example. The Type RA (Y1) and Type SA (Y2) high-performance products have rated voltages of AC 500V/DC 1.5kV and AC 400V/DC1kV, respectively, and can be used as products C1 and C5, as shown in Figure 4.

Table 2: Guaranteed performance of Type RA and SA

Safety standard class	Product type name	Performance category	Impulse voltage tolerance	Temperature range	Heat shock	Rated DC voltage
X1 / Y1	Type RA	High performance	12 kVo-p	-40°C to +125°C	-40°C to +125°C, 500 cycles	DC 1.5 kV
		Standard performance	8 kVo-p	-40°C to +125°C	-40°C to +125°C, 5 cycles	DC 300 V
	Type KX	-	8 kVo-p	-25°C to +125°C	-40°C to +125°C, 5 cycles	DC 300 V
X1 / Y2	Type SA	High performance	8 kVo-p	-40°C to +125°C	-40°C to +125°C, 500 cycles	DC 1 kV
		Standard performance	5 kVo-p	-40°C to +125°C	-40°C to +125°C, 5 cycles	DC 300 V
	Type KY	-	5 kVo-p	-25°C to +125°C	-40°C to +125°C, 5 cycles	DC 300 V

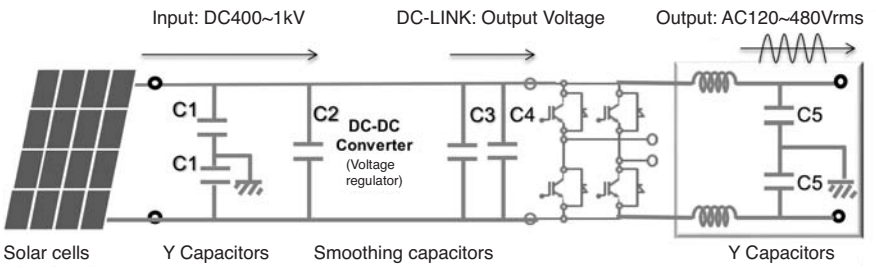

Fig. 4: Circuit diagram of a solar power system

Future Developments

Murata started mass production of some products in December 2016, and will expand the electrostatic capacity lineup. It will prepare main characteristic data on Type RA standard-performance products and Type SA high- and standard-performance products by June 2017. The specifications of the products and data on them are available at Murata's website (http://www.murata.com/en-global/about/newsroom/news/product/capacitor/2016/1206).

Endnotes:

**1 Standards or regulations implemented to prevent disasters from being caused by equipment or electrical components.*

**2 European Norms Electrical Certification, which is widely recognized in Europe as a license attesting compliance with EN standards, which are common in the EU.*

About This Article:

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