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Date : 2021/01/04

APPROVAL SHEET

Product Name : Large Size Multilayer Ceramic Chip Capacitors

Part No. : FG76X226K500TOG

Description : Size 3025, X7R, 22uF, ±10%, 50V

PREPARED BY	APPROVED BY

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SPECIFICATION

FOR

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Description : Size 3025, X7R, 22uF, ±10%, 50V

SPEC. No. : FG-018-002-01

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DRAWN BY	CHECEKED BY	APPROVED BY
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1. INTRODUCTION

Large Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. Reliable performances are built-in through exact formulation of dielectric powders, preparation of conductive paste, advanced automatic manufacturing, and strict quality control to assure excellent control in dielectric thickness, electrode integrity, and electrode-to-termination continuity.

2. FEATURES

- a. Special interior design offers wide voltage range.
- b. Wide capacitances.
- c. High reliability and stability.
- d. 100% RoHS compliant.
- e. HALOGEN compliant.

3. APPLICATIONS

- a. DC to DC converter.
- b. High power SMPS.
- c. Industrial application.
- d. Isolations.
- e. Radioactive detector.
- f. Medical application.

4. HOW TO ORDER

<u>FG</u>	<u>76</u>	<u>X</u>	<u>226</u>	<u>K</u>	<u>500</u>	<u>I</u>	<u>O</u>	<u>G</u>
PDC Family	Size	Dielectric	Capacitance	Tolerance	Rated Voltage	Packaging	Thickness	Control Code
FG= Large size Size>2225	76= 3025	X= X7R	226= $22 \times 10^6 = 22\mu\text{F}$	K= $\pm 10\%$	500= $50 \times 10^0 = 50\text{V}$	T= Tray Tape	O= 3.50 ± 0.20 mm	G= RoHS compliant

5. EXTERNAL DIMENSIONS

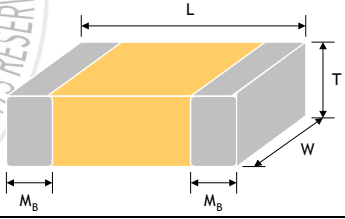
Size Inch (mm)	3025	
L (mm)	7.60 ± 0.50	
W (mm)	6.30 ± 0.50	
Code / T (mm)	O / 3.50 ± 0.20	
M _B (mm)	0.85 ± 0.35	

Fig. 5.1 The outline of MLCC

6. GENERAL ELECTRICAL DATA

Dielectric	X7R
Size	3025
Rated voltage (WVDC)	50V
Capacitance range	22 μF
Capacitance tolerance	K($\pm 10\%$)
Tan δ	$\leq 5.0\%$
Capacitance & Tan δ Test condition	Measured at the condition of 30~70% related humidity for 25°C at ambient temperature Apply $0.5 \pm 0.2\text{Vrms}$, $120\text{Hz} \pm 20\%$ for Cap.>10 μF
Insulation resistance*	$\geq 10\text{G}\Omega$ or $R_{\text{xC}} \geq 100\Omega\text{-F}$, whichever is smaller
Dielectric Withstanding Voltage**	200% of rated voltage
Operating temperature	-55 to +125°C
Temperature coefficient	$\pm 15\%$
Termination	Cu/Ni/Sn

* The components are charged at rated voltage (max. 500Vdc) for 60 seconds.

** The components are required to be immersed into insulating fluid while test voltage >6KV.

7. APPLICATION NOTES

7-1. Storage, Transportation and Handling

These large size ceramic capacitors are unavailable 'Tape and Reel' packed due to their physical dimension and mass. These ceramic capacitors are more sensitive to thermal and mechanical stresses. These capacitors will be supplied packed in a protective tray in individual cells, to prevent damage by contact during transportation.

It is recommended to store these capacitors in the original packing tray until used. These ceramic chips shall be treated carefully and do not contact with each other which can cause chips outs, cracks or other mechanical damage.

If stored in the original packing tray the capacitors shall be able to withstand all reasonable handling associated with transportation.

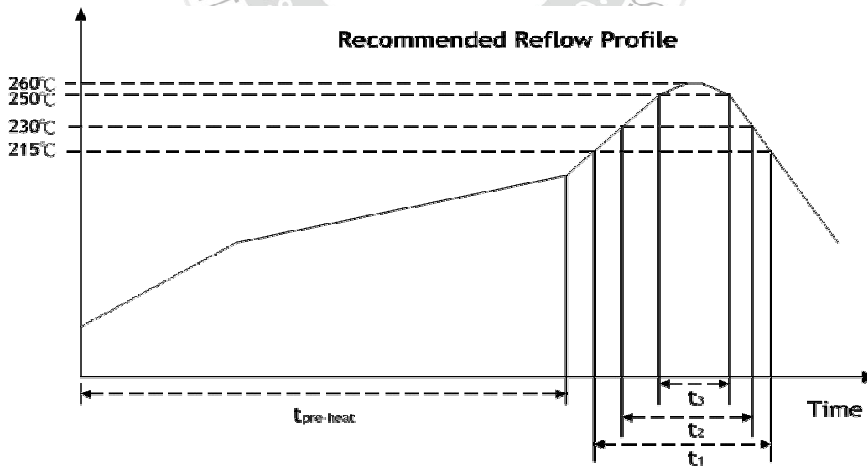
Due to their mass, the traditional SMT equipments are unavailable transfer them from tray to PCB. To transfer them by using tweezers with plastic tip is suitable and unique recommended technique, since any tweezers with hard material tip might cause chip outs. The chips need to be handling carefully to prevent any damage.

7-2. Soldering

The reflow soldering is recommended uniquely for soldering such kind of large dimension ceramic capacitors. In order to prevent thermal shock, wave soldering and manual soldering with an iron tip is not permitted. These ceramic capacitors must be preheated and cooled at a gradual rate. Any sudden increment or decrement of temperature may cause thermal cracks and affect their reliability.

Due to environmental issue is deeply concerned, most PCB assemblies will be forced to switch to a lead-free alloy the most common by far being a high Tin alloy with small amounts of Silver and Copper – Sn/Ag(3.0-4.0)/Cu(0.5-0.9).

This will require higher solder temperatures due to the higher melting point of the alloy. A typical soldering reflow profile is shown as follows :



Parameter	Recommended Specification
Average temperature gradient in preheating	2.0°C/sec.
$t_{pre-heat}$	3-4 minutes
t_1	Max. 60 sec.
t_2	Max. 50 sec.
t_3	Max. 10 sec.
Temperature gradient in cooling	Max. -3°C/sec.

However, the soldering profile shall be adjusted per actual application, but the ramp of temperature shall not set too rapid.

7-3. Mechanical considerations

These large size ceramic capacitors should be considered fragile and handled with appropriate care. Any product dropped or mishandled should be considered suspect and only used advisedly.

Designers should also consider the geometry and relatively high mass of this type of capacitor. When excessive mechanical shock or vibration is applied, the capacitor may be damaged, and may generate a crack since the body of the capacitor consists of ceramics that is fragile.

When the vibration or shock is applied to capacitors :

- 3-1. During equipment transportation on a rough road.
- 3-2. When handling at carrying in or taking out.
- 3-3. When it encounters a storm during sea route transportation.
- 3-4. At launch and landing of aviation.

7-4. Thermal Considerations

All these capacitors are large when compared to conventional ceramic capacitors. This large size makes the ceramic potentially susceptible to thermal shock cracking if they are subjected to rapid changes of temperature.

Another major cause of thermal cracking is difference of Coefficients of Thermal Expansion (CTE) between the capacitors and their surrounding environment. For example a capacitor mounted directly onto a PCB will have a different CTE to the PCB upon which it is mounted. As temperature changes while soldering, the board and the capacitor expand and contract at different rates, causing a build up of stress at the termination. If the rate of temperature change is too great, or the CTE mismatch is too great, then the stress build up at termination may be sufficient to cause cracking of the ceramic in soldering.

This effect worsens as the soldering increase in size, as the stress force acts over a greater area. For this reason we do not recommend mounting chip sizes ≥ 3530 to onto PCB boards directly, but suggest to process stand off legs for these capacitors,

To process stand off legs will minimize any reaction between the capacitor assembly and any PCB by allowing the legs to compensate and absorb thermal stress for mismatch by flexing.

7-5. Capacitance Aging

In ceramic dielectrics of high dielectric constant, the capacitance has an aging characteristic , where by the capacitor continually decreases its capacitance slightly if capacitor is left on for a long time at room temperature.

Most ceramic dielectric, high dielectric constant capacitor, has the ferroelectric characteristics and shows the Curie temperature characteristics.

When the temperature of the ceramic is above Curie temperature, the dielectric ceramic has cubic crystal structure, and it becomes an asymmetrical crystal structure below Curie temperature.

The aging phenomenon is reversible. By heating the capacitors over the "Curie Point" (approx 125°C for Barium Titanate capacitors), the crystalline structure of the capacitor is returned to its original stat and the capacitance value observed after manufacturing. This process is called as "De-Aging". The soldering process is also considered as an effective De-Aging process.

After soldering process, the capacitors have essentially been De-ageing. Capacitance measurement may be erratic in the initial 10 hours after testing. This is due to the initial capacitance value, dielectric type and the time between reflow and the capacitance measurement. For this reason, it may be necessary to wait for the capacitance to stabilize after reflow before testing. In high dielectric constant dielectrics, the capacitance may also appear a little high after the soldering process. This is normal as the capacitance is intended to be stable after 1000hrs so that there is adequate capacitance throughout the life of the circuit.

8. PACKAGE

All large size MLCCs are packaged with tray and suitable buffer material.

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