LTCC PROCESSING INSTRUCTIONS for
KEKO SK-47 LTCC Tape

KEKO LTCC Tape SK47 is a standard glass-ceramic low temperature co-fired ceramic (LTCC) system which combines the benefits high temperature co-fired ceramics and standard thick film technology each to provide a high density, high reliability, high performance low-cost interconnect package. The KEKO SK-47 LTCC tape is design for general applications where working frequencies are up to 30 GHz. This document will guide you through the standard processing of the LTCC tape and demonstrate the current typical capabilities of the KEKO SK-47 LTCC tape and can be used as a reference during the circuit design. The data in this guide should not be interpreted as design limits of the materials, machines and procedures. All the customers are encouraged to contact KEKO Equipment for support and information about the current advances of the system.

Size:

KEKO LTCC Tape SK47 is available in standard sizes of 6”× 6” and 8”× 8” sheets in 4 standard thicknesses of 50 µm, 114 µm, 165 and 254 µm.

Any other dimensions/forms (rolls and sheets with other widths and thicknesses) are available by request up to the width of 10”. Also the ceramic powder for custom tape casting process is available by the request.

Typical processing procedure for KEKO LTCC tape SK-47

This guide will guide you through the typical steps for production of electronic multilayer LTCC product listed process steps listed. In some cases, some extra steps should be included or excluded.

1. Via Forming: In this steps the vias (holes through each layer) are form using punching, CNC machine or laser cutting. Vias are usually used as a connection (electrical, thermal, optical or physical) between layers. Make vias in each layer of tape separately. If you connect more vias together you can cut out bigger parts of sheet which will than acts as a cavity.
2. Via fill: In this step the Vias are filled with conductive material using screen printing with metal stencil.
3. Printing conductors: In this step the conductors are printed on each sheet using screen printing.
4. Printing other co-fireable elements: In this step the resistors and/or dielectrics are printed on each sheet using screen printing.
5. Stacking: In this step the sheets are collated together in proper order as the functionality of the circuit demand.
6. Vacuum bag. In this step the collated and stacked structure is placed on the flat metal support and all together into the vacuum bag.
7. Isostatic lamination: The ceramic structure in the vacuumed bag is placed in the isostatic press. The structure will be homogenously join together.
8. Remove from vacuum bag: In this step the ceramic structure is take out of the vacuum bag, the metal supportive layer can be reused. The vacuum bag must not be reused.
9. Cutting into a desired size. In this step the structure is cut in the desired pieces.

10. Fire. Final sized pieces of ceramic should be placed on flat alumina (or other recommend material) and fired by the desired heating procedure.
11.Postfiring cutting, printing, grinding, gluing: After firing the monolithic ceramic structures can be cleaned or used in additional specific proses required.

Production processes:

Via Forming:
The vias in the KEKO SK-47 LTCC tape can be formed with any puncher available, however the use of the KEKO punching machines PAM series are recommended. The typical via size are but in some cases also smaller (50 µm) or bigger (3 mm) vias are desired. Vias can be also formed using KEKO CNC drilling machine series DM. Or with Nd:YAG laser.

Via Filling:
The vias are filled using KEKO Ag Viafill paste using screen printer and metal stencil. The use of the KEKO screen printing machines with stencils provided by KEKO are recommended. Usual parameters of printers are but may vary due to with the design of printing patterns. For the compatibility of the other commercial available pastes please contact KEKO Equipment stuff.

Via Fill drying:
It is recommended to dry sheets in KEKO dryer series SD. Any other conventional drying ovens at a maximum temperature of 70°C for 10 to 20 minutes may be used.

Screen printing:
Printed patterns are usually printed on KEKO SK-47 LTCC tape using screen printing technique and 325 mesh metal stencils. For the best results, the use of the KEKO Equipment screen printing machines from series P and stencils provided by KEKO are recommended. The KEKO SK-47 LTCC can be co-fired with compatible conductive pastes and other compatible pastes, which are available by us. For the compatibility of the other commercial available pastes please contact KEKO Equipment stuff.

Drying:
It is recommended to dry sheets in KEKO dryer series SD. Any other conventional drying ovens at a maximum temperature of 70°C for 10 to 20 minutes may be used.

Stacking:
Compatible with KEKO stacking machines SW and SB series. Usual stacking parameters are 70 bar, 8 second and table temperature of 55 °C.

Lamination:
The collated LTCC tapes can be laminated using isostatic or uniaxial lamination. The use of the isostatic lamination where it is possible is recommended. The collated sheets of LTCC should be put on the stainless steel plates in the vacuum bag. The KEKO SK-47 LTCC tape can be laminated in an isostatic press at 21MPa (3000 PSI) at 60°C, 10 minutes and pre-heating time of 5 min. The use of the KEKO Isostatic press from series ILS are recommended. For shrinkage adjustment the lamination pressure and lamination pressure can be accordingly modified. Please contact KEKO Equipment stuff for more information.

For complete uniaxial lamination the pressure of 200 bar (500 kN for 6” x 6” LTCC sheets), temperature of 60°C are recommended.

Lamination pressure influence the shrinkage of ceramic. The influence of lamination pressure on shrinkage of LTCC ceramic is presented in Figure 1.

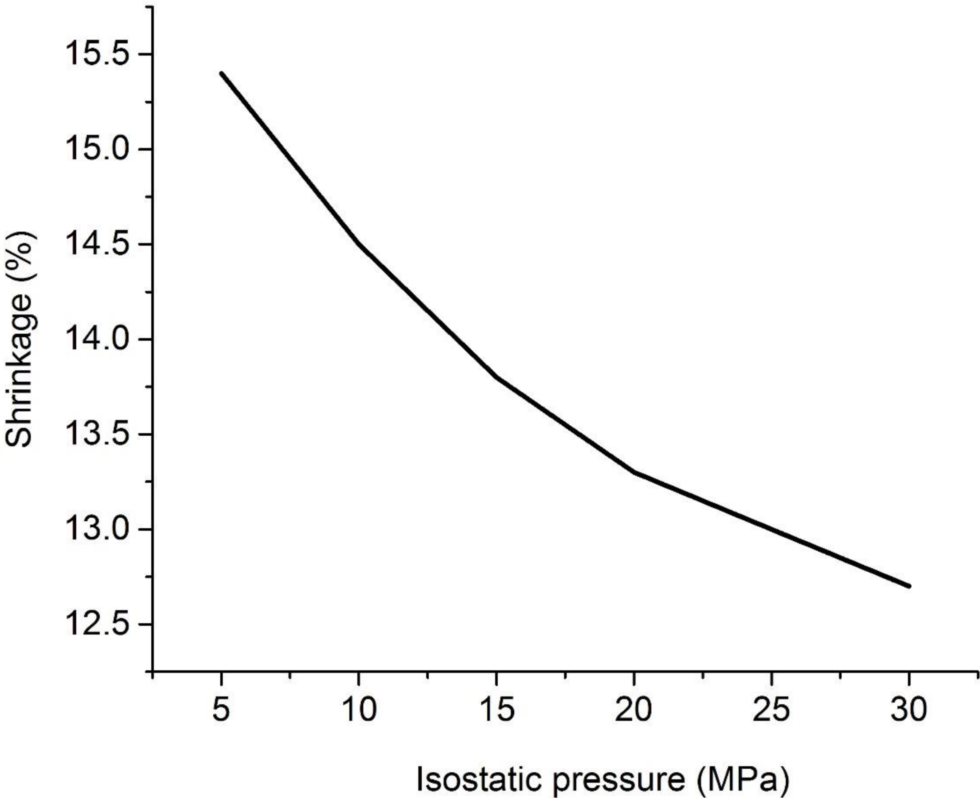

Figure 1. The influence of the isostatic pressure on shrinkage of the LTCC tape during the firing.

Cutting:
Cutting single or multilayers with a hot knife, like in cutting machine CM series is recommended. The use of Nd:YAG laser cutter can also be used with benefit with complex shaped objects.

Firing:
The KEKO SK-47 LTCC tape can be fired in air oxidizing or reduction atmospheres as well as is vacuum atmosphere. If not required otherwise, the firing in air with the air flow of 6 l/minute is recommended. The firing cycle strongly depends on the size of the sample. The firing of the thin, several layer structures can be completed in less than 5 hours. For such structures the fastest recommended firing profile is shown in Figure 2.

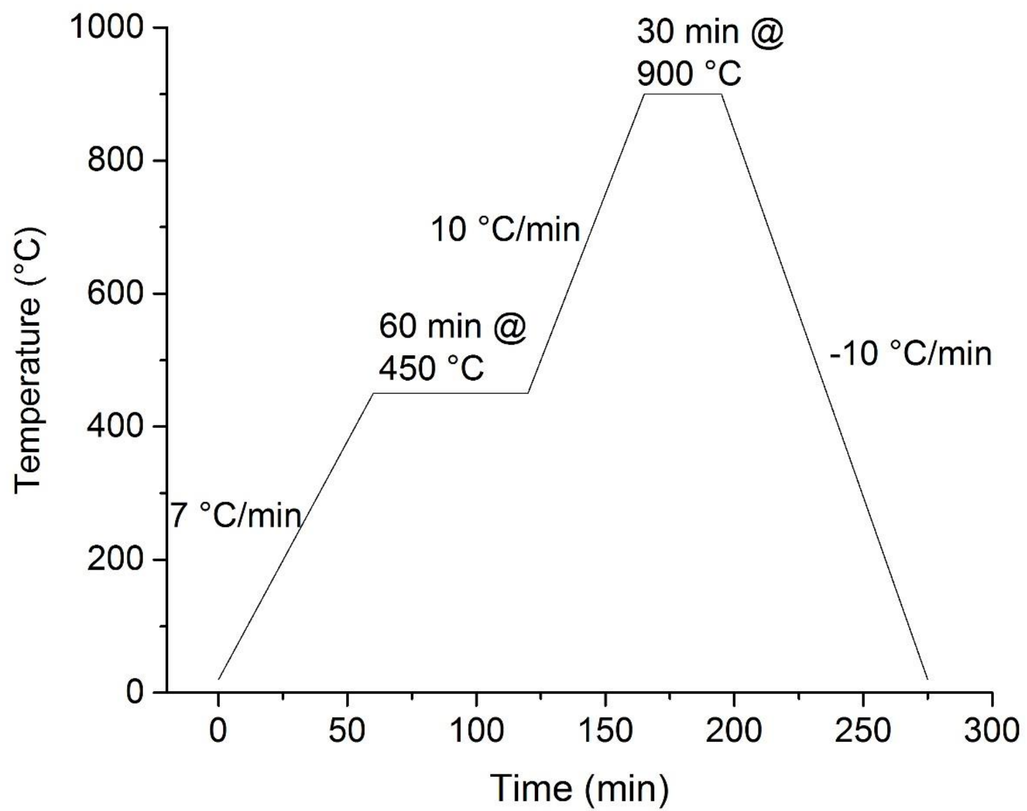

Figure 2. The recommended firing profile for standard LTCC specimens.

For structures with thickness up to 5 mm and sizes up to 8 x 8 inch we recommend long firing profile as presented in Figure 3.

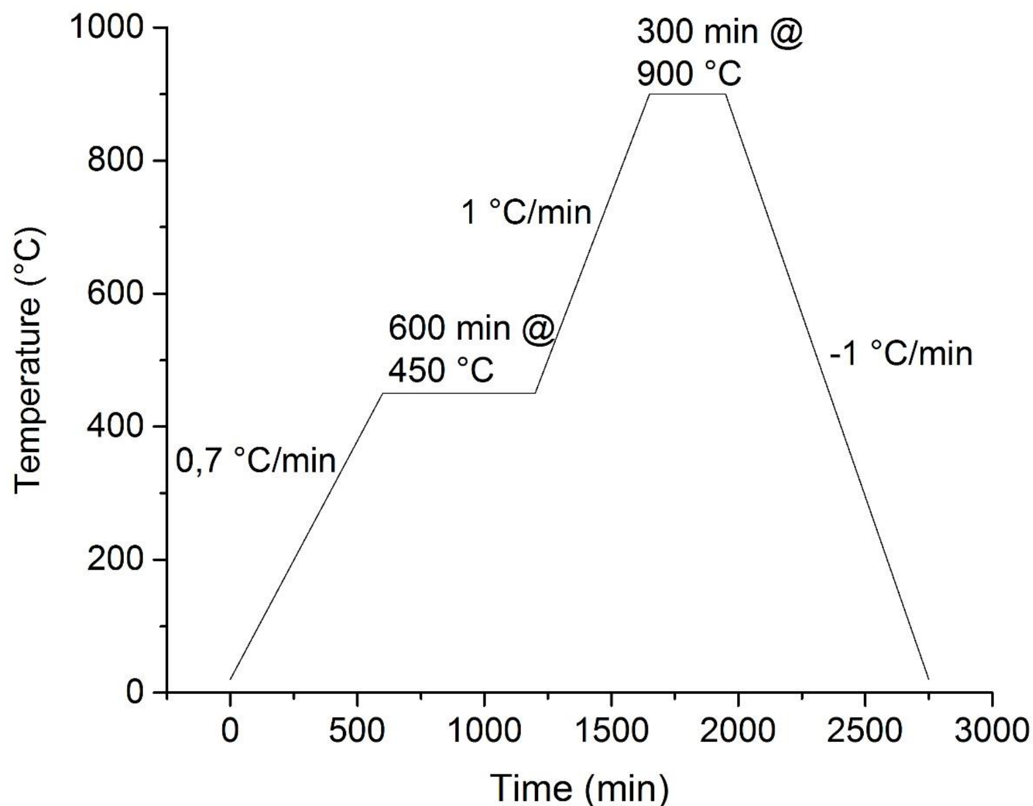

Figure 3. The firing profile for thicker and/or larger LTCC structures.

In the case of special specimens' dimensions and any other complex structures the firing profile should be modify accordingly. Please contact KEKO Equipment stuff for detail information.

Setters:
Alumina, porous alumina, fused quartz

Post firing cutting:
After firing use the diamond saw or a laser scribe (not recommended for finer cuts)

Post firing processing:
Print the compatible paste on the fired substrates and re-fire. Compatible with DuPont Green Tape 951 paste system.

Storage:
Store the tape roles or the green sheet boxes in a closed package at room temperature in clean environment. Avoid direct sunlight or other source of heat radiation. The shelf life of unopened package is 6 months.

Typical properties of fired KEKO LTCC tape SK47

Shrinkage:

X,Y 13 ± 0.5 %

Z 17 ± 0.5 %

Controllable with lamination pressure.

Fired density: 2.9 g/cm^3

Flexural strength (P3B): >200 MPa

Thermal expansion coefficient (30-300 °C): $6.9 \cdot 10^{-6}$ K^{-1}

Thermal conductivity: 2.9 W/m·K

Dielectric constant (10GHz): 7.1 ± 0.2

Dissipation factor (10GHz): = 0,3 %

Surface roughness: 0.60 µm ± 0,02 µm

This data represents typical properties measured by on our own test specimens and it is not intended to be used as specification limits.