Micromax™ Q42DR

Electronic Inks and Pastes

Dielectric Paste

Micromax™ developed dielectric and imaging pastes for use in high density via generation system.

• Micromax™ Q42DR, a silver-compatible, multilayer thick film dielectric composition.
• Micromax™ Q95IR imaging paste, a fugitive thick film via formation.
Both products are phthalate-free, Pb-free and Cadmium-free*.
Micromax™ Q42DR is compatible with Micromax™ QM System of thick film materials for the manufacture of multilayer hybrids and multichip modules.

Product benefits

When integrated with existing thick film processes, the diffusion patterning system incorporates all the advantages of the Micromax™ QM silver multilayer system, as well as the following advantages specific to diffusion patterning:

• High circuit density
• Reduced circuit cost
• Minimum capital investment
• Easily incorporated into thick film processes
• Environmentally safe processing
• Dense, hermetic dielectric
• Cadmium, Lead, Nickel and Phthalate free*

*Cadmium, Lead, Nickel and Phthalate 'free' as used herein means that cadmium, lead, nickel, and phthalate are not intentional ingredients in and are not intentionally added to the referenced product. Trace amounts however may be present.

Rheological properties

Viscosity	20 - 42[1]	Pa.s

[1]: Brookfield 0.5xRVT, UC&SP, SC4-14, 10 rpm, 25 °C ± 2 °C

Application technique

Mask mesh	165 - 200[2]	
Mask emulsion	12[3]	µm
Drying time	10	min
Drying temperature	85 - 90	°C
Theoretical coverage	90[4]	cm^2/g
Recommended film thickness, dried	35 - 39	µm
Recommended film thickness, fired	34 - 42[5]	µm
Via, diameter resolution	150	µm
Leveling time	5 - 10	min

[2]: Wire Diameter 40-55µm

[3]: base coat to 12µm

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[4]: at 38µm wet print thickness

[5]: between conductors

Electrical properties

Dielectric Constant	9 - 11[6]	
Dissipation Factor	≤0.4[6]	%
Insulation Resistance, DC	≥1E12[7]	Ohm
Breakdown Voltage	≥1800[8]	V

[6]: at 1 kHz

[7]: at 100 VDC

[8]: at 36µm, VDC

Storage and stability

Shelf life	3[9]	months

[9]: in unopened containers, from date of shipment, at temperature between 0-5 °C

Additional information

How to use

Processing

- Basic chemistry
  - The via forming process utilizing diffusion patterning technology is achieved by a complex acid/base reaction. The image paste, Micromax™ Q95IR, contains complex organic base [OH-]; the dielectric, Micromax™ Q42DR, contains the acidic acrylic polymer [H+]. Regions where both meet are reaction zones, which become water soluble, allowing the vias to be formed. The areas where the dielectric and image paste are not in contact remain water insoluble.
- Handling
  - Stir Micromax™ Q42DR and Micromax™ Q95IR thoroughly before each use. To maintain shelf life, do not return used Micromax™ Q42DR or Micromax™ Q95IR to the original container of paste. Also to maintain shelf life, minimize the length of time that the paste is on the screen when the printer is not in operation. To prevent "de-wetting", dry all cleaning solvents off the screen prior to printing.
- Substrates
  - Properties are based on tests using 96% alumina substrates. Substrates of other compositions and from various manufacturers may result in variations in performance properties.
- Printing Micromax™ Q42DR
  - Recommended screens
    - Mesh 165 - 200
    - Wire diameter 40 - 55µm

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        - Emulsion thickness, base coat to 12µm
    - Print speed 10 cm/s
    - Printing should be carried out in a clean and well ventilated area. For building multilayer hybrids, printing should taken place in class 10,000 conditions or better to minimize yield losses from airborne contamination. Print individual layers with the recommended stainless steel screen. The Micromax™ Q42DR screen requires a thinner emulsion to minimize the buildup of dielectric at the edge of the print, while still providing desired overall print thickness.
    - Use print/print mode to deposit the dielectric. Allow the wet dielectric print to level for 5-10 minutes. The single dried print thickness is 37µm ±2. Unlike conventional thick film dielectric processes, vias are not created at this step. Therefore, artwork for the dielectric screens does not include via openings.
    - Note : It is important to achieve uniform dielectric print thickness to obtain consistent via diameters in the imaging process.
- Drying Micromax™ Q42DR
    - Dry in air at 85-90°C for 10 minutes. Drying conditions may vary depending on use of conveyor dryers or box ovens.
- Printing Micromax™ Q95IR
    - Recommended screens
        - Mesh 290 - 400
        - Wire diameter 15 - 24µm
        - Emulsion thickness, base coat to 12µm
    - Print speed 10 cm/s
    - Micromax™ Q95IR is screen printed, in the from of dots, directly to the dried Micromax™ Q42DR surface. Use the recommended screen to ensure uniform dot deposits for all vias. Screens for printing Micromax™ Q95IR are selected to maximize the open area, with minimum wire diameter to produce uniform image paste deposits. Print Micromax™ Q95IR with two print strokes in the same direction. Micromax™ Q95IR is the imaging or patterning paste that forms vias, therefore the artwork and screens used to form vias can also be used to fill vias. Also consider that a basecoat emulsion may help improve or increase the via diameters. Knowing the actual measurement of the opening in the screen will help when setting up the process.
- Diffusing Micromax™ Q95IR
    - Micromax™ Q95IR is diffused into the dielectric by exposures to temperatures of 70 to 100°C (158-212°F). A belt dryer is recommended for volume production runs to insure uniform via size. Diffusing is the most critical step in the diffusion patterning process and uniform heating is required for the vias to be uniform in size and shape. For development, a box oven may be used for diffusing. Typical profiles obtained by attaching a thermocouple to parts on a tray placed into a box oven at several different

setpoints. For example, the 80°C setpoint requires approximately 10 minutes to actually reach 80°C. Consider the entire profile when correlating to conveyor belt dryer. All of these box oven profiles result in acceptable diffusion of the Micromax™ Q95IR, however the lower temperatures exhibit the largest process window.
    - The smaller the via size, the more precise the time/temperature profile must be.
    - These recommended diffusing profiles should be fine-tuned to achieve optimum via resolution for each specific dryer. If vias are not fully formed in the diffusing process, first increase diffusing time. If results are still not sufficient within a viable production process, return to the original time and increase temperature. Increasing temperature narrows the process window between "underdeveloped" and "capped" vias.
    - A "capped" via is a dried image dot of Micromax™ Q95IR, that is not removed by the development process step. If capped vias are observed, diffusing temperature is too high, diffusing time is too long, or there is excessive airflow in the drying equipment.
- Developing vias
    - Via developing
        - Water temperature : 35 - 45°C
        - Water pH : 6.5 - 8.5
        - Nozzle pressure : 10 - 25 psi
        - Development time : 8 - 25 s
    - Developing completely removes the Micromax™ Q95IR and the soluble Micromax™ Q42DR in order to form vias. It takes place in a conveyorized water spray developer unit. The water temperature is 35-45°C (95-113°F). The water pH is 6.5-8.5. The water pressure is 10-25 psi. The total developing time is 8-25 seconds. Excess water in blown off the circuit after the develop cycle, generally in the same piece of equipment.
    - The purchase of a conveyorized water spray developer represents the only investment that may be required beyond what is already found in a thick film hybrid manufacturing facility.
    - Developing is environmentally friendly, It is an aqueous process that may be operated in a closed /recycling system to minimize water disposal issues. In the closed loop system, solid waste is captured by 5-microm paper filters and periodically discarded. The waste consists primarily of alumina and inorganic solids from the Micromax™ Q42DR dielectric, and may be disposed of with other no hazardous materials.
- Firing
    - Fire the Micromax™ Q42DR and other system compositions in air using a standard 30-minute belt furnace profile.
- Via fill

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- Use the recommended materials and processes to fill vias. In most circuit designs, the screens used for applying the Micromax™ Q95IR may be used for via filling. Subsequent layers of conductor, dielectric, and via fill are created using the recommended via fill compositions and processes. Repeat the Micromax™ Q42DR and Micromax™ Q95IR process steps to create a second dielectric layer.
- The required separation between conductor layers is achieved in two dielectric print/dry/diffuse/fire cycles. The final fired thickness is 38µm ±2µm.

Screen cleaning tip

- On occasion, the via fill screen can become clogged with Micromax™ Q95IR paste. This can be cleaned using water. Ensure that the screen is completely dried prior to printing again after cleaning.

Properties

Typical Fired Properties & Composition Properties

Test	Proerties
Resistance to EMF Effects Number of refires without blistering at 36µm*[1]	≥ 20
Z Shrinkage Wet to Dry Thickness (%)	42
Z Shrinkage Dry to Fired Thickness (%)	17

Test Procedure : Typical fired prpoerties are based on laboratory tests. Unless expressly noted elsewhere, the following conditions have been used:
• Top and bottom conductor - QM14, Ag conductor composition.
• Dielectric printing - 200 mesh, 1.6 wire diameter stainless steel, 2 layers.
• Firing - Separately fired to a peak temperature of 850°C using a 30 minute cycle.
*1 Configuration : QM21R Ag/Pd top conductor; Q42DR dielectric; QM31 Au bottom conductor

Information in this datasheet shows anticipated typical physical properties for Micromax™ Q42DR and Q95IR based on specific controlled experiments in our labs and are not intended to represent the product specifications, details of which are available upon request.

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Figure 1. Diffusion Patterning Reaction

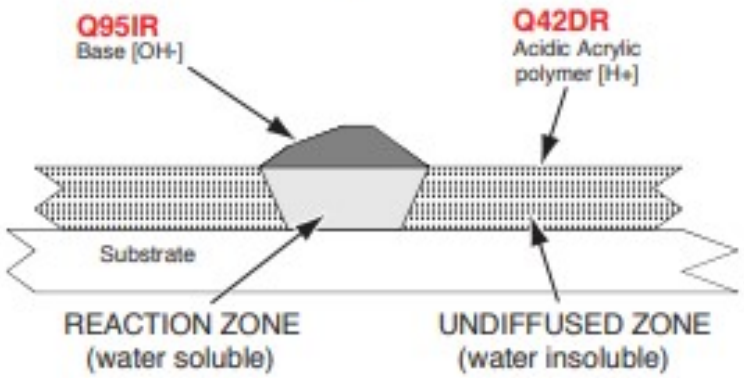

Figure 2. Q42DR Via Diameter Process Window

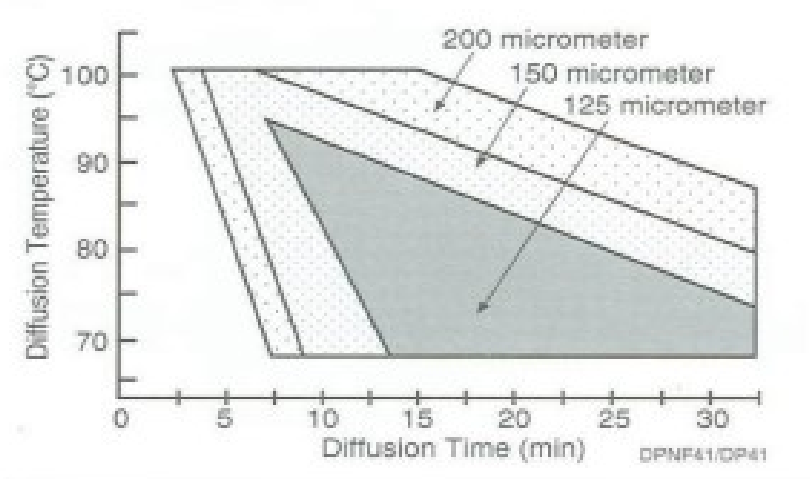

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Figure 3. Q42DR and Q95IR Diffusion Profiles

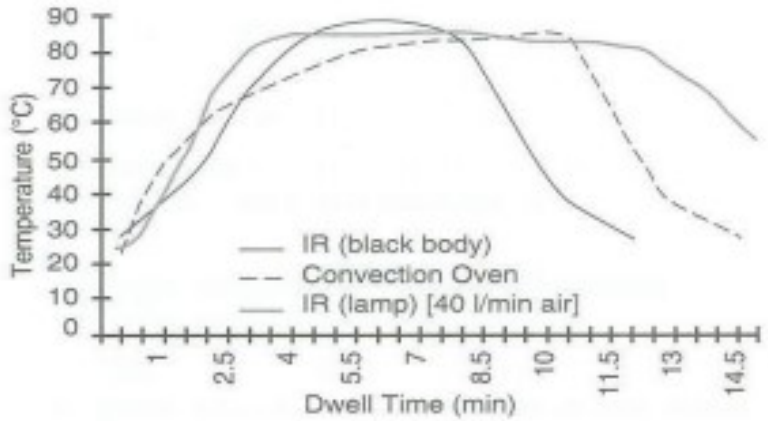
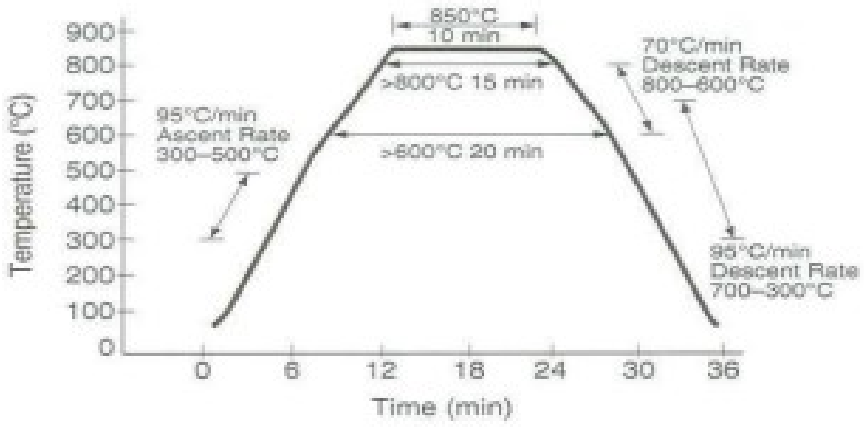


Figure 4. 30 minute Furnace Profile



Other system components

- Micromax™ QM21R silver/palladium top layer conductor
- Micromax™ QM14 silver conductor
- Micromax™ QM 34 silver/palladium buried layer via fill conductor
- Micromax™ QM 35 silver/platinum via fill
- Micromax™ QQ550 cadmium-free*, low-temperature resistor encapsulant

Storage and shelf life

Storage : Containers of Micromax™ Q42DR should be stored with their lids tightly

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sealed at refrigerated temperatures between 0-5°C. Storage at 0-5°C retards the solids from settling, increasing shelf life by several months. It is very important to allow jars to equilibrate to room temperature after the jar has been removed from refrigeration, before opening.
Shelf life : Micromax™ Q42DR is a unique thick film composition. The vehicle is an active part of the via formation process and not simply the transfer medium for the inorganic components. The ability of Micromax™ Q42DR dielectric to resolve vias will degrade with time. For factory sealed (un-opened) containers stored under 0-5°C refrigerated conditions, via resolution is certified three months from the date of shipment. Refrigerated storage at 0-5°C is recommended for Micromax™ Q42DR.

Safety and handling

For safety and handling information pertaining to this product, read Safety Data Sheet (SDS).

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