Micromax™ LF20A

Electronic Inks and Pastes

Lead Free Resistor Compositions

The Micromax™ LFx0A resistor series has been proven to have excellent performance properties for hybrid applications. Designed to give an ideal balance of properties, this lead-free(Pb)* and cadmium(Cd)-free* resistor series is fully blendable between adjacent members.

Product benefits

- Resistors are compatible with Pb-free conductors
- Lead free* and Cadmium free*
- Excellent ESD Stability
- Good power handling stability
- Reach compliant

Processing features

- Thin printing 12µm dried thickness
- Fast firing - 850°C/30 minute profile
- Narrow TCR gaps
- Linear blend behavior

*Lead and Cadmium 'free' as used herein means that these are not intentionally added to the referenced product. Trace amounts however may be present.

Product information

Solvent or thinner	Micromax™ 8250
Blend member or series	LFX0A srs

Rheological properties

Viscosity	150 - 240[1]	Pa.s

[1]: Brookfield HAT, UC&SP, SC4-14/6R, 10 rpm, 25°C ± 0.2°C

Application technique

Mask mesh	325	
Mask emulsion	10 - 15	µm
Drying time	10 - 15	min
Drying temperature	150	°C
Recommended film thickness, dried	10 - 14	µm
Leveling time	5 - 10	min

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Electrical properties

Surface resistivity	100000[2]	mOhm per square
Hot Temperature Coefficient Resistance	-100 - 100[3]	ppm/K
Cold Temperature Coefficient Resistance	-100 - 100[4]	ppm/K
Electrostatic discharge, 5kV	≤0.01[5]	(avgDeltaR)(%)
Noise	-36.9[6]	dB
Short Term Overload Voltage	30[7]	V/mm
Standard Working Voltage	12[8]	V/mm
Maximum Rated Power Dissipation	962[9]	m/(W.mm^2)

[2]: Glazed with Micromax™ QQ620, in the case of unglazed 80.0 - 120 Ω/sq.

[3]: Glazed with Micromax™ QQ620 and unglazed are the same. Hot TCR in PPM/°C measured 25°C to 125°C. Note : To obtain ±100 ppm/C, measured using 8 squares.

[4]: Glazed with Micromax™ QQ620 and unglazed are the same. Cold TCR in PPM/°C measured 25°C to -55°C. Note : To obtain ±100 ppm/C, measured using 8 squares.

[5]: Glazed with Micromax™ QQ620, in the case of unglazed 0.001 %, after 1x5kV pulse. ESD measured on 1mm x 1mm resistors untrimmed pulsed 1x2kV and 1x5kV on same resistor.

[6]: Glazed with Micromax™ QQ620, in the case of unglazed -34.1 dB.

[7]: Glazed with Micromax™ QQ620 and unglazed are the same. STOL : Short Time Overload Voltage (V/mm); Voltage required in a 5 second duration to induce a resistance change of 0.25%, at 25°C, in a 1mm x 1mm resistor trimmed to 1.5x fired value with a single plunge cut. Note : 630 volts is the equipment limit.

[8]: Glazed with Micromax™ QQ620 and unglazed are the same. SWV : Standard Working Voltage = 0.4x short term overload voltage.

[9]: Glazed with Micromax™ QQ620, in the case of unglazed 958 mW/mm^2. MRPD : Maximum Rated Power Dissipation = (standard working voltage)^2/trimmed resistance

Storage and stability

Shelf life	6[10]	months

[10]: in unopened containers, from date of shipment, at temperature <25°C

Additional information

How to use

Processing

- Terminations
  - Micromax™ LFx0A resistors were designed for use with high silver-containing Pb-free terminations. Reported properties are based on tests using Micromax™ LF171 Ag/Pt and Micromax™ LF121 Ag/Pd conductor terminating materials. Similar performance properties have been observed with other Micromax™ gold and silver-bearing conductors, however using different terminations may result in a shift of resistance and TCR values.
- Blendability
  - There are two 10K ohm blend members. Composition Micromax™ LF40A is to be blended with the lower 1K ohm member

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Micromax™ LF30A, while composition Micromax™ LF49A is to be blended with the higher 100K ohm member Micromax™ LF59A. Only adjacent members are blendable.

- Substrates
  - Reported properties are based on tests with 96% alumina substrates. Substrates of other compositions may yield variation in performance properties.
- Printing
  - Properties are based on resistors printed to 12±2µm dried thickness. A 325 mesh stainless steel screen with 10-15µm emulsion is recommended. Each composition must be thoroughly mixed before use. This is best achieved by slow, gentle, hand-stirring with a clean flexible burr-free spatula (plastic) for 0.5-1 minute.
- Thinning
  - Micromax™ LFx0A Series has been optimized for screen printing and thinning is not normally required or recommended. Micromax™ 8250 thinner may be added sparingly to compensate for evaporative losses.
- Drying
  - Allow prints to level at room temperature for 5-10 minutes, then dry at 150 °C for 10-15 minutes in a well-ventilated oven.
- Firing
  - Properties are based on a 30 minute firing cycle (100ºC - 100ºC) with 10 minutes at a peak temperature of 850ºC.
- Encapsulant
  - Micromax™ QQ620 is the recommended Pb-free encapsulant material that may be used to provide mechanical protection from extreme environments. Micromax™ QQ620 is recommended to be screen printed and fired over the pre-fired resistor prior to laser trimming.
- Laser trimming
  - Please see the table for recommended laser trim parameters. Use of encapsulant will improve trim stability performance of certain decade members.

Properties

Laser Trimming

Resistor	Power	Q-Rate	Bite Size
1Ω	P=2.0 W	QR=3000	BS=150
10Ω	P=2.0 W	QR=3000	BS=150

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100Ω	P=2.0 W	QR=3000	BS=200
1kΩ	P=2.0 W	QR=4000	BS=200
10kΩ	P=2.0 W	QR=3000	BS=150
10kΩ	P=2.0 W	QR=3000	BS=150
100kΩ	P=2.0 W	QR=3000	BS=200
1MΩ	P=2.0 W	QR=5000	BS=200
10MΩ	P=2.0 W	QR=3000	BS=150

Fired Properties - Glazed with QQ620 & Unglazed (preliminary)

- Test Procedure
  - Typical fired properties and Preliminary fired properties are based on the following :
  - Termination : LF171 Ag/Pt
  - Dry Thickness : 12±2µm
  - Resistor geometry : 1.0 x 1.0mm
  - Firing : 30 minute cycle 850°C peak for 10 minutes.
  - Substrate : 96% alumina
  - Resistance and TCR, Quan-tech Noise, and ESD are measured on untrimmed resistors.
  - Preliminary fired properties are based on the following : No encapsulation
- All values reported here are results of experiments in our laboratories intended to illustrate product performance potential with a given experimental design. They are not intended to represent the product's specifications.

Storage and shelf life

Containers should be stored, tightly sealed, in a clean, stable environment at room temperature (<25°C). Shelf life of material in unopened containers is six months from date of shipment. Some settling of solids may occur and compositions should be thoroughly mixed prior to use.

Safety and handling

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

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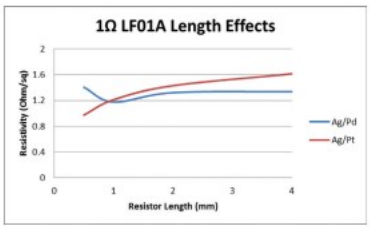
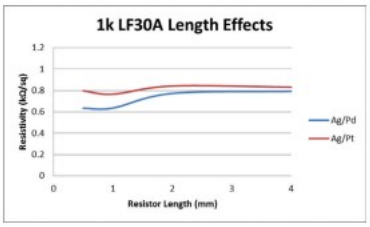
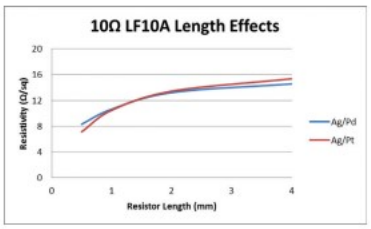
Resistor Termination Dependence

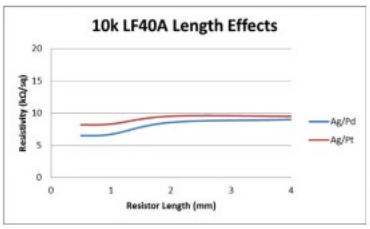
(Length Effect Curves) Resistivity

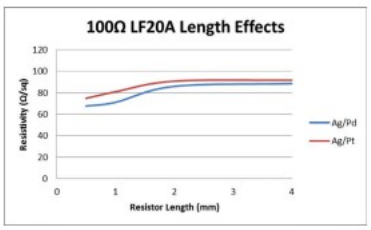
Data based on 1.0 mm width resistors with DuPont LF121 3:1 Ag/Pd and DuPont LF171 Ag/Pt Pb-free terminations

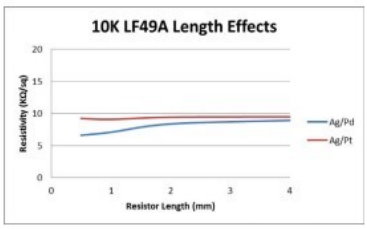


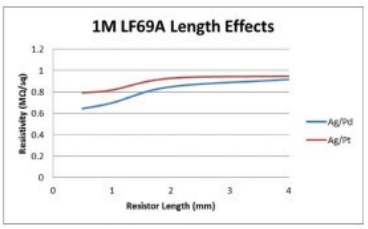


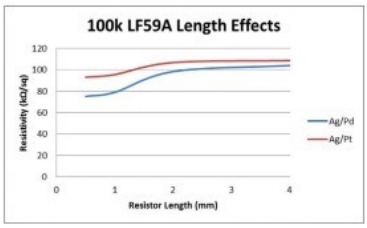


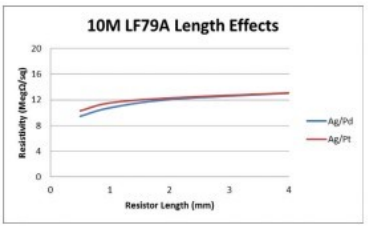












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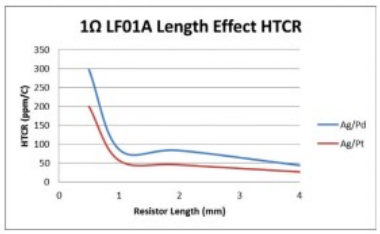
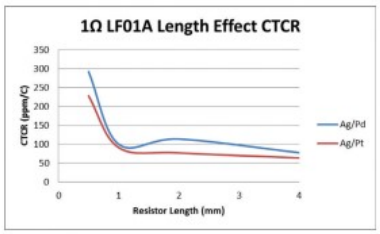
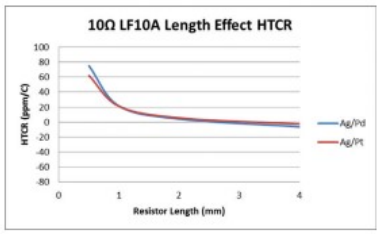
Resistor Termination Dependence

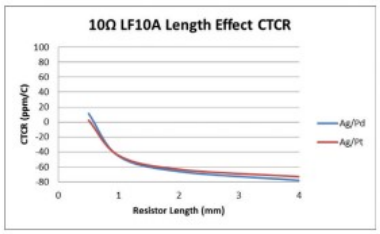
(Length Effect Curves) Hot & Cold TCR

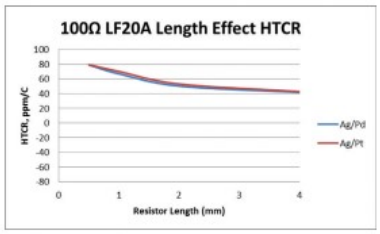
Data based on 1.0 mm width resistors with LF121 Ag/Pd and LF171 Ag/Pt Pb-free terminations

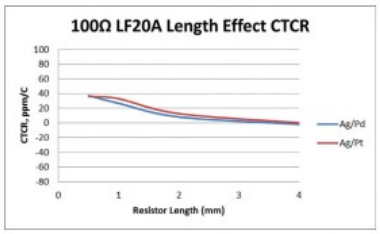


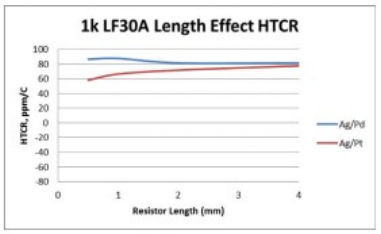


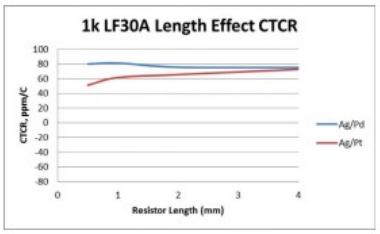


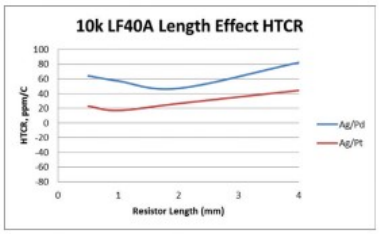


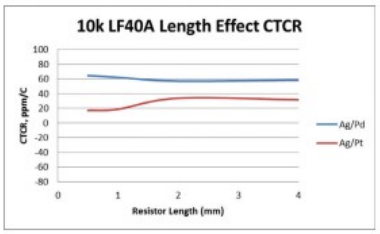












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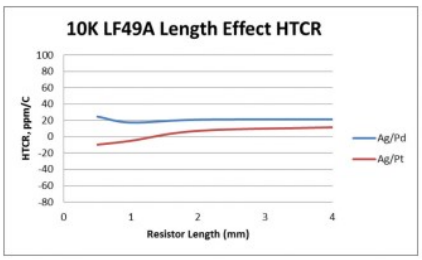

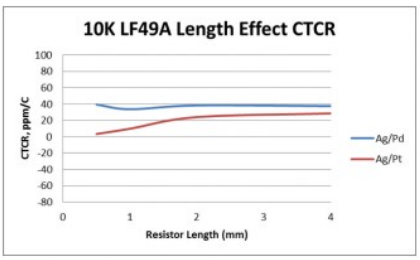

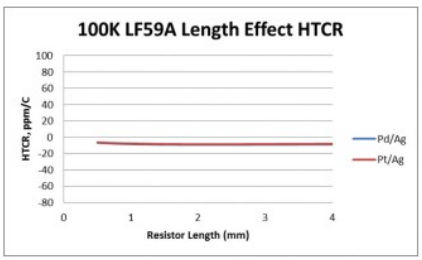

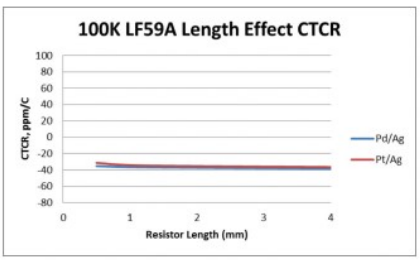

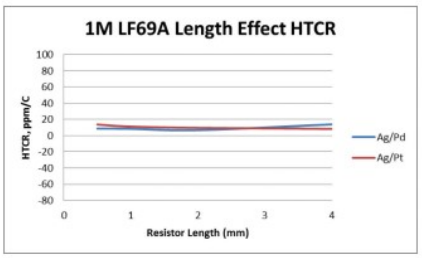

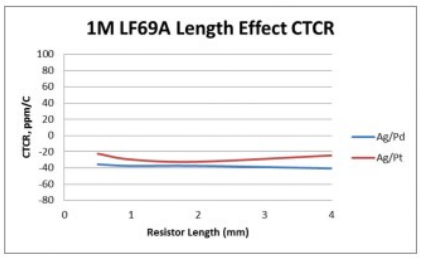

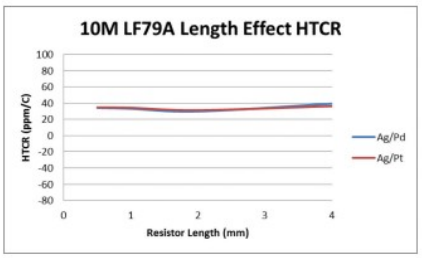

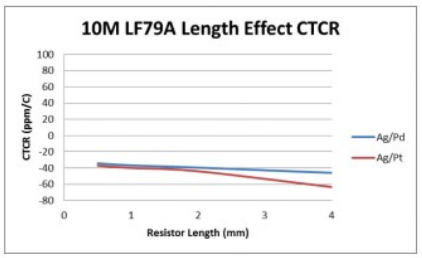

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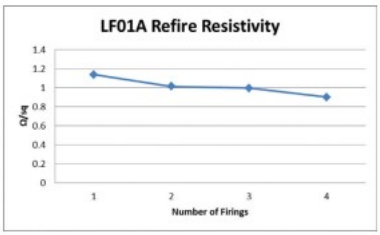
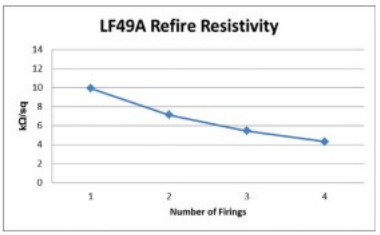
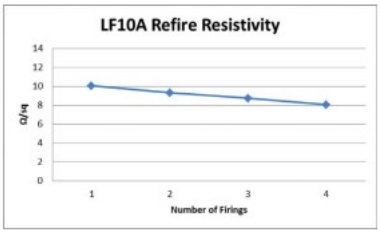
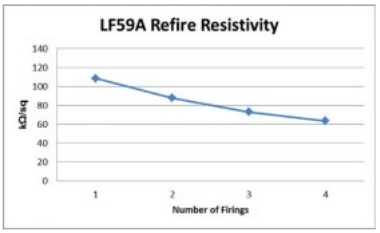
Refire Behavior

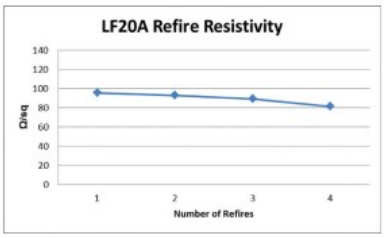
Data measured on 1.0x1.0 mm resistors on LF171 Ag/Pt Pb-free conductor terminations

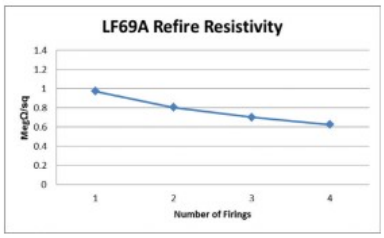


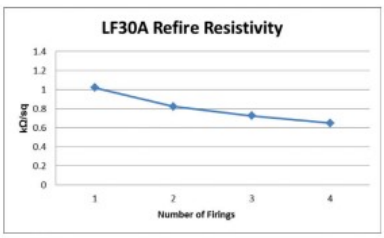


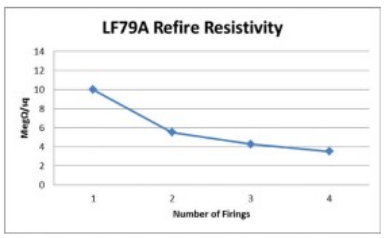


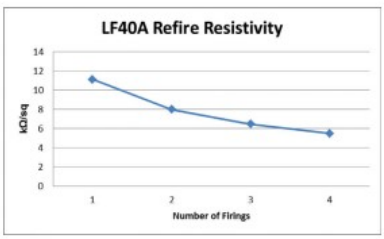












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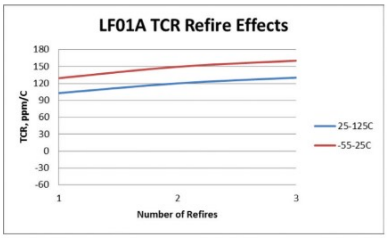
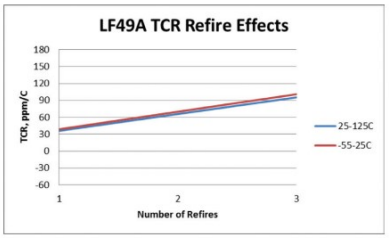
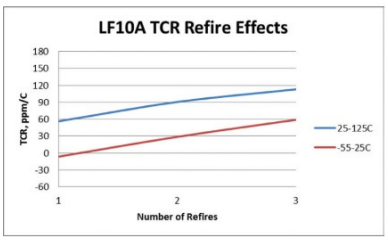
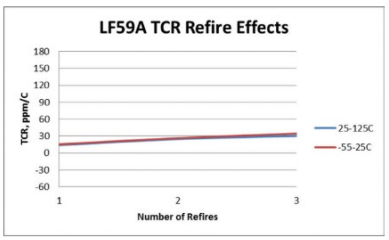
TCR Refire Effects

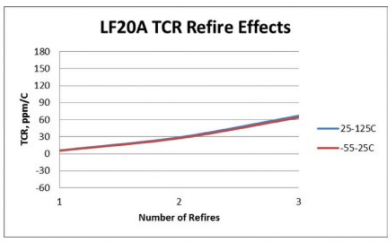
Data measured on 1.0x1.0 mm resistors with Pb-free LF171 Ag/Pt terminations

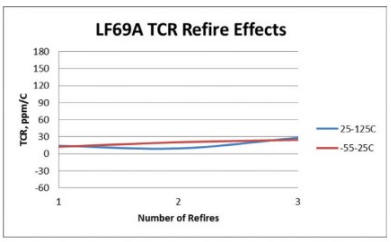


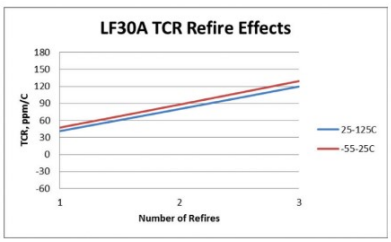


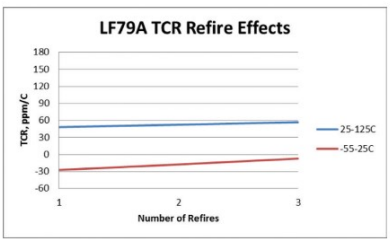


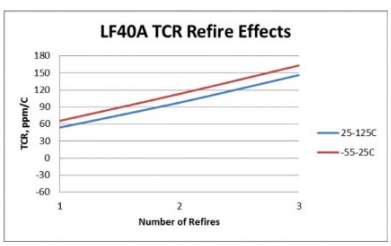












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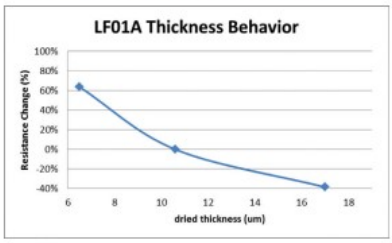
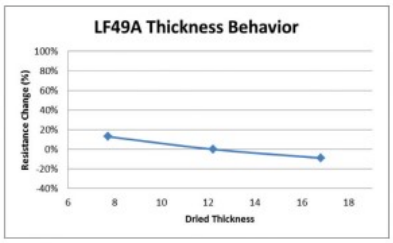
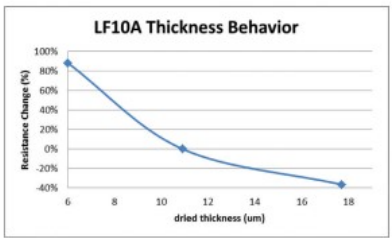
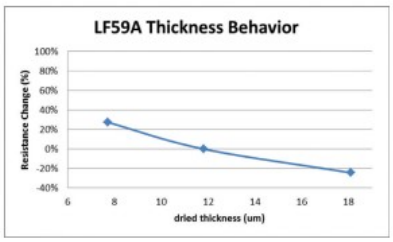
Thickness Behavior – Resistivity

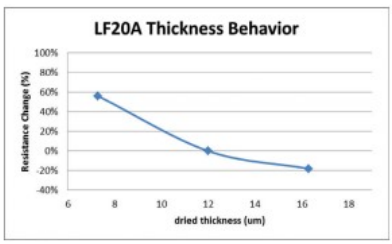
Data measured on 1.5x1.5 mm resistors with Pb-free Ag/Pt terminations

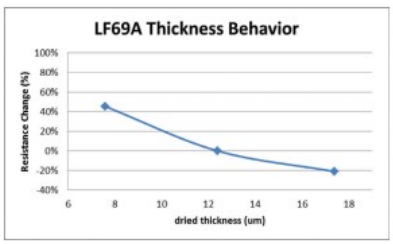


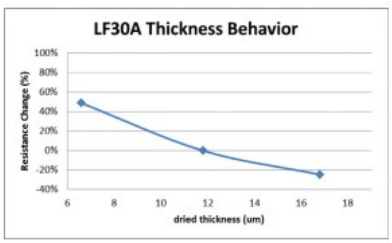


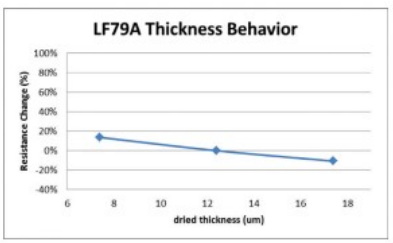


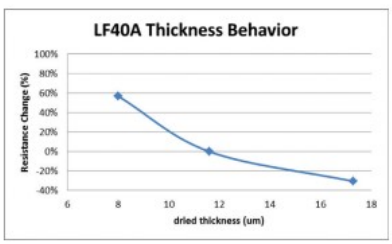










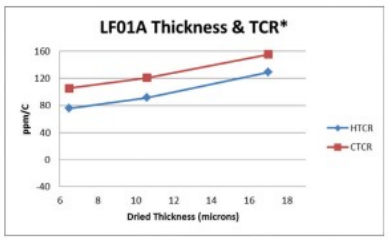


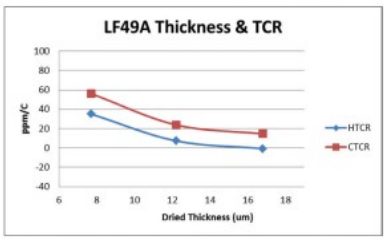
Micromax™ LF20A

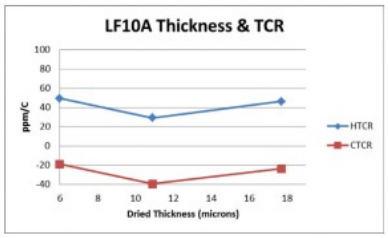
Electronic Inks and Pastes

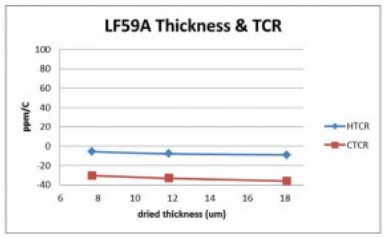
Thickness Behavior – TCR

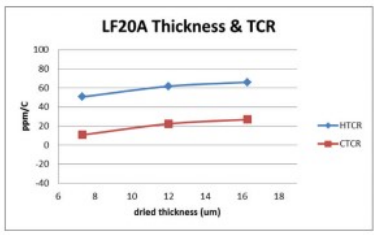
Data measured on 1.5x1.5 mm resistors with Pb-free Ag/Pt terminations

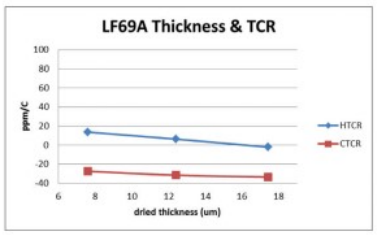


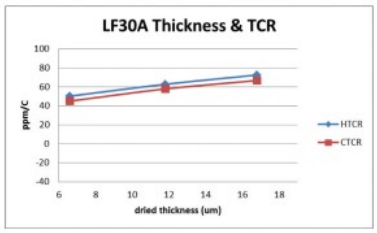


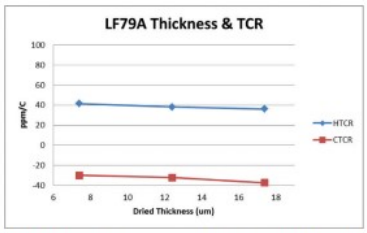


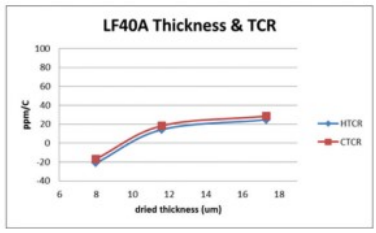












*LF01A charted data measured using 1 square resistor. QC is tested using 8 squares pattern to compensate for termination influence.

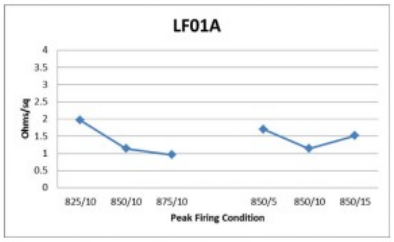
Micromax™ LF20A

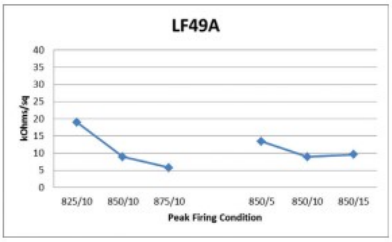
Electronic Inks and Pastes

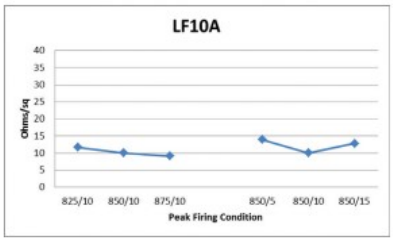
Sensitivity to Firing Conditions

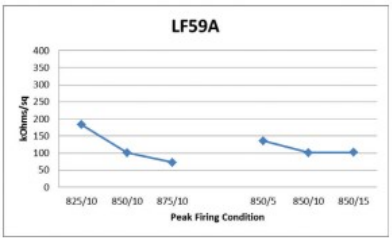
(Resistivity VS Peak Temperature and Time at Peak)

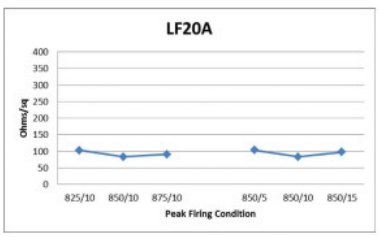
Data based on 1.0x1.0 mm resistors with Pb-free LF171 Ag/Pt terminations

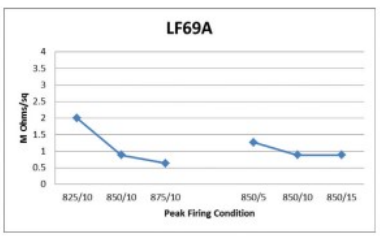


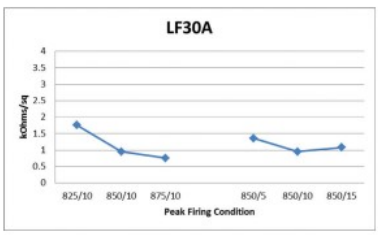


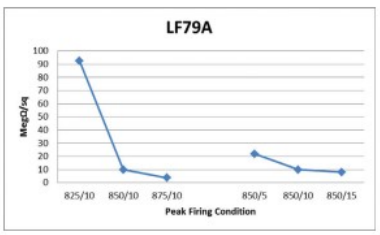


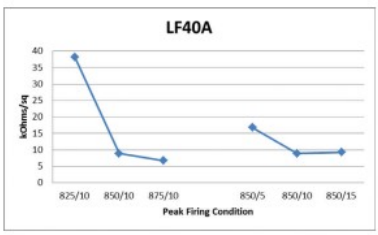












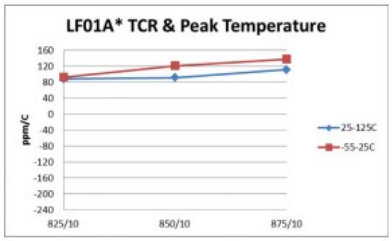
Micromax™ LF20A

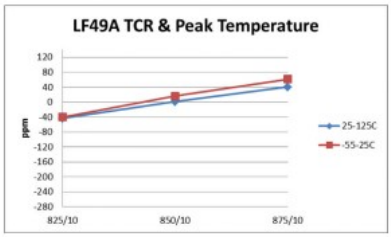
Electronic Inks and Pastes

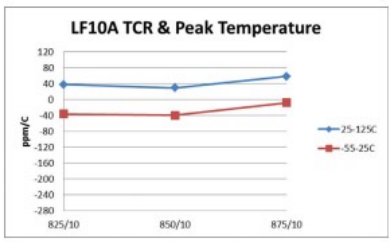
TCR Sensitivity to Firing Conditions

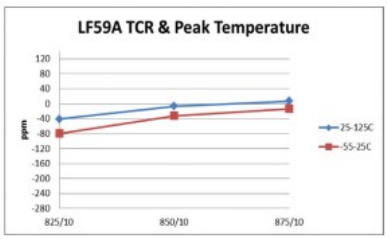
(Peak Temperature)

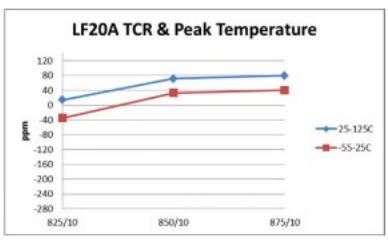
Data based on 1.0x1.0 mm resistors with Pb-free LF171 Ag/Pt terminations.

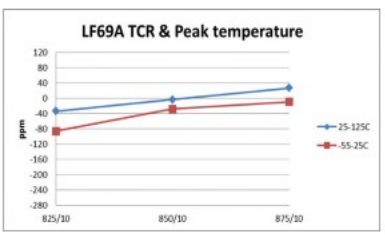


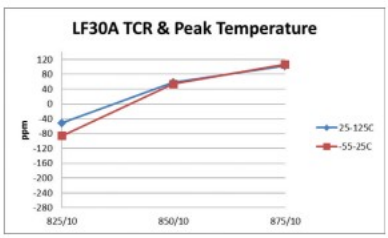


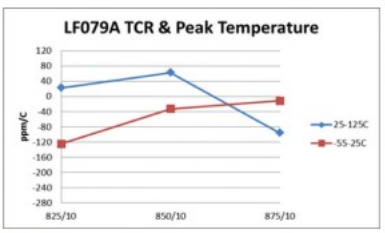




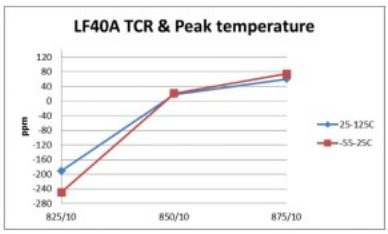








*LF01A data based on 1mm x 1mm resistor.



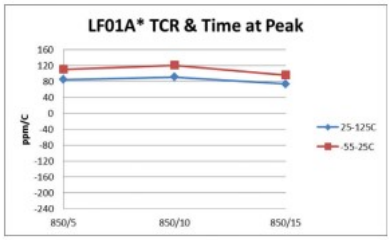
Micromax™ LF20A

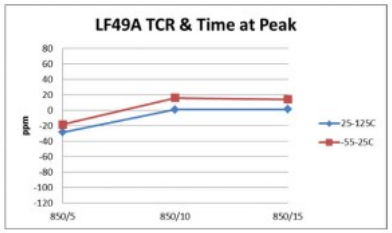
Electronic Inks and Pastes

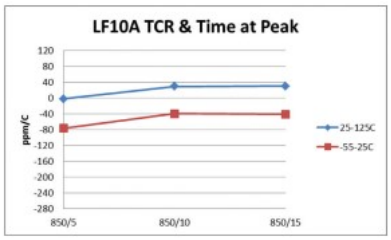
TCR Sensitivity to Firing Conditions

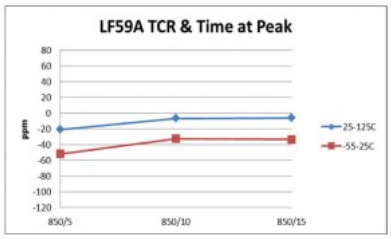
(Time at Peak)

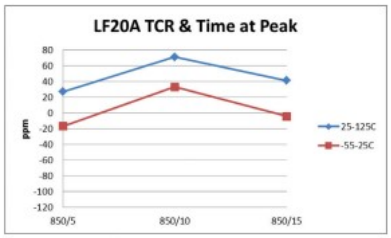
Data based on 1.0x1.0 mm resistors with Pb-free LF171 Ag/Pt terminations.

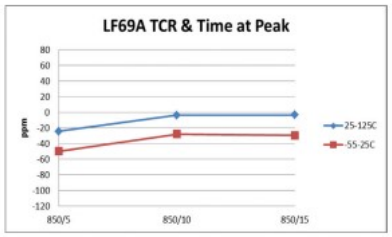


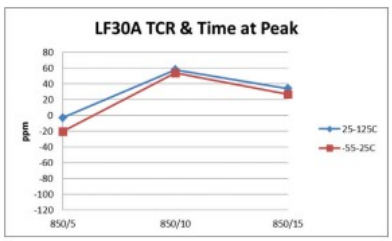


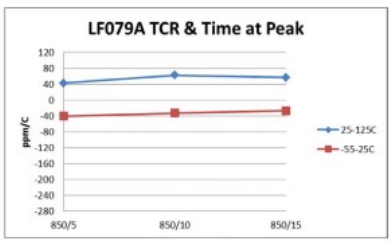




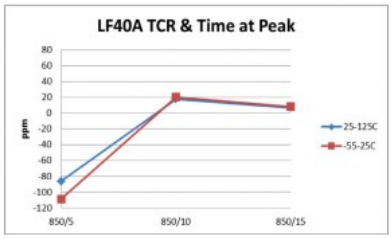








*LF01A data based on 1mm x 1mm resistor.

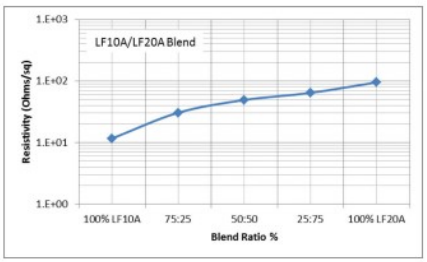


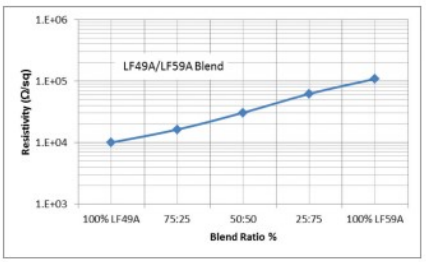
Micromax™ LF20A

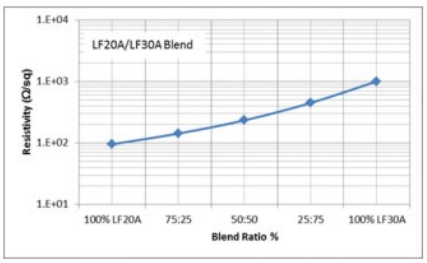
Electronic Inks and Pastes

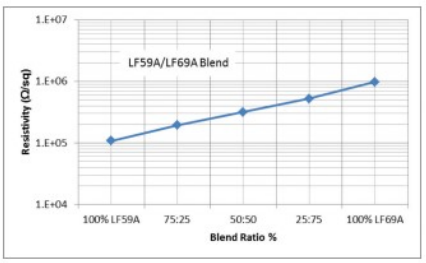
Blend Behavior – Resistivity

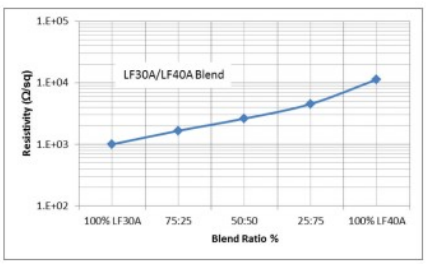
Data based on 1.0x1.0 mm resistors with Pb-free LF171 Ag/Pt terminations











Micromax™ LF20A

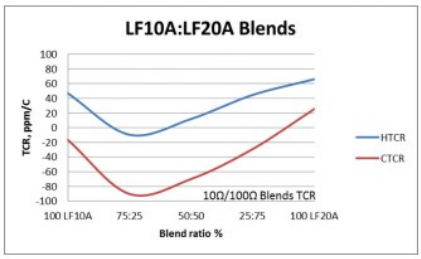
Electronic Inks and Pastes

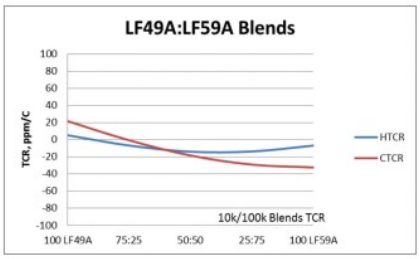
Blend Behavior – TCR

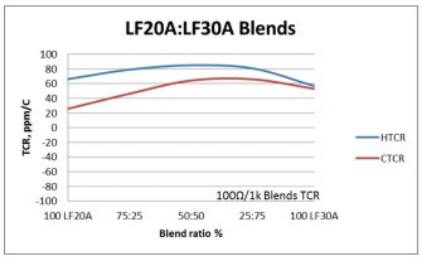
Data based on 1.0x1.0 mm

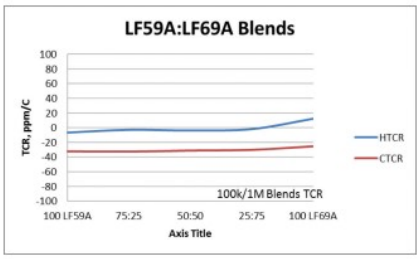
HTCR = 25°C - 125°C, CTCR = –55°C - 25°C

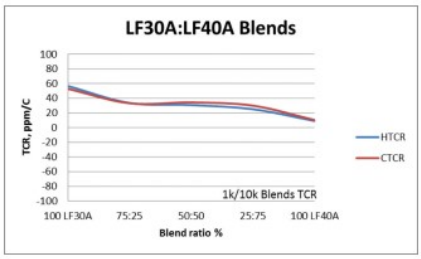
Data based on 1.0x1.0 mm resistors with Pb-free LF171 Ag/Pt terminations











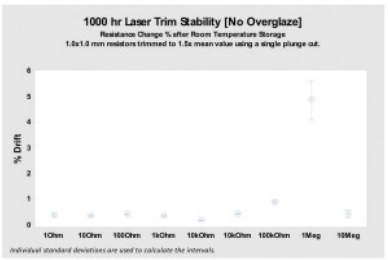
Micromax™ LF20A

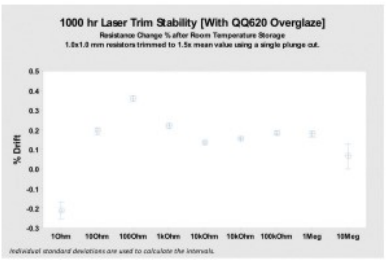
Electronic Inks and Pastes

Laser Trim Stability – 1000 hours

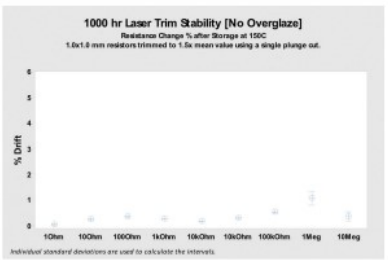
Unglazed **VS** **Glazed with QQ620**

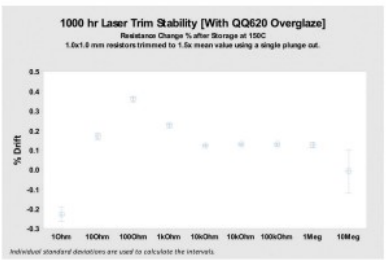
Room Temperature Storage



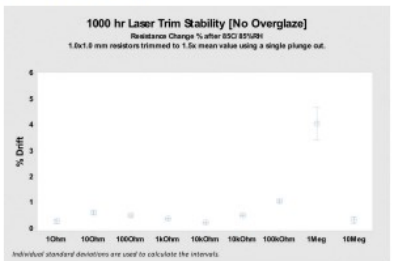


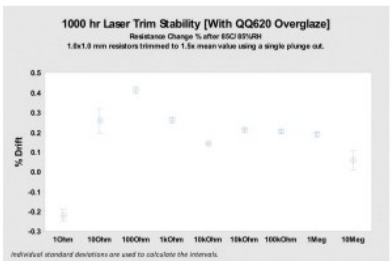
Storage at 150°C



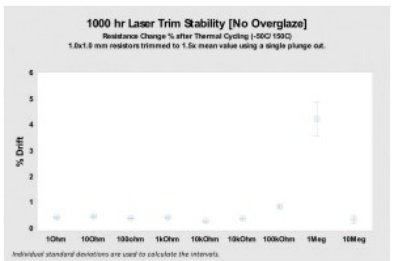


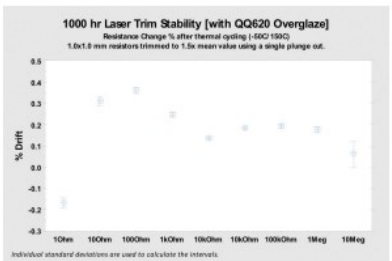
Storage at 85°C/85%RH





After Thermal Cycling –50°C/150°C

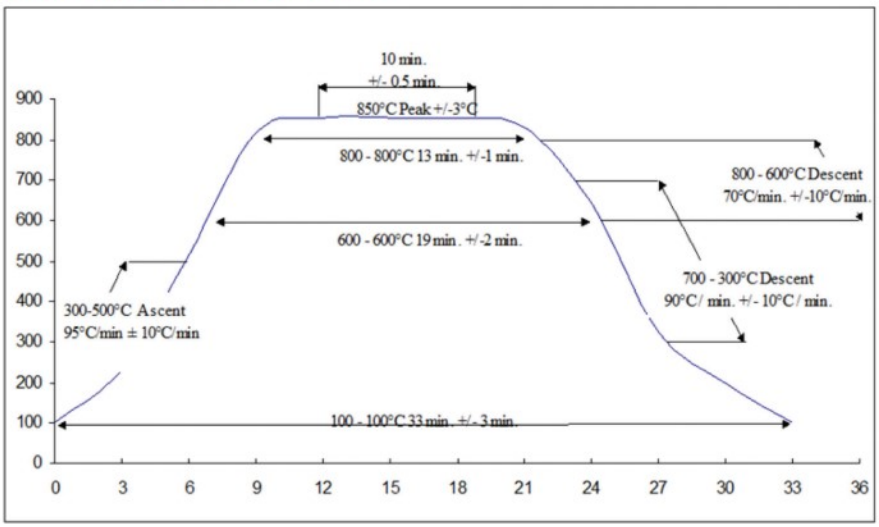




Micromax™ LF20A

Electronic Inks and Pastes

Figure 1 – Typical 30 minute Furnace Profile



Revised: 2023-06-27 Source: Celanese Materials Database