

# THICK FILM PASTE

Tanaka Kikinzoku International K.K.

## Thick Film Pastes for Markets and Applications-1

MARKET	APPLICATION	Ag paste	AgPt paste	AgPd paste	Au paste	Cu paste	Resistor paste	Glass paste
Hybrid IC	Alumina and Glass substrate	TR-3025	TR-3911	TR-4865	TR-1301	TR-8901	RXBseries	LS-402
		MH-2014	TR-3913	TR-4846	TR-114H	TR-8602	EX series	LS-453
		MH-201D	TR-3914	TR-4940	TR-1401	TR-8903		LS-656
		904T	TR-3911N	TR-4835	TR-1404			LS-655
		FSP-306T	TR-3929	TR-4931	TR-1531			LS-661
		MH-106D		TR-2637				LS-653
		TR-3026		TR-2634				
				TR-4920				
			AgPdPt paste	TR-4910				
			TR-2914	TR-4919				
	LTCC Low Temperature Co-fired Ceramic		TR-6610	TR-6027	TR1532		RL series	
			TR-6615					
			TR-6619					
Resistor Market	Chip resistor	TR-5600		TR-4868				LS-501
				TR-4844				
				TR-5850				
				TR-5852				
				TR-5822				
				TR-5825				
				TR-5811				
				TR-4821				
	Network Resistor	TR-3025	TR-3911	TR-4835			RXBseries	LS-402
				TR-4920			EXseries	
				TR-4910				
	Variable Resistor			TR-4943				
				TR-4944				
				TR-2960				
				TR-2961				
	Other Resistors			TR-4929				
				TR-4865				
				TR-4866				
				TR-4849				

## Thick Film Pastes for Markets and Applications-2

MARKET	DEVICE	Ag paste	AgPt paste	Au paste	Resistor paste	Glass Paste
Printer Market	Thermal Printer Head	TR-3026	TR-3911	TR-114G	GZX series	LS-201N
				TR-1206	GZK series	LS-213N
				TR-1202	GZC series	LS-223N
				TR-1203	GW series	LS-207
				TR-120E		
				GB-215AG		
	Laser Printer		TR-3911			LS-458
						LS-454
	Image sensor		TR-3913			LS-411
						LS-655
	DEVICE	Ag powder	Pd powder			
Capacitor Market	Ceramic Capacitor	AY-6010	AY-4010			
			AY-4030			
	MARKET	Pt paste	Pt powder	PtRh powder	PtAu powder	PtIr powder
Other Applications	Sensor	TR-7601	AY-1010	AY13 series	AY15 series	AY17 series
		TR-7902	AY-1020			
		TR-7905	AY105series			
		TR-709P				
		TR-707				
	Heater & Surge	AgPd resistor	Glass paste			
		TR9000series	LS-453			
			LS-454			
			LS-458			
	DEVICE	AgPd paste				
	Fuel Sensor	TR-4929				
		TR-4865				
		TR-4866				
		TR-4849				
	APPLICATION	Ag paste	Ag powder			
	Polymer	TS-5201	AY-6010			
		TS-5202	AY-6080			
	DEVICE	Ag paste				
	Display	MH-406A				

## Electronic Material for Thick Film Technology

Summary of TKI's thick film pastes for microelectronics products such as hybrid IC, chip resistors, resistor network, thermal printer heads and other electrical circuits of various form.

### ■ Silver/Silver alloy/Copper pastes

Products	Material	Resistivity mΩ/□ at 10 μm	Firing Temperature ℃	Feature & Applications
TR3025	Ag	< 3.5	850	Good solderbility and adhesion strength
904T	Ag	< 4	600	Applicable on Glass substrate
TR5600	Ag	< 3	600	2nd Electrode for Chip resistor
MH406A	Ag	< 3	500	Dense film at 3 μm after low temperature firing
TR3911	Ag/Pt	< 5	850	High conductivity, Excellent solder acceptance
TR3913	Ag/Pt	< 5	850	Good adhesion strength after Thermal cycle test
TR3914	Ag/Pt	< 6	850	Good adhesion strength after Thermal aging
TR3911N	Ag/Pt	< 6	850	Suitable for flip chip application
TR3929	Ag/Pt	< 5	850	Through hole printable AgPt paste
TR4910	Ag/Pd	< 7	850	TR4900 series has excellent adhesion strength after thermal aging and is available in several versions according to Pd content
TR4920	Ag/Pd	< 14	850	
TR4931	Ag/Pd	< 17	850	
TR4940	Ag/Pd	< 21	850	
TR4846	Ag/Pd	< 25	850	The best selling AgPd conductor paste in the world market.
TR4865	Ag/Pd	< 35	850	High resistance for silver migration and solder leach
TR2637	Ag/Pd	< 21	850	Excellent compatibility with dielectric paste for the multilayer circuit
TR2914	Ag/Pd/Pt	< 15	850	Minimize metal cost keeping solder leach resistance
TR8901	Cu	< 4	900	For high firing temperature
TR8903	Cu	< 4	900	Plating solution resistance
TR8602	Cu	< 7	600	For low firing temperature
TR9000	Ag/Pd	20~10000	850	Excellent TCR value covering lower resistivity range

### ■ Platinum conductor pastes

Products	Material	Resistivity mΩ/□ at 10 μm	Firing Temperature ℃	Feature & Applications
TR7601	Pt	< 55	930	Standard Pt paste with frit
TR7905	Pt	< 40	930	Fritless type
TR7902	Pt	< 40	1200	For High firing temperature
TR709P	Pt	< 20	1400	Dense film is applicable for thinner thickness
TR707	Pt	< 400	1200	Controlled sintering is suitable for sensor part

### ■ Gold conductor pastes

Products	Material	Resistivity mΩ/□ at 10 μm	Firing Temperature ℃	Feature & Applications
For Printing				
TR114H	Au	≤ 4.5	850	Excellent wire bondability and fine line resolution
TR1301	Au	≤ 4.5	850	Excellent wire bondability and fine line resolution with higher adhesion strength
TR1531	Au	≤ 4.5	850	Excellent & stable wire bondability by pin hole less film and fine line resolution
TR1532	Au	≤ 4.5	850	Applicable for top electrode of LTCC circuit
TR1401	Au	≤ 4.5	600	Applicable on glass substrate
For Etching				
TR114G	Au	≤ 4.5	850	Smooth and dense fired film at less than 3.5 μm
TR1202	Au	≤ 4.5	850	Smooth and dense fired film at less than 2.5 μm
TR1203	Au	≤ 4.5	850	Smooth and dense fired film at less than 2 μm
TR1206	Au	≤ 4.5	850	Higher adhesion strength version of TR114G
TR120E	Au	≤ 4.5	550	Applicable on glass substrate at less than 2 μm
MOD				
GB215AG	Au	≤ 60 at 1.0 μm	810	Fired thickness is 0.4~0.5 μm (1printing)

Values in above table are not specified, just representative values.

■ RuO<sub>2</sub> resistor pastes

Products	Resistivity Range $\Omega/\square$ at 10 $\mu\text{m}$	Firing Temperature $^{\circ}\text{C}$	Feature & Applications
<b>Hybrid IC applications</b>			
RX-B series	10~1M	850	High resistance for high voltage
EX series	10~10M	850	Conventional resister paste for HIC
RL series	10~500K	900	Pb Free resister paste for LTCC
<b>Thermal Printer Head applications</b>			
GZX series	0.5K~5K	830	Conventional resister paste for TPH
GZK series	0.5K~20K	800	High resistance for high power loading
GZC series	1K~20K	800	Suitable for Thin thickness
GW series	0.5K~10K	830	Suitable for Printer application
GWA series	10K~30K	830	Suitable for Printer application

## ■ Dielectric pastes

Products	Firing Temperature $^{\circ}\text{C}$	Feature & Applications
LS201N	800	Excellent surface roughness with Good wear resistance
LS213N	800	Better surface roughness with Better wear resistance
LS223N	850	Good surface roughness with Excellent wear resistance
LS207	600	Excellent surface roughness by firing at 600 $^{\circ}\text{C}$
LS402	530	Green color encapsulate
LS453	850	Green color, Suitable for surge circuit with TR9000 series
LS656	850	White color, High insulation resistance
LS653	850	For multilayer circuits
LS655	850	Black color, applicable for optical device like a image-sensor
LS661	900	N <sub>2</sub> fireble, Good compatible with TR8901

## ■ Precious metal powders

Precious metal powders			
Products	Tap density ( g/ml )	Particle Size ( $\mu$ m )	Surface Area ( $\text{m}^2/\text{g}$ )
Silver			
AY6010	1.2	9.5	1.7
AY6080	3	0.6	2.3
AY6032	2	6	0.3
Palladium & Silver Palladium alloy			
AY4010	3.5	2.3	4.5
AY4030	0.8	4	13
Platinum			
AY1010	5	5.5	1.7
AY1020	0.8	0.4	30
AY105 series	Newly developed Pt powders, details are available upon request		
Platinum Alloy & Rhodium			
AY13 series	Newly developed PtRh powders, details are available upon request		
AY15 series	Newly developed PtAu powders, details are available upon request		
AY304 series	Newly developed Rh powders, details are available upon request		

## ■ Solvent ( Applicable for the following our pastes )

Products	Paste products
TMS-1	For main Au paste, main Pt paste, GZ series, EX series, LS207, LS402, 904T
TMS-2	For Ag/Pd paste, Ag/Pt paste, MH2010, TR9000 series
TMS-3	For MH1429T
TMS-4	For TS8205, TS8244, TC8260
TMS-5	For LS601, RX-B series
TMS-7	For TR1202
TMS-8	For TR6619, TR1531, Cu paste, TR709P, TR707, LS453, LS656, LS661, LS653, LS655, LS201N, LS213N, LS223N,
TMS-10	For TR5852, TR5825, TR5811, TR3929

Values in above table are not specified, just representative value.



## Silver/Palladium conductor pastes

Our silver palladium pastes are designed to give excellent soldability and solder leach resistance with high adhesion strength for users.

### ■ Main features

High reliable performances with 22wt% palladium content in paste	TR4865
Most useful silver palladium paste with 15wt% palladium content in paste	TR4846
Excellent performance with 13wt% palladium content in paste	TR4940
Excellent performance with 11wt% palladium content in paste	TR4835
Excellent performance with 9.5wt% palladium content in paste	TR4931
Applicable for multilayer circuit with 9.5wt% palladium content in paste	TR2637
Applicable for multilayer circuit with 10wt% palladium content in paste	TR2634
Excellent performance with 7wt% palladium content in paste	TR4920
Excellent performance with 3wt% palladium content in paste	TR4910
Excellent performance with 1wt% palladium content in paste	TR4919

Typical Fired Properties			TR4865	TR4846	TR4940	TR4835	TR4931
Ag/Pd ratio		wt%	70/30	79/21	82/18	85/15	87/13
Recommended Firing Temperature		℃	850				
Fired Thickness		μ m	11±2				
Resistivity		mΩ /□ at 10 μ m	< 35	< 25	< 21	< 20	< 17
Solder acceptance		%	> 90				
Solder leach resistance		Cycles	> 4	> 3		> 2	
Adhesion strength	Initial	N/2mm□	30			25	30
	150℃ 1000H	N/2mm□	15		20	10	20
Viscosity		Pa•s	350±35	270±25	225±25	230±25	225±25
Thinner			TMS-2				

Typical Fired Properties			TR2637	TR2634	TR4920	TR4910	TR4919
Ag/Pd ratio		wt%	87/13		91/9	96/4	98.7/1.3
Recommended Firing Temperature		℃	850				
Fired Thickness		μ m	11±2			9±2	
Resistivity		m Ω /□ at 10 μ m	<21	<19	<14	<7	<15
Solder acceptance		%	>90				
Solder leach resistance		Cycles	>2	>3	>2		
Adhesion strength	Initial	N/2mm□	35		30	50	35
	150℃ 1000H	N/2mm□	25		20		10
Viscosity		Pa•s	225±25				325±25
Thinner			TMS-2				

Values in above table are not specified, just representative values.

## Silver/Platinum conductor pastes

## ■ Main features

Latest Silver Platinum paste with High Temperature Migration resistance

TR3911N

Excellent solder acceptance

TR3911

Excellent Adhesion Strength under Heat Cycle and High Temperature Aging

TR3913

Excellent Aged Adhesion Strength

TR3914

Improved from TR3913 to form through hole same as AgPd paste

TR3929

Typical Fired Properties			TR3911N	TR3911	TR3913	TR3914	TR3929
Ag/Pt ratio		wt%	99/1				99.5/0.5
Recommended Firing Temperature		℃	850				
Fired Thickness		μ m	11±4	9±2	11±2		
Resistivity		mΩ/□ at 10 μ m	<6	<5		<6	<5
Solder acceptance		%	>95			>90	>95
Solder leach resistance		Cycles	>2				
Adhesion strength	Initial	N/2mm□	50			40	50
	150℃ 1000H	N/2mm□	25	15		30	15
Viscosity		Pa•s	250±25	275±25	225±25		
Thinner			TMS-2				TMS-10

Values in above table are not specified, just representative values.

## Silver conductor pastes

## For Low firing temperature

## ■ Main features

These Ag pastes have good performance with weak heat resistance substrate for hybrid IC application such as glass and piezoelectric substrate.

Standard Ag paste for low firing temperature

904T

Suitable for lower firing temperature than 904T

FSP-306T

Suitable for soldering

MH106D

450 deg.C low firing temperature is available by using super fine Ag particle,

MH406A

Thin, dense and Pb free film is suitable for FPD (Flat Panel Display) application

Typical Fired Properties		904T	FSP306T	MH106D	MH406A
Recommended Firing Temperature	°C	600	550	600	500
Fired Thickness	μ m	9±2			3±1
Resistivity	mΩ/□ at 10 μ m	<4			<3
Adhesion strength	Initial	N/2mm□	Glass 5 Alumina 25	Glass 5 Alumina 10	No Peeling Tape Peel Test
Viscosity	Pa•s	100±20	175±25	375±25	150±30
Thinner		TMS-1	TMS-2		

## For High firing temperature

## ■ Main features

High electric conductive electrode can be formed easily on high heat resistive substrate like alumina.

Standard Ag paste for conventional firing temperature

TR3025

Suitable for Barium Titanate and Piezoelectric substrate

MH2014

Suitable for Low alumina and piezoelectric substrate

MH201D

Suitable for inner electrode of multi layer chip inductor using high crystallized Ag powder

TR6181

Low shrinkage paste, suitable for thermal via filling

TR690

Typical Fired Properties			TR3025	MH2014	MH201D	TR6181	TR690
Recommended Firing Temperature		℃	850			900	850
Fired Thickness		μ m	9±2	10±2		11±2	40±5
Resistivity		mΩ/□ at 10 μ m	<3.5	<5	<2.5	<3	<7
Solder acceptance		%	>90	>95		—	
Solder leach resistance		Cycles	>2			—	
Adhesion strength	Initial	N/2mm□	40	35	50	—	15
	150℃ 1000H	N/2mm□	25	15	—		
Viscosity		Pa•s	225±25		300±30	90±20	400±100
Thinner			TMS-2			TMS-14	TMS-8

Values in above table are not specified, just representative values.



## Silver conductor polymer pastes

### ■ Main features

These polymer Ag pastes are screen printable and have good adhesion and flexibility on PET film. Polyester resin is used, it has high temperature resistance in thermoplastics, .

Pot life is much longer as 6 months than usual epoxy Ag paste TS5201

Quite low resistivity as less than  $2 \times 10^{-5} \Omega \cdot \text{cm}$  can be achieved TS5202  
by curing at 150°C for 5minites

Typical Fired Properties		TS5201	TS5202
Ag content	wt%	80	78
Curing Temperature Range		120~180°C	
Recommended Curing Temperature	°C	150°C	
Recommended Cure time	min.	30	5
Cured Thickness	$\mu\text{m}$	$12 \pm 2$	
Printing Resolution	(325 mesh screen)	200 $\mu\text{m}$ line/150 $\mu\text{m}$ space	
Resistivity	$\text{m}\Omega/\square$ at 10 $\mu\text{m}$	$\leq 5 \times 10^{-5} \Omega \cdot \text{cm}$	$\leq 2 \times 10^{-5} \Omega \cdot \text{cm}$
Adhesion	Tape peel test	No peeling	
Viscosity	$\text{Pa} \cdot \text{s}$	$100 \pm 20$	$100 \pm 20$
Thinner		Thinner B	TMS-17

Values in above table are not specified, just representative values.

## Gold conductor pastes

### For Screen Printing

#### ■ Main Features

Applicable on alumina substrate with excellent Au wire bondability and fine line resolution

Excellent Au wire bondability and fine line resolution

TR114H

Less depleted adhesion after Ultrasonic treatment

TR1301

Excellent Au wire bondability and stability by dense fired film

TR1531

Applicable on glass substrate

Good adhesion strength and dense film after 600°C firing

TR1401

Excellent Au wire bondability with 3~5 μm fired film with less pin-hole

TR1404

Typical Fired Properties		on alumina substrate			on glass substrate	
		TR114H	TR1301	TR1531	TR1401	TR1404
Recommended Firing Temperature	°C	850			600	
Fired Thickness	μm	8 ± 2			7 ± 1	4 ± 1
Resistivity	mΩ/□ at 10 μm	≤ 4.5				
Viscosity	Pa·s	450 ± 50	400 ± 50			250 ± 50
Thinner		TMS-1		TMS-8	TMS-1	

### For Etching

#### ■ Main Features

Applicable on alumina substrate

Smooth surface and dense fired film at 3 μm fired thickness

TR114G

High adhesion strength, smooth surface and dense fired film at 3 μm fired thickness

TR1206

Applicable on glazed substrate (can use Alumina substrate as well)

Smooth surface and dense fired film at 2.5 μm fired thickness

TR1202

Smooth surface and dense fired film at 2 μm fired thickness (without dilution)

TR1203

Applicable on glass substrate

TR120E

Smooth surface and dense fired film at 2 μm fired thickness

MOD(Au organic compound) paste of high metal content

GB215AG

Typical Fired Properties		Alumina substrate		Glazed substrate		Glass subst.	MOD
		TR114G	TR1206	TR1202	TR1203	TR120E	GB215AG
Recommended Firing Temperature	℃	850				550	810
Fired Thickness	μ m	3.5±0.5		3.0±0.5	1.75±0.25		0.45±0.1
Resistivity	m Ω /□ at 10 μ m	≤4.5					≤60 (1.0 μ m)
Viscosity	Pa•s	350±50		200±40	25±15		60±20
Thinner		TMS-1		TMS-7	TMS-1		TMS-9

Values in above table are not specified, just representative values.

## Conductor pastes for Network Resister application

TKI can supply silver/palladium, silver/platinum, silver paste suitable for network resister

### ■ Main Features

Glass bond type of silver palladium paste	TR4835
Mix bond type of silver palladium paste	TR4920
Mix bond type of silver palladium paste	TR4910
Mix bond type of silver paste	TR3025
Mix bond type of silver platinum paste	TR3911

Typical Fired Properties			Ag/Pd			Ag	Ag/Pt
			TR4835	TR4920	TR4910	TR3025	TR3911
Ratio	wt%		85/15	91/9	96/4	100	99/1
Recommended Firing Temperature	℃		850				
Fired Thickness	μ m		11±2		9±2		
Resistivity	mΩ/□ at 10 μ m		<20	<14	<7	<3.5	<5
Solder acceptance	%		>90				>95
Solder leach resistance	Cycles		>2				
Adhesion strength	Initial	N/2mm□	25	30	50	40	50
	150℃ 1000H	N/2mm□	10	20	20	25	15
Viscosity	Pa•s		230±25	225±25			275±25
Thinner			TMS-2				

Values in above table are not specified, just representative values.

## Conductor pastes for Chip Device application

### ■ Main Features

Excellent chemical proof (plating solution) for first conductor (C1) Pd content 23% in paste	TR4868
Excellent chemical proof (plating solution) for first conductor (C1) Pd content 16% in paste	TR4844
Excellent chemical proof (plating solution) for first conductor (C1) Pd content 5% in paste	TR5852
Excellent chemical proof (plating solution) for first conductor (C1) Pd content 2% in paste	TR5825
Excellent chemical proof (plating solution) for first conductor (C1) Pd content 1% in paste	TR5811
Excellent chemical proof (plating solution) for first conductor (C1) silver paste	TR3026
Excellent chemical proof (plating solution) for second conductor (C2) Pd content 6.7% in paste	TR4821
Excellent chemical proof (plating solution) for second conductor (C2) silver paste	TR5600

Typical Fired Properties			Ag/Pd				
			TR4868	TR4844	TR5852	TR5825	TR5811
Ag/Pd ratio		wt%	70/30	79/21	93/7	97.5/2.5	98.7/1.3
Recommended Firing Temperature		℃	850				
Fired Thickness		μ m	10±1		6±1		
Resistivity		mΩ /□ at 10 μ m	< 30	< 21	< 10	< 5	
Adhesion strength	Initial	N/2mm□	30	35	40		
	10% HCl 12min.	N/2mm□	15				
Viscosity		Pa•s	280±30	275±25	225±25	270±30	
Thinner			TMS-2		TMS-10		

Values in above table are not specified, just representative values.

Typical Fired Properties			Ag	Ag/Pd	Ag
			TR3026	TR4821	TR5600
Ag/Pd ratio		wt%	100	90/10	100
Recommended Firing Temperature		℃	850	600	
Fired Thickness		μ m	9±2		
Resistivity		mΩ/□ at 10 μ m	<4	<23	<4
Adhesion strength	Initial	N/2mm□	35	25	40
	10% HCl 12min.	N/2mm□	15		
Viscosity		Pa•s	225±25	110±20	150±25
Thinner			TMS-2		

Values in above table are not specified, just representative values.

## Conductor Paste for Variable resister application

### ■ Main Features

Silver palladium composition with tough dried film strength	TR4943
Silver palladium composition with tough dried film strength for dipping process	TR4944
Ternary silver palladium platinum composition with excellent solder leach resistance	TR2960
Ternary silver palladium platinum composition with lower viscosity	TR2961
Ternary silver palladium platinum composition to reduce metal cost keeping solder reaching	TR2914

Typical Fired Properties			Ag/Pd		Ag/Pd/Pt		
			TR4943	TR4944	TR2960	TR2961	TR2914
Ratio	wt%		82/18	79/21	68/29/3	72/26/2	94.6/4.5/0.9
Recommended Firing Temperature	°C		850				
Fired Thickness	μ m		11 ± 2				
Resistivity	mΩ / □ at 10 μ m		< 21	< 25	< 47	< 44	< 15
Solder acceptance	%		> 90				
Solder leach resistance	Cycles		> 3		> 5	> 4	> 2
Adhesion	Initial	N/2mm□	30				40
strength	150°C 1000H	N/2mm□	20	15	20	18	20
Viscosity	Pa•s		225 ± 25	50 ± 10	300 ± 35	80 ± 20	225 ± 35
Thinner			TMS-2				

Values in above table are not specified, just representative values.

## Conductor Paste for Fuel Sensor application

### ■ Main Features

Low residual resistance	TR4929
Good wear resistance	TR4865
Excellent wear resistance	TR4866
Good wear resistance	TR4849

Typical Fired Properties			Ag/Pd			
			TR4929	TR4865	TR4866	TR4849
Ag/Pd ratio		wt%	90/10	70/30		79/21
Recommended Firing Temperature		℃	850			
Fired Thickness		μ m	11±2			
Resistivity		mΩ /□ at 10 μ m	< 15	< 35	< 40	< 43
Solder acceptance		%	>90		>50	—
Solder leach resistance		Cycles	>2	>4		—
Adhesion strength	Initial	N/2mm□	30			
	150℃ 1000H	N/2mm□	15			
Viscosity		Pa•s	225±25	350±35		225±25
Thinner			TMS-2			

Values in above table are not specified, just representative values.



## Conductor pastes for low temperature co-fired ceramic application

TKI can supply top and inner layer of conductor pastes for low temperature co-fireable ceramic (LTCC) substrate application.

### ■ Main Features

Fritless, Low resistivity and excellent solder acceptance AgPt paste	TR6610
Low resistivity and excellent solder leach resistance AgPt paste	TR6615
Frit type, Low resistivity and excellent solder acceptance AgPt paste	TR6619
Excellent solder leach resistance and silver migration resistance AgPd paste	TR6027
Frit type, Excellent wire bondability Au paste	TR1532

Typical Fired Properties			Ag/Pt			Ag/Pd	Au
			TR6610	TR6615	TR6619	TR6027	TR1532
Ratio	wt%		99.6/0.4	99/1	99.5/0.5	79/21	100
Recommended Firing Temperature	°C		850		900	850	
Fired Thickness	μm		11 ± 2	9 ± 2	24 ± 3	11 ± 2	8 ± 2
Resistivity	mΩ/□ at 10 μm		< 7	< 5	< 8	< 25	≤ 4.5
Solder acceptance	%		> 95		–	> 90	–
Solder leach resistance	Cycles		> 1	> 2	–	> 3	–
Adhesion strength	Initial	N/2mm□	40		–	30	–
	150°C 1000H	N/2mm□	15		–	15	–
Viscosity	Pa·s		225 ± 25	275 ± 25	250 ± 50		
Thinner			TMS-2		TMS-8	TMS-2	TMS-8

Values in above table are not specified, just representative values.

Performances depend on conditions like a substrate composition and firing temperature, please confirm details to TKI.

## Copper conductor pastes

## ■ Main Features

N<sub>2</sub> fireable at 900°C, High conductivity and excellent fine line resolution TR8901

Excellent solder leach resistance

N<sub>2</sub> fireable at 900°C, High conductivity and excellent fine line resolution TR8903

Excellent chemical proof (plating solution)

N<sub>2</sub> fireable at 600°C, High conductivity and excellent fine line resolution TR8602

Excellent solder leach resistance

Typical Fired Properties			TR8901	TR8903	TR8602
Recommended Firing Temperature		°C	900		600
Fired Thickness		μ m	12 ± 2		20 ± 2
Resistivity		mΩ/□ at 10 μ m	< 4		< 7
Solder acceptance		%	> 90	-----	> 70
Solder leach resistance		Cycles	> 4	-----	> 4
Adhesion strength	Initial	N/2mm□	35		30
	150°C	N/2mm□	20 (1000H)	* 13	15 (500H)
Viscosity		Pa·s	200 ± 25		335 ± 35
Thinner			TMS-8		

\*12 minuets dip in 10% of Hydrochloric acid (No thermal aging)

Values in above table are not specified, just representative values.

## Platinum pastes for sensor application

### ■ Main Features

Glass bond type for lower firing temperature	TR7601
Fritless for lower firing temperature	TR7905
For high firing temperature	TR7902
Dense film for thinner thickness	TR709P
Controlled sintering is suitable for sensing part	TR707

Typical Fired Properties			TR7601	TR7905	TR7902	TR709P	TR707
Recommended Firing Temperature		℃	930		1200	1400	1200
Fired Thickness		μ m	12±3		9±2	6±2	15±5
Resistivity		mΩ/□ at 10 μ m	< 55	< 40		< 20	300-400
Adhesion strength	Initial	N/2mm□	20	15		20	---
Viscosity		Pa•s	250±50			300±50	
Thinner			TMS-1			TMS-8	

Values in above table are not specified, just representative values.

## Low ohm resister

## ■TR9000 series

- Excellent performance against surge
- Excellent TCR, especially 100m $\Omega$  /  $\square$  to 10 $\Omega$  /  $\square$  version have  $\pm 50\text{ppm}/^\circ\text{C}$  as hot TCR.

Typical Fired Properties			TR9100	TR9200	TR9101	TR9102
Sheet resistivity	m $\Omega$ / $\square$ at 10 $\mu$ m		100	200	1000	10000
Tolerance of resistivity (batch to batch)	%		$\leq \pm 30$			
Standard deviation of resistivity (1 $\sigma$ )	%		$\leq 10$			
Recommended firing temperature	$^\circ\text{C}$		850			
Fired Thickness	$\mu$ m		$11 \pm 2$			
TCR	HOT	ppm/ $^\circ\text{C}$	$-50 \sim +50$			
	COLD	ppm/ $^\circ\text{C}$	$0 \sim +90$			
Viscosity	Pa $\cdot$ s		$275 \pm 25$			
Thinner			TMS-2			

Typical Fired Properties			TR9020	TR9040	TR9070	TH9060
Sheet resistivity		mΩ/□ at 10 μm	20	40	70	80
Tolerance of resistivity (batch to batch)		%	< ±30	≤ ±30		
Standard deviation of resistivity (1 σ)		%	< 10	≤ 10		
Recommended firing temperature		℃	850			
Fired Thickness		μm	11 ± 2			7 ± 1
TCR	HOT	ppm/℃	400 ~ 500	350 ~ 450	300 ~ 450	50 ~ 150
	COLD	ppm/℃	450 ~ 550	350 ~ 500	300 ~ 450	0 ~ 150
Viscosity		Pa·s	275 ± 25			250 ± 25
Thinner			TMS-2			

Values in above table are not specified, just representative values.

## Resister paste for Hybrid IC application

### ■RX-B series

•RuO<sub>2</sub>Pb<sub>6</sub> system

•Excellent ESD

Typical Fired Properties		RX					
		1101B	1102B	1103B	1104B	1105B	1106B
Sheet resistivity	$\Omega/\square$ at 12 $\mu$ m	10	100	1K	10K	100K	1M
Tolerance of resistivity (batch to batch)	%	$\leq \pm 20$					
Standard deviation of resistivity (1 $\sigma$ )	%	$\leq 5$					$\leq 7$
Recommended firing temperature	$^{\circ}\text{C}$	850					
Fired Thickness	$\mu$ m	10 $\pm$ 3					
TCR	ppm/ $^{\circ}\text{C}$	$\leq \pm 150$	$\leq \pm 100$				$\leq \pm 150$
Viscosity	Pa $\cdot$ s	170 $\pm$ 20				140 $\pm$ 20	
Thinner		TMS-5					

Note: Resister pastes of RX-B series are blendable to adjust resistance

### ■EX series

•Excellent performances with silver rich pastes

Typical Fired Properties		EX						
		11	12	13	14	15	16	17
Sheet resistivity	$\Omega/\square$ at 12 $\mu\text{m}$	10	100	1K	10K	100K	1M	10M
Tolerance of resistivity (batch to batch)	%	$\leq \pm 15$						
Standard deviation of resistivity (1 $\sigma$ )	%	$\leq 5$						$\leq 8$
Recommended firing temperature	$^{\circ}\text{C}$	850						
Fired Thickness	$\mu\text{m}$	$10 \pm 2$						
TCR	ppm/ $^{\circ}\text{C}$	$\leq \pm 100$						
Viscosity	Pa·s	$160 \pm 20$						
Thinner		TMS-1						

Note: Resister pastes of EX series are blendable to adjust resistance

Values in above table are not specified, just representative values.

## Resister paste for LTCC application

## ■ RL series

• Pb Free system

• Applicable for LTCC

Typical Fired Properties		RL					
		11	21	31	41	51	55
LTCC substrate		LFC *2					
Conductor		TR3913*3					
Over Glass		OG-B*3					
Recommended dry thickness	$\mu\text{ m}$	$20\pm2$					
Sheet resistivity	$\Omega/\square$ at $20\mu\text{ m}^{*1}$	10	100	1K	10K	100K	500K
Tolerance of resistivity (batch to batch)	%	$\leq\pm10$					$\leq\pm15$
Recommended firing temperature	$^{\circ}\text{C}$	900					
ESD	%	$\pm1$			$\pm5$	$\pm10$	
STOL	%	$\pm0.3$					
Hot TCR	ppm/ $^{\circ}\text{C}$	-50~150	$\leq\pm100$				-150~50
Cold TCR	ppm/ $^{\circ}\text{C}$	-50~150	$\leq\pm100$				-150~50
Viscosity	Pa•s	$220\pm30$					
Thinner		TMS-1					

Note: Resister pastes of RL series are blendable to adjust resistance

\*1: Sheet resistivity was calculated as dry thickness, because co-firing with OG is recommended.

\*2: LFC is a LTCC substrate produced by Sumitomo Kinzoku Electrodevice

\*3: TR3913 is Pb free AgPt paste, and OG-B is Pb free over glaze paste.

Values in above table are not specified, just representative values.

## Test Condition

## Screen

Stainless 200mesh emulsion  $35\mu\text{m}$  for RL11, RL21Stainless 200mesh emulsion  $20\mu\text{m}$  for RL31, RL41, RL51, RL55

## Firing

 $900^{\circ}\text{C}$  peak temperature for 8min.

## Sheet Resistivity

 $L \times W = 2.0\text{mm} \times 1.0\text{mm}$ 

## TCR

 $L \times W = 2.0\text{mm} \times 1.0\text{mm}$  Hot TCR:  $25 \sim 150^{\circ}\text{C}$ , Cold TCR:  $-55^{\circ}\text{C} \sim 25^{\circ}\text{C}$ 

## ESD

 $L \times W = 1.0\text{mm} \times 1.0\text{mm}$  100pF 5 pulse mediated 2KV and 1.5KV resistor

## STOL

 $L \times W = 1.0\text{mm} \times 1.0\text{mm}$  3V to RL11, 13.2V to RL21, 43V to RL31, 116V to RL41, 192V to RL51 and RL55 to 200V were loaded for 5 sec..



## Resister paste for Thermal Print Head application

### ■ GZX series

- Standard resistor paste for Thermal print Head has high power loading resistance

Typical Fired Properties		GZX			
Sheet resistivity	$\Omega/\square$	0.5K	1K	2K	5K
Tolerance of resistivity (batch to batch)	%	$\leq \pm 10$			
Standard deviation of resistivity ( $1\sigma$ )	%	$\leq 5$			
Recommended firing temperature	$^{\circ}\text{C}$	830			
Fired Thickness	$\mu\text{m}$	$15 \pm 2$			
SST W resistance ( $\Delta R+5\%$ )	W	$\geq 7$		$\geq 6$	
	Max minus $\Delta R\%$	$\leq 5$		$\leq 6$	$\leq 8$
Viscosity	$\text{Pa}\cdot\text{s}$	$300 \pm 50$			
Thinner		TMS-1			

Note: Resister pastes of GZX series are blendable to adjust resistance

### ■ GZK series

- Improved wattage resistance than GZX series
- Applicable for high dot density Thermal Print Head
- Small resistivity drift

Typical Fired Properties		GZK				
Sheet resistivity	$\Omega/\square$ at 12 $\mu$ m	0.5K	1K	5K	10K	20K
Tolerance of resistivity (batch to batch)	%	$\leq \pm 10$				
Standard deviation of resistivity (1 $\sigma$ )	%	$\leq 4$				
Recommended firing temperature	$^{\circ}\text{C}$	800				
Fired Thickness	$\mu$ m	$8 \pm 2$				
SST W resistance( $\Delta$ R+5%) Max minus $\Delta$ R%	W	$\geq 9$		$\geq 8$	$\geq 6$	$\geq 5$
	%	$\leq 1$		$\leq 2$	$\leq 3$	
Viscosity	Pa•s	$250 \pm 50$				
Thinner		TMS-1				

Note: Resister pastes of GZK series are blendable to adjust resistance

Values in above table are not specified, just representative values.

## Resister paste for Thermal Print Head application

### ■ GZC series

- Improved wattage resistance at  $4\mu\text{m}$
- Excellent thermal response and good for fast printer application
- Excellent surface roughness

Typical Fired Properties		GZC			
Sheet resistivity	$\Omega/\square$ at $3\mu\text{m}$	1K	5K	10K	20K
Tolerance of resistivity (batch to batch)	%	$\pm 10$			
Standard deviation of resistivity ( $1\sigma$ )	%	$\leq 4$			
Recommended firing temperature	$^{\circ}\text{C}$	800			
Fired Thickness	$\mu\text{m}$	$4 \pm 1$			
SST	W resistance ( $\Delta R+5\%$ )	$\geq 7$	$\geq 6$	$\geq 5$	$\geq 4$
	Max minus $\Delta R\%$	$\leq 1$	$\leq 2$	$\leq 3$	$\leq 3$
Viscosity	$\text{Pa}\cdot\text{s}$	$150 \pm 20$			
Thinner		TMS-1			

Note: Resister pastes of GZC series are blendable to adjust resistance

### ■ GW series

- Latest resistor paste for Thermal Print Head has excellent wattage resistance
- Suitable for low resistance Thermal Print Head required high power loading and heat resistance

Typical Fired Properties		GW			
Sheet resistivity	$\Omega/\square$ at $12\mu\text{m}$	0.5K	1K	5K	10K
Tolerance of resistivity (batch to batch)	%	$\pm 15$			
Standard deviation of resistivity ( $1\sigma$ )	%	$\leq 4$			
Recommended firing temperature	$^{\circ}\text{C}$	830			
Fired Thickness	$\mu\text{m}$	$11 \pm 2$			
SST	W resistance ( $\Delta R+5\%$ )	$\geq 12$	$\geq 11$	$\geq 8$	$\geq 7$
	Max minus $\Delta R\%$	$\leq 1$	$\leq 2$	$\leq 25$	$\leq 35$
Viscosity	$\text{Pa}\cdot\text{s}$	$250 \pm 50$			
Thinner		TMS-1			

Note: Resister pastes of GW series are blendable to adjust resistance

Values in above table are not specified, just representative values.

## Resister paste for Thermal Print Head application

### ■GWA series

- Latest resistor paste for Thermal Print Head has excellent wattage resistance
- Suitable for high resistance Thermal Print Head required high power loading and heat resistance

Typical Fired Properties		GWA			
Sheet resistivity	$\Omega / \square$ at $12 \mu\text{m}$	10K	15K	20K	30K
Tolerance of resistivity (batch to batch)	%	$\pm 15$			
Standard deviation of resistivity ( $1\sigma$ )	%	$\leq 4$			
Recommended firing temperature	$^{\circ}\text{C}$	830			
Fired Thickness	$\mu\text{m}$	$11 \pm 2$			
SST W resistance ( $\Delta R + 5\%$ ) Max minus $\Delta R\%$	W	$\geq 9$	$\geq 8$	$\geq 7$	$\geq 7$
	%	$\leq 5$	$\leq 10$	$\leq 10$	$\leq 10$
Viscosity	$\text{Pa}\cdot\text{s}$	$250 \pm 50$			
Thinner		TMS-1			

Note: Resister pastes of GWA series are blendable to adjust resistance  
 Values in above table are not specified, just representative values.

## Dielectric pastes

### For overcoat glass

#### ■ Main Features

Dense, Excellent trimmable and Excellent humidity resistance paste LS402

High insulation resistance of high firing temperature paste LS453

recommend for high voltage circuit and heater application

High insulation resistance of high firing temperature paste LS656

recommend for high voltage circuit and heater application

### For cross over

#### ■ Main Features

High insulation resistance and high adhesion with top conductor LS601

N<sub>2</sub> fireble cross over glass, High insulation resistance and high break down voltage LS661

Compatible with Cu paste TR8901

### For multilayer

#### ■ Main Features

High insulation resistance and high break down voltage LS653

Black version of LS653, recommend for Image sensor application LS655

Typical Fired Properties		Over Coat			Cross Over		Multilayer	
		LS402	LS453	LS656	LS601	LS661	LS653	LS655
Surface roughness	$\mu\text{ m}$	—	<0.1	<0.5	—	—	—	<0.5
Recommended firing temperature	$^{\circ}\text{C}$	530	850			900	850	
Viscosity	$\text{Pa}\cdot\text{s}$	$180\pm 20$	$200\pm 50$	$250\pm 50$	$170\pm 20$	$200\pm 50$	$250\pm 50$	
Color		Green		White	M-White	Blue	B-Green	Black
Thermal Expansion Coefficient	$\times 10^{-7}\text{^{\circ}C}$	70	73	70	53	66	70	
Insulation Resistance	$\Omega$	$>10^{10}$	$>10^{12}$					
Break Down Voltage	DC V/25 $\mu\text{ m}$	—	>2500	>2000	—	>1250	>2500	>2000
Dielectric Constant	1KHz 25 $^{\circ}\text{C}$	8~10	6~8	9~11	9~14	8~10	10~11	
Fired Thickness	$\mu\text{ m}$	—	$15\pm 5$		$35\pm 5$		$32\pm 5$	
Thermal Conductivity	W/m $^{\circ}\text{C}$	—	3.3	8.7	3.5	9.0	8.7	
Dielectric Loss	%	—	0.1		—	0.2		1.2
Thinner		TMS-1	TMS-8		TMS-5	TMS-8		

Values in above table are not specified, just representative values.

## Glass pastes for Thermal Print Head application

### ■LS200 series

- Excellent surface roughness, pin-holes free and Good wear resistance **LS201N**
- Better surface roughness, pin-holes free and Better wear resistance **LS213N**
- Good surface roughness, pin-holes free and Excellent wear resistance **LS223N**
- Excellent surface roughness, pin-holes free at 600°C firing **LS207**

Typical Fired Properties		Cd Free			
		LS201N	LS213N	LS223N	LS207
Surface roughness	$\mu\text{m}$	<0.2	<0.3	<0.5	<0.05
Recommended firing temperature	°C	800		850	600
Viscosity	Pa·s	110±30			150±30
Color		White			
Thermal Expansion Coefficient	$\times 10^{-7}/^{\circ}\text{C}$	65	66	68	81
Thermal Conductivity	W/m°C	9	10	16	9
Thinner		TMS-8			TMS-1

Values in above table are not specified, just representative values.

## Glass Pastes for other applications

### ■ Main Features

Excellent plating solution resistance, Dense fired film, suitable for chip resister application	LS501
N <sub>2</sub> fireble, Excellent insulation resistance and Break down voltage	LS661
good for cross over application with copper conductor paste (TR8901)	
Excellent surface roughness, good for over coat Heater application	LS454

Typical Fired Properties		Chip Resister	N <sub>2</sub> Fireble	Heaters
		LS501	LS661	LS454
Surface roughness	$\mu\text{ m}$	—	—	<0.05
Recommended firing temperature	$^{\circ}\text{C}$	600	900	700
Viscosity	$\text{Pa}\cdot\text{s}$	$100 \pm 30$	$200 \pm 50$	$200 \pm 30$
Color		Black	Blue	Clear
Thermal Expansion Coefficient	$\times 10^{-7}^{\circ}\text{C}$	76	66	77
Insulation Resistance	$\Omega$	$>10^{10}$	$>10^{12}$	$>10^{10}$
Break Down Voltage	DC V/25 $\mu\text{ m}$	—	>1250	>1000
Dielectric Constant	1KHz 25 $^{\circ}\text{C}$	—	8~10	12~14
Fired Thickness	$\mu\text{ m}$	—	$35 \pm 5$	—
Thermal Conductivity	W/m $^{\circ}\text{C}$	—	2.1	—
Dielectric Loss	%	—	0.2	—
Thinner		TMS-5	TMS-8	

Values in above table are not specified, just representative values.



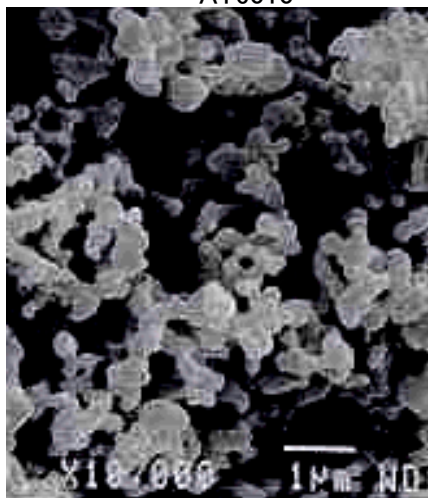
## Precious Metal Powders

### Silver

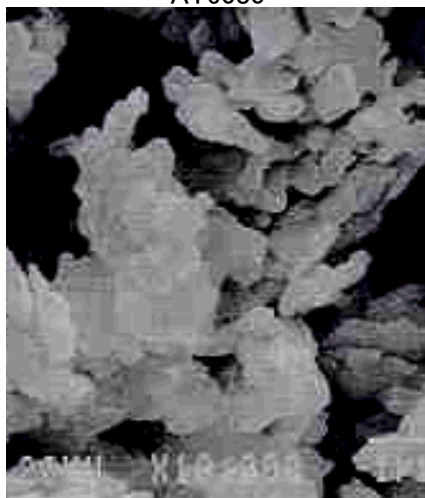
Products	AY6010	AY6080	AY6032
Tap density ( g/ml )	1.2	3	2
Particle Size ( $\mu\text{m}$ )	9.5*	0.6	6
Surface Area ( $\text{m}^2/\text{g}$ )	1.7	2.3	0.3

\*laser type particle sizer, ray transmission type is used for others.  
Values in above table are not specified, just representative values.

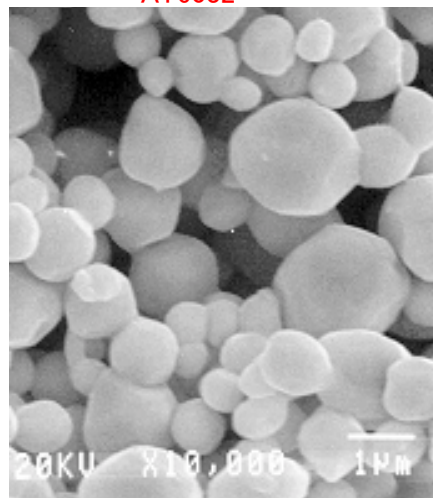
AY6010



AY6080



AY6032



### Palladium

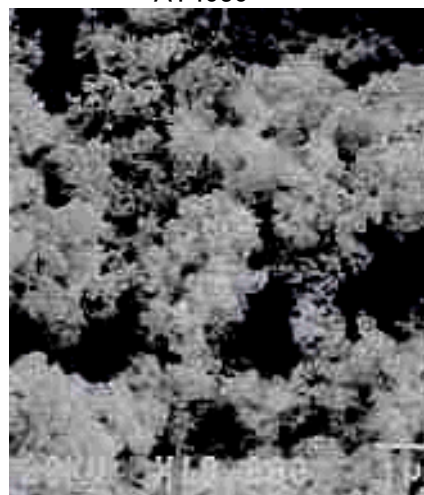
Products	AY4010	AY4030
Tap density ( g/ml )	3.5	0.9
Particle Size ( $\mu\text{m}$ )	2.8	4*
Surface Area ( $\text{m}^2/\text{g}$ )	4.5	13

\*laser type particle sizer, ray transmission type is used for others.  
Values in above table are not specified, just representative values.

AY4010



AY4030



## Precious Metal Powders

### Platinum

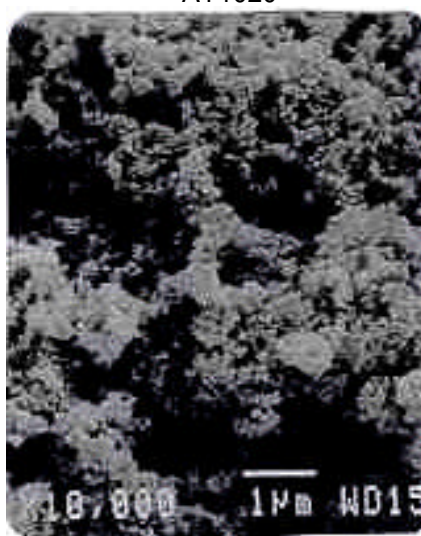
Products	AY1010	AY1020	AY105 series
Tap density ( g/ml )	5	0.8	Newly developed Pt powders, details are available upon request
Particle Size ( $\mu\text{m}$ )	5.5*	0.4	
Surface Area ( $\text{m}^2/\text{g}$ )	1.8	30	

\*laser type particle sizer, ray transmission type is used for others.  
Values in above table are not specified, just representative values.

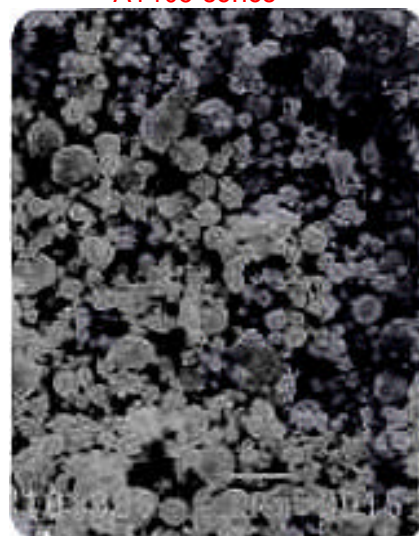
AY1010



AY1020



AY105 series

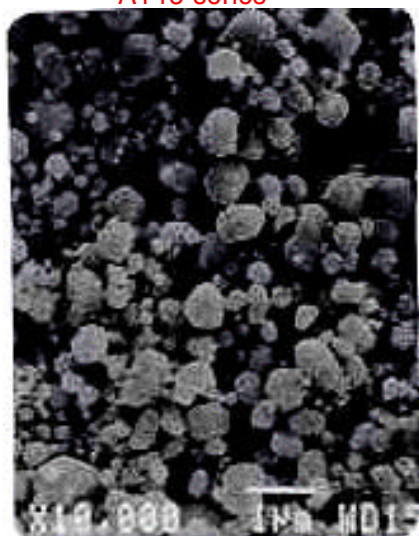


### Platinum Alloy & Rhodium

Products	AY13 series	AY15 series	AY304 series
Tap density ( g/ml )	Newly developed PtRh powders, details are available upon request	Newly developed PtAu powders, details are available upon request	Newly developed Rh powders, details are available upon request
Particle Size ( $\mu\text{m}$ )			
Surface Area ( $\text{m}^2/\text{g}$ )			

Values in above table are not specified, just representative values.

AY13 series



AY15 series



AY304 series



## TKI Test Condition

### Conductor Pastes

- |                            |   |
|----------------------------|---|
| 1) Fired Thickness         | On contact type of surface roughness gauge  |
| 2) Resistivity             | Digital multimeter  |
| 3) Solder acceptance       | Solder coverage after a 5sec. dip in 2Ag/36Pb/62Sn solder at 220°C  |
| 4) Solder Leach resistance | Numbers of dipped time was counted up to resistivity of 0.5mmW X 20mmL line achieve 1 ohm. Cycle consists of 10sec. dip in 2Ag/36Pb/62Sn solder at 250°C                                      |
| 5) Adhesion Strength       | Adhesion pad size of 2×2mm pad, 0.6mm dia tin plated copper wire at 90° to substrate plane  |
| 6) Viscosity               | Brookfield HBT model viscometer with spindle SC4-14, chamber No.6R at 10rpm within 25±1°C<br>MOD Au Brookfield HBT model viscometer with spindle SC4-14, chamber No.6R at 10rpm within 25±1°C |

### Resistor pastes

- |                  |                   |             |
|------------------|-------------------|-------------|
| Size of resistor | L/W=3.0/1.5mm     | RX-B series |
|                  | L/W=1.0/1.0mm     | EX series   |
| Conductor        | TR4846            | RX-B series |
|                  | TR3913            | EX series   |
| TCR              | Hot TCR 25~150°C  |             |
|                  | Cold TCR 25~-55°C |             |

### Low Ohm resistor

- |                  |                   |
|------------------|-------------------|
| Size of resistor | L/W = 74.2/0.7mm  |
| Conductor        | TR4846            |
| TCR              | Hot TCR 25~150°C  |
|                  | Cold TCR 25~-55°C |

### Resistor paste for Thermal Print Head

- |                  |  |
|------------------|--|
| Size of resistor | L/W = 3.0/1.5mm                                  |
| Conductor        | TR114H   |
| S.S.T.           | Pulse; 10msec. ON, 90msec. OFF, 3min. 1800 pulse |
|                  | L/W = 0.7/0.35mm ≤0.1KΩ                          |
|                  | L/W = 0.35/0.7mm ≥0.5KΩ                          |

### Glass pastes

- |                                  |   |
|----------------------------------|---|
| 1) Surface roughness             | On contact type of surface roughness gauge  |
|                                  | Cut off 0.08mm, distance 2.5mm, Magnification W×L = 2000×20                               |
| 2) Insulation resistance         | 100V DC   |
| 3) Thermal Expansion Coefficient | Measure voltage when it shows 2mA. applied voltage goes up every                          |
| 4) Dielectric Constant           | 1KHz, 1V at 25°C  |
| 5) Viscosity                     | Brookfield HBT model viscometer with spindle SC4-14, chamber No.6R at 10rpm within 25±1°C |

## Test Procedure of powder performance

The followings are our measurement methods for powder's physical properties.  
Please note that powder's physical properties depend on the measuring equipment and method.

### 1: Mean Particle Size

Use grinding distributions of a ray transmission machine with applied Stokes parameters.  
Mean particle size shows reach to 50% accumulated weight.

### 2: Tap Density

Fill the powders into measuring cylinders and fall from the height of 25mm.  
Be continuously natural falling test of those cylinders until saturation of powders volume.  
Tap density is calculated from volume and weight.

### 3: Specific Surface Area (SA)

$$\frac{6}{\rho D} = SA \quad \begin{array}{l} D = \text{Particle size} \\ \rho = \text{Specific gravity} \end{array}$$

Measurement of SA for Kantasove machine applied BET method

### 4: SEM

All powders are observed and photographed with SEM to make sure for shapes and size of particles.

## Instruction on Using Thick Film Paste Products

### 1. Storage

Tight a lid after using and store in dark and cold place. Shelf life is depend on a product, but ordinary speaking 6 months is maximum to use comfortably. Stirring with palette-knife or spatula is recommended before using.

### 2. Substrate

Properties are normally applicable on 96% alumina substrates ( standard IC grade ). There are possibility that similar result can not be achieved with a different of substrate manufacturer. Bend, surface roughness or cleanliness of substrate is effective to paste performances. If other substrate will be used with, please ask us about compatibility.

### 3. Viscosity and Adjustment

Brookfield viscometer type HBT with spindle SC4-14 and chamber 6R is mainly used in this catalogue. Viscosity and rheology have much effect on screen printability, severe control is recommended. Recommended solvents for each products is needed to adjust viscosity. Viscosity measurement is recommended to use comfortably after long sock term.

### 4. Screen Printing

C.W. Price and Presco Printer and mesh number between 200 and 400 of stainless screen are mainly used in TKK. Controlling emulsion thickness, stencil, print pressure, snap-off distance, squeegee speed and angle are important to get correct thickness and fine line printability.

### 5. Leveling and Drying

Leveling time for 5~10min. in room temp. is recommended not to remain mesh-mark of screen. Drying about 120°C for 10~15min. is recommended after leveling.

### 6. Firing

Belt furnaces are recommended for firing, some cautions are indicated as follows,

- Halogen solvent effect on performances of fired film, pay attention not to enter vapors into furnace.
- Set up the air entrance can be gotten fresh air
- Oil free dry pump with air filter needs for supplying air into furnace



## Caution

### ★Pastes, Thinner and Vehicle

These products are printing ink for industrial use.

- Inhalation, skin contact, and eye contact with paste with health hazard
- Use only at well ventilated area
- Wear proper protective clothes and goods for safety ( glasses, gloves )
- Keep away from open flame
- Wash immediately if pastes comes into contact with skin
- Wash with large amount of water immediately and have a medical aid if paste comes into eyes

### ★Powders ( Ag )

These products are materials for industrial use.

- Inhalation, skin contact, and eye contact with paste with health hazard
- Wear proper protective clothes and goods for safety ( glasses, gloves )
- Wash immediately if powders comes into contact with skin and have a medical aid if possible
- Pay attention to use with organic solvent, ignition can occur at contact organic solvent

### ★Powders ( Pd, Pt )

These products are materials for industrial use.

- Use only at well ventilated area. Allergic to metal from the constitution.
- Inhalation, skin contact, and eye contact with paste with health hazard
- Wear proper protective clothes and goods for safety ( glasses, gloves )
- Wash immediately if powders comes into contact with skin and have a medical aid if possible
- Pay attention to use with organic solvent, ignition can occur at contact organic solvent