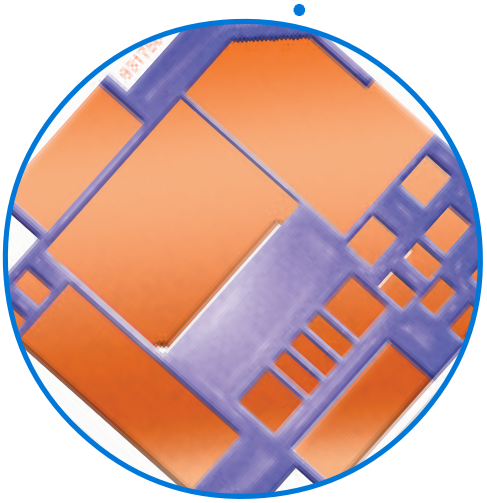
Thick Film Application Specific Capabilities

Design without limits



Today's engineers are pressed to design around a series of standard, off-the-shelf products, limiting creativity in design and ultimately the capabilities and performance of a final product. TT electronics' myriad capabilities in thick film technology allow for the flexible customization necessary to accomodate the innovative needs of design engineers.

IRC Advanced Film Division meets this need with custom thick film applications capabilities using a variety of unique materials and processes. Engineers can design around IRC's extensive selection of materials and process capabilities instead of being limited to a manufacturer's standard product line.

IRC

A subsidiary of TT Electronics plc

TT electronics

IRC Advanced Film Division

TT electronics and IRC AFD: An overview

Corporate Profile

TT electronics plc is one of the largest suppliers of electronic components worldwide, providing products to OEMs, major distributors and electronic manufacturing services. The wide range of products include fixed and variable resistors, networks, capacitors and assemblies, magnetic components and materials. Manufacture is worldwide including UK, mainland Europe, North America, Mexico, Barbados, Malaysia and India.

The markets served include Automotive, Industrial/Instrumentation, Telecommunication, Computing, Defense/Avionics and Medical.

TT Electronics has a proven track record over many years through its subsidiaries and continues to expand both internally and by acquisition to add to the depth and range of its products and technologies.

Our main emphasis is in supplying solutions to customer's needs, which will make them more competitive by using application engineering techniques to design components or assemblies tailored to individual requirements.

Company Profile

Based in Corpus Christi, Texas, International Resistive Company Advanced Film Division (IRC AFD) is a state of the art manufacturer of a variety of passive products utilizing a wide array of both thick and thin film technologies for resistive, capacitive, temperature sensing, current sensing, integrated passive and circuit substrate products.

IRC's thick film facilities are located in a 100,000 square foot facility in Corpus Christi, Texas, USA and a 30,000 square foot low cost assembly facility in Matamoros, Mexico. These facilities enclose a Class 10,000 clean room, automatic plating, printing, kiln load/unload, laser trim, lead attach, test and packaging equipment as well as an in-house laboratory for the formulation and production of proprietary non-noble inks.

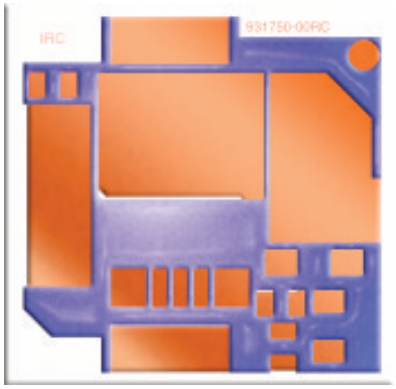
IRC AFD provides materials and processes to suit a wide array of application for designers and OEMs, including Anotherm™ printed circuit direct to aluminum heat sink technology, very low resistance films for current sense application and printed copper on ceramic circuit boards. A wide variety of substrates, resistive, conductive and overcoat materials are available to tailor solutions to fit almost any component or circuit design need.

Thick Film Printed Copper Substrates

TFC Series

For High Power and High Current Applications

- Up to 100 amps.
- Adhesive strength of copper: >20 N/mm^2.
- Temperature stability: 850 °C (cover gas)/350°C (air).
- Thermal expansion: 7.3 ppm/K.
- Thermal conductivity: 24W/mK@ 20°C



TFC is a proprietary thick film technology for electronic power circuits. In a special screen printing process, high current copper traces are printed onto a 96% alumina ceramic substrate and fired at temperatures approaching 1000°C.

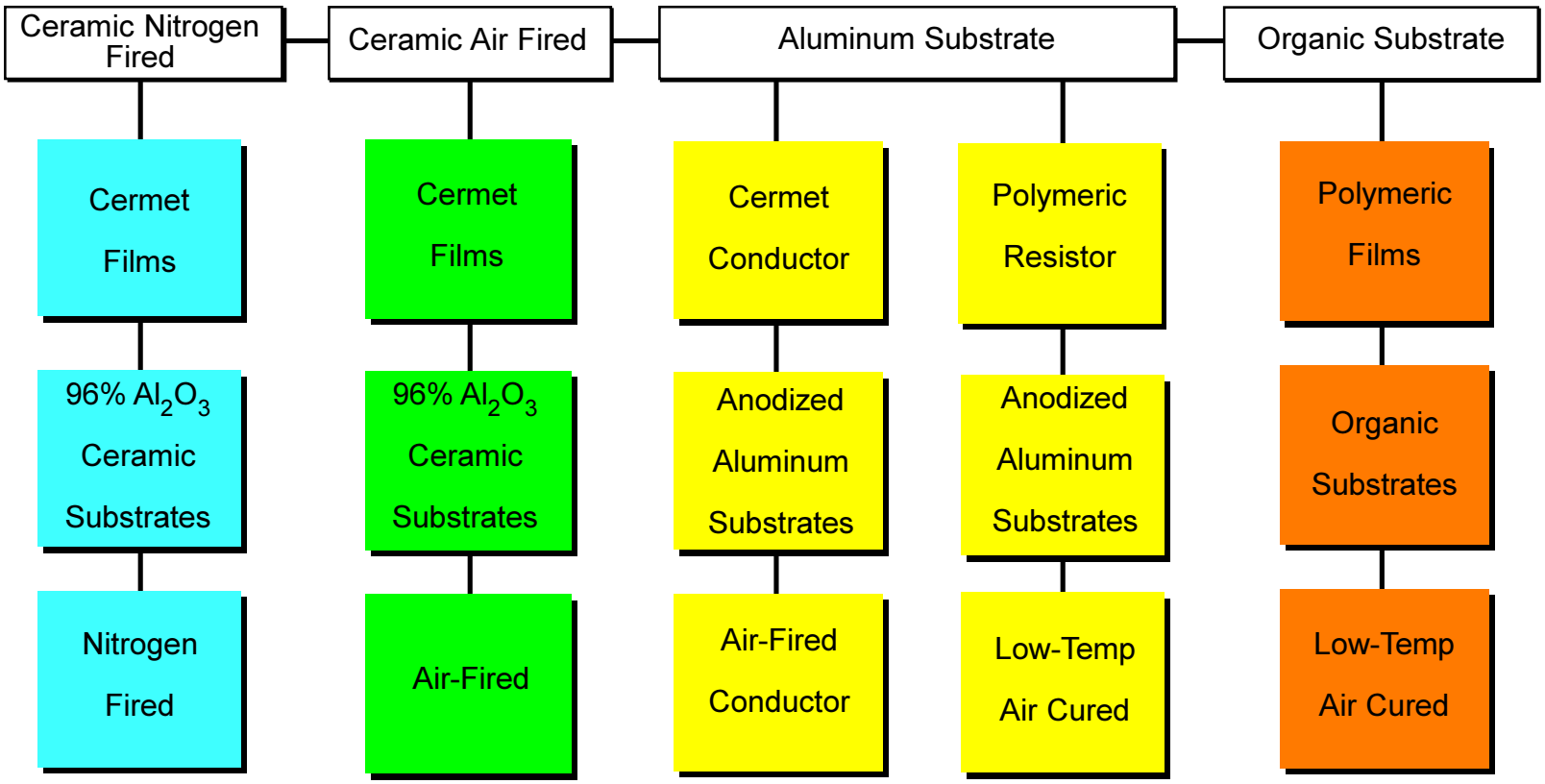
The copper formulation used for this process is a patented screen printed thick film material from IRC's Advanced Film Division in Corpus Christi, TX. High quality and low cost are achieved using this non-noble system and automated printing equipment. Integrated current sense and other resistors (down to 0.001Ω) may be integrated into the circuit to increase performance and reduce overall board size.

To improve solderability or bondability, electroplated conductors are available with a variety of metals. Selective Sn/Pb solder tinning is also available on conductors. Proven long term Thermal Shock data shows superior performance in comparison to Direct Bonded Copper (DBC) substrates.

Please consult our factory for custom ordering information.

- High Current / Low Resistance Traces
- Low Thermal Resistance - to 0.2 °K/W
- Copper on one or both sides
- Low cost alternative to Direct Bonded Copper (DBC)
- Integrated current sense resistors available
- Substrate sizes up to 4.5"X6.25"
- Conductor thickness: 20µm to 250 µm

Thick Film Systems



Substrates: strength in variety

Ceramic Substrate Advantages

- High-voltage applications.
- Dielectric strength > 600 volts/mil.
- Compatible with a wide variety of thick film conductor and resistor materials.
- High temperature – kiln-fired at 850°C.
- Sturdy – provides rigidity, stability for circuits.
- High frequency – low distributed capacitance.

Benefits of Aluminum Substrates

- Large substrate size capability.
- Low cost for large substrates.
- Optically reflective materials benefit optical applications.
- Substrates available individually or as scored arrays.
- Print circuits and resistors directly on heat sinks.
- Alternative to thermal clad PC boards.
- Eliminates heat sink assembly costs.
- Planar or extruded (finned) substrates available.
- Adds rigidity to organic PC boards.

Aluminum Substrates

Maximum Operating Voltage	250 VAC
Maximum Continuous Operating Temperature	400°C (w/o Solder Maskant) 175°C (w/ Solder Maskant)
Thermal Impedance	0.2°C/Watt**
Minimum Line Width/Spacing	0.005"/0.005" (0.127 mm/0.127 mm)
Conductor Trace Thickness	12±2 microns standard (470 microinches), up to 150 microns (0.006") for high current applications
Conductor Trace Resistivity	0.0037 Ω/sq./mil thickness
Dielectric Thickness	0.0014" (35 microns) Nominal
Maximum Substrate Size	8"x10" (203mm x 254mm)
Maximum Substrate Thickness	0.75" (19mm)

**Thermal Impedance from printed pad to aluminum core, pad size = 0.1 sq. in.

Applications

- Solid state relays
- Automotive power electronics
- LED displays
- DC-DC Switching Power Supplies
- Power Amplifiers
- Low Voltage Motor Controls
- High Temperature Electronics ("down-hole" telemetry, automotive engine compartment, etc.)

Anotherm™ substrates consist of a highly thermally conductive aluminum alloy substrate, with a special anodized aluminum oxide electrically insulating layer chemically grown on the aluminum core. This high temperature anodized layer offers good electrical isolation and excellent thermal transfer. Screen-printed, solderable conductors are then applied to the board and fired at 600°C. The result is a low cost, rigid circuit board with unsurpassed thermal efficiency. The completely inorganic construction results in substrate characteristics, that maintain their properties even at high continuous operating temperatures.

Traditional methods of removing excess heat from components have centered on the use of heat sinks with thermal grease or polymer pads to thermally connect the device to the heatsink. With Anotherm™ substrates, the entire board becomes the heat sink with no extra hardware (clips, screws, etc) required. In addition, the characteristics of the printed thick film conductors allow direct wirebonding from dice to the printed conductors.

The base material for the Anotherm® substrates is an aluminum alloy, either 3003 or 6061. This aluminum alloy has a high thermal conductivity and low cost. The thermal expansion coefficient of this material corresponds favorably with traditional P.C. board materials as shown in the table below. Long term thermal shock testing confirms the ruggedness of the dielectric medium.

Material	Thermal Expansion Coefficient (ppm/K)	Thermal Conductivity (W/m-K)
FR-4 P.C. Board	16-20	0.8
Anotherm® 3003/6061 Aluminum	23.4	173
304 Stainless Steel	16.4	17.3
96% Alumina Ceramic	6.5	21
Copper	16.5	386

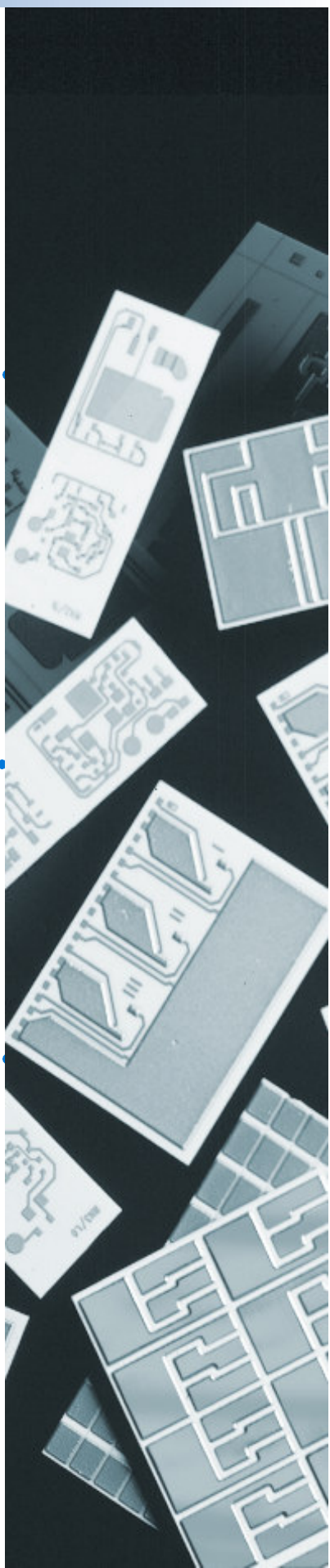
Thick Film Design Guidelines

Resistor Material	Sheet Resistance	TCR
Polymer Resistor	10Ω/sq to 100KΩ/sq.	±300ppm/°C
Ruthenium	10Ω/sq to 10MΩ/sq.	±50ppm/°C
Tantalum Nitride	10Ω/sq to 1KΩ/sq.	±100ppm/°C
Tin Oxide	1KΩ/sq to 3MΩ/sq.	±150ppm/°C
Copper-Nickel	40mΩ/sq to 1.6Ω/sq.	±100ppm/°C

Conductor Material	Sheet Resistance
Copper	2.0mΩ/sq.
Gold	2.5mΩ/sq.
Platinum-Silver	3mΩ/sq.
Palladium-Silver	20mΩ/sq.
Silver	3.7mΩ/sq.

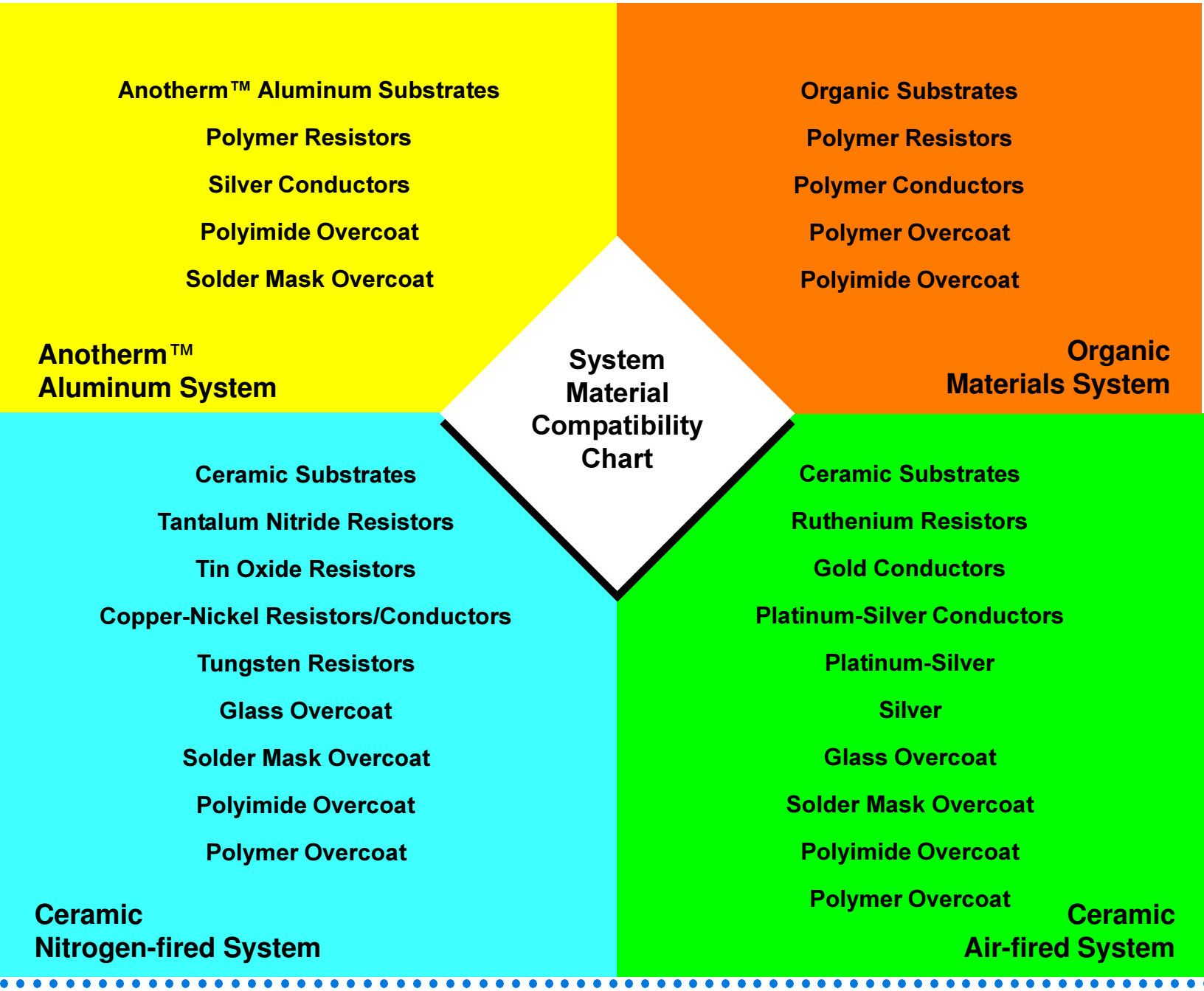
Overcoat Materials	Typical Thickness	Dielectric Strength
Hi-Temp Polyimide	0.04 to .4 mil.	3KV/mil
Epoxy	1 mil.	500V/mil
Solder Mask	1 mil.	750V/mil
Glass	1 mil.	750V/mil

Circuit Specifications	Dimension
Minimum trace width/spaces	0.005”
Maximum Conductor Thickness	0.010”
Substrate Thickness Range	
a. Ceramic	0.010 - .0500”
b. Aluminum	0.010 - 0.075”
c. Organic	0.010 - 0.075”



Thick Film Systems Compatible Materials

IRC offers the latest in design and production of thick film resistor systems. Consult the compatibility chart to decide which substrate is right for your needs, or contact one of our application engineers for a personal consultation.



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