

Microcircuit Technologies

Technology Comparison

Parameter	Thick-film	Thin-film	Monolithic
Performance	High	High	Limited
Design Flex, Digital	Medium	Medium	High
Design Flex, Analog	High	High	Low
Parasitic	Low	Low	High
Ω Max. Sheet	High	Low	High
Ω TCR	Low	Lowest	High
Ω Tolerance	Low	Lowest	High
Power Dissipation	High	High	Low
Frequency Limit	Medium	High	Medium
Voltage Swing	High	High	Low
Size	Small	Small	Smallest
Package Density	Medium	Medium	High
Reliability	High	High	Highest
Development Time	2 months	2 months	4 months
Turn Time Design Change	2 weeks	1 month	2 months
Cost Development	Low	Medium	High
Production Setup & Tooling Cost	Low	Medium	High

Thick Film / Thin Film Comparison

Parameter	Thick-film	Thin-film
Conductor Spacing	0.0005"	0.0001"
Conductor Line Width	0.0005"	0.0001"
Solder Pad Spacing	0.020"	0.020"
Resistor Tolerance	$\pm 1\%$	$\pm 0.1\%$
Resistor TCR	± 100 ppm/ $^{\circ}$ C	± 50 ppm/ $^{\circ}$ C
Resistor Tracking	25 ppm/ $^{\circ}$ C	1 ppm/ $^{\circ}$ C
Resistor Ratio Match	0.5%	0.01%
Resistor Length	0.20"	N/A
Resistor Width	0.015"	0.0025"
Via Hole Size	0.0005"	0.0001"
Ω /Sq Resistivity Range	1-100M	5-500
Ω Thermal Stability (150 $^{\circ}$ C/1000hrs)	$< \pm 0.5$	$< \pm 0.2$
Voltage Coefficient of Resistance PPM/V	0.5-5	1
Conductors Compatible with Resistors	Au,Ag,Cu PdAg,PtAg	Au,Cu,Al

Thin Film resistors based on tantalum nitride.

Capital Outlay: NONE when you partner with NATEL.

"Your Job"
Innovation and Marketing

"Our Job"
Quality Manufacturing
Quick Turnaround
Low Cost

With over 25 years of microelectronics experience, Natel understands and has participated in most of the dramatic changes that have taken place in the manufacturing of products for the Defense, Medical, Opto-electronic and RF/Microwave industries, meeting the need for lower cost, high quality components produced by innovative techniques.

With automatic and, in most cases, hands-free assembly capabilities for modules, hybrids, MCM and chip-on-board, Natel has pioneered the precision capabilities necessary for 10G-40G high frequency products -- products such as DWDM, clock drivers, transmitters/receivers and limiting amplifiers.

This level of automation has allowed Natel to address the market's need for cost, performance and size with increased levels of reliability never before possible. Due to our quick response, we are able to shorten "time-to-market" for your prototype as well as "time-to-volume" for your production needs. We realize how critical it is to your success.

**Natel stands ready as your
Manufacturing Partner!**



Substrate Manufacturing

To be placed on our mailing list to receive other issues of "Quick Reference Design Guide" simply call, fax or e-mail.

NATEL

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ISO 9001

Your Source for
MCM - COB - HYBRID

MIL-PRF-38534

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How can we help?

So that we can tailor an information package specific to your needs, please answer the following questions and **fax this page to Natel at 1-800-590-5764.**

For urgent need please call 1-800-590-5774.

What stage is your microcircuit module in?

- Initial design
- Prototype
- Product redesign
- Production

Would you consider packaging assistance?

- Essential
- Nice but not required
- No thank you

What type of module are you considering?

- Hybrid
- MCM
- Chip on board
- Flipchip/BGA
- Other _____

What type of package are you considering?

- Hermetic
- Non hermetic
- Metal
- Other _____

Comments:

YOUR

Name: _____

Phone: _____

email: _____

Please make necessary changes on the address label.

NATEL Engineering Co., Inc.

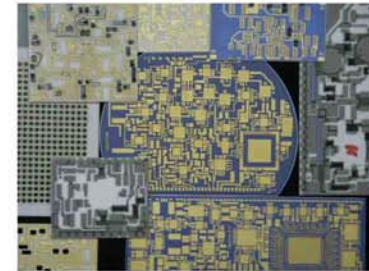
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The microelectronic packaging experts!

Design Guide #1

Quick Reference Design Guide



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(Thick/Thin Film, Monolithic)

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