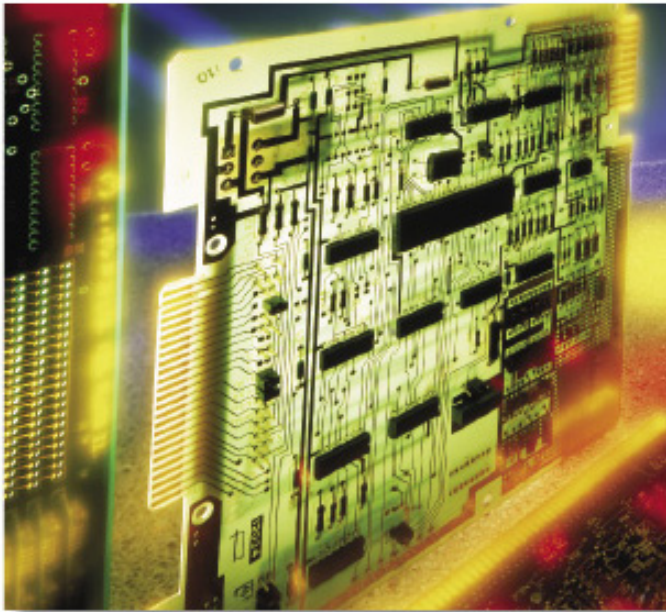




Technical Seminar Series

Be Smart — Choose the Right Parts

Welcome to “Choose the right Cap for the right App.”



The most active segment of capacitors are those in the 1 μF - 330 μF range. Designers can choose among a variety of dielectrics, each with unique price-performance characteristics.

This seminar will help engineering and purchasing professional evaluate their options by explaining the competing technologies and by revealing the product roadmaps of key capacitor manufacturers.



Technical Seminar Series

Be Smart — Choose the Right Parts

Welcome – Craig Conrad, TTI, Inc.

Market Trends

Global Markets for 1-300 μ F Capacitors

- Dennis Zogbi, The Paumanok Group

Technology Options

Niobium Oxide Technology

- Chris Reynolds, AVX

Conductive Polymer as Cathode System in Tantalum Capacitors

- John Prymak, KEMET

High Capacitance Multilayer Ceramic Chip Capacitors

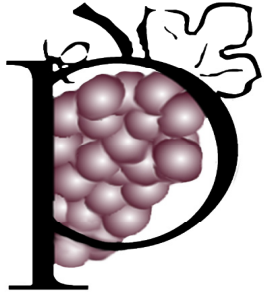
- Karun Malhotra, Murata

Specialty Polymer Aluminum Electrolytic Capacitors

- Robert Galli, Panasonic

Q&A

May 2005



RESEARCH & PRESENTATION

Dennis M. Zogbi

President

Paumanok Publications, Inc.

(919) 468-0384

dennis@paumanokgroup.com



May 25th 2005

TTI Technical Seminar Series

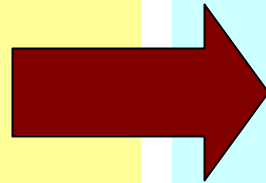
“Be Smart – Choose the Right Parts”



- 



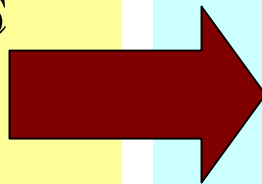
- Required in Every Electronic Circuit



- Capacitance is Equivalent to Physical



- Surface Area of the Capacitor



- **Economic Impact**

- Consumption is Ubiquitous and an Economic Indicator of High-Tech Economy

- Raw Materials and Their Supply Chain are a Significant Percentage of Cost of Goods Sold

Capacitor Trends: 2005

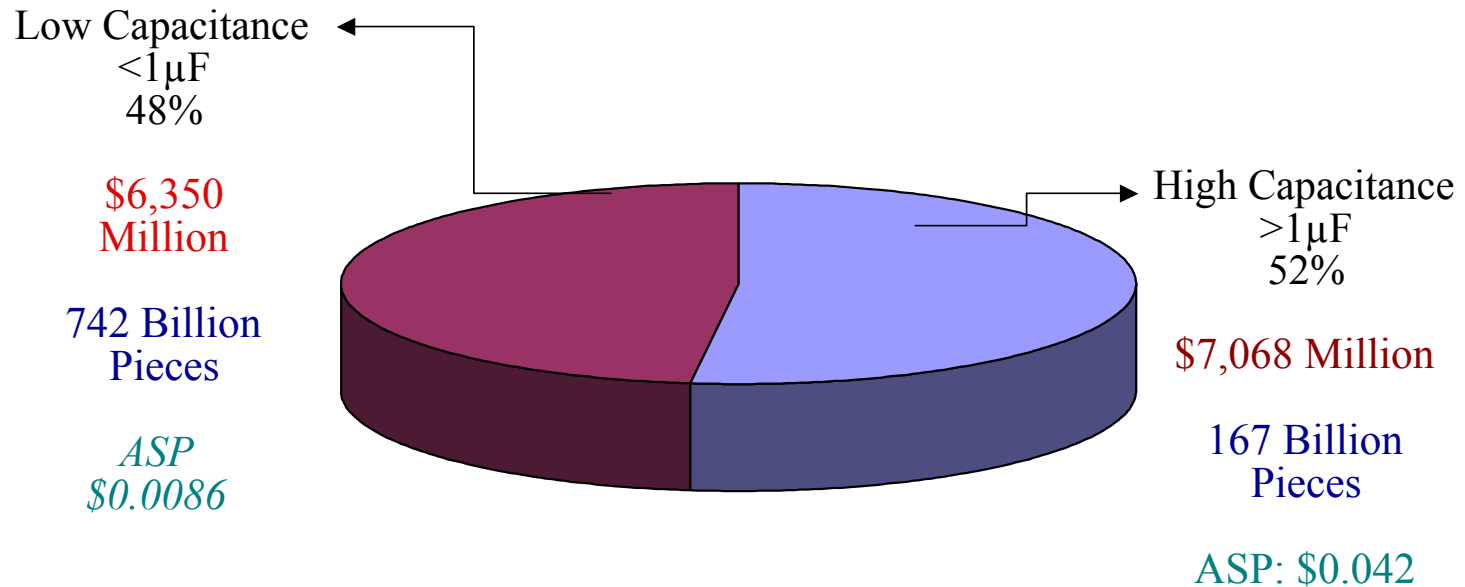
- Development of Massive Economies of Scale in Picofarad Electrostatic Capacitor Production in China
- Development of Application Specific Capacitor Product Portfolios in the West
 - High Voltage (500VDC+)
 - High Frequency (1GHz to 60GHz/Light Spectrum)
- Development of Value-Added Capacitor Lines That Offer Intrinsic Value Based On Performance and Quality (Microprocessor Market Driven)
 - BME MLCC from 1-220 μ F
 - MN02 Molded & Coated Tantalum Chips 1-330 μ F+
 - Polymer Molded Tantalum Chips 1-330 μ F+
 - V-Chip Aluminum (KOH/Water Based)
 - V-Chip/H-Chip Polymer Aluminum
 - Niobium Oxide Capacitors 1-330 μ F+

**Focus of
This Short
Market
Presentation**



Global Consumption Value for Capacitors by Capacitance Value 2004

{TAM= \$13,581 Million with 909 Billion Pieces Shipped}



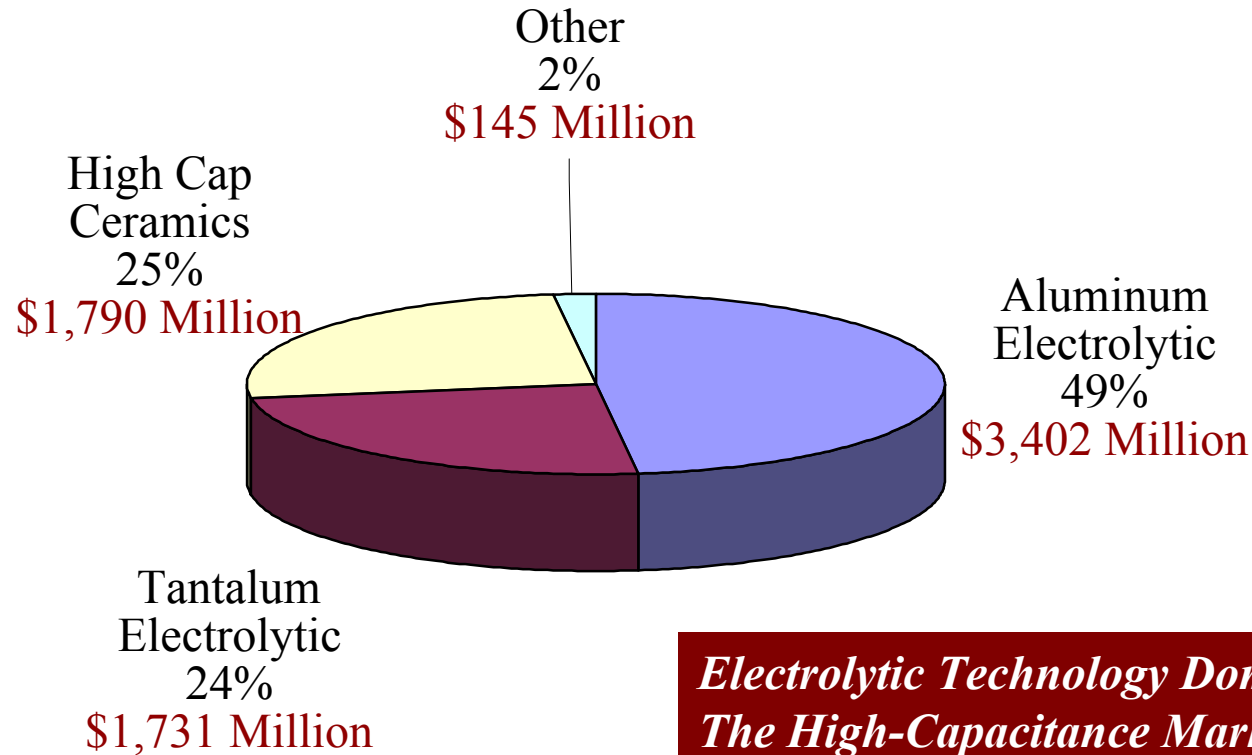
Capacitor Vendors Want to be Here Because This is Where Innovation is Driven by Customer Design



Global Consumption Value for High Capacitance Capacitors >1 μ F

2004 in Millions of USD

\$7,068 Million USD Worldwide Market

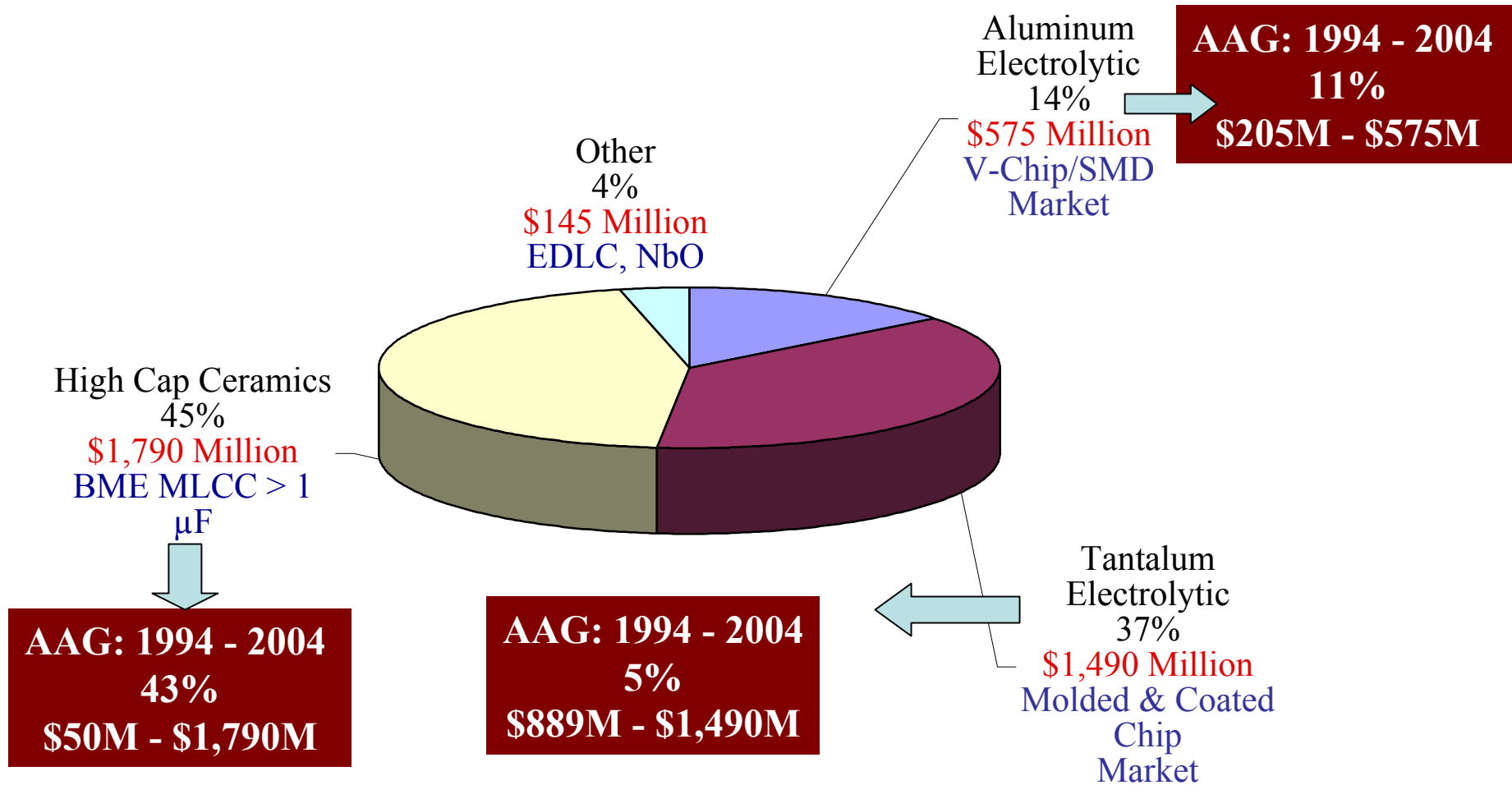


Electrolytic Technology Dominates The High-Capacitance Market, But Innovative Ceramic Technology Has Made Substantial Inroads Over The Past 12 Years.



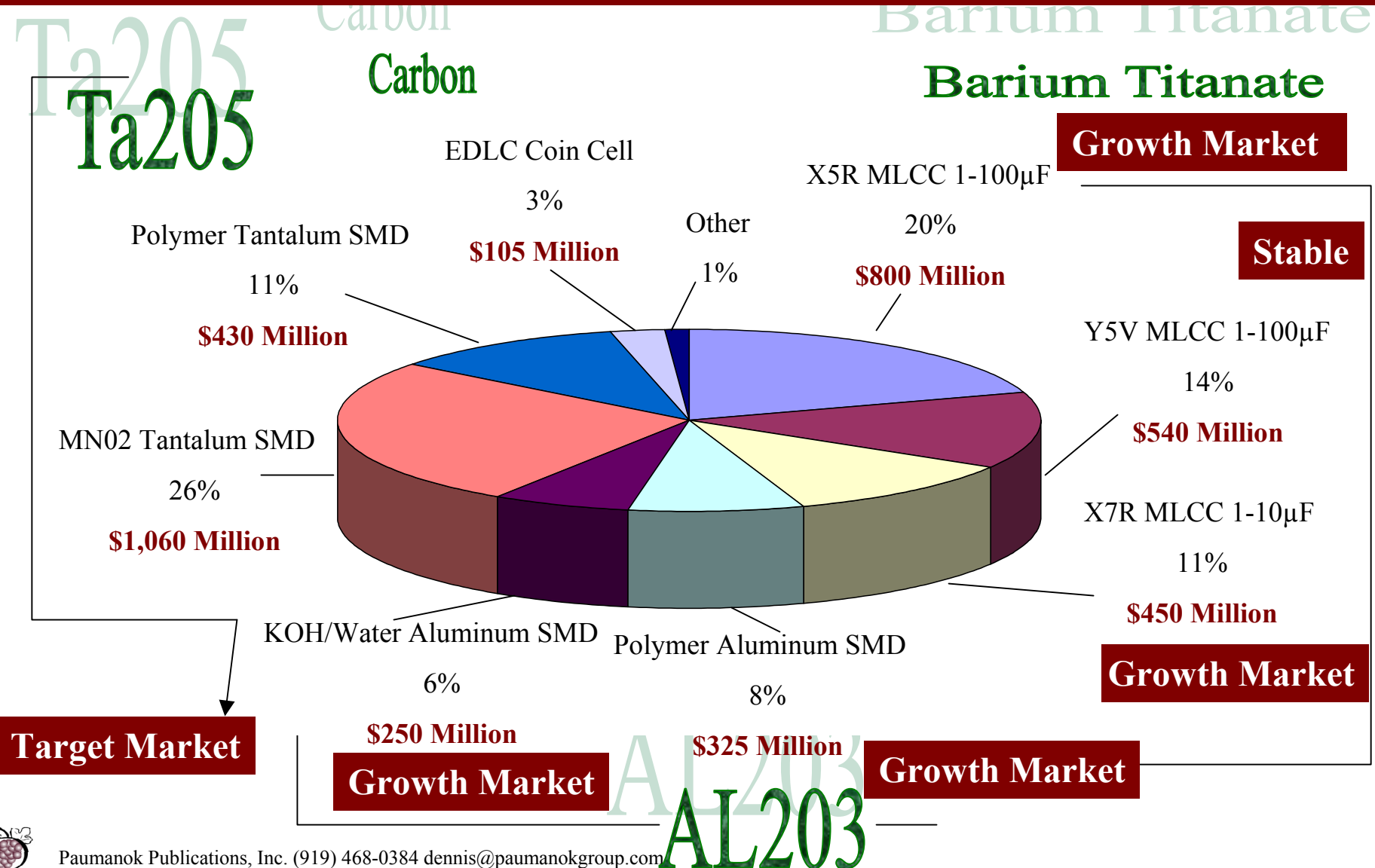
Surface-Mount Capacitor Markets for Applications >1 μ F 2004

\$400 Million USD Market



Global Consumption for Surface-Mount Capacitors >1μF: 2004

A \$4000 Global Market



Capacitor Revenues by End-Use Market Segment: 2005

Capacitor Type	Consumer A/V	Wireless	Ind'l / Power	Computer	Telecom	Auto	Specialty	Total
Aluminum	42%		25%	15%	5%	6%	7%	100%
Tantalum	18%	22%		36%	11%	6%	7%	100%
High Cap Ceramic	30%	17%	7%	22%	5%	14%	5%	100%
Niobium-Oxide			20%	75%	5%			100%

Price Sensitive ←

→ **Performance Sensitive**

Key Product Markets	Consumer A/V	Wireless	Ind'l / Power	Computer	Telecom	Auto	Specialty
	Flat Panel Display, Set Top Box, Digital Camera, Digital Video Camera, DVD Player, HDTV, Game Console, Portable MP3, Cordless Phone	Camera Phones	Power Supply, DC/DC Converter, Lighting Ballasts, DC Motors, Motor Controls	CPU-Desktop, CPU-Laptop, HDD, Graphics, Internal Modem Chipset, Keyboard, Mouse, Cable & ADSL	SLIC, Routers, Repeaters, LAN, WAN	Infotainment, Safety & Security, Power Train	Defense, Medical Test & Scan, Medical Implant, Instrumentation, Mining Electronics, Downhole Pump Electronics

V-Chip Aluminum

High Cap MLCC

Ultra Small Tantalum

Capacitor Usage Trends

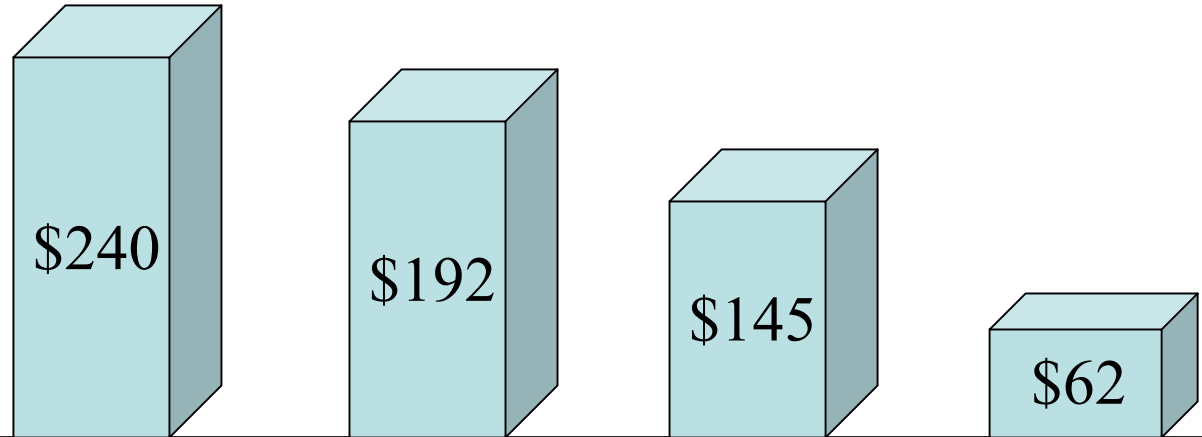
NbO

Tantalum Polymer



Capacitor Raw Material Cost Structure: Primary Building Blocks

Costs Associated with 1 Pound of Primary Raw Material*: 2005



	Tantalum	Ceramic/ High Cap	Niobium-Oxide	Aluminum
	Powder Wire	HP BT Nickel Copper	Powder Wire	Anode Foil Cathode Foil Separator
Yield (millions of pieces per pound)	11	175	11	33

*For Polymer Cathode in Tantalum, NbO, and Aluminum add 20% to the cost.



Capacitor Forecasts: 2005-2010 (1 Microfarad and Above)

Global Surface Mount Capacitor Consumption Forecasts:			
2005- 2010 For Applications > 1 μ F			
(In Millions of USD)			
Capacitor Type	2005	2010F	AAG
X5R MLCC >1 μ F	\$ 800	\$ 1,200	9%
Polymer Aluminum SMD	\$ 325	\$ 1,025	25%
Polymer Tantalum SMD	\$ 430	\$ 925	17%
MN02 Tantalum SMD	\$ 1,060	\$ 775	-7%
X7R MLCC >1 μ F	\$ 450	\$ 750	11%
Y5V MLCC >1 μ F	\$ 540	\$ 690	5%
KOH/Water Aluminum SMD	\$ 250	\$ 470	12%
EDLC Coin Cell	\$ 105	\$ 220	15%
NbO Capacitor	\$ 15	\$ 145	60%
Other	\$ 25	\$ 55	17%
Grand Total	\$ 4,000	\$ 6,255	9%

