It is our mission to empower manufacturers, distributors, OEM, EMS, financial institutions and governments with unbiased market research to protect their assets, build their wealth and prosper in goods times and bad.
Tantalum Capacitors:
World Markets, Technologies & Forecasts:
2019-2023

Table of Contents:
TANTALUM CAPACITORS: WORLD MARKETS, TECHNOLOGIES & OPPORTUNITIES: 2019-2023........................................... 16

1.0 INTRODUCTION AND SCOPE OF REPORT COVERAGE: .......................................................................................... 16

1.1 Passive Components: Capacitors, Resistors and Inductors Market Overview: FY 2018-2019 ........................................ 16
1.2 Research Methodology....................................................................................................................................................... 17
1.3 Government Data Collection and Resources: .................................................................................................................. 18
1.4 Secondary Published Sources: ......................................................................................................................................... 19
1.5 Primary Intelligence Gathering: ........................................................................................................................................ 19
1.6 The Passive Component Supply Chain: ........................................................................................................................... 20
1.7 Feedstocks and Raw Materials: ......................................................................................................................................... 21
1.8 Raw Materials Processing: .................................................................................................................................................. 21
1.9 Component Manufacturing: ............................................................................................................................................... 21
1.10 Component Distribution: .................................................................................................................................................. 21
1.11 End-Market Consumption: .............................................................................................................................................. 22
1.6 Recycling of Critical Materials:

1.7 The Technical Economic Maxims Associated With Passive Electronic Components:

1.8 The Two Technical Economic Maxims Associated With Passive Electronic Components:

1.9 Ubiquitous Nature of Passive Electronic Components In Electrical and Electronic Circuits:

1.10 Relationship Between Performance and Available Surface Area:

1.11 Financial Considerations With Respect To This Report:

1.12 Positive Market Indicators:

1.13 Negative Market Indicators:

1.14 Overall Outlook To 2023:

1.15 Changing View on Passive Component Unit Sales to 2023:


1.17 Key Passive Products Growth in USD Annualized year-On Year: FY 2018-FY 2019

1.18 Regional Growth in FY 2018 and FY 2019:

1.19 End Use Segment Growth in FY 2018 and FY 2019

1.20 Capacity Expansion Estimates

1.21 Price Adjustments:

1.22 Who paid the most for parts in FY 2018 and FY 2019

1.23 Strategies for Managing Short Supply Scenarios:

1.24 How MLCC Shortages Might Impact Demand For Other Dielectrics: FY 2019-2023

1.25 Using Tantalum Capacitors To Fill The Gaps in FY 2019

1.26 (A) Overlap Between MLCC and Molded Tantalum Chip Capacitors by Case Size

1.27 (B) Lead Times for Tantalum Capacitors By Month: April 2012-December 2018

1.28 Key Findings of This Report:

1.29 Tantalum Capacitor Orientation:

1.30 The Electrolytic Sub-Set:

1.31 Tantalum Capacitors As a Sub-Set of The Global Capacitor Industry:

1.32 Value Proposition of Tantalum Capacitors To The Design Engineer:

1.33 Tantalum: Alternative Technologies:

1.34 Tantalum and The High Capacitance Premium Component Markets:

1.35 Tantalum Supply Chain and Risk Factors:

1.36 Tantalum Cost of Ownership:

1.37 Tantalum Capacitors: 25 Year Market Cycle:

1.38 Continued Impact of Dodd-Frank On The Global Tantalum Market

1.39 Tantalum Legislation Is Confusing The Supply Chain:

1.40 The EU's 2017 Critical Raw Materials (CRM) list:

1.41 Closed Loop System Changes The Supply Chain:

1.42 Australia Activity in FY 2018:

1.43 Impact of Price Trends In The Tantalum Capacitor Industry:

1.44 Anti-Collusion Lawsuits:
2.0 TANTALUM CAPACITORS: TECHNOLOGY OVERVIEW: ................................................................. 46
  2.1 Tantalum Capacitor Component Configurations: ............................. 46
  2.2 Molded Chip: ......................................................... 48
  2.3 Coated Chip: ...................................................... 49
  2.4 Radial Dipped: .................................................. 49
  2.5 Molded Radial: ................................................. 49
  2.6 Molded Axial: .................................................. 49
  2.7 Hermetically Sealed: ........................................... 50
  2.8 Wet Slug Tantalum: ........................................... 50
  2.9 New and Emerging Tantalum Capacitor Component Configurations: 50
  2.10 Tantalum Capacitors: Polymer Vs. Manganese Cathode Systems Historical Development of Conductive Polymer Cathodes In Tantalum Capacitors: ......................... 50
  2.11 Why Lower The ESR In Tantalum Capacitors? ............................ 51
  2.12 Difference in Conductive Polymer Performance In The Finished Capacitor: ............................................................... 51
  2.13 What Process Is Most Effective at Lowering The ESR in Tantalum Anodes: ............................................................... 52
  2.14 Tantalum Capacitor Production Processing Differentiation: ............. 52
  2.15 Market Leaders In Conductive Polymer Tantalum Capacitors: ........ 53
  2.16 Market Potential and Growth in Conductive Polymer Capacitors: .... 53

3.0 TANTALUM CAPACITORS: GLOBAL VALUE, VOLUME AND PRICING: ........................................ 54
  3.1 Tantalum Capacitors: Changing Markets FY 2019 Forecast .............. 54
  3.2 Tantalum Capacitor Growth Comparison With Other Dielectrics: ........ 54
  3.3 Tantalum Capacitors: Near Term Sales and Forecasts: FY 2017-FY 2018; FY 2019 Forecast ................................................................. 56
  3.4 Tantalum Capacitors: Global Unit Shipments and Forecasts To 2023 . 58
  3.5 Tantalum Capacitors: Global Value Shipments and Forecasts To 2023. 60
  3.6 Tantalum Capacitors: Global Average Unit Selling Pricing and Forecasts To 2023 ................................................................. 61

4.0 TANTALUM CAPACITORS: MARKETS BY TYPE: ................................................................. 64
  4.1 Tantalum Capacitor Market Subsets: Demand By Configuration: FY 2019; ................................................................. 65
  4.2 Molded & Coated Chip Tantalum Capacitor Markets: FY 2019; ........ 65
5.0 TANTALUM CAPACITORS: END-USE MARKETS:

5.1 Where Tantalum Capacitors are Consumed:

5.2 Introduction To Tantalum Capacitor Consumption By End-Use Market Segment:

5.3 Tantalum Capacitor Content Per Black Box: FY 2019:

5.4 Tantalum Capacitor Unit Consumption By End-Use Market Segment: FY 2019:

5.5 Tantalum Capacitor Unit Consumption By End-Use Segment and Key Product Market: FY 2019:

5.6 Tantalum Capacitors: Market Drivers and Challenges: FY 2019:

6.0 TANTALUM CAPACITORS: MARKETS BY WORLD REGIONS:

6.1 Global Consumption Value for Tantalum Capacitors By World Region: FY 2019:

6.2 Asia Pacific Region: Tantalum Capacitor Market Demand: FY 2019:

6.3 The Chinese Market For Tantalum Capacitors: FY 2015:

6.4 The Japanese Market For Tantalum Capacitors: FY 2019:

6.5 The Korean Market For Tantalum Capacitors: FY 2019:

6.6 Other Important Markets in Asia For Tantalum Capacitors: FY 2019:

6.7 The Americas Region: Tantalum Capacitor Market Demand: FY 2019:

6.8 The USA Market For Tantalum Capacitors: FY 2019:

6.9 The Mexican Market For Tantalum Capacitors: FY 2019:

6.10 Other American Markets For Tantalum Capacitors: FY 2019:

6.11 The European Region: Tantalum Capacitor Market Demand: FY 2019:

6.12 The German Market For Tantalum Capacitors: FY 2019:

6.13 Other European Markets For Tantalum Capacitors: FY 2019:

7.0 TANTALUM CAPACITORS: GLOBAL DISTRIBUTION CHANNELS:

7.1 Introduction to Distribution Channels for Tantalum Capacitors:

7.2 Global Tantalum Capacitor Consumption Value By Channels of Distribution: FY 2019:

7.3 Electronic Component Distributors: FY 2019 Sales of Tantalum Capacitors Through Distribution:

7.4 Original Equipment Manufacturers: FY 2019 Sales of Tantalum Capacitors To OEM Customers:

7.5 Electronic Manufacturing Services Companies: FY 2019 Sales of Tantalum Capacitors To OEM Customers:

7.6 Top Global Distributors of Tantalum Capacitors: FY 2019:

7.7 Top OEM Companies Buying Tantalum Capacitors: FY 2019:

7.8 Top EMS Companies Buying Tantalum Capacitors: FY 2019:
8.0 TANTALUM CAPACITORS: WORLDWIDE COMPETITION AND MARKET SHARES: FY 2019

8.1 Recent Consolidation Among Vendors In The Tantalum Capacitor Industry:

8.2 KEMET Purchases TOKIN Corporation From NEC:

8.3 AVX Purchases Nichicon’s Tantalum Operations:

8.4 Holystone International Acquires The Hitachi AIC Tantalum Line:

8.5 Vishay Acquires The Hitachi AIC Tantalum Line from HS Polytech:

8.6 GAM’s Acquisition of Cabot Supermetals:

8.7 KEMET Vertically Integrates With Niotan; What This Means For The Supply Chain (Blue Powder) in FY 2019:

8.8 Global Competitive Environment For Tantalum Capacitors By Component Type and Configuration: FY 2019:

8.9 Global Competitive Environment For Tantalum Capacitors- Product Differentiation by Vendor: FY 2019:

8.10 Market Leaders in Tantalum Capacitor Differentiation:

8.11 125 Degree C (Automotive UTH):

8.12 Low Profile Tantalum Capacitors:

8.13 Low ESR Tantalum Capacitors:

8.14 Multi-Anode Tantalum Capacitors:

8.15 High Temperature Tantalum Capacitors: 150 to 230 Degrees C:

8.16 Fused Tantalum Capacitors:

8.17 Tantalum Capacitors for Hi-Reliability and Defense Applications:

8.18 Tantalum Capacitor Vendors: FY 2019 Global Sales and Market Shares:

8.19 KEMET Corporation:

8.20 AVX Corporation:

8.21 NEC Corporation/Tokein Electronics (KEMET):

8.22 Vishay Intertechnology:

8.23 Sanyo Electronics (Panasonic):

8.24 Rohm Company Limited:

8.25 Samsung Electro-Mechanics Company:

8.26 Greatbatch, Inc.:

8.27 Matsuo Electric:

8.28 Firdac, Inc.:

8.2 China and Russia Tantalum Capacitor Manufacturers:

8.29 Tantalum Value Chain To The Capacitor Industry: FY 2019:

8.30 KEMET, AVX AND VISHAY Revenue Trends:

8.31 Tantalum Alternatives In Electronics: FY 2019:
9.0 TANTALUM CAPACITORS: GLOBAL MARKET FORECASTS: ..................................................................................................................113
9.1 Tantalum Capacitors: Market Forecasting: FY 2019-2023 ..................................................................................................................113
9.2 Tantalum Capacitors: Global Unit Shipment Forecasts: FY 2019-2023 ..................................................................................................113
9.3 Tantalum Capacitors: Global Value Forecasts: FY 2019-2023 ............................................................................................................115
9.4 Tantalum Capacitors: Forecasts By End-Use Market Segment: FY 2019-2023 ..................................................................................119
9.5 Tantalum Capacitors: Forecasts By Channel of Distribution: FY 2019-2023 .....................................................................................121
9.6 Tantalum Capacitors: Forecasts By Cathode System (Polymer Versus Manganese): FY 2019-2023 ..........................................................121
9.7 Tantalum Capacitors: Forecasts By World Region: FY 2019-2023 .....................................................................................................123

10.0 SPECIAL SECTION: TANTALUM CAPACITOR MARKETS IN HIGH CAPACITANCE MLCC REPLACEMENT ........................................125
10.1 Introduction To The 2018 and 2019 MLCC Shortages ..........................................................................................................................125
10.2 Limited Capacity To Stack Ceramic Dielectric Will Extend MLCC Shortages To 2020 and beyond .........................................................125
10.3 Strategies for Managing Short Supply Scenarios ..............................................................................................................................125
10.4 Where The Bottleneck In The MLCC Supply Chain Exists and What Customers are Doing to Overcome It .............................................126
10.5 Increasing Capacitance While Decreasing Case Size Trends .........................................................................................................127
10.6 Technology Hurdles Keep Competition Minimal, Customers Have Limited Transparency, Think All MLCC Are The Same ...........................128
10.7 Limited Competition In X5R 0603 and 0805 MLCC ..............................................................................................................................128
10.8 Why The Shortage of MLCC May Last 5 Years .................................................................................................................................129
10.9 Applications of Nano-Technology Into MLCC Technology Advancement Can Take Up To 90 Months (BOX: JENKINS ANALYSIS) ...........130
10.10 How MLCC Shortages Might Impact Demand For Other Dielectrics: FY 2019-2023 ..........................................................................131
10.11 MLCC Substitution Markets, Technologies and Opportunities: 2018 ...............................................................................................133
10.12 MLCC Sets The Tone for The Technology Roadmap in Ultra-Small Next Generation Components ....................................................133
10.13 Thick Film Chip Resistors and Ferrite Beads Keep Up With Trends ..............................................................................................133
10.14 Leading Edge Ultra-Small Component Similarities .........................................................................................................................133
10.15 Solid Passive Components about To Make a Breakthrough in Technology ........................................................................................133
10.16 Tantalum Capacitors Making Technology Leaps As Well ..................................................................................................................134
10.17 Polymer Aluminum Limitations .......................................................................................................................................................134
10.18 Components Holding Back Technology (Limitations on Maximum Volumetric Efficiency) ...............................................................134
10.19 Polymer Aluminum Limitations .......................................................................................................................................................134
10.20 Components Holding Back Technology (Limitations on Maximum Volumetric Efficiency) ...............................................................134
10.21 Ultra-Small Passives: A Multibillion Industry .................................................................................................................................136
10.22 Global Markets By Case Size: .......................................................................................................................................................136
10.23 The Leading Edge Markets- 01005 and 00804: .................................................................................................................................136
10.24 The Core Value Markets- 0201 to 0805 ..............................................................................................................................................136
10.25 The Large Case Electrolytic Markets In Tantalum and Aluminum ....................................................................................................137
10.26 Increasing Capacitance While Decreasing Case Size- The Technology Game In Passives ..............................................................138
10.27 MLCC and Tantalum- Major Competition Coming ........................................................................................................................138
10.28 MLCC Vendors by Case Size Showing Limited Vendors In Larger Sets ..........................................................................................140
10.29 Alternatives To MLCC: Changing The Reference Design ..............................................................................................................142
10.30 Comparing Alternative Dielectrics and Their Alternative Case Sizes:..................................................................................142
10.31 MLCC Sets The Tone for The Technology Roadmap in Ultra-Small Next Generation Components..............................................142
10.32 Tantalum Capacitor Case Size Alternatives..................................................................................................................142
10.33 Polymer Aluminum Capacitor Case Sizes......................................................................................................................142
10.34 Plastic Film Chip Case Sizes.............................................................................................................................................142
10.35 Increasing Capacitance While Decreasing Case Size......................................................................................................144
10.36 Capacitance Overlap.......................................................................................................................................................144
10.37 The Tantalum Solution:......................................................................................................................................................146
10.38 Major Vendors and Market Shares For Molded Chip Conductive Polymer Capacitors Polymer Aluminum and Polymer Tantalum: FY 2018.................................................................146
10.39 Sources for Polymer Tantalum Capacitors As Alternatives to MLCC..............................................................................147
10.40 Solid Polymer Electrolytic Capacitors: Tantalum and Aluminum Molded Case Manufacturers by EIA Case Size: 2018.........................148
10.41 Tantalum Capacitor Economies of Scale..........................................................................................................................149

11.0 SPECIAL SECTION: TANTALUM CAPACITORS IN DEFENSE AND AEROSPACE ELECTRONICS.................................152
11.1 Passive Components In Defense Electronics:..................................................................................................................152
11.2 Passive Electronic Component Consumption Value in the Defense and Aerospace End-Use Segment: Historical Growth..................152
11.3 Benchmarking: Passive Component Revenues at The Three Top Public Companies Supplying the Defense and Aerospace Sector by Year: 2012 to 2017.................................................................154
11.4 Passive Component Consumption In Defense Electronics: By Type (Capacitors, Resistors and Inductors) 2017..........................156
11.5 Passive Component Consumption In Defense Electronics By World Region: 2017.................................................................158
11.6 Passive Component In Defense Electronics By Component Type: Historical Growth.........................................................158
11.7 Reasons for Market Changes In Defense Electronics.......................................................................................................158
11.8 Research and Development Spending on Passive Components For New Platforms:...............................................................158
11.9 Passive Component Consumption By Type and Military Specification In Defense Electronics: 2017.................................159
11.10 Capacitor Markets In Defense Electronics: Summary........................................................................................................159
11.11 Capacitor Military Specifications........................................................................................................................................161
11.12 Tantalum Capacitor Military Specifications........................................................................................................................161
11.13 MIL-PRF-39003 - Fixed, Electrolytic (Solid Electrolyte), Tantalum..........................................................................................161
11.14 MIL-PRF-39003 - Fixed, Electrolytic (Wet Electrolyte), Tantalum WETS................................................................................161
11.15 MIL-PRF-55365D - Capacitor, Fixed, Electrolytic (Tantalum), Chip, General Specification........................................................162
11.16 MIL-PRF-49137 - Capacitors, Fixed, Electrolytic (Solid Electrolyte), Tantalum, Molded, Conformal Coated and metal..................162
11.17 MIL-PRF-55365 - Capacitor, Fixed, Electrolytic (Tantalum), Chip.............................................................................................162
11.18 Tantalum Capacitor Vendors for Defense & Aerospace by Type and Specification.................................................................163
11.20 Vendors of Military Specification Capacitors: 2017 Sales & Market Shares........................................................................165
11.21 Passive Component Customers In The Defense Electronics Segment: FY 2017.................................................................166
11.24 Changes In The Competitive Landscape:..........................................................................................................................169
12.1 Global MedTech Market: 2019
12.2 Definition of “MedTech”
12.6 Global MedTech Market: Medical Electronic Devices Versus Materials
12.7 Medtech Electronics Markets By FDA Class Designation:
12.8 Class I Medical Electronics Markets: 2018
12.9 Class II Medical Electronics Markets: 2018
12.10 Class III Medical Electronics Markets: 2018
12.11 Global Consumption Value for Electronic Components in MedTech by Product Market: 2019
12.12 Capacitor Trends in MedTech:
12.13 Tantalum Capacitors:
12.14 Global Unit Growth in The CRM Device Market:
12.16 Consumption of Capacitors by Dielectric In Medical Devices: 2018
12.17 Specialty Tantalum Capacitor Configurations for Pulsed Medical Electronics
12.18 Global Tantalum Markets by Sub-Category: 2016 Final Data and 2017 Outlook
12.19 Global Consumption Value for Tantalum Capacitors in Medical Devices By Product Category With 2017 Forecasts
12.20 TANTALUM New and Emerging Configurations:
12.21 Market Leaders in Tantalum Capacitor Differentiation
12.22 Low Profile Tantalum Capacitors:....................................................................................................................... 191
12.23 Low ESR Tantalum Capacitors:.............................................................................................................................. 191
12.24 Multi-Anode Tantalum Capacitors:.......................................................................................................................... 191
12.25 Fused Tantalum Capacitors: ................................................................................................................................. 192
12.26 Tantalum Capacitors for Hi-Reliability:.................................................................................................................... 192
12.27 Tantalum Capacitor Vendors: 2018 Global Sales and Market Shares ......................................................................... 192
12.28 Tantalum Capacitor Suppliers To Medical Devices: 2018 Market Share Estimates .............................................................. 193
12.29 Global Consumption Value for Tantalum Capacitors in Medical Devices With Forecasts to 2023 ....................... 195
12.30 Tantalum Capacitors in Cardiovascular Electronics: Global Market Outlook to 2023 ............................................. 196
12.31 Tantalum Capacitors in Radiological Test & Scan Equipment: Global Market Outlook to 2023 ................................. 196
12.32 Tantalum Capacitors in Hearing Aid Electronics: Global Market Outlook to 2023 .................................................... 196
12.33 Tantalum Capacitors in Laboratory Test Equipment Electronics: Global Market Outlook to 2023 ...................... 196
12.34 Tantalum Summary of Five Year Growth Forecasts for Tantalum Capacitors in Medical Devices to 2023 .............. 196

13.0 SPECIAL SECTION: TANTALUM CAPACITORS IN OIL & GAS ELECTRONICS INDUSTRY.................................................. 197
13.1 Oil & Gas Electronics & Sub-Categories: 2019:........................................................................................................... 197
13.2 Oil & Gas Electronics: Types of Electronic Components and Sub-Assemblies Consumed: .................................... 197
13.3 Active Components:................................................................................................................................................ 198
13.4 Power Supplies: ...................................................................................................................................................... 198
13.5 Wire & Cable: .......................................................................................................................................................... 198
13.6 Printed Circuit Boards: ......................................................................................................................................... 198
13.7 Capacitor Markets: The Focus of This Report ........................................................................................................ 198
13.8 Historical Development of the Capacitor Markets for the Oil & Gas Electronics Industry: .................................. 198
13.9 Segmenting the Oil & Gas Electronics Markets Into Dedicated Sub-Categories: ..................................................... 199
13.10 The Downhole Pump Motor and Variable Speed Drive Markets for Capacitors: ...................................................... 199
13.11 The Down Hole Sensor Module Market for Capacitors: ....................................................................................... 201
13.12 Major Manufacturers of Downhole Pumping Motors and Drives (Capacitor Customers): 2018 ........................................ 204
13.13 Major Manufacturers of Downhole Sensors and Modules (Capacitor Customers): 2019 .............................................. 205
13.14 Capacitor Markets In Sonic Logging Tools: .......................................................................................................... 205
13.15 Capacitor Markets In Gamma-Ray Logging Tools: ............................................................................................... 206
13.16 Capacitor Markets In Density Logging Tools: ........................................................................................................ 206
13.17 Capacitor Markets In Resistivity Logging Tools: .................................................................................................. 206
13.18 Major Manufacturers of Logging Tools (Capacitor Customers): 2018 ................................................................. 207
13.19 Oil & Gas Electronics: Global Market Value Forecast: 2019-2023 ................................................................. 208
13.20 Historical Trends and Directions Global Market for Oil & Gas Electronics: 2005-2019 .............................................. 209
13.21 Global Revenue Trends By The Top Manufacturers of Oil & Gas Electronics: 2005-2018 ................................. 211
13.22 Technology Drivers Behind Oil & Gas Industry Electrical and Electronic Capacitors ................................................. 211
13.23 Capacitor Supply Chain to the Oil & Gas Industry: ............................................................................................. 211
13.24 Replenishment Rates: ........................................................................................................................................ 212
13.25 Similar Industries With Similar Capacitor Requirements (Defense, Space, Geothermal) .................................................. 212
13.26 Historical Market Development of Capacitors For The Oil & Gas Industry: 2005-2016 ............................................................. 212
3.3.1 Oilwell Industry Push for Performance Improvement in Capacitor Technology ................................................................. 214
3.3.2 The Development of Ultra-HPHT Wells .......................................................................................................................... 214
3.3.3 Shock and Vibration Exposure To Capacitors In Drilling .................................................................................................. 214
3.4 Oil & Gas Capacitors: Demand By Application: (High Temperature, High Voltage, Other Specialty): FY 2016 ................................................................. 214
3.4.1 High Temperature Capacitor Markets in the Oil & Gas Industry: FY 2016 ................................................................. 214
3.127 High Voltage and Other Capacitor Markets in the Oil & Gas Industry: FY 2019 ................................................................. 215
13.30 Global Vendors of Capacitors To The Oil & Gas Industry: FY 2019 Overall Market Shares ................................................................. 217
13.31 Top Overall Vendors of Capacitors to The Global Oil & Gas Industry: FY 2016 Market Shares (Aggregated all Dielectrics and Types): FY 2016 ................................................................. 217
13.32 Changes In Demand For Oil & Gas Electronic Capacitors By Type: 10 year Analysis: ................................................................. 219
13.33 High Temperature Capacitors for the Oil & Gas Industry: Market Growth Trend From 2005-2016 ................................................................. 219
13.342 High Temperature Capacitors for the Oil & Gas Industry: Market Forecasts 2017-2022 ................................................................. 219
13.35 High Voltage Capacitors for the Oil & Gas Industry: Market Growth Trend From 2005-2016 ................................................................. 219
13.36 High Voltage Capacitors for the Oil & Gas Industry: Market Forecasts 2017-2022 ................................................................. 219
13.37 Operating Voltage of Oil & Gas Electronic Tantalum Capacitors >175 Degrees C By Component Configuration: 2018 ................................................................. 223
13.38 Capacitance Value of Oil & Gas Electronic Tantalum Capacitors >175 Degrees C By Component Configuration: 2018 ................................................................. 223
13.39 Global Market Shares In Oil & Gas Electronic Tantalum Capacitors: 2018 ................................................................. 223

14.0 TANTALUM RESOURCE DIRECTORY .................................................. 225
AMG CIF- BRAZIL (TANTALUM POWDER FOR SUPER METALS) .................................................................................... 225
AVX CORPORATION (TANTALUM CAPACITOR MANUFACTURER) .................................................................................... 225
CABOT TANCO-TANTALUM MINING CORP. OF CANADA LTD. (TANTALUM MINING) .................................................... 226
COMPAHIA INDUSTRIAL FLUMINENSE (TANTALUM MINING) .................................................................................... 226
CONGHUA TANTALUM & NIOBium SMELTERY (TANTALUM POWDER, INGOT & CHEMICALS) .................................................... 226
DUOLOUISHAN SAPPHIRE RARE METAL CO. (TANTALUM POWDER) .................................................................................... 227
ETHIOPIAN MINERAL DEVELOPMENT SHARE COMPANY (TANTALUM MINING) .................................................................................... 227
F&X ELECTRO-MATERIALS LTD (TANTALUM POWDER) .................................................................................... 227
FIRADEC SA- EXCELIA (TANTALUM CAPACITOR MANUFACTURER) .................................................................................... 228
GAM GLOBAL ADVANCED METALS (TANTALUM MINING AND PROCESSING) .................................................................................... 228
GREATBATCH, INC. (TANTALUM CAPACITOR MANUFACTURER) .................................................................................... 229
H. C. STARCK GMBH & CO. KG (TANTALUM POWDER & WIRE) .................................................................................... 229
KEMET CORPORATION (TANTALUM CAPACITOR MANUFACTURER) .................................................................................... 229
MATSUO ELECTRIC COMPANY LIMITED (TANTALUM CAPACITOR MANUFACTURER) .................................................................................... 230
METALYSIS LTD. (TANTALUM METAL POWDER) .................................................................................... 230
List of Figures:

Figure 1: Paumanok Research Methodology ................................................................. 17
Figure 2: The Passive Electronic Component Supply Chain ........................................... 20
Figure 3: The Technical Economic Maxims Associated With Passive Electronic Components ................................................................. 24
Figure 4: Overlap Between MLCC, Tantalum Chips and Other Dielectrics ..................... 35
Figure 5: Lead Times for Tantalum Capacitors: FY 2012-2018 by Month ....................... 55
Figure 6: Tantalum Capacitors By Component Configuration: FY 2019 Estimates ............. 56
Figure 7: Tantalum Capacitor Global Market Growth Forecast for FY 2019 ....................... 57
Figure 8: Tantalum Capacitor Near Term Sales Worldwide: FY 2017-2018-2019 Forecast ................................................................. 59
Figure 9: Global Capacitor Markets by Dielectric (Type): FY 2018 .................................. 61
Figure 10: Global Unit Shipments for Tantalum Capacitors: 2003-2018; 2019-2023 Forecasts ................................................................. 63
Figure 11: Global Value of Shipments for Tantalum Capacitors: 2003-2018; 2019 to 2023 Forecasts ................................................................. 64
Figure 12: Global Average Unit Selling Prices for Tantalum Capacitors: 2003-2018; 2019-2023 Forecasts ................................................................. 68
Figure 13: Variations on Tantalum Capacitor Technology: An Important Point of Technical Granularity ................................................................. 70
Figure 14: Global Consumption Value for Tantalum Capacitors by Configuration: FY 2019 ................................................................. 71
Figure 15: Competitive Environment in Tantalum Capacitors By Component Configuration: FY 2019 ................................................................. 72
Figure 16: Tantalum Capacitor Demand By Cathode System: FY 2019 ............................ 73
Figure 17: Average Content of Tantalum Capacitors in Computers, Automobiles, Cameras, Smartphones and Other Items: FY 2019 .................................................. 72
Figure 18: Tantalum Capacitor Consumption Value By End-Use Market Segment: FY 2019 Source: Paumanok Publications, Inc. Estimates ........................................ 74
Figure 19: FY 2019: Tantalum Consumption by End-Use Market Segment .......................................................... 76
Figure 20: Global Consumption Volume for Tantalum Capacitors By End-Use Market Segment and End-Use Product Market: FY 2019 (In Millions of Pieces) 78
Figure 21: Tantalum Capacitor Unit Consumption by End-Use Market Segment: FY 2019 Estimates ................................. 79
Figure 22: Tantalum Capacitors: Market Drivers and Challenges: FY 2019 ........................................................................ 81
Figure 23: Global Consumption Value For Tantalum Capacitors By World Region: FY 2019 (In Millions of USD) ............................................... 86
Figure 24: Global Value of Consumption For Tantalum Capacitors By Channel of Distribution: FY 2019 ........................................... 89
Figure 25: Major Tantalum Capacitor Customers By Channel of Distribution: FY 2019 ................................................................. 91
Figure 26: Global Competitive Environment For Tantalum Capacitors By Component Type and Configuration: FY 2019 .......................... 98
Figure 27: Global Competitive Environment For Tantalum Capacitors- Product Differentiation by Vendor: FY 2019 .................................. 100
Figure 28: Vendor Consolidation in the Tantalum Capacitor Supply Chain From 2013 to 2019 ................................................................. 104
Figure 29: Tantalum Value Chain To The Worldwide Capacitor Industry: 2019 ................................................................. 109
Figure 30: Revenues at the World's Top Tantalum Capacitor Manufacturers by Quarter: ................................................................. 110
Figure 31: Alternatives To Tantalum in Electronics: FY 2019 ................................................................. 112
Figure 32: Tantalum Capacitor Global Unit Forecasts: FY 2019-2023 ............................................................................ 114
Figure 33: Tantalum Capacitor Global Dollar Value Forecasts: FY 2019-2023 ........................................................................ 116
Figure 34: Tantalum Capacitor Global Pricing Forecasts: FY 2016-FY 2023 ............................................................................ 118
Figure 35: Tantalum Capacitor Consumption Value Forecasts By End-Use Market Segment: FY 2023 ...................................................... 119
Figure 36: Tantalum Capacitors: Forecasts By Channel of Distribution: 2023 Forecast ................................................................. 121
Figure 37: Tantalum Capacitors: Forecasts By Cathode System: 2023 Forecast ................................................................. 122
Figure 38: Tantalum Capacitors: Forecasts By World Region: 2019-2023 ................................................................. 124
Figure 39: Increasing Capacitance While Decreasing Capacitor Case Size ........................................................................ 127
Figure 40: Limited Competition in X5R 0603 and 0805 MLCC ........................................................................ 128
Figure 41: Applications of Nano-Technology Into MLCC Over Time: 2004-2018 ................................................................. 130
Figure 42: Impact of the MLCC Parts Shortage of 2018 on Peripheral Components ................................................................. 132
Figure 43: MLCC Leads Way in Passive Component Volumetric Efficiency ................................................................. 135
Figure 44: Ultra-Small Passives: A $15 Billion Industry ........................................................................ 137
Figure 45: Increasing Capacitance While Decreasing Case Size ........................................................................ 139
Figure 46: MLCC Manufacturers by Case Size Showing Limited Vendors in Larger MLCC Case Sizes ................................................................. 141
Figure 47: MLCC Leads Way in Passive Component Volumetric Efficiency ........................................................................ 141
Figure 48: Increasing Capacitance While Decreasing Case Size ........................................................................ 145
Figure 49: Competition by Case Size in Conductive Polymer Capacitors by Dielectric ................................................................. 148
Figure 50: Global Consumption Volume for Tantalum Chip Capacitors By Case Size: 1995-2017 by Year With FY 2018 Forecasts ........................................................................ 150
Figure 51: Passive Electronic Component Consumption Value in the Defense and Aerospace End-Use Segment: Historical Growth ................................................................. 153

Paumanok Publications
Industrial Strength Market Research

Tantalum Capacitors: World Markets, Technologies & Opportunities: 2019-2023
Figure 52: Benchmarking: Passive Component Revenues At The Top Three Manufacturers of Passive Components Supplying the Defense and Aerospace Sector

Figure 53: Sales Trend of Passive Component Vendors To The Defense and Aerospace Sector: 2012-2017 by Year

Figure 54: Tantalum Capacitor Vendors To The Defense Segment

Figure 55: Top Manufacturers of Capacitors for Defense and Aerospace Electronics: FY 2017

Figure 56: Defense Hardware Manufacturer Revenues: 2005-2018

Figure 57: Defense Hardware Manufacturer Revenues: 2012-2017

Figure 58: Competitive Environment in Tantalum Capacitors By Component Configuration: 2016

Figure 59: High Temperature Tantalum Capacitors > 175 Degrees C By Vendor and Component Configuration: 2016

Figure 60: DOD Budget Trends 2010-2018; 2019 Requested

Figure 61: Global MedTech Market Growth: 2005-2018; 2019-2023 Forecasts

Figure 62: Global Market Breakdown for Medtech by Type: Materials Versus Electronics: 2018

Figure 63: Medical Electronics Market Breakdown By FDA Class Designation: 2018

Figure 64: Global Consumption Value for Electronics Components in Medtech By Product Market: 2019

Figure 65: Global Unit Shipments of CRM Devices (Implantable Defibrillators): 2005-2018; 2019-2023 FORECASTS

Figure 66: Global Unit Shipments of MRI and CT Equipment: 2005-2016; 2017 Forecasts

Figure 67: Global Consumption Value for Capacitors By Dielectric in Medical Devices: 2016

Figure 68: Global Consumption Value for Tantalum Capacitors in Medical Devices By Product Category With 2017 Forecasts

Figure 69: Tantalum Capacitor Suppliers To Medical Electronics: 2018 Market Shares

Figure 70: Global Consumption Value for Tantalum Capacitors in Medical Devices By Product Category With Forecasts to 2023

Figure 71: Downhole Pump Electronics Schematic: High Heat and Harsh Environment

Figure 72: Manufacturers of Downhole Pumping Equipment

Figure 73: Downhole Sensor Manufacturers (Capacitor Customers)

Figure 74: Logging Tool Manufacturers (Capacitor Customers)

Figure 75: Global Historical Trend in Markets for Oil & Gas Industry Electronics: FY 2005-2019

Figure 76: Global Manufacturers of Oil & Gas Electronics: 2005-2018 Revenues

Figure 77: Capacitor Revenues From The Oil & Gas Industry: 2005-2019

Figure 78: Percent Change Year On Year in Capacitor Sales To The Oil & Gas Industry

Figure 79: Oil & Gas Electronic Capacitor Markets By Type (High Temperature, High Voltage and Other): FY 2016

Figure 80: Global Vendors of Capacitors To The Oil & Gas Electronics Industry: FY 2016 Market Shares

Figure 81: Changes in Consumption for Oil & Gas Electronic Capacitors: 2005 Versus 2016 and 2021 Forecasts

Figure 82: Oil & Gas Electronic Tantalum Capacitors > 175 Degrees C By Vendor and Component Configuration: 2016

Figure 83: Global Market Shares in Oil & Gas Electronic Tantalum Capacitors: 2018

PLUS A 54 SLIDE PRESENTATION ENTITLED TANTALUM;STATE OF THE INDUSTRY 2019