Developments of Long-pulse Klystron Modulator for KEK SCRF Test Facility

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Of course you know KEK. Then, what is NICHICON?

Manufacturing Capacitors of various types;
Manufacturing Power Supplies of various types;
  for Appliances (NOT for Fire Engine), Industries,
  Vehicles, and Scientific Researches especially for Accelerators.
  - Pulsed or DC Manget Power Supply
  - Pulsed or DC Electron Tube Power Supply
  - Pulsed or DC High Voltage Power Supply
Company Name: NICHICON CORPORATION
Established: August 1, 1950
Paid-in Capital: 14,286 million yen
Sales: 106,718 million yen (Consolidated) Mar.31.'06
Number of Employees: 5,846 (Consolidated) Mar.31.'06

Product Lines:
- Aluminum, Tantalum, Film capacitors
- Hybrid ICs, Positive Thermistors
- Switching Power Supplies
- Capacitors applied systems and equipment

HEAD OFFICE
Kyoto, JAPAN
PRODUCT & TECHNOLOGY

NICHICON CORPORATION

Aluminum capacitors

Film capacitors

Tantalum capacitors

CAPACITORS FOR POWER & ELECTRONICS

Power Supplies

Speed & Flexibility
Novel Long Pulse Modulator

Crowbar-less system by highly reliable IGBT switch
Compact and highly reliable Self-Healing capacitors
Mass-Production oriented Transformer Design
Photos Inside the Modulator

Rear View

Front View of Switch Cubicle

IGBT Switch Stack

Bouncer Capacitors

Main Capacitors

Voltage Multiplier

Bouncer Thyristor/Diode Stack

Bouncer Inductor

Tail Clipper

Maintenance Corridor

IGBT Switch Stack

Bouncer Capacitors
Crowbar-less system
by highly reliable IGBT switch

Long-term performance in Nuclear Fusion Experiments
Optimal Snubber design
Two Optical fibers to control doubly and,
One Optical fiber to detect short-circuit of each IGBT module
Modulator Schematic Diagram

- Inverters
- Voltage Multipliers
- Main Capacitors
- Bouncer & Tail Clipper
- IGBT Switch Stack
Compact and highly reliable Self-Healing capacitors

Small Size and Higher Energy Density

<table>
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<tr>
<th>Supplier</th>
<th>NICHICON</th>
<th>GE</th>
<th>AVX</th>
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<tbody>
<tr>
<td>Capacitance (microF)</td>
<td>440</td>
<td>25</td>
<td>488</td>
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<tr>
<td>Cap bank no</td>
<td>4</td>
<td>56</td>
<td>3</td>
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<tr>
<td>Rated dc Voltage (kVdc)</td>
<td>11</td>
<td>12</td>
<td>12</td>
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<tr>
<td>Storage energy (kJ)</td>
<td>26.6</td>
<td>1.8</td>
<td>33.6</td>
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<tr>
<td>Weight (kg)</td>
<td>140</td>
<td>39</td>
<td>195</td>
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<tr>
<td>Volume/100kJ (m3/100kJ)</td>
<td>0.415</td>
<td>&lt;0.75</td>
<td>&lt;0.75</td>
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<tr>
<td>Weight/kJ</td>
<td>5.3</td>
<td>21.7</td>
<td>5.8</td>
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<td>Life time (minimum) (h)</td>
<td>90,000</td>
<td>90,000</td>
<td>139,000</td>
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Mass-Production Oriented Transformer Design

Divided into two transformers; one for full withstanding voltage and the other for half

Laminated core suitable to mass-production
Photos - Long Pulse Transformer

Tank

Impedance Measuring
Status & Plan

- Factory Test & Site Installation Completed
- Starting Up at KEK STF
- Multi-beam Klystron Aging & Power Test Planned
- Further Improvement for System Reliability and Optimum Engineering Design