Interphase reactor is not required.

Minimum ambient air temperatures of -5°C and -10°C are for variable conductance.

**Auxiliary power source**

- **Standard output**: DC voltage
- **Type of connection**: Rated class
- **Applicable standard**: Cooling method
- **Installed location**: Protective interlocking
- **Ground fault**: Overcurrent #51
- **Short circuit**: Overload
- **Internal fault**: Voltage
- **Overcurrent**: Overload

**Space heater circuit**: Single-phase 200 V AC, 600 W

**Control circuit**: 100/110 V DC

**Rated kW**: 4000, 2000, 1500
**Voltage**: 1500, 750, 600 V

**Transformer**: Three-phase bridge (6-pulse), or double three-phase bridge (parallel 12-pulse)

**Frequency**: 50 Hz or 60 Hz

**Type of connection**: Rated class

**Installed location**: Indoors or outdoors

**Cooling method**: Pure water vaporization-cooling silicon rectifier

**Temperature**: 5 to +40°C

**Resistance thermometer bulb**

**Anchor bolts**

**Download our catalog**

Your inquiry form

<table>
<thead>
<tr>
<th>No.</th>
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<th>Specification</th>
<th>Fills in your details in this column.</th>
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<tbody>
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<td>3000 Hz</td>
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<td>Yes, Cable</td>
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<tr>
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<td>Main circuit, sub circuit, and control circuit</td>
<td>3000 Hz</td>
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<td>Main circuit terminals</td>
<td>Necessary, main</td>
<td>3000 Hz</td>
</tr>
<tr>
<td>14</td>
<td>Transformer</td>
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<td>3000 Hz</td>
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Fujielectric’s pure water vaporization-cooling technology has created the ultimate silicon rectifier that is eco-friendly, compact, and lightweight.

The Key Point in the Innovation of Railway Substation Equipment is Protecting the Environment!

Implementation benefits and product concepts

Features
- Pure water vaporization natural cooling
- High efficiency
- Completely sealed structure
- High reliability
- Maintenance-free
- Freely of dust
- Free of auxiliary equipment
- Entire unit at ground potential
- Highly reliable insulation
- Reduced number of parts
- Compact and lightweight
- High efficiency
- Global warming potential: 0
- Perfluorocarbons (PFCs) removed

Benefits of implementation
- Prevention of global warming
- High efficiency
- Completely sealed structure
- Vaporization cooling such as for the snubber and surge absorber

Pure water vaporization-cooling rectifier.

Changing trend in the coolant used in vaporization-cooling silicon rectifiers for railway substations

<table>
<thead>
<tr>
<th>Substance</th>
<th>Global warming potential (GWP)</th>
<th>Lifetime (years)</th>
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<tbody>
<tr>
<td>Water</td>
<td>0</td>
<td>40</td>
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<tr>
<td>Chlorofluorocarbons (CFCs)</td>
<td>3200</td>
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<td>Carbon dioxide</td>
<td>20 to 200</td>
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<table>
<thead>
<tr>
<th>Period</th>
<th>Regulation</th>
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<tr>
<td>1970s</td>
<td>Montreal Protocol</td>
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<td>1980s</td>
<td>Montreal Protocol</td>
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<tr>
<td>1990s</td>
<td>Kyoto Protocol</td>
</tr>
<tr>
<td>2000s</td>
<td>Kyoto Protocol</td>
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</table>

Pure water filtration that contains no minerals at all.

*1: Pure water is H2O produced by ion exchange purification and distilled water for the coolant.

Note that the vessel is under constant negative pressure.

The heat generated by the silicon rectifier diode vaporizes the pure water inside the cooling body.

At that time, the latent heat of vaporization efficiently cools the silicon rectifier diode.

The wafer vapor is suctioned in the condenser and returns to the cooling body to become a liquid again.

This configuration thermally protects the cooling body.

This structure keeps out dust which makes a long period of use without needing cleaning.

Variable conductance

Due to its unique variable conductance technology, the cooling system prevents freezing, even when ambient air temperature drops to sub-zero levels.

- The heating of the silicon diode turns the water inside the silicon diode into vapor, which rises to the condenser, so freezing will not occur even when the temperature drops to sub-zero levels.
- The heating of the silicon diode turns the water inside the silicon diode into vapor, which rises to the condenser, so freezing will not occur even when the temperature drops to sub-zero levels.

Internal structure

Cooling body

- Silicon rectifier diode
- Condenser
- Cooling body
- Pure water
- Heater switch
- Dial
- Terminals
- Hand hole

Silicon rectifier diode

Condenser

Hand hole

Condenser

Cooling body

Pure water

Heater switch

Dial

Terminals

Hand hole

Input

Output

Operating principle of variable conductance

A non-condensable gas (nitrogen gas) and pure water are sealed inside the unit.

The heating of the silicon diode turns the water into vapor which rises to the condenser, so freezing will not occur even when the temperature drops to sub-zero levels.

Operating principle

- The heating of the silicon diode turns the water into vapor which rises to the condenser, so freezing will not occur even when the temperature drops to sub-zero levels.

Load condition | No load | Light load | Heavy load
---|---|---|---
Current | 0 | 3200 A | 58000 A
Voltage | 5500 V | 5200 V | 5000 V
Temperature | 25˚C | 30˚C | 50˚C

Montreal Protocol

Kyoto Protocol

Global warming potential of various substances
The Key Point in the Innovation of Railway Substation Equipment is Protecting the Environment!

Fuji Electric’s pure water*1 vaporization-cooling technology has created the ultimate silicon rectifier that is eco-friendly, compact, and lightweight.

**Implementation benefits and product concepts**

- **Benefits of implementation**
  - Prevention of global warming
  - Maintenance-free
  - High safety
  - Improved reliability

- **Features**
  - Pure water vaporization natural cooling
  - Variable conductance
  - Fine ceramics insulation
  - Completely sealed structure

---

**Cooling principle**

The heat generated by the silicon rectifier diode vaporizes the pure water inside the cooling body. At full load, the large latent heat of vaporization efficiently cools the silicon rectifier diode. The water vapor is suctioned into the condenser and returns to the cooling body to become a liquid again. Note that the vessel is under constant negative pressure.

**Internal structure**

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**Operating principle of variable conductance**

A non-condensable gas (nitrogen gas) and pure water are sealed inside the Unit, and the nitrogen gas pressure and temperature are fixed. The ratio occupied by the water vapor is controlled by the variation of the nitrogen gas pressure, which in turn controls the temperature of the cooling body. When the heating of the silicon diode vaporizes the water into vapor again, then, after moving in the direction of the red arrows, dissipates its heat in the downstream side of the condenser. Water vapor turns the water into vapor which further compressed on the downstream side of the condenser, and cools the silicon rectifier diode.

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**Subassembly diagram**

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*1: Pure water is H2O produced by ion exchange purification and distilled water filtration that contains no minerals at all.
Nucleon's pure water vaporization-cooling technology has created the ultimate silicon rectifier that is eco-friendly, compact, and lightweight.

**Cooling principle**

The heat generated by the silicon rectifier diode vaporizes the pure water inside the cooling body. This makes it possible to use the latent heat of vaporization to cool the silicon rectifier diode. The water vapor is suctioned by the condenser and returns to the cooling body to become a liquid again. Note that the vessel is under constant negative pressure.

**Internal structure**

The key point in the innovation of railway substation equipment is protecting the environment!

Fujitsu Electric's pure water vaporization-cooling technology has created the ultimate silicon rectifier that is eco-friendly, compact, and lightweight.

Features

- Pure water vaporization natural cooling: This method makes pure water into water vapor for cooling.
- Japan's largest silicon rectifier diode: We developed the high-voltage, large-capacity silicon rectifier diode based on our many years of experience and technology in power semiconductors. We have achieved a product with a significantly reduced number of parts, that is compact and lightweight, and has high efficiency.
- Variable conductance: We use variable conductance technology to improve cooling efficiency. The effective cooling area increases in comparison with our fixed-thermal-conductance cooling method.
- Fine ceramics insulation: The use of fine ceramics with high thermal conductivity and high insulation on both sides of the cooling body insulates the silicon rectifier diode and allows a high current conduction enabling the entire unit to be compact and lightweight.
- Completely sealed structure: We have achieved a completely sealed structure that uses water vaporization cooling such as for the snubber and surge absorber, and reduces the temperature rise in the stack storage unit.
**Pure Water Vaporization-cooling Silicon Rectifier**

DC 1,500/750/600 V, 1,500 to 6,000 kW

For Electric Railway Substations

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**Protective interlocking and coordination**

- **Protective interlocking**
- **Protective coordination**
- **Single-line diagram**

**External dimensions**

- **For Electric Railway Substations**
  - Silicon Rectifier

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**Fittings**

- **Standard specifications**
- **Options**

---

**Your inquiry form**

- **No.**
- **Specification**
- **Fill in your details in this column:**
  - **1. Rated voltage (V)**
  - **2. Rated output (kW)**
  - **3. Frequency (Hz)**
  - **4. Standard duty class**
  - **5. Cooling method**
  - **6. Standard output (kW)**
  - **7. Rated class**
  - **8. Type of connection**
  - **9. Rated voltage (V)**
  - **10. Frequency (Hz)**
  - **11. Applicable standard**
  - **12. Installed location**
  - **13. Environmental conditions**
  - **14. Name**
  - **15. External dimensions (mm)**
  - **16. Mass (kg)**
  - **17. Name**
  - **18. Quantity**

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**Information in this catalog is subject to change without notice.**

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