Meidensha's basic concept for railway systems is the stabilized supply of electrical power. Mass rapid transit is further increasing its significance and high reliability of transportation system is increasingly called for. To meet these requirements of the times, Meidensha railway systems offer state-of-the-art technologies in wide ranges of fields from Powertronics of substation facilities to Electronics of computer systems.
Installation of rail transport systems as environmentally friendly transportation infrastructure is advancing in cities around the world. Meidensha’s electric railway equipment is playing a part in this advance.

A bullet-train electrical substation supports stable transport of the Shinkansen, a form of high-speed mass transit. Electric-power command facilities that support safe transport and electric-power management systems for electric railways that centrally monitor and control many substations are in use in various locations.

Underground trains and new transportation systems are essential for commuting in urban centers. Electrical substations for electric railways maintain safety, reliability, and safe transportation.

Meidensha’s Electrical Facilities for Railways Actively Playing their Roles throughout the World

Constructing Rational Power Feeder Systems, by the Full Use of Railway Simulation Technologies.

Substation Facility Plan

When planning a railway substation, the overall capacity of the facility can be defined according to the distance between substations, the transportation plan, and car performance characteristics.

In the past, this capacity was calculated based on the power consumption rate of a similar line and possible train operation diagrams. Along with the sophistication of a traffic system, however, it has been difficult to use such a method based on experience in the past. Meidensha Corporation will support the user to construct a reasonable feeding system through the adoption of railway simulation technologies, the introduction of power-regeneration cars to cope with densely arranged traffic diagrams, the use of thyristor rectifiers, and the installation of power regeneration inverters, with the aid of computer analysis for sophisticated feeding systems.

The following result is obtainable from digital simulation:

1. Train running curves (each section between stations)
   - Grade curve
   - Limited speed curve
   - Speed curve
   - Running time curve
   - Running current curve
2. Substation’s output current, Voltage, and wattage curves
3. Current curves for substation feeder CBs
4. Max. and Min. feeder voltage curves
5. Frequency distribution curves

Railway Substation Facility Planning Procedures

The following result is obtainable from digital simulation:

1. Train running curves (each section between stations)
2. Substation’s output current, Voltage, and wattage curves
3. Current curves for substation feeder CBs
4. Max. and Min. feeder voltage curves
5. Frequency distribution curves
When planning a railway substation, the overall capacity of the feeding systems can be defined according to the distance between substations, the transportation plan, and car performance characteristics.

Along with the sophistication of a traffic system, however, it has been difficult to use such a method based on experience in the past. In the past, this capacity was calculated based on the power consumption rate of a similar line and possible train operation diagrams. The following result is obtainable from digital simulation:

- Maximum and minimum feeder voltage curves
- Substation's output current, voltage, and wattage curves
- Train running curves (for each section between stations)
- Current curves for substation feeder CBs
- Frequency distribution curves

### DC Railway Simulation Feeder System (Example)

**Examination**
- Main-circuit characteristics
- Non-flammability
- Digitization
- Downsizing

**Power Control**
- Examination
- Power receiving system
- Feeder system
- Location
- Equipment
- Specification

**Specification**
- Railway: Simulation
- Electrification
- Examination
- Main-circuit characteristics
- Non-flammability
- Digitization
- Downsizing

**Line data**
- Voltage drop
- Inverter capacity
- Filter capacity
- Capacity of main equipment

**A station**
- B station
- C station
- D station
- E station
- F station
- G station
- H station
- I station

**CAPAPOST**

### Table: Result of Substation Characteristic Calculation

<table>
<thead>
<tr>
<th>Start station</th>
<th>Arrival station</th>
<th>Train</th>
<th>Power-running capacity (kW)</th>
<th>Power-running efficacy (kW)</th>
<th>Regeneration power (kW)</th>
<th>Start station</th>
<th>Arrival station</th>
<th>Train</th>
<th>Power-running capacity (kW)</th>
<th>Power-running efficacy (kW)</th>
<th>Regeneration power (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>4M, 2T</td>
<td>3000.00</td>
<td>1500.00</td>
<td>1500.00</td>
<td>B</td>
<td>C</td>
<td>4M, 2T</td>
<td>3000.00</td>
<td>1500.00</td>
<td>1500.00</td>
</tr>
</tbody>
</table>

### Substation voltage - current curves

### Substation wattage curve

### Substation output-current, voltage, wattage curves

### Substation feeder CB (Circuit-Breaker) current curves

### Feeder voltage Max./Min. curves

### Railway-car voltage/current characteristics

### Pantograph point lowest/highest voltage

### Substation voltage......Max. voltage

### Min. voltage

### Substation wattage......Max. power-running wattage

### Average regeneration wattage

### Max. regeneration wattage

### Substation regenerating efficiency
Switchgears for Power Supply System

24kV/36kV SF6 Gas insulated Switchgear

HICLAD 20GB/HICLAD 30GB

Features
● No exposure of high-voltage live part to the air. Complete interlocking system against erroneous operation. Equipment of manual operation mechanism in an emergency.
● Visualized operation mechanisms equipped with mimic bus and symbols. All switching devices can be operated from remote. Compact size achieved by optimal arrangement of devices.
● High-voltage live part is completely protected against moisture and dust.
● Reliable gas-insulated busbar system. Keeping the ability of breaking circuit, even if the insulating gas pressure becomes zero. Enhancement of reliability by reduction in number of parts achieved by simple structure.
● Adaptable for various requirements of network by employing plug-in type voltage transformer and lightning arrester. Insulating performance is imperious to the installation altitude. Test of high-voltage part can be fully performed without any gas handling.
● Easy maintenance. No maintenance is needed for high-voltage equipment in the gas compartment. SF6 gas is not polluted by arc because of employing VCB. (SF6 gas is used only as insulation medium.)

Technical data

Table 1 Switchgear

<table>
<thead>
<tr>
<th>Switchgear model</th>
<th>HICLAD 20GB</th>
<th>HICLAD 30GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear type</td>
<td>NBG-24</td>
<td>BGB-36</td>
</tr>
<tr>
<td>Applicable standards</td>
<td>IEC62277-100</td>
<td></td>
</tr>
<tr>
<td>Classification of switchgear</td>
<td>SF6-insulated metal-enclosed</td>
<td></td>
</tr>
<tr>
<td>Service condition</td>
<td>Altitude &lt; 1000m</td>
<td>Ambient temperature Max. 40℃, Min. -5℃</td>
</tr>
<tr>
<td></td>
<td>24h. average &lt; 35℃</td>
<td>24h. average &lt; 90%</td>
</tr>
<tr>
<td>Rated voltage (kV)</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>Rated current (A)</td>
<td>1250, 2000</td>
<td>1250, 2000, 2500</td>
</tr>
<tr>
<td>Rated frequency (Hz)</td>
<td>50/60</td>
<td></td>
</tr>
<tr>
<td>Insulation level</td>
<td>1 min power frequency (kV rms) 50</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>1.2 x 50μs impulse (kV peak) 125</td>
<td>170</td>
</tr>
<tr>
<td>Rated short-time withstand current (kA)</td>
<td>25-3</td>
<td>31.5-3</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>HV compartment IP65</td>
<td>LV compartment IP40</td>
</tr>
<tr>
<td>Gas pressure</td>
<td>Rated pressure (MPa) 0.05</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Alarm pressure (MPa) 0.02</td>
<td>0.06</td>
</tr>
<tr>
<td>Operation of 3-position isolator</td>
<td>Motorized</td>
<td>Manual</td>
</tr>
<tr>
<td>Auxiliary voltage</td>
<td>Control circuit (V) DC 36, 110, 125, 220</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Motor circuit (V) AC 220, 230, 240 / DC 110, 125</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Vacuum Circuit-Breaker (VCB)

<table>
<thead>
<tr>
<th>VCB model</th>
<th>NVG-22</th>
<th>VGB-33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable standards</td>
<td>IEC62277-100</td>
<td></td>
</tr>
<tr>
<td>Rated voltage (kV)</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>Rated current (A)</td>
<td>1250, 2000</td>
<td>1250, 2000, 2500</td>
</tr>
<tr>
<td>Rated frequency (Hz)</td>
<td>50/60</td>
<td></td>
</tr>
<tr>
<td>Insulation level</td>
<td>1 min power frequency (kV rms) 50</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>1.2 x 50μs impulse (kV peak) 125</td>
<td>170</td>
</tr>
<tr>
<td>Rated short-circuit breaking current (kA)</td>
<td>25</td>
<td>31.5</td>
</tr>
<tr>
<td>Rated short-circuit making current (kA peak)</td>
<td>83</td>
<td>82</td>
</tr>
<tr>
<td>Rated short-time withstand current (kA)</td>
<td>25-3</td>
<td>31.5-3</td>
</tr>
<tr>
<td>Operating duty*</td>
<td>D-O-3sec.-CO-3min-CO</td>
<td></td>
</tr>
<tr>
<td>Rated closing time (s)</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Rated opening time (s)</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Rated break time (s)</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Rated TRV for terminal fault</td>
<td>Rate of rise (kV/μs) 0.47</td>
<td>0.57</td>
</tr>
<tr>
<td>TRV peak voltage (kV)</td>
<td>41</td>
<td>82</td>
</tr>
<tr>
<td>Type of operating mechanism</td>
<td>Motor charged spring</td>
<td></td>
</tr>
</tbody>
</table>

* Other duties, D-O-3sec.-CO-15sec.-CO, D-O-3sec.-CD-1min-CO-1min-CO are also available.
Switchgears for Power Supply System

12kV SF6 Gas insulated Switchgear

**HICLAD 10G**

**Features**
- SF6 gas insulation used in conjunction with vacuum circuit-breaker (VCB) has resulted in switchboards setting new standards with respect to
  - Operational reliability and availability
  - Reduced maintenance work
  - Safety of persons
  - Free from environmental pollution
  - Reduced dimensions and less space requirements
  - Current interruption with gas pressure 0 (equal to atmospheric pressure)

12kV Air insulated Switchgear

**HICLAD 10ZA**

**Features**
- Complete interlocking system against erroneous operation. Internal Arc Classification IAC AFLR.
- Compact and Light weight. 33% less footprint than our previous type AIS on typical layout. Easy maintenance.

168/204kV Changeover switch (Shinkansen)

- Commercialization of the world's first 204 kV rated model.
- Guaranteed high reliability
  - We adopted proven double-break technology with a 168 kV insulator-type VCB.
  - We developed a 168/204 kV tank-type VCB.
  - It utilizes the latest vertical magnetic-field electrode vacuum interrupter.
  - We adopted a proven operation mechanism with a 72 kV tank-type VCB.
- Maintenance labor-saving circuit breaker
  - Use of a vacuum interrupter eliminates the need for inspections of the interrupter section.
  - Life cycle cost can be reduced (total cost reduction compared to generator circuit-breakers (GCB)).
- Lower center of gravity improves earthquake performance
  - Guarantees a sufficient safety factor for 0.3 G, 3-wave resonance.

72/84kV Changeover switch (Shinkansen)

- Contributes to the prevention of global warming due to the absence of SF6 gas by means of dry air and composite insulation.
- Because a completely self-arc-extinguishing vacuum interrupter is used, the circuit breaker can handle multiple lightning strokes and evolving-fault breaks.
- Because a vacuum interrupter is used in the shut-off section, the device is designed to save maintenance and inspection labor compared to generator circuit-breakers (GCB).
- The use of an aluminum tank provides the following benefits.
  1. Lightweight (27% less compared to existing types)
  2. Effective for transportation weight, installation area, and earthquake performance
  3. No coating
  4. Effective for reducing maintenance costs
  5. Reduction of loss of passage of electric current (85% less compared to existing types at 1,200 A)
  6. Common up to 2000 A rated electric current

12kV SF6 Gas insulated Switchgear

**12kV SF6 Gas insulated Switchgear**

**Features**
- SF6 gas insulation in conjunction with vacuum circuit-breaker (VCB) has resulted in switchboards setting new standards with respect to
  - Operational reliability and availability
  - Reduced maintenance work
  - Safety of persons
  - Free from environmental pollution
  - Reduced dimensions and less space requirements
  - Current interruption with gas pressure 0 (equal to atmospheric pressure)

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12kV SF6 Gas insulated Switchgear

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- SF6 gas insulation used in conjunction with vacuum circuit-breaker (VCB) has resulted in switchboards setting new standards with respect to
  - Operational reliability and availability
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  - Safety of persons
  - Free from environmental pollution
  - Reduced dimensions and less space requirements
  - Current interruption with gas pressure 0 (equal to atmospheric pressure)

12kV Air insulated Switchgear

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**Features**
- Complete interlocking system against erroneous operation. Internal Arc Classification IAC AFLR.
- Compact and Light weight. 33% less footprint than our previous type AIS on typical layout. Easy maintenance.
AC power transformers

This optimal design meets needs from high voltage receiving and feeding transformers for the Shinkansen to converter transformers.

Features

- Optimal design
  - We provide highly reliable equipment through design know-how cultivated over many years with the Shinkansen.
- The design can also meet low-noise and low-loss needs.
- Roof-delta winding with small size, light weight, and low loss are manufactured for high voltage feeding.

Rectifier Transformer

Features

- Optimal design
  - We achieved the optimum design to meet special rated values, including electric railway load Class VI and Class S, with the goals of small size and light weight.
- Various types
  - Various types can be supported, including radiator package types, by-radiator installation types, auxiliary-transformer mounted types, and primary and secondary bushing, and bus duct systems.
- High reliability
  - Meticulous quality control provides high reliability.

Transformer for rectifier

<table>
<thead>
<tr>
<th>Item</th>
<th>Application</th>
<th>Cooling method</th>
<th>Rated capacity</th>
<th>Duty class</th>
<th>Rated primary voltage</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof-delta connection transformer</td>
<td>For power feeding a Shinkansen train</td>
<td>Oil immersed self-cooling type</td>
<td>Up to 120 MVA</td>
<td>300% for 2 min.</td>
<td>Up to 275 kV</td>
<td>Roof-delta connection</td>
</tr>
<tr>
<td>154 kV Scott connection transformer</td>
<td>For power feeding a Shinkansen train</td>
<td>Oil immersed self-cooling type</td>
<td>Up to 100 MVA</td>
<td>300% for 2 min.</td>
<td>Up to 194 kV</td>
<td>Scott connection</td>
</tr>
</tbody>
</table>

Gas-insulated transformer

Oil-immersed transformer

Double converter transformer

<table>
<thead>
<tr>
<th>Item</th>
<th>Application</th>
<th>Cooling method</th>
<th>Rated capacity</th>
<th>Duty class</th>
<th>Rated primary voltage</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double converter transformer</td>
<td>For DC Traction power supply</td>
<td>Oil immersed (silicone oil)</td>
<td>2500kVA</td>
<td>Class VI</td>
<td>100% continuous, 150% for 2 hr., 300% for 1 min.</td>
<td>220kV Y-△</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Features
● The insulation layer that forms the coil is a flame resistant epoxy-resin processed FRP insulator. Because insulating oil is not used, the number of firefighting facilities that must be installed by law can be reduced.

Use of a wound core of high-grade electromagnetic steel plate and the compact size greatly reduced non-load loss.

Features
● Since SF6 is used and core and windings are contained in a hermetically-sealed vessel, this type of transformer can be used safely in a building or underground town.

Rated voltage 750V
Duty class Class VI (100% continuous, 150% for 2 hr., 300% for 1 min.)
Class S
Cooling method Natural cooling
Installation location Indoor

Features
● Various patterns are available for bushing allocations, bus-duct shapes, etc.
● In addition to self-cooled type, there are, many types available, such as oil-immersed forced-air-cooled type, oil-immersed water-cooled type, forced-oil self-cooled type, forced-oil forced-air-cooled type, etc.
● Low-noise type is also available.
● Environmentally friendly transformers that use flame-resistant low-viscosity silicone oil are also manufactured.
● Transformers that use palm oil can also be manufactured as an environmental response.

Specifications
Rated direct voltage 1500 V
Duty class Class VI (100% continuous, 150% for 2 hr., 300% for 1 min.)
Class S
Cooling method Heat-pipe Cooling system
Installation location Indoor/outdoor

Features
● This rectifier for DC electric railway substations uses pure water for its heat pipe coolant for a low environmental burden.
● To prevent electrical shock accidents, aluminum nitride insulator with high heat-conduction characteristics is placed between the silicon rectifiers and the heat pipes, which makes the heat pipes a noncurrent carrying part.
● The main circuit storage section has an airtight construction to prevent deterioration due to dust and other elements.
● The structure was substantially reviewed, and the installation area (projected area) was reduced 36% compared to existing types.

Specifications
Rated voltage 750 V
Duty class Class VI (100% continuous, 150% for 2 hr., 300% for 1 min.)
Class S
Cooling method Natural cooling
Installation location Indoor

Features
● Simple construction
● Compact construction
● Easy maintenance and inspection

Specifications
Rated voltage 750 V
Duty class Class VI (100% continuous, 150% for 2 hr., 300% for 1 min.)
Class S
Cooling method Natural cooling
Installation location Indoor

Features
● Various patterns are available for bushing allocations, bus-duct shapes, etc.
● In addition to self-cooled type, there are, many types available, such as oil-immersed forced-air-cooled type, oil-immersed water-cooled type, forced-oil self-cooled type, forced-oil forced-air-cooled type, etc.
● Low-noise type is also available.
● Environmentally friendly transformers that use flame-resistant low-viscosity silicone oil are also manufactured.
● Transformers that use palm oil can also be manufactured as an environmental response.

Specifications
Rated direct voltage 1500 V
Duty class Class VI (100% continuous, 150% for 2 hr., 300% for 1 min.)
Class S
Cooling method Heat-pipe Cooling system
Installation location Indoor/outdoor
A Semi-Conductor-Applied System that Supports Railway Systems

Power Converter Equipment

**Double converter**

This unit enables the constant voltage control of feeding voltage, even in case of the sudden load fluctuations, and returns the regenerative power from electric trains to the AC side by inverting the power. This controls the cross-flow current flowing between substations and reduces feeding power loss, earth leakage current and touch voltage.

<table>
<thead>
<tr>
<th>Converter rating</th>
<th>Example installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectifier</td>
<td>2000kW S type (100% continuous, 150% for 2 hr, 300% for 1 min.)</td>
</tr>
<tr>
<td>Inverter</td>
<td>500 kW S type (100% continuous, 300% for 1 min.)</td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>DC 750V</td>
</tr>
</tbody>
</table>

**Regenerative power PWM inverter**

Supplying regenerative energy from electric-train breaking to station-building power-sources and so on maintains the validity of regeneration, and the effective use of energy contributes to energy conservation and reduces environmental burden.

**Features**

- Circulating current is not necessary.
- Lower harmonic waves are not generated.
- Commutation failure does not occur.

**Ratings / specifications**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control method</td>
<td>PWM control</td>
</tr>
<tr>
<td>Cooling method</td>
<td>Forced air cooling (during operation only)</td>
</tr>
<tr>
<td>Type/quantity</td>
<td>S type (100% continuous, 200% for 1 min.)</td>
</tr>
<tr>
<td>Direct current rating</td>
<td></td>
</tr>
<tr>
<td>Rated voltage</td>
<td>100V</td>
</tr>
<tr>
<td>Rated current</td>
<td>617A</td>
</tr>
<tr>
<td>Rated capacity</td>
<td>1000kW</td>
</tr>
<tr>
<td>Maximum allowable voltage</td>
<td>3000V</td>
</tr>
<tr>
<td>Alternating current rating</td>
<td></td>
</tr>
<tr>
<td>Number of phases</td>
<td>3 x 3phase</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50Hz / 60Hz</td>
</tr>
<tr>
<td>Performance</td>
<td>Regeneration start voltage setting range: 1600 to 1650 V</td>
</tr>
</tbody>
</table>

Regenerative Power Storage System

**CAPAPOST**

Direct-current electric-motor vehicles have a braking system that converts the kinetic energy from breaking into electrical energy (regenerative electric power), and then supplies that energy to other electric loads. We built the optimal feeding system for energy saving by storing breaking energy in an electric double layer capacitor and supplementing the energy to run electric vehicles in accordance with the feeding circumstances.

**Achieves energy conservation through the effective use of regenerative power**

- Absorbing regenerative power and releasing it while power is running is an economic use of energy and contributes to the reduction of emissions of carbon dioxide, a greenhouse gas.
- The effective use of regenerative electrical energy demonstrates its power in the peak shaving of electric-railway loads, which have large fluctuations.
- Energy is absorbed during breaking, which maintains the validity of regeneration.
- Regenerative vehicles can be introduced to train lines, which has been difficult to do up to now.

**Electric double layer capacitor is used**

- Because the electric double layer capacitor does not use chemical reactions in charging and discharging, it has excellent characteristics for repeated charging and discharging and rapid charging and discharging.
- The electric double layer capacitor is an environmentally friendly product as it does not use any heavy metals.
- Because the electric double layer capacitor is connected to the feeding wire via a step-down and step-up type chopper, high-voltage receiving equipment is not required.
Regenerative vehicles can be introduced.

Energy is absorbed during breaking, which maintains the validity of regeneration.

The effective use of regenerative electrical power and releasing it to train lines, which has been difficult to do, achieves energy conservation and reduces environmental burden.

Because the electric double layer capacitor (EDLC) can store the energy to run electric vehicles in accordance with the feeding circumstances, the EDLC is used.

While power is running, feeder voltage drops, and CAPAPOST discharges power. During regeneration, feeder voltage rises, and CAPAPOST is charged.

Regenerative power PWM inverter (regenerative electric power), and then supplements the energy to break the station-building power sources and reduces feeding power loss, earth leakage current, and touch voltage.

This controls the cross-flow current flowing between substations and case of the sudden load fluctuations, and returns the regenerative power.

This unit enables the constant voltage control of feeding voltage, even in high-voltage receiving equipment is not built the optimal feeding system for energy.

The standard rating and specification of KAISEI PLUS are shown in Table 1.

### Table 1: Rating and Specification

<table>
<thead>
<tr>
<th>Series</th>
<th>Description</th>
<th>Rating and specification</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAISEI PLUS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applicable standard</td>
<td>IEC60146</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>Peak</td>
<td>2600A, 3600A, 4300A</td>
<td>Based on current characteristics shown in Fig.2</td>
</tr>
<tr>
<td>Control method</td>
<td>PWM chopper control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrier frequency</td>
<td>3kHz</td>
<td>Variable in 1kHz steps</td>
<td></td>
</tr>
<tr>
<td>Rated class</td>
<td>Class S</td>
<td>Based on current characteristics shown in Fig.2</td>
<td></td>
</tr>
<tr>
<td>System voltage</td>
<td>750V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setting voltage</td>
<td>770V to 850V</td>
<td>Variable in 1V step</td>
<td></td>
</tr>
<tr>
<td>Maximum voltage</td>
<td>900V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Features

- Applicable standard: IEC 61992
- Large capacity: Rated current 8000A Max.
- High breaking capability: Rated short-circuit current 125kA
- Compactness and lightness
- Simple and highly reliable construction
  - Permanent magnet holding system
  - Magnet operation system
  - With simplified mechanisms and the extremely reduced number of parts, maintenance is simplified and high reliability is assured.

### Ratings

<table>
<thead>
<tr>
<th>Description</th>
<th>900V DC</th>
<th>1800V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>4000 / 6000 / 8000 A</td>
<td>4000 / 6000 A</td>
</tr>
<tr>
<td>Rated current</td>
<td>52I</td>
<td>54I</td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>750 VDC</td>
<td>1500 VDC</td>
</tr>
<tr>
<td>Power-frequency withstand level</td>
<td>9 kV</td>
<td>9 kV</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>71kA / 50kA at 250ms</td>
<td>71kA / 50kA at 250ms</td>
</tr>
<tr>
<td>Rated track time-constant</td>
<td>100 msec</td>
<td>100 msec</td>
</tr>
<tr>
<td>Rated short-circuit current</td>
<td>160kA / 125kA</td>
<td>142kA / 100kA</td>
</tr>
<tr>
<td>Bi-directional critical current</td>
<td>25 A</td>
<td>26 A</td>
</tr>
<tr>
<td>Mechanical endurance</td>
<td>50,000 operations</td>
<td>50,000 operations</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP2X</td>
<td>IP3X</td>
</tr>
<tr>
<td>Breaking characteristics</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Rated insulation voltage</td>
<td>1.8 kV</td>
<td>3 kV</td>
</tr>
<tr>
<td>Auxiliary operating supply</td>
<td>50 / 110 VDC</td>
<td>50 / 110 VDC</td>
</tr>
</tbody>
</table>

1. As defined in 85769-1
2. Other optional voltages for auxiliary operating supply is available.
Highly reliable product created from an abundance of experience

Lightning arrester

SORESTER (lightning arrester)

Meidensha utilized over 20 years of experience with zinc oxide lightning arresters to improve protection performance and guarantee small size, light weight, and high reliability for its arresters.

Porcelain insulation type
- The high-strength porcelain tube improves earthquake performance.

Polymer type
- This direct-mold type unifies the element unit and polymer housing.
- Use of highly weather-resistant silicone rubber substantially reduces size and weight.

Support the stable supply of traction power

Power Control Systems

Power SCADA  Supervisory Control And Data Acquisition

The traction power distribution control and monitoring system (Power SCADA) for Railway. Support the safety and stability of railway transportation by this product.

Features
- From high-speed rail to conventional lines, there are number of supply record of Power SCADA.
- A scalable, reliable software based on own real-time technology.
- Applying of human-centered design in pursuit of ease of use.
- RTUs that has been manufactured in our own factory are comply with IEC60870.

SCADA function list

<table>
<thead>
<tr>
<th>Function category</th>
<th>Individual functions</th>
<th>Function category</th>
<th>Individual functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring functions</td>
<td>Status monitoring</td>
<td>Monitoring confirmation</td>
<td></td>
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<tr>
<td></td>
<td>Numerical monitoring</td>
<td></td>
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<td></td>
<td>RTU monitoring</td>
<td>Mao</td>
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<td></td>
<td>System monitoring</td>
<td>Tag</td>
<td></td>
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<td></td>
<td>Latest alarm display</td>
<td>Automatic display</td>
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<td></td>
<td>Advance maintenance</td>
<td>Screen printing</td>
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<td></td>
<td>Monitoring configuration</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Operation control recording</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control functions</td>
<td>Individual control</td>
<td>Alarm summary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Current equipment control</td>
<td>System performance</td>
<td></td>
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<tr>
<td></td>
<td>Command sequence control</td>
<td>DUE information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time schedule control</td>
<td>Communication statistics</td>
<td></td>
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<tr>
<td></td>
<td>Power-outage planning connection</td>
<td></td>
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<td></td>
<td>Cellular telephone connection</td>
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<tr>
<td></td>
<td>Control configuration</td>
<td></td>
<td></td>
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<td></td>
<td>SOE information</td>
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<tr>
<td></td>
<td>Time schedule control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering functions</td>
<td>Data maintenance</td>
<td>Report creation</td>
<td></td>
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<td></td>
<td>Internal simulation functions</td>
<td></td>
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<td></td>
<td>User information maintenance</td>
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<td></td>
<td>System configuration control functions</td>
<td></td>
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<td></td>
<td>System monitoring</td>
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</tr>
</tbody>
</table>

2019
OCS Inspection System

**CATENARY EYE**

**OCS(Overhead Catenary System) Inspection system (CATENARY EYE)**

This system uses edge detection processing, model matching, and other image processing technologies to inspect overhead railway wiring items that must be maintained and inspected.

**Features**
- The system can be applied to various overhead wiring types (single/double overhead wiring and single/double overhead rigid wiring).
- The camera provides a compact system configuration, and the system can also be loaded on commercial vehicles.
- Images allow easy confirmation of locations that require special attention.
- This system can measure wavelike wear, which is not possible with existing devices.
- Daytime and nighttime inspections are possible.
- Inspection items:
  - Height, stagger, gradient
  - Pull-off arms detection, overhead crossing / contacting detection, obstacle detection
  - Pantograph monitor
  - Wear (remaining diameter), contact force (hard spots), contact loss
- Analysis on board train
  - Height, stagger, wear, and other important items can be analyzed on board a train.

**On-board Equipment Installation Categories**

**Class 1 : High-speed rail / Shinkansen**

**Features**
- All rooftop equipment is built in the rooftop cover in order not to affect the aerodynamic force of the pantograph.
- The contact force measurement using a non-contact method is the first application case in the world.
- Running Speed : Up to 350km/h.
- Daytime and Nighttime measurement.

**Measurement Items**
- Height, Stagger, Wear, Gradient, Pantograph monitoring, Geometric between mainline and crossover, Contact force, Contact loss
- Options : Geometric between pantograph and crossover

**Class 2 : Conventional Commercial Service Car**

**Features**
- For Non-inspections : The car is available for commercial service (The rooftop equipment is removed).
- For Inspections : Mounts the on-board equipment on the out-of-service car.
- Running Speed : Up to 160km/h.
- Daytime and Nighttime measurement.

**Measurement Items**
- Height, Stagger, Wear, Gradient, Hard spot, Pull-off arms detection, Pantograph monitoring
- Options : OCS pole monitoring, Contact loss

**Class 3: Conventional Dedicated Inspection Car**

**Features**
- Both rooftop and on-board equipment are permanent installation.
- Running Speed : Up to 350km/h.
- Daytime and Nighttime measurement.

**Measurement Items**
- Height, Stagger, Wear, Gradient, Hard spot, Pull-off arms detection, Pantograph monitoring, Geometric between pantograph and crossover, Contact force, Contact loss
- Options : Contact loss, OCS pole monitoring

**Class 4 : Dedicated Inspection car / Road-rail Vehicle**

**Features**
- Static measurement without pantograph.
- Rooftop equipment and on-board processing PC are removable.
- Laser sensor is used for height measurement.
- Running Speed : Up to 40km/h.
- Nighttime measurement.

**Measurement Items**
- Height, Stagger, Wear, Gradient
- Options : OCS pole monitoring, Pull-off arms detection

**System Configuration**

**Contact loss measuring equipment (photo-diode model)**

The contact loss measuring instrument is equipped with an ultraviolet sensor and detects contact loss that occur between pantographs and trolley wires.

**Features**
- The instrument is installed in ahead and behind the pantograph to detect contact loss.
- The equipment detects ultraviolet rays with wavelengths from 220 nm through 275 nm that occur during contact loss.
- A photo-diode converts the ultraviolet rays to electric voltage or electric current signals, which are then sent to an on-board computer to record the signals and display the results.

**OCS pole monitoring**

A camera attached to the head car records video of the route while the vehicle is running. After traveling the route, an office personal computer automatically extracts only OCS poles from the route video, which are saved as equipment ledger images, and the video of the route is played back for an inspection of the route.

**Features**
- High resolution video from an HD camera.
- The view from the head car provides excellent video.
- The video has a clear view, so abnormalities of OCS equipment and train lines can be detected visually.
- OCS pole images are organized and saved automatically.
- OCS pole images can always be managed close at hand to add powerful support for work to update complex equipment ledgers.

**Example of overhead wire wear**

The latest state of OCS poles can always be managed close at hand to add powerful support for work to update complex equipment ledgers.