SAFETY TAKES PRECEDENCE OVER ALL.

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.

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)
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

Meidensha Electrical Facilities for Railways

1. Train Running Curves (for Each Section between Stations)
   - Grade curve
   - Limited speed curve
   - Speed curve
   - Running time curve
   - Running current curve
   - Average speed
   - Power-running wattage
   - Regeneration power
   - Max. power-running current
   - Max. regeneration current
   - Car primary unit

DC Railway Simulation Feeder System (Example)

<table>
<thead>
<tr>
<th>Rectifier</th>
<th>Rectifier</th>
<th>Inverter</th>
</tr>
</thead>
<tbody>
<tr>
<td>A station</td>
<td>B station</td>
<td>C station</td>
</tr>
<tr>
<td>D station</td>
<td>E station</td>
<td>F station</td>
</tr>
<tr>
<td>G station</td>
<td>H station</td>
<td>I station</td>
</tr>
</tbody>
</table>

Limited speed

Speed

Time

Current

Slope

Regeneration power (kWh)
Start station
Arrival station
Time (sec)
Power-running wattage (kWh)
Regeneration power (kWh)
Start station
Arrival station
Time (sec)
Power-running wattage (kWh)

The Line Data

- Diagram data
- Line section data
- Car data
- Power system
- Location
- Feeder system

The Customer

MEIDEN

Customer

Electrification Plan
New-Line Construction Plan

Basic Plan for Electrical Facilities

Equipment Specification Examination

Main-Circuit Configuration Examination

Power Control System Examination
Constructing Rational Power Feeder Systems

- Inverters, with the aid of computer analysis for sophisticated thyristor rectifiers, and the installation of power regeneration cars to cope with densely arranged traffic diagrams.

Substation Facility Plan

By the Full Use of Railway Simulation Technologies.

- The past difficulty in using such a method based on experience in

Along with the sophistication of a traffic system, however, it

- Consumption rate of a similar line and possible train operation characteristics.

When planning a railway substation, the overall capacity of the

- Facility can be defined according to the distance between

Facility Planning Procedures

- Railway Substation

- MEIDEN

- ● Power regeneration

- ● Countermeasures against harmonics

- ● Feeder system

- ● No. of banks

- ● Power-receiving system

- Customer

- Configuration

- Examination

- Main-Circuit

- ● Non-flammability

- ● Digitization

- Environmental

- ● Downsizing

- Equipment

- Electrical Facilities

- Construction Plan

- Specification

- Electrification

- Examination

- Power Control

- Examination

- System

- ● No. of objective posts

- ● Data type

- ● Data volume

- ● Section scale

- Examination

- Capacity

- ● Voltage drop

- ● Voltage regulation

- ● Inverter capacity

- ● Filter capacity

- ● Capacity of main equipment

- Railway: Simulation

- ● Feeder system

- ● Location

- ● Power system

- ● Car data

- ● Line section data

- ● Diagram data

DC Railway Simulation Feeder System (Example)

- CAPAPOST X Rectifier Rectifier Inverter

A station B substation A substation B substation A station B substation

<table>
<thead>
<tr>
<th>Start station</th>
<th>Arrival station</th>
<th>Distance (km)</th>
<th>Power-running wattage (kW)</th>
<th>Regeneration power (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>H</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
<tr>
<td>B</td>
<td>G</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
<tr>
<td>C</td>
<td>J</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
<tr>
<td>D</td>
<td>F</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
<tr>
<td>E</td>
<td>G</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
<tr>
<td>F</td>
<td>G</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
<tr>
<td>G</td>
<td>H</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
<tr>
<td>H</td>
<td>I</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
<tr>
<td>I</td>
<td>A</td>
<td>89.2</td>
<td>179.1</td>
<td>348.7</td>
</tr>
</tbody>
</table>

1. Train Running Curves (for Each Section between Stations)

Grade curve
Limited speed curve
Speed curve
Running time curve
Running current curve
Average speed
Power-running wattage
Max. power-running current
Max. regeneration current
Car primary unit

2. Substation Output-Current, Voltage, Wattage Curves

- Substation output (power-running, regeneration) current curve
- Substation output (power-running, regeneration) voltage curve
- Substation output (power-running, regeneration) wattage curve
- Substation current........Average power-running current
- Max. power-running current
- Average regeneration current
- Max. regeneration current

Substation wattage........Average power-running
- Min. power-running voltage
- Max. power-running wattage
- Substation wattage........Average power-running wattage
- Average regeneration wattage
- Max. regeneration wattage

Substation regeneration efficiency

3. Substation Feeder CB (Circuit-Breaker) Current Curves

- Substation feeder CB current curve
- Substation feeder CB average current
- Substation feeder CB average rms current
- Substation feeder CB Max. current

4. Feeder Voltage Max./Min. Curves

5. Railway-Car Voltage/Current Characteristics

Partograph point lowest/highest voltage

Max. regeneration wattage
Average regeneration wattage
Max. power-running wattage
Substation wattage........Average power-running

6. Result of Substation Characteristic Calculation

<table>
<thead>
<tr>
<th>A station</th>
<th>B station</th>
</tr>
</thead>
<tbody>
<tr>
<td>2900.00</td>
<td>3000.00</td>
</tr>
<tr>
<td>1900.00</td>
<td>1800.00</td>
</tr>
<tr>
<td>0.00</td>
<td>1000.00</td>
</tr>
<tr>
<td>0.00</td>
<td>1692.00</td>
</tr>
<tr>
<td>2919.32</td>
<td>3627.47</td>
</tr>
<tr>
<td>1239.22</td>
<td>1480.39</td>
</tr>
<tr>
<td>1656.69</td>
<td>1648.50</td>
</tr>
</tbody>
</table>

Name of line TEST
Train configuration 4M, 2T
Operation intervals(min) 3.0
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 braking 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>
<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>IEC62271-200</td>
<td>IEC62271-30</td>
</tr>
<tr>
<td>Classification of switchgear</td>
<td>SF-insulated metal-enclosed</td>
<td></td>
</tr>
<tr>
<td>Service condition</td>
<td>● Altitude: &lt; 1000m Indoor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Ambient temperature: Max. 40℃, Min. -5℃</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Relative humidity: 24h average &lt; 95% 1 month average &lt; 90%</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>50/60</td>
</tr>
<tr>
<td>Insulation level</td>
<td>1 min power frequency (kV rms) 50 70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 × 50μs impulse (kV peak) 125 170</td>
<td></td>
</tr>
<tr>
<td>Rated short-time withstand current (kA) 25 31.5-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of protection</td>
<td>HV compartment</td>
<td>IP65</td>
</tr>
<tr>
<td></td>
<td>LV compartment</td>
<td>IP40</td>
</tr>
<tr>
<td>Gas pressure</td>
<td>Rated pressure (MPa) 0.05 0.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alarm pressure (MPa) 0.02 0.06</td>
<td></td>
</tr>
<tr>
<td>Operation of 3-position isolator</td>
<td>Motorized / Manual</td>
<td></td>
</tr>
<tr>
<td>Auxiliary voltage</td>
<td>Control circuit (V) DC 38, 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>
<thead>
<tr>
<th>Vacuum Circuit-Breaker (VCB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCB model</td>
</tr>
<tr>
<td>Applicable standards</td>
</tr>
<tr>
<td>Rated voltage (kV)</td>
</tr>
<tr>
<td>Rated current (A)</td>
</tr>
<tr>
<td>Rated frequency (Hz)</td>
</tr>
<tr>
<td>Insulation level</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Rated short-circuit braking current (kA) 25 31.5</td>
</tr>
<tr>
<td>Rated short-circuit making current (kA peak) 83 82</td>
</tr>
<tr>
<td>Rated short-time withstand current (kA) 25.3 31.5-3</td>
</tr>
<tr>
<td>Operating duty*</td>
</tr>
<tr>
<td>Rated closing time (s)</td>
</tr>
<tr>
<td>Rated opening time (s)</td>
</tr>
<tr>
<td>Rated break time (s)</td>
</tr>
<tr>
<td>Rated TRV for terminal fault</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Type of operating mechanism</td>
</tr>
</tbody>
</table>

* Other duties, O-0.3sec.-CO-15sec.-CO, O-0.3sec.-CO-1min-CO are also available.
Switchgears for Power Supply System

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.
- MEIDEN Vacuum technology adopted.
  Vacuum Interrupter is made in Japan, MEIDEN Numazu factory.

Accordance with IEC62271
- IEC62271-1 common
- IEC62271-200 switchgear
- IEC62271-100 circuit breaker
- IEC62271-102 earthing switch

Type tested at KERI
- Dielectric test
- Temperature test
- Short-time and peak withstand current test
- Short-circuit current making and braking tests
- Capacitive current switching test
- Internal arcing test

Technical Data

Model  HICLAD-10ZA
Type  BZ-C-13-25
Applicable Standard  IEC62271-200
Rated Voltage  12kV
Rated Current
  Main Busbar  630A, 1250A
  Branch Circuit  630A, 1250A
Rated Frequency  50Hz/60Hz
Short-Time Current  25kA-3s
Withstand Voltage  28kV
Impulse Withstand Voltage  75kV
Bus Configuration  Single Bus

Service Condition

- Attitude  < 1000m
- Ambient Temperature  -5 ~ 40°C (24h average < 35°C)
- Humidity  24h average < 95% (1 month average <90%)
- Location  Indoor

Degree of Protection

- Enclosure  IP4X
- Partition  IP2X

Partition Class  PM
Loss of Service Continuity Category  LSC2B (Figure 106, IEC62271-200)
Control Source  110Vdc (30Vdc, 125Vdc option)
Motor Charging Source  110Vdc 220-230/240Vac, 125Vdc option

Dead Tank Vacuum Circuit Breaker

168/204kV

- 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.

- 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 gas circuit-breakers (GCB)).

- Lower center of gravity improves earthquake performance.
  Guarantees a sufficient safety factor for 0.3 G, 3-wave resonance.

- Many of these switches are used in Shinkansen switching sections due to their multi-frequency opening and closing ability.
- The silicon steel plate lamination layer structure of the included electromagnetic iron core reduces eddy current loss.
- Optimization of the magnetic path of the included electromagnet reduces leakage of magnetic flux.
- High withstand-voltage specifications are also supported as a matching measure for power supplies of different frequencies and asynchronous power supplies.

- 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 gas circuit-breakers (GCB).

- The use of an aluminum tank provides the following benefits.
  (1) Lightweight (27% less compared to existing types)
  Effective for transportation weight, installation area, and earthquake performance
  (2) No coating
  Effective for reducing maintenance costs
  (3) Reduction of loss of passage of electric current (85% less compared to existing types at 1,200 A)
  Common up to 2000 A rated electric current

72/84kV

- Many of these switches are used in Shinkansen switching sections due to their multi-frequency opening and closing ability.
- The silicon steel plate lamination layer structure of the included electromagnetic iron core reduces eddy current loss.
- Optimization of the magnetic path of the included electromagnet reduces leakage of magnetic flux.
- High withstand-voltage specifications are also supported as a matching measure for power supplies of different frequencies and asynchronous power supplies.
Contribution to Stable Power Supply. Ranging from Ultra-High to Low Voltages

Transformers

AC Power Transformers

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

Features

- 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.


![Roof-delta connection transformer](image1)

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

![154 kV Scott connection transformer](image2)

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

Rectifier Transformer

Features

- 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 can be supported, including radiator package types, by-radiator installation types, auxiliary-transformer mounted types, and primary and secondary bushing, and bus duct systems.
- Meticulous quality control provides high reliability.

Transformer for Rectifier

![Gas-insulated transformer](image3)

![Oil-immersed transformer](image4)

![12-phase rectifier transformer](image5)

<table>
<thead>
<tr>
<th>Item</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>For DC Traction power supply</td>
</tr>
<tr>
<td>Insulation</td>
<td>Gas / Oil / Cast Resin</td>
</tr>
<tr>
<td>Rated capacity</td>
<td>Various range available</td>
</tr>
<tr>
<td>Duty class</td>
<td>Class VI (100% continuous, 150% for 2 hr., 300% for 1 min.)</td>
</tr>
<tr>
<td>Rated primary voltage</td>
<td>11kV/22kV/33kV</td>
</tr>
<tr>
<td>Connection</td>
<td>12-phase transformer Y-△</td>
</tr>
</tbody>
</table>

*The above specifications are typical examples. Another special specification is also available depending on the requirements.
Power Distribution Transformers

**Gas-Insulated Transformer**

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.

**Cast Resin Transformer**

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.

**Oil-Immersed Transformer**

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.

Natural Cooling Rectifier

Features
- Silicone diodes integrated with heat sink
- Simple construction
- Compact construction
- Easy maintenance and inspection

Specifications
- 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

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.

Converter rating

<table>
<thead>
<tr>
<th>Item</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 Absorbing Controller

Braking Resistor Unit (BRU)

Principle of Operation
The main dc input terminals of BRU are connected across the positive and negative traction system and its output is connected to the regenerative resistor unit. The control circuit will be triggered when the braking train(s) regenerates the excess energy and boost the traction line voltage up to the preset value. BRU regulates the traction voltage to setting voltage by means of dissipate the energy at the resistor unit. Its concept is shown as Fig. 1.

Rating and Specification
The standard rating and specification of BRU are shown in Table 1.

<table>
<thead>
<tr>
<th>Description</th>
<th>Rating and specification</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable standard</td>
<td>IEC60146</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>Ipeak 3000A/4000A/5000A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ims 822A/1118A/1544A</td>
<td></td>
</tr>
<tr>
<td>Control method</td>
<td>Stepwise firing control</td>
<td></td>
</tr>
<tr>
<td>Rated class</td>
<td>Class S</td>
<td></td>
</tr>
<tr>
<td>System voltage</td>
<td>750V</td>
<td></td>
</tr>
<tr>
<td>Setting voltage</td>
<td>770V to 850V Variable in 1V step</td>
<td></td>
</tr>
<tr>
<td>Maximum voltage</td>
<td>900V</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1 Concept of BRU Control

KAISEI PLUS

The technical principle of KAISEI PLUS is same as Braking Resistor Unit (BRU), and the PWM chopper control method is applied for KAISEI PLUS. The standard rating and specification of KAISEI PLUS are shown in Table 1.

<table>
<thead>
<tr>
<th>Description</th>
<th>Rating and specification</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable standard</td>
<td>IEC60146</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>Ipeak 2600A/3600A/4500A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ims 202A/300A/400A</td>
<td></td>
</tr>
<tr>
<td>Control method</td>
<td>PWM chopper control</td>
<td></td>
</tr>
<tr>
<td>Rated class</td>
<td>Class S</td>
<td></td>
</tr>
<tr>
<td>System voltage</td>
<td>750V</td>
<td></td>
</tr>
<tr>
<td>Setting voltage</td>
<td>750V to 850V Variable in 1V step</td>
<td></td>
</tr>
<tr>
<td>Maximum voltage</td>
<td>900V</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2 Typical regenerative braking current characteristics

Regenerative Inverter

Supplying regenerative energy from electric-train braking 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
- High efficiency
- User-Friendly interface
- Quick DC voltage control

Ratings / specifications

<table>
<thead>
<tr>
<th>Current class</th>
<th>Voltage</th>
<th>Current</th>
<th>Capacity</th>
<th>Maximum allowable</th>
<th>Alternating current rating</th>
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</thead>
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<tr>
<td>6 type</td>
<td>850V</td>
<td>2600A</td>
<td>3600A</td>
<td>4500A</td>
<td>2 x 3 phase</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>300A</td>
<td>1000W</td>
<td>50Hz - 60Hz</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>3000Ap</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>5000Ap</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2 Typical regenerative braking current characteristics

Configuration
Regenerative Inverter
KAISEI PLUS

- Quick DC voltage control
- User-friendly interface
- High efficiency

Energy conservation and reduces environmental burden through the effective use of regeneration, and the effective use of energy contributes to station-building power-sources and so on maintains the validity.

Ratings / Specifications

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

The chopper control method is applied for KAISEI PLUS.

![Typical regenerative braking current characteristics](image)

\[
\begin{align*}
T_0 &= 2600 \text{Ap} / 3600 \text{Ap} / 4500 \text{Ap} \\
100 \text{ms} \\
T_1 &= 20 \text{ms} \\
T_2 &= 20 \text{ms} \\
T_p &= 2 \text{s} \\
100 \text{ms}
\end{align*}
\]

**Configuration**

- Rectifier
- Regenerative power
- Braking train
- AC load
- Regenerative Disconnect Switch Panel
- Power Converter Equipment

**A Semi-Conductor-Applied System that Supports Railway Systems**

**Power Converter Equipment**

**Regenerative Power Storage System**

Direct-current electric-motor vehicles have a braking system that converts the kinetic energy from braking 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 braking energy in an electric double layer capacitor and supplementing the energy to run electric vehicles in accordance with the feeding circumstances.

**CAPAPOST**

- Achieves energy conservation through the effective use of regenerative power
- Electric double layer capacitor is used
- 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 braking, which maintains the validity of regeneration.
- Regenerative vehicles can be introduced to train lines, which has been difficult to do up to now.

- 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.

**Compact Space and Easy Maintenance Management**

**DC Switchgear**

**High Speed Circuit Breaker Panel**

**Features**

- Applicable standard: IEC 61992
- Large capacity: Rated current 8000A Max.
- High braking 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.

<table>
<thead>
<tr>
<th>Description</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>900V DC / 1800V DC</td>
</tr>
<tr>
<td>Rated current</td>
<td>4000 A / 6000 A / 8000 A</td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>750 VDC / 1500 VDC</td>
</tr>
<tr>
<td>Power-frequency withstand level</td>
<td>9 kV / 9 kV</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>71 kA / 50 kA at 250ms / 71 kA / 50 kA at 250ms</td>
</tr>
<tr>
<td>Rated track time constant</td>
<td>100 mscc / 100 mscc</td>
</tr>
<tr>
<td>Rated short-circuit current</td>
<td>180 kA / 125 kA / 142 kA / 100 kA</td>
</tr>
<tr>
<td>Bi-directional critical current</td>
<td>25 A / 26 A</td>
</tr>
<tr>
<td>Mechanical endurance</td>
<td>50,000 operations / 50,000 operations</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP3X / IP3X</td>
</tr>
<tr>
<td>Breaking characteristics</td>
<td>H / H</td>
</tr>
<tr>
<td>Rated insulation voltage</td>
<td>1.8 kV / 3 kV</td>
</tr>
<tr>
<td>Auxiliary operating supply</td>
<td>50 / 110 VDC / 50 / 110 VDC</td>
</tr>
</tbody>
</table>

**Over Voltage Protection Device**

Over Voltage Protection Device (OVPD) limits hazardous voltages between traction return circuit and earth within the permissible value allowed in EN50122-1. If the touch voltage exceeds predefined limit, the return circuit is solidly connected to earth.

<table>
<thead>
<tr>
<th>Description</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Voltage</td>
<td>900V DC</td>
</tr>
<tr>
<td>Rated insulation withstand current</td>
<td>50kA / 100kA</td>
</tr>
<tr>
<td>Nominal Voltage</td>
<td>750V DC / 1500V DC</td>
</tr>
</tbody>
</table>

**Disconnect Switch Panel**

- Depend on needs, various main circuit configuration can be designed.
- Negative Return Circuit
- Section Bypass
- Depot Distribution
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>
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<tbody>
<tr>
<td>Monitoring functions</td>
<td>Status monitoring</td>
<td>Security management</td>
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<td>Numerical monitoring</td>
<td>Monitoring confirmation</td>
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<td></td>
<td>RTU monitoring</td>
<td>Main</td>
<td></td>
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<td>System monitoring</td>
<td>Tag</td>
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<td>Latest alarm display</td>
<td>Automated display</td>
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<td>Advance maintenance</td>
<td>Screen printing</td>
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<tr>
<td></td>
<td>Monitoring configuration</td>
<td>Operation control recording</td>
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<td>Alarm summary</td>
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<td></td>
<td>System event recording</td>
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<td>SCIE information</td>
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<td>Individual control</td>
<td>Control configuration</td>
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<td>Command sequence control</td>
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<td>Power-outage planning connection</td>
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<td>Cellular telephone connection</td>
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<td>Control configuration</td>
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<td>Engineering functions</td>
<td>Data maintenance</td>
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<td>Internal simulation functions</td>
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<td>User information maintenance</td>
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</tbody>
</table>
Strong Support for Overhead-Wire Maintenance Work

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
- Car movement, Structure gauge clearance

Analysis on board train
- Height, stagger, wear, and other important items can be analyzed on board a train.

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
- Because the high image quality makes OCS poles clear, it is optimal for equipment ledger photographs.
- The view from the head car provides excellent video
- The video has a clear view, so abnormalities of OCS equipment and trail lines can be detected visually.
- OCS pole images are organized and saved automatically, and the latest state of OCS poles can always be managed close at hand to add powerful support for work to update complex equipment ledgers.

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 advance 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 onboard computer to record the signals and display the results.

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
- Option : Geometric between pantograph and crossover

Class 2 : Conventional Commercial Service Car

Features
- For Non-inspections : The car is available for commercial service (The on-board 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
- Car movement, Structure gauge clearance

Class 3: Conventional Dedicated Inspection Car

Features
- Both rooftop and on-board equipment are permanent installation.
- Rooftop equipment and on-board processing PC are removable.
- Running Speed : Up to 120km/h.
- Daytime and Nighttime measurement.

Measurement Items
- Height, Stagger, Wear, Gradient, 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
<table>
<thead>
<tr>
<th>Country</th>
<th>Company Name</th>
</tr>
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<tbody>
<tr>
<td>SINGAPORE</td>
<td>MEIDEN ASIA PTE. LTD.</td>
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<td>VIEETSTAR MEIDEN CORPORATION</td>
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<td>THE UNITED STATES</td>
<td>MEIDEN AMERICA, INC.</td>
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<td>MEIDEN AMERICA SWITCHGEAR, INC.</td>
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Specifications in this catalog are subject to change without notice.