MEIDEN

Power Conversion Systems

Empower for new days

The branches of the Meiden Power Conversion Systems are Growing in the 21st Century.

Power conversion is general terminology for electric power conversion and associated controls with the use of power semiconductor devices.
Starting with mercury arc rectifiers, Meidensha Corporation has dedicated itself to the development of power conversion products. Presently, as a result of almost half a century of remarkable power semiconductor device evolutions, its technologies have been introduced to a variety of industrial fields such as various types of power sources, railway facilities, industrial facilities, recyclable energy, and so on.
Based on its fundamental research and development of factory products (the root of product tree), the Meidensha staff is longing to grow a tree of Meiden power conversion systems into a “large tree that bears numerous dreams in the future,” advancing in the 21st century with our customers all together.

Tree of Meiden Power Conversion Systems

- Power conversion systems for renewable energy
  - Photovoltaic inverters
- High-quality power sources
  - Voltage dip compensators
  - Uninterruptible power systems (UPS)
- Power conversion systems for railway
  - For DC railway systems
  - For AC railway systems
- Distributed energy storage system
  - For lithium-ion batteries (LiB)
  - For NAS battery
  - For lead storage batteries
  - For Redox Flow (RF) batteries
  - For lithium-ion capacitors (LiC)
- Power sources
  - Pulse power sources
  - DC power sources
- Frequency converters
- Power quality improving equipment
  - Static var compensators
  - Multi-functional active filters

Technologies for product development

Applied technology

Technologies that support products

Fundamental technology

Analytical simulation

To attain a healthy society, Meidensha Corporation is always striving towards technological innovation. Meiden power conversion systems are contributing to society in many industrial fields, making full use of elaborated techniques such as those relating to renewable energy that are intended to reduce environmental loads, power storage for load leveling, high-quality power systems to compensate for voltage dips and power failure, and many other issues.

Photovoltaic Inverters

Photovoltaic power generation systems are expanding worldwide as an effective means to take protective actions for the global environment, and we offer photovoltaic inverters (PV inverters) as essential equipment for the above-mentioned systems.
The Meiden PCS for photovoltaic power generation has product lineups for both indoor and outdoor installations, available at users' choice according to their choice.

※PCS : Power Conditioning Subsystem

Applicable conditions:
Indoor installation

An example of enclosed air-conditioner package

Applicable conditions:
Minimum temperature of a year –15℃ (optional)
Coastal area where salt damage is anticipated

An example of outdoor panel

Applicable conditions:
Air-cooled system using open air
Coastal area where no salt damage is anticipated

Power conversion systems for batteries

Power conversion systems (PCS) can be combined with various types of batteries so that optimal distributed energy storage systems can be offered.
When distributed energy storage systems are adequately introduced, it is possible to expect the following results:

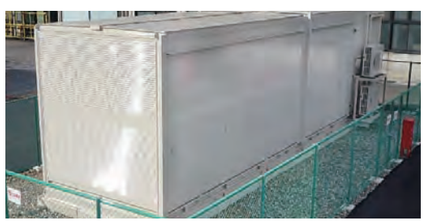
- Load leveling (reduction of electricity rates)
- Frequency regulation (stabilization of power systems)
- Emergency power supplies and compensation for momentary voltage dip (BCP and reinforcement of continued business undertaking)
- RE (renewable energy) coordination

※PCS : Power Conversion System

PCS for NAS batteries

PCS for lithium ion batteries

PCS for Redox Flow (RF) batteries



PCS for lithium ion capacitors (LiC)

High-Quality Power Sources

Voltage dip and power failure caused by accidents and natural phenomena like lightning strokes and snowfall are normally unavoidable. We propose the optimal combination of our product lineup to protect important facilities of our customers against voltage dip and power failure continuing for a range of time both short and long.

Voltage dip compensator

Uninterruptible power system (UPS)

Power conversion system for NAS battery and also for voltage dip compensator or emergency power generation

Pulsed Power Supply

Pulsed power supply delivers instantaneous high power in a short time of microseconds and nanoseconds. The MEIDEN Pulsed Power Supply has been used in various power supplies such as excimer laser, EUV light source, and algae treatment. These products offer unique features such as output pulse width of below 100 ns, recurrence frequency of 10 kHz, and output voltage of 120 kV.

Pulse generation unit

Charger unit

Semiconductor manufacturing
- Excimer laser
- EUV light source
- Plasma CVD
- Sputtering

Accelerator
- Synchrotron
- Charged particle beam
- Significant power microwave
- Electromagnetic accelerator (rail gun)

Environment
- Water and sewage treatment (ozonizer)
- Algae treatment
- Exhaust gas treatment
- Plasma deodorization

Others
- Nuclear fusion
- DLC coating
- Sterilization
- Medical, bio, etc.

Pulsed power supply has been used for various applications.

Power Conversion Systems for Railways

Electric railways are constantly increasing their needs for dense traffic such as requirements for mass transit and high-speed transportation. People are calling for further reliability in transportation systems. To meet such needs, we offer power conversion systems for DC and AC railway systems.

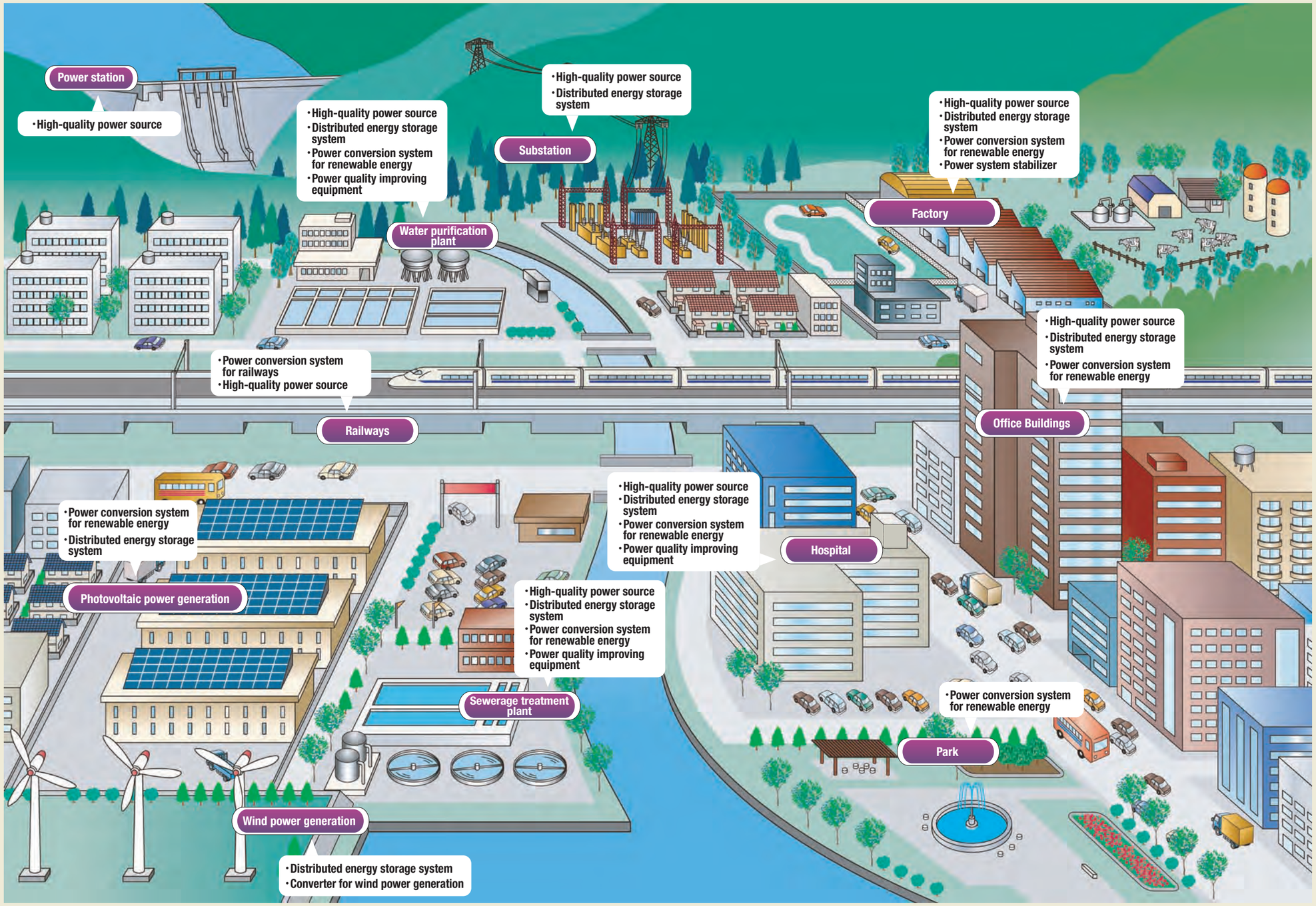
Railway Static Power Conditioner (RPC)

Natural air cooling type silicon rectifier with pure-water heat pipe

Large-capacity PWM power conversion system

Regenerative power storage system (CAPAPOST)

List of Power Conversion Products



JIS Standard Compliance

Photovoltaic Inverters SUNGENEC

SP310-250T

Features of SP310 Series

1. Characteristics most suitable for the MEGASOLAR

- Available up to 750V that is the upper limit of legal low-voltage range
- MPPT working voltage range: 400 ~ 750V (Rated input voltage: 500V)

2. High-efficiency inverters

- Adoption of a new PWM system that is the latest 6th generation IGBT (patent applied for)
- Attainment of 96.5% efficiency (rated) by optimized design

3. Emergency power interlinkage functions (optional)

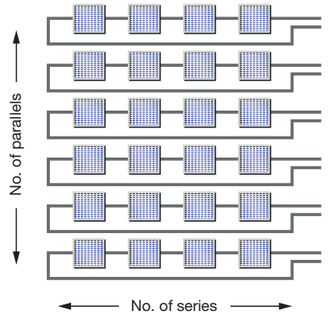
- Effective utilization of photovoltaic power systems with emergency power generators in operation
- Fuel saving for emergency power generators

4. Remote monitoring systems

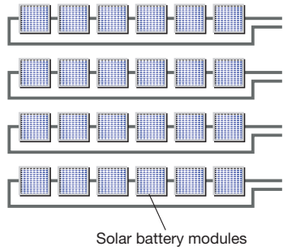
- Standard equipment of an external communication system conforming to RS-485

Advantages of the DC 750V systems

Former Meiden models (up to DC600V)



SP310 (up to DC750V)



When the number of series of solar battery strings is increased and that of parallels is decreased, it is possible to decrease the number of connection boxes and cables, thus reducing the system cost.

According to the conditions for installations, two types of packages are available.

An example of enclosed air-conditioner package

Applicable conditions:

Minimum temperature of a year –15℃ (optional)
Coastal area where salt damage is anticipated

An example of outdoor panel

Applicable conditions:

Air-cooled system using open air
Coastal area where no salt damage is anticipated

Standard Specifications

Type	SP310-250T-FN	SP310-100T-FN
DC input		
Input voltage range	400～750V	
MPPT working voltage range	400～750V	
Max. input voltage	750V	
No. of input circuits	2 circuits max. (Cable size: 325sq. max.)	
AC output		
Electrical system (Grounding system)	3-phase, 3-wire	
Rated output power	250kW	100KW
Rated output voltage	420／440V	
Rated output current	344／328A	138／132A
Rated frequency	50／60Hz	
Current distortion factor	3% or less for each order, 5% or less on average (rated)	
Output power factor	0.95 or more lagging (rated)	
Efficiency		
Efficiency	96.5% or more (rated)	96.7% or more (rated)
Dimensions & mass		
Dimensions (Width × Height × Depth)	1200×1950×1000mm (fan block excluded)	900×1950×1000mm (fan block excluded)
Mass approx	2050kg	1200kg
Applicable standards		
Applicable standards	JEAC9701-2010, JEC-2470	

IEC Standard Compliance

Photovoltaic Inverters SP100

SP100-250

Features

1. High-efficiency inverters

- Max. conversion efficiency 98% (SP100-250)
- Euro conversion efficiency 97.4% (SP100-250)

2. Space saving

- Installation space 0.96m^2 (SP100-250)
- Front maintenance work possible

3. Remote monitoring system

- Standard equipment applicable to Modbus-TCP
- Internet supervisory services offered

4. Conforming to PV inverter Safety Standard

- IEC62109-1(2010) adaptable (SP100-250)

5. China Gold Sun Certificate

- First acquisition for domestic PV inverter manufacturer (SP100-250T・250)

Examples of Introductions

Komekurayama Photovoltaic Power Station

Komekurayama Photovoltaic Power Station was constructed as a joint project by Tokyo Electric Power Co., Inc. and Yamanashi Prefecture. Its operation started in Junuary, 2012.
In Fiscal 2010, Meidensha accepted an order for this project including everything from basic design to construction and trial run.

Scale of power station 10MW
PCS: 250kW 40units
CIS thin film cell

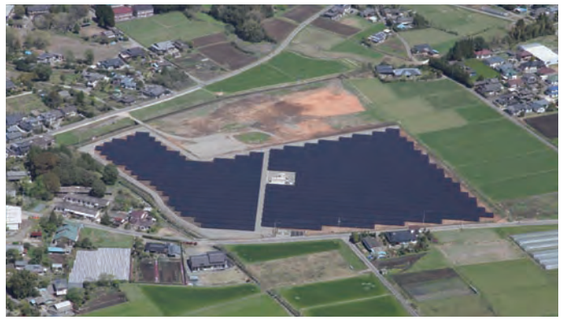
Lot 2 (Construction started in 2010), as seen from east side

Kumamoto Ichibu Solar Power Station

Meidensha Corporation received an order on full-turn-key basis for designing, manufacturing, and construction of a solar power station, named Kumamoto Ichibu Solar Power Station. This project has been planned and developed by MITSUI & CO., LTD. and the power station is located in the Ichibu Industrial Site situated in Kumagun Nishikimachi, Kumamoto Pref., Japan. Commercial operation was started in March 2013.

Scale of power station: 2.2MW
PCS: 6 units, 250kW each

Power conditioner (right) and high-voltage joint facility (left)



Kasai Water Reclamation Center for Bureau of Sewerage, Tokyo Metropolitan Government

As the first of many similar transactions in Japan, the company delivered in 2010 a new type of photovoltaic power generation system intended for regular introduction.
A “uniaxial tracking support” was adopted to improve power generation efficiency. The photovoltaic modules on this support move in tandem with the direction of the sun.

Scale of power station: 490kW
PCS: 250kW 1 unit
100kW 2 units
50kW 1 unit

Photovoltaic module

Overall facility view on south side

Tatsumi Terminal for Bureau of Port and Harbor, Tokyo Metropolitan Government

As part of renewable energy utilization policy of Tokyo Metoropolitan Government, a 136kW photovoltaic power generating system was delivered in 2010.

Scale of power station 136kW
PCS: 100kW 1 unit
50kW 1 unit

Project Work for the New Energy and Industrial Technology Development Organization (NEDO)

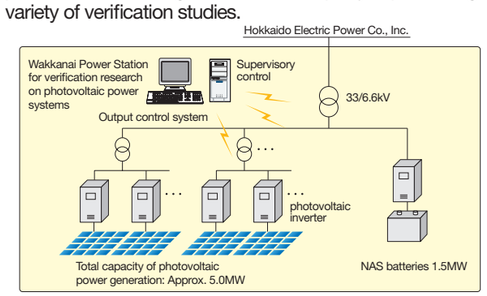
Verification of Grid Stabilization with Large-Scale PV Power Generation Systems

Consignee: Hokkaido Electric Power Co., Inc. & Wakkanai City

Total capacity of photovoltaic power generation: Approx. 5.0MW (Scheduled to install 16 units of photovoltaic inverter 250kW each) Verification research period: Fiscal 2006 ~ Fiscal 2010

Theme of Research Verification research was carried out on a megawatt class photovoltaic power system (Mega Solar) interconnected with a utility power system.

In addition to the shipment of photovoltaic inverter units, Meidensha Corporation, as a member of the joint researchers, delivered a NAS battery system for power system stabilization and an output control system for photovoltaic power station management. The company is promoting a variety of verification studies.



Located in Wakkanai, Hokkaido

Kasai Plant of Sanyo Electric Co., Ltd.

Kasai Plant of Sanyo Electric Co., Ltd. has introduced a 1MW photovoltaic power system and a 1.5MWh lithium battery bank. This facility is currently promoting various verification tests for energy-saving systems. In 2010, we delivered the photovoltaic inverters.

System capacity 1100kW
Photovoltaic inverter
250kW: 4 units
50kW: 2 units

Solar Frontier K.K. Kunitomi Plant

System capacity 2000kW
Photovoltaic inverter 250kW: 8 units

RES Photovoltaic Power Station in Bulgaria

System capacity 21MW
PCS 250kW 84 units

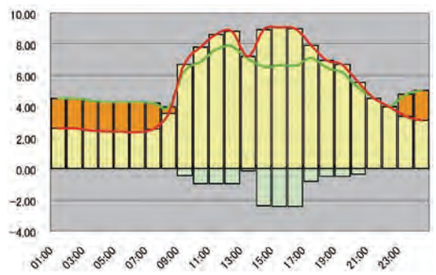
Power conversion systems for storage batteries

The Meiden PCS for batteries has been developed through a variety of delivery records and verification research (200 units, 330MVA in total) in order to meet various industrial needs. According to applications and purposes, the PCS can be combined with various types of batteries in order to provide the most optimal power system.
PCS: Power Conversion System

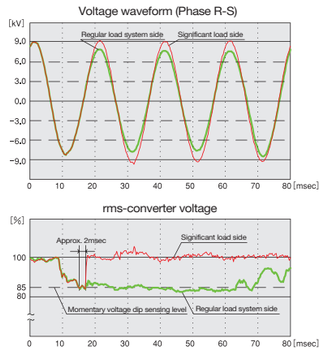
Functions:

[APR・AQR function] Generation of output according to commands from upper systems for active and reactive power
[DCACR function] Constant current control for batteries
[Constant voltage charging] Constant-voltage charging for batteries
[Constant voltage discharging] Constant-voltage discharging from batteries
[Auto-start] Prevention of transformer inrush current at the time of main CB closure
[Black start] Self-sustaining operation as an AC voltage source
[Frequency regulation function] Generation of active power in compliance with frequency changes
[Voltage regulation function] Generation of reactive power in compliance with voltage fluctuations
[Voltage imbalance compensation] Control of active and reactive power in each phase
[Momentary voltage dip compensation] Generation of active and reactive power when a momentary voltage dip occurs
[Harmonics compensation] Compensation for voltage distortion
[RE tidal variation relief control] Renewable energy leveling for photovoltaic and wind power, etc.
[SOC maintaining control] Control of SOC variations within a specified range
[Non-interference control between different battery types] Output change sharing between different battery types
[AFR function] Constant-frequency control
[FRT function] Continuation of discharge for a voltage dip under system interlinkage

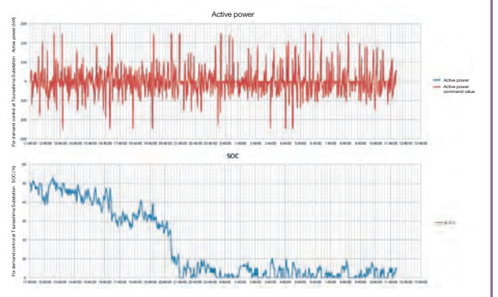
Peak-cut (reduction of electricity rates)



Emergency power and momentary voltage dip compensation (BCP, reinforced continuation of business)

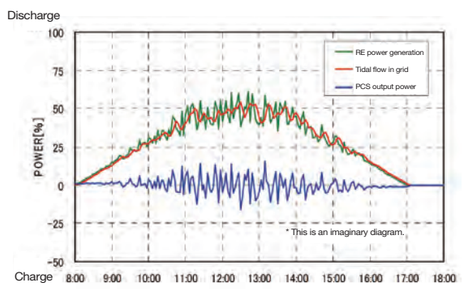


Frequency regulation (system stabilization)

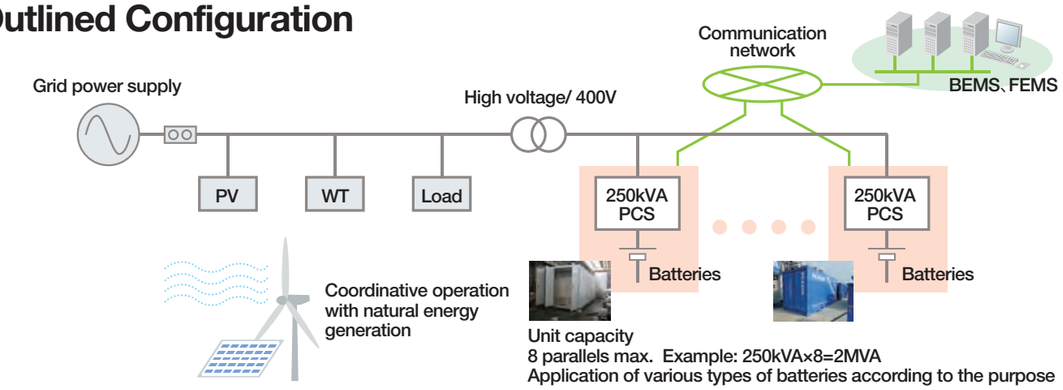


Upper: Active power command
Lower: SOC battery residual

RE (Renewable Energy) Coordination



Outlined Configuration



Unit capacity
8 parallels max. Example: 250kVA×8=2MVA
Application of various types of batteries according to the purpose

Product Lineups:

PCS for NAS batteries

Capacity: 250 ~ 4000kVA
Delivery record: 108 units, 170MVA
Application: For load leveling, emergency use, measures taken against service interruptions

PCS for Redox Flow (RF) batteries

Capacity: 250 ~ 2,000kVA
Delivery record: 1 unit, 0.5MVA
Application: For FMES and RE system stabilization

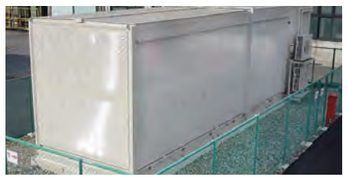
PCS for Lithium-ion Batteries(LiB)

Capacity: 250 ~ 2,000kVA
Delivery record: 17 units, 3.2MVA
Application: For BEMS, demand control, and RE system stabilization

PCS for lead batteries

PCS for lead batteries: 500 ~ 4,000kVA
Delivery record: 3 units, 2.6MVA
Application: For measures taken against service interruptions

PCS for Lithium-ion Capacitors (LiC)



PCS for LiC: 500 ~ 4,000kVA
Delivery record: 2 units, 1.1MVA
Application: Stabilization of renewable energy

Uninterruptible Power Systems (UPS)

THYRIC 7000 Series

Features

1. Long lifetime

Parts are designed to secure a long operational lifetime; 8 years for cooling fans and 15 years for control power supplies and electrolytic capacitors.
The parts replacement cycle has been completely reviewed. Where the expected life span is 15 years for uninterruptible power systems, replacement of a cooling fan is needed only once (8 years) and it is unnecessary to replace control power supplies and electrolytic capacitors.

* Ambient temperature: 25℃ or below

2. Space and cost saving

- The panel width of the UPS main body is 1500mm. Compared with conventional machines of 2000mm, the panel width has been reduced by 500mm.
- With the use of 400V I/O systems, installation cost has been curtailed compared with former 200V systems.

3. High reliability

- Applicable to various circuit configurations (single units, parallel units, spares in common)
- Attainment of maintainability and expansibility with the aid of the individual bypass changeover feature
- Security assurance sustained by the maintenance contract based on remote monitoring* and assistance by round-the-clock Customer Center

* Optional

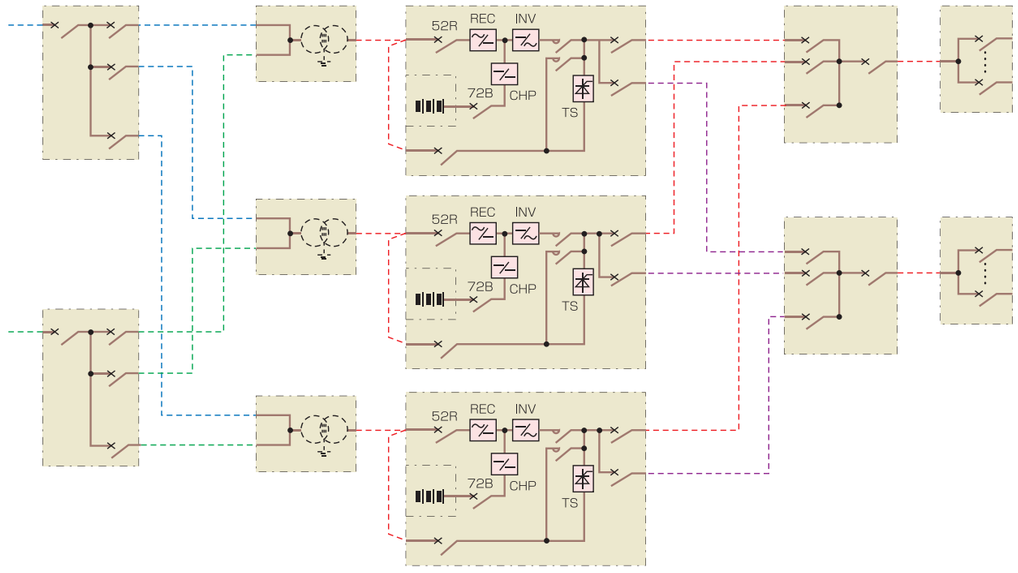
4. Energy-saving

Thanks to the adoption of 3-level inverter circuits, the world's highest class of combined efficiency 97% or more (at the load power factor of 1.0%(*1)) has been attained.

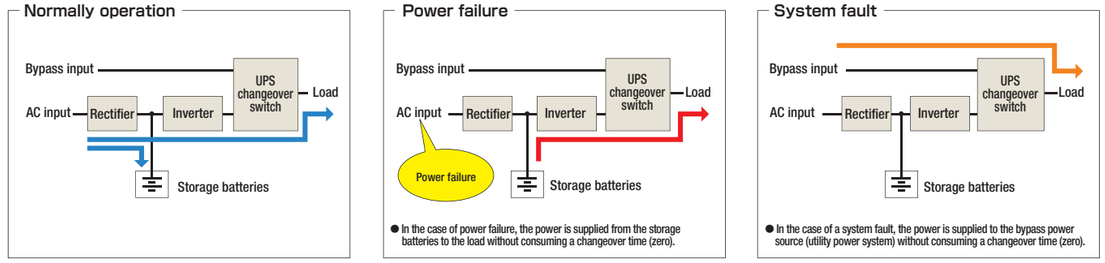
(*1) The load power factor of 1.0% is optional.

Circuit Configuration (Example)

Parallel-running system



Outlined Operation



Standard Specifications

Meidensha UPS (THYRIC Series)

On-line type UPS (AC→DC→AC conversion) → Inverter transformer type → 3-phase output → THYRIC 5000

On-line type UPS (AC→DC→AC conversion) → Inverter transformer-less type → 3-phase output → THYRIC 7000

Item		Standard specifications		Remarks
		THYRIC 5000	THYRIC 7000	
Power feeding system		On-line type		
No. of output phases		3-phase output		
Rated output capacity (kVA)		20 ～ 300	500	
System configuration		Single-unit UPS system / Common standby system / Parallel redundant (UPS changeover) system		Up to a maximum of 10 parallel units
AC input	No. of phases	3-phase 3-wire		
	Rated voltage	200V, 210V, 220V	415V, 420V	Regulation tolerable range ± 10%
	Rated frequency	50Hz or 60Hz		Regulation tolerable range ± 5%
Bypass Input	No. of phases	3-phase 3-wire		
	Rated voltage	200V, 210V, 220V	415V, 420V	
DC Input	Voltage regulation tolerable range	288 ～ 425V	393 ～ 600V	
	No. of battery cells	180 cells	246 ～ 269 cells	
AC output	No. of phases	3-phase 3-wire		
	Rated voltage	200V, 210V, 220V	415V, 420V	Accuracy ± 1.0%
	Voltage regulation range	Rated voltage ± 5%		
	Rated frequency	50Hz or 60Hz		Accuracy ± 0.01% (with internal oscillation)
	Rated power factor	0.9 lagging		
	Type of rating	100% continuous, 125% for 10 min., 150% for 1 min.	100% continuous, 125% for 10 min., 150% for 1 min., 200% for 2 sec.	
	Transient voltage regulation and setting time	Rated voltage ± 2% 30ms	Rated voltage ± 1% 20ms	Recovery from a service interruption or a sudden change in AC input: ± 10%
		Rated voltage ± 5% 30ms	Rated voltage ± 3% 50ms	Sudden load change 0 ⟷ 100%
	Voltage waveform distortion factor	≤ 2%		For linear load
		≤ 5%		For 100% rectifier load

Parallel Compensation Type Voltage Dip Compensators

MEIPOSS MCP Series

Features

1. High performance

A wide compensation time and high-speed switchover accomplished in 0.002 sec. are the attractive features.

- Selection of compensation time is arbitrary within the range of 1 to 10 seconds.
- The adoption of a parallel running compensation system enables a compensation even in the case of a service interruption.
- Switchover is possible without interruption (less than 2ms).

2. High efficiency

Successful attainment of high efficiency leads to the reduction of running cost.

- High efficiency of over 99% is attained. No wasteful power is consumed.

* When a high voltage type (indoor specification) is used.

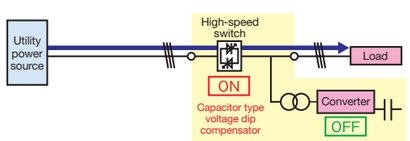
Standard Specifications

Item		Specifications			
		Low voltage type			High voltage type
Equipment type		Uninterruptible changeover system from utility power line			
Rated capacity		100kVA	150kVA	200kVA	1000～10,000kVA
Compensation time		1～10 sec.*1			
Operation efficiency*2		≥97%	≥98%		≥99%
AC input	Rated voltage (Regulation tolerable range)	200・210・220V (±10%)			3300*3・6600V (±10%)
	No. of phases	3-phase 3-wire			
	Frequency (Regulation tolerable range)	50・60Hz (±2%)			50・60Hz (±2%)
AC output*4	Rated voltage	200・210・220V			3300*3・6600V
	Voltage accuracy	≤±5%			
	No. of phases	3-phase 3-wire			
	Rated load power factor	0.8 (lagging)			1.0
	Voltage imbalance ratio	≤3% (with a 100% voltage imbalance)			≤5% (with a 30% voltage imbalance)
	Voltage waveform distortion factor	≤3% (with a linear load)			
	Transient voltage regulation	Conforming to JEC2433-Class II			
Cooling system		Forced air cooling			
Temperature		0～40℃			
Relative humidity		15～85%			

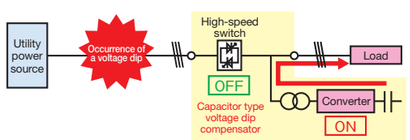
*1. 1 second for standard *2. When the power is fed from the utility power system *3. Equipment is available up to 5000kVA for 3300V class
*4. The specification when the voltage dip compensators are feeding power.

Outlined Operation

■ Nomally operation



■ Voltage dip compensation



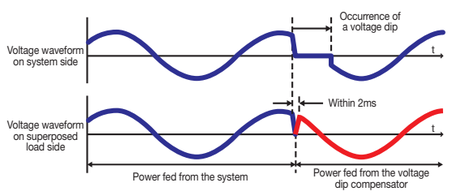
■ Functions of voltage dip compensation

① When voltage dip is detected in the system, the high-speed switch instantly works to separate the system from a significant load.

② Simultaneously, inverters are switched over to autonomous operation to continue power feeding toward the significant load.

③ As a result, the significant load can be protected against a voltage dip.

■ An example of operation in the case of a voltage dip detection



Dynamic Voltage Compensators (DVC)

MEIPOSS CS Series

Features

1. Small capacity

Since this is a series compensation system with the use of a series transformer, only a component of the voltage dip can be compensated for, superposed on the system voltage. As a result, the compensator unit becomes smaller compared with the load capacity.

2. Space saving

In addition to the reduction of the unit capacity, the capacitance of the energy storage element (DC capacitor) can be decreased, being equivalent to the scale needed to work only for the voltage dip period of hundreds of milliseconds. As a result, a remarkable space saving has been achieved.

3. Energy saving

The inverter stops in the standby mode. It works only if a voltage dip occurs. Therefore, this system suppresses losses.

4. Extension of capacities

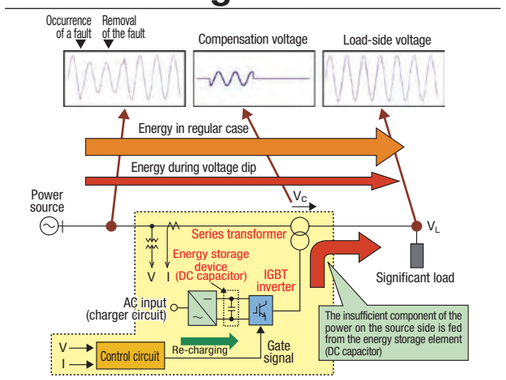
A large-capacity type of 1000 to 4000kVA are on the product lineups.
By reviewing the standby system, far more space and energy saving has been attained.

Standard Specifications

Item		Rating or performance											
		Medium-capacity series						Large-capacity series					
AC output	Rated capacity(kVA)	200	300	400	500	650	1000	1000	1500	2000	2500	3000	4000
	Rated voltage	6600V											
	Rated compensation voltage	1520V/phase (40% of rated voltage)*			3810V/phase (100% of rated voltage)								
	Rated current (A)	44	66	87	44	57	87	87	131	175	219	262	350
	Frequency	50 or 60Hz											
	No. of phases	3-phase 3-wire											
AC input (charger circuit)	Rated input voltage	200～440V											
	Frequency	50 or 60Hz											
Compensation performance	Response time	≤2ms											
	Compensation time	0.5s (30% voltage dip)			0.1s (100% voltage dip)								
	Applicable max. load capacity (kVA)	500	750	1000	500	650	1000	1000	1500	2000	2500	3000	4000
Cooling system		Forced air cooling						Natural air Cooling				Forced air cooling	
Dimentions	W (mm)	3800		3900	3900	4500	6200	5900	6800	6800	8200	10,400	
	D (mm)	1840		2000		2340	2000	2140					
	H (mm)	2350											

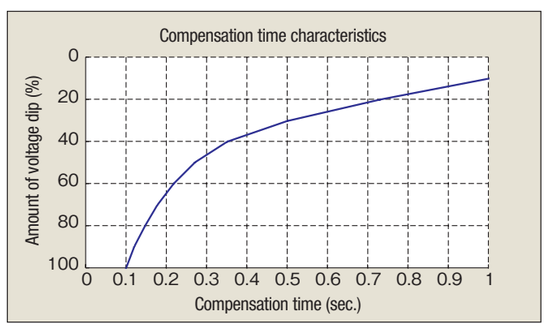
* Models can be manufactured up to 100% of the rated voltage.

Circuit Configuration



Voltage Dip - Compensation Time Characteristics

(For 100% voltage dip, rated current compensation for 0.1 sec.)



Multi-Functional Active Filters

Features

Consistent harmonics compensation

Conventional LC filters have only been able to eliminate a harmonic current of a single order, While the Meiden Multi-Functional Active Filter in a single unit widely restrains harmonics of multiple orders (from second to 25th harmonics).
Even when capasity of the unit is exceeded by harmonic currents, the unit does not stop its operation, but continues to suppress harmonics within its capacity. There is no anxiety for overloading and the unitcan be used safely.

Wide compensation by multiple functions

A variety of problems in the power source can be solved, thanks to the adoption of functions for harmonics suppression, reactive power compensation and unbalance compensation.

Harmonics suppression
Reduction of harmonics and voltage distortion and prevention of equipment overheating and misoperation

Power factor improvement
Power factor ≒1 by reactive power compensation

Imbalance compensation
Relieving the generator burden through compensation for negative-phase-sequence components

Voltage stabilization
Prevention of voltage drop through reactive power compensation

Easy installation

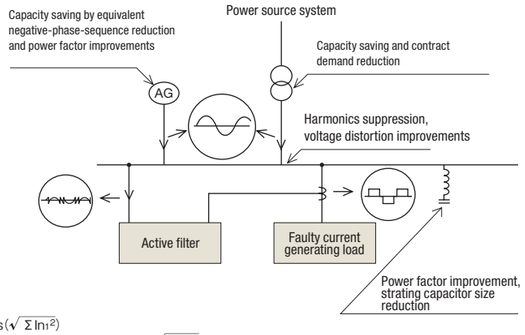
All that is needed is to connect an active filter unit to a power source system and to connect the secondary output circuit of the load-current detecting CT to the input circuit of load equipment. Even when plural active filters are connected in parallel, mutual interference cannot occur. In other words, arbitrary system extension is easy.

Standard Specifications

Unit capacity (kVA)	50	75	100	150	200	300	400	500	750	1000
No. of phases*1	3-phase 3-wire									
Input voltage (V)	200, 210, 220±10%, 400, 420, 440±10%, 6600±10%									
Frequency (Hz)	50 or 60Hz ±5%									
Restraint harmonic order	2nd ~ 25th order									
Harmonics restraining factor*2	≧85% at rated output*3									
Type of rating	Continuous									
Response	≦1ms*4									
Cooling system	Forced air cooling									
Noise (dB)	65			70				75		

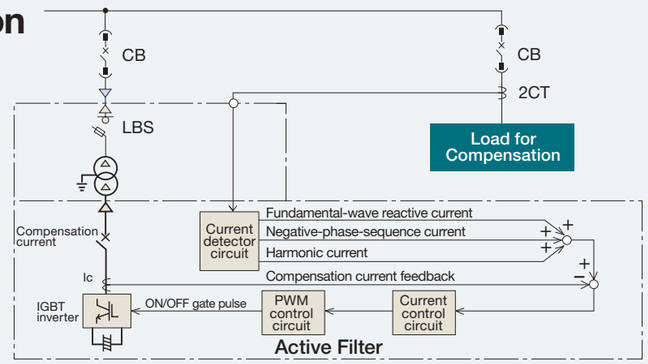
*1. Even a single-phase type is also available.
*2. Harmonics restraining factor=$(1-\frac{I_{H2}}{I_{H1}})\times 100(\%)$
I_{H1} : Harmonic current flowing on the source side when no measures are taken against harmonics ($\sqrt{\Sigma I_{h1}^2}$)
I_{H2} : Harmonic current flowing on the source side when measures are taken against harmonics with the aid of active filters ($\sqrt{\Sigma I_{h2}^2}$)
*3. Under the domestic test conditions of Meidensha
*4. For harmonics control

Circuit Configuration



An Example of Application

Application to high-voltage circuit



DC Power Sources

Features

1. Variety of applications

DC power source are applicable to a variety of facilities such as control power sources for small- to large-scale buildings where even a blink of service interruption is not permissible, batteries for emergency generator startup, and so on.

2. Applications to many kinds of storage batteries

DC power source can be used with stationary batteries such as valve regulated type lead acid batteries or nickel cadmium alkaline batteries, and others.

3. Abundant options

DC power source units come in the joint type, where storage batteries and a charger are accommodated together, and the separation type.

Standard Specifications

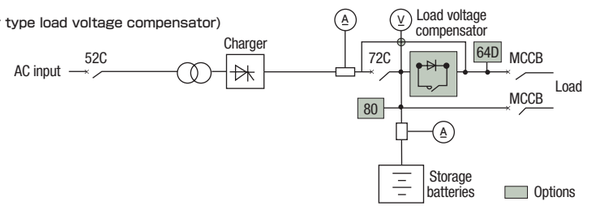
Item		Specifications									
Rated output current (A)		10	30	50	75	100	125	150	200	250	300
Circuiting system		Thyristor 3-phase non-uniform bridge*1									
Cooling system		Natural air cooling					Forced air cooling				
Type of rating		Class Ao 100% continuous									
AC input	No. of phases	3-phase 3-wire									
	Rated voltage (V)	200、 210、 220、 400、 420、 440									
	Rated frequency	50 or 60Hz									
	Voltage regulation range	±10%									
	Frequency regulation range	±5%									
DC output	Equalizing voltage range	115～140V									
	Floating voltage range	105～135V									
	Voltage accuracy	±1.5%									
	Max. drooping current	≦120% rated output current									
Operating environment	Installation place	Indoor*2									
	Ambient temperature	−10～40℃									
	Relative humidity	25～85%									
Others	Input capacity (kVA) *3	2.2	6.4	11	16	21	26	31	41	52	62
	Efficiency (%)	≧65	≧70	≧75	≧80		≧85				
Relevant standard		JIS C 4402 (2004)									

*1. For 125A and above, equipment with thyristors in uniform bridge configuration is also manufactured. *2. Out door type is also available. *3. At the rated output

Circuit Configuration

■ Output 10 ~ 300A

(Thyristor type charger and silicone dropper type load voltage compensator)



Pulsed Power Supply

Pulse generation unit

Charger unit

The MEIDEN Pulsed Power Supply can repeatedly supply instantaneous high-voltage and high-current pulsed power with high precision and stability. With the company's renowned manufacturing technologies, MEIDEN have delivered over 1500 units that are contributing to the development of semiconductor exposure technologies.

** Pulsed power: instantaneous high power*

Features

1. Small and light unit construction

- Unit construction of a charger, for charging a capacitor at high speed, and the pulse generation part, for pulsed power generation and voltage step-up and compression, achieves space-saving (being smaller and lighter).

2. Precipitous rise at a nanosecond (ns) level

- High voltage of over tens of kV can be supplied precipitously.

3. High-precision output pulse voltage

- Variation in output pulse voltage has been reduced to 1/40 compared to before.
- The time-axis jitter has been reduced to 1/55 compared to before.

4. Long life

- This totally-immobilized power with semiconductor switches and magnetic switches has a long life and supplies stable pulse output for a long time.

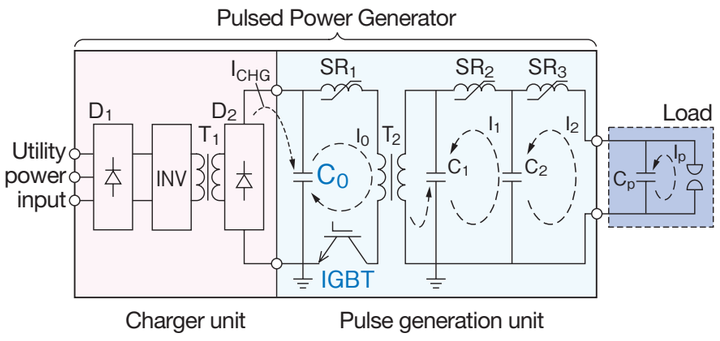
Standard Specifications

	Example of specification
Recurrence frequency	~6kHz
Output voltage	~30kV
Output average power	15kW class
Output pulse width*	<100ns
Dimensions	Pulse generation unit : W650×H230×D520mm Charger unit : W600×H380×D570mm
Mass	Pulse generation unit and charger unit: both 90kg

* The pulse width is a typical value on the assumption that C_2=C_P and C_P is installed in the proximity.

In addition to standard specifications, we have manufactured other models with specifications of maximum frequency of 20 kHz, output voltage of 120 kV, and average power of 200 kW. We will meet and respond to the various needs of customers so please feel free to consult us.

Circuit Construction (Example)

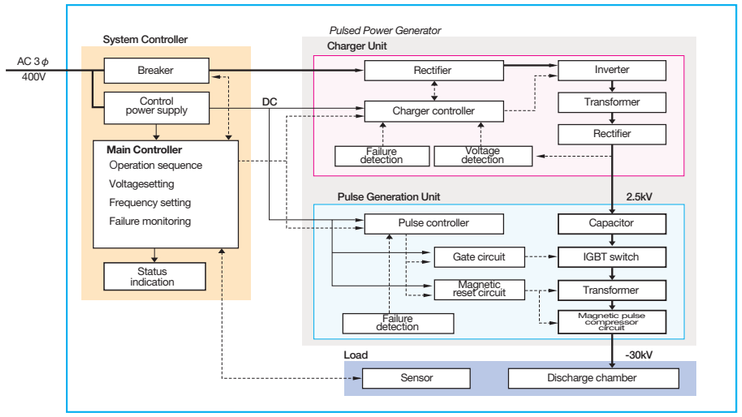


● Charger unit
The utility power is directly converted to charge up the initial-stage capacitor C_0.

● Pulse generation unit
Charged energy is converted into pulses by IGBTs and the compressed high-voltage short pulses processed in the voltage step-up and magnetic compression circuits are delivered to the load.

Pulsed power generator is comprised by the above two units.

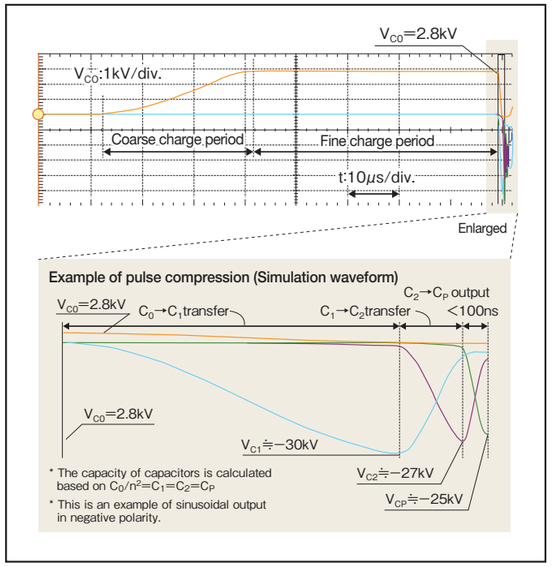
System Configuration (Example)



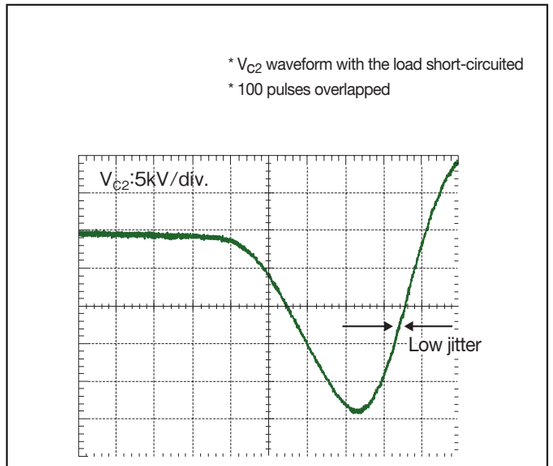
This is a configuration example of pulsed power system including controller. This system is composed of four units that are controller, charger, pulse generation, and load. Input power is three-phase AC400V. Charger output voltage is about 2.5kV. Pulse generation output voltage is about -30kV.
This system outputs highly precise pulsed power by the control with the voltage detection and the sensor.

Output Waveform and Characteristics of the Pulsed Power Supply

■ V_{C0} charger voltage waveform



■ Pulse output waveform (Example)



Applicable Fields

In addition to contribution to semiconductor exposure technologies, the effect of ultra-high energy density is widely applied to a variety of industrial fields such as a field of research.

Production of semiconductors:
- Pulsed power supply for excimer laser
  We have abundance of manufacturing experience with excimer laser. Our expertise is contributing to semiconductor exposure technologies.
- Pulsed power supply for EUV*
  We are contributing to cutting-edge development of EUV light sources.
  * EUV: Extreme Ultraviolet
- Plasma CVD

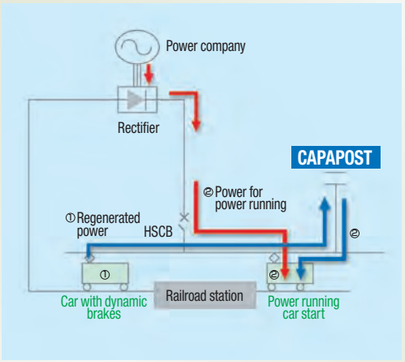
Pulsed Power
Technologies for chargers and power conversion systems
Technologies for pulsed power generators and molding
Technologies for high-voltage insulation
Technologies for instrumentation

Accelerator:
- Experimental equipment for nuclear physics (synchrotron)
- Electron beam processing machines

Environment:
- Algae treatment
- Water and sewage treatment (Ozonizer)
- Exhaust gas treatment

Others:
- DLC coating
- Concrete crushing
- Cancer therapy

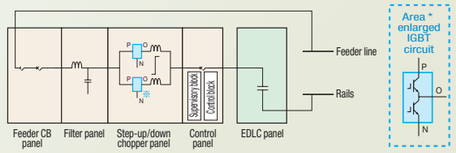
Electric Double Layer Capacitor Type Regenerative Power Storage Systems (CAPAPOST)



Energy saving and the reduction of environmental loading with the effective use of regenerative power.

As public transportation infrastructure, the role of railroads is increasing its significance in recent years together with the rise of the aspiration for the enviromental coservation.
To meet such a contemporary requirement, each railway operator thinks it important to raise the efficiency in the railway system, improve economy, and reduce the amount of CO_2 emission. Meidensha offers the regenerative power storage equipment that assures the effective utilization of the regenerated power.

Configuration of the regenerative power storage equipment [CAPAPOST]



Features

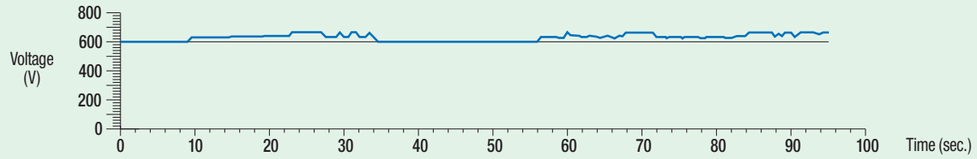
1. Energy saving
- Energy saving is achieved by absorbing the regenerative power and discharging it at the time of power running. Such a method contributes to reducing the emission of the CO_2 that is a greenhouse gas.

2. Peak-cut of railway loads
- The effective utilization of the regenerative power demonstrates a great result in the peak-cut of railroad loads that vary extremely.

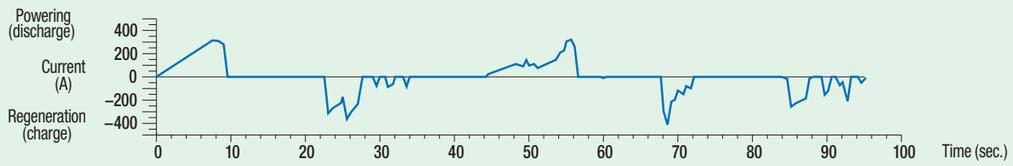
3. Prevention of regeneration failure
- Energy by dynamic braking is absorbed to prevent the regeneration failure.
- This equipment makes it possible to apply the regenerative cars to the lines where such cars were difficult to be used.

Simulation result (Rating : 600V DC, CAPAPOST operating voltage : 600V DC)

■ Time - voltage curve (Outgoing voltage at substation)



■ Time - current curve (Feeder side)



Standard specifications

■ Chopper specifications

Application	DC feeder facilities	1500V, 750V, 600V
Structure	Cooling system	Forced air cooling
Power	Capacity	500 ～ 3000kW
	Max. voltage	1800V, 900V, 720V
Voltage* control	Charging	Optimum value is determined by simulation
	Discharging	

* Setting values can be arbitrarily changed.

■ EDLC Specifications

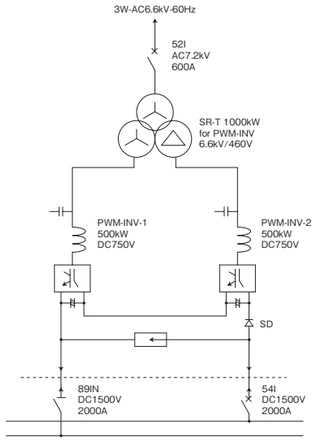
Type	600-type
Capacitor configuration	Bipolar type
Max. charging voltage	170V DC
Capacitance	4～5F
Internal resistance	0.5～0.6Ω

Others	Voltage monitor	Insulation amplifier → Sequencer input
	Voltage regulation	Sequencer output
	Full discharge function	Electromagnetic contactor + Resister
	Alarm output	Temperature, overcurrent, overvoltage

* According to the chopper specifications, series/parallel connections of capacitors are made in an optimal configuration

IGBT (PWM) Inverters

■ Circuit configuration



As the successor for conventional thyristor power regeneration inverters, Meidensha offers the power regeneration inverters of the PWM control type where IGBT devices are adopted.

Features

1. High-speed response characteristics
- Response speed is within 1ms without circulation current.

2. Sinusoidal waves output by high-speed switching under PWM control
- There is almost no generation of harmonics and no external filters are necessary.

Standard Specifications

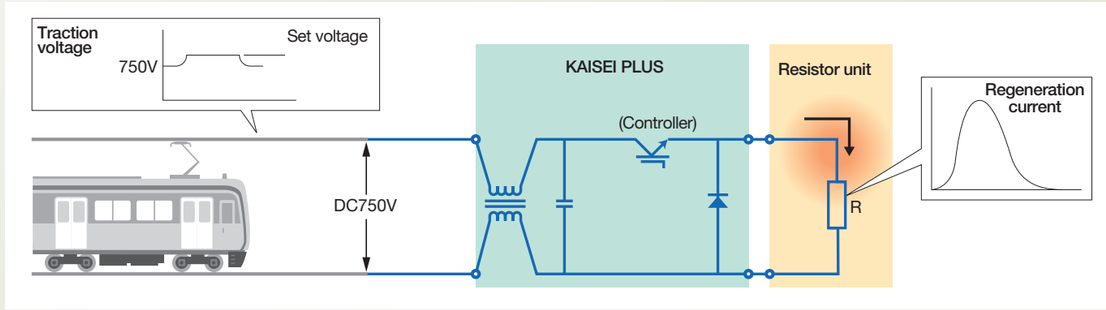
Voltage	1500V	750V
Capacity	1000kW	500kW、1000kW
Overload durability	100% continuous, 300% for 1 minute	
Current distortion factor	≤3% for each order, THD ≤ 5%	
Cooling system	Forced air cooling	

Resistor Type Regenerative Power Absorbers (KAISEI PLUS)

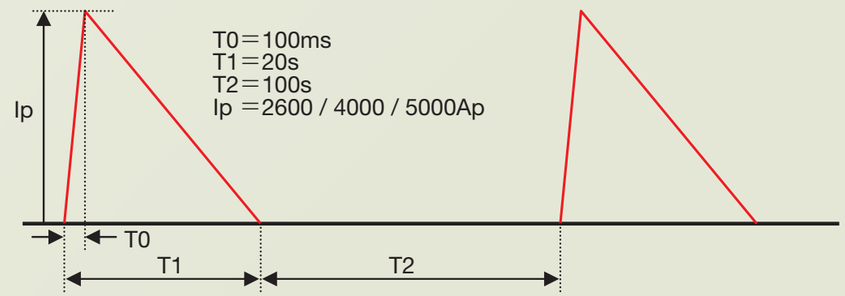
By PWM control, the KAISEI PLUS absorbs the regenerated power of the trains with minimum power loss and prevents the voltage rise and regeneration failure of train cars.
This equipment is especially recommended to be applied to the following systems.

- LRT system where no regenerative rheostat is installed in electric cars
- Section of low operating frequency
- Area where it is difficult to return the regenerated power to the AC circuit

The KAISEI PLUS is useful for the purposes of installation space saving and cost reduction. In addition it offers high efficiency and regeneration performance.



Standard operation pattern of PWM inverter, KAISEI PLUS (at 750V)



Large-Capacity PWM Power Conversion Systems

It has become possible to install large-capacity PWM power conversion equipment in railway DC1500V substation. This equipment can control the feeder voltage at a constant level even under the condition of extreme load variations. During train power regeneration, the regenerated train power can be fed back to the AC side by inverters. In this manner, crosscurrents among substations are controlled.

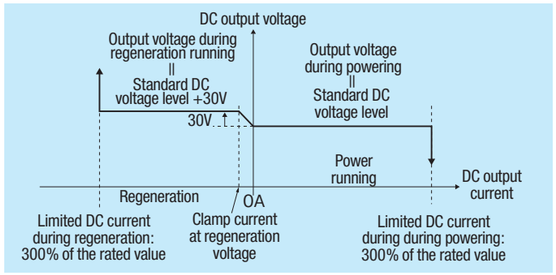
Functions

The PWM power converter controls the DC output voltage according to the direction and intensity of the DC output current. When a train performs power running, the DC voltage level is maintained 1500V. During regeneration, the DC output voltage is raised to limit crosscurrents among substations. When the regenerative current exceeds the clamping current value of the regenerative voltage, the DC output voltage is raised by 30V above the standard DC voltage level. The control system makes both the DC output voltage control and the reactive power compensation on the power receiving side at the same time. And both control values are managed to generate a gate signal as an AC input voltage command value for the conversion equipment.

Standard Specifications

Item	Specifications
Inverter capacity	4500kW Class S (100% continuous, 200% for 2 hrs, 300% for 1 min.)
Rated current	Power running 3000A, regenerative 2100A
AC input voltage	810V
DC voltage	1500V
Multiplex system	Series multiplex single phase bridge PWM control system
Cooling system	Forced air cooling with heat-pipe type
DC voltage control accuracy	≤ ±0.5%

* PWM: PWM Power Conversion Equipment (PWM = Pulse-Width Modulation)



Natural Cooling Type Silicon Rectifiers

Pure-water heat-pipe natural cooling silicon rectifier

The DC power is steadily supplied without sacrificing the freedom from environmental pollutions and low running cost.

Features

- The rectifiers for the DC railroad substations use pure water for a heat pipe coolant because it exerts less impact to the environment.
- The vertical type heat pipes are used so that the effect of convection can be improved and installation space can be saved.
- The nitrogen-aluminum insulation with high heat-conduction characteristics is allocated between the silicon rectifier elements and the heat pipes. This method assures that the heat pipes are non-electrified parts to prevent an accident of electric shocks.

Standard Specifications

Item	Specifications
Rated DC voltage	750V, 1500V
Type of rating	Class D (100% continuous, 150% for 2 hrs, 300% for 1 min.)
	Class E (100% continuous, 120% for 2 hrs, 300% for 1 min.)
Input frequency	50/60Hz
DC voltage regulation	6%, 8%

Natural air cooling rectifier

Easy maintenance.

Features

The rectifier elements incorporated in the heat sink are adopted. And developed design policy results in substantial compactness.

- Simple construction
- Compact configuration
- Easy maintenance and inspection

Pure-water heat-pipe natural cooling silicon rectifier

Natural air cooling rectifier

Power Conditioners for Railway Systems

Railway Static Power Conditioner (RPC)

In the AC electrification substations for Shinkansen, etc., the Scott-connected transformers are used for the 3-phase power systems into the single-phase feeder lines. Therefore at each power incoming point, voltage imbalance and voltage fluctuation are caused. The power conditioners are equipment intended to improve the quality of the power through voltage fluctuation power factor improvements, voltage compensation, and others.

Principle of operation

Through the active power interchange and the reactive power compensation of the teaser and the main phose loads by the power conditioners, each winding of a Scott-connected transformer is made to have the same amount of active power and to reduce the reactive power to zero. In this manner, voltage regulations in incoming power systems and imbalance in 3-phase currents are suppressed to the lower levels.

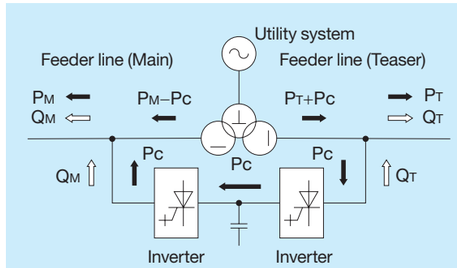
Single Phase Feeding Power Conditioner (SFC)

By the single-phase power feeding at the railway train yard, there are great voltage fluctuation at the power receiving point due to the effect of currents fed to the cars running in the train yard and parked trains. As a result, a phase imbalance is caused. The SFC has been adopted to compensate for such an imbalance.

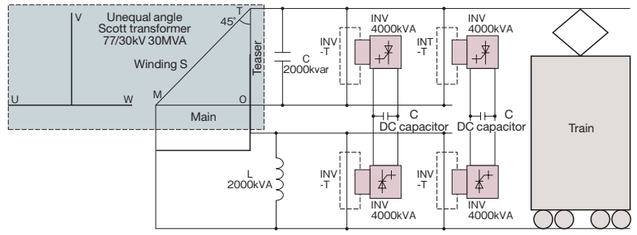
Features

1. Voltage drops in the feeder transformers can be controlled. Since power factor improvements and voltage balancing can be performed on the feeder buses.
2. The power factor can be improved at the power incoming point.
3. An antifreeze liquid is used for cooling. In consideration of usage in the Frigid Zone.

RPC Principle Diagram



SFC Configuration Diagram



Standard Specification

Item	Specifications
Inverter capacity	4～20MVA ex. 4MVA×2, 5MVA×2 (Either winding) ×2, 10MVA×2
AC input voltage	900～1800V
DC voltage	1700～3400V
Multiplex system	Series multiplex Single phase bridge PWM control system

Item	Specifications
Cooling system	Pure-water circulation cooling
Control mode	RPC control Active power interchange SVC-Q control Reactive power compensation SVC-V control Voltage compensation
Remarks	

*RPC: Railway Static Power Conditioner
*SFC: Single phase Feeding power Conditioner

Some examples of deliveries

Frequency converter for on-shore power supply system

Even when a ship is staying in port, an in-ship generator is operated to supply power. If this power supply is switched over to a on-shore power supply system, the in-ship generator can be cut to suspend emissions of CO2. However, the in-ship frequency is 60Hz, and in east Japan it is necessary to convert 50Hz of power frequency to 60Hz. Meidensha can manufacture a large-capacity (1,000kVA ~ 10,000kVA) frequency converter that is applicable to large ships.

4000kVA Frequency Converter (delivered in 2010) ▶

Converter for power storage lithium ion batteries

We have developed converter (AC 210V, 480kVA) for power storage lithium ion batteries (LiB).
Development of this equipment is the first such trial for large-capacity LiB (battery capacity: 1MW or above). It is intended for load leveling at a user's facility. The capacity of a single inverter unit is 60kVA and eight units are connected in parallel to set up a single inverter bank. According to the LiB status such as battery drain, each inverter line can be controlled for charge and discharge of an arbitrary amount of power. If converter or LiB in each line cannot be used for maintenance reasons, such a line can be separated from the overall system and remaining lines only can be operated continuously.

Converter for power storage lithium ion batteries (delivered in 2010) ▶

Railway static power conditioner for existing railway tracks delivered to East Japan Railway Company

We have delivered a Railway Static Power Conditioner (RPC) to Aomori-Nishi Substation of East Japan Railway Company. For AC power feeding, a Scott-connected transformer is used to convert the power from a 3-phase power system to two single-phase feeder lines. In this case, voltage imbalance and voltage regulations are caused by differences in loads on the main and teaser windings. The RPC is intended to improve the quality of power through active and reactive power compensation of the teaser and main loads.

Power conditioner (delivered in 2009) ▶

Static Var Compensators (SVC)

As a countermeasure taken against voltage fluctuations attributed to load variations, static var compensators (SVC) are widely used. In particular, in an area like at a far end of a power distribution system where the capability of power system is low, such a method is strongly recommended. Meidensha has developed the SVC adaptable to a variety of capacities ranging from 50kVA to 6MVA. Two 2MVA units and one 1MVA unit have been already delivered.

1MW SVC (delivered in 2012) ▶

PCS for 250kWh lithium-ion batteries

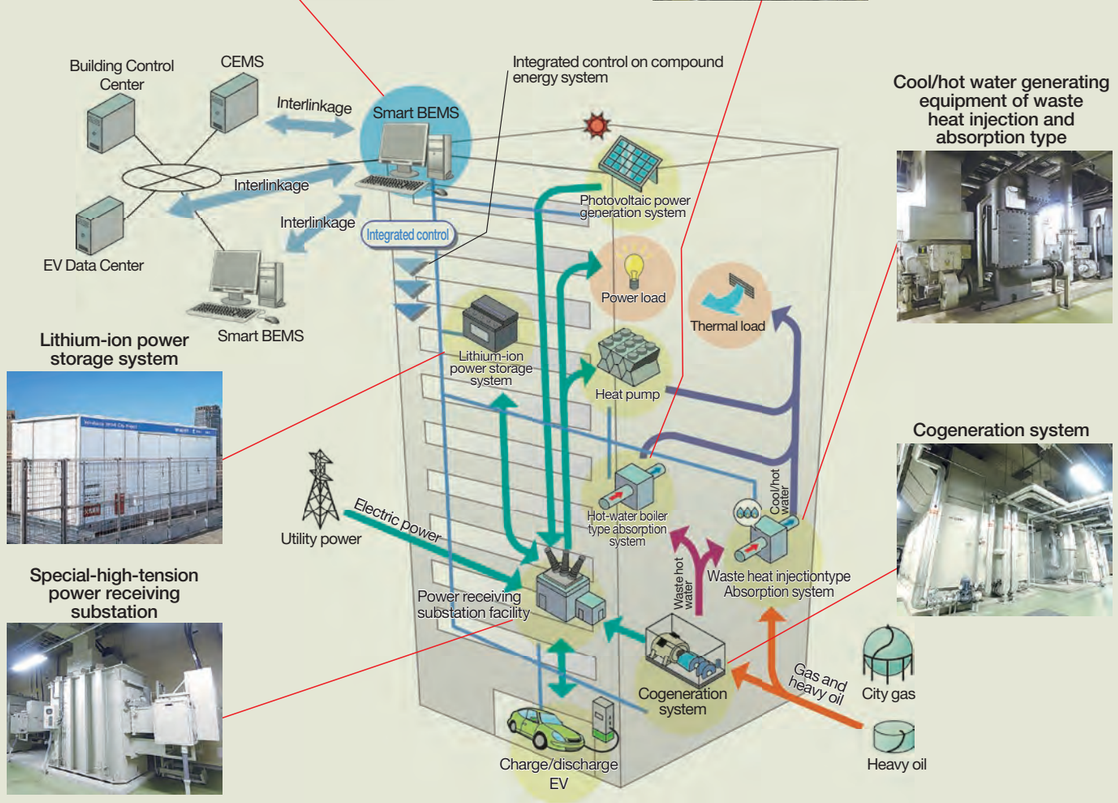
For the Yokohama Smart City Project (YSCP) that is part of the "Next-Generation Energy・Social System Verification Project" sponsored by the Ministry of Economy, Trade and Industry, Meidensha developed the PCS for 250kWh lithium-ion batteries and has been in charge of the verification test to be continued until Fiscal 2014.

Verification, Simulation, and Evaluation Model

The power storage systems are contributing to the power demand control on the premises.

Smart BEMS

Hot-water boiler type absorption refrigerator



Lithium-ion power storage system

Special-high-tension power receiving substation

Cool/hot water generating equipment of waste heat injection and absorption type

Cogeneration system

Peak-Cut Technology

What is the peak-cut technology?

This technology is intended to reduce the facility capacity and prevent the peak overflow of the incoming power by covering the peak load continuing for a short time (in seconds) according to the requirements of the factory facilities and production lines.

Examples of loads

- Run and standby are repeated in a short time (in seconds).
- The difference is great between maximum power and average power.
- Regenerative power is generated.
  (Examples) Servomotors, robots, physical distribution equipment, and press machines

Achievement by peak-cut technologies

- Contribution to the curtailment of contract power demand
- Prevention of peak overflow of the incoming power
- Contribution to the load factor improvements for incoming power facilities
- Contribution to the introduction of new facilities without changing existing power facilities

Others (Functions of power regeneration and voltage dip compensation)

- Contribution to the effective utilization of regenerated power
- Prevention of reverse tidal flow due to the effect of regenerated power
- Improvement of the power quality by virtue of the momentary voltage dip compensation

Outlined operation

● Peak-cut technologies

The facility capacity has to be assured for the amount of load power needed.

Power is discharged to the peak-cut equipment for the amount that has exceeded the goal value of the load power or peak-cut.

● Regenerative functions

The reverse tidal flow of regenerated power runs into the utility power system side.

Power is charged in the peak-cut equipment for the amount that has exceeded the regenerated power or the goal value of peak-cut. The charged power is discharged as required.

● Voltage dip compensation functions

Peak-cut of the load power is carried out.

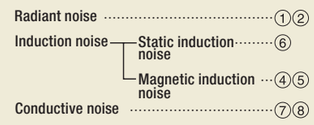
The high-speed switch is opened upon the occurrence of a voltage dip and the power is fed from the peak-cut equipment to the load facility.

Technologies for Reducing Harmonic Noise (including leakage currents)

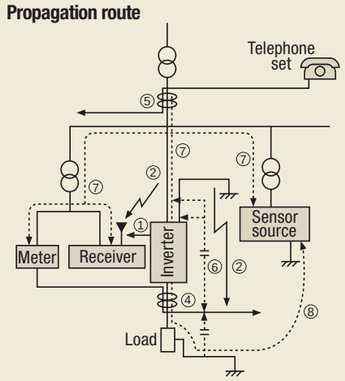
High frequency noise

As many semiconductors begin to be used for high speed switching, high frequency noise has tended to increase in power converter equipment. Therefore, it is necessary to suppress this noise and reduce an adverse influence upon the environment.
To solve this problem, we generally use filter circuits consisting of reactors, capacitors, etc. as well as low noise semiconductor devices, select the driver and snubber circuits that are effective in reducing noise, or use main circuit wiring in consideration of low inductance as well as a structure for reducing line-to-ground stray capacitance, according to the characteristics of the equipment being installed.

Classification of noise



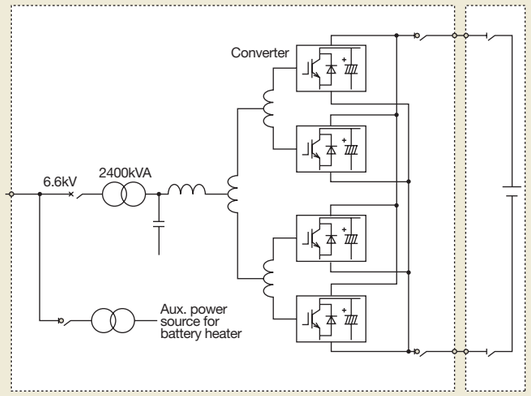
Propagation route



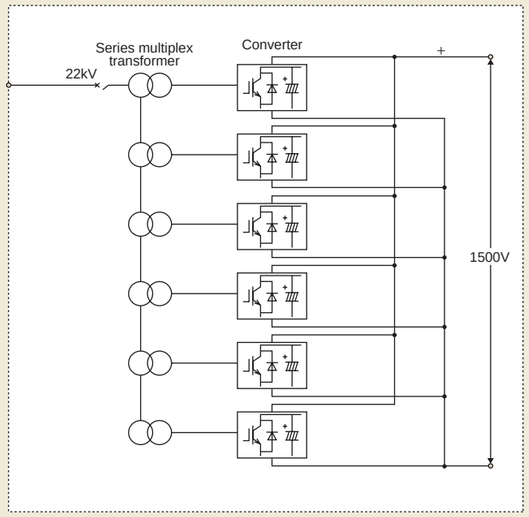
Capacity Expanding (multiplexing) Technologies

Multiplexed large-capacity converter

The large-capacity converters of several MW classes are expanding their capacities through multiplexing. Even for the classes conventionally with many GTO devices, they tend to use IGBT converters to expand their capacities by increasing their voltage durability and capacity.
There are two methods for multiplexing. Interphase reactors may be used with the IGBT unit for parallel multiplexing. Otherwise, the transformer windings may be connected in series for series multiplexing.



An example of parallel 4-multiple 2400kVA inverter with interphase reactors

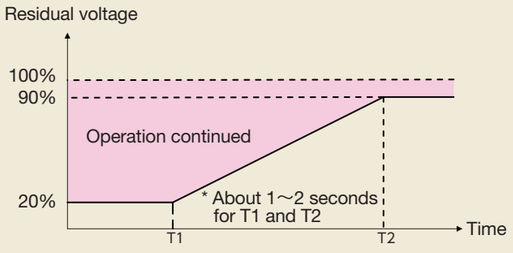


An example of series 6-multiple 9000kVA inverter

Associated Technologies

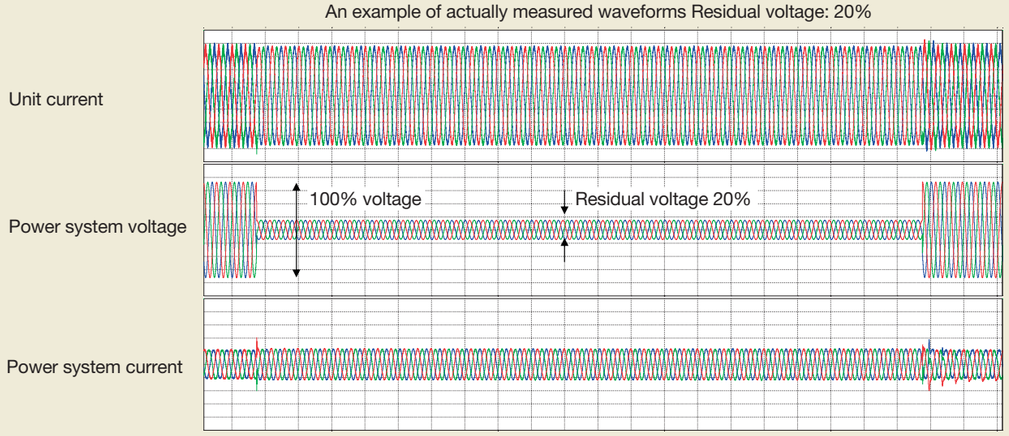
LVRT (Low Voltage Ride Through) functions

According to energy saving and environmental problems, introduction of high-tech systems has been promoted with using renewable energy such as photovoltaic power generation, wind power generation and etc. If amounts of these systems are introduced to power system and simultaneously paralleled off due to the occurrence of voltage dips, there will be adverse impacts on the power system. In a worst case scenario, a major power outage will occur. To avoid such influences upon power system, the LVRT functions of inverters in interconnected operation become active to maintain the power outputs even in the case of some voltage dips, without parallel off.



An example of operation range in the case of voltage dips

An example of actually measured waveforms Residual voltage: 20%



Simulation Technologies

- The simulation technologies are used for the purposes specified below.
  - Development of equipment and analysis of main-circuit duty and control performance at the stage of designing
  - Analysis of the overall system operation before and after the introduction of our products in consideration of the system conditions and loading situation on the customer side
  - Analysis of phenomena such as system faults, equipment malfunctions, and others, generally difficult to be proven by experiments
- For the momentary blackout compensation equipment, simulation techniques are used to examine the internal behavior of the equipment as well as the variations in system power sources and user loads plus the mutual influence related to equipment operation.
- The following general-purpose programs are used as the analytical tools:
  - EMTDC
  - EMTP
  - MATLAB/Simulink
  - SPICE

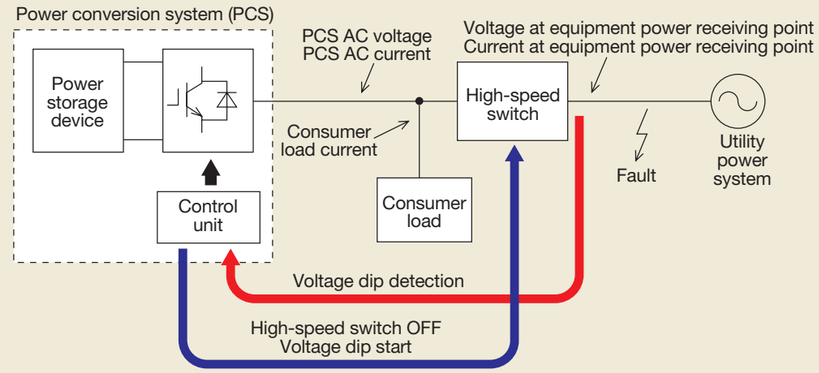
Power Conversion System Configuration and Contents of Investigation

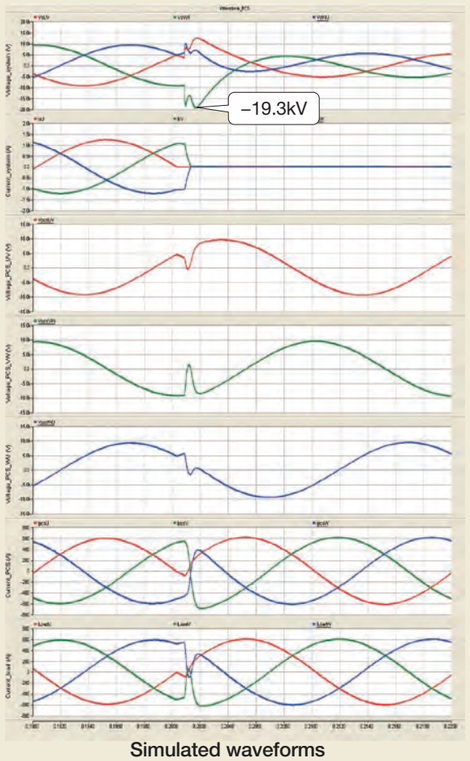
・Voltage regulation ・Frequency regulation ・Power failure ・Harmonics	・Main-circuit duty ・Control performance ・Stability	・Load fluctuations ・Short-circuit ・Harmonics

An example of analysis on voltage dip compensator operation

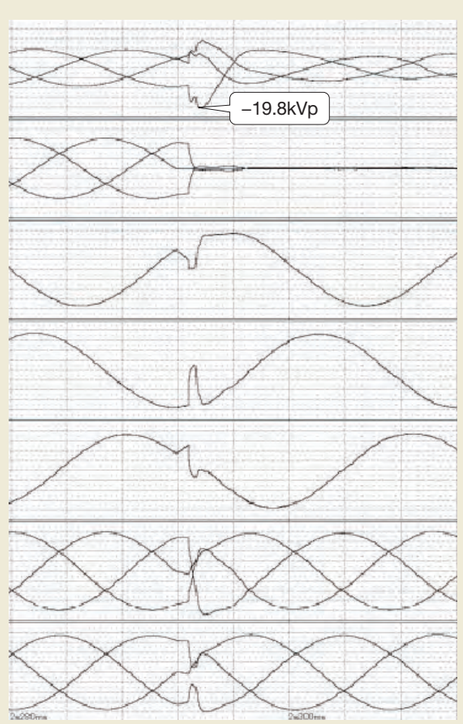
An example of an analysis on a momentary blackout compensator operation is shown, performed in the middle of a charged operation. This diagram shows the result of the analysis when this equipment detects a momentary voltage dip, turns off the high-speed switch, and starts up compensation. It is obvious that the obtained waveforms are close to the actually observed ones. According to this result, an evaluation is carried out on the voltage rise at the power incoming point at the time of the circuit changeover for compensation, variations in PCS AC voltages, changeover time, and so on.

Configuration Diagram for the Analysis on Voltage dip Compensator Operation





Simulated waveforms



Measured waveforms

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