

**Medium voltage, arc-proof, air-insulated,
metal-clad switchgear and controlgear
up to 12kV**

HS21

For marine and offshore use



Description

Characteristics

- Medium voltage switchgear for marine and offshore use
- Full type approval
- Type tested in accordance with IEC 62271-200
- Metal-clad construction
- Independently arc-fault tested
- Circuit breaker with safety metal shutter
- Option of air insulated bus bars
- Safety mechanical interlocks
- Front service operation
- Circuit breaker insertion and withdrawal with the front panel door closed
- Making current earthing switch
- Intelligent circuit monitoring devices



Application

All TERASAKI medium voltage switchboards are specifically designed and manufactured to meet the environmental and safety conditions of the marine and offshore industries.

TERASAKI's reputation throughout the marine and offshore industry ensures that reliability and safety are of prime importance in the design and manufacture of the HS21 medium voltage switchboard.

Design standards incorporated

The switchboard and the instrument have applied the following standards.

- IEC 62271-200 : switchboard
- IEC 62271-100 : circuit breaker
- IEC 62271-106 : contactor
- IEC 60044-1 : current transformer
- IEC 60044-2 : voltage transformer
- IEC 60255 : electrical measuring and protection relay
- IEC 60076-1 : power transformer
- JEC 1201 : zero phase transformer

Adapted various marine classification

- American Bureau of Shipping (ABS)
- Det Norske Veritas(DNV)
- Bureau Veritas(BV)
- Germanischer Lloyds (GL)
- Lloyds Register of Shipping (LR)
- Nippon Kaiji Kyokai(NK)

Environmental specification vessel types

- Ambient temperature : 45°C
- Relative humidity : 95%
- Vibration (, in accordance with IEC 60092-504)
all control devices
 - 2 ~ 13.2Hz, interval of vibration $\pm 1.0\text{mm}$
 - 13.2 ~ 100Hz, acceleration $\pm 0.7\text{g}$
max. acceleration 0.7g

Vessel types

The HS21 switchboard is designed for use in:

- Offshore Plant
- Oil Rig supply vessels
- Floating Production Storage Offloading vessels (FPSO)
- Floating Storage Offloading vessels(FSO)
- LNG Carriers
- Large Passenger vessels
- Container ships
- Storage and Work Barges
- Floating Docks, Various Dredgers, etc

Type testing

The HS21 switchboard is independently tested in accordance with IEC 62271-200 and marine classification society requirements.

- Temperature rise test
This test is carried out at the rated current of the switchboard with the classification societies requirements of a 45-degree C ambient temperature being taken into consideration.
- Dielectric test
Including impulse voltage and power frequency voltage test.
- Main circuit resistance measurement
There shall be less than 20% difference in the DC measured resistance values of the main and control circuits.
- Short-time and peak withstand current test
The panel is deemed to have passed the test if there is no deformation or damage to components and conductors following application of a short circuit current to the switchboard.
- Arcing due to internal fault test
The switchboard is deemed to have passed the test if following the application of an internal arc fault, in accordance with IEC 62271-200 Annex A the original mechanical integrity and inflammability of the panel is maintained.



Arcing due to internal fault test

General specification

- Basic specifications and panel size of 7.2 kV and 12 kV are the same
(Refer to the following pages for panel size)
- Miniaturization rather than a conventional switchboard
- Abundant prepared optional equipment

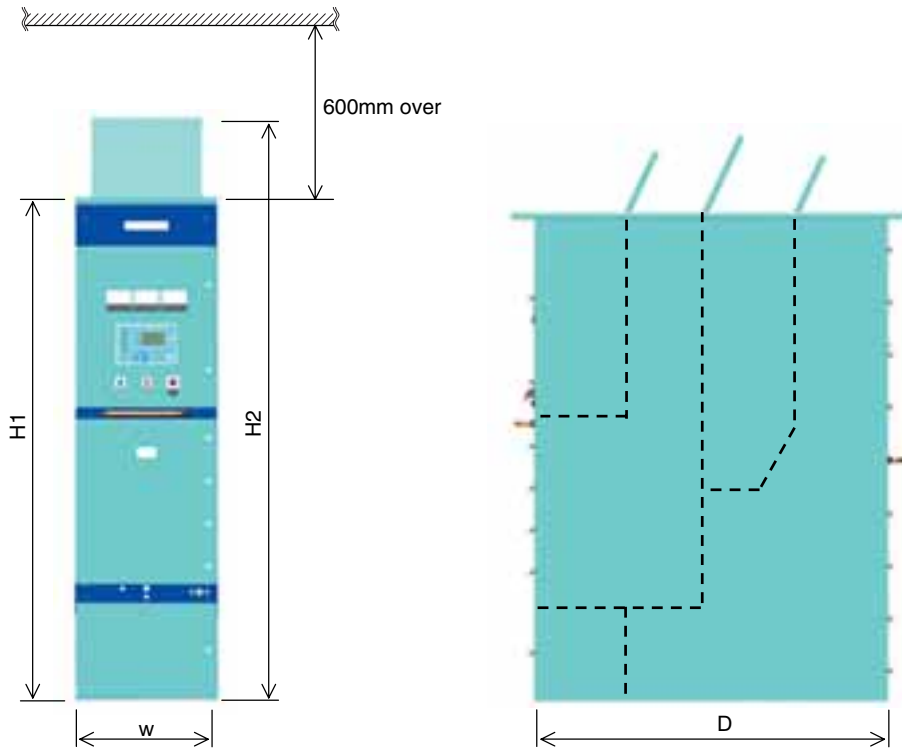
	Type			
	HS21-1	HS21-2	HS21-3	HS21-4
Application				
Standard conformance	IEC 62271-200 (IEC 60092-508) ¹⁾			
Classification	ABS, BV, DNV, LR, NK, GL and others			
Rating				
Rated voltage	AC 7.2 kV		AC 12 kV	
Rated frequency	50 / 60 Hz			
Rated power frequency withstand voltage	20 kV/min		28 kV/min	
Rated lightning impulse withstand voltage	60 kV		75kV	
Rated short time withstand current	25 kA 1sec (3sec) ²⁾			
Rated peak withstand current	65 kA			
Internal arc withstand current	25kA 0.2sec (20kA 1sec) ⁴⁾			
Main bus bar current	1250 A	2000 A	1250 A	2000 A
Load bus bar current	600 A	600/1000 A	600 A	600/1000 A
Construction				
Switchgear construction	Metal-clad			
Degree of protection	Low voltage compartment		IP32	
	High voltage compartment		IP42	
Optional equipment ³⁾				
- Inspection window	- Arc detecting system	- IP33 of low voltage compartment protection		
- Arc gas exhaust duct	- Insulation tube cover on bus bar	- IP43 of high voltage compartment protection		
- Earthing switch on main bus bar	- Surge arrester on main bus bar	- Infrared rays window		

Notes

- 1) ANSI C37.20.2 on request
- 2) 3 sec on request
- 3) Refer to the following pages about the details of optional equipment
- 4) With arc gas exhaust duct

Dimensions

Basic panel design (example)



H2 : With open pressure relief flap

Panel type	W (mm)	H1 (mm)	H2 (mm)	D (mm)
Generator panel	650	2300	2800	1680
Feeder panel				
Incoming panel				
GPT panel				
Motor panel				
Soft start motor panel				
Bus-tie panel 1 ¹⁾				
Bus riser & GPT panel	800			
Bus-tie panel 2 ²⁾	900			
Sync panel	1000			
ATr panel	1000			

Notes

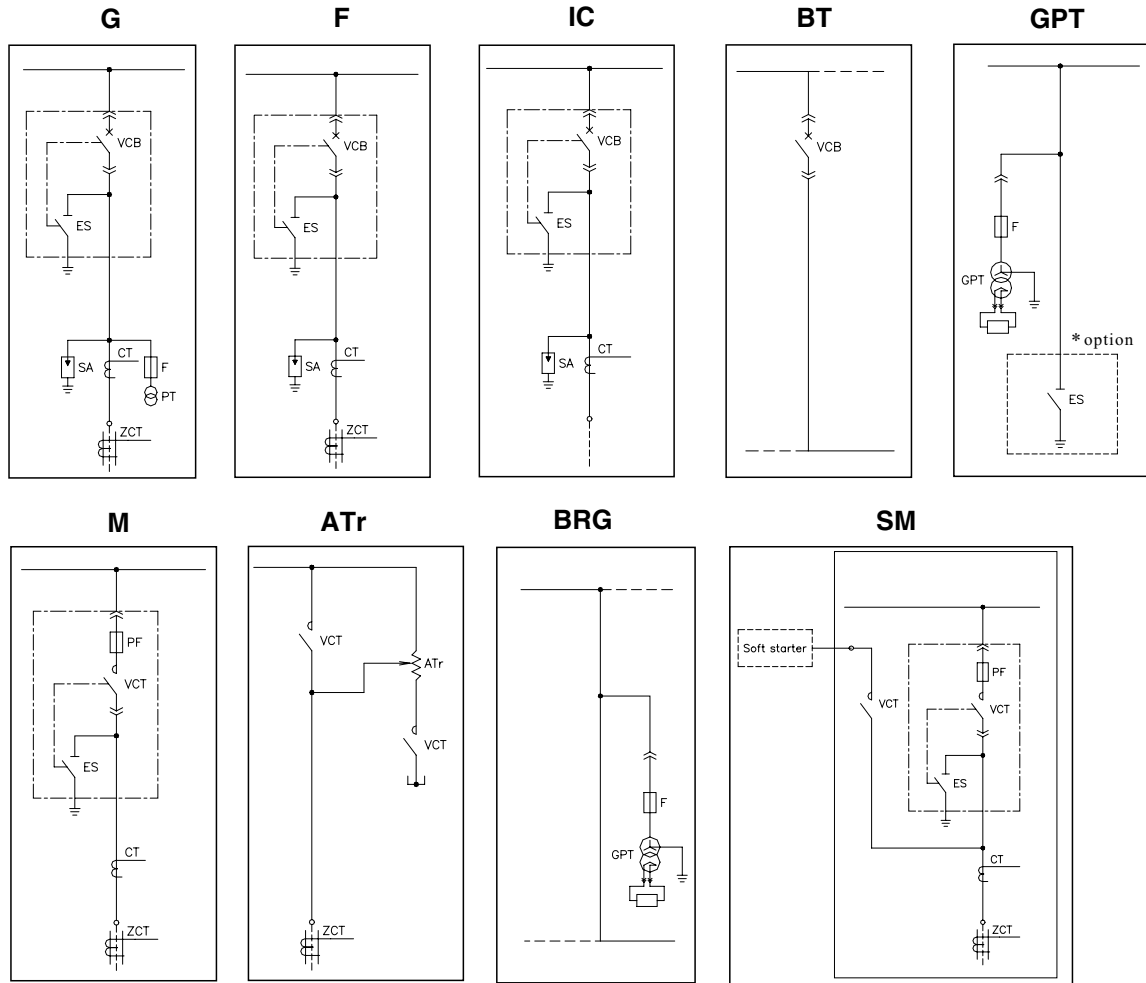
1) LNG vessel only

2) Container vessel only



Technical data

Typical unit



G	Generator panel	M	Motor panel
F	Feeder panel	ATr	Auto transformer panel
IC	Incoming panel	BRG	Bus riser & GPT panel
BT	Bus-tie panel	SM	Soft start motor panel
GPT	Grounded potential transformer panel		

* An earthing switch can be provided in the GPT panel if required.

Vacuum circuit breaker and Vacuum contactor application

Panel types	VCB			VCT
	630A	1250A	2000A	200/400A
Generator panel	○	○		
Feeder panel	○	○		○
Motor panel	○	○		○
Incoming panel	○	○		
Soft start motor panel				○
Bus-tie panel		○	○	

○ : Applicable

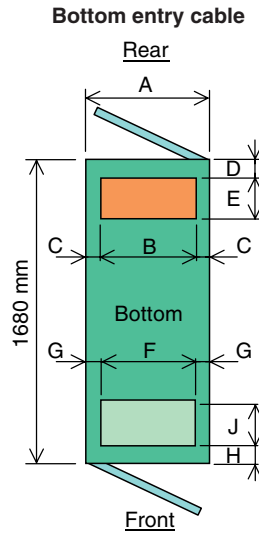
Technical data

Cable entry plan

The HS21 switchboard standard cable entry is from the bottom.

Power cables enter through the rear gland plate and control cables through the front gland plate.

Top cable entry can be provided, but consultation with TERASAKI is recommended as panel dimensions will increase.



Power cable entry (example)



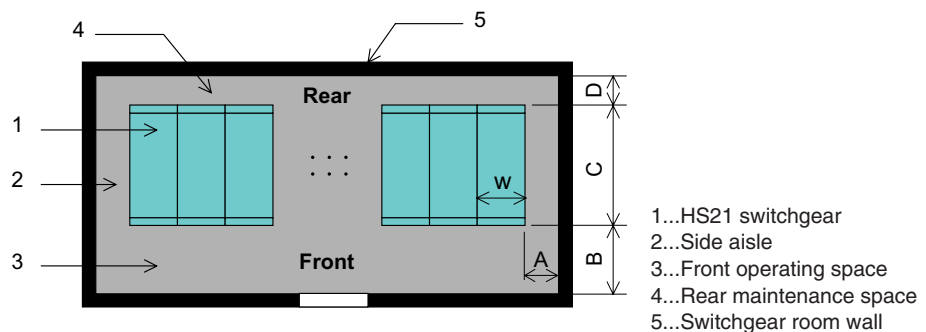
Panel type	Width	Power cable entry				Control cable entry			
	A(mm)	B(mm)	C(mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	J (mm)
Standard panel ¹⁾	650	450	125	140	150	450	125	140	200
Bus riser & GPT panel	800	550				550			
Bus-tie panel	900	—				650			
Synch panel	1000	—				750			
ATr panel	1000	750				—			

Notes

1) Refer to 650mm panel width on "Dimensions" page

Room planning

The room planning of installing HS21 in the switchgear room is shown below.



Panel width -W	Room height (mm)	A (mm)	B (mm)	C (mm)	D (mm)
only 650 mm	≥2900	≥1000	≥1600	1680	≥700
with 800 mm					≥850
with 900 mm					≥700
with 1000 mm					≥700

Metal-clad

Compartments

Each section of the HS21 metal-clad switchboard is separated into four compartments.

- Circuit breaker
- Main bus bar
- Cable terminations
- Low voltage equipment

To withstand internal arc faults, segregation between compartments is achieved by the use of metal partitions.

See picture below.

Circuit breaker compartment

This compartment is equipped with a vacuum circuit breaker and contactor.

The cradle is equipped with metal shutters.

Draw-out and insertion of the circuit breaker can not be carried out without first satisfying the safety interlock procedure.

Main bus bar compartment

The main bus compartment is designed for 1250A and 2000A round-edged, tinned-copper bus bars. Insulation between panels is maintained by the use of track-resistant epoxy insulation materials. A fully insulated bus bar system can be provided if required.

Cable compartment

Standard cable entry is from the rear bottom. However, if required cable, entry can be from above, but the depth of the panel will increase. Access can not be gained to this compartment without first satisfying the safety interlock procedure of the switchboard.

Also located within this compartment are:

- Earthing switch
- Zero-phase current transformer
- Surge arrester
- Voltage and current transformers

Low voltage compartment

The upper and lower low voltage compartments are located above and below the circuit breaker compartment. Cables routed through the circuit breaker compartment are protected by metal shielding.

Panel partitions

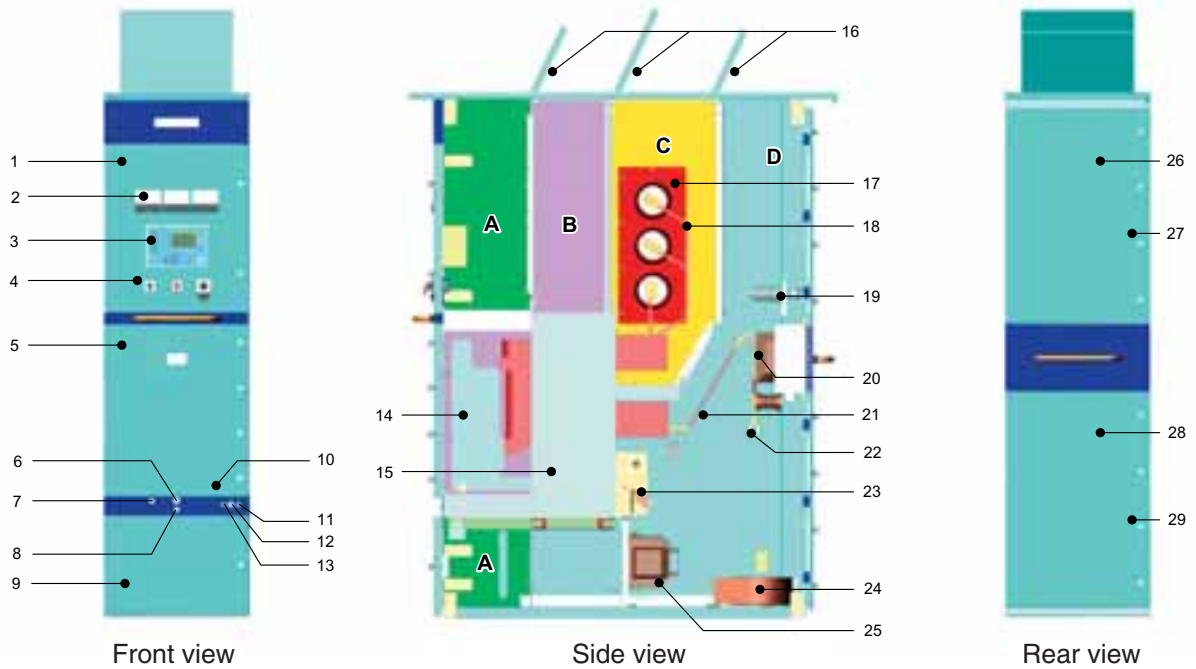
The compartment between each panel is divided by the metallic partition.

Since each compartment have not penetrated between panels, other panels are not affected even when the accident happens by a certain panel. Moreover, when extending in the future, it can install easily.



Construction

Basic panel design (example)



A Low voltage compartment

- 1 : Upper door
- 2 : Instrument
- 3 : Protection and control unit
- 4 : Switch
- 9 : Lower door

C Main bus bar compartment

- 16 : Pressure relief flap
- 17 : Insulation bushing
- 18 : Main bus bar

B Circuit breaker compartment

- 5 : Door of circuit breaker compartment
- 6 : VCB draw-in / out handle port
- 7 : Indicator of circuit breaker position
- 8 : VCB draw-in / out interlock key hole
- 10 : Emergency open mechanism
- 11 : Interlock key for de-excitation
- 12 : Earthing switch operating handle port
- 13 : Lower cable compartment door key
- 14 : Vacuum circuit breaker
- 15 : VCB cradle

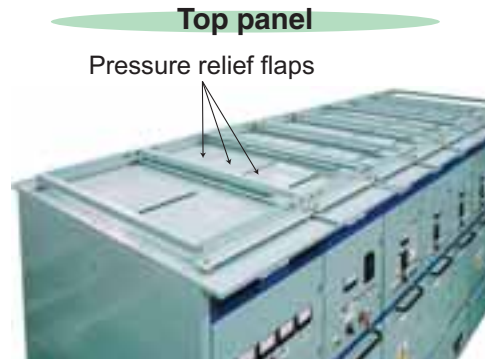
D Cable compartment

- 19 : Surge arrester
- 20 : Current transformer
- 21 : Load bus bar
- 22 : Power cable terminal
- 23 : Earthing switch
- 24 : Zero-phase current transformer
- 25 : Voltage transformer
- 26 : Upper door
- 27 : Upper cable compartment door key hole
- 28 : Lower door
- 29 : Lower cable compartment door key hole

Product description

Pressure relief flaps

To relieve pressure during an internal arc fault, pressure relief flaps are provided on the circuit breaker, bus bar and cable compartments at the positions shown.



Insulation bushing

To maintain electrical characteristics and mechanical strength the three-phase single molding insulation bushings are manufactured using high-grade epoxy resin material.

Insulation bushing



Specification

Rated voltage	12 kV
Rated power frequency withstand voltage	28 kV / min
Rated lightning impulse withstand voltage	75 kV
Over current strength	25 kA 1sec (3sec) ¹⁾

1) 3sec on request

VCB (VCT) cradle

The cradle is equipped with mechanical interlocking facilities on the basis of safety consideration. Metal shutters operate automatically on withdrawal or insertion of the VCB / VCT.

Metal shutters of VCB cradle

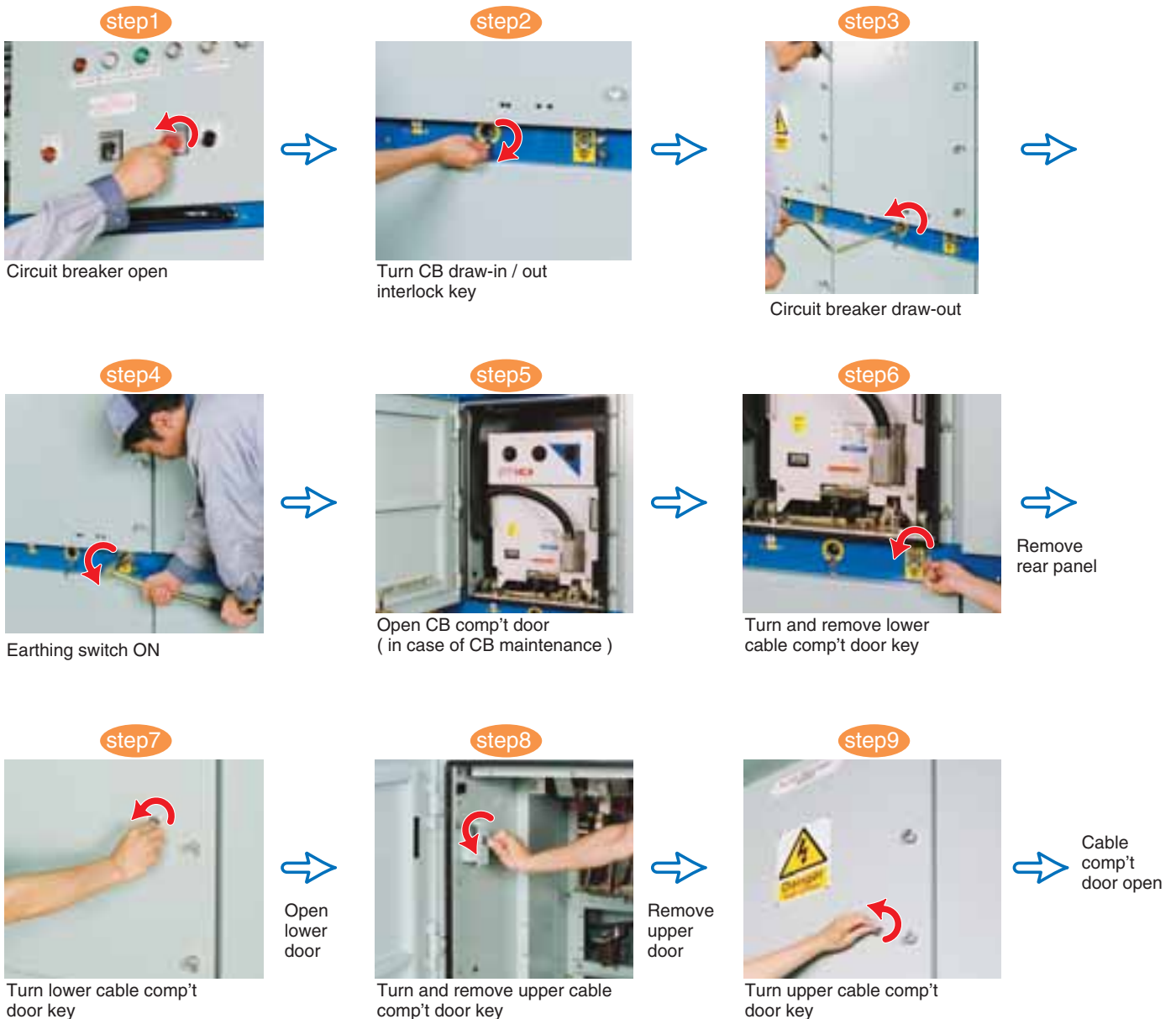
VCB cradle mechanism



Interlocks

- Mechanical interlocking facilities satisfy demand of IEC62271-200.
- Descriptions of the HS21 switchboard interlocks are shown below.
 - I. With metal-clad compartmented switchgear and controlgear, door should only be opened when the part of the main circuit contained in the compartment being made accessible is dead.
 - II. They shall be provided with locking facilities, unless the safety of persons is assured by a suitable interlocking device.
 - III. The withdrawal or engagement of a circuit breaker, switch or contactor shall be impossible unless it is in the open position.
 - IV. It shall be impossible to close the circuit breaker, switch or contactor in the service position unless it is connected to auxiliary circuit.
 - V. When circuit breaker is a connect position, it isn't possible to do the "ON" position of earthing switch.

Interlock release procedure for maintenance (example)



Components

Vacuum circuit breaker HVF

• Applicable standards

The HVF vacuum circuit breakers meet all the requirements of IEC 62271-100 and the other applicable standards.

• Service life time

HVF vacuum circuit breaker operating mechanism features reduced maintenance requirements, providing a long-life expectancy of 30,000 operations. Because of the small amount of contact erosion, contact life is increased to 20,000 operations for the rated normal current.

• Maintenance free

The circuit breaker require little maintenance. In fact, only the parts subject to normal wear and aging must be serviced to ensure fully reliable operation. This involves simple jobs carried out by the customer's personal with short servicing times and corresponding downtimes and also long operation periods between servicing. Maintenance is confined to lubricating the operating mechanism. The vacuum interrupters and their supports need not be serviced.

• Rapid load transfer, synchronizing and operating duty

With its consistent short closing and opening times, the HVF is especially beneficial in load transfer from one circuit to another without interruption of service. This high speed operation synchronizes the systems so that they are parallel at the moment of contact closure.

According to the relevant standards, tests were carried out for the following operation duty.

O - 0.3s - CO - 3min - CO (for auto-reclosing)

• Switching upload transformers

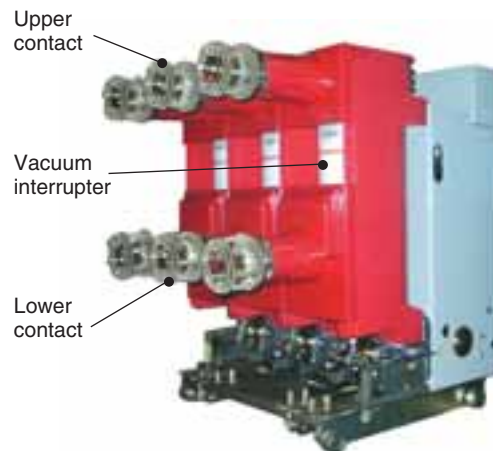
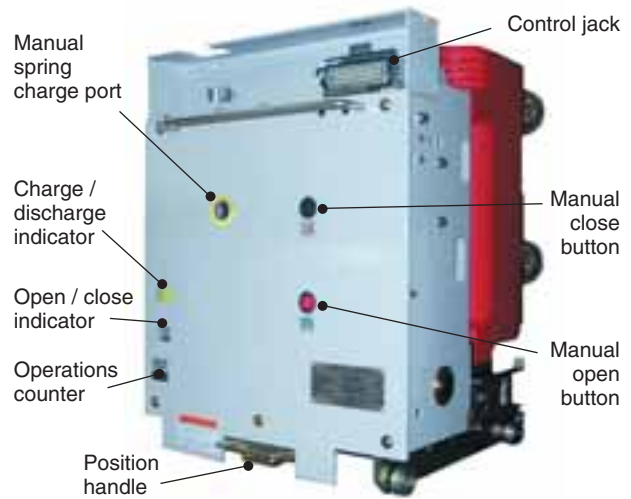
By using special contact materials, the chopping current of the vacuum circuit breakers is only 4 to 5A. This means that no dangerous over voltages arise when unloaded transformers are disconnected.

Specification

Type	HVF-104□ / HVF-204□ ¹⁾		
Rated voltage	7.2 / 12 kV		
Rated current	630 A	1250 A	2000 A
Rated frequency	50 / 60 Hz		
Rated short circuit breaking current	25 kA		
Rated short circuit making current	65 kA		
Rated short time withstand current	25 kA 3sec		
Rated control circuit voltage	DC 110V		

1) Type number in the square "□" 1) ...630A, 2) ...1250A, 3) ...2000A

Vacuum circuit breaker HVF



HVF breaker on cradle



Components

Vacuum contactor HCA

• Applicable standard

The HCA vacuum contactor is manufactured in accordance with international standard IEC 62271-106.

• Service life time

HCA vacuum contactor operating mechanism features reduced maintenance requirements, providing a long-life expectancy of 1,000,000 operations.

• Contact inspection

Inspection of contacts for wear can be easily carried out by removal of the front plate and examination of the maximum contact wear point (2mm) marked in white on the contact.

If the contacts are eroded below this mark, the vacuum interrupter should be immediately replaced.

Specification

Type	HCA-6□C□ ¹⁾	
Rated voltage	7.2 kV	
Rated frequency	50 / 60 Hz	
Rated current	200 A	400 A
Rated short circuit breaking current (with power fuse)	40 kA	
Rated short time current	3.2 kA 1sec	
Rated control circuit voltage	AC / DC 110V	
Max motor capacity	1500kW	3000kW

1) Type number in the square "□"

HCA-□C□

2...200A, 4...400A

F...fixed type without fuse

J...fixed type with fuse (double)

A...fixed type with fuse (single)

B...draw-out type without fuse

D...draw-out type with fuse (single)

H...draw-out type with fuse (double)

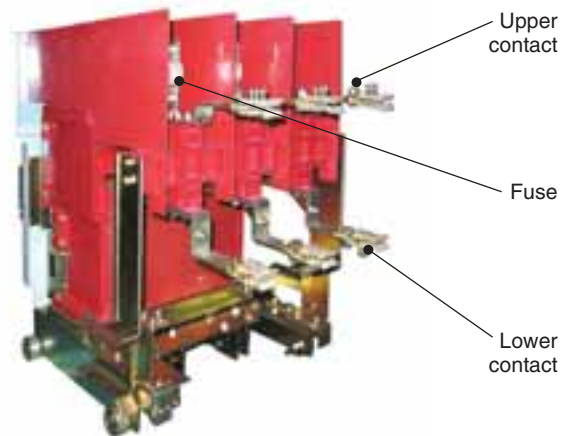
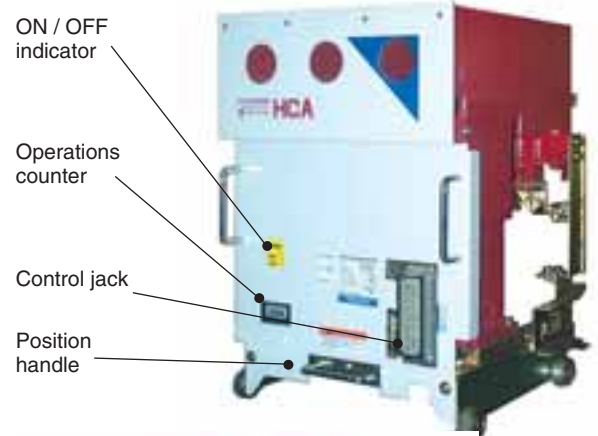
Earthing switch

The earthing switch is located on the VCB/VCT cradle and has a making current capacity rating that ensures maximum possible protection for the operator in case of an error.

Specification

Rated voltage	12 kV
Rated short time withstand current withstand voltage	25 kA 3sec
Rated short circuit making current withstand voltage	63 kA

Vacuum contactor HCA (with single fuse)



HCA contactor on cradle



Earthing switch



Components

Multi protection and control unit HIMAP-BCG

• General characteristic

The multi protection and control unit HIMAP-BCG is a bay control unit supplying Power Management System.

Nowadays our customers have required much more integrated multi protection relay, monitoring, control devices and power management for better and easier maintenance, performance, electrical system analysis and communication according to new trend of switchboard. HIMAP-BCG supplies those requirements of customers with easy handling and operation.

HIMAP-BCG provides a graphic display with rear-lit LCD and push buttons as HMI (Human Machine Interface).

HIMAP-BCG provides the parameter setting program, control setting program, various editors and fault recording and analysis program on Windows / 95 / 98 / NT / 2000 / XP for HMI.

In addition, HIMAP-BCG can be set manually and this manual setting function helps user to interface easily .

Multi protection and control unit HIMAP-BCG



• Protections

This protection functions are based on the IEC60255. HIMAP-BCG has non-volatile Flash Memory that can store data safely. The Flash Memory reserves the data regardless of disturbance or electromagnetic wave. In addition to this Flash Memory can store a lot of backup data through a mirror effect.

- ANSI 25 ... Auto synchronizing
- ANSI 27 ... Under voltage
- ANSI 32 ... Reverse power
- ANSI 50 ... Over current
- ANSI 51 ... Time delay over current
- ANSI 59 ... Over voltage relay
- ANSI 64 ... Over voltage ground relay
- ANSI 67 ... Directional over current relay
- ANSI 87 ... Generator differential protective relay
- ANSI 86 ... Lock out relay and more...

• Power management system

The power management function in HIMAP-BCG controls and coordinates the load sharing on a busbar from several parallel generators. HIMAP-BCG can manage a maximum of 4 independent networks separated by tie-breakers. Each network works on its own power management control simultaneously with the other networks. The power management contains the load-dependant start and stop, as well as the symmetrical load sharing of generators. This means all generators will share their load in such a way as to have the same percentage of their own nominal rated power supplied to the same network. Each network can be assigned and prioritized by function input.

HIMAP-BCG is equipped with a power management system that includes automatic connection to big consumers for controlling the entire mains system. Due to its modular structure, the system is not influenced by any central control unit. Since a HIMAP-BCG is assigned to each generator panel, all generator panels are identically constructed. A two-wire CAN bus communication connects the HIMAP-BCG to each other. In case of the failure of one HIMAP-BCG, the others will continue operating. Each HIMAP-BCG incorporates all important functions necessary for the power management. Thus, the system of independent and autonomous electric engines has been consistently developed for switching gears, control and monitoring (modular independent systems).

HIMAP-BCG has various pages for power management to access the power management system via HIMAP-BCG. The power management system with HIMAP-BCG doesn't mean the load depending start/stop only. It has the following functions for power management:

- Synchronizing
- Load sharing
- Frequency control
- Load shedding (Preferential trip)
- Load depending start / stop
- Load calculation for big motor start
- Protections
- Power factor (cos ϕ) control
- Asymmetrical power factor (cos ϕ) control
- Voltage regulating
- Engine control with alarm and priority

Components

• Measuring function

HIMAP-BCG supplies each analogous data pages for measuring as follows.

- 3-phase current
- 3-phase voltage
- Measured and calculated grand voltage
- Measured and calculated grand current
- Two different 3-phase bus bar voltages
- Frequency and power factor
- Power meter page
- Active power, reactive power
- Working current
- Harmonic wave
- Operating value
- Synchronizing

• Control function

HIMAP-BCG provides breaker functions. These functions can be set manually also allowing customers to conveniently handle HIMAP-BCG without a PC and downloading program (Flash Loader). Of course, HIMAP-BCG requires a password or transponder card to access these functions.

HIMAP-BCG is applied to various ship systems. Customers can select the graphic they want to apply. HIMAP-BCG has various graphic modes for each piece of electrical equipment or feeder. HIMAP-BCG also has an interlock between switching devices.

• Alarm / Event control functions

HIMAP-BCG provides detailed information about events, alarms and interlocks. By use of this information, and a historical data system, trend can be analyzed.

• Data recording functions

One of the most important function of HIMAP-BCG is extended fault recording function. HIMAP-BCG has additional CPU for this extended function as optional.

• Diagnostics and Monitoring

Diagnostics and supervision are very important functions of the bay controller.

• Panel automation

HIMAP-BCG provides convenient and perfect interlocking system for control logic of switchboard. In order to realize this function, HIMAP-BCG sensors position of each switching device and provides the position indication in feeder graphic. Every switching device can be controlled by HIMAP-BCG locally or remotely .

• Parameter setting program

HIMAP-BCG supplies program for easy setting of parameters. Several categories simplify page setting.

• Communication

HIMAP-BCG system treats very large data like as data recording or parameter data files via various communication systems in itself. The relevant signal is acknowledged in the related function.

• Extension boards CMA

The extension board is used when additional input / output is required.

Specification

Type	HIMAP-BCG
Standard conformance	IEC 60255
Certifications	ABS, BV, DNV, GL, LRS
Control power supply	DC 24V / DC 110V / AC 110V AC 220V
Communication	RS232C, CANbus, MODbus

Extension boards CMA



Components

Generating plant management system GAC21

• General characteristic

The GAC21 Generating Plant Management System is designed to be reliable and user friendly. The system design is based on TERASAKI's experience as a dedicated manufacturer of generator control technology and multiplex transmission systems that have successfully been supplied to a large number of marine projects for many years.

The GAC21 System is a function-dispersed type system that is designed to operate using its PLC (programmable logic controller).

It consists of two control units, the GAC21 Automatic Generator Controller and the Type EAS-101 Automatic Digital Synchroniser and can be utilized with up to a maximum of 5 generators.

• PLC (programmable logic controller)

The GAC21 automatically controls generators using its programmable logic controller. It covers the management of the entire generating plant, including the automatic load sharing function, automatic start, automatic switching and power management.

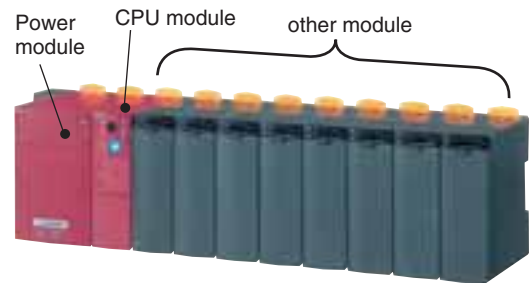
Control parameters and settings can be easily modified using the device provided with every GAC21 system.

• Automatic digital synchronizer EAS-101

The EAS-101 digital synchronizer has the following features:

1. A single chip CPU enables this product to be very small and light in weight. Simple program control allows flexibility performing synchronous closing and detection control.
2. The system has a self-diagnostic capability.
3. For voltage detection, an effective value detection circuit is used to avoid the situation of disabled synchronous closing due to harmonic waveform distortion.
4. Automatic and check synchronizing functions are available.

PLC (programmable logic controller)



Specification

Type	Micrex-SX
Standard conformance	IEC 61131
Control power supply	DC 24V (+30% to -25%)
CPU	32 bit processor
Processing speed	20 to 520 ns
Program memory	32 k step
Module function	analog input / output, digital input / output, communication
No. of controlled generators	Max. 5
Communication	RS232C, RS485, TM, SX-BUS, P-link

TM ... TERASAKI multiple transmission system
SX-BUS, P-Link ... Fuji Electric original high speed data link system

Automatic digital synchronizer EAS-101



Specification

Type	EAS-101
Control power supply	AC 110V (+10% to -15%)
Rated frequency	50 / 60 Hz (+5% to -5%)
Closing time of circuit breaker	0 to 500 ms
Limit of frequency difference for closing	0.1 to 0.5 Hz
Limit of voltage difference for closing	2.0 to 10.0 %
Maximum frequency difference for operation	8 Hz

Components

Feeder, incoming, transformer protection relay HIMAP-FI/T

• General characteristic

HIMAP is a multifunctional digital protection relay to protect incoming, feeder and transformer lines. Communication facilities are provided to enable measuring functions to be monitored remotely and power management systems to operate automatically.

HIMAP has a self-diagnosis function. Display of any internal malfunction can be shown on the integral display and also transmitted to a remote alarm system.

HIMAP has a digital filter to prevent malfunctions caused by harmonic frequencies in supply lines.

Specification

Type	HIMAP-FI (feeder, incoming)	HIMAP-T (transformer)
Control power supply	AC 110V / AC 220V / DC 110V / DC 220V	
Protect function	ANSI 27, 50/51, 59, 64, 67	ANSI 50/51, 67, 87
Communication	RS232C, RS485 HDLC	

Protection relay
HIMAP-FI/T



Motor protection relay MPR-6-DGF

• General characteristic

The MPR-6-DGF motor protection relay is a new generation of microprocessor based relay designed to protect three phase induction motors.

The MPR-6-DGF incorporates two main functions.

- a. Motor protection
- b. Supervision and communication

• Motor protection

AC motors are very rugged and reliable when operating within their limit. However, they are usually designed to operate close to their rated limits with minimal margins for operating under abnormal conditions. A comprehensive protection device is required to accurately create a thermal model for the motor to run safely up to its limits.

This relay should protect the motor from abnormal conditions in the power supply, motor and cable faults as well as operator malfunctions.

The MPR-6-DGF monitors three phase currents (true RMS line currents are measured at a sampling rate of 0.5m sec). The MPR-6-DGF monitors ground fault current (true RMS) and zero sequence voltage (3Vo), for Directional Ground Fault protection. The MPR-6-DGF monitors three temperature (RTD or PTC/NTC thermistor) inputs. All together the MPR-6-DGF provides a comprehensive protection package.

Motor protection relay
MPR-6-DGF



Specification

Type	MPR-6-DGF
Control power supply	DC 110V
Communication	RS485(MODbus)

• Protections

- ANSI 47 ... Phase sequence
- ANSI 48 ... Maximum start time
- ANSI 51L ... Load increase
- ANSI 49S/51 ... Thermal level (Overload)
- ANSI 50/51R ... stall and short circuit /over current jam
- ANSI 66 ... Start inhibit
- ANSI 67 ... Directional over current
- ANSI 46 ... Unbalanced current
- Temperature (3 sensors) ... RTD Pt.100 or PTN / NTC thermistor
- External fault 1 ... N.O / N.C contacts
- External fault 2 ... N.O / N.C contacts

• Actual data

Phase current, ground fault current and thermistor resistance, Motor load in % of FLC, Thermal capacity, Time to trip, Time to start, Unbalance current.

• Communication

RS485 serial link with MODbus communication protocol, operating at a baud rate of 1200 to 9600 bits/sec enables monitoring of set-points and actual parameters. The serial link enables remote control of both the MPR-6-DGF and the motors.

Optional equipment

HS21 prepares the various option equipment to improve safety more.

The list of the option equipment is shown below.

- **Inspection window**

Installed in the circuit breaker compartment door when visual confirmation is required by ships staff of the operating position of the circuit breaker.

- **IR Window**

Using Thermography enables temperature measurement of busbar without opening the closed compartment.

- **Arc detecting system**

Detection of an internal arc fault utilizing a light sensitive device (or current monitor) to detect arc flash. This enables the circuit breaker to open in the shortest possible time thereby minimizing damage to the switchboard.

- **Arc gas exhaust duct**

Should be used to divert arc gases to a safe location in the event of an internal arc fault.

- **Fully insulated bus bars**

This system affords additional insulated protection. Insulated tube on bus bar and boots are fitted to all bus bar connection points.

Insulation boots



- **Earthing switch on main bus bar**

If the customer requires additional safety, an earthing switch can be provided for the main bus bar.

- **Surge arrestor on main bus bar**

Additional protection can be provided on the main bus bar by the fitting of surge arrestors.

Inspection window



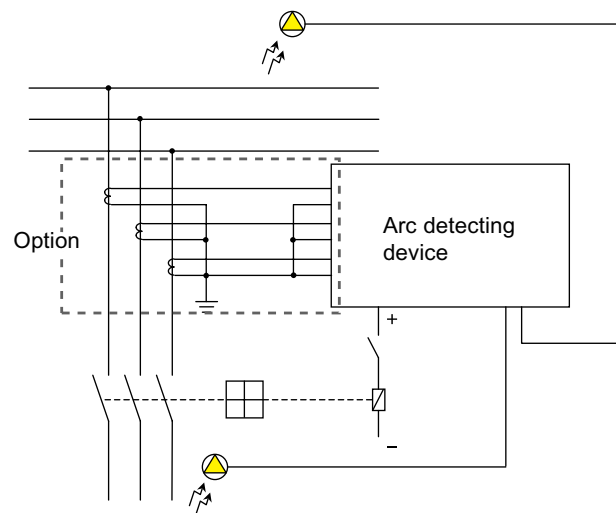
CB compartment door

IR Window



Cable compartment door

Arc detecting system



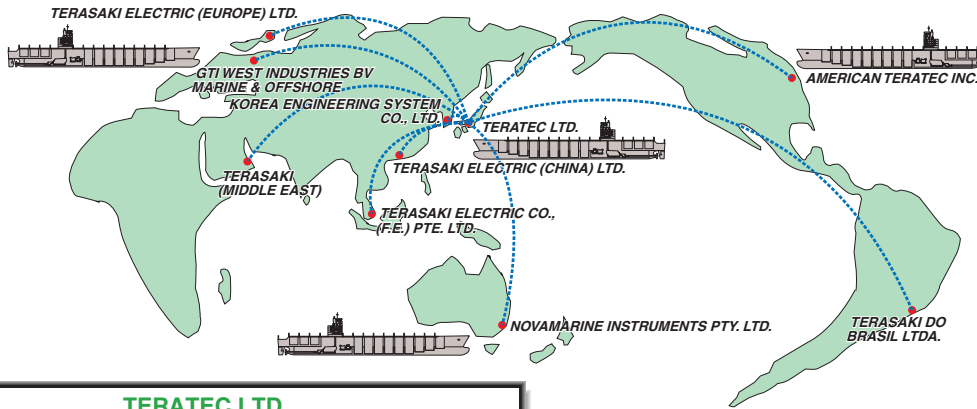
Arc gas exhaust duct



Fully insulated bus bars



TERASAKI Global Service Network service & supply



TERATEC LTD.

7-9-10 Hannancho, Abeno-ku, Osaka, 545-0021, JAPAN
 Tel: +81 6 6693 6974 : +81 6 6693 6971
 Fax: +81 6 6693 7116 : +81 6 6693 1716
 E-Mail parts: elparts@teratec.co.jp E-Mail maintenance: shipeng@teratec.co.jp
 Web site: <http://www.teratec.co.jp>

Main Service & Spares Centre

I.S.E.S. members worldwide
can also provide service required.

TERASAKI (MIDDLE EAST)

Lob 6, Office 13 Jebel Ali Free Zone
P.O.Box 261080
Dubai, U.A.E.

Tel: +971 4 881 2242
 Fax: +971 4 881 2243
 E-Mail: terasaki@emirates.net.ae

Covering Middle East

TERASAKI ELECTRIC (EUROPE) LTD.

79 Beardmore Way, Clydebank, industrial
Estate, Clydebank, Glasgow Scotland (UK)
 Tel: +44 141 941 1940
 Fax: +44 141 952 9246
 E-Mail: marketing@terasaki.co.uk
 Web site: www.terasaki.com

Covering Europe, Africa

AMERICAN TERATEC INC.

PO Box 479, 92 North Main Street.
Building 18-D
Windsor, NJ. 08561-0479, USA
 Tel: +1 609 443 5551
 Fax: +1 609 443 5590
 E-Mail: ati@teratecusa.com
 Web site: www.teratecusa.com

Covering North & Central America

TERASAKI ELECTRIC CO., (F.E.) PTE. LTD.

23 Bukit Batok Street 22,
Singapore 659590
 Tel: +65 6561 1165
 Fax: +65 6561 2166
 E-Mail: tefe@terasaki.com.sg
 Web site: www.terasaki.com.sg

Covering South East Asia

GTI WEST INDUSTRIES BV MARINE & OFFSHORE

Sluisjesdijk 37 3087 AD Rotterdam
The Netherlands
 Tel: +31 10 28 31 844
 Fax: +31 10 40 95 005
 E-Mail: info-marine-offshore@gti-group.com
 Web site: www.gti-group.com

Covering The Netherlands

TERASAKI ELECTRIC (CHINA) LTD.

72 Pacific Industrial Park,
Xing Tang Zengcheng, Guangzhou
511340, China

Tel: +86 20 8270 8556
 Fax: +86 20 8270 8586
 E-Mail: terasaki@public.guangzhou.gd.cn

Covering China

NOVAMARINE INSTRUMENTS PTY. LTD.

30 Downie Street, Newcastle
2293 Australia
 Tel: +61 2 4969 4477
 Fax: +61 2 4962 1210
 E-Mail: service@novamarine.com.au
 Web site: www.novamarine.com.au

Covering Oceania

TERASAKI DO BRASIL LTDA.

Rua Coldovil 259-Parada De Lucas,
Rio De Janeiro-RJ Brasil

Tel: +55 21 3301 9898
 Fax: +55 21 3301 9861
 E-Mail: terasaki@terasaki.com.br
 Web site: www.terasaki.com.br

Covering South America

KOREA ENGINEERING SYSTEMS CO., LTD.

327-4 Mugeo-Dong, Nam-ku
Ulsan Korea

Tel: +82 52 222 7773
 Fax: +82 52 222 7774
 E-mail: master@koes21.com

Covering Korea

TERASAKI ELECTRIC CO., LTD.

Head Office 7-2-10 Hannancho, Abenoku, Osaka 545-0021, Japan
 Tel. International +81-6-6692-1131 Fax. +81-6-6692-2122 <http://www.terasaki.co.jp/>

Osaka Sales Office 7-2-10 Hannancho, Abenoku, Osaka 545-0021, Japan
 Tel. International +81-6-6692-1241 Fax. +81-6-6694-5490 E-mail: hakuei-osaka@terasaki.co.jp

Tokyo Sales Office Nikko Kayabacho Building 5F, 1-6-10, Kayabacho, Nihonbashi, Chuo-ku, Tokyo 103-0025, Japan
 Tel. International +81-3-5644-0150 Fax. +81-3-5644-0155

Kyusyu Sales Office 3798-4 Kubara, Yamashiro-Cho, Imari-City, Saga Pref 849-4256, Japan
 Tel. International +81-955-20-2175 Fax. +81-955-20-2177

Shanghai Office Room No.1405-6, Tomson Commercial Building, 710 Dong Fang Road, Pudong Shanghai 200122, China
 Tel. International +86-21-58201611 Fax. +86-21-58201621 E-mail: terasaki@vip.163.com

Hamburg Office Anderheitsallee 4c, D-22175 Hamburg, Germany
 Tel. International +49-40-55-611-911 Fax. +49-40-55-611-912 E-mail: dan.graniceanu@terasaki.de



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