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

For marine and offshore use

catalog P1121-E
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
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 switchgear and controlgear and the instrument have applied the following standards.
- IEC 62271-200 : switchboard
- IEC 62271-100 : circuit breaker
- IEC 62271-106 : contactor
- IEC 61869-2 : current transformers
- IEC 61869-3 : voltage transformers
- IEC 60255 : Measuring relays and protection equipment
- IEC 60076-1 : power transformer
- JEC 1201 : zero-phase current transformer

**Adapted various marine classification**
- American Bureau of Shipping (ABS)
- DNV (DNV)
- Bureau Veritas (BV)
- Lloyd’s Register (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 ±1.0mm
  - 13.2 ~ 100Hz, acceleration ±0.7g
  - max. acceleration 0.7g

**Applications**
The HS21 switchboard is designed for use in:
- Offshore Plant
- Oil Rig supply vessels
- Shore connection & On-shore Power Supply System
- Floating Production Storage Offloading vessels (FPSO)
- Floating Storage Offloading vessels (FSO)
- LNG Carriers
- Large Passenger vessels
- Container ships
- Oil tankers
- Cruise ships
- Ferries
- Storage and Work Barges
- Floating Docks, Various Dredgers, others

**Type testing**
The HS21 switchgear and controlgear 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 switchgear and controlgear with the classification societies requirements of a 45-degree C ambient temperature being taken into consideration.
- Dielectric test
  Including impulse voltage and power frequency withstand 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 switchgear and controlgear.
- Arcing due to internal fault test
  The switchgear and controlgear 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](image-url)
**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)
- Abundant prepared optional equipment

<table>
<thead>
<tr>
<th>Application</th>
<th>Type</th>
<th>HS21-1</th>
<th>HS21-2</th>
<th>HS21-3</th>
<th>HS21-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard conformance</td>
<td></td>
<td>IEC 62271-200 (IEC 60092-508)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification</td>
<td></td>
<td>ABS, BV, DNV, LR, NK and others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of service continuity category (LSC) / Partition Class</td>
<td></td>
<td>LSC2B-PM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal arc classification (IAC)</td>
<td></td>
<td>AFLR</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

**Rating**

<table>
<thead>
<tr>
<th></th>
<th>HS21-1</th>
<th>HS21-2</th>
<th>HS21-3</th>
<th>HS21-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>7.2 kV</td>
<td></td>
<td>12 kV</td>
<td></td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50 / 60 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated power frequency withstand voltage</td>
<td>20 kV/min</td>
<td></td>
<td>28 kV/min</td>
<td></td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage</td>
<td>60 kV</td>
<td></td>
<td>75 kV</td>
<td></td>
</tr>
<tr>
<td>Rated short time withstand current</td>
<td>25 kA 1sec (3sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated peak withstand current</td>
<td>65 kA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal arc withstand current</td>
<td>25 kA 0.2sec (20kA 1sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main bus bar current</td>
<td>1250 A</td>
<td>2000 A</td>
<td>1250 A</td>
<td>2000 A</td>
</tr>
<tr>
<td>Load bus bar current</td>
<td>600 A</td>
<td>600/1000 A</td>
<td>600 A</td>
<td>600/1000 A</td>
</tr>
</tbody>
</table>

**Construction**

<table>
<thead>
<tr>
<th></th>
<th>HS21-1</th>
<th>HS21-2</th>
<th>HS21-3</th>
<th>HS21-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear construction</td>
<td></td>
<td>Metal-clad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of protection</td>
<td></td>
<td>Low voltage compartment</td>
<td>IP32</td>
<td>High voltage compartment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IP43</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Optional equipment**

- Inspection window
- Arc gas exhaust duct
- Surge arrestor on main bus bar
- Arc detecting system
- Insulation tube cover on bus bar
- Infrared rays window
- IP33 of low voltage compartment protection
- Earthing switch on main bus bar

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)**

![Diagram of basic panel design](image)

_H2 : With open pressure relief flap_

<table>
<thead>
<tr>
<th>Panel type</th>
<th>W (mm)</th>
<th>H1 (mm)</th>
<th>H2 (mm)</th>
<th>D (mm) (^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator panel</td>
<td>650</td>
<td>2300</td>
<td>2800</td>
<td>1680</td>
</tr>
<tr>
<td>Feeder panel</td>
<td></td>
<td></td>
<td></td>
<td>(\cdot)</td>
</tr>
<tr>
<td>Incoming panel</td>
<td></td>
<td></td>
<td></td>
<td>1880 (^4)</td>
</tr>
<tr>
<td>EVT panel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor panel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft start motor panel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus-tie panel 1 (^1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus riser &amp; EVT panel</td>
<td>800</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus-tie panel 2 (^2)</td>
<td>900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sync panel</td>
<td>1000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATr panel</td>
<td>1000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

1) LNG vessel only
2) Container vessel only
3) With panel thickness
4) Top cable entry only
Typical unit

Vacuum circuit breaker and Vacuum contactor application

<table>
<thead>
<tr>
<th>Panel types</th>
<th>VCB</th>
<th>VCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>630A</td>
<td>1250A</td>
</tr>
<tr>
<td>Generator panel</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Feeder panel</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Motor panel</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Incoming panel</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Soft start motor panel</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Bus-tie panel</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

○: Applicable

*An earthing switch can be provided in the EVT panel if required.*
**Technical data**

**Cable entry plan**

The HS21 switchboard standard cable entry is from the bottom. Power cables enter through the rear bottom plate and control cables through the front bottom plate. Top cable entry can be provided, but consultation with TERASAKI is recommended as panel dimensions will increase.

**Room planning**

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

---

**Table:**

<table>
<thead>
<tr>
<th>Panel type</th>
<th>Width (mm)</th>
<th>Power cable entry</th>
<th>Control cable entry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C1</td>
</tr>
<tr>
<td>Standard panel</td>
<td>650</td>
<td>450</td>
<td>75</td>
</tr>
<tr>
<td>Bus riser &amp; EVT panel</td>
<td>800</td>
<td>600</td>
<td>—</td>
</tr>
<tr>
<td>Bus-tie panel</td>
<td>900</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Sync panel</td>
<td>1000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>ATr panel</td>
<td>1000</td>
<td>800</td>
<td>—</td>
</tr>
</tbody>
</table>

Notes:
1) Refer to 650mm panel width on “Dimensions” page
2) 1880mm: Top cable entry

---

**Room width**

<table>
<thead>
<tr>
<th>Panel width (W)</th>
<th>Room height (mm)</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>C (mm)</th>
<th>D (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>only 650 mm</td>
<td>(\geq 2900)(^1)</td>
<td>(\geq 1000)</td>
<td>(\geq 1600)</td>
<td>1680</td>
<td>(\geq 700)</td>
</tr>
<tr>
<td>with 800 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 900 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 1000 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Without angle base
2) 1880mm: Top cable entry
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 reliable 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 top side, but the depth of the panel will increase. Access can not be gained to this compartment without first satisfying the reliable 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 top and bottom of 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

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

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

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 epoxy resin material.

Specification

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Rated power frequency</td>
<td>28 kV / min</td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage</td>
<td>75 kV</td>
</tr>
<tr>
<td>Over current strength</td>
<td>25 kA 1sec (3sec) 1)</td>
</tr>
</tbody>
</table>

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 and VCCT.

1) 3sec on request
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)

1. **Step 1** - Circuit breaker open
2. **Step 2** - Turn CB draw-in / out interlock key
3. **Step 3** - Circuit breaker draw-out
4. **Step 4** - Earthing switch ON
5. **Step 5** - Open CB comp’t door (in case of CB maintenance)
6. **Step 6** - Turn and remove lower cable comp’t door key
7. **Step 7** - Turn lower cable comp’t door key
8. **Step 8** - Turn and remove upper cable comp’t door key
9. **Step 9** - Turn upper cable comp’t door key

---

. 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.
. They shall be provided with locking facilities, unless the safety of persons is assured by a suitable interlocking device.
. The withdrawal or engagement of a circuit breaker, switch or contactor shall be impossible unless it is in the open position.
. It shall be impossible to close the circuit breaker, switch or contactor in the service position unless it is connected to auxiliary circuit.
. When circuit breaker is a connect position, it isn’t possible to do the “ON” position of earthing switch.
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**

<table>
<thead>
<tr>
<th>Type</th>
<th>HVF-104 / HVF-120 / HVF-204 / HVF-240</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>7.2 / 12 kV</td>
</tr>
<tr>
<td>Rated current</td>
<td>630 A / 1250 A / 2000 A</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50 / 60 Hz</td>
</tr>
<tr>
<td>Rated short circuit breaking current</td>
<td>25 kA</td>
</tr>
<tr>
<td>Rated short circuit making current</td>
<td>65 kA</td>
</tr>
<tr>
<td>Rated short time withstand current</td>
<td>25 kA 3sec</td>
</tr>
<tr>
<td>Rated control circuit voltage</td>
<td>DC 110V</td>
</tr>
</tbody>
</table>

1) Type number in the square "z...630A, x...1250A, c...2000A"
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**

<table>
<thead>
<tr>
<th>Type</th>
<th>HCA-6C [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>7.2 kV</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50 / 60 Hz</td>
</tr>
<tr>
<td>Rated current</td>
<td>200 A</td>
</tr>
<tr>
<td>Rated short circuit breaking current (with power fuse)</td>
<td>40 kA</td>
</tr>
<tr>
<td>Rated short time current</td>
<td>3.2 kA 1sec</td>
</tr>
<tr>
<td>Rated control circuit voltage</td>
<td>AC / DC 110V</td>
</tr>
<tr>
<td>Max motor capacity</td>
<td>1500kW</td>
</tr>
</tbody>
</table>

1) Type number in the square "□"  
HCA□□□□  
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 |
Components

Multi-Protection Relay PRR-1H

• General characteristic

PRR-1H is a multi-protection relay for medium or low voltage circuit breakers that is capable of indicating via LEDs that the load current is picked up or the breaker trips open and showing various information including the phase current, line voltage and fault current on the LCD. The relay is available in three types: for generator protection, feeder circuit protection, and transformer protection.

• Functions

- Multi-protection
- Detection via zero-phase voltage
- Directional ground fault current detection
- Ratio differential characteristic
- Reverse power trip
- Readout of trip/alarm cause
- Internal clock
- Self-diagnostic

• Measurement/event indication function

<table>
<thead>
<tr>
<th>Feature</th>
<th>PRR-1H-G</th>
<th>PRR-1H-F</th>
<th>PRR-1H-T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable long time-delay trip</td>
<td>LT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustable short time-delay trip</td>
<td>ST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustable instantaneous trip</td>
<td>INST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustable undervoltage trip</td>
<td>UV (27)</td>
<td>△</td>
<td>—</td>
</tr>
<tr>
<td>Adjustable overvoltage trip</td>
<td>OV (59)</td>
<td>△</td>
<td>—</td>
</tr>
<tr>
<td>Adjustable reverse power trip</td>
<td>RP (67R)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Adjustable ground fault trip</td>
<td>OVGR (64)</td>
<td>△</td>
<td></td>
</tr>
<tr>
<td>Adjustable ground fault trip</td>
<td>DGR (87G)</td>
<td>△</td>
<td>△</td>
</tr>
<tr>
<td>Ratio differential trip DIFF</td>
<td>(87T)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Pre-trip alarm</td>
<td>PTA</td>
<td>△</td>
<td>—</td>
</tr>
<tr>
<td>Pre-trip alarm</td>
<td>PTA2</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

○: Standard △: Optional

• Protective function

- The zero-phase voltage detection scheme is used for insulation monitoring, which allows the relay to apply to an isolated neutral system.

Then, the directional ground fault protection scheme prevents miss-detection due to occur ground fault of other system.

- The ratio differential characteristic permits application of the relay to fault detection in or protection of transformers and generators within a system. The bias function also serves to prevent a malfunction.
Components

• Connection diagram

Terminal description

- **S0, S1**: Control power input for Protective function 110V DC, 24V DC
- **P0, P1**: Control power input for Monitoring function 110V DC, 24V DC
- **KA, n**: Measuring CT
- **KB, n**: LT, ST, INST, PTA, PTA2, DIFF, RP, (NS)
- **KC, n**: Measuring CT for Differential protection
- **DA, Dn**: DIFF
- **DB, Dn**: Operation signal output
- **DC, Dn**: Monitoring function 4 – 20mA signal output
- **Z1, Z2**: ZCT
- **Ta, c**: Auxiliary switch input
- **TC, c**: Reset switch
- **re, c**: Trip signal input
- **UA, UB**: Rated voltage input for UV, OV, RP, (UF/OF)
- **Y1, Y2**: EVT
- **O1, O2**: Monitoring function CT for 4 – 20mA signal
- **O3, O4**: CT rated current: 1A or 5A

- **A1-A**: Monitoring function 4 – 20mA signal output
- **A2-A**: Operation signal output
- **A3-A**: PTA operation signal output
- **A4-A**: PTA2 operation signal output

- **1-2**: Lock-out
- **3-4**: Circuit self-diagnostic (For Protective function)
- **5-6**: Trip signal output
- **3-4**: Communication line (+)
- **17-18**: Communication line (−)
- **19-20**: Communication line (common)

• Other features
  - Separation of the control power for the protection circuit and measuring circuit enhances the redundancy and reliability.
  - Information displayed on the LCD of the front panel includes the phase currents, voltage, electrical energy, demand electrical power, power factor, pickup current & time settings, fault current and trip pickup time.
  - An internal clock allows the fault occurrence time to be displayed on the LCD and up to 100 fault events and 100 alarm events to be viewed in chronological order.
  - The self-diagnostic function comes standard with the relay, providing an alarm via a relay contact output if an error occurs in the CPU.

Optional functions are shown below.
- **Output signals including current and voltage are analogue and delivered via 4 to 20 mA DC terminals.**
- **Modbus communication is available.**
Components

Motor protection relay PRS-1S

- General characteristic
  The PRS-1S is an electronic motor protection relay with high functionality that detects various states when an AC motor starts and while it is operating. Measurement and monitoring functions are installed in addition to the basic 3 elements of the motor protection function (overload protection, open-phase protection, and reverse-phase protection).

- ANSI 51R : Overload protection function
  The protection function is adapted to the motor starting characteristics and the load characteristics.

- ANSI 46 : Open-phase protection function
  “Open phase” is a state in which the motor operated in a single-phase state because the power wire connected to the motor became disconnected, the connection area was loose, or there was a disconnection inside the motor. Open-phase states can cause motor winding burnout, and detecting open-phase states can prevent this.

- ANSI 47 : Reverse-phase protection function
  “Reverse-phase” is a state in which the phase sequence of a motor is connected in reverse and the motor rotates in the reverse direction. This cannot be checked visually in some installation locations, and reverse-phase protection is a function that is essential in order to prevent reverse rotation.

- Other protection functions
  • ANSI 51L : LOAD INCREASE
  • ANSI 50 : OVER CURRENT SHORT
  • ANSI 49S/51 : THERMAL CAPACITY
  • ANSI 46 : UNBALANCE
  • ANSI 48 : MAX START TIME
  • ANSI 66 : TOO MANY STARTS
  • ANSI 67 : DIRECTIONAL GROUND RELAY
  • ANSI 49R : TEMPERATURE
  • ANSI 37 : HIGH & LOW CURRENT
  • EXTERNAL FAULT

- Function that displays and saves the activation information and history
  • Trip and alarm activation: If trip or alarm occurs, the time of occurrence, cause of activation, activation value, and activation duration are displayed on the screen. The system can save 100 instances each of trip and alarm activation.
  • History of phenomena that occurred: The system can save a total of 200 instances of the history of the following phenomena that occurred. These phenomena will be displayed on the screen in chronological order, so it is easy to track detailed information about the phenomena that occurred.
  - Trip activation (time of occurrence / cause of activation)
  - Alarm activation (time of occurrence / cause of activation)
  - Reset operation (time of occurrence / reset operation details)
  - External input (time of occurrence / external input state)

- Measurement display function
  • The display screen displays the following measurement values.
    • Phase current
    • Unbalanced current
    • Motor winding temperature
    • Motor load current
    • Leakage current
    • Motor starting time
    • Motor starting current
    • Motor operating time
    • Motor operating cycles
    • External command input state
    • External output operating state

- Monitoring function
  • Communication function: In Modbus RTU mode (RS-485), it is possible to read and write protection setting values and output measurement values and histories.
  • Analog output: The maximum phase current value can be converted to 4-20 mA current and output externally.

Specifications

<table>
<thead>
<tr>
<th>Control voltage</th>
<th>DC110V</th>
</tr>
</thead>
<tbody>
<tr>
<td>VA consumption</td>
<td>5VA</td>
</tr>
<tr>
<td>Outline dimensions</td>
<td>Width 96 × height 144 × depth 116 (includes terminal area on back side)</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-10°C ~ +55°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-25°C ~ +75°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>95% or less, and there must not be any condensation</td>
</tr>
<tr>
<td>Based standard</td>
<td>IEC60255 Measuring relays and protection equipment IEC60947-4-1 Part 4 Contactors and Motor-Starters</td>
</tr>
</tbody>
</table>
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-201 Multi functional synchronizer 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.

Multi functional synchronizer EAS-201

The EAS-201 Multi functional synchronizer has following features:

• Characteristic
  • Check synchronizing function for manual operation support
  • Self-diagnostic capability for CPU error, ADC error and power low
  • Easy to realize error by LED indication
  • Independent LED synchro lamp function from CPU
  • Function for confirming normality of synchronous detection (Beat wave form)
  • Easy to save event log
  • Modbus communication can be transferred analogue data including voltage, frequency and so on.

Specification

<table>
<thead>
<tr>
<th>Type</th>
<th>Micrex-SX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard conformance</td>
<td>IEC 61131</td>
</tr>
<tr>
<td>Control power supply</td>
<td>24V DC (+30% to -25%)</td>
</tr>
<tr>
<td>CPU</td>
<td>32 bit processor</td>
</tr>
<tr>
<td>Processing speed</td>
<td>20 to 520 ns</td>
</tr>
<tr>
<td>Program memory</td>
<td>32 k step</td>
</tr>
<tr>
<td>Module function</td>
<td>analog input / output, digital input / output, communication</td>
</tr>
<tr>
<td>No. of controlled generators</td>
<td>Max. 5</td>
</tr>
<tr>
<td>Communication</td>
<td>RS232C, RS485, TM, SX-BUS, P-link, Modbus ¹</td>
</tr>
</tbody>
</table>

¹) Constraints conditions

Automatic digital synchronizer

EAS-201

Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>EAS-201</th>
</tr>
</thead>
<tbody>
<tr>
<td>Busbar input voltage</td>
<td>110 / 220V AC (switching)</td>
</tr>
<tr>
<td>Generator input voltage</td>
<td>50 / 60 Hz</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>250V AC 3A</td>
</tr>
<tr>
<td>Closing designation (selective)</td>
<td>SLOW, FAST, SLOW/FAST</td>
</tr>
<tr>
<td>Control output</td>
<td>24V DC 3A</td>
</tr>
<tr>
<td>Control output</td>
<td>RS-485, Modbus</td>
</tr>
<tr>
<td>Controlled source</td>
<td>Busbar side</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>W96 X H96 X D182</td>
</tr>
</tbody>
</table>
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.

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

- **Surge arrester on main bus bar**
  Additional protection can be provided on the main bus bar by the fitting of surge arrestors.
The accessories provided as standard are shown below.

- **Circuit breaker lifter**
  Used to assist in the removal of the circuit breaker, contactor etc.
<table>
<thead>
<tr>
<th>Standard type</th>
<th>Compact type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>1800 mm</td>
</tr>
<tr>
<td>Width</td>
<td>600 mm</td>
</tr>
<tr>
<td>Depth</td>
<td>1250 mm</td>
</tr>
</tbody>
</table>

- **Circuit breaker draw-in/out handle**
  Used to assist in the withdrawal and insertion of the VCB and VCT.

- **Earthing switch operating handle**
  Used for earth switching operations.

- **Charging handle**
  Used to charge the closing spring of the circuit breaker.

- **Vacuum checker**
  Used for check the vacuum degree.

  **Specification**
  | Input voltage | 200 / 220 V AC |
  | Out-pul voltage | 11 kV / 22 kV AC |
  | Weight | 22kg |

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**Memo**