SIEMENS

PROPOSAL FOR:

Virgin Islands East End Sub
GIS Startup

Project:

TFA installation, Startup, Commissioning and Training:
Siemens 8DA10 15kV

Prepared by:

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March 27, 2020

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1. Overview

This offer includes TFA startup services to be provided by Siemens for the equipment referenced quote SF201615506.

Siemens will provide Technical Field Assistance (TFA) engineering services to customer personnel during start up. This is an advisory service to assist the customer when these services are under the responsibility of & is performed by customer or other non-Siemens personnel. TFA services will be provided on an "allocation" basis per the schedule below.

5 panels of 8DA10 switchgear

2. General Work Scope

8DA10

- Siemens will supervise/perform the recommended installations, tests and inspections (per the Siemens Installation Manual 8DX 3210-2BA00).
- Installation Assistance.
- Uncrate switchgear and check for physical damage. Check filled gas chambers for leakage compared to factory filling.
- Check bill of material against actual equipment inventory and notify Siemens Frankfurt of any missing items.
- After splits are assembled, check torque of all bus connections and housings.
- After assembly, perform resistance measurement across any bus splits and through circuit breakers to confirm no loose connections are present.
- After chambers are filled with gas, perform AC hi-pot test for one minute to include all high-voltage compartments. Short capacitive voltage indicator plugs for AC test. Refer to the installation/operation manual for test voltage. Voltage transformers must be disconnected, and dummy plugs should be installed in any open cable terminations before the hi-pot test. The test is pass or fail.
- After gas chambers have settled for 48 hours, perform gas quality and dewpoint tests. Dewpoint must be -15° C or less, and quality must be 90% or higher, however, refer to the instruction manual for the latest requirements. Exception-for waiting times less than 48 hours, record elapsed time on protocol sheets.
- Optional - check current transformer ratios, polarities, and saturation curve. Burden test also optional but not usually needed with microprocessor relay burdens being so low.
- Verify all ground connections are made between splits, and switchgear is properly connected to the ground grid. One ground per every five cubicles.
- Check voltage transformer secondary connections.
- Make sure inter-panel control wires are connected through splits.
- Check all control wire connections for proper crimps and good connection to terminal blocks before control voltage is applied.
- Apply control power. By use of schematics, verify control circuits operate as designed. Verify accessories are working properly.
- By using the camera system, check disconnect switches in every position and adjust as necessary. If disconnects are motor operated, verify electrical operation by schematics.
- Verify electrical interlocks between disconnects, breakers, and possible external field wiring points. Use jumpers when external wiring is not complete.
- Perform gas leak check with a high-quality SF6 gas sniffer.

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Breaker Testing

Visual and mechanical test of the circuit breaker will be performed as follows:

- Inspect breaker operator.
- Mechanically Trip and Close the operator and confirm indicators and interlocks are working properly.
- Confirm LOTO interlocks are operating correctly.

The following electrical tests will be performed:

- Electrically operate breaker with the control switch.
- Perform 100A digital low ohm resistance test across vacuum bottles and confirm values are within manufacturer's tolerance.

Training

- Identify and define product ratings.
- Training for 8DA & 8DB equipments is based on Siemens Installation Manual 8DX 3210 2BA00.
- Identify and define product ratings.
- Handling and storage requirements
- LOTO features.
  - 3 position switch operations
  - Use of the camera and laptop.
- Review and interpret Siemens drawings, including schematics and wiring diagrams.
- Locate and identify key components and tools.
- PT and CPT locations and use
- Racking and/or connecting procedures:
- SF6 Gas
  - SF6 gas filling procedures
  - SF6 gas test (Purity & Dewpoint)
- How to execute standard field test for vacuum breakers and switchgear:
  - Hi-pot; Includes Vacuum Integrity, Phase to Phase and Phase to Ground
  - Contact Resistance Test with Micro-ohmmeter (DLRO/Ductor)
  - Insulation resistance test.
- Maintenance of circuit breaker operating mechanism
  - Proper lubrication of switchgear components and breaker mechanisms.
  - Acceptable lubricants
  - Cleaning Agents and their applications.
- Field test reports.

Test Data Sheets
A test data sheet will be supplied showing the date of test, customer name, location, identification, rating, test results and any pertinent observations or comments by the test personnel.

3. Division of Responsibilities

Customer will be responsible for the following:

- As part of the checkout scope, provide the following equipment.
  - Field Test equipment required to complete standard tests
    - AC or DC Hi-potential Test Set (Hi-pot)
    - 100A Digital Low Resistance Ohmmeter (DLRO/Ductor)
    - Insulation Test Set
    - SF6 Vacuum Pump & Compressor Unit
    - SF6 Gas Percent Purity Analyzer
    - SF6 Gas Dew point Analyzer
    -
- Provide for standard industry safety equipment required by Siemens Safety Guidelines and in compliance with pertinent standards, consistent with the typical hazards associated with the standard installation work scope.
  These items include:
- Employee PPE – Safety glasses, Hardhats, and safety shoes
- Fall Protection – Full body harness, lanyards, and safety railing (as required)
- Assured Grounding – GFI receptacles, static grounds
- Complete final reporting upon completion of work scope & provide daily reports as applicable.
- Provide a contact person at the site available during work scope performance.
- Lockout and tag out & personal grounding as required
- Obtain any permits required to perform the work.
- All equipment to move, lift and handle installation.
- Complete Safety walk and review of work scope location to include identification and proof of in service and out of service bus/equipment/power/etc.

4. Clarifications

Following are the clarifications, comments and exceptions for this project:

- Delays beyond the control of Siemens are not included in this work scope. Delays beyond Siemens' control will be billed at the appropriate daily crew and equipment rate.
- Work should be scheduled at least (4) weeks in advance to accommodate scheduling of field personnel and acquisitions of special visas and other travel requirements.
- This proposal is conditional on this clarification: Receipt of acceptable PO and agreed work schedule at least (4) weeks in advance to accommodate field personnel scheduling and travel requirements.
- Specific site safety training and or orientation is not considered in work scope duration and may be billed as additional
- Training programs are provided in English language only.
- Relay coordination studies are not included in this proposal.
- Relay testing is not considered in this proposal.

- Siemens FSE will not remain on site “after recommended time period” unless additional consideration is made for pricing.
- All auxiliary power required to support testing and tools will be provided at point of need
- This proposal does not consider VAT, tariffs, import/export duties or any other fees in the final pricing.

5. Schedule-Typical

- For the standard installation TFA and commissioning work scope of the Siemens switchgear. Siemens standard crew size will be (1) field service personnel for approximately (5) days.

- For the standard training/ startup work scope of the Siemens switchgear. Siemens standard crew size will be (1) field service personnel for approximately (3) days.

Work will commence during normal business hours, and it is expected that the total project will take 8 workdays 10 hours per day. Normal business hours are defined as Monday through Friday 8:00 AM to 5:00 PM. In addition, 16 hours of travel time is included for each Siemens Factory Representative dispatched to travel to and from the site for each mobilization, this proposal considers (1) mobilizations.

International Work – All work beyond the Domestic 48 States- Expenses to include Business Flights, Visas, Taxes, any expenses not normally associated with Domestic Work. Work will be strictly Technical Field Assistance, all hands-on work to be performed by others. Any lost equipment will be replaced at customer cost. Time will be invoiced from home until back at home. Saturdays and Sundays will be considered Standby Time.

6. Pricing Fixed Price

- Pricing is based on fixed pricing. Any additional work or any delay according to paragraph 4 will be charged based on “time and material” rates (see attached rate sheet).

For invoicing purpose, the following must be shown on the given purchase order:

“P.O. is issued based on fixed price.”

Please make P.O. out to: Siemens Industry, Inc. 7000 Siemens Road Wendell, NC 27591
Payment terms: NET30
PO must include the following quote number: SF201615506
Please Email to: james.powers@siemens.com

Site Details MUST BE GIVEN at time of PO or order will not be processed:

Site Contact:
Site Address:
Shipping Address:
Special PPE if required:
Special safety training if needed to enter site:
Requested start date:

- Price is valid for 60 days.

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7. Terms & Conditions

This proposal is quoted using Siemens Industry Inc. Standard Terms and Conditions of Sale for Products and Services, which can be reviewed at:

http://www.usa.siemens.com/terms-emcs

Confidential Information

This proposal, including all its attachments, exhibits, appendices, etc. ("Proposal"), is provided “as-is” for your evaluation of Siemens Industry, Inc. ("Siemens") as the provider of work discussed therein and contains information that is confidential to and solely owned by Siemens. Your acceptance, viewing or storage of this Proposal is an acknowledgment of a confidential relationship between you and Siemens. We require that this Proposal be returned or destroyed when no longer required for the purpose identified herein. This Proposal and any information obtained from this Proposal may not be re-produced, transmitted, disclosed or otherwise used, in whole or in part, without the prior written authorization of Siemens.

The above terms supersede any click-wrap or other terms not expressly set forth in a signed agreement between the parties covering the Proposal. All such click-wrap or other terms are expressly rejected by Siemens.

Installations - 370 sections

Caribbean Utility Company via EM TS	Cayman Island
Caribbean Utility Company via EM TS	Cayman Island
Tren Urbano	PR
PREPA - San Juan Steam Pwr Plant	PR
PREPA - Covadonga	PR
PREPA - Covadonga	PR
PREPA - Olympic Coliseum	PR
Tren Urbano	PR
PREPA - Isla Grande	PR
PREPA - Martin Pena	PR
PREPA - Banco Popular	PR
PREPA - LMM Airport	PR
PREPA - Palo Seco	PR
PREPA - Steam Power Plant	PR
PREPA - San Juan Steam Pwr Plant -rebuilt	PR
Steel Plant - Non disclosure agreement	PR
Tren Urbano	PR
PREPA Palo Seco II Puerto Rico	PR
Pharmaceutical - Non disclosure agreement	PR
PREPA Mocha	PR
PREPA Museo del Nino	PR
The Mall of San Juan	PR
Military Project	PR
Hovensa	St Croix
Hovensa	St Croix
Hovensa	St Croix
Hovensa	St Croix
Trinidad and Tobago Electric Commission	Trinidad
Trinidad and Tobago Electric Commission	Trinidad
ISPAT - O2N2	Trinidad
Steel Plant	Trinidad
Steel Plant	Trinidad
Trinidad and Tobago Electric Commission	Trinidad
Steel Plant - Non disclosure agreement	Trinidad
Steel Plant - Non disclosure agreement	Trinidad
Steel Plant - Non disclosure agreement	Trinidad
The Power Generation Company Ltd.	Trinidad
Steel Plant - Non disclosure agreement	Trinidad
Steel Plant - Non disclosure agreement	Trinidad

Air - Insulated - Catastrophic Fault

Remote Push Button Station

Front Door (LV panel)

External Electrical Breaker Racking Mechanism

Switchgear across the aisle is damaged

8 foot wide aisle

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Personal safety
Causes of Internal Faults

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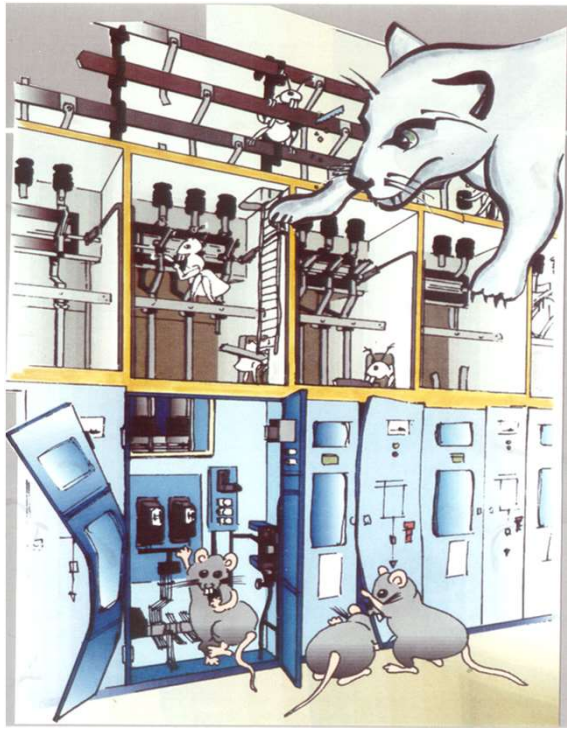
- Ageing of insulating materials under electrical stress
- Corrosion
- Overstressing
- Ferroresonance, overvoltages
- Defective installation, incorrect maintenance
- Maloperation (human errors)
- Pollution, humidity, small animals penetrating in the switchgear



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Siemens Packaged/Bundling Power Solutions
Your Solution Provider

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(MV) Bundling

PM: Simple interface: one Siemens project manager for multiple Siemens products

Typical content:

- Power distribution centers (PDC's)
- Power transformers
- Distribution transformers
- MV and/or LV switchgear
- MV controllers
- Motor control centers
- Battery systems
- Capacitors.

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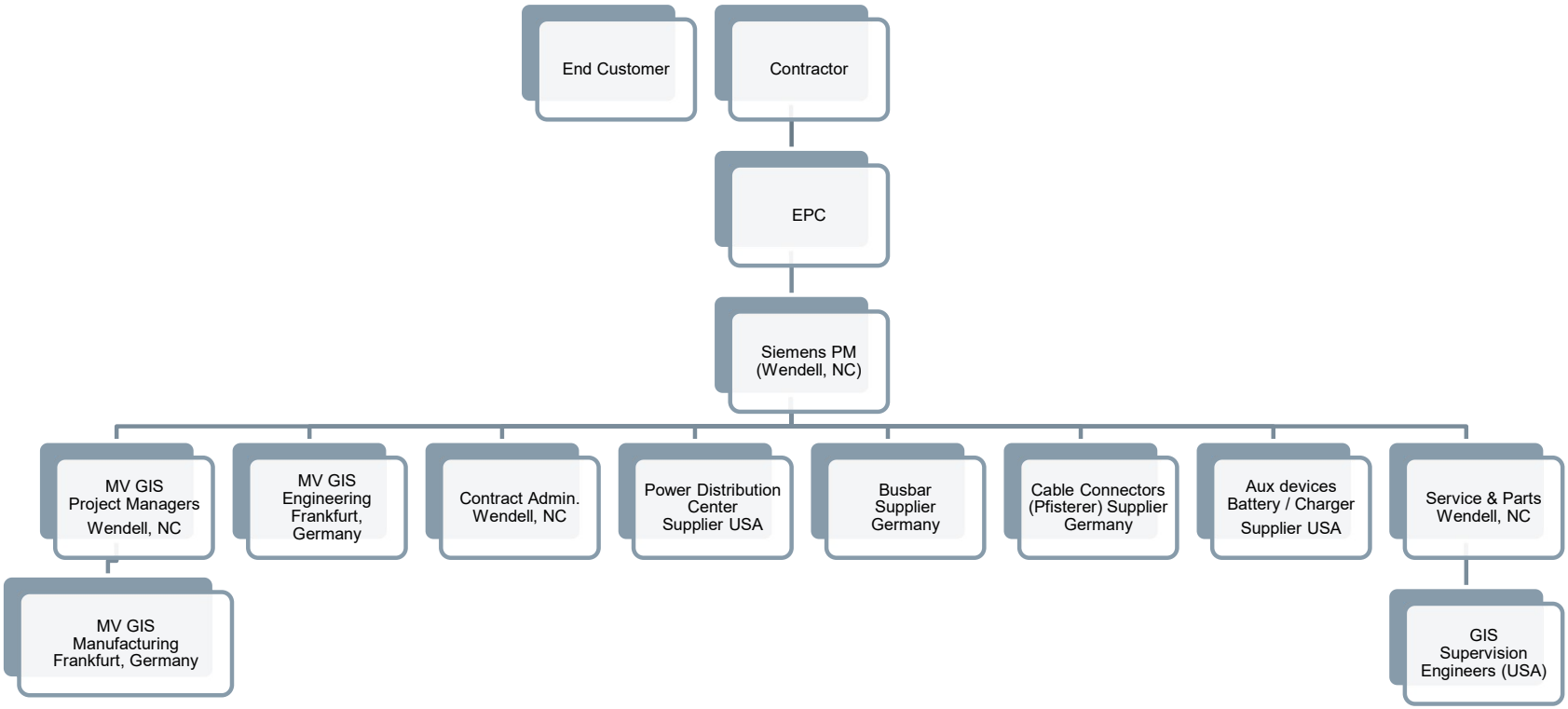
Project Structure
Organization and Location



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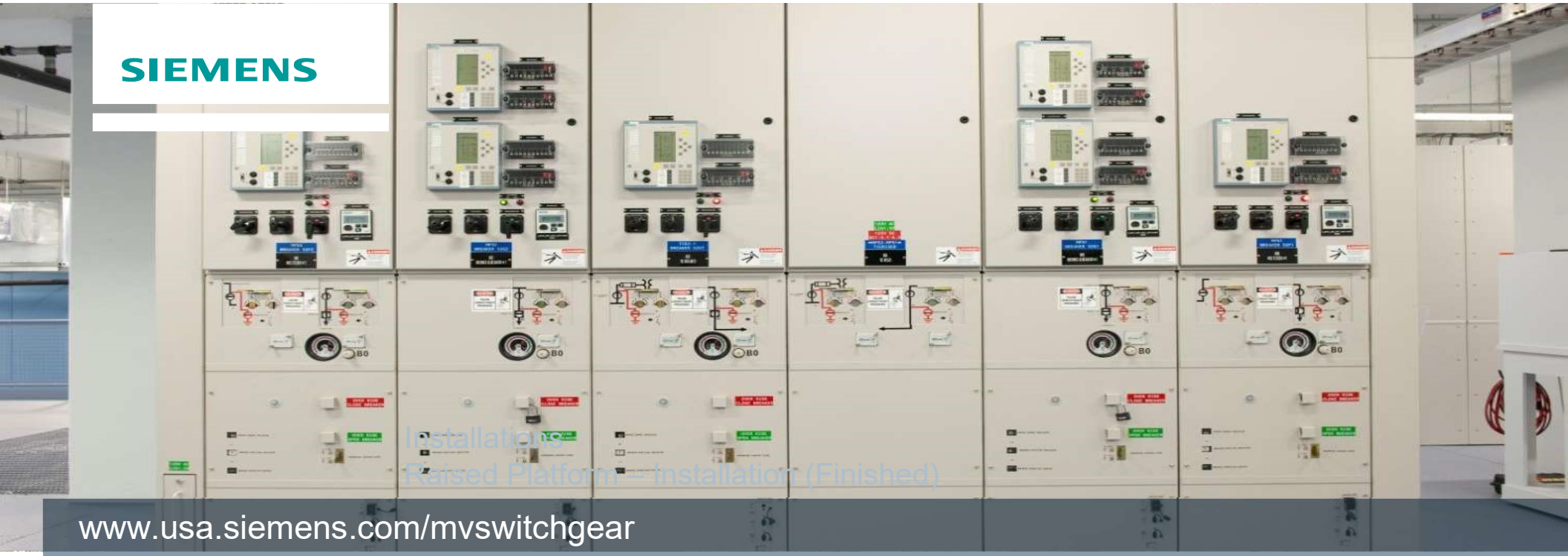

www.usa.siemens.com/mvswitchgear

Medium-Voltage, Gas-Insulated, Arc-Resistant Switchgear, Types 8DA10 & 8DB10

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Medium-Voltage Gas-Insulated Switchgear

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Ingenuity for life

Increased safety	Easy to use	Cost effective	Improved reliability	Innovative features	Increased flexibilty
• Arc resistant type 2B • Isolated-phase design	• Vacuum interrupters capable of 30,000 mechanical operations or 50 full-fault operations	• Low maintenance product life cycle, 10 year no maintenance	• Sealed pressure system protects against environmental influences (IP65)	• Compact • Video camera for visible disconnect • Capacitive voltage indication (no hotstick required) • Integral grounding switch	• More compact than conventional switchgear 75% smaller Compact footprint: 24” wide x 64” (8DA) or 105” (8DB) deep

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Medium-Voltage Gas-Insulated Switchgear
MV GIS Technology On The Rise In The U.S.

Established Technology

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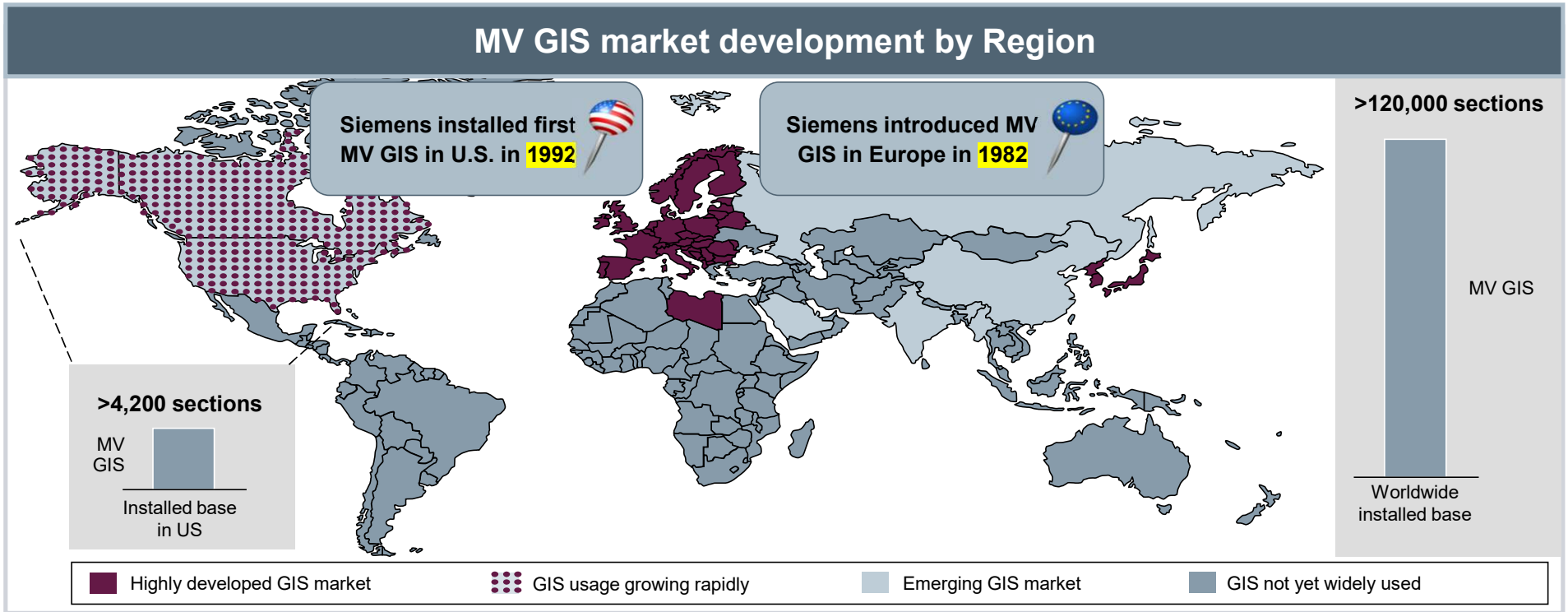
Overview of Siemens installed base for MV GIS



MV GIS is not a new technology – it is established in many regions of the world

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Manufacturing Location
Frankfurt - Germany

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Flights
NYC - Frankfurt
Delta, Lufthansa , United, i.e.

Factory employees -1200

SF_6-insulated switchgear for primary and secondary distribution systems

Products:
- 8DA10/8DB10
- 8DJ10,20 &36
- NXPLUS-C

Siemens MV GIS Manufacturing in Frankfurt (SWF): The Home of GIS!

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Switchgear Factory Frankfurt at One Glance
(8DA/8DB, 8DJ, NXPLUS C)

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Assembly line 8DA/8DB10

Assembly line 8DJ10/20/36

Assembly line NXPLUS C

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Medium-Voltage Gas-Insulated Switchgear

MV GIS Smaller Than MV AIS – Compact Footprint

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Footprint comparison (MV AIS & MV GIS - only equipment size considered)

75% smaller footprint at 38kV

8DA10
Air-Insulated

8DA10
Gas-Insulated

Isolated Phases more reliable than poly phase

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Medium Voltage Switchgear Voltage Classes, Continuous Current Ratings, and Short-circuit (Interrupting) Current Ratings

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Item	Unit	Single-busbar (8DA10) & double-busbar (8DB10) switchgear			Single- pole (8DA11) & double-pole (8DA12) traction power supply switchgear*	
Rated maximum design voltage	kV	15	27	38**	17.5	27.5
Rated frequency	Hz	50/60	50/60	50/60	16.7	50/60
Rated short-duration power-frequency withstand voltage	kV	36	50	80	50	95
Rated lightning-impulse withstand voltage	kV	95	125	200	125	200
Rated peak-withstand current	kA	104	104	104	82	104
Rated short-circuit making current (peak)	kA	104	104	104	82	104
Rated short-circuit withstand current 3 s	kA	40	40	40	31.5	40
Rated short-circuit breaker current	kA	40	40	40	31.5	40
Rated normal current of busbar, maximum	A	5,000	5,000	5,000	2,500	3,150
Rated normal current of feeders, maximum	A	3,000	3,000	3,000	2,000	3,000

(4000 & 5000A circuit breaker rating is achieved by mechanically interlocking and paralleling two circuit breakers

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Vacuum interrupters

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Medium-Voltage Gas-Insulated Switchgear
Vacuum Interrupters - Industry Leader

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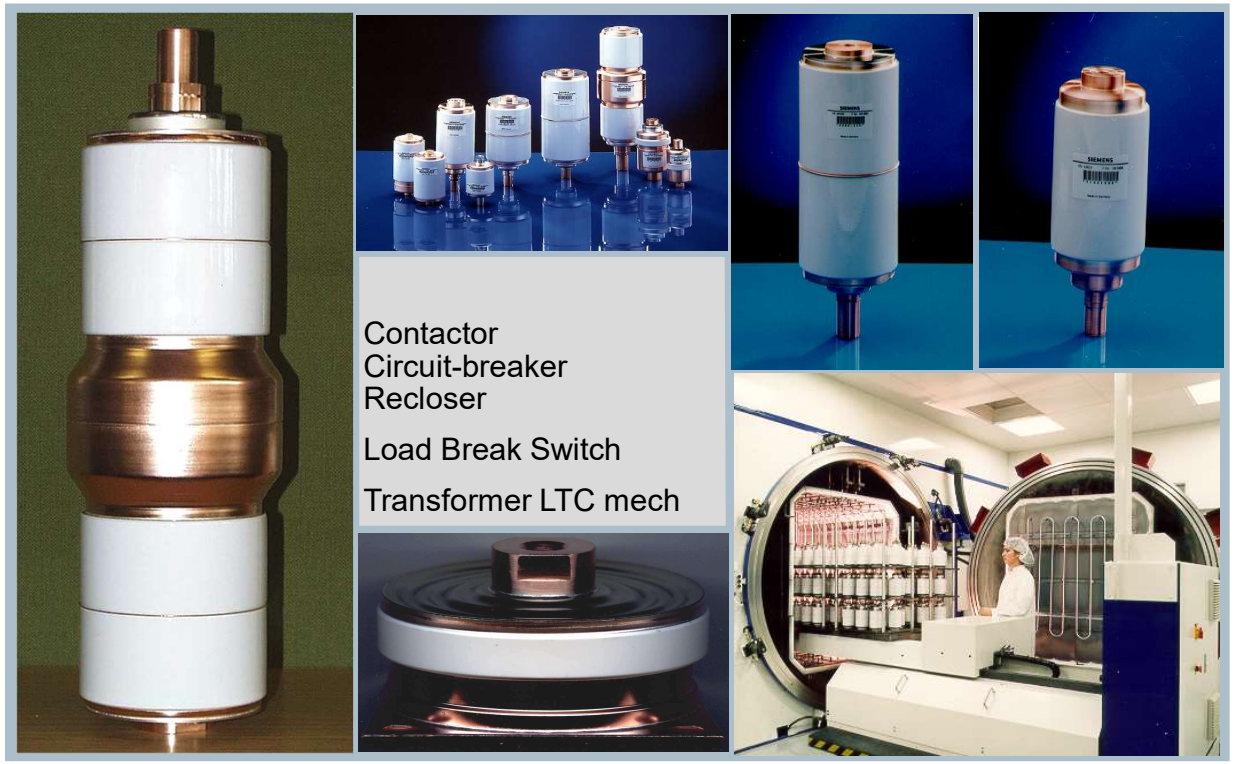
- **Siemens factory Berlin Germany**
- **Largest vacuum interrupter manufacturer in the world**
- **Greater amount of number of faults available versus competitors**

  (based on VI fault curves)



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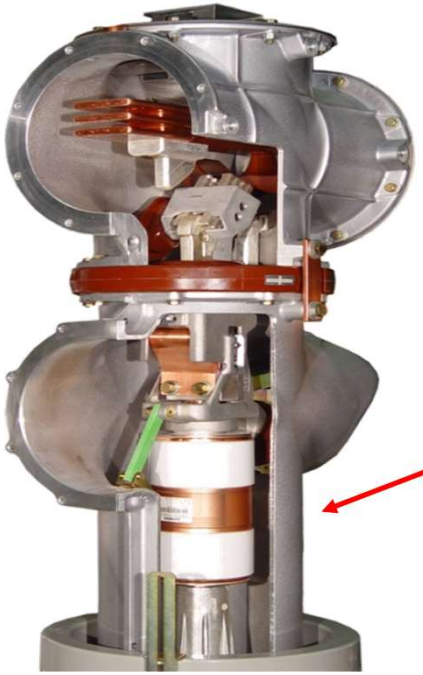
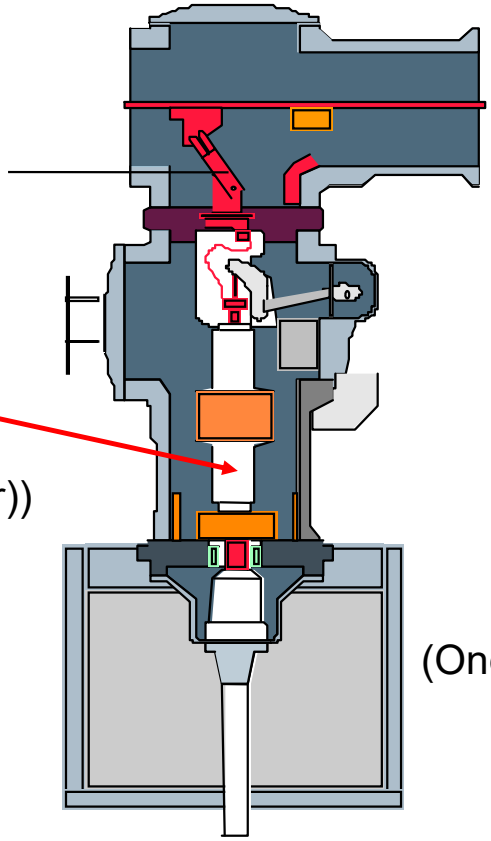
- Vacuum interrupter mounted in circuit breaker in single-phase pole housing surrounded by SF6 gas



Cut-away
(One-phase)

Vacuum interrupter
(surrounded by gas
acting as an insulator))



(One of Three
phase
shown)

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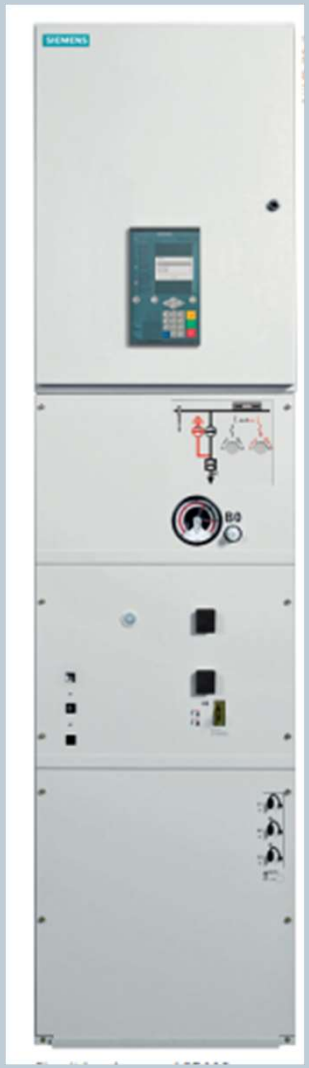

>120,000
3AH circuit
breakers
produced

Vacuum circuit breakers

Usa.siemens.com/mvswitchgear

Vacuum Circuit Breaker
8DA10/8DB10

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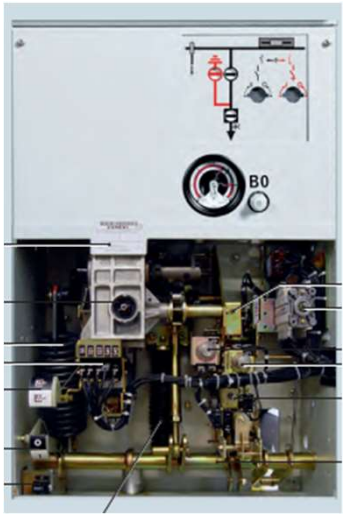
- The Siemens 8DA10/8DB10 is the most robust breaker, technically superior to all other breakers on the market.
- Fixed breaker (non draw-out) eliminates bent finger cluster or mis-alignment problems when inserting/removing circuit breaker from a breaker cell.
- The Siemens breaker utilizes the 3AH operator. The 3AH “operator” is used in the Siemens metal-clad air-insulated switchgear and SDV7 outdoor substation breakers.
- Available breaker ratings 1200A, 2000A, & 3000A. When 3000A circuit breaker is required, all manufactures utilize a 3000A breaker that is fan cooled.
- Fault or Short Circuit ratings of 20 - 40kA
- 3 cycle (50ms) opening time

Breaker Outside Gas Zone



Front Cover Removed

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Medium-Voltage Gas-Insulated Switchgear
Type 3AH Circuit Breaker Operator
Used in 8DA/8DB, GM-SG, GM38, SDV7 breakers

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Item	Description
1	Auxiliary switch S1
2	ON pushbutton
3	Closing solenoid
4	Shunt release
5	OFF pushbutton
6	Operating shaft for circuit breaker
7	Opening spring
8	Operating cycle counter
9	Switch position indicator for circuit breaker
10	Closing spring CHARGED/NOT CHARGED indicator
11	Position switches
12	Closing spring
13	Gear with hand-crank coupling
14	Rating plate

Same Spare Parts

No Re-training

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Medium-Voltage Gas-Insulated Switchgear
UL Listed* & Test Certificates

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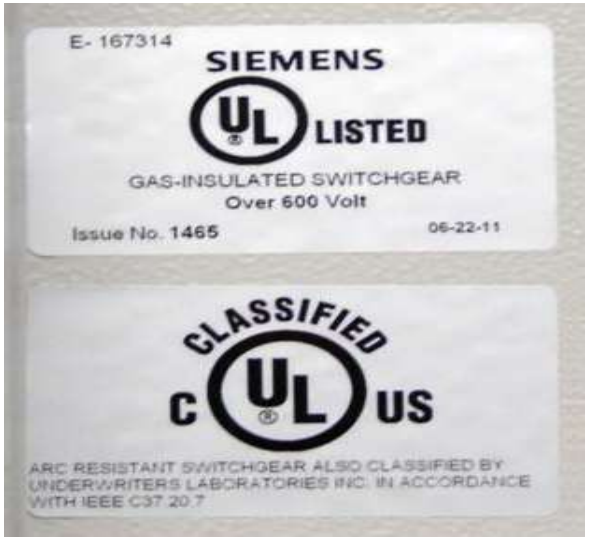
UL/cUL Listed* as
arc resistant to
ANSI/IEEE C37.20.7-2007

- **Ratings dependent**



Tests: Request from vendors before purchasing

- **Arc-Resistant Tests**
- **Rain Tests**
- **Siesmic Tests**
- **Temperature Rise**
- **Type Tests**
- **Etc..**

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Summary of key MV GIS advantages over MV AIS

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Features	MV GIS characteristic	Comparison to MV AIS	GIS
Safety	▪ Arc-resistant	▪ Not always arc-resistant	▪ All ratings
Footprint	▪ Smaller footprint due to SF_6 insulation and integral disconnect/grounding functions	▪ Much larger size required due to air insulation and need for rear aisle	▪ 38kV
Reliability	▪ High reliability due to hermetically enclosed system and single phase encapsulation	▪ Lower reliability due to environmental influence and possibility of phase-to-phase faults	▪ All ratings
Mainte-nance	▪ Lower maintenance costs due to hermetically enclosed system and enclosed cable plugs	▪ Higher maintenance cost due to regular bus bar and circuit breaker maintenance	▪ All ratings
Total cost of ownership	▪ Lower Total Cost of Ownership (TCO) especially in 38 kV and 27 kV applications	▪ Higher TCO especially in 38 kV and 27 kV applications	▪ 38kV

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Medium-Voltage Gas-Insulated Switchgear
AIS versus GIS

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AIS		GIS
Circuit Breaker - Drawout		Circuit Breaker - Non-Drawout (Fixed) Visible disconnect achieved by Three-Position Isolation Disconnect Switch (Closed-Open-Ground)
Ground & Test Device		Not require grounding via Three-Position Isolation Disconnect Switch (Closed-Open-Ground)
Ground Studs		Not require grounding via Three-Position Isolation Disconnect Switch (Closed-Open-Ground)
Hotstick		Not required - low voltage indicators (LRM) in front panels of GIS indicates voltage present

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Medium-Voltage Gas-Insulated Switchgear
AIS versus GIS

AIS		GIS
Heaters-Space (Condensation)		Not required the busbar is surrounded by a positive pressure not allowing condensation to enter.
MOC switches (Most circuit breakers only have two 52a/52b) contacts		Circuit breaker has sufficient contacts (12NO & 12NC) for electrical interlocking.
TOC (Connected/Test/Disconnect) switch		TOC not required, non-drawout breaker. Control circuits can be tested in the “test position”

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Medium-Voltage Gas-Insulated Switchgear
AIS versus GIS

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AIS		GIS
Potential Transformers (PT) - draw-out		PT non-drawout (fixed). Visible disconnect achieved by Three-Position Isolation Disconnect Switch (Closed-Open-Ground)
Visible Disconnect typically achieved by draw-out mechanism		Visible Disconnect is verified by a web cameras connected to the three-position switch connected to laptop or front HMI.

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Medium-Voltage Gas-Insulated Switchgear
8DA10 Single Busbar Lineup Up To 38 kV

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Front view

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Medium-Voltage Gas-Insulated Switchgear
Types 8DA10 & 8DB10

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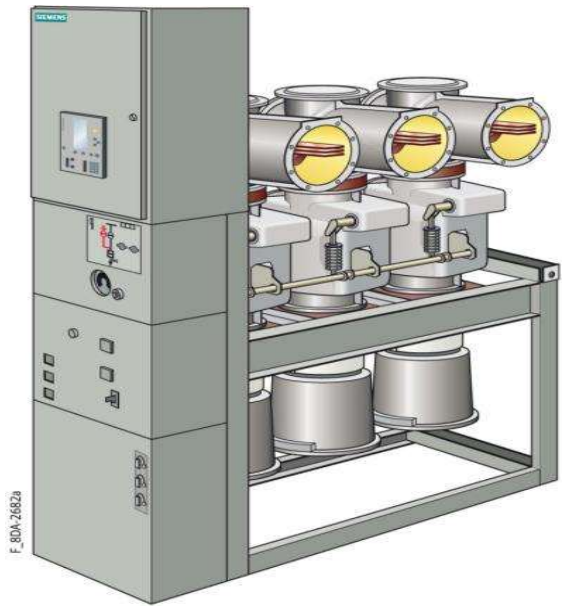
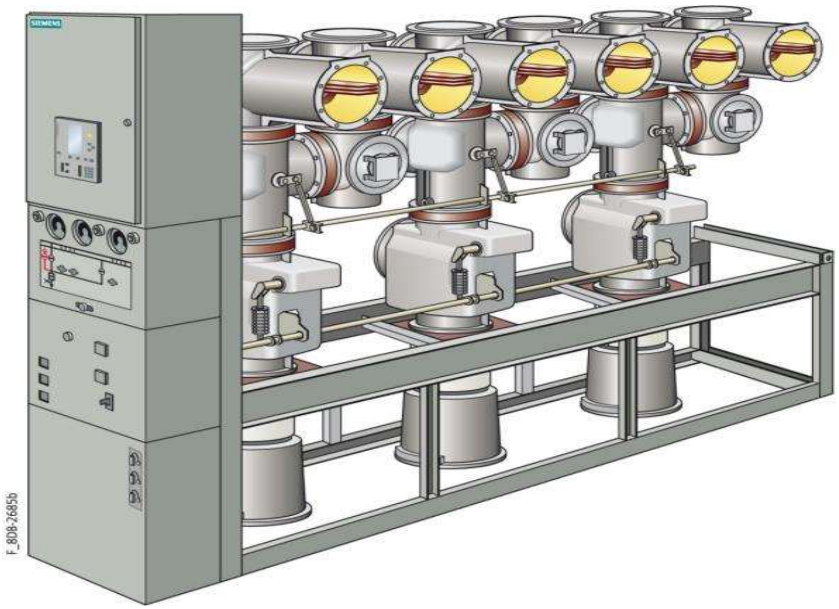
8DA10 single bus bar



8DB10 double bus bar



Isolated-phase design eliminates possibility of phase-to-phase faults inside the switchgear

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Circuit-Breaker Panel 8DA11/12
1-Pole and 2-Pole Traction Systems

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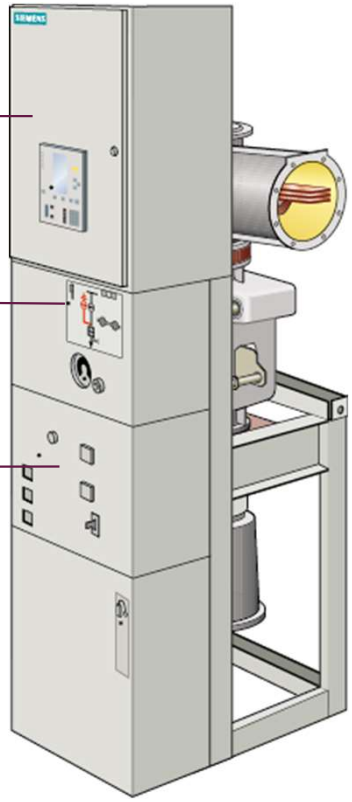
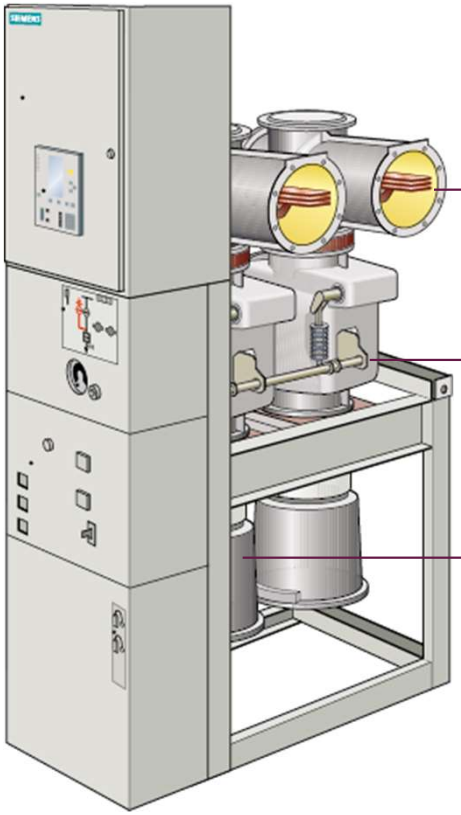
Low-voltage compartment
Installation of secondary devices

Operating mechanism for three-position switch
Disconnector and earthing switch

Operating mechanism for circuit-breaker
Vacuum switching technology





Busbar housing
Light-metal vessel

Circuit-breaker housing
Light-metal vessel

Cable connection
Inside-cone system

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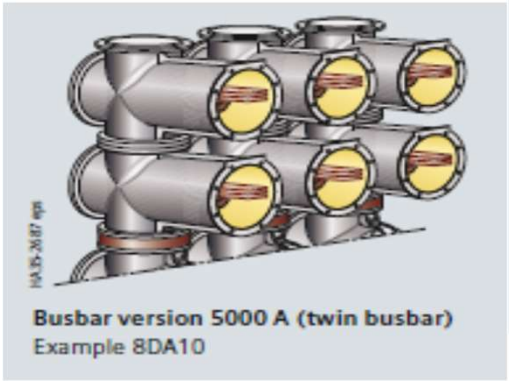
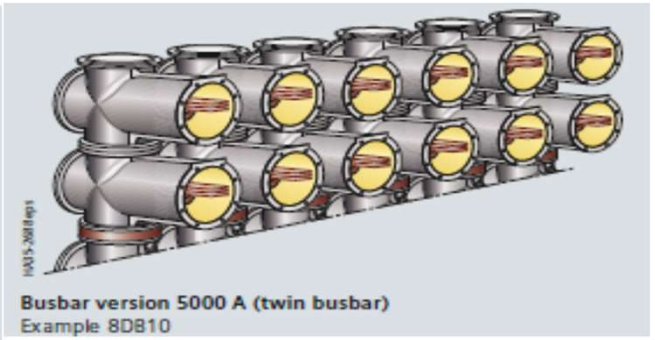
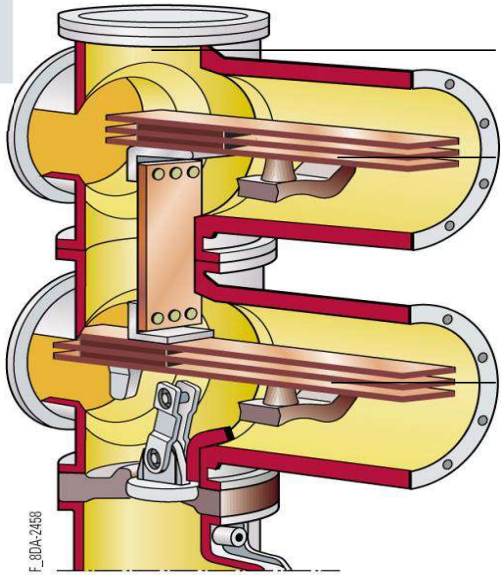
Medium-Voltage Gas-Insulated Switchgear
Main Bus Bar 5000A UL/cUL

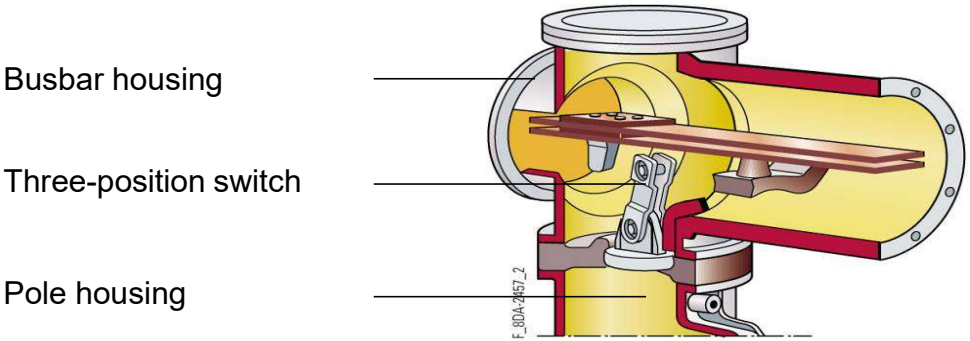




Busbar 5000 A



Busbar up to 4000 A



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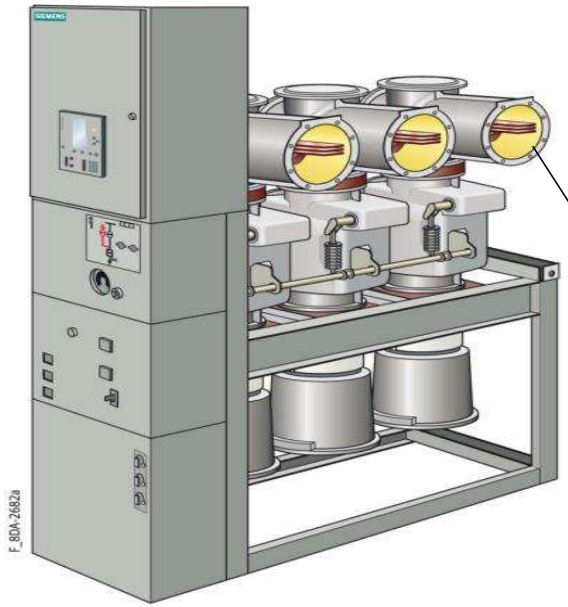
Medium-Voltage Gas-Insulated Switchgear
High-Operational Reliability

SIEMENS

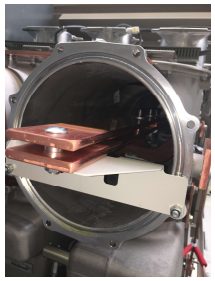
Overview of reliability features



Isolated Phases more reliable than poly phase (No phase-phase faults)

No need for bus diff. (87B) relay & ct's

- Sealed pressure system protects against environmental influences (IP65)
- Single-pole enclosure eliminates possibility of phase-to-phase faults inside switchgear
- Division of gas compartments enables rapid problem isolation



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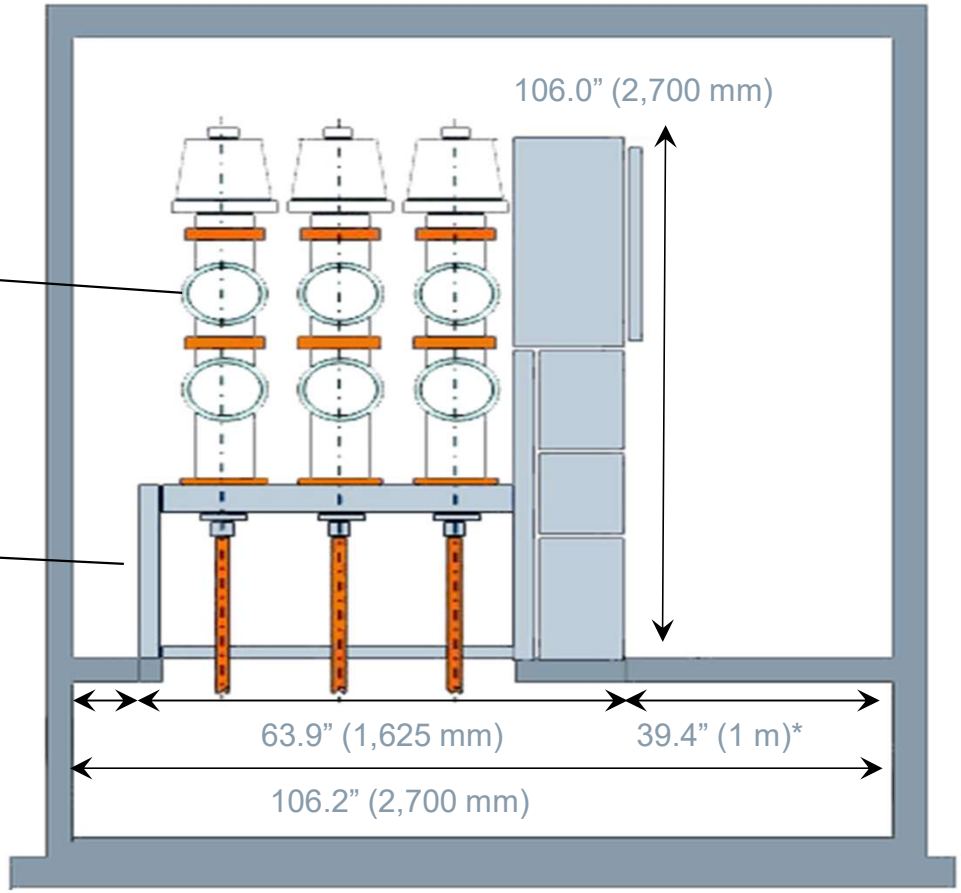
Medium-Voltage Gas-Insulated Switchgear
Side View Single Busbar (Type 8DA)



* Workspace required by design. NEC & NESC may require larger working area.

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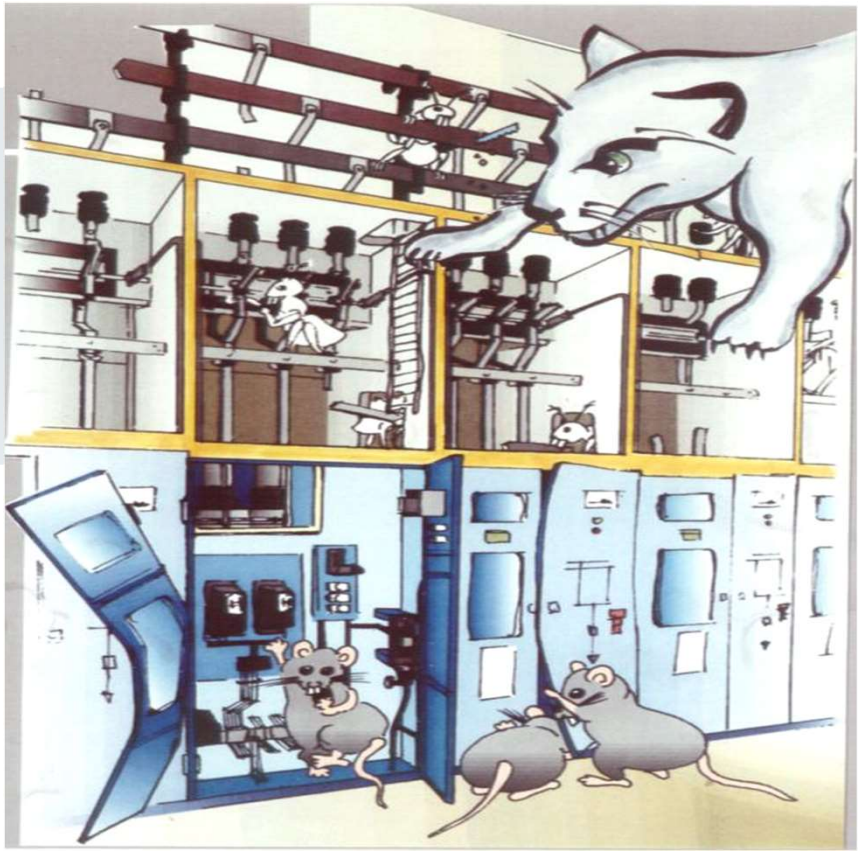
Medium-Voltage Gas-Insulated Switchgear
Environmental Problems?

SIEMENS

Primary circuit is IP65*

Environmental problems:

- Dust?
- Salt?
- Moisture? (Space Heaters)
- Corrosive gases?
- Mice?
- Rats?
- Cats?
- Squirrels?
- Snakes?
- Altitude?



*** IP65 – protected against access to live parts using a wire, dust-tight, & protected against water jets (no equivalent NEMA 250 designation)**

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Medium-Voltage Gas-Insulated Switchgear

Reduces Or Eliminates Causes Of 50% Of Failures In MV AIS

SIEMENS

Overview of failure causes for MV AIS

MV AIS failure cause	Share	Not applicable to MV GIS
• Thermocycling	7%	☐
• Mechanical structure failure	3%	☐
• **Mechanical damage from foreign source**	**7%**	☑
• **Shorting by snakes, birds, rodents, etc.**	**3%**	☑
• Malfunction of protective device	10%	☐
• Above normal ambient	3%	☐
• Exposure to chemicals or solvents	3%	☑
• **Exposure to moisture (Space Heater failure)**	**30%**	☑
• **Exposure to dust or other contaminants**	**10%**	☑
• Exposure to non-electrical fire	7%	☐
• Normal deterioration from age	10%	☐
• Severe weather condition	3%	☐
• Others	4%	☐

50% of failures eliminated with GIS

Source: IEEE 493 Gold Book, Annex E, table XVIII, page 479

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Siemens MV GIS advantages
Maintenance

SIEMENS

MV AIS

Required latest after five years of service:

- Switch off of lines, feeders and busbars
- Grounding
- All circuit breakers in test position
- Test function of circuit breakers and and all other switching devices
- Remove the drawout circuit breaker and remove covers partly to access to busbars and cable sections
- Clean the sections and all insulation, and check all bolted connections
- Lubricate all bearings and surfaces; check panel function and put switchgear back into service

Example: Estimated time per section: **four hours**

- For a 20-section lineup **80 working hours, respective to 8 working days for maintenance**
- Average **$180 per person per hour, i.e., $14,400** for a 20-section lineup

MV GIS

Requires minimal maintenance

Visual inspection: 5 years

- Check gas-pressure gauges
- General visual survey

Example:
For the 20-section lineup, potential **savings $14,400.**

After 30 years, total savings $86,400

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Siemens MV GIS advantages
Availability

SIEMENS

MV AIS

During maintenance, switchgear is out of service.

- Provisions for alternative supply circuits must exist.
- Switching procedures must be followed.
- After maintenance, original conditions need to be re-established.

Risks:

- Switching failures.
- Network disturbances may occur.
- Human errors, tools left in equipment, loose connections, loose bolts, missing covers, etc.

Therefore, the risk of failures inside the switchgear (including potential for arc fault) may be higher.

MV GIS

- Almost maintenance free.
- No human errors can occur due to hermetically- sealed isolation.
- Insulation cannot be contaminated

Peace of mind

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Medium-Voltage Gas-Insulated Switchgear
Maintenance Checks

SIEMENS

Maintenance	After 1,000 operating cycles of the disconnectors & grounding switches or after 10,000 operating cycles of the circuit breaker.

Visual inspection Every 5 years	Condition inspection Every 10 years	Maintenance	Description
X	X	X	Check & document SF_6 gas pressure
	X	X	Check & document dew-point (humidity content) (≤15 ˚C)
	X	X	Check & document gas quality (air content) (SF_6 share ≥ 95%)
		X	Check operating mechanism & interlocking of disconnector & grounding switch. If required, grease linkage & bearings.
		X	Vacuum circuit breaker operating mechanism

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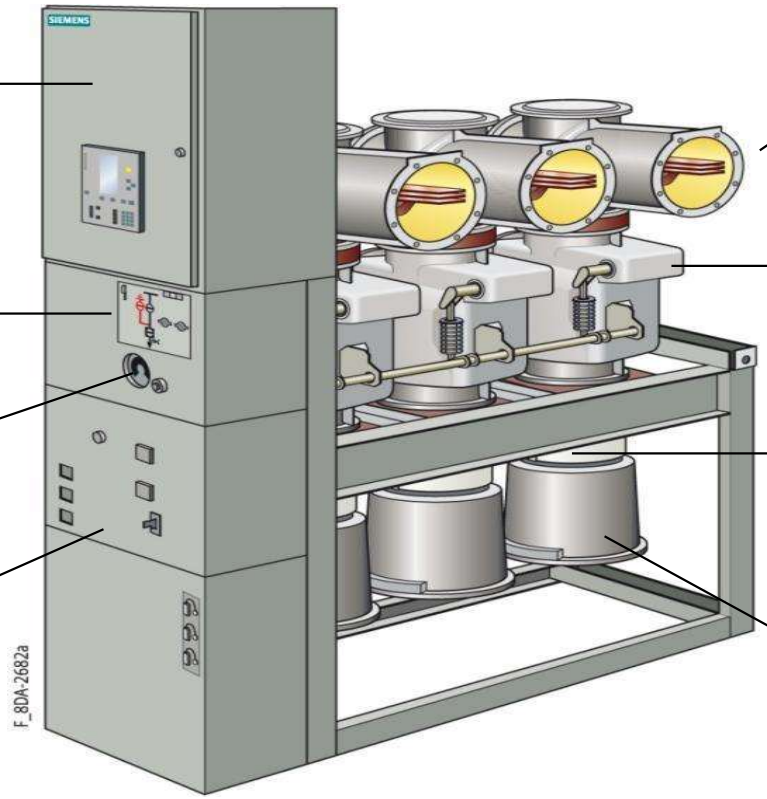
Medium-Voltage Gas-Insulated Switchgear
Circuit Breaker Section (8DA10 Single Bus Shown)



Low-voltage compartment (fits 19” relay)

Drive mechanism/ three-position switch (On/Off-Ground)

Gas monitoring

Drive mechanism/ circuit breaker

Busbar (isolated phases) no phase-phase fault

Circuit breaker pole housing

Current transformer (outside gas-zone)

Pfisterer cable connection from the bottom

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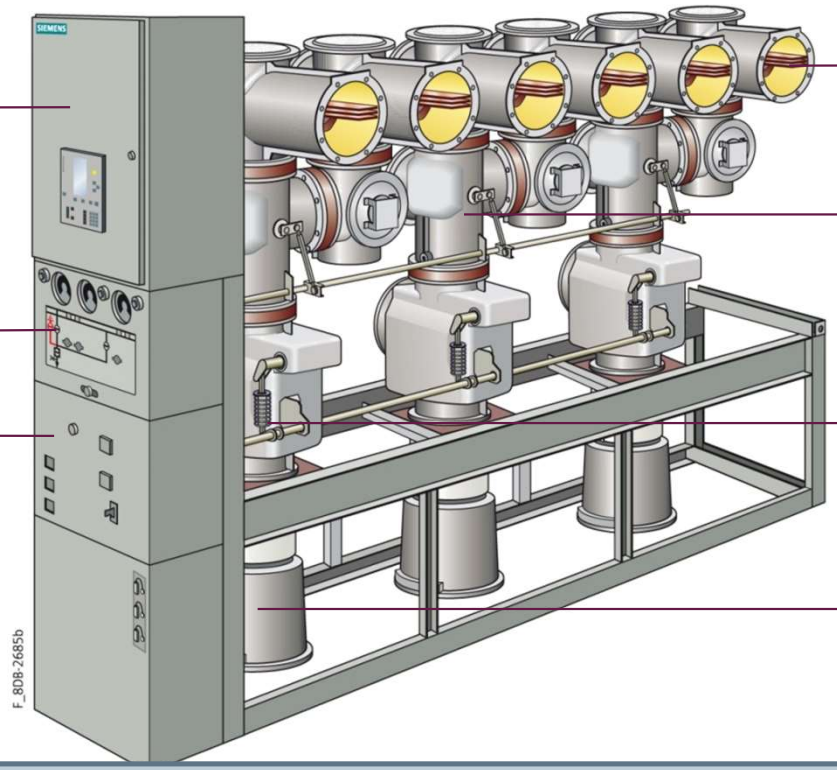
Medium-Voltage Gas-Insulated Switchgear
Circuit Breaker Section (8DB10 Double Bus Shown)

Low-voltage compartment
Installation of secondary devices

Operating mechanism for three-position switch
Disconnector and earthing switch

Operating mechanism for circuit-breaker
Vacuum switching technology



Busbar housing
Light-metal vessel

Three-position switch housing
Light-metal vessel

Circuit-breaker housing
Light-metal vessel

Cable connection
Inside-cone system

Isolated-phase design eliminates possibility of phase-to-phase faults inside the switchgear

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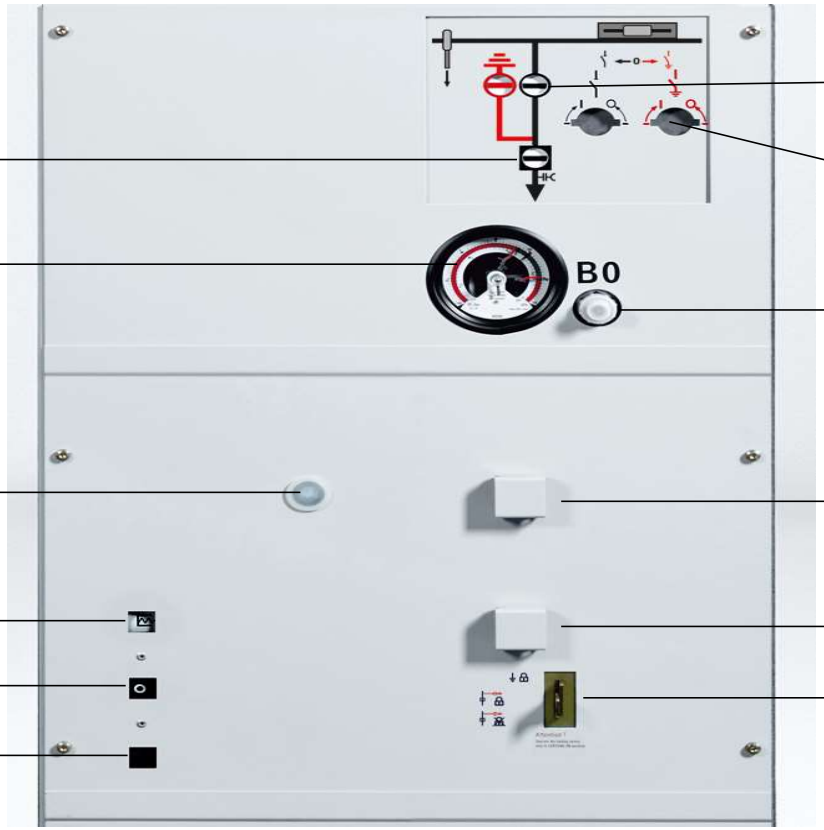

Position indicator/ circuit breaker

Manometer (pressure gauge)

Opening for manually charging the circuit breaker closing spring

Spring-charged indicator

Circuit breaker “ON/OFF”

Operations counter

Position indicator/ disconnector switch

Operating shaft disconnector switch/ grounding switch

SF_6 filling valve

ON pushbutton

OFF pushbutton

Grounding lockout

Drive mechanism

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Medium-Voltage Gas-Insulated Switchgear

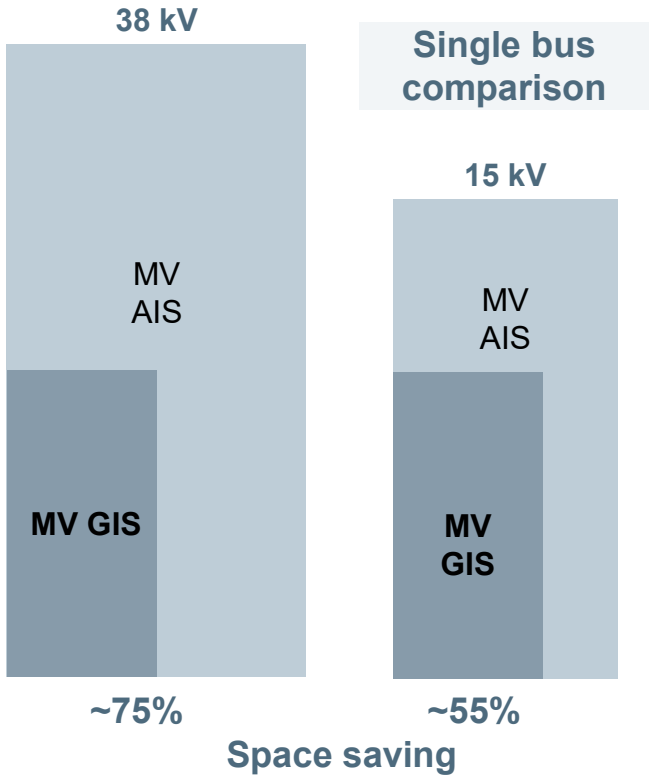
MV GIS Smaller Than MV AIS - Compact Footprint

SIEMENS

Footprint comparison (MV AIS & MV GIS - only equipment size considered)

GM38 **8DA10**

(Rear Aligned)



Single bus comparison

Space saving

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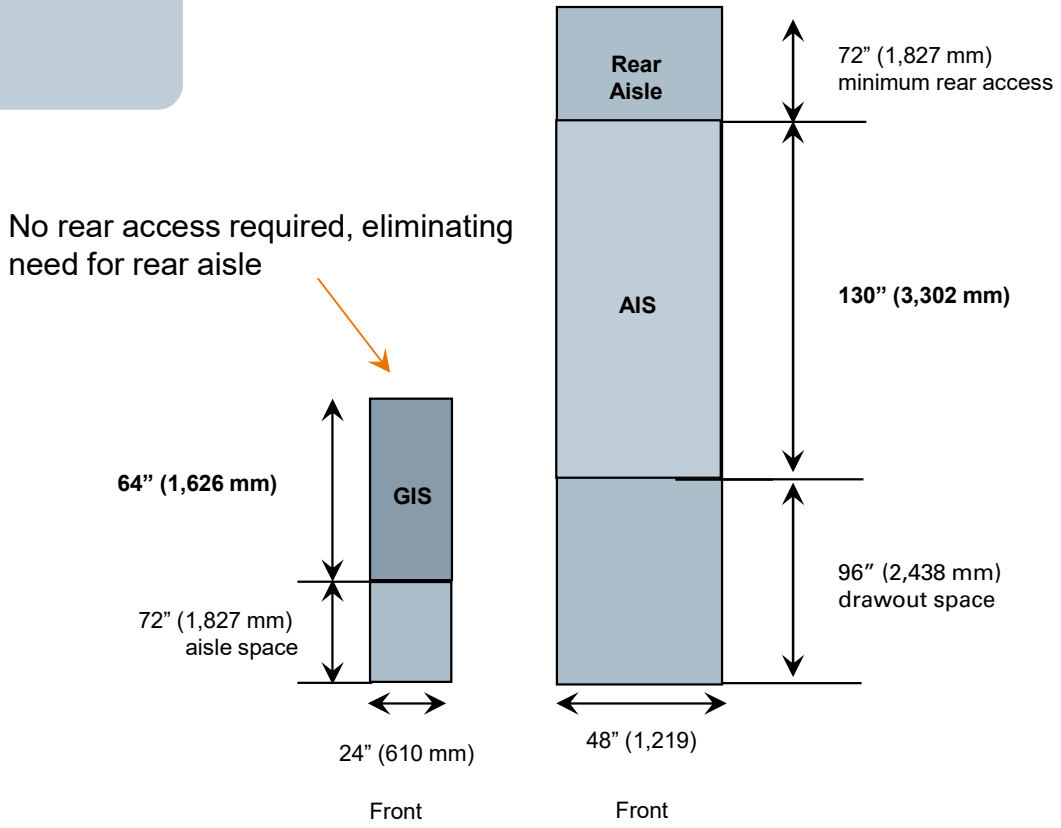
Medium-Voltage Gas-Insulated Switchgear
Space Problems?

SIEMENS

"I have to double the substation MVA, but don't have the space?"

38 kV switchgear space requirements single bus comparison

- Air-insulated switchgear 99.3 ft^2 = 9.2 m^2
- Gas-insulated switchgear 22.7 ft^2 = 2.1 m^2



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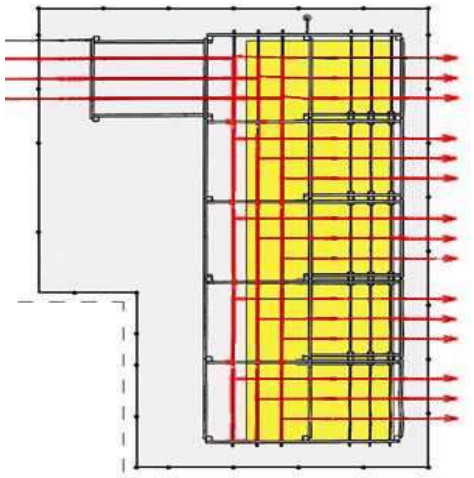
Medium-Voltage Gas-Insulated Switchgear

Size Comparison 38 kV MV GIS & Other Alternatives

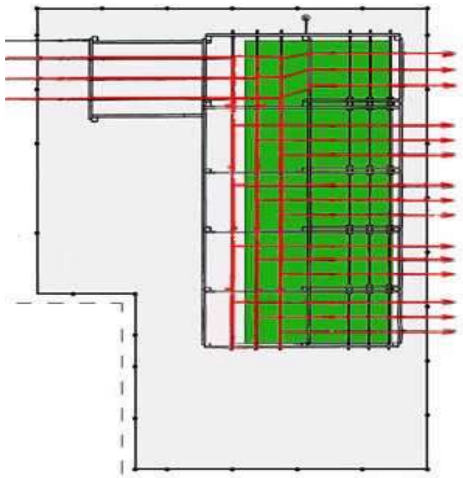
SIEMENS

38kV Outdoor circuit breakers SDV7



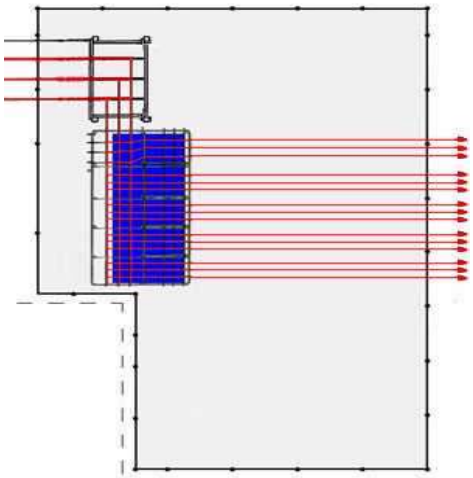
278 ft²
26 m²
100%

38kV Air-insulated switchgear GM38



91 ft²
8.5 m²
33%

Gas-insulated switchgear 8DA10



23 ft²
2.1 m²
8%

Comparison of footprint of four circuit breakers

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Medium-Voltage Gas-Insulated Switchgear
MV GIS Is Tested For Arc Resistance

SIEMENS

- Tested to **ANSI/IEEE C37.20.7-2007/IEC 62271-200** for internal arcing faults
- Arc-resistant internal arc classification **type 2B** (front, side, rear with low-voltage compartment door open)
- Reduced level of PPE permitted by NFPA 70E for arc-resistant switchgear

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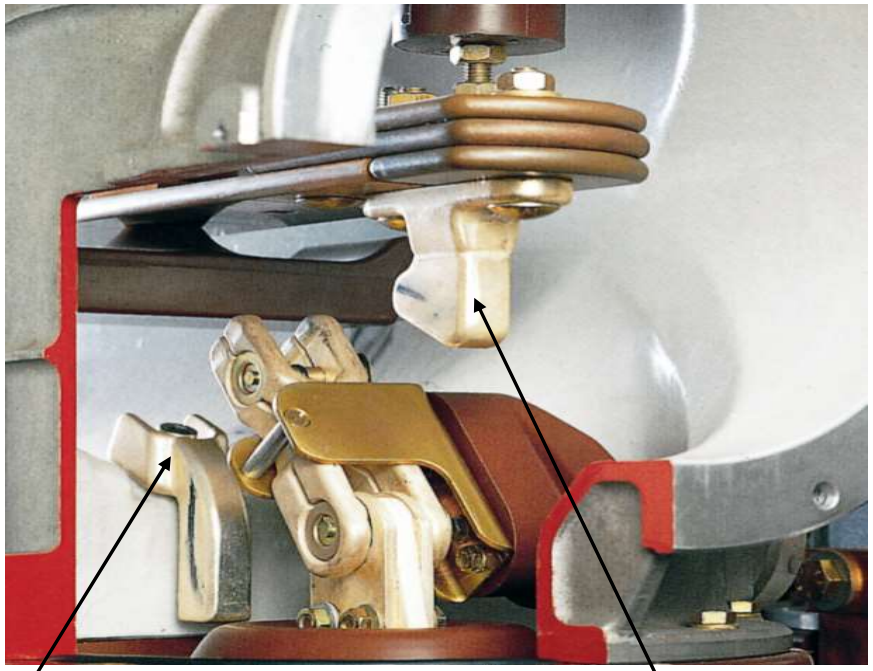
Medium-Voltage Gas-Insulated Switchgear
Three-Position Isolation Selector Switch (Closed - Open - Grounded)

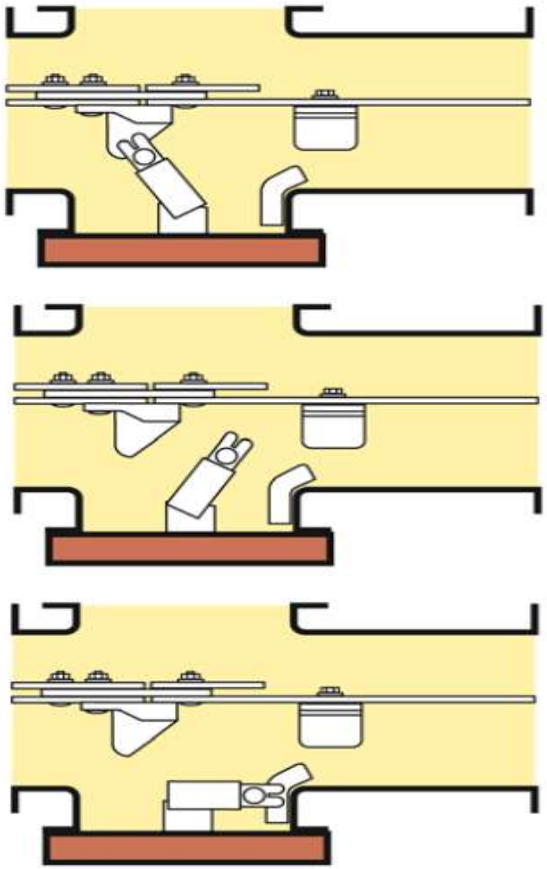
SIEMENS



Open Position

Ground Position

Closed Position



CLOSED

Q1

Isolation

Breaker

Q0

OPEN

READY-TO-GROUND

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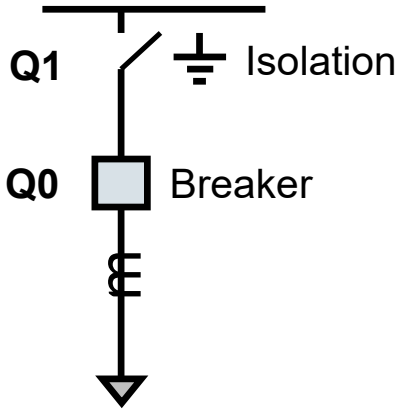
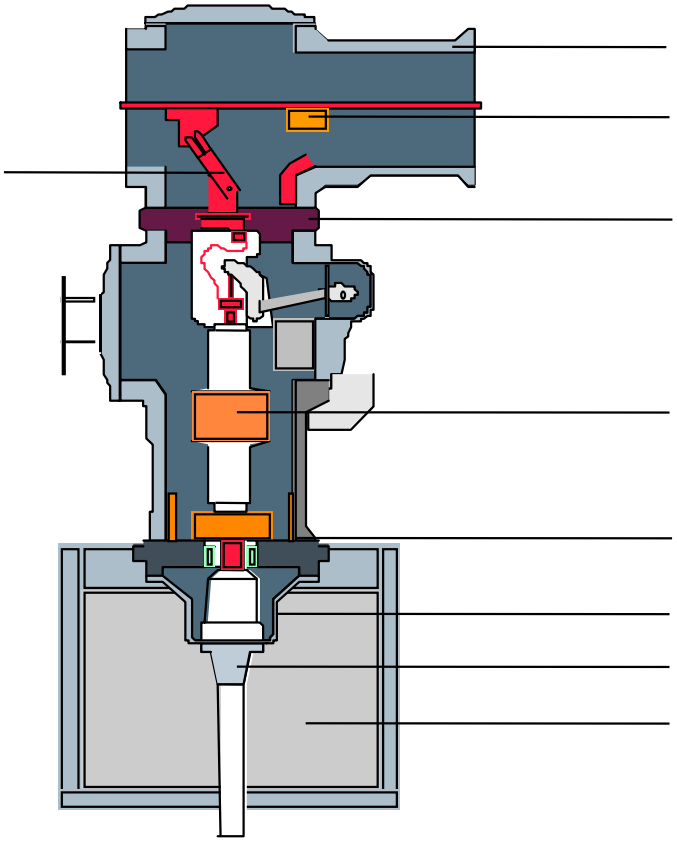
Medium-Voltage Gas-Insulated Switchgear
Three-Position Switch, Vacuum Interrupter & Cable Connection (Sideview)

SIEMENS

Three-position “isolation” selector switch (shown CLOSED)





Cut-away (One-phase)

- Cast aluminum housing
- Busbar with sliding supports
- Gas tight bushing
- Vacuum interrupter (surrounded by gas acting as an insulator)
- Capacitive voltage sensor
- Cast aluminum housing
- Shock-proof cable termination (Pfisterer)
- Torodial-core current transformer

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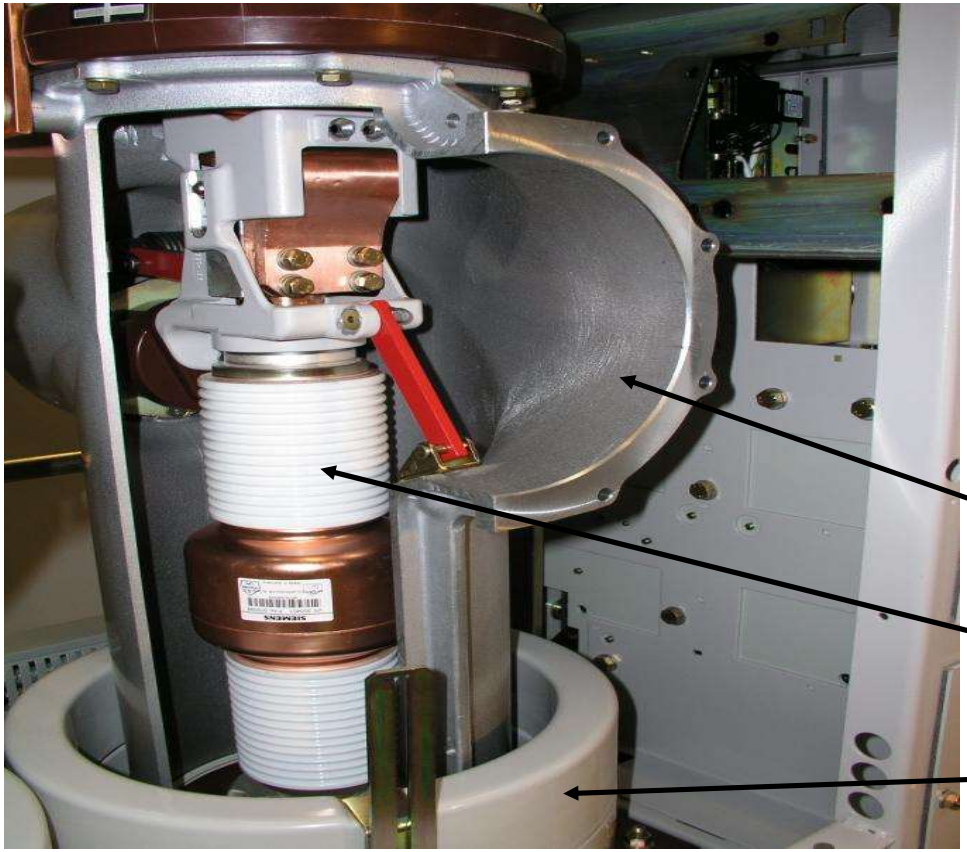
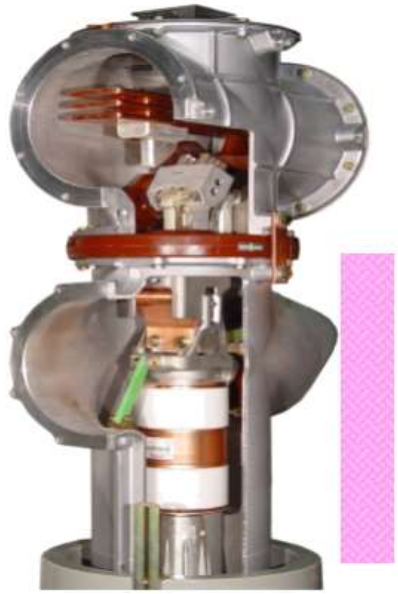
Medium-Voltage Gas-Insulated Switchgear
Vacuum Interrupter & Current Transformers

SIEMENS



Cut-away (One-phase)

- Vacuum interrupter mounted in circuit breaker pole housing surrounded by gas
- Non-sliding current transfer from vacuum interrupter moving contact to three-position switch



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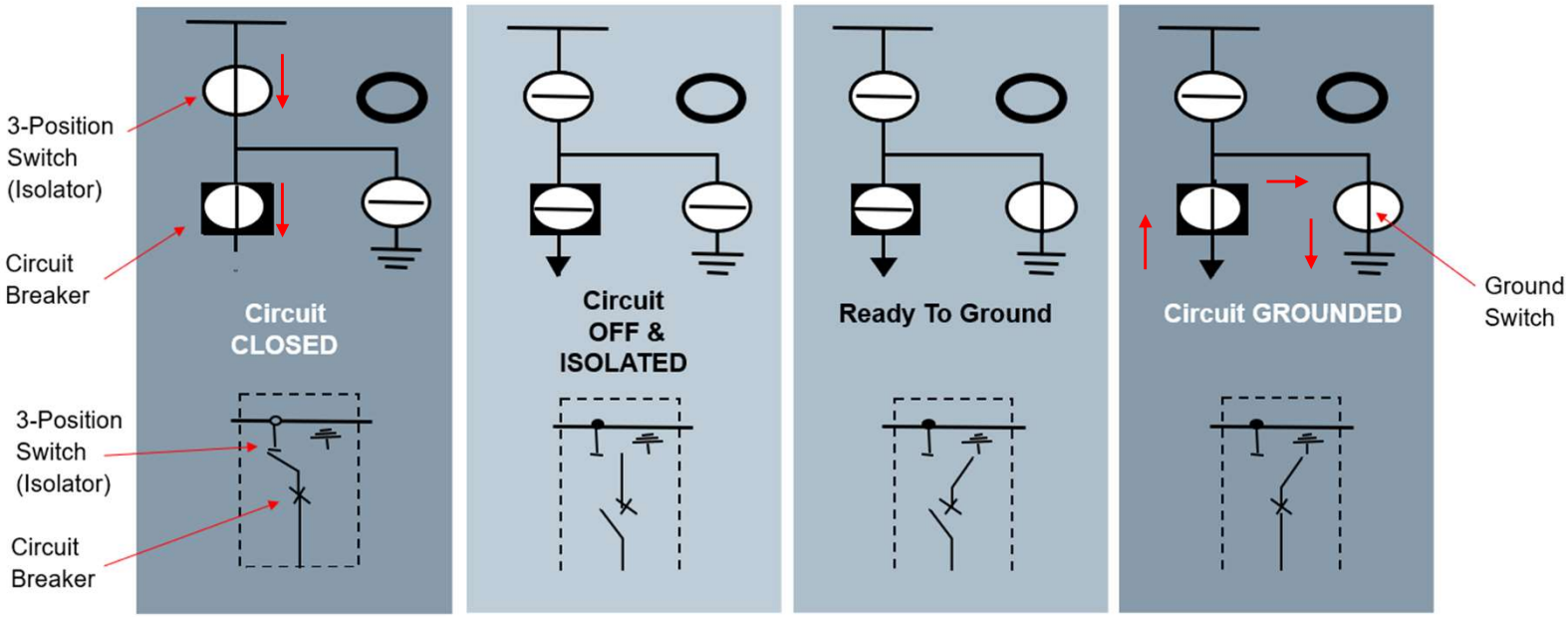
Medium-Voltage Gas-Insulated Switchgear

Circuit Breaker & 3-Position Isolation Switch Operation Sequence



STATUS

3-Position - Closed
Ground Sw. - Open
CB - Closed

STATUS

3-Position - Open
Ground Sw. - Open
CB - Open

STATUS

3-Position - Open
Ground Sw. - Close
CB - Open

STATUS

3-Position - Open
Ground Sw. - Close
CB - Close

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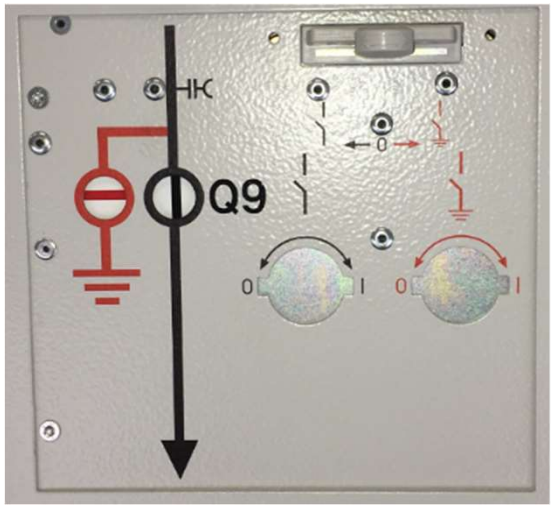
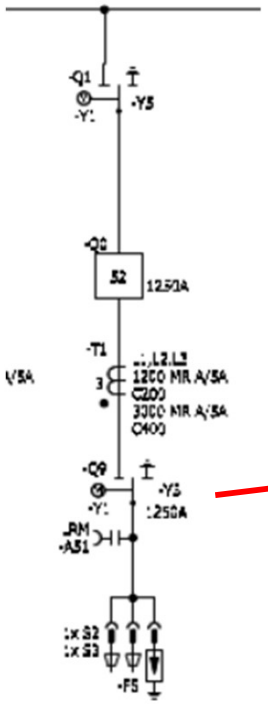
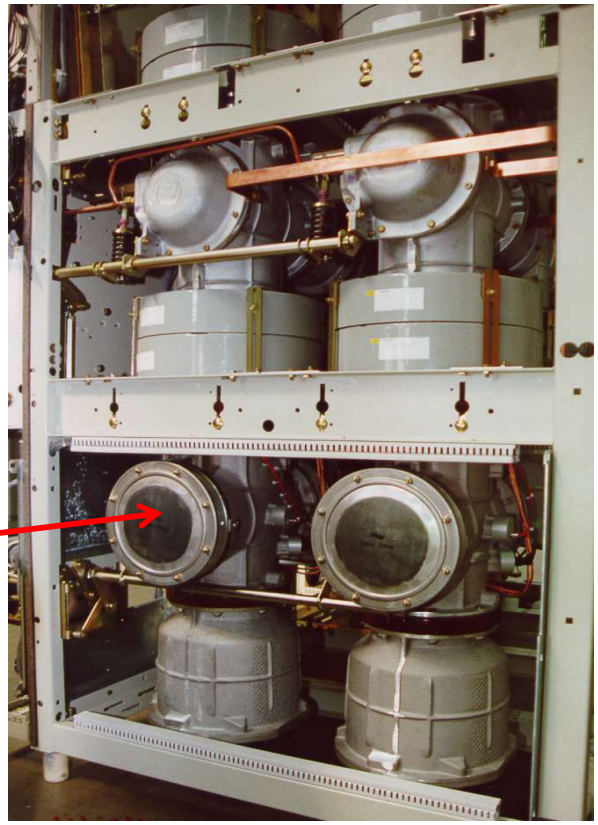
Medium - Voltage Gas-Insulated Switchgear - 8DA10

Q9 - Line / Load side Service Disconnector & Grounding switch (option)

- Allows direct grounding of the load side cable
- Up to 3000A







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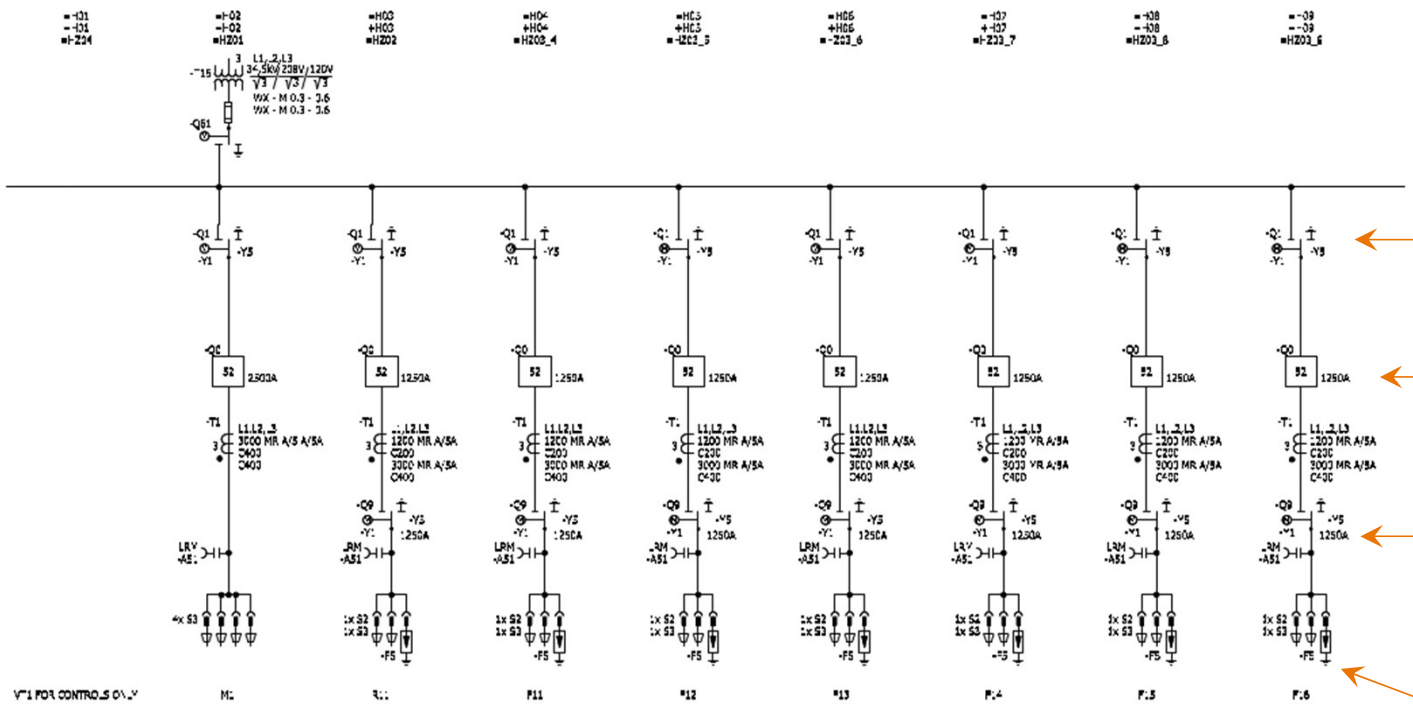
Configurations
Single Bus (8DA10)



Three-position bus side disconnect switch (on/off/ground) (standard)

Fixed non-drawout circuit breaker

Q9 - Three-position cable side disconnect switch (on/off/ground) (optional)

Quick disconnect cable connection (Pfisterer)

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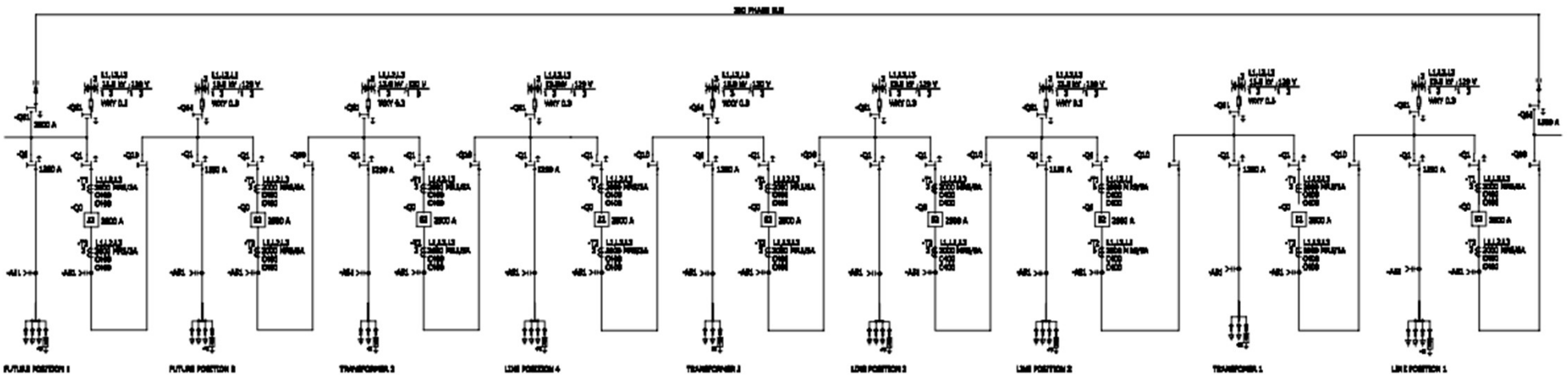
Configurations
Single Bus (8DA10) - Ring Bus

Solid Busbar (Ritz)



Main 1

Main 2

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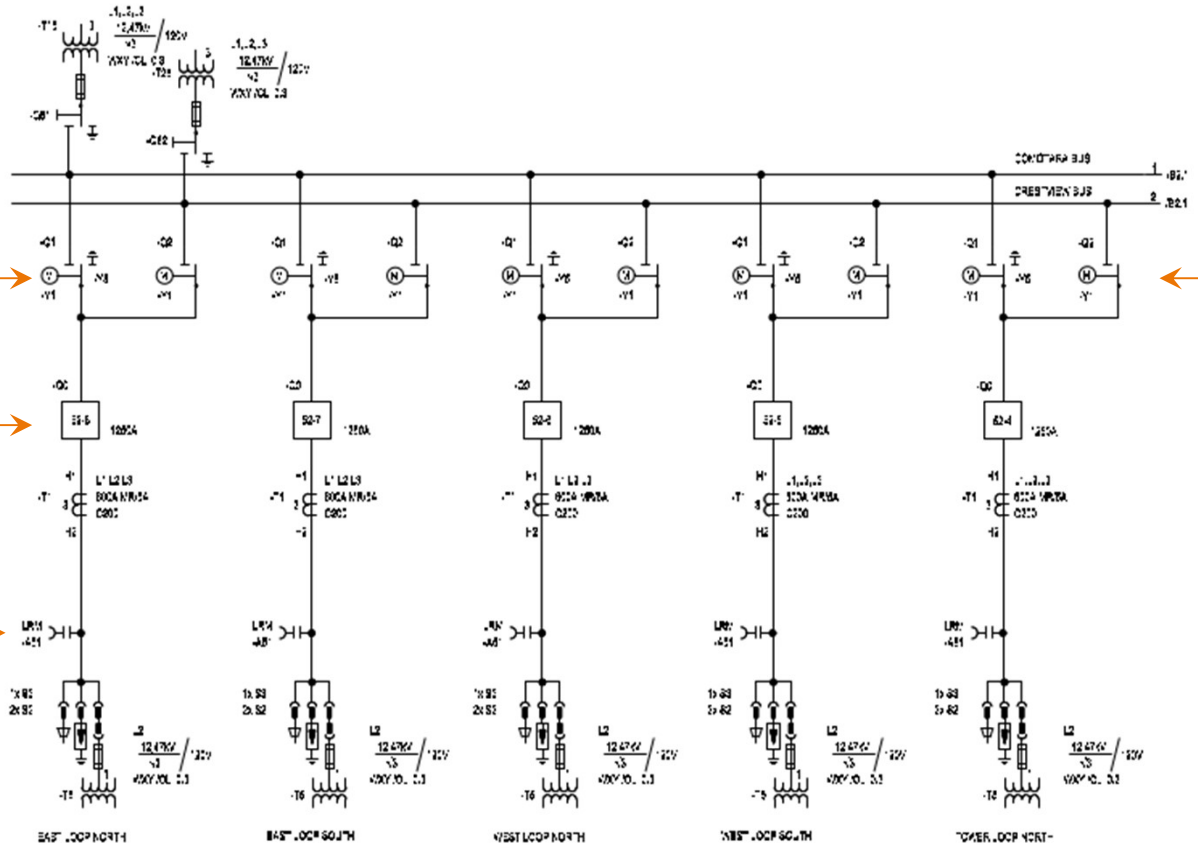
Configurations
Double Bus (8DB10) - Standard Configuration

Q1 - Three-position bus side disconnect switch (Closed/Open/Ground) (standard)

Q0 - Fixed non-drawout vacuum circuit breaker

Capacitive Voltage Present Indicator - LRM



Q2 -Two-position bus side disconnect switch (Closed/Open) (standard)

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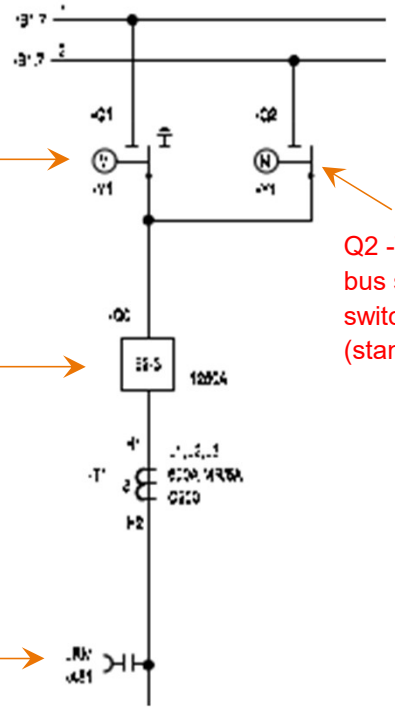
Configurations
Double Bus (8DB10)

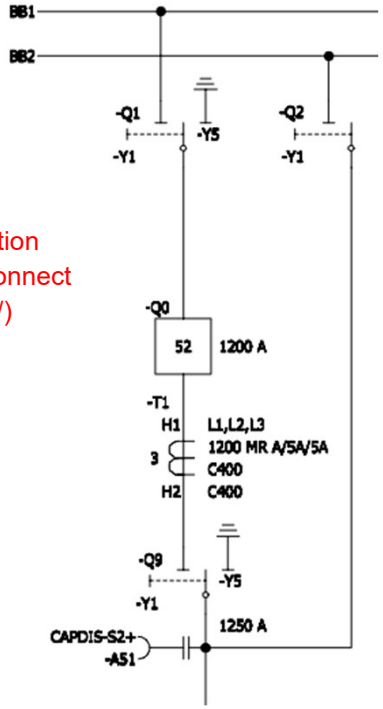
Q1 - Three-position bus side disconnect switch (Closed/Open/Ground) (standard)

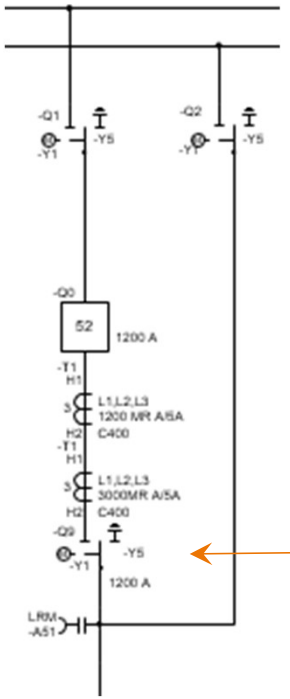
Q0 - Fixed non-drawout circuit breaker

Capacitive Voltage Present Indicator - LRM



Q2 -Two-position bus side disconnect switch (on/off/) (standard)





Q2 -Three-position bus side disconnect switch (Closed/Open/Ground) (optional)

Q9 - Three-position cable side disconnect switch (Closed/Open/Ground) (optional)

Standard Design

Breaker By-Pass (Optional)

Breaker By-Pass (Optional)

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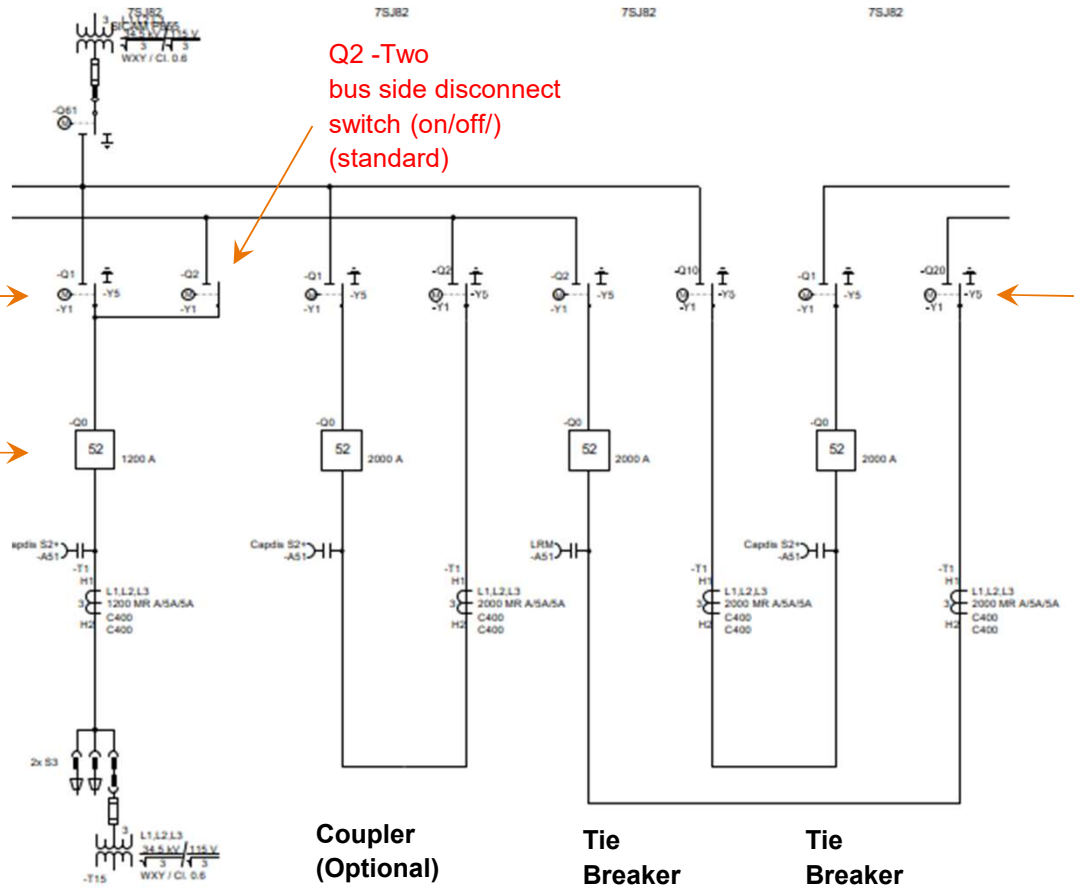
Configurations
Double Bus (8DB10) Tie Breaker & Bus Coupler

Q2 -Two bus side disconnect switch (on/off/) (standard)

Q1 - Three-position bus side disconnect switch (Closed/Open/Ground) (standard)

Q0 - Fixed non-drawout circuit breaker

Capacitive Voltage Present Indicator - LRM



Q2 -Three-position bus side disconnect switch (Closed/Open/Ground) (optional)

Coupler with Circuit Breaker for Safety

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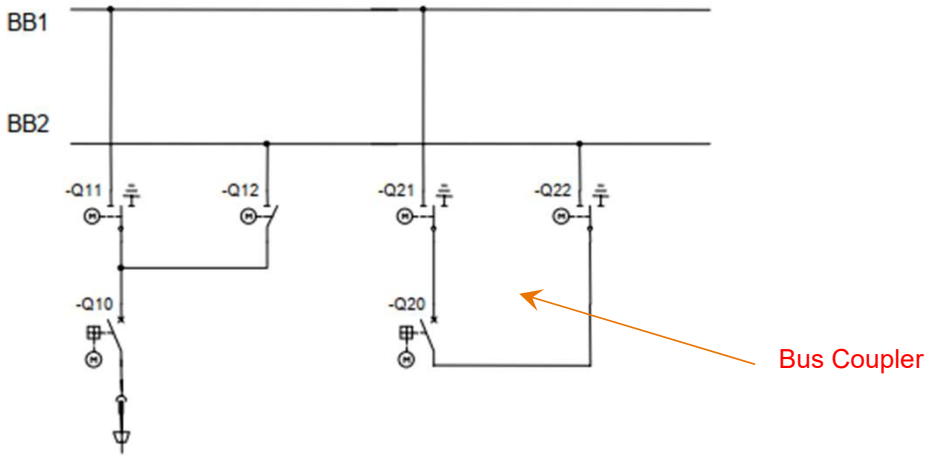
Configurations
Uninterrupted Bus Transfer (8DB10)

1 Uninterrupted busbar transfer

For operational reasons, in double-busbar switchgear it has to be possible to change over from one busbar system to the other with interrupting the power supply.



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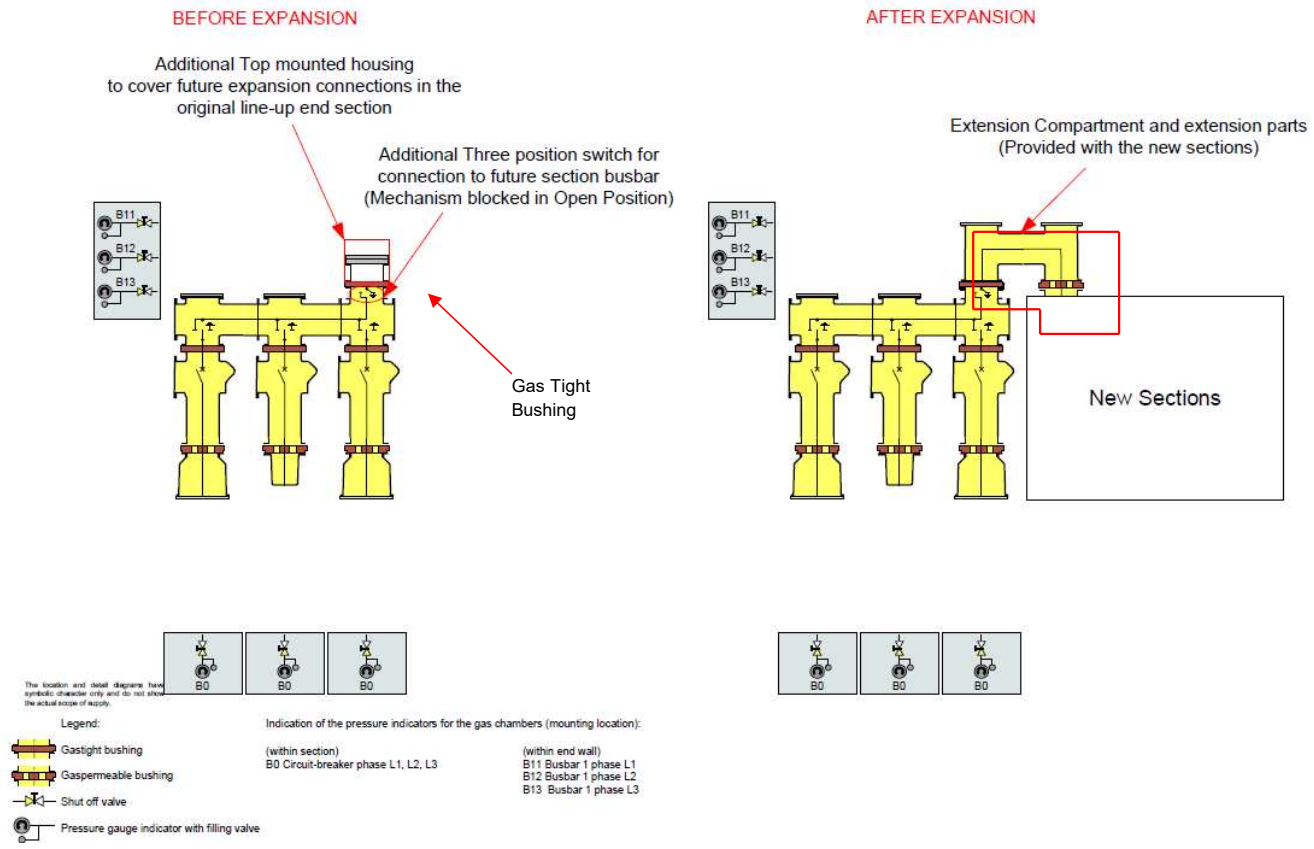
Medium-Voltage Gas-Insulated Switchgear - 8DA10

Q11 - Future Expansion Switch - no de-energization



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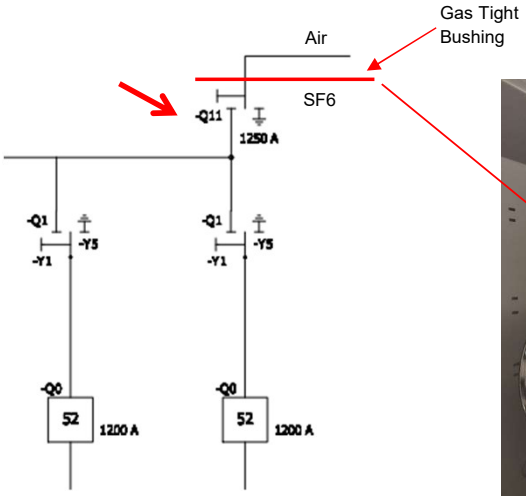
Medium-Voltage Gas-Insulated Switchgear - 8DA10
Q11 - Future Expansion Switch - no de-energization

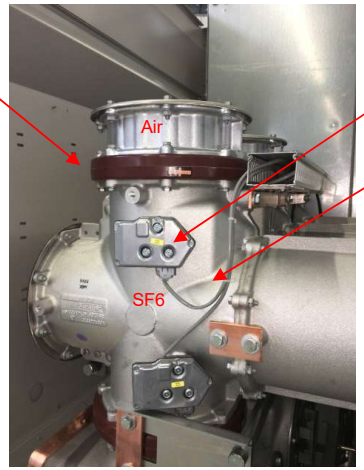
SIEMENS

Features

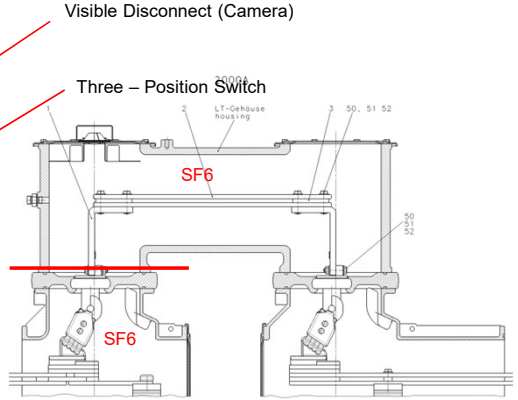
- No de-energization required if ordered with last section with optional “Future expansion switch”
- Does not require additional section (space saving)
- Three-position switch (Closed-Open-Ground)
- Visible disconnect - web camera (NEC requirement)
- Gas-tight bushing (no degassing) of main bus prior to “Future Expansion Switch”



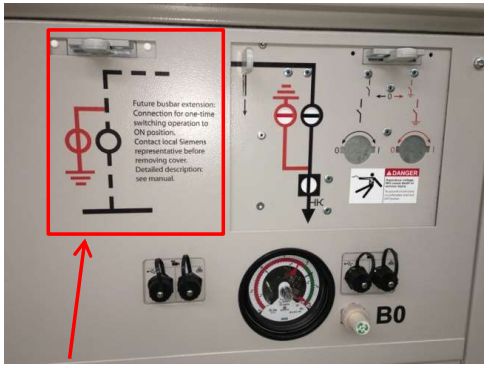
Before
(Rear View)



Before
(New Section)



After



Before

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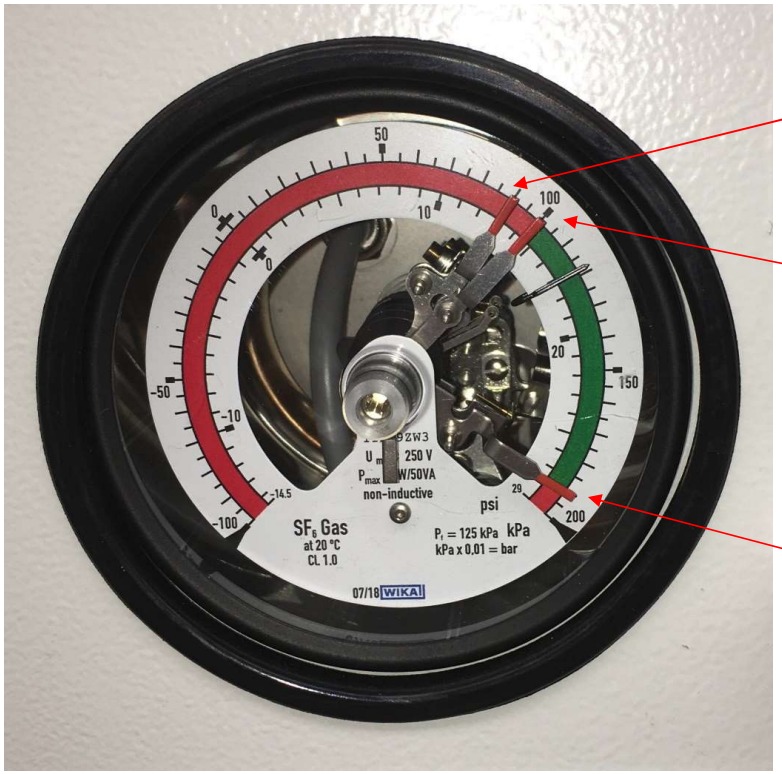
Medium-Voltage Gas-Insulated Switchgear
Manometers (Pressure Gauge)

- Temperature compensated
- 0.1% annual leakage guaranteed
- Up to three sets of adjustable alarm contacts (High, low, low-low)
- Alarm contacts can be wired to protective relay, HMI
- Standard 3 contacts
- One manometer per circuit breaker
- Three manometers per main bus
- Temperature compensated manometers available

Does not require control power - ie. density meters



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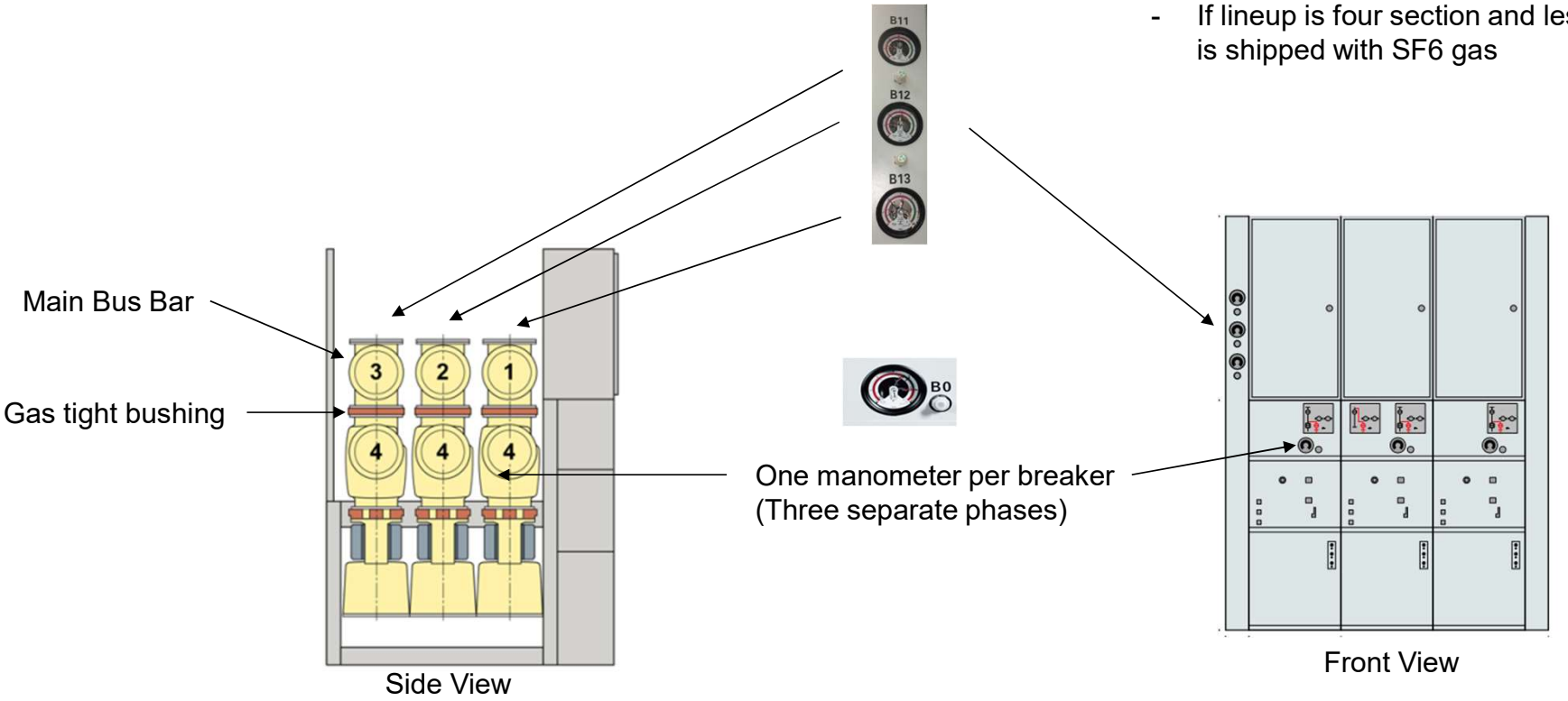
Medium-Voltage Gas-Insulated Switchgear
Gas Compartmentalization (Zones)

Single-busbar switchgear
Arrangement of gas-filled compartments

- Breaker section shipped with SF6 gas
- If lineup is four section and less main bus is shipped with SF6 gas



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Medium-Voltage Gas-Insulated Switchgear
Three-Position Selector Switch - Viewing Visible Disconnect (Camera)

- Complies with NEC visible disconnect requirement - NEC 225.51 & 230.204

Use of PC to view position of selector switch

No control power required - cameras powered by laptop

No need to open LV cabinet and view through "Peep Holes" and use a Flash lights

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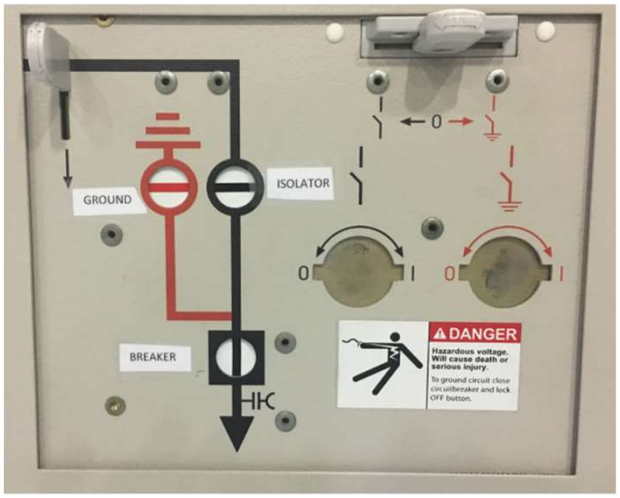
Medium-Voltage Gas-Insulated Switchgear

Three-Position Selector Switch - Viewing Visible Disconnect (Camera)

- Video cameras installed outside of the gas housing, with plug & play
- Connections to any Windows® operating system laptop. Used for
  - Bus Side Disc. Switch (Q1)
  - Bus PT
  - Future Expansion Switch
  - Line Side Disc. Switch (Q9)

Video camera mounting



Breaker & Three Position Panel

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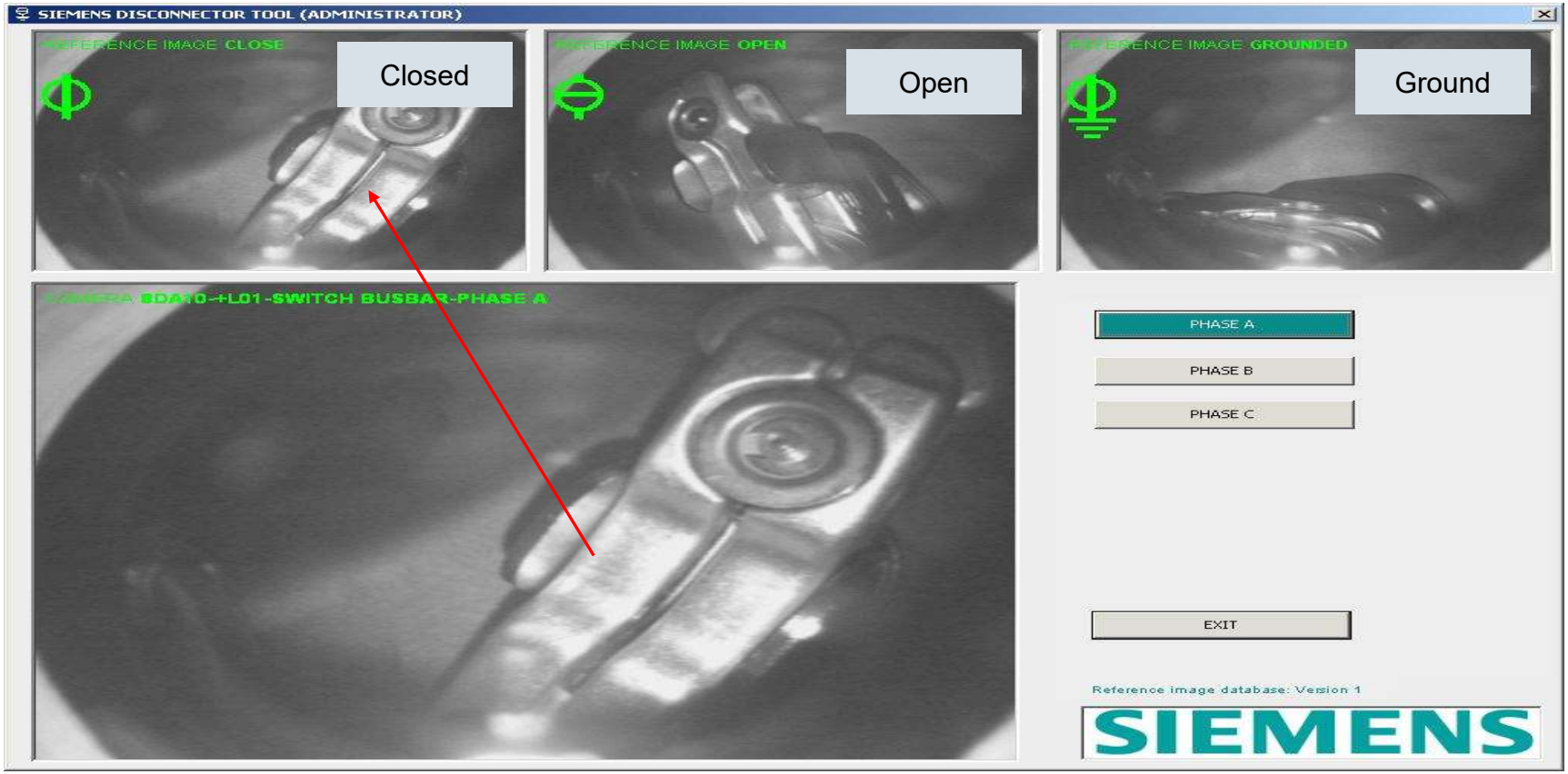
Medium-Voltage Gas-Insulated Switchgear
Viewing Selector Switch Position Via Video Camera

SIEMENS

Reference Screens

Live Screen



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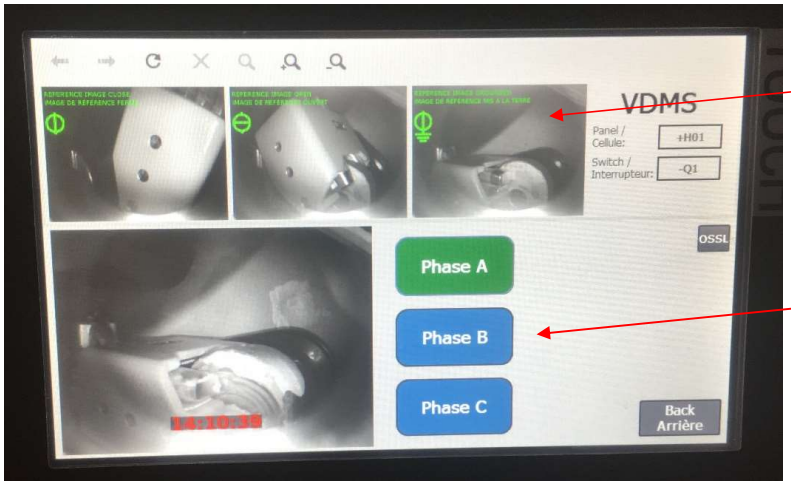
Medium-Voltage Gas-Insulated Switchgear
View Port Via Video Camera - Visible Disconnect
HMI Touch Screen (optional)

SIEMENS



Reference Image
(On-Off-Ground)

Live Image
of Phase-B in Ground Position

HMI Touch Screen (option)

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Interlocks (Selection)

Interlocks are designed according to IEC 62 271-200

Standard interlocks

- Three-position disconnector against circuit-breaker – mechanical
- Disconnector against earthing switch (within three-position disconnector) – mechanical
- Locking device at the circuit-breaker switch
- Locking device at the three-position disconnector switch

Additional interlocks

- Electromagnetic interlock at the three-position switch / disconnector switch
- Electromagnetic interlock at the three-position switch / earthing switch

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Medium-Voltage Gas-Insulated Switchgear
Lockout/Tagout

How to Lockout & Tagout

Open isolator switch

Close ground switch

Close circuit breaker

Place padlock

Grounded and padlocked via mechanical interlock

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Medium-Voltage Gas-Insulated Switchgear
Current Measurement (CT's)

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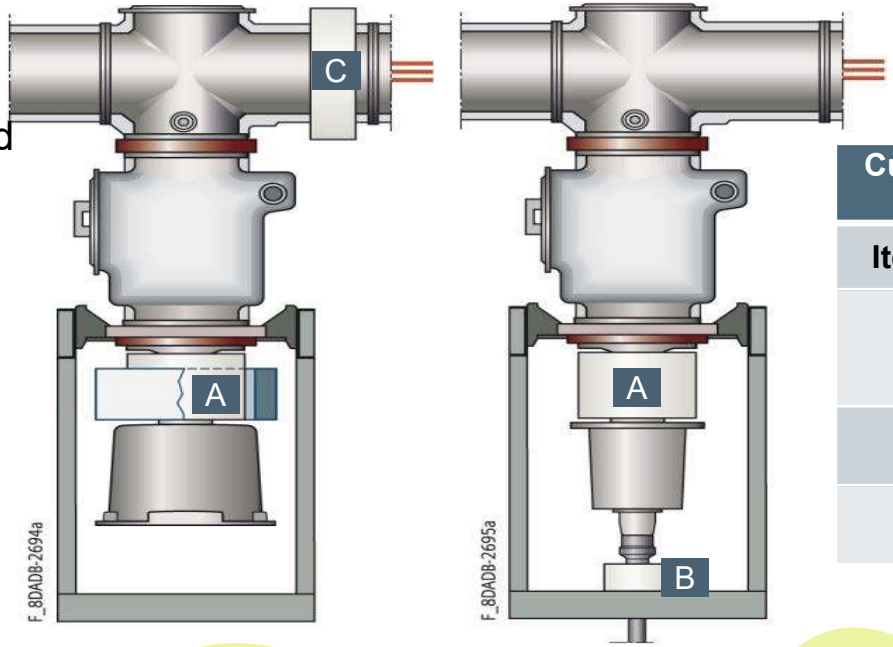
Ring-core current transformers:

- Current transformers located <u>outside gas zone</u>
- Secondary part accessible outside the enclosure (& gas zone) without exposure to primary voltage
- Free of dielectrically-stressed cast-resin parts



Current transformer installation (basic scheme)	
Item	**Description**
A	Feeder current transformer on the cable housing
B	Feeder current transformer on the cable
C	Busbar current transformer

CT's outside Gas zone Easy to inspect

Competitors: Major surgery" required if CTs must be replaced inside gas zone

Ring Type not Block Type CT's

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Medium-Voltage Gas-Insulated Switchgear
Current Measurement - Bus side

Bus side ct's
(Adds 12" height)

Line side ct's

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Medium-Voltage Gas-Insulated Switchgear
Current Measurement - Zero-Sequence (Ground Sensor) CT

SIEMENS

- AKA - Ground Sensor
- Typically 50:5A ratio

Line side ct's

Zero-Sequence ct's

Rear View of Switchgear

Rear View of Switchgear

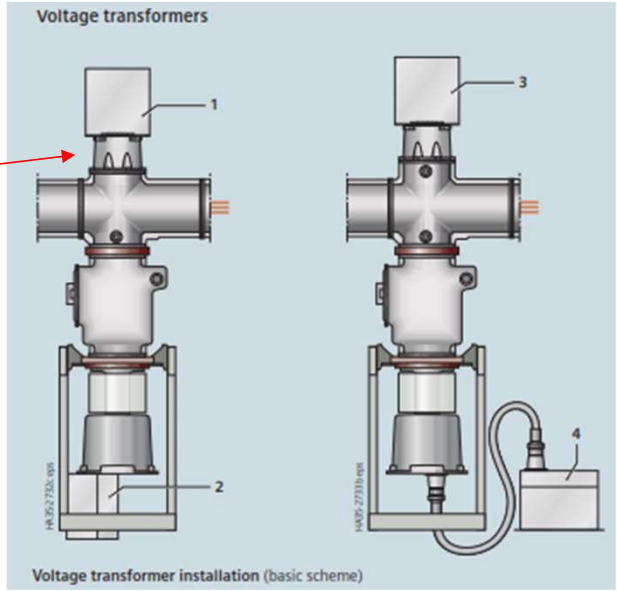
© Siemens Industry, Inc.

Medium-Voltage Gas-Insulated Switchgear
Busbar & Line-Side (Cable-Side) Potential Transformers (PT's)

SIEMENS

- Mounted separately & connected via a plug-in cable
- Grounded metal-enclosed
- Connected line-ground
- VT solid insulated with grounded metal-enclosure
- Outside main circuit
- No gas work required to remove or install

Three-Position Switch (ON-Off-Ground)



1 2

Voltage transformer with primary fuse

PT's Primary fused - NEC requirement

Item	Description
1	Bus connected VT
2	Cable connected VT

VT located loose underneath (Indoor application)

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Medium-Voltage Gas-Insulated Switchgear
Plug-In Cable Termination System (Pfisterer - Connex)

- Internal cone type plug-in connections per EN-50181/DIN 47637
- Sizes available up to 1,250 A per conductor (cable) and up to
  2,500 A for cast-epoxy insulated bus
  - Size 2, up to 40 mm (1.57”) O.D., up to 800 A
  - Size 3, up to 46 mm (1.81”) O.D., up to 1,250 A
  - Size 3.5, up to 50 mm (1.97”) O.D., up to 1,250 A
- Diameter is over insulation, without voltage detection tap

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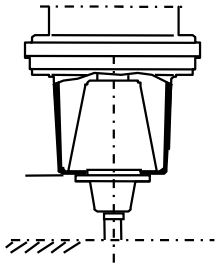
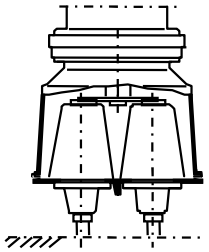
Medium-Voltage Gas-Insulated Switchgear

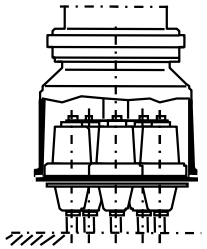
Variants Of Multiple Plug-In Cable Termination (Pfisterer - Connex)



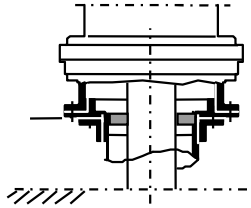
Size 3 single plug-in cable termination



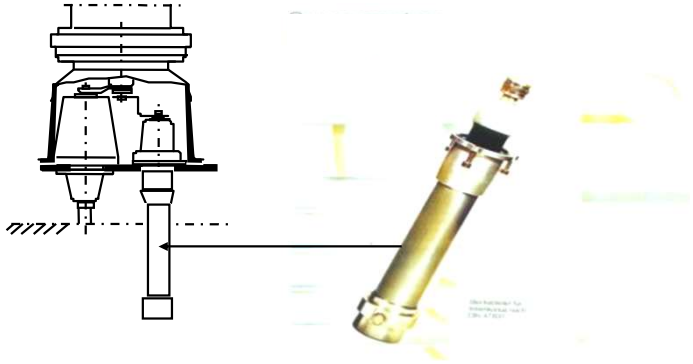
2 or 3 cables per phase with plug size 3



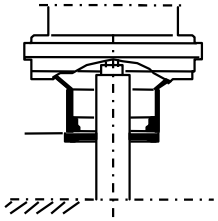
Up to 6 cables per phase 500 kcmil or 4 cables per phase 1,000 kcmil



Termination for tubular gas bar



Surge arresters



Termination for solid-insulated bar

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Medium-Voltage Gas-Insulated Switchgear
Cable Connections (Pfisterer - Connex)

SIEMENS

- No compression lugs required
- Quick Disconnect Male Plug (3 allen bolts)
- Uses Connex (Pfisterer) Plug-In Connector, typically used in high voltage applications
- Inner-cone system according to EN 50181/DIN 47637
- Metal-enclosed, all-insulated
- Dead front
- Integrated capacitive voltage tap for checking energization state

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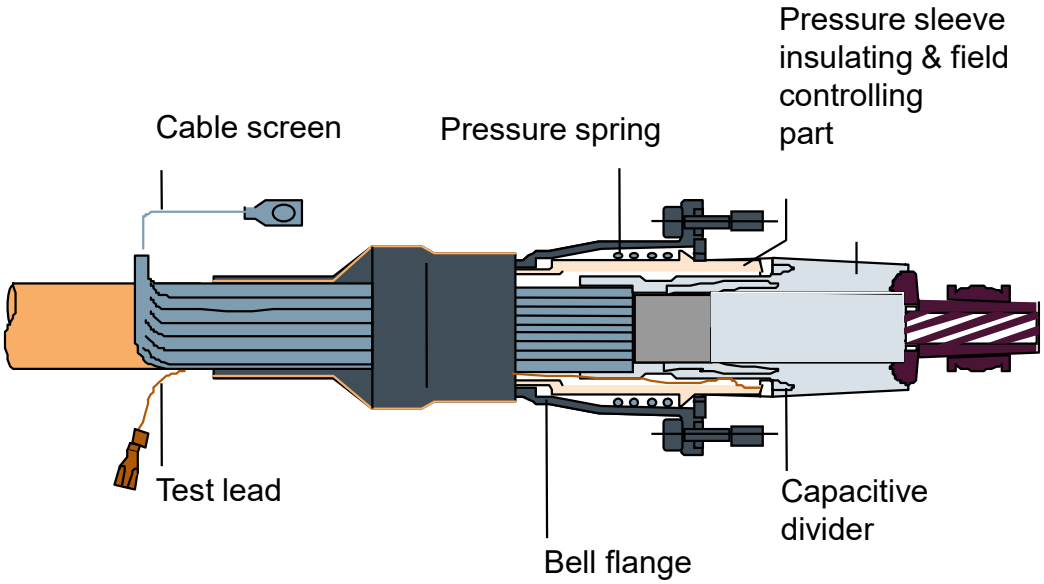
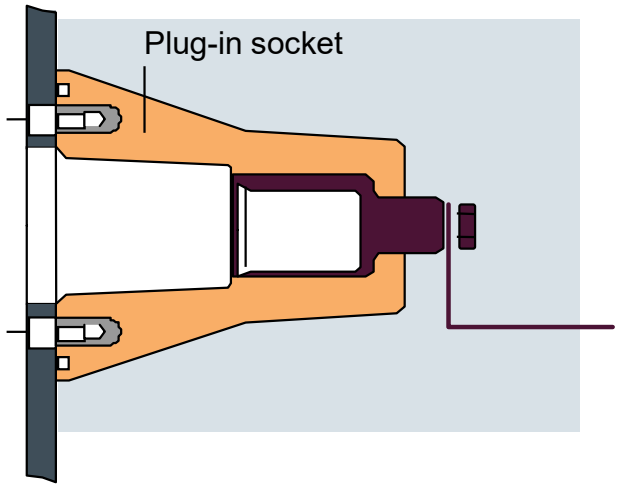
Medium-Voltage Gas-Insulated Switchgear
Plug-In Cable Termination System (Pfisterer - Connex)

- Inner-cone system according to EN 50181/DIN 47637
- Metal-enclosed, all-insulated
- Dead front
- Integrated capacitive voltage tap for checking energization state



Connex (Pfisterer) Plug-In Connector



Cable Socket in GIS

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Medium-Voltage Gas-Insulated Switchgear
Cable Connection Termination Installation Tools (Pfisterer - Connex)

SIEMENS

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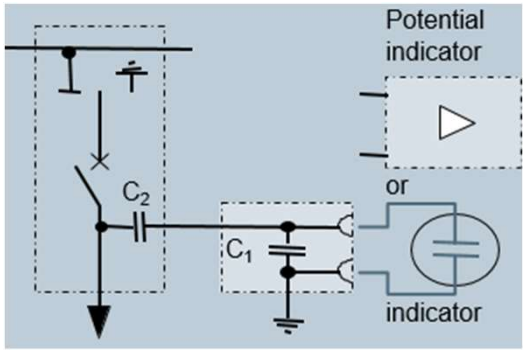
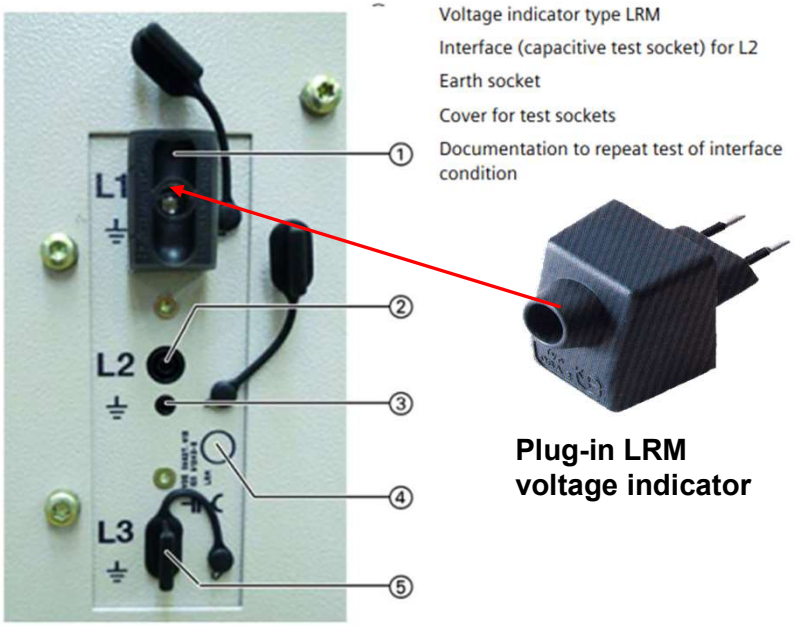
Medium-Voltage Gas-Insulated Switchgear
Capacitively Coupled Voltage Indication System

SIEMENS

- Coupling electrode built into pole-support plate of the circuit breaker
- For checking the energization state of each pole
- **No hot stick required** to check voltage presence
- Plug-in LRM voltage indicator pulses when voltage is present

Cut-Away





Front of Switchgear (LRM Port)

Plug-in LRM voltage indicator

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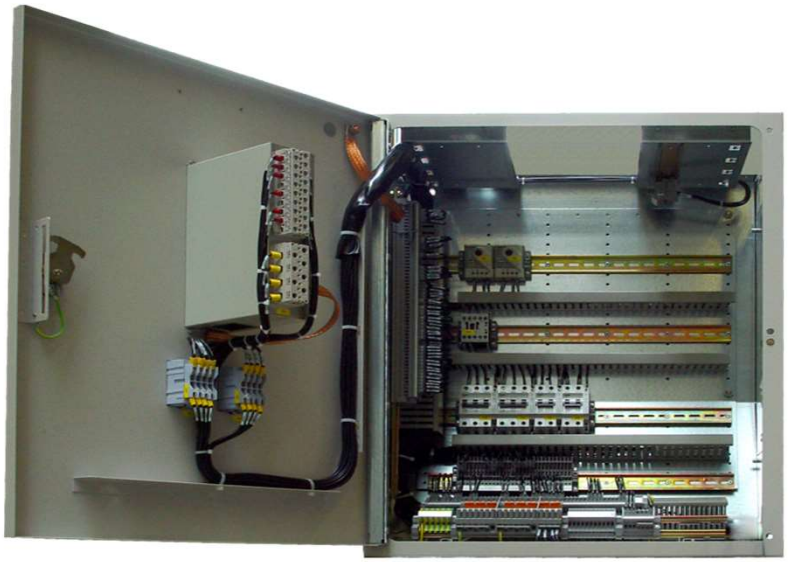
Medium-Voltage Gas-Insulated Switchgear
Low-Voltage Compartment

SIEMENS

- Height: 47.2” (1,200 mm)
  33.5” (850 mm) (option)
- Fit 19” Wide Protective Relays
- Removable, bus wires & control cables plugged in (via 6- or 10-pole coded module plug connectors)
- Circuit breaker control via conventional control devices or digital bay controller
- User-specific equipment
  (i.e., protection, control, metering, & annunciation)
- Wiring in SIS or H07VK, optionally also halogen-free



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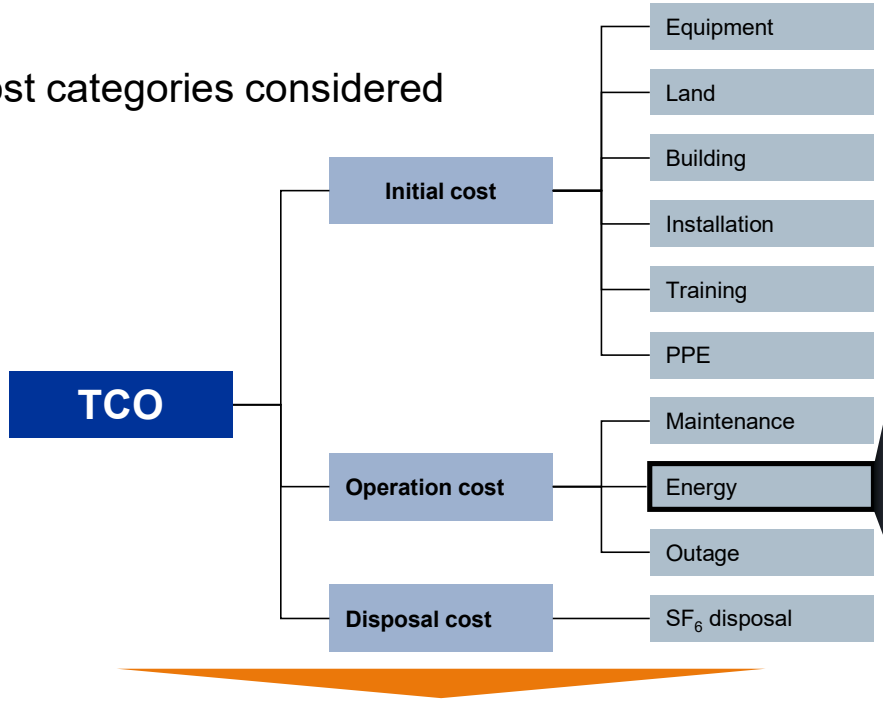
Medium-Voltage Gas-Insulated Switchgear
Consider These Investment Decision Advantages

SIEMENS

TCO - Total Cost of Ownership

Cost categories considered



Net present value for MV AIS and MV GIS as well as **breakeven year** are calculated

Example: Energy cost for space heater

	MV AIS	MV GIS
Requirement of space heater	▪ Recommended for indoor ▪ Mandatory for outdoor	▪ Sometimes needed (only in the secondary device area)
Power of space heater per unit	▪ 400 W/panel for up to 15 kV ▪ 750 W/panel for up to 38 kV	▪ 30 W or 100 W/panel
US average cost for industrial users	7 cents/kWh	
Yearly energy cost	▪ $ 247/panel up to 15 kV ▪ $ 464/panel above 15 kV up to 38 kV	$ 19 or $ 62/panel

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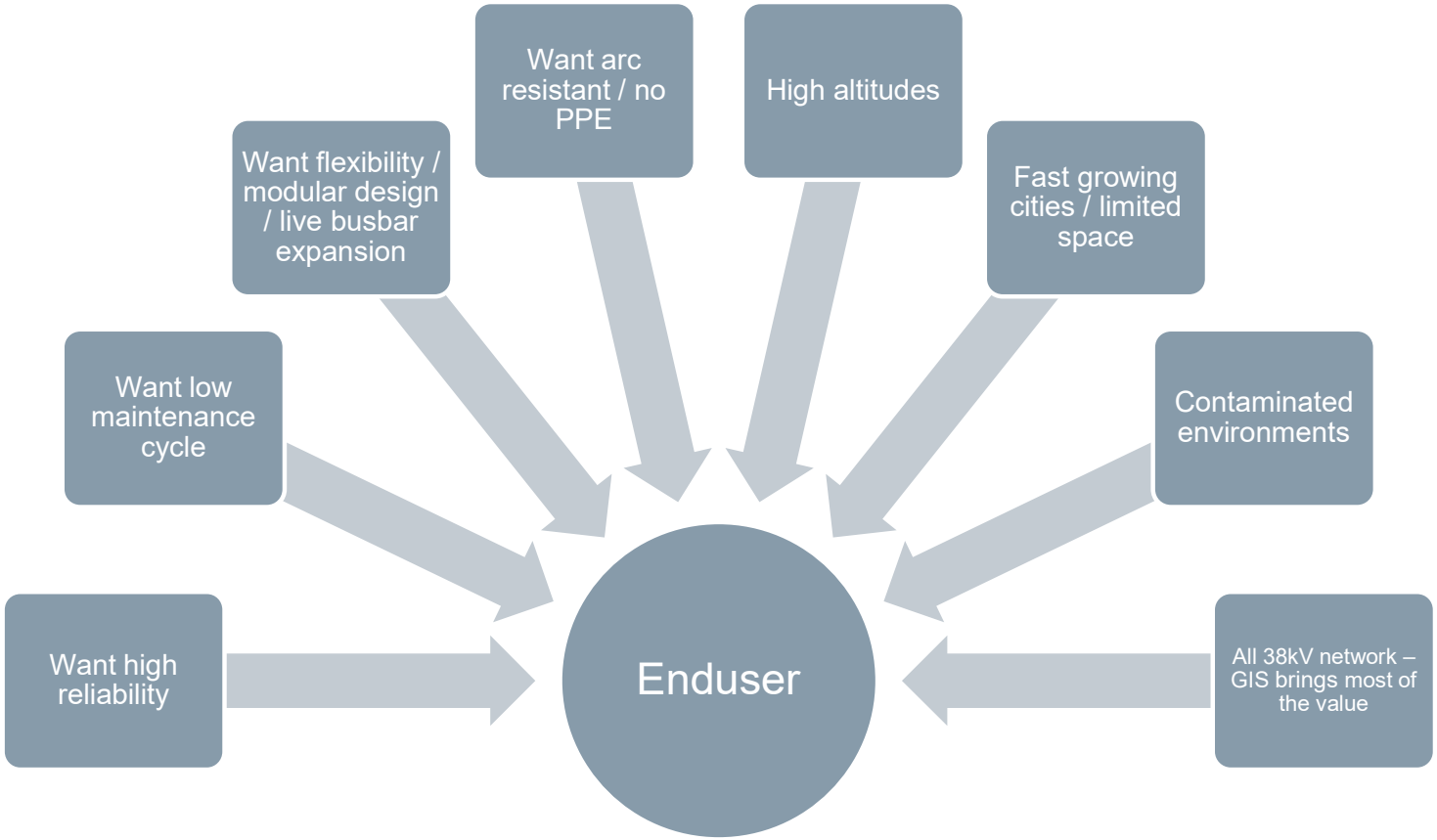
GIS Benefits



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Why Siemens MV GIS?

Superior Design

SAFETY & SECURITY

- ✓ Inherently Arc Resistant type 2B, C37.20.7-2007
- ✓ Factory UL listed
- ✓ Unique laptop interface for visual means of disconnect for disconnect & ground switch

RELIABILITY

- ✓ Unique ISO phase design – impervious to Environment – No chance for Phase to Phase Faults
- ✓ The highest MTBF in the industry
  MBB 93,250 y and Complete Section 9,000 y
- ✓ In case of emergency, 100% manual operation possible – 180° turn of switch operator
- ✓ Unique "Positive Pressure Manometer". No need of auxiliary supply

TOTAL COST OF OWNERSHIP

- ✓ Lowest Total Cost of Ownership – Designed to be "Virtually Maintenance Free" (5 year visual & 10 year SF_6 gas condition inspection)

LIFECYCLE SERVICE & SUPPORT

- ✓ Dedicated Application Engineering & PMP Certified Project Management
- ✓ Frankfurt factory certified GIS Field Technical Support located across USA
- ✓ Nucor installbase 105 sections – common spares, staff already trained

Lived Quality Assurance
Based on ISO 9001 and 14001

SIEMENS

Incoming material

Raw material
Semi-finished products
Purchased parts
Assemblies from suppliers

Testing station for incoming material
Optical, dimensional inspection
according to test specifications in drawings

Material testing station
Mechanical,
chemical,
climatic tests

Pre-production

Production testing station for metal and copper production
Dimensional inspection

Routine test, cast-resin parts
Visual inspection
X-ray test
HV/PD test
Helium tightness test

Testing station for surface treatment
Coating thickness
Surface structure
Colour deviations

Production / Switchgear installation

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Medium-Voltage Gas-Insulated Switchgear

Medium-Voltage Gas-Insulated Switchgear

SIEMENS

Increased safety	Easy to use	Cost effective	Improved reliability	Innovative features	Increased flexibilty
• Arc resistant type 2B • Isolated-phase design	• Vacuum interrupters capable of 30,000 mechanical operations or 50 full-fault operations	• Low maintenance product life cycle, 10 year no maintenance	• Sealed pressure system protects against environmental influences (IP65)	• Compact • Video camera for visible disconnect • Capacitive voltage indication (no hotstick required) • Integral grounding switch	• More compact than conventional switchgear 75% smaller Compact footprint: 24” wide x 64” (8DA) or 105” (8DB) deep

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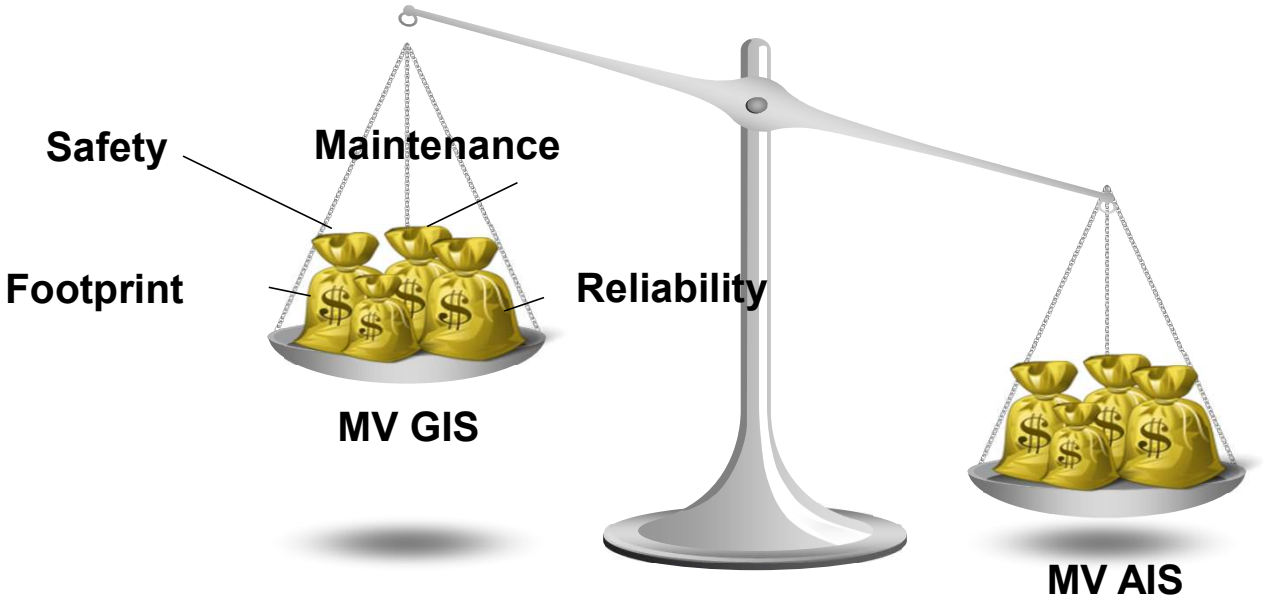
Medium-Voltage Gas-Insulated Switchgear
Consider These Investment Decision Advantages



Consider not just the one-time purchase cost,
but also **the total life-cycle cost**

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GIS - Installed Base in the USA
Since 1992 (Status November 2019)

SIEMENS

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Contact Information

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Medium-voltage, gas-insulated, arc-resistant switchgear
Type 8DA https://www.youtube.com/watch?v=FTEZzVZPetw

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Ratings

- 4.16 kV to 38 kV
- Up to 200 kV lightning-impulse withstand voltage
- Interrupting ratings up to 40 kA

Compact footprint saves real estate

Up to 75% smaller footprint compared to traditional air-insulated switchgear

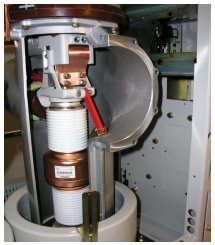
Improved safety for operators

- Tested to ANSI/IEEE C37.20.7-2017/IEC 62271-200 for internal arcing faults
- Arc-resistant internal arc classification type 2B (front, side, rear with low-voltage compartment door open)
- Reduced level of PPE permitted by NFPA 70E® for arc-resistant switchgear
- Single-phase design eliminates phase-to-phase faults inside the switchgear
- The position of the switches is indicated by contact position indicators and can also be visibly verified from the front of the unit using a convenient camera system and laptop computer.
- Capacitive voltage indicators – avoids need for hot-stick for checking energization of primary
- Integral grounding switch – grounding cables are unnecessary

Low maintenance

- Visual inspection every 5 years; condition inspection every 10 years
- After 1,000 operating cycles of the disconnectors & grounding switches or after 10,000 operating cycles of the circuit breaker
- Sealed pressure system protects against environmental influences (IP65)

Vacuum for interruption; SF_6 for insulation



- Vacuum interrupter mounted in circuit breaker pole housing
- No oxidation inside of enclosure
- Non-poisonous, non-flammable, inert, self-restoring insulation
- Dielectric strength six times that of air
- Low current arcs are self-extinguishing
- SF_6 only insulates therefore no arcing by-products
- Gas leakage rate < 0.1% annually; 24/7 monitoring of gas pressure via internal manometer connected to alarm contacts
- Gas insulation eliminates derating due to altitude

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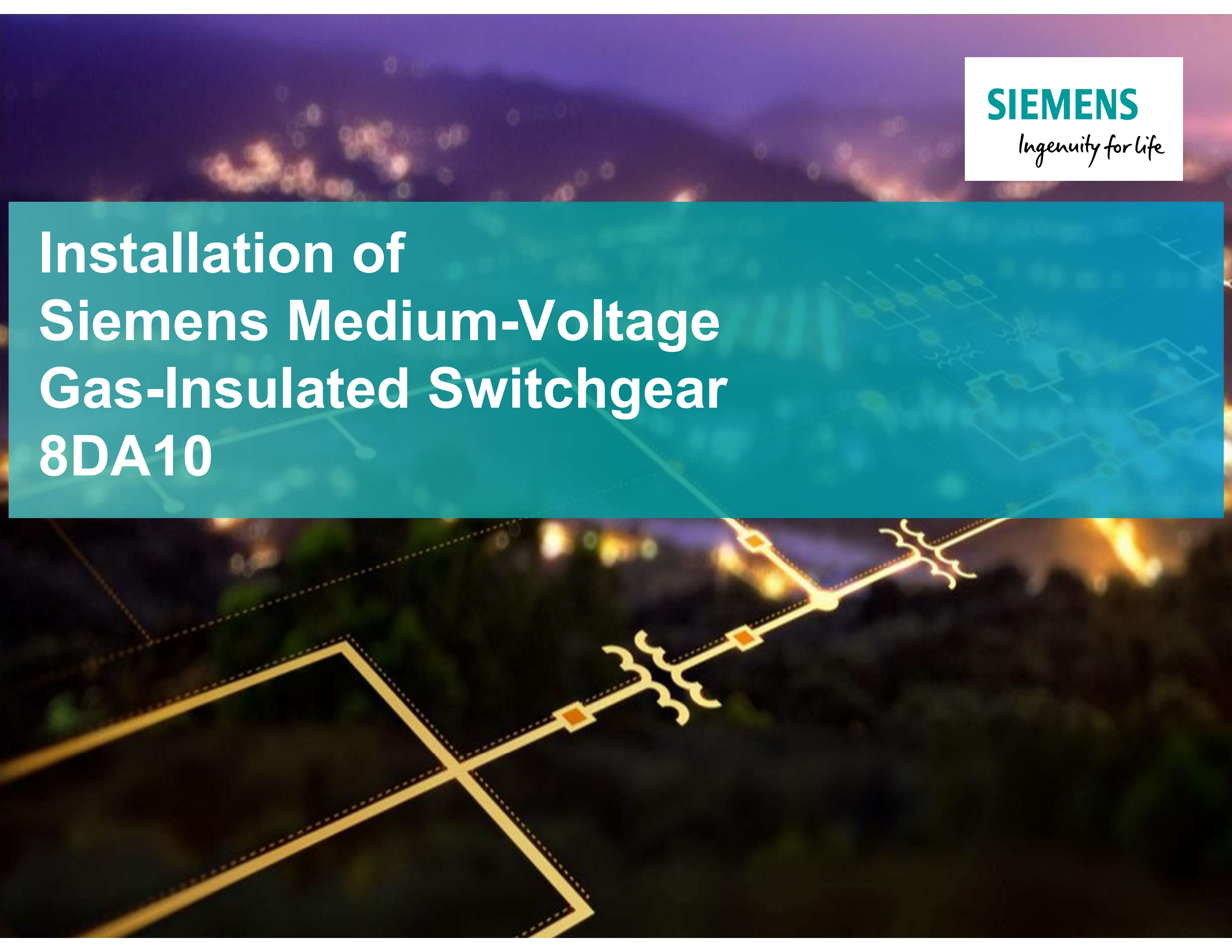

Installation of Siemens Medium-Voltage Gas-Insulated Switchgear 8DA10

SIEMENS

www.usa.siemens.com/mvswitchgear

Medium-Voltage, Gas-Insulated, Arc-Resistant Switchgear, Types 8DA10 & 8DB10

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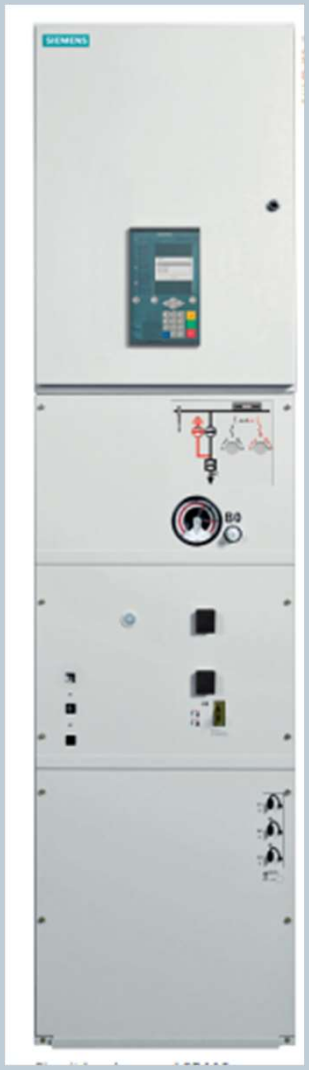
Answers for infrastructure and cities.

Installation Supervision



Supervision of Installation

SIEMENS

A Siemens authorized GIS technical field service engineer for installation of GIS and installation/startup for Siemens 8DA10.

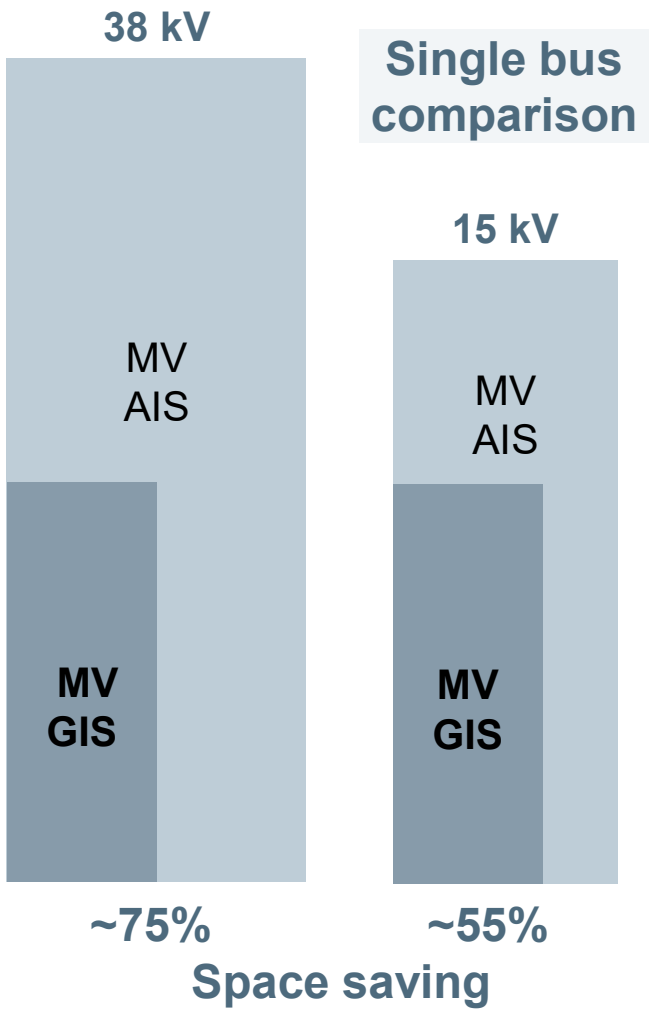
- Supervision of assembly technical assistance at PEC manufacturer (if applicable)
- Supervision of installation, GIS functional check/tests and supervision during commissioning at final Jobsite.
- Installation of power equipment center at final job site (where applicable)

Medium-Voltage Gas-Insulated Switchgear

MV GIS Smaller Than MV AIS – Compact Footprint

SIEMENS

Footprint comparison (MV AIS & MV GIS - only equipment size considered)



Cable Vault Installations (Indoor)
8DA10/8DB10

SIEMENS

Concrete pad is not an option (need bottom cable access)

- Siemens 8DA10/8DB10 requires bottom primary cable entry (some top entry limited configuration)

Four types of installations

1. Cable vault / Pit / Basement installation (indoor) - (minimum depth five feet due to cable bending radius)

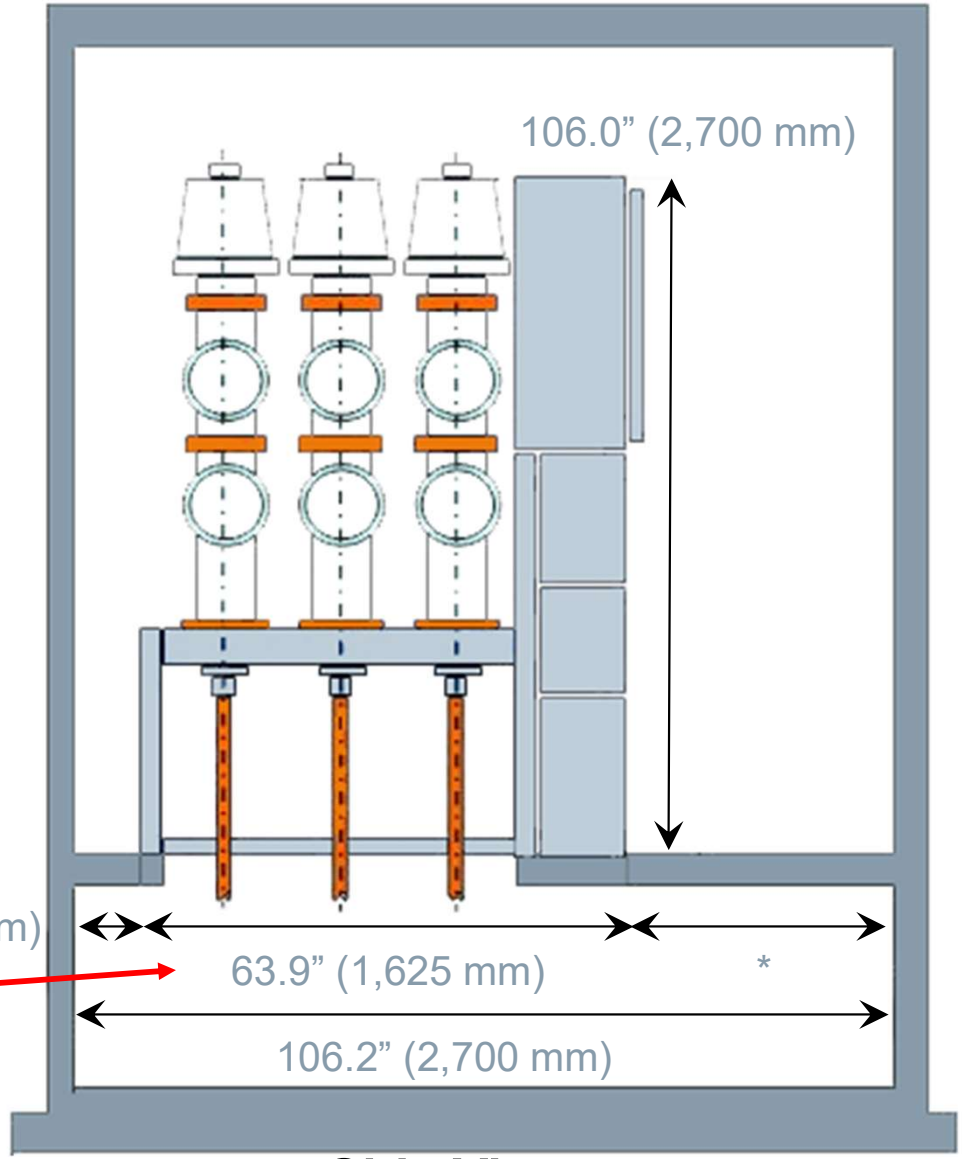
2. Raised Metal platform installation (indoor)

3. e-House/Power Equipment Center (PEC) installation (outdoor)

4. GIS Mobile Substation

Cable Vault Installations (Indoor)
8DA10/8DB10

SIEMENS



Rear

Front

Cable Vault

Side View

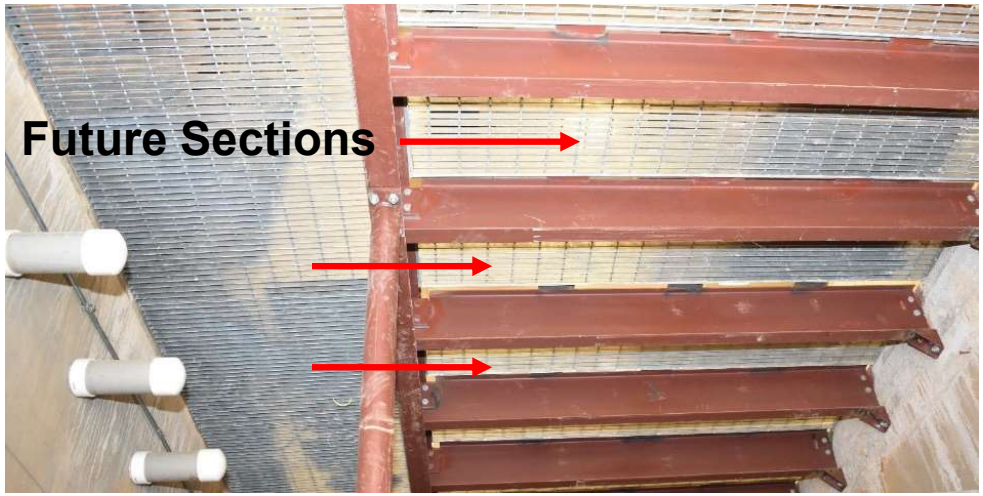
* Workspace required by design. NEC & NESC may require larger working area.

Switchgear with Cable Vault

Before Equipment Installation

After Equipment Installation
(8+ years later)

Switchgear with Cable Vault



Switchgear with Cable Vault

Floor Grates = Future Section

Future Section
approx. 24” width

Protective Relay Cabinets remote from switchgear

SIEMENS

Protective Relay Cabinets
(stand alone)

Protective Relay Cabinets
(stand alone)

Installations - Setting the switchgear
Cable Vault

Installations -
Setting the switchgear Cable Vault

SIEMENS

Installing temporary steel plates

Installations -
Setting the switchgear Cable Vault
Double Bus - 8DB10

SIEMENS

Double Bus (8DB10) installation

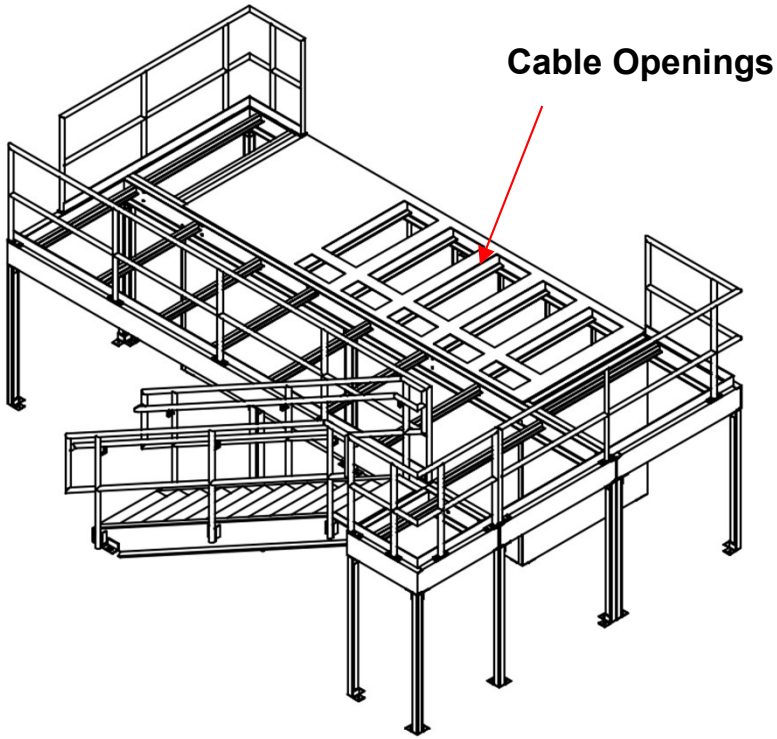
Installations -
Setting the switchgear Cable Vault
Single Bus - 8DA10

SIEMENS

Single Bus (8AB10) installation

Installations:
Raised (Elevated) Platform (Indoor)

- No excavation required – prefered if high water table
- Raised platform can be supplied by Siemens shipped similar to erecto set
- Siemens or customer supplied raised platform
- Recommend mimimum of five feet mimimum bottom clearance for cable access



Installations:
Raised (Elevated) Platform (Indoor)

SIEMENS

Switchgear across the aisle
(15kV & 38kV)

Installations:
Raised (Elevated) Platform (Indoor)

Rear Aisle
(Unfinished)

Rear Aisle
(Finished)

Installations
Raised (Elevated) Platform - Installation (Unfinished)

Unfinished Installation

Installations
Raised (Elevated) Platform - Installation (Finished)

Finished Installation

Installations
Raised (Elevated) Platform

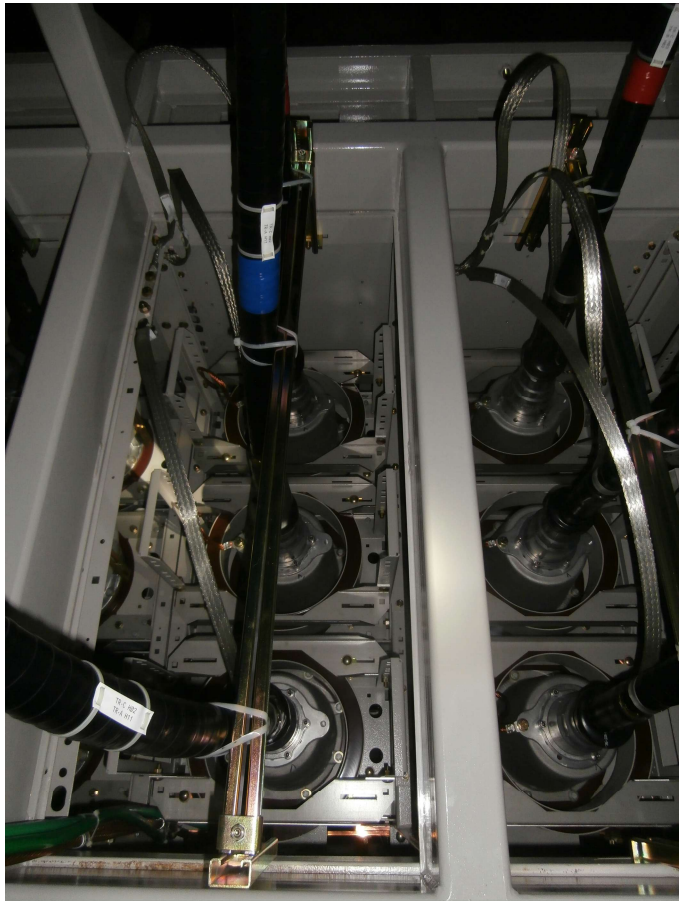
Raised Platform with optional grounding cabinets

Installations
Raised (Elevated) Platform

Raised Platform with optional grounding cabinets

Installations
Raised (Elevated) Platform - Bottom View

Fig. 38: Frame construction with longitudinal girders (cable basement)



Bottom View
(Cable Connections)

Power Equipment Center (PEC) Installations
aka e-House, power distribution centers (PEC)

SIEMENS

- PEC can include switchgear, relay cabinets, cable trays, battery systems are pre-installed by the PEC manufacturer
- Reduce field construction cost, weather delays, less expensive commissioning.
- Most cases ship building without a ship split, less trucks and crane time required.

- Partner with various manufacturers in the US
- Atkinson
- Crown
- InterMountain
- Lectrus
- Metron
- And more…

Installations - Power Equipment Centers (PEC)
Access to several manufacturers

Installations - Power Equipment Centers (PEC)
Prior to adding walls & roof

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Installations - Power Equipment Centers
Concrete piers

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Installations - Power Equipment Centers
Steel piers

SIEMENS

Installations - Power Equipment Centers
Concrete Skirt

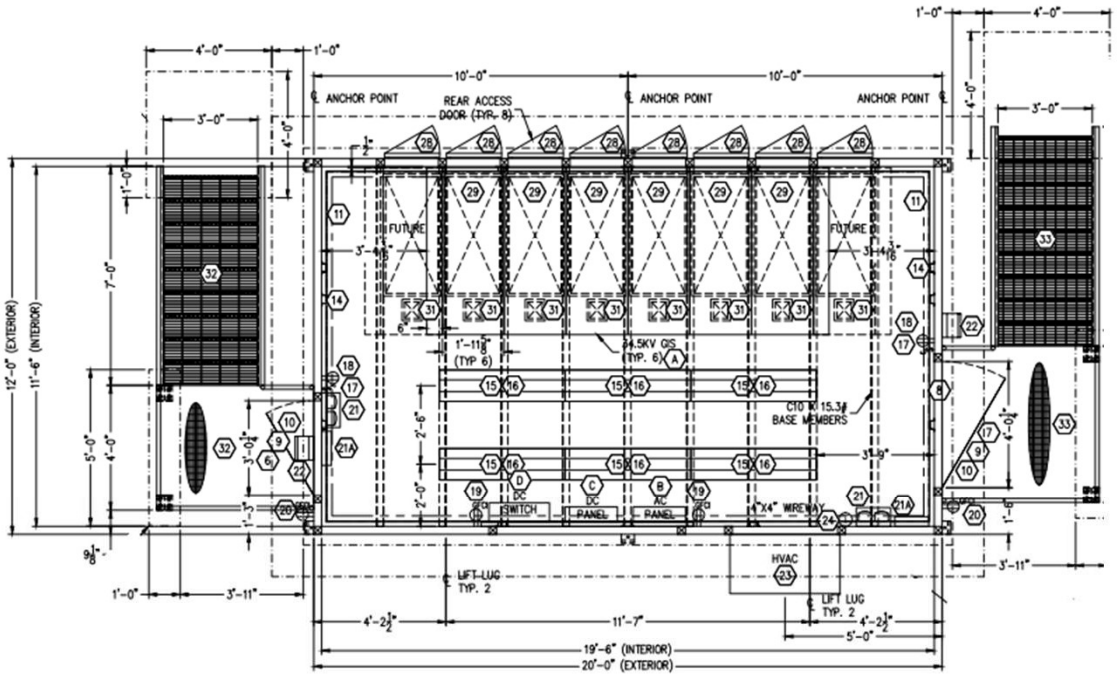
SIEMENS

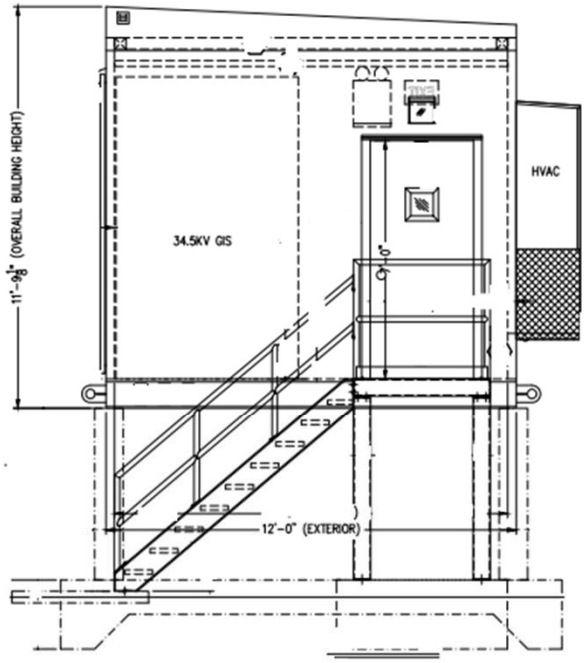
8 Circuit Breakers

W = 12 ft, L = 20 ft

Front

Installations - Power Equipment Centers
Concrete Skirt





8 Circuit Breakers

W = 12 ft, L = 20 ft

Installations - Power Equipment Centers
Future Expansion

SIEMENS

- Removable Header:
  - Ability to install future sections

Installations - Power Equipment Centers
Future Expansion - Rear Doors

- Future Rear Doors:

Installations - Power Equipment Centers
Future Expansion - Floor Cutouts

SIEMENS

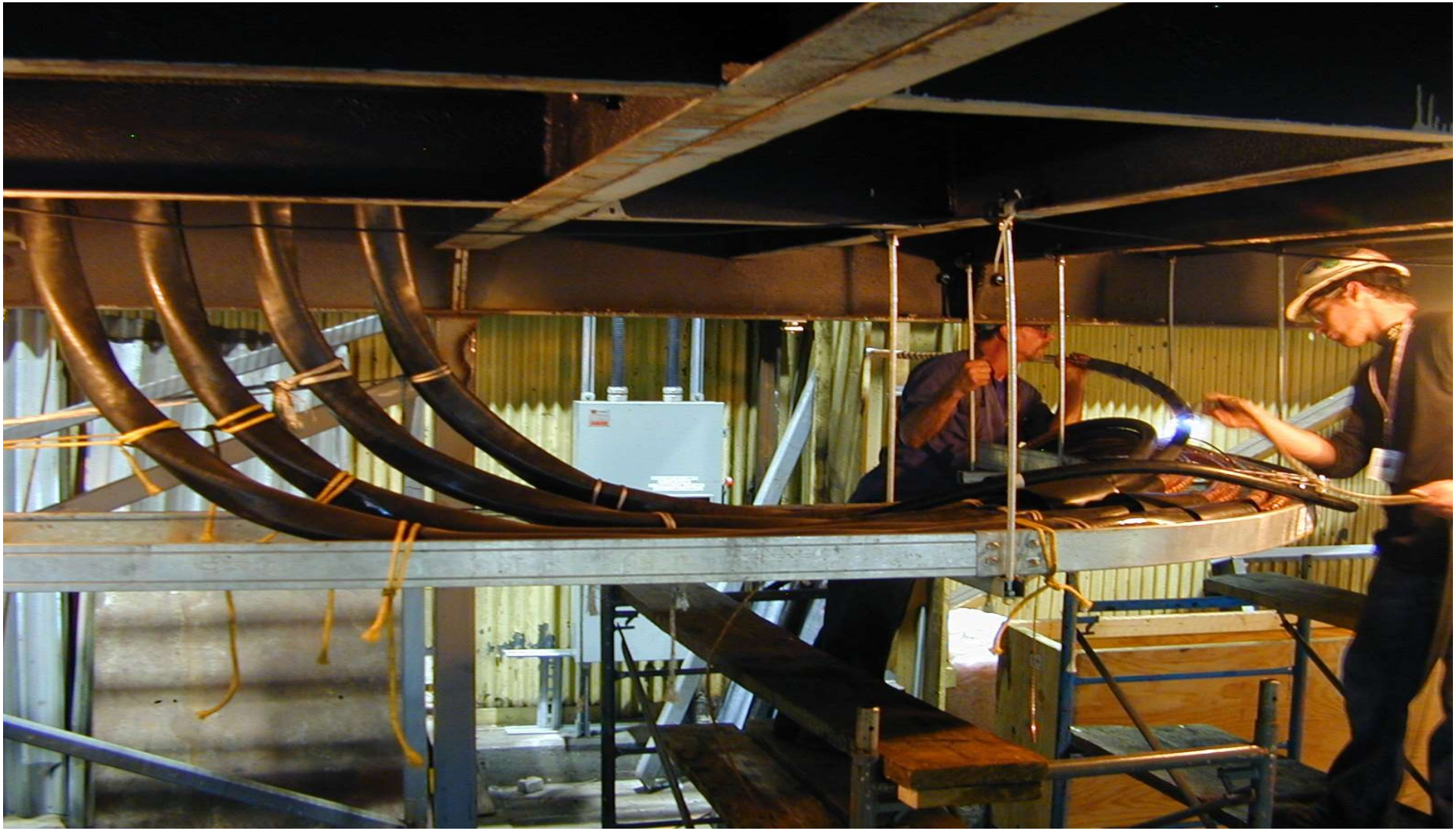
- Future Floor Cutouts:
  - Primary Cable
  - Secondary Cable

EXIT

EXIT

DANGER
HIGH VOLTAGE

Installations - Power Equipment Centers
Primary Cable - Cable Tray



Installations - Power Equipment Centers
Sealing Bottom Entrance

SIEMENS

Cable gland plate supplied & installed after primary cables by the general/electrical contractor

Before

After

Enclosed Mobile Substation

- Expandable Aisle
- Dual operating voltage 27kV & 13.8kV
- Dual voltage auxiliary transformer (27kV & 13.8kV)
- Dual voltage transformer (vt) (27kV & 13.8kV)
- HMI cabinet
- Quick primary cable connections

Enclosed Mobile Substation

SIEMENS

Expandable Aisle

Enclosed Mobile Substation

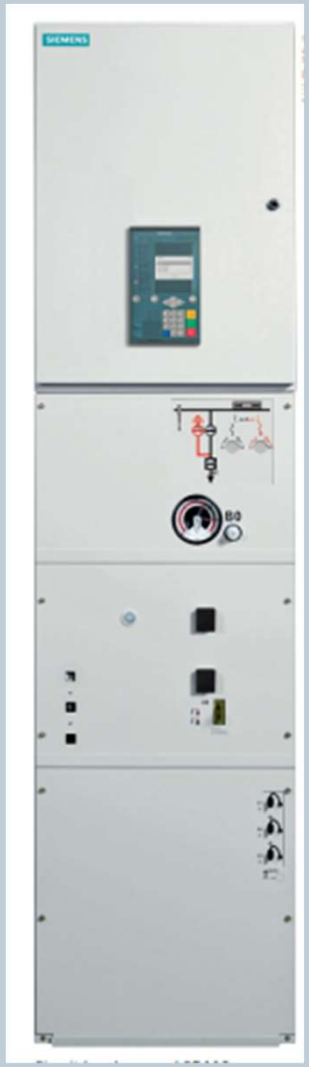
SIEMENS

Expandable Aisle

Switchgear

Aisle

Rigging



Lifting/Jacking

Fig. 43: Position of transport holes

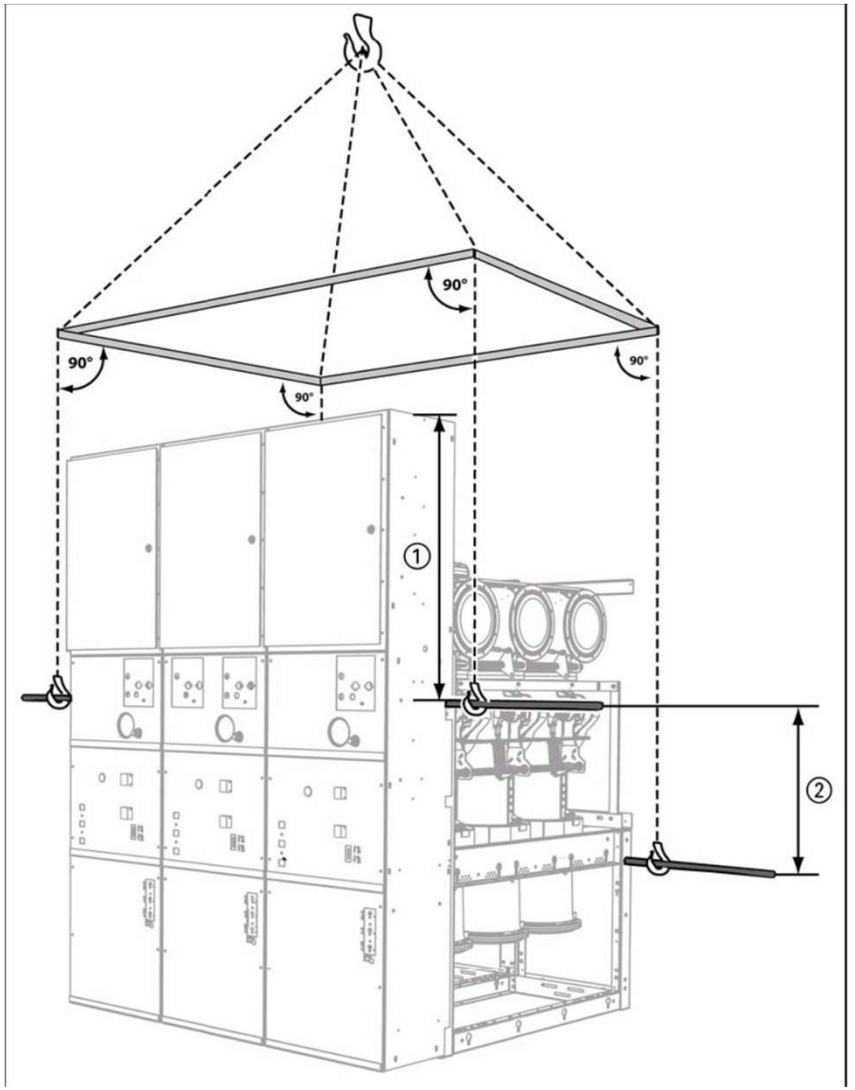
Fig. 44: Marking of transport holes

Two round steel bars with a diameter of 25 mm are required

Lifting/Jacking

Lifting/Jacking

Example spreader bar



Power Equipment Centers - Rigging

SIEMENS

Power Equipment Centers - Rigging

Power Equipment Centers - Rigging

SIEMENS

Installations - Power Equipment Centers

Rigging - Roof to Room

Installation -
Placing GIS in Power Equipment Center (PEC) (End walls removed)

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Anchoring/Assembly

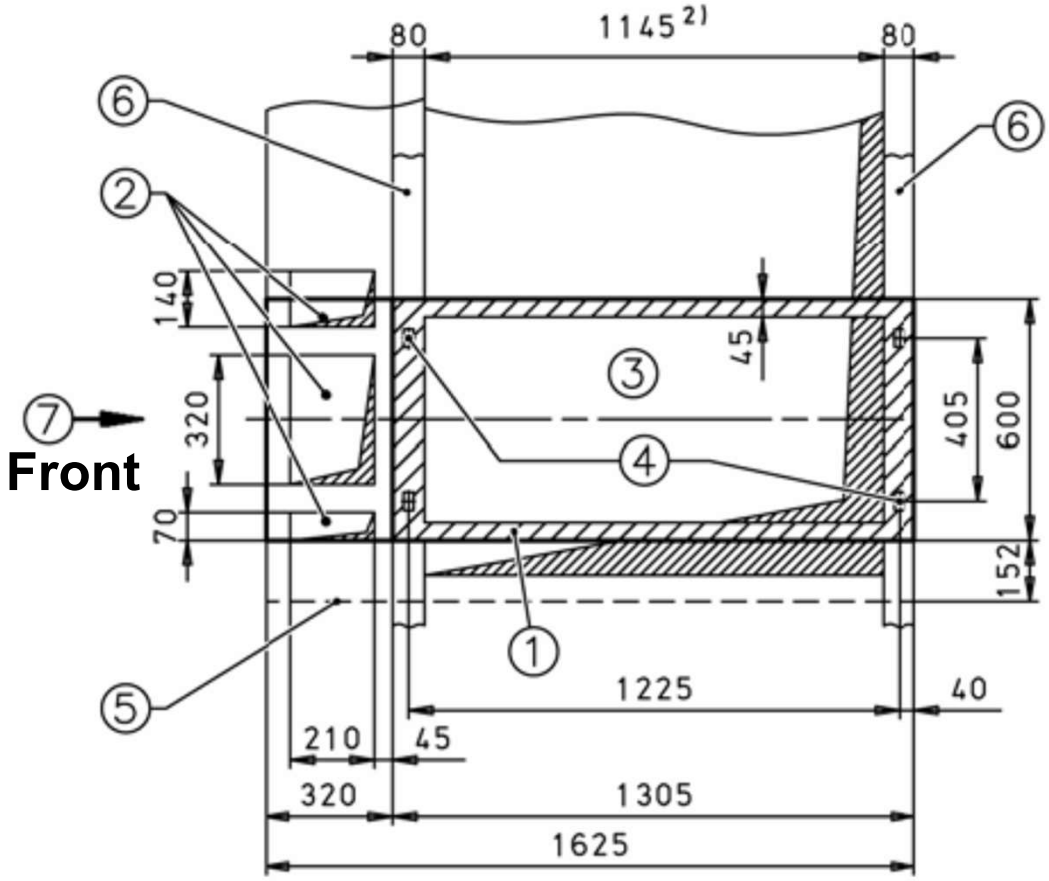
Mounting/Fixing/Anchoring

Item 4

- Anchor/fixing holes (26x45) for M10

Item 6

- Foundation rails

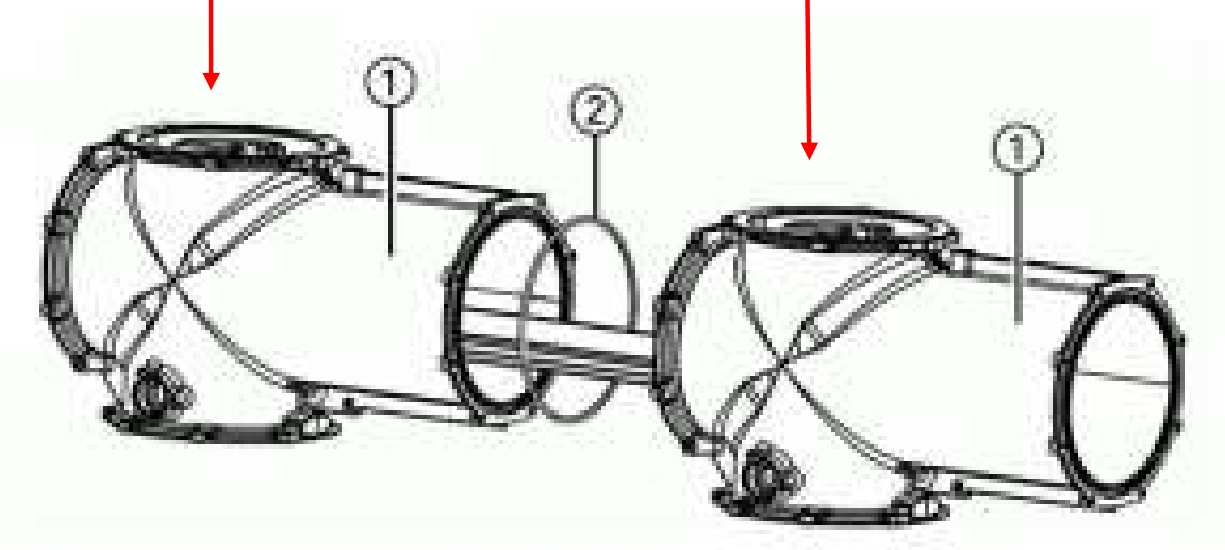


Top View

Flange connection / sealing with O-rings (Ship Splits)

Tighten busbar hardware

Tighten busbar hardware



1 Busbar housing
2 Toroidal sealing ring

Fig. 78: Flange-to-flange connection

Installation Examples

Installations

SIEMENS

Installations

SIEMENS

Installations

SIEMENS

Installations

SIEMENS

Installations

Installations

SIEMENS

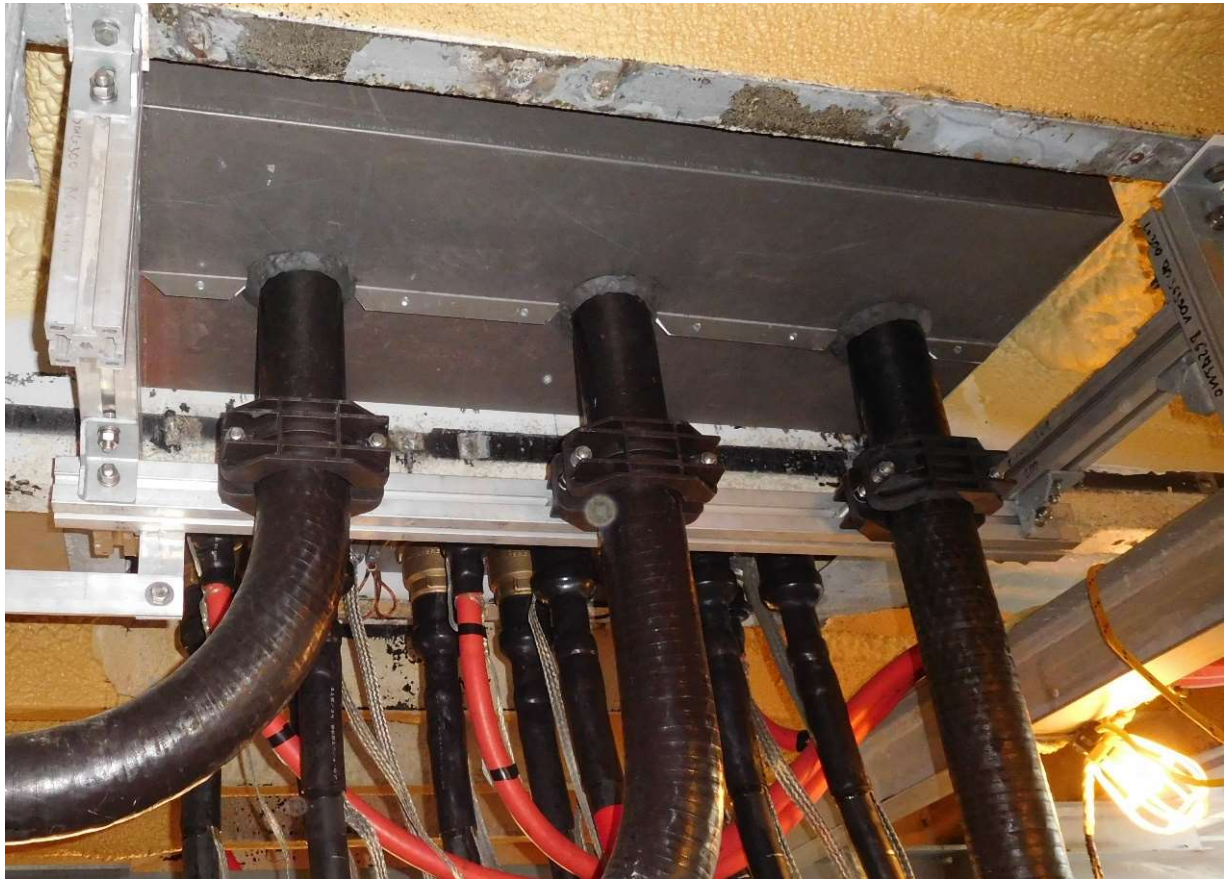
Demo Unit at Georgia Power (private tours available)

Double bus (8DB10)

Installations - Power Equipment Centers

Sealing Bottom Entrance

Continued:



After

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Answers for infrastructure and cities.

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Ingenuity for life

Catalog
HA 35.11 · U.S.
Edition January
2019

Fixed-mounted circuit breaker switchgear types 8DA and 8DB, up to 40.5 kV, gas-insulated

Medium-voltage switchgear

usa.siemens.com/mvswitchgear

Application

Typical uses

R-HA35-170.tif

Application
Public power supply system

R-HA35-132c.tif

Application
Traction power supply

R-HA35-171.tif

Application Industry

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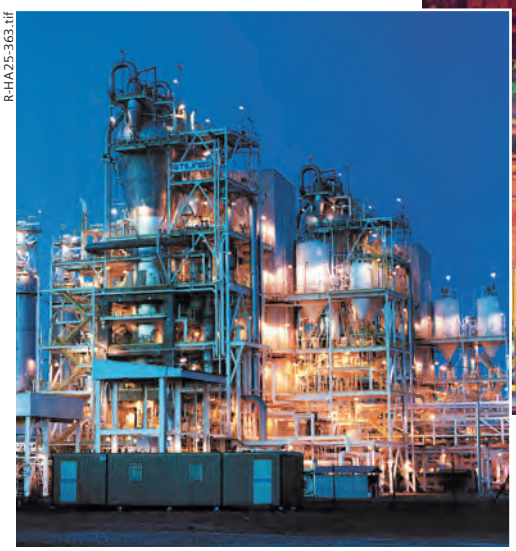

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Application
Offshore and industry

R-HA35-123.psd

Fixed-mounted circuit breaker switchgear, types 8DA and 8DB, up to 40.5 kV, gas-insulated

Medium-Voltage Switchgear

Catalog HA 35.11 · U.S.
Edition January 2019

www.usa.siemens.com/mvswitcgear

The products and systems described in this catalog are manufactured and sold according to a certified management system (acc. to ISO 9001, ISO 14001 and BS OHSAS 18001).

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Application

Versions

R-HA35-135.tif

Circuit breaker panel 8DA10

R-HA35-136.tif

Circuit breaker panel 8DB10

R-HA35-137.tif

Circuit breaker panel 8DA11/12

Fixed-mounted circuit breaker switchgear 8DA and 8DB is indoor, factory-assembled, type-tested, single-pole metal-enclosed, gas-insulated switchgear with metallic partitions[3)], for single-busbar and double-busbar applications, as well as for traction power supply systems.

It is used in transformer and switching substations, e.g., in:

- Power supply companies
- Power stations
- Cement industry
- Automobile industry
- Iron and steel works
- Rolling mills
- Mining industry
- Textile, paper, and food industries
- Chemical industry
- Petroleum industry
- Pipeline installations
- Offshore installations
- Electrochemical plants
- Petrochemical plants
- Shipbuilding industry
- Diesel power plants
- Emergency power supply installations
- Lignite open-cast mines
- Traction power supply systems.

Electrical data (maximum values) and dimensions

Single-busbar and double-busbar switchgear

Rated voltage	kV	**12**	**24**	**36**	**40.5**
Rated frequency	Hz	50/60	50/60	50/60	50/60
Rated short-duration power-frequency withstand voltage	kV	28 [1)]	50	70	85 [2)]
Rated lightning-impulse withstand voltage	kV	75 [1)]	125	170	185 [2)]
Rated peak-withstand current	kA	100/104	100/104	100/104	100/104
Rated short-circuit making current	kA	100/104	100/104	100/104	100/104
Rated short-time withstand current 3 s	kA	40	40	40	40
Rated short-circuit breaking current	kA	40	40	40	40
Rated normal current of the busbar	A	5,000	5,000	5,000	5,000
Rated normal current of feeders	A A	2,750 [4)] 3,150 [5)]	2,750 [4)] 3,150 [5)]	2,750 [4)] 3,150 [5)]	2,750 [4)] 3,150 [5)]
Width	mm	600	600	600	600
Depth (wall-standing arrangement): – Single busbar – Double busbar	 mm mm	 1,625 2,665	 1,625 2,665	 1,625 2,665	 1,625 2,665
Height: – Standard – With high low-voltage compartment	 mm mm	 2,350 2,700	 2,350 2,700	 2,350 2,700	 2,350 2,700

Single-pole and double-pole traction power supply switchgear

Rated voltage	kV	**17.25**	**27.5**
Rated frequency	Hz	16.7	50/60
Rated short-duration power-frequency withstand voltage	kV	50	95
Rated lightning-impulse withstand voltage	kV	125	200
Rated peak-withstand current	kA	80	80
Rated short-circuit making current	kA	80	80
Rated short-time withstand current 3 s	kA	31.5	31.5
Rated short-circuit breaking current	kA	31.5	31.5
Rated normal current of the busbar	A	3,150	3,150
Rated normal current of feeders	A	2,500	2,500
Width	mm	600	600
Depth: – Single pole-traction switchgear – Double pole-traction switchgear	 mm mm	 865 1,245	 865 1,245
Height: – Standard – With high low-voltage-compartment	 mm mm	 2,350 2,700	 2,350 2,700

1) 42 kV / 70 kV according to some national requirements
2) 95 kV / 190 kV according to some national requirements
3) Corresponds to "metal-clad" according to former standard IEC 60298
4) 2,750 A without forced ventilation (8DB10 on request)
5) 3,150 A with forced ventilation (8DB10 on request)

Requirements

Features

Environmental independence

The enclosed high-voltage part of 8DA and 8DB switchgear is suitable for applications under aggressive ambient conditions, such as:

- Saline air
- Air humidity
- Dust
- Condensation.

It is tight to ingress of foreign objects, such as:

- Dust
- Pollution
- Small animals.

The application is independent of the site altitude.

Compact design

Thanks to the use of gas insulation, compact dimensions are possible.

Thus:

- Existing switchgear rooms can be used effectively
- New constructions cost little
- Costly city-area space is saved.

Maintenance-free design

Switchgear housings designed as sealed pressure systems, maintenance-free switching devices and enclosed cable plugs ensure:

- Maximum supply reliability
- Personnel safety
- Sealed-for-life design according to IEC 62271-200 (sealed pressure system)
- Reduced operating costs
- Cost-efficient investment.

Innovation

The use of digital secondary systems and combined protection and control devices ensures:

- Clear integration in process control systems
- Flexible and highly simplified adaptation to new system conditions and thus to cost-efficient operation.

Service life

Under normal operating conditions, the expected service life of gas-insulated switchgear 8DA and 8DB is at least 35 years, probably 40 to 50 years, taking the tightness of the enclosed high-voltage part into account. The service life is limited by the maximum number of operating cycles of the switching devices installed:

- For circuit breakers, according to the endurance class defined in IEC 62271-100
- For three-position disconnectors and earthing switches, according to the endurance class defined in IEC 62271-102.

Safety

Personal safety:

- Safe-to-touch and hermetically sealed primary enclosure
- All high-voltage parts including the cable terminations, busbars and voltage transformers are metal-enclosed
- Capacitive voltage detecting system to verify safe isolation from supply
- Operating mechanisms and auxiliary switches safely accessible outside the primary enclosure (switchgear housings)
- Due to the system design, operation is only possible with closed switchgear enclosure
- Standard degree of protection IP 65 for all high-voltage parts of the primary circuit, IP 3XD for the switchgear enclosure according to IEC 60529
- High resistance to internal arcs by logical mechanical interlocks and tested switchgear enclosure
- Panels tested for resistance to internal faults up to 40 kA
- Logical mechanical interlocks prevent maloperation
- Make-proof earthing by means of the vacuum circuit breaker.

Security of operation:

- Hermetically sealed primary enclosure independent of environmental effects (pollution, humidity, and small animals)
- Maintenance-free in an indoor environment according to IEC 62271-1
- Two-phase and three-phase short circuits between the primary conductors of the switchgear are excluded by the single-pole primary enclosure
- In isolated or compensated systems, low-current earth-fault currents are self-extinguishing
- Operating mechanisms of switching devices accessible outside the primary enclosure (switchgear housings)
- Metal-enclosed, plug-in inductive voltage transformers mounted outside the switchgear housings
- Current transformers as ring-core current transformers mounted outside the switchgear housings
- Complete switchgear interlocking system with logical mechanical interlocks
- Bolted switchgear housings sealed for life
- Minimum fire load
- Option: aseismic design.

Reliability:

- Type and routine-tested
- Standardized, NC production processes
- Quality assurance in accordance with DIN EN ISO 9001, DIN EN ISO 14001 and BS OHSAS 18001
- Up to now, more than 100,000 8DA and 8DB switchgear panels successfully in operation worldwide.

General:

- Single-pole enclosure of the primary part by modular switchgear housings made of corrosion-resistant aluminum alloy
- Insulating gas SF_6 (fluorinated greenhouse gas in sealed pressure system according to IEC 62271-1)
- Three-position disconnector as busbar disconnector and feeder earthing switch
- Make-proof earthing by means of the vacuum circuit breaker
- Compact dimensions due to gas insulation
- Hermetically bolted switchgear housings made of corrosion-resistant aluminum alloy
- Single-pole, metal-enclosed, gas-insulated busbars
- Cable connection with inside-cone plug-in system, or for connection of gas-insulated and solid-insulated bars
- Wall-standing or free-standing arrangement
- Installation and extension of existing switchgear at both ends without modification of existing panels.

Interlocks:

- According to IEC 62271-200
- Logical mechanical interlocks prevent maloperation
- Three-position disconnector can only be operated with circuit breaker in OPEN position
- Circuit breaker can only be operated with three-position disconnector in end position and operating lever removed
- Locking device for circuit breaker
- Locking device for three-position disconnector
- "Feeder earthed" locking device
- Option: electromagnetic interlocks.

Modular design:

- Replacement of the panel connection housings or the circuit breaker possible without interrupting busbar operation
- Low-voltage compartment removable, plug-in bus wires
- Extension of double-busbar switchgear 8DB10 possible without interrupting operation
- Option: extension of single-busbar switchgear 8DA10 possible without interrupting operation.

Instrument transformers:

- Current transformers not subjected to dielectric stress
- Metal-enclosed, plug-in, and disconnectable voltage transformers.

Vacuum circuit breaker:

- Maintenance-free under normal ambient conditions according to IEC 62271-1
- No relubrication or readjustment
- Vacuum interrupters sealed for life
- Up to 10,000 operating cycles (maintenance-free)
- Option: Up to 30,000 operating cycles (maintenance required).

Secondary systems:

- Protection, measuring, and control equipment
- Option: numerical multifunction protection relay with integrated protection, control, communication, operating, and monitoring functions
- Can be integrated in process control systems.

Technical data

Electrical data, functional level, temperature for single-busbar and double-busbar switchgear

Common electrical data, functional level and temperature	Rated insulation level	Rated voltage U_r	kV	**12**	**24**	**36**	**40.5**
		Rated short-duration, power-frequency withstand voltage U_d:					
		– phase-to-earth, open contact gap	kV	28 [1]	50 [2]	70	85 [3]
		– across the isolating distance	kV	32 [1]	60 [2]	80	90 [3]
		Rated lightning-impulse withstand voltage U_p:					
		– phase-to-earth, open contact gap	kV	75	125	170	185 [4]
		– across the isolating distance	kV	85	145	195	220 [4]
	Rated frequency f_r		Hz	50/60	50/60	50/60	50/60
	Rated normal current I_r	of the busbar [9]	A	1,250	1,250	1,250	1,250
			A	2,000	2,000	2,000	2,000
			A	2,500	2,500	2,500	2,500
			A	3,150	3,150	3,150	3,150
			A	4,000	4,000	4,000	4,000
			A	5,000	5,000	5,000	5,000
	Rated functional level p_{re}	(relative) of the busbar		70/120 kPa at 20 °C			
	Minimum functional level p_{me}			50/100 kPa at 20 °C			
	Ambient air temperature			–5 °C to +55 °C [13]			

Data of the switchgear panels

Circuit breaker panel, disconnector panel [6]	Rated normal current I_r [9]		A	1,250	1,250	1,250	1,250
			A	1,600	1,600	1,600	1,600
			A	2,000	2,000	2,000	2,000
			A	2,500	2,500	2,500	2,500
			A	2,750 [10]	2,750 [10]	2,750 [10]	2,750 [10]
			A	3,150 [11]	3,150 [11]	3,150 [11]	3,150 [11]
	Rated short-time withstand current I_k $t_k = 3$ s		up to kA	40	40	40	40
	Rated peak-withstand current I_p [5]		up to kA	100/104	100/104	100/104	100/104
	Rated short-circuit making current I_{ma} [5]		up to kA	100/104	100/104	100/104	100/104
	Rated short-circuit breaking current I_{sc}		up to kA	40	40	40	40
	Electrical endurance of vacuum circuit breakers	at rated normal current		10,000 operating cycles [12]			
		at rated short-circuit breaking current		50 breaking operations			
	Rated functional level p_{re}	(relative) for feeders		70/120 kPa at 20 °C			
	Minimum functional level p_{me}			50/100 kPa at 20 °C			
Bus sectionalizer, bus coupler [7]	Rated normal current I_r [9]		A	1,250	1,250	1,250	1,250
			A	2,000	2,000	2,000	2,000
			A	2,500	2,500	2,500	2,500
			A	2,750 [10]	2,750 [10]	2,750 [10]	2,750 [10]
			A	3,150 [11]	3,150 [11]	3,150 [11]	3,150 [11]
	Rated short-time withstand current I_k $t_k = 3$ s		up to kA	40	40	40	40
	Rated peak-withstand current I_p [5]		up to kA	100/104	100/104	100/104	100/104
	Rated short-circuit making current I_{ma} [5]		up to kA	100/104	100/104	100/104	100/104
	Rated short-circuit breaking current I_{sc}		up to kA	40	40	40	40
	Electrical endurance of vacuum circuit breakers	at rated normal current		10,000 operating cycles [12]			
		at rated short-circuit breaking current		50 breaking operations			
	Rated functional level p_{re}	(relative) for feeders		70/120 kPa at 20 °C			
	Minimum functional level p_{me}			50/100 kPa at 20 °C			
Cable connection panel, metering panel	Rated normal current I_r [8] [9]		A	1,250	1,250	1,250	1,250
			A	2,000	2,000	2,000	2,000
			A	2,500	2,500	2,500	2,500
			A	2,750 [10]	2,750 [10]	2,750 [10]	2,750 [10]
			A	3,150 [11]	3,150 [11]	3,150 [11]	3,150 [11]
	Rated short-time withstand current I_k $t_k = 3$ s		up to kA	40	40	40	40
	Rated peak-withstand current I_p [5]		up to kA	100/104	100/104	100/104	100/104
	Rated functional level p_{re}	(relative) for feeders		70/120 kPa at 20 °C			
	Minimum functional level p_{me}			50/100 kPa at 20 °C			

Common electrical data, functional level and temperature	Rated insulation level	Rated voltage U_r	kV	**17.25**	**27.5**
		Nominal voltage according to IEC 60850/EN 50163	kV	15	25
		Rated short-duration power-frequency withstand voltage U_d:			
		– phase-to-earth, open contact gap	kV	50	95
		– across the isolating distance	kV	60	110
		Rated lightning-impulse withstand voltage U_p:			
		– phase-to-earth, open contact gap	kV	125	200
		– across the isolating distance	kV	145	220 [4]
	Rated frequency f_r		Hz	16.7	50/60
	Rated normal current I_r	of the busbar [9]	A	1,250	1,250
			A	2,000	2,000
			A	2,500	2,500
			A	3,150	3,150
	Rated functional level p_{re}	(relative) of the busbar		120 kPa at 20 °C	
	Minimum functional level p_{me}			100 kPa at 20 °C	
	Ambient air temperature			–5 °C to +55 °C [13]	

Data of the switchgear panels

Circuit breaker panel, disconnector panel	Rated normal current I_r [9]		A	1250	1250
			A	1600	1600
			A	2000	2000
			A	2500	2500
	Rated short-time withstand current I_k $t_k = 3$ s		up to kA	31.5	31.5
	Rated peak-withstand current I_p [5]		up to kA	80	80/82
	Rated short-circuit making current I_{ma} [5]		up to kA	80	80/82
	Rated short-circuit breaking current I_{sc}		up to kA	31.5	31.5
	Electrical endurance of vacuum circuit breakers	at rated normal current		20,000 operating cycles	
		at rated short-circuit breaking current		50 breaking operations	
	Rated functional level p_{re}	(relative) for feeders		120 kPa at 20 °C	
	Minimum functional level p_{me}			100 kPa at 20 °C	
Bus sectionalizer	Rated normal current I_r [9]		A	1250	1250
			A	2000	2000
			A	2500	2500
	Rated short-time withstand current I_k $t_k = 3$ s		up to kA	31.5	31.5
	Rated peak-withstand current I_p [5]		up to kA	80	80/82
	Rated short-circuit making current I_{ma} [5]		up to kA	80	80/82
	Rated short-circuit breaking current I_{sc}		up to kA	31.5	31.5
	Electrical endurance of vacuum circuit breakers	at rated normal current		20,000 operating cycles	
		at rated short-circuit breaking current		50 breaking operations	
	Rated functional level p_{re}	(relative) for feeders		120 kPa at 20 °C	
	Minimum functional level p_{me}			100 kPa at 20 °C	

Footnotes for pages 8 and 9

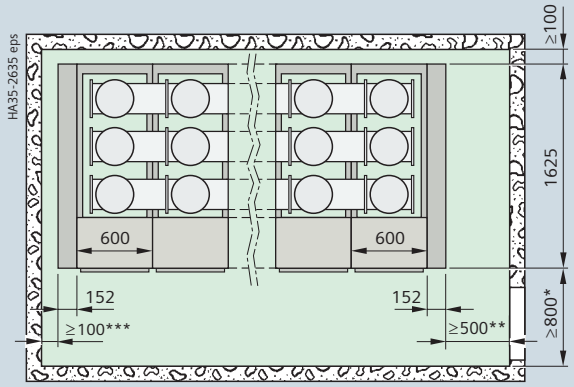
1) Higher values of the rated short-duration power-frequency withstand voltage available with:
   - 42 kV for phase-to-earth and open contact gap, as well as
   - 48 kV across the isolating distance
2) Higher values of the rated short-duration power-frequency withstand voltage available with:
   - 65 kV for phase-to-earth and open contact gap, as well as
   - 75 kV across the isolating distance
3) Higher values of the rated short-duration power-frequency withstand voltage available with:
   - 95 kV for phase-to-earth and open contact gap, as well as
   - 120 kV across the isolating distance
4) Higher values of the rated lightning-impulse withstand voltage available with:
   - 190 kV for phase-to-earth and open contact gap, as well as
   - 230 kV across the isolating distance
5) Higher value applies to 60 Hz
6) Disconnector panel available for single-busbar switchgear 8DA10
7) Bus coupler available for double-busbar switchgear 8DB10
8) Rated normal current I_r for cable connection panels
9) Maximum permissible normal current dependent on ambient air temperature
10) 2750 A without forced ventilation (8DB10 on request)
11) 3150 A with forced ventilation (8DB10 on request)
12) Option: 30,000 operating cycles
13) Option: Ambient air temperature –25 °C to +55 °C

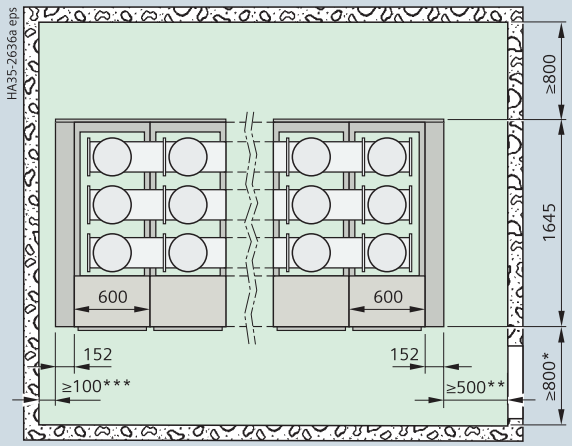
Technical data

Room planning

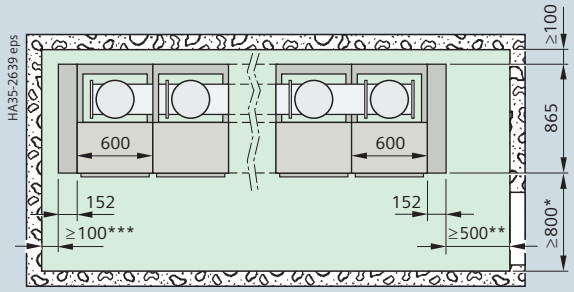
Wall-standing arrangement (top view)	Free-standing arrangement (top view)

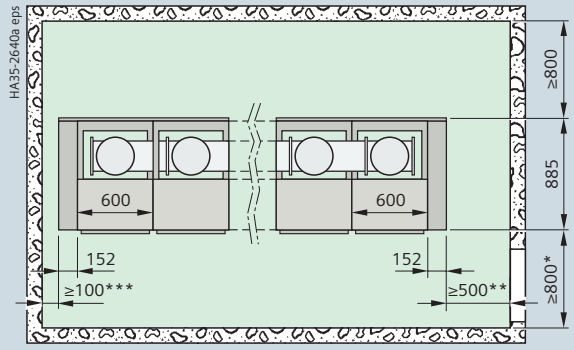
Room planning for single-busbar switchgear 8DA10



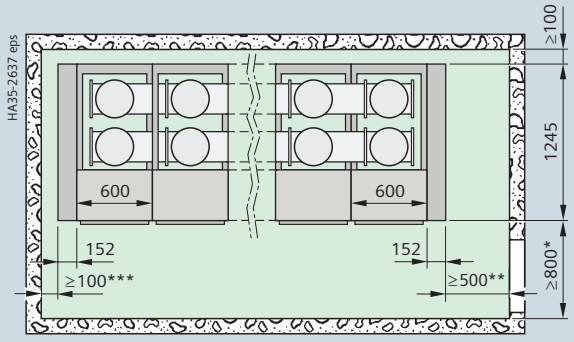


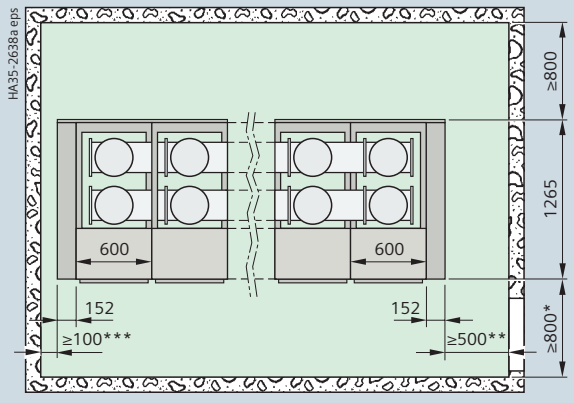
Room planning for traction power supply switchgear 8DA11





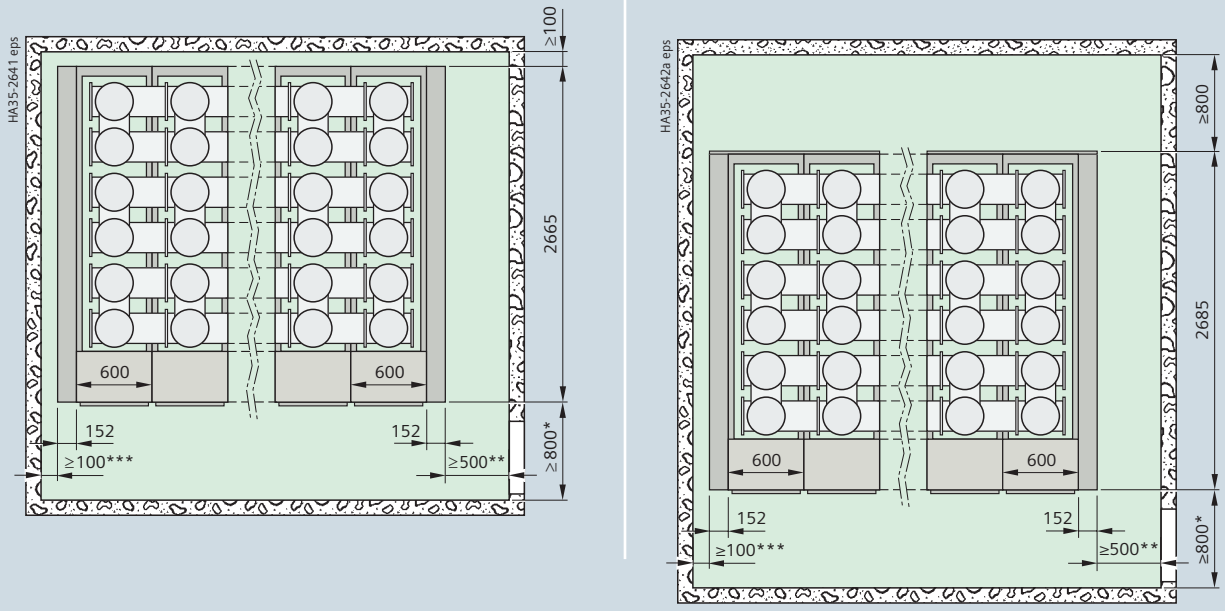
Room planning for traction power supply switchgear 8DA12





Wall-standing arrangement (top view) | **Free-standing arrangement (top view)**

Room planning for double-busbar switchgear 8DB10



Switchgear installation

- Wall-standing arrangement without rear wall (IAC AFL)
- Free-standing arrangement without rear wall (IAC AFL)
- Free-standing arrangement with rear wall (IAC AFLR).

Room dimensions

See dimension drawings above.
Room height: ≥ switchgear height + 200 mm.
If there are any busbar components, the minimum room height may have to be higher.
For switchable busbar components in 8DB10, free-standing arrangement is required.

Door dimensions

The door dimensions depend on the dimensions of the individual panels (see pages 14 to 21).

Switchgear fixing

- For floor openings and fixing points of the switchgear, see pages 14 to 21
- Foundations:

– Steel girder construction
– Steel-reinforced concrete with foundation rails, welded or bolted on.

Panel dimensions

See pages 14 to 21.

*) Depending on national requirements
**) Lateral wall distance ≥ 500 mm optionally required on the left or on the right
***) Lateral minimum wall distance ≥ 100 mm optionally possible on the left or on the right

Technical data

Shipping data

Transport

Single-busbar switchgear 8DA10 and traction power supply switchgear 8DA11/12 is delivered in transport units comprising up to four panels.
Double-busbar switchgear 8DB10 is delivered in transport units comprising up to three panels.
Please observe the following:

- Transport facilities on site
- Transport dimensions and transport weights
- Size of door openings in building.

Packing

- Means of transport: Truck
  - Panels on pallets
  - Open packing with PE protective foil.
- Means of transport: Ship and airplane
  - Panels on pallets
  - In closed crates with sealed upper and lower PE protective foil
  - With desiccant bags
  - With sealed wooden base
  - Max. storage time: 6 months.
- Long-time packing
  - Panels on pallets
  - In closed crates with sealed, aluminum-coated PE protective foil
  - With desiccant bags
  - With sealed wooden base
  - Max. storage time: 12 months.

Transport dimensions, transport weights [1)]

Panel widths mm	Transport dimensions Width × Height × Depth mm × mm × mm	Transport weight with packing approx. kg	Transport weight without packing approx. kg
Single-busbar switchgear 8DA10			
Means of transport: Truck			
1 × 600	1370 × 2550 × 1888	850	750
2 × 600	1764 × 2550 × 1870	1700	1500
3 × 600	2400 × 2550 × 1870	2550	2250
4 × 600	2964 × 2550 × 1870	3400	3000
Means of transport: Ship and airplane			
1 × 600	1388 × 2700 × 1888	850	750
2 × 600	1764 × 2700 × 1888	1700	1500
3 × 600	2400 × 2700 × 1888	2550	2250
4 × 600	2964 × 2700 × 1888	3400	3000
Double-busbar switchgear 8DB10			
Means of transport: Truck			
1 × 600	1370 × 2550 × 3124	1300	1200
2 × 600	1870 × 2550 × 3124	2600	2400
3 × 600	2416 × 2550 × 3124	3900	3600
Means of transport: Ship and airplane			
1 × 600	1388 × 2850 × 3124	1300	1200
2 × 600	1888 × 2850 × 3124	2600	2400
3 × 600	2440 × 2850 × 3124	3900	3600
Traction power supply switchgear 8DA11/12			
Means of transport: Truck			
1 × 600	1370 × 2550 × 1888	600	500
2 × 600	1764 × 2550 × 1870	1200	1000
3 × 600	2400 × 2550 × 1870	1800	1500
4 × 600	2964 × 2550 × 1870	2400	2000
Means of transport: Ship and airplane			
1 × 600	1388 × 2700 × 1888	600	500
2 × 600	1764 × 2700 × 1888	1200	1000
3 × 600	2400 × 2700 × 1888	1800	1500
4 × 600	2964 × 2700 × 1888	2400	2000

1) Average values based on standard subframe with LV compartment 850 mm depending on the degree to which panels are equipped

Classification of 8DA and 8DB switchgear according to IEC 62271-200

Design and construction

Partition class	PM (metallic partition) [1]
Loss of service continuity category	LSC2
Accessibility to compartments (enclosure) Busbar compartment Switching-device compartment Low-voltage compartment Cable compartment	 Tool-based Tool-based Tool-based Tool-based

Internal arc classification

Designation of the internal arc classification IAC IAC class for: Wall-standing arrangement Free-standing arrangement	 IAC AFL 40 kA, 1 s IAC AFLR 40 kA, 1 s
Type of accessibility A – F – L – R	Switchgear in closed electrical service location, access "for authorized personnel only" according to IEC 62271-200 Front Lateral Rear (for free-standing arrangement)
Rated short-time withstand current	40 kA
Rated duration of short-circuit	1 s

Classification of 8DA and 8DB switchgear according to IEEE Std C37.20.7™-2007

Internal arc classification

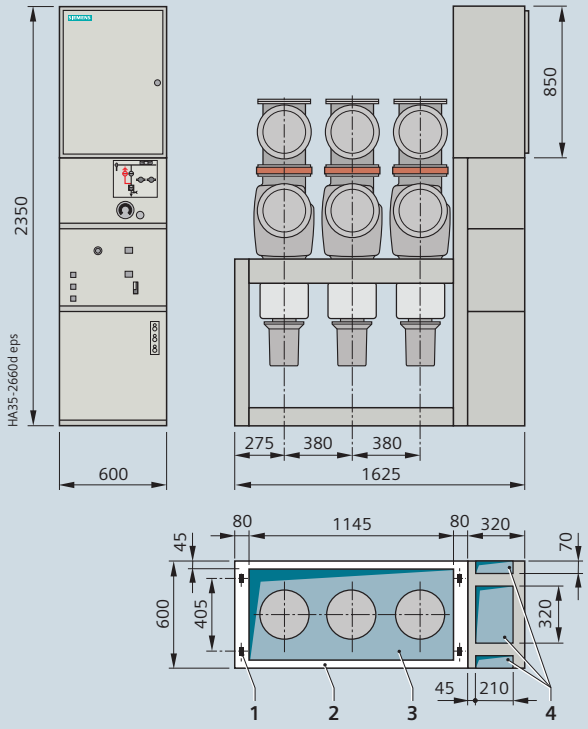
Designation of the internal arc classification IAC IAC class for: Wall-standing arrangement Free-standing arrangement	 Type 1B 40 kA, 0.5 s Type 2B 40 kA, 0.5 s
Type of accessibility – Type 1B – Type 2B – Type BC	Switchgear in closed electrical service location, access "for authorized personnel only" according to IEEE Std C37.20.7™-2007 Front Front, lateral, rear (for free-standing arrangement) Front with open low-voltage compartment
Rated short-time withstand current	40 kA
Rated duration of short-circuit	0.5 s

1) Corresponds to "metal-clad" according to former standard IEC 60298

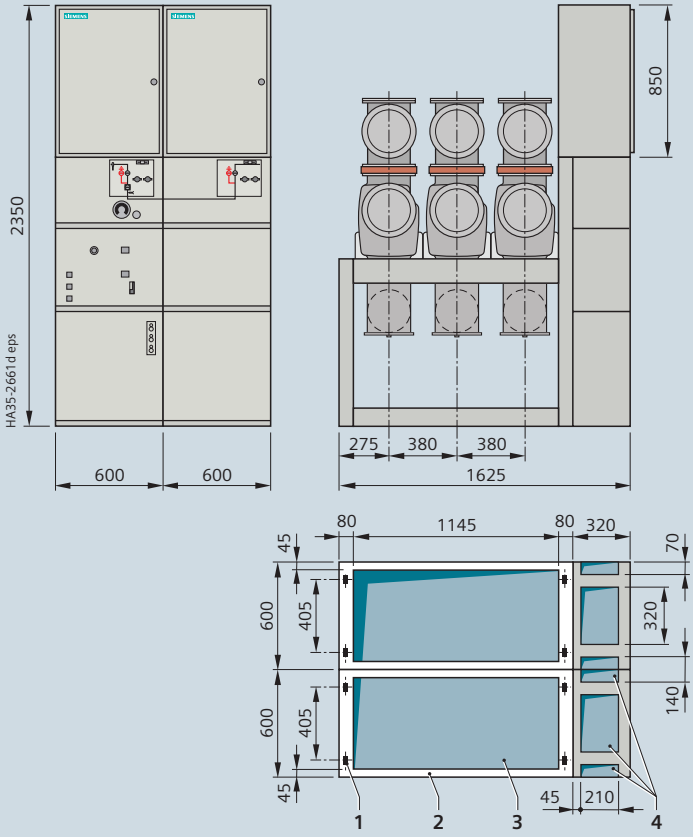
Dimensions

Front views, sections, floor openings, fixing points for 8DA10

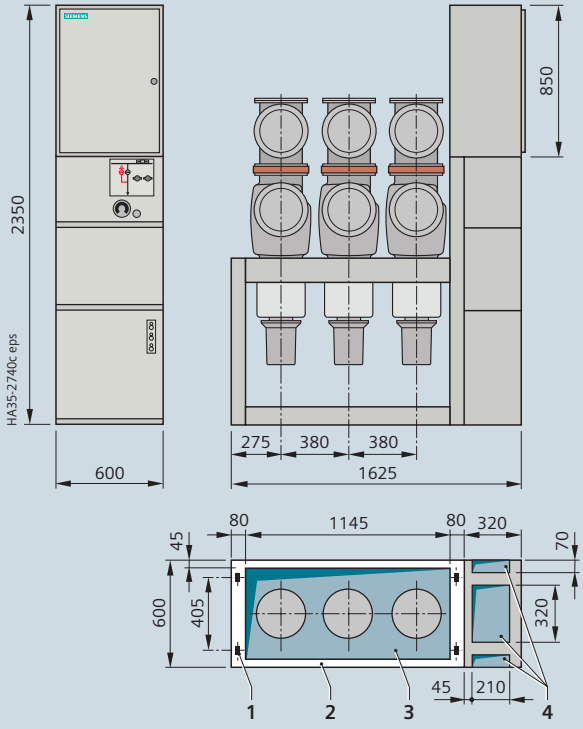
Circuit breaker panel up to 3150 A



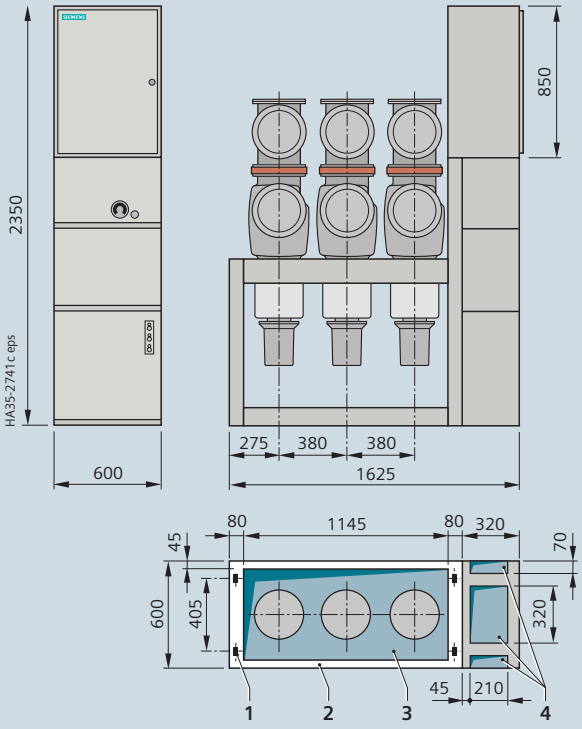
Bus sectionalizer up to 3150 A



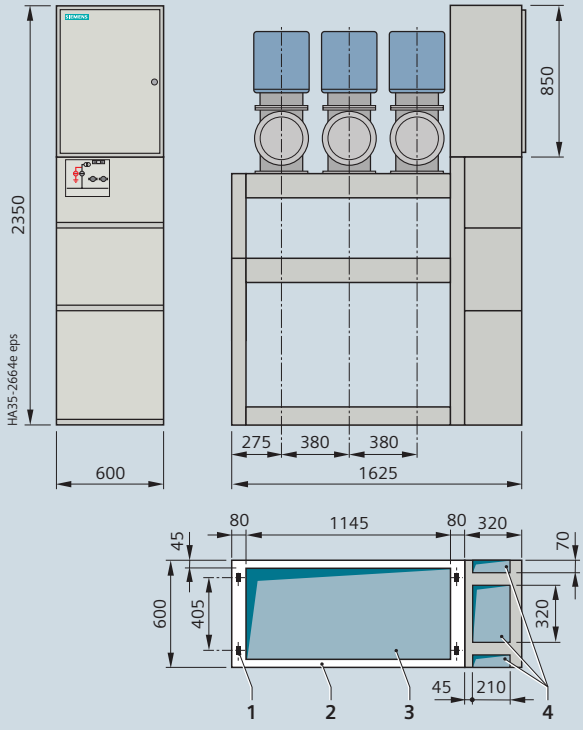
Disconnector panel up to 3150 A



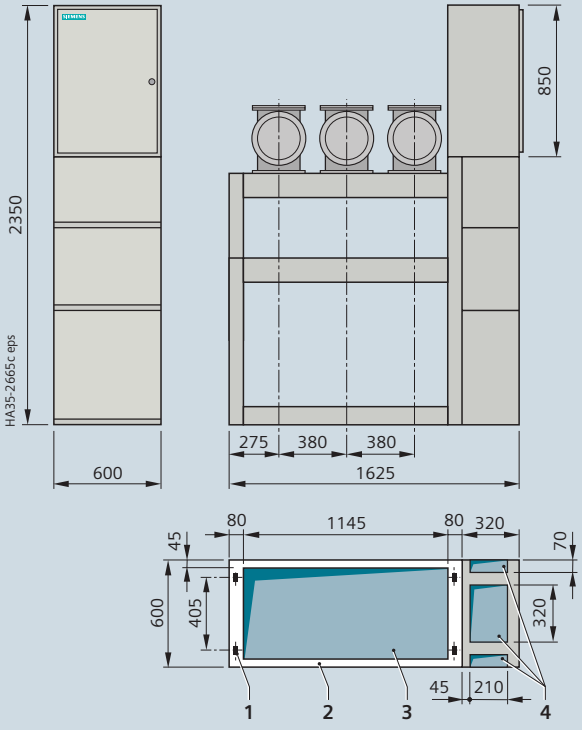
Cable connection panel up to 3150 A



Metering panel



Dummy panel



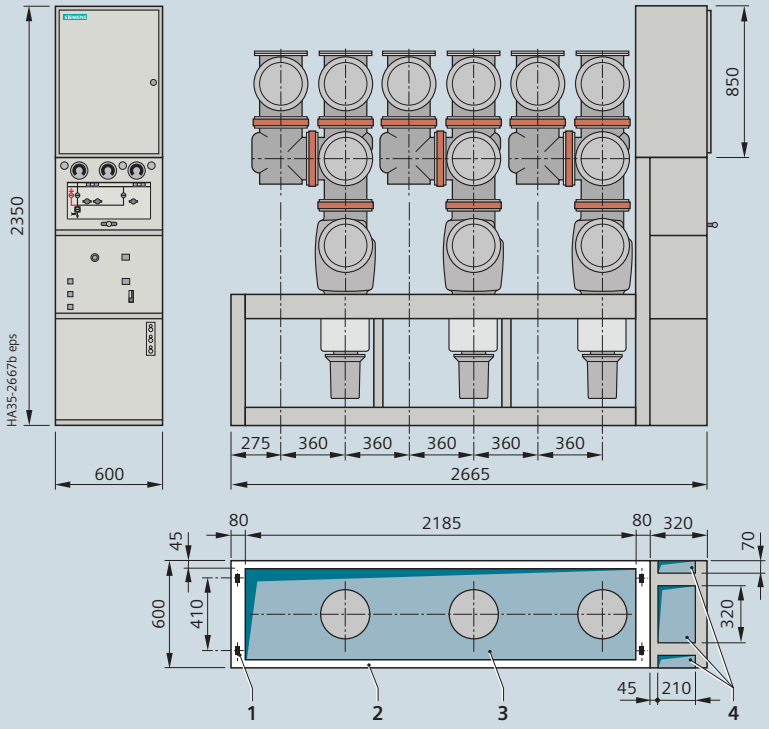
Legend and footnotes for pages 14 and 15

1 Fixing hole for 26 mm × 45 mm
2 Base frame
3 Floor opening for high-voltage cables
4 Area for floor openings for control cables

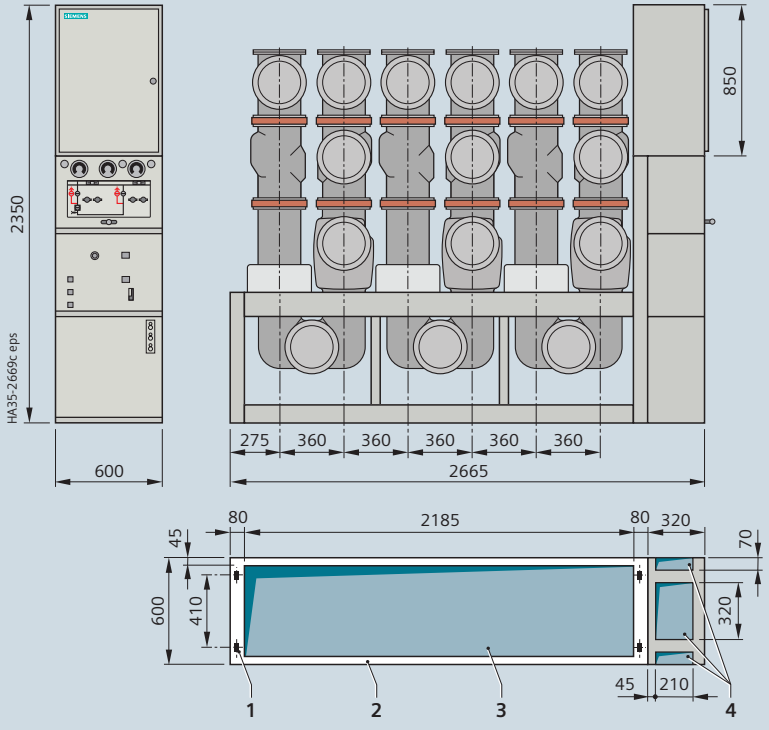
Dimensions

Front views, sections, floor openings, fixing points for 8DB10

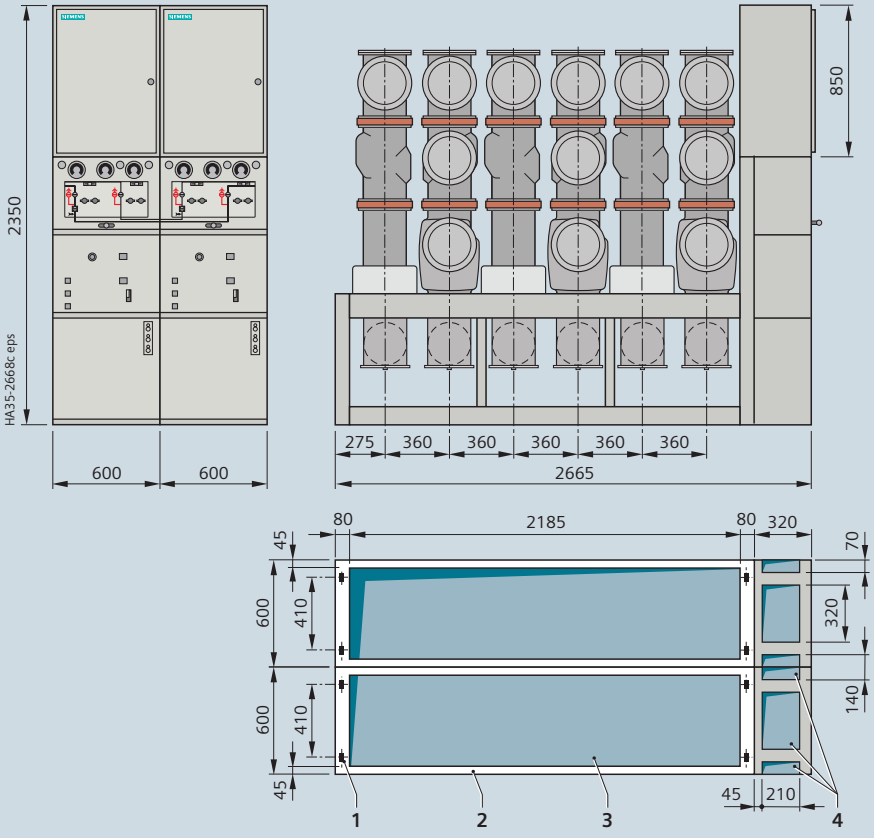
Circuit breaker panel up to 2500 A



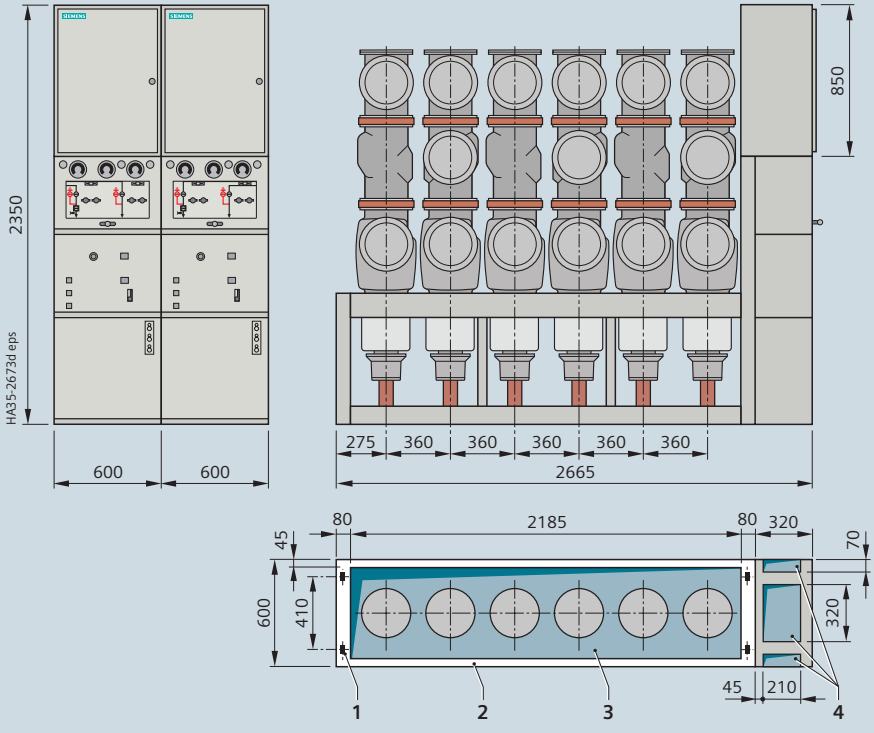
Bus coupler up to 2500 A



Bus sectionalizer up to 2500 A (busbar system 1 and 2)



Bus sectionalizer with panel connection up to 2500 A (busbar system 1 and 2)



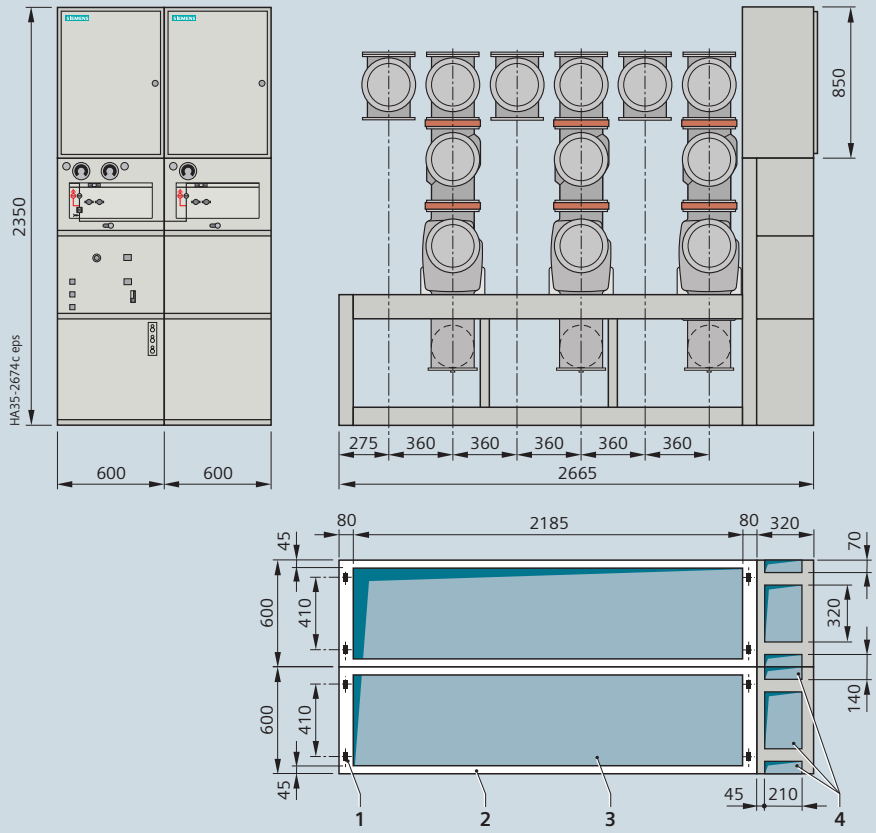
Legend and footnotes for pages 16 and 17

1 Fixing hole for 26 mm × 45 mm
2 Base frame
3 Floor opening for high-voltage cables
4 Area for floor openings for control cables

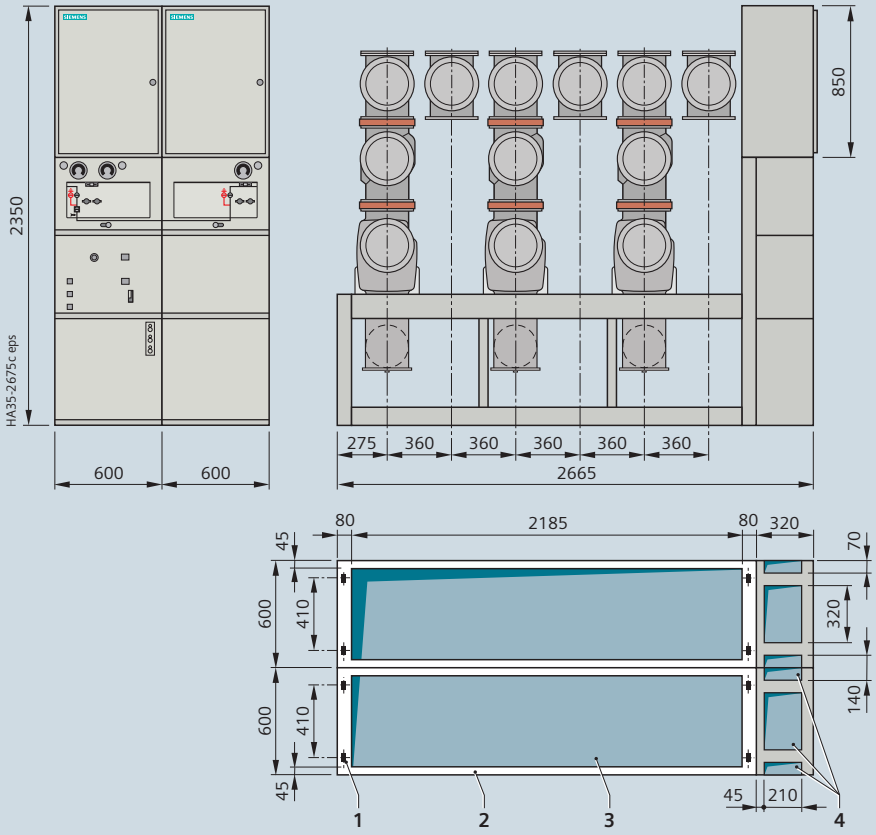
Dimensions

Front views, sections, floor openings, fixing points for für 8DB10

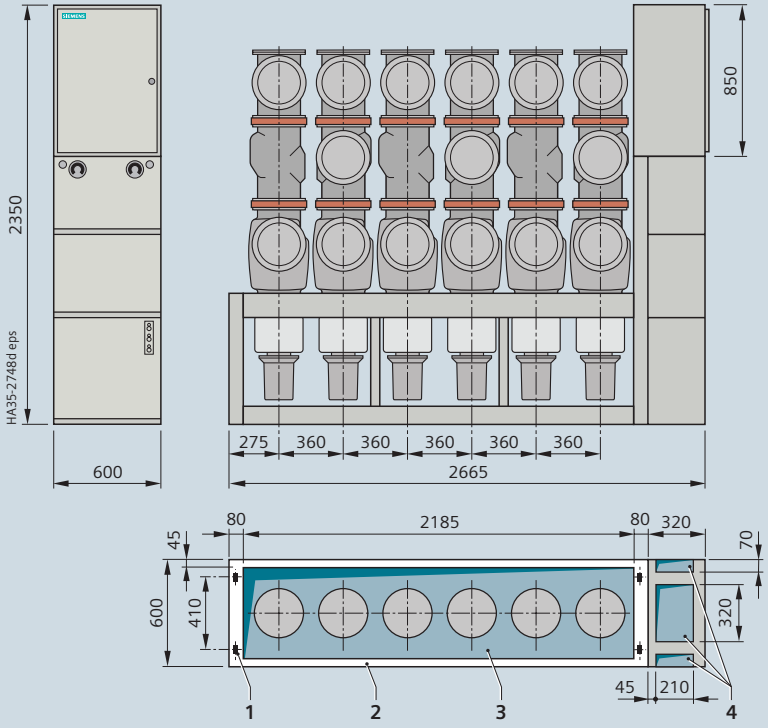
Bus sectionalizer up to 2500 A (busbar system 1)



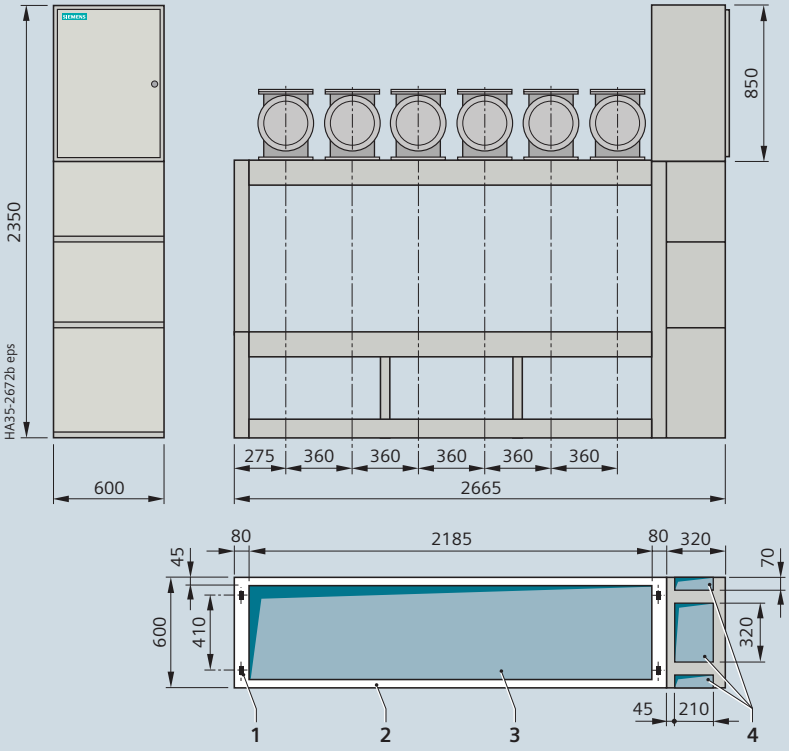
Bus sectionalizer up to 2500 A (busbar system 2)



Cable connection panel up 2500 A



Dummy panel



Legend and footnotes for pages 18 and 19

1 Fixing hole for 26 mm × 45 mm

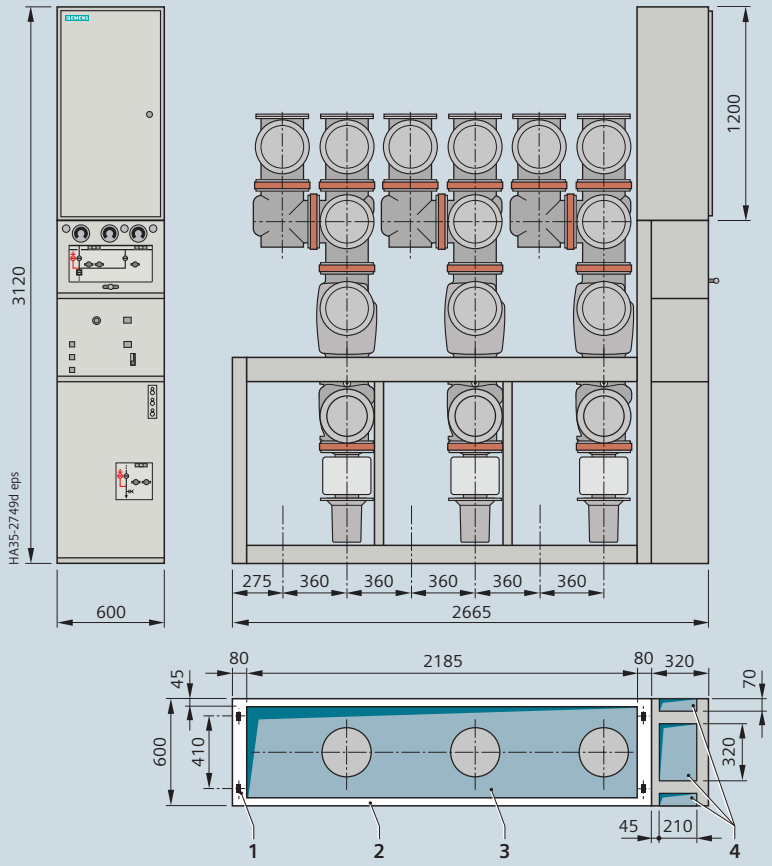
2 Base frame

3 Floor opening for high-voltage cables

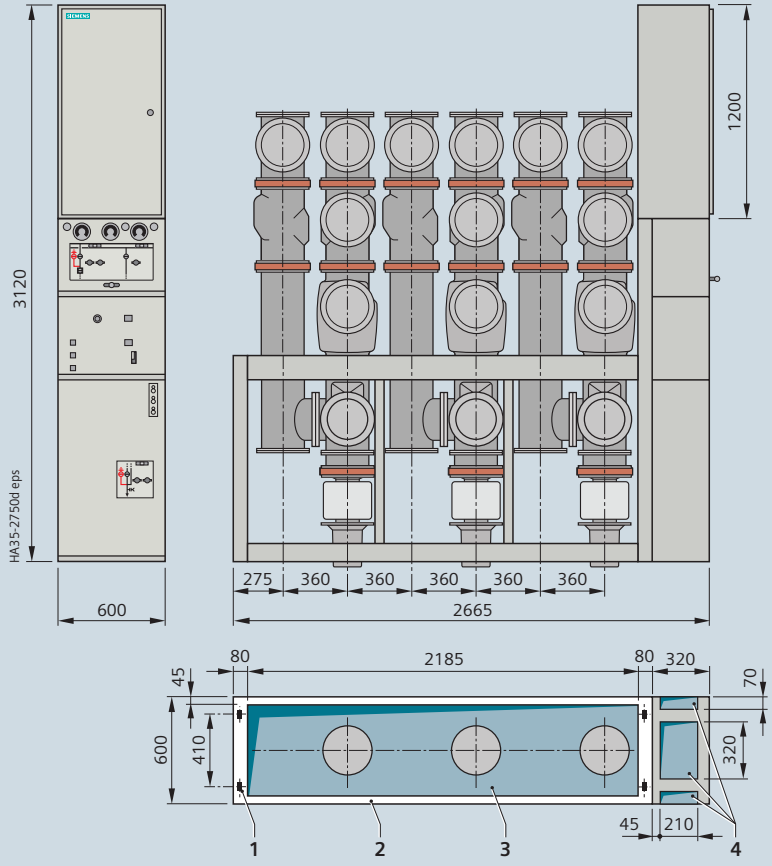
4 Area for floor openings for control cables

Dimensions

Front views, sections, floor openings, fixing points for 8DB10 ANSI

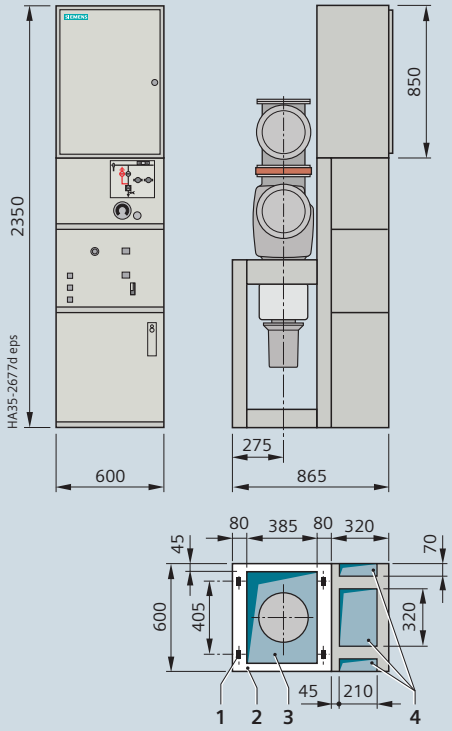


Example: Circuit breaker panel with three-position disconnector at the feeder (option)

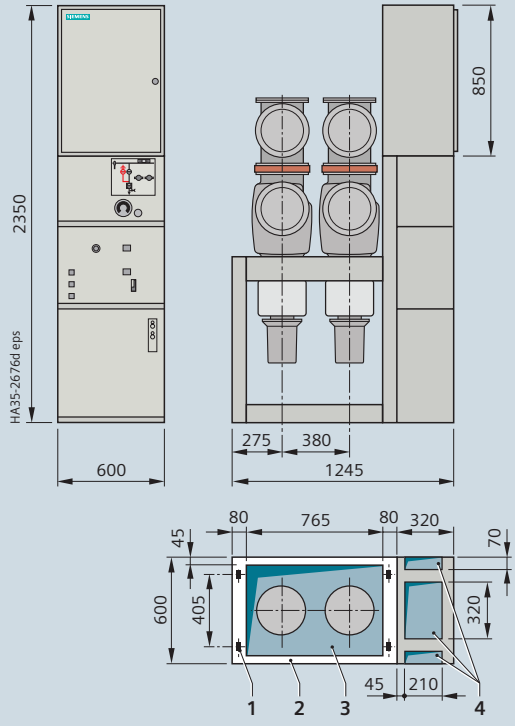


Example: Circuit breaker panel with disconnector bypass

Single-pole circuit breaker panel up to 2500 A



Double-pole circuit breaker panel up to 2500 A



Legend and footnotes for pages 20 and 21

1 Fixing hole for 26 mm × 45 mm

2 Base frame

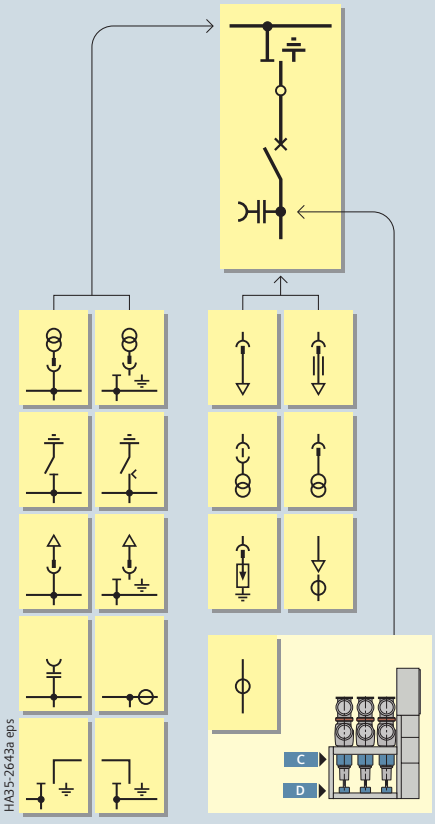
3 Floor opening for high-voltage cables

4 Area for floor openings for control cables

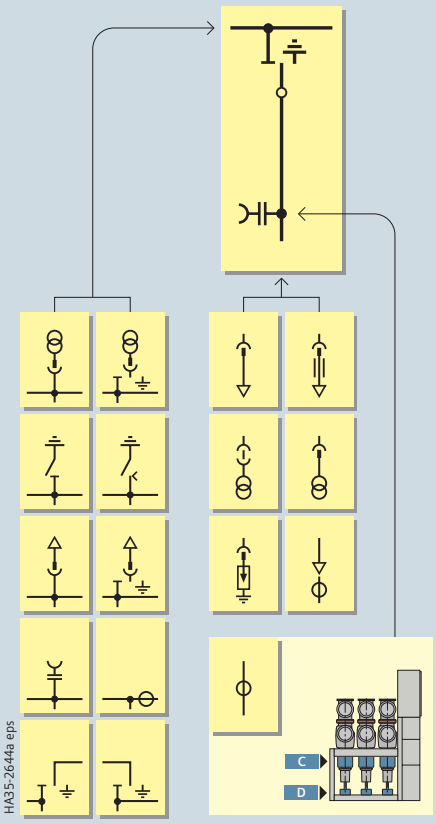
Product range

Single-busbar panels 8DA10

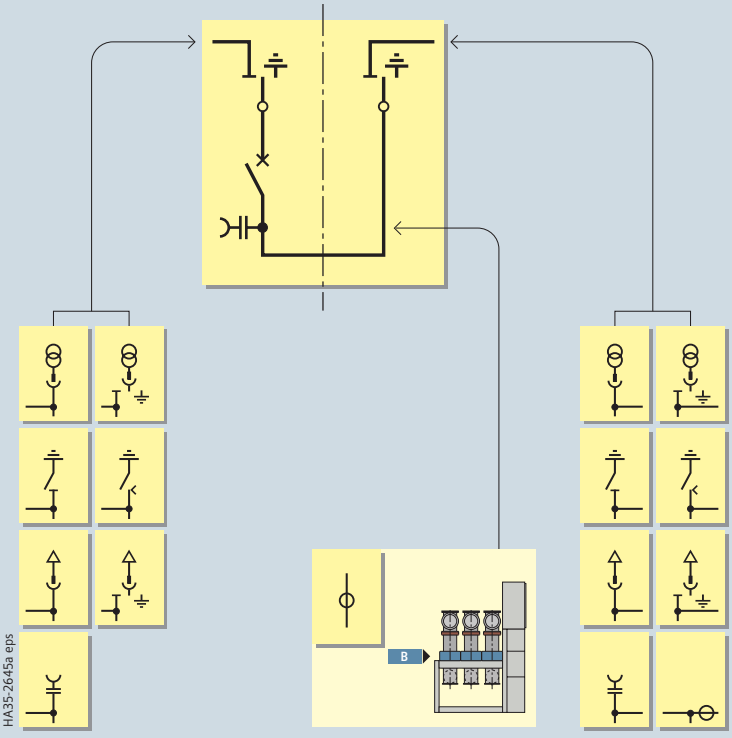
Circuit breaker panel



Disconnector panel



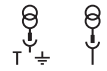
Bus sectionalizer (2 panels)



Three-position disconnector

Vacuum circuit breaker

Plug-in voltage transformer (directly plugged or with cable connection)

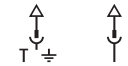


Voltage transformer with or without three-position disconnector

Current transformer

Capacitive voltage detecting system

Busbar
– earthing switch and
– make-proof earthing switch

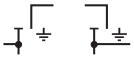


Busbar connection with or without three-position disconnector

Surge arrester

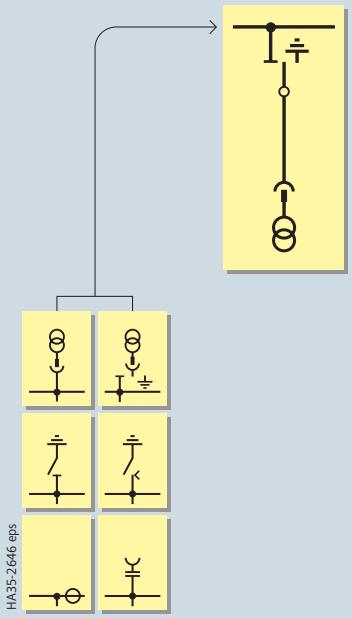
Panel connection with inside-cone plug or bar connection

Zero-sequence current transformer

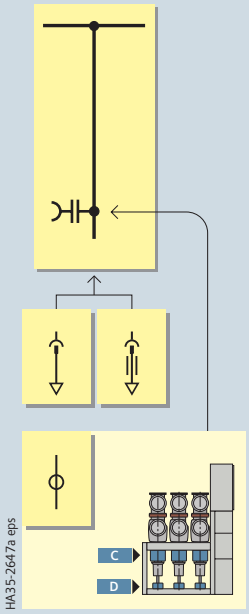


Top-mounted bus sectionalizer

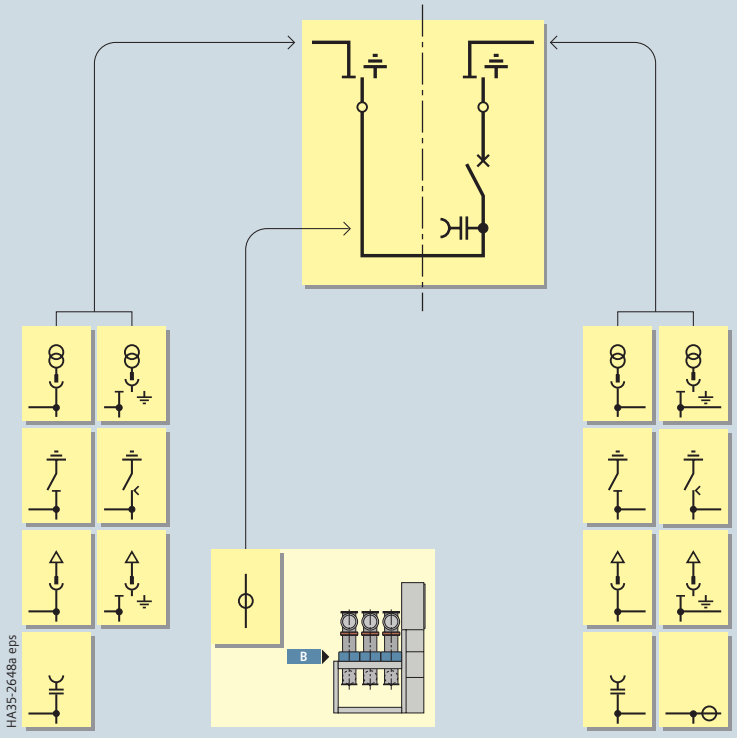
Metering panel



Cable connection panel



Bus sectionalizer (2 panels)



Three-position disconnector

Vacuum circuit breaker

Plug-in voltage transformer (directly plugged or with cable connection)

Voltage transformer with or without three-position dis-connector

Current transformer

Capacitive voltage detecting system

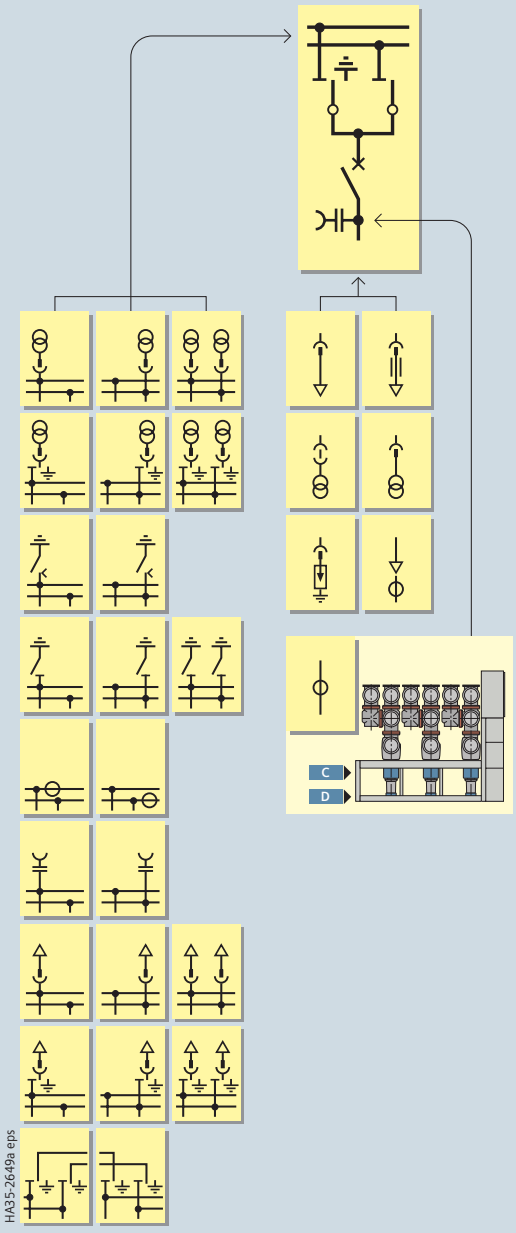
Busbar
– earthing switch and
– make-proof earthing switch

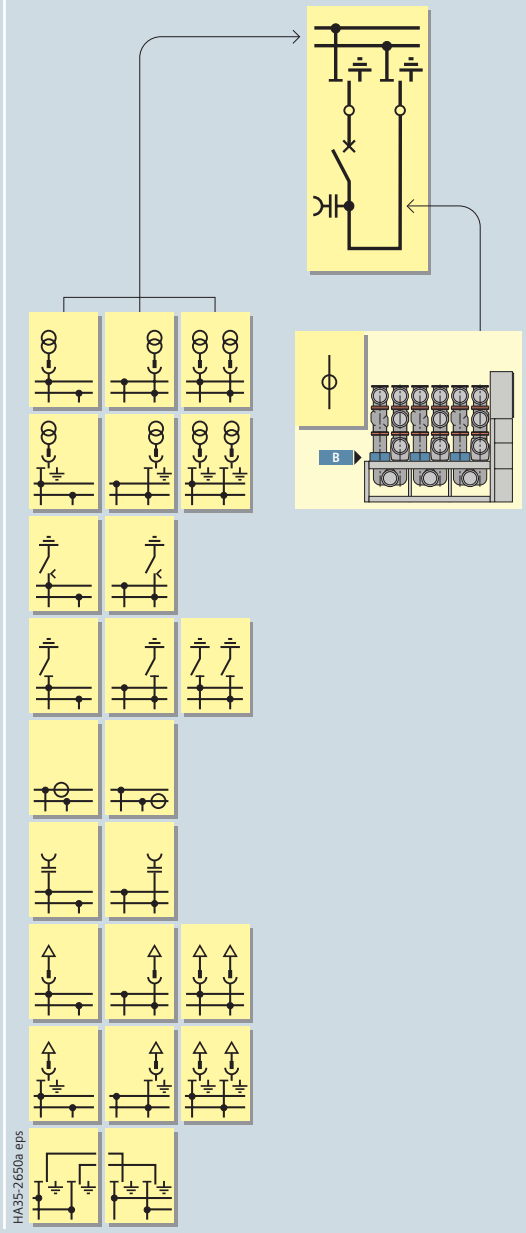
Busbar connection with or without three-position disconnector

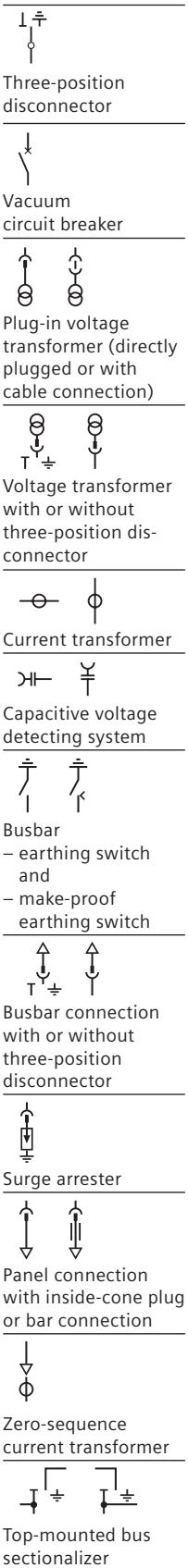
Panel connection with inside-cone plug or bar connection

Product range

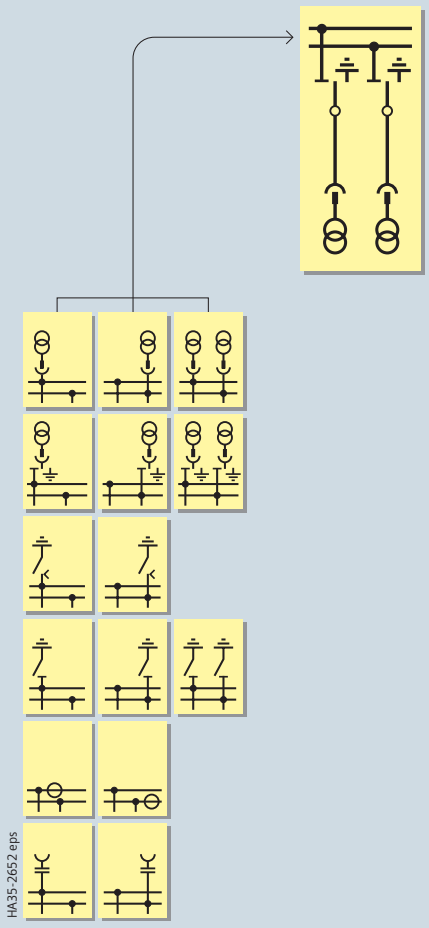
Double-busbar panels 8DB10



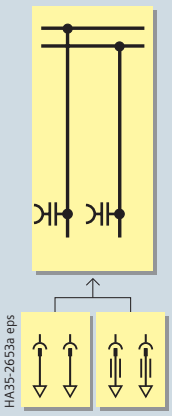




Metering panel



Cable connection panel



Three-position disconnector

Plug-in voltage transformer (directly plugged)

Voltage transformer with or without three-position disconnector

Current transformer

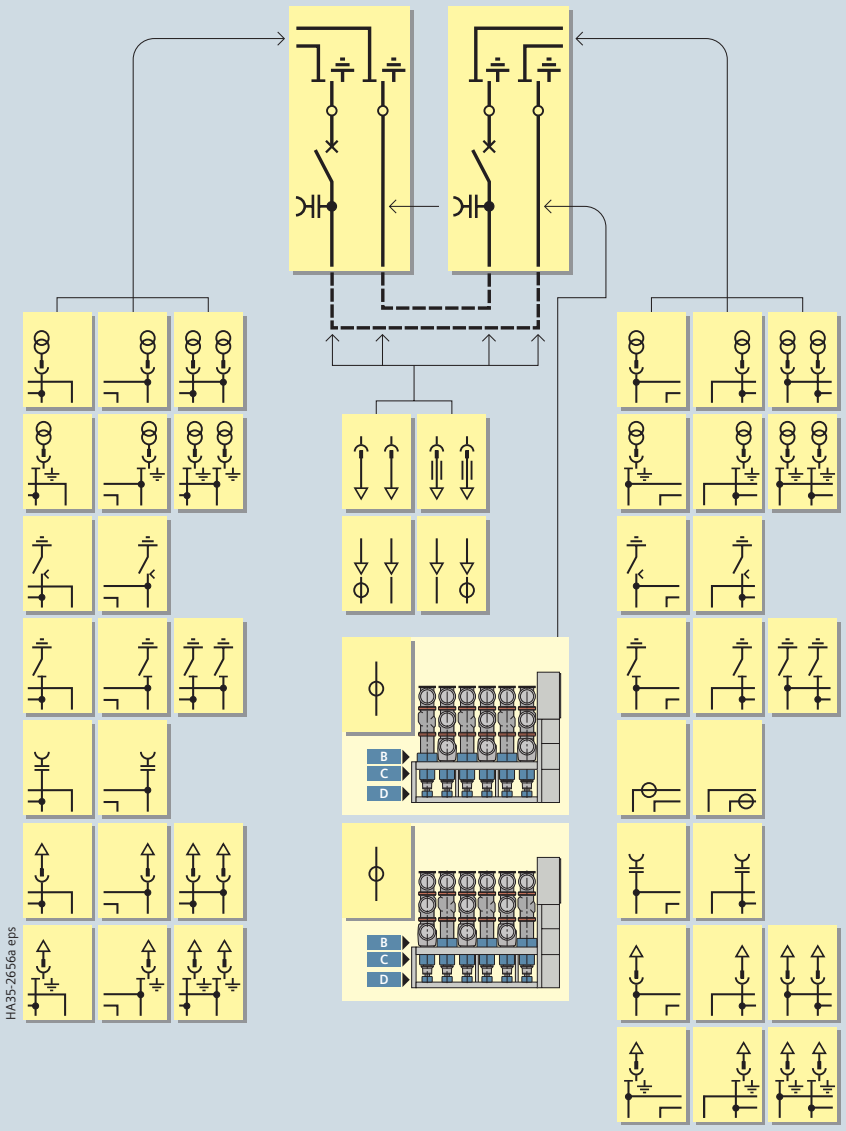
Capacitive voltage detecting system

Busbar
– earthing switch and
– make-proof earthing switch

Busbar connection with or without three-position disconnector

Panel connection with inside-cone plug or bar connection

Bus sectionalizer (busbar system 1 and 2)



Three-position disconnector

Vacuum circuit breaker

Voltage transformer with or without three-position disconnector

Current transformer

Capacitive voltage detecting system

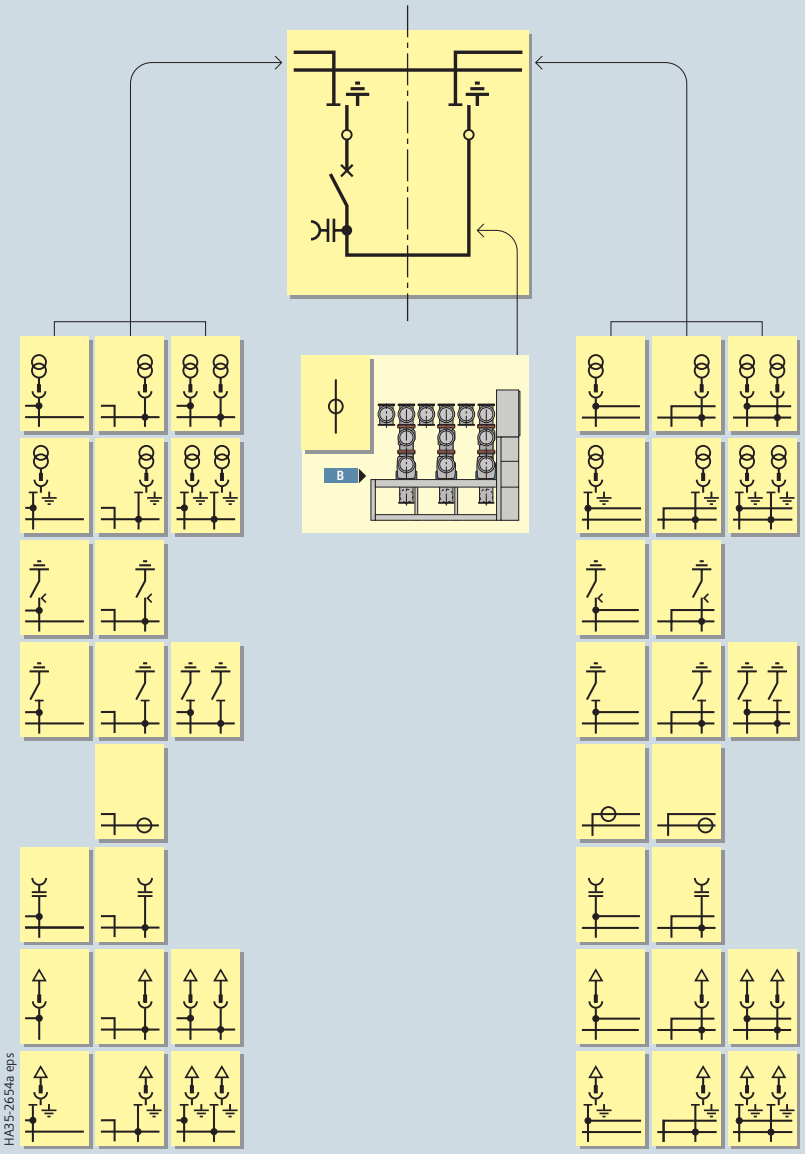
Busbar
– earthing switch and
– make-proof earthing switch

Busbar connection with or without three-position disconnector

Panel connection with inside-cone plug or bar connection

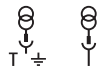
Zero-sequence current transformer

Bus sectionalizer (busbar system 1)

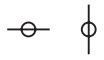


Three-position disconnector

Vacuum circuit breaker



Voltage transformer with or without three-position disconnector



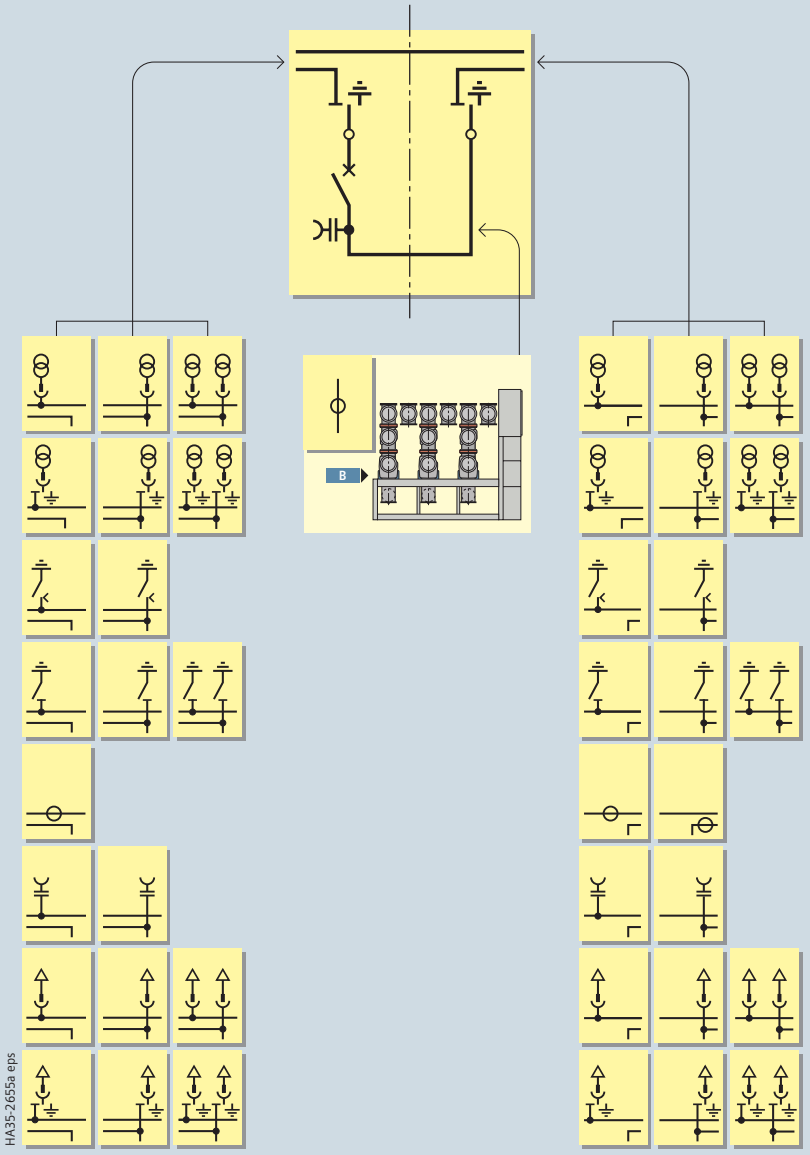
Current transformer

Capacitive voltage detecting system

Busbar
– earthing switch and
– make-proof earthing switch

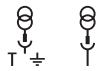
Busbar connection with or without three-position disconnector

Bus sectionalizer (busbar system 2)

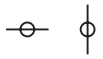


Three-position disconnector

Vacuum circuit breaker



Voltage transformer with or without three-position disconnector



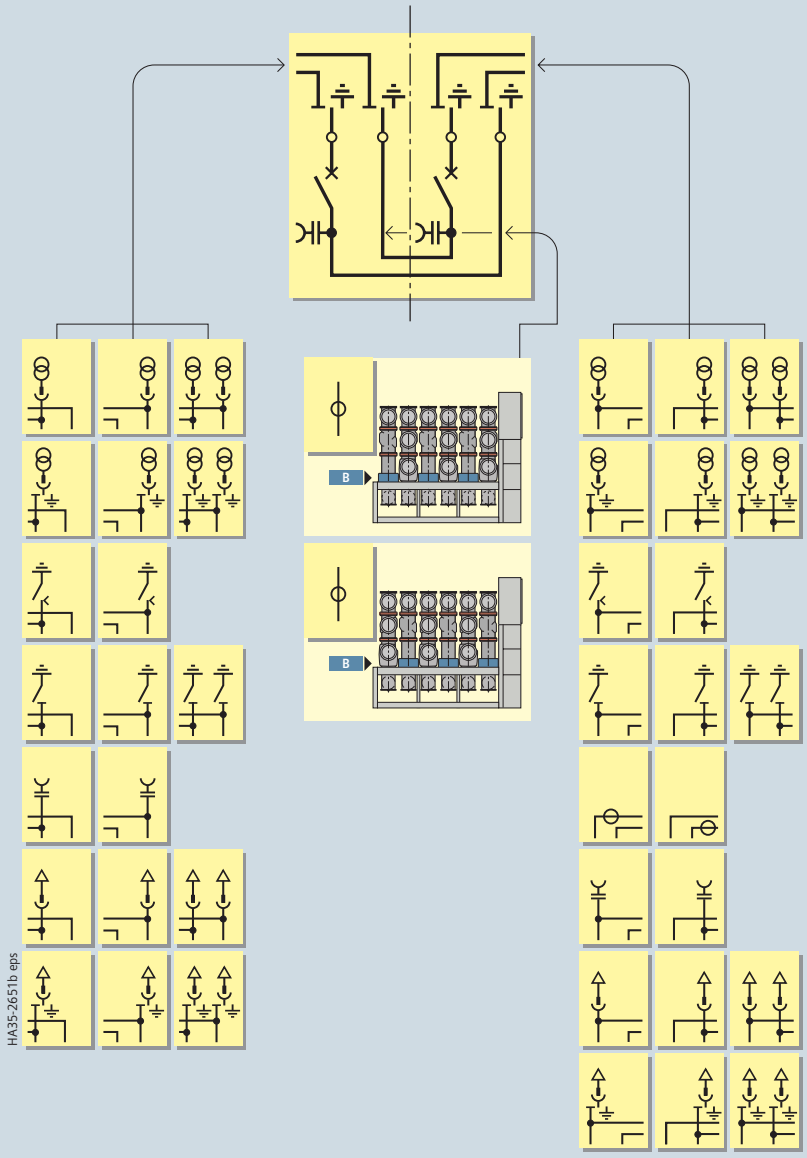
Current transformer

Capacitive voltage detecting system

Busbar
– earthing switch and
– make-proof earthing switch

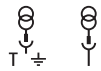
Busbar connection with or without three-position disconnector

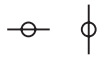
Bus sectionalizer (busbar system 1 and 2)



Three-position disconnector

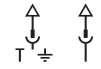
Vacuum circuit breaker


Voltage transformer with or without three-position disconnector

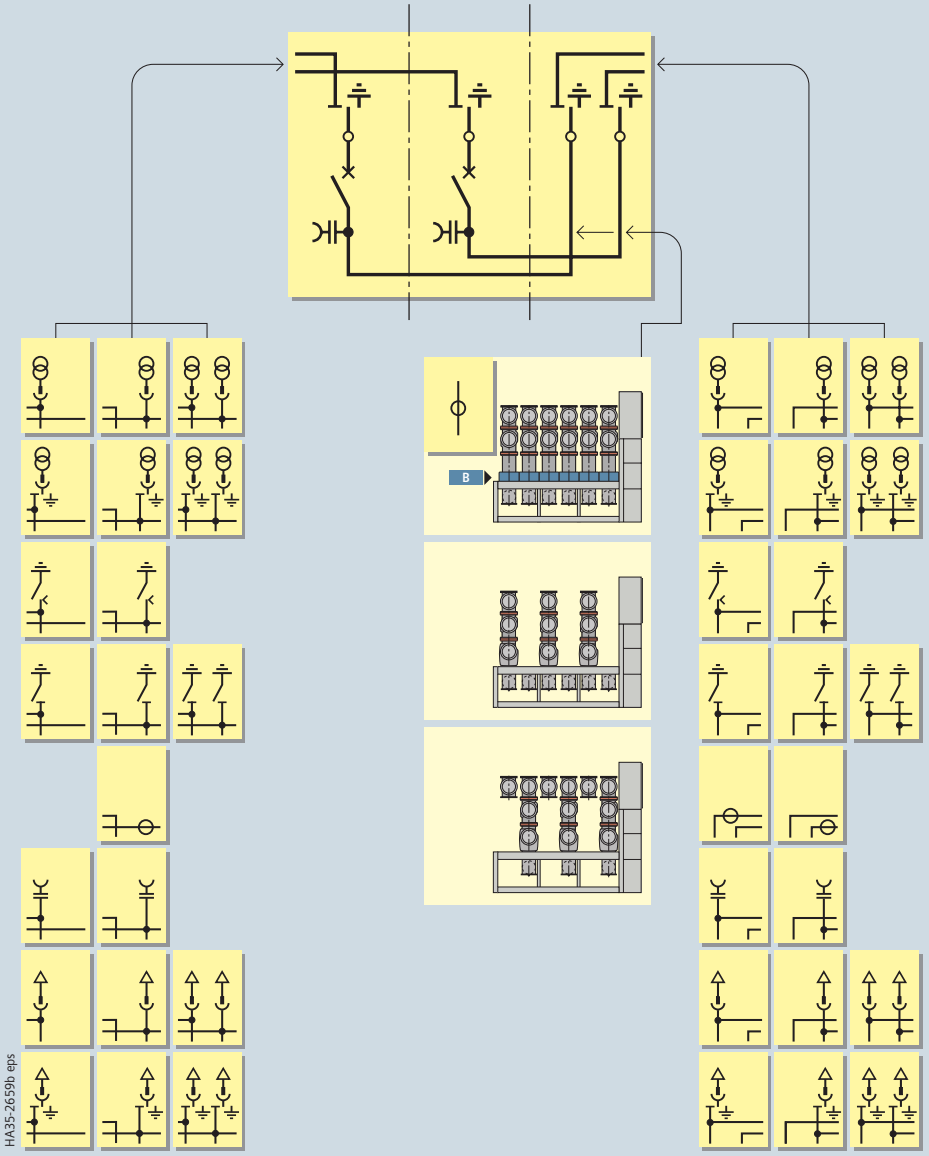

Current transformer

Capacitive voltage detecting system

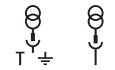
Busbar
– earthing switch and
– make-proof earthing switch


Busbar connection with or without three-position disconnector

Bus sectionalizer (busbar system 1 and 2)



Three-position disconnector



Voltage transformer with or without three-position disconnector

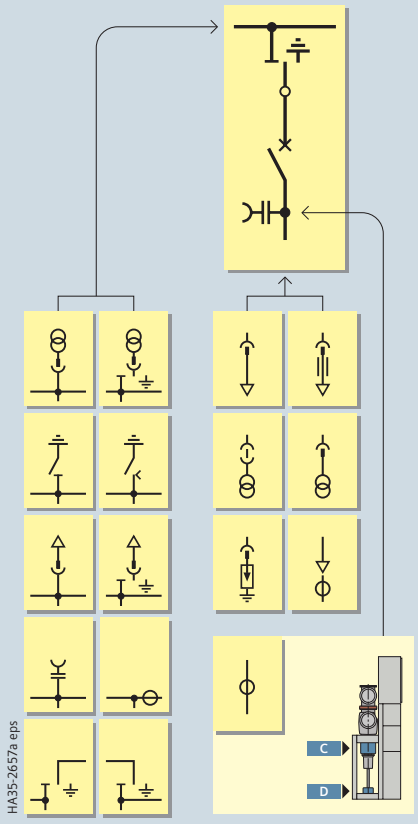
Current transformer

Capacitive voltage detecting system

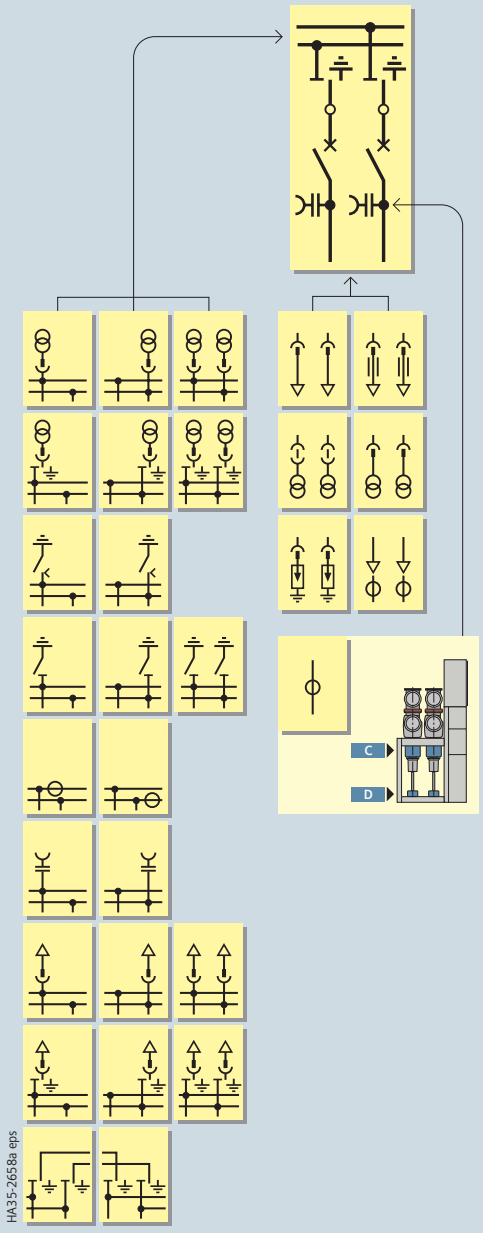
Busbar
– earthing switch and
– make-proof earthing switch

Busbar connection with or without three-position disconnector

Single-pole circuit breaker panel



Double-pole circuit breaker panel



Three-position disconnector

Vacuum circuit breaker

Plug-in voltage transformer (directly plugged or with cable connection)

Voltage transformer with or without three-position dis-connector

Current transformer

Capacitive voltage detecting system

Busbar
– earthing switch and
– make-proof earthing switch

Busbar connection with or without three-position disconnector

Surge arrester

Panel connection with inside-cone plug or bar connection

Zero-sequence current transformer

Top-mounted bus sectionalizer

Insulating system

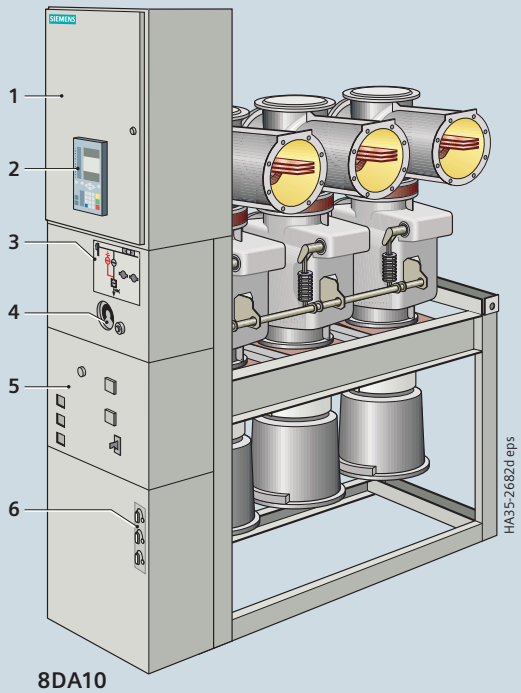
- Switchgear housing filled with SF_6 gas
- Features of SF_6 gas:
  - Non-toxic
  - Odorless and colorless
  - Non-inflammable
  - Chemically neutral
  - Heavier than air
  - Electronegative (high-quality insulator)
  - GWP (Global Warming Potential) = 22,800
- Pressure of the SF_6 gas in the switchgear housing dependent on the electrical ratings (relative pressure at 20 °C):
  - Rated functional level (relative): 70 kPa to 120 kPa
  - Design pressure: 190 kPa
  - Design temperature of the SF_6 gas: 90 °C
  - Operating pressure of bursting disc: ≥ 300 kPa
  - Bursting pressure: ≥ 600 kPa
  - Gas leakage rate: < 0.1 % per year.

Panel design

- Factory-assembled, type-tested
- Single-pole metal-enclosed, with metallic partitions [1)]
- Hermetically bolted switchgear housings made of corrosion-resistant aluminum alloy
- Switchpanel poles arranged one behind the other
- Maintenance-free in an indoor environment (IEC 62271-1)
- Degree of protection
  - IP 65 for all high-voltage parts of the primary circuit
  - IP 3XD for the switchgear enclosure
- Option: IP 31D for the switchgear enclosure
- Option: IP 41 for the low-voltage compartment
- Vacuum circuit breaker
- Three-position disconnector for disconnecting and earthing
- Make-proof earthing by means of the vacuum circuit breaker
- Cable connection with inside-cone plug-in system according to EN 50181
- Wall-standing or free-standing arrangement
- Instrument transformers removable, located outside the gas compartments
- Subframe, front cover, rear cover and end walls powder-coated in color "light basic" (light gray RAL 7035)
- Low-voltage compartment removable, plug-in bus wires
- Standardized production processes and certified quality and environmental management system according to ISO 9001 and ISO 14001.

1) Corresponds to "metal-clad" according to former standard IEC 60298

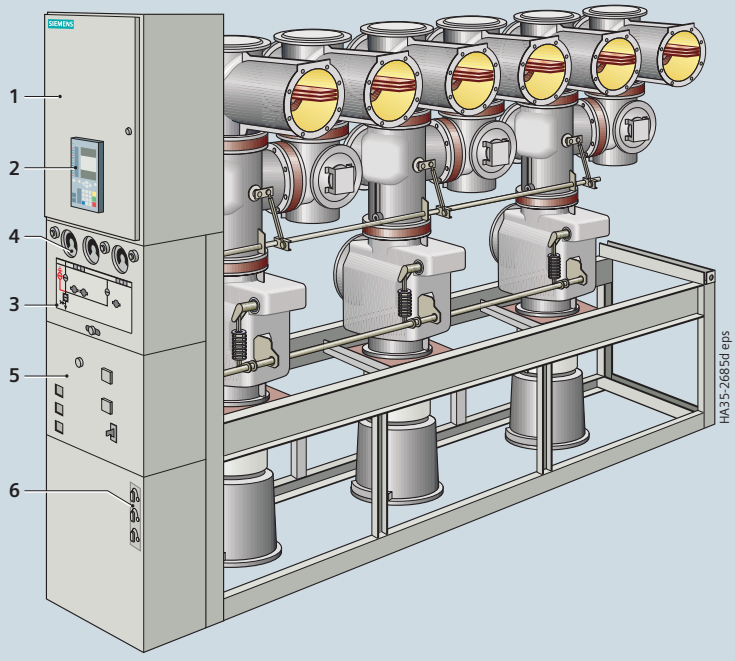
Panel design (examples)



Legend for 8DA10 and 8DB10

1 Low-voltage compartment
2 Electronic control board, e.g. multifunction protection
3 Operating mechanism and interlock for three-position disconnector, as well as mechanical position indicators for three-position disconnector and circuit breaker
4 Manometer for gas monitoring of feeder gas compartments
5 Circuit breaker operating mechanism
6 Voltage detecting system

8DA10
Panel for single-busbar switchgear



8DB10
Panel for double-busbar switchgear

Single-pole and double-pole design for AC traction power supply

Typical uses

- Single-pole and double-pole panels 8DA11/12 for the supply of overhead contact line sections in AC traction power supply systems
- Double-pole panels 8DA12 for application in traction power supply systems with autotransformers, e.g. for high-speed railway traffic.

Panel design

- Panel design based on standard version of single-busbar switchgear 8DA10.

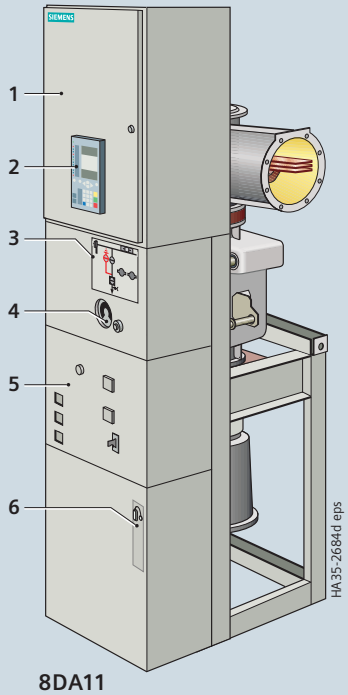
8DA11

Single-pole switchgear panel for traction power supply.

8DA12

Double-pole switchgear panel for traction power supply.

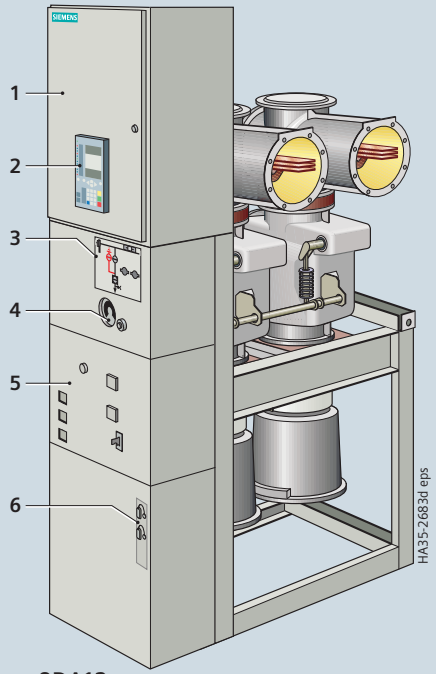
Panel design (examples)



Legend for 8DA11 and 8DA12

1 Low-voltage compartment
2 Electronic control board, e.g. multifunction protection
3 Operating mechanism and interlock for three-position disconnector, as well as mechanical position indicators for three-position disconnector and circuit breaker
4 Manometer for gas monitoring of feeder gas compartments
5 Circuit breaker operating mechanism
6 Voltage detecting system

8DA11
Single-pole switchgear panel for traction power supply



8DA12
Double-pole switchgear panel for traction power supply

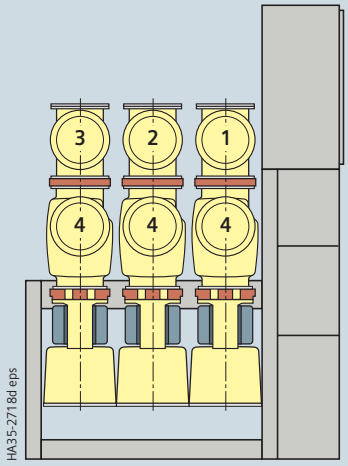
Gas compartment scheme

- Sealed pressure system (according to IEC 62271-1)
- No refilling required throughout the entire service life
- Gas compartments distributed to several areas
- Simple, visual check of the ready-for-service indicator by red/green indication areas
- Indication of gas pressure also guaranteed without auxiliary voltage supply
- Gas pressure manometers arranged at the switchgear front
- Gas filling equipment with non-return valve arranged at the switchgear front beside the associated gas pressure manometer
- Gas pressure manometers with two signaling contacts for "gas pressure too low / gas pressure too high" indication
- Option: Gas pressure manometers with three signaling contacts for "gas pressure too low / very low" and "gas pressure too high" indication
- Option: Gas pressure manometers with temperature and pressure compensation.

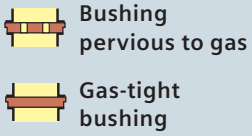
Example: Gas quantity circuit breaker panel (36 kV, 40 kA, 1250 A, cable connection 1 × plug size S2)

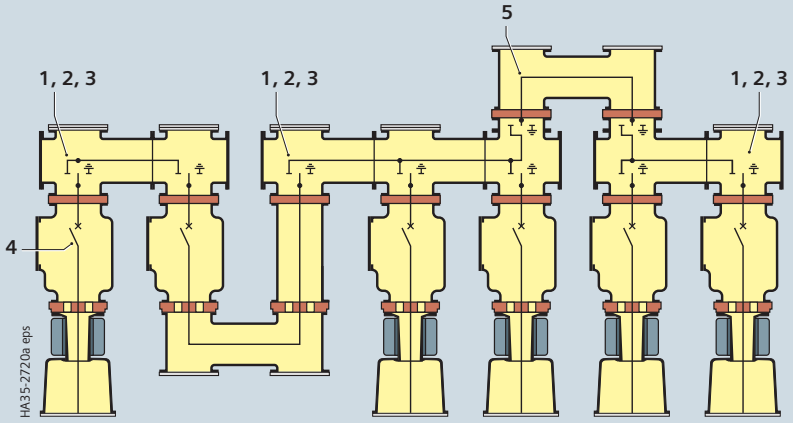
- 8DA10:
  SF_6 = 2.5 kg
  CO_2e = 57 t
- 8DB10:
  SF_6 = 4.5 kg
  CO_2e = 105 t.

Arrangement of gas compartments in 8DA10



Single-busbar panel 8DA10



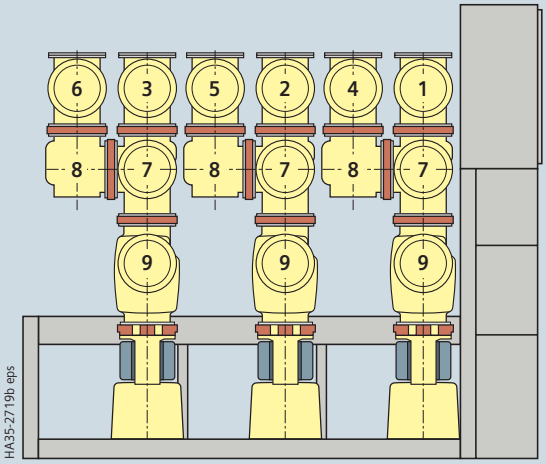


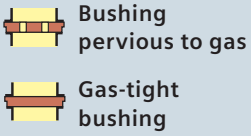
Single-busbar switchgear 8DA10

Legend for 8DA10

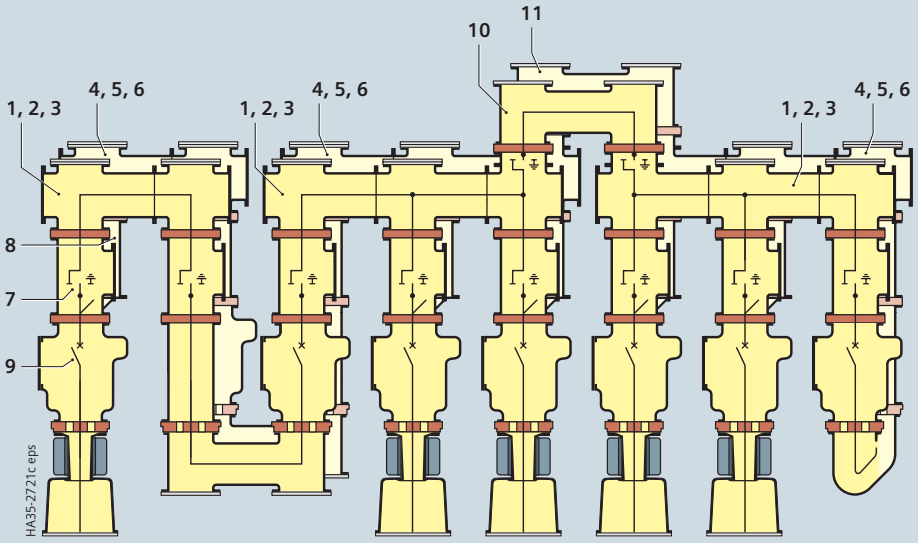
1 Busbar L1 (manometer B11)
2 Busbar L2 (manometer B12)
3 Busbar L3 (manometer B13)
4 Circuit breaker L1, L2, L3 (manometer B0)
5 Top-mounted bus sectionalizer L1, L2, L3 (manometer B15)

Arrangement of gas compartments in 8DB10





Double-busbar panel 8DB10



Double-busbar switchgear 8DB10

Legend for 8DB10

1 Busbar system 1, L1 (manometer B11)
2 Busbar system 1, L2 (manometer B12)
3 Busbar system 1, L3 (manometer B13)
4 Busbar system 2, L1 (manometer B21)
5 Busbar system 2, L2 (manometer B22)
6 Busbar system 2, L3 (manometer B23)
7 Three-position disconnector, busbar system 1, L1, L2, L3 (manometer B1)
8 Disconnector, busbar system 2, L1, L2, L3 (manometer B2)
9 Circuit breaker L1, L2, L3 (manometer B0)
10 Top-mounted bus sectionalizer, busbar system 1, L1, L2, L3 (manometer B15)
11 Top-mounted bus sectionalizer, busbar system 2, L1, L2, L3 (manometer B25)

Features

- According to IEC 62271-100 (for standards, see page 58)
- Application in hermetically bolted switchgear housings in conformity with the system
- Vacuum interrupter in gas-filled switchgear housing
- Maintenance-free for indoor installation according to IEC 62271-1
- Individual secondary equipment
- A metal bellows is used for gasketless separation between the gas insulation and the vacuum (already used with success for over 5 million vacuum interrupters).

Trip-free mechanism

The vacuum circuit breaker is fitted with a trip-free mechanism according to IEC 62271-100.

Switching duties and operating mechanisms

The switching duties of the vacuum circuit breaker are dependent, among other factors, on its type of operating mechanism.

Motor operating mechanism

- Motor-operating stored-energy mechanism

– For auto-reclosing (K)
– For synchronization and rapid load transfer (U)

Further operating mechanism features

- Located outside the switchgear housings in the operating mechanism box and behind the control board
- Stored-energy spring mechanism for 10,000 operating cycles
- Optional: Stored-energy spring mechanism for 30,000 operating cycles.

Operating mechanism functions

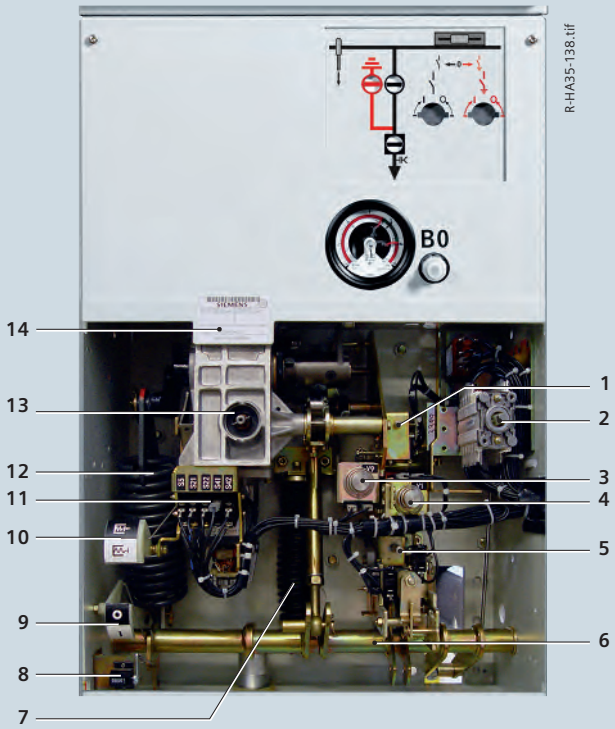
Motor operating mechanism [1] (M1 *)
In the case of motor operating mechanism, the closing spring is charged by means of a motor and latched in the charged position ("spring charged" indication is visible). Closing is effected either by means of an ON pushbutton or a closing solenoid. The closing spring is recharged automatically (for auto-reclosing).

Endurance class of circuit breaker

Function	Class	Standard	Property of 8DA and 8DB
BREAKING	M2	IEC 62271-100	10,000 times mechanically without maintenance
	E2	IEC 62271-100	10,000 times rated normal current without maintenance 50 times short-circuit breaking current without maintenance
	C2	IEC 62271-100	Very low probability of restrikes

Operating times

Closing time		Closing solenoid	< 95 ms
Opening time		1st shunt release 2nd shunt release Undervoltage release	< 65 ms < 55 ms < 55 ms
Arcing time	at 50 Hz at 60 Hz		< 15 ms < 12 ms
Break time	at 50 Hz	1st shunt release 2nd shunt release Undervoltage release	< 80 ms < 70 ms < 70 ms
Dead time			300 ms
Total charging time			< 15 s



Circuit breaker operating mechanism 3AH49 for 8DA and 8DB

1 ON pushbutton
2 Auxiliary switch S1
3 Closing coil for CLOSE
4 Tripping coil for OPEN
5 OFF pushbutton
6 Operating shaft for circuit breaker
7 Opening spring
8 Operations counter
9 Position indicator for circuit breaker
10 "Closing spring charged / not charged" indicator
11 Auxiliary switch
12 Closing spring
13 Gear with hand crank coupling
14 Rating plate

Abbreviations for switching duties:
U = Synchronization and rapid load transfer
K = Auto-reclosing

1) Motor rating at 24 V to 250 V DC: max. 500 W
110 V and 240 V AC: max. 650 VA

* Item designation

For further technical data and description of typical applications, please refer also to Catalog HG 11.04 "3AH4 Vacuum Circuit-Breakers"

Secondary equipment

The scope of the secondary equipment of the vacuum circuit breaker depends on the type of application and offers a wide range of possible variations, allowing almost every requirement to be satisfied.

Closing solenoid

- Type 3AY15 10 (Y9 *)
- For electrical closing.

Shunt releases

- Types:
– Standard: 3AY15 10 (Y1 *)
– Option: 3AX11 01 (Y2 *), with energy store
- Tripping by protection relay or electrical actuation.

Undervoltage release

- Type 3AX11 03 (Y7 *)
- Comprising:
– Energy store and unlatching mechanism
– Electromagnetic system, which is permanently connected to voltage while the vacuum circuit breaker is closed; tripping is initiated when this voltage drops
- Connection to voltage transformers possible.

Anti-pumping

- Function: If constant CLOSE and OPEN commands are present at the vacuum circuit breaker at the same time, the vacuum circuit breaker will return to the open position after closing. It remains in this position until a new CLOSE command is given. In this manner, continuous closing and opening (= pumping) is avoided.

Circuit breaker tripping signal

- For electrical signaling (as pulse > 10 ms), e.g. to remote control systems, in the case of automatic tripping (e.g. protection)
- Via limit switch (S6 *) and cutout switch (S7 *).

Varistor module

- To limit overvoltages to approx. 500 V for protection devices (when inductive components are mounted in the vacuum circuit breaker)
- For auxiliary voltages ≥ 60 V DC.

Auxiliary switch

- Type 3SV9 (S1 *)
- Standard: Up to 22 NO + 22 NC.

Position switch

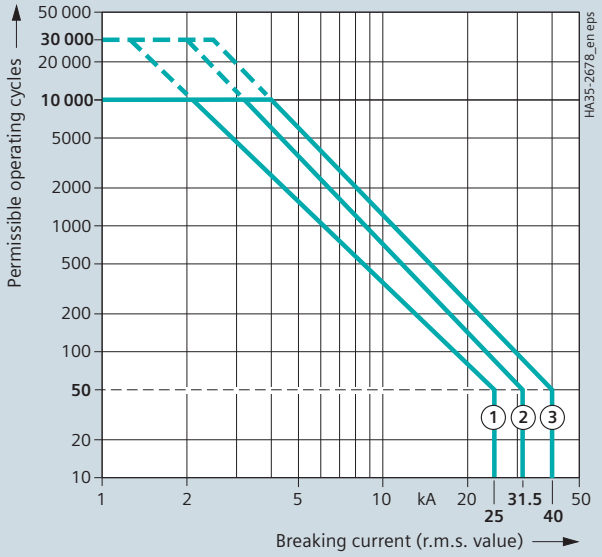
- Type 3SE4 (S4 *)
- For signaling "closing spring charged".

Mechanical interlock

- Mechanical interlocking to the three-position disconnector
- During operation of the three-position disconnector, the vacuum circuit breaker cannot be operated.

Abbreviations: NO = normally open contact,
NC = normally closed contact

Operating cycle diagram



Examples

Electrical data (curve 1)
Rated short-circuit breaking current 25 kA
Rated normal current 1250 A

Electrical data (curve 2)
Rated short-circuit breaking current 31.5 kA
Rated normal current 2000 A

Electrical data (curve 3)
Rated short-circuit breaking current 40 kA
Rated normal current 2500 A

Rated operating sequences
Rapid load transfer (U): O-t-CO-t'-CO (t = 0.3 s, t' = 3 min)
Auto-reclosing (K): O-t-CO-t'-CO (t = 0.3 s, t' = 3 min)
Auto-reclosing (K): O-t-CO-t'-CO (t = 0.3 s, t' = 15 s)

O = OPEN operation
CO = CLOSE operation with subsequent OPEN operation at the shortest internal close-open time of the vacuum circuit breaker

Possible release combinations

Release	1	2	3	4	5
1st shunt release type type 3AY15 10	•	•	•	•	•
2nd shunt release type type 3AX11 01	–	•	•	–	•
3rd shunt release type 3AX11 01	–	–	•	–	–
Undervoltage release type 3AX11 03	–	–	–	•	•

* Item designation

Features

- Rated normal currents up to 3150 A
- 2000 operating cycles for the disconnector (higher operating cycles on request)
- 1000 operating cycles for the earthing switch (higher operating cycles on request)
- Option: Up to 2000 operating cycles for the earthing switch
- Operating shaft and contact blades with common center of rotation and reliable switch position up to the operating front of the panel
- Gas-tight bushings separate the busbar and circuit breaker housings underneath the busbar disconnector contacts
- Cable connection and circuit breaker housings can be removed without interrupting busbar operation
- Maintenance-free.

Switch positions

- CLOSED, OPEN, EARTHED or READY-TO-EARTH
- CLOSED: Contact blades connected with the busbar: Main circuit closed between busbar and circuit breaker
- OPEN: Main circuit open between busbar and circuit breaker: Test voltages for isolating distances are withstood
- READY-TO-EARTH: Contact blades connected with the earthing contact
- EARTHED: Feeder earthed and short-circuited by closing the circuit breaker.

Operating mechanism

- Only permissible operations possible due to logical mechanical interlocks
- Mechanically coupled position indicator
- Separate operating shafts for the "DISCONNECTING", "EARTHING" and "READY-TO-EARTH" functions
- With manual operating mechanism
- Option: With motor operating mechanism
  Motor rating at 24 V to 250 V DC: max. 100 W
  110 V to 240 V AC: max. 130 VA
- Same sense of rotation for the switching operations of the "CLOSE" or "OPEN" functions.

Endurance class of three-position disconnector

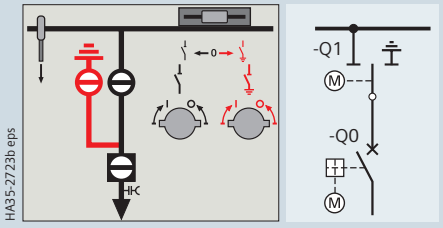
Function	Class	Standard	Property of 8DA and 8DB
DISCONNECTING	M1	IEC 62271-102	2000 times mechanically without maintenance
READY-TO-EARTH			1000 times mechanically without maintenance
EARTHING	E2 [1)]	IEC 62271-102	50 times rated short-circuit making current I_{ma} without maintenance

Endurance class of make-proof earthing switch

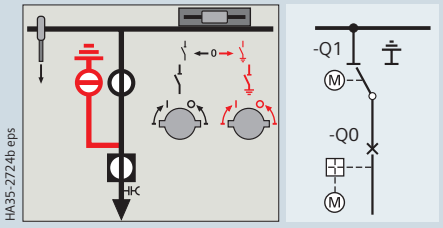
Function	Class	Standard	Property of 8DA and 8DB
EARTHING	E1	IEC 62271-102	1000 times mechanically without maintenance 2 times rated short-circuit making current I_{ma} without maintenance

1) By closing the circuit breaker

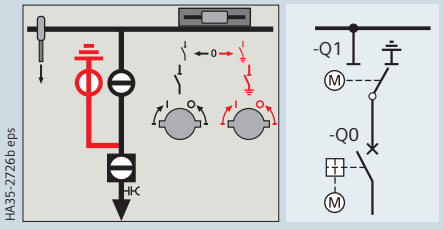
Position indicators of 8DA10
for three-position disconnector and vacuum circuit breaker



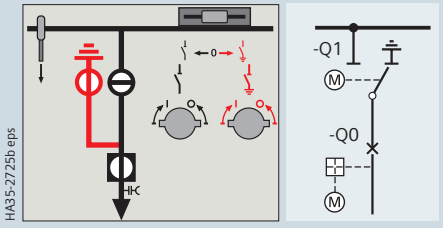
Feeder OPEN



Feeder CLOSED



Feeder READY-TO-EARTH

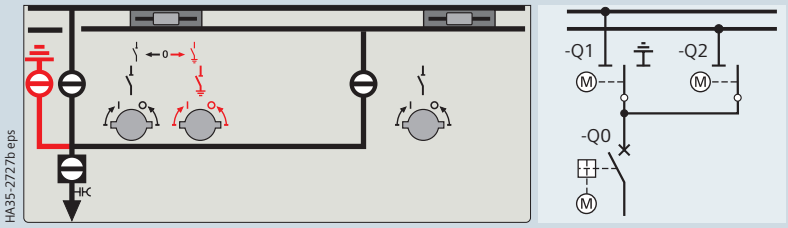


Feeder EARTHED

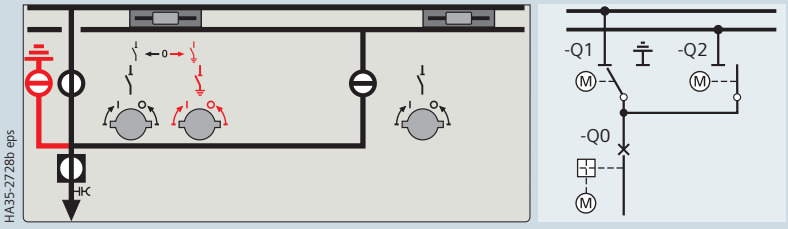
Interlocks

- Selection of permissible switching operations by means of a control gate with mechanically interlocked vacuum circuit breaker
- Selection of permissible switching operations in double-busbar switchgear additionally by means of a control gate with mechanically interlocked vacuum circuit breaker
- Corresponding operating shafts are not released at the operating front until they have been pre-selected with the control gate
- Operating lever cannot be removed until switching operation has been completed
- Circuit breaker cannot be closed until the control gate is in neutral position again
- Option: Switchgear interlocking system with electromechanical interlocks (mechanical interlocking for manual operation remains).

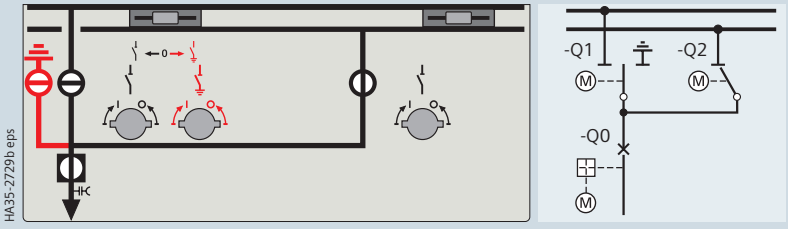
Position indicators of 8DB10
for three-position disconnector
and vacuum circuit breaker



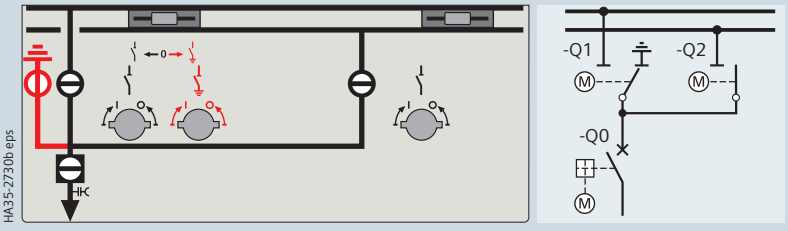
Feeder OPEN



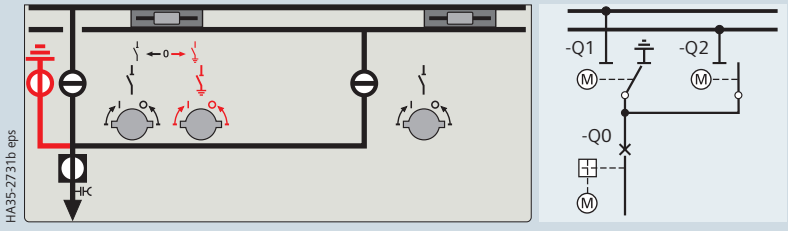
Feeder busbar system 1 CLOSED



Feeder busbar system 2 CLOSED



Feeder READY-TO-EARTH



Feeder EARTHED

Features

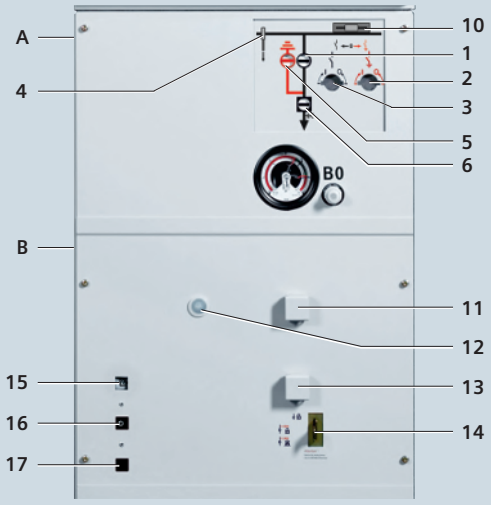
- Mechanical control board below the low-voltage compartment
- Actuations directly at the operating mechanisms
- Mechanical position indicators integrated in the switchgear front
- Unambiguous assignment of actuating openings and control elements to the corresponding position indicators
- Ergonomic height of all control elements.

Interlocking

- Panel-internal mechanical interlocks
- Operation of three-position disconnector (CLOSED, OPEN, EARTHED or READY-TO-EARTH)
- Vacuum circuit breaker interlocked mechanically
- Control gate for opening the actuating openings (with single-busbar systems it can only be operated if the interrogation lever (4) is pushed downwards)
- Actuating openings (2, 3 and 8) cannot be opened as long as the vacuum circuit breaker is in CLOSED position
- Operating lever can be inserted when the actuating openings are open
- Operating lever cannot be removed before the definite end position of the disconnecting or earthing function is reached
- Feeder de-earthing is secured by the vacuum circuit breaker

– electrically via the auxiliary switch
– mechanically through the lever (14) of the mechanical circuit breaker tripping block.

Single-busbar panels 8DA10



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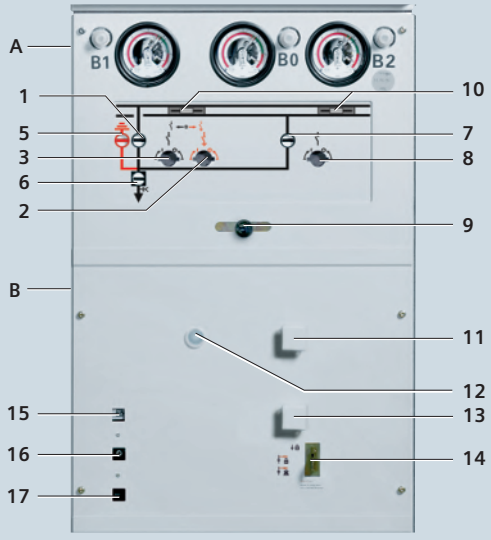
Double-busbar panels 8DB10



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A Operating mechanism of the three-position disconnector
1 CLOSED/OPEN position indicator for disconnecting function of three-position disconnector
2 Actuating opening for earthing function
3 Actuating opening for disconnector function
4 Interrogation lever
5 CLOSED/OPEN position indicator for earthing function of three-position disconnector
6 CLOSED/OPEN position indicator for vacuum circuit breaker
7 CLOSED/OPEN position indicator for 2nd disconnector in double-busbar systems
8 Actuating opening for 2nd disconnector in double-busbar systems
9 Selector gate for selecting the three-position disconnector or the disconnector in double-busbar systems
10 Control gate for opening the actuating openings (with single-busbar systems it can only be operated if the interrogation lever (4) is pushed downwards)
B Operating mechanism of the vacuum circuit breaker
11 Mechanical ON pushbutton for vacuum circuit breaker
12 Actuating opening for manual charging of the circuit breaker operating spring
13 Mechanical OFF pushbutton for vacuum circuit breaker
14 Lever for locking the vacuum circuit breaker against “de-earthing”
15 “Circuit breaker spring charged” indicator
16 CLOSED/OPEN position indicator for vacuum circuit breaker
17 Operations counter for vacuum circuit breaker

Busbar features

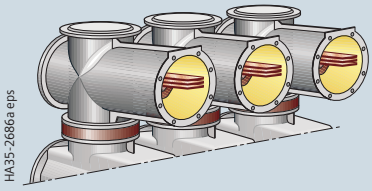
- Single-pole enclosure with modular switchgear housings made of corrosion-resistant aluminum alloy
- Continuous gas insulation without plug-in connections or adapters
- No alteration of the insulating medium throughout the complete busbar assembly
- Up to 4000 A with copper bar connection in one busbar housing
- 5000 A with copper bar connection in two busbar housings (twin busbar).

Design of busbar components

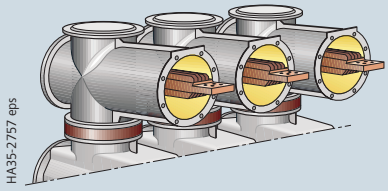
The busbars of single-busbar switchgear 8DA and double-busbar switchgear 8DB can be equipped with the following busbar components:

- Plug-in, metal-enclosed busbar voltage transformers with or without three-position disconnector
- Busbar current transformers
- Busbar connection with cable plug, or with solid-insulated or gas-insulated bar connection, with or without three-position disconnector
- Busbar earthing switch or make-proof earthing switch
- Capacitive voltage detecting system according to IEC 61243-5 or IEC 61958
- Top-mounted bus sectionalizer for distribution into two busbar sections without additional switchgear panels and space requirements.

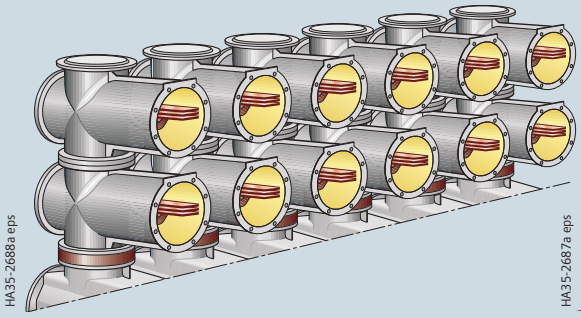
Busbar versions



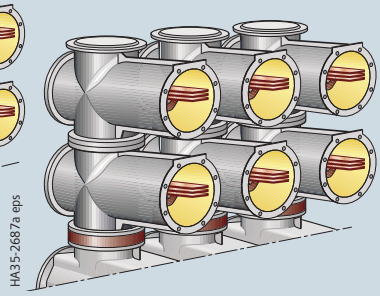
Busbar version up to 3150 A
Example 8DA10



Busbar version 4000 A
Example 8DA10

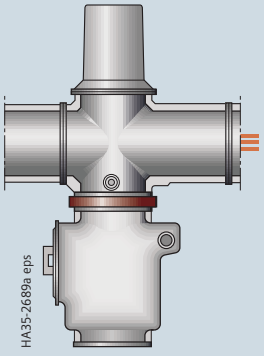


Busbar version 5000 A (twin busbar)
Example 8DB10

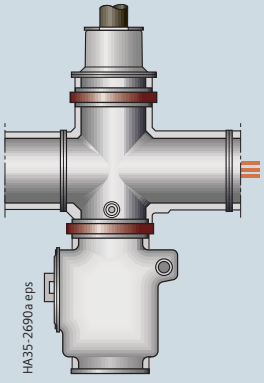


Busbar version 5000 A (twin busbar)
Example 8DA10

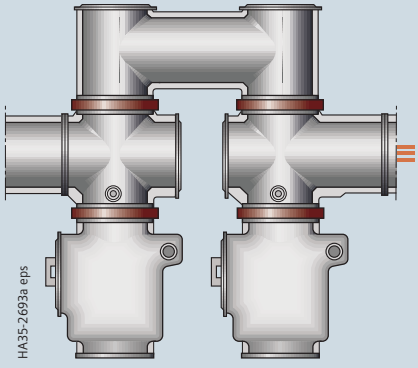
Busbar components



Busbar connection with cable plug size S2 or size S3



Busbar connection with solid-insulated or gas-insulated bar



Top-mounted bus sectionalizer

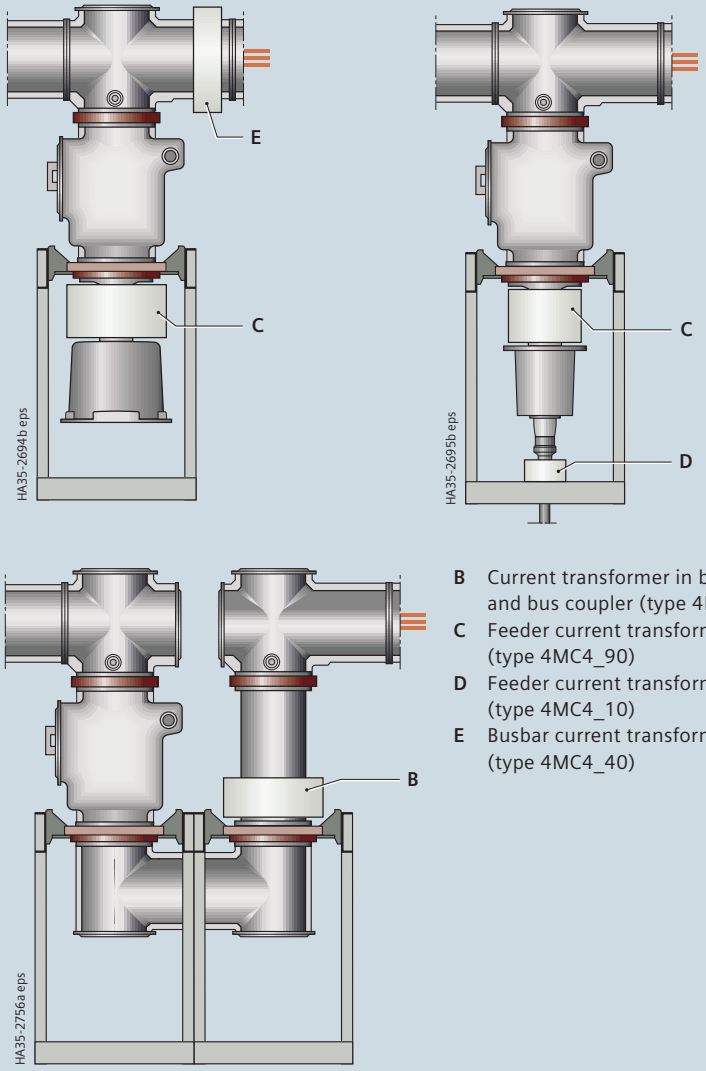
Features

- According to IEC 61869-2
- Designed as ring-core current transformers, single-pole
- Free of dielectrically stressed cast-resin parts (due to design)
- Insulation class E
- Inductive type
- Certifiable
- Climate-independent
- Secondary connection by means of a terminal strip in the low-voltage compartment of the panel
- Cast-resin insulated.

Installation

- Arranged outside the primary enclosure (switchgear housing).

Current transformers



B Current transformer in bus sectionalizer and bus coupler (type 4MC4_40)
C Feeder current transformer (type 4MC4_90)
D Feeder current transformer (type 4MC4_10)
E Busbar current transformer (type 4MC4_40)

Current transformer installation (basic scheme)

Electrical data *

Designation		Type 4MC4
Operating voltage		max. 0.8 kV
Rated short-duration power-frequency withstand voltage (winding test)		3 kV
Rated frequency		50/60 Hz
Rated continuous thermal current		max. 1.2 × rated current (primary)
Rated thermal short-time current, max. 3 s		max. 40 kA
Rated current	dynamic primary secondary	unlimited 40 A to 3150 A 1 A and 5 A

Designation		Type 4MC4
Multiratio (secondary)		200 A – 100 A up to 3150 A – 1575 A
Core data according to rated primary current:		max. 3 cores
Measuring core		
	Rating	2.5 VA to 30 VA
	Class	0.2 to 1
	Overcurrent factor	FS 5, FS 10
Protection core		
	Rating	2.5 VA to 30 VA
	Class	5 P or 10 P
	Overcurrent factor	10 to 30
Permissible ambient air temperature		max. 60 °C
Insulation class		E

* Further electrical data on request

Features

- According to IEC 61869-3
- Single-pole, plug-in design
- Connection system with plug-in contact according to EN 50181
- Inductive type
- Safe-to-touch due to metal enclosure
- Certifiable
- Climate-independent
- Secondary connection by means of plugs in the low-voltage compartment of the panel
- Cast-resin insulated.

Installation

- Arranged outside the primary enclosure (switchgear housing).

Mounting locations

- On the busbar
- At the panel connection housing.

Voltage transformer types

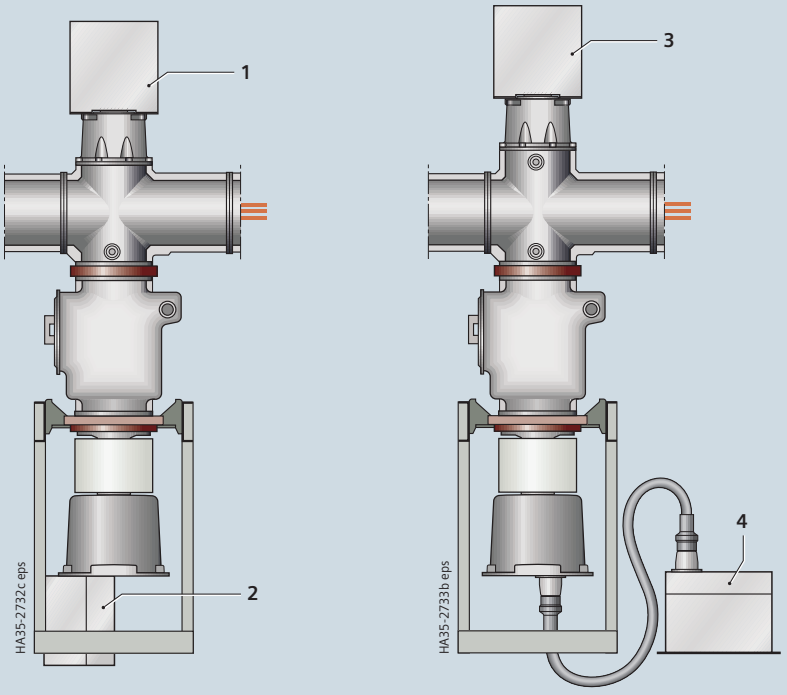
Busbar voltage transformers 4MT3 and 4MU4

- Pluggable on the busbar with plug-in system according to EN 50181
- No separate metering panel required
- Option: Three-position disconnector for busbar voltage transformer CLOSED – OPEN – EARTHED
- Option 4MU4: Repeat test at 80 % of the rated short-duration power-frequency withstand voltage possible with mounted voltage transformer.

Feeder voltage transformers 4MT7 and 4MU3

- Pluggable at the feeder with plug-in system according to EN 50181
- Connection of 4MT7 directly at the panel connection housing
- Connection of 4MU3 via flexible cable with plug size S2 at the panel connection housing, and metal-enclosed voltage transformer.

Voltage transformers



Voltage transformer installation (basic scheme)

1 Busbar voltage transformer 4MU4
2 Feeder voltage transformer 4MT7 (connection at panel connection housing)
3 Busbar voltage transformer 4MU4 with three-position disconnector
4 Feeder voltage transformer 4MU3 (not in the panel, connection via flexible cable with plug size S2 at the panel connection housing, and metal-enclosed voltage transformer)

Electrical data (maximum values)

Designation		4MT3	4MU4	4MT7	4MU3
Rated voltage	kV	24.0	40.5	40.5	40.5
Rated short-duration power-frequency withstand voltage	kV	65	95	95	95
Rated lightning-impulse withstand voltage	kV	125	200	200	200
Rated voltage factor		U_n/8h = 1.9	U_n/8h = 1.9	U_n/8h = 1.9	U_n/8h = 1.9
		U_n/continuous = 1.2	U_n/continuous = 1.2	U_n/continuous = 1.2	U_n/continuous = 1.2
Standard		IEC	IEC	IEC	IEC
		GOST	GOST	GOST	GOST
		GB	GB	GB	GB

Features

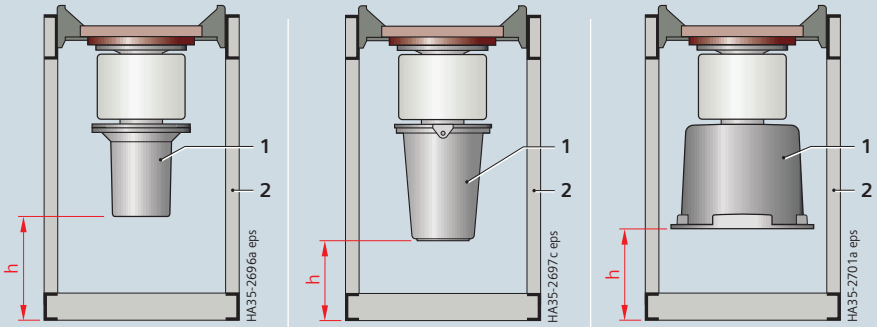
- Bushings for plugs with inside-cone plug-in system according to EN 50181
- Inside-cone plug-in system for plug sizes 2, 3 and 4
- Single and multiple connections possible per phase
- Connection of several cables with different plug sizes possible per phase
- Connection of solid-insulated or gas-insulated bar possible
- Connection of 4MT7 voltage transformer plugged in at the panel connection housing version 3
- Connection of 4MU3 voltage transformer via flexible cable and plug size 2 at the panel connection housing
- For rated normal currents up to 3150 A.

Surge arresters

- Pluggable via inside-cone plug-in system size 2 or 3
- Surge arresters recommended if, at the same time,

– the cable system is directly connected to the overhead line,
– the protection zone of the surge arrester at the end tower of the overhead line does not cover the switchgear.

Panel connection of 8DA10, 8DB10 and 8DA11/12 for cable plugs and bar systems



Version 1	Version 2	Version 3			
S2	S3	S2	S3	4MT7	Solid-insulated bar connection
1	1	1	1	–	–
		2	–	–	–
		3	–	–	–
		–	2	–	–
		–	3	–	–
		1	2	–	–
		1	–	1	–
		2	–	1	–
		–	1	1	–
		–	2	1	–
		1	1	1	–
		–	–	1	1
		1	–	–	1
		2	1	–	–

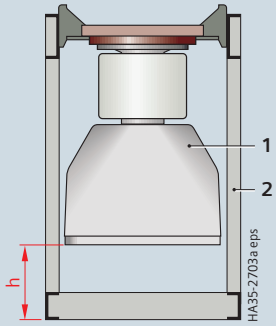
Switchgear type	Rated normal current [A]	Standard subframe	High subframe	Connection height of panel connection versions (mm)			
8DA10 8DA11 8DA12	up to 3150	X		320	240	275	240.5
			X	540	460	495	460.5
8DB10	up to 2500 [1)]	X		120	40	75	40.5
			X	540	460	495	460.5

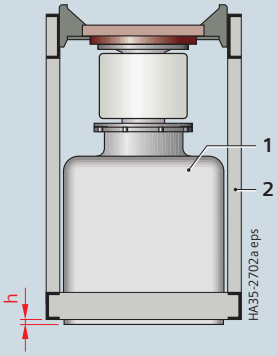
Legend

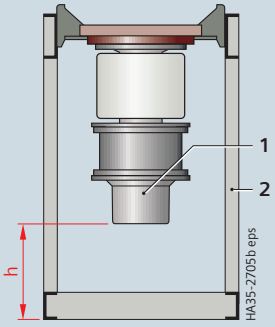
1 Panel connection housing
2 Subframe
h Connection height of panel connection versions

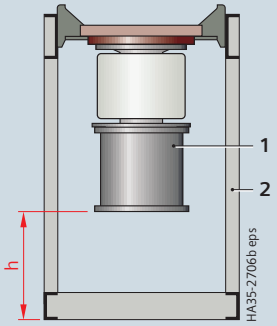
1) 3150 A on request

Panel connection of 8DA10, 8DB10 and 8DA11/12 for cable plugs and bar systems









Version 4			Version 5			Version 6	Version 7
S2	S3	Solid-insulated bar connection	S2	S3	S4	Solid-insulated bar connection	Gas-insulated bar connection
4	–	–	–	–	1	1	1
5	–	–	1	–	1		
6	–	–	2	–	1		
–	4	–	–	1	1		
1	3	–	1	1	1		
1	4	–	–	–	2		
2	2	–	–	2	1		
2	3	–					
3	1	–					
3	2	–					
4	1	–					
2	–	1					
–	1	1					
–	2	1					
1	1	1					

Connection height (h) of panel connection versions (mm)				
222	219	-15	290	327
442	439	205	510	547
22	19	-215	90	127
442	439	205	510	547

Components

Panel connection (commercially available cable plugs and bar connections)

Busbar and panel connection (commercially available cable plugs)

Cable type	Cable sealing end					Remark
	Make	Type	Size	Diameter across cable insulation mm	Conductor cross-section mm2	
Thermoplastic-insulated cables ≤ 12 kV according to IEC 60502-2						
Single-core cable or three-core cable, PE and XLPE-insulated, N2YSY (Cu) and N2XSY (Cu) or NA2YSY (Al) and NA2XSY (Al)	**nkt cables**	CPI 2	2	12.7 - 33.6	25 - 300	Insulation material silicone rubber, with or without metal housing, installation without special tools
		CPI 3	3	21.2 - 45.6	185 - 630	
	Pfisterer	CONNEX	2	13.5 - 44.0	25 - 400	Insulation material silicone rubber, with metal housing
		CONNEX	3	15.5 - 55.0	35 - 800	
		CONNEX	4	33.0 - 78.5	95 - 1600	
	Südkabel	SEIK 14	2	13.0 - 40.6	25 - 300	Insulation material silicone rubber, with metal housing
		SEIK 15	3	19.3 - 50.6	120 - 630	
	Tyco Electronics	RPIT-321x	2	19.5 - 36.0	95 - 300	Insulation material silicone rubber, with metal housing
		RPIT-331x	3	26.0 - 50.0	240 - 630	
Thermoplastic-insulated cables ≤ 24 kV according to IEC 60502-2						
Single-core cable or three-core cable, PE and XLPE-insulated, N2YSY (Cu) and N2XSY (Cu) or NA2YSY (Al) and NA2XSY (Al)	**nkt cables**	CPI 2	2	17.0 - 40.0	25 - 300	Insulation material silicone rubber, with or without metal housing, installation without special tools
		CPI 3	3	21.2 - 45.6	95 - 630	
	Pfisterer	CONNEX	2	13.5 - 44.0	25 - 400	Insulation material silicone rubber, with metal housing
		CONNEX	3	15.5 - 55.0	35 - 800	
		CONNEX	4	33.0 - 78.5	95 - 1600	
	Südkabel	SEIK 24	2	13.0 - 40.6	25 - 300	Insulation material silicone rubber, with metal housing
		SEIK 25	3	19.3 - 50.6	50 - 630	
	Tyco Electronics	RPIT-521x	2	19.5 - 36.0	50 - 300	Insulation material silicone rubber, with metal housing
		RPIT-531x	3	26.0 - 50.0	150 - 630	
Thermoplastic-insulated cables ≤ 40.5 kV according to IEC 60502-2						
Single-core cable or three-core cable, PE and XLPE-insulated, N2YSY (Cu) and N2XSY (Cu) or NA2YSY (Al) and NA2XSY (Al)	**nkt cables**	CPI 2	2	17.0 - 40.0	25 - 300	Insulation material silicone rubber, with or without metal housing, installation without special tools
		CPI 3	3	21.2 - 51.0	50 - 630	
	Pfisterer	CONNEX	2	13.5 - 44.0	25 - 400	Insulation material silicone rubber, with metal housing
		CONNEX	3	15.5 - 55.0	35 - 800	
		CONNEX	4	33.0 - 78.5	95 - 1600	
	Südkabel	SEIK 34	2	13.0 - 40.6	35 - 300	Insulation material silicone rubber, with metal housing
		SEIK 35	3	19.3 - 50.6	50 - 630	
	Tyco Electronics	RPIT-621x	2	19.5 - 36.0	50 - 185	Insulation material silicone rubber, with metal housing
		RPIT-631x	3	26.0 - 50.0	95 - 630	

Busbar and panel connection (commercially available bar systems)

Bar type	Bar connection				Remark
	Make	Type	Conductor material	Max. rated current [1)]	
Solid-insulated bar	**MGC Moser Glaser**	Duresca DE	Copper, aluminum	2500 A	Outer sheath made of polyamide
		Duresca DG	Copper, aluminum	2500 A	Outer sheath made of CrNi steel or aluminum
	Tefelen Preissinger	ISOBUS MR	Copper, aluminum	2500 A	Outer sheath made of heat shrinkable tube
	Ritz	SIS	Copper, aluminum	2500 A	Outer sheath made of heat shrinkable tube
Gas-insulated bar	**MGC Moser Glaser**	Gaslink	Copper	2500 A	Aluminum housing
	Tefelen Preissinger	ISOBUS MG	Copper	2500 A	Aluminum housing

Busbar and panel connection (commercially available dummy plugs)

Accessories	Dummy plug				Remark
	Make	Type	Size	Rated voltage	
Inside-cone plug-in system according to EN 50181	**nkt cables**	FPI 2	2	40.5 kV	Insulation material silicone rubber, with metal housing
		FPI 3	3	40.5 kV	
	Pfisterer Blindstecker		2	40.5 kV	Insulation material silicone rubber, with metal housing
			3	40.5 kV	
			4	40.5 kV	
	Südkabel	ISIK 14/24/34	2	12 / 24 / 40.5 kV	Insulation material silicone rubber, with metal housing
		ISIK 15/25/35	3	12 / 24 / 40.5 kV	
	Tyco Electronics	RPIC-2	2	40.5 kV	Insulation material silicone rubber, with metal housing
		RPIC-3	3	40.5 kV	

1) Higher values on request

Voltage detecting systems according to IEC 61243-5 or VDE 0682-415, IEC 62271-206

- To verify safe isolation from supply
- LRM detecting systems
- – with plug-in indicator
- – with integrated indicator, type VOIS+, VOIS R+
- – with integrated indicator, with integrated repeat test of the interface, with integrated function test, type CAPDIS-S1+, WEGA 1.2 C, WEGA 1.2 C Vario, with integrated signaling relay, type CAPDIS-S2+, WEGA 2.2 C, WEGA 3.

Plug-in voltage indicator

- Verification of safe isolation from supply phase by phase
- Indicator suitable for continuous operation
- Measuring system and voltage indicator can be tested, repeat test according to local specifications and standards
- Voltage indicator flashes if high voltage is present.

VOIS+, VOIS R+

- Integrated display, without auxiliary power
- With indication "A1" to "A3" (see legend)
- Maintenance-free, repeat test according to local specifications and standards required
- With integrated 3-phase LRM test socket for phase comparison
- With integrated signaling relay (only VOIS R+)
- Degree of protection IP54.

Common features of CAPDIS-Sx+

- Maintenance-free
- Integrated display, without auxiliary power
- Integrated repeat test of the interfaces (self-monitoring)
- With integrated function test (without auxiliary power) by pressing the "Display-Test" pushbutton
- Adjustable for different operating voltages (adjustable capacitance C2)
- With integrated 3-phase LRM test socket for phase comparison
- With connectable signal-lead test
- With overvoltage monitoring and signaling (1.2 times operating voltage)
- Degree of protection IP54.

CAPDIS-S1+

- Without auxiliary power
- With indication "A1" to "A7" (see legend)
- Without ready-for-service monitoring
- Without signaling relays (without auxiliary contacts).

CAPDIS-S2+

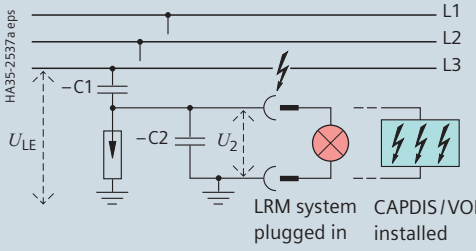
- With indication "A0" to "A8" (see legend)
- Only by pressing the "Test" pushbutton: "ERROR" indication (A8), e.g. in case of missing auxiliary voltage
- With ready-for-service monitoring (auxiliary power required)
- With integrated signaling relay for signals (auxiliary power required).

Indicators and detecting systems

Plug-in voltage indicator
per phase at the panel front

Integrated voltage indicator VOIS+, VOIS R+

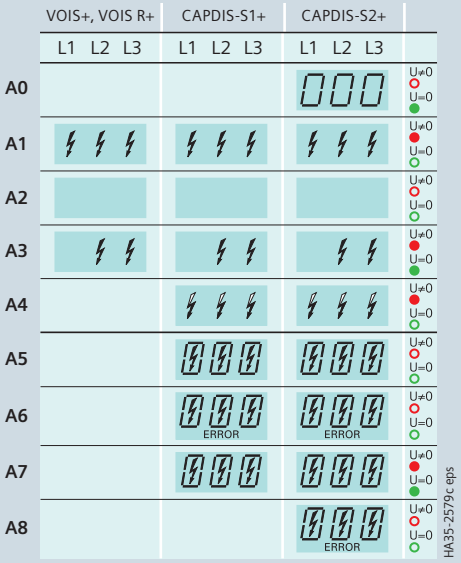
Integrated voltage detecting system CAPDIS-S1+, -S2+



Voltage indication
via capacitive voltage divider (principle)

– C1 Capacitance integrated into bushing
– C2 Capacitance of the connection leads and the voltage indicator to earth
$U_{LE} = U_N/\sqrt{3}$ during rated operation in the three-phase system
$U_2 = U_A$ = Voltage at the capacitive interface of the switchgear or at the voltage indicator

Symbols shown



CAPDIS S2+: The red and green LEDs show the state of the relay contacts
LED doesn't light up
LED lights up
U = Operating voltage

A0 CAPDIS-S2+: Operating voltage not present
A1 Operating voltage present
A2 – Operating voltage not present
– For CAPDIS-S2+: Auxiliary power not present
A3 Failure in phase L1, operating voltage at L2 and L3 (for CAPDIS-Sx+ also earth-fault indication)
A4 Voltage (not operating voltage) present
A5 Indication "Test" passed (lights up briefly)
A6 Indication "Test" not passed (lights up briefly)
A7 Overvoltage present (lights up permanently)
A8 Indication "ERROR", e.g.: in case of missing auxiliary voltage

WEGA 3

- Display indication "A1" to "A5"
- Integrated repeat test of the interface (self-monitoring)
- With integrated 3-phase LRM test socket for phase comparison.

WEGA 1.2 C, WEGA 1.2 C Vario

- Display indication "A1" to "A6" (see legend)
- Maintenance-free
- Integrated repeat test of the interface (self-monitoring)
- With integrated function test (without auxiliary power) by pressing the "Display Test" pushbutton
- With integrated 3-phase LRM test socket for phase comparison
- Without integrated signaling relay
- Without auxiliary power
- Degree of protection IP54
- Adjustable for different operating voltages (adjustable capacitance C2) (only for WEGA 1.2 C Vario).

WEGA 2.2 C

- Display indication "A0" to "A7" (see legend)
- Maintenance-free
- Integrated repeat test of the interface (self-monitoring)
- With integrated function test (without auxiliary power) by pressing the "Display Test" pushbutton
- With integrated 3-phase LRM test socket for phase comparison
- With two integrated signaling relays (auxiliary power required)
- Degree of protection IP54.

R-HA35-WEGA-3.psd

Integrated voltage indicator WEGA 3

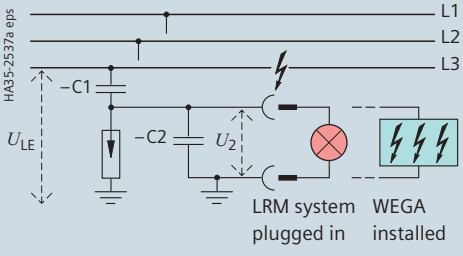
R-HA35-WEGA-1-2-C.psd

Integrated voltage indicator WEGA 1.2 C, WEGA 1.2 C Vario

R-HA35-WEGA-2-2-C.psd

Integrated voltage indicator WEGA 2.2 C

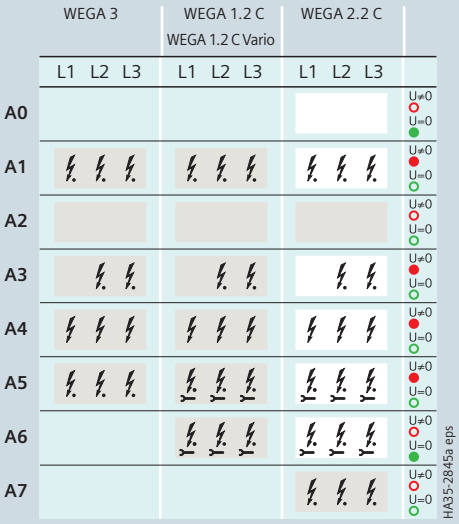
HA35-2537a eps



Voltage indication
via capacitive voltage divider (principle)

– C1 Capacitance integrated into bushing
– C2 Capacitance of the connection leads and the voltage indicator to earth
$U_{LE} = U_N/\sqrt{3}$ during rated operation in the three-phase system
$U_2 = U_A$ = Voltage at the capacitive interface of the switchgear or at the voltage indicator

Symbols shown



LC display gray: not illuminated
LC display white: illuminated

WEGA 2.2 C: The red and green LEDs show the state of the relay contacts
LED doesn't light up
LED lights up
U = Operating voltage

A0 For WEGA 2.2 C:
Operating voltage not present, auxiliary power present, LCD illuminated
A1 Operating voltage present
For WEGA 2.2 C: Auxiliary power present, LCD illuminated
A2 Operating voltage not present
For WEGA 2.2 C: Auxiliary power not present, LCD not illuminated
A3 Failure in phase L1, operating voltage at L2 and L3
For WEGA 2.2 C: Auxiliary power present, LCD illuminated
A4 Voltage present, current monitoring of coupling section below limit value
For WEGA 2.2 C: Auxiliary power present, LCD illuminated
A5 Indication "Display-Test" passed
For WEGA 2.2 C: Auxiliary power present, LCD illuminated
A6 Indication "Display Test" passed
For WEGA 2.2 C:
Auxiliary power present
A7 For WEGA 2.2 C: LCD for missing auxiliary voltage is not illuminated

Verification of correct terminal-phase connections

- Verification of correct terminal-phase connections possible by means of a phase comparison test unit (can be ordered separately)
- Safe-to-touch handling of the phase comparison test unit by inserting it into the capacitive taps (socket pairs) of the switchgear.

Phase comparison test units according to IEC 61243-5 or VDE 0682-415

R-HA40-059.eps

Phase comparison test unit make Pfisterer, type EPV
as combined test unit (HR and LRM) for:
– Voltage detection
– Phase comparison
– Interface test
– Integrated self-test
– Indication via LED.

R-HA40-089.tif

Phase comparison test unit make Horstmann, type ORION 3.1
as combined test unit (HR and LRM) for:
– Phase comparison
– Interface testing at the switchgear
– Voltage detection
– Integrated self-test
– Indication via LED and acoustic alarm
– Phase sequence indicator.

R-HA35-124.eps

Phase comparison test unit make Kries, type CAP-Phase
as combined test unit (HR and LRM) for:
– Voltage detection
– Repeat test
– Phase comparison
– Phase sequence test
– Self-test
The unit does not require a battery.

R-HA41-ORION-M-1.tif

Phase comparison test unit make Horstmann, type ORION M1
as combined test unit (HR and LRM) for:
– Voltage detection
– Phase comparison
– Interface testing at the switchgear
– Integrated self-test
– Indication via display and acoustic alarm
– Phase sequence indication and status LED
– Measurement of interface current up to 25µA
– Measurement of phase angle from –180° to +180°
– Measurement of harmonics up to 40th harmonic
– Securing the measured values via PC software (ORION explorer) and USB.

Ready-for-service indication

Features

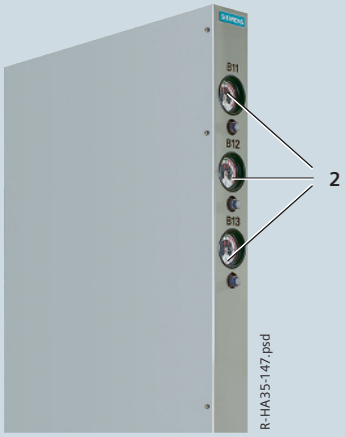
- Simple, visual check of the ready-for-service indicator by red/green indication areas
- Indication of gas pressure also guaranteed without auxiliary voltage supply
- Gas pressure manometers arranged at the switchgear front
- Gas filling equipment with non-return valve arranged at the switchgear front beside the associated gas pressure manometer
- Gas pressure manometers with two signaling contacts for “gas pressure too low / gas pressure too high” indication
- Option: Gas pressure manometers with three signaling contacts for “gas pressure too low / very low” and “gas pressure too high” indication
- Option: Gas pressure manometers with temperature and pressure compensation.

Low-voltage compartment

- For accommodation of protection, control, measuring and metering equipment
- Partitioned safe-to-touch from the high-voltage part of the panel
- Low-voltage compartment can be removed, bus wires and control cables are plugged in
- Option: Higher low-voltage compartment (1200 mm instead of 850 mm) possible.

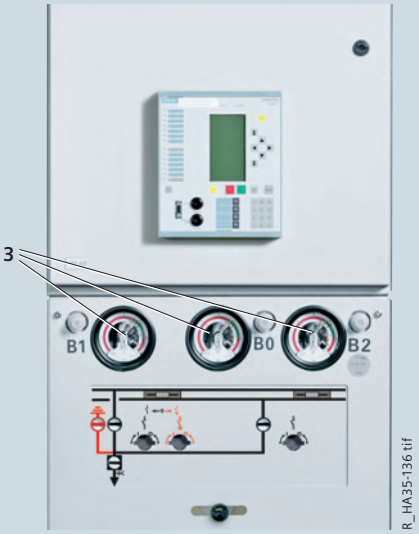
Gas monitoring of single-busbar switchgear 8DA10

Gas pressure manometer (1) for circuit breaker housing (arranged at the panel front)

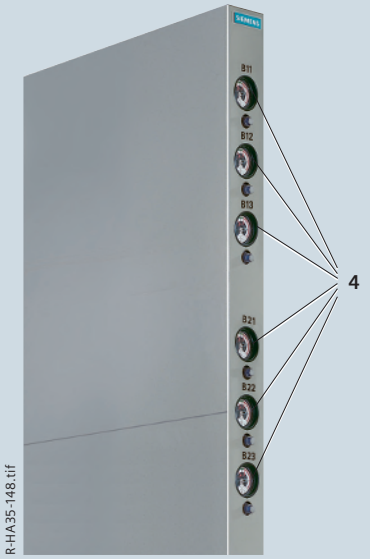


Gas pressure manometers (2) for busbar housings (arranged at the lateral switchgear termination)

Gas monitoring of double-busbar switchgear 8DB10



Gas pressure manometers (3) for circuit breaker and disconnector housings (arranged at the panel front)



Gas pressure manometers (4) for busbar housings (arranged at the lateral switchgear termination)

Protecting, controlling and monitoring are the basic requirements placed on a complete bay controller across all technology generations. The properties the user expects from modern bay controllers are: multifunctionality, reliability, safety and communication capability.
The increasing integration of many functions in one multifunctional device leads to an optimally supported engineering process, IT security, service and testability, or simple and safe operability of the devices and tools.
On the following pages you will find functional descriptions for some selected devices. The low-voltage compartment can accommodate all customary protection, control, measuring and monitoring equipment available on the market:

Overview of digital protection devices

Main function	SIPROTEC 5	SIPROTEC Compact	SIPROTEC 4	Reyrolle
Overcurrent and feeder protection				
Overcurrent protection with PMU[1)] and control	7SJ82/85	7SJ80/81	7SJ61/62/63/64/66	7SR10/11/12/21/22
Self powered overcurrent protection			7SJ45	7SR45
Line protection				
Distance protection with PMU[1)] and control	7SA82/86/87		7SA61/63/64	
Line differential protection with PMU[1)] and control	7SD82/86/87	7SD80	7SD610, 7SD5	7SR18 Solkor
Combined line differential and distance protection with PMU[1)] and control	7SL82/86/87		7SD5	
Breaker management with PMU[1)] and control	7VK87		7VK61	
Overcurrent protection for lines with PMU[1)]	7SJ86			
Transformer differential protection				
Transformer differential protection with PMU[1)], control and monitoring	7UT82/85/86/87		7UT612/613/63	7SR242 Duobias
Motor- and generator protection				
Motor protection with PMU[1)] and control	7SK82/85	7SK80/81	7SJ61/62/63/64/66	7SR105 Argus, 7SR17 Argus
Generator protection with PMU[1)] and control	7UM85		7UM61/62	
Busbar differential protection				
Centralized busbar differential protection	7SS85		7SS52	
Bay controller				
Bay controller for control/interlocking tasks with PMU[1)], monitoring and protection functions[1)]	6MD85/86		6MD63/66	
Fault recorder				
Fault recorder, fault recorder with power quality recordings and fault recorder with PMU	7KE85			
Voltage and frequency protection				
Applicable for system decoupling, load shedding and load restoration		7RW80		7SR158 Argus
Synchronizing				
Synchronizing			7VE61/63	7SR157 Argus
Distribution automation				
Protection and automation for overhead lines		7SC80		7SR224 Argus
Capacitor bank protection				
Capacitor bank protection	7SJ82/85			7SR191 Capa
High impedance protection				
High impedance protection				7SR23 DAD
High speed busbar transfer				
High speed busbar transfer			7VU68	

1) Optional for SIPROTEC 5

SIPROTEC 5 device series

- Powerful automation with graphical CFC (Continuous Function Chart)
- Secure serial protection data communication, also over large distances and all available physical media (fiber-optic cable, 2-wire connections and communication networks)
- Recognition of static and transient earth faults (passing contact function in resonant-earthed and isolated systems)
- Measurement of operational values
- Phasor Measurement Unit (PMU) for synchrophasor measured values and IEEE C37.118 protocol
- Powerful fault recording
- Control of switching devices.

Overcurrent protection device SIPROTEC 7SJ82

- Directional and non-directional time-overcurrent protection with additional functions
- Time optimization of the tripping times by directional comparison and protection data communication
- Frequency protection and rate-of-frequency-change protection for load shedding applications
- Overvoltage and undervoltage protection in all required variations
- Power protection, configurable as active or reactive power protection
- Control, synchrocheck and system interlocking
- Firmly integrated electrical Ethernet port J for DIGSI
- Complete IEC 61850 (reporting and GOOSE) via integrated port J
- Two optional, pluggable communication modules usable for different and redundant protocols (IEC 61850, IEC 60870-5-103, DNP3 (serial+TCP), Modbus RTU Slave, protection data communication).

Distance protection SIPROTEC 7SA86

- Line protection for all voltage levels with 3-pole tripping
- Very short tripping time
- Selective protection of overhead lines and cables with single- and multi-ended infeeds
- Time-graded backup protection to differential protection relays
- Suitable for radial, ring-shaped, or any type of meshed systems of any voltage level with earthed, resonant-earthed or isolated neutral point
- Main protection function: 6-system distance protection
- Detection of current transformer saturation for fast tripping with high accuracy at the same time.

Differential protection SIPROTEC 7SD86

- Line protection for all voltage levels with 3-pole tripping
- Phase-selective protection of overhead lines and cables with single- and multi-ended infeeds of all lengths with up to 6 line ends
- Transformers and shunt reactors within the protection zone are possible
- Suitable for radial, ring-shaped, or any type of meshed systems of any voltage level with earthed, resonant-earthed or isolated neutral point
- Protection of lines with capacitive series compensation
- Directional backup protection and various additional functions.

SIPROTEC 7SJ82

SIPROTEC 7SA86

SIPROTEC 7SD86

1 Modularly expandable
2 Pluggable and retrofittable communication ports
3 Pluggable current and voltage terminal blocks

Transformer differential protection SIPROTEC 7UT85

- Transformer differential protection for two-winding transformers with versatile additional protection functions
- Universal utilization of the permissible measuring points
- Flexible adjustment to the transformer vector group, controlling of making and overexcitation processes, secure performance in case of current transformer saturation with different saturation degrees.
- Protection of standard power transformers and auto-transformers
- Increased sensitivity in case of earth short-circuits close to the neutral point by means of a separate earth-fault differential protection
- Additional current and voltage inputs can be provided for standard protection functions such as overcurrent, voltage, frequency, etc.
- In the standard version, two communication modules can be plugged in, and different protocols can be used (IEC 61850, IEC 60870-5-103, DNP3 (serial, TCP), Modbus RTU Slave).

Digital fault recorder SIPROTEC 7KE85

- Fast-scan recorder
- Up to 2 slow scan recorders
- Up to 5 continuous recorders
- Usable as Phasor Measurement Unit (PMU) according to IEEE C37.118 Standard
- Transfer of recordings and triggering via IEC 61850
- Variable sampling rates programmable between 1 kHz – 16 kHz
- No-loss data compression
- Time synchronization via IRIG-B, DCF77 and SNTP
- Free mapping of measured values to the individual recorders
- Free combination of measuring groups for power calculation
- Quality bits for displaying the momentary channel quality
- The trigger functions of a function block are the fundamental value, r.m.s. value, zero-sequence, positive-sequence, negative-sequence system, Σ active, Σ reactive and Σ apparent power
- Level trigger and gradient trigger for each trigger function
- Flexible cross and network trigger
- Creation of trigger functions with the graphical automation editor CFC (Continuous Function Chart)
- Trigger functions by combination of single signals, double signals, analog values, binary signals, Bool signals and GOOSE messages.

SIPROTEC Compact series
Overcurrent protection SIPROTEC 7SJ80

- Pluggable current and voltage terminals
- Binary input thresholds settable using DIGSI (3 stages)
- Secondary current transformer values (1A/5A) settable using DIGSI
- 9 programmable function keys
- 6-line display
- Buffer battery exchangeable from the front
- USB front port
- 2 additional communication ports
- IEC 61850 with integrated redundancy (electrical or optical)
- Relay-to-relay communication through Ethernet with IEC 61850 GOOSE
- Millisecond-accurate time synchronization through Ethernet with SNTP.

SIPROTEC 7UT85

SIPROTEC 7KE85

1 Modularly expandable

SIPROTEC Compact 7SJ80

Panel design

- Factory-assembled, type-tested according to IEC 62271
- Single-pole metal-enclosed, with metallic partitions [1)]
- Hermetically bolted switchgear housings made of corrosion-resistant aluminum alloy
- Switchpanel poles arranged one behind the other
- Maintenance-free in an indoor environment (IEC 62271-1)
- Cable connection with inside-cone plug-in system according to EN 50181
- Wall-standing or free-standing arrangement
- Subframe, front cover, rear cover and end walls powder-coated in color "light basic" (light gray RAL 7035)
- Low-voltage compartment removable, plug-in bus wires
- Degree of protection
  - IP 65 for all high-voltage parts of the primary circuit
  - IP 3XD for the switchgear enclosure
- Option: IP 31D for the switchgear enclosure
- Option: IP 41 for the low-voltage compartment
- Vacuum circuit breaker
- Three-position disconnector for disconnecting and grounding by means of the circuit breaker
- Make-proof grounding by means of the vacuum circuit breaker
- Option: Three-position disconnector for disconnecting and grounding at the feeder
- For further dimensions and product range, see pages 14 to 31.

Insulating system

- Switchgear housing filled with SF_6 gas
- Features of SF_6 gas:
  - Non-toxic
  - Odorless and colorless
  - Non-inflammable
  - Chemically neutral
  - Heavier than air
  - Electronegative (high-quality insulator)
  - GWP (Global Warming Potential) = 22,800
- Pressure of the SF_6 gas in the switchgear housing dependent on the electrical ratings (relative pressure at 20 °C):
  Rated functional level (relative): 120 kPa
  Gas leakage rate: < 0.1 % per year.

Camera system

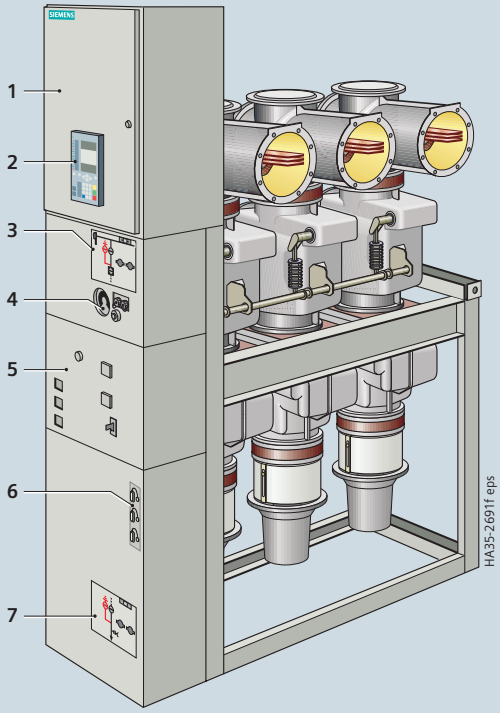
- Camera system for visual monitoring of the switch positions of the disconnectors and grounding switches (see also page 56).

UL certification

- For 8DA and 8DB ANSI design options there is a UL or cUL certificate available.

1) Corresponds to "metal-clad" according to former standard IEC 60298

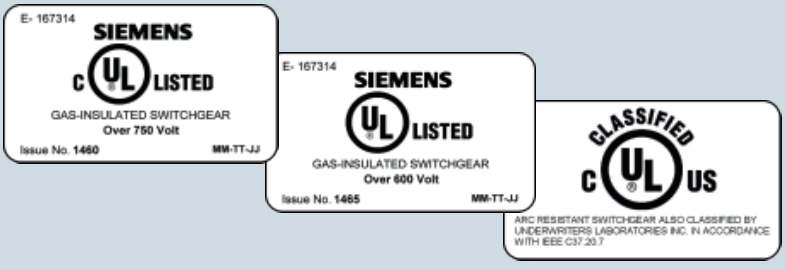
Basic panel design



Legend for 8DA10

1 Low-voltage compartment
2 Electronic control board, e.g. multifunction protection
3 Operating mechanism and interlock for three-position disconnector, as well as mechanical position indicators for three-position disconnector and circuit breaker
4 Manometer for gas monitoring of feeder gas compartments
5 Circuit breaker operating mechanism
6 Voltage detecting system
7 Operating mechanism and interlock for the three-position disconnector, as well as mechanical position indicator for the three-position disconnector at the feeder

Example 8DA10
Single-busbar panel with three-position disconnector at the feeder



Electrical data, functional level, temperature for single-busbar and double-busbar switchgear according to ANSI

Common electrical data, functional level and temperature	Rated insulation level	Rated voltage U_r	kV	4.76	8.25	15	27	38	40.5 [1]
		Rated short-duration power-frequency withstand voltage U_d:							
		– phase-to-phase, phase-to-earth, open contact gap	kV	19	36	36	70	80	80
		– across the isolating distance	kV	21	40	40	80	95	95
		Rated lightning impulse withstand voltage U_p:							
		– phase-to-phase, phase-to-earth, open contact gap	kV	60	95	95	125	200	200
		– across the isolating distance	kV	66	105	105	138	220	220
	Rated frequency f_r		Hz	60	60	60	60	60	60
	Rated normal current I_r [6]	of the busbar	A	1250	1250	1250	1250	1250	
			A	2000	2000	2000	2000	2000	
			A	2500	2500	2500	2500	2500	
			A	3000	3000	3000	3000	3000	
			A	4000	4000	4000	4000	4000	
			A	5000	5000	5000	5000	5000	5000
	Rated functional level p_{re}	(relative) of the busbar		120 kPa at 20 °C					
	Minimum functional level p_{me}			100 kPa at 20 °C					
	Ambient air temperature			–5 °C to +55 °C [8]					

Data of the switchgear panels

Circuit breaker panel, disconnector panel [2], bus sectionalizer, bus coupler [3]	Rated normal current I_r [4]		A	1250	1250	1250	1250	1250	1250
			A	1600	1600	1600	1600	1600	1600
			A	2000	2000	2000	2000	2000	2000
			A	2500	2500	2500	2500	2500	2500
			A	2700 [5]	2700 [5]	2700 [5]	2700 [5]	2700 [5]	2700 [5]
			A	3000 [6]	3000 [6]	3000 [6]	3000 [6]	3000 [6]	3000 [6]
	Rated short-time withstand current 3 s		up to kA	40	40	40	40	40	40
	Rated peak-withstand current		up to kA	104	104	104	104	104	104
	Rated short-circuit making current		up to kA	104	104	104	104	104	104
	Rated short-circuit breaking current		up to kA	40	40	40	40	40	40
	Electrical endurance of vacuum circuit breakers	at rated normal current		10,000 operating cycles [7]					
		at rated short-circuit breaking current		50 breaking operations					
	Rated functional level p_{re}	(relative) for feeders		120 kPa at 20 °C					
	Minimum functional level p_{me}			100 kPa at 20 °C					

1) Higher values of the rated voltage available with 42 kV
2) Disconnector panel available for single-busbar switchgear 8DA10
3) Bus coupler available for double-busbar switchgear 8DB10
4) Maximum permissible normal current dependent on ambient air temperature
5) 2700 A without forced ventilation (8DB10 on request)
6) 3000 A with forced ventilation (8DB10 on request)
7) Option: 30,000 operating cycles
8) Option: Ambient air temperature –30 °C to +55 °C

Camera system

8DA and 8DB switchgear can be designed according to ANSI requirements. For this purpose, every three-position disconnector is equipped with a digital camera monitoring system VDMS (Visible Disconnect Monitoring System). The CLOSED - OPEN - GROUNDED positions are transmitted per phase through a USB / RJ45 interface and signaled to a mobile computer.

Current transformer features

- Designed as ring-core current transformers, single-pole
- Free of dielectrically stressed cast-resin parts (due to design)
- Inductive type
- Climate-independent
- Secondary connection by means of a terminal strip in the low-voltage compartment of the panel
- Cast-resin insulated.

Voltage transformer features

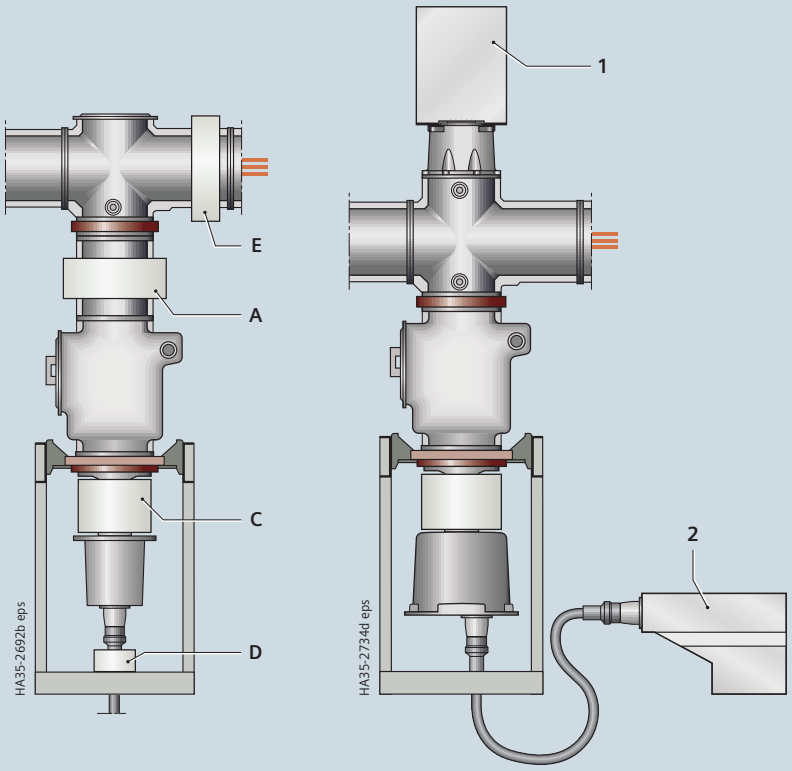
- Single-pole, plug-in design
- Connection system with plug-in contact according to EN 50181
- Inductive type
- Safe-to-touch due to metal enclosure
- Climate-independent
- Secondary connection by means of plugs in the low-voltage compartment of the panel
- Cast-resin insulated.

Installation

Arranged outside the primary enclosure (switchgear housing).

Internal arc classification

- Internal arcing test according to IEEE Std C37.20.7™-2007 (see also page 13).



Current transformer installation (basic scheme)

C Feeder current transformer (type 4MC4_90)
D Feeder current transformer (type 4MC4_10)
E Busbar current transformer (type 4MC4_40)

Option:
A Feeder current transformer between circuit breaker and three-position disconnector on the busbar (type 4MC4_90)

Voltage transformer installation (basic scheme)

1 Busbar voltage transformer 4MU4_FUSE with primary fuses and three-position disconnector
2 Feeder voltage transformer 4MU3_FUSE with primary fuses (not in the panel, connection via flexible cable with plug size S2 at the panel connection housing and metal-enclosed voltage transformer)

LAN interface

USB interface

USB and LAN interface for visual monitoring of the positions of the three-position disconnector

Option:
In accordance with ANSI requirements, 8DA and 8DB switchgear can be equipped with an additional three-position disconnector at the feeder.

Features

- Rated normal currents up to 2000 A
- 2000 operating cycles for the disconnector (higher operating cycles on request)
- 1000 operating cycles for the earthing switch (higher operating cycles on request)
- Operating shaft and disconnector contacts with common center of rotation and reliable switch position up to the operating front of the panel
- Gas-tight bushings separate the busbar and circuit breaker housings underneath the busbar disconnector contacts
- Cable connection and circuit breaker housings can be removed without interrupting busbar operation
- Maintenance-free.

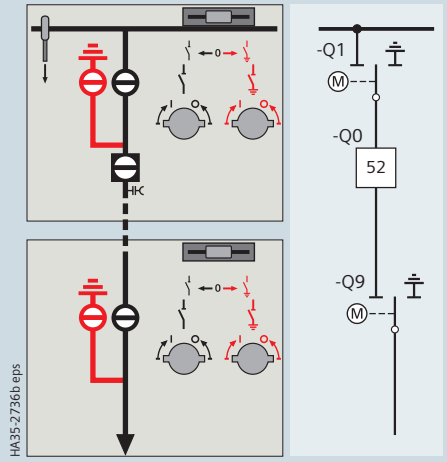
Switch positions

- CLOSED, OPEN, GROUNDED or READY-TO-GROUND
- CLOSED: Disconnector contact connected with the busbar: Main circuit closed between busbar, circuit breaker and feeder
- OPEN: Main circuit open between busbar, circuit breaker and feeder: Test voltages for isolating distances are withstood
- READY-TO-GROUND: Contact blades connected with the earthing contact
- GROUNDED: Circuit breaker closed. Three-position disconnector at the feeder connected with grounding contact.

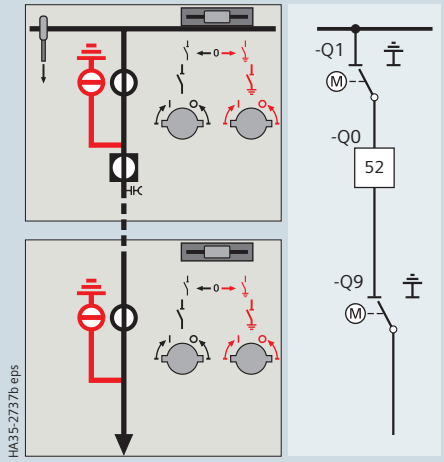
Operating mechanism

- Only permissible operations possible due to logical mechanical interlocks
- Mechanically coupled position indicators
- Separate operating shafts for the "DISCONNECTING", "GROUNDING" and "READY-TO-GROUND" functions
- With manual operating mechanism
- Option: With motor operating mechanism
  Motor rating at
  24 V to 250 V DC: max. 100 W
  110 V to 240 V AC: max. 130 VA
- Same sense of rotation for the switching operations of the "CLOSE" or "OPEN" functions.

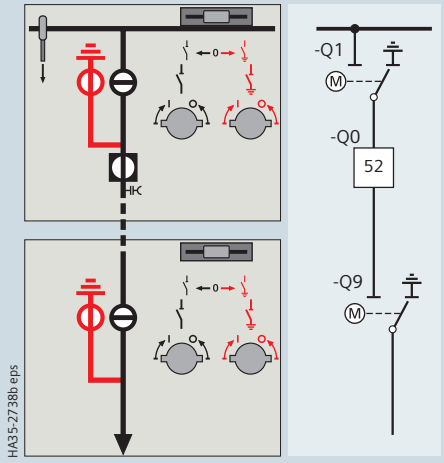
Example:
Position indicators of 8DA10 with additional three-position disconnector at the feeder



Feeder OPEN



Feeder CLOSED



Feeder GROUNDED

Standards

Standards, specifications, guidelines

Type of service location

The switchgear can be used as indoor installation according to IEC 61936 (Power installations exceeding 1 kV AC)

- Outside lockable electrical service locations at places which are not accessible to the public. Enclosures of switchgear can only be removed with tools
- In lockable electrical service locations. A lockable electrical service location is a place outdoors or indoors that is reserved exclusively for housing electrical equipment and which is kept under lock and key. Access is restricted to authorized personnel and persons who have been properly instructed in electrical engineering. Untrained or unskilled persons may only enter under the supervision of authorized personnel or properly instructed persons.

Terms

"Make-proof earthing switches" are earthing switches with short-circuit making capacity according to IEC 62271-102 and EN 62271-102.

Dielectric strength

- The dielectric strength is verified by testing the switchgear with rated values of short-duration power-frequency withstand voltage and lightning-impulse withstand voltage according to IEC 62271-1 (see table "Dielectric strength").
- The rated values are referred to sea level and to normal atmospheric conditions (1013 hPa, 20 °C, 11g/m3 humidity according to IEC 60071).

The gas insulation at a relative gas pressure of > 50 kPa permits switchgear installation at any desired altitude above sea level without the dielectric strength being adversely affected.

Standards

8DA and 8DB switchgear complies with the relevant standards and specifications applicable at the time of type tests.
In accordance with the harmonization agreement reached by the countries of the European Union, their national specifications conform to the IEC standard.

Table – Dielectric strength
Single-busbar and double-busbar switchgear 8DA10 and 8DB10

Rated voltage	kV	12	24	36	40.5
Rated short-duration power-frequency withstand voltage					
– Between phase and earth	kV	28	50	70	85
– Across isolating distance	kV	32	60	80	90
Rated lightning-impulse withstand voltage					
– Between phase and earth	kV	75	125	170	185
– Across isolating distance	kV	85	145	195	220

Table – Dielectric strength
Traction power supply switchgear 8DA11 / 12

Rated voltage according to EN 50124-1	kV	17.25	27.5
Nominal voltage according to IEC 60850 / EN 50163	kV	15	25
Rated short-duration power-frequency withstand voltage			
– Between phase and earth	kV	50	95
– Across isolating distance	kV	60	110
Rated lighting impulse withstand voltage			
– Between phase and earth	kV	125	200
– Across isolating distance	kV	145	220

Overview of standards (September 2017)

		IEC standard	VDE standard	EN standard
Switchgear	8DA and 8DB	IEC 62271-1	VDE 0671-1	EN 62271-1
		IEC 62271-200	VDE 0671-200	EN 62271-200
Devices	Circuit breakers	IEC 62271-100	VDE 0671-100	EN 62271-100
	Disconnectors and earthing switches	IEC 62271-102	VDE 0671-102	EN 62271-102
	Voltage detecting systems	IEC 61243-5	VDE 0682-415	EN 61243-5
Degree of protection	IP code	IEC 60529	VDE 0470-1	EN 60529
	IK code	IEC 62262	VDE 0470-100	EN 50102
Insulation	–	IEC 60071	VDE 0111	EN 60071
Instrument transformers	–	IEC 61869-1	VDE 0414-9-1	EN 61869-1
	Current transformers	IEC 61869-2	VDE 0414-9-2	EN 61869-2
	Voltage transformers	IEC 61869-3	VDE 0414-9-3	EN 61869-3
Installation, erection	–	IEC 61936-1	VDE 0101	–
Insulating gas SF_6	Use and handling of SF_6	IEC 62271-4	VDE 0671-4	EN 62271-4
	Specification for new SF_6	IEC 60376	VDE 0373-1	EN 60376
	Guidelines for the checking and treatment of SF_6 taken from electrical equipment	IEC 60480	VDE 0373-2	EN 60480

Overview of standards for traction applications

		IEC standard	–	EN standard
Supply voltage	8DA11 and 8DA12	IEC 60850	VDE 0115-102	EN 50163
Switchgear	8DA11 and 8DA12	IEC 62505	VDE 0115-320	EN 50152
Insulation	8DA11 and 8DA12	–	VDE 0115-107	EN 50124

Current carrying capacity

- According to IEC 62271-200 or IEC 62271-1, the rated normal current refers to the following ambient air temperatures:
  – Maximum of 24-hour mean + 35 °C
  – Maximum + 40 °C
- The current carrying capacity of the panels and busbars depends on the ambient air temperature outside the enclosure.

Internal arc classifications

- Protection of operating personnel by means of tests for verifying the internal arc classification
- Internal arcing tests must be performed in accordance with IEC 62271-200 and IEEE Std C37.20.7™-2007
- Definition of criteria according to IEC:

– Criterion 1
Correctly secured doors and covers do not open, limited deformations are accepted
– Criterion 2
No fragmentation of the enclosure, no projection of small parts above 60 g
– Criterion 3
No holes in accessible sides up to a height of 2 m
– Criterion 4
No ignition of indicators due to hot gases
– Criterion 5
The enclosure remains connected to its earthing point.

Resistance to internal faults

Due to the single-pole enclosure and the gas insulation of the switchgear and the switching devices, the possibility of faults in gas-insulated switchgear is a mere fraction of that typical of other switchgear types:

- There are no effects due to external influences, such as:
– Pollution layers
– Humidity
– Small animals and foreign objects
- Maloperation is practically excluded due to logical arrangement of operating elements
- Short-circuit-proof feeder earthing by means of the circuit breaker.

In the unlikely event of a fault within the switchgear housing, the energy conversion in the case of an internal arc fault is minor thanks to the SF_6 insulation and the shorter length of the arc, approximately only ⅓ of the converted energy of an arc in air insulation.

Resistance to short circuits and earth faults

Two-phase and three-phase short circuits between the primary conductors are excluded by the single-pole primary enclosure.

Seismic withstand capability (optional)

8DA and 8DB switchgear can be upgraded for regions at risk from earthquakes.

For upgrading, earthquake qualification testing has been carried out in accordance with the following standards:

- IEC 60068-3-3 "Guidance – seismic test methods for equipment"
- IEC 60068-2-57 "Test Ff: Vibration – Time-history method"
- IEC 60068-2-6 "Test Fc: Vibration (sinusoidal)"
- IEEE 693-2005 "Recommended Practice for Seismic Design of Substations"
- IEEE 344-2004 "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"
- IEEE C37.81-1989 "IEEE Guide for Seismic Qualification of Class 1E Metal-Enclosed Power Switchgear Assemblies"
- IEC 60980-1989 "Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations".

For installation on even and rigid concrete or steel structure (without considering building influences), the tested ground accelerations meet the following requirements:

- Uniform Building Code 1997 (UBC) – Zone 4
- California Building Code 1998 (CBC) – Zone 4
- International Building Code 2006 (IBC) – 200 %
- American Society of Civil Engineers 2005 (ASCE) – 200 %
- IEEE 693-2005 – High required response spectrum (Figure A.1).

Color of the panel front

Siemens standard (SN) 47 030 G1, color "light basic" (light gray RAL 7035) (similar to RAL 7044 / silk grey).

Climate and environmental influences

8DA and 8DB switchgear is completely enclosed and insensitive to climatic influences.

- All medium-voltage devices are installed in gas-tight and bolted switchgear housings made of corrosion-resistant aluminum alloy and filled with SF_6 gas
- Live parts inside and outside the switchgear housing are provided with single-pole enclosure
- At no point can creepage currents flow from high-voltage potentials to earth
- Operating mechanism parts which are functionally important are made of corrosion-resistant materials
- Bearings in the operating mechanism are designed as dry-type bearings and do not require lubrication.

Recycling

The switchgear can be recycled in ecological manner in compliance with existing legislation. Auxiliary devices such as short-circuit indicators have to be recycled as electronic scrap. Batteries have to be recycled professionally. Insulating gas SF_6 has to be evacuated professionally as a reusable material and recycled (SF_6 must not be released into the environment).

Protection against solid foreign objects, electric shock and water

8DA and 8DB switchgear fulfills according to the standards

IEC 62271-1	EN 62271-1
IEC 62271-200	EN 62271-200
IEC 60529	EN 60529
IEC 62262	EN 50102

the following degrees of protection:

Degree of protection	Type of protection
IP 65	for parts of the primary circuit under high voltage
IP 3XD	for switchgear enclosure
IP 31D	for switchgear enclosure (optional)
IP 41	for low-voltage compartment (optional)

Degree of protection	Type of protection
IK 07	for switchgear enclosure

First gas-insulated circuit breaker switchgear 8DA10 – 1982

Up to now, over 100,000 8DA and 8DB switchgear panels successfully in operation worldwide.

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Notes

Notes

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January
2019

SIEMENS

Customer: VIWAPA
Project: Virgin Islands East End Sub
Reference: 300087-SF201621962.10

Offer 8DA10
8DAB-73642

8DA10

Gas Insulated, Metal-Enclosed

Medium-Voltage Switchgear

Single Busbar System

Technical Description

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1 Switchgear Description

1.1. General

The offered switchgear 8DA10 is an SF6-insulated, type-tested, single-phase metal-enclosed medium-voltage vacuum interrupter switchgear designed as single-busbar switchgear for indoor installation.

The SF_6-gas is only used as insulating, but not as quenching medium. The insulation level required is maintained inside the gas compartments without additional insulation material. Enclosures have degree of protection IP65. The single pole encapsulation with modular housings consists of corrosion-resistant aluminium housings.

The modular design allows the replacement of the panel connection housing or the circuit breaker without interrupting the main horizontal busbar operation.

Each closed gas compartment has its own pressure relief which prevents rupture of the housing in case of an arc fault.

The monitoring of the gas compartment is carried out with alarm contact manometers.

The offered switchgear is tested according to ANSI / IEEE C37.20.7-2007 type 2B internal arc-fault standard.

The switchgear is UL certified and will have UL-label on the switchgear

1.2. Panel Design

Each of the three single poles of the panel are arranged from front to back. Each pole consists of a vertical housing with the vacuum interrupter and a horizontal bus housing mounted on top of the circuit breaker housing containing the three-position switch and the busbar.

Circuit-breaker housings and busbar housings are separated from each other with gas-tight bushings.

The cable connection compartment housing with the cable sockets is located below the circuit breaker.

1.3. Switchgear Housings

The switchgear housings consist of a corrosion-resistant high nickel content aluminium alloy and are assembled using O-rings for gas tightness.

The rated operating pressure amount of max. 120 kPa relative gas pressure (depends on isolation level and rated current) at 20° C.

The individual gas compartments are monitored using alarm contact manometers.

1.4. Circuit-Breaker

Circuit-breakers are vacuum circuit-breakers of the 3AH4 product series. The circuit breaker operating drive and the vacuum switching interrupter are maintenance-free up to 10,000 switching cycles as a standard design.

The maintenance-free operating mechanism has the following equipment features:

- Motor charged stored-energy spring operated mechanism with auto-reclosing capability.
- "Trip-Free" according to IEC 6227-100
- Auxiliary switch contacts for control / signaling as specified in the Scope of Supply, Chapter 5.
- Operations counter
- Circuit breaker trip solenoid

- Circuit breaker close solenoid
- Auxiliary switch contacts for control / signalling as specified in the Scope of Supply, Chapter 5.
- 'Spring charged' indication
- Open/close mechanical position indication
- Mechanical OFF pushbutton
- Mechanical ON pushbutton
- The mechanical grounding lever is lockable and tagable for a grounded feeder circuit.

Endurance class of circuit-breaker:

Function	Class	Standard	Properties
BREAKING	M2	IEC 62271-100	10,000 x Mechanically without maintenance *
	E2	IEC 62271-100	10,000 x rated normal current without maintenance *
			50 x rated short-circuit breaking current without maintenance
	C2	IEC 62271-100	Very low probability of restrikes

* Option: 30.000 operating cycles

1.5. Three Position Switch

To reduce moving parts, the disconnector and grounding switches are designed as single three-position switches. In combination with the circuit-breaker, the non-load break three-position switch is used for fault close (make-proof) feeder grounding.

The disconnector / ground stationary and movable contacts are mounted in the busbar housings. Mechanical coupling is made through an external shaft.

The three-position switch operating mechanism is located on the panel front. For the two operating functions (disconnecting and grounding) separate interlocked operating handles are provided.

The switching positions of the three-position-switches are visually monitored (as required by NEC article 225) using a web-camera system and are displayed with a provided laptop.

The maintenance-free operating mechanism has the following equipment features:

- Manual or optional motor operating mechanism as specified in the Scope of Supply, Chapter 5
- Auxiliary contacts for disconnector switch: 4NO + 4NC + 2CO
- Auxiliary contacts for grounding switch: 2NO + 2NC + 4CO
- Mechanical switch position indication for connected and grounding switch positions
- Manual operation with mechanical interlock to the circuit-breaker
- Locking device as specified in the Scope of Supply, Chapter 5

Endurance class of three-position disconnector:

Function	Class	Standard	Properties
DISCONNECTING	M1	IEC 62271-102	2.000 x mechanically without maintenance
READY-TO-GROUND			1,000 x mechanically without maintenance
GROUNDING	E2 [1)]	IEC 62271-102	50 x rated short-circuit making current I_{ma} without maintenance

[1)] By closing the circuit-breaker

1.6. Interlocks

1.6.1. Vertical section internal interlocking

The combination of non load-break three-position switch and circuit-breaker meet the following vertical section internal interlock conditions:

To prevent the three-position switch from operating under load, the three-position switch is mechanically interlocked to only operate with the circuit-breaker in the open position.

The three-position switch can only be brought into the ready-to-earth position if the disconnector and circuit-breaker are open.

The three-position switch is prevented from switching through from the CLOSED state into the "ready-to-earth" state.

Closing of the circuit breaker is blocked if the three-position switch is in an intermediate position.

1.6.2. Vertical section internal and overall interlocking

All internal vertical section interlocks are mechanical. In tie-breaker and tie-riser sections, additional electromagnetic interlocks are provided. If the control voltage fails, an interlocked emergency operation of the feeder is possible.

1.6.3. Grounding of the feeder

For grounding of the feeder, reliable "verification interlocking" is provided: Only after the three-position switch has been switched into the "ready-to-ground" position can the feeder be grounded by closing the circuit-breaker.

The remote control and protective relay tripping operation of the circuit breaker are automatically disabled as soon as the three-position switch is switched to the "ready-to-ground" position and the feeder grounded locking device is padlocked.

A "feeder grounded" locking device prevents the local mechanical and electrical tripping by blocking the tripping mechanism of the circuit breaker mechanically.

1.6.4. Un-grounding of the feeder

Once grounded, the feeder remains in the grounded position.

The locking device is removed and the circuit-breaker must be manually opened with the mechanical OPEN push-button of the circuit-breaker.

The three-position switch can be operated as described above.

1.7. Power Cable Connection

Power cable connections are accessible from below from an elevated platform / mezzanine or the cable vault. Cable connections are designed for fully insulated inside cone connections as per DIN EN 50181.

There is a variety of combinations for cable connections for single-core or multiple-core cables per phase with the cable sizes 2/0 AWG through 1000 kcmil.

Iso-phase bus-bar connections can be made with solid-insulated bus-bars or with gas-insulated bus-bars.

Quoted equipment is specified in the Scope of Supply, Chapter 5

The following suppliers are released:

Company	Type of cable plugs
Pfisterer	CONNEX size 2, size 3 and size 4
Südkabel	SEIK
nkt cables	CPI 2, CPI 3
Tyco Electronics	RPIT-2, RPIT-3

1.8. Current Transformers

Current transformers are designed as toroidal current transformers. The CTs are mounted on the outside of the single phase aluminum housing, without any dielectric or thermal stresses.

Current transformers are specified in the Scope of Supply, Chapter 5

1.9. Voltage Transformers

Voltage transformers are designed as inductive, cast-resin insulated voltage transformers in metal-enclosed safe-to-touch design. The VTs are located outside the gas compartments.

The voltage transformers can get connected to the busbar directly or over a three position switch

Voltage transformers for feeders can be plugged directly or connected through a separate cable at the cable connection.

Voltage transformers are specified in the Scope of Supply, Chapter 5

1.10. Busbar

The busbar consists of profile copper.

1.11. Low-voltage Compartment

Low-voltage compartments are located on the vertical section front above the operating mechanisms of the circuit-breaker and the three-position switch. The electrical control connections from section to section are made via flexible cable harnesses. Control wiring is run in a wire-way located at the top of the LV compartment.

Internal vertical section wires run in metal-enclosed wiring ducts. The metal-enclosed wiring ducts are located on the left and on the right in the front part of the switchgear enclosure and are accessible from the front.

Inside the low-voltage compartment, secondary equipment is mounted on a rear mounting plate or on a DIN-rail system. Individual secondary devices can be integrated in the door of the low-voltage compartment.

Wiring is performed as specified in the Scope of Supply, Chapter 5

2 Special Switchgear Features

2.1. Operational Reliability

The gas-tight enclosure of all live parts from to busbar down to the cable excludes any external influences on the primary part.

Single-pole enclosure and long-time experience in the application of this switchgear has proven its exceptional operational reliability.

2.2. Personnel Safety

Personnel safety is achieved by internal single-pole enclosure of the primary circuit tested to ANSI / IEEE C37.20.7-2007 type 2B internal arc-resistant design.

2.3. Environmental Independence

Due to the gas-tight enclosure, 8DA10 is almost insensitive to environmental effects. Moreover, the dielectric strength (BIL) and rated voltage are independent of the site altitude.

2.4. Environmental Compatibility

The switchgear forms a hermetically sealed system in accordance with IEC 62271 part 1 over the complete life time of the unit, i.e. the SF6 gas exchanging is not necessary under normal operating conditions.

2.5. Compactness

The low pressure SF6 insulation enables very compact dimensions, offering at the same time a high switchgear performance. This provides an economical utilization of floor space, especially in cities and metropolitan areas for both existing rooms and new buildings.

2.6. Modularity

The modularity of the switchgear allows e.g. to replace the circuit-breaker module without isolating the busbars.

Due to its modular design 8DA10 shows a high re-availability even in case of fault.

3 Standards

		IEC-Standard EN-Standard	Title
Switchgear		62 271-1	High-voltage switchgear and controlgear – Part 1: Common specifications
		62 271-200	A.C. metal- enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
Switching devices	Circuit-breakers	62 271-100	High-voltage alternating-current circuit-breakers
	Disconnectors and earthing switches	62 271-102	High-voltage alternating current disconnectors and earthing switches
Voltage detecting systems		61 243-5	Voltage detecting systems (VDS)
Surge arresters Surge limiters		60 099	Surge arresters
Degree of protection		60 262	Degrees of protection by enclosures (IP Code)
Degree of protection		60 529	Degrees of protection by enclosures (IK Code)
Insulation		60 071	Insulation co-ordination
Instrument transformers		61 869-1	Instrument transformers
		61 869-2	Current transformers
		61 869-3	Voltage transformers
SF_6		60 376	Specification of technical grade sulphur hexafluoride (SF_6) for use in el. equipment
		62 271-4	Use and handling of sulphur hexafluoride (SF_6)
Installation		61 936-1	Power installations exceeding 1 kV
Environmental conditions		60 721-3-3	Classification of environmental conditions
Operation		EN 50 110	Operation of electrical installations

4 Technical Data

Voltages

Rated voltage ..... 15.0 kV
Operating voltage ..... 13.2 kV
Rated short-duration power-frequency withstand voltage ..... 36 kV
Rated lightning impulse withstand voltage ..... 95 kV
Rated frequency ..... 60 Hz

Short-circuit ratings

Rated short-time withstand current ..... 31.5 kA
Rated peak withstand current ..... 82 kA
Rated duration of short-circuit ..... 3 s
Rated short-circuit making current (max.) ..... 82 kA
Rated short-circuit breaking current ..... 31.5 kA

Current ratings

Rated normal current of the busbar ..... 2000 A
Max. permissible busbar current at 40 °C ..... 2030 A

General switchgear data

Type of arrangement ..... Free-standing arrangement with rear walls
Degree of protection (operation) ..... IP3XD (IP4X for LV compartment)
Degree of protection, primary part IP65
Partition class ..... PM
Loss of service continuity ..... LSC 2
Internal arc classification ..... 2B 31.5 kA 0.5 s
Exterior section special colour .....
Mimic diagram colour ..... black/red (standard)
Vertical section width ..... 600 mm
Vertical section depth ..... 1625 mm
Vertical section height with low-voltage compartment ..... 2920 mm
Height of switchgear room (min.) .....
..... 3120 mm
Width of control aisle (min.) ..... 800 mm
Min./Max. ambient air temperature for operation .....
..... -5 °C/55 °C
Min./Max. ambient air temperature for storage and transport .....
..... -30 °C/70 °C

5 Scope of Supply

The switchgear is designed as a single-busbar switchgear according to the enclosed single-line diagram.

Item No.	Quantity	Typical No.	Description
5.1	1	=KZ01	Circuit-breaker panel 2000 A
5.2	4	=KZ02	Circuit-breaker panel 1250 A
5.3	1	=KZ00	*Switchgear accessories*

In case of particularly customer-specific design it might be possible that individual points of the switchgear description are not valid anymore.

The offered scope of supply is equipped in detail as follows:

Item No.	Quantity	Description	Typical No.
5.1	1	**Circuit-breaker panel 2000 A** Maximum permissible feeder current at 40 °C: 2095 A	**=KZ01**
5.1.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.1.1.1	1	**Busbar earthing switch (-Q15)** With motor operating mechanism with camera system for monitoring the switching positions of the earthing switch Auxiliary voltage of motor operating mechanism: DC 125 V With electromagnetic interlocking Auxiliary voltage of electromagnetic interlock: DC 125 V with locking device Free auxiliary contacts earthing switch: 4NO + 4NC + 2CO	
5.1.2		**Panel construction**	
5.1.2.1	1	**Three-position disconnector (-Q1)** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With motor operating mechanism with camera system for monitoring the switching positions of the three-position-switch Auxiliary voltage of motor operating mechanism: DC 125 V With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 4NO + 4NC + 2CO Free auxiliary contacts earthing switch: 4NO + 4NC + 2CO with Locking device at the disconnector and earthing switch (separate function)	
5.1.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 15.0 kV Rated short-time withstand current: 31.5 kA Rated current: 2000 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 2 shunt releases Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Auxiliary voltage of 2 nd shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable	

Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"

5.1.2.3 3 **Current transformers at feeder**
Current transformer type: 4MC4_90
Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel.
Arranged outside the primary enclosure.
Current transformer installation in the panel
3 x 3 cores in L1/L2/L3
Primary current, core 1 : 2000 A MR
Primary current, core 2 : 2000 A MR
Primary current, core 3 : 2000 A MR
Secondary current, core 1 : 5 A
Secondary current, core 2 : 5 A
Secondary current, core 3 : 5 A
Rating, class and overcurrent factor of core 1 : C400
Rating, class and overcurrent factor of core 2 : C200
Rating, class and overcurrent factor of core 3 : 0.3 B-1.8
With routine test certificate

5.1.3 **Panel connection**

5.1.3.1 1 **Panel connection at feeder**
by 3 cable per phase plug size 3

5.1.3.2 1 **Capacitive voltage detecting system at the feeder**
Design:
LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage

5.1.3.3 3 **Voltage transformers at the feeder (short cable connection)**
Voltage transformer type: 4MU3_FUSE
Single-pole plug-in design, inductive type, climate-independent, secondary connection by means of plugs.
Length: 5 m
Arranged outside the primary enclosure.
3 x single-pole
Metal-enclosed
Voltage of secondary winding: 120 / v3 V
Rating and class of secondary winding: WXY / Cl. 0.3
With routine test certificate

5.1.3.4 3 **Surge arrester**
Surge arrester 3EH4 (Siemens), size 2
Rated discharge current 10 kA
Rated voltage Ur 12,5 kV
Continuous load voltage Uc 10 kV

5.1.3.5 1 **additional three-position disconnector at feeder (-Q9)**
Switching position ON-OFF-EARTHED, installation within feeder compartment, mechanism outside the gas room
With motor operating mechanism

with camera system for monitoring the switching positions of the three-position-switch
Auxiliary voltage of motor operating mechanism: DC 125 V
With electromagnetic interlocking at the disconnector and earthing switch
Auxiliary voltage of electromagnetic interlock: DC 125 V
Free auxiliary contacts disconnector switch:
4NO + 4NC + 2CO
Free auxiliary contacts earthing switch:
4NO + 4NC + 2CO
with Locking device at the disconnector and earthing switch (separate function)

5.1.4 **Low-voltage compartment**

Height: 1200 mm

1	Circuit Breaker control switch
1	Local remote selector switch
2	Trip coil monitoring relay, 125V DC
1	illuminated pushbutton with red LED for Circuit breaker CLOSED indication
1	illuminated pushbutton with green LED for Circuit breaker OPEN indication
1	illuminated pushbutton with red LED for -Q1 disconnector switch CLOSED
1	illuminated pushbutton with green LED for -Q1 disconnector switch OPEN
1	illuminated pushbutton with red LED for -Q1 grounding switch CLOSED
1	illuminated pushbutton with green LED for -Q1 grounding switch OPEN
1	illuminated pushbutton with red LED for -Q9 disconnector switch CLOSED
1	illuminated pushbutton with green LED for -Q9 disconnector switch OPEN
1	illuminated pushbutton with red LED for -Q9 grounding switch CLOSED
1	illuminated pushbutton with green LED for -Q9 grounding switch OPEN
1	illuminated pushbutton with red LED for -Q15 busbar grounding switch CLOSED
1	illuminated pushbutton with green LED for -Q15 busbar grounding switch OPEN

Item No.	Quantity	Description	Typical No.
5.2	4	**Circuit-breaker panel 1250 A** Maximum permissible feeder current at 40 °C: 1300 A	**=KZ02**
5.2.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.2.2		**Panel construction**	
5.2.2.1	1	**Three-position disconnector (-Q1)** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With motor operating mechanism with camera system for monitoring the switching positions of the three-position-switch Auxiliary voltage of motor operating mechanism: DC 125 V With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 4NO + 4NC + 2CO Free auxiliary contacts earthing switch: 4NO + 4NC + 2CO with Locking device at the disconnector and earthing switch (separate function)	
5.2.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 15.0 kV Rated short-time withstand current: 31.5 kA Rated current: 1250 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 2 shunt releases Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Auxiliary voltage of 2 nd shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"	
5.2.2.3	3	**Current transformers at feeder** Current transformer type: 4MC4_90 Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel. Arranged outside the primary enclosure. Current transformer installation in the panel for Switchgear: 8DADB	

Rated short-time withstand current: 31.5 kA
With routine test certificate
Maximum core dimension: 190 mm
1. Core: 2000MR / 5 A
Class: C400
Connection wires length: 3.8 m
Used in Phase L1 L2 L3
2. Core: 1200MR / 5 A
Class: C200
Connection wires length: 3.8 m
Used in Phase L1 L2 L3
3. Core: 1200MR / 5 A
Class: 0.3
Burden: B–1.8 Ω
Connection wires length: 3.8 m
Used in Phase L1 L2 L3

5.2.3 **Panel connection**

5.2.3.1 1 **Panel connection at feeder**
by 2 cable per phase plug size 3

5.2.3.2 1 **Capacitive voltage detecting system at the feeder**
Design:
LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage

5.2.3.3 3 **Surge arrester**
Surge arrester 3EH4 (Siemens), size 2
Rated discharge current 10 kA
Rated voltage Ur 12,5 kV
Continuous load voltage Uc 10 kV

5.2.3.4 1 **additional three-position disconnector at feeder (-Q9)**
Switching position ON-OFF-EARTHED, installation within feeder compartment, mechanism outside the gas room
With motor operating mechanism
with camera system for monitoring the switching positions of the three-position-switch
Auxiliary voltage of motor operating mechanism: DC 125 V
With electromagnetic interlocking at the disconnector and earthing switch
Auxiliary voltage of electromagnetic interlock: DC 125 V
Free auxiliary contacts disconnector switch:
4NO + 4NC + 2CO
Free auxiliary contacts earthing switch:
4NO + 4NC + 2CO
with Locking device at the disconnector and earthing switch (separate function)

5.2.4 **Low-voltage compartment**
Height: 1200 mm
1 Circuit Breaker control switch
1 Local remote selector switch
2 Trip coil monitoring relay, 125V DC
1 illuminated pushbutton with red LED for Circuit breaker CLOSED indication

1	illuminated pushbutton with green LED for Circuit breaker OPEN indication
1	illuminated pushbutton with red LED for -Q1 disconnector switch CLOSED
1	illuminated pushbutton with green LED for -Q1 disconnector switch OPEN
1	illuminated pushbutton with red LED for -Q1 grounding switch CLOSED
1	illuminated pushbutton with green LED for -Q1 grounding switch OPEN
1	illuminated pushbutton with red LED for -Q9 disconnector switch CLOSED
1	illuminated pushbutton with green LED for -Q9 disconnector switch OPEN
1	illuminated pushbutton with red LED for -Q9 grounding switch CLOSED
1	illuminated pushbutton with green LED for -Q9 grounding switch OPEN

Item No.	Quantity	Description	Typical No. =KZ00
		Switchgear accessories comprising:	
	1	Gas pressure indication, temperature compensated for busbar system	
	2	End walls	
	1	Laptop flap within the end wall left	
	1	Gas pressure indication with auxiliary contacts 2NO	
	1	Operation and installation manual 8DA10 ANSI Design 2012 in English	
	1	Operation and installation manual 8DAB ANSI camerasystem in English	
	1	Service flap within the right end wall	
	1	Hand-crank for circuit-breaker 3AH, 3AE	
	1	Handle for disconnector operation	
	1	Handle for earthing operation	
	1	Socket spanner for low voltage door	
	1	Adapter for emergency operation	
	1	junction cable USB/RJ45 for camera system VDMS	
	15	Voltage detector for LRM-system	
	1	Laptop for ANSI Design	
	11	Set of Cable Plugs, size 2 or 3 or dummy plugs as required	
	1	SF6 Gas Cylinder - 115 pounds	
	1	Cable Termination Kit, size 2-3	

6 Documentation

6.1	Single-Line Diagram	Annex 1
6.2	Panel Arrangement Diagram	Annex 2
6.3	Constructional Data	Annex 3
6.4	Side View Of Typicals	Annex 4
6.5	Gas Compartment Arrangement	Annex 5

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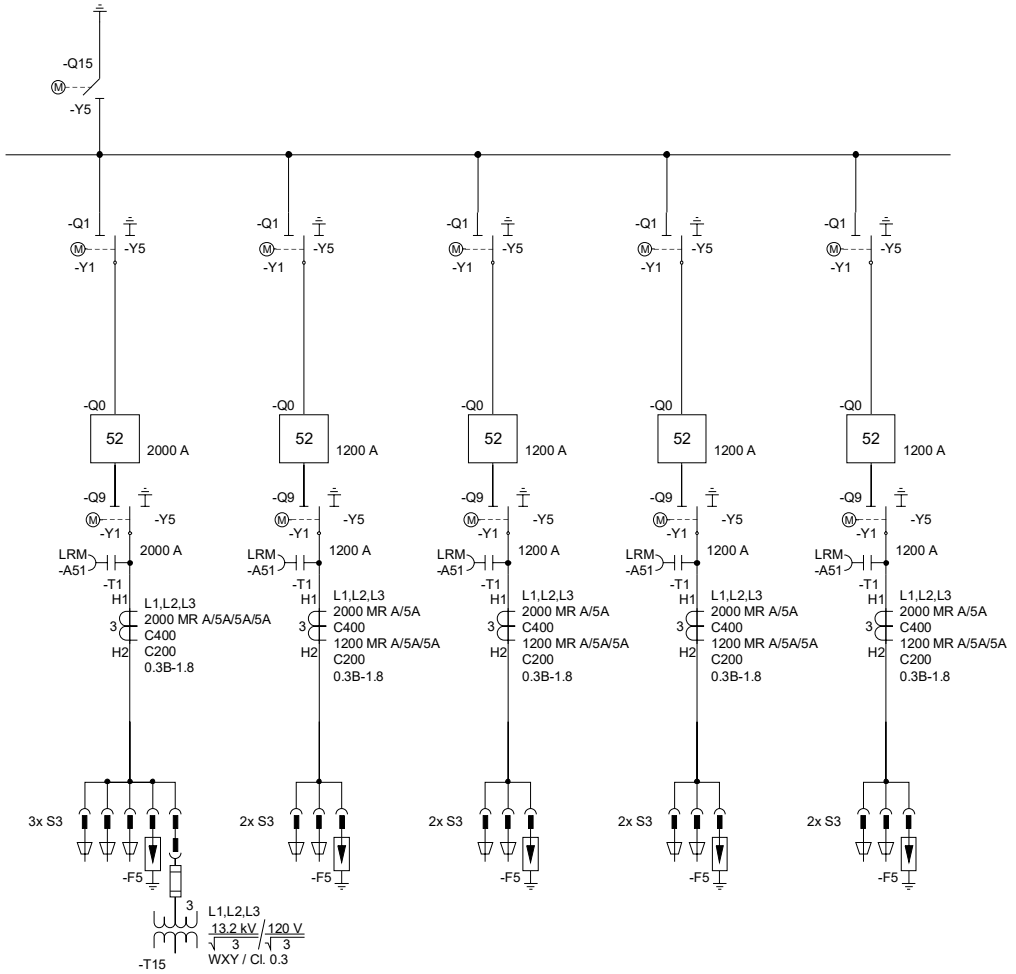
=K01	=K02	=K03	=K04	=K05
+K01	+K02	+K03	+K04	+K05
=KZ01	=KZ02	=KZ02	=KZ02	=KZ02

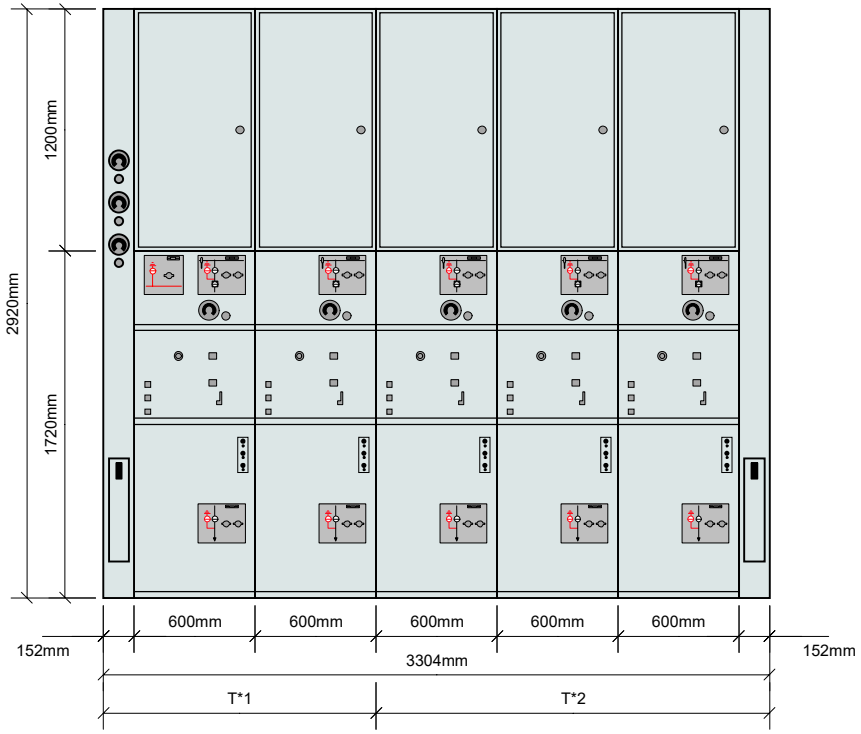


System/rated frequency	Operating voltage	Rated voltage	Rated short-time withst. curr.	Rated normal current	Auxilary voltage, control/protection	Auxilary voltage, motor	Ambient air temp / normal current
3~60 Hz	13.2 kV	15.0 kV	31.5 kA (3 s)	2000 A	DC 125 V	DC 125 V	40 °C/2030 A

				Printout	3/25/2020	VIWAPA Virgin Islands East End Sub	SIEMENS	8DA10 8DA/B 8DAB-73642	300087-SF201621962.10	=K00	
				Created by	Rebollar Orozco					+K00	B01
				Checked by							Sh.No 01-
Issue	Revision	Date	Name	Standard		Orig. / Repl. f. / Repl. by		Single-line diagram			1

FRONT VIEW

=K01	=K02	=K03	=K04	=K05
+K01	+K02	+K03	+K04	+K05
=KZ01	=KZ02	=KZ02	=KZ02	=KZ02



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Load data and minimum distances

1.)	Permanent loads	
	Vertical single load G_v	10.8 kN
2.)	Nonpermanent loads	
	Live load q_k	13.8 kN/m²
3.)	Minimum distances	
	Operating aisle	≥ 800 mm *)
	Minimum wall clearance left or right	≥ 500 mm
	Wall clearance left or right	≥ 100 mm
	Wall clearence rear	
	Free-standing arrangement	≥ 800 mm
	Wall-standing arrangement	≥ 100 mm
	Height of ceiling	≥ 3120 mm

The location and detail diagrams have symbolic character only and do not show the actual scope of supply.

System/rated frequency	Operating voltage	Rated voltage	Rated short-time withst. curr.	Rated normal current
3~60 Hz	13.2 kV	15.0 kV	31.5 kA (3 s)	2000 A

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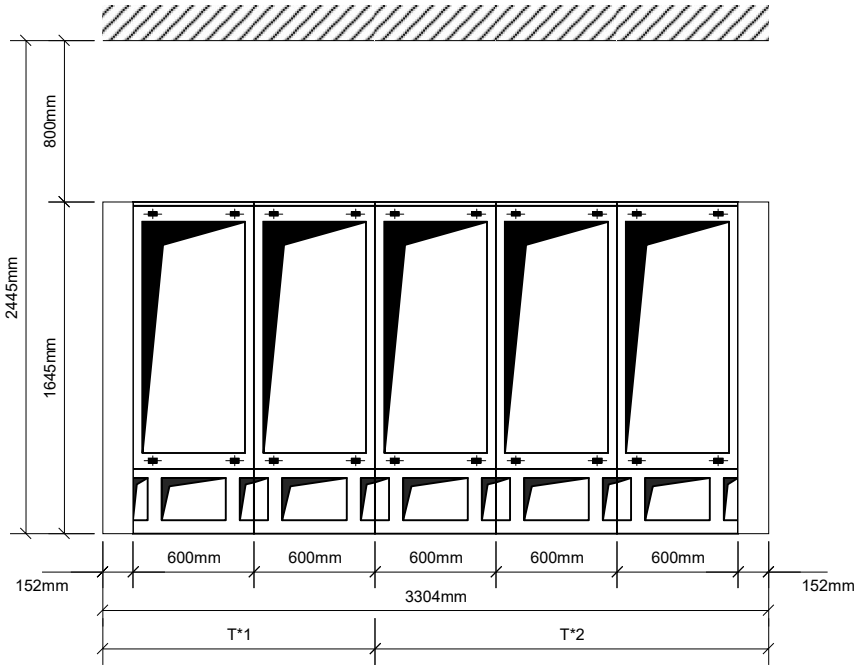
				Created by	Rebollar Orozco					+K00	B01
				Checked by							Sh.No 01-
Issue	Revision	Date	Name	Standard		Orig. / Repl. f. / Repl. by		Arrangement diagram			1

PLAN VIEW

=K01	=K02	=K03	=K04	=K05
+K01	+K02	+K03	+K04	+K05
=KZ01	=KZ02	=KZ02	=KZ02	=KZ02



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Load data and minimum distances

1.) Permanent loads
Vertical single load G_v 10.8 kN

2.) Nonpermanent loads
Live load q_k 13.8 kN/m²

3.) Minimum distances
Operating aisle ≥ 800 mm *)
Minimum wall clearance left or right ≥ 500 mm
Wall clearance left or right ≥ 100 mm
Wall clearence rear
Free-standing arrangement ≥ 800 mm
Wall-standing arrangement ≥ 100 mm
Height of ceiling ≥ 3120 mm

For information only, not to be used for construction. Further construction data can be found in the related operating and instruction manual

*) According to national regulations
T*) Transportation Unit
Note: With transport units with intermediate panels the busbar housing and busbar stick out appr. 230mm to the right side.

For fittings at the busbar observe additional height of panels

1) The floor penetration for the high-voltage termionationsshould take the form of a continuous slot for each row of panels. Beam beneath the panel junction is possible.
2) Floor penetration required if there is a beam nebeath the panel junction.

Tolerances:
Fall (max.) 1mm/1m, 2mm over the total length, flatness 1mm within 1m measured length. Adjust tolerances with SHMS.

System/rated frequency	Operating voltage	Rated voltage	Rated short-time withst. curr.	Rated normal current
3~60 Hz	13.2 kV	15.0 kV	31.5 kA (3 s)	2000 A

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				Checked by		Virgin Islands East End Sub				+K00	B01
Issue	Revision	Date	Name	Standard		Orig. / Repl. f. / Repl. by		Constructional data			Sh.No 01-1

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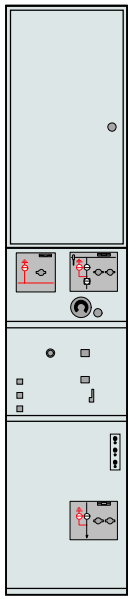
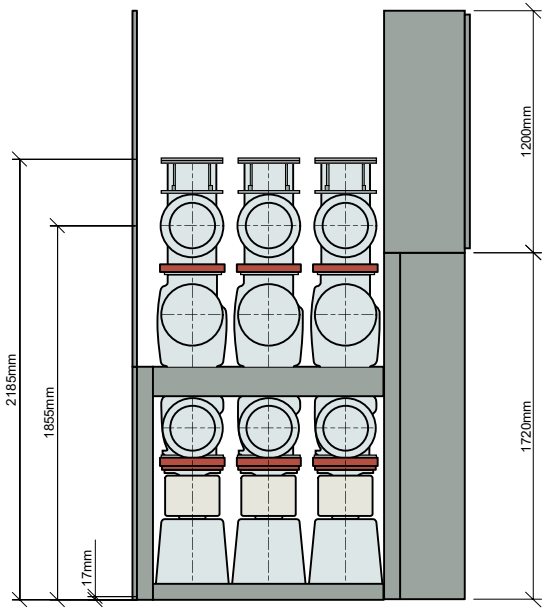
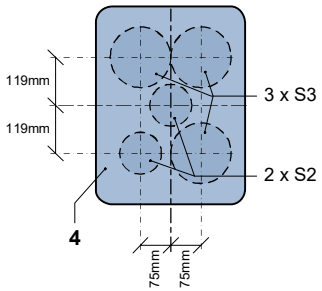
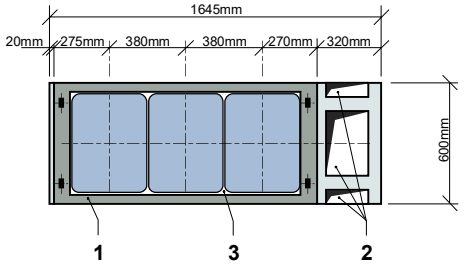




Top view





Top view / Inscription:

1. Base frame
2. Area for floor openings for control cables
3. Floor opening (e.g. for high-voltage cable)
4. Plug connection - detail view (optional)

The location and detail diagrams have symbolic character only and do not show the actual scope of supply.

System/rated frequency	Operating voltage	Rated voltage	Rated short-time withst. curr.	Rated normal current
3~60 Hz	13.2 kV	15.0 kV	31.5 kA (3 s)	2000 A

				Printout	3/25/2020		300087-SF201621962.10	=K00
				Created by	Rebollar Orozco	VIWAPA	SIEMENS 8DA10 8DA/B 8DAB-73642	+K00 B01
				Checked by		Virgin Islands East End Sub		Sh.No 01+
Issue	Revision	Date	Name	Standard		Orig. / Repl. f. / Repl. by	In detail	=KZ01 2

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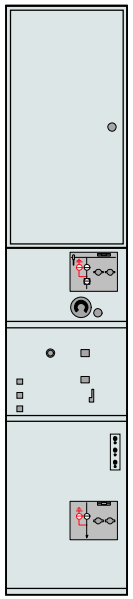
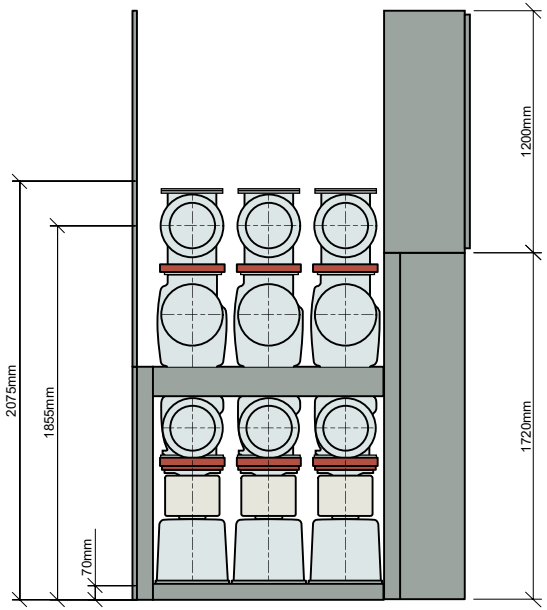
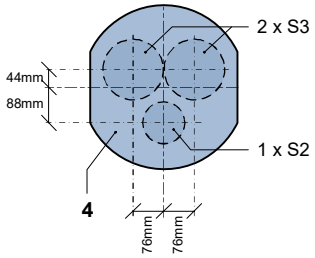
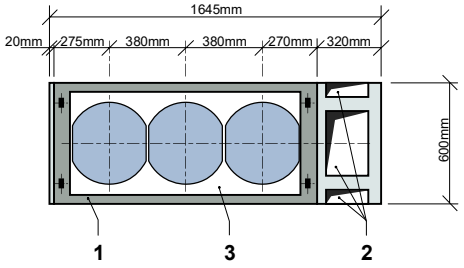




Top view





Top view / Inscription:

1. Base frame
2. Area for floor openings for control cables
3. Floor opening (e.g. for high-voltage cable)
4. Plug connection - detail view (optional)

The location and detail diagrams have symbolic character only and do not show the actual scope of supply.

System/rated frequency	Operating voltage	Rated voltage	Rated short-time withst. curr.	Rated normal current
3~60 Hz	13.2 kV	15.0 kV	31.5 kA (3 s)	2000 A

				Printout	3/25/2020				
				Created by	Rebollar Orozco	VIWAPA	SIEMENS	8DA10	300087-SF201621962.10	=K00	
				Checked by		Virgin Islands East End Sub		8DA/B		+K00	B02
Issue	Revision	Date	Name	Standard		Orig. / Repl. f. / Repl. by		8DAB-73642 In detail	=KZ02		Sh.No 02-2

=K01	=K02	=K03	=K04	=K05
+K01	+K02	+K03	+K04	+K05
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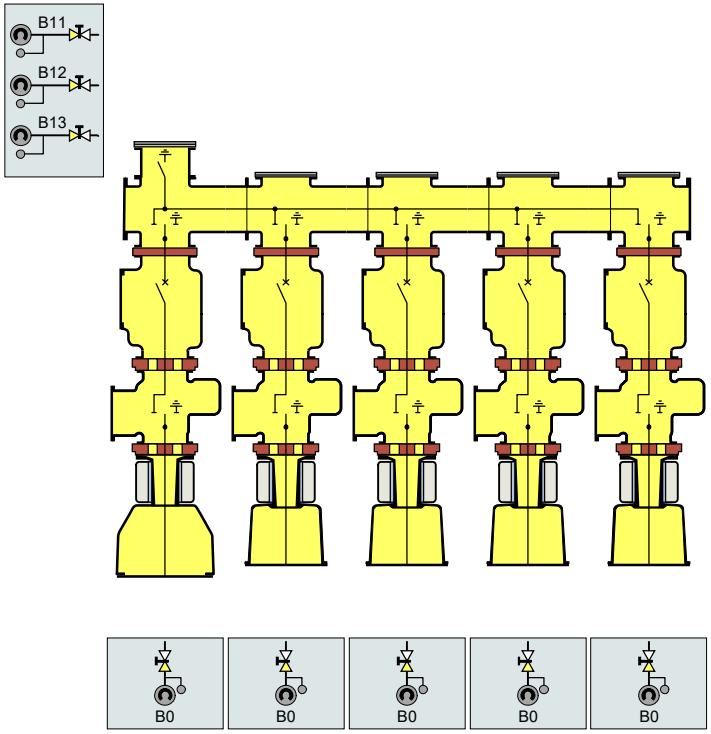

The location and detail diagrams have symbolic character only and do not show the actual scope of supply.

Legend:

- Gastight bushing
- Gaspermeable bushing
- Shut off valve
- Pressure gauge indicator with filling valve

Indication of the pressure indicators for the gas chambers (mounting location):

(within section)
B0 Circuit-breaker phase L1, L2, L3

(within end wall)
B11 Busbar phase L1
B12 Busbar phase L2
B13 Busbar phase L3

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				Printout	3/25/2020			=K00	
				Created by	Rebollar Orozco	VIWAPA	SIEMENS	+K00	D01
				Checked by		Virgin Islands East End Sub	8DA10 8DA/B 8DAB-73642		Sh.No 01-
Issue	Revision	Date	Name	Standard		Orig. / Repl. f. / Repl. by	Gas compartment	300087-SF201621962.10	1