SF6 GAS INSULATION
VACUUM INTERRUPTION

Ring Main Circuit Breaker

SMCB-26-A1-42 (25.8kV, 4 ways 2CB)

SMCB SERIES
15kV, 25.8kV
400A, 630A

SHINSUNG INDUSTRIAL ELECTRIC

Introduction

SMCB Ring Main Circuit Breaker is pad mounted fully dead-tank switchgear for up to 25.8kV, 630A underground power distribution system. This is a distribution automation switchgear of load-break switches ("Switch" after this) and vacuum circuit breakers ("CB" after this) combination. SMCB series switchgear incorporates Earthing Switch in every way to provide added safety and efficient operation.

SMCB series Ring Main Circuit Breakers have been fully certified in accordance with ANSI C37.60, ANSI/IEEE C37.71 and IEC 60265-1 to meet and exceed customer specifications. SMCB is fit for installation and operation under the following environmental conditions:

- ☐ Ambient air temperature : -25~70 ℃
- ☐ Maximum Radiation : 1,100 W/m^2
- ☐ Relative humidity: up to 100%
- ☐ Altitude: up to 1000m above sea level
- ☐ Climatic condition: tropical climate

Features and Description

All Integrated Design for SCADA system

- CT's, voltage sensors fitted on bushings, Capacitor-PT (Power Transformer), RTU are all integrated in SMCB. These enable SMCB to be easily applicable to DAS or SCADA System without any extra costs.
- Integrated Capacitor-PT achieves a self-power supply system for the control circuit. With this, customers can reduce the costs for a separate PT installation, connection cable, protection fuse cutout, installation accessories etc. It integrates a short-circuit protection system and power fuse in itself.

Minimum Maintenance, Robustness and Long Service Life

- Using SF 6 gas as an insulating medium, it eliminates the necessity for periodical oil maintenance.
- Stainless steel Tank is TIG welded and the other sealing points (bushings, operating shafts, gas filling valve) are sealed by EPDM rubber, so the Tank keeps good gas and water sealing characteristics for its service life.
- The leakage rate of the SF6 gas from the Tank is less than 4.0×10^{-6} cc/sec, 0.012% per year and 4,100 years theoretical service life (based on 4 ways configuration.
- To maintain the insulating capacity of SF6 gas during the service life, there is a moisture absorber bag inside the tank.
- Energy stored spring charge mechanism (for CB) and quick close quick open spring toggle mechanism (for Switch) are located inside the mechanism case on the switching tank. Therefore, the mechanism parts are protected from every physical and environmental attack.
- Control Unit (by its switches and input part) provides automatic protection to CT's from its second side opening (shorting) and also to control circuit from the surge voltage generated at the voltage sensors.
- Stainless steel Tank made of SUS 304L with 3-5 mm thickness is designed for its maximum robustness and minimum welding line.
- The Tank is designed for its maximum robustness. Therefore, even at a bursting pressure of the safety membrane (4-6 kgf/cm^2 G), the switching

operation is not disturbed, and the Tank and bushings are not damaged up to that pressure. Its minimum welding line on stainless steel Tank minimizes its corrosion.

- Time-, industry-proven vacuum interrupter ensures safe and lifetime interruption for CB.
- Switch part experienced 5,000 times mechanical operations and CB part experienced 2,000 times mechanical operations, and 10,000 times mechanical operations are guaranteed for both CB and Switch parts.

Operation Mechanism

- The operation mechanism of SMCB is comprised of energy stored spring charge mechanism for CB, spring toggle action mechanism for load-break switch and three phase group-operating principle for both.
- Manual close/open of CB part is carried out by two operation parts, spring charging part and close/open button on the mechanism case. Electrical operation is performed by spring charging motor and close/open button on the control panel.
- Manual close/open of Switch is carried out by an operating shaft. Electrical operation is performed by driving motor and close/open button on the control panel.
- Earthing Circuit close/open of CB and Switch is manually carried out by an operating shaft.
- Energy stored spring charge mechanism has about 25 ms opening time, 2.7 cycles clearing time, mechanical trip free and anti-pumping characteristics.
- Spring toggle mechanism shows operator-independent closing/opening speed, quick close quick open (700 ms) closing/opening time.
- Since any manual operating mechanism of CB and Switch is independent of each electrical operating mechanism, manual operation is always guaranteed, even when driving motor or any part of electrical operation module is out of order.

Reliable Insulation and Interruption

- SF 6 gas is non-flammable, odorless, color-less, non-toxic and very stable insulation medium by nature. SF 6 gas quality used in SMCB meets the requirement of IEC60376.
- In case of CB part, SF 6 gas provides electrical insulation only, but load and fault interruption takes place inside the sealed vacuum interrupter. In case of Switch part, insulation and interruption are all carried out by SF 6 gas.
- Mastery breaking part design of Switch part including pure puffer principle makes the arcing time just half a cycle. Thus the decomposed SF 6 gas quantity by the arc is negligible and the insulation capacity of SF6 gas doesn’t decrease during its service life.
- In the breaking parts of the CB and Switch, every interruption and insulation ratings or characteristics are guaranteed at atmospheric gas pressure.
- The industry proven vacuum interrupter of CB part experienced 58 times fault making and interrupting duty cycles at 20 kA with 15kV class SMCB and 12.5 kA with 25.8kV class SMCB.
- The heavy duty tulip type contacts of Switch part are made of copper-tungsten arc resistance material. The contacts experienced 5 making current operations and 100 load current switching operations. However, since the contacts are common with pole top Switch, we can guarantee for 400 times load current switching operations, citing the test reports of SPGAS pole top Switch.
- Epoxy Bushings are installed in-line at the front. Cable terminal and

connectors are put on the epoxy bushings. Both IEEE 386 and DIN standard bushings are available to SMCB.

- One front Earthing Circuit Bushing can be installed for every way, for every two ways or for the whole ways, for easy main cable testing.
- Main Cable Earthing Terminals at the front-bottom area provide earthing to all power cables.

Safety Devices

- In the event of an internal insulation failure, Safety Bursting Membrane at the rear side of the Tank ruptures (at 4-6 kgf/cm^2 G) and release over-pressure gas in the safe direction. This eliminates the risk of the Tank explosion.
- Since SMCB is using SF 6 gas instead of oil, a major fire hazard from the internal insulation failure is eliminated and SMCB can be located close to more sensitive outdoor locations.
- Mechanical Interlock between Main Switch and Earthing Switch: Closed state of Main Switch prevents Earthing Switch operation, and also closed state of Earthing Switch prevents Main Switch operation.
- Low Pressure Sensor detects minimum gas pressure (0.1 kgf/cm^2G) and gives dry contact to control unit to raise an alarm and/or lockout the electrical operation.
- Gas Pressure Gauge at front side can always monitor the gas pressure. It’s graduation is divided into safe pressure range and dangerous pressure range in colors.
- A padlock of Manual Operating Shaft Hole is provided to its lid in order to secure safety for maintenance persons.
- SF 6 gas is filled into the Tank normally at 0.7 kgf/cm^2G. However all the electrical ratings and characteristics of SMCB are guaranteed at atmospheric gas pressure, as far as the gas in the Tank leaks out within 40% of its normal quantity?
- SMCB is totally dead-tank design for the safety of maintenance persons.

Microprocessor Based Control

- Combined with CT's and voltage sensors externally fitted at bushings, micro-processor controlled relays, SEL-551 or SEL-501-2 can not only protect the distribution line but also measure (SEL-551 only) and report current values of distribution lines.
- Logic of SEL-551 relay is programmable from local or remote, so easy optimal coordination with upstream and downstream devices are available.
- Rogowski coil CT’s are available instead of ordinary core type CT if a higher level of CT functions are required. Resistive voltage sensors are also available instead of capacitive voltage sensors if more precise voltage metering is required. Resistive voltage sensor has ±0.5% accuracy and Capacitive has ± 3% accuracy.

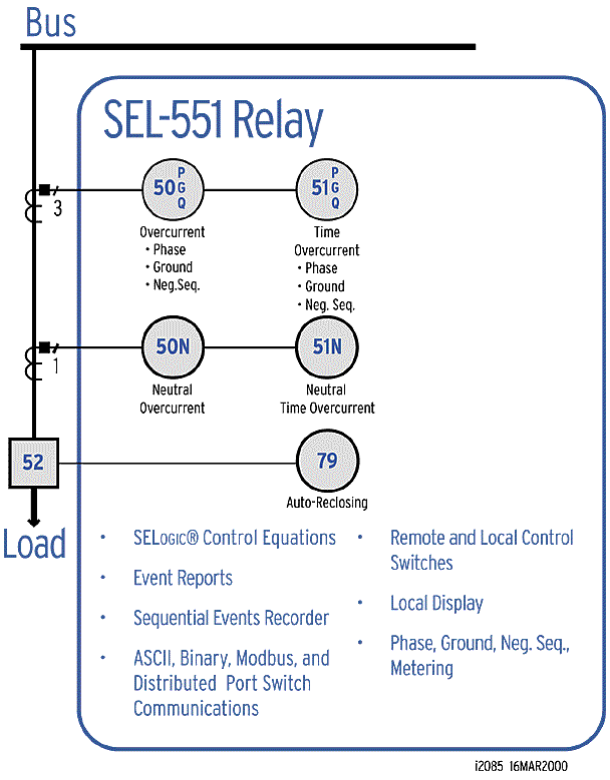
C3 Circuit Breaker Control

Overview

C3 Control based on SEL-551 relay or SEL-501-2 relay is designed to work with SMCB series Ring Main Circuit Breaker and to be installed in SCADA system or DAS (Distribution Automation System) via RTU and modem.

Control Relay

- SEL-551 is over-current and reclosing relay. It is installed by one unit per one way of CB. It protects power distribution lines from phase, ground, and negative-sequence over-current and performs multiple-shot reclosing with sequence coordination with 10 TCC's (Time-Current Curves) including 5 IEC curves and 5 US curves. It provides over-current protection and reclosing; instantaneous, peak, and demand metering; 20 data event reporting and 256 Sequential Events records; configuration from local front panel or remote.
- SEL-501-2 is dual over-current relay with non-reclosing duty. It is installed by one unit for two ways of CB. It protects phase, ground, and negative-sequence over-current with 8 TCC's (Time-Current Curves) including 4 IEC curves and 4 US curves. It provides over-current protection; 20 summarized event reports and 12 fifteen-cycle event reports; configuration from local front panel.



- For more information about SEL-551 or SEL-501-2, connect below links.
  http://www.selinc.com/sel-551.htm;
  http://www.selinc.com/sel-501.htm

Local Control Board

- General control part
  - Auxiliary power on/off switch
  - Auxiliary power (220 Vac or 110 Vac) outlet
  - LED lamp test button
  - Low gas pressure status LED
  - Control wake-up button
  - Battery and battery charger test button and each status LED
  - Battery voltage and current metering terminals
  - 3A AC power fuse holder
  - 15A motor protection fuse holder

- 10A control protection fuse holder
- Voltage magnitude of voltage sensors

■ Load-break Switch control part
- Local/remote control selection switch
- Operation lockout/ unlock selection switch and lockout status LED
- Main Switch close/open button and each status LED
- Earth Switch close status LED

■ Circuit Breaker control part
- Local/remote selection switch
- Operation lockout/ unlock selection switch and lockout status LED
- Main Switch close/open button and each status LED
- Earth circuit close status LED
- Spring-charged status LED

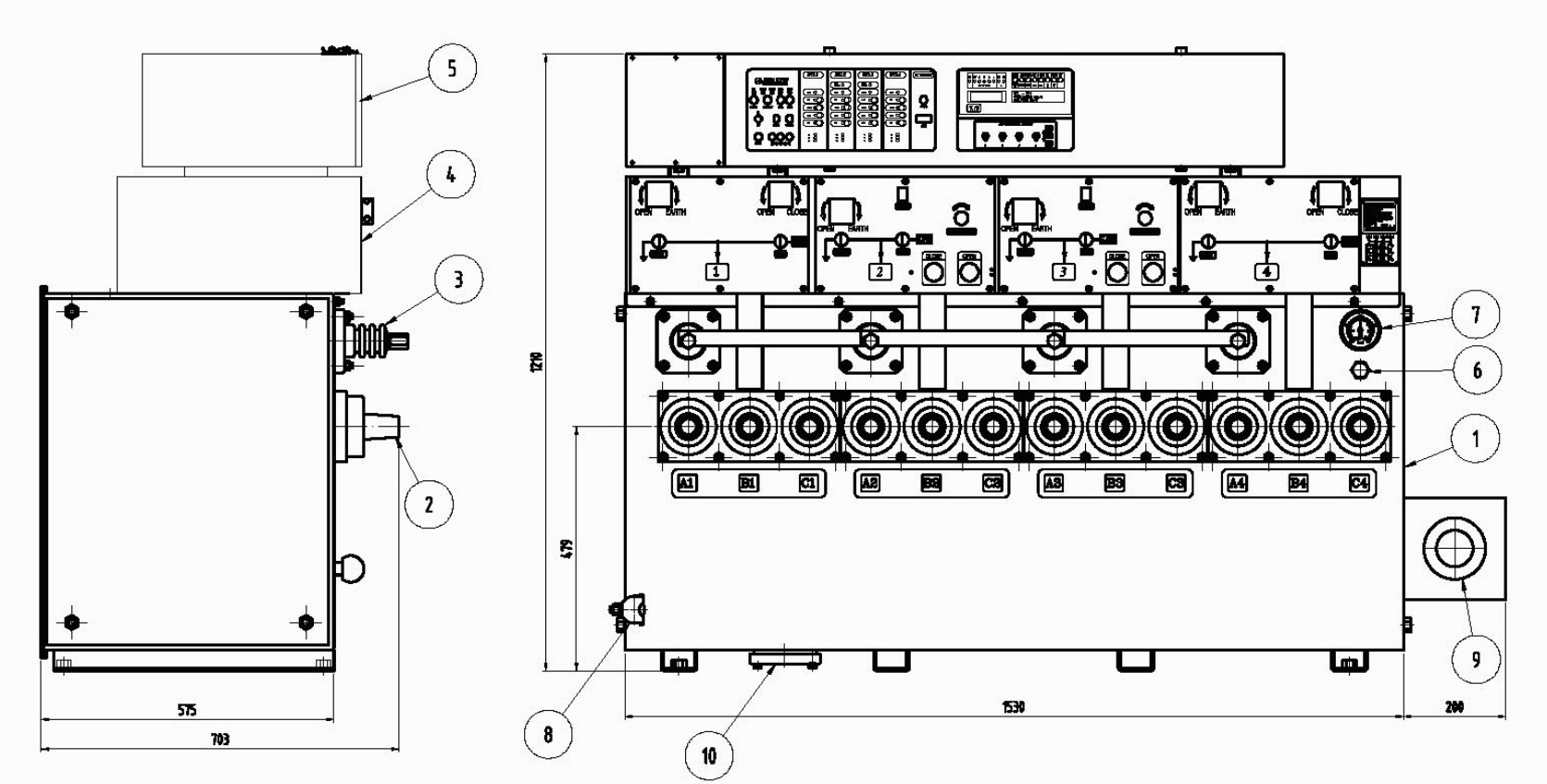
Power Supply

- It is available to select one power source system among 2 alternatives, separate PT and built-in PT for the control circuit power. The built-in power source consists of an integrated capacitor and potential transformer.
- AC power source inputs 220 V (or 120 V) to Control Cubicle, and Low Voltage Transformer (and diode) convert it to DC 24 V. This DC 24 V is connected with the control circuit.
- A battery charger and battery (lead acid 35 Ah, 24 Vdc) is parallel-connected with DC 24V power circuit. Therefore the control circuit usually receives DC 24V from both Low Voltage Transformer and battery at the same time.
- The lead acid battery has sufficient capacity to sustain more than 24 hour operation while AC power supply’s failure, with 3 years minimum lifetime.
- The battery is automatically disconnected from the control circuit when the battery voltage drops below a preset value in order to prevent its deep discharge.
- The battery charger has two modes: one is a rapid charging mode with higher current and the other is a trickle charging mode with lower current.

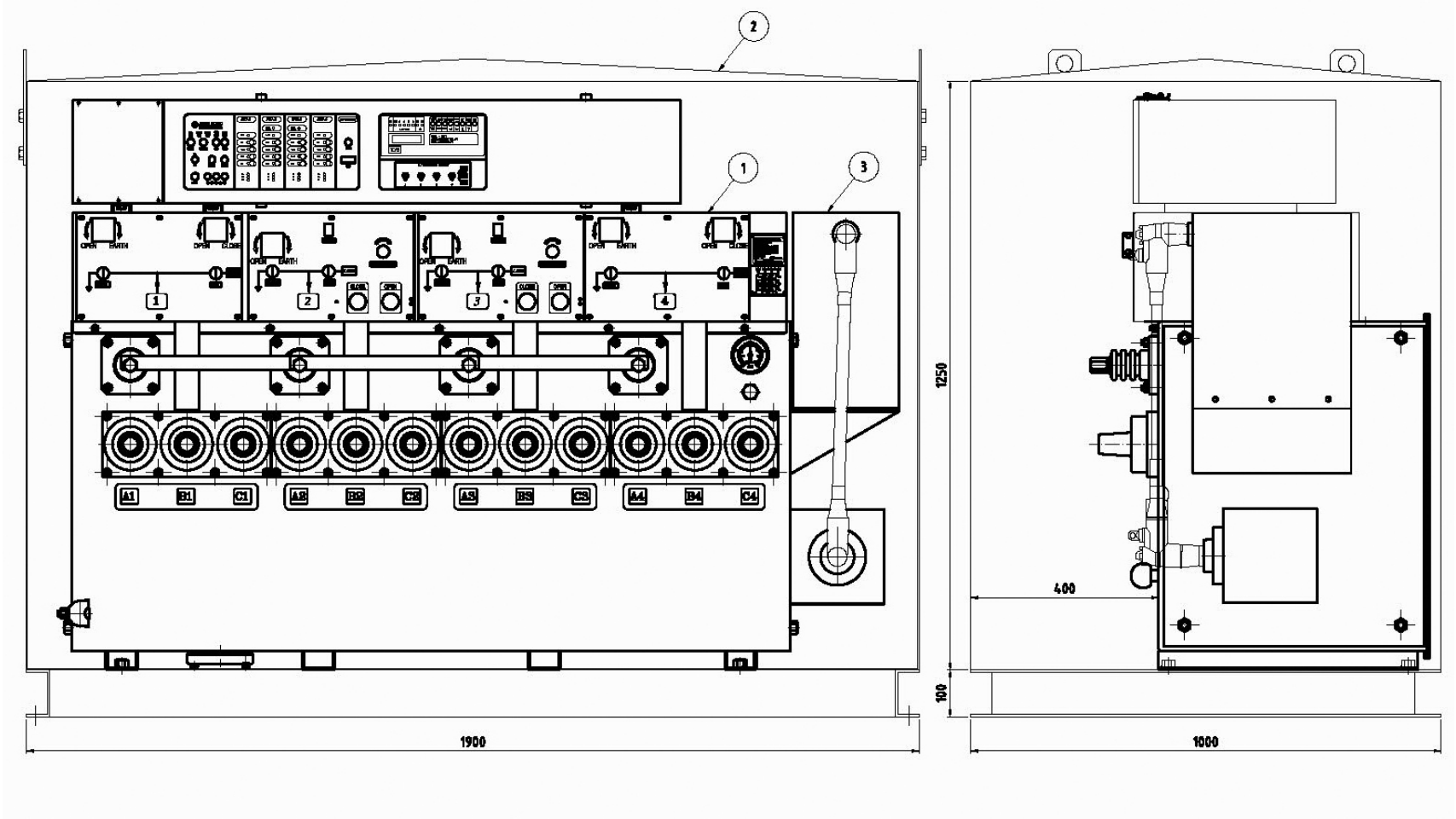
Ratings & Specifications

Ring Main Circuit Breaker	15 kV	25.8 kV
Basic Ratings		
Rated Maximum Voltage	15 kV	25.8 kV
Rated Continuous Current	630 A	630 A
Rated Frequency	50Hz /60 Hz	50Hz /60 Hz
Making & Interrupting Capacity - CB		
Short Circuit Making Current (peak)	50 kAp	32.5 kAp
Fault Interrupting Current (rms)	20 kA	12.5 kA
Cable Charging Current	25 A	25 A
Transformer Magnetizing Current	21 A	21 A
Making and Breaking Capacity – Load-break Switch		
Mainly Active Load Current - Main	630 A	630 A
Number of Load Current Operations - Main	100 times	100 times
Short-time Withstand Current - Main& Earth	20 kA/ 4 sec	12.5 kA / 1sec
Momentary Current / 10 cycles (sys./asym.) - Main	12 kAsym/ 19.2 kAasym	12 kAsym/ 19.2 kAasym
Short Circuit Making Current (peak) - Main & Earth	50 kAp (Main)	32.5 kAp
Number of Making Operations - Main/Earth	5 times (Main)	5 times/ 3 times
One Second Current (sym.?) - Main & Earth	12 kA	12 kA
Cable Charging Current - Main	25A	25A
Line Charging Current - Main	1.5 A	1.5 A
Transformer Magnetizing Current - Main	21 A	21 A
Closed Loop Current - Main	630 A	630 A
Power Frequency Insulation Level		
AC Voltage Withstand Test - 1 min, CB & Main SW (Phase to Earth, Phase to Phase, Across Poles)	50 kV	60 kV
AC Voltage Withstand Test - 1 min, Earth SW (Phase to Earth, Phase to Phase, Across Poles)	50 kV	60 kV
DC Voltage Withstand Test - 15 min, CB & Main SW (Phase to Earth, Phase to Phase, Across Poles)	53 kV	78 kV
Basic Insulation Level (1.2 x 50 µs)		
CB & Main Switch (Phase to Earth, Phase to Phase, Across Poles)	95 kV	125 kV
Earth Switch (Phase to Earth, Phase to Phase, Across Poles)	95 kV	125 kV
Interruption & Insulation Medium		
Arc Extinction Medium	SF6 Gas/ Vacuum	SF6 Gas/ Vacuum
Insulation Medium	SF 6 Gas	SF 6 Gas
Operation Performance		
Close/Open DC Voltage - CB & SW	24 Vdc	24 Vdc
Mechanical & Electrical Operations- CB	2000 times	2000 times
Mechanical Operations - Main SW / Earth SW	5000/ 1000 times	5000/ 1000 times
Operating Temperature- CB & SW	-25 ~ 50° C	-25 ~ 50° C
SF6 Gas Pressure		
Nominal Pressure (kgf/cm^2 G)	0.7	0.7
Bursting Pressure (kgf/cm^2 G)	4~ 6	4~ 6
Minimum Gas Pressure (kgf/cm^2 G)	0.1	0.1
Leakage Rate (cc/sec)	3.9×10^{-6}	3.9×10^{-6}

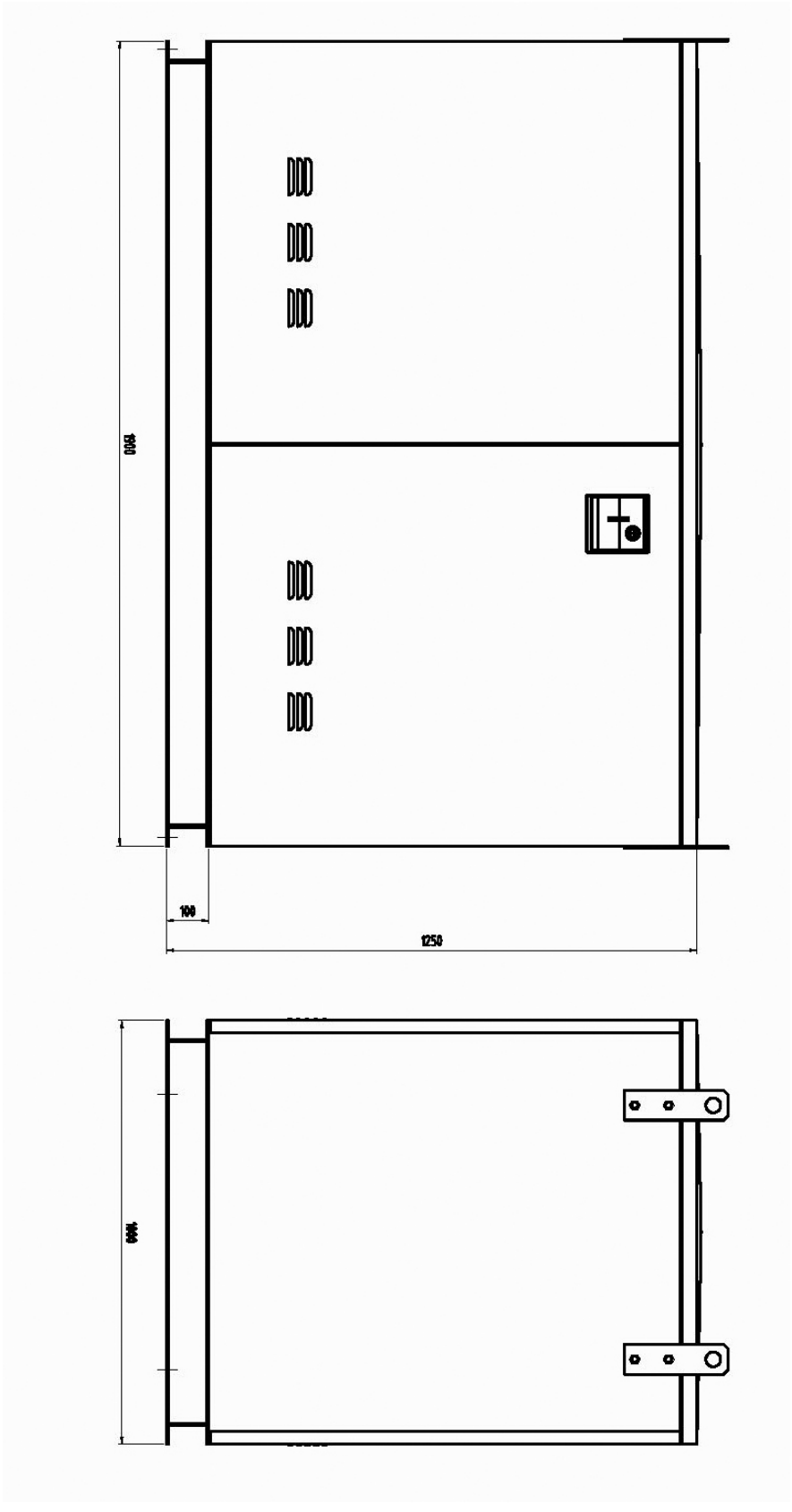
Dimension & Layout of “SMCB-26-A1-42” RMCB



① Tank Case
② Bushing
③ Earth Bushing
④ Mechanism Box
⑤ Control Box
⑥ Gas Filling Valve
⑦ Gas Pressure Gauge
⑧ Earth Terminal
⑨ Power Supply PT Bushing
⑩ Safety Bursting Membrane



① RMU body
② Outer Enclosure
③ Power Supply PT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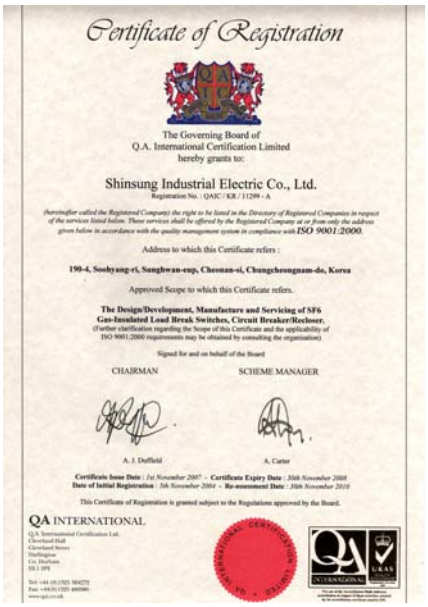
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