SF6 GAS INSULATED
VACUUM INTERRUPTION

POLE MOUNTED
Automatic Circuit Recloser

SMRC SERIES
15kV, 27kV
400A, 630A

SHINSUNG INDUSTRIAL ELECTRIC
Introduction

SMRC is 3 phase SF6 gas insulated vacuum interruption auto circuit recloser designed for pole mounted or substation applications. The SMRC series recloser incorporates field proven technology regarding integrated line sensors, vacuum interrupters, solenoid dual latch mechanism, dead line operation module and the world leading microprocessor based R6 relay to provide reliable operations without maintenance.

SMRC series recloser has been fully certified in accordance with ANSI C 37.60 to meet and exceed customer specifications. SMRC reclosers are suitable for installation and operation under the following environmental conditions:

- Ambient air temperature: -25~70 °C
- Maximum Radiation: 1,100 W/m²
- Relative humidity: Up to 98% RH
- Wind Velocity: 45 m/sec
- Altitude: Up to 2500m above Sea Level
- Climatic condition: Tropical Climate
- Pollution Level: Heavy Pollution (ESDD 0.35 mg/cm²)

Features and Description

All Integrated Design for SCADA system

- CT's, voltage sensors are all fitted abound bushings inside the switching tank. These enable SMRC recloser to be easily applicable to DAS or SCADA System without any extra costs.
- The SMRC is outdoor, three-phase, SF6 insulated type. SCADA applications can be made for remote sectionalizing by means of a motorized mechanism.

Enhanced Microprocessor Based Control

- Micro-processor controlled relay combined with 3 thru 6 CT's, 6 voltage sensors can not only protect the distribution system but also measure the voltage, power, power factors etc.
- CT's are available instead of ordinary core type CT if higher level 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.
- Additional functions of R6 based control:
  - Many accessories integrated as a standard
    - Cooper curve, IEC and US curve
    - Complex curve
    - High current trip, lock-out
    - Cold load pick up
    - Sequence coordination
    - SEF (Sensitive Earth Fault)
  - Under frequency load shedding
  - Sequential events record and fault event report
  - 6 selectable setting groups for loop scheme application
  - DNP version 3.0 level 2 or IEC60870-5-101
  - Mirrored Bits communications protocol for relay-to-relay logic communications
- The operation and protection functions are programmable into the control unit by means of LCD display and keyboard; notebook computer and RS 232 port on the control panel in R6 Recloser Control. Since the main control cable of SMRC recloser has the same pin number as Cooper recloser, Cooper conventional control cable can be used. Accordingly customers can use MET tester as ever.
Maintenance Free, Robustness and Long Service Life

- Using SF6 gas as an insulating and interrupting medium eliminates the necessity for periodical maintenance for oil.
- Stainless steel tank case is TIG welded and the other sealing points (bushings, driving shaft, gas filling valve and Manual Open-lock Lever) are double 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 $1.0 \times 10^{-6}$ cc/sec, 0.015% per year and 2500 years theoretical service life (based on SMRC-26 type).
- To maintain the insulating capacity of SF6 gas during the service life, a moisture absorber is also contained in the tank.
- Compact solenoid dual latch mechanism assembly is located inside the thoroughly sealed tank case. Therefore, the mechanism assembly is protected from corrosion and every physical and environmental attack.
- Protection PCB inside the Auxiliary Box 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 Case made of SUS 304L with more than 3 mm thickness is designed for its maximum robustness and minimum welding line.
- Tank Case is designed for its maximum robustness. Therefore, even at a bursting pressure of the safety membrane(4-6 kgf/cm² G), the switching operation is not disturbed, and up to this pressure the tank case and bushings are not damaged. And its minimum welding line on stainless steel tank minimizes its corrosion.
- Time-, industry-proven Vacuum Interrupter ensures safe and lifetime stable interruption.
- Robust mechanical construction of SMRC recloser experienced 5,000 times mechanical operation test, and 10,000 times mechanical operations are guaranteed.

Advanced Operation Mechanism

- Low Voltage Closing Solenoid and Dual Latch Mechanism enables opening time less than 25 ms, clearing time less than 2.7 cycles, mechanical trip free, anti-pumping characteristics, emergency close/open and dead line operability.
- Since Dual Latch Mechanism eliminates the problem from the residual flux of closing solenoid, the mechanism realizes fast clearing time (below 0.045 sec or 2.7 cycle)
- Dead Line Operability: The closing solenoid can be operated with low voltage AC power or battery DC power, using DC/DC converter and capacitor in the control unit. This module is necessary for the reconfiguration of power line during the line outage. R6 Recloser Control has this function.
- Electrical Emergency Close/Open: R6 Recloser Control ensures close/open operation when relay gets out of order.
- Manual Open-lock Lever at the reclosing body provides a secured open-lock state, and Manual Closing Shaft at the reclosing body provides manual closing in the de-energized power line, without any control operation.
Reliable Insulation and Interruption

- **SF 6 gas** is non-flammable, odorless, colorless, non-toxic and very stable insulation medium by nature. SF 6 gas quality used in SMRC meets the requirement of IEC60376.
- SF 6 gas provides electrical insulation only, and load and fault interruption takes place inside the sealed vacuum interrupter. Therefore, there is no SF 6 gas de-composition or switching by-products to contaminate insulation medium. This means “maintenance free” during the service life of recloser.
- With the industry proven vacuum interrupter and SF6 gas insulation medium, every interruption and insulation ratings of the recloser are guaranteed at atmospheric gas pressure (0.0 kgf/cm²G).
- The industry proven vacuum interrupter has been experienced 116 times fault making and interrupting duty tests at Maximum 20 kA with SMRC-15-S0 recloser and at maximum 12.5 kA with SMRC-26-S0 recloser.

Multiplex Safety Solutions

- SMRC recloser has been designed based on the concept of insulation coordination: external flash-over precedes internal flash-over or puncture at atmospheric gas pressure.
- In the event of an internal insulation failure, Safety Bursting Membrane which is located opposite to the manual operating handle ruptures (at 4-6 kgf/cm² G) to release over-pressure gas in the safe direction. This eliminates the risk of explosion or detachment of the reclosing body from the power pole.
- Since SMRC recloser is using SF 6 gas instead of oil, a major fire hazard from the internal insulation failure is eliminated, so SMRC recloser can be located close to more sensitive outdoor locations.
- Manual Open- Lock Lever provides lockout to the operating mechanism when it is pulled down to the lock position using a hook stick.
- Low Pressure Sensor detects minimum gas pressure (0.1 kgf/cm²G) and gives dry contact to control to raise an alarm and/or lockout the electrical operation.
- Gas Pressure Gauge at the bottom side can always monitor the gas pressure. It’s graduations are divided into safe pressure range and dangerous pressure range in colors, to be seen through a telescope on the ground level.
- SF 6 gas is filled normally at the pressure of 0.7 kgf/cm²G and all the electrical ratings and characteristics are guaranteed at atmospheric gas pressure, as far as the gas in the tank leaks out within 40% of its normal quantity.
- SMRC is totally dead-tank design for the safety of maintenance persons.

Additional Description

- **Bushing**
  - Horizontally mounted bushings to the tank case have characteristics such as free from electromagnetic repulsion force, superior insulating capability and strong short circuit characteristics compared with vertically mounted bushings. Also the recloser is easily installed on a pole because a line-post insulator is not necessary.
  - However, we manufacture vertical bushing type recloser for restricted mounting space such as H-pole type structure and for the customers who like to install traditional shape of recloser because their existing recloser
accessories has matched with vertical bushing type recloser.

- Porcelain bushing is standard. It is horizontally mounted to the tank case. The inside bushing hole walls are treated with semi-conductive painting to shorten the gap between the copper stud and the bushing wall. This enables the switch to have good RIV characteristics and also good partial discharge control.
- Alternatively, epoxy bushing and silicon rubber boot is also available. Silicon rubber boot is put on the epoxy bushing to increase the voltage insulation and to protect inner bushing from external impact. We have both IEEE 386 and DIN cable connecting interface standard.

**Bushing Terminal**

- NEMA type flat bare terminal made of copper alloy is standard for bushing terminal. In accordance with local environments, customers can select Mold Cone and lead wire.
- Standard NEMA type flat bare terminal for Pollution Density 0.06 mg/cm²
- Optionally Mold cone and lead wire of insulated copper conductor is helpful for high pollution (Pollution Density 0.35 mg/cm²) and salt fog area.
- Insulation Cable filled with anti-water-penetration jelly together with bird-guard cap

**Auxiliary Box**

Supplement magnet for solenoid mechanism, relay and Protection PCB are located inside the Auxiliary Box attached underneath the tank case. These components are connected to the control unit through control cable.

< SMRC-26-S0 Layout>

1: Tank  7: Auxiliary Box
2: Position Indicator  8: Name Plate
3: Bushing (Porcelain)  9: Operation Counter
5: Over Pressure Bursting Membrane  11: Pole Mounting Hanger
6: Gas Filling Valve  12: Surge Arrester Plate (Option)
R6 Recloser Control

Overview

R6 is automatic circuit recloser control and feeder remote terminal unit (RTU) for distribution automation application.

Main functions of R6 are 3-phase and ground protection, auto-reclosing and RTU functions for remote operations of recloser. R6 is a fully digitalized and microprocessor-based control devices, so the customers can utilize this control for the powerful function of existing recloser and distribution automation demand at present and in the future.

Function

- **Main Recloser Function**
  - Dual Timing: fast, delay
  - Number of operation to lockout: 1~5
  - Programmable min. pickup: phase, ground, SEF
  - Programmable Reclosing interval
  - Time Current Curve: 36 conventional curves, 5 US curves, 5 IEC curves, 4 user defined curves
  - Complex curve
    - Constant time adder
    - Vertical multiplier
    - Minimum response
  - High current trip, lockout
  - Cold load pick up
  - Sequence coordination
  - SEF (Sensitive Earth Fault)

- **Additional Control Function**
  - Negative sequence
  - Demand/ Min and Max/ Energy metering
  - Six (6) selectable setting groups ideal for loop scheme application.
  - Sequential events record
  - Fault events report
  - Fault wave form report
  - Load profiling
  - Breaker wear monitor
  - Operation counter
  - Gas pressure monitor
  - Battery monitor
  - Hot line tag against unexpected local and remote operation
  - Three (3) stage security for setting change
  - Local and remote operation
  - RS 232 and RS 485 port
  - DNP version 3.00 level 2 or IEC60870-5-101 for monitoring/ MODBUS for setting, analysis, control, maintenance and PC communication
  - Emergency Operation: Without relay, you can close/open the recloser electrically with Emergency Operation Button in the control.
- MET Tester Compatibility: Since the main control cable of SMRC & R6 has the same pin number as Cooper recloser, Cooper conventional control cable and MET tester can be used at SMRC recloser and R6 control.
- Dead Line Operation (option): Consisting of Battery, DC/DC converter and Capacitor, it achieves dead line operability that is necessary for reconfiguration of the power line during the line outages.

**Front panel Interface**

**Display panel**
- **Display** - Initial display shows IA, IB, IC, IN primary current.
- **MENU/ESC button** - access to setting, metering, event, status menu and escape to initial display.
- **Scroll button** - scroll left, right, up, down on display.

**Status & Trip Target LEDs**
- **AC POWER** - shows present AC power.
- **BATTERY TROUBLE** - indicates any of following battery problems.
  - discharge test failure
  - disconnected
  - monitor/charger failure
- **CONTROL ENABLED** - the R6 Recloser control is enabled.
- **HANDLE LOCK** - indicates that Recloser TRIP/LOCK lever has located TRIP/LOCK position.
- **GAS LOW** - indicates SF6 gas low
- **79RS, 79CY, 79LO** - reclosing relay status.
- **VA, VB, VC, VR, VS, VT** - each phase line voltage alive.
- **A, B, C - PHASE** - phase A, B or C involved in fault
- **GROUND** - ground involved in fault
- **SEF** - sensitive earth fault over current element trip.
- **FAST** - fast curve trip
- **Delay** - delay curve trip
- **High** - high current trip
- **AUX1, 2, 3, 4, 5** - reserved LEDs
Operator Quick Button and LED

- **PROTECTION ENABLED**: Enables/disables over current protection elements, and enabled status
- **RECLOSE ENABLED**: Enables/disables auto-reclosing, and enabled status
- **GROUND ENABLED**: Enables/disables ground over current elements, and enabled status
- **FAST CURVE ENABLED**: Enables/disables trip by fast curve, and enabled status. Only delay curve works when enabled.
- **REMOTE ENABLED**: Enables/disables remote monitoring, setting, and Close/Open operation. Local control still works when enabled.
- **BUTTON LOCK**: Blocks the function of other buttons except WAKE UP, BATTERY TEST, TRIP and 6 LCD Buttons, and lock status
- **HOT LINE TAG**: Enables/disables remote Close operation, but monitoring is available from remote. Local Close/Open operation still works when enabled.
- **SEQUENCE COORDINATION**: Enables/disable sequence coordination function.
- **AUX 1, 2, 3, 4**: User programmable; e.g., program to Normal Open.
- **CLOSE**: Close recloser/recloser closed status
- **TRIP**: Trip recloser/recloser open status

Wake-up and Test Buttons

- **WAKE-UP/LAMP TEST/TARGET RESET** - wakes up the control after it has been put to sleep/tests lamp healthy/clear trip-latched targets (A, B, C-PHASE, GROUND, SEF, FAST, DELAY, HIGH)
- **SEQUENCE TRIP TEST** - tests trip and auto-reclosing sequence according to setting value
- **BATTERY TEST** - checks the battery healthy and charger circuit.

Event Reports

- The R6 Recloser Control offers three reports of event:
  - Standard 20-cycle event reports (20cycle fault wave event reports)
  - Fault Events reports
  - Sequential Events Recorder (SER) Report
- Resolution: 1ms
- Accuracy: +1/4 cycle

Standard 20-cycle event reports

- These event reports contain date, time, current, voltage, relay element, optoisolated input, and output contact information.
- Up to fifty 20-cycle reports are stored in non-volatile memory. If more reports are triggered, the newest event report overwrites the oldest event report.
Fault event reports
- These event reports contain date, time, fault current magnitude and shot count information
- The control stores the latest 300 events of the fault events report in non-volatile memory. If the report fills up, newer rows overwrite the oldest rows in the report.

Sequential Events Recorder (SER) Report
- The control adds lines in the SER report for a change of state of a programmable condition. The SER lists data and time-stamped lines of information each time when a programmed condition changes state. The control stores the latest 4000 lines of the SER report in non-volatile memory. If the report fills up, newer rows overwrite the oldest rows in the report.
Options and Accessories

Standard Construction

- Industry Proven Vacuum Interrupter
- Dual Latch Mechanism
- Safety Bursting Membrane
- Low Gas Pressure Sensor Module
- Porcelain Bushings and NEMA Hole Flat Bare Terminals
- On/Off Position Indicator
- Mechanical Operation Counter
- Manual Open-Lock Lever (Trip Lever)
- Manual Operation Shaft and Operating Metal Bar as a separate accessory
- Moisture and decomposed gas absorber
- 3 Ordinary Core Type CT's and 6 Capacitive Voltage Sensors
- Auxiliary Box containing Protection PCB, supplement magnet and relay
- Control Unit Consisting of the Parts Below
  - Stainless Steel Control Cubicle
  - 2 Pieces of Control Cables with 8 m Length
  - 3 Receptacles for Control Cables
  - Low Voltage Transformer (220VAC: 24VDC)
  - Local Control Panel
  - Battery and Battery Charger
  - R6 Relay including RTU Function within
  - Emergency Close/Open Module
- English Marking Language

Optional Components

- Epoxy-Silicone Bushings with DIN (standard) or ANSI standards
- Eyebolt Type/Clamp Type Bushing Terminal
- Gas Pressure Gauge
- Control Cubicle Heater
- Number of CT’s and its Ratio (Standard: 1:1000, 3 pieces)
- Voltage Sensor’s Output Voltage (Standard: 4 VAC)
- Resistive Voltage Sensors
- Length Of Control Cables Other Than 8 m length
- AC Power Source Voltage to Control Unit (Standard:220VAC)
- R6 Relay including RTU function within itself
- Dead Line Operation Module (DC to DC converter and capacitor assembly)
- IP degree other than standard (Main Body 54 and Control Cabinet 33)
- Marking Language
- Lightning Arrester Plate
- Bird Guard Cap
- Pole Mounting Bracket(Cross Arm or Mounting Bracket for One Pole or H type Pole) or Substation Mounting Frame
### Ratings & Specifications

<table>
<thead>
<tr>
<th>Pole Top Auto Circuit Recloser</th>
<th>15kV</th>
<th>27 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Ratings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum System Voltage</td>
<td>15.5 kV</td>
<td>27 kV</td>
</tr>
<tr>
<td>Rated Continuous Current</td>
<td>630 A</td>
<td>630 A</td>
</tr>
<tr>
<td>Rated Frequency</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td><strong>Operation Duty Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Test Current (sym. rms)</td>
<td>20 kA</td>
<td>16 kA</td>
</tr>
<tr>
<td>Number of Unit Operation</td>
<td>116 times</td>
<td>116 times</td>
</tr>
<tr>
<td>Min. Circuit X/ R Value</td>
<td>≥14, ≥7, ≥3</td>
<td>≥14, ≥7, ≥3</td>
</tr>
<tr>
<td><strong>Current Capacity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit Making Current (asym. peak)</td>
<td>50 kAp</td>
<td>32.5 kA</td>
</tr>
<tr>
<td>Cable Charging Current</td>
<td>5A</td>
<td>5A</td>
</tr>
<tr>
<td>Transformer Magnetizing Current</td>
<td>22A</td>
<td>22A</td>
</tr>
<tr>
<td><strong>Power Frequency Withstand Current Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet Condition- 10 sec (Ph- Ph, Ph-Eth, Across Interrupters)</td>
<td>45 kV</td>
<td>50 kV</td>
</tr>
<tr>
<td>Dry Condition - 1 min (Ph- Ph, Ph-Eth, Across Interrupters)</td>
<td>50 kV</td>
<td>60 kV</td>
</tr>
<tr>
<td><strong>Impulse Withstand Current Test</strong> (1.2 x 50 μs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase to Phase, Phase to Earth</td>
<td>125 kV</td>
<td>150 kV</td>
</tr>
<tr>
<td>Across Interrupter</td>
<td>125 kV</td>
<td>150 kV</td>
</tr>
<tr>
<td><strong>Other Ratings &amp; Specifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc Extinction Medium</td>
<td>Vacuum</td>
<td>Vacuum</td>
</tr>
<tr>
<td>Insulation Medium</td>
<td>SF 6 Gas</td>
<td>SF 6 Gas</td>
</tr>
<tr>
<td>Creepage Distance (Porcelain)</td>
<td>550 mm</td>
<td>740 mm</td>
</tr>
<tr>
<td>Creepage Distance (Silicon)</td>
<td>615 mm</td>
<td>790 mm</td>
</tr>
<tr>
<td><strong>Operation Performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Clearing Time</td>
<td>2.7 cycle</td>
<td>2.7 cycle</td>
</tr>
<tr>
<td>Mechanical Operations (Guaranteed)</td>
<td>10,000 times</td>
<td>10,000 times</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-25 ~ 70° C</td>
<td>-25 ~ 70° C</td>
</tr>
<tr>
<td><strong>SF 6 Gas Pressure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Pressure (kgf/cm² G)</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Bursting Pressure (kgf/cm² G)</td>
<td>4 ~ 6</td>
<td>4 ~ 6</td>
</tr>
<tr>
<td>Minimum Gas Pressure (kgf/cm² G)</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Leakage Rate (cc/sec)</td>
<td>&lt; 1.0 x 10⁻⁶</td>
<td>&lt; 1.0 x 10⁻⁶</td>
</tr>
<tr>
<td><strong>Shipping Data</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Weight of Recloser Body (Porcelain)</td>
<td>190 kg</td>
<td>210 kg</td>
</tr>
<tr>
<td>Net Weight of Control Unit</td>
<td>60 kg</td>
<td>60 kg</td>
</tr>
<tr>
<td>Gross Weight with Control Unit</td>
<td>380 kg</td>
<td>400 kg</td>
</tr>
<tr>
<td>Packing Size with Control Unit (mm)</td>
<td>1250 x 1184 x 803</td>
<td>1402 x 1264 x 838</td>
</tr>
</tbody>
</table>
Pole Mounting Layout (in case External PT)
Worldwide Sales Location

Headquarters in Korea
Shinsung Industrial Electric Co., Ltd
190-4 Soohyang-ri, Sunghwan-eup, Seobuk-gu,
Cheoan-si, Chungcheongnam-do, Republic of Korea
Postal(Zip) Code: 331-802
Tel: +82-41-582-5029  Fax: +82-41-582-8752
E-mail: shinsungglobal@empas.com / intbiz@ssiec.co.kr
Website: http://www.ssiec.co.kr

Information and specifications in this document are subject to change without prior notice.