

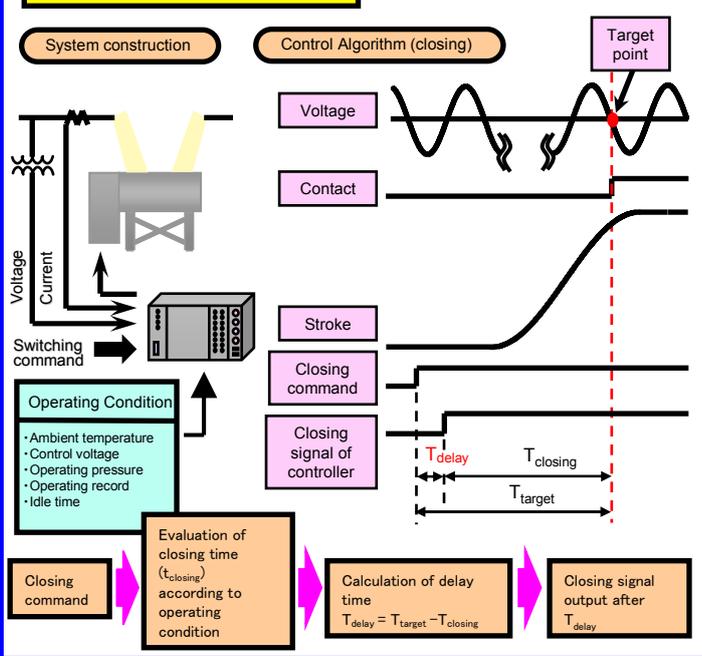
Solutions of Surge Elimination by Conventional GCB and Synchronous Switching GCB

Technique of controlling the switching point of GCB with respect to voltage or current phase in order to minimize electrical transients

- **Cost Reduction and Reliability Enhancement**
; Elimination of Closing Resistor, Surge Arresters
- **Maintenance Benefits**
; Extension of Replace Interval for Nozzle and Contacts
- **Operation Benefits**
; Reduction of Overvoltage, Improving the Power Quality, and Prevention of Protection Relay Maloperation

Load	Target	Conventional practice	Synchronous switching
• Transformer	• Elimination of high inrush current (High stress on winding, voltage disturbance)	• Closing resistor	• Synchronous closing (Accounting residual flux)
• Line	• Elimination of switching overvoltage (Harmful to system insulation)	• Closing resistor • Surge arrester	• Synchronous closing (Voltage zero point)
• Shunt capacitor	• Elimination of high inrush current (Erosion of contacts, voltage disturbance) • Ensure re-strike free performance (Harmful to system insulation)	• Closing resistor • Series reactor	• Synchronous closing (Voltage zero point)
• Shunt reactor	• Elimination of re-ignition (Harmful to system insulation, erosion of contacts)	• Surge arrester • Opening resistor • Surge arrester	• Synchronous opening (Maximum arcing time)

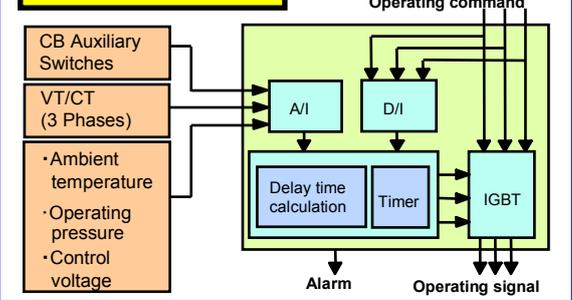
Controlling Algorithm (Closing)



Features of Mitsubishi Controller

- **Highly reliable CPU** used widely for monitoring systems in high-voltage switchgears
- **Memory storage** to record the ambient temperature, hydraulic pressure, opening/closing time, current and voltage waveform and travel signal for past 100 switching operations
- **Self-monitoring function** of a failure of the controller itself
- **Function for a judgement** for the success or failure of controlled switching and the occurrence of re-ignition
- Proved to withstand under different environmental stress such as fast transient surge, high and low temperature and mechanical vibration

Construction of Controller



Type: SSC-SP1 for Capacitor Bank / Shunt Reactor

• Standard model with full compensation functions

Shunt Reactor Application

Capacitor Bank Application

High accuracy with compensation of various operating condition

The graphs show the performance of the SSC-SP1. The top graph plots Ambient temperature (°C) against Time (day), showing a clear diurnal cycle. The middle-left graph shows Voltage (kV) and Current (kA) waveforms for 1st, 2nd, and 3rd phase make and break. The bottom-left graph shows Closing Time (PI) and Error from target (ms) against Time (day), demonstrating high accuracy and stability.

Type: SSC-TR for Transformer

• Added residual flux measuring function to SSC-SP1

Transformer Application

Significantly reduction of inrush current and voltage disturbance

The comparison shows that with synchronous closing, there is a significant reduction in inrush current and voltage disturbance compared to conventional closing. The waveforms for Voltage (BUS), Voltage (Tr), Flux in Tr., and Current are shown for both cases.