# Circuit breaker control guidelines for VacClad-W metal-clad switchgear

## Circuit breaker control

### Control breaker control equipment

Eaton's VCP-W circuit breaker has a motor charged spring type stored energy closing mechanism. Closing the breaker charges accelerating springs. Protective relays or the control switch will energize a shunt trip coil to release the accelerating springs and open the breaker. This requires a reliable source of control power for the breaker to function as a protective device. **Figure 2** and **Figure 3** show typical ac and dc control schematics for type VCP-W circuit breakers.

For ac control, a capacitor trip device is used with each circuit breaker shunt trip to ensure that energy will be available for tripping during fault conditions. A control power transformer is required on the source side of each incoming line breaker. Closing bus tie or bus sectionalizing breakers will require automatic transfer of control power. This control power transformer may also supply other ac auxiliary power requirements for the switchgear.

For dc control, it would require a dc control battery, battery charger, and an ac auxiliary power source for the battery charger. The battery provides a very reliable dc control source, because it is isolated from the ac power system by the battery charger. However, the battery will require periodic routine maintenance, and battery capacity is reduced by low ambient temperature.

Any economic comparison of ac and dc control for switchgear should consider that the ac capacitor trip is a static device with negligible maintenance and long life, while the dc battery will require maintenance and replacement at some time in the future.

### Relays

Microprocessor-based or solid-state relays would generally require dc power or reliable uninterruptible ac supply for their logic circuits.

### Auxiliary switches

Optional circuit breaker and cell auxiliary switches are available where needed for interlocking or control of auxiliary devices. Typical applications and operation are described in **Figure 1** and **Table 1**.

Breaker auxiliary switches and MOC switches are used for breaker open/close status and interlocking.

Auxiliary contacts available for controls or external use from auxiliary switch located on the circuit breaker are typically limited in number by the breaker control requirements as follows:

- Breakers with ac control voltage: 1NO and 3NC
- Breakers with dc control voltage: 2NO and 3NC

When additional auxiliary contacts are needed, the following options are available:

- 5/15/27 kV breakers: Each breaker compartment can be provided with up to three mechanism operated cell (MOC) switches, each with 5NO and 4NC contacts. The MOC switches are rotary switches, mounted in the cell, and operated by a plunger on the breaker. Two types of MOC switches can be provided—MOC that operates with breaker in connected position only, or MOC that operates with breaker in connected, as well as test position
- 38 kV breakers: Each 38 kV breaker can be provided with an additional breaker mounted auxiliary switch, with 5NO and 5NC contacts

Another optional switch available is called a TOC–Truck Operated Switch, which is mounted in the cell and operates when the circuit breaker is levered into or out of the operating position. This switch changes its state when the breaker is moved from test to connected position and vice versa. The TOC provides 4NO and 5NC contacts.

Auxiliary switch contacts are primarily used to provide interlocking in control circuits, switch indicating lights, auxiliary relays or other small loads. Suitability for switching remote auxiliary devices, such as motor heaters or solenoids, may be checked with the interrupting capacity listed in **Table 1**. Where higher interrupting capacities are required, an interposing contactor should be specified.

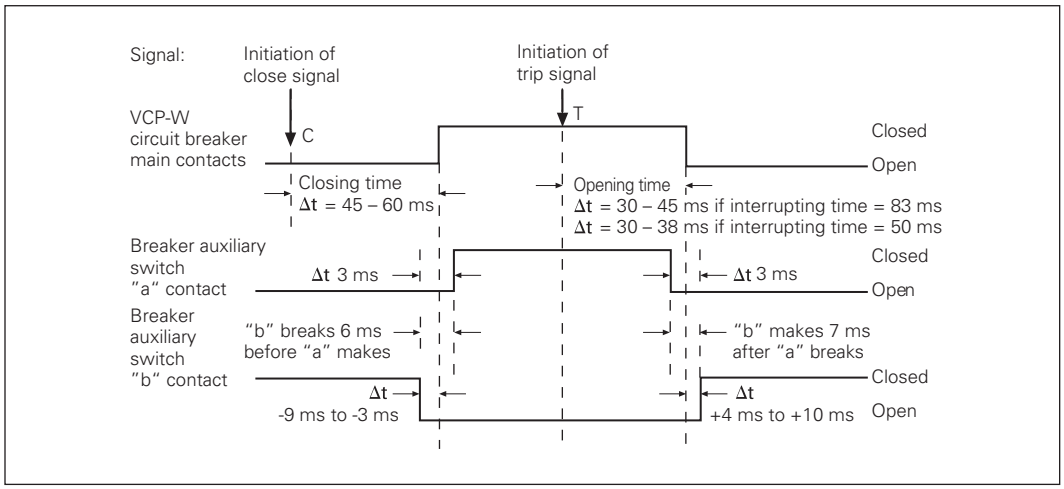


**Figure 1. Breaker auxiliary switch operating times**

**Table 1. Auxiliary switch contacts interrupting capacities**

| Auxiliary switch type | Continuous current amperes | Control circuit voltage | | | | |
|---|---|---|---|---|---|---|
| | | 120 Vac | 240 Vac | 48 Vdc | 125 Vdc | 250 Vdc |
| **Non-inductive circuit interrupting capacity in amperes** | | | | | | |
| Breaker auxiliary switch | 20 | 15 | 10 | 16 | 10 | 5 |
| TOC switch | 20 | 15 | 10 | 16 | 10 | 5 |
| MOC switch | 20 | 15 | 10 | 16 | 10 | 5 |
| **Inductive circuit interrupting capacity in amperes** | | | | | | |
| Breaker auxiliary switch | 20 | 15 | 10 | 16 | 10 | 5 |
| TOC switch | 20 | 15 | 10 | 16 | 10 | 5 |
| MOC switch | 20 | 15 | 10 | 16 | 10 | 5 |

**Table 2. VCP-W breaker stored energy mechanism control power requirements**

| Rated control voltage | Spring charging motor | | | Close or trip amperes | UV trip mA maximum | Voltage range | | Indicating light amperes |
|---|---|---|---|---|---|---|---|---|
| | Inrush amperes | Run amperes | Average run time, sec. | | | Close | Trip | |
| 48 Vdc | 36.0 | 9 | 6 | 16 | 200 | 38–56 | 28–56 | 0.02 |
| 125 Vdc | 16.0 | 4 | 6 | 7 | 80 | 100–140 | 70–140 | 0.02 |
| 250 Vdc | 9.2 | 2 | 6 | 4 | 40 | 200–280 | 140–280 | 0.02 |
| 120 Vac | 16.0 | 4 | 6 | 6 | — | 104–127 | 104–127 | 0.02 |
| 240 Vac | 9.2 | 2 | 6 | 3 | — | 208–254 | 208–254 | 0.02 |

## Control schematics

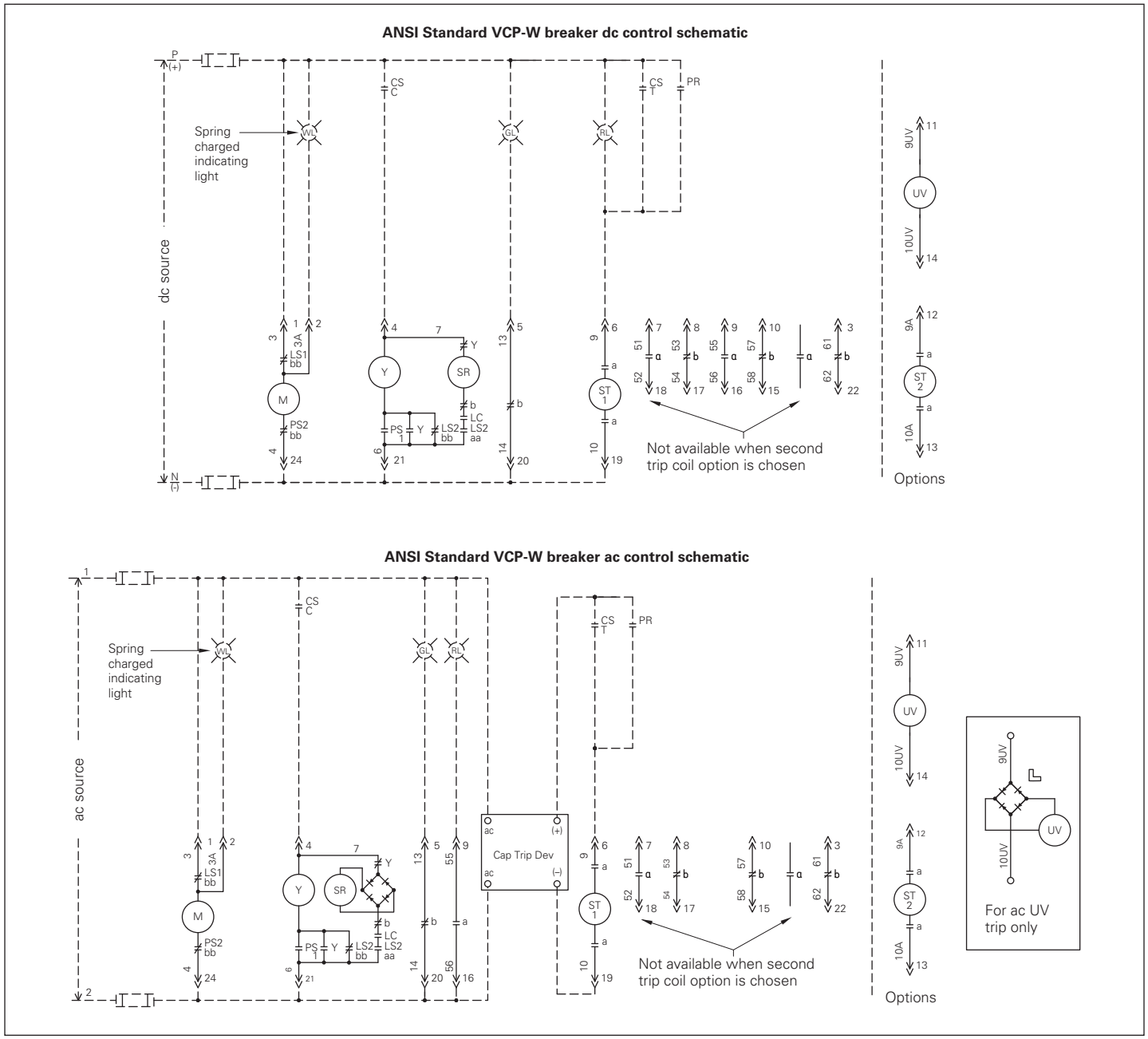


**Figure 2. Typical 5/15/27 kV VCP-W "dc" and "ac" control schematics**

**Legend**

| | | |
|---|---|---|
| **CS C** | = | Breaker control switch–close |
| **CS T** | = | Breaker control switch–trip |
| **Y** | = | Anti pump relay |
| **SR** | = | Spring release coil (coil) |
| **M** | = | Spring charge motor |
| **ST** | = | Shunt trip |
| **PR** | = | Protective relay |
| **^ ^** | = | Secondary disconnect |

**Operation**

| | | |
|---|---|---|
| **LS1 bb** | = | Closed until springs are fully charged |
| **LS2 aa** | = | Open until springs are fully charged |
| **LS2 bb** | = | Closed until springs are fully charged |
| **LC** | = | Open until mechanism is reset |
| **PS1** | = | Open in all except between "test" and "connected" positions |
| **PS2** | = | Closed in all except between "test" and "connected" positions |

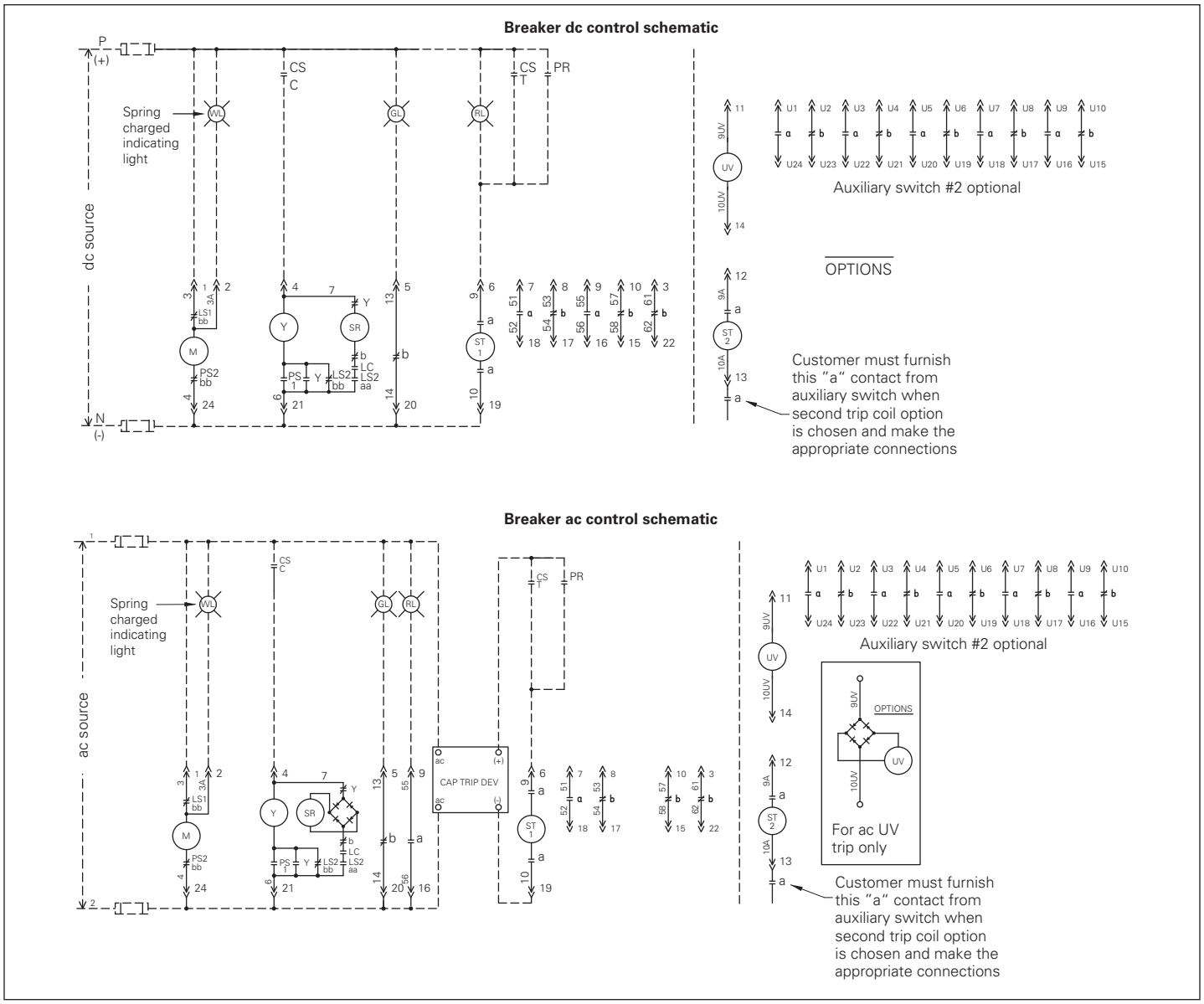


**Figure 3. Typical 38 kV VCP-W "dc" and "ac" control schematics**

**Legend**

| | | |
|---|---|---|
| **CS C** | = | Breaker control switch–close |
| **CS T** | = | Breaker control switch–trip |
| **Y** | = | Anti pump relay |
| **SR** | = | Spring release coil (coil) |
| **M** | = | Spring charge motor |
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