APPLICATION NOTE

# Controlled Closing (Point on Wave Switching) and Sync Check

APN-096, Edition 2023-07-26

SIEMENS

# SIPROTEC 5 - Application: SIP5-APN-096 Controlled Closing (Point on Wave Switching) and Sync Check

## Edition 2023-07-26

## Content

# Controlled Closing (Point on Wave Switching) and Sync Check

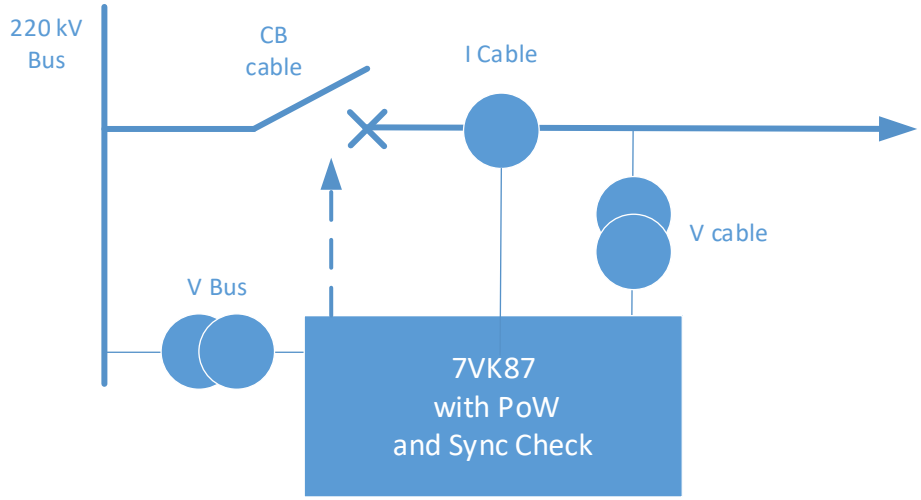
## 1 Introduction

The individual advantage of Controlled Closing, Point-on-Wave (PoW) switching, and the sync check function are described in the device manuals. When using both in parallel some special factors must be considered. This application note will describe this using a basic example of a cable feeder at 220 kV.

The application uses a line protection 7VK87, but it can be done in a similar manner in other devices such as 6MD86 etc.

## 2 Example Configuration

The diagram below shows the basic scope of the example:




The 7VK87 is applied by adding new device in DIGSI and using the standard application template “Basic” with 25 Sync Check – AR, 50BF and other functions not relevant to this application note are deleted.

The application is configured in the 7VK87 as follows:

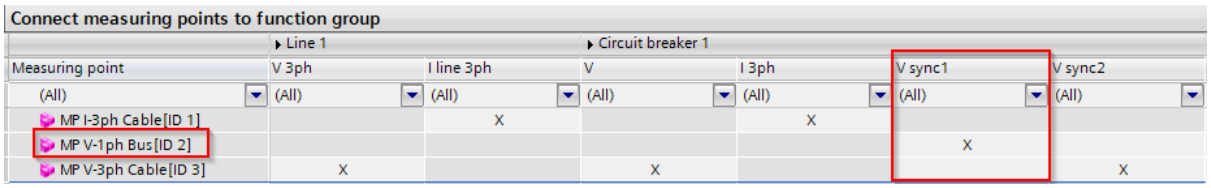
**Current-measuring points**

| | | Base module | | | |
|---|---|---|---|---|---|
| | | 1A | | | |
| | | 1A1-1A2 | 1A3-1A4 | 1A5-1A6 | 1A7-1A8 |
| Measuring point | Connection type | I P 1A1 | I P 1A2 | I P 1A3 | I P 1A4 |
| (All) | (All) | (All) | (All) | (All) | (All) |
| MP I-3ph Cable | 3-phase | I A | I B | I C | |

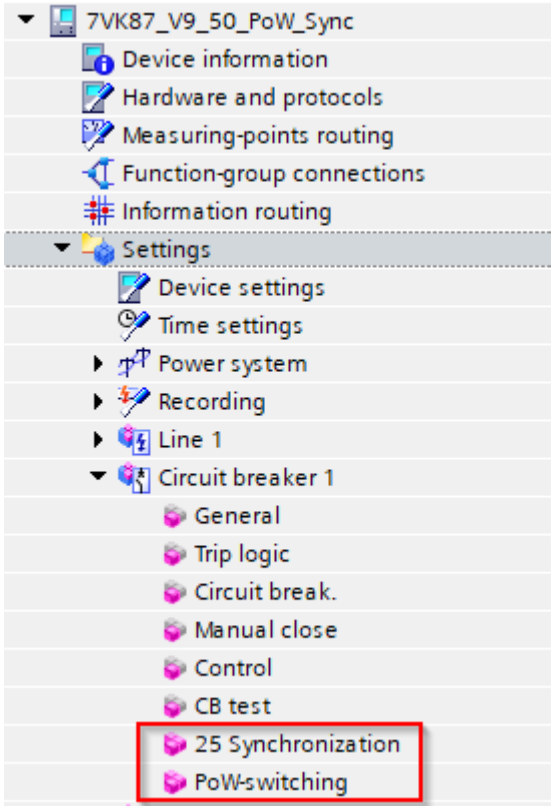
**Voltage-measuring points**

| | | Base module | | | |
|---|---|---|---|---|---|
| | | 1B | | | |
| | | 1B1-1B2 | 1B3-1B4 | 1B5-1B6 | 1B7-1B8 |
| Measuring point | Connection type | V 1.1 | V 1.2 | V 1.3 | V 1.4 |
| (All) | (All) | (All) | (All) | (All) | (All) |
| MP V-1ph Bus | | | | | V AB |
| MP V-3ph Cable | 3 ph-to-gnd voltages | V A | V B | V C | |
| Add new | | | | | |

The V sync1 below must be assigned to the bus voltage measuring point (Reference Voltage for PoW):



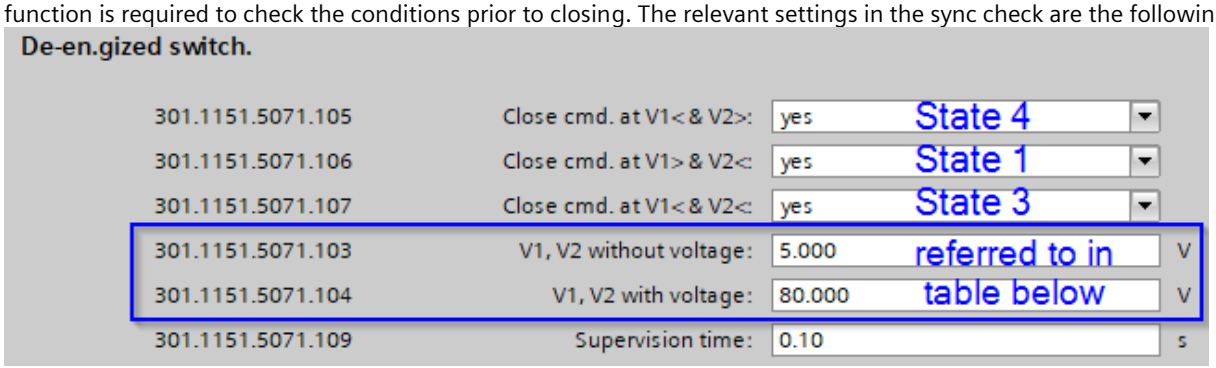

Make sure that Sync Check and PoW are applied in the Function Group Circuit Breaker:




If the functions are not yet in the Function Group Circuit Breaker, they can be applied from the Global Library.

# 3 Combination PoW and Sync Check closing

The PoW closing is required for "Deadline Charging" when the cable side (Vsync2) is de-energized. The Sync Check function is required to check the conditions prior to closing. The relevant settings in the sync check are the following:

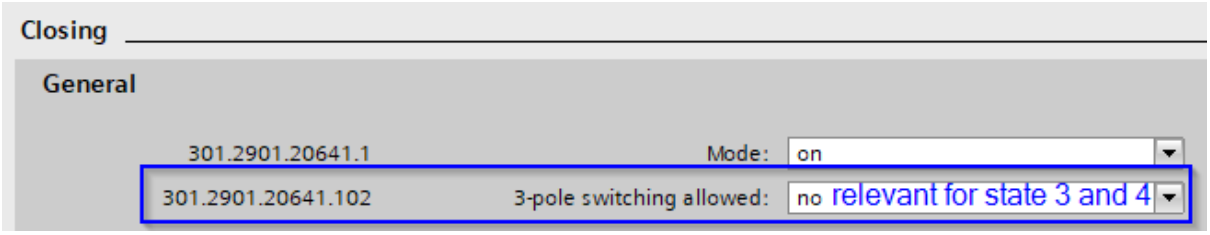



For the closing there are 4 States: The sync Check (State 2) and the 3 "de-energized switching" states configured in the settings above. The Table below defines these 4 states for closing.

| No. | State | Bus (Vsync 1) | Cable (Vsync 2) | Method of Closing |
|---|---|---|---|---|
| 1 | Live Bus, Dead Cable | V bus > 80 V sec | V Cable < 5 V sec | PoW |
| 2 | Live Bus, Live Cable | V bus > 80 V sec | V Cable > 80 V sec | Sync Check |
| 3 | Dead Bus, Dead Cable | V bus < 5 V sec | V Cable < 5 V sec | If allowed close with no additional check |
| 4 | Dead Bus, Live Cable | V bus < 5 V sec | V Cable > 80 V sec | |

The voltage thresholds shown are the secondary settings as shown in the screen shot above the table.

### 3.1 For States 3 and 4 the following setting is relevant:




If set to “no” the close command will not be issues in States 3 and 4. If closing with states 3 and 4 is required, change the setting above to “yes”.

## 3.2 Response when Sync Check and PoW Closing are applied without additional measures:

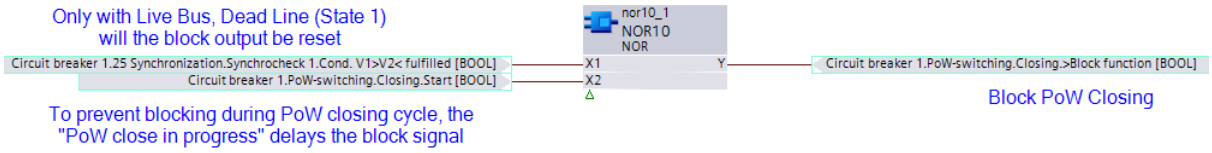
**State No. 1 (Controlled Closing):** The Sync Check function detects the Dead Line condition (Sync Check must permit dead line charging) and permits closing which is then done as set with the PoW function.

**State No. 2 (Sync Check)**: the Sync Check function releases closing as set. The PoW function then attempts to close each pole individually. This is not the desired result.

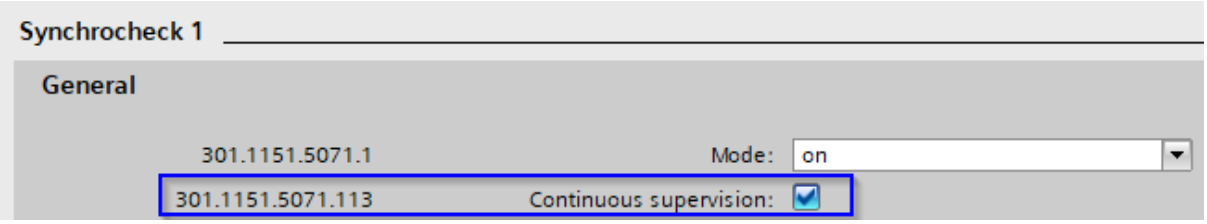
**State No. 3 and 4 (Dead Bus – Dead Line and Dead Bus Live Line):** With the setting “3-pole switching allowed” set to “yes”, the Sync Check function releases as set in screenshot the closing for de-energized switch. The PoW function does not respond as the reference voltage is absent.

# 4 Additional Logic

The standard response for the 4 defined States, as described above, indicate that only for State 2 (Sync Check) the response is not exactly as required (delayed closure due to PoW after Sync Check close release). To improve this the following additional logic can be implemented:




As the block signal may not be dynamically changed during the closing cycle (Block signal during PoW cycle would terminate without close), the Sync Check function must be set to Continuous supervision, as follows:




In this manner the State 1 condition (V1>V2<) is signaled to the CFC logic above before the close command is initiated.

# 5 Conclusion

The Controlled Closing (PoW) can be used together with the Sync Check function. By including a blocking signal via CFC the closing with Sync Check condition and de-energized switching includes all the necessary functions.

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