

TEXAS A&M UNIVERSITY

Relay Conference



Get In Step with Synchronization

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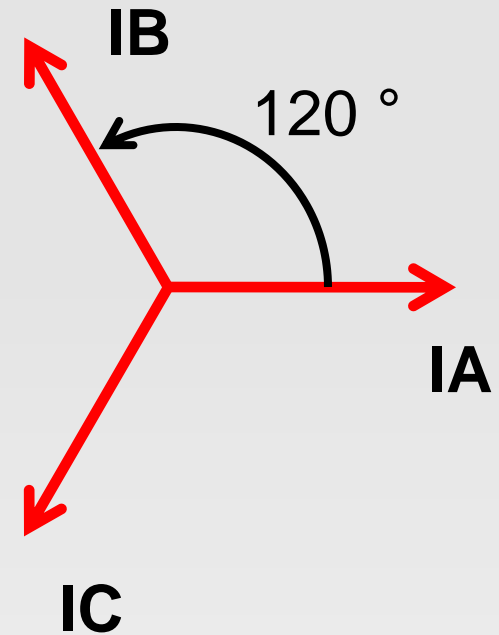
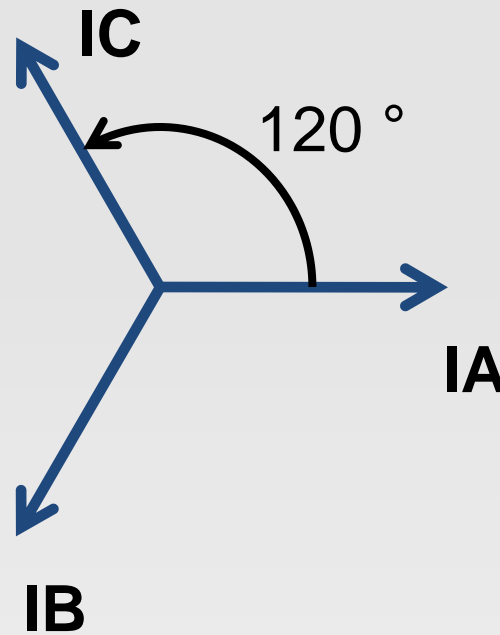


Our Synchronization Discussion

- Why should I care about synchronization?
 - What are some ways to sync my sources?
 - What are common sync-check settings?
 - How can I safeguard automatic closing?
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Connecting Two AC Systems

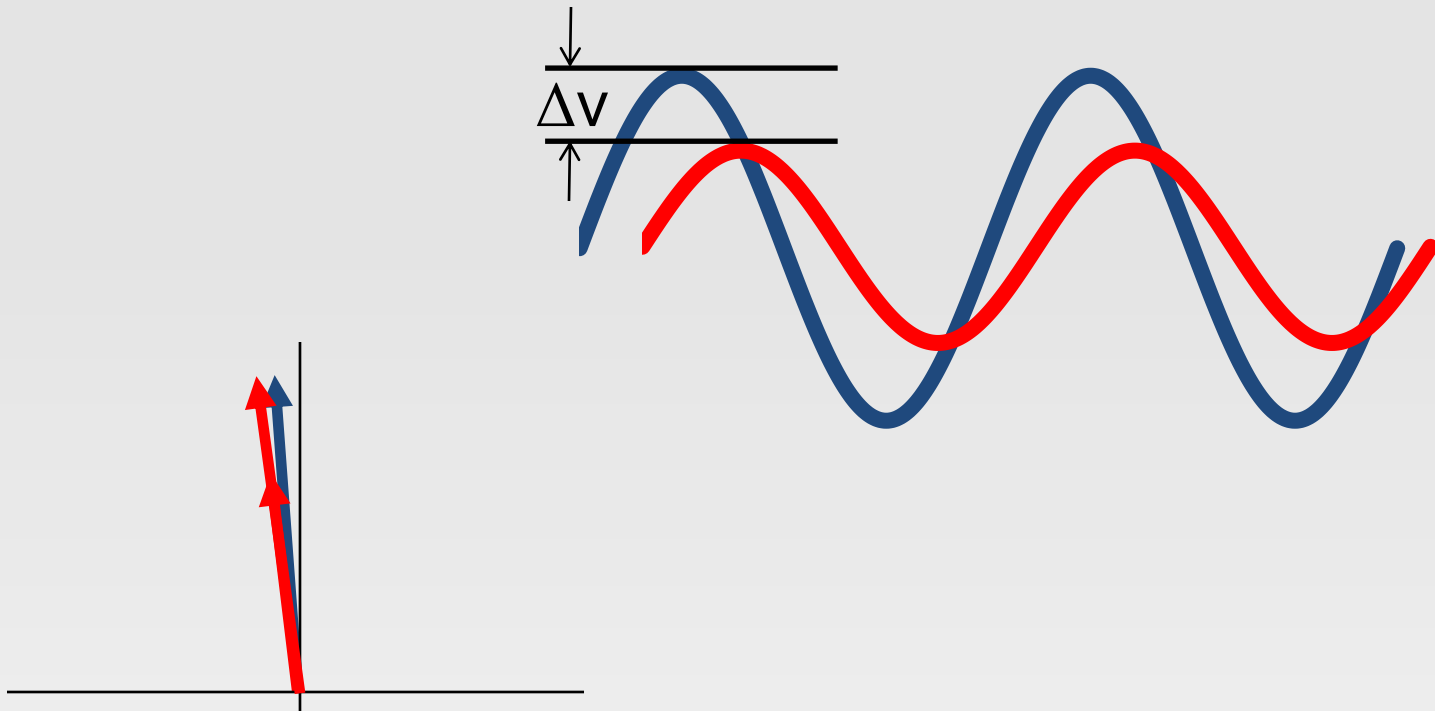
- Match: phase sequence



Get This Right, First!

Connecting Two AC Systems

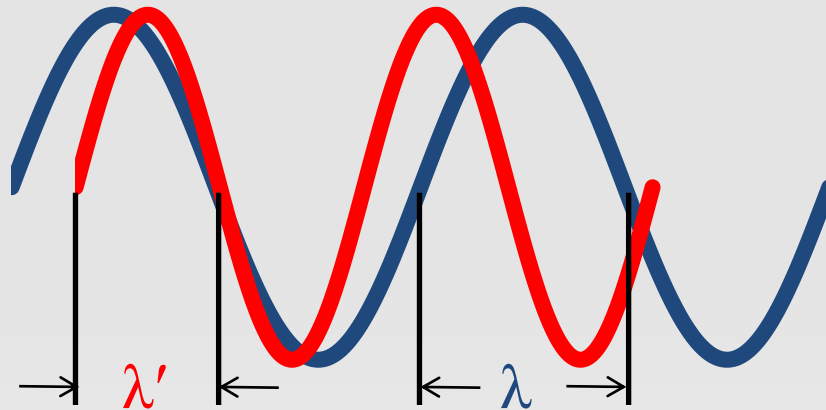
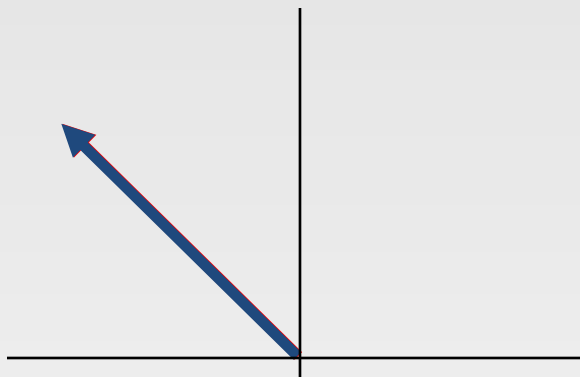
- Match: voltage amplitude



Connecting Two AC Systems

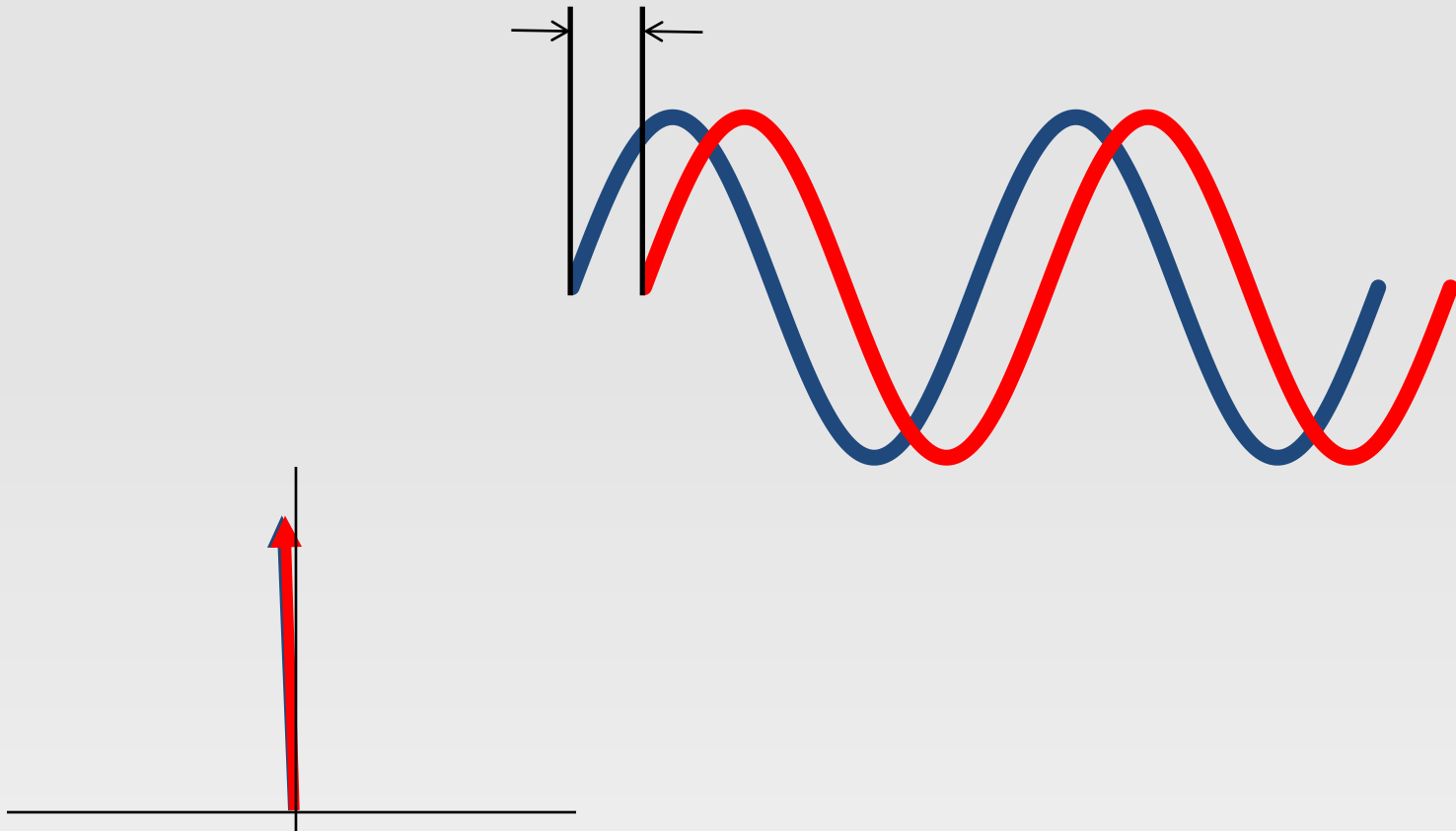
- Match: frequency

$$\lambda' < \lambda$$

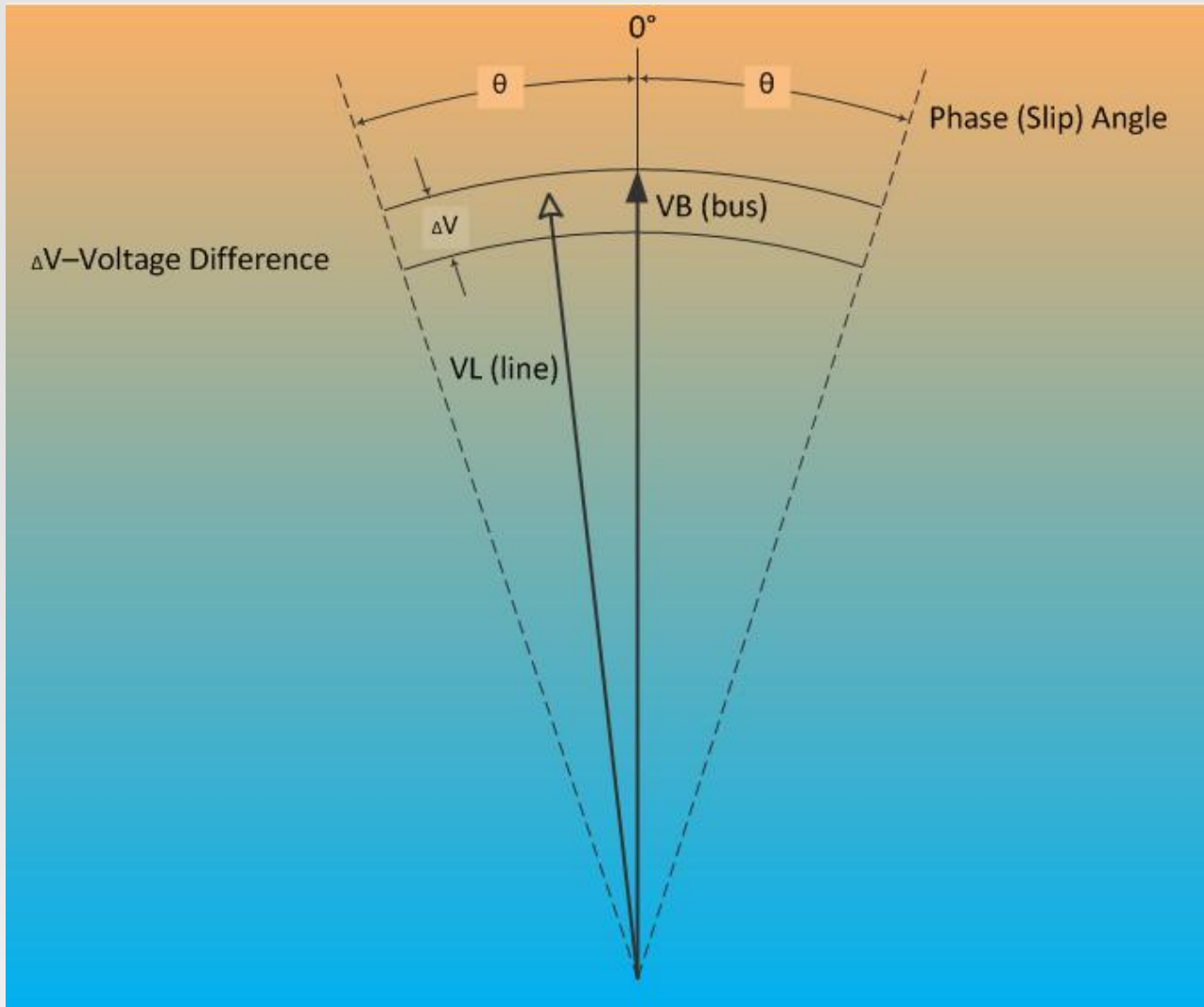


Connecting Two AC Systems

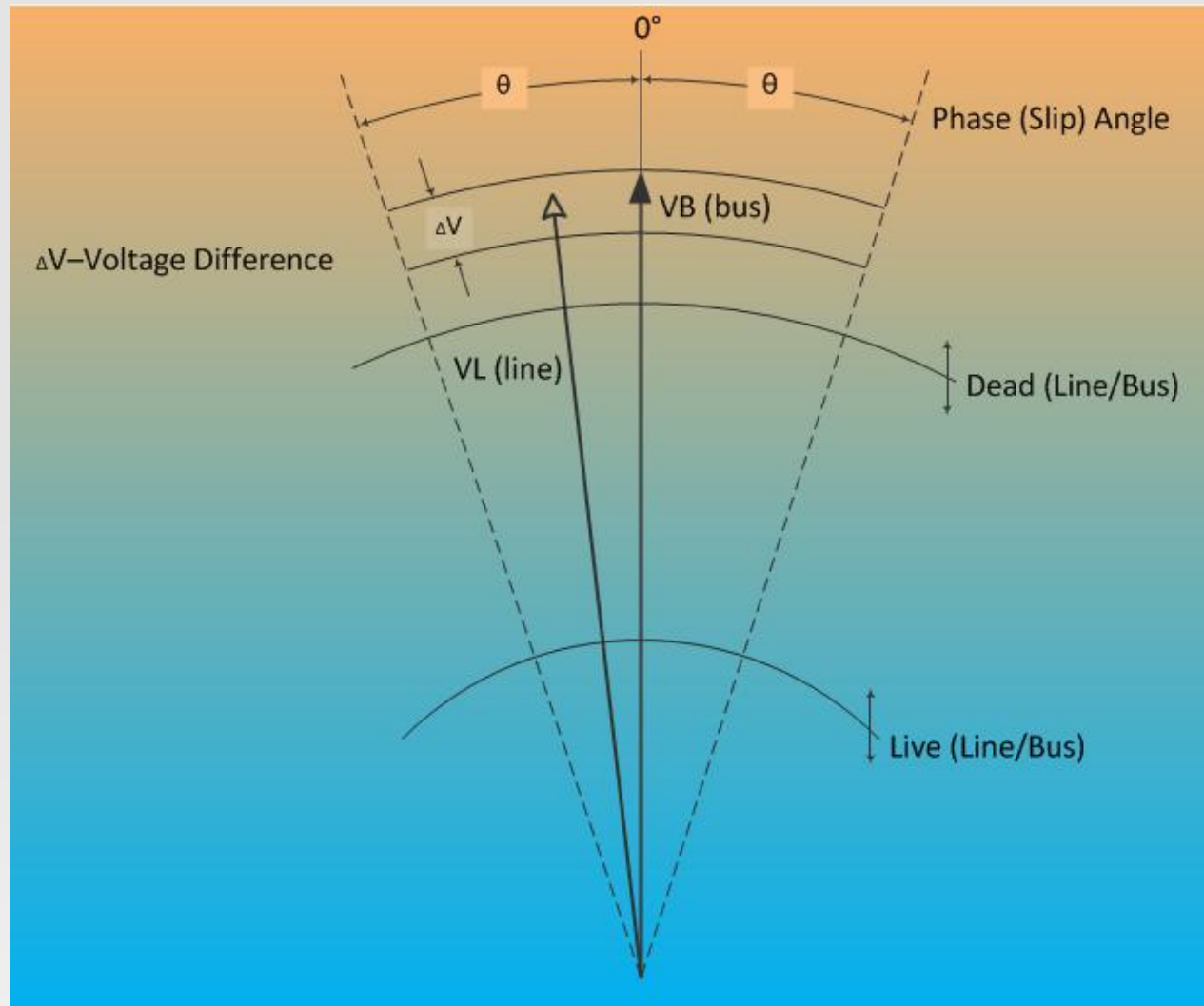
- Match: phase angle



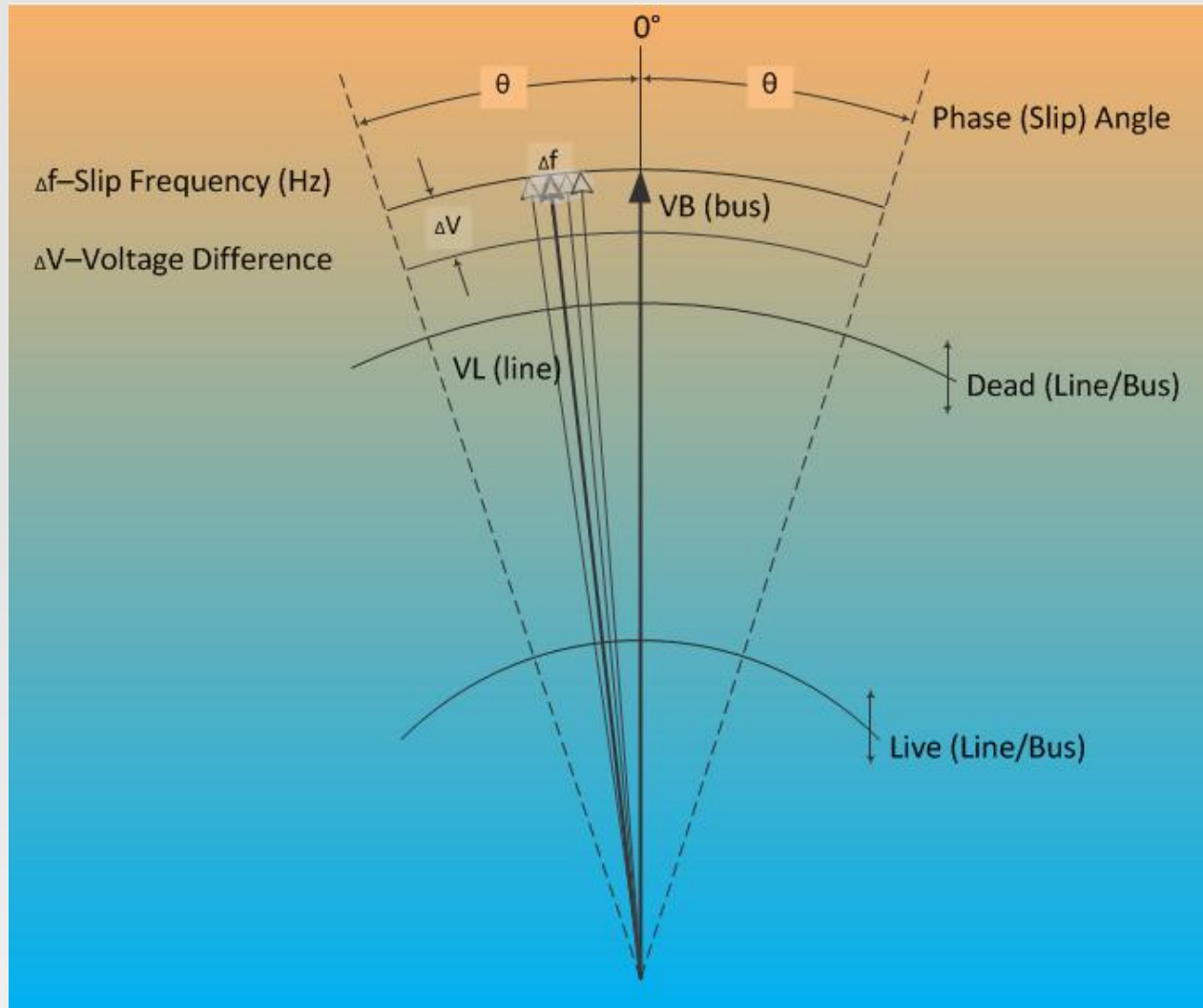
Sync-Check Window



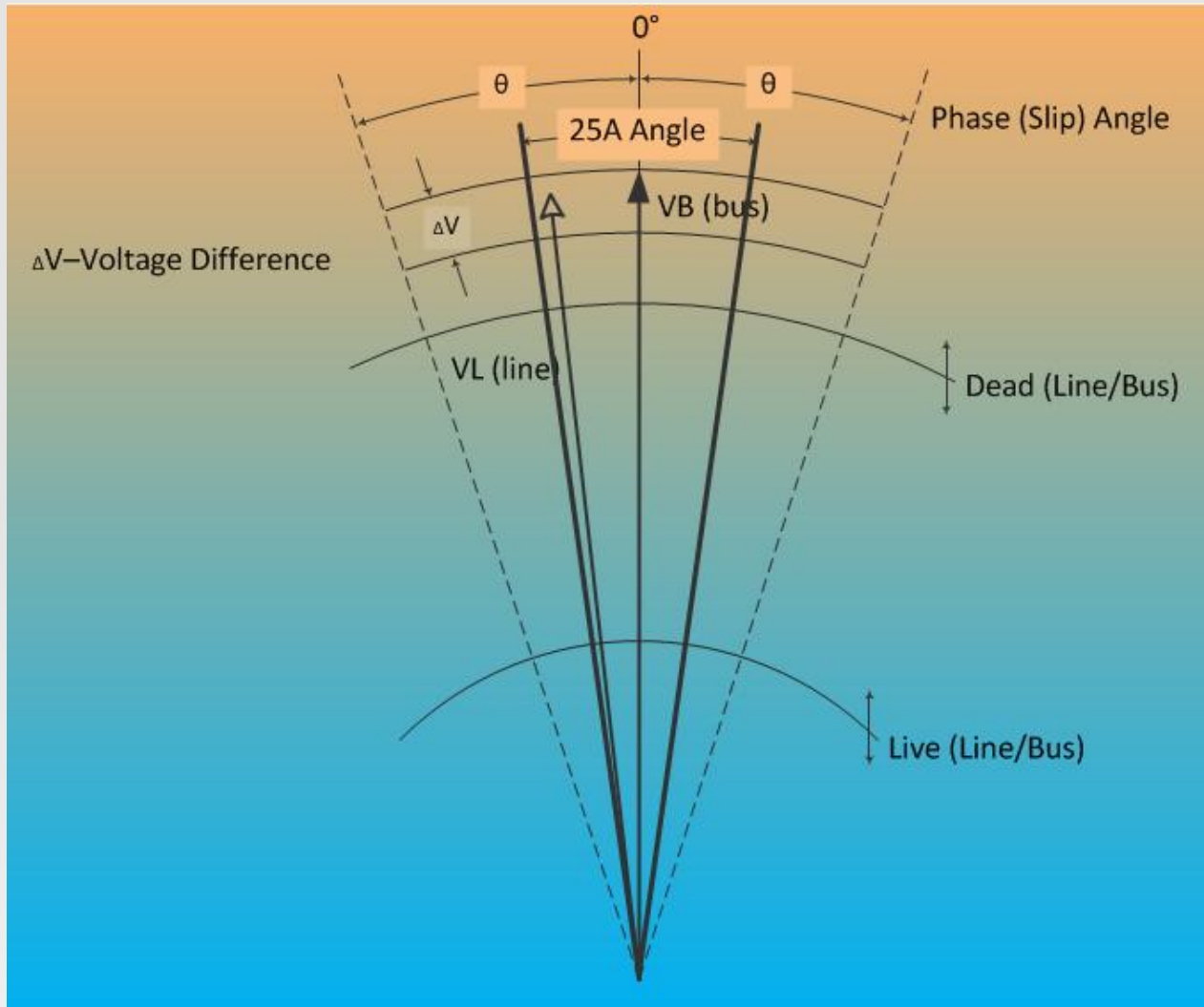
Add Live/Dead Voltage-Monitor



Instantaneous Slip Effect



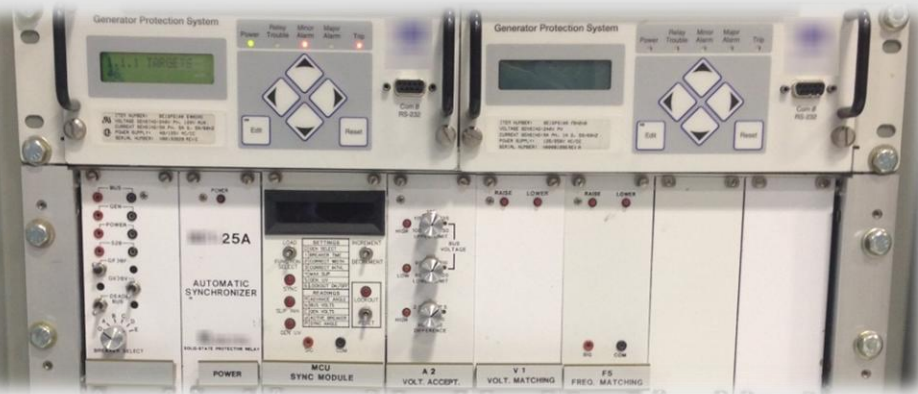
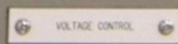
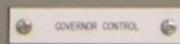
Auto-Sync 25A Window



Ways to Synchronize

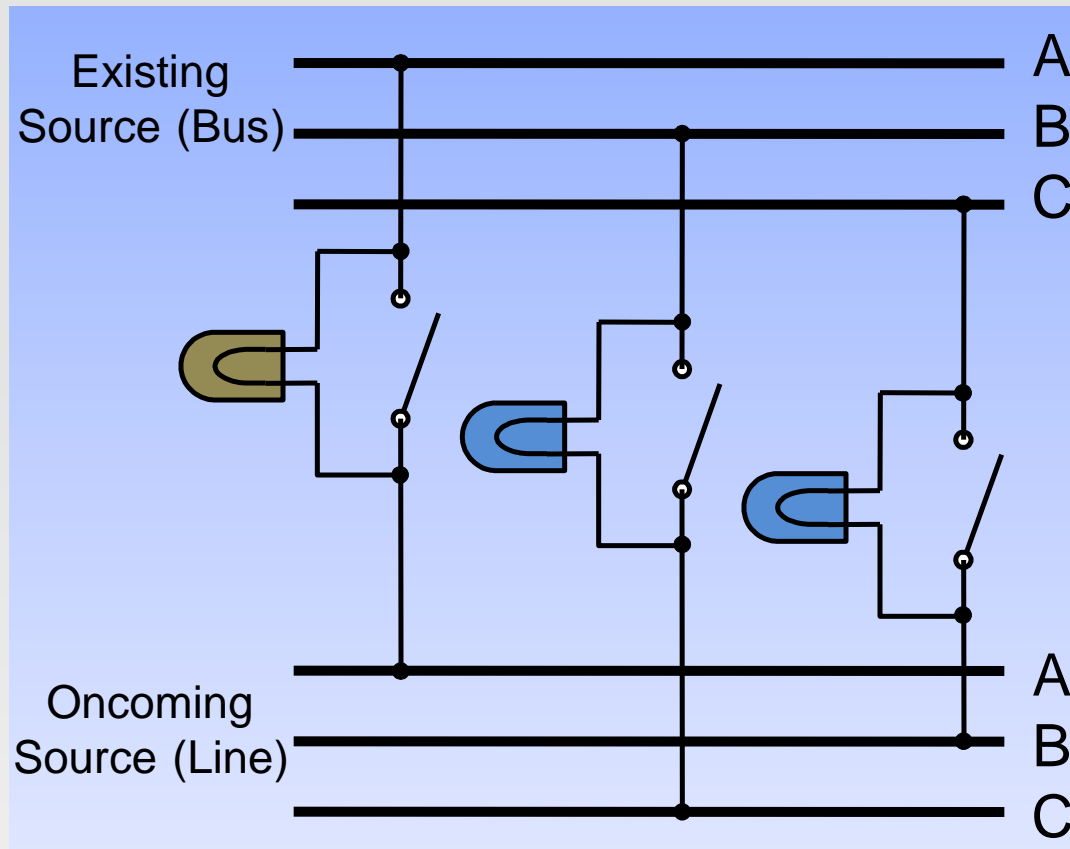
- Manual
 - Operator closes
 - Synchroscope, lamps, meters
- Assisted Manual
 - Operator commands close
 - Sync-check relay supervision
- Automatic
 - Synchronizer steers V and F , and closes
 - Sync-check relay supervision

Tools for Synchronizing



Manual Synchronization

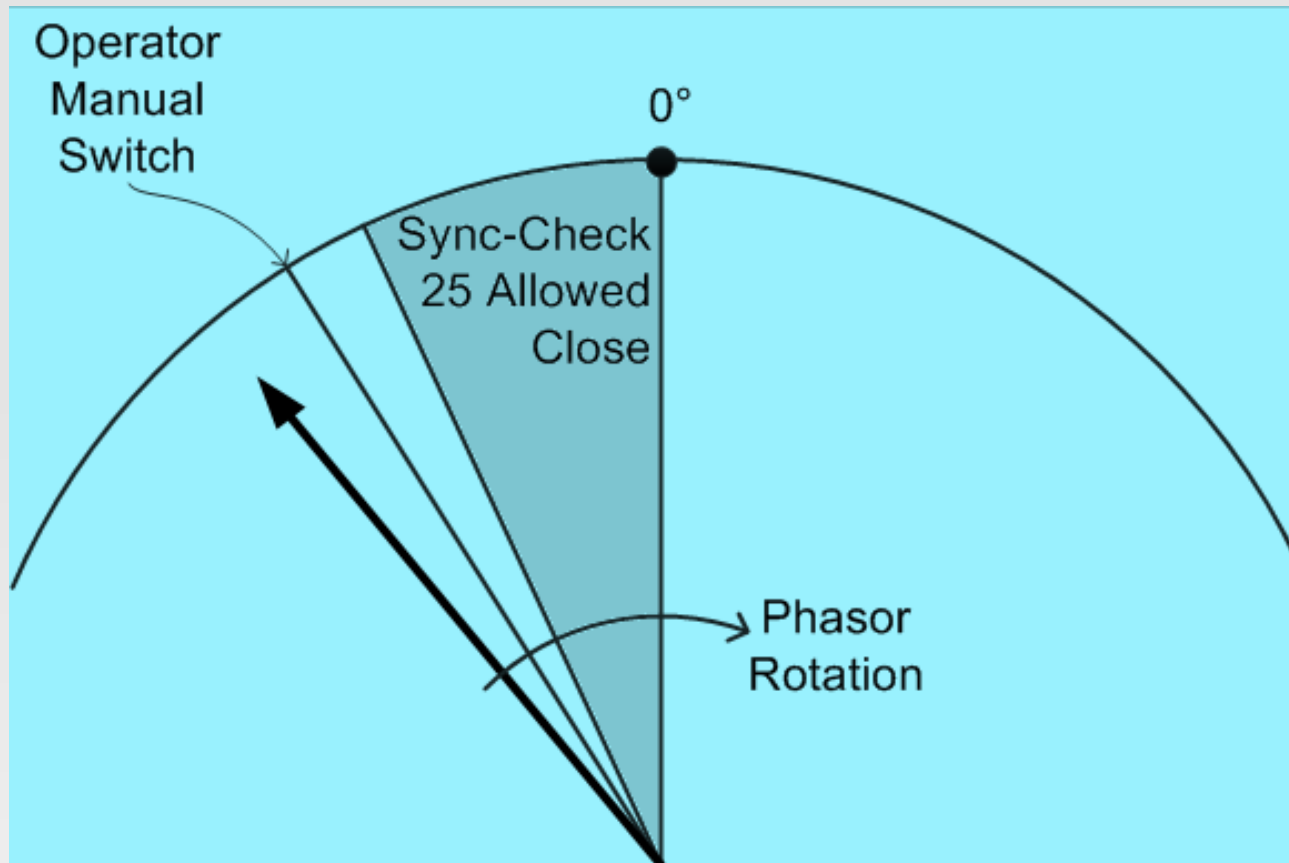
- Two bright, one dark lamp



Synchroscope Indicates “Midnight”



Assisted-Manual Synchronization



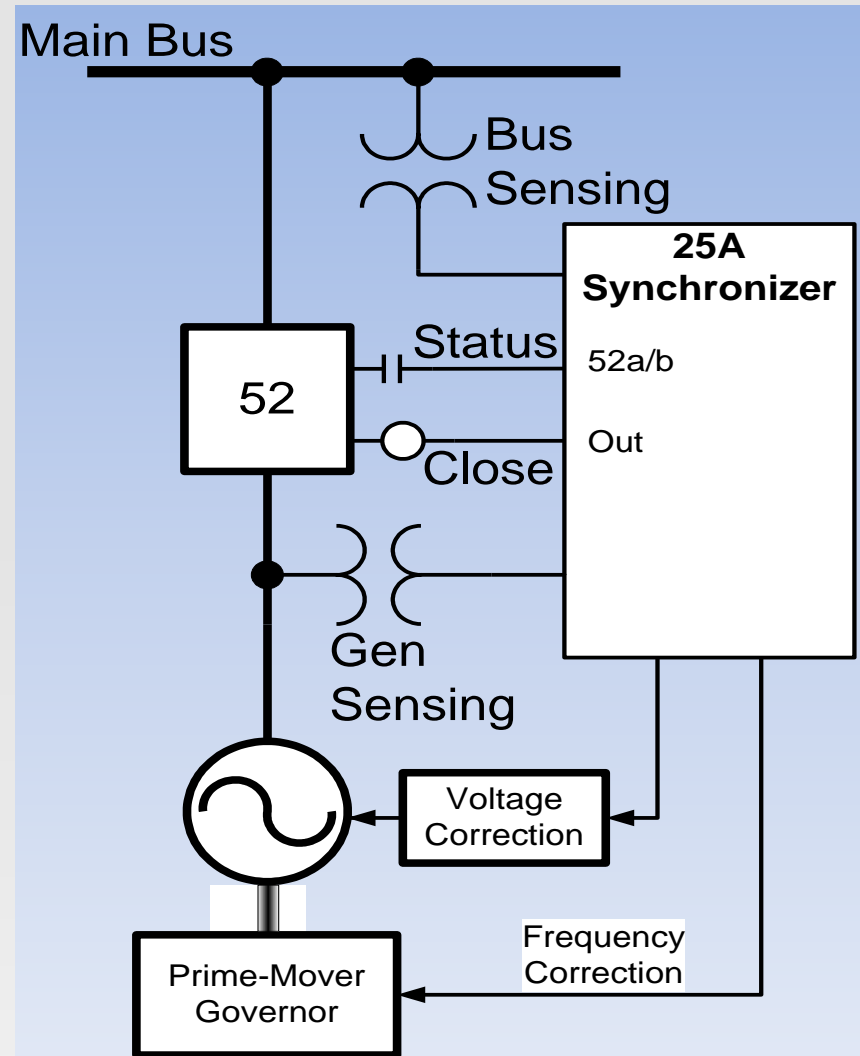
Sync-Check Parameters

- Typical settings
- Modify for particular requirements

Parameter	Typical Value
Voltage Difference	5—15 percent
Phase (Slip) Angle	0°–30°
Slip Frequency	0.10 Hz

Autosynchronizer Does This

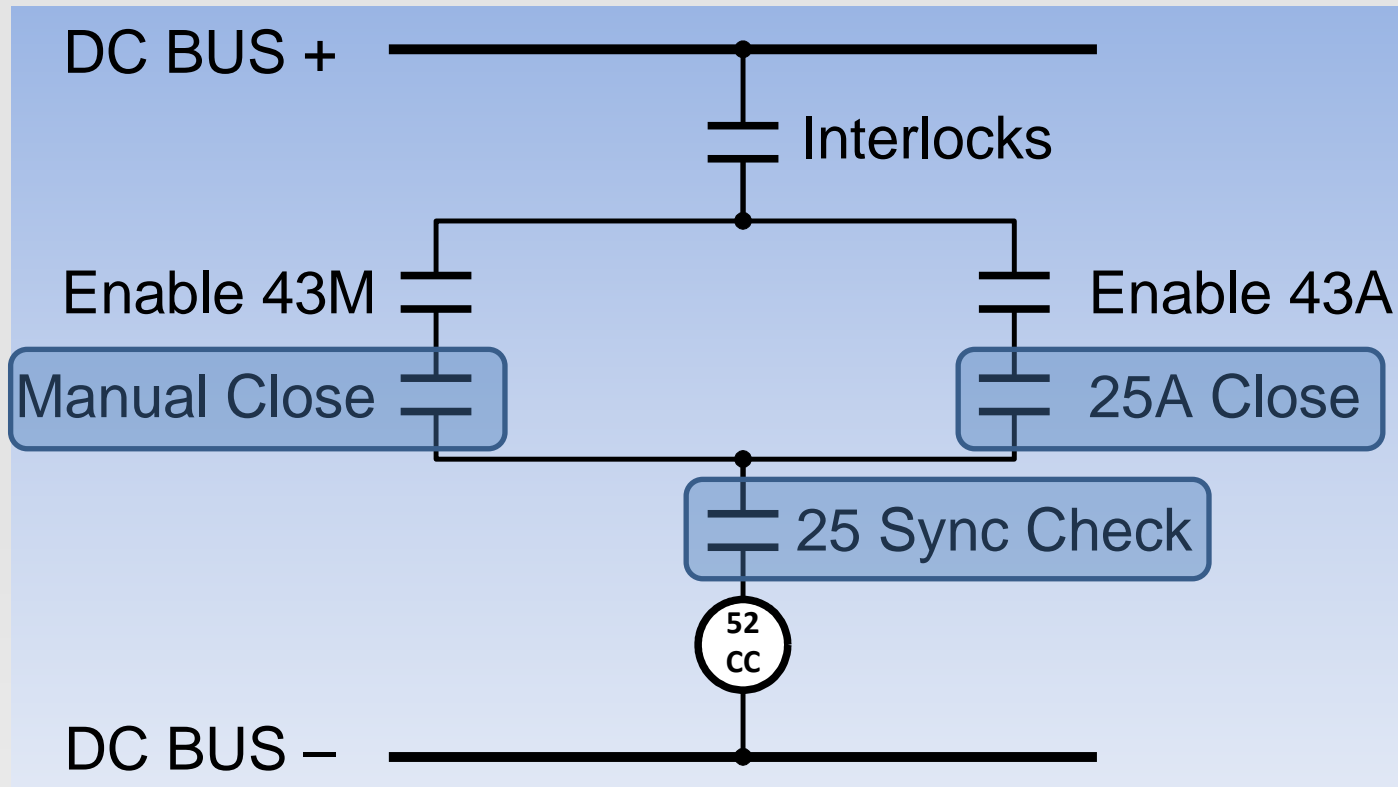
- Senses Bus and Gen pts
- Raises and lowers, voltage and frequency
- Issues close command when synced



Anticipatory: Close Before 0°

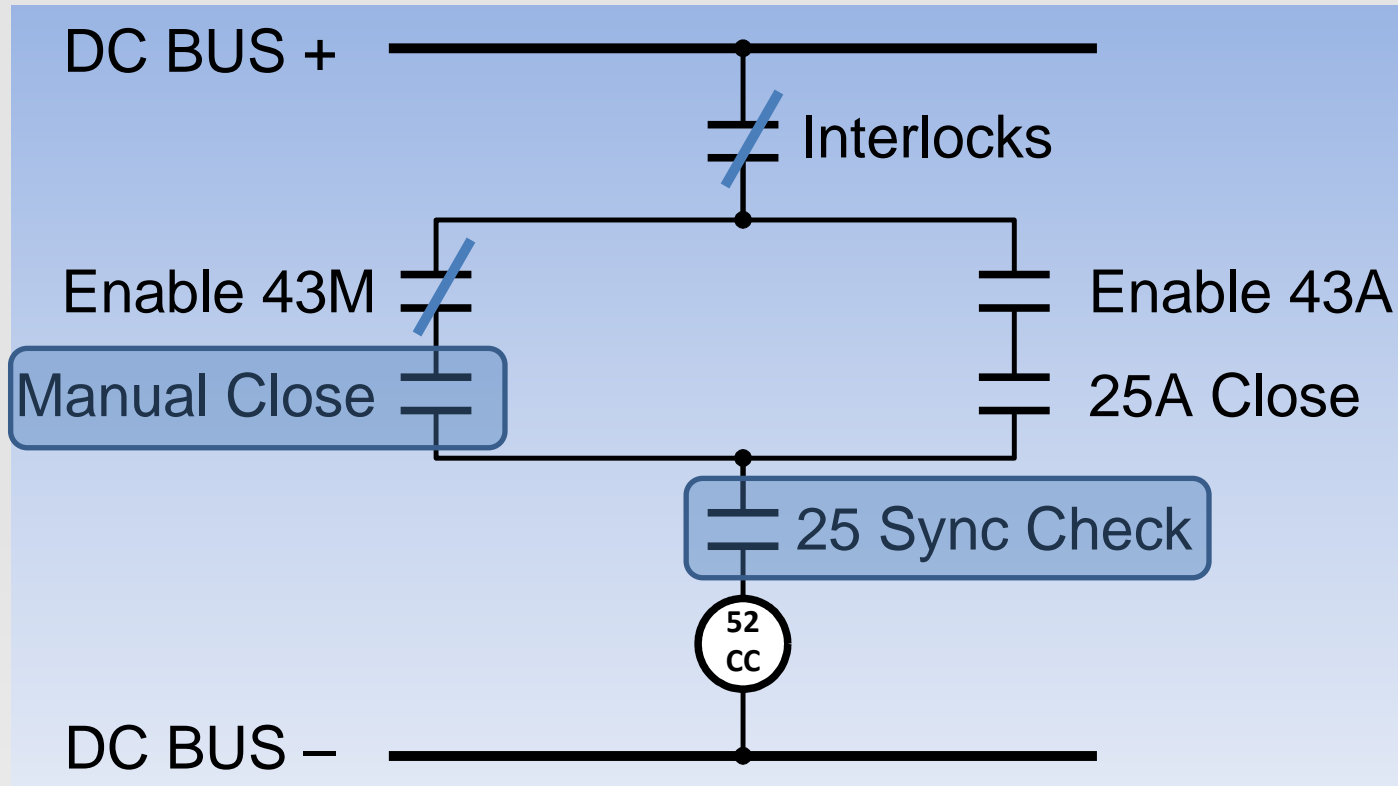
- Issue close command at advance angle—
“anticipate midnight”
- $AA = 360^\circ \cdot (TCB + TR) \cdot FS$
 - AA advance angle
 - TCB circuit-breaker close time
 - TR output relay travel (6–8 ms)
 - FS is the slip frequency

Wiring 25A, Manual Close, and 25



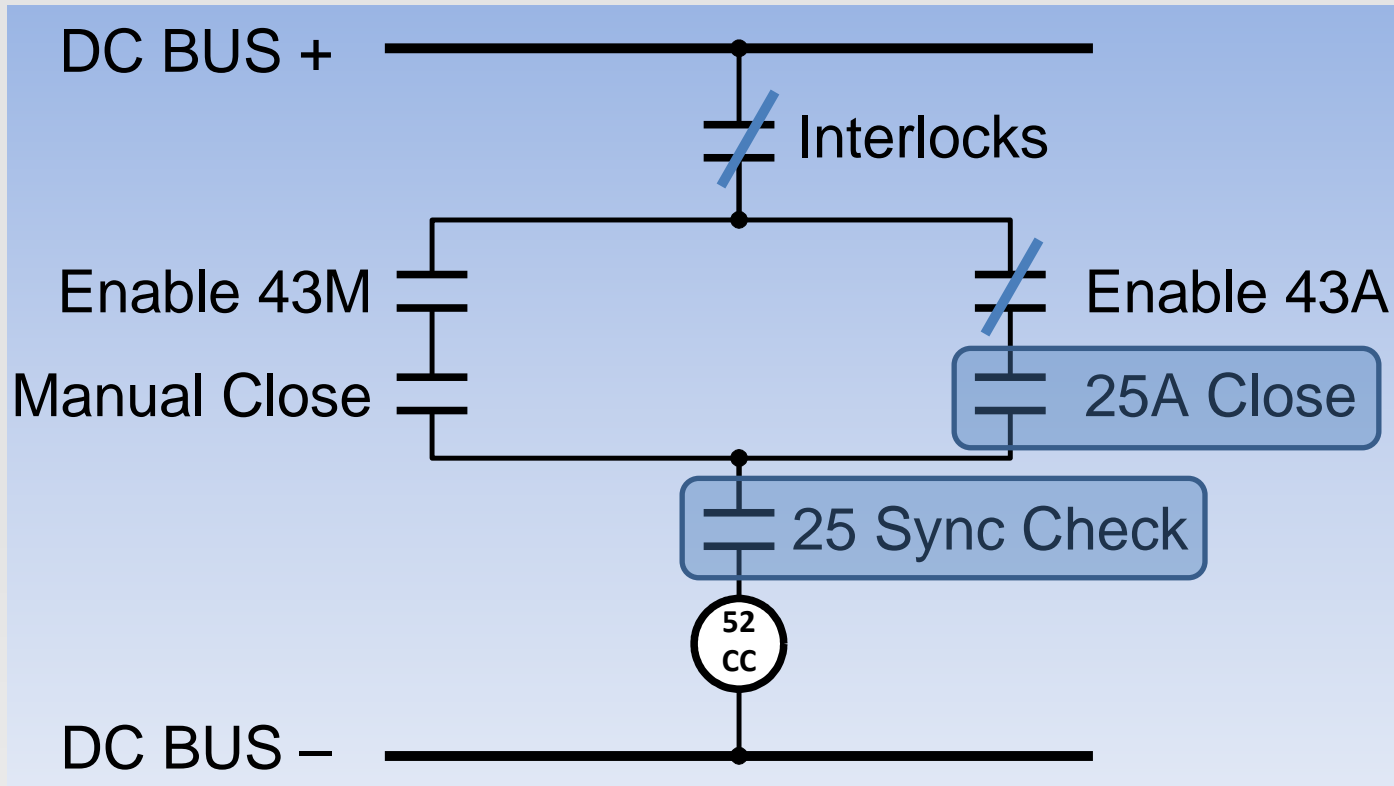
- 25A - Autosynchronizer
- 25 - Sync Check
- 43 - Switch

Manual Supervised Close



- 25A - Autosynchronizer
- 25 - Sync Check
- 43 - Switch

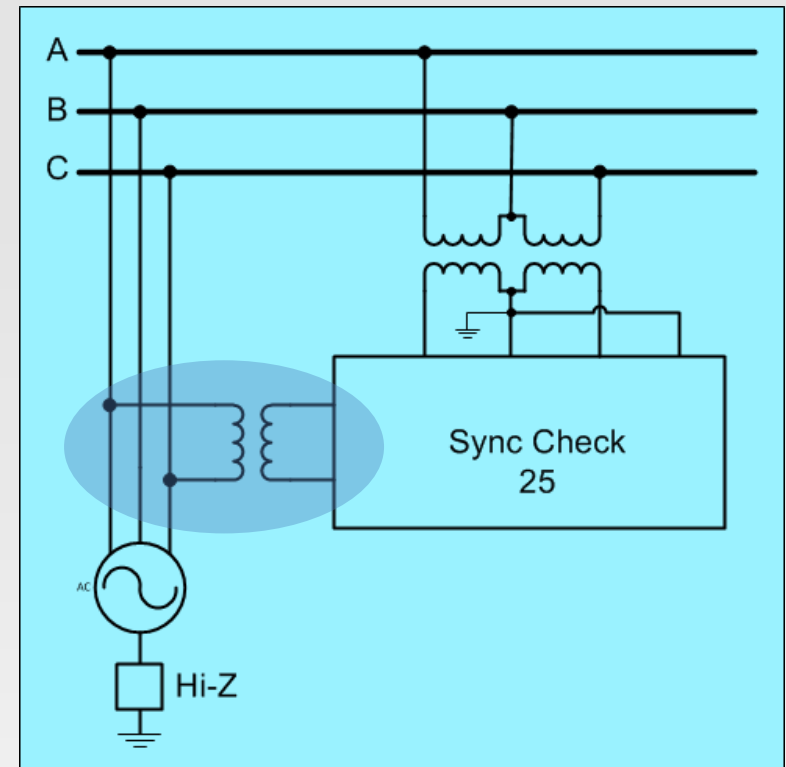
Automatic Synchronized Close



- 25A - Autosynchronizer
- 25 - Sync Check
- 43 - Switch

PT Connection w/ Hi-Z Grounding

- Connect pt phase to phase
 - Phase-to-neutral pts: unreliable voltage output
 - Phase-to-phase pts: no neutral offset



Conclusions

- Understand your synchronization and sync-check methods
 - Automatic synchronizer 25A adjusts voltage and frequency
 - Anticipatory synchronizer accounts for circuit-breaker closing time
 - Supervise automatic and manual close with sync check 25
 - Modern sync check compensates for pt connections and phase angle
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Questions?
