TOSHIBA
Leading Innovation

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APPLICATION GUIDELINE: Synchronous Transfer / Capture Procedure

Toshiba has developed technology that has been proven in the field since 2003 for speed control that includes smooth transfer of motors to and from the power grid. The operation of transferring from the ASD (Adjustable Speed Drive) to line is called TRANSFER and from the line to ASD is called CAPTURE, hereafter in this document.

The T300MVi drive with 24 pulse Input and 5 level output topology has achieved significant success for retrofits to existing applications as well as new applications and shown an impressive track record for reliability. Toshiba's cutting Edge technology in the field of medium voltage drives supply the most advanced and up to date product in the industry.

Toshiba has been very successful with MV drive applications with sync transfer with the topology as described below. We are very proud to say that we have recorded ZERO% semiconductor failure for sync transfer applications with our standard topology for more than 1500 applications with 2 or 3 motors per drive.

Synchronous Transfer and Capture offers several important operational benefits:

1. A single drive can be used to accelerate multiple motors to synchronous line speed, minimizing drive investment.
2. A single drive can be shared by a group of motors, with one or more of the motors being run on the ASD while other motors are running at fixed speed. This allows optimizing process control, and maximizing energy utilization.
3. When the process requires full -speed operation, a connected motor can be returned directly to the utility, maximizing energy efficiency by eliminating any losses introduced by drive operation.
4. Multiple motors can be "soft started" sequentially, minimizing power line surges and impact.

What is provided with Toshiba SyncXFR scheme?

1. Synchronization of the ASD output to line power is an integral feature of the digital microprocessor controlling the ASD functions. This ensures accurate synchronization compared to using an external sync control module. Toshiba uses a redundant sync check relay to confirm of synchronization as a secondary safety measure.
2. Integral sync reactor within the ASD cabinet, which eliminates complications of site installation and reduce capital cost, compared to an outdoor physically large sync reactors used by competition.

3. Toshiba can provide the ASD, sync control, motor control gear and required PLC with programming as a total integrated package with single point of responsibility. This will eliminate coordination issues.
4. Unique control strategy using current feedback from BYPASS circuit in addition to the contactor status feedback. This control scheme provides a closed TRANSFER function that ensures the motor is not subjected to any mechanical shock during the procedure.
5. Extensive application experience with different load profiles and configurations. Toshiba is able to provide a tailor made solution for your application.
6. Experienced field service personal who can handle an entire sync transfer scheme, including the ASD, MCC and logic.

For the purpose of proper operation per the scheme developed by Toshiba, the following feedback and control I/O is proposed to use for projects, only the minimum required signals are indicated below. It is assumed the required control signals are provided by a station PLC for the purpose of explanation below.

Input signals required from the Station PLC to ASD.

1. Motor Select Logic from Station PLC to ASD one for each motor.
2. Drive Run/Stop signal from Station PLC to ASD. This command will act as capture command if the capture mode is used
3. Transfer signal from Station PLC to ASD.
4. Speed reference
5. Motor stop command , one for each motor, will coast to stop motor on BYPASS
6. Motor across the line start command, one for each motor. This function to be activated if the ACL mode is required to be selected on the bypass cabinet.

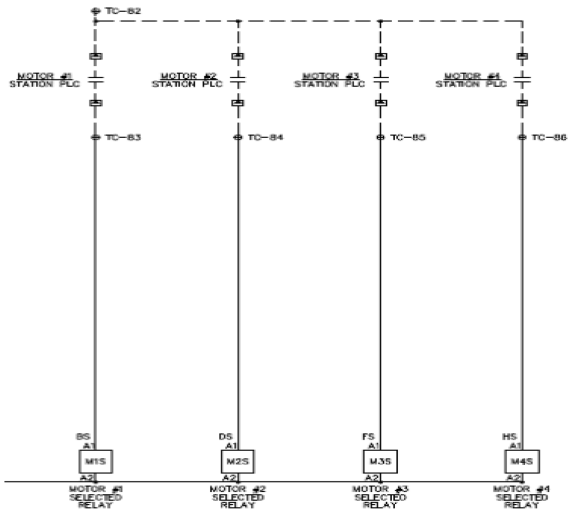
Output status signals from the ASD to station PLC

1. ASD ready condition
2. ASD fault condition
3. ASD in operation (RUN) status
4. Output contactor close/open status signal, one for each motor
5. Bypass contactor close/open status signal one for each motor
6. SYNC fail status

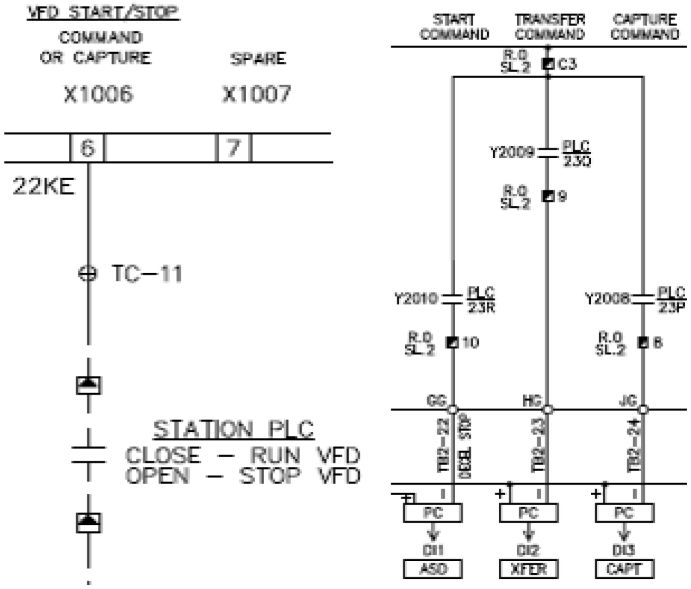
Description of logic and sequence of operation of sync TRANSFER and CAPTURE is given below,

TRANSFER sequence:

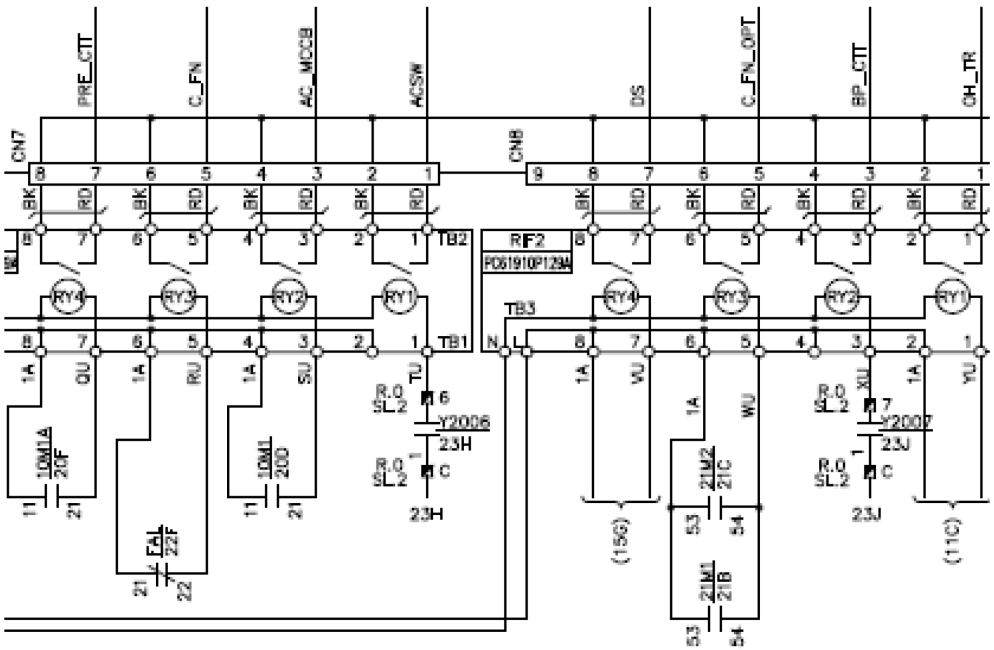
1. Station PLC makes motor selection. Motor selection is required to be energized (maintained) while the motor is operated by the ASD or in sync transfer sequencing. Motor selection can be removed after the sync transfer is complete and motor BYPASS contactor is closed.



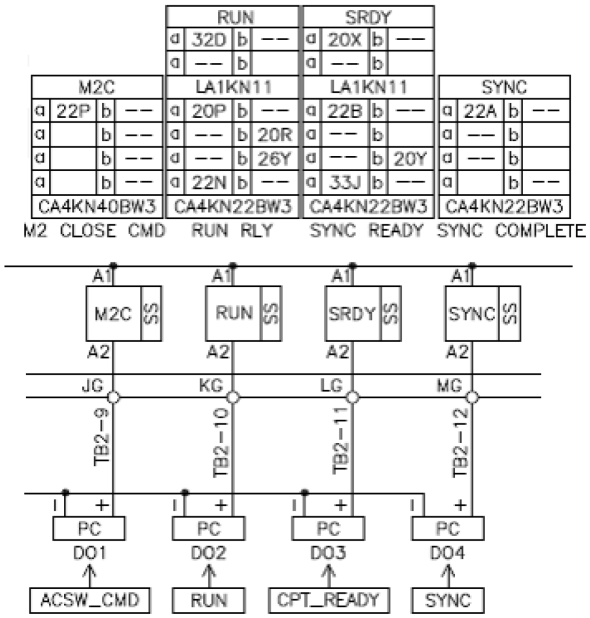
2. When the ASD READY status is received, Station PLC provides Drive START command.



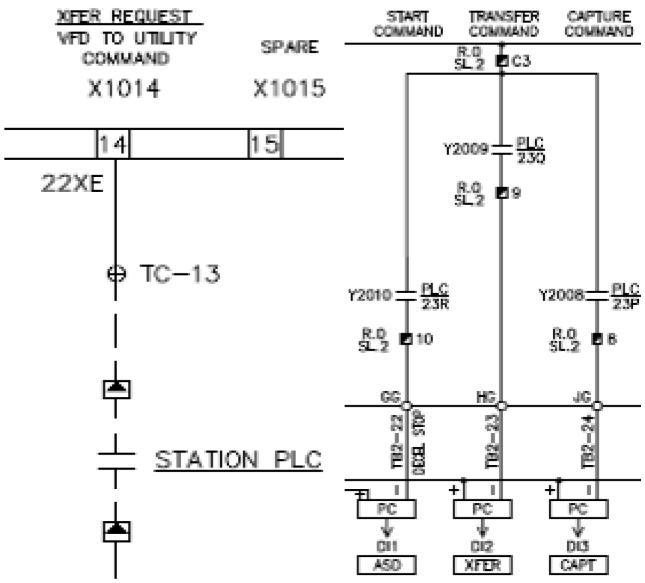
3. ASD will check the contactor status for the selected motor. If the motor is not running (both contactors open), ASD will close the Drive output contactor for the motor and run motor per speed reference input.



4. Station PLC receives the VFD RUN status which indicates successful start of the motor.

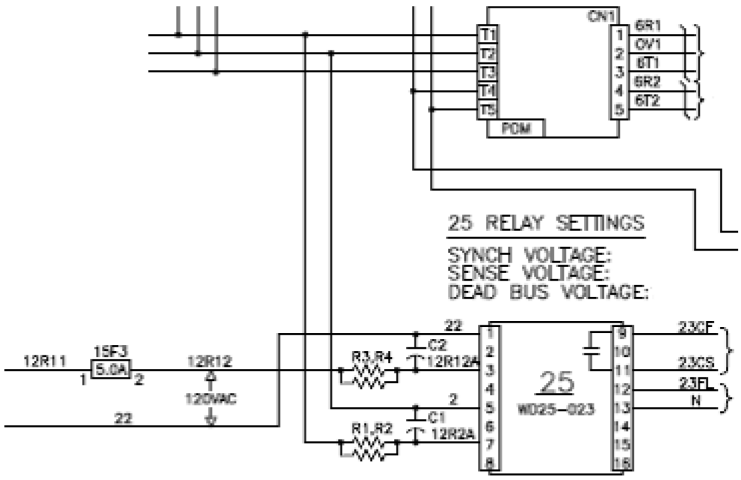


5. Station PLC initiates synchronize process by providing TRANSFER command. It is important to maintain the START command until TRANSFER sequence is completed.

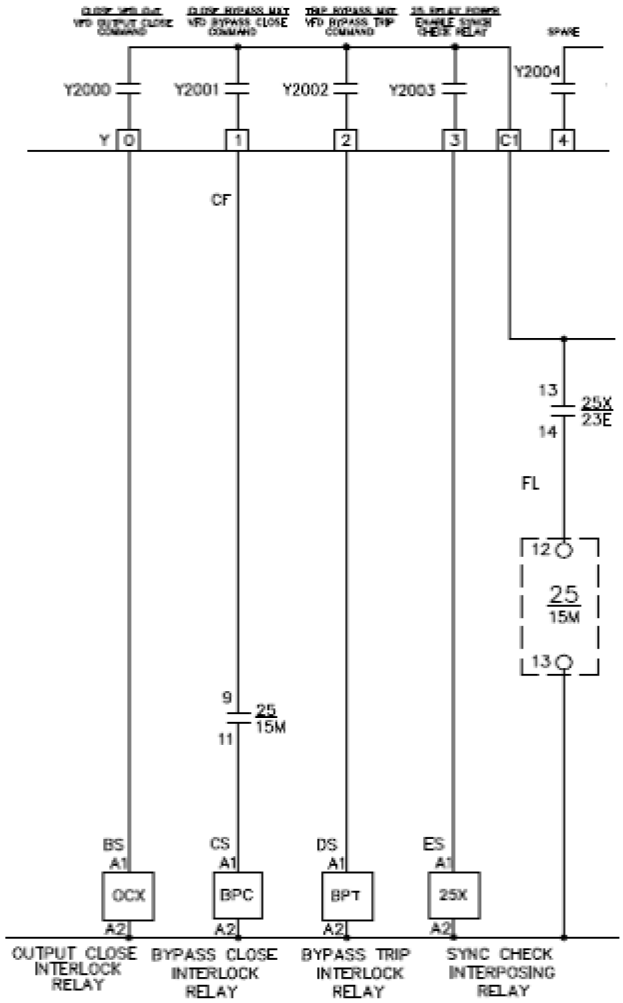


6. Upon receipt of the TRANSFER command ASD will accelerate the motor to full speed, to synchronize with Utility. The ASD will synchronize output voltage to input voltage.

7. Synchronizing Check Relay (25 Relay) permissive verifies that ASD is synchronized with Utility.

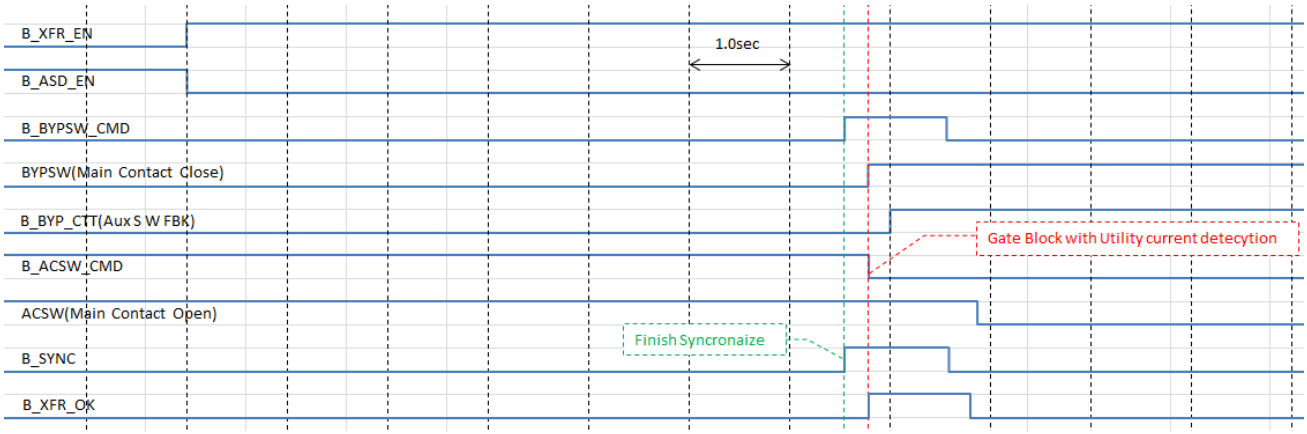


8. When ASD and Utility are synchronized, Bypass contactor close command is initiated by the ASD. Both the 25 Relay and ASD must agree for sequence to continue.



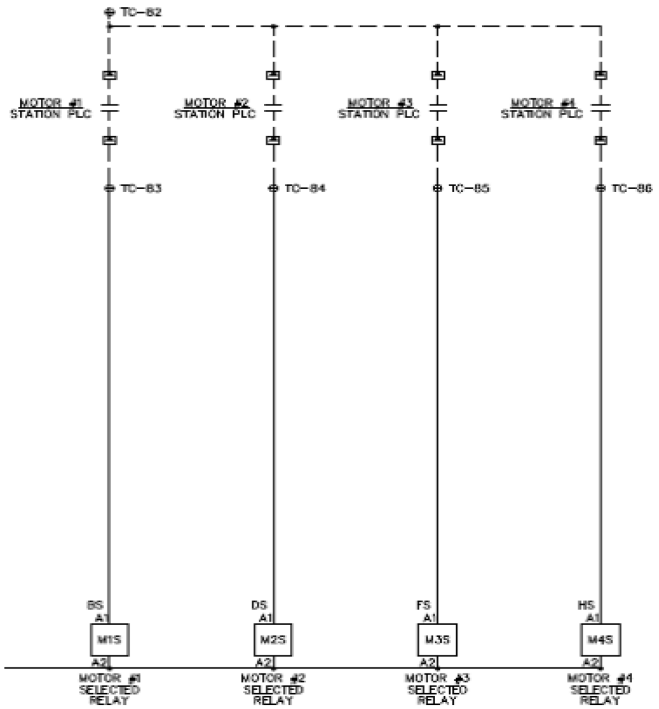
9. ASD blocks IGBT gate pulses and opens Drive output contactor when 10% Bypass current is detected or after time programmed in TIME_XFR_END usually 0.3 seconds. TIME_XFR_END is set at or above the time it takes for bypass contactor to close.
10. If bypass current is not present and TIME_XFR_END is too long the drive may trip on overcurrent or overvoltage due to remaining in parallel too long.
11. Without Bypass current and TIME_XFR_END too short, the ASD will gate block before Bypass contactor closes. This will result in the deceleration of the motor and mechanical and electrical shock to the motor and bypass feeder when bypass contactor closes.
12. If sync transfer was not successful, Drive will fault on TRANSFER FAILURE, or the ASD can be programmed to keep to keep control of the motor and retry at a later time.
13. If cause of TRANSFER FAILURE cannot be determined, download Tracesave data and email to tic-casd-tracesavesupport@toshiba.com for evaluation.
14. Upon completion of TRANSFER sequence, TRANSFER command and motor selection can be removed.
15. ASD is available for another motor start or Start command can be removed.
16. While on Bypass, station PLC can stop motor with motor stop command, opening the motor Bypass contactor.

TRANSFER Timing Sequence

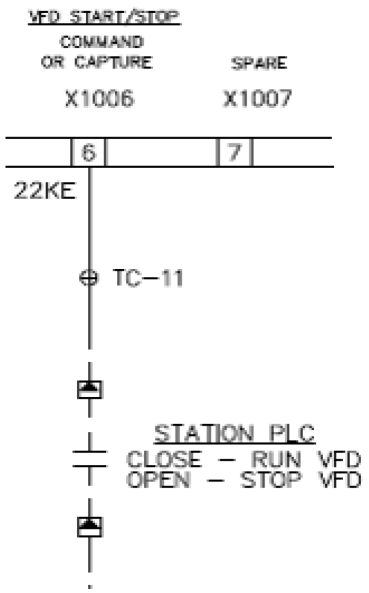


CAPTURE sequence if used:

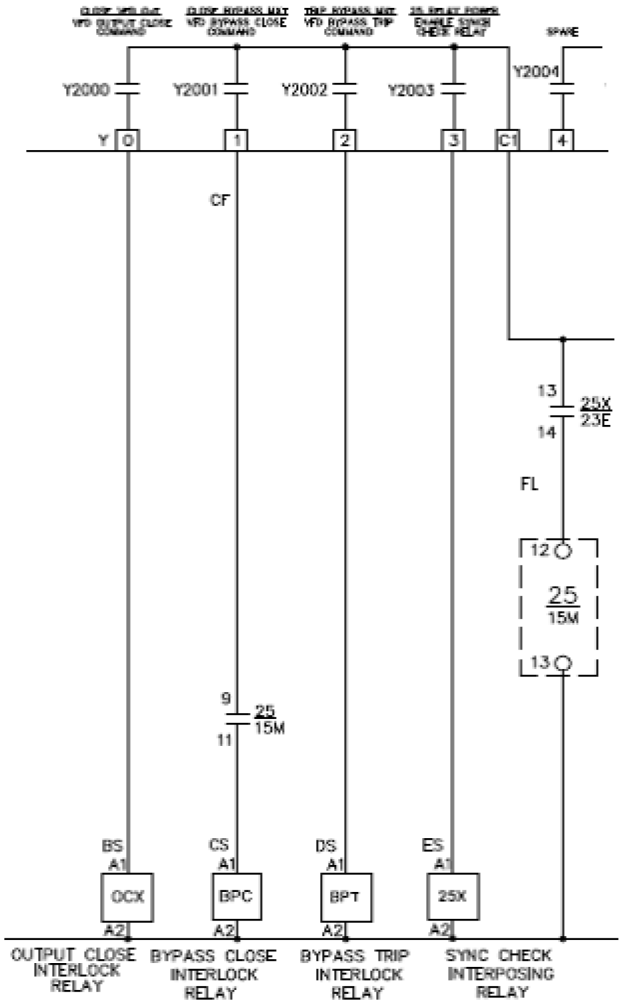
1. Station PLC makes motor selection. Motor selection is required to be energized (maintained) while the motor is operated by the ASD or in CAPTURE sequence. Motor selection can be removed after motor is stopped or transferred back to utility power.



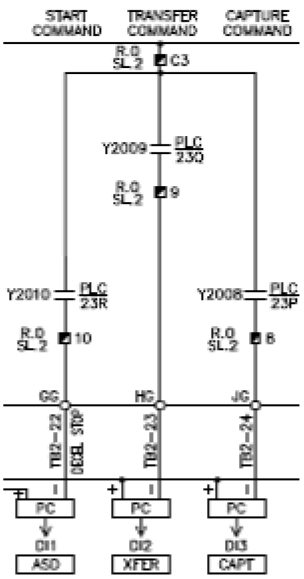
2. When the drive READY status is received, Station PLC provides Drive START command (which is the CAPTURE command).



3. ASD will check contactor status for the selected motor. If the motor is running (Bypass contactor closed), ASD will closed Drive output contactor and begin the CAPTURE sequence.

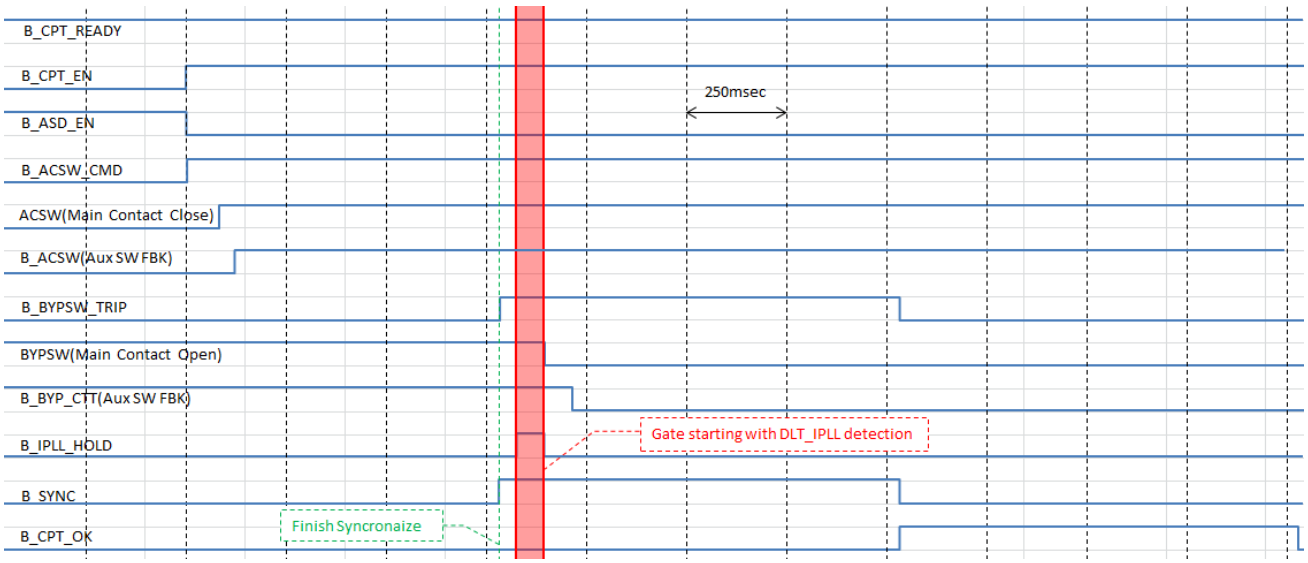


4. CAPTURE Permissive is activated by Drive PLC.

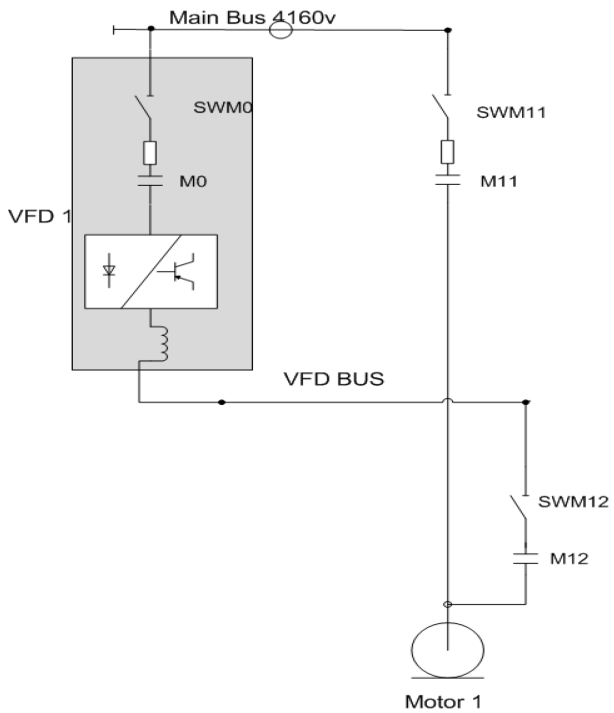


5. Bypass contactor open command is initiated by the ASD.
6. When Bypass contactor open status is received by the ASD, the Drive will begin gating IGBTs and motor is controlled by ASD.

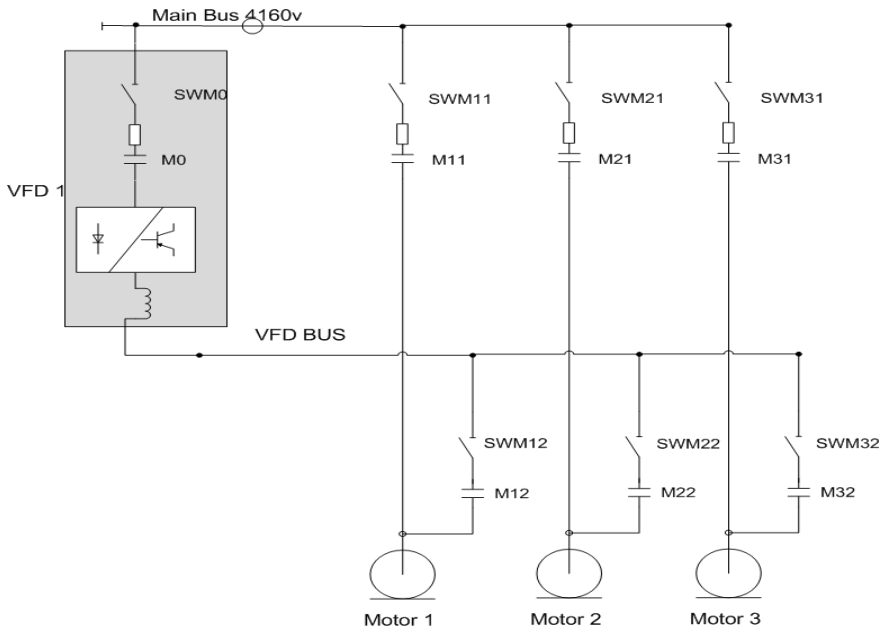
CAPTURE Timing Sequence



Single Drive / Motor Synchronous Transfer Lineup



Single Drive / Multiple Motor Synchronous Transfer Lineup



Two Drives / Multiple Motor Synchronous Transfer Lineup

Schematic below shows a typical system in which multiple motors and drives are configured for synchronizing operation. In this configuration, any motor can be connected to any drive, or to the utility source. The logic for selecting which motor and which drive are to be connected it is determined and set up in a PLC included with the drive and output switchgear.

Operation of the TRANSFER and CAPTURE is identical to the single motor description above. The proper utility-to-motor CT is selected by relay logic according to which motor is being TRANSFERED or CAPTURED from the power line. This provides complete redundancy. In the event of either of the drives being down, the opposite side drive can run all motors with the cross tie closed and the downed drive is isolated from the system.