



AC Line Voltage Considerations for the 2070 ATC Cabinet

Reliable cabinet operation under low AC Line service conditions requires special attention to specifications to ensure that the cabinet automatically returns to normal signal operation when the AC Line restores back to normal service voltages. Neither the Caltrans TSCE Specifications for the Type 170 Controller Unit and associated 332, 334, and 336 cabinets, nor the TEES Specifications for the 2070 Advanced Traffic Controller (ATC) adequately deal with this issue when a signal monitor with Red Monitoring capabilities is used.

The main issue involves selecting the correct set points for both the 2070 ATC and 2010 signal monitor in recognizing a low voltage power failure condition. For reliable operation during a brown-out low voltage condition, *the signal monitor must be the first device in the cabinet to respond to the brown-out event (i.e. enter flash mode), and the last device in the cabinet to respond to the restore event (i.e. exit flash mode)*. This ensures that the cabinet is in flash mode before any devices drop out (reset) or operate erratically due to the low voltage condition, and that all devices have (re)initialized and are ready to operate before the cabinet transfers to the signal state.

When the 2070 ATC detects a “power failure”, it responds with a reset mode where all signal outputs are disabled (dark) and the Watchdog output stops. If the 2070 ATC recognizes the brown-out before the signal monitor and goes to the reset state, the signal monitor will respond with a latched Red Fail or Watchdog fault.

The model 2070 ATC specifications for low voltage operation are as follows:

Power Failure at 92 +/- 2 Vac for greater than 525 +/- 25 ms

Power Restore at 97 +/- 2 Vac for greater than 275 +/- 25 ms

The model 210ECL monitor and 2010ECL monitor meet the following specifications for low voltage operation:

Model 210ECL

Power Failure at 92 +/- 2 Vac for greater than 82 +/- 16 ms

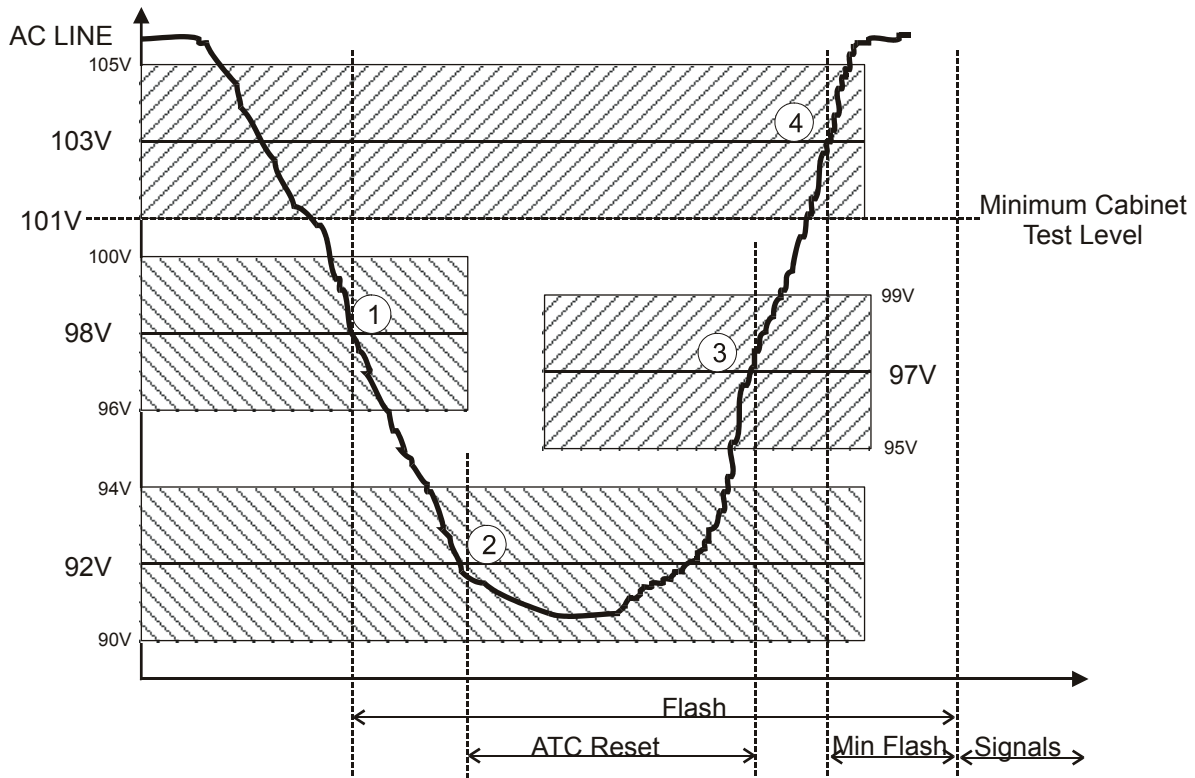
Power Restore at 98 +/- 2 Vac for greater than 82 +/- 16 ms

Model 2010ECL

Power Failure at 98 +/- 2 Vac for greater than 400 +/- 50 ms

Power Restore at 103 +/- 2 Vac for greater than 400 +/- 50 ms

A plot of AC Line service voltage versus time shows the correct response for a cabinet with a 2010ECL monitor installed. In this example the cabinet will remain in flash until the AC Line voltage is sufficient for all devices to operate correctly and then transfer to signal mode without manual intervention.



1. When the AC Line voltage drops below 98 +/- 2 Vac, the 2010ECL will place the cabinet in flash mode.
2. When the AC Line voltage drops below 92 +/- 2 Vac, the 2070 ATC goes to the Reset state. All outputs are Off and the Watchdog Output is Off.
3. When the AC Line voltage rises above 97 +/- 2 Vac, the 2070 ATC will reboot and initialize to the start-up phases.
4. When the AC Line voltage rises above 103 +/- 2 Vac, the 2010ECL will begin timing the minimum flash interval (6 seconds). At the end of minimum flash, the cabinet will return to signals mode.

If the conventional 210 specification is used, the 92 +/- 2 Vac Power Failure threshold overlaps that of the 2070 ATC. When the AC Line voltage drops into the 92 +/- 2 Vac range (94 Vac to 90 Vac), either device depending on calibration may respond to the power failure first. If the 2070 ATC responds first and goes to the Reset state, the monitor will detect a Red Fail fault and place the cabinet into a latched fault condition. A technician will be required to reset the monitor to allow the cabinet to return to signal operation.

The 2010 specification resolves this by moving the monitor Power Failure threshold up six volts to 98 Vac, thus a guard band of two volts is provided that guarantees the monitor will detect the brownout first even with worst case calibration of both devices. The 2010 specification also provides several less obvious improvements in operation during a slow AC Line brownout event:

1. The 210 specification defines a function called Watchdog Disable. This requires the monitor to disable the Watchdog monitoring function when the AC Line voltage drops below 98 +/- 2 Vac, and restore the monitoring function when the AC Line voltage rises above 103 +/- 2 Vac. This leaves the 2070 ATC watchdog output unmonitored when the AC Line voltage is between 98 Vac and 92 Vac, yet the cabinet is still

- operating in signals mode. Monitor functions should never be disabled unless the cabinet is in flash.
2. Many older flash transfer relays (FTR) will not pull-in completely until the voltage on the coil is in the 90 to 95 Vac range. Transferring to flash at 98 Vac provides better assurance that all FTRs will be solidly transferred to the flash mode (energized).

Using the 210 Power Failure specifications with a 2070 ATC can lead to unnecessary maintenance trips to reset signal monitors from a latched Red Fail fault state. The changes made to create the 2010 specifications were specifically designed to resolve this problem. The Caltrans specifications do not have to deal with this Red Fail issue since Red Monitoring is not provided in Caltrans cabinets.

Using the 2010 Power Failure specifications also means that low voltage cabinet testing specifications must be modified from the traditional 95 Vac (92 + 3 Vac) test point to ensure the cabinet is in the signal state during test. Depending on the accuracy of the test fixture, the cabinet low voltage test point should be greater than 101 Vac (98 + 3 Vac) for worst case monitors (98 + 2 Vac). The 101 Vac test point provides a 1 Vac guard band to a worst case calibrated signal monitor.