WOODWARD

Application Note 51651
(Revision -, 8/2024)
Original Instructions

Digital Valve Positioner
Unable to Pass Startup Check Issue

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Introduction

A series of Woodward valves and actuators are supported by the Digital Valve Positioner (DVP) driver. An anomaly has been discovered in the DVP software for certain valve and actuator variants that can incorrectly lead to alarms or failures being reported during the position resolver startup checks. This anomaly has been corrected in the latest version of DVP software.

Read the following sections for additional detail on the issue, symptoms, likelihood of occurrence, workarounds, software revisions, and impacted units.

Background

The DVP software performs a “startup check” sequence during initial startup of the position controller to confirm the reference point for the position sensors (resolvers). In many instances this resolver is a rotary sensor which will need to go through multiple revolutions to achieve the full range of movement. The resolver values are reported in units of percent electrical revolution (% Elec Rev), and there is a discontinuity in the resolver readings at the 99.99 ←→ 0.00% Elec Rev boundary.

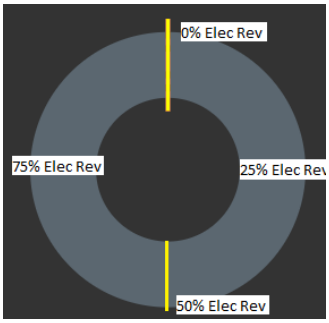

Figure 1-1. Rotary Resolver

Description of Problem

If there is no boundary crossing within the samples used to calculate the startup check resolver average, then the calculation is accurate, and there are no conditions leading to false alarms. However, if boundary crossing does occur within the samples, then the result is inconsistent, and incorrect startup check averages could lead to alarm or fault conditions. In the most severe case, the fault will keep the valve or actuator from becoming operational in position control.

Note that the startup check sequence is only run prior to the DVP position controller going online. This applies under the following conditions:

- Following a power-cycle of the DVP.
  - Depending on the valve or actuator, this may happen immediately after power-up or may wait until the user issues a Reset command to the DVP.
- Following a detected failure in the DVP, which results in the position controller being taken offline or remaining offline.
  - This requires the user to issue a Reset command to the DVP.
  - These error conditions (known as Shutdown Position or Shutdown System) are not typical errors in the system.
- Following a user request to go to the Shutdown Position state.
  - This can be sent via CANopen or via control of the External Shutdown Input signal.

Symptoms

The outward symptom which may be shown by an incorrect average is the presence of an alarm/fault. The reported alarms/faults may include one or more of the following:

- Startup Close Motor Error
- Startup Open Motor Error
- Startup Motor Direction Error
- Startup Close Motor 2 Error (if redundant motor resolvers are present)
- Startup Open Motor 2 Error (if redundant motor resolvers are present)
- Startup Motor Direction 2 Error (if redundant motor resolvers are present)
- Startup Close Shaft Error (if a shaft resolver is present)
- Startup Open Shaft Error (if a shaft resolver is present)

The most common alarm/failure reported will be (listed from most likely to least likely):

1. A resolver reporting Startup Close alarm or Startup Open alarm.
2. A resolver reporting Startup Direction alarm along with either Startup Close alarm or Startup Open alarm.
3. A resolver reporting Startup Direction alarm.

Another symptom of this anomaly is to have the alarm/fault occur and then being unable to repeat it. This is due to the very narrow window of conditions required for the resolver position to trigger this particular error. If the alarm/fault is very repetitive (perhaps 5 or more times out of 10), then it is most likely a different cause.

See the following screenshots showing several of the alarm/fault conditions mentioned. Note several details when viewing these:

- For a properly operating unit, the average values reported for redundant resolvers (i.e. Motor 1 and Motor 2) should be approximately the same.
- For each case shown, the Min Direction Startup Check value for Motor 1 and Motor 2 should be near the 99.99% ←→ 0.00% Elec Rev boundary.

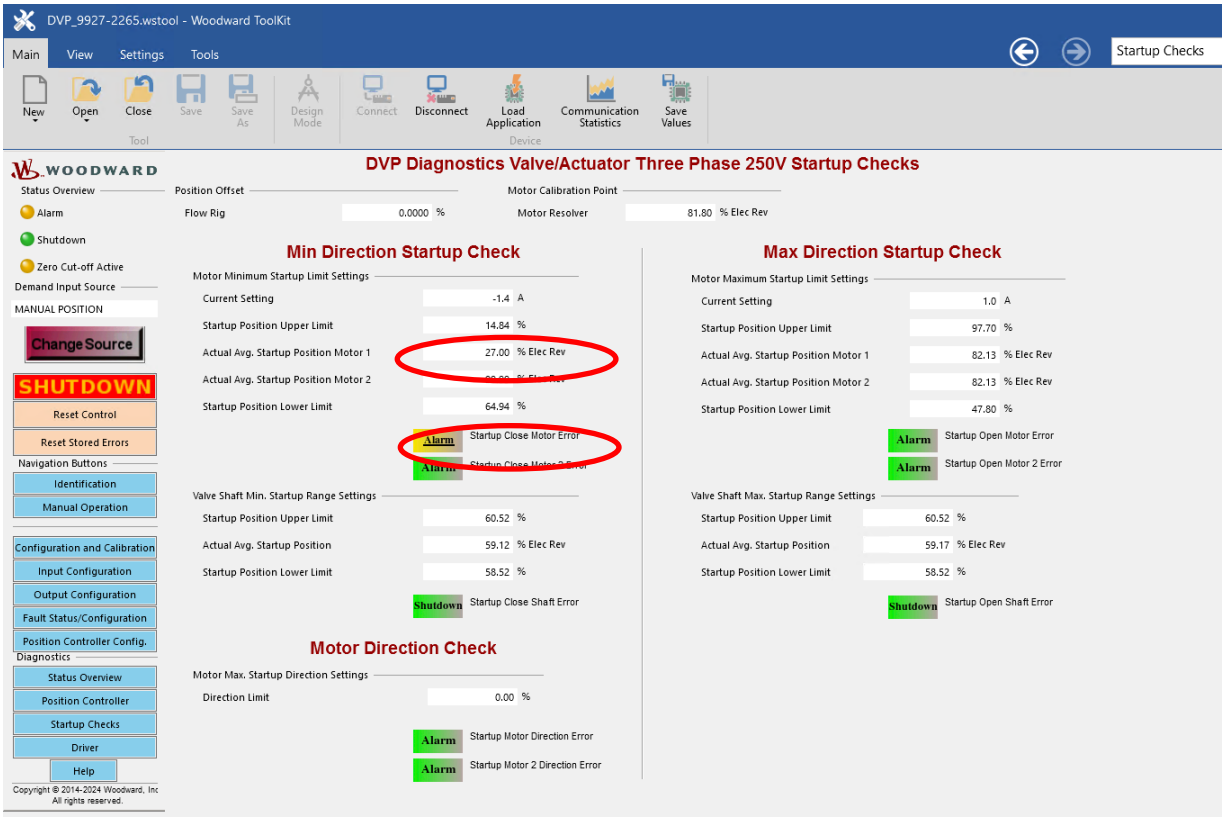

Figure 1-2. Startup Close Motor Error

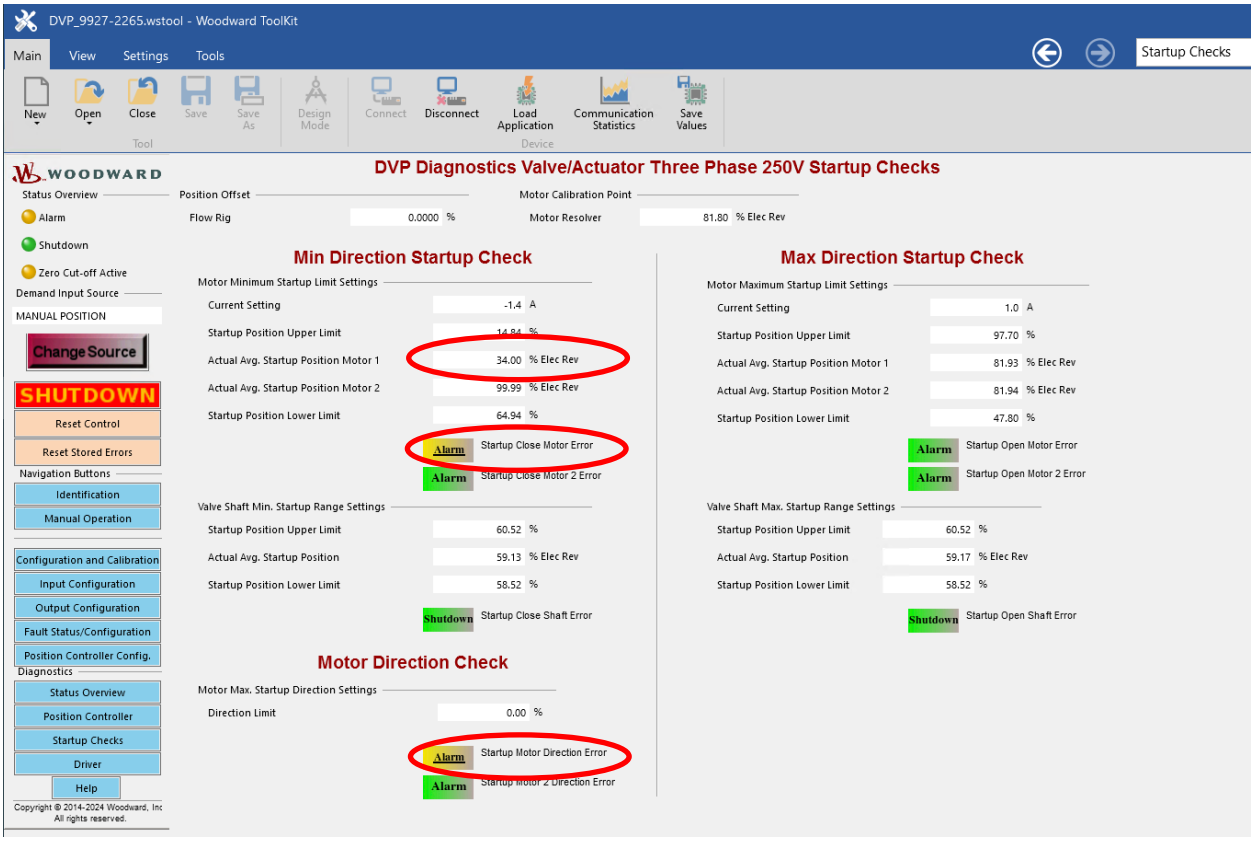

Figure 1-3. Startup Close Motor Error and Startup Motor Direction Error

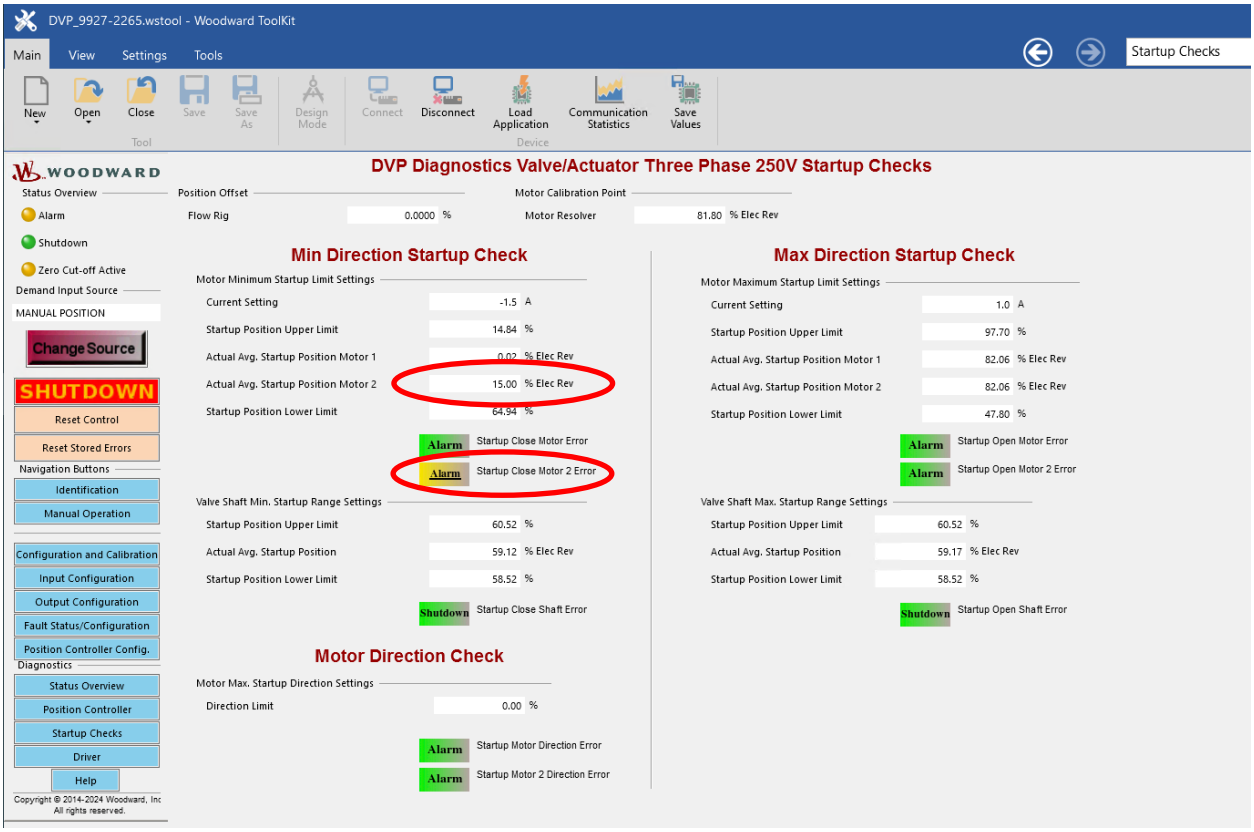

Figure 1-4. Startup Close Motor 2 Error

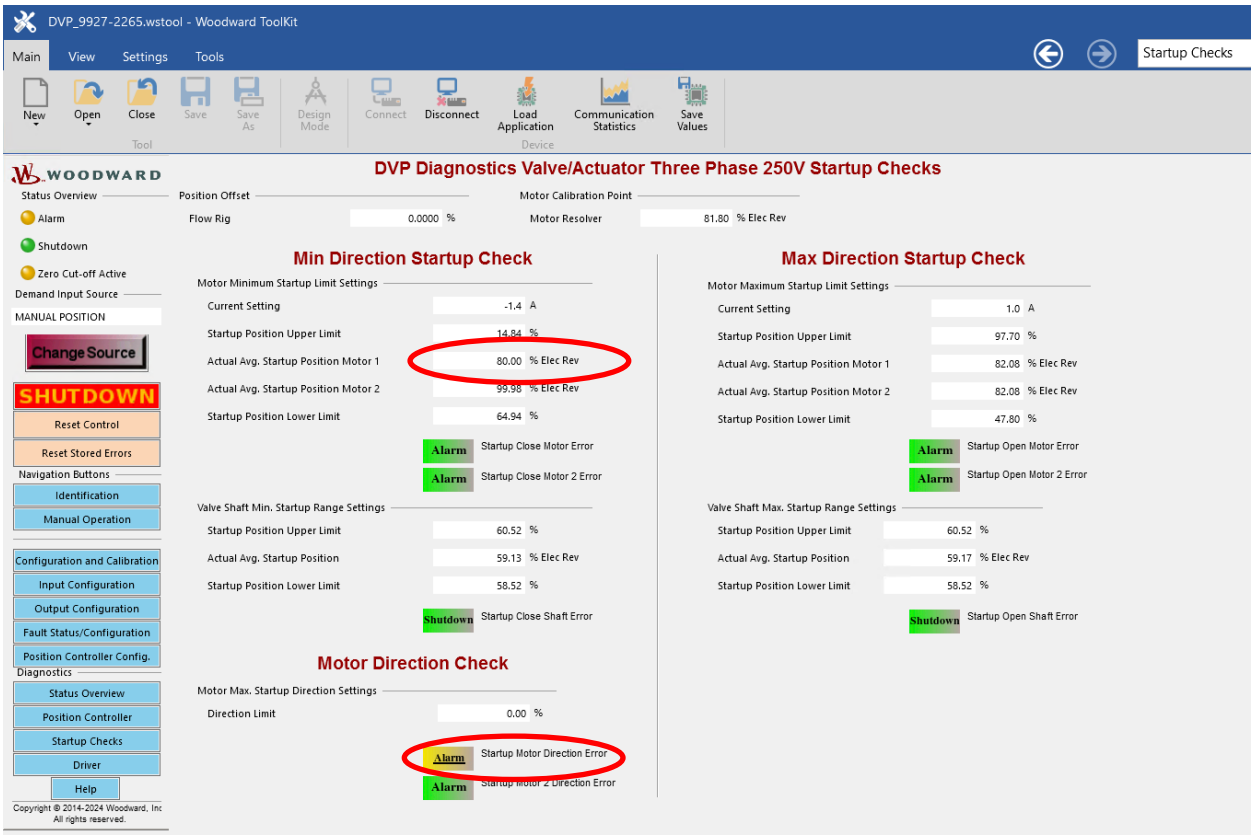

Figure 1-5. Startup Motor Direction Error

Likelihood of Encountering

This failure is very uncommon due to the narrow range of conditions required to create it. It requires a resolver to be operating right at the 99.99 ←→ 0.00% Elec Rev position during resolver data averaging and to have enough mechanical movement or resolver measurement variation to cross the 99.99 ←→ 0.00% boundary multiple times during the sampling period. Even under controlled lab conditions, the occurrence was difficult to repeat on an actual system due to typical variation of the mechanical system and measurement system.

The startup checks occur only when the DVP position controller is preparing to go from the offline to online state (see details in **Description of Problem** section).

It is most common and highly likely that this failure occurs on only one resolver within the system for a given failure. If the valve or actuator has redundant resolvers and the failure occurs on one of the redundant resolvers, then the unit will transition to the position controller being online. However, the resolver with the active alarm will remain in a faulted state and will not participate in position control operation until:

- A Reset command is issued (for the case of Startup Close or Startup Open).
- The next passing startup check (for the case of Startup Motor Direction).

Fix

The issue has been resolved in the 5418-8088A (version 6.13) DVP software. This software is available by request from Woodward.

All versions of DVP software prior to 5418-8088A contain the issue for the units identified in the **Units Impacted** section.

Workaround

There is no workaround to completely avoid the problem with older firmware.

One mitigation after failing a startup check is taking the position controller offline (see details in **Description of Problem** section) and attempting the startup checks again. This has a high likelihood of the issue not repeating since the averaging problem requires a resolver to operate in a very narrow window of values.

Units Impacted

The resolver averaging issue is only present on valves and actuators supported by the DVP and HODVP which use brushless DC (BLDC) motors. These include the following families of Woodward products:

- LMS100 (EGMV, ELMV, ELBV, EWMV)
- LESV/LESV-II (LELA/LELA II)
- 31xx (3103/3151/3171)
- GSxE
- IGV
- VSV
- ELA

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **https://www.woodward.com/support**, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

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