WOODWARD

Application Note 51552
(Revision NEW, 6/2016)
Original Instructions

AO_RM_DVR Trip Setup for Redundant/TMR Systems

Power Generation, Compression, Other

Title
Lines

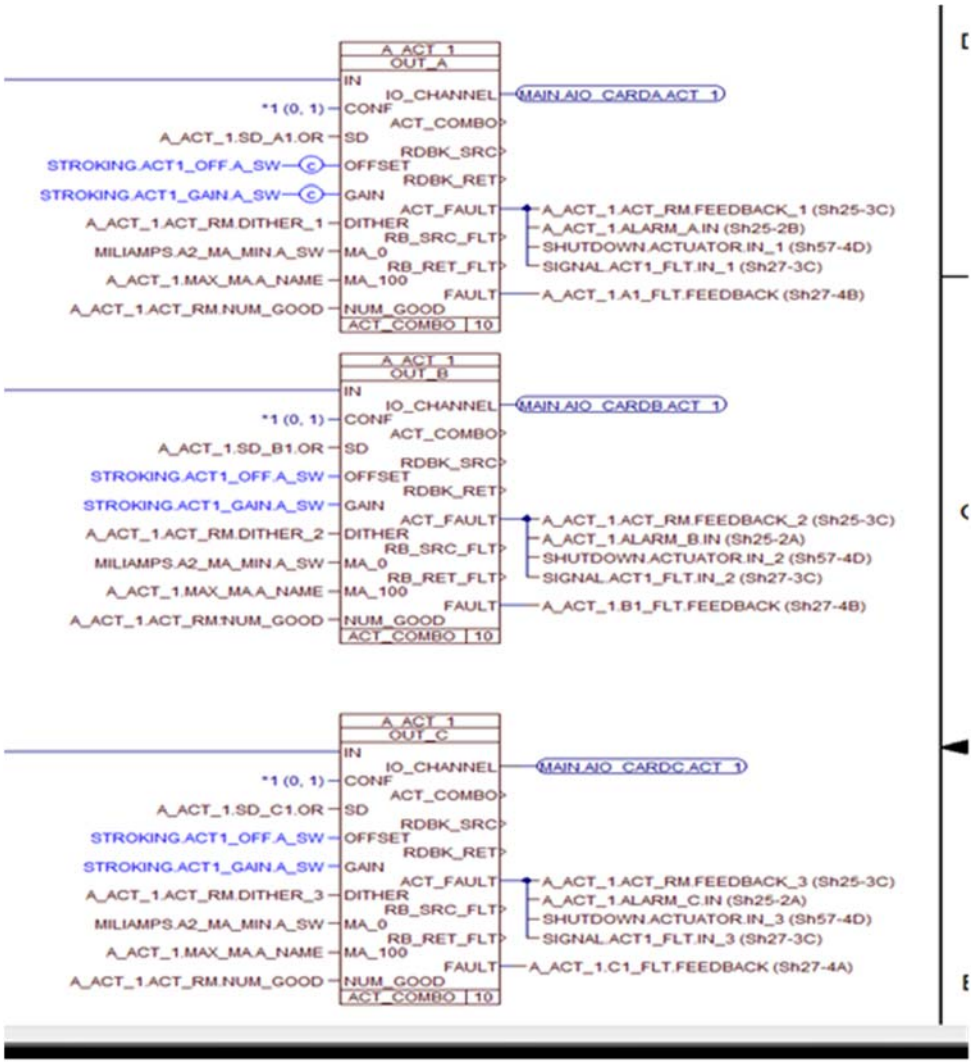
Introduction

Abstract:

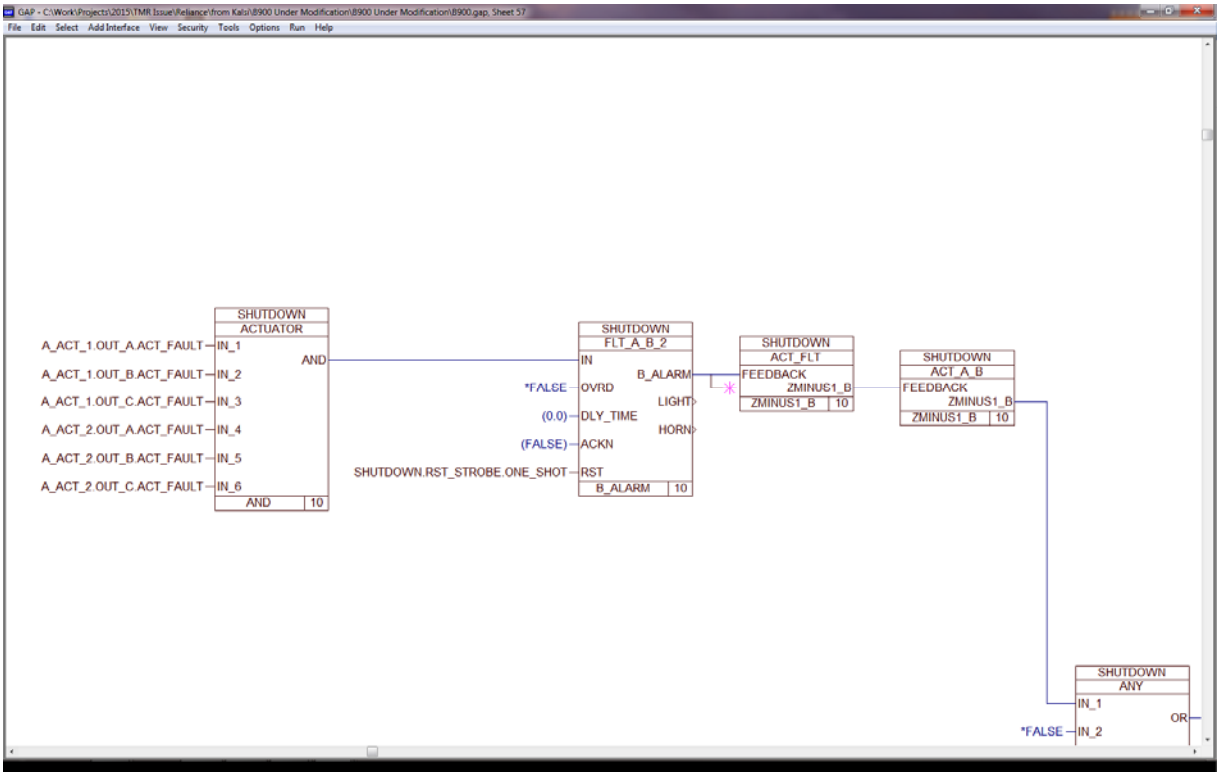
When using the AO_RM_DVR Gap Template Block, there are some scenarios that will cause a Turbine Trip if the logic is not implemented correctly. For an Actuator Failure Trip, an “OR” block looking at the Load Fault, and a compare of the Num_Good must be used for all trips. Also, an issue was found when using either coder 5.04-1 or 5.04-2, which has been corrected using coder 5.04-3.

History:

Woodward India requested assistance when one of their customers had a turbine shutdown while resetting the “B” kernal CPU in a TMR application, using coder 2.10. There was a hardware failure in the CPU, which prompted the customer to replace the CPU. Once the CPU was reset, the turbine tripped on Loss of Actuator. The trip occurred when the “ACT_FAULT” output on the “ACT_COMBO” block went true for all of the outputs. See Examples 1 and 2.



Example 1



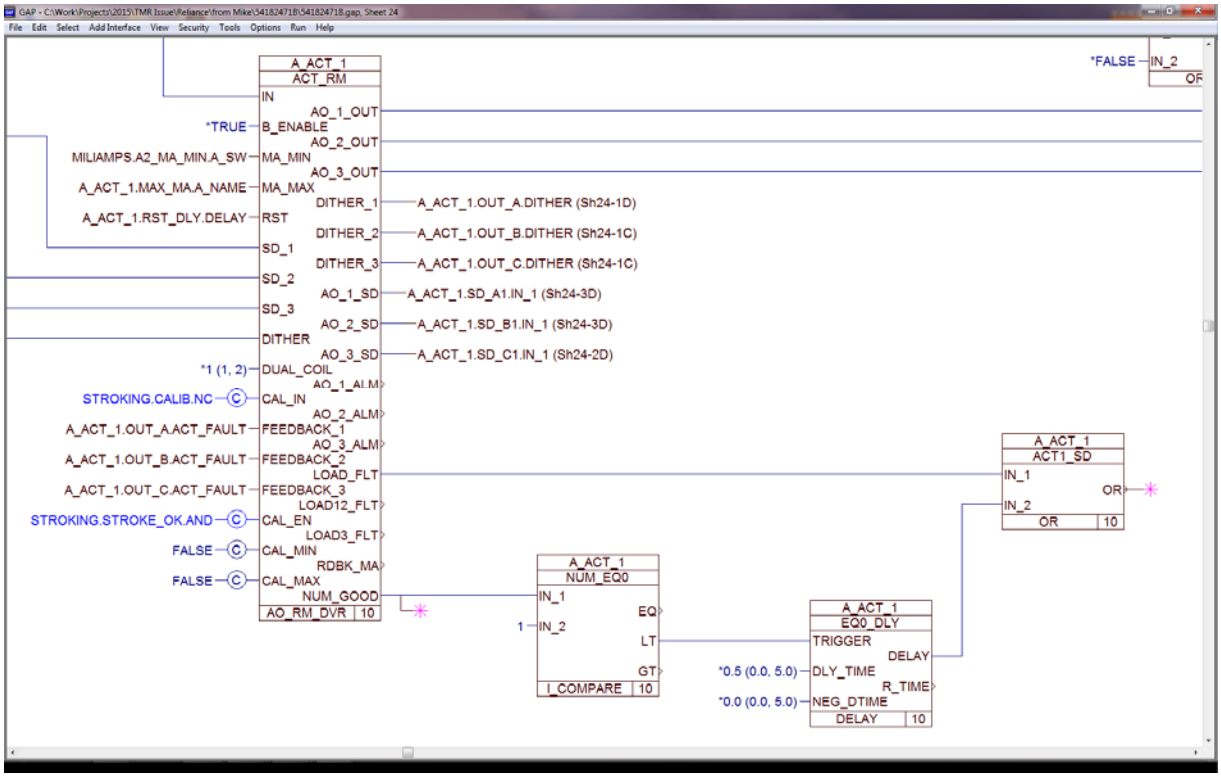
Example 2

The ACT_FAULT goes true whenever the Source and the Readback current has an error of greater than 10%. In a TMR system, if all 3 kernals are working correctly, the source current will be divided equally among 3 cards and the readback current is divided equally between 3 cards. If a CPU has failed (in I/O Lock), the source current is divided equally between 2 cards; however the readback current is still divided equally between 3 cards, as the card readback electronics are still active. Because of this difference the ACT_FAULT will go True on the Kernal with an active CPU. Once the failed CPU has been replaced, and reset, the ACT_FAULT will be true for all 3 Kernals for a few seconds, as the board diagnostics are executed. Because there will be a few seconds where all of the ACT_FAULTS will be true, this caused a Shutdown in the System. When testing the same application in Coder 5.04, the turbine would trip immediately on a CPU failure as detailed above.

In the process of testing the above issue, while using Coder 5.04-2, an issue with the backup CPU in a MicroNet Plus redundant system was found. The back-up CPU AO_RM_DVR status was not being updated, which could cause a trip if the Syscon was transferred to the Backup CPU.

Detailed Solution:

For all applications that are using the AO_RM_DVR in a TMR application, the correct logic for Actuator Shutdowns is to use an “OR” block, with the “LOAD_FLT” as one input, with the other input to the OR block being the LT output of an “I_COMPARE”, with Input 1 of the compare block being the “NUM_GOOD” field from the AO_RM_DVR, and Input 2 with a value of 1; See Example 3. The Delay block in this example is not required as part of the fix, but was implemented for testing. This delay can be implemented if wanted, to delay the trip from the Num_Good output. This example is in GAP 2.18F, as the original GAP with the issue was in GAP 2.18, however the same logic applies to GAP 3.0 applications also.



Example 3

For Redundant applications, this logic is not required, as the issue is only in TMR systems. For design consistency, this method is preferred in a redundant system, so if a software core is made, it becomes hardware independent. Coder 5.04-3, or newer, must be used in a redundant system though, as there are known issues in earlier versions of coder 5.04.

Required Action:

For all new applications, use the logic above for all actuator trips. For existing units, no action required, unless doing other software upgrades and an incorrect actuator shutdown algorithm is noticed.

We appreciate your comments about the content of our publications.

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Please reference publication 51552.

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