

False Alarm Calculations in eXpress

In 2009, DSI first introduced the ability to calculate Diagnostic False Alarm rates using STAGE, DSI’s simulation-based assessment tool. A diagnostic false alarm is a failure to a sensor or other item associated primarily with testing/diagnostics that is isolated to a fault group that also contains at least one operational item (an item that plays a functional role in the system). Ambiguity and misdiagnosis are the chief contributors to diagnostic false alarms. STAGE was thus able to determine the contribution of sub-optimal diagnostics to the system’s overall false alarm rate.

Although STAGE—because it captures how changes in maintenance impact system failures—was the ideal tool for evaluating false alarms, the resulting calculations were difficult to verify. Earlier this year, as part of the *eXpress* version 8.1 Maintenance Module, DSI introduced three new reports that evaluate diagnostic false alarms (and similar problematic scenarios) using a method similar to that used when calculating Testability statistics. Although these metrics lack the maintenance-derived nuances that inform the STAGE calculations, they benefit from being easily verified using basic equations.

The first of these reports, the **Alarms by Type Report**, lists failure modes, sorted by failure probability, in separate tables for each of the following alarm types: diagnostic false alarms, isolated diagnostic alarms, operational (true) alarms and non-alarm faults.

Summary				
Failure Modes Diagnosed: 341				
Diagnostic False Alarms: 0.817%				
Isolated Diagnostic Alarms: 2.744%				
Operational (True) Alarms: 95.433%				
Non-Alarm Faults: 1.006%				
Failure Mode Details				
Diagnostic False Alarms [4]				
##	Failure Mode (Item)	Failure Probability	Isolated Fault Group	Fault Group Severity (all phases)
1	UB-Indication of FPGA configuration done failed [UB]	0.005879	Fault Group # 93	Category III - Marginal
2	R42-Failed Open [R42]	0.000588	Fault Group # 59	Category I - Catastrophic
3	R47-Failed Open [R47]	0.000588	Fault Group # 190	Category I - Catastrophic
4	U17-False indication of over-temperature condition [U17]	0.000588	Fault Group # 190	Category I - Catastrophic
Isolated Diagnostic Alarms [24]				
##	Failure Mode (Item)	Failure Probability	Isolated Fault Group	Fault Group Severity (all phases)
1	UB-Watchdog output to master reset failed [UB]	0.005879	Fault Group # 98	Category III - Marginal
2	UB-Detect motor rotation failed [UB]	0.005879	Fault Group # 148	Category I - Catastrophic
3	UB-Detect motor position failed [UB]	0.005879	Fault Group # 148	Category I - Catastrophic
4	UB-Blue LED failed [UB]	0.000588	Fault Group # 92	Category IV - Minor

The second report, the **Alarms by Severity Report**, lists failure modes, sorted by failure probability, in separate tables based on the maximum severity (e.g., Category I - Catastrophic) of the fault group to which each failure mode is isolated.

Summary				
Failure Modes Diagnosed: 341				
Category I - Catastrophic: 1.508%				
Category III - Marginal: 1.328%				
Category IV - Minor: 0.568%				
No Effect: 0.157%				
Failure Mode Details				
Category I - Catastrophic [6]				
##	Failure Mode (Item)	Failure Probability	Isolated Fault Group	Alarm Type
1	UB-Detect motor rotation failed [UB]	0.005879	Fault Group # 148	Isolated Diagnostic Alarm
2	UB-Detect motor position failed [UB]	0.005879	Fault Group # 148	Isolated Diagnostic Alarm
3	R42-Failed Open [R42]	0.000588	Fault Group # 59	Diagnostic False Alarm
4	R47-Failed Open [R47]	0.000588	Fault Group # 190	Diagnostic False Alarm
5	U17-False indication of over-temperature condition [U17]	0.000588	Fault Group # 190	Diagnostic False Alarm
6	R45-Failed Open [R45]	0.000588	Fault Group # 114	Isolated Diagnostic Alarm
Category III - Marginal [4]				
##	Failure Mode (Item)	Failure Probability	Isolated Fault Group	Alarm Type
1	UB-Indication of FPGA configuration done failed [UB]	0.005879	Fault Group # 93	Diagnostic False Alarm
2	UB-Watchdog output to master reset failed [UB]	0.005879	Fault Group # 98	Isolated Diagnostic Alarm
3	R45-Failed Open [R45]	0.000588	Fault Group # 76	Isolated Diagnostic Alarm
4	J5-T2-RESET_T2 failed [J5]	0.000078	Fault Group # 77	Isolated Diagnostic Alarm

Finally, the **Alarm Ambiguity Report** lists relatively minor failure modes that are isolated in ambiguity with failures that have a higher severity rating—indicating areas where diagnostics can be improved to prevent unnecessary mission aborts.

Summary					
Failure Modes Diagnosed: 325					
Failure Modes Categorized: 7					
Fault Group Details					
Ambiguous Alarms per Fault Group [4]					
##	Isolated Fault Group	Failure Probability	Failure Mode Severity (all phases)	Fault Group Severity (all phases)	
1	Fault Group # 13	0.001176	No Effect	Category I - Catastrophic	
2	Fault Group # 100	0.001176	No Effect	Category I - Catastrophic	
3	Fault Group # 25	0.000588	No Effect	Category I - Catastrophic	
4	Fault Group # 108	0.000392	No Effect	Category I - Catastrophic	
Failure Mode Details					
Ambiguous Alarms per Failure Mode [6]					
##	Failure Mode (Item)	Failure Probability	Failure Mode Severity (all phases)	Isolated Fault Group	Fault Group Severity (all phases)
1	L2-Failed Open [L2]	0.001176	No Effect	Fault Group # 13	Category I - Catastrophic
2	U17-VCC load failed short to ground [U17]	0.000588	No Effect	Fault Group # 25	Category I - Catastrophic
3	U10-VREG voltage failed [U10]	0.000392	No Effect	Fault Group # 108	Category I - Catastrophic
4	U10-False indication of VREG voltage [U10]	0.000392	No Effect	Fault Group # 100	Category I - Catastrophic
5	U10-Power on reset failed to clear [U10]	0.000392	No Effect	Fault Group # 100	Category I - Catastrophic
6	U10-Detect Internal Temperature failed [U10]	0.000392	No Effect	Fault Group # 100	Category I - Catastrophic

For more details, refer to the CE-363 video—Continuing Education: False Alarms in *eXpress* and STAGE.

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Latest Software Versions

- eXpress* 8.1.1 10/25
- eXpress* Design Viewer 2.2.4 7/24
- Run-Time Authoring Tool 6.5.2 10/25
- DSI Workbench 5.4.3 11/25
- TestDRIVE 2.5.2 8/25
- STAGE Act III, Scene 1 10/25

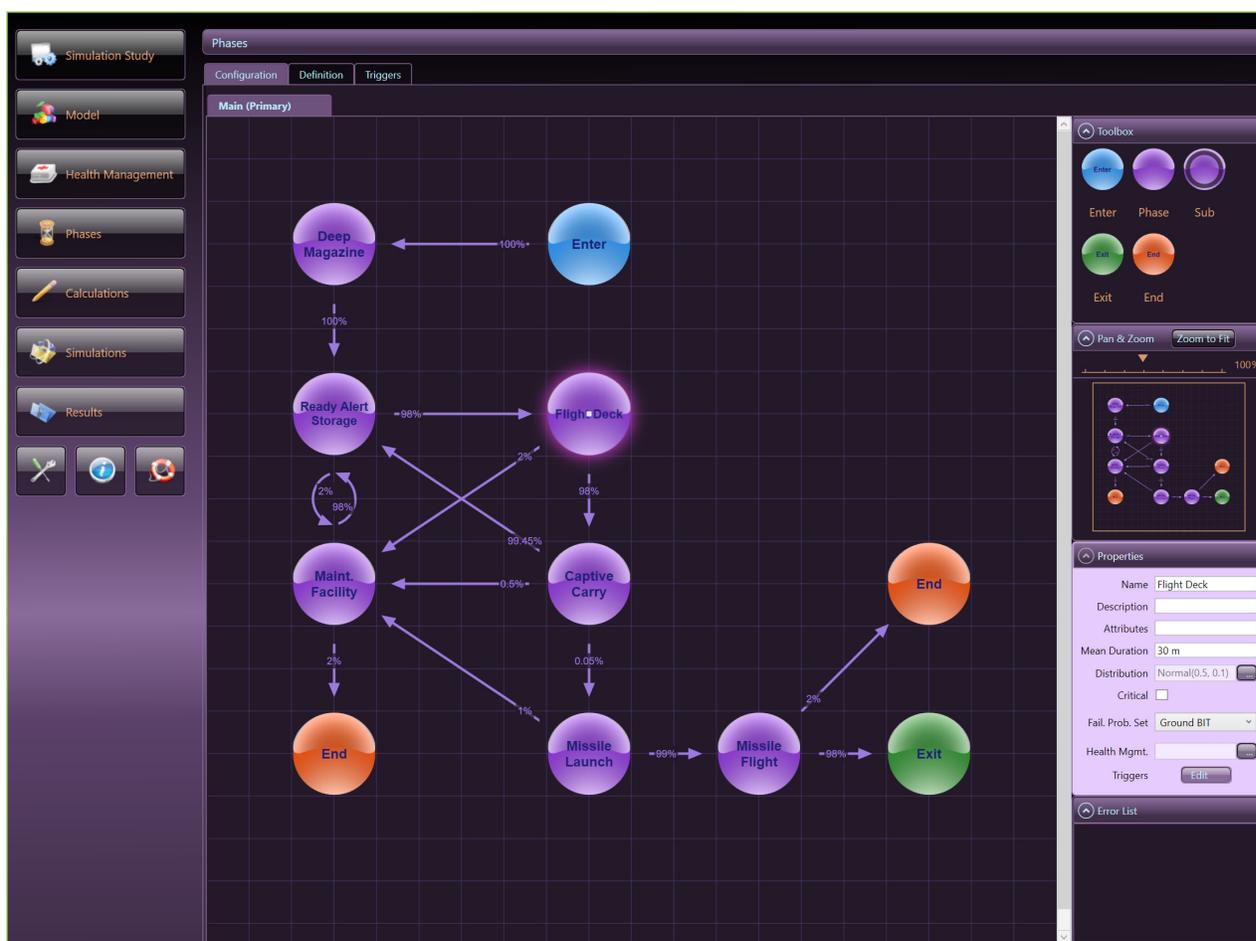
Introducing STAGE Act III, Scene 1

STAGE—DSI’s simulation-based tool for performing sustainment trade studies—now includes the ability to define phase diagrams that represent a system or device’s anticipated usage. A phase diagram in STAGE is basically a state transition diagram with simulation-specific information defined for each phase. These should not be confused with design states in *express*, which represent testable configurations of the system or device.

On the Phases panel of the software (shown below), the analyst models the system’s various phases, including the entry and exit points of the diagram. Phase diagrams can be defined hierarchically, with one diagram representing sub-phases of a phase in a higher-level diagram. The following information is included for each phase:

- phase name & description
- allowed transitions w/ probabilities
- phase duration (mean)
- phase duration (distribution curve)
- failure probability set
- health management allowed in that phase (diagnostics, prognostics, maintenance & remediation)
- critical failure flag
- associated attributes*
- triggers*

The failure probability sets consist of factors that are used to adjust the event times for simulated failures to reflect differences in failure rates within the various phases. The health management settings are used to specify whether specific diagnostic, prognostic or maintenance procedures are allowed in each phase, as well as whether remediation (repair) can be performed in that phase.

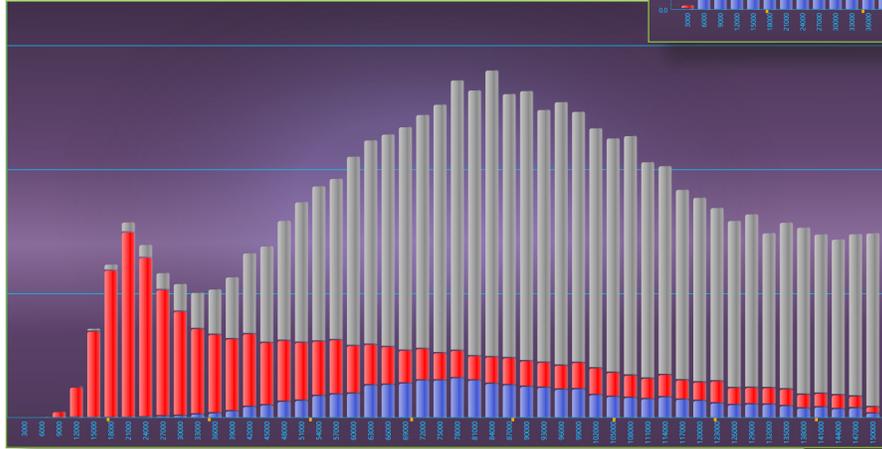
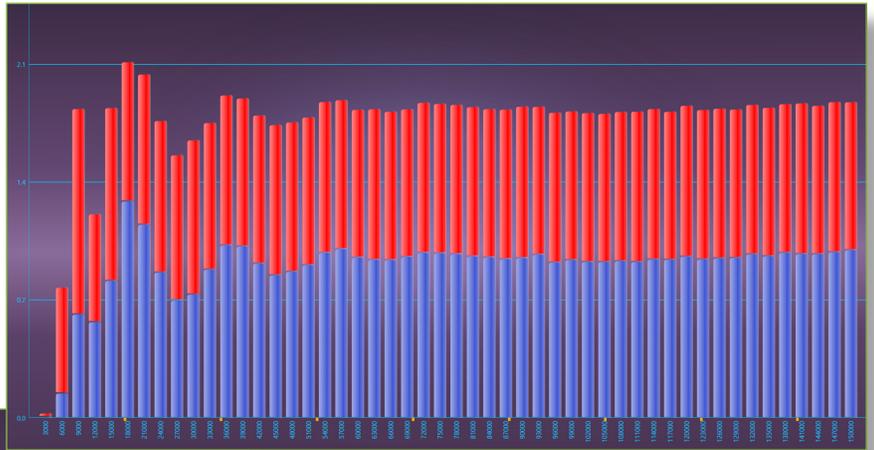


STAGE phase diagram for simulating an air-launched ballistic missile (ALBM) on board an aircraft carrier. The “Flight Deck” phase has been selected.

Phase diagrams allow STAGE to simulate behavior in calendar time rather than system time—accounting for uptime and downtime through failure probability sets—while also producing metrics that are more realistic than those derived from equation-based approaches. Moreover, STAGE calculations can shed light on aspects of system behavior that standard design assessments are unlikely to reveal.

One effect of using phase diagrams is that the faults are now only diagnosed in phases that permit diagnostics. This may result in *undiagnosed faults*, as a given simulation run can exit or time out before reaching a phase where certain faults can be diagnosed.

The chart at right shows detected (blue) and non-detected (red) faults over time in a simulation where phases are not employed. Compare this with the chart below, where phases were used. Here, faults that are not diagnosed are represented using gray bars.



In this example, the high percentage of undiagnosed faults is a red flag that should be investigated. There are a number of factors that could have contributed to this outcome. There could be faults that are most likely to occur after a point of no return, so to speak, where they are no longer able to be diagnosed. There could be faults that themselves trigger an end to a simulation run, thereby rendering themselves non-diagnosable. Or there can simply be an error in the phase diagram.

To address this issue, the first step would be to rerun the simulation, incorporating the **Failures per Phase** calculation (shown at right) and **Fault Detection per Failure Mode** calculation (shown below in report format).

In the chart at right, the colored bars represent diagnosed faults within the phase where they are *diagnosed*, whereas the gray bars represent undiagnosed faults within the phase in which they *occur*. If this chart does not reflect the way diagnostics should work, review the Health Management settings in the phase diagram for inaccuracies.



Simulation Calculation Report

Simulation Name: 7000 Iterations
Simulation Date and Time: 10/7/2025 2:00:02 PM
Simulation Mode: Monte Carlo
Simulation Length (Hours): 160000
Iterations Completed: 7000 of 7000
Simulation Seed: 14089

Fault Detection per Failure Mode (Number)

#	Failure Modes / Functions	Number of Faults (Detected)	Number of Faults (Non-Detected)	Number of Faults (Non-Diagnosed)	Totals
1	WARHEAD failed [WARHEAD]	.000	2.773	4.655	7.428
2	ROCKET MOTOR failed [ROCKET MOTOR]	.000	.727	4.089	4.816
3	FS2-Battery Power failed [FS2]	.207	.000	.487	.693
4	PS1-Battery Power failed [PS1]	.202	.000	.485	.687
5	FS2-Umbilical Power failed [FS2]	.198	.000	.462	.660
6	PS1-Umbilical Power failed [PS1]	.197	.000	.454	.651
7	PS3-Battery Power failed [CONTROL ACTUATORS]	.175	.000	.453	.628
8	PS3-Umbilical Power failed [CONTROL ACTUATORS]	.167	.000	.413	.580
9	SEEKER-SEEKER DATA failed [SEEKER]	.078	.000	.239	.317
10	SEEKER-Configuration failed [SEEKER]	.075	.000	.238	.313
11	SEEKER-PI::SEEK TAR DATA failed [SEEKER]	.075	.000	.231	.306
12	Failure of directional data RF signal. [DIRECTIONAL ANTENNA]	.001	.000	.004	.005
13	Failure to read/write to targeting processor. [DIRECTIONAL ANTENNA]	.001	.000	.003	.004
14	IGU-Startup Configuration failed [INERTIAL GUIDANCE UNIT]	.001	.000	.002	.003
15	Failure at PI of rocket motor fire command to eISD. [CONTROL PROCESSOR]	.000	.000	.002	.002
16	IGU-PI::IGU DATA failed [INERTIAL GUIDANCE UNIT]	.001	.000	.001	.002
17	Failure of startup configuration. [DIRECTIONAL ANTENNA]	.000	.000	.001	.001
18	TARGET ID PROC-PI::TAR_SEEK DATA failed [TARGETING PROCESSOR]	.000	.000	.000	.000
19	GUID_CONT INTERFACE-PI::TAR_SYS_TIME failed [GUIDANCE INTERFACE]	.000	.000	.000	.000
20	Failure of eISD to detect RELEASE CONSENT. [ROCKET MOTOR]	.000	.000	.000	.000
21	Failure of RF test pattern. [DIRECTIONAL ANTENNA]	.000	.000	.000	.000
22	TARGET ID PROC-PI::TAR_DIR_DATA failed [TARGETING PROCESSOR]	.000	.000	.000	.000
23	GUID_CONT INTERFACE-PI::INT_TAR_DATA failed [GUIDANCE INTERFACE]	.000	.000	.000	.000
24	CONTROL PROCESSOR-Environmental Timer 1 Elapsed. failed [CONTROL PROCESSOR]	.000	.000	.000	.000
25	CONTROL PROCESSOR-Warhead Armed failed [CONTROL PROCESSOR]	.000	.000	.000	.000
26	Failure at PI to detect release consent. [CONTROL PROCESSOR]	.000	.000	.000	.000
27	Failure at PI of GUIDANCE BAT_SQUIB output. [CONTROL PROCESSOR]	.000	.000	.000	.000
28	Failure at PI of CA_BAT_SQUIB output. [CONTROL PROCESSOR]	.000	.000	.000	.000
29	Failure at PI to detect umbilical power good. [CONTROL PROCESSOR]	.000	.000	.000	.000
30	Failure to detect control battery has been squibbed. [CONTROL PROCESSOR]	.000	.000	.000	.000
31	CONTROL BATTERY-BAT POWER failed [CONTROL BATTERY]	.000	.000	.000	.000
32	CONTROL MB-J9:WDL POWER failed [CONTROL MB]	.000	.000	.000	.000
33	WDL-Startup Configuration failed [WEAPON DATA LINK]	.000	.000	.000	.000
34	UMBILICAL-1553 BUS failed [UMBILICAL]	.000	.000	.000	.000
35	UMBILICAL-1553 BUS Out failed [UMBILICAL]	.000	.000	.000	.000
36	UMBILICAL-UMB POWER failed [UMBILICAL]	.000	.000	.000	.000
37	UMBILICAL-UMB RELEASE CONSENT failed [UMBILICAL]	.000	.000	.000	.000

If the Health Management settings appear to be correct, the next step would be to determine which specific faults are not being diagnosed. The report shown at left lists all failure modes, sorted (in this case) by the average number of times per simulation run that each failure mode remains undiagnosed.

In this example, there are two failure modes that remain undiagnosed frequently enough to warrant further attention. Review the failure probability sets (and the phases to which they are assigned) to determine where these failures *should* be most likely to occur. Then trace the transitions downstream from these phases, looking to see if there is a likely reason why a simulation run might end prior to the faults being diagnosed. What you discover may surprise you!

ISDD Training Subscription What's NEW for 2026?

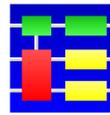
DSI now includes “Virtual Coaching” sessions with each ISDD Training Subscription. Subscribers can receive up to 3-hours/month of expert diagnostic engineering assistance for individuals or groups in their organization. This Virtual Coaching, which can occur either once or twice per month, is conducted via a privately scheduled web meeting for the organization’s group members. In some cases, an NDA may need to be arranged in advance, depending on the nature of the requested assistance. “Virtual Coaching” sessions can be used to

- bridge the gap between training and real-life projects
- refresh your knowledge of infrequently used features
- guide you through tricky modeling scenarios
- assist in the digital integration of diagnostic engineering
- introduce your team to advanced, up-to-date, and highly efficient methods used by DSI for its own contract work

Yes, you read that correctly. DSI also provides modeling & analysis services and can support your team on contract. With decades of diagnostic engineering experience, it helps to have DSI on board—if not by doing the actual work, then by helping you work much more efficiently.

Of course, this is all in addition to your subscription’s current benefits—free admission to all scheduled training courses & access to the Continuing Education archive.

Recent Software Releases



eXpress
Version 8.1.1

FTA Module Now Automatically Included
Available Capella to eXpress Translation



RTAT
Version 6.5.2

Now with Automated View Mapping



DSI Workbench
Version 5.4.3

Now with TCP/IP Interface



STAGE
Act III, Scene 1

Now with Mission Phases

Coming Up...

- **New Redline Module for the eXpress Design Viewer**
- **Integrated Comment Viewing within eXpress**
- **Instruction on SysML to eXpressML Conversion**
- **eXpress User’s Group (May, 2026)**

Schedule of Events

Course Number	Prerequisite	Description	Dates	Location	POC
CE-363	none	Continuing Education: False Alarms in eXpress and STAGE	December 9, 2025 One 90-minute session	Virtual: Webex	info@dsintl.com
CE-364	none	Continuing Education: Subsets & Diagnostic Analysis in eXpress	January 27, 2026 One 90-minute session	Virtual: Webex	info@dsintl.com
TLS-100	2 hours home study prior to first session (video)	System Diagnostics Concepts and Applications Basic Modeling & Introduction to Testing	Starting February 2, 2026 Eight 4-hour sessions (Mon-Thu for 2 weeks)	Virtual: Webex In Person: Orange, CA	info@dsintl.com
CE-365	none	Continuing Education: The Redline Module & eXpress Comment Viewer	February 24, 2026 One 90-minute session	Virtual: Webex	info@dsintl.com

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