Viking Motorsports Digital Dash

Test Plan

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V 1.2

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Objectives

1.1. Purpose

This document describes the plan for testing the prototype of the Viking Motorsports Digital Dash. This Test Plan document supports the following objectives:

- Identify existing project information and the software and hardware that should be tested.
- List the recommended test requirements (high level).
- Recommend and describe the testing strategies to be employed
- Identify the required resources and provide an estimate of the test efforts.
- List the deliverable elements of all tests.

1.2. Scope

This test plan describes the integration and system tests that will be conducted on the Viking motorsports digital dash following the integration of subsystems and components identified in the Design Considerations for prototyping document [1].

The purpose of this test plan is to test the feasibility and performance of the Digital Dash. It is critical that all subsystems be tested before integration into the system so as to ensure a proper user experience when using the digital dash is integrated into racing vehicle.

The following modules and interfaces will be tested:

- CAN message interpretation
- Data transmission to LCD
- GUI on LCD screen

Critical performance measures to test are:

- Minimal time to capture and interpret CAN data
- Time to display data on LCD screen after data interpretation
- Initialization time before the digital dash is ready to use

1.3. References

1. Design Considerations, Version 1.0
2. Digital Dash for an Electric Race Car

2. Requirements for Test

The lists below identify items (functional requirements, non-functional requirements and use cases) that have been targeted for testing. This listing represents <u>what will</u> be tested.

2.1. Function Testing

- Project requirements: The system must be powered by a 12V source
- Data from CAN network is being relayed to Arduino Due for analysis.
- Data from Arduino Due is being sent to LCD display.
- Data is being properly interpreted and displayed in GUI on LCD display.

2.2. User Interface Testing

- LCD screen must be viewable in sunlight.
- Project requirements: "The digital dash should be easily readable, big fonts, non-cluttered display."
- The following variables must be displayed on the LCD screen

  - Main battery voltage
  - PMI100 temperature
  - Max Cell temperature

- The following Warnings must be displayed on the LCD screen

  - Main battery voltage low
  - PM100 temperature high
  - Max cell temperature high

- The following errors must be displayed on the LCD screen

  - Battery voltage below limit
  - PM100 temperature above limit
  - Max cell temperature above high
  - BMS error
  - Insulation Monitoring Device error
  - PM100 error

2.3. Performance Testing

- Project requirements: "The unit must boot up in less than 30 seconds."

2.4. Load Testing

- Verify system response when CAN network heavily loaded

2.5. Stress Testing
None.

2.6. Ruggedized Testing

- Requirements Document: "The unit must be weatherproof." [2]
- Ruggedized to survive one season of racing.

3. Test Strategy

The test strategy is the recommended approach to test the hardware and software. The previous section described what will be tested. This section describes how it will be tested.

3.1. Testing Types

3.1.1. Function Testing

The goal of these tests is to verify proper data acceptance, processing and transmission. This testing is based on black and white box techniques. These tests are to check that modules can handle typical situations.

Test Objective:	• Ensure proper data entry and processing and transmission.
Technique:	• Execute each use case, case flow, or function, data, to verify the expected results occur when valid data is used.
Completion Criteria:	• All planned tests have been executed. • All identified defects have been addressed.
Special Considerations:	• N/A

3.1.2. User Interface Testing

User Interface testing verifies a user's interaction with the software. The goal of this testing is to ensure the UI provides appropriate feedback.

Test Objective:	• Verify the following: Ensure LCD screen displays information properly on the screen and is visible to the driver. • Verify that screen is readable in sunlight
Technique:	• Predefined messages are broadcast over the CAN network and the corresponding information should be displayed onto the screen • Take unit outside and see if screen is readable
Completion Criteria:	• All user interface modules functioning properly • All identified defects have been addressed
Special Considerations:	• If visibility of screen in sunlight is sub-par a new type of screen will need to be sourced and all interface testing will have to be repeated.

3.1.3. Performance Testing

Performance testing measures the transaction time and other time sensitive requirements. The goal of performance testing is to tune the system to ensure that interaction with the system is not excessively slow and doesn't use excessive energy.

Test Objective:	• Validate System Response time for designated transactions.
Technique:	• Measure the time it takes to perform predetermined operations to ensure they complete within a satisfactory time range.
Completion Criteria:	• Completion of operation is found to be satisfactory based on predetermined time range
Special Considerations:	• N/A

3.1.4. Stress Testing

This section is not applicable to test the Digital Dash prototype.

3.1.5. Load Testing

Load testing measures the ability of the system to function properly under different workloads. The goal of the load testing is to determine and ensure the system functions properly beyond the expected maximum workload.

Test Objective:	• Validate System Response time for designated operations.
Technique:	• Saturate CAN network with data to determine if data can properly be captured and processed.
Completion Criteria:	• Data still properly displayed on screen without system locking up or becoming unusable.
Special Considerations:	• NA

3.1.6. Ruggedness Testing

Ruggedness testing verifies the operation of the unit while meeting Formula SAE Rules requirements and sponsor design requirements.

Test Objective:	• Verify unit adheres to requirements of Formula SEA Article 7 EV7.3.3 • Ensure meets any additional ruggedness requirements
Technique:	• Physical tests to ensure that enclosure can function after being exposed to water for 240 seconds
Completion Criteria:	• System is still operational after all tests have been completed.
Special Considerations:	• Exposed to water means rain like conditions not immersion

4. Testing Equipment

Equipment needed to carry out testing.

- Windows compatible PC
- Viking Motorsports electric race car
- EVCU programming software
- Spray hose

5. Resources

This section presents the recommended resources for testing the Digital Dash prototype.

Human Resources		
Role	**Minimum Resources Recommended**	**Specific Responsibilities/Comments**
Test Designer	Chad Thueson	Identifies, prioritizes, and implements test cases Responsibilities: Generate test plan

System Testers	Chad Thueson, Sean Kppenhoffer, Jaime Rodriquez, Noah Erickson, Rishal Dass	Executes the tests
		
		Responsibilities:
		
		  Execute tests
		  Log results
		  Recover from errors
		  Document defects

Designer	Chad Thueson	Identifies and defines the operations, attributes, and associations of the test classes
		
		Responsibilities:
		
		  Identifies and defines the test class(es)
		  Identifies and defines the test packages

Implementer	Chad Thueson	Implements and unit tests the test classes and test packages Responsibilities: Creates the test classes and packages implemented in the Test Suite.

6. Appendix Test Record Sheets

6.1. Functional Test Cases

Test Writer: Chad Thueson				
Test Case Name:	Power ON test		Test ID#	Pow-ON
Description:	Ensure system powers on when 12 power source is applied			
Tester Information				
Name of Tester:			Date :	
Hardware version:			Time:	
Setup:	After all dependent modules are implemented, install into electric race car and ensure system powers up when 12v source has been applied.			

Test		Pass	Fail	Comments
1	System powers on with 12v source			

Test case for Power on

Test Writer: Chad Thueson				
Test Case Name:	Data from CAN network to uP		Test ID#	CAN - uP
Description:	Data is being captured from the CAN network and being captured by the uP			
Tester Information				
Name of Tester:			Date :	
Hardware version:			Time:	
Setup:	Program the arduino due to broadcast a message on CAN bus 0 and have it be received on CAN bus 1. Have the program display the message out to the serial monitor if message is received on Can 1.			

Test		Pass	Fail	Comments
1	Message capture from CAN to uP successful			

Test case for CAN to uP

Test Writer: Chad Thueson				
Test Case Name:	Data from uP to LCD over serial		Test ID#	uP -LCD
Description:	Data is being transmitted from uP over serial to LCD			
Tester Information				
Name of Tester:			Date :	
Hardware version:			Time:	
Setup:	Program arduino to send a message out over serial. Message should be displayed on serial monitor if succesful.			

Test		Pass	Fail	Comments
1	Message is being sent over serial			

Test Case for uP to LCD

6.1 cont.

Test Writer: Chad Thueson						
Test Case Name:		Display data on LCD Screen		Test ID#		Data-LCD
Description:		Ensure data being sent to LCD is being displayed properly				
Tester Information						
Name of Tester:				Date :		
Hardware version:				Time:		
Setup:		Can be performed in conjunction with uP to LCD over serial test. Program arduino due to transmit a message to the lcd and have it be displayed				
Test				Pass	Fail	Comments
1		Message from Due being displayed on LCD screen				

Test Case for displaying data on LCD screen

6.2. User Interface Test Cases

Test Writer: Chad Thueson						
Test Case Name:		Required Variables to be displayed		Test ID#		Disp-Var
Description:		Ensure that the required data is being displayed on the screen				
Tester Information						
Name of Tester:				Date :		
Hardware version:				Time:		
Setup:		Can be performed when all submodules have been integrated into system. Install digital dash system into electric race car and power it up. After initialization there should be specific variables displayed on the screen.				
Test				Pas	Fail	Comments
1		Main Battery Voltage displayed				
2		PM100 temperature displayed				
3		Max Cell temperature				

Test Case for required variable

Test Writer: Chad Thueson						
Test Case Name:		Required Warnings to be displayed		Test ID#		Disp-Var
Description:		Ensure that specific warnings are displayed on the screen				
Tester Information						
Name of Tester:				Date :		
Hardware version:				Time:		
Setup:		Create a small CAN network consisting of Digital Dash and a laptop. Using software on the laptop, broadcast warning messages on the CAN network. These warnings should be captured by the digital dash and displayed				
Test				Pas	Fail	Comments
1		Main Battery Voltage low displayed				
2		PM100 temperature high displayed				
3		Max Cell temperature high displayed				

Test case for warnings displayed

6.2 cont.

Test Writer: Chad Thueson				
Test Case Name:	Required Errors to be displayed		Test ID#	Disp-Err
Description:	Ensure that specific warnings are displayed on the screen			
Tester Information				
Name of Tester:			Date :	
Hardware version:			Time:	
Setup:	Create a small CAN network consisting of Digital Dash and a laptop. Using software on the laptop, broadcast warning messages on the CAN network. These warnings should be captured by the digital dash and displayed.			

Test		Pass	Fail	Comments
1	Battery Voltage below limit			
2	PM100 temperature above limit			
3	Max Cell temperature above limit			
4	BMS error			
5	Insulation monitoring device error			
6	PM100 error			

Test case error display

Test Writer: Chad Thueson				
Test Case Name:	Screen Viewing		Test ID#	Scr-View
Description:	Determine if information on screen can be viewed when outdoors in sunlight			
Tester Information				
Name of Tester:			Date :	
Hardware version:			Time:	
Setup:	Power up system and have it display information on screen. Take the system outside and determine if information is still viewable			

Test		Pass	Fail	Comments
1	Data viewable while outdoors			

Test case for screen viewing in sunlight

6.3. Performance Test Case

Test Writer: Chad Thueson				
Test Case Name:	Boot Time		Test ID#	Boot-time
Description:	Time it takes Digital Dash to initialize			
Tester Information				
Name of Tester:			Date :	
Hardware version:			Time:	
Setup:	Can be done in conjunction with Power on test. After power has been supplied to the Digital Dash record time it takes for initialization			

Test		Pass	Fail	Comments
1	Does Digital Dash take less than 30 sec to initialize			

Test case for system boot time

6.4. Load Test Case

Test Writer: Chad Thueson				
Test Case Name:	High Load		Test ID#	High-Id
Description:	Ensures that Digital Dash will function when multiple messages are relayed to it			
Tester Information				
Name of Tester:			Date :	
Hardware version:			Time:	
Setup:	Can be done in conjunction with warning or error user interface tests. Create a large number of messages that the dash needs to display and determine if system performance degrades (error message or warning missed) or freezes.			

Test		Pass	Fail	Comments
1	Digital Dash displays all errors and warnings			
2	Digital Dash doesn't freeze during high load			

Test case high load

6.5. Ruggedness Test Case

Test Writer: Chad Thueson				
Test Case Name:	Ruggedness		Test ID#	Rugg
Description:	Ensure Digital Dash complies with SEA article 7 EV 7.3.3 and any ruggedness requirements			
Tester Information				
Name of Tester:		Date :		
Hardware version:		Time:		
Setup:	Using a hose simulate possible rain fall onto Digital Dash enclosure. After exposure to water for 240 seconds power Digital Dash up (make sure water has been dried from all surfaces) to ensure it is still functional. Also perform number of vibration and shake tests to ensure robustness of system			

Test		Pass	Fail	Comments
1	Digital Dash powers on after being submitted to rain water			
2	Shake Digital Dash make sure all components are secured then test power on			
3	Place digital dash loose in car foot well and drive around to test against vibration test power on			

Test case for ruggedness/robustness