System Design Validation Test Plan

Overview

- Data bus timing - Timing samples will be taken from the E-Plex data bus at various points of the system to verify that communication is optimal.
- Low voltage - The voltage will be set to the recommended low voltage requirements to verify that the system still operates properly.
- Inrush - Tests will be done on each load suspected of exceeding the limitations of the module. Limitation is dependent on the module and leg driving the load.
- Lock rotor - All motors will be lock rotor tested to verify that the fly back voltage does not exceed the 40V threshold.
- Individual short circuit -
    1. Verify that each individual load, when shorted, does not exceed the fly back voltage threshold of 40V. All other loads will not be powered.
    2. Verify that each individual fused load, which is not part of the E-Plex system but is powered from the same power bus as the E-Plex system, does not exceed the fly back voltage threshold of 40V. All other loads will not be powered.
- Individual load - Verify that each individual load, one at a time, is powered and operating properly.
- All loads - Verify that every load is powered and operating properly.

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Data Bus Timing

Samples of the data bus should be taken from various points of the system with a scope, preferably the longer runs. Then the timings from the sample need to be within the restraints below.

When the E-Plex output turns on in the 400ECM and it first shows signs of rising is 3.0us, with 7.2us until it reaches V+.

Streaming Ack Pulse = 2.5V (approx)

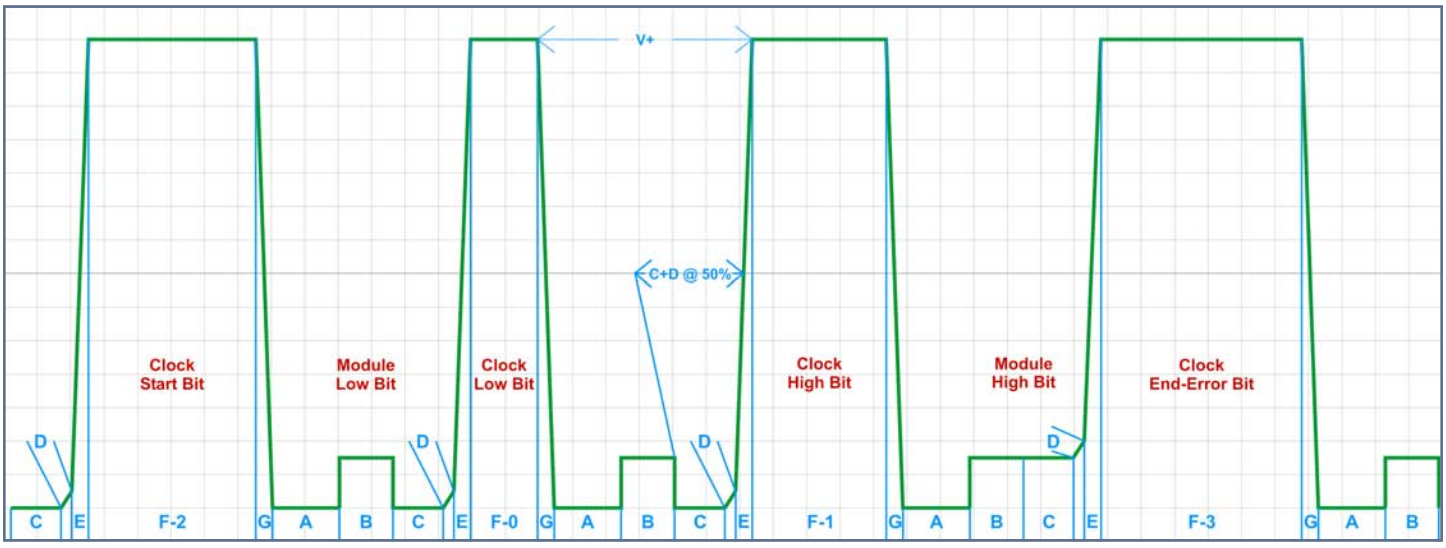
C Time from falling edge of ack pulse to first visible indication of rising edge of clock pulse

3.5us	BAD	4.4us	GOOD
3.6us	BAD	4.6us	GOOD
3.8us	BAD	4.8us	GOOD

Ack pulse must be completely low at least 4us before E-Plex starts rising (C)

On a high bit, the time from when E-Plex high bit is turned on until when ack bit is no loger detected: 3.8us

C+D (Min) 6us From falling edge of small ack pulse to the 50% point of the rising edge



SPEC 4

TIME	MIN	NOMINAL	MAX	MEASURED
A		10 µs		
B		8 µs		
C		7.5 µs		
C + D @ 50%	6 µs	10 µs		
D		1.6 µs		
E		3 µs		
F - 0 Low		20 µs	30 µs	
F - 1 High		40 µs	50 µs	
F - 2 Start		60 µs	70 µs	
F - 3 End Error		80 µs	90 µs	
G		5 µs		

LENGTH	CURRENT LIMIT	COMMENTS
50 m	800 mA	1 µs of stretch per 100 mA at 50 m (approx)

SPEC 5

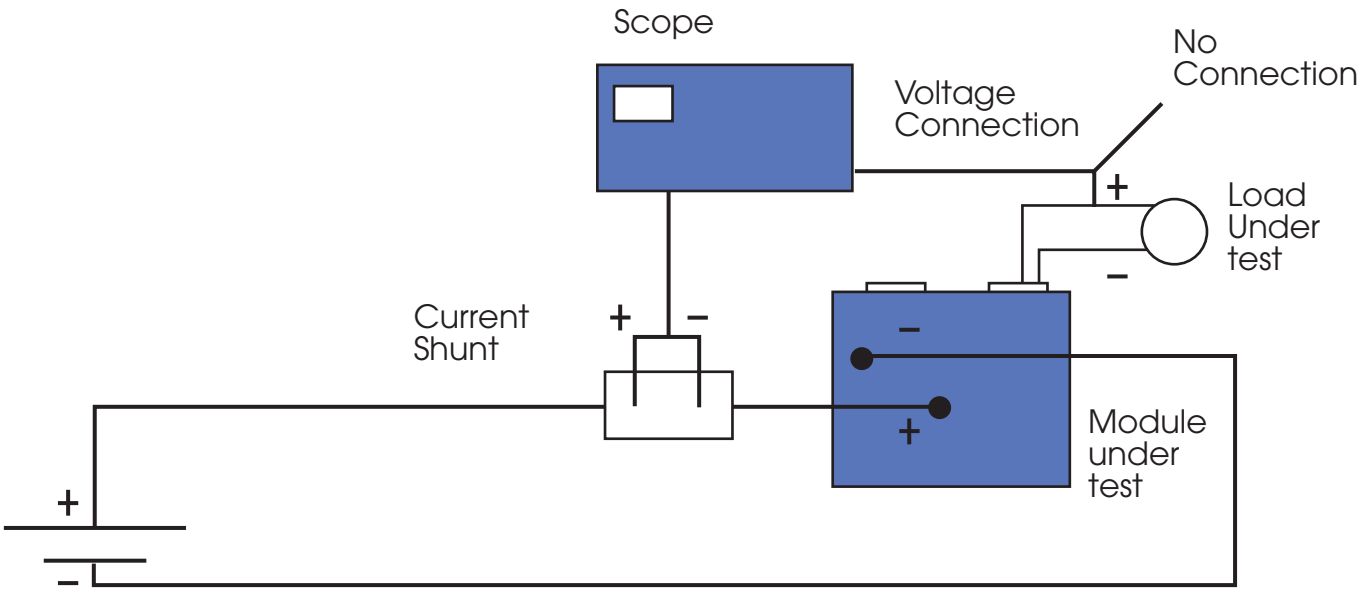
TIME	COMMENTS
A	Approx. 10 µs rest of time high for bit
C + D	Approx. 10 µs, rest of time high (including A) for 0 bit

Low Voltage

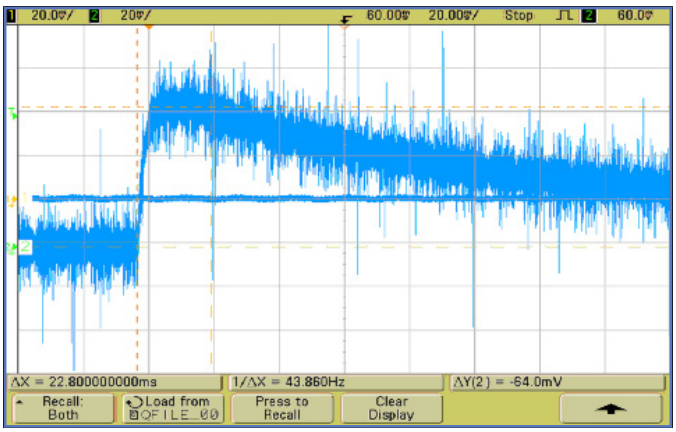
The easiest way to test this is to drain the battery to the expected low voltage requirement. With the voltage at the low voltage requirement, solid state outputs should be test to see if the legs are trying to power the load.

Inrush

This test is designed for modules like the 366HMM, 407QHM, and 436MMX. This test needs to be done one leg/output at a time per module. For the inrush test a scope and current shunt are needed. *Make sure the scope is isolated (i.e. earth ground is not connected)*. The current shunt needs to be connected inline with the power being proved to the module under test. One of the scope probes need to go across the current shunt. The other probe needs connect to the positive/output leg of the module under test. (Illustrations below)

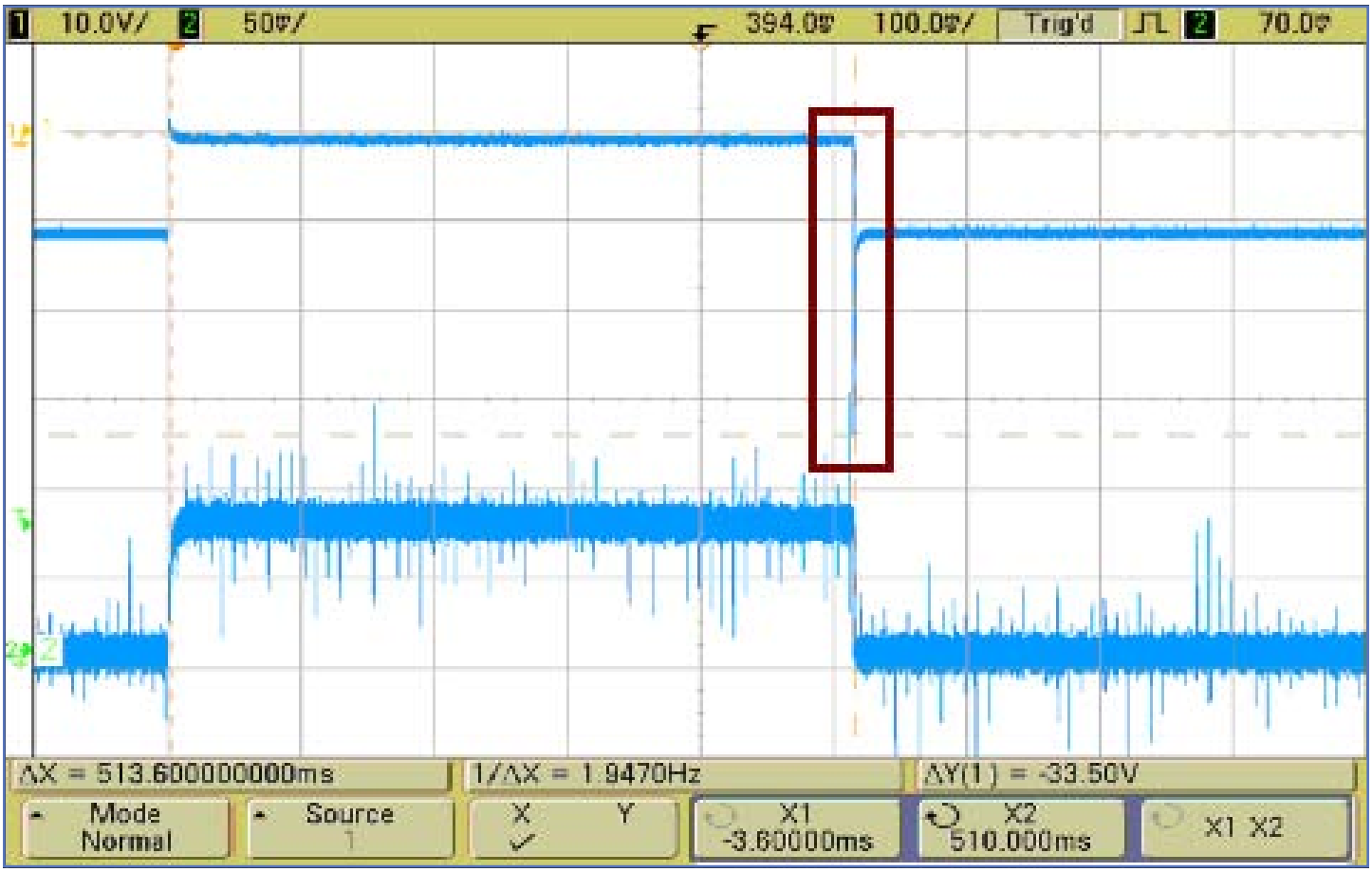


Below you can see the current dignified in millivolts (1mV = 1Amp). The reading for the inrush below was about 64 Amps for around 22.8ms.



Lock Rotor

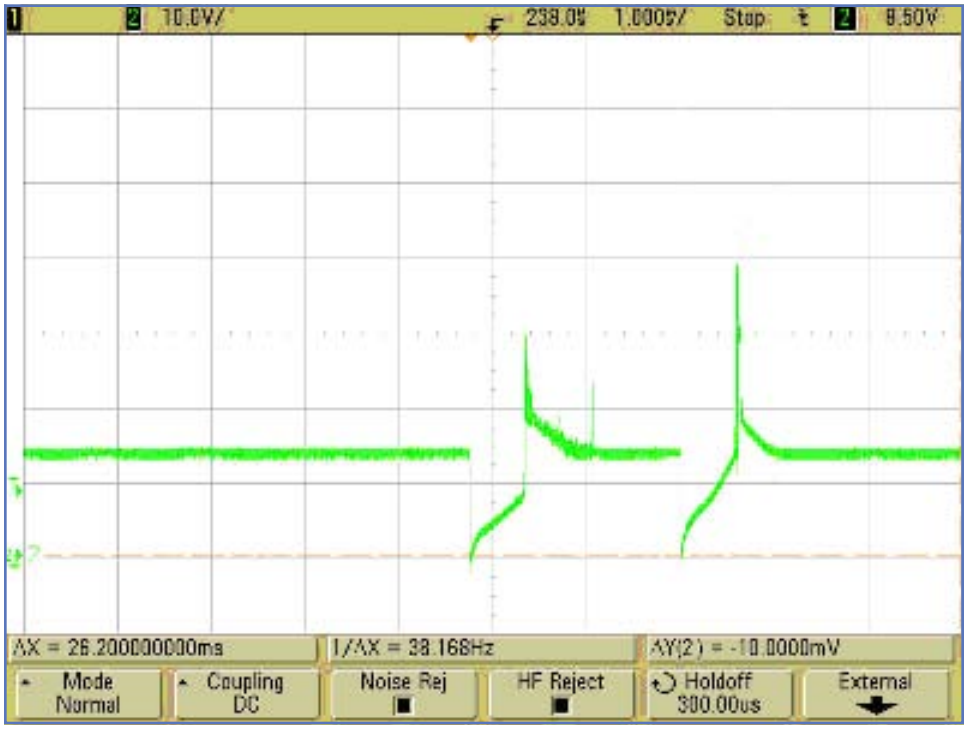
This test is design for motors. This test needs to be done one leg/output at a time per module. The connection method will be the same as the inrush test. Below is an illustration showing what you should see on the scope.



The section boxed in red is the instance when the surge occurred (fly back voltage). The fly back voltage is measured by taking the difference between the max and the min values. In the illustration above there is a fly back voltage of 33.5V. This is with our threshold of 40V.

Individual Short Circuit

This test is designed for shorting any solid state outputs (366HMM, 407QHM, 436MMX, etc.) and fused parts connected to the same power bus as the E-Plex system. This test needs to be done one leg/output at a time per module. The connection method will be the same as the inrush test. Below is an illustration showing a short circuit test done to a fuse attached to the same power bus as the E-Plex system.



The illustration above shows the fly back voltage from the short circuit test to be roughly 45V (difference between the max and the min). Since the fly back voltage exceeded our threshold of 40V, we recommend using a smaller fuse or add extra surge suppression to the power lines.

Individual Load

All that is needed to pass this test is to power each load individually and verify it operates properly.

All Loads

This requires that you power all the loads on the system and verify they are all running properly.

Notes

Used for stating any extra validation or comments that might be useful in the future:

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Sign-Off

After all the tests have been completed and accepted. The appropriate people need to sign off on the test, which states their accepts of the system.

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____