6.1 Scope

Within a SCSI domain, measure response of driver-receiver connections to controllable changes in driver properties. This is accomplished by validating the entire domain then testing the margins of the analog drivers that make up each driver-receiver connection.

6.2 Assumptions

1. Topology discovery is left to the application client developer.
2. Devices of any maximum synchronous SCSI transfer rate will be tested.
3. Devices that do not have variable analog driver settings will provide a graceful rejection of any inappropriate message.
4. All devices were set (e.g., through firmware) to allow the maximum SCSI transfer rate intended for that application.

6.3 Domain Validation

6.3.1 Test Order

Before Margining is executed, the domain should be tested to insure that Margin tests will return valid results. Note that this test, and the flow described herein, could be used as part of a device initialization sequence. Such a sequence is part of initializing a device driver under any given operating system.

1. Execute the Basic Integrity Check as shown in Section 5.2.1.1.
2. Execute the Enhanced Integrity Check as shown in Section 5.2.2.1.

6.3.2 Test Conditions

The entire domain will be evaluated, on a target by target basis, from the perspective of each initiator in the domain.

1. Each initiator-target connection will be tested individually, in order from lowest SCSI ID to highest SCSI ID.
2. Basic and Enhanced integrity checks will be executed on each target consecutively. This can be worked into a bus scan sequence.
3. If Basic or Enhanced integrity checks fail, a fall-back setting will be set and the test executed again. Fall-back order: Fast-160, Fast-80, Fast-40 (with DT clocking enabled), Fast-40 (with ST clocking enabled), Fast-20, Fast-10.
4. Data patterns for Enhanced integrity check:
   a) Counting (0001h, 0102h, 0203h, 0405h,…);
   b) Alternating ones and zeros (0000h, FFFFh, 0000h, FFFFh,…);
   c) Cross-talk (5555h, AAAAh, 5555h, AAAAh, …);
   d) Shifting bit (0000h, FFFeh, 0000h, FFFDh,…then FFFFh, 0001h, FFFFh, 0002h, …);
   e) User defined pattern (e.g., psuedo random pattern).

6.3.3 Test Criteria

1. The Basic Integrity Check fails when the first 36 bytes of data returned at the negotiated synchronous speed does not match the data received at the asynchronous speed. A CRC error (or parity error for non-DT clocking) or a transaction timeout are considered errors as well.
2. Due to potential changes in the target's condition, it is recommended that the basic integrity check be repeated if a failure is encountered.

3. The Enhanced Integrity Check fails if the data used in the R/W Buffer command fails to compare, has a CRC error (or parity error for non-DT clocking), or encounters a transaction timeout.
4. It is recommended that "Echo" R/W Buffer command be used. If the "Echo" function is not available, the application client may use file R/W commands.

6.3.4 Test Output
1. If no issues were encountered, no user interaction is required and Margin tests will commence.
2. It is recommended that Margining not be executed if any negotiated synchronous setting for any target is set to a fall-back setting.
3. If issues were encountered, actions that may be taken.
   a) Recommend a course of debug activity based on the application client's determination of the topology. This could be displayed to the user in a dialog box or stored in a file for future access.
   b) Submit an error to the operating system's event notification log.

6.4 Margining

6.4.1 Assumption
The topology has been ascertained by the application client.

6.4.2 Test Order
1. Margin the driver-receiver connections on the segment directly connected to the initiator.
2. Continue to expand the Margin tests to the driver-receiver connections at the far port of the first layer of expanders, i.e., those expanders directly connected to the initiator. See Figure 5 and note the expanders connected to SCSI Bus Segment 0.
3. Continue to expand the Margin tests to the driver-receiver connections at the far port of the second layer (and so on) of expanders, i.e., those expanders directly connected to the first layer of expanders. See Figure 5 and note the expander between SCSI Bus Segment 1 and SCSI Bus Segment 4.

6.4.3 Test Conditions
1. The test flow is based on all driver-receiver connections within an individual segment (segment), as detailed herein.
2. After a segment has completed Margin tests, all analog drivers, whether delivering data to or from a target or expander, are set to nominal. See Figure 5 and consider Target 5, Initiator, and the near port of all expanders connected to SCSI Bus Segment 0 as set to nominal when Margin tests are complete on Segment 0 driver-receiver connections.
3. A segment has not completed testing until one SCSI target on the far side of all connected expanders has been tested using nominal analog driver settings on the far port of the appropriate expander and the target under test. This will ensure that the signal reaching each driver-receiver connection is legitimate. NOTE: This test will not be valid unless the target under test is capable of achieving the maximum speed of the expander.
4. Honor Pre-Compensation Enable/Disable settings. Do not alter for Margin test purposes.
5. Use of mode pages will allow the application client to set multiple analog driver settings within a target.
6. Use of Expander Communication Protocol will allow the application client to set multiple analog driver settings within an expander.
7. If a SCSI Bus Reset is used to recover from any hang conditions, this should set all initiator, target, and expander analog driver settings to nominal.

8. To avoid unnecessary failures, respond to check condition if issued after Read Echo Buffer command. Check sense data for Echo Buffer Overridden. This will indicate a corrupted Echo Buffer.

6.4.4 Test Combinations

1. Execute Margin tests to (from) each target while manipulating only one parameter at a time, on one driver-receiver connection at a time. Execute Margin tests at each register setting of each parameter while holding all other parameters at nominal.
2. For combination testing, the application client may be responsible for too many combinations. Restraint is recommended. For instance, an application client could test the minimum and the maximum of a set of analog driver settings. Manipulation of four parameters would result in sixteen tests. It is possible that maximum and minimum may be user defined to be something other than the full swing the hardware can apply.
3. Execute Margin tests to (from) each target while manipulating minimum and maximum settings on all driver-receiver connections along the path to (from) each target.

6.4.5 Test Direction

1. All of the above must be executed through an outbound data path "TO" a particular target and inbound "FROM" a particular target. It is recommended that no simultaneous action of inbound and outbound margining exist.

6.4.6 Test Criteria

1. A test executed to a device that is operating with DT clocking, is determined to have failed when a CRC error is detected, or data miscompares, or a transaction timeout occurs.
2. A test executed to a device that is operating without DT clocking, is determined to have failed when a parity error is detected, or data miscompares, or a transaction timeout occurs.
3. Margin tests are intended to be run on devices that support Fast-10 or higher operation.
4. It is recommended that "Echo" R/W Buffer command be used. If the "Echo" function is not available, the application client may use file R/W commands.

6.4.7 Test Output

1. Upon completion of Margin tests, all analog driver settings in the domain will be set to nominal.
2. It is expected that a test report will be issued to the display.
3. If issues were encountered, several actions may be taken.
   a) Suggest that the user reduce the peripheral's maximum negotiated SCSI transfer rate. See Section 6.3.2 for recommended SCSI transfer rate reduction.
   b) Recommend a course of debug activity based on the application client's determination of the topology. This could be displayed to the user in a dialog box or stored in a file for future access.
   c) Submit an error to the operating system's event notification log.

6.4.8 Flow Chart

From Low-to-High
SCSI ID

Fall-Back

Execute Basic Integrity Check

First Failure at
this ID

Async Fails

2nd-n^{th} Failure

Basic Check
Pass?

YES

Execute Enhanced
Integrity Check

NO

Enhanced Check
Pass?

Async Fails

YES

Last SCSI ID?

NO

YES

```
                                    NO
                          ◇ Fall-Back Occur
                            or Async Fail?

                                    YES

                      ⬡ User Interaction
                        With Failure
                        Indication and
                        Debug Tips

                      ⬭ END

                      [ Reference Topology Map ]

  [ Substitute "far        [ Margin initiator drivers to
    port" for initiator      each target in the same
    after first pass ]       segment ]

  [ Use ECP to set         [ Margin each target's drivers
    expander driver          back to the initiator (same
    settings ]               segment) ]

                    NO
                          ◇ Are more segments
                            present?

                                    YES
```

Margin this segment's host-side drivers to near port of each expander using target on far port

Margin near port drivers of each expander to host-side receivers using target on far port

All Devices Margined?

NO

YES

Margin entire path to all targets using combinations of driver settings

Margin entire path from all targets using combinations of driver settings

Display results & recommended action

END