

# Setting up a Signal Integrity Lab

## 4 Step Process

### 1

#### Where to Start: Basic Guidelines

##### PURPOSE OF THE LAB

◆ Before attempting to select the equipment needed in any laboratory, it is important to first understand the purpose of the lab. Too often, a company will disregard this fundamental step and decisions regarding equipment requirements versus available lab budgets are not clear.

##### Standard vs. Proprietary Products

“Do we need to meet specifications established by a standards organization, the end customer, or have the requirements been specified internally?”

##### Functional vs. Performance Testing

“Are we testing the basic functional operation of a device, or, are we testing the performance of that device?”

“What is the difference and why do we need to know?”

##### CAPABILITY BEFORE CAPACITY

◆ As a guideline for instrumentation, a Signal Integrity Lab should incorporate capability before capacity. Increasing the testing capacity of an SI Lab by purchasing multiple systems will not provide the capability needed for a comprehensive test. If you find that your lab is basically a room full of similar equipment, then capability is not the strength of that lab and it will most likely not be able to satisfy the range of tests required.

#### INTRODUCTION

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There is **NO ONE UNIVERSAL TEST INSTRUMENT** for the broad range of Signal Integrity testing. Therefore, when choosing equipment for a test lab, it is important to look at several criteria.

Both functional and performance testing are important. A Signal Integrity Lab needs to be set up so that the basic functionality of a device can be tested first, then its performance analyzed, enhanced, and ultimately its test margins improved.

Close attention to the application must also be made. Industry specifications associated with the application will best define what types of tests are most important and which test instruments are most appropriate. Some instruments are better suited to specific types of tests than others.

This document is designed as a guide to help better define Signal Integrity test needs and to assist in determining proper equipment choices.

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# 2

## Examine Test Objectives through Application Criteria and Performance Parameters

### IDENTIFYING PARAMETERS

- ◆ When testing parts that need to adhere to a serial data standard such as PCI Express™, Fibre Channel, or SATA, etc., the specifications for that standard will identify necessary parameters. Additionally, customer driven specifications, as well as production yield goals, will determine specific testing requirements.

### DEFINING OBJECTIVES AND RESULTS

- ◆ Some questions to ask here are, "Do I need results in my SI Lab that will correlate with the Characterization Lab, Validation Lab, QA Lab or in Production Test?" "What objective or expectation should the results of this Signal Integrity test meet?" The key word in both these questions is *results*. Aside from being the product of any test, measurement results are the comparison of your objectives with the actual performance of that test. Therefore, by identifying your test objectives and the needed results, you will be able to better define the capability requirements your instrument must fulfill.

### EXAMPLE

The following chart is an example of an exercise that can assist you in working through this examination process. This chart is representative of setting up a PCI Express lab. The charts you develop should represent your specific objectives and applications.

Objective	Results Needed	Instrument Capabilities
Test Compliance on PCI Express parts	Measure all parameters as described by the PCI Express 1.1 standard	Compliant test instrument as per PCI-SIG * Must cover Gen 1 @ 2.5Gb and Gen 2 @ 5Gb Easy to use interface with pass/fail test capability
Measure tolerance limits on PCI Express parts	Maximum and minimum jitter values and amplitude values before parts fail	Ability to accurately measure the results needed in the face of extreme noise
Design base test for correlation between design validation and characterization	A subset of the compliance test to track jitter issues in order to keep yield high	Must be able to interface with Advantest T2000 and Agilent 93K platforms

# 3

## Determine Type and Range of Testing Needed

### REVISIT PARAMETERS

- ◆ The type and range of test needed should be based on the parameters established in Step 2 and not the capabilities of the equipment currently in use in your present lab. Allowing test instruments to govern testing parameters will place limitations on the range of the test and in turn diminish the quality of the results.

It is here that we revisit the idea of Functional Testing as necessary to verify basic operation of a device, and Performance Testing as needed to analyze, characterize and refine the efficiency of that device. In a Signal Integrity Lab, where the purpose is to expand the range of test capability, both Functional and Performance Tests are needed.

Before moving on to the next step, note how many of the tests are performance related.

### EXAMPLE

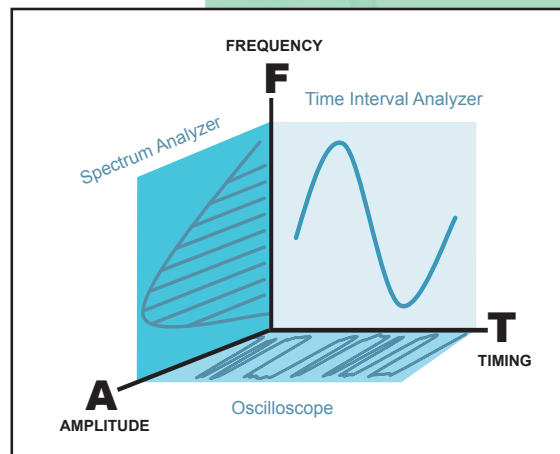
The following chart details some of the types of tests required to obtain the "needed results" in the previous example.

Results Needed	Test	Performance Range	Func. ————— Perf.
PCI Express timing compliance parameters	Unit Interval (UI) TJ @ 10 <sup>-6</sup> TJ @ 10 <sup>-12</sup> Median to Max	399.88ps to 400.12ps Sample size > 1M Sample size > 1M Sample size > 1Mx	—————▲————— —————▲————— —————▲—————
PCI Express amplitude compliance parameters	Amplitude levels	340 to 520 mV	—————▲—————
Tolerance limits	RJ/DDJ/PJ Minimum eye amplitude	Accuracy to w/i 2ps Able to measure > 0.8 UI noise Able to measure amplitudes down to 50 mV	—————▲————— —————▲—————
PCI Express ref-clock	Transfer function peaking	<3dB peaking between 1.5 MHz and 22MHz	—————▲—————

### NOTES

#### TESTING IN THREE DOMAINS

A three dimensional approach to Signal Integrity should also be realized. Testing in any one particular domain, amplitude for example, will impose assumptions on other parameters such as time or frequency. A specific analysis in those other domains can help determine if your assumptions are correct.

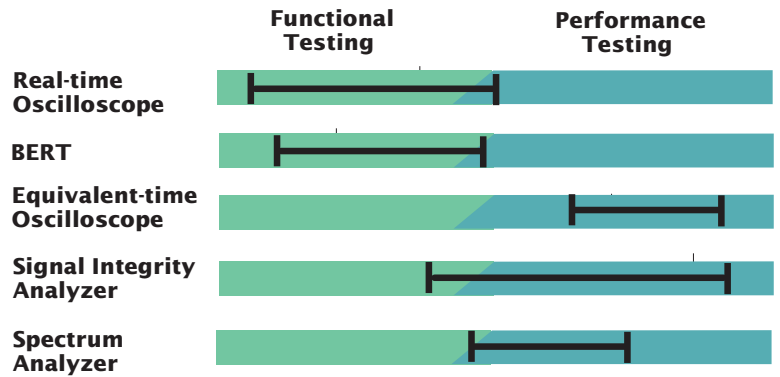


# 4


















## Choose Proper Instrumentation

Since there is NO ONE UNIVERSAL TEST INSTRUMENT, it is important to select the appropriate types of instruments for your Signal Integrity measurements. Care should be taken here not to allow banner specifications such as bandwidth numbers or sample rate to solely govern your choices. Think through all of the specifications of a test instrument. What do they mean? How does the performance of the test instrument affect the results of the test?

**Instrument Capabilities Chart**



**Select the right tools for the job**

	<b>Basic SI Lab</b>	<b>Intermediate SI Lab</b>	<b>Advanced SI Lab</b>
<b>Functional Testing</b>	 Real-time Oscilloscope or  BERT	 Real-time Oscilloscope and  BERT	 Real-time Oscilloscope and  BERT and  Signal Integrity Analyzer
<b>Performance Testing</b>	 Signal Integrity Analyzer or  Equivalent-time Oscilloscope or  Spectrum Analyzer	 Signal Integrity Analyzer and  Equivalent-time Oscilloscope or  Spectrum Analyzer	 Signal Integrity Analyzer and  Equivalent-time Oscilloscope and  Spectrum Analyzer or  BERT

Note: This is a sampling of measurement equipment and should not be considered all-inclusive.

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