DIMENSIONAL

VLSI Standards

Application Note: Step Height Standards for use with KLA-Tencor Instruments

REV AB
January 2010

SECTION 1. Thin SHS-QS Height Standard models below 1 µm thick, for model numbers KTS-80QS, KTS-440QS, KTS-880QS, KTS-1800QS, KTS-4500QS, KTS-9400QS

Thick SHS-QS Height Standard models above 1 µm thick, for model numbers, KTS-4.5QS, KTS-8.0QS, and KTS-50QS can be found in Section 2 starting on page 5.

KLA-Tencor

PRODUCT DESCRIPTION

The Thin SHS-QS Height Standard (Thin SHS-QS) is designed for the calibration of mechanical profilers. The standard consists of a positive step, along with a pitch cluster diagnostic feature, etched in a silicon dioxide film on a 10 mm x 10 mm silicon die mounted in the center of a 24.5 mm x 24.5 mm x 5.08 mm quartz block. The step is 100 micrometers wide and 750 micrometers long and is clearly marked with pointers, as shown in **Figure 1**.The 400 micrometer certified area is located in the center of the measurement bar.

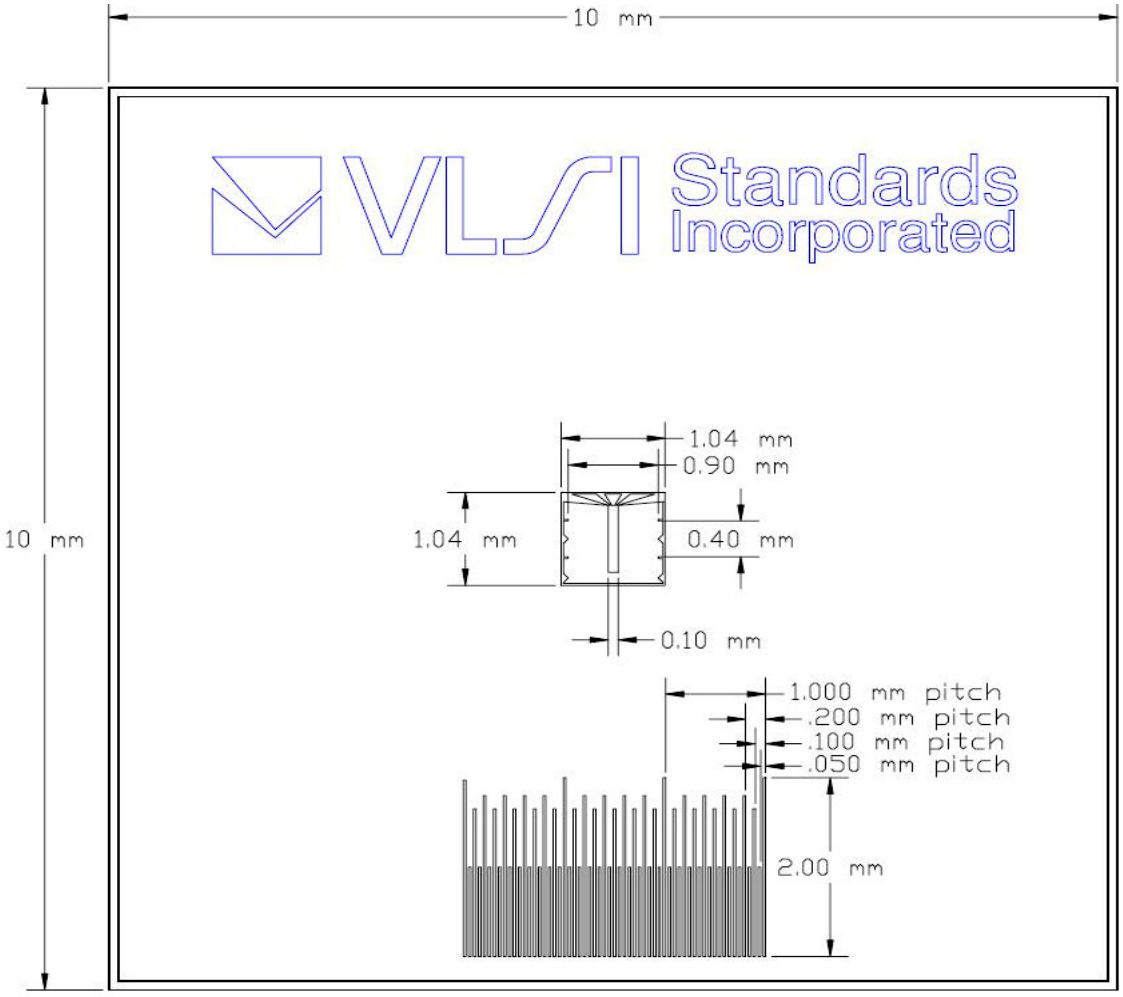


Figure 1

Revision AB
Specifications subject to change.

Five Technology Drive, Milpitas, CA 95035-7916 phone 800.228.8574 fax 408.428.9555 www.vlsistandards.com

Each standard bears an individual serial number which is kept on file, with the complete calibration data, in the archives of VLSI Standards, Inc. This serial number is printed on the front surface of the standard, and noted on the Certificate of Calibration. Should you have any questions regarding your standard, please identify this serial number so that we may refer to our internal records.

Note for users of KTS-80QS, 8 nm step height: The pitch bars for 8 nm step height may not be visible. To assist finding the bars the 1000 angstrom of thermal oxide will remain on the pitch bars above and below the 8 nm pitch bars. ***See figure 1A below****.*

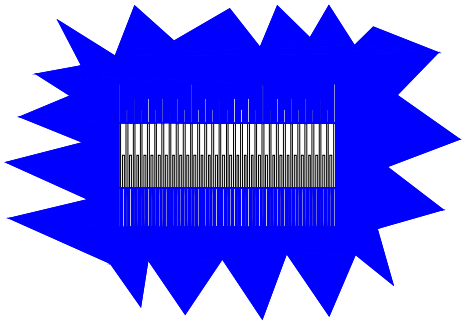


Figure 1A

Prior to using the standard, check that both the top and bottom surfaces of the standard and the instrument stage are clean to ensure that the working surface of the standard is parallel to the instrument stage. The certified area is shown in **Figure 2**.

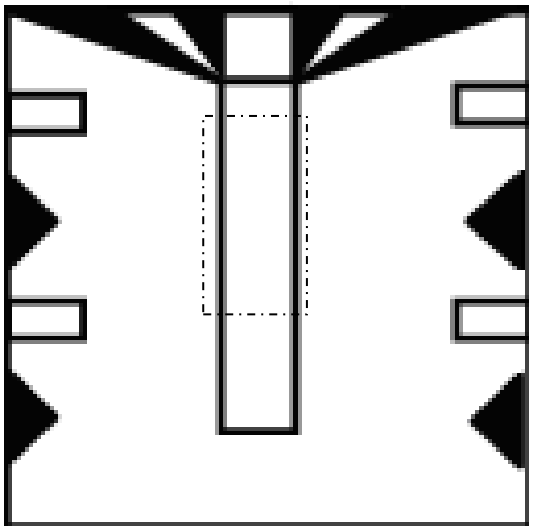


Figure 2

It is important to understand what the certified quantity on the standard is, so that that same quantity can be measured during instrument calibration, and so that a valid direct comparison can be performed between what was certified at VLSI Standards, and what is measured on the instrument to be calibrated.

To understand what the certified quantity is, let's take a look at how the certification is done at VLSI Standards. First, let's examine one individual profile across the step. The result will look as shown in **Figure 3**, where we have used the symbol W to indicate the width of the step. At VLSI, we only consider three sections of the profile, indicated as a, b, c in Figure 3, for calibration.

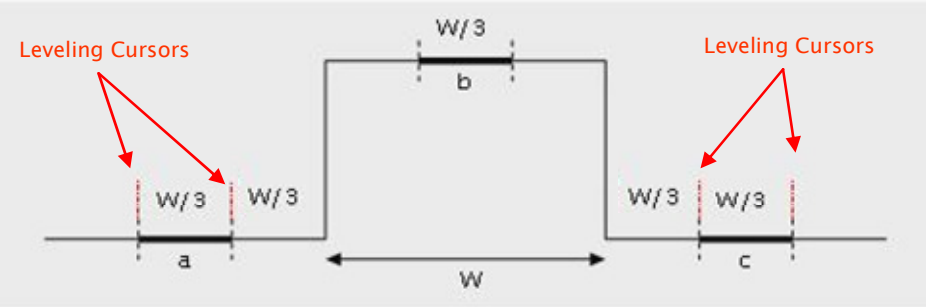


Figure 3

Five Technology Drive, Milpitas, CA 95035-7916 phone 800.228.8574 fax 408.428.9555 www.vlsistandards.com

Each of these three sections has a width equal to w/3, and is located a distance w/3 away from the edge of the step. We calculate the average height of each of these three sections.

We then perform an operation of leveling, whose result is to level the measured profile so that the height of section a is the same as the height of section c. Last, we measure the height of the step as the difference between the height of section b and the height of section c.

We then repeat this same measurement for a total of 9 times at different locations along the step, and we report on the certificate of calibration the average of the 9 measurements. The 9 profiles are taken a distance of 50 microns apart, and are centered around the pointers as shown in Figure 2. Additional information can be found in ASME B46.1.

THE INCREMENTAL PITCH DIAGNOSTIC FEATURE

This is a test track that consists of adjacent series of lines at specific pitches, as shown in **Figure 4**.

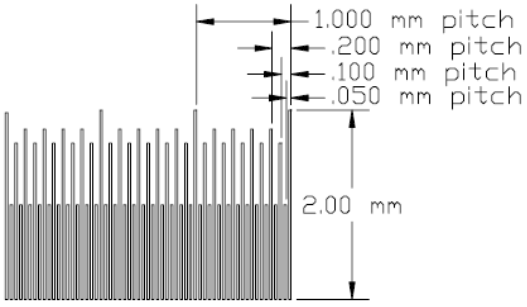


Figure 4

The pitch (wavelength) is defined as the distance from the leading edge of one step to the leading edge of the next step. The available pitches are 50, 100, 200 and 1,000 µm. To check the instrument's ability to resolve a series of steps at a given pitch and at the calibrated height, a scan of the desired track should be made. If the instrument can resolve the given pitch, the trace of the scan should appear as a series of symmetrical pulses of similar height as the calibrated step height bar. **See Figure 5**.

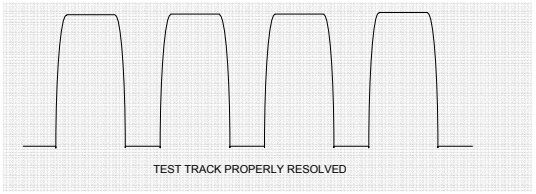


Figure 5

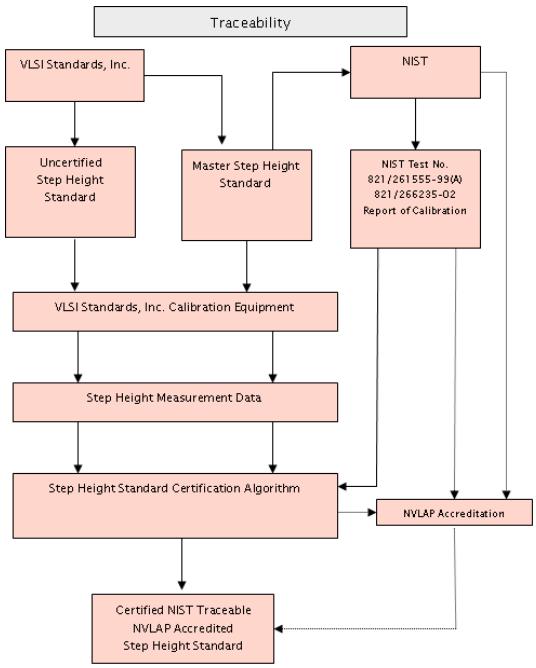
Please note that the topography of the pitch structure is not certified and should not be used for calibration.

Revision AB
Specifications subject to change.

Five Technology Drive, Milpitas, CA 95035-7916 phone 800.228.8574 fax 408.428.9555 www.vlsistandards.com

CERTIFICATION AND TRACEABILITY

The step on the Si-SHS is calibrated to a standard which has been measured and certified by the National Institute of Standards and Technology. The exact height of the step and the specific information about measurement uncertainty and environmental conditions are noted on the Certificate of Calibration. The combined standard uncertainty of the measurement and its components, as defined by the *ISO Guide for the Expression of Uncertainty in Measurement* are also reported in the Annex to the Certificate of Calibration.



Revision AB
Specifications subject to change.

Five Technology Drive, Milpitas, CA 95035-7916 phone 800.228.8574 fax 408.428.9555 www.vlsistandards.com

SECTION 2. Thick Si-Step Height Standard models above 1 µm thick, for model numbers KTS-4.5QS, KTS-8.0QS, and KTS-50.0QS.

Thin SHS-QS Height Standard models above 1 µm thick, for model numbers KTS-80QS, KTS-440QS, KTS-880QS, KTS-1800QS, KTS-4500QS, KTS-9400QS, can be found in Section 1 starting on page 1.

KLA-Tencor

PRODUCT DESCRIPTION

The Thick SHS-QS Height Standard (Thick Si-SHS) is designed for the calibration of mechanical and optical surface profilers. The standard consists of a trench (negative step), along with a pitch cluster diagnostic feature, etched into a 10 mm x 10 mm silicon die mounted in the center of a 24.5 mm x 24.5 mm x 5.08 mm quartz block. The trench is 1 mm wide and 5 mm long and is clearly marked with pointers, as shown in **Figure 6**. The 800 micrometer certified area is located in the center of the measurement bar.

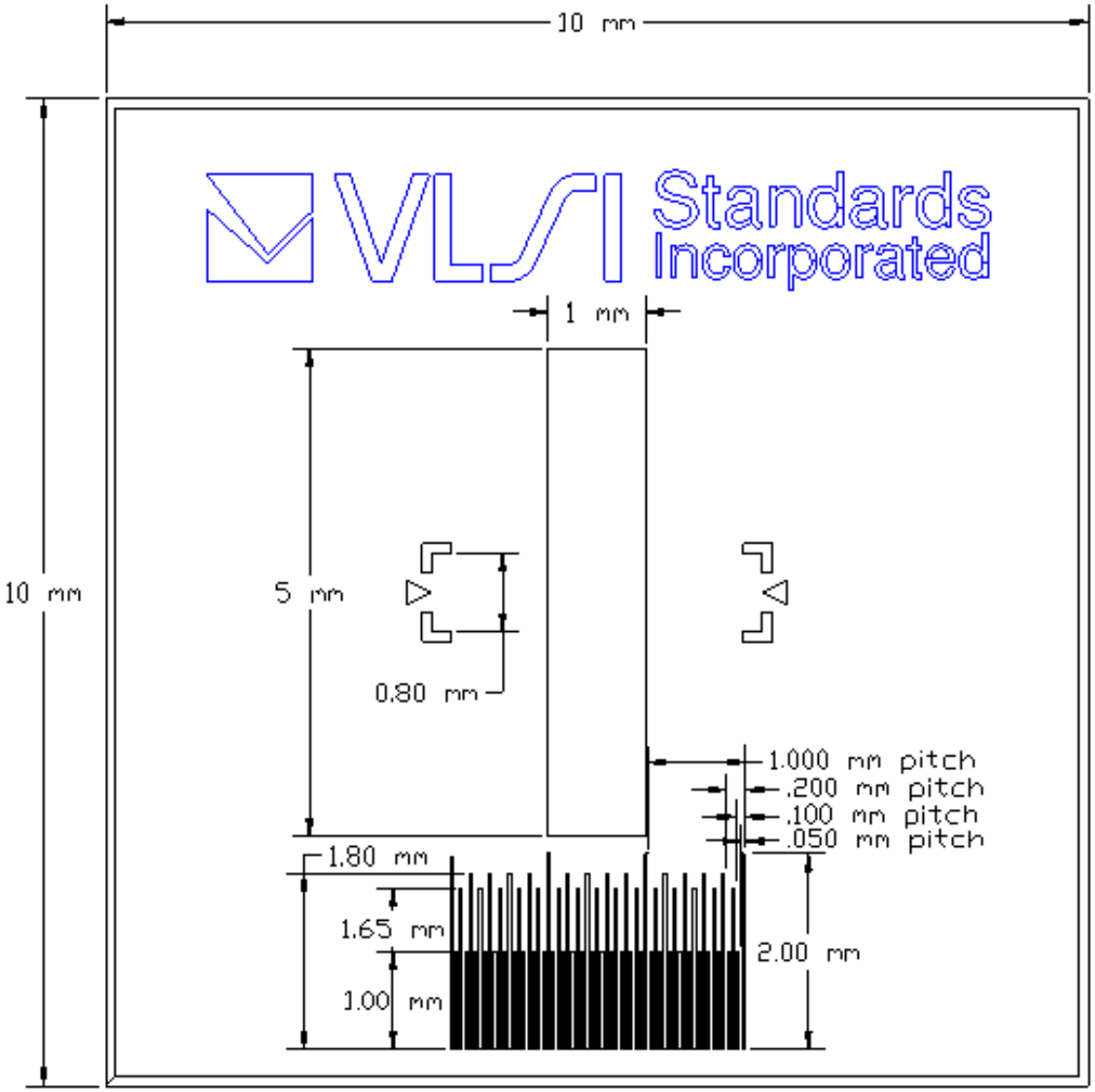


Figure 6

Revision AB
Specifications subject to change.

Five Technology Drive, Milpitas, CA 95035-7916 phone 800.228.8574 fax 408.428.9555 www.vlsistandards.com

Each standard bears an individual serial number, which is kept on file, with the complete calibration data, in the archives of VLSI Standards Inc. This serial number is etched on the front surface of the standard and noted in the accompanying Certificate of Calibration. Should you have any questions regarding the standard, please identify this serial number so we can refer to our internal records.

Prior to using the standard, check that both the back surface of the standard and the instrument stage are clean to ensure that the working surface of the standard is parallel to the instrument stage.

It is important to understand what the certified quantity on the standard is, so that that same quantity can be measured during instrument calibration, and so that a valid direct comparison can be performed between what was certified at VLSI Standards, and what is measured on the instrument to be calibrated.

To understand what the certified quantity is, let's take a look at how the certification is done at VLSI Standards. First, let's examine one individual profile across the step. The result will look as shown in Figure 7, where we have used the symbol *W* to indicate the width of the step. At VLSI, we only consider three sections of the profile, indicated as *a, b, c* in **Figure 7**, for calibration.

THE INCREMENTAL PITCH DIAGNOSTIC FEATURE

This is a test track that consists of adjacent series of lines at specific pitches, as shown in **Figure 8**.

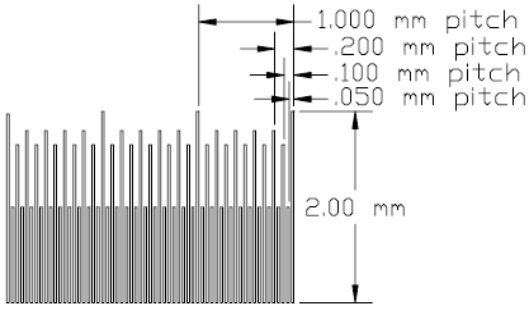


Figure 8

The pitch (wavelength) is defined as the distance from the leading edge of one step to the leading edge of the next step. The available pitches are 50, 100, 200 and 1,000 µm. To check the instrument's ability to resolve a series of steps at a given pitch and at the calibrated height, a scan of the desired track should be made. If the instrument can resolve the given pitch, the trace of the scan should appear as a series of symmetrical pulses of similar height as the calibrated step height bar. **See Figure 9.**

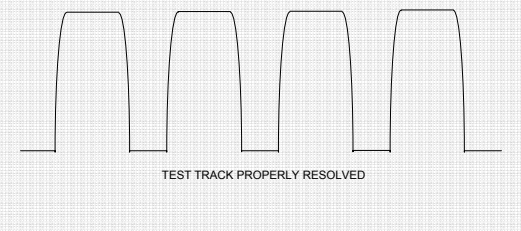


Figure 9

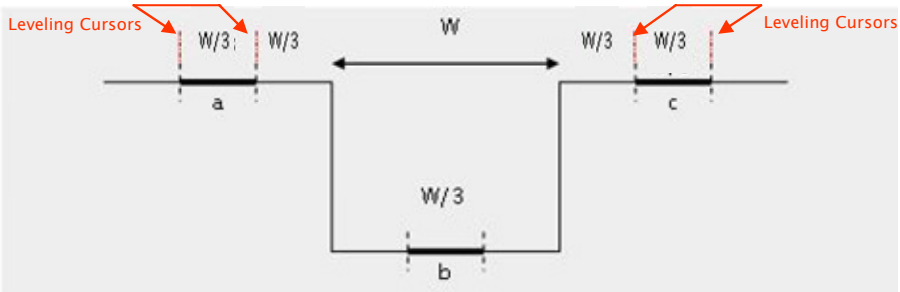


Figure 7

Five Technology Drive, Milpitas, CA 95035-7916 phone 800.228.8574 fax 408.428.9555 www.vlsistandards.com

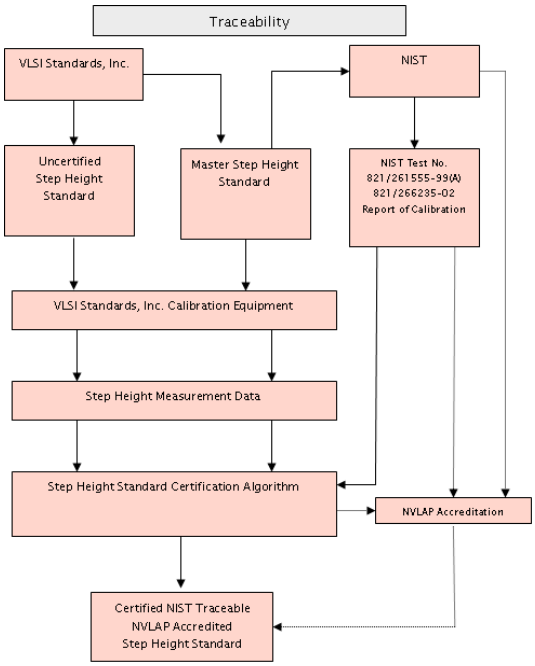
Please note that the topography of the pitch structure is not certified and should not be used for calibration. Also note that the 50 μm step height, model no. KTS-50.0QS, does not have either 50 μm or 100 μm pitches.

CERTIFICATION AND TRACEABILITY

The step on the SHS is calibrated to a standard which has been measured and certified by the National Institute of Standards and Technology. The exact height of the step and the specific information about measurement uncertainty and environmental conditions are noted on the Certificate of Calibration. The combined standard uncertainty of the measurement and its components, as defined by the ISO Guide to the Evaluation and Expression of Uncertainties in Measurement are also reported in the Annex to the Certificate of Calibration.

CARE AND HANDLING OF EITHER THIN OR THICK MODELS

To maintain the accuracy of the step height standard we recommend that it be stored in its container in as clean an area as possible. The measurement area should not be touched, even with gloved hands. Always handle the standard from the sides.
For routine maintenance, often a short burst of clean dry nitrogen will remove lint and large particles. To clean the standard, use deionized water.



Revision AB
Specifications subject to change.

Five Technology Drive, Milpitas, CA 95035-7916 phone 800.228.8574 fax 408.428.9555 www.vlsistandards.com