



TABLE TOP SHADOW MOIRÉ



USER MANUAL

Akrometrix Proprietary Information

No reproduction, adaptation, or translation without prior written approval.

Warranty

The information contained in this document is subject to change without notice.

Akrometrix makes no warranty of any kind with respect to this information.

Akrometrix shall not be liable for any direct, indirect, incidental, consequential, or other damage alleged in connection with the furnishing or use of this information.

Trademark Credits

Microsoft®, Windows®, Excel®, and Notepad® are registered trademarks of Microsoft Corporation.

TherMoiré® is a registered trademark of Akrometrix, LLC.

Contents

- 1 Introduction..... 4**
 - 1.1 Overview 4
 - 1.2 Warnings and Precautions 4
 - 1.3 System Configuration 6
 - 1.4 System Components 6
 - 1.5 Technical Support 8
- 2 System Set-up and Use..... 9**
 - 2.1 System Set-up..... 9
 - 2.2 System Shutdown 9
 - 2.3 Replacing Gratings and Lenses 9
 - 2.4 Cleaning a Grating 9
- 3 Troubleshooting 10**
 - 3.1 Troubleshooting Data Acquisition..... 10
- Appendix A - Miscellaneous Information 11**
 - A.1 Equipment Ratings 11
 - A.2 Installation and Assembly..... 11
 - A.3 Transport..... 12
 - A.4 Disassembly..... 12
 - A.5 Maintenance..... 13
 - A.6 Camera Lens..... 14

1 Introduction

1.1 Overview

The Akrometrix Table Top Shadow Moiré (TTSM) is a small-scale system designed to measure sample surface warpage at room temperature. It uses a full-field, non-contact optical technique called shadow moiré in combination with automated image processing. Samples are measured on a pull-out tray at the base of the unit.

This manual describes the system hardware of the TTSM. Data acquisition is described in the Surface Measurement User Manual and analysis is described in the Surface Analysis User Manual. Surface Measurement requires system hardware to operate and, thus, will only be installed on the TTSM. Surface Analysis may reside on the TTSM computer and/or on a remote computer.

The main body of this manual emphasizes the system hardware and its operation. A user unfamiliar with shadow moiré and its applications is advised to first read **Akrometrix Optical Techniques and Analyses 101**, and **Section 3**, Troubleshooting in order to make best use of the system.

Before operating the system, the user should carefully read **Section 1.2.2**, which describes safety and health hazards associated with the system.

Sections 1.3 and **1.4** identify system components and controls. **Section 2** describes basic procedures for system setup and shutdown. **Section 3** describes basic troubleshooting.

Appendix A describes recommended procedures for maintenance, transport and disassembly of the system. This section also contains equipment ratings and technical support material.

1.2 Warnings and Precautions

1.2.1 Warnings and Notes in this Manual

Warnings and Notes are marked throughout the manual with these icons:



Figure 1.1 Warning Icon



Figure 1.2 Note Icon

Warnings are specific health hazards for the operator or potential sources of damage to the TTSM system. Notes highlight system limitations or automatic responses that may require corrective action by the operator for successful operation.

1.2.2 Health and Safety Hazards

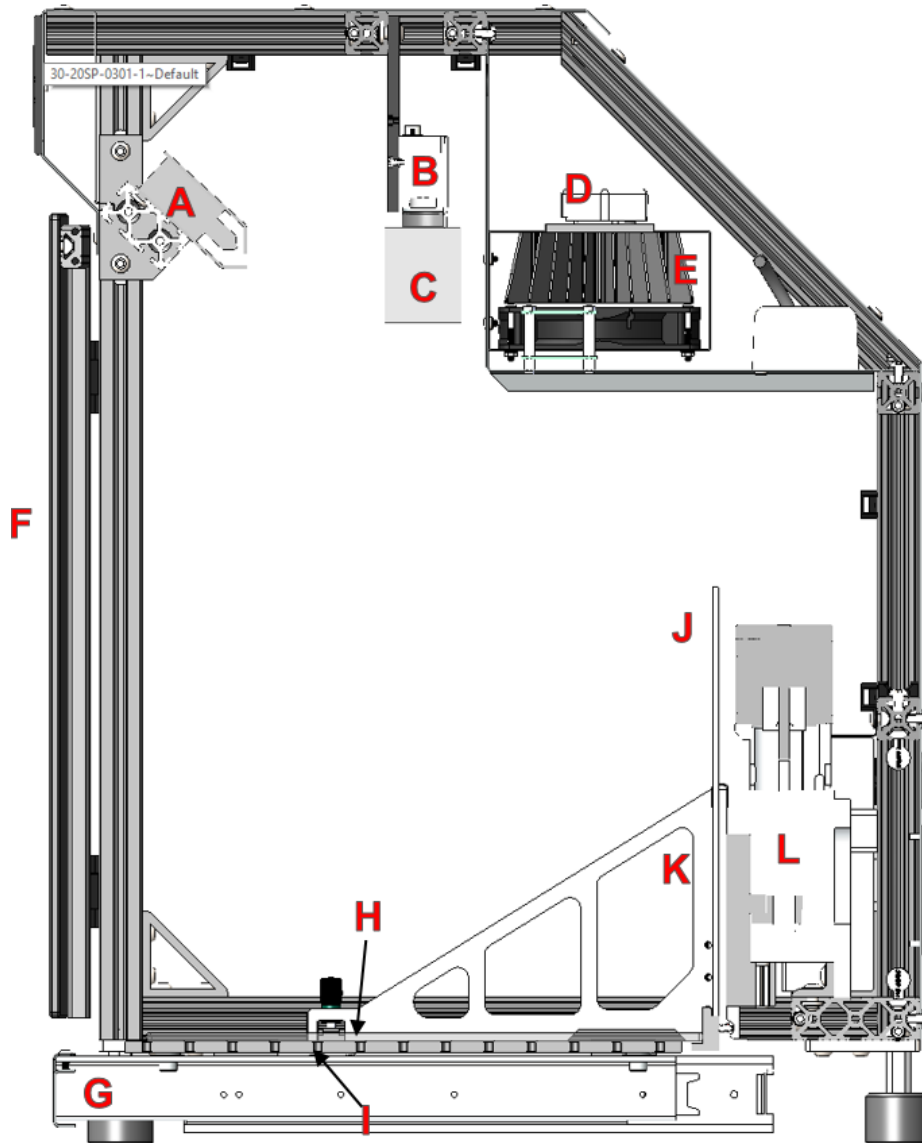
- Keep hands out of the system during measurements. The grating is motorized, and there is the potential for pinch points between moving and stationary components, especially the grating and sample drawer supports. Keep the grating translation path free from obstruction.

- Take care when opening and closing the system doors, as pinching is possible when they are moved.
- Do not operate the light sources with the fiber optic bundle connectors removed from the light source housings.
- Do not sit on any part of the system enclosure. Do not place loads greater than 15 kg (33 lbs) on top of the system.
- Caution should be exercised when lifting the TTSM. Use two people at all times and take care to use proper lifting technique when transporting the unit.
- Follow transport procedures described in **Appendix A.3** when moving the unit.
- Removing the back panel exposes all electrical components, and some components, especially the light source heat sink, can be hot enough to burn if touched. Make sure that the light has been off for at least 30 minutes before opening the back panel.
- MSDS data sheets for all supplied chemicals are available upon request.

1.2.3 System Operating Precautions

- Do not install additional software on the TTSM computer, change computer system settings, or upgrade system software or hardware without consulting Akrometrix. Unauthorized modifications can cause problems in normal system operation.
- In order to eliminate any eye, hand, or back strain, adjust the monitor and keyboard cart for ease and comfort of use. The monitor can be tilted and raised on its pedestal. The cart can be raised and lowered for proper hand position on the keyboard.

1.3 System Configuration



A Line Light	E Heat Sink	I Sample Tray
B Camera	F Door	J Mirror
C Lens	G Sample Drawer	K Grating Support
D Light Source	H Grating	L Motor Stage

Figure 1.3 Overall System Components

1.4 System Components

This system contains four main hardware components.

- Grating
- Sample Drawer
- Camera
- Light Source

It is important to understand the basic design and operation of these components in order to fully utilize the system’s capabilities. See the following sections for a brief description of each component.

1.4.1 Grating

Each TTSM system is provided with a single Ronchi ruled grating with either 100 or 200 lines per inch. These frequencies, when combined with appropriate camera lenses, allow the user good accuracy at a variety of part sizes and working distances. Please see **Table 1.1** and the Akrometrix Optical Techniques and Analyses 101 document for more details.

A linear motion stage drives the grating up and down to achieve phase stepping in the TTSM. The system’s mirror is mounted to the stage assembly, and moves along with it. A single motor in the back of the unit is attached to a linear motion stage that provides a 5.08 cm (2 inch) range of travel. A limit switch prevents the motor from operating past the stage travel limits. Control over the motor is done exclusively using the Surface Measurement software. Please see the **Surface Measurement User Manual** for instructions on its use.

1.4.2 Sample Drawer

Samples are supported by a sliding aluminum tray contained within a drawer which can be manually extended from the system for easy access. A catch locks the drawer into place once it is fully pushed inside the machine.

1.4.3 Camera

The system is equipped with a single 2.0 megapixel camera to capture image data. Multiple of lenses are provided with the camera, allowing the user control over field of vision and level of zoom. **Table 1.1** shows the relationship between lens size, grating frequency, and maximum field of vision.

Table 1.1 Grating Frequency, Lens Size, and Field of Vision

Grating/Lens	4.4-11 mm Lens	12-36 mm Lens
100 LPI Grating	FOV: 310x300mm	Not compatible
200 LPI Grating	FOV: 302x230mm - 310x300mm	FOV: 206x154mm – 276x209mm

1.4.4 Light Source

An LED light source feeds light to a pair of fiber optic line lights which are pointed at the mirror in the back of the unit. The light source should generally be set to maximum intensity for shadow moiré tests to maximize contrast.

1.5 Technical Support

For technical support, contact Akrometrix:

Akrometrix	404-486-0880	support@akrometrix.com
2700 NE Expressway	404-486-0890 (fax)	http://www.akrometrix.com
Building B, Suite 500		
Atlanta, GA 30345		

When contacting Akrometrix, please provide the system serial number, the version numbers of the Akrometrix software being used, a description of the problem or question, and contact information for reply. If the question concerns a particular measurement or analysis, please provide electronic copies of the phase images, reference images, and final results and a description of data acquisition and/or analysis conditions. If the problem concerns changes or failure in general system operation, please describe any events or system modifications that occurred immediately before the problem arose.

2 System Set-up and Use

2.1 System Set-up

1. Turn the TTSM system on.
 - a. Ensure that the TTSM System is correctly connected to the computer (see **Section A.2**).
 - b. Turn on the light source and ensure that it is set to 100% power.
2. Run Surface Measurement by clicking the Surface Measurement button in the Studio Manager bar on the left side of the screen. A start-up splash screen appears while the software initializes. Refer to the **Surface Measurement User Manual** for operating procedures.
3. To access the sample tray, push firmly inward on the front of the sample drawer. This will release the catch that holds the drawer closed, allowing the sample tray to be pulled towards the user. Place all samples on the tray so that they are oriented in line with the tray and parallel with each other.
4. Push the sample drawer closed until the catch engages. The system is now ready to begin operation.

2.2 System Shutdown

The TTSM has a rocker switch on the back, near the main power cord, that serves as the master on/off switch.

2.3 Replacing Gratings and Lenses

Both gratings and lenses can be swapped out to change the field of view, data density, and Z-resolution requirements (see **Table 1.1** for details). In order to swap gratings, open the system doors and carefully lift out the old grating before putting a new one in its place. To replace a lens, open the door and unscrew the old lens from the camera, then screw on a new one.

2.4 Cleaning a Grating

Maintaining a clean grating is critical to optimizing measurement resolution and reducing measurement noise when using shadow moiré. Gratings should be cleaned on an as needed basis, when dust collects on the top surface or fingerprints are present.

Gratings should be cleaned with a lint free cloth or wipe and typically with a mild glass cleaner or 30-70% IPA solution. The etched lines in the grating surface are not easily removed. Users are free to press firmly on the grating and wipe in multiple directions to clean the grating surface effectively. If the grating is removed for cleaning, be careful not to drop it, as they are relatively fragile.



Note: Refer to the cleaning product precautions for any personal protection equipment needed and for disposal of soiled cloths.

3 Troubleshooting

3.1 Troubleshooting Data Acquisition

As with any measurement system, the TTSM has its limitations. These limitations exist because the shadow moiré technique with phase stepping analysis is sensitive to the optical properties of the samples measured.

The optical and analytical limitations of the system include:

- Failure to obtain good fringe phase information.
- Loss of resolution on samples with a wide range of reflectivity.
- Fine pitch surface patterns.

For further troubleshooting details, please see the Surface Analysis User Manual as well as the Akrometrix Optical Techniques and Analyses 101 manual.

Appendix A - Miscellaneous Information

A.1 Equipment Ratings

Electrical	
Supply Voltage	100 – 240 VAC, 50-60 Hz
Full Load Amp Rating	10 A
Mechanical	
Footprint	490 (w) x 531 (d) x 678 (h) mm
Weight	32 kg (70.5 lbs)

A.2 Installation and Assembly

1. The TTSM is designed to be installed atop a table, in a room with a temperature between 20–26C and humidity between 20-80% non-condensing. The lighting should not be overly bright, nor so dim that these instructions cannot be read.
2. The TTSM can be lifted and carried by two people, and should be held by the frame at the base. Place it on the table where it will be installed.
3. Remove any packing materials attached to the equipment.
4. Unscrew the grating support from the motor stage and remove it.
5. Remove the strap from the motor stage (see **Figure A.1** and **Figure A.2**).
6. Screw the grating support back into place.
7. Install the grating on the grating support.
8. Install the mirror on the back of the grating support.
9. Attach one of the included lenses to the camera. Match the lens with the grating using **Table 1.1**.
10. Assemble the monitor and place it on the table next to the unit. Place the keyboard and mouse on the table.
11. Install the computer where it can be attached to both the monitor and the system.
12. Connect all cables.
 - a. The TTSM unit and monitor must be plugged into wall sockets.
 - b. The Ethernet cable on the back of the unit connects to the top Ethernet add-on card port on the back of the computer.
 - c. The RS2-32 cable on the back of the unit connects to the S1 port on the computer's break-out serial port cable.
 - d. Monitor cable, keyboard and mouse cables, Ethernet cable to local network connects to motherboard Ethernet port.

A.3 Transport

When transporting the TTSM system to a new location, Akrometrix recommends that certain components be removed from the system and packed separately. These include:

- Grating
- System Mirror
- Camera lenses (place lens caps on lenses, both ends, and a cap over the exposed camera element)

Other moving parts should be either restrained from movement with zip-ties or removed and shipped separately, including:

- Sample Drawer
- Vertical translation stage. There is a metal strap that is shipped installed on the stage. This should be saved and reused in the event the system needs to be moved long distance again. **Figure A.1** shows the strap attached to the underside of the motor stage, and **Figure A.2** shows the strap in place on the motor stage.



Figure A.1 Bottom View of Stage Strap Installed for Shipping

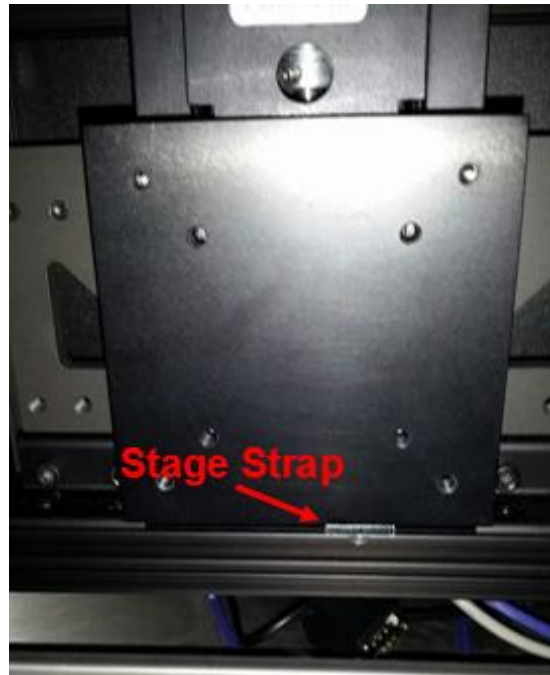


Figure A.2 Front View of Stage Strap Installed for Shipping

A.4 Disassembly

No special precautions or procedures are required for disassembly or final disposal, beyond normal care in handling the heavier components. No materials incorporated in the TTSM are known to require special handling or disposal. The metals used are aluminum and steel. The outer panels are acrylic.

A.5 Maintenance

A.5.1 Stage Lubrication

A syringe of lubricant called Lubriplate (see **Figure A.3**) is supplied with each Akrometrix system. This lubricant should be applied to the stage leadscrews at 6 month intervals. The procedure to do so is as follows.



Figure A.3 Lubriplate Stage Lubricant

1. Remove the grating carefully from the machine.
2. Remove the mirror from the grating support.
3. Unscrew the grating support and remove it, exposing the motor stage.
4. Using the Surface Measurement application, lower the stage to its bottom position. The leadscrews will be visible as shown in **Figure A.4**.
5. Apply a small bead of Lubriplate along the visible portion of the stage leadscrew. A small flathead screwdriver or wooden coffee stirrer can be used, just take care to not damage the leadscrew.
6. Raise the stage to its top position.
7. Apply another small bead of Lubriplate along the visible portion of the leadscrew.
8. Jog the stages up and down to their limits several times to ensure that the lubricant is adequately spread onto the leadscrew.



Warning: Avoid contact with skin and do not inhale. This product has a NFPA Health rating of 1. In the event of skin contact, wash with warm water and soap. A full MSDS is available upon request.

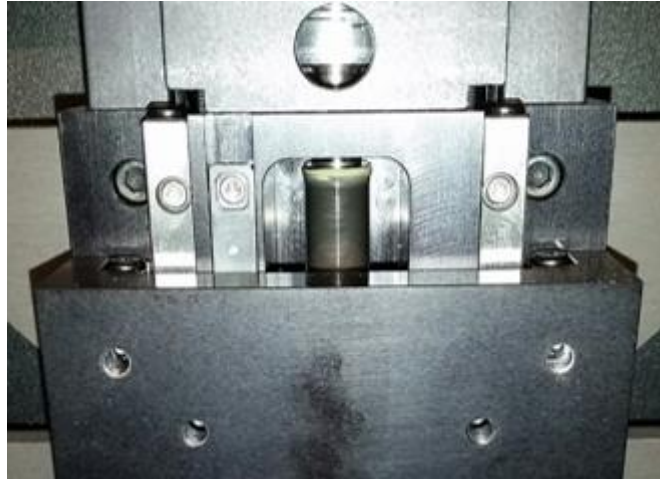


Figure A.4 Leadscrew Visible with Grating at Top Position

A.5.2 Servicing the Light Source

The LED light source in the TTSM has a serviceable life of ~50,000 hours. If any problems are encountered with this light source, contact your local Akrometrix representative for repair or replacement.

A.6 Camera Lens

Clean the lens as needed. The recommended product for cleaning the camera lens is Tech Spec Lens Cleaner. An eight fluid ounce bottle is included in the accessories kit. When using this product read and follow all directions and precautions on the bottle.



Warning: Avoid contact with the eyes. This product has a NFPA Health rating of 1. In the event of eye contact, rinse immediately with plenty of water for at least 15 minutes. Seek medical attention if irritation develops or persists. A full MSDS is available upon request.