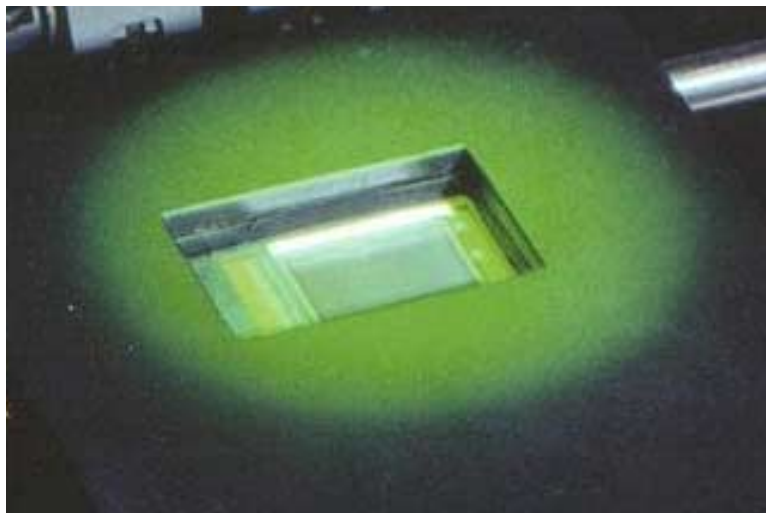


01 October 2003



Micro Display Tester Catalogue



DisplayCheck's mission is to provide the best possible service to our customers in the display industry so they may deliver the highest-quality display devices.

We shall accomplish this by designing, building, and supporting the most accurate, repeatable, and reliable display inspection solutions.

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Micro Display Tester Catalogue

This catalogue provides descriptions for the standard DisplayCheck system offerings and options. Since many of the options have overlapping hardware requirements, these prices must be computed based upon the selected packages. Please contact us for pricing details, additional technical information, or if a desired inspection solution is not listed here.

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Projection Panel Characterization System

The projection panel characterization system provides a system designed to meet the QA/QC needs of a company that uses microdisplays in its product line. These systems provide an optimized architecture for macroscopic measurements needed for display panel characterization.

Model MDT-205L

Description With an optics and lens assembly optimized for panel characterization, this model can perform the tests listed in the 200L package. The hardware assembly is designed for bench-top use in order to allow for maximum flexibility for use of varying drive electronics and display devices.



MDT-205L Configuration Example¹

Contents

- **Included Assessment Packages**
 - 200L: [Low Magnification Assessments](#)
- **Tester Electronics**
 - Main MDT Processing Computer
 - 12 bit 1024x1024 CCD camera and frame grabber
 - DC-controlled light source
 - DUT Interface and Control Computer
- **Mechanical Items**
 - Base plate to hold camera stanchion and DUT fixture
 - Camera stanchion with alignment adjustments
 - High System-Contrast PBS Optics assembly
 - Light shielding enclosure (not pictured).
 - Fixture for one style part
- **Optional Assessment Packages**
 - 200L-F: Flicker and retention measurements
 - 200LH-R: Rotational alignment for contrast measurements
 - 200L-S: Spectrometer measurements
 - 200LH-T: Temperature measurements
 - 200LH-V: Voltage setting for electronics and display.

¹ Shown without standard light shielding enclosure or DUT interface computer

Laboratory and R&D Systems

The DisplayCheck MDT laboratory and R&D models provide entry-level systems that can be expanded to meet the growing needs of an LCoS manufacturing or product company. These systems provide an optimized architecture for either macroscopic or microscopic measurements.

Model MDT-210L

Description This model is a low magnification R&D system that was designed for maximum flexibility in a laboratory environment. With an optics and lens assembly optimized for macroscopic measurements, this model can perform the tests listed in the 200L package. The hardware assembly, which includes optical alignment adjustments, is designed for bench-top use in order to allow for maximum flexibility for use of varying drive electronics and display devices.



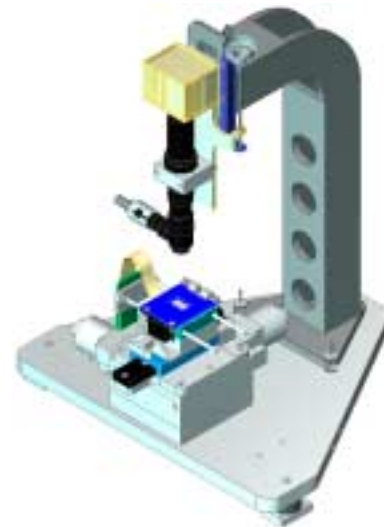
MDT-210L Configuration Example

Contents

- **Included Assessment Packages**
 - 200L: [Low magnification assessments](#)
- **Tester Electronics**
 - Main MDT Processing Computer
 - Motion controller and drive amplifier
 - 12 bit 1024x1024 CCD camera and frame grabber
 - Digital I/O and RS-232 interfaces
 - Rotational stage
 - DC-controlled light source
- **Mechanical Items**
 - Vibration Isolation base plate and light shielding enclosure
 - Camera stanchion with alignment adjustments
 - High System-Contrast PBS Optics assembly
 - Fixture for one style part

Model MDT-210H

Description This model is a high magnification R&D system that was designed for maximum flexibility in a laboratory environment. With an optics and lens assembly optimized for microscopic measurements, this model can perform the tests listed in the 200H package. The hardware assembly, which includes optical alignment adjustments, is designed for bench-top use in order to allow for maximum flexibility for use of varying drive electronics and display devices.



MDT-210H Configuration Example

Contents

- **Standard Assessment Packages**
 - 200H: [High Magnification Assessments](#)
- **Tester Electronics**
 - Main MDT Processing Computer
 - Motion controller and drive amplifier
 - 12 bit 1024x1024 CCD camera and frame grabber
 - Digital I/O and RS-232 interfaces
 - X-Y Translation stage
 - DC-controlled light source
- **Mechanical Items**
 - Vibration Isolation base plate and light shielding enclosure
 - Camera stanchion with alignment adjustments
 - PBS Optics assembly
 - Fixture for one style part

Entry-Level Production System

Entry-level Production systems provide a system that can be expanded to meet the growing needs of a microdisplay manufacturing company.

Model MDT-250LH

Description This model is a self-contained system that offers maximum capability in an entry-level production environment. With an optics and lens assembly optimized for both macroscopic and microscopic measurements, this model can perform the standard tests listed in the MDT-200L and MDT-200H packages. This system also comes standard with a dual-camera mounting system in a vibration-isolation and light-shielding cabinet. All assessments can be performed with an optional heated fixture.

This cabinet and camera mounting system can be expanded to the MDT-270 or MDT-290 inspection systems.



MDT-250LH Configuration Example

- Contents
- **Standard Assessment Packages**
 - 200L: [Low Magnification Assessments](#)
 - 200H: [High Magnification Assessments](#)
 - **Tester Electronics**
 - Dual-CPU Computer
 - Motion controller and drive amplifier
 - Dual 12 bit 1024x1024 CCD cameras and frame grabbers
 - Digital I/O and RS-232 interfaces
 - Rotational and X-Y Translation stages
 - DC-controlled light source
 - **Mechanical Items**
 - Self-contained cabinet with vibration isolation mounts
 - Dual-Camera stanchion with alignment adjustments
 - High System-Contrast PBS Optics assembly
 - Fixture for one style part

Automated Production Systems

These systems extend the entry-level production systems into a range of higher-volume production systems. The MDT-270 series provides “semi-automated” processing capabilities. This series can either handle a tray of manually loaded parts or provide an interface to external production handling equipment. The MDT-290 series provides a completely automated parts handling capability. This line is designed to facilitate total integration into a process flow by handling either magazines of parts or other handling mechanisms.

Model MDT-270LH Semi-Automatic Microdisplay Tester

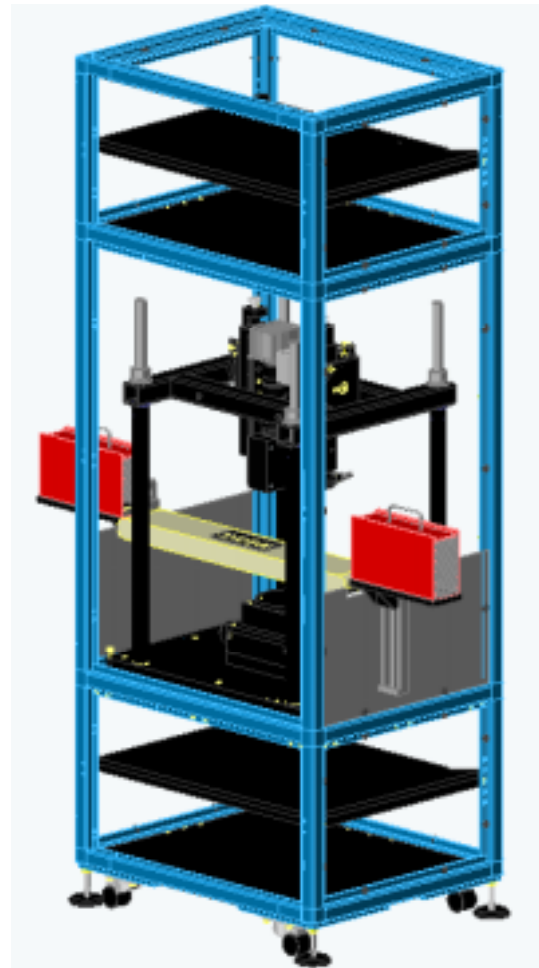
The MDT-270LH Microdisplay Tester has been designed for use with externally loaded trays of parts to be tested. This approach allows for a more cost-effective inspection scheme by not requiring a totally custom design for each packaging format. By utilizing a standard tray approach, only the final electrical connectivity and circuitry needs to be designed.

Operationally, the MDT-270 system uses a tray of approximately 10 parts. The final device count will depend upon the configuration of the individual parts. A tray loaded with parts is inserted into the system and the operator makes an electrical connection. Localization and inspection is then carried out for all parts on the tray. A report is provided by tray location for use by the operator for the parts sorting process.



Model MDT-290LH Automatic Microdisplay Tester

The MDT-290LH Microdisplay Tester Series is designed as fully automated handling, stand-alone, microdisplay inspection system. Input and output magazines feed and remove trays loaded with display devices to the measurement system and will operate unmanned for periods based on queue size. Once the tray is positioned, the MDT-290 measurement system automatically probes and inspects the microdisplay. The MDT-290 Series has the same low and high magnification capabilities and software test suites as that of all the MDT family of testers with options to accommodate many forms of display device carrier methods.



Since all Microdisplay parts are different, these systems will require a certain amount of customization. The level of specialized equipment will depend upon factors such as the size and form-factor of the parts, the electrical interconnection or probe points on the parts, and the overall process flow restrictions. We have several designs and candidate arrangements for this type of process automation. Please contact us for more information concerning our current and future capabilities for these systems.



Standard Microdisplay Assessments

Low Magnification Assessments (200L)

- Blemishes – Bubbles, particles, and scratches.
- Contrast – Ratio of bright to dark state at user defined ROI's on the panel.
- Contrast Uniformity – Variance of contrast at user defined ROI's on the panel.
- Cross Talk – Bleeding of black in to white regions and vice versa.
- EO Curve – Throughput vs. commanded gray level.
- Geometric Alignment – Alignment of active area to package.
- Image Retention – Residual or latent image fade time.
- Newton Fringes – Interference rings.
- Throughput – Reflectance or transmission at user defined ROI's on the panel.
- Uniformity – Variance of throughput at user defined ROI's on the panel.

High Magnification Assessments (200H)

- Display Blemishes – Bubbles, particles, and scratches.
- Focus – Planarity (focus) across the display.
- Geometric Alignment – Alignment of active area to package.
- Pixel Defects – Stuck or weak pixels, defect clusters, and lines.
- Sub-Pixel Defects – Bright or dark spots smaller than a pixel in size, sub-pixel defect clusters, and lines.
- Texture Analysis – Semi-periodic patterns such as rub marks.
- Uniformity – Variance of throughput at user defined ROI's on the panel.

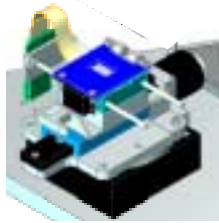
Optional Microdisplay Assessments

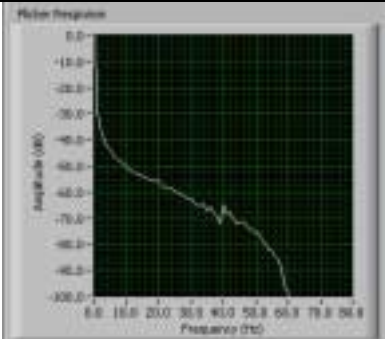
This section lists optional packages that can be used on the low and high magnification systems². Each option is described by the hardware and the assessments that can be performed by the optional equipment. The pricing for these options will have to be provided once all options are selected since the options can have overlapping hardware requirements.


- 200LH-C: Cell measurements (powered and/or unpowered).
- 200L-F: Flicker and image retention assessments.
 - Flicker dominant frequency.
 - Flicker dominant frequency amplitude.
 - Rise Time.
 - Fall Time.
- 200LH-R³: Rotational alignment for contrast measurements.
 - Minimum darkness angle used for Contrast Ratio measurement.
 - Contrast vs. angle.
 - Minimum darkness angle used for pixel and sub-pixel defect analysis.
- 200L-S: Spectrometer assessments.
 - CIE color co-ordinates.
 - Maximum response wavelength.
 - Reflectance vs. wavelength.
 - Contrast vs. wavelength.
- 200LH-T: Temperature controlled assessment.
- 200LH-U: User test development.
- 200LH-V: Voltage setting for electronics and display.
- 200L-W: Wafer (unpowered) assessments.
- 200H-Z: Z-height adjustment for inspection of glass blemishes.

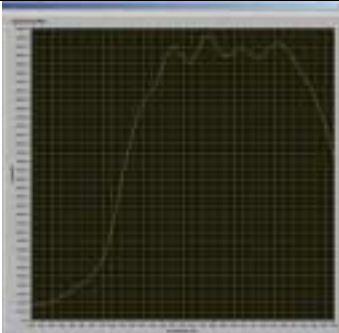
² LH packages available in high or low magnification. L pkgs are low mag only. H pkgs are high mag only.


³ Included on MDT-250LH and higher models.

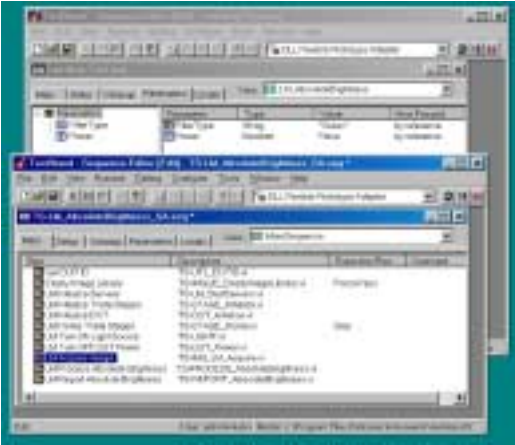
Option	MDT-200LH-C	
Description	This option provides the necessary hardware and software to perform macroscopic assessments on singulated but unpackaged device cells. These can be either powered or unpowered cells. The state of the cell will determine the assessments that can be performed on the device.	 <p>MDT-200LH-C Configuration Example</p>

Option	MDT-200L-F	
Description	This option provides the necessary hardware and software to perform macroscopic assessments for flicker, image retention, and response time.	 <p>MDT-200L-F Configuration Example</p>

Option	MDT-200LH-R	
Description	This option provides the necessary hardware and software to perform rotational alignment of the DUT. This allows for finding the orientation with maximum contrast during low magnification (macroscopic) processing and high magnification (microscopic) pixel and sub-pixel defect processing.	 <p>MDT-200LH-R Configuration Example</p>

Option	MDT-200L-S	
Description	This option provides the necessary hardware and software to perform macroscopic assessments for spectrometer measurements.	
		MDT-200L-S Configuration Example

Option	MDT-200LH-T	
Name	Optional Temperature Controlled Assessment Fixture	
Description	This option provides a heated fixture (room temperature to 100 degrees C) for the MDT-200 family of microdisplay inspection systems.	
		MDT-200LH-T Configuration Example

Option	MDT-200LH-U	
Name	Optional User Test Development Suite	
Description	<p>This option provides the LabVIEW and TestStand full development software from National Instruments and training to allow the end user to develop and install their own tests into the MDT software architecture.</p> <p>This option is not needed for general control of parameters and test setup. The standard software package provides complete debugging capabilities for the Test Stand sequences. The MDT software provides the necessary utilities for setting test parameters. This option is only needed if development of new tests by the end user is required.</p>	 <p>MDT-200LH-U Configuration Example</p>

Option	MDT-200L-V	
Description	This option provides the necessary hardware and software to set the drive electronics voltages based upon user-defined criteria.	

Option	MDT-200L-W	
Description	This option provides the necessary hardware and software to perform macroscopic assessments on unpowered wafers.	

Option	MDT-200H-Z	
Description	This option provides the necessary Z-Stage hardware and software to perform microscopic assessments on the DUT glass surface.	



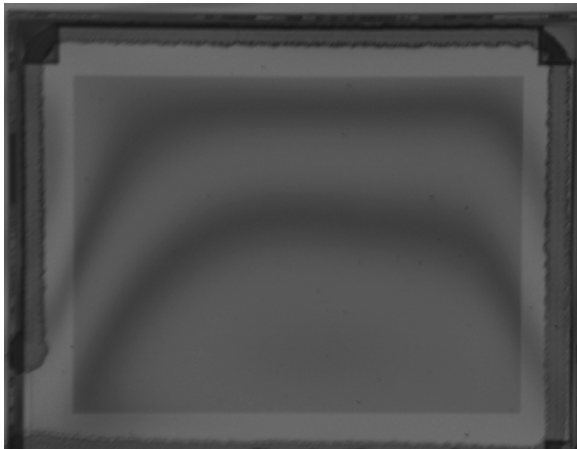
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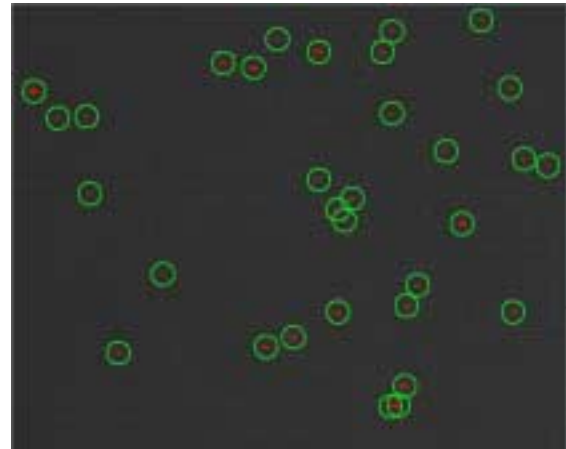
Notes:

Microdisplay Assessments

This catalogue lists the standard DisplayCheck solutions and optional assessment packages that can be used on the low and high magnification systems within these systems. The low magnification assessments provide macroscopic metrics on the display's performance. These measurements include items such as contrast and uniformity. The high magnification tests provide a quantifiable measurement of the individual pixel and sub-pixel performance. Representative images are shown in the following figures. The macroscopic image depicts severe Newton Fringes on an unfilled cell on a wafer. The microscopic image shows the individual pixels to be processed for weak and stuck-off conditions. By selecting optimum optics and lens assemblies for each measurement, the DisplayCheck microdisplay inspection solutions provide unequalled performance in defect inspection technology. This technology has been in production use since 2000, thus providing an additional value to the user by including this experience in the overall solution.



Example Macroscopic Measurement Image



Example Microscopic Measurement Image

The DisplayCheck systems provide for a range of display assessments. These assessments include quantitative tests, qualitative inspections, and precision judgment evaluations. Tests provide absolute measurements of parameters such as contrast. Inspections give qualitative grading of visually perceptible defects such as blemishes. Evaluations detect judgmental quantities such as flicker.

All assessments are groups according to like function and similar hardware needs. The base package for both high and low magnification processing include as many assessments as possible without the addition of extra hardware in order to provide the most cost-effective solutions. Optional packages include the necessary hardware and associated processing technology. Some options are available solely on high or low magnification systems. Others can be used on both. In addition, several options have overlapping hardware needs so significant investment reductions can be achieved by combining related options.