

# Smart System® 20/20

## Visual Acuity Systems

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### User & Operation Guide

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# Smart System® 20/20

## Visual Acuity and Fixation Systems

### User & Operation Guide

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Smart System® 20/20 User and Operation Guide

# Introduction

## Purpose of Manual

This manual provides the essential information necessary for installation, operation, and routine care of Smart System® 20/20. The instructions within this manual should be carefully followed for safe and effective equipment use. It contains important operation and maintenance information for personnel trained to use this device.

It is important that all personnel who will operate Smart System® 20/20:

- Read and understand this manual before device operation.
- Follow all warnings and precautions outlined in the sections **Operational Precautions and Limitations** and **Hazards** for their own safety and the safety of those around them.

In this manual, the following definitions apply for all WARNING and CAUTION statements:



**WARNING:** A warning statement covers any operation, procedure, practice, etc., which if not strictly observed, might result in serious injury or long-term health hazards to personnel or patients.



**CAUTION:** A caution statement covers any operation, procedure, practice, etc., which if not strictly observed, might result in mild or moderate injury or damage or destruction of equipment or loss of performance.

## Abbreviations









The abbreviations used in this manual are listed and defined in the following table.

cm	Centimeter (1 cm = .01 m)
CPU	Central processing unit
EHR workstation	Electronic Health Record workstation
IFU	Instructions For Use
IR	Infrared
USB	Universal Serial Bus
VGA	Video Graphics Array
°C	Degrees (Celsius)
°F	Degrees (Fahrenheit)

Our devices are stand-alone systems and do not require Internet access or network connections for their operation. All functionalities are self-contained within the device, ensuring that they perform optimally without external connectivity.

## Label Graphics Explanations

The following table provides an explanation of the label graphics found on the Smart System® 20/20.

	Warning / Caution
	Reference Number
	Manufacturer
	Medical Device
	Temperature Limits
	Consult Instructions for Use
	Keep Dry
	Electric Shock Hazard

## System Description

### Intended Use

Smart System® 20/20 is intended for use in displaying computerized images on a screen for vision testing.

### Safety

Smart System® 20/20 is safe when used as described in this manual.

### Contraindications

There are no known contraindications when used as directed.

### Medical Device Classification

Class I	FDA listed device
Class I	EU MDD 93/42/EEC
Class I	Health Canada

## Physical Description

Smart System® 20/20 is comprised of an All-in-One Unit (CPU and display screen); an IBM-compatible 101-key keyboard; computer mouse; USB 2.0 IR Detector; remote control; power strip; brackets and mounting software (optional); Glare Testing System (optional).

\*For end users who prefer to supply their own computer equipment (CPU and LCD computer monitor required), Smart System® 20/20 may be supplied as software only. See Device Specifications and Assembly Instructions for configuration details.

### All-in-One Unit

The All-In-One Unit consists of a CPU with a widescreen flat display panel. The Unit is intended to be installed in a permanent location within the exam room. See Assembly Instructions for directions on positioning the All-in-One Unit.

### Keyboard and Mouse

A standard IBM-Compatible 101-key keyboard, computer mouse, and USB keyboard / mouse adaptor are supplied for use with the All-In-One Unit.

### USB Infrared Detector

The USB Infrared (IR) Detector, when connected to the All-in-One Unit via USB 2.0 port, receives data input from the Remote Control.

### Remote Control

The Remote Control is used to control the operation of the Smart System® 20/20.

### Foot Pedal (optional)

The Foot Pedal is an optional input controller of Smart System 20/20.

### Smart System Android Tablet Controller (optional)

The Smart System Tablet is an optional input controller of Smart System 20/20 and may also be used for limited Near Vision testing applications. See the Smart System Tablet Instructions For Use for more information.

### Power Strip (optional)


An optional power strip is provided for ease of set-up for the User.

### Brackets and Mounting Hardware (optional)

Brackets and mounting hardware are provided for ease of set-up by the User.

### Glare Testing System (optional)

The M&S Glare Testing System is an optional accessory which may be used in conjunction with Smart System® 20/20. It consists of four Glare Lights, a Glare Control Module, and 15V AC Adapter.

 **WARNING:** All M&S Glare Testing System users must be familiar with the Instructions For Use (IFU) prior to installation or use. The Glare Testing System has unique warnings and precautions which are specific to its use.

# Specifications, Precautions, Limitations

## Device Specifications

<b>Intended Use</b>	Smart System® 20/20 is intended for use in displaying computerized images on a screen for vision testing.
<b>Indications for Use</b>	Smart System® 20/20 is indicated for use in vision testing as part of a standard ophthalmic exam.
<b>Operating System</b>	Windows® 11 IoT (64-bit)
<b>Processor</b>	Intel® Celeron™ N6210 1.2GHz
<b>Dimensions</b>	23.8" W x 18.2" H x 3.5" D (60.5 cm x 46.2 cm x 8.9 cm)
<b>Weight</b>	15.6 lbs. (7.1 Kg)
<b>Memory</b>	4GB DDR4 SODIMM
<b>Video</b>	Intel® HD Graphics
<b>Display</b>	22" Widescreen Flat Panel Display (16:10), 1680 x 1050
<b>Storage</b>	128 GB M.2
<b>Network Interface</b>	Intel® I225 V/I226V 2.5 GbE Controller
<b>Audio</b>	Realtek ALC888S, integrated 2 x speakers
<b>I/O Ports</b>	2 USB 3.2 ports 2 USB 2.0 2 Serial ports 2 RJ45 1 HDMI 1 Display Port 3 Audio Ports (In, Out, Mic)
<b>Input Voltage Range</b>	12V DC 5A
<b>System Included AC Adapter</b>	100 ~ 240V AC 50/60Hz North America UL Listed
<b>Storage Conditions</b>	10°C - 35°C (50°F - 95°F); 35% - 80% humidity
<b>Operating Conditions</b>	10°C - 35°C (50°F - 95°F); 35% - 80% humidity

## Operational Precautions and Limitations

The following information will affect the operator's success in using Smart System® 20/20.


**Should Be Used Only by Trained Professionals** – Federal law restricts the sale of this device to physicians and medical professionals only. Use of the device in procedures other than those described in this manual may result in injury.


**Connect the System to an External Power Supply According to Labeling** – Smart System® 20/20 uses externally supplied electricity to operate. Check the voltage and amperage ratings of the external supplies and make sure they match the labeled ratings for electricity inputs shown on the rear of Smart System® 20/20.


**Shut System Down on a Daily Basis** – Smart System® 20/20 should be shut down on a daily basis. See “System Shut Down” section for the shut-down procedure.

**Conduct of Examinations and Interpretation of Results** – M&S Technologies does not suggest or endorse any specific method of conducting any examination, nor do we suggest any interpretation of results obtained by conducting such an examination. As a medical professional, it is your responsibility to determine the appropriate method for conducting an examination as well as the interpretation of the results.

## Hazards

 **WARNING:** A small percentage of users may experience epileptic seizures when exposed to certain light patterns or backgrounds on a computer screen or while using the hardware. Certain conditions may induce previously undetected epileptic symptoms even in users who have no history of prior seizures or epilepsy. If patient or anyone in the patient's family has an epileptic condition, consult a physician prior to using the hardware. Immediately discontinue use of the hardware and consult a physician if patient experiences any of the following symptoms while using the hardware: dizziness, altered vision or muscle twitches, loss of awareness, disorientation, any involuntary movement, convulsions, or any unusual behavior or condition.

 **WARNING:** To prevent or reduce the risk of electrical shock or fire, do not expose the unit to rain or moisture.

 **CAUTION:** There are no user serviceable parts inside this unit. Attempting repairs will void the manufacturer's warranty. If unit requires service, please contact M&S Technologies Technical Support helpline.



# Hardware Specifications

## Operating System

Windows® 11 Home IoT (64-bit)

## Processor

Intel® Celeron™ N6210 1.2GHz

## Dimensions/Weight

23.8"W x 18.2"H x 3.5"D, 15.6 lbs

## Memory

4GB DDR4 SODIMM

## Video

Intel® HD Graphics

## Display

22" Widescreen Flat Panel Display (16:10), 1680 x 1050

## Storage

128GB M.2

## Network Interface

Intel® I225 V/I226 V 2.5 GbE Controller

## Audio

Realtek ALC888S, integrated 2 x speakers

## I/O Ports

2 USB 3.2 ports

2 USB 2.0 ports

2 Serial Ports

2 RJ45

1 HDMI

1 Display Port

3 Audio Ports (In, Out, Mic)

## Input Voltage Range

12V DC 5A

## System Included AC adapter

100 ~ 240V AC, 50/60Hz America UL Listed

# Spécifications matérielles

## **Système d'exploitation**

Windows® 11 Édition IoT (64-bit)

## **Processeur**

Intel® Celeron™ N6210 1.2GHz

## **Dimensions et poids**

60.452cm W x 45.228cm H x 8.89cm D, 9.979 kg  
(23.8"W x 18.2" H x 3.5" D, 15.6 lbs)

## **Mémoire**

4GB DDR4 SODIMM

## **Vidéo**

Intel® HD Graphique

## **Affichage de l'ordinateur**

22" Écran Large et Plat (16:10), 1680 x 1050

## **Stockage**

128GB M.2

## **Interface réseau**

Intel® 1225 V/1226 V 2.S GbE contrôleur

## **Audio**

Realtek ALC888S, intégré 2 x haut-parleurs

## **I/O Ports**

2 USB 3.2 ports

2 USB 2.0 ports

2 Serial Ports

2 RJ45

1 HDMI

1 Display Port

3 Audio Ports (in, Out, Mic)

## **Gamme de tension**

12V DC 5A

## **Système Inclus AC adaptateur**

100 ~ 240V AC, 50/60Hz Amérique du Nord UL  
Listé

# Assembly Instructions

The following are step-by-step instructions for the Smart System<sup>®</sup> 20/20 wireless system. Carefully follow each step to ensure proper operation.

## 1) General Installation

- a) Unpacking: Carefully unpack each of the components. The following is a list of components:
  - 1) Computer & LCD Computer Monitor OR All-in-One Unit
  - 2) IBM Compatible 101 Key Keyboard
  - 3) Mouse
  - 4) USB IR Detector (Built into USA 2.0)
  - 5) Remote Control
  - 6) Power Strip
  - 7) Brackets and Mounting Hardware (optional)
- b) Locate the Monitor and Computer at a permanent location within the exam room.
  - 1) In a direct-view situation, the center of the monitor should be approximately 60" off the ground and represent a direct line of sight from the average adult patient in the exam chair to the center of the monitor.
  - 2) In a mirrored environment, the center of the mounting bracket or monitor should be roughly 78" off the ground.
  - 3) With a mirror the monitor should be moved over 18" from the center of the chair to the opposite side of the stand so as not to interfere with the phoroceptor or near-rod.
  - 4) **Note** that the computer and monitor can be mounted in different locations if long audio and video cables are run between the two units.
  - 5) If using customer-provided computer (e.g., EHR workstation):
    - (A) A second graphics card must be provided and installed with VGA output for Smart System<sup>®</sup>
    - (B) Windows<sup>®</sup> must be configured in advance for dual-video
    - (C) M&S recommends working with an IT professional to specify and install card and set up video output
    - (D) Smart System<sup>®</sup> and drivers should be installed using Software Installation Instructions and CD
- c) Plug Keyboard and mouse adapter into any open USB port
- d) Plug USB Infrared Detector into Computer (Built into USA 2.0).
- e) Plug Computer Power Cord into the back of Computer at location.
- f) Plug Monitor Cable into the back of Computer at Monitor Input location Color Coded Blue (if not using All-in-One unit).
- g) Plug in Monitor Power Cable into the back of the Monitor (if not using All-in-One unit).
- h) Plug Power Cables into Outlet or optional Power Strip.

# Initialize and Calibrate Equipment

## Complete Calibration

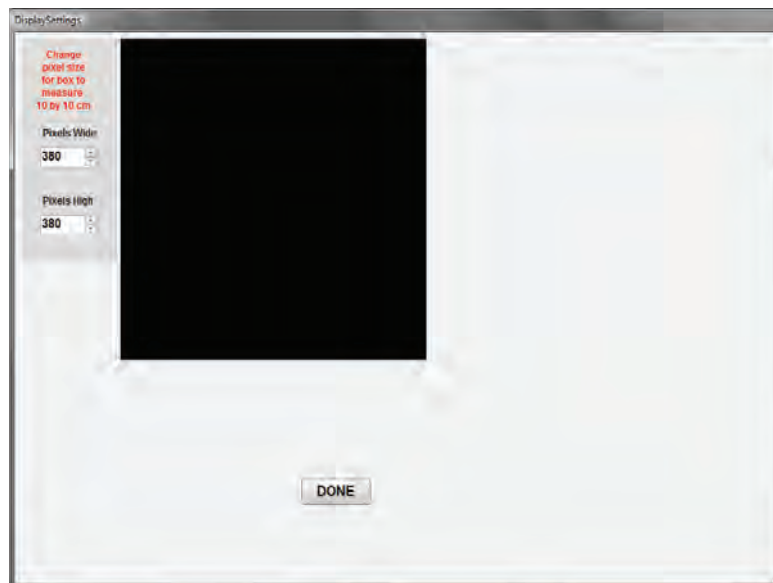
1. Upon completing all of the connections, turn on the computer and monitor. System will initialize and the startup process begins. If using a user-supplied computer, the software will need to be installed and registered at this point using the separate installation instructions provided. Upon completion of the start-up process on first-use, the monitor will display System Calibration set-up.
2. Smart System<sup>®</sup> will launch – if calibration does not automatically appear on first use, press “z” or “Home” key to make the set-up screen appear.

The screenshot shows the 'M&S Main Configuration Screen' with the following sections:

- Display Settings:**
  - Distance From the Screen to the Bridge of the Patient's Nose: Feet (selected), Dist 1: 19 FT, 8 IN, Direct; Dist 2: 9 FT, 10 IN, Direct.
  - Screen Position - Direct or Using a Mirror: Direct (selected).
  - List of Monitors Available to Display Smart System: 1920x1200\\.DISPLAY1 (selected).
  - Note: For Partial Screen, go to Advanced/Other.
  - Buttons: Display, Worth4Dot ColorAdjuster.
- System Functionality:**
  - Edit Letter Charts and Lines, Defaults, Random, ...: Letter
  - Edit Movie Ordering and add Image/Movies to Lists: Media
  - Create/Edit Protocols you can Execute During Runtime: Protocol
  - Program your Wireless Remote, Wired Keypad, and Footpedal: Device
  - For more settings press the Advanced Settings Button: Advanced
- Timer Settings:**
  - Blank Screen Timer (minutes): 20
  - Letter Cycle Timer (Seconds): 4
  - Silent Fixation Timer (MilliSeconds): 400
  - Choose Green or Blue: Green Worth 4 Dot (selected), Blue Worth 4 Dot.
  - This Checkbox Will Revert to Old Standard: unchecked.
- Buttons:** DONE, Import Config Files, Export Config Files.

3. Move the cursor to the FT field for **DIST1**.
4. Enter the new Focal Distance in FT and IN (e.g., 10 feet and 2 inches).
5. Select **Direct** or **Mirrored**.
6. If a Second Distance is desired, for instance with Wheelchairs or Clinical Trials, move the cursor to the FT field for **DIST2**.
7. Enter the new Focal Distance in FT and IN (e.g., 10 feet and 2 inches).
8. Select **Direct** or **Mirrored**.
9. Press **Display** button.

## Initialize and Calibrate Equipment (Cont'd)



10. Measure the 10cm x 10cm square and use the adjusting arrows to size the black box correctly. **Note: This is crucial for correct optotype sizing!** This is a change from previous software that was based on 4" x 4".
11. Click **Done**.
12. Click **Done**.
13. Smart System<sup>®</sup> is now calibrated and ready for use.

# Re-Calibration of Focal Distance Only

Note that the focal distance is measured from the bridge of the nose of the average patient to the monitor (direct) or from the bridge of the nose to the mirror and then from the mirror to the monitor (mirrored).

1. Press “z” or “Home” key to make the set-up screen appear.

The screenshot displays the 'M&S Main Configuration Screen' with the following sections:

- Display Settings:**
  - Distance From the Screen to the Bridge of the Patient's Nose:** Radio buttons for 'Feet' (selected) and 'Meters'. Two distance fields: 'Dist 1' (FT: 19, IN: 8) and 'Dist 2' (FT: 9, IN: 10). Both have dropdown menus set to 'Direct'.
  - Screen Position - Direct or Using a Mirror:** A dropdown menu set to 'Direct'.
  - List of Monitors:** A dropdown menu showing '1920x1200\.\DISPLAY1' with a note: 'Note: For Partial Screen, go to Advanced/Other'.
  - Timer Settings:** 'Blank Screen Timer (minutes): 20', 'Letter Cycle Timer (Seconds): 4', 'Silent Fixation Timer (MilliSeconds): 400'.
  - Worth 4 Dot Controls Section:** Includes 'Worth4Dot ColorAdjuster', 'Choose Green or Blue' (radio buttons for 'Green Worth 4 Dot' and 'Blue Worth 4 Dot'), and a checkbox 'This Checkbox Will Revert to Old Standard'.
  - Buttons:** 'Display', 'DONE', 'Import Config Files', and 'Export Config Files'.
- System Functionality (VERSION: 2014.1):**
  - 'Edit Letter Charts and Lines, Defaults, Random, ...' button: 'Letter'
  - 'Edit Movie Ordering and add Image/Movies to Lists.' button: 'Media'
  - 'Create/Edit Protocols you can Execute During Runtime' button: 'Protocol'
  - 'Program your Wireless Remote, Wired Keypad, and Footpedal.' button: 'Device'
  - 'For more settings press the Advanced Settings Button.' button: 'Advanced'

2. Move the cursor to the FT field for **DIST1**.
3. Enter the new Focal Distance in FT and IN (e.g., 10 feet and 2 inches).
4. Select **Direct** or **Mirrored**.
5. If a second distance, for instance with wheelchairs or clinical trials, is desired, move the cursor to the FT field for **DIST2**.
6. Enter the new Focal Distance in FT and IN (e.g., 10 feet and 2 inches).
7. Select **Direct** or **Mirrored**.
  - **Note:** toggling between Feet and Meters allows the distance to be entered in the appropriate format.
8. Click **Done**.

# Remote Control & Designations

The Wireless Remote is used to control the operation of the Smart System<sup>®</sup> 20/20.

The remote control is laid out in logical sections: Tests, Patient Education, Isolation, Additional Tests, and Sizing.



## Primary Remote Assignments & Functions

<b>10, 15, ...</b>	Directly select a given acuity level (e.g., 30 = 20/30; pressing a 2 <sup>nd</sup> time will randomize)
<b>SGL</b>	Displays a single optotype (i.e., Letters, Numbers, LEA SYMBOLS <sup>®</sup> , Allen Pictures)
<b>LINE</b>	Displays a single line of any optotype
<b>LINES</b>	3 lines of the same size
<b>VLine</b>	A vertical line of optotypes
<b>B</b>	Blank Screen
<b>LTR</b>	Sloan & Snellen Letters
<b>PIX</b>	LEA SYMBOLS <sup>®</sup>
<b>CONT</b>	Contrast Sensitivity
<b>#'s</b>	Displays Numbers
<b>Arrow</b>	Displays an arrow beneath the first Optotype in a single line – vertical or horizontal
<b>HOTV</b>	HOTV
<b>E</b>	Tumbling E's
<b>CYC</b>	Adolescent/Older Child Fixation, single optotype (Letters, LEA SYMBOLS <sup>®</sup> , Allen, and Numbers) or single line on screen will randomize at regular timing intervals. User can program the timing of the intervals.
<b>R/G</b>	Red/Green
<b>W4D</b>	Worth 4 Dot
<b>FNC</b>	"Shift" Key provides access to less commonly used features
<b>+</b>	Scroll up in size on any optotype or scroll up through movies/images
<b>-</b>	Scroll down in size on any optotype or scroll down through movies/images
<b>Round 1</b>	Plays the selected image or movie
<b>Round 2</b>	Glare Medium (Optional)
<b>Round 3</b>	Directory of Images (Patient Education) JPG Format
<b>Round 4</b>	Directory of Videos MPG or WMV Format



# Function-Level Remote Control

## Assignments and Functions

Press **FNC**, release, and then press the desired key.

Key-press	Function	Description
<b>FNC + WFD</b>	On Screen Size	Toggles the Large On-Screen Size Display that shows the sizing of the optotypes
<b>FNC + LTR</b>	ETDRS	Toggles between Snellen and the ETDRS Chart
<b>FNC + PIX</b>	Allen Pictures	Allen Pictures for children
<b>FNC + RANDOM</b>	Play DVD	Plays DVD if DVD present
<b>FNC + LINE</b>	Black/White Toggle	Toggles black optotypes on white screen and white optotypes on black screen. Useful for low vision.
<b>FNC + SGL</b>	Sine Wave Contrast	Linear Sine Wave Grating Contrast test – See appendix for additional information
<b>FNC + B</b>	Exit	Exits the software to Windows®
<b>FNC + 10</b>	Additional Tests	Fixation disparity and Maddox rod – use + and – to step through tests
<b>FNC + 15</b>	Color Vision Test	ColorCheck Color Testing
<b>FNC + 20</b>	Astigmatic Dial	Displays the Astigmatic dial: use + and – to step the pointer-ball around the dial
<b>FNC + 50</b>	Random Dot Stereo	Random Dot Stereo – See Appendix
<b>FNC + 80</b>	Contour Stereo	Contour Stereo - Landolt Rings – See Appendix
<b>FNC + 200</b>	LEA SYMBOLS® Contour	Distance Stereo
<b>FNC + 400</b>	Retinoscopy E	A red-green screen with a 20/400 E used by some doctors for fixation during retinoscopy

# Remote Control Use & Operation

## Most Common Tasks Accomplished with the Remote Control

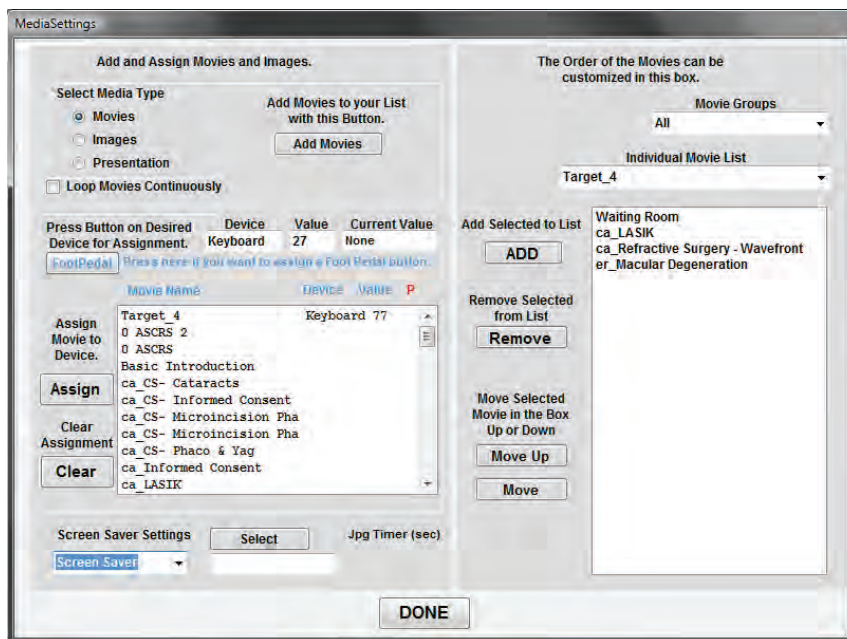
1. **Switching between Tests** – To switch between tests, for instance moving from Snellen letters to LEA SYMBOLS<sup>®</sup>, press the appropriate test mode button. In this example, pressing **PIX** will switch to LEA SYMBOLS<sup>®</sup>.
2. **Isolating a Line** – To isolate a single line of optotypes, press the **Line** key. To isolate a vertical line of descending optotypes, press **VLine**.
3. **Isolating a Letter** – To isolate a single optotype, press the **SGL** button.
4. **Randomizing** – There are several ways to randomize the display:
  - a. Press the test mode button again. For example, if you desire to randomize the Snellen letters, simply press **LTR** a second time.
  - b. Press the optotype size button again. For example if the top line of the chart is 20/40 and you wish to randomize the chart, simply press **40**.
  - c. If working with a single optotype or single line, press the **SGL** or **Line** button a second time.
5. **Access to a Particular Size** – To access a particular size of optotype or a particular line of the chart, press the numbered button corresponding to it. For example, to bring up 20/100, press **100**.
6. **Increasing and Decreasing Size** – To increase or decrease the optotype size, simply press + (Plus) or – (Minus) on the keypad.
7. **Blanking the Screen** – To blank the screen, press the **B** key.
8. **The Optotype Pointer** – When working in a Line or Vertical Line of optotypes, press the **Arrow** key to bring up the optotype pointer. Next use the left side Up/Down (+/-) buttons to move the arrow left or right. Using the right side Up/Down (+/-) buttons will change the optotype size. Subsequently pressing **Arrow** will toggle off the arrow.
9. **Cycling a Line or Single Optotype** – To randomize a single optotype or line of optotypes at a predetermined rate, press the **Cyc** key. The row will refresh every several seconds. This works well for adult fixation.

# Fixation and Patient Education Movies

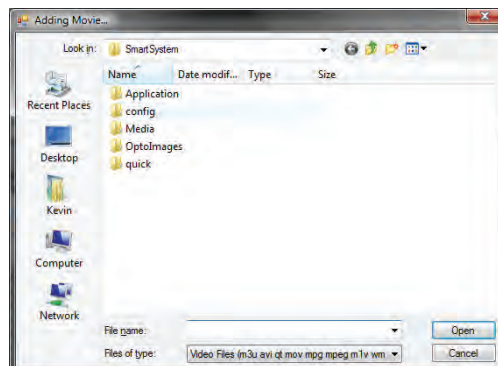
## Copying a Movie, Image or Presentation from Media

If you purchase or own additional Patient Education or Fixation Movies (MPGs), Images or Presentations, to copy the file, please follow the instructions below:

1. Plug in the Keyboard and Mouse.
2. Connect the Media to the Smart System<sup>®</sup> unit.
3. Press “z” or “Home” key to enter the configuration.
4. Press the “Media” button.



5. In the **Select Media Type**, click the appropriate choice: Movies, Images or Presentation.
6. Click **Add [Movie/Image/Presentation]** button just to the right.
7. Using the dialog box, navigate to the location of the movie, image or presentation (Note that presentations will be the folder name, rather than a file).



## **Fixation and Patient Education Movies (Cont'd)**

8. Click **Open**.
9. The file(s) will copy to the proper Smart System<sup>®</sup> folder automatically and be ready for use.

### **To “Play” the movies**

1. Press “4” on the Round Button to display list.
2. Scroll through the movies using the + and – keys.
3. “Play” the selected movie by pressing “1” on the Round Button.

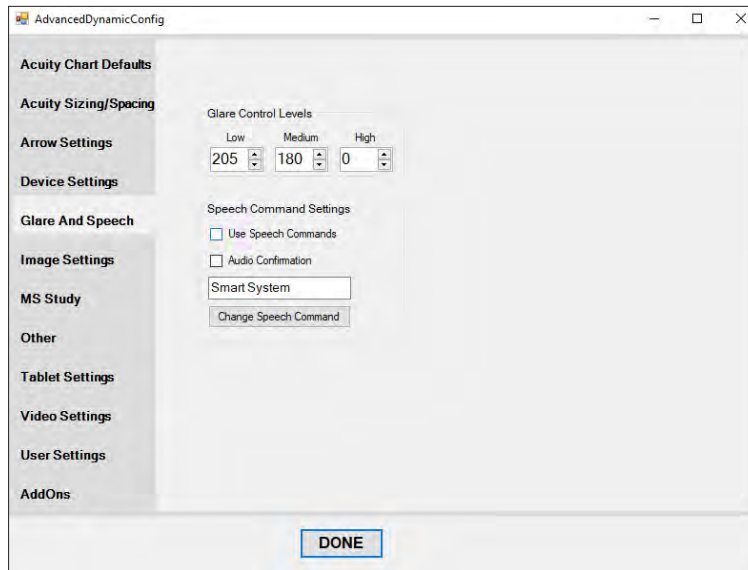
### **To “Display” an image**

1. Press “3” on the Round Button to display list.
2. Scroll through the movies using the + and – keys.
3. “Display” the selected image by pressing “1” on the Round Button.

# Smart System® Dynamic Voice Recognition (Optional)

## ENABLING VOICE ACTIVATION

1. Press the **Z** or **HOME** button on the keyboard to access the **Main Configuration** screen.
2. Click the **Advanced** button in the lower right corner.
3. Select **Glare and Speech** – click to place a check mark in the box “Use Speech Commands” – the system will default to “Smart System” as the audible command key word. The command word can be changed, but must remain two words.



4. Click **Done** to exit the Advanced Dynamic Config screen.
5. Click **Done** to exit the M&S Main Configuration screen.
6. Restart the software – Press the **X** or **END** button on the keyboard to exit and relaunch the software.

\* Note – the software must be restarted after enabling voice activation

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## VOICE COMMANDS

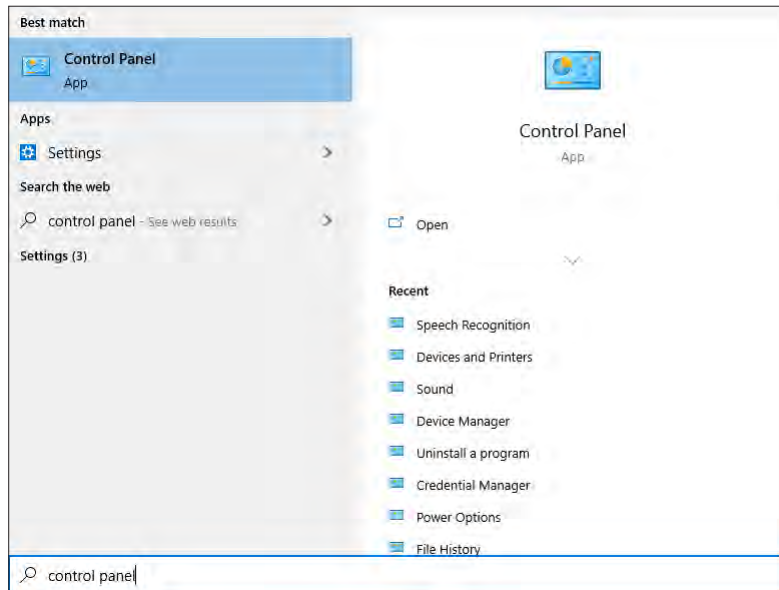
Speech Commands – Start with “**Smart System**” then say the word(s) below. Make sure there is at least a 1 second pause after you say Smart System before you do one of the power commands below.

- **Sizing**
  - Size Up
  - Size Down
  - Size 1 (10)
  - Size 2 (20)
  - Size 3 (30)
  - Size 4 (40)
  - Size 5 (50)
  - Size 6 (60)
  - Size 7 (70)
  - Size 8 (80)
  - Size 10 (100)
- **Letter Types**
  - Letters (Snellen)
  - Numbers
  - Lea Symbols
  - Allen Pictures
  - E (Tumbling E)
  - H O T V
- **Contrast**
  - Letter Contrast
  - Contrast Up
  - Contrast Down
- **Chart/Letter Functions**
  - One Line
  - Three Lines
  - Single (single character on screen)
  - Vertical Line
  - Chart (back to full chart)
  - Arrow
  - Move Right
  - Move Left
  - Cycle
  - Random
  - Red Green
  - Worth Four Dot
  - White Dot
- **Other Functions**
  - Astig Dial, Astigmatic Dial
  - Color Check
  - Blank
- **Media**
  - Play Video (Video)

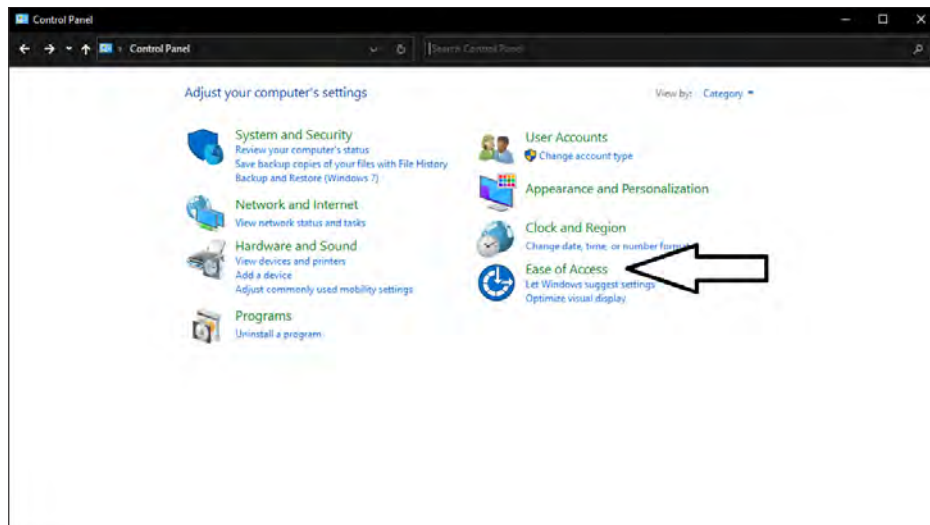
## Smart System® Dynamic Voice Recognition (Continued)

\* Please note: It may be necessary to “train the computer” to better understand you if the speech recognition is not responding as expected. To do so:

1. Press the **X** or **END** button on the keyboard to exit Smart System
2. Click the start button and immediately begin typing *Control Panel* – as you type windows will begin searching. Click to select the Control Panel.

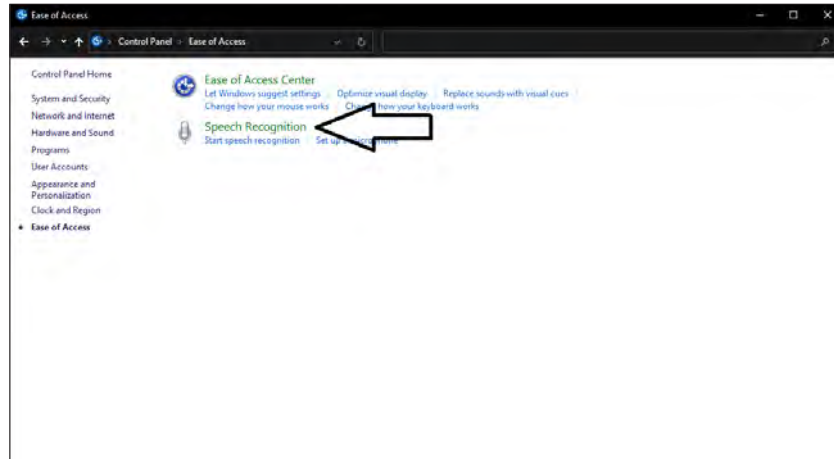


3. Inside the control panel click **Ease of Access**

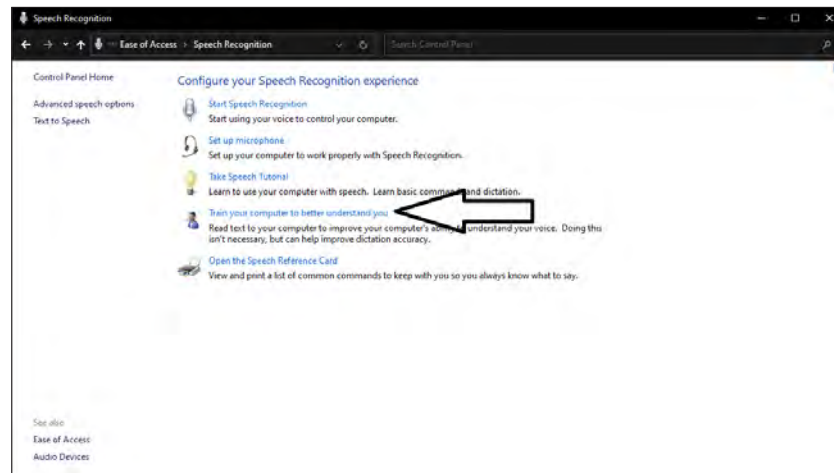


## Smart System® Dynamic Voice Recognition (Continued)

### 4. Click **Speech Recognition**



### 5. Click **Train your computer to better understand you**



### 6. **This will begin the Speech Recognition Voice Training**

Follow the prompts through the speech training. Windows will guide you through several sentences that you will speak aloud. As you speak the sentences, Windows will listen and learn your speech patterns. Voice recognition within Smart System should be improved upon completion of the voice training. Please restart the Smart System software after completing the voice training.

*\* Please note the voice training process will take approximately 10-15 minutes to complete. Microphone required for speech recognition.*

# System Shut Down

The System should be Shut Down on a Daily Basis. The procedure is as follows:

1. Press **FNC + B** key. The system will exit out of Smart System<sup>®</sup> software and return to the Windows<sup>®</sup> operating system.
2. Press ON\Off button on the Computer and the CPU will shut down.
3. If using the optional keypad, turn it off using the switch on the top of the keypad.
4. **The monitor should remain on**, but will automatically go to power-saver mode. This is indicated when the monitor's power light turns from green to amber.



# Appendix

## Snellen Distance Equivalents

This Chart shows the Conversion between Common Optotype Size Measuring Units. If you work in 6-meter based metric or decimal units, use this table to convert from the displayed size based on 20-feet to the metric or decimal equivalent. To switch to a different format shown on-screen, please see Adjusting the Letters & Symbols.

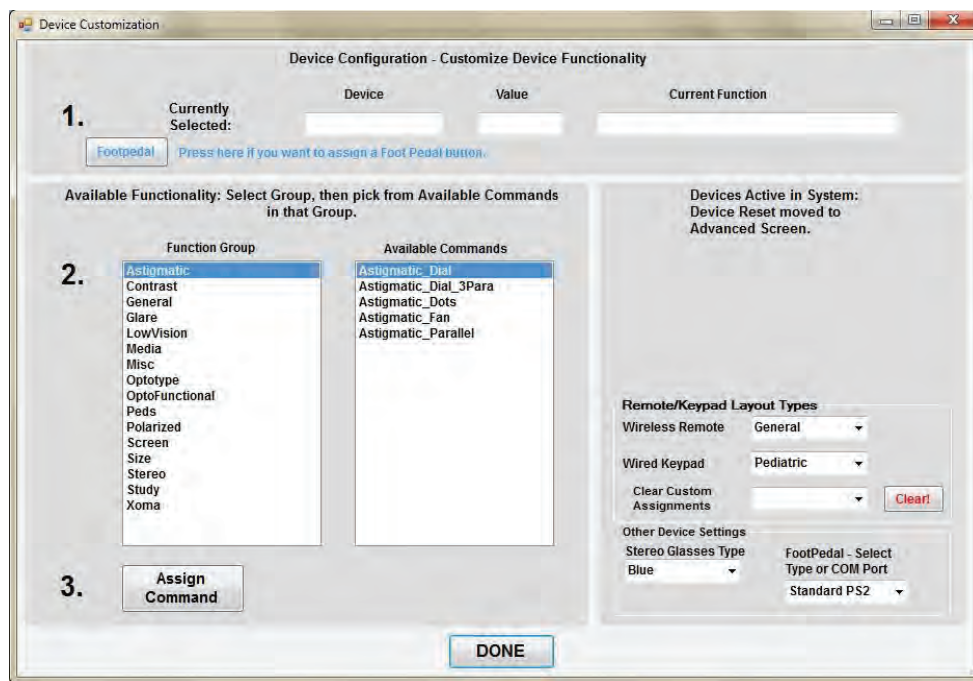
<b>Size</b>	<b>20 foot</b>	<b>Metric</b>	<b>Decimal</b>
<b>10</b>	20/10	6/3	2.00
<b>12.5</b>	20/12.5	6/3.8	1.60
<b>16</b>	20/16	6/4.8	1.25
<b>20</b>	20/20	6/6	1.00
<b>25</b>	20/25	6/7.5	.80
<b>32</b>	20/32	6/9.5	.63
<b>40</b>	20/40	6/12	.50
<b>50</b>	20/50	6/15	.40
<b>63</b>	20/63	6/19	.32
<b>80</b>	20/80	6/24	.25
<b>100</b>	20/100	6/30	.20
<b>125</b>	20/125	6/38	.16
<b>160</b>	20/160	6/48	.12
<b>200</b>	20/200	6/60	.10
<b>250</b>	20/250	6/75	.080
<b>320</b>	20/320	6/95	.063
<b>400</b>	20/400	6/120	.050

# Customizing the Keypad, Remote Control and Footpedal

**Note:** Some peripheral controls such as the keypad and footpedal may be dependent on the hardware configuration purchased. The information that follows covers all possible control options for the Smart System software.

To customize the layout of the Keypad, Remote Control, or Footpedal, please follow these instructions:

- Plug in a keyboard and mouse.
- Press “z” or “Home” on the keyboard to enter the configuration.
- At the main configuration screen, click the **Device** button to reach the Device Customization screen.



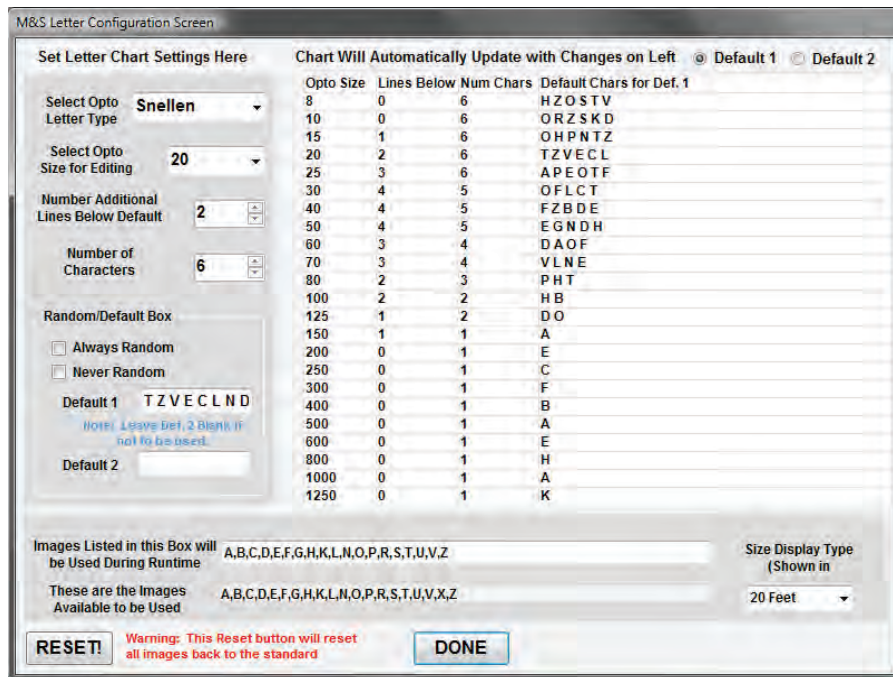
**Note: DO NOT change the Layout Type for any of the controllers without instruction from M&S Technical Support (877-225-6101).**

1. Press the button on the device you wish to customize (Keypad, Remote, Footpedal, Marco or Topcon) – this can include **FNC** or SHIFT with a button (e.g. **FNC** + 50 or SHIFT + 200).
2. **Note** – For the Footpedal, press the Footpedal button and the button will switch to *Waiting ...*. Press the footpedal switch desired and the value shown above it will reflect 1, 2 or 3. Continue as shown below.
3. Choose the Function Group of the feature you'd like to set and then from the Available Commands. For a complete list of functions see the “Appendix Entry for *Function Groups and Associated Functions*”.
4. Click **Assign Command**.
5. Click **Done** to exit Device Customization.
6. Click **Done** to exit Main Configuration.

## Adjusting the Letters and Symbols

It is possible to Remove Letters or Symbols from Smart System<sup>®</sup> as well as Adjusting the Number of Lines shown and Letters/Symbols across:

1. Plug in the Keyboard and Mouse.
2. Press “z” or “Home” to enter the M&S Main Configuration Screen.
3. Press the “Letter” button and the M&S Letter Configuration Screen displays.



**Note:** “The Reset Button” will reset all letters to the default lines and should be used with caution.

To change the “**Size Display Indicator**” to local notation 20 feet, Logmar Int, Logmar Decimal, 6 meter or Decimal follow the procedure below:



1. In the “**Size Display Type**” (shown in bottom left corner), **Click** the down-arrow.
2. **Select** 20 feet, 6 meter, Logmar Int, Logmar Decimal or Decimal.
3. Click **Done**.
4. Click **Done**.

## Adjusting the Letters and Symbols (Cont'd)

To change to **“Always Random”** or **“Never Random”** Charts:



1. In the **“Random/Default”** box, check the box **Always Random** or **Never Random**.
2. Click **Done**.
3. Click **Done**.

## Removing Letters/Symbols



1. In the **“Images Listed in this Box will be Used During Runtime”** box remove any unwanted letters or symbols, maintaining a space between each choice.
2. The list of valid letters/symbols is shown for reference below.
3. Press **Enter** key on keyboard when done editing the list.
4. If the **Reset** Button is pressed, the symbol will be removed and replaced on all lines.
5. Click **Done**.
6. Click **Done**.

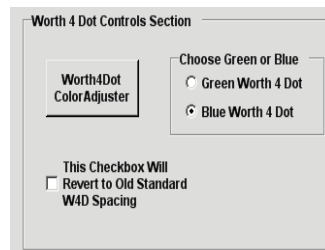
## Adjusting Chart Defaults: Number of Characters, Lines Displayed, and Default Characters

1. In the **“Set Letter Chart Settings Here”** section, select the Opto Letter Type set by clicking the down-arrow and selecting the set to be modified.
2. Each size row can now be individually edited.
3. Select Opto Size for Editing by clicking the down-arrow and choosing the size.
4. To alter the number of lines shown, in the **“Number Additional Lines below Default in Chart”** section, increase or decrease the default number shown. Note that the total number of lines shown is 1 greater than the number selected as the choice made for the number of lines shown below the current line. (To have a total of 3 lines shown, set the number to 2).
5. To alter the number of letters/symbols displayed on the line, in the **“Number of Characters Displayed on Line”** section, increase or decrease the number shown. Letters will be added or removed automatically to match the number shown up to 8 across.
6. To alter the Default 1 and Default 2 characters shown, in the Random/Default Box, adjust the letters in the Default 1 and Default 2. Note that Default 2 allows a second set of defaults so that a semi-random chart can be presented to patients.
7. Repeat steps 4-7 for each Line of the Chart.
8. Click Done.
9. Click Done.

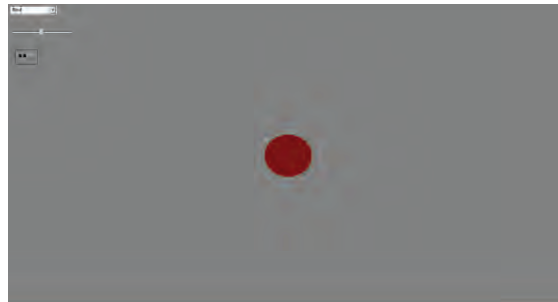
## Worth 4 Dot Adjustment

To adjust the brightness of the Red, Green, or Blue Worth 4 Dots and Distance Stereo, follow these instructions:

1. Plug in a Keyboard and Mouse.
2. Press “**z**” or “**Home**” on the keyboard to enter the configuration.
3. In the Worth 4 dot section of the Main Configuration, select Blue or Green for the Worth 4 dot type.



4. To adjust the color of the dot to perfectly occlude with the glasses found in the exam room, press **Worth 4 Dot Color Adjuster**.
5. The following screen will display.
6. In the Upper Left, select the color of dot you wish to adjust – the choices are Red, Blue, or Green.



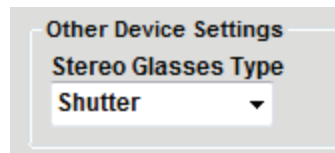
7. Using your red-blue or red-green glasses, slide the slider left or right to decrease or increase the brightness until the filtering is correct for your glasses.
  - **Note** that you should view the dot through the opposite colored lens (e.g., view the red dot with the blue or green lens).
8. Once correct, select the next color for your glasses and repeat step 16.
9. When finished, click **Done**.
10. At the Main Configuration screen, click **Done**.

## Distance Stereo

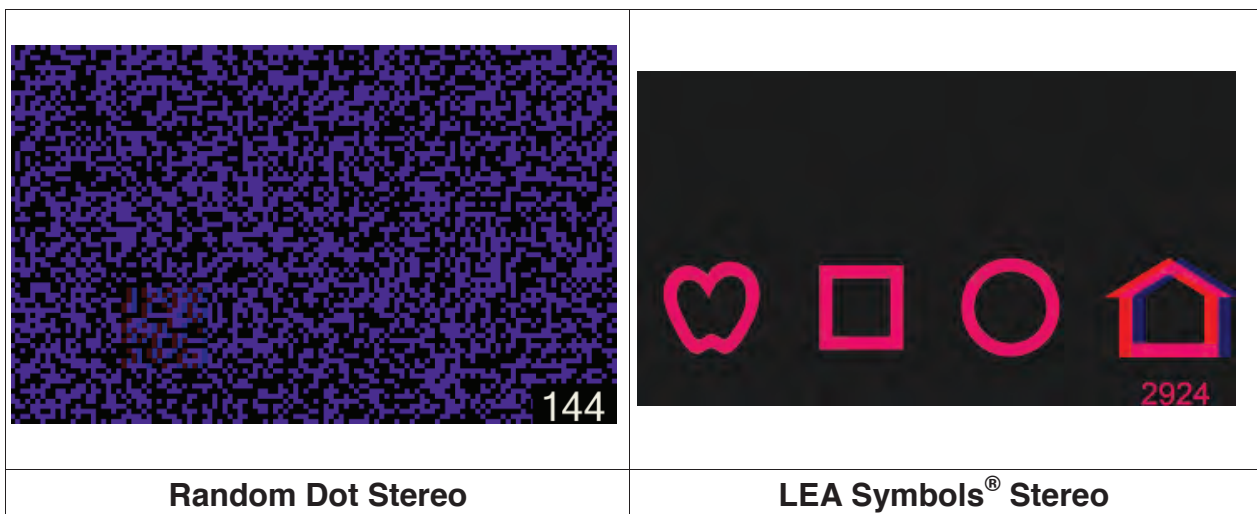
Smart System® provides three methods for measuring distance stereo: Random Dot, Contour Stereo using Rings, and Contour Lea Symbols® Stereo.

### To select Red-Blue or Shutter Glasses for Distance Stereo

1. Plug in a Keyboard and Mouse.
2. Press “z” or “Home” on the keyboard to enter the configuration.



3. Click **Device**.
4. In the **Stereo Glasses Type** select “Blue” or “Shutter” - Note that the dots will not have to be adjusted for shutter glasses – **shutter glasses are not available for the All-in-one system**.
5. Click **Done**.
6. Click **Done**.
7. It is critical that the Worth 4 Dot settings be adjusted to completely occlude the colors as detailed in the **Worth 4 Dot** appendix section if using Red/Blue stereo. The color levels are used to accurately present the stereo separation.

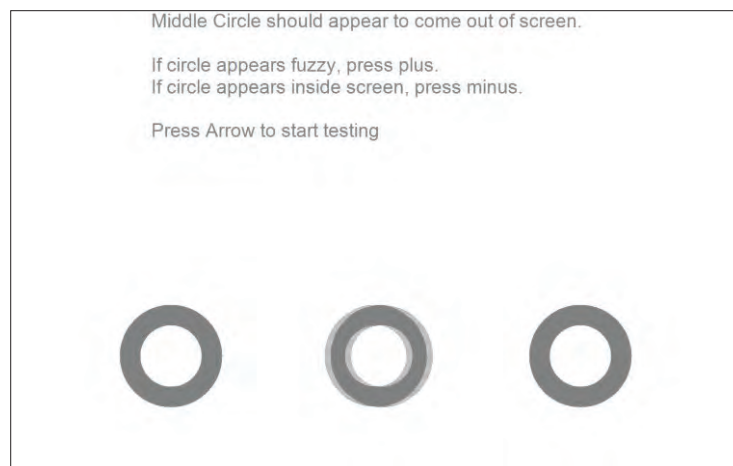


## Distance Stereo (Cont'd)

### Press the Assigned Key to Enable Stereo Testing

- **FNC** + 50 Random Dot Stereo
- **FNC** + 80 Contour Stereo Rings
- **FNC** + 200 Contour LEA Symbols<sup>®</sup> Symbol Stereo

If using Shutter Glasses or polarized glasses, the commencement of testing will display a screen to verify that Stereo is working properly through the glasses.



- If the circle appears fuzzy, press Up or +
- If the middle circle is not in front of the two circles and appears behind them instead, press down or -
- Press Arrow to start testing.

### **Note:**

- If using the wired keypad, the indicator for position and arc-seconds will be shown on the keypad rather than on the screen.
- If using the remote control, the screen will show the position in the lower right corner (if Red-Blue, the quadrant 1 indicating upper left, 2 upper right, 3 lower left and 4 lower right or if LC Shutter glasses, the position 1-4 left to right) followed by the arc-seconds of separation.
- The “Minus” key reduces the separation and the “Plus” key increases the separation.



## Customized Protocols

Smart System<sup>®</sup> allows the creation of customized testing protocols, allowing various charts and isolations to be combined into a repeatable protocol. This is useful when it is required to test the same way every time.

1. Plug in the Keyboard and Mouse.
2. Press “**z**” or “**Home**” to enter the M&S Main Configuration Screen.
3. Press the **Protocol** button.

Protocol

Protocol Creation, Selection, and Control Assignment.

Protocol Name: Protocol 1 [Delete] [ADD] [Rename]

Selected Protocol in this List Can be Assigned in the Box Below.

Build your Protocol commands in this box. Select your Image Type, Opto Size and Function then Click the Add Button.

OptoType/Test: Test\_AstigmaticDial | Opto Size: 30 | LinesPerHand: 1 [ADD]

Snellen: Standard Chart, Size = 40  
Snellen: Standard Chart, Size = 30  
Test\_AstigmaticDial: Lines Per Clock Hand: 1 [Remove]

Remove Selected from List [Remove]

Move Selected Command in the Box Up [Move Up] [Move Down]

Press Button on Desired Device for Assigning Protocol.

Device	Value	Current Value
Keyboard	49	10

Pressing this Button Will Reassign Command to Selected Protocol! [Assign]

[DONE]

4. In the **Protocol Name** box, enter a descriptive name.
5. Click **Add**.
6. The Name will now show in the list.
7. Click on the Name.
8. To add tests, select an Image Type or Optotype, Snellen, LEA Symbols<sup>®</sup>, etc.
9. Select the Opto Size that should be displayed.
10. Click on the appropriate function: Chart, Single Line, Single Char, Vertical Line or 3 Lines of the same size.
11. Click **Add**.
12. Repeat steps 8-11 to add additional steps.
13. If a mistake is made, click the line and click **Remove**.
14. The list can be ordered with the **Move Up** and **Move Down** buttons.
15. Steps 4-14 can be repeated for multiple protocols. This can be useful to create adult and pediatric protocols or to create custom protocols for consistent testing.



## Customized Protocols (Cont'd)

### Assigning the Protocol to the Keypad or Remote Control

Press Button on Desired Device for Assigning Protocol.	Device <input type="text" value="Keyboard"/>	Value <input type="text" value="49"/>	Current Value <input type="text" value="10"/>	Pressing this Button Will Reassign Command to Selected Protocol!	<input type="button" value="Assign"/>
-----------------------------------------------------------	-------------------------------------------------	------------------------------------------	--------------------------------------------------	------------------------------------------------------------------------	---------------------------------------

### Remote Control

1. Click the “Button” or “FNC” + button on the Remote that will activate the protocol (e.g.,  + 50).
- Note:** the keypad can also be used by just pressing the “Key” or “SHIFT” + key.
2. The Current Command will display if the key is already assigned.
3. Click **Assign** to set the protocol to the button.

### Keypad

1. Click the key or SHIFT + key on the keypad that will activate the protocol (e.g.,  + 200).
2. *The Currently Set To...* will display if the key is already assigned.
3. Click **Assign** to set the protocol to the key.

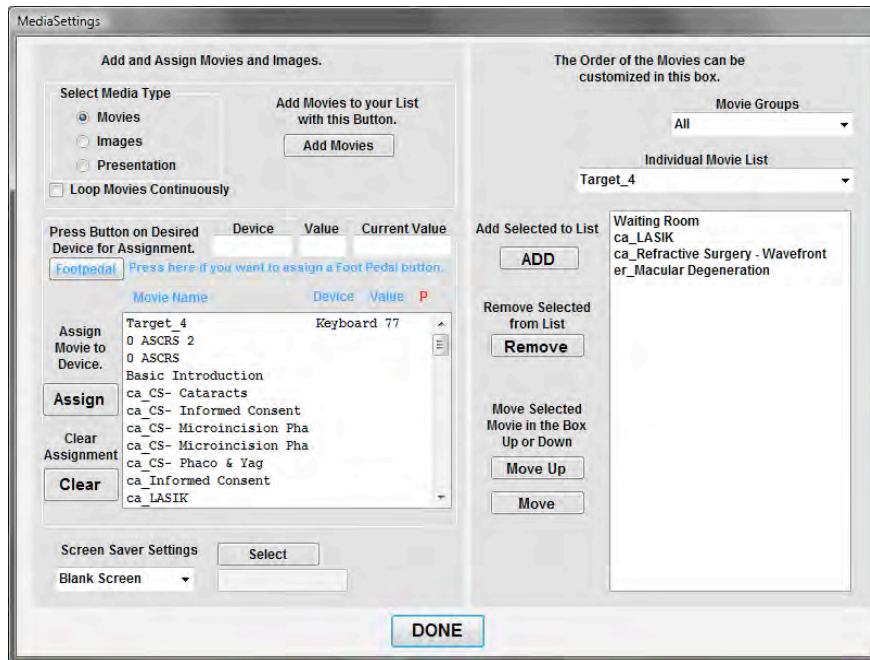
### Using the Protocol

1. Press the assigned key to activate the protocol.
2. Use + and – to move forward or backward through the protocol.
3. Press any other key to escape the protocol.

## Customizing the Video and Image Lists

The Video and Image display is now completely customizable. To enter the Media Settings Configuration, follow these steps:

1. Plug in a keyboard and mouse.
2. Press “z” or “Home” on the keyboard to enter the configuration.
3. Click the **Media** button and the Media Settings screen will appear.



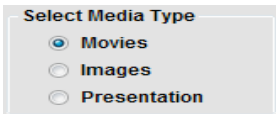
**Note:** The Loop Videos Continuously is used for fixation primarily so that the videos continue from the beginning after reaching the end. With patient education, this will cause the video to loop.

To order from our list of videos, click the “Individual Movie List” drop-down arrow.

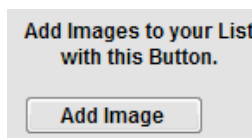
1. Select a video from the list.
2. Click **Add** button.
3. Continue steps 1-3 until the videos are selected.
4. You can order the list with the **Move Up** and **Move Down** buttons.
5. When complete, click **Done**.
6. The videos will now be sorted when the list is displayed as selected.

## Customizing the Video and Image Lists (Cont'd)

### To Add additional Movies, Images, and Presentations



1. Click the **Radio Button**.
2. Click the **Add** button (Add Movie, Add Image, Add Presentation).

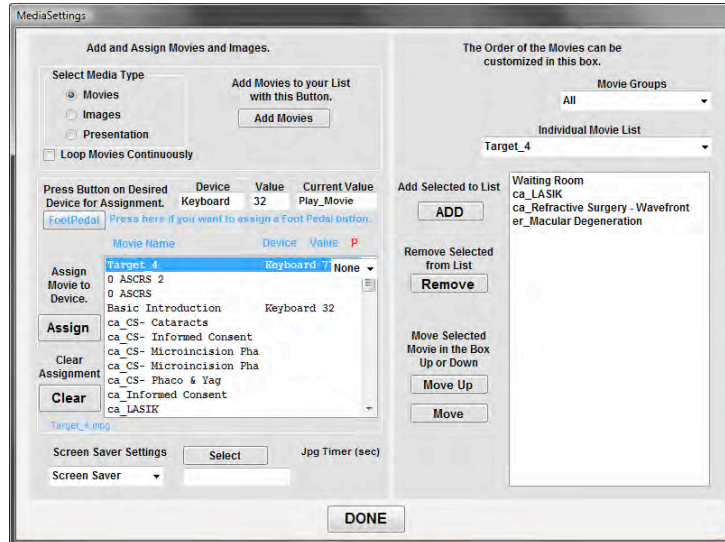


3. From the Windows<sup>®</sup> Dialog, select the image you wish to copy. You may use a USB "thumb drive" or "portable hard drive".
4. Use the Windows<sup>®</sup> file navigation to find and select your movie or image file – presentations are selected by selecting the Folder.
5. Click **OK**.
6. Click **Done**.
7. Click **Done**.
8. The images will now be available using the key assigned to display a list of Movies or Images.

# Assigning Buttons to Display Movies, Images, and Presentations

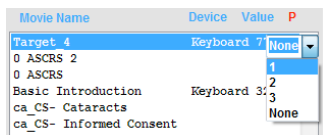
Any of the Smart System<sup>®</sup> controllers can be programmed to directly play a particular movie, including Images, or Presentation. To program the controller, with a Keyboard and Mouse:

1. Press “z” or “Home” on the keyboard to enter the configuration
2. Press the **Media** button
3. Select the **Media Type: Movies, Images, or Presentation**



4. Press the desired button or FNC/Shift Combination (e.g., **FNC** 100).  
**Note:** For the Footpedal, press the **Footpedal** button you wish to program and continue.
5. Select the Movie, Image or Presentation from the **Movie Name** list.
6. Click **Assign**.
7. Continue steps 3-6 to program additional or Click **Done**.
8. Click **Done**.

In some settings, primarily Pediatric Smart System<sup>®</sup> PC-Plus Systems, 3 assigned movies have been the norm and work via SHIFT + 10, SHIFT + 15, and SHIFT + 20, the three foot-pedal switches, and the Up, Left and Right buttons on the remote. To change this, either use the traditional methods described earlier in this manual or perform the following steps:



1. Click on a *Movie* in the **Movie Name** list
2. To the right in the column under the red-letter **P**, right click the mouse.
3. A drop-down will appear.
4. Choose 1, 2, or 3 which is Remote: Up, Left or Right / Keypad:  
Shift + 10 Shift + 15 and Shift + 20 or Footpedal: Left Center Right
5. The number will appear in the column.
6. Repeat for steps 2 and 3 or Click **Done**.
7. Click **Done**.

## Function Groups and Associated Functions

The table below is used for assigning functionality to any of the controls as described in the section above **Customizing the Keypad, Remote Control and Footpedal**. First, choose the appropriate Function Group and then the Function you wish to assign.

Function Group	Function
<b><i>Astigmatic</i></b>	Dial
	Dots
	Fan
	Parallel
	3 Parallel
<b><i>Contrast</i></b>	Contrast_Contrast_Sensitivity
	Landolt_Contrast
	SineGrating
	SineGrating_Protocol
	ETDRS Contrast
	Richer Glare Disability Test
	Harris Contrast
	Harris Sine Contrast
	Richer Glare Disability
<b><i>Glare</i></b>	Low
	Medium
	High
<b><i>General</i></b>	MINUS
	MINUS_Control_2
	PLUS
	PLUS_Control_2
<b><i>Low Vision</i></b>	Amsler Grid
	Circle Quadrant Test
	Dynamic Visual Acuity
	ELVT
	Masked_LowVision
	OneMeter_Testing

	Low Size Progression
	SineGrating_Contrast
	Masked Low Vision
	One Meter Testing
<b>Media</b>	Assign_Image
	Assign_Video
	Directory_Movies
	Directory_Images
	Directory_Presentations
	Presentation_Play
	Image_General_Group
	Image_Patient_Ed
	Image_Show Specific
	Play_Selected
	WinTV_Play
	WinTV_Reset
	Pause_Movie
	Start_Over
	Language_Select
	Skip_Forward_30_Seconds
<b>Misc</b>	Blank
	Exit_to_Windows®
	Change User
	No_Function
	Quick_Custom_Letter
	Toggle_Full_Screen
	Print
	Open_Config_Screen
	RedGreen_E_20_400
	Version_Info
<b>OptoFunctional</b>	Arrow_Display
	Crowding_50_Percent
	Crowding_100_Percent
	Crowding_Line_25_Percent
	Crowding_Line_50_Percent

	Chart_MultiLine
	Cycle_Interval
	One_Dot
	One_Line
	Randomize
	Red-Green
	Single_Char
	Snellen_Logmar
	Three_Lines
	Vertical_Line
	Vertical_Line_SameSize
	White_Black_Reverse
	Worth_4_Dot
	Verhoeff_Circles
	Harris Acuity
<b>Optotype</b>	Allen_Pictures
	LEA_Numbers®
	ETDRS_Chart
	Hebrew
	HOTV
	Landoldt_Rings
	LEA_Symbols®
	Sloan_Letters
	Snellen_Letters
	Tumbling_E
	Extra_Numbers
	Japanese Letters
<b>Peds</b>	External_Fixation
Some Features Not	Assign_Movie1
Available on General	Assign_Movie2
Systems	Assign_Movie3
	Play_Movie1
	Play_Movie2
	Play_Movie3
	Phidgets_Port_1
	Phidgets_Port_2

	Phidgets_Port_3
	Phidgets_Port_4
	Phidgets_Port_1_and_2
	Phidgets_Port_3_and_4
	Fix_DancingBear
	Fix_NonAccommodative_Target – Dr. Robert Gross' non-accommodative distance fixation target
<b>Polarized</b>	Cross
Some features may	Cross Dot
Require a separate	VLines
Polarized monitor	1Line
	3Line
	Binocular Balance
	Horizontal Coincidence
	Vertical Coincidence
	RG Fixation Disp
	RG Fixation Disp Dot
	RG Fixation Disp Enhanced
	RG Fixation Disp Enhanced Dot
	Phoria
	Worth 4 Dot
<b>Screen</b>	Screen_Monitor_2nd_Distance
	Screen_On_Screen_Size
<b>Size</b>	8
	10
	15
	20
	25
	30
	40
	50
	60
	70
	80
	100
	125

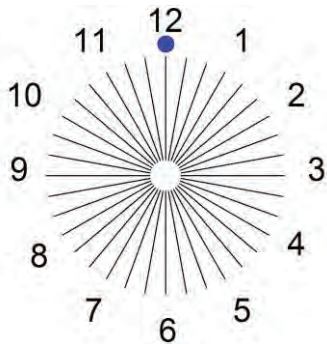
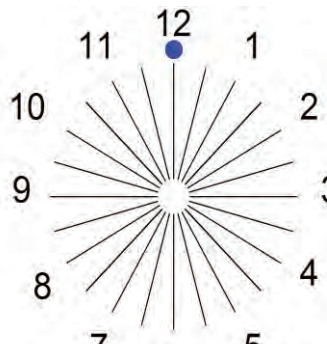
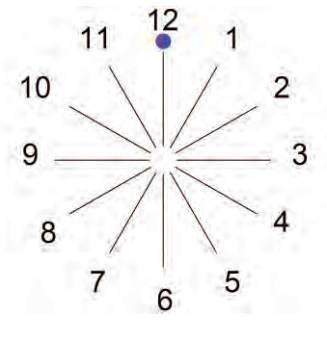


	150
	200
	250
	300
	400
	500
	600
	800
	1000
	1250
	1600
<b>Stereo</b>	Contour
	LEA_Symbols®
	Random_Dot
<b>Study</b>	ATS_Hotv_Protocol
	eEDTRS_Protocol
	Dynamic_eETDRS_Protocol
	ColorCheck

# Astigmatic Dial

Smart System® has an astigmatic dial that can be utilized with the blue-ball pointer. To get the Astigmatic Dial, press **FNC** + 20 on the remote control. Then, use Up/Down on the remote to move the pointer. The number of lines can be configured by Pressing “z” to enter the configuration and clicking **Advanced**. Click the drop-down next to Astigmatic Dial – Num Arms per Clock Section and choose 1 (Hourly), 2 (Every 30 Minutes), or 3 (Every 20 Minutes). Click **Done** and click **Done** again.

The table below shows the result for each:

  	<p>Every 20 minutes</p> <p>Astigmatic Dial - Num Arms per Clock Section. <input type="text" value="3"/></p> <p>Every 30 minutes</p> <p>Astigmatic Dial - Num Arms per Clock Section. <input type="text" value="2"/></p> <p>Every hour</p> <p>Astigmatic Dial - Num Arms per Clock Section. <input type="text" value="1"/></p>
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

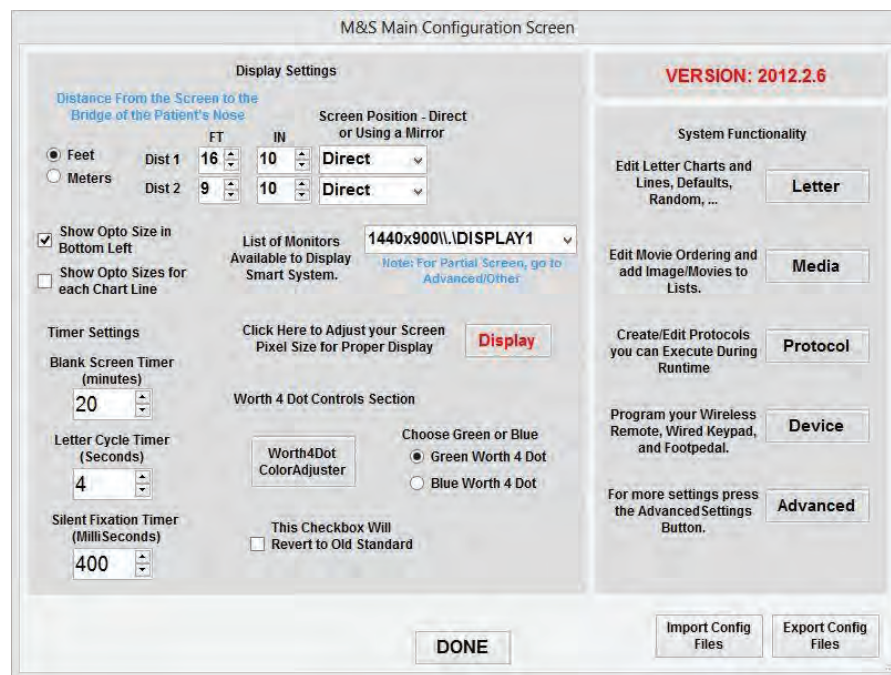
## Showing Sizing for each Line

Smart System® 20/20 has the ability to show the size for each line of a chart on the right side.



### To enable this feature:

1. Press “z” or “Home” to enter the configuration.



2. On the Main Configuration Screen, check the box marked “**Show Opto Sizes for Each Chart Line**”.
3. Click **Done**.
4. The line sizing will now appear on the right edge of the chart for easy reference.

# M&S Smart System® 20/20 – Contrast Functions

## Operation of the Smart System® 20/20 Contrast Testing

### Contrast Control

When the Smart System® is in contrast test mode, the left “+/-” keys control the contrast level and the right “+/-” keys control the optotype size.

### Contrast Display

When the Smart System® is in contrast mode, the on-screen display shows the contrast level in the lower right corner and the optotype size, as usual, in the lower left corner. The contrast levels are 63, 50, 32, 25, 20, 16, 12, 10, 9, 8, 7, 6, 5, 4, 3, 2, and 1 percent.

### Contrast Testing with the M&S Smart System® 20/20 Letter Contrast Test

The M&S Smart System® 20/20 Letter Contrast Test uses Sloan Letters. Optotype contrast uses a "pixel density" approach that sets the gray value to the percent of contrast between the Black and White values of the monitor.

### Monitor Calibration

If using a monitor from M&S Technologies it has been calibrated as closely as possible to a luminance of approximately 85 cd/m<sup>2</sup> and a color temperature of 3300K as the standards specify. This will be a warmer of almost yellower appearance than standard monitors that can have values in excess of 165 cd/m<sup>2</sup> and 7800K, which result in a brighter bluer image.

**M&S Technologies** does not suggest or endorse any specific method of conducting any examination, including contrast testing, nor do we suggest any interpretation of results obtained by conducting such an examination. As a medical professional, it is your responsibility to determine the appropriate method for conducting an examination as well as the interpretation of the results.

### Monitor Benchmark Settings

The monitors provided by M&S are pre-set to the values found below for optimal use in testing contrast. If you feel that your monitor has been modified, please consult the table below or contact Technical Support for assistance.

<b>NEC AccuSync 72V LCD Monitor</b> Brightness: 86% Contrast: 40% User Color Settings: R=93, G=67, B=0	<b>NEC Mutisync 225WXM 22”</b> Brightness: 54.0% Contrast: 50% User Color Settings: R=92.9 G=73.7 B=25.5
<b>NEC Mutisync 1770NXM &amp; 1990NXM</b> Brightness: 67.9% Contrast: 50% User Color Settings: R=92.9 G=73.7 17” B=43.5 / 19” B = 34.5	<b>NEC Accusync 224 22”</b> Brightness: 54.0% Contrast: 50% User Color Settings: R=92.9 G=73.7 B=25.5
<b>NEC Mutisync 205WXM 20”</b> Brightness: 54.0% Contrast: 50% User Color Settings: R=92.9 G=73.7 B=25.5	<b>NEC Accusync 221</b> Brightness: 54.0% Contrast: 50% User Color Settings: R=92.9 G=73.7 B=25.5

## Suggested Contrast Test Procedure (Example 1)

Determine visual acuity threshold at 100% contrast, black letters. This test assumes Corrected or Uncorrected VA of 20/20. **The room lights should be off for contrast testing.**

1. Press **CONT** and then **SGL** to get a single Sloan Letter.
2. Use “-” to reduce the contrast until the patient no longer correctly answers.
3. Record the previous value (last correct).
4. Press “+” three times, check to see if the patient is correct. If not, press “+” until a correct answer.
5. Use “-” to once again reduce the contrast percentage until the patient answers incorrectly again.
6. Record the last correct value.
7. Compare and record the higher percentage using the two results. Perform for each of the following:

**Begin testing at the following lines and percentages:**

- 20/25 @ 25%
- 20/50 @ 8%
- 20/100 @ 4%
- 20/200 @ 3%

## Suggested Contrast Sensitivity Form (Example 1)

Patient Name:	Chart:
Date:        /        /	Time:        :        AM    PM
VA OD:	VA OS:
Pupil Size OD:	Pupil Size OS:

*Exam should be conducted in dark exam room*

	OD		OS	
Beginning Contrast %	Acuity	Contrast %	Acuity	Contrast %
100		100		100
25	20/25		20/25	
8	20/50		20/50	
4	20/100		20/100	
3	20/200		20/200	

Record Contrast % as the last correct value. Compare and record the higher percentage using the two results as directed.

## Suggested Contrast Test Procedure (Example 2)

Determine visual acuity threshold at 100% contrast, black letters. This test assumes Corrected or Uncorrected VA of 20/20. **The room lights should be off for contrast testing.**

1. Press **CONT** to enter contrast – it will automatically switch to a single line at 63% contrast.
2. Press **Size** button to switch to 20/30, 20/50 or 20/70 as directed below.
3. Use “-” to reduce the contrast until the patient answers 3 out of 5 letters incorrectly.
4. Record the previous value (last line with 3 out of 5 correct).
5. Press “-” to reach 0.8%.
6. Use “+” to increase the contrast percentage until the patient answers 3 out of 5 letters correctly.
7. Record the last line where the patient reported 3/5 correct.
8. Compare and record the higher percentage using the two results. Perform for each of the following.

**Begin testing at the following lines and percentages:**

- 20/30 @ 25%
- 20/50 @ 25%
- 20/70 @ 25%

## Suggested Contrast Sensitivity Form (Example 2)

Patient Name:	Chart:
Date:        /        /	Time:        :        AM    PM
VA OD:	VA OS:
Pupil Size OD:	Pupil Size OS:

***Exam should be conducted in dark exam room***

Size	OD	OS	Norm
Acuity			20/20
20/70			4%
20/50			5%
20/30			10%



# Sine Wave Grating Contrast

Contrast testing using Sine Wave Gratings is available in Smart System<sup>®</sup> 20/20. This uses gratings at Horizontal, Vertical, 45 degrees and 135 degrees in the following spatial frequencies: 1.5, 3, 6, 12, and 18 cycles/degree and allows contrast percentages from 0.4% to 100%. To activate Sine Wave Grating Contrast Testing:

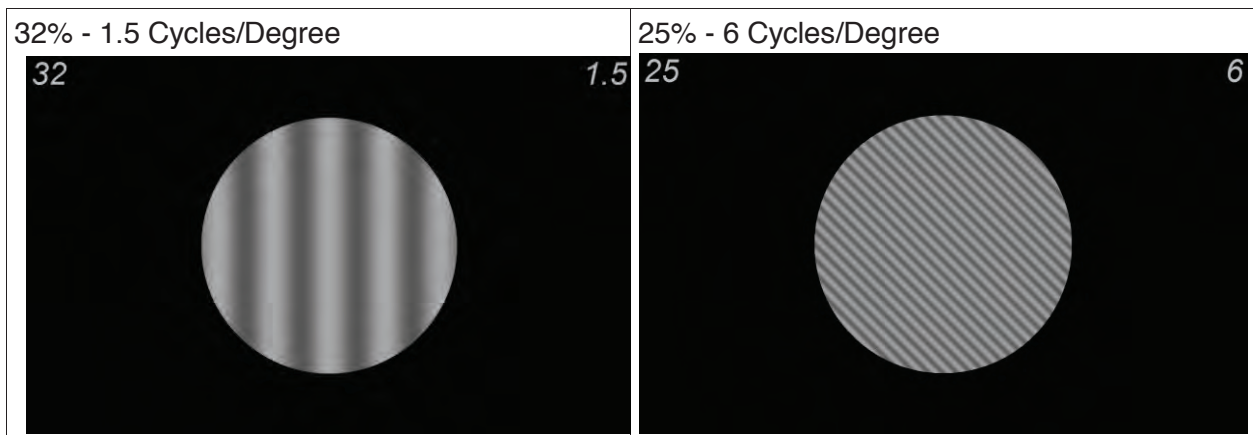
1. Press the **FNC** + SGL Button.
2. The Left Up/Down button changes the contrast percentage up and down.
3. The Right Up/Down button changes the Spatial Frequency in Cycles/Degree.
4. The Contrast Percentage is shown in the Upper Left.
5. The Spatial Frequency is shown in the Upper Right.

## Adjust the Contrast Percentage

On the wired keypad, + and – adjusts the Contrast Percentage and Shift & +/- adjusts the spatial frequency.

## Spatial Frequency

To toggle the Spatial Frequency and Contrast Percentage, simply press the Arrow Button **ARW**.



## Integrating with Marco, Topcon and Reichert Automated Refraction Systems

Smart System<sup>®</sup> can be integrated with the Marco 6100, 5100 and 3100 and Topcon KB50/CV5000 and Reichert APRS using CustomLink<sup>®</sup> technology.

Topcon is wireless and requires the Topcon wireless transmitter be plugged into the KB50 unit. The system will automatically detect the presence of the Topcon device and pressing the touchpad will result in the chart being changed. The chart “projector” selected on the CV5000 can be set in the M&S Advanced Configuration’s *Other* tab:



Example

Marco can be wireless or wired for the 6100, 5100 and 3100. The integration kit can be ordered by contacting M&S Technologies. The M&S IR detector will automatically detect the presence of the Marco device and pressing the touchpad will result in the chart being changed. The current *Chart Type* for the 5100 and 3100 is **SC2000 Type M**, and for the 6100 **SC1600 Type M**.

The Reichert APRS can either use Bluetooth or a cable. The integration requires a software update and hardware available from M&S Technologies and Reichert. Please contact Technical Support for additional assistance.

# ATS-HOTV and eETDRS™ Protocols

Smart System® can run both the ATS-HOTV and eETDRS Protocols, providing a consistent and repeatable testing methodology. These tests can be assigned to a **FNC** button combination on the remote control. After pressing this combination, up/down +/- record correct (up/+) and incorrect (down/-) responses and test commences following the algorithms described below. At the completion of the test, the resulting VA is displayed on the screen.

## **ATS HOTV Algorithm**

The ATS HOTV Algorithm is a 4 part test that uses the HOTV optotypes crowded at 100% with crowding or interaction bars.

**Screening:** The screening phase begins at either 20/400 or 20/100 depending on the choice the doctor or technician makes during the selection of the test. It begins at the selected size and reduces the size with each correct answer until a wrong answer is made. The size is then set two lines higher and it enters Phase 1.

**Phase 1:** The first phase begins two lines above the previous wrong answer and randomly presents each of the four optotypes H O T and V. If the patient gets three or more correct out of four, the line is reduced in size by one and again, the four optotypes are presented. This continues until the patient misses two of the four or worse. The size is increased by three and the Reinforcement phase begins.

**Reinforcement:** The reinforcement phase helps to regain interest in the test by presenting three optotypes beginning 3 lines higher in size than the line they did not get correct in Phase 1. For example, if the patient misses on 20/100, the reinforcement would show a 200, 150 and 125 optotype to help the patient regain interest and focus on the test.

**Phase 2:** The second phase begins at the line the patient missed in Phase 1 and provides another opportunity to get this line correct and work lower still. At the next miss of two or more optotypes, the visual acuity will be the last line where the patient responded with three out of four correct answers.

## ATS-HOTV and eETDRS Protocols (Cont'd)

### eETDRS Algorithm

The eETDRS Visual Acuity Testing Protocol is conducted in two distinct phases, culminating in the determination of the visual acuity and the Letter Score. Each phase is described below.

1. **Screening Phase** – Single crowded optotypes are presented to determine the smallest logMAR level that is correctly identified by the patient. The testing commences with 20/400 and moves 3 log units smaller with each correct answer until an optotype is missed. For instance, 20/400, 20/200, 20/100, 20/50, etc. When an optotype is missed, the screening then moves up two log units and presents an optotype. If this is correctly answered, the screening moves down in one log unit steps until the next miss whereupon the last correct answer is the acuity used to begin the Testing Phase. If the optotype shown after moving back up two log units is incorrectly answered, the screening moves up in one log unit steps until a correct answer and this answer is used to begin the Testing Phase.
2. **Testing Phase** – The Testing Phase commences with the last correctly identified size from the Screening Phase and one level smaller. For example if the Screening Phase found the smallest level to be 20/50, the Testing Phase would begin with 20/50 and intermix 20/40 level optotypes. If an optotype is missed, one level larger is added to the testing pool. If a letter is correct at a given level, one additional level smaller is added to the testing pool. So continuing the example, if the patient identifies the 20/40 optotype, 20/32 would be added to the testing pool, and if the user misidentifies the 20/50 optotype, 20/63 would be added to the testing pool. For each level that becomes part of the testing pool, five presentations are made. The test continues until the smallest level with 5 out of 5 correct is determined as well as the smallest level with 0 out of 5 correct. This determines the upper and lower logMAR levels.
3. **Visual Acuity** – The Approximate Snellen Visual Acuity is determined based on the letter score to provide the traditional measure of acuity.
4. **Letter Score** – The Letter Score is determined to be the total number of optotypes correctly identified during the Testing Phase plus 5 times the number lines above (larger) than the upper logMAR level (5/5 correct) through 20/800. For example, if 20/63 is the upper logMAR level, there are 11 lines above (larger) than 20/63. So, the formula would be the number of correctly identified optotypes plus  $5 * 11$  (55). If there were 8 correctly identified optotypes during the testing phase, the score would be 63.

At the completion of the testing, both the Visual Acuity and Letter Score are presented for recording. The complete list of correct/incorrect responses by logMAR level is also presented for review.

Note that the crowding is “100% crowding” where the bars are one full optotype width from the next optotype.

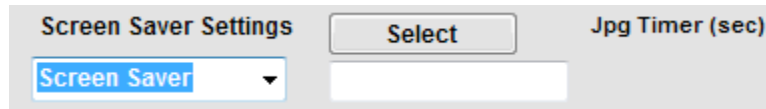
## Assigning a Screen Saver

Smart System<sup>®</sup> can do one of four things as a screen saver. Note that the regular system screen saver should not be used, but rather one of the built-in Smart System<sup>®</sup> screen-savers should be utilized, which includes system screen savers. The screen saver can be:

- Blank Screen – The traditional blank screen
- Windows<sup>®</sup> Screen Saver – Choose any of the Windows<sup>®</sup> Screen Savers
- JPG Directory Play – Pick a presentation folder to cycle through allowing customized marketing and education for your practice

To set a Screen Saver using a Keyboard and Mouse:

1. Press “**z**” or “**Home**” to enter the configuration.
2. Press **Media** button.
3. In the Screen Saver Settings, click the drop-down and choose between the four types.



The image shows a software dialog box titled "Screen Saver Settings". At the top right, there is a "Select" button and a label "Jpg Timer (sec)". Below the title bar, there is a dropdown menu with "Screen Saver" selected, and an empty text input field.

4. For Windows<sup>®</sup> Screen Saver, JPG Directory and Eyemaginations, press **Select** to navigate to the file or folder desired.
5. For JPG Directory, use the JPG Timer to choose how fast to cycle the images.
6. Click **Done**.
7. Click **Done**.

# Low Vision

## Masking

Smart System<sup>®</sup> now allows an optotype to be “masked” for use with Low-Vision patients. This function can be assigned to any key, **FNC** + Key or SHIFT + Key. Assigning a key is described in the section entitled “**Customizing the Keypad, Remote Control and Footpedal**”. The function is found in **LowVision I Masked\_LowVision**

When the resulting key is pressed, a single optotype will be masked and will appear on the screen as shown below.



## One Meter Testing

Smart System<sup>®</sup> now allows one meter testing for Low-Vision patients, greatly increasing the range of sizes available to 20/1600. This function can be assigned to any key, **FNC** + Key or SHIFT + Key. Assigning a key is described in the section entitled “**Customizing the Keypad, Remote Control and Footpedal**”. The function is found in **LowVision I One\_Meter\_Testing**

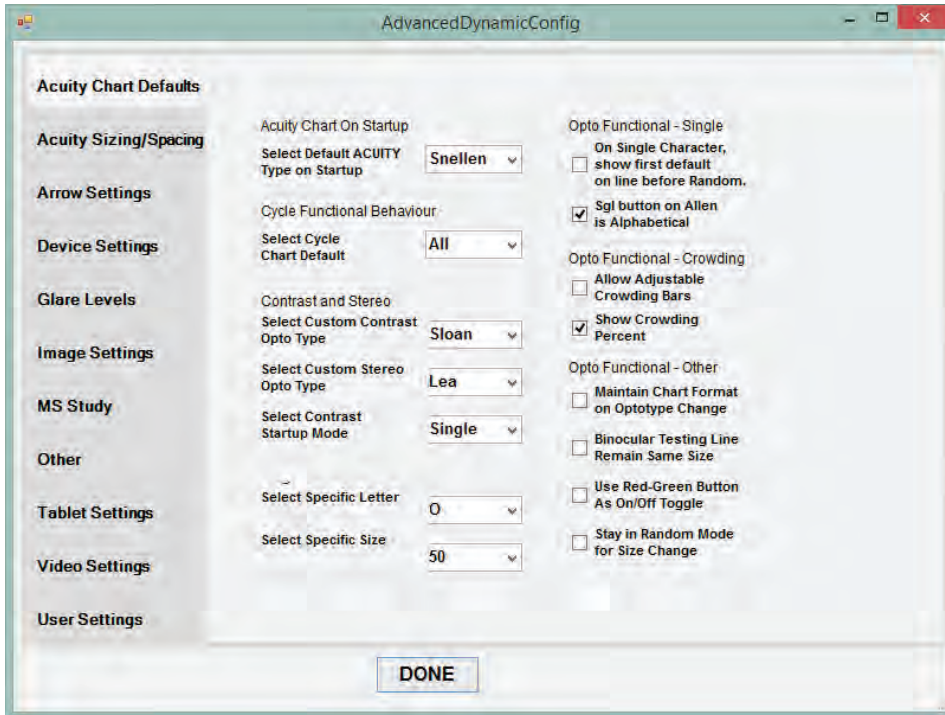




# Advanced Configuration

There are many aspects of the Smart System<sup>®</sup> that can be set using the Advanced Configuration.

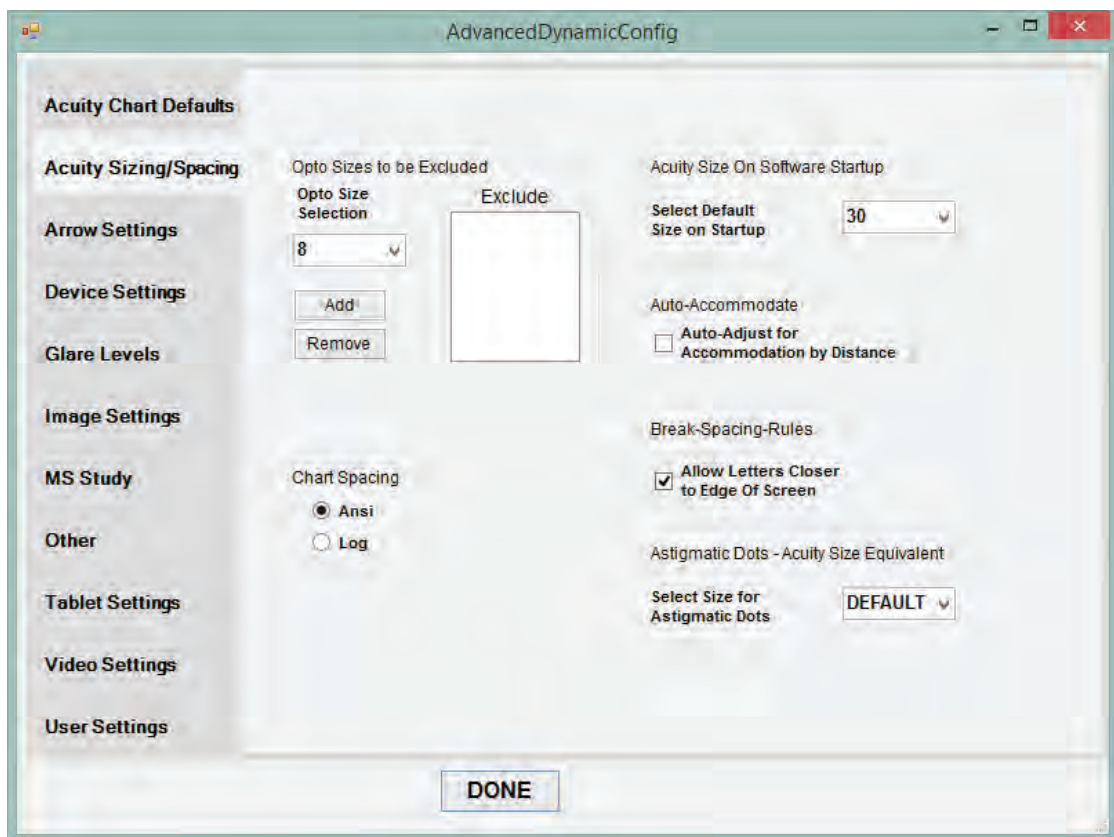
1. Using the Keyboard & Mouse, press the “**Home**” key (near page up and page down) to open the Main configuration.
2. Click the **Advanced** button.



3. The **Acuity Chart Defaults** screen allows changing several parameters:
  1. The default optotype at system startup can be changed from Snellen to any other set.
  2. The Cycling function can be set to cycle all (full chart) or only lines or letters.
  3. Contrast & Stereo
    1. Select Custom Contrast Optotype: allows the contrast test to use Sloan or other available optotypes.
    2. Select Customer Stereo Optotype: allows the stereo test to use LEA Symbols<sup>®</sup> or other optotypes for stereo measurements.
  3. Single Letter Test
    - a) It is possible to have a particular letter at a particular size be available via the remote control (e.g. a 20/40 “O”) – set this to pick the letter and size.
  4. To have the single optotype when first pressed be the first letter of the corresponding line (e.g., if the line is FZBDE, the single will first be F), check off the “On Single Character” box.

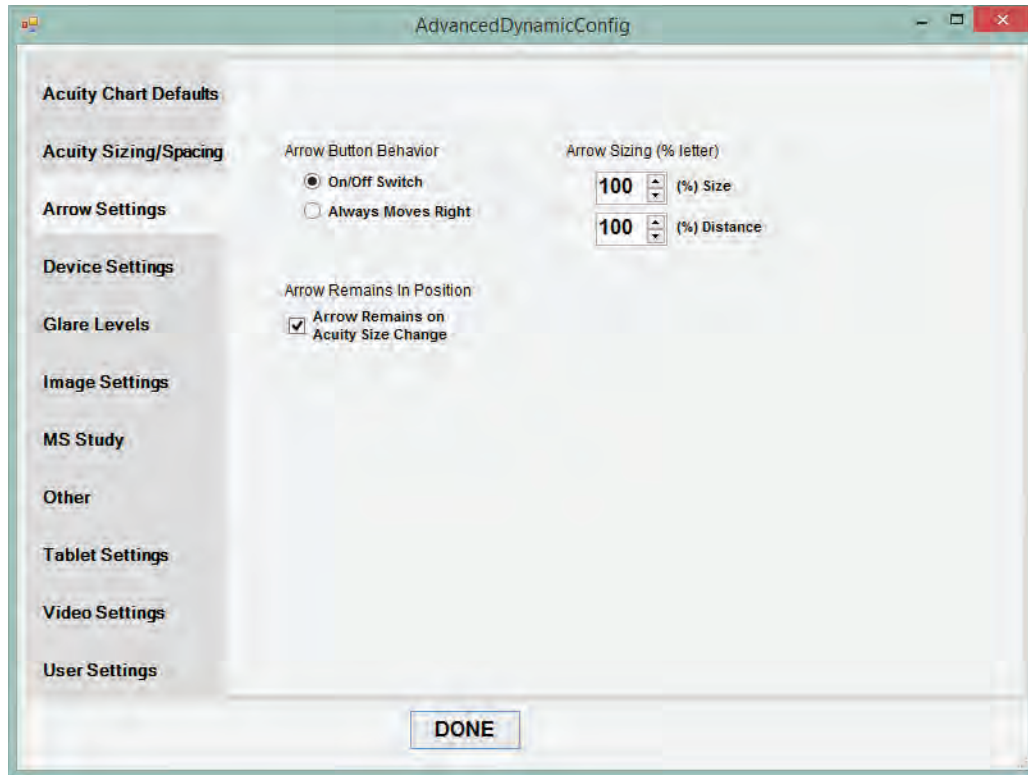


5. To “Maintain Chart Format on Optotype Change” or to stay in a line when moving between Snellen and Allen, check this box.
  6. “Allow Adjustable Crowding Bars” is a research tool.
  7. Show Crowding Percent will show whether the bars are 50% or 100%.
  8. The “Sgl button on Allen is Alphabetical” allows the doctor to step through the Allen pictures in Alphabetical Order to familiarize the children with the pictures if desired.
  9. Binocular Testing Line is for use with autophoroptors.
  10. Use Red-Green Button as On/Off Toggle. It allows the Red/Green mask to be enabled/disabled with the R/G button – default behavior is randomization of the chart.
4. The **Acuity Sizing/Spacing** allows several chart changes.



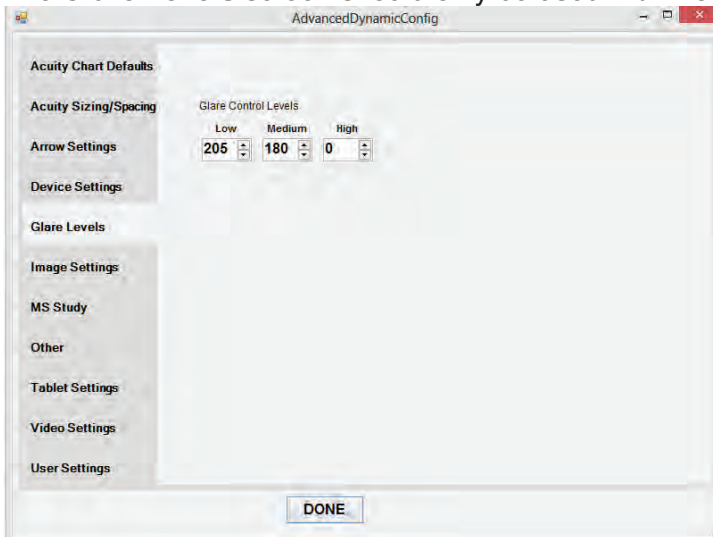
1. Particular line sizes can be excluded.
2. Chart Spacing can be ANSI (space between lines equal to height of larger) or Log (space between lines equal to height of smaller).
3. The Default Startup size can be selected.
4. Auto-accommodate should only be used with the direction of M&S Technical Support.
5. Allow Letters Closer to edge of screen permits letters to approach the edge of the screen – by default, an optotype width of separation is kept.
6. The Jackson Cylinder/Dots default sizing can be adjusted.

5. The **Arrow Settings** screen can allow the arrow to be adjusted.

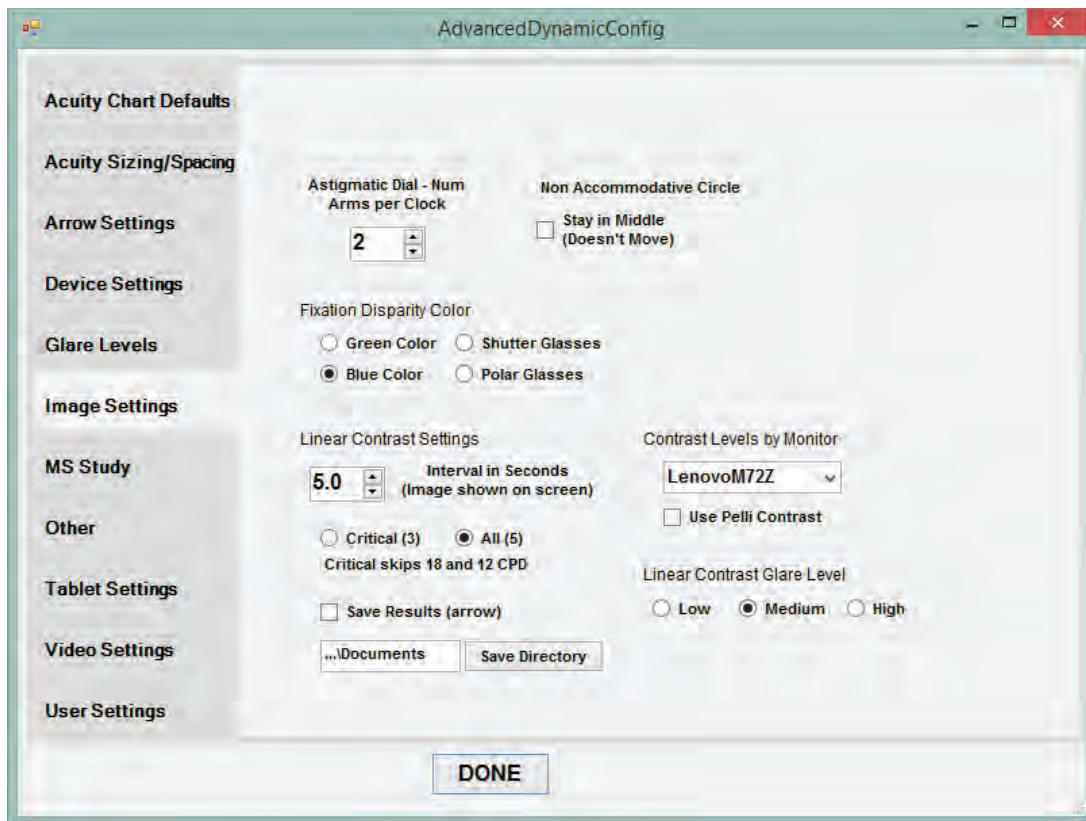


1. The Arrow button can be set to toggle where +/- move the arrow or for the Arrow to always move right when the ARW button is pressed.
  2. The Arrow can be set to stay in its current position when size is changed so that if the arrow is pointing to the 3<sup>rd</sup> character. If the size of the chart is changed, the arrow will still point to the 3<sup>rd</sup> character.
  3. The Size and Spacing of the arrow can be adjusted.
6. The **Device Settings** screen allows advanced configuration for the devices. It is mostly for use with M&S Technical Support. For systems running dual-monitor with EHR, the **Ignore Keyboard Commands** box should be checked. This limits the keyboard to just the **Home** (for configuration) & **End** (exit) Keys. The Info Window/Virtual Keypad is used to drop in a virtual window if using multiple monitors. All other use should be with M&S Technologies Technical Support.

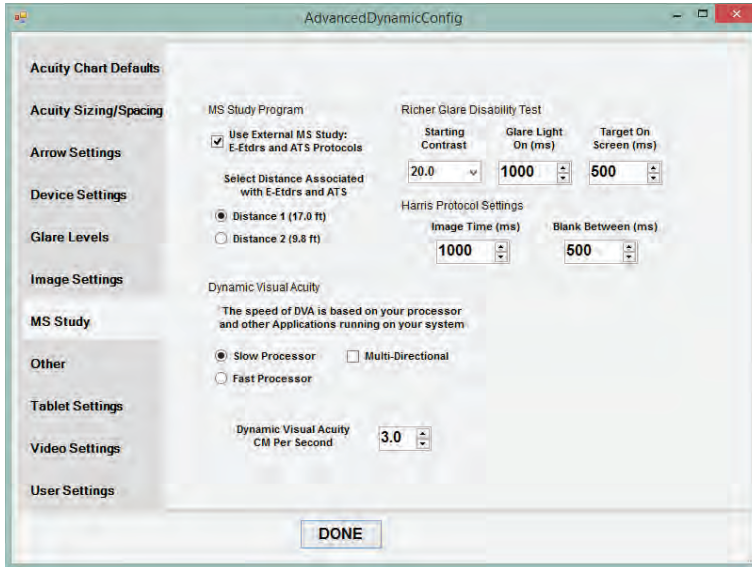
7. The **Glare Levels** screen should only be used with M&S Technical Support.



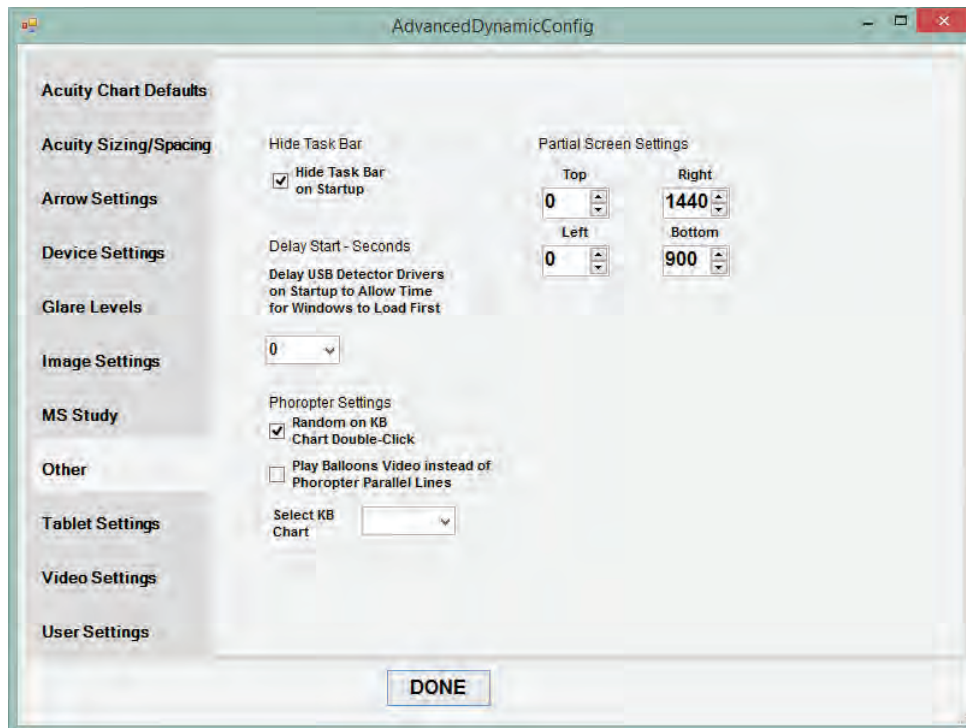
8. The **Image Settings** screen controls the number of increments in the astigmatic dial (20 minutes, 30 minutes or hourly) and the non-accommodative fixation Target behavior – float or stay in middle of screen. The color for Fixation Disparity can be selected Green or Blue, Shutter or Polarized. The Linear Sine Grating Protocol settings can be adjusted for the time the presentation is on-screen and as well for all spatial frequencies or Critical (1.5, 3 and 6 cpd). The Contrast settings can be adjusted for the monitor or All-in-one unit.



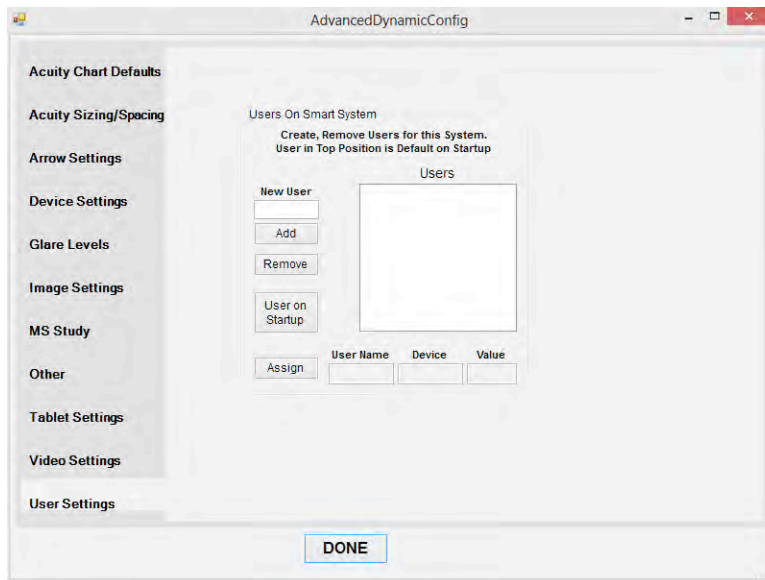
9. The **MS Study** screen determines if the separate program for Jaeb Center studies should be used. The choice is grayed-out if software is not present. The test distance can be selected to be either Distance 1 or Distance 2 from the Main configuration. Dynamic Visual Acuity speed can be adjusted. The Richer Glare Disability test settings can be adjusted for timing and contrast. The Harris Protocol for Contrast and Acuity timing can be adjusted.



10. The **Other** screen controls the behavior of the Windows<sup>®</sup> Task bar and should only be used with assistance from Technical Support. The Delay of the software to allow Windows<sup>®</sup> to load can be adjusted from 0 to 60 seconds. The other items are for M&S Technical Support.



11. The **Tablet Settings** Screen allows the tablet layout to be customized to the doctor's preferences. Buttons can be added, deleted and renamed and additional tabs can be created. For additional information, consult the separate instructions for the tablet.
  
12. The **Video Settings** Screen allows the user to select in Pediatric fixation whether to return to a blank screen, chart, single line or single letter.
  
13. The **User Settings** allows multiple doctors to maintain different configurations such as assigned buttons on the remote, tablet or keypad, or separate Patient Education lists. Each user name can be added and buttons assigned will switch between users. Once added, any configuration changes will only affect the user currently in usage.





# Sine Grating Protocol Use

## Assign a Button to Sine Grating Protocol

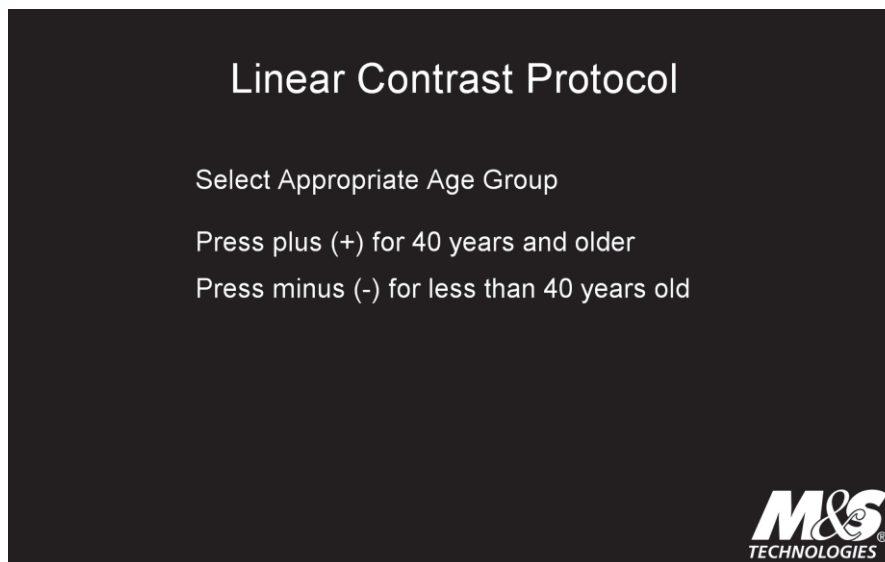
Follow the instructions in the Appendix for Customizing the Keypad, Remote Control and Footpedal to assign a button on the remote control to the Sine Grating Protocol.

## Protocol

The protocol for Sine Gratings uses a 3 Round algorithm. Round 1 has 0.3 log unit steps, Round 2 has 0.2 steps and Round 3 has 0.1 log step. The test begins at 25% contrast. If the patient answers correctly, the test reduces the contrast in 0.3 log unit steps until an incorrect answer is recorded. The protocol then goes up 0.2 log units and will reduce in 0.2 log unit steps until the next incorrect answer. Finally, the test moves up 0.1 log units and reduces contrast until the final incorrect answer. Then, the best (lowest) two contrast levels are averaged for a final result. At completion of the 5 spatial frequencies, a graph is presented detailing patient performance against the normative data.

## To run the Linear Sine Grating Protocol:

1. Press towards the assigned button on the remote control.
2. The Sine Contrast Main Screen will appear.



3. Select the age as prompted.
4. If the Glare testing is in use, select to use Glare.

## Linear Contrast Protocol

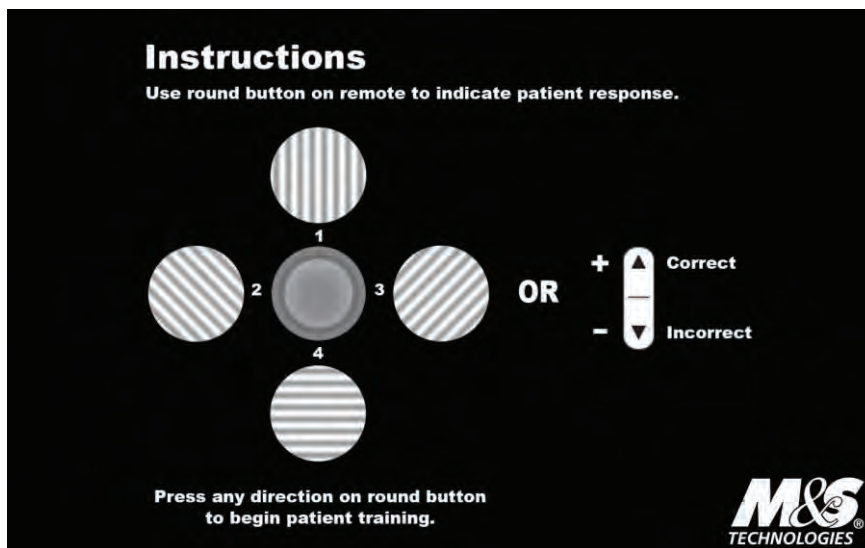
Select Glare On/Off

Press plus (+) for Glare ON

Press minus (-) for Glare OFF



5. The Instructions will be shown on screen:



6. 1, 2, 3 and 4 are the cardinal directions on the Round button of the remote control:
- 1 is Up
  - 2 is to the Left
  - 3 is to the Right
  - 4 is Down
  - OR** Up ▲ is correct | Down ▼ is Incorrect
7. Press any direction on the remote to continue and begin the protocol.

## Sine Grating Protocol Use (Cont'd)

8. A Demo is shown, displaying a target of 6 cycles per degree at 50%, 25%, 12.5% and 6% contrast. This will familiarize the patient with the test.

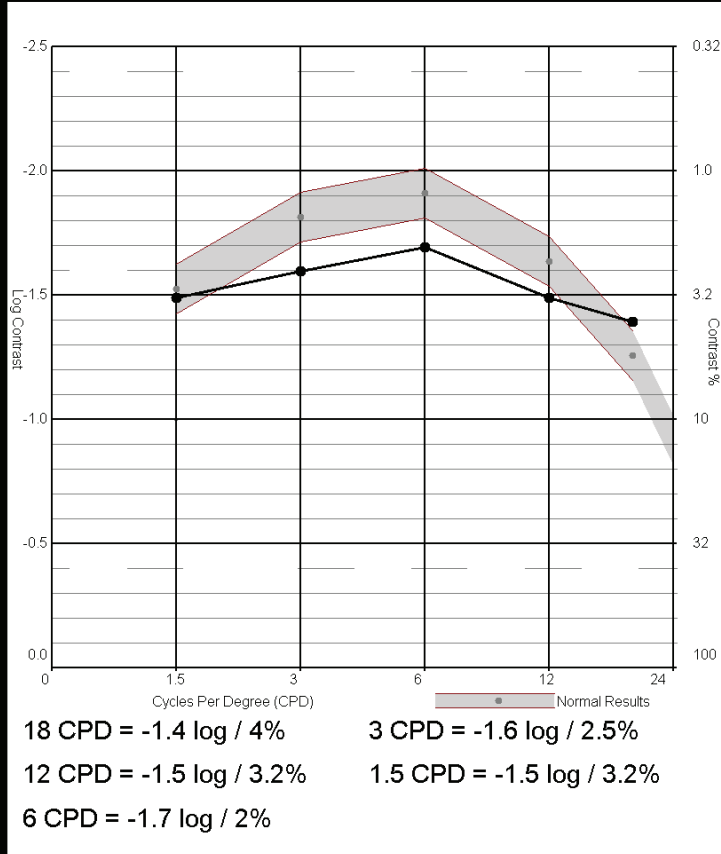


9. Once complete, the test will commence and test the user at 18 cpd, 12 cpd, 6 cpd, 3 cpd and 1.5 cpd.
10. The Round button is used to record the direction the gratings run as indicated on the initial screen. If neither the patient nor the doctor can ascertain the direction, indicate NO by pressing down on one of the Up/Down size buttons. Alternately, correct responses can be indicated by pressing Up to indicate YES.
  - a. Yes – Up on size buttons
  - b. No – Down on size buttons
  - c. Up/"1" – Vertical grating
  - d. Down/"4" – Horizontal grating
  - e. Left/"2" – Gratings slope to upper left
  - f. Right/"3" – Gratings slope to upper right
11. The results will be displayed for recording. The results will also be saved to a comma delimited file for later review.
12. Press any key to leave the protocol.



M&S Contrast Sensivity Function Test Results

# M&S<sup>®</sup> Contrast Sensivity Function Test Results.

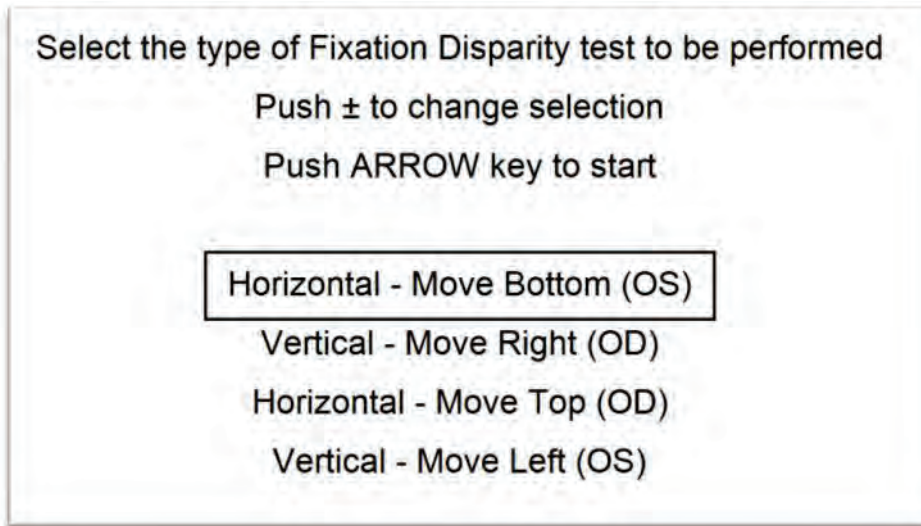


## Enhanced Fixation Disparity Test

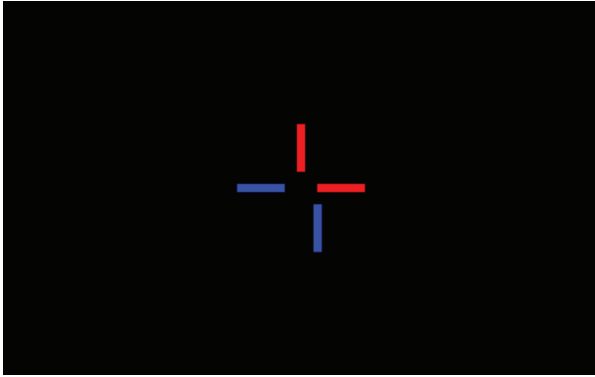
Developed with Dr. David Kirschen, OD, PhD the Enhanced Fixation Disparity Tests provide an accurate assessment of fixation disparity either with or without the central dot.

### How to perform a Fixation Disparity measurement

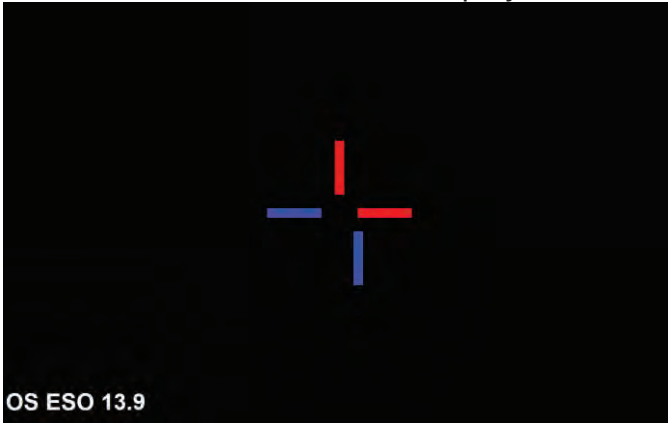
1. Have the patient wear his/her best distance glasses.
2. Put the R/B glasses (supplied with the M&S FD test) over their glasses (if the patient doesn't wear glasses for distance vision then just wear the R/B glasses).
3. Push the assigned button on the remote control to activate FixationDisp Enhanced (For assistance in programming the remote buttons, see the Appendix below).



4. Choose from the menu **Horizontal-Move Bottom (OS)** for horizontal FD measurements.
5. Instruct the patient to continuously look at the bottom of the top line and tell you which way the bottom line has to be moved to be aligned with the top line (left or right).
6. Push the + or – button on the remote to move the bottom line either right or left until the patient reports that the lower line is aligned with the top line. (The right-side + and – button (up/down) is used for large movements and the left-side + and – button is used for small or finer movements of the line.)



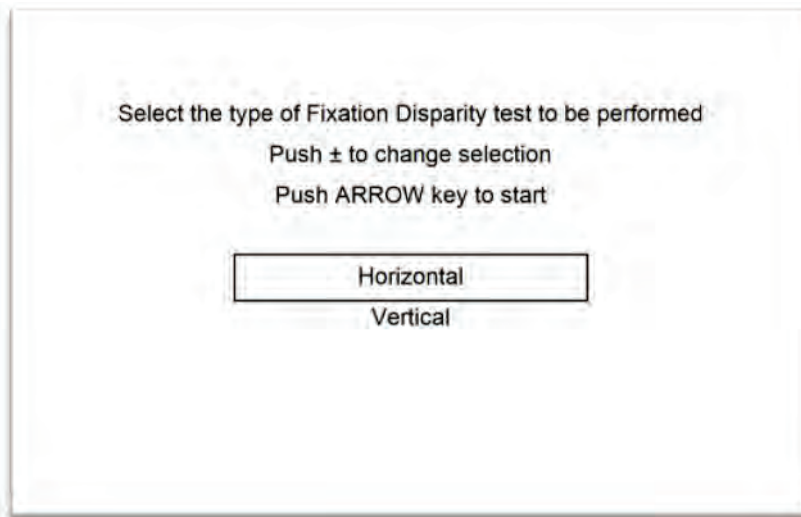
7. When the patient says that the upper and lower lines are aligned push the **Arrow** button.
8. The answer in arc-minutes is displayed on the screen. Record the result.



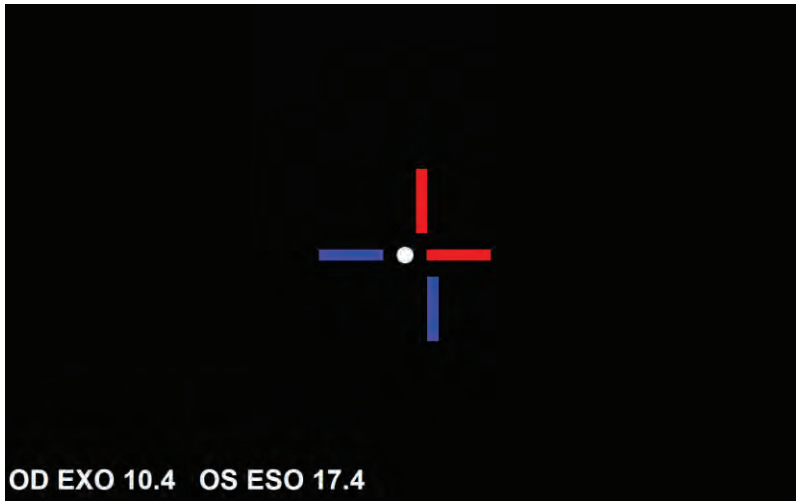
9. Push the **Arrow** button again to return to the main menu.
10. Repeat the procedure for **Vertical** FD by selecting the appropriate choice from the menu.
11. If you prefer to have the patient fixate with the left eye, choose **Horizontal-Top Line moves (OD)** and repeat steps 5-8 above. When selecting this option, instruct the patient to continuously look at the top of the bottom line.

## Fixation Disparity measurements using the central dot

1. Push the assigned button on the remote control to activate FixationDisp Enhanced\_Dot (For assistance in programming the remote buttons, see the Appendix below).



2. Select **Horizontal** or **Vertical** from the menu.
3. Instruct the patient to always look at the central white dot and tell you to move the upper line to the left or the right so that the upper line is aligned with the white dot.
4. Push the + or - button (up/down) on the hand controller to move the line the desired amount.
5. When aligned, push the **Arrow** button.
6. Then ask the patient which way the lower line has to be moved to line up in the center (left or right).
7. Push the + or - button (up/down) until the lower line is lined up with the center dot.
8. Push the **Arrow** button to display the answer in arc-minutes on the screen. Record the answer.



9. Push the **Arrow** button again to return to the main menu.
10. If you wish to measure the monocular components of vertical FD, repeat steps 3-8 above after selecting **Vertical** FD from the menu.

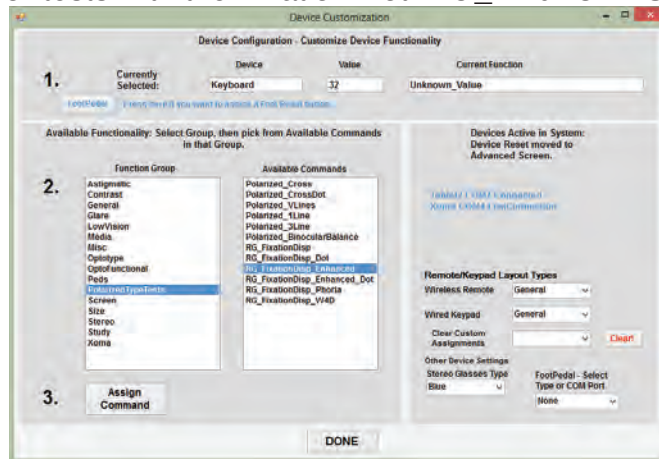
## How to plot a Ogle Forced Vergence Curve

1. Have the patient wear his/her best distance glasses.
2. Put the R/B glasses (supplied with the M&S FD test) over his/her glasses (if the patient doesn't wear glasses for distance vision then just wear the R/B glasses).
3. Push the assigned button on the remote control for FixationDisp Enhanced (For assistance in programming the remote buttons, see the Appendix below).
4. Choose from the menu - **Horizontal-Bottom line moves (OS) for horizontal FD measurements.**
5. Instruct the patient to continuously look at the bottom of the top line and tell you which way the bottom line has to be move to be aligned with the top line (left or right).
6. Push the + or – button on the remote to move the bottom line either right or left until the patient reports that the lower line is aligned with the top line. (The **right** + and – button is used for large movements and the **left** + and – button is used for small or finer movements of the line.)
7. When the patient says that the upper and lower lines are aligned push the arrow button and the answer is displayed on the screen. Record the result on the graph.
8. Put a 2pD Base In prism in front of the patient's left eye and repeat steps 5 thru 7 above. Continue to add Base In prism and make measurements until there is either:
  - a. A significant increase in Eso FD or
  - b. A break down in binocular vision (suppression or diplopia)
9. Now add Base Out prism in front of the patient's left eye and repeat steps 5 thru 7 above. Continue to add Base Out prism and make measurements until there is either:
  - a. A significant increase in Exo FD or
  - b. A break down in binocular vision (suppression or diplopia)

## ***Programming the Enhanced Fixation Disparity features to the remote control or keypad***

If the remote control isn't pre-set with the new Enhanced Fixation Disparity functions perform the following steps.

1. With Smart System running, press the **HOME** key on the computer keyboard
2. Click **Device** button
3. On *Device Configuration*
  - a. Choose the button on the remote you wish to use and press it – for example #2 on the remote (Left on Round Button) or a SHIFT+Button on the keypad
  - b. In **Section 2**, in the left column *Function Group* choose **Polarized Type Tests**
  - c. In the right column, *Available Commands*, choose
    - For tests without the Dot: **RG\_FixationDisp\_Enhanced**
    - For tests with the Fixation Dot: **RG\_FixationDisp\_Enhanced\_Dot**

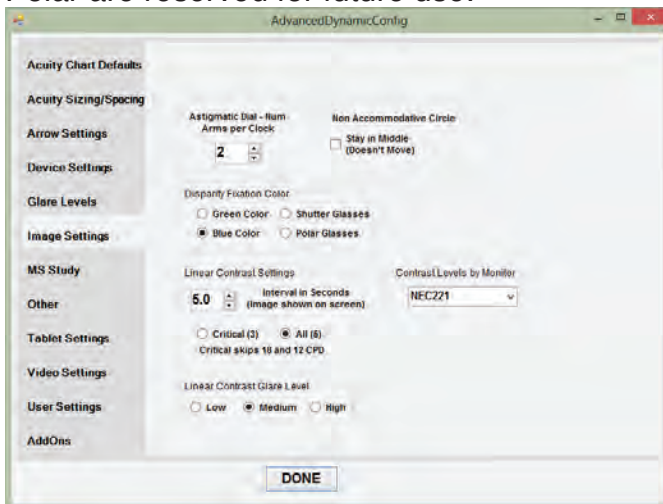


- d. In **Section 3**, click **Assign Command**
  - e. Repeat steps a-e for the other test if desired
  - f. Click **Done**
4. Click **Done**

## Setting Red-Green or Red-Blue Glasses

Fixation Disparity can use either Red-Green or Red-Blue glasses or lenses in the refractor head. To choose, follow these steps:

1. With Smart System running, press the **HOME** key on the computer keyboard
2. Click **Advanced** button
3. Choose **Image Settings** tab
4. In the box *Fixation Disparity Color*, choose either Green or Blue – Shutter and Polar are reserved for future use.



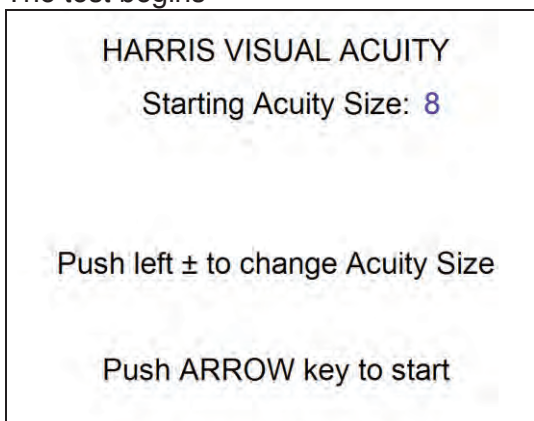
5. Click **Done**
6. Click **Done**



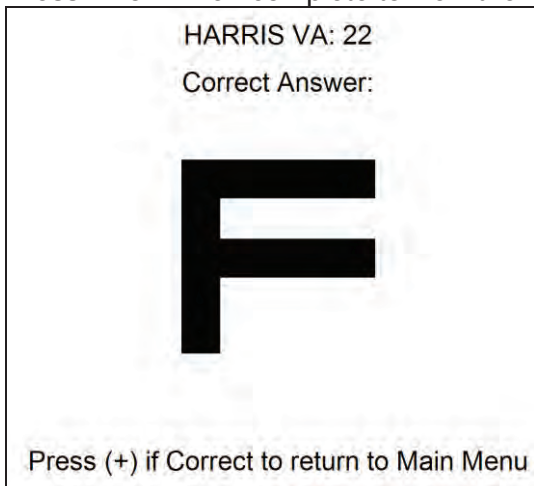
## Harris Visual Acuity Test

The Harris Visual Acuity Test was developed by Paul Harris, OD, FCOVD, FACBO, FAAO Associate Professor of Optometry at Southern College of Optometry, to quickly measure very specific visual acuities in between the normal increments (e.g. 20/170). The test will need to be assigned to a button on the remote control following the steps in the Appendix Section **Customizing the Keypad, Remote Control and Footpedal**. The *Function Group* is **OptoFunctional** and the *Function* is **Harris Acuity**.

1. Press the assigned button on the remote control
2. The test begins



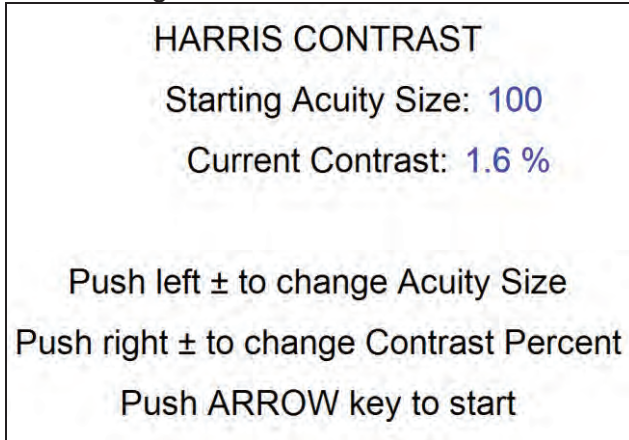
3. Choose a starting acuity size using the Up/Down +/- buttons – 20/8 is the default starting point
4. Press the ARROW button to begin
5. The test presents a single letter
6. Press Up (+) until the patient gets the answer correct – the test goes up in standard size increments (10, 15, 20, etc)
7. When the patient gets the correct answer, press Down (-)
8. The letter is reduced to the next smaller line size
9. Press Up (+) until the patient gets the answer correct – the test goes up in single increments (10, 11, 12, 13, etc). At larger sizes the test will move in 5's, 2's and then 1's as the patient gets closer to the true visual acuity
10. Press Arrow when complete to view the final size



## Harris Contrast Test

The Harris Contrast Test was developed by Paul Harris, OD, FCOVD, FACBO, FAAO Associate Professor of Optometry at Southern College of Optometry, to quickly measure very specific contrast sensitivity function. The test will need to be assigned to a button on the remote control following the steps in the Appendix Section ***Customizing the Keypad, Remote Control and Footpedal***. The *Function Group* is **Contrast** and the *Function* is **Harris Contrast**.

1. Press the assigned button on the remote control
2. The test begins

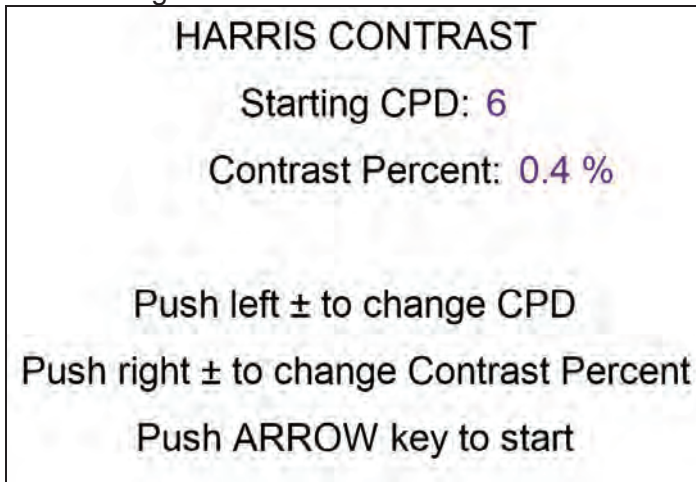


3. Choose a starting acuity size using the Left Up/Down +/- buttons
4. Choose the starting contrast percentage using the Right Up/Down +/- buttons
5. Press the ARROW button to begin
6. The test presents a single letter
7. Press Up (+) until the patient gets the answer correct – the contrast increases in 0.3 log unit steps
8. When the patient gets the correct answer, press Down (-)
9. The letter contrast is reduced by 0.3 log steps
10. Press Up (+) until the patient gets the answer correct – the test goes up in 0.1 log steps
11. Use Up/Down to verify the results
12. When ready for result, press Arrow when complete to view the final contrast percentage

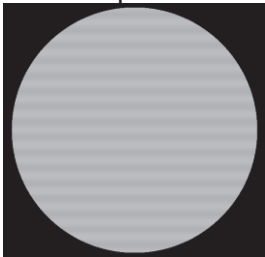
## Harris Sine Contrast Test

The Harris Sine Contrast Test was developed by Paul Harris, OD, FCOVD, FACBO, FAAO Associate Professor of Optometry at Southern College of Optometry, to quickly measure very specific contrast sensitivity function using sine wave gratings with a Gabor patch. The test will need to be assigned to a button on the remote control following the steps in the Appendix Section ***Customizing the Keypad, Remote Control and Footpedal***. The *Function Group* is **Contrast** and the *Function* is **Harris Sine Contrast**.

1. Press the assigned button on the remote control
2. The test begins



3. Choose a starting Cycles/Degree size using the Left Up/Down +/- buttons
4. Choose the starting contrast percentage using the Right Up/Down +/- buttons
5. Press the ARROW button to begin
6. The test presents a sine grating



7. Press Up (+) until the patient gets the answer correct – the contrast increases in 0.3 log unit steps
8. When the patient gets the correct answer, press Down (-)
9. The letter contrast is reduced by 0.3 log steps
10. Press Up (+) until the patient gets the answer correct – the test goes up in 0.1 log steps
11. Use Up/Down to verify the results
12. When ready for result, press Arrow when complete to view the final contrast percentage



## ColorCheck for Smart System®

Color vision deficiency (CVD) is the inability or decreased ability to see color or perceive color differences under normal lighting conditions. In the US, about 7% of the male population and 0.4% of the female population either cannot distinguish red from green, or see red and green differently from how others do. More than 95% of all variations in human color vision involve the red and green receptors. Only a very small percentage of the population is “blind” to the blue end of the color spectrum.

Inherited CVD can be congenital or it can develop later on in childhood or adulthood. Depending on the mutation, it can remain the same throughout a person’s lifetime, or progress.

Other causes of color deficiencies include accidents and other trauma which produce swelling of the brain in the occipital lobe, damage to the retina caused by exposure to ultraviolet light, and substance toxicity (antibiotics, chemical solvents, etc.).

CVD may also present itself in the spectrum of degenerative diseases of the eye, such as age-related macular degeneration, and as part of the retinal damage caused by diabetes.

**ColorCheck** for Smart System® is the Color Vision Testing System from M&S Technologies.

It screens for Red, Green and Blue (Protan, Deutan and Tritan) color deficiencies in an easy-to-use, patient-driven protocol. Much like the traditional books, ColorCheck presents a series of pseudo-isochromatic plates for the patient to identify the number or symbol shown.

1. Launch ColorCheck by pressing the assigned button on the remote control or keypad. In version 2013.4 and higher, this is FNC + 15. If the older plates are shown, please follow the instructions at the end of this document to assign a button for ColorCheck.
2. ColorCheck will build test plates dynamically so that patient memorization is impossible.



Loading your customized  
ColorCheck protocol...

3. Select *Adult* (Numbers) or *Pediatric* (Lea Symbols) – the top two choices are automated protocols; the bottom two choices are manual and can be changed like flipping pages in a book:

ADULT

PEDIATRIC

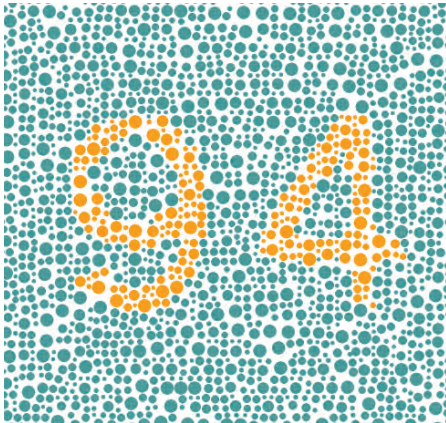
Adult -manual

Pediatric -manual

Press Arrow to Begin

4. Use the Up/Down buttons to select
5. Press the Arrow button to commence testing

6. An example plate will appear – this will also screen for malingerers:



7. The patient will be presented with choices and selects an answer:

Select your answer.

Blank
5 4
8 9
6 9
3 7
3 1

Press Arrow to Enter

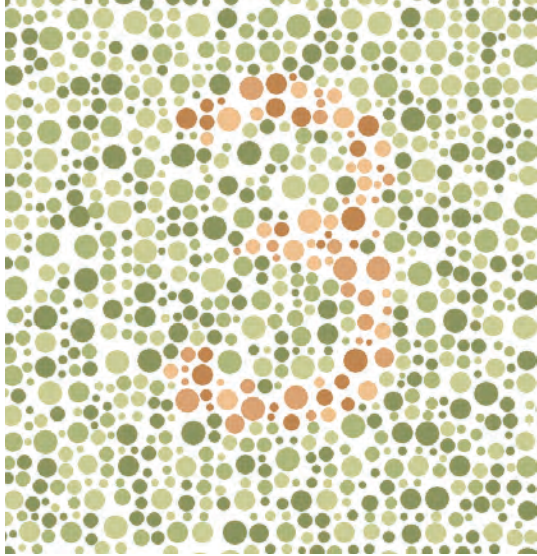
8. Use the Up/Down buttons to select an answer

9. Press the Arrow button to select and enter the choice

10. The user is prompted to “**Get Ready**” in anticipation of the next plate.

11. The plate is displayed and will stay on the screen for 3 seconds.

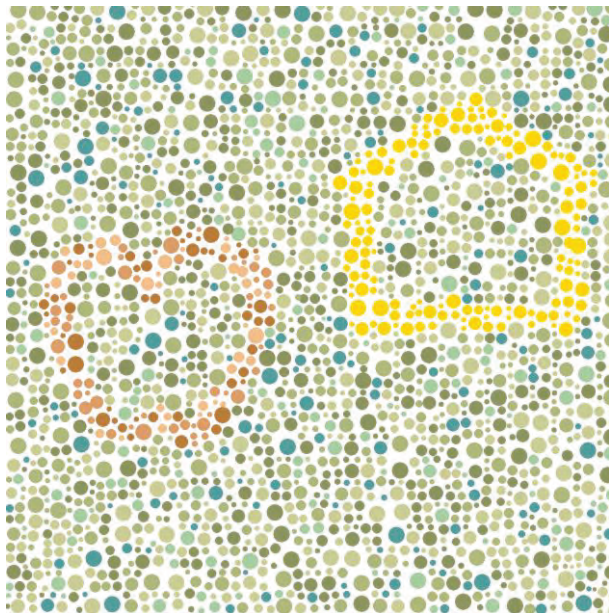




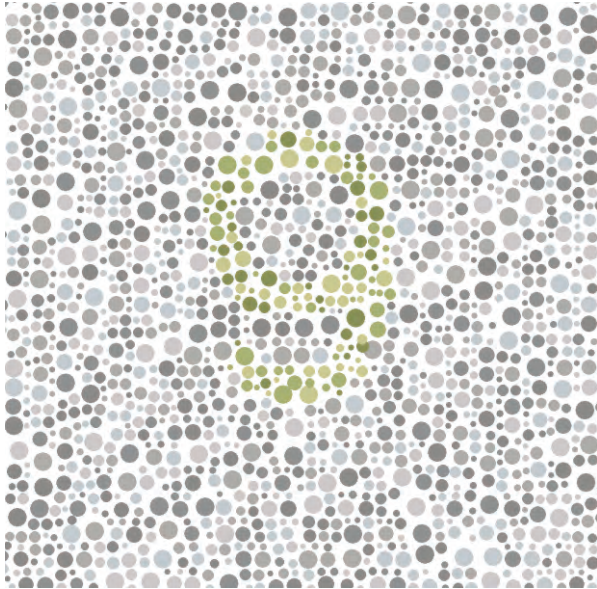
12. Again, the user will be presented with answer choices and should select the number or symbol that matches what he/she saw, or *Blank* if he/she saw nothing on the plate.

13. Several of the plates have color combinations that will be seen more clearly by those with deficiencies than those with normal color vision.

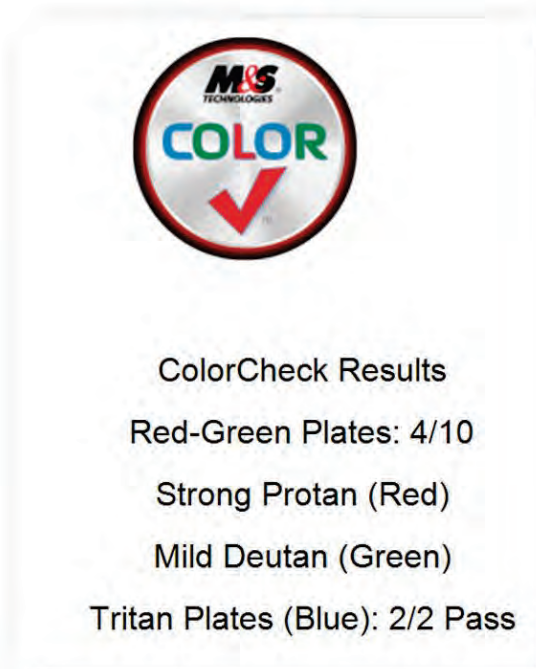
14. An example of a Pediatric plate:



15. The final phase of the test screens for Blue (Tritan) deficiencies (Adult Only).



16. The conclusion of the test will show the patient results:



17. Press the Arrow button to return to ColorCheck main screen or **LTR** to return to eye chart.



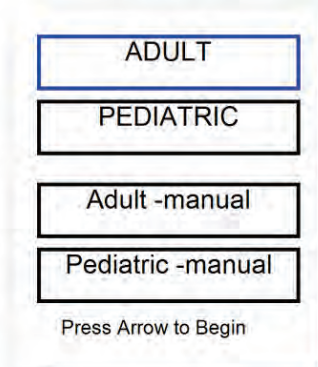
## Running a Manual Color Test

ColorCheck may be run manually in a similar manner to the traditional books. This may be useful for a quick screening where the entire automated protocol may not be needed.

1. Launch ColorCheck by pressing the assigned button on the remote control or keypad. In version 2013.4 and higher this, is FNC + 15. If the older plates are shown, please follow the instructions at the end of this document to assign a button for ColorCheck.
2. ColorCheck will build test plates dynamically so that patient memorization is impossible.

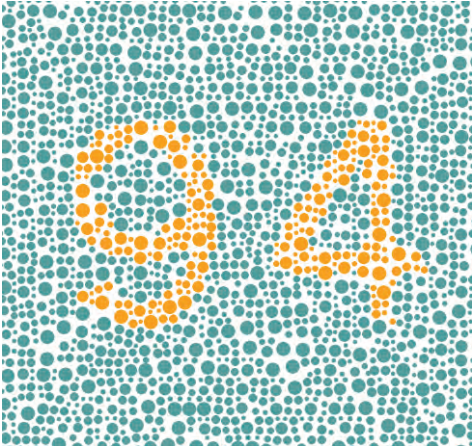


3. Select *Adult* (Numbers) or *Pediatric* (Lea Symbols) – the top two choices are automated protocols; the bottom two choices are manual and can be changed like flipping pages in a book. Select Adult or Pediatric Manual.

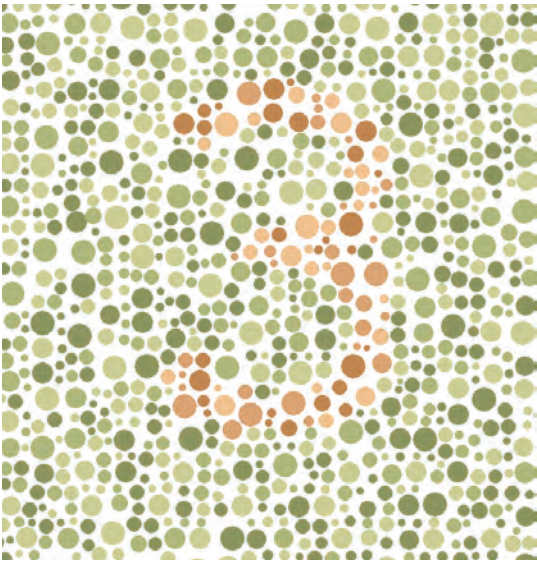


4. Use the Up/Down buttons to select – to run a manual test choose “manual”

5. Press the Arrow button to commence testing
6. An example plate will appear – this will also screen for malingerers:



7. Press the Arrow button to move through the plates



8. At completion, the press Arrow button.

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Contractor: M&S Technologies, 5715 W. Howard Street, Niles, IL 60714.

**Entire Agreement.** This agreement constitutes the entire agreement between Licensee and MST and supersedes any other prior agreements or communications regarding the WBS. If any provision of this agreement is held invalid, the remainder of this agreement shall continue in effect.



# **M&S® Technologies, division of The Hilsinger Company Parent LLC ("MST")**

## **End User Limited Hardware Warranty**

Computer hardware products and related accessories purchased new from M&S Technologies, or on behalf of M&S through its Authorized Distributors ("AD"), come with a 1-year limited hardware warranty. Refurbished computer hardware products and related accessories purchased from M&S Technologies, or on behalf of M&S through its Authorized Distributors, come with a 30-day limited hardware warranty.

This limited hardware warranty covers defects in M&S Technologies, materials and workmanship relating to purchased hardware and accessory product purchases by M&S end-users customers.

This limited hardware warranty does not cover:

- Software, including the operating system and software added to the M&S-purchased hardware products. (See the M&S Software License Agreement and related Limited Lifetime Warranty for any M&S-developed software.)
- Hardware products and accessories not purchased through M&S Technologies, or its Authorized Distributors
- Problems that result from:
  - External causes such as accident, abuse, misuse, or problems with electrical power
  - Servicing not authorized by M&S Technologies
  - Usage that is not in accordance with product instructions
  - Failure to follow the product instructions or failure to perform preventive maintenance
  - Problems caused by using accessories, parts, or components not supplied by M&S
- Products with missing or altered serial numbers
- Products for which M&S has not received payment
- Expendable and/or consumable parts
- Normal wear and tear

This warranty gives M&S Purchaser of Record (POR) specific legal rights, and POR may also have other rights which vary from state to state (or jurisdiction to jurisdiction). M&S' responsibility for malfunctions and defects in hardware is limited to troubleshooting with the end user, repair and/or replacement as set forth in this warranty statement. All express and implied warranties for the product, including but not limited to any implied warranties and conditions of merchantability and fitness for a particular purpose, are limited in time to the term of the 1-year limited warranty period or the 30-day limited warranty period. No warranties, whether express or implied, will apply after the limited warranty period has expired.

M&S does not accept liability beyond the remedies provided for in this limited hardware warranty or for consequential or incidental damages, including, without limitation, any liability for third-party claims against POR for damages, for products not being available for use, or for lost data or lost software. M&S liability will be no more than the amount POR paid for the product that is the subject of a claim. This is the maximum amount for which M&S is responsible.

A small percentage of users may experience epileptic seizures when exposed to certain light patterns or backgrounds on a computer screen or while using the hardware. Certain conditions may induce previously undetected epileptic symptoms even in users who have no history of prior seizures or epilepsy. If POR, or anyone in POR's family, have an epileptic condition, consult a physician prior to using the hardware. Immediately discontinue use of the hardware and consult a physician if POR experiences any of the following symptoms while using the hardware: dizziness, altered vision or muscle twitches, loss of awareness, disorientation, any involuntary movement, convulsions, or any unusual behavior or condition.

The limited hardware warranty on all M&S-purchased hardware products begins on the earliest date of the packing slip, invoice, or receipt. The warranty period is not extended if M&S repairs or replaces a warranted product or any parts. M&S may change the availability of limited hardware warranties, at its discretion, but any changes will not be retroactive.

M&S warrants that the Products that POR purchased from M&S, or on behalf of M&S through our Authorized Distributors, are free from defects in materials or workmanship under normal use during the Limited Warranty Period. POR's are entitled to warranty service according to the terms and conditions of this document if a repair to POR's Product is required within the Limited Warranty period. This Limited Warranty extends to the original end user purchaser and is not transferable. Warranty service availability and response times may vary.

Before the warranty expires, please contact M&S Technical Support at 847-763-0500 or our Authorized Distributors. Please also have your hardware serial number or invoice number available.

During the 30 days of the 30-day limited refurbished hardware warranty and the first year of all other limited hardware warranties, M&S or its Authorized Distributor will provide telephone support, repair or replace any M&S-purchased hardware products that prove to be defective in materials or workmanship. If M&S or its Authorized Distributor is not able to troubleshoot the problem with the end user or repair the product, M&S will replace it with a comparable product that is new or refurbished. M&S may also provide loaner hardware in circumstances whereby a repair or replacement is required. It is at the full discretion of M&S, as to the best approach for providing warranty service.

As part of warranty repairs or replacement, M&S or its Authorized Distributor may require the system software/firmware be brought up-to-date.

During the Limited Warranty Period, M&S will troubleshoot and correct the issue with the end user, repair or replace any defective component. This is POR's exclusive remedy for defective products. M&S reserves the right to elect, at its sole discretion, to give POR a refund of POR's purchase price instead of a replacement.

All warranty service calls handled directly by M&S will be assigned a Technical Support tracking number.

When POR's warranty service requires POR to return hardware to the M&S Technologies, Illinois warehouse, M&S will provide a loaner and a return label to ship POR M&S-purchased product for repair. POR must return the defective products to M&S in their original or equivalent packaging, or accept the risk if the product is lost or damaged in shipment. M&S will return the repaired or replacement products to POR. M&S will pay to ship the repaired or replaced products to POR if you use an address in the United States (excluding Puerto Rico and U.S. possessions and territories). Otherwise, M&S will ship the product to POR freight collect. If the failed M&S-purchased hardware is not received by M&S within twenty-one (21) business days from the date that the loaner was dispatched to customer, or the unit is not returned in the specific packaging, the Customer will be invoiced at list price for the replacement unit. Upon receipt of the repaired or replaced hardware, POR must ship any loaned hardware to the M&S Technologies, Illinois warehouse using the prepaid freight provided.

If M&S determines that the problem is not covered under this warranty, M&S will notify POR and inform POR of service alternatives that are available to POR on a fee basis. Products returned will not be accepted if there is damage due to external causes, including accident, abuse, misuse, natural and unnatural disasters, acts of God, problems with electrical power, servicing not authorized by the M&S, usage not in accordance with product instructions, failure to perform required preventative maintenance, problems caused by use of parts and components not supplied by M&S, and damage incurred during shipment of defective parts to M&S for repair. If damage is evident from these causes, the CUSTOMER will be invoiced at list price for the replacement parts. Servicing fees may also be applied at the sole discretion of M&S. Although M&S is not under any obligation to provide warranty service for Product damaged in any of the ways mentioned herein, M&S may, at its sole discretion, agree to provide additional service for such Products if, after inspection by M&S, we determine that the Product is still in acceptable operating condition.

If warranty service is provided by an M&S Authorized Distributor, depending on circumstances, POR may be required to return M&S-purchased hardware to the Authorized Distributor via prepaid freight.

**NOTE: Before POR ships the product(s) to us, make sure to back up the data on the hard drive(s) and any other storage device(s) in the product(s). Remove any confidential, proprietary, or personal information and removable media such as floppy disks, CDs, or PC Cards. M&S is not responsible for any of POR's confidential, proprietary, or personal information; lost or corrupted data; or damaged or lost removable media.**

M&S is not responsible for the preservation of any data or the protection of any confidential, proprietary or personal data contained in any product, nor is M&S responsible for the restoration or reinstallation of any programs or data other than software written and installed by M&S or its Authorized Distributor when the product was provided to the end user by M&S or on behalf of M&S by its Authorized Distributor.

Upon the expiration of the limited hardware warranty, POR will be offered an option to purchase an extended service contract. Hardware service will be provided to POR under the terms of the service agreement. Please refer to that contract for details on how to obtain service.

M&S uses new and refurbished parts made by various manufacturers in performing warranty repairs and in building replacement parts and systems. Refurbished parts and systems are parts or systems that have been returned to M&S, some of which were never used by a customer. All systems are inspected and tested for quality.

Replacement parts and systems are covered for the remaining period of the limited hardware warranty for the product POR bought. M&S owns all parts removed from repaired products.

This limited hardware warranty coverage terminates if POR sell or otherwise transfer this product to another party.

This Limited Warranty is made as of the date of shipment of the Products to the Customer (the "Effective Date") by and between M&S Technologies, its subsidiaries and affiliates, with offices at 5715 W. Howard Street, Niles, Illinois 60714 ("collectively "the Company"), and the Customer (as defined below).

#### 1. Definitions.

In addition to the terms defined elsewhere in this Agreement, the following terms whenever used in this Agreement shall have the following meanings:

**"Customer"** means the end user of the Products.

**"Hardware"** means the hardware purchased from M&S, along with any end user manuals supplied by M&S. This includes M&S Products purchased through M&S Authorized Distributors.

**"Maintenance Releases"** means any update, upgrade, revision, patch, bug fix or an improved, upgraded or enhanced version of the Products released by M&S to which Customer is rightfully entitled by way of a valid maintenance agreement, warranty, or other M&S offering. Third Party Products are excluded and subject to their own terms and conditions.

**"Object Code"** means computer programs assembled, compiled, or converted to magnetic or electronic binary form on software or hardware media, which are readable and usable by computer equipment, but not generally readable by humans without reverse assembly, reverse compiling, reverse conversion, reverse engineering and/or any other disassembly or decompilation.

**"Product(s)"** means, collectively, the Hardware and Software which may be supplied to Customer.

**"Software"** means all components of M&S vision testing industry software and related documentation made generally available by M&S from time to time, which is accompanied by its own license agreement. The term "Software" shall include any and all software, scripts, firmware, and microcode running on Hardware or any computer system, including all Maintenance Releases supplied in accordance with this Agreement. The Software shall be provided in Object Code form only. No source code will be provided.

**"Third Party Products"** means any hardware or software licensed or distributed by M&S to Customer that is not owned by M&S.

Except as expressly set forth in this limited warranty, M&S makes no other warranties or conditions, expressed or implied, including any implied warranties of merchantability and fitness for a particular purpose, title and non-infringement. M&S expressly disclaims all warranties and conditions not stated in this limited warranty. Any implied warranties that may be imposed by law are limited in duration to the limited warranty period. Some states or countries do not allow a limitation on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages for consumer products. In such states or countries, some exclusions or limitations of this limited warranty may not apply to POR.

This Limited Warranty applies only to Products sold by M&S or on behalf of M&S by their Authorized Distributors.

These terms and conditions constitute the complete and exclusive warranty agreement between POR and M&S regarding the purchased hardware and accessories from M&S Technologies, POR have purchased. These terms and conditions supersede any prior agreements or representations, including representations made in M&S sales literature or advice given to POR by M&S or an agent or employee of the M&S that may have been made in conjunction with your purchase of the Product. No change to the conditions of this Limited Warranty is valid unless it is made in writing and signed by an Authorized Distributor of the M&S.

**M&S Technologies**

5715 W. Howard Street  
Niles, IL 60714

Sales: 1/877-225-6101  
1/847-763-0500

Fax: 1/847-763-9170

Technical Support: 1/847-763-0500

**mstech-eyes.com**



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