

## TT-HUD™

Head-up Display Test Module for TrueTest™ Software

### Applications

- Evaluate virtual images and projections generated by head-up display (HUD) systems
- Use with a Radiant ProMetric® Imaging Colorimeter or Photometer (29MP or higher) with 200 mm lens
- Measure absolute luminance and chromaticity in projected images
- Test image clarity, distance, and position; characterize image distortion and other effects

### Benefits

- Single test suite captures luminance, chromaticity, and dimensional measurement data for analysis
- Quickly apply pre-defined tests for advanced HUD measurement
- Software test sequencing and API device integration to control display test images in conjunction with software analyses, enabling automated production-level testing
- Apply tolerances and obtain pass/fail data to enable in-line quality control
- Supports Society of Automotive Engineers standard requirements for HUD measurement (SAE J1757-1) and methodology (SAE J1757-2), as well as standard requirements for HUD visibility from the International Organization for Standardization (ISO/TC 22/SC 35/WG 3, Visibility).



Software module with tests for evaluating the quality of HUD system projections

Radiant Vision Systems TrueTest™ Software provides a comprehensive set of tests for image analysis within a flexible framework that enables evaluation using a single test, or multiple tests in sequence. Test sequencing and pass/fail reporting functionality make TrueTest the ideal software package for production environments. TrueTest Software can be combined with a Radiant ProMetric® Imaging Colorimeter or Photometer to create a complete testing system for light and color measurement or machine vision inspection.

The TT-HUD™ module for TrueTest Software provides a test suite to efficiently perform light, color, and dimensional measurements used to evaluate the quality of virtual images and projections, such as those emitted by head-up display (HUD) systems.

The TT-HUD software module includes:

- **Light Measurement**

*Characterize luminance and chromaticity, and evaluate other photometric qualities including contrast and uniformity.*

- **Image Quality Analysis**

*Evaluate projected image distortion, warping, ghosting, eyebox accuracy, and MTF (image clarity based on line pair algorithms).*

- **Virtual Image Distance Calculation**

*Use software to auto-adjust camera lens focus for the virtual image and calculate virtual image distance (e.g., in meters).*

## TT-HUD™ System Requirements

- ProMetric® Imaging Photometer or Colorimeter (29MP or higher), or ProMetric I-SC Solution
- 200 mm lens
- Windows® 10, 64 bit
- 16-32 GB RAM
- Additional system requirements vary by camera. See hardware specification sheet for more information.

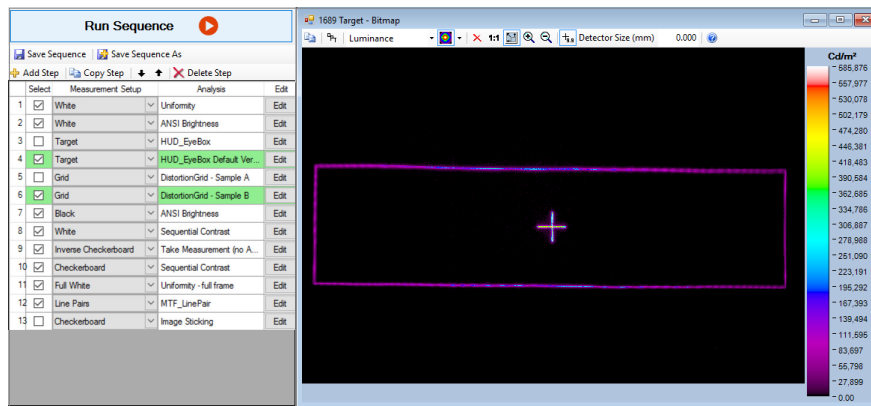
## Test Library

TT-HUD includes tests for HUD quality and defect detection, including:

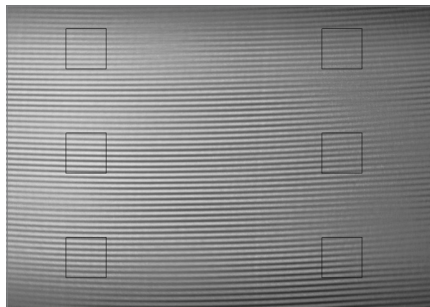
- ANSI Brightness
- ANSI Color Uniformity
- AutoPOI
- Checkerboard Contrast
- Chromaticity
- Compare Points of Interest
- DFF Image Sticking Analysis
- Diagonal Checkerboard Analysis
- Distortion 9 Point
- Distortion Dot Grid
- Distortion Line Grid Analysis
- Eyebox
- Field of View
- Ghosting Analysis
- Image Export
- MTF Line Pair
- Particle Defects
- Pixel Defects
- Points of Interest
- Sequential Contrast
- Uniformity
- Virtual Image Distance
- Warping Analysis

Captures dimensional measurements for projected image size and x,y position. Software converts camera focal distance to real distance units to test image location.

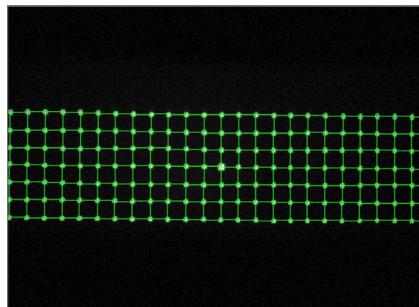
## Examples of TT-HUD analyses:



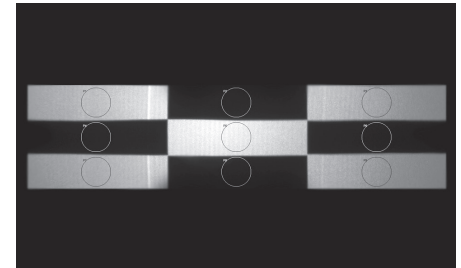
Apply tests separately or in sequence to evaluate all critical display quality parameters. TT-HUD can integrate with the HUD system to control display test images in conjunction with the test sequence for production-level automation.



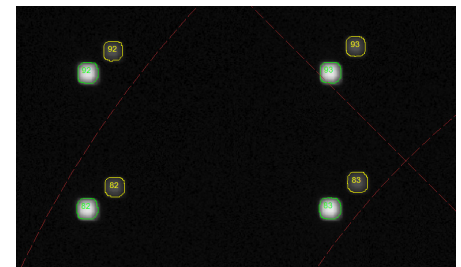
Use Modulation Transfer Function (MTF) line pair algorithms to calculate contrast at different spatial frequencies to determine image clarity. Testing uses horizontal and vertical pairs of black and white lines.



Test distortion of the virtual image using Distortion Dot Grid to measure the spatial offset between dots of the primary image and a test pattern. Distortion can also be tested using Distortion Line Grid Analysis.



Measure values between black and white areas of the HUD projection using Checkerboard Contrast to test contrast.



Detect duplicate projections caused by ghosting effects using Ghosting Analysis.

## Lens Specifications:

Parameter	ProMetric I29, I61, I61-SC
Focal Distance	200 mm
Type	Electronically controlled focus and aperture
Field of View (Full Angle, H x V degrees)	11° x 7°

*Specifications subject to change without notice.*