**Instrument
Systems**
KONICA MINOLTA Group

# NVIS Measurement of Displays and Panel Graphics

## According to MIL-L-85762A / MIL-STD-3009 NVIS-A/-B/-C

Accurate measurement of NVIS radiance according to MIL-L-85762A / MIL-STD-3009 is a challenging  task, and often very time consuming. Usually, experienced and skilled experts are needed to perform the measurements. Traditional spectroradiometers are complex to operate, not portable, and also very slow. Some measurements can take up to a couple of minutes to be completed. This application note describes the features of the NVIS display test system **DTS 140D NVIS** and discusses its measurement performance in specific applications. The DTS 140D NVIS is ideal for manufacturing and quality control applications that require long-term dependability as well as simple and fast push button operation.

APPLICATION
NOTE

## \\  1. INTRODUCTION

For NVIS measurements it is critical that the extremely high intensity differences between the visible and near infrared spectral ranges are measured correctly (380 to 780 nm and 650 to 930 nm, respectively - the latter being the sensitivity range of the NVG Night Vision Goggle).
The NVIS display test system DTS 140D NVIS combines the advantages of the high-end array spectroradiometer CAS 140D and the Telescoptic Optical Probe TOP 200. Specific modifications to the CAS 140D include further suppression of stray light and automatic adjustment of measurement sensitivity to cope with the differing signal intensities. The TOP 200 guarantees a perfectly round and sharp measuring spot with an optimized Pritchard style optical system.
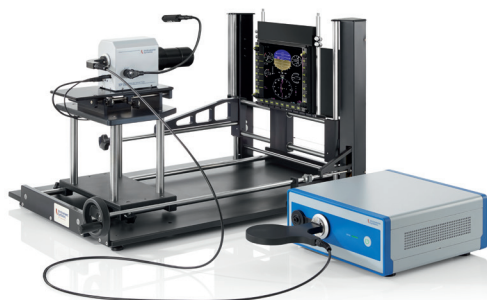


*Fig. 1: DTS 140D NVIS – turnkey solution designed to measure night vision compatible displays and panel graphics.*

## \\  2. WHY USE AN NVIS SPECTRORADIOMETER?

The complexity of NVIS radiance measurement is caused by two factors:

» The spectral response function rendered by the image intensifier which is used in night vision goggles has the following characteristics: optical radiation in the spectral range from approximately 650 to 930 nm is amplified by some 5 orders of magnitude and converted to visible green. Thus, the radiance of the display in that spectral region must be extremely low compared to the visible spectrum.
» The NVIS radiance readings have to be ratioed to the luminance of the same sample. Thus, the luminance

as well has to be measured precisely. The difference in NVIS radiance and luminance is significant.

By design, spotmeters are not suitable for absolute measurements since filters are used to imitate the image intensifier as well as the the response function of the human eye. A filter / detector combination can only be manufactured with moderate accuracy. Temperature changes as well as aging cause additional shift in the response. An NVIS spotmeter must be calibrated for each specific sample to be measured.

Only spectroradiometers meet the requirements for accuracy as they acquire the radiation spectrum from 380 to 930 nm. Luminance and NVIS radiance are calculated from the spectral data enabling proper ratioing and scaling. Different integration functions can easily be implemented by the user in the software.

## \\  3. BASIC PRINCIPLE OF AN NVIS SPECTRORADIOMETER

In the past, NVIS spectroradiometers have been based on a monochromator with a diffraction grating that is rotated to scan the spectrum.

Modern systems like the CAS140D high-end array spectroradiometer based DTS 140D use a crossed Czerny-Turner spectrograph with a fixed grating to simultaneously capture the complete spectrum.

The radiation to be analyzed is launched into the spectrograph through the entrance slit and hits the first concave mirror which collimates the radiation. Then, a diffraction grating reflects the radiation while dispersing it into its spectral components. A second concave mirror focusses the radiation on the detector, a CCD array (see Fig. 2).

In order to achieve the required 6.5 orders of magnitude optical stray light performance, special NVIS band pass filters are applied to parts of the spectrum and bracketing is used to stitch them together.
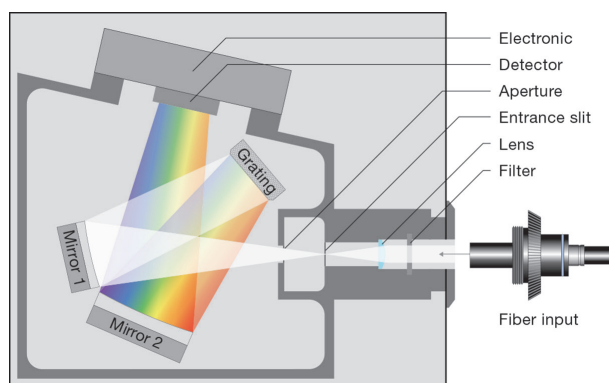
Fig. 2: Spectroradiometer with optimized crossed Czerny-Turner spectrograph.

## \\ 4. FIELDS OF APPLICATION FOR THE DTS 140D NVIS

» Measurement of luminance and spectral NVIS radiance according to MIL-L-85762A / MIL-STD-3009.

» Spectral range allows GOST PB 58-55-002-2010 tests.

» NVIS irradiance measurements / NRI according to SAE ARP 5825.

» Push button Pass / Fail testing and reporting.

» Supports contrast / sun light readability measurement.

» Emission pattern / viewing angle measurement with the automated positioning system DTS 500.

» Fiber coupled Telescopic Optical Probe allows cockpit / limited space measurements.



Fig. 3: DTS 140D NVIS allows MIL-L85762A / MIL-STD-3009 compliant measurement of night vision displays and panels (e.g. in aircraft cockpits).

## \\ 5. FEATURE LIST DTS 140D NVIS

» Four selectable apertures / different fields of view, software controlled.

» Measurement spot decoupled from the entrance slit / band pass function. Therefore, consistent results for all spot sizes.

» Large dynamic range, extended with fully automatic filter wheel.

» Polarization is scrambled by the fiber coupling. Therefore, no negative effects from LCDs / polarized light sources (polarization error < 1%).

» 75 µm smallest spot with HRL 90 (0.003 inch).

» View finder features a large field of view which allows easy orientation on the sample. Image can be displayed in the software and saved with the measurement results.

» Target illumination is provided through a gooseneck mounted LED spot light illumination on the TOP 200.

» Fully compatible with positioner systems (e.g. DTS 500 series). Optional collision protection with HRL 90.

» Noise floor below $1*10^{-12}$ W/m$^2$sr.

» Spectral range 380 - 1040 nm.

» Accessory recognition.

» Optional stray light correction matrix.

## \\ 6. SYSTEM CONFIGURATION

The NVIS display test system DTS 140D NVIS consists of a special version of the high-end array spectroradiometer CAS140D-153 (VIS-NIR model) and the fiber coupled Telescopic Optical Probe TOP 200. The band pass / spectral resolution is adapted to the MIL requirements. The system is calibrated with a MIL-L-85762A / MIL-STD-3009 compliant certificate. Different lenses allow the measurement of fine structures on switches or larger areas on display panels.

A wide range of accessories allows to cover a lot of additional applications such as NVIS filter transmission measurements, NVIS irradiance measurements, LED measurements, reflection measurements, etc. Accessories can be swapped without influencing the calibration of the system.

## \\ 7. TOP 200 TELESCOPIC OPTICAL PROBE

The lens choice determines the field of view / possible measuring spot sizes for corresponding working distances (see Fig. 4 at right). As a software feature, a reticle is imaged onto the sample in the closed aperture position. If an aperture is selected, the exact measurement spot can be seen.

The DTS 140D NVIS is supplied with a multi-mode fiber and a mode mixer. The patented mode mixer compensates for changes in the transmission caused by fiber movement. With it, the error is below 1% as compared to up to 20% without the mode mixer.



*Fig. 4: View of the sample and imitated transparent measurement spot represented in the software.*

## \\ 8. SPECWIN PRO SOFTWARE

SpecWin Pro Software (see Fig. 5) includes Pass / Fail criteria as defined in the MIL standards plus standard colorimetric and spectroradiometric results. Simple push button operation including data export and reporting.

## \\ 9. FURTHER INFORMATION

For more information about CAS 140D and TOP 200, please visit the Instrument Systems website or contact the sales team under sales@instrumentsystem.com.



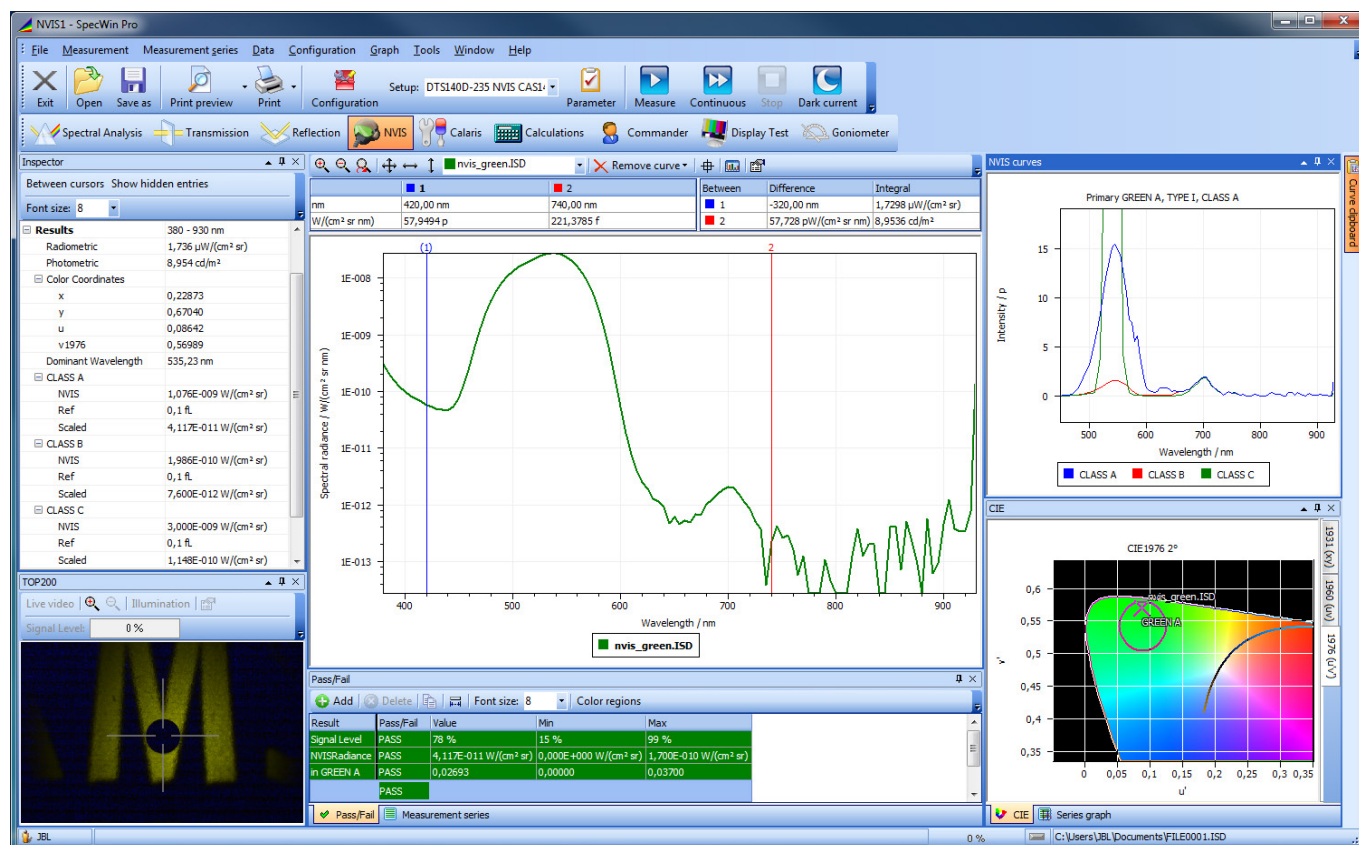*Fig. 5: NVIS measuring mode of the SpecWin Pro software with functions like live image display or automatic Pass/Fail test*

**Instrument Systems**

KONICA MINOLTA Group

**We bring quality to light.**

an_dts140d_nvis_en_V1.1