410-DHR HANDHELD REFLECTOMETER

Infrared reflectance measurements

The 410-DHR is a product of collaboration between U.S. Naval Air Systems Command and Surface Optics, with vital input from the Naval Research Lab (NRL) and National Institute of Standards and Technology (NIST).

It was developed to answer a broad need for a portable device for verification of optical properties of large objects in the field. The 410-DHR measures the integrated surface reflectance of a surface at two angles of incidence (20° and 60°) and for six discreet wavelength bands in the .9 to 12 µm spectral range.

BENEFITS

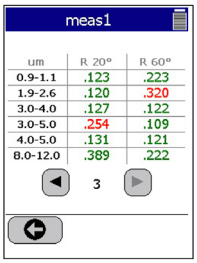
- **In-band reflectance & emittance**
  9-1.1, 1.9-2.4, 3.0-4.0, 3.0-5.0, 4.0-5.0, 8.0-12.0.
- **Measures curved & large objects**
  Measurements can be taken without special jigs or fixtures.
- **Dual angles of incidence**
  Near normal 20° and near grazing 60° incident angles.
- **Grazing angle**
  80° incident angle optional model.
- **Easy to use**
  Simply press port against sample and pull trigger.
- **Fast data collection**
  Measurements in 10 seconds or less.
- **Fast calibration**
  One minute calibration at start of measurement session.

APPLICATIONS

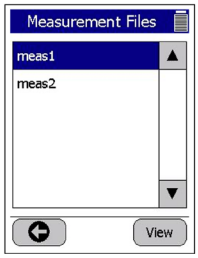
- **Defense | Aerospace**
  IR Signature | Low observable paint & coatings
- **Radiative Heat Transfer**
  Emissivity for thermal modeling | Thermal camera calibration
- **Semiconductors**
  Wafer fab hardware emissivity
- **Stealth Coatings**
  Bands tailored for low-observable spectral signatures

EXAMPLE MENU SCREENS

Measurement screen. Results are displayed on the liquid crystal display touchscreen, and stored on a SecureDigital (SD) card.



Data file selection screen.



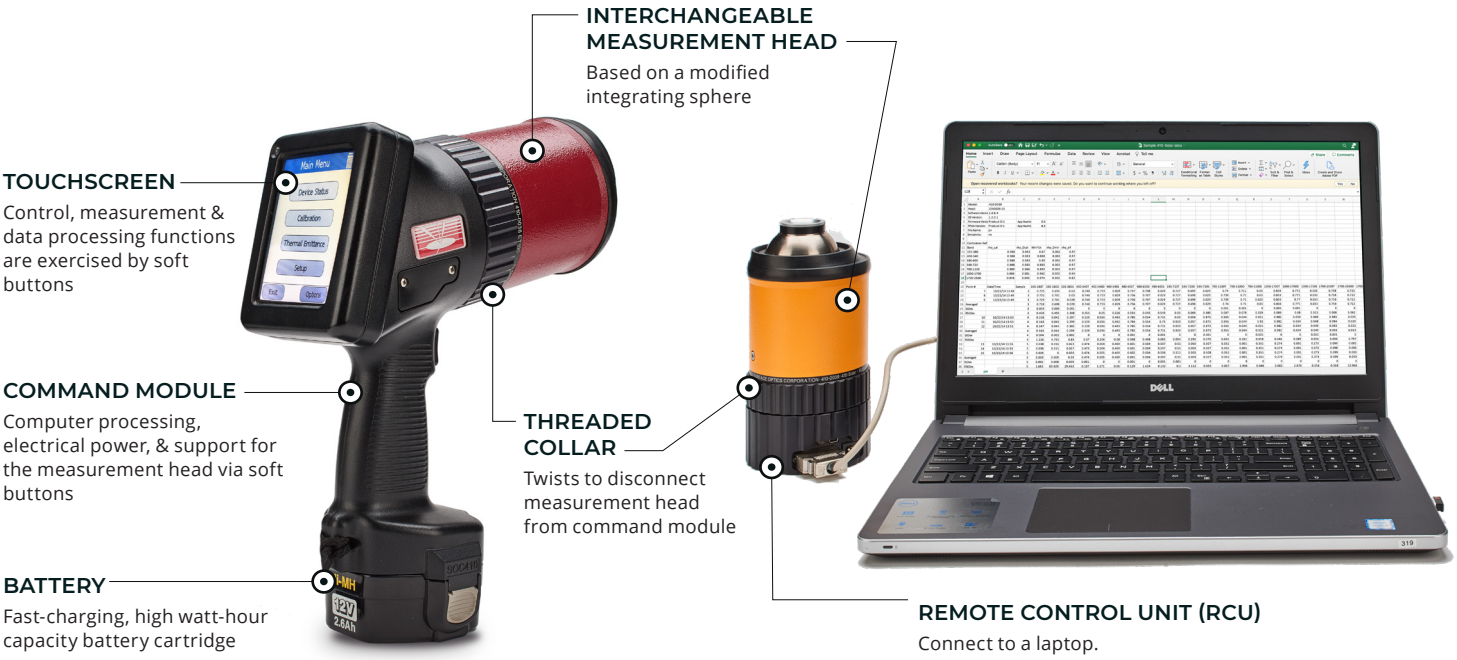
ORDERING

Standard components	0410-0003	410-DHR Emissometer Measurement Head
	0410-0001	Handheld Command Module - 120VAC
	0410-0100	Specular Gold Calibration Coupon (Non-NIST Traceable)
Options	0410-0002	Benchtop Remote Control Unit - 120VAC
	0410-0101	Specular Gold Calibration Coupon (NIST Traceable)
	0410-1016	410-Series Reflectometer Maintenance and Calibration Plan (Non-NIST)
	0410-1009	410-Series Reflectometer Maintenance and Calibration Plan (NIST)
	0410-1001	SOC 410 DHR Extended Warranty
	0410-0206	SD Card for Extra Data Storage
	0410-0200	Handheld Command Module - 220VAC
	0410-0019	Benchtop Remote Control Unit - 220VAC
80 Degree Grazing Angle Model	0410-0005	SOC-410-DHR Grazing Angle Reflectance Measurement Head
	0410-0105	Grazing Angle Calibration Coupon (Non-NIST Traceable)
	0410-1006	SOC-410-DHR Grazing Angle Extended Warranty

CE Equipment described herein is subject to US export regulations and may require a license prior to export. Diversion contrary to US law is prohibited.

SPECIFICATIONS 410-DHR

	410-DHR
MEASURED DATA	
Measured Parameter	Directional hemispherical reflectance (DHR)
Method	Integrated total reflectance in a band for a given angle of incidence
Measured Value	Absolute reflectance (0-1)
Calculated Value	In-band emissivity
Wavelength Bands (microns)	9-1.1, 1.9-2.4, 3.0-4.0, 3.0-5.0, 4.0-5.0, 8.0-12.0
Angle of Incidence	20° & 60° from normal incidence
Calibration Coupon	Specular Gold
PERFORMANCE	
Accuracy	+/- .03
Repeatability	±.005 units
Beam Spot Size	0.50 inches
Measurement Time	10 sec
Sample Size & Geometry	Flat: ≥ 0.5 in. diameter Curved: 6 in. convex; 12 in. concave
Warm Up Time	90 seconds
Time Between Measurements	2 seconds
Sample Temperature	Ambient or heated/cooled to 0 - 100° C
Operating Temp	0° to 40° C
POWER	
Run Time	2 hours on one battery. Battery easily replaced with continuous operation after battery replacement.
Power Source	Rechargeable battery (standard environmentally friendly NiMH)
Battery Recharge Time	1 hour
IR Source	Kanthal filament operated at about 1,000°C
ENVIRONMENT	
Storage	-25° to 70°C
Operating	0° to 40° C
DIMENSIONS	
Weight	4.7 lbs
Form Factor/Size	H 11.54”, L 9.04”, W 3.27” (29.31 cm x 22.96 cm x 9.44 cm)
INTERFACE	
Operator Interface	LCD graphics screen, 1/4 VGA, touch screen, software buttons; trigger switch in handle
Inspection Applications	Pass/fail can be incorporated, user set values
Diagnostics	On screen status and signals monitor. Signal values stored with data. Raw data collection and display.
MISCELLANEOUS	
Date Format	Data files can be opened and post processed with Excel or a text processor
Data Storage	Removable SanDisk (SD) card
Export control	ECCN #3A999.F



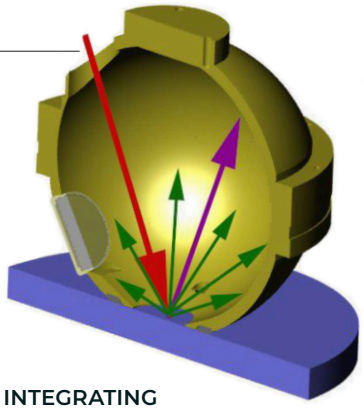
HANDHELD CONFIGURATION **BENCHTOP CONFIGURATION**

METHODOLOGY

The basic structure of a measurement head is an internal source, a modified integrating sphere, and detectors. The reflectance measurement is made by collimating the source beam onto the target, the energy is reflected back into the sphere, and eventually detected or dissipated.

The 410 Series Reflectometers measures the integrated surface reflectance of a surface at a given angle of incidence (20° or 60°). The integrating sphere captures the reflected light from the target material, integrating reflections in all directions. Wavelength-filtered detectors measure the total light reflected in each wavelength band and converts it to an analog electrical signal.

The 410 Series Reflectometer electronics processes the detector signals for initial amplification (fixed), filtering, offset adjustment, secondary amplification (variable), and analog to digital conversion. The digitized signals are read by the on-board processor, stored in memory, and then used to determine the target sample reflectance at each incident angle and wavelength band. Those reflectances are used to calculate additional properties such as directional thermal emittance or total hemispherical emittance. Results are displayed on the liquid crystal display touchscreen, and stored on a SecureDigital (SD) card.



INTEGRATING SPHERE SCHEMATIC

Schematic of the integrating sphere in contact with a sample.

Red arrow – illuminating beam

Purple arrow – reflected beam

Green arrows – scattered light

CALIBRATION COUPON

CALIBRATION

An easy calibration process is required before each measurement session. The software GUI will walk the user through the process. Calibration is performed using calibration coupon(s) with known reflectance values.

410 REFLECTOMETERS MODEL COMPARISON GUIDE

The SOC410 Series Reflectometers are portable contact measurement devices designed to take precise, accurate reflectance and emittance measurements. Made with an ergonomic power-drill design, the SOC410 Series lets you easily take measurements in-the-field or around the lab—no cords or external batteries necessary. The world's largest defense, aerospace, and energy companies rely on SOC410 data.

Model	410-Solar	410-Solar-i	410-VIS-IR	ET-100	ET-10	410-DHR
Spectral Bands	335 - 380 nm 400 - 540 nm 480 - 600 nm 590 - 720 nm 700 - 1100 nm 1000 - 1700 nm 1700 - 2500 nm	335 - 380 nm 400 - 540 nm 480 - 600 nm 590 - 720 nm 700 - 1100 nm 1000 - 1700 nm 1700 - 2500 nm	Dual measurement head package consisting of a 410-Solar model and ET100 measurement heads with a single command module	1.5 - 2.0 µm 2.0 - 3.5 µm 3.0 - 4.0 µm 4.0 - 5.0 µm 5.0 - 10.5 µm 10.5 - 21.0 µm	3.0-5.0 µm 8.0-12.0 µm	0.9 - 1.1 µm 1.9 - 2.4 µm 3.0 - 4.0 µm 3.0 - 5.0 µm 4.0 - 5.0 µm 8.0 - 12.0 µm
Calculated Properties	Total, diffuse & specular reflectance absorptance	Total reflectance/ absorptance		In-band total reflectance Directional thermal emissivity at 20° Directional thermal emissivity at 60° Hemispherical thermal emissivity	Directional thermal emissivity at 20°	In-band total reflectance In-band emissivity
Angle of Incidence	20°	20°		20° and 60°	20°	20° and 60°
Calibration Coupon(s)	Solar Diffuse Solar Specular	Glazed Ceramic		Specular Gold	Specular Gold	Specular Gold
ASTM Compliance	C1549 E903 E1980	C1549 E903 E1980		E408 E1980		N/A

SURFACE OPTICS CORPORATION

11555 Rancho Bernardo Road
San Diego, CA 92127

For Information and Ordering

Email: contact@surfaceoptics.com
Phone: +1 858 675-7404
Website: surfaceoptics.com

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