

# 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.

um	R 20°	R 60°
0.9-1.1	.123	.223
1.9-2.6	.120	.320
3.0-4.0	.127	.122
3.0-5.0	.254	.109
4.0-5.0	.131	.121
8.0-12.0	.389	.222

Data file selection screen.

Measurement Files
meas1
meas2

### ORDERING

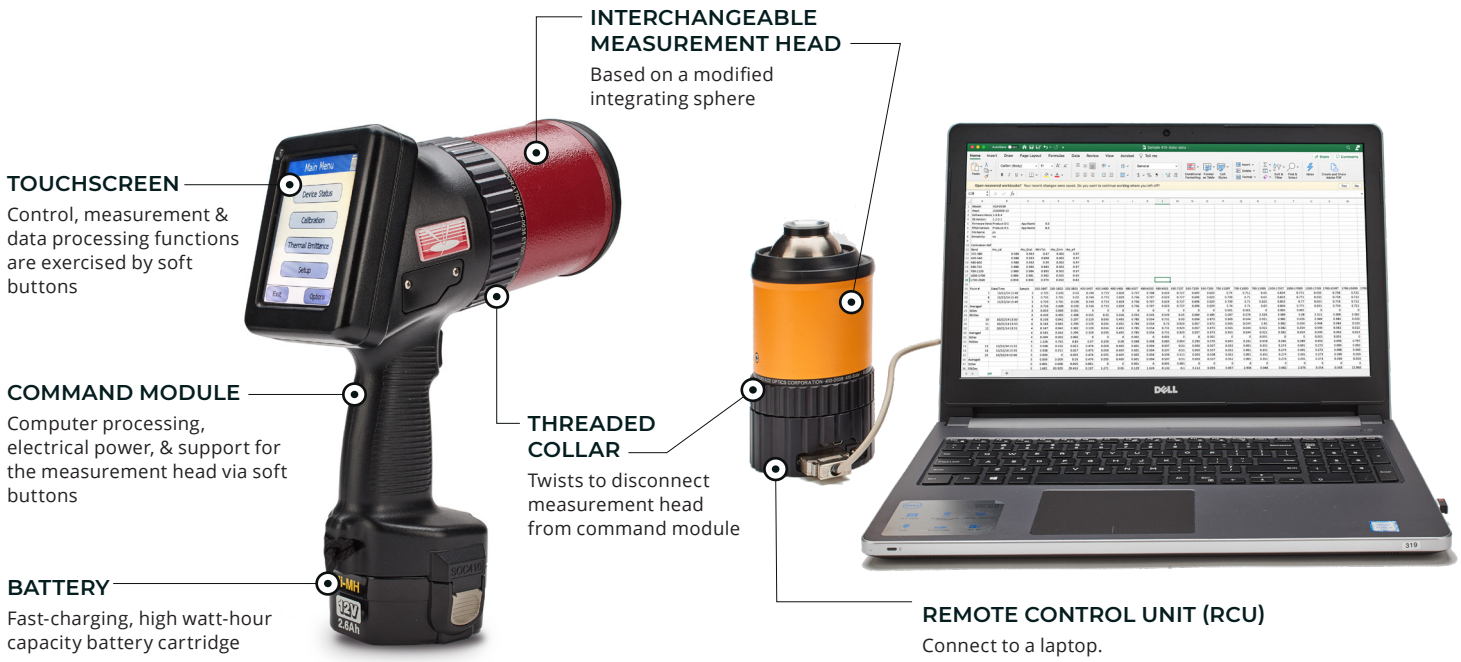
Standard components	0410-0003	410-DHR Emissometer Measurement Head
	0410-0001	Handheld Command Module - 120VAC
	0410-0100	Specular Gold Calibration Coupon (Non-NIST Traceable)
Options	0410-0002	Benchtop Remote Control Unit - 120VAC
	0410-0101	Specular Gold Calibration Coupon (NIST Traceable)
	0410-1016	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	
<b>MEASURED DATA</b>	
<i>Measured Parameter</i>	Directional hemispherical reflectance (DHR)
<i>Method</i>	Integrated total reflectance in a band for a given angle of incidence
<i>Measured Value</i>	Absolute reflectance (0-1)
<i>Calculated Value</i>	In-band emissivity
<i>Wavelength Bands (microns)</i>	9-1.1, 1.9-2.4, 3.0-4.0, 3.0-5.0, 4.0-5.0, 8.0-12.0
<i>Angle of Incidence</i>	20° & 60° from normal incidence
<i>Calibration Coupon</i>	Specular Gold
<b>PERFORMANCE</b>	
<i>Accuracy</i>	+/- .03
<i>Repeatability</i>	±.005 units
<i>Beam Spot Size</i>	0.50 inches
<i>Measurement Time</i>	10 sec
<i>Sample Size &amp; Geometry</i>	Flat: ≥ 0.5 in. diameter Curved: 6 in. convex; 12 in. concave
<i>Warm Up Time</i>	90 seconds
<i>Time Between Measurements</i>	2 seconds
<i>Sample Temperature</i>	Ambient or heated/cooled to 0 - 100° C
<i>Operating Temp</i>	0° to 40° C
<b>POWER</b>	
<i>Run Time</i>	2 hours on one battery. Battery easily replaced with continuous operation after battery replacement.
<i>Power Source</i>	Rechargeable battery (standard environmentally friendly NiMH)
<i>Battery Recharge Time</i>	1 hour
<i>IR Source</i>	Kanthal filament operated at about 1,000°C
<b>ENVIRONMENT</b>	
<i>Storage</i>	-25° to 70°C
<i>Operating</i>	0° to 40° C
<b>DIMENSIONS</b>	
<i>Weight</i>	4.7 lbs
<i>Form Factor/Size</i>	H 11.54", L 9.04", W 3.27" (29.31 cm x 22.96 cm x 9.44 cm)
<b>INTERFACE</b>	
<i>Operator Interface</i>	LCD graphics screen, 1/4 VGA, touch screen, software buttons; trigger switch in handle
<i>Inspection Applications</i>	Pass/fail can be incorporated, user set values
<i>Diagnostics</i>	On screen status and signals monitor. Signal values stored with data. Raw data collection and display.
<b>MISCELLANEOUS</b>	
<i>Data Format</i>	Data files can be opened and post processed with Excel or a text processor
<i>Data Storage</i>	Removable SanDisk (SD) card
<i>Export control</i>	ECCN #3A999.F

# 410 SERIES REFLECTOMETERS & EMISSOMETERS



## HANDHELD CONFIGURATION

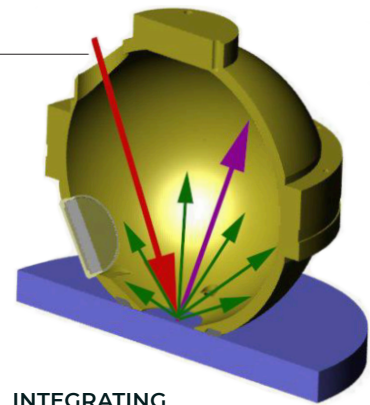
## BENCHTOP CONFIGURATION

### 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 ( $20^\circ$  or  $60^\circ$ ). 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
<i>Spectral Bands</i>	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 $\mu\text{m}$ 2.0 - 3.5 $\mu\text{m}$ 3.0 - 4.0 $\mu\text{m}$ 4.0 - 5.0 $\mu\text{m}$ 5.0 - 10.5 $\mu\text{m}$ 10.5 - 21.0 $\mu\text{m}$	3.0-5.0 $\mu\text{m}$ 8.0-12.0 $\mu\text{m}$	0.9 - 1.1 $\mu\text{m}$ 1.9 - 2.4 $\mu\text{m}$ 3.0 - 4.0 $\mu\text{m}$ 3.0 - 5.0 $\mu\text{m}$ 4.0 - 5.0 $\mu\text{m}$ 8.0 - 12.0 $\mu\text{m}$
<i>Calculated Properties</i>	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
<i>Angle of Incidence</i>	20°	20°		20° and 60°	20°	20° and 60°
<i>Calibration Coupon(s)</i>	Solar Diffuse Solar Specular	Glazed Ceramic		Specular Gold	Specular Gold	Specular Gold
<i>ASTM Compliance</i>	C1549 E903 E1980	C1549 E903 E1980		E408 E1980		N/A