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Report of Test

Absolute Spectral Radiance Responsivity

of the

NASA GLAMR IGA Radiometer
Model DET-8, S/N 107

Request Submitted by:

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1. Description of Calibration Items

The device under test (DUT) consists of an indium gallium arsenide (IGA) radiance meter manufactured by L-1 Standards and Technology, Inc. (L-1), model DET-8, S/N 107 (referred to as GLAMR IGA) along with accessory components consisting of a temperature controller and transimpedance amplifier. The device is housed in a 2-inch diameter tube with fore-optics consisting of two apertures to form a Gershun-tube radiometer. The detector is temperature controlled (L-1 model 3100 1-L, S/N 12114) and the rear of the device has inputs for the L-1 temperature controller and a BNC output for the detector signal. Throughout the test, the temperature set point was -19.0 °C and maintained the temperature at a reading of -18.992 °C. A transimpedance amplifier (L-1 model 3300v2, S/N 027) was provided with the device and used for the calibration. Figure 1.1 shows the detector and accessory equipment as received packaged with the silicon (Si) and extended-indium gallium arsenide (ex-IGA) radiometers and accessory components.

Figure 1.1 Photographs of GLAMR IGA Radiometer as received consisting of the L-1 temperature controller (left), transimpedance amplifier (middle), and radiometer (right). The temperature controller and transimpedance amplifier were received together with the same components for the IGA and exIGA radiometers whereas the IGA radiometer was packaged with the Si radiometer.

1.1 Calibration Request

The request was to calibrate the DUT, GLAMR IGA, for absolute radiance responsivity from 885 nm to 1620 nm with a standard uncertainty of 0.28 % (k=1) or better.

2. Description of Test

The detector was characterized for absolute spectral radiance responsivity on the NIST facility for Spectral Irradiance and Radiance responsivity Calibrations using Uniform Sources (SIRCUS).[1,2] The calibration took place in various stages from May 11, 2021 to May 21, 2021. During each calibration test, the detector was temperature controlled at -18.992 °C by the L-1 controller and checked at the beginning and end of each calibration session. This calibration was performed in two parts. First, the spectral range 900 nm to 1630 nm was completed using a NIST SIRCUS radiance meter (DET-8 #101) as the standard reference detector. Second, the spectral range 880 nm to 980 nm was completed using a silicon trap detector, T-06, as the standard reference detector.

Description of laser systems used: A Picosecond mode-locked lithium triborate-optical parametric oscillator (LBO-OPO) laser (~80 mHz repetition rate) was used that consists of two separate cavities. The main cavity is designed to oscillate the signal beam and the other cavity is designed to intracavity double the oscillated idler beam. For this calibration, only the main cavity was used but it was used in several different ways

a. Below 1064 nm, the main cavity oscillates the signal beam and emits it through the output coupler. The signal beam was used from 880 nm to 980 nm.
b. Above 1064 nm, the main cavity oscillates the idler beam and emits it through the same output coupler. Cavity mirror reflectance limits the wavelength tunability here and was used from 1070 nm to 1150 nm.
c. When the signal beam is oscillated in the cavity below 1064 nm, the corresponding idler beam is ejected from the cavity through one of the other cavity mirrors. This output of the idler beam was used from 1150 nm to 1630 nm.

The laser output was coupled to an optical fiber. The optical fiber was in turn connected to a side port on the integrating sphere and illuminated an area toward the front of the sphere. Typically, these measurements utilize speckle reduction techniques but for the LBO-OPO speckle effects are inherently reduced by laser bandwidth. A Brockton Electro-Optics Corporation (BEOC) laser power controller stabilized the beam to less than the 0.1 % level using feedback from a photodiode in the sphere, removing short term as well as long term fluctuations in the power output from the various laser sources. A Bristol 621 wavemeter (S/N: 6208) was used to measure the vacuum wavelength of the signal beam or idler beam when oscillated by the main cavity. When the idler beam was used as in part c, above, the signal wavelength was measured and converted to the corresponding idler wavelength according to equation 2.1,

$$\lambda = \frac{1}{\left(\frac{1}{\lambda_{pump}} - \frac{1}{\lambda_{signal}}\right)} \tag{2.1}$$

where λ_{pump} is 532.2 nm and λ_{signal} is measured by the Bristol wavemeter. All wavelengths measured by the Bristol wavemeter were the vacuum value and converted to the air value for data analysis by dividing by a factor of 1.00027.

Integrating Sphere: The integrating sphere used for radiance responsivity was a LabSphere 30.48 cm (12”) diameter, Spectralon-coated sphere equipped with a 5.08 cm (2”) diameter exit aperture fabricated by LabSphere (non-point source geometry).

Data Acquisition and Control Program: The data was acquired using the Labview program “SIRCUS Main Program v10.vi.” Background subtracted DC signals were sequentially collected for each detector (DUT and reference standard) along with simultaneously recorded monitor signals (also background subtracted). The collections were repeated 11 times. Each repeat sample was ratioed to the monitor signal and the average and percent standard deviation was determined.

Description of calibration detectors: The working standard reference trap detector T-06 was used to measure the radiance and irradiance emitted from the source sphere from 880 nm to 980 nm. It was equipped with an aperture having an area of 19.6591 mm^2 and a precision transimpedance amplifier, Femto SIRCUS 12 (Femto, MN: DPLCA-100, SN: 01-41-1435), was used with the trap detector. T-06 was previously calibrated for power responsivity directly against the NIST Primary Optical Watt Radiometer (POWR).[3–5] The irradiance responsivity scale for T-06 is derived from the power responsivity scale and the area of the precision aperture, which was determined by the NIST aperture area measurement facility.[6]

A second standard reference detector, NIST SIRCUS DET-8 #101, was used for the range 900 nm to 1630 nm. This reference detector is the same model radiometer as the DUT but has been previously calibrated for radiance responsivity against the NIST SIRCUS Pyro #2 irradiance meter.[7] The transimpedance amplifier used with this detector was SIRCUS Prec. #2. This detector also utilizes an L-1 temperature controller (model 3100) which maintained the temperature at -19.5 °C with the setpoint at -22.0 °C.

The monitor detector was an IGA photodiode mounted directly to the source sphere. It was connected to a Stanford Research Systems current preamplifier (Model SR570, S/N: 57687).

3-axis stage: The integrating sphere is mounted on an XYZ translation stage, with the Z-position (along the optical axis) measured with a linear encoder. The X- and Y-axes enable the source to be properly positioned in front of an instrument before it measures the sphere radiance. The Z-position is used to accurately determine the separation between relevant apertures.

Measurement Setup: Detectors used in these experiments were mounted to tip-tilt stages and aligned to the optical axis of the integrating sphere source using a double-headed laser. To align the detectors to the sphere, the double-headed laser was first mounted in-front of the large sphere where one end of the laser was previously aligned to the center of the sphere aperture. The other end of the laser was retroreflected from a glass microscope slide on each detector to align to the optical axis. Lastly, the laser was centered on each detector using the 3-axis stage to determine the X,Y position. See Figures 2.1 and 2.2 for photographs of the measurement setup and Figure 2.3 for a photograph of the DUT temperature controller and transimpedance amplifier setup.

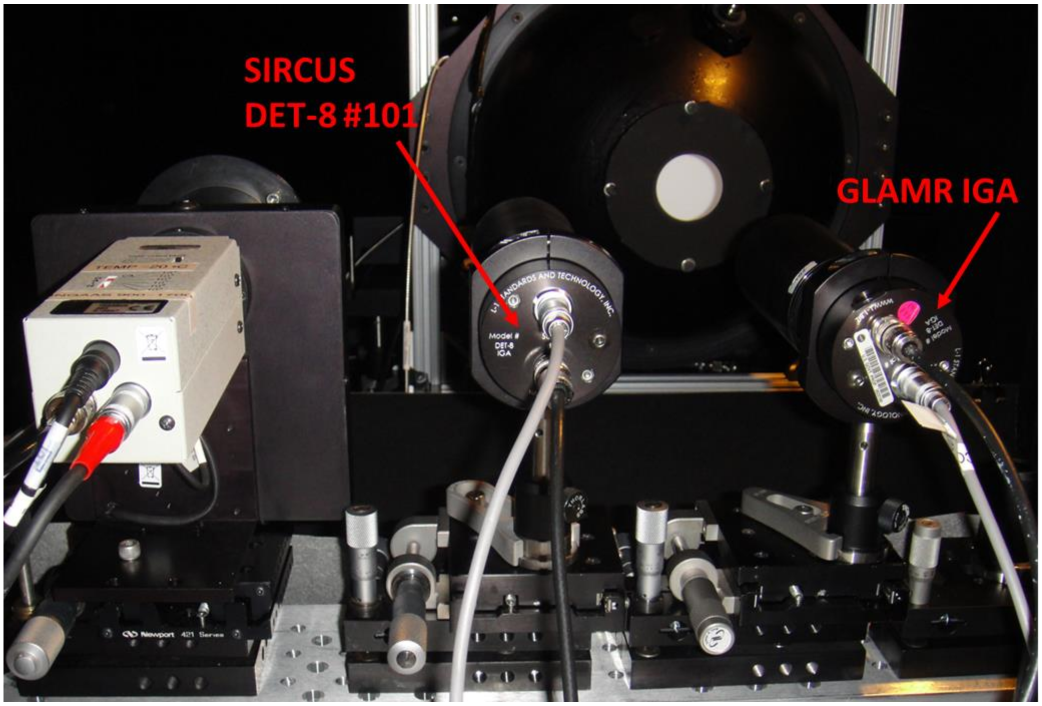


Figure 2.1 Back-view of detector bench setup for the radiance measurements of the DUT using DET-8 #101 as the standard reference detector.

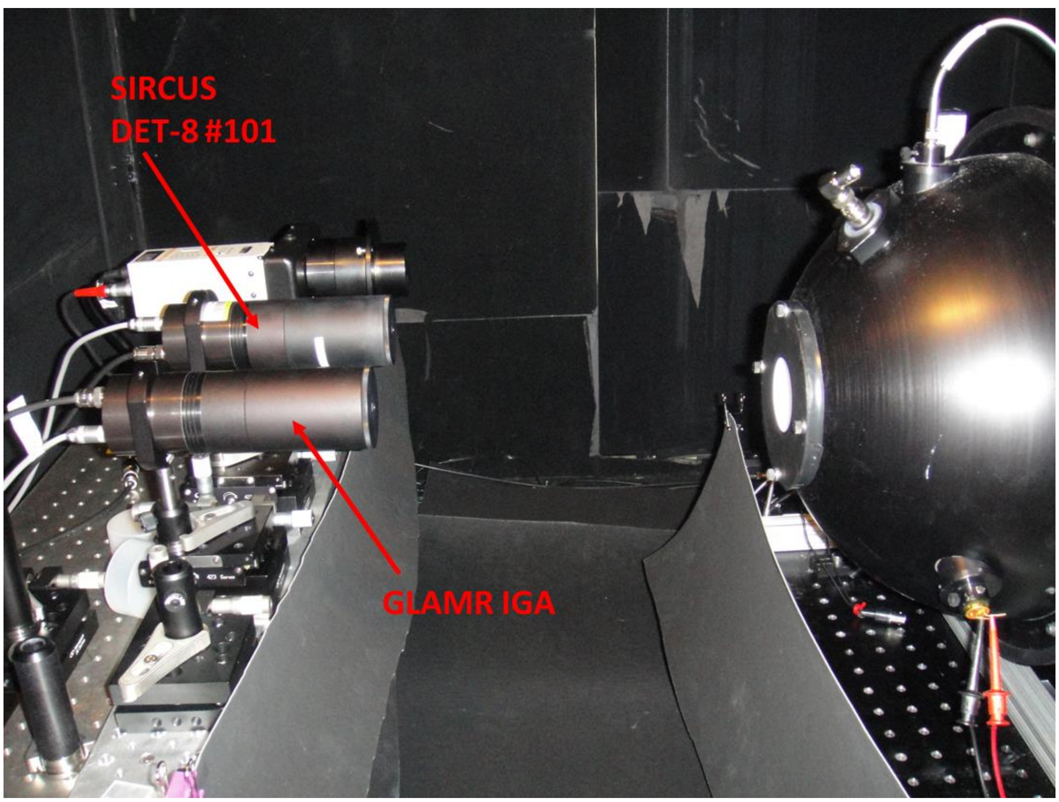


Figure 2.2 Side-view of detector bench setup for radiance measurements of the DUT using DET-8 #101 as the standard reference detector.

Figure 2.3 Photograph showing the setup of the GLAMR temperature controller and transimpedance amplifiers

2.1 Radiance Responsivity of GLAMR IGA from T-06 and DET-8 #101

Absolute radiance responsivity measurements were completed for GLAMR IGA DUT (with associated transimpedance amplifier) versus the standard reference trap detector T-06 from 880 nm to 980 nm, and radiance meter DET-8 #101 from 900 nm to 1630 nm using the SIRCUS facility. The integrating sphere source was the 30.5 cm (12-inch) diameter sphere described in Section 2 with a 5.08 cm (2-inch) aperture and was placed at a fixed position relative to both the GLAMR IGA DUT and the reference detectors at position Z = -431.5 mm. This placed the sphere approximately 28 cm from the GLAMR IGA aperture, as measured by a Mitutoyo ruler, and placed the field of view completely within the 5.08 cm diameter sphere output aperture. Similarly, the reference detector DET-8 #101, a radiance meter of similar design to the DUT, was placed such that the sphere was ≈ 28 cm away from the detector aperture at the same Z-position with the field of view completely within the 2-inch diameter sphere output aperture. An X-Y response map was also measured for the DUT and the DET-8 #101 reference detector, verifying the central position and underfilled configuration of each relative to the sphere aperture. Using DET-8 #101 allowed for a direct radiance-to-radiance scale transfer and eliminated the distance contribution to the uncertainty typically present when irradiance meter standard reference detectors are used. For the calibration against trap T-06, an irradiance meter, the sphere position placed it well within its acceptance angle as suggested in Section 3.1, below. The working distance was determined for T-06 from the sphere Z-position and the radiometrically determined detector position, as described in Section 3.2 below.

The pre-amplifier gain for GLAMR IGA and DET-8 #101 was generally 1 x 10^6 V/A for all measurements. For T-06, measurements were made using the Femto SIRCUS 12 amplifier with gain setting 1 x 10^6 V/A. A gain correction factor of 1.0012 is known for 1 x 10^7 V/A gain setting for the Femto SIRCUS 12 amplifier. At a gain setting 1 x 10^6 V/A, a gain correction factor of 1.0033 was determined by taking a measurement at each gain setting. There was no gain correction factor for DET-8 #101 associated with the known high accuracy gain settings for the SIRCUS Prec #2 amplifier.

3. Results of Test

For this calibration, a radiance calibration measurement was performed using two different reference detectors depending on the wavelength range of interest. The reference detectors (trap T-06 or DET-8 #101) established the radiance emitted from the source sphere. For DET-8 #101, the radiance of the source was determined directly from the previously calibrated radiance responsivity. Even though T-06 is an irradiance meter, it was also used to determine the source radiance, requiring knowledge of the solid angle of the source. To determine the solid angle, the distance between the reference detector aperture and the integrating sphere source aperture was measured, along with the integrating sphere and trap aperture areas: See Section 3.1. The reference detector (T-06) position was determined radiometrically, as described in Section 3.2, and the distance from the source was determined by measuring the Z-position with the linear encoder on the Z-axis stage.

3.1 Determination of the sphere source radiance for irradiance meter reference detectors

The radiance of the sphere source was determined with the flux transfer method for the calibration against the trap irradiance meter T-06. Radiant power was measured from the sphere source passing through two precision apertures, one on the source sphere and the other on the reference trap detector T-06. The radiance L [W m^{-2} sr^{-1}] of the sphere was determined from radiant power P [W] and the geometric extent G by:

$$L = \frac{P}{G} \tag{3.1}$$

The geometric extent G [m^2 sr] is given by

$$G = \frac{\pi^2}{2}\left[(d^2 + r_s^2 + r_D^2) - \{(d^2 + r_s^2 + r_D^2)^2 - 4r_s^2 r_D^2\}^{1/2}\right] \tag{3.2}$$

where r_S is the radius of the aperture in front of the source, r_D is the radius of the aperture in front of the reference detector, and d is the distance between the two apertures. The diameter of the sphere aperture was large enough (50.8 mm) to overfill the radiance measurement angle of the DUT radiometer by the sphere output radiation. The distance, d, was chosen large enough (383.91 mm for T-06) so that the sphere aperture was well within the acceptance angle of the working reference detector for power measurement.

3.2 Detector offset and offset uncertainty determination for irradiance meters

For radiance measurements using an irradiance meter, knowledge of the distance between the source and the reference detector aperture is required and that distance for T-06 was determined radiometrically. At several different Z positions, the detector and monitor voltages were recorded to yield a relative irradiance. Using the $1/Z^2$ law for on-axis irradiance (inverse square law) the resultant data can be fit by a point-source geometry (Equation 3.3) and an extended source geometry (the experimental configuration, Equation 3.4) to yield the Z-position of the detector aperture plane. From the Z-position encoder reading used in the radiance or irradiance responsivity measurements and the detector Z-position from the radiometric $1/Z^2$ law fit, the actual detector aperture to sphere aperture distance in millimeters (working distance) was determined. Figure 3.1 is a schematic of the configuration.

The inverse square law fitting equation for a point-source geometry is:

$$y = \frac{m_1}{(M_0 - m_2)^2} \tag{3.3}$$

Where y is the relative irradiance, m_1 is a fitting constant, M_0 is Z-position of the integrating sphere that is read by the Z-encoder, and m_2 is the Z-position of zero offset between the two apertures. The fitting uncertainty in m_2, for the sphere position during calibration, gives the uncertainty in the distance between the two apertures.

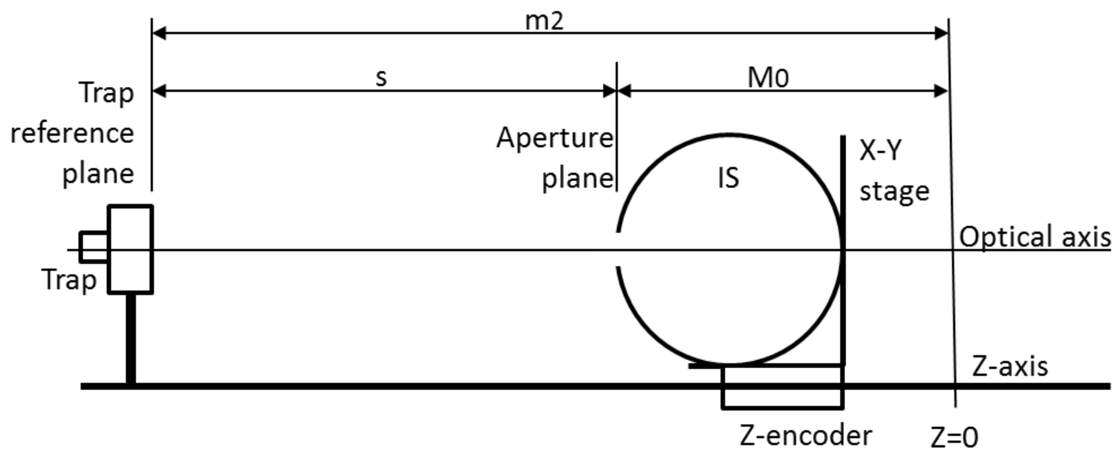


Figure 3.1. Schematic of the configuration for determining trap-sphere distance radiometrically.

If the source aperture is large, the extended source geometry expression is fit to the data:

$$y = \frac{m_1}{((M_0 - m_2)^2 + m_3^2 + m_4^2)} \tag{3.4}$$

where y, m_1, M_0, and m_2 are the same as in Eq. 3. $m_3 = r_d$, the radius of the detector aperture, and $m_4 = r_s$, the radius of the integrating sphere aperture. Equation 3.4 is valid in the limit where

$$(r_s^2 + r_d^2 + s^2) \gg 2 r_s r_d \tag{3.5}$$

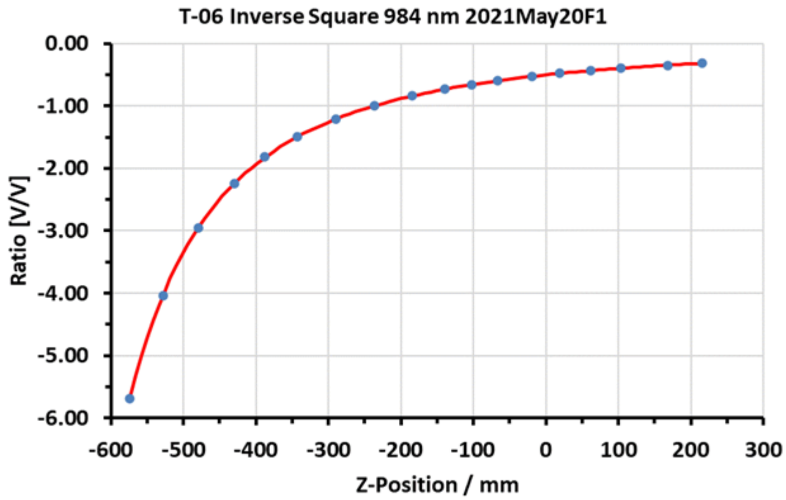
and s is the distance between the source and detector apertures. The inverse square law measurements along with the fit of equation 3.4 to the data for the reference detector can be seen in Figure 3.2, below. At a separation, *s*, equal to the working distance, the ratio given by equation 3.5 was determined for each detector. This result is summarized in Table 3.1 and shows the condition of equation 3.5 holds and that equation 3.4 is valid in each case. The residuals are approximately 3 orders of magnitude smaller than the base measurement and show there is no obvious bias or offset. The fitting results are also summarized in Table 3.2.

Table 3.1 Results of equation 3.5 at minimum separation distances.

Detector	r_s (cm)	r_d (cm)	s (cm)	Ratio (Eq 3.5)
T-06	2.54	0.178	38.391	1637

Table 3.2 Results of the inverse square law fits of equation 3.4 to the data.

Detector	m_2 (mm)	Fitting Uncertainty (mm) (k=1)	R, fit
T-06	-815.38	0.0612	1



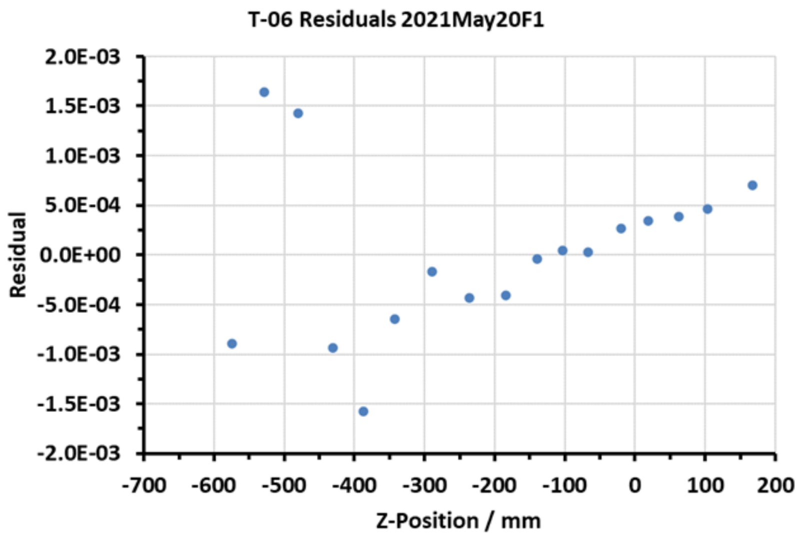


Figure 3.2 Offset and uncertainty fit of the non-point source geometry equation 3.4 to the irradiance response data at a wavelength of 984 nm (top) and residuals from the fit (bottom) for distance determination of T-06.

3.3 Radiance Responsivity of GLAMR IGA

Radiance responsivity of GLAMR IGA was measured from 880 nm to 1630 nm using two standard reference detectors to cover the separate but overlapping spectral ranges. Standard reference detector T-06 was used from 880 nm to 980 nm and DET-8 #101 was used from 900 nm to 1630 nm as shown in Figure 3.3 and tabulated in Table 3.3. Figure 3.4 shows an expanded view of the overlap region between 880 nm and 1000 nm. In the overlap region, good agreement within the standard uncertainties was found between the responsivities derived from the two reference detectors. Comparing the absolute values measured when using DET-8 #101 and T-06 at equivalent wavelengths resulted in an average absolute percent difference of 0.25 %. A few points at 926 nm, 933 nm, and 938 nm, had higher percent differences which likely resulted from errors in interpolation in the shoulder region at 920 nm and single-point wavelength differences between the radiance responsivity measurements when using either T-06 or DET-8 #101 as the reference detector. For example, at 915 nm where the point from the T-06 and DET-8 #101 calibrations are almost equivalent the difference between the two radiance responsivity measurements is less than 0.1%. When excluding the percent differences at the 3 wavelengths noted, the average percent difference is only 0.1 %.

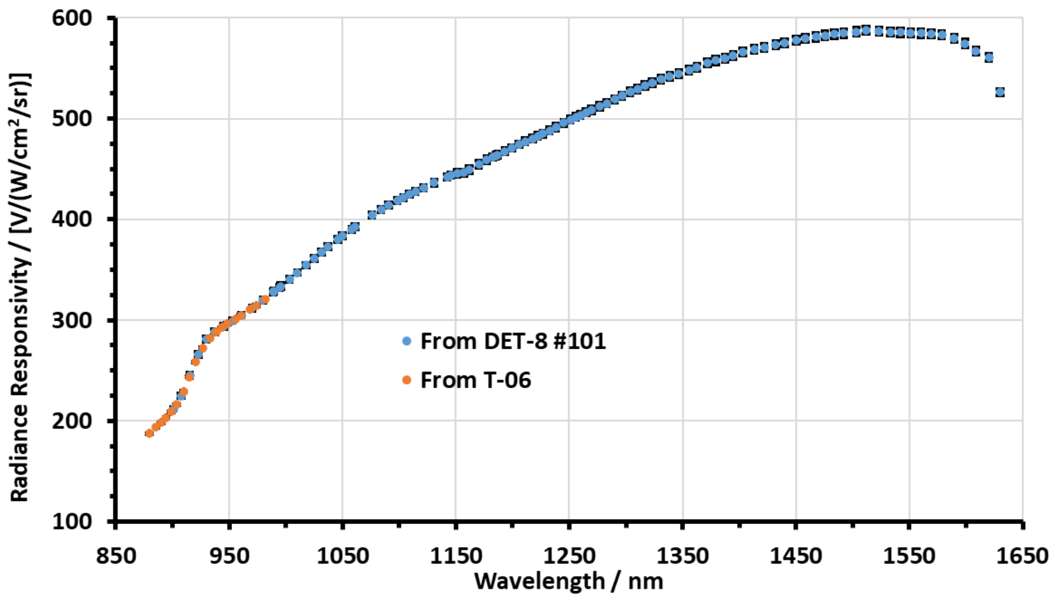


Figure 3.3 Radiance responsivity of GLAMR IGA radiometer from T-06 (Orange) and DET-8#101 (Blue). The y-axis error bars (black) represent the k=2 absolute uncertainty.

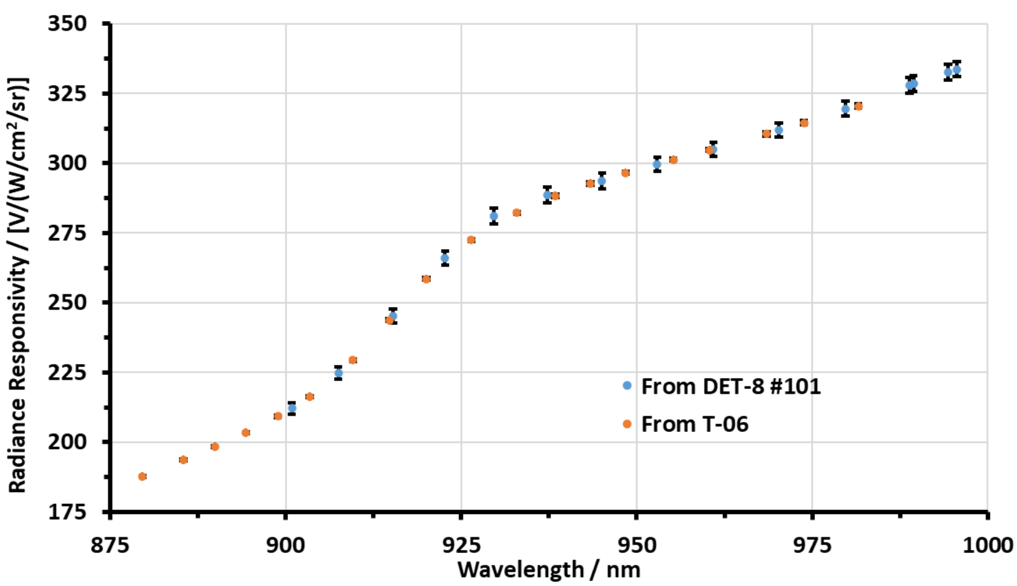


Figure 3.4 An expanded view of Figure 3.3 showing the transition region from 875 nm to 1000 nm where both T-06 and DET-8 #101 reference detectors were used. The error bars represent the k=2 absolute uncertainty.

Table 3.3 Tabulated absolute spectral radiance responsivity data for GLAMR IGA DET-8, S/N 107.

Reference Detector	Wavelength [nm]	Radiance Responsivity [V/(W/cm²/sr)]	Total k=1 uncertainty (%)
T-06	879.63	187.7	0.08
T-06	885.46	193.7	0.08
T-06	889.89	198.4	0.08
T-06	894.36	203.4	0.08
T-06	898.87	209.2	0.08
DET-8 #101	900.87	212.2	0.49
T-06	903.44	216.2	0.08
DET-8 #101	907.52	224.9	0.48
T-06	909.60	229.4	0.08
T-06	914.79	243.8	0.09
DET-8 #101	915.30	245.2	0.49
T-06	920.05	258.5	0.09
DET-8 #101	922.69	266.0	0.48
T-06	926.44	272.5	0.09
DET-8 #101	929.66	281.1	0.48
T-06	932.93	282.3	0.09
DET-8 #101	937.28	288.7	0.48
T-06	938.41	288.3	0.09
T-06	943.40	292.7	0.09
DET-8 #101	945.04	293.8	0.48
T-06	948.42	296.6	0.09
DET-8 #101	952.91	299.5	0.42
T-06	955.21	301.3	0.09
T-06	960.36	304.8	0.10
DET-8 #101	960.91	304.9	0.42
T-06	968.50	310.5	0.11
DET-8 #101	970.22	311.8	0.42
T-06	973.80	314.5	0.12
DET-8 #101	979.73	319.6	0.42
T-06	981.57	320.5	0.13
DET-8 #101	988.82	327.9	0.42
DET-8 #101	989.43	328.5	0.42
DET-8 #101	994.35	332.7	0.42
DET-8 #101	995.59	333.7	0.42
DET-8 #101	1003.07	340.4	0.42
DET-8 #101	1010.04	347.2	0.36
DET-8 #101	1017.74	354.5	0.36
DET-8 #101	1024.92	361.3	0.36

DET-8 #101	1031.54	367.6	0.36
DET-8 #101	1036.89	372.5	0.36
DET-8 #101	1045.70	380.2	0.34
DET-8 #101	1049.84	383.6	0.34
DET-8 #101	1058.16	390.1	0.34
DET-8 #101	1061.01	392.3	0.34
DET-8 #101	1075.99	404.3	0.34
DET-8 #101	1084.02	409.4	0.33
DET-8 #101	1090.69	413.8	0.33
DET-8 #101	1098.24	418.5	0.33
DET-8 #101	1103.63	421.6	0.33
DET-8 #101	1108.97	424.8	0.33
DET-8 #101	1114.35	427.8	0.33
DET-8 #101	1121.40	431.5	0.33
DET-8 #101	1130.94	436.3	0.33
DET-8 #101	1142.20	442.2	0.33
DET-8 #101	1145.41	443.7	0.33
DET-8 #101	1151.16	445.7	0.38
DET-8 #101	1156.81	446.1	0.38
DET-8 #101	1161.85	449.2	0.38
DET-8 #101	1170.35	454.7	0.38
DET-8 #101	1177.23	459.2	0.38
DET-8 #101	1182.45	461.8	0.34
DET-8 #101	1185.08	463.1	0.34
DET-8 #101	1186.83	463.8	0.34
DET-8 #101	1193.03	467.6	0.33
DET-8 #101	1199.27	470.9	0.33
DET-8 #101	1205.59	474.4	0.33
DET-8 #101	1211.06	477.2	0.33
DET-8 #101	1217.50	480.2	0.33
DET-8 #101	1222.14	482.6	0.33
DET-8 #101	1226.84	484.8	0.33
DET-8 #101	1232.51	488.0	0.33
DET-8 #101	1238.25	491.5	0.33
DET-8 #101	1244.99	495.6	0.33
DET-8 #101	1250.83	498.9	0.33
DET-8 #101	1255.73	501.7	0.33
DET-8 #101	1259.68	503.5	0.33
DET-8 #101	1264.68	506.1	0.33
DET-8 #101	1269.68	508.7	0.33
DET-8 #101	1276.77	512.2	0.33
DET-8 #101	1282.91	515.3	0.33
DET-8 #101	1290.14	519.0	0.33

DET-8 #101	1296.42	522.6	0.33
DET-8 #101	1303.80	526.5	0.33
DET-8 #101	1310.20	529.5	0.33
DET-8 #101	1316.66	532.6	0.33
DET-8 #101	1323.18	535.7	0.33
DET-8 #101	1330.87	539.4	0.33
DET-8 #101	1338.66	542.1	0.33
DET-8 #101	1346.53	544.2	0.33
DET-8 #101	1355.69	547.7	0.33
DET-8 #101	1362.60	551.0	0.33
DET-8 #101	1371.92	555.0	0.33
DET-8 #101	1378.98	557.6	0.33
DET-8 #101	1387.36	559.8	0.33
DET-8 #101	1394.61	562.8	0.33
DET-8 #101	1403.17	565.9	0.33
DET-8 #101	1413.08	568.8	0.33
DET-8 #101	1421.86	570.8	0.33
DET-8 #101	1432.03	573.2	0.33
DET-8 #101	1439.75	575.0	0.33
DET-8 #101	1450.19	577.7	0.33
DET-8 #101	1458.09	579.3	0.33
DET-8 #101	1467.44	581.0	0.33
DET-8 #101	1475.55	582.7	0.33
DET-8 #101	1483.73	583.7	0.33
DET-8 #101	1492.02	584.5	0.33
DET-8 #101	1503.21	586.1	0.33
DET-8 #101	1511.72	587.6	0.33
DET-8 #101	1523.21	586.6	0.33
DET-8 #101	1533.40	585.6	0.33
DET-8 #101	1542.23	585.4	0.33
DET-8 #101	1551.18	585.1	0.33
DET-8 #101	1560.24	584.6	0.33
DET-8 #101	1569.40	584.1	0.33
DET-8 #101	1578.67	583.0	0.33
DET-8 #101	1589.61	579.7	0.33
DET-8 #101	1599.13	574.6	0.33
DET-8 #101	1608.77	566.7	0.33
DET-8 #101	1620.16	560.3	0.33
DET-8 #101	1630.03	526.2	0.33

3.4 Uncertainty analysis for the Radiance Responsivity of GLAMR IGA (DET-8, S/N 107)

	Relative Standard Uncertainty [%]	
Uncertainty Component	**T-06 880 nm to 980 nm**	**DET-8 #101 900 nm to 1630 nm**
Reference detector Irradiance. Cal.[1]	0.035 to 0.11	0.32 to 0.48
Measurement % St Dev[2]	0.01	0.011
Reference Detector Distance	0.032	N.A.
Geometry Alignment	0.05	0.05
Amplifier Gain[3]	0.05	N.A.
Reference Detector Aperture Area	N.A.	0.02
Sphere Aperture Area	0.03	0.03
Wavelength	0.03	0.03
Total k = 1 % Uncertainty[4]	**0.08 and 0.13**	**0.33 to 0.49**

Note 1: For T-06 the relative %uncertainty is 0.05 or less below 950 nm and increases up to 0.11 % at 980 nm. For DET-8 the uncertainty is higher at shorter wavelengths due to traceability of the calibration through the pyroelectric detector.
Note 2: This is the average measurement percent standard deviation across the entire range. Values for individual wavelengths can be found in the calibration file.
Note 3: The reference detector DET-8 #101 used the SIRCUS Prec #2 amplifier which has known high accuracy gain settings and therefore this component doesn't contribute to the uncertainty. The calibration does not include any uncertainty component from the GLAMR IGA amplifier.
Note 4: This is not the full calibration uncertainty budget. The uncertainty budget, Table 3.4, does not include environmental effects on both the reference detector and the GLAMR radiometer. No evaluations of instrument performance characteristics such as temperature dependence, response linearity or temporal stability were performed. For estimates in the interpolated uncertainty, see the reference.[8]

4. General Information

It should be noted that the reported results were measured using the dial gain value of 1 x 10^6 V/A on the provided DUT pre-amplifiers to give the radiance responsivity in [V/(W/cm^2/sr)].

Information was recorded in the SIRCUS Vis #21 laboratory notebook, pp.69-81.

The calibration measurements, data analysis, and report writing were performed by Brian G. Alberding and John T. Woodward.

This calibration required 7 days of laboratory work (including setup, troubleshooting, and data collection) on SIRCUS and 5 days of data reduction, analysis, and reporting.

Significant experimental notes:

1. Previous calibrations of GLAMR IGA utilized a method that changed the z-position between measurements of the sphere source by the reference detector and DUT which introduced errors due to water vapor absorption from large differences in pathlength. This was avoided here in two ways. One, for the T-06 calibration a single sphere z-position was chosen such that the sphere aperture was well within the acceptance angle of the working reference detector for power measurement and the DUT field-of-view was overfilled by the sphere aperture. To fulfill this requirement, the z-position for T-06 was somewhat closer than typical. For the DET-8 calibration, the reference detector is a radiance meter which simplifies the distance requirement.

Information about data files:

1. Full data files for the radiance responsivity of GLAMR Si are located on Elwood under:

   \\cfs2e.nist.gov\685\internal\G04\SIRCUS\SIRCUS\Calibrations\SIRCUS Calibrations\FY 2021 Calibrations\GLAMR\GLAMR IGA

   Data file for the radiance responsivity of GLAMR Si: “Rad Resp GLAMR IGA FY2021 combined results.xlsx”

The files located in these directories are meant for internal NIST use only. Please do not distribute without authorization.

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Distribution Restrictions: None

Tabulated calibration data files were provided along with this report.
Filename: "Radiance Responsivity GLAMR IGA FY2021 combined results.xlsx"
"Preliminary Rad Resp GLAMR IGA FY2021.xlsx"

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