



Report Title Repeatability of WISE Response to MIC2 Scatter Source	Document Number SDL/09-102c
Prepared By Joel Cardon	Date May 11, 2009
Proprietary Data Notice	
<p>This document contains data that shall not be disclosed outside the Jet Propulsion Laboratory and shall not be duplicated, used or disclosed – in whole or in part – for any purposes other than to the extent provided in contract 1255923. This restriction does not limit JPL's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in sheets marked "Proprietary" or that contain the legend prescribed by FAR 52.215-1.</p>	

1. INTRODUCTION

The response of WISE to the MIC2 scatter source was measured during testing over the period November 4-20, 2008 as part of the MIC2 Test 1 instrument characterization. The scatter source response and medium-term response repeatability (on the order of an orbit period) were measured using the *Dark Offset and Gain Variation Test Procedure* (SDL/07-578) at three FPA temperatures, as shown in Table 1.

Table 1: Summary of FPA Temperatures for Each Data Set

FPA Temperature	Band 1 FPA	Band 2 FPA	Band 3 FPA	Band 4 FPA
Nominal	32K	32K	7.8K	7.8K
Low	30K	30K	6.8K	6.8K
High	34K	34K	8.8K	8.8K

In addition, the procedure was repeated at nominal FPA temperatures with an improved (but still not optimal) grounding configuration, and was repeated with EM electronics and nominal FPA temperatures.

The as-run procedures are located in the file \\hera\wise_mic2\MIC2_Test_1\WISE_on_MIC_test_1.pdf. Table 2 identifies the data sets acquired during testing.

Table 2 Summary of Response Repeatability Data Sets

Test	Files (10 images/file) [Response (background)]	Notes	Report section
Nominal FPA temperatures (11/08/2008)	DRK0002 (0003), DRK0005 (0006), DRK0008 (0009), DRK0011 (0012), DRK0015 (0016), DRK0018 (0019), DRK0021 (0022), DRK0024 (0025), DRK0028 (0029), DRK0031 (0032), DRK0034 (0035), DRK0037 (0038), DRK0041 (0042), DRK0044 (0045), DRK0047 (0048), DRK0050 (0051), DRK0054 (0055), DRK0057 (0058), DRK0060 (0061), DRK0063 (0064), DRK0067 (0068), DRK0070 (0071), DRK0073 (0074), DRK0076 (0077), DRK0080 (0081), DRK0083 (0084), DRK0086 (0087) DRK0089 (0090)	The complete procedure took about 5 hours	1.1
Low FPA temperatures (11/09/2008)	DRK0094 (0095), DRK0097 (0098), DRK0100 (0101), DRK0103 (0104), DRK0107 (0108), DRK0110 (0111), DRK0113 (0114), DRK0116 (0117), DRK0120 (0121), DRK0123 (0124), DRK0126 (0127), DRK0129 (0130), DRK0133 (0134), DRK0136 (0137), DRK0139 (0140), DRK0142 (0143), DRK0146 (0147), DRK0149 (0150), DRK0152 (0153), DRK0155 (0156), DRK0159 (0160), DRK0162 (0163), DRK0165 (0166), DRK0168 (0169), DRK0172 (0173), DRK0175 (0176), DRK0178 (0179), DRK0081 (0182)	The complete procedure took about 5 hours	1.2
High FPA temperatures (11/11/2008)	DRK0186 (0187), DRK0189 (0190), DRK0192 (0193), DRK0195 (0196), DRK0199 (0200), DRK0202 (0203), DRK0205 (0206), DRK0208 (0209), DRK0212 (0213), DRK0215 (0216), DRK0218 (0219), DRK0221 (0222), DRK0225 (0226), DRK0228 (0229), DRK0231 (0232), DRK0234 (0235), DRK0238 (0239), DRK0241 (0242), DRK0244 (0245), DRK0247 (0248), DRK0251 (0252), DRK0254 (0255), DRK0257 (0258), DRK0260 (0261), DRK0264 (0265), DRK0267 (0268), DRK0270 (0271), DRK0273 (0274)	The complete procedure took about 5 hours	1.3
Repeated nominal FPA temperatures	DRK0094 (0095), DRK0097 (0098), DRK0100 (0101), DRK0103 (0104), DRK0107 (0108), DRK0110 (0111), DRK0113 (0114), DRK0116 (0117), DRK0120 (0121), DRK0123 (0124), DRK0126 (0127), DRK0129 (0130), DRK0133 (0134), DRK0136 (0137), DRK0139 (0140), DRK0142 (0143), DRK0146 (0147), DRK0149 (0150), DRK0152 (0153), DRK0155 (0156), DRK0159 (0160), DRK0162 (0163), DRK0165 (0166), DRK0168 (0169), DRK0172 (0173), DRK0175 (0176), DRK0178 (0179), DRK0081 (0182)	No configuration change occurred between this and the previous quick look data set. The LHe dewars were changed out prior to starting the 5 hour procedure. <i>Band 4 was partially saturated during this test</i>	1.4
EM electronics, nominal FPA temperatures	DRK0094 (0095), DRK0097 (0098), DRK0100 (0101), DRK0103 (0104), DRK0107 (0108), DRK0110 (0111), DRK0113 (0114), DRK0116 (0117), DRK0120 (0121), DRK0123 (0124), DRK0126 (0127), DRK0129 (0130), DRK0133 (0134), DRK0136 (0137), DRK0139 (0140), DRK0142 (0143), DRK0146 (0147), DRK0149 (0150), DRK0152 (0153), DRK0155 (0156), DRK0159 (0160), DRK0162 (0163), DRK0165 (0166), DRK0168 (0169), DRK0172 (0173), DRK0175 (0176), DRK0178 (0179), DRK0081 (0182)	The complete procedure took about 5 hours	1.5

Note: the B3 and B4 test temperature range of 6.8K - 8.8K is outside the required operating range of 7.3K – 8.3K. The test range was increased on the low and high sides by 0.5K to take into account the 0.5K uncertainty in the Si:As FPA temperature sensor (DT-670) readouts. The sensors will be calibrated to an accuracy much better than 0.5K during payload H2 testing in February, 2009. The WISE cryostat has been designed by LMATC to maintain the Si:As arrays in the temperature range 7.3K – 8.3K throughout the mission.

For all of these measurements, the MIC2 scatter plate was illuminated by external blackbody radiation which was attenuated by an ND filter in the MIC2 filter slide. Along with each response measurement, a companion measurement was made with the scatter plate in place, but with the MIC2 aperture slide in the closed position (to provide a background for subtraction).

Since the spectral transmittance of the ND filter is not well characterized, and since the BRDF of the MIC2 internal scatter plate is not known to high accuracy, *these measurements were intended to characterize medium-term response repeatability rather than absolute responsivity.*

As discussed in the *Payload Electro-Optical Characterization Plan* (SDL/05-091), based on previous blackbody characterization, the monitored temperature of the blackbody should vary by ≤ 0.5 C (p-p), and this variation can be accounted for. Any variation in blackbody radiance not accounted for (i.e. not seen in the temperature monitor) should be less than 0.3% (p-p).

However, as discussed in Section 2.1.2, a rapid and significant variation in radiance was observed in bands 3 and 4 which probably compromises the measurements of response repeatability in those bands.

An overall summary of the results and conclusions that will be presented in the report is included here. Tables 3 and Table 4 summarize the overall results discussed in following sections for:

- file-average, array-average response levels, \mathfrak{R}_{arr} , and
- array-average medium-term repeatability, $\sigma_{mt,arr}$.

The values are reported for nominal pixels only (as defined by the SDL good pixel map).

Table 3: Summary of Results for Bands 1 and 2

Test	Band1			Band2		
	\mathfrak{R}_{arr} (DN)	$\sigma_{mt,arr}$ (DN)	T_{FPA} (K)	\mathfrak{R}_{arr} (DN)	$\sigma_{mt,arr}$ (DN)	T_{FPA} (K)
Nominal	13429	17.64	31.9	12683	14.26	31.9
Low	13360	19.73	30.0	12446	14.91	30.0
High	13579	21.71	34.0	12938	30.79	34.0
Repeat Nominal	13833	31.07	31.9	13000	25.18	31.9
EM	13156	17.21	32.2	12368	14.88	32.1

Table 4: Summary of Results for Bands 3 and 4

Test	Band 3			Band 4		
	\mathcal{R}_{arr} (DN)	$\sigma_{mt,arr}$ (DN)	T_{FPA} (K)	\mathcal{R}_{arr} (DN)	$\sigma_{mt,arr}$ (DN)	T_{FPA} (K)
Nominal	9437	36.59	7.9	702	9.79	7.9
Low	9288	28.34	6.9	676	5.35	6.9
High	9494	91.06	8.8	707	6.29	8.7
Repeat Nominal	9614	37.16	7.8	*785	*159.76	7.7
EM	9111	165.70	7.8	692	11.84	7.8
*Note: the Band 4 array was partially saturated						

Overall conclusions based on these results are:

- The scatter source response data collected using the EM electronics is suitable for comparison with similar measurements post-vibe (to demonstrate unchanged responsivity)
- Due to the rapid and significant temporal variation of MIC2 scatter source radiance observed in Bands 3 and 4 (both in illuminated and un-illuminated scatter source observations), the medium-term response repeatability listed is likely worse than the true flight repeatability
- The source of the MIC2 scatter source radiance variations is not known, since they are not correlated with any of the monitored MIC2 or WISE housekeeping parameters
- Even with the observed radiance variability, the medium-term response repeatability (background-subtracted) is typically in the 0.3-1.4% range for bands 3 and 4, and in the 0.1-0.2% range for bands 1 and 2
- Likely due to long-term scatter source radiance variability, the Repeat Nominal test (November 18th) shows higher response and larger medium term repeatability relative to the Nominal, Low, and High temperature tests (November 8th, 9th, and 11th, respectively) in all four bands
- The Band 4 array was partially saturated during the Repeat Nominal test
- The Nominal, Low and High temperature tests suggest that background-subtracted response (and hence gain) may vary with FPA temperature in all four bands, although the relatively high response observed in the Repeat Nominal test, along with the rapid and significant temporal radiance variations in Bands 3 and 4 make it difficult to quantify the dependence

2. TEST RESULTS

2.1 BACKGROUND RESPONSE AND REPEATABILITY FOR NOMINAL FPA TEMPERATURES

2.1.1 Response for Nominal FPA Temperatures

The mean pixel response value, $\eta_k(m)$, for pixel k and test m was determined using

$$\eta_k(m) = \frac{1}{N} \sum_{n \in N} F_{lin,k} (r_k(m,n) - DO_k) \quad (1)$$

where DO_k is the dark offset, $F_{lin,k}(r_k(m,n) - DO_k)$ is the *non-linearity corrected* response for the n th observed value of pixel k in test m , N is the number of frames collected in a given test, and n is the index for an individual frame (i.e. a single sample-up-the-ramp image).

The nonlinearity correction for each pixel is applied using [\\hercules\wise\SE\Characterization\IDLcode\wise_nonlincor.pro](#).

WISE darkfield images, DO_k , for each of the 4 bands are located in [\\hera\wise_mic2\Processed WISE data\MIC2 Test 1\Darkfields\darkfield_bn.deb](#) where $n=1-4$.

The mean pixel background response (looking at the scatter source, but with the MIC2 entrance aperture closed), $\eta_{Bkgd,k}(m)$, for pixel k and test m was determined using

$$\eta_{Bkgd,k}(m) = \frac{1}{N} \sum_{n \in N} F_{lin,k}(Bkgd_k(m,n) - DO_k) \quad (2)$$

where $F_{lin,k}(Bkgd_k(m,n) - DO_k)$ is the *non-linearity corrected* background response for the n th observed value of pixel k in test m .

The background-subtracted mean pixel response for pixel k and test m , is then

$$\mathfrak{R}_k(m) = \eta_k(m) - \eta_{Bkgd,k}(m) \quad (3)$$

Since there was a significant temporal variation in the response observed in bands 3 and 4 (as discussed in Section 2.1.2), the mean pixel background response, $\eta_{Bkgd,k}(m)$, was interpolated to the same time as $\eta_k(m)$ before subtraction.

The background-subtracted mean pixel response for pixel k and set of tests M is

$$\mathfrak{R}_k = \frac{1}{M} \sum_{m \in M} \mathfrak{R}_k(m) \quad (4)$$

For each WISE band, a histogram was generated to display the distribution of background-subtracted mean pixel response, \mathfrak{R}_k , for all nominal pixels (as specified by the WISE bad pixel maps [\\hera\wise_mic2\Processed WISE data\Masks\Bandn Mask.deb](#) for $n=1-4$) for nominal FPA temperatures. The histograms are shown in Figures 1-4. The array mean and median (for nominal pixels) is shown on each histogram. Note that the histograms were generated using all but the first file after each interspersed dark measurement (Table 2, column 2). This was done to avoid the transient behavior that will be discussed in Section 2.1.2.

The background-subtracted array mean response, $\mathfrak{R}_{arr}(m)$, for test m and set of pixels, K , is

$$\mathfrak{R}_{arr}(m) = \frac{1}{K} \sum_{k \in K} \mathfrak{R}_k(m) \quad (5)$$

And the background-subtracted array mean response, \mathfrak{R}_{arr} , for a set of tests, M , is the average of $\mathfrak{R}_{arr}(m)$ over all the tests m in the set of tests M

$$\mathfrak{R}_{arr} = \frac{1}{M} \sum_{m \in M} \mathfrak{R}_{arr}(m) \quad (6)$$

The file-average, array-average response levels, \mathfrak{R}_{arr} , observed during the nominal temperature FPA test were

$$\mathfrak{R}_{arr,B1} = 13429 \text{ DN}, \quad \mathfrak{R}_{arr,B2} = 12683 \text{ DN}, \quad \mathfrak{R}_{arr,B3} = 9437 \text{ DN}, \quad \mathfrak{R}_{arr,B4} = 702 \text{ DN}.$$

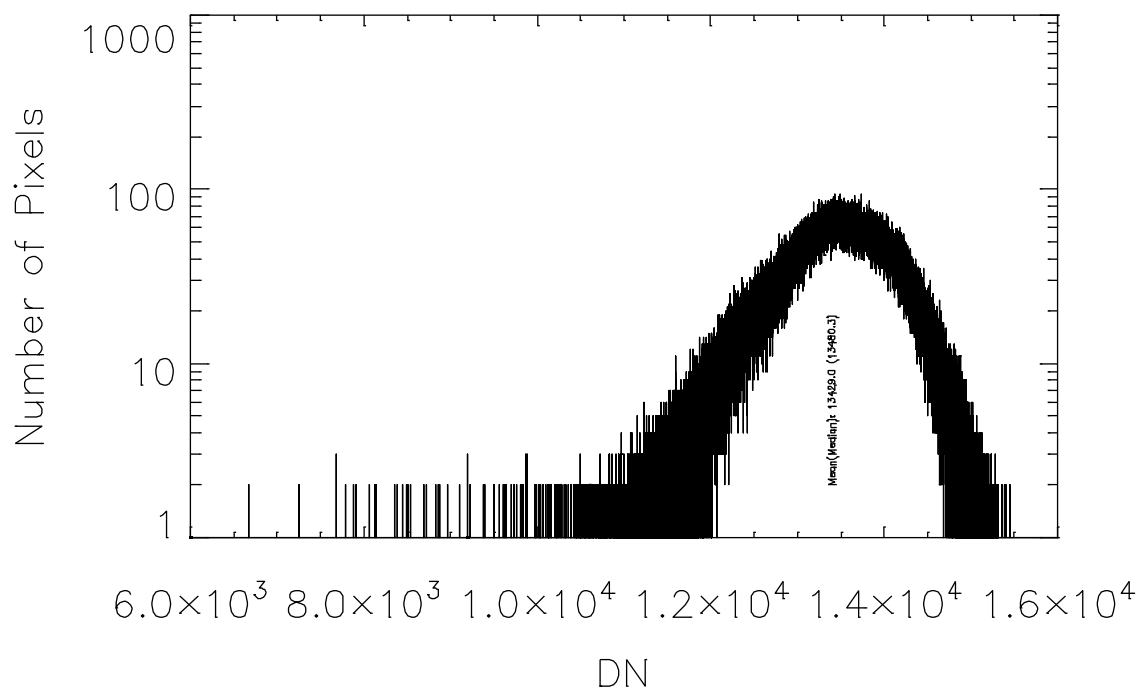


Figure 1: Band 1 Response Histogram (Nominal Temperature)

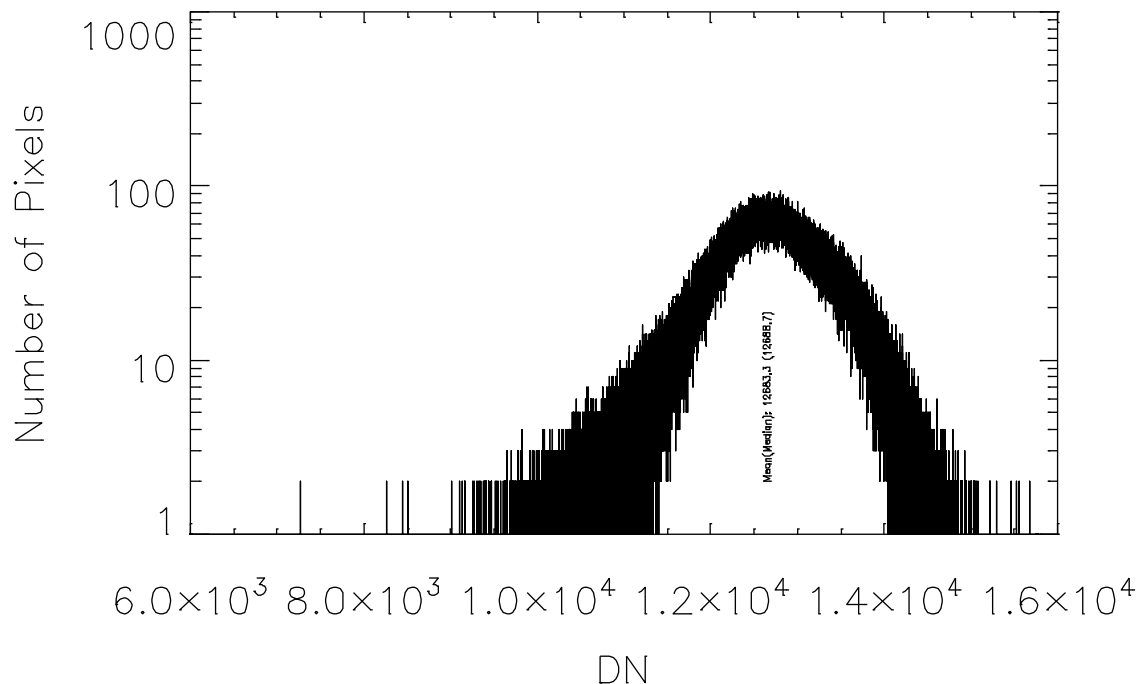


Figure 2: Band 2 Response Histogram (Nominal Temperature)

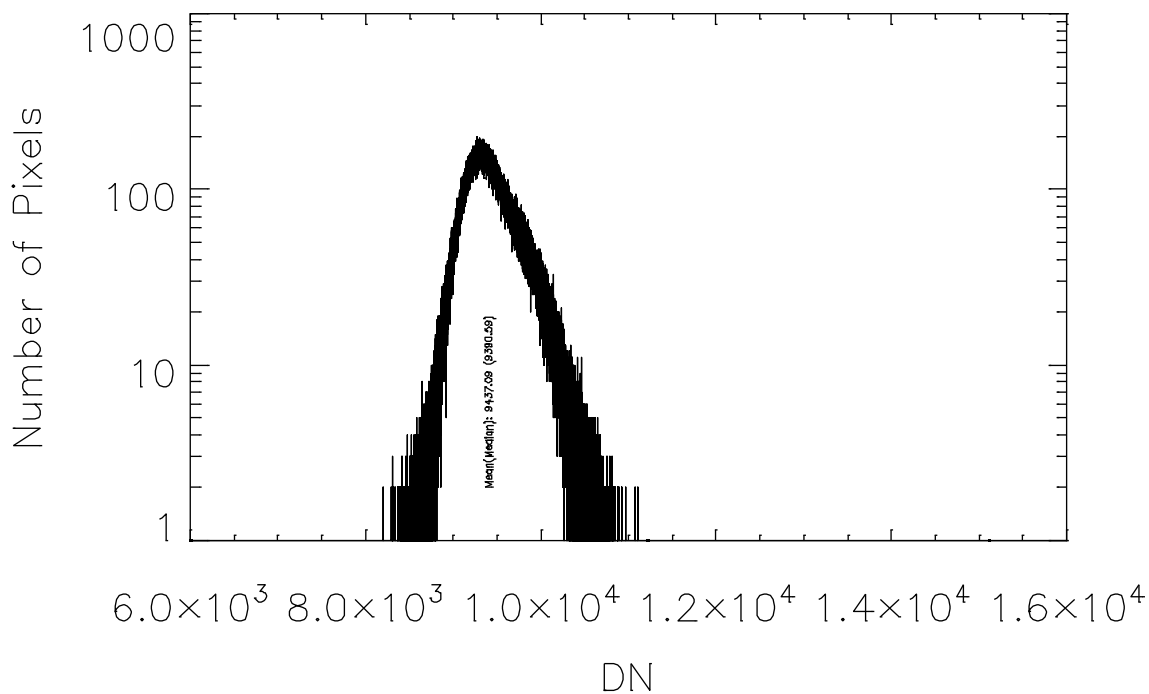


Figure 3: Band 3 Response Histogram (Nominal Temperature)

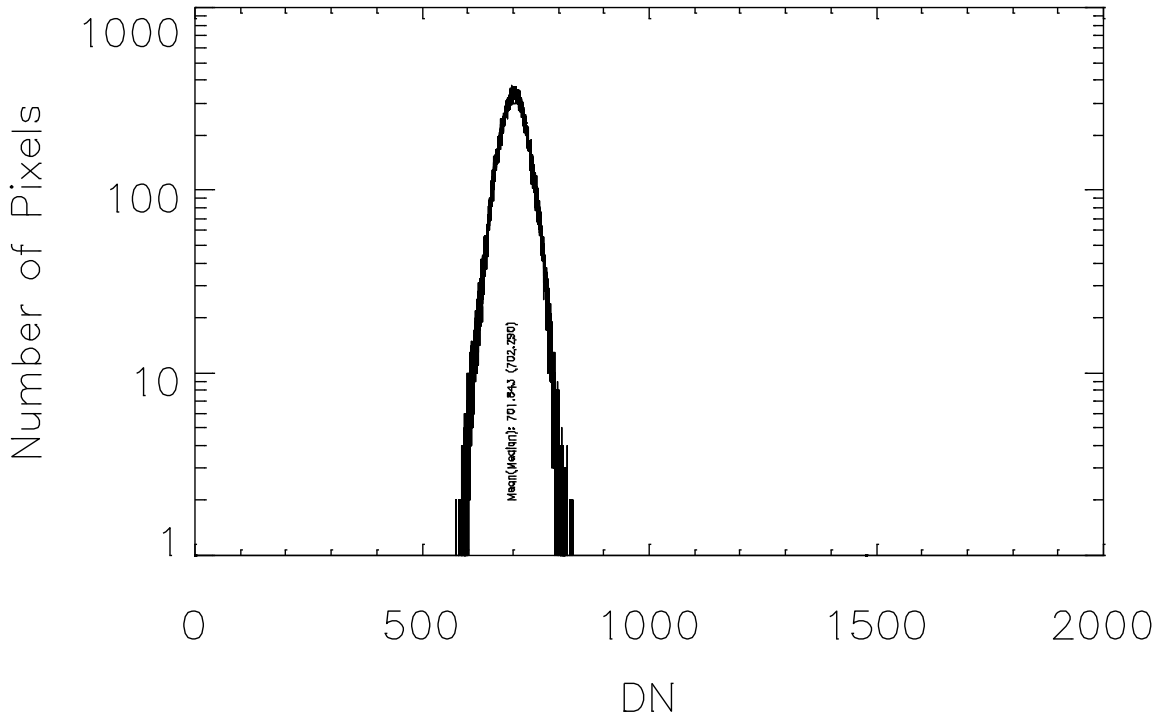


Figure 4: Band 4 Response Histogram (Nominal Temperature)

2.1.2 Response Repeatability for Nominal FPA Temperatures

The medium-term response repeatability (defined as the variation in the mean response over about 90 minutes, or approximately one orbit) was quantified using data from the Dark and Gain Variation Procedure.

As discussed in the system engineering report on dark offset and background response repeatability, the noise in all four bands was excessive during Dark and Gain Variation measurements due to 1) a short between the shields of the B4 warm cable, 2) improper grounding of the cryostat internal shields to the external cryostat, and 3) MEB and DEB connector backshells not adequately grounded to the boxes. It is not believed that this excessive read noise compromised the medium-term response repeatability measurements.

Note that in the case of scatter source response discussed in this report, a rapid and significant variation in radiance was observed in bands 3 and 4 which probably compromises the measurements of medium-term response repeatability in those bands. The MIC2 log files were examined to determine if the radiance changes are correlated with any reported internal MIC2 or WISE temperatures – no correlation was found. As shown in the system engineering report on dark offset and background response repeatability (SDL/09-092), the interspersed dark response measurements (WISE viewing cold extended source) were quite stable during this time, indicating that the radiance, not the WISE responsivity, was changing. Therefore, the band 3 and 4 medium-term repeatability was re-measured during the post-environmental MIC2 test staring at the MIC2 extended source instead of the scatter source, giving much better results (reported in the Appendix) Note also that neither the scatter source radiance nor the stim source radiance was stable over the many days of MIC2 testing. The stim source intensity changed with time, and the scatter source radiance changed likely due to a variable light leak or unmonitored

changing temperature inside MIC2 (which doesn't affect the dark measurements or the absolute responsivity measurements made with the MIC2 extended source in place). Therefore, long-term response repeatability cannot be determined from benchmark measurements made using the MIC2 scatter or stim sources.

As an example of the radiance variability, Figures 5-8 show the response to the scatter source for the "repeated nominal" FPA temperature data set. Note that the time is reported in seconds since the beginning of the MIC2 testing on the plots. The un-illuminated scatter source background response (red symbols) is evident for bands 3 and 4, but insignificant (approximately dark offset level) for bands 1 and 2. Also, the band 4 plot shows background measurements interpolated (blue symbols) to the same time as the illuminated scatter plate measurements (since the observed response is varying significantly in bands 3 and 4, interpolation is necessary).

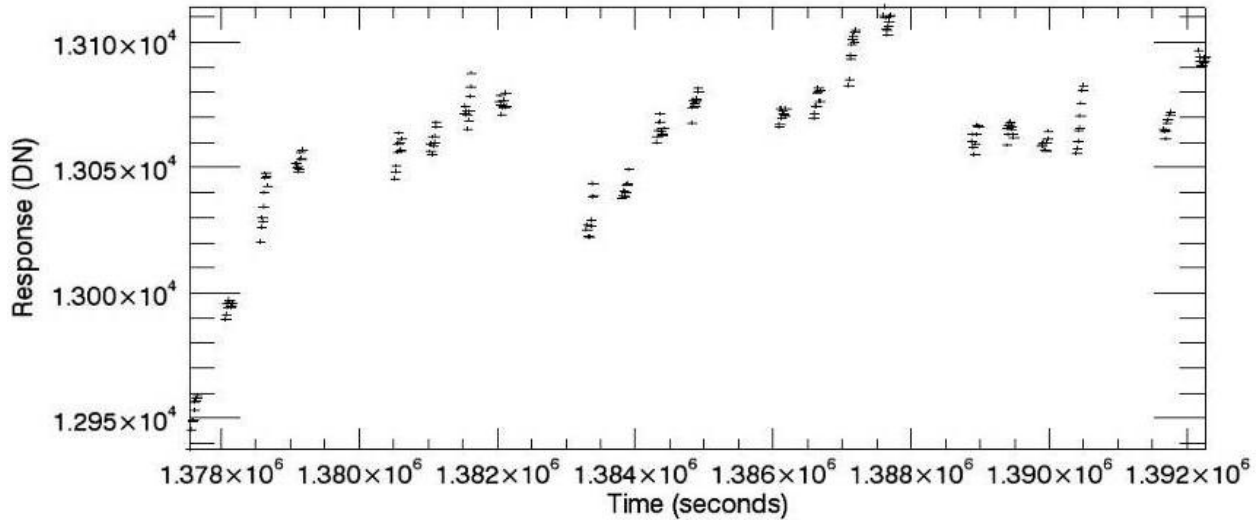


Figure 5: Band 1 Repeated Nominal FPA Temperature Response (each frame)

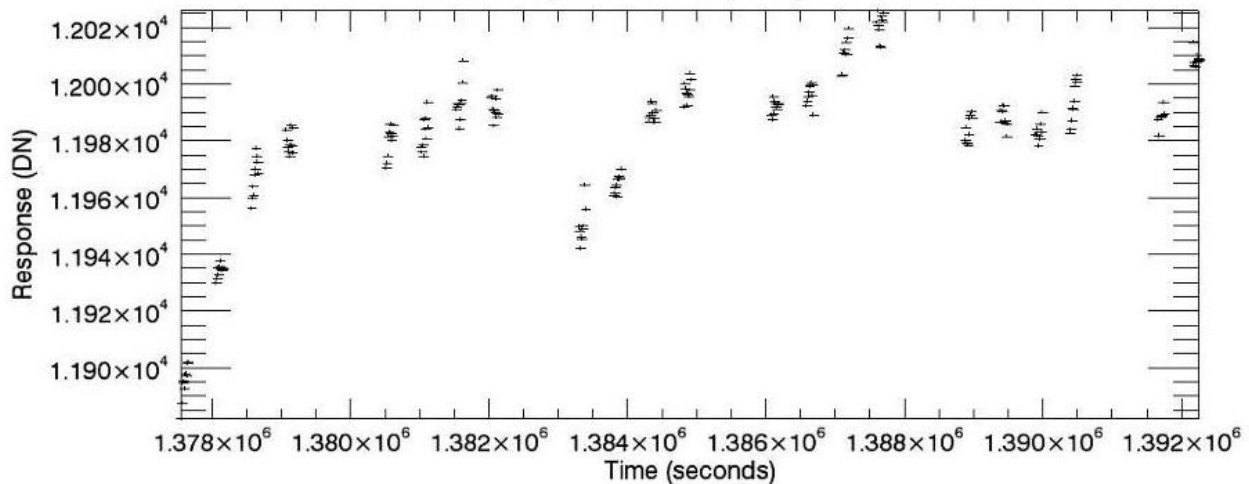


Figure 6: Band 2 Repeated Nominal FPA Temperature Response (each frame)

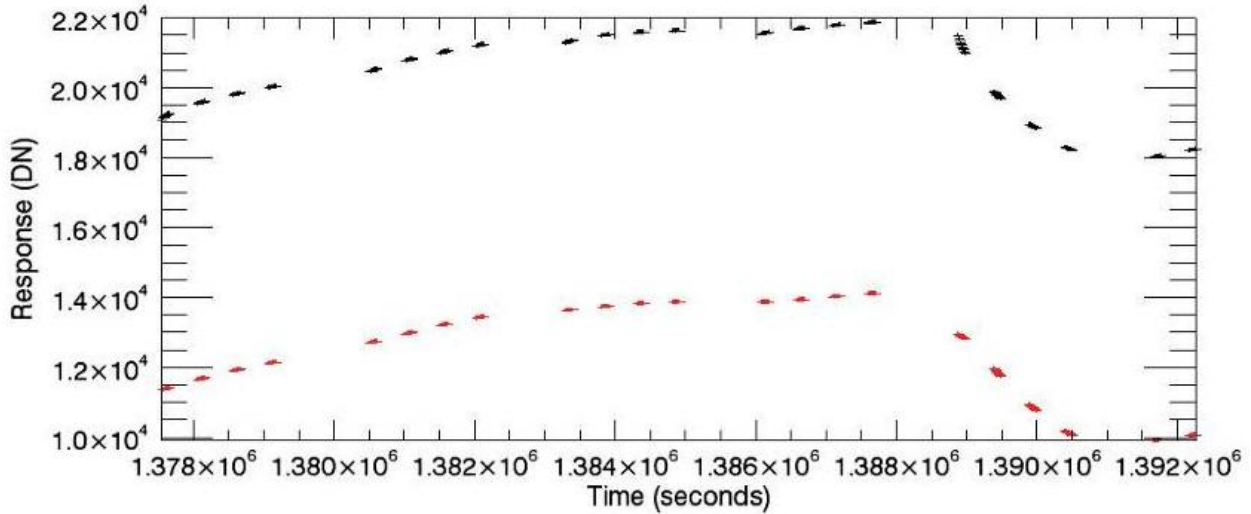


Figure 7: Band 3 Repeated Nominal FPA Temperature Response and Background (each frame)

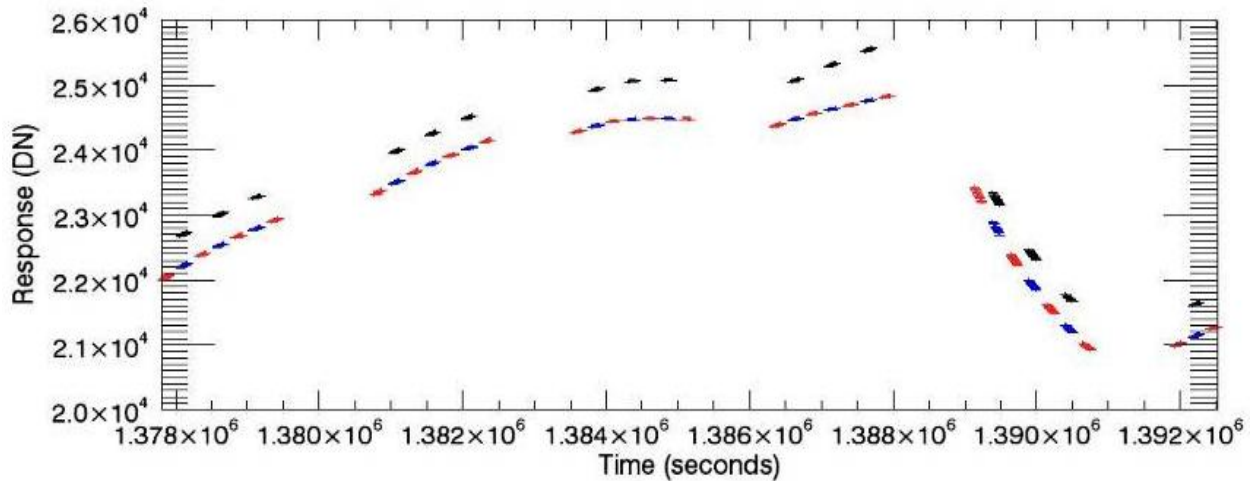


Figure 8: Band 4 Repeated Nominal FPA Temperature Response and Background (each frame)

The medium-term repeatability of response for the “nominal” FPA temperature data set was quantified using data from the Dark and Gain Variation Procedure at nominal FPA temperatures. In those data, a transient is observed in the array average response level for each of the files immediately following one of the interspersed background response measurements (see Table 2). Figure 9 shows the time history of the Band 4 background-subtracted array-average response for the nominal temperature data set. Time in the figure is in seconds since the beginning of MIC2 testing. The transient behavior is probably due to short-lived latents in Bands 3 and 4. The transient behavior is avoided by discarding the first file after each interspersed background response measurement.

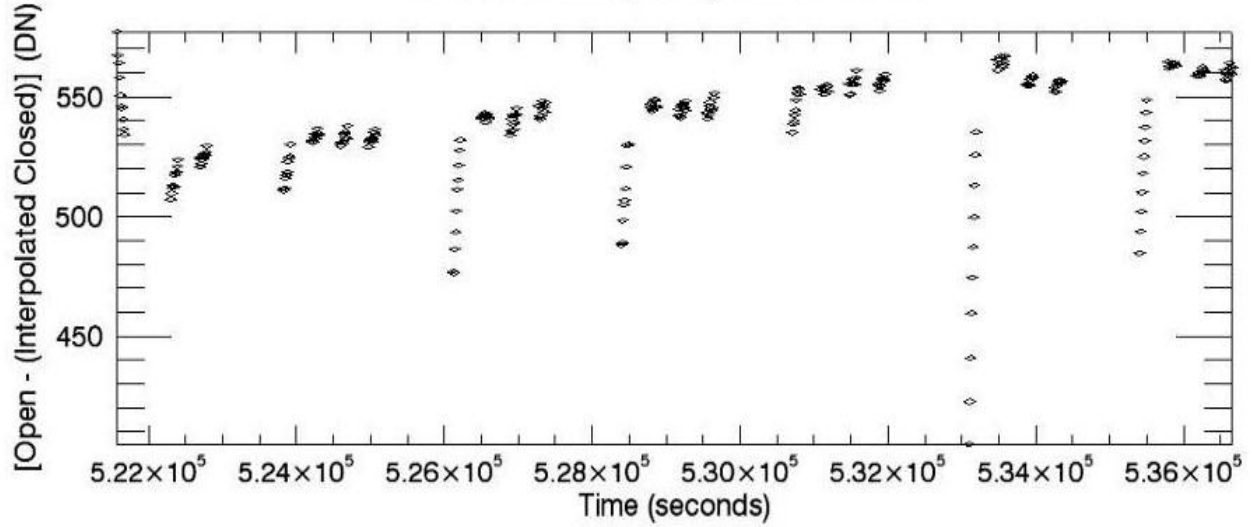


Figure 9: Band 4 Background-Subtracted, Array-Average Response for Nominal FPA Temperatures

2.1.2.1 Medium-Term Repeatability (Nominal FPA Temperatures)

Medium-term response repeatability is the repeatability for a period of about 90 minutes, or on the order of a single orbit. The medium-term repeatability was also measured as part of the Dark and Gain Variation procedure at nominal FPA temperatures.

The background-subtracted array mean response, $\mathfrak{R}_{arr}(m)$, for test m was specified in Equation 5, and the background-subtracted test-averaged (same as file-averaged) and array-averaged response, \mathfrak{R}_{arr} , was defined in Equation 6.

The medium-term repeatability, $\sigma_{mt,arr}$, is the standard deviation of the background-subtracted array mean response, $\mathfrak{R}_{arr}(m)$, over all tests m in the set of tests M

$$\sigma_{mt,arr} = \sqrt{\frac{1}{M-1} \sum_{m \in M} (\mathfrak{R}_{arr}(m) - \mathfrak{R}_{arr})^2} \quad (13)$$

Note that due to the significant variation of radiance observed in bands 3 and 4, the medium-term repeatability reported here is likely larger than the true flight repeatability.

Tables 5-8 below show a summary of $\mathfrak{R}_{arr}(m)$ versus time for all four focal plane arrays. Only nominal pixels are considered. The medium-term repeatability, $\sigma_{mt,arr}$, is

$$\sigma_{mt,arr,B1} = 17.64 \text{ DN}, \quad \sigma_{mt,arr,B2} = 14.26 \text{ DN}, \quad \sigma_{mt,arr,B3} = 36.59 \text{ DN}, \quad \sigma_{mt,arr,B4} = 9.79 \text{ DN}.$$

Table 5: Band 1 Response Statistics (Nominal FPA Temperature)

File	B1					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0005	13419.90	13471.80	13429	17.64	31.91	0.00
DRK0008	13419.70	13471.60		0.13%	31.91	0.01
DRK0011	13418.40	13470.80			31.90	0.01
DRK0018	13420.20	13471.10			31.91	0.01
DRK0021	13439.60	13490.70			31.90	0.01
DRK0024	13447.60	13498.80			31.90	0.01
DRK0031	13419.20	13470.00			31.90	0.01
DRK0034	13421.50	13472.40			31.90	0.01
DRK0037	13407.90	13458.90			31.90	0.01
DRK0044	13439.50	13491.50			31.91	0.01
DRK0047	13442.00	13494.20			31.90	0.01
DRK0050	13438.70	13490.90			31.90	0.01
DRK0057	13405.40	13454.20			31.89	0.01
DRK0060	13425.40	13474.50			31.90	0.01
DRK0063	13449.20	13498.50			31.90	0.01
DRK0070	13416.20	13468.70			31.91	0.01
DRK0073	13401.70	13454.20			31.90	0.01
DRK0076	13416.80	13469.50			31.90	0.01
DRK0083	13434.50	13484.70			31.90	0.01
DRK0086	13469.40	13519.70			31.90	0.01
DRK0089	13456.10	13506.40			31.90	0.01

Table 6: Band 2 Response Statistics (Nominal FPA Temperature)

File	B2					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0005	12671.90	12679.80	12683	14.26	31.89	0.01
DRK0008	12674.10	12682.10		0.11%	31.89	0.01
DRK0011	12681.00	12689.30			31.89	0.01
DRK0018	12683.80	12688.30			31.89	0.01
DRK0021	12693.10	12697.90			31.88	0.01
DRK0024	12700.20	12705.40			31.89	0.01
DRK0031	12679.60	12683.60			31.89	0.01
DRK0034	12682.20	12686.50			31.89	0.01
DRK0037	12674.10	12678.40			31.89	0.01
DRK0044	12687.20	12694.90			31.88	0.01
DRK0047	12688.00	12695.80			31.89	0.01
DRK0050	12690.00	12698.10			31.89	0.01
DRK0057	12671.10	12670.70			31.89	0.01
DRK0060	12681.80	12681.90			31.89	0.01
DRK0063	12701.10	12701.40			31.89	0.01
DRK0070	12663.00	12672.70			31.89	0.01
DRK0073	12656.40	12666.50			31.89	0.02
DRK0076	12667.50	12677.70			31.89	0.01
DRK0083	12684.50	12686.90			31.89	0.01
DRK0086	12714.90	12717.50			31.89	0.01
DRK0089	12704.10	12707.20			31.89	0.01

Table 7: Band 3 Response Statistics (Nominal FPA Temperature)

File	B3					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0005	9356.71	9315.34	9437	36.59	7.82	0.01
DRK0008	9372.56	9329.42		0.39%	7.83	0.00
DRK0011	9385.76	9341.88			7.85	0.00
DRK0018	9403.14	9358.50			7.83	0.00
DRK0021	9404.18	9359.15			7.82	0.01
DRK0024	9414.24	9369.00			7.83	0.02
DRK0031	9429.48	9383.89			7.87	0.01
DRK0034	9431.47	9385.87			7.88	0.01
DRK0037	9432.90	9387.06			7.87	0.01
DRK0044	9445.63	9399.55			7.86	0.01
DRK0047	9445.35	9399.16			7.86	0.01
DRK0050	9446.13	9399.67			7.87	0.01
DRK0057	9453.21	9405.96			7.88	0.01
DRK0060	9453.99	9406.91			7.87	0.01
DRK0063	9458.54	9411.32			7.86	0.00
DRK0070	9460.46	9414.20			7.88	0.01
DRK0073	9453.75	9407.15			7.88	0.01
DRK0076	9471.89	9424.83			7.89	0.00
DRK0083	9480.88	9432.35			7.88	0.00
DRK0086	9492.42	9444.11			7.88	0.01
DRK0089	9486.24	9437.75			7.87	0.01

Table 8: Band 4 Response Statistics (Nominal FPA Temperature)

File	B4					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0005	683.32	683.59	702	9.79	7.82	0.01
DRK0008	685.12	685.21		1.39%	7.83	0.01
DRK0011	689.62	689.75			7.85	0.01
DRK0018	695.14	695.36			7.83	0.00
DRK0021	693.93	694.16			7.82	0.01
DRK0024	695.21	695.33			7.83	0.01
DRK0031	711.30	711.56			7.88	0.01
DRK0034	698.68	698.69			7.89	0.01
DRK0037	698.78	698.95			7.89	0.01
DRK0044	710.83	711.26			7.86	0.01
DRK0047	701.15	701.38			7.87	0.01
DRK0050	701.61	701.80			7.88	0.01
DRK0057	713.47	713.78			7.90	0.01
DRK0060	702.18	702.46			7.88	0.01
DRK0063	701.41	701.69			7.87	0.00
DRK0070	720.70	721.16			7.89	0.01
DRK0073	702.82	703.15			7.90	0.01
DRK0076	702.05	702.29			7.91	0.00
DRK0083	718.04	718.44			7.90	0.00
DRK0086	707.60	707.79			7.89	0.01
DRK0089	705.77	705.95			7.89	0.01

2.2 RESPONSE AND REPEATABILITY FOR LOW FPA TEMPERATURES

2.2.1 Response for Low FPA Temperatures

For each WISE band, a histogram was generated to display the distribution of background-subtracted mean pixel response, \mathcal{R}_k , for all nominal pixels (as specified by the WISE bad pixel maps) for low FPA temperatures. Histograms for low FPA temperatures are shown in Figures 10-13. The array mean and median (for nominal pixels) is shown on each histogram. Note that the histograms were generated using all but the first file after each interspersed dark measurement (Table 2, column 2). This was done to avoid the transient behavior that was discussed in Section 2.1.2.

The file-average, array-average levels, \mathfrak{R}_{arr} , observed during the test were

$\mathfrak{R}_{arr,B1} = 13360 \text{ DN}$, $\mathfrak{R}_{arr,B2} = 12446 \text{ DN}$, $\mathfrak{R}_{arr,B3} = 9288 \text{ DN}$, $\mathfrak{R}_{arr,B4} = 676 \text{ DN}$.

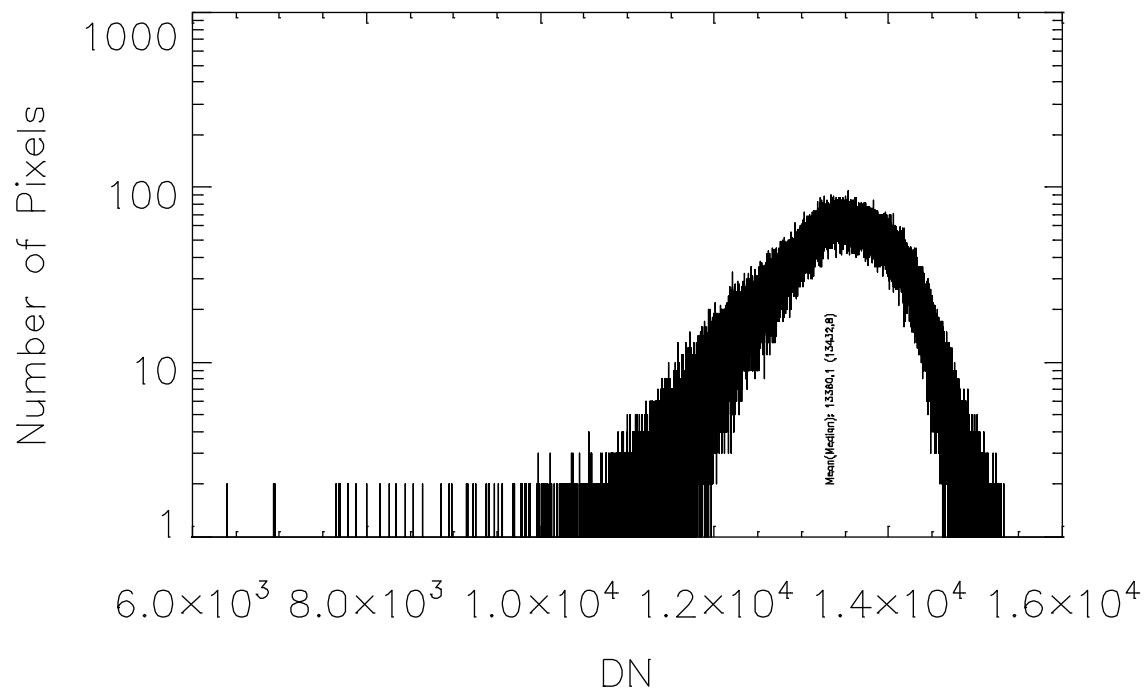


Figure 10: Band 1 Response Histogram for Low Temperature

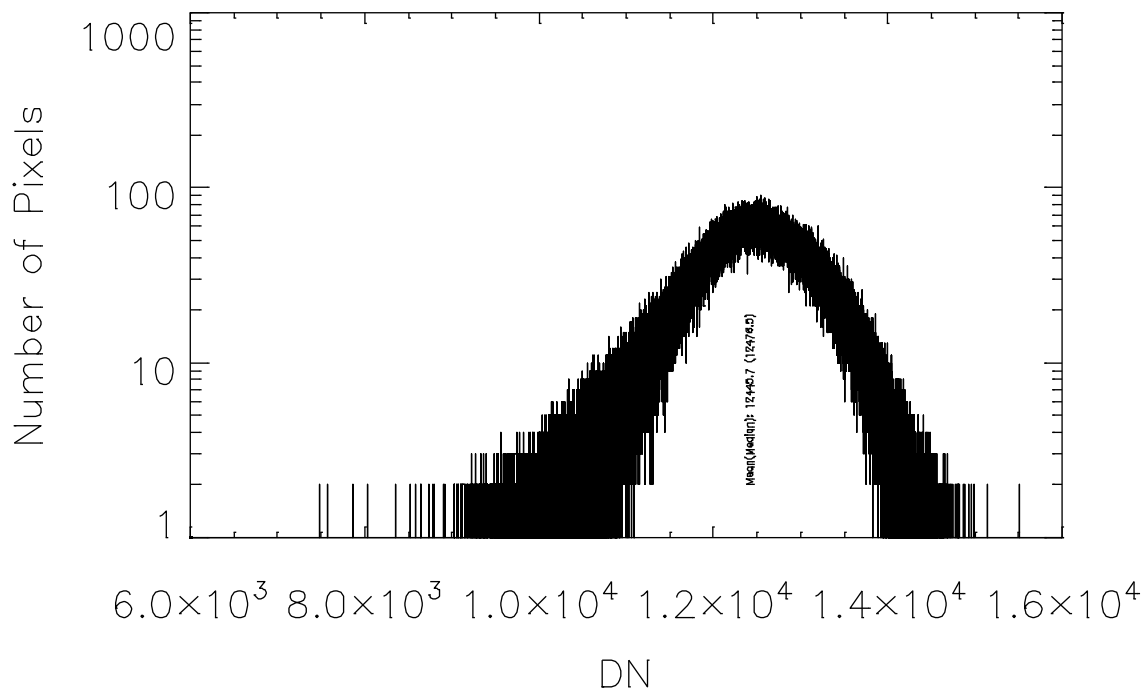


Figure 11: Band 2 Response Histogram for Low Temperature

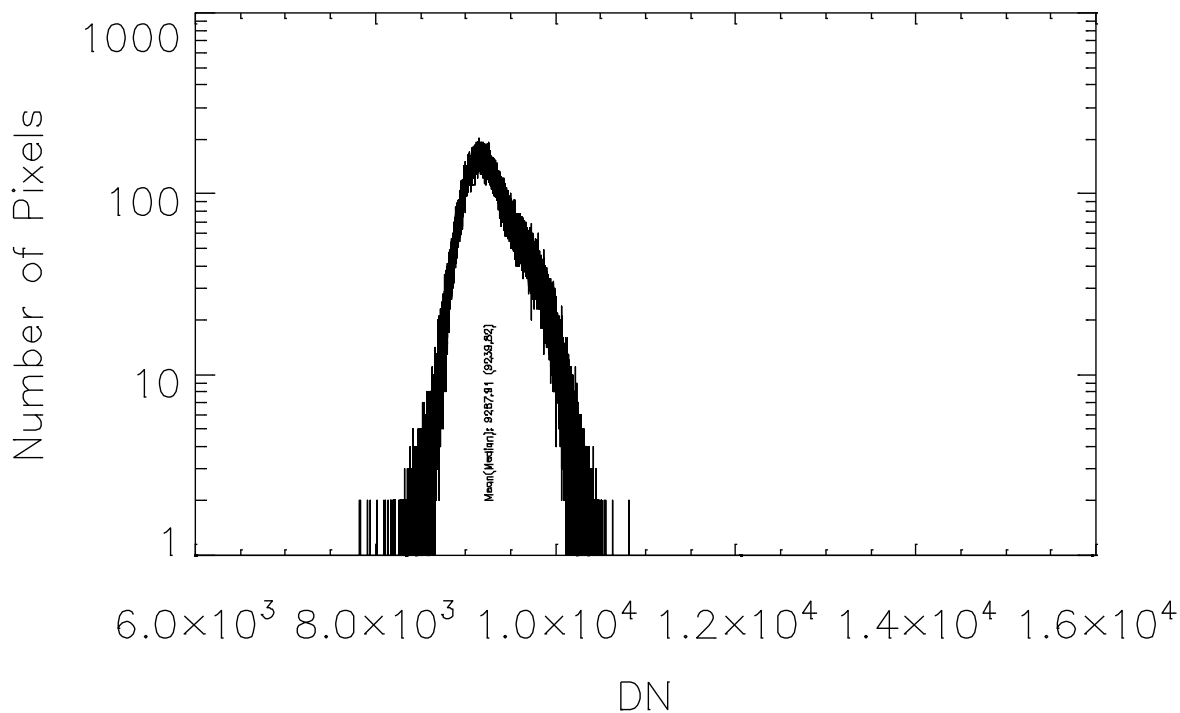


Figure 12: Band 3 Response Histogram for Low Temperature

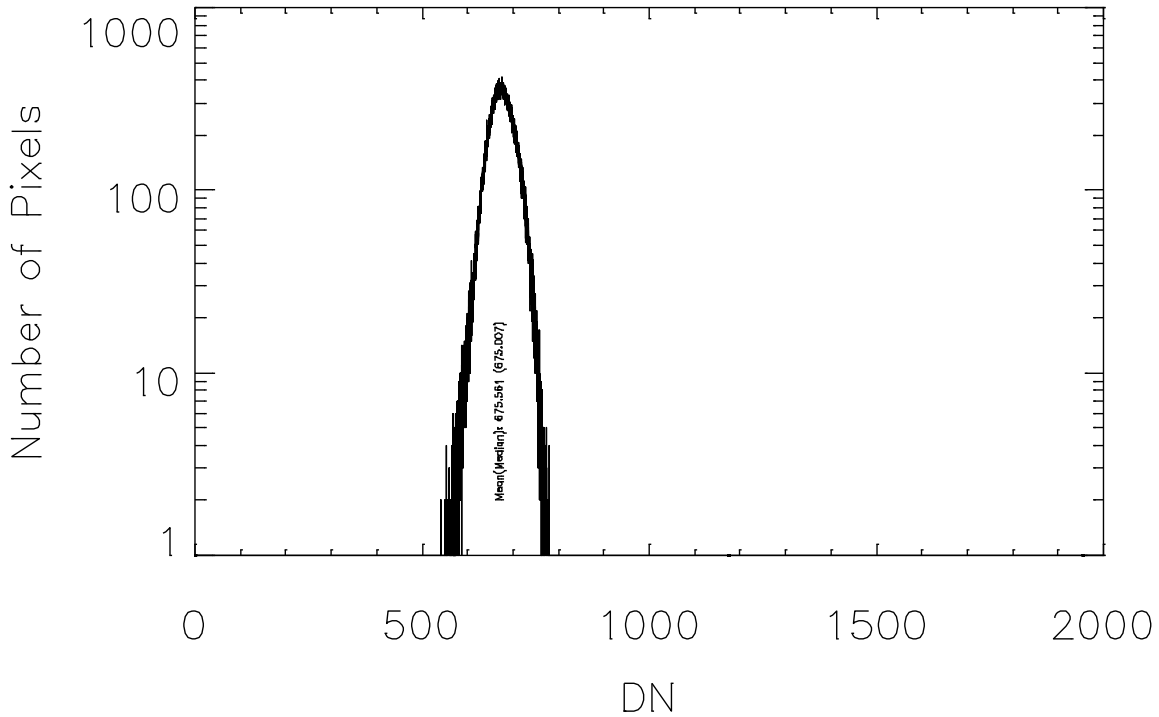


Figure 13: Band 4 Response Histogram for Low Temperature

2.2.2 Response Repeatability for Low FPA Temperatures

The medium-term repeatability of response for low FPA temperatures was quantified using data from the Dark and Gain Variation Procedure at low FPA temperatures. The first file following each interspersed background response measurement was excluded from the calculations in order to avoid transients.

2.2.2.1 Medium-Term Background Repeatability (Low FPA Temperatures)

Note that due to the significant variation of radiance observed in bands 3 and 4, the medium-term repeatability reported here is likely larger than the true flight repeatability.

Tables 9-12 below show a summary of $\eta_{arr}(m)$ versus time for all four focal plane arrays. Only nominal pixels are considered. The medium-term repeatability is:

$$\sigma_{mt,arr,B1} = 19.73 \text{ DN}, \sigma_{mt,arr,B2} = 14.91 \text{ DN}, \sigma_{mt,arr,B3} = 28.34 \text{ DN}, \sigma_{mt,arr,B4} = 5.35 \text{ DN}.$$

Table 9: Band 1 Response Statistics (Low FPA Temperature)

File	B1					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0097	13342.80	13414.90	13360	19.73	29.99	0.01
DRK0100	13332.10	13404.20		0.15%	29.98	0.01
DRK0103	13329.30	13401.70			29.99	0.01

DRK0110	13366.10	13438.30			29.99	0.01
DRK0113	13359.80	13432.10			29.99	0.01
DRK0116	13356.90	13429.10			29.99	0.01
DRK0123	13340.50	13413.10			29.99	0.01
DRK0126	13360.90	13433.70			29.98	0.01
DRK0129	13369.20	13442.10			29.98	0.01
DRK0136	13353.40	13426.20			29.98	0.01
DRK0139	13337.70	13410.30			29.99	0.01
DRK0142	13329.60	13402.50			29.99	0.01
DRK0149	13373.90	13446.60			29.98	0.01
DRK0152	13380.50	13453.50			29.99	0.01
DRK0155	13369.50	13442.50			29.98	0.01
DRK0162	13355.80	13428.20			29.99	0.01
DRK0165	13363.90	13436.60			29.98	0.01
DRK0168	13402.00	13475.10			29.98	0.02
DRK0175	13370.30	13442.90			29.99	0.01
DRK0178	13381.70	13454.30			29.99	0.01
DRK0181	13386.70	13459.20			29.98	0.01

Table 10: Band 2 Response Statistics (Low FPA Temperature)

File	B2					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0097	12431.90	12462.10	12446	14.91	29.97	0.01
DRK0100	12424.80	12455.10		0.12%	29.97	0.01
DRK0103	12423.00	12453.30			29.97	0.01
DRK0110	12443.20	12473.30			29.97	0.01
DRK0113	12438.70	12469.10			29.98	0.02
DRK0116	12438.00	12468.40			29.97	0.01
DRK0123	12433.30	12463.90			29.97	0.01
DRK0126	12442.40	12473.20			29.98	0.01
DRK0129	12450.60	12481.80			29.97	0.01
DRK0136	12442.20	12472.90			29.97	0.01
DRK0139	12432.30	12463.50			29.97	0.01
DRK0142	12428.60	12459.90			29.96	0.01
DRK0149	12456.60	12487.40			29.97	0.02
DRK0152	12458.00	12489.00			29.97	0.01
DRK0155	12449.30	12480.50			29.98	0.01
DRK0162	12447.30	12477.60			29.97	0.01
DRK0165	12451.30	12482.00			29.97	0.01
DRK0168	12481.90	12513.00			29.97	0.01
DRK0175	12453.90	12484.30			29.97	0.01
DRK0178	12463.10	12493.80			29.97	0.01
DRK0181	12468.50	12499.30			29.98	0.01

Table 11: Band 3 Response Statistics (Low FPA Temperature)

File	B3					
	$\mathfrak{R}_{arr}(m)$		\mathfrak{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0097	9248.11	9206.19	9288	28.34	6.85	0.01
DRK0100	9246.25	9203.57		0.31%	6.85	0.01
DRK0103	9254.01	9211.15			6.84	0.01
DRK0110	9269.15	9225.24			6.85	0.01
DRK0113	9269.08	9224.71			6.86	0.01
DRK0116	9272.68	9227.98			6.87	0.01
DRK0123	9280.82	9234.73			6.88	0.01
DRK0126	9277.05	9230.56			6.87	0.01
DRK0129	9281.29	9234.73			6.87	0.01
DRK0136	9292.23	9244.83			6.92	0.02
DRK0139	9291.67	9243.72			6.93	0.03
DRK0142	9290.38	9242.20			6.92	0.03
DRK0149	9299.73	9250.82			6.91	0.03
DRK0152	9303.62	9254.14			6.92	0.03
DRK0155	9299.97	9250.27			6.92	0.03
DRK0162	9291.29	9240.99			6.83	0.01
DRK0165	9288.44	9237.77			6.85	0.01
DRK0168	9304.29	9253.13			6.86	0.01
DRK0175	9383.95	9330.91			7.12	0.04
DRK0178	9304.63	9253.08			6.88	0.01
DRK0181	9297.40	9245.58			6.83	0.00

Table 12 Band 4 Response Statistics (Low FPA Temperature)

File	B4					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0097	690.89	691.04	676	5.35	6.90	0.01
DRK0100	678.69	678.25		0.79%	6.90	0.01
DRK0103	674.71	674.37			6.90	0.01
DRK0110	679.52	679.56			6.90	0.01
DRK0113	673.27	673.01			6.91	0.01
DRK0116	674.46	674.16			6.93	0.01
DRK0123	678.57	678.48			6.94	0.01
DRK0126	672.01	671.57			6.94	0.01
DRK0129	671.30	670.86			6.93	0.01
DRK0136	675.94	675.82			6.99	0.02
DRK0139	672.56	672.10			7.00	0.03
DRK0142	671.53	671.09			7.00	0.03
DRK0149	679.24	679.06			6.98	0.03
DRK0152	673.48	672.92			6.99	0.03
DRK0155	670.45	669.88			7.00	0.03
DRK0162	680.80	680.73			6.89	0.01
DRK0165	672.52	672.09			6.91	0.01
DRK0168	672.19	671.72			6.92	0.01
DRK0175	684.74	684.65			6.92	0.01
DRK0178	670.56	670.08			6.87	0.01
DRK0181	669.37	668.70			6.86	0.00

2.3 RESPONSE AND REPEATABILITY FOR HIGH FPA TEMPERATURES

2.3.1 Response for High FPA Temperatures

For each WISE band, a histogram was generated to display the distribution of background-subtracted mean pixel response, \mathcal{R}_k , for all nominal pixels (as specified by the WISE bad pixel maps) for high FPA temperatures. Histograms for high FPA temperatures are shown in Figures 14-17. The array mean and median (for nominal pixels) is shown on each histogram. Note that the histograms were generated using all but the first file after each interspersed dark measurement (Table 2, column 2). This was done to avoid the transient behavior that was discussed in Section 2.1.2.

The file-average, array-average levels, \mathfrak{R}_{arr} , observed during the test were

$\mathfrak{R}_{arr,B1} = 13579$ DN, $\mathfrak{R}_{arr,B2} = 12938$ DN, $\mathfrak{R}_{arr,B3} = 9494$ DN, $\mathfrak{R}_{arr,B4} = 707$ DN.

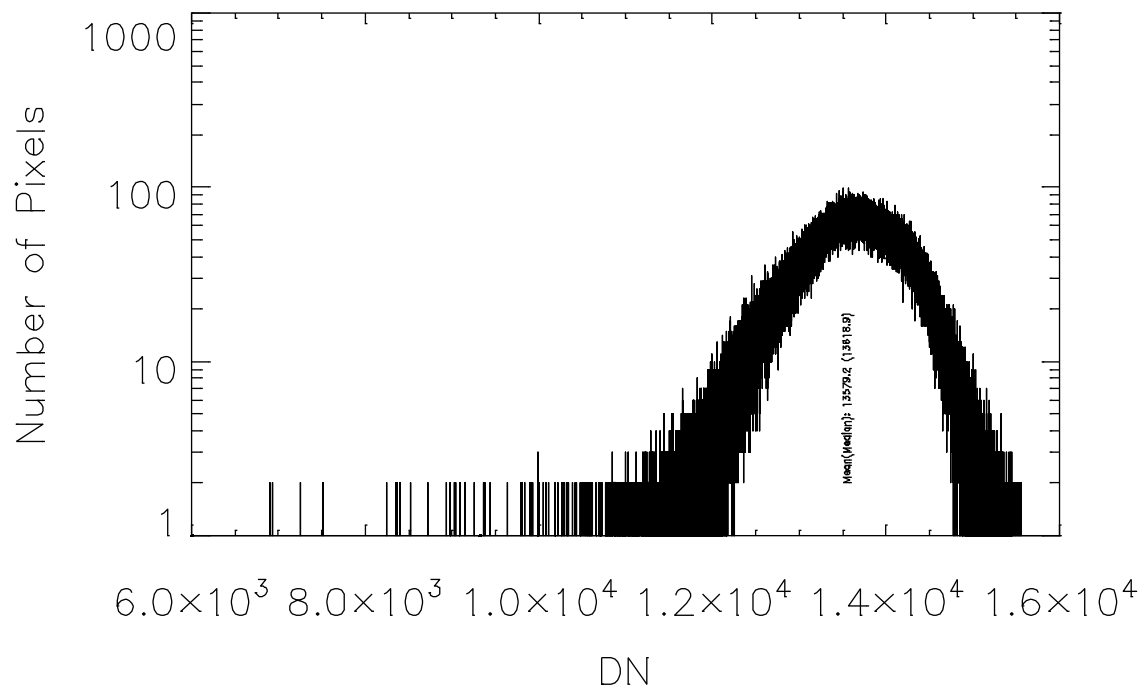


Figure 14: Band 1 Response Histogram for High Temperature

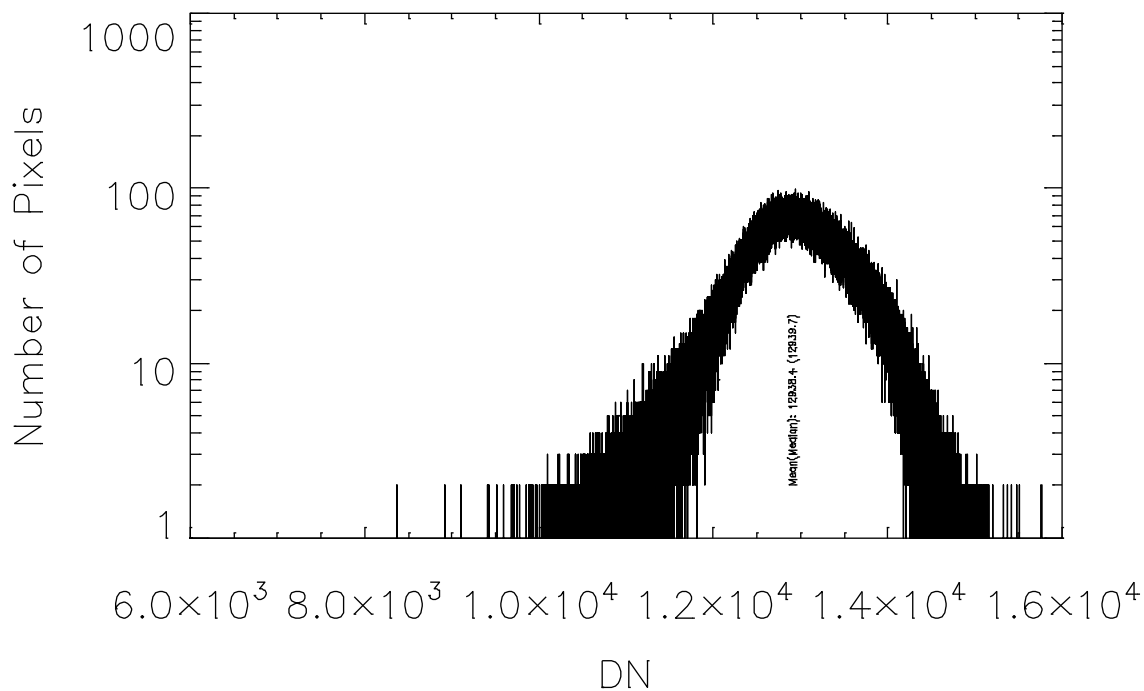


Figure 15: Band 2 Response Histogram for High Temperature

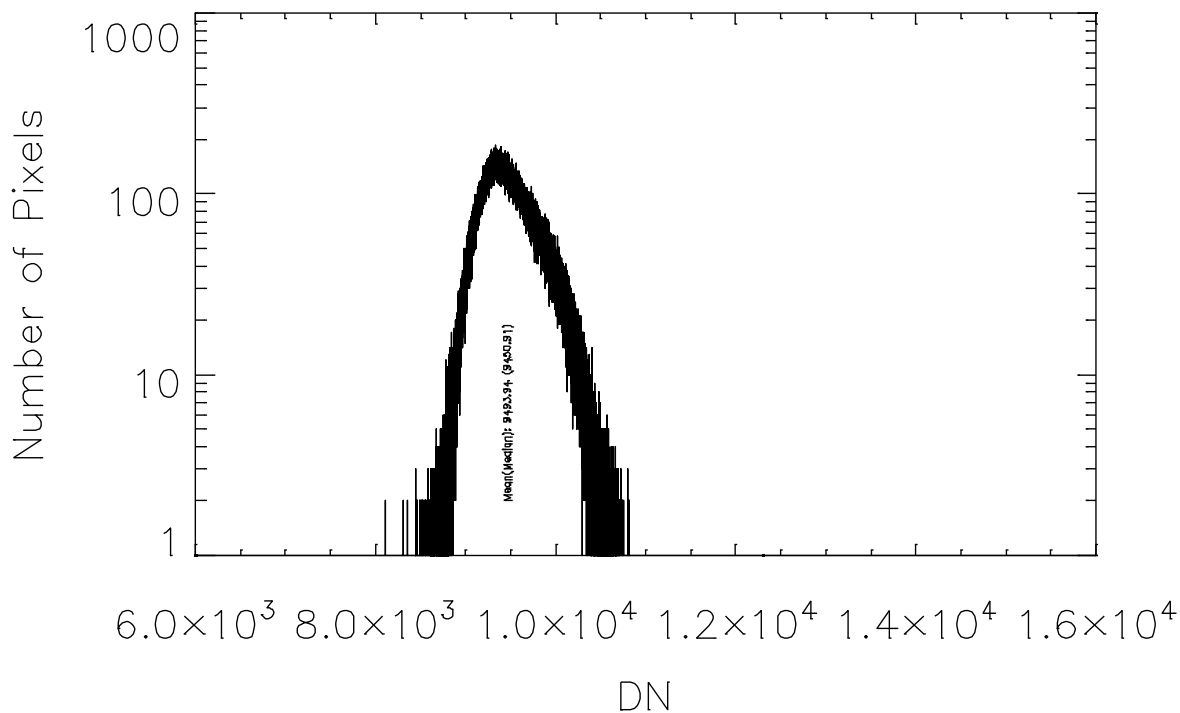


Figure 16: Band 3 Response Histogram for High Temperature

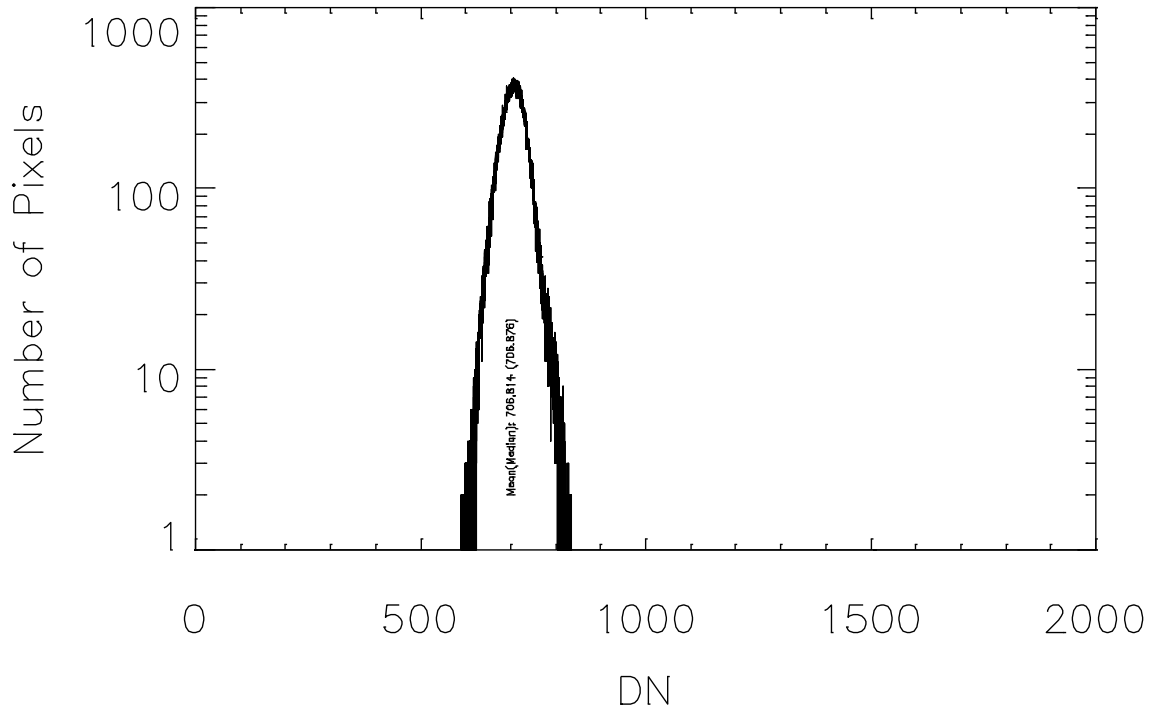


Figure 17: Band 4 Response Histogram for High Temperature

2.3.2 Response Repeatability for High FPA Temperatures

The medium-term repeatability of response for high FPA temperatures was quantified using data from the Dark and Gain Variation Procedure at high FPA temperatures. The first file following each interspersed background response measurement was excluded from the calculations in order to avoid transients.

2.3.2.1 Medium-Term Background Repeatability (High FPA Temperatures)

Note that due to the significant variation of radiance observed in bands 3 and 4, the medium-term repeatability reported here is likely larger than the true flight repeatability.

Tables 13-16 below show a summary of $\eta_{arr}(m)$ versus time for all four focal plane arrays. Only nominal pixels are considered. The medium-term repeatability is:

$$\sigma_{mt,arr,B1} = 21.71 \text{ DN}, \quad \sigma_{mt,arr,B2} = 30.79 \text{ DN}, \quad \sigma_{mt,arr,B3} = 91.06 \text{ DN}, \quad \sigma_{mt,arr,B4} = 6.29 \text{ DN}.$$

Table 13: Band 1 Response Statistics (High FPA Temperature)

File	B1					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0189	13558.80	13599.40	13579	21.71	33.97	0.01
DRK0192	13537.00	13577.40		0.16%	33.97	0.02
DRK0195	13562.70	13603.30			33.97	0.02
DRK0202	13589.90	13629.90			33.97	0.01
DRK0205	13566.90	13606.90			33.97	0.02
DRK0208	13567.10	13607.30			33.98	0.01
DRK0215	13579.30	13617.30			33.98	0.02
DRK0218	13612.30	13650.00			33.97	0.01
DRK0221	13578.80	13616.50			33.97	0.01
DRK0228	13567.30	13607.20			33.97	0.01
DRK0231	13556.30	13596.50			33.97	0.01
DRK0234	13603.00	13643.60			33.97	0.01
DRK0241	13573.20	13613.00			33.97	0.01
DRK0244	13605.60	13645.50			33.97	0.01
DRK0247	13568.30	13608.10			33.98	0.02
DRK0254	13571.40	13611.30			33.98	0.01
DRK0257	13577.90	13617.90			33.97	0.01
DRK0260	13617.90	13658.10			33.98	0.01
DRK0267	13572.80	13612.90			33.98	0.01
DRK0270	13575.60	13615.90			33.97	0.01
DRK0273	13621.00	13661.20			33.97	0.02

Table 14: Band 2 Response Statistics (High FPA Temperature)

File	B2					
	$\mathfrak{R}_{arr}(m)$		\mathfrak{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0189	13043.40	13044.40	12938	30.79	33.96	0.01
DRK0192	12891.50	12894.70		0.24%	33.96	0.01
DRK0195	12913.70	12917.40			33.96	0.01
DRK0202	12931.70	12933.30			33.95	0.01
DRK0205	12909.90	12911.70			33.95	0.01
DRK0208	12919.00	12921.20			33.96	0.01
DRK0215	12938.90	12935.00			33.96	0.01
DRK0218	12961.90	12958.30			33.96	0.01
DRK0221	12931.90	12928.80			33.96	0.01
DRK0228	12927.30	12929.80			33.95	0.01
DRK0231	12914.60	12917.60			33.95	0.02
DRK0234	12950.90	12954.20			33.96	0.01
DRK0241	12929.70	12930.60			33.96	0.01
DRK0244	12960.30	12961.70			33.96	0.01
DRK0247	12922.40	12924.30			33.96	0.01
DRK0254	12930.00	12932.00			33.95	0.01
DRK0257	12931.10	12933.40			33.96	0.01
DRK0260	12966.50	12969.00			33.96	0.02
DRK0267	12933.80	12936.40			33.96	0.01
DRK0270	12934.20	12936.90			33.96	0.01
DRK0273	12964.70	12967.80			33.96	0.02

Table 15: Band 3 Response Statistics (High FPA Temperature)

File	B3					
	$\mathfrak{R}_{arr}(m)$		\mathfrak{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0189	9304.54	9265.34	9494	91.06	8.84	0.02
DRK0192	9324.50	9285.01		0.96%	8.84	0.01
DRK0195	9356.23	9316.58			8.84	0.02
DRK0202	9407.50	9367.13			8.85	0.03
DRK0205	9418.38	9377.98			8.86	0.03
DRK0208	9432.36	9391.56			8.87	0.04
DRK0215	9463.35	9421.46			8.83	0.01
DRK0218	9485.80	9443.70			8.83	0.01
DRK0221	9483.92	9441.45			8.84	0.01
DRK0228	9499.98	9457.89			8.84	0.01
DRK0231	9501.73	9459.42			8.84	0.01
DRK0234	9527.16	9484.55			8.84	0.01
DRK0241	9536.71	9492.77			8.84	0.02
DRK0244	9554.81	9510.53			8.84	0.01
DRK0247	9546.24	9501.89			8.84	0.01
DRK0254	9568.32	9523.52			8.84	0.01
DRK0257	9571.10	9526.20			8.84	0.01
DRK0260	9590.91	9545.67			8.83	0.01
DRK0267	9592.24	9546.37			8.84	0.01
DRK0270	9594.25	9548.14			8.84	0.01
DRK0273	9612.82	9566.68			8.83	0.01

Table 16: Band 4 Response Statistics (High FPA Temperature)

File	B4					
	$\mathfrak{R}_{arr}(m)$		\mathfrak{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0189	703.21	702.94	707	6.29	8.73	0.02
DRK0192	700.26	699.99		0.89%	8.73	0.02
DRK0195	696.75	696.55			8.73	0.02
DRK0202	702.46	702.32			8.75	0.03
DRK0205	705.35	705.17			8.75	0.03
DRK0208	703.35	703.23			8.77	0.04
DRK0215	708.90	708.65			8.72	0.01
DRK0218	706.46	706.34			8.72	0.01
DRK0221	703.38	703.22			8.72	0.01
DRK0228	701.61	701.40			8.72	0.01
DRK0231	700.32	700.06			8.72	0.01
DRK0234	701.83	701.62			8.73	0.02
DRK0241	719.79	719.62			8.73	0.02
DRK0244	712.19	712.00			8.72	0.03
DRK0247	707.54	707.40			8.73	0.01
DRK0254	720.37	720.36			8.72	0.01
DRK0257	710.58	710.43			8.72	0.01
DRK0260	707.62	707.39			8.72	0.01
DRK0267	716.40	716.32			8.72	0.01
DRK0270	708.45	708.25			8.72	0.01
DRK0273	706.27	706.10			8.72	0.01

2.4 RESPONSE AND REPEATABILITY FOR NOMINAL FPA TEMPERATURES (REPEATED)

2.4.1 Response for Nominal FPA Temperatures (Repeated)

As discussed in the system engineering report on dark offset and background repeatability (SDL/09-092), it was observed early on in the MIC2 testing that read noise was higher than that expected based on earlier tests at DRS and SDL. The background response measurements acquired immediately after fixes were made showed improved read noise performance. Scatter source response measurements were also repeated at that time. *Likely due to the long-term variations in scatter source configuration radiance, the response was higher during this repeated data set than for the earlier nominal-, low-, and high-temperature FPA measurement*

already reported. The Band 4 array became partially saturated during several of the measurements.

For each WISE band, a histogram was generated to display the distribution of background-subtracted mean pixel response, \mathfrak{R}_k , for all nominal pixels (as specified by the WISE bad pixel maps) for nominal FPA temperatures. Response histograms for nominal FPA temperatures are shown in Figures 18-21. The array mean and median (for nominal pixels) is shown on each histogram. Note that the histograms were generated using all but the first file after each interspersed dark measurement (Table 2, column 2). This was done to avoid the transient behavior that was discussed in Section 2.1.2.

The file-average, array-average levels, \mathfrak{R}_{arr} , observed during the test were

$$\mathfrak{R}_{arr,B1} = 13833 \text{ DN}, \quad \mathfrak{R}_{arr,B2} = 13000 \text{ DN}, \quad \mathfrak{R}_{arr,B3} = 9614 \text{ DN}, \quad \mathfrak{R}_{arr,B4} = 785 \text{ DN}.$$

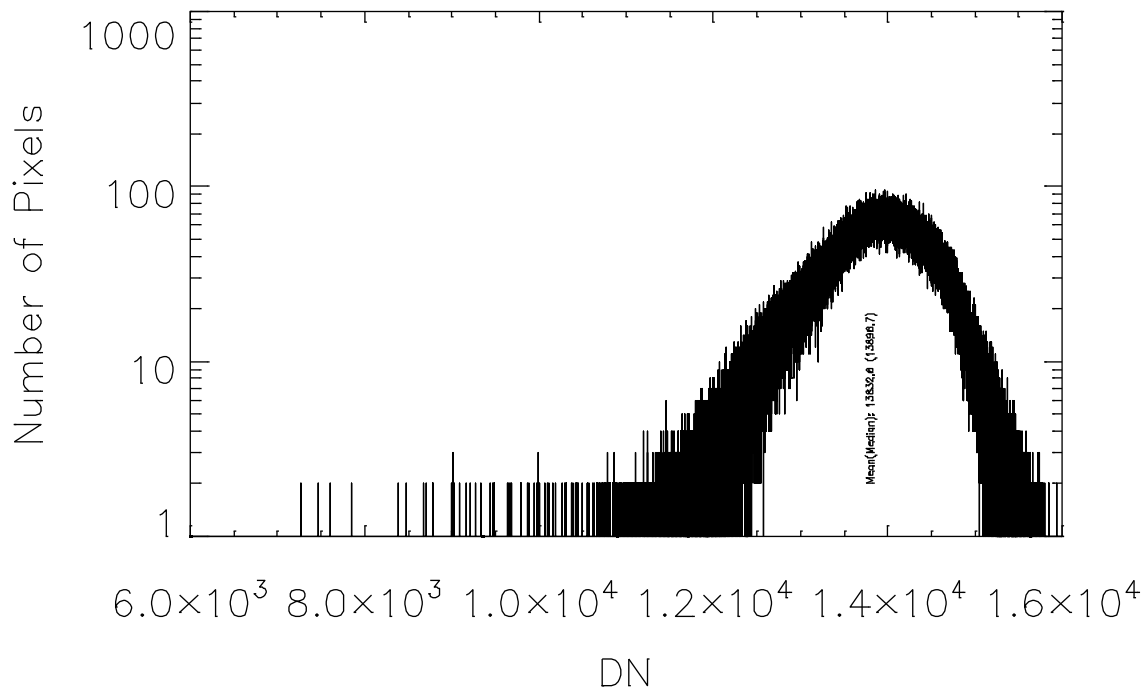


Figure 18: Band 1 Response Histogram for Nominal Temperature (Repeated)

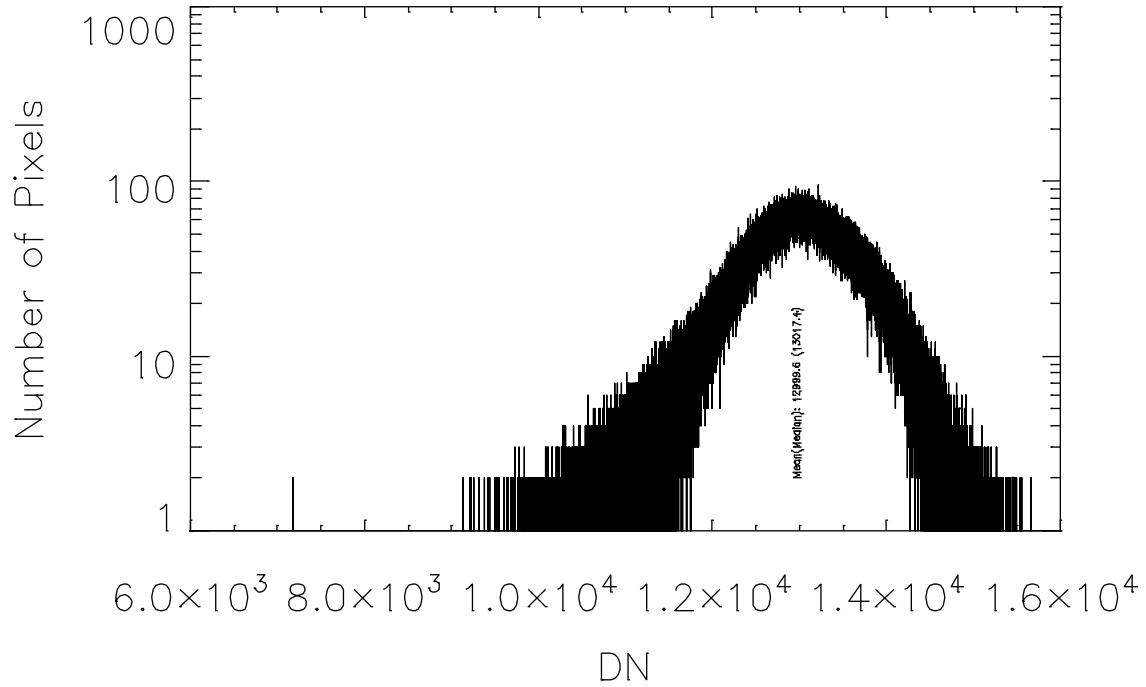


Figure 19: Band 2 Response Histogram for Nominal Temperature (Repeated)

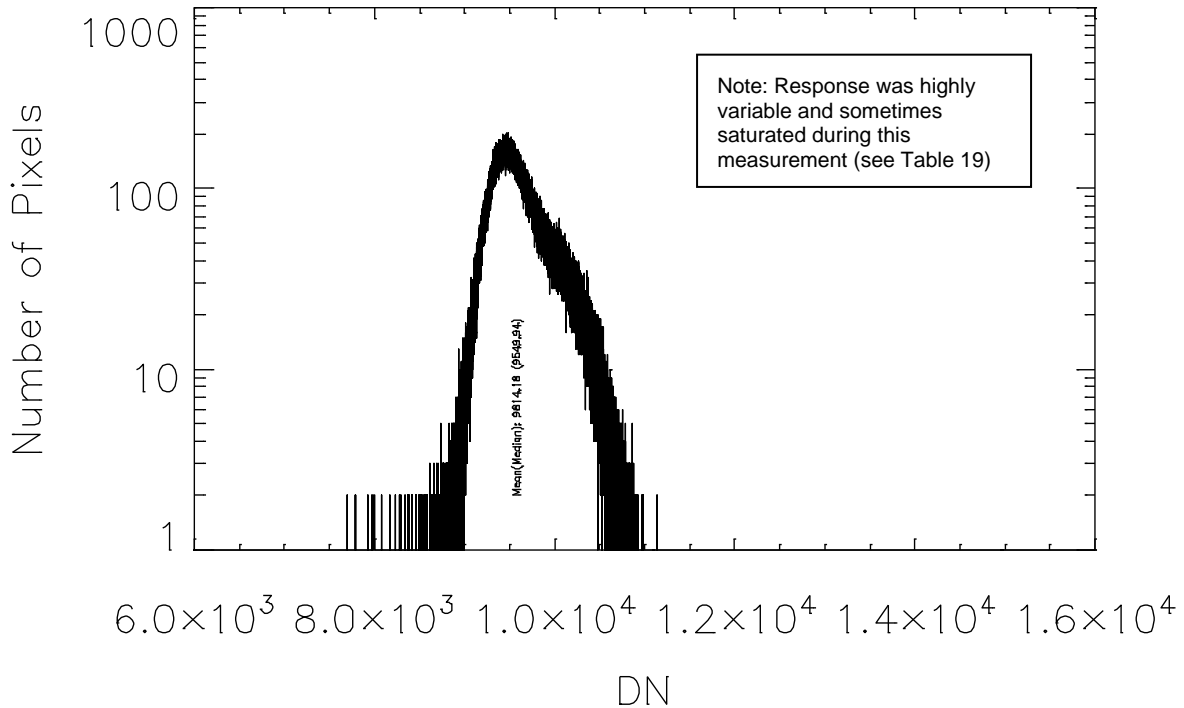


Figure 20: Band 3 Response Histogram for Nominal Temperature (Repeated)

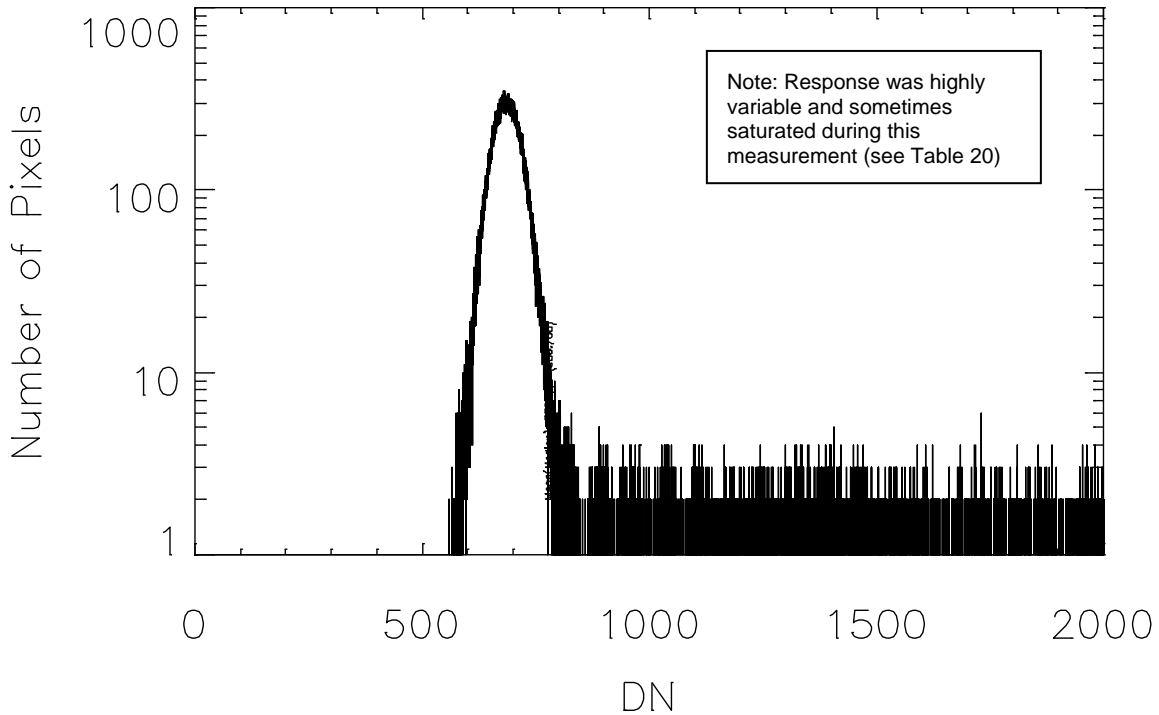


Figure 21: Band 4 Response Histogram for Nominal Temperature (Repeated)

2.4.2 Response Repeatability for Nominal FPA Temperatures (Repeated)

The medium-term repeatability of response for nominal FPA temperatures was quantified using data from the Dark and Gain Variation Procedure at nominal FPA temperatures. The first file following each interspersed background response measurement was excluded from the calculations in order to avoid transients.

2.4.2.1 Medium-Term Background Repeatability (Nominal FPA Temperatures, Repeated)

Note that due to the significant variation of radiance observed in bands 3 and 4, the medium-term repeatability reported here is likely larger than the true flight-like repeatability. Also, the Band 4 array was partially saturated during several of the measurements.

Tables 17-20 below show a summary of $\eta_{arr}(m)$ versus time for all four focal plane arrays. Only nominal pixels are considered. The medium-term repeatability is as follows:

$$\sigma_{mt,arr,B1} = 31.07 \text{ DN}, \quad \sigma_{mt,arr,B2} = 25.18 \text{ DN}, \quad \sigma_{mt,arr,B3} = 37.16 \text{ DN}, \quad \sigma_{mt,arr,B4} = 159.76 \text{ DN}.$$

Table 17: Band 1 Response Statistics (Repeated Nominal FPA Temperature)

File	B1					
	$\mathfrak{R}_{arr}(m)$		\mathfrak{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0287	13750.30	13813.30	13833	31.07	31.90	0.02
DRK0291	13798.70	13862.40		0.22%	31.90	0.01
DRK0295	13817.30	13881.50			31.90	0.01
DRK0304	13827.30	13891.30			31.89	0.01
DRK0308	13843.20	13907.50			31.90	0.01
DRK0312	13844.50	13908.90			31.90	0.01
DRK0321	13804.80	13868.00			31.90	0.01
DRK0325	13832.40	13896.30			31.90	0.01
DRK0329	13845.10	13909.10			31.90	0.01
DRK0338	13845.70	13909.70			31.90	0.01
DRK0342	13869.10	13933.50			31.90	0.01
DRK0346	13882.70	13947.40			31.90	0.01
DRK0355	13832.00	13895.80			31.90	0.02
DRK0359	13825.80	13889.70			31.91	0.01
DRK0363	13837.40	13901.50			31.90	0.01
DRK0372	13864.70	13929.00			31.89	0.01

Table 18: Band 2 Response Statistics (Repeated Nominal FPA Temperature)

File	B2					
	$\mathfrak{R}_{arr}(m)$		\mathfrak{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0287	12933.90	12950.10	13000	25.18	31.87	0.01
DRK0291	12974.40	12991.40		0.19%	31.88	0.01
DRK0295	12989.60	13007.50			31.88	0.01
DRK0304	12993.40	13011.60			31.88	0.01
DRK0308	13007.10	13025.50			31.88	0.01
DRK0312	13004.80	13023.70			31.88	0.01
DRK0321	12971.40	12988.40			31.89	0.01
DRK0325	13001.70	13019.40			31.88	0.01
DRK0329	13011.80	13029.70			31.88	0.02
DRK0338	13010.30	13028.60			31.88	0.01
DRK0342	13028.50	13047.30			31.87	0.01
DRK0346	13040.40	13059.30			31.88	0.01
DRK0355	13000.10	13017.20			31.88	0.01
DRK0359	12993.80	13011.60			31.88	0.01
DRK0363	13007.00	13024.90			31.88	0.01
DRK0372	13025.80	13043.70			31.88	0.02

Table 19: Band 3 Response Statistics (Repeated Nominal FPA Temperature)

File	B3					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0287	9566.18	9509.72	9614	37.16	7.77	0.01
DRK0291	9584.91	9527.22		0.39%	7.77	0.01
DRK0295	9595.27	9536.35			7.77	0.02
DRK0304	9594.08	9531.77			7.77	0.01
DRK0308	9597.10	9534.22	Note: Noise was highly variable and the array was partially saturated during this measurement.		7.77	0.01
DRK0312	9595.87	9531.70			7.76	0.01
DRK0321	9597.95	9532.72			7.76	0.00
DRK0325	9606.39	9541.03			7.76	0.00
DRK0329	9609.46	9543.81			7.76	0.00
DRK0338	9611.56	9544.58			7.75	0.00
DRK0342	9618.69	9551.71			7.75	0.00
DRK0346	9625.86	9558.67			7.75	0.00
DRK0355	9590.55	9526.08			7.75	0.00
DRK0359	9641.29	9578.76			7.75	0.00
DRK0363	9673.09	9612.28			7.75	0.00
DRK0372	9718.55	9657.15			7.75	0.00

Table 20: Band 4 Response Statistics (Repeated Nominal FPA Temperature)

File	B4					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0287	702.56	702.60	785	159.76	7.74	0.01
DRK0291	688.45	688.32		20.35%	7.73	0.01
DRK0295	687.40	686.85			7.74	0.02
DRK0304	698.20	697.44	Note: Noise was highly variable and the array was partially saturated during this measurement		7.74	0.01
DRK0308	688.45	685.73			7.73	0.01
DRK0312	700.80	683.39			7.73	0.01
DRK0321	849.03	715.39			7.72	0.00
DRK0325	891.70	695.30			7.72	0.01
DRK0329	893.16	685.81			7.72	0.00
DRK0338	904.56	706.09			7.72	0.00
DRK0342	1036.49	699.08			7.72	0.00
DRK0346	1187.63	703.79			7.71	0.00
DRK0355	629.18	626.08			7.71	0.00
DRK0359	649.61	647.57			7.71	0.00
DRK0363	655.43	653.90			7.71	0.00
DRK0372	701.19	700.83			7.71	0.00

2.5 RESPONSE AND REPEATABILITY FOR EM ELECTRONICS AND NOMINAL FPA TEMPERATURES

2.5.1 Response for EM Electronics and Nominal FPA Temperatures

The Dark and Gain Variation procedure was repeated using EM electronics. These data can be compared with data that will be acquired during the second MIC2 test following payload environmental testing.

For each WISE band, a histogram was generated to display the distribution of background-subtracted mean pixel response, \mathcal{R}_k , for all nominal pixels (as specified by the WISE bad pixel maps) for nominal FPA temperatures. Response histograms for nominal FPA temperatures are shown in Figures 22-25. The array mean and median (for nominal pixels) is shown on each histogram. Note that the histograms were generated using all but the first file after each interspersed dark measurement (Table 2, column 2). This was done to avoid the transient behavior that was discussed in Section 2.1.2.

The file-average, array-average levels, \mathfrak{R}_{arr} , observed during the test were

$\mathfrak{R}_{arr,B1} = 13156 \text{ DN}$, $\mathfrak{R}_{arr,B2} = 12368 \text{ DN}$, $\mathfrak{R}_{arr,B3} = 9111 \text{ DN}$, $\mathfrak{R}_{arr,B4} = 692 \text{ DN}$.

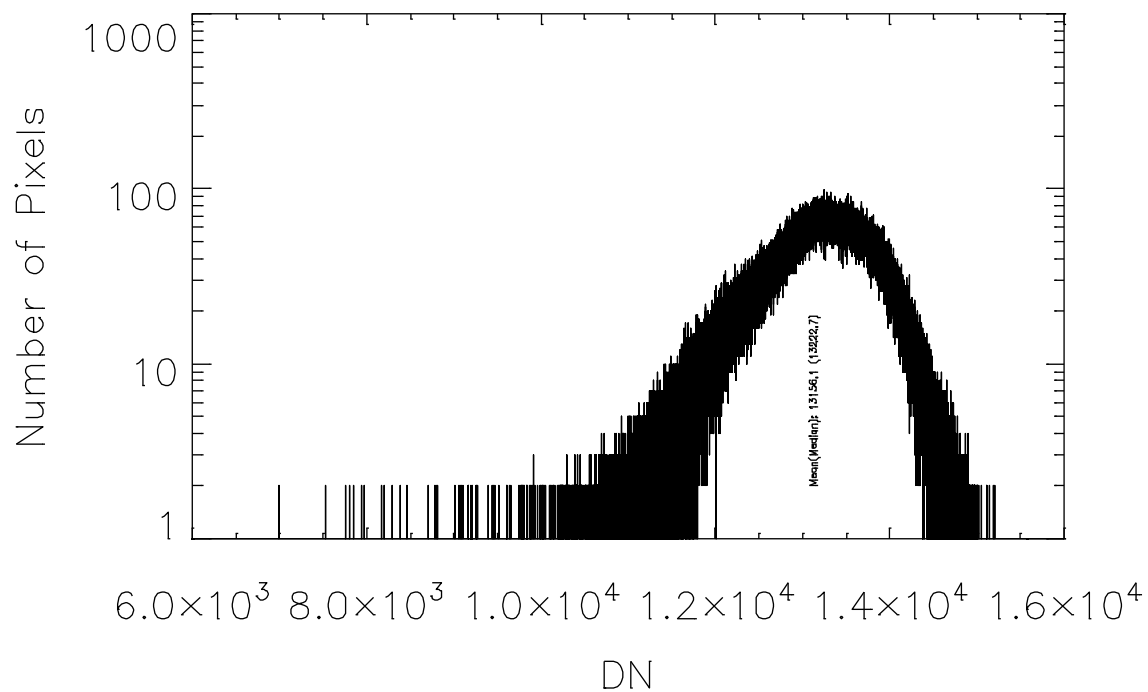


Figure 22: Band 1 Response Histogram (EM Electronics, Nominal FPA Temperature)

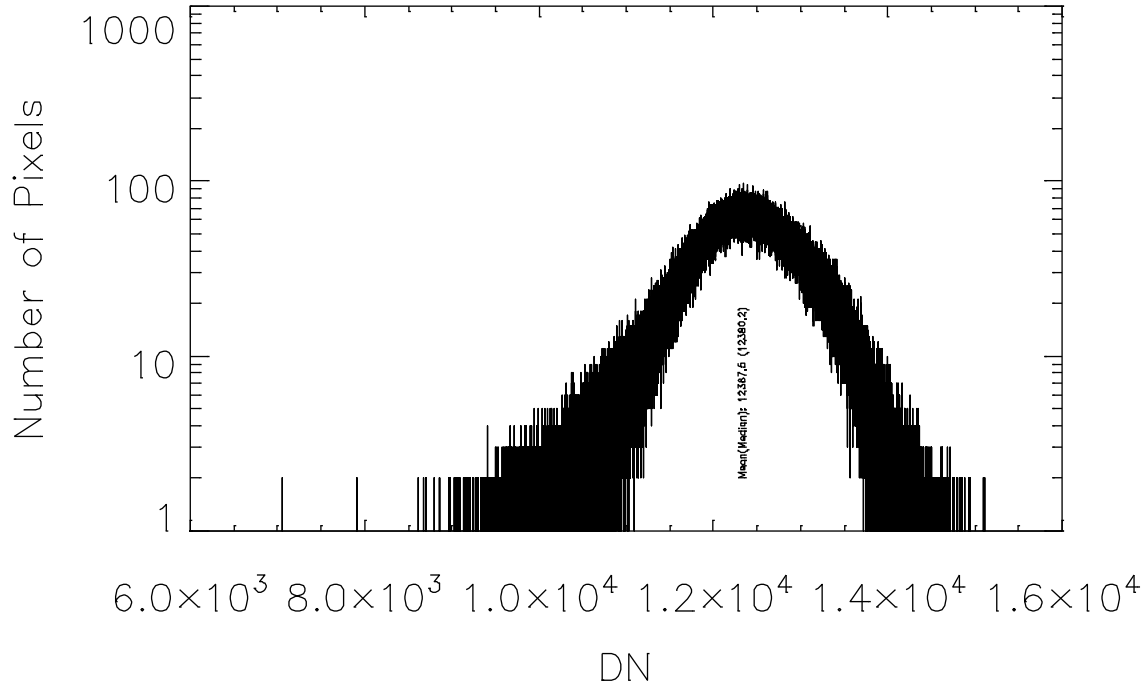


Figure 23: Band 2 Response Histogram (EM Electronics, Nominal FPA Temperature)

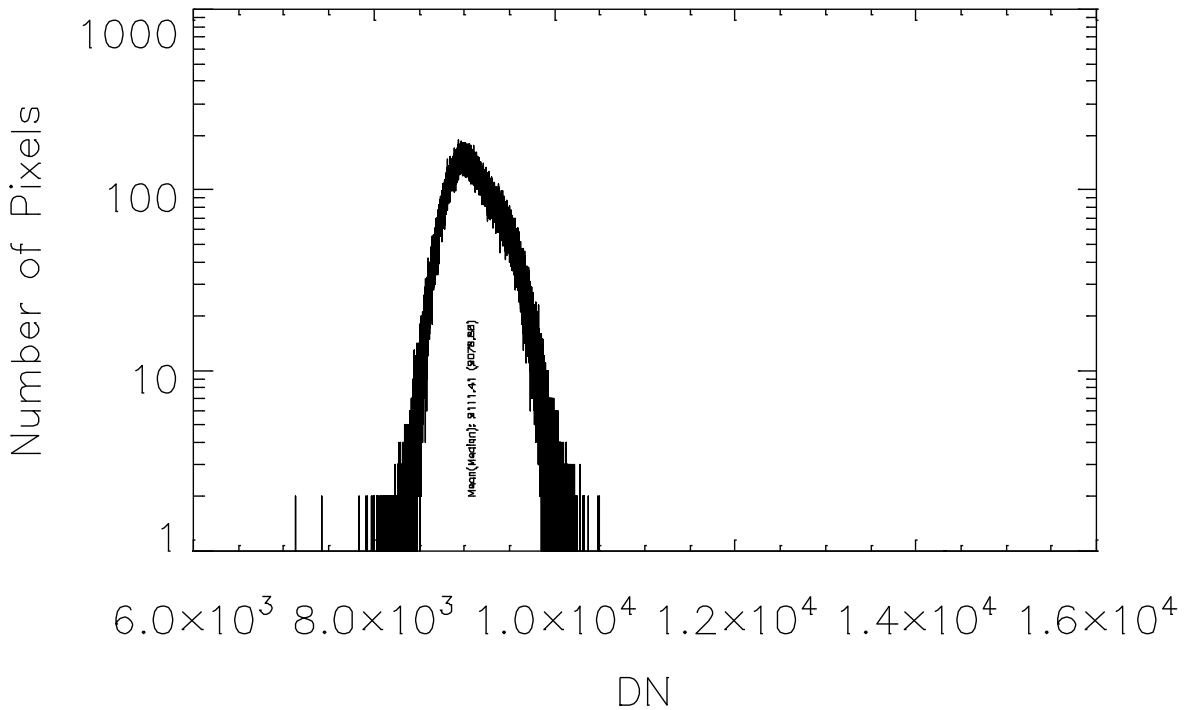


Figure 24: Band 3 Response Histogram (EM Electronics, Nominal FPA Temperature)

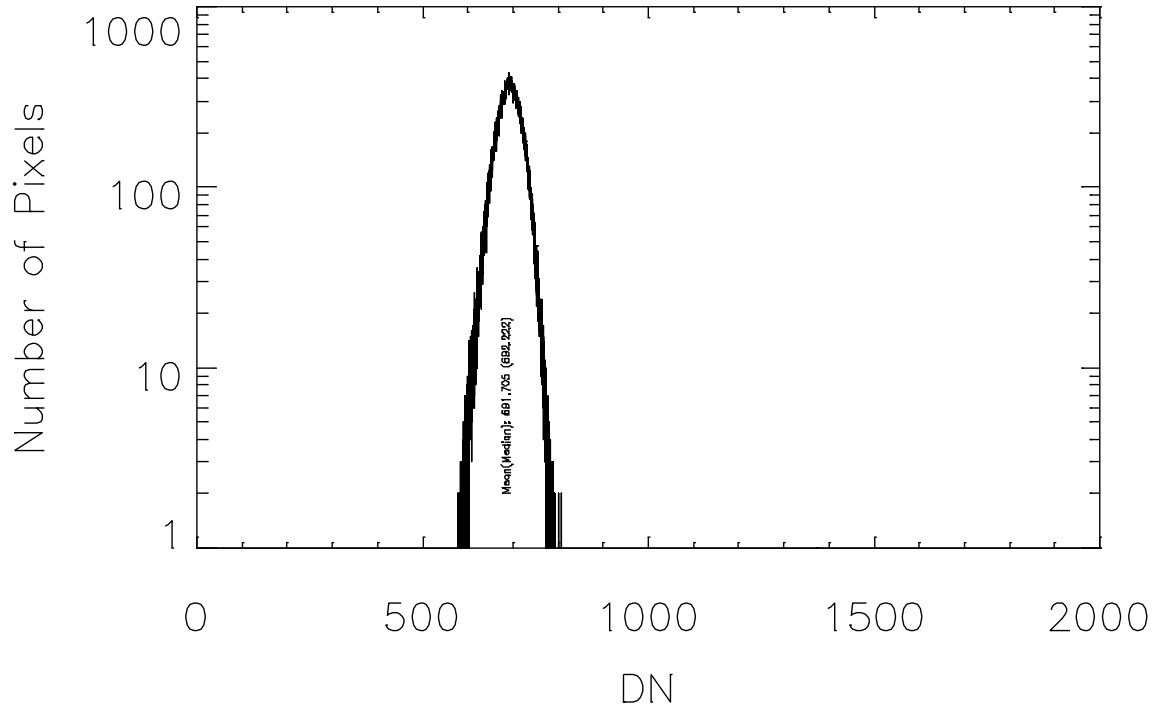


Figure 25: Band 4 Response Histogram (EM Electronics, Nominal FPA Temperature)

2.5.2 Response Repeatability for EM Electronics and Nominal FPA Temperatures

The medium-term repeatability of response using EM electronics and for nominal FPA temperatures was quantified using data from the Dark and Gain Variation Procedure at nominal FPA temperatures. The first file following each interspersed background response measurement was excluded from the calculations in order to avoid transients.

2.5.2.1 Medium-Term Repeatability (EM Electronics and Nominal FPA Temperatures)

Note that due to the significant variation of radiance observed in bands 3 and 4, the medium-term repeatability reported here is likely larger than the true flight-like repeatability.

Tables 21-24 below show a summary of $\eta_{arr}(m)$ versus time for all four focal plane arrays. Only nominal pixels are considered. The medium-term repeatability is:

$$\sigma_{mt,arr,B1} = 17.21 \text{ DN}, \quad \sigma_{mt,arr,B2} = 14.88 \text{ DN}, \quad \sigma_{mt,arr,B3} = 165.70 \text{ DN}, \quad \sigma_{mt,arr,B4} = 11.84 \text{ DN}.$$

Table 21: Band 1 Response Statistics (EM Electronics, Nominal FPA Temperature)

File	B1					
	$\mathfrak{R}_{arr}(m)$		\mathfrak{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0383	13107.90	13173.80	13156	17.21	32.14	0.01
DRK0387	13137.60	13203.80		0.13%	32.14	0.01
DRK0396	13151.20	13217.90			32.15	0.01
DRK0400	13157.00	13224.00			32.15	0.01
DRK0409	13151.50	13217.90			32.15	0.01
DRK0413	13179.10	13246.00			32.16	0.01
DRK0422	13165.60	13232.40			32.16	0.01
DRK0426	13164.70	13231.20			32.16	0.01
DRK0435	13155.30	13222.00			32.16	0.01
DRK0439	13154.50	13221.50			32.16	0.01
DRK0448	13159.10	13225.10			32.16	0.01
DRK0452	13172.70	13239.00			32.16	0.01
DRK0461	13163.70	13230.70			32.17	0.01
DRK0465	13166.10	13233.00			32.16	0.01

Table 22: Band 2 Response Statistics (EM Electronics, Nominal FPA Temperature)

File	B2					
	$\mathfrak{R}_{arr}(m)$		\mathfrak{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0383	12325.70	12336.70	12368	14.88	32.14	0.01
DRK0387	12352.00	12364.10		0.12%	32.14	0.01
DRK0396	12360.50	12374.10			32.14	0.02
DRK0400	12364.20	12378.30			32.13	0.01
DRK0409	12364.80	12377.20			32.14	0.01
DRK0413	12385.60	12398.60			32.14	0.01
DRK0422	12375.40	12388.10			32.14	0.01
DRK0426	12373.60	12386.60			32.13	0.01
DRK0435	12367.80	12381.40			32.14	0.01
DRK0439	12370.00	12383.90			32.13	0.01
DRK0448	12372.10	12383.30			32.14	0.01
DRK0452	12382.40	12394.30			32.14	0.01
DRK0461	12373.30	12386.40			32.13	0.02
DRK0465	12378.20	12391.80			32.13	0.01

Table 23: Band 3 Response Statistics (EM Electronics, Nominal FPA Temperature)

File	B3					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0383	8697.84	8671.42	9111	165.70	7.83	0.00
DRK0387	8849.05	8819.84		1.82%	7.83	0.00
DRK0396	8999.33	8969.19			7.84	0.01
DRK0400	9042.77	9012.21			7.84	0.01
DRK0409	9103.27	9072.38			7.83	0.00
DRK0413	9127.29	9096.02			7.83	0.00
DRK0422	9165.77	9132.70			7.83	0.00
DRK0426	9171.65	9138.31			7.83	0.00
DRK0435	9200.04	9166.45			7.84	0.00
DRK0439	9210.37	9176.48			7.83	0.00
DRK0448	9235.37	9200.89			7.87	0.01
DRK0452	9239.93	9205.30			7.82	0.00
DRK0461	9251.92	9217.23			7.83	0.00
DRK0465	9265.09	9230.29			7.82	0.00

Table 24: Band 4 Response Statistics (EM Electronics, Nominal FPA Temperature)

File	B4					
	$\mathcal{R}_{arr}(m)$		\mathcal{R}_{arr}		Temperature	
	Mean	Med	μ	σ	Mean	Std
DRK0383	703.92	703.81	692	11.84	7.78	0.00
DRK0387	678.59	678.92		1.71%	7.78	0.00
DRK0396	681.54	682.15			7.78	0.01
DRK0400	676.76	677.23			7.78	0.01
DRK0409	704.74	705.22			7.78	0.00
DRK0413	682.33	682.76			7.77	0.00
DRK0422	707.78	708.40			7.77	0.01
DRK0426	684.61	685.09			7.77	0.00
DRK0435	706.94	707.52			7.78	0.00
DRK0439	689.08	689.55			7.78	0.00
DRK0448	703.88	704.44			7.81	0.01
DRK0452	680.88	681.28			7.76	0.00
DRK0461	698.57	699.05			7.77	0.00
DRK0465	684.25	684.68			7.76	0.00

2.6 POST-ENVIRONMENTAL RESPONSE AND REPEATABILITY FOR EM ELECTRONICS AND PREDICTED ON-ORBIT FPA TEMPERATURES

2.6.1 Post-Environmental Response for EM Electronics and Predicted On-Orbit FPA Temperatures

Due to the scatter source variability discussed in previous sections of this report, the band 3 and band 4 medium-term repeatability was re-measured post-environmental using the MIC2 extended source instead of the scatter source. Approximately 90 minute stares were acquired, during which time the extended source temperature was very stable (see as-run log).

For WISE bands 3 and 4, a histogram was generated to display the distribution of background-subtracted mean pixel response, \mathfrak{R}_k , for all nominal pixels (as specified by the WISE *pre-environmental* bad pixel maps) for the predicted on-orbit FPA operating temperatures. Response histograms are shown in Figures 26 and 27. The array mean and median (for nominal pixels) is shown on each histogram.

The file-average, array-average levels, \mathfrak{R}_{arr} , observed during the test were

$$\mathfrak{R}_{arr,B3} = 26685 \text{ DN}, \quad \mathfrak{R}_{arr,B4} = 24829 \text{ DN}.$$

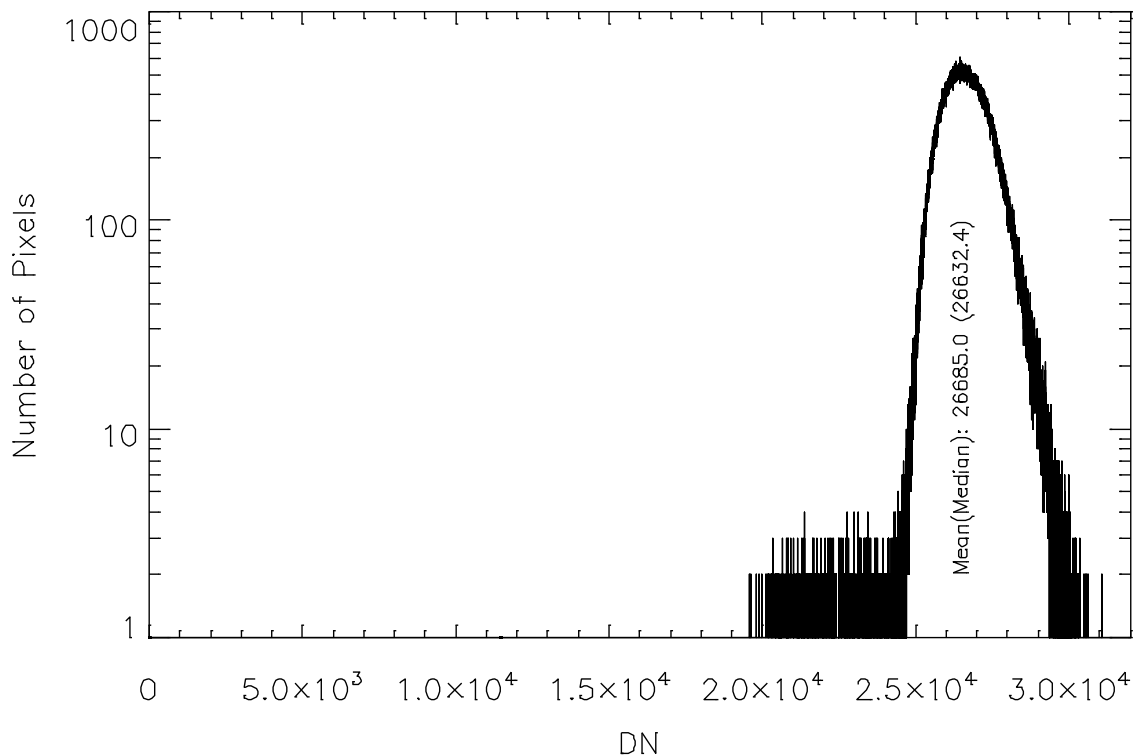


Figure 26: Post-Environmental Band 3 Response Histogram (EM Electronics, On-Orbit FPA Temperature)

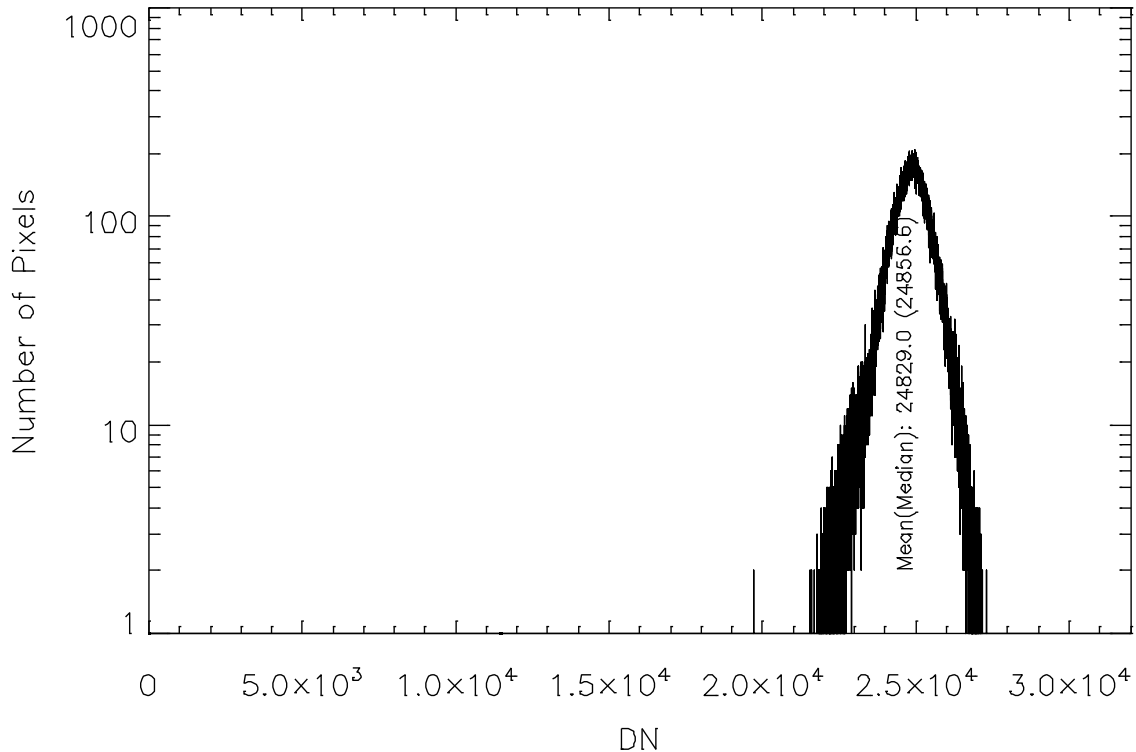


Figure 27: Post-Environmental Band 4 Response Histogram (EM Electronics, On-Orbit FPA Temperature)

2.6.2 Post-Environmental Medium-Term Response Repeatability for EM Electronics and Predicted On-Orbit FPA Temperatures

The post-environmental band 3 and band 4 medium-term repeatability of response using EM electronics and for the predicted on-orbit FPA temperatures was measured using 90 minute extended source stares.

Note that the MIC2 scatter source radiance was much more stable than the scatter source radiance measured pre-environmental, and therefore the medium-term repeatability reported here is much better than that reported in previous sections.

Tables 25 and 26 below show a summary of $\eta_{arr}(m)$ versus time for all four focal plane arrays. Only nominal pixels are considered. The medium-term repeatability is:

$$\sigma_{mt,arr,B3} = 21.87 \text{ DN}, \quad \sigma_{mt,arr,B4} = 2.98 \text{ DN}.$$

Table 25: Band 3 Response Statistics (Post-Environmental Extended Source Stare, EM Electronics, Predicted On-Orbit FPA Temperature)

File	B3							
	Noise		Average		Noise		Average	
	Mean	Med	Mean	Med	μ	σ	μ	σ
RSP0061_b3.deb	67.05	66.89	26658.50	26609.80	67.143	0.231	26685.050	21.871
RSP0062_b3.deb	67.49	67.26	26677.60	26625.60		0.34%		0.08%
RSP0063_b3.deb	67.01	66.83	26695.10	26640.80				
RSP0064_b3.deb	67.02	66.86	26709.00	26652.60				

Table 26: Band 4 Response Statistics (Post-Environmental Extended Source Stare, EM Electronics, Predicted On-Orbit FPA Temperature)

File	B4							
	Noise		Average		Noise		Average	
	Mean	Med	Mean	Med	μ	σ	μ	σ
RSP0054_b4.deb	36.79	36.71	24824.90	24853.10	36.098	0.645	24828.975	2.981
RSP0055_b4.deb	36.50	36.41	24828.60	24856.20		1.79%		0.01%
RSP0056_b4.deb	35.53	35.47	24831.30	24858.70				
RSP0057_b4.deb	35.57	35.51	24831.10	24857.90				

3. CHANGE RECORD

Rev	Date	Description	Changed By
–	3/9/2009	Original Release	–
A	3/18/2009	Changes throughout to account for nonlinearity correction.	JCardon
B	3/23/2009	Added proprietary markings	JDrake
C	5/11/2009	Throughout—removed references to short-term repeatability, including deleting sections 2.1.2.1, 2.2.2.1, 2.3.2.1, 2.4.2.1, and 2.5.2.1. 2.1.2—Changed first paragraph to read “The medium-term response...Dark and Gain Variation Procedure.” Added to third paragraph: sentence beginning “Therefore, the band 3 and 4...”	