5.1.3 SENSOR BLEMISHES

5.1.3.1 NAC FM SENSOR BLEMISHES CALIBRATION RESULTS

As reported in Reference 5.1.3.1-1

Reference 5.1.3.1-1 - IOM 388-PAG-CCA98-2, "NAC FM Calibration Results: Sensor Blemishes - Revision 1", Charlie Avis, January 20, 1998, Revision Summary: Corrected last sentence of 'Introduction'

Reference 5.1.3.1-2 - C. Avis, "Software Design Document for Instrument Calibration - Cassini ISS", Version 2.1, 10 July 1995

Reference 5.1.3.1-3 - C. Avis, "NAC FM Calibration Results: Linearity", IOM 388-PAG-CCA97-7, 24 September 1997

5.1.3.1.1 INTRODUCTION

The Narrow-angle Flight Model thermal/vacuum testing included the acquisition of a set of flat-field images for determination the system gain. These data were also applicable for assessing the response of each pixel over the full dynamic range of the instrument. Reference 5.1.3.1-3 reported upon the global and regional variations in linearity for the various camera modes. This report deals with the linearity of each pixel and documents those which show non-linear behavior.

Sequences of increasing exposures were taken at temperatures of +25° C. Gain 0 and 1 were taken in 4x4 and 2x2 mode respectively and Gain 2 and 3 in 1x1 mode. All data were taken with Antiblooming 'OFF' except that Gain 2 was also taken with Antiblooming 'ON'. (Data were taken at +5° C, but with a different set of Main Electronics).

Multiple input files submitted to the blemish analysis were combined at each exposure level to suppress data errors and improve the signal-to-noise ratio.

All data were taken with PC_Voltage=9. This commandable parameter, however, has no direct effect on the full-well level of the sensor (at least in the value range between 4 and 10).

5.1.3.1.2 METHOD

Sensor blemishes are defined in this analysis as pixels having a light transfer function with nonlinearities greater than specified thresholds.

The characteristics of the light transfer curve of each pixel are analyzed through the use of a set of radiometric files. These are generated by fitting the data from a light transfer sequence to a linear model for each pixel. Given that

$$e = r(t - t_0)$$

where e is the 'energy' received by a pixel

r	is the scene radiance
t	is the commanded exposure time
t_0	is the shutter offset

Then, the linear model is defined as

$$d = ce + d_0$$

where d is the recorded DN
c is the radiometric slope
d_0 is the dark-current

The following radiometric files are created containing values for each pixel:

1. The slopes $z = 1/c$ are output to the radiometric slope file CAL (REAL*4 data).
2. The d_0 are output to the dark-current file DC as $128 \times d_0$ (16-bit integer).
3. The highest tested DN value (d_{fw}) before the pixel's response drops below a specified threshold is stored in the saturation file SAT (16-bit integer). Pixels which show no drop are given a value of 32767.
4. The maximum absolute difference (in DN) between the input data samples and the fitted curve

$$\varepsilon_{max} = max\{|ce_i + d_0 - d_i|\}$$

   is stored in the error file ERR (16-bit integer).
5. The RMS error (in DN) for the fit

$$\varepsilon_{rms} = \sqrt{\frac{1}{m}\sum_{i=1}^{m}\left(ce_i + d_0 - d_i\right)^2}$$

   is stored in the RMS file (16-bit integer).

The CAL, ERR, RMS, and DC files are used to identify and classify camera blemishes. The user specifies the valid range of d_0, ε_{rms}, $\varepsilon_{\max}$, and z :

1. $MINDC < d_0 < MAXDC$
2. $\varepsilon_{rms} > MAXRMS$
3. $\varepsilon_{max} > MAXERR$
4. $MINSLOPE < z < MAXSLOPE$

The criteria are checked in the order: 1 - 4. A pixel is not checked further after failing a given check. The blemishes are recorded in a Blemish File used by subsequent programs to remove blemishes.

The Blemish File is in 16-bit integer format, and defines blemishes by using vectors of the form ($line, samp, CLASS, d_{fw}$), where *line* and *samp* are the picture coordinates where the blemish occurs, d_{fw} is the DN value at which the pixel saturates at full-well, and *CLASS* classifies each blemish by which neighbors are available for interpolation to remove the blemish (see Reference 5.1.3.1-2). The format of the Blemish File was not designed to handle hundreds of thousands of low-full-well pixels. This prohibited them from being classified and stored in the Blemish File, so only the permanent blemishes are stored there, i.e., $d_{fw} = 0$ in all cases.

5.1.3.1.3 RESULTS: NON-LINEARITIES

The valid ranges used for the blemish tests were set as follows:

1. Slope: Any slope > 0 allowed
2. Dark-current: Any dark-current > 0 allowed
3. $\varepsilon_{\max}$ and ε_{rms}: Limits based upon the histogram of the values, but $\varepsilon_{\max}$ no larger than 40 (1% of 4095)

The distribution of the histogram of the $\varepsilon_{\max}$ and ε_{rms} clearly showed the difference between the values for normal pixels and the values for the various blemish pixels.

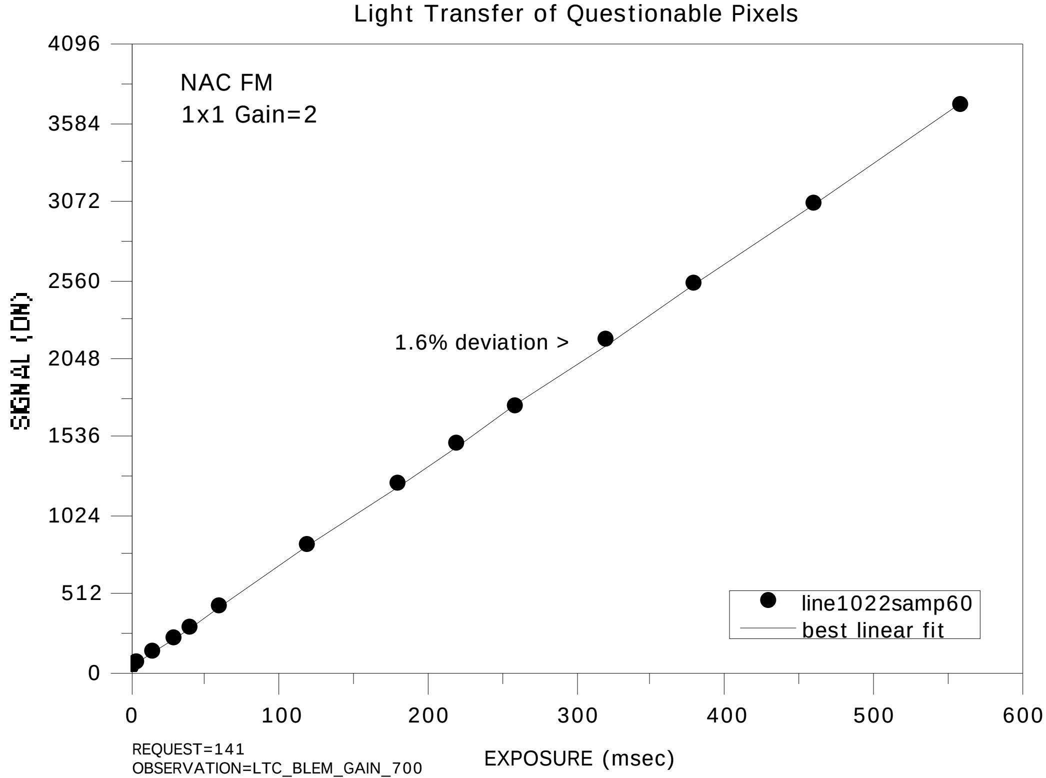
The following table shows the number of pixels flagged as blemishes and their location.

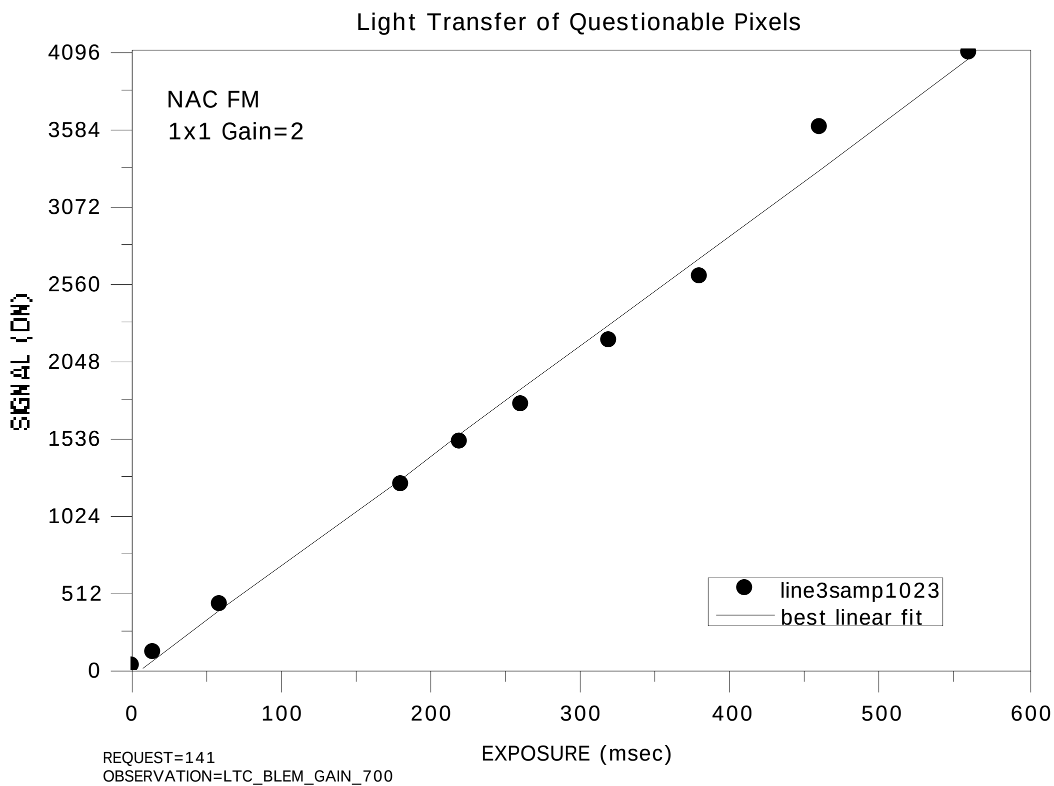
+25° C

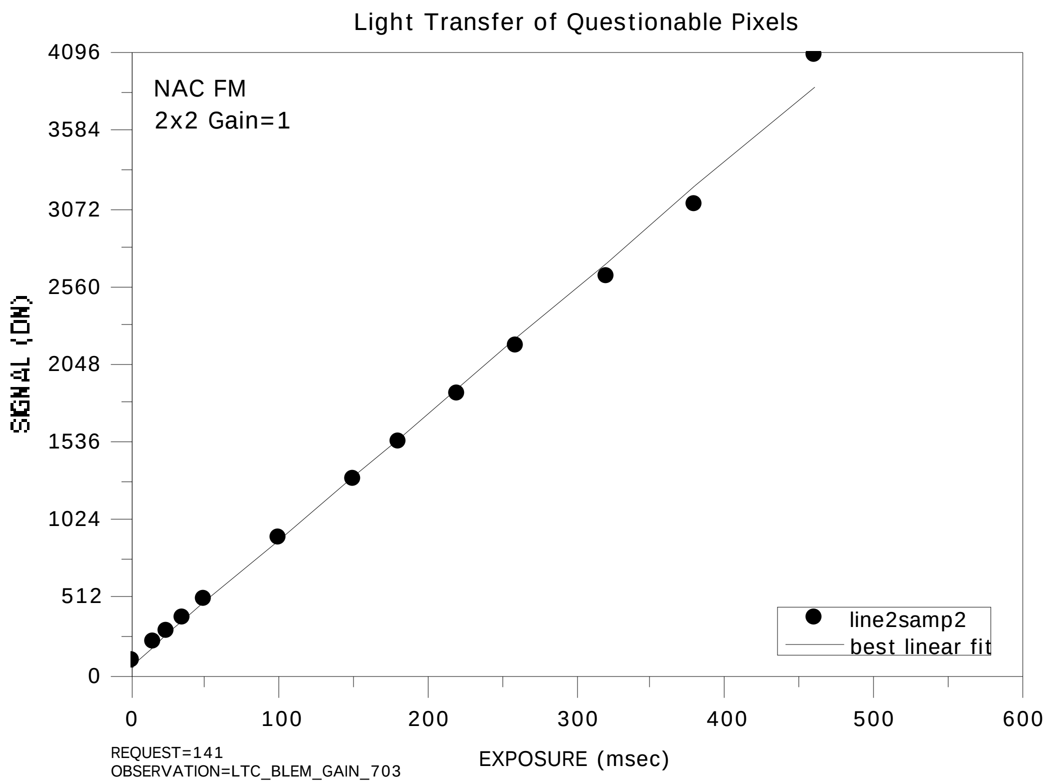
Gain/AB	Permanent blemishes	Blems not in first or last line, or first or last sample	Location (line,sample)
3/OFF	0	0	
2/OFF	80	3	(3,1023) (1022,60) (2,567)
2/ON	4	0	
1/OFF	959	1	(2,2)
0/OFF	511	0	

The blemish test for the 4x4 mode was performed on the low end of the light transfer curve only. Otherwise, all pixels would also be flagged as permanent blemishes by failing the $\varepsilon_{\max}$ and ε_{rms} tests at the high exposure levels.

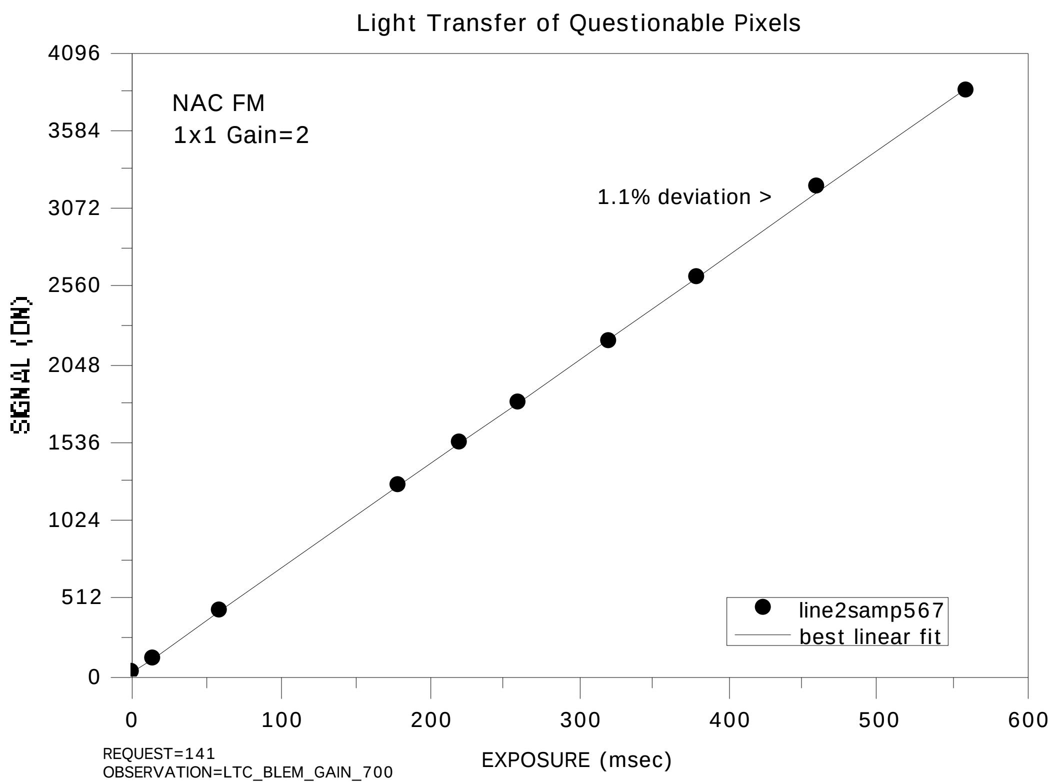
The following plots show the response of four interior pixels that were flagged as permanent blemishes. Two show deviations at one point of less than 2% while others have large excursions from linearity.







Light Transfer of Questionable Pixels
NAC FM
2x2 Gain=1
line2samp2
best linear fit
SIGNAL (DN)
EXPOSURE (msec)
REQUEST=141
OBSERVATION=LTC_BLEM_GAIN_703



Light Transfer of Questionable Pixels
NAC FM
1x1 Gain=2
1.1% deviation >
line2samp567
best linear fit
SIGNAL (DN)
EXPOSURE (msec)
REQUEST=141
OBSERVATION=LTC_BLEM_GAIN_700

5.1.3.1.4 RESULTS: RESPONSE FALLOFF

In some camera modes, the high DN regime shows a falloff in sensor response. The degree of shortfall can be easily extracted from the DN of the last two exposures and the exp=0 value:

$$d'(n) = \frac{ex(n)}{ex(m)}\left(d(m) - d(0)\right) + d(0)$$

where *d'(n)* is the expected DN of the highest exposure level

ex(n) is the exposure time of highest exposure level

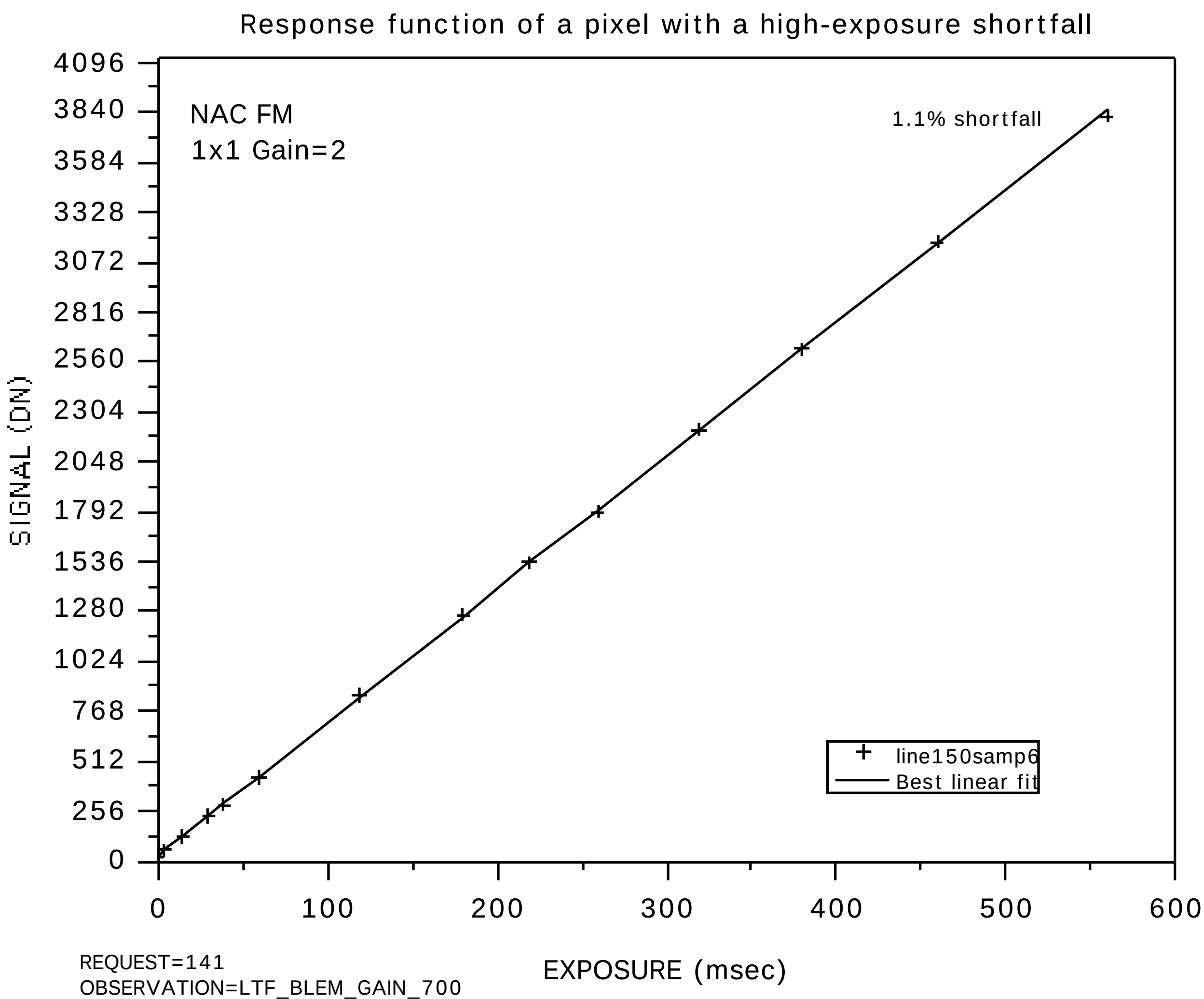
d(0) is the DN of the exp=0 frame

d(m) is the DN of highest exposure level without shortfall

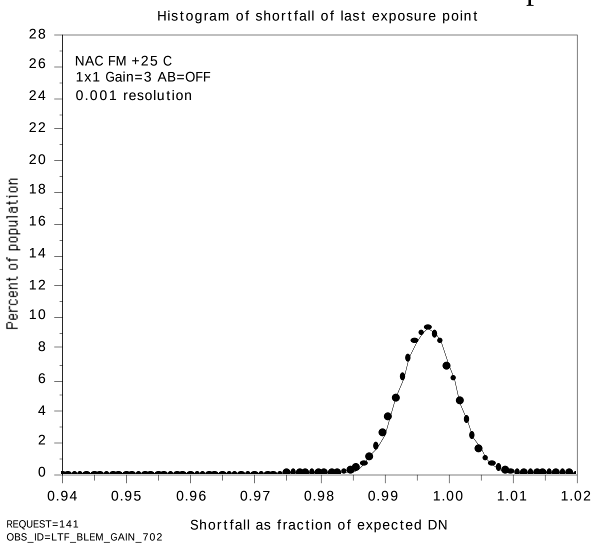
ex(m) is the exposure time of highest exposure level without shortfall

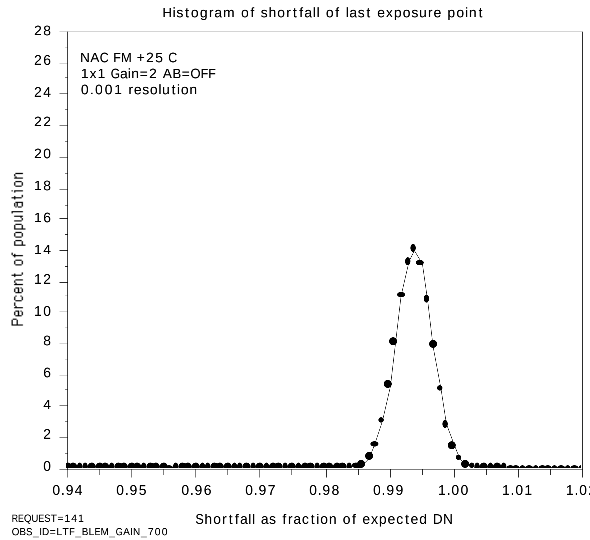
Therefore, the shortfall at the highest exposure level is defined as the ratio of the actual to the expected DN.

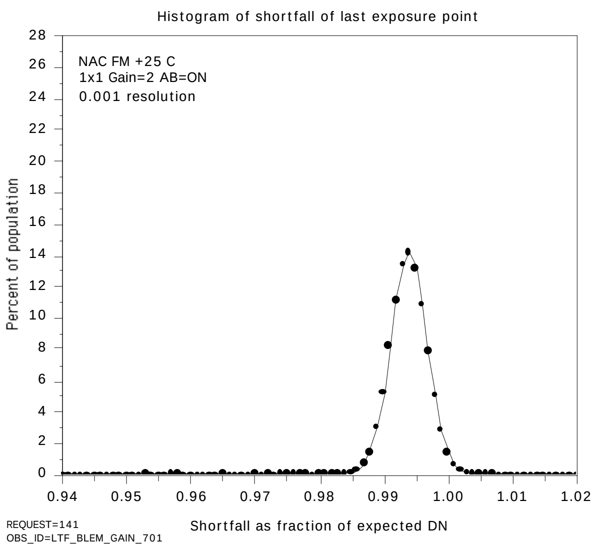
The following plot shows an example of a pixel with a 1.1 % shortfall.

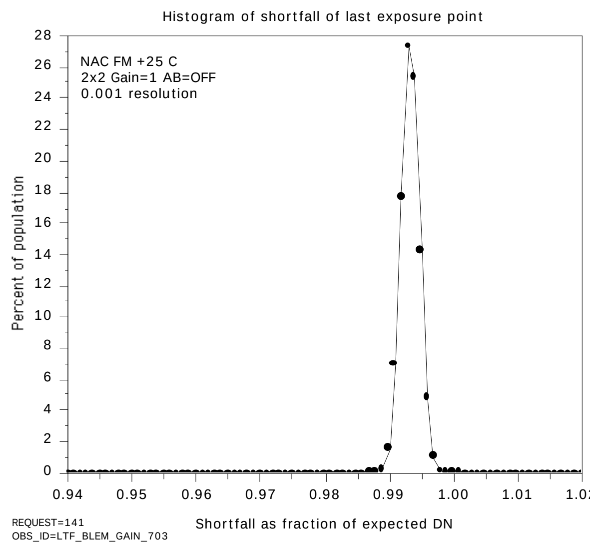


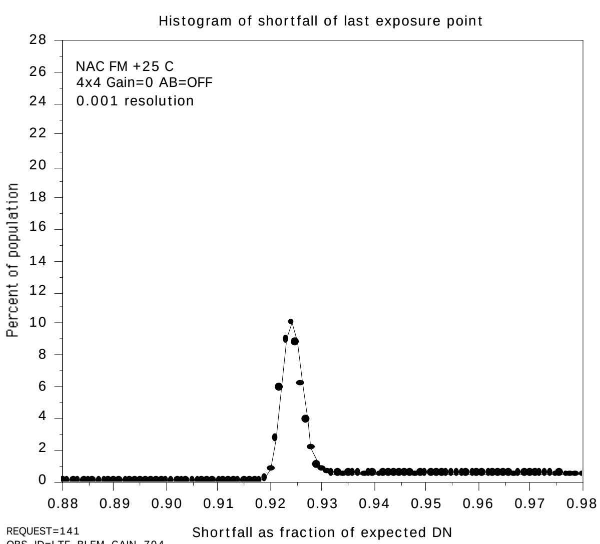
The following histograms show how many pixels have what degree of shortfall in the various camera modes. Note that the 4x4 Gain 0 plot has a different scale than the others.



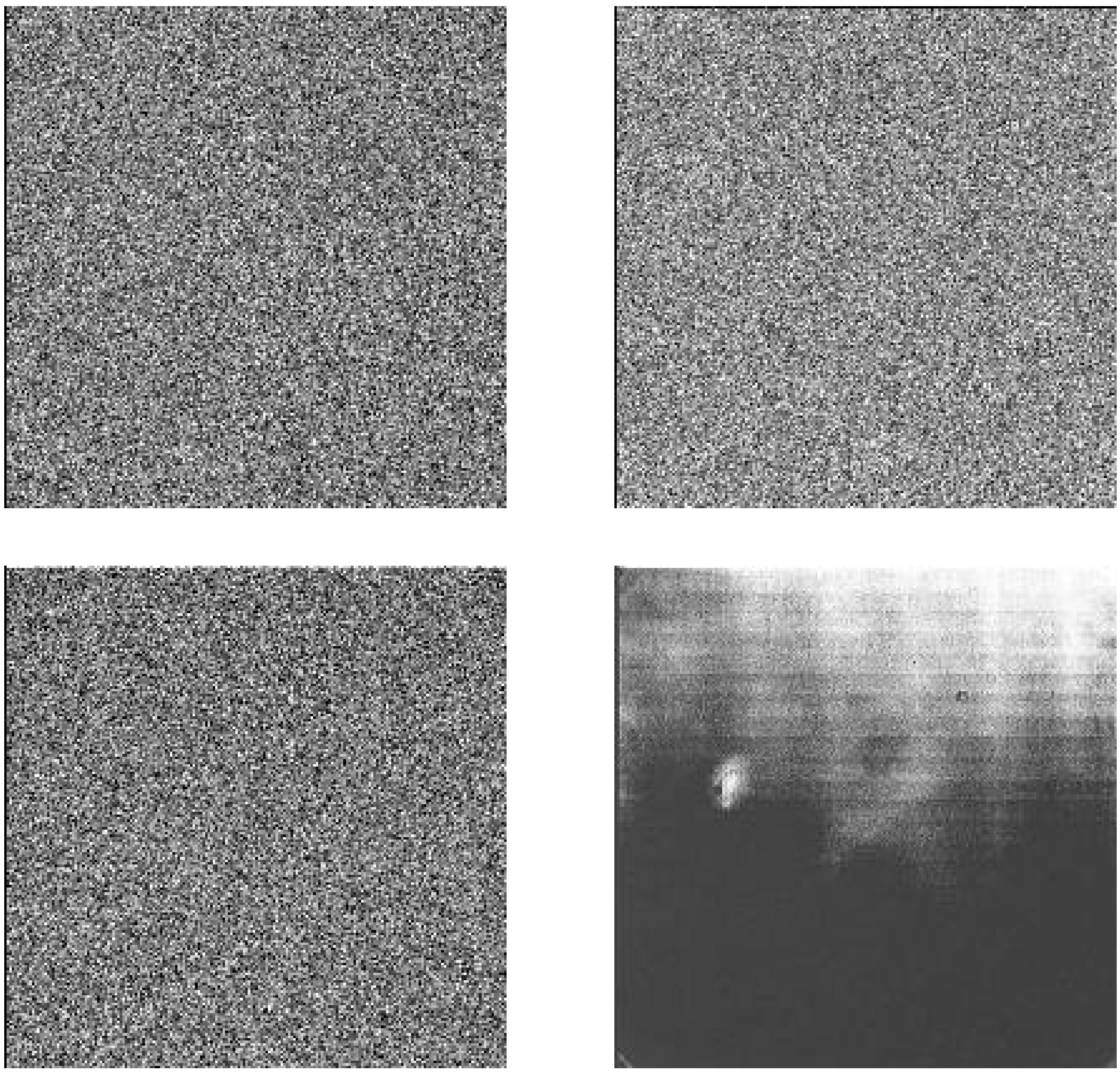








The images below illustrate the spatial distribution of the shortfall in the various gain states. The top row shows Gain 3 (left) and Gain 2. The bottom row shows Gain 1 (left) and Gain 0. The images have been stretched to bring out any patterns.



5.1.3.1.5 CONCLUSIONS

1. Most of the pixels with significant errors in the linear fit (blemishes) were confined to the image borders. Image interior pixels flagged as a blemishes were limited to three in Gain 2 and 1 in Gain 1 (and these were all within 3 pixels of an border).
2. It was the high-exposure behavior which generally caused the pixels to be flagged as blemishes. The low-exposure behavior seen in the WAC was not observed here.
3. The degree of shortfall at the highest exposure level varies according to the gain state.
    - Gain 3: -0.5 to 1%
    - Gain 2: 0 to 1 %
    - Gain 1: 0 to 1 %
    - Gain 0: 7 to 8 %
4. Only Gain 0 showed any spatial structure in the degree of response falloff at high exposure (shortfall). The high exposure used for calculating the shortfall was well into the DN range of the known unusual response of this gain state.
5. Another type of anomalous behavior is inherent in the Antiblooming=ON case. For very long exposures, some pixels will appear in bright-dark pairs aligned vertically. The data set studied here was not affected by this, but the effect needs to be analyzed.

IMAGES USED IN SENSOR BLEMISH ANALYSIS

image	day	time	observation	gain	mode	exp
134579	213	0:48:4.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	0
134581	213	0:51:3.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	0
134621	213	2:14:23.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	0
134582	213	0:52:32.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	5
134583	213	0:54:1.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	5
134584	213	0:55:30.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	5
134585	213	0:57:11.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	15
134586	213	0:58:40.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	15
134587	213	1:0:10.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	15
134588	213	1:1:39.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	30
134589	213	1:3:8.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	30
134591	213	1:6:12.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	40
134592	213	1:7:41.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	40
134622	213	2:15:59.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	40
134594	213	1:10:40.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	60
134595	213	1:12:9.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	60
134596	213	1:13:38.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	60
134597	213	1:15:13.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	120
134598	213	1:16:42.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	120
134599	213	1:18:12.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	120
134600	213	1:19:41.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	180
134601	213	1:21:10.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	180
134602	213	1:22:39.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	180
134603	213	1:24:14.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	220
134604	213	1:25:43.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	220
134605	213	1:27:13.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	220
134609	213	1:33:15.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	320
134611	213	1:36:14.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	320
134624	213	2:44:38.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	320
134612	213	1:37:43.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	380
134613	213	1:39:12.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	380
134614	213	1:40:41.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	380
134615	213	1:42:16.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	460
134616	213	1:43:45.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	460
134618	213	1:46:44.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	560
134619	213	1:48:13.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	560
134620	213	1:49:42.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	560
134606	213	1:28:42.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	1800
134607	213	1:30:11.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	1800
134608	213	1:31:40.0	LTC_BLEM_GAIN_700	2 (100K)	FULL	1800
134625	213	3:34:21.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	0
134626	213	3:41:28.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	0
134627	213	3:42:58.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	0
134628	213	3:44:27.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	0
134629	213	3:45:56.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	5
134630	213	3:47:25.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	5
134631	213	3:48:54.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	5
134632	213	3:50:30.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	15
134633	213	3:51:59.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	15
134634	213	3:53:28.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	15
134635	213	3:54:57.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	30
134636	213	3:56:26.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	30
134637	213	3:57:55.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	30
134639	213	4:1:0.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	40
134640	213	4:2:29.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	40
134668	213	5:2:56.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	40
134641	213	4:3:58.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	60
134643	213	4:6:56.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	60
134669	213	5:4:25.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	60
134644	213	4:8:32.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	120
134645	213	4:10:1.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	120
134646	213	4:11:30.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	120
134647	213	4:12:59.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	180
134649	213	4:15:57.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	180
134670	213	5:6:1.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	180
134650	213	4:17:38.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	220
134651	213	4:19:7.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	220
134652	213	4:20:36.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	220
134653	213	4:22:5.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	260
134654	213	4:23:34.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	260
134655	213	4:25:3.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	260
134656	213	4:26:39.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	320
134657	213	4:28:8.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	320
134658	213	4:29:37.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	320
134659	213	4:31:6.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	380
134661	213	4:34:4.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	380
134671	213	5:7:37.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	380
134662	213	4:35:41.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	460
134663	213	4:37:10.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	460
134666	213	4:41:37.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	560
134667	213	4:43:6.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	560
134672	213	5:9:13.0	LTC_BLEM_GAIN_701	2 (100K)	FULL	560
134678	213	5:34:27.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	0
134679	213	5:35:56.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	0
134680	213	5:37:25.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	0
134681	213	5:38:54.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	5
134682	213	5:40:23.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	5
134683	213	5:41:52.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	5
134684	213	5:43:28.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	15
134685	213	5:44:57.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	15
134686	213	5:46:26.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	15
134687	213	5:47:55.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	20
134688	213	5:49:24.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	20
134689	213	5:50:53.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	20
134690	213	5:52:29.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	25
134691	213	5:53:58.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	25
134692	213	5:55:27.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	25
134693	213	5:56:56.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	30
134695	213	5:59:54.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	30
134720	213	6:52:17.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	30
134696	213	6:1:30.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	60
134697	213	6:2:59.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	60
134698	213	6:4:28.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	60
134699	213	6:5:57.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	90
134700	213	6:7:26.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	90
134701	213	6:8:55.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	90
134702	213	6:10:31.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	100
134703	213	6:12:0.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	100
134704	213	6:13:29.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	100
134705	213	6:14:58.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	120
134707	213	6:17:56.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	120
134721	213	6:53:53.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	120
134708	213	6:19:32.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	150
134709	213	6:21:1.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	150
134710	213	6:22:30.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	150
134711	213	6:23:59.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	180
134712	213	6:25:28.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	180
134713	213	6:26:57.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	180
134714	213	6:28:33.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	220
134715	213	6:30:2.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	220
134716	213	6:31:31.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	220
134717	213	6:33:0.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	260
134718	213	6:34:29.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	260
134719	213	6:35:58.0	LTC_BLEM_GAIN_702	3 (40K)	FULL	260
134725	213	7:15:57.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	0
134726	213	7:17:1.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	0
134727	213	7:18:5.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	0
134728	213	7:19:9.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	15
134729	213	7:20:13.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	15
134730	213	7:21:17.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	15
134731	213	7:22:26.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	25
134732	213	7:23:30.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	25
134733	213	7:24:34.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	25
134734	213	7:25:38.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	35
134735	213	7:26:42.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	35
134736	213	7:27:46.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	35
134737	213	7:28:59.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	50
134738	213	7:30:3.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	50
134739	213	7:31:7.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	50
134740	213	7:32:11.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	100
134741	213	7:33:15.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	100
134742	213	7:34:19.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	100
134743	213	7:35:28.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	150
134744	213	7:36:32.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	150
134745	213	7:37:36.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	150
134746	213	7:38:40.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	180
134747	213	7:39:44.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	180
134748	213	7:40:48.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	180
134749	213	7:42:1.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	220
134750	213	7:43:5.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	220
134751	213	7:44:9.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	220
134752	213	7:45:13.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	260
134753	213	7:46:17.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	260
134754	213	7:47:21.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	260
134755	213	7:48:34.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	320
134756	213	7:49:38.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	320
134757	213	7:50:42.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	320
134758	213	7:51:46.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	380
134759	213	7:52:50.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	380
134760	213	7:53:54.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	380
134761	213	7:55:5.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	460
134762	213	7:56:9.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	460
134763	213	7:57:13.0	LTC_BLEM_GAIN_703	1 (400K)	SUM2	460
134771	213	10:32:20.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	0
134772	213	10:33:11.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	0
134790	213	12:8:41.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	0
134774	213	10:34:53.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	5
134775	213	10:35:44.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	5
134776	213	10:36:35.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	5
134778	213	10:38:24.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	15
134779	213	10:39:15.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	15
134791	213	12:9:39.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	15
134780	213	10:40:6.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	20
134781	213	10:40:57.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	20
134782	213	10:41:48.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	20
134783	213	10:42:48.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	25
134784	213	10:43:39.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	25
134785	213	10:44:30.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	25
134786	213	10:45:21.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	30
134787	213	10:46:12.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	30
134788	213	10:47:3.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	30
134792	213	12:10:39.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	60
134793	213	12:11:30.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	60
134794	213	12:12:21.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	60
134795	213	12:13:12.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	90
134796	213	12:14:3.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	90
134797	213	12:14:54.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	90
134798	213	12:15:52.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	100
134799	213	12:16:43.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	100
134800	213	12:17:34.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	100
134801	213	12:18:25.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	120
134802	213	12:19:16.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	120
134803	213	12:20:7.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	120
134804	213	12:21:5.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	150
134805	213	12:21:56.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	150
134806	213	12:22:47.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	150
134807	213	12:23:38.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	180
134808	213	12:24:29.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	180
134809	213	12:25:20.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	180
134810	213	12:26:20.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	220
134811	213	12:27:11.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	220
134812	213	12:28:2.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	220
134813	213	12:28:53.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	260
134814	213	12:29:44.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	260
134815	213	12:30:35.0	LTC_BLEM_GAIN_704	0 (1400K)	SUM4	260