These notes "formally" capture the e-mail exchange (see point 3) and subsequent telecon on the further definition of the data to be provided by JPL in the BDA EIDPs for subsequent deliveries.

1. It is accepted that the BDA test report is in the form of an Excell spreadsheet as shown in the appendix (extra calculation pages not shown).

2. The following points are taken as the final agreement on the additional data that will be provided

   Feedhorn metrology will be provided as part of the standard documentation. The information will be made available on a per pixel basis (labelled according to drawing 721) and will be as follows:

   - the waveguide diameter
   - the waveguide position
   - the backshort distance
   - diameter of feedhorn
   - overall length

   Filter data will be provided in duplicate by Cardiff University – one set goes to JPL for inclusion in the BDA EIDP one set comes directly to RAL.

   Bodac Test log and a brief description of the test conditions (probably the procedure?) will be provided with the EDIP to allow the conditions under which the BDA was tested to be understood. The raw data (including load curves) will also be provided. An estimate of the total error on the measurement will be quoted on the results Excell spreadsheet that constitutes the test report.

3. E-mail exchange – reponse from Jamie Bock on 1/10/2003

```
Hi Matt,

Here are some partial answers:

> 1.  Feedhorn metrology was provided but not as part of the official
>     document set - it should be in the EIDP for future deliveries.

I agree, also can send backshort distances.

> 2.  All metrology data should refer to appropriate engineering drawings.
>
>     The data provided on the waveguides are o.k. as far as they go
>     but it isn't easy to understand which position each of the feedhorns
>     is in. We propose that a proper engineering drawing be provided, not
>     just a sketch.
>
>     Note that the sketch provided appears to be upside down - we can
>     clarify that in Friday's telecon.
>
> 3.  There is no meterology data on the length of the waveguide, position
>     of the back, or the feed horn aperture size - these are knowable from
>     the mandrels at least so should be included in the data pack.

The feedhorn metrology data is provided by Custom Microwave.  I'm not sure
how much of this information is available since it comes from the vendor.

> 4.  The measured data on the filter should be in the EIDP for the BDA as
>     well - from Cardiff via JPL. [It's noted that the problem is on the
>     Cardiff side here.]
```

```
>
>     We propose that for future deliveries, the Cardiff filter EIDP as
>     delivered to JPL be included as an annex or section in the BDA EIDP
>     as delivered to RAL.
>
> 5.  The historical log does not contain the record of when the bowing on
the
>      filter occured - there is very little actual information in the EIDP on
>     what happened when, and the outcome of before and after inspections.
It
>     is not clear for instance whether any problem was observed after the
cold
>     vibration.

We do not have a process to denote all inspections as a function of time.
We
will do what we can in this particular instance, but spotting variances is
not
part of any standard process by definition.

> 6.  Detailed manufacturing information on the hardware as built is very
>     interesting and useful for later correlation studies (e.g.; how many
>     feedhorns were made per mandrel).

Please be more specific on what you want.  Not all of this information is
available.

> 7.  The EIDP spreadsheet calculations can be reproduced to good
> accuracy by
>     Matt's Mathcad bolometer model (which is based on the same theory but
>     implemented a little differently) when the same numbers are used.
>
> 8.  No detectors meet the optical efficiency MP value of 0.65.
> The cause(s)
>     are under discussion (telecon of Sept. 30).
>
>     There is no correlation between low optical efficiency and any other
>     parameters in the EIDP spreadsheet.
>
>     There is a correlation between low efficiency and waveguide diameter,
>     except for the pixels with anomalously low efficiency on one end of
>     the array (see Bruce's e-mail of Oct. 1).
>
> 9.  All detectors meet the MP time constant value of 32 ms or better,
>     with 28 detectors meeting the design value of 18 ms or better.
>
> 10. Seven detectors don't meet the DQE MP value of 0.46.
>     Three detectors meet the DQE Design value of 0.55.
>
>     The DQE is strongly correlated with Ro (as one would expect, as
>     it's calculated), with all three detectors that meet the design
>     value having Ro > 200.

I have submitted a waiver on R0 through Tim Larson.

> 11. Eleven detectors don't meet the 1/f noise knee MP value of 100 mHz.

Note the channels flagged as noisy BoDAC channels.  These channels have
excess
noise associated with the testbed, and are being diagnosed and fixed as we
go
along.  They were excluded from the 1/f knee and NEP medians.

>     The 1/f knee was measured at 8-mV bias whereas the NEP was evaluated
>     for a bias of 16 mV. (Question: does the knee frequency
> depend on bias?)
```

Yes, mostly in the case of the noisy BoDAC channels which are picking up
preamp oscillations from open channels. This is a question for Hien.

>   23 detectors meet the time constant, DQE, and 1/f noise knee MP values
>   simultaneously.
>
> 12. The combination of low DQE and low optical efficiency has a big
>   impact on the corresponding iunstrument sensitivity/mapping speed
>   (Matt will do some more calculations to characterise that this week).
>
>   The implications for the CQM are not necessarily serious, since a
>   science-grade array is not essential, but would be serious for the
>   FM or FS.

R0 requires changing NTD material. As we discussed at RAL, we both agreed
not to change material. We don't yet understand the reason for low
efficiency,
so can't speculate on what the solution might be.

> 13. The EIDP should include comprehensive test reports (not just a
>   compilation of test results).

I disagree. "Comprehensive test report" was never an agreed deliverable; a
summary of test results was. We sent early versions of the EIDP exactly for
this reason, and did not receive any comments from the UK along these lines.
We cannot provide full test reports without significant delay to deliveries.
We are delivering the eidp, data log, and raw data, as discussed previously.

> General comment: The EIDP should contain as much detailed information as
> possible. Verbal or other reports (e.g. telecon minutes) are not enough
> becuase they will not spring to mind when problems are being investigated
> at future times and possibly/probably by other people than the current UK
> or JPL teams - all of the relevant information should be in one place,
> the EIDP.

I'm not sure what you are implying by this comment. We are sending you
advance
comment by telecon and doing our best to send out the data on the eidp.
Hien is
now testing the S/LW array. We are trying to make the eidp comprehensive as
we
can, but all we hear is schedule pressure from Europe. We can't do both.

> Questions:
> ---------
>
> 1. Can we have the load curve data (preferably blanked and loaded) for
>   each detector?

As I mentioned, we will send raw data and a log.

> 2. Is the value of absorbed power used (2.5 pW) estimated from a
>   photometric model or or measured from the load curves?

That is simply the assumed absorbed optical power specified in the SSSD.

> 3. The amplifier noise is taken as 10 nV Hz-1/2 - does this represent
>   both JFET and warm amplifier noise?

Yes, prior to demodulation.

> 4. What errors are associated with the measurements and the derived
>   parameters?

Statistically, small. Systematically, difficult to quantify. Quantifying

the errors is a large job, larger in fact than evaluating the expected
value.
We are not set up programmatically to include an evaluation of errors in
the eidp.

> 5. The calucated NEPs are for a base temperature of 300 mK, and use
> computed noise values from Mather's model. Do the MEASURED noise
> values agree with what theory predicts under the actual measurement
> conditions?

Compare the measured dark NEP values to the calculated ones in the
spreadsheet.
The measured NEPs are derived from noise data and Sdc from the load curve.
The
calculated ones are based on the noise model.

> 6. Can we have the measured frequency response data? That will allow
> characterisation of whether or not it is well described by a single
> time constant.
>
> 7. Time constant and C300/G300 are strongly correlated - presumably this
> means that C300 is evaluated from the time constant. Is it
> correct that
> C300 is derived from the measured time constant with G300 having been
> derived from the load curves?

Yes.

Jamie

PERFORMANCE VERIFICATION MATRIX - CQM PLW BDA - S/N 10209800-1-006

BDA Specifications

Item	DeValue	Min Perf	Measured Median	Unit	Reference	Note	
Number of bad optical pixels	≤ 4	≤ 11	7		BDA-PER-01		
(NEPphoton/NEPtotal)^2	> 0.55	> 0.46	0.48		BDA-PER-02	at 17.5 mV bias	
Optical efficiency*	> 0.85	> 0.65	0.47		BDA-PER-03		
Detector time constant	< 18	< 32	15	ms	BDA-PER-06	at 16 mV bias	
Vmax***	< 11.0		9.5	mV	BDA-DRCU-22		
Calibration uniformity**	> 0.99	> 0.99	N/M		BDA-PER-08		
Cross-talk (n-n)**	< 0.01	< 0.05	N/M		BDA-PER-09		
Cross-talk (non n-n)**	< 0.001	< 0.001	N/M		BDA-PER-09		
1/f knee frequency	< 30	< 100	28	mHz	BDA-PER-10	at 8 mV bias	
Average conducted heat load from 1.7 K	< 1.6	< 3.0	< 2.6	uW	BDA-TEC-06		

BDA Design Values (at 300 mK)

Item	Target	Measured Median	Unit	Reference	Note	
R0	180.0	124.2	Ohms	BDA-SSSD		
Delta	41.8	41.8	K	BDA-SSSD		
R300	24.0	15.0	MOhms	BDA-SSSD		
G300	40.0	48.5	pW/K	BDA-SSSD		
Beta	1.50	1.54		BDA-SSSD		
C300	1.00	1.00	pJ/K	BDA-SSSD		
Rlr	10.0	10.8	MOhms	BDA-SSSD	room temp	
Dark Sdc	7.5	6.4	e8 V/K	derived	at 16 mV bias	
Dark NEP (1 Hz), incl 10 nV/rtHz amp. noise	2.9	3.4	e-17 W/rtHz	derived	at 16 mV bias	
Dark NEP (0.1 Hz), incl 10 nV/rtHz amp. noise	2.9	3.0	e-17 W/rtHz	derived	at 16 mV bias	
Vmax	0.005	0.0056	Vrms	BDA-SSSD		
BDA temperature rise from 1.7 K	< 10	N/M	mK	BDA-HCO-1		
BDA thermal time constant	> 100	150	s	BDA-HCO-2		

*assumes νlower = 1.02 νcutoff
**not tested
***Thermistor values are not included

Pixel Specifications																								
Item	**DV**	**MP**																						
BDA connector			J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06
BDA pins			1,26	2,27	3,28	4,29	5,30	6,31	7,32	8,33	9,34	10,35	11,36	12,37	13,38	14,39	15,40	16,41	17,42	18,43	19,44	20,45	21,46	22,47
Channel ID			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Detector ID			E1	E2	E3	E4	D1	D2	D3	D4	C1	C3	C5	T2	E5	C6	C8	D5	D6	D7	D8	E7	E6	E8
BDA Pixel Operability			**No**	Yes	**No**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes	Yes	**No**	Yes	Yes	Yes
BoDAC channel Operability	N/A	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	N/A	N/A	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No
(NEPphoton/NEPtotal)^2	> 0.55	> 0.46	N/M	0.52	N/M	0.46	0.50	0.48	0.47	0.51	0.51	0.57	0.43	N/M	0.54	0.46	0.45	N/M	0.47	0.52	N/M	0.47	0.56	0.47
Optical efficiency*	> 0.85	> 0.65	N/M	0.57	N/M	0.59	0.48	0.49	0.47	0.53	0.66	0.54	0.47	N/M	0.55	0.50	0.43	N/M	0.45	0.38	N/M	0.54	0.55	0.17
Detector time constant	< 18	< 32	N/M	14	N/M	13	8	13	17	19	19	14	16	N/M	17	12	20	N/M	18	18	N/M	20	17	16
Calibration uniformity**	> 0.99	> 0.99	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (n-n)**	< 0.01	< 0.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (non n-n)**	< 0.001	< 0.001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/f knee frequency	< 30	< 100	N/M	28	N/M	295	25	13	14	26	126	26	17	N/M	14	0	193	N/M	17	12	N/M	366	25	16
Pixel Design Values																								
Item	**Target**																							
R0	180.0		N/M	174.4	N/M	99.6	126.9	144.3	105.7	142.0	141.5	292.4	90.3	N/M	290.3	94.3	92.4	N/M	92.1	131.0	N/M	124.7	234.7	105.9
Delta	41.8		N/M	41.4	N/M	41.8	42.3	40.4	41.5	42.2	41.6	41.7	41.2	N/M	39.7	42.0	41.4	N/M	42.2	42.5	N/M	40.0	41.9	41.3
G300	40		N/M	52.1	N/M	51.7	51.6	51.4	47.5	51.8	47.7	51.6	51.0	N/M	51.8	47.7	47.1	N/M	47.3	46.8	N/M	43.5	49.4	42.3
Beta	1.5		N/M	1.54	N/M	1.52	1.58	1.52	1.58	1.53	1.55	1.53	1.53	N/M	1.51	1.54	1.49	N/M	1.54	1.58	N/M	1.49	1.54	1.53
C300	1.00		N/M	0.99	N/M	0.95	0.58	0.93	1.18	1.37	1.28	1.02	1.09	N/M	1.20	0.83	1.32	N/M	1.20	1.22	N/M	1.20	1.18	0.98
Gamma	1 (fixed)		N/M	1.0	N/M	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/M	1.0	1.0	N/M	1.0	1.0	1.0
R300	24.1		N/M	22.2	N/M	13.4	18.3	15.9	13.5	20.1	18.3	38.7	11.0	N/M	28.8	12.9	11.7	N/M	13.0	19.3	N/M	12.9	31.8	13.3
Rlr+	10.0		11.8	11.8	11.8	11.8	11.7	11.8	11.8	11.8	11.8	11.8	11.8	11.9	11.6	11.8	11.7	11.8	12.0	12.0	12.0	12.1	12.0	12.0
Rlr-	10.0		11.6	11.5	11.6	11.6	11.5	11.6	11.6	11.7	11.7	11.7	11.7	11.8	11.7	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
Dark Sdc	7.46		N/M	7.2	N/M	6.1	6.7	6.4	6.2	7.0	6.9	8.8	5.7	N/M	7.8	6.2	6.0	N/M	6.3	7.2	N/M	6.4	8.3	6.5
Dark NEP (1 Hz), incl 10 nV/rtHz amp. noise	2.87		N/M	3.4	N/M	5.1	3.6	4.0	4.6	3.5	3.1	2.8	3.8	N/M	4.4	4.3	4.0	N/M	3.4	3.7	N/M	5.1	3.2	3.5
Dark NEP (0.1 Hz), incl 10 nV/rtHz amp. noise	2.87		N/M	3.0	N/M	15.5	3.1	3.7	4.9	3.6	5.9	2.4	3.9	N/M	3.9	4.3	13.0	N/M	3.4	3.2	N/M	14.7	2.6	3.4
Vmax	5		N/M	7.2	N/M	5.6	6.6	6.1	5.4	6.9	6.2	9.5	5.1	N/M	8.2	5.3	5.0	N/M	5.3	6.5	N/M	5.0	8.4	5.1
Chip + In bump height	median =	29.8		21.5	32.5	34.5	25.0	27.0	30.0	23.5	26.5	16.5	34.0		17.5	34.5	37.5	17.5	36.5	27.0	24.5	32.5	17.5	35.0
Chip height	median =	26.8		18.5	29.5	31.5	22.0	24.0	27.0	20.5	23.5	13.5	31.0		14.5	31.5	34.5	14.5	33.5	24.0	21.5	29.5	14.5	32.0

																										Unit	Reference
J06	J06	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05		
23,48	24,49	1,26	2,27	3,28	4,29	5,30	6,31	7,32	8,33	9,34	10,35	11,36	12,37	13,38	14,39	15,40	16,41	17,42	18,43	19,44	20,45	21,46	22,47	23,48	24,49		
23	**24**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**		
DK2	E9	R1	A8	A7	A6	A9	C9	B8	B7	C7	B5	B6	A5	T1	B4	C4	B3	C2	B2	B1	A3	A4	A1	DK1	A2		
Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**	**No**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes	Yes		
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No		
0.51	0.50	N/M	0.49	0.50	0.46	0.48	0.48	0.50	0.48	0.48	N/M	N/M	0.45	N/M	0.45	0.50	0.50	0.45	0.55	0.53	0.50	0.42	N/M	0.47	0.45		BDA-PER-02
0.04	0.21	N/M	0.34	0.39	0.48	0.25	0.25	0.28	0.33	0.52	N/M	N/M	0.54	N/M	0.51	0.47	0.42	0.48	0.41	0.42	0.52	0.53	N/M	0.04	0.52		BDA-PER-03
18	18	N/M	9	13	15	30	20	7	8	11	N/M	N/M	23	N/M	15	12	17	13	11	12	12	19	N/M	8	12	ms	BDA-PER-06
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		BDA-PER-08
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		BDA-PER-09
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		BDA-PER-09
289	32	N/M	58	65	24	24	144	234	40	23	N/M	N/M	2003	N/M	18	0	26	41	35	357	49	302	N/M	176	49	mHz	BDA-PER-10

																										Unit	Reference
119.2	113.7	N/M	121.9	125.7	95.3	102.3	123.8	118.7	101.8	142.2	N/M	N/M	98.5	N/M	88.3	130.3	154.2	86.6	243.3	182.0	137.6	153.4	N/M	87.6	132.8	Ohms	BDA-SSSD
42.1	41.8	N/M	41.6	42.0	41.8	42.1	40.3	42.1	41.9	40.1	N/M	N/M	41.4	N/M	41.9	41.8	40.9	41.8	41.6	42.0	42.0	36.9	N/M	42.8	39.5	K	BDA-SSSD
39.3	38.3	N/M	43.7	43.8	46.2	42.7	36.5	42.3	45.7	44.3	N/M	N/M	48.7	891.1	53.2	45.6	48.6	48.9	50.2	49.8	50.9	51.2	N/M	48.5	53.0	pW/K	BDA-SSSD
1.54	1.55	N/M	1.54	1.57	1.55	1.53	1.55	1.57	1.54	1.50	N/M	N/M	1.59	N/M	1.51	1.60	1.57	1.56	1.57	1.58	1.56	1.45	N/M	1.64	1.51		BDA-SSSD
1.02	0.98	N/M	0.57	0.87	1.01	1.88	1.10	0.47	0.56	0.69	N/M	N/M	1.61	N/M	1.14	0.82	1.25	0.90	0.81	0.90	0.93	1.36	N/M	0.55	0.88	pJ/K	BDA-SSSD
1.0	1.0	N/M	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/M	N/M	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/M	1.0	1.0		
16.7	15.2	N/M	15.8	17.2	12.8	14.3	13.3	16.6	13.8	14.8	N/M	N/M	12.4	N/M	11.9	17.4	18.0	11.6	31.6	24.9	18.9	10.1	N/M	13.5	12.7	MOhms	BDA-SSSD
12.0	12.1	10.1	10.1	10.1	10.1	10.1	10.1	10.2	10.1	10.2	10.1	10.1	10.2	10.1	10.1	10.1	10.1	10.2	10.1	10.2	10.1	10.2	10.2	10.1	10.1	MOhms	BDA-SSSD
11.8	11.9	10.1	10.1	10.0	10.2	10.2	10.1	10.1	10.1	10.1	10.2	10.1	10.1	10.1	10.1	10.1	10.1	10.2	10.1	10.1	10.1	10.1	10.1	10.1	10.1	MOhms	BDA-SSSD
7.2	7.0	N/M	6.4	6.6	5.9	6.3	6.3	6.6	6.1	6.2	N/M	N/M	5.7	N/M	5.5	6.5	6.5	5.6	7.8	7.2	6.5	5.2	N/M	5.9	5.6	e8 V/K	derived
3.4	3.1	N/M	3.5	3.5	3.9	3.5	3.4	3.9	3.9	3.9	N/M	N/M	23.2	N/M	4.1	5.0	3.4	4.2	3.4	6.8	5.1	7.2	N/M	6.5	4.4	e-17 W/rtHz	derived
11.8	3.4	N/M	4.2	4.5	3.9	3.4	5.8	9.4	4.0	3.7	N/M	N/M	55.3	N/M	4.0	4.8	3.4	4.4	2.8	11.4	6.7	16.4	N/M	10.3	4.9	e-17 W/rtHz	derived
5.6	5.2	N/M	5.7	5.9	5.2	5.3	4.8	5.8	5.4	5.5	N/M	N/M	5.3	N/M	5.4	6.1	6.4	5.1	8.6	7.6	6.7	4.9	N/M	5.6	5.5	mVrms	BDA-DRCU-22
28.0	30.0		28.5	27.5	33.5	32.5	31.5	26.5	32.5	29.5	32.5	33.0	37.0		38.0	25.0	24.5	38.0	18.5	23.0	25.0	36.0	23.0	37.0	30.5		
25.0	27.0		25.5	24.5	30.5	29.5	28.5	23.5	29.5	26.5	29.5	30.0	34.0		35.0	22.0	21.5	35.0	15.5	20.0	22.0	33.0	20.0	34.0	27.5		