



Technical Note

Integration of Photometer PFM BDAs: alignment
issues

Ref: SPIRE-RAL-NOT-
002344

Issue: 0.1

Date: 16/02/2005

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TITLE: Integration of Photometer PFM BDAs: alignment issues

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CHANGE RECORD

ISSUE	DATE	SECTION	REASON FOR CHANGE
0.1	16/02/2005	All	First issue as draft TN

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3. Conclusion and proposed corrective actions on respective interface plates

APPLICABLE AND REFERENCE DOCUMENTS

RD1 Alignment Measurement Summary for PFM PMW BDA 10209800-2 SN012, Mark Weilert (JPL – 28 Jan 05), *as part of the delivered EIDP*

RD2 Alignment Measurement Summary for PFM P?W BDA 10209800-? SN0??, Mark Weilert (JPL – ?? ?? ??), *added in the delivered EIDP*

RD3 Alignment Requirements of detector arrays in SPIRE, SPIRE-RAL-NOT-000912 v0.3, Bruce Swinyard & Tony Richards (RAL, 17-Oct-2001)



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This note briefly assesses the impact of the alignment measurements performed on PFM PMW BDA (see RD1) wrt the integration of the respective BDAs into the SPIRE PFM FPU sub-assembly (Photometer detector box). The case of PSW and PLW will be discussed when the relevant EIDP (RD2) are made available.

This note comes in parallel with a similar assessment performed for the Spectrometer PFM BDAs in SPIRE-RAL-NOT-002194 (issue 0.3, 03/11/04).

1. Defocus and lateral shift

From RD1, the local coordinates system is reproduced below (originally from ICD). The local z axis is out-of-the plane of the figure.

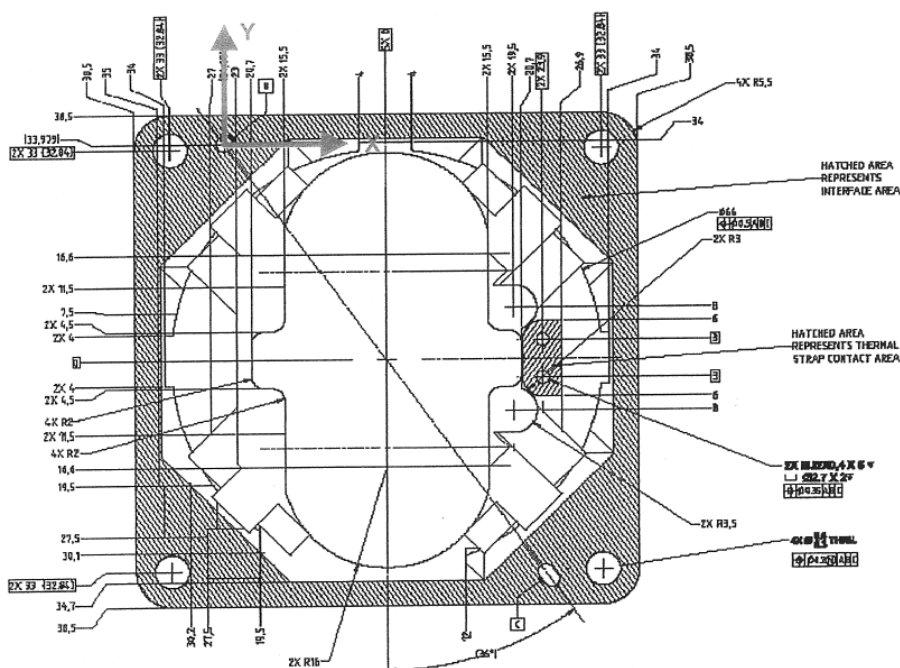


Figure 1 (excerpt from ICD dwg 10209721, with coordinate axes shown)

1.1 Case of PMW

The deviation found (total i.e. ambient and cold measurement from RD1) from the nominal plane along the local z axis is -0.088 ± 0.05 mm. This translates into a very small defocus of the PMW BDA in operation wrt the nominal best focal plane, well within the ± 0.5 mm allowed margin in RD3, even if uncertainty is included. This is therefore acceptable as it's a small value (about 2 orders of magnitude lower) when compared to the F/5 depth-of-focus at PMW wavelengths.

NB: this is assumed to be the residual after the correction of the initial defocus issue discussed in the note "Assessment of defocus tolerance and margin on SPIRE PMW BDA", Marc Ferlet, 19/05/04.

The lateral in-plane shift of the BDA centre wrt to nominal centre is found to be (total i.e. ambient and cold measurement):

- along X: -0.033 ± 0.05 mm
- along Y: $+0.249 \pm 0.05$ mm



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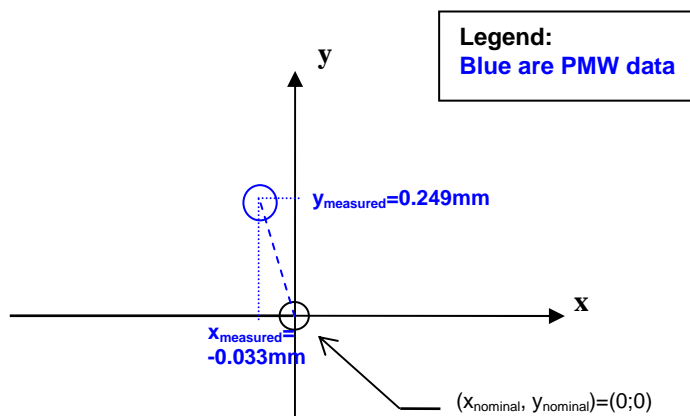
so that the max displacement from centre is $\sqrt{dx^2+dy^2} \sim 0.251 \pm 0.100\text{mm}$. This represents $\sim 8\%$ of the PMW pixel size and, at the entrance focal plane (CFIL1 location), is equivalent to $0.436 \pm 0.175\text{mm}$ displacement which is within the oversize (wrt FoV) of the shaped aperture at CFIL1. Nevertheless this means that the centre of the PMW FoV is shifted on sky by $\sim 3.16 \pm 1.26\text{arcsec}$ wrt the nominal location in the Herschel coordinates system but this does not affect directly the performances of the SLW channel.

1.2 Case of PSW & PLW

TBD

1.3 Conclusion (Preliminary)

There is no direct requirement in RD3 wrt the in-plane lateral shift but a need to maintain co-alignment with PSW centre to within $120\mu\text{m}$. Below is the illustrated summary of the BDAs centres lateral shift as-measured and reported in RD1. **Waiting for PSW and PLW data.**



2. Tilt and rotation

2.1 Case of PMW

The measured tilt of the as-built x-y plane compared to the nominal one is found at ambient to be 0.5deg wrt the local z axis. Although this measurement is at ambient only, this is at the limit of the $\pm 30\text{arcmin} = \pm 0.5\text{deg}$ acceptable tolerance around the gut ray which nominally is aligned with the local z axis at the centre of the array. The cryo data indicates supplementary hysteretic effect (in rotation about x) which is equivalent to uncertainty in the range of $\pm 0.025\text{deg}$ on the above value.

This tilt wrt z axis will reduce the coupling from science beam into BDA PMW feedhorns. First-order estimate indicate that $\sim 1\%$ loss in coupling efficiency could be resulting from such a tilt.

A correction is still desirable and experience with SSW BDA shows the possibility of having a wedge shape interface plate to correct even smaller amount of tilt deg in the case of SSW).



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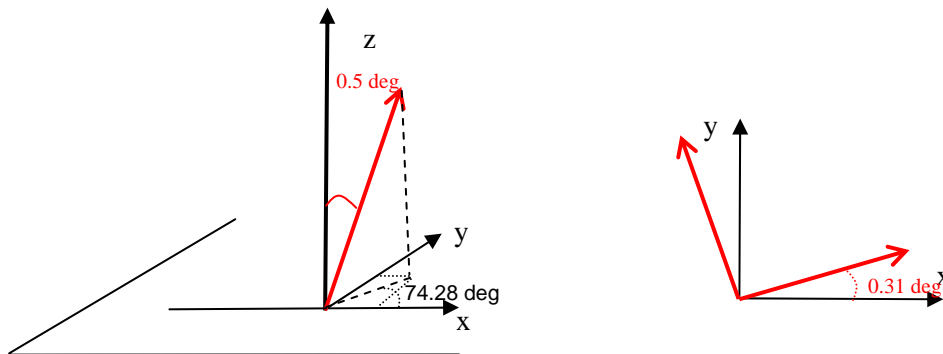
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The in-plane rotation has been found (ambient + cold) to be 0.31deg which is larger than the allowed $\pm 0.233\text{deg}$ (± 14 arcmin stated in RD3) but the impact may (or not) be acceptable depending on the respective value for in-plane rotation for PLW and PSW; PSW chop axis being the main reference.

NB: As the Photometer is the main imager of SPIRE and Herschel at long wavelengths, any complete field rotation (i.e. in case of no compensation) should be quantified on-sky and Science team and/or users should be informed.

2.2 Case of PSW & PLW

TBD

2.3 Conclusion

Likely need for correction by 0.5deg of the PMW BDA tilt wrt z axis via wedge in interface plate (as per SSW). Extra correction of the in-plane rotation is dependent on the PSW value.

3. Conclusion and proposed corrective actions on respective interface plates

None for the moment. Waiting for data on PSW and PLW BDAs.