# MAGNET DIVISION NOTES

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Title: Effect of the Position of Bus Conduit on the Field Harmonics at the Center of a SSC Dipole

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# Effect of the position of bus conduit on the field harmonics at the center of a SSC Dipole

**Ramesh C Gupta**

In this note we present the calculations with the computer codes POISSON and MDP of the effect of the various positions of "bus conduit". The effects are examined at the center of C358D SSC Dipole in terms of field harmonics. These harmonics were computed earlier by Cottingham[1], using simplified assumptions which gave unacceptably large numbers.

We consider the following three positions for the placement of the bus conduit:

- Vertical (Fig 1)
- Horizontal (Fig 2)
- Up-down (Fig 3)

The up-down position, proposed by Cottingham, gives the least change in harmonics.

It should be pointed out that in such cases, where the effects are small, we are stretching computer programs to their limits in computing the absolute values of field harmonics. To reduce this effect we subtract the noise (field harmonics in the absence of the bus conduit). The effect is maximum at the highest operating field where $\mu$ of the iron is lowest. In SSC this field is 6.6 Tesla. In the case of MDP we do all calculations only at this field. However, with POISSON we have done calculations at a number of values of the Central field $B_0$. In table 1 we give the results of POISSON run and in table 2 the results of MDP run.

## References

1. J.G. Cottingham, Feb 3, 1989, "Memo to E. Willen"

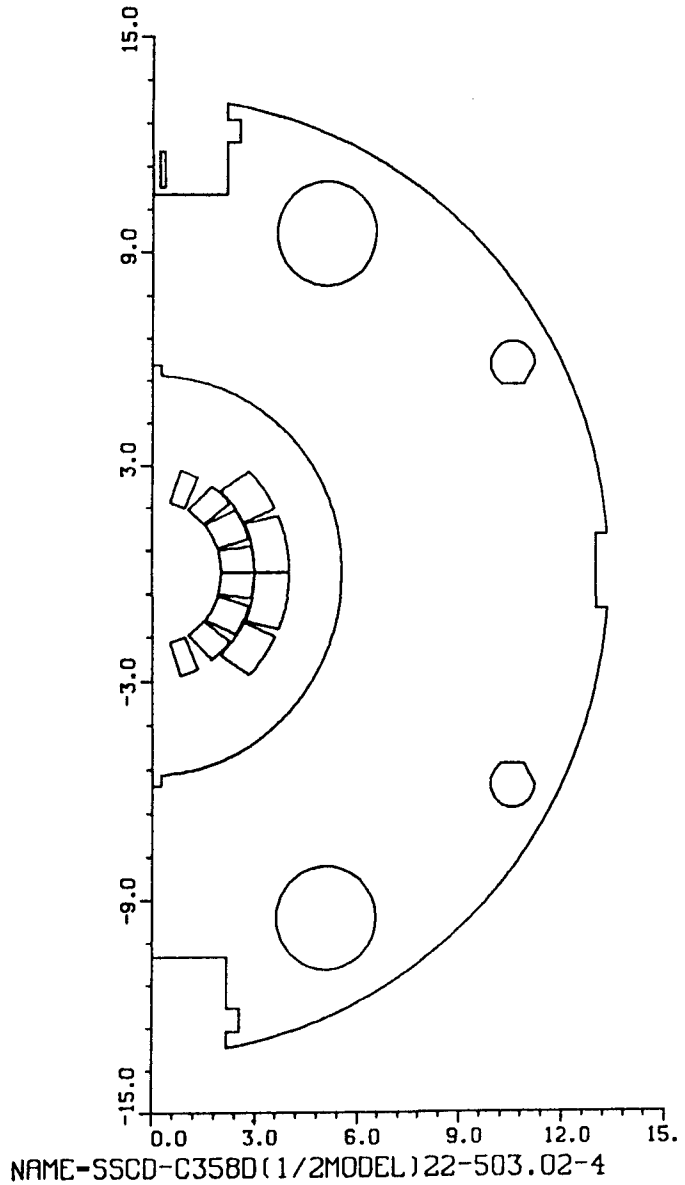


Fig 1. Bus conduits placed in vertical position

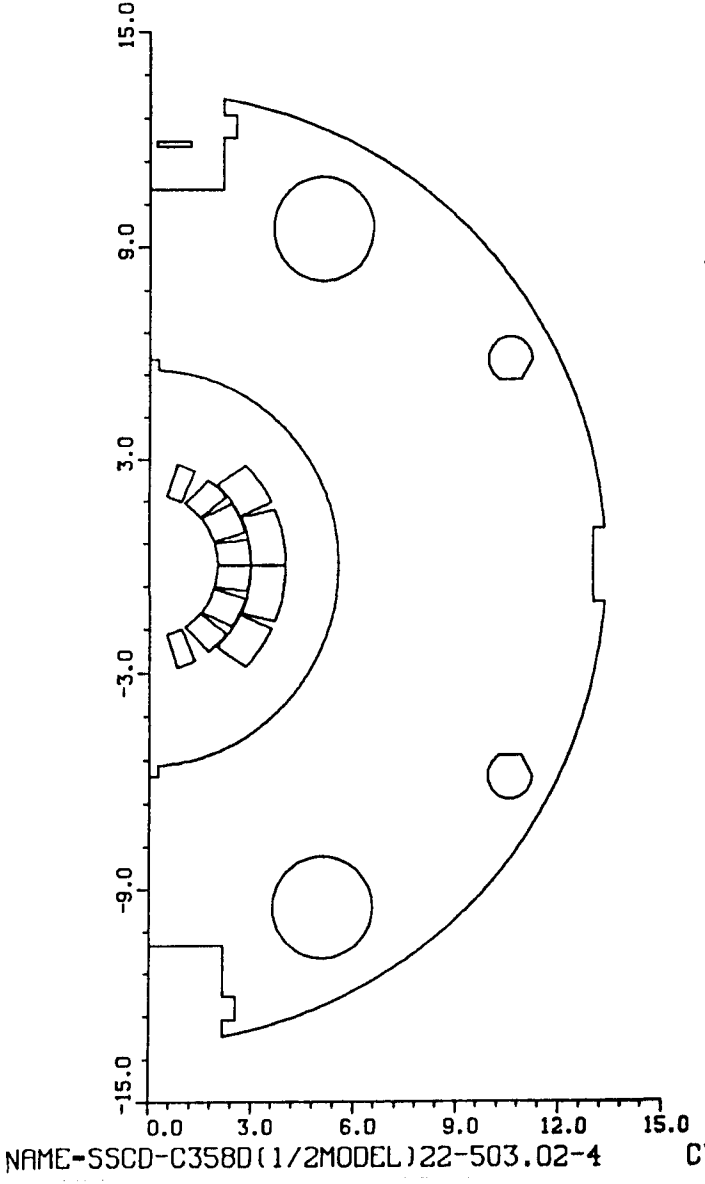


Fig 2. Bus conduits placed in horizontal position

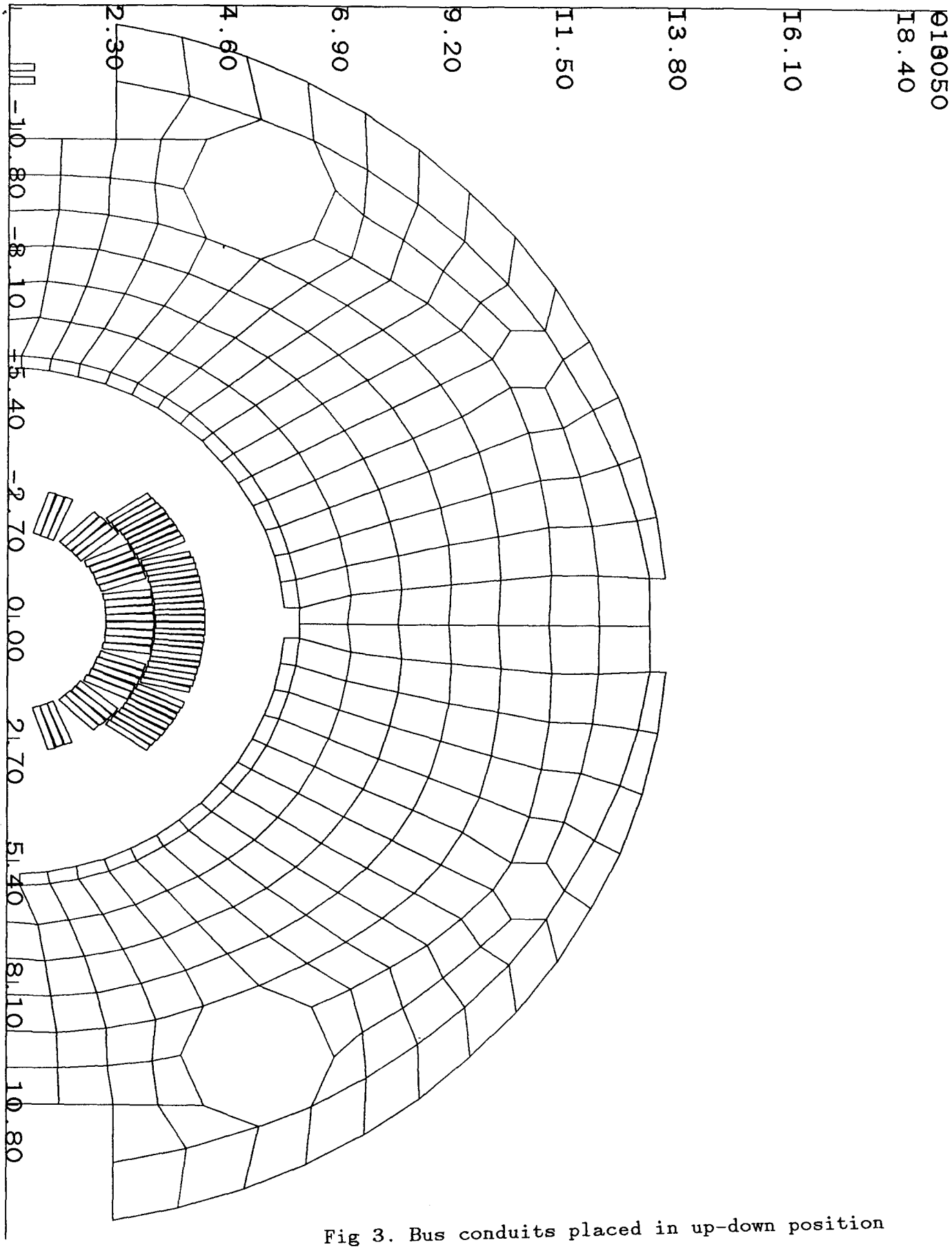


Fig 3. Bus conduits placed in up-down position

**Table 1:** POISSON calculations for the effect of the position of the superconductor in the "bus conduit" on the field harmonics

| Superconductor (Position) | $B_0$ (Tesla) | $a_0$ $10^{-4}$ | $a_1$ $10^{-4}$ | $a_2$ $10^{-4}$ | $a_3$ $10^{-4}$ | $b_2$ $10^{-4}$ |
|---|---|---|---|---|---|---|
| None (Noise) | 6.067 | 0.06 | 0.09 | 0.05 | 0.01 | 0.77 |
| Vertical-None | — | 0.01 | 0.01 | 0.01 | 0.0 | 0.0 |
| Horizontal-None | — | 0.02 | 0.03 | 0.02 | 0.0 | 0.0 |
| None (Noise) | 6.603 | 0.10 | 0.15 | 0.08 | 0.01 | 0.18 |
| Vertical-None | — | 0.02 | 0.03 | 0.02 | 0.0 | 0.0 |
| Horizontal-None | — | 0.07 | 0.10 | 0.05 | 0.0 | 0.0 |
| None (Noise) | 7.114 | 0.08 | 0.13 | 0.07 | 0.01 | -0.78 |
| Vertical-None | — | 0.03 | 0.14 | 0.03 | 0.0 | 0.0 |
| Horizontal-None | — | 0.08 | 0.10 | 0.05 | 0.01 | 0.0 |
| None (Noise) | 8.105 | 0.03 | 0.06 | 0.04 | 0.01 | -2.38 |
| Vertical-None | — | 0.06 | 0.08 | 0.04 | 0.01 | 0.0 |
| Horizontal-None | — | 0.13 | 0.18 | 0.09 | 0.01 | 0.0 |

**Table 2:** MDP calculations for the effect of the position of the superconductor in the "bus conduit" on the field harmonics

| Superconductor (Position) | $B_0$ (Tesla) | $a_1$ $10^{-4}$ | $b_2$ $10^{-4}$ |
|---|---|---|---|
| None (Noise) | 6.693 | 0.0 | 0.14 |
| Vertical-None | — | 0.12 | 0.02 |
| Horizontal-None | — | 0.19 | 0.01 |
| PROPOSED-None | — | 0.01 | 0.0 |