

Booster 2nd Harmonic Choke

V.S.Kashikhin, January 29, 2004

Choke specification:

Inductance $L=0.026$ H

Maximum current $I=350$ A

Frequency $f=30$ Hz

$W=L*I^2/2=1592$ J

Calculated choke parameters :

| | |
|--|---------------------------------|
| Magnetic field in the air gap | 1.1 T |
| Magnetic field in the yoke | 1.1 T – 1.25 T |
| Magnet effective length | 0.804 m |
| Pole width | 186 mm |
| Air gap | 19 mm |
| Peak current | 350 A |
| RMS current | 200 A |
| DC Power | 440 W |
| Number of turns | 48 |
| Resistance | 0.011 Ohm |
| Energy of magnetic field | 1980 J |
| Inductance/ meter length | 0.032 H/m |
| Magnet inductance | 0.026 |
| Copper conductor | 221 mm ² |
| Conductor dimensions | 16mm x 16mm, 7 mm diameter hole |
| Length of water circuit | 120 m |
| Water pressure drop | 0.2 Mpa |
| Water flow | 0.03 l/s |
| Water temperature rise (only DC losses) | 4 C |
| Current form | ? |
| AC losses | ? |
| Laminations: | |
| Width | 532 mm |
| Height | 439 mm |
| Core weight | 1300 kg |
| Copper weight | 230 kg |

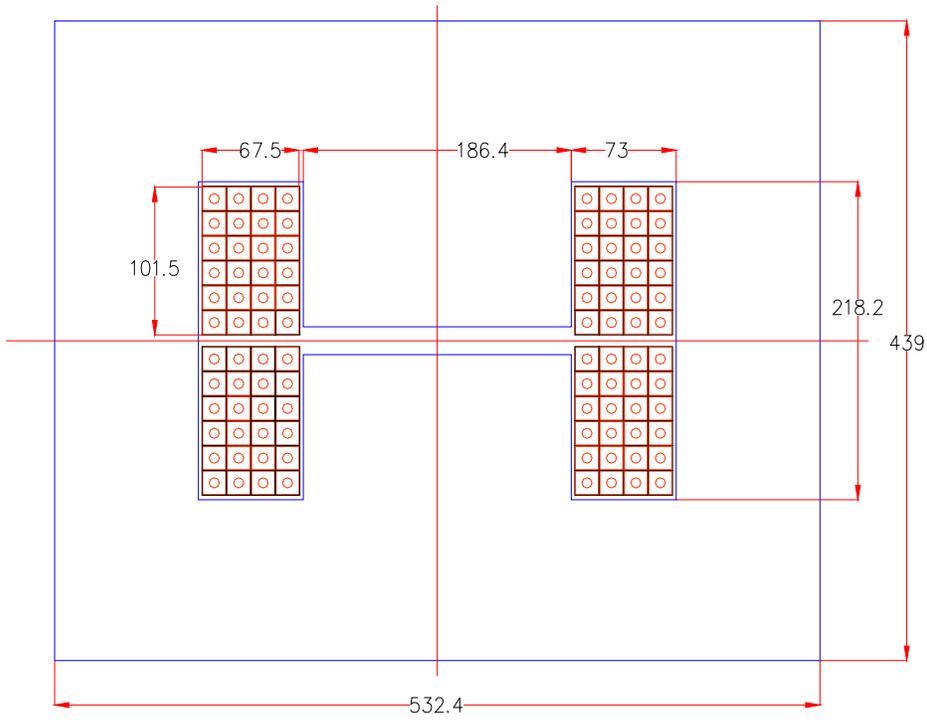


Fig. 1. Magnet cross-section

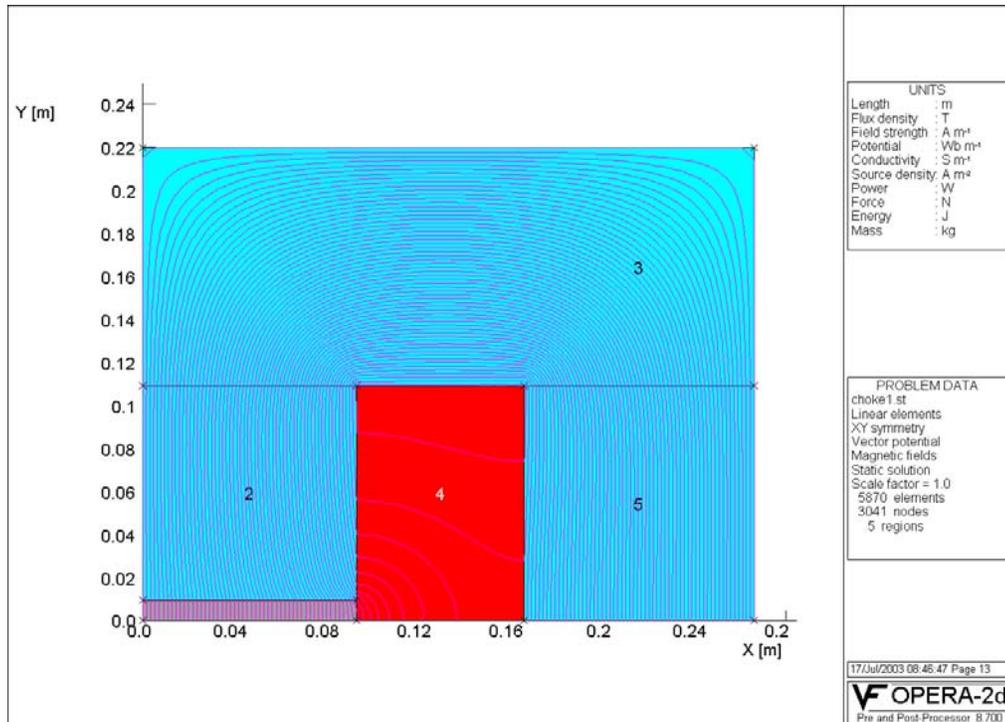


Fig. 2. Flux lines

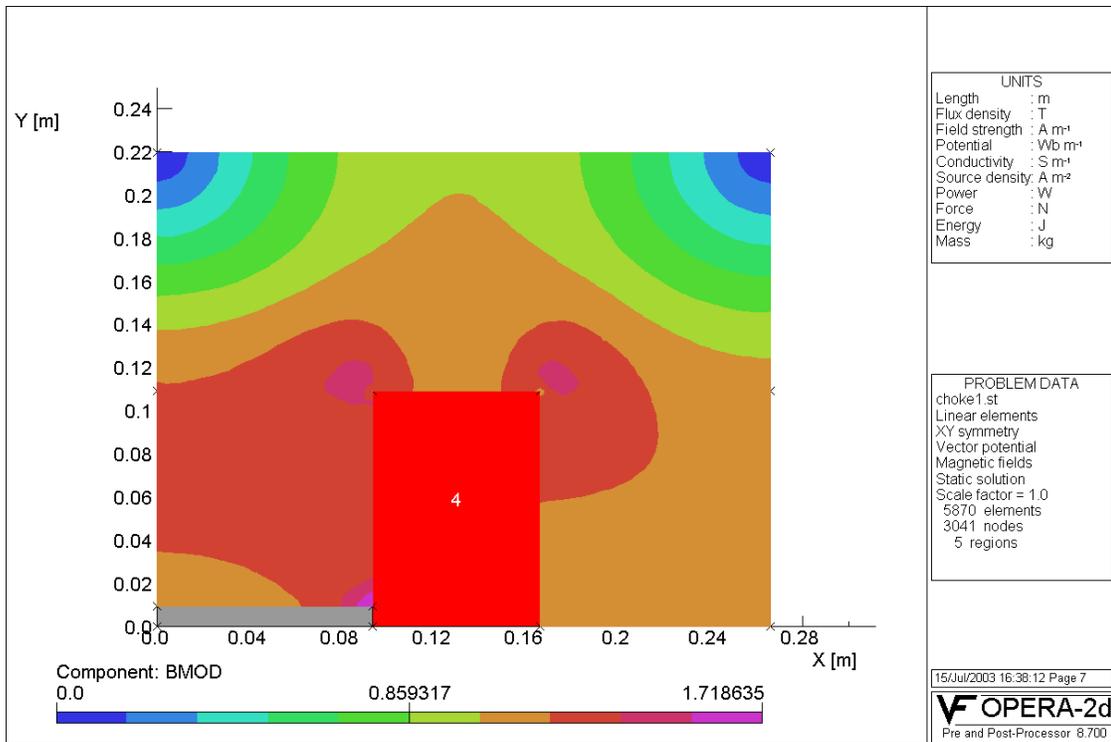


Fig. 3. Flux density distribution in an iron core

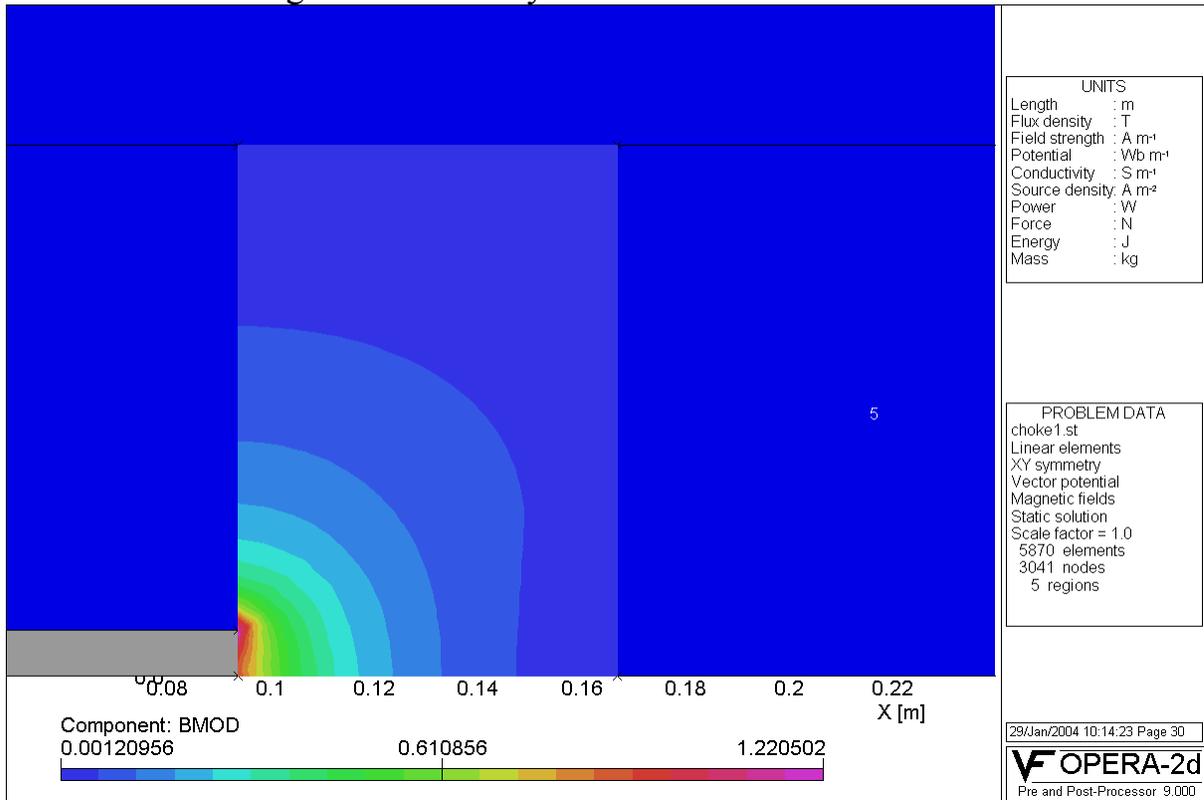


Fig. 4. Flux density in the coil

Summary

The calculation of proposed variant confirmed specified parameters. This variant is close to the optimal from an economic point of view. The laminated iron core has weight 1300 kg and cost of manufacturing can be one of the main components. It is possible to use laser-cutting technology for the model to eliminate the cost of stamping. AC losses should be carefully estimated. To reduce the core cost manufacturing better to use the coated laminations with adhesive. Hand made epoxy coating will be expensive and time consuming. It is also possible to reduce the DC losses with larger conductor and AC losses by moving the coil from the air gap on the distance 10mm - 20mm. In this case the coil field will be less than 0.6 T. The AC losses also can be extremely reduced by using Litz conductor or foil type. But the cooling conditions in this case should be carefully estimated including extra load for tunnel ventilation system, The AC losses in the core are in the range of fields, frequency of industrial transformer but also should be estimated when the steel will be chosen.