Booster 2nd Harmonic Choke

V.S.Kashikhin, July 17, 2003

Choke parameters :

Magnetic field	1.1 T
Magnet length	0.86 m
Pole width	186 mm
Air gap	19 mm
Peak current	350 A
RMS current	200 A
DC Power	312 W
Number of turns	48
Resistance	0.0078 Ohm
Energy of magnetic field	1703 J
Inductance	0.0278
Copper conductor	221 mm²
Laminations:	
Width	532 mm
Height	439 mm
Core weight	1300 kg

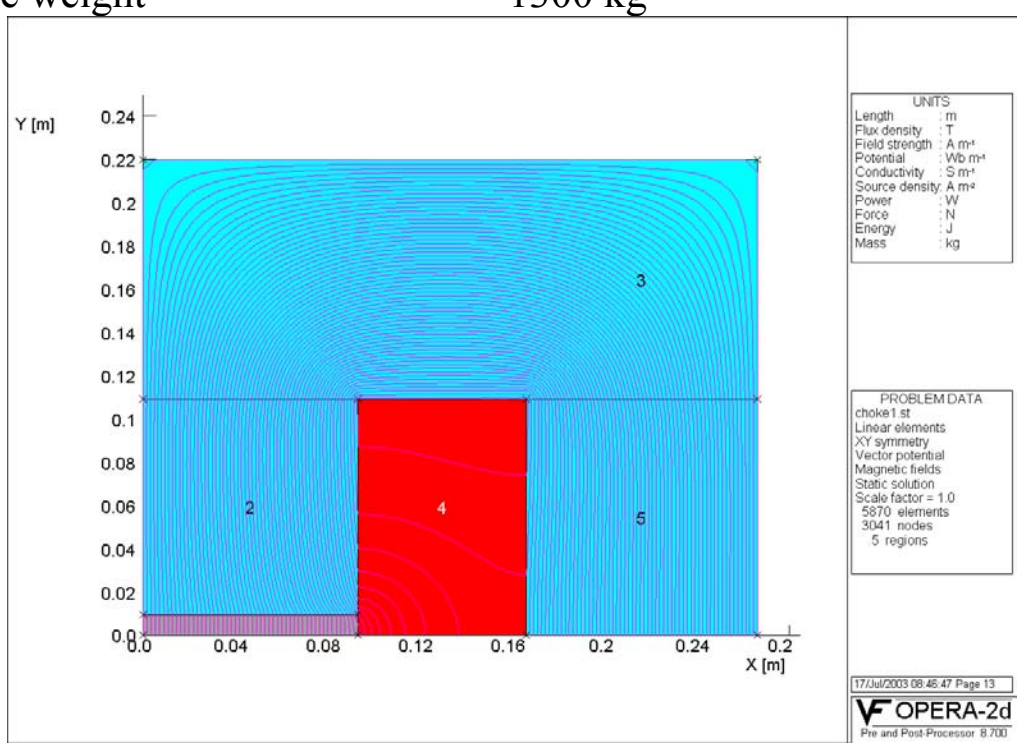


Fig.1 Flux lines

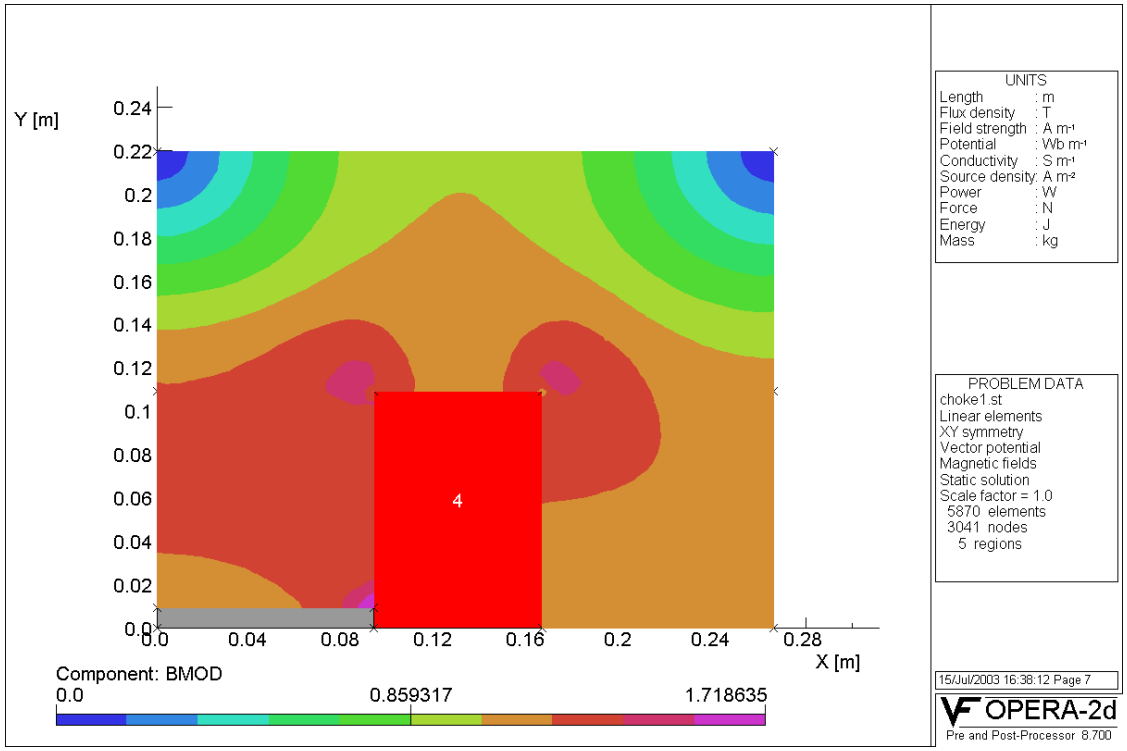
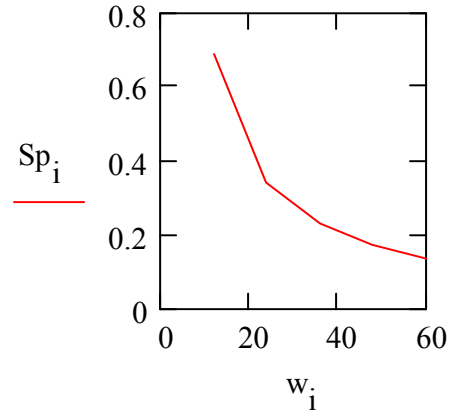


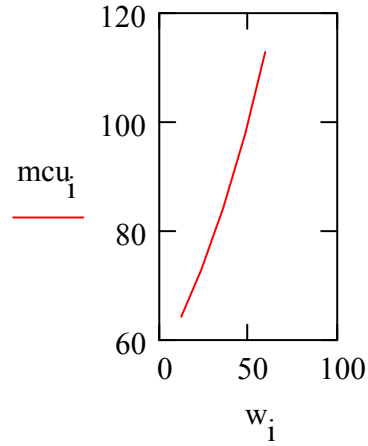
Fig.2 Flux density distribution in an iron core

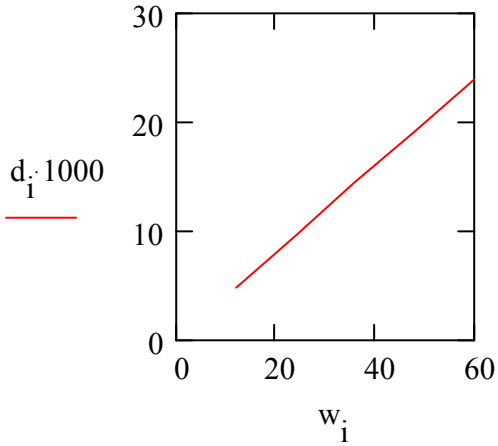
Fixed parameters:

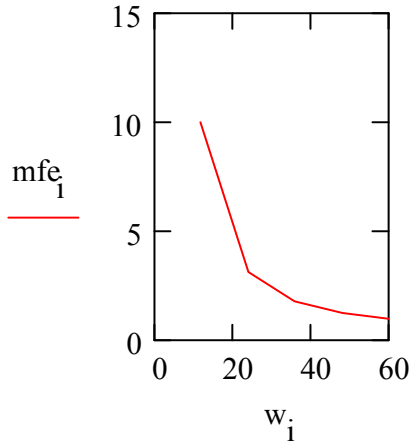
L=0.026 H, I= 350 A
W=L*I*I/2= 1592 J
Bfe=1.1T, Jav=1 A/mm², Lm=0.86 m
Cfe=1000 $/t, Ccu=30 $/kg

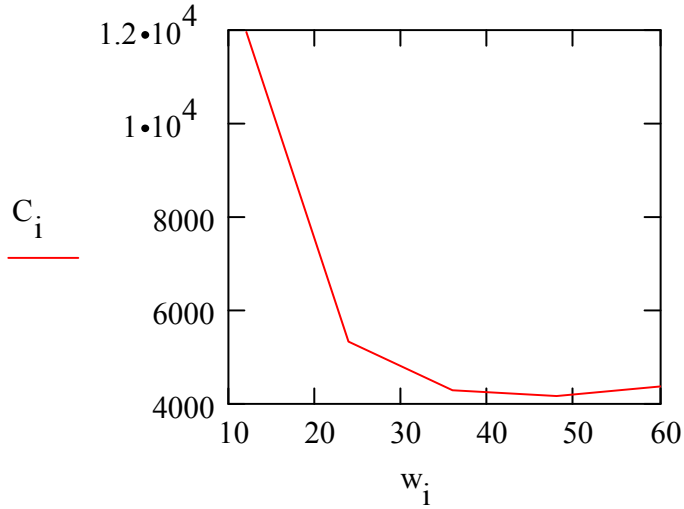
w_i	Sp_i	bp_i	d_i	bw_i	Pdc_i	mfe_i	mcu_i	C_i
12	0.689	0.802	$4.796 \cdot 10^{-3}$	0.065	0.118	10.015	64.159	$1.195 \cdot 10^{4}$
24	0.345	0.401	$9.591 \cdot 10^{-3}$	0.092	0.135	3.141	72.933	$5.343 \cdot 10^{3}$
36	0.23	0.267	0.014	0.112	0.156	1.763	84.296	$4.308 \cdot 10^{3}$
48	0.172	0.2	0.019	0.13	0.18	1.236	97.751	$4.187 \cdot 10^{3}$
60	0.138	0.16	0.024	0.145	0.209	0.968	113.014	$4.381 \cdot 10^{3}$











Sp- pole area in m*m, d- air gap in m, mcu- copper weight in kg, mfe- core weight in tons, C- total cost in $ vs. w- number of winding turns

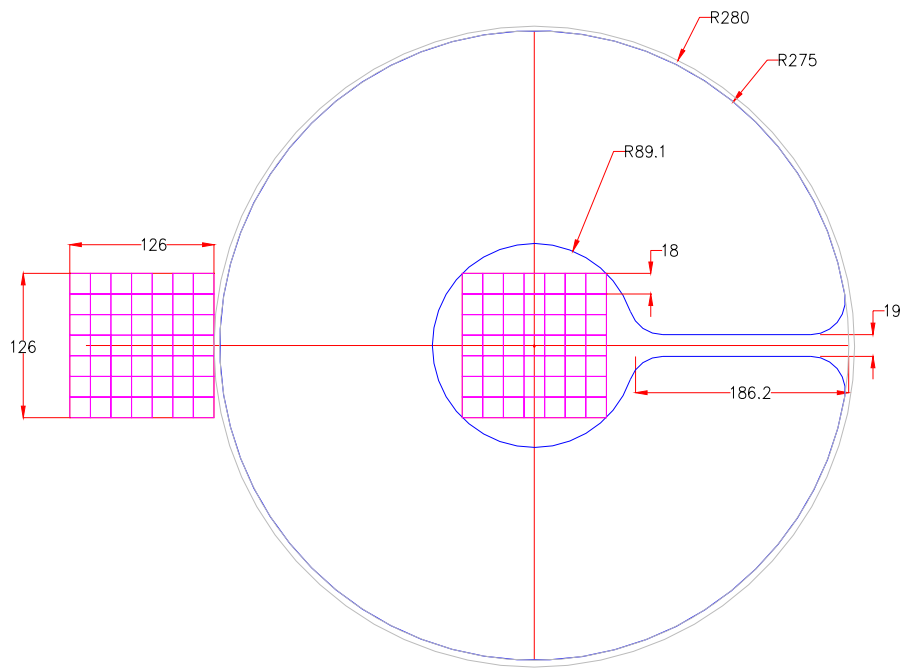


Fig.3 Variant with the rolled type iron core

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 component. It is possible to reduce this cost if use the glued rolled core. Air gap should be machined using EDM technique to avoid laminations short circuits. Seven single layer pancake coils can be moved inside core through the 19 mm air gap. The length of core rolls should be chosen in agreement with maximum cut of EDM machine. Outer stainless steel shell will provide core mechanical stability. Magnet and coil support structures should be welded to this shell forming the final magnet assembly unit.