

**national  
accelerator  
laboratory**

Author  
J. Dinkel  
J. Ryk

Section  
Booster

Page  
1 of 2

Date  
August 29, 1968

Category  
0320

Serial  
TM-23

Subject            SECOND HARMONIC COMPONENT IN BOOSTER MAGNET CURRENT

It has been acknowledged that a saving of 500 k\$ can be realized in the booster rf equipment by the introduction of a second harmonic component in the magnet current.

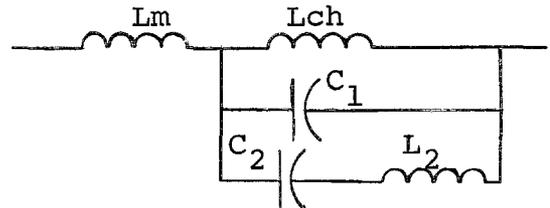
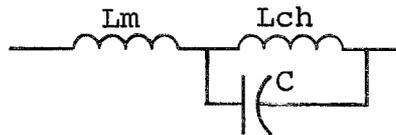
We have investigated a number of possible circuits and optimized the design with respect to minimum cost. The following gives a comparison of the basic resonance system and the system with the added second harmonic component.

Basic resonance system fundamental only

Same system with added second harmonic component

Magnet current  $I_m = I_{dc} - \hat{I} \cos \omega t$

$I_m = I_{dc} - \hat{I} \cos \omega t - \hat{I}/8 \cos(2 \omega t + 1)$



$L_m = .06 \text{ H}$   
 $L_{ch} = .07 \text{ H}$   
 $C = 3479 \text{ } \mu\text{F}$

$L_m \neq .06 \text{ H}$   
 $L_{ch} = .07 \text{ H}$   
 $C_1 = 2400 \text{ } \mu\text{F}$   
 $C_2 = 670 \text{ } \mu\text{F}$   
 $L_2 = .06 \text{ H}$

$\hat{E}_m = 9.7 \text{ kJ}$   
 $\hat{E}_{ch} = 9.9 \text{ kJ}$   
 $\hat{E}_C = 4.0 \text{ kJ}$

$\hat{E}_m = 9.7 \text{ kJ}$   
 $\hat{E}_{ch} = 9.9 \text{ kJ}$   
 $\hat{E}_{C_1} = 3.0 \text{ kJ}$   
 $\hat{E}_{C_2} = 2.1 \text{ kJ}$   
 $\hat{E}_{L_2} = 0.9 \text{ kJ}$

$\hat{V}_{ac} = 1513 \text{ volts}$

$\hat{V}_{ac} = 1513 \text{ volts}$

Cost

Choke = 5382

Cap. = 5400

Cost Total: 10,782/cell

Cost 48 Cells: 518 k\$

Cost

Choke 1 = 5382

Choke 2 = 1100

Cap. 1 = 3600

Cap. 2 = 1680

Cost Total: 11,762/cell

Cost 48 Cells: 565 k\$

The additional cost to add a second harmonic to the magnet current with an amplitude of 1/8 of the fundamental and leading 1 radian with respect to the fundamental is 47 k\$.

The components for this system fit in the magnet support structure.