Design of the High-Current DCCT Applied to the FTPMF System

I. Introduction

The measurement accuracy of current directly, which determines the stability of high flat-top pulsed magnetic field (FTPMF), is a key aspect in some scientific studies, such as nuclear magnetic resonance (NMR). The Direct-Current Current Transformers (DCCT) is the best choice to improve the stability. However, upping to tens of kiloamperes in the FTPMF system, the magnitude of current makes it a challenge for DCCT to achieve fast tracking when the current rises and precise measurement during the flat top simultaneously.

II. Design and Simulation

Excitation windings are formed by 1000-turns coils on the two cores, respectively. The internal and external diameters of each core are 350 mm and 366 mm, and their square sections are 80 mm².

The cores are made of the nanocrystalline material with high permeability, and the inductance of these two windings is about 1.5 H.

III. Result and Discussion

In Wuhan National High Magnetic Field Center (WHMFC), a prototype of 30kA DCCT applied to the FTPMF is designed. This poster will show the calculating formulation of the linear region of the magnetic modulator, the key component to detect magnetic flux in the cores, the result of simulation and the pretest.

Table I EXPERIMENTAL RESULTS OF LINEAR RANGE

<table>
<thead>
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<th>No</th>
<th>Test</th>
<th>Calculated</th>
<th>Corresponding</th>
<th>Difference</th>
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<td>9.7</td>
<td>10.1</td>
<td>0.4</td>
</tr>
<tr>
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<td>151</td>
<td>9.7</td>
<td>10.1</td>
<td>0.4</td>
</tr>
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<td>9.7</td>
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<td>151</td>
<td>9.7</td>
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<td>0.4</td>
</tr>
</tbody>
</table>

IV. Conclusion

Experimental results show that the dynamic performance of prototype can meet the measurement requirement. The linear range of magnetic modulation depends on peak of the excitation current and the saturation current of excitation core, and its calculating formula is given.

However, the accuracy of optical fiber current sensor is lower than DCCT, thus the accuracy of DCCT cannot be calibrated. We are actively seeking help from the national measurement stations.

References