DESIGN OF A PROXIMITY SENSOR USING INDUCTORS, COMPATIBLE WITH INTEGRATED CIRCUIT FABRICATION

by

Vikas Inderpal Gupta, B.E.

Thesis

Presented to the Faculty of the Graduate School
of The University of Texas at Austin
in Partial Fulfillment
of the Requirements
for the Degree of

Master of Science in Engineering

The University of Texas at Austin

August 1995

Copyright

by

Vikas Inderpal Gupta

1995

Dedicated to my parents,

Inderpal Gupta and Shardarani Gupta

and my brother

Vishal Gupta

Acknowledgments

I would like to thank my supervising professor, Dean Neikirk, for giving me the opportunity to pursue this research under his guidance. I am grateful to him for inspiring me to take up solid-state electronics. I am grateful to Dr. Ilene Busch-Vishniac for her guidance in this project and for reading my thesis.

I would like to thank Vijay “Mr.-Walking-Reference-Library” Reddy for the first planar inductor paper I read and for the lunches, Chinese dinners, coffee-breaks (at Whole Foods) and the “intense” discussions. Special thanks to Youngmin Kim for the lunches, for teaching me how to use a lot of the “Team Neikirk” equipment (I know that required a lot of patience) and for his friendship. A big thanks to Jason Lewis for just being around. I have yet to meet a nicer guy. I would also like to thank Olin “Mac Hater” Hartin for alleviating the tedium of working at the MERB. I am grateful to Emre Tuncer, Kiran Gullapalli, Jaeheon Han, Boemtaek Lee, Sangwoo Kim and Robert Friar for making Team Neikirk a great team. A thanks to Anand Srinivasan for his friendship. I would like to thank Bernice Wootton for the administrative support. I am amazed at her patience with us Team Neikirk guys. I would also like to thank the support staff at the MERB (Terrace Demerjian, Donna Larson, Jim Wenner and Patti Esfandiari).

I would like to thank Dr. William Weldon and Dr. Kristin Wood and other members from the “Smart Bearings” group for their guidance.

A big thanks to Jayendran Abraham (at Tandem), Eliot Franklin (at IBM) and Khurram Qureshi (at Metrowerks) for the Sixth Street jaunts, bouts of beer, dinners/ lunches, hiking trips, football games movies and support through my highs and lows.

I am indebted to Dr. J. K. Aggarwal and Dr. Shanti Aggarwal (my parents away from home) for their love and for being there whenever I needed them.

Finally I would like to thank my parents for their love and support and for helping make my dreams come true.

Vikas Gupta
The University of Texas at Austin
May 1995

Abstract

DESIGN OF A PROXIMITY SENSOR USING PLANAR INDUCTORS, COMPATIBLE WITH INTEGRATED CIRCUIT FABRICATION

by

Vikas Inderpal Gupta, M.S.E.

The University of Texas at Austin, 1995

SUPERVISOR: Dean P. Neikirk

This work consists of designing an eddy-current proximity sensor, using a planar inductor as it's transducer. The sensor is capable of measuring distances between a metal target and it's transducer. Single coil designs for the transducer are studied. Methods to calculate the self inductance and resistance of these coils and the mutual inductance between the coils and the target are discussed. The effect of scaling these coils down to microelectronic dimensions is studied.

Two coil transformer designs are studied as an alternative to the single coil designs. The scaling of single coil designs causes the resistance of these coils to increase affecting their performance. This can be circumvented by using a two coil design.

Various fabrication issues which arise due to the specific application of the eddy-current proximity sensor are also studied.

Table of Contents

List of Figures