Harmonic Reduction and Power Factor Correction in Low Power Supply System

by

Chan Weng Hong

Master of Science in Electrical and Electronics Engineering

2002

Faculty of Science and Technology
University of Macau

TABLE OF CONTENTS

LIST OF FIGURES VII
LIST OF TABLES IX
LIST OF ABBREVIATIONS X
PREFACE XI
CHAPTER 1 INTRODUCTION 1
1.1 Introduction 1
1.2 Power Factor Topology 1
1.3 Power Factor Correction method 3
1.3.1 Passive Power Filter 3
1.3.2 Active Power Filter 4
1.3.3 Power Factor Corrector 5
1.4 Brief summary 6
CHAPTER 2 A SINGLE PHASE ACTIVE AC POWER FILTER 7
2.1 Introduction 7
2.2 Harmonic detection 7
2.3 System controller 9
2.4 System configuration 11
2.5 Experiment Result of A single phase Active AC Power Filter 11
2.5.1 Experiment results of inductance loads 12
2.5.2 Experiment results of switching mode power supply loads 15
2.6 Brief Summary 18
CHAPTER 3 POWER FACTOR CORRECTION 20
3.1 Introduction 20
3.1 Power Factor Correction Working Theory 20
3.2 Switching-Mode Regulators 21
3.2.1 Buck Regulator 21
3.2.2 Boost Regulators 28
3.2.3 Buck-Boost Converter 33
3.2.4 Cúk Regulators 36
3.3 Power factor controller Design 43
3.4 P.F.C. Boost Topology Operation 44
3.5 Controller Function Description 47
3.5.1 Controller Function Block Description 47
3.5.2 Boost Inductor Designation 51

3.6 Experiment Results 57
3.6.1 Block Diagram of testing PC Switching Mode Power Supply 57
3.6.2 Experiment result of PC without PFC 57
3.6.3 Experiment results of PC with PFC 60
3.7 Brief Summary 64
CHAPTER 4 CONCLUSIONS 65
BIBLIOGRAPHY 65
APPENDIX A: TESTING RESULT OF 14" COMPAQ MONITOR WITH ACTIVE POWER FILTER 70
APPENDIX B: TESTING RESULT OF ELECTRONIC BALLAST WITH ACTIVE POWER FILTER 72
APPENDIX C: PC IN 180 VOLT TESTING RESULT WITH PFC 74
APPENDIX D: PC IN 250 VOLT TESTING RESULT WITH PFC 77
APPENDIX E: INPUT VOLTAGE DATA OF INDUCTANCE LOADS 80
APPENDIX F: INPUT CURRENT DATA OF INDUCTANCE LOADS IN ACTIVE POWER FILTER STOP AND START 82
APPENDIX G: CERTIFICATION OF PATENT 91
APPENDIX H: CERTIFICATION OF 7TH TIAO ZHAN BEI THIRD PRIZE 92