MICROPROCESSOR-BASED THREE-PHASE HYSTERESIS CURRENT CONTROLLER FOR AC MACHINE DRIVES

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BEKE

MAY 2009

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"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Power Electronic and Drives)"

Signature :

Supervisor's name : Professor Madya Dr. Zulkifilie bin Ibrahim

Date : 12 May 2009

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QUAN VOON BING

A report submitted in partial fulfillment of requirements for the degree of Bachelor In Electrical Engineering (Power Electronic and Drive)

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MAY 2009

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I hereby declared that this report "*Microprocessor-base Three-phase Hysteresis Current Controller for AC Machine Drives*" is a result of my own work research except as cited in the references.

Signature :

Name : QUAN VOON BING

Date : 12 MAY 2009

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To my dearly loved father and mother

To all my teachers and friends

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ABSTRACT

The project is titled as "**To devise and develop a hysteresis current controller for AC motor drives**". In this project, the embedded controller developed is based on 8-bit Atmel microprocessor-based. The current control method implemented in this project is hysteresis current control method. A hysteresis current controllers need to be developed and be complied in Atmel which is microprocessor-based in order to endow with a particular control signal for the AC motor drive. Instead to using assembly language to compile the controller algorithm, this controller will use C/C++ programming language and the Atmel development environment to develop the algorithm. The aspiration of the project is to devise and develop a laboratory scale functioning prototype in order to demonstrate the digital hysteresis current controller operation implemented in ATmega168 microcontroller for motor drives application. The 8-bit Atmel microprocessor-based hysteresis current controller is to generate Pulse Width Modulation (PWM) signals. The PWM signal generated is fed into the IGBT module of the VSI through parallel ports interfacing with three-phase hysteresis current controllers. The major hardware implementation in this project is an embedded microprocessor-based. This Atmel microprocessor-based is selected due to its specification features of high-performance, low power AVR 8-bit microcontroller, easy-to-used hardware and software system, low power consumption and high endurance non-volatile memory segments.

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ABSTRAK

Tajuk projek saya adalah berjudul sebagai "**Untuk menciptakan dan membangunkan satu histeresis pengawal arus untuk enjin arus ulang-alik**". Dalam projek tersebut, pengawal tersirat yang diciptakan adalah berasaskan 8-bit Atmel mikropemprosesan berpangkalan. Cara kawalan arus dilaksanakan dalam projek ini adalah histeresis cara kawalan arus. Satu histeresis alatan kawalan arus hendaklah diciptakan dan dipatuhi dalam Atmel yang ada dalam mikropemprosesan berpangkalan teratur untuk membiayai dengan satu perincian isyarat kawalan untuk enjin arus ulang-alik. Sebaliknya untuk menggunakan bahasa perhimpunan untuk mengumpul algoritma pengawal, pengawal ini akan menggunakan bahasa pengaturcaraan C/C++ dan persekitaran pembangunan Atmel bagi membangunkan algoritma tersebut. Aspirasi projek itu adalah untuk mencipta dan membangunkan satu skala makmal yang berfungsi prototaip sistematik untuk menunjukkan digital histeresis operasi pengawal semasa dilaksanakan dalam mikropengawal ATmega168 untuk permohonan motor berjentera. 8-bit Atmel mikropemprosesan berpangkalan histeresis pengawal arus adalah untuk menjanakan isyarat-isyarat Pemodulan Lebaran Denyutan (PWM). Isyarat PWM yang dijanakan tersebut akan suap ke dalam modul IGBT pengantaramukaan yang selari dan ini akan diteruskan dengan histeresis alat-alat kawalan semasa tiga fasa. Pelaksanaan perkakasan utama dalam projek ini adalah satu mikropemprosesan berpangkalan tersirat. Ini Atmel mikropemprosesan berpangkalan adalah terpilih disebabkan oleh spesifikasinya yang berciri-ciri prestasi tinggi, mikropengawal AVR 8-bit yang berkuasa rendah dan mengandungi segmen-segmen ingatan tak meruap yang berketahanan tinggi.

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LIST OF ABBREVIATIONS

AC	Alternating Current
A/D	Analog-to-Digital
ADC	Analog-to-Digital Converter
AIN	Analog Comparator Input
ALU	Arithmetic Logic Unit
AVR	Automatic Voltage Regulator
AREF	Analog reference pin for A/D Converter
AVcc	Supply voltage pin for A/D Converter
BCD	Binary Coded Decimal
C	Capacitor
CAL	Control Axial Lifetime Technology
CBI	Clear Bit in I/O Register
CLK	Clock

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CPU	Central Processing Unit
CTC	Clear Time on Compare Match
CISC	Complex Instruction Set Computer
CMOS	Complementary Metal Oxide Semiconductor
DC	Direct Current
DAC	Digital-to-Analog Converter
DCB	Direct Copper Bonding
DDR	Double Date Rate
DMM	Digital-Multi-Meters
E	Emitter
EMI	Electromagnetic Interference
EMC	Electromagnetic Compatibility
EPROM	Erasable Programmable Read Only Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
FHP	Fractional Horse Power
FYP	Final Year Project
FTDI	Future Technology Devices International
GND	Ground
IC	Integrated Circuit
I/O	Input/Output
ICP	Input Capture Input

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IDE	Integrated Development Environment
INT	External Interrupt
ISP	In-System Programming
IGBT	Insulated Gate Bipolar Transistor
L	Inductance of inductor
LED	Light Emitter Diode
LSB	Less Significant Bit
LD/LDS/LDD	Load Indirect / Load Direct from SRAM / Load Indirect with Displacement
M	Three-phase AC motor
MAX	Maximum
MCU	Short form of “Microcontroller” used in Arduino environment
MHz	Mega Hertz
MLF	Micro Lead Frame Package
MIPS	Million Instructions Per Second
MISO	Master Input/Slave Output
MOSI	Master Output/Slave Input
MCUCR	Microcontroller Control Register
NPT	Non punch-through
NXT	Lego Mindstorms NXT, a kit for building robots with Lego bricks
OC	Output Compare

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OCF	Output Compare Flag
OCR	Output Compare Register
PC	Program Counter
PCB	Printed Circuit Board
PIC	Programmable Interface Controller
PLL	Phase-Locked Loop
PWM	Pulse Width Modulation
PUD	Pull-up Disable
PDIP	Plastic Dual-In Line Package
PRADC	Power Reduction Analog-to-Digital Converter bit
PCINT	Pin Change Interrupt
QFN	Quad Flat No-Lead Package
R	Resistor
RCD	Resistor-Capacitor-Diode
R&D	Research & Development
ROM	Read Only Memory
RXD	Receive Data
RISC	Reduced Instruction Set Computer
RS-232	Recommended Standard 232
RX LED	Receive Light Emitter Diode in POP-Interface Board
SP	Stack Pointer

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SS	Slave Select
SCK	SPI Bus Master Clock Input
SCL	Serial Bus Clock Line
SDA	2-Wire Serial Bus Data Input/Output Line
SBI	Set Bit in I/O Register
SHE PWM	Selected Harmonic Selection Pulse Width Modulation
SMD	Surface-Mounted Devices
SPI	Serial Peripheral Interface
SPM	Store Program Memory
SVM	Space Vector Pulse Width Modulation
SBIC	Skip if Bit in I/O Register Cleared
SBIS	Skip if Bit in I/O Register Set
SPWM	Sinusoidal Pulse Width Modulation
SRAM	Static Random Access Memory
ST/STS/STD	Store Direct / Store Direct to SRAM / Store Indirect with Displacement
T	Timer
THD	Total Harmonic Distortion
TXD	Transmit Data
TTL	Transistor-Transistor Logic
TOSC	Timer Oscillator
TQFP	Thin Profile Plastic Qua Flat Package

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TX LED	Transmit Light Emitter Diode in POP-Interface Board
USB	Universal Serial Bus
USART	Universal Asynchronous Receiver/Transmitter
VCC	Digital Voltage Supply
Vin	Voltage Input
VOM	Volt-ohm-meters
VSI	Voltage Source Inverter
VLSI	Very-Large-Scale Integration
XCK	External Clock Input/Output
XTAL	Chip Clock Oscillator

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