

Three-phase Inverter Using Microcontroller for Speed Control Application on Induction motor

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Abstract - This paper presents a PWM-controlled three-phase inverter designed for controlling the speed of a three phase induction motor. Inverter has very important role as a power conditioning on the electric power system and industrial field. The speed of the induction motor can be controlled by changing the voltage frequency input of the induction motor. The three phase inverter is implemented by using a Power MOSFET and the PWM signal is generated by a Microcontroller. The inverter performance is measured by simulation and experimental test. Inverter circuit is simulated using PSpice software to investigate the inverter behavior and performance. The testing is conducted using two induction motors with different rpm specification. The testing result shows that the Microcontroller can control well the motor speed in no-load mode with various speed references.

I. INTRODUCTION

Induction motor is the most widely electrical machine used in industry, due to its simple construction, sturdy, cheap, and easy maintenance. The induction motor have shifted the use of DC motor in the industry. However, induction motor has several parameters that are non-linear, especially the rotor resistance which varies for different operating conditions. It causes speed control on induction motor is more difficult in comparison with speed control on DC machine.

Common application of induction machine is for constant speed rotation by direct connection to the grid, rotor speed is determined by the grid system frequency. For variable speed application of induction motor, power conditioning device is required [1].

Speed control of an induction machine can be made by any change of pole number or input voltage frequency of induction motor. However, changing of its pole number is unfractical. Changing of input voltage frequency is realized by using a power conditioning or inverter. The use of inveter is a simple and easy way for controlling speed of induction motor and it has been broadly used on industry application [2],[3].

Inverter converts DC voltage into AC voltage where magnitude and frequency voltage can be varied as required. AC voltage generated is a square waveform or trapesoid. The application of filter device is required to produce pure sinusoidal waveform.

Voltage output regulation of inverter can be done in two ways. First, by adjusting the DC input voltage but the switching frequency is constant. Second, by adjusting the switching frequency while the DC input voltage is constant. In the second methode, the effective AC voltage generated is a function of the pulse width of the switching. How is called Pulse Width Modulation (PWM). [3]

II. THREE-PHASE INVERTER CIRCUIT

The basic circuit of three-phase inverter is presented in Figure 1. It has two capacitors to generate N points for each capacitor voltage $V_i / 2$ remains constant. There are three sides of the switch, namely: switch S1 and S1 + S2 + and S2- as well. Both sides of the switch, the switch S1 and S4, S3 and S4, and S5 and S2. Each switch, S1 and S4, or S3 and S4, or S5 and S2, can not operate simultaneously, because there will be short circuit. ON and OFF from both sides of the switch is determined by the PWM modulation technique [4],[5].

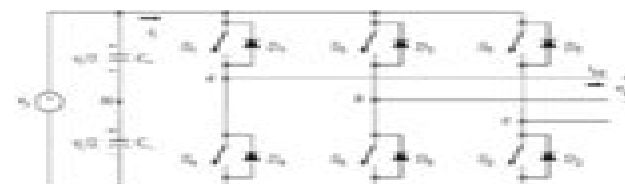


Figure 1. Three fase Inverter Circuit

To produce the output voltage (V_u) in three phases, eight switching conditions configuration as shown in Table 1 should be applied.

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Three Phase Inverter Using Microcontroller:

Microelectronics, Electromagnetics and Telecommunications Ganapati Panda, Suresh Chandra Satapathy, Birendra Biswal, Ramesh Bansal, 2018-11-02 The book discusses the latest developments and outlines future trends in the fields of microelectronics, electromagnetics, and telecommunication. It contains original research works presented at the International Conference on Microelectronics, Electromagnetics and Telecommunication ICMEET 2018 organised by GVP College of Engineering A Andhra Pradesh India. The respective papers were written by scientists, research scholars, and practitioners from leading universities, engineering colleges, and R D institutes from all over the world and share the latest breakthroughs in and promising solutions to the most important issues facing today's society. **PWM Control of a Three Phase Inverter Using a Microcontroller** Mohd Zaidi Sofian, 1998 *Innovations in Electrical and Electronics Engineering* Akhtar Kalam, Saad Mekhilef, Sheldon S. Williamson, 2025-01-16 This book features selected high quality papers presented at the 2024 International Conference on Electrical and Electronics Engineering ICEEE 2024 jointly organized by ADSRS Education and Research and Swinburne University of Technology Melbourne Australia during September 11-12, 2024 at Advanced Technologies Centre Swinburne University of Technology 427-451 Burwood Rd Hawthorn VIC 3122. The book covers electrical engineering topics: power and energy including renewable energy, power electronics and applications, control and automation, and instrumentation. Book two covers the areas of robotics, artificial intelligence, and IoT electronics devices, circuits, and systems; wireless and optical communication; RF and microwaves; VLSI and signal processing; and others. The book brings both single and multidisciplinary research on these topics to provide the most up-to-date information in one place. The book offers an asset for researchers from both academia and industries involved in advanced studies. *Information and Communication Technology for Competitive Strategies (ICTCS 2020)* Amit Joshi, Mufti Mahmud, Roshan G. Ragel, Nilesh Singh V. Thakur, 2021-07-26 This book contains the best selected research papers presented at ICTCS 2020 Fifth International Conference on Information and Communication Technology for Competitive Strategies. The conference was held at Jaipur Rajasthan India during 11-12 December 2020. The book covers state of the art as well as emerging topics pertaining to ICT and effective strategies for its implementation for engineering and managerial applications. This book contains papers mainly focused on ICT for computation, algorithms, and data analytics, and IT security. **Smart Grids for Smart Cities, Volume 1** O. V. Gnana Swathika, K. Karthikeyan, Sanjeevikumar Padmanaban, 2023-07-05 SMART GRIDS for SMART CITIES. Written and edited by a team of experts in the field, this first volume in a two-volume set focuses on an interdisciplinary perspective on the financial, environmental, and other benefits of smart grid technologies and solutions for smart cities. What makes a regular electric grid a smart grid? It comes down to digital technologies that enable two-way communication between a utility and its customers, as opposed to the traditional electric grid where power flows in one direction. Based on statistics and available research, smart grids globally attract the largest investment venues in smart cities. Smart grids and city buildings that are

connected in smart cities contribute to significant financial savings and improve the economy The smart grid has many components including controls computers automation and new technologies and equipment working together These technologies cooperate with the electrical grid to respond digitally to our quickly changing electric demand The investment in smart grid technology also has certain challenges The interconnected feature of smart grids is valuable but it tremendously increases their susceptibility to threats It is crucial to secure smart grids wherein many technologies are employed to increase real time situational awareness and the ability to support renewables as well as system automation to increase the reliability efficiency and safety of the electric grid This exciting new volume covers all of these technologies including the basic concepts and the problems and solutions involved with the practical applications in the real world Whether for the veteran engineer or scientist the student or a manager or other technician working in the field this volume is a must have for any library

ICS EDTI 2022 Herve Boileau, Lu Wen Feng, Lauric Garbuio, Hilfi Pardi, 2023-01-16 This book is the proceeding of the International Conference on Sustainable Engineering Development and Technological Innovation ICS EDTI 2022 that was successfully held on 11-13 October 2022 using an hybrid platform The conference is themed Sustainable empowerment of innovative solutions through the development of integrated scientific researches to enhance the advanced technological world which represents our belief of how the sustainability is essential in our approach to solve problems through technological innovation A total of 56 papers were submitted and presented within the sessions of the conference The papers topics revolve around Informatics Technology Electrical Technology Marine Technology Manufacturing System and Technology Mechanical Engineering And also Information Industry and Management In addition to the technical paper presentations there were also five keynote speeches featured and eight plenary talks were delivered Two of the keynote speeches were delivered in person by Professor Selo from Universitas Gajah Mada Indonesia and Professor Goib Wiranto from the National Research and Innovation Agency Indonesia The rest of the keynote speeches were delivered online by Professor Yvon Kermarrec from IMT Atlantique France Professor Ian Gibson from University of Twente Netherlands and Dr Ilham Akbar Habibie from The Association of Indonesian Engineer Indonesia It was a great pleasure to work with the technical program committee led by Mr Hilfi Pardi who have completed the imperative process of peer review on the technical papers submitted in this conference We are also very fortunate to have on our side the excellent organizing committee team of the Faculty of Engineering of UMRAH who work very hard to organize and support the conference Finally our appreciation to all the authors who have participated in this conference with their amazing achievements and enthusiasm We firmly believe that ICS EDTI is a suitable platform for researchers engineers and developers who are concerned with sustainability in engineering and technological development We hope in the coming years ICS EDTI will be better in terms of the organization of the conference the quantity and the quality of the researches submitted and most importantly the impact on the sustainability of technological innovation

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Anandharamakrishnan,V. R. Sinija,R. Mahendran,2024-02-29 Depending on the mechanisms involved in non thermal technologies such as ozonization irradiation ultrasound processing plasma processing and advanced oxidative processes interaction with food molecules differs which might lead to desirable reactions Non Thermal Technologies for the Food Industry Advances and Regulations explores the possibility of using non thermal technologies for various purposes such as shelf life extension reduced energy consumption adhesion and safety improvement Further it reviews the present status of these technologies international regulations and sustainability aspects in food processing including global case studies Features Provides a comprehensive overview of all the non thermal processing technologies that have potential for use within food manufacturing Covers novel disinfectant technologies and packaging methods for non thermal processing Includes electro spraying and electrospinning low temperature drying techniques cold plasma techniques hydrodynamic cavitation oscillating magnetic field processing and so forth Focus on topics such as the valorization of agri food wastes and by products and sustainability Reviews ClO₂ in combined hybrid technologies for food processing This book is aimed at researchers and graduate students in food and food process engineering Power Electronics Design Handbook Nihal

Kularatna,1998-09-09 Power Electronics Design Handbook covers the basics of power electronics theory and components while emphasizing modern low power components and applications Coverage includes power semiconductors converters power supplies batteries protection systems and power ICs One of the unique features of the Power Electronics Design Handbook is the integration of component and system theory with practical applications particularly energy saving low power applications Many chapters also include a section that looks forward to future developments in that area References for further information or more in depth technical reading are also included Nihal Kularatna is a principal research engineer with the Arthur C Clarke Foundation in Sri Lanka He is also the author of Modern Electronic Test and Measuring Instruments published by the Institute of Electrical Engineers Emphasizes low and medium power components Offers a unique mix of theory and practical application Provides a useful guide to further reading **Computational Intelligence**

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Artificial Intelligence for Integrated Smart Energy Systems in Electric Vehicles Surender Reddy Salkuti, 2025-07-02 This book provides a comprehensive exploration of cutting edge research in electric vehicles EVs integrated smart energy systems with a main focus on the application of artificial intelligence AI This book offers a wide and comprehensive practical approach with the applications of AI to address the challenges and opportunities of modern hybrid energy systems for developing advanced hybrid intelligent methodologies for forecasting and scheduling variable power output from renewable energy sources RESs and EVs This will enhance system flexibility and facilitate the integration of RESs and EVs efficiently which is a step towards a sustainable future The chapters cover diverse topics offering valuable knowledge and methodologies including an introduction to Artificial Intelligence AI Machine Learning ML Internet of Things IoT Cybersecurity and their applications in modern power and energy systems intelligent control of power electronics for RESs and EVs intelligent charging management of EVs etc This book aims to provide insights into various suitable solutions to increase the security reliability and interoperability of the grid under high penetration of renewable energy storage systems and electric transport in the context of the modern smart grid The multi objective optimization problems such as economic and emission dispatch problems flexibility and reliability problems and economic and reliability problems are solved to determine the trade off solutions using efficient evolutionary algorithms The chapters cover diverse topics offering valuable knowledge and methodologies including an introduction to Artificial Intelligence AI Machine Learning ML IoT Cybersecurity and their applications in modern power and energy systems intelligent control of power electronics for RESs and EVs intelligent charging management of EVs etc

SiC based Miniaturized Devices Stephen Edward Sadow, Daniel Alquier, Jing Wang, Francesco LaVia, Mariana Fraga, 2020-06-18 MEMS devices are found in many of today's electronic devices and systems from air bag sensors in cars to smart phones embedded systems etc Increasingly the reduction in dimensions has led to nanometer scale devices called NEMS The plethora of applications on the commercial market speaks for itself and especially for the highly precise manufacturing of silicon based MEMS and NEMS While this is a tremendous achievement silicon as a material has some drawbacks mainly in the area of mechanical fatigue and thermal properties Silicon carbide SiC a well known wide bandgap semiconductor whose adoption in commercial products is experiencing exponential growth especially in the power electronics arena While SiC MEMS have been around for decades in this Special Issue we seek to capture both an overview of the devices that have been demonstrated to date as well as bring new

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Vector Control of Three-Phase AC Machines Nguyen Phung Quang,Jörg-Andreas Dittrich,2015-05-14 This book addresses the vector control of three phase AC machines in particular induction motors with squirrel cage rotors IM permanent magnet synchronous motors PMSM and doubly fed induction machines DFIM from a practical design and development perspective The main focus is on the application of IM and PMSM in electrical drive systems where field orientated control has been successfully established in practice It also discusses the use of grid voltage oriented control of DFIMs in wind power plants This second enlarged edition includes new insights into flatness based nonlinear control of IM PMSM and DFIM The book is useful for practitioners as well as development engineers and designers in the area of electrical drives and wind power technology It is a valuable resource for researchers and students

Proceedings of the 2nd International Conference on Green Energy Conversion System Adel Mellit,Lassaad Sbita,Karim Kemih,Malek Ghanes,2024-11-05 This book presents peer reviewed articles from the 2nd International Conference on Green Energy Conversion Systems held in Djerba Tunisia from 13 15 September 2023 It brings together researchers and professionals from all over the world to share and discuss recent advancements and developments in renewable energy and its applications and foster future collaboration tending towards zero carbon

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what they are doing why they are doing it and how to do it Advances in Power Systems and Energy Management Amik Garg,Akash Kumar Bhoi,Padmanaban Sanjeevikumar,K. K. Kamani,2017-11-28 This book is a collection of research articles and critical review articles describing the overall approach to energy management The book emphasizes the technical issues that drive energy efficiency in context of power systems This book contains case studies with and without solutions on modelling simulation and optimization techniques It covers some innovative topics such as medium voltage MV back to back BTB system cost optimization of a ring frame unit in textile industry rectenna for radio frequency RF energy harvesting ecology and energy dimension in infrastructural designs 2 4 kW three phase inverter for aircraft application study of automatic generation control AGC in a two area hydrothermal power system energy efficient and reliable depth based routing protocol for underwater wireless sensor network and power line communication using LabVIEW This book is primarily targeted at researchers and senior graduate students but is also highly useful for the industry professional and scientists Communication Systems and Information Technology Ming Ma,2011-06-21 This volume includes extended and revised versions of a set of selected papers from the International Conference on Electric and Electronics EEIC 2011 held on June 20 22 2011 which is jointly organized by Nanchang University Springer and IEEE IAS Nanchang Chapter The objective of EEIC 2011 Volume 4 is to provide a major interdisciplinary forum for the presentation of new approaches from Communication Systems and Information Technology to foster integration of the latest developments in scientific research 137 related topic papers were selected into this volume All the papers were reviewed by 2 program committee members and selected by the volume editor Prof Ming Ma We hope every participant can have a good opportunity to exchange their research ideas and results and to discuss the state of the art in the areas of the Communication Systems and Information Technology *Smart Power ICs* Bruno Murari,2002-06-13 This book provides a survey of the state of the art of technology and future trends in the new family of Smart Power ICs and describes design and applications in a variety of fields ranging from automotive to telecommunications reliability evaluation and qualification procedures The book is a valuable source of information and reference for both power IC design specialists and to all those concerned with applications the development of digital circuits and with system architecture *Intelligent Computing in Control and Communication* G.T. Chandra Sekhar,H. S. Behera,Janmenjoy Nayak,Bighnaraj Naik,Danilo Pelusi,2021-01-04 This book consists of peer reviewed papers presented at the First International Conference on Intelligent Computing in Control and Communication ICC3 2020 It comprises interesting topics in the field of applications of control engineering communication and computing technology As the current world is witnessing the use of various intelligent techniques for their independent problem solving so this book may have a wide importance for all range of researchers and scholars The book serves as a reference for researchers professionals and students from across electrical electronic and computer engineering disciplines *Advances of Science and Technology* Mulugeta Admasu Delele,Mekuanint Agegnehu Bitew,Abebech Abera Beyene,Solomon Workneh

Fanta, Addisu Negash Ali, 2021-07-14 This two volume set constitutes the refereed post conference proceedings of the 8th International Conference on Advancement of Science and Technology ICAST 2020 which took place in Bahir Dar Ethiopia in October 2020 The 74 revised full papers were carefully reviewed and selected from more than 200 submissions of which 157 were sent out for peer review The papers present economic and technologic developments in modern societies in 6 tracks Chemical food and bio process engineering Electrical and computer engineering IT computer science and software engineering Civil water resources and environmental engineering Mechanical and industrial engineering Material science and engineering

Switching Power Converters Dorin O. Neacsu, 2017-12-19 An examination of all of the multidisciplinary aspects of medium and high power converter systems including basic power electronics digital control and hardware sensors analog preprocessing of signals protection devices and fault management and pulse width modulation PWM algorithms

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