

On the Design and Control of an Electronic Parking Brake System

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ABSTRACT

An Electronic Parking Brake System (EPB) is developed for actuating the hand brake in vehicles based on design requirements. Auto actuating the brake function of EPB is provided with the extinguishing moment. And auto releasing the brake function of EPB can be executed when the vehicle start moving at the moment. An attached button and indicator must be set up on the driver ' s master for manual actuating the EPB. The dynamic analysis is also proceeded for the safe EPB mechanisms. Controller Area Network bus system is setup therefore the system can communicate with the master controller of vehicle.

Keywords : Electronic parking brake ; dynamic analysis ; CAN bus system

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REFERENCES

- [1] Trinh Chat, Le Van Uyen “ Tinh toan thiet ke he dan dong co khi I, II ” , Published by Nha Xuat Ban Giao Duc, Tran Hung Dao, Hanoi, Vietnam, 2006.
- [2] Cristtopher T.Kilian, “ Modern control Technology ” , West Publishing Company- USA, 1966.
- [3] “ MITcalc ” software of engineering, industrial, and technical calculations, website <http://www.mitcalc.com>, Czech Republic.
- [4] Tong Van On, Hoang Duc Hai, “ Ho vi dieu khien 8051 ” , Published by “ Nha xuat ban lao dong xa hoi ” , Ly Thai To, Hanoi, Vietnam, 2001.

[5] " CX51 Compiler Optimizing C Compiler and Library Reference for Classic and Extended 8051 Microcontrollers " , Keil Electronic GmbH. and Keil Software, Inc, 2001.

[6] " Atmel Microcontrollers for Controller Area Network (CAN) " - By Michel Passemard, Industrial Control Business Development Director - Atmel Corporation 2325 Orchard Parkway San Jose, CA 95131 [7] Arthur Mychael " D.C. machines " Printed in Australia by Griffin Press, Adelaide, McGraw-hill Book Company Australia Pty Limited, Copyright 1977 [8] U.S. Patent No. 5,004,077. " Electromechanical parking brake system " Carlson; Harold L. (Moberly, MO), DeWitt; Michael D. (Columbia, MO), Martel, Jr.; Louis (Moberly, MO), Kelley; Larry W. (Salisbury, MO), Tayon; Jeffrey E. (Moberly, MO). United States Patent April 2, 1991 [9] U.S. Patent No 6,213,259. " Device, method and system for control of an electrically powered parking brake " Hanson; John (Bloomfield Hills, MI), Mercer; Daniel R. (Clarkston, MI). United States Patent April 10, 2001 [10] U.S. Patent No 6,533,082. " Electric parking brake " Gill; Jeremy J. (Clarkston, MI), Slumba; Michael (Clarkston, MI). United States Patent March 18, 2003 [11] U.S. Patent No 6,997,289. " Electrically-operated parking brake device " Iwagawa; Yoshihiro (Saitama, JP), Miyakawa; Jun (Saitama, JP), Taniguchi; Makoto (Saitama, JP), Kichima; Yutaka (Saitama, JP), Takei; Katsuyuki (Saitama, JP), Bessho; Makoto (Saitama, JP). United States Patent February 14, 2006 [12] U.S. Patent No 6,782,978. " Electrical vehicle parking brake device " , Tachiiri; Yoshikazu (Chiryu, JP), Tanaka; Wataru (Anjo, JP), Kozakai; Asao (Anjo, JP). United States Patent August 31, 2004