

Anti-Lock Braking Systems

Overview

Anti-lock braking systems (ABS) are designed to maintain driver control and stability of the car during emergency braking. Locked wheels slow a car but do not provide steering ability. ABS allows maximum braking to be applied while retaining the ability to “steer out of trouble.” The operation of ABS can slightly reduce stopping distance in some cases such as wet road surfaces, but it can increase the stopping distance in others, such as in deep snow or gravel.

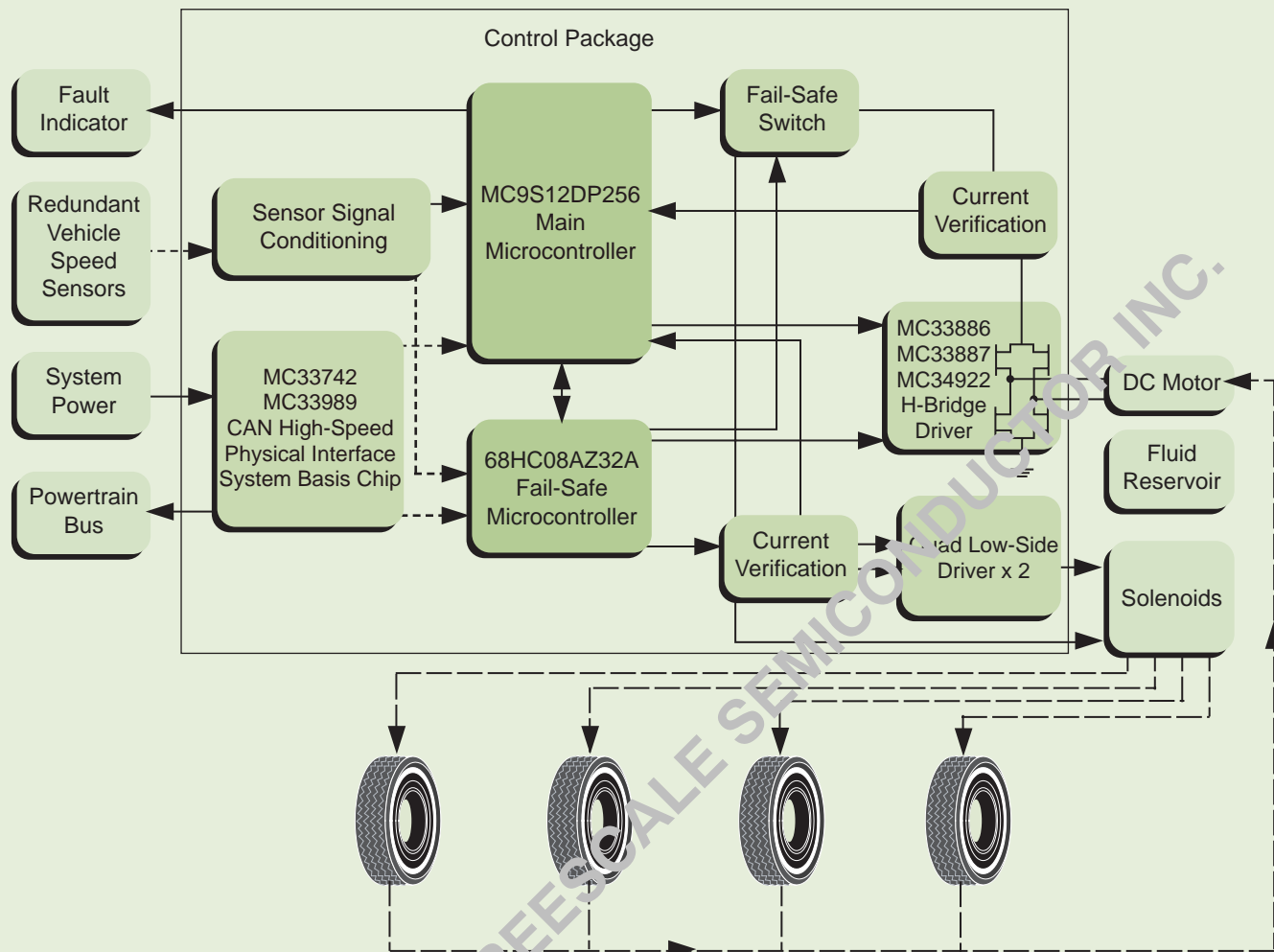
An ABS system monitors four-wheel speed sensors to evaluate wheel slippage. Slip can be determined by calculating the ratio of wheel speed to vehicle speed, which is continuously calculated from the four individual wheel speeds. During a braking event, the function of the control system is to maintain maximum possible wheel grip on the road—without the wheel locking—by adjusting the hydraulic fluid pressure to each brake through electronically controlled solenoid valves.

For passenger car applications, the majority of ABS components are often housed together in a single, under-hood mounted module.

Key Benefits

- > Retains directional control of the vehicle during emergency braking
- > Improves stability of the vehicle during emergency braking
- > Allows near optimal braking even by non-expert drivers
- > Removes tire “flat spot” wear caused by wheel lockup

ANTI-LOCK BRAKING SYSTEM CONTROL PACKAGE



Freescale Ordering Information^{Note}

Part Number	Product Highlights	Additional Information
MC33742	System Basis Chip with Enhanced High-Speed CAN	www.freescale.com/analog
MC33886	H-Bridge Driver (5.2 A)	
MC33887	H-Bridge Driver with Sleep Mode (5.2 A)	
MC33989	System Basis Chip with High-Speed CAN	
MC34922	Dual Power H-Bridge (4.0 A)	
MC68HC08AZ32	8-Bit Microcontroller Unit	www.freescale.com
MC68HC912D60	16-Bit Microcontroller Unit	

Note: Search on the listed part number.

Design Challenges

Because of the safety-related nature of the ABS application, special emphasis is placed on functions designed to detect system faults and ensure that a fail-safe state occurs during faults. These functions may be implemented with techniques such as dual processors and specialized self test and watchdog modules.

ABS systems typically include eight electric solenoid valves and other electrical loads, such as relays and pump motors, that require considerable drive currents. Electronic drive circuitry is often required to sense any failure of these components during operation.

Freescale Semiconductor Solution

ABS system components include the following:

- > Wheel speed sensors on each vehicle wheel
- > Electrically controlled hydraulic valves
- > Electric motor powered hydraulic pump
- > Electronic control unit (ECU)

The following example solution uses the 16-bit 68HC912D60 microcontroller for main application processing, with a 68HC08AZ32 processor functioning as an asymmetrical watchdog processor. Both controllers incorporate controller area network (CAN) communications modules to allow the ABS ECU to communicate with other vehicle systems. Standard devices such as the

MC33886 and MC33887 are designed to enable control of the higher power loads in the system. CAN physical layer devices and power supply regulation components MC33742 and MC33989 are offered in single chip packages.

Freescale Semiconductor also has extensive experience in the development of specialized components for high-volume ABS applications. Freescale Semiconductor *SMARTEOS™* technology allows a large number of the analog and power electronics functions of the system to be integrated into a single device. Novel microcontroller architectures with comprehensive self-testing features have also been developed.

Development Tools *Note*

Vendor	MPC555	MPC561	MPC562	MPC563	MPC564	MPC565	MPC566	TPU
Metrowerks								
CodeWarrior™ for PowerPC ISA Embedded Systems	•	•	•	•	•	•	•	
CodeWarrior for OSEK RTOS	•	•	•	•	•	•	•	
CodeWarrior Development Systems	•					•		
OSEKturbo (RTOS)	•			•		•		
TPU Low-Level Driver Library								•
Flash Programming — CodeWarrior for Embedded PowerPC ISA				•	•	•	•	
Flash Programming — CodeWarrior for OSEK RTOS	•			•	•	•	•	
Wind River Systems								
BDM Debugger — SingleStep	•	•		•		•		
BDM Debugger — SingleStep with Vision	•	•		•		•		
Flash Programming — SingleStep	•			•		•		
BDM Debugger — VisionCLICK	•	•		•		•		
Nexus Debugger — VisionCLICK		•		•		•		
Nexus Debugger — SingleStep with Vision		•		•		•		
Flash Programming — VisionCLICK	•			•		•		
Compiler — Diab/Keil	•	•	•	•	•	•	•	
MATRIX	•	•		•		•		
Simulator — SingleStep	•	•	•	•	•	•	•	
Lauterbach								
BDM Debugger Trace32	•	•	•	•	•	•	•	•
Nexus Debugger Trace32		•	•	•	•	•	•	•
Code Trace (with Bus access)	•	•	•	•	•	•	•	
Code Trace (Nexus)	•	•	•	•	•	•	•	

Note: Search on the listed product name.

Development Tools (continued)^{Note}

Vendor	MPC555	MPC561	MPC562	MPC563	MPC564	MPC565	MPC566	TPU
Axiom Manufacturing								
Low-Cost Evaluation Board	•	•						
Mid-Range Evaluation Board	•	•						
Full-Feature Evaluation Board	•	•	•	•	•	•	•	
Ashling Microsystems								
BDM Debugger — Opella, Genia, and Vitra	•	•	•	•	•	•	•	
Nexus Debugger — Vitra (w/trace)		•		•		•		•
Nexus Debugger — Opella, Genia		•		•		•		
Green Hills Software								
IDE, Debugger — Multi	•	•		•		•		
Compiler — C/C++/EC++	•	•		•		•		
P&E Microcomputer Systems								
Low-Cost Debugger	•	•		•		•		
Flash Programming Tools	•			•		•		
GNU								
Compiler/Debugger	•	•		•		•		
ASH WARE								
TPU Simulator								•
ETAS								
ErCOSEK	•	•		•		•		
Calibration Tools (ETK)	•	•		•		•		
Calibration Tools (ETK) Nexus	•	•		•		•		
dSPACE								
Targetlink	•	•		•		•		
dli								
Logic Analyzer	•	•		•		•		
Agilent Technologies								
Logic Analyzer	•	•		•		•		
Inverse Assembler, Source Correlation	•	•		•		•		
Emulation Probe (BDV)	•	•		•		•		
Tektronix								
Logic Analyzer	•	•		•		•		
Abatron AG								
BDM Support	•	•		•		•		
Accelerated Technology								
Nucleus (RTOS)	•	•		•		•		

Note: Search on the listed product name.

Tool Type	Product Name	Vendor	Description	Additional Information
Evaluation Kit	KIT33886DHEVB	Metrowerks	H-Bridge Integrated Circuit	www.metrowerks.com
Evaluation Kit	KIT33887DWBEVB	Metrowerks	225 mΩ 150°C and Sleep Mode and Current Sense	
Evaluation Kit	KIT33922PNBEVB	Metrowerks	Dual H-Bridge	
Evaluation Kit	KIT33989DWEVB	Metrowerks	System Basis Chip with High-Speed CAN	

Note: Search on the listed product name.

Disclaimer

This document may not include all the details necessary to completely develop this design. It is provided as a reference only and is intended to demonstrate the variety of applications for the device.

Third Party Support

Vendor	Contact Information
Metrowerks	800-377-5416 (www.metrowerks.com)
Axiom Manufacturing	972-926-9303 (www.axman.com)
Wind River Systems	800-872-4977 (www.windriver.com)
Green Hills Software	805-965-6044 (www.ghs.com)
Lauterbach	508-303-6812 (www.lauterbach.com)
Accelerated Technology	800-468-6853 (www.acceleratedtechnology.com)
Ashling Microsystems	408-732-6490 (www.ashling.com)
ASH WARE	503-533-0271 (www.ashware.com)
GNU	617-542-5942 (www.gnu.org)
ETAS	888-382-7462 (www.etasinc.com)
dSPACE	248-567-1300 (www.dspace.com)
P&E Microcomputer Systems	617-353-9206 (www.pemicro.com)

Online Topics

Description	Location
Analog and Mixed Signal	www.freescale.com
M68HC12	www.freescale.com
MPC500	www.freescale.com
32-Bit Development Tools	www.freescale.com

Related Documentation^{Note}

Document Number	Description	Additional Information
APDPAK	Analog ICs Integrated Solutions Pin Pack	www.freescale.com
SG187	Automotive Selector Guide	

Note: Search on the listed document number.

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Notes

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