By-Wire

Overview

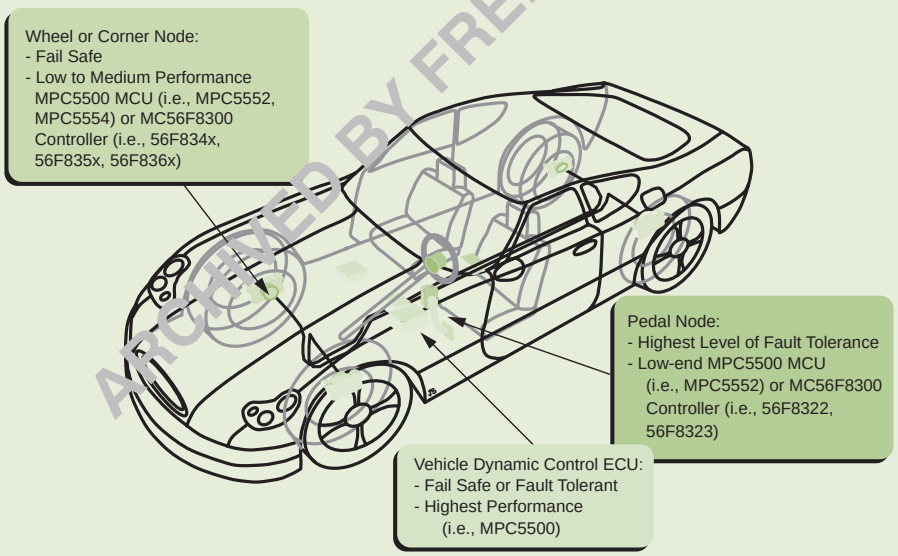
A “by-wire” denotes a control system that replaces traditional mechanical or hydraulic linkages with electronic connections between control units that drive electromechanical actuators. Originally used in the aerospace industry, by-wire technology is making its way into the ground transportation sector. Automotive by-wire includes three categories: throttle by-wire, steer by-wire, and brake by-wire.

A throttle by-wire system replaces the cable connecting the gas pedal and throttle valve(s) with an electrical connection. The throttle is electronically controlled for more efficient operation. In addition, electronic throttle units enhance safety systems such as a Traction Control System (TCS) or Electronic Stability Program (ESP).

A steer by-wire system replaces the steering column with control units linked by a fault-tolerant network. The driver's steering controller is connected through the network to motors that are connected to the steering rack or individual corners. Steer by-wire systems enhance safety, increase fuel economy, provide varying levels of “road feel”, and allow car designers more flexibility.

A brake-by wire system uses electrical connections to connect the four braking “corners” to the pedal and to each other. This system provides better control of pedal stiffness, traction control, vehicle stability, and brake force distribution.

BRAKE BY-WIRE SYSTEM ARCHITECTURE AND PERFORMANCE REQUIREMENTS



Key Benefits

> Uses “by-wire” vehicle control systems that do not rely on mechanical or hydraulic linkages

> Links control units by electronic means that drive electromechanical actuators to control the vehicle

> Supports three categories of automotive by-wire systems: throttle by-wire, steer by-wire, and brake by-wire

> Includes the potential customer benefits of enhanced safety, enhanced road feel, and savings on gas mileage—about three percent for steer by-wire

freescale semiconductor

Freescale Ordering Information

Part Number	Product Highlights	Additional Information
MPC500 Family	> Floating point unit > 40MHz or 56MHz CPU > Compatible with the PowerPC ISA > Available with code compression > Up to 1MB Flash memory	www.freescale.com[Note]
MPC5500 Family	> Book E PowerPC ISA e500™ core > Up to 300 MHz core speed > Up to 4MB embedded Flash memory > Up to 128K embedded SRAM memory > Memory management unit (MMU) > Single instruction multiple data (SIMD) unit for DSP functionality > Enhanced time processor unit (eTPU) > Superfast QADC - for multiple ADC readings without any CPU intervention > Direct memory access (DMA) controller > Nexus Class IEEE-ISTO 5001 three multi-core debug capabilities > Multiple controller area network (CAN) controllers with flexible buffers sizes ranging up to 64 deep	www.freescale.com[Note]
MC56F8300 Family	60 MHz, 60 MIPS, up to 576KB Flash, 36KB RAM and Off-Chip Memory, SCI, SPI, ADC, PWM, Quadrature Decoder, Quad Timer, FlexCAN, GPIO, COP/Watchdog, PLL, MCU-style software stack support, JTAG/OnCE for debug, temperature sensor	www.freescale.com[Note]

Note: Search on the listed part number.

Design Challenges

By-wire systems are generally more expensive than conventional systems, but with wider adoption, the costs should decrease with the economies of scales that are realized. However, these systems tend to replace mechanical and/or hydraulic systems with much smaller, safer, and efficient electromechanical ones.

Freescale Semiconductor Solution

A by-wire system requires a high-performance control architecture, such as the ones offered by the MPC500/MPC5500 microcontroller or 56F800E hybrid controller families from Freescale Semiconductor. Furthermore, high-speed protocol networks that are deterministic, fault-tolerant, and capable of supporting distributed control systems are necessary. FlexRay provides these capabilities and more.

Development Tools

Vendor	MPC555	MPC561	MPC562	MPC563	MPC564	MPC565	MPC56[illegible]	MC56F8300	TPU
Freescale Semiconductor									
56F8300 Developers Starter Kit								●	
Metrowerks									
CodeWarrior™	●	●	●	●	●	●	●	●	
CodeWarrior for OSEK RTOS	●	●	●	●	●	●	●		
CodeWarrior Development Systems	●					●		●	
OSEKturbo (RTOS)	●	●		●		●		●	
TPU Low-Level Driver Library									●
Flash Programming — CodeWarrior	●			●	●	●	●	●	
Flash Programming — CodeWarrior for OSEK RTOS	●			●	●	●	●	●	
Processor Expert Plug-in for CodeWarrior								●	
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 — DiabData	●	●	●	●	●	●	●		
MATRIXX	●	●		●		●			
Simulator — SingleStep	●	●	●	●	●	●	●		
Lauterbach									
BDM Debugger Trace32	●	●	●	●	●	●	●	●	●
Nexus Debugger Trace32		●	●	●	●	●	●		●
Code Trace (w[illegible] access)	●	●	●	●	●	●	●		
Code Trace (Nexus)	●	●	●	●	●	●	●		
Axiom Manufacturing									
Low-Cost Evaluation Board	●	●							
Mid-Range Evaluation Board	●	●							
Full-Feature Evaluation Board	●	●	●	●	●	●	●		

Development Tools (continued)

Vendor	MPC555	MPC561	MPC562	MPC563	MPC564	MPC565	MPC566	MC56F8300	TPU
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)	●	●		●		●			

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
FlexRay™ Consortium	www.flexray.com
32-Bit Development Tools	www.freescale.com
MPC500 family	www.freescale.com
MC56F8300	www.freescale.com

Notes

Learn More: Contact the Technical Information Center at +1-800-521-6274 or +1-480-768-2130.
For more information about Freescale products, please visit **www.freescale.com**.

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