

KEY BENEFITS

- MPC500 embedded microcontrollers are ideal for control-intensive applications like the robotic arm
- Compatible with the PowerPC ISA instruction set architecture
- Features CAN 2.0B (TouCAN) for system control
- Available in 125 kbps for simple control (repetitive acts of part movement from point A to B in a production line) and in 250 kbps or 500 kbps for complex control for use in mobile machinery moving through various environments and requiring many sensor feedbacks from numerous sources

OVERVIEW

Use of hybrid architecture combining an MPC5xx microcontroller unit (MCU) and two to three TouCAN modules can be used in applications from toys to industrial manufacturing. Each node on a robotic arm application has a standalone functioning module designed to enable modular construction, which leads to adaptable robotic arms. Nodes include sensors designed to gauge temperature, pressure, and position to allow feedback to the central control unit. Up to 32 nodes can be driven from one embedded controller.

The MPC500 embedded microcontrollers are ideal for control intensive applications like the robotic arm. Compatible with the PowerPC ISA instruction set architecture, these devices are available with two or three TouCAN modules that send control signals to CAN drivers (one for each TouCAN module). The systems communication is essentially achieved between two lines with a CAN 2.0B protocol. Each CAN driver is engineered to be able to drive up to 32 nodes across an entire robotic application. The nodes are designed to independently deliver control commands to motors or actuators or send and receive sensor information about the robot or the surrounding environment.

Imagine a cave exploration robot rolling downward into a rough, dark terrain. It examines a rock with a remote controlled arm—scratching the surface and detecting compounds. Next, the robot plunges into a liquid pool. Sensors on the arm inform the central processor that the liquid is di-hydrous oxide (water), and proceeds to the next observation.

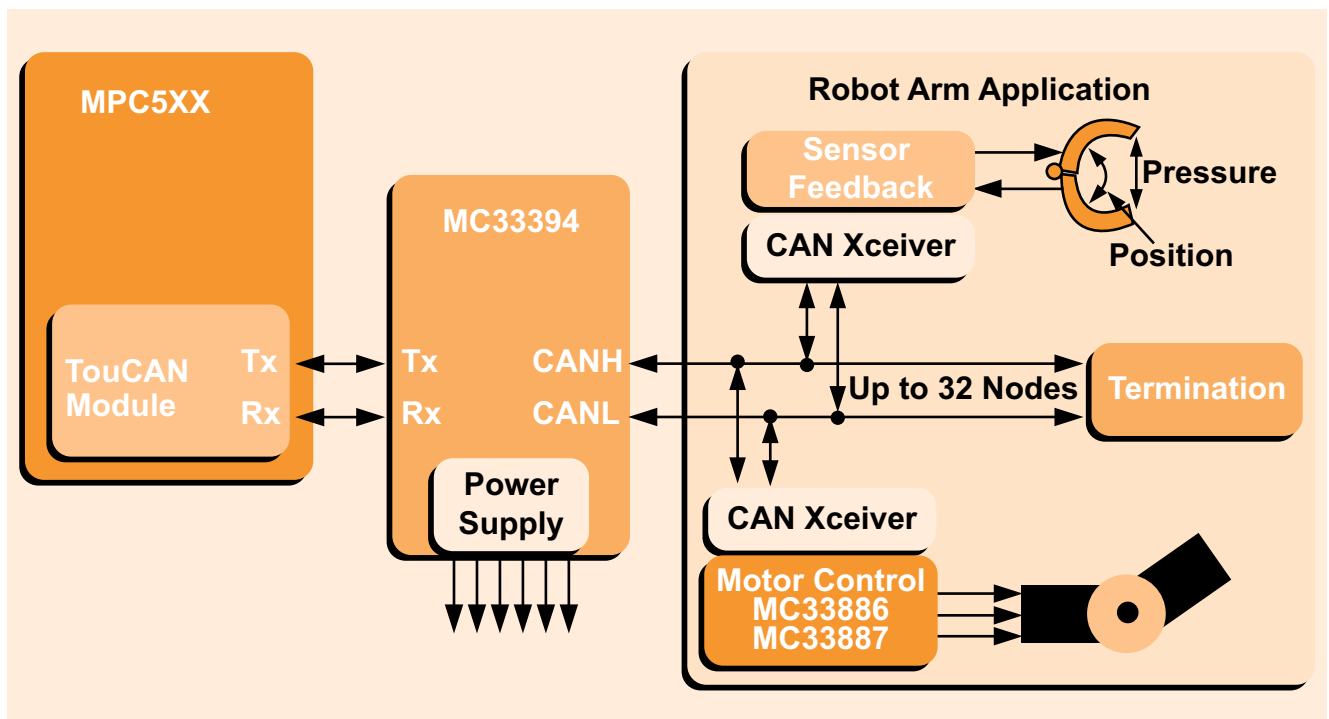


Figure 1. Robotic Arm Application

MOTOROLA ORDERING INFORMATION

Part Number	Product Highlights	Additional Information
MPC500	<ul style="list-style-type: none"> Floating point unit 40 or 56 MHz CPU Compatible with PowerPC ISA Available with code compression Up to 1MB Flash memory 	www.motorola.com/semiconductors ^{NOTE}
MC33394	<ul style="list-style-type: none"> 3.5 V to 26.5 V operating range (45 V transient) Step-up/step-down switching preregulator Multiple linear regulators with current limiting Adjustable low voltage linear regulator with external pass transistor 	www.motorola.com/semiconductors ^{NOTE}
MC33886	<ul style="list-style-type: none"> 225 mΩ @ 150°C Integrated H-Bridge 	www.motorola.com/semiconductors/analog
MC33887	<ul style="list-style-type: none"> 130 mΩ @ 25°C, sleep mode Integrated H-Bridge 	www.motorola.com/semiconductors/analog

NOTE: Search on the listed part number.

DESIGN CHALLENGES

Design challenges for robotic manipulations include boundary control, strength of movement, and intricate interaction between various parts of one arm or dual robotic arms working together. Boundary control and controlling the force applied to the movement is essential for safety and proper motion of a robotic arm. This can be assisted with the use of the queued analog-to-digital converter (QADC) modules. Intricate timing of interactions can be assisted with the use of the timer processor unit (TPU) modules. Timely communication of these and other controls may be achieved through the TouCAN modules. All of these modules are a part of Motorola's MPC500 family.

MOTOROLA SOLUTION

The robotic arm features Controller Area Network (CAN) 2.0B (TouCAN) for system control. It is available in 125 kbps for simple control such as repetitive acts of part movement from point A to B in a production line. It is also available in 250 kbps or 500 kbps for complex control for use in mobile machinery that moves through various environments requiring many sensor feedbacks from numerous sources. An example of this functionality can be seen in a vehicle such as a submersible cave explorer that has arms for exploration, which can provide feedback about texture, hardness, and grip.

Line termination is a requirement of the system for it to function properly. It is important for the customer to know about line termination to remove the "mystery physics" required to operate the system. This requirement is achieved in one of three ways:

- A 60 Ohm resistor across CANH and CANL
- Two 120 Ohm resistors at each end across CANH and CANL and a 30 Ohm resistor from CANH
- One 30 Ohm resistor from CANL with a capacitor between the resistors

Motorola offers the MPC500 embedded microcontrollers featuring three TouCAN controllers on each MPC500 part (two on the MPC555). This connectivity provides the customer with a higher degree of freedom when developing the final application. Several operations can be run in parallel or can be independently segmented from the rest of the system to operate under unique parameters. Additionally, it offers a 2.0B CAN protocol and much more. The companion chip—the MC33394 SmartMOS Power Oak—controls up to 32 control/communication nodes with a high-speed CAN module designed for communication speeds up to 500 kbps. However, noise immunity at such speeds may not be achieved by wave shaping alone. The use of a common mode choke may be required in some applications. The device is engineered with an additional three levels of power supply for the control board (2.6 V, 3.3 V, 5 V) as well as one serial peripheral interface (SPI) module with 16-bit Data/StatusExchange.

DEVELOPMENT TOOLS

Vendor	MPC555	MPC561	MPC562	MPC563	MPC564	MPC565	MPC566	TPU
Metrowerks								
CodeWarrior for PowerPC Embedded Systems	X	X	X	X	X	X	X	
CodeWarrior for OSEK RTOS	X	X	X	X	X	X	X	
CodeWarrior Development Systems	X					X		
OSEKturbo (RTOS)	X	X		X		X		
TPU Low-Level Driver Library								X
Flash Programming — CodeWarrior for Embedded PowerPC	X	—	—	X	X	X	X	
Flash Programming — CodeWarrior for OSEK RTOS	X	—	—	X	X	X	X	
Wind River Systems								
BDM Debugger - SingleStep	X	X		X		X		
BDM Debugger - SingleStep with Vision	X	X		X		X		
Flash Programming - SingleStep	X	—		X		X		
BDM Debugger - VisionCLICK	X	X		X		X		
Nexus Debugger - VisionCLICK		X		X		X		
Nexus Debugger - SingleStep with Vision		X		X		X		
Flash Programming - VisionCLICK	X	—		X		X		
Compiler - DiabData	X	X	X	X	X	X	X	
MATRIXx	X	X		X		X		
Simulator - SingleStep	X	X	X	X	X	X	X	
Lauterbach								
BDM Debugger Trace32	X	X	X	X	X	X	X	X
Nexus Debugger Trace32		X	X	X	X	X	X	X
Code Trace (with Bus access)	X	X	X	X	X	X	X	
Code Trace (Nexus)	X	X	X	X	X	X	X	
Axiom Manufacturing								
Low-Cost Evaluation Board	X	X						
Mid-Range Evaluation Board	X	X						
Full-Feature Evaluation Board	X	X	X	X	X	X	X	
Ashling Microsystems								
BDM Debugger - Opella, Genia, and Vitra	X	X	X	X	X	X	X	
Nexus Debugger - Vitra (w/trace)		X		X		X		X
Nexus Debugger - Opella, Genia		X		X		X		
Green Hills Software								
IDE, Debugger - Multi	X	X		X		X		
Compiler - C/C++/EC++	X	X		X		X		

MOTOROLA REFERENCE DESIGNS

Design Number	Description	Additional Information
RD68HC908RKE	Radio Frequency Reference Design for Remote Keyless Entry Radio frequency is an ideal wireless technology for low-cost applications where users only need to transmit data. There are many uses for RF technology such as in gate openers, smoke detectors, and remote sensors for a variety of consumer and industrial products.	www.motorola.com/semiconductors ^{NOTE}
RD68HC08PIR	Passive Infrared (PIR) for Security Peripherals and Other Remote Networks The self-calibrating PIR detector reference design demonstrates the ability of a device from the 68HC908JL/JK family of MCUs to form the core of an intelligent PIR detector that is capable of self-calibration and walk-through test from data provided by a handheld remote control unit communicating via an infrared protocol. The remote control unit is also to be implemented using an MC68HC908GP32.	www.motorola.com/semiconductors ^{NOTE}

NOTE: Search on the listed design number.

RELATED INFORMATION

For inquiries about Motorola products, please contact the Technical Information Center at 800-521-6247, or visit us online at www.motorola.com/semiconductors.

Document Number	Description
APDPAK/D	Analog ICs Integrated Solutions Pitch Pack
SG1002/D	Analog Product Selector Guide

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