

# CR16HCS5/CR16HCS9/CR16MAR5/CR16MAS5/ CR16MAS9/CR16MBR5/CR16MCS5/CR16MCS9 Family of 16-bit CAN-enabled CompactRISC Microcontrollers

## General Description

The family of 16-bit CompactRISC™ microcontroller is based on a Reduced Instruction Set Computer (RISC) architecture. The device operates as a complete microcomputer with all system timing, interrupt logic, flash program memory or ROM memory, RAM, EEPROM data memory, and I/O ports included on-chip. It is ideally suited to a wide range of embedded controller applications because of its high performance, on-chip integrated features and low power consumption resulting in decreased system cost.

The device offers the high performance of a RISC architecture while retaining the advantages of a traditional Complex Instruction Set Computer (CISC): compact code, on-chip memory and I/O, and reduced cost. The CPU uses a three-stage instruction pipeline that allows execution of up to one instruction per clock cycle, or up to 25 million instructions per second (MIPS) at a clock rate of 24 MHz.

The device contains a FullCAN class, CAN serial interface for low/high speed applications with 15 orthogonal message buffers, each supporting standard as well as extended message identifiers.

The device has up to 64K bytes of reprogrammable flash EEPROM program memory or ROM memory, 1.5K bytes of flash EEPROM In-System-Programming memory, 3K bytes of static RAM, 2K bytes of non-volatile EEPROM data memory and 128 bytes with high endurance, two USARTs, two 16-bit multi-function timers, one SPI/MICROWIRE-PLUS™ serial interface, a 12-channel A/D converter, two analog comparators, WATCHDOG™ protection mechanism, and up to 56 general-purpose I/O pins.

The device operates with a high-frequency crystal as the main clock source and either the prescaled main clock source or with a low frequency (32.768 kHz) oscillator in Power Save mode. The device supports several Power Save modes which are combined with multi-source interrupt and wake-up capabilities. This device also has a Versatile Timer Unit (VTU) with four timer sub-systems, a CAN interface, and ACCESS.bus synchronous serial bus interface.

Powerful cross-development tools are available from National Semiconductor and third party suppliers to support the development and debugging of application software for the device. These tools let you program the application software in C and are designed to take full advantage of the CompactRISC architecture.

In the following text, device is always referred to the family of 16-bit CAN-enabled CompactRISC Microcontroller.

Please check the web for the latest update to this datasheet.

## Features

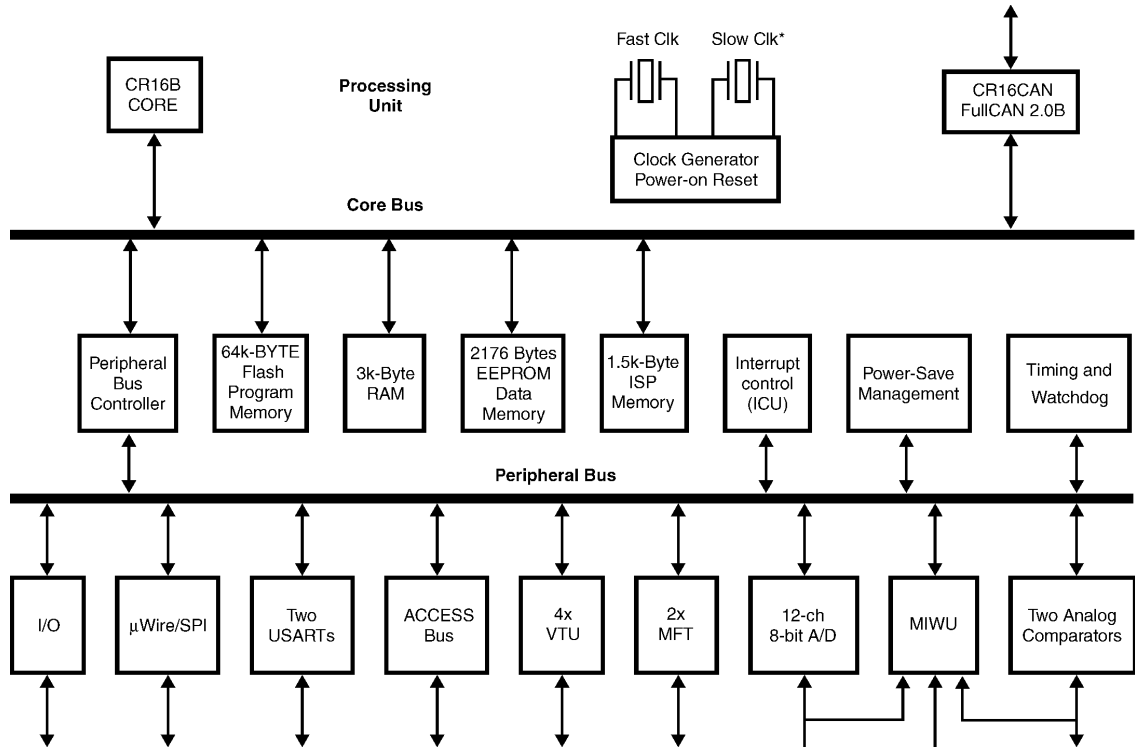
- CPU Features
  - Fully static core, capable of operating at any rate from 0 to 24 MHz (4 MHz minimum in active mode)
  - Multi-source vectored interrupts (internal, external, and on-chip peripheral)
  - Dual clock and reset
- On-chip power-on reset
- On-Chip Memory
  - Up to 64 kbytes flash EEPROM program memory; can be programmed, erased, and reprogrammed by software (100 kcycles)
  - 3 kbytes of static RAM data memory
  - For flash program memory devices, 1.5 kbytes flash EEPROM memory is available to store boot loader code (100 kcycles)
  - 2 kbytes of non-volatile EEPROM data memory with low endurance (25 kcycles) and 128 bytes with high endurance (100 kcycles)
- On-Chip Peripherals
  - Two Universal Synchronous/Asynchronous Receiver/Transmitter (USART) devices
  - Programmable Idle Timer and real-time clock (T0)
  - Two dual 16-bit multi-function timers (MFT1 and MFT2)
  - 8/16-bit SPI/MICROWIRE-PLUS serial interface
  - 12-channel, 8-bit Analog-to-Digital (A/D) converter with external voltage reference, programmable sample-and-hold delay, and programmable conversion frequency
  - ACCESS.bus synchronous serial bus
  - FullCAN interface with 15 message buffers compliant to CAN specification 2.0B active
  - Versatile Timer Unit with four subsystems (VTU)
  - Two analog comparators
  - Integrated WATCHDOG logic
- I/O Features
  - Up to 56 general-purpose I/O pins (shared with on-chip peripheral I/O pins)
  - Programmable I/O pin characteristics: TRI-STATE output, push-pull output, weak pull-up input, high-impedance input
  - Schmitt triggers on general purpose inputs
- Power Supply
  - 4.5V to 5.5V single-supply operation
- Temperature Range
  - -40°C to +85°C
  - -40°C to +125°C

## Features (Continued)

— CompactRISC tools provide C programming and debugging support

- Development Support
  - Real-time emulation and full program debug capabilities available

## Block Diagram



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# CR16MAS9 Product Folder

## Family of 16-bit CAN-enabled CompactRISC Microcontrollers

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### Parametric Table

Operating Frequency (MHz)	25
Code Memory (in K Bytes) (Bytes)	64
Code Memory Type	Flash
SRAM (in K Bytes) (Bytes)	3
EEPROM Data Memory	-
CAN	Yes
ACCESS.Bus/I2C	Yes
Operating Voltage	5.0V
General Purpose I/O	56
SCI/SPI	2 / 1

### Parametric Table

Halt/Idle	Yes
MIWU	Yes
Timers	MFT, VTU
Interrupts	32 + 1NMI
Power on Reset	Yes
Watchdog	Yes
A/D Converter # Ch	none
Comparators	No
Microwire Plus	Yes
USART Interface	Yes

### Datasheet

Title	Size in Kbytes	Date	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
CR16HCS5 CR16HCS9 CR16MAR5 CR16MAS5 CR16MAS9 CR16MBR5 CR16MCS5 CR16MCS9 Family of 16-bit CAN-enabled CompactRISC Microcontrollers	50 Kbytes	2-Jan-02	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>

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### Package Availability, Models, Samples & Pricing

Part Number	Package			Status	Models		Samples & Electronic Orders	Budgetary Pricing		Std Pack Size	<a href="#">Package Marking</a>
	Type	Pins	MSL		SPICE	IBIS		Qty	\$US each		
CR16MAS9VJE7	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Full production	N/A	N/A	<a href="#">Buy Now</a>	1K+	\$10.8000	tray of 84	[logo]2¢Z¢3¢T¢P CR16MAS9VJE7
CR16MAS9VJE8	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Full production	N/A	N/A	<a href="#">Buy Now</a>	1K+	\$10.7000	tray of 84	[logo]2¢Z¢3¢T¢P CR16MAS9VJE8

CR16MAS9VJE9	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Full production	N/A	N/A	<a href="#">Samples</a> <a href="#">Buy Now</a>	1K+	\$10.4000	tray of 84	[logo]2çZç3çTçP CR16MAS9VJE9
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## General Description

The family of 16-bit CompactRISC™ microcontroller is based on a Reduced Instruction Set Computer (RISC) architecture. The device operates as a complete microcomputer with all system timing, interrupt logic, flash program memory or ROM memory, RAM, EEPROM data memory, and I/O ports included on-chip. It is ideally suited to a wide range of embedded controller applications because of its high performance, on-chip integrated features and low power consumption resulting in decreased system cost.

The device offers the high performance of a RISC architecture while retaining the advantages of a traditional Complex Instruction Set Computer (CISC): compact code, on-chip memory and I/O, and reduced cost. The CPU uses a three-stage instruction pipeline that allows execution of up to one instruction per clock cycle, or up to 25 million instructions per second (MIPS) at a clock rate of 24 MHz.

The device contains a FullCAN class, CAN serial interface for low/high speed applications with 15 orthogonal message buffers, each supporting standard as well as extended message identifiers.

The device has up to 64K bytes of reprogrammable flash EEPROM program memory or ROM memory, 1.5K bytes of flash EEPROM In-System-Programming memory, 3K bytes of static RAM, 2K bytes of non-volatile EEPROM data memory and 128 bytes with high endurance, two USARTs, two 16-bit multi-function timers, one SPI/MICROWIRE-PLUS™ serial interface, a 12-channel A/D converter, two analog comparators, WATCHDOG™ protection mechanism, and up to 56 general-purpose I/O pins.

The device operates with a high-frequency crystal as the main clock source and either the prescaled main clock source or with a low frequency (32.768 kHz) oscillator in Power Save mode. The device supports several Power Save modes which are combined with multi-source interrupt and wake-up capabilities. This device also has a Versatile Timer Unit (VTU) with four timer sub-systems, a CAN interface, and ACCESS.bus synchronous serial bus interface.

Powerful cross-development tools are available from National Semiconductor and third party suppliers to support the development and debugging of application software for the device. These tools let you program the application software in C and are designed to take full advantage of the CompactRISC architecture.

In the following text, device is always referred to the family of 16-bit CAN-enabled CompactRISC Microcontroller.

Please check the web for the latest update to this datasheet.

## Features

- CPU Features
  - Fully static core, capable of operating at any rate from 0 to 24 MHz (4 MHz minimum in active mode)
  - Multi-source vectored interrupts (internal, external, and on-chip peripheral)
  - Dual clock and reset
- On-chip power-on reset
- On-Chip Memory
  - Up to 64 kbytes flash EEPROM program memory; can be programmed, erased, and reprogrammed by software (100 kcycles)
  - 3 kbytes of static RAM data memory
  - For flash program memory devices, 1.5 kbytes flash EEPROM memory is available to store boot loader code (100 kcycles)
  - 2 kbytes of non-volatile EEPROM data memory with low endurance (25 kcycles) and 128 bytes with high endurance (100 kcycles)

- On-Chip Peripherals
  - Two Universal Synchronous/Asynchronous Receiver/Transmitter (USART) devices
  - Programmable Idle Timer and real-time clock (T0)
  - Two dual 16-bit multi-function timers (MFT1 and MFT2)
  - 8/16-bit SPI/MICROWIRE-PLUS serial interface
  - 12-channel, 8-bit Analog-to-Digital (A/D) converter with external voltage reference, programmable sample-and-hold delay, and programmable conversion frequency
  - ACCESS.bus synchronous serial bus
  - FullCAN interface with 15 message buffers compliant to CAN specification 2.0B active
  - Versatile Timer Unit with four subsystems (VTU)
  - Two analog comparators
  - Integrated WATCHDOG logic
- I/O Features
  - Up to 56 general-purpose I/O pins (shared with on-chip peripheral I/O pins)
  - Programmable I/O pin characteristics: TRI-STATE output, push-pull output, weak pull-up input, high-impedance input
  - Schmitt triggers on general purpose inputs
- Power Supply
  - 4.5V to 5.5V single-supply operation
- Temperature Range
  - -40°C to +85°C
  - -40°C to +125°C
- Development Support
  - Real-time emulation and full program debug capabilities available
  - CompactRISC tools provide C programming and debugging support

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# CR16MCS9 Product Folder

## CompactRISC 16-Bit Reprogrammable/ROM Microcontroller

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### Parametric Table

Operating Frequency (MHz)	25
Code Memory (in K Bytes) (Bytes)	64
Code Memory Type	Flash
SRAM (in K Bytes) (Bytes)	3
EEPROM Data Memory	2176
CAN	Yes
ACCESS.Bus/I2C	Yes
Operating Voltage	5.0V
General Purpose I/O	56
SCI/SPI	2 / 1

### Parametric Table

Halt/Idle	Yes
MIWU	Yes
Timers	MFT, VTU
Interrupts	32 + 1NMI
Power on Reset	Yes
Watchdog	Yes
A/D Converter # Ch	8 bit, 12 channel
Comparators	Yes
Microwire Plus	Yes
USART Interface	Yes

### Datasheet

Title	Size in Kbytes	Date	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			View Online	Download	Receive via Email
CR16MCS9 CR16MCS5 CR16HCS9 CR16HCS5 CompactRISC 16-Bit Reprogrammable ROM Microcontroller	50 Kbytes	23-Apr-02	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>

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### Package Availability, Models, Samples & Pricing

Part Number	Package			Status	Models		Samples & Electronic Orders	Budgetary Pricing		Std Pack Size	<a href="#">Package Marking</a>
	Type	Pins	MSL		SPICE	IBIS		Qty	\$US each		
CR16MCS9VJE8XXX	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Preliminary	N/A	N/A		1K+	\$11.3000	tray of 84	[logo]2¢Z¢3¢T¢P CR16MCS9 VJE8XXX
CR16MCS9VJE9XXX	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Preliminary	N/A	N/A		1K+	\$11.0000	tray of 84	[logo]2¢Z¢3¢T¢P CR16MCS9 VJE9XXX

CR16MCS9VJE8	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Custom	N/A	N/A	<a href="#">Buy Now</a>	1K+	\$11.3000	tray of 84	[logo]2¢Z¢3¢T¢P CR16MCS9 VJE8
CR16MCS9VJE7XXX	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Preliminary	N/A	N/A		1K+	\$11.3000	tray of 84	[logo]2¢Z¢3¢T¢P CR16MCS9 VJE7XXX
CR16MCS9VJE7	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Full production	N/A	N/A	<a href="#">Samples</a>	1K+	\$11.4000	tray of 84	[logo]2¢Z¢3¢T¢P CR16MCS9 VJE7
CR16MCS9VJE9	<a href="#">PQFP</a>	80	<a href="#">MSL</a>	Full production	N/A	N/A	<a href="#">Samples</a> <a href="#">Buy Now</a>	1K+	\$11.0000	tray of 84	[logo]2¢Z¢3¢T¢P CR16MCS9VJE9

## General Description

The CR16MCS9/CR16MCS5/CR16HCS9/CR16HCS5 CompactRISC™ microcontrollers are general-purpose 16-bit microcontrollers based on a Reduced Instruction Set Computer (RISC) architecture. The device operates as a complete microcomputer with all system timing, interrupt logic, flash program memory or ROM memory, RAM, EEPROM data memory, and I/O ports included on-chip. It is ideally suited to a wide range of embedded controller applications because of its high performance, on-chip integrated features and low power consumption resulting in decreased system cost. The CR16MCS9/CR16MCS5/CR16HCS9/CR16HCS5 devices contains a Full-CAN class, CAN serial interface for low/high speed applications with 15 orthogonal message buffers, each supporting standard as well as extended message identifiers.

## Features

- CPU Features include: up to 24MHz operating frequency, 41.67 ns instruction cycle, Multi-source vectored interrupts, Dual clock and reset.
- On-chip power on reset
- On-Chip Memory
- On-Chip Peripherals including: USARTs, Multi Function Timers, SPI/Microwire-Plus, A/D, ACCESS.bus, Full CAN interface, Versatile timer units, Analog comparators, Integrated watchdog logic
- I/O Features include: up to 56 general purpose I/O pins with TRI-STATE output
- 4.5V to 5.5V Single supply operation
- Full temperature range options
- Competitive Development support

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