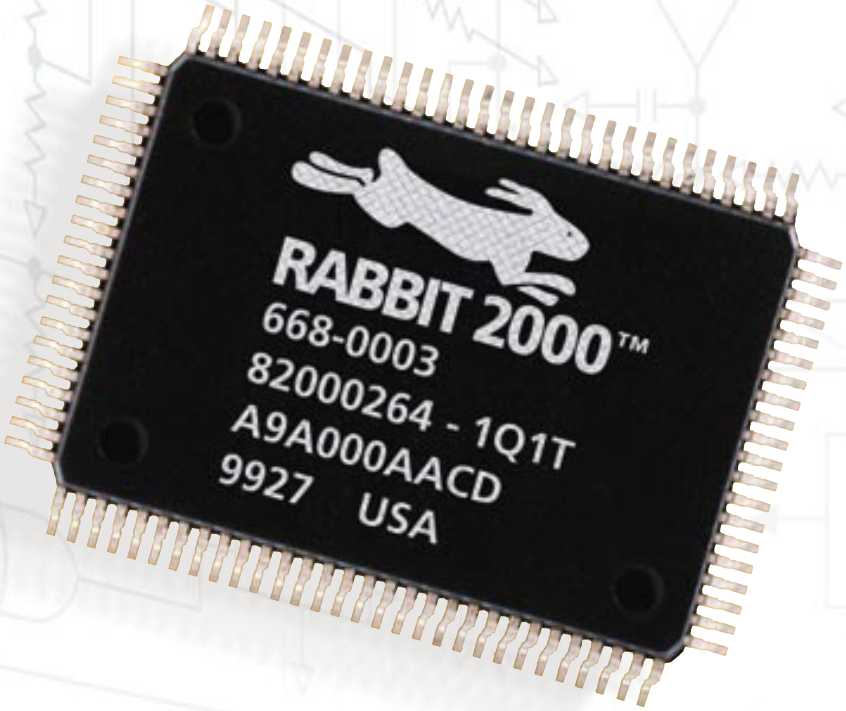


Rabbit 2000™ Microprocessor

The Rabbit 2000 is a high-performance, 8-bit microprocessor distinguished by its C-friendly instruction set, fast number crunching ability and numerous on-chip peripherals. Built-in features include 4 serial ports, a slave port, remote bootstrap capability, advanced clocking options, and glueless interfacing to both memory and I/O — making hardware design easy.

With a clock speed of up to 30 MHz, and optimized for C-oriented instruction set, the Rabbit 2000 outperforms alternative processors. High compute performance and plentiful on-chip peripherals make the Rabbit 2000 an alternative to 16 and 32-bit processors at a much lower system cost.

Supported by industry-proven Dynamic C®, the Rabbit 2000 can handle C-language applications of approximately 1 megabyte (50,000+ C statements). Dynamic C provides an interactive compiler, editor, and source-level debugger. Numerous application libraries are also included. This close integration of hardware and software shortens development time and makes programming much easier.

Design Advantages

- **Glueless architecture**
  makes hardware design easy
- **Slave port**
  allows using the Rabbit 2000 as an intelligent peripheral device
- **Remote cold boot**
  allows start-up via serial or slave port with no pre-existing code in memory
- **4 serial ports**
  provide synchronous and asynchronous communications at high baud rates
- **Excellent math performance**
  16 x 16 multiply in 12 clocks
- **Control of clock speed**
  by software allows dynamic trading of power versus speed
- **4 levels of interrupt priority**
  allow fast response to real-time events
- **40-plus I/O pins**
- **Five 8-bit timers and two 10-bit timer devices**
- **General purpose periodic clock interrupt**
- **Watchdog timer**
- **Battery-backed real-time clock**

RABBIT™ Semiconductor

www.rabbitsemiconductor.com

The Instruction Set

The Rabbit 2000™ features an updated Z180 style architecture improved for higher performance. A number of obsolete or redundant Z180 instructions have been dropped to allow efficient 1-byte operation-codes for new instructions. Existing Z180 assembly language can be ported to the Rabbit 2000 with minimal change.

New C-friendly instructions are included for fetching and storing 16-bit words located at a computed memory address or on the stack. New instructions perform fetches, stores, calls, returns and jumps over a full megabyte of address space.

The new instructions improve communication between Z180 registers, effectively enlarging the register set. Other new instructions provide 16-bit logical and arithmetic operations. Software floating point routines for add, subtract, and multiply require less than 12 microseconds at maximum clock speed.

Memory access instructions can be turned into I/O access instructions by using a prefix. As a consequence, I/O access is faster and more flexible.

The new instructions are natural improvements to the Z180 instructions, making a comfortable environment for the experienced Z80/Z180 assembly language programmer.

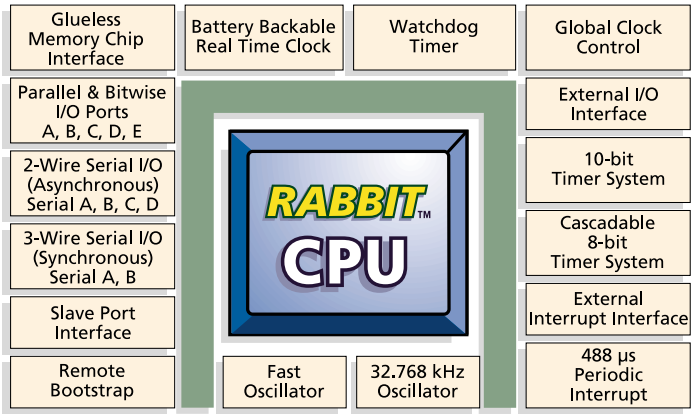


Figure 1, Block Diagram of Rabbit 2000

Hardware Architecture

Interrupt Structure

Four levels of interrupt priority allow fast response to real-time events. Complete interrupt routines can execute in less than 4 microseconds. 16-bit load and store I/O instructions improve I/O data transfer speed. Data transfer rates in excess of 250,000 bytes per second can be obtained using interrupts.

Memory Management/Glueless Design

- Three built-in memory chip select lines
- Two memory chip output enable lines
- Two memory chip write enable lines
- Up to six static memory chips (RAM, flash) connect directly to the Rabbit 2000 without glue logic
- Glueless architecture makes memory design much easier
- One megabyte normal code space accessible directly by call and jump instructions
- More memory is easily supported

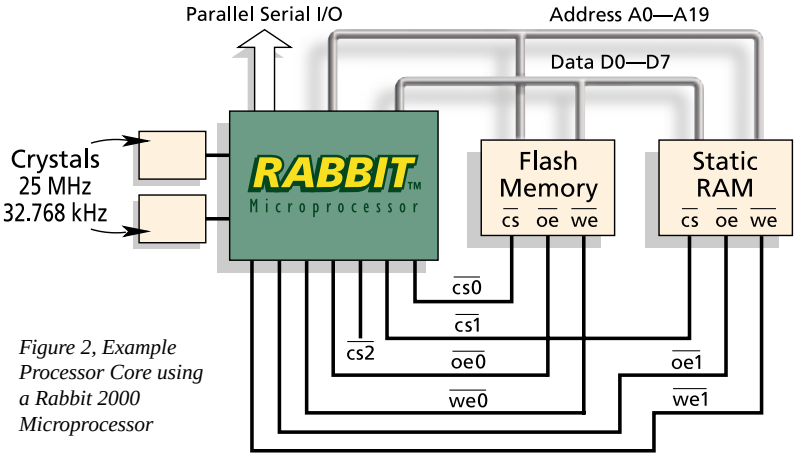


Figure 2, Example Processor Core using a Rabbit 2000 Microprocessor

Battery Backup Feature

The Rabbit 2000 has a special support feature for battery-backed RAM. In typical processors, a battery switch-over circuit maintains at least 2 volts of power to RAM and pulls the chip select line up to the same voltage as the battery. This method has a propagation delay often as much as 20 nanoseconds.

The Rabbit's special battery backup feature allows chip select #1 to be always forced low under program control, thus avoiding clock slow down. A hardware memory write-protect feature protects battery-backed RAM and flash memory from inadvertent write operations.

On-Chip Peripherals

Slave Interface

The slave port allows the Rabbit 2000™ to be treated as an intelligent peripheral device. The slave port has six I/O registers, three for each direction. Handshaking flags and mutual interrupt capability are supported. This feature is excellent for off-loading communications protocols or motion control functions.

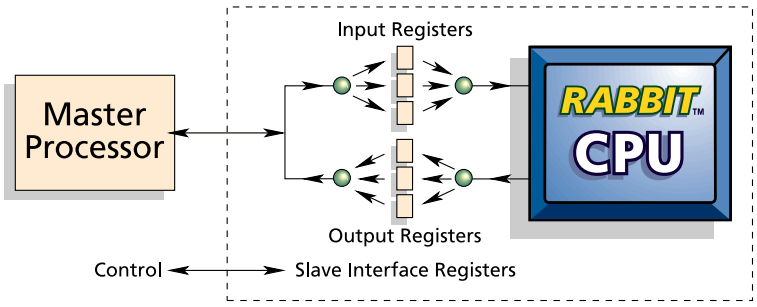


Figure 3, Slave Processor Data Paths

Remote Bootstrap

The Rabbit 2000 may be remotely booted by an external device via serial port or slave port with no pre-existing program. This allows complete reprogramming of soldered-in flash memory. Also allows RAM-only configurations with external boot and program initialization.

I/O Interface and Ports

There are 40-plus I/O pins grouped in five 8-bit ports. Eight external programmable I/O interface signals can be configured as I/O chip selects, I/O write strobes, I/O read strobes and I/O read/write strobes. Standard I/O read and I/O write enable signals are also available. I/O devices can be directly connected to the I/O interfaces, and often without glue logic.

Four asynchronous serial ports are on-chip. Two of the ports also have synchronous communication capability. The asynchronous ports operate at speeds up to 1/32 of the clock frequency, while synchronous mode allows baud rates up to 1/8th of the clock frequency.

Timer synchronized parallel I/O allow generation of pulses under software control, but precisely synchronized by hardware timers.

Low Power *Sleepy* Mode

A unique *sleepy* mode of operation is available on the Rabbit 2000. Normally, the main oscillator is implemented by directly connecting a crystal or ceramic resonator with a frequency in the range of 1.8 to 30 MHz. The frequency can be doubled or divided by 8 internally to modulate power consumption and speed of execution. In *sleepy* mode, the main oscillator is turned off and the main clock is taken from the Rabbit's 32.768 kHz oscillator. Roughly 3,000 instructions per second can be executed with a current consumption of around 200 µA. The *sleepy* mode is far more flexible than sleep modes of other microprocessors because instruction execution and decision making capability are maintained. This feature is excellent for many battery-powered applications.

Clock Speed

The Rabbit 2000 performs 1-byte reads (and most 1-byte operations) in two clock cycles, and 1-byte writes in three clock cycles. It requires 55 nanosecond memory to operate at 30 MHz with no wait states. The Rabbit 2000 runs at 24 MHz with 70 nanosecond flash memory and no wait states. The Rabbit 2000 is about 3 times faster than the Z180 for the same memory speed running C code.

Time/Date Oscillator

The 32.678 kHz oscillator uses an external 32.768 kHz quartz crystal. The 32.768 kHz clock is used to drive a battery-backable internal 48-bit counter or real-time clock.

Timers

The Rabbit 2000 has two sets of timers, as well as a general purpose clock interrupt. The periodic interrupt is driven by the 32.768 kHz oscillator divided by 16, giving an interrupt every 488 microseconds if enabled.

Timer A consists of five 8-bit reloadable down counters. The output of four of the timers is used to provide baud clocks for the serial ports. These timers can also cause interrupts and clock the timer synchronized parallel output ports.

Timer B consists of a 10-bit free running counter and contains two 10-bit match registers. The timer generates an output pulse whenever the counter reaches the match value. This output pulse can be programmed to generate an interrupt.

Packaging

100-pin rectangular PQFP

Electrical And Environmental

Operating Voltage: 2.5 to 5 volts
Operating Temp: -40° C to 85° C
Storage Temp: -55° C to 125° C

Rabbit 2000™ Software Development

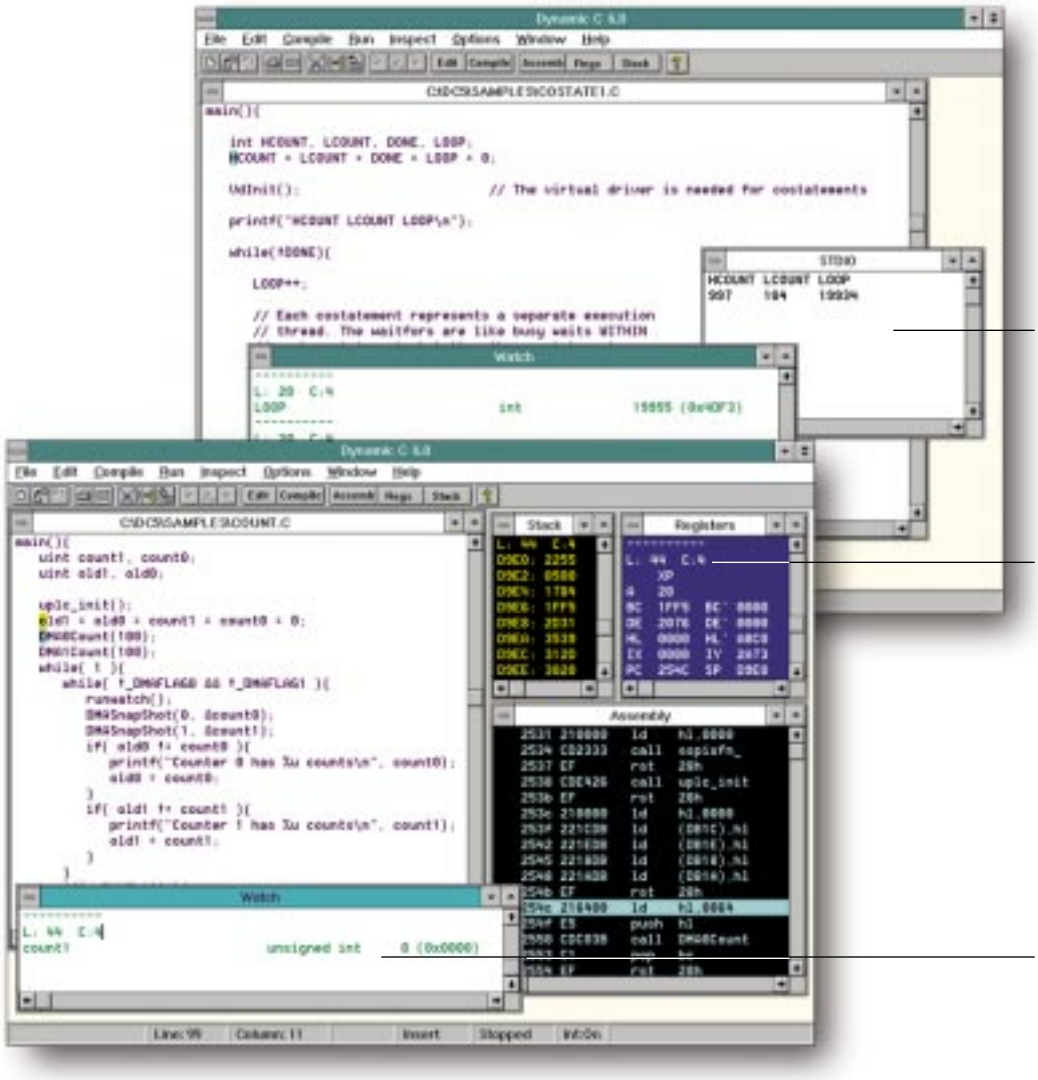
Software is developed using Dynamic C®, a C language development system. Dynamic C operates on a PC under Windows or Windows NT and includes:

- Easy-to-use program editor
- Fast C compiler that compiles, links, and downloads directly to your target in one step
- Embedded assembler
- Source-level debugger
- Hundreds of functions in source-code libraries

No In-Circuit Emulator Needed

A simple smart cable connects the PC serial port to one of the Rabbit 2000 processor's serial ports while the processor is running in the target system. No in-circuit emulator is needed, simplifying development.

Dynamic C libraries contain highly developed software for the Rabbit 2000 microprocessor. Developing software with Dynamic C is easy. Code can be written in C or Assembly, compiled and tested without leaving the Dynamic C development environment.



STDIO Window
*Easily track the progress of a program using **printf** output on the standard I/O window.*

Register, Stack, and Assembly Windows
Pop-up windows display the contents of the target system's registers and stack, together with equivalent assembly language. All three windows are updated with a snapshot of the most recent information every time the debugger comes to a stopping place. These windows provide valuable information when searching for a program error or when optimizing code.

Watch Window
Easily monitor and change program variables and evaluate C expressions at any time. You can execute function calls from the watch dialog.

Features of Dynamic C

Dynamic C is specifically tailored for embedded systems. It is designed to compile the users program and applicable library routines and simultaneously download the compiled code to the target system.

Compilation is quick allowing rapid correction of errors. Breakpoints, single stepping, observation of variables in a running program, complex watch expressions, and ***printf*** to the Dynamic C console are all supported to aid in debugging. Dynamic C also supports cooperative multitasking through language extensions.

Assembly language code may be embedded in C code or be supplied as a stand alone function.

Dynamic C includes device drivers for Rabbit 2000 on-chip peripheral devices. The floating point and math libraries supplied with Dynamic C are notable for exceptional speed of execution.

Clock (MHz)	Voltage	Current (mA)	Power (mW)
29.412	5.0	109	545
14.7456	5.0	58	290
14.7456	3.3	36	118
3.6864	3.3	11	36
1.8432	3.3	6	20
Sleepy Mode 0.032	5.0	280µA	1400µW
" 0.032	3.3	113µA	372µW
" 0.032	2.7	72µA	194µW

Note: The processor clock is derived from the main oscillator output and can also be driven by the 32.768 kHz oscillator — excellent for low power applications.

Figure 4, Power Consumption (typical)

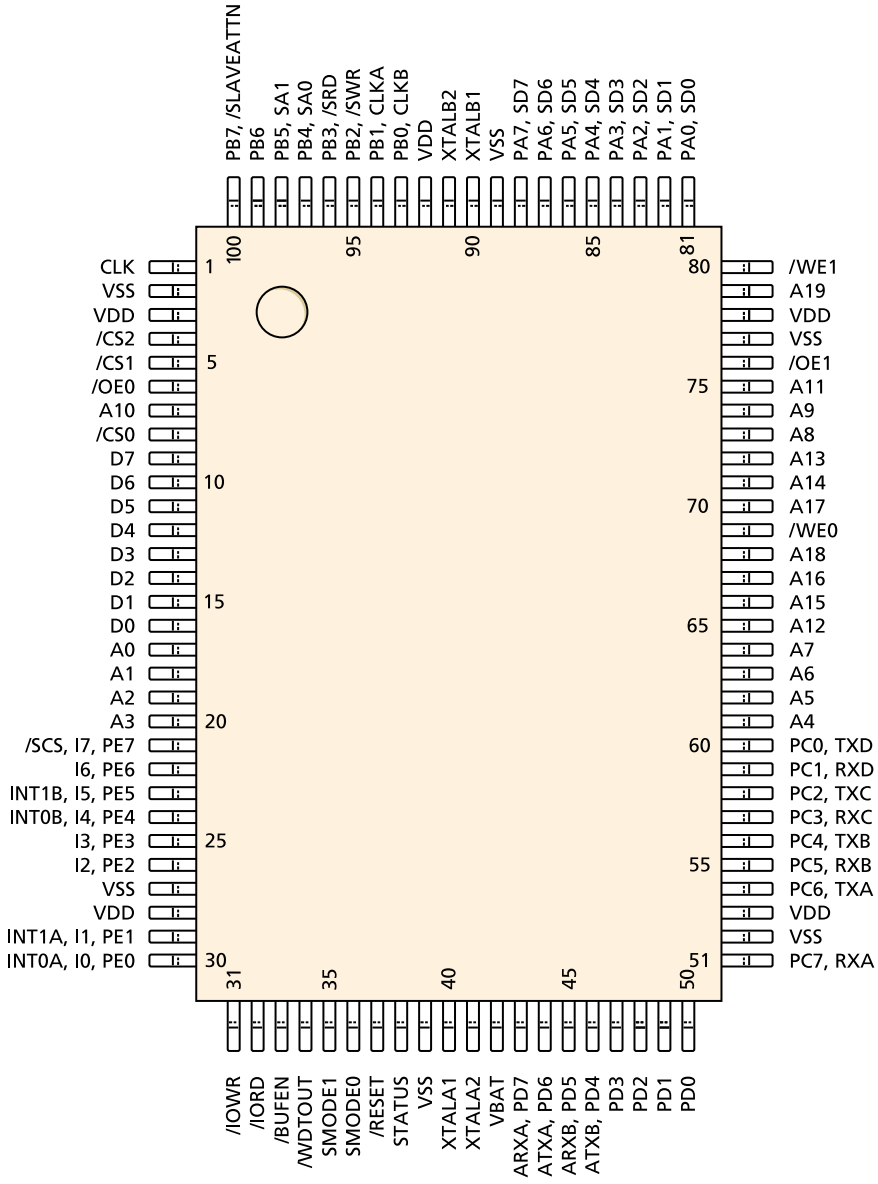


Figure 5, Pinout of Rabbit 2000

Rabbit 2000™ Development Kit

The Rabbit 2000™ Development Kit includes everything you need to fully evaluate the capabilities of the Rabbit 2000 microprocessor.

You'll be able to develop software specific to your application using the Dynamic C® development system while putting the Rabbit 2000 through the paces.

Included in the Development Kit is a single-board computer with memory, I/O and a Rabbit 2000. No need to spend time developing an evaluation board. The included PC serial interface cable allows you to perform real-time debugging.

Start your evaluation and design immediately. Call for your Development Kit today!

Ordering Information

Item	Description
Rabbit 2000™	25 MHz CPU
Rabbit 2000™	30 MHz CPU
Development Kit	See text above

Online Information

- Manuals
- Ordering
- Tech Notes

Only $139

Includes:

Single-board computer with 25MHz Rabbit 2000 processor, 32K SRAM and 128K Flash; prototyping board with LEDs, switches, beeper and prototyping area; PC serial cable; power supply; Dynamic C® development software and documentation on CD ROM. All Dynamic C® libraries and the debugging BIOS are included.

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