

P.A.R.T.S

Portland Area Robotics Society

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The \$15.00 Wonder Computer.

The MC68HC11A1 is one of the most popular microcontrollers today. This chip can be found in everything from airplanes to automobiles. This article will discuss the 68HC11 in one its most overlooked (and most useful) modes. The single chip mode. The single chip mode is ideal when space is limited and a small program is needed to perform a task. Single chip mode makes all the chip resources available:

All of these features, and more, in a chip the size of a postage stamp. This chip has no built in programming language, but it does have one special feature that makes it very powerful, and easy to program. The 68HC11 contains a special BOOT loader ROM.

The Boot loader program runs when the chip is first powered up, and tries to load/run a program coming into it's serial port. If no communication signal is present at the serial port, the boot loader then tries to run a program it's internal EEPROM.

It's the EEPROM, that is really interesting. A small program can be loaded into the EEPROM and made to autostart. The program won't be lost, even at power down. EEPROM is like EPROM, but it can rewritten without extra equipment. (No EPROM erasers or programmers needed). Granted 512 byte EEPROM is not very big, but with all the chips unique features, and a powerful instruction set, much can be accomplished with a small amount of memory.

68HC11 Features

5 parallel ports
8 A/D Converter
2 serial ports
Event Counter
16-bit timer
COP Monitor
10 ma current
256 bytes RAM
512 bytes EEPROM

This chip is easy to program

because Motorola has done a great job of supporting this chip. They have a FREE BBS (512) 891-3733 that has many programs to support the 68HC11. You can find small 'C' compilers, assemblers, emulators, and down loaders. Here are some suggested programs that you should download:

pcbugb.arc	Interactive programming assemble/disassembler that runs even with limited resources.
sim6841.arc	A newer version of my SIM68 Version 0.41 of my 68HC11 simulator.
as11.exe	Cross assembler for the MC68HC11
assembler.doc	Documentation for assemblers
sc_11.zip	BETA version C compiler for the HC11.
wipe.arc	Utility to program 68HC11 EEPROM from PC
loadall.arc	Programs various MC68HC11 MCUs directly from a PC using the internal Boot loader (on chip).

The PCBUG program runs on your PC (while connected to 68HC11) and allows easy interactive programming of the 68HC11. It has on screen help, an assembler / disassemble, trace and breakpoint functions. You can develop and test your programs right on the chip. The manual is also free:

PCBUG11

To receive your free copy of the User's Manual, send a large (6" X 9") stamped (2ea. 1st class stamps) self addressed envelope to :

The Schematic of the 68HC11 single chip microcontroller

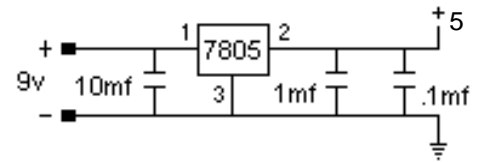
is very easy to build, and consists of four major parts. Part one is the RS232 interface that connects the chip to a PC serial port. Secondly is the clock circuit using an 8Mz crystal, next the reset circuit using a MC34064 and then the power supply. The jumpers

PCBUG11 Manual

Mail Stop #OE319
6501 William Cannon Dr. W.
Austin, Texas, 78735

are for auto starting a program in EEPROM. When the Tx and Rx lines are tied together, this forces the boot loader to jump to the program located in EEPROM.

The MAX232 chip is used to convert the PD1 (Tx) and PD0 (Rx) signals to voltage levels of the PC, and should connect to a standard 9 pin or 25 pin serial connector on your PC. The chip should be mounted in a socket so it can be removed if not needed when all programming is completed.



The 8Mz crystal can be misleading because the 68HC11 divides the crystal frequency by four, and the chips clock speed is actually 2Mz.

The MC34064 should be used to give the 68HC11 chip a good 'firm' reset signal. The 8054HN can also be used.

A five volt regulator is all that is needed to convert a nine volt battery to power the chip. The 68HC11 can't push much current, and the outputs should be connected to some kind of driver. (such as a transistor if driving a relay.)

With all the power of the 68HC11 has to offer, a very tiny microcontroller can be built with ease. The 68HC11 can be networked together, with the SPI port, to form a very complex parallel processing system. For example in a robot, a single chip can be the brain for a decent line following robot. (only 512 bytes needed.) A series of controllers can be networked together, one chip controlling all motor speed control and current sensing, and another handling bumpers and monitoring battery voltage.

This microcontroller was put together for about \$15. The programming software was free, the documentation was free... Who could ask for more? Contact your local Motorola Rep. or Motorola for the MC68HC11 technical summary and document 68HC11RM/AD.

PARTS

68HC11A1 MCU chip	\$5.95	52 pin PLCC socket	\$1.59	B.G. MICRO
8Mhz crystal	\$1.49	MAX232 RS232 chip	\$2.30	P.O. Box
280298				
16 pin socket	\$.10	7805 voltage reg.	\$.35	Dallas, Texas 75228
MC34064P	\$1.20	ACTIVE call 1-800-677-8899		(214) 271-5546
				for free catalog.

Misc. resistors, capacitors and circuit board can be found at local Radio Shack, or ACTIVE. Take care when building this project, and use a serial cable to connect the MCU to your PC. If you need any help with this project, give me a call.

