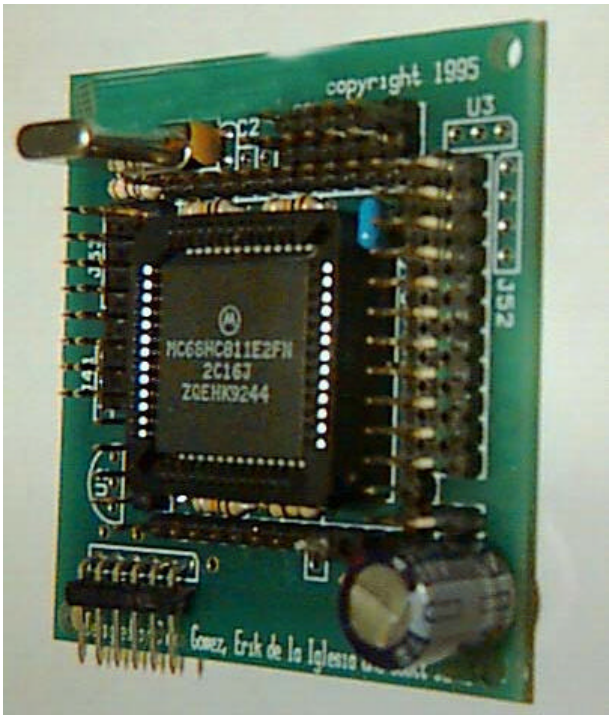
ASSEMBLY MANUAL
MSCC11 SINGLE CHIP MC68HC11 MICROCONTROLLER BOARD

by Keith L. Doty



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- Open architecture,
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1 ASSEMBLING MEKATRONIX PRINTED CIRCUIT BOARDS

1.1 Skill Level

Assembling this board requires the ability to solder and modest manual dexterity. If you are inexperienced in soldering or would like a quick review of soldering techniques, refer to *Soldering Note (http://www.mekatronix.com in the manuals section)* for soldering tips. If you feel uncomfortable with assembling a printed circuit board you might want to consider purchasing one assembled and tested from the factory.

1.2 Personal Safety

Practice safe assembly techniques. When assembling printed circuit boards, be sure to work in a well-ventilated area and wear eye protection. If you have not been instructed in PCB assembly techniques, you should seek assistance from an experienced technician.

1.3 Component Protection

Integrated circuits (IC) and other semiconductor devices are static sensitive. One can easily destroy an IC with static discharge. To protect against static discharge from destroying semiconductor devices, you might want to wear a wrist grounding strap while assembling your board. Axial and radial leaded components, such as resistors and capacitors, while rugged, can be damaged by careless handling. A common failure results when the leads are bent too much and their connection to the component is weakened or broken. Pins on headers and connectors occasionally get bent. To restore the pin to proper function, careful straightening them with needle nose pliers should do the trick, but bending a pin certainly does not improve the pin's performance and can lead to failure.

1.4 Questions and Further Information on the MSCC11

For technical support email all questions to tech@mekatronix.com **.**

1.5 Equipment Needed to Construct the MSCC11

The following tools are needed to complete this board. Make sure you have them handy before you start work.

1. Soldering iron
2. 60/40 rosin core 0.032 diameter electronics solder (do not use an acid core solder or acid flux on the board)
3. Small diagonal cutters for cutting wire and headers
4. Needle nose pliers
5. Wire stripers
6. Hot glue gun and hot glue for mechanically securing wires to connectors.
7. Masking tape

1.6 Equipment Needed for Testing the MSCC11

You will need the functionality or equivalent to the following equipment.

1. Multimeter
2. A MEKATRONIX™ MB2325 communications board with a MEKATRONIX™ C2325 6-wire serial cable.
3. A Personal Computer running DOS or Windows with a 25 pin serial cable connector capability for COM1 or COM2 to connect with the MB2325 board.
4. Motorola PCBUG11 (freeware) or Interactive C (freeware for versions less than 3.1) or ICC11 (purchase from a MEKATRONIX™ distributor).
5. Power supply or a 6-pack of AA rechargeable batteries to supply about 6-7volts.
6. Cables, connectors, jumpers and/or switches

2 The MSCC11 SINGLE CHIP COMPUTER BOARD

The MSCC11, with its on-board 2Kbytes of EEROM and 256 Bytes of RAM , serves as a general purpose sensor data acquisition and digital Input/Output control board for robotics and other applications requiring sensory capability and program control. Extensive use of male headers around the processor makes the board extremely versatile and easy to interface with sensors and actuators.

2.1 MSCC11 Parts

Table 1 lists the MSCC11 parts and Figure 1 pictures those parts. The part labels in Table 1 correspond to the part labels in circuit schematic of Figure 4. The layout of the MSCC11 in Figure 5 indicates where to insert the various components. Figure 5 and Table 1 illustrate how to place the components for soldering. The user places the MC68HC11 microprocessor of choice into the PLCC. For TJ™ the E2 processor is used.

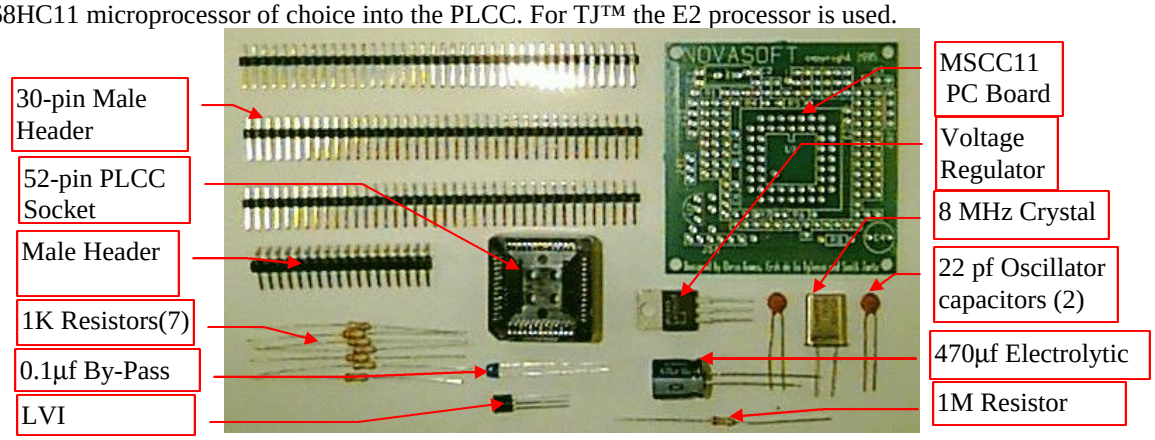


Figure 1 The MSCC11 parts inventory: 3 30-pin male headers in the upper right.

3 ASSEMBLING THE MSCC11

Note:

- *top of board* refers to the side with the white part outlines and text on it.
- *bottom of board* refers to the non-text side of the board.

3.1 Cutting, Mounting and Soldering Headers

Use small, thin blade dikes (diagonal cutters) to cut male headers from a male header strip (Figure 2). For example, cut two pins for a two pin male header, three pins for a three pin header, etc.

Caution: When cutting headers, hold both parts being separated by the cut, otherwise, the one not being held will fly across the room. Wear eye protection as a precaution.

When cutting headers be careful not to cut away too much plastic and expose the pins where the cut is made.

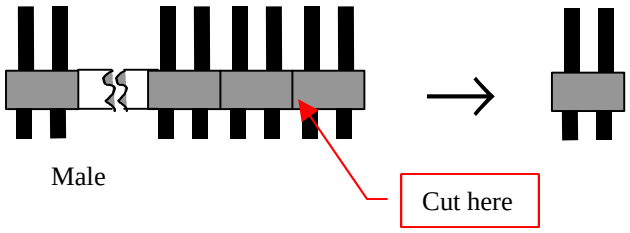


Figure 2 Cutting a two pin male header. Insert the short leads of the male header into the PCB and solder on underneath side of the board.

3.2 Mounting Resistors Around the PLCC

1. Insert the PLCC socket into the board, ***but do not solder.*** The PLCC will serve as a resistor mounting guide. Insert resistor leads of R2, R3, R4, R5, R6, R7 and bypass capacitor C3 through top of board and bend towards each other underneath the board to clamp part snugly to board. Solder and cut excess leads from the backside of the board.

Caution*: Wear eye protection and hold the leads (make sure they are cool!) while cutting them. If you do not hold the leads, they can fly away with high velocity when cut.*

3.3 Soldering Headers

Note*: The header for J54 should be mounted on the non-component side of the pcb when the MSCC11 is to be used in a TALRIK JR. Robot.*

The user will probably want to arrange the male headers according to individual project requirements. Figure 3 indicates the maximum arrangement of male headers to take full advantage of the MSCC11 control capabilities.

Note*: Occasionally one bends a pin. Use the needle nose pliers to straighten them.* ***Caution****: Pins cannot withstand too much bending without damage and loss of function.*

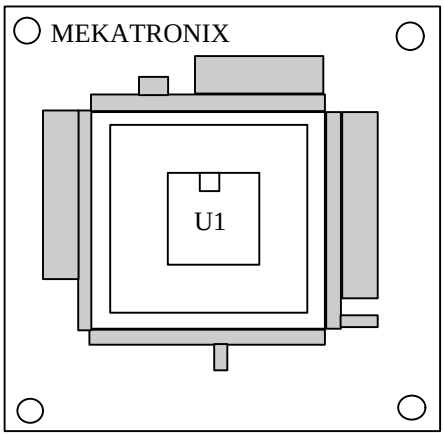
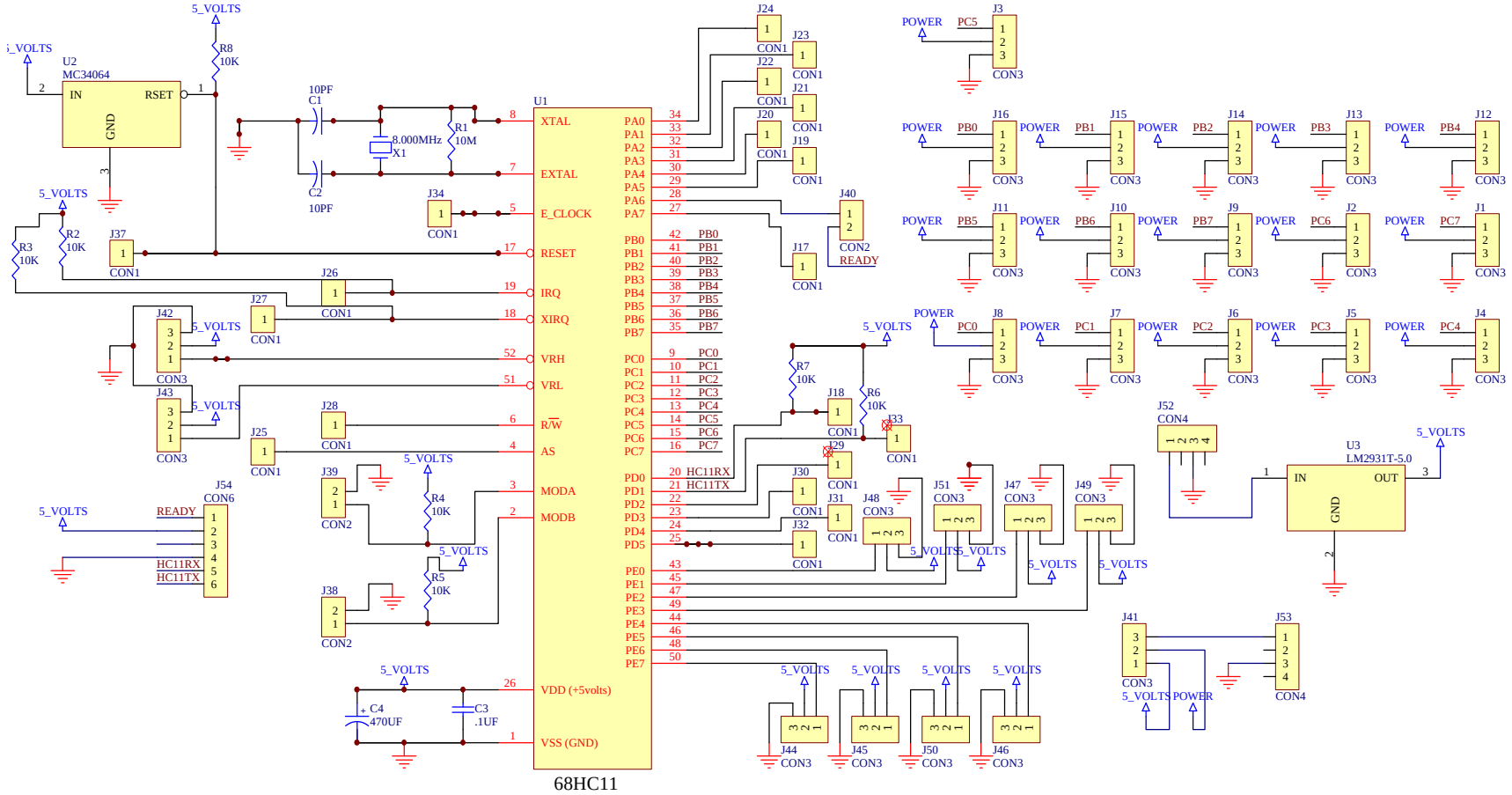


Figure 3 Shaded areas designate maximum header placement on the MSCC11.



68HC11

Figure 4 Schematic of the MSCC11.

Table 1 MSCC11 Parts List

Label	Value	Component Description	Polarized Device
C1-C2	22pf	Capacitor	No
C3	0.1µf	Capacitor	No
C4	470mf	Electrolytic capacitor (Polarity marked correctly in Figure 5, but incorrectly on some PC boards.)	Yes
J1-J16	3 files of single row Male Headers[1]	Power(middle rail), Ground (outer rail), Signal for digital/servo output (inner rail, processor pins 9 to 16 and 35 to 42). Mounted as required by the user's application.	No
J38	2 pin Male Header[1]	MODE B jumper	No
J39	2 pin Male Header[1]	MODE A jumper	No
J42	3 pin Male Headers[1]	VRH A/D voltage reference high pull up	No
J43	3 pin Male Headers[1]	VRL A/D voltage reference low pull down	No
J41	3 pin Male Header [1]	Jump 5 volt regulated power to Port B and Port C Power Rails	No
J44-J51	3 pin Male Headers Constructed from male header strips[1]	Analog/Digital-Input for sensors on PortE . A 3 pin header consists of a processor PortE pins 43 to 50 (inner rail), V_{dd} (middle rail) and ground (outer rail).	No
J52	4 pin Male Header[1]	Power Connector	No
J53	4 pin Male Header[1]	Select regulated power or alternate power source for J1-J16	No
J54	6 pin Male Header[1]	RS232C Serial communication pins	No
PLCC	Socket	52 pin plastic leaded chip carrier for microprocessor	Yes
R1	10MΩ	Resistor	No
R2-R8	10KΩ	Resistor	No
U1	MC68HC11	Microprocessor IC	Yes
U2	MC34064	Low voltage inhibit IC	Yes
U3	LM2931T	5 volt regulator	Yes
X1	8MHz	Crystal	No

IMPORTANT: *If a part is polarized (last column in Table 1), then the insertion orientation is important. Incorrect insertion may cause the part to fail when power is applied.*

***Note**: TALRIK Jr. uses only straight male headers in its MSCC11E2 kit.*

[1] Headers and connectors are constructed from male header strips and female connector strips as described in later sections.

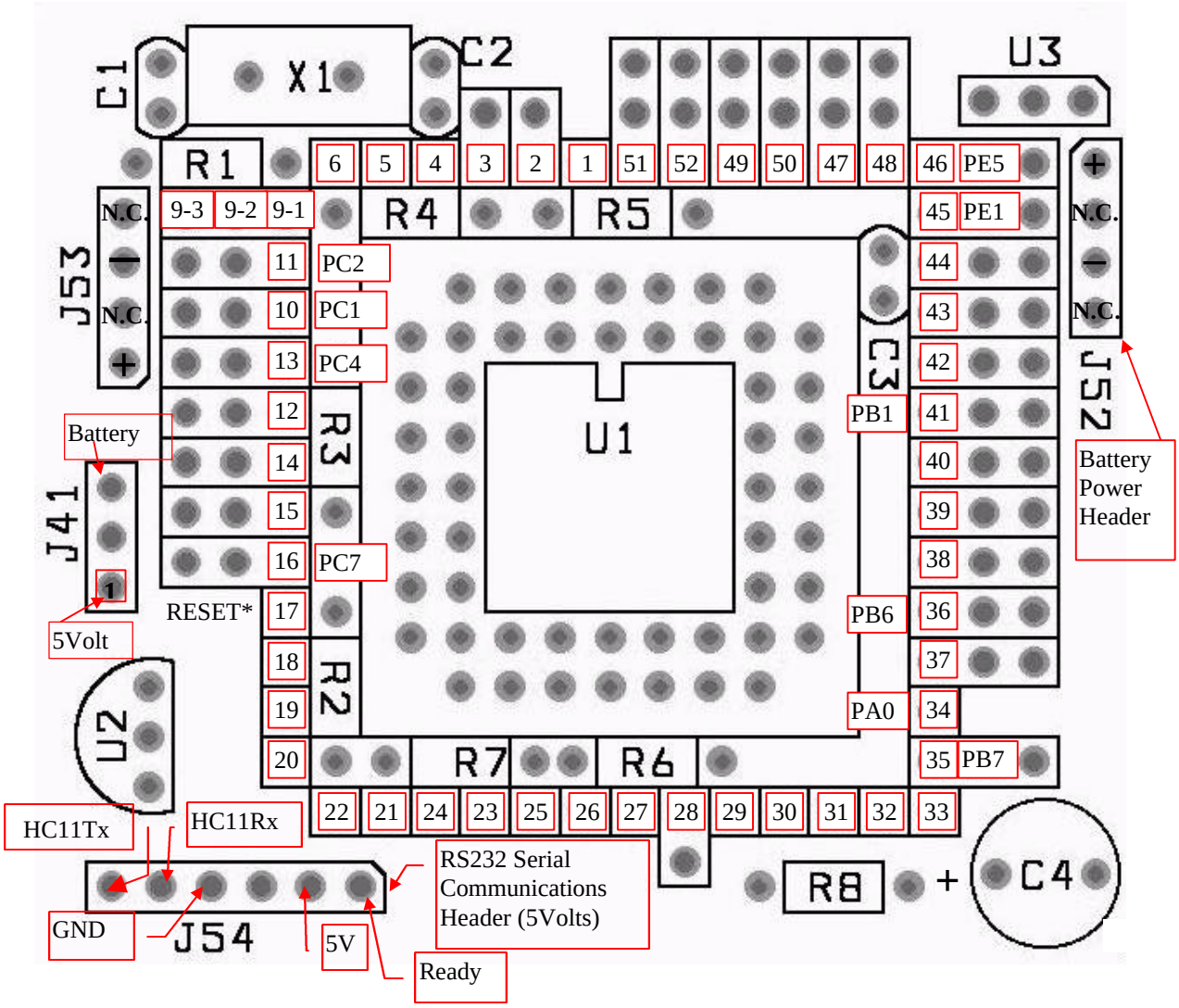


Figure 5 Layout of the MSCC11E2. Pin numbers refer to MC68HC11 pins

Before soldering the headers, ensure that they are straight, aligned, and placed firmly against the board. If necessary align them with a piece of 100 mil perforated board. The headers should look like Figure 6 when completed:

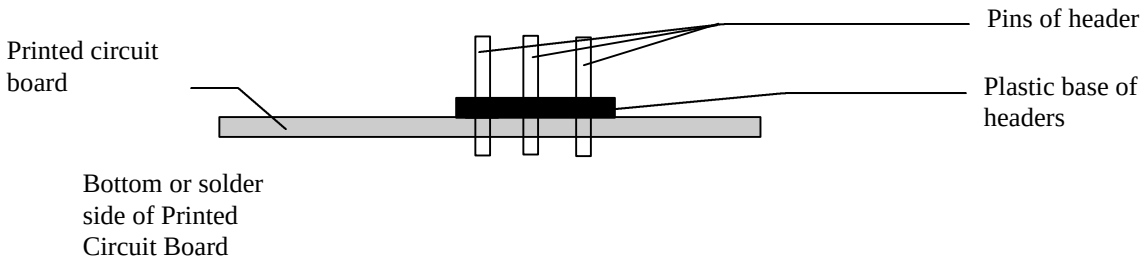


Figure 6 Proper placement of headers.

2. Solder in all the male headers you plan to use in your application. The male header positions surround the PLCC (Figure 5) and make the features of the MSCC11 available to external circuitry.
3. After R2-R7, C3 and the male headers are properly installed and soldered, insert the PLCC socket into the board with the rounded corner nearest the crystal X1 (Figure 5). Observe the notch for U1 and the location of pin 1 at the top of Figure 5. Tape the socket securely onto the PC board and make sure it is seated securely before soldering a corner pin on the underneath side. Now, keeping the socket firmly placed against the board, solder the diagonally opposite corner. The PLCC is now firmly in place. Examine your work carefully to insure correct installation. Now, solder the remaining pins of the socket.

***Caution**: Inserting the PLCC socket correctly is extremely important. Improper installation may cause the destruction of the microprocessor when power is applied.*

4. Mount the discrete circuit components, C1, C2, X1, R1, R8, listed in Table 1, according to the layout shown in Figure 5. Insert the leads from the top of the board into the appropriate holes. Bend the leads towards each other to secure the part snugly against the top of the board. Solder the leads to the pads underneath the board and clip the leads.
5. Mount the electrolytic capacitor C4. The positive pole of C4 must be inserted into the hole nearest to R8 (Figure 5). Some polarized capacitors may have markings indicating the negative side. Make sure you understand the markings on the capacitor before soldering it on the board. Improperly soldered electrolytic capacitors can rupture with applied voltage.

***Caution:** Some boards have the polarity of C4 marked incorrectly. Follow the instructions here exclusively.*

6. U2 must be mounted with the flat side pointing in the direction shown in Figure 5. The metal tab side of U3 should be facing J52.

3.4 Constructing Jumpers and Connectors

The MSCC11 kit does not include female connectors. The TALRIK, JUNIOR kit, which uses the MSCC11 does provide female connectors. In any case, at some time or another you will need to cut out various sized female connectors from a large single row female connector. Use small, thin blade dikes (diagonal cutters) to cut various sized female connectors from a female connector strip (Figure 7). For example, cut two pins for a two pin female connector, three pins for a three pin female connector, etc.

Caution: When cutting, hold both parts being separated by the cut, otherwise, the one not being held will fly across the room. Wear eye protection as a precaution.

When cutting connectors be careful not to cut away too much plastic and expose the pins where the cut is made. The process for cutting a two pin female connector is illustrated in

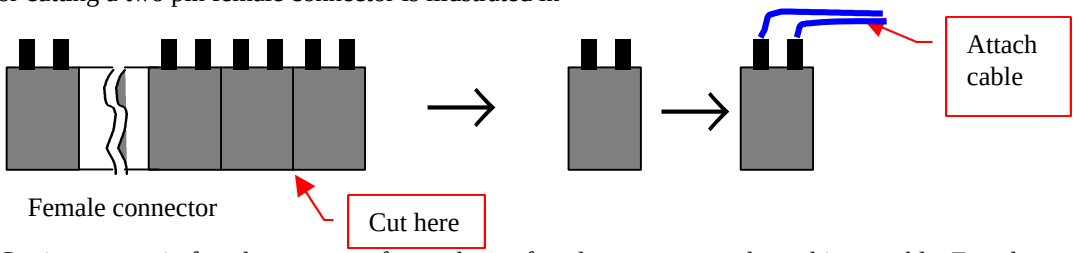


Figure 7 Cutting a two pin female connector from a larger female connector and attaching a cable. Female connectors are not provided with the MSCC11 kit, but are provided for the MEKATRONIX robot kits.

3.5 Constructing a Voltage Reference High (VRH) Pull Up Jumper

A 3-pin female connector is wired with a 10 K Ohm resistor as shown in Figure 8. This stabilizes the A/D voltage reference.

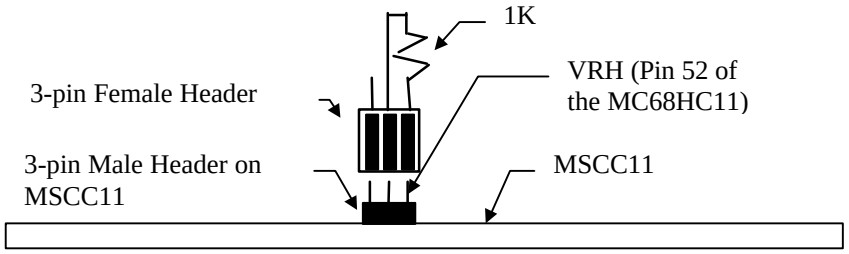


Figure 8 VRH Pull-Up Jumper.

3.6 Constructing a Voltage Reference Low (VRL) Jumper

The outside pins of a 3-pin female connector are shorted, as shown in Figure 9. This establishes the A/D voltage reference low as ground. To choose other voltages consult the Motorola technical manuals.

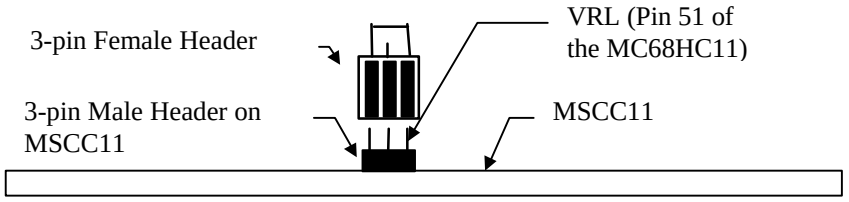


Figure 9 Shorting jumper for VRL.

3.7 Other Jumpers/Switches

In most configurations, you will want to add jumpers or switches to the MSCC11 (refer to Figure 5):

1. Reset (Pin 17) (Usually a push button switch)
2. MODE_A (Pin 3) and MODE_B (Pin 2) (For example, to be used with a SPST Download-Run toggle switch)
3. Power connectors J52 and J53 (Usually a combination of jumper wiring and a SPST On-Off toggle switch).

4 TESTING THE MSCC11

4.1 Eliminate Power-Ground Shorts

1. With no processor in the PLCC socket, and the VRH and VRL jumpers installed, use a multimeter to test for shorts between the positive and negative terminals of J54 (pins two and four). If there is a short circuit between power and ground, check for solder bridges or improper component placement. **Do not continue until all shorts are eliminated**. The multimeter should read a large resistance (>1Mohm) on a correctly assembled board.

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2. With ***NO*** microprocessor IC in the socket and with all shorts cleared, connect a 6-AA NiCd Battery pack or 6-7volts on J52[1] = plus terminal and J52[3]= minus terminal. Connect the same supply to J53[1] = plus terminal

and J53[3]= minus terminal. ***DO NOT connect the battery directly to the 5volt supply!*** You can use TALRIK, JUNIOR's 6-AA NiCd Battery pack for the power supply. Be sure you have the correct polarity. If the battery supply runs through a power-on switch, flip the power on. Check the output voltage of the regulator U3, pin 3, (the notched end of U3 is pin one) to verify it is 5 volts. If the voltage regulator U3 (LM2931T) gets hot, quickly unplug the battery pack and test for shorts again. If the voltage regulator (LM2931T) remains cool, use a multimeter to test for 5 volts and ground at the IC pins indicated in the following table:

IC	Ground at Pin No.	+5VDC at Pin No.
U1	1	26
U2	3	2
U3	2	3

If your readings do not match the above table make sure you are reading the correct pins (Note: testing from the bottom of the board mirrors the pin positions and makes the measurement process error prone). To be on the safe side, verify that none of the other pins on the sockets have either 5volts or ground on them.

3. After completing the previous step, disconnect power. Insert the microprocessor in the PLCC. Power up the board and check the voltages again.

4. Set MOD_A and MODE_B to single chip mode selection with jumpers or switches.

5. With the processor installed and voltages checked, power up the board once again. Connect the MSCC11 to a PC via the C2325 cable connecting the J54 on the MSCC1 to J2 on the MB2325 communications board (refer to Figure 10). You can now communicate with your MSCC11 board and test whether the processor runs and whether the memory functions properly. Power up the board with an 6-AA NiCd battery pack connected to the battery connections. ***DO NOT connect the battery directly to the 5volt supply!***

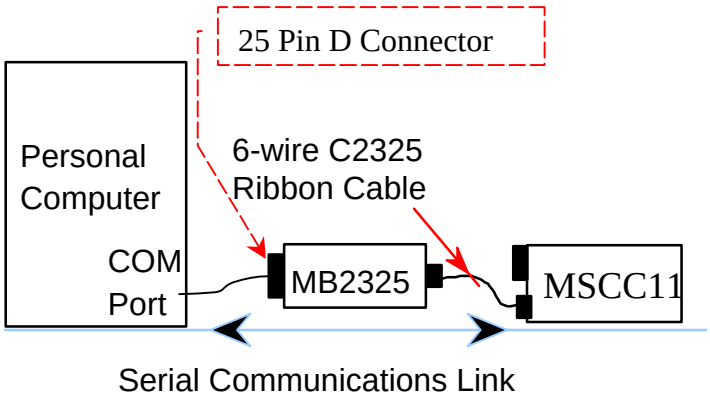

Figure 10 Configure your PC, the MB2325 communications board, and the MSCC11 as shown. The MB2325 requires a 25-pin D-connector on the PC side. If the COM port on your PC has a 9-pin D-connector, you will have to get a 9-pin to 25-pin D-connector converter plug.

6. Short the RESET line to ground with a momentary push button switch or a piece of wire. When the reset line (Pin 17) is shorted, the other LED on the MB2325 board will light. If not, reverse the 6-wire connector.

7. Execute PCBUG11 on your PC. Use the appropriate options. For example, if the board has an E2, then this must be specified to PCBUG11. If you have attached the serial cable to COM2 of your PC, specify that to PCBUG11. Refer to the PCBUG11 manual for details.

8. A successful download indicates communications with the processor and the system is up and running.

9. You can now manipulate RAM and EEROM with PCBUG11. This will verify operation further.

Successful execution of the following tests gives strong indication that the MSCC11 is working properly.

- Execute PCBUG11 to verify communications with the processor.
- Use PCBUG11 to read processor registers and a few of the processor memory locations.
- Write a short program to write data to memory, read it back, and check the read data against the written data while stepping through all RAM addresses.

After successful interaction with PCBUG11, you are ready to proceed with your application.

10. Your board works! You now have constructed a general purpose microcontroller that is useful for a number of projects, including the control of the mobile robot TJ.