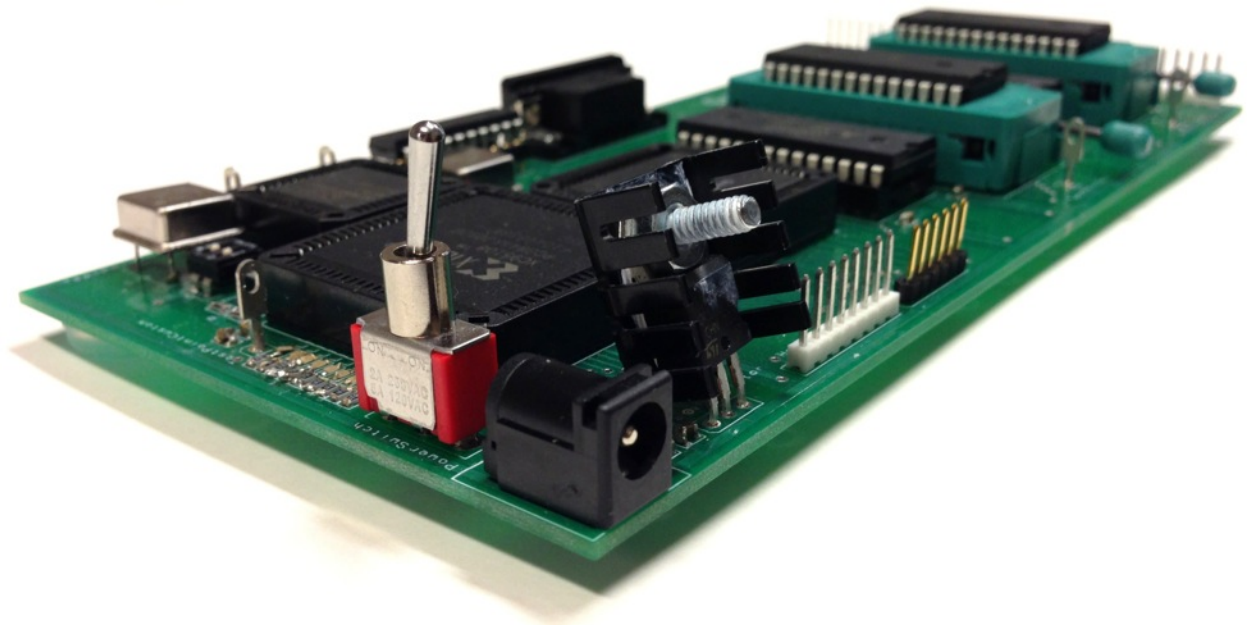


Microcomputer Design



FINAL REPORT

Spring 2014

Logan Turner

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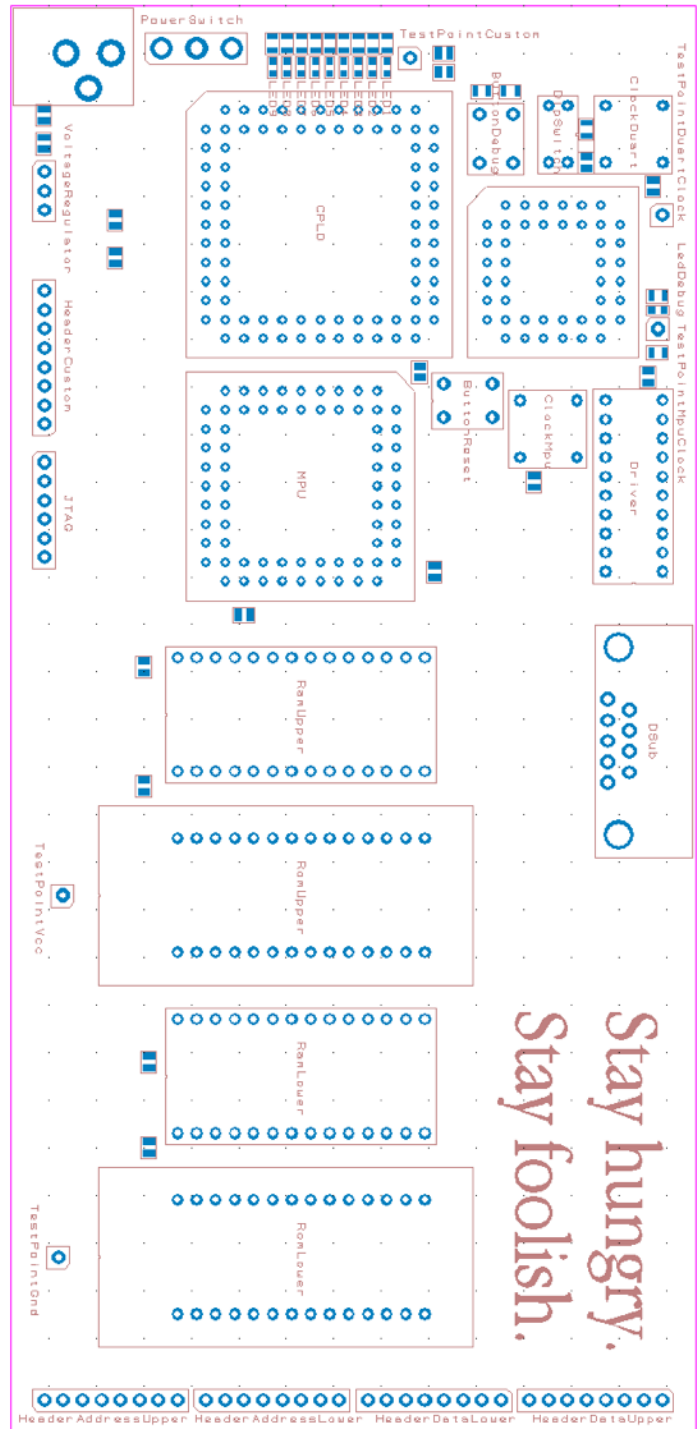
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PROJECT

The goal of Microcomputer Design is to build a single-board microcomputer using components found and integrated by the student. The student then designs an electrical schematic and printed circuit board, connects the components to the circuit board, and writes software for the computer in order to demonstrate that it works.

Board Layout



(actual size)

Device and Chip Specifications

Microprocessor

Motorola 68k (MC68000CFN)

clocked at 12 MHz, rated for 16 MHz

68-pin PLCC package manufactured by Freescale Semiconductor

Complex Programmable Logic Device (CPLD)

Xilinx XC95108-7PC84C

72 macrocells

84-pin PLCC package

Read-Only Memory (ROM)

Atmel EEPROM - AT28C256-15PU

2 chips x 32 kB

150 ns response time

28-pin DIP package

Random-Access Memory (RAM)

Alliance SRAM - AS6C62256-55PCN

2 chips x 32 kB

55 ns response time

28-pin DIP package

Dual Universal Asynchronous Receiver / Transmitter (DUART)

SCC68681 UART Interface - C1A44,518

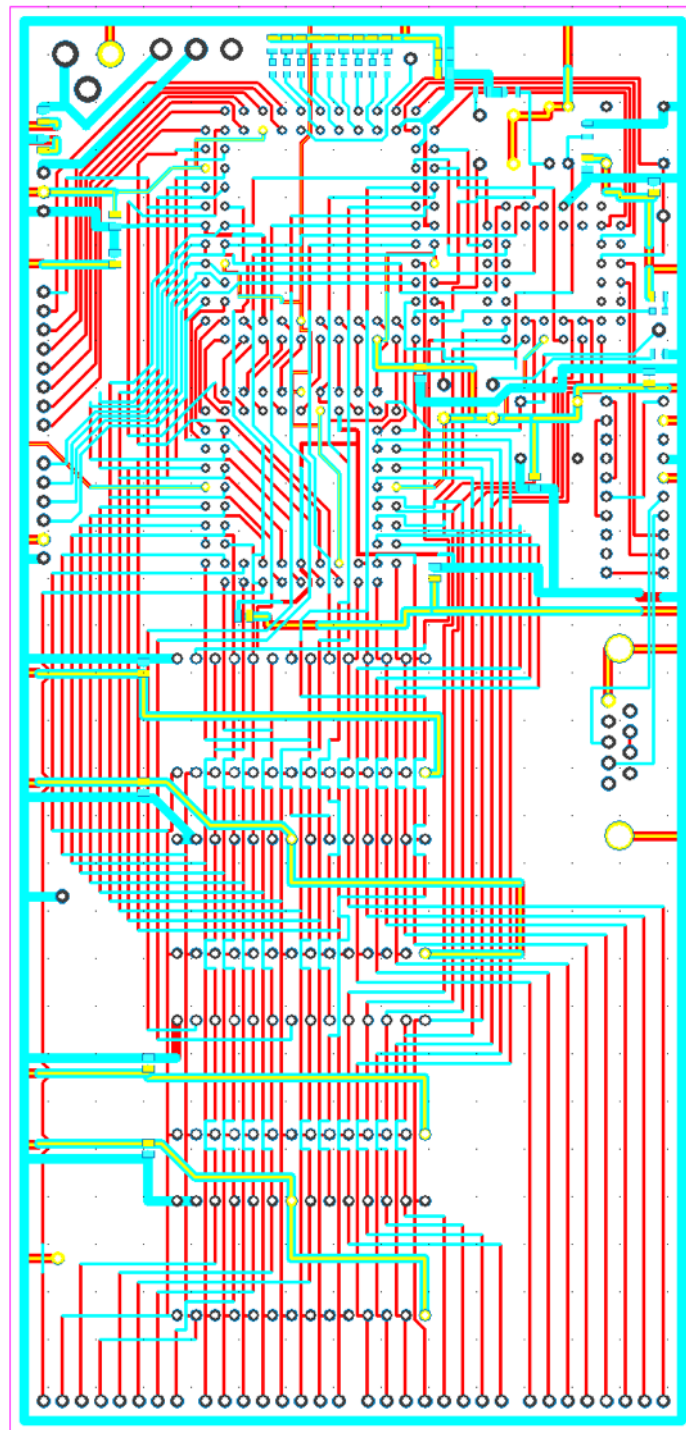
2-channel, running at 115.2 kbaud

serial interface

44-pin PLCC package manufactured by NXT

Electrical Schematic

Printed Circuit Board Schematic



(actual size)

Parts List

Master Parts List				
Item	Quantity	Price(each)	Price(sum)	Manufacturers Part Number
Processor	1	\$14.25	\$14.25	MC68EC000FN16
Processor Socket	1	\$1.92	\$1.92	8468-11B1-RK-TP
CPU Oscillator	1	\$1.60	\$1.60	ACH-12.000MHZ-EK
CPLD	1	\$15.80	\$15.80	XC95108-7PC84C
CPLD Socket	1	\$2.24	\$2.24	8484-11B1-RK-TP
Jtag	1	\$0.40	\$0.40	22284061
DUART	1	\$4.40	\$4.40	SCC68681C1A44,518
Duart Socket	1	\$1.43	\$1.43	8444-11B1-RK-TP
Duart CLK	1	\$2.98	\$2.98	ECS-2100AX-036
RS232 Driver	1	\$10.43	\$10.43	MAX233ACPP+G36
RS232 Driver Socket	1	\$3.02	\$3.02	110-13-320-41-001000
D-Sub connector	1	\$1.62	\$1.62	182-009-113R531
Ram	2	\$1.79	\$3.58	AS6C62256-55PCN
Rom	2	\$9.74	\$19.48	AT28C256-15PU
Ram Socket	2	\$0.70	\$1.40	110-13-628-41-001000
Rom Socket	2	\$19.55	\$39.10	228-1277-00-0602J
5v Regulator	1	\$0.73	\$0.73	L78S05CV
Heat sink for regulator	1	\$0.23	\$0.23	507302B00000G
Wall power adapter	2	\$20.07	\$40.14	WSU090-3500-R
8-pin headers	5	\$0.46	\$2.30	3-644456-8
Barrel power connector	1	\$1.18	\$1.18	PJ-102AH
ON/OFF switch	1	\$2.11	\$2.11	100SP1T1B4M2QE
Debug Button	1	\$0.35	\$0.35	B3F-1000
Reset Button	1	\$0.19	\$0.19	TL1105F250Q
DIP switch for testing mode	1	\$0.44	\$0.44	210-2MS
Test Points	5	\$0.18	\$0.90	4952
LEDs	10	\$0.17	\$1.70	LB Q39G-L2N2-35-1
Capacitor 1 uF	25	\$0.10	\$2.50	CC0805KKX7R7BB105
Capacitor 10 uF	2	\$0.16	\$0.32	CC0805ZKY5V6BB106
Resistor 330 Ohm	10	\$0.10	\$1.00	RC0805JR-07330RL
Resistor 10k Ohm	20	\$0.02	\$0.34	RC0805JR-0710KL
PCB Board	1	\$33.00	\$33.00	
PCB Shipping and H	1	\$25.54	\$25.54	
Digikey Shipping	1	\$8.00	\$8.00	
Mouser Shipping+Tax	1	\$8.00	\$8.00	
Ebay Shipping	1	\$5.00	\$5.00	
		Total Cost w/ Shipping	\$257.62	

SOFTWARE

General Introduction

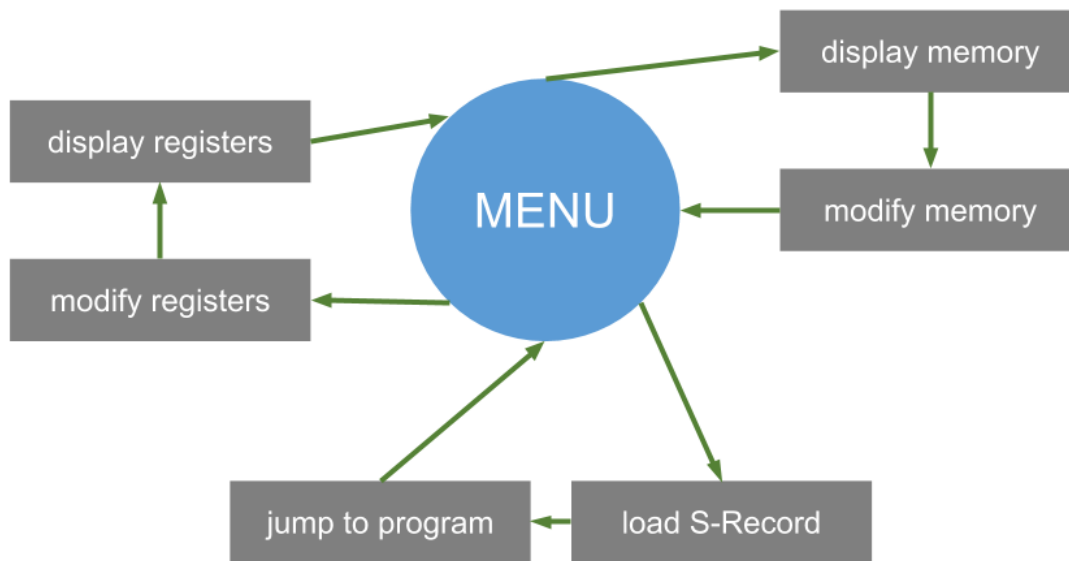
All software was written by hand in 68k assembly and tested using the Easy68k emulator. The three required pieces of functionality were:

- Modify any register in the 68k
- Modify any location in RAM
- Upload an S-record through the serial port and run it in RAM

Memory Mapping

Since both RAM and ROM consisted of two chips with 32 kB apiece, ROM was allotted the first 32kB, and RAM was allotted the second. Address line 17 selects between memory and the DUART, and Address line 16 selects between RAM and ROM.

Flowchart



Source Code

Source code available at <http://github.com/loganturner/MicroDesign>

TROUBLESHOOTING

Overall, few problems were encountered.

On the hardware side, the first DIP socket ordered for the RAM was the wrong width, so another socket had to be ordered. Also, the CPU oscillator was initially soldered in the wrong orientation, and had to be de-soldered and re-soldered correctly. Finally, during the public presentation, the serial driver chip came loose in its socket, causing serial communication to fail.

In software, a few hours were spent trying to reconcile differing behavior between the Easy68k simulator and the actual hardware. The fix ended up having two different sets of subroutines specified in the code, with one set selected at assembly time.