SS-50C Motherboard
Rev 3 and later

Introduction

Thank you for buying our SS-50 motherboard!

Is this board vintage? Well, it was designed in 2014, so technically it is not. However, it uses a design very similar to those used on motherboards back in the heyday of SS-50/SS-50C using parts available at that time.

Features

The motherboard is very similar to other motherboards of that era but is smaller and has fewer slots. Given the high density of modern memory chips, not as many memory boards are required to "max out" a system.

Features include:

- Can be configured as either SS-50/SS-30 (6800), or SS-50C/SS-30C (6809).
- Three SS-50 slots fully compatible with the standard.
- Two SS-30 I/O slots. The slots may be set to any slot address from 0 to 7.
- I/O decode logic that decodes either four I/O addresses per slot (SS-30) or sixteen addresses per slot (SS-30C).
- I/O space cab be jumpered for either address $8000 (6800) or $E000 (6809).
- Power good indicator LEDs for each of the three supplies.
- Connections via screw terminals or plugs so no soldering is required.
- On-board RESET switch and a connector for an external switch (only for 6800 systems as the SS-50C bus does not have a reset line).
- Expansion connectors for addition of more SS-30 and SS-50 slots.

Circuit boards are priced based on the number of square inches, thickness of the board, number of holes and other factors. This board is large and thick, so it's fairly expensive to produce in small quantities.

Configuring the Jumpers

There are a lot of jumpers on the motherboard, and setting them all up seems a bit complicated until things are working. There are three main areas to configure: I/O address decoding, baud rate selection, and the I/O slot addresses. We'll cover each of them:

I/O Address Decoding

On the original SWTPC systems, all I/O started at memory address $8000, and each of the eight slots had four addresses reserved for them. So, slot 0 had $8000 to $8003, slot 1 had $8004 to $8007, etc. While there were very few systems with more than 16K back then, having I/O right in the middle of the address space meant that there could never be more than 32K of contiguous memory, from $0000 to $7FFF.

When the 6809 board came out, the I/O was fortunately move to $E000 so there could be 56K of contiguous memory for RAM. Since some of the I/O devices were getting more complex, the amount of space reserved for each board was increased to 16 bytes.

To support both of these options, there are four jumpers on the motherboard that must be configured. JP8 sets the base address to E000 or 8000. JP13, JP14 and JP15 can be set to either "4" or "16" to select the number of addresses for each I/O slot. While the base address can be set independently of the I/O size, the three jumpers that control the size must be set to all the same setting or strange things will happen.

For a 6800 system, the typical settings are "8000" and "4" for those four jumpers.

For a 6809 system, the most typical settings are "E000" and "16" for the four jumpers. Note that some versions of 6809 based monitor programs assume four bytes per slot, but the EPROM on the Corsham Technologies 6809 board requires 16.

Baud Rate Selection

This is tricky and depends on the processor board being used. In the original SS-5 spec, five pins were defined for carrying baud rate clocks, while the SS-50C spec allows those pins to be used for extended addressing instead. Some SS-50C

machines did not have any baud rate clocks on the SS-50 bus and only had them on the SS-30C side, and our motherboard allows for all these combinations.

The schematic for the motherboard can be consulted for all possible options, but most people are looking for specific instructions to get their systems set up, these are short-cuts based on using either ouf 6800 or 6809 boards using a single baud rate clock (not different clocks for different interface boards):

6800 Baud Rate Setup

The 6800 board allows several common baud rates (1200, 2400, 4800 and 9600) to be set to what is normally the 150 baud line. By selecting the jumper on the CPU board for the desired baud rate, it will appear on the 150 baud line.

On the motherboard, install a jumper on JP12 (150_B) so that line is connected through to the SS-30 bus.

On your serial board, select the 150 baud jumper. Now your board will have the clock selected.

6809 Baud Rate Setup

For the 6809, we need to set up the baud rate and also enable the four extended address bits. On the CPU board, select the four jumpers to A16 to A19. Set the other jumper to select the VAR baud rate, and then use the VAR jumper block to select the desired baud rate. This will put the clock onto the 110 baud line.

On the motherboard, install a jumper at JP3 (110_B).

On your serial board, select the 110 baud jumper so your board will have the desired baud rate clock.

I/O Slot Addresses

SS-50 motherboards have I/O slot address decoding on the motherboard, with either 4 or 16 memory addresses decoded for each slot. Our motherboard has two I/O slots that can be configured for any of the eight possible slot addresses via two jumpers.

Along the left side of the motherboard adjacent to each of the two I/O slots are two jumpers with settings from SLOT 0 to SLOT 7. Each slot can be set to respond to multiple slot addresses, but do not set both slots to the same setting.

Most 6800 and 6809 SS-50 software expect the main console to be installed in slot 1.

Hooking It Up

Power

You will need an external +8 volt power supply, and possibly external +12 and -12 supplies if any of your boards need those voltages. None of the Corsham Technologies boards need anything other than +8. How much current? That depends on what you install, but with one of our serial boards, a 6800 CPU and 64K, the total current consumption is still under 750 ma. With the 6809 board and serial port, it's also still under 750 ma.

There are three "power good" indicator LEDs on the motherboard, along with a jumper to remove +8 from the on-board 5 volt regulator. Please follow these steps to connect the power supplies:

1. Turn off the power supplies!
2. Connect the common rails from all supplies to the GND screw terminals on the motherboard. All of the terminals with the same names are connected together so it doesn't matter which you use.
3. Remove the jumper labeled ENABLE 8V located near the voltage regulator in the top corner of the board.
4. Turn on the power supplies.
5. The LED for each connected supply should come on; if not, check your connections.
6. Once all three LEDs are on, turn off the power supplies.
7. Put the ENABLE 8V back on.

I/O Connectors

The next step is to properly jumper your SS-30 connectors for the desired slot. The original SWTPC motherboard had all eight slots but ours has two, so you need to select which two they are.

The console adaptor is normally installed in slot 1, so set one of the jumpers to the "1" position and install your MP-S or MP-C board there. It doesn't matter what position the jumper for the other slot is set to.

Reset

There is a reset button on the motherboard to the left of the power connectors. There is also a connector for use with a front-panel reset switch. Simply shorting those two pins forces a reset of the system.

Expansion Connectors

While two SS-30 I/O slots and three SS-50 slots are enough to build a working system, it is highly likely users of the motherboard will want to eventually have more slots. This is especially true if you are using genuine SWTPC memory boards which had 8K each, so filling the lower 32K with RAM requires four boards.

To allow users to expand their systems we have included expansion connectors for both the SS-30 and SS-50 buses so plug-in expanders can be added. As of this writing, those boards are not available but they have been in the planning stages since the motherboard was originally thought out.

SS-30 Expansion Pins

A single 40 pin plug labeled EXP I/O handles the SS-30 bus.

Pin	SS-30 Pin	Definition
1	1	UD-3
2	2	UD-4
3	3	-12V power
4	4	+12V power
5-8	5-6	Ground
9	7	Index – not actually connected
10	8	/NMI
11	9	/IRQ
12	10	RS0
13	11	RS1
14	12	D0
15	13	D1
16	14	D2
17	15	D3
18	16	D4
19	17	D5
20	18	D6
21	19	D7
22	20	/Phase 2

23	21	R/W
24		unused
25-28	22-23	+8V power
29	25	600 Baud
30	24	1200 Baud
31	27	150 Baud
32	26	300 Baud
33	29	/RESET
34	28	110 Baud
35	30	/SELECT_2
36	30	/SELECT_3
37	30	/SELECT_4
38	30	/SELECT_5
39	30	/SELECT_6
40	30	/SELECT_7

You will notice that there are six /SELECT signals. Since there are two SS-30 connectors on the motherboard, those are meant to be slots 0 and 1 while the other six slots are on the expansion board.

SS-50 Expansion Pins

The main SS-50 bus is handled by a pair of 30 pin connectors.

Connector EXP A:

Pin	SS-50 Pin	Definition
1-2	28-30	+8 V
3-6	25-27	Ground
7	23	A1
8	24	A0
9	21	A3
10	22	A2
11	19	A5
12	20	A4
13	17	A7
14	18	A6
15	15	A9
16	16	A8
17	13	A11
18	14	A10
19	11	A13

20	12	A12
21	9	A15
22	10	A14
23	8	/D7
24	7	/D6
25	6	/D5
26	5	/D4
27	4	/D3
28	3	/D2
29	2	/D1
30	1	/D0

Connector EXP B:

Pin	SS-50 Pin	Definition
1-6		Unassigned
7	50	1200 Baud
8	49	600 Baud
9	48	300 Baud
10	47	150 Baud
11	46	110 Baud
12	45	/HALT
13	44	/PHASE 1
14	43	BA
15	42	/RESET
16	41	R/W
17	40	/VMA
18	39	/PHASE 2
19	38	UD 2
20	37	UD 1
21	36	/IRQ
22	35	/NMI
23	34	/M.RESET
24		Unassigned
25-26	32	+12 V
27-28	31	-12 V
29-30	28-30	+8 V

Go Spurs!

All of our circuit boards have something unusual on them, and since SWTPC was in San Antonio, it seemed the city would make for some interesting additions. Fortunately, I have a friend who is a native of San Antonio, so I asked Suzanne for some ideas or else I'd resort to Googling for something appropriate. A short email with *Go Spurs!* provided all I needed.

Why This?

Back when SWTPC was around, I was a teenager without much money to spare. I got their catalogs and was intrigued by their inexpensive kits and simple designs that could be assembled by average people. The entry point for a working system was a bit beyond my means, so I ended up with a KIM-1 instead.

Years later, I have my own company that has been making Apple/Franklin and KIM-1 expansion boards and one night I decided it was within my abilities to make a clone of the original SWTPC machine. By using some parts available now, the design can be simplified.

Bob Applegate
May 2014

Revision History

Version	Changes
A	Initial Beta.
1	First release; SS-50 only
2	Various fixes; SS-50 only
3	SS-50 and SS-50C. Added third SS-50 slot, ability to select base address and addresses per slot, and other changes required to support a 6809 board.

Errata

Part IC4 is labeled on the schematic and PC board as a 74367 but is actually a 74LS367. Either should work fine.

Resistor networks RN2, RN3 and RN4 are not populated.

6809 FIRQ Issue

The motherboard is properly wired for NMI to work on 6800 based systems. However on a 6809 system, if the FIRQ line is desired on the SS-30 bus then a cut and jumper must be installed.

For 6800, SS-50 pin 35 (/NMI) is connected to SS-30 pin 8.

For 6809, SS-50 pin 37 (/FIRQ) is connected to SS-30 pin 8.

To make the change, locate SS-50 pin 35 on the bottom of the board. The trace runs to a via. Cut the trace before the via on the bottom of the board. Next, connect a jumper from that via to SS-50 pin 37 (FIRQ).

Parts List

Part	Number	Description
PCB	1	Printed Circuit Board (Corsham Tech)
SS-50/SS-30	21	AMP 1-640384-0
JP1- 4, 6-7, 9, 11-12, 16-21	15	1x2 jumper block

JP5, JP8, JP13, JP14, JP15	5	1x3 jumper block
SELECT0, SELECT1	2	2x8 jumper block
EXP_A, EX_B	2	2x15 right angle female connector
EXP_IO	1	2x20 right angle female connector
R1-R7	7	680 ohm
R8-R9	2	6800 ohm
R11	1	220 ohm
R12, R13	2	2K ohm
RN1-RN4	4	680 ohm 8x1 common lead resistor network
RN5-RN6	2	680 ohm 4x1 common lead resistor network
C6	1	220uf, 25v electrolytic capacitor
C7-C10	9	.1 uf disc capacitor
S1	1	4 pin SPST pushbutton
LED1-LED3	3	5mm LEDs
IC1	1	74LS02
IC2	1	74LS640
IC3	1	7805 +5 VDC regulator, TO-220 case
IC4	1	74LS367
IC5, IC6	2	74LS138
IC7	1	74LS32
	2	14 pin IC sockets for IC1, IC7
	3	16 pin IC sockets for IC4, IC5, IC6
	1	20 pin IC sockets for IC2