Serial Board
May 31, 2015

The Apple 1 Serial board uses a 6551 ACIA. The addressing for this board has been designed to mimic the Apple 1 6820 PIA at the $D01X locations and still provide full access to the 6551 in the $D00X space. The 6820 is disabled during Serial Board accesses using the VMA mod where the VMA line short to +5 is replaced by a resistor and capacitor so the VMA line can become active. Using this modification the 6820 can be disabled on a cycle by cycle basis by pulling down the VMA line and the Serial board function can be enabled in its place. The board has no on board firmware and no additional software is needed for the boards operation.The board is compatible with all Apple 1 software. Figure 1 is a photo of the finished board.

Figure 1

Table 1 shows the valid addresses on the Serial board and the suggested addresses to be used. . Table 2 shows where the addresses map into the 6551 space. Table 3 shows the corresponding Apple 1 locations so that with the remapping the Serial board has exactly the same register mapping as the Apple 1 6820. Note that on the reads from $D011 and $D012 the appropriate bit is remapped to provide the proper ready bits to match the Apple 1 Keyboard and Display locations. Therefore when the VMA is pulled disabling the 6820, the Serial board provides an exact substitution. This means that the serial board operates exactly like the 6820 and there are no software changes of any kind to use the serial board. On the other hand the full set of Serial Board 6551 registers are still available at locations $D002 to $D005.

Apple 1 Serial Board Description

Full Binary Address x = "don't care"	**Suggested Address to Use**
1101 xxxx xxx0 x0x0	$D002
1101 xxxx xxx0 x0x1	$D003
1101 xxxx xxx0 x1x0	$D004
1101 xxxx xxx0 x1x1	$D005
1101 xxxx xxx1 x0x0	$D010
1101 xxxx xxx1 x0x1	$D011
1101 xxxx xxx1 x1x0	$D012
1101 xxxx xxx1 x1x1	$D013

Table 1

The VMA line action from the serial board can be disabled by removing the jumper labeled VMA on the board. The address locations at $D002 to $D005 could still be used since the 6820 is disabled at these addresses but the 6820 would not be disabled at locations $D010 to $D013. This makes the Serial board useable even if there is no VMA mod made, however, substitution could not be used.

Attached is a schematic of the Serial Board. One circuit of note is Q1 and Q2 that form a circuit that will detect a Break sent from a remote device and will reset the Apple 1 when a Break is received. This permits remotely managing the Apple 1 so that the Apple 1 could be made into a dial up computer and if the Apple 1 requires a reset it can be sent. This function can be disabled by removing the jumper labeled RESET from the board.

When using the Serial Board with a Mac using the CoolTerm program and a Keyspan 19HS we observed that the use of the high bit of the characters being a 1 caused some issues. The CoolTerm expects the high bit to be a zero and sends the characters with the high bit a zero. This caused the CoolTerm to recognize the incoming characters as special characters when in 8 bit transmission mode and the characters with the high bit cleared caused the Apple 1 to not respond properly to the incoming keystrokes. J9 and J10 labeled Tx and Rx were added to optionally force the high bit to be a one as needed for general use. This change only affects the $D01x addresses so that custom programs using the $D00x space are not affected. The exact behavior is described in Table 2.

Apple 1 Serial Board Description

Switch Status	Address	Write				Read			
		Register	VMA	Bit 7 Tx Jumper		Register	VMA	Bit 7 Rx Jumper	
				On	Fixed			On	Fixed
Don't Care	D002	6551 Write Transmit Data Register	Low	6551 Bit 7	6551 Bit 7	6551 Read Receive Data Register	Low	6551 Bit 7	6551 Bit 7
Don't Care	D003	6551 Programmed Reset (Data "don't care")	Low	6551 Bit 7	6551 Bit 7	6551 Read Status Register	Low	6551 Bit 7	6551 Bit 7
Don't Care	D004	6551 Write Command Register	Low	6551 Bit 7	6551 Bit 7	6551 Read Command Register	Low	6551 Bit 7	6551 Bit 7
Don't Care	D005	6551 Write Control Register	Low	6551 Bit 7	6551 Bit 7	6551 Read Control Register	Low	6551 Bit 7	6551 Bit 7
KBD ON	D010	6551 Disabled	Open	N/A	N/A	6551 Read Receive Data Register	Low	6551 Bit 7	1
KBD ON	D011	6551 Disabled	Open	N/A	N/A	6551 Read Status Register	Low	6551 Bit 3	6551 Bit 3
KBD OFF	D010	6551 Disabled	Open	N/A	N/A	6551 Disabled	Open	N/A	N/A
KBD OFF	D011	6551 Disabled	Open	N/A	N/A	6551 Disabled	Open	N/A	N/A
DSP ON	D012	6551 Write Transmit Data Register	Low	6551 Bit 7	6551 (Not Bit 7)	6551 Read Status Register	Low	6551 (Not Bit 4)	6551 (Not Bit 4)
DSP OFF	D012	6551 Disabled	Open	N/A	N/A	6551 Disabled	Open	N/A	N/A
Don't Care	D013	6551 Disabled	Open	N/A	N/A	6551 Disabled	Open	N/A	N/A

Table 2

Apple 1 Serial Board Description

Address	Write	Read
D00X	6820 Inactive	
D010		KBD Data Register
D011		KBD Control Register Bit 7=1 Ready
D012	DSP Data Register	DSP Status Register Bit 7= 0 Ready
D013	DSP Control Register	

Table 3

Table 4 shows the serial pinout on the board and the mapping for various RJ45 to DB configurations.

Signal	Serial Bd RJ45	DB9 Adapter	DB9 Xover	DB25 Adapter	DB25 Xover
Clear To Send (CTS)	8	8	7	5	4
Data Set Read (DSR) + Carrier Detect (DCD)	7	6	4	6	20
Receive Data (RXD)	6	2	3	3	2
Gnd	5	5	5	7	7
Gnd	4	5	5	7	7
Transmit Data (TXD)	3	3	2	2	3
Data Terminal Ready (DTR)	2	4	6	20	6
Request To Send (RTS)	1	7	8	4	5

Table 4 Adapter Pinouts

Apple 1 VMA Signal Activation

The VMA signal is a signal needed for the 6800 microcomputer but is not used on the 6502, the pin is a no-connect on the 6502 and a shorting connection area is provided on the Apple 1 board to short it to +5V. The signal is of interest because it is available on the I/O connector. The signal goes to the NAND gate at B1 where it is combined with refresh and the result goes to the 74514 decoder disable pins 18 and 191 disabling all the decoded addresses whenever there is either a refresh or the VMA is low. The signal also goes to a chip select pin on the 6820 PIA which is redundant because the 6820 is disabled whenever the decoder is disabled. The VMA signal can be restored to availability again by replacing the short at approximately A8 labelled 6502 with a pull up resistor. A 2200 ohm resistor in parallel with a 100 pf capacitor should be used, the capacitor controls some crosstalk that has been observed on the signal. When small surface mount parts such as the 0402 parts shown in Figure 1 are used the alteration is nearly invisible.

An alternate implementation is to remove the short at the location and put the added parts under the board between pins 5 and 8 of the 6502 at location A7 or pins 12 and 14 of the DIP at location B1. The capacitor must be connected to the +5V rail instead of GND.

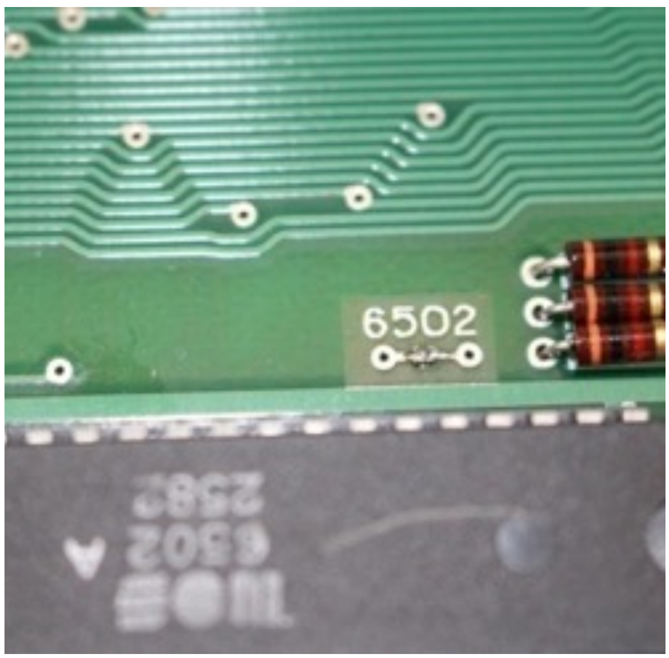

Figure 1

This modification makes available a signal on the peripheral connector that can be used to disable anything accessed using the decoder on a cycle by cycle basis. This includes the 6820 PIA, all on board RAM, the boot ROM and any peripheral using the R, S, or T signals. This permits a peripheral to perform hardware substitution for any of those functions.

For testing the Serial Board the Apple 1 or Clone must have the VMA mod performed meaning that the short on the Apple 1 labeled “6502” near the 3 3K resistors and near pin 1 of the 40 pin socket at A7 should be removed and replaced by a 100pf Capacitor and 2200Ω resistor across the terminals with surface mount parts or between pins 5 and 8 of the 6502 at location A7 or pins 12 and 14 of the DIP at location B1. The Serial board should be configured as shown in Figure 3 and plugged onto the PC board connector of the Apple 1 or can be plugged into an expansion slot of a known good Expansion Board configured as shown in Figure 2.

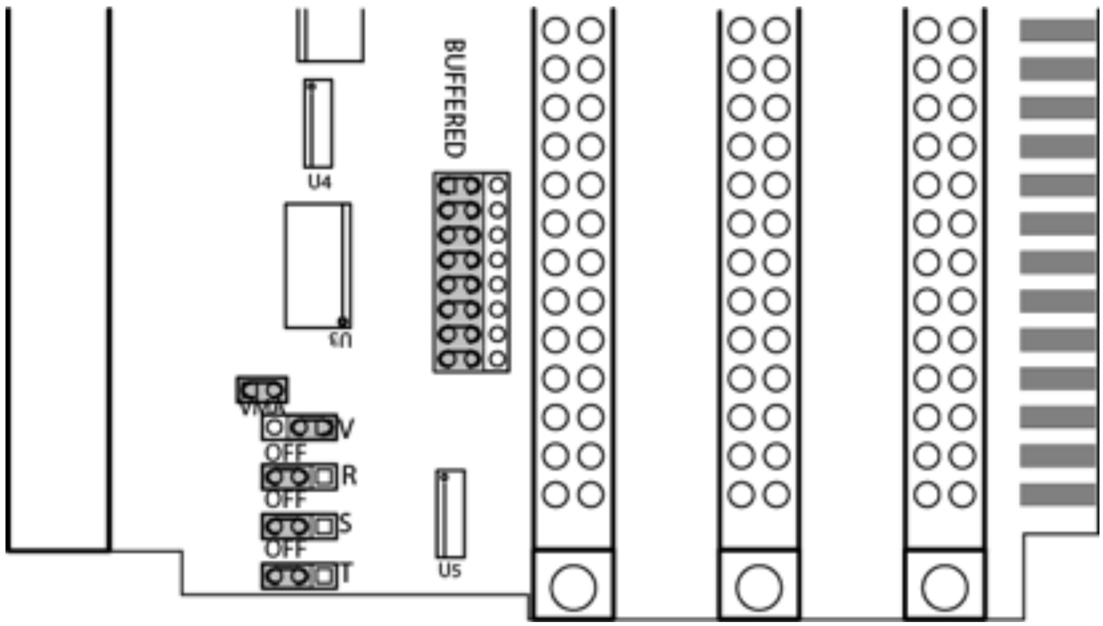

Figure 2

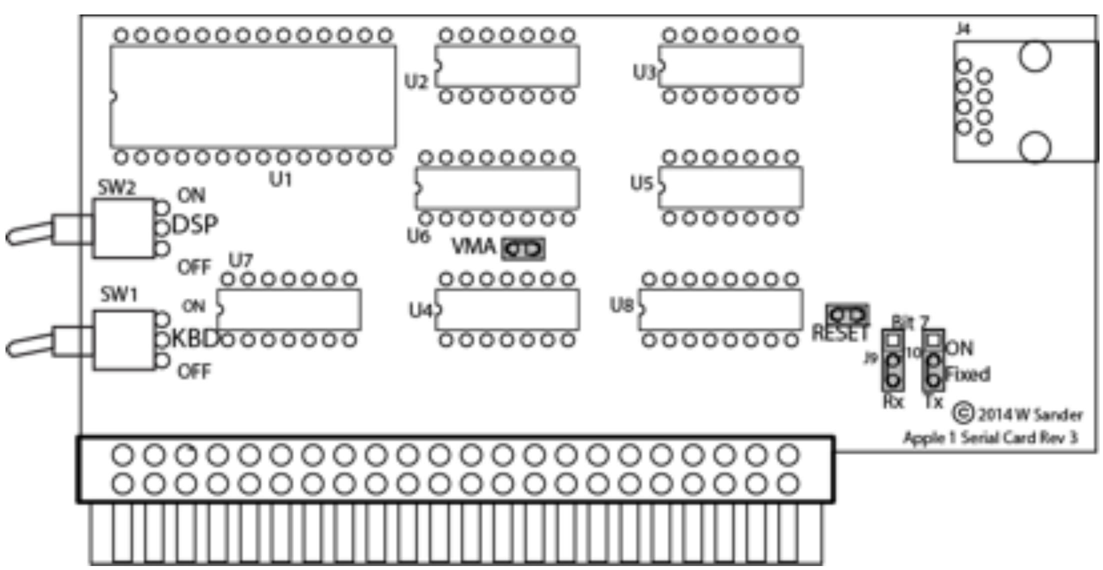

Figure 3

Power on the Apple 1 and verify that the system will reset and that the Keyboard and Display work normally.

Type `D004:8B 96`

Verify that the write was successful by reading locations D004 and D005. This will set the Serial Card to be 300 baud, 8 bit, 2 stop bits, parity disabled. Connect the serial board to an RS232 source that is configured as a dumb terminal. The Keyboard and Display should still work normally. Turn ON the KBD switch as shown in Figure 4.

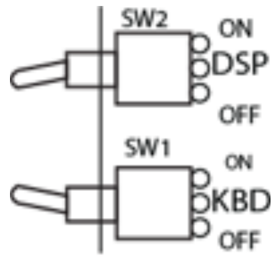

Figure 4

Now typing on the terminal device should be active and the Apple 1 display should remain active while the Apple 1 keyboard should not be active. Turn OFF the KBD switch and turn ON the DSP switch as shown in Figure 5.

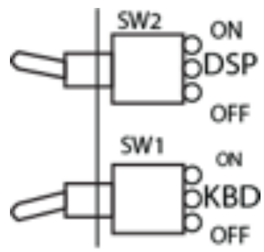

Figure 5

Now the display on the terminal device should be active and the Apple 1 Keyboard should be active while the Apple 1 display should not be active. Now turn ON the KBD switch so that both switches are ON as shown in Figure 6.

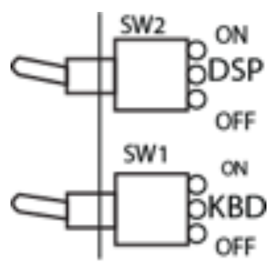

Figure 6

Now both the display and keyboard on the terminal device should be active and the display and keyboard on the Apple 1 disabled.

Send a Break signal from the dumb terminal and see that the Apple 1 is reset. The reset will take place regardless of the KBD and DSP switch settings on the Apple 1 Serial Card.

USING AN APPLE II AND SUPER SERIAL CARD AS A DUMB TERMINAL
Install an Apple II Super Serial Card into the Apple II with the Super Serial Card configured as shown in Figure 7. This will set the data rate at 300 baud and match all the settings on the Apple 1 Serial card. Connect the Apple 1 serial card using an RJ45 to DB25 adapter such as the CUI AMK-0233 wired as a "DB25 Adapter" as shown in Table 4 of the "Apple 1 Serial Board February 2015" document.

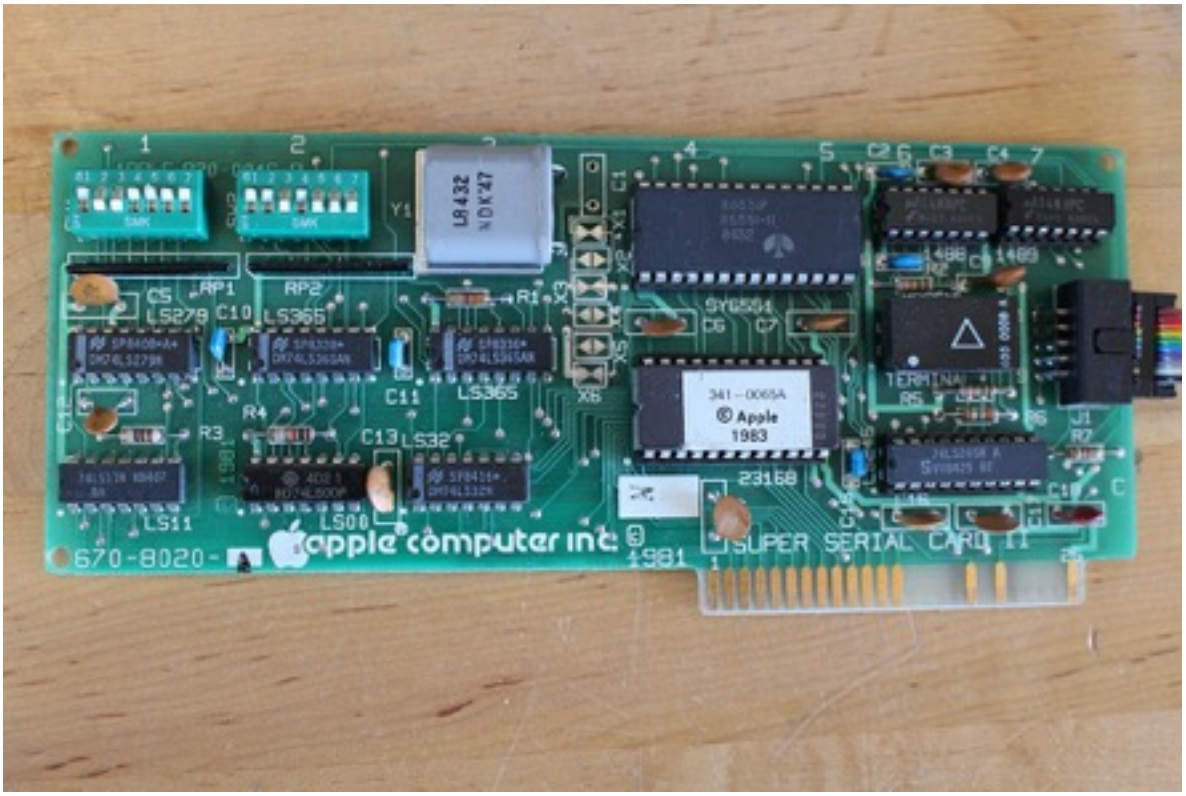

Figure 7

In this example it is assumed the Super Serial Card is in Slot 2. On the Apple II type

`]IN#2` Type IN#2 to activate the Super Serial Card

`]` After the] prompt type ctrl(A)
`APPLE SSC:T` The Apple II will respond with APPLE SSC: then type T carraige return
The SSC is now in Terminal Mode.

To send a break signal again type ctrl(A)

`APPLE SSC:B` The Apple II will respond with APPLE SSC: then type B carraige return

The SSC will now send a Break Signal. If the Apple 1 Serial card has the DSP switch ON then the Apple II screen will show

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USING A MAC WITH A KEYSPAN USA-19HS AND COOLTERM AS A DUMB TERMINAL

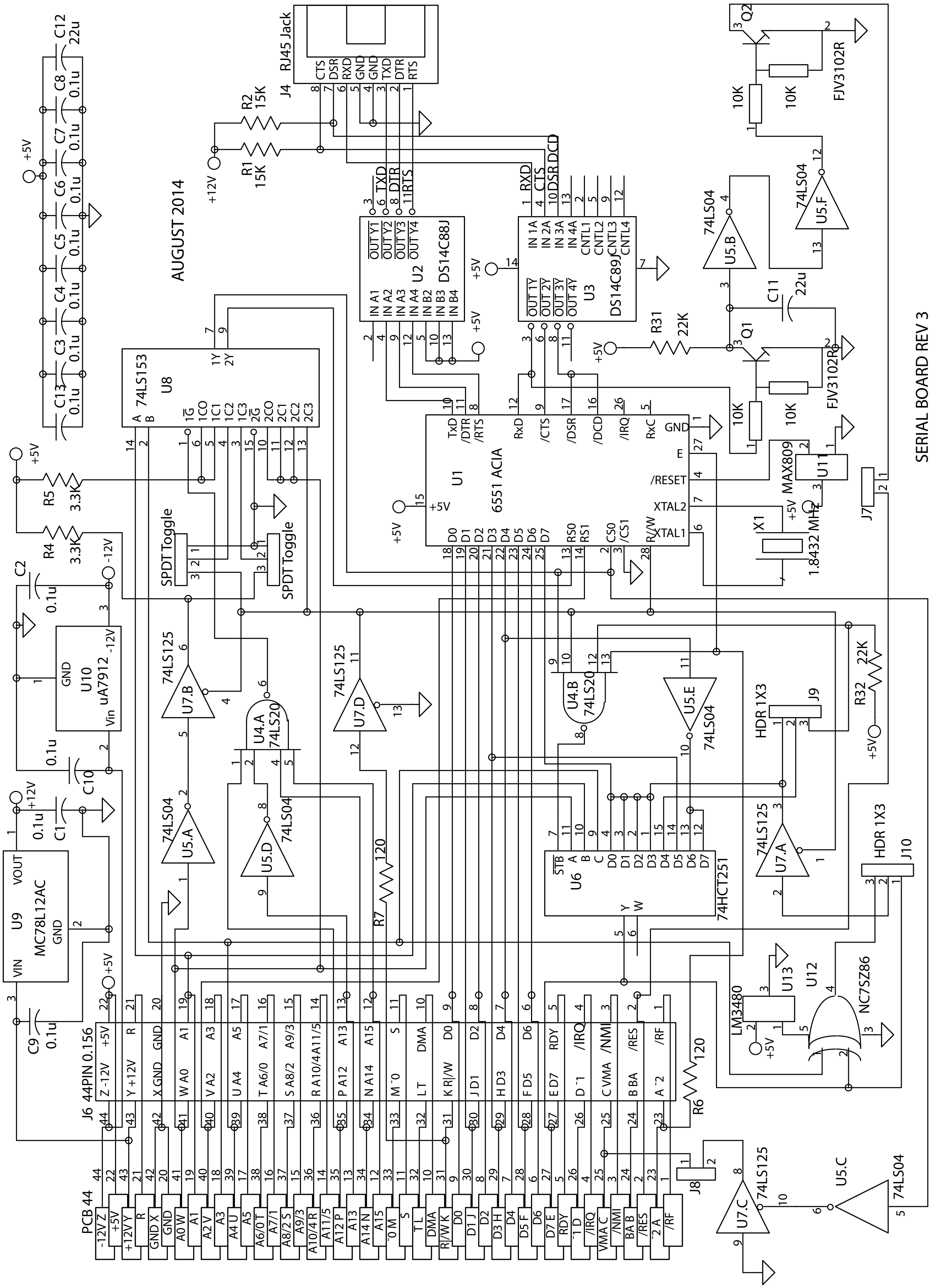
Connect the Apple 1 Serial card to the USA-19HS using an RJ45 to DB9 adapter such as the CUI AMK-0001 wired as a "DB9 Adapter" as shown in Table 4 of the "Apple 1 Serial Board February 2015" document.

Using the configuration file labeled "CoolTerm Terminal" attached the Mac will behave as a dumb Terminal. The Send Break command is under the "Connections" tab. If a Break is sent when the Apple 1 Serial card has the DSP switch ON the response on the Mac screen will be

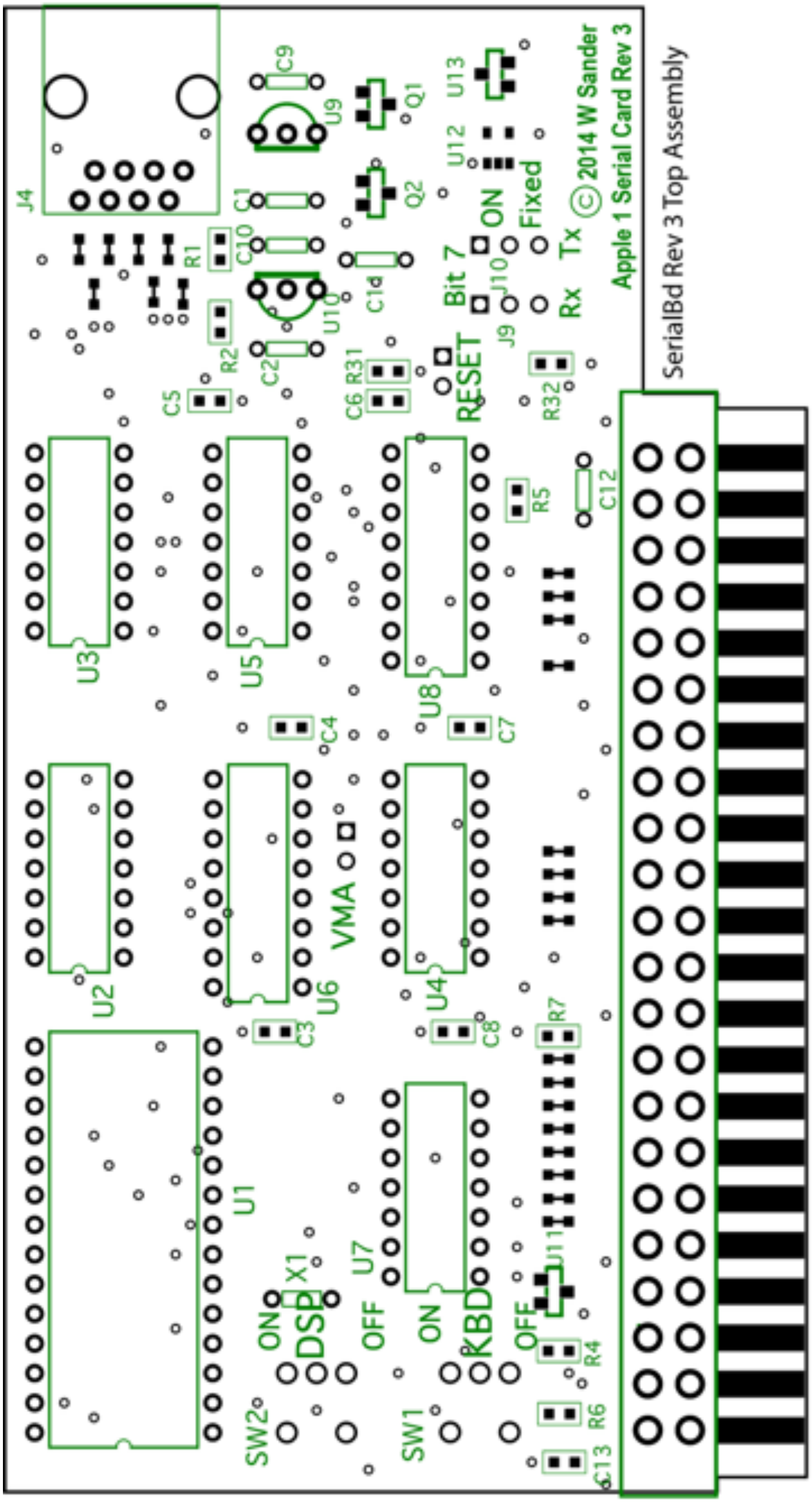
```
..\
```

The CoolTerm Terminal file uses the font "PrintChar21" as this is a match to the Apple 1 and Apple II Fonts. This font is available from

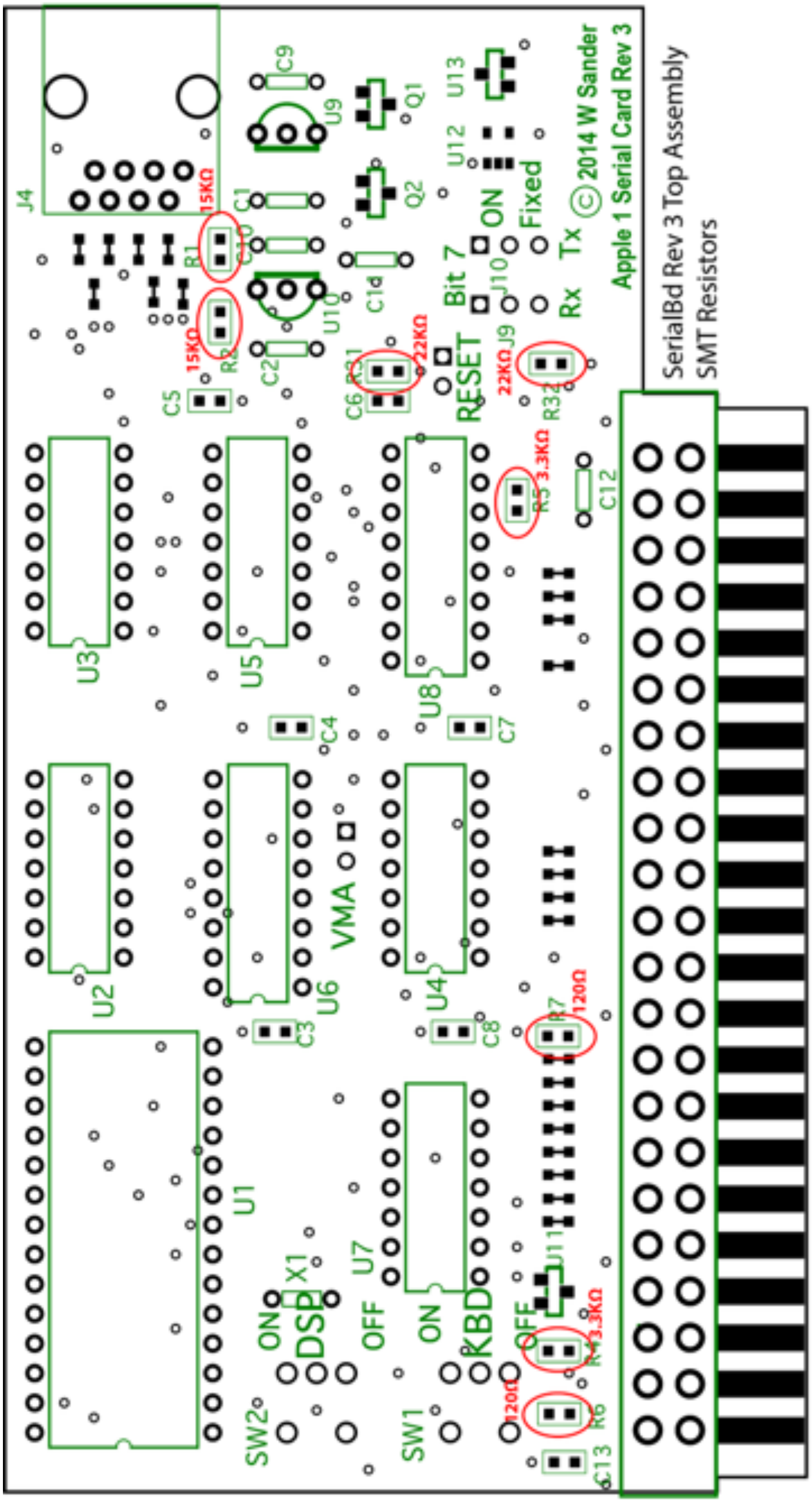
http://www.kreativekorp.com/software/fonts/apple2.shtml



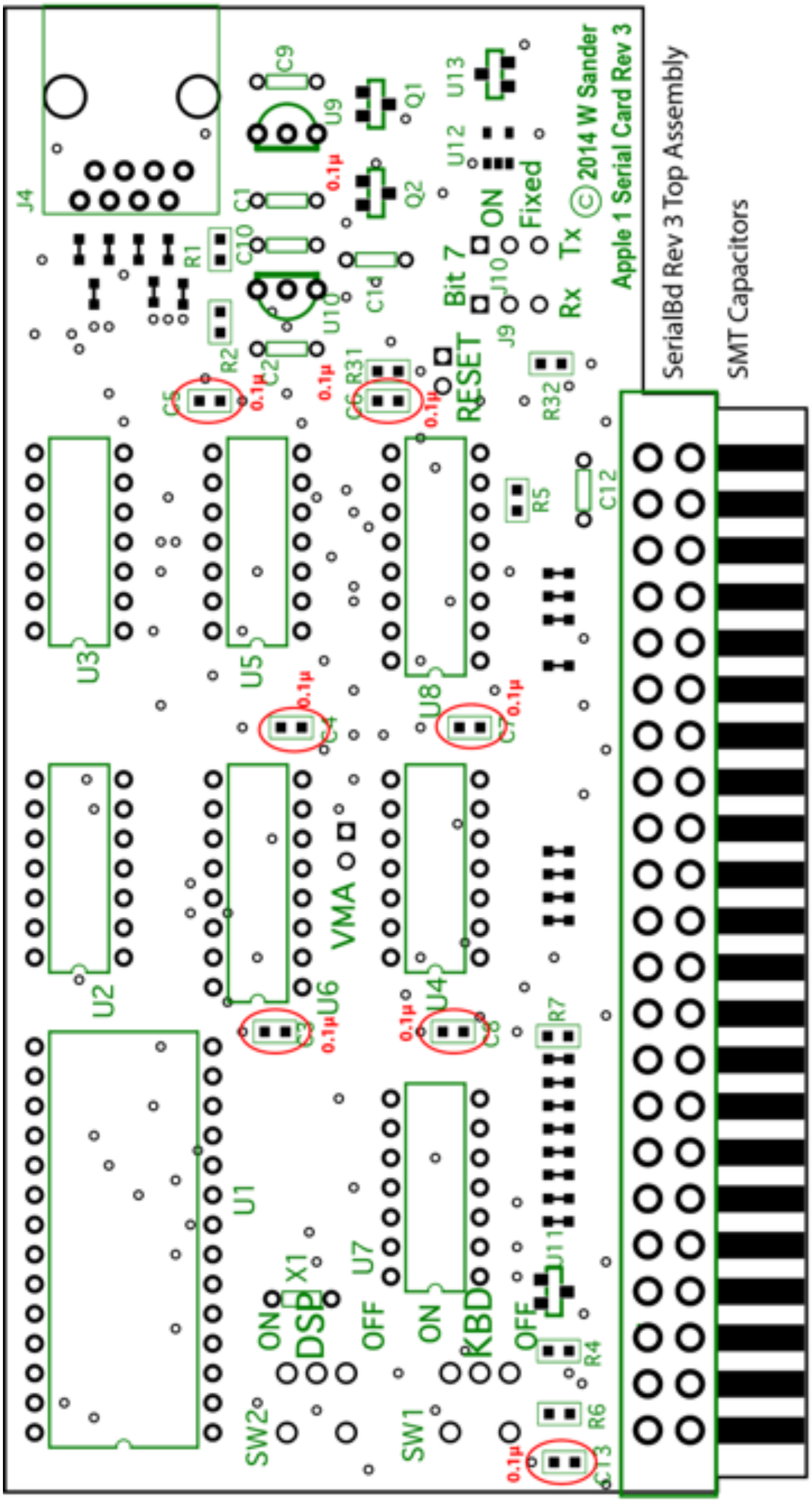
SERIAL BOARD REV 3
AUGUST 2014
RJ45 Jack
J4
CTS
DSR
RXD
GND
GND
TXD
DTR
RTS
R1
15K
R2
15K
+12V
+5V
DS14C88J
U2
DS14C89J
U3
74LS153
U8
6551 ACIA
U1
1.8432 MHz
X1
MAX809
U11
FJV3102R
Q1
Q2
10K
R31
22K
C11
22u
74LS04
U5.A
U5.B
U5.C
U5.D
U5.E
U5.F
74LS125
U7.A
U7.B
U7.C
U7.D
74LS20
U4.A
U4.B
74HCT251
U6
SPDT Toggle
R4
3.3K
R5
3.3K
uA7912
U10
MC78L12AC
U9
LM3480
U13
NC7SZ86
U12
HDR 1X3
J9
J10
J7
J8
R32
22K
R6
120
R7
120
J6 44PIN 0.156
PCB 44
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C12
C13
0.1u
22u
-12V



SerialBd Rev 3 Top Assembly

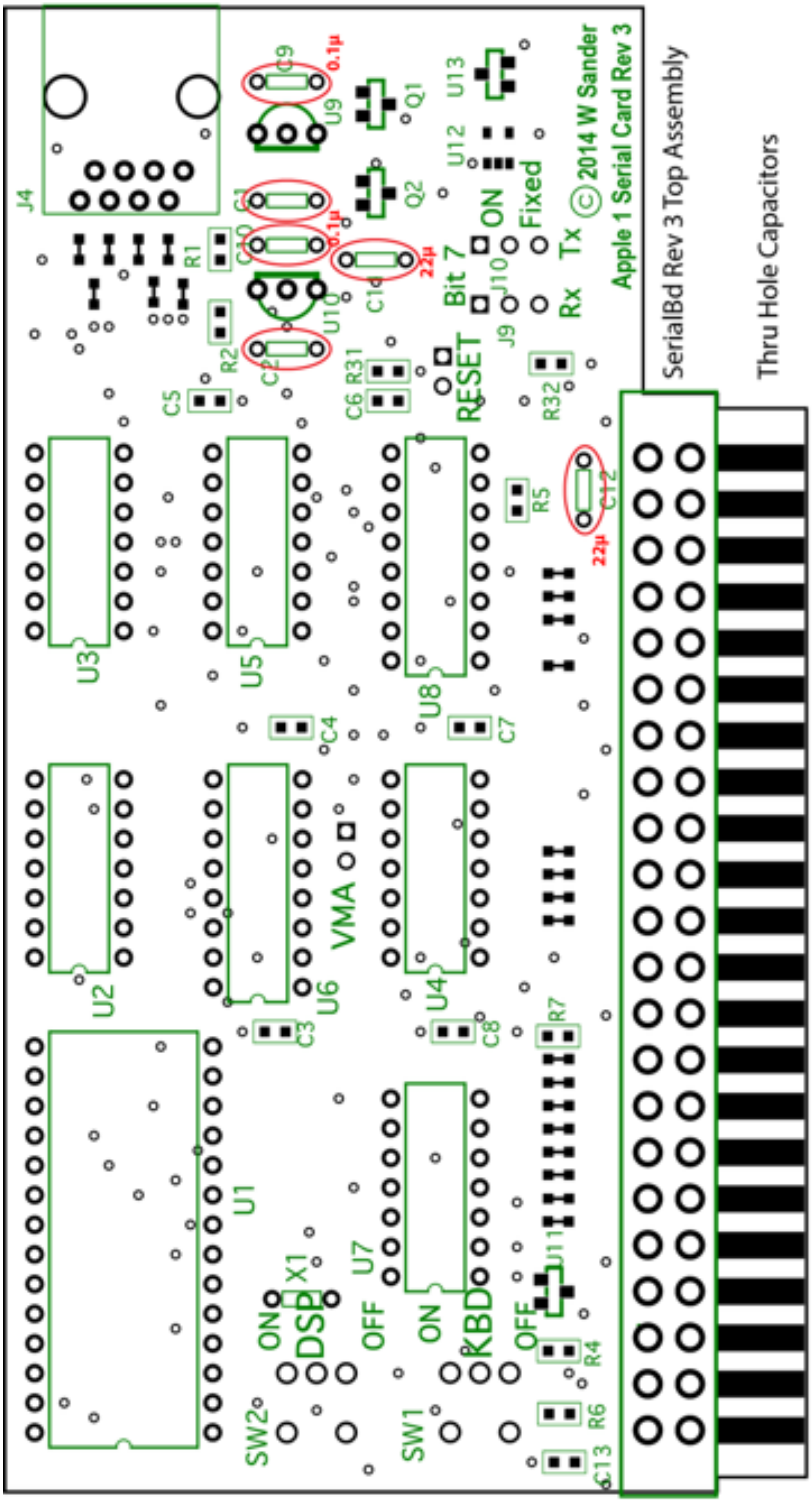


SerialBd Rev 3 Top Assembly
SMT Resistors



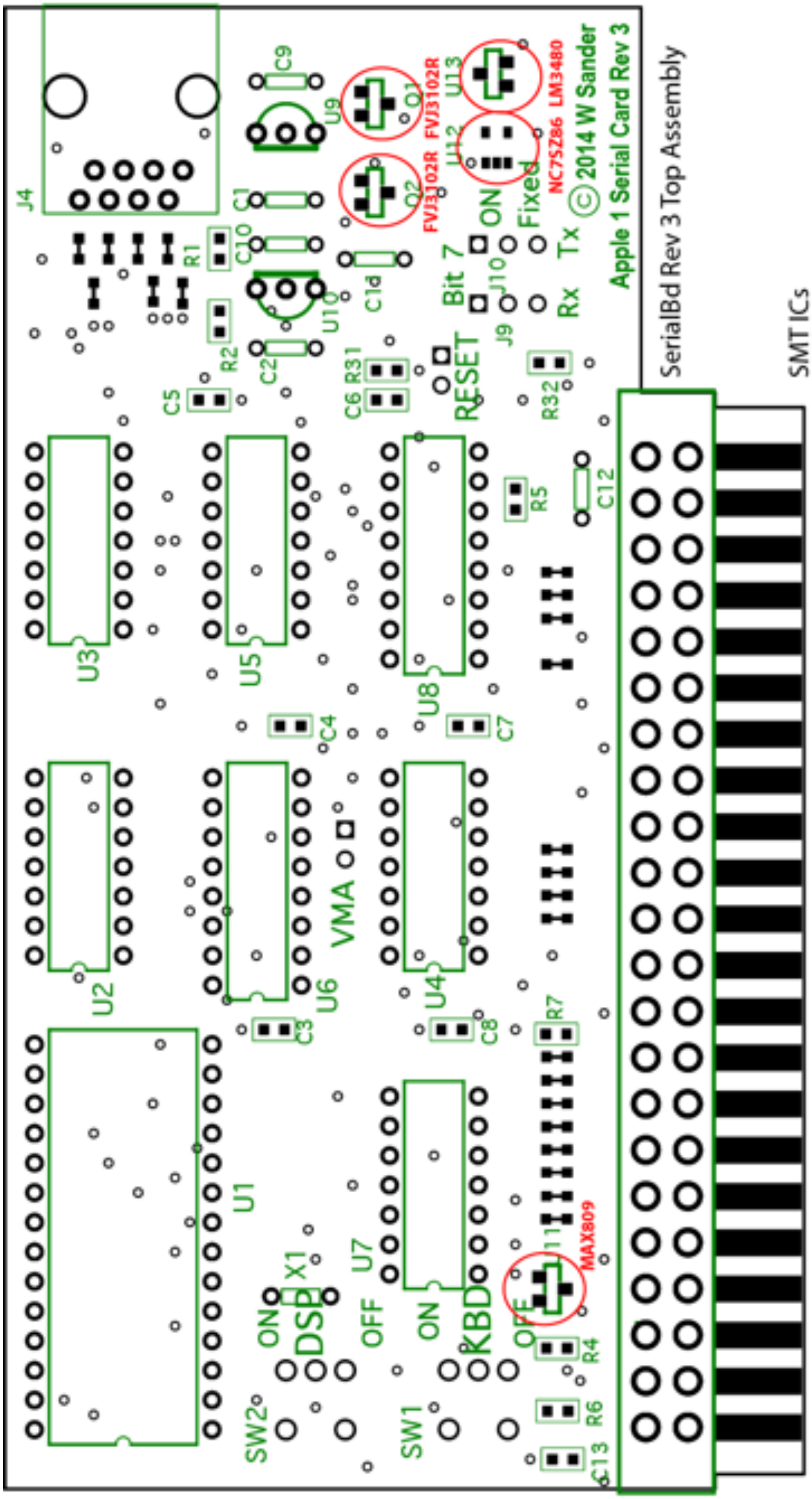
SerialBd Rev 3 Top Assembly

SMT Capacitors



SerialBd Rev 3 Top Assembly

Thru Hole Capacitors


SerialBd Rev 3 Top Assembly
SMT ICs
Apple 1 Serial Card Rev 3
© 2014 W Sander
NC7SZ86 LM3480
FVJ3102R FVJ3102R
MAX809
J4
R1
R2
C1
C2
C5
C6
C9
C10
C1d
R31
R32
U9
U10
U12
U13
Q1
Q2
Bit 7
ON
Fixed
Tx
Rx
J9
J10
RESET
C12
R5
U3
U5
U8
C4
C7
U2
U6
U4
VMA
R7
C3
C8
U1
U7
X1
ON
DSP
OFF
ON
KBD
OFF
R4
R6
C13
SW1
SW2

Serial Board Rev 3 Parts List

Designator	Part	Value	Manufacturer	Mfg Part No.	Description
C1	CAPACITOR	0.1u			0.2 In Radial Monlythic
C2	CAPACITOR	0.1u			0.2 In Radial Monlythic
C3	CAPACITOR	0.1u			0603 CAPACITOR
C4	CAPACITOR	0.1u			0603 CAPACITOR
C5	CAPACITOR	0.1u			0603 CAPACITOR
C6	CAPACITOR	0.1u			0603 CAPACITOR
C7	CAPACITOR	0.1u			0603 CAPACITOR
C8	CAPACITOR	0.1u			0603 CAPACITOR
C9	CAPACITOR	0.1u			0.2 In Radial Monlythic
C10	CAPACITOR	0.1u			0.2 In Radial Monlythic
C11	CAPACITOR	22u			0.2 In Radial Monlythic
C12	CAPACITOR	22u			0.2 In Radial Monlythic
C13	CAPACITOR	0.1u			0603 CAPACITOR
J4	RJ45 Jack		Molex	85503-5001	RJ45 Jack
J6	Card Connector	44 PIN 0.156	EDAC	305-044-520-202	44-Pin .156 Connector
J7	HEADER	1X2	SAMTEC	TSW-102-07-L-S	1X2 0.1 In Header
J8	HEADER	1X2	SAMTEC	TSW-102-07-L-S	1X2 0.1 In Header
J9	HEADER	1X3	SAMTEC	TSW-103-07-L-S	1X3 0.1 In Header
J10	HEADER	1X3	SAMTEC	TSW-103-07-L-S	1X3 0.1 In Header
Q1	FJV3102R		Fairchild	FJV3102R	SOT23
Q2	FJV3102R		Fairchild	FJV3102R	SOT23
R1	RESISTOR	15KΩ			0603 RESISTOR
R2	RESISTOR	15KΩ			0603 RESISTOR
R4	RESISTOR	3.3KΩ			0603 RESISTOR
R5	RESISTOR	3.3KΩ			0603 RESISTOR
R6	RESISTOR	120Ω			0603 RESISTOR
R7	RESISTOR	120Ω			0603 RESISTOR
R31	RESISTOR	22KΩ			0603 RESISTOR
R32	RESISTOR	22KΩ			0603 RESISTOR
SW1	SPDT Toggle		C&K	T101MH9ABE	SBDT TOGGLE 2 POS
SW2	SPDT Toggle		C&K	T101MH9ABE	SBDT TOGGLE 2 POS
U1	6551 ACIA				28 PIN 0.6 DIP
U2	DS14C88J		TI	DS14C88J	14 PIN DIP
U3	DS14C89J		TI	DS14C89J	14 PIN DIP
U4	74LS20			74LS20	14 PIN DIP
U5	74LS04			74LS04	14 PIN DIP
U6	74HCT251			74HCT251	16 PIN DIP
U7	74LS125			74LS125	14 PIN DIP
U8	74LS153			74LS153	16 PIN DIP
U9	LM78L12ACZ		TI	LM78L12ACZ	TO92
U10	LM79L12ACZ		TI	LM79L12ACZ	TO92
U11	MAX809	4.38V	ON SEMI	MAX809MTRG	SOT23
U12	NC7SZ86M5X	TinyLogic EOR	FAIRCHILD	NC7SZ86M5X	SOT23-5
U13	LM3480-3.3	3.3 V LDO	TI	LM3480IM3	SOT23
X1	XTAL1	1.8432 MHz	Fox Electronics	FOXLF018S	Metal Can 0.2 Center