

PACKAGE 2 LOW/HIGH RESOLUTION MODIFICATION PROCEDURE

CONTENTS

NINETEEN PAGES DESCRIBING WHAT AND HOW TO MODIFY ASTROCADE MOTHER BOARD PLUS WIRE RAM BOARD, WHICH CONTAINS VIDEO AND USER RAM.

COMMENTS

IT IS ASSUMED THE USER OF THIS PROCEDURE HAS A COPY OF THE BALLY SERVICE MANUAL PA-1. BEGINNING EXPERIMENTERS IN DIGITAL ELECTRONICS SHOULD NOT ATTEMPT THIS UPGRADE. SEVERAL UNUSED GATE INPUTS ARE SHOWN WIRED TO +5V VIA A 10K CURRENT LIMITING RESISTOR ALLOWING TTL CHIPS TO BE OCCASIONALLY SUBSTITUTED IN LIEU OF LSTTL CHIPS. IF ONLY LSTTL CHIPS WILL BE UTILIZED, THEN WIRE THE UNUSED INPUTS DIRECTLY TO +5V (NO RESISTOR). NUMBERS FOLLOWING PROCEDURE STATEMENTS INDICATE A REFERENCE SHOULD BE MADE TO THE NOTE NUMBERS WHICH ARE LISTED FOLLOWING THE PROCEDURE.

TWO LOW RESOLUTION DEMOS AND A HIGH RESOLUTION DEMO, FOR TESTING PURPOSES, ARE AVAILABLE ON CASSETTE TAPE. MAIL THE REQUEST FOR THE DEMOS ALONG WITH \$7.00, TO COVER THE COST OF THE TAPE, POSTAGE AND PACKAGING, TO:

MICHAEL C. MATTE
8605 W. DOUGLAS AVE.
MILWAUKEE, WI. 53225

REASONABLE QUESTIONS CONCERNING THE UPGRADE MAY ALSO BE MAILED TO THE ABOVE ADDRESS. A SELF-ADDRESSED STAMPED ENVELOPE WILL PRODUCE A REPLY TO ANY QUESTION(S).

LOW/HIGH RESOLUTION MODIFICATION

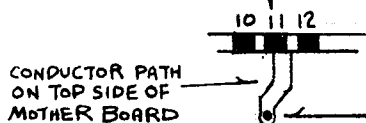
PROCEDURE

- ① DISASSEMBLE MOTHER BOARD FROM BALLY ARCADE.¹⁹
- ② DISCONNECT PINS 11 AND 12 OF CUSTOM DATA CHIP U18 FROM EACH OTHER. CONFIRM DISCONNECTION WITH OHM-METER.



USE SHARP KNIFE TO BREAK CONDUCTOR PATH, ON UNDERSIDE OF MOTHER BOARD, BETWEEN PINS 11 AND 12 OF U18 SOCKET.

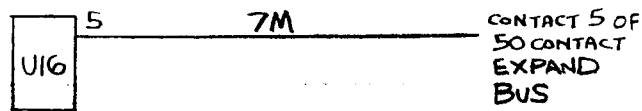
- ③ DISCONNECT PIN 11 OF CUSTOM DATA CHIP U18 FROM GROUND.



HEAT SOLDER AND RUN WIRE THROUGH HOLE TO REMOVE SOLDER. USE SHARP POINTED KNIFE TO DISCONNECT CONDUCTOR PATH FROM GROUND.

CONFIRM DISCONNECTION WITH OHM-METER. USE OHM-METER TO CONFIRM PIN 1 OF U18 IS NOT DISCONNECTED FROM GROUND.

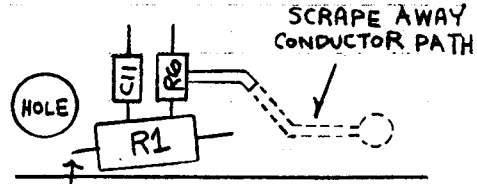
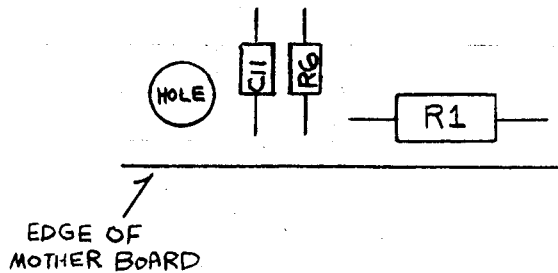
- ④ THE MOTHER BOARD SHOULD STILL OPERATE AT THIS POINT. SEE NOTES 1-3.
- ⑤ REMOVE SIX 1K Ω PULL-UP RESISTORS, USED FOR VIDEO RAM ADDRESS LINES A0-A5, FROM MOTHER BOARD. FIVE OF THE RESISTORS ARE NEAR RESISTOR R1. THE SIXTH RESISTOR IS BETWEEN CAPACITORS C78 AND C79.
- ⑥ REPLACE RESISTOR R14 ON MOTHER BOARD WITH A JUMPER WIRE. CONFIRM WITH OHM-METER THE FOLLOWING CONNECTION:



REMOVE CAPACITOR C18 FROM MOTHER BOARD.

- ⑦ THE MOTHER BOARD SHOULD STILL OPERATE AT THIS POINT. SEE NOTES 1-3.

- ⑧ MOVE RESISTOR R1 ON MOTHER BOARD TO ALLOW ROOM FOR MOUNTING OF A 24 PIN WIRE WRAP SOCKET.

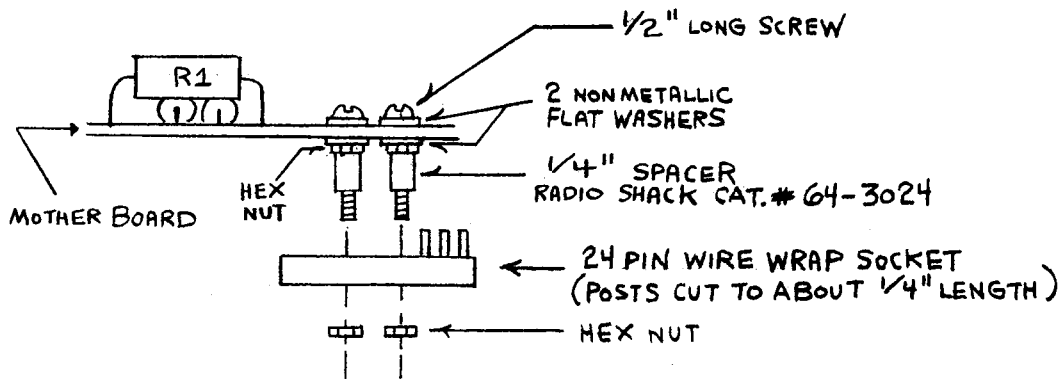
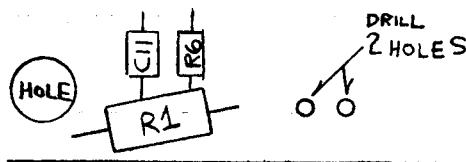


DRILL SMALL HOLE. TWIST TWO PIECES OF #30 WRAPPING WIRE TOGETHER. ON BOTTOM SIDE OF MOTHER BOARD, SOLDER ONE END OF WIRE TO R1 AND THE OTHER END OF WIRE SOLDER TO VOLTAGE REGULATOR VR2 INPUT TERMINAL.

BEFORE

AFTER

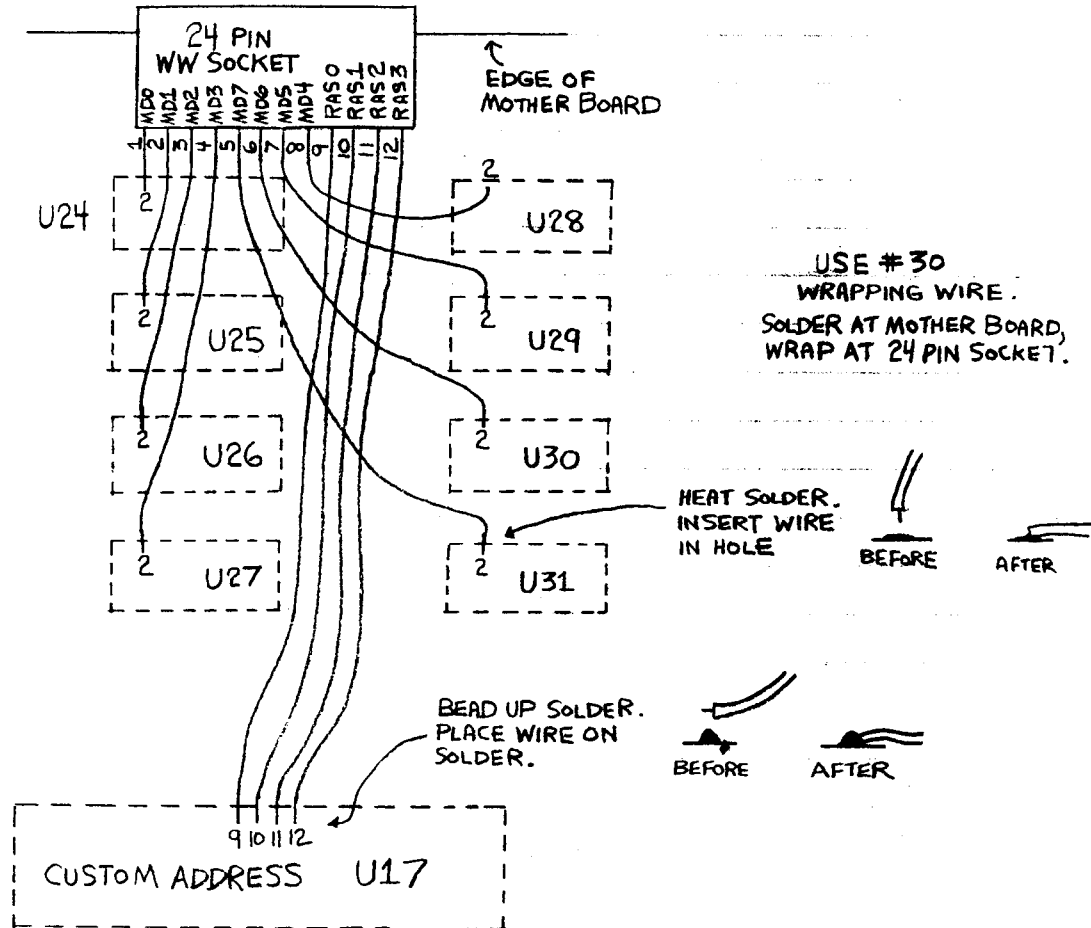
- ⑨ MOUNT 24 PIN WIRE WRAP SOCKET ON MOTHER BOARD.



- ⑩ CUT OUT RECTANGULAR HOLE IN BOTTOM PLASTIC CABINET, METAL AND PAPER SHIELDING SO MOTHER BOARD CAN BE PLACED IN ITS NORMAL POSITION ON CABINET BOTTOM.
- ⑪ THE MOTHER BOARD SHOULD STILL OPERATE AT THIS POINT. SEE NOTES 1-3.
- ⑫ REMOVE THE 24 PIN WIRE WRAP SOCKET FROM MOTHER BOARD. REMOVE CHIP U23 (DM81LS95) AND EIGHT VIDEO RAM CHIPS U24-U31 FROM MOTHER BOARD. CLEAN UP AREAS ON

MOTHER BOARD TOUCHED BY SOLDERING IRON AND CHECK FOR SHORTS.

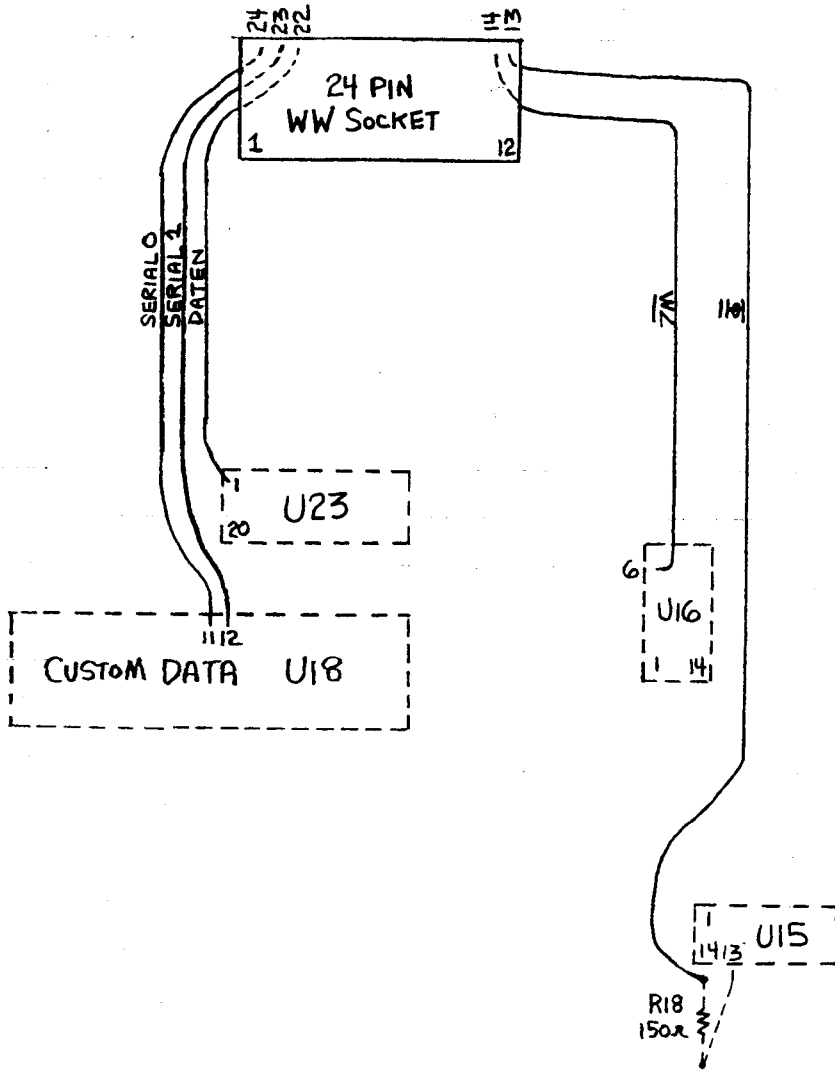
- ③ WIRE FROM BOTTOM OF MOTHER BOARD TO 24 PIN WIRE WRAP SOCKET THE DATA LINES MD0-MD7 AND LINES RAS0-RAS3.



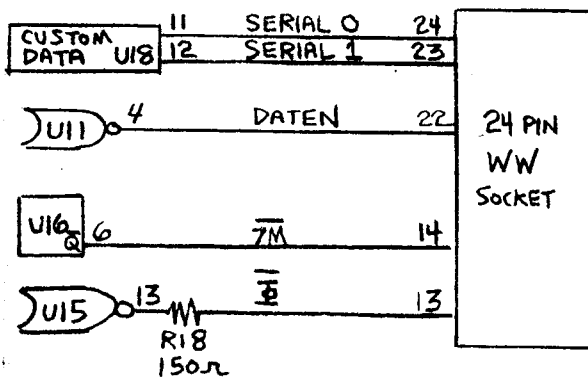
USE OHM-METER TO CONFIRM CONNECTIONS.

CUSTOM DATA U18	28	MD0	1	24 PIN WW SOCKET
	30	MD1	2	
	32	MD2	3	
	34	MD3	4	
	37	MD4	8	
	39	MD5	7	
	3	MD6	6	
5	MD7	5		
CUSTOM ADDRESS U17	9	RAS0	9	
	10	RAS1	10	
	11	RAS2	11	
	12	RAS3	12	

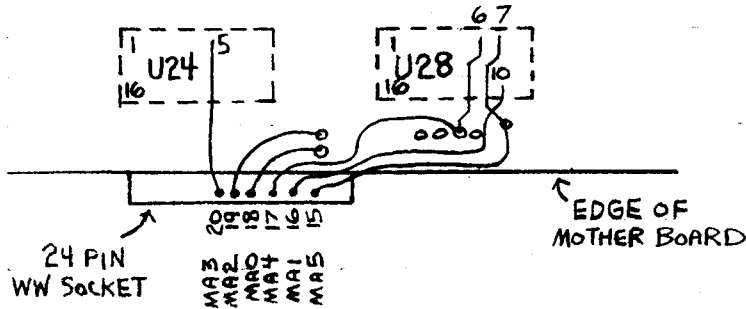
⑭ WIRE FROM BOTTOM OF MOTHER BOARD TO 24 PIN WIRE WRAP SOCKET THE LINES DATEN, SERIAL 1, SERIAL 0, $\bar{\Phi}$ AND $\bar{7M}$.



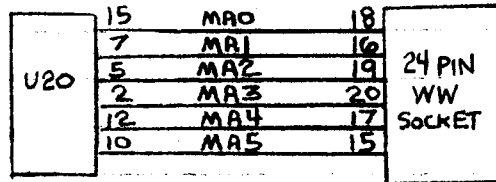
USE OHM-METER TO CONFIRM CONNECTIONS.



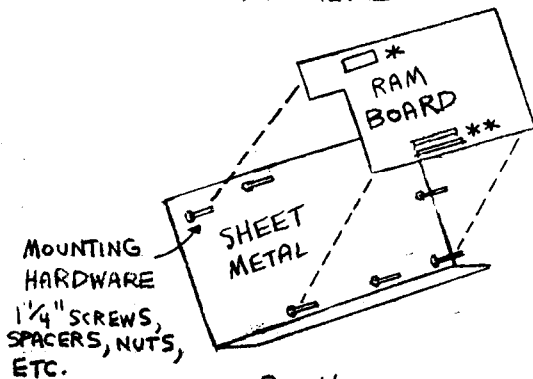
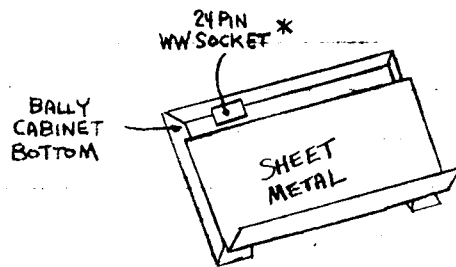
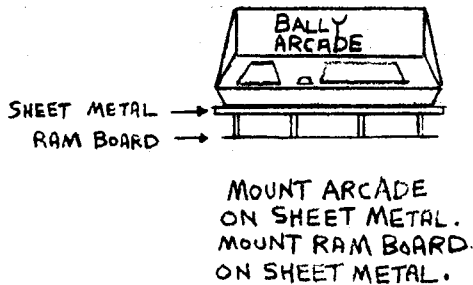
⑮ WIRE FROM TOP OF MOTHER BOARD TO 24 PIN WIRE WRAP SOCKET THE ADDRESS LINES MA0-MA5.



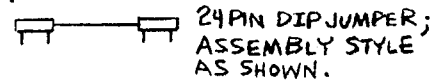
USE OHM-METER TO CONFIRM CONNECTIONS.



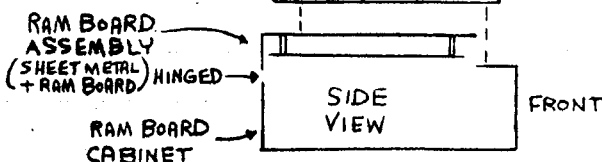
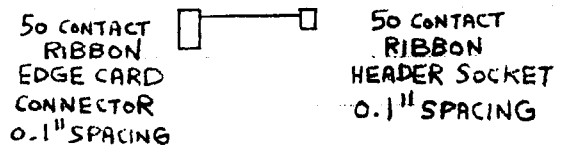
⑯ DECIDE HOW RAM BOARD WILL BE MOUNTED. 5



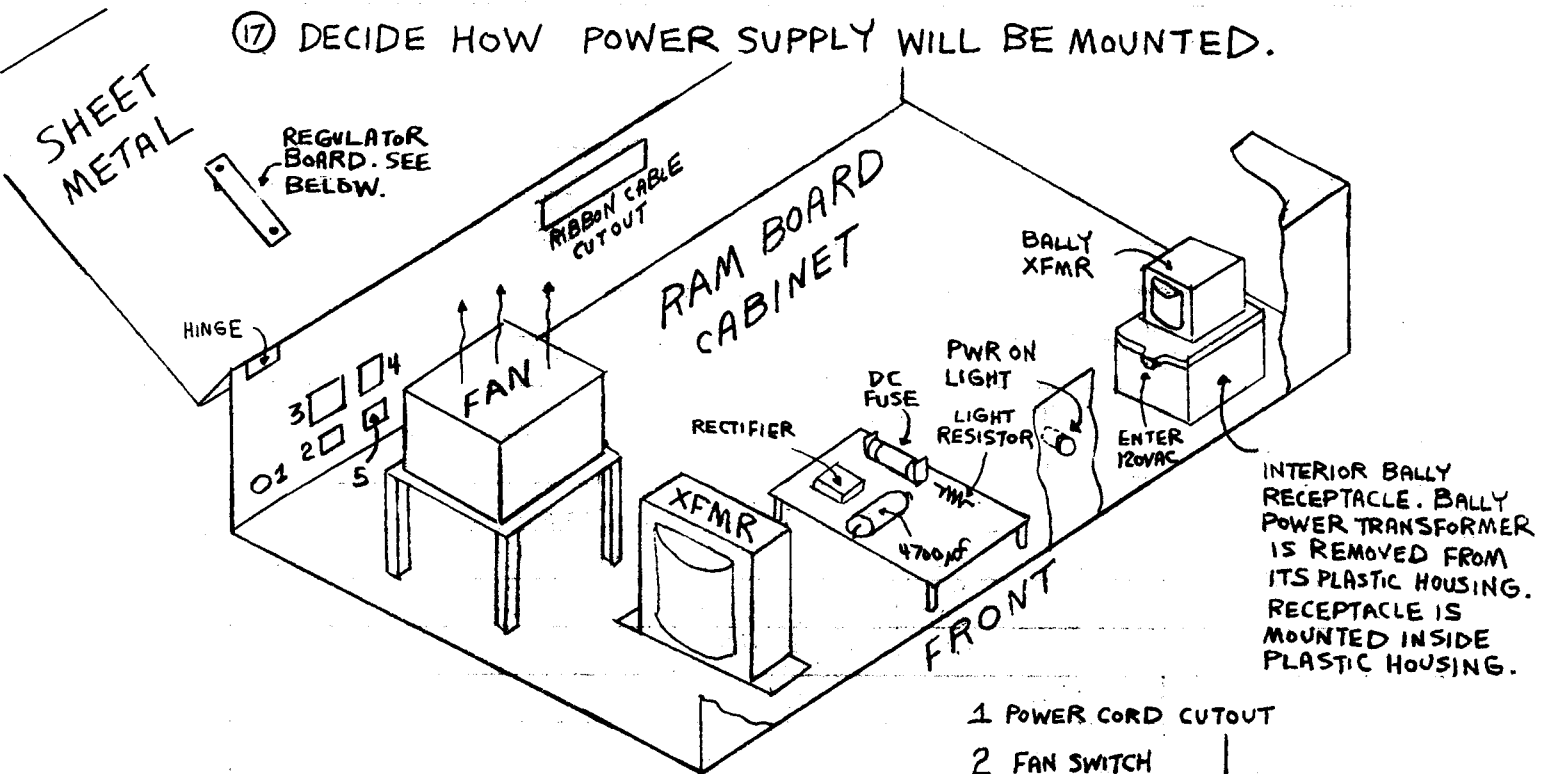
* 24 PIN WW SOCKET. 24 PIN DIP JUMPER CONNECTS RAM BOARD TO BALLY MOTHER BOARD.



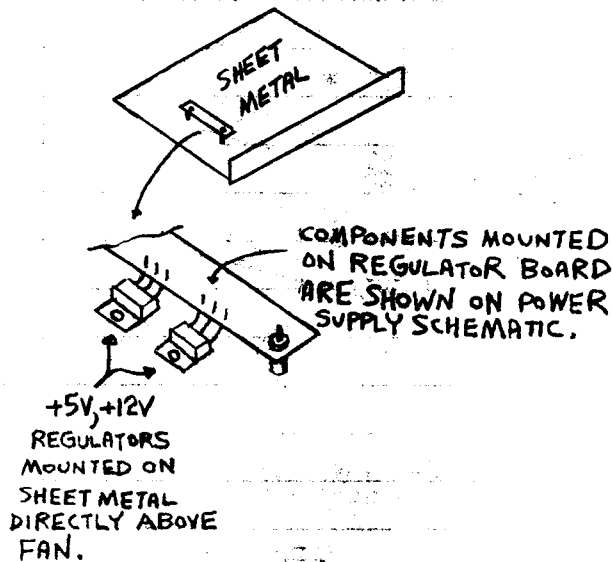
** TWO WW HEADERS (ONE FOR FUTURE EXPAND) CONNECTOR SHOWN BELOW CONNECTS RAM BOARD TO BALLY MOTHER BOARD.



⑰ DECIDE HOW POWER SUPPLY WILL BE MOUNTED.

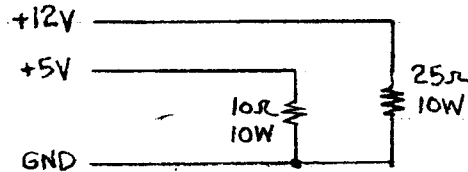


- 1 POWER CORD CUTOUT
- 2 FAN SWITCH
- 3 RECEPTACLE
- 4 AC FUSE
- 5 ON/OFF SW



⑱ MOUNT POWER SUPPLY COMPONENTS ON RAM BOARD CABINET AND SHEET METAL. CUT RAM BOARD (VECTORBOARD 169P84WE) TO SIZE. MOUNT RAM BOARD AND BALLY CABINET TO SHEET METAL. MOUNT THAT ASSEMBLY TO RAM BOARD CABINET CHECKING FOR CLEARANCES. CHECK CLEARANCES WITH RIBBON CONNECTORS DESCRIBED IN ⑯ CONNECTED FROM MOTHER BOARD TO RAM BOARD.

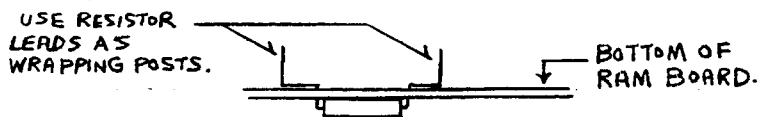
- ① WIRE THE POWER SUPPLY. TEST THE +5V AND +12V DC SUPPLIES USING A DC VOLTMETER AND 1/2 AMP LOAD.



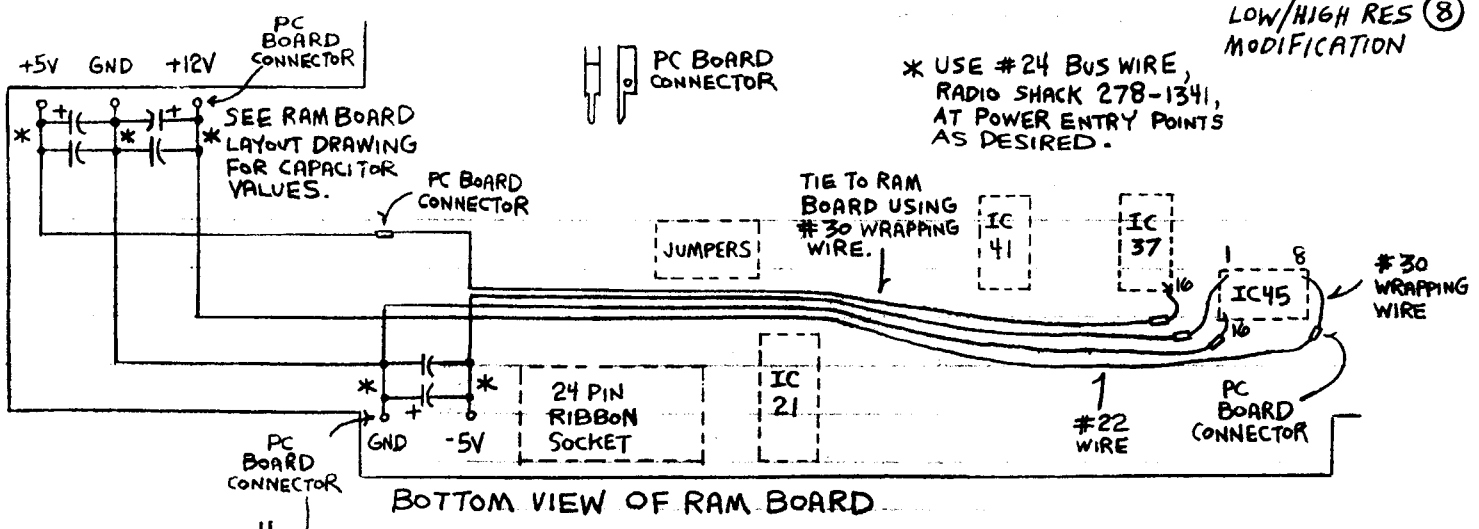
DESIGNER'S VOLTMETER READ 4.5VDC ACROSS 10Ω RESISTOR AND 10.5VDC ACROSS 25Ω RESISTOR AFTER 30 MINUTES OF OPERATION.

TEST THE TWO 120VAC RECEPTACLES USING A 120VAC PORTABLE RADIO.

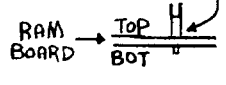
- ② MOUNT THE FIRST BANK OF VIDEO RAM (SOCKETS IC45-IC52).^{6,7} WIRE LINES VWE, VRAS, CASO, MA0-MA5, A6, -5V, +12V, +5V AND GND OF FIRST BANK. MOUNT SOCKETS IC36-IC44, IC31 AND 24 PIN RIBBON SOCKET.^{6,7} WIRE THE +5V POSTS TOGETHER AND THE GND POSTS TOGETHER FOR SOCKETS IC36-IC44 AND IC31. WIRE LINES MD0-MD7 FROM 24 PIN RIBBON SOCKET TO SOCKET IC36, MOUNTING THE EIGHT 100Ω RESISTORS AS SHOWN BELOW.⁸



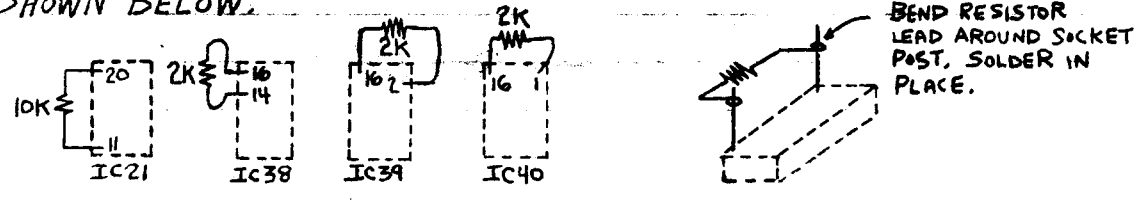
WIRE LINES MD0-MD7 FROM SOCKET IC36 TO SOCKETS IC37-IC40.⁸ WIRE LINES D10-D17 FROM SOCKET IC36 TO RESPECTIVE SOCKETS IC45-IC52.⁸ GROUND POSTS 1 AND 19 OF SOCKET IC36 (WIRE TO POST 7 OF SOCKET IC31).⁸ WIRE THE EIGHT LINES D10-D17 FROM SOCKETS IC37-IC40 TO THE RESPECTIVE SOCKETS IC45-IC52.⁸ WIRE POSTS 14 TOGETHER, POSTS 2 TOGETHER AND POSTS 1, 15 TOGETHER FOR SOCKETS IC37-IC40.⁸ WIRE POST 22 OF 24 PIN RIBBON SOCKET TO POST 1 OF SOCKET IC37.⁸ TEMPORARILY GROUND POSTS 2 AND 14 OF SOCKETS IC37-IC40 BY WIRING POST 2 OF SOCKET IC40 TO POST 8 OF SOCKET IC44 AND BY WIRING POSTS 2 AND 14 OF SOCKET IC40 TOGETHER.⁸ WIRE THE +5V POST 16 OF SOCKET IC37 TO THE +5V POST 9 OF SOCKET IC45.⁸ WIRE THE GND POST 8 OF SOCKET IC37 TO THE GND POST 16 OF SOCKET IC45.⁸ MOUNT JUMPERS SOCKET AND SOCKETS IC30 AND IC21.⁶ MOUNT THE SIX 33Ω RESISTORS NEXT TO SOCKET IC21.⁸ WIRE THE +5V, +12V, -5V AND GND WIRES AS SHOWN BELOW.⁸



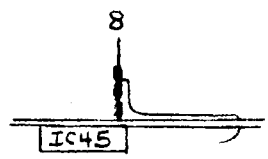
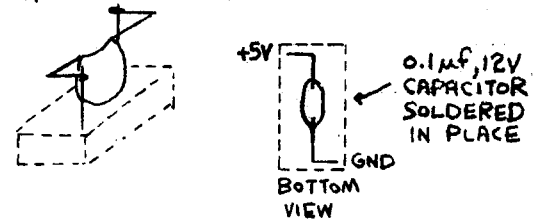
* USE #24 BUS WIRE, RADIO SHACK 278-1341, AT POWER ENTRY POINTS AS DESIRED.



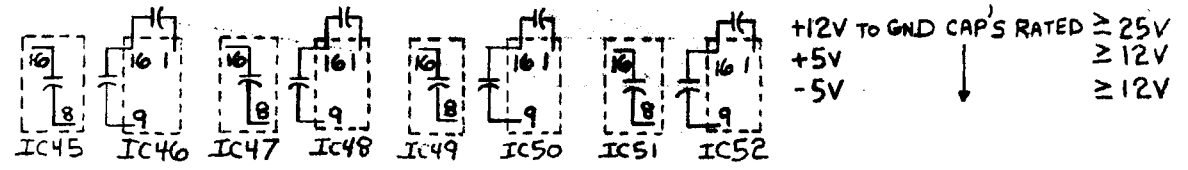
GROUND LINE A6 OF THE FIRST BANK BY WIRING TOGETHER POSTS 13 AND 16 OF SOCKET IC45. WIRE THE +5V AND GND POSTS OF SOCKETS IC30 AND IC21 TO THE RESPECTIVE +5V AND GND POSTS OF SOCKET IC31. GROUND POSTS 1 AND 19 OF SOCKET IC21 BY WIRING THEM TO POST 10 OF THE SAME SOCKET. WIRE SIX LINES MA0-MA5 FROM 24 PIN RIBBON SOCKET TO SOCKET IC21. WIRE TOGETHER POSTS 8 AND 11 OF SOCKET IC21. SOLDER FOUR RESISTORS TO THE BOTTOM OF THE SOCKET POSTS SHOWN BELOW.



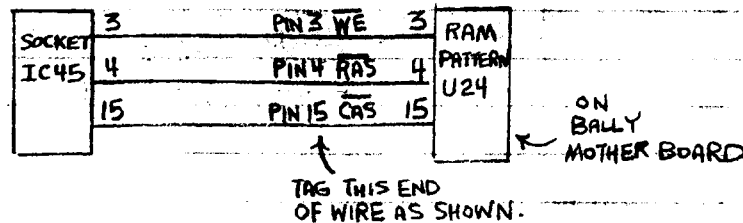
SOLDER, FROM THE +5V POST TO THE GND POST 0.1µf 12V DISC CAPACITORS ON THE BOTTOM OF SOCKETS IC36-IC40 AND IC21.



WRAP A 4" LENGTH #30 WIRE TO +12V POST 8 OF IC45 LEAVING THE UNCONNECTED END UNSTRIPPED BUT NOT LAYING LOOSE. THIS WIRE WILL EVENTUALLY BE CONNECTED TO +12V POST 8 OF IC53. SOLDER 0.1µf DISC CAPACITORS ON THE BOTTOM OF SOCKETS IC45-IC52 AS SHOWN BELOW.

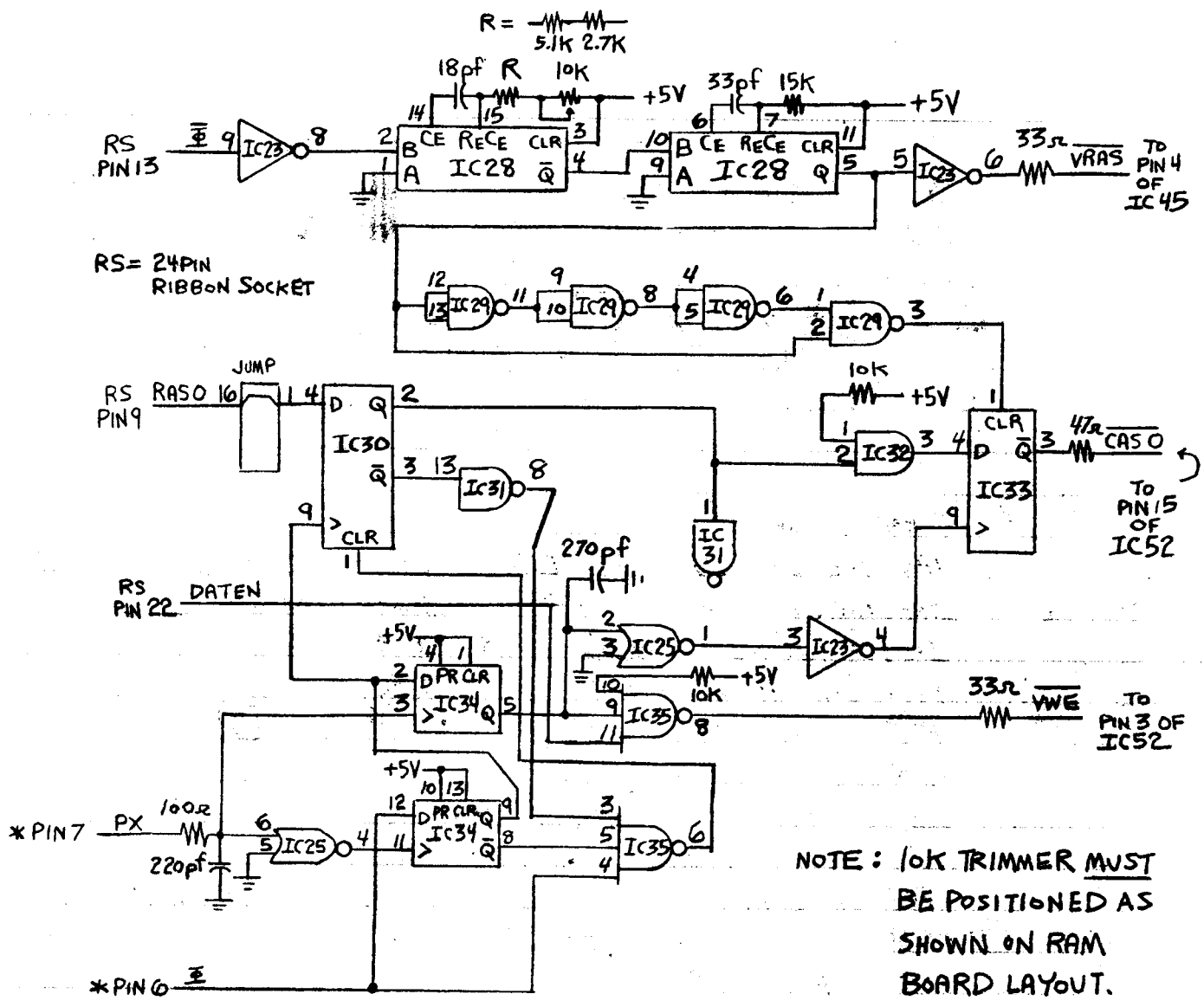


SOLDER 1200 Ω RESISTOR, AS SHOWN IN POWER SUPPLY SCHEMATIC, IN U28 RAM PATTERN. CUT 3 PIECES OF #30 WRAPPING WIRE LONG ENOUGH TO MAKE THE CONNECTION SHOWN BELOW.



CONNECT ONE END OF EACH OF THE 3 WIRES TO SOCKET IC45 AS SHOWN. TAG THE UNCONNECTED END OF EACH OF THE 3 WIRES. INSERT IC21 IN ITS APPROPRIATE SOCKET. INSERT IC36-IC40 AND IC45-IC52 IN THEIR APPROPRIATE SOCKETS.⁴ MOUNT THE RAM BOARD AND BALLY MOTHER BOARD IN THEIR NORMAL POSITIONS (SEE PROCEDURE STEPS (16) AND (17)). SOLDER THE 3 UNCONNECTED WIRES TO RAM PATTERN U24. SEE NOTE 9. SEE NOTE 10. WHEN SYSTEM IS TURNED ON, THE MENU SHOULD BE ABLE TO BE DISPLAYED AFTER PRESSING THE RESET BUTTON.²

- THE ON-BOARD GAMES WILL NOT FUNCTION AND WILL "CRASH".
- (2) REMOVE CHIP U22 (74LS74) AND RESISTOR R38 FROM MOTHER BOARD. CLEAN UP AREAS ON MOTHER BOARD TOUCHED BY SOLDERING IRON AND CHECK FOR SHORTS. DISCONNECT (BREAK CONDUCTOR PATH) LINE RAS0 FROM PIN 12 OF CHIP U21 (74LS74) ON MOTHER BOARD. DISCONNECT LINES VIDOUT (PIN 2) AND VIDIN (PIN 3) FROM 50 PIN EXPAND BUS ON MOTHER BOARD. REMOVE THE 3 TAGGED WIRES, SHOWN ABOVE, FROM RAM BOARD. MOUNT SOCKETS IC23, IC22, IC28, IC29, IC9, IC35, IC5, IC34, IC25, IC32, IC33 AND IC77.^{6,7} MOUNT THE TWO 50 PIN HEADERS. WIRE THE +5V POSTS TOGETHER AND THE GND POSTS TOGETHER FOR THE 12 SOCKETS JUST MOUNTED.⁸ WIRE THE +5V POST 14 OF SOCKET IC23 TO THE +5V PC CONNECTOR NEXT TO THE SOCKET IC23.⁸ WIRE THE GND POST 7 OF SOCKET IC23 TO THE GND PC CONNECTOR NEAR THE 24 PIN RIBBON SOCKET.⁸ WIRE THE CIRCUIT SHOWN BELOW.⁸



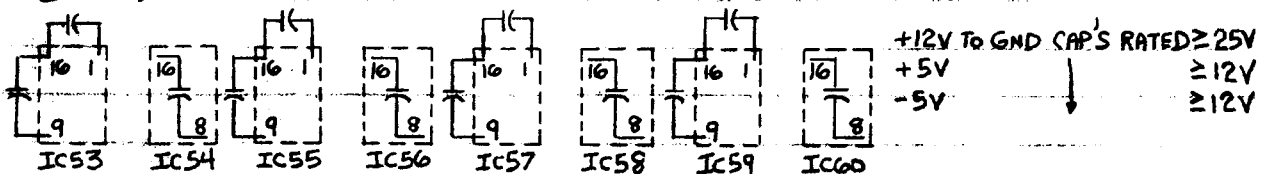
NOTE: 10K TRIMMER MUST BE POSITIONED AS SHOWN ON RAM BOARD LAYOUT.

* VIA 50 CONTACT HEADER

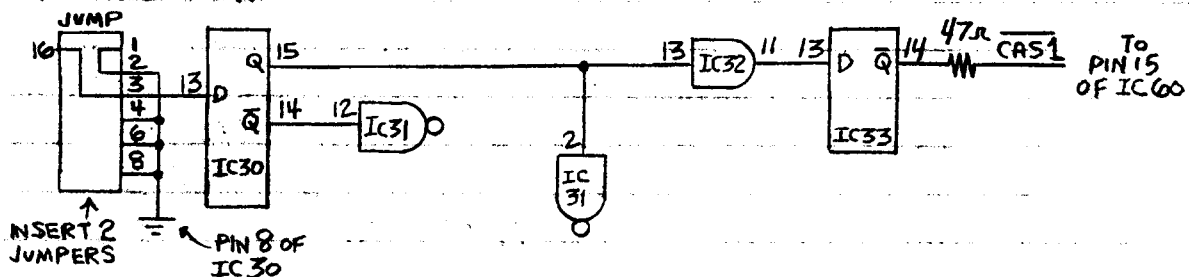
SOLDER, FROM THE +5V POST TO THE GND POST, 0.1µf 12V DISC CAPACITORS ON THE BOTTOM OF SOCKETS IC23, IC25 AND IC28-IC35. INSERT IC23, IC25 AND IC28-IC35 IN THEIR APPROPRIATE SOCKETS. SEE NOTE 9. SEE NOTE 10 AND ADJUST 10K TRIMMER TO GET THE COMPUTER TO RUN PROPERLY.

- ⑫ MOUNT THE SECOND BANK OF VIDEO RAM (SOCKETS IC53-IC60). ^{6,7} WIRE LINES \overline{VWE} , \overline{VRAS} , $\overline{CAS1}$, $\overline{MA0-MA5}$, \overline{AG} , $-5V$, $+12V$, $+5V$ AND GND OF SECOND BANK. WIRE LINES $\overline{D10-D17}$ FROM FIRST BANK TO SECOND BANK. ⁸ WIRE THE EIGHT LINES $\overline{D20-D27}$ FROM SOCKETS IC37-IC40 TO THE RESPECTIVE SOCKETS IC53-IC60. ⁸ WIRE THE $-5V$, \overline{VWE} , \overline{VRAS} , $\overline{MA0-MA5}$, $+12V$, $+5V$ AND GND POSTS OF SOCKET IC45 TO THE RESPECTIVE POSTS OF SOCKET IC53. ⁸ GROUND

LINE A6 OF THE SECOND BANK BY WIRING TOGETHER POSTS 13 AND 16 OF SOCKET IC53. ⁸ WRAP THREE 4" LENGTH #30 WIRES TO THE -5V POST 1, +5V POST 9 AND GND POST 16 OF SOCKET IC53 LEAVING THE UNCONNECTED ENDS UNSTRIPPED BUT NOT LAYING LOOSE. THESE WIRES WILL EVENTUALLY BE CONNECTED TO THE RESPECTIVE POSTS OF SOCKET IC61. SOLDER 0.1μF DISC CAPACITORS ON THE BOTTOM OF SOCKETS IC53-IC60 AS SHOWN BELOW.



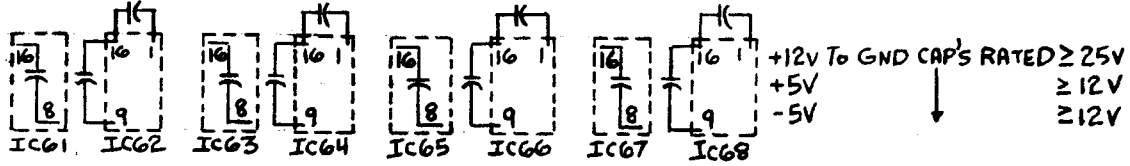
REMOVE THE JUMPER FROM THE JUMPERS SOCKET. MAKE THE CONNECTIONS SHOWN BELOW. ⁸



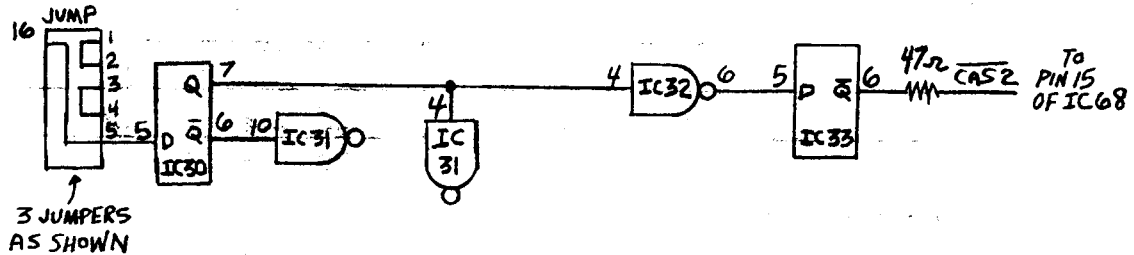
DISCONNECT THE "TEMPORARY GROUND" FROM POST 14 TO POST 2 ON SOCKET IC40. INSERT IC53-IC60 IN THE SECOND BANK OF SOCKETS. ⁴ SEE NOTE 9. SEE NOTE 10 AND READJUST 10K TRIMMER, IF REQ'D, TO GET THE COMPUTER TO RUN PROPERLY (BANK 2 IS OPERATING, BANK 1 IS INACTIVE).

- (23) MOUNT THE THIRD BANK OF VIDEO RAM (SOCKETS IC61-IC68). ^{6,7} WIRE LINES VWE, VRAS, CAS2, MA0-MA5, A6, -5V, +12V, +5V AND GND OF THIRD BANK. WIRE LINES D10-D17 FROM THE SECOND BANK TO THE THIRD BANK. ⁸ WIRE THE EIGHT LINES D30-D37 FROM SOCKETS IC37-IC40 TO THE RESPECTIVE SOCKETS IC61-IC68. ⁸ WIRE THE -5V, VWE, VRAS, MA0-MA5, +12V, +5V AND GND POSTS OF SOCKET IC53 TO THE RESPECTIVE POSTS OF SOCKET IC61. ⁸ GROUND LINE A6 OF THE THIRD BANK BY WIRING TOGETHER POSTS 13 AND 16 OF SOCKET IC61. ⁸ WRAP TWO 4" LENGTH #30 WIRES TO THE +12V POST 8 AND GND POST 16 OF SOCKET IC61 LEAVING THE UNCONNECTED ENDS UNSTRIPPED BUT NOT LAYING LOOSE. THESE WIRES WILL

EVENTUALLY BE CONNECTED TO THE RESPECTIVE POSTS OF SOCKET IC69. SOLDER 0.1μf DISC CAPACITORS ON THE BOTTOM OF SOCKETS IC61-IC68 AS SHOWN BELOW.

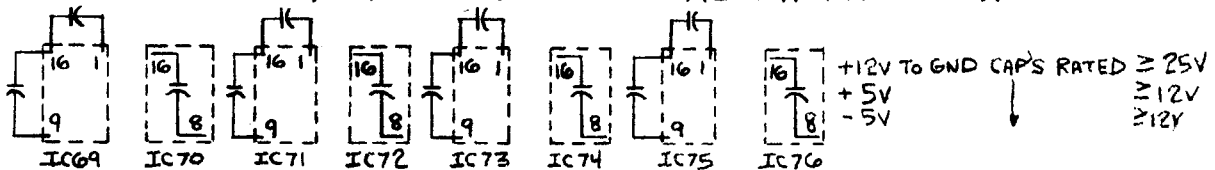


MAKE THE CONNECTIONS SHOWN BELOW. ⁸

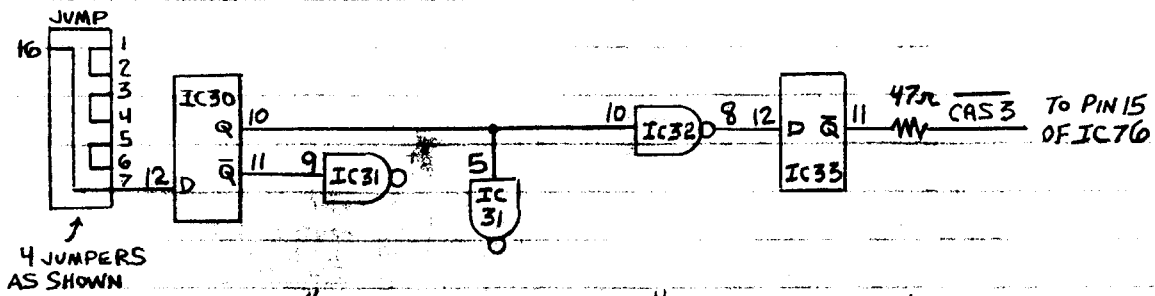


DISCONNECT THE "TEMPORARY GROUND" FROM POST 2 ON SOCKET IC40, THEN GROUND POST 14 OF THE SAME SOCKET. INSERT IC61-IC68 IN THE THIRD BANK OF SOCKETS. ⁴ SEE NOTE 9. SEE NOTE 10 AND READJUST 10K TRIMMER, IF REQ'D, TO GET THE COMPUTER TO RUN PROPERLY (BANK 3 IS OPERATING, BANKS 1 AND 2 ARE INACTIVE).

(24) MOUNT THE FOURTH BANK OF VIDEO RAM (SOCKETS IC69-IC76). ^{6,7} WIRE LINES VWE, VRAS, CAS3, MA0-MA5, A6, -5V, +12V, +5V AND GND OF FOURTH BANK. WIRE LINES D10-D17 FROM THE THIRD BANK TO THE FOURTH BANK. ⁸ WIRE THE EIGHT LINES D40-D47 FROM SOCKETS IC37-IC40 TO THE RESPECTIVE SOCKETS IC69-IC76. ⁸ WIRE THE -5V, VWE, VRAS, MA0-MA5, +12V, +5V AND GND POSTS OF SOCKET IC61 TO THE RESPECTIVE POSTS OF SOCKET IC69. ⁸ GROUND LINE A6 OF THE FOURTH BANK BY WIRING TOGETHER POSTS 13 AND 16 OF SOCKET IC69. ⁸ SOLDER 0.1μf DISC CAPACITORS ON THE BOTTOM OF SOCKETS IC69-IC76 AS SHOWN BELOW.



MAKE THE CONNECTIONS SHOWN BELOW. ⁸

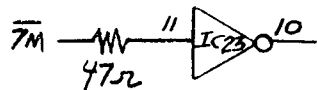


DISCONNECT THE "TEMPORARY GROUND" FROM POST 14 ON SOCKET IC40. INSERT IC69-IC76 IN THE FOURTH BANK OF SOCKETS. ⁴ SEE NOTE 9. SEE NOTE 10 AND READJUST 10K TRIMMER, IF REQ'D, TO GET THE COMPUTER TO RUN PROPERLY (BANK 4 IS OPERATING, BANKS 1, 2 AND 3 ARE INACTIVE).

(25) MOUNT SOCKETS IC4, IC7, IC24, IC8, IC6, IC26, IC27, IC18, IC20, IC19, IC1-IC3 AND IC10-IC17. ^{6,7} WIRE LINES \overline{WE} , \overline{RAS} , \overline{CAS} , A0-A7, +5V AND GND FOR SOCKETS IC10-IC17 CONTINUING THE LINES FROM SOCKET IC14 TO SOCKET IC15 (WIRE IC11 TO IC13, IC13 TO IC16, IC16 TO IC14, IC14 TO IC15, IC15 TO IC17, IC17 TO IC12, IC12 TO IC10). WIRE THE +5V POSTS AND THE GND POSTS OF SOCKETS IC4, IC7, IC24, IC8, IC6, IC26, IC27, IC18, IC20, IC19 AND IC1-IC3 TO THE RESPECTIVE +5V AND GND POSTS OF SOCKET IC9. ⁸ REMOVE TEMPORARILY THE THREE 0.1 μ F DISC CAPACITORS FROM THE BOTTOM OF SOCKETS IC52 AND IC60. ¹¹ WIRE +5V AND GND POSTS OF SOCKET IC52 TO THE RESPECTIVE +5V AND GND POSTS OF SOCKET IC11. ⁸ WIRE +5V AND GND POSTS OF SOCKET IC60 TO RESPECTIVE +5V AND GND POSTS OF SOCKET IC10. ⁸ SOLDER BACK THE THREE CAPACITORS JUST REMOVED FROM SOCKETS IC52 AND IC60. WIRE ALL OF THE CIRCUITRY SHOWN ON THE 50 PIN EXPAND INTERFACE SCHEMATIC, USER RAM DECODER SCHEMATIC AND USER RAM SCHEMATIC WITH THE EXCEPTION THAT PIN 1 OF IC24 SHOULD BE GROUNDED (TEMPORARILY). ⁸ SOLDER 0.1 μ F DISC CAPACITORS TO THE BOTTOM OF SOCKETS IC1-IC20 AND IC24. ¹⁷ INSERT IC1-IC9, IC18-IC20, IC24 AND IC77 IN THEIR RESPECTIVE SOCKETS. INSERT IC10-IC17 IN THEIR SOCKETS. ⁴ MAKE SURE THE 50 CONTACTS OF THE 50 CONTACT EXPAND BUS ON MOTHER BOARD ARE CLEAN. SEE NOTE 9. SEE NOTE 10. SEE NOTE 12. ADJUST \overline{CAS} DELAY IF REQ'D SO DEMO RUNS PROPERLY. ^{13,14}

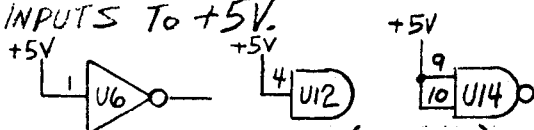
(26) REMOVE "TEMPORARY GROUND" FROM PIN 1 OF IC24. WIRE THE

IN THEIR SOCKETS. SEE NOTE 9. SEE NOTES 10 AND 14. RUN THE GAME "CHECKMATE". WHILE THE GAME IS RUNNING, TURN THE 10K TRIMMER CLOCKWISE VERY SLOWLY UNTIL THE GAME (COMPUTER) BECOMES INOPERATIVE.¹⁸ NOW TURN THE TRIMMER COUNTER CLOCKWISE SLIGHTLY AND PRESS THE COMPUTER RESET BUTTON. IF THE COMPUTER IS STILL INOPERATIVE, TURN THE TRIMMER COUNTER CLOCKWISE SLIGHTLY AGAIN AND PRESS THE COMPUTER RESET BUTTON. THIS IS THE STARTING POINT AT WHICH THE COMPUTER RUNS PROPERLY IN THE LOW RESOLUTION MODE. TURN THE TRIMMER COUNTER CLOCKWISE ABOUT 45° AND LOAD THE HIGH RESOLUTION DEMO INTO USER RAM AND RUN THE DEMO FOR 3 OR MORE HOURS. USE THE VERTICAL HOLD CONTROL ON THE TV TO SLOWLY ROLL THE PICTURE SO THE CRT WILL NOT BE "BURNED". CHECK FREQUENTLY THE SCREEN FOR GLICHES DURING THIS 3 HOUR TEST. NOTE THAT THE 4 BYTES IN SCREEN LOCATION'S 4FEF, 4FF0, 4FF1 AND 4FF2_H (IN UPPER QUARTER OF SCREEN) ARE UTILIZED BY THE DEMO AND ARE NOT GLICHES. IF GLICHES DO OCCUR DURING THIS TEST, TURN THE TRIMMER IN ANOTHER POSITION. IF THE GLICHE PROBLEM CAN'T BE RESOLVED USING THE TRIMMER, THEIR MAY BE A RINGING PROBLEM AT PIN 11 OF IC 23.



TRY SOME DIFFERENT VALUES SUCH AS 68, 82 OR 100 OHMS IN LIEU OF 47 OHMS.

- ⑳ WIRE THE UNUSED INPUTS OF THE SPARE GATES INDICATED ON THE SPARES SCHEMATIC.
- ㉑ THE FOLLOWING MODIFICATIONS TO THE MOTHER BOARD ARE OPTIONAL. REMOVE CAPACITORS C52-C55.¹⁵ REMOVE CAPACITORS C56-C61.¹⁵ REMOVE RESISTOR R37. REMOVE RESISTORS R40-R42. REMOVE CAPACITORS C67-C77, C80-C84, C91 AND C106.¹⁶ REMOVE CAPACITORS C62-C64. USE # 30 WRAPPING WIRE TO SOLDER THE FOLLOWING UNUSED INPUTS TO +5V.



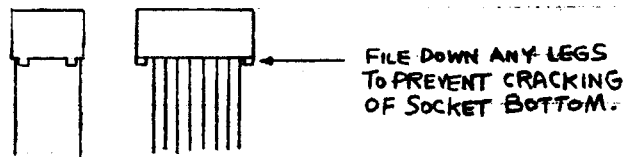
REMOVE CHIP U21 (74LS74).

- ㉒ AT THIS POINT YOUR COMPUTER SHOULD RUN PROPERLY IN THE LOW

OR HIGH RESOLUTION MODE.²⁰ AN OUTPUT 01_H TO PORT 8 TELLS THE CUSTOM CHIPS TO MAP THE SCREEN RAM IN HIGH RESOLUTION AND RESPECTIVELY AN OUTPUT 00_H TO PORT 8 TO MAP THE SCREEN RAM IN LOW RESOLUTION. REFERENCE DAVE NUTTING ASSOCIATES MANUAL P. 81 - 91 FOR GENERAL SYSTEM DESCRIPTION.

NOTES

- 1 TURN ON THE COMPUTER TO SEE IF ITS OPERATING PROPERLY, ie, PUSH THE RESET BUTTON, ENTER 2, 0 AND 0 TO RUN THE GAME "CHECKMATE" FOR A WHILE.
- 2 SCREEN GLICHES MIGHT APPEAR OCCASIONALLY. THE COMPUTER MIGHT EVENTUALLY WONDER OFF INTO "NEVER-NEVER LAND".
- 3 THE MOTHER BOARD CAN OPERATE WITHOUT THE KEYBOARD HOUSING OR METAL SHIELDING. HOWEVER, MAKE SURE THERE IS A HEAT SINK ON TOP OF CUSTOM DATA CHIP V18 OR BLOW AIR ACROSS THE MOTHER BOARD VIA A PORTABLE FAN.
- 4 BEWARE OF DESTROYING THE CHIP(S) BY STATIC ELECTRICITY. HANDLE WITH CAUTION.
- 5 DESIGNER MOUNTED BALLY ARCADE ON A VIPER CABINET.
- 6 USE 2-56 x 1/4" SCREWS AND 2-56 x 3/16" x 1/16" HEX NUTS. BOTTOM OF SOCKET SHOULD MOUNT FLUSH WITH RAM BOARD, OTHERWISE SOCKET MAY CRACK WHEN SCREWS ARE TIGHTENED.



- 7 FOUR LEVEL (≥ 0.625 " POST LENGTH) WIRE WRAP SOCKETS SHOULD BE USED.
- 8 USE OHM-METER TO TEST WIRING, PERFORMING THE TEST ON THE TOP OF SOCKETS (WHERE IC IS INSERTED).
- 9 MAKE ALL NECESSARY CONNECTIONS SO RAM BOARD AND MOTHER BOARD CAN BE TURNED ON:
+5V, +12V, -5V AND GND CONNECTED TO RAM BOARD (-5V COMES

FROM BALLY MOTHER BOARD- SEE POWER SUPPLY SCHEMATIC).
 24 PIN DIP JUMPER CONNECTED FROM RAM BOARD TO MOTHER BOARD.

50 PIN RIBBON CABLE CONNECTED FROM RAM BOARD TO MOTHER BOARD.

BALLY POWER TRANSFORMER CONNECTED TO MOTHER BOARD.

RF MODULATOR CONNECTED TO MOTHER BOARD.

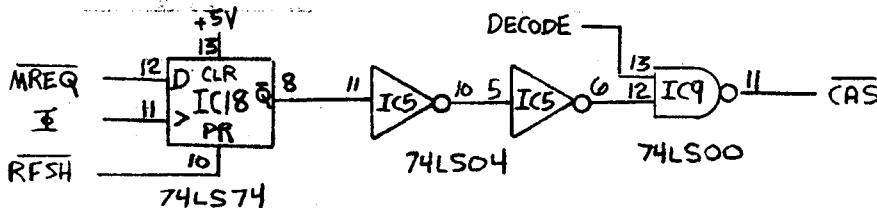
HEAT SINK CONNECTED TO CUSTOM DATA CHIP U18 ON MOTHER BOARD. SEE NOTE 3.

10. TURN ON RAM BOARD AND BALLY MOTHER BOARD SIMULTANEOUSLY.

11. DESOLDER THE IC SOCKET POSTS USING DESOLDER TOOL RADIO SHACK CAT # 64-2098 OR EQUAL. DO NOT FORCE WRAPPING TOOL OVER SOLDERED POST, BUT PRESS LIGHTLY DOWNWARD WITH A TURNING MOTION.

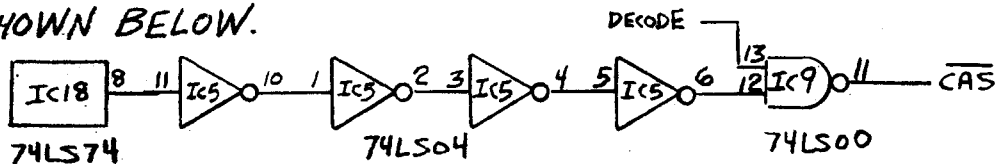
12. LOAD LOW RESOLUTION DEMO INTO USER RAM AND RUN THE DEMO. IF DEMO DOESN'T RUN CORRECTLY, THE PROBLEM IS MOST PROBABLY AN IMPROPER $\overline{\text{CAS}}$ DELAY.

13. TIMING OF $\overline{\text{CAS}}$ IS CRITICAL. BOARD LAYOUT, LOADING EFFECTS OR TOLERANCES ON CHIP PROPAGATION DELAY CAN EFFECT THE TIMING OF $\overline{\text{CAS}}$. THE ADJUSTMENT TO THE $\overline{\text{CAS}}$ DELAY IS MADE ON THE CIRCUIT SHOWN BELOW.

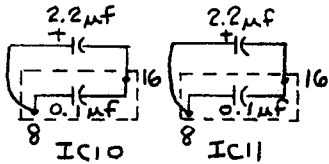


NOTE:
 TRY ANOTHER 74LS04 CHIP IF $\overline{\text{CAS}}$ DELAY NEEDS AN ADJUSTMENT.

THE DELAY CAN BE INCREASED OR DECREASED BY ADDING/DELETING GATES OR BY UTILIZING 74S IN LIEU OF 74LS TTL. FOR EXAMPLE, THE DELAY CAN BE INCREASED BY ADDING TWO GATES AS SHOWN BELOW.



ADDING TWO GATES AS SHOWN ABOVE WOULD INCREASE THE DELAY OF \overline{CAS} AS LONG AS 20 ns (1981 NATIONAL SEMICONDUCTOR DATABOOK). IMPROPER TIMING OF \overline{CAS} CAN CREATE GLICHES ON THE SCREEN OR "CRASHES" WHEN A PROGRAM IN USER RAM IS EXECUTED. IF IMPROPER TIMING OF \overline{CAS} IS SUSPECTED, THEN AN EXPERIMENTAL ADJUSTMENT IS NECESSARY.

- 14 A POOR CONNECTION FROM THE 50 CONTACT EXPAND BUS ON MOTHER BOARD TO 50 CONTACT HEADER ON RAM BOARD WILL CAUSE THE SYSTEM TO OPERATE IMPROPERLY.
- 15 TAG COMPONENT FOR USE AS A SPARE PART. MANUFACTURER MAY HAVE DELETED COMPONENT FROM MOTHER BOARD.
- 16 TAG COMPONENT(S) FOR USE AS SPARE PART(S).
- 17 SOLDER A 2.2 μ F TANTALUM CAPACITOR (RADIO SHACK CAT. #272-1435 OR EQUAL) TO THE BOTTOM OF SOCKETS IC10 AND IC11 OBSERVING POLARITY OF CAPACITOR
- 
- 18 DUE TO TOLERANCES IN 74LS123 CHIPS (IC18), THE 10K TRIMMER COULD BE TURNED FULLY CLOCKWISE AND STILL THE SYSTEM WOULD BE OPERATIVE.
- 19 REFERENCE BALLY SERVICE MANUAL PA-1 DISASSEMBLY PROCEDURE.
- 20 RUN LOW AND HIGH RESOLUTION DEMOS TO TEST THE SYSTEM. IF THE VIDEOCADES RUN PROPERLY, BUT THE LOW RESOLUTION DEMO DOES NOT, REFER TO NOTES 14, 12 AND 13 (USER RAM IS AT FAULT). IF VIDEOCADES AND LOW RESOLUTION DEMO RUN PROPERLY, BUT HIGH RESOLUTION DEMO DOES NOT, REFER TO PROCEDURE STEP 27. NOTE THAT BANK 1 (IC45-IC52) IS THE LOW RESOLUTION RAM BANK.