

2-1974

Macromodular Computer Design, Part 2, Volume 05, Logic Drawings

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MACROMODULAR
COMPUTER DESIGN
PART 2
MANUFACTURING DESCRIPTION

VOLUME V
LOGIC DRAWINGS

Technical Report No. 34

FINAL REPORT - FEBRUARY, 1974
CONTRACT SD-302 (ARPA)
COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR COMPUTER DESIGN
FINAL REPORT - CONTRACT SD-302
FEBRUARY, 1974

Technical Report No. 34

PART 2 - MANUFACTURING DESCRIPTION
VOL.V - LOGIC DRAWINGS

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Computer Systems Laboratory
Washington University
St. Louis, Missouri

ABSTRACT

This volume contains the circuit diagrams for the vertical boards used in the macromodule electronic subassemblies.

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A GUIDE TO DRAWING CONVENTIONS

In the process of designing a circuit board, the logic drawing has been our principal piece of documentation up until the time that the production documents are generated. The drawings thus contain circuit diagrams, parts lists, component counts, and certain information that is useful at specific stages of the design process. About half of the drawings in this volume are original logic drawings. The other drawings are revisions that no longer contain obsolete information or information to be found elsewhere. The revisions also have an improved notational form. In the text that follows, we first treat the conventions common to all of the drawings in this volume, and then treat the conventions peculiar to specific subsets of the drawings.

1. LOGIC FUNCTION SYMBOLOGY

The logic function symbology conforms in general to MIL-STD-806B. The principal exceptions are as follow:

A) Function Identification Only two tagging lines are used. The top line locates the function on the circuit board and the bottom line identifies the hardware. Most logic hardware used in the modules is Motorola's MECL II series. This logic hardware is identified by an M followed by two digits. The M is an abbreviation for MC12 so that a tag such as M47 identifies the element as an MC1247. When there is also a letter suffix, e.g. M47B, the suffix indicates that the hardware is tested to standards other than those specified by Motorola. For more information on that, see the section on IC Testing. When hardware is not MECL II series, the bottom tag line contains the manufacturer's own designation number.

B) Interconnected Outputs The outputs of MECL II circuits can be tied together to implement the AND and OR functions, a feature which has been used extensively in the design of the modules. When outputs are tied together, the interconnection point is high if one or more of the outputs are high (the OR function) and is low if all outputs are low (the AND function). In the circuit diagrams, the interconnection point is generally not enveloped by a logic symbol. The symbols have been omitted in order to reduce the overall density of logic symbols and thereby make the drawings easier to read.

2. OTHER CONVENTIONS --- ALL DRAWINGS

A) The symbols used for components such as resistors, capacitors, diodes, etc., are industry standards. Each of these items is identified by a single tag line. In most cases, one must refer to the parts list for the circuit board in order to get any information about these components. This is only partly true for resistors, however. Resistors are tagged by an R followed by three digits. If the digit immediately following the R is listed in the table below, then the value of the resistor can be found from the table. If the digit is not in the table, then one must refer to the parts list.

<u>Digit</u>	<u>Resistor Value In Ohms</u>
0	zero (a jumper)
1	1500
2	750
3	121
4	15K
5	57.6
6	130

B) Connector terminals for signals entering and leaving the circuit board are represented by ovals. Tags internal to the ovals identify the terminals.

C) A small triangle with no internal tag represents a connection to -5.2 volts. This voltage is V_{EE} for MECL II circuits.

D) When MECL II logic functions are shown with inputs tied to -5.2 volts, the device behaves as if those inputs were tied to a logic low.

E) On some circuit boards, a few of the integrated circuits have unused logic elements. These elements are shown on the diagrams in a group unto themselves.

3. DRAWINGS 200.9D3 THROUGH 210.2D3

These are revisions of the original logic drawings. Obsolete information and information now found elsewhere has been eliminated. The circuit diagrams have been revised in an attempt to make them easier to understand and follow. They have the following features:

A) The elements of the diagram are arranged so as to minimize the number of long lines, minimize the number of interconnecting lines, and accentuate functional groupings. In a few instances, tie-points are used to eliminate long lines that could not be comfortably eliminated by other means. See 3D for an explanation of tie-point notation.

B) Certain functional groupings are enclosed in boxes and labeled to indicate the functions performed by the groupings.

C) Signals entering and leaving the circuit board are identified by two tag lines. One tag gives the name of the signal while the other tag, always in parentheses, indicates the significance of a logic high or low. (See 3E for a special case.) The polarity-indicating tag is subject to the following rules:

1. If the signal is a data bit, the polarity representing the data value 1 is indicated. The possible tags are

(1-L) and (1-H).

2. If the signal is a condition, the polarity representing assertion of the condition is indicated. The possible tags are

(A-L) and (A-H).

3. If the signal is a transition signal, the preset polarity of the signal is indicated. The possible tags are

(P-L) and (P-H).

D) Two forms of tie-point notation have been used. The more commonly occurring form employs a triangle (flag) containing a letter tag. The rule is that all identically flagged points on a diagram are interconnected. The other form of tie-point notation occurs only on drawing 203.2D3. A tie-point source is identified by a small arrow which is usually perpendicular to a line and pointing away from it. The number of destinations is indicated by a digit near the arrow. If the line to which the arrow is affixed is not already named, a name is given at the head of the arrow. A tie-point destination is identified by a logic function input connected to a tag. This tag is either the signal name of the tie-point source or the complement (NOT) of it. The assertion polarity (or value 1 polarity) for this tag agrees with the assertion polarity of the input to which it is connected.

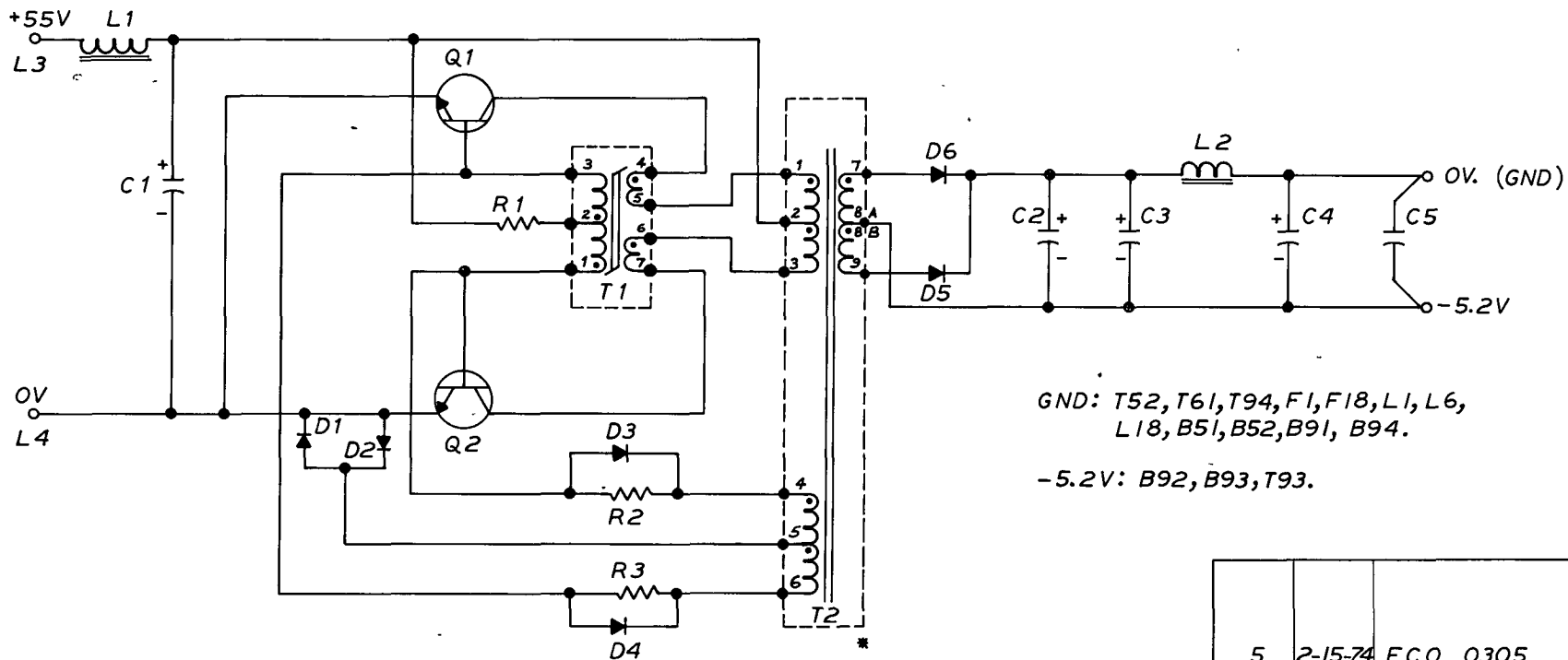
E) On drawings 205.2D3 and 210.2D3 there is a pair of inputs whose second tagging line is "(A-NC)." The possible states for these inputs are NC (no connection) and ground (zero volts).

4. DRAWINGS 211.3D3 THROUGH 218.4D3

A) A small circle on a line (with a tag beginning with an H or a LH) specifies a plated-through-hole into which a component is not inserted. The function of this hole is to take the signal from one surface of the circuit board to the other surface. This type of information has been deleted on the revised drawings discussed in section 3.

B) The numbers 1 and 2 that occur at the ends of resistors, capacitors, and diodes are engineering aids that were useful at a specific phase of the circuit board design process. These numbers should be ignored.

C) The character string that identifies a signal entering (or leaving) a circuit board can be considered a single tag. Somewhere within this tag there is either an isolated L or H, or there is a -L or a -H. These are the polarity indicators. The significance of the indicator depends on the nature of the signal, i.e., depends on whether the signal is a data bit, a condition, or a transition signal. For modules other than the Multiply and Interlock modules, an asterisk identifies the signal as a transition signal and the polarity indicator thus indicates the preset polarity for the signal. Except for this, the nature of the signal is not indicated in the tag.

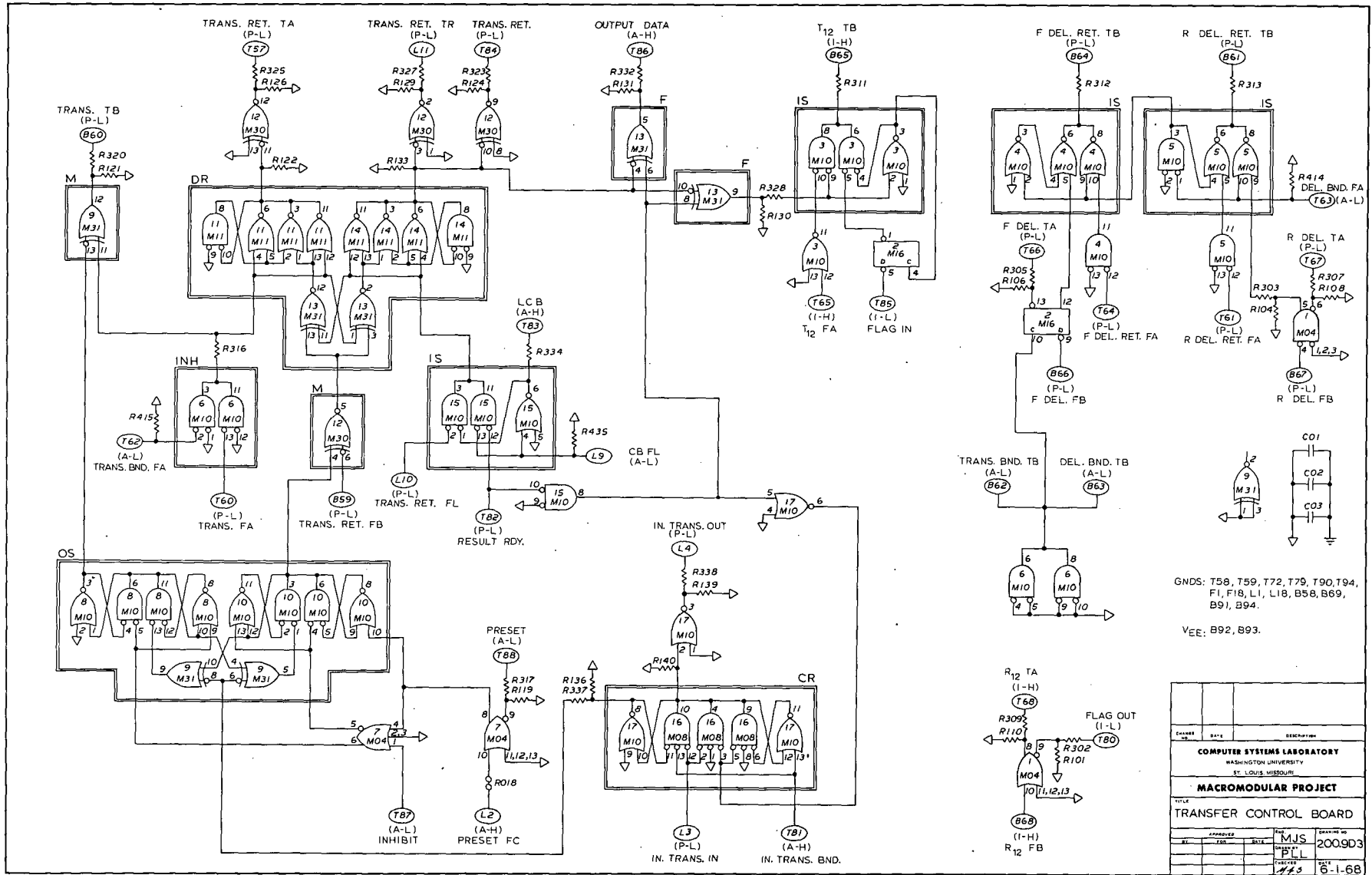


GND: T52, T61, T94, F1, F18, L1, L6,
L18, B51, B52, B91, B94.

-5.2V: B92, B93, T93.

* THE TURNS RATIO OF T2 IS MATCHED TO THE LOAD OF THE TYPE MODULE IN WHICH IT WILL BE USED.

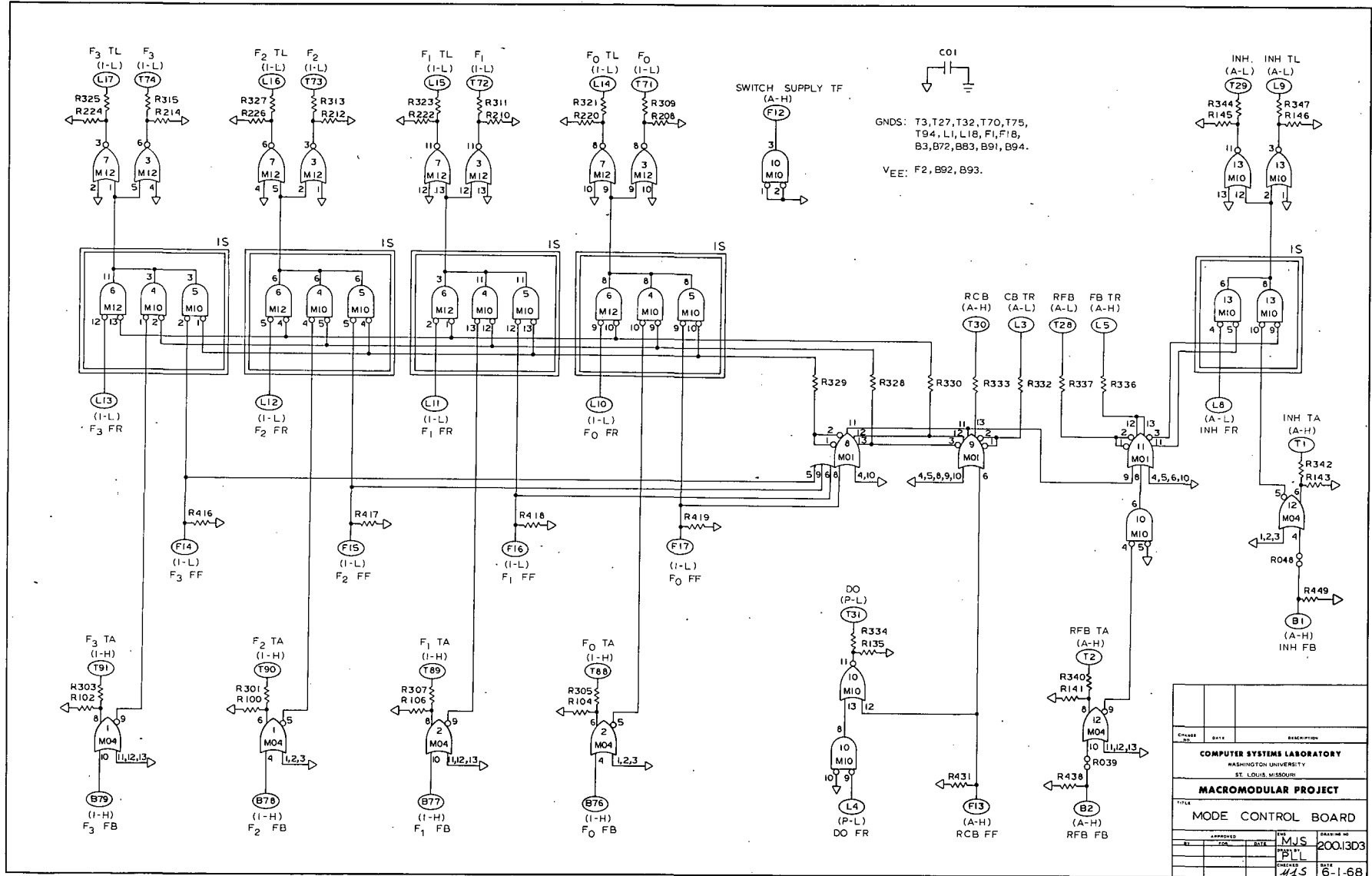
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MACROMODULAR PROJECT			
TITLE 15 WATT DC/DC 5 VOLT CONVERTER SCHEMATIC			
APPROVED		ENG	DRAWING NO
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		DRAWN BY	
		PLL	
		CHECKED	DATE
		<i>ajc</i>	10-31-68



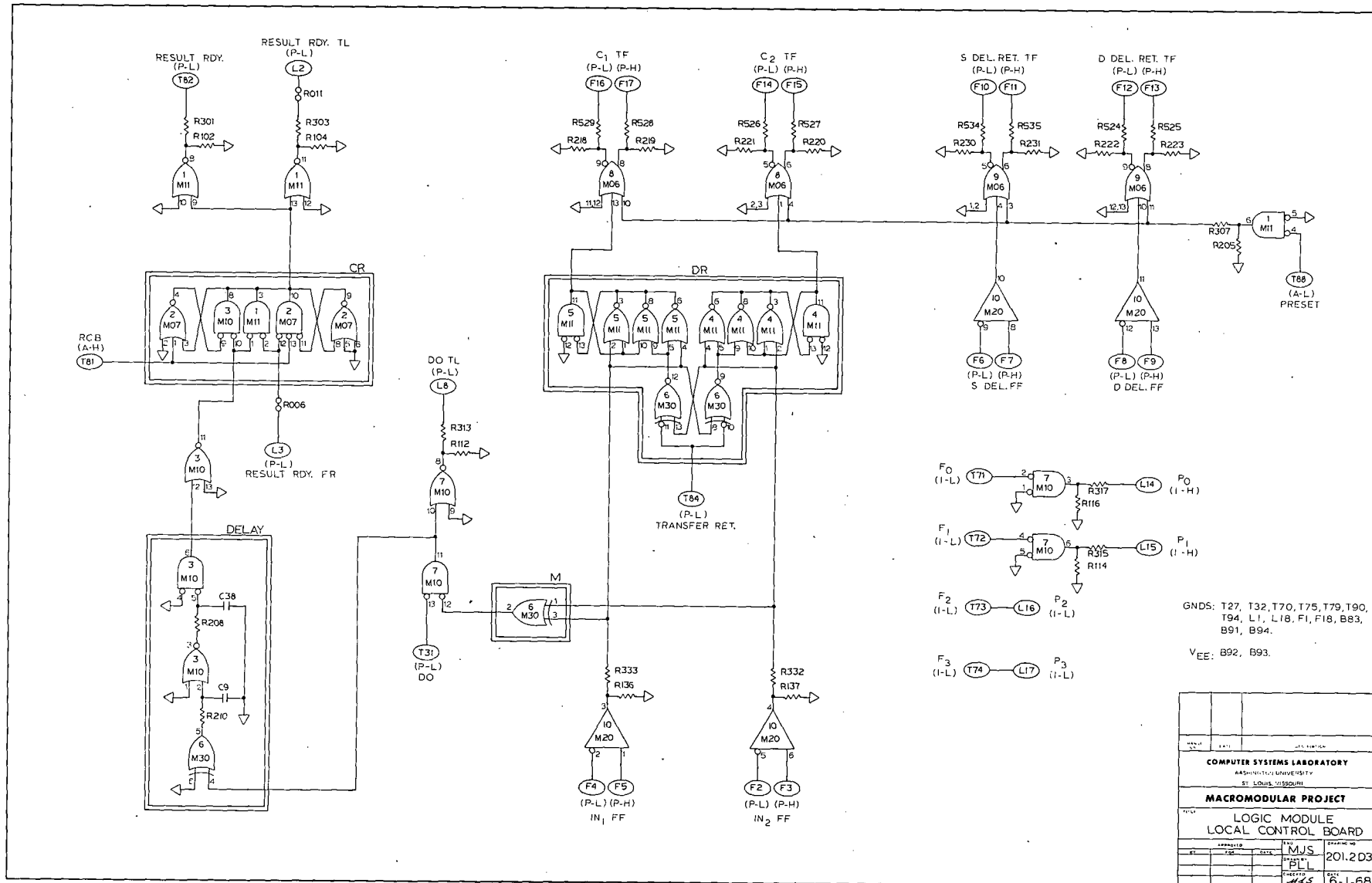
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VEE: B92, B93.

DESIGN	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
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APPROVED	DATE	DESIGN NO.
MJS	FLL	2009D3
PL		
PROJECT	DATE	
	6-1-68	



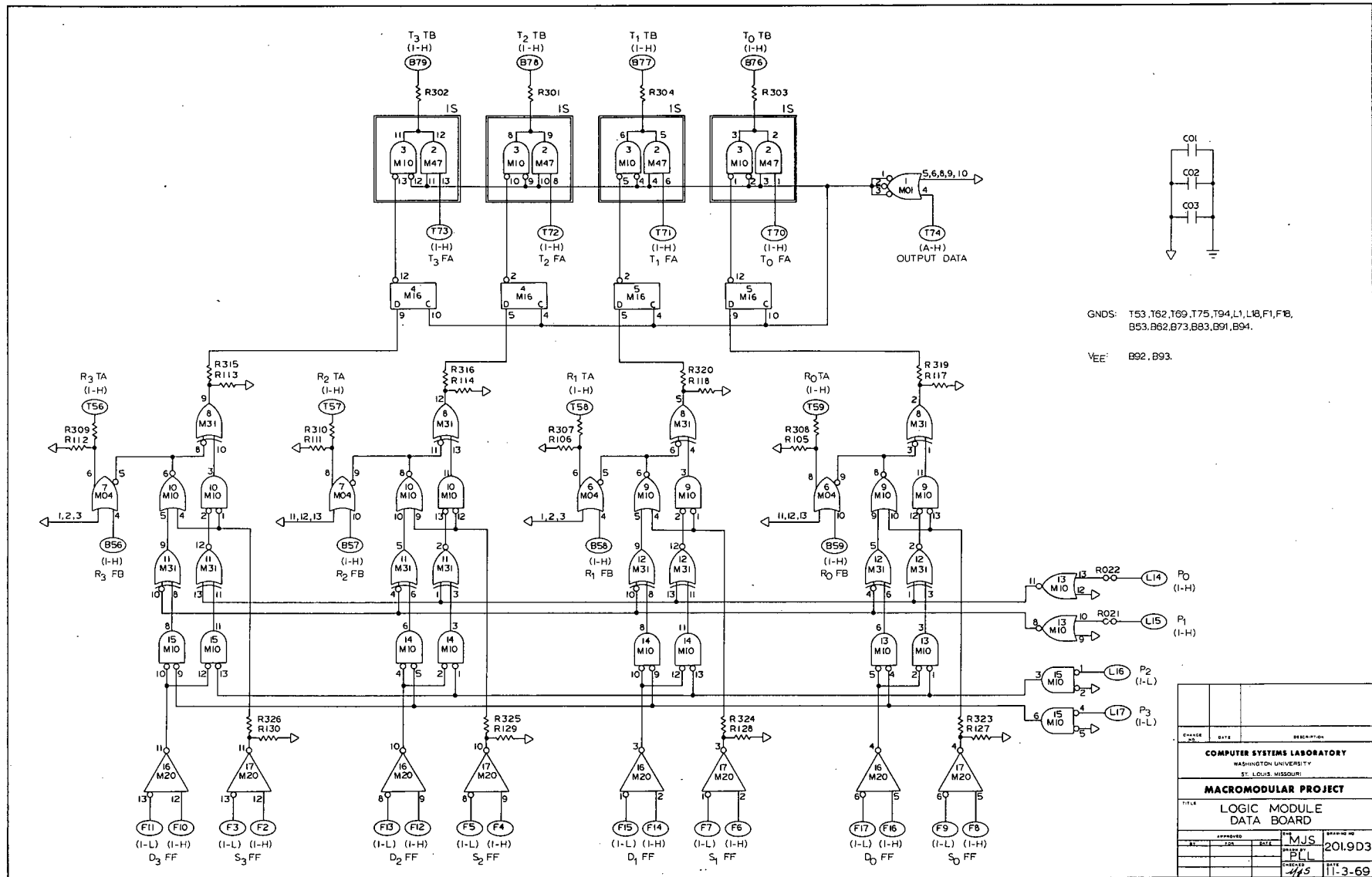
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MACROMODULAR PROJECT		
MODE CONTROL BOARD		
APPROVED	DATE	DRAWING NO.
MJS		20013D3
PL		
CHECKED	DATE	
MJS	6-1-68	



GNDS: T27, T32, T70, T75, T79, T90,
T94, L1, L18, F1, F18, B83,
B91, B94.

V_{EE}: B92, B93.

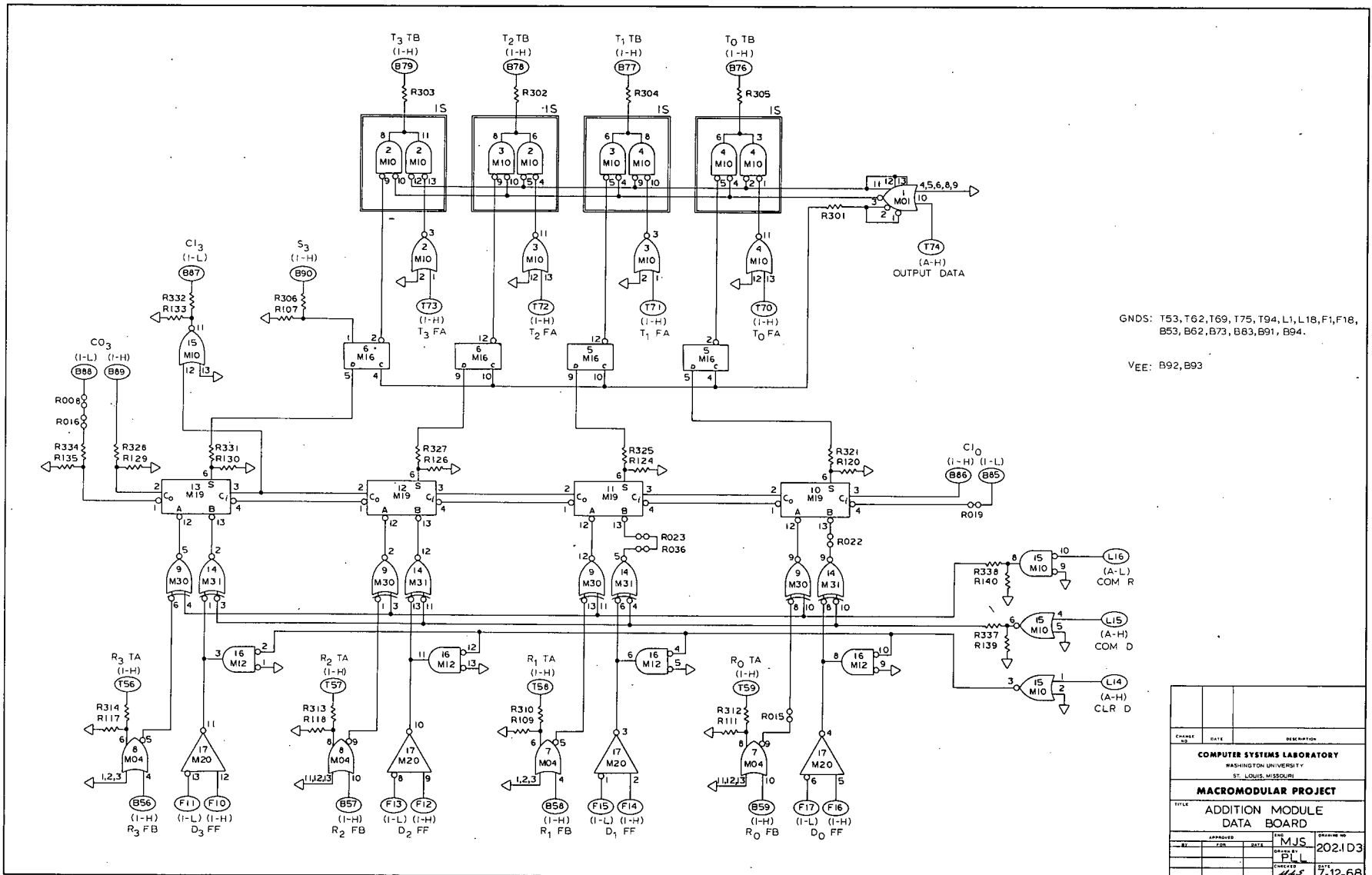
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MACROMODULAR PROJECT			
LOGIC MODULE LOCAL CONTROL BOARD			
APPROVED	DATE	BY	DATE
		MJS	201.203
		STL	
			6-1-68



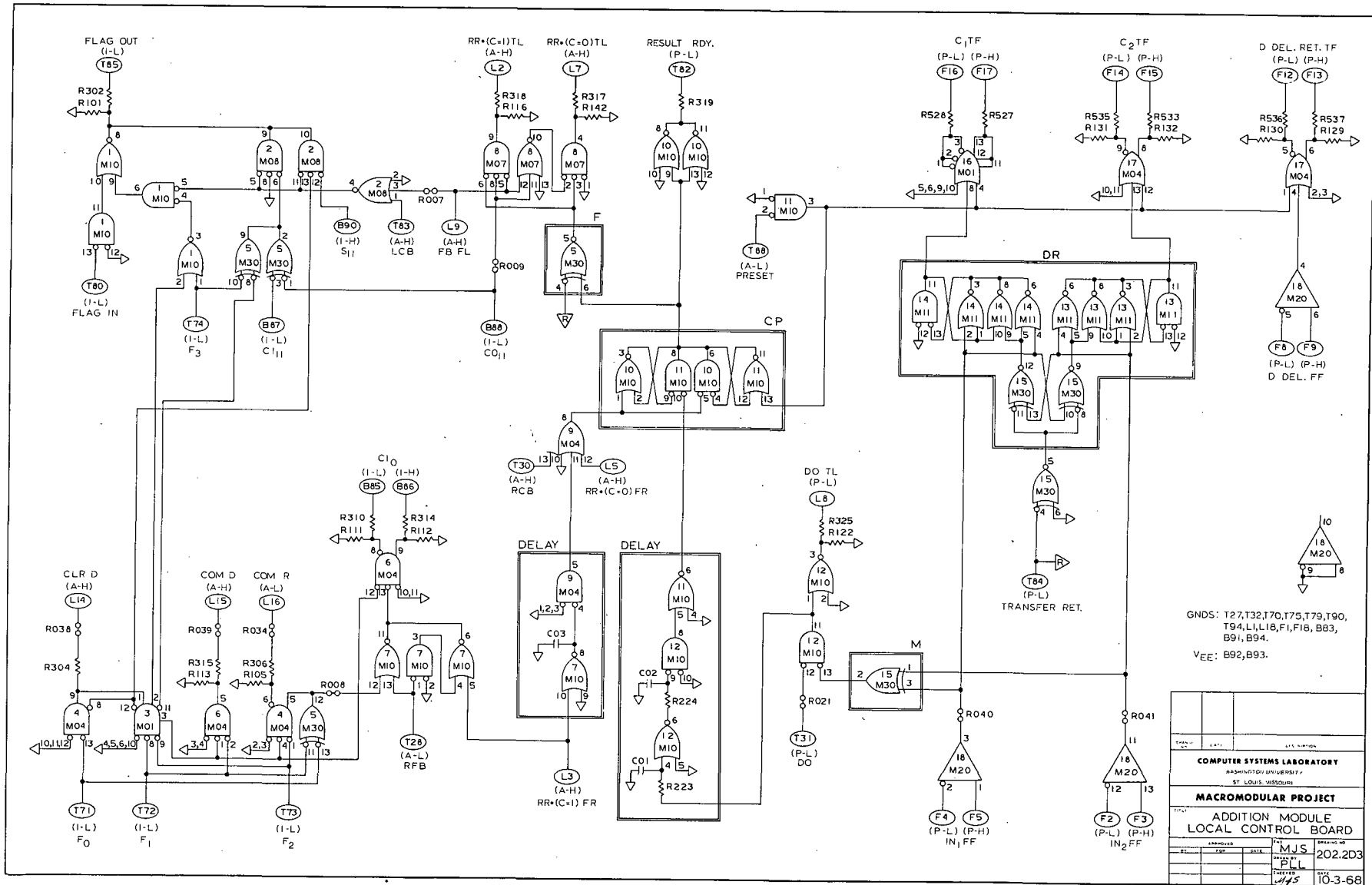
GNDS: T53, T62, T69, T75, T94, L1, L18, F1, FB, B53, B62, B73, B83, B91, B94.

VEE: B92, B93.

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
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APPROVED	BY	DATE
	MJS	201.9.03
DESIGNED	BY	DATE
	445	11-3-69

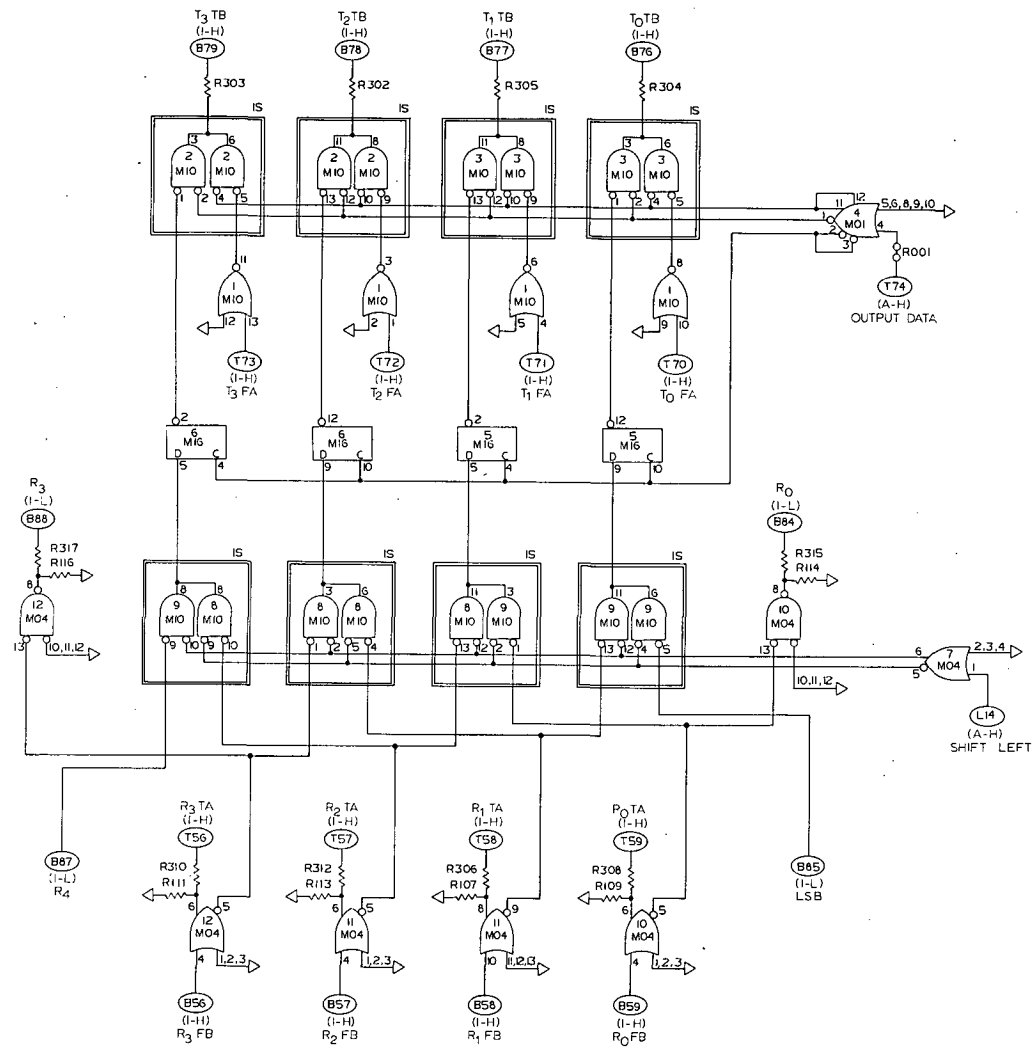


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APPROVED	DATE	DESIGNED BY
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BY	DATE	CHECKED BY
		PLL
		DATE
		7-12-68



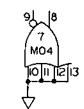
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 VEE: B92, B93.

DATE		REV. NO.	
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MACROMODULAR PROJECT			
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APPROVED	DATE	DESIGNED BY	REVISED BY
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		PLL	
		443	10-3-68

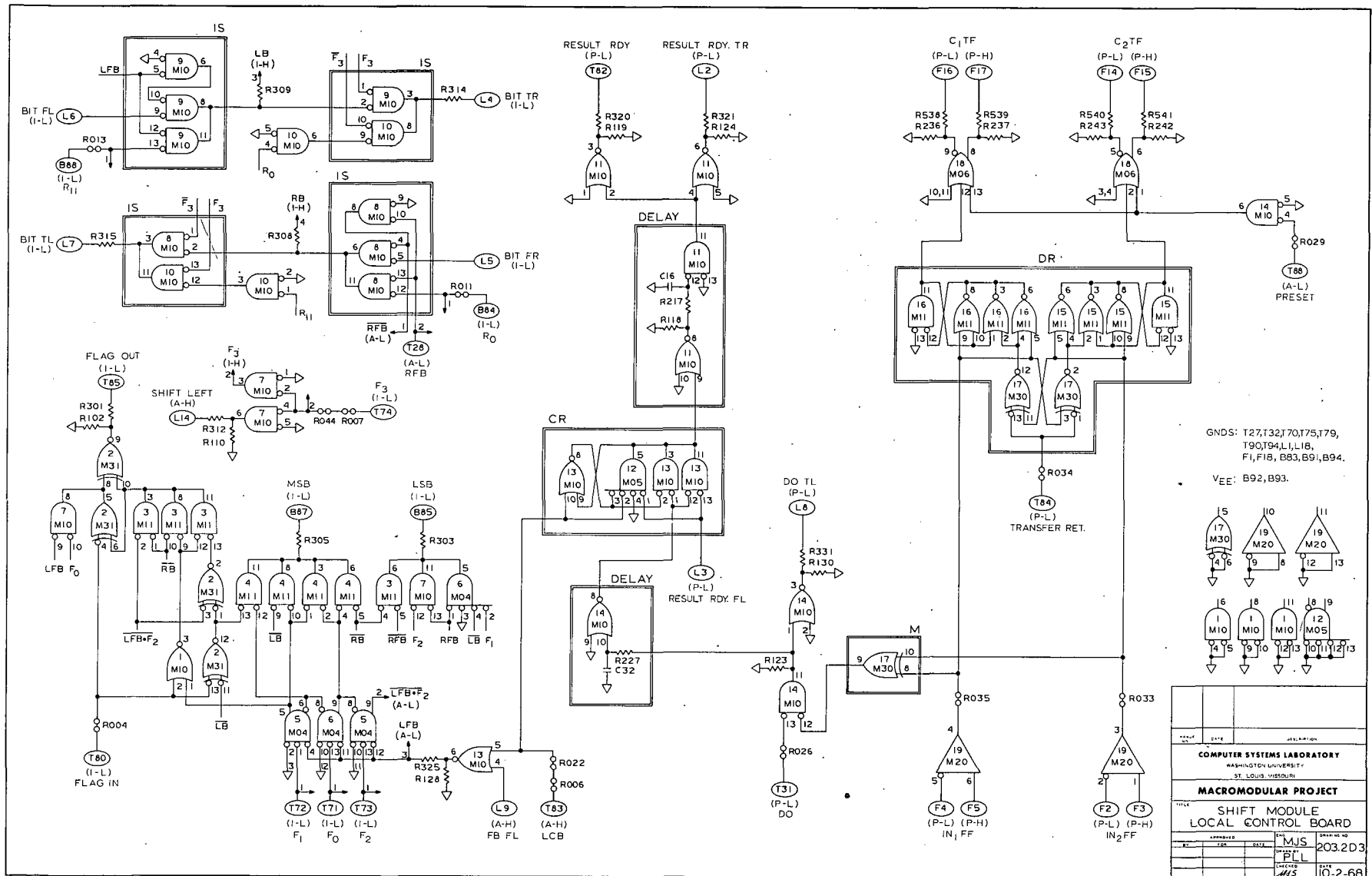


GNDS: T53, T62, T69, T75, T94, L1...18, F1, F18, B53, B62, B73, B83, B91, B92

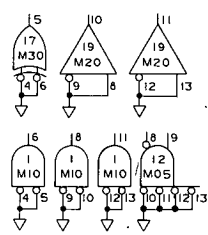
V_{EE}: B92, B93



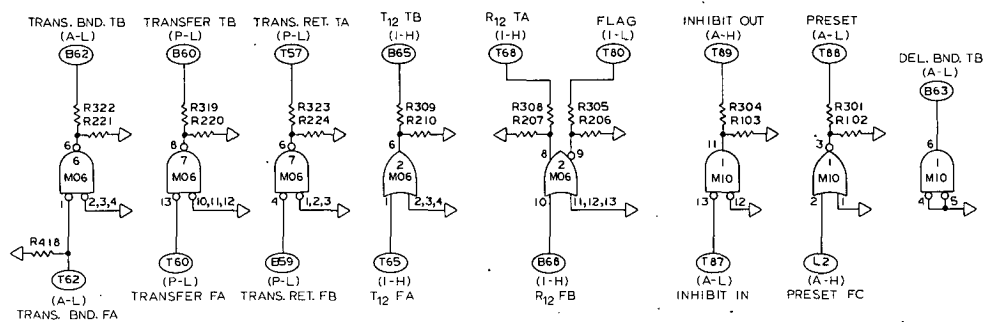
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CHECKED	DATE: PLL	
	DATE: 7-17-68	



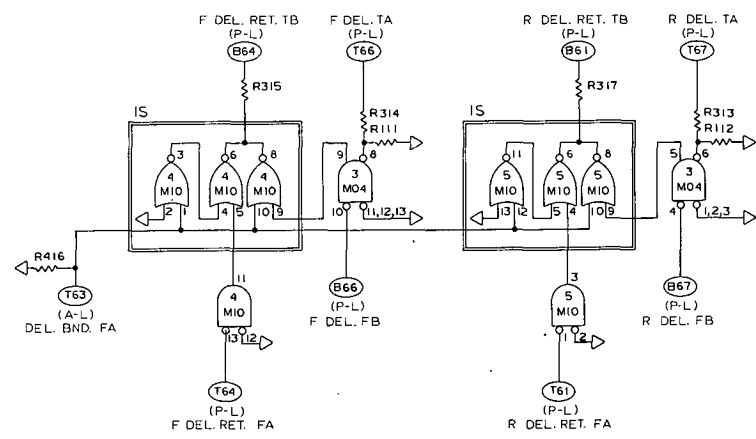
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VEE: B92, B93.



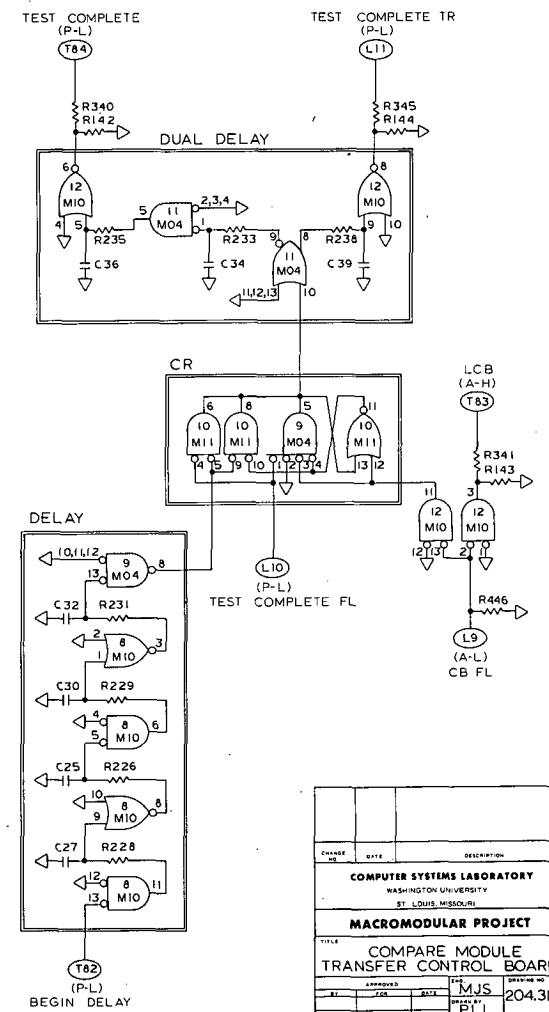
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APPROVED	BY	DATE	SHAW NO.
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REV.			FILE
			10-2-68



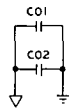
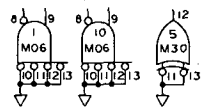
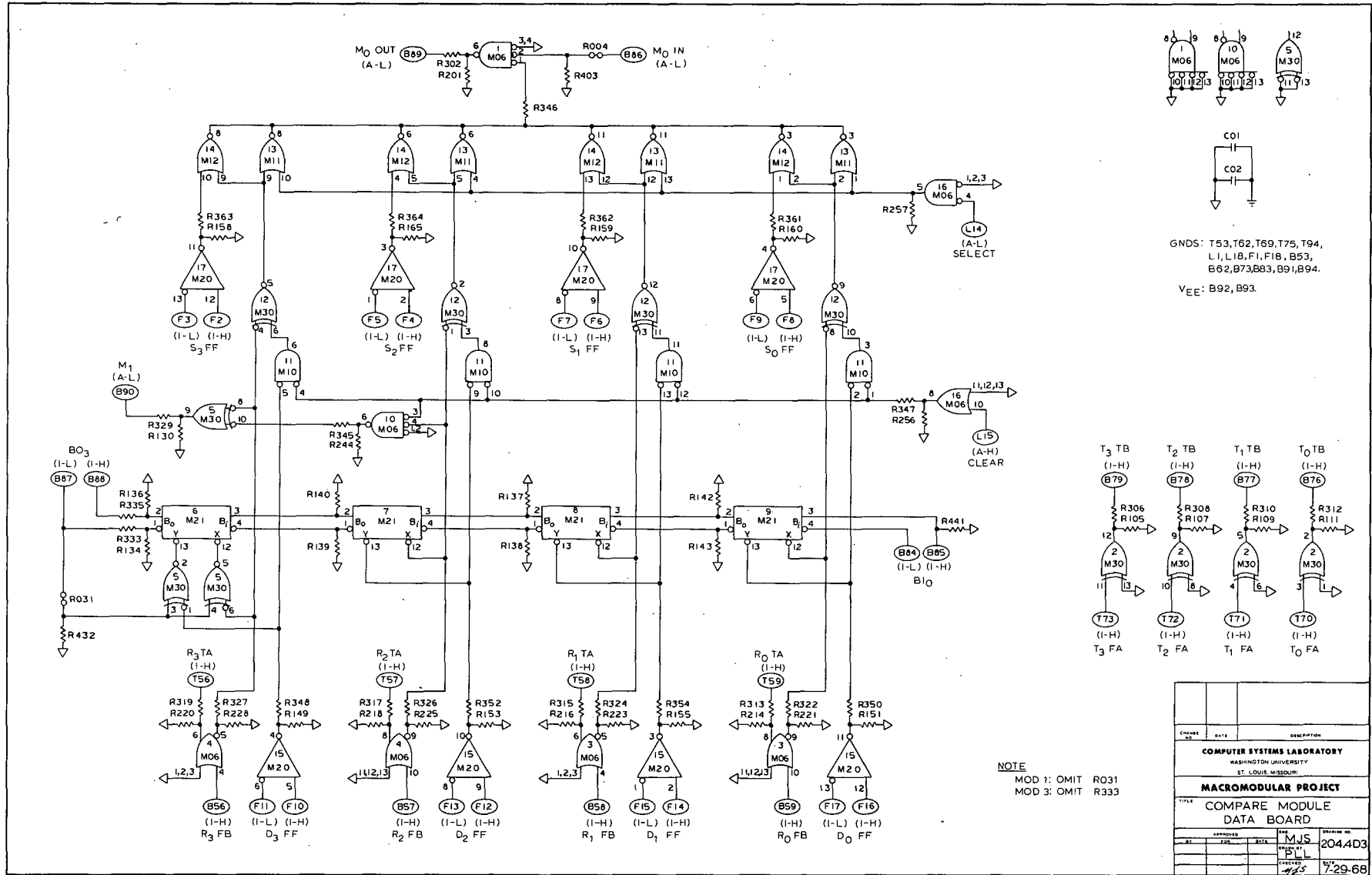
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 TRANSFER FA (P-L) T60
 TRANS. RET. FB (P-L) E59
 T₁₂ FA (I-H) T65



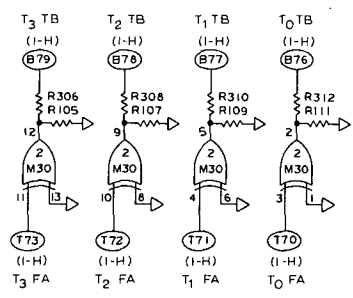
GNDS: T58, T59, T72, T79, T90, T94, L1, L18, F1, F18, B58, B69, B91, B94.
 VEE: B92, B93.



CHANGE NO.	DATE	DESCRIPTION
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WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
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APPROVED BY	DATE	ISSUED TO
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BY		
CHECKED BY		
		10-31-68

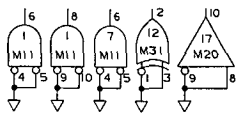
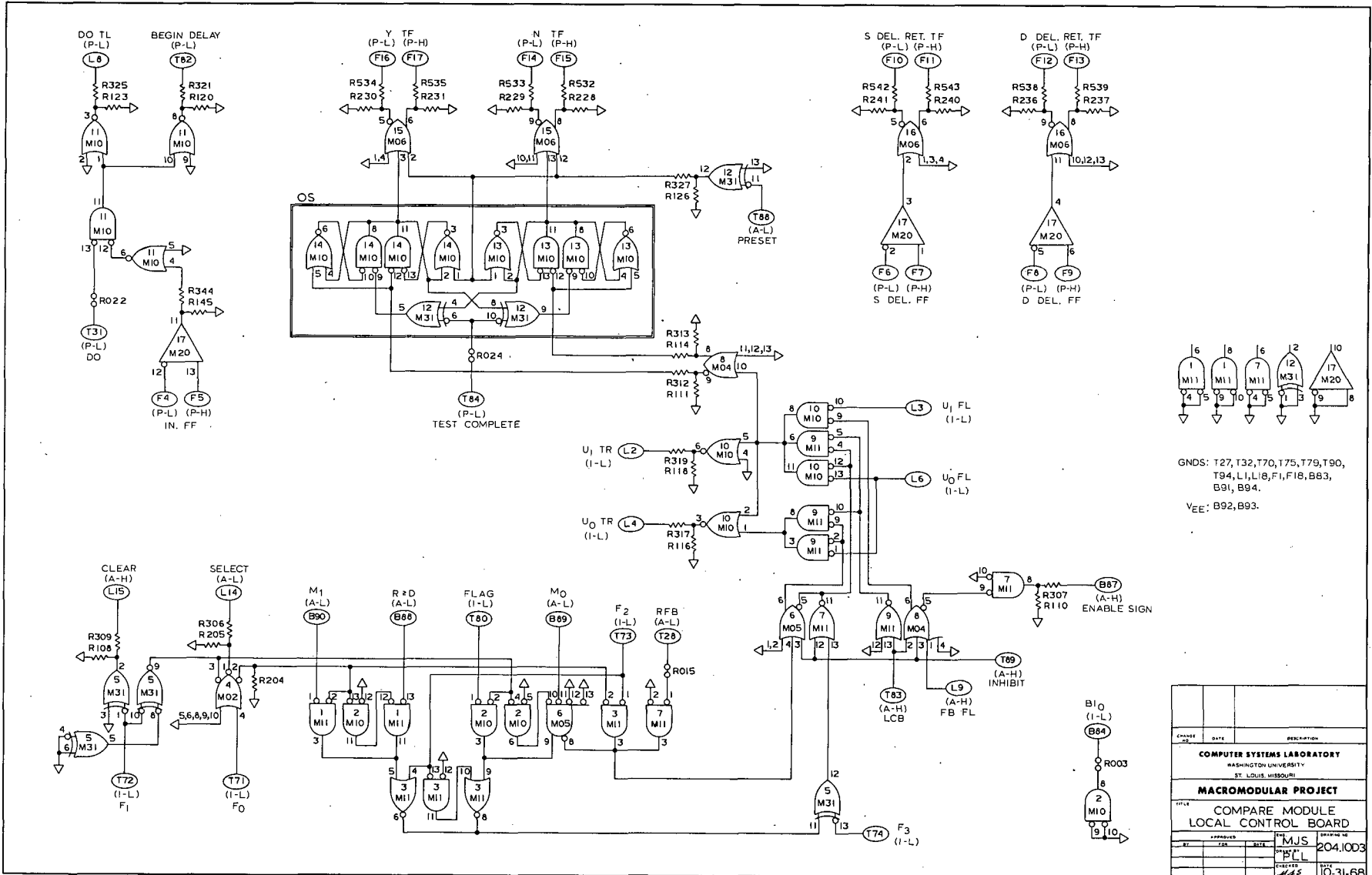


GNDS: T53, T62, T69, T75, T94,
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V_{EE}: B92, B93.



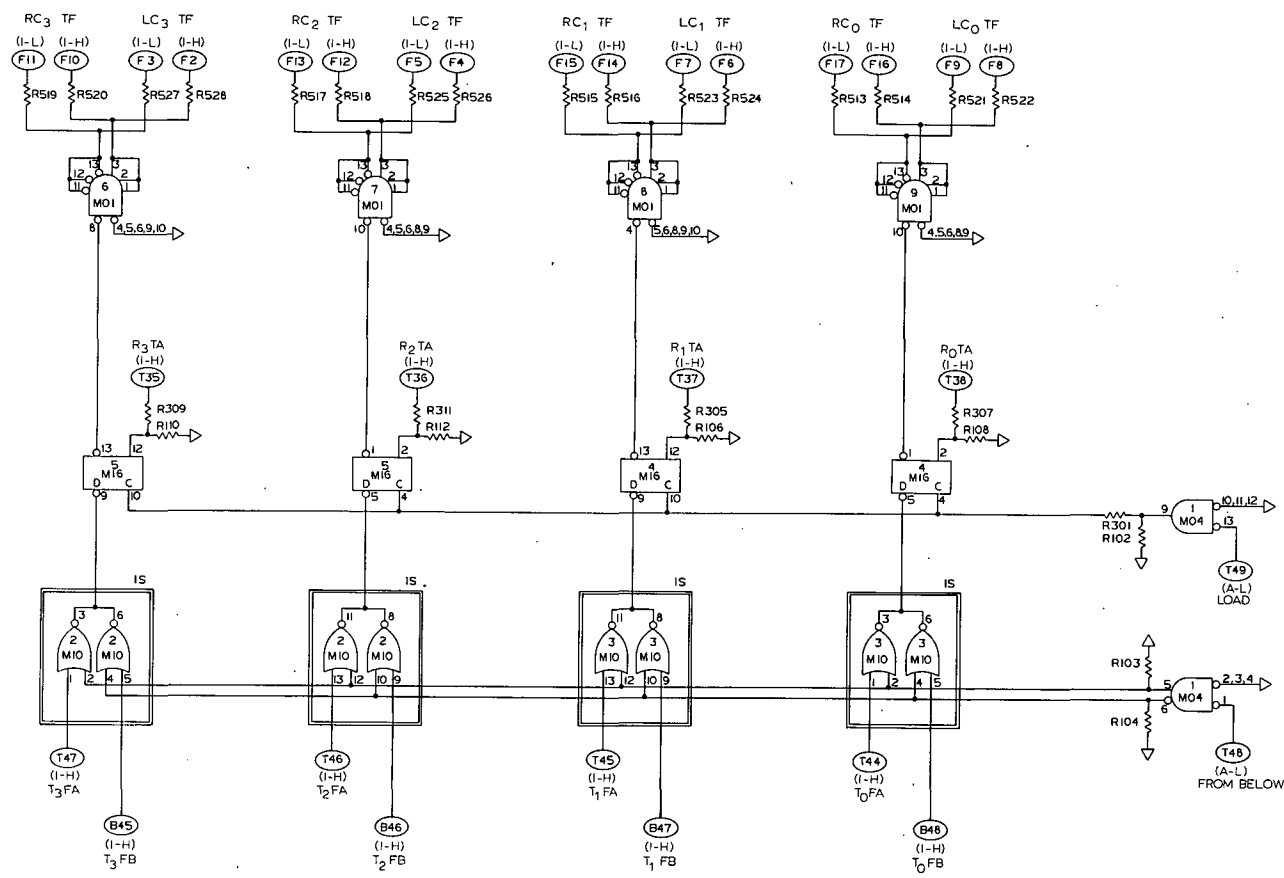
NOTE
MOD 1: OMIT R031
MOD 3: OMIT R333

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APPROVED:	DATE:	ISSUE NO.:
CHANGED BY:	DATE:	ISSUE NO.:



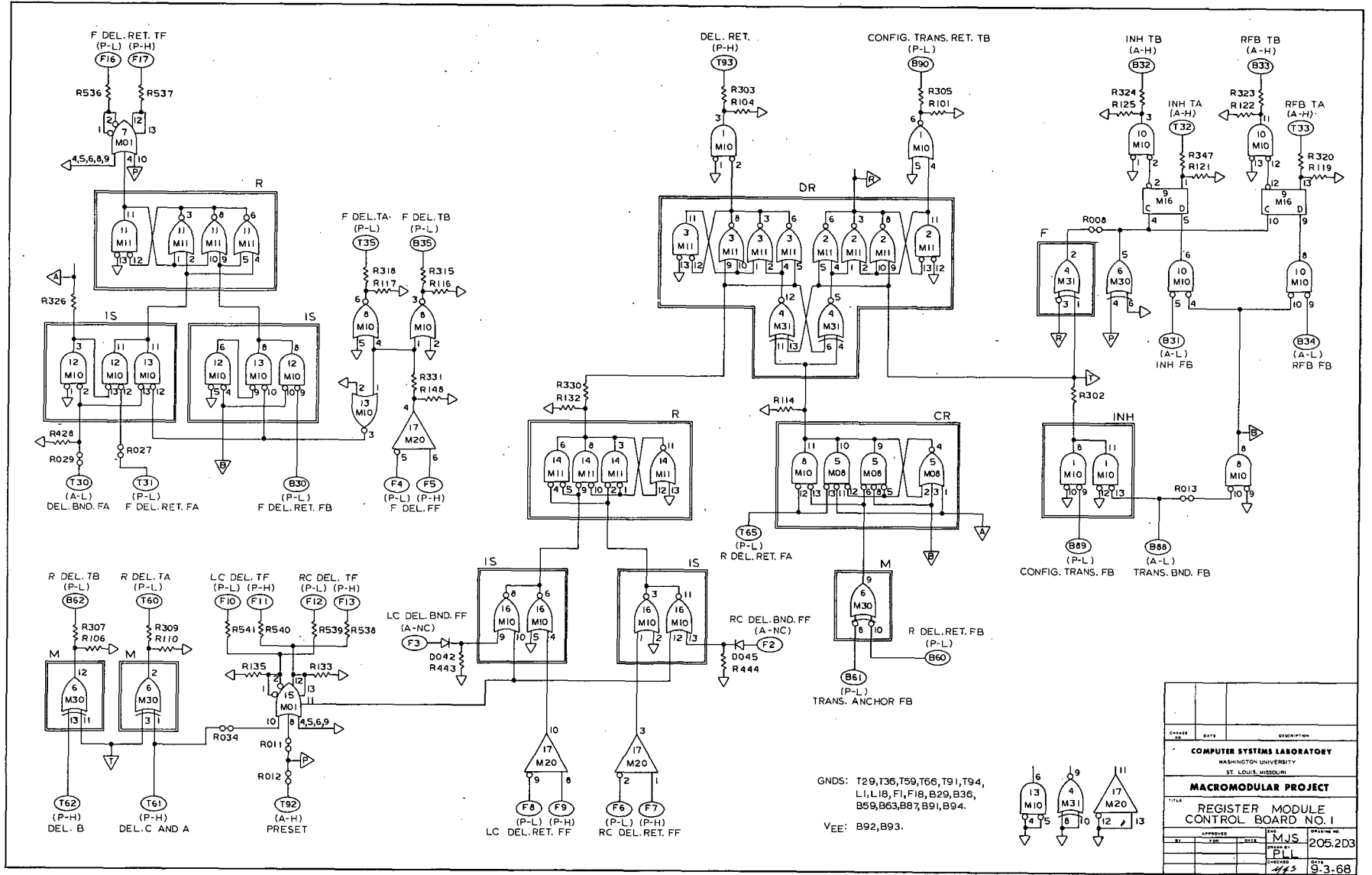
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VEE: B92, B93.

PROJECT NO.	DATE	DESCRIPTION
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MACROMODULAR PROJECT		
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DESIGNED BY	DATE	PROJECT NO.
TESTED BY	DATE	PROJECT NO.
APPROVED BY	DATE	PROJECT NO.
REVISIONS	DATE	PROJECT NO.
DRAWN BY		DATE
CHECKED BY		DATE
APPROVED BY		DATE



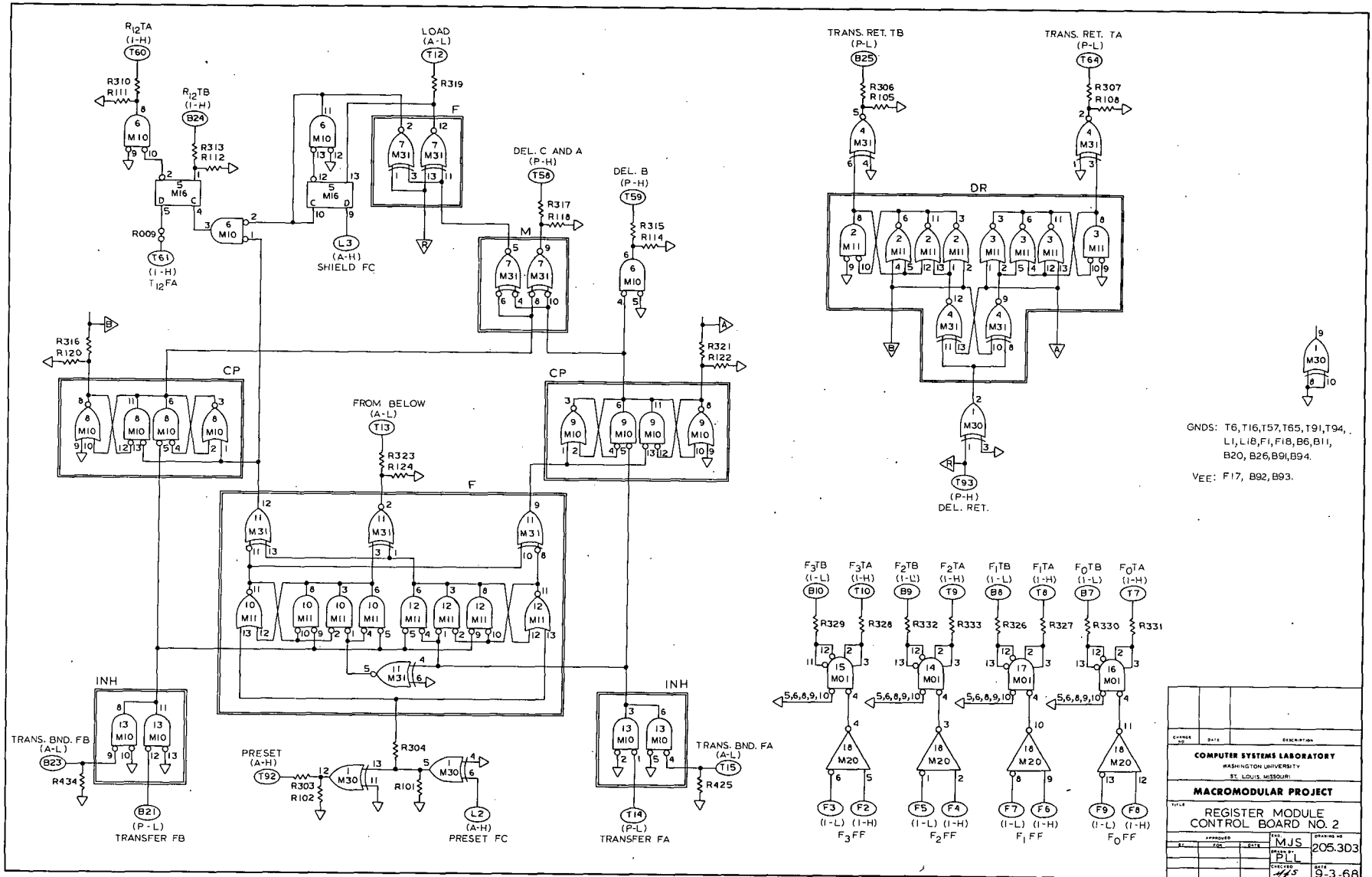
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 F1, F18, B44, B49, B91, B94
 VEE: B92, B93

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CHECKED BY	DATE	
BY: [Signature]	DATE: 7-12-68	



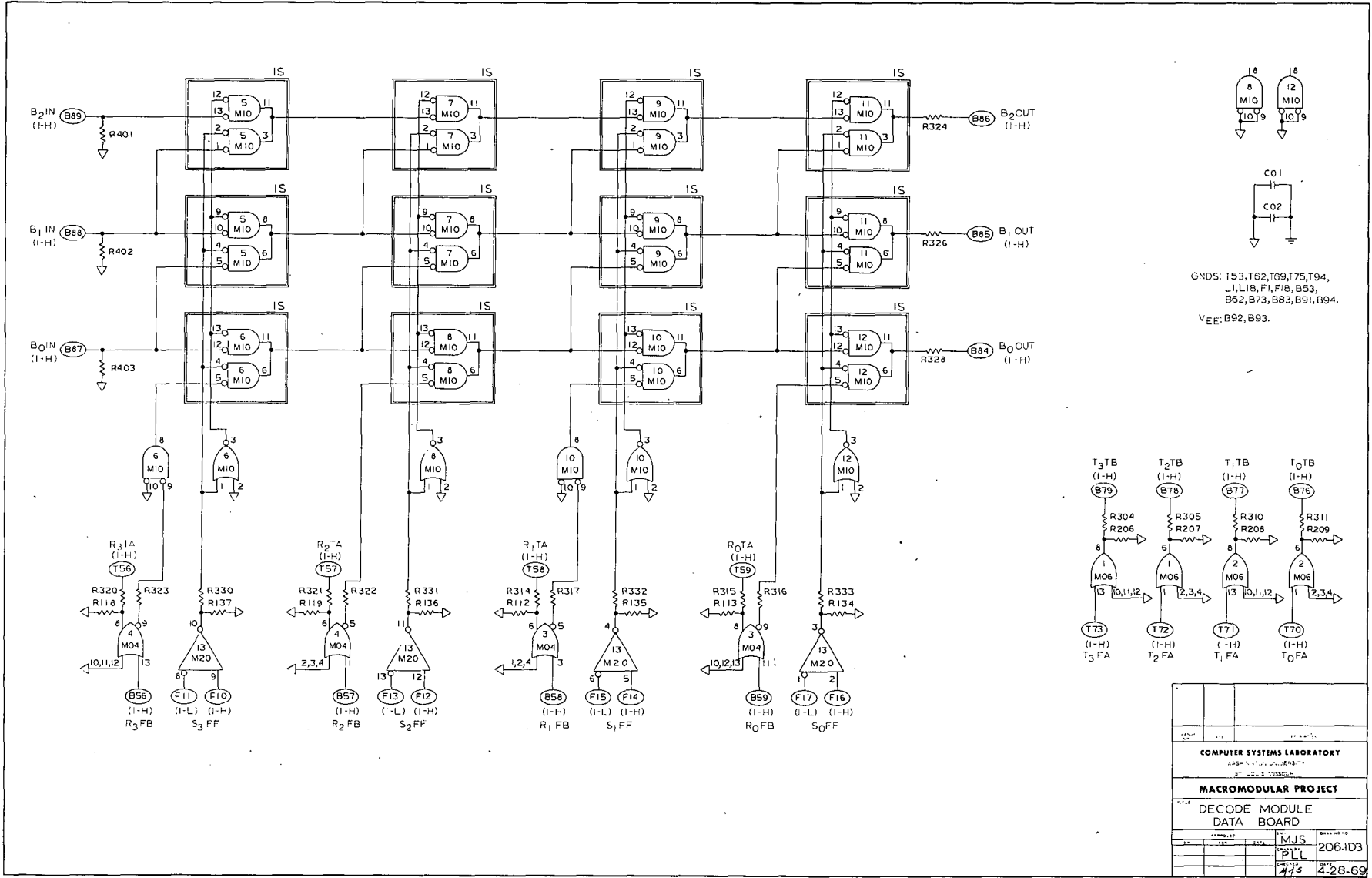
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APPROVED	DATE
DESIGNED BY	DATE
CHECKED	DATE

COMPUTER SYSTEMS LABORATORY
 WASHINGTON UNIVERSITY
 ST. LOUIS, MISSOURI
MACROMODULAR PROJECT
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 APPROVED: MJS DATE: 205.203
 DESIGNED BY: PL DATE: 9.3.68
 CHECKED: 425 DATE: 9.3.68

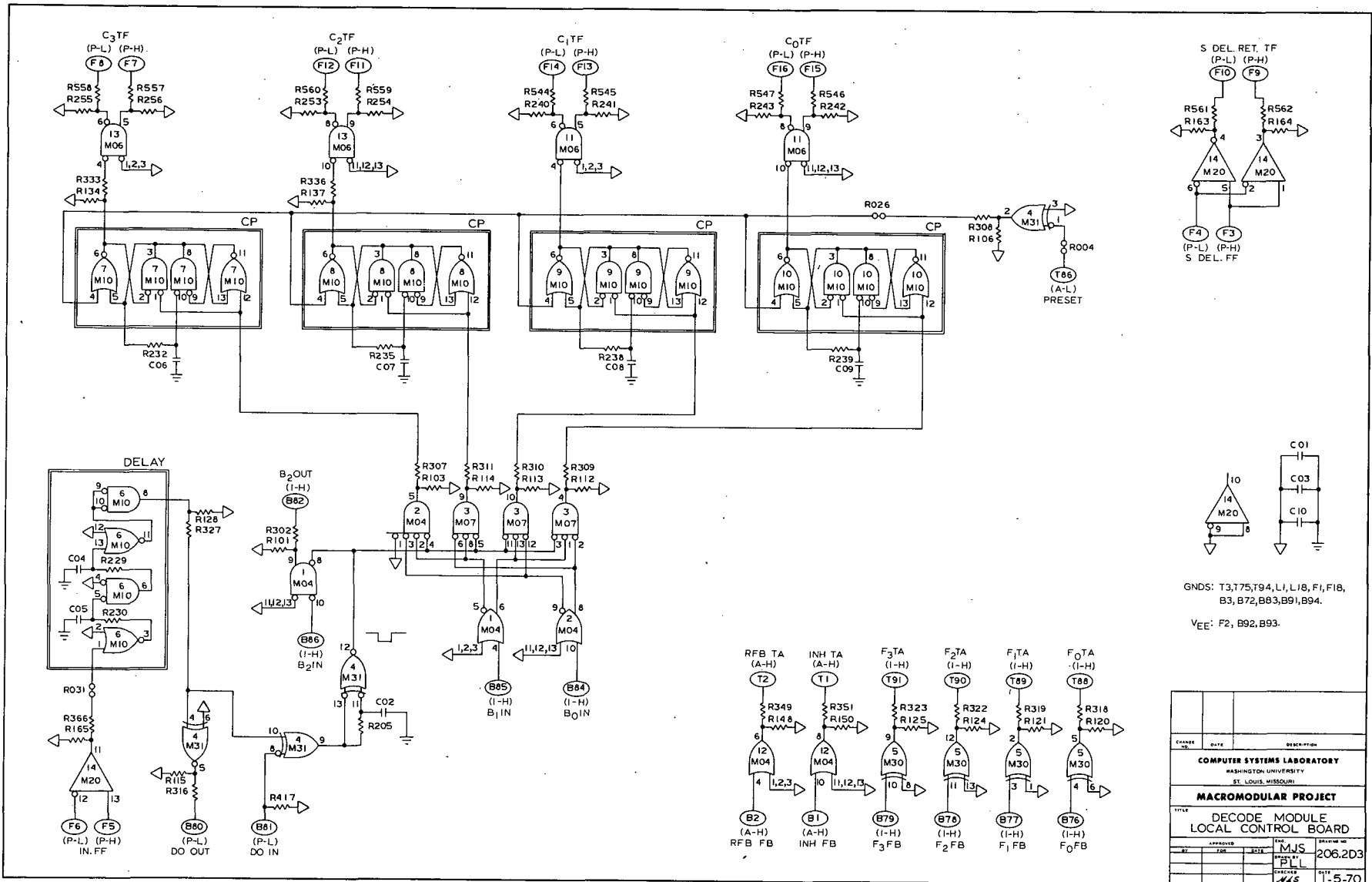


GNDs: T6, T16, T57, T65, T91, T94,
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VEE: F17, B92, B93.

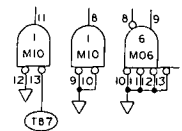
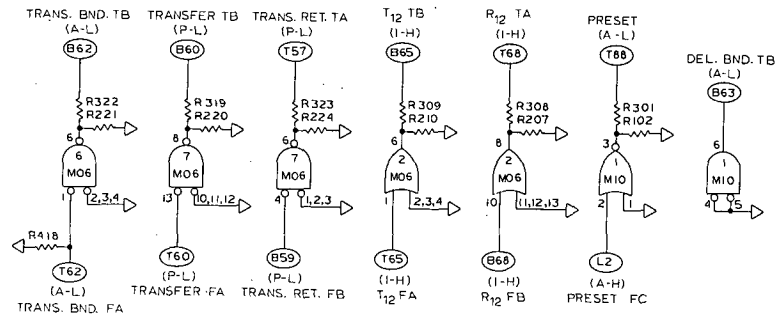
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APPROVED	DESIGNED	DATE
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	PL	
		9-3-68



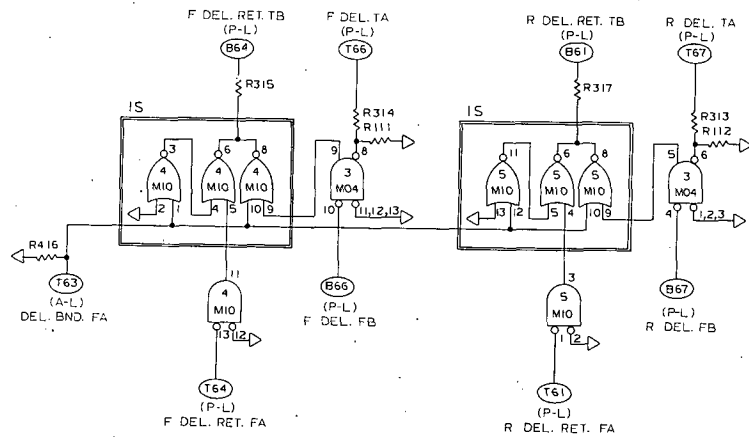
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MACROMODULAR PROJECT			
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REV	DATE	BY	APP'D
1		MJS	206.1D3
2		B11	
3		113	4-28-69



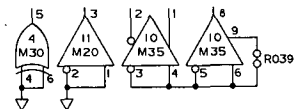
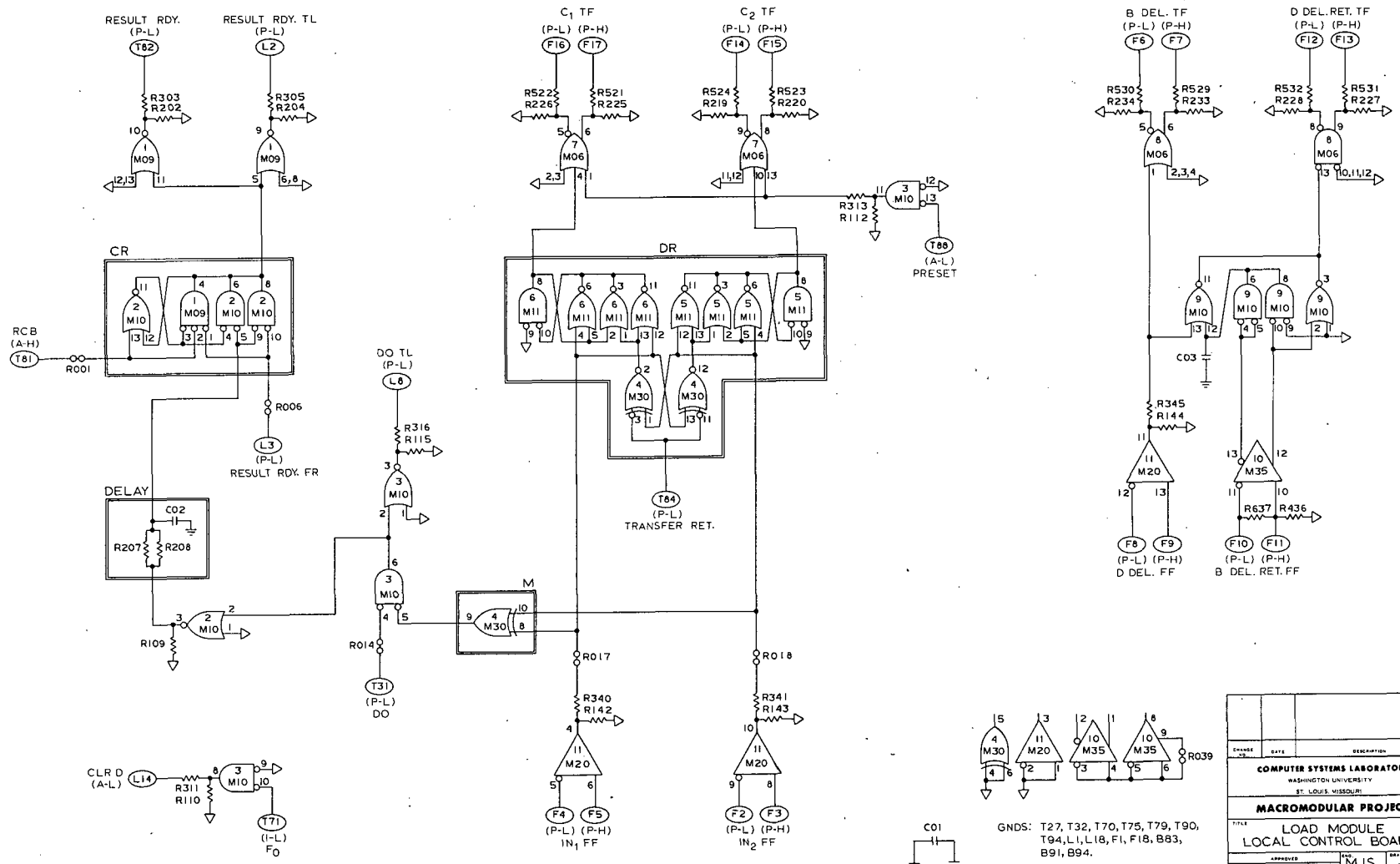
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COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
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APPROVED BY:	DATE:	FILE NO:
		MJS
BY:	DATE:	REV:
		1
		206.2D3
		DATE: 11-5-70



GNDS: T58, T59, T72, T79, T90, T94,
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VEE: B92, B93.

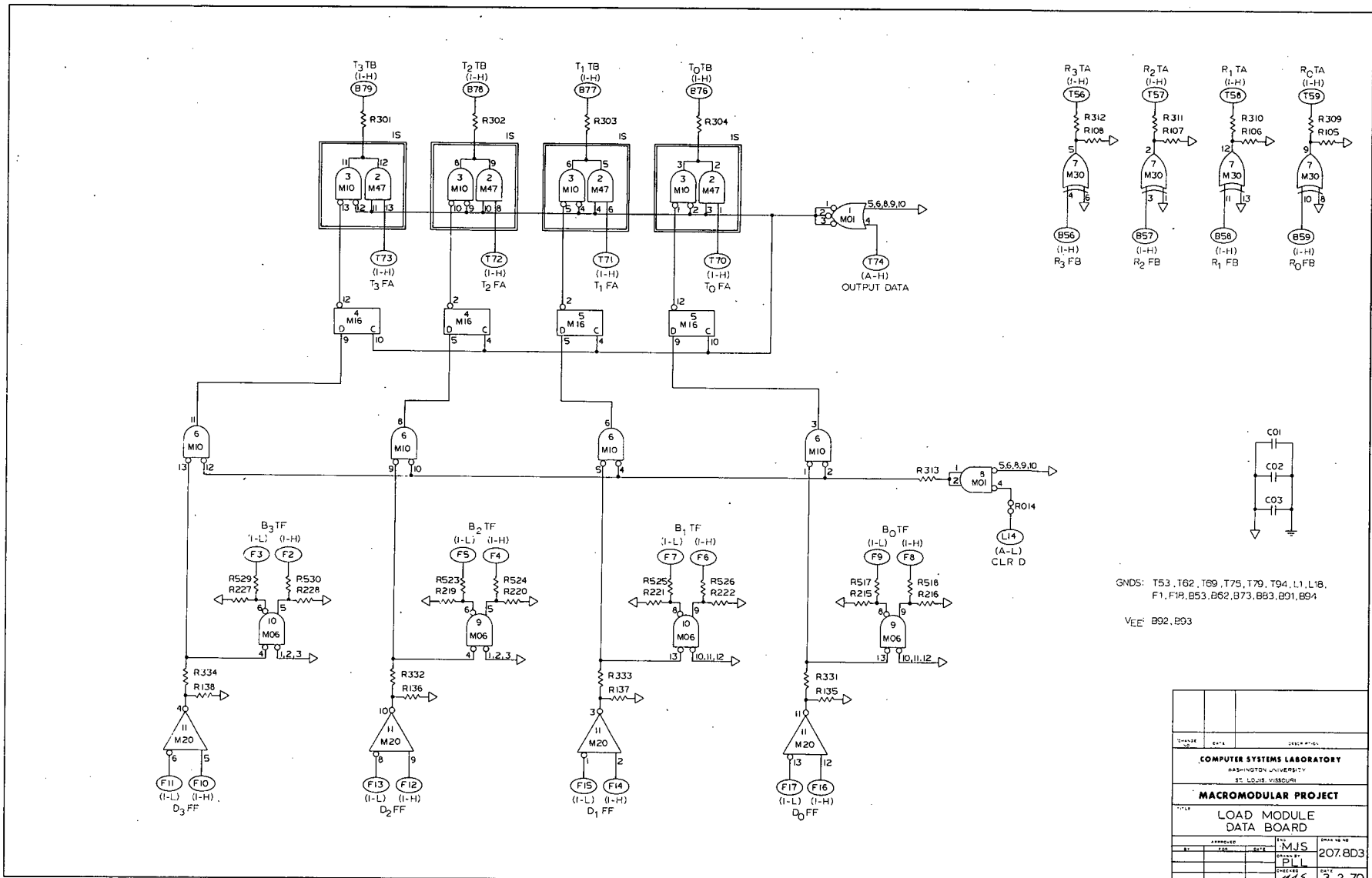


COMPUTER SYSTEMS LABORATORY	
UNIVERSITY OF CALIFORNIA	
MACROMODULAR PROJECT	
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TRANSFER CONTROL BOARD	
DESIGNED BY	MJS
APPROVED BY	PLL
DATE	10-31-68
PROJECT NO.	206.8D3

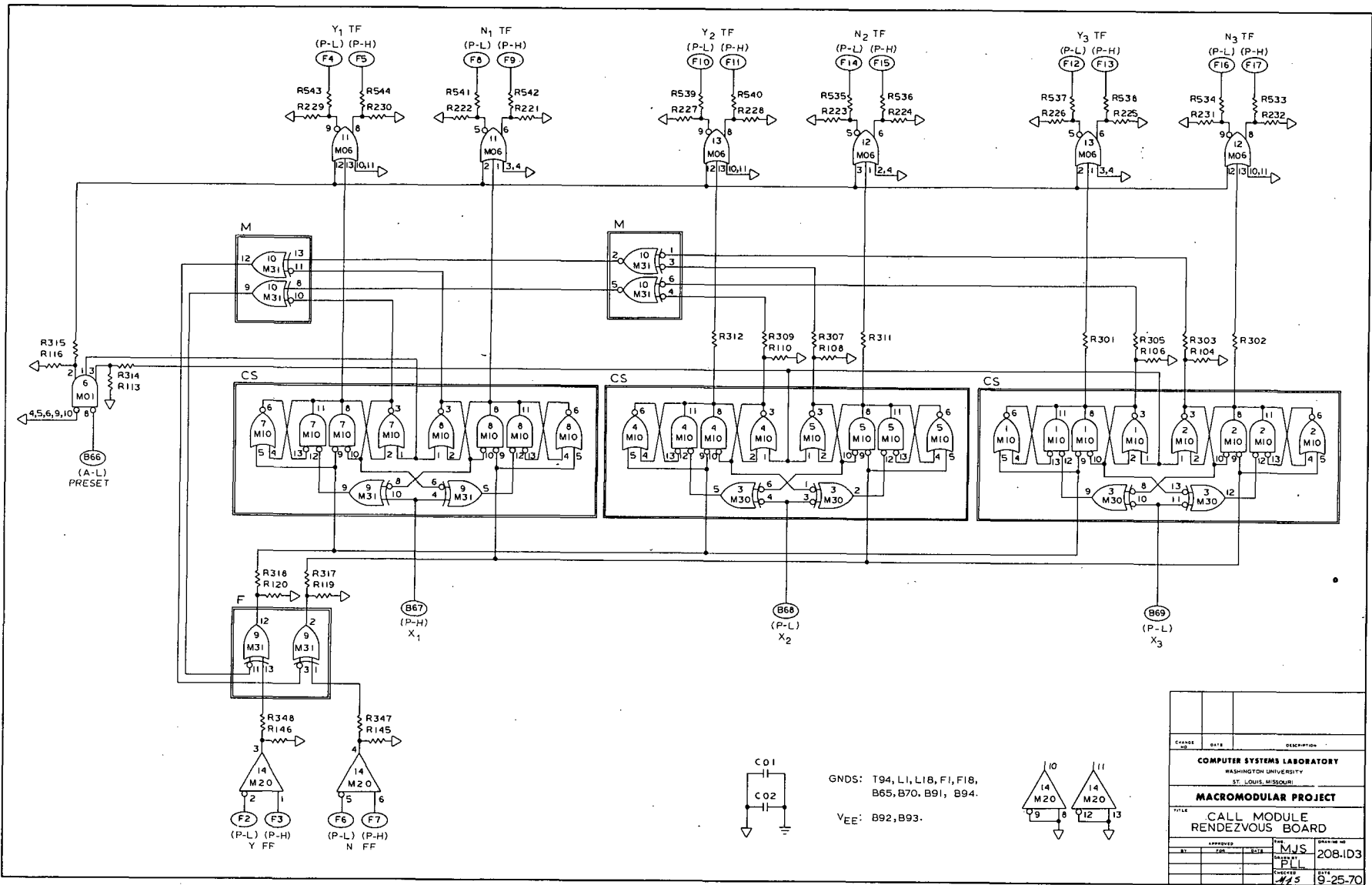


GNDS: T27, T32, T70, T75, T79, T90,
T94, L1, L18, F1, F18, B83,
B91, B94.
VEE: B92, B93.

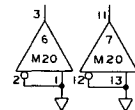
CHANGE	DATE	DESCRIPTION
		COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI
		MACROMODULAR PROJECT
		LOAD MODULE LOCAL CONTROL BOARD
APPROVED	DATE	REVISION NO.
MJS	2072D3	
FLL		
CHANGES	DATE	
125	3-27-70	



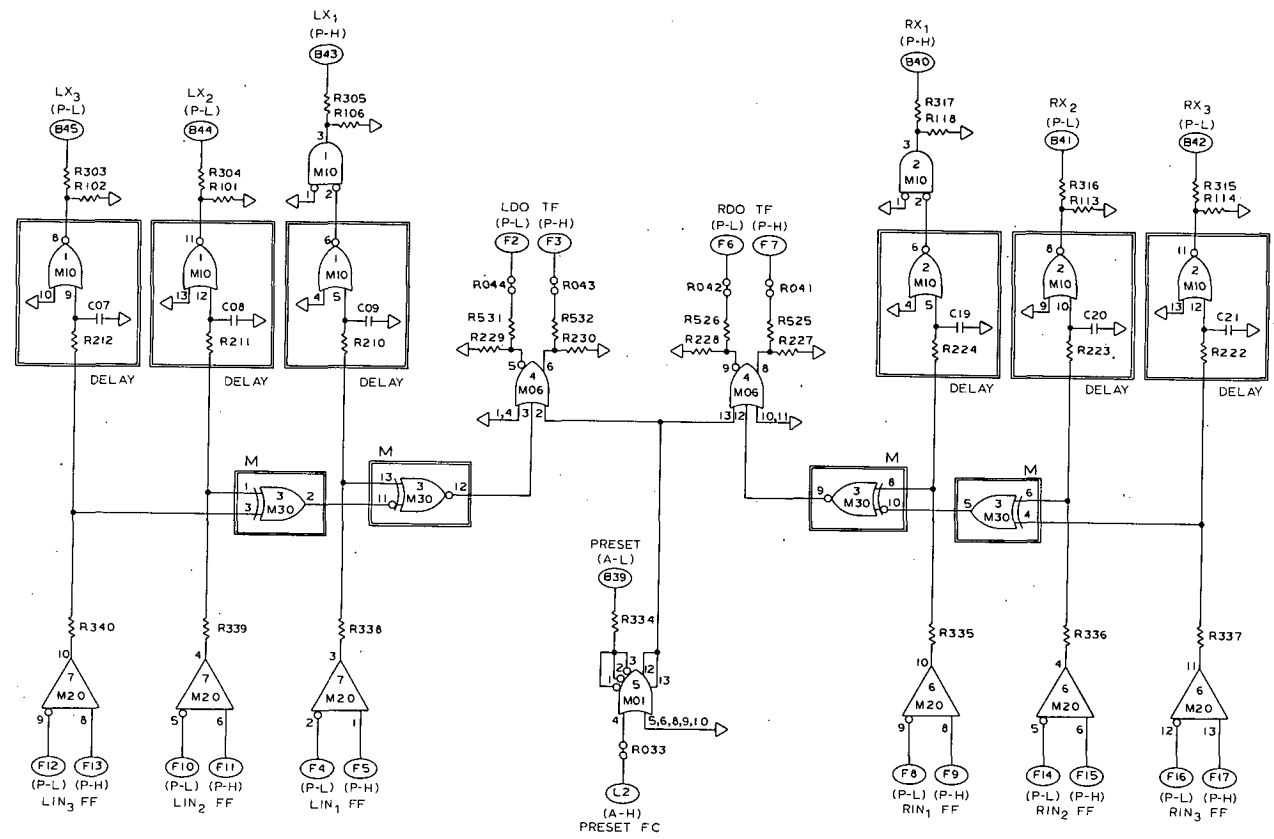
REV	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
LOAD MODULE DATA BOARD		
APPROVED	DATE	DRAWN BY
MJS	207.8D3	
CHECKED	DATE	DATE
JZS	3-2-70	



CHANGES	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
CALL MODULE RENDEZVOUS BOARD		
APPROVED	DATE	DESIGN NO.
MJS	9-25-70	208-ID3
BY	DATE	DESIGNED BY
		FLM
CHECKED	DATE	DRWING NO.
		113

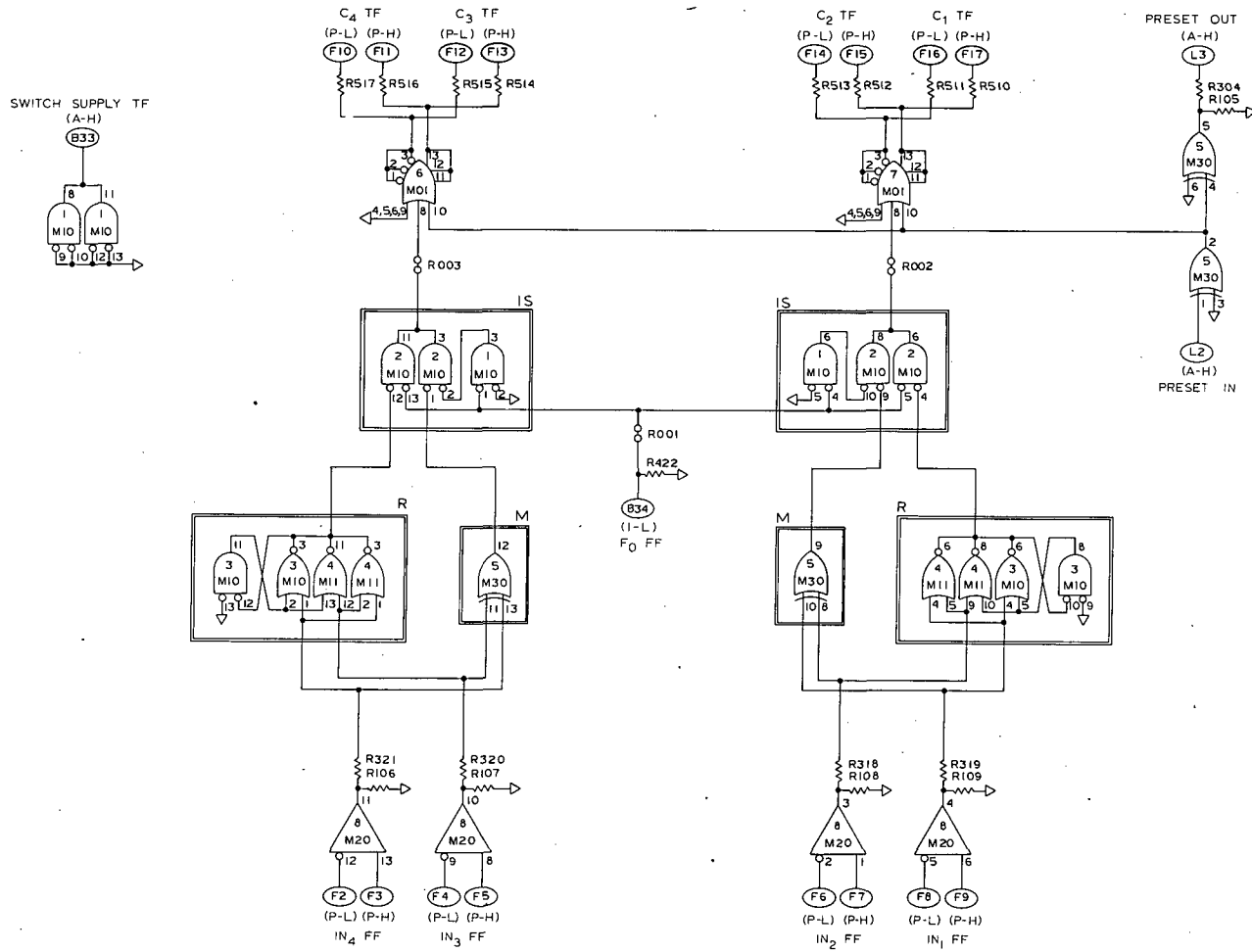


GNDS: T94, L1, L18, F1, F18,
B34, B46, B91, B94.
VEE: B92, B93.



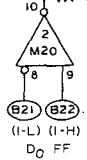
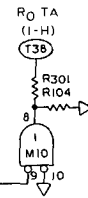
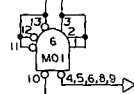
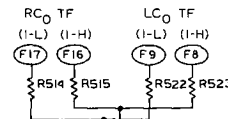
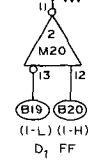
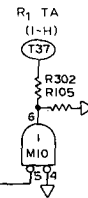
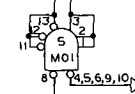
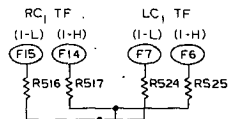
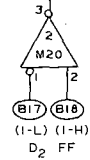
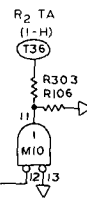
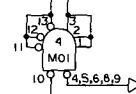
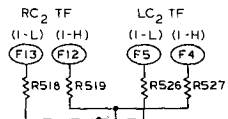
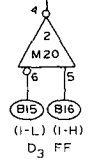
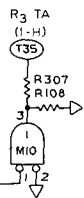
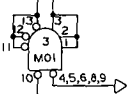
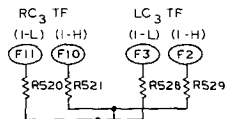
NOTE
PREFIX R: RIGHT CALL UNIT.
PREFIX L: LEFT CALL UNIT.

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE CALL MODULE MERGE BOARD		
DESIGNED BY MJS	DATE 208.203	DRAWN BY BLL
CHECKED BY HFS	DATE 3-24-69	



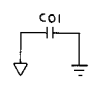
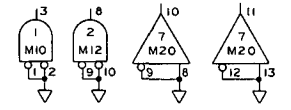
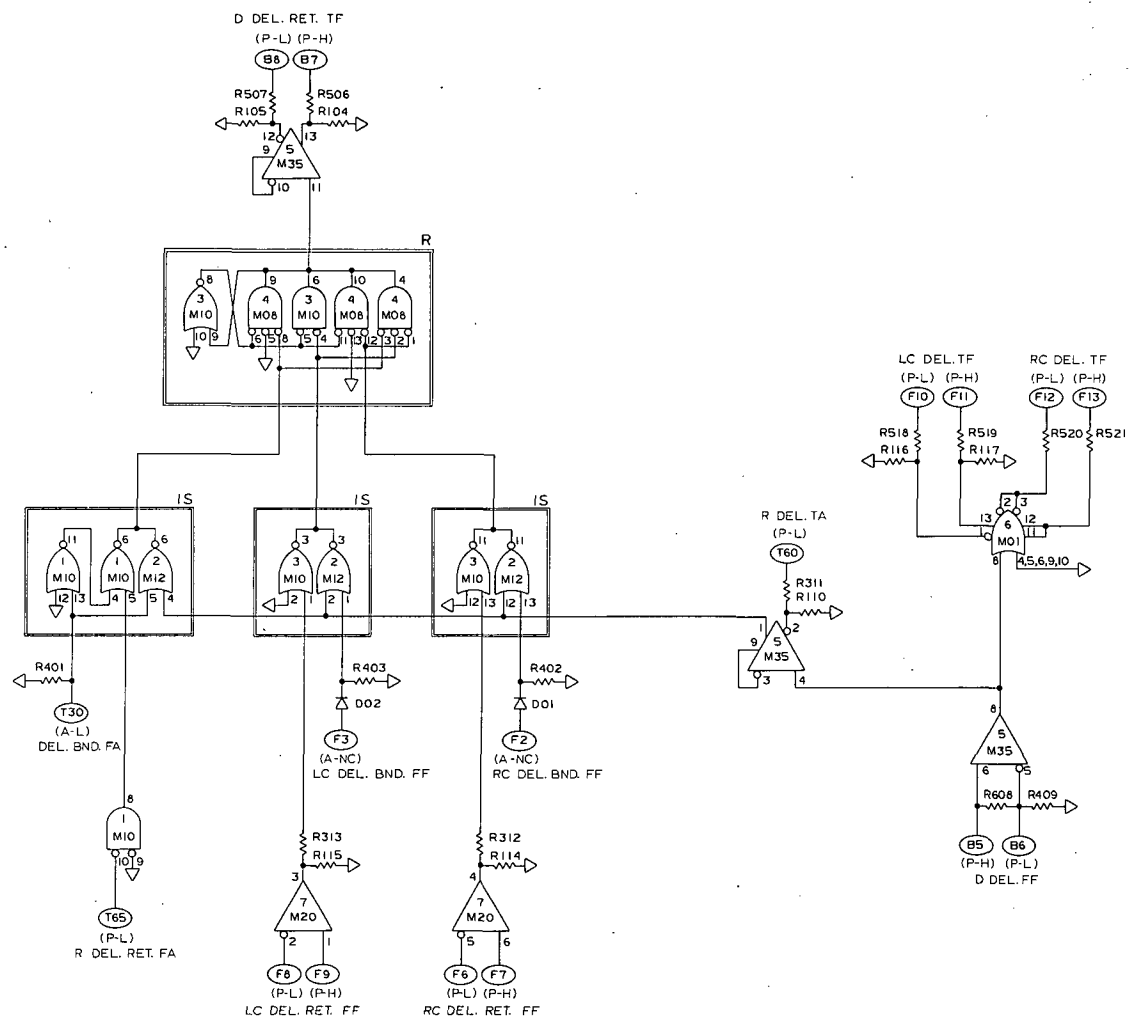
GNDS: T94, L1, L18, F1, F18,
B32, B35, B91, B94.
VEE: B92, B93.

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
MERGE-RENDEZVOUS MODULE CONTROL BOARD		
APPROVED	DATE	DRAWING NO.
ET	JRL	MJS
		PPL
		209.1D3
		7-15-68



GNDS: T32, T41, T94, L1, L18, F1, F18, B14, B23, B91, B94.
 VEE: B92, B93.

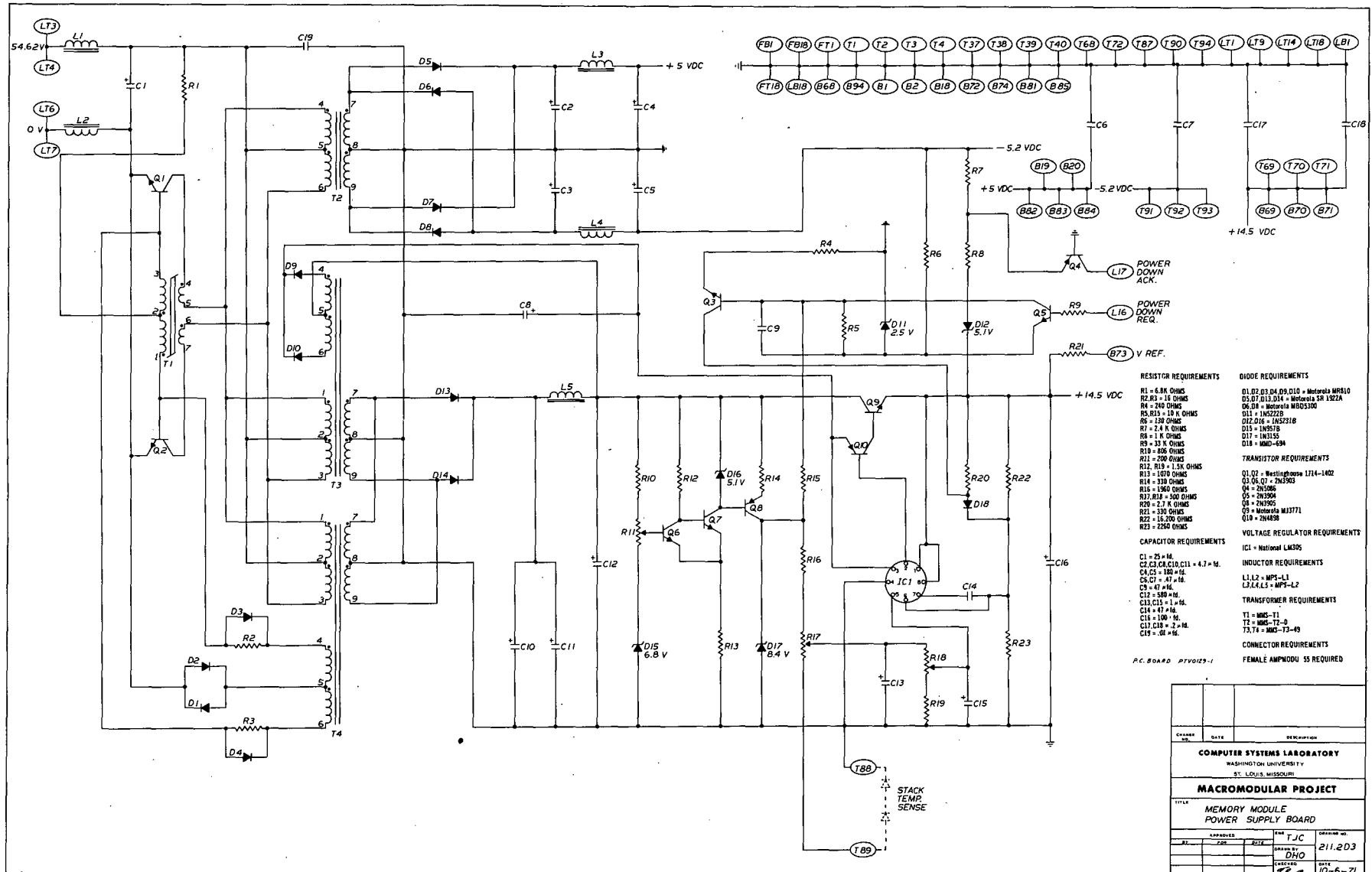
CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE DATA BRANCH MODULE DATA BOARD		
APPROVED	DATE	DESIGNED BY
		MJS
REVISION	DATE	DESIGNED BY
		ELL
		DATE
		7-19-68



GNDS: T29, T36, T59, T66, T94, L1, L18,
F1, F18, B4, B9, B91, B94.

VEE: B92, B93.

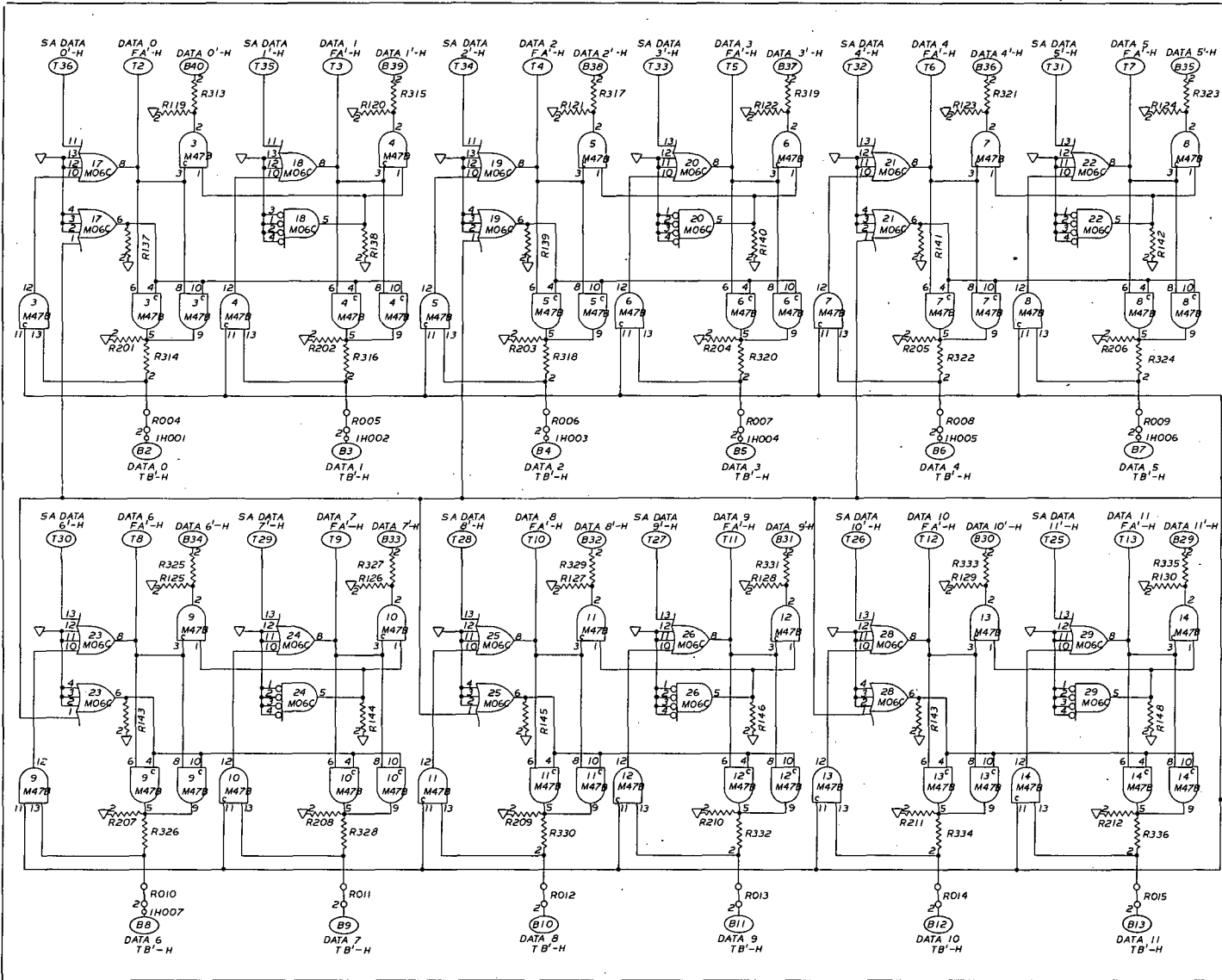
CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE DATA BRANCH MODULE CONTROL BOARD		
APPROVED BY	DATE	DRAWING NO.
MJS		210.2D3
BY	DATE	DESIGNED BY
		PLI
CHECKED BY	DATE	DESIGNED BY
		MJS
		DATE
		7-19-68



- RESISTOR REQUIREMENTS**
- R1 = 4.8K OHMS
 - R2, R3 = 15 OHMS
 - R4 = 240 OHMS
 - R5, R13 = 10 K OHMS
 - R6 = 150 OHMS
 - R7 = 2.4 K OHMS
 - R8 = 1 K OHMS
 - R9 = 33 K OHMS
 - R10 = 80K OHMS
 - R11 = 200 OHMS
 - R12, R19 = 1.5K OHMS
 - R13 = 1070 OHMS
 - R14 = 330 OHMS
 - R16 = 1500 OHMS
 - R17, R18 = 500 OHMS
 - R20 = 2.7 K OHMS
 - R21 = 330 OHMS
 - R22 = 15,000 OHMS
 - R23 = 2200 OHMS
- DIODE REQUIREMENTS**
- D1, D2, D3, D4, D9, D10 = Motorola MP10
 - D5, D7, D13, D14 = Motorola SR 1922A
 - D6, D8 = Motorola MDS350
 - D11 = 1N4222B
 - D12, D16 = 1N4521B
 - D15 = 1N4518
 - D17 = 1N4155
 - D18 = MMD-634
- TRANSISTOR REQUIREMENTS**
- Q1, Q2 = Westinghouse 1714-1402
 - Q3, Q6, Q7 = 2N3503
 - Q4 = 2N3066
 - Q5 = 2N3004
 - Q8 = 2N3950
 - Q9 = Motorola MJ3771
 - Q10 = 2N4958
- VOLTAGE REGULATOR REQUIREMENTS**
- IC1 = National LM305
- INDUCTOR REQUIREMENTS**
- L1, L2 = MP1-L1
 - L3, L4, L5 = MP3-L2
- TRANSFORMER REQUIREMENTS**
- T1 = MMS-T1
 - T2 = MMS-T2-0
 - T3, T4 = MMS-T3-49
- CONNECTOR REQUIREMENTS**
- FEMALE AMPMODU 55 REQUIRED

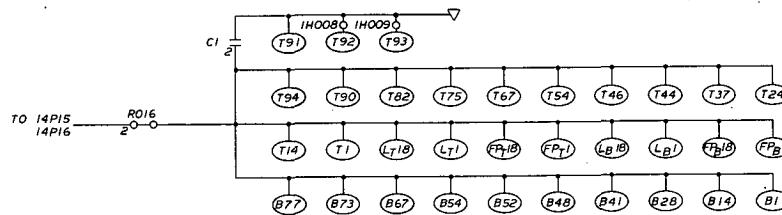
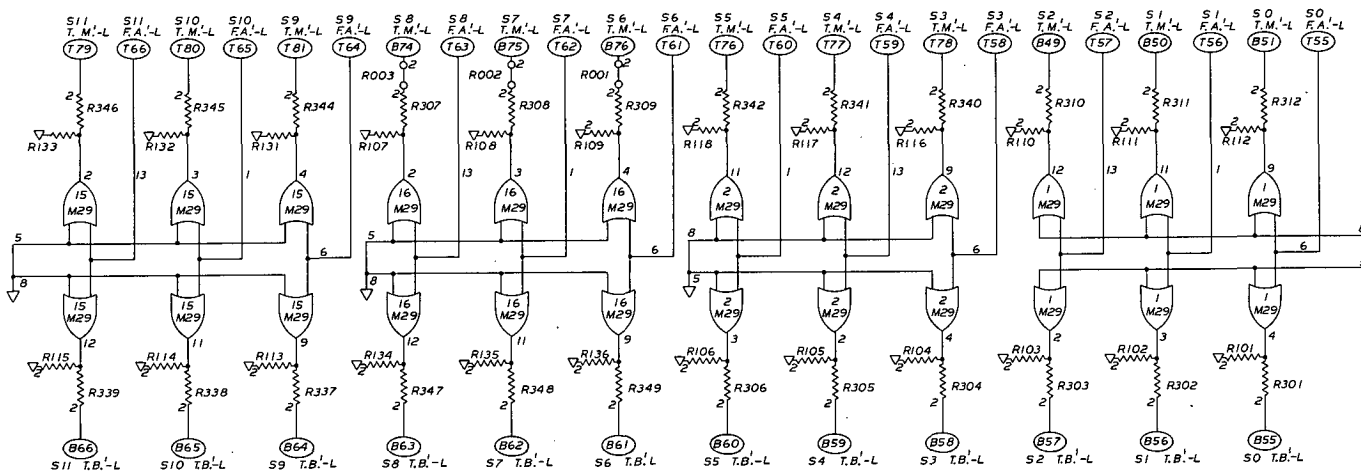
A.C. BOARD PIVOTS-1

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE MEMORY MODULE POWER SUPPLY BOARD		
DESIGNED BY	DATE	REVISED BY
DHO	10-6-71	TJC
CHECKED BY	DATE	DESIGNED BY
		DHO
PROJECT NO.		211.203
DATE		10-6-71



GROUND, POWER CONNECTIONS, AND PARTS LIST INCLUDED IN LISTING ON DWG. NO. 211.304 (MEMORY ADDRESS BUFFER)

CHANGE NO.	DATE	DESCRIPTION
		COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI
		MACROMODULAR PROJECT
TITLE BI DIRECTIONAL DATA BUSS MEMORY MACROMODULE		
APPROVED		DWG. NO. 211.303
BY	FOR	DATE 9-30-71



INTEGRATED CIRCUIT IDENTIFICATION

- | | | |
|----------|----------|---------|
| 1. M29 | 11. M47B | 21. M5C |
| 2. M29 | 12. M47B | 22. M5C |
| 3. M47B | 13. M47B | 23. M5C |
| 4. M47B | 14. M47B | 24. M5C |
| 5. M47B | 15. M29 | 25. M5C |
| 6. M47B | 16. M29 | 26. M5C |
| 7. M47B | 17. M5C | 27. M5C |
| 8. M47B | 18. M5C | 28. M5C |
| 9. M47B | 19. M5C | 29. M5C |
| 10. M47B | 20. M5C | |

INTEGRATED CIRCUIT REQUIREMENTS

- | | |
|------|----|
| M47B | 1 |
| M5C | 12 |
| M29 | 4 |
| M47B | 12 |

RESISTOR REQUIREMENTS

- R0XX = ZERO OHMS 17 REQUIRED
 R1XX = 1,500 OHMS 48 REQUIRED
 R2XX = 750 OHMS 12 REQUIRED
 R3XX = 121 OHMS 49 REQUIRED

CONNECTOR REQUIREMENTS

- AMP MODU FEMALE 11A REQUIRED

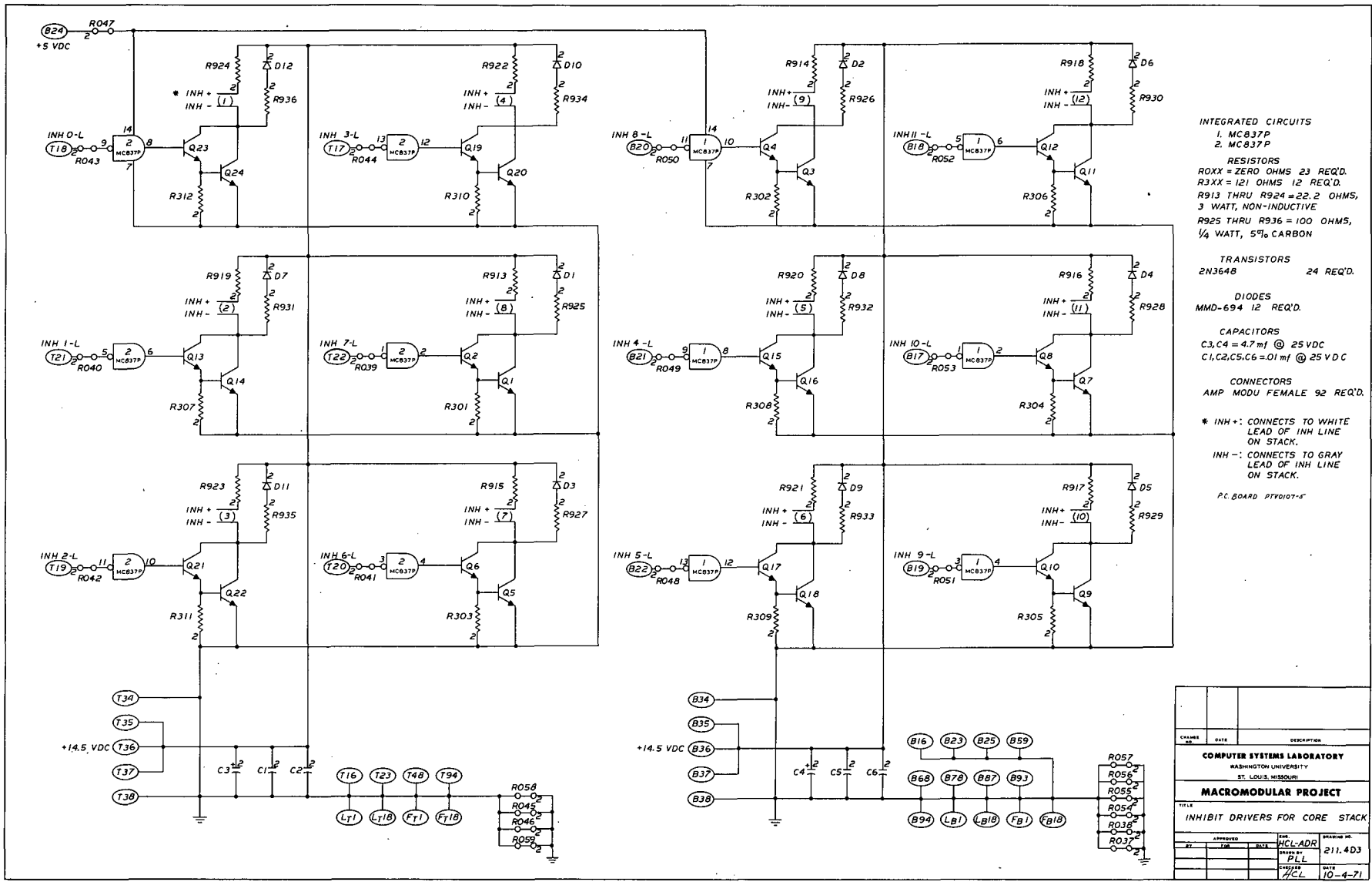
CAPACITOR IDENTIFICATION

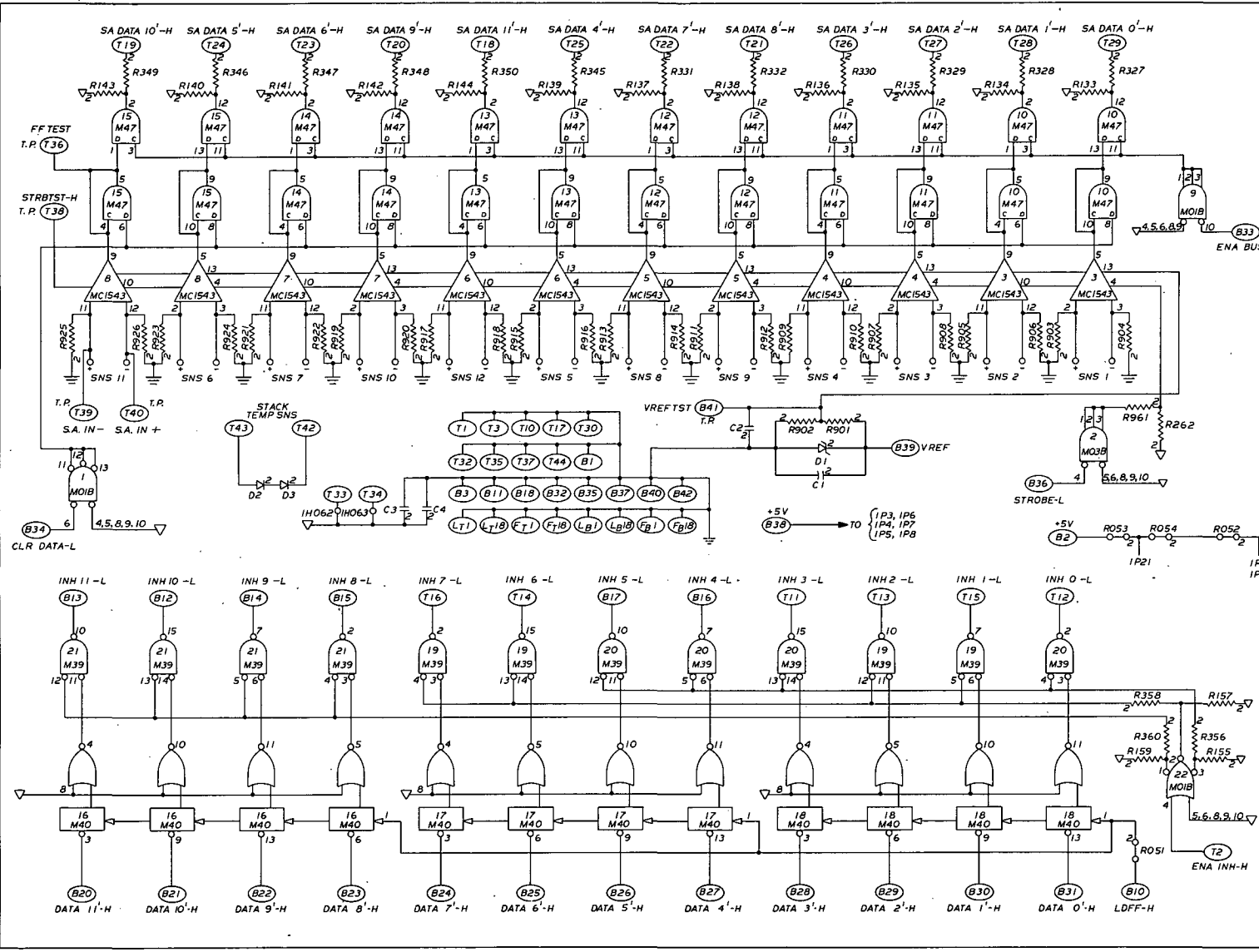
- C01 = .01 - 1 DISC - 15V

PC BOARD: PTV0109-2

LOGIC FOUND ON DWG. NO. 211.3D3
 (BI DIRECTIONAL DATA BOARD)

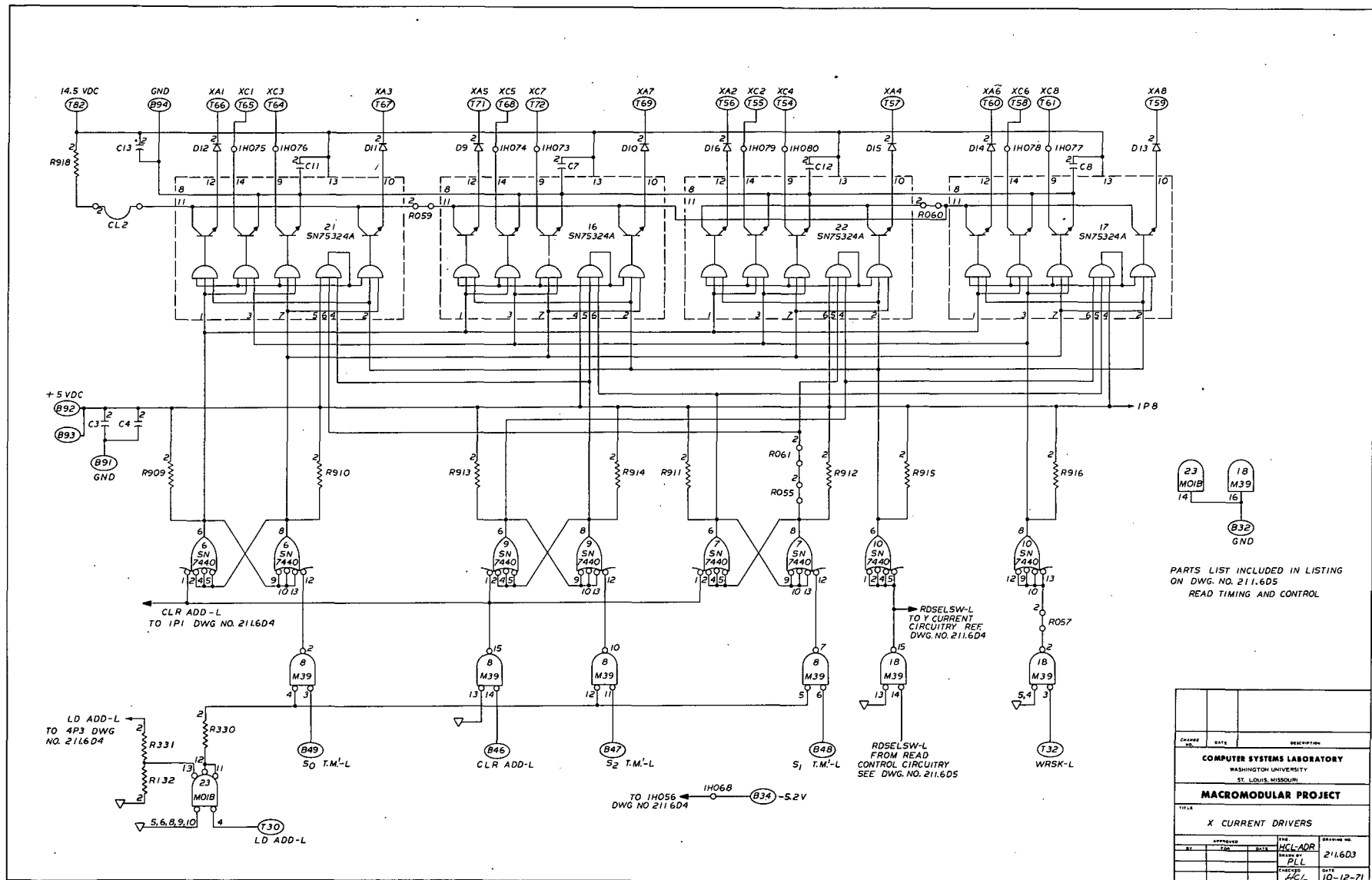
CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
MEMORY ADDRESS BUFFER		
APPROVED	DATE	REVISION NO.
BY	DATE	NO.
		211.3D4
		PL L
		77C L
		10-1-71





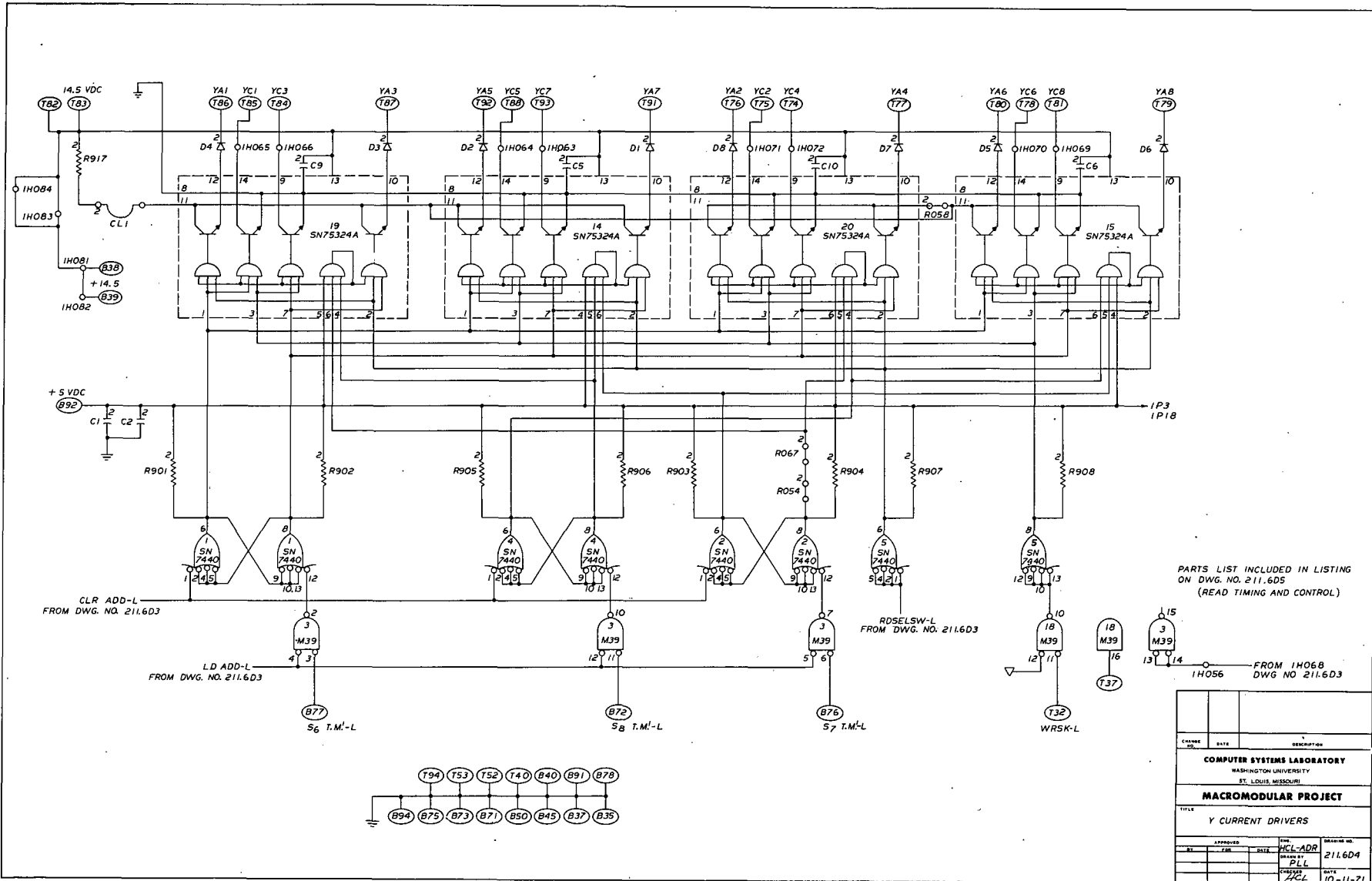
- SENSE AMP AND DATA REGISTERS**
- INTEGRATED CIRCUIT IDENTIFICATION**
- 1. M01B
 - 2. M02B
 - 3. M03B
 - 4. M04B
 - 5. M05B
 - 6. M06B
 - 7. M07B
 - 8. M08B
 - 9. M09B
 - 10. M10B
 - 11. M11B
 - 12. M12B
 - 13. M13B
 - 14. M14B
 - 15. M15B
 - 16. M16B
 - 17. M17B
 - 18. M18B
 - 19. M19B
 - 20. M20B
 - 21. M21B
 - 22. M22B
 - 23. M23B
 - 24. M24B
 - 25. M25B
 - 26. M26B
 - 27. M27B
 - 28. M28B
 - 29. M29B
 - 30. M30B
 - 31. M31B
 - 32. M32B
 - 33. M33B
 - 34. M34B
 - 35. M35B
 - 36. M36B
 - 37. M37B
 - 38. M38B
 - 39. M39B
 - 40. M40B
 - 41. M41B
 - 42. M42B
 - 43. M43B
 - 44. M44B
 - 45. M45B
 - 46. M46B
 - 47. M47B
 - 48. M48B
 - 49. M49B
 - 50. M50B
 - 51. M51B
 - 52. M52B
 - 53. M53B
 - 54. M54B
 - 55. M55B
 - 56. M56B
 - 57. M57B
 - 58. M58B
 - 59. M59B
 - 60. M60B
 - 61. M61B
 - 62. M62B
 - 63. M63B
 - 64. M64B
 - 65. M65B
 - 66. M66B
 - 67. M67B
 - 68. M68B
 - 69. M69B
 - 70. M70B
 - 71. M71B
 - 72. M72B
 - 73. M73B
 - 74. M74B
 - 75. M75B
 - 76. M76B
 - 77. M77B
 - 78. M78B
 - 79. M79B
 - 80. M80B
 - 81. M81B
 - 82. M82B
 - 83. M83B
 - 84. M84B
 - 85. M85B
 - 86. M86B
 - 87. M87B
 - 88. M88B
 - 89. M89B
 - 90. M90B
 - 91. M91B
 - 92. M92B
 - 93. M93B
 - 94. M94B
 - 95. M95B
 - 96. M96B
 - 97. M97B
 - 98. M98B
 - 99. M99B
 - 100. M100B
- INTEGRATED CIRCUIT REQUIREMENTS**
- M01B 3
 - M02B 1
 - M03B 3
 - M04B 3
 - M05B 3
 - M06B 3
 - M07B 3
 - M08B 3
 - M09B 3
 - M10B 3
 - M11B 3
 - M12B 3
 - M13B 3
 - M14B 3
 - M15B 3
 - M16B 3
 - M17B 3
 - M18B 3
 - M19B 3
 - M20B 3
 - M21B 3
 - M22B 3
 - M23B 3
 - M24B 3
 - M25B 3
 - M26B 3
 - M27B 3
 - M28B 3
 - M29B 3
 - M30B 3
 - M31B 3
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 - M92B 3
 - M93B 3
 - M94B 3
 - M95B 3
 - M96B 3
 - M97B 3
 - M98B 3
 - M99B 3
 - M100B 3
- RESISTOR REQUIREMENTS**
- R00X - ZERO OHMS 4 REQUIRED
 - R00Y - ZERO OHMS 4 REQUIRED
 - R00Z - ZERO OHMS 4 REQUIRED
 - R01X - 750 OHMS 1 REQUIRED
 - R01Y - 750 OHMS 1 REQUIRED
 - R01Z - 750 OHMS 1 REQUIRED
 - R02X - 1.5K OHMS 15 REQUIRED
 - R02Y - 1.5K OHMS 15 REQUIRED
 - R02Z - 1.5K OHMS 15 REQUIRED
 - R03X - 10K OHMS 15 REQUIRED
 - R03Y - 10K OHMS 15 REQUIRED
 - R03Z - 10K OHMS 15 REQUIRED
 - R04X - 22K OHMS 15 1/8 W 1 REQUIRED
 - R04Y - 22K OHMS 15 1/8 W 1 REQUIRED
 - R04Z - 22K OHMS 15 1/8 W 1 REQUIRED
 - R05X - 22K OHMS 15 1/8 W 24 REQUIRED
 - R05Y - 22K OHMS 15 1/8 W 24 REQUIRED
 - R05Z - 22K OHMS 15 1/8 W 24 REQUIRED
- DIODE IDENTIFICATION**
- D1 - 1N421 6.2 VOLT ZENER
 - D2 - 1N463 G.E.
 - D3 - 1N483 G.E.
- CAPACITOR IDENTIFICATION**
- C1 - .01 uF DISC + 15 V
 - C2 - .01 uF DISC + 15 V
 - C3 - .01 uF DISC + 15 V
 - C4 - .01 uF DISC + 15 V
- CONNECTOR REQUIREMENTS**
- AMP MOD FEMALE 79 REQUIRED
 - CIRCUIT BOARD PTV024-3

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY		
ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
SENSE AMPS AND DATA REGISTERS		
APPROVED	DATE	REVISION NO.
BY	FOR	DATE
		211.503
		PLL
		CHW
		10-6-71



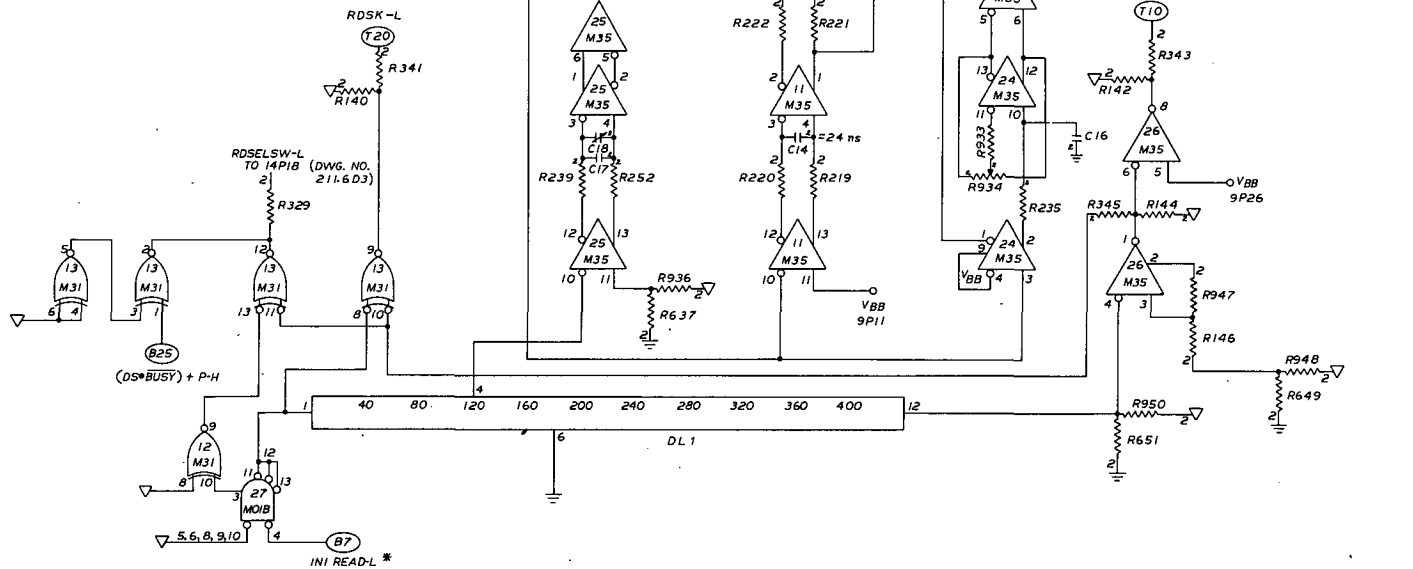
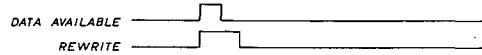
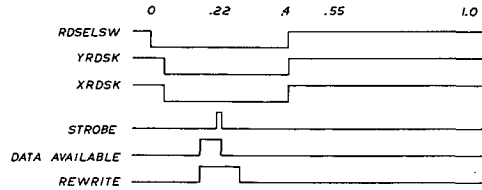
PARTS LIST INCLUDED IN LISTING
ON DWG. NO. 211.6D5
READ TIMING AND CONTROL

CHANGED BY	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
X CURRENT DRIVERS		
APPROVED BY	DATE	REVISION NO.
HCLADR	211.6D3	
PLL		
DATE		
10-12-71		



PARTS LIST INCLUDED IN LISTING ON DWG. NO. 211.6D5 (READ TIMING AND CONTROL)

CHANG. NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE Y CURRENT DRIVERS		
APPROVED	DATE	ISSUE NO.
BY: [Signature]	DATE: 10-11-71	211.6D4
DESIGNED BY: [Signature]	DATE:	
CHECKED BY: [Signature]	DATE:	



PARTS LIST FOR DRAWINGS 211.601, 211.604, 211.605

INTEGRATED CIRCUIT IDENTIFICATION

1. SN7440	10. SN7440	19. SN75324A
2. SN7440	11. M35	20. SN75324A
3. M35	12. M31	21. SN75324A
4. SN7440	13. M31	22. SN75324A
5. SN7440	14. SN75324A	23. M31B
6. SN7440	15. SN75324A	24. M35
7. SN7440	16. SN75324A	25. M35
8. M35	17. SN75324A	26. M35
9. SN7440	18. M35	27. M31B

INTEGRATED CIRCUIT REQUIREMENTS

M31B 7 EA.
M31 7 EA.
M35 4 EA.
M39 3 EA.
SN7440 8 EA.
SN75324A 8 EA.

RESISTOR REQUIREMENTS

R11X = 1500 OHMS 7 EA.
R22X = 150 OHMS 7 EA.
R23X = 121 OHMS 7 EA.
R53X = 130 OHMS 3 EA.
R502 thru R515 = 47K OHMS
R517, R518 = 29.2 OHMS 3W
R53C, R546, R550 = 430 OHMS
R553 = 250 OHMS
R547 = 2.00K OHMS
R554 = 2.00K OHM TRIMPOT

DIODE REQUIREMENTS

D1 thru D16 = MMD-694 (CSL DIODE)

CONNECTOR REQUIREMENTS

AMP MODU FEMALE NO. 65663-4 94 EA.

PRINTED CIRCUIT BOARD

PTV6104-4

CAPACITOR REQUIREMENTS

C1 thru C4, C19 = .01 uF 15 V 5 EA.
C5 thru C12 = .01 uF 25V
C13 = 4.7 uF ELECTROLYTIC
C15 = 30 pf
C16 = 150 pf
C18 = 45-50 pf VARIABLE
C14 = 27 pf
C17 (CM11)

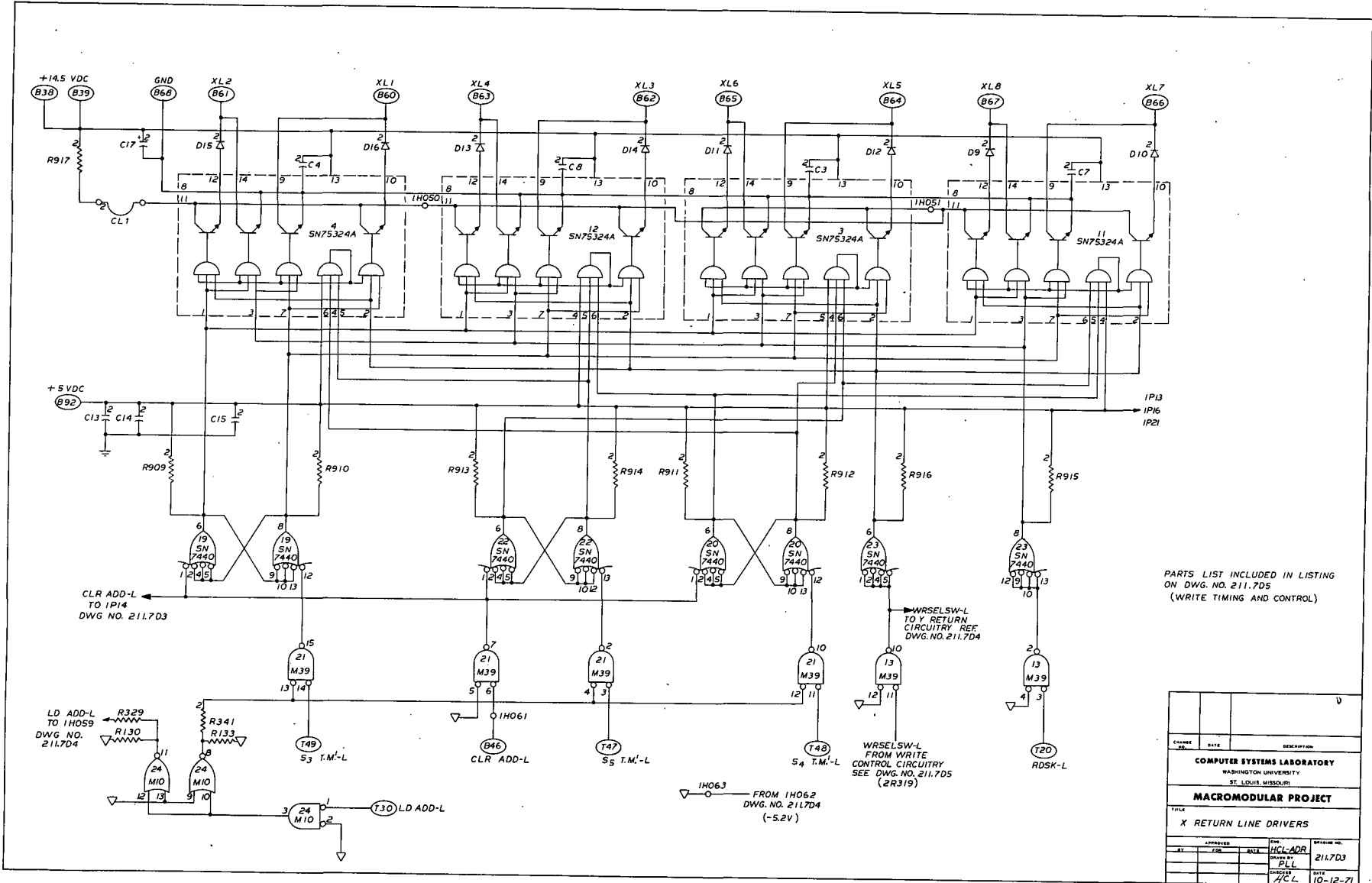
CURRENT LOOPS

CL1, CL2, NO.22 STRANDED WIRE 2 IN. LONG
TEFLON INSULATED

DELAY LINE

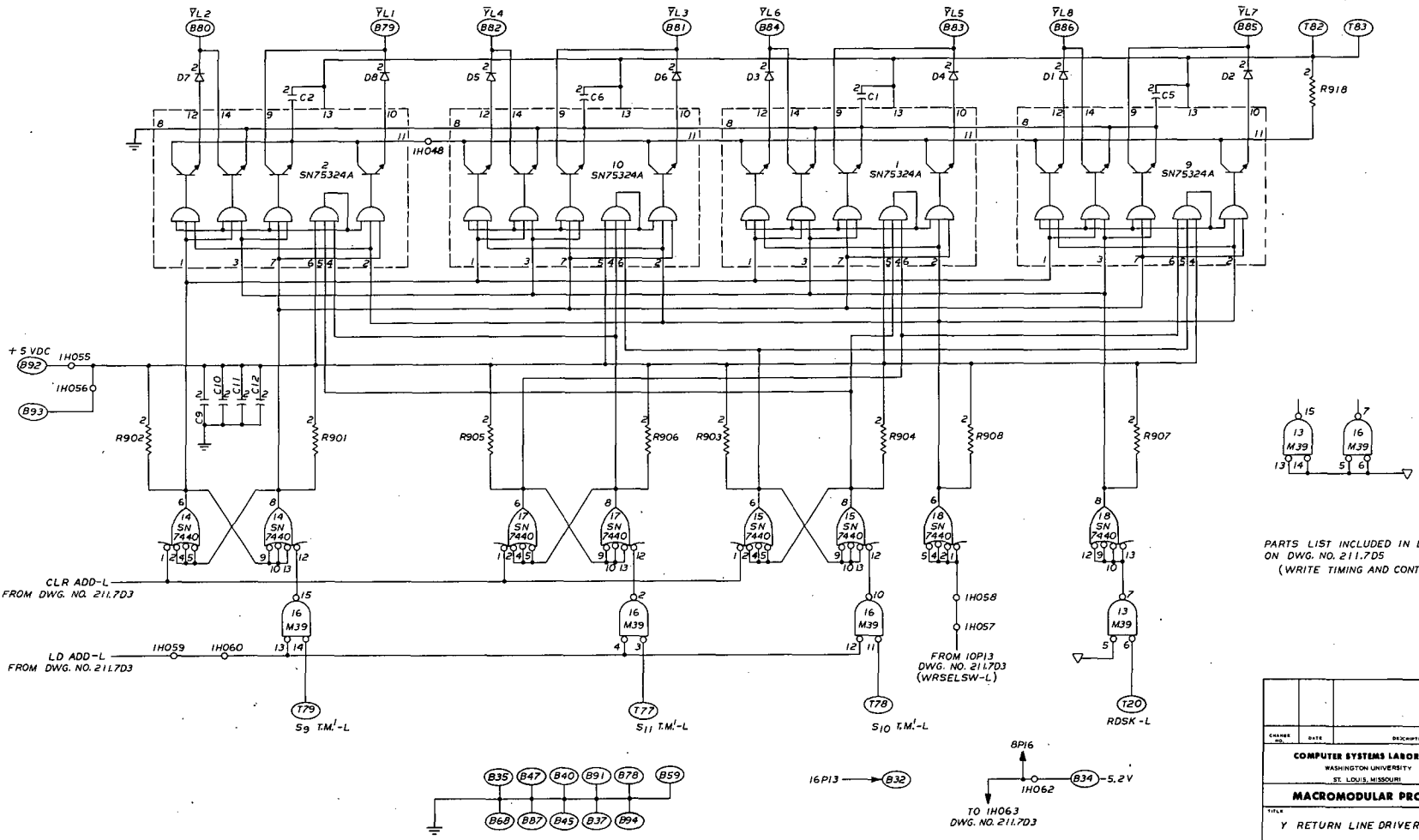
DL1 = PE-7118

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
READ TIMING AND CONTROL		
APPROVED	DATE	DRAWING NO.
BY	DATE	211.605
CHECKED	DATE	3-21-72



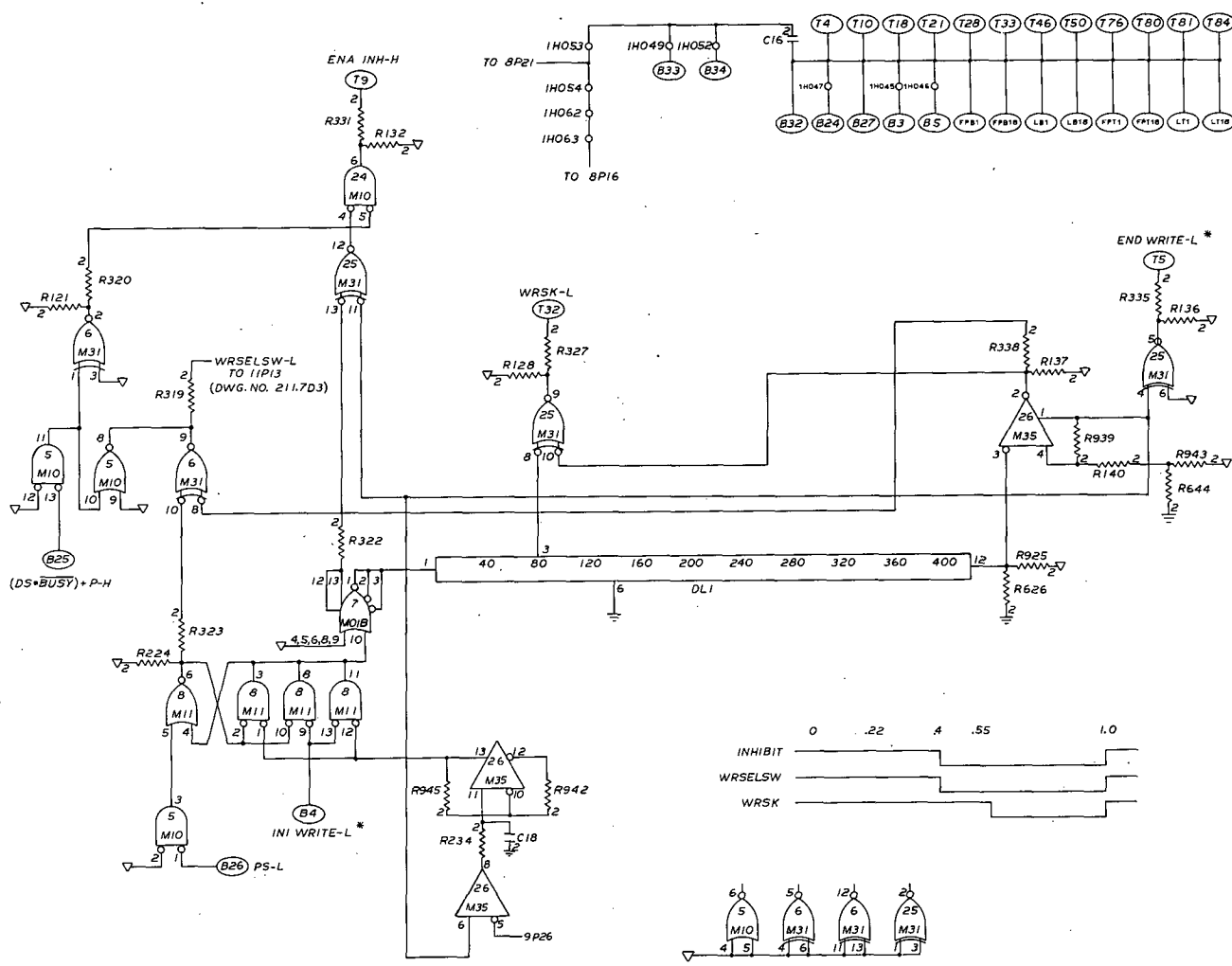
PARTS LIST INCLUDED IN LISTING ON DWG. NO. 211.705 (WRITE TIMING AND CONTROL)

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE X RETURN LINE DRIVERS		
APPROVED	DESIGNED BY	DRAWING NO.
		211.703
		DATE
		10-12-71



PARTS LIST INCLUDED IN LISTING
ON DWG. NO. 211.7D5
(WRITE TIMING AND CONTROL)

CHG	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
Y RETURN LINE DRIVERS		
APPROVED	DATE	DRAWING NO.
HCL-ADR		211.7D4
PL		
CHECKED	DATE	
HCL	10-11-71	



PARTS LIST FOR DRAWINGS
211.703, 211.704, 211.705

INTEGRATED CIRCUIT IDENTIFICATION

1. SN75204A	10. SN75234A	19. SN7440
2. SN75244A	11. SN75244A	20. SN7440
3. SN75244A	12. SN75244A	21. M39
4. SN75244A	13. M39	22. SN7440
5. M10	14. SN7440	23. SN7440
6. M31	15. SN7440	24. M10
7. M31B	16. M39	25. M31
8. M11	17. SN7440	26. M35
9. SN75244A	18. SN7440	

INTEGRATED CIRCUIT REQUIREMENTS

M31B	3 EA.
M10	2 EA.
M11	1 EA.
M31	2 EA.
M35	1 EA.
M39	3 EA.
SN7440	8 EA.
SN75244A	6 EA.

DIODE REQUIREMENTS

D1 thru D16 - M10-624 (CSL DIODE)	16 EA.
-----------------------------------	--------

CAPACITOR REQUIREMENTS

C1 thru C8 - .01 uF 25V	
C9 thru C16 - .01 uF 15V	
C17 - 4.7 uF ELECTROLYTIC	
C18 - 200 pF	

CONNECTOR REQUIREMENTS

AMP MODU FEMALE NO 85863-4	75 EA.
----------------------------	--------

RESISTOR IDENTIFICATION

R1X - 1500 OHMS	8 EA.
R2X - 750 OHMS	2 EA.
R3X - 121 OHMS	10 EA.
R4X - 130 OHMS	2 EA.
R51 thru R516 - 470 OHMS	16 EA.
R517, R518 - 282 OHMS	
R519, R543 - 430 OHMS	
R520 - 2000 OHMS	
R542 - 1000 OHMS	
R545 - 3000 OHMS	

CURRENT LOOP

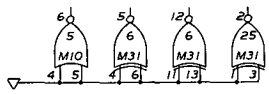
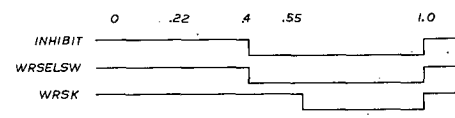
DL1 - NO. 22 STRANDED WIRE 2 IN LONG	
TEFLON INSULATED	

DELAY LINE

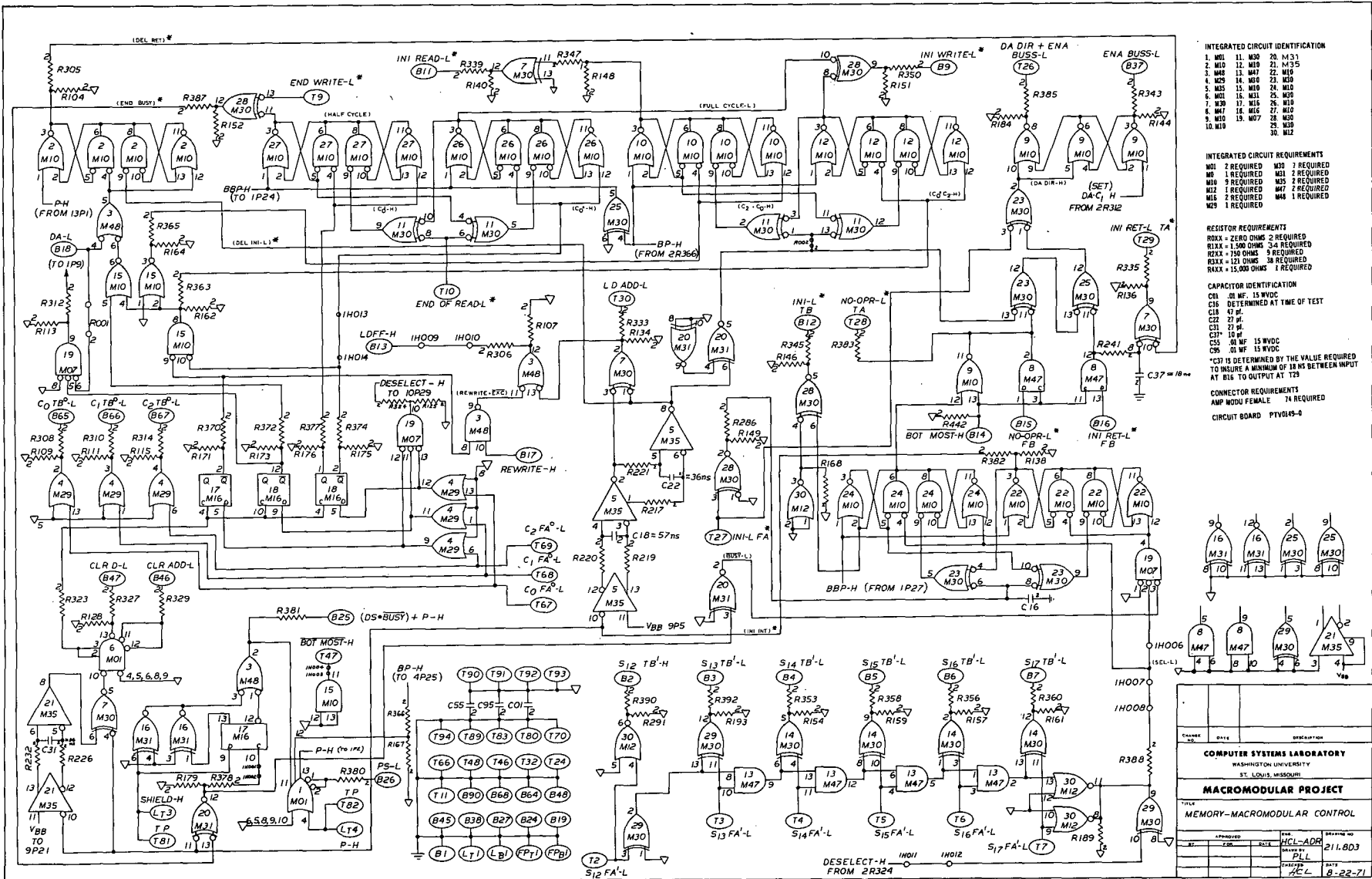
DL1 - PFT118	
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PRINTED CIRCUIT BOARD

P1V100-3	
----------	--



CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE WRITE TIMING AND CONTROL		
APPROVED	BY	DATE
	HCL-ADR	211.705
	PLI	
	DATE	5-3-72



- INTEGRATED CIRCUIT IDENTIFICATION**
- 1. M10 11. M30 20. M31
 - 2. M10 12. M19 21. M35
 - 3. M48 13. M47 22. M19
 - 4. M29 14. M10 23. M30
 - 5. M35 15. M10 24. M10
 - 6. M10 16. M31 25. M10
 - 7. M29 17. M16 26. M10
 - 8. M47 18. M16 27. M10
 - 9. M10 19. M07 28. M30
 - 10. M19 29. M30
 - 30. M12

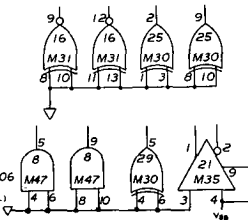
- INTEGRATED CIRCUIT REQUIREMENTS**
- M01 2 REQUIRED M30 3 REQUIRED
 - M02 1 REQUIRED M31 2 REQUIRED
 - M03 9 REQUIRED M35 2 REQUIRED
 - M04 1 REQUIRED M47 2 REQUIRED
 - M05 2 REQUIRED M48 1 REQUIRED
 - M06 1 REQUIRED

- RESISTOR REQUIREMENTS**
- R0XX = 280 OHMS 2 REQUIRED
 - R1XX = 1500 OHMS 34 REQUIRED
 - R2XX = 750 OHMS 9 REQUIRED
 - R3XX = 121 OHMS 38 REQUIRED
 - R4XX = 15,000 OHMS 1 REQUIRED

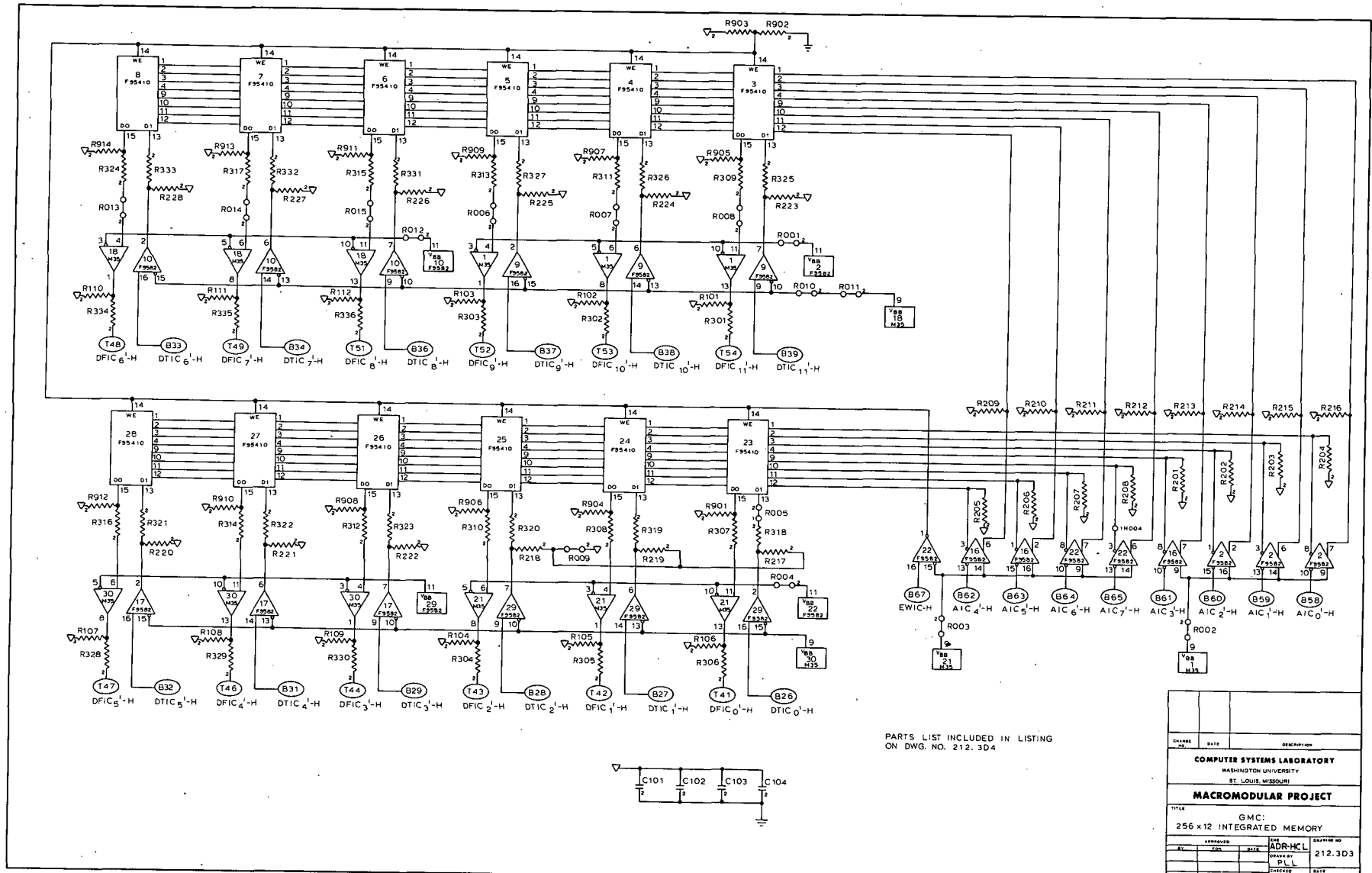
- CAPACITOR IDENTIFICATION**
- C01 10 MF 15 WVDC
 - C15 DETERMINED AT TIME OF TEST
 - C18 47 pF
 - C22 22 pF
 - C31 22 pF
 - C37 10 pF
 - C55 10 MF 15 WVDC
 - C95 10 MF 15 WVDC

*C37 IS DETERMINED BY THE VALUE REQUIRED TO INSURE A MINIMUM OF 18 NS BETWEEN INPUT AT B16 TO OUTPUT AT T28

- CONNECTOR REQUIREMENTS**
- AMP MODU FEMALE 74 REQUIRED
 - CIRCUIT BOARD PTV049-4

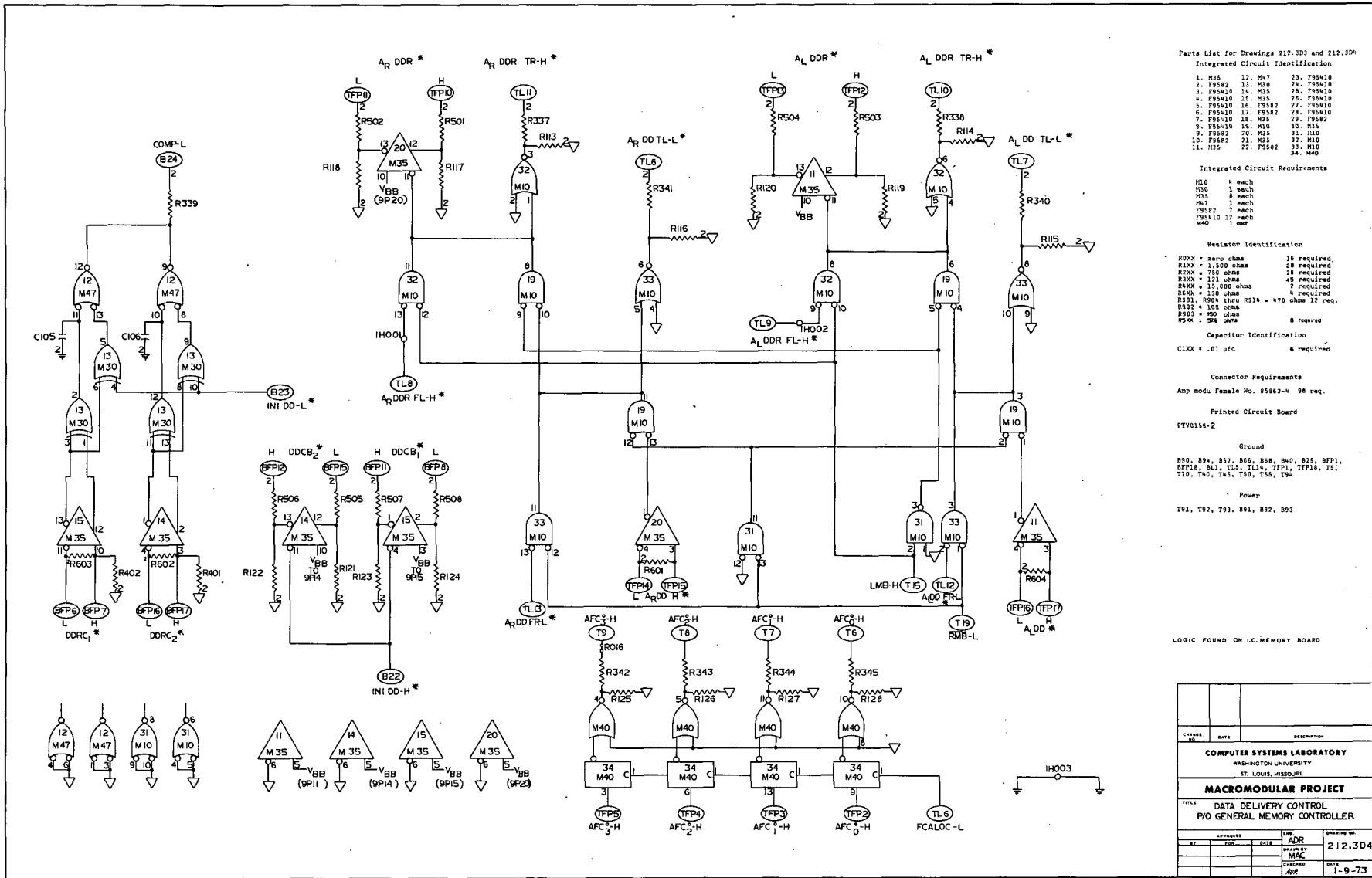


CHANG NO	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
MISSOURI UNIVERSITY		
ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
MEMORY-MACROMODULAR CONTROL		
APPROVED	DATE	DRAWING NO
		HCL-ADR
		PILL
		211.803
		DATE
		8-22-71



PARTS LIST INCLUDED IN LISTING ON DWG. NO. 212.3D4

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE GMC: 256 x 12 INTEGRATED MEMORY		
APPROVED	DATE	DESIGNED BY
DR	ADR-HCL	212.3D3
DR	PL	
DR	DATE	
DR	1-8-72	



Parts List for Drawings 212.3D3 and 212.3D4
Integrated Circuit Identification

- | | | |
|-----------|-----------|------------|
| 1. M35 | 12. M47 | 23. F95410 |
| 2. F9582 | 13. M10 | 24. F95410 |
| 3. F95410 | 14. M35 | 25. F95410 |
| 4. F95410 | 15. M35 | 26. F95410 |
| 5. F95410 | 16. F9582 | 27. F95410 |
| 6. F95410 | 17. F9582 | 28. F95410 |
| 7. F95410 | 18. M35 | 29. F9582 |
| 8. F95410 | 19. M10 | 30. M35 |
| 9. F9582 | 20. M35 | 31. M10 |
| 10. F9582 | 21. M35 | 32. M10 |
| 11. M35 | 22. F9582 | 33. M10 |
| | | 34. M40 |

- Integrated Circuit Requirements
- | | |
|--------|---------|
| M10 | 4 each |
| M35 | 1 each |
| M40 | 8 each |
| M10 | 1 each |
| F9582 | 7 each |
| F95410 | 17 each |
| M40 | 1 each |

- Resistor Identification
- | | | |
|----------------------|---------------------|--------------|
| R30X | = zero ohms | 16 required. |
| R1XX | = 1,500 ohms | 28 required. |
| R2XX | = 750 ohms | 24 required. |
| R3XX | = 121 ohms | 45 required. |
| R4XX | = 15,000 ohms | 7 required. |
| R5XX | = 120 ohms | 6 required. |
| R801, R900 thru R914 | = 470 ohms 1/2 req. | |
| R802 | = 100 ohms | |
| R903 | = 500 ohms | |
| R904 | = 516 ohms | 8 required. |

- Capacitor Identification
- | | | |
|------|-----------|-------------|
| C1XX | = .01 µfd | 6 required. |
|------|-----------|-------------|

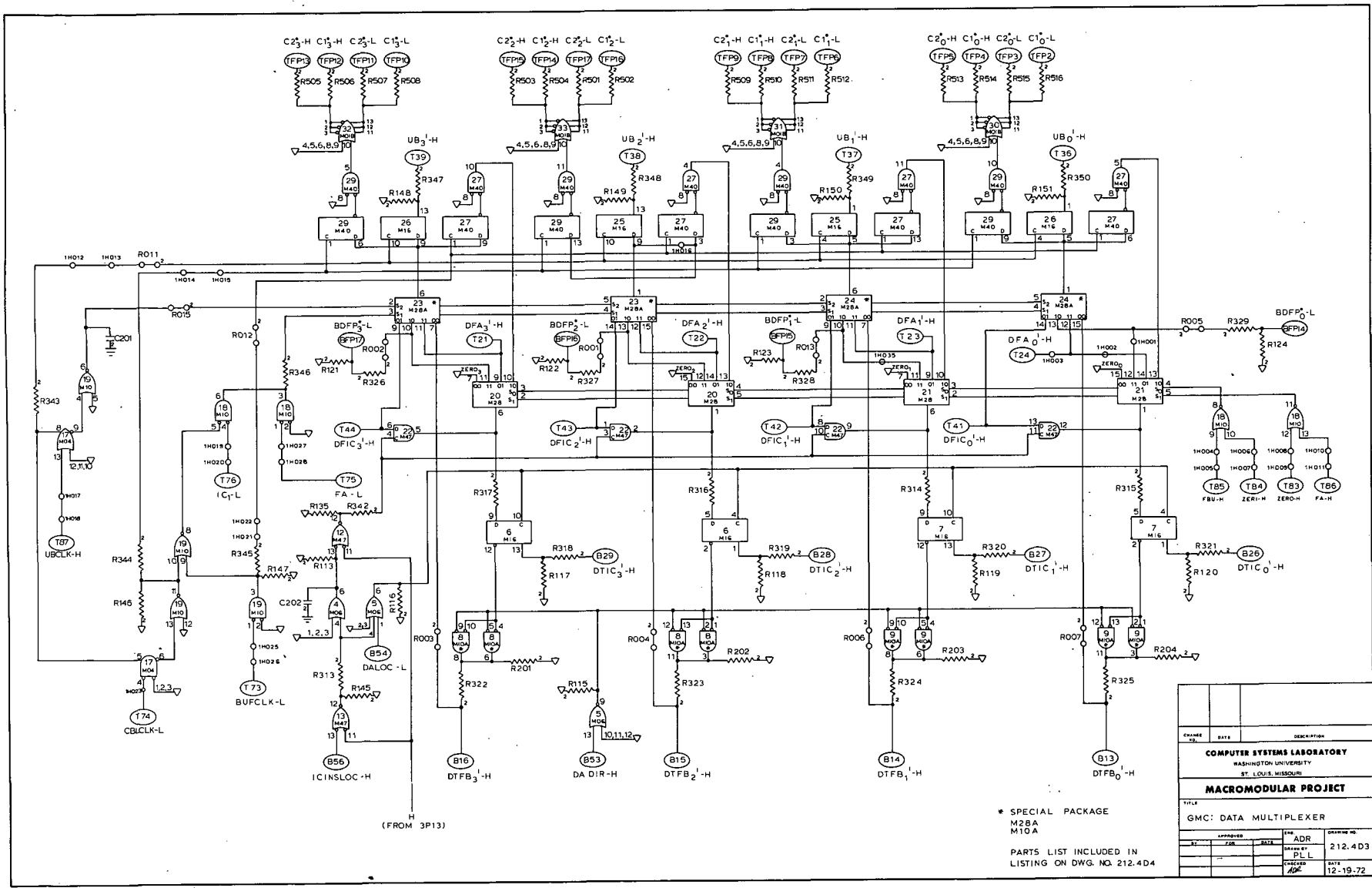
- Connector Requirements
- Asp mod. Female No. 85863-4 98 req.
- Printed Circuit Board
- PTV0156-2

- Ground
- R50, R59, R57, R56, R68, R40, R25, RFP1, RFP14, R13, T55, TL5, TL4, TFP1, TFP18, T5, T10, T40, T45, T50, T55, T94

- Power
- T91, T92, T93, R91, R92, R93

LOGIC FOUND ON I.C. MEMORY BOARD

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE DATA DELIVERY CONTROL P/O GENERAL MEMORY CONTROLLER		
REV.	DATE	DRAWING NO.
1	1-9-73	212.3D4
DRWEN	MAC	
CHECKED	DATE	
APP.		



(FROM 3P13)

* SPECIAL PACKAGE
M2BA
M10A
PARTS LIST INCLUDED IN
LISTING ON DWG. NO. 212.4D4

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
GMC: DATA MULTIPLEXER		
APPROVED	DATE	DRAWING NO.
BY	DATE	212.4D3
BY	DATE	
BY	DATE	
BY	DATE	
BY	DATE	

Integrated Circuit Identification

- 1. M16 12. M47 23. M28A
- 2. M16 13. M47 24. M5A
- 3. M16 14. M28 25. M16
- 4. M06B 15. M28 26. M16
- 5. M06 16. M28 27. M40
- 6. M16 17. M04 28. M20
- 7. M16 18. M10 29. M40
- 8. M10A 19. M10 30. M20B
- 9. M10A 20. M28 31. M20B
- 10. M20 21. M28 32. M20B
- 11. M20 22. M47 33. M20B

Integrated Circuit Requirements

- M20B 4 ea. M20 2 ea.
- M04 1 ea. M28 3 ea.
- M06 1 ea. M28A 2 ea.
- M06B 1 ea. M20 1 ea.
- M10 2 ea. M40 2 ea.
- M16A 2 ea. M47 3 ea.
- M16 7 ea.

Resistor Requirements

- R0XX = zero ohms 75 required
- R1XX = 1,500 ohms 50 required
- R2XX = 750 ohms 54 required
- R3XX = 121 ohms 54 required
- R4XX = 15,000 ohms 6 required
- R5XX = 27k ohms 6 required
- R6XX = 130 ohms 6 required

Diode Requirements

- D1XX = GE IN3604 2 required

Capacitor Requirements

- C1XX = .01 ufd 4
- C201 = NOT REQUIRED
- C202 = 62 pf

Connector Requirements

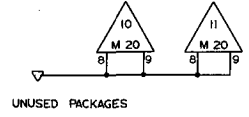
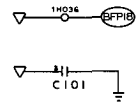
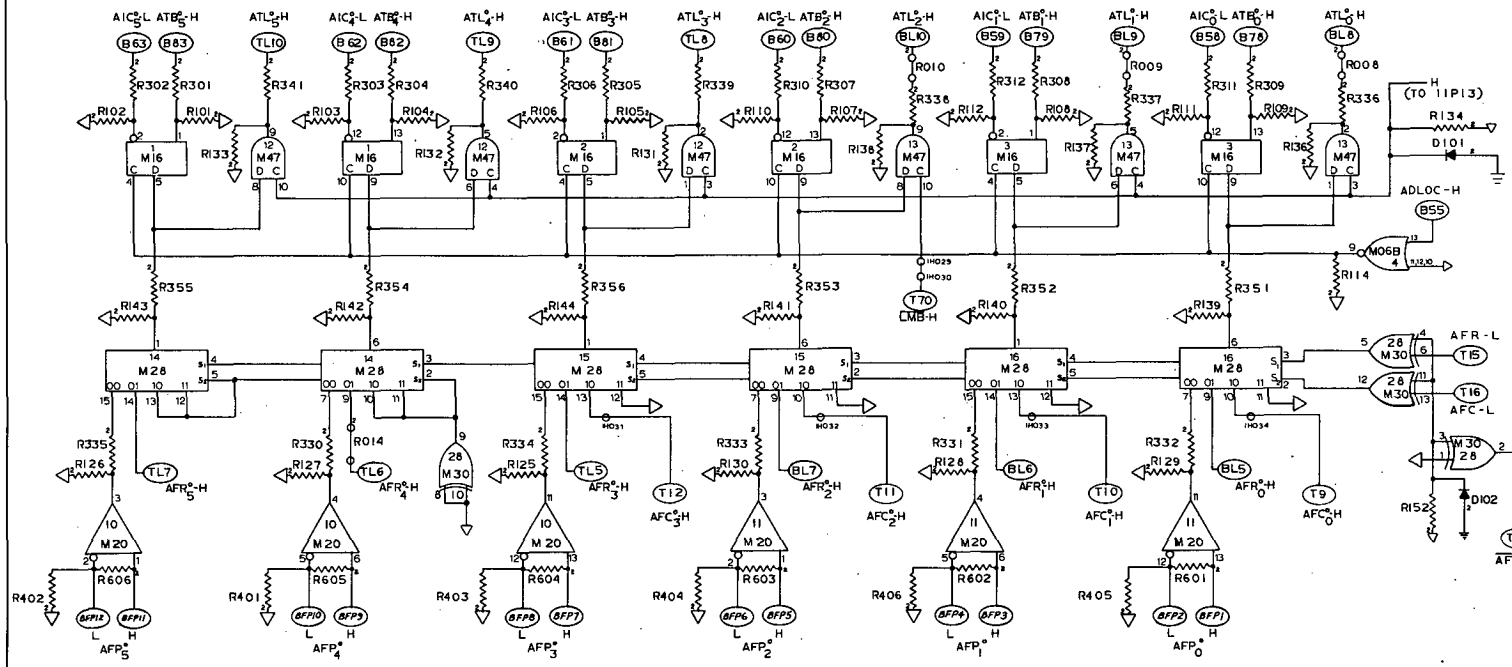
- Amp Mod Female #85603-4 135 req.

Printed Circuit Board PTV0162-Z

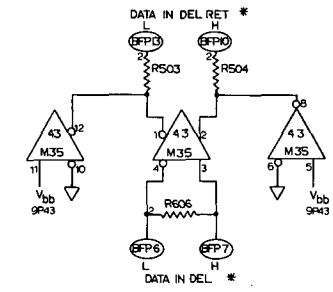
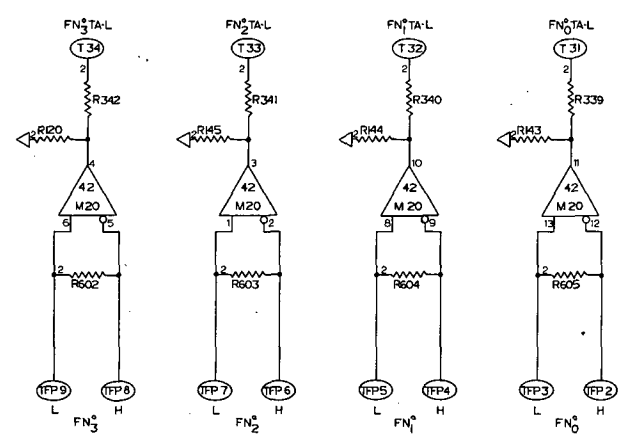
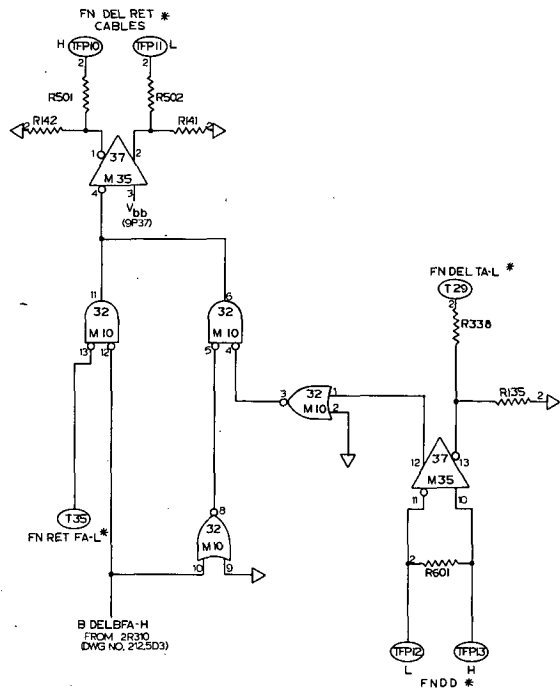
Ground: 894, 899, 884, 877, 857, 852, 830, 825, 812, 8P219, 8L1, 8L4, 8L11, T920, T918, T11, T14, T131, 78, F13, T17, T20, T22, T35, T40, T68, T77, T90, T94

Power: 891, 892, 893, T91, T92, T93

LOGIC FOUND ON 4 BIT DATA BOARD (PTV0162-0)



CHANGE	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE GMC ADDRESS MULTIPLEXER		
APPROVED	DATE	DESIGNED BY
		MAC
CHECKED	DATE	DRAWN BY
ACB	12-7-72	

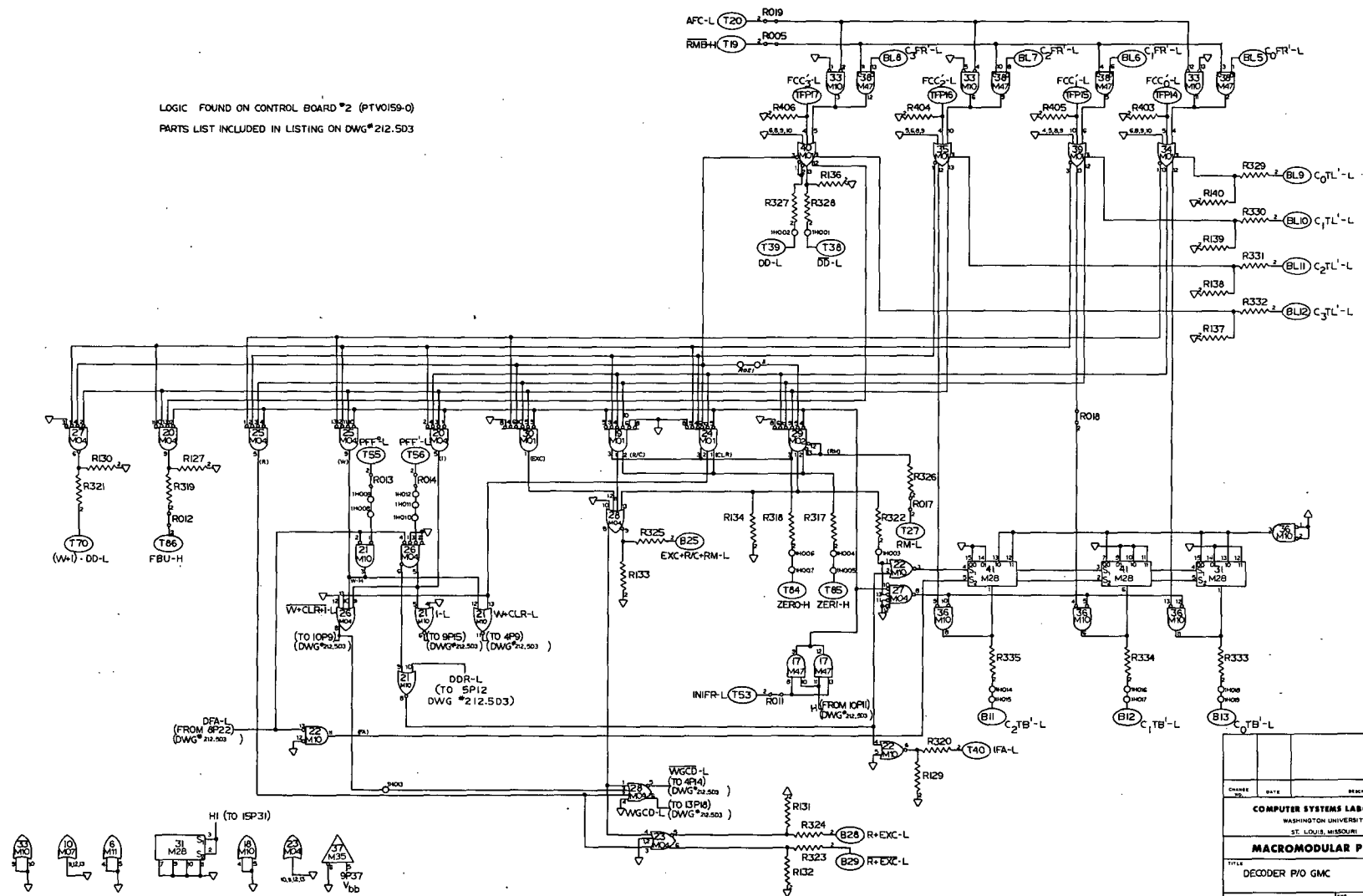


PARTS LIST INCLUDED IN LISTING ON DWG NO 212.503

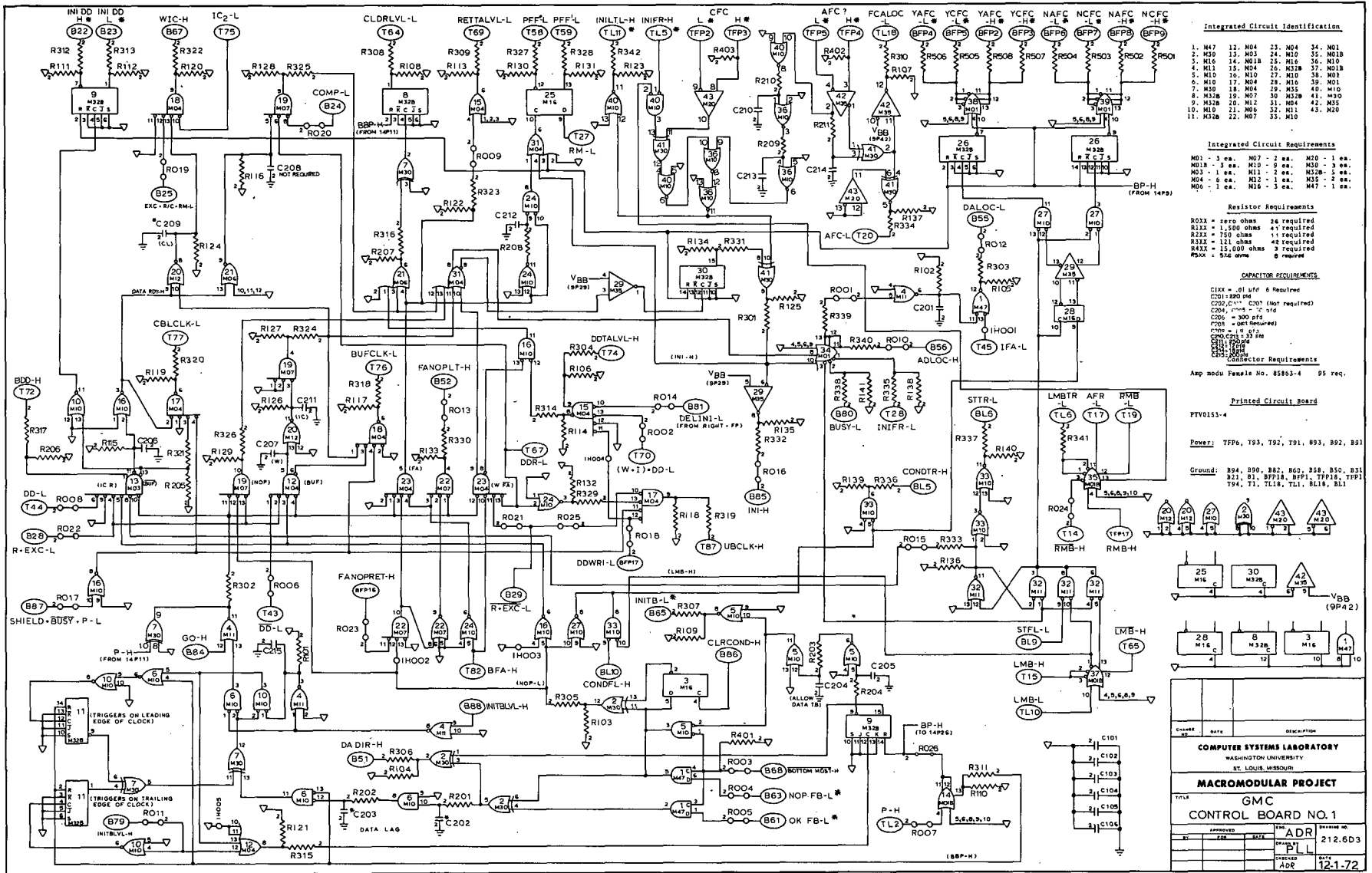
LOGIC FOUND ON CONTROL BOARD NO. 2 (PTV0159-0)

CHG	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE .GMC: MISCELLANEOUS DATA DELIVERY		
APPROVED	BY	DRAWING NO.
ADR	MAC	212.504
CHECKED	DATE	
ADR	12-7-72	

LOGIC FOUND ON CONTROL BOARD *2 (PTVO159-0)
 PARTS LIST INCLUDED IN LISTING ON DWG*212.503



CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE DECODER P/O GMC		
APPROVED BY	DATE	DRAWN BY
		ADR
CHECKED BY	DATE	212.505
		1-10-73



Integrated Circuit Identification

- 1. M47 12. M04 23. M04 34. M01
- 2. M30 13. M03 24. M10 35. M01B
- 3. M16 14. M10 25. M06 36. M10
- 4. M11 15. M04 26. M32B 37. M01B
- 5. M10 16. M10 27. M10 38. M01
- 6. M10 17. M04 28. M10 39. M01
- 7. M10 18. M04 29. M35 40. M10
- 8. M32B 19. M07 30. M32B 41. M30
- 9. M32B 20. M12 31. M04 42. M35
- 10. M10 21. M06 32. M16 43. M20
- 11. M32B 22. M07 33. M10

Integrated Circuit Requirements

- M01 - 5 ea. M07 - 2 ea. M10 - 1 ea.
- M01B - 3 ea. M10 - 9 ea. M30 - 3 ea.
- M03 - 1 ea. M11 - 2 ea. M32B - 5 ea.
- M04 - 6 ea. M12 - 1 ea. M35 - 2 ea.
- M06 - 3 ea. M16 - 3 ea. M47 - 1 ea.

Resistor Requirements

- R03X - zero ohms 26 required
- R13X - 1,500 ohms 41 required
- R22X - 750 ohms 11 required
- R33X - 121 ohms 42 required
- R43X - 15,000 ohms 9 required
- R45 - 550 ohms 9 required

CAPACITOR REQUIREMENTS

- C10X - .01 ufd 6 Required
- C201 - 200 pf 4 Required
- C202, C203, C207 (not required)
- C204, C205 - .1 ufd 2 Required
- C206 - 300 pf 3 Required
- C208 - (not required)
- C209 - .1 ufd 1 Required
- C210 - .1 ufd 2 Required
- C211 - .1 ufd 2 Required
- C212 - .1 ufd 2 Required
- C213 - .1 ufd 2 Required
- C214 - .1 ufd 2 Required

Connector Requirements

Amp modu Female No. 85603-A 95 req.

Printed Circuit Board

PTV0153-4

Power: TFP6, T93, T92, T91, R93, R92, R91

Ground: R94, R90, R82, R80, R58, R50, R31, R32, R31, BFF14, BFF1, TFP13, TFP1, T94, T1, T18, T1, B11, B1, 1

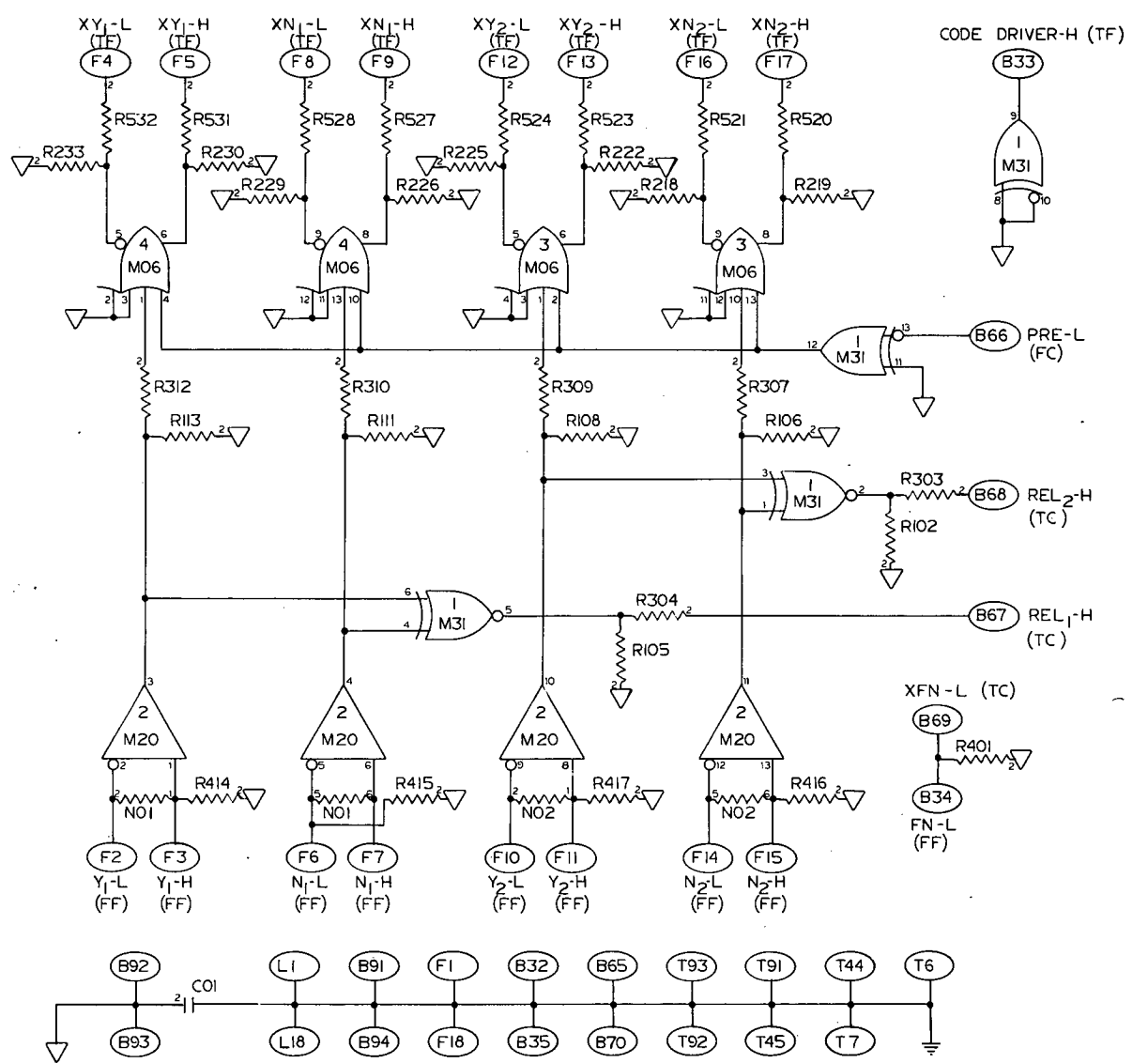
Created	Date	Description

COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

GMC
CONTROL BOARD NO. 1

APPROVED		DATE	REVISION NO.



INTEGRATED CIRCUIT IDENTIFICATION

- 1. M31
- 2. M20
- 3. M06
- 4. M06

RESISTOR IDENTIFICATION

- R1XX = 1500 ohms 8 required
- R2XX = 750 ohms 8 required
- R3XX = 121 ohms 6 required
- R4XX = 15000 ohms 5 required
- R5XX = 57.0 ohms 8 required
- R01 = LTN-2
- R02 = LTN-2

CAPACITOR IDENTIFICATION

CO1 = .001 ufd Ceramic Disc

CONNECTOR REQUIREMENTS

Amp Modu Female No. 85863-4 41 req.

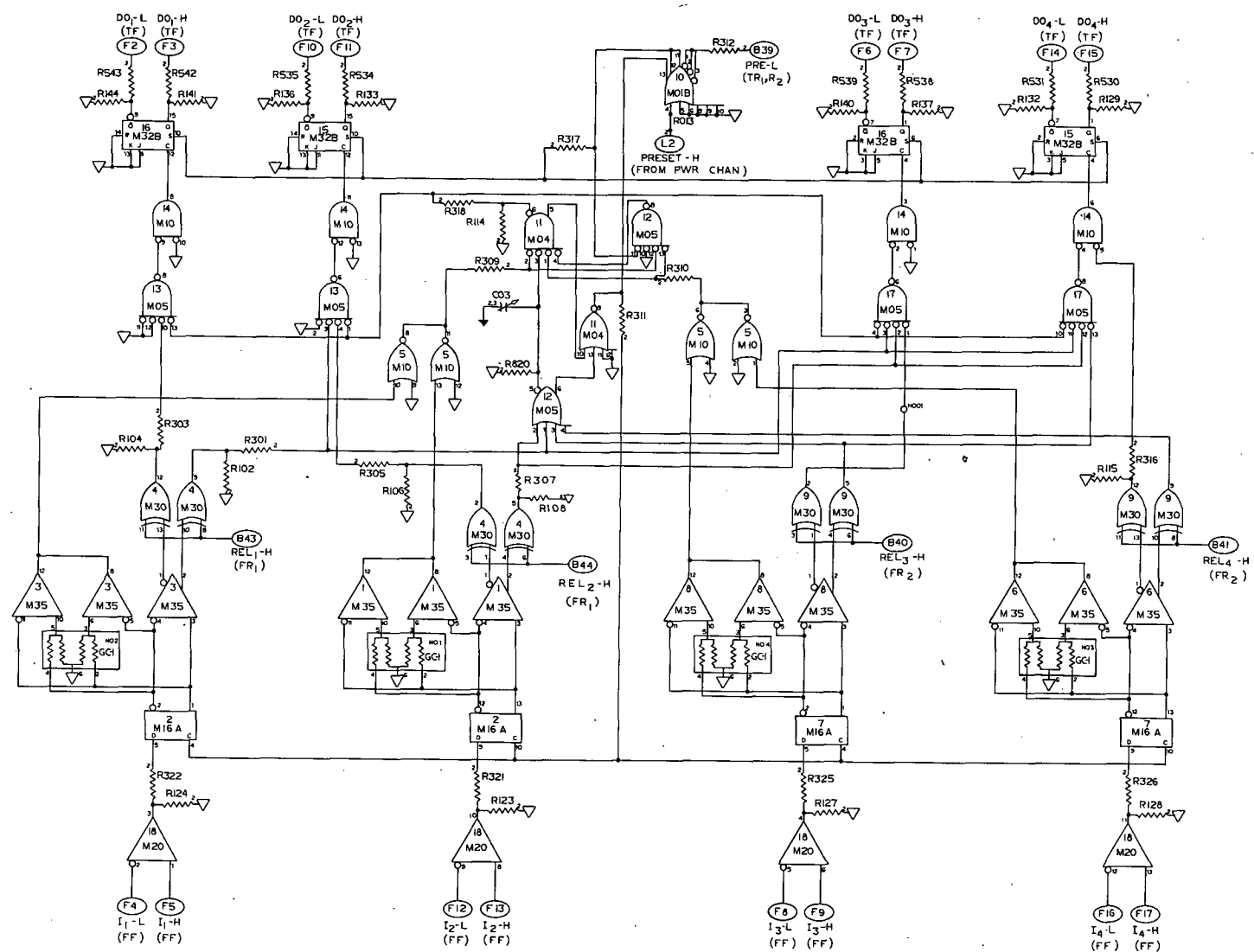
PRINTED CIRCUIT BOARD

PTV0141-1

COMPUTER CHECKED 2-28-73 MLP

NOTE: FN, XFN, AND CODE DRIVER HAVE NO FUNCTION IN THE PRESENT INTERLOCK MACRO-MODULE.

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE INTERLOCK RETURN BOARD		
APPROVED	ENG	DRAWING NO.
BY	FOR	DATE
	MLP	
	MAC	215.303
CHECKED	DATE	
MLP	1-11-73	



INTEGRATED CIRCUIT IDENTIFICATION

- 1. M01B
- 2. M16A
- 3. M35
- 4. M20
- 5. M10
- 6. M38
- 7. M16A
- 8. M35
- 9. M10
- 10. M01B
- 11. M05
- 12. M05
- 13. M05
- 14. M10
- 15. M32B
- 16. M32B
- 17. M05
- 18. M20

INTEGRATED CIRCUIT REQUIREMENTS

- M01B 1 each
- M16A 2 each
- M35 1 each
- M10 1 each
- M05 3 each
- M32B 2 each
- M10 2 each
- M35 4 each

RESISTOR REQUIREMENTS

- R0XX = Zero ohms 1 required
- R1XX = 1500 ohms 19 required
- R2XX = 60 ohms 1 required
- R3XX = 121 ohms 14 required
- R500 = 57.6 ohms 4 required
- G01 = 100 ohms 4 required
- R35 omitted

CAPACITOR REQUIREMENTS

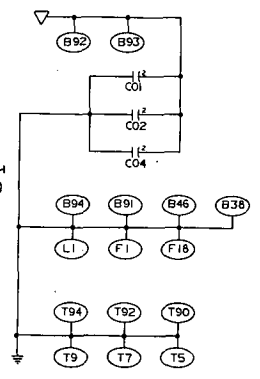
- C01, C02, C03 = .01uF Ceramic Disc
- C04 = Johnson 5334 (Variable)

CONNECTOR REQUIREMENTS

- Asp Modu Female No. 65863-37 req.

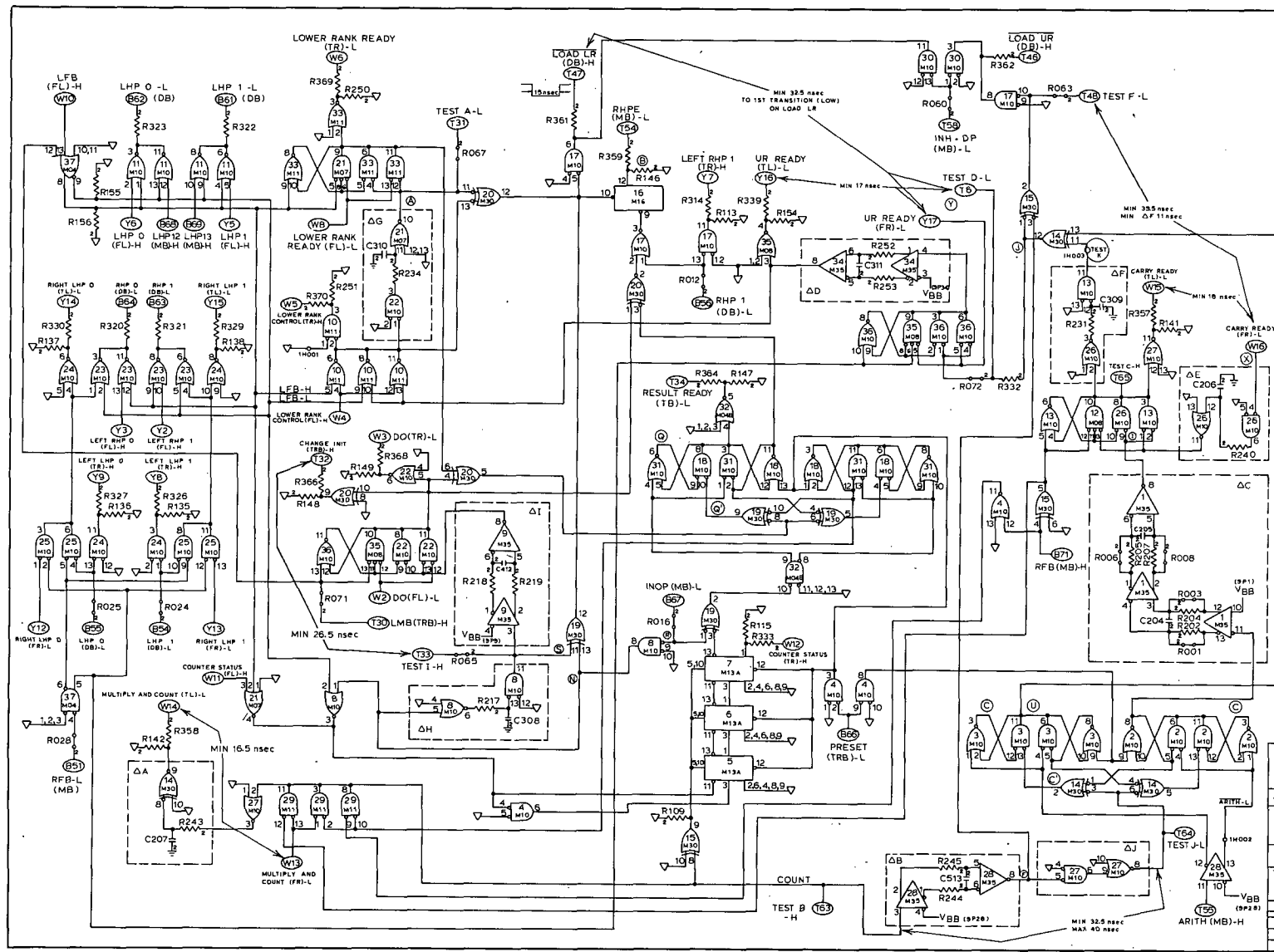
PRINTED CIRCUIT BOARD

PTV6163-1



COMPUTER CHECKED 2-28-73 MAF

DATE	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY		
ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE		
INTERLOCK CONTROL BOARD		
APPROVED	DATE	DESIGNER
		M.L.P.
DESIGNED	DATE	DRAWN BY
		MAC
CHECKED	DATE	
		PROJECT NO.
		215.403
		DATE
		1-5-73



INTEGRATED CIRCUIT IDENTIFICATION

1-M35	13-M10	25-M10
2-M10	14-M30	26-M10
3-M10	15-M30	27-M10
4-M10	16-M16	28-M35
5-M13A	17-M10	29-M11
6-M13A	18-M10	30-M10
7-M13A	19-M30	31-M10
8-M10	20-M30	32-M08
9-M35	21-M07	33-M11
10-M11	22-M10	34-M35
11-M10	23-M10	35-M05
12-M08	24-M10	36-M10
		37-M08

INTEGRATED CIRCUIT REQUIREMENTS

M04B	1 EA.	M11	3 EA.
M04A	1 EA.	M33A	1 EA.
M07	1 EA.	M16	1 EA.
M08	7 EA.	M20	1 EA.
M10	17 EA.	M35	1 EA.

RESISTOR IDENTIFICATION

R03X = ZERO OHMS	15 EA.
R23X = 150 OHMS	16 EA.
R23X = 150 OHMS	17 EA.
R33X = 121 OHMS	22 EA.

CAPACITOR IDENTIFICATION

C1XX = 10,000pF	3 EA.
C230X = OMIT	4 EA.
C3XX = 10pF	4 EA.
C412 = 15pF	1 EA.
C513 = 27pF	1 EA.

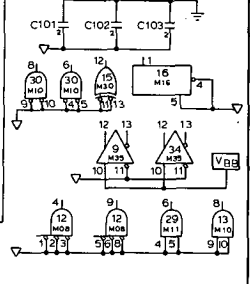
CONNECTOR REQUIREMENTS

AMP MODU FEMALE NO. 85863-4 8/ REQ.

GROUND: T94, T90, T66, T33, T40, T35, T29, T1, B94, B96, B72, B68, B57, B1, W1, W16, Y1, Y18, Z1, Z18

POWER: T93, T32, T51, B58, B92, B91

PRINTED CIRCUIT BOARD
PTV0147-3



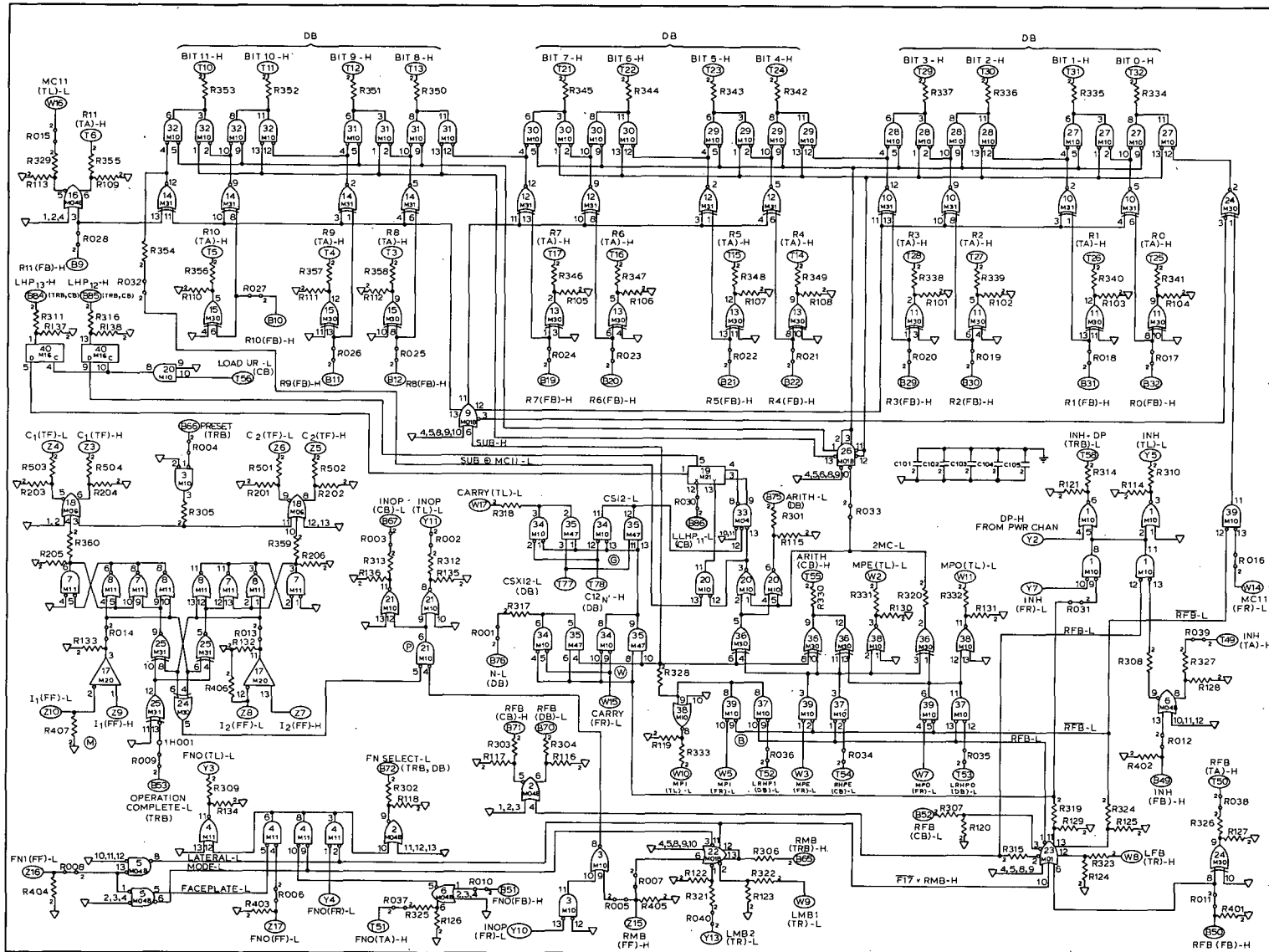
CHANGE	DATE	DESCRIPTION

COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE: MULTIPLY MODULE LOCAL CONTROL BOARD

APPROVED:	DATE:	DRAWN BY:	DATE:
MAW	PL		216.3D3
CHECKED:	DATE:		6-9-72



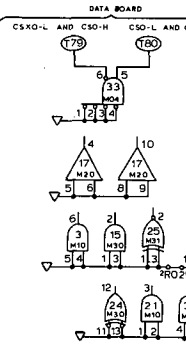
- INTEGRATED CIRCUIT IDENTIFICATION**
- 1. M10 31. M30 21. M10 31. M10
 - 2. M04B 12. M11 22. M10B 32. M10
 - 3. M10 13. M10 23. M31 33. M04
 - 4. M11 14. M31 24. M30 34. M10
 - 5. M04B 15. M30 25. M31 35. M17
 - 6. M04B 16. M04B 26. M04B 36. M30
 - 7. M11 37. M10 27. M10 37. M10
 - 8. M11 16. M04 28. M10 38. M10
 - 9. M04B 15. M17 29. M10 39. M10
 - 10. M11 20. M10 30. M10 40. M16

- INTEGRATED CIRCUIT REQUIREMENTS**
- M10 1 REQUIRED M16 1 REQUIRED
 - M10B 3 REQUIRED M20 1 REQUIRED
 - M04B 4 REQUIRED M30 5 REQUIRED
 - M06 1 REQUIRED M31 4 REQUIRED
 - M10 14 REQUIRED M37 1 REQUIRED
 - M11 3 REQUIRED M40 1 REQ.
 - M21 1 REQ.

- RESISTOR IDENTIFICATION**
- R1XX = 200 OHMS 40 REQUIRED
 - R1XX = 1,500 OHMS 25 REQUIRED
 - R2XX = 750 OHMS 6 REQUIRED
 - R3XX = 120 OHMS 50 REQUIRED
 - R4XX = 15,000 OHMS 7 REQUIRED
 - R5XX = 37.6 OHMS 4 REQUIRED

- CONNECTOR REQUIREMENTS**
- AMP MODU FEMALE NO. 85B63-4 135 REQD.
- GROUND: 17, 133, 174, 133, 174, 141, 170, 174, 171, 181, 171, 178, 21, 218, 84, 833, 848, 854, 864, 877, 890, 894

- POWER:** T31, T32, T33, B31, B32, B33
- CAPACITOR IDENTIFICATION**
- C1XX = 10,000PF 5 REQUIRED
 - PC BOARD PTV0146-3



CHANGE NO.	DATE	DESCRIPTION

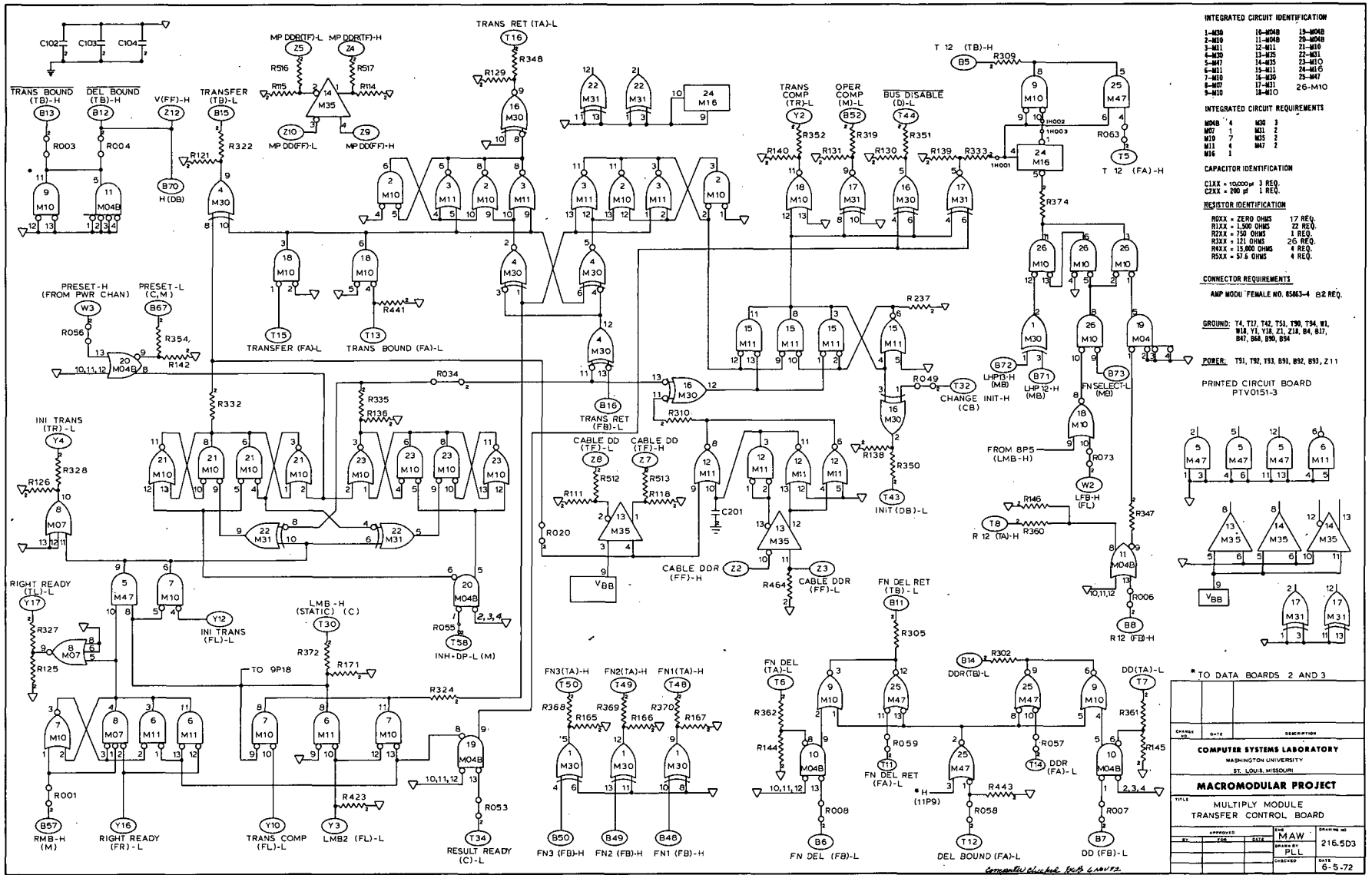
COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE: MULTIPLY MODULE: MODE CONTROL BD.

APPROVED	DATE	FILE NO.	DATE

216.4D3
DATE: 5.23-72



INTEGRATED CIRCUIT IDENTIFICATION

1-M30	10-M08	13-M08
2-M10	11-M08	20-M08
3-M11	12-M11	21-M10
4-M30	13-M75	22-M11
5-M47	14-M25	23-M10
6-M11	15-M11	24-M16
7-M10	16-M30	25-M47
8-M10	17-M11	26-M10
9-M10	18-M10	

INTEGRATED CIRCUIT REQUIREMENTS

M08	4	M30	3
M07	1	M11	2
M10	7	M31	2
M11	4	M47	2
M16	1		

CAPACITOR IDENTIFICATION
 C1XX = 100000 pF 3 REQ.
 C2XX = 200 pF 1 REQ.

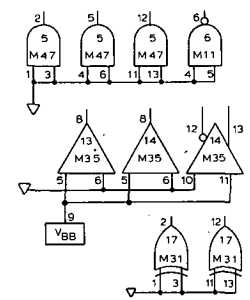
RESISTOR IDENTIFICATION
 R0XX = ZERO OHMS 17 REQ.
 R1XX = 1.500 OHMS 22 REQ.
 R2XX = 150 OHMS 1 REQ.
 R3XX = 121 OHMS 26 REQ.
 R4XX = 15.000 OHMS 4 REQ.
 R5XX = 51.6 OHMS 4 REQ.

CONNECTOR REQUIREMENTS
 AMP MODU FEMALE NO. 65663-4 B2 REQ.

GROUND: T4, T7, T12, T31, T30, T34, W1, W18, W17, W18, Z1, Z18, B4, B17, B47, B48, B50, B54

POWER: T31, T32, T33, B31, B32, B33, Z11

PRINTED CIRCUIT BOARD
 PIV0151-3



* TO DATA BOARDS 2 AND 3

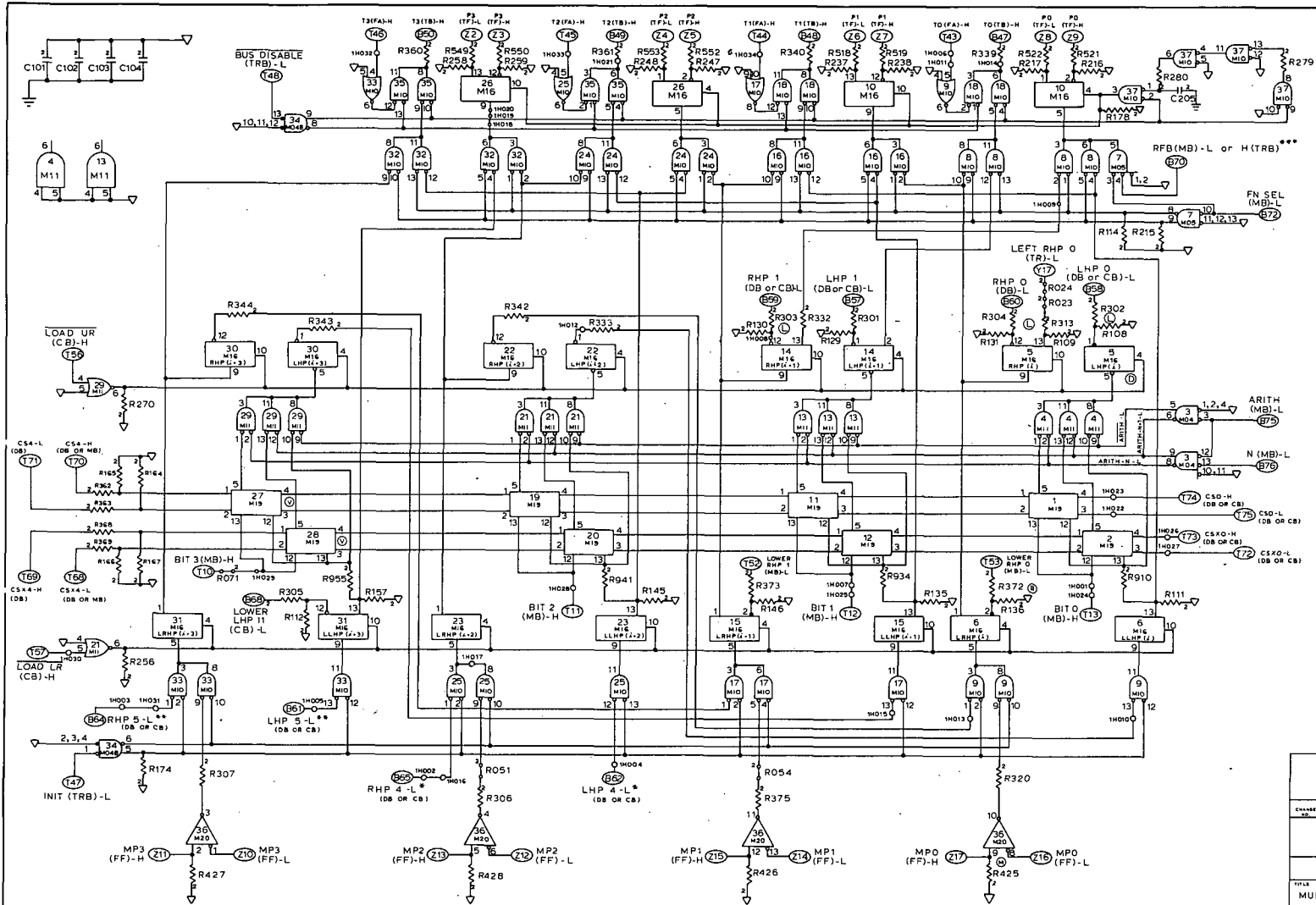
CHANGE NO.	DATE	DESCRIPTION

COMPUTER SYSTEMS LABORATORY
 WASHINGTON UNIVERSITY
 ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE: MULTIPLY MODULE
 TRANSFER CONTROL BOARD

DESIGNED BY	MAW	DATE	6-5-72
CHECKED BY	PLL	PROJECT NO.	216.503
		REVISION	



- INTEGRATED CIRCUIT IDENTIFICATION**
- | | | |
|--------|--------|--------|
| 1-M19 | 13-M11 | 25-M10 |
| 2-M19 | 14-M15 | 26-M16 |
| 3-M04 | 15-M16 | 27-M19 |
| 4-M16 | 16-M10 | 28-M19 |
| 5-M16 | 17-M10 | 29-M11 |
| 6-M16 | 18-M10 | 30-M16 |
| 7-M05 | 19-M10 | 31-M10 |
| 8-M10 | 20-M10 | 32-M10 |
| 9-M10 | 21-M11 | 33-M10 |
| 10-M16 | 22-M02 | 34-M09 |
| 11-M19 | 23-M15 | 35-M10 |
| 12-M19 | 24-M10 | 36-M20 |
| | | 37-M10 |

- INTEGRATED CIRCUIT REQUIREMENTS**
- | | | | |
|-----|--------|-----|--------|
| M04 | 1 EA. | M11 | 4 EA. |
| M05 | 1 EA. | M16 | 10 EA. |
| M09 | 1 EA. | M19 | 8 EA. |
| M10 | 11 EA. | M20 | 1 EA. |

- RESISTOR IDENTIFICATION**
- | | | |
|------|---------------|--------|
| R0XX | = ZERO OHMS | 5 EA. |
| R1XX | = 1.50 OHMS | 29 EA. |
| R2XX | = 750 OHMS | 1 EA. |
| R3XX | = 121 OHMS | 25 EA. |
| R4XX | = 15,000 OHMS | 4 EA. |
| R5XX | = 57.5 OHMS | 4 EA. |
| R6XX | = 68 OHMS | 4 EA. |

- CAPACITOR IDENTIFICATION**
- | | | |
|------|-----------|-------|
| C1XX | = 0.00047 | 4 EA. |
| C2XX | = 0.01 | 1 EA. |

CONNECTOR REQUIREMENTS

AMP MODU FEMALE NO. 85841 - 85 EA.

PRINTED CIRCUIT BOARD NO. PTV0150-3

GROUND: T94, T99, T16, T97, T55, T51, T42, T9, T11, M10, T21, T18, B1, R27, B31, B36, B67, B71, B99, B94, Y11, Y18

POWER: T93, T92, T91, B93, B92, B91

* CORRESPONDS TO LHP (0) OR LLHP (0) IF LEFTMOST DATA BOARD
 ** CORRESPONDS TO LHP (1) OR LLHP (1) IF LEFTMOST DATA BOARD
 *** CORRESPONDS TO DATA BOARDS IN POSITIONS 2 AND 3

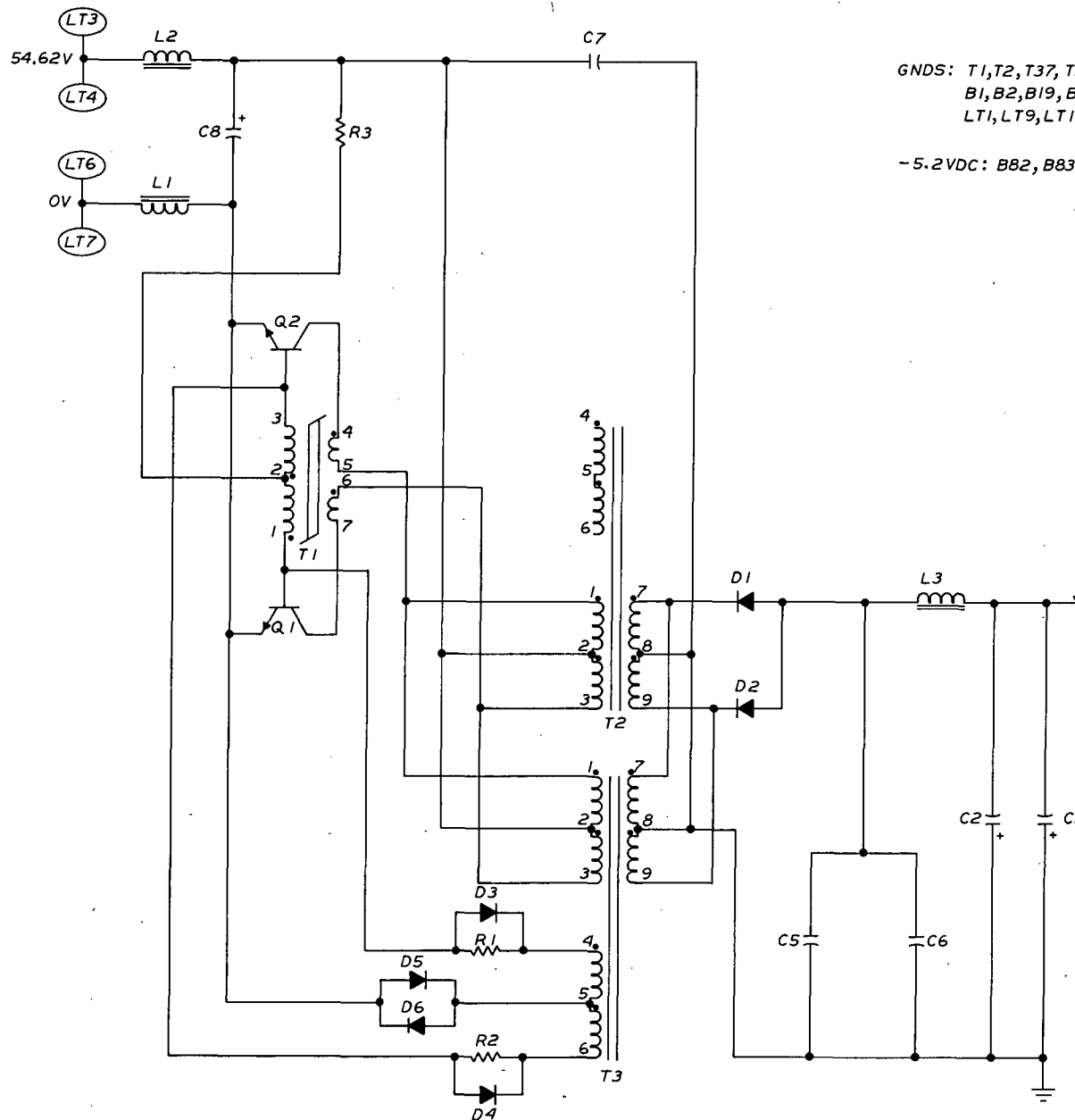
CHANGE NO.	DATE	DESCRIPTION

COMPUTER SYSTEMS LABORATORY
 WASHINGTON UNIVERSITY
 ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

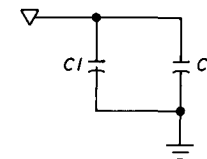
TITLE: MULTIPLY MODULE: DATA BOARD

APPROVED	DATE	DESIGNED BY	PRINTING NO.
MAW			216-603
ELL			
CHECKED			DATE: 5-13-72

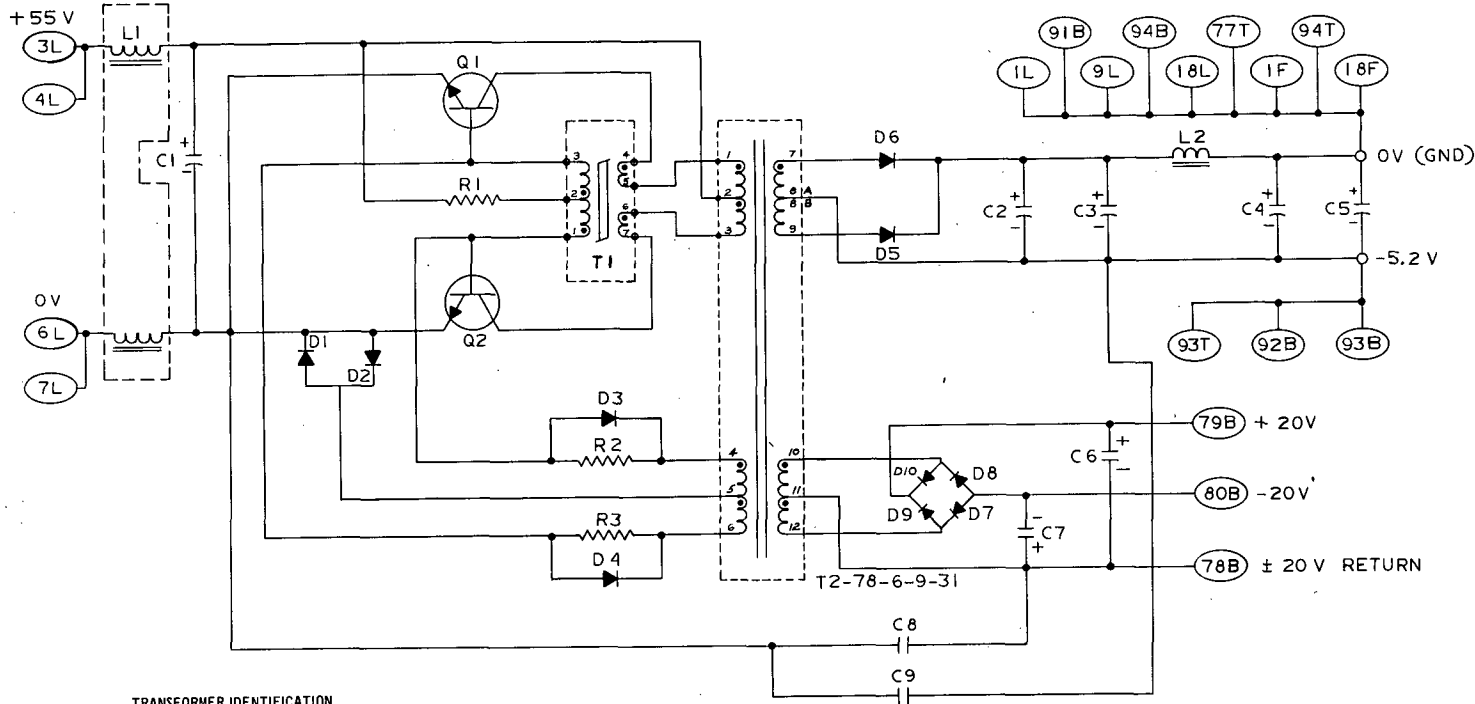


GNDS: T1, T2, T37, T38, T39, T40, T69, T70, T89, T90, T94,
 B1, B2, B19, B20, B69, B70, B81, B85, FB1, FB18,
 LT1, LT9, LT14, LT18, LB1, LB18, B94.

-5.2VDC: B82, B83, B84, T91, T92, T93.



CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE POWER SUPPLY SCHEMATIC MULTIPLY AND GMC MODULES		
APPROVED	ENG. TJC	DRAWING NO.
BY	DATE	216.1203
	DRAWN BY PLL	
	CHECKED TJC	DATE 2-16-74



TRANSFORMER IDENTIFICATION

T1 = MPS-T1
T2 = MPS-T2 -78-6-9-31

INDUCTOR IDENTIFICATION

L1 = MPS-L3
L2 = MPS-L2

TRANSISTOR REQUIREMENTS

Q1, Q2 = RCA 40374

DIODE REQUIREMENTS

D1, D2, D3, D4, D7, D8, D9, D10 = MOTOROLA MR810
D5, D6 = MOTOROLA SR1922A

CAPACITOR REQUIREMENTS

C1 = 25 μ F 60V
C2, C3, C4, C5 = 4.7 μ F 50V
C6, C8, C9 = .47 μ F 12V

RESISTOR REQUIREMENTS

R1 = 13,000 OHMS $\frac{1}{4}$ W.
R2, R3 = 75 OHMS $\frac{1}{4}$ W.

CONNECTOR REQUIREMENTS

19 FEMALE

PRINTED CIRCUIT BOARD
PTV0117-1

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE 15 WATT DC DC 5 VOLT, \pm 20V CONVERTER SCHEMATIC PART NO 217.1		
APPROVED	ENG	DRAWING NO.
BY	FUR	217.1D3
FOR	DRAWN BY	PLL
DATE	CHECKED	DATE
	ZUR	1-28-71

RESISTOR IDENTIFICATION

R4, R5 = 6.8K OHMS
 R1, R6 = RANGES SELECTED FROM 100 OHMS TO 2000 OHMS
 R2, R7 = 20K OHMS; 22.1K OHMS OR 23.7K OHMS
 R3 = 3.0 OHMS
 R8 = 8.2 OHMS

COILS REQUIRED
 L1, L2 = MPS-L2

SERIES REGULATOR
 IC1 = MC1469R
 IC2 = MC1463R

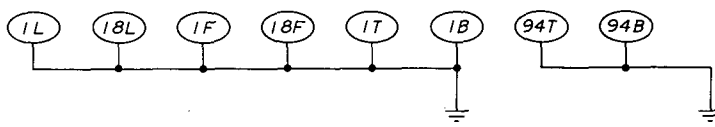
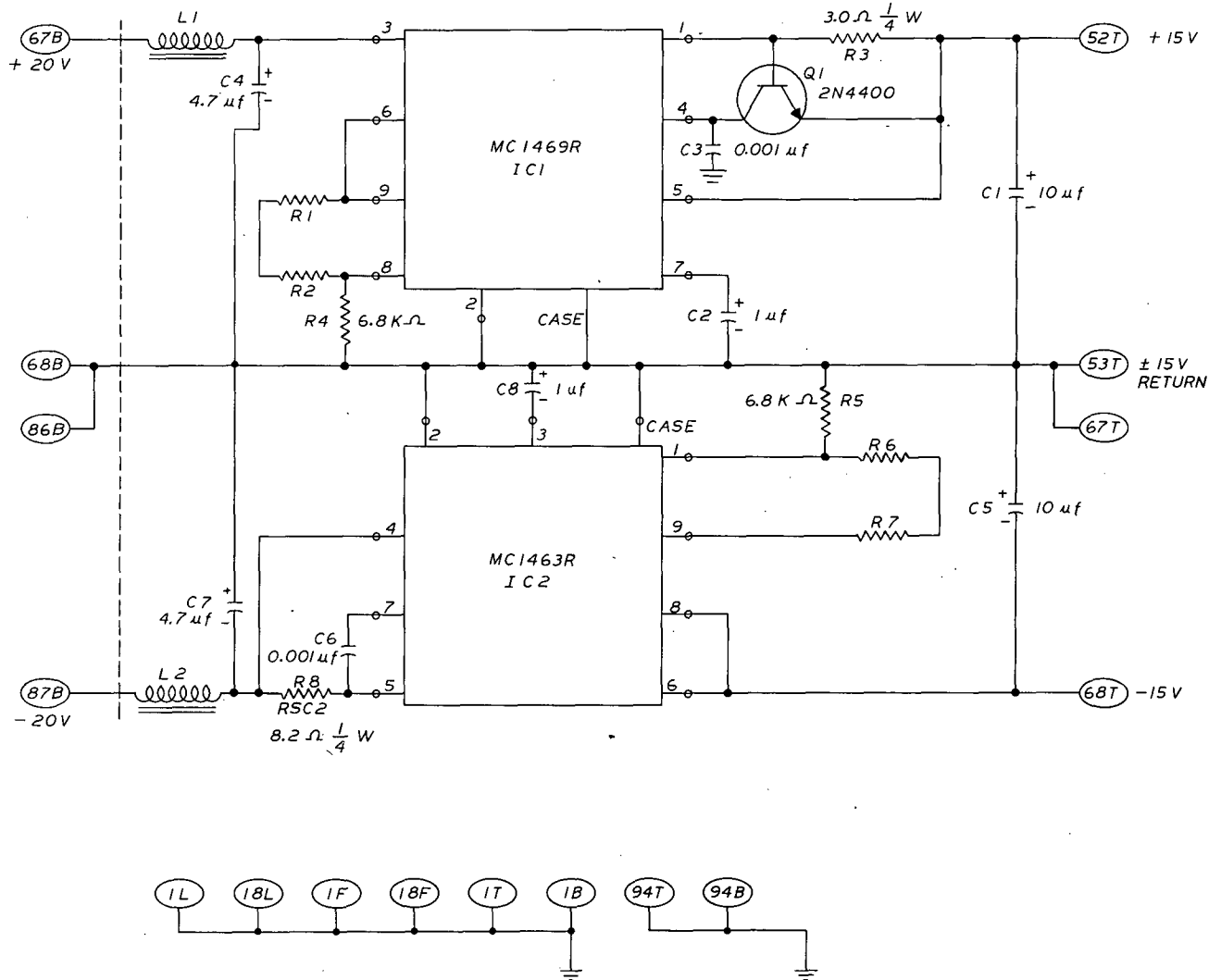
TRANSISTOR REQUIRED
 Q1 = 2N4400

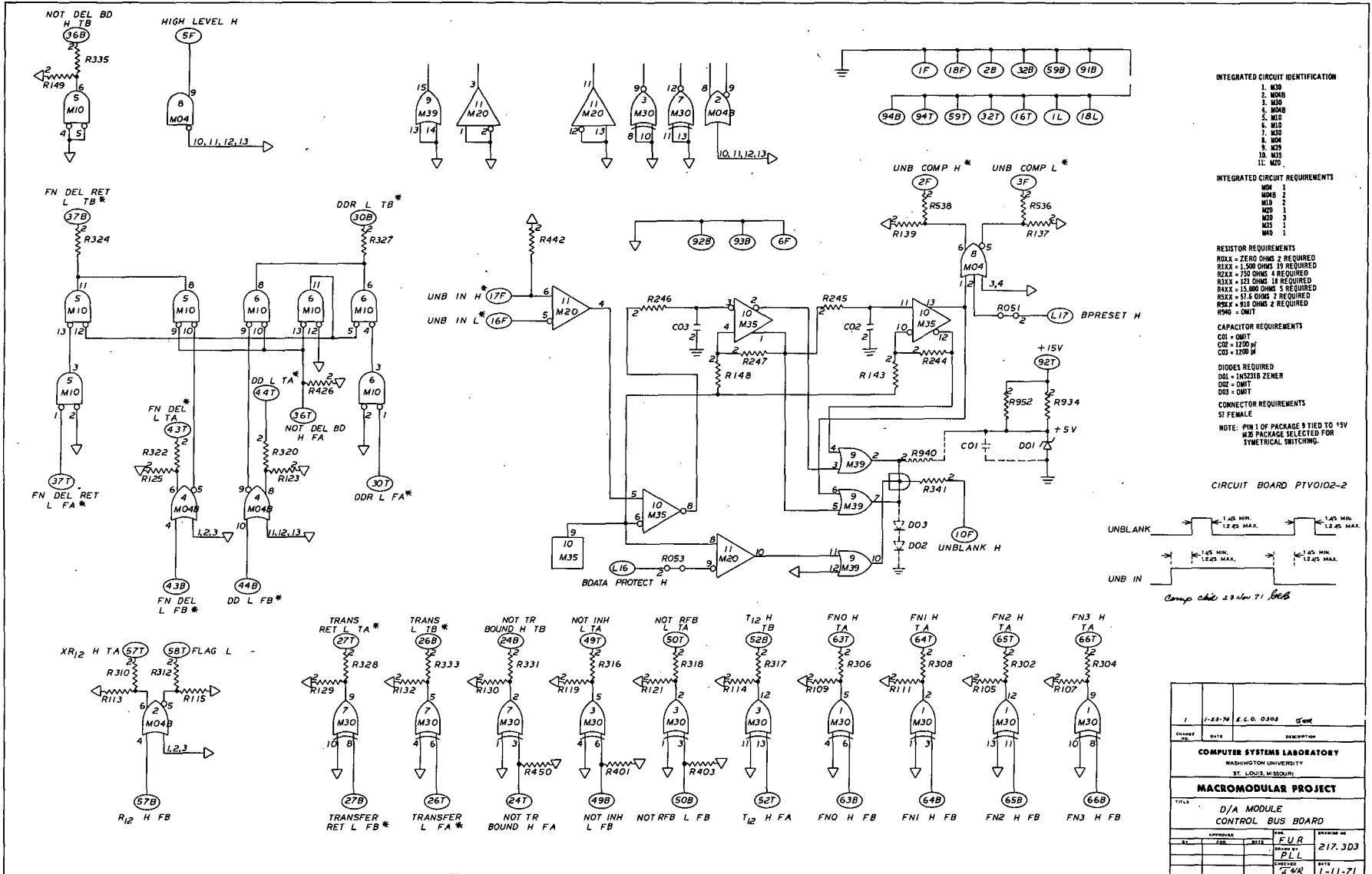
CAPACITOR REQUIREMENTS
 C1 & C5 10µf 20V
 C2 & C8 1µf 35V
 C3 & C6 .001µf
 C4 & C7 4.7µf 50V

CONNECTOR REQUIREMENTS
 16 FEMALE

CIRCUIT BOARD
 PTV0118-1

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE CIRCUIT DIAGRAM SERIES REGULATOR PART NO. 2172		
APPROVED	ENG.	DRAWING NO.
BY: _____	FOR: FUR	DATE: _____
DATE: _____	DRAWN BY: PLL	217.203
CHECKED: ZUR	DATE: 1-22-71	





- INTEGRATED CIRCUIT IDENTIFICATION**
1. M30
 2. M30B
 3. M30
 4. M30B
 5. M30
 6. M30
 7. M30
 8. M30
 9. M30
 10. M30
 11. M30

- INTEGRATED CIRCUIT REQUIREMENTS**
- | | |
|------|---|
| M30 | 1 |
| M30B | 2 |
| M30 | 1 |
| M30B | 1 |
| M30 | 1 |
| M30 | 1 |

- RESISTOR REQUIREMENTS**
- R01X = ZERO OHMS 2 REQUIRED
 - R10X = 1,500 OHMS 19 REQUIRED
 - R20X = 750 OHMS 4 REQUIRED
 - R30X = 121 OHMS 18 REQUIRED
 - R40X = 15,000 OHMS 5 REQUIRED
 - R50X = 97.5 OHMS 2 REQUIRED
 - R60X = 910 OHMS 2 REQUIRED
 - R940 = OMIT

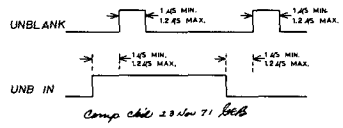
- CAPACITOR REQUIREMENTS**
- C01 = OMIT
 - C02 = 1500 PF
 - C03 = 1200 PF

- DIODES REQUIRED**
- DO1 = 1N2318 ZENER
 - DO2 = OMIT
 - DO3 = OMIT

- CONNECTOR REQUIREMENTS**
- 57 FEMALE

NOTE: PIN 1 OF PACKAGE 9 TIED TO +5V
M30 PACKAGE SELECTED FOR SYMMETRICAL SWITCHING.

CIRCUIT BOARD PIV0102-2



1	1-22-70	Z.C.O. 0303	PLL
CHANGE NO.	DATE	DESCRIPTION	
COMPUTER SYSTEMS LABORATORY			
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			
MACROMODULAR PROJECT			
TITLE D/A MODULE CONTROL BUS BOARD			
DESIGNED BY	DATE	REV.	DESCRIPTION
PLL	217.303		
DATE			
			1-11-71

INTEGRATED CIRCUIT IDENTIFICATION

- 1 M04B
- 2 M04B
- 3 M30
- 4 M04B
- 5 M04B
- 6 M30
- 7 M04B
- 8 M04B
- 9 M30
- 10 M30

INTEGRATED CIRCUIT REQUIREMENTS

- M04B 6
- M30 4

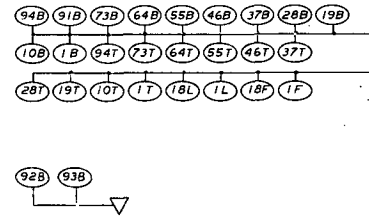
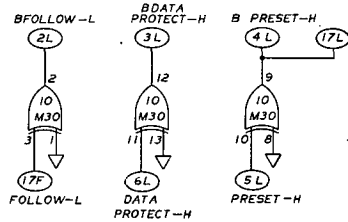
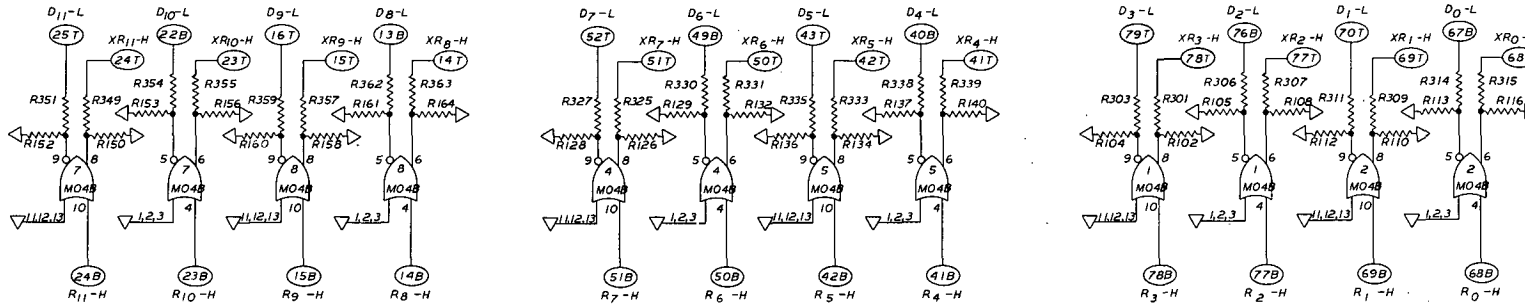
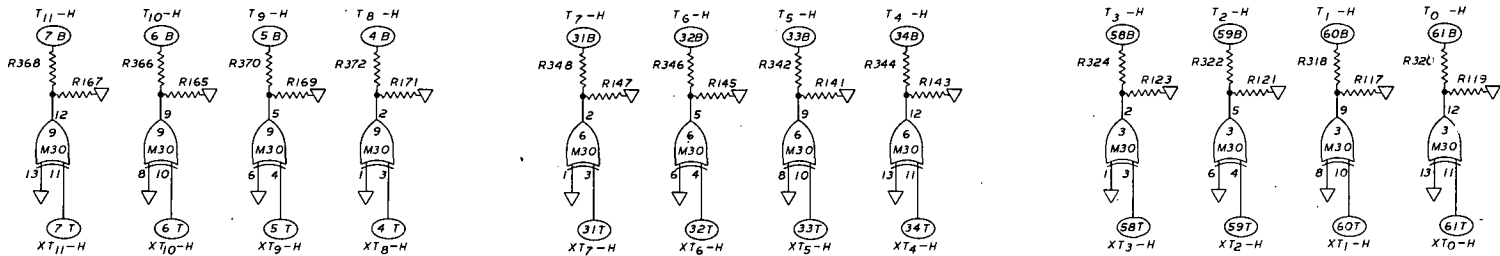
RESISTOR REQUIREMENTS

R1XX - 1.5% OHMS 36 REQUIRED
R3XX - 12% OHMS 36 REQUIRED

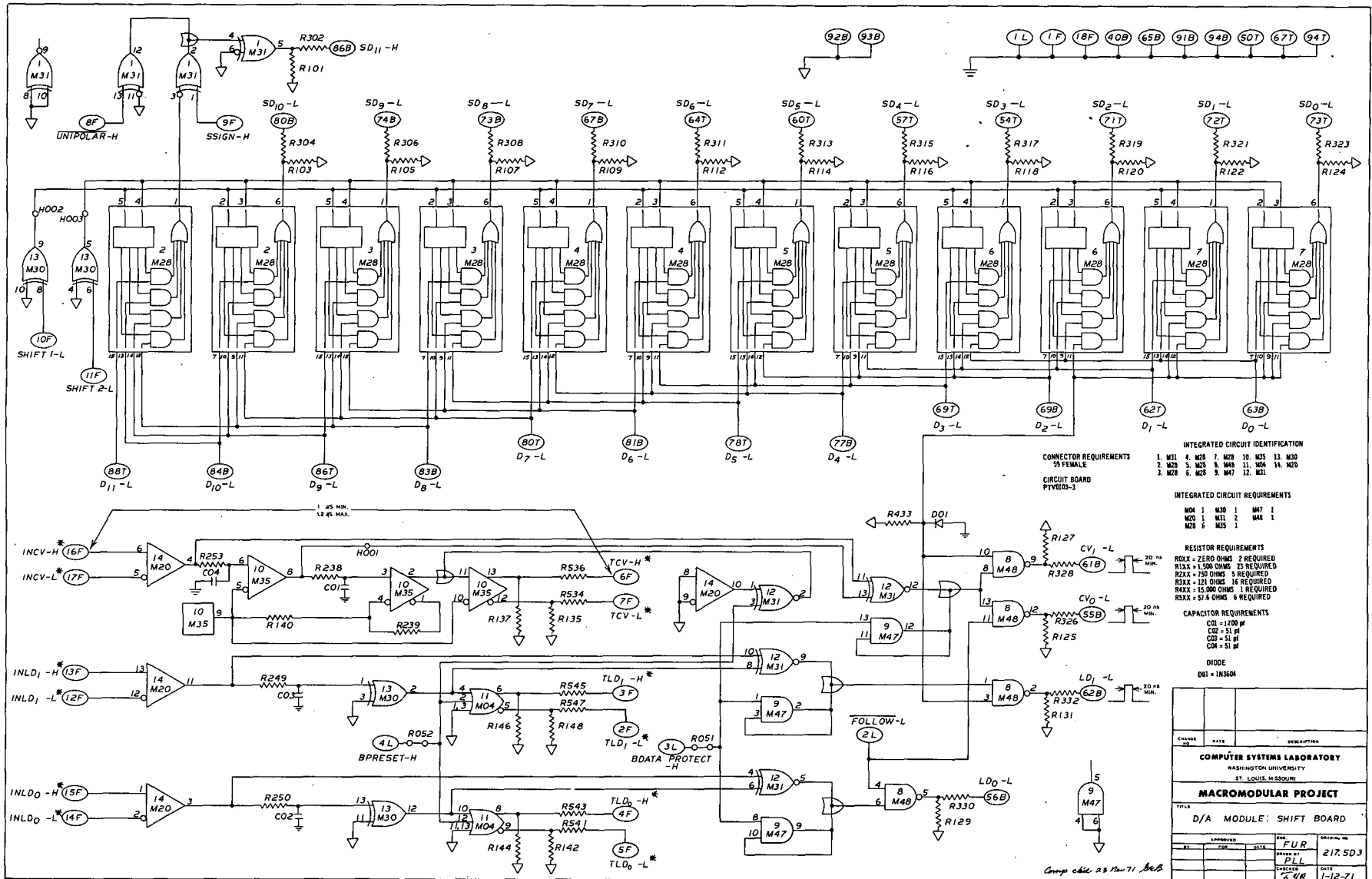
CIRCUIT BOARD
PTV08B-2

CONNECTOR REQUIREMENTS
94 FEMALE

Comp adds 2.8 thru 71. 364



CHANGE	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE D/A MODULE: BUS BOARD PART NO. 217.4		
APPROVED	DATE	DRAWING NO.
BY: FUR	DATE: 217.403	
BY: P.L.L.		
BY: C	DATE: 1-19-70	



- INTEGRATED CIRCUIT IDENTIFICATION**
- CONNECTOR REQUIREMENTS**
59 FEMALE
- CIRCUIT BOARD**
PTV103-3
- INTEGRATED CIRCUIT REQUIREMENTS**
- RESISTOR REQUIREMENTS**
R1XX = 2200 OHMS 2 REQUIRED
R1XX = 1,500 OHMS 23 REQUIRED
R2XX = 750 OHMS 5 REQUIRED
R2XX = 120 OHMS 16 REQUIRED
R3XX = 51.5 OHMS 6 REQUIRED
- CAPACITOR REQUIREMENTS**
C01 = 1200 pF
C02 = 51 pF
C03 = 51 pF
C04 = 51 pF
- DIODE**
D01 = 1N3504

CHANGE NO.	DATE	DESCRIPTION

COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

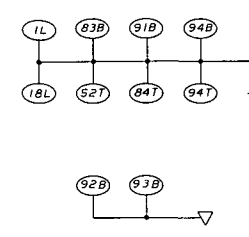
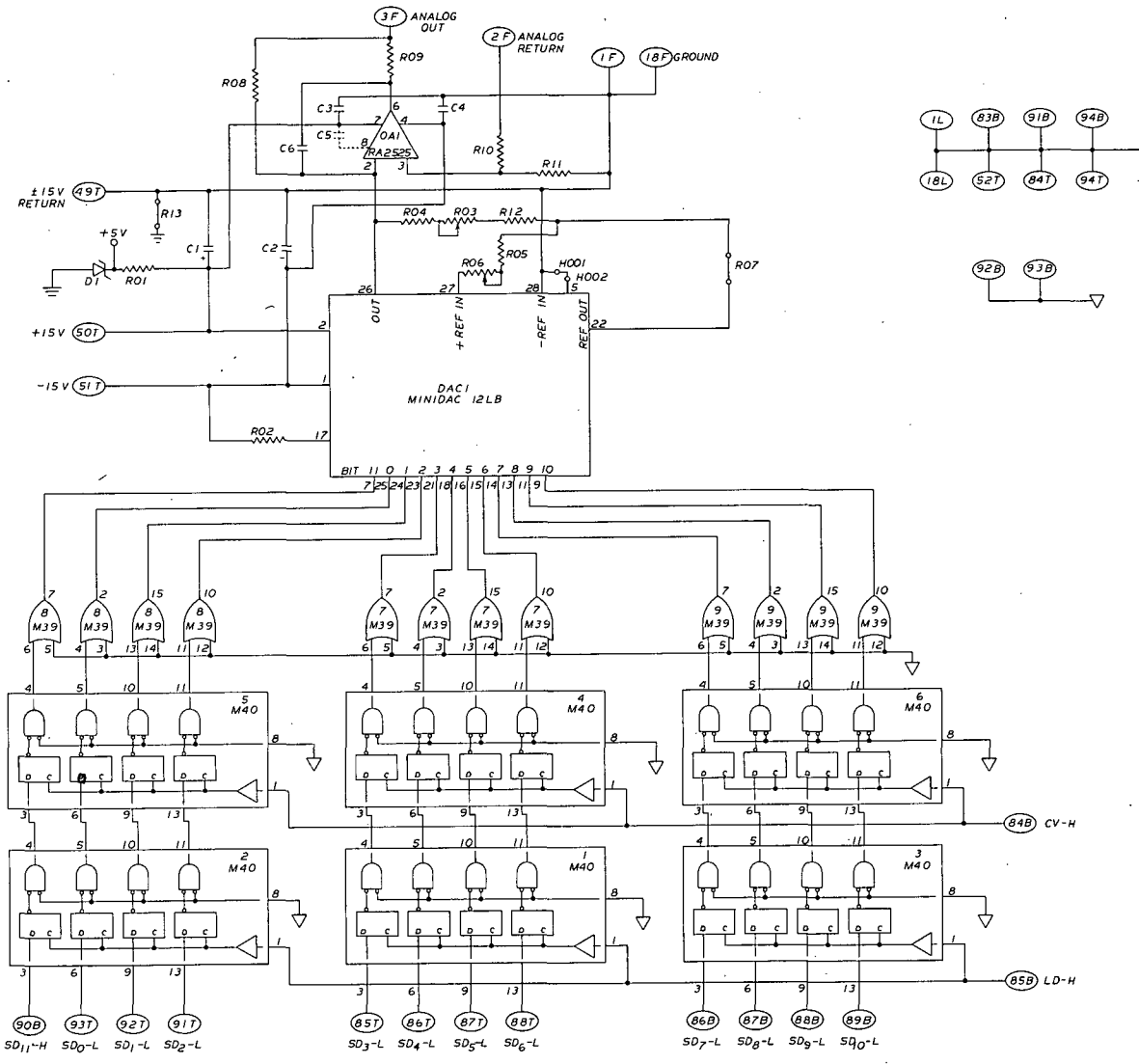
TITLE: **D/A MODULE: SHIFT BOARD**

BY	FOR	DATE	DRWING NO.

APPROVED: **FUR** 217.5D3
DRAWN BY: **PLL**
CHECKED BY: **GR** DATE: 1-12-71

Comp. chie. 23 Nov 71 868

Comp. Chk. 20 Nov 71. BLS



INTEGRATED CIRCUIT IDENTIFICATION
 1. M40 4. M40 7. M39
 2. M40 5. M40 8. M39
 3. M40 6. M40 9. M39

INTEGRATED CIRCUIT REQUIREMENTS
 M39 3
 M40 6

RESISTOR REQUIREMENTS
 R01 200 OHMS 5%
 R02 240 OHMS 5%
 R03, R06 250 OHMS 5% POTENTIOMETER
 R04 6,000 OHMS 1%
 R05 400 OHMS 1%
 R07, R13 0 OHMS -
 R08 5,000 OHMS 1%
 R09 51 OHMS 5%
 R10 110 OHMS 5%
 R11 330 OHMS 5%
 R12 200 OHMS 1%

CAPACITOR REQUIREMENTS
 C1, C2 = 10-1 20V
 C3, C4 = 10-1
 C5 = 10F
 C6 = OMIT

DIODE REQUIREMENTS
 D1 = 1N5331B

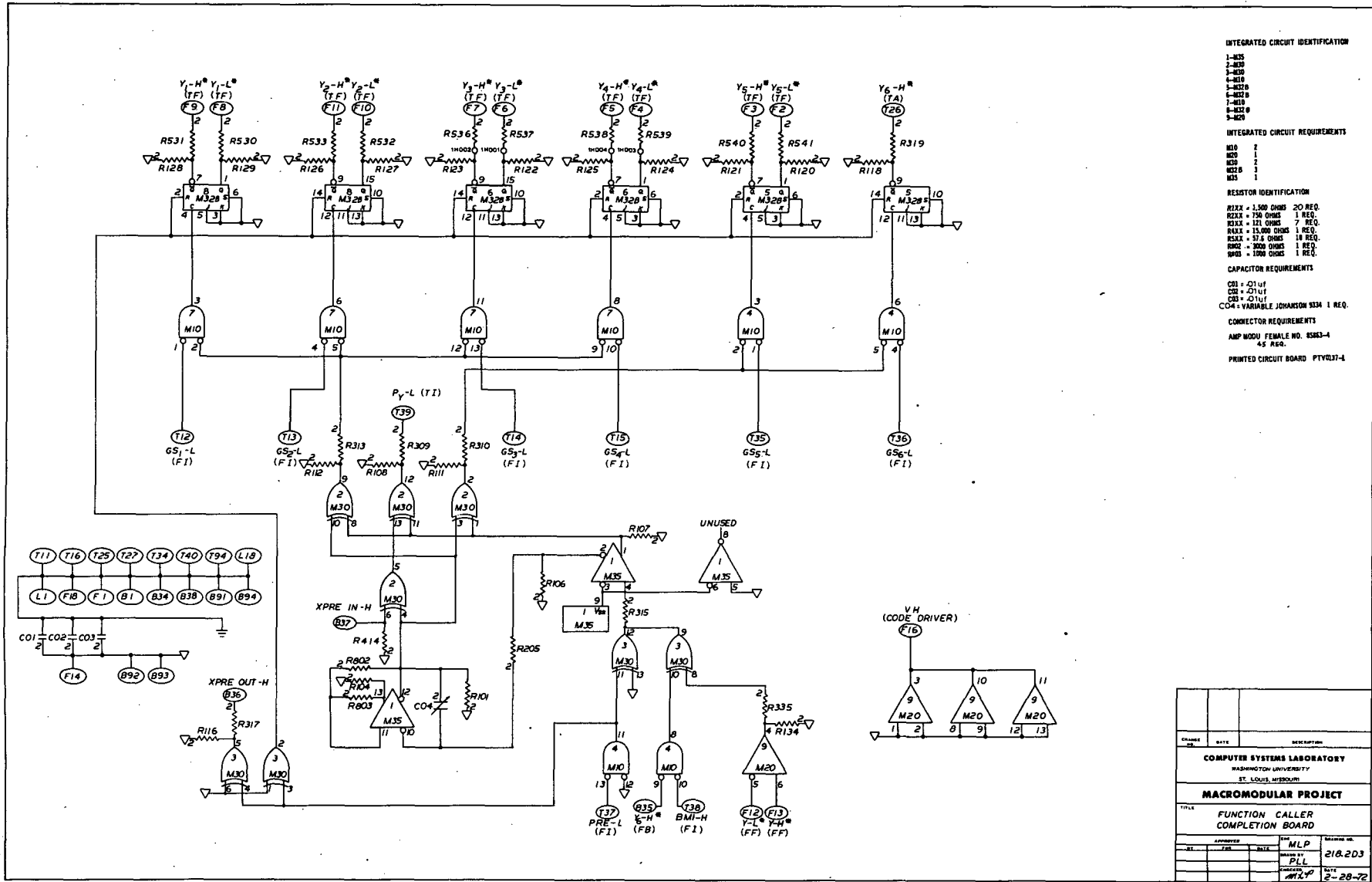
OPERATIONAL AMPLIFIER REQUIREMENTS
 OA1 = HARRIS RA-2525

DIGITAL ANALOG CONVERTER REQUIREMENTS
 DAC1 = ANALOG DEVICES MINIDAC 12L

CONNECTOR REQUIREMENTS
 J1 FEMALE

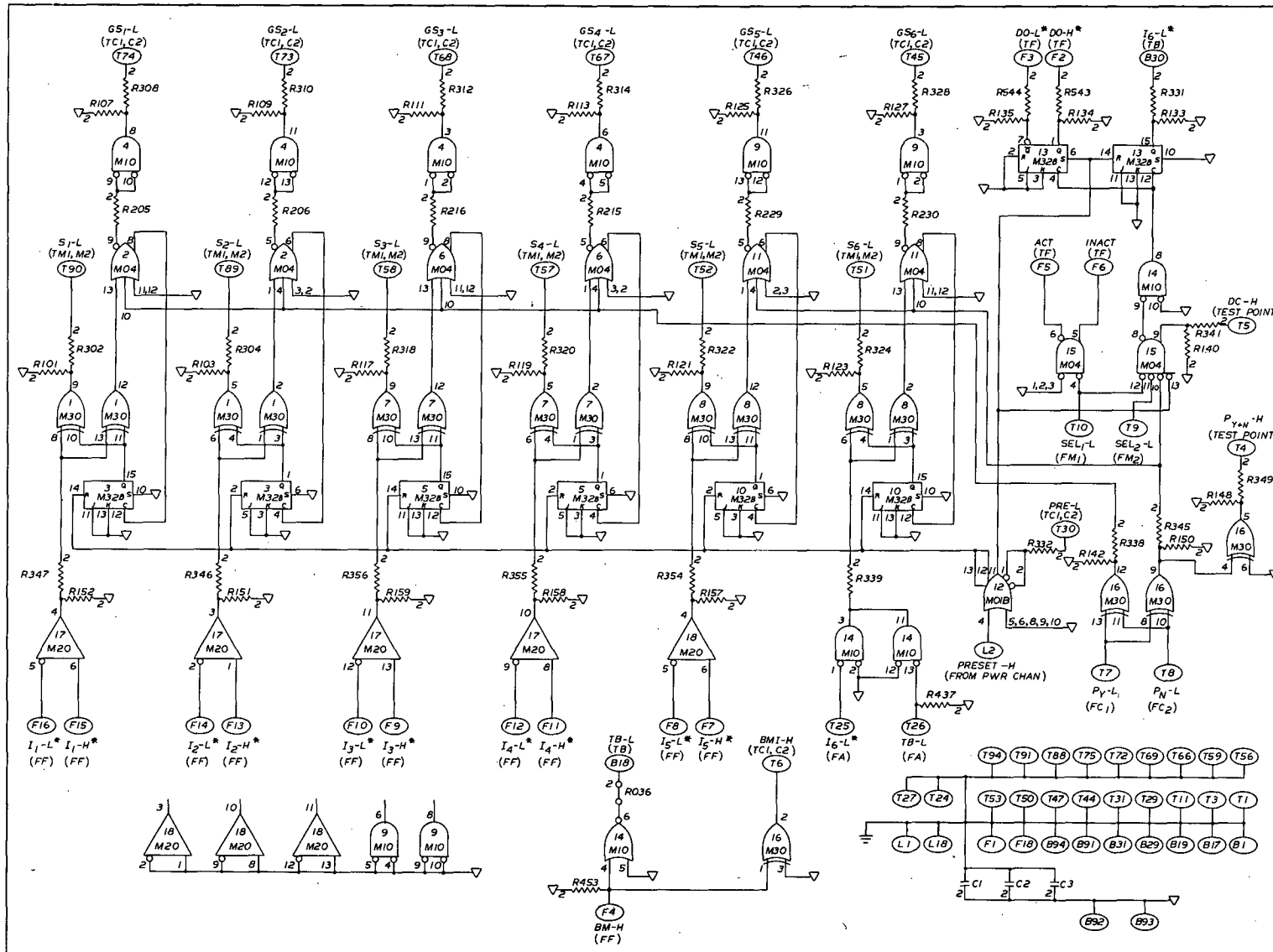
CIRCUIT BOARD
 PTVO100-3

1	1-23-74	E.C.O. 0303	T.M.C.
REV	DATE	DESCRIPTION	
COMPUTER SYSTEMS LABORATORY			
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI			
MACROMODULAR PROJECT			
TITLE: D/A MODULE: CONVERTER BOARD PART NO. 217.6			
APPROVED	DESIGNED	DATE	REVISION NO.
BY: FUR	DATE: P.L.L.	217.6D3	
BY: C.W.K.	DATE: 2-1-71		



- INTEGRATED CIRCUIT IDENTIFICATION**
- 1-M10
 - 2-M10
 - 3-M10
 - 4-M10
 - 5-M10
 - 6-M10
 - 7-M10
 - 8-M10
 - 9-M10
- INTEGRATED CIRCUIT REQUIREMENTS**
- M10 2
 - M10 1
 - M10 1
 - M10 1
 - M10 1
- RESISTOR IDENTIFICATION**
- R128 = 1,500 OHMS 20 REQ.
 - R129 = 150 OHMS 1 REQ.
 - R126 = 121 OHMS 7 REQ.
 - R127 = 15,000 OHMS 1 REQ.
 - R122 = 51.5 OHMS 18 REQ.
 - R125 = 3000 OHMS 1 REQ.
 - R124 = 1000 OHMS 1 REQ.
- CAPACITOR REQUIREMENTS**
- CO1 = 0.1uf
 - CO2 = 0.1uf
 - CO3 = 0.1uf
 - CO4 = VARIABLE JOHANSON 9334 1 REQ.
- CONNECTOR REQUIREMENTS**
- AMP 9004 FEMALE NO. 9583-4 45 REQ.
- PRINTED CIRCUIT BOARD PTV037-1**

CHANGE NO.	DATE	DESCRIPTION
COMPUTER SYSTEMS LABORATORY		
WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE FUNCTION CALLER COMPLETION BOARD		
APPROVED BY	DATE	REVISION NO.
BY	DATE	216.203
BY	DATE	MLP
BY	DATE	PLL
BY	DATE	MLP
BY	DATE	2-28-72



INTEGRATED CIRCUIT IDENTIFICATION

1-M10	7-M10	13-M20B
2-M04	8-M30	14-M10
3-M32B	9-M10	15-M04
4-M10	10-M32B	16-M30
5-M32B	11-M04	17-M20
6-M04	12-M04B	18-M20

INTEGRATED CIRCUIT REQUIREMENTS

M04B	1	M20	2
M04	4	M30	4
M10	3	M32B	4

RESISTOR IDENTIFICATION

RXX = ZERO OHMS	1 REQ.
R1XX = 1500 OHMS	24 REQ.
R2XX = 750 OHMS	6 REQ.
R3XX = 121 OHMS	24 REQ.
R4XX = 15,000 OHMS	2 REQ.
R5XX = 97.6 OHMS	2 REQ.

CAPACITOR IDENTIFICATION

C1XX = 0.1 uF
C2XX = 0.1 uF
C3XX = 0.1 uF

CONNECTOR REQUIREMENTS

AMP MOD/FEMALE NO. 8508-4 73 REQ.

PRINTED CIRCUIT BOARD PTV 0135-1

CHANGE	DATE	DESCRIPTION

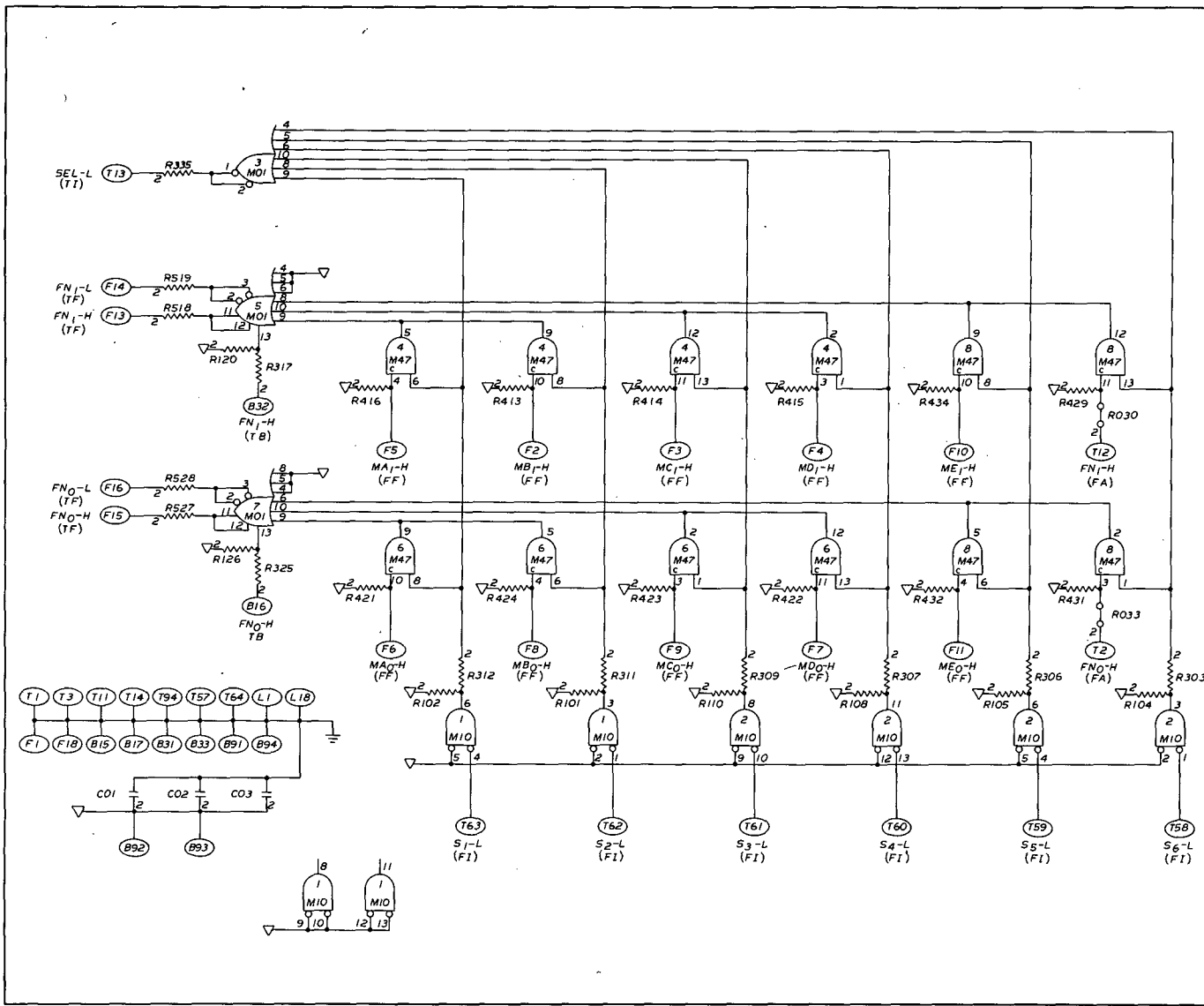
COMPUTER SYSTEMS LABORATORY
WASHINGTON UNIVERSITY
ST. LOUIS, MISSOURI

MACROMODULAR PROJECT

TITLE: **FUNCTION CALLER INITIATE BOARD**
PART NO. **218.3**

APPROVED	DATE	MLP	DRAWING NO.
			218.3D3

DATE: **2-8-72**



- INTEGRATED CIRCUIT IDENTIFICATION**
- 1-M10
 - 2-M10
 - 3-M01
 - 4-M47
 - 5-M01
 - 6-M47
 - 7-M01
 - 8-M47
- INTEGRATED CIRCUIT REQUIREMENTS**
- M01 2
 - M10 2
 - M47 3
- RESISTOR IDENTIFICATION**
- ROXX = ZERO OHMS 2 REQ.
 - R1XX = 1500 OHMS 4 REQ.
 - R2XX = 121 OHMS 9 REQ.
 - R4XX = 15000 OHMS 12 REQ.
 - R5XX = 57.6 OHMS 4 REQ.
- CAPACITOR IDENTIFICATION**
- C01 = 01 uF
 - C02 = 01 uF
 - C03 = 01 uF
- CONNECTOR REQUIREMENTS**
- AMP MODU FEMALE NO. 8583-4 44 REQ.
- PRINTED CIRCUIT BOARD PTV 0136-1

CHANGE NO.	DATE	DESCRIPTION
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WASHINGTON UNIVERSITY ST. LOUIS, MISSOURI		
MACROMODULAR PROJECT		
TITLE FUNCTION CALLER MULTIPLEXER BOARD		
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