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|            |  |                  |  |           |  |                      |  |                         |                   |                             |  |            |                   |  |  |  |  |  |     |         |  |  |  |
|------------|--|------------------|--|-----------|--|----------------------|--|-------------------------|-------------------|-----------------------------|--|------------|-------------------|--|--|--|--|--|-----|---------|--|--|--|
| REV. _____ |  | CHANGE NO. _____ |  | CHK _____ |  | USED ON OPTION/MODEL |  | DRN.<br>RW<br>Caunter   | DATE<br>2 June 78 | TITLE<br><br>TIM RAM OPTION |  |            |                   |  |  |  |  |  |     | digital |  |  |  |
|            |  |                  |  |           |  | PDT11/150            |  | CHK'D.<br>RW<br>Caunter | DATE<br>2 June 78 | SIZE<br>B                   |  | CODE<br>DD | NUMBER<br>MST11-0 |  |  |  |  |  | REV |         |  |  |  |
|            |  |                  |  |           |  | PDT11/130            |  | PROD.<br>Ruff           | DATE<br>7-20-78   | DIST.                       |  |            |                   |  |  |  |  |  |     |         |  |  |  |
|            |  |                  |  |           |  | PDT11/110            |  | PRO. ENG.<br>D. Ruff    | DATE<br>9-24-78   |                             |  |            |                   |  |  |  |  |  |     |         |  |  |  |
|            |  |                  |  |           |  |                      |  |                         |                   |                             |  |            |                   |  |  |  |  |  |     |         |  |  |  |
|            |  |                  |  |           |  |                      |  |                         |                   |                             |  |            |                   |  |  |  |  |  |     |         |  |  |  |
|            |  |                  |  |           |  | SHEET 1 OF 2         |  |                         |                   |                             |  |            |                   |  |  |  |  |  |     |         |  |  |  |



## DIGITAL EQUIPMENT CORPORATION PARTS LIST

|                                                     |                                                     |                     |
|-----------------------------------------------------|-----------------------------------------------------|---------------------|
| MADE BY <i>RW Counter</i><br>DATE <i>19 June 78</i> | CHECKED <i>RW Counter</i><br>DATE <i>19 June 78</i> | SECTION<br>1        |
| ENG <i>MT</i><br>DATE <i>6-29-78</i>                | PRODR <i>4</i><br>DATE <i>6-29-78</i>               | ISSUED SECTION<br>1 |

QUANTITY / VARIATION

|        |                                                            |
|--------|------------------------------------------------------------|
| NOTES: | 1. * FOR VENDOR FOR MOS MEMORY CHIPS SEE B-PL-5413275-0-0. |
|--------|------------------------------------------------------------|

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|            |        |
|------------|--------|
| E.C.O. NO. | VE 11- |
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|       |                 |
|-------|-----------------|
| TITLE | TIM RAM OPTIONS |
|-------|-----------------|

ASSY NO.  
B-DD-MST11-Ø

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|          |           |
|----------|-----------|
| SIZE     | CODE      |
| <b>B</b> | <b>PL</b> |

PL

NUMBER  
MST11-0-0

REV.  
A

INSERTION PARTS LIST DATA BASE REV

## DIGITAL EQUIPMENT CORPORATION PARTS LIST

|                                                     |                                                     |                     |
|-----------------------------------------------------|-----------------------------------------------------|---------------------|
| MADE BY <i>RW Caunter</i><br>DATE <i>17 June 78</i> | CHECKED <i>RW Caunter</i><br>DATE <i>19 June 78</i> | SECTION<br>1        |
| ENG <i>A. Thompson</i><br>DATE <i>6-20-78</i>       | PROD <i>Ralf Hamilton</i><br>DATE <i>7-20-78</i>    | ISSUED SECTION<br>1 |

QUANTITY / VARIATION

|        |
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| NOTES: |
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REF DESIGNATION

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|       |                 |
|-------|-----------------|
| TITLE | MST11 SHIP LIST |
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|          |
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| ASSY NO. |
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B-DD-MST11-Ø

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|      |  |
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**B**

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| CODE |  |
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**PL**

NUMBER

MST11-Ø-3 :

REV.

INSERTION PARTS LIST DATA BASE REV

MR

|                                                                       |               |          |           |                      |                       |      |
|-----------------------------------------------------------------------|---------------|----------|-----------|----------------------|-----------------------|------|
| <b>DIGITAL EQUIPMENT CORPORATION</b><br><b>MAYNARD, MASSACHUSETTS</b> |               |          |           |                      |                       |      |
| <b>ENGINEERING SPECIFICATION</b>                                      |               |          |           |                      | <b>DATE 17 MAY 78</b> |      |
| <b>TITLE</b> TIM Memory Daughter Module                               |               |          |           |                      |                       |      |
| <b>REVISIONS</b>                                                      |               |          |           |                      |                       |      |
| REV                                                                   | DESCRIPTION   | CHG NO   | ORIG      | DATE                 | APPD BY               | DATE |
|                                                                       |               |          |           |                      |                       |      |
| Empty space for revisions                                             |               |          |           |                      |                       |      |
| ENG                                                                   | APPD          | SIZE     | CODE      | NUMBER               | REV                   |      |
| <i>H. Tunesa</i>                                                      | <i>John G</i> | <b>A</b> | <b>SP</b> | <b>MST11-8-2</b>     |                       |      |
| DEC 16 (392)-1079A-R873                                               |               |          |           |                      |                       |      |
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| <b>ENGINEERING SPECIFICATION</b>                                                                                   |                                                                                                                                                                                                                                                                                                           |                  |            | CONTINUATION SHEET  |     |
|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------|---------------------|-----|
| <b>TITLE</b>                                                                                                       | TIM Memory Daughter Module                                                                                                                                                                                                                                                                                |                  |            |                     |     |
| 1.Ø                                                                                                                | <u><b>Document Scope</b></u>                                                                                                                                                                                                                                                                              |                  |            |                     |     |
|                                                                                                                    | This specification will define the mechanical, electrical and environmental characteristics of the Terminal Intelligence Module (TIM) Memory Daughter Module. (MDM) It is assumed the reader is familiar with the operation of the LSI-11 and has read a description of the Terminal Intelligence Module. |                  |            |                     |     |
| 1.1                                                                                                                | <u><b>Reference Document</b></u>                                                                                                                                                                                                                                                                          |                  |            |                     |     |
|                                                                                                                    | The Documents referenced by this specification are the following;                                                                                                                                                                                                                                         |                  |            |                     |     |
|                                                                                                                    |                                                                                                                                                                                                                                                                                                           |                  |            |                     |     |
| Refer to the Terminal Intelligence Module Engineering Spec<br>(A-SP- ) for a more complete description of the TIM. |                                                                                                                                                                                                                                                                                                           |                  |            |                     |     |
|                                                                                                                    |                                                                                                                                                                                                                                                                                                           | SIZE<br><b>A</b> | CODE<br>SP | NUMBER<br>MST11-Ø-2 | REV |

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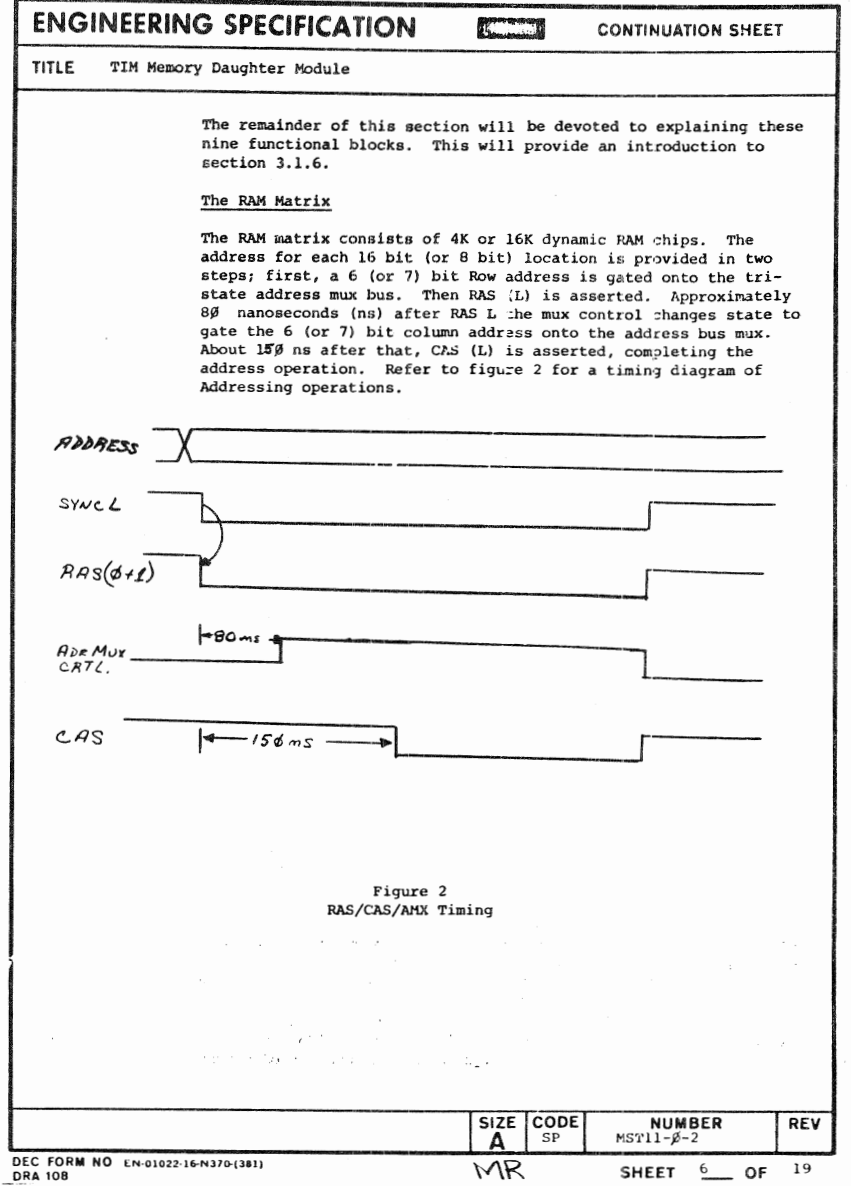
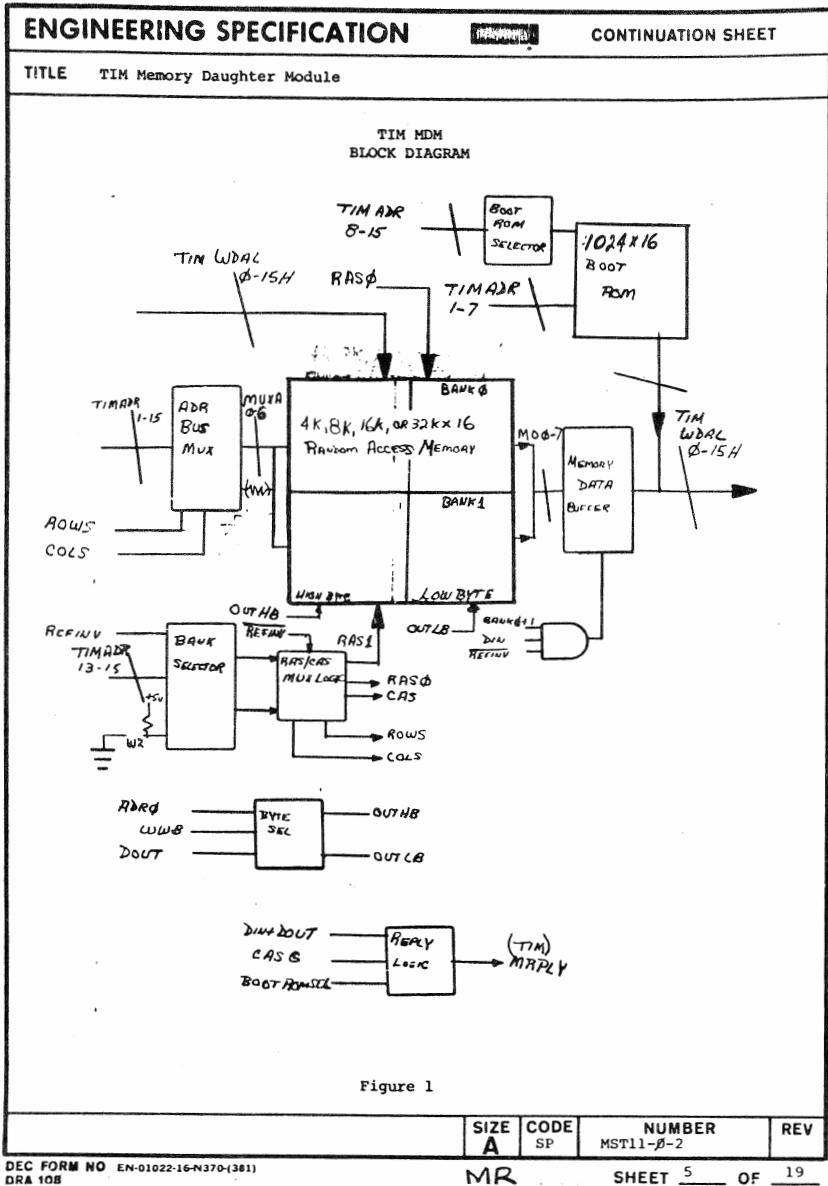
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| ENGINEERING SPECIFICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | CONTINUATION SHEET |  |
| <b>TITLE</b> TIM Memory Daughter Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                    |  |
| <div style="margin-bottom: 10px;"> <b>2.0    General Description</b> </div> <div style="margin-bottom: 10px;"> <b>2.1    Purpose</b> <p style="margin-left: 40px;">This module is intended for use as resident memory with the Western Digital Chip Set on the Terminal Intelligence Module. It will contain LSI-11 code for the RXT-11 object program.</p> </div> <div style="margin-bottom: 10px;"> <b>2.2    Introduction</b> <p style="margin-left: 40px;">This module has a MOS memory and a ROM or PROM. The memory can be 4K X 16, 8K X 16, 16K X 16 or 32K X 16 by using either 4K or 16K dynamic RAM chips.</p> <p style="margin-left: 40px;">The ROM (PROM) is used as a bootstrap to facilitate program loading. The ROM will contain the boot written in 11 code for the RXT-11 floppy disk.</p> </div> <div style="margin-bottom: 10px;"> <b>3.0    Option Description</b> <p style="margin-left: 40px;">The MST11 consists of a 5413275 TIM MOS RAM and all the reference documentation.</p> </div> <div style="margin-bottom: 10px;"> <b>3.1    Hardware</b> <div style="margin-left: 20px;"> <b>3.1.1    Block Diagram Description</b> <p style="margin-left: 40px;">This module is intended for use as a memory of 4K (4096), 8K (8192), 16K (16384) or 32K (32768) word by 16 bit with the Terminal Intelligence Module. Refer to the TIM Engineering Spec (A-SP- ) for a complete description of the TIM.</p> <p style="margin-left: 40px;">This memory will function as the resident memory for the 11 based processor on the TIM. It will be the memory that contains the customer program or the RT11 operating system.</p> <p style="margin-left: 40px;">It connects to the Western Digital chip set via a connection from the TIM. Refer to section 3.1.2 for a complete description of the interface signals. It is designed as a daughter board and will <u>not</u> stand alone. It always operates as a slave device as it has no capability of bus mastership. Along with the optional memory matrix configurations, there is a 1K X 16 bootstrap ROM (PROM) for program loading.</p> <p style="margin-left: 40px;">The TIM memory Daughter Module consists of nine basic functional areas: the RAM Matrix, the address bus mux, the byte selector, the Bootstrap ROM (PROM), the boot ROM selector, and the reply logic. Figure 1 brings all these functional blocks together.</p> </div> </div> |  |                    |  |

|  |      |      |           |     |
|--|------|------|-----------|-----|
|  | SIZE | CODE | NUMBER    | REV |
|  | A    | SP   | MST11-B-2 |     |

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TITLE TIM Memory Daughter Module

Bank selection is facilitated by having separate RAS signals for each bank. RAS 0 L selects bank 0 while RAS 1 L selects bank 1.

Since this memory is a dynamic memory it must be refreshed at least every 2 milliseconds to keep the data recirculating. This will be done by LSI-11 microcoded refresh cycles. 64 consecutive RAS cycles are performed every 1 millisecond. To refresh the 128 rows of a 16K memory, a two-state device is needed for the seventh row address bit.

The Address Bus Mux

This is a tri-state bus fed by address lines 1 to 14 for Row and Column addresses and address 0 to 5 and the extension for refresh cycles.

To allow for refreshing 128 rows with the 64 row refresh generated by the LSI-11 microcode a flip flop is attached to the seventh multiplexor input. This flip flop is toggled by refresh so that the first 64 rows are refreshed on the first interval then the next 64 rows are refreshed on the second interval. The refresh interval has to be 1 millisecond (ms) in order to refresh the 128 rows every 2 ms. When 4K chips are installed, this toggling is disabled.

The Bank Selector

A jumper (W2) is provided to select either 16K or 4K RAM chips. The jumper is installed for 4K parts and removed for 16K parts. If 16K RAM chips are used, (jumper removed), address bit 15 selects the bank. If 4K RAM chips are used Address 13, 14, and 15 are decoded to select the bank. Refresh will assert both Bank select signals. W3 is installed if only a single 4K is wanted, W4 is installed for a single 16K bank.

RAS/CAS/Mux Control Generator

Assertion of Sync generates RAS 0 L or RAS 1 L (depending on selected bank). There is an RC delay circuit connected to a 75107 chip to control the address path and CAS L.

The delay from RAS L to mux going high is = 80 ns. The delay from RAS L to CAS L is = 150 ns.

Memory Data Buffer

The memory data buffer prevents the RAM's from sending erroneous data to the WDAL bus on the TIM. It is enabled by selection of Bank 0 or Bank 1 during a DIN (Data In) cycle while refresh is unasserted.

| SIZE | CODE | NUMBER  | REV |
|------|------|---------|-----|
| A    | SP   | MST11-2 |     |

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TITLE TIM Memory Daughter Module

The Byte Selector

Byte selection is accomplished by decoding address 0 with WNB (write byte) during a DOUT (data out) cycle.

The Bootstrap ROM (PROM)

The bootstrap ROM is a 1024 word by 16 bit Read only memory that contains a floppy disk bootstrap program to get the RAT-11 operating. The Bootstrap ROM is enabled by asserting addresses in the range of 170000 to 173776 during a DIN cycle.

Bootstrap ROM Selector

Asserting any address in the range 170000-173776 will cause the ROM selector to enable the memories. A DIN or DOUT operation at these addresses will cause a reply to be generated. This allows DAT 10 cycles to be used.

Reply Logic

The signal, MRPLY (L) is generated by a DIN or DOUT cycle and selection of the boot ROM or assertion of CAS.

3.1.2 Interface Signals

The interconnection signals will be listed along with a brief description of their function.

| Signal Name | Type | Description                                                                                                                  |
|-------------|------|------------------------------------------------------------------------------------------------------------------------------|
| WDAL 0-15H  | I/O  | These lines act as data lines on the TIM and are data in and data out on the memory daughter module.                         |
| ADR 0-15    | I    | These are the latched addresses from the TIM. The higher order bits are used for bank selection. Address 0 selects the byte. |
| WDIN L      | I    | This is used to signify a Data IN operation (read). Used to enable the memory buffer for RAM read and enable the ROM.        |
| DOUT 0H     | I    | Signifies Data OUT operation (write). Asserts WE (write enable) on RAM's.                                                    |
| WSYNC L     | I    | Signals the beginning of a WD bus cycle. Used to enable the decoders, address mux, and start the memory cycle.               |
| FDIN (1)H   | I    | Signifies fast DIN cycle. Generates BRPLY.                                                                                   |
| WNB H       | I    | Used during DOUT cycles to signify half word (byte) operations. Byte = 8 bits                                                |

| SIZE | CODE | NUMBER  | REV |
|------|------|---------|-----|
| A    | SP   | MST11-2 |     |

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| Signal Name | Type | Description                                                                                         |
|-------------|------|-----------------------------------------------------------------------------------------------------|
| REF (Ø)H    | I    | When asserted, a 64 row refresh operation                                                           |
| MRPLY L     | O    | Asserted by the selected device when the device has accepted data or has data ready for the master. |
| +5V         | I    | Vcc (+5V) for Logic power.                                                                          |
| -5V         | I    | Vbb for RAM's and 751Ø7.                                                                            |
| +12V        | I    | Vdd for RAM's                                                                                       |

3.1.3 Memory Options

The memory can be either 4K, 8K, 16K or 32K. The memory chips used for this implementation are either 4K Dynamic RAM's for the 4 and 8K version or 16K Dynamic RAM's for the 16 and 32K versions. The worst case access time for the 4 and 8K versions is 431 ns. The worst case access time for the 16 and 32K memories is 431 ns. These access times are calculated relative to the leading edge of assertion of SYNC L.

3.1.4 Power Requirements

The voltages required for operation of the daughter module are +5V, +12V and -5V ± 5%.

| Voltage | I ave.                  | I peak            |
|---------|-------------------------|-------------------|
| +5V     | .654 A                  | NA                |
| +12V    | .96 A (4K) 1.12 A (16K) | 2.82A (Switching) |
| -5V     | 18.2 ma (4K) 24.4 ma    | NA                |

3.1.5 Ordering Information

The MST11 Terminal Intelligence Module Memory Daughter Module consists of a module and documentation as noted in the option parts list.

3.1.6 Logic Description

Before reading this section, the reader should be familiar with the block diagram description.

3.1.6.1 Memory Matrix

The memory matrix can be configured with 4K dynamic RAM chips or 16K dynamic RAM chips. Mixing of memory chip types is not allowed; all 4K or all 16K parts must be used.

There are two memory banks, bank Ø and bank 1. MUXAØ through MUXA6 are brought up to the matrix for address selection.

| SIZE | CODE | NUMBER    | REV |
|------|------|-----------|-----|
| A    | SP   | MST11-Ø-2 |     |

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TITLETIM Memory Daughter Module

WDAL Ø-15 H connects to the data in pins of the RAM chips. The memory outputs MO Ø-15 H are connected to the memory data buffer.

On the low byte of either bank the W input (write) is connected to OUT LB L. OUT HB L is used for the high byte.

Bank selection is accomplished by having two separate RAS (row address strobe) signals. RASØ L selects bank Ø while RAS 1 L selects bank 1. RAS is asserted by SYNC L becoming true (low).

CAS L (column address strobe) finishes the addressing operation and indicates the chosen operation. (Either read or write).

The memory is structured internally like a capacitor which means the data must be recharged to keep it from being lost. This recharging or refresh is accomplished by performing a RAS L (asserted) only cycle on the 64 (or 128) rows every 2 milliseconds. Section 3.1.6.2 presents a more detailed description of the logic used to handle this.

3.1.6.2 Address Bus Mux

The multiplexing of the 12 (or 14) bit address needed for 4Ø96 or 16384 locations is done with 2 74LS373 octal latches with tri-state outputs. The Latches are enabled by assertion of SYNC L.

The 74LS373 driving the bus is selected by ROWS L or COLS L. During the first part of the memory cycle ROWS L gates the contents of address Ø1 through Ø6 and address 14 to MUXAØ through MUXA6. When the 751Ø7 changes state, COLS L is asserted and ROWS L is unasserted allowing the contents of ADR Ø7 through ADR 13 to be gated onto MUXAØ through MUXA6.

Use of a common CAS allows the unselected memory to go to standby power.

| SIZE | CODE | NUMBER    | REV |
|------|------|-----------|-----|
| A    | SP   | MST11-Ø-2 |     |

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TITLETIM Memory Daughter Module

ADDR 14 is gated with REFINV L (Unasserted) to allow for the seventh address. During refresh, TGGLR (1) H is used to provide the seventh row address.

3.1.6.3 Bank Selector

To select 4K or 16K RAM chips, along with jumper W1, jumper W2 is included to enable different sections of the Bank Selection Logic. Jumper W2 is inserted for selection of 4K RAM chips. This unasserts 16K SEL H. For bank selection, ADR 13, 14, and 15 H are decoded to select bank Ø or 1.

BS7 L is asserted when ADR 13, 14 and 15H are high. BS7 is used as one of the enable inputs to the Boot ROM selector.

Logic Equations for Bank Selector

$BS7.5L = \overline{ADR13H} \cdot \overline{ADR14H} \cdot \overline{ADR15H} \cdot \overline{ADR12H}$

$BANKØSEL L = \overline{REFINTV H} + \overline{16KSELH} \cdot \overline{ADR13H} \cdot \overline{ADR14H} \cdot \overline{ADR15H}$

$\overline{BS7.5L} + 16SELH \cdot \overline{BS7.5L} \cdot \overline{ADR15H}$

$BANK 1 SEL L = \overline{REFINTV H} + \overline{16KSELH} \cdot \overline{ADR13H} \cdot \overline{ADR14H} \cdot \overline{ADR15H}$

$\overline{ADR15F} \cdot \overline{BS7.5L} + 16KSELH \cdot \overline{BS7.5H} \cdot \overline{ADR15H}$

For 16K Bank Selection ADR15H selects the Bank. Jumper W1 is removed asserting 16KSELH. 3ØK of Memory is directly addressable by the TIM. Addresses > 17ØØØØ are reserved for the I/O page.

Jumpers W3 and W4 are used to select a single 4K or 16K bank.

During the refresh interval, BANK Ø SEL L and BANK 1 SEL L are asserted.

3.1.6.4 RAS/CAS/MUX Logic

Two separate RAS signals are used for bank selection. RAS Ø L is generated by assertion of SYNCB H and Bank Ø SEL L. RAS 1 L is generated by assertion of SYNCB H and Bank 1 SEL L.

The delay between SYNB H asserting and MUX control and CAS L changing state is done with an RC delay attached to the differential inputs of a 751Ø7 chip. See figure 3 for a diagram of the RAS/CAS/MUX generator.

The memory can be speeded up by lowering the capacitor value. Keep in mind that the row address hold time is 25 ns. The threshold voltages on the 751Ø7 may have to change if high speed is wanted.

| SIZE | CODE | NUMBER    | REV |
|------|------|-----------|-----|
| A    | SP   | MST11-Ø-2 |     |

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TITLETIM Memory Daughter Module

The mux control delay is accomplished by the 6.8K and 909 Ø 1k in parallel and a 1ØØ pf capacitor connected between the output of a 74LSØ5 and the differential leg A of the 751Ø7. One side of the 751Ø7 is connected to a resistor divider. This places the lower 751Ø7 at ≈ 1.5 volts on leg A and the upper 751Ø7 at ≈ 3.0 volts on leg B.

With SYNCB H unasserted, A-B ≤ -25 mv in both cases and each output is low. CAS L is unasserted, COLS L is unasserted and ROWS L is asserted when REFINV L is passive.

The mux control changes state after SYNC B H asserts after the time required for input A on the lower 751Ø7 to go from .4V (VCE (SAT) of the 74LSØ5) to 1.5 volts (A-B ≥ 25 mv) plus the propagation delays of the gates involved.

The time required for CASG H to assert will be equal to the time required for input A on the upper 751Ø7 to go from .4V to 3 volts plus the propagation delays.

The 6.8K resistor is used to provide for changing values due to aging and other unpredictable variations. If the time gets to be < 75 ns, clip the resistor.

For a more detailed timing analysis, consult section 3.1.9.

3.1.6.5 Memory Data Buffer

The memory data buffer has MO Ø-15 H as inputs and drives WDAL ØØ-15 H when BANK Ø + 1 H is asserted, DIN B is asserted, and REFINV L is unasserted.

Two 74LS373's are used for the memory data buffer.

3.1.6.6 Byte Selector

The Byte selector consists of 1 74LS37 and an inverter. Out LBL and Out HBL are asserted when WWB H is low during a DOUT cycle. When WWB H is asserted, ADRØH will select the byte. ADRØH asserted will assert OUT HB L during a DOUT cycle. ADRØH low will assert OUT L B L during a DOUT cycle.

3.1.6.7 Bootstrap PROM (ROM)

The Bootstrap PROM is a 1024 X 16 bipolar PROM. It will contain the floppy disk bootstrap loader needed to get the system running.

| SIZE | CODE | NUMBER    | REV |
|------|------|-----------|-----|
| A    | SP   | MST11-Ø-2 |     |

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[illegible]

Figure 3. RAS/CAS/MUX Generator

|                  |            |                     |     |
|------------------|------------|---------------------|-----|
| SIZE<br><b>A</b> | CODE<br>SP | NUMBER<br>MST11-Ø-2 | REV |
|------------------|------------|---------------------|-----|

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DRA 10R

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The Bootstrap ROM is enabled by BOOTROMSEL L going low and DINBUF L going low.

### 3.1.6.8 Boot ROM Selector

Assertion of 170000 to 173777 will cause BOOT ROM SEL H to become true. An inverter is needed to provide the correct level for ROM enabling.

BOOT ROM SEL H = BS7.5L · ADRI1H · SYNC3H

$$\text{BOOT ROM SEL L} = \overline{\text{BOOT ROM SEL H}}$$

### 3.1.6.9 Reply Logic

MRPLY L is asserted by BOOT ROM SEL H, high and DINBUF L or DOUT B L or DINBUF L or DOUT B L and CASG H.

### 3.1.7 Signal Connections

The following table contains the pin numbers of the interconnection signals from the Terminal Intelligence Module to the TIM Memory Daughter Module.

| <u>Signal Name</u> | <u>Pin #</u> | <u>Signal Name</u> | <u>Pin #</u>      |
|--------------------|--------------|--------------------|-------------------|
| WDAL 15H           | J2-4Ø        | ADR 1ØH            | J1-15             |
| WDAL 14H           | J2-39        | ADR Ø9H            | J1-16             |
| WDAL 13H           | J2-38        | ADR Ø8H            | J1-33             |
| WDAL 12H           | J2-37        | ADR Ø7H            | J1-34             |
| WDAL 11H           | J2-36        | ADR Ø6H            | J1-32             |
| WDAL 1ØH           | J2-35        | ADR Ø5H            | J1-31             |
| WDAL Ø9H           | J2-34        | ADR Ø4H            | J1-3Ø             |
| WDAL Ø8H           | J2-33        | ADR Ø3H            | J1-17             |
| WDAL Ø7H           | J2-32        | ADR Ø2H            | J1-28             |
| WDAL Ø6H           | J2-31        | ADR Ø1H            | J1-29             |
| WDAL Ø5H           | J2-3Ø        | ADR ØØH            | 11-17             |
| WDAL Ø4H           | J2-29        | WDIN L             | J2-2Ø             |
| WDAL Ø3H           | J2-28        | DOUT (Ø)H          | J1-2Ø             |
| WDAL Ø2H           | J2-27        | WSYNC L            | J2-1              |
| WDAL Ø1H           | J2-26        | FDIN (1)H          | J1-3              |
| WDAL ØØH           | J2-25        | WMB H              | J1-4              |
| ADR 15H            | J2-3         | REF (Ø)H           | J1-22             |
| ADR 14H            | J2-4         | MRPLY L            | J1-5              |
| ADR 13H            | J2-5         | +5V                | J1-23,24,25,26,27 |
| ADR 12H            | J2-22        | -5V                | J1-6,7,8,9,1Ø     |
| ADR 11H            | J1-12        | +12V               | J1-36,37,38,39,4Ø |
| GND                | J2-11,12     | GND                | J2-13,14,15       |

|                  |            |                     |     |
|------------------|------------|---------------------|-----|
| SIZE<br><b>A</b> | CODE<br>SP | NUMBER<br>MS-11-0-2 | REV |
|------------------|------------|---------------------|-----|

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### 3.1.8 Power Consumption Details

| QTY.       | DESC.                         | +5VI (ma) per      | I-5V (ma) per               | I+12V (ma) per                                         | I+(+5V)  |
|------------|-------------------------------|--------------------|-----------------------------|--------------------------------------------------------|----------|
| 4          | 74LS173                       | 40                 | 0                           | 0                                                      | 160      |
| 1          | 74LS174                       | 8                  | 0                           | 0                                                      | 8        |
| 1          | 74LS127                       | 5.25               | 0                           | 0                                                      | 5.25     |
| 32         | 4K RAMS                       | .1                 | .1                          | 30                                                     | 1.6      |
| (Optional) | (2113735-01)                  | Depends on Loading |                             | (150 I peak)                                           |          |
| 1          | 74LS00                        | 4.4                | 0                           | 0                                                      | 4.4      |
| 2          | 74LS01                        | 4.4                | 0                           | 0                                                      | 8.8      |
| 2          | 74LS04                        | 6.6                | 0                           | 0                                                      | 13.2     |
| 1          | 74LS05                        | 6.6                | 0                           | 0                                                      | 6.6      |
| 1          | 74LS08                        | 8.8                | 0                           | 0                                                      | 17.6     |
| 1          | 74LS10                        | 3.3                | 0                           | 0                                                      | 3.3      |
| 2          | 74LS17                        | 12                 | 0                           | 0                                                      | 24       |
| 1          | 74LS21                        | 4.4                | 0                           | 0                                                      | 4.4      |
| 2          | 1024X8 PROMS<br>(23000-13-01) | 175                | 0                           | 0                                                      | 350      |
| 1          | 75107                         | 30                 | 15                          | 0                                                      | 30       |
| 32         | 16K RAMS                      | .1                 | .2                          | 35                                                     | 1.6      |
| (Optional) | 2113825-01                    | Depends on Loading |                             | (150 I peak)                                           |          |
| Resistor   |                               |                    |                             |                                                        |          |
| Divider    |                               | 16.4               | 0                           | 0                                                      | 16.4     |
| Pullups    |                               | .5                 | 0                           | 0                                                      | .5       |
| Totals     |                               |                    | 18.2ma (4K)<br>24.4ma (16K) | 960ma (4K)<br>1.12A (16K)<br>2.8A (peak)<br>4K and 16K | 654.05ma |

|                  |            |                     |     |
|------------------|------------|---------------------|-----|
| SIZE<br><b>A</b> | CODE<br>SP | NUMBER<br>MST11-Ø-2 | REV |
|------------------|------------|---------------------|-----|

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## CONTINUATION SHEET

### 3.1.9 RAS/CAS/MUX Timing Analysis

Propagation Delays of Chips involved:

|        | tp(LH) typ         | tp(LH) max | tp(HL) typ         | tp(HL) max |
|--------|--------------------|------------|--------------------|------------|
| 74LS04 | 9 ns               | 15 ns      | 10 ns              | 15 ns      |
| 74LS05 | 17 ns              | 32 ns      | 15 ns              | 28 ns      |
| 75107  | <del>12.5 ns</del> | 25 ns      | <del>12.5 ns</del> | 25 ns      |
| 74LS37 | 12 ns              | 24 ns      | 12 ns              | 24 ns      |
| 74LS10 | 9 ns               | 15 ns      | 10 ns              | 15 ns      |
| 74LS00 | 9 ns               | 15 ns      | 10 ns              | 15 ns      |

Resistor value variation for timing components:

$$r_1 = 909 \, \Omega \quad 1\%$$

$$r_2 = 6.8K \, \Omega \quad 5\%$$

variance of value

|                                   |              |        |
|-----------------------------------|--------------|--------|
|                                   | low          | high   |
| $R_p = \frac{r_1 r_2}{r_1 + r_2}$ | $r_1$ 899.91 | 918.89 |
|                                   | $r_2$ 6.46K  | 7.14K  |
|                                   | $R_p$ 789.8  | 813.4  |

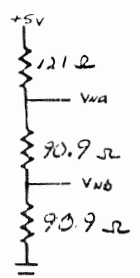
75107 thresholds differential:

| A-B                      |       | OUTPUT        |
|--------------------------|-------|---------------|
| $VID \geq 25 \text{ mv}$ |       | H             |
| $-25 \text{ mv} < VID$   | 25 mv | Indeterminate |
| $VID < -25 \text{ mv}$   |       | L             |

CASG H normally L goes H when VID  $\geq$  25 mv.  
Lower output normally L goes H when VIP  $\geq$  25 mv.

Voltages on resistor divider:

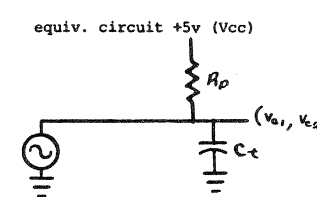
$$\begin{aligned} v_{na} &\approx 3.0 v \pm 2\% \\ v_{nb} &\approx 1.5 v \pm 2\% \end{aligned}$$



|                  |            |                                  |     |
|------------------|------------|----------------------------------|-----|
| SIZE<br><b>A</b> | CODE<br>SP | NUMBER<br>MST11- <del>p</del> -2 | REV |
|------------------|------------|----------------------------------|-----|

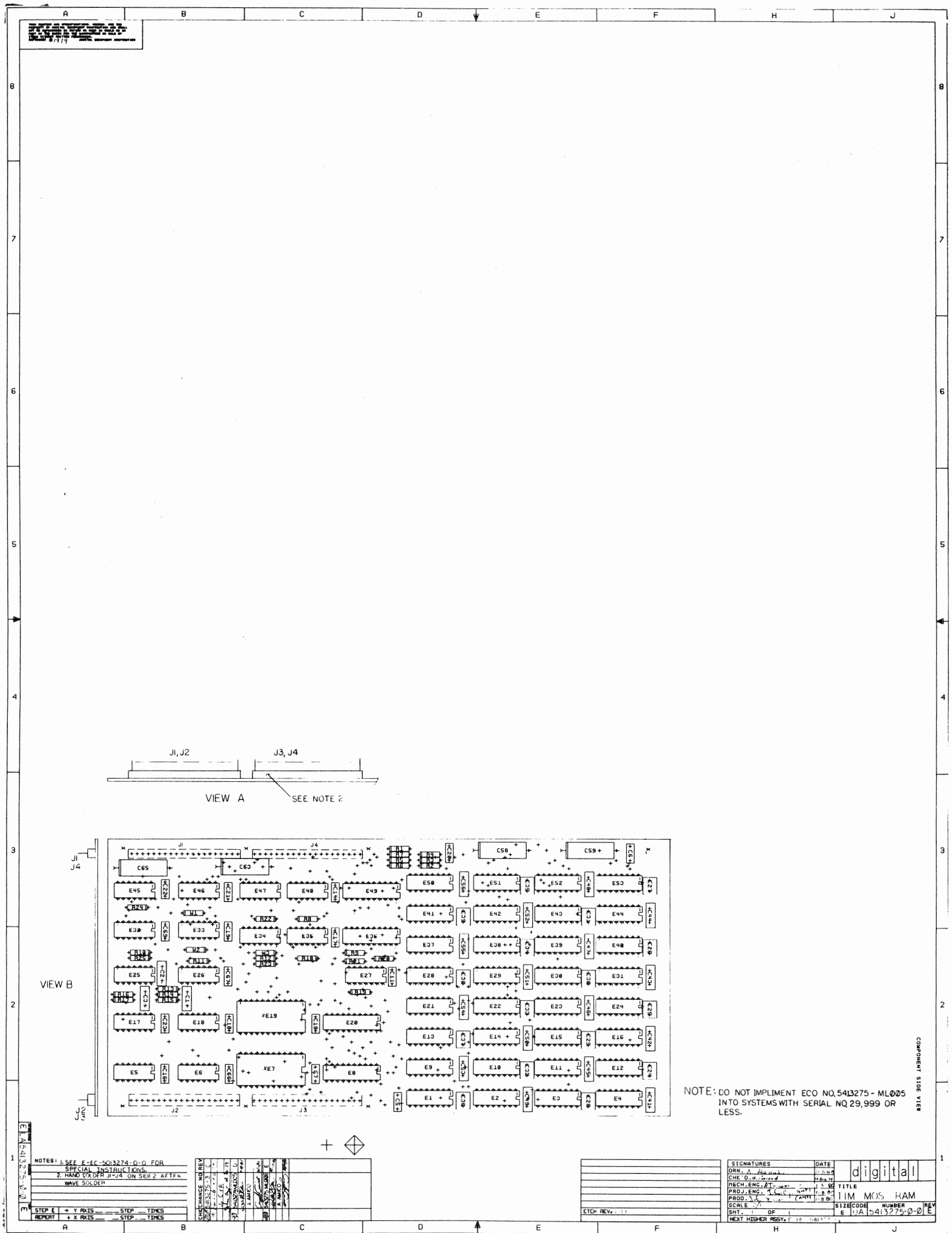
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |                    |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|-----|
| ENGINEERING SPECIFICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | CONTINUATION SHEET |     |
| TITLE TIM Memory Daughter Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |                    |     |
| <p>v nb + 25 mv = Threshold voltage (v<sub>c1</sub>) for lower RC timing<br/>v na + 25 mv = Threshold voltage (v<sub>c2</sub>) for upper RC timing (CASG H)</p> <p>Capacitor value variation - 180 pf 5%</p> <p>low high<br/>C 171 189 pf</p> <p>Time between SYNCB H 74LS05 (output) and input threshold.<br/>equiv. circuit +5v (Vcc)</p>  <p><math>t = RC \ln \frac{V_{cc}}{V_{cc} - v_c}</math></p> <p>R<sub>D</sub> = 789.8 - 813.4 Ω<br/>C = 171 - 189 pf<br/>V<sub>cc</sub> = +5V<br/>v<sub>c</sub> = 1.5V</p> <p>t varies from 48.1 ns to 64.8 ns on MUX control.</p> <p>Time between 74LS05 (output) and input threshold:<br/>Same equivalent circuit v<sub>c2</sub> = 3.0V</p> <p><math>t = RC \ln \frac{V_{cc}}{V_{cc} - v_c}</math></p> <p>R<sub>D</sub> = 789.8 - 813.4 Ω<br/>C = 171 - 189 pf<br/>V<sub>cc</sub> = 5V<br/>v<sub>c</sub> = 3.0V</p> <p>t varies from 123.7 ns to 140.8 ns.</p> <p>Time between RAS0 L or RAS1 L and SYNC L</p> <p>max 15 ns + 24 ns = 39 ns<br/>typ 9 ns + 12 ns = 21 ns</p> <p>Time between SYNC L and COLS L</p> <p>max 15 ns + 28 ns + 32 ns + 54.8 ns + 25 ns + 15 ns + 15 ns = 164.8 ns<br/>typ 9 ns + 15 ns + 17 ns + 57.5 ns + 12 ns + 9 ns + 10 ns = 124 ns</p> <p>min 0 ns + 0 ns + 0 ns + 48.1 ns + 0 ns + 0 ns = 48.1 ns<br/>typ prop. delays assumed.</p> |      |                    |     |
| SIZE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | CODE | NUMBER             | REV |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | SP   | MST11-0-2          |     |
| DEC FORM NO EN-01022-16-N370-(381)<br>DRA 108                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                    |     |
| MR SHEET 17 OF 19                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                    |     |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |                    |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|-----|
| ENGINEERING SPECIFICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      | CONTINUATION SHEET |     |
| TITLE TIM Memory Daughter Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                    |     |
| <p>Time between SYNC L and CAS L</p> <p>max 15 ns + 28 ns + 32 ns + 140.8 ns + 25 ns + 24 ns = 264.8 ns<br/>typ 9 ns + 15 ns + 17 ns + 132.3 ns + 12 ns + 12 ns = 197.8 ns</p> <p>min 0 ns + 0 ns + 0 ns + 123.7 ns + 0 ns + 0 ns = 123.7 ns</p> <p>Conclusions: At 48.1 ns minimum there is plenty of slack to stay within the ROW Address Hold time (TAHX) of 25 ns. 16K TRLL AX1 is 25 ns.</p> <p>RAS0 or RAS1 L will stay asserted for the rest of the cycle. SYNC L shouldn't be any longer than 10 μs. This shouldn't occur because the Reply is directly attached to the WD chip set.</p> <p>4K maximum access time 332.8 ns These figures are<br/>16K maximum access time 332.8 ns relative to WSYNC L</p> |      |                    |     |
| 4.0 Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |                    |     |
| 4.1 Environmental -<br>- Class B2<br>Ambient temperature<br>Operating: 10° to 50°C<br>Non-operating: -40° to 66°C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |                    |     |
| Humidity: 10 to 95 percent non-condensing with wet bulb 28°C and minimum dew point 2°C.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                    |     |
| Altitude: Operating: sea level to 8000 ft.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                    |     |
| 4.2 Electrical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |                    |     |
| Access time (4 and 8K versions) 33 ns<br>Access time (16 and 32K versions) 33 ns                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                    |     |
| +5V @ 654ma<br>+12V @ 1.12A 2.8A (peak)<br>-5V @ 24.4ma                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                    |     |
| 4.3 Mechanical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |                    |     |
| The board mounts in the RX36 system box and plugs into the Terminal Intelligence module via a board interconnecting plug.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |                    |     |
| Dimensions: 10.2" Long x 5.202" Wide<br>Mounting: Via 6-4-40 screws that align the stacking connectors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                    |     |
| SIZE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CODE | NUMBER             | REV |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | SP   | MST11-0-2          |     |
| DEC FORM NO EN-01022-16-N370-(381)<br>DRA 108                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                    |     |
| MR SHEET 18 OF 19                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |                    |     |

|                                               |                        |                     |     |    |     |
|-----------------------------------------------|------------------------|---------------------|-----|----|-----|
| ENGINEERING SPECIFICATION                     |                        | CONTINUATION SHEET  |     |    |     |
| TITLE TIM Memory Daughter Module              |                        |                     |     |    |     |
| 4.4 Configuration Chart                       |                        |                     |     |    |     |
| Memory Size                                   | Chip Type Desc.        | No. of Memory Chips | W1  | W2 | W3  |
| 4K                                            | 200 ns 4K dynamic RAM  | 16                  | IN  | IN | OUT |
| 8K                                            | 200 ns 4K dynamic RAM  | 32                  | IN  | IN | IN  |
| 16K                                           | 200 ns 16K dynamic RAM | 16                  | OUT | IN | OUT |
| 30K                                           | 200 ns 16K dynamic RAM | 32                  | OUT | IN | IN  |
| SIZE                                          | CODE                   | NUMBER              | REV |    |     |
| A                                             | SP                     | MST11-0-2           |     |    |     |
| DEC FORM NO EN-01022-16-N370-(381)<br>DRA 108 |                        |                     |     |    |     |
| MR SHEET 19 OF 19                             |                        |                     |     |    |     |



| LINE | ITEM | DOCUMENT NUMBER  | PART NUMBER | DESCRIPTION                      | QTY PER VARIATION |    |    |    | REFERENCE DESIGNATOR                              |
|------|------|------------------|-------------|----------------------------------|-------------------|----|----|----|---------------------------------------------------|
|      |      |                  |             |                                  | 00                | AB | AC | AD |                                                   |
| 1    | 1    | E-MD-5013274-0-0 | 5013274-00  | 5413275                          | 1                 | 1  | 1  | 1  |                                                   |
| 2    | 2    |                  | 1010274-00  | .22 MFD 50V +80-20% Z5U CER      | 18                | 18 | 18 | 18 | C1,C2,C41-C56                                     |
| 3    | 3    |                  | 1000020-00  | 180.0 MMF 100V 5%200PPM MICA     | 1                 | 1  | 1  | 1  | C3                                                |
| 4    | 4    |                  | 1001610-01  | .01 MFD50/100V +80-20% DISC      | 17                | 17 | 17 | 17 | C5-C7,C10,C11,C14,C16-C23,C66,<br>CONT<br>C67,C69 |
| 5    | 5    |                  | 1000075-00  | .25 MFD 25V +75-10% AL EL        | 4                 | 4  | 4  | 4  | C58,C59,C63,C65                                   |
| 6    | 6    |                  | 1010279-00  | .47 MFD 25V 20% CER              | 16                | 16 | 16 | 16 | C24-C39                                           |
| 7    | 7    |                  | 1215006-06  | SOCKET 24PIN IC LOW PROFILE      | 2                 | 2  | 2  | 2  | XE7,XE19                                          |
| 8    | 8    |                  | 1302751-00  | 30.0 .25 W 5.0 % CC              | 9                 | 9  | 9  | 9  | R1-R7,R20,R21                                     |
| 9    | 9    |                  | 1302124-00  | 18.0 .25 W 5.0 % CC              | 3                 | 3  | 3  | 3  | R8,R9,R19                                         |
| 10   | 10   |                  | 1300479-00  | 10.0 K .25 W 5.0 % CC            | 1                 | 1  | 1  | 1  | R10                                               |
| 11   | 11   |                  | 1300365-00  | 1.0 K .25 W 5.0 % CC             | 7                 | 7  | 7  | 7  | R11,R12,R18,R22-R25                               |
| 12   | 12   |                  | 1303037-00  | 90.90 .25 W 1.0 % RN55D-F10      | 2                 | 2  | 2  | 2  | R14,R15                                           |
| 13   | 13   |                  | 1302957-00  | 121.0 .25 W 1.0 % RN55D-F10      | 1                 | 1  | 1  | 1  | R13                                               |
| 14   | 14   |                  | 1302685-00  | 909.0 .25 W 1.0 % RN55D-F10      | 1                 | 1  | 1  | 1  | R16                                               |
| 15   | 15   |                  | 1301423-00  | 6.80 K .25 W 5.0 % CC            | 1                 | 1  | 1  | 1  | R17                                               |
| 16   | 16   |                  | 1912803-00  | 74LS04 INVERTER GATE,HEX         | 2                 | 2  | 2  | 2  | E5,E47                                            |
| 17   | 17   |                  | 1910268-00  | DEC 75107B RECEIVER,LINE,DUAL,   | 1                 | 1  | 1  | 1  | E25                                               |
| 18   | 18   |                  | 1915219-00  | LS373 FF-D OCTAL-TRANSPARE       | 4                 | 4  | 4  | 4  | E8,E20,E36,E49                                    |
| 19   | 19   |                  | 1912811-00  | LS21 AND GATE-DUAL 4IN,PO        | 1                 | 1  | 1  | 1  | E17                                               |
| 20   | 20   |                  | 1912804-00  | LS05 INVERTER GATE-HEX 1I        | 1                 | 1  | 1  | 1  | E34                                               |
| 21   | 21   |                  | 1912805-00  | LS08 AND GATE-QUAD 2IN,PO        | 2                 | 2  | 2  | 2  | E6,E33                                            |
| 22   | 22   |                  | 1912800-00  | LS01 NAND-GATE-QUAD 2IN,P        | 2                 | 2  | 2  | 2  | E32,E45                                           |
| 23   | 23   |                  | 1912817-00  | LS37 NAND GATE-QUAD 2IN,P        | 2                 | 2  | 2  | 2  | E27,E35                                           |
| 24   | 24   |                  | 1912807-00  | LS10 NAND GATE-TRIPLE 3IN        | 1                 | 1  | 1  | 1  | E18                                               |
| 25   | 25   |                  | 1912813-00  | LS27 NOR GATE-TRIPLE 3IN         | 1                 | 1  | 1  | 1  | E46                                               |
| 26   | 26   |                  | 1912799-00  | LS00 NAND-GATE-QUAD 2IN,P        | 1                 | 1  | 1  | 1  | E26                                               |
| 27   | 27   |                  | 1912824-00  | LS74 FF-D DUAL,EDGE TRIGG        | 1                 | 1  | 1  | 1  | E48                                               |
| 28   | 28   |                  | 9009185-00  | JUMPER, WIRE, INSULATED, BLACK B | 3                 | 3  | 3  | 3  | W1-W3                                             |
| 29   | 29   |                  | 2113735-01  | 4K MOS RAM 200NS 1               | -                 | 32 | -  | -  | E1-E4,E9-E16,E21-E24,E28-E31,                     |

| REVISION HISTORY |               |     | BASIC PART NO: 5413275  |  |  | DRN: M. NORMAND         |  |  | DATE: 11-APR-78      |  |  | D I G I T A L        |  |  |
|------------------|---------------|-----|-------------------------|--|--|-------------------------|--|--|----------------------|--|--|----------------------|--|--|
| ENG              | ECO NUMBER    | REV | SECTION A OF D          |  |  | CHK'D: M. NORMAND       |  |  | DATE: 11-APR-78      |  |  | TITLE PARTS LIST     |  |  |
|                  | INITIAL       | B   | SECTION VARIATION INDEX |  |  | CHK'D: M. NORMAND       |  |  | DATE: 11-APR-78      |  |  | TIM MOS RAM          |  |  |
| JC               | 5413275-MR003 | B   | [A] 00,AB,AC,AD         |  |  |                         |  |  |                      |  |  |                      |  |  |
| AA               | 5413275-ML005 | C   | [B] AE,BB,BC,BD         |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [C] BE,BF,CB,CC         |  |  | DES.ENG: A. TUNNESSEN   |  |  | DATE: 20-APR-78      |  |  |                      |  |  |
|                  |               |     | [D] CD,CE,CF            |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [E]                     |  |  |                         |  |  |                      |  |  | DOCUMENT NUMBER      |  |  |
|                  |               |     | [F]                     |  |  | RESP.ENG.: A. TUNNESSEN |  |  | DATE: 20-APR-78      |  |  |                      |  |  |
|                  |               |     | [H]                     |  |  |                         |  |  |                      |  |  | SIZE CODE NUMBER REV |  |  |
|                  |               |     | [J]                     |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [K]                     |  |  | MFG.ENG.: R. HAMILTON   |  |  | DATE: 20-APR-78      |  |  | K PL 5413275-0-DBP C |  |  |
|                  |               |     | [L]                     |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [M]                     |  |  | ASSEMBLY NUMBER:        |  |  | TOP DOCUMENT NUMBER: |  |  | FILE NAME:           |  |  |
|                  |               |     | [N]                     |  |  | E-UA-5413275-0-0        |  |  | B-DD-5413275-0-0     |  |  | Z0869C.PLS           |  |  |
|                  |               |     |                         |  |  |                         |  |  |                      |  |  | EDIT # 13            |  |  |

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| LINE | ITEM | DOCUMENT NUMBER  | PART NUMBER | DESCRIPTION                      | QTY PER VARIATION |    |    |    | REFERENCE DESIGNATOR                           |
|------|------|------------------|-------------|----------------------------------|-------------------|----|----|----|------------------------------------------------|
|      |      |                  |             |                                  | AE                | BB | BC | BD |                                                |
| 1    | 1    | E-MD-5013274-0-0 | 5013274-00  | 5413275                          | 1                 | 1  | 1  | 1  |                                                |
| 2    | 2    |                  | 1010274-00  | .22 MFD 50V +80-20% Z5U CER      | 18                | 18 | 18 | 18 | C1,C2,C41-C56                                  |
| 3    | 3    |                  | 1000020-00  | 180.0 MMF 100V 5%200PPM MICA     | 1                 | 1  | 1  | 1  | C3                                             |
| 4    | 4    |                  | 1001610-01  | .01 MFD50/100V +80-20% DISC      | 17                | 17 | 17 | 17 | C5-C7,C10,C11,C14,C16-C23,C66,<br>CONT C67,C69 |
| 5    | 5    |                  | 1000075-00  | 25 MFD 25V +75-10% AL EL         | 4                 | 4  | 4  | 4  | C58,C59,C63,C65                                |
| 6    | 6    |                  | 1010279-00  | .47 MFD 25V 20% CER              | 16                | 16 | 16 | 16 | C24-C39                                        |
| 7    | 7    |                  | 1215006-06  | SOCKET 24PIN IC LOW PROFILE      | 2                 | 2  | 2  | 2  | XE7,XE19                                       |
| 8    | 8    |                  | 1302751-00  | 30.0 .25 W 5.0 % CC              | 9                 | 9  | 9  | 9  | R1-R7,R20,R21                                  |
| 9    | 9    |                  | 1302124-00  | 18.0 .25 W 5.0 % CC              | 3                 | 3  | 3  | 3  | R8,R9,R19                                      |
| 10   | 10   |                  | 1300479-00  | 10.0 K .25 W 5.0 % CC            | 1                 | 1  | 1  | 1  | R10                                            |
| 11   | 11   |                  | 1300365-00  | 1.0 K .25 W 5.0 % CC             | 7                 | 7  | 7  | 7  | R11,R12,R18,R22-R25                            |
| 12   | 12   |                  | 1303037-00  | 90.90 .25 W 1.0 % RN55D-F10      | 2                 | 2  | 2  | 2  | R14,R15                                        |
| 13   | 13   |                  | 1302957-00  | 121.0 .25 W 1.0 % RN55D-F10      | 1                 | 1  | 1  | 1  | R13                                            |
| 14   | 14   |                  | 1302685-00  | 909.0 .25 W 1.0 % RN55D-F10      | 1                 | 1  | 1  | 1  | R16                                            |
| 15   | 15   |                  | 1301423-00  | 6.80 K .25 W 5.0 % CC            | 1                 | 1  | 1  | 1  | R17                                            |
| 16   | 16   |                  | 1912803-00  | 74LS04 INVERTER GATE,HEX         | 2                 | 2  | 2  | 2  | E5,E47                                         |
| 17   | 17   |                  | 1910268-00  | DEC 75107B RECEIVER,LINE,DUAL,   | 1                 | 1  | 1  | 1  | E25                                            |
| 18   | 18   |                  | 1915219-00  | LS373 FF-D OCTAL-TRANSPARE       | 4                 | 4  | 4  | 4  | E8,E20,E36,E49                                 |
| 19   | 19   |                  | 1912811-00  | LS21 AND GATE-DUAL 4IN,PO        | 1                 | 1  | 1  | 1  | E17                                            |
| 20   | 20   |                  | 1912804-00  | LS05 INVERTER GATE-HEX 1I        | 1                 | 1  | 1  | 1  | E34                                            |
| 21   | 21   |                  | 1912805-00  | LS08 AND GATE-QUAD 2IN,PO        | 2                 | 2  | 2  | 2  | E6,E33                                         |
| 22   | 22   |                  | 1912800-00  | LS01 NAND-GATE-QUAD 2IN,P        | 2                 | 2  | 2  | 2  | E32,E45                                        |
| 23   | 23   |                  | 1912817-00  | LS37 NAND GATE-QUAD 2IN,P        | 2                 | 2  | 2  | 2  | E27,E35                                        |
| 24   | 24   |                  | 1912807-00  | LS10 NAND GATE-TRIPLE 3IN        | 1                 | 1  | 1  | 1  | E18                                            |
| 25   | 25   |                  | 1912813-00  | LS27 NOR GATE-TRIPLE 3IN         | 1                 | 1  | 1  | 1  | E46                                            |
| 26   | 26   |                  | 1912799-00  | LS00 NAND-GATE-QUAD 2IN,P        | 1                 | 1  | 1  | 1  | E26                                            |
| 27   | 27   |                  | 1912824-00  | LS74 FF-D DUAL,EDGE TRIGG        | 1                 | 1  | 1  | 1  | E48                                            |
| 28   | 28   |                  | 9009185-00  | JUMPER, WIRE, INSULATED, BLACK B | 3                 | 3  | 3  | 3  | W1-W3                                          |
| 29   | 29   |                  | 2113735-01  | *** THIS ITEM IS NOT USED ***    | -                 | -  | -  | -  |                                                |

| REVISION HISTORY |               |     | BASIC PART NO: 5413275  |  |  | DRN: M. NORMAND         |  |  | DATE: 11-APR-78      |  |  | D I G I T A L        |  |  |
|------------------|---------------|-----|-------------------------|--|--|-------------------------|--|--|----------------------|--|--|----------------------|--|--|
| ENG              | ECO NUMBER    | REV | SECTION B OF D          |  |  | CHK'D: M. NORMAND       |  |  | DATE: 11-APR-78      |  |  | TITLE PARTS LIST     |  |  |
| ---              | INITIAL       | B   | SECTION.VARIATION INDEX |  |  | CHK'D: M. NORMAND       |  |  | DATE: 11-APR-78      |  |  | TIM MOS RAM          |  |  |
| JC               | 5413275-MR003 | B   | [A] 00,AB,AC,AD         |  |  |                         |  |  |                      |  |  |                      |  |  |
| AA               | 5413275-ML005 | C   | [B] AE,BB,BC,BD         |  |  | DES.ENG: A. TUNNESSEN   |  |  | DATE: 20-APR-78      |  |  |                      |  |  |
|                  |               |     | [C] BE,BF,CB,CC         |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [D] CD,CE,CF            |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [E]                     |  |  | RESP.ENG.: A. TUNNESSEN |  |  | DATE: 20-APR-78      |  |  | DOCUMENT NUMBER      |  |  |
|                  |               |     | [F]                     |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [G]                     |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [H]                     |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [I]                     |  |  | MFG.ENG.: R. HAMILTON   |  |  | DATE: 20-APR-78      |  |  | K PL 5413275-0-DBP C |  |  |
|                  |               |     | [J]                     |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [K]                     |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [L]                     |  |  |                         |  |  |                      |  |  |                      |  |  |
|                  |               |     | [M]                     |  |  | ASSEMBLY NUMBER:        |  |  | TOP DOCUMENT NUMBER: |  |  | FILE NAME:           |  |  |
|                  |               |     | [N]                     |  |  | E-UA-5413275-0-0        |  |  | B-DD-5413275-0-0     |  |  | Z0869C.PLS           |  |  |
|                  |               |     |                         |  |  |                         |  |  |                      |  |  | EDIT # 13            |  |  |

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| LINE | ITEM | DOCUMENT | NUMBER | PART       | NUMBER | DESCRIPTION                   | QTY PER VARIATION |    |    |    | REFERENCE                                                              | DESIGNATOR |
|------|------|----------|--------|------------|--------|-------------------------------|-------------------|----|----|----|------------------------------------------------------------------------|------------|
|      |      |          |        |            |        |                               | AE                | BB | BC | BD |                                                                        |            |
| 30   | 30   |          |        | 2114475-01 |        | *** THIS ITEM IS NOT USED *** | -                 | -  | -  | -  |                                                                        |            |
| 31   | 31   |          |        | 2113914-01 |        | *** THIS ITEM IS NOT USED *** | -                 | -  | -  | -  |                                                                        |            |
| 32   | 32   |          |        | 2114114-01 |        | 4K MOS RAM 200NS 1            | 32                | -  | -  | -  | E1-E4,E9-E16,E21-E24,E28-E31,<br>CONT E37-E44,E50-E53                  |            |
| 33   | 33   |          |        | 2113825-01 |        | 16K MOS RAM 200NS 1           | -                 | 16 | -  | -  | E3,E4,E11,E12,E15,E16,E23,E24,<br>CONT E30,E31,E39,E40,E43,E44,E52,E53 |            |
| 34   | 34   |          |        | 2114408-01 |        | 16K MOS RAM 200NS 1           | -                 | -  | 16 | -  | E3,E4,E11,E12,E15,E16,E23,E24,<br>CONT E30,E31,E39,E40,E43,E44,E52,E53 |            |
| 35   | 36   |          |        | 2114927-01 |        | *** THIS ITEM IS NOT USED *** | -                 | -  | -  | -  |                                                                        |            |
| 36   | 37   |          |        | 2114897-01 |        | *** THIS ITEM IS NOT USED *** | -                 | -  | -  | -  |                                                                        |            |
| 37   | 38   |          |        | 1215901-02 |        | HEADER 20PIN STRAIGHT         | 4                 | 4  | 4  | 4  | J1-J4                                                                  |            |

38 NOTE: 1. 5413275-AA,BA,CA ARE PRIMARY VARIATIONS OF THE 4K,16K OR 32K SYSTEM. (NOT A MODULE TYPE)  
39 NOTE: 5413275-AB,AC,AD,AE,BB,BC,BD,BE,BF,CB,CC,CD,CE AND CF ARE MODULE TYPES, USING  
40 NOTE: DIFFERENT 4K OR 16K MOS DEVICES AND ARE IDENTICAL IN FUNCTION AND PURPOSE.

|   |   |   |   |   |   |   |             |                |      |      |                 |     |
|---|---|---|---|---|---|---|-------------|----------------|------|------|-----------------|-----|
| D | I | G | I | T | A | L | TITLE       | SECTION B OF D | SIZE | CODE | DOCUMENT NUMBER | REV |
|   |   |   |   |   |   |   | TIM MOS RAM |                | K    | PL   | 5413275-0-DBP   | C   |



| LINE | ITEM | DOCUMENT NUMBER | PART NUMBER | DESCRIPTION                   | QTY PER VARIATION |    |    |    | REFERENCE DESIGNATOR                                              |
|------|------|-----------------|-------------|-------------------------------|-------------------|----|----|----|-------------------------------------------------------------------|
|      |      |                 |             |                               | BE                | BF | CB | CC |                                                                   |
| 30   | 30   |                 | 2114475-01  | *** THIS ITEM IS NOT USED *** | -                 | -  | -  | -  |                                                                   |
| 31   | 31   |                 | 2113914-01  | *** THIS ITEM IS NOT USED *** | -                 | -  | -  | -  |                                                                   |
| 32   | 32   |                 | 2114114-01  | *** THIS ITEM IS NOT USED *** | -                 | -  | -  | -  |                                                                   |
| 33   | 33   |                 | 2113825-01  | 16K MOS RAM 200NS 1           | -                 | -  | 32 | -  | E1-E4,E9-E16,E21-E24,E28-E31,<br>E37-E44,E50-E53                  |
| 34   | 34   |                 | 2114408-01  | 16K MOS RAM 200NS 1           | -                 | -  | -  | 32 | E1-E4,E9-E16,E21-E24,E28-E31,<br>E37-E44,E50-E53                  |
| 35   | 36   |                 | 2114927-01  | 16K MOS RAM 200NS 1           | 16                | -  | -  | -  | E3,E4,E11,E12,E15,E16,E23,E24,<br>E30,E31,E39,E40,E43,E44,E52,E53 |
| 36   | 37   |                 | 2114897-01  | 16K MOS RAM 200NS 1           | -                 | 16 | -  | -  | E3,E4,E11,E12,E15,E16,E23,E24,<br>E30,E31,E39,E40,E43,E44,E52,E53 |
| 37   | 38   |                 | 1215901-02  | HEADER 20PIN STRAIGHT         | 4                 | 4  | 4  | 4  | J1-J4                                                             |

38 NOTE: 1. 5413275-AA,BA,CA ARE PRIMARY VARIATIONS OF THE 4K,16K OR 32K SYSTEM. (NOT A MODULE TYPE)  
39 NOTE: 5413275-AB,AC,AD,AE,BB,BC,BD,BE,BF,CB,CC,CD,CE AND CF ARE MODULE TYPES, USING  
40 NOTE: DIFFERENT 4K OR 16K MOS DEVICES AND ARE IDENTICAL IN FUNCTION AND PURPOSE.

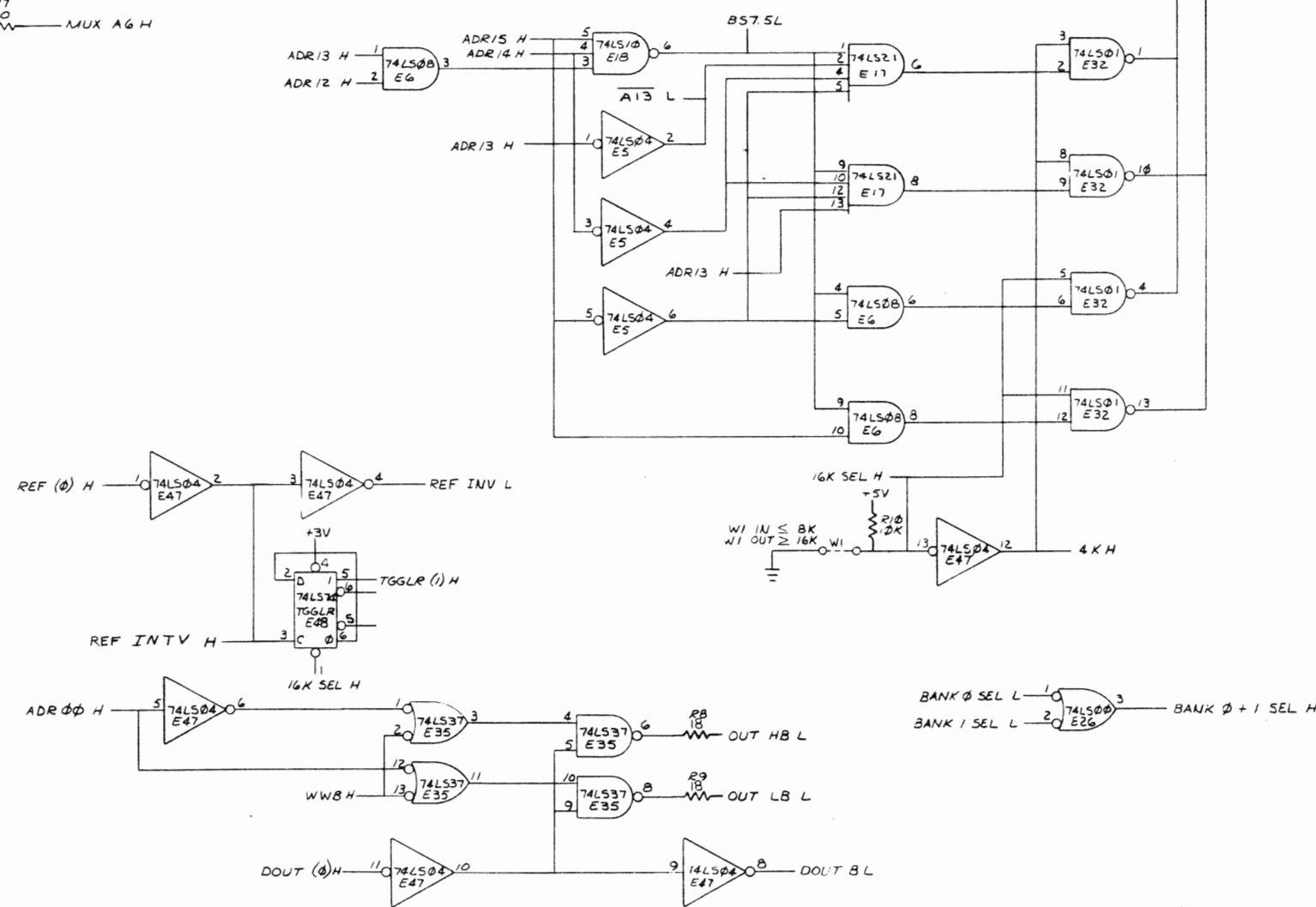
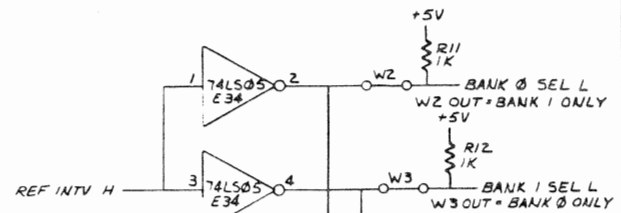
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|---|---|---|---|---|---|---|-------------|----------------|------|------|-----------------|-----|
| D | I | G | I | T | A | L | TITLE       | SECTION C OF D | SIZE | CODE | DOCUMENT NUMBER | REV |
|   |   |   |   |   |   |   | TIM MOS RAM |                | K    | PL   | 5413275-0-DBP   | C   |



| LINE | ITEM | DOCUMENT NUMBER | PART NUMBER | DESCRIPTION                   | QTY PER VARIATION |    |    | REFERENCE DESIGNATOR                                  |
|------|------|-----------------|-------------|-------------------------------|-------------------|----|----|-------------------------------------------------------|
|      |      |                 |             |                               | CD                | CE | CF |                                                       |
| 30   | 30   |                 | 2114475-01  | *** THIS ITEM IS NOT USED *** | -                 | -  | -  |                                                       |
| 31   | 31   |                 | 2113914-01  | *** THIS ITEM IS NOT USED *** | -                 | -  | -  |                                                       |
| 32   | 32   |                 | 2114114-01  | *** THIS ITEM IS NOT USED *** | -                 | -  | -  |                                                       |
| 33   | 33   |                 | 2113825-01  | *** THIS ITEM IS NOT USED *** | -                 | -  | -  |                                                       |
| 34   | 34   |                 | 2114408-01  | *** THIS ITEM IS NOT USED *** | -                 | -  | -  |                                                       |
| 35   | 36   |                 | 2114927-01  | 16K MOS RAM 200NS 1           | -                 | 32 | -  | E1-E4,E9-E16,E21-E24,E28-E31,<br>CONT E37-E44,E50-E53 |
| 36   | 37   |                 | 2114897-01  | 16K MOS RAM 200NS 1           | -                 | -  | 32 | E1-E4,E9-E16,E21-E24,E29-E31,<br>CONT E37-E44,E50-E53 |
| 37   | 38   |                 | 1215901-02  | HEADER 20PIN STRAIGHT         | 4                 | 4  | 4  | J1-J4                                                 |

38 NOTE: 1. 5413275-AA,BA,CA ARE PRIMARY VARIATIONS OF THE 4K,16K OR 32K SYSTEM. (NOT A MODULE TYPE)  
39 NOTE: 5413275-AB,AC,AD,AE,BB,BC,BD,BE,BF,CB,CC,CD,CE AND CF ARE MODULE TYPES, USING  
40 NOTE: DIFFERENT 4K OR 16K MOS DEVICES AND ARE IDENTICAL IN FUNCTION AND PURPOSE.

|   |   |   |   |   |   |   |             |                |      |      |                 |     |
|---|---|---|---|---|---|---|-------------|----------------|------|------|-----------------|-----|
| D | I | G | I | T | A | L | TITLE       | SECTION D OF D | SIZE | CODE | DOCUMENT NUMBER | REV |
|   |   |   |   |   |   |   | TIM MOS RAM |                | K    | PL   | 5413275-0-DBP   | C   |



|                     |           |                                   |        |             |      |
|---------------------|-----------|-----------------------------------|--------|-------------|------|
| DRN. M. Norwood     | 30 JAN 78 | FIRST USED ON                     | RXT-11 | digital     |      |
| CHKD. J. L. L. L.   | 31 DEC 78 | TITLE<br>MST II TIM<br>RAM MODULE |        |             |      |
| ENG. T. L. L.       | 12 DEC 78 |                                   |        |             |      |
| PROJ. ENG. M. L. L. | 2 DEC 78  |                                   |        |             |      |
| PROD. L. L. L.      | 1 DEC 78  |                                   |        |             |      |
| NEXT HIGHER ASSY.   |           |                                   |        |             |      |
| B-DC-5413275-0      |           | SIZE                              | CODE   | NUMBER      | REV. |
| SCALE               |           | D                                 | CS     | 5413275-0-1 | E    |
| SHEET 1 OF 8        |           | DIST.                             |        |             |      |

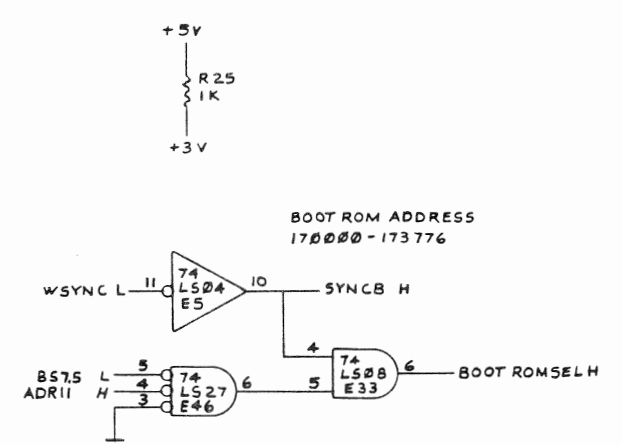
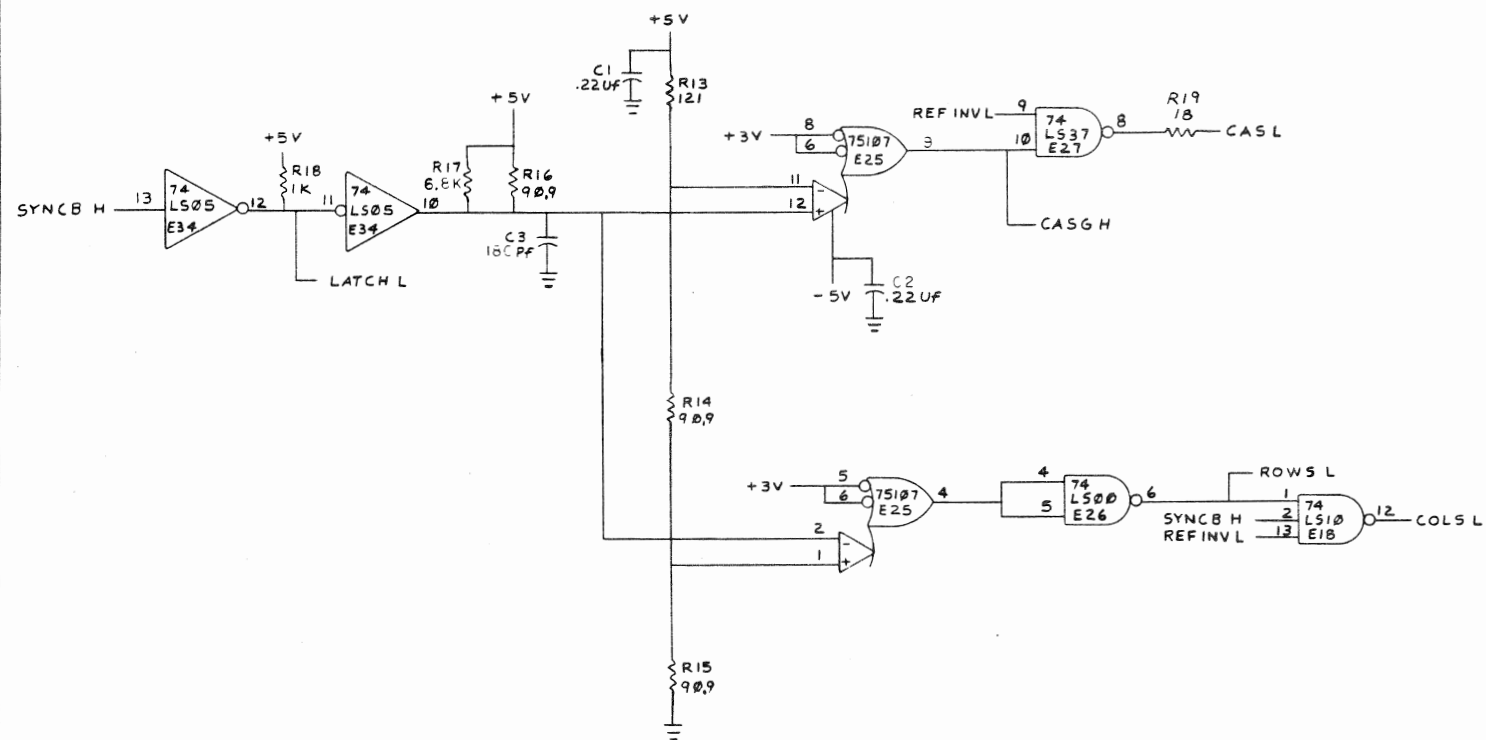
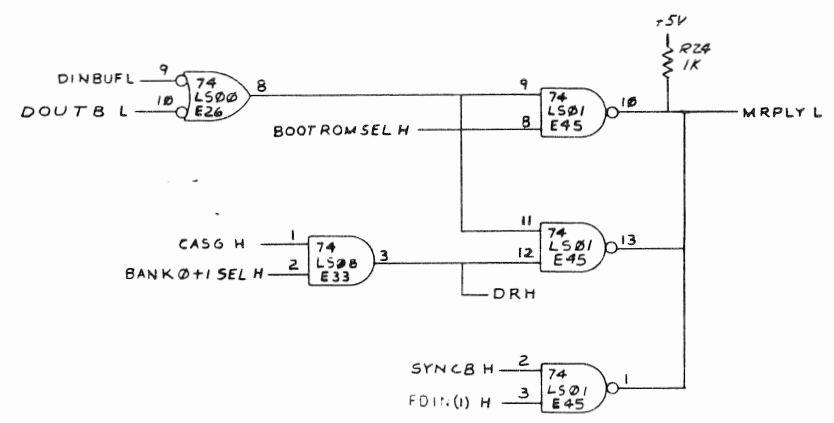
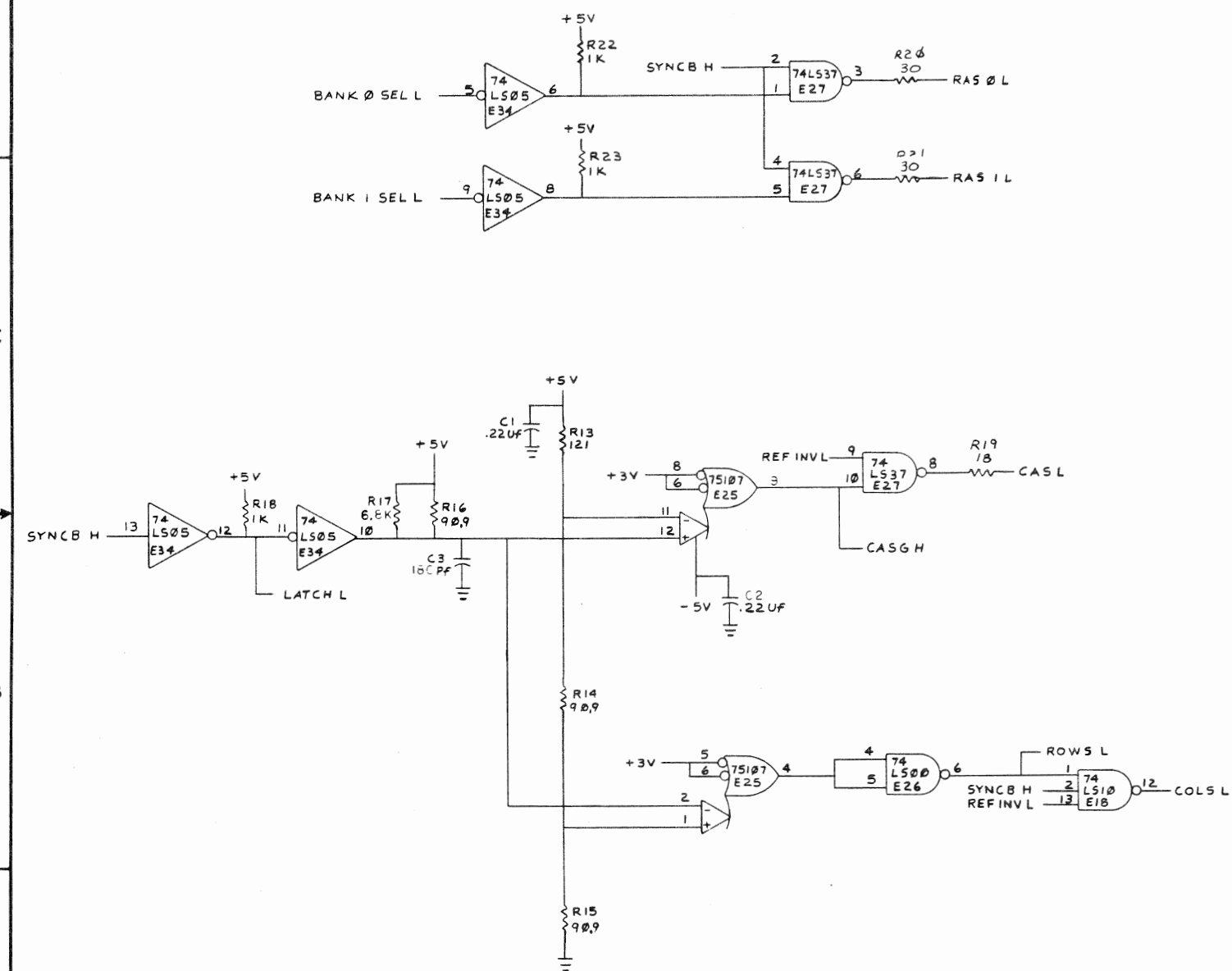
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C

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| REVISIONS |            |      |
|-----------|------------|------|
| CHK       | CHANGE NO. | REV. |
|           |            |      |

DEC 1978

| TITLE      |  | SIZE | CODE | NUMBER | REV. |
|------------|--|------|------|--------|------|
| MSTII/TIN  |  |      |      |        |      |
| RAM MODULE |  |      |      |        |      |
| SCALE      |  |      |      |        |      |
| SHEET      |  |      |      |        |      |
| 2 OF 8     |  |      |      |        |      |
| DIST.      |  |      |      |        |      |
| ME         |  |      |      |        |      |

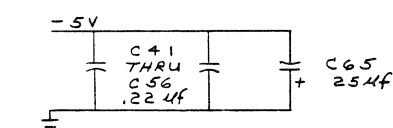
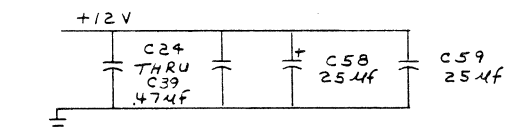
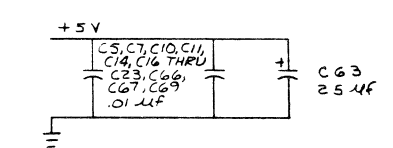
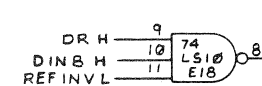
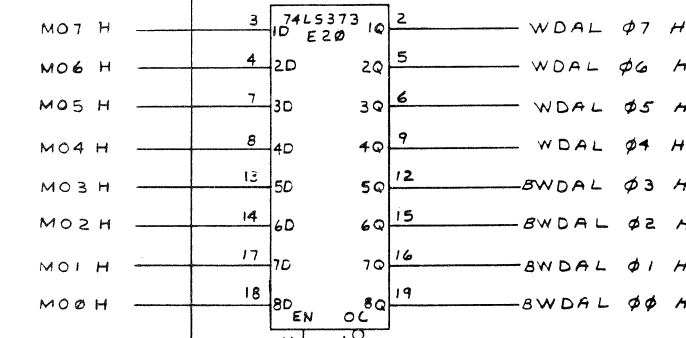
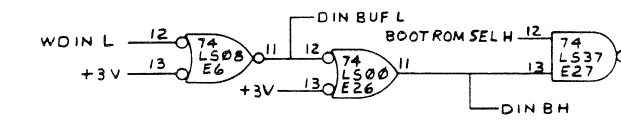
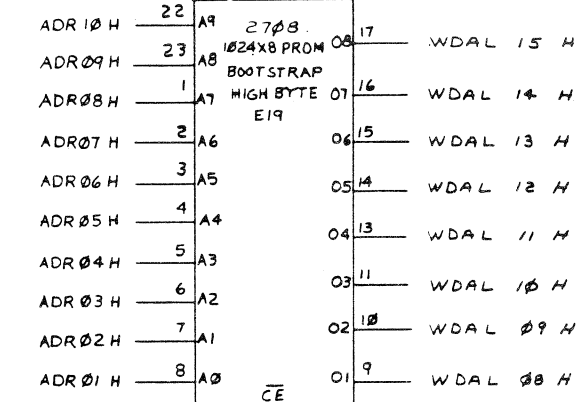
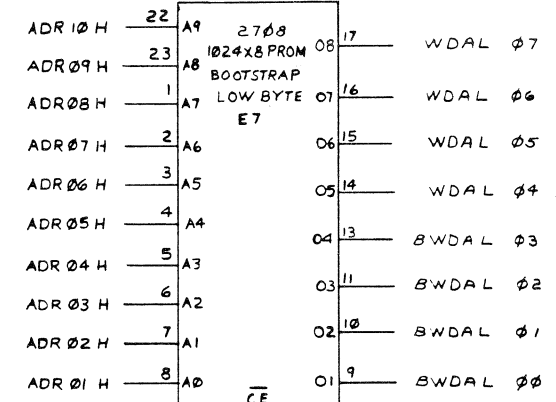
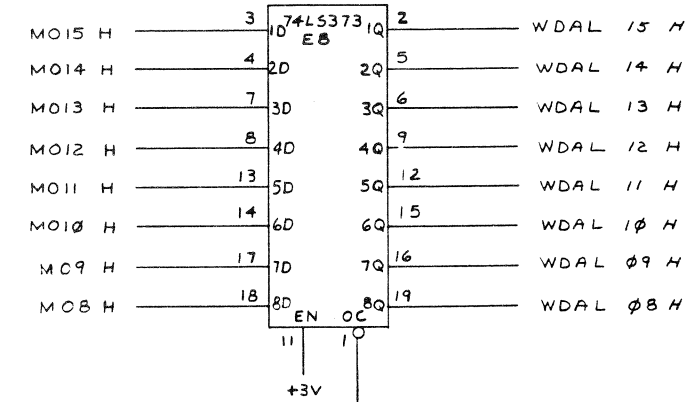
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C

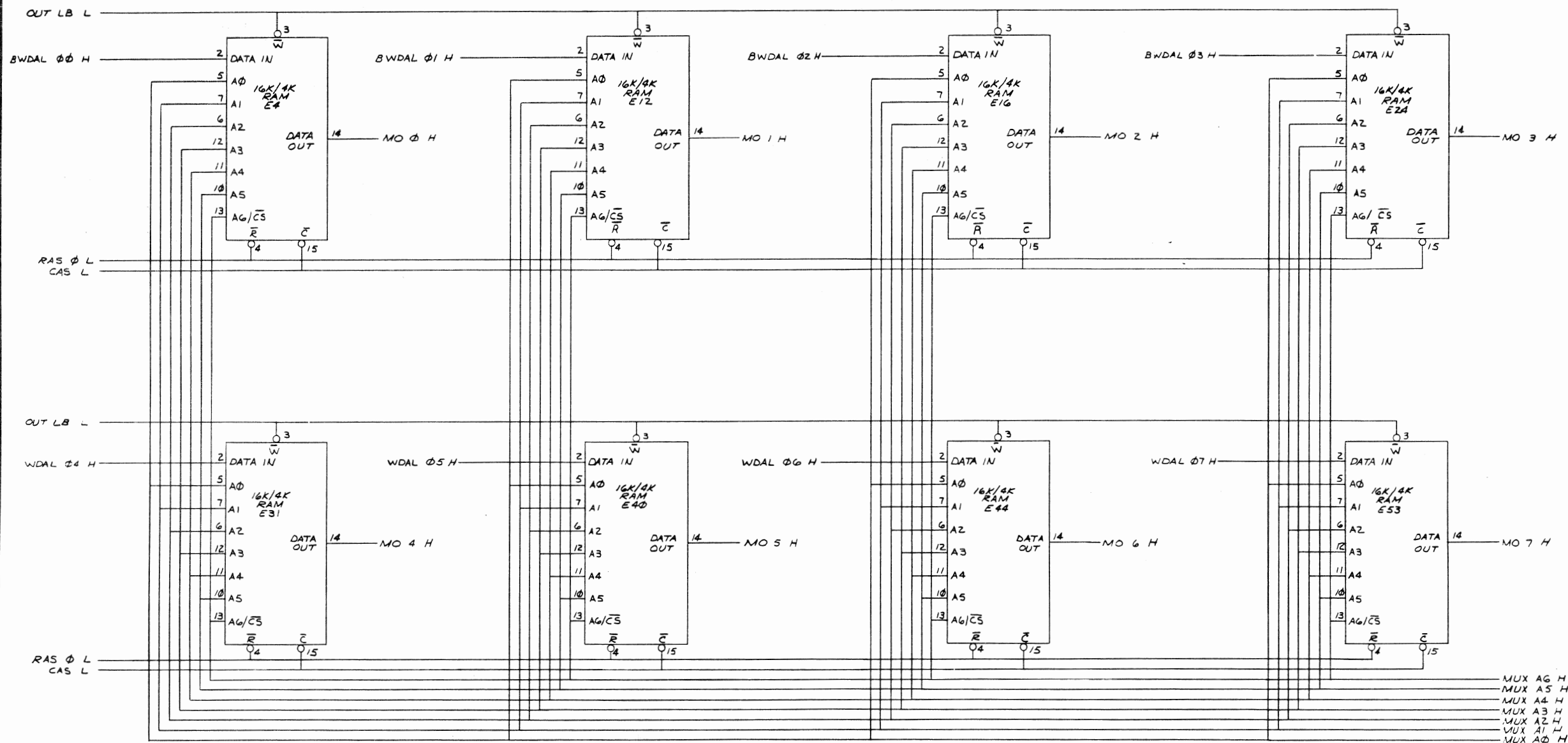
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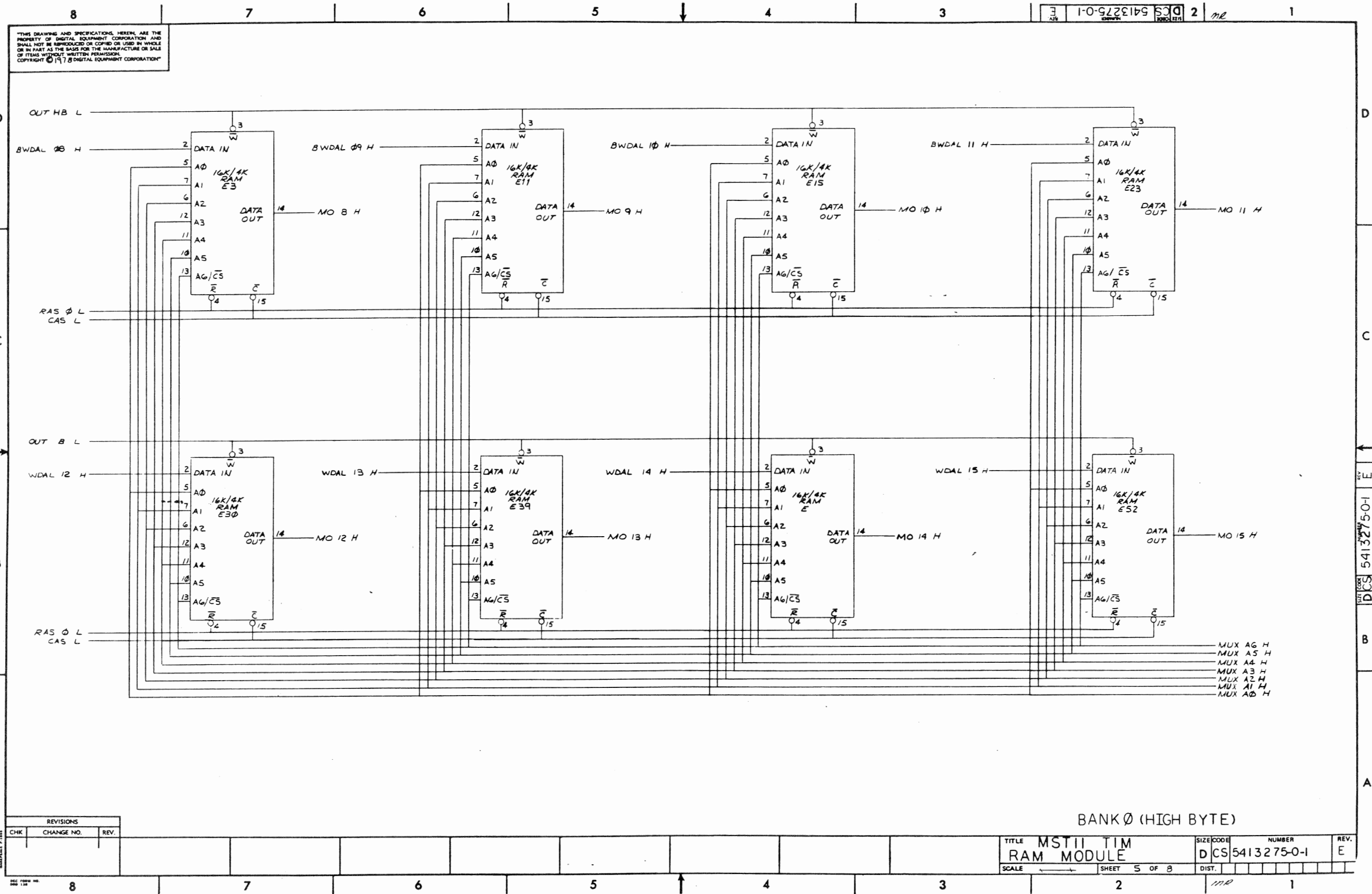


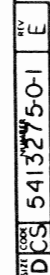
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| REVISIONS |            |      |
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| CHK       | CHANGE NO. | REV. |
|           |            |      |

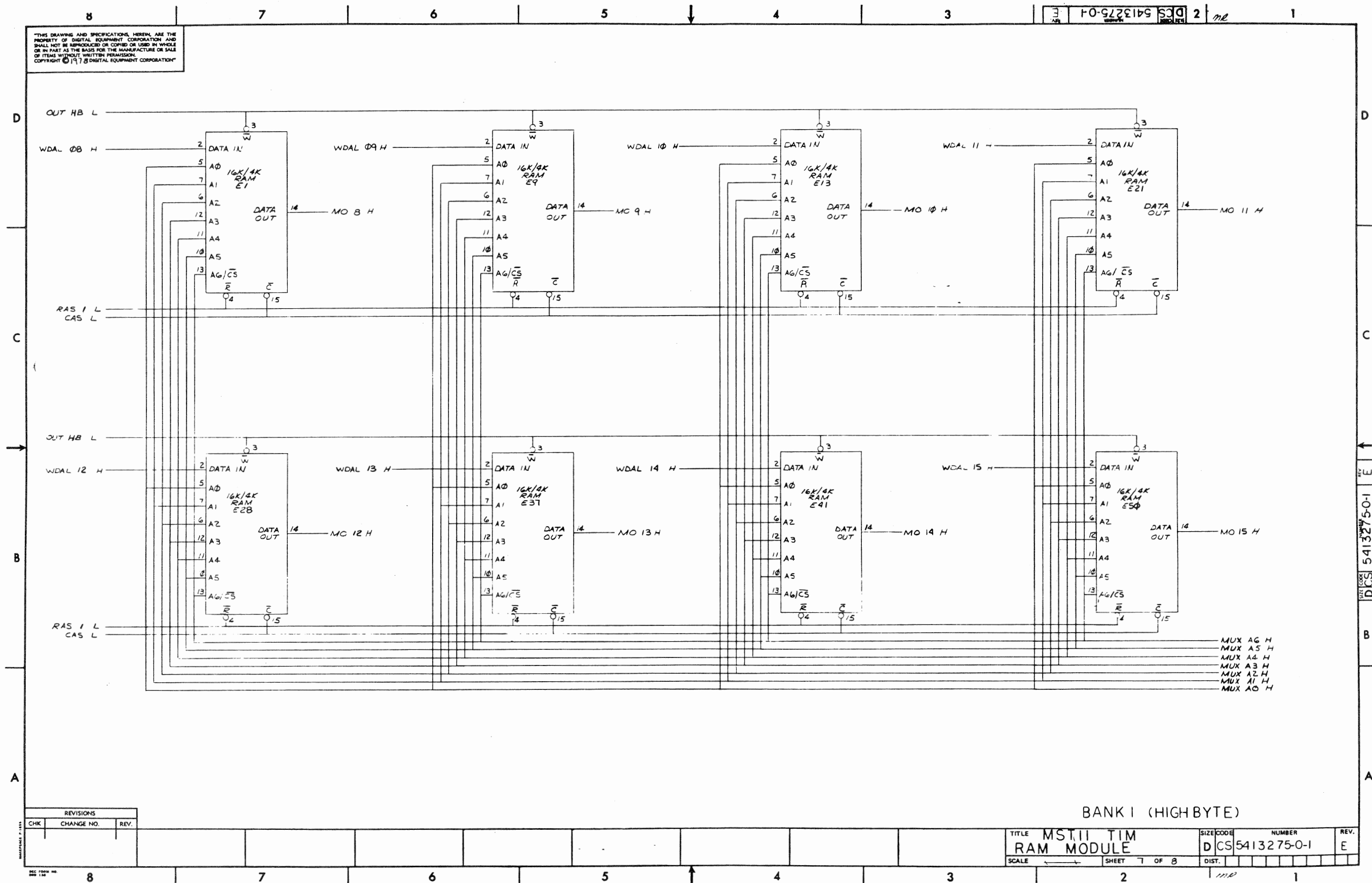
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| TITLE      |  | SIZE CODE    | NUMBER         | REV. |
| MSTII TIM  |  | D            | CS 5413275-0-1 | E    |
| RAM MODULE |  |              |                |      |
| SCALE      |  | SHEET 4 OF 8 | DIST.          |      |





|       |  |           |  |      |  |      |  |             |  |       |  |
|-------|--|-----------|--|------|--|------|--|-------------|--|-------|--|
| TITLE |  | MSTII TIM |  | SIZE |  | CODE |  | NUMBER      |  | REV   |  |
| RAM   |  | MODULE    |  | D    |  | CS   |  | 5413275-0-1 |  | E     |  |
| SCALE |  | SHEET     |  | 6    |  | OF   |  | 8           |  | DIST. |  |

| REVISIONS |            |      |
|-----------|------------|------|
| CHK       | CHANGE NO. | REV. |



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DCS 5413275-0-1 E

2

1

D

C

B

A

D

C

B

A

J4



+12V

ADR07 H  
ADR08 H  
ADR06 H  
ADR05 H  
ADR04 H  
ADR01 H  
ADR02 H  
DR03 H

+5V

REF(0) H

DOUT (0) H

ADR00 H  
ADR09 H  
ADR10 H

ADR11 H

-5V

MRPLY L  
WWB H  
FD IN (1) H

J1

J3



WDAL 15  
WDAL 14 H  
WDAL 13 H  
WDAL 12 H  
WDAL 11 H  
WDAL 10 H  
WDAL 09 H  
WDAL 08 H  
WDAL 07 H  
WDAL 06 H  
WDAL 05 H  
WDAL 04 H  
BWDAL 03 H  
BWDAL 02 H  
BWDAL 01 H  
BWDAL 00 H

ADA 12 H

WD IN L



ADR 13 H  
ADR 14 H  
ADR 15 H  
WSYNC L

J2

| REVISIONS |            |      |
|-----------|------------|------|
| CHK       | CHANGE NO. | REV. |
|           |            |      |
|           |            |      |
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|           |            |      |
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| TITLE                |              | SIZE CODE | NUMBER      | REV. |
|----------------------|--------------|-----------|-------------|------|
| MSTII TIM RAM MODULE |              | DCS       | 5413275-0-1 | E    |
| SCALE                | SHEET 8 OF 8 | DIST.     |             |      |