24K x 8 static memory • S-100
using MM5257/TMS40L44 • 4MHz
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TECHNICAL OVERVIEW

This board incorporates proven static memory tech-
nology. There are currently two popular types of memory
being used in products such as this: static and dynamic.
Static memories are the overwhelming choice in applica-
tions where speed, complexity, ease of use, and reliability
must all be considered. There is no refresh slowdown, the
CPU is freed from the drudgery of caring for the memory,
and techniques such as direct memory access (DMA) are far
more reliable and easier to implement.

The individual memory ICs used on this board are
grouped together to form four larger blocks of memory, two
4K X 8 and two 8K X 9. The 4K blocks may be addressed on
any 4K boundary, and the 8K blocks on any 8K boundary by
setting the starting locations with the on-board dip switch
(and jumpers required). Additional features include write pro-
tect switches for each of the four blocks; a write strobe
telegraph switch which allows use of memory in systems
with or without a front panel (MWRITE strobe); allowance for
use with or without the PHANTOM line; and bypassing of supply lines to suppress transients plus on-
board regulation and heat-sinking for reliably cool opera-
tion. All this and sockets for all ICs go onto a double-sided,
solder-masked printed circuit board with a complete com-
ponent-layout legend.

Parts List

Upon receipt of your kit, check your parts against the list below.

☑ (1) Econogram VIIa circuit board

INTEGRATED CIRCUITS (note: the following parts
may have letter suffixes and prefixes along with the
key numbers given below.)

(48) MM5527N-3L, or TMS 40L44 (U14 - U61)
(1) 74LS200 NAND gate (U6)
(1) 74LS10 2-input NAND gate (U7)
(1) 74LS32 nor gate (U6)
(1) 74LS240 20-STATE* inverters (U13)
(4) 74LS216 ex-nor o.c. (U1 - U4)
(4) 7805 Positive 5V regulators (U62 - U65)

OTHER ELECTRONIC COMPONENTS

(3) S.I.P. resistor packs (R1 - R3)*
(3) < 2.7K 1/4 watt resistors (red-violet-red; R4 - R6)
(4) 3µF tantalum capacitors (C1 - C8)
(25) ceramic disk bypass capacitors*

MECHANICAL COMPONENTS

(6) low profile sockets*
(4) TO-220 heat sinks
(4) 6-32 bolts
(4) 6-32 lockwashers
(1) instruction booklet

*supplied already soldered to board.
ASSEMBLY PROCEDURES

Proper operation of your kit depends on good soldering technique, along with correct identification and handling of the various parts used during construction. Read this manual thoroughly before plugging in your soldering iron.

SOLDERING TECHNIQUES. The Econogram Board is solder-masked. In case you are not familiar with solder-masked boards, they are similar to standard PC boards, but are screened with a solder-resistant coating. This mask is screened over the entire board, except where there are solder connections to be made: since solder does not completely hold to or flow over the resist, the chances of getting a bridge between tight, adjacent traces are decidedly minimized.

However, soldering a solder-masked board requires a bit of care. All soldering is performed on the solder side of the Board: we recommend your keeping the component leads straight up at all times, not bent over as with some other types of boards (see figure 1). When soldering, bring the iron tip in at an angle, against the board pad and component lead; then feed in a tiny bit of solder at opposite ends of the lead (see figure 2). This makes a good joint with no excess solder. NOTE: Use of any type of solder other than rosin-core solder invalidates the warranty. Do not use any type of solder-paste or corrosive flux under any conditions.

IDENTIFICATION OF PARTS. There are many ICs used in this kit; each one must be oriented correctly for proper operation. Most ICs have a dot near one corner that indicates pin 1 (see figure 3); sometimes this dot appears in conjunction with a deeply cut notch or circle. Other types indicate the pin 1 end of the IC by a deep notch, or a notch within a shallow circle (see figure 4). In case of doubt, place the IC in front of you so that any identifying numbers read from left to right; pin 1 is almost always in the lower left-hand corner (figure 5)

Additionally, the tantalum capacitors must be correctly identified as to the (+) and (-) ends. The (+) end is the rounded end and is also identified with a (+) mark on the body (see figure 6).

HANDLING OF PARTS. All integrated circuits may be damaged by static electricity discharges; however, MOS ICs - such as the memory ICs included with your kit - are most susceptible to this problem. You can easily accumulate a static charge on your body in the thousands-of-Volts range (say, by walking across a rug on a dry day). If you then touch the pins of an IC, those thousands of Volts flow into the IC and can damage the internal structure. To prevent this from happening, leave the ICs in their protective foil until needed; then, before plugging in each IC, touch the protective foil with your finger to drain off any residual charge. Also, avoid wearing clothing that is prone to generating static electricity during construction (such as sweaters, certain types of acrylic fabrics, and so on).

Another caution concerns the mounting of resistors. These are small, somewhat fragile parts, and excessive force used while bending the leads may cause damage or crack the part. Either use a commercial lead bender (available from Godbout's and many other electronic vendors), or use needle-nosed pliers to grasp the lead close to the body of the resistor and then bend the lead downward (see figure 7).

Figure 1.

Figure 2.

Figure 3.

Figure 4.

Figure 5.

Figure 6.

Figure 7.

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CONSTRUCTION

Keeping the preceding information in mind, it is now time to mount the various components and install the ICs into their sockets. Orient the board as shown in the component layout. Then, referring to this layout, follow the steps below in the order given.

1. Bend leads, mount and solder the resistors in place as indicated.

2. Bend leads, mount and solder the 6 tantalum capacitors in place as indicated, carefully observing the orientation of the (+) end.

3. Mount the 4 regulators and the regulator heat sinks in place. Referring to Figure 8, observe that the heat sinks mount on top of the board, and then, the regulators mount on top of the heat sinks. If desired, a small dab of heat sink compound may be added between the regulator cases and the heat sinks to improve thermal transfer from regulator to sink. Again referring to Figure 8, bend all regulator leads as shown, then bolt the heat sink regulator assemblies into place using the provided nut, bolt, and lockwasher hardware. After these assemblies are in place, solder the regulator leads on the solder side of the board.

4. Observe the 8 pole dip switches. The side with the number 1-8 faces the upper edge of the board (see Figure 9). Mount the switch in place, then solder. (Note: may be already soldered in place.)

5. Before proceeding, check your work so far by testing the board for any shorts between supply lines and ground. Referring to Figure 10, use a voltmeter to test for a shorted condition at the test points indicated on the regulator. Perform this test at each regulator. If you find a short circuit at any of these points, carefully check over your board for the cause of the short. If all readings are satisfactory, proceed with construction of the board.

6. Prepare to plug in all ICs in accordance with the component layout, Page 5. All ICs should have the pin 1 end facing towards the left side of the board. Any numbers or other markings on the IC should be right side up with the board oriented as shown in the component layout. If any of the writing is upside-down, the IC may not be correctly inserted.

A common problem with boards returned for repair is improper insertion of the IC. Sometimes a lead from the IC will bend under the part instead of going into the socket contacts. We recommend inserting each IC halfway, and verifying visually that all pins are indeed going into the socket. Then, push the IC in the rest of the way.

Keeping the preceding in mind, insert the support ICs first and then insert all memory ICs.

7. Check your work over carefully for errors in construction, improperly inserted ICs, or improper polarity of the tantalum capacitors. If all is well, assembly of your board is now complete.

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MEMORY ADDRESS CONFIGURATION

This board is configured as two 4K blocks addressable on 4K boundaries and two 8K blocks independently addressable on 8K boundaries. Switches S1 and S2 each select one 4K and one 8K block. (Switch S1: block A - 4K and block B - 8K, switch S2: block C - 4K and block D - 8K) as follows:

<table>
<thead>
<tr>
<th>4K SWITCH</th>
<th>STARTING ADDRESS</th>
<th>8K SWITCH</th>
<th>STARTING ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4</td>
<td>0000</td>
<td>5 6 7</td>
<td>0000</td>
</tr>
<tr>
<td>7</td>
<td>1000</td>
<td>1</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>2000</td>
<td>2</td>
<td>3000</td>
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<td>6</td>
<td>7000</td>
<td>6</td>
<td>8000</td>
</tr>
<tr>
<td>7</td>
<td>8000</td>
<td>7</td>
<td>9000</td>
</tr>
</tbody>
</table>

In addition, position 0 on each switch enables (OFF) or disables (ON) the associated 8K block. Positions 1 and 2 of switch S3 disable/enables the 4K blocks A and C respectively.

MEMORY PROTECT SWITCHES

Switch S3 positions 3-8 are write enable switches. Conversely they may be used for manual write protection of the memory. Each position 3, 4, 5 and 6 is associated with one memory block A, B, C and D respectively. Any combination of these four switches may be ON write enabling or OFF write protecting the particular block.

WRITE STROBE SELECT SWITCHES

Switch S3 positions 7 and 8 select write strobe. S3-8 ON causes PWK to qualify the memory for write commands. S3-7 ON causes MWRITE to qualify the memory for write commands. In normal operations with systems which have front panels etc., Altel, Imael etc., or others which generate MWRITE with or without front panels use MWRITE. All others use PWK. Positions 7 and 8 both ON at the same time will ground MWRITE on the bus, this condition must be avoided if MWRITE is present.

MEMORY TESTING

If the memory board seems to be working properly, the Memory Testing Routine (page 11) can be used to give the board a more thorough workout. It is rather slow but will do the job well. It can be entered via editor/assembly or front panel switches. The routine is set up to test 24K from 4000 hex up to AFFFF hex. This may be changed by entering a different starting address at "SRTT" (3001 - 3002) and/or a different end address at "END" (3004 - high order byte only). If the memory passes the test it starts over again. You may on the other hand, enter a jump instruction at "MARK" to some user routine or, if desired the user may enter an output instruction or, can do a notification routine at "MARK" to show successful completion and restart.

If the memory fails the test, critical information is stored and the routine enters a software "HALT", that is a "jump to here" at "SHLT". Front panel lights, if any, will show this state. The user may then use the front panel or dump routines to display the following stored failure info:

3069 "FDE" = D, E pair . . . D is the fill character and E is the test character
306B "FHL" = H, L pair . . . the failure address
306D "FOUT" = the data expected at this address
306E* "FIN" = the data read from, the address
* from Memory Testing Routine Listing.

The user may replace the "jump" at "SHLT" with a jump to a display or notification routine. The difference between "FOUT" and "FIN" should indicate which bit is failing, indicating which chip or area is causing the problem. This test will find most of the harder to distinguish errors.

PHANTOM LINE

In response to increasing numbers of users who have requested inclusion of "PHANTOM LINE": bus pin 67 which is often used for implementing power on jump features. This board is designed for use with active or inactive PHANTOM lines.

Figure 11.

CAUTION

Some manufacturers use PHANTOM line (bus pin 67) for a refresh signal. This will conflict with the PHANTOM feature, and cause boards with PHANTOM to fail. If your system has this conflict it must be resolved by either eliminating the refresh signal on the CPU board or disabling the PHANTOM feature on this and other boards.

The PHANTOM feature may be disabled by cutting the trace on the back of the PC board between pads for J1. It may be reactivated at any time simply by installing a jumper at J1 (see Figure 11).

If you want the PHANTOM feature, the conflicting refresh signal may be eliminated (IF NOT USED ELSEWHERE IN THE SYSTEM) by cutting the trace connect to bus pin 67 on the CPU board. BE SURE OF YOUR SYSTEM CONFIGURATION BEFORE CUTTING ANY TRACES.
CIRCUIT DESCRIPTION

The heart of Econoram VII is the MMS257/TM4044 static memory IC (RAM), which can store 4096 single bits of information (thus, each is a \(4 \times 4 \times 1\) memory IC). Unlike standard RAMs, those included with your kit are specifically designated by the manufacturer as low power, high speed parts.

These ICs are arranged in rows that are 8 ICs wide. This way, each row can store 4k x 8 bits of information. Parallelizing 6 of these rows together produces a total memory storage of 24k x 8 bits. (Note that the bit number corresponding to a given column of ICs is indicated along the top edge of the memory array).

Now that we have this storage, there are still other aspects we must consider. First, we need to address a specific location in memory; and, we need to be able to write data into the memory, or read data from the memory.

The schematics on pages 6 and 9 show the address circuitry along with the other Econoram VII circuitry. Each memory IC requires 12 address bits (A0-A11) to access any one of the 4096 bits available in the IC. These address bits are generated by the CPU and are buffered by a number of inverters. After buffering, a particular address is presented to all IC address selection pins. However, we additionally need to select which particular row of ICs is to react to the given address. This requires 4 more address bits (A12-A15), which are decoded and used to enable the desired row of ICs (note row markings along the right hand side of the memory array).

When data is to be written into memory, it first passes through 8 inverting buffers before being put on the data pins of the RAMs (buffering prevents loading of the data buss). Data to be read on to the data buss from memory passes through 8 TRI-STATE\( ^\text{TM} \) inverting buss drivers; when data is not being read on to the buss, the outputs of these inverters are open, thus impedance or "disconnected" state.

An unfortunate fact of life is that logic ICs generate switching transients that travel along the power supply lines. If these transients work their way into the logic circuitry, problems can appear. To prevent such occurrences, bypass capacitors are wired across the power lines to provide short current "loops" and short time intervals in the memory array and at every support IC.

This board is guaranteed to operate at 4MHz over the full temperature range (-0° to 70°C ambient) and to draw less than 2500 mA (2.5 amps). Our typical measured currents were less than 2.1 mA at cold start-up, rapidly decreasing to around 1600-1900 mA, depending on the surrounding temperature. We have heard similar reports from the people already using these boards.

It is interesting to note that static RAM technology has progressed to the point that this high-performance static RAM board is comparable in cost and power consumption to dynamic memory boards.

THANK YOU

This board is the result of much work, time and effort, and the experience of a number of people. We hope you find a board that doesn't just work the first time, but continues to give reliable operation for a long time. If we can be of any help to you in applying this board, or if you have any questions, please let us know. As always, we solicit your comments, letters, and new product suggestions.

HAPPY COMPUTING!

8/11
CUSTOMER SERVICE INFORMATION

Our paramount concern is that you be satisfied with any Godbout CompUKit product. If this product fails to operate properly, it may be returned to us, see warranty information below.

If you have any questions about assembly, performance, specifications or need further information feel free to write us at:

P.O. Box 2355, Oakland Airport, CA 94614.

When writing, please be as specific as possible concerning the nature of your query. We maintain a 24 hour a day phone, for taking orders, (415) 562-0636. If you have problems or questions which cannot be handled by mail, this number can be used to connect you with our technical people. ONLY during normal business hours (10am-5pm Pacific Time). Unfortunately, we cannot return calls, or accept collect calls.

LIMITED WARRANTY INFORMATION

Godbout Electronics will repair or replace, at our option, any parts found to be defective in either materials or workmanship for a period of 1 year from date of invoice. Defective parts must be returned for replacement.

If a defective part or design error causes a Godbout Electronics product to operate improperly during the 1 year warranty period, we will service it free (original owner only) if delivered and shipped at owner's expense to Godbout Electronics. If improper operation is due to an error or errors on the part of the purchaser, there may be a repair charge.

Purchaser will be notified if this charge exceeds $10.00.

We are not responsible for damage caused by use of solder intended for purposes other than electronic equipment construction, failure to follow printed instructions, misuse or abuse, unauthorized modifications, use of our products in applications other than those intended by Godbout Electronics, theft, fire, or accidents.

Return to purchaser of a fully functioning unit meeting all advertised specifications in effect as of date of purchase is considered to be complete fulfillment of all warranty obligations assumed by Godbout Electronics. This warranty covers only products marketed by Godbout Electronics and does not cover other equipment used in conjunction with said products. We are not responsible for incidental or consequential damages.

Prices and specifications are subject to change without notice, owing to the volatile nature and pricing structure of the electronics industry.

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