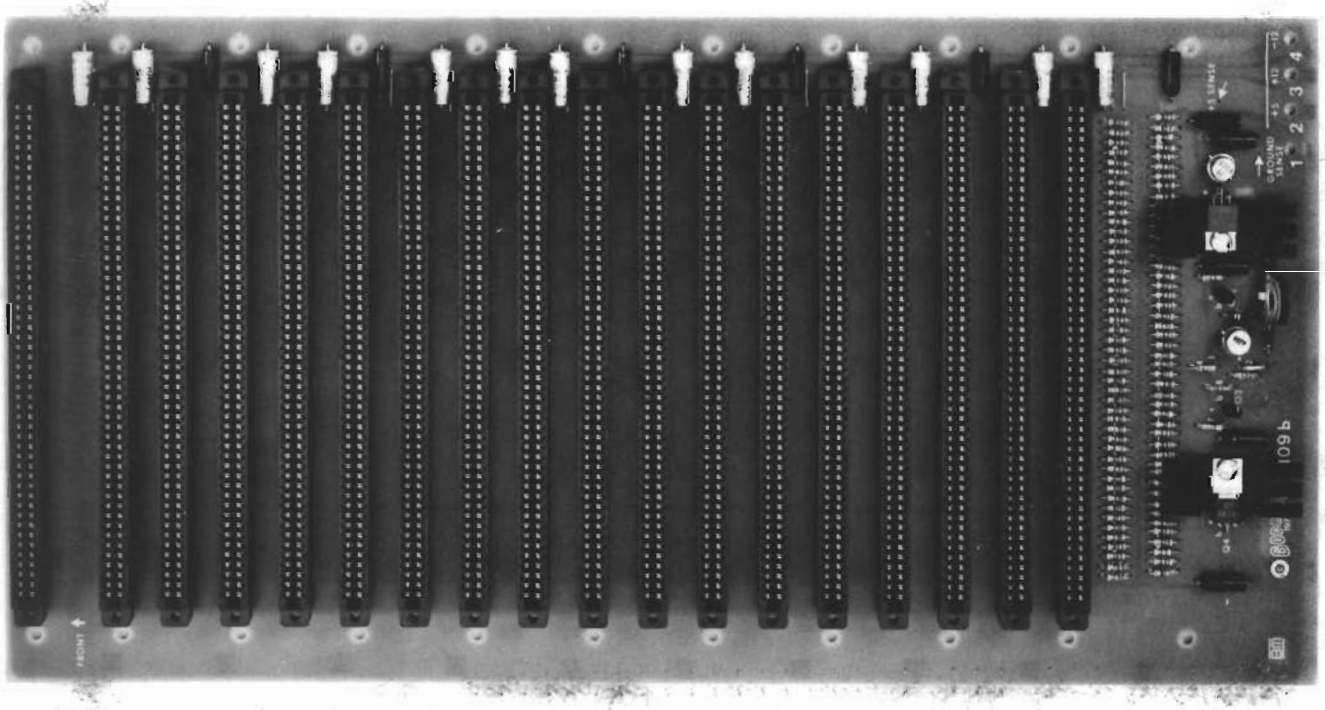
CK-105
CK-109

Motherboard Instructions

For both the 10/11 slot and 18 slot versions



GODBOUT
BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

ORDER OF ASSEMBLY Read these instructions carefully before beginning construction, take your time and do not rush; after about 3½ hours you will end up with a high quality Motherboard. When completed, the Motherboard makes an ideal stand-alone unit to form the nucleus of a custom computer system; or, use it to add more peripheral cards to an existing machine.

(1) Check parts against the parts list for completeness and accuracy.

(2) This board uses a solder mask that virtually makes solder bridges a thing of the past. However, solder masked boards require a specific style of soldering, so read the section on soldering techniques before proceeding.

(3) Bend the leads of resistors R9 through R55, then mount in place as shown on the component layout diagram. Flip the board over as shown under soldering techniques, then solder all leads and clip off excess lead lengths.

(4) Bend leads and mount resistors R56-R102 in a manner similar to the previous step; then flip the board over, solder all leads, and clip off all excess lead lengths.

(5) Mount and solder all other resistors except the 10K trimpot in a manner similar to the previous 2 steps.

(6) There are 7 jumpers on the 10 slot board and 10 jumpers on the 18 slot board. Locate these jumpers, then install and solder jumper wires. Use #22 or heavier gauge wire.

(7) Install all capacitors on the board, carefully observing polarity. The positive end of each capacitor is marked with a (+) on the part, which corresponds to the (+) mark screened on the board at each capacitor location. Please note that on the 10 slot board, the positive end of C18 faces towards the inside of the board; on the 18 slot version, C18's positive end faces away from the board. We recommend mounting the capacitors so that the values face upwards and are easily readable.

(8) There are 10 edge connectors supplied with the 10 slot board and 18 connectors supplied with the 18 slot board. Mount and solder the edge connectors in place, noting that with the 10 slot board, there are 11 possible places to mount the edge connectors. The 11th position is for jumpering over to an existing computer motherboard if so desired.

(9) Straighten the leads of the 10K trimpot, then mount and solder in place.

(10) Install IC1, the three terminal regulator. Solder carefully in this and the next step to prevent possible heat damage to the ICs.

(11) Spread the leads of IC2 in accordance with figure 5; note that the lead associated with the flange would be pin 8 of a mini dip package. When viewed from the top, the lead to the immediate left of the flange inserts into the hole marked "1" on the circuit board.

(12) Install and solder transistors Q1 and Q2, orienting the leads as shown in figures 1 and 2. PLEASE NOTE: Transistors Q1-Q4 must be oriented correctly for proper operation of your kit. Also, solder quickly and carefully as semiconductors may be damaged by excessive heat.

(13) Referring to figure 3, mount Q3 and its associated heat sink on the board. The heat sink goes between Q3 and the circuit board as shown. Before screwing the transistor/heat sink combination into place with the hardware provided, first bend the leads of Q3 so that they fit into the holes marked E, B, and C. Next, bolt into place and then solder Q3's leads on the foil side of the board.

(14) Referring to figure 4, mount Q4 in place in a manner similar to the last step.

(15) Attach the 4 solder lugs provided, using the remaining hardware, to the 4 power connections located near the lower right hand corner of the board.

(16) Examine your work carefully (magnifying glasses are a big help in checking over solder connections). When you are satisfied that all is well, proceed to the calibration procedure step.

CALIBRATION AND BRING-UP: To bring up the board, remove any peripheral cards and attach either +8V filtered but unregulated or +5V regulated to the power supply lug marked +5 (lug 2). If you are using a regulated +5V supply, leave IC1 out of the circuit and short its I and O pads together so that R103 connects directly to the +5V regulated supply. Then, measure the voltage across C5 with a Voltmeter or DC reading oscilloscope; set trimpot R1 so that your meter reads 2.6V. The active terminator circuitry is now properly calibrated.

Read the remainder of this booklet to acquaint yourself with the theory behind your motherboard and the available options to accomodate specific systems.

ERRATUM: On some boards, C5 (lower left hand corner of the board) may be marked C3.

PARTS LIST

(Those items marked with an asterisk (*) are included with the 18 slot version, but not with the 10 slot version)

RESISTORS

R1	10K trimpot
R2	150K resistor (brown/green/yellow)
R3, R5	560 ohm (green/blue/brown)
R4, R8	1K resistor (brown/black/red)
R6, R7	910 ohm resistor (white/brown/brown)
R9-R102	270 ohm resistor (red/violet/brown)
R103, R104	1.8K resistor (brown/gray/red)

CAPACITORS

C1, 3, 4, 5, 6, 7, 10, 13, 16, 20*, 23*	39 uF tantalum capacitor
C2	0.47 tantalum capacitor
C8, 9, 11, 12, 14, 15, 17, 18, 19*, 21*, 22*, 24*, 25*	20 uF aluminum electrolytic

SEMICONDUCTORS

Q1	PNP transistor F137 (2N2907A)
Q2	NPN transistor 3560-2/PT134 (2N3904)
Q3	NPN power transistor (GE red)
Q4	PNP power transistor D41D1
IC1	Three terminal regulator (G309H)
IC2	Micropower op amp (G4250H)

MECHANICAL PARTS

(2)	THM6070 heat sinks
(1)	Circuit board
(10)	S-100 edge connectors (note: 18 edge connectors supplied with 18 slot kit)
(4)	Solder lugs
(6)	Nuts and bolts
(1)	Data booklet

FIGURE 1

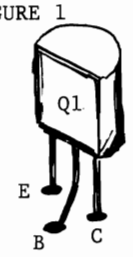
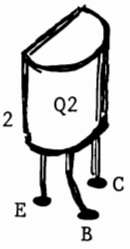


FIGURE 2



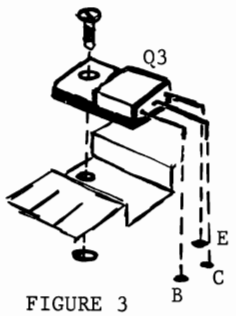


FIGURE 3

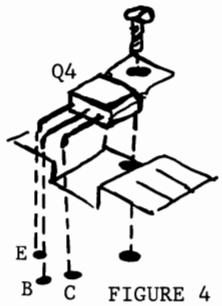


FIGURE 4

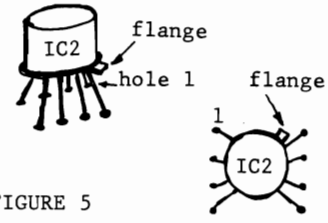
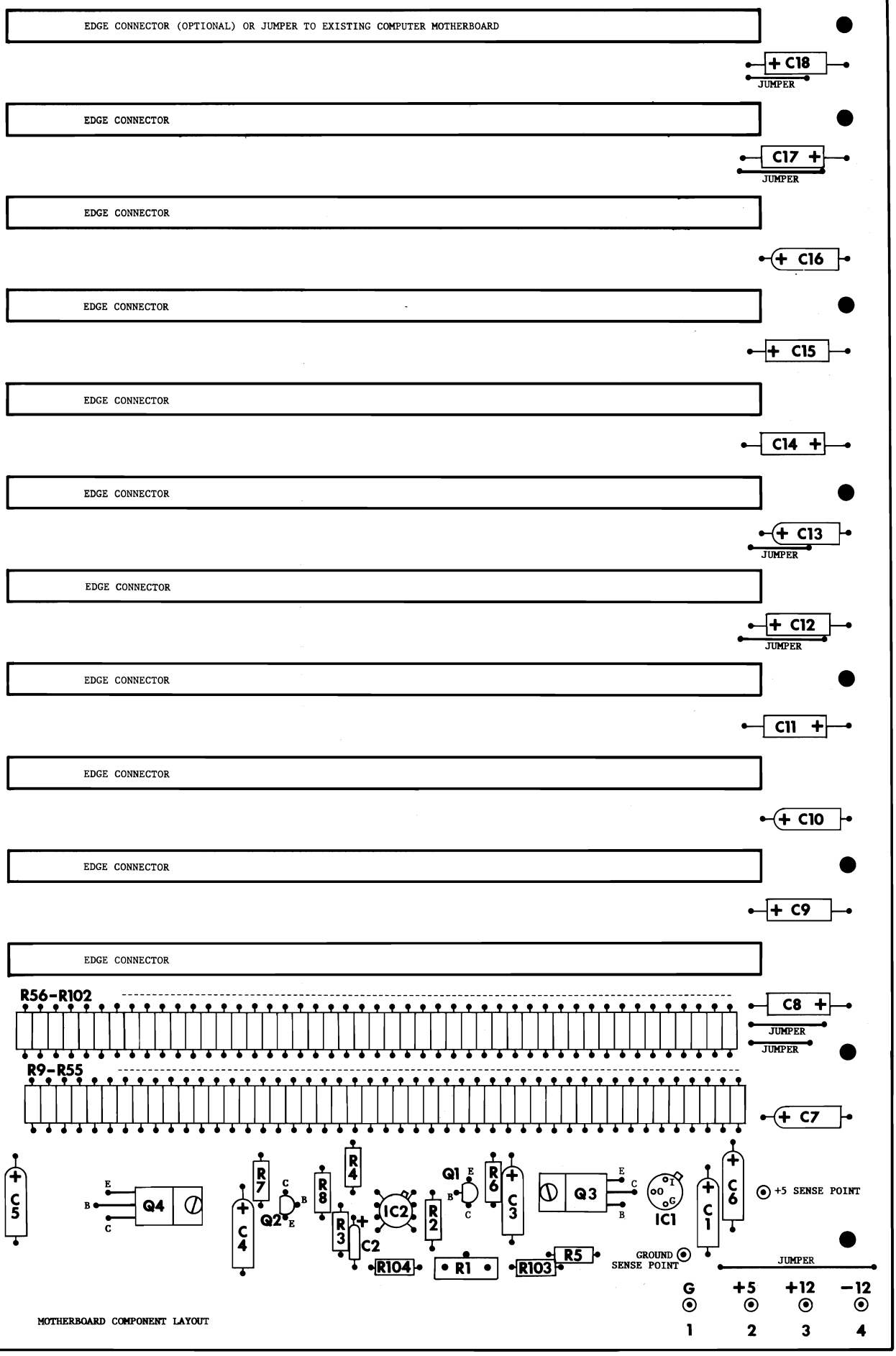


FIGURE 5



MOTHERBOARD COMPONENT LAYOUT

SOLDERING TECHNIQUES 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 on the foil side. This mask is screened over the entire board, except where there are solder connections to be made. Thus, solder does not run down a trace but adheres to the junction of exposed board and exposed lead. Because of this, soldering requires a bit of care; trying to force lots of solder on to this type of joint will make it ball up around the lead. On the other hand, since solder does not comfortably hold to or flow over the resist, the chances of getting a bridge between tight, adjacent traces are decidedly minimized.

When soldering with a solder masked board, we recommend keeping the component leads straight up at all times, not bent over as with other types of boards (see figure 6). To prevent components from falling out when you flip the board over to solder, flip the board over on to a table, book, or other flat surface, which pushes the parts against the component side of the board.

To solder, 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 7). This makes for a good joint with no excess solder. Use of any type of solder other than rosin core solder invalidates the warranty.

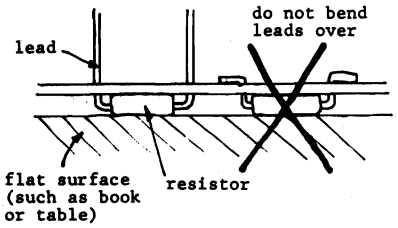
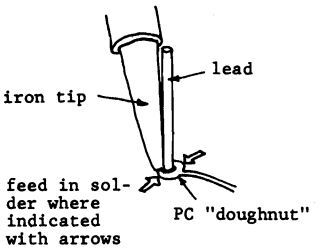


Figure 6

Figure 7



MOUNTING HOLES There are several mounting holes towards the outside vertical borders of the motherboard. With the 10 slot motherboard, these are spaced in such a manner that the board may bolt directly into an IMSAI size frame, and some of the Vector-Pak enclosures also.

SENSE HOLES Many power supplies incorporate sense lines that provide voltage reference feedback to the power supply. However, in systems with heavy current demands, there can be a voltage drop between the output of the supply and the peripherals connected to the motherboard; therefore, the sense information does not take into account the aforementioned voltage drop. On the board, there are sense points for both +5V and ground. If you want your power supply to read the voltage present at the motherboard, connect sense lines up to these points.

POWER SUPPLY TRACES When many current-hungry cards are loaded into a motherboard, the current strain on the power supply traces (especially the +12 and -12 Volt lines) becomes quite large. To overcome this unbalanced current demand, the Godbout motherboard uses extra wide traces that run off to the side of the edge connectors, then connect over to the buss power lines through wire jumpers. This contributes to a more reliable design. Also, note that all power supply lines, as well as the active termination output, are liberally bypassed with bypass capacitors.

ACTIVE TERMINATION THEORY The standard TTL termination is a 2.6V reference, comprising a 360 ohm and a 390 ohm resistor in series across the power supply; the TTL line terminates at the junction of these two resistors. This type of passive termination allows for proper sourcing and sinking of the TTL line, and keeps the impedance of the line to a minimum to minimize pickup of noise and crosstalk. Each one of these terminations, however also draws about 6.7 mA from the power supply. So, terminating 94 lines in this manner means a standby current drain through the terminators of well over half an amp! These passive terminations don't just put a strain on your power supply, they waste energy and create heat inside your computer's cabinet. I don't think we have to go much further to realize that passive termination is not such a good way to do things, although it's better than no termination at all.

The active termination in the Godbout motherboard takes advantage of the fact that there is an equivalent active structure, based around a voltage source and isolating resistor, that can accomplish the same results (see figure 8). Current can either source or sink through the 270 ohm resistor, either dumping into or drawing from the voltage source. Terminating more lines simply means adding more 270 ohm resistors between the line and voltage source. As a result, the standby current is slashed to the standby current of the voltage source circuitry---about 15 or 20 mA, which is quite a savings in energy.

The current requirement goes up as lines require more sourcing or sinking, but here we are somewhat fortunate. At any given moment, on 94 lines there will be a fairly random mix of 1s and 0s from instant to instant---these tend to cancel out and thus reduce the current drive requirements of the voltage source. Nonetheless, although this keeps average current consumption down, there are instances when you might have an extreme momentary need for current. As a result, the voltage source has enough capacity built-in to take care of the most adverse cases.

The structure of the voltage source is fairly simple (see schematic); IC1 sets up a stable voltage reference independent of master supply variations. IC2, a micropower op amp, hooks up as a simple voltage divider with Q1-Q4 set up as current boosting devices to cover any large current demands. R1, the trimpot, adjusts the output voltage of the op amp---hence the terminator voltage---to 2.6V. Since the op amp is forced to run from +5V when the motherboard is powered from a regulated +5V supply, you might expect some problems since that low a supply voltage range is marginal for most op amp types. However, the 4250 micropower op amp chosen for this application can work satisfactorily down to +3V, so it's working well within spec.

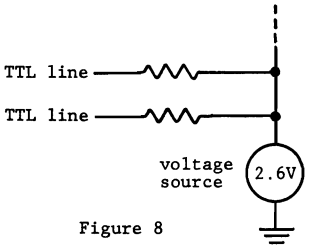
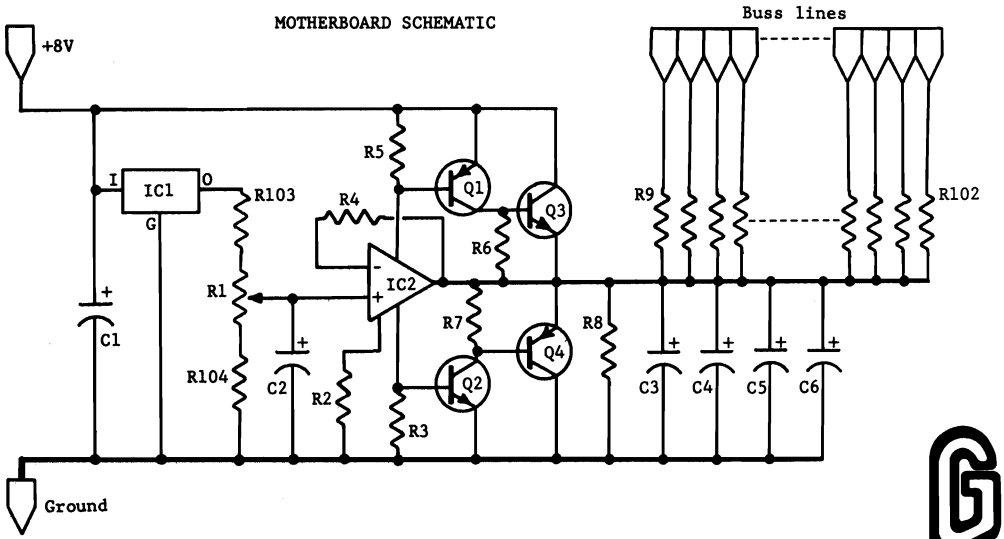


Figure 8

MOTHERBOARD SCHEMATIC



In the 10 slot version, the following bypass capacitors tie across the following supply lines:

+5 : C7, C10, C13, C16
+12: C9, C12, C15, C18
-12: C8, C11, C14, C17

In the 18 slot version, the following bypass capacitors tie across the following supply lines:

+5 : C7, C10, C13, C16, C20, C23
+12: C9, C12, C15, C19, C22, C25
-12: C8, C11, C14, C17, C18, C21, C24

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