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31229

GE Mobile Communications

UNIVERSAL RADIO PROGRAMMER

TQ2310 (19B234413G1)

Maintenance Manual

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PART NUMBERS

Hand Held Computer	RL-H1800
I/O Adapter	RL-P6001
AC Adapter	RD-9498
Mini Printer	RL-P1004

NOTE

All maintenance and user operating instructions should be stored in the top cover of the programmer case. Cables and the Socket Adapter should also be stored in the top cover.

NOTE

IT IS THE RESPONSIBILITY OF THE INDIVIDUAL WHO INSTALLS ANY RADIO EQUIPMENT TO CONFIRM THAT THE OPERATOR OF THE EQUIPMENT IS LEGALLY LICENSED FOR THE USE OF THE FREQUENCIES WHICH ARE PROGRAMMED INTO THE RADIO.

WARNING

This equipment generates and uses radio frequency energy and if not installed and used properly, i.e., in strict accordance with the instruction manual, may cause harmful interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment.

Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

GE Mobile Communications

General Electric Company
Lynchburg, Virginia 24502

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DESCRIPTION

The Universal Radio Programmer is a convenient, portable instrument for loading and displaying programmable information in General Electric Mobile Radio products. Its molded carrying case and battery/AC operation make it suitable for field or benchtop use. The detachable lid provides storage for adapter cables and instruction manuals. The Programmer is controlled by a commercially-available handheld computer which facilitates "user friendly" operation and versatility to handle an array of current and future products.

The programmer transfers data to/from the radio by means of a serial bit stream. It is also capable of directly programming certain programmable memory devices (EEPROM) while they are removed from the radio. Control programs to properly interpret and format the data, and interconnect cables are optionally available for the supported radio products. Generally, a different control program, provided in a PROM (Programmable Read Only Memory), and interconnect cable are required for each product line.

The handheld computer, Printer, I/O Adapter, and AC Adapter are manufactured by Matushita Electric, and sold by Panasonic and Quasar. Two peripherials, the Data I/O Module and Program Storage Module, and the case, were designed by General Electric.

ASSEMBLY/DISASSEMBLY

The programmer, consisting of the computer, peripherals, and the AC adapter are contained in the lower (smaller) half of the carrying case. The computer and peripherals are retained by a tray which is part of the I/O Adapter, and are lifted out of the case as an assembly. To remove the tray, grasp the tray at the top and bottom finger holes and lift up. The tray may be easier to remove if the AC Adapter is removed first. (See Figures 1 and 2).

NOTE

When installing the tray, note that the leftmost portion of the tray (containing the 3 small module slots) is detachable and may detach if that area is not pressed in together with the rest of the tray. If it detaches, it can be easily snapped together again. A buzzer in the computer will sound if peripheral modules become unseated from the I/O Adapter. Re-seat the modules if this occurs.

The computer or peripheral is removed from the I/O Adapter by sliding it apart from the I/O Adapter approximately 2 inches and lifting it out of the tray. Reverse the procedure to install a device noting that the computer will sound a buzzer while the device is only partially installed.

The computer can only be installed in the lower right slot of the tray; peripherals can be installed in any other slot but should generally be installed as shown in Figure 2.

The AC Adaptor is fitted into a foam padded cavity. Lift it straight up to remove.

The top cover contains storage for interconnect cables, instruction manuals and accessories behind a hinged partition (see Figure 3). Lift the two velcro fasteners to open the partition. Additional velcro pads in the top of the case will retain the velcro straps in the open position for easy closure.

OPERATION

The following information and operational procedures are general instructions for the use of the programmer equipment. All vendor "Instruction for Use" manuals should be studied before operating the equipment. Detailed programming instructions for the applicable General Electric programmable radios are supplied under separate cover. Refer to Table of Contents for reference manuals.

INITIAL POWER-ON

The Ni-Cd batteries in the handheld computer have been switched off during storage to prevent discharge and possible damage to the batteries. The batteries must be reconnected before using the Programmer, by activating a switch on the rear of the handheld computer marked "ALL OFF". First unplug the charger cable from the handheld computer, if connected. Then grasp the I/O Adapter tray at the finger slots located at the front and rear of the case and lift the tray out of the case. Then slide the handheld computer away from the main body of the I/O Adapter approximately 2 inches and lift it out of the tray. Locate the recessed switch on the rear of the handheld computer marked "ALL-OFF" and, using a screw driver or pencil, move it from "OFF" to "ON". Reinstall the handheld computer in the tray by placing it in the tray approximately 2 inches away from the I/O Adpater body and sliding it toward the I/O Adapter until firmly seated. A buzzer in the handheld computer will sound while the computer is being plugged into

the I/O Adapter and will cease when it is properly seated. Reinstall the I/O Adapter tray in the case and reconnect the charger cable to the handheld computer.

NOTE

The leftmost portion of the tray (containing the 3 small module slots) is detachable and may detach if the tray is lifted by that side. If it detaches, it can be easily snapped together again. The buzzer will sound if peripheral modules becomes unseated from the I/O Adapter. Re-seat the modules if this occurs.

Check AC Adapter for proper line voltage setting, and plug it into a wall receptacle. Then press the keys on the front of the computer marked "ON" followed by "CLEAR". The word RESTART should appear in the display. Press "CLEAR" again and the display should sequence through a list of items.

Note that the "ALL-OFF" switch performs a different function from the "ON" and "OFF" switches on the front of the computer. It disconnects all power from the computer, resulting in loss of data in internal RAM memory (Time, Clock/Controller alarms, and saved radio personality files). The switch should normally be left on unless the programmer is to be stored for an extended period, or rough handling during transit is likely to separate a module from the I/O Adapter.

CAUTION

The computer when turned off, will discharge a completely charged battery in about 200 hours (8 days). For extended storage, turn computer off with the ALL-OFF switch on rear. If internal RAM memory is required, use the AC Adaptor to keep the battery charged. DO NOT CLOSE CASE COVER -- AC Adaptor requires adequate ventilation!

KEYBOARD KEYS

Operation of the programmer is made simple by extensive use of multiple-choice menus. Very few of the keys are required for normal operation, and these are described below. Consult the handheld computer instruction manual for additional information.

ON — Powers the Programmer on.

OFF — Powers the Programmer off. When powered back on, the Programmer will retain its state at power off. Note that this key does not remove backup power from the internal RAM memory.

ENTER — Causes a text entry to be accepted by the handheld computer. Text entry characters can be changed by retyping until ENTER is pressed.

CLEAR — If you are at the beginning of a program, CLEAR returns you to the primary menu. If you are in the middle of a program, CLEAR returns you to the beginning of the program. In most cases, pressing CLEAR twice returns you to the primary menu. Some programs require a different exit procedure.

ARROW — keys move the cursor in the indicated direction when inputting data. Normally only the (leftarrow) and (rightarrow) keys are required with programmer application programs. The (uparrow) and (downarrow) keys are used by some application programs to move from one entry to the next.

STP/SPD — Press this key to freeze action on the display. Press the key to resume the activity. This key also changes the rate at which menu items are displayed and the speed at which autorepeat keys operate. To change this rate, press STP/SPD to freeze the display followed by a number from 1 (slowest) to 5 (medium) to 0 (fastest). The setting will remain until changed or the ALL-OFF switch is switched OFF.

I/O — Pressing this key displays the menu of I/O devices attached. While in this mode you can enable or disable attached I/O devices, or change the RAM memory selection if you have added Programmable Memory (RAM) modules. Press the key again to return to the previous display.

MENU OPERATION

The Programmer makes extensive use of menus to simplify operation. The highest level menu, the Primary Menu, lists functions or application programs that are installed in the system. The menu of programs will be displayed on the handheld computer display preceeded by a number or letter. Press the number or letter on the keyboard to enter the corresponding program. The first four

entries in the menu are functions contained in the handheld computer itself, and are further described in the handheld computer instruction manual. They are displayed

1=CALCULATOR
2=CLOCK/CONTROLLER
3=FILE SYSTEM
4=RUN SNAP PROGRAMS
(See Panasonic Instructions)

Following these programs, are programmer application programs contained in the Program Storage Module, SELF-TEST, contained in the Data I/O Module, and TYPEWRITER, contained in the printer. Any programs purchased from the computer manufacturer, such as BASIC or Serial I/O will also appear. The order in which programs are displayed, and corresponding number, is determined by the I/O Adapter slot number (and socket location in the Program Storage Module).

Application programs will frequently have one or more levels of menu selection. Simply press the key corresponding to the number displayed with the desired item. Press CLEAR to return to the beginning of a program. Press CLEAR again to return to the Primary Menu.

EPROM INSTALLATION

Programmed EPROMs for the various General Electric programmable mobile radios are required in the Program Storage Module before radio programming can be accomplisbed. These EPROMs are provided separately, as ordered, and are not initially installed in the Program Storage Module. The following installation procedure is suggested (refer to Installation Instruction 19B234423):

CAUTION

The EPROM devices can be destroyed by static discharges. Before handling one of these, the installer should be discharged by touching the test bench ground bus. The PW board and EPROM should also be at ground potential. EPROMs should be stored in conductive material.

1. Remove the Program Storage Module from the system I/O Module. Turn off the handheld computer before disconnecting.
2. Remove the four screws from bottom cover and open. Do not remove boards.
3. Install the first EPROM in socket 1, the second in socket 2, etc. (Note socket designations and numerical sequence. Programs will be displayed according to socket number.)
4. Close the cover and replace the four screws in bottom.
5. Reinstall the Program Storage Module in the programmer.

PRINTER PAPER REPLACEMENT

(Refer to vendor instruction manual)

1. Remove paper cover by sliding in direction of arrow (away from printer head).
2. Remove paper spool.
3. Insert new roll of thermal paper with leading edge going into feed mechanism. Leading edge must come from bottom of roll.
4. Advance paper using paper feed knob. Note: Knob rotates in direction of arrow only.
5. Replace paper cover.

NOTE

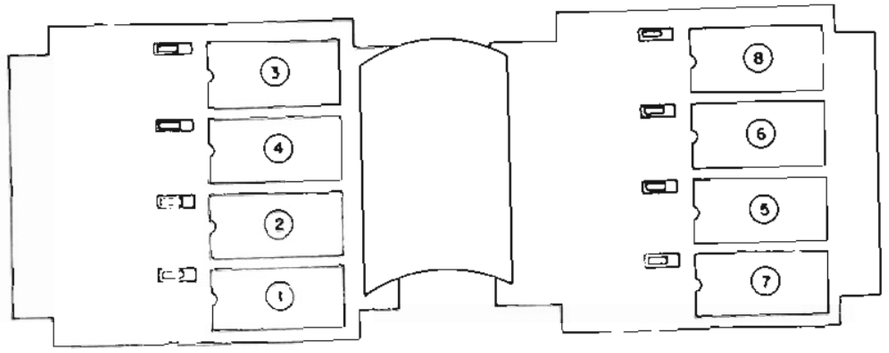
Damage may result to thermal head if printer is activated without paper being set correctly.

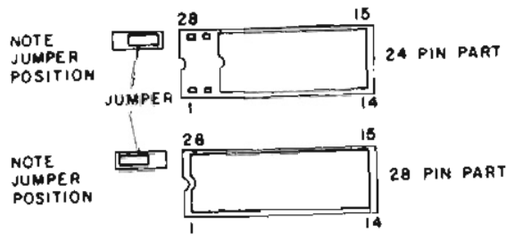
IN CASE OF DIFFICULTY

It is possible that on occasion, unexplained problems will occur which may be caused by static electricity, jostling the unit, etc. The programmer may fail to operate as described or the word "RESET" may appear in the display. If this occurs, press CLEAR once to return to the start of the program being run. The data previously entered will be lost, but no data stored in files will be affected.

If "RESTART" appears, press CLEAR twice. This should return you to the primary menu.

If you cannot reach the primary menu by pressing CLEAR twice, turn the computer off by means of the ALL-OFF switch in the back of the unit. You will have to remove the I/O Adaptor from the case and the computer from the I/O adaptor to reach the switch. Wait about two minutes and turn the ALL-OFF switch on. Then using the AC Adaptor as a power source, press ON and then CLEAR. The word "RESTART" should appear in the display and pressing CLEAR again should display the primary menu. Otherwise the computer needs servicing. This procedure results in the loss of all internally stored files, including time and date.





PROM INSTALLATION

1. REMOVE 4 SCREWS IN BOTTOM COVER AND OPEN.
2. INSTALL FIRST PROM IN SOCKET 1, SECOND PROM IN SOCKET 2, ETC. (PROGRAMS WILL BE DISPLAYED ACCORDING TO SOCKET NUMBER)
3. NOTE PIN COUNT OF PROM (28 OR 24) AND SET JUMPER, IF NEEDED.
4. CLOSE COVER AND REPLACE 4 SCREWS IN BOTTOM.

OPERATING PRECAUTIONS

Do not store the unit for more than a week with the ALL-OFF switch ON without recharging the batteries. There is a very small current drain even when the unit is off, which will result in loss of stored files and possible damage to the batteries.

Charge the batteries every six months, even if the ALL-OFF switch is set to OFF.

Do not subject the unit to a temperature of over 60 C (140 F), because characteristics of the internal parts may be adversely affected by heat. Never leave the unit in a car exposed to the direct sunlight for a long time or the cabinet may become deformed and deterioration of performance may result.

SYSTEM DESCRIPTION

AC ADAPTER

The AC Adapter converts AC line voltage to 9 VDC for charging NiCd batteries in the handheld computer and printer. This voltage also powers certain peripherals not provided with the Programmer, such as the TV Adaptor.

HANDHELD COMPUTER

Besides the keyboard and LCD display the handheld computer module contains an 8-bit microprocessor, random access memory (RAM), system software in read only memory (ROM), and an NiCd battery to power the computer and most attached peripherals. A bus connector at the left side and ROM capsule sockets in the rear provide expansion capability.

I/O ADAPTER

The I/O Adapter provides connectors for attaching up to 6 peripherals to the handheld computer. It buffers bus signals between the computer and peripherals and decodes device addresses of the peripheral slots.

PRINTER

The printer contains the thermal printer mechanism and drive electronics. It also contains a control firmware ROM to drive the printer and a NiCd battery to power the printer mechanism.

DATA I/O MODULE

The Data I/O module provides the interface to the device being programmed and also contains EEPROM programmer circuitry. Connection to the radio is via a separate interconnect cable designed for each product. A socket adapter, which plugs onto the Data I/O module, is required for programming an EEPROM directly.

PROGRAM STORAGE MODULE

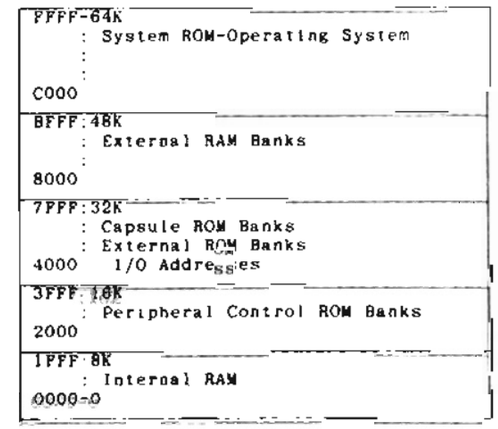
The Program Storage module contains 8 EPROM sockets for application programs provided by General Electric.

SYSTEM ARCHITECTURE

The handheld computer is based on a 6502 microprocessor, which is an 8-bit NMOS device capable of addressing 64K bytes of memory. To allow battery operation, the microprocessor and other high current devices are powered off when not required. Only the display/keyboard driver, RAM memory, and certain peripheral device components are powered continuously while the computer is on. The high current devices are powered up in response to a keyboard key depression, a peripheral device interrupt, or expiration of the internal timer. The microprocessor then performs the required task and powers itself down again.

MEMORY MAP

The 64K byte microprocessor address space is partitioned into 5 areas. Three of these areas utilize bank switching to increase total memory capacity beyond 64K bytes. Note: All memory addresses are in hexadecimal (hex) notation unless otherwise noted.



Memory Map

System ROM - Contained in the handheld computer. Software in this ROM controls overall computer operation and provides the calculator, clock/controller, file system, and run SNAP programs functions.

External RAM Banks - This 16K byte area addresses memory in Programmable Memory (RAM) peripherals. Addressing this area of memory activates the RAM BANK SEL bus signal, which is used as an enable signal by the Programmable Memory Peripherals. Each peripheral contains bank enable circuits, under system software control, to access the desired external RAM bank.

Capsule ROM, External ROM, and I/O - This 16K byte area addresses either internal ROM Capsules, External ROM, or I/O as determined by select circuits inside the handheld computer, under system software control. No bus signal is activated when any of the internal ROM Capsules are selected. The EXT ROM BANK SEL bus signal is activated when this area of memory is if an external ROM is selected. This signal is used as an enable signal by ROM peripherals such as the General Electric Program Storage Module. Each ROM peripheral also contains bank enable circuits similar to the RAM bank enable circuits, so that system software can select the desired ROM.

Most application programs, such as the Programmer's personality programs or Panasonic's Basic language program, reside in this area. Properly formatted programs are automatically recognized by the system and added to the computer's primary menu.

Peripheral I/O addresses are also mapped into this address space and are enabled instead of capsule or external ROM under system software control. I/O is further decoded inside the computer as follows.

47FC-47FF I/O addresses for peripheral slot 0 (direct attachment to the computer). These addresses activate the $\overline{PS}$ (peripheral select) bus signal.

4800-483B I/O addresses for peripheral slots 1-6 (via I/O Adapter). These addresses activate the I/O PAGE bus signal which is recognized by the I/O Adapter. The I/O adapter further decodes this area, generating individual $\overline{PS}$ signals for each slot.

Slot	Address
1	4800-4803
2	4804-4807
3	4808-480B
4	480C-480F
5	4810-4813
6	4814-4817

5800-58FF I/O addresses for keyboard and LCD driver. No external bus signals are generated.

Control ROM - This address space contains peripheral control programs located within the peripherals. Peripheral control ROMs may also contain application programs, such as the SELF TEST program contained in the Data I/O Module.

Internal RAM - Up to 8K bytes of RAM inside the handheld computer. This RAM is used for data buffers, working area, and file storage.

Peripheral I/O Addresses - Each peripheral slot is allocated four memory locations for I/O addresses. Certain bits have defined functions while others vary with the peripheral. The standard definitions are listed below:

Write

Address 0 (ex. 4800) Power on/off - bit 7 of this address controls power to those portions of the peripheral that may be powered down when the peripheral is not in use.

Address 1 (ex. 4801) Output Data - normally used to output a byte of data to the peripheral.

Address 2 (ex. 4802) Bank Select - This byte is used to enable bank selectable memory in the peripheral; External RAM, External ROM, or Control ROM. RAM or ROM peripherals may have up to 8 banks, each enabled by a different bit in the byte. I/O peripherals, such as the GE Data I/O peripheral, have only one Control ROM and it is enabled by bit 0 (least significant bit). In all cases, writing a "1" enables the bank.

Address 3 (ex. 4803) Status - Contains peripheral control bits, such as interrupt enables, mode control bits, etc.

Read

Address 0 (ex. 4800) ID - Contains a code that defines the type of peripheral, RAM, ROM, or I/O. This byte is periodically examined by system software.

Address 1 (ex. 4801) Input Data - Normally used to input a byte of data from the peripheral.

Address 2 (ex. 4802) Not used.

Address 3 (ex. 4803) Interrupt Request - Contains interrupt request status bit and other status bits. Bit 7 (most significant) = 0 indicates to the system that the peripheral has an interrupt pending. Other bits may indicate the type of interrupt or other status information and are peripheral dependant.

SYSTEM BUS STRUCTURE

Input/Output Connector

Pin		Pin	
1	$\overline{\text{EXT ROM BANK SEL}}$	2	BUS PROTECT
3	VBB	4	VBB
5	VDC	6	VDC
7	$\overline{\text{CTL BANK}}$	8	ø2
9	$\overline{\text{I/O PAGE}}$	10	$\overline{\text{IRQ}}$
11	$\overline{\text{PS}}$	12	BUS PROTECT
13	$\overline{\text{NMI}}$	14	SYNC
15	R/$\overline{\text{W}}$	16	A0
17	A1	18	A2
19	A3	20	A4
21	A5	22	Vdd
23	A6	24	A7
25	A8	26	A9
27	A10	28	A11
29	A12	30	A13
31	$\overline{\text{RAM BANK SEL}}$	32	$\overline{\text{INT RAM SEL}}$
33	D0	34	D1
35	D2	36	D3
37	D4	38	D5
39	D6	40	D7
41	GND	42	GND
43	Vcc	44	BUS PROTECT

PIN 1. $\overline{\text{EXT ROM BANK SEL}}$

A decode signal for EXT ROM peripherals. (Not available now).

PIN 2, 12, 44. BUS PROTECT

These connector pins are designed so that, when peripherals are connected to the I/O adaptor, the pins make contacted before any other lines in order to protect internal operation; CPU becomes RESET, and when the connection is secure, the RESET is opened.

PIN 3, 4, VBB

A power supply which is supplied from the main unit battery.

PIN 5, 6, VDC

A power supply which is supplied from AC adaptor.

PIN 7. $\overline{\text{CTL BANK}}$

A signal, which is active "L", used in order to access the control ROM in order to control each peripheral.

PIN 8. ø2

The phase 2 system clock derived from CPU and used by peripheral such as EXT RAM (PROGRAMMABLE MEMORY) or TV adaptor.

PIN 9. $\overline{\text{I/O PAGE}}$

The signal decodes 4800 to '4FFF of memory map (used only with the I/O adaptor); active "L".

PIN 10. $\overline{\text{IRQ}}$

An interrupt-request signal. When this line becomes "L" and the CPU accepts the interruption the interrupt-processing routine is executed. (The go/no-go of the interrupt can be controlled by the I flag of 6502.)

PIN 11. $\overline{\text{PS}}$

The bytes from '47FC to '47FF, as the $\overline{\text{PS}}$ signal, acts as the selection signal for peripherals. These signals output from the main unit are effective only when the main unit and peripheral are directly connected.

PIN 13. $\overline{\text{NMI}}$

A non-maskable interrupt signal with no relationship to the I flag. When there is a change from "H" to "L", the CPU is interrupted; and edge-sensitive signal.

PIN 14. SYNC

A signal which is output only during the program-fetch cycle of the CPU.

PIN 15. R/$\overline{\text{W}}$

A read/write signal. "H" when the CPU reads, "L" when it writes. Formed during ø1, self-sustaining during ø2.

PIN 16 to 30. ADDRESS (except in 22) A0 to A13.

Address bus signal formed during ø1, and self-sustaining during ø2.

PIN 22. Vdd

A line to supply power to the CMOS ICs. Always supplied when ALL-OFF switch is ON.

PIN 31. $\overline{\text{RAM BANK SEL}}$

A $\overline{\text{RAM BANK SELECT}}$ signal which is output from DEC 2 when CPU accesses address '8000 to 'BFFF; active "L".

PIN 32. $\overline{\text{INT RAM SEL}}$

A signal which is output when the CPU accesses '1000 to '1FFF within the INT RAM area ('0000 to '1FFF). This address space is currently used as the HHC debugger; active "L".

PIN 33 to 40 DATA0 to D7

Data-base signals. Data is put on data bus after start of o2 and after accessing CPU or peripheral.

PIN 41,42. GND

The system ground.

PIN 43. Vcc

A +5 power-supply line which is output only when the CPU is ON.

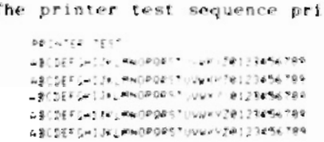
MAINTENANCE

SELF TEST PROGRAM

A self test program is included to check operation of the printer, Data I/O Module, and application programs contained in the Program Storage Module. The self test program appears in the primary menu as SELF TEST and is selected by depressing the number or letter displayed before it.

When selected, the program name will appear momentarily in the LCD display, followed by the printer test sequence. The printer test sequence and all subsequent output, is printed by the printer as it is being displayed on the LCD display. All output is also routed to any other (optional) peripheral devices such as the TV Adaptor and RS-232C Serial Interface. All such devices, including the printer, must be enabled in the I/O Menu to receive output. Refer to Panasonic instruction page 48 for I/O Key and Menu.

The printer test sequence prints:



The program memory test follows the printer test. It lists each General Electric application program and version number on the LCD display, printer and any other enabled output device. Each program name is followed by good if the program's checksum is good, or bad if it is not (indicating that the program's bit pattern has been corrupted).

(program name)	(program version)	(good/bad indicator)
PHOENIX-MOBILE	V30	GOOD
DELTA MOBILE	V30	GOOD
SELF TEST	V01	GOOD

Any installed programs that do not appear in this list were not readable and indicate a problem with the EPROM containing the program or the Program Storage Module electronics.

> **NOTE**
>
> Non-General Electric programs such as TYPEWRITER will not be displayed or tested since they do not have the proper test checksums imbedded in them.

The SELF TEST program will then test the Data I/O Module. The program tests the timer and displays (and prints) TIMER ERROR if the timer is inoperative or out of adjustment. A test connector, socket adaptor, and spare EEPROM are required for the rest of the test. The test can be skipped if these items are not available. The LCD display will display:

TEST CONNECTOR INSTALLED (Y/N)?

> **NOTE**
>
> The Test Connector is not provided as a part of the Programmer and the user will need to provide this device. The schematic and suggested parts are as follows:

Install the test connector in the radio cable socket and press Y on the keyboard. Pressing N will cause the test to be skipped and the message TEST SKIPPED to be displayed. When the test completes, the message TEST COMPLETE will be displayed. Any errors will be displayed in the form

EXPECTED 00110000 ACTUAL 00010000

The bit pattern displayed after EXPECTED is the expected bit pattern for peripheral I/O address 3 of the Data I/O

Module (bit 7 first) and the pattern displayed after ACTUAL is the pattern actually read.

SELF TEST will next request that a socket adaptor and blank EEPROM be installed. Press Y to perform the test or N to skip the test. TEST SKIPPED will be displayed and printed if the test is skipped.

SOCKET ADAPTOR AND EEPROM INSTALLED (Y/N)?

When the test is completed, the message SOCKET GOOD will be displayed and printed if the socket is good. If an error is encountered, the message SOCKET ERROR will be printed instead.

ADJUSTMENTS

Periodic adjustments are not required. However, the Data I/O Module timer frequency may require adjustment if timer components are replaced or TIMER ERROR appears during the SELF TEST program.

Adjust the timer as follows:

1. With the computer off, remove the I/O Adaptor tray from the case and remove the Data I/O Module. Remove the four screws securing the Data I/O Module top cover.
2. Reinstall the Data I/O Module in the I/O Adaptor (preferably in Slot 1). Lift and fold back the Data I/O Module top cover.
3. Turn the handheld computer on and run the SELF TEST program until:

   TEST CONNECTOR INSTALLED (Y/N)?

   appears.
4. Adjust R56 until the frequency at U10 pin 3 is 2000 Hz ±10 Hz.
5. Press CLEAR twice to return to the primary menu and turn the computer off.
6. Remove the Data I/O Module. Reinstall the top cover and screws. Install module in its normal location and reinstall I/O Adaptor tray in the case.

TROUBLESHOOTING

Problems can often be isolated to a particular module by observing the symptoms and unplugging suspected modules. This table is provided as an aid to locating the problem.

No Operation:

1. Check that "ALL-OFF" switch on rear of computer is on.
2. Battery discharged - charge battery.
3. Bad I/O Adaptor or peripheral. Remove computer from I/O adapter and try. If computer works, add I/O adapter and peripheral one-at-a-time.

Programmer operates on AC Adaptor but not on batteries:

1. Batteries not charged
2. Blown battery fuse in computer
3. Batteries defective

Only intrinsic programs appear:

1. Defective I/O Adaptor - plug a peripheral directly into computer and see if its program(s) appear in main menu.
2. Defective peripheral loading I/O Adapter bus - remove peripherals and re-install one at a time.

Radio Programmer programs do not appear in main menu but TYPEWRITER does:

1. PROMs installed incorrectly.
2. Defective Program Storage Module
3. Defective I/O Adaptor - try another slot.
4. Defective computer - no EXT ROM BANK SEL signal.

ATTACH or OPEN failure when entering programmer programs:

1. Defective Data I/O Module.
2. Data I/O Module PROM installed incorrectly.
3. Defective I/O Adaptor.

Printer inoperative:

1. Printer battery discharged - charge battery.
2. Printer battery defective.

Programmer reads incorrect data or VERIFY errors:

1. Defective radio interconnect cable.
2. Defective Data I/O Module - run SELF TEST program.

c. Defective radio.

REPAIR SERVICE

If the Universal Radio Programmer becomes inoperable, as determined by the SELF TEST program, the complete programmer should be returned to the General Electric Company for repair and return. Send programmer prepaid to:

General Electric Company
Mobile Communications Division
Attention: Repair Facilities
Customer Services Center
Lynchburg, Virginia 24502

NOTE

If it has been determined that fault is in Panasonic equipment, you have the option of sending Panasonic modules (only) prepaid to:

Panasonic Factory Servicenter
425 East Algonquin Road
Arlington Heights, IL 60005

PROGRAM STORAGE MODULE

DESCRIPTION

The Program Storage Module provides storage for up to eight application programs for the Programmer. It contains interface electronics and sockets for 8 EPROMs, each of which may contain an application program.

All EPROMs are mapped into the capsule ROM address space from 4000 to 7FFF, and bank enable circuits select which EPROM is enabled. The use of 28 pin sockets and jumpers allows the use of 4K, 8K, and 16K byte EPROMs. Power switching the EPROMs reduces standby current drain.

Peripheral Addresses

Only one output and one input peripheral address are implemented. Peripheral reads are decoded by U9D and U8A and applied to the enable of read address decoder U10A. The 0 output of U10A is inverted by U9C and applied to the base of Q4. Q4 grounds data bus D3 causing F7 (hex) to appear in response to a read from Peripheral Address 0 (ID Byte). This is the device code for a ROM peripheral.

Peripheral writes are decoded by U9A and applied to the write pulse generator U9B and U8B. This circuit produces an active-low pulse approximately at the midpoint of the write cycle. This pulse is applied to the enable input of write address decoder U10B. The 2 output drives the clock input of bank enable latches U11 and U12. A logic 1 written to any bit of the latch will enable the corresponding EPROM.

EPROM Bank Enable/Chip Enable/Power Switch

External EPROMs are accessed by the handheld computer when it activates the EXT. ROM BANK signal. U6A inverts the polarity of the signal. The output of U7 is logic 1 whenever one (or more) of the EPROM bank enable latches is set. Its output is ANDed with EXT. ROM BANK by U6D to produce a module enable signal. This signal enables data buffer U5 and the EPROM chip enable gates U14 and U16. It is buffered by U6C and U6B to produce a power switch enable (G3) for the address buffers (U1-U4).

The outputs of bank enable latches U11 and U12 are inverted and buffered by U13 and U15. Each output of U13 and U15 drives an EPROM power switch transistor (Q5-Q12) which applies voltage to any bank-enabled EPROM. The outputs of U13 and U15 are also individually or-ed with the module enable signal by U14 and U16 to produce a chip enable for any EPROM that is bank enabled when EXT. ROM BANK is activated.

Address Buffers

U1-U4 buffer the address signals to the EPROMs. Their Vcc is switched on only during accesses to on-board EPROMs to reduce power consumption and bus loading.

Regulators

There are two voltage regulators and a power switch circuit in the module, in addition to the EPROM power switch circuits. The Vcc regulator, consisting of Q1 and Q2, regulates the handheld computer's battery voltage (6 VDC nominal) down to 5 VDC for powering the LS TTL integrated circuits and EPROMs. This regulator is controlled by and referenced to the Vcc bus signal. Bus Vcc is at 5 VDC while the microprocessor in the handheld computer is operating and 0 VDC otherwise, thus this regulator is on only while the microprocessor is operating. Power switch Q3 switches power to address buffers U1-U4. They are powered only while an EPROM is being accessed.

The Vdd regulator, consisting of Q13 and Q19, is similar to the Vcc regulator described above, except that it is referenced to the bus Vdd signal. Bus Vdd is +5 VDC at all times (unless the rear "ALL-OFF" switch is off), regardless whether the microprocessor is powered up. Thus regulated Vdd is present at all times and powers the high speed CMOS IC, U5 and U6. All other CMOS ICs are powered directly from bus Vdd.

DATA I/O MODULE

DESCRIPTION

The Data I/O Module provides a serial communications interface to General Electric Mobile Radio products and an EEPROM programmer. The serial interface is software-programmable to accommodate a number of serial data formats. The module connects with the unit being programmed by an interconnect cable designed for the product.

The module consists of peripheral address decoder circuits, data buffers, output data latches, serial data buffers/level converters, and a control EPROM.

Peripheral Addresses

Three of the four possible read peripheral addresses are used while all four write addresses are used. I/O reads are decoded by U9D and U5B and the resultant active-low signal is applied to the enable input of read address decoder U6A.

Read decode 0 (ID byte) enables one section of U7, which forces data bus D6 and D7 low, resulting in 3F (hex) being read. This is the ID code for a read/write peripheral.

Read decode 1 enables the read data buffers from the internal data bus to the external data bus (U15 and part of U16) and produces a chip enable for the EEPROM (via U18C and U18D).

Read decode 2 enables the status read data buffers (part of U7 and part of U17), which apply the status of the radio I/O lines and timer flip-flop to the data bus.

I/O writes are decoded by U4B and applied to the write pulse generator circuit consisting of U4C and U5C. This circuit produces an active-low pulse approximately in the center of the write cycle. The write pulse is applied to the enable input of write address decoder U6B.

Write decode 0 is applied to the clock input of power-on flip-flop U9A. This flip-flop is controlled by data bus D0 and controls power to the radio I/O interface and EEPROM socket.

Write decode 1 produces a chip enable to the EEPROM socket and is used to write data to the EEPROM.

Write decode 2 is applied to the clock input of bank enable flip-flop U3B. This flip-flop, controlled by data bus D0, enables the device control ROM.

Write decode 3 latches status information into the status latches (U8, U3A) and the timer latch (U9B).

Control ROM

The control ROM (U2) contains software which drives the Data I/O Module to transmit/receive data to/from the unit being programmed. It also controls the EEPROM programmer hardware. It resides in control ROM address space from 2000 to 3FFF (hex) and is enabled when the handheld computer activates CONTROL BANK. Bank flip-flop U3B must also be set, under control of system software.

In addition to device driver software called by Programmer application programs, the control ROM contains a test program called SELF TEST. This program exercises the Data I/O Module.

Radio I/O

The radio I/O consists of four bi-directional lines and one output line to the radio cable connector. The lines are connected to a parallel output latch and input buffer addressed by peripheral address 3. The serial data stream is generated by the system microprocessor reading and writing the proper codes to peripheral address 3, under control of software located in the control ROM.

Write data is latched in U8 and U9B, and inverted by U13. U12 converts the signals to open-collector before going to the external connector. Input data is level shifted and inverted by U11 before being applied to read data buffer U7. This buffer is enabled by a read to peripheral address 3.

Power to the interface circuits (U11, U12) is switched by the regulator consisting of Q2, Q5, and Q6, controlled by power switch flip-flop U9A. Power is applied to these circuits only when a data transfer is to be performed.

Timer

Timer U10 produces 2 kHz pulses that are coupled to the SET input of U9B. If the output of U9B was previously logic 0, it will change to logic 1 when a pulse occurs. The state of U9B is monitored by testing bit 0 of peripheral address 3 (via U17). During serial data transfer, control ROM software uses this timer for timing serial data. It monitors the state of this bit and assumes that 0.5 msec has elapsed when the bit becomes set. Software then clears flip-flop U9B

by writing a logic 0 to bit 0 of peripheral address 3 to reset the timer. It then performs any functions required at that time and waits for the input bit to become set again.

EEPROM Programmer

The EEPROM programmer is capable of programming XD2212 type 5V EEPROMs. These EEPROMs are read and written like a RAM, with a mass transfer of data to permanent storage when the STORE input is activated. The EEPROM address is generated by counter U14. This counter is reset to 0 and incremented by manipulating bits 1 and 5 of peripheral address 3. The EEPROM STORE, RECALL, and WRITE inputs are controlled by other bits of peripheral address 3. EEPROM data is read and written by accessing peripheral address 1. U18B and U18D negative-or the read and write decodes to form a chip enable for the EEPROM. Read and write data are buffered from the bus connector by buffers U15, U16, and U17.

Regulators

There are two voltage regulators in the module, one of which may be switched on and off by the power control flip-flop (U9A). The switched regulator, consisting of Q2, Q5, and Q6, regulates the computer's battery voltage (6 VDC nominal) down to 5 VDC to power the serial interface circuits and EEPROM. Q5 and Q6 form the basic regulator, which is referenced to the bus Vdd supply. Q2 switches the supply on by pulling R14 to ground.

The second regulator, consisting of Q3 and Q4, regulates voltage for U1 and U2. It is referenced to the bus Vcc supply, which is present only while the microprocessor is running. Thus this supply is on only while the microprocessor is running.

The remainder of the circuits are powered directly by the bus Vdd supply.

EEPROM SOCKET ADAPTER (TQ2313) EARLIER MODELS

The Socket Adapter is an adjunct device for the Data I/O Module. The adapter plugs into J3 and J4 on the top of the Data I/O Module. The 18 pin socket J1 has spring loaded contacts that are lever-opened. This assures firm-positive contact connections. The Socket Adapter is used when programming EEPROMs only.

CAUTION

Remove the Socket Adapter before closing the case - to prevent damage to the Socket Adapter or Data I/O Module.

EEPROM SOCKET ADAPTER (TQ2330)

TQ2313 Socket Adapter has been replaced by TQ2330 Socket Adapter. TQ2330 has an 18-pin and 24-pin socket, whereas TQ2313 has only an 18-pin socket. TQ2330 can program the 2212-type, 18-pin EEPROM in the Phoenix radio and similar products, and the 2816-type, 24-pin EEPROM in the S950 Control Unit.

Coincident with introduction of the TQ2330 Socket Adapter, the Control EPROM in the Data I/O Module was revised to support programming the 24-pin EEPROM and serial load of the S950 and other new products. The EPROM was changed from 19A148240G1 to 19A148240G2 and the SELF TEST software version number changed from V03 to V04.

In addition to programming and serial load changes, changes were made to the operation of SELF TEST.

1. SELF TEST now prints only one line of printer test pattern.
2. SELF TEST now beeps whenever a test fails.
3. SELF TEST now tests both the 18-pin and 24-pin sockets.

The Panasonic RL-P1004 Mini Printer is replaced by the Panasonic RL-P1004A Printer/Cassette Adaptor in some programmers. The RL-P1004A contains an audio cassette interface for saving/loading files in addition to the printer. This change causes the Primary Menu item "TYPEWRITER" to appear as "PRINTER/CASSETTE" in the examples in this manual and other related publications. Selecting "PRINTER/CASSETTE" will cause the following menu to appear:

1= TYPEWRITER
2=CASSETTE LOAD/SAVE

Selecting "TYPEWRITER" will place the user in the TYPEWRITER program, similar to the TYPEWRITER program in the RL-P1004 Mini Printer.

Selecting "CASSETTE LOAD/SAVE" will place the user in the cassette load/save program. This program allows the user to save and load files on an audio cassette recorder. This feature has not been extensively tested by General Electric and reliability of the recording cannot be guaranteed. Preliminary tests indicate that a quality recorder and good tape are required for satisfactory performance.

MODULE LOCATION

Generally, any peripheral module can be placed in any I/O Adaptor slot. For example, you may wish to move the Data I/O Module to slot 1 if you program large numbers of EEPROMs outside the radio.

CAUTION

Always return the computer to the primary menu and turn it off before removing or installing peripherals.

Restrictions are:

1. The computer can only be plugged into the lower right slot.
2. Dual length modules should only be installed in the dual length slots above the computer. Single length modules can be installed in any slot, but should have a foam block installed behind them if they are installed in dual length slots and the unit is subject to rough handling.
3. Panasonic RL-P6006 Cable (not supplied) is recommended for connection to slot 6. The Program Storage Module will not operate properly when connected via this cable.
4. The Panasonic RL-P3001 RS-232C Serial Interface (not supplied) should generally be installed in slot 1. Refer to the manual accompanying the module.

Peripheral/Software Compatibility

A broad range of peripherals is available from the computer manufacturer. However, each General Electric application program will support only certain peripherals. Check the instruction book accompanying the program(s) before purchasing additional peripherals.

While an attempt has been made to maintain compatibility with Panasonic system conventions, General Electric cannot guarantee compatibility with programs supplied by others. It may be necessary, under certain conditions, to remove the Program Storage Module and/or Data I/O Module for such programs to function properly.

NOTE

For ease of operation and convenience in changing Printer paper, the Printer may be interchanged with the Program Storage Module. The new positions will not change operation of either component.

Figure 1 - Universal Radio Programmer TQ2120

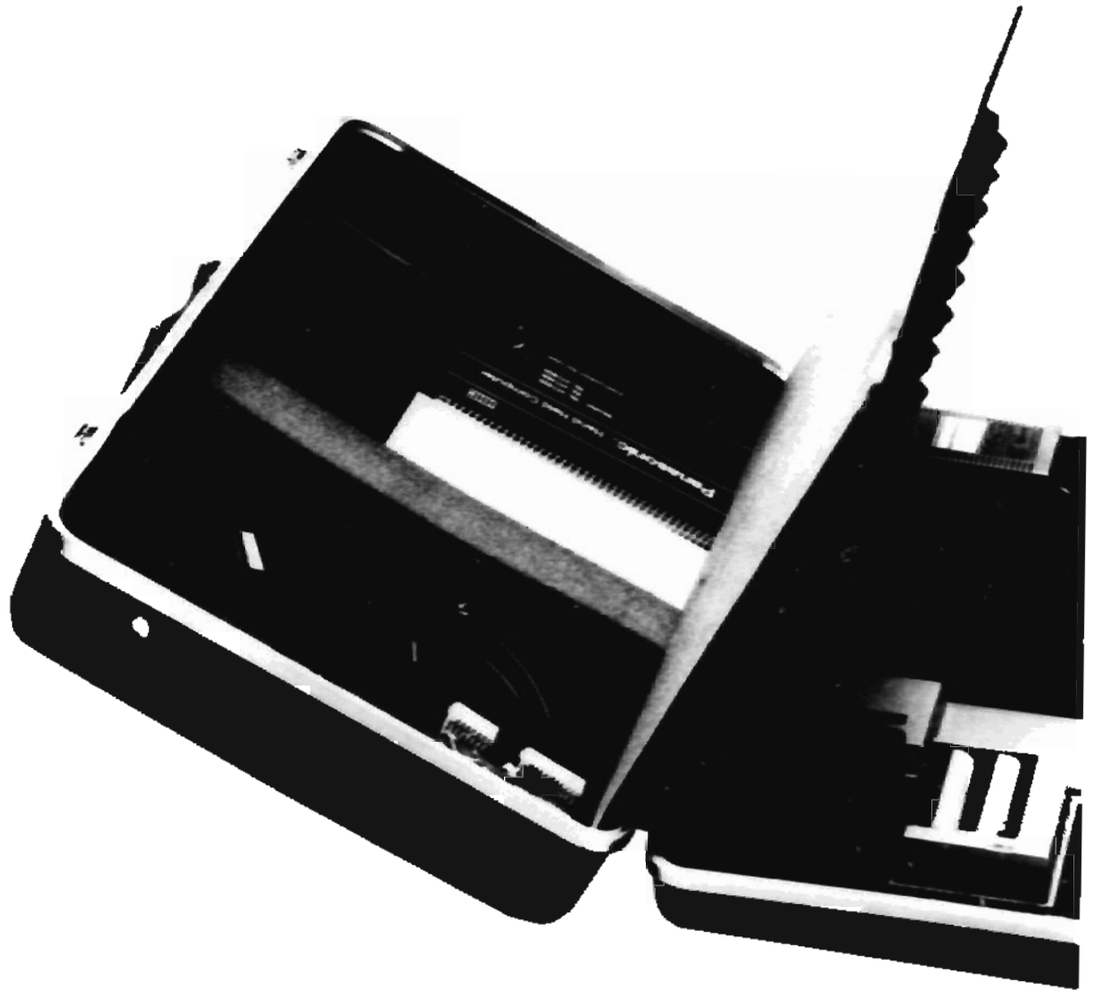


Figure 3 - Storage Space in Case Top

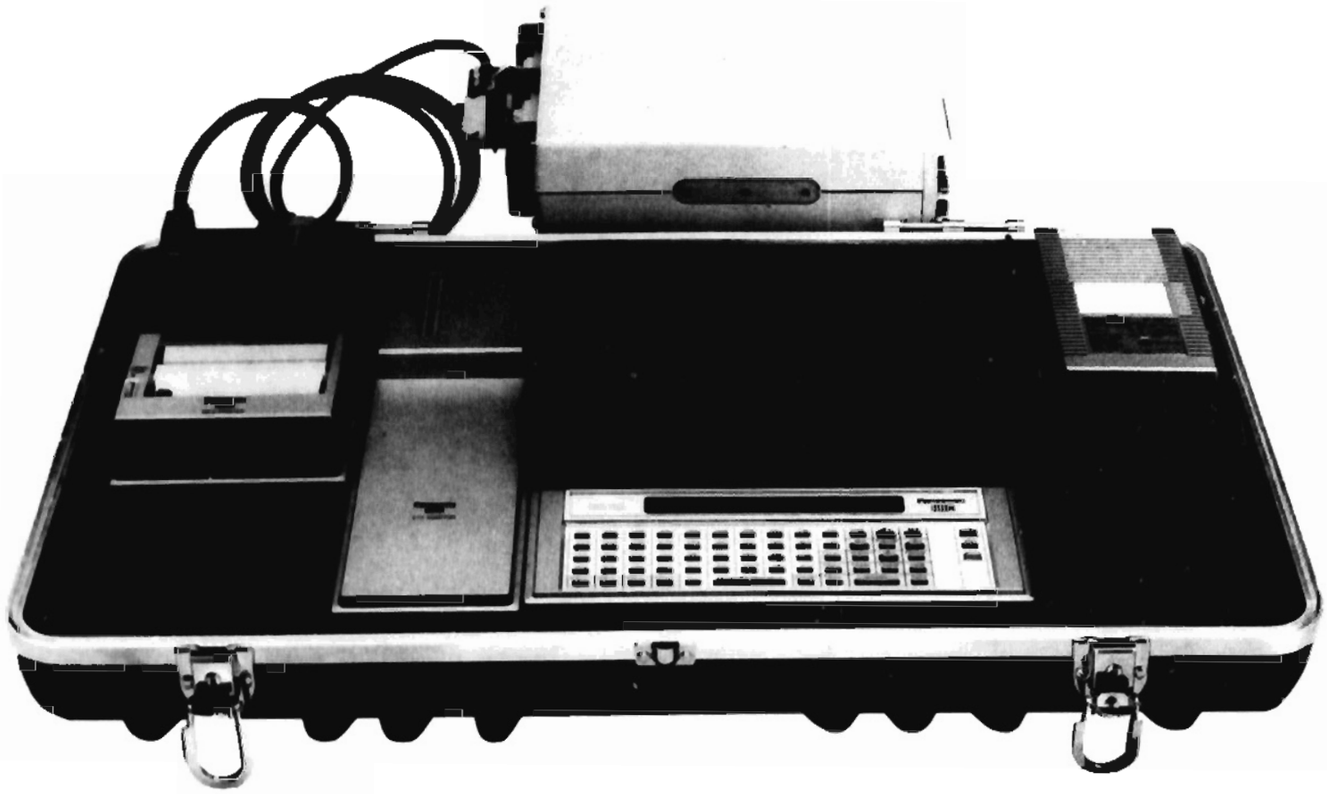


Figure 1 - Programmer connected to Phoenix-S Mobile Radio

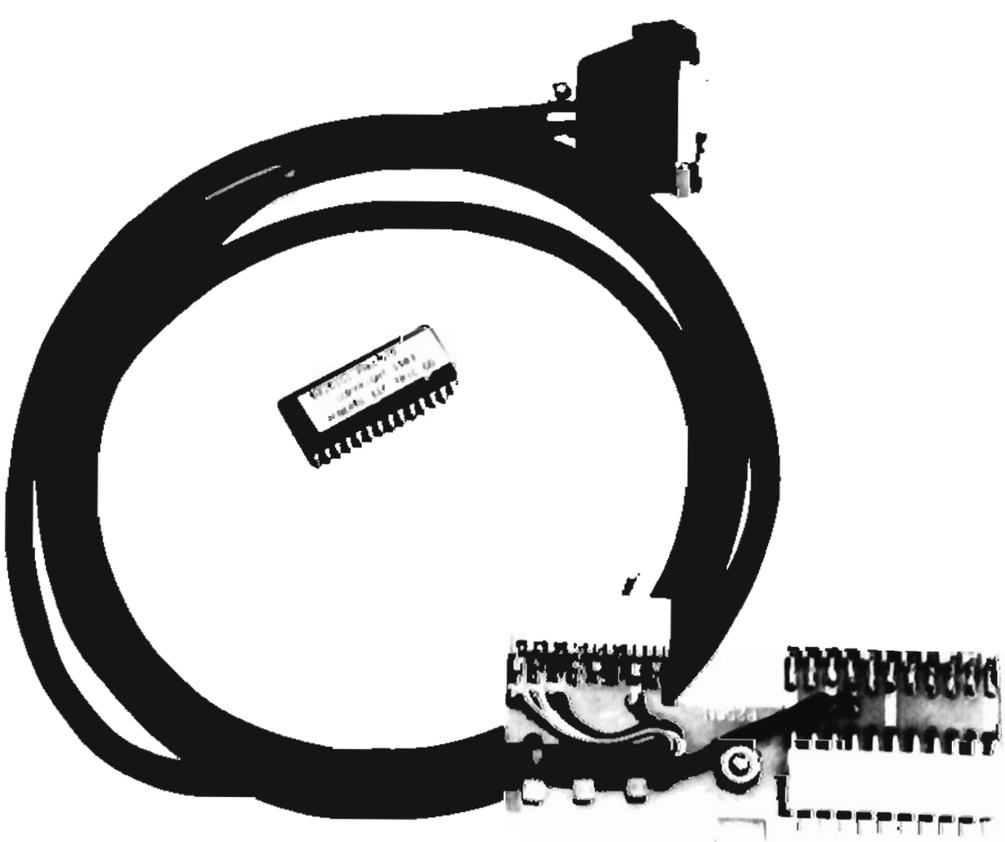


Figure 2 - Phoenix Cable and EEPROM

RC4407

RC - 4399

Figure 7 - Program Storage Module

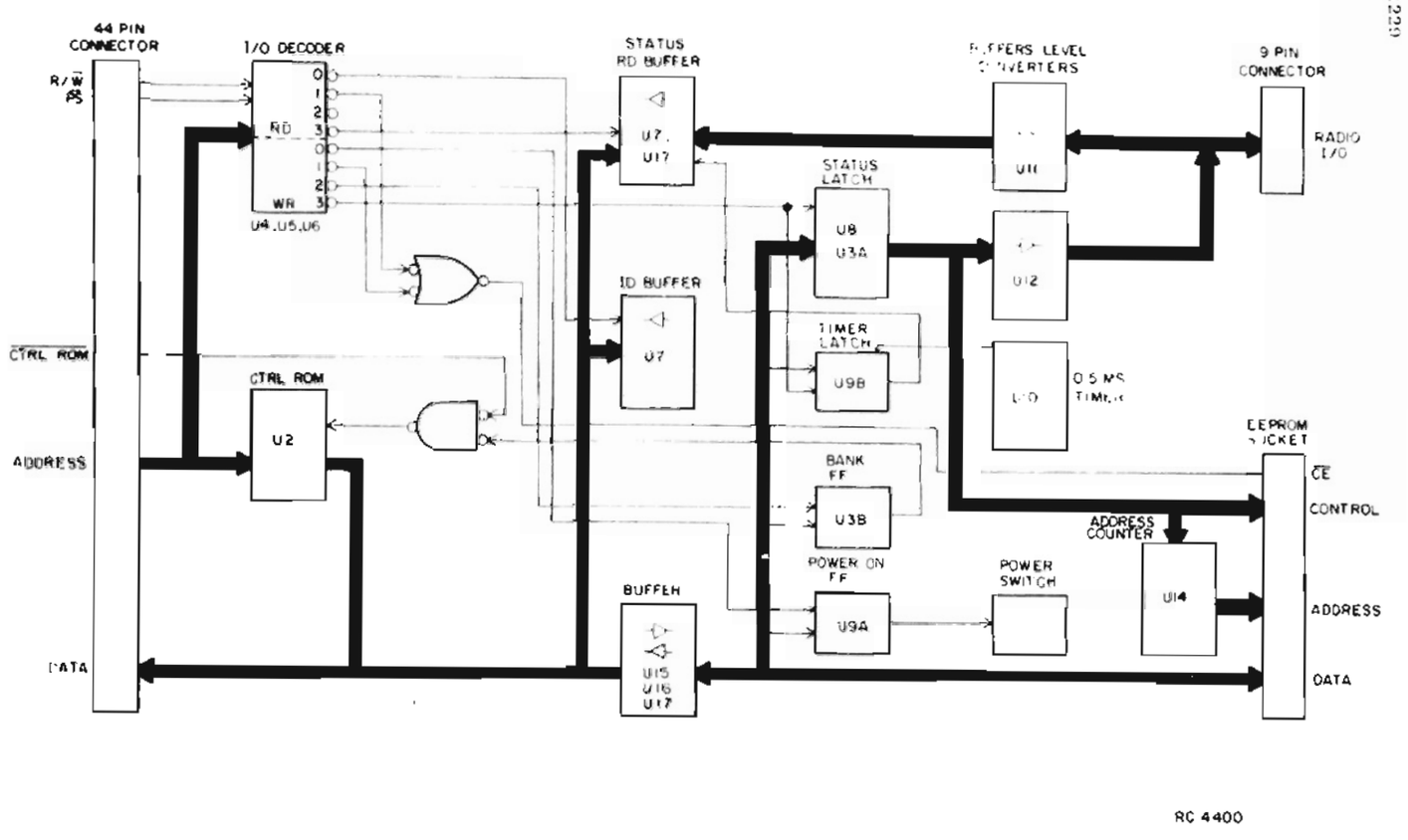
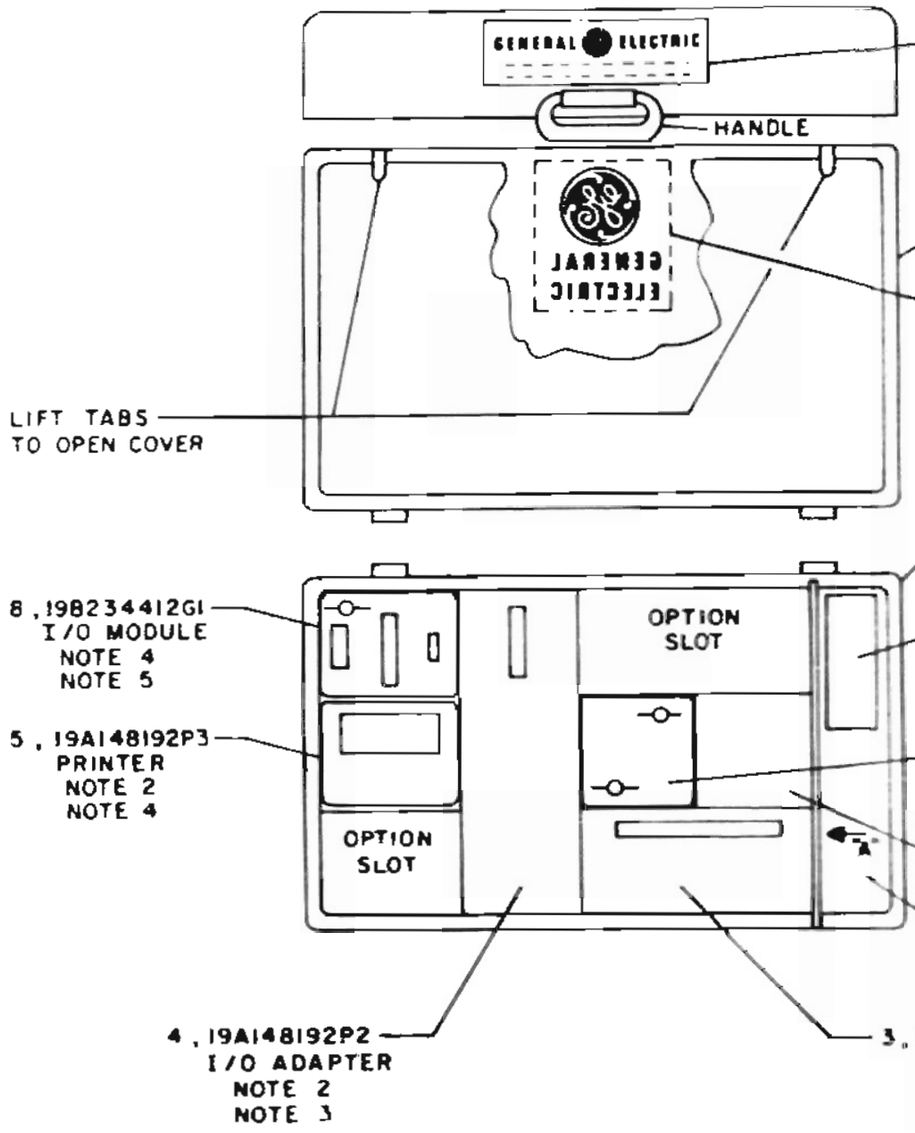


Figure 8 - Data I/O Module



13, 19A148239P2
LABEL
ORIENT AS SHOWN

2, 19A148191P1
CASE
(TOP HALF)

12, 19A148239P1
LABEL

2, 19A148191P1
CASE
(BOTTOM HALF)

8, 19823441261
I/O MODULE
NOTE 4
NOTE 5

5, 19A148192P3
PRINTER
NOTE 2
NOTE 4

6, 19A148192P4
AC ADAPTER
NOTE 2

7, 19823441161
PROGRAM STORAGE MODULE
NOTE 4

FOAM BLOCK
(SUPPLIED W/CASE)

NOTE 1

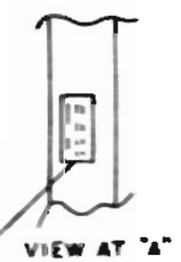
4, 19A148192P2
I/O ADAPTER
NOTE 2
NOTE 3

3, 19A148192P1
HANDHELD COMPUTER
NOTE 2
NOTE 4

(1) NOTES:

1. PLACE AC ADAPTER CORDS HERE.
2. STORE ACCOMPANYING INSTRUCTION BOOKS IN TOP HALF OF CASE.
3. SNAP AUXILIARY TRAY ONTO LEFT SIDE OF I/O MODULE.
4. PLUG ITEM INTO I/O ADAPTER.
5. STORE SOCKET ADAPTER ITEM 27 (TQ 2330) IN TOP HALF OF CASE.
6. STORE PAPER ITEM 25 IN TOP HALF OF CASE

(40) SAME AS PART 1 EXCEPT INCLUDES ONLY ITEMS 2, 12 AND 13.



21
19A148239P3
LABEL

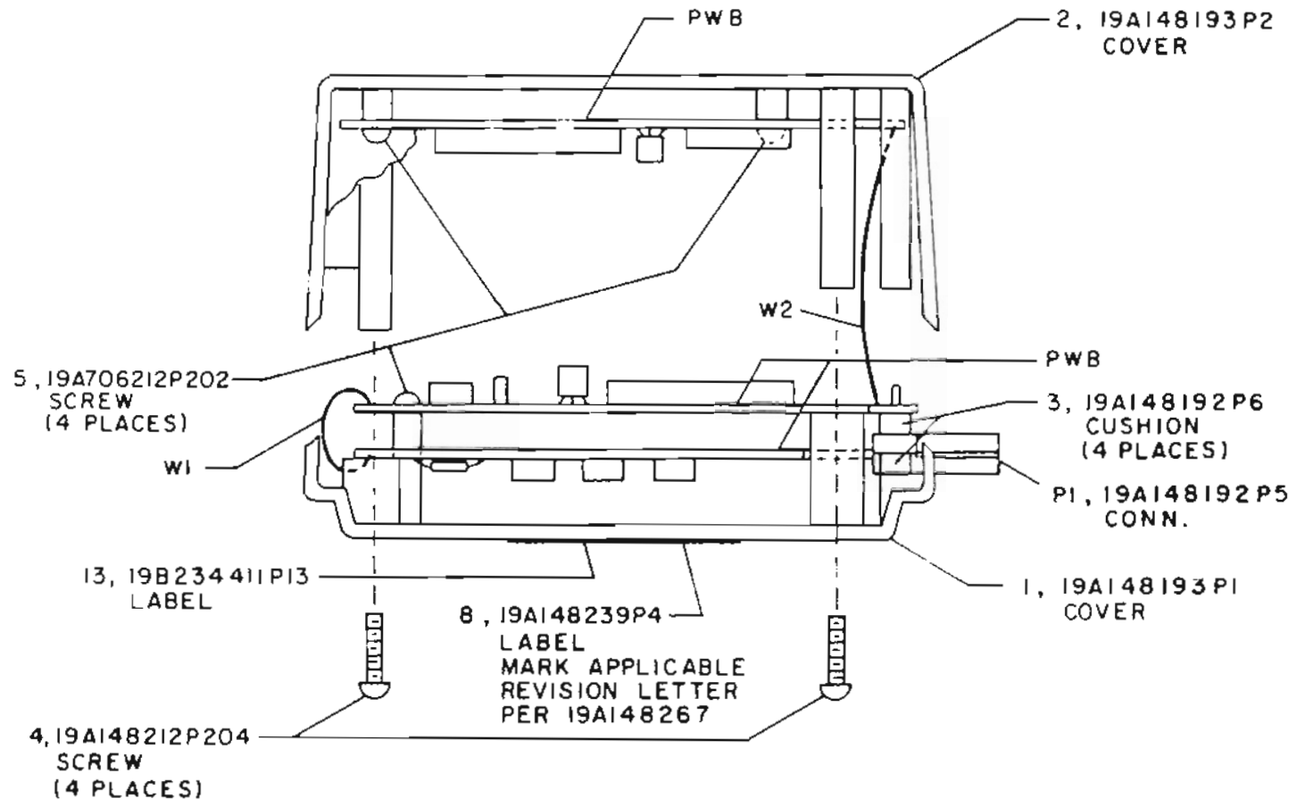
OUTLINE DIAGRAM

UNIVERSAL RADIO PROGRAMMER
TQ2310
19823441361

SYMBOL	GE PART NO	DESCRIPTION

* COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PL ISSUED



(10)

(13) LABEL, PER 19A700154P10
BLACK LETTERS
WHITE BACKGROUND

REF .312

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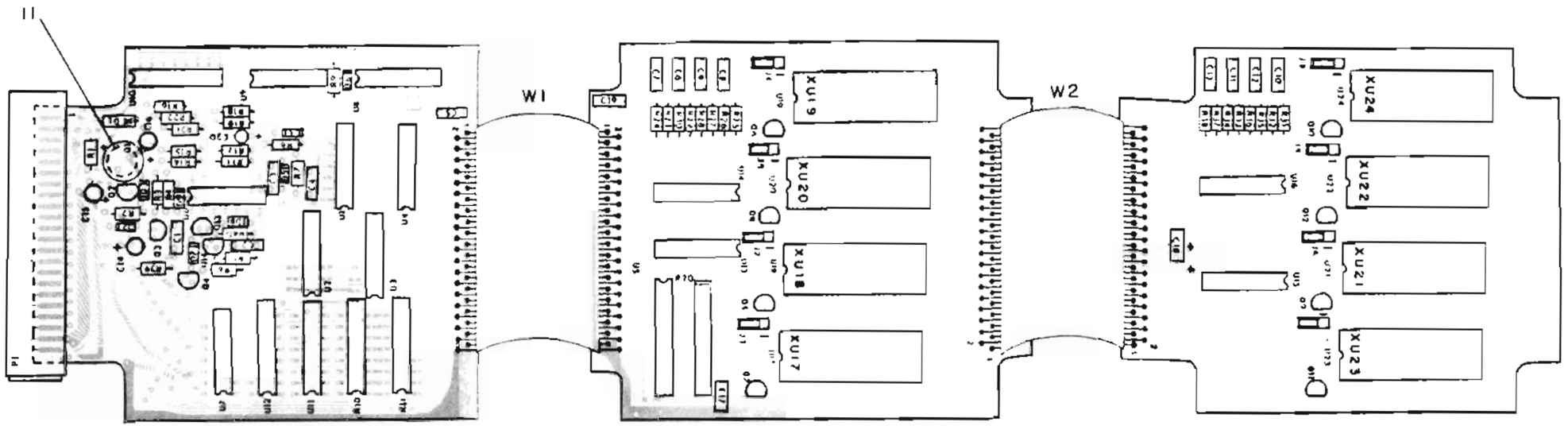
GENERAL ELECTRIC CO.

1.312 REF.

CAUTION
OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

OUTLINE DIAGRAM

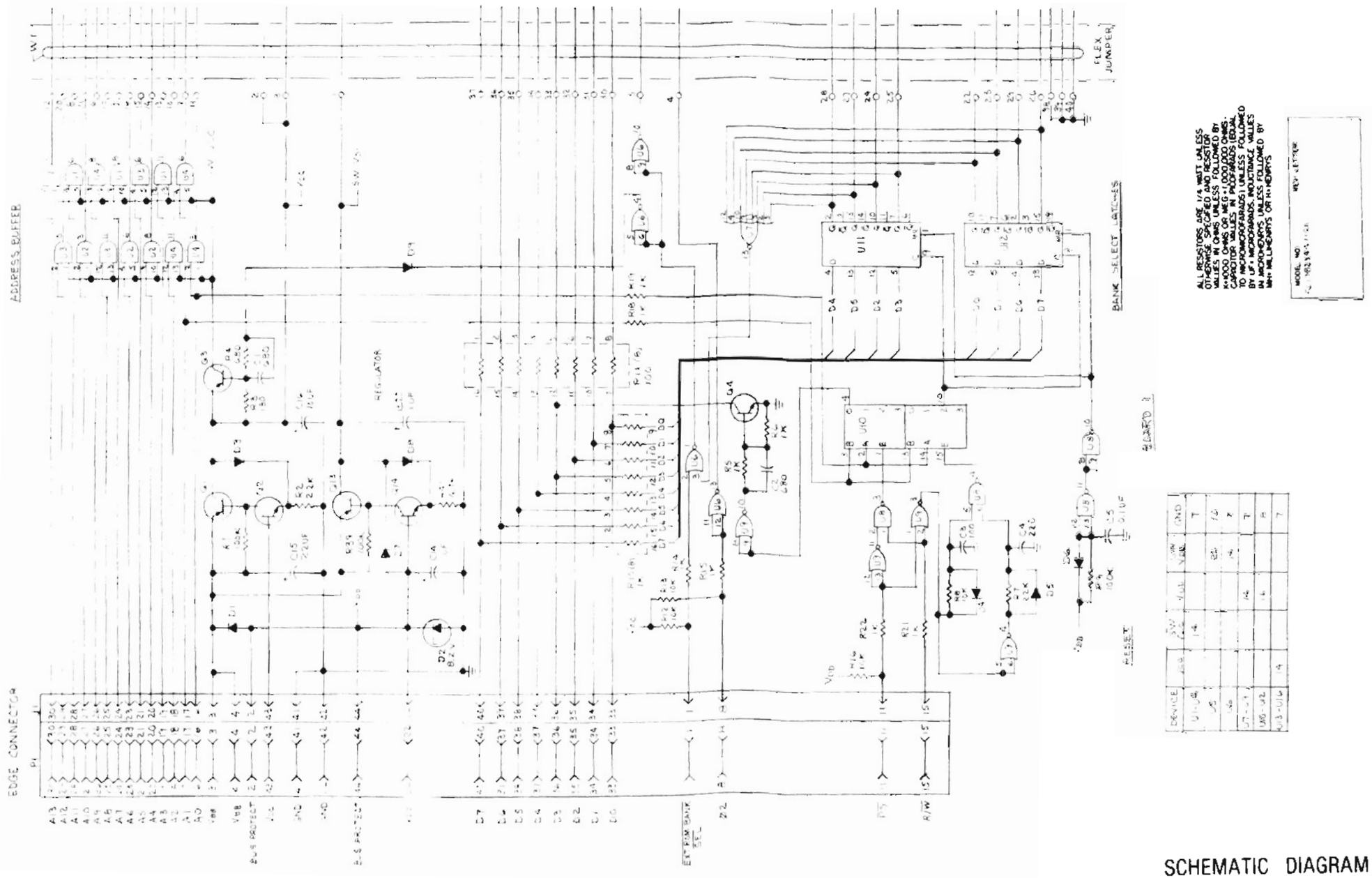
PROGRAM STORAGE MODULE
19B234411G1



BOARD 1 BOARD 2 BOARD 3

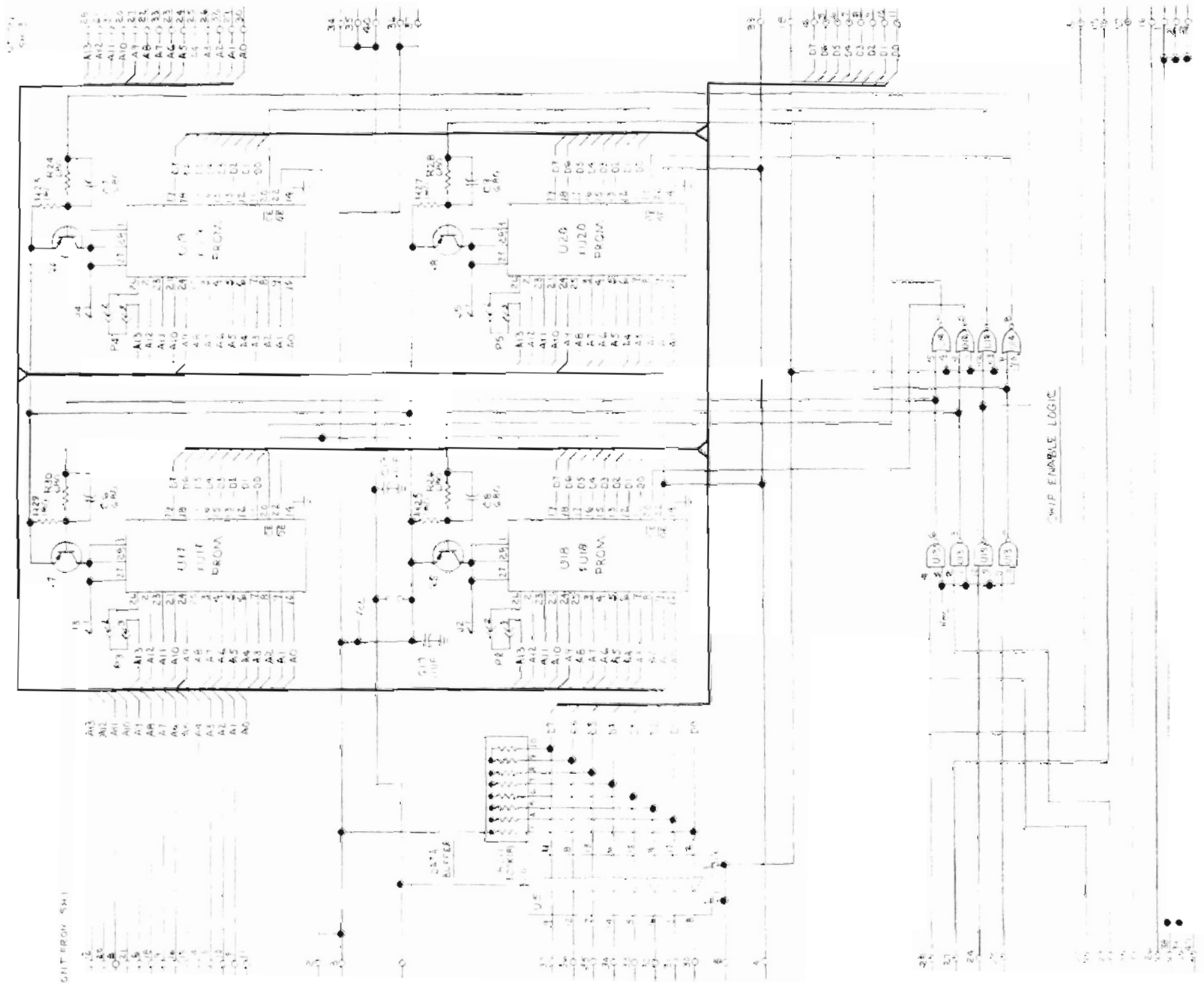
OUTLINE DIAGRAM

PROGRAM STORAGE MODULE
PRINTED WIRE BOARD



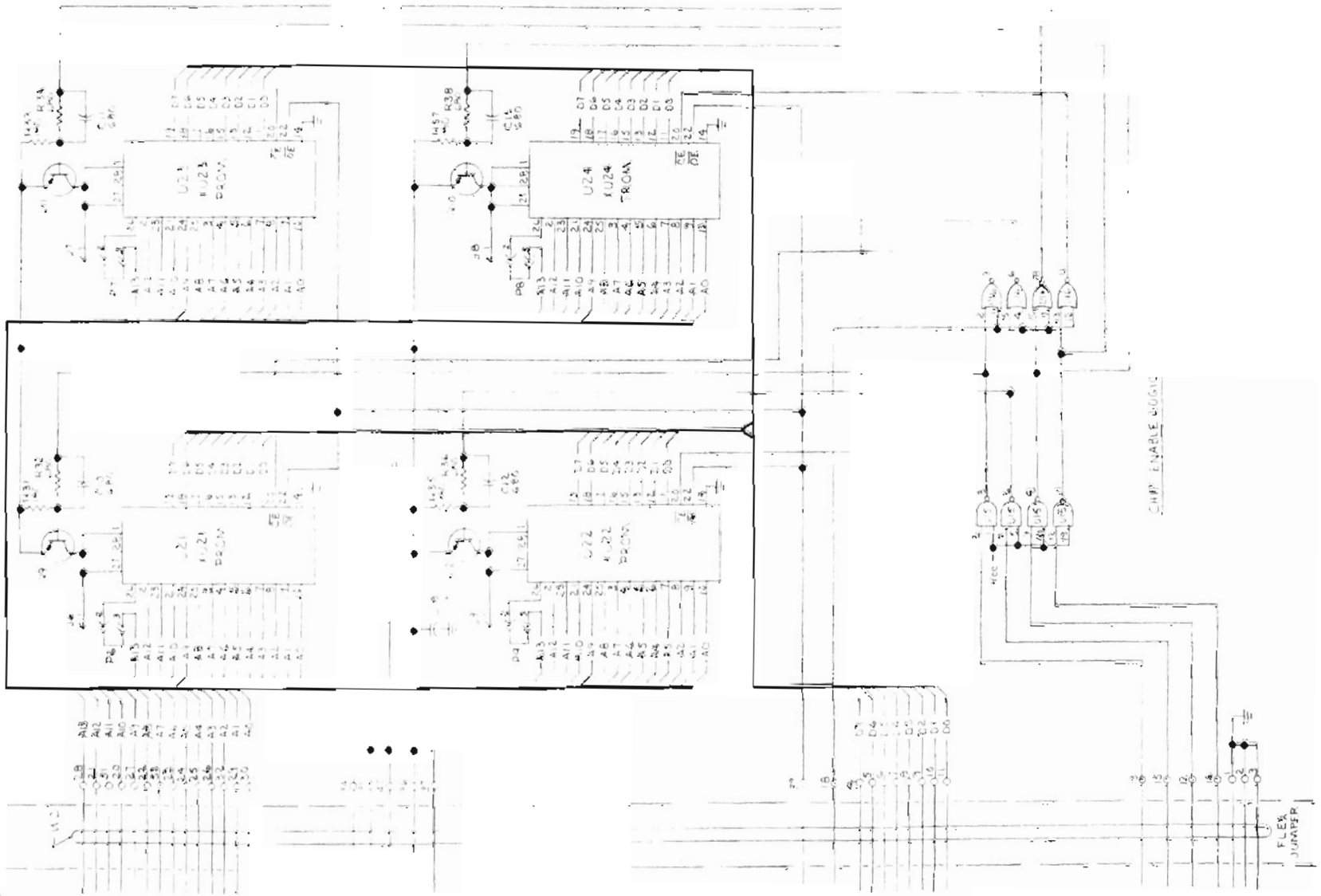
SCHEMATIC DIAGRAM

PROGRAM STORAGE MODULE
BOARD 1



SCHEMATIC DIAGRAM

PROGRAM STORAGE MODULE
BOARD 2



SCHEMATIC DIAGRAM

PROGRAM STORAGE MODULE
BOARD 3

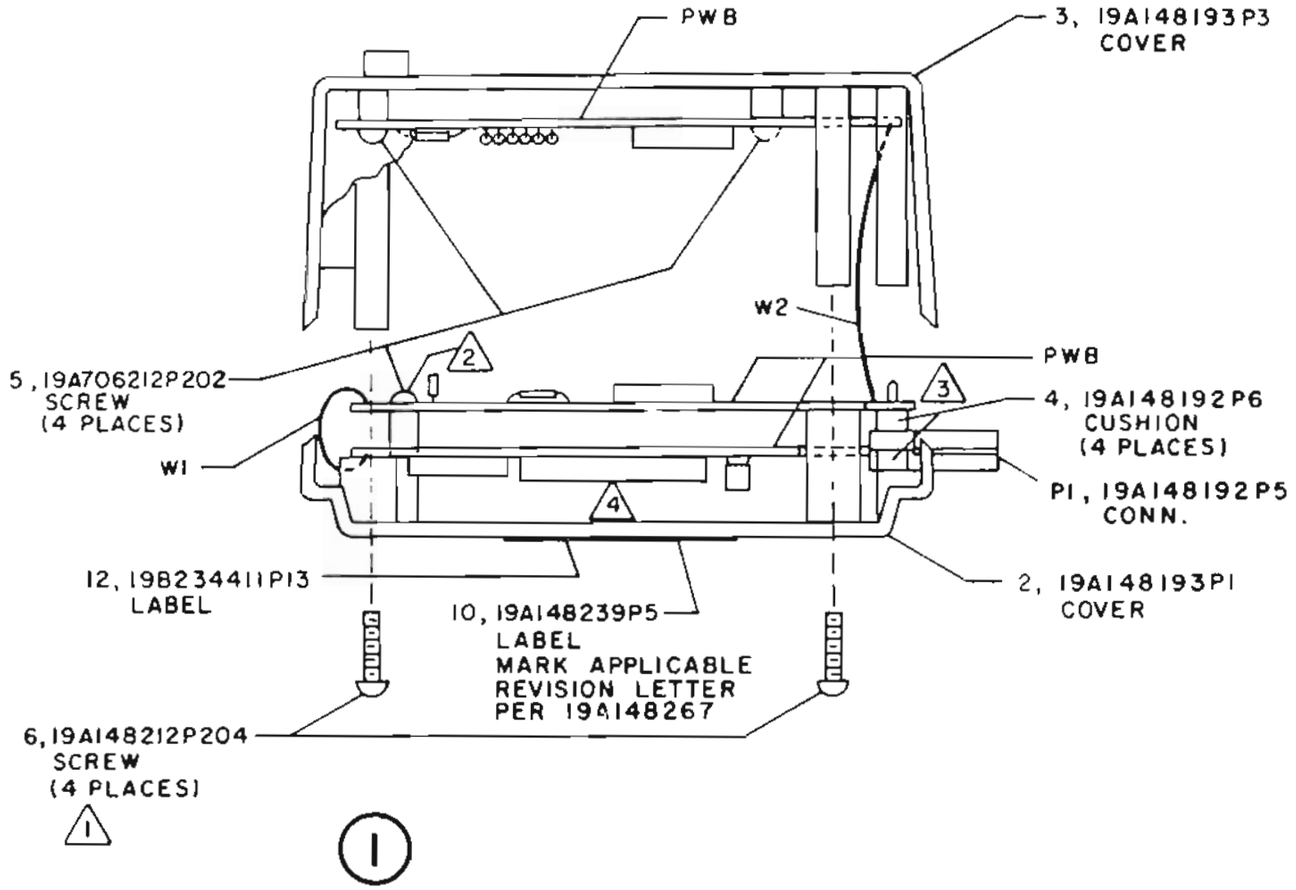
PARTS LIST

SYMBOL	GE PART NO	DESCRIPTION
[illegible]	[illegible]	[illegible]
J1		[illegible]
J2 thru J9	[illegible]	[illegible]
		- - - - - - - - PLUGS - - - - - - - -
P1	19A14[illegible]	Connector: [illegible]
P2 thru P9	19A70[illegible]	Receptacle: 2 position; [illegible] 3 amps; sim to Berg [illegible]
		- - - - - - - - TRANSISTORS - - - - - - - -
Q1	19A11[illegible]	Silicon, PNP: sim to 2N[illegible]
Q2	19A70002[illegible]	Silicon, NPN: sim to Type 2N3904.
Q3	19A134960P1	Silicon, PNP: sim to Type 2N4403.
Q4	19A700023P1	Silicon, NPN: sim to Type 2N3904.
Q5 thru Q13	19A134960P1	Silicon, PNP: sim to Type 2N4403.
Q14	19A700023P1	Silicon, NPN: sim to Type 2N3904.
		- - - - - - - - RESISTORS - - - - - - - -
R1	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R2	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R3	19A700019P28	Deposited carbon: 180 ohms ±5%, 1/4 w.
R4	19A700019P35	Deposited carbon: 680 ohms ±5%, 1/4 w.
R5 and R6	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R7	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R8	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R9	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.

SYMBOL	GE PART NO	DESCRIPTION
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Digital: QUAD 2-INPUT POSITIVE-AND GAT
U5	19A70[illegible]	Digital: [illegible] TRI-STATE BUFFER
U6	[illegible]	Digital: HIGH-SPEED CMOS [illegible] GATE
U7	19A700029P[illegible]	Digital: 4-INPUT NOR GATE; [illegible]
U8	19A70002[illegible]	Digital: QUAD 2-INPUT NAND GATE
U9	19A7000291[illegible]	Digital: QUAD 2-INPUT NOR GATE.
U10	19A700029P[illegible]	Digital: DUAL BINARY TO 1-OF-4 DECODER [illegible]
U11 and U12	19A700029P[illegible]	Digital: DUAL D FLIP-FLOP
U13	19A700037P301	Digital: QUAD 2-INPUT POSITIVE-NAND GA
U14	19A700037P322	Digital: QUAD 2-INPUT POSITIVE-OR GATE
U15	19A700037P[illegible]	Digital: QUAD 2-INPUT POSITIVE-NAND GA
U16	19A700037P[illegible]	Digital: QUAD 2-INPUT POSITIVE-OR GATE
		- - - - - - - - CABLES - - - - - - - -
W1	19A148222P1	Jumper
W2	19A148222P2	Jumper
		- - - - - - - - SOCKETS - - - - - - - -
XU3 thru XU24	19A700156P[illegible]	Integrated circuit: [illegible] contacts; sim to AMP [illegible]

SYMBOL	GE PART NO.	DESCRIPTION
[illegible]	[illegible]	[illegible]

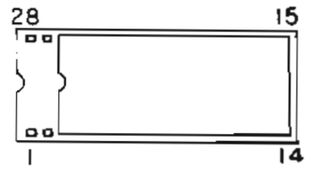
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



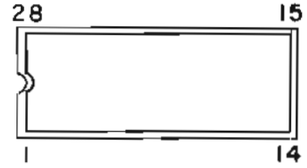
PL ISSUED

PROM REPLACEMENT

1. REMOVE 4 BASE SCREWS AND OPEN CASE.
2. REMOVE 1 SCREW SECURING BOARD.
3. REMOVE 2 CUSHIONS AND LIFT BOARDS
4. REMOVE PROM AND INSTALL REPLACEMENT PART AS SHOWN.



24 PIN PART



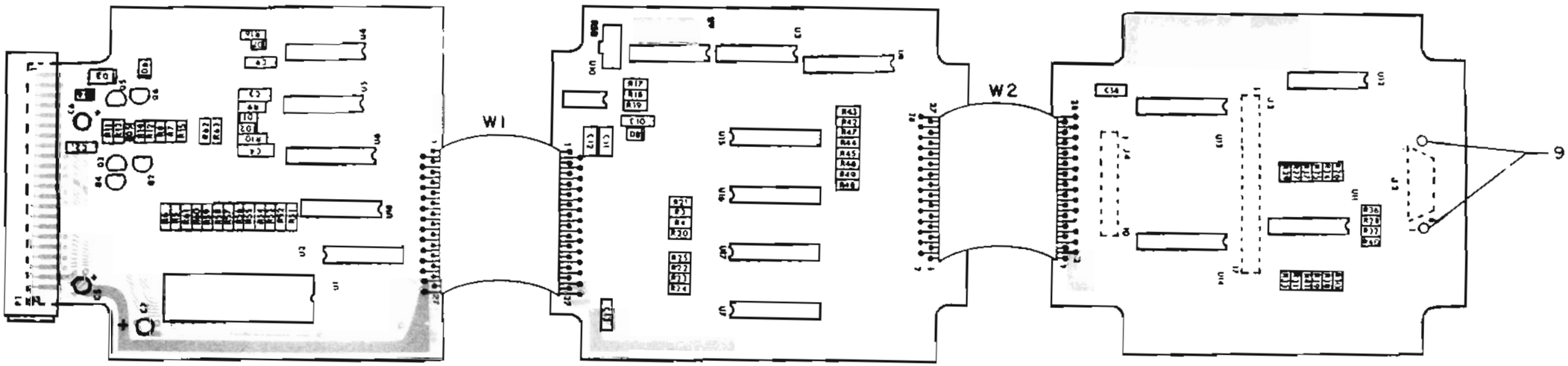
28 PIN PART

CAUTION

OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

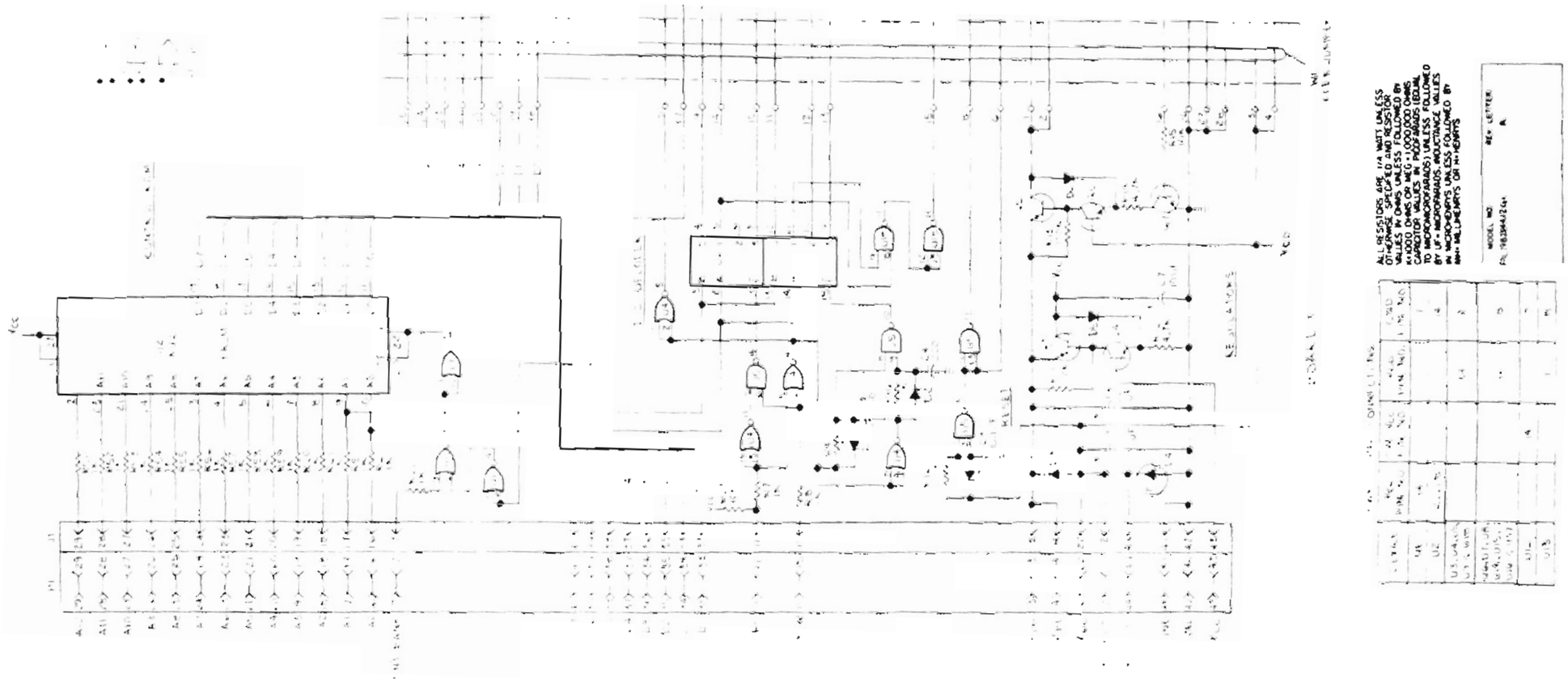
OUTLINE DIAGRAM

DATA I/O MODULE
19B234412G1



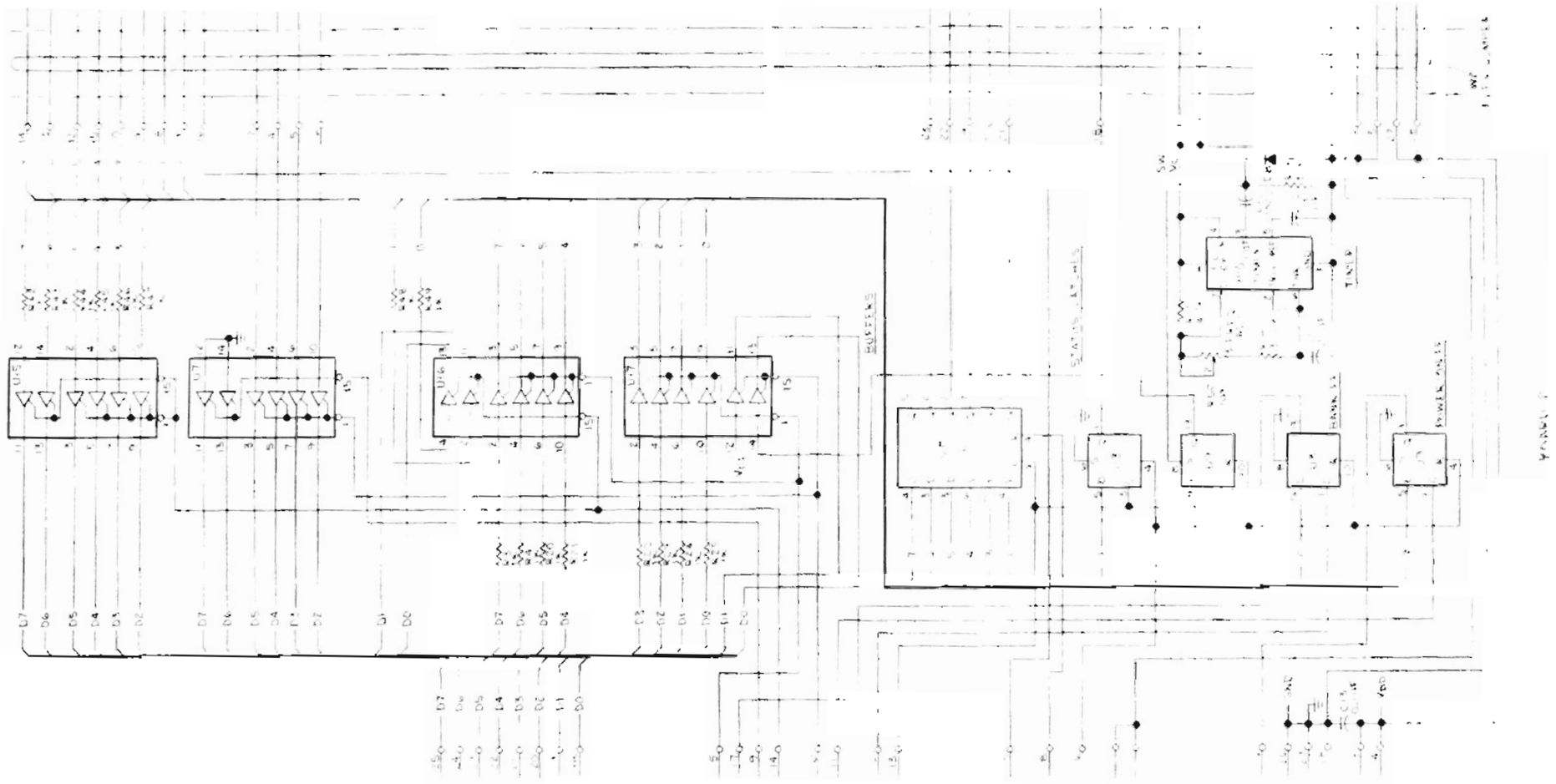
OUTLINE DIAGRAM

DATA I/O MODULE
PRINTED WIRE BOARD



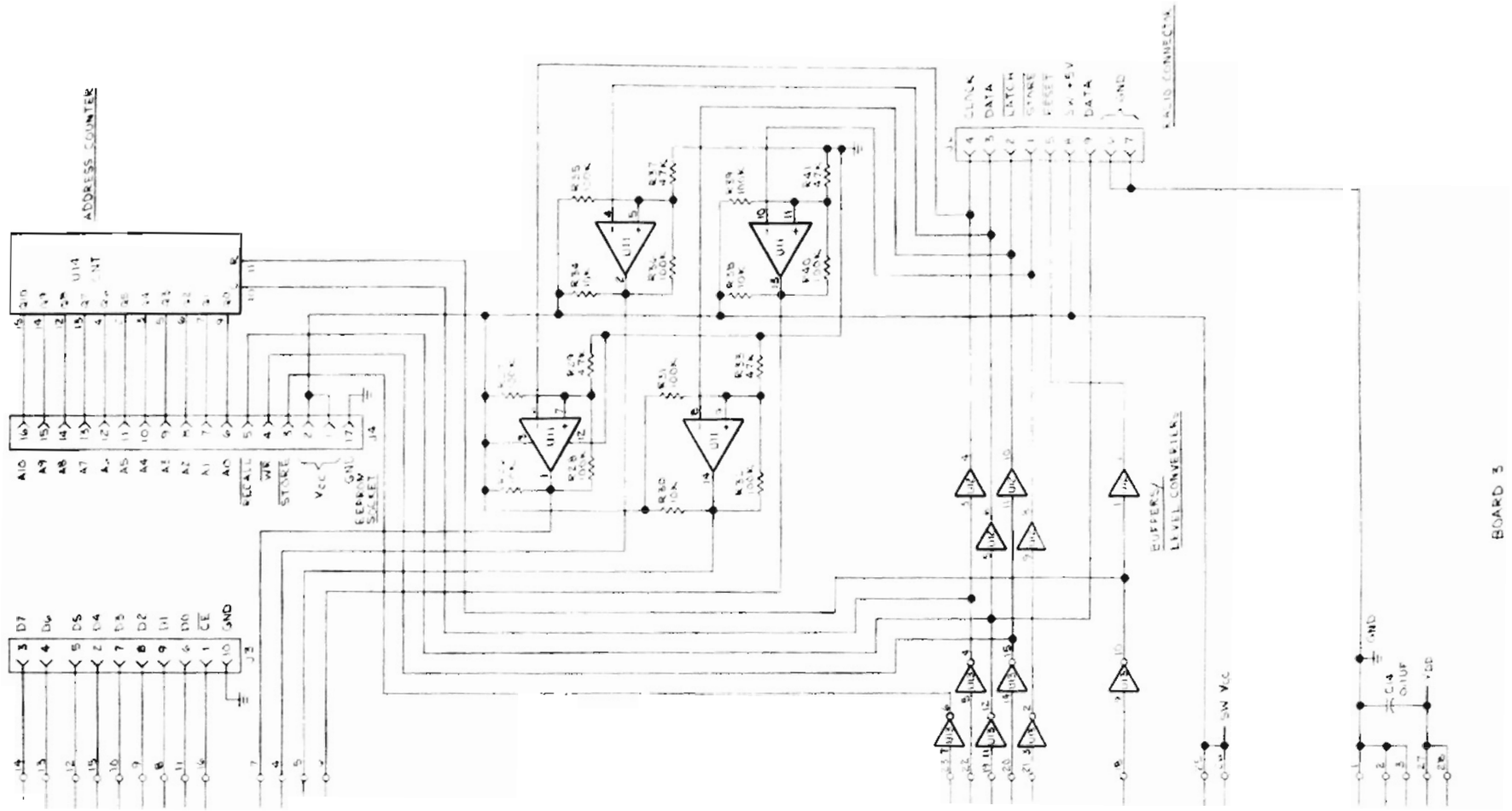
SCHEMATIC DIAGRAM

DATA I/O MODULE
BOARD 1



SCHEMATIC DIAGRAM

DATA I/O MODULE
BOARD 2



BOARD 3

SCHEMATIC DIAGRAM

DATA I/O MODULE
BOARD 3

PARTS LIST

DATA I/O MODULE
19D234412P1
ISSUE 2

SYMBOL	GE PART NO	DESCRIPTION
		- - - - - - - - - - - - CAPACITORS - - - - - - - - - - - -
C2	19A116192P14	Ceramic: 0.1 uF ±20%, 50 VDCW, sim to Erie CKCC CW20C104-M2.
C3	19A700235P25	Ceramic: 100 pF ±5%, 50 VDCW.
C4	19A700235P29	Ceramic: 220 pF ±5%, 50 VDCW.
C5	19A701534P1	Tantalum: 1 uF ±20%, 35 VDCW.
C6	19A701534P4	Tantalum: 0.47 uF ±20%, 35 VDCW.
C7	19A701534P5	Tantalum: 10 uF ±20%, 16 VDCW.
C9	19A116192P14	Ceramic: 0.1 uF ±20%, 50 VDCW, sim to Erie CKCC CW20C104-M2.
C10	19A700233P3	Ceramic: 1000 pF ±20%, 50 VDCW.
C11 and C12	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C13 and C14	19A116192P14	Ceramic: 0.1 uF ±20%, 50 VDCW, sim to Erie CKCC CW20C104-M2.
		- - - - - - - - - - - - DIODES - - - - - - - - - - - -
D1 and D2	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D3	19A704142P1	Rectifier, silicon, general purpose.
D4	19A700025P9	Silicon, zener: 400 mW max; sim to BZX55-C5V2.
D5 thru D8	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J1		(Part of Printed Board).
J2	19CB51121P1	8 contacts; sim to Positronic MDSF-3POS.
J3	19A700041P59	Connector, printed wiring: sim to Molex 22-02-2101.
J4	19A700041P66	Printed wire: 17 circuits rated at 2.5 amps each; sim to Molex 22-02-2175.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P1	19A148192P5	Connector: 44 pin; sim to Panasonic RJS-1927A.
		- - - - - - - - - - - - TRANSISTORS - - - - - - - - - - - -
Q3	19A700023P1	Silicon, NPN; sim to Type 2N3904.
Q3	19A134960P1	Silicon, PNP; sim to Type 2N4403.
Q4	19A700023P1	Silicon, NPN; sim to Type 2N3904.
Q5	19A134960P1	Silicon, PNP; sim to Type 2N4403.
Q6	19A700023P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - - - RESISTORS - - - - - - - - - - - -
R3 thru R8	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R9	19A700019P49	Deposited carbon: 20K ohms ±5%, 1/4 w.
R10	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R11	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R12	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R13	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R14	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R15	19A700019P48	Deposited carbon: 10K ohms ±5%, 1/4 w.

SYMBOL	GE PART NO.	DESCRIPTION
R16	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R17	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R18	19A701250P347	Metal film: 30.1K ohms ±1%, 250 VDCW, 1/4 w.
R19	19A700019P55	Deposited carbon: 33K ohms ±5%, 1/4 w.
R20 thru R25	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R26	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R27 and R28	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R29	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R30	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R31 and R32	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R33	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R34	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R35 and R36	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R37	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R38	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R39 and R40	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R41	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R47 thru R49	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R50	19A700-09P8	Variable: 25 ohms to 10K ohms ±20%, 1/2 w.
R51 thru R62	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R63	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
		- - - - - - - - - - - - INTEGRATED CIRCUITS - - - - - - - - - - - -
U1	19A7034*3P1	Digital: HIGH-SPEED CMOS LOCK GATES.
U2	19A[4*]24002	PROGRAMMABLE PROM.
U3	19A700029P9	Digital: DUAL "D" FLIP-FLOP WITH SET RESET.
U4	19A700029P2	Digital: QUAD 2 INPUT NOR GATE.
U5	19A700029P7	Digital: QUAD 2-INPUT NAND GATE.
U6	19A700029P228	Digital: DUAL BINARY TO 1-OF-4 DECODER (INVERTING).
U7	19A700029P229	Digital: HEX 3-STATE BUFFER.
U8	19A700029P53	Digital: HEX D FLIP-FLOP, 4174S.
U9	19A700029P9	Digital: DUAL "D" FLIP-FLOP WITH SET RESET.
U10	19A701865P1	Linear: 555 TIMER.
U11	19J706018P1	Linear: QUAD COMPARATOR.
U12	19A116180P54	Digital: HEX BUFFERS/DRIVERS WITH OPEN-COLLECTOR HIGH VOLTAGE OUTPUT.
U13	19A700178P1	Digital: HEX BUFFER/CONVERTER (INVERTING).
U14	19A700029P28	Digital: 12 STAGE BINARY RIPPLE COUNTER.
U15 thru U17	19A700029P229	Digital: HEX 3-STATE BUFFER.
U18	19A700029P7	Digital: QUAD 2-INPUT NAND GATE.
		- - - - - - - - - - - - CABLES - - - - - - - - - - - -
W1	19A148222P3	Jumper.
W2	19A148222P4	Jumper.

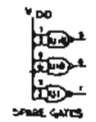
SYMBOL	GE PART NO.	DESCRIPTION
XU1	19A700016P23	- - - - - - - - - - SOCKETS - - - - - - - - - - Integrated circuit: 28 contacts; sim to AMP 499928-5.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19A148193P1	Cover: (81 wide).
	19A148193P3	Cover: (Notes with 19A148193P1 cover).
	19A148192P6	Cushion: (Located at P1).

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a Revision Letter, which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

Rev. A — Data I/O Module 19D236612G1

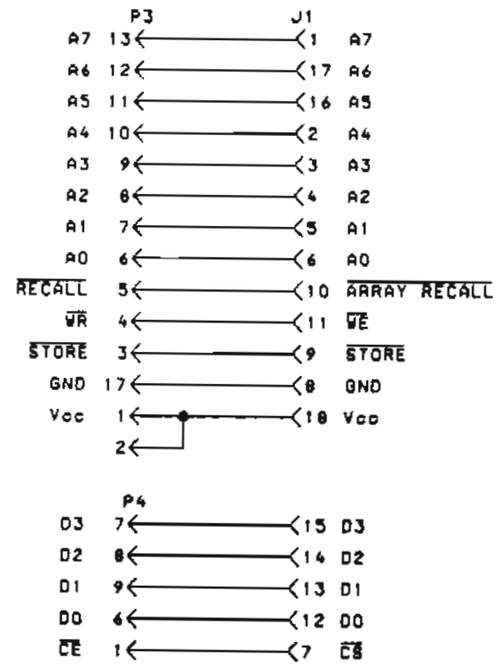
To eliminate fluctuating standby currents, spare gate inputs were connected to VDD as shown in partial schematic (19D413186, SH 1, REV. 1) below.



*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SCHEMATIC DIAGRAM

FCTO PL19B234413



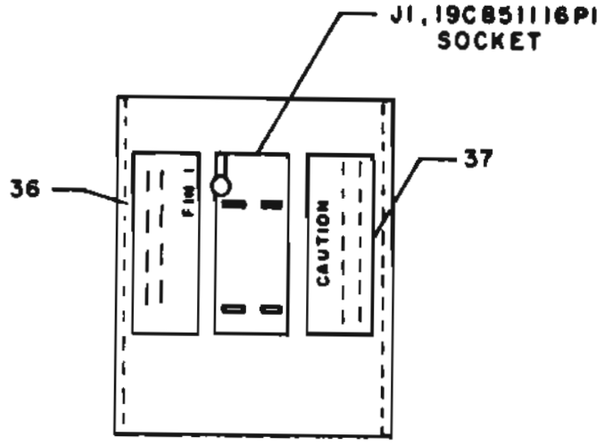
(19A148256, Rev. 0)

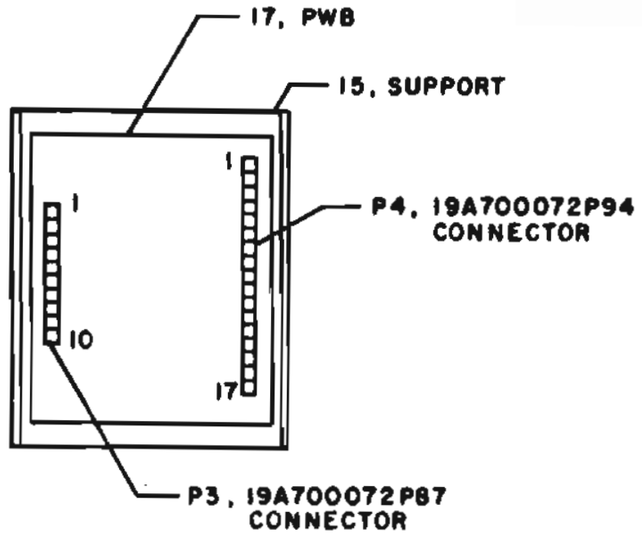
PARTS LIST

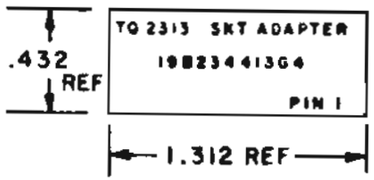
SOCKET ADAPTER
19B234413G4
ISSUE 1

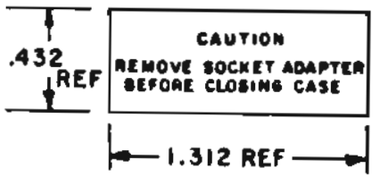
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
	19A700154P10	Integrated circuit, 18 contacts spaced on 1/4" (Textool 218-1341-05-0602).
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
	19A700072P87	Printed wire, 10 contacts spaced at 3.5 mm (.138 in) Molex 22-03-2102.
P4	19A700072P94	Printed wire, 17 contacts spaced at 3.5 mm (.138 in) Molex 22-03-2172.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES









(19B234413, Sh. 2, Rev. 2)

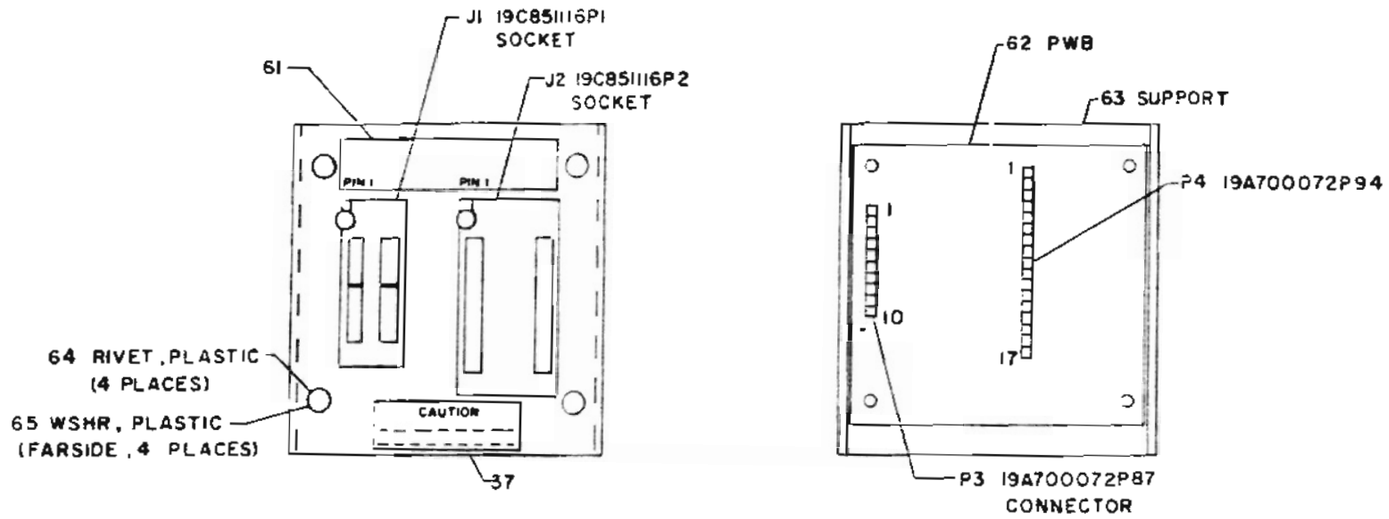
(11) SOCKET ADAPTER, TQ 2313

(36) LABEL, PER 19A700154P10
BLACK LETTERS
WHITE BACKGROUND

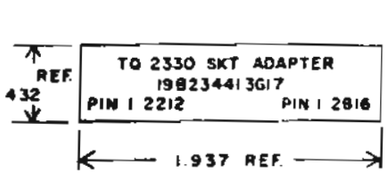
(37) LABEL, PER 19A700154P10
BLACK LETTERS
YELLOW BACKGROUND

SERVICE SHEET

SOCKET ADAPTER
TQ2313
19B234413G4



(60) SOCKET ADAPTER, TQ 2330



(61) LABEL, PER 19A700154P10
BLACK LETTERS
YELLOW BACKGROUND

(19B234413, Sh. 4, Rev. 0)

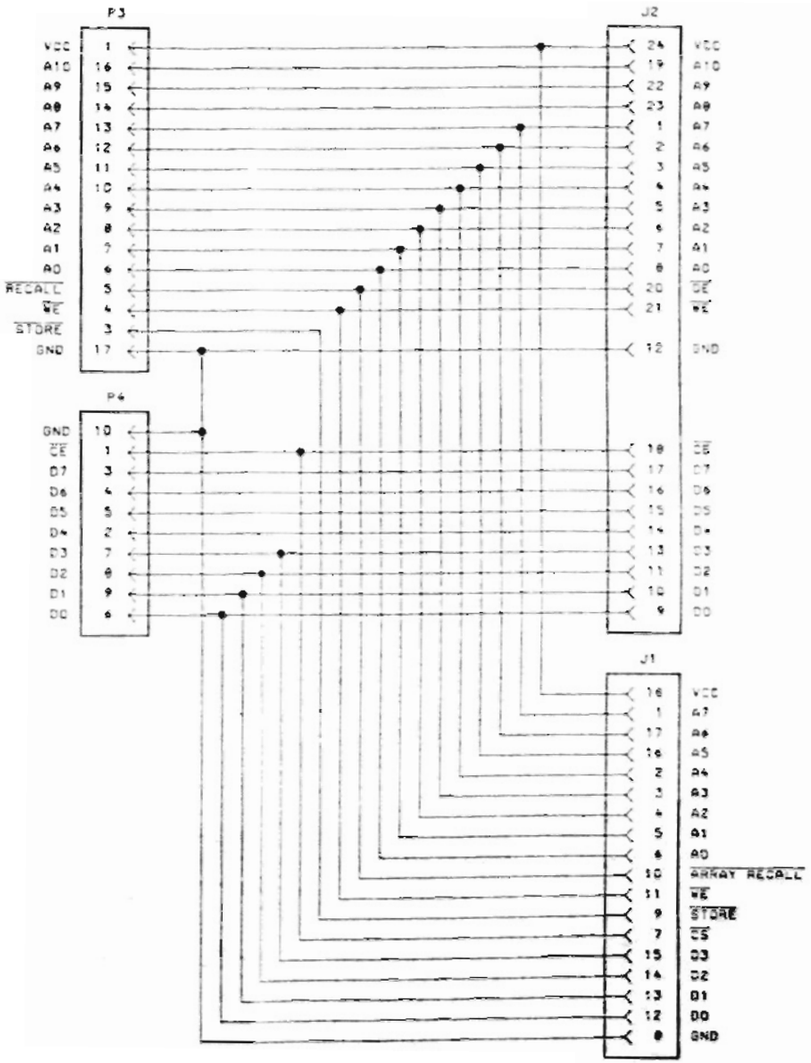
OUTLINE DIAGRAM

SOCKET ADAPTER TQ2330
19B234413G17

PARTS LIST

SOCKET ADAPTER TQ2330
19B234413G17
ISSUE 1

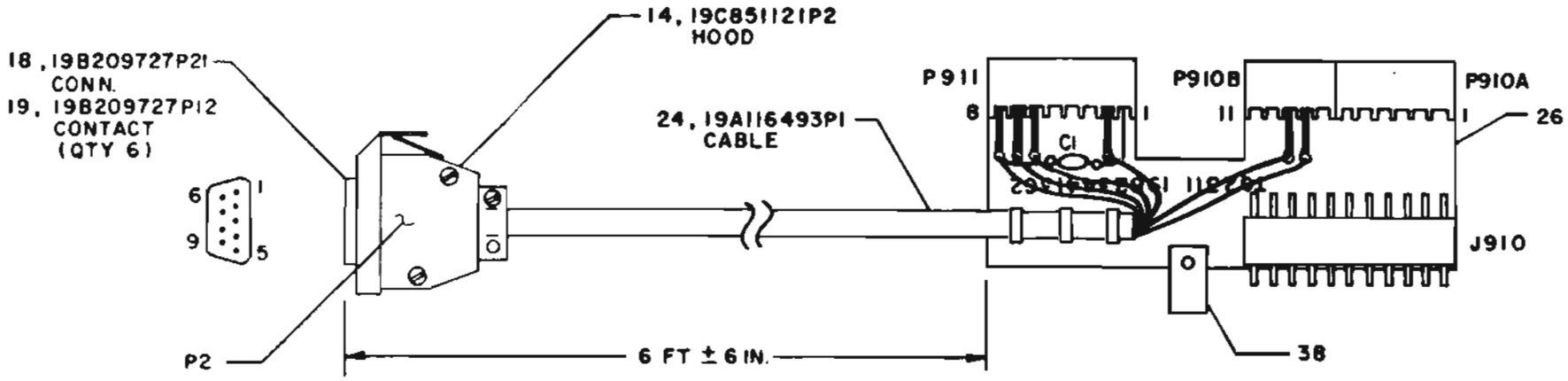
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J1	19C851116P1	Integrated circuit: 18 contacts; sim to 3M Textool 218-3341-00-0602.
J2	19C851116P2	Integrated circuit: 24 contacts; sim to 3M Textool 224-3344-00-0602.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P3	19A700072P87	Printed wire: 10 contacts rated at 2.5 amps; sim to Molex 22-03-2102.
P4	19A700072P94	Printed wire: 17 contacts rated at 2.5 amps; sim to Molex 22-03-2172.



(19D437832, Rev. 01)

SCHEMATIC DIAGRAM

SOCKET ADAPTER TQ2330
19B234413G17



9 PHOENIX CABLE (TQ 2311)

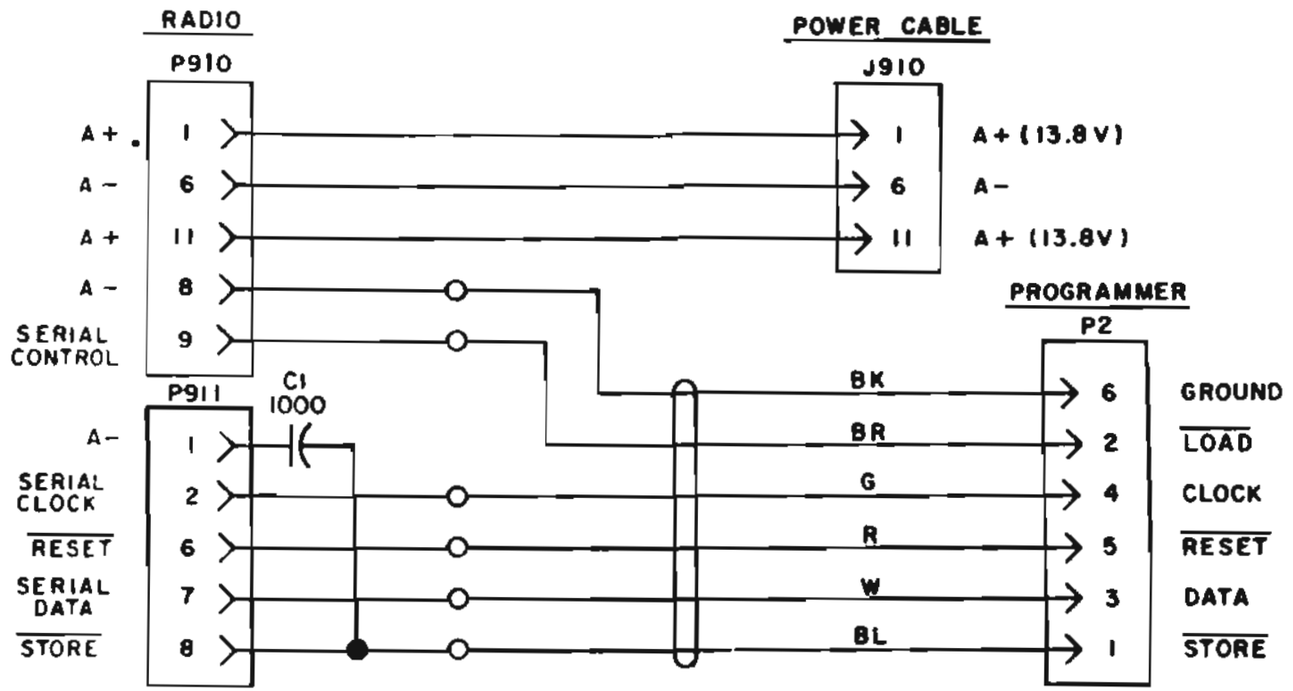
ITEM 24, CABLE, CONNECTION CHART		
WIRE COLOR	FROM	TO
BLUE	P2-1	P911-8
BROWN	P2-2	P910-9
WHITE	P2-3	P911-7
GREEN	P2-4	P911-2
RED	P2-5	P911-6
BLACK	P2-6	P910-8

OUTLINE DIAGRAM

(19B234413, Sh. 2, Rev. 2)

PHOENIX CABLE
TQ2311
19B234413G2

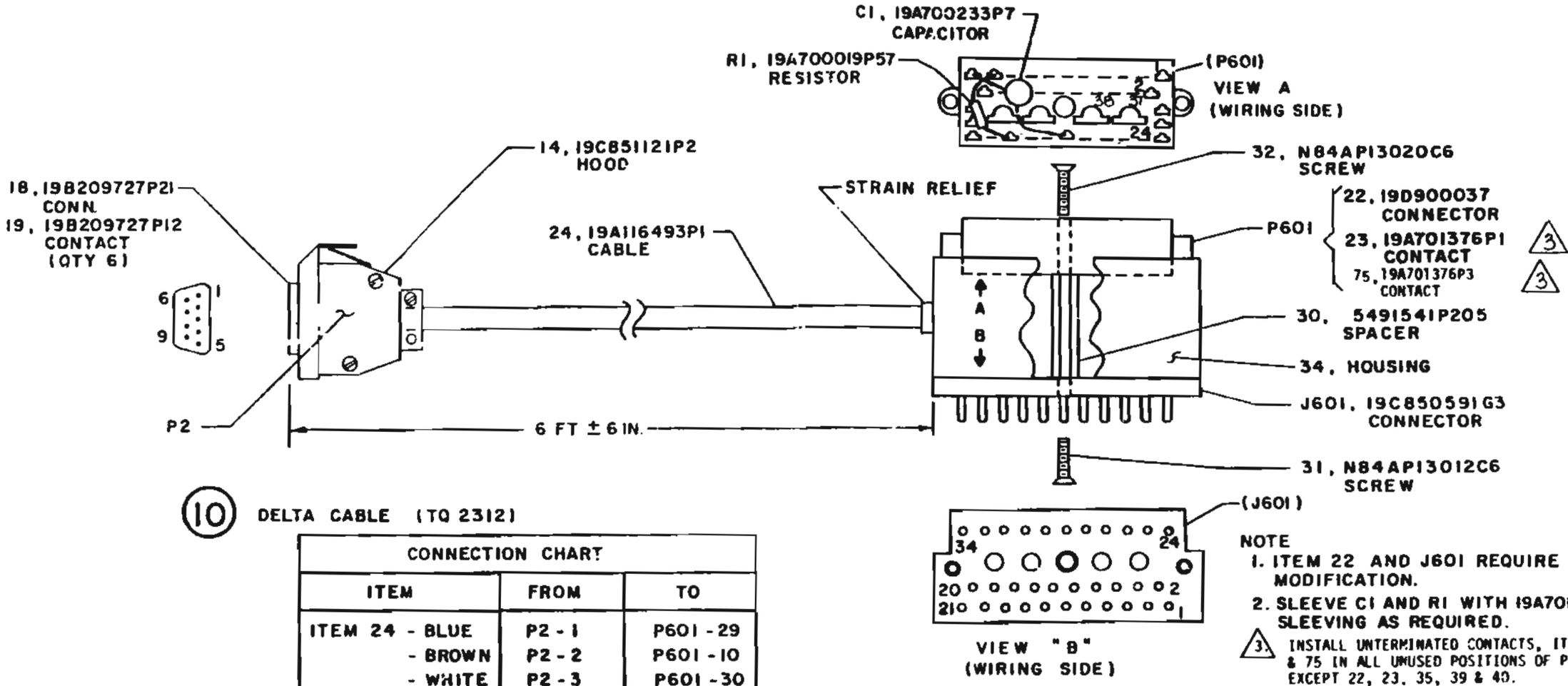
38



ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

SCHEMATIC DIAGRAM

PHOENIX CABLE
TQ2311
19823441362



NOTE
1. ITEM 22 AND J601 REQUIRE MODIFICATION.
2. SLEEVE C1 AND R1 WITH 19A701278P1 SLEEVING AS REQUIRED.
3. INSTALL UNTERMINATED CONTACTS, ITEM 23 & 75 IN ALL UNUSED POSITIONS OF P601 EXCEPT 22, 23, 35, 39 & 40.

(10) DELTA CABLE (TQ 2312)

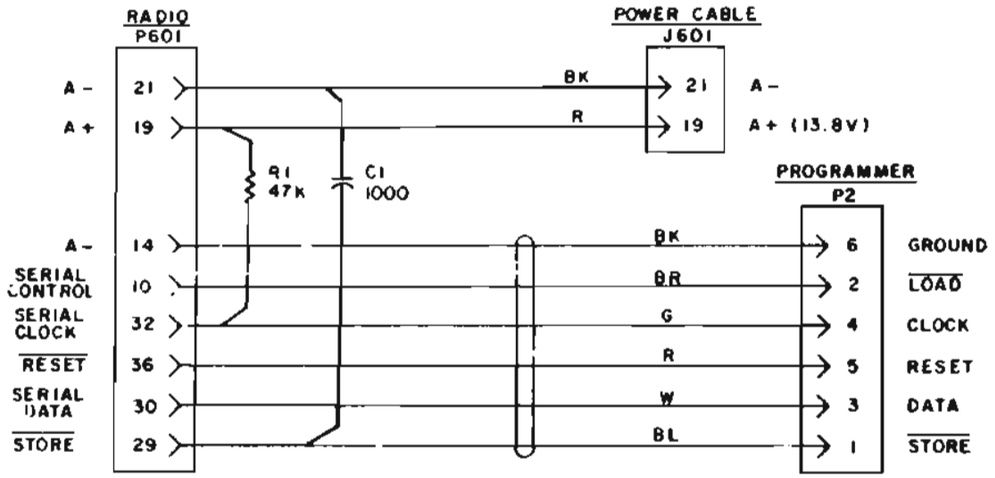
CONNECTION CHART		
ITEM	FROM	TO
ITEM 24 - BLUE	P2 - 1	P601 - 29
- BROWN	P2 - 2	P601 - 10
- WHITE	P2 - 3	P601 - 30
- GREEN	P2 - 4	P601 - 32
- RED	P2 - 5	P601 - 36
ITEM 24 - BLACK	P2 - 6	P601 - 14
22 AWG - BLACK	J601 - 21	P601 - 21
22 AWG - RED	J601 - 19	P601 - 19
C1	P601 - 21 *	P601 - 29 *
R1	P601 - 32 *	P601 - 19 *

* PINS DUPLICATED

OUTLINE DIAGRAM

DELTA CABLE
TQ2312
19B234413G3

(19B234413, Sh 3, Rev. 3)



ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

(T98234425, Sh 1, Rev 2)

SCHEMATIC DIAGRAM

DELTA CABLE
TQ2312
19B234413G3