LIFESTAT™ 200

noninvasive blood pressure monitor

Operating and Service Manual

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WARRANTY

LS 200 is warranted against all defects in parts and workmanship for a period of one year from date of delivery. Physio-Control will repair or replace any products which prove to be defective during the warranty period provided proper use and maintenance procedures are followed as prescribed in the operating and service manual.

All defective products or components must be returned to Physio-Control, or its authorized service center, with a detailed explanation of the failure. Transportation charges must be prepaid.

Service performed by other than Physio-Control or its authorized agents may, at the discretion of Physio-Control, be cause to void this warranty.

No other party is authorized to make any other warranty, or to assume any liability for Physio-Control products. No other warranty, either implied or in writing, will be recognized.

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CONFIGURATION AND CHANGE INFORMATION

This manual is current according to the listed revision level of the following part numbers.

PART NUMBER	REV
802267	A
802306	B
802583	A4
802597	C
802603	B2
802634	B2
802648	A2
802673	ORIG2
802675	ORIG1
802678	ORIG
802680	ORIG
802978	ORIG1
802985	ORIG1
803008	ORIG1
803012	ORIG
803020	ORIG
803114	B
803116	A5

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HOW TO USE THIS MANUAL

Section 1 of the manual provides introductory information with GENERAL SPECIFICATIONS and CIRCUIT DESCRIPTIONS.

Section 2 familiarizes the user with OPERATION OF THE EQUIPMENT, identifies CONTROLS AND INDICATORS, provides a PERIODIC OPERATIONAL CHECKOUT, and gives simple OPERATOR MAINTENANCE INSTRUCTIONS. This section is not intended to instruct the operator in the clinical use of the instrument. A separate OPERATING INSTRUCTIONS booklet is provided for this purpose.

Section 3 provides FUNCTIONAL TEST AND CALIBRATION PROCEDURES and TROUBLESHOOTING guidance in the form of FAULT ISOLATION to major replaceable assemblies and SIGNATURE ANALYSIS.

Section 4 consists of CORRECTIVE MAINTENANCE PROCEDURES and DISASSEMBLY INSTRUCTIONS.

Section 5 contains ILLUSTRATED PARTS LISTS with EXPLODED VIEWS of MECHANICAL ASSEMBLIES, COMPONENT LAYOUTS, AND SCHEMATICS FOR PRINTED CIRCUIT BOARD ASSEMBLIES.

Section 6 contains reference data for ELECTRONIC COMPONENTS used in this instrument.

SAFETY

SAFETY SUMMARY

The general safety information in this summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS IN THIS MANUAL

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury.

TERMS AS MARKED ON EQUIPMENT

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS IN THIS MANUAL

This symbol indicates where applicable cautionary or other information is to be found.

SYMBOLS AS MARKED ON EQUIPMENT


DANGER--High voltage.


Protective ground (earth) terminal.


ATTENTION--refer to manual.

MAKE PERIODIC SAFETY INSPECTIONS

Inspect the power cord periodically for fraying or other damage, and replace as needed. Do not operate the apparatus from mains power with a damaged power cord or plug.

Electrical and visual checks should be made on cables and wires. Broken or frayed wires may cause interference or loss of signal. Particular attention should be paid to the point at which the wires enter the terminals, since flexure will eventually cause breakage of strands at this point.

POWER SOURCE

This product is intended to operate from a power source that does not apply more than 250 volts RMS (132V RMS in U.S.A. and Canada) between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

The product is compatible with isolated power systems as used in operating rooms.

USE THE PROPER POWER CORD

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

This product requires a three-wire (18 gauge, SJT-grade) power cord which is supplied (in U.S.A. and Canada) with a three-terminal, polarized plug (Hospital Grade) for connection to the power source and protective ground. The ground (earth) terminal of the plug is directly connected to the frame of the product. For electric shock protection, insert this plug only in a mating (Hospital Grade) power outlet with a protective ground contact. Do not bypass the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.

USE THE PROPER FUSE

To avoid fire hazard, use only the fuse specified for your product, identical in type, voltage rating, and current rating. Fuse replacement instructions are in the Maintenance Section.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

Do not operate this product in the presence of flammable gasses or anesthetics. Explosion can result. Safety document NFPA 56A, Standards for the Use of Inhalation Anesthetics, states that portable electronic equipment must not be operated at less than 5 feet above the floor in the presence of flammable anesthetics.

USE ONLY SAFE METHODS OF INTERCONNECTION

To protect against electrical shock from the product cabinet whenever auxiliary equipment is electrically connected to this product, proper grounding is essential. When this product is connected to other line-operated equipment, battery operation should be avoided unless the product is equipped with an approved ground terminal on the rear panel. It is extremely important that equipment interconnections be made in accordance with NFPA No. 70, National Electrical Code, Article 517, Heath Care Facilities. Compliance with paragraph 517-80 and 517-120 is especially important.

NOTE: Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. After interconnection with accessory equipment, leakage current and grounding requirements must be maintained.

SERVICE

Component replacement and internal adjustments must be made by qualified service personnel only.

DO NOT MOUNT PRODUCT DIRECTLY ABOVE PATIENT

Place the product in a location where it cannot harm the patient should it fall from its shelf or other mount.

USE ONLY RECOMMENDED ACCESSORIES

To ensure patient safety, use only accessories recommended by Physio-Control. For a list of those accessories recommended for use with this product, see ACCESSORIES AND REPLACEMENT ITEMS, TABLE 2-1.

USE ONLY RECOMMENDED STERILIZATION METHODS

Do not autoclave this product.

Do not autoclave accessories unless the manufacturer's instructions clearly approve it. Many accessories can be severely damaged by autoclaving.

A product that has been dropped or severely abused should be checked by qualified service personnel to verify proper operation and acceptable leakage current values.

SECTION 1
DESCRIPTION

1-1. SCOPE

This section provides a description of the circuits and general features of the LIFESTAT 200 Noninvasive Blood Pressure Monitor. The section is divided into three parts: Physical Description provides a general description of the LS 200 and lists specifications; Functional Description briefly describes the LS 200 circuitry at the functional block diagram level; Theory of Operation reviews the pneumatic system and provides detailed circuit descriptions at the schematic level of the LS 200 PCBs.

1-2. PHYSICAL DESCRIPTION

The LS 200 is a microprocessor based portable blood pressure and pulse monitor used for noninvasive determination of systolic/diastolic blood pressure, pulse rate, and mean arterial pressure. All vital signs are displayed simultaneously on LED displays.

Additional product features include OVERRIDE pressure selection for initial cuff inflation pressure, MODE SELECT function for automatic repeat of measurement cycles at 1, 2, 3, 5, 10, 15 and 30 minute intervals, and ALARM limits which can be assigned to Systolic, Mean, Diastolic, or Systolic high/Diastolic low. In addition, an adaptive algorithm is active during the automatic cycle mode that adjusts the cuff inflation pressure, the cuff deflation bleed rate, and the cuff dump pressure based upon previous reading information. By adapting these features to specific patients, accurate readings are obtained in a shorter time frame.

Operation of the LS 200 is based upon the oscillometric measurement technique which utilizes arterial pulsations acting against an inflated pressure cuff for blood pressure and pulse determination. A standard single hose pressure cuff with Luer fitting is utilized. Options include pediatric, adult, large adult and thigh sized cuffs.

The LS 200 is powered from either an internal battery or an internal line operated power supply/battery charger. The internal battery pack contains four rechargable D-size sealed lead-acid cells. The battery pack must be present in the unit for proper operation with or without connection to line power.

The optional PRINTER is a factory installed graphics plotter that provides hard-copy recording of the displayed vital signs information. In automatic mode the Systolic, Mean and Diastolic readings are located on a vertical pressure axis and connected with trending lines to subsequent readings for comparison. Pulse Rate is also recorded at each reading. In addition, interval changes, artifact conditions, and alarm violations are noted. This option includes a Real-Time Clock feature for the printing of day, date and time with each recording.

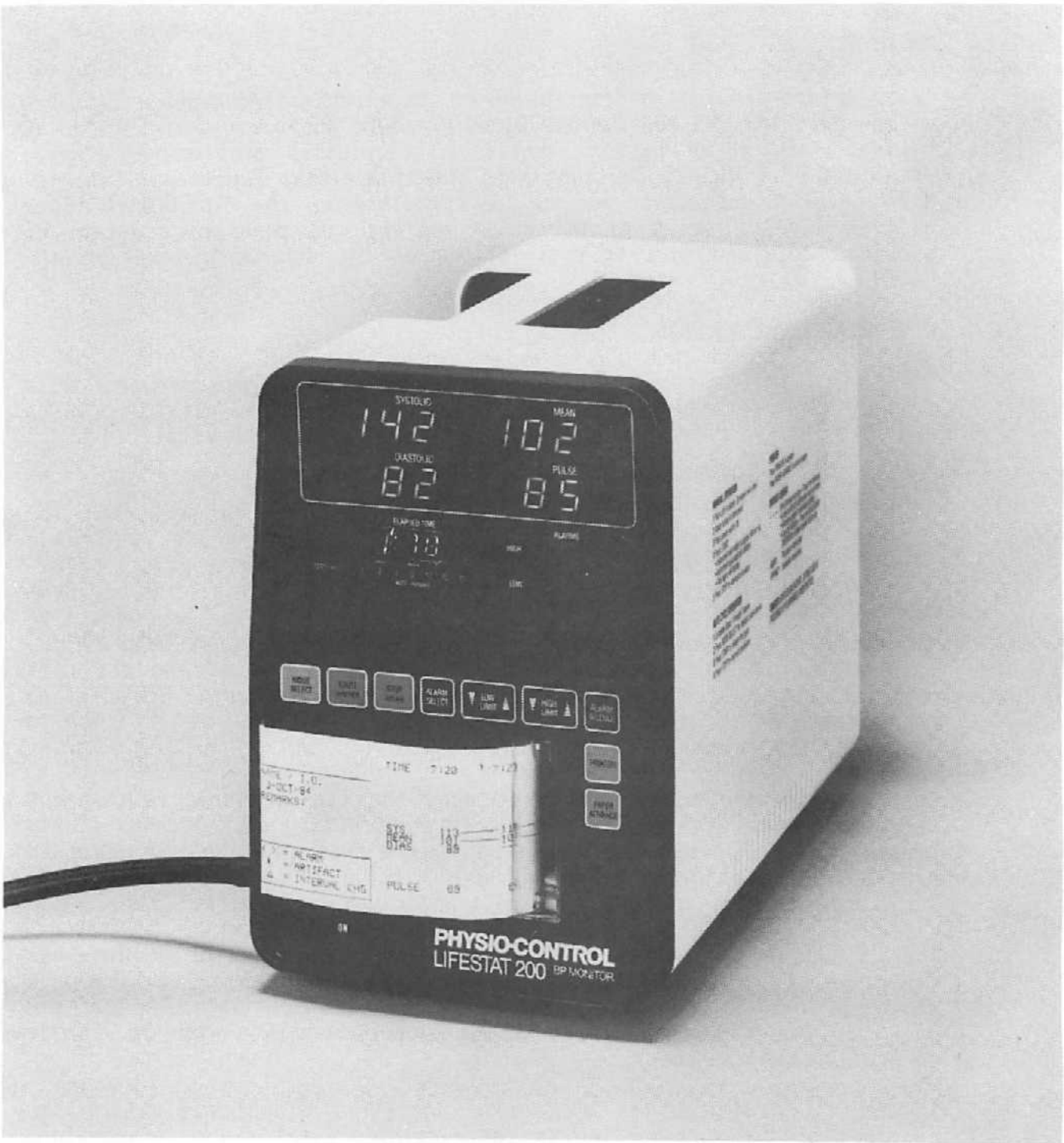

FIGURE 1-1. LIFESTAT 200 NONINVASIVE BLOOD PRESSURE MONITOR

TABLE 1-1

GENERAL SPECIFICATIONS

CHARACTERISTIC	QUANTITY OR SPECIFICATIONS
RANGE	40mmHg diastolic to 260mmHg systolic.
ACCURACY	
● PRESSURE	± 5mmHg over the range of 60mmHg (diastolic) to 180mmHg (systolic).
● PULSE	±4BPM over the range of 30BPM to 170BPM.
INFLATION RATE	Less than 80mmHg/sec.
INFLATION PRESSURE	180 + 10mmHg/-15mmHg initially. 290 + 10mmHg/15mmHg maximum.
INITIAL DEFLATION RATE	-4 ± 1mmHg/sec.
R/T CLOCK ACCURACY	± 3 minutes/week.
OPERATING MODES	Manual and Automatic cycle.
POWER SOURCE	
● AC INPUT POWER	90 to 130Vac or optional 198 to 264Vac (50 or 60Hz).
● POWER CONSUMPTION	70W maximum at 115Vac, 60Hz.
● BATTERY CAPACITY	Approximately 45 minutes with a 16 hour charge in 5 minute cycle mode at 25°C using adult cuff, 6 ft hose and printer on.
● BATTERY TYPE	Sealed, rechargeable, lead-acid battery 8Vdc, 2.5A-h.
GENERAL	
● SIZE	6"W X 11.5"D x 8.6"H.
● WEIGHT	15 pounds.
ENVIRONMENTAL	
● TEMPERATURE	5 to 45°C (41 to 113°F).
● RELATIVE HUMIDITY	0 to 95% (noncondensing).
● ATMOSPHERIC PRESSURE	775 to 500mmHg (-570 ft. to +10,000 ft).

1-3. FUNCTIONAL DESCRIPTION

The following paragraphs contain a brief description of the LS 200 electrical circuitry and pneumatic system. Refer to Figure 1-2, LS 200 Functional Block Diagram and Figure 1-3, LS 200 Pneumatic System.

The LS 200 contains pneumatic and electrical circuits. The pneumatic system consists of the pump, the linear bleed servo valve assembly, and the overpressure switch. The pump inflates the patient cuff. The linear bleed servo valve assembly deflates the cuff at controlled rates, implements auto-zeroing, and contains the pressure transducer. The overpressure switch causes rapid deflation if cuff pressure becomes excessive.

The LS 200 electronics are contained in four printed circuit boards, the System PCB, Interface PCB, Charger PCB, and Display PFC. The System PCB contains all of the data processing electronics. The System Control Processor, U7, does the machine control processing, controls the analog-to-digital conversion of cuff, pulse, and servo error data, operates the pump, servo valve, beeper, and displays, and pre-processes the pulse and cuff data before passing it to the 6809 Blood Pressure Computation Processor, U14. The Blood Pressure Computation Processor does all of the data processing involved in converting the cuff and pulse data into systolic, diastolic, and mean pressure and pulse rate measurements. The regulated +5Vdc power supplies and Analog +12Vdc and -12Vdc Power Supply are also generated on the System PCB.

Blood pressure determination is initiated when START is pressed on the Control Panel, causing the System Control Processor to turn on the pump and inflate the cuff. After the cuff is inflated, the servo valve opens and allows the pressure to bleed-down. During this bleed-down time the pressure transducer converts arterial pulsations into variations in an analog signal. The analog signal is conditioned into three separate signals: cuff, pulse, and servo error. The signals are multiplexed and converted into digital signals which are accepted by the System Control Processor.

Blood pressure and pulse rate are calculated by the Blood Pressure Computation Processor. When the System Control Processor contains blood pressure and pulse data it periodically sends the data to the Blood Pressure Computation Processor. The data is processed and returned to the System Control Processor, which sends the results to the Display PFC. The Display PFC contains all display drivers, displays, and the power switch.

A printer controller on the Interface PCB receives data from the System PCB and provides the printer with annotated graphic blood pressure information. A Systems Connector is also mounted on the Interface PCB. This I/O port permits external control of the LS 200 and allows serial transmission of data from the unit to a remote location.

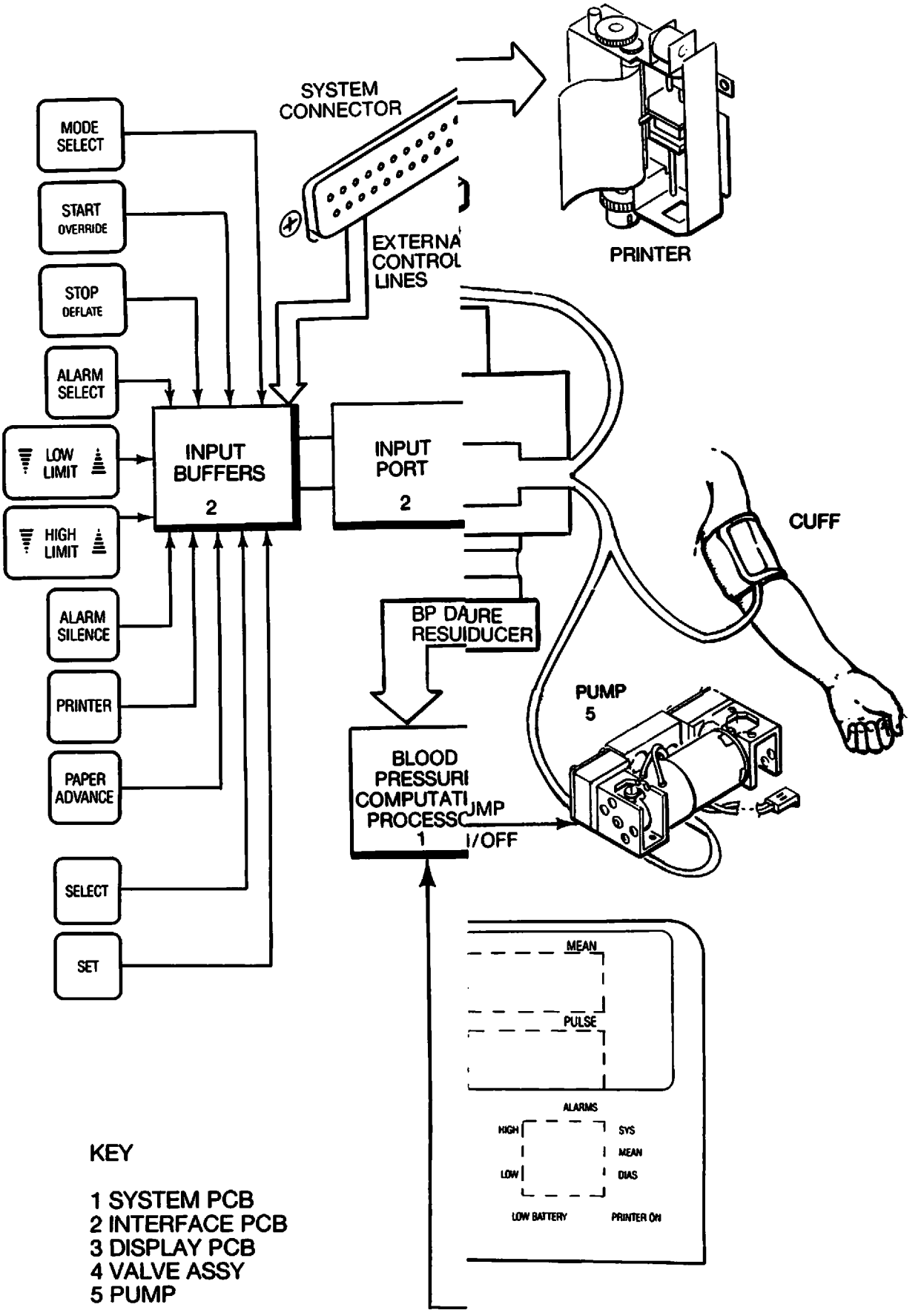

FIGURE 1-2. LS 200 FUNCTIONAL BLOCK DIAGRAM

1-4. CIRCUIT DESCRIPTION

The following paragraphs contain detailed descriptions of the LS 200 Battery Charger PCB Assembly, Interface PCB Assembly, System PCB Assembly, Display PFC Assembly, and Pneumatic System. Schematic diagrams of the electrical circuits which are provided in Section 5 should be referred to while reading the circuit descriptions. Section 6 contains additional information about selected ICs to aid in circuit analysis and troubleshooting.

1-5. BATTERY CHARGER PCB ASSEMBLY (802597).

The Battery Charger PCB provides the unit with a regulated 9.8Vdc at 25°C and a current limit of 3.5A ± 18%. This maintains a temperature compensated constant voltage charge on the 8 volt sealed lead acid battery (see Figure 5-3).

1-6. Transformer and Rectifier/Filter. The transformer supplies the Battery Charger PCB Assembly with 20Vac at a input voltage of 115V. Diode bridge CR1 rectifies the ac. A 5000µF off-board capacitor and C1 provide smoothing of the rectified signal to an ac ripple value of 4 volts peak to peak. Thermistor RT1 limits inrush current, protecting CR1, C1 and the off-board capacitor.

1-7. Semiconductor Switch. Darlington transistor pair Q1 and Q3 switch power from the rectifier/filter into the LC filter. CR4 is a free wheeling diode which maintains current through L1 when Q1 is not conducting. The transistors are controlled by the open collector outputs of the pulse width modulation controller U1. U1 switches Q1 and Q3 on and off at a frequency of approximately 50kHz. The switching frequency is set by R13 and C7. The controller, U1, compares an internal reference with a fraction of the output voltage of the regulator. The resulting error voltage, adjusted by R6, controls the duty cycle of Q1 and Q3, thus providing voltage regulation. Pulse width at start-up is limited by R14 and C5, giving a soft start with time constant of 100ms.

1-8. LC Filter. Inductor L1 and capacitors C2 and C3 form a low pass filter for the 50kHz pulses from Q1. CR3 limits voltage transients that may occur in the circuit. R5 provides a minimum load current for the inductor. CR2 isolates the charger from the battery when not operating from the ac line. The voltage drop across it is compensated by the voltage feedback loop. C8 is included to damp the switching noise generated by the regulator.

1-9. Error Amplifier. Current sensing is performed by R3 in parallel with R17. The negative voltage at R4 is summed with +5 volt reference (U1, pin 14) at R8. When the voltage at U1, pin 15, drops below ground, the duty cycle of Q1 and Q3 decreases. This causes a current limit at approximately 3.5 Amps.

Voltage sensing is performed by R15, R19, RT2, R6, Q2 and R7 in series. RT2 senses ambient temperature and compensates the voltage feedback path. The sense voltage at U1, pin 1, is compared with a reference voltage of 0.82 volts at the junction of R12 and R18. The parallel

combination of R11 with R10 and C6 rolls off the gain of the voltage error amplifier at high frequencies. This is necessary because of the phase shift introduced by the LC filter. VFET Q2 isolates the voltage sense line from the battery when the charger is not on.

1-10. INTERFACE PCB ASSEMBLY (803114).

The Interface PCB Assembly converts address and data information from the System PCB Assembly, into on and off signals for the pneumatic system, printer, LED displays, and systems connector. The Interface PCB Assembly also converts commands from the systems connector and control panels into data that may be used by the System PCB Assembly (see Figure 5-5).

1-11. Serial Communication Port. Serial communication is implemented by an asynchronous communication interface adapter (ACIA) U9. This type of device is also referred to as a UART. The time base for U9 is generated by Y1 a 1.8432 MHz crystal. The serial communication port transmits serial out data (SOD), and outputs +5V at pin 6 (DSR, data set ready) and pin 20 (DTR, data terminal ready) when the unit is on. These are available at J1, on the rear panel systems connector.

The input and output logic levels for U9 are 0=0V and 1=+5V. The logic levels at J1 are 0=-12V and 1=+12V, so voltage translators U14A and U14B are used. Any signal applied to U14B, pin 6, that is below the forward voltage of CR19 will be shifted to -12V and any signal above the forward voltage of CR19 will be shifted to +12V at U14B, pin 7. Thus 0V and 5V are translated as -12V and +12V respectively. Likewise, U14A accomplishes the reverse translation for inputs into U9. If the signal level applied at J1, pin 3, is above or below the forward voltage of CR19 then the output will accordingly be +12V or -12V. A +12V level will be reduced to 4.7V by zener CR18 and a -12V level will be reduced to -0.3V by germanium diode CR17. Thus the inputs to U9 are translated to safe input levels.

1-12. Front Panel Interface. The front panel switches are connected to the Interface PCB through J7. The active low inputs are passed through buffers U16 and U18 when their outputs are enabled by control lines SWIN1 EN and SWIN2 EN from U4. The outputs from U16 and U18 are passed to the System PCB through transceiver port U10. The clock select and set lines are also read through these ports, but these lines come through the Display PFC on J12.

1-13. Display PFC Interface. The Display PFC has five latches, U5 through U9, which must be accessed. Data to the Display PFC comes from the System PCB through Interface PCB transceiver U10, display buffer U17 which is always enabled, and J12. Latch enable (LE) signals for the five latches are generated on the Interface PCB by PAL (programmed array logic) U11. As each latch is written to, U11 decodes the address from its input signals and sends out a high pulse on the LE lines, pins 12 through 16. As each line is toggled the data is latched into U5, U6, U7, U8 or U9 (see Figure 5-6).

1-14. Operating Mode Selection. The unit may be placed in one of 8 operating modes: MANUAL, 1, 2, 3, 5, 10, 15, and 30 minutes. The mode is incremented by U7 on the System PCB each time the front panel MODE SELECT switch is depressed.

The mode may also be selected through systems connector J1, pins 22-25. When U18, pin 13, is driven low, external control is asserted. The System Control Processor U7 (on the System PCB) then responds only to mode select inputs from J1, pins 22, 23, and 24.

1-15. Power Supplies. There are two 5 volt regulators on the Interface PCB Assembly, U22 and U23. U22 provides the printer power and U23 provides the logic power. CR7 and CR8 are 5 volt tranzorbs that protect the components in case of regulator failure.

1-16. Grounding. The circuit layout utilizes 7 grounds, G0 through G6. Each ground is routed back to star ground before returning to the power supply. The function of each ground is as follows:

G0 Return to charger board
G1 Low Battery detect, real time clock power and chip enable ground
G2 Digital ground
G3 Analog ground
G4 Display drivers' ground
G5 Printer ground
G6 Pump ground

1-17. Servo. The servo is controlled by the System Control Processor U7 on the System PCB through buffer U20, pins 2, 5, 16 and 19. A high output on these lines pulls the open collector outputs of U19 low. This energizes the stepper motor windings through connector J8.

1-18. Beeper Circuit. The alarm has two available tones. Both alarm frequencies are generated and controlled by the System Control Processor (U7, System PCB) through buffer U20, pins 9 and 12. If U20, pin 9, is low a constant alarm sounds by energizing transducer X1. Pulling pin 12 low sounds the adjustable beeper for both pulse and front panel touch switch feedback. This volume is adjusted by the rear panel potentiometer.

1-19. Auto Zero Valve. The auto zero valve is energized by a high output at buffer U20, pin 15. This turns on transistor Q2 and allows current from VBSW to energize the valve.

1-20. Dump Valve. The System Control Processor (U7, System PCB) energizes the dump valve by sending a high signal through J4, pin 31, to Q3. If relay K2 is open, no power is applied to the valve so it will open and allow air to bleed out of the cuff.

1-21. Pump. The pump is turned on by the System Control Processor (U7, System PCB) through buffer U20, pin 6. A high output from this buffer will cause the output of the AND gate U26A to go high if the FAIL SAFE input to U26A, pin 2, is also high. The AND gate U26B then turns on the open collector transistor in U19. The low output at U19, pin 12, turns on transistor Q13 which provides power to the pump through J3, pin 2. CR35 serves as a catch diode to protect the pump from reversed polarity.

1-22. Fail Safe Circuitry. This circuitry insures that the pump will not run and that the dump valve will open: if cuff pressure exceeds 320mmHg or if the dump valve is closed for longer than 128 seconds. If either of these conditions occurs relay K2 will open. This interrupts power to the dump valve and provides a low input to AND gate U26A which disables the pump.

If the normally closed overpressure switch opens due to excessive cuff pressure, current flow ceases through the coil of K2. The relay then opens deactivating the DUMP VALVE POWER line and causing the dump valve to open. This also causes the FAIL SAFE input to U26A to go low. U26A then outputs a low to Darlington switch array U19, pin 5, which turns off the pump.

Relay K2 can also be opened by a 128 second time-out pulse appearing at U1 pin 13. U1 is removed from RESET by U3D and begins its count when the dump valve power line goes high. U1 then divides the 8kHz input at pin 3 down to 128 seconds. If U1 times out, pin 13 goes high. This signal, inverted by U3C, U3B and U3A, turns off Darlington transistors in U19 which causes K2 to open. R5 and C11 delay the U1 RESET signal to prevent the unintentional energizing of the relay due to contact bounce when K2 opens.

During normal operation when the START switch is pressed, U3A pin 2 goes low. This is inverted at pin 3 and applied to U19 pin 6 which turns on the Darlington transistors. Relay K2 is enabled and the dump valve is closed.

1-23. Real Time Clock Supply. The power to the real time clock chip (U8) on the System PCB Assembly is provided by Interface Board Circuitry. If the unit is on then power is provided by 5V regulator U6. If the unit is off then the power is provided by B1, a 3.6V nicad battery. CR2 and CR3 direct the current flow to protect U6 and allow B1 only be charged when the unit is plugged in. The charging of B1 is directed by CR1 and limited by R10. Voltage is only available at J2, pin 5, when the unit is powered by the AC mains.

1-24. Real Time Clock Enable Delay. This circuitry prevents the System Control Processor (U7, System PCB) from writing incorrect data to the real time clock (U8, System PCB) during power-up. When the LS 200 is turned on, opto-isolator U7 removes counter U8 from a RESET state. After 128 counts, U8, pin 14, goes high and enables the real time clock.

1-25. Power On Relay. Main battery power is switched from either the main power switch on the front panel or from pin 13 of systems connector J1. The RS latch formed by U25A and U25B is set at power up by R56 and C7. This drives Q14 on, which energizes power relay K1. The latch is reset by the System Control Processor (U7, System PCB) through U11, pin 18, and Q12 in the event of a low battery power shut down. R66 and C8 bypass VBATT power into the latch circuitry.

1-26. Low Battery Detect Circuit. Battery voltage sensing is performed by the System Control Processor (U7, System PCB) by sampling the output of U24 voltage detector. Processor involvement allows a controlled shut

down of the unit after a blood pressure reading has taken place. It also enables the battery voltage to be sampled during the times when a predefined load is present. U24 compares the input voltage at pin 3 with an internal reference of 1.15V. When the voltage at pin 3 drops below 1.15V, the open collector output at pin 4 turns off, sending the low battery detect line high. This line is then read by the System Control Processor. Trip voltage is set by R63 to 7.80V. C9 serves as a noise filter on the sense line. R67 provides a small amount of hysteresis during voltage detection.

1-27. Printer Circuitry. The printer circuitry has its own microprocessor, U12, a masked version of a 6805, to control the printer. Commands from the System Control Processor (U7, System PCB) are sent to U12 through buffer U5. The command words are read by U12 on input pins 18 through 24. Input pin 3 is used for interrupt detection. Typically, commands to the printer controller U12 are sent from the System Control Processor, by writing three bytes to U5. The first byte presents data to the printer control with the interrupt line high (U12, pin3). The second byte leaves the data unchanged but drops the interrupt line low. The third byte, after meeting the interrupt timing requirement, sets the interrupt line high again. U12 pulls pin 13 low indicating to the System Control Processor that the command is being executed. The internal timing of U12 is set by a 4MHz crystal Y2. A separate input, pin 36, lets the System Control Processor start and stop the paper feed. The same pin is used to initiate the printer self test when combined with the RESET signal.

U12 output pins 25 through 32 control the x and y position of the printer stepper motors. By sending high pulses out on these lines the current drivers in U13 are turned on, which energize the phases in the printer's stepper motor windings. This allows the pen to be moved to the desired position. Two other outputs, pins 9 and 10, control when the pen will be up or down. These outputs are complementary. A low output on one pin energizes the solenoid in one direction to pull the pen down, while a low output on the other pin will energize the solenoid in the opposite direction, pulling the pen up. Transistors Q5 through Q11 convert low outputs from the Printer Control Processor to energize the pen solenoid connected at J5 pins 10 and 11. When the pen down output is low, Q7 is turned on. Q7's rising collector voltage turns on the base of Q11. When Q11 comes on, its falling collector voltage will turn on Q8. Thus current can flow through Q8, out J5, pin 10, through the solenoid, back in J5, pin 11, and through Q11 to ground. A similar series of events occurs with Q6, Q9 and Q10 when the pen up output is low. Q5 Ensures that Q6 and Q7 will never come on simultaneously. Voltage spiking caused by shutting off the solenoid is clamped at approximately 12V by CR5 and CR6. Due to the heavy current draw the printer has its own 5V regulator U22. U22 powers the stepper motor and the pen up/down solenoid. U12 and U5 are powered by the digital 5V supply. If J10 is connected at pins 2 and 3, the printer will print a test pattern following a power on reset.

1-28. Static Protection. Static protection circuitry is provided at systems connector J1 by metal oxide varistors RV1-RV15.

1-29 SYSTEM PCB ASSEMBLY (803116).

The System PCB contains the analog input circuitry for cuff pressure, ±12 volt supply, System Control Processor, Real Time Clock, and Blood Pressure Computation Processor (see Figure 5-5).

1-30. Analog Circuitry. The analog pressure circuitry on the System PCB acquires and conditions data from the cuff pressure transducer. Voltage regulator U38 provides +10V for the transducer. As pressure is applied to the transducer, it generates a voltage at J3, pins 2 and 4. Differential amplifier U34 amplifies this voltage by approximately 110 times. R58 allows adjustment of the voltage offset. The offset provided at the output of U34D is -1 volt; less offset than this places the analog multiplexer U29 in a nonlinear operating region. U28B is a low pass filter with -3dB point at 6.1Hz. The output U28B, pin 14, into analog multiplexer U29 represents the instantaneous cuff pressure.

The pulse waveform envelope is enhanced by passing the cuff pressure through the third order high pass filter formed by U28C and U28D. The -3dB rolloff point can be shifted between .5 to 3Hz. When the System Control Processor U7 sends a high signal to analog switch U27, pins 3, 5, and 6, switches A, C, and D are closed. This changes the frequency response of U28C and U28D by switching in parallel resistors R75 and R77. This frequency shift allows the filter to recover quickly from large cuff pressure changes caused by cuff inflation or artifact.

The instantaneous unfiltered cuff pressure from U34, pin 1, provides the input to the servo error signal. The servo error signal provides the necessary feedback to System Control Processor, U7, so the cuff bleed down rate may be controlled. The servo error signal is generated by op-amp U28A, sample and hold U35, and op-amp U36. Similar to the pulse channel filter select, the -3dB point of U28A's low pass filter is controlled by the System Control Processor, U7, through analog switch input U27, pin 4. Closure of the switch, U27 pins 13 and 14, places R76 in the circuit, detuning the filter thus making its rolloff slope far more gradual. This prevents the servo error filter from responding to artifact during cuff inflation which allows the servo channel to recover quickly insuring stability within seconds after the cuff inflation cycle terminates. U35 samples the instantaneous cuff pressure at intervals determined by the System Control Processor, U7. The instantaneous cuff pressure is subtracted from this sampled value, providing a running measure of cuff bleed rate. The servo valve is adjusted as necessary to maintain a linear bleed down rate.

1-31. A to D Conversion. U37A buffers the output of the analog multiplexer U29 and drives pin 18 of U32, a multiplying digital to analog converter. The multiplying D to A converter is used with a successive approximation routine in the System Control Processor, U7, to convert analog cuff pressures to a digital form. The voltage input to the converter at U32, pin 18, is always negative. The D to A converter reads this voltage as a current, because of the constant input resistance at pin 18 (10KΩ).

The System Control Processor U7, controls a reference current which is summed at U32, pin 1, with current into U32, pin 18. This reference current is equal to the current into U32, pin 17, multiplied by the digital word at U32, pin 4 through pin 15. This digital word is the System Control Processors approximation of the analog input. The current output at U32, pin 1, indicates how far off the System Control Processors approximation is from the actual analog input.

U31 detects the current out of U32, pin 1, and outputs a low signal if the magnitude of the analog signal is smaller than the System Control Processors approximation. The comparator (U30) buffers U31's output and converts it to TTL levels.

A software successive approximation routine, run by the System Control Processor, U7, drives the Analog to Digital conversion. The digital input to U32 is first driven with a 00 hex. The high order bit is set to 1, then the comparator, U31, output is sampled. If the comparator output is low, the high order bit is reset, otherwise the next lower bit is set and the test is repeated. The set-test-decision-next bit set process is repeated until all the bits are checked. The digital input to U32 then represents the analog signal level.

Resistor R90 is adjusted so the digital output of the successive approximation routine is equivalent to cuff pressure times .1mmHg. The reference voltage at U32, pin 17, is adjusted to 8.70 volts, giving an ideal reference current of 870uA. This adjustment would give a valid voltage input range of 0 to -8.70V with a conversion factor of approximately 2.1mV per count.

U37B is used only during self-test to verify the linearity of the A/D conversion circuitry. U37B multiplies the cuff pressure channel signal by two and applies it to multiplexer U29. During self-test the cuff pressure channel reading and the twice cuff pressure reading are displayed for comparison.

1-32. ±12 Volt Supply. The +12V and -12V supply is generated by U33, Q3, Q4, and T1. This push-pull switching converter is driven at approximately 30kHz by switching voltage regulator U33. C37 and R92 control the switching frequency of U33 which in turn provides opposite-phase base drive to Q3 and Q4. L1 and C28 serve as energy storage elements. The secondary voltage of T1 is full wave rectified by CR7, filtered by C31, C36, and regulated to ±12V by U39 and U40. C32 through C35 dampen switching noise.

The output of CR7 also supplies linear regulator U38. The output of U38 is set at +10V which is trimmed to +8.7V at U32, pin 17, by R90.

1-33. System Control Processor. The System Control Processor, U7, services the front panel switches, controls the display, pneumatic system, blood pressure computation processor, and performs A to D conversions on the analog cuff pressure inputs. The System Control Processor also communicates with the analog section via dedicated ports PA0-7 and PB0-7 on the processor chip. U7 communicates with all other peripherals through U13 address latch, U12 data bus buffer, and U6 control buffer. U11 programmable array logic decodes higher order address bits and selects memory mapped devices.

The System Control Processor's data bus, ADB0-7, also connects to an output latch and an input buffer. The output latch, U16 COM1, performs the following: provides an interrupt to the Blood Pressure Computation Processor U14, controls the HALT input and the RESET line to U14, triggers the watchdog timer, changes the cutoff frequency of the servo error input channel, changes the filter frequency of the pulse channel filter, controls the dump valve and printer paper feed. The input buffer, U15 SEN 1, inputs the following information: operating mode commands from the system connector, status of failsafe circuitry, printer busy signal, selection of 12 or 24 hour clock mode, A to D comparator output, and bus ready status for the interface to Blood Pressure Computation Processor.

The System Control Processor's data bus (ADB0-7), address lines and device select lines connect to the Interface PCB through J1. These signals allow the processor to communicate with another output latch, (U20) on the Interface PCB, and the Interface PCB's data bus, ADC0-7.

1-34. Real Time Clock. The real time clock provides year, month, date, and time of day for output to the system connector and printer. The clock circuit (U8) and oscillator (U1) are powered by their own battery and power supply located on the interface board. Decoding for U8 is performed by U3, U4, U21, U5, and U11. The decoding simulates a single access from a multiplexed bus by alternately writing address and data bytes to U8 via ADB0-7. For a single read cycle, the System Control Processor (U7) first writes an address byte on the bus. The decoding circuitry simulates the address strobe input to U8 by decoding the System Control Processor Data Strobe (DS) when the address byte is on ADB0-7. Next, the processor does a normal read of the clock circuit with the DS of U7 acting as the DS of U8. The chip enable for U8 is held low while the system power is on. When this signal goes high at power off, U8 disconnects control lines and data lines from external circuitry, but continues timekeeping.

1-35. Watchdog Circuit. The watchdog circuit is provided to ensure continuous operation of the System Control Processor. At power up, the output of U4D sends 5MHz pulses to the dual one-shot, U2, pins 4 and 12. These pulses continue to activate the RESET line by triggering the one shots until the charge on C7 reaches the threshold of U5B. At this time, RESET continues to be active until the RC time constant of U2A (10ms) has elapsed. The System Control Processor, U7, must continually send trigger pulses to U2B, pin 11, at least once every 100ms or else U2B will time out and reset the processor.

1-36. Blood Pressure Computation Processor. The Blood Pressure Computation Processor U14 computes the Systolic, Mean and Diastolic blood pressures, and the pulse rate. The processor also formats data for output to the printer. Pressure information is sent to the Blood Pressure Processor once every 10ms during cycle deflation, and results are calculated at the conclusion of the cycle. The CPU, U14, is an 8-bit microprocessor utilizing a 16-bit address bus. Memory consists of two EPROMs, U25 and U26, and one 8K X 8 static RAM chip U24 which is shared with the System Control Processor U7. The address latch is U22, the data buffer U17. Address decoding is performed by a PAL U18. The Blood Pressure Computation Processor's RESET is controlled by the System Control Processor through COM1, U16.

In normal operating mode U7 resets U14 and places it in halt mode by setting pin 40 low. The halt mode is detected by U7 through bus available (BA) and bus status (BS) signals via SEN1 (U15). When the halt mode is verified, indicating that U14 is not using address and data buses, the blood pressure data from the A/D converter is stored in shared RAM U24. U14 is then taken out of halt mode and begins blood pressure calculations. This sequence is repeated approximately every 10ms until a complete bleed down cycle has occurred. When U14 completes the blood pressure calculations a flag is set in shared RAM U24. System Control Processor U7 detects the flag and loads the processed data from shared RAM U24 into RAM U9. Data transfer and address setup are performed through U17 and U22. When tri-stated, they isolate the address and data buses for the two microprocessors.

U7 sends the blood pressure and pulse data to the Display PFC. U14 formats the data for the printer and for output via the system connector, J1 on Interface PCB.

The interrupt request inputs are dedicated for test purposes and can be activated via test jumpers J7 and J8.

1-37. DISPLAY PFC ASSEMBLY (802583).

The LS 200 Display board has 40 displays, circuitry to latch the display information, drive the displays, and adjust the on-time. Information is passed to this board through connector J1 from the Interface board. Connector J3 conducts the clock set inputs from the front panel to the Interface Board and J2 is the power ON switch connection (see Figure 5-6).

1-38. Data Display. Once every 1ms the System Control Processor (U7, System PCB) loads data into the five latches U5 through U9. Latches U5 through U8 contain segment information. U9 receives the digit select data The DIG LE signal latches data into U9 and also triggers the one shot, U11, through inverter U10B. When U11 is triggered, its output (pin 3) goes high. This signal is inverted by U10A which enables the outputs of latch U9. The duration of the U9 enabling pulse is inversely dependent on battery voltage. This inverse dependency keeps the displays at a constant brightness, regardless of battery voltage. The battery, through R52 and Q1 charges capacitor C5. When the voltage on C5 is approximately 3.3 volts, U11, pin 3, goes low, disabling U9 through inverter U10A. When the next DIG LE pulse goes low, capacitor C5 is discharged by U11 and the cycle repeats itself. The net on time for U9 is .2 to .7ms depending on battery voltage. As the battery voltage increases, the current through R52 is increased and C5 reaches its threshold voltage of 3.3 volts sooner.

When U9 is enabled the displays turn on. Only one of the 7 output lines from U9 will be high at any time. Each line is connected to 4 open collector current sinks, the quad Darlington switch devices U12 through U18. When they turn on, current flows from display drivers U1, U2, U3 and U4, through the light emitting diodes and into the four selected current sinks. Whether current flows through the segments on a display

is determined by the information that was written to latches U5, U6, U7 and U8. A high output from these buffers allows current to flow which turns on a display segment. Since only 4 digits can be enabled at a time, it takes 7 enables before all digits and indicators have been turned on. Therefore, it takes the system 7ms for a complete cycle.

The AC MAINS display is turned on by the V CHG OUT line which is active when the unit is connected to line power.

1-39. Pneumatic System.

The LS 200 pneumatic system is responsible for cuff inflation, cuff deflation at a linear rate, and sensing of raw pressure data. The pneumatic system also implements safeguards to prevent excessive cuff pressures and to ensure that high cuff pressures are not sustained for more than two minutes.

Figure 1-3 depicts the pneumatic system in simplified form. The system consists of the patient cuff, the pump assembly, the linear bleed servo valve, the overpressure switch, and all interconnecting tubes and tube fittings. The pump assembly, in turn, consists of the pump and the pump drive motor. The linear bleed servo valve assembly is comprised of the servo valve itself, the dump valve, the auto zero valve, the manifold block, the stepper motor, and the pressure transducer.

Before the cuff is inflated, the dump valve is closed, the servo valve is nearly closed, and the auto zero valve is open. The open auto zero valve references the transducer to atmospheric pressure. This is to insure that the transducer is zeroed to atmosphere rather than to residual pressure that the cuff may have. When the pump is enabled, the auto zero valve closes, sealing the system and permitting the cuff to inflate. As the cuff inflates, the pressure transducer inputs an analog signal to the System PCB proportional to the rising pressure. When the predetermined peak pressure is reached, the pump is disabled and bleed down begins.

Bleed down is accomplished by the needle-type bleed valve, which is operated by the stepper motor. Under control of the 6805 microprocessor, the stepper motor opens the servo valve in controlled increments to ensure a linear bleed rate. This linear bleed rate provides a reference against which pulse-induced pressure variations are measured. The servo error signal provides the System Control Processor (U7, System PCB) with feedback necessary to maintain the linear rate. The microprocessor then signals the stepper motor to increase or decrease the servo valve aperture as required.

Cuff pressure is monitored by the overpressure switch as well as by the transducer. If pressure exceeds 320mmHg (approximately) the overpressure switch interrupts system power. This causes the dump valve to open, and the cuff rapidly deflates. A failsafe feature in the software will cause the dump valve to open in any event if cuff pressure is sustained for more than two minutes.

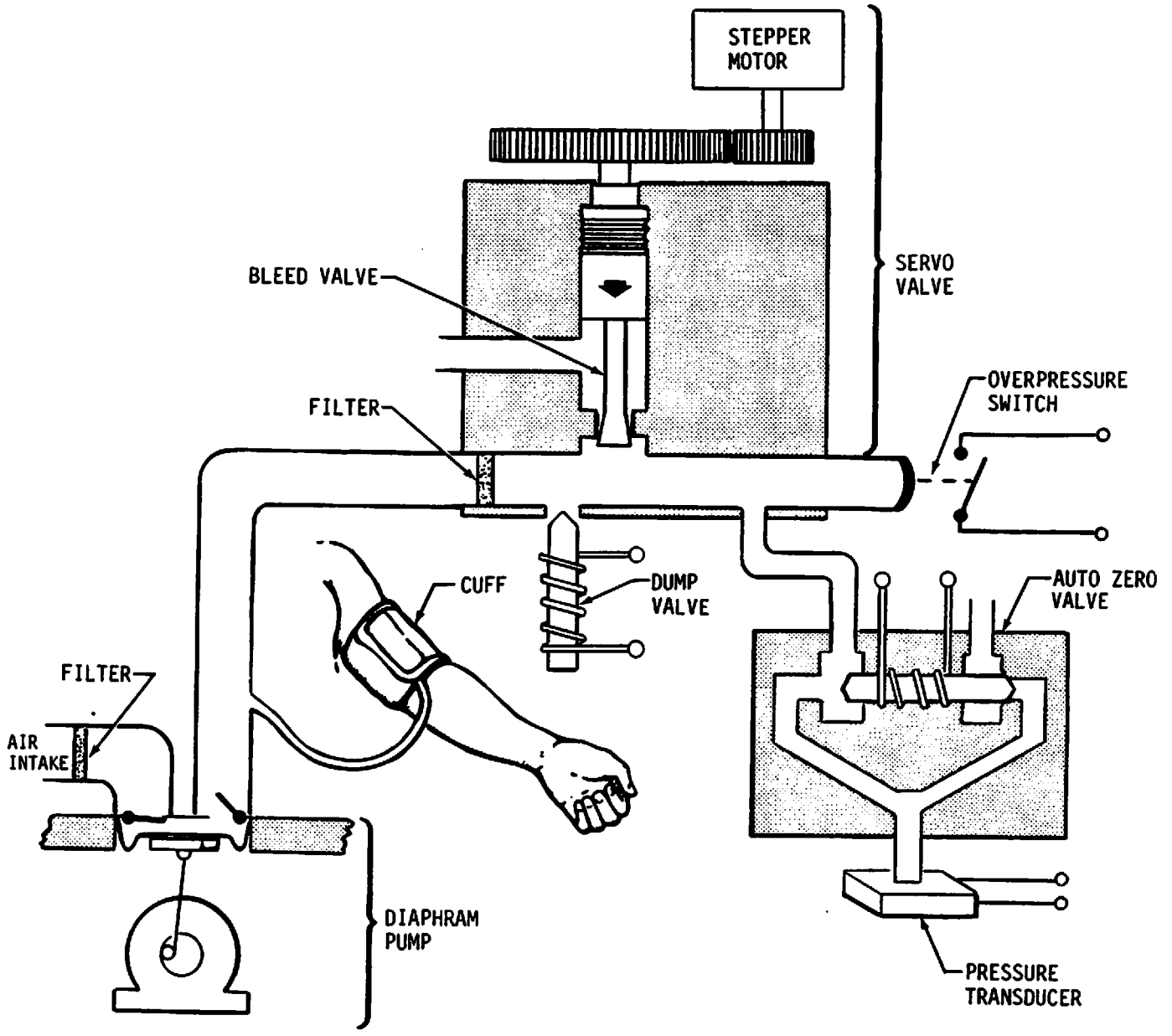

FIGURE 1-3. PNEUMATIC SYSTEM DIAGRAM

SECTION 2
OPERATION

2-1. GENERAL

This section of the manual contains information and procedures for the operation and testing of the LIFESTAT 200. A list of accessories and replacement items is also provided.

2-2. OPTIONAL ACCESSORIES AND REPLACEMENT ITEMS

The following items may be obtained by contacting a Physio-Control Sales Representative.

TABLE 2-1

ACCESSORIES AND REPLACEMENT ITEMS

PART NUMBER	DESCRIPTION
803029-00	ACCESSORIES BAG, LS 200
801315-02	ASSEMBLY, Pole Mount
801099-01	ASSEMBLY, Wall Mount
802505-00	CUFF, Adult Inflatable
802505-01	CUFF, Large Adult Inflatable
802505-02	CUFF, Thigh Inflatable
802505-03	CUFF, Child Inflatable
802604-00	PAPER, LS 200 Printer, 3 Rolls (1 Box)
802601-01	PAPER, LS 200 Printer, 1 Case (50 Boxes)
201716-001	PEN, LS 200 Printer, Black Ink, 4 Pens (1 Tube)
201716-002	PEN, LS 200 Printer, Black Ink, 1 Box (50 Tubes)
201716-003	PEN, LS 200 Printer, Black Ink, 1 Case (50 Boxes)
803027-00	PLATE, Mount With Hardware
802611-00	PUBLICATION, LS 200 Operating Manual
802450-02	PUBLICATION, LS 200 Service Manual
802537-00	TUBING SET, Latex, 24 Inch Cuff Extension
802537-01	TUBING SET, Latex, 72 Inch Cuff Extension
802537-02	TUBING SET, Latex, 144 Inch Cuff Extension

2-3. CONTROLS AND INDICATORS

A. The controls and indicators on the Front Panel and Hidden Panel are shown in Figures 2-1 and 2-2. Each item is keyed on the figure to a corresponding listing in Table 2-2 or 2-3. These tables give the nomenclature and briefly describe the function of each item.

B. Figure 2-3 provides the rear panel view of the LS 200. Each item on this figure is keyed to a corresponding listing in Table 2-4. The table lists the nomenclature of each item and briefly describes its function.

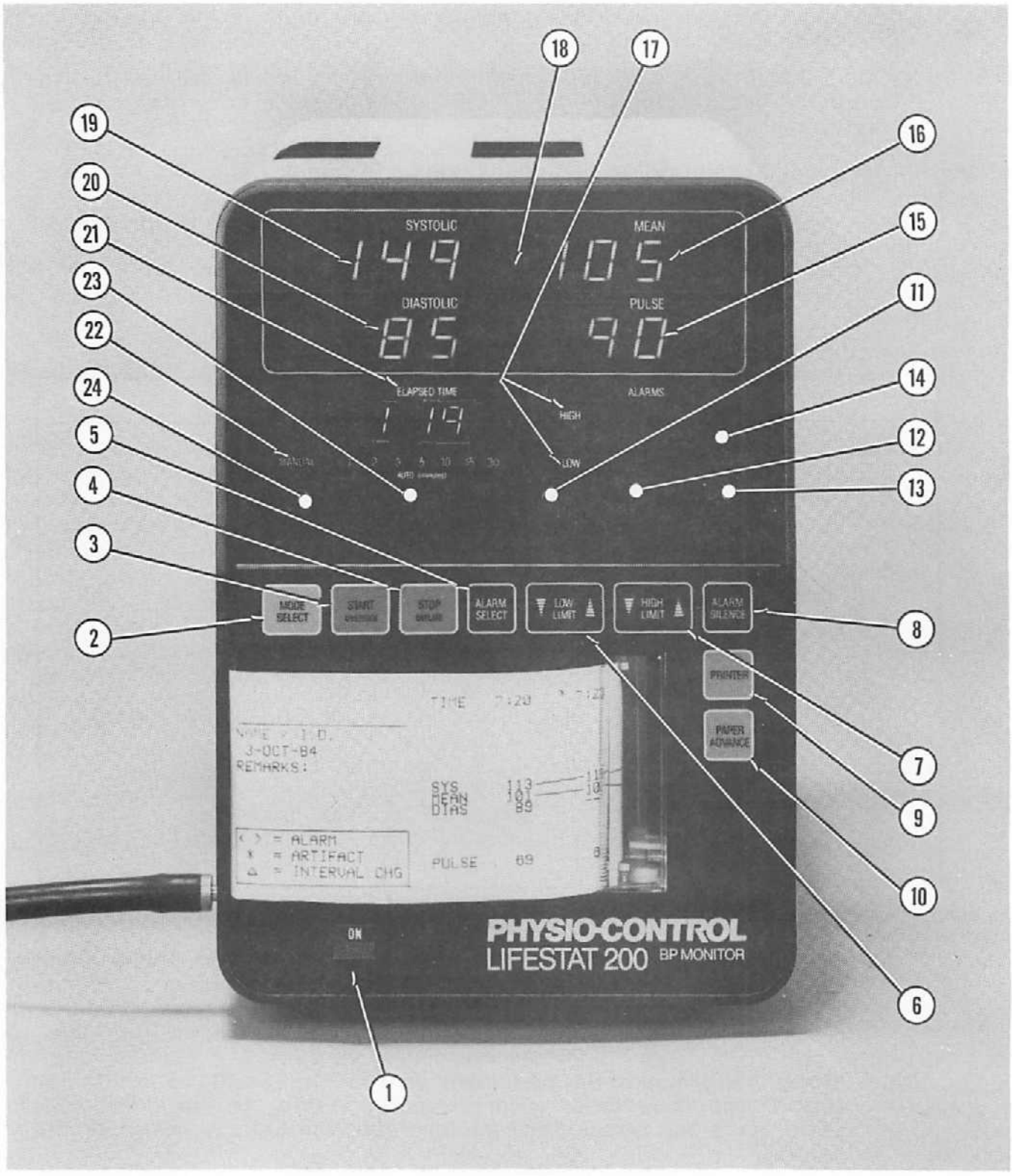

FIGURE 2-1. LS 200 FRONT PANEL CONTROLS AND INDICATORS

TABLE 2-2

LS 200 FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
①	ON	Rocker switch for main power control.
②	MODE SELECT	Membrane switch for selection of manual or automatic inflation modes. Repeated or sustained pressure on switch selects 1, 2, 3, 5, 10, 15, and 30 minute automatic cycles, and manual successively.
③	START/OVERRIDE	Membrane switch to start and/or sustain cuff inflation. Momentary pressure initiates inflation cycle in any mode at any time (unless a cycle is already in progress). Pressing and holding switch causes inflation to continue up to 300mmHg or until switch is released.
④	STOP/DEFLATE	Membrane switch to abort inflation cycle and deflate cuff to less than 10mmHg within 10 seconds. In AUTO mode, STOP/DEFLATE also resets cycle timer and blanks elapsed time display.
⑤	ALARM SELECT	Membrane switch to turn High and Low alarms on and off and to select the BP parameter monitored (systolic, diastolic, or mean). Repeated or sustained pressure on switch selects systolic, mean, diastolic, high systolic/low diastolic, and off, successively.
⑥	LOW LIMIT	Dual membrane switch to set low alarm limit. Repeated or sustained pressure on left side of switch lowers limit; repeated or sustained pressure on right side of switch raises limit. Range is 30 to 160mmHg in increments of 5mmHg.
⑦	HIGH LIMIT	Dual membrane switch to set high alarm limit. Repeated or sustained pressure on left side of switch lowers limit; repeated or sustained pressure on right side of switch raises limit. Range is 50 to 260mmHg in increments of 5mmHg.
⑧	ALARM SILENCE	Membrane switch to silence alarm.

TABLE 2-2 (Continued)

LS 200 FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
(9)	PRINTER	Membrane switch for turning printer on and off.
(10)	PAPER ADVANCE	Membrane switch to advance printer paper.
(11)	ARTIFACT	LED to indicate that pressure measurement contains excessive artifact. Accompanied by audio tone.
(12)	LOW BATTERY	LED to indicate low battery condition.
(13)	PRINTER ON	LED to indicate when printer is on.
(14)	SYS MEAN DIAS	LED to indicate BP parameter being alarm-monitored. When SYS and DIAS are simultaneously illuminated, high alarm monitors systolic BP, low alarm monitors diastolic BP.
(15)	PULSE	Digital display to indicate pulse rate at completion of cycle. Also during bleed down an LED in this display flashes as each pulse is detected.
(16)	MEAN	Digital display to indicate mean blood pressure at completion of cycle.
(17)	HIGH Alarm LOW Alarm	Digital display to indicate high and low alarm limits as set by ALARM SELECT.
(18)	CUFF	Used for test purposes only.
(19)	SYSTOLIC	Digital display to indicate systolic blood pressure at completion of cycle.
(20)	DIASTOLIC	Digital display to indicate diastolic blood pressure at completion of cycle.
(21)	ELAPSED TIME	Digital display to indicate time elapsed since beginning of last inflation cycle in minutes and seconds. Displays 00:00 until first inflation cycle after power up.

TABLE 2-2 (Continued)

LS 200 FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
(22)	Mode Select Display	LED to indicate manual inflation cycle or 1, 2, 3, 5, 10, 15, or 30 minute automatic cycle.
(23)	ABORT	LED to indicate that inflation cycle has been aborted by failsafe circuit, repeated error rejection, or pressing STOP/DEFLATE. Accompanied by audio tone.
(24)	AC Mains	LED to indicate that LS 200 is connected to ac line power.

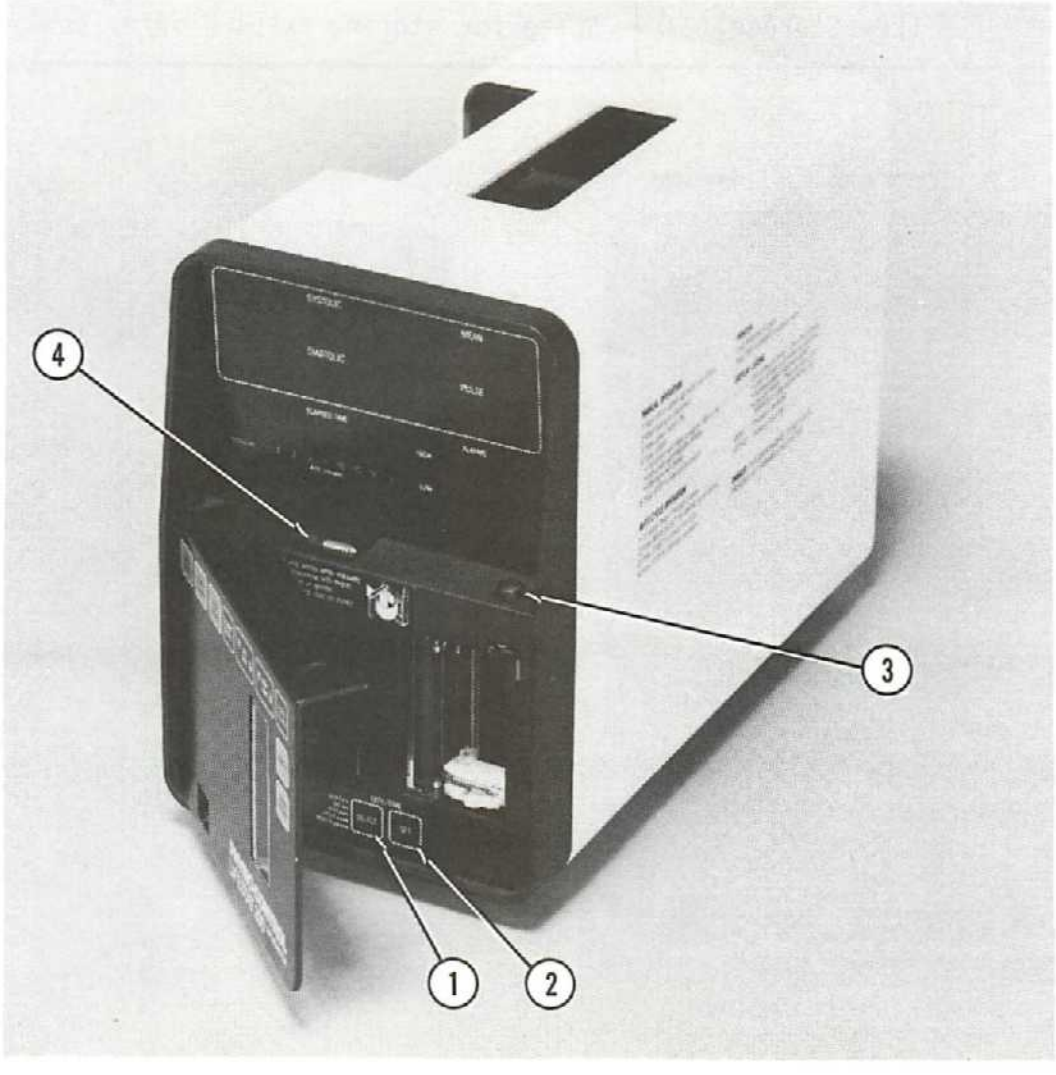

FIGURE 2-2. LS 200 HIDDEN PANEL CONTROLS

TABLE 2-3

LS 200 HIDDEN PANEL CONTROLS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
(1)	SELECT	Membrane switch to select real time clock parameter to be set. Repeated or sustained pressure on switch selects month, day, year, hour, and minute, successively.
(2)	SET	Membrane switch to set real time clock. Repeated or sustained pressure increments real time clock parameter selected by SELECT.
(3)	Printer Door Release Button	Pushbutton to release Printer door.
(4)	(Pen Storage)	Space for storing extra Printer pens.

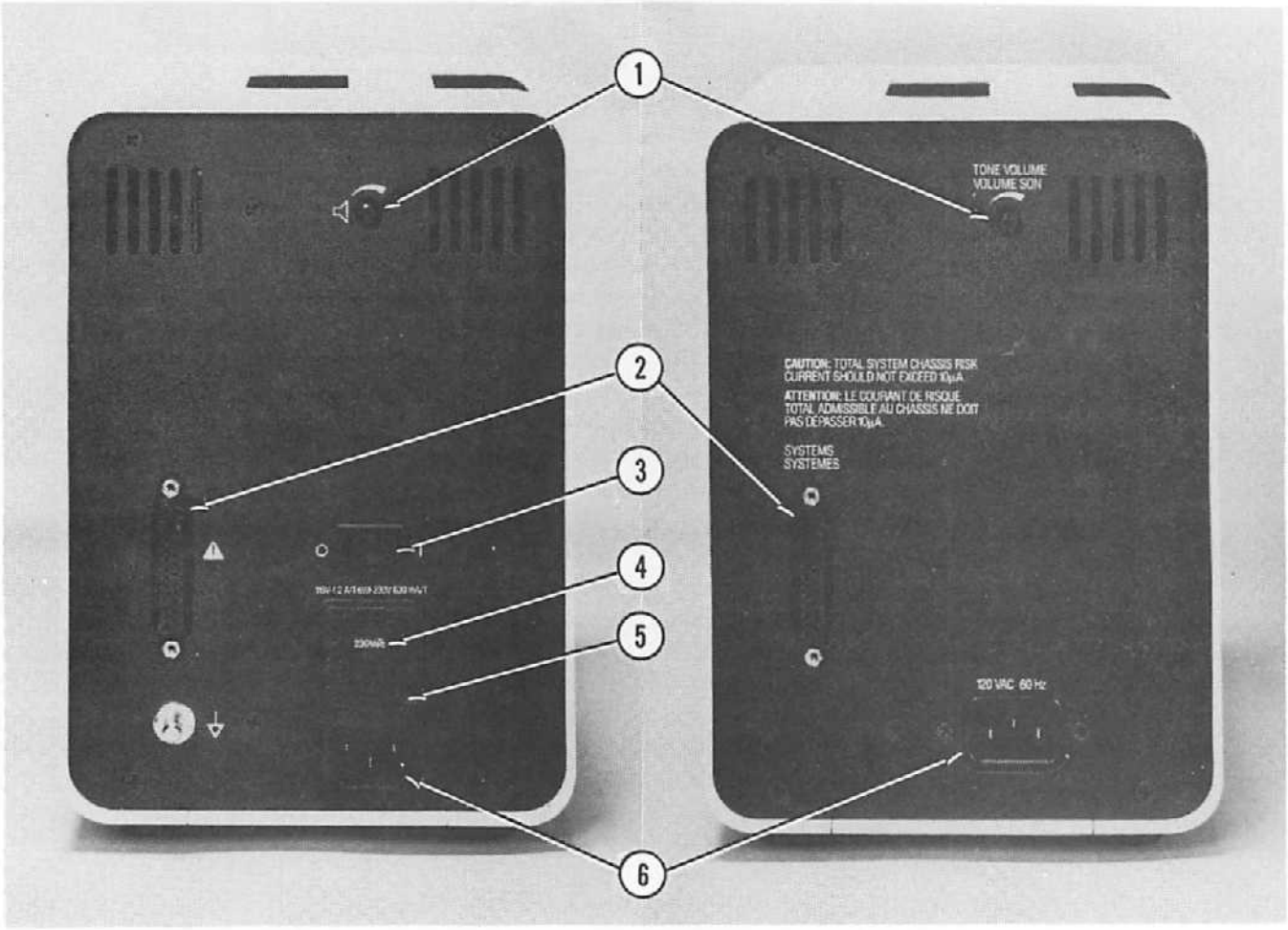

FIGURE 2-3. LS 200 REAR PANEL CONTROLS

TABLE 2-4

LS 200 REAR PANEL CONTROLS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
(1)	ALARM VOL	Turn clockwise to increase alarm volume, counterclockwise to decrease alarm volume.
(2)	SYSTEMS Connector	I/O connector for remote control and test purposes.
(3)	Mains Power Switch	On/Off switch for AC Mains
(4)	Voltage Select Switch	Configures input for 115 or 230 Vac.
(5)	AC Mains Fuses	Provide overload protection.
(6)	AC Mains Power Input	Receptacle for power cord.

2-4. SUGGESTED PERFORMANCE VERIFICATION PROCEDURES

To assure accurate blood pressure measurements, the following tests on the fully assembled LS 200 should be performed at three month intervals. A suggested Performance Verification Procedure (PVP) and Check Off List for the LS 200 are included in this section. The Check Off List is provided for the customer's use and may be copied when needed. As each of the following tests is completed, the Check Off List should be marked accordingly. (See Figure 2-7.)

1. PHYSICAL INSPECTION.

   Inspect all controls, indicators, and displays for physical condition and proper operation. Check surfaces for fluid spills, cracks, dents, condition of labels, loose or missing hardware. Check Luer fitting, pressure cuff and tubing for physical condition, obvious leaks, or obstructions. Check printer door for ease of operation, positive latch function.

2. AC MAINS (BATTERY CHARGE) INDICATOR.

   Verify that the AC MAINS LED is illuminated when the unit is connected to ac power. Verify that when mains power is disconnected, indicator is extinguished.

3. POWER UP INITIALIZATION CHECK.

   A. Set the main power switch to the ON position. Verify that all displays are illuminated, with the seven-segment displays showing "888"s.

B. Verify that self test sequence lasts for approximately 10 seconds and that the printer draws a square.

C. Insure that upon completion of this self test period all seven-segment displays are blanked, and that the sound of the servo valve closing has stopped.

D. Verify that the legend MANUAL is backlit, and that no other display is illuminated (except for AC MAINS).

4. TEST 1 (DISPLAY FUNCTION).

A. Simultaneously depress START/OVERRIDE, STOP/DEFLATE, and ALARM SELECT. Verify that "tSt 1" appears briefly in the alarm limit window, and that the seven-segment displays cycle through numbers 0 through 9, with all light bar displays illuminated when odd numbers are displayed.

B. Depress ALARM SELECT, and verify that alarm sounds. Press ALARM SILENCE to disable alarm.

5. TEST 2 (ANALOG CALIBRATION).

A. Using a "T" tubing connector, connect the LIFESTAT 200 to a mercury manometer and a standard volume aspirator bottle (see paragraphs 3-2 and 3-3). Insure that all fittings are airtight.

B. Depress MODE SELECT, and verify that "tSt 2" appears in the alarm limit display window.

C. Depress START/OVERRIDE. The inflation pump will run until the SYSTOLIC display reads 215. The mercury manometer should read 215 ± 2mmHg at its lowest point.

6. TEST 3 (SYSTEM LEAKAGE).

A. Press MODE SELECT, and verify that "tSt 3" is displayed in the alarm limit window. Verify that the diastolic window displays a threshold value of 250mmHg.

B. Depress START/OVERRIDE. Verify that the pump inflates the system to 250mmHg, after which the pump shuts down, and the elapsed timer begins. Insure that after 30 seconds system pressure still exceeds 210mmHg.

C. Press STOP/DEFLATE. The dump valve should open, depressurizing the system.

D. Press START/OVERRIDE again. When threshold pressure is again achieved, depress HIGH LIMIT up. Verify that CUFF legend is illuminated, and that the servo bleed valve opens partially (note increased bleed rate). Press HIGH LIMIT down to close bleed valve and extinguish CUFF display.

E. Repeat the inflation cycle test. Verify that the systolic blood pressure displayed is above the high alarm limit and that, if so, the systolic display flashes and an alarm tone is heard.

7. TEST 4 (OVERPRESSURE SWITCH).

A. Press MODE SELECT. Insure that "tSt 4" is displayed in the alarm limit display window. Verify that all displays read 000, except for DIASTOLIC, which displays a threshold of 350mmHg.

B. Press START/OVERRIDE. The system should attempt to inflate to 350mmHg. Verify that the overpressure switch trips between 320 and 330mmHg on the mercury manometer.

C. Cycle LIFESTAT 200 power off and on to clear test mode. Disconnect test apparatus, and connect standard pressure cuff to the LIFESTAT 200 Luer fitting.

8. INFLATION CYCLE TEST.

A. Place cuff snugly around arm with the mark over the brachial artery. (For convenience, the cuff may be fastened around itself and slipped onto the arm like a sleeve.)

B. Press START. Verify that the pressure display rises rapidly to approximately 180mmHg as cuff inflates.

C. Verify that cuff bleeds down (descending pressure is displayed) and that a light flashes periodically under PULSE, accompanied by a beep.

D. Verify that systolic pressure, diastolic pressure, mean arterial pressure, and pulse values appear in their respective displays. If an error message is generated, verify that the cycle is repeated, with higher cuff inflation threshold and lower bleed rate.

9. ALARM CHECK.

A. Press ALARM SELECT. Verify that the SYS legend is illuminated.

B. Verify also that a HIGH display of 260 appears. This is the high alarm limit. Press and hold HIGH LIMIT down switch until the high alarm limit decreases to a value approxiamtely 20mmHg less than the systolic blood pressure determination currently displayed.

C. Repeat the inflation cycle test. Verify that the systolic blood pressure displayed is above the high alarm limit and that, if so, the systolic display flashes and an alarm tone is heard.

D. Press ALARM SILENCE. Verify that alarm tone is silenced, but flashing display persists.

E. Press and hold HIGH LIMIT up switch until high alarm limit rises above the systolic pressure displayed. Verify that systolic pressure display stops flashing.

10. AUTO MODE CHECK.

A. Press MODE SELECT and verify that MANUAL goes off and 1 is backlit on AUTO scale. Successive presses of MODE SELECT should produce backlighting behind 2, 3, 5, 10, 15, and 30, respectively.

B. Set automatic cycle at 2 and repeat inflation cycle test. When cuff inflation begins, verify that ELAPSED TIME displays an initial value of 0 and begins incrementing.

C. Verify that when elapsed time reaches approximately 2 minutes, inflation cycle begins again automatically.

11. PRINTER CHECK.

A. Press PAPER ADVANCE. Verify that printer paper advances.

B. Press PRINTER. Verify that PRINTER ON is illuminated.

C. Return MODE SELECT to MANUAL.

D. Repeat the inflation cycle test. Verify that the printer annotates the blood pressure/pulse values as shown in Figure 2-4. Note: If LS 200 is operated in 12 hour clock mode instead of 24 hour mode, an "A" or a "P" will appear after the time indicating AM or PM.

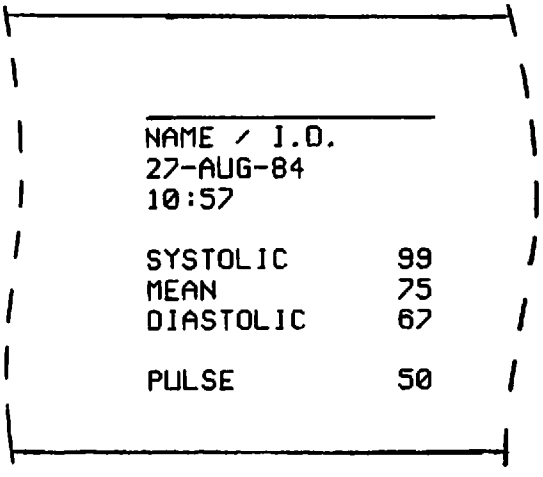

FIGURE 2-4. PRINTER ANNOTATION - MANUAL MODE

E. Press MODE SELECT to select a one minute automatic cycle. Repeat inflation cycle test, and insure that the printer annotates the blood pressure/pulse values as shown in Figure 2-5.

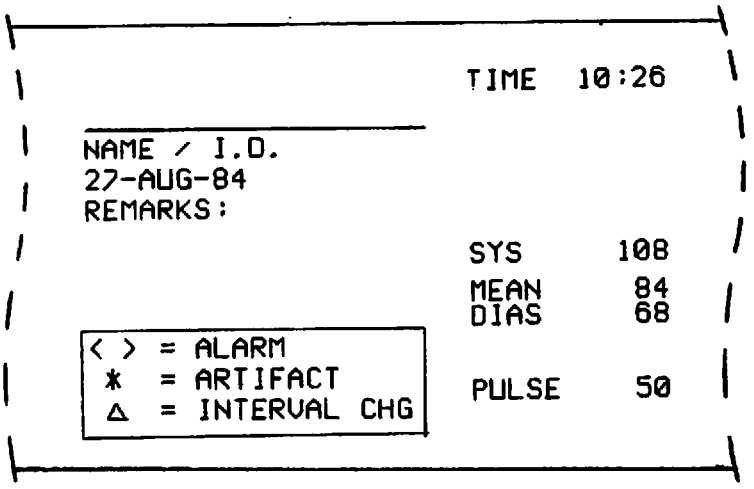

FIGURE 2-5. PRINTER ANNOTATION - AUTOMATIC MODE

F. The inflation cycle should repeat automatically. When the second determination is complete, verify that the printer trends the first and second determinations. See Figure 2-6.

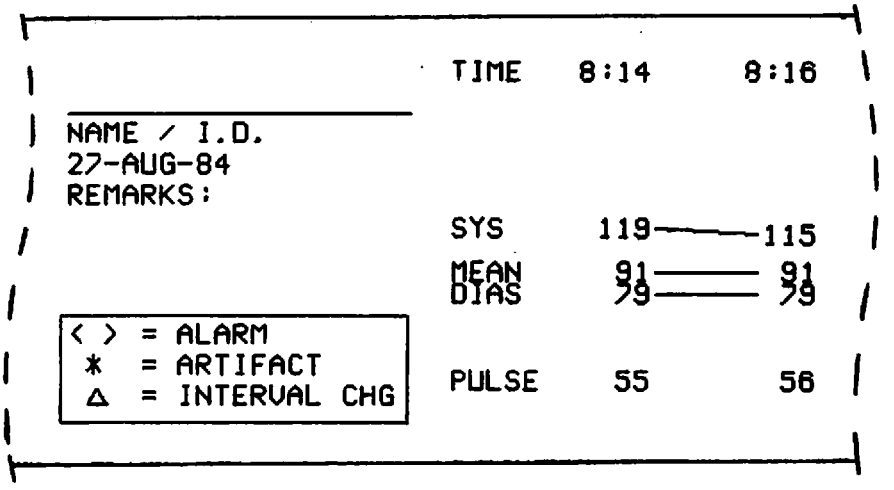

FIGURE 2-6. PRINTER ANNOTATION - AUTOMATIC MODE, TRENDED

DATE_____

FIGURE 2-7. LS 200 PERFORMANCE VERIFICATION PROCEDURE

CHECK OFF LIST

1. PHYSICAL INSPECTION . . . . . _____

2. AC MAINS INDICATOR . . . . . _____

3. POWER UP INITIALIZATION CHECK . . . . . _____

4. TEST 1 (DISPLAY FUNCTION)

   A. Displays cycle through 0-9, bar LEDs illuminated on odd numbers . . . . . _____

5. TEST 2 (ANALOG CALIBRATION)

   A. SYSTOLIC display reads 215mmHg . . . . . _____

6. TEST 3 (SYSTEM LEAKAGE)

   A. LOW LIMIT switches toggle threshold from 250 to 150mmHg _____
   B. System inflates to 250mmHg, after 30 seconds cuff pressure still exceeds 210mmHg . . . . . _____
   C. STOP/DEFLATE: System depressurizes . . . . . _____
   D. HIGH LIMIT up: CUFF illuminates, bleed valve opens partially . . . . . _____
   E. HIGH LIMIT down: CUFF display extinguished, bleed valve closed . . . . . _____

7. TEST 4 (OVERPRESSURE SWITCH)

   A. DIASTOLIC display reads 350mmHg . . . . . _____
   B. Overpressure switch trips at 320 to 330mmHg on manometer. . . . . _____

8. INFLATION CYCLE TEST

   A. System inflates to 180mmHg . . . . . _____
   B. Descending pressure display, pulse indicator, audible tone . . . . . _____
   C. Parameters displayed . . . . . _____

9. ALARM CHECK

   A. HIGH LIMIT switch functional: display flashes and alarm tone sounds when limit violated . . . . . _____
   B. ALARM SILENCE switch operational . . . . . _____
   C. HIGH LIMIT up causes display flashing to cease . . . _____

LS 200 PERFORMANCE VERIFICATION PROCEDURE

CHECK OFF LIST (Continued)

10. AUTO MODE CHECK

A.	MODE SELECT switch operational	_____
B.	Elapsed time timer operational	_____
C.	Inflation cycle begins automatically after 2 minutes.	_____

11. PRINTER CHECK

A.	PAPER ADVANCE switch operational	_____
B.	PRINTER ON switch operational, illuminates display .	_____
C.	Manual mode printer annotation	_____
D.	Auto mode printer annotation.	_____
E.	Trending	_____

2-5. OPERATOR MAINTENANCE

The following routine maintenance recommendations will help insure trouble-free operation of the LS 200 and should be observed by both operator and technician.

2-6. Batteries.

The LS 200 batteries are depleted electrolyte sealed lead-acid. The life expectancy of lead-acid batteries is dependent upon many variables, but the primary factors are temperature and use.

Optimum battery performance will occur when the unit is operated and charged at normal room temperatures. When unit is charging, ambient temperatures greater than 40°C may adversely affect battery life.

CAUTION

DO NOT DISCHARGE THE BATTERIES COMPLETELY. TO DO SO WILL CAUSE DAMAGE. TURN INSTRUMENT POWER OFF AND CONNECT TO AC POWER WHEN NOT IN USE.

Batteries will also perform best when kept as much as possible in the fully charged state. Completely discharging the batteries will damage them. When the LS 200 is not in use, connect the ac power cord and insure that the power switch is off. Use of the connection to ac power is also recommended for long periods of storage. If this is not possible, insure that the batteries are fully charged when placed in storage and that ambient temperatures do not exceed 25°C.

2-7. Cuff Inflation Systems.

Cuff inflation systems should be checked periodically for worn or damaged fittings, leaking bladder, or leaking tubing. Parts that are worn or defective should be repaired or replaced. These defects, if not corrected, will make it impossible to obtain accurate results and may result in repeated error signals.

2-8. Cuff Cleaning.

After removing the latex bladder, the cuff may be machine or hand washed. Make sure the cuff is thoroughly rinsed and then allowed to air dry.

2-9. Care and Cleaning.

Avoid dropping instrument or exposing to extremes of heat or cold which might damage electronic components. It should also be protected from exposure to water and spilled fluids.

Air circulation vents in instrument should not be obstructed by linen, clothing, or other devices when in use or plugged into AC power.

The instrument should be cleaned with a mild soap and water. Use a damp sponge or towel to clean.

CAUTION

DO NOT IMMERSE ANY PART OF THIS INSTRUMENT IN WATER. DO NOT USE ALCOHOL OR KETONES (MEK, ACETONE, ETC.) TO CLEAN.

2-10. Pen Removal Procedure.

A. Turn off power and open printer door.

B. Push the pen ejector lever to the left and the pen will fall out of the carriage.

2-11. Pen Installation Procedure.

A. Turn off power and open printer door.

B. Place pen point into hole in pen return spring then push pen body into pen retention fingers.

C. Feed leading edge of paper roll through door exit slit as door is closed.

2-12. Paper Loading Procedure.

A. Turn off power and open printer door.

B. Remove spent paper roll tube.

C. Guide the paper (with a trimmed leading edge) into printer with the left hand while turning paper drive roller clockwise with the right hand. The paper should unroll in a clockwise direction.

D. Place roll on paper spindle.

E. Feed leading edge through slot in door before closing door.

2-13. Preparation for Storage or Shipment.

It is recommended that the original shipping box and packing for the LS 200 be saved for later use in storage or shipment.

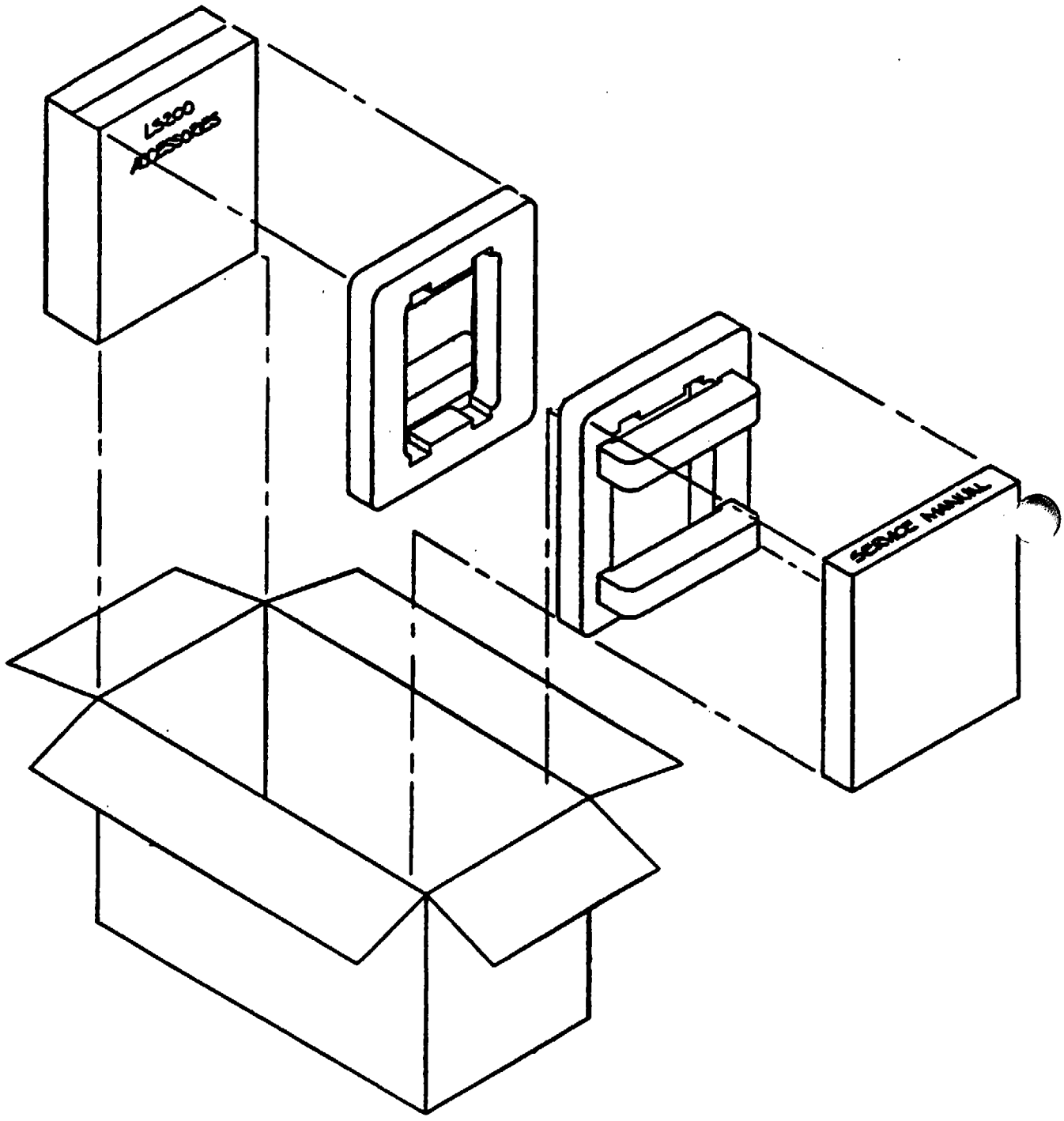

FIGURE 2-8. PREPARATION FOR STORAGE OR SHIPMENT

SECTION 3
TESTING AND TROUBLESHOOTING

3-1. GENERAL

This section will guide the user in a sequential fashion from routine, system-level test and calibration procedures to the identification of faulty circuits in the LIFESTAT 200. Included are Functional Testing and Calibration, Troubleshooting Guide and Signature Analysis. Functional Testing and Calibration provide complete test and calibration procedures for the major circuits in the LIFESTAT 200. The Troubleshooting Guide references malfunctions discovered during the functional test to specific circuits or components. Signature Analysis provides a means of troubleshooting the digital circuits.

CAUTION

SOME PCB ASSEMBLIES IN LIFESTAT 200 CONTAIN STATIC SENSITIVE DEVICES (SSDs). REFER TO SECTION 5 AND USE SPECIAL HANDLING PROCEDURES.

3-2. TEST EQUIPMENT

Test equipment suitable for maintenance and calibration of the LIFESTAT 200 are listed in Table 3-1. Although specific, commercially available test instruments are recommended, OTHER TEST EQUIPMENT WITH EQUIVALENT SPECIFICATIONS MAY BE USED.

TABLE 3-1

TEST EQUIPMENT

NOMENCLATURE	CHARACTERISTICS	MANUFACTURER
Oscilloscope	100 MHz Dual Trace	Hewlett Packard 1741A
Digital Multimeter	3 1/2 Digit Accuracy: 0.5% of full Scale on dcV and resistance ranges, 1% of reading on acV.	Fluke 8000A
Frequency Counter		Fluke 1900A
Mercury Manometer	340 mmHg minimum	
Signature Analyzer		Hewlett Packard 5006A
Aspirator bottle (PCC #50973-02)	1/2 gallon or 1900 ml	Cole Parmer Instrument Co. Catalog TJ6080-20

3-3. TEST SET-UP

The procedures in this section require that the unit be in the test configuration, as shown in Figure 3-1. The test equipment connections are indicated. To disassemble the unit to this level, refer to paragraph 4-5.

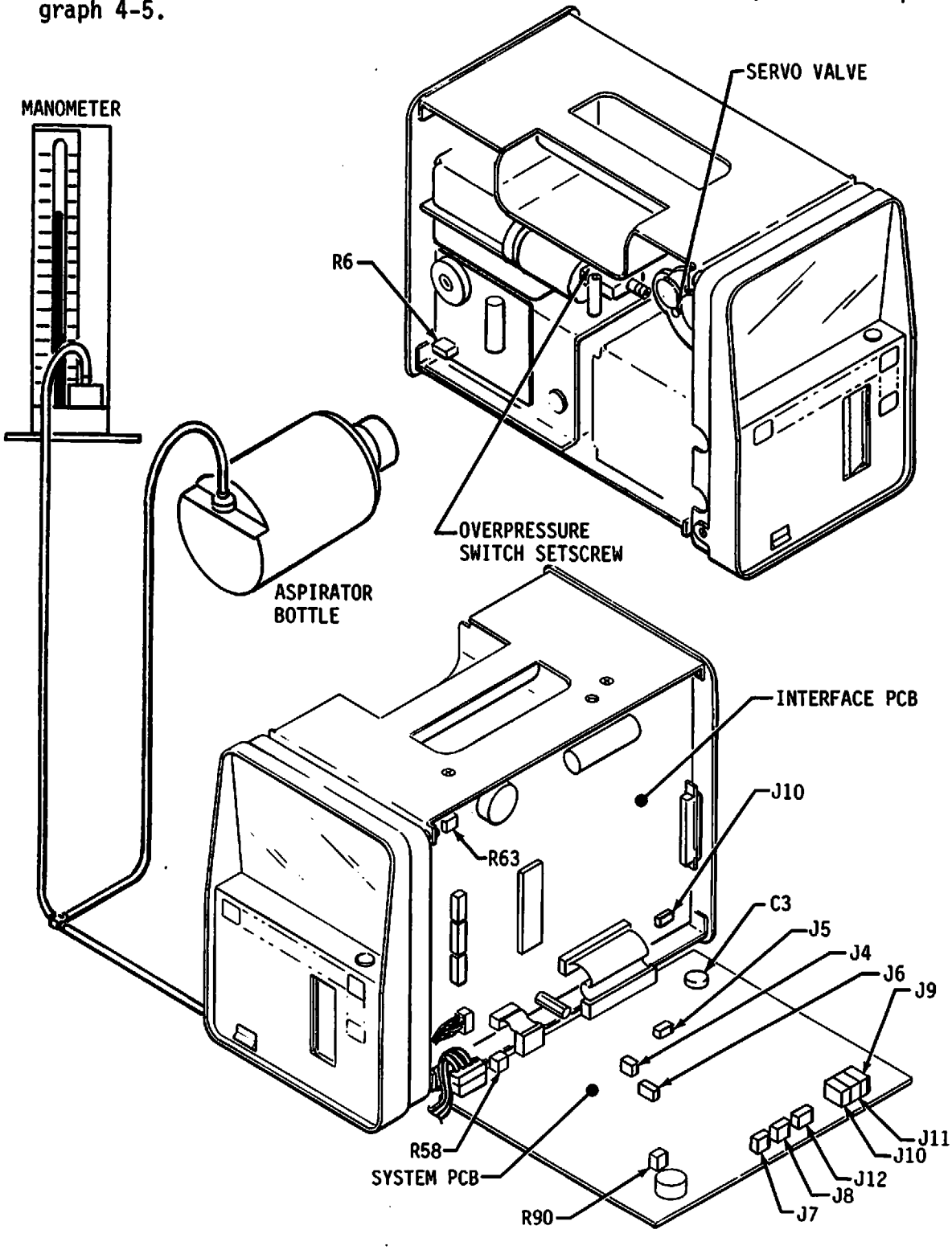

FIGURE 3-1. TEST CONFIGURATION

3-4. FUNCTIONAL TEST AND CALIBRATION

These paragraphs provide a complete functional test and calibration procedure for the LS 200 and may be performed as routine periodic maintenance or as a first-level diagnostic procedure. If the unit fails to pass any of the tests in this procedure and the problem cannot be remedied by calibration, proceed to paragraph 3-17 or 3-18.

CAUTION

WHEN REJOINING CONNECTORS, OBSERVE CORRECT POLARITY. MISALIGNED CONNECTORS MAY CAUSE EXTENSIVE DAMAGE TO ALL PCBs.

3-5. Power Supply Tests.

A. Disconnect power cord.

B. Disconnect harnesses from J1 and J3, Charger PCB. Verify that Filter Capacitor (Item 15, Figure 5-1) is wired correctly. See Figure 5-2.

C. Reconnect power cord.

D. Verify that dc voltage across TP9(+) and TP8(-) is +9.8 ± 0.1Vdc. Adjust R6, Battery Charger PCB, as necessary (see Figure 3-1).

E. Verify that dc voltage across TP1(+) and TP2(-) is 28 ± 2Vdc.

F. Using TP8 for ground, place oscilloscope probe at TP3 (switching drive to Q1 and Q2). NOTE: For the 802596-02 and -03 Battery Charger bare boards only, place the oscilloscope probe at the base of Q3 or at the R2-R16 junction. Verify that waveform obtained is 55 ± 5kHz (pulse width 18 ± 2µS).

G. Verify that voltage drop across TP2(-) and TP8(+) is 7 ± 2mV. Leave voltmeter in place.

H. Observing polarity (fins on plug go toward clip), reconnect battery harness to J3.

I. Verify that with battery connected, voltage across TP2(-) and TP8(+) increases by no more than 220mV. Leave voltmeter in place.

J. Insure that power switch is off and reconnect Interface PCB/Battery Charger PCB Harness at J1, Battery Charger PCB.

K. Turn on power switch. Verify that voltage drop across TP2(-) and TP8(+) does not exceed 220mV.

L. After the unit has completed its power on tests (the "888"s on the Display have been blanked) remove connector at J3 on Charger PCB. Verify that voltage across TP2(-) and TP8(+) is 60 ± 20mV.

NOTE: The following error messages will be displayed if a memory or communication error occurs during power on self tests:

"err 1": Internal (to chip) 6805 RAM error
"err 2": External 6805 RAM error
"err 3": Cyclic Redundancy Check (CRC) error of 6805 EPROM
"err 4": RAM or EPROM error on 6809
"err 5": No communication between processors
"err 6": Pressure (greater than 15mmHg) in cuff at power on

Any malfunction noted by an error message must be corrected before proceeding with the functional test. Refer to paragraph 3-19.

M. With J3 still disconnected, place voltmeter across TP9(+) and TP8(-). Adjust R6 on Charger PCB until voltage across test points is 7.80V.

N. Monitor U24, pin 4, on Interface PCB (part of Low Battery Detect circuitry). Use TP1 on Interface PCB for scope ground.

Adjust R63 until U24, pin 4, transitions from low to high. Verify that slight adjustment of R6 on Charger PCB causes U24, pin 4, to be low at 7.85V and high at 7.75V measured across TP8 and TP9.

Verify that LOW BATTERY is illuminated when U24, pin 4, is high.

NOTE: If LOW BATTERY LED is left active for more than 5 minutes, the LS 200 will execute a software controlled shut-down. To reinitialize the unit turn the power off, adjust R63 1 or 2 turns clockwise, then turn power on.

CAUTION

IN THE FOLLOWING TWO STEPS, O AND P, WHEN ADJUSTING R6, CHARGER OUTPUT VOLTAGE MUST NOT EXCEED 9.9V.

O. First adjust R6 so that the LOW BATTERY LED is off, then turn potentiometer R6 until the LED remains on. Then cycle ac power and wait until the "888"s display blanks.

Verify that unit shuts off after 10 seconds and will not respond to any front panel controls except the power switch.

P. Turn R6 1 or 2 turns clockwise and cycle the power switch on. Readjust R6 for 9.8 ± 0.1V between TP9(+) and TP8(-). Verify that output of U24, pin 4, is now low and that LOW BATTERY LED is off.

Q. Verify that Charger PCB output voltage at J1, pin 5, is 10.5 ± .4Vdc.

R. Turn off LS 200. Reconnect battery to Charger PCB at J3.

3-6. Systems Connector.

Turn LS 200 on and monitor Systems Connector, pin 2. Verify that a pulsed 24 ± 3V p-p square wave is present after the "888"s display has blanked.

NOTE: Self-Test Procedures. The LS 200 is equipped with test software that exercises the circuits in ways that facilitate diagnosis and calibration. The unit is placed in self-test mode by pressing simultaneously START/OVERRIDE, STOP/DEFLATE, and ALARM SEL. This causes "tSt" to appear in the HIGH ALARM display and a "1" to appear in the LOW ALARM display, verifying that the unit is in Test 1 mode. Repeated or sustained pressure on MODE SELECT then selects Tests 2, 3, 4, and 5 successively.

During these tests, the LED displays are used as diagnostic windows. The various parameters being displayed are noted in each paragraph.

3-7. Test 1: Display System and Alarm Audio.

A. Simultaneously press START/OVERRIDE, STOP/DEFLATE, and ALARM SELECT. Verify that "tSt 1" appears in the alarm limit display.

B. Verify that all 7-segment LEDs count from 0 to 9 and then blank. Verify that all bar LEDs are alternately turned on and off except AC MAINS which remains on.

C. Press the ALARM SELECT button and verify that the audible alarm is turned on. Verify that volume is not adjustable from the rear panel control.

D. Press ALARM SILENCE to shut off alarm.

3-8. Test 2: A/D Converter.

A. Press the MODE SELECT switch until "tSt 2" appears in alarm limit display. The red LED displays should appear as follows:

SYSTOLIC	MEAN	
000	0XX	(An "X" indicates any numeric value from 0 to 9.)
DIASTOLIC	PULSE	
XXX	0XX	

B. Adjust R58 System PCB (see Figure 3-1) for a reading of -1.00 ± .05Vdc at TP12. TP16 on System PCB is ground. Press STOP to auto zero the system.

C. Connect a manometer and a 1/2 gallon aspirator bottle (see Table 3-1) to the front panel Luer fitting as shown in Figure 3-1. Zero the manometer. Press START switch.

D. Verify that the pump pressurizes the system until SYSTOLIC display reads approximately 215 and that pump is turned on briefly each time display drops below 215.

E. Adjust R90 System PCB so that the manometer reads 215mmHg at its lowest point.

F. Press STOP and repeat steps C, D, and E until R90 needs no further adjustment.

G. Press STOP. Allow the system pressure to drop to zero, then verify the following readings:

SYSTOLIC display reads 000 (raw cuff pressure with offset).
DIASTOLIC display reads 150 ±25, and is stable within ± 2 (pulse channel).
MEAN display reads 040-050 (true cuff pressure).
PULSE display reads 080-100 (twice true cuff pressure).

H. Press START again. Wait until 215mmHg (manometer) is reached and verify that PULSE display reads 409.

I. Press HIGH LIMIT up (right side). The CUFF LED should turn on.

Verify that DIASTOLIC display reading returns to its static value within 1 second each time the pump is activated.

J. Press HIGH LIMIT down (left side). The CUFF LED should turn off and DIASTOLIC reading should be shown to stabilize (within 3 seconds) each time the pump is activated.

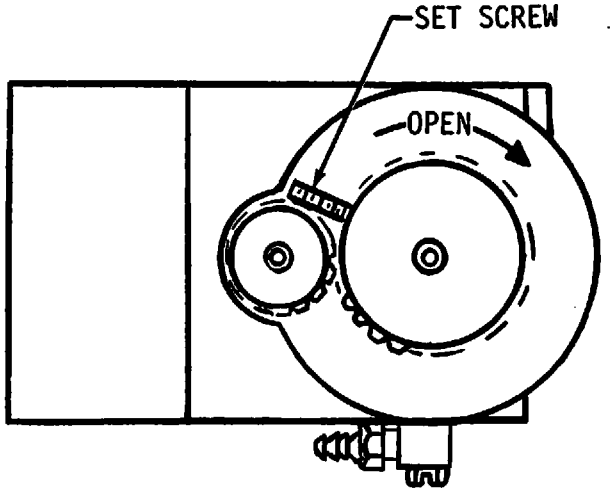

FIGURE 3-2. LINEAR BLEED SERVO VALVE

3-9. Test 3: Static Leakage.

NOTE: For some of the following tests, the open or closed position of the servo valve must be determined. This assembly is located behind the handle-mounted filter capacitor. See Figures 3-1 and 3-2. Note also that if the Servo Valve Assembly is malfunctioning it must be returned to the factory for service.

A. Press the MODE SELECT switch until "tSt 3" appears in alarm limit display.

Verify that servo bleed valve is closed completely. The large gear set screw should be in contact with the small gear wheel. See Figure 3-2.

B. Press START. The pump should pressurize system to 250 ± 2mmHg (shown in MEAN display) and stop. The ELAPSED TIME display should then activate.

Verify that after 30 seconds, the pressure reading in SYSTOLIC display is greater than 210.

C. Press STOP. After the display has initialized, press HIGH LIMIT up (right side).

Verify that servo valve opens about 1/4 turn (see Figure 3-2) and that CUFF LED turns on.

Note that pressing HIGH LIMIT down (left side) will close servo valve completely and CUFF LED will be turned off.

D. With servo valve open 1/4 turn, press START again to reinflate to 250. Verify that after 30 seconds on ELAPSED TIME, the SYSTOLIC display is greater than 160.

E. Press STOP and wait for display to initialize. This test verifies the failsafe timeout, the time from start of pump until the dump valve opens to depressurize the system. Use a stopwatch or equivalent to perform this test, NOT the ELAPSED TIME display.

Simultaneously press START and begin stopwatch timing. Verify that pressure is dumped at 128 ± 5 seconds.

F. Press LOW LIMIT down (left side) to select a threshold of 150mmHg. The DIASTOLIC display changes from 250 to 150.

Press START. After pressure reaches 150 (shown on MEAN display), press STOP and verify that pressure rapidly returns only to less than 10mmHg on manometer within 30 seconds. (Note: valid only with the specified aspirator bottle volume.)

3-10. Test 4: Overpressure Switch.

A. Press MODE SELECT switch until "tSt 4" appears in alarm limit display. SYSTOLIC display should read "000." DIASTOLIC should read "350."

B. Press START. Observing the manometer, verify that the pump halts and the dump valve opens between 320 and 330mmHg.

Adjust set screw at top rear of overpressure switch as required.

NOTE: To adjust set screw, first remove Handle Assembly (see paragraph 4-5). This is a very sensitive switch. Adjustments should be less than 1/8 turn. Turn set screw clockwise to increase trip point. Remove manometer connection and allow pressure to return to zero between trip point checks.

C. After the overpressure switch has been adjusted if necessary to a trip point between 320 and 330mmHg on the manometer, press START. Verify that at trip point the SYSTOLIC display reads higher than 290.

3-11. Test 5.

Disregard Test 5 displays. Test 5 is for factory use only.

3-12. Additional Pressure Systems Tests.

A. To return LS 200 to normal operating mode, turn unit off then on. Verify that after the "888" display blanks the MANUAL LED remains on.

B. Press and hold the START switch. The pump should run rapidly until the MEAN display reads 50 and then slow down as system pressure is increased.

Verify that the pump stops at 290 +10mmHg/-15mmHg (shown on the MEAN display) and that the overpressure switch does not trip.

C. Press the STOP switch. Verify that the ABORT LED is on and that pressure rapidly returns to zero.

D. Press START again and release it.

Verify that the system pumps up to 180 +10mmHg/-15mmHg (on MEAN display) within 12 seconds. (Note: valid only with the specified aspirator bottle volume.)

E. Allow pressure to decrease the 150mmHg then press STOP switch. Verify that the pressure drops to less than 10mmHg within 30 seconds.

F. Press and hold START switch until manometer reads approximately 225 mmHg, then release. Verify that time required to reduce pressure from 150mmHg to 100mmHg (on MEAN display) is 10-17 seconds.

G. Verify that after the pressure has bled down to 15mmHg, the SYSTOLIC, DIASTOLIC, PULSE, and MEAN displays are all dashes and that the ARTIFACT LED turns on.

H. Verify that the LS 200 automatically executes a retry inflation that pressurizes the system to 255 +10mmHg/-15mmHg.

I. Verify that the time required to deflate from 150 to 100mmHg is 12 to 25 seconds.

J. Verify again that the pressure is bled down to 15 and that displays again show dashes and the ARTIFACT and ABORT LEDs turn on.

K. Push ALARM SELECT switch five times in succession. Verify that the front panel alarm limit LEDs display 30 for the LOW limit and 260 for the HIGH limit. Verify that the bar LEDs cycle as follows:

SYS
MEAN
DIAS
SYS and DIAS
All Off

L. Push ALARM SELECT again. Verify that the LOW LIMIT up and down switches cycle the LOW limits display from 30 to 160 and back to 30. Verify that the HIGH LIMIT down and up switches cycle the HIGH alarm limit from 260 to 50 and back to 260.

3-13. Real Time Clock Set/Check.

A. Turn off the LS 200. Adjust if necessary C3 on System PCB to set real time clock oscillator to 32.768kHz ± 5Hz at U1, pin 8. Use TP10 on System PCB for frequency counter ground.

B. Turn the LS 200 on. Set the real time clock as follows (printer units only):

1. Open the printer door.

2. Press the SELECT switch to advance through the date/time functions indicated next to switch.

3. At each function use the SET switch to set that function to the current date and time. This will appear in the ELAPSED TIME window on the front panel.

4. Press the SELECT switch once more to blank the date/time functions display.

5. Placing the J5 jumper (System PCB) in 1-2 position will cause the printer to annotate in 24 hour clock mode. Moving the J5 jumper to 2-3 position results in 12 hour clock annotation. An "A" or "P" following the time indicates AM or PM when in 12 hour clock mode.

C. For an LS 200 without printer the real time clock may be set via the rear panel systems connector.

1. Build a Clock Set Fixture as shown in Figure 3-3 and connect it to the systems connector as indicated.

2. Using the "SELECT" switch on the clock set fixture select each clock function (month, day, year, hour, minute). Using the "SET" switch on the fixture set each function to the current date and time.

3. When finished, press the "SELECT" switch one more time to blank the time display.

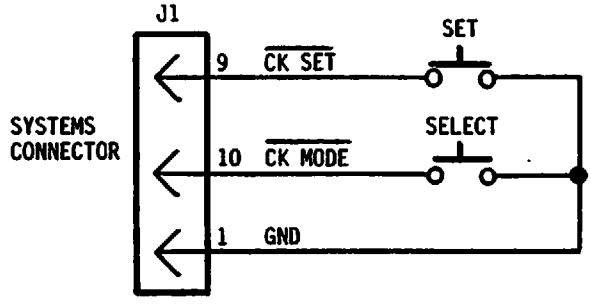

FIGURE 3-3. CLOCK SET FIXTURE

3-14. Printer.

A. Printer Self-Test. Set jumper J10 on Interface PCB to test position (2,3). Turn unit on and immediately return jumper to normal position (1,2). Failure to return jumper to normal position will cause continuous paper advance following test. The printer should draw a square and then print its character set in three lines. Verify that all characters are legible.

B. Press the PAPER ADVANCE switch for about 2 seconds. Paper should advance as long as the switch is pressed. No printing should occur.

C. Press PRINTER switch. Verify that PRINTER ON LED turns on and that printer does not run.

D. Press PRINTER switch again. Verify that PRINTER ON LED turns off and that about 3/4" of unprinted paper is advanced through printer.

NOTE: There are additional printer tests in the following paragraph 3-15.

3-15. Pulse, Alarms and Printer.

A. Press ALARM SELECT switch. Verify that SYS is illuminated and that HIGH alarm displays 260 and LOW alarm 30.

Verify that repeated or sustained pressure on ALARM SELECT switch successively selects SYS, MEAN, DIAS, SYS/DIAS, off.

B. Place pressure cuff snugly around arm with the "Ø" over the brachial artery. (For convenience, the cuff may be fastened around itself and slipped onto the arm like a sleeve.)

NOTE: Since a test fixture is not being used to check pulse and alarms, there may be reasons other than unit malfunction that are responsible for noncompliance with test specifications.

C. Turn the volume potentiometer on rear panel fully clockwise.

D. For units with printers, turn printer on.

E. Press MODE SELECT to place unit in 1 minute mode. Press START and allow unit to run through two complete measurements. Verify that the decimal point LED to the right of least significant digit in PULSE display flashes with each pulse and that an audible beep is simultaneously heard.

Verify also that the printer records the results and draws trend lines between first and second readings.

F. Set ALARM SELECT mode to SYS and DIAS. Press HIGH ALARM down switch to set systolic alarm approximately 20 points lower than the systolic pressure reading just obtained. Press LOW ALARM up switch to set diastolic alarm approximately 20 points higher than diastolic reading. (This is done so that an alarm condition will exist during the next BP measurement.)

G. Press MODE SELECT to place unit in MANUAL mode. Press START. Verify that at completion of measurement both SYSTOLIC and DIASTOLIC displays are flashing (if measured values violate alarm levels) and that alarm sounds.

Verify that volume potentiometer on rear panel has no effect on the alarm volume or pitch. Press ALARM SILENCE and verify that alarm stops, but that displays continue to flash.

Verify that printer has bracketed the alarmed values.

H. Press STOP. Press PRINTER to turn off printer.

I. Depress all front panel switches and verify that with the volume pot fully counterclockwise no audible beep is heard, and that with the pot fully clockwise an audible beep is present.

3-16. Ground Continuity.

A. Turn off LS 200. Verify that all displays are off except AC MAINS.

B. Unplug the ac line cord. Verify that AC MAINS LED is off.

C. Connect the leads of a DVM together and zero the instrument on its lowest scale. Measure the resistance from the third wire ground pin on the ac input jack to chassis ground. Verify that resistance is less than or equal to 0.1 ohms.

NOTE: This completes the unit functional test and calibration. Paragraphs 3-19 through 3-25 give detailed instructions for testing the System PCB and the Interface PCB.

3-17. FAULT ISOLATION

Table 3-2 references key failed tests in the Functional Test and Calibration Procedure to the major assembly or assemblies most likely to be at fault. It is assumed that the unit has passed every test in the sequence prior to the failed test in question.

TABLE 3-2

FAULT ISOLATION

TESTS	STEPS FAILED	SUSPECTED ASSEMBLY
POWER SUPPLY	3-5: D-G	Battery Charger PCB
	I	Battery Charger PCB Battery Pack
	K	Battery Charger PCB Wire Harness W4
	L	Display PFC System PCB
SYSTEMS CONNECTOR	3-6	Interface PCB System PCB
TEST 1	3-7	Display PCB System PCB Interface PCB Door Membrane Switch
TEST 2	3-8	System PCB Interface PCB Pump/Tubing Set Servo Valve Assembly

TABLE 3-2 (Continued)

FAULT ISOLATION

TESTS	STEPS FAILED	SUSPECTED ASSEMBLY
TEST 3	3-9	Servo Valve Assembly Pump/Tubing Set System PCB
TEST 4	3-10	Overpressure Switch
PRESSURE SYSTEM	3-12	System PCB Interface PCB Pump/Tubing Set Servo Valve Assembly
REAL TIME CLOCK	3-13	System PCB Date/Time Membrane Switch Interface PCB Printer
PRINTER	3-14	Interface PCB System PCB Printer
PULSE, ALARMS	3-15: D	System PCB Interface PCB Display PFC
	E,F	Interface PCB System PCB Rear Panel Potentiometer (Part of W1)
CONTINUITY	3-16: A	Display PFC
	B	Battery Charger PCB
	C	Input Connector Battery Charger PCB

3-18. TROUBLESHOOTING GUIDE

Table 3-3, Troubleshooting Guide, references failed tests in the Functional Test and Calibration Procedure to probable faults in the equipment. No attempt is made to cover all possible failure modes or all possible causes for the failure in question. The Troubleshooting Guide is intended only as a supplement to the technician's diagnostic skills and his or her use of the circuit descriptions and schematics provided in this manual. The component reference diagrams in Section 6 are provided as an additional troubleshooting aid.

TABLE 3-3

LS 200 TROUBLESHOOTING GUIDE

SYMPTOM	PROCEDURE
CHARGER PCB TEST	
1. Voltage across TP1 and TP2, Charger PCB, not 28 ± 2V.	1. Disconnect Transformer at J2, Charger PCB (A14) and check secondary for 20Vac. If 20Vac is not present, suspect Transformer or off-board capacitor. If 20Vac is present, proceed to next step. 2. Check C1, Charger PCB (A14). 3. Check CR1, Charger PCB (A14).
2. Voltage across TP9 and TP8, Charger PCB, not to specification (+9.8 ± .1Vdc) or not adjustable via R6.	1. Check U1, Charger PCB (A14).
3. Waveform at TP3, Charger PCB, not to specification (55 ± 5kHz).	1. Check U1, C7, and tolerance of R13, Charger PCB (A14).
4. Voltage across TP2 and TP8 not to specification (7 ± 2mV) with battery and unit's other electronics disconnected.	1. Check tolerance of R3, Charger PCB (A14).
5. No voltage across J3-1 and 2 with P1 disconnected.	1. Check F1, Charger PCB.
6. Unit does not perform power up sequence as described in paragraph 3-5L.	1. If "ERR 1" appears, a 6805 internal RAM failure is indicated. Refer to paragraph 3-19.

TABLE 3-3 (Continued)

LS 200 TROUBLESHOOTING GUIDE

SYMPTOM	PROCEDURE
CHARGER PCB TEST (Continued)	
	2. If "ERR 2" appears, a 6805 External RAM failure is indicated. Refer to paragraph 3-19. 3. If "ERR 3" appears, a CRC (cyclic redundancy check) error of 6805 EPROM is indicated. Refer to paragraph 3-19. 4. If "ERR 4" appears, a 6809 RAM and/or EPROM failure is indicated. Refer to paragraph 3-19. 5. If "ERR 5" appears, 6809 is not responding to 6805 query. Refer to paragraph 3-19. 6. If "ERR 6" appears, the cuff pressure is greater than 15mmHg. Deflate cuff.
7. Load voltage across TP9 and TP8, Charger PCB, not adjustable to +7.80Vdc at R6.	1. Check R6, Q2, U1, Battery Charger PCB.
8. U24 does not respond to changes in Charger PCB voltage.	1. Check U24, Interface PCB, by substitution. 2. If no change is observed, check R63, R64, and R67, and C9, Interface PCB.
9. LOW BATT does not come on when U24, pin 4, is high.	1. Check U18, U10, Interface PCB; U12, System PCB, by substitution. 2. Check DS17, Display PCB.

TABLE 3-3 (Continued)

LS 200 TROUBLESHOOTING GUIDE

SYMPTOM	PROCEDURE
SYSTEM CONNECTOR CHECK	
1. +5Vdc not present at J1 pins 6 and 20 when unit is turned on.	1. Check R46 and RV12 Interface PCB (A5).
2. Pump does not run when +8V pump power threshold at J1, pin 14 is reached.	1. Check Pump (A3) for mechanical or electrical defects.
SELF-TEST PROCEDURES	
1. Test 1.	
a. Display segments missing.	1. If only one LED is affected, check LED on Display PCB (A2). 2. If all LEDs are affected, check U11, Interface PCB (A5).
b. Alarm does not sound.	1. Check CR20, R51, R52 and X1 Interface PCB.
2. Test 2.	
a. 1.00 ± .05Vdc cannot be obtained at TP12, System PCB, by adjusting R58, System PCB.	1. Check U38, System PCB (A1), output for +10Vdc. 2. Check pressure transducer. 3. Check U34, System PCB (A1). By adjusting R58, voltage at U28, pin 7, (TP12) should cross -1.0 ±.05Vdc. U34 can have large dc offsets inherent in chip design.
b. PULSE display does not equal twice MEAN display in paragraph 3-8G.	1. Check U37B, pin 7, System PCB, for -2Vdc ± 100mV. If specified voltage is not present, check C22, R61, R82 and U37. 2. If U37B, pin 7, is at -2Vdc ± 100mV, suspect failure in A/D Converter (U29,U30,U31,U32,U37).

TABLE 3-3 (Continued)

LS 200 TROUBLESHOOTING GUIDE

SYMPTOM	PROCEDURE
SELF-TEST PROCEDURES (Continued)	
c. Pressure displayed on LS 200 cannot be made to agree with manometer pressure by adjusting R90.	1. Check pressure transducer.
3. Test 3.	
a. System bleeds down too fast.	1. Check for leakage in Servo Valve (A4), Overpressure Switch and Pump (A3), or internal or external tubing.
b. System bleeds down too slowly with Servo Valve open.	1. Check Servo Valve (A4) for improper adjustment or blockage.
4. Test 4.	
a. Overpressure Switch cannot be adjusted to trip at proper time.	1. Replace Overpressure Switch.
b. Pressure exceeds 290 ± 10mmHg when override is used.	1. Adjust Overpressure Switch trip point.
c. System bleeds down too fast.	1. Check for leakage in Servo Valve (A4), Overpressure Switch and Pump (A3), or internal or external tubing.
FRONT PANEL/CLOCK SET	
1. Unit does not cycle alarm limit displays as described in paragraph 3-15A, when ALARM SELECT is pressed.	1. Check RN3, U16, U17, Interface PCB (A5). 2. Check RN1A, U12 System PCB (A1).
2. High and/or Low limits do not increment and decrement in response to HIGH and LOW LIMIT controls.	1. Check RN3, U16, U17, Interface PCB (A5). 2. Check RN1A, U12, System PCB (A1).

TABLE 3-3. (Continued)

LS 200 TROUBLESHOOTING GUIDE

SYMPTOM	PROCEDURE
FRONT PANEL/CLOCK SET (Continued)	
3. Unit gives error rejection display repeatedly.	1. Kinked Hoses, Overpressure Switch.
4. Alarm does not sound	1. Check X1, CR20, CR21 on the Interface PCB.
5. Printer does not plot and trend blood pressure determinations as described in paragraph 2-10D.	1. Insure that jumper J10, Interface PCB (A5), is in normal position (pins 1 and 2 shorted). 2. Check U5 and U12, Interface PCB (A5). 3. Check U22 output, Interface PCB (A5) for +5V. 4. If problem involves horizontal or vertical plotting, check U13, Interface PCB (A5). 5. If problem involves pen contact with paper, check Q5-11, CR5, and CR6, Interface PCB (A5).
6. Real Time Clock does not respond to SELECT and/or SET controls.	1. Check RN2 and U18, Interface PCB (A5).

3-19. SIGNATURE ANALYSIS

The following signature analysis (SA) procedures provide a means of diagnosing failures involving LS 200 microprocessors and/or their associated RAM, ROM, buffers, latches, decoders, and peripheral interface devices. The jumper arrangement specified exercises the digital circuitry in essentially the same way it is exercised during the power up sequence. In signature analysis, however, the test routines continue to run as a closed loop so long as power is applied. It is then possible to obtain signatures representing recurrent signal patterns for verification purposes.

System PCB signature analysis tests follow in paragraph 3-20 through 3-24. SA tests for the Interface PCB are found in paragraph 3-25.

3-20. 6809 RAM Test.

A. Turn off the LS 200.

B. Set test jumpers as follows on the System PCB:

J9, J10 and J11 to normal position (1,2)
J4, J6, and J12 to test position (2,3)
J8 to normal (1,2)
J7 to test (2,3)

C. Configure signature analysis (SA) meter as follows: Set START for rising edge, set STOP for falling edge, set CLOCK for falling edge.

D. Connect the START and STOP lines to TP6.

E. Connect the CLOCK line to TP8.

F. Connect GROUND line to U14-1.

NOTE: Placing the ground line at other grounds may cause unstable readings.

G. Connect a separate ground line to U14-1 from probe ground pin.

H. Turn on the LS 200 unit, it will display "Err 5." Lift and replace the jumper on J12 (2,3).

I. Verify frequency at TP8 is 1.20 ± .10MHz.

J. The SA meter should read 9FFP with the probe attached to +5V.

K. Turn the LS 200 off.

3-21. 6809 EPROM Test.

A. Return test jumper J7 to normal position (1,2) and set J8 to test position (2,3).

B. Turn the LS 200 on. It will display "Err 5." Lift and replace the jumper on J12 (2,3).

C. The SA meter should read A191 at +5V.

NOTE: The gate time (the interval before a stable reading appears on SA meter) for this test is approximately 10 seconds.

D. Turn the LS 200 off.

3-22. 6805 RAM Test.

A. Reset to normal position (1,2) jumpers J4, 6, 8, 7, and 12. Short together TP10 and TP11 with a jumper. Leave jumper in place for all 6805 SA tests.

B. Setup SA meter as follows: set START to falling edge, set STOP to rising edge, and set CLOCK to falling edge.

C. Connect START and STOP probes to TP13.

D. Connect CLOCK probe to TP3.

E. Connect GROUND probe to U7-20.

NOTE: Placing ground line at other grounds may cause unstable readings.

F. Set jumper J10 to test position (2,3).

G. Turn on the unit.

H. Verify frequency of TP3 is 1.00 ± .05MHz (1.0 ± 0.5µS).

I. Verify signature on SA meter is 29F3 with the probe connected to +5V.

J. Turn the unit off.

3-23. 6805 EPROM Test.

A. Return J10 to normal (1,2) and set J11 to test position (2,3).

B. Turn on power and verify signature is U67C at +5V.

NOTE: Gate time for this test is approximately 5 seconds.

3-24. 6805 I/O Test.

A. Turn the unit off. Set J10 and J11 to the test position (2,3).

B. Turn the LS 200 on and verify the following signatures.

1. 6805 Microprocessor

U7-1	118U	12	074F	35	CU8P
2	118U	13	16F3	36	AP01
4	118U	14	074F	37	118U
5	7182	20	0000	40	118U
6	0000	29	0000		
7	16F3	30	AP01		
8	074F	31	118U		
9	118U	32	118U		
10	047F	33	0000		
11	16F3	34	0000		

2. Control Line Buffer

U6-1	0000	8	118U
2	7182	9	118U
3	7182	10	0000
4	0000	13	0000
5	0000	14	118U
6	0000		
7	0000		

3. PAL Outputs

U11-9	118U	19	16PC
10	0000	20	488A
11	1782	21	UH46
12	0000	22	4UPP
13	P7P6	23	U669
14	P7P6	24	118U
15	H6CP		
16	FAU3		
17	0000		
18	3AP2		

4. ROM Inputs

U10-1	118U
14	0000
20	U669
22	0000
27	118U
28	118U

5. COM-1 Outputs

U16-1	0000	11	2C6H
2	118U	12	FHC6
5	118U	15	0000
6	FHC6	16	118U
9	0000	19	0000
10	0000	20	118U

6. SEN-1 Inputs

U15-1	118U	11	0000
2	118U	15	118U
4	118U	17	0000
6	118U	19	118U
8	0000	20	118U
10	0000		

7. RAM Inputs

U9-12	0000
18	H6CP
20	H6CP
21	7182
24	118U

8. Real Time Clock

U8-12	0000	18	118U
13	0000	20	0000
14	7309	22	118U
15	7182	24	118U
17	309H		

9. Inverter/Buffer

U20-3	4UPP	10	0000
4	5P61	11	118U
5	3AP2	12	PFF9
6	2C6H	13	UH46
7	0000	14	118U
8	HC7F		
9	FAU3		

10. NAND Gates

U21-1	118U	8	UH46
2	118U	9	118U
3	0000	10	PFF9
4	2112	12	5P61
5	118U	14	118U
6	309H		
7	0000		

11. Real Time Clock Controls

U4-1	309H	8	118U
2	118U	9	118U
3	309H	10	118U
4	118U	14	118U
5	7309		
6	7309		
7	0000		

12. Real Time Clock AS/DS Decode

U3-3	7182	11	118U
4	0000	12	118U
5	16PC	13	557U
6	118U	14	6286
7	118U	15	2112
8	0000	16	118U
9	118U		
10	118U		

13. 6809 Address Latch

U22-1	0000	11	0000
10	0000	20	118U

14. 6809 Data Latch

U17-1	7182	19	UH46
10	0000	20	118U

15. PAL Outputs

U18-8	118U	15	UH46
9	UH46	16	118U
10	0000	17	118U
11	118U	18	PFF9
12	7182	19	118U
13	4P19	20	118U

3-25. Interface PCB Signature Analysis.

A. Turn LS 200 off.

B. Set jumpers J10 and J11 on System PCB to test position (2,3).

C. Connect at jumper between TP10 and TP11 on System PCB.

D. Configure the SA meter as follows:

Set START for falling edge, set STOP for rising edge, set CLOCK for falling edge.

E. Connect START and STOP lines to TP13 on System PCB.

F. Connect CLOCK line to TP3 on System PCB.

G. Connect GROUND to U7 pin 20 on System PCB.

NOTE: Using other grounds may cause unstable signatures.

H. Turn LS 200 on and verify the following signatures on the Interface PCB.

1. PAL Outputs

U11-20	118U		
12	1730		
13	4173		
14	5417		
15	0541		
16	9054		
17	H3C1		

2. Latch Output

U4-5 16PC

3. Printer Buffer Outputs

U5-2	4P90
5	5U1U
6	4P90
9	5U1U
12	4P90
15	118U
16	4P90
19	0000

4. Bus Buffer Outputs

U20-2	6HA8
5	6HA8
6	6HA8
9	6HA8
12	6HA8
15	6HA8
16	6HA8
19	6HA8

5. ACIA (UART)

U9-3 488A

I. Turn LS 200 off. Return jumpers J10 and J11 on System board to normal position (1,2) and remove jumper between TP10 and TP11.

SECTION 4
SERVICE AND MAINTENANCE

4-1. GENERAL

This section provides maintenance procedures for LIFESTAT 200. Included are a List of Tools and Materials, Disassembly Procedures, Inspection, Cleaning and Repair Techniques, and Assembly Procedures.

4-2. TOOLS AND MATERIALS

Following is a list of recommended tools, materials and chemicals to have available for maintenance and repair activities.

4-3. List of Tools and Materials for Cleaning Activities.

A. Vacuum cleaner.

B. Nonmetallic, soft-bristle brush.

C. Clean, lint-free cloth.

D. Dry, low pressure compressed air (60 psi).

E. Isopropyl alcohol, 99% pure (preferred solvent).

F. Ethyl alcohol, Fed-Std O-E-760, Grade 1, Class A or B.

G. Perchloroethylene.

NOTE: The above equipment and solvents are either standard shop commodities or are available from commercial sources.

4-4. List of Tools and Materials for Repair Activities.

A. Crocus cloth, available from commercial sources.

B. Solder, activated rosin-core, tin-lead wire Sn 60 or Sn 63 Type R or RMA per Federal Specification QQ-S-571d.

C. Sleeving, silicone-treated fiberglass, Class HA1 or HC1 per MIL-I-3190 or equivalent.

D. 5-Minute Epoxy - Manufactured by Devcon Corporation, 59 Endicott Street, Danvers, Massachusetts, 01923.

E. Solder Vacuum Part Number LTS13 - Manufactured by EDSYN Inc., 15954 Arminta Street, Van Nuys, California, 91406.

F. Isopropyl alcohol, 99% pure, available from commercial sources.

G. Trichloroethylene.

H. Acid brush and cotton swabs.

I. RTV Silicon Rubber, Sealant - General Electric RTV 102, White.

4-5. DISASSEMBLY PROCEDURE

The following procedures provide a logical sequence for removing the major components of the LS 200. Special disassembly notes are provided as required. Refer to Figure 5-1 drawings and parts list, the parenthetical numbers refer to item numbers.

4-6. Cover Removal.

A. Disconnect the line cord from the Rear Panel.

B. Remove four screws and lockwashers (77) (110) attaching rubber feet (28) to the Cover.

C. Remove cover grounding screw (67) and lockwasher (109) then slide the Cover off toward the rear of the instrument.

D. Disconnect the Battery Pack cable from J3 on the Charger PCB.

CAUTION

BEFORE TROUBLESHOOTING A UNIT AFTER COVER REMOVAL, RECONNECT THE BATTERY PACK FIRST THEN THE LINE CORD, IN THAT ORDER, BEFORE TURNING THE UNIT ON.

CAUTION

SOME PCB ASSEMBLIES IN LS 200 CONTAIN STATIC SENSITIVE DEVICES (SSDs). REFER TO SECTION 5 AND USE SPECIAL HANDLING PROCEDURES.

4-7. System PCB Removal.

After Cover Removal proceed as follows:

A. Remove three screws and lockwashers (75) (110) connecting the System PCB (A1) to the hinged standoffs (85).

B. Disengage the System PCB from the three locking PCB retainers (62).

C. Lower the PCB to a horizontal position and remove the connectors at J1, J2 and J3.

D. Separate the System PCB from the LS 200.

4-8. Front Bezel Removal.

After Cover Removal proceed as follows:

A. Remove two screws and lockwashers (76) (110) securing the Bottom Cover (18) to the Front Bezel (5).

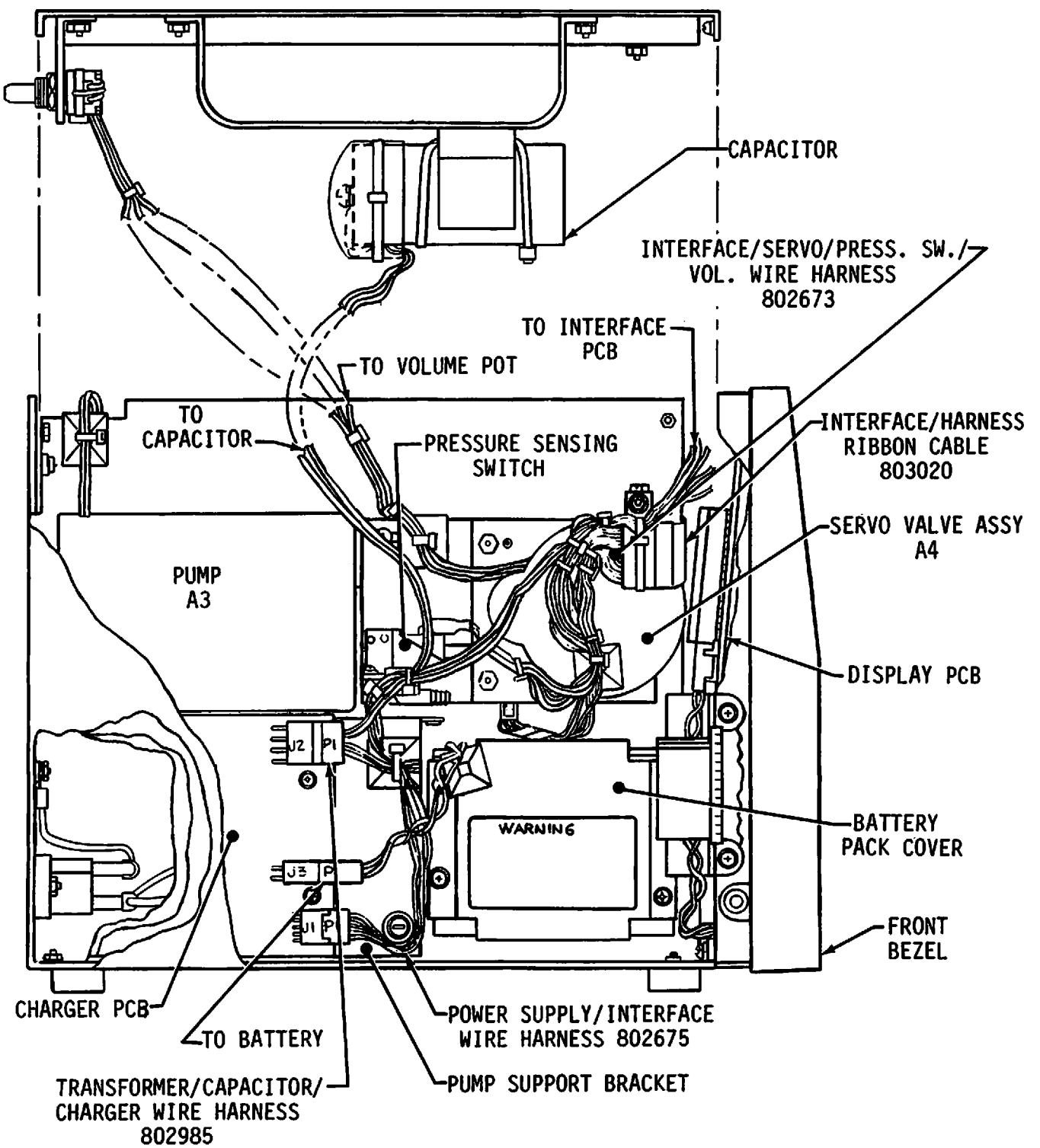

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FIGURE 4-1. WIRE ROUTING

B. Remove two screws and lockwashers (76) (110) attaching the Handle Support (10) to the Front Bezel.

C. Disconnect flex cable, ribbon cable, and wire harness connections, J7, J12 and J5, respectively on the Interface PCB (A5).

D. Cut tie wrap and disconnect tubing from Luer fitting on Front Bezel.

E. Separate the Front Bezel from the LS 200.

4-9. Display PFC Removal.

After Front Bezel Removal proceed as follows:

A. Disconnect wire harness at J2 and flex cable at J3 on Display PFC (A2).

B. Remove three screws and lockwashers (73) (112) from the Display PFC.

C. Carefully unfold the PFC and remove three additional screws, lock washers (72) (112), the Display Flex Shield (79), and the Front Display Flex Shield (80).

D. Separate the Display PFC from the Front Bezel.

4-10. Printer Removal.

After Front Bezel Removal and Display PFC Removal, proceed as follows:

A. Remove the paper from the Printer.

B. Remove three screws and lockwashers (72) (113) securing the Printer Cover (21) to the Front Bezel, then remove the Printer Cover.

C. The Printer (A7) can now be removed from the Front Bezel.

4-11. Door/Membrane Switch Removal.

After Front Bezel Removal, proceed as follows:

A. Remove two screws and lockwashers (72) (113) securing the Hinge Plate (38) to the Front Bezel.

B. Carefully remove Door and attached Membrane Switch from the Front Bezel.

4-12. Interface PCB Removal.

After System PCB Removal, proceed as follows:

A. Remove the four screws and lockwashers (76) (110) securing the Front Bezel (5) to the LS 200 and carefully angle the Bezel slightly forward, away from the Interface PCB (A5).

B. Disconnect J2, J3, J5, J7, J8 and J12 at the Interface PCB.

C. Remove the two nuts and lockwashers (51) (115) securing the PCB I.C. bracket (heat sink) to the Rear Panel (54).

D. Remove six screws and lockwashers (75) (110) securing the PCB to the Chassis (14).

NOTE: When removing Interface PCB do not allow circuit side leads of Battery (B1) to touch Chassis (14).

E. Move the Interface PCB until the Systems Connector and the I.C. bracket (heat sink) clear the Rear Panel.

F. Separate the Interface PCB from the LS 200.

4-13. Charger PCB Removal.

After Cover Removal proceed as follows:

A. Disconnect the wire harness at J1 and J2 on the Charger PCB (A6).

B. Remove two kepnuts (50) securing PCB heat sink to Rear Panel (54).

C. Remove two screws and lock washers (72) (115) securing the PCB to the Pump Support Bracket (8).

D. Hold the Pump Foam Housing (39) in place while removing the Charger PCB from the LS 200.

4-14. Handle Support Removal.

After Cover Removal, proceed as follows:

A. Remove two screws and lockwashers (76) (110) attaching the Handle Support (10) to the Front Bezel.

B. Remove two screws (68) securing the Handle Support (10) to Chassis (14) and two screws (64) attaching the Handle Support to Rear Panel (54).

C. Remove kepnut (50) securing Handle Support to Chassis.

D. To completely separate the Handle Support from the LS 200 remove two kepnuts (50) securing the Potentiometer Bracket (7), then cut the nylon cable tie (60) and slip Capacitor (13) from Retainer Clip (61).

4-15. Pump Removal.

After Handle Support Removal (Step 4-14, A and B), proceed as follows:

A. Cut the nylon cable tie connecting the Pump (A3) to the Luer "Y" fitting. Disconnect the Pump tubing at this point.

B. Disconnect the wire harness at J3 on the Interface PCB and cut retaining cable tie.

C. Remove the Foam Pump Housing (39) from the LS 200.

D. Remove the Pump from the Housing.

4-16. Overpressure Switch Removal.

After Handle Support Removal (Step 4-14, A and B), proceed as follows:

A. Cut the two nylon cable ties connecting the Overpressure Switch (88) to the Tubing Set (101) and wire harnesses. Disconnect the tubing from the Overpressure Switch fitting.

B. Remove the two terminal connectors from the Switch.

C. Remove two screws and lockwashers (74) (112) securing the Switch assembly to the Pump Support Bracket (8).

D. Separate the Switch from the LS 200.

CAUTION

THE SERVO VALVE ASSEMBLY IS NOT FIELD SERVICEABLE. THE ENTIRE ASSEMBLY MUST BE RETURNED TO THE FACTORY FOR ADJUSTMENT, CALIBRATION OR REPAIR.

4-17. Servo Valve Assembly Removal.

After Handle Support Removal, proceed as follows:

A. Remove two screws and lockwashers (74) (112) securing the Overpressure Switch (88) to the Pump Support Bracket (8). Leave terminal connectors and tubing attached and move the Switch assembly aside during the following Servo Valve Removal.

B. Cut the nylon cable tie at the Servo Valve (A4) manifold elbow fitting. Disconnect the tubing from the fitting.

C. Also cut the cable ties securing the Pressure Transducer (attached to front of manifold) and Servo Valve Assembly wiring.

D. Remove two screws and lockwashers (76) (110) securing the Servo Valve to the Chassis-mounted standoffs (82).

E. Remove one screw and lockwasher (76) (110) securing the Servo Valve manifold to the Chassis (14).

F. Disconnect the Interface/Servo Valve/Pressure Switch/Volume Wire Harness (W1) at connector P2.

G. Separate the Servo Valve from the LS 200.

4-18. Battery Pack Removal.

After Cover Removal, proceed as follows:

A. Cut the nylon cable ties attaching tubing set to the Battery Pack Cover (3).

B. Remove four screws and lockwashers (75) (110).

C. Remove Battery Pack Cover (3).

D. Separate Battery Pack (4) from LS 200.

4-19. Transformer Removal.

After Cover Removal, Handle Support Removal and Charger PCB Removal, proceed as follows:

A. Disconnect J3 on the Interface PCB.

B. Carefully lift the Foam Pump Housing (39) from the Pump Support Bracket (8) and lay it to one side.

C. Remove two screws (67) securing the Pump Support Bracket to the Bottom Cover (18).

D. Remove two screws and washers (75) (110) securing Pump Support Bracket to Chassis (14).

E. Disconnect transformer wire harness terminals.

F. Remove three screws and lockwashers (78) (114) securing Transformer (100) to the Pump Support Bracket.

4-20. INSPECTION TECHNIQUES

4-21. Exterior Visual Inspections.

Visually inspect the entire LS 200 for wear, maintenance damage, corrosion, deterioration, and damage resulting from extreme temperature, or droppage.

4-22. Interior Visual Inspection.

A. Use a minimum of five-power magnification to check components, wiring, solder joints and printed circuit conductor patterns.

B. Inspect for the following conditions:

1. Check all connectors for loose, bent or corroded contact pins.

2. Check wires, harnesses and cables for signs of wear or deterioration.

3. Inspect sleeving and tubing for proper installation or evidence of damage.

4. Inspect components and their leads for security of mounting, deterioration or leakage.

5. Check terminals and connections for proper installation, faulty soldering, loss or wear.

6. Inspect printed circuit board surfaces for charring, cracking or brittleness.

NOTE: Some degree of discoloration to the PCB surface may be expected due to continued exposure to operating temperatures of some of the components mounted thereon.

7. Check identification nameplate and other decals for legibility.

8. Inspect chassis, covers and brackets for warping, bending, surface damage or missing hardware.

9. Check all screws and nuts for tightness or signs of stripped or cross-threaded threads.

10. Check for damaged traces on PCBs. Look for lifted conductors and inspect for breaks, scratches, nicks or pinholes.

11. Check for any other form of mechanical damage which may indicate a failure.

4-23. CLEANING TECHNIQUES

4-24. General.

A. This section contains instructions for periodic cleaning of the LS 200 as a preventive maintenance measure and specific cleaning procedures to be conducted after disassembly and/or repair.

B. Parts having identical cleaning procedures are grouped under common headings.

C. No special tools are required.

4-25. Interior Cleaning.

WARNING

VENTILATE WORK AREA THOROUGHLY WHEN USING SOLVENTS. OBSERVE MANUFACTURERS' WARNINGS ON SOLVENT CONTAINERS WITH REGARD TO PERSONNEL SAFETY AND EMERGENCY FIRST AID. BE SURE FIRST AID EQUIPMENT IS AVAILABLE BEFORE USING CHEMICALS.

WARNING

OBSERVE SHOP SAFETY AND FIRE PRECAUTIONS. VENTILATE ALL WORK AREAS WHERE SOLVENTS ARE USED. STORE SOLVENTS AND SOLVENT SOAKED RAGS IN APPROVED CONTAINERS. REFER TO MANUFACTURERS' INSTRUCTIONS ON CONTAINERS FOR RECOMMENDED FIRE FIGHTING PROCEDURES AND NOTE THAT FIRE FIGHTING EQUIPMENT IS AVAILABLE.

A. Magnetics.

Clean transformers and inductors with a dry nonmetallic soft-bristle brush.

CAUTION

DO NOT USE SOLVENTS TO CLEAN TRANSFORMERS OR INDUCTORS. THE CHEMCIAL ACTION OF SOLVENTS MAY REMOVE THE VARNISH FROM THE WIRE COILS, RENDERING THE COMPONENT USELESS. THE SOLVENT ALSO NEUTRALIZES THE ADHESIVE OF THE COVER TAPE, RESULTING IN EVENTUAL TAPE SEPARATION FROM THE WINDINGS.

B. Printed Circuit Boards.

CAUTION

SOME PRINTED CIRCUIT BOARD ASSEMBLIES IN THE LS 200 CONTAIN STATIC SENSITIVE DEVICES. USE STATIC SENSITIVE DEVICES  (SSDs) SPECIAL HANDLING PROCEDURES.

1. Clean assembled parts with a vacuum cleaner or low pressure compressed air (60 psi).

2. Prior to soldering, clean surfaces with nonmetallic, soft-bristle brush dipped in solvent.

3. Dry with low pressure compressed air.

CAUTION

TAKE CARE WHEN CLEANING PRINTED CIRCUIT BOARDS THAT WIRES OR COMPONENT LEADS ARE NOT BENT BACK AND FORTH IN SUCH A MANNER TO WEAKEN THEM AND CAUSE THEM TO EVENTUALLY BREAK.

4. Remove excess solder from solder joints and chassis components after repairs.

C. Metallic and Plastic Parts.

1. Brush all surfaces and parts with a nonmetallic, soft-bristle brush.

2. Wipe metal surfaces with soft, nonabrasive cloth dampened with isopropyl alcohol.

CAUTION

DO NOT WIPE OVER SURFACES OF NAMEPLATES OR LABELS WITH ABRASIVE CLEANERS OR MATERIALS, AS THIS WILL EVENTUALLY WEAR AWAY THE NAMEPLATE INFORMATION.

CAUTION

DO NOT USE SOLVENTS TO CLEAN PLASTIC PARTS.

3. Dry cleaned surfaces with clean cloth.

4. Wipe surfaces of nameplates and labels with clean dry cloth.

4-26. Exterior Cleaning.

Case and Display. Use soap and water to clean external covers and line cord. Do not use alcohol, solvents, or cleaning solutions. These cleaning agents may damage the surfaces of the instrument.

4-27. REPAIR TECHNIQUES

4-28. General

A. Instructions contained in this section provide the information necessary to return the LS 200 unit and its subassemblies to serviceable condition.

B. Conduct the necessary level of disassembly and inspection to identify all areas requiring repair.

C. Before removing an assembly for repair or replacement, label each lead or draw a sketch showing the location of cables and wires.

4-29. Repair Procedures.

NOTE: Repair procedures contained here are recommended only as an alternative to complete assembly replacement.

4-30. General.

A. Do not attempt to straighten bent connector pins or chassis frame members unless the bending or warpage is slight. Parts damaged beyond this level should be replaced.

B. PCB installed components are normally nonrepairable and must be replaced when found faulty.

4-31. PCB Component Replacement.

A. Replace all electronic components not meeting the requirements outlined in Testing and Calibration.

B. Replace electrical wire as required with wire of same length, color and gage as that being replaced. Install the terminations identified on the applicable wire list.

C. Remove excess solder from pad by wicking or vacuuming.

D. Grasp the component with pliers and use a 60 watt soldering iron to remove components from circuit board, being careful not to lift solder pads.

CAUTION

WHEN INSTALLING COMPONENTS ON PRINTED CIRCUIT BOARD, REFER TO TRANSISTOR INDEXING, TAB POSITIONS, DIODE MARKINGS, CAPACITOR POLARITIES ILLUSTRATED IN SECTION 5 COMPONENT LAYOUTS.

E. Bend new component leads to fit mounting solder pads on PCB and trim leads to desired length. Be sure component is oriented in the proper polarity position and install it on the board, then solder in place.

NOTE: On heat sink mounted components, verify the isolation between the component tab and the heat sink with an ohmmeter before soldering the leads.

CAUTION

USE A HEAT SINK WHEN SOLDERING DIODES AND TRANSISTORS, AND USE A MINIMUM OF HEAT WHEN SOLDERING COMPONENTS TO PRINTED CIRCUIT BOARDS.

F. Clean residual flux from soldered areas with an acid brush and isopropyl alcohol then dry with compressed air.

G. Test before reassembly.

4-32. Repair Of Damaged Or Defective Conductor. A damaged conductor may be a complete break or scratches, nicks, or pinholes which reduce the cross-sectional area of the conductor beyond original design specifications (See Figure 4-2).

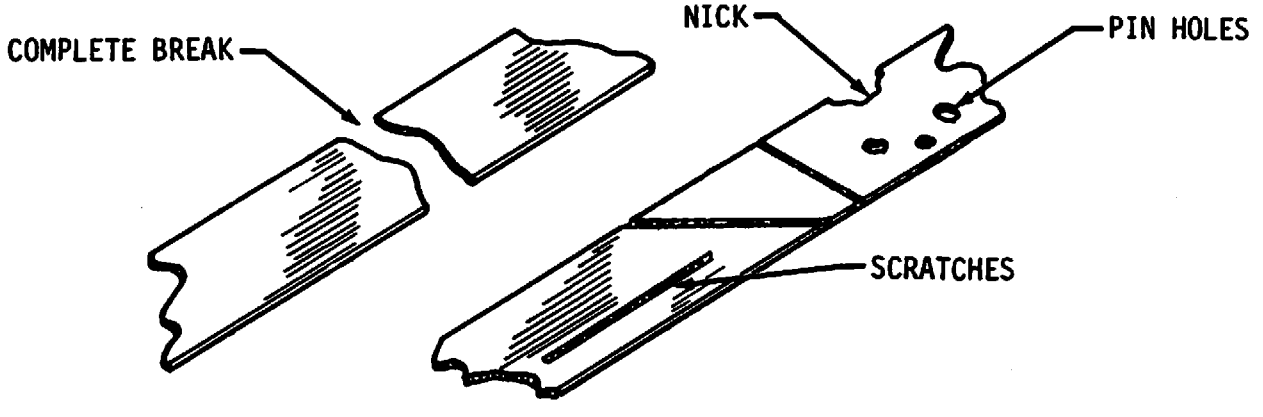

FIGURE 4-2. TYPICAL PRINTED WIRING DAMAGE

NOTE: Repair should be limited to two repairs per board. The damaged section of the conductor should not exceed five times the conductor width.

A. Clean both sides of break in conductor, at least 1/4 inch on each side, with a rubber eraser, then clean with an acid brush and isopropyl alcohol.

B. Cut a piece of 22 or 24 gage solid, tinned copper wire a minimum of 1/4 inch longer than the break. The wire may optionally be flattened by placing it between smooth metal plates and pressing with a bench vise.

C. Hold the wire on the centerline of the conductor, across the break, and solder in place (See Figure 4-3).

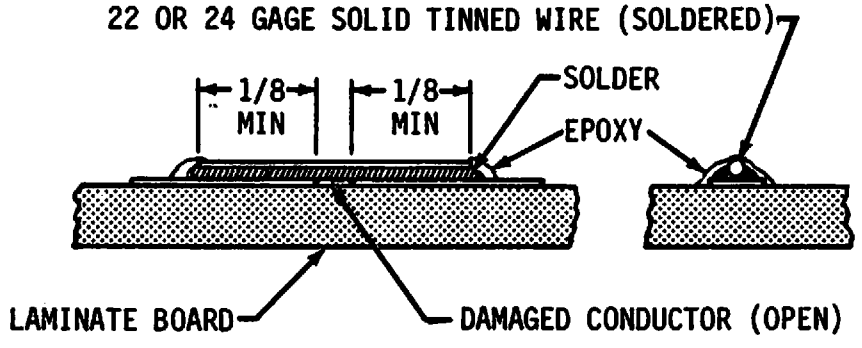

FIGURE 4-3. REPAIRING DAMAGED CONDUCTOR

D. Remove solder flux with cloth dampened with isopropyl alcohol and dry with compressed air.

E. Flow a small amount of 5-minute epoxy cement over the entire repair and allow to dry at room temperature for 15 minutes.

4-33. Repairing Lifted Conductors. A lifted conductor is present when a portion of the conductor is separated from the PC board surface, but is not broken (See Figure 4-4).

A. Rinse area to be repaired with isopropyl alcohol and dry with compressed air. Be sure that underside of lifted conductor is clean and remove any obstacles which prevent the lifted conductor from making total contact with the substrate surface.

B. Apply 5-minute epoxy to surface of lifted conductor and to a distance of at least 1/8 inch in all directions from the damaged area.

C. Dry at room temperature for one hour.

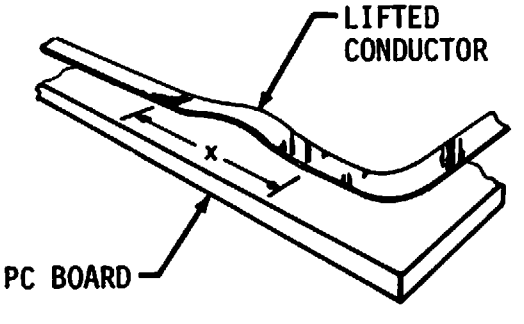

FIGURE 4-4. TYPICAL LIFTED CONDUCTOR

NOTE: The length of the lifted conductor which is repairable shall not exceed one half the length of the conductor path between two terminal areas or one half inch, whichever is smaller. See dimension X in Figure 4-4.

4-34. Cover and Case Repair/Replacement. Cover and case repair should be attempted only if the damage is minor; otherwise the damaged part should be replaced. Minor damage is damage that does not effect the structural integrity of the case.

NOTE: Do not attempt to straighten severe bends or to repair a severely cracked cover, panel or plate. Should any damage of this nature be present, replace defective part.

A. Replacement.

1. Replace all cross- or strip-threaded items.

2. If restoration does not return damaged parts to a serviceable condition, then the damaged parts should be replaced.

B. Repair.

1. Remove all traces of grease, dirt or other foreign matter from the damaged area with isopropyl alcohol.

2. Apply trichloroethylene along the line where the pieces meet with a cotton swab.

3. If the joint being repaired is closed, such as a crack, clamping is not necessary; however, if a separate piece is being rejoined that will not hold itself together then clamping is necessary. Allow either joint to set for 24 hours before reassembly.

4. Should surfaces be nicked, scratched or burred, the damaged area can be refinished as follows:

5. Using crocus cloth, work burrs or nicks down to the level of the surrounding area.

6. Brush apply a coat of matching color model paint to the repaired surface.

4-35. LS 200 ASSEMBLY PROCEDURE

The following paragraphs provide directions for reassembly of the LS 200. Refer to Figure 5-1, drawing and parts list. For wire routing refer to Figure 4-1.

4-36. Transformer Installation.

A. Secure Transformer (100) to the Pump Support Bracket (8) with three screws and lockwashers (78) (114).

B. Reconnect transformer wire harness terminals.

C. Secure Pump Support Bracket to Chassis (14) with two screws and washers (75) (110).

D. Attach the Pump Support Bracket to the Bottom Cover (18) with two screws (67).

E. Replace the Foam Pump Housing on the Pump Support Bracket and reconnect J3 to the Interface PCB.

4-37. Battery Pack Installation.

A. Replace the Battery Pack (A5) and Battery Pack Cover (3) in the LS 200.

B. Secure the Battery Pack Cover to the Chassis (14) using four screws and lockwashers (75) (110).

4-38. Servo Valve Installation.

A. Connect the Interface/Servo Valve/Pressure Switch/Volume Wire Harness (W1) at connector P2.

B. Secure Servo Valve (A4) manifold to the Chassis (14) with one screw and lockwasher (76) (110).

C. Secure the Servo Valve to two Chassis-mounted standoffs (82) with two screws and lockwashers (76) (110).

D. Reconnect the tubing to the manifold elbow fitting and secure with a nylon cable tie (58).

E. Secure the Pressure Transducer and Servo Valve wiring with nylon cable ties as indicated in Figure 4-1.

4-39. Overpressure Switch Installation.

After replacing the Servo Valve and Transformer proceed as follows:

A. Secure the Switch assembly to the Pump Support Bracket with two screws and lockwashers (74) (112). Note that Cable Tie Mount Fastener (25) is secured with one of these screws (See Figure 5-1).

B. Reconnect the two terminal connectors to the Switch.

C. Reconnect the tubing to the Switch as shown in Figure 4-1 and secure with a nylon cable tie.

4-40. Pump Installation.

A. Replace Pump in Pump Housing (39) as indicated in Figure 5-1 and place this assembly on the Pump Support Bracket (8).

B. Reconnect wire harness at J3 on the Interface PCB when that board is in position.

C. Reconnect the Pump tubing to the Luer "Y" fitting and secure this juncture with a nylon cable tie.

4-41. Handle Support Installation.

A. Reinstall the Volume Potentiometer Bracket using two kepnuts (50).

B. Reinstall the Capacitor (13) in its mount and secure with nylon cable tie (60) as shown in Figure 4-1.

C. Secure the Handle Support (10) to the Chassis (14) with kepnut (50) and screws (68), and to the Rear Panel (54) with two screws (64).

4-42. Charger PCB Installation.

A. Secure the Charger PCB (A6) heat sink to the Rear Panel (54) with two kepnuts (50).

B. Secure the Charger PCB to the Pump Support Bracket (8) with two screws and lock washers (72) (115).

NOTE: Do not reconnect J3 on the Charger PCB until the unit has been fully assembled to the point of Cover (20) replacement.

C. Connect the wire harness at J1 and J2 on the Charger PCB.

4-43. Interface PCB Installation.

NOTE: When installing Interface PCB, do not allow circuit side leads of Battery (B1) to touch the Chassis.

A. Carefully replace the Interface PCB positioning the PCB heat sink on the two Rear Panel studs and secure with two nuts and lockwashers (51) (115).

B. Connect J3 on the Interface PCB to the Pump wire harness.

C. Secure the Interface PCB to the Chassis (14) with six screws and lockwashers (75) (110).

D. Connect J2, J3, J5, J7, J8, and J12 on the Interface PCB.

4-44. Front Bezel Assembly.

A. Door/Membrane Switch.

1. Slide the door-mounted Membrane Switch flex cable through the Front Bezel (5) and replace the two screws and lockwashers (72) (113) securing the Hinge Plate (38) to the Front Bezel.

2. Carefully align the Door before tightening the Hinge Plate screws.

B. Printer. Replace the Printer (A7), then the Printer Cover (21) in Front Bezel and secure with three screws and lockwashers (72) (113).

C. Display PFC.

1. Place the LED-containing half of the Display PFC (A2) in position in the Front Bezel, replace the shields (79) (80) and secure with three screws and lockwashers (72) (112).

2. Carefully fold the IC-containing half of the PFC into position and secure with three screws and lockwashers (73) (112).

3. Connect J2 from the ON/OFF Switch to Display PFC.

4. Connect J3 from the DATE/TIME Membrane Switch to Display PFC. Note that Pin 4 has no flex connection.

4-45. Front Bezel Installation.

A. Attach flex cable ribbon cable and wire harness connectors, J7, J12, and J5, respectively, on the Interface PCB (A5).

B. Secure Front Bezel to the Handle Support (10) with two screws and washers (76) (110) and to the Bottom Cover (18) with two screws and washers (76) (110). When securing Bottom Cover to Bezel, note that grounding terminals mount on screws between lockwasher and Bottom Cover.

C. Attach tubing to the Front Bezel and secure with a nylon cable tie.

4-46. System PCB Installation.

A. First reconnect J3, J2, and J1.

B. Secure System PCB (A1) to the three hinged Standoffs (85) on the Interface PCB with three screws and lockwashers (75) (110).

C. Close System PCB until secured by three nylon, locking standoffs (62) mounted on the Interface PCB.

NOTE: Before replacing Cover (20), reconnect J3 on the Charger PCB.

4-47. Cover Installation.

A. Carefully slide Cover (20) over the unit starting from the rear of the instrument.

B. Attach four Rubber Feet (28) to the bottom of the Cover with four screws and lockwashers (77) (110).

SECTION 5
ASSEMBLIES, PARTS LISTS, SCHEMATICS

5-1. GENERAL

This section provides exploded views for mechanical assemblies, parts lists, component layouts and schematics for electronic PCB assemblies. Table 5-1 lists the assemblies and their corresponding figure numbers. For those I.C.'s marked with a star (*) on the schematics, additional reference information can be found in Section 6.

5-2. PARTS LISTS

A. **FIG-ITEM** This column contains the figure number of the illustrated assembly and the assigned item number or reference designation of each part.

B. **PART NUMBER** Physio-Control Corporation (PCC) part number or other part number as specified is contained in this column for each part listed.

C. **DESCRIPTION** This column contains the nomenclature and descriptive information for each part listed. Static Sensitive Devices (SSDs) are identified in this column by this symbol * . Special handling of PCB assemblies containing SSDs is required.

D. **USE CODE** This column contains an alphabetical code which indicates configuration differences. Consult the first entry in the part list for code effectivity.

E. **QTY** This column lists the total quantity of parts for each particular assembly. The abbreviation "REF" (reference) indicates that the part has been listed for reference purposes.

5-3. PARTS ORDERING

Some parts may be purchased locally. When ordering from Physio-Control Corporation, give the instrument model and serial number. Include part number, reference designation, and description. Different parts may be substituted by Physio-Control to reflect modifications and improvements of instrument circuitry.

TABLE 5-1

PARTS LISTS, ASSEMBLY DRAWINGS AND SCHEMATIC DIAGRAMS

DRAWING NO.	NOMENCLATURE	FIGURE NO.
802603	LS 200 FINAL ASSEMBLY	5-1
802603	LS 200 INTERCONNECT DIAGRAM	5-2
802597	BATTERY CHARGER PCB ASSEMBLY	5-3
803114	INTERFACE PCB ASSEMBLY	5-4
803116	SYSTEM PCB ASSEMBLY	5-5
802583	DISPLAY PFC ASSEMBLY	5-6
802673	INTERFACE/SERVO/PRESSURE SWITCH/VOLUME WIRE HARNESS	5-7
802680	INTERFACE/DISPLAY RIBBON CABLE	5-8
802267	SYSTEM/INTERFACE RIBBON CABLE	5-9
802675	POWER SUPPLY/INTERFACE WIRE HARNESS	5-10
802678	INTERFACE/SYSTEM POWER RIBBON CABLE	5-11
802985	TRANSFORMER/CAPACITOR CHARGER WIRE HARNESS	5-12
803012	INTERFACE/PRINTER WIRE HARNESS	5-13
803020	INTERFACE/HARNESS RIBBON CABLE	5-14
802306	PRESSURE TRANSDUCER WIRE HARNESS	5-15
803008	ON/OFF SWITCH HARNESS	5-16
802634	DOOR MEMBRANE SWITCH	5-17
802648	DATE/TIME MEMBRANE SWITCH	5-18

TABLE 5-2

LS 200 ASSEMBLY LOCATION CODES

DRAWING NO.	NOMENCLATURE	FIGURE NO.
803116	SYSTEM PCB ASSEMBLY	A1
802583	DISPLAY PFC ASSEMBLY	A2
803194	PUMP ASSEMBLY	A3
802290	SERVO VALVE	A4
803114	INTERFACE PCB ASSEMBLY	A5
802597	BATTERY CHARGER PCB ASSEMBLY	A6
802987	PRINTER	A7
---	CHASSIS/HARNESS	A8

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PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1				
	802603-14	LS 200 FINAL ASSEMBLY, W/Printer, English, UL/CSA, 115Vac	A	REF
	802603-15	LS 200 FINAL ASSEMBLY, No Printer, English, UL/CSA, 115Vac	B	REF
	802603-16	LS 200 FINAL ASSEMBLY, W/Printer, French, CSA, 115Vac	C	REF
	802603-17	LS 200 FINAL ASSEMBLY, No Printer, French, CSA, 115Vac	D	REF
	802603-18	LS 200 FINAL ASSEMBLY, W/Printer, English, Intl, 115/230Vac	E	REF
	802603-19	LS 200 FINAL ASSEMBLY, No Printer, English, Intl, 115/230Vac	F	REF
	802603-20	LS 200 FINAL ASSEMBLY, W/Printer, French, Intl, 115/230Vac	G	REF
	802603-21	LS 200 FINAL ASSEMBLY, No Printer, French, Intl, 115/230Vac	H	REF
	802603-22	LS 200 FINAL ASSEMBLY, W/Printer, German, Intl, 115/230Vac	I	REF
	802603-23	LS 200 FINAL ASSEMBLY, No Printer, German, Intl, 115/230Vac	J	REF
	802603-24	LS 200 FINAL ASSEMBLY, W/Printer, Spanish, Intl, 115/230Vac	K	REF
	802603-25	LS 200 FINAL ASSEMBLY, No Printer, Spanish, Intl, 115/230Vac	L	REF
A1	803116-01	. SYSTEM PCB ASSEMBLY (See Figure 5-5)		1
A2	802583-01	. DISPLAY PFC ASSEMBLY (See Figure 5-6)		1
A3	803194-00	. PUMP ASSEMBLY		1
A4	802290-07	. SERVO VALVE, Linear Bleed	A-H,K,L	1
	802290-09	. SERVO VALVE, Linear Bleed, PTB	I,J	
A5	803114-00	. INTERFACE PCB ASSEMBLY (See Figure 5-4)	A,C,E,G, I,K	1
	803114-01	. INTERFACE PCB ASSEMBLY	B,D,F,H, J,L	1
A6	802597-00	. BATTERY CHARGER PCB ASSEMBLY (See Figure 5-3)		1
A7	802978-01	. PRINTER, Plotter	A,C,E,G, I,K	1
U25	803004-202	. I.C., Digital, 2764, EPROM, (On System PCB) ATTENTION (See Figure 5-5)	A,B,D-F, H,J,L	1
	803004-302	. I.C., Digital, 2764, EPROM, (On System PCB) ATTENTION	C,G	1
	803004-402	. I.C., Digital, 2764, EPROM, (On System PCB) ATTENTION	I	1
	803004-502	. I.C., Digital, 2764, EPROM, (On System PCB) ATTENTION	K	1
W1	802673-02	. WIRING HARNESS, Interface/Servo/Pressure Switch/Volume (See Figure 5-7)		1
W2	802680-00	. CABLE ASSEMBLY, Ribbon, Interface/Display (See Figure 5-8)		1
W3	802267-02	. RIBBON CABLE, System/Interface (See Figure 5-9)		1
W4	802675-00	. HARNESS, Power Supply/Interface (See Figure 5-10)		1
W5	802678-00	. CABLE ASSEMBLY, Ribbon, Interface/System, Power (See Figure 5-11)		1
W6	802985-01	. WIRING HARNESS, Transformer/Capacitor/Charger (See Figure 5-12)		1
W7	803012-00	. WIRING HARNESS, Interface/Printer (See Figure 5-13)	A,C,E,G, I,K	1
W9	803020-00	. RIBBON CABLE ASSEMBLY, Interface/Harness (See Figure 5-19)		1
W10	803008-01	. HARNESS, On/Off Switch (See Figure 5-16)		1
2	90-09241	. ADHESIVE, Loctite, 27L, Bottle, 50cc (Not Shown)		A/R
3	802649-00	. BATTERY COVER		1
4	802565-00	. BATTERY PACK		1
5	802099-03	. BEZEL	A,C,E,G, I,K	1
	802984-01	. BEZEL, No Printer, Modified (Not Shown)	B,D,F,H, J,L	1
6	802205-00	. BRACKET, Mounting, Printer	A,C,E,G, I,K	1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1				
7	802644-03	. BRACKET, Potentiometer		1
8	802642-05	. BRACKET, Pump		1
9	802974-01	. BRACKET, Paper Spindle	A,C,E,G, I,K	1
10	802636-08	. BRACKET, Handle Support		1
11	803120-00	. BUTTON, Door Release (Snap-on Fit with #29)	A,C,E,G, I,K	1
12	201566-002	. CAP, Closure, Vinyl, 1.38 Diameter (Used on C1)		1
13	201619-138	. CAPACITOR, Electrolytic, 5000µF, ±20%		1
14	802641-08	. CHASSIS		1
15	201767-000	. CONNECTOR, Inlet, 115/230V, 5 X 20mm Fuses	E-L	1
16	201393-005	. CONNECTOR, Plug, Potential Equalization, VDE	E-L	1
17	201296-001	. CONNECTOR, Plug, Power, AC, 3 Contact, 6A/250V	A-D	1
18	802639-08	. COVER, Bottom		1
19	802983-00	. COVER, End, Foam		1
20	802635-03	. COVER, Monitor		1
21	802362-00	. COVER, Printer	A,C,E,G, I,K	1
22	802214-02	. DOOR, Fixed (Not Shown)	B,D,F,H, J,L	1
23	802676-11	. DOOR, Hinged, Printer	A,C,E,G, I,K	1
24	90-10019	. FASTENER, Mount, Cable Tie, Mini, Adhesive Back		8
25	90-10034	. FASTENER, Mount, Cable Tie, Screw Mount, #8 Screw		2
26	201519-000	. FITTING, Adjustable L, Slotted Head, Brass		1
27	201518-001	. FITTING, Hose, Barb, #10-32, Brass		1
28	201245-000	. FOOT, Mounting, With Washers #8		4
29	803121-00	. FOOT, Door, Release (Snap-on Fit with #11)	A,C,E,G, I,K	1
30	200490-000	. FOOT, Rubber, SJ5018-Black, Self-adhesive		1
31	200256-140	. FUSE, Slow Blow, Dual Element, 250V, 1.2/10A	A-D	1
32	200619-013	. FUSE, Slow Blow, 630mA/250V, 5 X 20mm	E-L	2
33	201203-014	. FUSE CARRIER	A-D	1
34	201203-002	. FUSE HOLDER	A-D	1
35	201605-001	. GROMMET, Continuous, .125G, Nylon, Natural		A/R
36	802637-01	. HANDLE		1
37	802679-01	. HINGE, Door	A,C,E,G, I,K	2
38	802201-03	. HINGE, Plate	A,C,E,G, I,K	1
39	802653-01	. HOUSING, Foam, Pump		1
40	803456-03	. LABEL, Battery Package Specification		1
41	01-50318-15	. LABEL, Caution, Shock	A,B	1
	01-50318-08	. LABEL, Caution, Shock	E,F	1
	01-50318-09	. LABEL, Caution, Shock	C,D,G,H	1
	01-50318-10	. LABEL, Caution, Shock	I,J	1
	01-50318-11	. LABEL, Caution, Shock	K,L	1
42	802501-02	. LABEL, Operating Instructions, English	A,E	1
	802501-03	. LABEL, Operating Instructions, English	B,F	1
	802501-04	. LABEL, Operating Instructions, French	C,G	1
	802501-05	. LABEL, Operating Instructions, French	D,H	1
	802501-10	. LABEL, Operating Instructions, German	I	1
	802501-07	. LABEL, Operating Instructions, German	J	1
	802501-08	. LABEL, Operating Instructions, Spanish	K	1
	802501-09	. LABEL, Operating Instructions, Spanish	L	1
43	802590-00	. LABEL, Paper Load Instructions	A,E	1
	802590-01	. LABEL, Paper Load Instructions	C,G	1
	802590-02	. LABEL, Paper Load Instructions	I	1
	802590-03	. LABEL, Paper Load Instructions	K	1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1				
44	800897-01	. LABEL, Serial Number, English	E,F	1
	800896-03	. LABEL, Serial Number, Universal/CSA	A,B	1
	800897-04	. LABEL, Serial Number, German	I,J	1
	800897-05	. LABEL, Serial Number, Spanish	K,L	1
	800896-09	. LABEL, Serial Number, French/CSA	C,D	1
	800897-07	. LABEL, Serial Number, French	G,H	1
45	801517-04	. LABEL, UL	A,B	1
46	801362-05	. LABEL, Warning, Fuse, 1.2 Amp/250 Volt	A-D	1
47	803119-01	. LATCH, Paw, Door (Used With #11)	A,C,E,G, I,K	1
48	803118-00	. LATCH PLATE (Used With #11)	A,C,E,G, I,K	1
49	90-03019	. NUT, Hex, Kep, 4-40 X .250W/.098 T	A-D	4
		. NUT, Hex, Kep, 4-40 X .250W/.098 T	E-L	2
50	90-03021	. NUT, Hex, Kep, 6-32 X .250 W/.098 T		14
51	201199-100	. NUT, Hex, 4-40 X .188W X .063 T	A,C,E,G, I,K	2
	201199-100	. NUT, Hex, 4-40 X .188W X .063 T	B,D,F,H, J,L	6
52	201393-001	. NUT, Hex, Jam, Heavy, M6 (Used With #16, Not Shown)	E-L	1
53	802677-00	. PAD, Foam, Pump		1
54	802640-12	. PANEL, Rear	A-D	1
55	803294-03	. PANEL, Rear, IEC	E-H,K,L	1
	803294-04	. PANEL, Rear, IEC, German, PTB	I,J	1
56	802604-02	. PAPER, Printer, LS 200, 1 Roll (Not Shown)	A,C,E,G, I,K	1
57	201716-000	. PEN, Printer	A,C,E,G, I,K	1
58	200536-009	. RETAINER, Cable Tie, Nylon, .10 W X 4.06 L		16
59	200536-002	. RETAINER, Cable Tie, Nylon, .10 W X 8.0 L		1
60	200536-004	. RETAINER, Cable Tie, Nylon, .19 W X 12.0 L		1
61	201470-011	. RETAINER, Component Clip		1
62	200364-023	. RETAINER, PCB, Support, Locking		3
63	201105-538	. SCREW, Flat Head, 4-40 X .375L	A-E	2
64	201105-568	. SCREW, Flat Head, 6-32 X .250L		7
65	201105-502	. SCREW, Flat Head, 2-56 X .125 L	A,C,E,G, I,K	10
66	201105-536	. SCREW, Flat Head, 4-40 X .250 L	A,C,E,G, I,K	1
67	200478-792	. SCREW, Flat Head, 6-32 X .250L		2
68	200478-794	. SCREW, Flat Head, 6-32 X .375L		6
69	200476-726	. SCREW, Pan Head, 2-56 X .125 L	A,C,E,G, I,K	1
70	200476-727	. SCREW, Pan Head, 2-56 X .187 L	A,C,E,G, I,K	8
71	200476-758	. SCREW, Pan Head, 4-40 X .125 L (Not Shown, Used with Printer Grounding Wire)	A,C,E,G, I,K	1
72	200476-760	. SCREW, Pan Head, 4-40 X .250 L	A,C,E,G, I,K	10
	200476-760	. SCREW, Pan Head, 4-40 X .250 L	B,D,F,H, J,L	5
73	200476-764	. SCREW, Pan Head, 4-40 X .500 L		3
74	200476-768	. SCREW, Pan Head, 4-40 X .750 L		2
75	200476-792	. SCREW, Pan Head, 6-32 X .250 L		18
76	200476-793	. SCREW, Pan Head, 6-32 X .312 L		7
77	200476-796	. SCREW, Pan Head, 6-32 X .500 L		4
78	200476-824	. SCREW, Pan Head, 8-32 X .250 L		3
79	802971-00	. SHIELD, Display Flex		1
80	803511-01	. SHIELD, Display Flex, Front		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1				
81	802638-02	. SHROUD, Handle		1
82	201118-314	. SPACER, Hex, Threaded, 6-32 X 1.000L X .250W		2
83	802645-00	. SPINDLE, Support, Paper	A,C,E,G, I,K	1
84	802188-03	. SPRING, Bezel, LS 200 (Used With #11)	A,C,E,G, I,K	1
85	201421-036	. STANDOFF, Hinged, M/F, 6-32, 1.000 X .250 OD		3
86	802648-01	. SWITCH, Membrane, Date/Time, English (See Figure 5-18)	A,E	1
	802648-02	. SWITCH, Membrane, Date/Time, French	C,G	1
	802648-03	. SWITCH, Membrane, Date/Time, German	I	1
	802648-04	. SWITCH, Membrane, Date/Time, Spanish	K	1
87	802634-08	. SWITCH, Membrane, Door (See Figure 5-17)	A,E	1
	802634-09	. SWITCH, Membrane, Door	B,F	1
	802634-10	. SWITCH, Membrane, Door	C,G	1
	802634-11	. SWITCH, Membrane, Door	D,H	1
	802634-16	. SWITCH, Membrane, Door	I	1
	802634-13	. SWITCH, Membrane, Door	J	1
	802634-14	. SWITCH, Membrane, Door	K	1
	802634-15	. SWITCH, Membrane, Door	L	1
88	201379-001	. SWITCH, Pressure Sensing, SPDT		1
89	201665-001	. SWITCH, Rocker, DPDT, Panel Mount, 250V	E-L	1
90	90-08006	. TAPE, Adhesive, Double Stick, .500 W X .025 T (Used on W2, Not Shown)		A/R
91	200276-211	. TERMINAL, Lug, Ring Tongue, AWG #22-16, #6 (Not Shown)		1
92	200276-004	. TERMINAL, Lug, Ring Tongue, AWG #22-26, #4 (Not Shown)	A,C,E,G, I,K	2
		. TERMINAL, Lug, Ring Tongue, AWG #22-26, #4 (Not Shown)	B,D,F,H, J,L	1
93	90-06068	. TERMINAL, Lug, Ring Tongue, AWG #22-18, #6 (Not Shown)	A,C,E,G, I,K	2
		. TERMINAL, Lug, Ring Tongue, AWG #22-18, #6 (Not Shown)	B,D,F,H, J,L	1
94	200267-002	. TERMINAL, Receptacle, Quick Disconnect, AWG #22-18 (Not Shown, Used With #15)	E-L	8
95	200514-008	. TERMINAL, Receptacle, Quick Disconnect, 90°, .187 X .020, AWG #16-14 (Not Shown)		2
96	200514-006	. TERMINAL, Receptacle, Quick Disconnect, 90°, .187 X .020, AWG #22-18 (Not Shown)		2
97	200916-000	. TERMINAL, Receptacle, Quick Disconnect, .23W/.02T, AWG #22-18 (Not Shown, Used With #89)	E-L	4
98	200267-020	. TERMINAL, Receptacle, Quick Disconnect, 90°, AWG #22-18 (Not Shown)	A-D	2
99	200514-000	. TERMINAL, Receptacle, Quick Disconnect, 90°, .25W/.03T, AWG #22-18 (Not Shown)	A-D	3
100	802690-02	. TRANSFORMER		1
101	803026-02	. TUBING SET, LS 200		1
102	200283-005	. TUBING, Heat Shrink, Red, .250 I.D. (Not Shown, Used With #89)	E-L	A/R
103	90-07023	. TUBING, PVC, Clear, #10, 105 (Not Shown, Used With #17)		A/R
104	201489-000	. TUBING, Vinyl, .250 O.D. X .062 T		A/R
105	90-04051	. WASHER, Flat, #4 X .250 OD/.020 T (Used with #5 and #22, Not Shown)	B,D,F,H, J,L	2
106	90-04010	. WASHER, Flat, #6 X .312 OD/.050 T (Used with #5 and #22, Not Shown)	B,D,F,H, J,L	2
107	201393-002	. WASHER, Flat, M6 (Not Shown, Used with #16)	E-L	1
108	201393-003	. WASHER, Lock, External Tooth, M6 (Not Shown, Used With #16)	E-L	1
109	201351-001	. WASHER, Lock, External Tooth, #6		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1				
110	90-04014	. WASHER, Lock, Internal Tooth, #6 X .285 OD/.025 T	A,C,E,G,I,K	31
		. WASHER, Lock, Internal Tooth, #6 X .285 OD/.025 T	B,D,F,H,J,L	29
111	201575-000	. WASHER, Lock, Internal Tooth, #2 X .085 OD/.013 T	A,C,E,G,I,K	3
112	201575-002	. WASHER, Lock, Internal Tooth, #4 X .260 OD/.015 T		8
113	201575-002	. WASHER, Lock, Internal Tooth, #4 X .260 OD/.015 T	A,C,E,G,I,K	6
114	201575-005	. WASHER, Lock, Internal Tooth, #8, .335 OD X .020 T		3
115	90-04061	. WASHER, Lock, Split, #4 X .195 OD/.025 T		4
116	90-04061	. WASHER, Lock, Split, #4 X .195 OD/.025 T (Not Shown)	B,D,F,H,J,L	4
117	802189-02	. WINDOW, Display	A,B,E,F	1
	802189-03	. WINDOW, Display	C,D,G,H	1
	802189-04	. WINDOW, Display	J	1
	802189-05	. WINDOW, Display	K,L	1
	802189-06	. WINDOW, Display	I	1
118	802179-01	. WINDOW, Exit, Paper, Door	A,C,E,G,I,K	1
119	200357-060	. WIRE, Stranded, PVC, 300V, #18, CSA, Brown (Not Shown)		A/R
120	200357-272	. WIRE, Stranded, PVC, 300V, #18, CSA, Green/Yellow (Used With #15 and #17)		A/R
121	200357-059	. WIRE, Stranded, PVC, 300V, #18, CSA, Blue		A/R
122	200357-274	. WIRE, Stranded, PVC, 300V, #22, CSA, Green/Yellow		A/R
123	200357-069	. WIRE, Stranded, PVC, 300V, #18, White/Brown (Not Shown)		A/R

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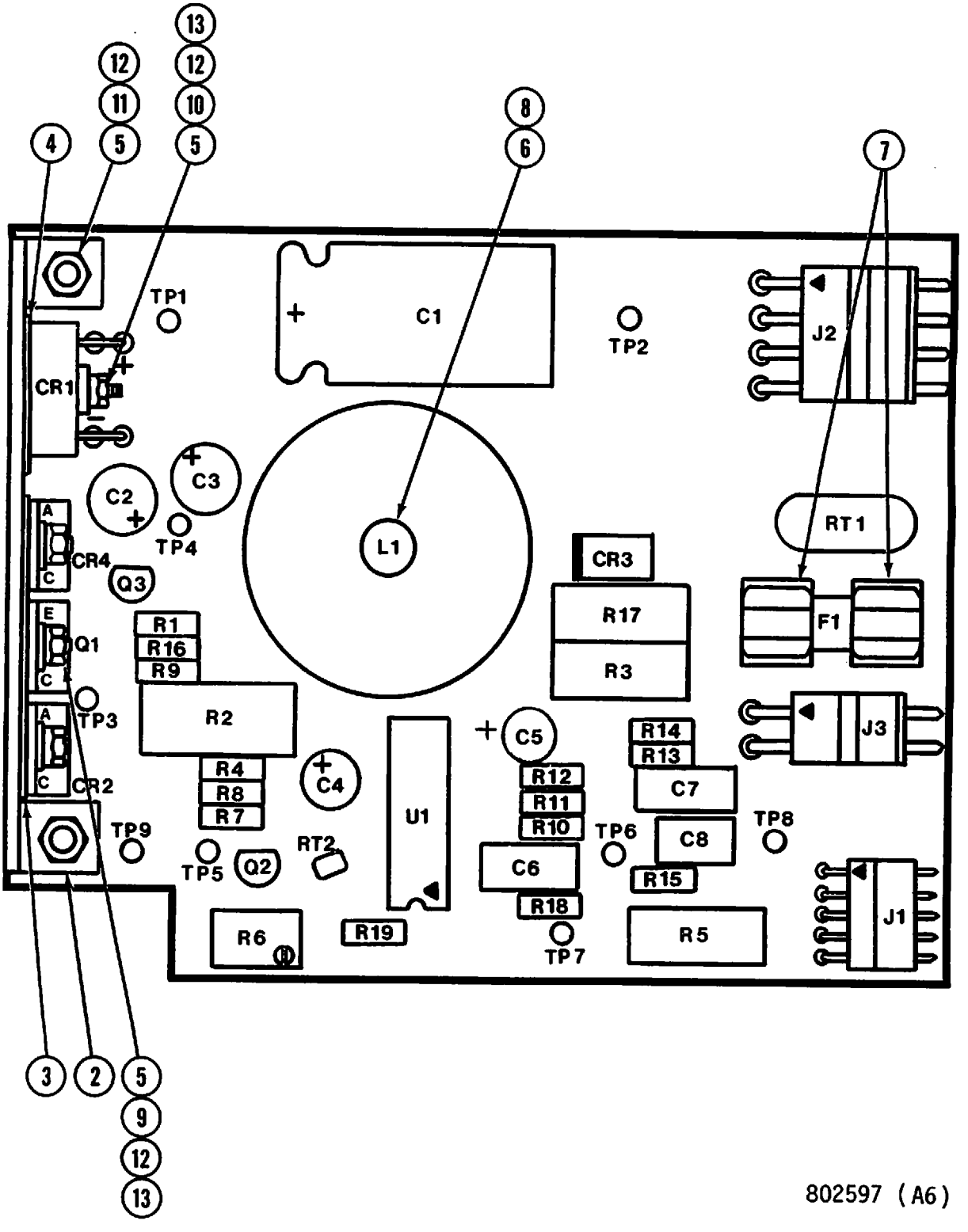
PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-3				
A6	802597-00	BATTERY CHARGER PCB ASSEMBLY		REF
C1	200204-070	. CAPACITOR, Electrolytic, 220µF/50V, -50 to +50%		1
C2,3	200701-013	. CAPACITOR, Electrolytic, 22µF/25V, 100%		2
C4	200205-046	. CAPACITOR, Electrolytic, 2.2µF/50V, 10%		1
C5	200205-014	. CAPACITOR, Electrolytic, 10µF/16V, -20% to +50%		1
C6	200966-017	. CAPACITOR, .033µF/50V, 5%		1
C7	200966-014	. CAPACITOR, .01µF/50, 5%		1
C8	200893-034	. CAPACITOR, 0.1µF/50V, 10%		1
CR1	803304-00	. DIODE, Bridge, 10A, 50V		1
CR2	803305-00	. DIODE, GP80A, 8A, 50V		1
CR3	802299-03	. DIODE, Zener, ICTE-12		1
CR4	802656-02	. DIODE, VSK64, 6A		1
F1	200662-006	. FUSE, Fast, 6A/32V, .625L X .25D		1
J1	200534-081	. CONNECTOR, Plug, Locking, 5 Contact		1
J2	200663-002	. CONNECTOR, Plug, Locking, 4 Contact		1
J3	200663-000	. CONNECTOR, Plug, Locking, 2 Contact		1
L1	802160-00	. INDUCTOR, Coil, Toroid, 330µH, 3A		1
Q1	801175-00	. TRANSISTOR, PNP, D45H11		1
Q2	801338-01	. TRANSISTOR, VFET, VN0106N3, TO-92		1
Q3	801233-01	. TRANSISTOR, PNP, PN2907A, TO-92		1
R1	200470-040	. RESISTOR, 47 Ω, 1/4W, 5%		1
R2	200257-048	. RESISTOR, 1.0 kΩ, 2W, 5%		1
R3	200270-000	. RESISTOR, .10 Ω, 2W, 5%		2
R4	200054-126	. RESISTOR, 200 Ω, 1/8W, 1%		1
R5	200676-027	. RESISTOR, 75 Ω, 3W, 5%		1
R6	200527-028	. POTENTIOMETER, 10 kΩ, 1/2W, 10%, Multi-Turn		1
R7	200470-069	. RESISTOR, 750 Ω, 1/4W, 5%		1
R8	200054-262	. RESISTOR, 5.36 kΩ, 1/8W, 1%		1
R9	200470-054	. RESISTOR, 180 Ω, 1/4W, 5%		1
R10	200470-092	. RESISTOR, 6.8 kΩ, 1/4W, 5%		1
R11	200470-144	. RESISTOR, 1 MΩ, 1/4W, 5%		1
R12	200470-113	. RESISTOR, 51 kΩ, 1/4W, 5%		1
R13	200470-080	. RESISTOR, 2.2 kΩ, 1/4W, 5%		1
R14	200470-096	. RESISTOR, 10 kΩ, 1/4W, 5%		2
R15	200470-082	. RESISTOR, 2.7 kΩ, 1/4W, 5%		1
R16	200470-064	. RESISTOR, 470 Ω, 1/4W, 5%		1
R17		. (Same As R3)		
R18		. (Same As R14)		
R19	200470-071	. RESISTOR, 910 Ω, 1/4W, 5%		1
RT1	200486-002	. THERMISTOR, 2.5 µ, 9A		1
RT2	200660-006	. THERMISTOR, 1.1 kΩ, 10%		1
TP1-9	801959-00	. TERMINAL, Test Point		9
U1	801229-02	. I.C., Linear, TL494, Switching Voltage Regulator		1
XU1	200907-020	. SOCKET, DIP, 16 Contact		1
2	802682-01	. HEAT SINK, I.C. Bracket		1
3	802980-00	. INSULATOR, Heat Sink, 3 Hole Silipad, TO-220		1
4	801665-00	. INSULATOR, Silicone, .18817/.900 OD		1
5	201199-100	. NUT, Hex, 4-40 X .188W X .063T		6
6	200681-001	. RETAINER, Toroid		1
7	201345-001	. RETAINER, Clip, Fuseholder		2
8	201112-044	. SCREW, Pan Head, Nylon, 4-40 X .750L		1
9	200478-761	. SCREW, Flat Head, 4-40 X .312 L		3
10	200478-764	. SCREW, Flat Head, 4-40 X .500 L		1
11	200476-760	. SCREW, Pan Head, 4-40 X .250 L		2
12	90-04061	. WASHER, Lock, Split, #4 X .195 OD/.025T		6
13	200431-849	. WASHER, Shoulder, Nylon, #4 X .115 ID/.060T		4



802597 (A6)

FIGURE 5-3. BATTERY CHARGER PCB ASSEMBLY
(SHEET 1 OF 2)

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PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-4				
A5	803114-00	INTERFACE PCB ASSEMBLY, With Printer	A	REF
	803114-01	INTERFACE PCB ASSEMBLY, No Printer	B	REF
B1	201426-001	. BATTERY, Nicad, Rechargeable, PCB Mount, 3.6 V		1
C1	200893-042	. CAPACITOR, .47µF/50V, 10%		3
C2,3	200893-034	. CAPACITOR, .1µF/50V, 10%	A	9
	200893-034	. CAPACITOR, .1µF/50V, 10%	B	7
C4	200205-028	. CAPACITOR, Electrolytic, 100µF/25V, 10%	A	1
C5	200901-046	. CAPACITOR, .01µF/50V, 5%		2
C6		. (Same As C2)		
C7		. (Same As C1)		
C8		. (Same As C2)		
C9		. (Same As C1)		
C10	200264-000	. CAPACITOR, 470pF/50V, 20%		1
C11	200893-038	. CAPACITOR, .22µF/50V, 10%	A	3
	200893-038	. CAPACITOR, .22µF/50V, 10%	B	2
C12		. (Same As C2)		
C13		. (Same As C5)		
C14		. (Same As C2)	A	
C15		. (Same As C2)		
C16		. (Same As C2)	A	
C17		. (Same As C11)		
C18		. (Same As C11)	A	
C19		. (Same As C2)		
C20	200274-005	. CAPACITOR, 10pF/500V, 5%	A	1
C21-24	201679-003	. CAPACITOR, .03µF/50V, +100-20%, 20 Pin		4
C25	200701-006	. CAPACITOR, Electrolytic, 33µF/16V, 100%		1
C26	200893-046	. CAPACITOR, 1µF/50V, 10%	A	1
CR1	801164-00	. DIODE, 1N3595, 500mA, PIV 125		3
CR2	801159-00	. DIODE, 1N5817, 1A/20V		1
CR3,4		. (Same As CR1)		
CR5	801167-02	. DIODE, Bridge, VE28X, 200nS, 1A, 400V	A	1
CR6	803307-00	. DIODE, Zener, 1N6000A, 10V	A	1
CR7	802299-00	. DIODE, Zener, ICTE-5, Tranzorb	A	2
	802299-00	. DIODE, Zener, ICTE-5, Tranzorb	B	1
CR8		. (Same As CR7)	A	
CR9-11	200971-000	. DIODE, 1N914B, 8nS, PIV 75	A	8
	200971-000	. DIODE, 1N914B, 8nS, PIV 75	B	7
CR17	802093-00	. DIODE, 1N270, 200mA, PIV 80		1
CR18	801209-01	. DIODE, Zener, 1N4732A, 5%, 4.7V		1
CR19-21, 23		. (Same As CR9)		
CR24		. (Same As CR9)	A	
CR25, 33-35	801160-00	. DIODE, 1N4005, 600V, 1.0 A		4
J1	201582-002	. CONNECTOR, Receptacle, With Jack, 25 Contact		1
J2	200534-030	. CONNECTOR, Plug, Locking, 5 Contact		1
J3	200534-027	. CONNECTOR, Plug, Locking, 2 Contact		1
J4	200397-019	. CONNECTOR, Plug, 40 Contact		1
J5	200396-044	. CONNECTOR, Plug, 11 Contact	A	1
J7	201542-011	. CONNECTOR, Plug, 12 Contact		1
J8	200397-009	. CONNECTOR, Plug, 20 Contact		1
J9	200397-004	. CONNECTOR, Plug, 10 Contact		1
J10	200396-036	. CONNECTOR, Plug, 3 Contact	A	1
J12	200397-016	. CONNECTOR, Plug, 34 Contact		1
K1	201564-000	. RELAY, DPST, 6Vdc		1
K2	201720-016	. RELAY, Reed, 5Vdc, 500 Ohm		1
Q1	801508-01	. TRANSISTOR, PNP, 2N3906, TO-92	A	4
	801508-01	. TRANSISTOR, PNP, 2N3906, TO-92	B	1
Q2,3	801507-01	. TRANSISTOR, NPN, 2N3904, TO-92		2
Q5-7		. (Same As Q1)	A	
Q8,9	803308-00	. TRANSISTOR, PNP, NA32, Power, TO-92	A	2
Q10,11	803309-00	. TRANSISTOR, NPN, NA31, Power, TO-92	A	2

PARTS LIST

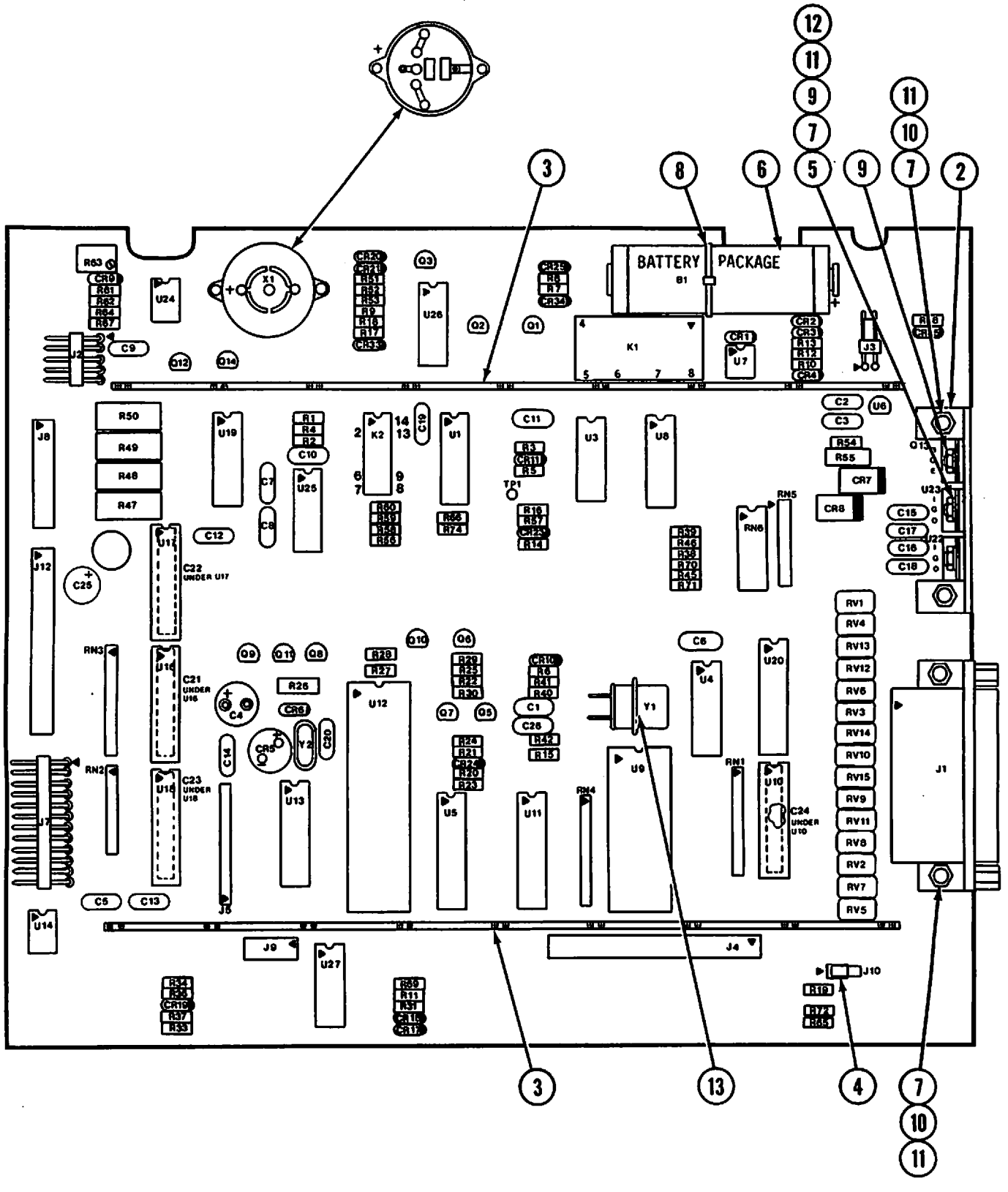
FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-4				
Q12	801186-00	. TRANSISTOR, NPN, PN2222A, TO-92		2
Q13	801175-00	. TRANSISTOR, PNP, D45H11, Power, TO-220		1
Q14		. (Same As Q12)		
R1	200470-096	. RESISTOR, 10 kΩ, 1/4W, 5%	A	9
	200470-096	. RESISTOR, 10 kΩ, 1/4W, 5%	B	8
R2	200470-087	. RESISTOR, 4.3 kΩ, 1/4W, 5%		1
R3	200470-084	. RESISTOR, 3.3 kΩ, 1/4W, 5%		2
R4	200470-056	. RESISTOR, 220 Ω, 1/4W, 5%	A	5
	200470-056	. RESISTOR, 220 Ω, 1/4W, 5%	B	1
R5	200470-120	. RESISTOR, 100 kΩ, 1/4W, 5%	A	5
	200470-120	. RESISTOR, 100 kΩ, 1/4W, 5%	B	3
R6		. (Same As R5)		
R7		. (Same As R1)		
R8	200470-072	. RESISTOR, 1 kΩ, 1/4W, 5%	A	4
	200470-072	. RESISTOR, 1 kΩ, 1/4W, 5%	B	5
R9	200470-093	. RESISTOR, 7.5 kΩ, 1/4W, 5%		2
R10	200470-069	. RESISTOR, 750 Ω, 1/4W, 5%		3
R11		. (Same as R14)	A	
R12		. (Same As R1)		
R13		. (Same As R5)		
R14-16	200470-088	. RESISTOR, 4.7 kΩ, 1/4W, 5%	A	12
	200470-088	. RESISTOR, 4.7 kΩ, 1/4W, 5%	B	9
R17		. (Same as R10)		
R18		. (Same As R9)		
R19		. (Same As R14)		
R20		. (Same As R14)	A	
R21		. (Same As R1)	A	
R22,23	200470-090	. RESISTOR, 5.6 kΩ, 1/4W, 5%	A	2
R24,25		. (Same As R5)	A	
R26	200471-000	. RESISTOR, 1 Ω, 1/2W, 5%	A	1
R27-30		. (Same As R4)	A	
R31		. (Same As R14)		
R33		. (Same As R1)		
R34		. (Same As R14)		
R36	200470-103	. RESISTOR, 20 kΩ, 1/4W, 5%		1
R37		. (Same As R8)		
R38		. (Same As R14)		
R39		. (Same As R1)		
R40	200470-107	. RESISTOR, 30 kΩ, 1/4W, 5%		3
R41		. (Same As R14)		
R42	200470-104	. RESISTOR, 22 kΩ, 1/4W, 5%	A	1
R45		. (Same As R40)		
R46		. (Same As R8)		
R47-50	200676-020	. RESISTOR, 39 Ω, 3W, 5%		4
R51	200470-080	. RESISTOR, 2.2 kΩ, 1/4W, 5%		3
R52	200470-064	. RESISTOR, 470 Ω, 1/4W, 5%		1
R53		. (Same As R10)		
R54		. (Same As R8)		
R55	200578-072	. RESISTOR, 100 Ω, 1W, 5%		1
R56	200470-132	. RESISTOR, 330 kΩ, 1/4W, 5%		1
R57	200470-042	. RESISTOR, 56 Ω, 1/4W, 5%		1
R58		. (Same As R3)		
R59,60		. (Same As R1)		
R61,62		. (Same As R51)		
R63	200527-032	. POTENTIOMETER, 100 kΩ, 1/2W, 10%, Multi-Turn		1
R64		. (Same As R1)		
R65	200470-073	. RESISTOR, 1.1 kΩ, 1/4W, 5%	A	1
R66	200470-065	. RESISTOR, 510 Ω, 1/4W, 5%		2
R67	200470-161	. RESISTOR, 5.1 MΩ, 1/4W, 5%		1
R68	200470-045	. RESISTOR, 75 Ω, 1/4W, 5%		1
R69		. (Same As R14)	A	
R70		. (Same As R14)		
R71		. (Same As R40)		
R72		. (Same As R66)		
R73		. (Same As R8)	B	
R74	200470-062	. RESISTOR, 390 Ω, 1/4W, 5%		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-4				
RN1	200422-083	. RESISTOR NETWORK, 9 X 3.3 kΩ, 1.1W, 2%, 10 Pin		1
RN2	200422-035	. RESISTOR NETWORK, 7 X 4.7 kΩ, 1.1W, 2%, 8 Pin		2
RN3,4	200422-085	. RESISTOR NETWORK, 9 X 4.7 kΩ, 1.1W, 2%, 10 Pin		2
RN5		. (Same As RN2)		
RN6	200176-075	. RESISTOR NETWORK, 7 X 27 kΩ, 1.52W, 2%, 14 Pin		1
RV1-10	201251-009	. VARISTOR, 2000pF, 22V		14
RV11	201251-240	. VARISTOR, 4500pF, 8V		1
RV12-15		. (Same As RV1)		
TP1	801959-00	. TERMINAL, Test Point		1
U1	802319-00	. I.C., Digital, MC14536, Programmable Timer		1
U3	803299-00	. I.C., Digital, 74HC132, NAND Gate		1
U4	801127-00	. I.C., Digital, 74LS138, 3 To 8 Demultiplexer		1
U5	803301-00	. I.C., Digital, 74HC273, Buffer	A	1
U6	801143-00	. I.C., Linear, 78L05A, Voltage Regulator, TO-202		1
U7	801237-00	. I.C., Linear, MCT-2, Opto-Coupler		1
U8	801239-00	. I.C., Digital, MC14520B, Counter		1
U9	802323-01	. I.C., Digital, 6551A, ACIA		1
U10	802324-00	. I.C., Digital, 74LS245, Transceiver		1
U11	802465-100	. I.C., Digital, PAL10HB, Programmable Logic Array		1
U12	802665-00	. I.C., Digital, DLG-12, Printer-Controller	A	1
U13	803298-00	. I.C., Linear, LB1257, Driver	A	1
U14	801152-00	. I.C., Linear, LF353, Op Amp		1
U16-18	802321-00	. I.C., Digital, 74HC244, Buffer	A	3
U19	802308-07	. I.C., Linear, ULN2013A, High Voltage Darlington		1
U20	802310-00	. I.C., Digital, 74HC373, Latch		1
U22	200227-000	. I.C., Linear, LM340T-5, Voltage Regulator, +5V	A	2
	200227-000	. I.C., Linear, LM340T-5, Voltage Regulator, +5V	B	1
U23		. (Same As U22)	A	
U24	802311-00	. I.C., Linear, ICL8212, Voltage Detector		1
U25	801124-01	. I.C., Digital, 4011, CMOS, NAND Gate		1
U26	803302-00	. I.C., Digital, 74HC08, AND Gate		1
U27	802334-00	. I.C., Digital, 74HC04, Inverter		1
X1	201490-000	. TRANSDUCER, Piezo Electric Buzzer		1
XU1	200907-020	. SOCKET, DIP, 16 Contact		4
XU3	200907-019	. SOCKET, DIP, 14 Contact		3
XU4		. (Same As XU1)		
XU5	200907-022	. SOCKET, DIP, 20 Contact	A	3
XU8		. (Same As XU1)		
XU9	200907-025	. SOCKET, DIP, 28 Contact		1
XU10	200675-024	. SOCKET, DIP, 20 Contact		4
XU11		. (Same As XU5)		
XU12	200907-026	. SOCKET, DIP, 40 Contact	A	1
XU13	200907-021	. SOCKET, DIP, 18 Contact	A	1
XU14	200907-018	. SOCKET, DIP, 8 Contact		2
XU16-18		. (Same As XU10)		
XU19		. (Same As XU1)		
XU20		. (Same As XU5)		
XU24		. (Same As XU14)		
XU25,26		. (Same As XU3)		
Y1	200417-006	. CRYSTAL, 1.8432 MHz		1
Y2	200417-004	. CRYSTAL, 4.0000 MHz	A	1
2	802681-00	. BRACKET, I.C., Interface, (Heat Sink)		1
3	201526-000	. BUSS BAR, High Capacitance, 9 Pitches		2
4	201176-000	. CONNECTOR, Receptacle, Jumper, 2 Contact (Used On J10)	A	1
5	802980-00	. INSULATOR, Silipad, 3 Holes, TO-220		1
6	803456-05	. LABEL, Specification, Battery Package		1
7	201199-100	. NUT, Hex, 4-40 X .188 W/.063T	A	7
	201199-100	. NUT, Hex, 4-40 X .188 W/.063T	B	6
8	200536-009	. RETAINER, Cable Tie, Nylon, 4.06 L X .10 W		1
9	201256-760	. SCREW, Flat Head, 4-40 X .250 L	A	3

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-4				
	201256-760	. SCREW, Flat Head, 4-40 X .250 L	B	2
10	200476-761	. SCREW, Pan Head, 4-40 X .312 L		4
11	90-04061	. WASHER, Lock, Split, #4 X .195 OD/.025 T	A	7
	90-04061	. WASHER, Lock, Split, #4 X .195 OD/.025 T	B	6
12	200431-849	. WASHER, Shoulder, Nylon, #4 X .115 ID/.060 T	A	3
	200431-849	. WASHER, Shoulder, Nylon, #4 X .115 ID/.060 T	B	2
13	201301-129	. WIRE, Jumper, Noninsulated, Awg #22, .500 L		1



803114 (A5)

FIGURE 5-4. INTERFACE PCB ASSEMBLY
(SHEET 1 OF 4)

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PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-5				
A1	803116-01	SYSTEM PCB ASSEMBLY		REF
C1	200893-022	. CAPACITOR, .01µF/50V, 10%		2
C2	200893-018	. CAPACITOR, .0047µF/50V, 10%		1
C3	200870-016	. CAPACITOR, 3-15pF/200V, Variable		1
C4,5	200893-034	. CAPACITOR, .10µF/50V, 10%		11
C6	200893-046	. CAPACITOR, 1.0µF/50V, 10%		1
C7	200205-007	. CAPACITOR, Electrolytic, 47µF/10V, 10%		1
C9	200049-039	. CAPACITOR, .1µF/50V, 20%		3
C10	200274-036	. CAPACITOR, 270pF/500V, 5%		1
C11	200893-015	. CAPACITOR, 2700pF/50V, 10%		1
C12,13	200744-013	. CAPACITOR, .47µF/50V, 5%		5
C15,16		. (Same As C12)		
C17	200744-009	. CAPACITOR, .22µF/50V, 5%		1
C19		. (Same As C12)		
C20	200893-234	. CAPACITOR, .10µF/50V, 20%		6
C21	200893-210	. CAPACITOR, 1000pF/50V, 20%		2
C22		. (Same As C1)		
C23		. (Same As C9)		
C24		. (Same As C9)		
C25	200274-005	. CAPACITOR, 10pF/500V, 5%		1
C26		. (Same As C20)		
C27	200701-021	. CAPACITOR, Electrolytic, 10µF/35V, 20%		2
C28	200701-006	. CAPACITOR, Electrolytic, 33µF/16V, 20%		1
C29		. (Same As C27)		
C31	200701-013	. CAPACITOR, Electrolytic, 22µF/25V, 20%		2
C32-35		. (Same As C20)		
C36		. (Same As C31)		
C37	200901-034	. CAPACITOR, 1000pF/50V, 5%		1
C38		. (Same As C4)		
C39	200893-038	. CAPACITOR, .22µF/50V, 10%		1
C40-46		. (Same As C4)		
C48-51	201679-003	. CAPACITOR, .03µF/50V, +100-20%, 20 Pin		4
C52	201679-010	. CAPACITOR, .07µF/50V, +100-20%, 28 Pin		1
C53		. (Same As C21)		
C54,55	200893-050	. CAPACITOR, 2.2µF/50V, 10%		2
C56	200701-000	. CAPACITOR, Electrolytic, 47µF/10V, 20%		1
C57		. (Same As C4)		
CR1	201272-000	. DIODE, FDH300, 500mA, PIV 125		1
CR2	200284-005	. DIODE, 1N4005, 600V, 1.0 A		1
CR3	200971-000	. DIODE, 1N914B, 8nS, PIV 75		1
CR5,6	200991-001	. DIODE, 1N5712, 35mA/20V		2
CR7	200510-002	. DIODE, Bridge, VE28X, 200nS, 1A, 200V		1
J1	200397-019	. CONNECTOR, Plug, 40 Contact		1
J2	200397-004	. CONNECTOR, Plug, 10 Contact		1
J3	200534-002	. CONNECTOR, Plug, 4 Contact		1
J4	200396-036	. CONNECTOR, Plug, 3 Contact		8
J5	201542-002	. CONNECTOR, Plug, 3 Contact		1
J6-12		. (Same As J4)		
L1	200833-013	. INDUCTOR, 500µH, 500mA		1
Q3,4	200942-001	. TRANSISTOR, NPN, PN2222A, TO-92		2
Q5	200986-000	. TRANSISTOR, NPN, PN2484, TO-92		1
R1,2	200470-144	. RESISTOR, 1 MΩ, 1/4W, 5%		2
R3,4	200054-435	. RESISTOR, 340 kΩ, 1/8W, 1%, RN55C		2
R5	200470-104	. RESISTOR, 22 kΩ, 1/4W, 5%		3
R7	200470-120	. RESISTOR, 100 kΩ, 1/4W, 5%		2
R13		. (Same As R7)		
R14	200470-072	. RESISTOR, 1 kΩ, 1/4W, 5%,		10
R15	200470-080	. RESISTOR, 2.2 kΩ, 1/4W, 5%		2
R16,18		. (Same As R14)		
R19,20	200470-096	. RESISTOR, 10 kΩ, 1/4W, 5%		9
R21		. (Same As R5)		

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-5				
R22,23		. (Same As R14)		
R24,25		. (Same As R19)		
R26		. (Same As R14)		
R27	200470-048	. RESISTOR, 100 Ω, 1/4W, 5%		2
R29,30		. (Same As R14)		
R31-33	200470-083	. RESISTOR, 3 kΩ, 1/4W, 5%		3
R34		. (Same As R19)		
R35	200470-088	. RESISTOR, 4.7 kΩ, 1/4W, 5%		3
R40-43	200054-384	. RESISTOR, 100 kΩ, 1/8W, 1%, RN55C		10
R44	200054-218	. RESISTOR, 1.82 kΩ, 1/8W, 1%, RN55C		1
R45-48		. (Same As R40)		
R49	200054-355	. RESISTOR, 49.9 kΩ, 1/8W, 1%, RN55C		5
R50	200054-373	. RESISTOR, 76.8 kΩ, 1/8W, 1%, RN55C		1
R51	200054-206	. RESISTOR, 1.37 kΩ, 1/8W, 1%, RN55C		2
R52	200054-442	. RESISTOR, 402 kΩ, 1/8W, 1%, RN55C		1
R53	200054-487	. RESISTOR, 1.21 MΩ, 1/8W, 1%, RN55C		1
R54		. (Same As R51)		
R55	200054-430	. RESISTOR, 301 kΩ, 1/8W, 1%, RN55C		1
R56,57		. (Same As R49)		
R58	200527-028	. POTENTIOMETER, 10 kΩ, 1/2W, 10%, Multi-Turn		1
R59,60		. (Same As R19)		
R61		. (Same As R49)		
R62	200054-427	. RESISTOR, 280 kΩ, 1/8W, 1%, RN55C		1
R63	200054-372	. RESISTOR, 75 kΩ, 1/8W, 1%, RN55C		1
R64	200054-474	. RESISTOR, 866 kΩ, 1/8W, 1%, RN55C		2
R65		. (Same As R19)		
R66		. (Same As R15)		
R67	200054-450	. RESISTOR, 487 kΩ, 1/8W, 1%, RN55C		1
R68	200054-374	. RESISTOR, 78.7 kΩ, 1/8W, 1%, RN55C		2
R70		. (Same As R68)		
R72	200054-463	. RESISTOR, 665 kΩ, 1/8W, 1%, RN55C		1
R73	200054-264	. RESISTOR, 5.62 kΩ, 1/8W, 1%, RN55C		1
R74	200054-388	. RESISTOR, 110 kΩ, 1/8W, 1%, RN55C		1
R75	200054-397	. RESISTOR, 137 kΩ, 1/8W, 1%, RN55C		2
R76	200054-193	. RESISTOR, 1 kΩ, 1/8W, 1%, RN55C		1
R77		. (Same As R75)		
R78		. (Same As R64)		
R79	200054-330	. RESISTOR, 27.4 kΩ, 1/8W, 1%, RN55C		1
R80	200054-279	. RESISTOR, 8.06 kΩ, 1/8W, 1%, RN55C		1
R82,83		. (Same As R40)		
R84		. (Same As R27)		
R85	200470-084	. RESISTOR, 3.3 kΩ, 1/4W, 5%,		1
R86	200054-338	. RESISTOR, 33.2 kΩ, 1/8W, 1%, RN55C		1
R87	200054-136	. RESISTOR, 255 Ω, 1/8W, 1%, RN55C		1
R88	200054-282	. RESISTOR, 8.66 kΩ, 1/8W, 1%, RN55C		1
R89	200054-202	. RESISTOR, 1.24 kΩ, 1/8W, 1%, RN55C		1
R90	200527-027	. POTENTIOMETER, 5 kΩ, 1/2W, 10%, Multi-Turn		1
R91	200470-087	. RESISTOR, 4.3 kΩ, 1/4W, 5%		1
R92	200470-100	. RESISTOR, 15 kΩ, 1/4W, 5%		2
R93,94	200470-065	. RESISTOR, 510 Ω, 1/4W, 5%,		2
R95	200471-060	. RESISTOR, 330 Ω, 1/2W, 5%		1
R96		. (Same As R14)		
R97		. (Same As R92)		
R98		. (Same As R49)		
R101		. (Same As R35)		
R102		. (Same As R5)		
R103	200470-093	. RESISTOR, 7.5 kΩ, 1/4W, 5%		1
R105	200054-469	. RESISTOR, 768 kΩ, 1/8W, 1%, RN55C		1
R106	200054-490	. RESISTOR, 1.3 MΩ, 1/8W, 1%		1
R107	200054-395	. RESISTOR, 130 kΩ, 1/8W, 1%		1
R108		. (Same As R35)		
R109		. (Same As R19)		
R110		. (Same As R14)		
RN1	200422-083	. RESISTOR NETWORK, 9 X 3.3 kΩ, 1.1W, 2%, 10 Pin		1
RN2	200422-085	. RESISTOR NETWORK, 9 X 4.7 kΩ, 1.1W, 2%, 10 Pin		1
RN3	200422-033	. RESISTOR NETWORK, 7 X 3.3 kΩ, 1.1W, 2%, 8 Pin		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-5				
RN4	200422-086	. RESISTOR NETWORK, 9 X 5.6 kΩ, 1.1W, 2%, 10 Pin		1
RN5	201240-033	. RESISTOR NETWORK, 4 X 1.0 kΩ, 1/3W, 2%, 8 Pin		1
TP1-16	801959-00	. TERMINAL, Test Point		16
T1	802615-00	. TRANSFORMER		1
U1	200181-000	. I.C., Digital, 4069UB, Inverter/Buffer		1
U2	200472-000	. I.C., Digital, MC14538, Monostable Multivibrator		1
U3	200333-000	. I.C., Digital, 74LS138, Decoder/Demultiplexer		1
U4	201497-000	. I.C., Digital, 74LS08, AND Gate		1
U5	201458-000	. I.C., Digital, 74HC04, Inverter		1
U6	201454-000	. I.C., Digital, 74LS125, Buffer		1
U7	201392-000	. I.C., Digital, MC146805E2, Microprocessor		1
U8	201463-000	. I.C., Digital, MC146818, Real Time Clock, With RAM		1
U9	802486-01	. I.C., Digital, D446/5517, RAM, Static, 2K X 8		1
U10	803292-103	. I.C., Digital, 27128, EPROM		1
U11	201468-000	. I.C., Digital, PAL12L10MJ, Programmable Logic Array		1
U12	201309-000	. I.C., Digital, 74LS245, Transceiver		2
U13	200340-000	. I.C., Digital, 74LS373, Latch		2
U14	201318-001	. I.C., Digital, MC68A09, Microprocessor		1
U15	201511-000	. I.C., Digital, 74HC244, Buffer		1
U16	201510-000	. I.C., Digital, 74HC373, Latch		1
U17		. (Same As U12)		
U18	201509-000	. I.C., Digital, PAL12L6, Programmable Logic Array		1
U19	200227-000	. I.C., Linear, LM340T5, Voltage Regulator, +5V		1
U20	200332-000	. I.C., Digital, 74LS04, Inverter/Buffer		1
U21	200342-000	. I.C., Digital, 74LS00, NAND Gate		1
U22		. (Same As U13)		
U24	201732-000	. I.C., Digital, RAM, Static, 8K X 8		1
U25	803004-XXX	. (See Final Assembly Parts List, Figure 5-1)		1
U26	803004-102	. I.C., Digital, 2764, EPROM		1
U27	200856-000	. I.C., Interface, 7510DIJN, Analog Gate		1
U28	200287-000	. I.C., Linear, TL064, Op Amp		1
U29	201388-000	. I.C., Digital, AD7501JN, Multiplexer		1
U30	200806-001	. I.C., Linear, LM311N, Voltage Comparator		1
U31	200254-000	. I.C., Linear, LF355N, Op Amp		2
U32	801194-00	. I.C., Interface, 7541, D/A Converter		1
U33	200580-000	. I.C., Linear, TL494CN, Voltage Reference		1
U34	200287-001	. I.C., Linear, TL064A, Op Amp		1
U35	200855-000	. I.C., Linear, LF398N, Sample & Hold		1
U36		. (Same As U31)		
U37	200487-000	. I.C., Linear, LF353, Op Amp		1
U38	200414-008	. I.C., Linear, LM317LZ, Voltage Regulator, TO-92		1
U39	200673-007	. I.C., Linear, 78L12, Voltage Regulator, +12V, TO-92		1
U40	200203-002	. I.C., Linear, 79L12, Voltage Regulator, -12V, TO-92		1
U41	201545-000	. I.C., Crystal Oscillator, 5MHz		1
XU1	200907-019	. SOCKET, DIP, 14 Contact		8
XU2,3	200907-020	. SOCKET, DIP, 16 Contact		5
XU4-6		. (Same As XU1)		
XU7	200907-026	. SOCKET, DIP, 40 Contact		2
XU8,9	200907-024	. SOCKET, DIP, 24 Contact		2
XU10	200675-026	. SOCKET, DIP, 28 Contact		1
XU11	201525-000	. SOCKET, DIP, 24 Contact		1
XU12,13	200675-024	. SOCKET, DIP, 20 Contact		4
XU14		. (Same As XU7)		
XU15,16	200907-022	. SOCKET, DIP, 20 Contact		3
XU17		. (Same As XU12)		
XU18		. (Same As XU15)		
XU20,21		. (Same As XU1)		
XU22		. (Same As XU12)		
XU24-26	200907-025	. SOCKET, DIP, 28 Contact		3
XU27		. (Same As XU2)		
XU28		. (Same As XU1)		
XU29		. (Same As XU2)		
XU30,31	200907-018	. SOCKET, DIP, 8 Contact		5

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-5				
XU32	200907-021	. SOCKET, DIP, 18 Contact		1
XU33		. (Same As XU2)		
XU34		. (Same As XU1)		
XU35-37		. (Same As XU30)		
Y1	200417-003	. CRYSTAL, 32.768KHz		1
2	201526-001	. BUSS BAR, High Capacitance, 7 Pitches		2
3	201176-000	. CONNECTOR, Receptacle, Jumper, 2 Contact		9
4	201734-000	. HEAT SINK, Transistor, Black, TO-220		1
5	201797-004	. INSULATOR, Heat Sink, Silipad, TO-220		1
6	90-03021	. NUT, Hex, Kep, 6-32 X .250W/.098T		2
7	200476-792	. SCREW, Pan Head, 6-32 X .250 L		1
8	200476-796	. SCREW, Pan Head, 6-32 X .500 L		1
9	201124-540	. SPACER, Round, Fiber, .250 D X .125 L		1
10	90-09138	. WIRE, Solid, Noninsulated, AWG #22		A/R

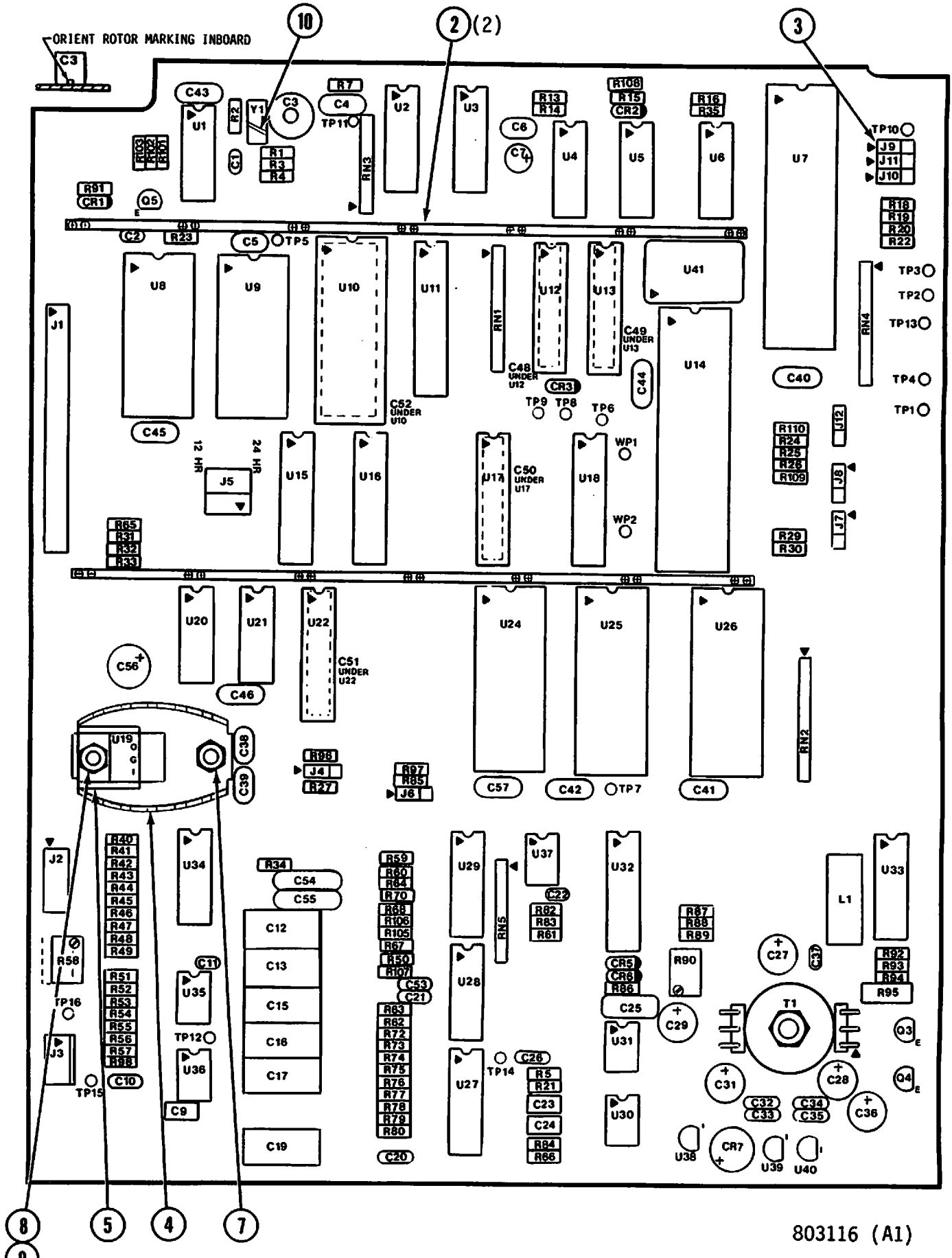
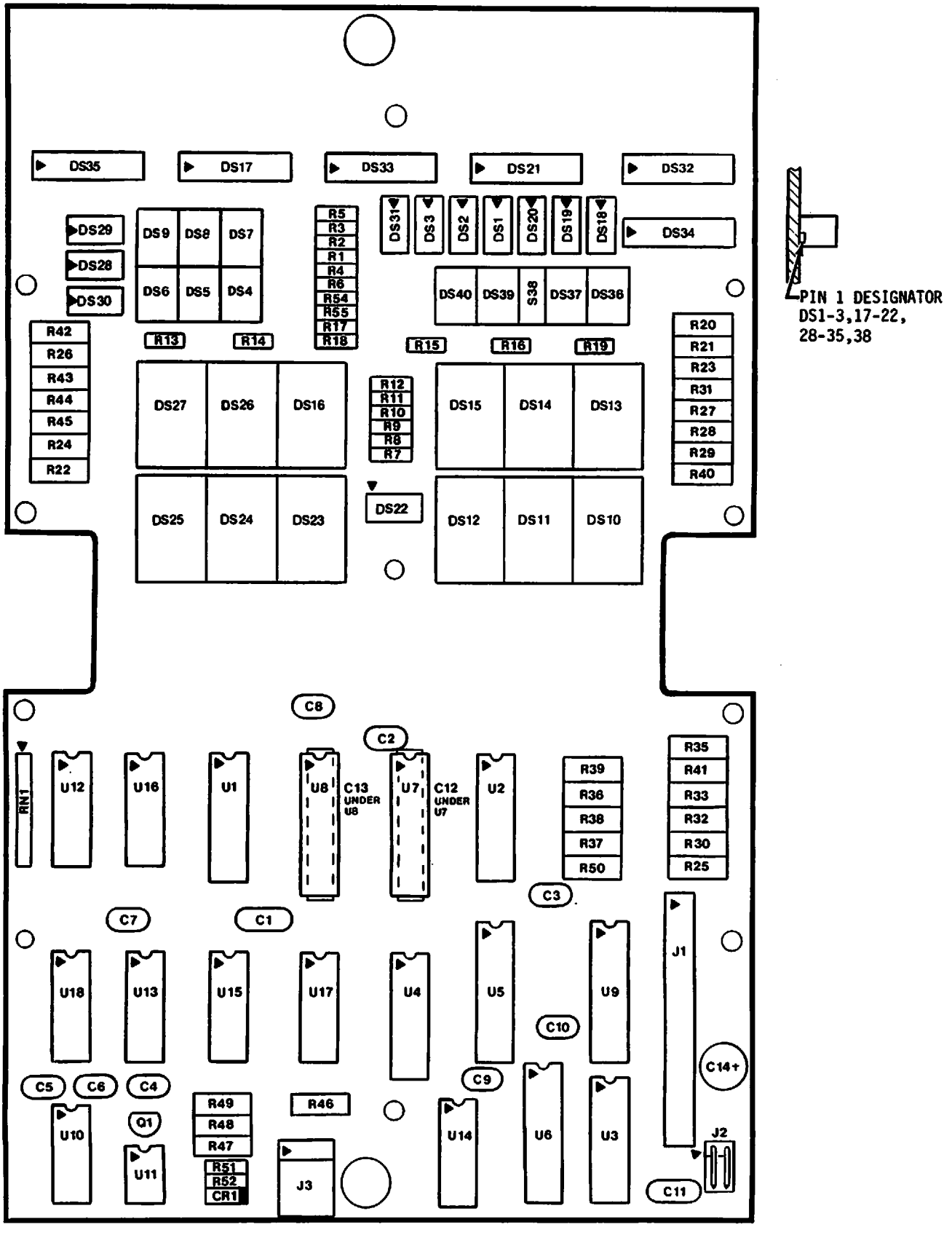


FIGURE 5-5. SYSTEM PCB ASSEMBLY
(SHEET 1 OF 6)

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-6				
A2	802583-01	DISPLAY PFC ASSEMBLY		REF
C1	200893-046	. CAPACITOR, 1.0µF/50V, 10%		2
C2-4	200893-034	. CAPACITOR, .10µF/50V, 10%		7
C5	200901-054	. CAPACITOR, .047µF/50V, 5%		1
C6	200901-046	. CAPACITOR, .01µF/50V, 5%		1
C7-10		. (Same As C2)		
C11		. (Same As C1)		
C12,13	201679-003	. CAPACITOR, .03µF/50V, +100-20%, 20 Pin		2
C14	200701-000	. CAPACITOR, Electrolytic, 47µF/10V, 20%		1
CR1	200971-000	. DIODE, 1N914B, 8nS, PIV 75		1
DS1-3	802342-68	. LED, Display, Lightbar, Red		8
DS4-9	201570-009	. LED, Display, 7 Segment, Green		10
DS10-16	802994-02	. LED, Display, 7 Segment, Red		12
DS17	802342-52	. LED, Display, Lightbar, Red		3
DS18-20		. (Same As DS1)		
DS21		. (Same As DS17)		
DS22		. (Same As DS1)		
DS23-27		. (Same As DS10)		
DS28-30	802342-78	. LED, Display, Lightbar, Green		4
DS31		. (Same As DS1)		
DS32	802342-62	. LED, Display, Lightbar, Green		2
DS33	802342-57	. LED, Display, Lightbar, Yellow		1
DS34		. (Same As DS17)		
DS35		. (Same As DS32)		
DS36,37		. (Same As DS4)		
DS38		. (Same As DS28)		
DS39,40		. (Same As DS4)		
J1	200397-016	. CONNECTOR, Plug, 34 Contact		1
J2	200892-000	. CONNECTOR, Plug, 2 Contact		1
J3	200892-002	. CONNECTOR, Plug, 4 Contact		1
Q1	801508-01	. TRANSISTOR, PNP, 2N3906, TO-92		1
R1-6	200470-021	. RESISTOR, 7.5 Ω, 1/4W, 5%		13
R7-12	200470-011	. RESISTOR, 3.0 Ω, 1/4W, 5%		8
R13-19		. (Same As R1)		
R20-25	200471-037	. RESISTOR, 36 Ω, 1/2W, 5%		22
R26	200471-039	. RESISTOR, 43 Ω, 1/2W, 5%		1
R27-33	200471-038	. RESISTOR, 39 Ω, 1/2W, 5%		7
R35-50		. (Same As R20)		
R51	200470-083	. RESISTOR, 3 kΩ, 1/4W, 5%		1
R52	200470-092	. RESISTOR, 6.8 kΩ, 1/4W, 5%		1
R54,55		. (Same As R7)		
RN1	200422-038	. RESISTOR NETWORK, 7 X 10 kΩ, 1.1W, 2%, 8 Pin		1
U1-4	802309-00	. I.C., Linear, UDN2981, High Voltage Driver		4
U5-9	802310-00	. I.C., Digital, 74HC373, Latch ATTENTION		5
U10	802454-00	. I.C., Digital, 74LS14, Inverter		1
U11	801139-00	. I.C., Digital, NE555, Timer		1
U12-18	803297-06	. I.C., Linear, ULN2068B, Darlington Switch		7
2	200655-003	. STANDOFF, Round, .250 X 3/16L (Not Shown)		3



802583 (A2)

FIGURE 5-6. DISPLAY PFC ASSEMBLY
(SHEET 1 OF 4)

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PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-7				
W1	802673-02	INTERFACE/SERVO/PRESSURE SWITCH/VOLUME WIRE HARNESS		REF
P1	200389-044	. CONNECTOR, Receptacle, 20 Contact		1
P2	200389-008	. CONNECTOR, Receptacle, 9 Contact		1
P3,4	200267-000	. TERMINAL, Receptacle, Quick Disconnect, Insulated, #22-18 AWG		2
R1	201584-001	. POTENTIOMETER, 5kΩ, 1 Turn		1
2	200536-009	. RETAINER, Cable Tie, Nylon		9
3	200979-115	. TERMINAL, Receptacle, Crimp, #22-26 AWG		8
4	201485-001	. CONNECTOR, Pin, Crimp, #22-26 AWG		15
5	200357-109	. WIRE, Stranded, PVC, 300V, #22, CSA, Black		A/R
6	200357-116	. WIRE, Stranded, PVC, 300V, #22, CSA, Gray		A/R
7	200357-111	. WIRE, Stranded, PVC, 300V, #22, CSA, Green		A/R
8	200357-115	. WIRE, Stranded, PVC, 300V, #22, CSA, Orange		A/R
9	200357-110	. WIRE, Stranded, PVC, 300V, #22, CSA, Red		A/R
10	200357-108	. WIRE, Stranded, PVC, 300V, #22, CSA, White		A/R
11	200357-112	. WIRE, Stranded, PVC, 300V, #22, CSA, Yellow		A/R

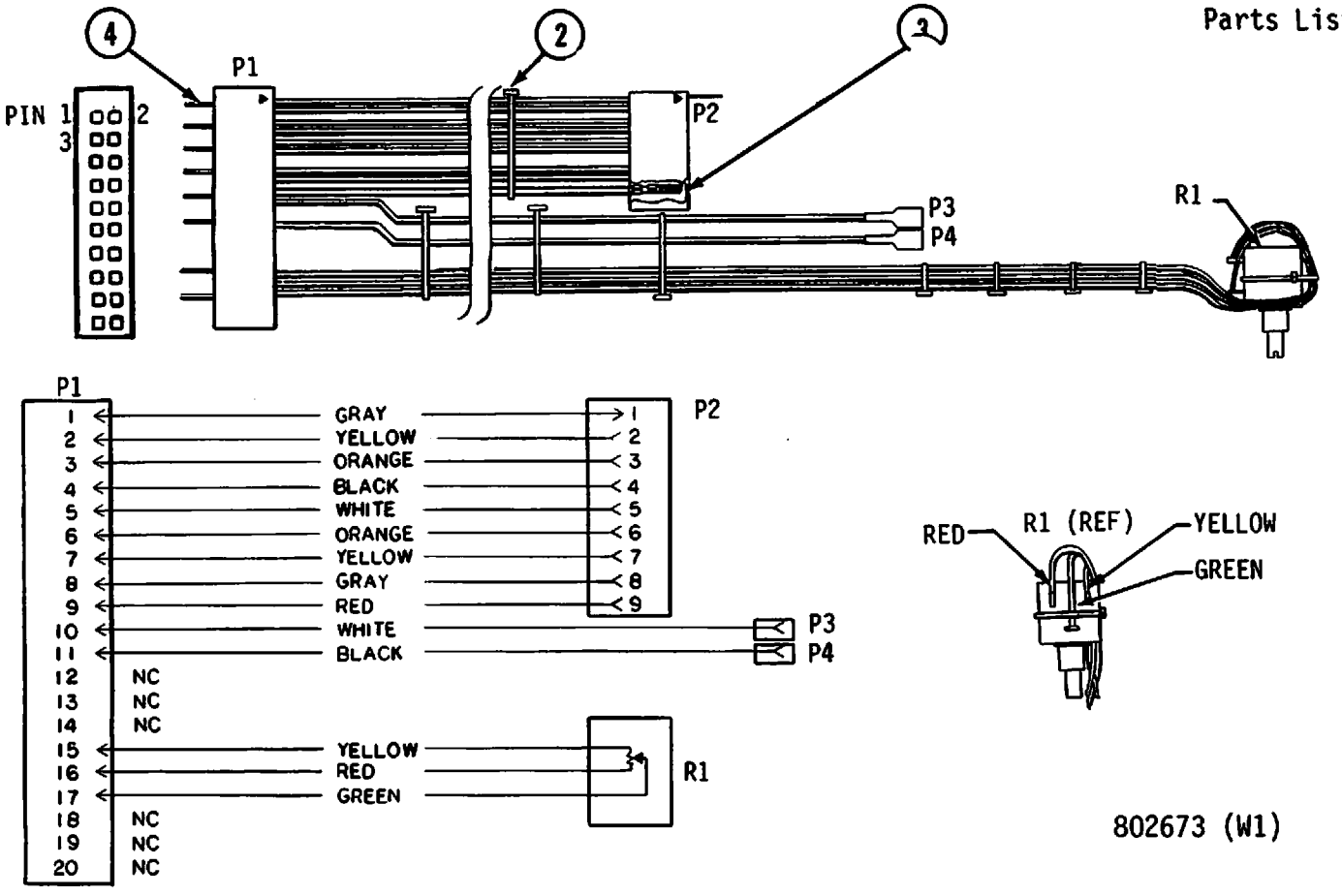


FIGURE 5-7. INTERFACE/SERVO/PRESSURE SWITCH/VOLUME WIRE HARNESS

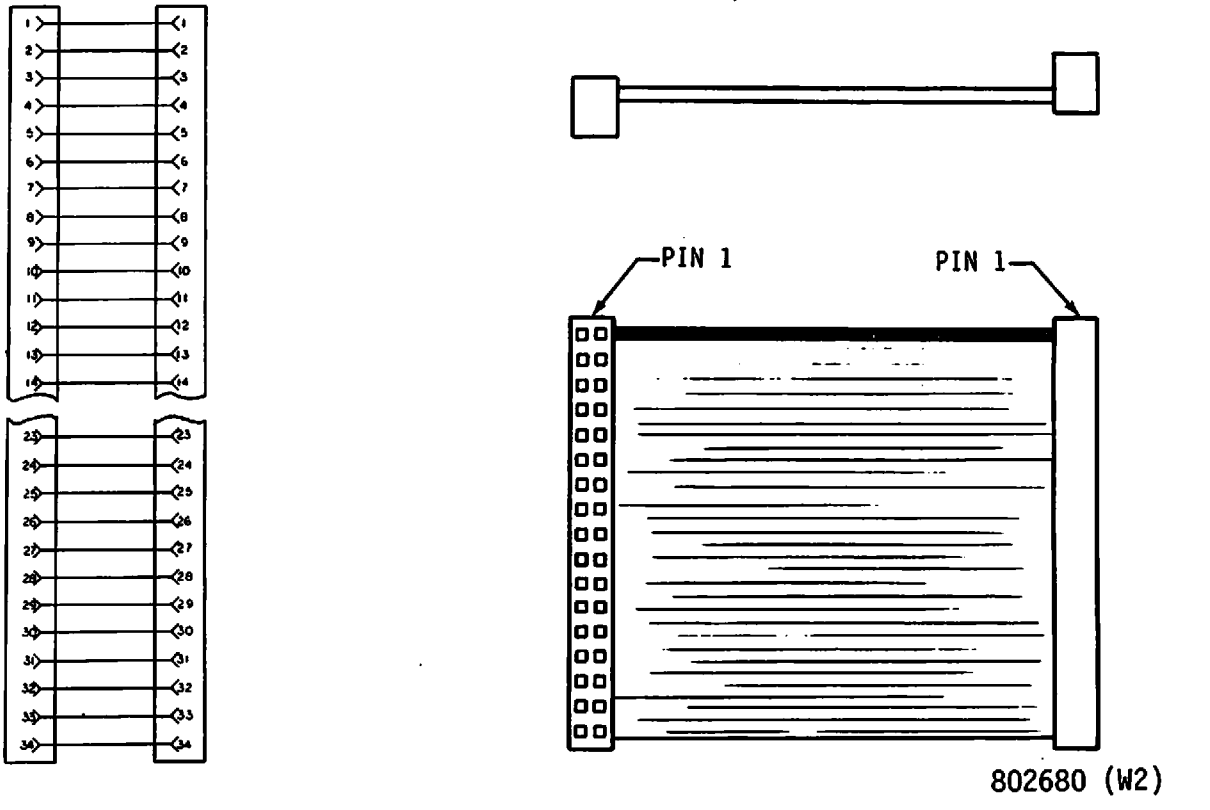


FIGURE 5-8. INTERFACE/DISPLAY RIBBON CABLE

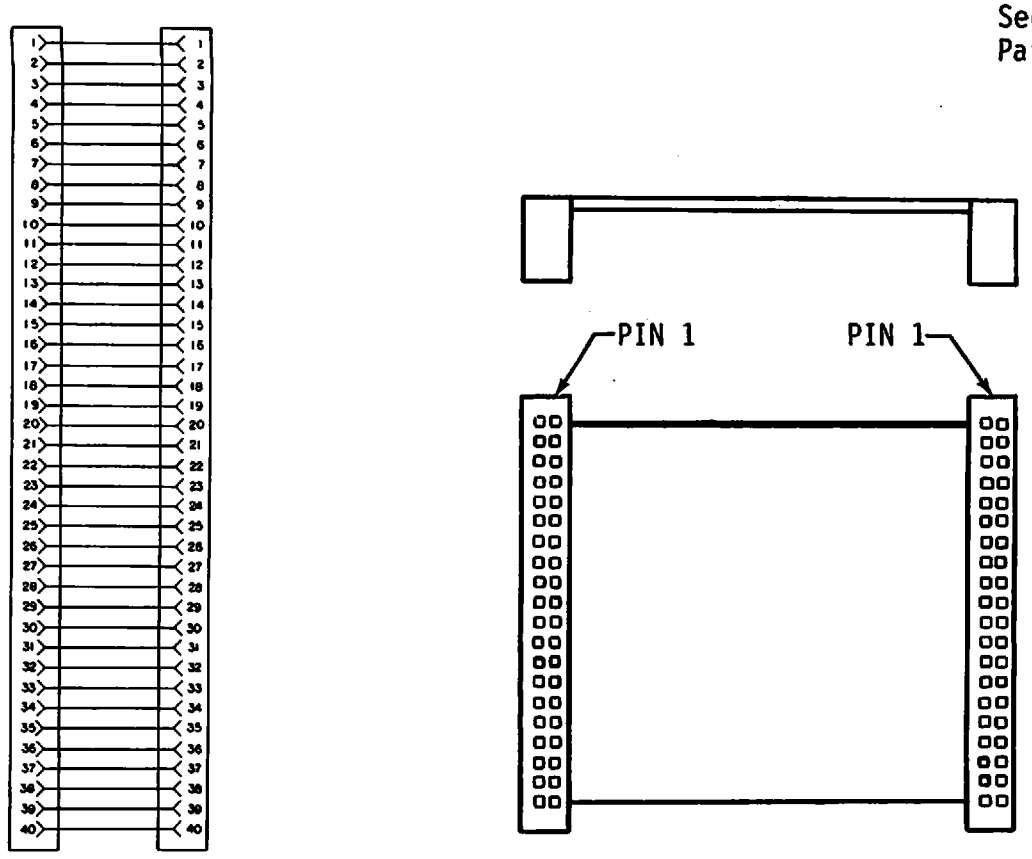


FIGURE 5-9. SYSTEM/INTERFACE RIBBON CABLE 802267 (W3)

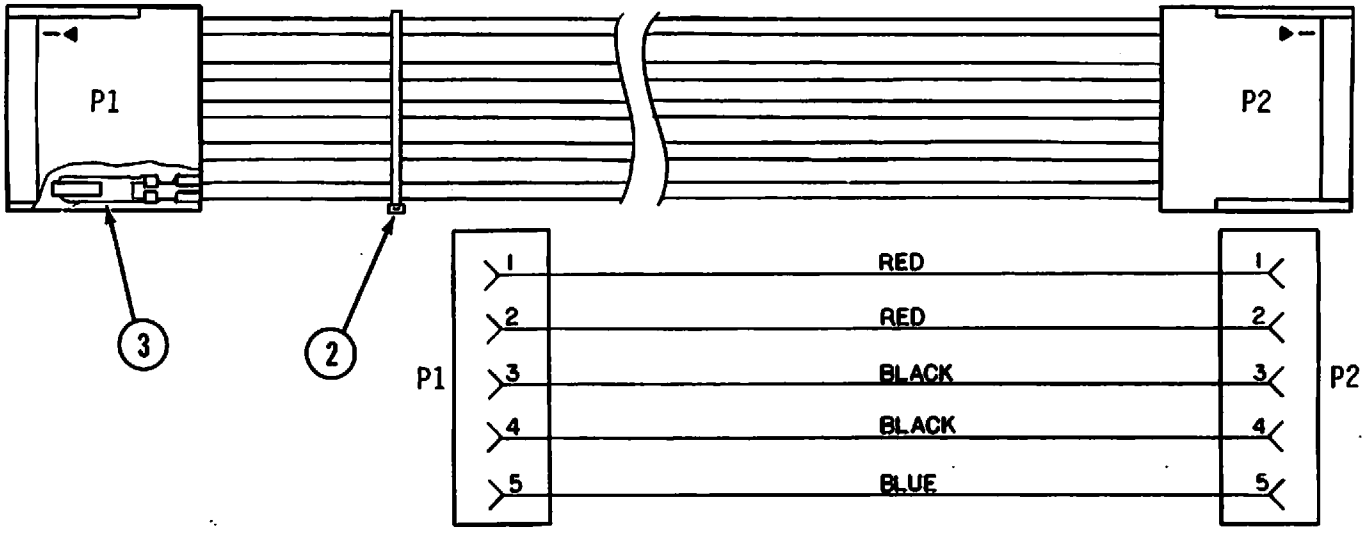


FIGURE 5-10. POWER SUPPLY/INTERFACE WIRE HARNESS 802675 (W4)

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-10 W4	802675-00	POWER SUPPLY/INTERFACE WIRE HARNESS		REF
P1,2	200419-022	. CONNECTOR, Receptacle, Locking, 5 Contact		2
2	200536-009	. RETAINER, Cable Tie, Nylon		4
3	200390-004	. TERMINAL, Socket, Crimp, #22-30 AWG		10
4	200357-109	. WIRE, Stranded, PVC, 300V, #22, CSA, Black		A/R
5	200357-113	. WIRE, Stranded, PVC, 300V, #22, CSA, Blue		A/R
6	200357-110	. WIRE, Stranded, PVC, 300V, #22, CSA, Red		A/R

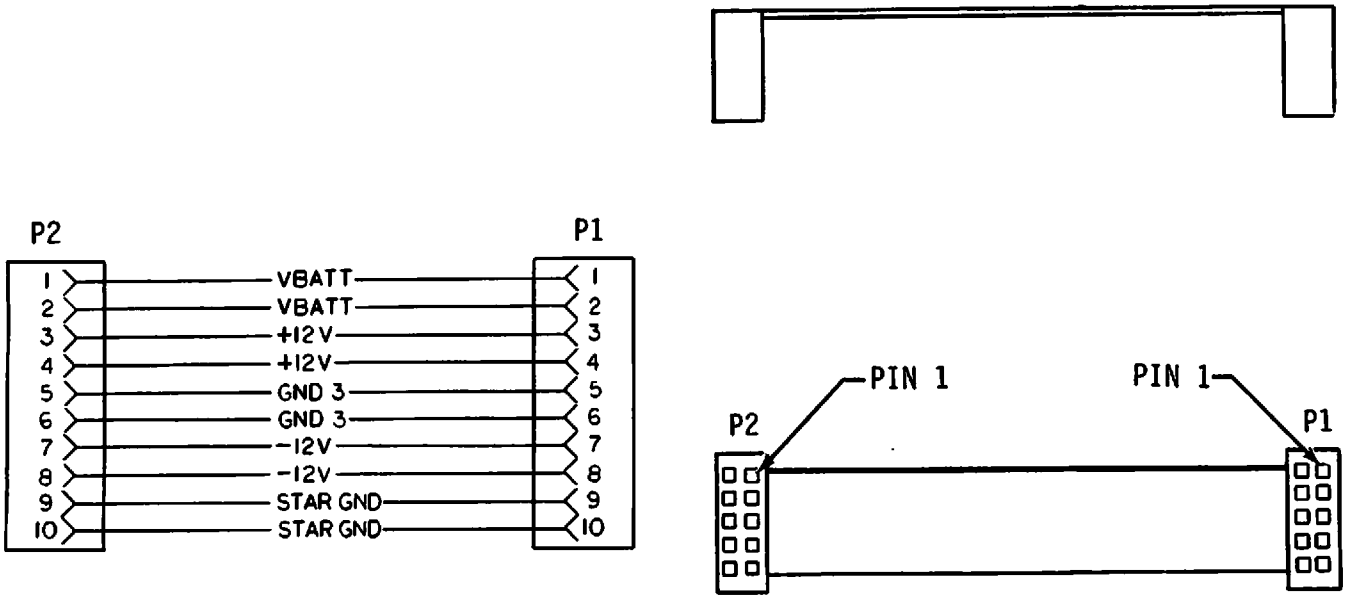


FIGURE 5-11. INTERFACE/SYSTEM POWER RIBBON CABLE

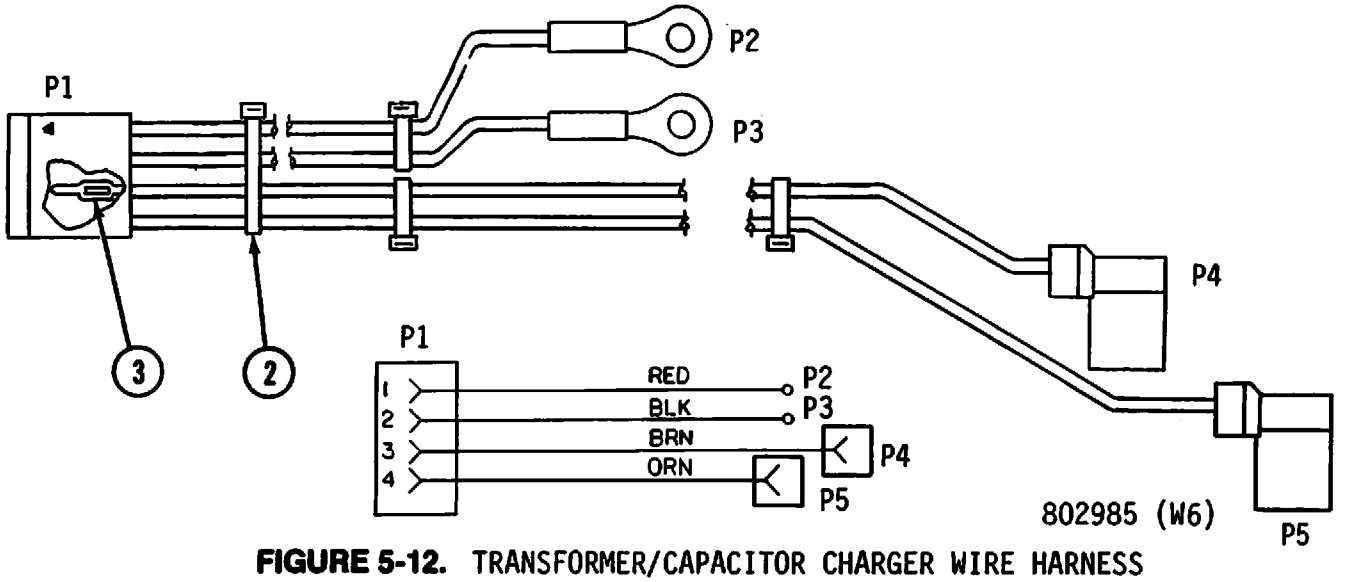


FIGURE 5-12. TRANSFORMER/CAPACITOR CHARGER WIRE HARNESS

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-12 W6	802985-01	TRANSFORMER/CAPACITOR CHARGER WIRE HARNESS		REF
P1	200277-002	. CONNECTOR, Receptacle, 4 Contact		1
P2,3	200276-209	. TERMINAL, Lug, Ring, #10, 22-16 AWG		2
P4,5	200514-006	. TERMINAL, Receptacle, Quick Disconnect, Insulated, 22-18 AWG		2
2	200536-009	. RETAINER, Cable Tie, Nylon		4
3	200390-016	. TERMINAL, Crimp, #18-24 AWG		4
4	200357-055	. WIRE, Stranded, PVC, 300V, #18, CSA, Black		A/R
5	200357-060	. WIRE, Stranded, PVC, 300V, #18, CSA, Brown		A/R
6	200357-061	. WIRE, Stranded, PVC, 300V, #18, CSA, Orange		A/R
7	200357-056	. WIRE, Stranded, PVC, 300V, #18, CSA, Red		A/R

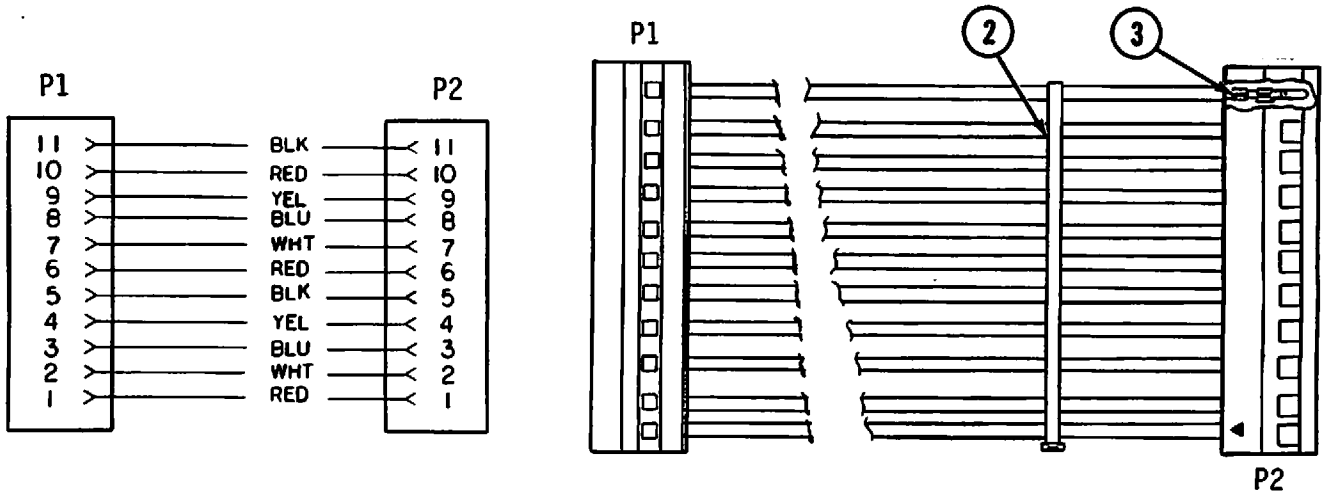
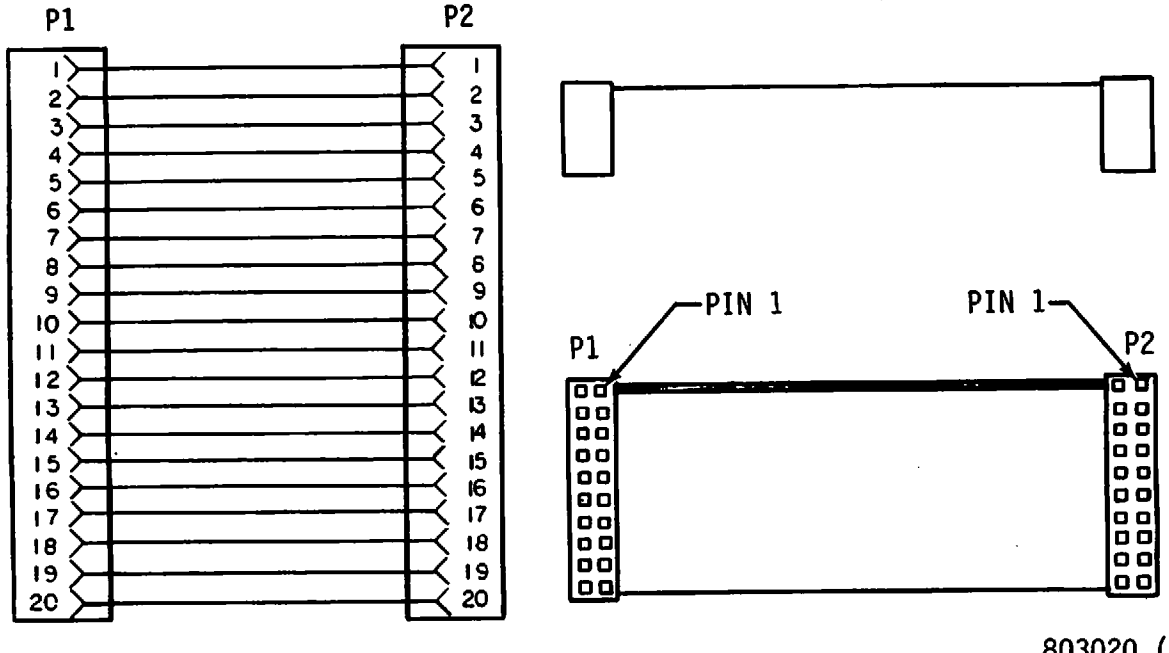


FIGURE 5-13. INTERFACE/PRINTER WIRE HARNESS

803012 (W7)

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-13 W7	803012-00	INTERFACE/PRINTER WIRE HARNESS		REF
P1	201662-090	. CONNECTOR, Mass Termination Assembly, 11 Circuits		1
P2	200389-010	. CONNECTOR, Receptacle, 11 Contacts		1
2	200536-009	. RETAINER, Cable Tie, Nylon		1
3	200979-115	. TERMINAL, Receptacle, Crimp, #22-26 AWG		11
4	200357-109	. WIRE, Stranded, PVC, 300V, #22, CSA, Black		A/R
5	200357-113	. WIRE, Stranded, PVC, 300V, #22, CSA, Blue		A/R
6	200357-110	. WIRE, Stranded, PVC, 300V, #22, CSA, Red		A/R
7	200357-108	. WIRE, Stranded, PVC, 300V, #22, CSA, White		A/R
8	200357-112	. WIRE, Stranded, PVC, 300V, #22, CSA, Yellow		A/R



803020 (W9)

FIGURE 5-14. INTERFACE/HARNESS RIBBON CABLE

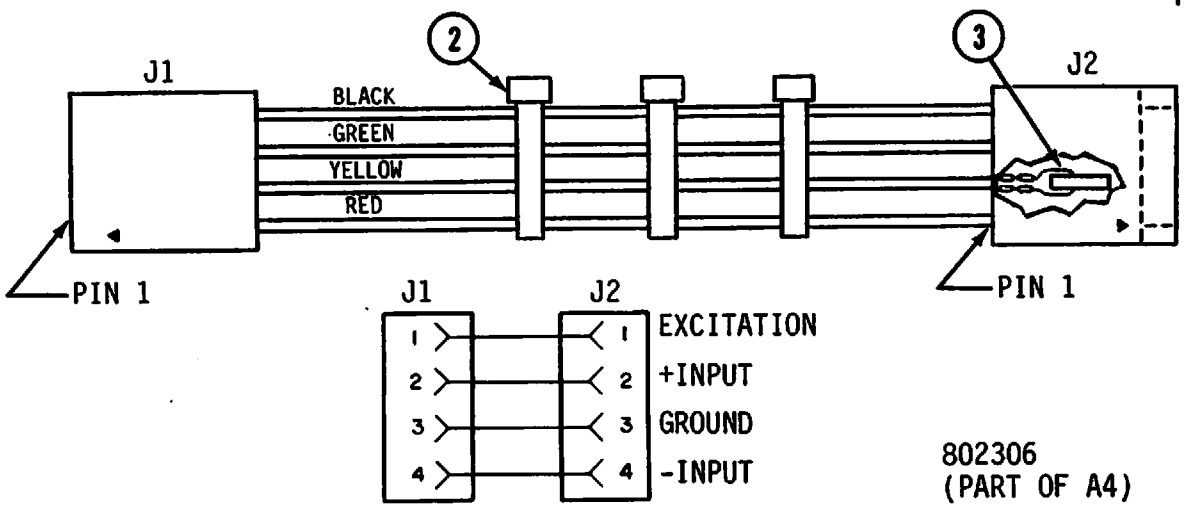


FIGURE 5-15. PRESSURE TRANSDUCER WIRE HARNESS

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-15	802306-02	PRESSURE TRANSDUCER WIRE HARNESS		REF
J1	200419-002	. CONNECTOR, Receptacle, 4 Contact		1
J2	200419-021	. CONNECTOR, Receptacle, 4 Contact		1
2	200536-009	. RETAINER, Cable Tie, Nylon		3
3	200390-002	. TERMINAL, Crimp, #22-30		8
4	200357-109	. WIRE, Stranded, PVC, 300V, #22, CSA, Black		A/R
5	200357-111	. WIRE, Stranded, PVC, 300V, #22, CSA, Green		A/R
6	200357-110	. WIRE, Stranded, PVC, 300V, #22, CSA, Black		A/R
7	200357-112	. WIRE, Stranded, PVC, 300V, #22, CSA, Yellow		A/R

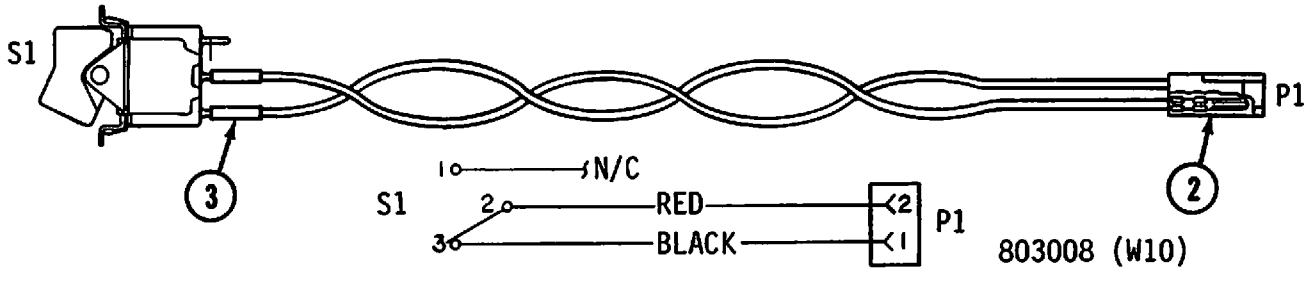


FIGURE 5-16. ON/OFF SWITCH HARNESS

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-16 W10	803008-01	ON/OFF SWITCH HARNESS		REF
P1	200419-019	. CONNECTOR, Receptacle, 2 Contact		1
S1	802674-01	. SWITCH, Rocker, ON/OFF		1
2	200390-000	. TERMINAL, Crimp, #22-30		2
3	200283-003	. TUBING, Heat Shrink, Red, .125ID		A/R
4	200357-109	. WIRE, Stranded, PVC, 300V, #22, CSA, Black		A/R
5	200357-110	. WIRE, Stranded, PVC, 300V, #22, CSA, Red		A/R

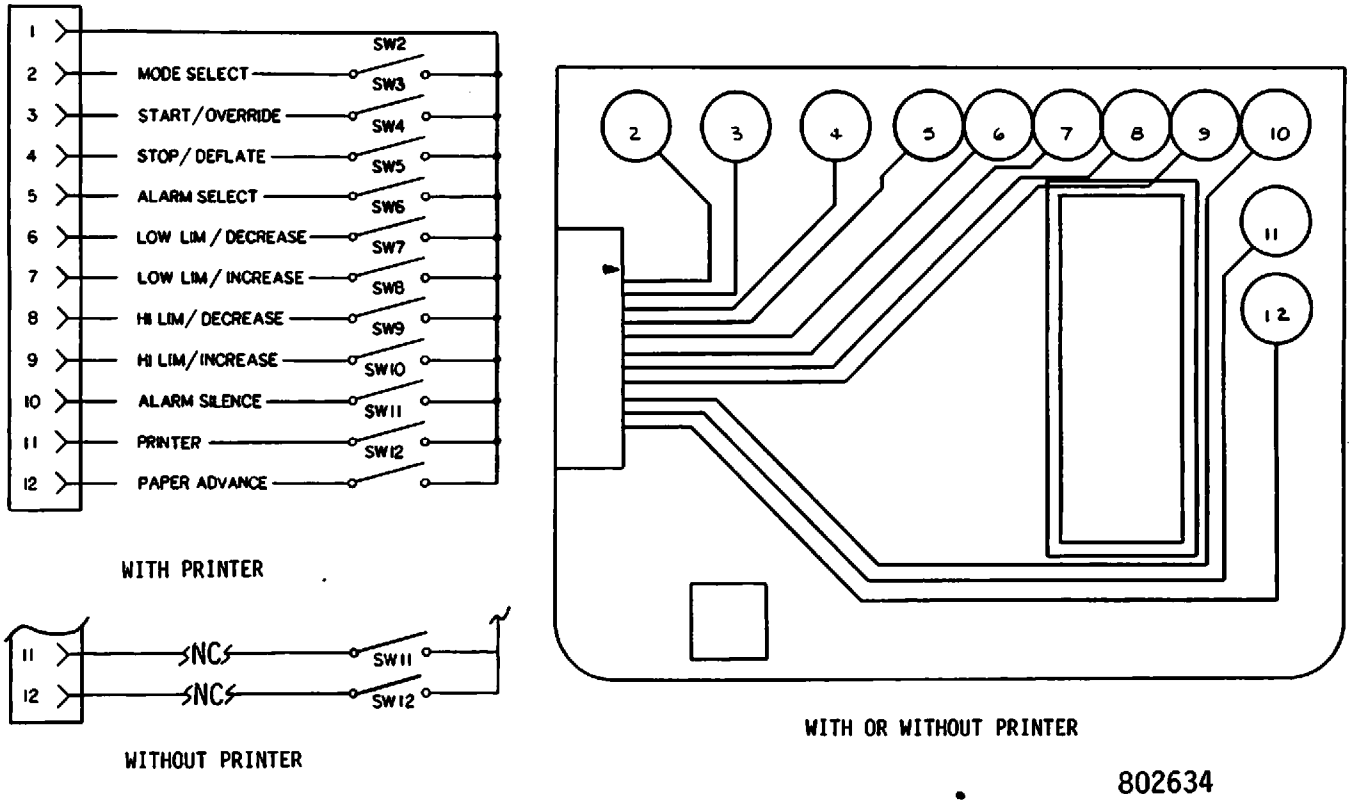


FIGURE 5-17. DOOR MEMBRANE SWITCH

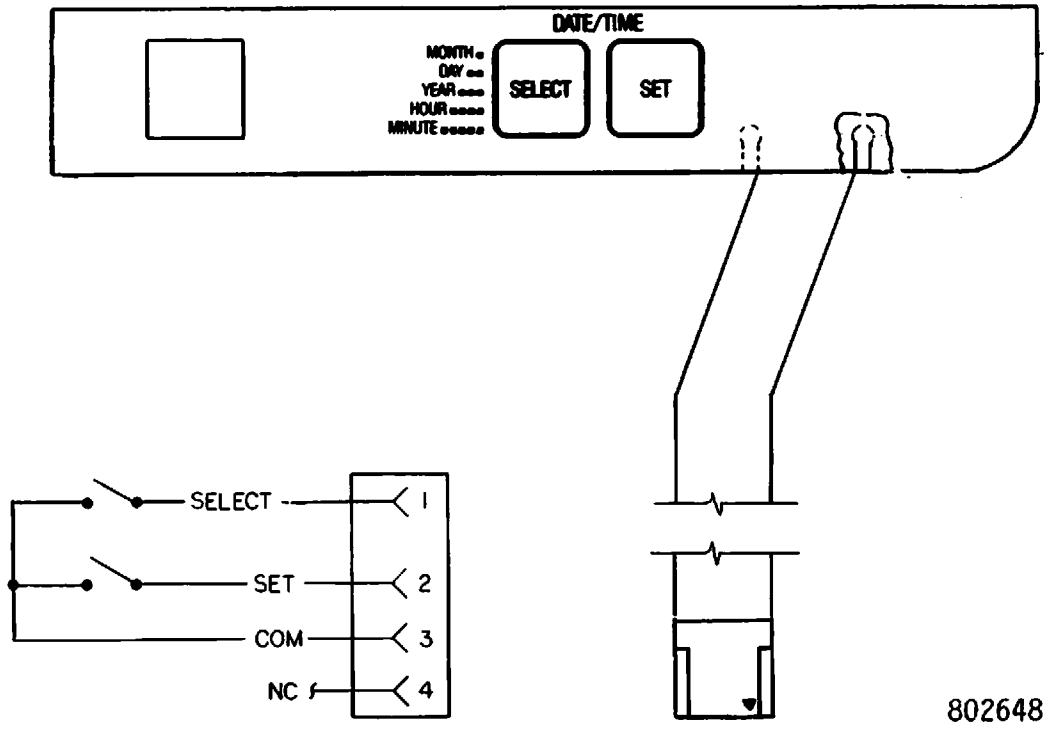


FIGURE 5-18. DATE/TIME MEMBRANE SWITCH

SECTION 6
COMPONENT REFERENCE DIAGRAMS

6-1. GENERAL

This section provides information about selected components in the LS 200. The pin configurations, function tables and block diagrams are provided as reference material for analyzing circuits and troubleshooting. Figures 6-1 to 6-26 are arranged alphabetically by IC type.

TABLE 6-1

LS 200 COMPONENT REFERENCE DIAGRAMS

LOCATION	REF. DES.	IC NUMBER	TYPE	FIG. NO
Battery Charger (A6)	U1	TL494	Voltage Regulator, Switching	6-26
Display (A2)	U5-U9	74HC373	Latch	6-12
	U11	NE555	Timer	6-22
	U12-U18	ULN2068B	Switch,Darlington	6-21
Interface (A5)	U1	MC14536	Timer,Programmable	6-23
	U4	74LS138	Decoder/Demultiplexer	6-7
	U5	74HC273	Flip-Flop,D Type	6-10
	U8	14520B	Counter,Up	6-5
	U9	6651A	ACIA (UART)	6-1
	U10	74LS245	Transceiver, Bus	6-24
	U12	DLG-12	Printer Controller	6-17
	U16-U18	74HC244	Buffer	6-3
	U19	2013A	Switch, Darlington	6-20
	U20	74HC373	Latch	6-12
	U24	ICL8212	Voltage Detector	6-25
System (A1)	U2	MC14538	Multivibrator,Monostable	6-16
	U3	74LS138	Decoder/Demultiplexer	6-7
	U6	74LS125	Buffer,Tri-State	6-2
	U7	MC146805E2	Microprocessor	6-13

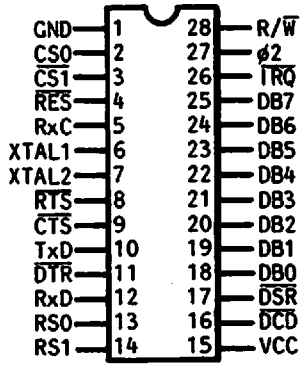
TABLE 6-1 (Continued)

LS 200 COMPONENT REFERENCE DIAGRAMS (Continued)

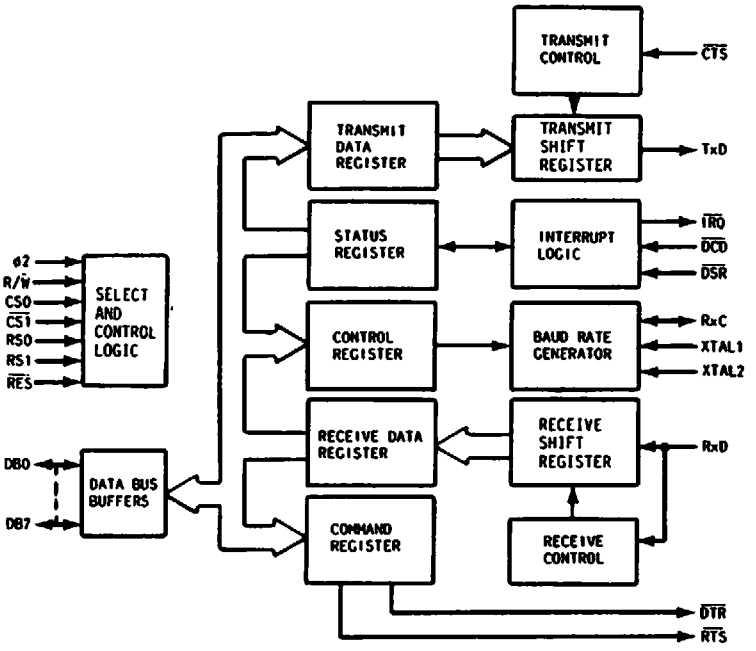
LOCATION	REF. DES.	IC NUMBER	TYPE	FIG. NO
System (Cont)	U8	146818	Clock,Real Time w/Ram	6-4
	U9	D446/5517	RAM,Static, 2K X 8	6-18
	U10	27128	EPROM, 16K X 8	6-9
	U12	74LS245	Transceiver, Bus	6-24
	U13	74LS373	Latch	6-12
	U14	MC68A09	Microprocessor	6-14
	U15	74HC244	Buffer	6-3
	U16	74HC373	Latch	6-12
	U17	74LS245	Transceiver, Bus	6-24
	U22	74LS373	Latch	6-12
	U24		RAM,Static, 8K X 8	6-19
	U26	2764	EPROM, 8K X 8	6-8
	U27	7510DIJN	Gate, Analog	6-11
	U29	AD7501JN	Multiplexer	6-15
	U32	7541	D/A Converter	6-6
	U33	TL494CN	Voltage Regulator,Switching	6-26

TYPE	IC NUMBER	LOCATION	REF. DES.
ACIA (UART)	6651A	INTERFACE (A5)	U9

ATTENTION



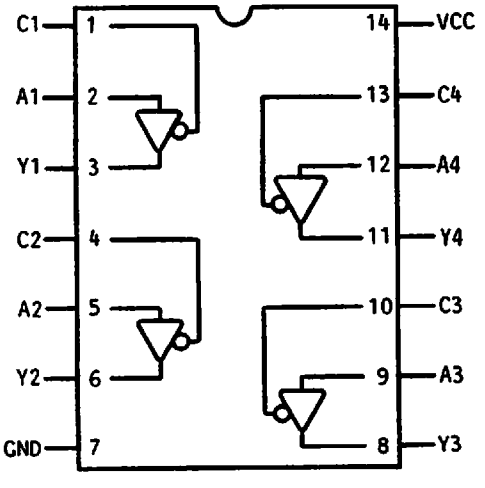
PIN CONFIGURATION



BLOCK DIAGRAM

FIGURE 6-1.

TYPE	IC NUMBER	LOCATION	REF. DES.
BUFFER, TRI-STATE	74LS125	SYSTEM (A1)	U6



CONNECTION DIAGRAM

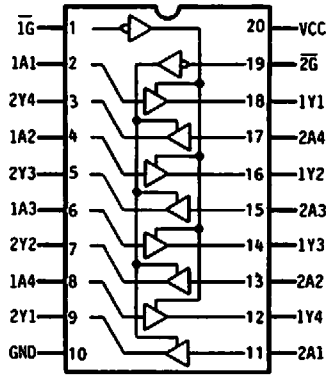
INPUTS		OUTPUT
A	C	Y
H	L	H
L	L	L
X	H	HI-Z

Y = A
H = High level
L = Low level
X = Irrelevant

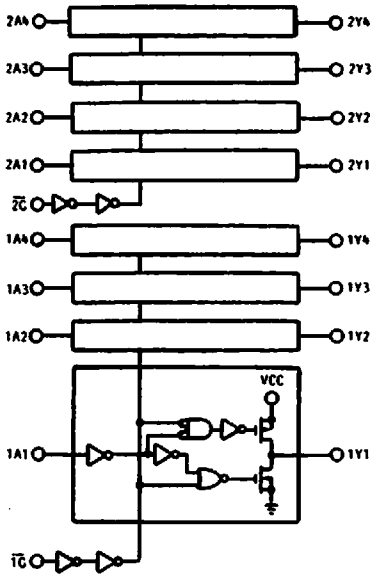
FUNCTION TABLE

FIGURE 6-2.

TYPE	IC NUMBER	LOCATION	REF. DES.
BUFFER	74HC244	INTERFACE (A5) SYSTEM (A1)	U16-U18 U15



CONNECTION DIAGRAM



FUNCTIONAL DIAGRAM

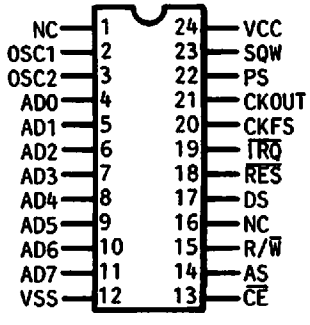
1G	1A	1Y	2G	2A	2Y
L	L	L	L	L	L
L	H	H	L	H	H
H	L	Z	H	L	Z
H	H	Z	H	H	Z

H = High level
L = Low level
Z = High impedance output state

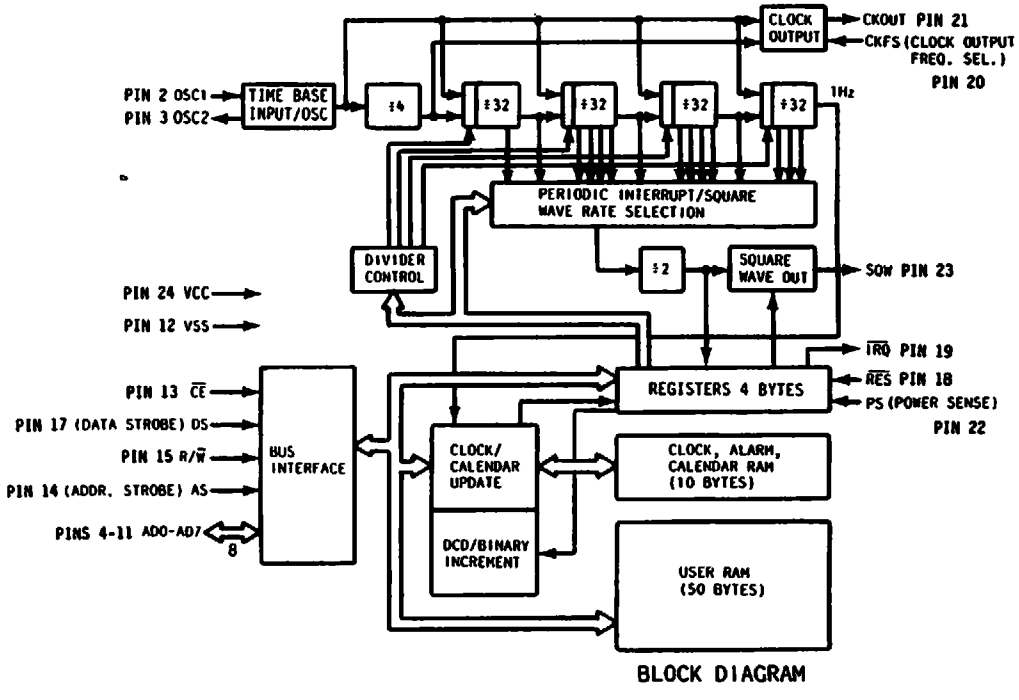
FUNCTION TABLE

FIGURE 6-3.

TYPE	IC NUMBER	LOCATION	REF. DES.
CLOCK, R.T. W/RAM	146818	SYSTEM (A1)	U8



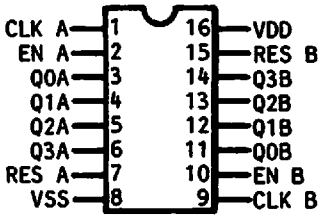
PIN CONFIGURATION



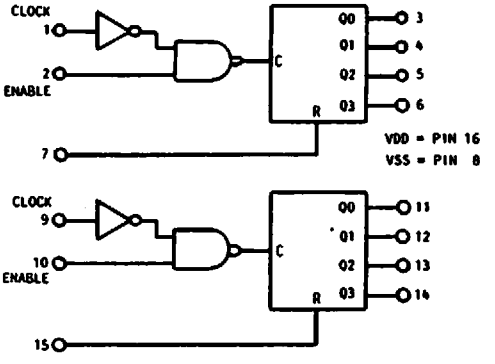
BLOCK DIAGRAM

FIGURE 6-4.

TYPE	IC NUMBER	LOCATION	REF. DES.
COUNTER, UP	14520B	INTERFACE (A5)	U8



PIN CONFIGURATION



FUNCTIONAL DIAGRAM

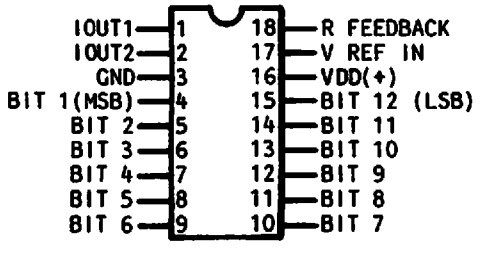
CLOCK	ENABLE	RESET	ACTION
↑	1	0	Increment Counter
0	↑	0	Increment Counter
↑	X	0	No Change
X	↓	0	No Change
↓	0	0	No Change
1	↓	0	No Change
X	X	1	Q0 thru Q3 = 0

X = Irrelevant
↑ = Transition from Low to High
↓ = Transition from High to Low

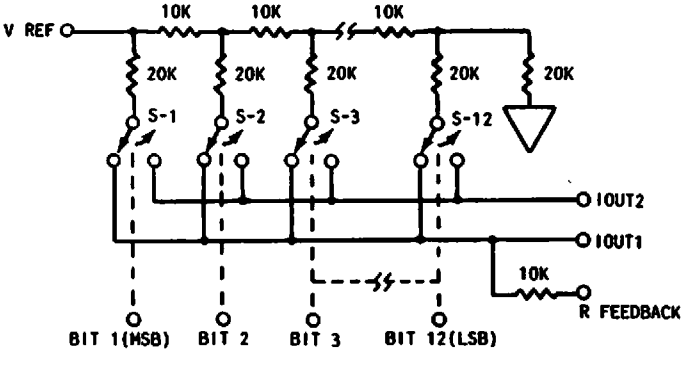
FUNCTION TABLE

FIGURE 6-5.

TYPE	IC NUMBER	LOCATION	REF. DES.
D/A CONVERTER	7541	SYSTEM (A1)	U32



PIN CONFIGURATION

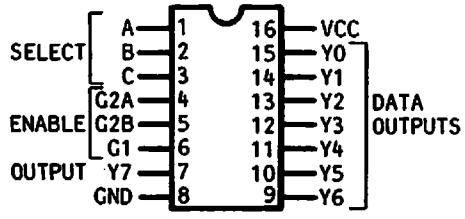


LOGIC: A SWITCH IS CLOSED TO IOUT1 FOR ITS DIGITAL INPUT IN A "HIGH" STATE.

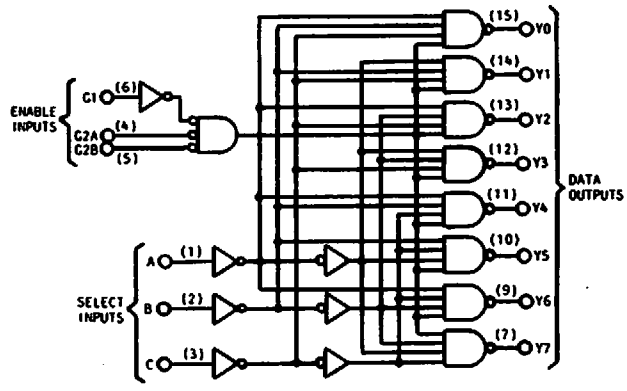
FUNCTIONAL DIAGRAM

FIGURE 6-6.

TYPE	IC NUMBER	LOCATION	REF. DES.
DECODER/DEMUX.	74LS138	INTERFACE (A5)	U4
		SYSTEM (A1)	U3



PIN CONFIGURATION



FUNCTIONAL DIAGRAM

INPUTS			OUTPUTS							
ENABLE		SELECT								
G1	G2*	C B A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X X X	H	H	H	H	H	H	H	H
L	X	X X X	H	H	H	H	H	H	H	H
H	L	L L L	L	H	H	H	H	H	H	H
H	L	L L H	H	L	H	H	H	H	H	H
H	L	L H L	H	H	L	H	H	H	H	H
H	L	L H H	H	H	H	L	H	H	H	H
H	L	H L L	H	H	H	H	L	H	H	H
H	L	H L H	H	H	H	H	H	L	H	H
H	L	H H L	H	H	H	H	H	H	L	H
H	L	H H H	H	H	H	H	H	H	H	L

*G2 = G2A + G2B

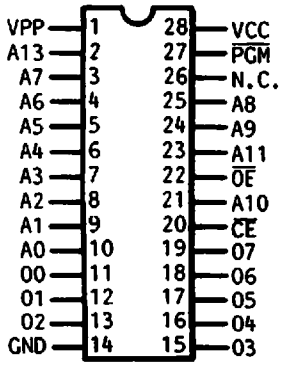
H = High level
L = Low level
X = Irrelevant

FUNCTION TABLE

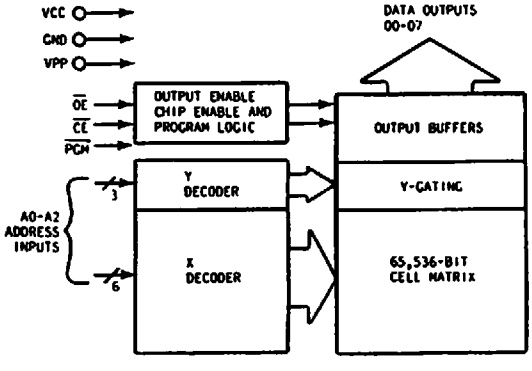
FIGURE 6-7.

TYPE	IC NUMBER	LOCATION	REF. DES.
EPROM, 8K X 8	2764	SYSTEM (A1)	U26

ATTENTION



PIN CONFIGURATION



BLOCK DIAGRAM

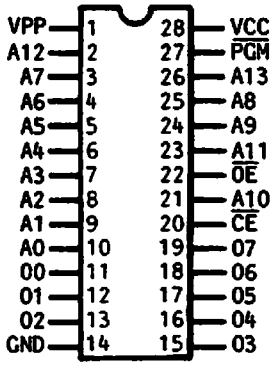
PINS / MODE	$\overline{CE}$ (20)	$\overline{OE}$ (22)	$\overline{PGM}$ (27)	V_{PP} (1)	V_{CC} (28)	OUTPUTS (11-13,15-19)
Read	V_{IL}	V_{IL}	V_{IH}	V_{CC}	V_{CC}	D_{OUT}
Standby	V_{IH}	X	X	V_{CC}	V_{CC}	HIGH Z
Program	V_{IL}	X	V_{IL}	V_{PP}	V_{CC}	D_{IN}
Program Verify	V_{IL}	V_{IL}	V_{IH}	V_{PP}	V_{CC}	D_{OUT}
Program Inhibit	V_{IH}	X	X	V_{PP}	V_{CC}	HIGH Z

x can be either V_{IL} or V_{IH}

FUNCTION TABLE

FIGURE 6-8.

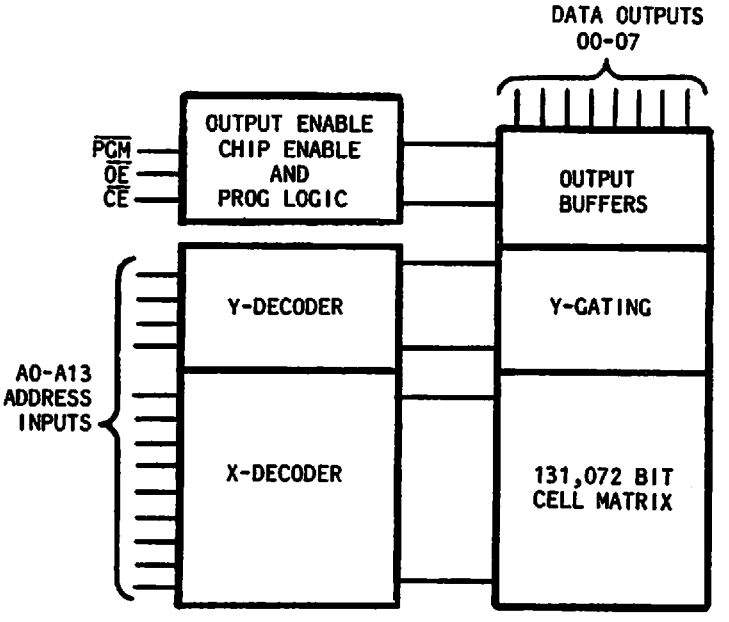
TYPE	IC NUMBER	LOCATION	REF. DES.
EPROM, 16K X 8	27128	SYSTEM (A1)	U10



PIN CONFIGURATION

A0-A13	ADDRESSES
$\overline{CE}$	CHIP ENABLE
$\overline{OE}$	OUTPUT ENABLE
O0-O7	OUTPUTS
$\overline{PGM}$	PROGRAM

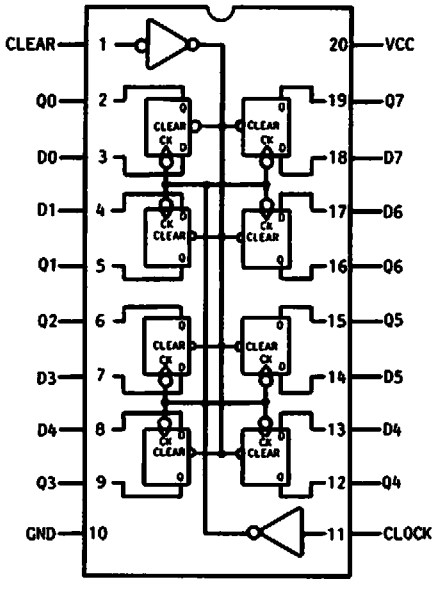
PIN NAMES



BLOCK DIAGRAM

FIGURE 6-9.

TYPE	IC NUMBER	LOCATION	REF. DES.
FLIP-FLOP, D TYPE W/CLEAR	74HC273	INTERFACE (A5)	U5



CONNECTION DIAGRAM

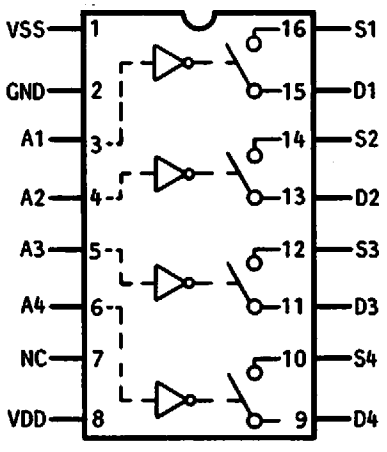
INPUTS			OUTPUTS
CLEAR	CLOCK	D	Q
L	X	X	L
H	↑	H	H
H	↑	L	L
H	L	X	Q0

H = High level
L = Low level
X = Irrelevant
↑ = Transition from Low to High
Q0 = The level of the output before steady-state input conditions were established.

FUNCTION TABLE

FIGURE 6-10.

TYPE	IC NUMBER	LOCATION	REF. DES.
GATE, ANALOG	7510DIJN	SYSTEM (A1)	U27



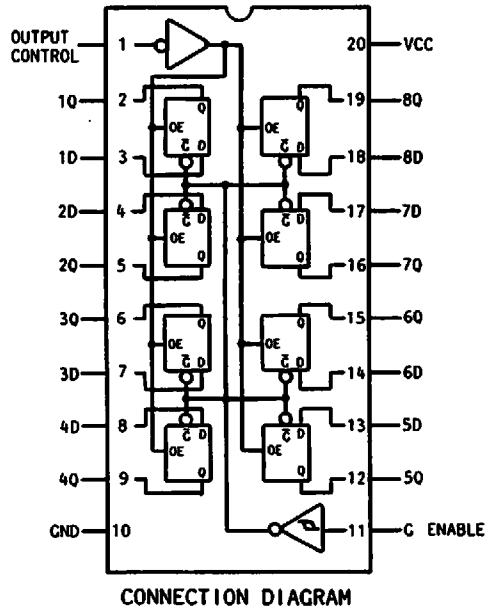
CONNECTION DIAGRAM

CONTROL LOGIC
SWITCH "ON" FOR ADDRESS "HIGH"

FIGURE 6-11.

TYPE	IC NUMBER	LOCATION	REF. DES.
LATCH	74LS373	SYSTEM (A1)	U13, U22
LATCH (CMOS) ATTENTION	74HC373	DISPLAY (A2)	U5-U9
		INTERFACE (A5)	U20
		SYSTEM (A1)	U16

NOTE: THESE TWO ICs CANNOT BE INTERCHANGED.



CONNECTION DIAGRAM

OUTPUT CONTROL	ENABLE G	D	OUTPUT Q
L	H	H	H
L	H	L	L
L	L	X	QO
H	X	X	Z

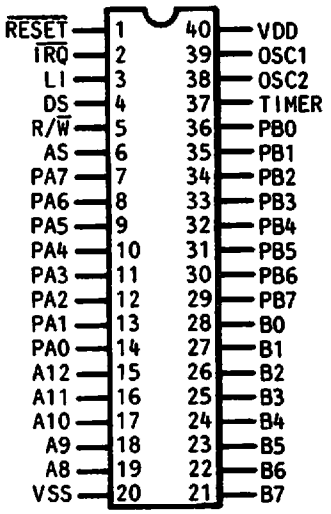
H = High level
L = Low level
X = Irrelevant
QO = The level of the output before steady-state input conditions were established.

FUNCTION TABLE

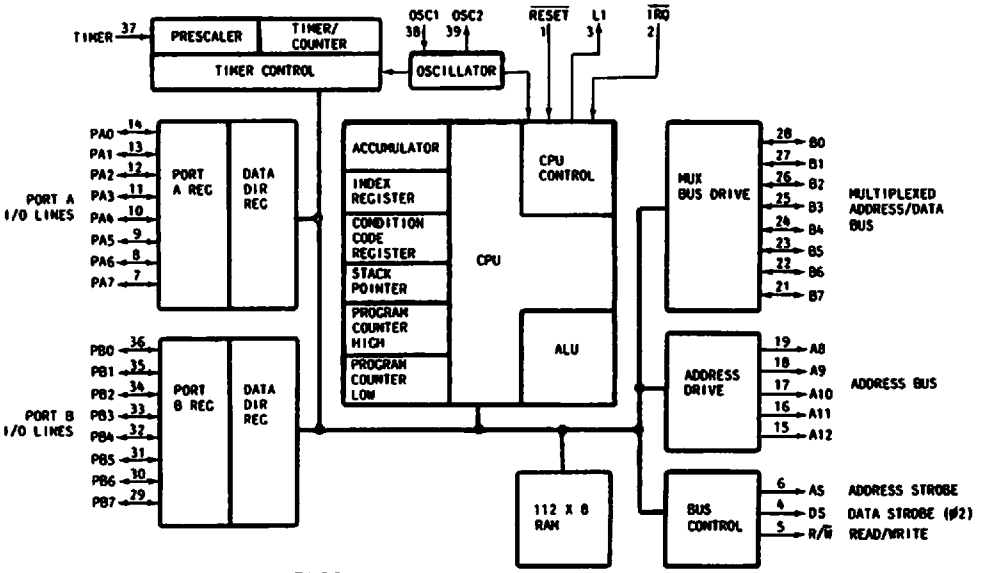
FIGURE 6-12.

TYPE	IC NUMBER	LOCATION	REF. DES.
MICROPROCESSOR	MC146805E2	SYSTEM (A1)	U7

ATTENTION



PIN CONFIGURATION

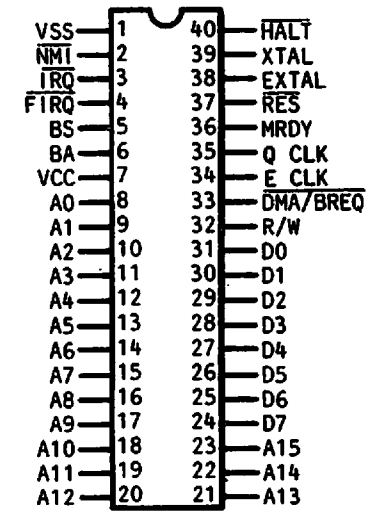


BLOCK DIAGRAM

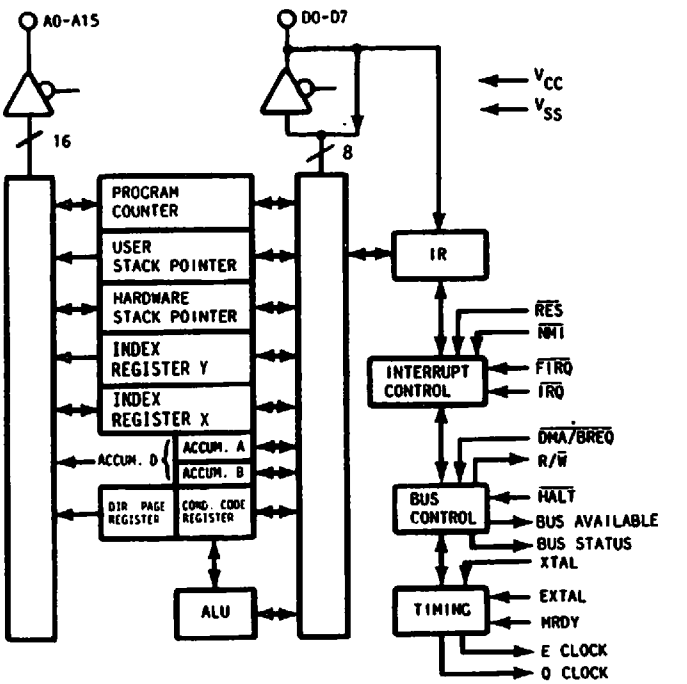
FIGURE 6-13.

TYPE	IC NUMBER	LOCATION	REF. DES.
MICROPROCESSOR	MC68A09	SYSTEM (A1)	U14

ATTENTION



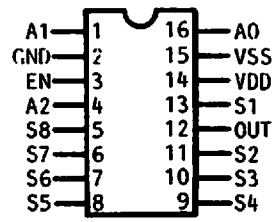
PIN CONFIGURATION



BLOCK DIAGRAM

FIGURE 6-14.

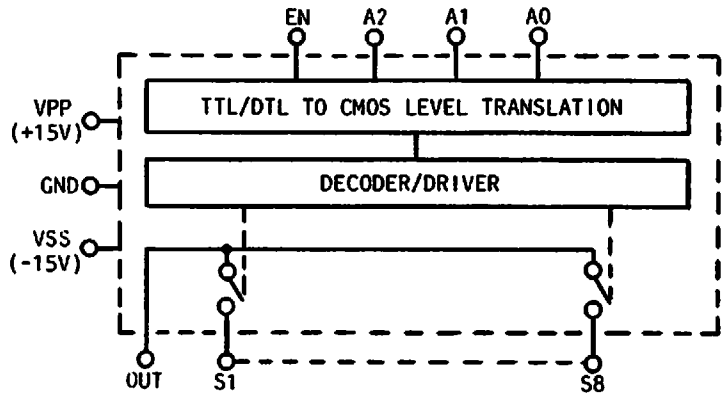
TYPE	IC NUMBER	LOCATION	REF. DES.
MULTIPLEXER	AD7501JN	SYSTEM (A1)	U29



PIN CONFIGURATION

A2	A1	A0	EN	"ON"
0	0	0	1	1
0	0	1	1	2
0	1	0	1	3
0	1	1	1	4
1	0	0	1	5
1	0	1	1	6
1	1	0	1	7
1	1	1	1	8
X	X	X	0	None

FUNCTION TABLE



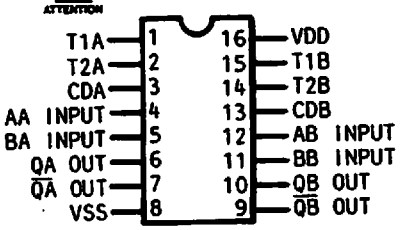
CONNECTION DIAGRAM

FIGURE 6-15.

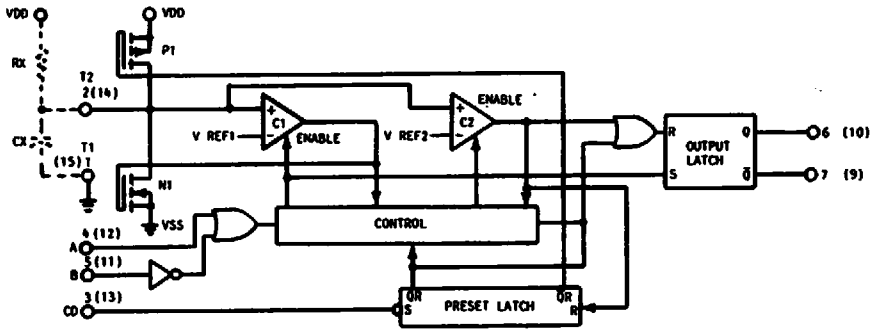
TYPE	IC NUMBER	LOCATION	REF. DES.

FIGURE DELETED

TYPE	IC NUMBER	LOCATION	REF. DES.
MULTIVIBRATOR, MONOSTABLE	MC14538	SYSTEM (A1)	U2



PIN CONFIGURATION



FUNCTIONAL DIAGRAM

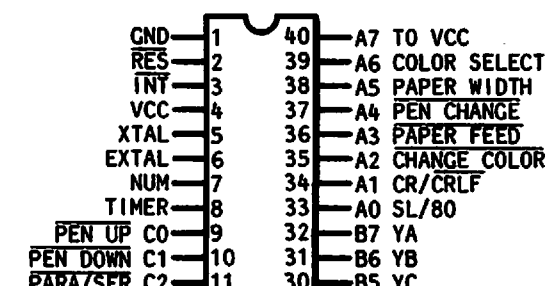
Inputs			Outputs	
CLEAR (CD)	A	B	Q	$\bar{Q}$
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↓	⊓	⊔
H	↓	H	⊓	⊔

H = High level
L = Low level
↓ = Transition from Low to High
↑ = Transition from High to Low
⊓ = One High level pulse
⊔ = One Low level pulse
X = Irrelevant

FUNCTION TABLE

FIGURE 6-16.

TYPE	IC NUMBER	LOCATION	REF. DES.
PRINTER CONTROLLER	DLG1203	INTERFACE (A5)	U12



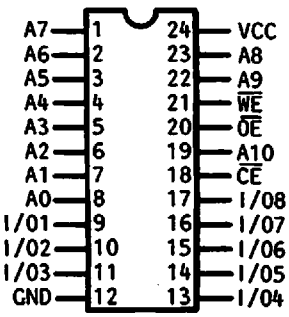
PIN CONFIGURATION

PIN NO.	NAME	FUNCTION		
33	A0	Character Scale Set	H: 1+0	L: 5+1
34	A1	Carriage Return Mode	H: Cronly	L: CR/LF
35	A2	Color Select Switch		
36	A3	Paper Feed Switch	Active low	
37	A4	Pen Change Switch		
38	A5	PRINTER Select: Paper width	H: 58mm	L: 114mm
39	A6	PRINTER Select: Color	H: 1 color	L: 4 color
40	A7	Connect to Vcc		
25	B0	X D		
26	B1	X C		
27	B2	X B	Stepping Motor drive pulse (X)	Active High
28	B3	X A		
29	B4	Y D		
30	B5	Y C		
31	B6	Y B	Stepping Motor drive pulse (Y)	Active High
32	B7	Y A		
9	C0	Pen--up		
10	C1	pen--down		
11	C2	parallel/serial	H: para.	L: serial
12	C3	color detect switch		
13	C4	Busy		
14	C5	ACK		
15	C6	strobe latch F/F Reset		
16	C7	serial data input		
24	D0	Data -- 0		
23	D1	1		
22	D2	2		
21	D3	3	para. data input	
20	D4	4		
19	D5	5		
18	D6	6		
17	D7	7		
1	Vss	GND (Minus)		
2	RES	reset		
3	INT	data strobe input (Active low)		
4	Vcc	+5V		
5	XTAL	crystal OSC.		
6	EXTAL			
7	NUM	connect to GND		
8	TIMER	connect to Vcc		

FUNCTION TABLE

FIGURE 6-17.

TYPE	IC NUMBER	LOCATION	REF. DES.
RAM, STATIC, 2K X 8	D446/5517	SYSTEM (A1)	U9

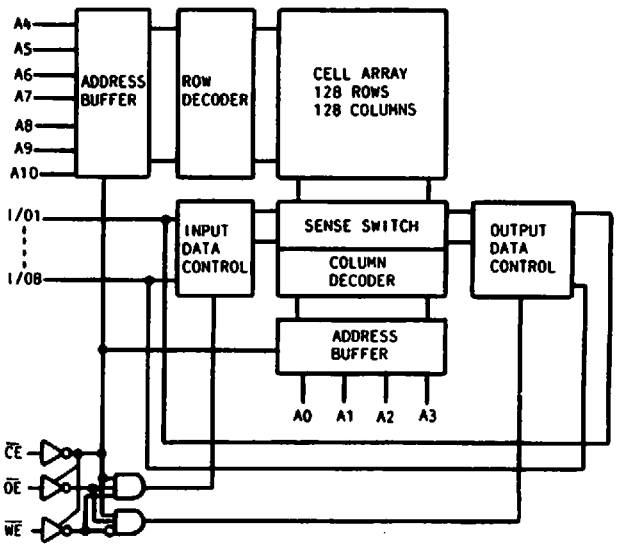


PIN CONFIGURATION

CE	OE	WE	MODE	I/O	ICCURR
H	X	X	Not Selected	HZ	Standby
L	H	H	Not Selected	HZ	Active
L	L	H	Read	D_{OUT}	Active
L	X	L	Write	D_{IN}	Active

H = High level
L = Low level
X = Irrelevant
Hi-Z = High impedance output state

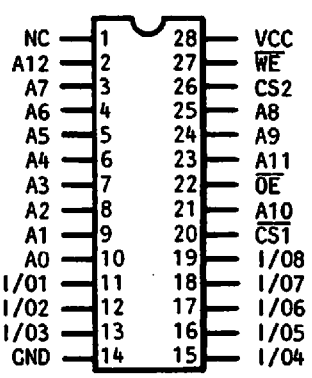
FUNCTION TABLE



FUNCTIONAL DIAGRAM

FIGURE 6-18.

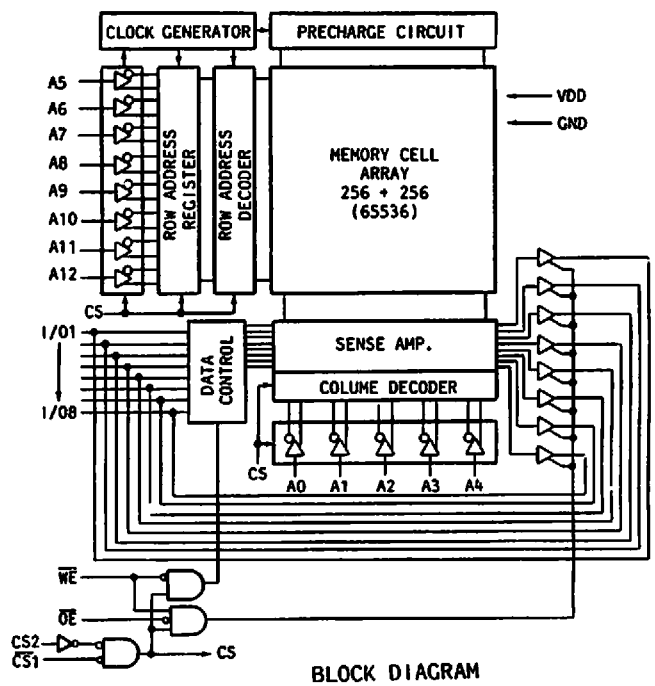
TYPE	IC NUMBER	LOCATION	REF. DES.
RAM, STATIC, 8K X 8		SYSTEM (A1)	U24



PIN CONFIGURATION

WE	CS1	CS2	OE	MODE	I/O PIN
X	H	X	X	NOT SELECTED (POWER DOWN)	HIGH Z
X	X	L	X		HIGH Z
H	L	H	H	OUTPUT DISABLED	HIGH Z
H	L	H	L	READ	DOUT
L	L	H	H	WRITE	DIN
L	L	H	L		DIN

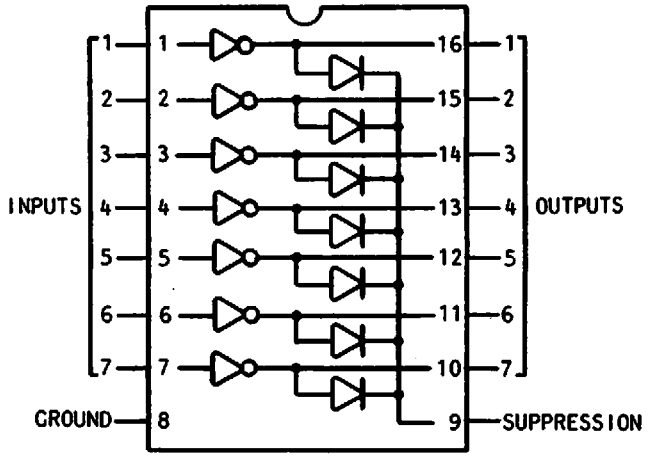
FUNCTION TABLE



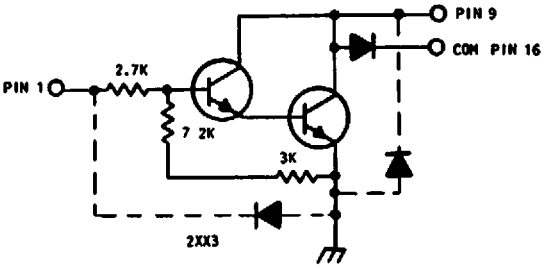
BLOCK DIAGRAM

FIGURE 6-19.

TYPE	IC NUMBER	LOCATION	REF. DES.
SWITCH, DARLINGTON	2013A	INTERFACE (A5)	U19



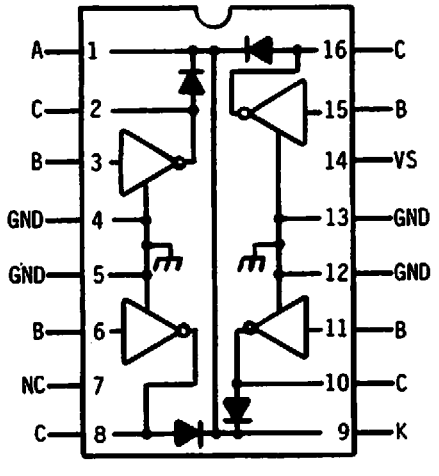
CONNECTION DIAGRAM



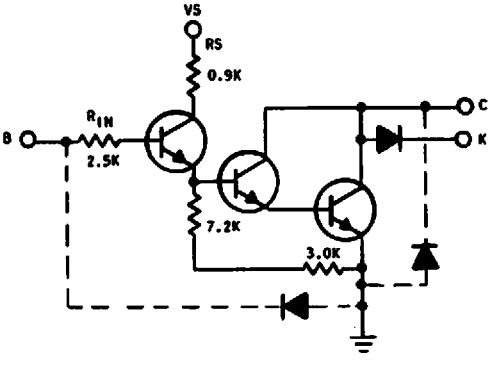
PARTIAL SCHEMATIC

FIGURE 6-20.

TYPE	IC NUMBER	LOCATION	REF. DES.
SWITCH, DARLINGTON	ULN2068B	DISPLAY (A2)	U12-U18



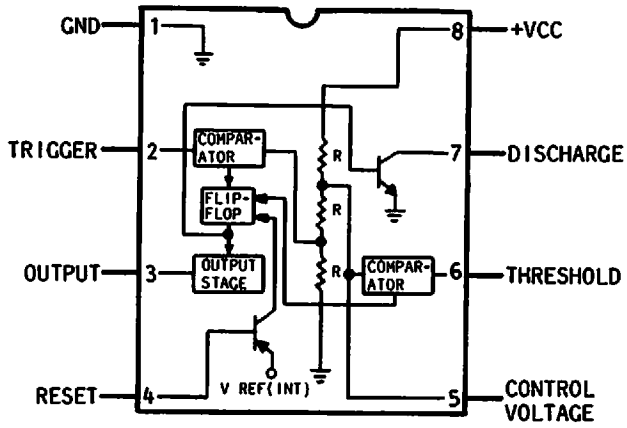
CONNECTION DIAGRAM



PARTIAL SCHEMATIC

FIGURE 6-21.

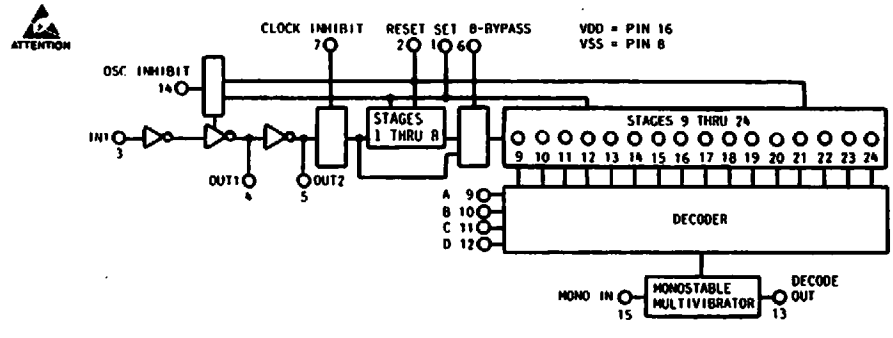
TYPE	IC NUMBER	LOCATION	REF. DES.
TIMER	NE555	DISPLAY (A2)	U11



CONNECTION DIAGRAM

FIGURE 6-22.

TYPE	IC NUMBER	LOCATION	REF. DES.
TIMER, PROGRAMMABLE	MC14536	INTERFACE (A5)	U1



FUNCTIONAL DIAGRAM

INPUTS				F/F STAGE CONNECTED TO DECODE OUT	
D	C	B	A	W BYPASS	W/O BYPASS
0	0	0	0	9	1
0	0	0	1	10	2
0	0	1	0	11	3
0	0	1	1	12	4
0	1	0	0	13	5
0	1	0	1	14	6
0	1	1	0	15	7
0	1	1	1	16	8
1	0	0	0	17	9
1	0	0	1	18	10
1	0	1	0	19	11
1	0	1	1	20	12
1	1	0	0	21	13
1	1	1	0	23	14
1	1	1	1	24	16

FUNCTION TABLE

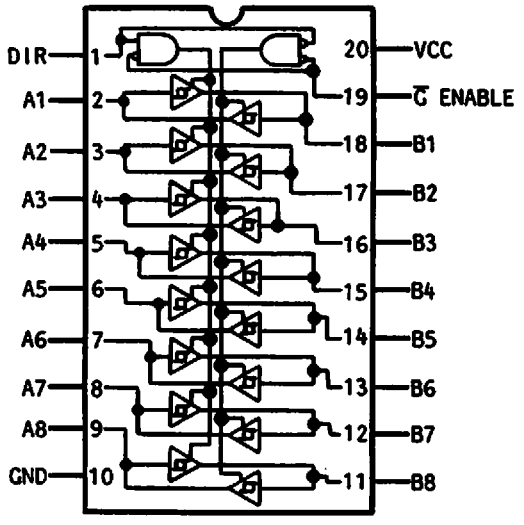
IN_1	Set	Reset	Clock Inh	Clock Inh	Out2	Out2	Decode Out
↑	0	0	0	0	↑	↓	No Change
↓	0	0	0	0	↓	↑	Advance to next state
X	1	0	0	0	0	1	1
X	0	1	0	0	0	1	0
X	0	0	1	0			No Change
0	0	0	0	X	0	1	No Change
1	0	0	0	↑	↓	↑	Advance to next state

X = Irrelevant
↑ = Transition from Low to High
↓ = Transition from High to Low

FUNCTION TABLE

FIGURE 6-23.

TYPE	IC NUMBER	LOCATION	REF. DES.
TRANSCEIVER, BUS	74LS245	INTERFACE (A5) SYSTEM (A1)	U10 U12, U17



CONNECTION DIAGRAM

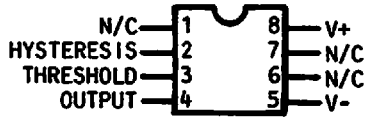
ENABLE $\overline{G}$	DIRECTION CONTROL DIR	OPERATION
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

H = High level
L = Low level
X = Irrelevant

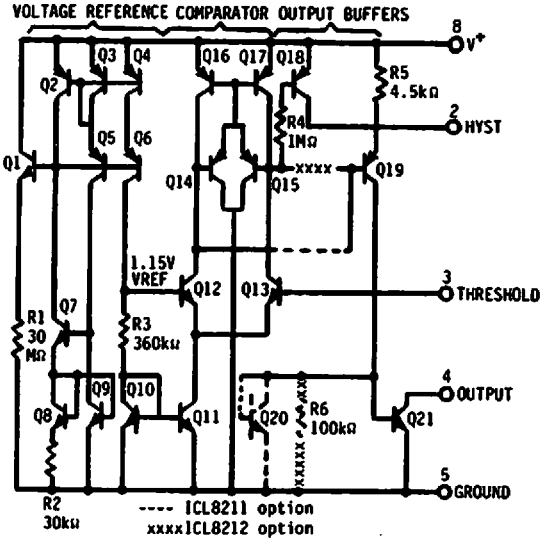
FUNCTION TABLE

FIGURE 6-24.

TYPE	IC NUMBER	LOCATION	REF. DES.
VOLTAGE DETECTOR	ICL8212	INTERFACE (A5)	U24



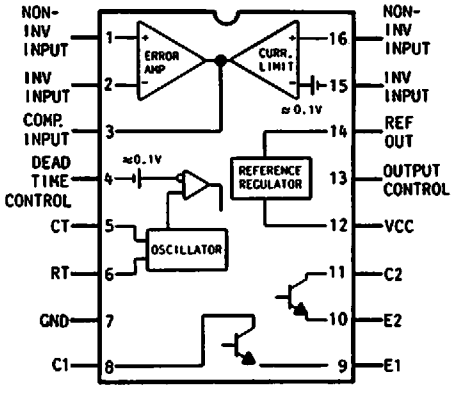
PIN CONFIGURATION



FUNCTIONAL DIAGRAM

FIGURE 6-25.

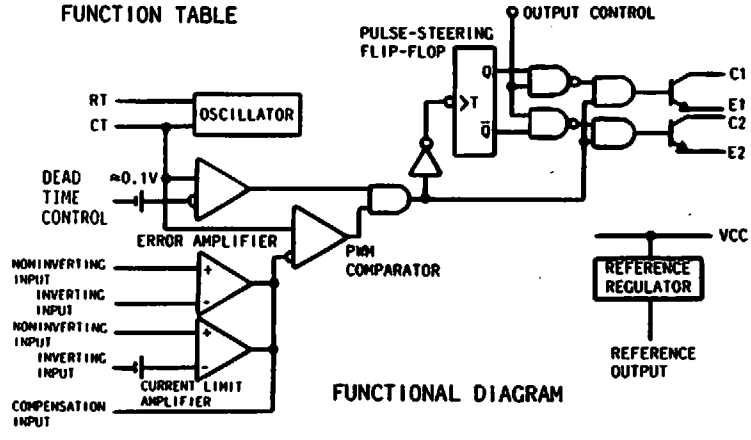
TYPE	IC NUMBER	LOCATION	REF. DES.
VOLTAGE REGULATOR SWITCHING	TL494	BATTERY CHARGER (-02) (A6)	U1
		SYSTEM (-00) (A1)	U33



CONNECTION DIAGRAM

PHYSIO DASH NO.	TEMPERATURE RANGE °C
-00	0 TO +70
-01	0 TO +70
-02	-25 TO +85
-03	-25 TO +85
-04	-55 TO +125

FUNCTION TABLE



FUNCTIONAL DIAGRAM

FIGURE 6-26.