

Description

This invention relates to pumps for delivering medical fluids and particularly relates to peristaltic pumps for delivery of enteral nutrition fluids to a patient.

In accordance with known techniques the delivery of enteral nutrition fluids to a patient can be accurately controlled as to volumetric delivery rate by the use of a delivery system which includes a motor unit and a disposable delivery set. Likewise similar systems may be used for pumping of other fluids for medical purposes, such as intravenous infusion, blood pumping or supply of measured volumes of liquid medication to pre-loaded syringes or other containers.

In known systems for delivering enteral fluids the rate of fluid delivery is controlled by regulating the speed of a pump motor in accordance with the desired volume rate. Pump motor speed may be controlled, for example, by providing pulses to a stepper motor. Another system for providing variable rate fluid delivery makes use of a peristaltic pump with variable tension on the pump tube in combination with a constant speed motor.

In other known systems for pumping medical fluids there are provided means for monitoring rotation of the pump rotor, for example, by magnetic detection or by optical rotation detectors. In such systems the actual rotation rate of the motor is compared to the desired rotation rate for purposes of making corrections to the rotation rate of the motor. Alternately the motor may be operated to rotate the pump by a number of rotations corresponding to the desired volume.

It is an object of the present invention to provide a new and improved method for regulating the volumetric device is implantable into the body or is carried externally on the body. The device includes means for metering the amount of fluid infused. Monitoring of the rotary movement of the rollers may be provided by means of magnets on the pump rotor passing underneath a detector carried on an arm above the rotor.

It is an object of the present invention to provide a new and improved method for regulating the volumetric rate of fluid delivery in a medical fluid delivery system and to provide apparatus for carrying out the improved method.

In accordance with the present invention there is provided a motor unit for a medical fluid delivery system for use with a disposable delivery set for pumping medical fluid, comprising:

pump operating means, including a motor, for acting in cooperation with the delivery set having a pump tube to deliver a volume of the fluid during each operating cycle;

a housing, surrounding the motor;

a rotor, attached to and adapted to be driven by the motor, the rotor having at least one roller so that rotation of the rotor by the motor causes the roller to contact the pump tube and move fluid through the pump tube,

pump control means for controlling the pump operating means to deliver the fluid at a desired volumetric rate, the pump control means including means responsive to signals indicating the desired rate for activating the pump operating means for one of the operating cycles and for repeating the activation at variable time intervals selected in accordance with the desired volumetric rate;

characterised in that

the pump control means, including means for sensing the condition of the pump operating means with respect to the operating cycle, comprises at least one magnet and a magnetic field sensor whereby the magnetic field sensor is adapted to sense the magnet passing as the rotor rotates,

the motor is a DC motor

and there are provided means for detecting the AC component of the current provided to the DC motor; and means for comparing the detected AC component to a reference level to detect the presence or absence of a pump tube on the rotor.

Preferably the magnet is, or the magnets are, attached to the rotor and the magnet field sensor is located behind the rotor and attached to the housing.

In accordance with the present invention the motor is a DC motor and the AC component of the DC motor current is detected and compared to a reference level in order to detect the current variation which results from the presence of a pump tube on the rotor. Accordingly, any mis-installation of the pump tube will be detected by the fluid delivery pump.

A method for controlling the rate of fluid delivery in a medical fluid delivery system of the invention comprising a housing containing a motor unit and a rotor driven by the motor unit and a disposable fluid delivery set for mounting to the motor unit to form a pump, in which the motor unit is adapted to act on the fluid delivery set in repeated operating cycles to deliver a volume of fluid for each cycle and means are provided for detecting the completion of the operating cycle, including at least one magnet attached to the

rotor and a magnetic field detector located behind the rotor and attached to the housing so that the magnetic field sensor senses the magnet passing as the rotor rotates comprises:
operating the motor unit until the completion of the operating cycle is detected by the magnetic field sensor detecting the passing of the magnet;

- 5 and repeating operation of the motor unit at time intervals selected in accordance with the desired rate of fluid delivery.

For a better understanding of the present invention, together with other and further objects, reference is made to the following description, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a plan elevation view of an enteral fluid delivery system incorporating the present invention.

- 10 Figure 2 (comprising Figures 2a, 2b and 2c) is a circuit diagram for the system of Figure 1.

Figure 3 is a circuit diagram for a portion of a modified delivery system in accordance with the present invention.

Figure 4 is a timing diagram illustrating signals utilized in the present invention.

- 15 Figure 1 is an illustration of an enteral fluid delivery system incorporating a motor unit in accordance with the present invention. The enteral delivery system 10 includes a motor unit 12 and a disposable delivery set generally indicated as 14 which is arranged to be mounted on the motor unit. The motor unit 12 includes a housing 16, which in the illustrated embodiment includes a recess 17 within which a rotor 18 is mounted. Rotor 18 is driven by a conventional constant speed DC motor which drives shaft 42. The delivery set 14 includes a pump tube 20, made of flexible plastic which surrounds rotor 18 and interacts with 3 rollers 36, 38 and 40 mounted on rotor 18 to form a peristaltic pump. Rotation of the rotor 18 in the direction indicated by the arrow in Figure 1 causes the rollers 36, 38 and 40 to interact with pump tube 20 and pump fluid through the tube at a rate which is determined by the rate rotation of rotor 18.

- 20 Delivery set 14 includes an inlet tube 22, which is connected to a supply of enteral fluids, such as a fluid reservoir which may be mounted on an IV pole above the motor unit 12. The inlet tube 22 is connected to drip chamber 24 which is mounted to a recess on housing 16 and secured to one end of pump tube 20. The outlet end of pump tube 20 is provided with a mounting member 26 which is received in another recess on housing 16 to thereby secure the outlet end of tube 20. A fluid delivery tube 28 is connected to mounting member 26 and supplies fluid pumped by the system to an enteral feeding tube connected to a patient or to another medical fluid delivery system.

- 30 The system illustrated in Figure 1 additionally includes a light source 30 and a light detector 32 for operation in connection with drip chamber 24 to detect the occurrence of drops in the drip chamber which pass between light source 30 and detector 32 in a manner which is known in the art. Mounting member 26 includes magnetized material, the presence of which can be detected by magnetic field detector 34.

- The motor unit 12 includes control buttons 51 through 58 for operating the unit to turn it on or off, to set 35 the dose or volume rate of fluid delivery by the pump, to interrupt operation of the pump and to increase or decrease the designated fluid volume or volume rate. A four digit alphanumeric segment display 59 is provided for indicating the selected fluid delivery rate or delivered volume and for providing alarm messages or codes. Light emitting diode 60 and 61 are provided for indicating that the unit is plugged into AC power or indicating that the volume setting has been cleared. An enunciator 62 is provided for signalling 40 an audible alarm to indicate, for example, that the pump has completed delivering a designated volume of fluid.

- Housing 16 is provided with a magnetic field sensor 50 which is arranged adjacent and behind rotor 18 in order to detect the magnetic field provided by magnets 44, 46 and 48 which are mounted on rotor 18. The presence of the magnets 44, 46 and 48 is detected as the magnets pass sensor 50 during rotation of 45 rotor 18.

Figure 2 is a schematic diagram of the circuits in the pump motor unit 12 of Figure 1. The schematic representations of the various components of Figure 1 have been given same reference numerals in Figure 2.

- The motor unit operates under the control of a microcomputer 64 which is provided with a control 50 program which is set forth in Appendix I. A programmable interval timer 68 is provided for operating and initiating microcomputer 64. A clock 66, operating at 2 Mhz, provides clock pulses to the system. The various controls of the unit, 51 through 58, are provided as input signals which ground various input terminals of the microcomputer to thereby signal the operators input instructions. The alphanumeric display 59 is driven by the microcomputer as is LED indicator 61. Additional inputs to the microcomputer are 55 provided by the magnetic field sensors 34 and 50 which sense respectively the magnetized mounting member 26 and the magnets 44, 46 and 48 on rotor 18. Likewise the drop detector 30, 32 is connected to provide input signals to the microcomputer. An AC power rectifier 72 is provided for AC operation and battery charging. Portable DC operation is available using battery 74. The AC circuit is arranged to charge

the DC battery when the unit is connected to AC power. A low battery and dead battery detector circuit 70 is provided to signal the microcomputer that the battery needs recharging. The microcomputer provides an output motor signal which is coupled by transistor 80 to switching transistors 82, 84. Transistor 82 turns on the power supply to motor voltage regulator 88 when the motor is to be operated and transistor 84 short circuits the motor to lock it into position when the motor signal is no longer present. Switching transistor 78, which is provided with a power signal by transistor 76, operates to supply current to the motor system and the other electronic systems by voltage regulator 86 when power is turned on. The motor 90 is provided with a safety circuit 92 which provides a short circuit when the motor is operated for an excess period of time. The short circuit causes fuse 94 to open thereby disabling the set when continuous motor operation occurs, to avoid providing excess enteral fluid to a patient.

Unlike conventional enteral nutrition systems the system 10 of the present invention is designed to provide an intermittent motor operation with the periodicity of the intermittent operation being regulated to adjust to the desired rate of fluid delivery. The operation of the system of the present invention is therefore cyclical and will be explained with respect to timing diagrams of Figure 4. Graph A of Figure 4 illustrates the motor voltage of the enteral fluid delivery system 10. The motor voltage is turned on and operated for a time period G which is regulated by detecting the rotation of rotor 18, in the case of Graph A for one complete revolution. With reference to Figure 1 it may be seen that during one complete revolution, represented by motor voltage period G, three magnets 44, 46 and 48 all pass magnetic field detector 50 and are sensed thereby. Curve B in Figure 4 illustrates the output signal from the rotor sensing magnetic field detector 50 which occurs during the cycle of operation indicated by motor voltage G. During an initial period of approximately .45 seconds designated F in Figure 4 the operation of the rotor sensing is inhibiting by software in microcomputer 64, so that the initial on period J of magnetic field detector 50 is not responded to by the program. Thereafter, during one complete revolution of the rotor, the signal from detector 50 goes to zero as each magnet is encountered by detector 50. Upon detection of the third magnet, at the end of period G, the motor voltage is turned off. In accordance with the preferred embodiment of the present invention the unit repeats the cyclical operation a time period I after initiation of the first operation. The time period H during which there is provided no motor voltage is permitted to be variable, since it depends on the actual time taken for rotation of the rotor and the selected interval I. The interval I is selected according to the rate of fluid delivery to be provided by the set which is set by the operator. In one embodiment of the invention period I varies from 13.5 seconds corresponding to a delivery rate of 100 milliliters per hour to 4.5 seconds corresponding to a fluid delivery rate of 300 milliliters per hour. Motor operation period G takes approximately 4 seconds but may vary according to mechanical conditions of the motor and pump tube.

Graph E in Figure 4 shows an alternate timing arrangement wherein the motor cycle consists of a single one-third of a rotation of the rotor 18. In accordance with the operation method of Graph E the motor current period G' is ended by the detection of the first of the three circumferentially arranged magnets by magnetic field sensor 50. Again the timing I between each operating cycle of the motor is varied in order to control volumetric fluid rate delivered by the pump. In the same embodiment as previously discussed a fluid rate of 1 to 100 milliliters per hour can be delivered using a cycle interval I which ranges from 450 to 4.50 seconds.

In addition to providing magnets on rotor 18 for purposes of detecting completion of a motor cycle, the motor current may be monitored for purposes of determining the rotational position of the rotor 18. Figure 3 is a schematic diagram of a circuit wherein there is provided a motor current monitoring circuit 96 which includes a low resistance resistor in series with the motor the voltage across which is AC coupled to an AC amplifier 92 for purposes of monitoring the AC component of the DC motor current. Graph C of Figure 4 illustrates a typical motor current for the operating cycle of Graph A of Figure 4. The motor current initially rises to a high level for purposes of overcoming the starting resistance and accelerating rotor 18 to its normal velocity. Thereafter the motor current drops but reaches periodic peaks corresponding to the resistance of rollers 36, 38 and 40 as they stretch pump tube 20 to its furthest position. The peak periods of motor current, which are illustrated as negative going pulses in the digitized signal of curve D, which is the output at point 96 of the circuit of Figure 3, may be used for purposes of detecting rotor position and may be used also for assuring that the pump tube 20 is properly mounted to rotor 18. Because of the initially high rotor current, which results from starting up the rotor, the current sensing is software inhibited for time period K of approximately .25 seconds prior to initiating the threshold detection which results in the pulses of curve D. Each of the pulses illustrated in curve D, which are negative going, have a positive going pulse which occurs a time period L prior to the end of a motor cycle, there being three such pulses during one rotation of the rotor. Accordingly, the curve D signal can be used for purposes of detecting and monitoring rotation position of rotor 18, and thereby indicating to the motor control circuit the completion of an

operating cycle. As an alternate to providing delay L after the end of the curve D pulses, the motor cycle may be arranged to end at the end of the pulse, providing a different rotor position between cycles.

The motor current monitoring previously described can additionally be used in cases wherein the motor voltage is provided only for a one-third rotation of the rotor as discussed with respect to curve E.

5 An additional use of the motor current monitoring circuit, which provides the signal of curve D of Figure 4 is to provide assurance to the system that the pump tube 20 has been properly mounted on rotor 18. Accordingly at the initiation of motor current and after a delay period K a flag can be set by the microprocessor which is cleared by the negative going pulse of curve D to indicate proper pump tube positioning. The flag would be reset at the start of each operating cycle or may also be reset on the 10 occurrence of the one-third rotation of the rotor sensing current shown by curve B. If the flag is not cleared by the negative going pulse of curve D there is an indication that either there is no pump tube or that the pump tube has been improperly mounted and an alarm signal can be initiated.

15 APPENDIX I

Avocet 6805 Assembler v1.12, #01040 Chip=6305 12/18/87 16:08:57 Page 1
K224/324 PUMP

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1 $CHIP(6305)
2 $pagewidth=132
3 $PAGINATE
4 $TITLE(K224/324 PUMP)
5 $XREF
6 ;
7 ;
8 ; This file contains the software for the K224/K324 series of
9 ; Enteral Feeding Pumps. It is based on COMB02.ASM a combined
10 ; F1500 and K224 program. See COMB02.ASM for revision history.
11 ;
12 ;
13 ; FILE NAME= KEMP31.ASM
14 ;
15 ; DATE | REVISION | DESCRIPTION

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16 ;-----
17 ;
18 ; 12/04/87 | 031.0 | DISPLAY LEADING ZERO'S IN DOSE MODE.
19 ; | | CHECK FOR DROPS CONTINUOUSLY IN RUN MODE
20 ; | | WHEN RATE IS < 100 ML/HR.
21 ;-----
22 ;
23 ; 11/24/87 | 030.0 | ADD NOPS TO IR TEST DURING TESTID.
24 ; | | CLEAR TESTID FLAG WHEN OFF MODE IS ENTERED TO
25 ; | | ALLOW PUMP TO DISABLE IF NECESSARY.
26 ; | | CLEAR VOL MODE FLAG WHEN LO BAT IS ENTERED
27 ; | | LOCK-OUT HOLD/START AND VOL BUTTONS WHEN
28 ; | | INC OR DEC BUTTONS ARE PRESSED.
29 ; | | FIX CLR VOL LED ERROR
30 ; | | CHECK DEC BUTTON BEFORE INC BUTTON.
31 ; | | ADD DELAY TO INC AND DEC BUTTON IN DOSE MODE TO
32 ; | | ALLOW TIME FOR DOSE DISPLAY.
33 ;-----
34 ;
35 ; 11/11/87 | 029.0 | CHANGE PUMP ID FROM PORID(1), TO PORID(6).
36 ;-----
37 ;

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38	;	10/23/87	028.0	FIXED 24 HOUR TIME ERROR. PUMP WAS TIMING 21 HOURS
39	;			MODIFIED SO THAT PUMP DISABLES AFTER 24 HOURS
40	;			WHEN ON AC OR BATTERY POWER.
41	;			
42	;			
43	;	10/16/87	027.0	CHANGED SETCK ROUTINE TO TEST FOR SET WHENEVER
44	;			PUMP IS IN RUN MODE. OLD VERSION ONLY CHECKED
45	;			WHEN MOTOR IS RUNNING.
46	;			RATE CHECK FOR 324 IS DISABLED DURING TEST MODE.
47	;			DISABLE DOSE BUTTON WHILE INC OR DEC BUTTONS
48	;			ARE PRESSED.
49	;			
50	;			
51	;	10/13/87	026.0	ADD RECHECK OF PUMP ID DURING TESTID
52	;			ADDED DELAY FROM MOTOR TURN-ON TO DEAD BAT ROUTINE
53	;			CHANGED LOW BAT ROUTINE SO IT KILLS POWER IF
54	;			LO BAT OCCURS WHEN UNIT IS ALREADY OFF.
55	;			CHANGE POLARITY OF AC DETECT LINE. (REV 7 BOARD)
56	;			
57	;			
58	;	10/13/87	025.0	CORRECTED ERROR IN 1/2 SEC TIMER.
59	;			ADDED DOSE DEL CHECK PRIOR TO RUN MODE

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60 ;-----
61 ;
62 ; 10/12/87 | 024.0 | ADD NOPS IN DROPCK BETWEEN IR TURN-ON AND
63 ; | | TEST TO ALLOW FOR SETTLING.
64 ; | | SHORTED IR ON TIME.
65 ; | | MOVE DROPCK FROM 8 MS TO 2 MS TO IMPROVE
66 ; | | DROP DETECTION.
67 ;-----
68 ;
69 ; 10/10/87 | 023.0 | DEL STOP INSR. FROM EACH DISABLE ROUTINE.
70 ; | | BLANK ALL DIGITS IN EACH DISABLE ROUTINE.
71 ;-----
72 ;
73 ; 10/07/87 | 022.0 | THE RESET ROUTINE HAS BEEN MODIFIED TO KEEP
74 ; | | THE PUMP OFF. TURN-ON IS NOW ACCOMPLISHED IN
75 ; | | THE INT ROUTINE. CHANGE WAS MADE TO PREVENT STRAY
76 ; | | RESEST SIGNALS FROM WATCHDOG FROM ACCIDENTLY
77 ; | | TURNING PUMP ON DURING DISABLE SEQUENCE.
78 ;-----
79 ; 9/29/87 | 021.0 | REVISED THE DISABLE ROUTINES TO DISABLE INT
80 ; | | AND LOOP UNTIL POWER DISSIPATES.
81 ;-----

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82 ;
83 ; 9/22/87 | 020.0 | TEST ROUTINE HAS BEEN ADDED. IT IS INITIATED BY
84 ; | | PRESSING THE OFF AND HOLD BUTTONS DOWN AT THE
85 ; | | SAME TIME FOR APPROX. 3 SEC WHEN PUMP IS OFF.
86 ;
87 ; 9/22/87 | 019.0 | MOTOR CONTROL SIGNAL POLARITY HAS BEEN REVERSED
88 ; | | AND TEST MODE WAS CHANGED SO THAT CLR VOL LED
89 ; | | IS TURNED OFF WHEN BUZZER IS.
90
91 ; 9/08/87 | 018.0 | THE INCREMENT AND DECREMENT KEYS HAVE BEEN
92 ; | | REVERSED TO COMPENSATE FOR PC BOARD R4.
93 -----
94 ;
95 ; 9/03/87 | 017.0 | THIS PROGRAM HAS BEEN MODIFIED TO RUN ON A 2 MHZ
96 ; | | CLOCK.
97 ; | | THE LOW BAT TIME HAS BEEN SET TO 15 MIN.
98 -----
99 -----
100
101 ; 8/28/87 | 016.0 | THE CLEAR DOSE FEATURE HAS BEEN DELETED
102 -----
103 ;

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104 ; 8/28/87 | 015.0 | THE HOLD ROUTINE HAS BEEN MODIFIED TO OCCUR
105 ; | | 2 1/2 MIN FROM LAST BUTTON PRESSED.
106 ; | | A WAIT STATEMENT HAS BEEN ADDED TO THE MAIN LOOP
107 ; | | AND OFF LOOP ROUTINES.
108 ;
109 ; 8/21/87 | 014.0 | THIS VERSION HAS BEEN MODIFIED TO ACCOMADATE
110 ; | | THE NEW ENCODED ROTARY SWITCH.
111 ; | | THE HOLD AND INCREMENT BUTTONS HAVE BEEN SWITCHED
112 ; | | TO SIMPLIFY THE RATE KNOB DECODE OPERATION.
113 ;
114 ;
115 ; 8/12/87 | 013.0 | THIS VERSION HAS BEEN REDUCED BY CONVERTING
116 ; | | THE RATE INCREMENT ROUTINES TO BINARY WITH
117 ; | | DECIMAL ADJUST ADDING.
118 ;
119 ;
120 ; 8/05/87 | 012.0 | BLINK SUBROUTINE WAS MODIFIED SO THAT ONLY 3
121 ; | | DIGITS ARE ACTIVE WHEN PUMP IS 224.
122 ;
123 ;
124 ; 7/30/87 | 011.0 | MODIFIED SO THAT VOLUME AND DOSE CAN BE CLEARED
125 ; | | WITH CLR V/D BUTTON WHILE PUMP IS RUNNING.

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126 ; | | THE DISPLAY HAS BEEN CHANGED TO EYE ERR IF
127 ; | | THE IR SENSOR IS BLOCKED DURING TEST SEQUENCE.
128 ;-----
129 ;
130 ; 7/25/87 | 010.0 | MODIFY DOSE DEL ERROR, SO THAT PRESSING HOLD
131 ; | | BUTTON ONCE DISABLED ALARM AND MESSAGE. THIS
132 ; | | WILL ALLOW THE USER TO UPDATE DOSE OR VOLUME
133 ; | | WITH THE NEXT KEY STROKE.
134 ;-----
135 ;
136 ; 7/21/87 | 009.0 | modified to display DP scroll when motor on
137 ; | | in LOW BAT state.
138 ;-----
139 ;
140 ; 7/16/87 | 008.0 | MODIFY HOLD BUTTON OPERATION FOR LO BAT STATE.
141 ; | | WHEN HOLD PRESSED, ALARM STOPS AND MOTOR STOPS.
142 ;-----
143 ;
144 ; 7/13/87 | 007.0 | ADD NO SET FEATURE.
145 ; | | MODIFY VOLUME DISPLAY. ADD SHORTED MOTOR SENSOR
146 ; | | DETECTION SOFTWARE. MODIFY 24 HR TIME ROUTINE
147 ; | | TO CLEAR VOL DELIVERED, BUT NOT TO KILL POWER.

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148 ;-----
149 ; 7/10/87 | 006.0 | FIX HIGH RATE ERROR BUG. MODIFY LOW BAT TO
150 ; | | CONTINUE TO RUN MOTOR WITH ALARM.
151 ;-----
152 ;
153 ; 7/08/87 | 005.0 | TRY NEW INCREMENT METHOD FOR DOSE.
154 ; | | SAVES APPROX. 40 BYTES. ADDED LOW BAT TIMER,
155 ; | | AND DEAD BAT SIGNAL.
156 ;-----
157 ;
158 ; 7/07/87 | 004.0 | 324 RATE INCREMENT CHANGED TO 5 ML FOR RATES
159 ; | | GREATER THEN 50.
160 ;-----
161 ; | |
162 ; 6/29/87 | 003.0 | DOSE FEATURE IS ADDED. CURRENT SENSE SOFTWARE FOR
163 ; | | SET DETECTION DELETED.
164 ; | |
165 ;-----
166 ; 6/25/87 | 002.0 | RATE INITIALIZED TO 0 ON POWER UP AND
167 ; | | TURN-ON. WRAP AROUND OF DISPLAY REMOVED.
168 ;
169 ;-----

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page 9

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170	:	;	001.0	---	FIRST PUMP VERSION SEPARATED
171	:	:	6/01/87	---	
172	:	:		---	FROM COMBO2.ASM
173	:	:			
174					\$EJECT

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219      DEFSEG ABSLSEG,ABSOLUTE
220      SEG ABSLSEG
221      ;
222      ;
223      ;***** SET UP RAM/ROM AND PORT ADDRESSES *****
224      ;
225      USRRAM EQU $40      ;STARTING ADDRESS OF USER RAM.
226      USRRROM EQU $1000   ;STARTING ADDRESS OF USER ROM.
227      PMPIST EQU $1C00   ;STARTING ADDRESS OF PUMP TEST SOFTWARE.
228      ;
229      PORTA EQU $00       ;PORT A DATA.
230      PORTB EQU $01       ;PORT B DATA.
231      PORTC EQU $02       ;PORT C DATA.
232      PORTD EQU $03       ;PORT D DATA.
233      ;
234      DORA EQU $04        ;PORT A DATA DIRECTION REGISTER.
235      DORB EQU $05        ;PORT B " " "
236      DORC EQU $06        ;PORT C " " "
237      DORD EQU $07        ;PORT D " " "
238      TDR EQU $08         ;TIMER DATA REGISTER.
239      TCR EQU $09         ;TIMER CONTROL REGISTER.
240      MISC EQU $0A        ;MISCELLANEOUS REGISTER

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241 ;
242 ; *****
243 ;          EQUATES
244 ; *****
245 ;
246 TABLE EQU $101C
247 TABLES EQU $1000
248 ;
249 TIMEST EQU $02
250 ;
251 TRMS EQU $03
252 T33MS EQU $03
253 T1S EQU $0F          ;1/2 SEC TIME CONSTANT
254 T6M EQU $02          ;(02 + 1) = 03 x 2.0 = 6 MINUTES
255 T142S EQU $EF        ;(EF + 1) = 240 x 0.5 = 2 MINUTES
256 ;
257 ;
258 ;***** INTERRUPT/RESET VECTOR TABLE *****
259 ;
260          ORG $1FF4
261 ;
262          DW RESET ;SERIAL INTERRUPT TIMER 2
          1FF4 102D

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1FF6 1089	DW	TTINP	;TIMER INTERRUPT VECTOR (WAIT STATE)
1FF8 1089	DW	TTINP	;TIMER INTERRUPT VECTOR
1FFA 103E	DW	ONFOW	;EXTERNAL INTERRUPT VECTOR
1FFC 103E	DW	ONFOW	;SOFTWARE INTERRUPT VECTOR
1FFE 102D	DW	RESET	;RESET VECTOR
263			
264			
265			
266			
267			
268			;
269			;
270			\$EJECT

```

271 ;
272 ;***** DEFINE VARIABLES IN USER RAM AREA *****
273 ;
274 ;
275          ORG      USRRAM
276 ;
277 TS      DB      0      ;READING OFF BRIDGE BEFORE RISE BEGINS (AMBIENT)
278 TS      DB      0      ;READING FROM AMP 5 SECOND AFTER BRIDGE RISE.
279 T10     DB      0      ;      "      10
280 T15     DB      0      ;      "      15
281 T20     DB      0      ;      "      20
282 T25     DB      0      ;      "      25
283 ;
284 ALGO     DB      0
285 ;
286 TIMLO    DB      0      ;LOWER BYTE OF 5 MINUTE DOWN COUNTER.
287 TIMHI    DB      0      ;UPPER " " " "
288 ;
289 BATIM1    DB      0      ;15 MIN BATTERY TIMERS
290 BATIM2    DB      0
291 ;
292 HLDIM1    DB      0      ;HOLD TIME COUNTERS: 2 1/2 MIN

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=0040

0040 00

0041 00

0042 00

0043 00

0044 00

0045 00

0046 00

0047 00

0048 00

0049 00

004A 00

004B 00

004C 00	293	HIDTM2 DB	0		
	294	;			
004D 00	295	SAMPL1 DB	0		;STORAGE FOR THE LAST 5 A-TO-D READINGS.
004E 00	296	SAMPL2 DB	0		;(SAMPL5 IS THE MOST RECENT).
004F 00	297	SAMPL3 DB	0		
0050 00	298	SAMPL4 DB	0		
	299	;			
0051 00	300	DSPDG1 DB	0		;7-SEGMENT DATA FOR LSD. (BIT 7 IS BACKPLANE CLOCK)
0052 00	301	DSPDG2 DB	0		;" " " " DIG 2.
0053 00	302	DSPDG3 DB	0		;" " " " DIG 3. (BIT 7 IS POWER CONTROL)
0054 00	303	DSPDG4 DB	0		;" " " " MSD. (BITS 7-3 ARE A/D CONTROL)
	304	;			
	305	;			
	306	;			
0055 00	307	DS1 DB	0		;CONTAINS FIRST TWO DIGITS OF DOSE
0056 00	308	DS2 DB	0		;CONTAINS LAST TWO DIGITS OF DOSE
	309	;			
	310	;			DS1 AND DS2 ARE TRANSFERRED TO SAMPL1-SAMPL4 BY BCDEXP
	311	;			ROUTINE.
	312	;			
0057 00	313	DOSECT DB	0		;COUNTER FOR TIME IN DOSE MODE
	314	;			

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315 ; VS1 AND VS2 ARE TRANSFERRED TO SAMPL1-SAMPL4 BY BDEEXP
316 ;
317 DECML1 DB 0 ;FRACTION OF 1ML IN VOLUME
318 VS1 DB 0 ;CONTAINS FIRST TO DIGITS OF VOLUME
319 VS2 DB 0 ;CONTAINS LAST TO DIGITS OF VOLUME
320 ;
321 REG1 DB 0 ;TEMPORARY STORAGE
322 ;
323 REG2 DB 0 ; "

324 ;
325 DRCNT1 DB 0 ;DROP COUNTERS
326 DRCNT2 DB 0
327
328 REG3 DB 0 ; "
329 REG4 DB 0 ; "
330 REG5 DB 0 ; "
331 ;
332 ;
333 ;
334 ;

0058 00
0059 00
005A 00

005B 00
005C 00

005D 00
005E 00

005F 00
0060 00
0061 00

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0062 00      335      COUNT1 DB 0      ;GENERAL PURPOSE COUNTER REGISTER.
0063 00      336      COUNT2 DB 0      ;
0064 00      337      COUNT3 DB 0      ;
338      ;
339      ;***** REGISTERS AND VARIABLES USED DURING PREDICTION *****
340      ;
341      ;
342      XH DB 0      ;ARGUMENT STORAGE FOR 16-BIT MATH ROUTINES.
343      XL DB 0      ;
344      QH DB 0      ;
345      QL DB 0      ;
346      PH DB 0      ;
347      PL DB 0      ;
348      ;
349      TEMPA DB 0
350      TEMPX DB 0
351      ;
352      PSTAT1 DB 0      ;FIRST PUMP STATUS BYTE
353      ;          0=HOLD 1=Unit on hold
354      ;          1=MOTOR 1=Motor on
355      ;          2=ON 1=Unit on
356      ;          3=START 1=Unit in start mode

```

```

357 ; 4=DISPLAY 1=Display on
358 ; 5=CW 1=Clock wise rate change
359 ; 6=CCW 1=Counter clock wise rate change
360 ; 7=MODEL 1=324 0=224 Model
361 ;
362 ;
363 PSTAT2 DB 0 ;SECOND PUMP STATUS BYTE
364 ;
365 LOWBAT EQU PSTAT2 0=BATTERY 1=Low battery
366 ACON EQU PSTAT2 1=AC 1=AC ON
367 NDROP EQU PSTAT2 2=FLOW 1=Drop error
368 HOLDER EQU PSTAT2 3=HOLD 1=Hold error
369 NOSET EQU PSTAT2 4=SET 1=No set error
370 ALRM EQU PSTAT2 5=ALARM 1=Audio alarm on
371 VOLM EQU PSTAT2 6=VOLUME 1=Volume mode
372 ERRON EQU PSTAT2 7=ERROR 1=Error mode
373 ;
374 TSTERR DB 0 ;B0 IS TEST ERROR FLAG
375 ; SET IF EYES BLOCKED DURING TEST
376 ;
377 DOSER DB 0 ;DOSE DELIVRIED FLAG B0=1: DOSE DEL
378 DFLAG DB 0 ;DOSE MODE FLAG

```

```

379 ;          B0= DOSE  1=DOSE MODE ON
380 ;          B1= DTEST 1=DOSE BUTTON PRESSED
381 ;          LAST CYCLE, USED FOR
382 ;          DEBOUNCE.
383 ;          B2= ZERO  1=DISPLAY ZERO
384 ;
385 ;          DB 0      ;MAGNET LOW COUNTER, USED TO CHECK IF SENSOR
386 ;          LITEST    ;IS STUCK LOW. INCREMENTED AS LONG REV SIGNAL
387 ;          ;IS LOW. CLEARED WHEN SIGNAL GOES HIGH.
388 ;          HTEST DB 0 ;B0 - TEST FLAG FOR HOLD DEBOUNCE
389 ;          ;B1 - TEST FLAG FOR CLR VOL DEBOUNCE
390 ;          ZEROST DB 0 ;ZERO STATUS FLAG
391 ;          ; B5 = 1 : DISPLAY IS ZERO
392 ;          ; B6 = 1 : MSD IS ZERO
393 ;          ; B7 = 1 : MSD-1 IS ZERO
394 ;
395 ;          VFLAG DB 0 ;VOLUME DISPLAY TEST FLAG. SET WHEN 'VOL'
396 ;          ;IS DISPLAYED.
397 ;          CWF DB 0  ;CLOCKWISE FLAG
398 ;          CCWF DB 0 ;COUNTER CLOCKWISE FLAG
399 ;          SPEED1 DB 0 ;ROLL UP/DOWN SPEED
400 ;          VOLTIM DB 0 ;VOLUME MODE ON TIMER

```

0072 00

0073 00

0074 00

0075 00

0076 00

0077 00

0078 00

0079 00

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007A 00      401      THIRD1      DB      0      ;1/3 REV COUNTER
007B 00      402      THIRDR      DB      0      ;1/3 REV COUNTER
007C 00      403      OUTSPD      DB      0      ;SCROLLING SPEED COUNTER
007D 00      404      MOTIM1      DB      0      ;FIRST MOTOR TIME COUNTER
007E 00      405      MOTIM2      DB      0      ;SECOND MOTOR TIME COUNTER
007F 00      406      ERRCNT      DB      0      ;COUNTING FOR TWO ERROR MODES
0080 00      407      DSPTST      DB      0      ;TEST FLAG
0081 00      408      COUNT4      DB      0      ;DROP COUNTER
0082 00      409      LSTRAT      DB      0      ;LAST RATE USED FOR ENCODED RATE KNOB
                                410      ;
0083 00      411      CKBEP DB      0      ;CHECK BEEP FLAG USED IN CKCLR
0084 00      412      CKRTM DB      0      ;USED IN CKCLR TO TIME BEEP
                                413      ;
                                414
                                415
                                416      =1000
                                417      ;
                                418      ;
                                ORG      USRR0M

```

```

419 ; *****
420 ;          CONSTANTS IN ROM
421 ; *****
422 ; *****
1000 F8 9C FF      IO      DB      $F8,$9C,$FF      ;DISPLAY IO ON LEDS
1003 98 81 B8      BATT    DB      $98,$81,$B8      ;DISPLAY BAT ON LEDS
1006 B1 F8 C0      FLO     DB      $B1,$F8,$C0      ;DISPLAY FLO ON LEDS
1009 B0 BD BD      ERR     DB      $B0,$BD,$BD      ;DISPLAY ERR ON LEDS
100C 9D 9C FF      NO      DB      $9D,$9C,$FF      ;DISPLAY NO ON LEDS
100F 92 B0 B8      SET     DB      $92,$B0,$B8      ;DISPLAY SET ON LEDS
1012 89 F8 8C      HLD     DB      $89,$F8,$8C      ;DISPLAY HLD ON LEDS

1015 8C 9C 92 B0    DOSE    DB      $8C,$9C,$92,$B0      ;DISPLAY DOSE ON LEDS
1019 8C B0 F8      DEL     DB      $8C,$B0,$F8      ;DISPLAY OUT ON LEDS
101C 92 8A 92      SYS     DB      $92,$8A,$92      ;DISPLAY SYS ON LEDS
101F C0 CF A4 86    DIGITS  DB      $C0,$CF,$A4,$86,
1023 8B            $8B ;DISPLAY NUMBERS 0-9 ON LED
1024 92 90 C7 80    DB      $92,$90,$C7,$80,
1028 83            $83
435 ;
1029 F7 FB FD FE    INUM    DB      $F7,$FB,$FD,$FE      ;DIGIT OUTPUT

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440

SEJECT

```

441 ;
442 ;
443 ;
444 ;
445 ;
446 ;
447 ;
448 ;
449 ;
450 ;
451 RESET LDX #$40 ;FIRST, CLEAR RAM.
452 CTR A
453 CLEAR STA ,X
454 INCK
455 CPX #$FF
456 BNE CLEAR
457
458 ;
459 ;
460 ;
461 JSR TMRON ;GO START TIMER COUNTER
462 BSET 5,MISC ;SET INT SENSE FOR EDGE AND LEVEL

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463 ;
464 ; Wait for timer interrupt
465 ;
466 LOOPW WAIT
467 BRA LOOPW
468 ;
469 $EJECT
    
```

```

103B 8F
103C 20 FD
    
```

```

470 ;
471 ;
472 ;
473 ;
474 ;
475 ;
476 ;
477 ;
478 ONFOW BCIR 5,NISC ;RETURN INT SENSE TO EDGE LEVEL
479 BRSET 7,ERRON,NOON ;IF IN ERROR MODE DONT DO
480 BRSET 2,PSTAT1,NOON ;DONT DO IF ON
481 ;
482 LDA #$19 ;INITIALIZE PUMP STAT REGISTER
483 STA PSTAT1
484 ;
485 ;
486 ;
487 BRSET 7,PSTAT1 ;PRESET ID FLAG FOR 324
488 LDA #$FF ;PRELOAD ACCA TO SET PORTB ALL OUTPUT
489 BRCLR 6,PORTB,CONON ;IF PORTB(6)=0, PMP IS 324 SO CONTINUE
490 BCIR 7,PSTAT1 ;ELSE, PMP IS 224 SO CLEAR ID FLAG
491 LDA #$BF ; AND SET ACCA TO MAKE PORTB(6) INPUT

```

```

1055 B7 05      ;
1057 A6 FF      ;
1059 B7 04      ;
105B B7 00      ;
105D A6 1F      ;
105F B7 01      ;
1061 A6 60      ;
1063 B7 07      ;
1065 4F          ;
1066 B7 03      ;
1068 B7 06      ;

492      ;
493      CONON STA   DRRB      ;
494      LDA   #$FF      ;
495      STA   DRA      ;
496      STA   PORTA      ;
497      LDA   #$1F      ;
498      STA   PORTB      ;
499      LDA   #$60      ;
500      STA   DRD      ;
501      CLRA      ;
502      STA   PORID      ;
503      STA   DRC      ;
504      ;
505
506      ;      Initialize display pointers
507      ;
508      ;SET UP INITIAL DISPLAY
509      ;POINTERS SO DISPLAY
510      ;READS 0
511      ;WHEN THE DISPLAY IS
512      ;ACTIVATED
513      ;

```

```

514 106A 3F 79      CLR  VOLTIM      ;CLEAR THE VOLUME DISPLAY TIMER
515
516 106C 5F        CLRX              ;INITIALIZE DOSE
517 106D 4F        CIRA              ;AND RATE
518 106E E7 51     CLEAR1 STA  DSPDGL,X ;DISPLAY
519 1070 5C        INCX              ;TO READ ZERO
520 1071 A3 07     CPX  #07          ;
521 1073 26 F9     BNE  CLEAR1        ;
522 1075 1A 74     BSET 5,ZEROST      ;SET DISPLAY ZERO FLAG
523 1077 14 71     BSET 2,DFLAG      ;SET DOSE ZERO FLAG
524
525 1079 1D 6E     BCLR 6,VOLM        ;CLEAR THE VOLUME FLAG
526 107B 10 80     BSET 0,DSPTST      ;SET TEST FLAG
527 107D CD 1756   JSR  UPDATE        ;GO SET DISPLAY TO READ 125
528 1080 14 6D     BSET 2,PSTAT1      ;UNIT ON
529
530               ; INITIALIZE RATE KNOB LOCATION
531
532 1082 B6 02     LDA  PORIC          ;GET PORIC
533 1084 A4 03     AND  #03           ;MASK 2 LOWER BITS
534 1086 B7 82     STA  LSTRAT        ;STORE IN LAST RATE LOCATION
535

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NOON RTI
;
;
\$EJECT

536
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538
539

1088 80

```

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546 ;
547 ;
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552 ;
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555 ;
556 ;
557 ;
558 ;
559 ;
560 ;
561 ;

                    TIMER INTERRUPT ROUTINE

                    This routine is called every-
                    2.00 ms it services the LED mux.
                    8.00 ms it calls rpm, motor on, rate, hold, and off.
                    32.00 ms it checks drop status and set.
                    .5000 s it checks for low battery, updates charge status and display on/off
                    142. s it checks charge time to control battery charge rate.

                    ***** 2 MS CHECK LOOP *****
TIMINP LDA #F9
STA TDR
BCIR 7,TCR ;RESET THE TIMER

JSR WATCHD ;GO OUTPUT PULSE TO HOLD OFF AUTO RESET
JSR LED ;GO MULTIPLEX THE LEDS

```

```

1089 A6 F9
108B B7 08
108D 1F 09

```

```

108F CD 110C
1092 CD 1115

```

```

1095 CD 12DA      562      JSR  INRATE1      ;GO UPDATE RATE FOR 224
1098 CD 1185      563      JSR  DROPCK      ;GO CHECK FOR DROP
                    564      ;
109B B6 40        565      LDA  TS          ;TEST IF TIME TO DO NEXT TESTS
109D 3C 40        566      INC  TS
109F A1 03        567      CMP  #T8MS
10A1 27 01        568      BEQ  TIME2
10A3 80           569      RTI
                    570      ;
                    571      ; ***** 8 MS LOOP *****
                    572      ;
10A4 3F 40        573      TIME2 CLR TS
                    574      ;
10A6 CD 11CF      575      JSR  RPMCK      ;GO CHECK MOTOR FOR ONE RPM
10A9 CD 1290      576      JSR  MOTCK      ;GO CHECK MOTOR TIME TO TURN ON
10AC CD 12BD      577      JSR  SETCK      ;GO CHECK FOR SET CURRENT
10AF CD 140E      578      JSR  OFFCK      ;GO SEE IF OFF PUSHED
                    579      ;
10B2 B6 41        580      LDA  T5          ;GET STATUS OF SECOND TIMER
10B4 3C 41        581      INC  T5          ;INCREMENT FOR NEXT TIME
10B6 A1 03        582      CMP  #T33MS      ;DOES IT EQUAL 32 MS
10B8 27 01        583      BEQ  TIME3      ;YES SO GO TEST

```

```

584      10BA 80      RTI      ;RETURN TO PROGRAM
585      ;
586      ; ***** 33 MSEC CHECK LOOP *****
587      ;
588      10BB 3F 41    TIME3 CLR T5      ;CLEAR T5 FOR NEXT TIME THRU
589      ;
590      10BD CD 1458    JSR TESTD      ;DO TEST DISPLAY
591      10C0 CD 14EC      JSR HOLDCK      ;GO TEST IF HOLD PRESSED
592      10C3 CD 15A9      JSR DOSECK      ;GO CHECK DOSE BUTTON
593      10C6 CD 15EE      JSR VOIDIS      ;DISPLAY VOLUME CHECK MODEL 324
594      10C9 CD 1640      JSR CKCLR      ;GO CHECK VOLUME CLEAR
595      10CC CD 1687      JSR INRATE2     ;INPUT ROUTINE FOR MODEL 324
596      ;
597      10CF B6 42      LDA T10          ;GET TIMER3 STATUS
598      10D1 3C 42      INC T10          ;INCREMENT FOR NEXT TIME
599      10D3 A1 0F      CMP #T1S        ;DOES IT EQUAL 1S
600      10D5 27 01      BEQ TIME4        ;YES SO GO TIME4
601      10D7 80      RTI      ;RETURN TO PROGRAM
602      ;
603      ; ***** 1/2 SEC BAT CHECK *****
604      ;
605      10D8 3F 42      TIME4 CLR T10     ;RESET TIMER3 FOR NEXT TIME

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606      ;
607      10DA CD 17DD      JSR  ACDC      ;GO TEST AC OR DC
608      10DD CD 17E6      JSR  BATCK     ;GO DO BATTERY CHECK
609      10E0 CD 1836      JSR  DBATCK    ;GO CHECK FOR DEAD BATTERY
610      10E3 CD 184E      JSR  ALARM      ;GO TEST ALARM
611      10E6 CD 1860      JSR  BLINK      ;GO BLINK DISPLAY
612      10E9 CD 1909      JSR  HLDER      ;go test if on hold 142sec then error
613      ;
614      10EC B6 43      LDA  T15         ;GET TIMER4 STATUS
615      10EE 3C 43      INC  T15         ;ADD ONE FOR NEXT TIME
616      10F0 A1 EF      CMP  #T142S      ;DOES IT EQUAL 142 SEC
617      10F2 27 01      BEQ  TIMES       ;YES SO GO TIME 5
618      10F4 80      RPT      ;RETURN TO PROGRAM
619      ;
620      ; ***** 142 SEC LOOP *****
621      ;
622      10F5 3F 43      TIMES CLR T15      ;CLEAR FOR NEXT TIME
623      ;
624      ;
625      10F7 B6 44      LDA  T20
626      10F9 3C 44      INC  T20
627      10FB A1 02      CMP  #TGM

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```
10FD 27 01      628      BEQ  TIME6
10FF 80          629      RTI
                    ;
                    ; ***** 2415 SEC LOOP *****
                    ;
1100 3F 44      633      TIME6 CLR  T20
                    ;
1102 CD 192E    635      JSR  TIM24      ;go test if off 24 hrs then kill power
                    ;
1105 80          637      RTI
                    ;
                    ;
                    ; $EJECT
                    640
```

```

641 ;
642 ; SUBROUTINES
643 ;
644 ;
645 ;
646 ;
647 ; INITIALIZE COUNTER TIMER
648 ;
649 ;
650 ;
651 ;
652 TIMEON LDA #TIMEST ;SET COUNTER TO 4
653 STA TCR ;ENABLE TIMER INT
654 CLI ;ENABLE INTERRUPTS
655 RDS ;RETURN;
656 ;
657 ;
658 ;
659 ; WATCH DOG TIMER
660 ;
661 ; Output clock to hold off reset
662 ;

```

1106 A6 02
1108 B7 09
110A 9A
110B 81

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110C 0B 03 03	663	WATCHD	BRCIR 5, PORID, SETPR	; IF CLOCK LOW MAKE HIGH
110F 1B 03	664	BCIR 5, PORID		
1111 81	665	RTS		
	666	;		
1112 1A 03	667	SETPR BSET 5, PORID		
1114 81	668	RTS		
	669	;		
	670	\$EJECT		

```

671 ;
672 ;
673 ;
674 ;
675 ;
676 ;
677 ;
678 ;
679 ;
680 ;
681 ;
682 ;
683 ;
684 ;
685 ;
686 ;
687 ;
688 ;
689 ;
690 LED      ERCLR    2, PSTAT1, NOD4    ;IF UNIT OFF DONT DO MUX
691          LDA      #$0F                ;Turn all digits off
692          ORA      PORTB

1115 05 6D 36
1118 A6 0F
111A BA 01

```

LED MUX ROUTINE

This routine is called every 4 ms
 It handles 0 suppression and outputs 7 seg data
 VARIABLES USED: COUNT3=This is the digit number and is changed every
 time this routine is called.
 SAMPLE1=location of Current value of digit 1.
 add count3 and use as pointer.
 7,pstat2 (error)=test if in error mode for blinking.
 4,pstat1 (display)=test if display blanked (blinking
 mode).
 ZEROST=bit 6 set=zero in msd
 bit 7 set=zero in next digit

```

111C B7 01      693      STA  PORTB
111E BE 64      694      LDX  COUNT3      ;GET CURRENT DIGIT NO.
1120 A3 03      695      CPX  #$03      ;HAVE WE DONE 4
1122 26 04      696      BNE  GO      ;IF NOT GO ON
1124 3F 64      697      CLR  COUNT3      ;IF SO RESET ALL VARIABLES
1126 20 02      698      BRA  GO2
;
1128 3C 64      700      GO  INC  COUNT3
;
112A 0C 6E 0E   702      BRSCT 6,VOLM,NOTZERO ;IF IN VOL NO ZERO TEST
112D 00 71 0B   703      BRSCT 0,DFLAG,NOTZERO ;IF IN DOSE NO ZERO TEST
1130 A3 03      704      CPX  #$03      ;IF DIGIT 1 DONT TEST FOR 0
1132 27 07      705      BEQ  NOTZERO
1134 CD 1175     706      JSR  TEST0      ;GO TEST
1137 24 02      707      BCC  NOTZERO      ;IF NO CARRY IT CANT BE 0
1139 20 14      708      BRA  ZERO
;
;
113B E6 4D      711      NOTZERO LDA  SAMPLE1,X
113D 0E 6E 05   712      BRSCT 7,ERRON,OUT1 ;IF error mode dont blank
1140 08 6D 02   713      BRSCT 4,PSTAT1,OUT1 ;if display on flag set dont blank
1143 4F         714      CLRA ;blank display if display flag is low

```

```

1144 43      715      COMA      ;SET PORTA=FF ALL OFF
1145 B7 00      716      ;
1147 D6 1029    717      OUTL STA PORTA
114A B4 01      718      LDA INUM,X      ;GET DIGIT TO OUTPUT
114C B7 01      719      AND PORTB      ;ENABLE
114E 81      720      STA PORTB
114F A3 00      721      NOD4 RTS
1151 27 17      722      ;
1153 A3 01      723      ;
1155 27 17      724      ZERO CPX #$00      ;IS THIS FIRST TIME THROUGH (MSD)
1157 0D 74 E1    725      BEQ ZERO1      ;IF SO BLANK AND SET FLAG IF ZERO
115A 0F 74 DE    726      CPX #$01      ;IS THIS SECOND TIME THRU
115B 27 17      727      BEQ ZERO2      ;IF SO CHECK FIRST FLAG
115D E6 4D      728      BRCLR 6,ZEROST,NOTZERO ;ON THIRD TIME CHECK FIRST TWO
115F 49      729      BRCLR 7,ZEROST,NOTZERO ;IF EITHER NOT SET DONT BLANK
1160 24 04      730      ;
1162 A6 FF      731      ZEROT LDA SAMPL1,X ;GET DIGIT DATA
1164 20 DF      732      ROLA      ;CHECK IF DP ON
1166 A6 7F      733      BCC ZERODP      ;IF SO LEAVE ON
1167 49      734      LDA #$FF      ;IF NOT BLANK
1168 20 DF      735      BRA OUT1      ;GO OUTPUT IT
1169 A6 7F      736      ZERODP LDA #$7F      ;LEAVE DP ON

```

```

1168 20 DB      737      BRA OUT1
                                     ;
116A 1C 74      738      ;
116C 20 EF      739      ZERO1 BSET 6,ZEROST ;SET ZERO FLAG
116E 0D 74 CA   740      BRA ZEROT ;OUTPUT BLANK
1171 1E 74      741      ZERO2 BRCLR 6,ZEROST,NOTZERO ;CHECK FIRST DIGIT FLAG
1173 20 E8      742      BSET 7,ZEROST ;IF SET THEN BLANK 2ND DIGIT
                                     ;
1175 E6 4D      743      TEST0 LDA SAMPL1,X ;test if digit is 0
1177 98         744      CLC
1178 49         745      ROLA
1179 A1 80      746      CMP #80
117B 27 04      747      BEQ SETCAR
117D 98         748      CLC ;clr carry if not zero
117E E6 4D      749      LDA SAMPL1,X
1180 81         750      RTS
1181 99         751      SETCAR SEC ;set carry if it is
1182 E6 4D      752      LDA SAMPL1,X
1184 81         753      RTS
                                     ;
                                     $EJECT

```

```

759 ;
760 ; DROP CHECK
761 ;
762 ; This routine is called every 8ms
763 ; After a delay of .4 sec to clear all transients,
764 ; it turns on the IR source and looks at the photo transistor.
765 ; If the line is low a drop is there the counter is cleared.
766 ; If there is no drop the counter is incremented and if it reaches
767 ; a count of 95 or 95 X .008=.76 sec then the second counter is incremented
768 ; This counter is tested in the RPM routine if it gets to 2 or 1.76s then
769 ; it will alarm.
770 ;
771 ;
772 ; Conditions
773 ;
774 DROPCK BRCLR 2, PSTAT1, NODRP ;DONT DO IF UNIT OFF
775 BRSET 0, PSTAT1, NODRP ;DONT DO IF PUMP NOT IN RUN MODE
776 ;
777 ; CHECK RATE
778
779 LDA DSPDG3 ;IF RATE < 100, CHECK FOR DROPS
780 CMP #501

```

```

118F 25 03      781      BLO DELCK
1191 03 6D 37   782      BRCIR 1,PSTAT1,NDRP ELSE, CHECK DROPS WHEN MOTOR ON ONLY
783      ;
784      ; DELAY CHECK
785      ;
1194 B6 5B      786      DELCK LIA REG1 ;CHECK REG1
1196 A1 7C      787      CMP #124 ;IF 0.248 SEC ELAPSED SINCE MOTOR ON
1198 27 04      788      BEQ DROP1 ;DO DROP TEST AND SKIP INCREMENT.
119A 4C          789      INCA ;ELSE,
119B B7 5B      790      STA REG1 ;INCREMENT AND RETURN.
119D 81          791      RTS
792      ;
793      ; Test for drop
794      ;
119E 1C 03      795      DROP1 BSET 6,FORD ;TURN IR SOURCE ON
11A0 9D          796      NOP ;ADD SOME DELAY TO ALLOW SETTLING
11A1 9D          797      NOP
11A2 9D          798      NOP
11A3 9D          799      NOP
800      ;
11A4 0A 02 1C   801      BRESET 5,FORTC,CLERK ;CHECK FOR LOW (DROP)
11A7 1D 03      802      BCLR 6,FORD ;TURN OFF IR SENSOR

```

```

11A9 10 81      803      BSET 0,COUNT4      ;WE HAVE DROP SO SET FLAG
804      ;
11AB 3C 5D      805      INC  DRCNT1      ;INCREMENT DROP COUNTERS
11AD 26 02      806      BNE  CONDRP
11AF 3C 5E      807      INC  DRCNT2
11B1 B6 5E      808      CONDRP  LDA  DRCNT2      ;CHECK IF DROP CNT = 0.76 SEC
11B3 A1 01      809      CMP  #$01
11B5 25 14      810      BLO  NODRP      ;IF DRCNT2 < 1 END TEST
11B7 B6 5D      811      LDA  DRCNT1      ;ELSE CHECK DROP CNT 1
11B9 A1 7C      812      CMP  #$7C
11BB 27 02      813      BEQ  NEXTBY      ;IF DRCNT1 >= 7C, INCREMENT REG3
11BD 20 0C      814      BRA  NODRP      ;ELSE, EXIT DROPCK
815      ;
11BF 3C 5F      816      NEXTBY  INC  REG3
11C1 20 08      817      BRA  NODRP      ;REG3 IS TESTED IN THE RPM ROUTINE
818      ;      ; IF 2 IT ERRORS
819      ;
820      ;      No drop
821      ;
11C3 1D 03      822      CLERK BCLR 6,PORTD
11C5 3F 5D      823      CLR  DRCNT1      ;CLEAR THE COUNTERS FOR BLOCKED EYES
11C7 3F 5E      824      CLR  DRCNT2

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REC3

CIR

NOIRP RTS

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;

\$EJECT

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826

827

828

829

11C9 3F 5F

11CB 81

```

830 ;
831 ;
832 ;
833 ; RPM CHECK
834 ;
835 ; This routine samples the hall effect line. At rates over 95 it stops
836 ; the motor every 3 magnets or one rev. At rates under 100 it stops
837 ; every magnet 1/3 rev.
838 RPM3 JMP RPM1
839 ;
840 ; Conditions
841 ;
842 REMCK BRCLR 2,PSTAT1,NOIRP ;DONT DO IF UNIT OFF
843 BRCLR 1,PSTAT1,NOIRP ;DON'T DO IF MOTOR IS OFF
844 ;
845 ; Delay until circuit settles
846 ;
847 LDA MOTIM2 ;DON'T DO IF MOTOR NOT RUN ENOUGH
848 ENR RPM2 ;IF 2ND BYTE >0 THEN DO TEST
849 LDA MOTIM1 ;IF-OM THEN TEST 1ST BYTE FOR>$32
850 CMP #86 ;
851 BLO NOIRP ;IF <THEN 86*.00816=.7017 SEC THEN DONT DO

```

```

852 ;
853 ; Test magnet
854 ;
855 RPM2 BRSET 0,PORTD,RPM3 ;IF LINE HIGH THERE IS NO MAGNET
856 CLR ERRCNT
857 INC ITEST ;UPDATE MAG LOW COUNTER
858 LDA ITEST
859 CMP #255 ;IF MAG SENSED FOR 2 CONS. SEC
860 BRQ TIMERR ;THEN MAGNET OR ROTOR ERROR.
861 CMP #501 ;IF ITEST > 1,
862 BHI NORM ;SAME PULSE DETECTED SO DON'T UPDATE
863 ;
864 ;----- If this is model 324 add .376 to volume for every rev -----
865 ;
866 BRCLR 7,PSTAT1,OFMOT1 ;IF 224 DONT ADD
867 ;
868 JSR CALCV ;ELSE, CALCULATE VOLUME
869
870 ;
871 ;
872 XYZV BRCLR 6,VOLM,OFMOT ;IF NOT IN VOLUME MODE OR
873 BRSET 0,VFLAG,OFMOT ;VOL TEST DISPLAY ENABLED

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11FC CD 1634      874      JSR   VSEXP      ;GO UPDATE VOLUME NUMBERS
                   875      ;
                   876      ;
                   877      ;
                   878      ;
                   879      ;      Test 1/3 OR 1 REV AND Turn off the motor
                   880      ;
                   881      OFMOT LDA DS1      ;IF DOSE!=0, CHECK DOSE
                   882      ORA   DS2
                   883      BNE   CMFDOS
                   884      ;
                   885      OFMOTL CLR REG1
                   886      INC   REG5      ;CHECK IF THIS IS START UP
                   887      LDA   REG5      ;IF SO IGNORE THE FIRST MAGNET
                   888      CMP   #02      ;AS IT COULD BE LESS THEN 1/3
                   889      BLO   NORM      ;IT IS SO JUMP OVER SET CHECK
                   890      ;
                   891      DEC   REG5      ;ITS NOT START SO KEEP FROM OVERFLOW
                   892      INC   THIR01
                   893      LDA   THIR01

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916 ;
917 ; Reset pulse status
918 ;
919 RFW1 CLR LTEST ;CLEAR MAG LOW COUNTER
920 INC ERRCONT
921 LDA ERRCONT
922 CMP #255 ;IF NO MAGNET IN 255X.008=2.04 SEC THEN ERR
923 BEQ TIMERR
924 RTS
925 ;
926 ;
927 CMPDOS JSR CFWTOD ;CALL COMPARE VOL TO DOSE
928 CPX #$FF ;X IS FF IF VOL >= DOSE
929 BNE OFMOT1 ;IF X NOT FF, CONTINUE
930 ; ;ELSE DOSERR
931 ;
932 DOSERR BSET 0,DOSER
933 LDA PSTAT2
934 ORA #$A0
935 AND #$BD

```

1230 3F 72

1232 3C 7F

1234 B6 7F

1236 A1 FF

1238 27 14

123A 81

123B CD 1951

123E A3 FF

1240 26 C3

1242 10 70

1244 B6 6E

1246 AA A0

1248 A4 BD

```

124A B7 6E          936      STA  PSTAT2
124C 20 DB          937      BRA  OFFM
                               938      ;
                               939      ;
124E 1E 6E          940      TIMERR  BSET 7,ERRON      ;ENABLE ERROR FLAG
1250 1A 6E          941      BSET 5,ALRM      ;ENABLE ALARM
1252 3F 7F          942      CLR  ERRCNT
1254 CD 1229        943      JSR  OFFM
1257 81             944      RTS
                               945      ;
                               946      ;      Count every 3 magnet hits
                               947      ;
1258 3C 7B          948      STP3  INC  THIROR      ;BUMP THIRD OF A REV COUNTER;
125A B6 7B          949      LDA  THIROR
125C A1 03          950      CMP  #03      ;IF THIRD ONE THEN STOP
125E 24 CB          951      BHS  OFFML      ;DONT SET HOLD FLAG
1260 81             952      RTS
                               953      ;
                               954      ;
                               955      ;      No drop error
                               956      ;
1261 14 6E          957      DROPER  BSET 2,NIDROP      ;SET FLOW ERROR FLAG

```

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1263 1E 6E      958      BSET 7,ERRON      ;ENABLE DISPLAY ERROR MODE
1265 1A 6E      959      BSET 5,ALRM      ;ENABLE ALARM ERROR
1267 1D 6E      960      BCIR 6,VOIM      ;GET OUT OF VOLUME MODE
1269 11 71      961      BCIR 0,DFLAG      ;CLEAR DOSE MODE FLAG
126B 20 BC      962      BRA OFFM
;
963 ;
964 ;          .125 ml/ 1/3 rev 8*.125=1
965 ;
126D 3C 58      966      CALCV INC DECML1      ;INCREMENT DECML COUNTER
126F B6 58      967      LDA DECML1
1271 A1 08      968      CMP #08      ;IF DECML=8, TIME TO INCREMENT VS1, VS2
1273 26 1A      969      BNE ENDCALC      ;ELSE, ENDCALC
;
1275 3F 58      970 ;
1275 3F 58      971      CLR DECML1      ;CLEAR DECML COUNTER
972 ;
1277 A6 99      973      LDA #99      ;CHECK FOR FULL COUNTER
1279 B1 59      974      CMP VS1
127B 26 04      975      BNE CONCAL      ;IF VS1 != 99, CONTINUE CALCULATION
127D B1 5A      976      CMP VS2      ;ELSE, CHECK VS2
127F 27 0E      977      BEQ ENDCALC      ;IF VS1 & VS2 = 99, END CALCULATION
978 ;
1281 B6 59      979      CONCAL LDA VS1      ;INCREMENT VS1

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1283 AB 01	980	ADD #01	
1285 8D	981	DAA	;DECIMAL ADJUST RESULT
1286 B7 59	982	STA VS1	;STORE VS1
	983		
1288 B6 5A	984	LDA VS2	;ADD VS2
128A A9 00	985	ADC #00	
128C 8D	986	DAA	;DECIMAL ADJUST RESULT
128D B7 5A	987	STA VS2	;STORE RESULT
128F 81	988	ENDCALC RTS	
	989		
	990	\$EJECT	

```

991 ;
992 ;
993 ;
994 ; This routine compares the calculated vs. timed motor on time and restarts
995 ; the motor every time they are equal.
996 ; The motor is turned off in the rpm routine>
997 ; the calculated values are generated by the UPDATE subroutine.
998 ;
999 ; Variables: MOTIM1=INCREMENTED EACH TIME
1000 ; MOTIM2=INCREMENTED EACH TIME MOTIM1 OVERFLOWS
1001 ; TIMLO= CALCULATED FIRST BYTE OF TIME ON GENERATED IN UPDATE
1002 ; TIMHI= CALCULATED SECOND BYTE OF TIME
1003 ;
1004 ; Conditions
1005 ;
1006 MOTCK BRCLR 2,PSTAT1,END1 ;DONT DO IF UNIT OFF
1007 BRSET 0,PSTAT1,END1 ;DON'T DO IF HOLD
1008 BRSET 7,ERRON,END1 ;DON'T DO IF ERROR MODE
1009 BRSET 3,PSTAT1,END1 ;DONT DO IF START MODE
1010 ;
1011 ; ABOVE LINES DELETED TO ALLOW MOTOR TO
1012 ; PUMP WITH LO BAT ERROR

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1013 ;
1014 ;
1015 ; Check if time running equals time calculated
1016 ;
1017 CLC
1018 LDA MOTIM1
1019 ADD #S01
1020 STA MOTIM1
1021 BCS INCM2
1022 BACK LDA TIMLO
1023 CMP MOTIM1
1024 BNE END1
1025 LDA TIMHI
1026 CMP MOTIM2
1027 BEQ MOTON
1028 RTS
1029 ;
1030 INCM2 CLC
1031 INC MOTIM2
1032 JMP BACK
1033 ;
1034 ; Times are equal so turn motor on again

```

1296 98

1297 B6 7D

1299 AB 01

129B B7 7D

129D 25 0D

129F B6 47

12A1 B1 7D

12A3 26 17

12A5 B6 48

12A7 B1 7E

12A9 27 07

12AB 81

12AC 98

12AD 3C 7E

12AF CC 129F

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1035 ;
1036 MOTON BSET 1, PSTAV1L ;MOTOR ON FLAG
1037 BSET 5, PORTB ;TURN MOTOR ON
1038 CLR THIRDR ;CLR THIRD OF A REV COUNTER
1039 CLR MOTIM1 ;RESET POINTER
1040 CLR MOTIM2 ;
1041 ENDL RTS
1042 ;
1043 ;
1044 $EJECT
12B2 12 6D
12B4 1A 01
12B6 3F 7B
12B8 3F 7D
12BA 3F 7E
12BC 81

```

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1045 ;
1046 ;
1047 ; SET CHECK
1048 ;
1049 ; Conditions
1050 ;
1051 SETCK BRCLR 2, PSTAT1, NOSCK ;DONT DO IF UNIT OFF
1052 BRSET 3, PSTAT1, NOSCK ;DONT DO IF UNIT IS IN START MODE
1053 BRSET 0, PSTAT1, NOSCK ;DONT DO IF UNIT IS IN HOLD
1054 ;
1055 ; CHECK FOR PROPER SET PLACEMENT
1056 ;
1057 BRCLR 3, FORTC, NOSCK ;IF SET PRESENT, RETURN
1058 ; ELSE SET ERROR
1059 BRSET 4, NOSET ;ENABLE SET ERROR FLAG
1060 BRSET 7, ERROR ;ENABLE ERROR MODE
1061 BRSET 5, ALRM ;ENABLE AUDIO ALARM
1062 BRCLR 6, VOLM ;GET OUT OF VOLUME MODE
1063 BRCLR 0, DFLAG ;CLEAR DOSE MODE FLAG
1064 BRCLR 1, PSTAT1 ;CLEAR MOTOR ON FLAG
1065 BRCLR 5, FORTB ;TURN OFF MOTOR
1066 BRSET 0, PSTAT1 ;SET HOLD FLAG TO DISABLE MOTCK

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1067 ;
1068 NOSCK RIS
1069
1070
1071
1072
1073 \$EJECT

12D9 81

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1074 ;
1075 ;
1076 ; INPUTTING THE RATE (model 224)
1077 ;
1078 ; Conditions
1079 ;
1080 INRATE1 BRCLR 2,PSTAT1,OVER ;DONT DO IF OFF
1081 BRSET 0,DSIPST,OVER ;DONT DO IF TEST MODE
1082 BRSET 0,LOWEAT,OVER ;DONT DO IF LOWEAT
1083 BRSET 7,ERRON,OVER ;DONT DO IF ERROR MODE
1084 BRSET 7,PSTAT1,OVER ;DONT DO IF MODEL 324
1085 BRSET 3,PSTAT1,CKRTE ;IF START MODE DO
1086 BRCLR 0,PSTAT1,OVER ;DONT DO IN HOLD OFF MODE
1087 ;
1088 ; DECODE RATE SWITCH
1089 ;
1090 CKRTE LSL LSTRAT ;SHIFT LSTRAT LEFT 2 BITS
1091 LSL LSTRAT
1092 LDA PORIC ;GET AND MASK CURRENT KNOB POSITION
1093 AND #$03
1094 ORA LSTRAT ;MERGE PREVIOUS AND CURRENT POSITIONS
1095 AND #$0F ;MASK OUT UPPER NIBBLE

```

12FB B7 82 ;STORE RATE POSITION FOR NEXT TIME

1096 STA ISTRAT

1097 ;

12FD A1 01

12FE 27 64

1301 A1 07

1303 27 60

1305 A1 08

1307 27 5C

1309 A1 0E

130B 27 58

130D A1 02

130F 27 0D

1311 A1 04

1313 27 09

1315 A1 0B

1317 27 05

1319 A1 0D

131B 27 01

131D 81

131E 27 01

131F 27 01

1320 27 01

1322 27 01

1324 27 01

1326 27 01

1328 27 01

132A 27 01

132C 27 01

132E 27 01

132F 27 01

1330 27 01

1332 27 01

1334 27 01

1336 27 01

1338 27 01

133A 27 01

133C 27 01

133E 27 01

133F 27 01

1340 27 01

1342 27 01

1344 27 01

1346 27 01

1348 27 01

134A 27 01

134C 27 01

134E 27 01

134F 27 01

1350 27 01

1352 27 01

1354 27 01

1356 27 01

1358 27 01

135A 27 01

135C 27 01

135E 27 01

135F 27 01

1360 27 01

1362 27 01

1364 27 01

1366 27 01

1368 27 01

136A 27 01

136C 27 01

136E 27 01

136F 27 01

1370 27 01

1372 27 01

1374 27 01

1376 27 01

1378 27 01

137A 27 01

137C 27 01

137E 27 01

137F 27 01

1380 27 01

1382 27 01

1384 27 01

1386 27 01

1388 27 01

138A 27 01

138C 27 01

138E 27 01

138F 27 01

1390 27 01

1392 27 01

1394 27 01

1396 27 01

1398 27 01

139A 27 01

139C 27 01

139E 27 01

139F 27 01

13A0 27 01

13A2 27 01

13A4 27 01

13A6 27 01

13A8 27 01

13AA 27 01

13AC 27 01

13AE 27 01

13AF 27 01

13B0 27 01

13B2 27 01

13B4 27 01

13B6 27 01

13B8 27 01

13BA 27 01

13BC 27 01

13BE 27 01

13BF 27 01

13C0 27 01

13C2 27 01

13C4 27 01

13C6 27 01

13C8 27 01

13CA 27 01

13CC 27 01

13CE 27 01

13CF 27 01

13D0 27 01

13D2 27 01

13D4 27 01

13D6 27 01

13D8 27 01

13DA 27 01

13DC 27 01

13DE 27 01

13DF 27 01

13E0 27 01

13E2 27 01

13E4 27 01

13E6 27 01

13E8 27 01

13EA 27 01

13EC 27 01

13EE 27 01

13EF 27 01

13F0 27 01

13F2 27 01

13F4 27 01

13F6 27 01

13F8 27 01

13FA 27 01

13FC 27 01

13FE 27 01

13FF 27 01

1400 27 01

1402 27 01

1404 27 01

1406 27 01

1408 27 01

140A 27 01

140C 27 01

140E 27 01

140F 27 01

1410 27 01

1412 27 01

1414 27 01

1416 27 01

1418 27 01

141A 27 01

141C 27 01

141E 27 01

141F 27 01

1420 27 01

1422 27 01

1424 27 01

1426 27 01

1428 27 01

142A 27 01

142C 27 01

142E 27 01

142F 27 01

1430 27 01

1432 27 01

1434 27 01

1436 27 01

1438 27 01

143A 27 01

143C 27 01

143E 27 01

143F 27 01

1440 27 01

1442 27 01

1444 27 01

1446 27 01

1448 27 01

144A 27 01

144C 27 01

144E 27 01

144F 27 01

1450 27 01

1452 27 01

1454 27 01

1456 27 01

1458 27 01

145A 27 01

145C 27 01

145E 27 01

145F 27 01

1460 27 01

1462 27 01

1464 27 01

1466 27 01

1468 27 01

146A 27 01

146C 27 01

146E 27 01

146F 27 01

1470 27 01

1472 27 01

1474 27 01

1476 27 01

1478 27 01

147A 27 01

147C 27 01

147E 27 01

147F 27 01

1480 27 01

1482 27 01

1484 27 01

1486 27 01

1488 27 01

148A 27 01

148C 27 01

148E 27 01

148F 27 01

1490 27 01

1492 27 01

1494 27 01

1496 27 01

1498 27 01

149A 27 01

149C 27 01

149E 27 01

149F 27 01

14A0 27 01

14A2 27 01

14A4 27 01

14A6 27 01

14A8 27 01

14AA 27 01

14AC 27 01

14AE 27 01

14AF 27 01

14B0 27 01

14B2 27 01

14B4 27 01

14B6 27 01

14B8 27 01

14BA 27 01

14BC 27 01

14BE 27 01

14BF 27 01

14C0 27 01

14C2 27 01

14C4 27 01

14C6 27 01

14C8 27 01

14CA 27 01

14CC 27 01

```

1118 ;
1119 INC R1 BCLR 5,ZEROST ;CLEAR DISPLAY ZERO FLAG
1120 BSET 3,PSSTAT1 ;MAKE START ON
1121 BSET 4,PSSTAT1 ;MAKE DISPLAY ON
1122 LDA #03 ;IF 300, RETURN
1123 CMP DSPDG3
1124 BEQ OVER
1125 ;
1126 BRCLR 7,PSSTAT1,UPFIVE ;IF MODEL 224 GO UP BY 5 ONLY
1127 ;
1128 ; IF RATE >= 50, INCREMENT BY 5
1129 LDA DSPDG3 ;
1130 BNE UPFIVE ;IF DIGIT 3 IS NOT 0, INCREMENT BY 5
1131 LDA DSPDG2
1132 CMP #05
1133 BHS UPFIVE ;IF DIGIT 2 IS >= 5, INCREMENT BY 5
1134 ;
1135 UPONE CLC ;ELSE INCREMENT BY 1
1136 LDA #07 ;TEST FOR 9
1137 ADD DSPDG1
1138 BCS DEC91 ;IF 9 MAKE 0 AND INC NEXT DIGIT
1139 INC DSPDG1 ;IF NOT THEN INC BY ONE

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1340 CC 1756      1140      JMP  UPDATE
                   1141      ;
1343 3F 51        1142      DECS1 CLR  DSPDG1
1345 20 09        1143      BRA  INC2
                   1144      ;
                   1145      ;      increment by five
                   1146      ;
                   1147      ;
1347 CD 174B      1148      UPFIVE JSR  TOGGLE      ;ELSE INCR BY 5
134A A6 05        1149      LDA  #05
134C B1 51        1150      CMP  DSPDG1
134E 27 12        1151      BEQ  DEC3
                   1152      ;
                   1153      ;      Increment digit 2 by one
                   1154      ;
1350 98           1155      INC2  CLC      ;IF DIGITB IS 9 THEN GO MAKE IT 0
1351 A6 F7        1156      LDA  #F7      ;ADD 255-8 TO DIGITB
1353 BB 52        1157      ADD  DSPDG2      ;IF OVER FLOW THEN MAKE 0
1355 25 05        1158      BCS  DEC9
1357 3C 52        1159      INC  DSPDG2      ;IF OK THEN DIGIT=DIGIT+1
1359 CC 1756      1160      JMP  UPDATE      ;NOW GO DO DIGIT3
135C 3F 52        1161      DEC9  CLR  DSPDG2      ;DIGIT2=0

```

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1162 ;
1163 ;      Increment digit 3 by one
1164 ;
135E 3C 53      INC3 INC      DSPDG3
1360 1F 74      BCLR 7,ZEROST
1362 CC 1756    DEC3 JMP      UPDATE
1168 ;
1169 ;      Do a rate decrease
1170 ;
1171 ;      test for decrement by 5
1172 ;
1365 16 6D      DECRI BSET 3,PSTAT1 ;MAKE START ON
1367 18 6D      BSET 4,PSTAT1 ;MAKE DISPLAY ON
1369 0A 74 B1    BSET 5,ZEROST,OVER ;IF DISPLAY IS 0 THEN DONT DECR
136C B6 53      LDA DSPDG3 ;PREPARE ACCA FOR ZERO TEST OF
136E BA 52      ORA DSPDG2 ;DSPDG2 AND DSPDG3
1370 0E 6D 03    BSET 7,PSTAT1,CH324 ;IF 324 GOTO CH324, ELSE
1373 26 62      CH224 BNE DECR5 ;IF 224 AND DIGIT 2 & 3 ARE NOT ZERO, DECR5
1375 81          RUS ;ELSE DONT DECR
1181 ;
1376 26 07      CH324 BNE DECON ;IF DIGIT2 & 3 ARE NOT ZERO, CONTINUE
1378 B6 51      LDA DSPDG1 ;ELSE, TEST DIGIT 1 FOR 1

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137A A1 01      1184      CMP    #$01
137C 26 13      1185      BNE    DOWN1      ;IF NOT 1,DECR BY 1
137E 81          1186      RTS
                  1187      ;
137F B6 53      1188      DECCN LDA DSPDG3      ;IF DIGIT3 NOT ZERO,
1381 26 54      1189      BNE    DECR5      ;DECR BY 5
1383 B6 52      1190      LDA    DSPDG2      ;IF DIGIT2 > 5,
1385 A1 05      1191      CMP    #$05      ;
1387 22 4E      1192      BHI    DECR5      ;DECR BY 5
1389 25 06      1193      BLO    DOWN1      ;ELSEIF DIGIT2 < 5 DECR BY 1
138B B6 51      1194      LDA    DSPDG1      ;ELSE TEST DIGIT1
138D A1 00      1195      CMP    #$00      ;IF DIGIT1 NOT ZERO,
138F 26 46      1196      BNE    DECR5      ;DECR BY 5
                  1197      ;
                  1198      ;
                  1199      ;    DECREMENT BY 1
                  1200      ;
1391 B6 51      1201      DOWN1    LDA    DSPDG1      ;GET DIGIT 1
1393 27 09      1202      BEQ    TET2      ;IF ZERO THEN MAKE 9
1395 A1 01      1203      CMP    #$01
1397 27 34      1204      BEQ    CHR300
1399 3A 51      1205      DEC2    DEC    DSPDG1      ;IF NOT THEN JUST DECREMENT

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139B CC 1756      1206      JMP      UPDATE      ;GO UPDATE THE RATE
1207      ;
139E B6 52      1208      LDA      DSPDG2      TET2
13A0 26 0B      1209      BNE      INC9A
13A2 3A 53      1210      DEC      DSPDG3
13A4 A6 09      1211      LDA      #$09
13A6 B7 51      1212      STA      DSPDG1
13A8 B7 52      1213      STA      DSPDG2
13AA CC 1756      1214      JMP      UPDATE
1215      ;
13AD 3A 52      1216      INC9A DEC DSPDG2      ;IF NOT DECREMENT BY ONE
13AF A6 09      1217      LDA      #$09      ;MAKE FIRST DIGIT 9
13B1 B7 51      1218      STA      DSPDG1
13B3 CC 1756      1219      JMP      UPDATE      ;GO UPDATE THE DISPLAY
1220      ;
13B6 A6 03      1221      GO300 LDA #$03      ;CHANGE DIGIT 3 TO 3
13B8 B7 53      1222      STA      DSPDG3
13BA A6 00      1223      LDA      #$00      ;MAKE DISPLAY 300
13BC B7 52      1224      STA      DSPDG2
13BE B7 51      1225      STA      DSPDG1
1226      ; CLR      ZEROST
1227      LDA      SPEED1

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13C2 A1 40      1228      CMP      #$40
13C4 25 04      1229      BLO      SPDY1
13C6 A6 41      1230      LDA      #$41
13C8 B7 78      1231      STA      SPEED1
13CA CC 1756     1232      SPDY1 JMP UPDATE
                  1233      ;
13CD B6 52      1234      CHK300    LDA      DSPDG2      ;IF DIGIT 2 IS ZERO MAKE 300
13CF 26 C8      1235      BNE      DEC2
13D1 B6 53      1236      LDA      DSPDG3
13D3 26 C4      1237      BNE      DEC2
13D5 20 DF      1238      BRA      GO300
                  1239      ;
                  1240      ;      change rate by 5
                  1241      ;
13D7 4F          1242      DECF5 CIRA
13D8 B1 53      1243      CMP      DSPDG3      ;IF DIGIT 2,3 ARE 0 THEN MAKE 000
13DA 26 0D      1244      BNE      TOG2
13DC B1 52      1245      CMP      DSPDG2
13DE 26 09      1246      BNE      TOG2
13E0 B7 51      1247      STA      DSPDG1
13E2 A6 03      1248      LDA      #$03
13E4 B7 53      1249      STA      DSPDG3

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1250      ;      CLR      ZERO ST
1251      ;      JMP      UPDATE
1252      TOG2 JSR      TOGGLE      ;GO MAKE 0 OR 5
1253      LDA      #$00
1254      CMP      DSPDG1
1255      BEQ      INCD3
1256      ;
1257      ;      Decrement digit 2 by one
1258      ;
1259      LDA      DSPDG2      ;GET POINTER
1260      BEQ      INC9      ;IF 0 THEN MAKE 9
1261      DEC      DSPDG2      ;IF>0 THEN SUB 1
1262      SETZ     JMP      UPDATE      ;GO DO DIGIT 3
1263      INC9     LDA      DSPDG3
1264      BEQ      INCD3
1265      LDA      #$09      ;RESET TO 9
1266      STA      DSPDG2
1267      ;
1268      ;      Decrement digit 3 by one
1269      ;
1270      DECD3 LDA      DSPDG3      ;GET DIGIT 3 POINTER
1271      BEQ      INCD3      ;IF 0 THEN MAKE 2

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1407 3A 53
1409 1F 74
140B 0C 1756

1272
1273
1274
1275
1276
1277

DEC DSPDG3
BCLR 7,ZEROST
INCD3 JMP UPDATE
;
;
$EJECT

;>0 80 SUB 1
```

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1278 ;
1279 ;
1280 ; OFF CHECK
1281 ;
1282 ; Conditions
1283 ;
1284 OFFCK BRCLR 2,PSTAT1,TSTCK ;IF OFF, CHECK IF TIME FOR TEST MODE
1285 BRCLR 2,FORIC,GOFF ;IF OFF BUTTON PRESSED GO OFF
1286 NOOFF RIS
1287 ;
1288 ; Do off
1289 ;
1290 GOFF BRSET 0,LOWBAT,KILLP1 ;IF LOW BATT KILL POWER
1291 CLR PSTAT2 ;NO ALARMS OR OPTIONAL MODES
1292 CLR DFLAG ;CLEAR DOSE FLAG
1293 CLR DSPST ;CLEAR DISPLAY TEST FLAG
1294 ;
1295 LDA #19 ;SET PSTAT1 FOR NEXT TURN-ON
1296 STA PSTAT1
1297 LDA #1F ;KILL DISPLAY AND MOTOR 0001 1111 OR
1298 STA PORTB
1299 JSR TIMRST ;CLEAR ALL TIMERS FOR 24HR KEEPING
140E 05 6D 2C
1411 05 02 01
1414 81
1415 00 6E 1E
1418 3F 6E
141A 3F 71
141C 3F 80
141E A6 19
1420 B7 6D
1422 A6 1F
1424 B7 01
1426 CD 1948

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1429 3F 45      CLR T25
142B 3F 55      CLR DS1      ;CLEAR DS1 AND DS2 FOR USE AS
142D 3F 56      CLR DS2      ;3 SEC TEST TIMER.
142F 8F          LOOPF      WAIT      ; GO SLEEP
1430 20 FD      BRA LOOPF
1300             ;
1301             ; wake up by on button (external int)
1302             ;
1303             ;
1304             ;
1305             ;
1306             ;
1307             ;
1308             JSR TIMEON      ;RESET COUNTER TIMER
1309             RTS
1310             ;
1311             KILLP1      SET      ;SET INT MASK TO PREVENT TURN-ON
1312             LDA #SOF      ;DISABLE PMP
1313             STA PORIB
1314             BRA KILLP1      ;LOOP UNTILL POWER DISSIPATES
1315             ;
1316             ; TEST CHECK
1317             ;
1318             TSTCK RESET 2, PORIC, TSTOUT      ;IF OFF BUTTON NOT PUSHED, RETURN
1319             BRCLR 2, PORID, TSTONT      ;ELSE, IF HOLD BUTTON PRESSED INCREMENT
1320             ; TES COUNTER
1321             TSTOUT CLR DS1
1443 3F 55
143D 04 02 03
1440 05 03 05

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1445 3F 56      1322      CLR DS2
1447 81         1323      RTS
                        ;
1448 3C 55      1325      TSTCNT      INC DS1      ; INCREMENT TEST TIMER
144A 26 02      1326      BNE TST1
144C 3C 56      1327      INC DS2
144E B6 56      1328      TST1 LDA DS2      ; IF 3 SEC ELAPSED, GOTO PMPTST
1450 A1 02      1329      CMP #502
1452 24 01      1330      BHS PMPT
1454 81         1331      RTS      ; ELSE RETURN
1455 0C 1C00    1332      PMPT JMP PMPTST
                        ;
                        1333
                        1334      $EJECT

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1335 ;
1336
1337 ;
1338 ;
1339 ;
1340 TESTD BRCLR 2, PSTAT1, NOIST ;DONT DO IF UNIT OFF
1341 BRCLR 0, DSIPST, NOIST ;DONT DO IF TEST FLAG NOT SET
1342 BRCLR 7, PSTAT1, TSTD2 ;IF 224, DO SHORT TEST MODE
1343 INC VOLTIM ;DO FOR .033*60=1.98 SEC
1344 LDA VOLTIM
1345 CMP #120 ;GO CLEAR TEST MODE
1346 BHI CLTEST
1347 CMP #100 ;GO DISPLAY DOSE NUMBER
1348 BHI DOSDIS
1349 CMP #80 ;GO DISPLAY DOSE
1350 BHI DOSTST
1351 CMP #60 ;GO DISPLAY VOLUME NUMBER
1352 BHI VOLDS
1353 CMP #40 ;GO DISPLAY VOL
1354 BHI VOLSTST
1355 CMP #20 ;GO KILL ALARM FIRST
1356 BHI CLATST

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147D 1E 01      1357  CONTST      BSET 7,PORTB      ;ALARM ON
147F 1C 01      1358      BSET 6,PORTB      ;CLEAR LED ON
1481 1C 6E      1359      BSET 6,VOLM      ;SET VOLM FLAG TO ENABL 4 DIGITS
1483 3F 4D      1360      CLR  SAMPLE1      ;MAKE DISPLAY "8888"
1485 3F 4E      1361      CLR  SAMPLE2
1487 3F 4F      1362      CLR  SAMPLE3
1489 3F 50      1363      CLR  SAMPLE4
148B 1D 03      1364      NOIST BCLR 6,PORTD      ;TURN IR SOURCE OFF
148D 81          1365      RTS
                  1366      ;
                  1367      ; SHORT TEST FOR K224
                  1368      ;
148E 1C 6E      1369      TSTD2 BSET 6,PSTAT2      ;VOLUME FLAG SET TO ENABLE 4 DIGITS
1490 3C 79      1370      INC  VOLTIM      ;DO FOR .033*60=1.98 SEC
1492 B6 79      1371      LDA  VOLTIM
1494 A1 3C      1372      CMP  #$3C
1496 22 20      1373      BHI  CTEST
1498 A1 14      1374      CMP  #$14
149A 22 03      1375      BHI  CLATST
149C 0C 147D    1376      JMP  CONTST
                  1377      ;
                  1378

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```

149F 1F 01      1379      CLATST      BCLR 7,FORTB      ;TURN ALARM OFF
14A1 1D 01      1380      BCLR 6,FORTB      ;LED OFF
1381      ;
1382      ;      test sensor eyes
1383      ;
1384      BSET 6,FORTD      ;TURN IR SOURCE ON
1385      NOP      ;ADD 8 USEC DELAY TO ALLOW IR
1386      NOP      ;SENSOR TO SETTLE
1387      NOP
1388      NOP
1389      BRSET 5,FORTC,NOTST      ;IF RECIEVER LOW EYES BLOCKED THEN ERROR
1390      BCLR 6,FORTD      ;TURN OFF IR SOURCE
1391      BSET 5,PSTAT2      ;ENABLE ALARM
1392      BSET 2,NDROP      ;ENABLE FLOW ERROR FLAG
1393      BSET 7,PSTAT2      ;ENABLE ERROR FLAG
1394      BCLR 7,FORTB      ;TURN ALARM OFF
1395      BCLR 3,PSTAT1      ;CLEAR START FLAG
1396      ;
1397      CLATST      JSR UPDATE      ;RESTORE DISPLAY
1398      CLR DSPTST      ;CLEAR TEST FLAG
1399      BCLR 6,VOLM      ;CLEAR VOLUME FLAG FOR 224
1400      CLR VOLTIM      ;CLEAR TIMER

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14C1 81      1401      RUS
                ;
14C2 A6 F8   1402      ;
14C4 B7 50   1403      VOLIST      LDA  #F8
14C6 A6 9C   1404      STA  SAMPLE4
14C8 B7 4F   1405      LDA  #9C
14CA A6 C8   1406      STA  SAMPLE3
14CC B7 4E   1407      LDA  #C8
14CE A6 FF   1408      STA  SAMPLE2
14D0 B7 4D   1409      LDA  #FF
14D2 81      1410      STA  SAMPLE1
                1411      RUS
                ;
14D3 CD 1634 1412      ;
14D6 81      1413      VOLDS JSR  VSEXP
                1414      RUS
                ;
14D7 A6 B0   1415      ;
14D9 B7 50   1416      DOSIST      LDA  #B0
14DB A6 92   1417      STA  SAMPLE4
14DD B7 4F   1418      LDA  #92
14DF A6 9C   1419      STA  SAMPLE3
14E1 B7 4E   1420      LDA  #9C
14E3 A6 8C   1421      STA  SAMPLE2
                1422      LDA  #8C

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14E5 B7 4D	1423	STA	SAMPL1	
14E7 81	1424	RTS		
	1425			
14E8 CD 1745	1426	DOSDIS	JSR DSEXP	;DISPLAY PROGRAMMED DOSE
14EB 81	1427	RTS		
	1428			
	1429			
	1430			
	1431			\$EJECT

```

1432 ;
1433 ; HOLD CHECK
1434 ;
1435 ; Conditions
1436 ;
1437 HOLDCK BRCLR 2,PSTAT1,NOHOLD ;IF OFF DONT DO
1438 BRSET 0,DSPTST,NOHOLD ;DONT DO IF TEST MODE
1439 BRSET 0,CWF,NOHOLD ;DONT DO IF INC OR DEC
1440 BRSET 0,CWF,NOHOLD ;BUTTON IS PRESSED
1441 ;
1442 BRSET 2,PORID,NOHL ;IS HOLD BUTTON DOWN RETURN IF NOT
1443 ;
1444 ; Hold button down
1445 ;
1446 ; Debounce switch
1447 ;
1448 BRSET 0,HTEST,NOHOLD ;WE MUST BE SEEING SAME PULSE SO IGNORE
1449 BRSET 0,HTEST ;IF NOT SAME SET THE FLAG
1450 ;
1451 ; CLEAR HOLD TIME COUNTERS
1452 ;
1453 CLR HLDINI

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1502 3F 4C      CLR  HLDIM2
1454
1455
1456      ;      Check for alarm conditions
1457      ;
1458      ;
1458      ;      HRSET 0,LOWBAT,HLDIBAT ;IF LOW BAT,STOP ALARM AND MOTOR.
1504 00 6E 2F
1459      ;      HRSET 0,DOSE,STDOSE ;IF DOSE DEL FLAG SET, STOP DOSE MESS.
1507 00 70 37
1460      ;      HRSET 5,ALRM,NOAUDIO ;IF WE ARE ALARMING THEN KILL AUDIO
150A 0A 6E 2F
1461      ;      HRSET 7,ERRON,NOMESS ;IF WE ARE FLASHING ERROR MESSAGE THEN GO RUN
150D 0E 6E 3F
1462      ;      HRSET 6,VOLM,NOVOLM ;IF IN VOL GO RESTORE RATE
1510 0C 6E 34
1463      ;      HRSET 0,DFLAG,NODOS ;IF DOSE MODE, GO RESTORE RATE
1513 00 71 35
1464      ;
1465      ;      Are we in hold now run if yes, hold if not
1516 06 6D 3E
1466      ;      HRSET 3,PSTAT1,RUN ;IF IN START MODE THEN DO RUN
1467      ;
1468      ;      HRSET 0,PSTAT1,RUN ;IF YES GO RUN
1519 00 6D 3B
1469      ;      HOLD BSET 0,PSTAT1 ;IF NOT SET HOLD FLAG
151C 10 6D
1470      ;      BCLR 5,PORIB ;MOTOR OFF
151E 1B 01
1471      ;      BCLR 1,PSTAT1 ;CLEAR MOTOR ON FLAG
1520 13 6D
1472      ;
1473      ;      LDA PORIC ;RE-INITIALIZE RATE KNOB
1522 B6 02
1474      ;      AND #03
1524 A4 03
1475      ;      STA LSTRAT
1526 B7 82

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1476 ;
1477 CLR PSTAT2
1478 CLR DOSER ;CLR DOSE ERROR FLAG
1479 JSR UPDATE ;RESTORE DIGITS TO KILL SCROLLING DP
1480 JSR TIMRST
1481 NOHOLD RTS
1482 ;
1483 ; Hold button not down so reset the flag and return
1484 ;
1485 NOHL BCIR 0,HTEST
1486 RTS
1487 ;
1488 ; LOW BAT HOLD
1489 ;
1490 ; Kill motor
1491 ;
1492 HLD BAT BCIR 1,PSTAT1 ;CLEAR MOTOR ON FLAG
1493 BCIR 5,FORTB ;TURN MOTOR OFF
1494 BSET 0,PSTAT1 ;SET HOLD FLAG
1495 ;
1496 ; AND
1497 ;

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1498 ; Kill the audio
1499 ;
1500 NOAUDIO BCLR 5,ALRM ;RESET BEEPER FLAG
1501 BCLR 7,PORTB ;STOP AUDIO NOW
1502 RTS
1503 ;
1504 ; STOP DOSE DELIVIERED MESSAGE
1505 ;
1506 STDOSE BCLR 6,VOLM ;CLEAR ALARM FLAG
1507 BCLR 7,PORTB ;STOP ALARM
1508 ERA HOLD ;PUT PUMP IN HOLD
1509 ;
1510 ; Recovery from error KILL THE MESSAGE
1511 ;
1512 NOVOLM BCLR 6,VOLM
1513 ERA HOLD
1514 ;
1515 NODOS BCLR 0,DFLAG
1516 ERA HOLD
1517 ;
1518 ;
1519 NOMESS CLR PSTAT2
153C 1B 6E
153E 1F 01
1540 81

1541 1D 6E
1543 1F 01
1545 20 D5

1547 1D 6E
1549 20 D1

154B 11 71
154D 20 CD

154F 3F 6E

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1551 CD 1756      1520      JSR  UPDATE      ;RESTORE DISPLAY TO RATE
1554 OC 1557      1521      JMP  RUN        ;GO RUN MOTOR
                    1522      ;
                    1523      ;
                    1524      ;
                    1525      ;----- RUN MOTOR PUMPING -----
                    1526      ;
                    1527      ;
1557 17 6D        1528      RUN  BCIR 3,PSTAT1 ;SET UNIT START OFF
1559 18 6D        1529      BSET 4,PSTAT1    ;SET DISPLAY ON
                    1530      ;
155B B6 55        1531      LDA  DS1        ;CHECK IF DOSE DEL BEFORE TURNING
155D BA 56        1532      ORA  DS2        ;MOTOR ON
155F 27 16        1533      BEQ  RUN1      ;IF DOSE = 0, NO NEED TO CHECK
1561 CD 1951      1534      JSR  CPTOD      ;ELSE, CALL CMP VOL TO DOSE ROUTINE
1564 A3 FF        1535      CPX  #$FF      ;X IS FF IF VOL >= DOSE
1566 26 0F        1536      BNE  RUN1      ;IF X != FF, OK TO START MOTOR
                    1537      ;
1568 10 70        1538      BSET 0,DOSER    ;ELSE, SET DOSE DEL MESSAGE
156A 10 6D        1539      BSET 0,PSTAT1    ;SET HOLD FLAG TO DISABLE MOTCK
156C 1E 6E        1540      BSET 7,ERRON    ;ENABLE ERROR FLAG
156E 1A 6E        1541      BSET 5,ALRM     ;ENABLE ALARM

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1570 1D 6E      1542      BC1R 6,VOLM      ;CLEAR VOL MODE FLAG
1572 11 71      1543      BC1R 0,DFLAG      ;CLEAR DOSE MODE FLAG
1574 19 6E      1544      BC1R 4,NOSET      ;CIR NO SET FLAG
1576 81          1545      R1S
                        1546      ;
                        1547      ;
1577 3F 7D      1548      RUN1 CIR MOTIM1
1579 3F 7E      1549      CIR MOTIM2
157B 3F 81      1550      CIR COUNT4
157D 3F 63      1551      CIR COUNT2
157F 3F 5B      1552      CIR REG1
1581 3F 5D      1553      CIR DRCNT1
1583 3F 5E      1554      CIR DRCNT2
1585 3F 5F      1555      CIR REG3
1587 3F 60      1556      CIR REG4
1589 3F 61      1557      CIR REG5
158B 3F 7A      1558      CIR THIR01
158D 3F 7B      1559      CIR THIR0R
158F 3F 7F      1560      CIR ERRCNT
1591 3F 6E      1561      CIR PSTAT2
                        1562      ; LDA #10
                        1563      ; STA PSTAT2

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1564 ;
1565 LDA DSPDG1 ;CHECK RATE VALUE
1566 ORA DSPDG2
1567 ORA DSPDG3
1568 ORA DSPDG4
1569 BNE RUNMOT
1570 ; IF RATE!=0, RUNMOT
1571 BSET 7,ERRON ;IT =000 SO SET ERROR BIT
1572 BSET 5,ALRM ;SET ALARM BIT
1573 ;
1574 RTS ;AND RETURN
1575 RUNMOT BSET 1,PSTAT1 ;MOTOR ON FLAG
1576 BCIR 0,PSTAT1 ;RUN FLAG ON
1577 BSET 5,FORTB ;MOTOR ON
1578 RTS
1579 ;
1580
1581
1582 $EJECT

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1583 ; DOSE CHECK
1584 ;
1585 ; Conditions
1586 ;
1587 DOSECK BRCLR 2,PSTAT1,NDOSE ;DON'T DO IF UNIT IS OFF
1588 BRSET 0,DSPIST,NDOSE ;DON'T DO IF TEST MODE
1589 BRCLR 7,PSTAT1,NDOSE ;DON'T DO IF UNIT IS 224
1590 BRSET 7,PSTAT2,NDOSE ;DON'T DO IF ERROR MODE ON
1591 ;
1592 BRSET 0,DFLAG,DOS1 ;IF DOSE FLAG SET THEN DOS1
1593 ;
1594 BRSET 0,CWF,NDOSE ;IF INC OR DEC FLAG PRESSED
1595 BRSET 0,CWF,NDOSE ;DONT SET UP DOSE FEATURE
1596 ;
1597 BRCLR 1,FORDID,SEILOS ;IF DOSE BUTTON PUSHED THEN
1598 ;INITIALIZE DOSE MODE
1599 RTS ;ELSE RETURN
1600 ;
1601 DOS1 INC DOSECT
1602 LDA DOSECT
1603 CMP #30
1604 BHI DOS2

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15CA CD 14D7      1605      JSR   DOSTST
15CD 81           1606      NDOSE RTS
                  1607      ;
15CE 10 71       1608      SETDOS   BSET 0,DFLAG   ;SET DOSE MODE FLAG
15D0 1D 6E       1609      BCIR 6,VOLM   ;CLEAR VOLUME FLAG
                  1610      ;
15D2 01 6D 04    1611      BRCLR 0,PSTAT1,CONDO   ;IF PUMP IN HOLD,
15D5 16 6D       1612      BSET 3,PSTAT1   ;SET START FLAG TO DISABLE FLASH
15D7 18 6D       1613      BSET 4,PSTAT1   ;MAKE DISPLAY ON
                  1614      ;ELSE, JUST CONTINUE WITH DOSE
15D9 3F 57       1615      CONDO CLR DOSECT   ;CLEAR DOSE COUNTER
15DB 20 E5       1616      BRA  DOS1   ;CONTINUE DOSE HANDLING
                  1617      ;
15DD CD 1745     1618      DOS2 JSR DSEXP
15E0 B6 57       1619      LDA  DOSECT
15E2 A1 78       1620      CMP  #120
15E4 25 E7       1621      BLO  NDOSE
15E6 CD 1756     1622      JSR  UPDATE
15E9 11 71       1623      BCIR 0,DFLAG   ;NO DOSE MODE
15EB 3F 57       1624      CLR  DOSECT
15ED 81          1625      RTS
                  1626      ;

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SELECT

1627

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1628 ;
1629 ; VOLUME DISPLAY CHECK
1630 ;
1631 ; Conditions
1632 ;
1633 VOLDIS HRCIR 2,PSTAT1,NVL ;DONT DO IF OFF
1634 HRSER 0,DSPTST,NVL ;DONT DO IF IN TEST MODE
1635 HRCIR 7,PSTAT1,NVL ;DONT DO IF MODEL 224
1636 ; HRSER 0,DFLAG,NVL ;DON'T DO IF IN DOSE MODE
1637 HRSER 7,ERRON,NVL ;DON'T DO IF ERROR MODE
1638 HRSER 0,CNF,NVL ;DONT DO IF INC OR DEC BUTTON
1639 HRSER 0,CNF,NVL ;IS PRESSED
1640 ;
1641 IDA VS1 ;UPDATE CLEAR VOLUME LED.
1642 ORA VS2
1643 BEQ NOVLED
1644 BCLR 6,PORTB ;TURN VOLUME LED OFF IF VOLUME NOT ZERO
1645 BRA VOLBUT1
1646 NOVLED BSET 6,PORTB ;IF NO VOLUME TURN ON LED
1647 ;
1648 VOLBUT1 HRSER 6,VOLM,VOLL ;IF VOL FLAG SET UPDATE DISPLAY
1649 HRCIR 3,PORTD,SETVOL ;IF VOL BUTTON PUSHED, INITIALIZE DISPLAY

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1612 81      1650      RTS
1651      ;
1613 1C 6E      1652      SETVOL      BSET 6,VOLM      ;SET VOLUME DISPLAY MODE FLAG
1615 11 71      1653      BCIR 0,DFLAG      ;CLEAR DOSE FLAG
1617 3F 79      1654      CIR  VOLTIM      ;CLEAR VOLUME TIMER
1619 01 6D 04      1655      BRCIR 0,PSTAT1,VOL1      ;IF PUMP IN HOLD MODE,
161C 16 6D      1656      BSET 3,PSTAT1      ;SET START FLAG TO DISABLE FLASH
161E 18 6D      1657      BSET 4,PSTAT1      ;MAKE DISPLAY ON
1658      ;ELSE, JUST CONTINUE VOLUME
1659      ;
1620 3C 79      1660      VOL1 INC  VOLTIM      ;INCREMENT VOLTIM
1622 B6 79      1661      LDA  VOLTIM
1624 A1 1E      1662      CMP  #30      ;IF ELAPSED TIME IS
1626 22 06      1663      BHI  VOL2      ; > 1.00 S, DISPLAY VOLUME
1628 CD 14C2      1664      JSR  VOLTST      ;ELSE DISPLAY VOLIST
162B 10 75      1665      BSET 0,VFLAG      ;SET VOL TEST DISPLAY FLAG
162D 81      1666      NVL  RTS
1667      ;
162E A1 78      1668      VOL2 CMP  #120      ;CHECK ELAPSED TIME, ACCA LOADED
1669      ;WITH VOLTIM IN VOL1 ROUTINE
1630 22 08      1670      BHI  ENDVOL      ;IF TIME > 5 SEC, END VOL MODE
1671      ;

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1632 11 75      1672      BC1R 0,VFLAG      ;CLEAR VOL TEST DISPLAY FLAG
                  1673      ;
1634 AE 59      1674      VSEXP LDX #VSL      ;SET POINTER TO VSL ADDRESS
1636 CD 19E7    1675      JSR BCDEXP
1639 81        1676      RTS
                  1677      ;
163A CD 1756    1678      ENDVOL JSR UPDATE      ;RETURN DISPLAY TO RATE
163D 1D 6E      1679      BC1R 6,VOLM
163F 81        1680      RTS
                  1681      ;
                  1682      ;
                  1683      ;
                  1684      ;
1685      $EJECT

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1686 ;
1687 ;
1688 ;
1689 ; CHECK CLEAR VOLUME BUTTON
1690 ;
1691 ; Conditions
1692 ;
1693 CKCLR BRCLR 2,PSTAT1,NOCLR ;DONT DO IF OFF
1694 BRSET 0,DSPIST,NOCLR ;DONT DO IF IN TEST MODE
1695 BRCLR 7,PSTAT1,NOCLR ;DONT DO IF MODEL 224
1696 BRSET 0,CKBEP,CVALRM ;IF ALARM ALREADY SET, HANDLE BEEP
1697 ;
1698 ; Has volume clr button been pressed
1699 ;
1700 CLR BRSET 4,PORID,NCLR1 ;IF CLR BUTTON NOT PRESSED RETURN
1701 ;
1702 ; DEBOUNCE SWITCH
1703 BRSET 1,HTEST,NOCLR ;IF BUTTON SENSED LAST CYCLE, MUST BE
1704 ; ;SAME PULSE SO IGNORE
1705 BSET 1,HTEST ;ELSE SET FLAG FOR NEXT CYCLE
1706 ;
1707 BRCLR 6,VOLM,NOCLR ;IF NOT VOLUME MODE, RETURN

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1657 B6 79      LDA VOLTIM      ;CHECK VOLTIM
1659 A1 1F      CMP #31        ;IF 'VOL' DISPLAY STILL ON
165B 23 26      BLS NOCIR      ;DON'T CLEAR YET

1708 ;
1709      LDA VOLTIM      ;CHECK VOLTIM
1710      CMP #31        ;IF 'VOL' DISPLAY STILL ON
1711      BLS NOCIR      ;DON'T CLEAR YET
1712 ;
1713      CHECK IF OK TO    CLEAR VOLUME
1714 ;
1715      LDA DS1          ;IF DOSE = 0, CONTINUE CLEAR
1716      ORA DS2
1717      BEQ CIR1
1718 ;
1719      JSR CPVTOD        ;IF DOSE != 0 AND DOSE DEL.,
1720      CPX #$FF
1721      BEQ CIR1          ;IF X = FF, CONTINUE WITH CLEAR VOL
1722 ;                  ;ELSE, ENABLE SHORT ALARM
1723      CKALRM BSET 0,CKBEP ;SET CHECK ALARM BIT TO ENABLE BEEP
1724      CLR CKTIM        ;INITIALIZE BEEP TIME
1725      BSET 7,PORUB      ;TURN ON ALARM
1726 ;
1727      CVALRM INC CKTIM   ;INCREMENT BEEP TIMER
1728      LDA CKTIM        ;CHECK IF TIME TO STOP BEEP
1729      CMP #505

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1676 25 04      1730      BLO CONBP      ;IF CKTIM < AA, CONTINUE BEEP
1678 1F 01      1731      BC1R 7,PORTB      ;ELSE, TURN OFF BEEP
167A 11 83      1732      BC1R 0,CKBEP      ;CLEAR CK BEEP FLAG
167C 81          1733      CONBP RTS
                  1734      ;
                  1735      ; CLEAR VOLUME
                  1736      ;
167D CD 1941     1737      CLR1 JSR CLVOL      ;CLEAR VOLUME
1680 CC 1634     1738      JMP VSEXP
                  1739      ;
1683 81          1740      NOCLR RTS
                  1741      ;
1684 13 73      1742      NC1R1 BC1R 1,HTEST
1686 81          1743      RTS
                  1744      ;
                  1745      $EJECT

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```

1746 ;
1747 ;
1748 ;
1749 ;
1750 ;      Inputting the rate (model 324)
1751 ;
1752 ;
1753 ;      Conditions
1754 ;
1755 INRATE2  BRCLR 2,PSTAT1,OVER1  ;IF OFF DONT DO
1756          BRSET 0,LOWBAT,OVER1  ;DONT DO IF LOWBAT
1757          BRSET 7,ERRON,OVER1   ;DONT DO IF ERROR MODE
1758          BRCLR 7,PSTAT1,OVER1  ;IF MODEL 224 DONT DO
1759          BRSET 0,DSPTST,OVER1  ;DONT DO IF IN TEST MODE
1760          BRSET 6,VOLM,OVER1    ;DONT DO IF IN VOLUME DISPLAY
1761          BRSET 3,PSTAT1,CRIE   ;IF IN START MODE DO NOW
1762          BRCLR 0,PSTAT1,OVER1  ;DON'T DO IN RUN MODE
1763 ;
1764 ;      Check for rate change
1765 ;
1766 CRIE BRCLR 1,PORIC,CCWL      ;IF BUTON DOWN DO DECREASE
1767 CLR  CCWF      ;CLEAR FLAG IF NOT DOWN

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16A4 01 02 07      1768      HRCUR 0,PORIC,CWL ;IF BUTTION DOWN GO INCREASE
16A7 3F 76         1769      CLR CWF      ;CLEAR FLAG IF NOT DOWN
16A9 3F 78         1770      CLR SPEED1
16AB 3F 7C         1771      CLR OUTSPD
16AD 81            1772      OVERL RTS      ;RETURN IF NO BUTIONS DOWN
                        1773      ;
                        1774      ;      Set flag to increase the rate
                        1775      ;
16AE 10 76         1776      CWF BSET 0,CWF      ;SET FLAG FOR RATE INCREASE
16B0 CD 16BA       1777      JSR SPEED      ;GO GET SPEED AND UPDATE
16B3 81            1778      RTS
                        1779      ;
                        1780      ;      Set flag to decrease the rate
                        1781      ;
16B4 10 77         1782      CCWL BSET 0,CCWF      ;SET FLAG FOR RATE DECREASE
16B6 CD 16BA       1783      JSR SPEED      ;GO SET SPEED AND UPDATE
16B9 81            1784      RTS
                        1785      ;
                        1786      ;      Speed control for touch panel
                        1787      ;
16BA 3C 78         1788      SPEED INC SPEED1
16BC B6 78         1789      LDA SPEED1

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16BE A1 40      1790      CMP    #540      ;WAIT 1.98 SEC
16C0 23 0A      1791      BLS    SPD1      ;AT FIRST SPEED
16C2 A1 90      1792      CMP    #590      ;WAIT 3.465 SEC
16C4 23 15      1793      BLS    SPD2
16C6 A6 F0      1794      LDA    #5F0
16C8 B7 78      1795      STA    SPEED1
16CA 20 21      1796      BRA    SPD4
                1797      ;
                1798      ;      Speed 1
                1799      ;
16CC 3C 7C      1800      SPD1  INC  OUTSPD
16CE B6 7C      1801      LDA    OUTSPD
16D0 A1 0F      1802      CMP    #50F
16D2 27 19      1803      BEQ    SPD4
16D4 B6 78      1804      LDA    SPEED1
16D6 A1 01      1805      CMP    #501
16D8 27 13      1806      BEQ    SPD4
16DA 81         1807      RJS
                1808      ;
                1809      ;      Speed 2
                1810      ;
16DB 3C 7C      1811      SPD2  INC  OUTSPD

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;CHANGE EVERY .495 SEC
;EXCEPT FIRST TIME THROUGH

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16DD B6 7C      1812      LDA      OUTSPD
16DF A1 06      1813      CMP      #$06      ;CHANGE EVERY .198 SEC
16E1 27 0A      1814      BEQ      SPD4
16E3 81         1815      RTS
1816      ;
1817      ;      Speed 3
1818      ;
1819      SPD3 INC      OUTSPD
1820      LDA      OUTSPD
1821      CMP      #$05
1822      BEQ      SPD4
1823      RTS
1824      ;
1825      SPD4 CLR      OUTSPD
1826      BSET 3, PSTAT1      ;MAKE START ON
1827      BSET 4, PSTAT1      ;TURN DISPLAY ON
1828      BSET 0, CCWF, DECI      ;IF CCW FLAG SET DEC DOSE OR RATE
1829      ;      ;ELSE INCREASE DOSE OR RATE
1830      ;      INCREASE
1831      ;
1832      BSET 0, DFLAG, INCRD      ;IF DOSE, INCREMENT DOSE
1833      JMP      INCR1      ;ELSE, INCREMENT RATE
16F6 00 71 09
16F9 CC 131E

```

```

1834 ;
1835 ; DECREMENT
1836 ;
1837 DECI RSET 0,DFLAG,DECRD ;IF DOSE, DECREMENT DOSE
1838 JMP DECR1 ;ELSE, DECREMENT RATE
1839 ;
1840
1841 INCR1D LDA DOSECT ;DELAY INC TO ALLOW DOSE DISPLAY
1842 CMP #31
1843 BLS NODOSE ;RETURN FROM INC
1844 BCLR 2,DFLAG ;CLR DOSE 0 FLAG
1845 LDA #61 ;RESET DOSE TIMER EACH
1846 STA DOSECT ;TIME BUITION IS PRESSED
1847 ;
1848 LDA DS2 ;IF DOSE IS 2000 DONT INCREMENT
1849 AND #$F0 ;MASK LOWER NIBBLE TO GET MSD
1850 CMP #$20
1851 BEQ OVER1 ;IF MSD IS 2, SKIP INCREMENT
1852
1853 LDA DS1
1854 ADD #$05 ;BINARY ADD DS1
1855 DAA ;CONVERT TO BCD

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171B B7 55      1856      STA DS1
171D B6 56      1857      LDA DS2
171F A9 00      1858      ADC #500      ;BINARY ADD CARRY
1721 8D         1859      DAA          ;CONVERT TO BCD
1722 B7 56      1860      STA DS2
1724 CC 1745     1861      JMP DSEXP      ; UPDATE DOSE
                        ;
                        ;      DECREMENT DOSE BY 1
1727 B6 57      1862
1729 A1 1F      1863
172B 23 1D      1864
172D A6 3D      1865      DECRD      LDA DOSECT      ;DELAY INC TO ALLOW DOSE DISPLAY
172F B7 57      1866      CMP #31
1731 B6 55      1867      BLS NODOSE      ;RETURN FROM INC
1733 BA 56      1868      LDA #61      ;RESET DOSE TIMER
1735 27 13      1869      STA DOSECT      ;EACH TIME BUTTON IS PUSHED
                        ;
1737 B6 55      1870
1739 AB 95      1871      LDA DS1      ;IF DOSE IS 0 DONT DECREMENT
                        ;
1737 B6 55      1872      ORA DS2
1739 AB 95      1873      BEQ NODOSE
1737 B6 55      1874
1739 AB 95      1875
1737 B6 55      1876      LDA DS1
1739 AB 95      1877      ADD #95      ;10 COMPLIMENT BINARY SUBTRACT

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173B 8D      1878      DAA          ;CONVERT RESULT TO BCD
173C B7 55   1879      STA DS1
173E B6 56   1880      LDA DS2
1740 A9 99   1881      ADC #999      ;10 COMPLIMENT BINARY SUBTRACT WITH C
1742 8D      1882      DAA          ;CONVERT TO BCD
1743 B7 56   1883      STA DS2
1884          ;
1745 AE 55   1885      DSEXP LDX #DS1  ;SET POINTER TO DS1 ADDRESS
1747 CD 19E7 1886          JSR BCDEXP
174A 81      1887      NODOSE      RTS
1888          ;
1889          ;
1890          ;----- TOGGLE DIGIT ONE -----
1891          ;
1892          ;
1893          ;
174B 00 51 05 1894      TOGGLE      BRSET 0,DSPDG1,DECS ;IF 5 MAKE 0
174E A6 05   1895          LDA #505      ;IF 0 MAKE 5
1750 B7 51   1896          STA DSPDG1
1752 81      1897          RTS
1753 3F 51   1898      DECS CLR DSPDG1 ;
1755 81      1899          RTS

```

```

1900 ;
1901 ;
1902 ; Update the digit numbers
1903 ;
1904 ;
1905 UPDATE LDX DSPDG1
1906 LDA DIGITS,X
1907 STA SAMPLE4
1908 LDX DSPDG2
1909 LDA DIGITS,X
1910 STA SAMPLE3
1911 LDX DSPDG3
1912 LDA DIGITS,X
1913 STA SAMPLE2
1914 LDX DSPDG4
1915 LDA DIGITS,X
1916 STA SAMPLE1
1917 ;CHECK THIS CODE FOR HANDLING ZEROST FLAG
1918 ;
1919 BCIR 6,ZEROST ;INITIALIZE ZEROST
1920 BCIR 7,ZEROST ;AND
1921 CLR COUNT3 ;COUNT3 FOR LED MUX ROUTINE

```

1756 BE 51
1758 D6 101F
175B B7 50
175D BE 52
175F D6 101F
1762 B7 4F
1764 BE 53
1766 D6 101F
1769 B7 4E
176B BE 54
176D D6 101F
1770 B7 4D

1772 1D 74
1774 1F 74
1776 3F 64

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1797 B7 6A	1944	STA PL
1799 CD 196F	1945	JSR MULT16
179C B6 46	1946	LDA ALGO
179E B7 6A	1947	STA PL
17A0 CD 1962	1948	JSR ADD16
17A3 B6 67	1949	LDA QH
17A5 B7 69	1950	STA PH
17A7 B6 68	1951	LDA QL
17A9 B7 6A	1952	STA PL
17AB A6 D6	1953	LDA #SD6
17AD B7 67	1954	STA QH
17AF A6 E8	1955	LDA #SE8
17B1 B7 68	1956	STA QL
17B3 CD 1993	1957	JSR DIV16
17B6 B6 53	1958	LDA DSPDG3
17B8 26 09	1959	BNE MULT3
17BA B6 65	1960	LDA XH
17BC B7 48	1961	STA TIMHI
17BE B6 66	1962	LDA XL
17C0 B7 47	1963	STA TIMLO
17C2 81	1964	RTS
	1965	

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17C3 B6 65	1966	MULT3	IDA	XH
17C5 B7 67	1967	STA	QH	
17C7 B6 66	1968	IDA	XL	
17C9 B7 68	1969	STA	QL	
17CB A6 03	1970	IDA	#3	
17CD B7 6A	1971	STA	PL	
17CF 3F 69	1972	CLR	PH	
17D1 CD 196F	1973	JSR	MULT16	
17D4 B6 68	1974	IDA	QL	
17D6 B7 47	1975	STA	TIMLO	
17D8 B6 67	1976	IDA	QH	
17DA B7 48	1977	STA	TIMHI	
17DC 81	1978	RIS		
	1979	:		
	1980	:		
	1981	\$EJECT		

```

1982 ;
1983 ;
1984 ;
1985 ;
1986 ;
1987 ACDC BRCLR 6,PORTC,AC ;IF CLR ITS AC
1988 BCLR 1,ACON ;IF NOT CLEAR THE FLAG
1989 RTS
1990 AC BSET 1,ACON ;SET FLAG ITS AC
1991 ; CLR T25 ;RESET TIMER FOR AUTO OFF
1992 ; CLR T20
1993 RTS
1994 ;
1995 $EJECT

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```

17DD 0D 02 03
17E0 13 6E
17E2 81
17E3 12 6E
17E5 81

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1996 ;
1997 ;
1998 ;
1999 ;
2000 ;
2001 BATCK BRSET 1,ACON,NOLB ;IF ON AC DONT DO
2002 BRSET 0,DSPIST,NLB ;DONT DO IF TEST MODE
2003 BRSET 0,LOWBAT,LBTM ;IF LOW ALREADY TIME 15 MIN.
2004 BRCLR 1,PSSTAT1,LOBCK ;IF MOTOR OFF CHECK
2005 LDA REG1 ;WAIT UNTILL MOTOR RUNS .4 SEC
2006 CMP #30
2007 BHI LOBCK
2008 RTS
2009 LOBCK BRSET 4,PORTC,NLB ;IF NO SIGNAL THEN LOW BAT
2010 BRCLR 2,PSSTAT1,KLUTIM ;IF PUMP IS OFF, DISABLE PUMP
2011 BRSET 0,LOWBAT ;SET LOW BAT FLAG
2012 BRSET 7,ERRON ;SET ERROR
2013 BRSET 5,ALRM ;SET ALARM
2014 BRCLR 3,PSSTAT1 ;GET OUT OF START MODE TO ENABLE LOW BAT
2015 BRCLR 0,DFLAG ;CLEAR DOSE MODE FLAG
2016 BRCLR 6,VOIM ;CLEAR VOLUME MODE FLAG
2017 RTS
17E6 02 6E 37
17E9 00 80 45
17EC 00 6E 1D
17EF 03 6D 07
17F2 B6 5B
17F4 A1 1E
17F6 22 01
17F8 81
17F9 08 02 35
17FC 05 6D 1A
17FF 10 6E
1801 1E 6E
1803 1A 6E
1805 17 6D
1807 11 71
1809 1D 6E
180B 81

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2018 ;
2019 ; INCREMENT 15 MIN TIMER
2020 ;
2021 LBIM INC BATIM1 ;INCREMENT BATTERY TIMER: BATIM1, BATIM2
2022 BNE CONCNT
2023 INC BATIM2
2024 CONCNT LDA BATIM2
2025 CMP #507 ;IF BAT TIMER HAS COUNTED 15 MIN
2026 BEQ KILTIM ;KILL POWER
2027 RTS
2028 KILTIM SEI ;SET INT MASK TO PREVENT TURN-ON
2029 LDA #50F ;DISABLE PUMP
2030 STA PORTB
2031 BRA KILTIM
2032 ;
2033 NOLOB BRCLR 0, LOWBAT, NLB ;DONT CLEAR ANY THING IF NO LOW BAT
2034 ;THIS MAINTAINS OTHER ERRORS IF PRESENT
2035 BCIR 0, LOWBAT ;CLR LOW BAT FLAG
2036 BCIR 7, ERRON ;CLR ERROR FLAG
2037 BCIR 5, ALRM ;CLR ALARM
2038 BSET 4, PSTAT1 ;MAKE SURE DISPLAY ON
2039 JSR UPDATE ;UPDATE DISPLAY

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110

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2049 ;
2050 ;      DEAD BATTERY CHECK
2051 ;
2052 ;      This routine checks the dead battery signal (portc(7)).
2053 ;      If this signal is active (portc(7)=0), then the routine
2054 ;      kills power to the processor.
2055 ;
2056 ;
2057 ;      DEATCH      BRSET 1,ACON,NODECK      ;DON'T DO IF AC POWERED
2058 ;      BRCLR 1,FSTAT1,DEADCK ;IF MOTOR OFF CHECK
2059 ;      LDA  REG1      ;WAIT UNTILL MOTOR RUNS .4 SEC
2060 ;      CMP  #30
2061 ;      BHI  DEADCK
2062 ;      RTS
2063 ;
2064 ;      DEADCK BRSET 7,PORTC,NODECK ;IF NO DEAD BAT SIGNAL, RETURN
2065 ;
2066 ;      DEKIL SETI      ;SET INT MASK TO PREVENT TURN-ON
2067 ;      LDA  #$0F      ;DISABLE PUMP
2068 ;      STA  PORTB
2069 ;      BRA  DEKIL      ;LOOP UNTILL POWER DISSIPATES
2070 ;

```

```

1836 02 6E 14
1839 03 6D 07
183C B6 5B
183E A1 1E
1840 22 01
1842 81
1843 0E 02 07
1846 9B
1847 A6 0F
1849 B7 01
184B 20 F9

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RIS

NODECK

:

\$EJECT

2071

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2073

184D 81

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2074 ;
2075 ; ALARM
2076 ;
2077 ; Conditions
2078 ;
2079 ALARM BRCLR 2,PSTAT1,NOALM ;IF OFF DONT ALARM
2080 BRSET 6,VOIM,NOALM ;IF IN VOLUME DONT DO
2081 BRSET 5,ALRM,ALRMRT ;IF ALARM FLAG SET THEN ALARM
2082 ;
2083 ;
2084 ALCLR BCLR 7,FORTB ;SET ALARM HIGH
2085 NOALM RTS
2086 ALRMRT BRSET 4,PSTAT1,ALCLR
2087 BRSET 7,FORTB
2088 RTS
2089 ;
2090 $EJECT

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2091 ;
2092 ;
2093 ;
2094 ; BLINK THE DISPLAY
2095 ;
2096 ;
2097 ; Conditions
2098 ;
2099 BLINK HRCIR 2,PSTAT1,NOBLIN ;IF OFF DONT DO
2100 HRSET 3,PSTAT1,NOBLIN ;DONT BLINK IF START ON
2101 HRSET 7,ERRON,BL1 ;GO BLINK IF ERROR MODE
2102 HRCIR 0,PSTAT1,DOTBL ;DONT BLINK IN RUN
2103 ;
2104 ; Blink
2105 ;
2106 BL1 LDA #SCO ;BLANK 4TH DIGIT
2107 STA SAMPL1
2108 HRCIR 4,PSTAT1,SETBL ;IF DISPLAY ON BLANK
2109 HRCIR 4,PSTAT1
2110 HRCIR 7,ERRON,NOBLIN
2111 HRSET 0,LOWBAT,LO1 ;IF LO BAT ON THEN DO
2112 HRSET 4,NOSET,NO1 ;IF NO SET THEN DO

```

```

187E 04 6E 50      2113      BRSET 2,NDROP,FLO1      ;IF FLOW ERR THEN DO
1881 00 70 45      2114      BRSET 0,DOSER,DOSE1      ;IF DOSE ERROR THEN DO
1884 06 6E 46      2115      BRSET 3,HOLDER,HLD1      ;IF HOLD ERROR THEN DO
1887 20 59          2116      BRA ERR1
1889 81             2117      NOBLIN      RUS
1890             2118      ;
1891             2119      ;      Hold mode blink
1892             2120      ;
1893             2121      SETBL BSET 4,PSTAT1      ;BLANK DISPLAY
1894             2122      BRCLR 7,ERRON,NOBLIN
1895 04 6E 4A      2123      BRSET 0,LOWBAT,BAT1      ;GO DO BAT IF LO BAT
1896 08 6E 5E      2124      BRSET 4,NOSET,SET2      ;GO DO SET IF NO SET
1897 04 6E 4A      2125      BRSET 2,NDROP,ERR1      ;GO DO ERR IF FLOW ERR
1898 00 70 26      2126      BRSET 0,DOSER,OUT2      ;GO DO DEL IF DOSE ERR
1899 06 6E 44      2127      BRSET 3,HOLDER,ERR1      ;GO DO ERR IF HOLD ERR
1900 20 3E          2128      BRA SYS1
1901 81             2129      RUS
1902             2130      ;
1903             2131      ;      Blink the DP during the run mode
1904             2132      ;
1905             2133      DOTBL IDX COUNT2      ;GET DP #
1906             2134      LDA SAMPLE1,X      ;GET NEW DIGIT

```

```

18A5 AA 80      2135      ORA  #80      ;CLEAR DP
18A7 E7 4D      2136      STA  SAMPL1,X  ;STORE IT FOR DISPLAY
18A9 5C         2137      INCX           ;HUMP POINTER TO NEXT DIGIT
18AA A3 04      2138      CPX  #04       ;DONE ALL THREE
18AC 27 09      2139      BEQ  NEWX      ;RESET IF SO
18AE E6 4D      2140      DOTON LDA SAMPL1,X ;GET NEXT DIGIT
18B0 A4 7F      2141      AND  #7F       ;TURN DP ON
18B2 E7 4D      2142      STA  SAMPL1,X  ;STORE IT FOR DISPLAY
18B4 BF 63      2143      STX  COUNT2     ;SAVE COUNT
18B6 81         2144      RTS
                ;
18B7 0F 6D 03   2145      NEWX BRCLR 7,PSTAT1,DOT24 ;IF 224, SCROLL 3 DIGITS
18BA 5F         2146      CLRX           ;RESET COUNTER
18BB 20 F1      2147      BRA  DOTON     ;GO TURN ON
                ;
18BD AE 01      2148      DOT24 LDX #01     ;IF THIRD DIGIT
18BF 20 ED      2149      BRA  DOTON     ;ELSE CONTINUE WITH BLINK ROUTINE
                ;
                ;      Error messages
                ;
18C1 A6 8C      2150      OUT2 LDA #8C
18C3 B7 4D      2151      STA  SAMPL1
                ;

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2157 ;
18C5 AE 16 LDX #S16 ;DISPLAY ?
18C7 20 2E BRA CUTCHR
2160 ;
18C9 AE 19 DOSE1 LDX #S19 ;DISPLAY DOSE
18CB 20 2A BRA CUTCHR
2163 ;
2164 ;
18CD AE 12 HLD1 LDX #S12 ;POINT TO ERR MESSAGE
18CF 20 26 BRA CUTCHR ;GO LOAD UP DIGITS
2167 ;
18D1 AE 06 FLO1 LDX #S06 ;POINT TO FLO MESSAGE
18D3 20 22 BRA CUTCHR ;GO LOAD UP DIGITS
2170 ;
18D5 AE 00 LO1 LDX #S00
18D7 CD 18F7 JSR CUTCHR
18DA 01 6D C4 BRCLR 0,ESTAT1,DOTEL ;IF IN RUN MODE, UPDATE DP SCROLL
18DD 81 RTS
2175 ;
18DE AE 1C SYS1 LDX #S1C ;DISPLAY SYS
18E0 20 15 BRA CUTCHR
2178 ;

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2179 ;
2180 ERR1 LDX #S09
2181 ERA OUTCHR
2182 ;
2183 BAT1 LDX #S03
2184 JSR OUTCHR
2185 ERCLR 0,PSTAT1,DOTEL ;IF IN RUN MODE, UPDATE DP SCROLL.
2186 RTS
2187 ;
2188 NO1 LDX #S0C
2189 ERA OUTCHR
2190 ;
2191 SET2 LDX #S0F
2192 ERA OUTCHR
2193 ;
2194 OUTCHR LDA TABLE5,X
2195 STA SAMPLE2
2196 INCX
2197 LDA TABLE5,X
2198 STA SAMPLE3
2199 INCX
2200 LDA TABLE5,X

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1906 B7 50	2201	STA	SAMPL4
1908 81	2202	RIS	
	2203	;	
	2204	\$EJECT	

```

2205 ;
2206 ; HOLD ERROR
2207 ;
2208 ; Conditions
2209 ;
2210 HLDER BRCLR 2, PSTAT1, NOHE ;DONT DO IF OFF
2211 BRCLR 0, PSTAT1, NOHE ;DONT DO IF NOT IN HOLD
2212 ;
2213 ; Test for hold error
2214 ;
2215 INC HLDTM1 ;INCREMENT HOLD COUNTER
2216 BNE CNCNT
2217 INC HLDTM2
2218 CNCNT LDA HLDTM2 ;CHECK IF 2 1/2 MIN ELAPSED
2219 CMP #501
2220 BHI HLDER1 ;IF HLDTM2 > 1, HOLDER
2221 BEQ CONCK ;IF HLDTM2= 1, CHECK HLDTM1
2222 RTS ;ELSE RETURN
2223 ;
2224 CONCK LDA HLDTM1
2225 CMP #527 ;IF HLDTM1 >= 27, HOLDER
2226 BHS HLDER1

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1924 81      2227      RTS
1925 17 6D    2228      ;
1927 16 6E    2229      HLDRL      BCLR 3,PSIAT1      ;CLEAR START FLAG
1929 1A 6E    2230      BSET 3,HOLDER      ;SET HOLD ERROR FLAG
192B 1E 6E    2231      BSET 5,ALRM      ;ALARM ON
192D 81      2232      BSET 7,ERRON      ;ERROR FLAG ON
                2233      NOHE RTS
                2234      ;
                2235      $EJECT

```

```

2236 ;
2237 ;
2238 ;-----
2239 ; Conditions
2240 ;
2241 TIM24 BRSET 2,PSTAT1,KEEPON ;IF UNIT ON DONT DO
2242 ;
2243 ; 24HR TURN OFF
2244 ;
2245 INC T25 ;GET COUNTER
2246 LDA T25
2247 CMP #SEF ;(EF + 1) = 240 x 6 = 24 HOURS
2248 BLO KEEPON
2249 ;
2250 KILLP SET ;SET INT MASK TO PREVENT TURN-ON
2251 LDA #SOF ;DISABLE PUMP
2252 STA PORTB
2253 BRA KILLP ;LOOP UNTIL POWER DISSAPTES
2254 ;
2255 KEEPON RTS
2256 ;
2257 ;

```

192E 04 6D 0F

1931 3C 45

1933 B6 45

1935 A1 EF

1937 25 07

1939 9B

193A A6 0F

193C B7 01

193E 20 F9

1940 81

```

2258 ; CLEAR VOLUME SUBROUTINE
2259 ; This routine is called by tim24 and cklr routines.
2260 ;
2261 ;
2262 CINVOL CLR DECML1
2263 CLR VS1
2264 CLR VS2
2265 RJS
2266 ;
2267 ; CLEAR TIMER COUNTERS
2268 ;
2269 ;
2270 TIMRST CLR TS
2271 CLR TS
2272 CLR T10
2273 CLR T15
2274 RJS
2275 ; COMPARE DOSE TO VOLUME
2276 ;
2277 ;
2278 ; IF VOLUME DELIVERED >= PROGRAMMED DOSE, SET X REGISTER TO FF
2279 ;

```

```

1941 3F 58
1943 3F 59
1945 3F 5A
1947 81

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1948 3F 40
194A 3F 41
194C 3F 42
194E 3F 43
1950 81

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```

1951 5F      2280      CFWTOD      CIRX
1952 B6 5A    2281      LDA VS2
1954 B1 56    2282      CMP DS2
1956 25 09    2283      BLO VLT0
1958 22 06    2284      BHI VGT0
                2285      ;
195A B6 59    2286      LDA VS1
195C B1 55    2287      CMP DS1
195E 25 01    2288      BLO VLT0
                2289      ;
1960 53      2290      VGT0 COMX
1961 81      2291      VLT0 R1S
                2292      ;
                2293      ;
                2294      $EJECT

;IF VOLUME < DOSE, CLEAR C
;IF VOLUME > DOSE, SET C
;ELSE, CHECK VS1

;IF VOLUME < DOSE, CLEAR C
;IF VOLUME < DOSE, CLEAR C
;SET X TO FF

```

```

2295 ;*****
2296 ; *
2297 ; *
2298 ; MATH UTILITIES FOLLOW
2299 ; *
2300 ; *
2301 ;*****
2302 ;
2303 ;
2304 ;*****
2305 ; *
2306 ; PROGRAM ADDS 2, 16-BIT UNSIGNED BINARY NUMBERS, PRODUCING A 17-BIT
2307 ; RESULT.
2308 ; ENTER WITH: 2, UNSIGNED 16-BIT OPERANDS TO BE ADDED IN
2309 ; FH , FL and QH , QL.
2310 ; EXIT WITH: 17-BIT RESULT IN: CARRY , QH, QL
2311 ; (QH, QL DESTROYED).
2312 ;
2313 ;*****
2314 ;
2315 ;
2316 ADD16 IDA QL ;ADD 16 BYTES.

```

1962 B6 68

```

1964 BB 6A      2317      ADD      PL
1966 B7 68      2318      STA      QL
1968 B6 67      2319      LDA      QH      ;ADD MS BYTES.
196A B9 69      2320      ADC      PH
196C B7 67      2321      STA      QH      ;16-BIT RESULT IN QH, QL. OVERFLOW IN CARRY.
                2322      ;
196E 81         2323      RTS
                2324      ;
                2325      ;
                2326      ;
                2327      ;
                2328      ;*****
                2329      ;      *
2330      ;      ; PROGRAM MULTIPLIES 2, 16 BIT UNSIGNED BINARY OPERANDS, CREATING A 32--*
2331      ;      ; BIT UNSIGNED RESULT. (NO OVERFLOW IS POSSIBLE).      *
2332      ;      ; ENTER WITH: OPERANDS TO BE MULTIPLIED IN:      *
2333      ;      ;      QH , QL      *
2334      ;      ;      and PH , PL      *
2335      ;      ; EXIT WITH: 32-BIT RESULT IN:      XH , XL , QH , QL      *
2336      ;      ;      *
2337      ;*****
2338      ;

```

196F AE 10	2339 ;			
1971 3F 65	2340 MULT16 LDX	#16		;LOOP COUNTER.
1973 3F 66	2341 CIR	XH		;CLEAR UPPER 16 BITS OF 32-BIT ACCUM.
1975 36 67	2342 CIR	XL		
1977 36 68	2343 ROR	QH		;CHECK BIT 0 OF QL.
1979 24 0C	2344 ROR	QL		
197B B6 66	2345 NXT	BOC	ROTAT	;IF 0, DON'T ADD, JUST SHIFT.
197D BB 6A	2346 LDA	XL		;OTHERWISE, ADD IN THE CONTENTS OF PH , PL TO
197F B7 66	2347 ADD	PL		;XH , XL.
1981 B6 65	2348 STA	XL		
1983 B9 69	2349 LDA	XH		
1985 E7 65	2350 ADC	PH		
	2351 STA	XH		
	2352 ;			
1987 36 65	2353 ROTAT	ROR	XH	;SHIFT THE 32-BIT ACCUM. 1 BIT RIGHT.
1989 36 66	2354 ROR	XL		
198B 36 67	2355 ROR	QH		
198D 36 68	2356 ROR	QL		
	2357 ;			
198F 5A	2358 DECX			;DO AGAIN IF NOT DONE WITH ALL 16 BITS.
1990 26 E7	2359 BNE	NXT		
	2360 ;			

```

1992 81      2361      RTS      ;OTHERWISE, RETURN WITH RESULT IN XH,XL,QH,QL.
                2362      ;
                2363      ;
                2364      ;*****
                2365      ;
                2366      ; PROGRAM PERFORMS THE DIVISION OF 2, 16 BIT UNSIGNED OPERANDS, PRODUC--
                2367      ; ING A 16 BIT UNSIGNED RESULT:
                2368      ;
                2369      ; (QH , QL/ PH , PL) -----> XH , XL
                2370      ;
                2371      ; ENTER WITH: 16 BIT DIVISOR IN PH , PL
                2372      ; 16 BIT DIVIDEND IN QH , QL
                2373      ;
                2374      ; EXIT WITH: QUOTIENT TRUNCATED TO 16 BITS
                2375      ; IN XH , XL
                2376      ; REGISTERS AFFECTED: X, A, COUNT1, TEMP1, TEMPX
                2377      ; (QH, QL, PH, PL DESTROYED)
                2378      ;
                2379      ;*****
                2380      ;
                2381      ;
                2382      DIV16 LDA #1
1993 A6 01

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1995 3D 69	2383	TST PH		
1997 2B 0B	2384	EMI DIV153		;IF DIVISOR IS LEFT-JUSTIFIED.
1999 4C	2385	DIV151 INCA		;OTHERWISE, KEEP SHIFTING DIVISOR LEFT
199A 38 6A	2386	ASL PL		;UNTIL THE MSB IN PH = 1, OR UNTIL
199C 39 69	2387	ROL PH		;16 SHIFTS HAVE BEEN DONE.
199E 2B 04	2388	EMI DIV153		
19A0 A1 11	2389	CMP #17		
19A2 26 F5	2390	ENE DIV151		
19A4 B7 62	2391	STA COUNT1		COUNT1 = # SHIFTS REQUIRED +1.
19A6 B6 67	2392	LDA QH		;MOVE THE DIVIDEND INTO A, X.
19A8 BE 68	2393	LDX QL		
19AA 3F 67	2394	CLR QH		;MAKE WAY FOR THE QUOTIENT.
19AC 3F 68	2395	CLR QL		
19AE BF 6C	2396	DIV163 STX TEMPX		;STORAGE FOR THE DIVIDEND AFTER SUBTRACTING
19B0 B7 6B	2397	STA TEMPA		;OUT DIVISOR.
19B2 9F	2398	TXA		
19B3 B0 6A	2399	SUB PL		;TRY SUBTRACTING THE DIVISOR.
19B5 B7 6C	2400	STA TEMPX		
19B7 B6 6B	2401	LDA TEMPA		;SAVE THE REMAINDER IN TEMPA, TEMPX.
19B9 B2 69	2402	SBC PH		
19BB B7 6B	2403	STA TEMPA		
19BD BE 6C	2404	LDX TEMPX		

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19BF 24 10      2405      BOC      DIV165      ;IF CARRY=0, THEN DIVISOR WAS SMALLER THAN
2406      ;      ;DIVIDEND. GO SET THE CURRENT QUOTIENT BIT.
2407      ;      ;OTHERWISE, ADD THE DIVISOR BACK IN,
2408      TXA
2409      ADD      PL
2410      STA      TEMPX
2411      LDA      TEMPX
2412      ADC      PH
2413      STA      TEMPX
2414      LDX      TEMPX
2415      CLC
2416      BRA      DIV167
2417      DIV165 SEC
2418      DIV167 ROL      QL
2419      ROL      QH
2420      LSR      PH
2421      ROR      PL
2422      DEC      COUNT1
2423      BNE      DIV163
2424      LDA      QH
2425      STA      XH
2426      LDA      QL

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;AND SAVE IT.
 ;THE QUOTIENT BIT WILL BE 0.
 ;THE QUOTIENT BIT WILL BE 1.
 ;ROTATE THE QUOTIENT LEFT 1 BIT,
 ;SHIFTING THE MOST RECENT QUOTIENT BIT
 ;INTO THE LSB.
 ;KEEP GOING UNTIL THE COUNTER=0.
 ;WHEN DONE, MOVE THE RESULT INTO XH, XL.

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19E4 B7 66      2427      STA      XL
                  ;
19E6 81      2428
                2429      RTS      ;RETURN.
                2430
                2431      ;*****
                2432      ;
                2433      ;      BCDEXP
                2434      ;
                2435      ;  PROGRAM CONVERTS 2 BYTE BCD NUMBER POINTED TO BY THE X REGISTER TO
                2436      ;  A 4 BYTE DECIMAL NUMBER. THE FOUR BYTE NUMBER IS CONVERTED ON THE FLY *
                2437      ;  TO THE CORRECT LED DISPLAY SEGMENT CODE WHICH IS SENT TO THE DISPLAY *
                2438      ;  BY THE LED MUX ROUTINE.
                2439      ;
                2440      ;      ENTER WITH: ADDRESS OF LOWER BCD BYTE IN X
                2441      ;
                2442      ;      EXIT WITH: LED DISPLAY CODE FOR 4 DECIMAL DIGITS
                2443      ;      IN SAMPLE1, SAMPLE2, SAMPLE3, SAMPLE4
                2444      ;      *
                2445      ;      REGISTERS AFFECTED: X, A, SAMPLE1 - SAMPLE4, TEMPX
                2446      ;
                2447      ;*****
                2448

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19E7 BF 6C      2449      BCDEXP      STX  TEMPX      ;STORE POINTER FOR LATER USE
19E9 F6         2450      LDA  ,X          ;GET LOWER BYTE OF BCD DIGIT
19EA A4 0F      2451      AND  #$0F        ;MASK UPPER NIBBLE
19EC 97         2452      TAX              ;
19ED D6 101F    2453      LDA  DIGITS,X    ;CONVERT DECIMAL TO LED CODE
19F0 B7 50      2454      STA  SAMPL4
19F2 BE 6C      2455      ;
19F4 F6         2456      LDX  TEMPX        ;RESTORE FIRST BCD BYTE
19F5 44         2457      LDA  ,X          ;
19F6 44         2458      LSRA
19F7 44         2459      LSRA
19F8 44         2460      LSRA
19F9 97         2461      LSRA
19FA D6 101F    2462      TAX              ;PUSH UPPER NIBBLE TO LOWER NIBBLE
19FD B7 4F      2463      LDA  DIGITS,X    ;CONVERT DECIMAL TO LED CODE
19FE 4F         2464      STA  SAMPL3
19FF 3C 6C      2465      ;
1A01 BE 6C      2466      INC  TEMPX        ;SET POINTER TO UPPER BCD DIGIT
1A03 F6         2467      LDX  TEMPX        ;GET SECOND BCD DIGIT
1A04 A4 0F      2468      LDA  ,X          ;
1A06 97         2469      AND  #$0F        ;MASK UPPER NIBBLE
1A07 97         2470      TAX

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2471 1A07 D6 101F          LDA DIGITS,X      ;CONVERT DECIMAL TO LED CODE
2472 1A0A B7 4E          STA SAMPLE2
2473          ;
2474 1A0C BE 6C          LDX TEMX              ;RESTORE SECOND BCD DIGIT
2475 1A0E F6          LDA ,X
2476 1A0F 44          ISRA
2477 1A10 44          ISRA
2478 1A11 44          ISRA
2479 1A12 44          ISRA              ;PUSH UPPER NIBBLE TO LOWER NIBBLE
2480 1A13 97          TAX
2481 1A14 D6 101F          LDA DIGITS,X      ;CONVERT DECIMAL TO LED CODE
2482 1A17 B7 4D          STA SAMPLE1
2483          ;
2484          ; UPDATE DISPLAY FLAGS USED BY LED MUX
2485          ;
2486 1A19 1D 74          BCLR 6,ZEROST        ;CLEAR MSD ZERO FLAG
2487 1A1B 1F 74          BCLR 7,ZEROST        ;CLEAR MSD-1 ZERO FLAG
2488 1A1D 3F 64          CLR COUNT3          ;CLEAR MUX COUNTER
2489 1A1F 81          RJS
2490          ;
2491          $EJECT

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2492						
2493		ORG	PMPST			
2494						
2495				ELOOP RSET 7,PORTB		
2496				ERR ELOOP		
2497						
2498					END	

	=1C00	
1C00 1E 01		
1C02 20 FC		

Claims

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1. A motor unit for a medical fluid delivery system for use with a disposable delivery set for pumping medical fluid, comprising:
pump operating means, including a motor, for acting in cooperation with the delivery set (14) having a

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2492					
2493	ORG	PMPTST			
2494					
2495			ELOOP RSET 7, PORTB		
2496			HRA ELOOP		
2497					
2498				END	

=1C00

1C00 1E 01
1C02 20 FC

Claims

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1. A motor unit for a medical fluid delivery system for use with a disposable delivery set for pumping medical fluid, comprising:
pump operating means, including a motor, for acting in cooperation with the delivery set (14) having a



pump tube (20) to deliver a volume of the fluid during each operating cycle;

a housing (16), surrounding the motor;

a rotor (18), attached to and adapted to be driven by the motor, the rotor (18) having at least one roller (36,38,40) so that rotation of the rotor by the motor causes the roller to contact the pump tube and move fluid through the pump tube (20),

pump control means for controlling the pump operating means to deliver the fluid at a desired volumetric rate, the pump control means including means responsive to signals indicating the desired rate for activating the pump operating means for one of the operating cycles and for repeating the activation at variable time intervals selected in accordance with the desired volumetric rate;

characterised in that

the pump control means, including means for sensing the condition of the pump operating means with respect to the operating cycle, comprises at least one magnet (44,46,48) and a magnetic field sensor (50) whereby the magnetic field sensor is adapted to sense the magnet passing as the rotor rotates, the motor is a DC motor

and there are provided means for detecting the AC component of the current provided to the DC motor; and means for comparing the detected AC component to a reference level to detect the presence or absence of a pump tube (20) on the rotor (18).

2. A motor unit as claimed in claim 1 wherein the operating cycle comprises a selected angular rotation of the pump rotor.

3. A motor unit as claimed in claim 1 or 2 wherein at least one magnet (44,46,48) is attached to the rotor (18) and the magnetic field sensor (50) is located behind the rotor and attached to the housing (16).

Patentansprüche

1. Motoreinheit für ein Abgabesystem für medizinisches Fluid, zur Verwendung mit einem Einweg-Abgabeset zum Pumpen eines medizinischen Fluids, umfassend:

eine Pumpenbetätigungseinrichtung mit einem Motor, für den gemeinsamen Betrieb mit dem Abgabeset (14), welche ein Pumprohr (20) zur Abgabe eines Fluidvolumens während jedes Betätigungszyklus aufweist;

ein den Motor umgebendes Gehäuse (16),

einen am Motor befestigten und von diesem antreibbaren Rotor (18), welcher Rotor (18) mindestens eine Rolle (36, 38, 40) aufweist, so daß die Drehung des Rotors durch den Motor bewirkt, daß die Rolle mit dem Pumprohr in Kontakt gelangt und Fluid durch das Pumprohr (20) bewegt,

eine Pumpensteuerungseinrichtung zur Steuerung der Pumpenbetätigungseinrichtung zwecks Abgabe des Fluids mit einer bestimmten Durchflußmenge, welche Pumpensteuerungseinrichtung Mittel enthält, die auf die gewünschte Menge anzeigende Signale reagieren, um die Pumpensteuerungseinrichtung für einen der Betriebszyklen zu aktivieren und die Aktivierung in entsprechend der gewünschten Durchflußmenge gewählten, variablen Zeitintervallen zu wiederholen;

dadurch gekennzeichnet, daß

die Pumpensteuerungseinrichtung, einschließlich Mittel zum Erfassen des Zustandes der Pumpenbetätigungseinrichtung in bezug auf den Betriebszyklus, mindestens einen Magnet (44, 46, 48) und einen Magnetfeldsensor (50) aufweist, wobei der Magnetfeldsensor den beim Drehen des Rotors passierenden Magnet erfassen kann,

der Motor ein Gleichstrommotor ist,

und Einrichtungen zum Detektieren der Wechselstromkomponente des vom Gleichstrommotor gelieferten Stroms sowie Einrichtungen zum Vergleich der detektierten Wechselstromkomponente mit einem Referenzpegel zwecks Detektierens der Anwesenheit oder Abwesenheit eines Pumprohres (20) am Rotor (18) vorgesehen sind.

2. Motoreinheit nach Anspruch 1, bei welcher der Betriebszyklus eine gewählte Winkeldrehung des Pumpenrotors umfaßt.

3. Motoreinheit nach Anspruch 1 oder 2, bei welcher mindestens ein Magnet (44, 46, 48) am Rotor befestigt und der Magnetfeldsensor (50) hinter dem Rotor angeordnet und am Gehäuse (16) befestigt ist.



Revendications

1. Dispositif moteur pour un système de distribution de fluide médical à utiliser avec un dispositif distributeur jetable pour pomper un fluide médical, comprenant :

un dispositif d'actionnement de pompe, comprenant un moteur, destiné à agir en coopération, avec le dispositif distributeur (14) comportant un tube de pompage (20) pour débiter un volume du fluide pendant chaque cycle de fonctionnement;

un boîtier (16) entourant le moteur;

un rotor (18) fixé au moteur et propre à être entraîné par celui-ci, le rotor (18) comportant au moins un galet (36, 38, 40) de sorte que la rotation du rotor par le moteur force le galet à venir en contact avec le tube de pompage et à refouler du fluide dans le tube de pompage (20),

un dispositif de commande de pompe pour commander le dispositif d'actionnement de pompe en vue de débiter le fluide à un débit volumique souhaité, le dispositif de commande de pompe comprenant un moyen réagissant à des signaux indiquant le débit souhaité pour activer le dispositif d'actionnement de pompe pendant l'un des cycles de fonctionnement et pour répéter l'activation à des intervalles de temps variables sélectionnés en fonction du débit volumique souhaité,

caractérisé en ce que

le dispositif de commande de pompe, comprenant un moyen pour détecter l'état du dispositif d'actionnement de pompe par rapport au cycle de fonctionnement, comprend au moins un aimant (44, 46, 48) et un détecteur de champ magnétique (50), ce détecteur de champ magnétique étant à même de détecter le passage de l'aimant lorsque le rotor tourne,

le moteur est un moteur à courant continu

et des moyens sont prévus pour détecter la composante alternative du courant fourni au moteur à courant continu; ainsi que des moyens pour comparer la composante alternative détectée à un niveau de référence en vue de détecter la présence ou l'absence d'un tube de pompage (20) sur le rotor (18).

2. Dispositif moteur suivant la revendication 1, dans lequel le cycle de fonctionnement comprend une rotation angulaire sélectionnée du rotor de pompe.

3. Dispositif moteur suivant la revendication 1 ou 2, dans lequel au moins un aimant (44, 46, 48) est fixé au rotor (18) et le détecteur de champ magnétique (50) est installé derrière le rotor et est fixé au boîtier (16).

