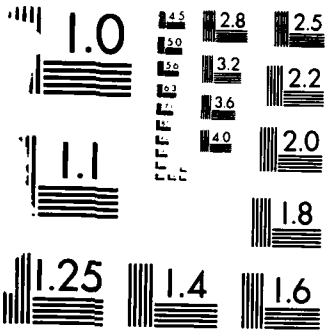
AD-A165 296 THERMAL SHUTDOWN SYSTEM FOR IBM 4341 COMPUTERS(U) ARMY 1/1
ARMAMENT RESEARCH AND DEVELOPMENT CENTER WATERVLIET NY
CLOSE COMBAT ARMAMENTS CENTER M JOHNSON DEC 85
UNCLASSIFIED ARCCB-TR-85004 SBI-AD-E440 312 F/G 9/2 NL



(12)

ADE440312

AD-A165 296

TECHNICAL REPORT ARCCB-TR-85004

THERMAL SHUTDOWN SYSTEM FOR IBM 4341 COMPUTERS

MARK JOHNSON

DECEMBER 1985

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT CENTER
CLOSE COMBAT ARMAMENTS CENTER
BENÉT WEAPONS LABORATORY
WATERVLIET, N.Y. 12189-4050

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

DISCLAIMER

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

The use of trade name(s) and/or manufacture(s) does not constitute an official indorsement or approval.

DISPOSITION

Destroy this report when it is no longer needed. Do not return it to the originator.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARCCB-TR-85004	2. GOVT ACCESSION NO. AD-A165 296	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) THERMAL SHUTDOWN SYSTEM FOR IBM 4341 COMPUTERS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Mark Johnson		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-CCB-TL Watervliet, NY 12189-4050		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Close Combat Armaments Center Dover, NJ 07801-5001		12. REPORT DATE December 1985 13. NUMBER OF PAGES 11
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

IBM 4341
Microprocessor
Shutdown
Temperature
Computer

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes a thermal shutdown system designed to augment an IBM 4341 processor running the VM/CMS operating system. The microprocessor system monitors room temperature and alerts computer users to an impending shutdown when the temperature becomes too high. A user defined shutdown procedure is then executed prior to powering off the processor and all local peripherals.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF SYMBOLS

ASCII	American Standard Code for Information Interchange
CPU	Central Processing Unit
EPROM	Electrically Programmable Read Only Memory
I/O	Input/Output
MOS RAM	Metal Oxide Semiconductor Random Access Memory
RS-232	Standardized interface between a modem and associated data terminal equipment
TTL	Transistor-Transistor Logic
TWX	Teletype Exchange
USART	Universal Synchronous/Asynchronous Receiver/Transmitter
VM/CMS	Virtual Machine/Conversational Monitor System

INTRODUCTION

The resources of the central computer at Benet Weapons Laboratory (BWL), an IBM 4341 group 12, are shared by more than 100 engineers and scientists. Countless man-hours have been expended in the development, maintenance, and utilization of a wide variety of applications on the system. The computer has become a useful and necessary tool on a daily basis for many people at BWL.

The central computer must be maintained in a temperature and humidity-controlled environment. Unfortunately, the computer is not well equipped to effectively handle deviations from ideal climate conditions. Experience has shown that if the air conditioning units fail, the computer and its peripherals generate enough heat to raise the temperature beyond the allowed maximum in a matter of minutes. It has also been discovered that some of the circuitry is destroyed or severely weakened when the computer either fails to shut down or shuts down too late. Isolating and replacing the faulty circuitry may require a week or more. Even after the hardware is repaired, problems may arise in the operating system because the proper shutdown procedure was not executed prior to powering the system off. The net effect is disastrous to users who rely on the computer to help them generate satisfactory work output on a daily basis.

This report describes a system which monitors room temperature and alerts all computer users to an impending thermal shutdown. Shutdown date and time are recorded and an orderly operating system shutdown is executed prior to powering down processor and peripherals.

The goal of this project was to assure maximum availability of computing resources to Benet personnel.

SYSTEM DESIGN

Hardware

The system is designed around an Intel 8085A microprocessor. The 8085A processor was selected because a system design kit capable of simulating models of the design was available, and the 8085A was found to provide sufficient speed and processing power. 8085A series of compatible chips included in the design are the 8155 2K bit static MOS RAM with I/O ports and timer, 8251A programmable communications interface (USART), and the 8755A 16K bit EPROM. A Texas Instrument high speed SN74LS138 3-to-8 line decoder was used for address decoding. Motorola MC1488 and MC1489 line drivers convert the TTL level signals to/from RS-232C required levels used by the IBM 3704 communications controller. Power for all chips is provided by an Adtech TAPS series triple output power supply. Figure 1 shows the I/O ports of the 8155 as used for input and output, however, the need for the 8155 chip arises from its use as a program stack and baud rate generator for the USART. Input is taken from a standard Honeywell wall-mount thermostat and discrete transistors amplify port outputs to three pilot lamps and Potter & Brumfield dry reed relay. Shutdown status is maintained by the pilot lights, so large lamps were necessary to monitor the status from outside the secure area housing the central computer. Power is interrupted to the CPU and all peripherals by using the reed relay to bypass air flow sensor 202 on gate 02A at the CPU. The use of the relay isolates the electrical properties of the two systems.

Figure 1 shows the 8085A interrupt system as disabled since all I/O is program controlled. Isolated I/O is used for input and device control except for the memory-mapped interface to the 3704 through the USART. The address

space for the system is given below to aid in the readability of the source code.

Address Space of Chips Included in the Design

Device	Hex Address
8755A EPROM	0000 - 3FFF
8155 RAM	4000 - 7FFF
8215A (Data)	8000 - 9FFF
8215A (Command)	A000 - BFFF

Software

Figure 2 shows the machine code and assembler mnemonics for the program stored in the 8755A EPROM. On power up or a reset condition, the program branches to location 0000 where it continually monitors the input from the thermostat to determine if the temperature limit has been exceeded. If the temperature is too high, the input is tested again after one minute to insure that the reading was valid. If the temperature increase was temporary, the program returns to its reset state. Otherwise, the 8155 timer is set up to generate a 300 baud clock (based on a 6.144 MHz crystal) for the USART. The 8085A then connects to the IBM as a remote TWX terminal through the IBM 3704 communications controller. Once the 8085A attaches to the system as a virtual machine, it remains in a wait state until it receives a message from the host indicating that the system shutdown procedure has started. This handshaking scheme allows any procedure defined by the systems programmer to execute before the final shutdown procedure begins. Upon receiving these character(s) from the host, the 8085A delays for one minute to allow time for the operating

shutdown to complete. The CPU and all peripherals within the central site are then powered off.

CURRENT PROCEDURE

The VM/CMS operating system allows any shutdown procedure to be defined in a logon command file ('PROFILE EXEC') of the virtual machine under which the 8085A attaches to the system. A valid userid and password are all that is required to connect to the system, however, security is enhanced using a password containing ASCII control characters that cannot be manually entered from a keyboard (see Figure 2). The procedure currently defined for the 8085A initially notifies all users that a thermal shutdown is pending. A warning is given every minute for three minutes to allow time for anyone using the system to save all work generated during the current session that might be otherwise destroyed. Next, a file is created and transmitted to the operator informing him of the exact date and time the shutdown occurred. Finally, the message is transmitted to the 8085A enabling the power off sequence to begin.

FUTURE APPLICATIONS

The 8085A connects to the system as a virtual machine with as much capability as the systems programmer defines for it. This allows the 8085A access to any application available to the system operator including automatic file back-up and dial-up of authorized personnel. The system is not limited to the current procedures and can easily accommodate any future requirements.

The software resident in the 8755A EPROM indicates that not only a thermostat, but other devices such as a humidistat or water sensor, could be incorporated using other input ports available on the 8155. Only the code in

the EPROM locations 000F and 0011 would have to be changed unless individual procedures were implemented for each device.

The original design concept utilized high power 24V solenoids which called for the large Adtech power supply. The revised design requires much less power, so a smaller power supply could be used to house the unit in a more compact case than that shown in Figure 3.

SUMMARY

A system has been designed and implemented to effectively respond to adverse temperature conditions in the secure area housing the central computer at BWL. The unit was designed to minimize computer down time, thereby reducing the effect on BWL personnel who require access to computer resources on a daily basis. The unit has been installed for several months and successfully tested many times. Fortunately, no malfunction in the air conditioning units has yet forced it into operation.

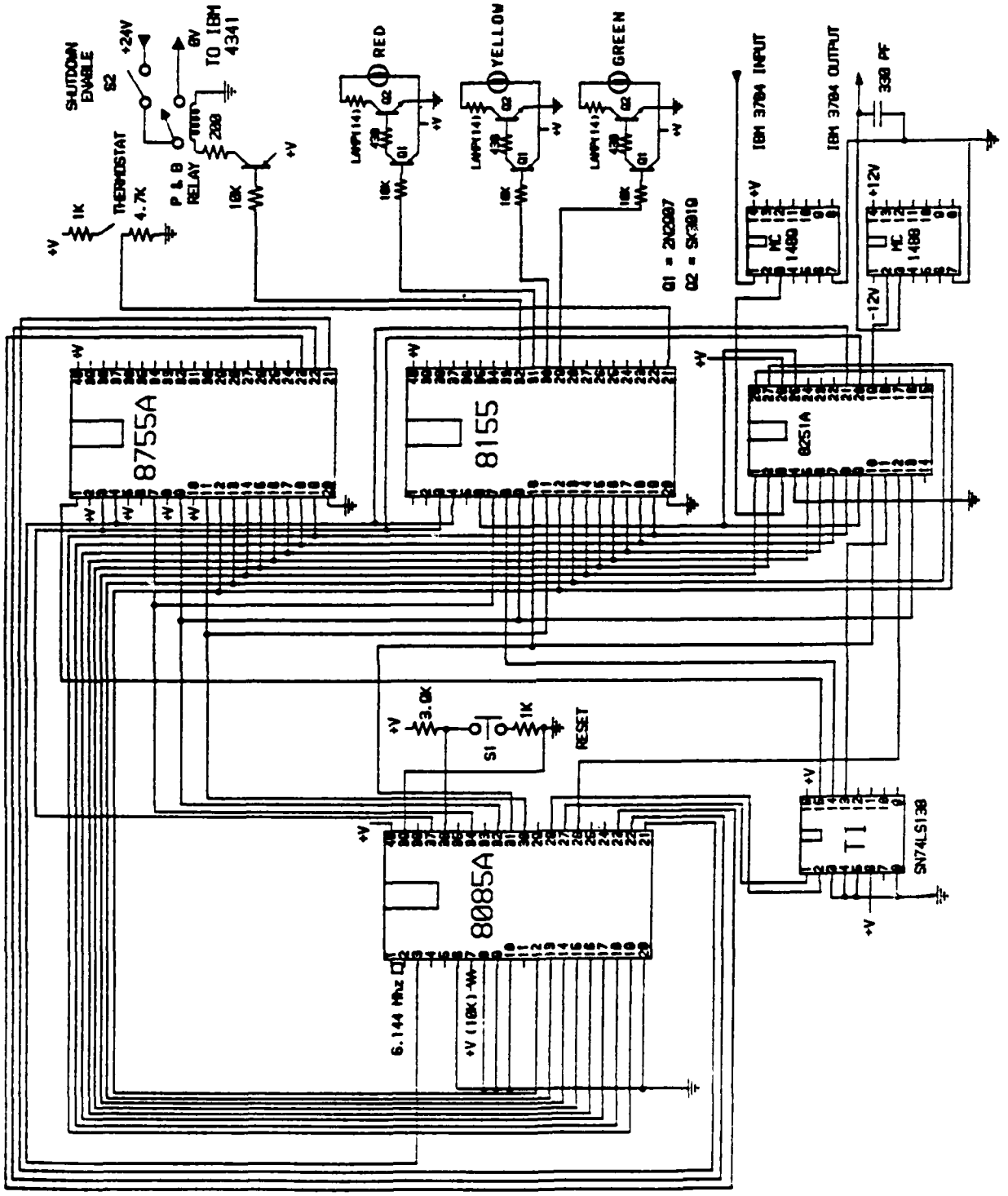


Figure 1. Circuit Diagram.

```
 ADDRESS          HEX CODE          MNEMONIC                COMMENT
0000,0001,0002     31FF7F          LXI SP,7FFF     SET UP STACK POINTER
0003               F3              DI              DISABLE INTERRUPTS
0004,0005          3E02            MVI A,02        PORT A,C = INPUT, PORT B = OUTPUT
0006,0007          D340            OUT 40
0008,0009          3EFE      LOOP1 MVI A,FE        RELAY,RED,YELLOW,GREEN = 1110
000A,000B          D342            OUT 42          TURN GREEN LIGHT ON
000C,000D          DB41      LOOP2 IN 41           CHECK FOR THERMAL CONDITION
000E,000F          E601            ANI 01          CHECK BIT 1 OF INPUT
0010,0011          FE01            CPI 01
0012,0013,0014     C20C00          JNZ LOOP2
0015,001C          3EFD            MVI A,FD        INPUT RAISED TO 1 -- TOO HOT !
0017,0018          D342            OUT 42          RELAY,RED,YELLOW,GREEN = 1101
0019,001A          16E0            MVI D,E0        1 MINUTE = 240 * .25 SECONDS
001B,001C,001D     CDA600          CALL DELAY      WAIT 1 MIN & RECHECK TEMPERATURE
001E,001F          DB41            IN 41
0020,0021          E601            ANI 01          CHECK INPUT AGAIN
0022,0023          FE01            CPI 01
0024,0025,0026     C20800          JNZ LOOP1       JUMP IF A FALSE ALARM
0027,0028          3E00            MVI A,00        L.S.B. OF TIMER COUNT
0029,002A          D344            OUT 44
002B,002C          3E68            MVI A,68        M.S.B. OF TIMER COUNT
002D,002E          D345            OUT 45
002F,0030          3EC2            MVI A,C2        START TIMER (ALT = 11)
0031,0032          D340            OUT 40
0033,0034          26A0            MVI H,A0        SET UP FOR 8251A I/O
0035,0036          2E00            MVI L,00        ADDRESS OF COMMAND = A000
0037,0038          36C9            MVI M,C9        SEND MODE COMMAND (C9)
0039,003A          3637            MVI M,37        SEND COMMAND (37)
003B,003C          2680            MVI H,80        SET UP FOR 8251A DATA I/O
003D,003E,003F     CDBB0C          CALL CHKXMT     CHECK FOR TXRDY = 1
0040,0041          360D            MVI M,0D        SEND 'CR'
0042,0043,0044     CDD400          CALL CHKDOT     CHECK FOR DOT '.' -- HOST INPUT PROMPT
0045,0046,0047     CDBB00          CALL CHKXMT     CHECK FOR TXRDY = 1
0048,0049          364C            MVI M,4C        SEND 'L'          -- LOGON TO HOST
004A,004B,004C     CDBB00          CALL CHKXMT     WAIT FOR TXRDY = 1
004D,004E          3620            MVI M,20        SEND ' '
004F,0050,0051     CDBB00          CALL CHKXMT     WAIT FOR TXRDY = 1
0052,0053          3658            MVI M,58        SEND 'X' -- 'XX' IS NOT ACTUAL USERID
0054,0055,0056     CDBB00          CALL CHKXMT     WAIT FOR TXRDY = 1
0057,0058          3658            MVI M,58        SEND 'X'
0059,005A,005B     CDBB00          CALL CHKXMT     WAIT FOR TXRDY = 1
005C,005D          360D            MVI M,0D        SEND 'CR'
005E,005F,0060     CDD400          CALL CHKDOT     WAIT FOR DOT '.'  WAIT FOR ENTER PASSWORD PROMPT
0061,0062,0063     CDBB00          CALL CHKXMT     WAIT FOR TXRDY = 1
0064,0065          3605            MVI M,05        SEND '5'  '05' IS NOT THE ACTUAL PASSWORD
0066,0067,0068     CDBB00          CALL CHKXMT     WAIT FOR TXRDY = 1
0069,006A          360D            MVI M,0D        SEND 'CR'
006B,006C,006D     CDD400          CALL CHKDOT     WAIT FOR DOT '.' WAIT FOR 'CMSZER' PROMPT
006E,006F,0070     CDBB09          CALL CHKXMT     WAIT FOR TXRDY = 1
0071,0072          360D            MVI M,0D        SEND 'CR' --- SHOULD BE LOGGED ON NOW .
0073,0074,0075     CDC600    LOOP3 CALL CHKRCV     WAIT FOR A 'B' FROM EXEC TO BEFORE CONTINUING
0076,0077          FE51            CPI C2
0078,0079,007A     C27300          JNZ LOOP3
007B,007C          2620            MVI H,20        FLASH YELLOW LIGHT
```

Figure 2. Program Listing.

```
007D,007E       3EFF        LOOP4 MVI A,FF          RELAY,RED,YELLOW,GREEN = 1111 (YELLOW OFF)
007F,0080       D342              OUT 42
0081,0082       1602              MVI D,02
0083,0084,0085  CDA600            CALL DELAY
0086,0087       3EFD              MVI A,FD          RELAY,RED,YELLOW,GREEN = 1101 (YELLOW ON)
0088,0089       D342              OUT 42
008A,008B       1602              MVI D,02
008C,008D,008E  CDA600            CALL DELAY
008F            25                DCR H             FLASH TO ALLOW TIME FOR HARDWARE DISABLE
0090            7C                MOV A,H
0091,0092       FE00              CPI 00
0093,0094,0095  C27D00            JNZ LOOP4         LAST CHANCE TO DISABLE HARDWARE
0096,0097       3EF3              MVI A,F3          RELAY,RED,YELLOW,REAL = 0011
0098,0099       D342              OUT 42
009A            76                HALT              DONE !
009B            00                NOP
009C            00                NOP
009D            00                NOP
009E            00                NOP
009F            00                NOP
00A0            00                NOP
00A1            00                NOP
00A2            00                NOP
00A3            00                NOP
00A4            00                NOP
00A5            00                NOP
00A6,00A7       068E        LOOP1 MVI B,8E      ****** SUBROUTINE DELAY ******************
00A8,00A9       0EC6              MVI C,C6
00AA            7A                MOV A,D           # OF .25 SECOND DELAYS IN REG.D
00AB,00AC       FE00              CPI 00
00AD,00AE,00AF  C2B100            JNZ LOOP2
00B0            C9                RETURN
00B1            0B          LOOP2 DCX B
00B2            78                MOV A,B
00B3            B1                ORA C             WAIT FOR ALL BITS = 0
00B4,00B5,00B6  C2B100            JNZ LOOP2
00B7            15                DCR D
00B8,00B9,00BA  C3A600            JMP LOOP1
00BB,00BC,00BD  3A00A0            LDA A000    ************ SUBROUTINE CHKXMT *************
00BE,00BF       E601              ANI 01            CHECK TXRDY = 1
00C0,00C1       FE01              CPI 01
00C2,00C3,00C4  C2BB00            JNZ CHKXMT
00C5            C9                RETURN
00C6,00C7,00C8  3A00A0            LDA A000    ************ SUBROUTINE CHKRCV *************
00C9,00CA       E602              ANI 02            CHECK RCVRDY = 1
00CB,00CC       FE02              CPI 02
00CD,00CE,00CF  C2C600            JNZ CHKRCV
00D0,00D1,00D2  3A0080            LDA 8000
00D3            C9                RETURN
00D4,00D5,00D6  CDC600            CALL CHKRCV ************ SUBROUTINE CHKDOT *************
00D7,00D8       FE11              CPI 11
00D9,00DA,00DB  C2D400            JNZ CHKDOT
00DC            C9                RETURN
```

Figure 2. Program Listing (Cont'd).

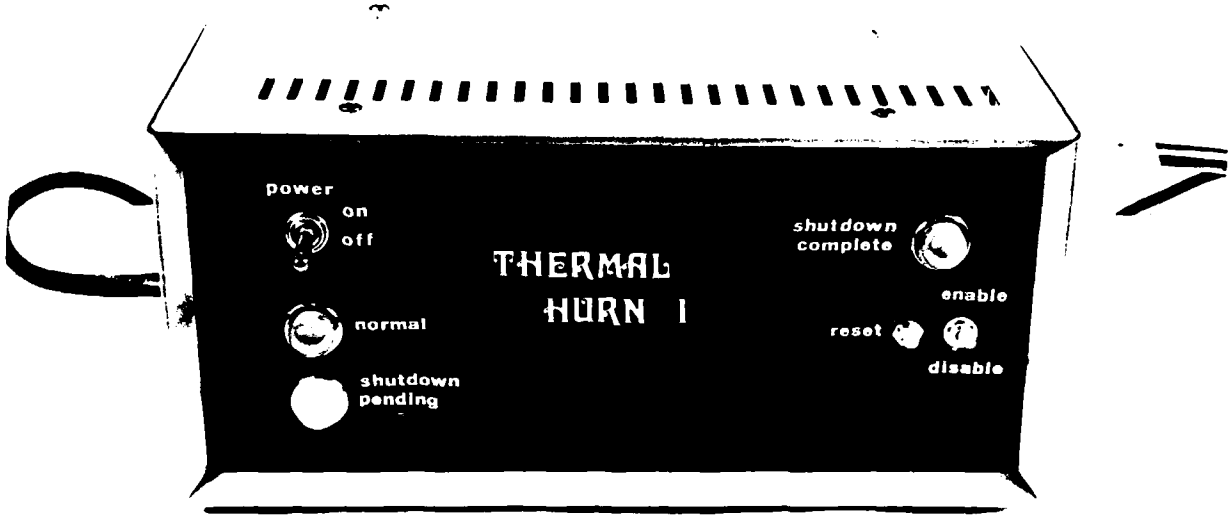


Figure 3a. Photograph of control unit.

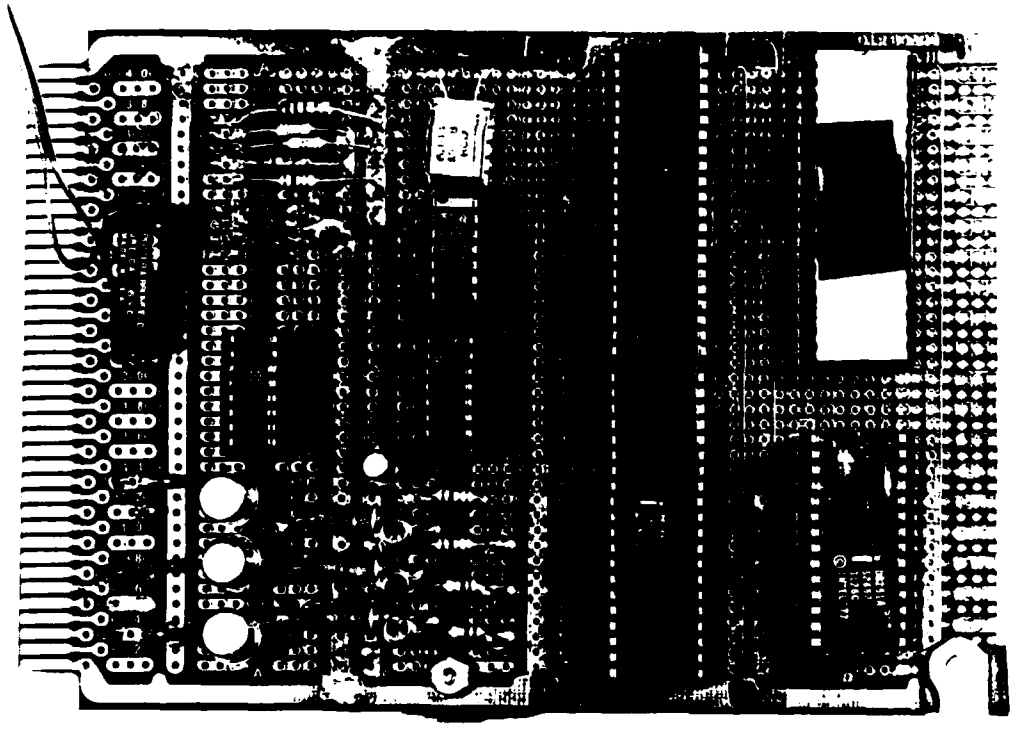


Figure 3b. Photograph of circuit design.

TECHNICAL REPORT INTERNAL DISTRIBUTION LIST

	NO. OF COPIES
CHIEF, DEVELOPMENT ENGINEERING BRANCH	
ATTN: SMCAR-CCB-D	1
-DA	1
-DP	1
-DR	1
-DS (SYSTEMS)	1
-DS (ICAS GROUP)	1
-DC	1
-DM	1
CHIEF, ENGINEERING SUPPORT BRANCH	
ATTN: SMCAR-CCB-S	1
-SE	1
CHIEF, RESEARCH BRANCH	
ATTN: SMCAR-CCB-R	2
-R (ELLEN FOGARTY)	1
-RA	1
-RM	1
-RP	1
-RT	1
TECHNICAL LIBRARY	5
ATTN: SMCAR-CCB-TL	
TECHNICAL PUBLICATIONS & EDITING UNIT	2
ATTN: SMCAR-CCB-TL	
DIRECTOR, OPERATIONS DIRECTORATE	1
DIRECTOR, PROCUREMENT DIRECTORATE	1
DIRECTOR, PRODUCT ASSURANCE DIRECTORATE	1

NOTE: PLEASE NOTIFY DIRECTOR, BENET WEAPONS LABORATORY, ATTN: SMCAR-CCB-TL, OF ANY ADDRESS CHANGES.

TECHNICAL REPORT EXTERNAL DISTRIBUTION LIST

	NO. OF COPIES
ASST SEC OF THE ARMY RESEARCH & DEVELOPMENT ATTN: DEP FOR SCI & TECH THE PENTAGON WASHINGTON, D.C. 20315	1
COMMANDER DEFENSE TECHNICAL INFO CENTER ATTN: DTIC-DDA CAMERON STATION ALEXANDRIA, VA 22314	12
COMMANDER US ARMY MAT DEV & READ COMD ATTN: DRCDE-SG 5001 EISENHOWER AVE ALEXANDRIA, VA 22333	1
COMMANDER ARMAMENT RES & DEV CTR US ARMY AMCCOM ATTN: SMCAR-FS SMCAR-FSA SMCAR-FSM SMCAR-FSS SMCAR-AEE SMCAR-AES SMCAR-AET-O (PLASTECH) SMCAR-MSI (STINFO) DOVER, NJ 07801	1 1 1 1 1 1 1 2
DIRECTOR BALLISTICS RESEARCH LABORATORY ATTN: AMXBR-TSB-S (STINFO) ABERDEEN PROVING GROUND, MD 21005	1
MATERIEL SYSTEMS ANALYSIS ACTV ATTN: DRXSY-MP ABERDEEN PROVING GROUND, MD 21005	1
COMMANDER US ARMY AMCCOM ATTN: SMCAR-ESP-L ROCK ISLAND, IL 61299	1
COMMANDER ROCK ISLAND ARSENAL ATTN: SMCRI-ENM (MAT SCI DIV) ROCK ISLAND, IL 61299	1
DIRECTOR US ARMY INDUSTRIAL BASE ENG ACTV ATTN: DRXIB-M ROCK ISLAND, IL 61299	1
COMMANDER US ARMY TANK-AUTMV R&D COMD ATTN: TECH LIB - DRSTA-TSL WARREN, MI 48090	1
COMMANDER US ARMY TANK-AUTMV COMD ATTN: DRSTA-RC WARREN, MI 48090	1
COMMANDER US MILITARY ACADEMY ATTN: CHMN, MECH ENGR DEPT WEST POINT, NY 10996	1
US ARMY MISSILE COMD REDSTONE SCIENTIFIC INFO CTR ATTN: DOCUMENTS SECT, BLDG. 4484 REDSTONE ARSENAL, AL 35898	2
COMMANDER US ARMY FGN SCIENCE & TECH CTR ATTN: DRXST-SD 220 7TH STREET, N.E. CHARLOTTESVILLE, VA 22901	1

NOTE: PLEASE NOTIFY COMMANDER, ARMAMENT RESEARCH AND DEVELOPMENT CENTER, US ARMY AMCCOM, ATTN: BENET WEAPONS LABORATORY, SMCAR-CCB-TL, WATERVLIET, NY 12189, OF ANY ADDRESS CHANGES.

TECHNICAL REPORT EXTERNAL DISTRIBUTION LIST (CONT'D)

	NO. OF COPIES
COMMANDER US ARMY LABCOM MATERIALS TECHNOLOGY LAB ATTN: SLCMT-IML WATERTOWN, MA 01272	2
COMMANDER US ARMY RESEARCH OFFICE ATTN: CHIEF, IPO P.O. BOX 12211 RESEARCH TRIANGLE PARK, NC 27709	1
COMMANDER US ARMY HARRY DIAMOND LAB ATTN: TECH LIB 2800 POWDER MILL ROAD ADELPHIA, MD 20783	1
COMMANDER NAVAL SURFACE WEAPONS CTR ATTN: TECHNICAL LIBRARY CODE X212 DAHLGREN, VA 22448	1
DIRECTOR US NAVAL RESEARCH LAB ATTN: DIR, MECH DIV CODE 26-27, (DOC LIB) WASHINGTON, D.C. 20375	1 1
COMMANDER AIR FORCE ARMAMENT LABORATORY ATTN: AFATL/DLJ AFATL/DLJG EGLIN AFB, FL 32542	1 1
METALS & CERAMICS INFO CTR BATTELLE COLUMBUS LAB 505 KING AVENUE COLUMBUS, OH 43201	1

NOTE: PLEASE NOTIFY COMMANDER, ARMAMENT RESEARCH AND DEVELOPMENT CENTER, US ARMY AMCCOM, ATTN: BENET WEAPONS LABORATORY, SMCAR-CCB-TL, WATERVLIET, NY 12189, OF ANY ADDRESS CHANGES.

END

DTIC

4-86