Home Applications for the 6800

By David E. Shambaugh

This article deals with a Motorola MEK 6800 D2 kit, which sells for about $225. The "D2" kit comes with several capabilities: an MC6800 MPU; three MCM6810 RAMs (128x8 each); two MC6820 Peripheral Interface Adapters (PIA); one Asynchronous Communication Interface Adapter (ACIA); one MC6871 Clock Generator and one MCM6830 ROM with JBUG monitor.

When assembled, the kit consists of these parts separated on two boards, the MPU board and the display board. The display board contains the six 7-segment displays, the keyboard and the audio cassette circuitry. This allows the ACIA and second PIA available to the user in the event that the user has access to an RS-232 TTY terminal. Wire wrap space is available for up to twenty 16-pin DIP packages for user designed circuitry.

The kit as built with the JBUG ROM, is a very powerful device which can be used for all sorts of applications around the home.

This article tells you how to take a D2 kit and make:

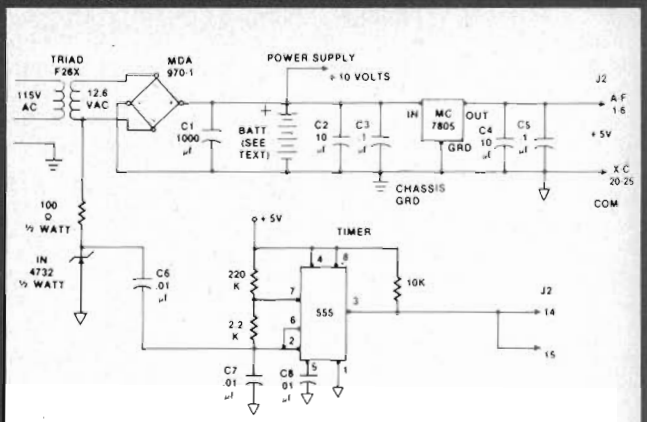
A Digital Clock. Hours, minutes, and seconds will be continuously displayed on the six 7-segment displays. The circuit in Figure 1 is a timer which replaces the 60 cycle line frequency during power failures. Thus the clock keeps running when the power is out, assuming that the battery back up system shown in Figure 2 is added. Another feature is that by changing data in two memory locations, as shown in the program listing, the 12-hour clock can become a military 24-hour clock.

A Burglar Alarm. This alarm, wired as shown in Figure 3, is unique in that is is an "adaptive" alarm system. This is done by having the MPU look at the state of the alarm switches and "memorize" each one. The MPU then comes back a few seconds later and looks at all of the switches again. If any switch(es) has changed, the alarm is triggered for an adjustable period of time. At the end of this time the MPU shuts off the alarm and looks at the state of the switches again. This state is now accepted as the "new" condition and the entire cycle starts over. With this system a switch can fail, be destroyed, be tripped or whatever and the rest of the alarm is not disabled.

A Timer/Control. The wiring for the timer output is shown in Figure 4. Each time the clock program updates the hour count, it checks to see if the program wants the timer output turned on. If it does, it turns the output on, then checks every minute count to see if it has been on for the desired time. If the time is up, the output is shut off. This output will control a sprinkler system or other home device.

HARDWARE AND SUPPORTING SOFTWARE

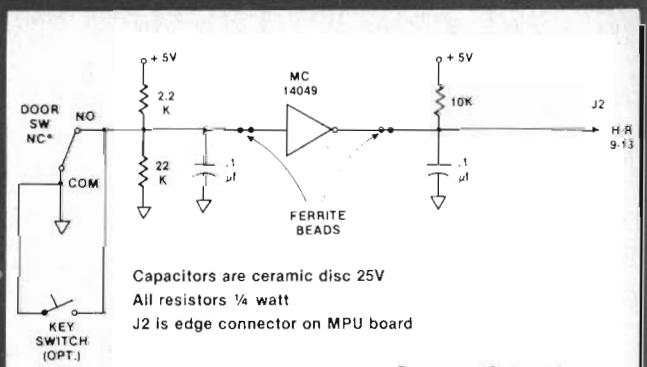
As stated, Figure 1 shows the interrupt timer and power supply. The power supply uses four each Gates rechargeable lead acid cells at 2 volts each. This 8-volt source is regulated down to +5 volts with a 3-terminal voltage regulator (MC 7805). The batteries are supplied with a charge as long as 60 Hz power is present by using a 12.6 volt, 2 amp transformer and full wave bridge rectifier with a 1000 μf capacitor. This produces 10V DC, with battery loading the circuit and is within specifications supplied by battery manufacturer.



C1,2,4 Electrolytic 25V
C3,5,6,7,8 Ceramic Disc 25V
All resistors ¼ watt except where noted
J2 is edge connector on MPU board

Figure 1. Power Supply and Interrupt Timer.

The interrupt timer (also in Figure 1) uses a 555 timer wired in the astable mode. The oscillation rate is slightly faster than 60 Hz (the period is approximately 17 msec and the pulse is approximately 150 μsec), which is more than long enough for recognition by the MPU as a valid interrupt.



Capacitors are ceramic disc 25V
All resistors ¼ watt
J2 is edge connector on MPU board

Figure 2. Typical Input Connection.

Figure 2 shows a typical input connection. An MC 14049 inverter buffer is used to protect the PIA from noise and voltage spikes on the input lines because of the length of the wire going to the switches. There are also numerous pull ups, pull downs and bypass capacitors for elimination of false triggers. There are also other ways of designing around noise problems. Ferrite beads are used in some places to get rid of the interference caused by CB enthusiasts and their 1 KW linears. The switch connection is shown, and can be wired in the Normally Open or Normally Closed configuration. It is shown wired Normally Closed in this figure because it also shows the use of a Key Switch which is used to short the switch for entering the premises without tripping the alarm.

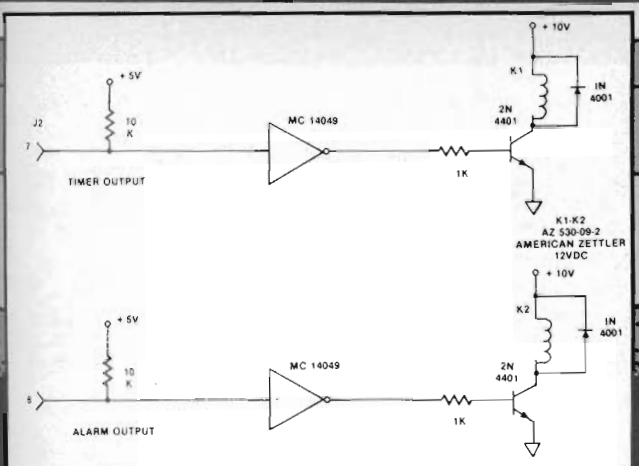


Figure 3. Typical Output Connection.

Figure 3 shows a typical output connection. The outputs from the PIA are also protected by an MC 14049 inverter buffer as on the inputs. The outputs are not as critical for noise problems as the inputs, so are much simpler.

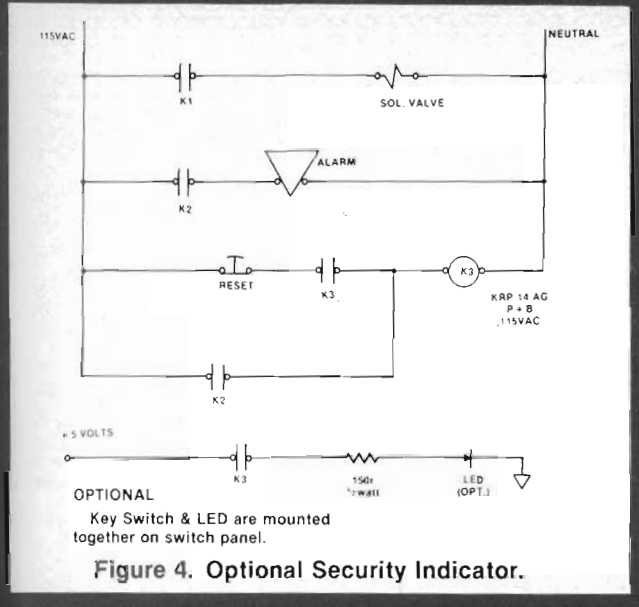


Figure 4. Optional Security Indicator.

Shown in Figure 4 is a latching relay circuit used in the system for a special feature. The relay latches through a Normally Closed reset push button every time the alarm is sounded. When the relay is energized, it lights a solid state LED mounted on a switch panel with a key switch by the door used for entering.

This is important in that it will tell if the alarm system was triggered while no one was in. If the LED is on, be cautious in entering the premises in case an intruder is still present.

Now on to some explanations on the supporting software. The main program, which is the digital clock, works in this way. It first looks for an interrupt which is present out at PIA location HEX 8006. When this input goes high it checks the validity by also reading the MSB of the input at HEX 8006. This bit is also high when the interrupt occurs. When the MSB is high it means a minus number is there. This is accepted as a valid interrupt and it updates the SSEC accumulator which keeps track of the 1/60 second count. If the data is not a minus number, it goes back and looks for another interrupt. This is a noise eliminating check. The program counts sixty interrupts and updates the seconds accumulator. It then jumps to the display subroutine in the JBUG ROM and updates the display. Every time it counts sixty seconds, it updates the minute accumulator and jumps to the display routine in the JBUG ROM again and updates the appropriate display. This happens with the hour accumulator in the same way at every hour.

Every time the display is updated the program jumps to the timer subroutine starting at HEX 009B and checks to see if the hour accumulator, HEX location 0003 and the Hour Setpoint, HEX location 0009 are the same. If they are the same, it compares the Minutes Accumulator, HEX 0004 and the Minutes Setpoint, HEX 000A. If they are the same, it sets the timer output high and also sets the Timer Triggered Flag, HEX 0007, and returns to the main program. Once the Timer Triggered Flag is set, the program compares the Minutes Accumulator, HEX 0008, with Delay 1, HEX 000B, and when they are the same will turn the timer output back low again and clear the Timer Triggered Flag.

Every time the program updates the second count it jumps to the Alarm Subroutine at location HEX 00CE. In this routine, it compares the PIA locations at HEX 8004 and 8006 to the two Alarm Status Registers at HEX 000F and 0010. In the first few steps of the main program the data at these two PIA locations was loaded into the two Alarm Status Registers. When the Alarm Subroutine compares the PIA location with the appropriate Alarm Status Register, it should see no difference unless a switch condition was changed. If a difference occurs in either place, the delay register is incremented and compared to the delay which was input at location HEX 00DE.

Once this seconds count is finished and the condition is still present, the alarm output is set high and the Flag 1 register, HEX 000E is set. This delay eliminates noise and false triggers. Once the flag is set, the program counts seconds in the Delay 3 register, HEX 000D and compares them with the delay put in at location HEX 0102. This the alarm on time. Once this delay is counted out, the alarm output is turned back low and the PIAs (HEX 8004 and 8006) are read and loaded into the two Alarm Status registers. This puts the new data in the registers for future comparisons. This means if a door or window is opened, the alarm sounds for an adjustable time and scares the intruder off. When the alarm is reset, the window or door left opened is taken as a normal condition. The alarm will sound off again if another door or window is opened or if the opened door or window is closed. A HEX entry of 01 at 0102 will disable the alarm.□

Location	Load
0003	Present Hour
0004	Present Hour
0005	00
0006	00
0007	00
0008	00
0009	Hour you want timer on (00-23)
000A	Minute you want timer on (00-59)
000B	Minutes you want timer to be on (00-FF)
000C	00
000D	00
000E	00
000F	00
0010	00
007F	12 for 12 hour clock — 24 for 24 hour clock
0083	01 for 12 hour clock — 00 for 24 hour clock
00DE	01 for 1 second delay[1]
0102	Alarm on time (00-FF)[2] 01 disables alarm

[1]Any HEX number from HEX 00-FF can be put in here, but 01 is the best number for noise elimination and fast recognition of intruder and will allow alarm to trigger after 1 second.

[2]Any HEX number from HEX 00-FF can be put in here also. HEX 00 gives you 256 seconds of alarm time. HEX 01 will disable alarm. Any other HEX number will provide the appropriate alarm on time. **Program Listing Follows**

PROGRAM LISTING

```
00001                                NAM     DAVE
00002                                OPT     P
00003          8004     PIADA    EQU     $8004
00004          8005     PIACA    EQU     $8005
00005          8006     PIADB    EQU     $8006
00006          8007     PIACB    EQU     $8007
00007          E0FE     OUTDS    EQU     $E0FE
00008          E275     MISD01   EQU     $E275
00009          E327     REGST6   EQU     $E327
00010          E31C     REGST5   EQU     $E31C
00011          A000     INTLOC   EQU     $A000
00012 0000                           ORG     $0000
00013 0000 7E 0011                   JMP     START
00014 0003 0001     HR       RMB     1
00015 0004 0001     MIN      RMB     1
00016 0005 0001     SEC      RMB     1
00017 0006 0001     SSEC     RMB     1
00018 0007 0001     TIMTR    RMB     1
00019 0008 0001     MINAC    RMB     1
00020 0009 0001     HRSPT    RMB     1
00021 000A 0001     MINSPT   RMB     1
00022 000B 0001     DEL1     RMB     1
00023 000C 0001     DEL2     RMB     1
00024 000D 0001     DEL3     RMB     1
00025 000E 0001     FLG1     RMB     1
00026 000F 0001     AS1      RMB     1
00027 0010 0001     AS2      RMB     1
00028 0011 01       START    NOP
00029 0012 0F                        SEI
00030 0013 4F                        CLR A
00031 0014 97 06                     STA A   SSEC
00032 0016 97 07                     STA A   TIMTR
00033 0018 B7 8007                   STA A   PIACB
00034 001B B7 8005                   STA A   PIACA
00035 001E 97 0C                     STA A   DEL2
00036 0020 97 0D                     STA A   DEL3
00037 0022 97 0E                     STA A   FLG1
00038 0024 CE 03FF                   LDX     #$03FF
00039 0027 FF 8006                   STX     PIADB
00080 0084 97 03                     STA A   HR
00081 0086 96 05    SETDSP   LDA A   SEC
00082 0088 BD E275                   JSR     MISD01
00083 008B 96 04                     LDA A   MIN
00084 008D BD E327                   JSR     REGST6
00085 0090 96 03                     LDA A   HR
00086 0092 BD E31C                   JSR     REGST5
00087 0095 20 04                     BRA     TIMCK
00088 0097 8B 01    CKDEC    ADD A   #01
00089 0099 19                        DAA
00090 009A 39                        RTS
00091 009B 96 07    TIMCK    LDA A   TIMTR
00092 009D 2B 1E                     BMI     X3
00093 009F 96 09                     LDA A   HRSPT
00094 00A1 91 03                     CMP A   HR
00095 00A3 27 02                     BEQ     X1
00096 00A5 20 26                     BRA     X5
00097 00A7 96 0A    X1       LDA A   MINSPT
00098 00A9 91 04                     CMP A   MIN
00099 00AB 27 02                     BEQ     X2
00100 00AD 20 1E                     BRA     X5
00101 00AF 86 80    X2       LDA A   #$80
00102 00B1 97 07                     STA A   TIMTR
00103 00B3 7F 0008                   CLR     MINAC
00104 00B6 86 01                     LDA A   #$01
00105 00B8 B7 8006                   STA A   PIADB
00106 00BB 20 10                     BRA     X5
00107 00BD 96 08    X3       LDA A   MINAC
00108 00BF 91 0B                     CMP A   DEL1
00109 00C1 27 02                     BEQ     X4
00110 00C3 20 08                     BRA     X5
00111 00C5 86 00    X4       LDA A   #$00
00112 00C7 B7 8006                   STA A   PIADB
00113 00CA 7F 0007                   CLR     TIMTR
00114 00CD 3B       X5       RTI
00115 00CE 96 0E    ALM1     LDA A   FLG1
00116 00D0 26 24                     BNE     X6
00117 00D2 B6 8004                   LDA A   PIADA
00118 00D5 D6 0F                     LDA B   AS1
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00040 002A CE 0045        LDX     #INTRG
00041 002D FF A000        STX     INTLOC
00042 0030 CE 0004        LDX     #$0004
00043 0033 FF 8004        STX     PIADA
00044 0036 B6 8004        LDA A   PIADA
00045 0039 97 0F          STA A   AS1
00046 003B B6 8006        LDA A   PIADB
00047 003E 97 10          STA A   AS2
00048 0040 01             NOP
00049 0041 0E             CLI
00050 0042 7E E0FE        JMP     OUTDS
00051 0045 01       INTRG NOP
00052 0046 B6 8006        LDA A   PIADB
00053 0049 2B 01          BMI     INT2
00054 004B 3B       INT1  RTI
00055 004C 7C 0006  INT2  INC     SSEC
00056 004F 96 06          LDA A   SSEC
00057 0051 81 3C          CMP A   #$3C
00058 0053 26 F6          BNE     INT1
00059 0055 7F 0006        CLR     SSEC
00060 0058 BD 00CE        JSR     ALM1
00061 005B 96 05          LDA A   SEC
00062 005D 8D 38          BSR     CKDEC
00063 005F 97 05          STA A   SEC
00064 0061 81 60          CMP A   #$60
00065 0063 26 21          BNE     SETDSP
00066 0065 7F 0005        CLR     SEC
00067 0068 7C 0008        INC     MINAC
00068 006B 96 04          LDA A   MIN
00069 006D 8D 28          BSR     CKDEC
00070 006F 97 04          STA A   MIN
00071 0071 81 60          CMP A   #$60
00072 0073 26 11          BNE     SETDSP
00073 0075 7F 0004        CLR     MIN
00074 0078 96 03          LDA A   HR
00075 007A 8D 1B          BSR     CKDEC
00076 007C 97 03          STA A   HR
00077 007E 81 24          CMP A   #$24
00078 0080 26 04          BNE     SETDSP
00079 0082 86 00          LDA A   #$00
00119 00D7 11             CBA
00120 00D8 27 0A          BEQ     X7
00121 00DA 96 0C    X9    LDA A   DEL2
00122 00DC 4C             INC A
00123 00DD 81 02          CMP A   #$02
00124 00DF 27 15          BEQ     X6
00125 00E1 97 0C          STA A   DEL2
00126 00E3 39             RTS
00127 00E4 B6 8006  X7    LDA A   PIADB
00128 00E7 84 7C          AND A   #$7C
00129 00E9 D6 10          LDA B   AS2
00130 00EB C4 7C          AND B   #$7C
00131 00ED 11             CBA
00132 00EE 27 02          BEQ     X8
00133 00F0 20 E8          BRA     X9
00134 00F2 7F 000C  X8    CLR     DEL2
00135 00F5 39             RTS
00136 00F6 B6 8006  X6    LDA A   PIADB
00137 00F9 8A 02          ORA A   #$02
00138 00FB B7 8006        STA A   PIADB
00139 00FE 96 0D          LDA A   DEL3
00140 0100 4C             INC A
00141 0101 81 02          CMP A   #$02
00142 0103 27 07          BEQ     X10
00143 0105 97 0D          STA A   DEL3
00144 0107 86 FF          LDA A   #$FF
00145 0109 97 0E          STA A   FLG1
00146 010B 39             RTS
00147 010C B6 8006  X10   LDA A   PIADB
00148 010F 84 FD          AND A   #$FD
00149 0111 B7 8006        STA A   PIADB
00150 0114 7F 000D        CLR     DEL3
00151 0117 7F 000E        CLR     FLG1
00152 011A B6 8004        LDA A   PIADA
00153 011D 97 0F          STA A   AS1
00154 011F B6 8006        LDA A   PIADB
00155 0122 84 7C          AND A   #$7C
00156 0124 97 10          STA A   AS2
00157 0126 39             RTS
00158       0000          END
```