DP8570A Experiments to Test the Low Battery Bit or Generate a Periodic Interrupt

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SUMMARY

This application note describes two experiments. One experiment allows the user to check that the low battery bit is working correctly. The other allows the user to generate a 10 ms periodic interrupt.

A program named RTC, written in Microsoft™ Quick C version 1, is used for both experiments. The code works with the circuit shown in *Figure 3*. This circuit is a general purpose interface for use with an IBM® PC-XT® or PC-AT® (or equivalent). Keyboard entries may be either upper or lower case, but the underscores must be included.

Type rtc to execute the program, then follow the instructions on the monitor.

LOW BATTERY BIT EXPERIMENT

Equipment: Variable lab supply or 20k pot, center tapped to the V_{BB} pin.

An oscilloscope with 10 MΩ, 10 pF probe or higher impedance.

The initial screen output is shown in Message 1. Before selecting the LOW__BATT__BIT mode, set the voltage at the V_{BB} pin to about 2.5V. If V_{BB} is GND or too low a voltage, a message should appear (see Message 2). Once the LOW__BATT__BIT mode is running, you should see screen output (see Message 3). The status of the low battery bit is displayed in the lower left of the monitor. A value of 0 indicates V_{BB} is higher than the internal threshold detector. A value of 40 indicates the low battery bit is set.

Monitor the waveform at the OSC OUT pin. Observing the peak-to-peak voltage of this waveform is the only way to know that the DP8570A is in the battery backed mode, unless the test mode is selected. The waveform is sinusoidal in form and swings within 0.6V of V_{BB} and ground. Refer to *Figures 1a, 1b, 1c*.

Vary the V_{BB} voltage slowly as you approach 2.3V. If the V_{BB} voltage gets too low (less than 1.8V) the oscillator may stop. During the low battery bit mode, if V_{BB} is grounded or a too low a voltage, you will not get any indication on screen. If you hit the spacebar and re-enter the LOW__BATT__BIT mode, Message 1 warning will appear on the monitor.

10 mS INTERRUPT EXPERIMENT

Equipment: An oscilloscope is needed to monitor the INTR pin.

Before starting this section of the program, connect V_{BB} to ground. The INTR__10 ms code configures the DP8570A in the Single Supply mode. Message 4 is output to the monitor indicating you are in the 10 ms Interrupt mode. *Figure 2a* shows expected waveforms for a PC-XT (4.77 MHz); *Figure 2b* a 386/33 MHz AT.

```
                    Check that the Oscillator has started.
          If you don't get osc running in 5 seconds, the program will abort

                   The Oscillator is running. The Clock is started.

You may choose the    'Low Battery Bit' Test    or
                      'the l0ms Interrupt' Test or
                      'END to return to DOS'

Type in your choice in the following format, then hit ENTER:

Choices are:      LOW_BATT_BIT   or
                  INTR_l0ms   or
                  END    to exit the Program

Enter your choice now:
```

Message 1: Initial Screen Display (Normal Operation)

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```
Watch out! VBB is at Ground or some illegal value

VBB voltage should be between 2.2V and VCC - 0.4V
```

Message 2: V_{BB} Warning

```
Battery backed mode selected.
Check waveform at osc out to see if referenced
to the battery voltage
Peak value should be less than the battery voltage


Adjust voltage on VBB pin while monitoring screen.
The bottom left side of the screen will display zero
if VBB > threshold (about 2.1 volts),
or 40 if VBB < threshold.
This test may be ended by hitting the space bar.
```

Message 3: Normal Message after Selecting LOW__BATT__BIT

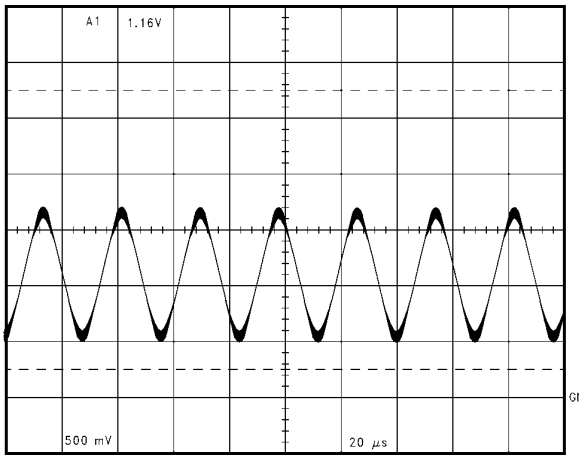

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FIGURE 1a

Conditions:
LOW_BATT_BIT chosen
V_{BB} = 2.5V
V_{CC} = 5V

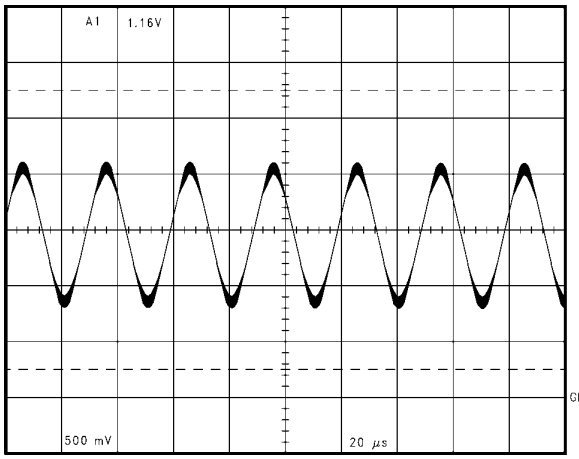

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FIGURE 1b

Conditions:
LOW_BATT_BIT chosen
V_{BB} = 3V
V_{CC} = 5V

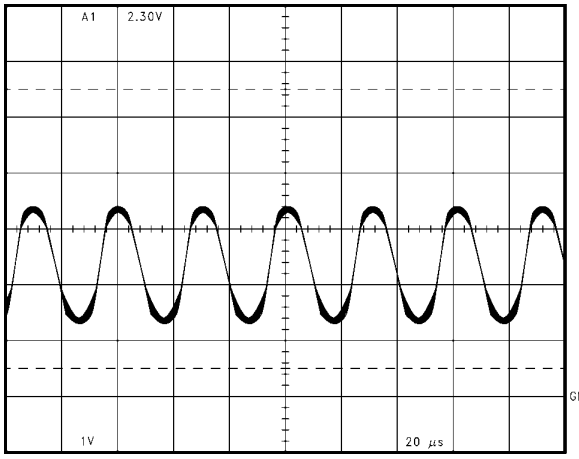

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FIGURE 1c

Conditions:
INTR_10 ms chosen
V_{BB} = 0V
V_{CC} = 5V
(default to single supply mode)

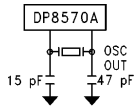

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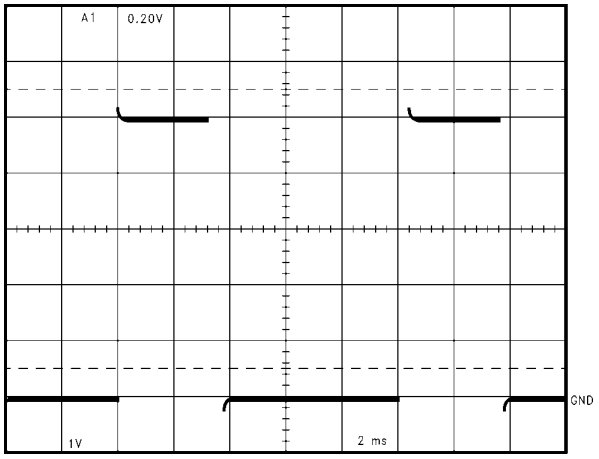
FIGURE 1d

```
The Oscillator is running. The Clock is started.
Now you are in the 10ms_Interrupt mode
Use an oscilloscope to view the waveform at the INTR pin
Hit spacebar to return to 'Selection Menu'
```

Message 4: Normal Message after Selecting INTR__10ms



Conditions:
V_{CC} = 5V
V_{BB} = GND
INTR pin out running
on a PC/XT (4.77 MHz)

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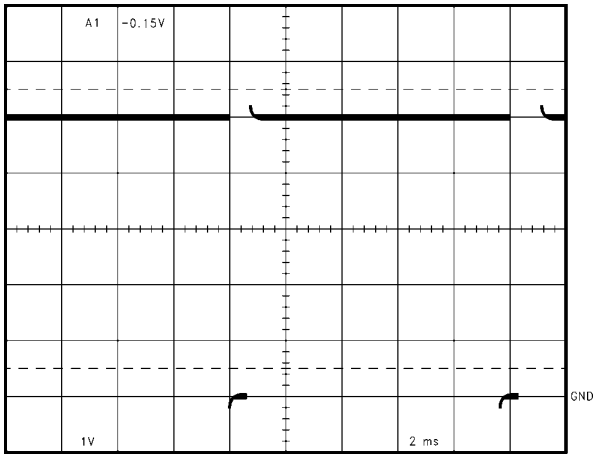
FIGURE 2a: Expected Waveforms at INTR Pin



Conditions:
V_{CC} = 5V
V_{BB} = GND
INTR pin out running
on a 386/33 MHz AT

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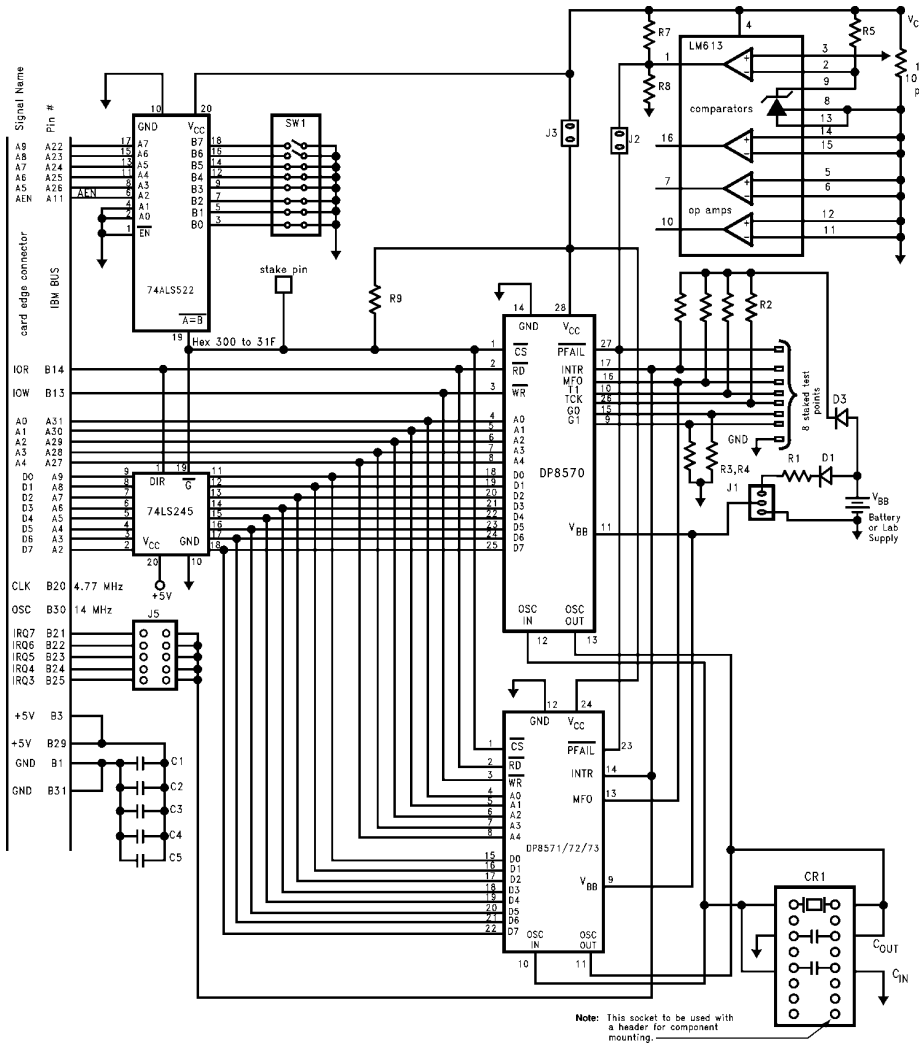
FIGURE 2b: Expected Waveforms at INTR Pin



Component and Placement List

pot 1 = 10 kΩ
CR1 = see Table I
C_{IN} = see Table I
C_{OUT} = see Table I
C1 = 0.047 μF ceramic placed at U1
C2 = 0.047 μF ceramic placed at U2
C3 = 0.047 μF ceramic placed at U3
C4 = 0.047 μF ceramic placed at U4
C5 = 5.6 μF solid tantalum placed at card edge
D1, D2, D3 = 1N914 or 1N4001 or 1N4933
R1 = 2.7 kΩ
R2 = 3.9 kΩ
R3 = 10 kΩ
R4 = 10 kΩ
R5 = 3.3 kΩ
R6 = 10 turn 10 kΩ
R7 = 20 kΩ
R8 = 39 kΩ
R9 = 5 kΩ
V_{BB} = 3.0V to 3.4V Lithium battery (coin cell)

Table I

CR1 (crystal)	C_{IN} (pF)	C_{OUT} (pF)
32.768/32.0 kHz	15	47
4.194304 MHz	36	68
4.9152 MHz	36	68

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FIGURE 3. General Purpose Interface to IBM PC-XT or PC-AT for Experiments

```
/*************************************************************************
 * This program RTC.C is designed to work with the DP857x family of      *
 * Real Time Clocks. It works with a demoboard interfaced to a PC/XT      *
 * or PC/AT. This 'C' program is written in Microsoft C (version 6.0).    *
 * This program has two parts:                                            *
 * Part 1  allows testing the Low Battery Bit, in the Batt_Back Mode.     *
 * Part 2  initializes the 10 millisecond periodic interrupt.             *
 * Also, it delays clearing the INT, after polling the int flag in        *
 * the 'MSR' for the purpose of observing the output on an Oscilloscope. *
 * ************************************************************************/


#include <stdio.h>
#include <conio.h>
#include <time.h>
#include <graph.h>

#define MSR   0x300    /* main status register           */
#define PFR   0x303    /* periodic flag register         */
#define RTMR  0x301    /* real time mode register        */
#define IRR   0x304    /* interrupt routing register     */
#define OMR   0x302    /* output mode register 8         */
#define ICR0  0x303    /* interrupt control register 0   */
#define ICR1  0x304    /* interrupt control register 1   */
#define TCR0  0x301    /* timing control register 0      */
#define TCR1  0x302    /* timing control register 1      */
#define TESTR 0x31F    /* Test Mode register             */

enum { LOW_BATT_BIT, INTR_10ms, END } mode;
char buf[80];
char *mode_str[] = { "LOW_BATT_BIT", "INTR_10ms", "END" };

main()
{
char *input;
int i;

/* Initialize the RTC, select 32.768KHz.                */

/* The following while loop tries to start the clock     */
/* and tests the osc fail bit to see that the oscillato  */
/* is running. The oscillator must be running in order   */
/* to configure the DP857X for battery back mode         */

_clearscreen(_GCLEARSCREEN);
printf("\n\t Check that the Oscillator has started.");
printf("\nIf you don't get osc running in 5 seconds, the program will abort\n")
;
init();

printf("\n\nYou may choose the   'Low Battry Bit' Test\tor");
printf("\n                    'the 10ms Interrupt' Test\tor");
printf("\n                    'END to return to DOS'       ");

outp(MSR,0);

mode = - 1;

do {
   while (mode != LOW_BATT_BIT && mode != INTR_10ms && mode != END)
   {
    printf("\n\nType in your choice in the following format,then hit ENTER:");
```

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```
    printf("\n\nChoices are:\tLOW_BATT_BIT    or\n\t\tINTR_10ms  or\n");
    printf("\t\tEND    to exit the Program\n");
    printf("\nEnter your choice now: \n\n");

    input = gets(buf);
    for (i=0; i<=3; i++)
    if (!strcmpi(input, mode_str[i]))
    mode = i;
   }
  switch(mode)
{
case LOW_BATT_BIT:

init();                          /* Call  'init'  function */
batbak();                        /* Call 'batbak' function */
mode = -1;
break;

case INTR_10ms:

init();                             /* Call init routine  */
intr();                             /* Call intr Routine  */
mode = -1;
break;

case END:

printf("\n This is the END of the Program");
break;
}
} while (mode != END);
}


batbak()

/* This program configures the DP857X 32.768KHz oscillator
   Conditions:  Vcc = 5V, VBB = 3.0V (adjustable),
   T = ambient temperature                                  */
{
   outp(MSR,0x40);      /* select bank 1                   */
   outp(ICR1,0x80);     /* set PFAIL enable in ICR1        */
   outp(MSR,0);
   outp(PFR,0);         /* select battery backed mode      */

   if(inp(IRR) & 0x40)
    {
     _clearscreen(_GCLEARSCREEN);
     _settextposition(11,15);
     printf("Watch out! VBB is at Ground or some illegal value");
     _settextposition(13,15);
     printf("VBB voltage should be between 2.2V and VCC - 0.4V");
     _settextposition(24,0);
     mode = -1;
     exit();
    }
   _clearscreen(_GCLEARSCREEN);
   printf("\n\t Battery backed mode selected.");
   printf("\n\t Check waveform at osc out to see if referenced");
   printf("\n\t to the battery voltage.\n\t Peak value should be less");
   printf(" than the battery voltage\n");
```

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```
   printf("\n\n");

   printf("\n\t Adjust voltage on VBB pin while monitoring screen.");
   printf("\n\t The bottom left side of the screen will display zero");
   printf("\n\t if VBB > threshold (about 2.1volts),");
   printf("\n\t or 40 if VBB < threshold.");
   printf("\n\t This test may be ended by hitting the space bar.");
   printf("\n\n\n");
   outp(MSR,0);                              /* select bank 0        */

   while(!kbhit())
   {
   _settextposition(24,0);
    printf("%x",inp(IRR) & 0x40);          /* display low batt bit  */
   }
   getch();

}

   intr()
  {
       int i;
       i = 0;

   outp(MSR,0x3E);             /* clear all pending interrupts      */
   outp(PFR,0x40);
   outp(TCR0,0);
   outp(TCR1,0);
   outp(IRR,0x1D);            /* select per. intr to intr pin       */
   outp(MSR, 0x40);           /* select register bank 1             */
   outp(OMR,0x8);             /* intr = push pull active lo         */
   outp(ICR0,0x10);           /* select 10ms periodic intr          */
   outp(ICR1,0x80);

    printf("\n\Now you are in the 10ms_Interrupt mode");
    printf("\nYou can use Oscilloscope to view the waveform");
    printf("\nHit spacebar to return to 'Selection Menu'");

   do {
    for (i=0; (i < 1300) && ((inp(MSR) & 0x05) != 5); i++)
     ;

     if (i == 1300)
    {
    printf("\nThere is something WRONG !!");
    printf("\n Please check the Voltage at the VBB pin");
    exit();
    }
 else

  for(i=0; i < 300; i++)               /* this loop is for          */
      ;                                /* viewing the waveform      */
  /* The value in the 'FOR' loop is dependent on the speed of       */
  /* the Processor. The value '200' in this example is for          */
  /* the PC/XT running at 4.7 MHz.                                  */

   outp(MSR,0x3E);                                 /* clear per intr   */

  } while (!kbhit());
  getch();
 }
```

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```
init ()                                    /* function initialization  */

{
/* This function selects 32 KHz Oscillator and attempts to start the *
 * clock. Check for 'OSC Running'. If not running, output message    *
 * 'Harware Problem, not running'. Return to DOS.                    */

unsigned long int dt;
int pfr=0x40,rtmr=0, irr;
time_t t1, t2;
dt = 0;                          /* delta time. difference between     */
                                 /* the start & stop time.             */
                                 /* start time.                        */

 outp(MSR,0);                    /* select page 0, register bank 0     */
 outp(PFR,0xC0);                 /* select test mode                   */
 outp(TESTR,0);                  /* clear test register                */
 outp(PFR,0x40);                 /* deselect test mode                 */
 outp(MSR,0x40);
 outp(ICR1,0x80);
 outp(RTMR,8);                   /* issue start clock command          */
 time(&t1);

while(((pfr == 0x40)||(rtmr == 0)) && dt <5 )

                                      /* if 1 stay in while loop       */
{
 outp(MSR,0x40);                             /* select bank 1          */
 outp(RTMR,0x08);                /* select 32KHz,start clock           */
 rtmr = inp(RTMR) & 8;           /* get start/stop bit                 */
 outp(MSR,0);                    /* select bank 0                      */
 pfr = (inp(PFR)&0x40);          /* get osc fail bit                   */
 irr = inp(IRR);
 time(&t2);
 dt = t2 - t1;
}
 if (dt == 5)
 {
 printf("\nThere is something wrong with the Harware !");
 exit(0);
 }
else
printf("\n\t The Oscillator is running. The Clock is started.");

}
```

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