Kommunikáció - UART

MICLAB-10

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Mérőhely: 7 bal

Jegyzőkönyv készítése

A jegyzőkönyvek az órán végzett munka dokumentálására szolgálnak. A letölthető minta jegyzőkönyvet kell kiegészíteni a megfelelő információkkal: név, dátum, mérőhely (pl. 3. jobb), a feladatokhoz tartozó esetleges kifejtendő válaszokkal, valamint a kódok lényeges részével.

A jegyzőkönyveket a CooSpace-en kell feltölteni, külön pdf formátumban csatolni kell a jegyzőkönyvet (a fájl neve a következő mintát kövesse: NagyJ.KissB.03.pdf), egy külön zip fájlban pedig a kódokat (*.c, *.cwg). Amennyiben probléma merül fel a beadás során, az anyagokat az oktató e-mail címére kell elküldeni, levél tárgya legyen pl. MicLab 03.

1. feladat – Karakter küldése és fogadása polling módban

Kösse össze a két mikrovezérlő kit UART RX és TX vonalait, valamint a GND-t (ügyeljen arra, hogy kimenetet csak bemenettel kössön össze). A baud rate legyen 115200 bit/s (a SYSCLK legyen 24,5 MHz, a Timer 1 Clock Source beállítása a Use SYSCLK legyen). A páros egyik tagja készítsen egy olyan programot, ami a BTN0 nyomógomb lenyomására elküld egy „L” karaktert UART-on polling módban. A páros másik tagja pedig folyamatosan fogadja az UART-on beérkező adatot és ha a „L” karakter érkezik be, akkor kapcsolja be az EFM8 kiten lévő LED0-át.

Küldés programja

A program részekre bontott forráskódja (Config, Main.c, Interrupts.c, ha van):

Config

```
<?xml version="1.0" encoding="ASCII"?>
<device:XMLDevice xmi:version="2.0" xmlns:xmi="http://www.omg.org/XMI"
xmlns:device="http://www.silabs.com/ss/hwconfig/document/device.ecore" name="EFM8BB10F8G-A-QSOP24"
partId="mcu.8051.efm8.bb1.efm8bb10f8g-a-qsop24" version="4.0.0" contextId="%DEFAULT%">
  <mode name="DefaultMode">
    <property object="CLOCK_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="CLOCK_0" propertyId="clock.clockselect.clocksourcedivider" value="SYSCLK / 1"/>
    <property object="CLOCK_0" propertyId="clock.clockselect.sysclk" value="24.500 MHz"/>
    <property object="CROSSBAR0" propertyId="xbar0.uart0.data" value="Enabled"/>
    <property object="DefaultMode" propertyId="mode.diagramLocation" value="100, 100"/>
    <property object="P0.4" propertyId="ports.settings.iomode" value="Digital Push-Pull Output"/>
    <property object="P0.4" propertyId="ports.settings.outputmode" value="Push-pull"/>
    <property object="PBCFG_0" propertyId="pbcfg.settings.enablecrossbar" value="Enabled"/>
    <property object="TIMER01_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER01_0" propertyId="timer01.timer1highbyte.timer1highbyte" value="150"/>
    <property object="TIMER01_0"
propertyId="timer01.timer1mode2:8bitcountertimerwithautoreload.targetoverflowfrequency"
value="230400"/>
    <property object="TIMER01_0"
propertyId="timer01.timer1mode2:8bitcountertimerwithautoreload.timerreloadvalue" value="150"/>
```

```
    <property object="TIMER16_2" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER16_3" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER_SETUP_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer01control.timer1runcontrol"
value="Start"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.clocksource" value="Use SYSCLK"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.mode" value="Mode 2, 8-bit
Counter/Timer with Auto-Reload"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.timerrunningstate" value="Timer is
Running"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.timerswitch1:runcontrol"
value="Start"/>
    <property object="UART_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="WDT_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="WDT_0" propertyId="wdt.watchdogcontrol.wdtenable" value="Disable"/>
  </mode>
  <modeTransition>
    <property object="RESET &#x2192; DefaultMode" propertyId="modeTransition.source" value="RESET"/>
    <property object="RESET &#x2192; DefaultMode" propertyId="modeTransition.target"
value="DefaultMode"/>
  </modeTransition>
</device:XMLDevice>
```

Main.c

```c
//-----------------------------------------------------------------------------
// Includes
//-----------------------------------------------------------------------------
#include <SI_EFM8BB1_Register_Enums.h>                  // SFR declarations
#include "InitDevice.h"
// $[Generated Includes]
// [Generated Includes]$

#define ONBOARD_BTN P0_B2

enum {
  PRESSED,
  RELEASED
};

static uint8_t button_state = RELEASED;

//-----------------------------------------------------------------------------
// SiLabs_Startup() Routine
// ----------------------------------------------------------------------------
// This function is called immediately after reset, before the initialization
// code is run in SILABS_STARTUP.A51 (which runs before main() ). This is a
// useful place to disable the watchdog timer, which is enable by default
// and may trigger before main() in some instances.
//-----------------------------------------------------------------------------
void SiLabs_Startup (void)
{
  // $[SiLabs Startup]
  // [SiLabs Startup]$
}

void write_to_uart(uint8_t data_to_send)
{
  SBUF0 = data_to_send;

  while (!SCON0_TI);
  SCON0_TI = 0;
}

//-----------------------------------------------------------------------------
// main() Routine
// ----------------------------------------------------------------------------
int main (void)
{
  // Call hardware initialization routine
```

```
  enter_DefaultMode_from_RESET();
  SCON0_TI = 1;

  while (1)
  {
    // $[Generated Run-time code]
    // [Generated Run-time code]$
    if (!ONBOARD_BTN && button_state == RELEASED) {
        write_to_uart('L');
        button_state = PRESSED;
    }

    if (ONBOARD_BTN && button_state == PRESSED) {
        button_state = RELEASED;
    }
  }
}
```

Fogadás programja

A program részekre bontott forráskódja (Config, Main.c, Interrupts.c, ha van):

Config

```
<?xml version="1.0" encoding="ASCII"?>
<device:XMLDevice xmi:version="2.0" xmlns:xmi="http://www.omg.org/XMI"
xmlns:device="http://www.silabs.com/ss/hwconfig/document/device.ecore" name="EFM8BB10F8G-A-QSOP24"
partId="mcu.8051.efm8.bb1.efm8bb10f8g-a-qsop24" version="4.0.0" contextId="%DEFAULT%">
  <mode name="DefaultMode">
    <property object="CLOCK_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="CLOCK_0" propertyId="clock.clockselect.clocksourcedivider" value="SYSCLK / 1"/>
    <property object="CLOCK_0" propertyId="clock.clockselect.sysclk" value="24.500 MHz"/>
    <property object="CROSSBAR0" propertyId="xbar0.uart0.data" value="Enabled"/>
    <property object="DefaultMode" propertyId="mode.diagramLocation" value="100, 100"/>
    <property object="P0.4" propertyId="ports.settings.iomode" value="Digital Push-Pull Output"/>
    <property object="P0.4" propertyId="ports.settings.outputmode" value="Push-pull"/>
    <property object="PBCFG_0" propertyId="pbcfg.settings.enablecrossbar" value="Enabled"/>
    <property object="TIMER01_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER01_0" propertyId="timer01.timer1highbyte.timer1highbyte" value="150"/>
    <property object="TIMER01_0"
propertyId="timer01.timer1mode2:8bitcountertimerwithautoreload.targetoverflowfrequency"
value="230400"/>
    <property object="TIMER01_0"
propertyId="timer01.timer1mode2:8bitcountertimerwithautoreload.timerreloadvalue" value="150"/>
    <property object="TIMER16_2" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER16_3" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER_SETUP_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer01control.timer1runcontrol"
value="Start"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.clocksource" value="Use SYSCLK"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.mode" value="Mode 2, 8-bit
Counter/Timer with Auto-Reload"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.timerrunningstate" value="Timer is
Running"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.timerswitch1:runcontrol"
value="Start"/>
    <property object="UART_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="UART_0" propertyId="uart.serialportcontrol.enablereceive" value="Enabled"/>
    <property object="WDT_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="WDT_0" propertyId="wdt.watchdogcontrol.wdtenable" value="Disable"/>
  </mode>
  <modeTransition>
    <property object="RESET &#x2192; DefaultMode" propertyId="modeTransition.source" value="RESET"/>
    <property object="RESET &#x2192; DefaultMode" propertyId="modeTransition.target"
value="DefaultMode"/>
  </modeTransition>
</device:XMLDevice>
```

Main.c

```
//-----------------------------------------------------------------------------
// Includes
//-----------------------------------------------------------------------------
#include <SI_EFM8BB1_Register_Enums.h>                  // SFR declarations
#include "InitDevice.h"
// $[Generated Includes]
// [Generated Includes]$

#define ONBOARD_LED P1_B4

//-----------------------------------------------------------------------------
// SiLabs_Startup() Routine
// ----------------------------------------------------------------------------
// This function is called immediately after reset, before the initialization
// code is run in SILABS_STARTUP.A51 (which runs before main() ). This is a
// useful place to disable the watchdog timer, which is enable by default
// and may trigger before main() in some instances.
//-----------------------------------------------------------------------------
void SiLabs_Startup (void)
{
  // $[SiLabs Startup]
  // [SiLabs Startup]$
}

uint8_t read_uart(void)
{
  while(!SCON0_RI);
  SCON0_RI = 0;

  return SBUF0;
}

//-----------------------------------------------------------------------------
// main() Routine
// ----------------------------------------------------------------------------
int main (void)
{
  // Call hardware initialization routine
  enter_DefaultMode_from_RESET();
  ONBOARD_LED = 1;

  while (1)
  {
    // $[Generated Run-time code]
    // [Generated Run-time code]$

    uint8_t input = read_uart();

    if (input == 'L') {
        ONBOARD_LED = 0;
    }
  }
}
```

Az elkészült programot be kell mutatni!

A gyakorlatvezető ellenőrizte:

- Igen
- Nem

A program működött:

- Igen
- Nem

2. feladat –4 jegyű szám küldése PC-re UART-on

A mikrovezérlővel az USB kábelen keresztül UART üzeneteket lehet küldeni a PC-nek (fogadni is lehet PC-től). Ehhez egy segédprogramot kell használni a PC-n, aminek a leírása a feladat végén található.

A SYSCLK legyen a maximális 24,5 MHz. A baud rate legyen közelítőleg 115200 bit/s.

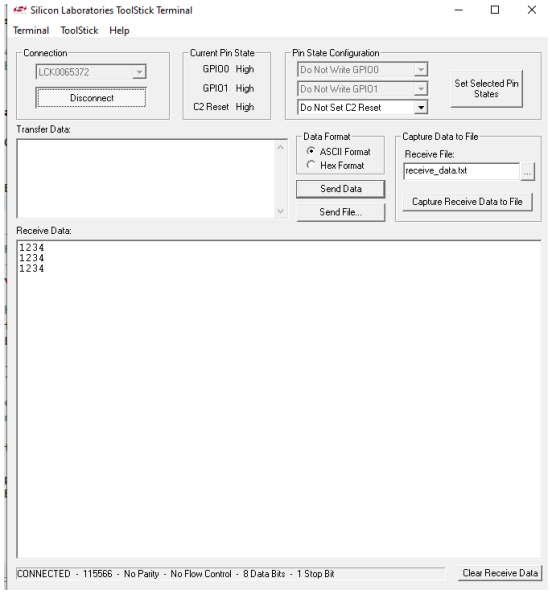
Az UART-ot polling módban használja a kódban, amihez írjon egy saját függvényt. Az „sprintf" függvény segítségével konvertálja át az 1234 négyjegyű számot stringbe. A kapott stringet és egy '\n' karaktert egy megfelelő méretű tömbben tároljon el.

Ezután a karakter tömb elemeit egyesével ki lehet küldeni az UART-on. Másodpercenként egyszeri ismétléssel küldje a négyjegyű számot.

Tipp: a sorvégi '\0' karaktert figyelje az tömb indexelésnél, azt már nem kell kiküldeni.

A bejövő adatokat a PC-n a ToolStick Terminal programmal lehet megjeleníteni. A programot nagyon egyszerű használni: csak a „Connect" gombra kell kattintanunk az előlapon. Fontos, hogy csak akkor tudunk kapcsolódni, ha nem debug módban fut a kódunk, azaz a feltöltés után állítsuk le a debugolást, ekkor újraindul a kódunk, de már nem debug módban. A mikrovezérlőtől fogadott üzenet a „Receive Data:" ablakban jelenik meg.

Készítsen képernyőképet a ToolStick Terminalról működés közben.



1. ábra: Saját képernyőkép a ToolStick Terminalról.

A program részekre bontott forráskódja (Config, Main.c, Interrupts.c, ha van):

Config

```
<?xml version="1.0" encoding="ASCII"?>
<device:XMLDevice xmi:version="2.0" xmlns:xmi="http://www.omg.org/XMI"
xmlns:device="http://www.silabs.com/ss/hwconfig/document/device.ecore" name="EFM8BB10F8G-A-QSOP24"
partId="mcu.8051.efm8.bb1.efm8bb10f8g-a-qsop24" version="4.0.0" contextId="%DEFAULT%">
  <mode name="DefaultMode">
    <property object="CLOCK_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="CLOCK_0" propertyId="clock.clockselect.clocksourcedivider" value="SYSCLK / 1"/>
    <property object="CLOCK_0" propertyId="clock.clockselect.sysclk" value="24.500 MHz"/>
    <property object="CROSSBAR0" propertyId="xbar0.uart0.data" value="Enabled"/>
    <property object="DefaultMode" propertyId="mode.diagramLocation" value="100, 100"/>
    <property object="P0.4" propertyId="ports.settings.iomode" value="Digital Push-Pull Output"/>
    <property object="P0.4" propertyId="ports.settings.outputmode" value="Push-pull"/>
```

```
    <property object="PBCFG_0" propertyId="pbcfg.settings.enablecrossbar" value="Enabled"/>
    <property object="TIMER01_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER01_0" propertyId="timer01.timer1highbyte.timer1highbyte" value="150"/>
    <property object="TIMER01_0"
propertyId="timer01.timer1mode2:8bitcountertimerwithautoreload.targetoverflowfrequency"
value="230400"/>
    <property object="TIMER01_0"
propertyId="timer01.timer1mode2:8bitcountertimerwithautoreload.timerreloadvalue" value="150"/>
    <property object="TIMER16_2" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER16_2" propertyId="timer16.control.runcontrol" value="Start"/>
    <property object="TIMER16_2" propertyId="timer16.control.timerrunningstate" value="Timer is
Running"/>
    <property object="TIMER16_2" propertyId="timer16.initandreloadvalue.targetoverflowfrequency"
value="100"/>
    <property object="TIMER16_2" propertyId="timer16.initandreloadvalue.timerreloadvalue"
value="45119"/>
    <property object="TIMER16_2" propertyId="timer16.reloadhighbyte.reloadhighbyte" value="176"/>
    <property object="TIMER16_2" propertyId="timer16.reloadlowbyte.reloadlowbyte" value="63"/>
    <property object="TIMER16_3" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER_SETUP_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer01control.timer1runcontrol"
value="Start"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.clocksource" value="Use SYSCLK"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.mode" value="Mode 2, 8-bit
Counter/Timer with Auto-Reload"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.timerrunningstate" value="Timer is
Running"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.timerswitch1:runcontrol"
value="Start"/>
    <property object="UART_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="WDT_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="WDT_0" propertyId="wdt.watchdogcontrol.wdtenable" value="Disable"/>
  </mode>
  <modeTransition>
    <property object="RESET &#x2192; DefaultMode" propertyId="modeTransition.source" value="RESET"/>
    <property object="RESET &#x2192; DefaultMode" propertyId="modeTransition.target"
value="DefaultMode"/>
  </modeTransition>
</device:XMLDevice>
```

Main.c

```c
//-----------------------------------------------------------------------------
// Includes
//-----------------------------------------------------------------------------
#include <SI_EFM8BB1_Register_Enums.h>                  // SFR declarations
#include "InitDevice.h"
#include <STDIO.H>
// $[Generated Includes]
// [Generated Includes]$

#define UART_BUFFER_SIZE 6u
#define NUM_COUNT 4u
#define BEST_NUMBERRING_SYSTEM_FOR_HUMANS 10u
#define LAST_NUMBER 9u
#define LAST_NUMBER_CHAR '9'

#define MAGIC_NUMBER 1234u

static char buffer[UART_BUFFER_SIZE];
static uint8_t counter = 0;

//-----------------------------------------------------------------------------
// SiLabs_Startup() Routine
// ----------------------------------------------------------------------------
// This function is called immediately after reset, before the initialization
// code is run in SILABS_STARTUP.A51 (which runs before main() ). This is a
// useful place to disable the watchdog timer, which is enable by default
// and may trigger before main() in some instances.
//-----------------------------------------------------------------------------
void SiLabs_Startup (void)
{
```

```
  // $[SiLabs Startup]
  // [SiLabs Startup]$
}

void write_to_uart(uint8_t data_to_send)
{
  SBUF0 = data_to_send;

  while (!SCON0_TI);
  SCON0_TI = 0;
}


void send_string_uart(const char *str)
{
    while (*str != '\0')
    {
        write_to_uart(*str);
        str++;
    }
}

//-----------------------------------------------------------------------------
// main() Routine
// ----------------------------------------------------------------------------
int main (void)
{
  // Call hardware initialization routine
  enter_DefaultMode_from_RESET();

  sprintf(buffer, "%d\n", MAGIC_NUMBER);

  while (1)
  {
    // $[Generated Run-time code]
    // [Generated Run-time code]$

    while(!TMR2CN0_TF2H);
    TMR2CN0_TF2H = 0;
    ++counter;

        if (counter >= 100)
        {
            send_string_uart(buffer);
            counter = 0;
        }
  }
}
```

Az elkészült programot be kell mutatni!

A gyakorlatvezető ellenőrizte:

- Igen
- Nem

A program működött:

- Igen
- Nem

Szorgalmi feladat – Karakter küldése és fogadása interrupt módban

Készítsen egy programot, ami UART-on elküld egy 'L' karaktert, ha a BTN0 nyomógomb le van nyomva, ha nincs lenyomva, akkor a 'o' karaktert küldje. A küldés mellett fogadja is a program az UART-on beérkező adatot és az 'L' karakter beérkezése esetén kapcsolja be a LED0 LED-et, a 'o' karakter

beérkezése esetén pedig kapcsolja le a LED-et. A küldés és a fogadás is interrupt módban történjen. A páros mindkét tagjánál ugyanaz a kód fusson.

A program részekre bontott forráskódja (Config, Main.c, Interrupts.c, ha van):

Config

```
<?xml version="1.0" encoding="ASCII"?>
<device:XMLDevice xmi:version="2.0" xmlns:xmi="http://www.omg.org/XMI"
xmlns:device="http://www.silabs.com/ss/hwconfig/document/device.ecore" name="EFM8BB10F8G-A-QSOP24"
partId="mcu.8051.efm8.bb1.efm8bb10f8g-a-qsop24" version="4.0.0" contextId="%DEFAULT%">
  <mode name="DefaultMode">
    <property object="CLOCK_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="CLOCK_0" propertyId="clock.clockselect.clocksourcedivider" value="SYSCLK / 1"/>
    <property object="CLOCK_0" propertyId="clock.clockselect.sysclk" value="24.500 MHz"/>
    <property object="CROSSBAR0" propertyId="xbar0.uart0.data" value="Enabled"/>
    <property object="DefaultMode" propertyId="mode.diagramLocation" value="100, 100"/>
    <property object="INTERRUPT_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="INTERRUPT_0" propertyId="interrupt.interruptenable.enableallinterrupts"
value="Enabled"/>
    <property object="INTERRUPT_0" propertyId="interrupt.interruptenable.enableuart0interrupt"
value="Enabled"/>
    <property object="P0.4" propertyId="ports.settings.iomode" value="Digital Push-Pull Output"/>
    <property object="P0.4" propertyId="ports.settings.outputmode" value="Push-pull"/>
    <property object="P1.4" propertyId="ports.settings.iomode" value="Digital Push-Pull Output"/>
    <property object="P1.4" propertyId="ports.settings.outputmode" value="Push-pull"/>
    <property object="PBCFG_0" propertyId="pbcfg.settings.enablecrossbar" value="Enabled"/>
    <property object="TIMER01_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER01_0" propertyId="timer01.timer1highbyte.timer1highbyte" value="150"/>
    <property object="TIMER01_0"
propertyId="timer01.timer1mode2:8bitcountertimerwithautoreload.targetoverflowfrequency"
value="230400"/>
    <property object="TIMER01_0"
propertyId="timer01.timer1mode2:8bitcountertimerwithautoreload.timerreloadvalue" value="150"/>
    <property object="TIMER16_2" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER16_3" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER_SETUP_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer01control.timer1runcontrol"
value="Start"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.clocksource" value="Use SYSCLK"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.mode" value="Mode 2, 8-bit
Counter/Timer with Auto-Reload"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.timerrunningstate" value="Timer is
Running"/>
    <property object="TIMER_SETUP_0" propertyId="timer_setup.timer1.timerswitch1:runcontrol"
value="Start"/>
    <property object="UART_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="UART_0" propertyId="uart.serialportcontrol.enablereceive" value="Enabled"/>
    <property object="WDT_0" propertyId="ABPeripheral.included" value="true"/>
    <property object="WDT_0" propertyId="wdt.watchdogcontrol.wdtenable" value="Disable"/>
  </mode>
  <modeTransition>
    <property object="RESET &#x2192; DefaultMode" propertyId="modeTransition.source" value="RESET"/>
    <property object="RESET &#x2192; DefaultMode" propertyId="modeTransition.target"
value="DefaultMode"/>
  </modeTransition>
</device:XMLDevice>
```

Main.c

```
//-----------------------------------------------------------------------------
// Includes
//-----------------------------------------------------------------------------
#include <SI_EFM8BB1_Register_Enums.h>                  // SFR declarations
#include "InitDevice.h"
```

```c
// $[Generated Includes]
// [Generated Includes]$

#define ONBOARD_LED P1_B4
#define ONBOARD_BTN P0_B2

enum {
  UNSENT,
  SENT
};

enum {
  UNREAD,
  READ
};

volatile uint8_t data_to_send = 0;
volatile uint8_t data_to_send_status = SENT;

volatile uint8_t data_to_read = 0;
volatile uint8_t data_to_read_status = READ;

//-----------------------------------------------------------------------------
// SiLabs_Startup() Routine
// ----------------------------------------------------------------------------
// This function is called immediately after reset, before the initialization
// code is run in SILABS_STARTUP.A51 (which runs before main() ). This is a
// useful place to disable the watchdog timer, which is enable by default
// and may trigger before main() in some instances.
//-----------------------------------------------------------------------------
void SiLabs_Startup (void)
{
  // $[SiLabs Startup]
  // [SiLabs Startup]$
}

//-----------------------------------------------------------------------------
// main() Routine
// ----------------------------------------------------------------------------
int main (void)
{
  // Call hardware initialization routine
  enter_DefaultMode_from_RESET();

  SCON0_TI = 1;

  while (1)
  {
    // $[Generated Run-time code]
    // [Generated Run-time code]$

    if (data_to_send_status == SENT)
    {
      data_to_send = ONBOARD_BTN ? 'o' : 'L';
      data_to_send_status = UNSENT;
    }

    if (data_to_read_status == UNREAD)
    {
      ONBOARD_LED = data_to_read == 'o';
      data_to_read_status = READ;
    }
  }
}
```

Interrupts.c

```c
// USER INCLUDES
#include <SI_EFM8BB1_Register_Enums.h>

enum {
  UNSENT,
```

```
  SENT
};

enum {
  UNREAD,
  READ
};

extern volatile uint8_t data_to_send;
extern volatile uint8_t data_to_send_status;

extern volatile uint8_t data_to_read;
extern volatile uint8_t data_to_read_status;

//-------------------------------------------------------------------------
// UART0_ISR
//-------------------------------------------------------------------------
//
// UART0 ISR Content goes here. Remember to clear flag bits:
// SCON0::RI (Receive Interrupt Flag)
// SCON0::TI (Transmit Interrupt Flag)
//
//-------------------------------------------------------------------------
SI_INTERRUPT (UART0_ISR, UART0_IRQn)
{
  if (SCON0_RI) {
      data_to_read = SBUF0;
      data_to_read_status = UNREAD;

      SCON0_RI = 0;
  }

  if (SCON0_TI) {
      SBUF0 = data_to_send;
      data_to_send_status = SENT;

      SCON0_TI = 0;
  }
}
```

Az elkészült programot be kell mutatni!

A gyakorlatvezető ellenőrizte:

- Igen
- Nem

A program működött:

- Igen
- Nem

Megjegyzések