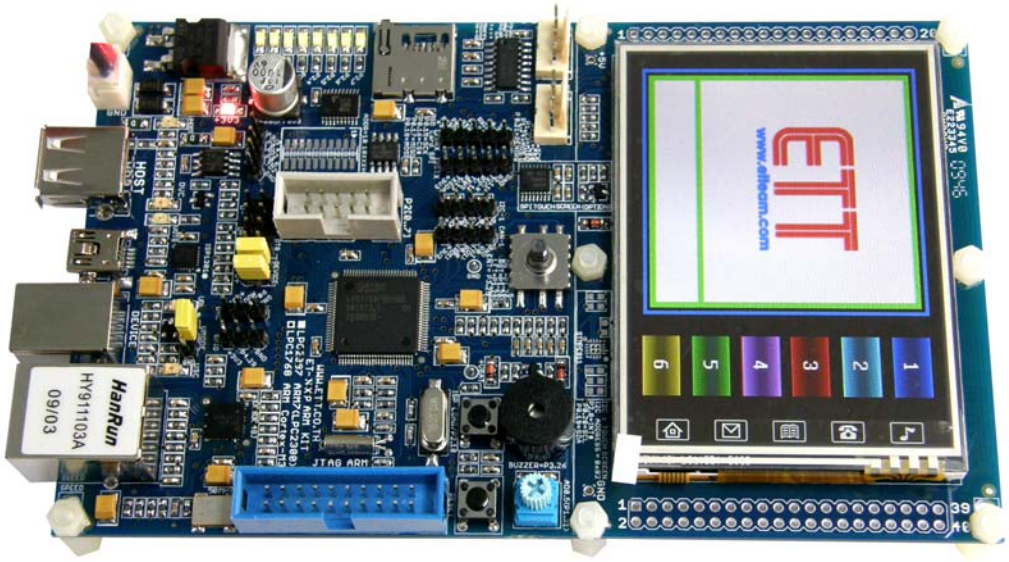
ET-NXP ARM KIT (LPC1768)



ET-NXP ARM KIT (LPC1768) is Board Microcontroller in the series of ARM Cortex M3 Core that uses 32-Bit 100Pin(LQFP) Microcontroller No.LPC1768 from NXP. Resources Systems internal LPC1768 are quite perfect and suitable for learning and testing the operations; if user learns and understands all resources internal MCU well, user is able to adapt and apply or develop many additional applications well. Due to the Hardware System of LPC1768 includes necessary devices in one MCU such ad USB, Ethernet, SD Card, ADC, DAC, Timer/Counter, PWM, Capture, I2C, SPI, UART, and etc.

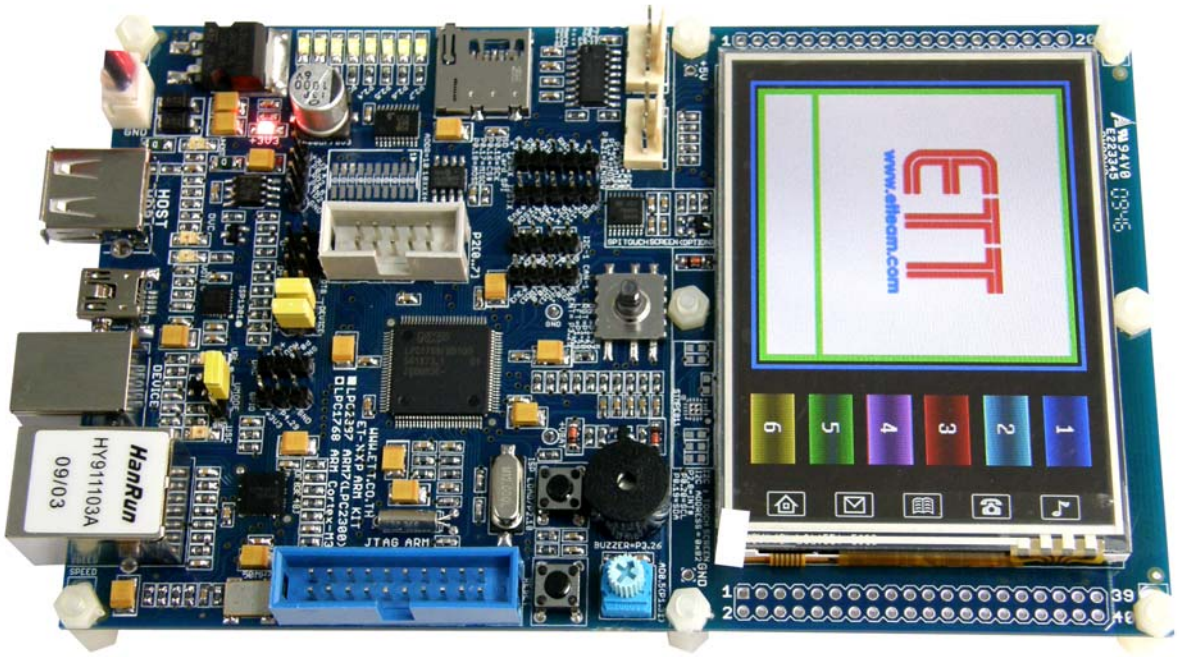
That is the reason why ETT studies and researches on details of LCP1768, we develop and design Board Microcontroller version "ET-NXP ARM KIT(LPC1768)" because we hope that our customers who are interested in this board will study, test and develop more applications as preferred under the reasonable price. Moreover, the main purpose of designing Board ET-NXP ARM KIT(LPC1768) is to support group of customers who actually want to study, test, adapt or apply application by self. This board's structure consists of necessary devices that are suitable for basic test and study; for example, LED to display Output Logic, Push Button Switch and Joy Switch to test Logic Input,

Volume to adjust voltage for testing A/D, Mini-Speaker or Buzzer to makes sound or Beep sound. Moreover, it provides high level devices to support more application such as USB Device/Host/OTG Port, SD Card, Ethernet LAN Port, Graphic LCD, RS232, and available free GPIO that can be designed to use them with other devices as desired.

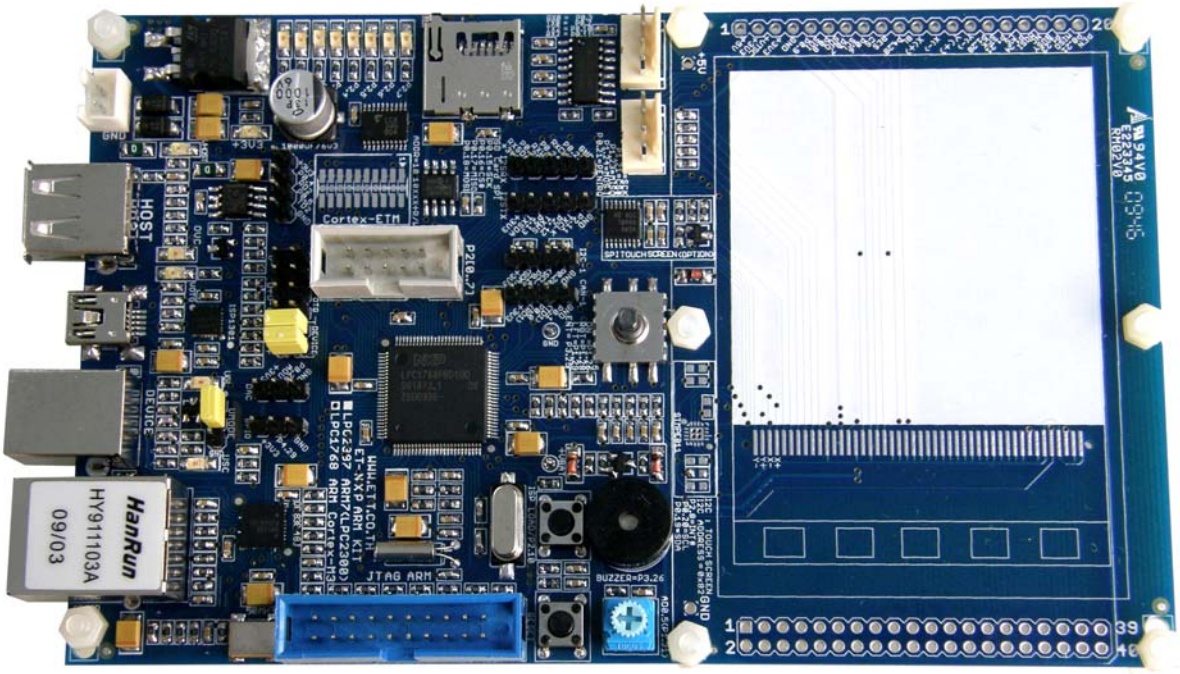
Features and Specifications of Board ET-NXP ARM KIT(LPC1768)

1. Use 32-Bit MCU that is the series of ARM Cortex M3 No.LPC1768 from NXP
2. Has 512KB Flash Memory, 64KB Static RAM internal MCU
3. Use Crystal 12.00MHz; so, MCU is able to process data with high speed at 100MHz when using with Phase-Locked-Loop(PLL) internal MCU itself
4. Has Circuit RTC(Real Time Clock) with XTAL 32.768KHz and Battery Backup
5. Support In-System Programming(ISP) and In-Application Programming(IAP) through On-Chip Boot-Loader Software via Port UART0(RS232)
6. Has circuit to connect with the standard 20Pin JTAG ARM for Real Time Debug
7. Use +5VDC Power Supply from 2 different sources; from external Power Supply that uses 2PIN Connector and from Connector USB Device with Circuit Regulate +3V3/3A.
8. Has Circuit USB Device 2.0 Full Speed internally (USB Function has 32 End Point)
9. Has Circuit USB Host with Circuit Over Current Protection
10. Has Circuit USB OTG by using ISP1301 to be OTG(On-The-Go) Transceiver
11. Has Circuit Ethernet LAN 10/100MB by using the standard Connector RJ45 1-Channel
12. Has Circuit SD Card(Micro-SD) 1-Channel for SPI Interface
13. Has Circuit RS232 Communication by using Connector 4-PIN 2-Channel ETT standard

14. Has circuit TFT LCD Color 320x240 Pixel (3.2 inch) with Touch Screen
15. Has 1 of Circuit Push Button Switch with Switch RESET
16. Has 1 of Circuit 5-directional Joy Switch
17. Has 8 of Circuit LED to display testing statuses of Output with Circuit Buffer
18. Has 1 of Circuit 0-3V3 Generator by using Adjustable Resistor to test A/D
19. Has 1 of circuit to generate and drive beep sound by using Mini Speaker or Buzzer
20. Has independent 22Bit GPIO for various modification such as D/A, I2C, I2S, CAN and Input/ Output
    a. Header 10Pin IDE(P2[0..7]) for GPIO or Full-Duplex Serial UART
    b. 3Pin Header(P0[26]) for GPIO or D/A
    c. 3Pin Header(P4[29]) for GPIO
    d. 4Pin Header(P0[19..20]) for GPIO or I2C Bus
    e. 4PIN Header(P0[0..1]) and P0[4..5] for GPIO or CAN1 and CAN2 Bus
    f. 5Pin Header(P0[23..25] and P2[11..13] for GPIO or I2S-RX and I2S-TX



Picture displays the structure of Board ET-NXP ARM KIT LPC1768 & TFT LCD.



Picture displays the structure of Board ET-NXP ARM KIT (LPC1768).

Structure of Board ET-NXP ARM KIT (LPC1768)

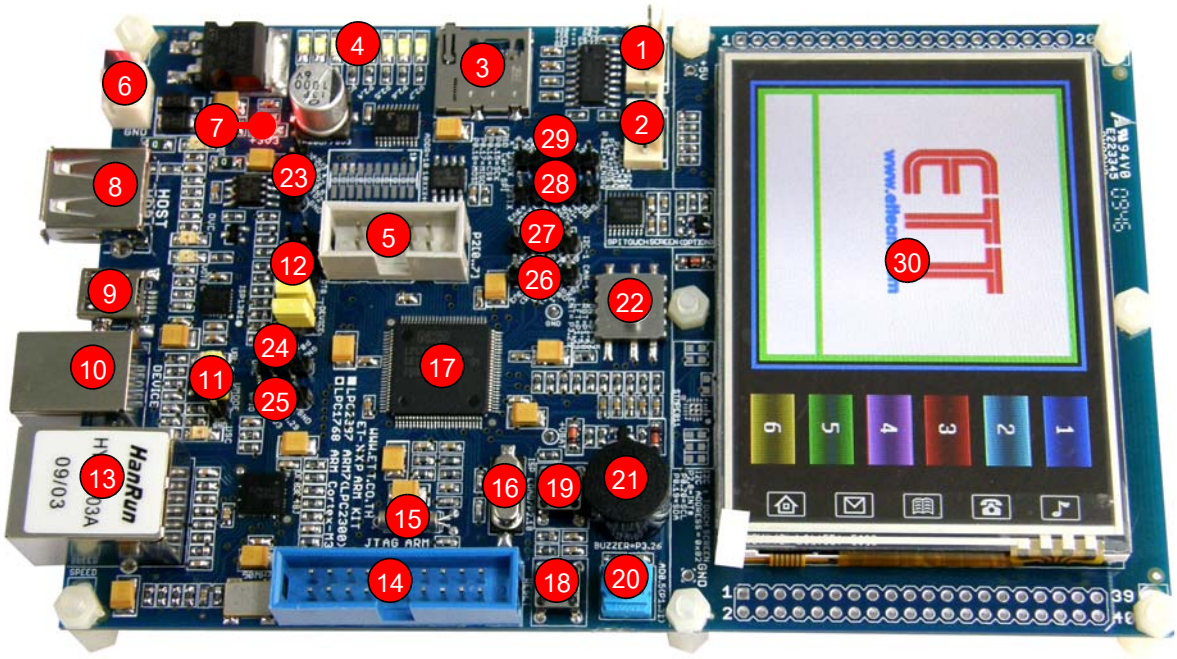


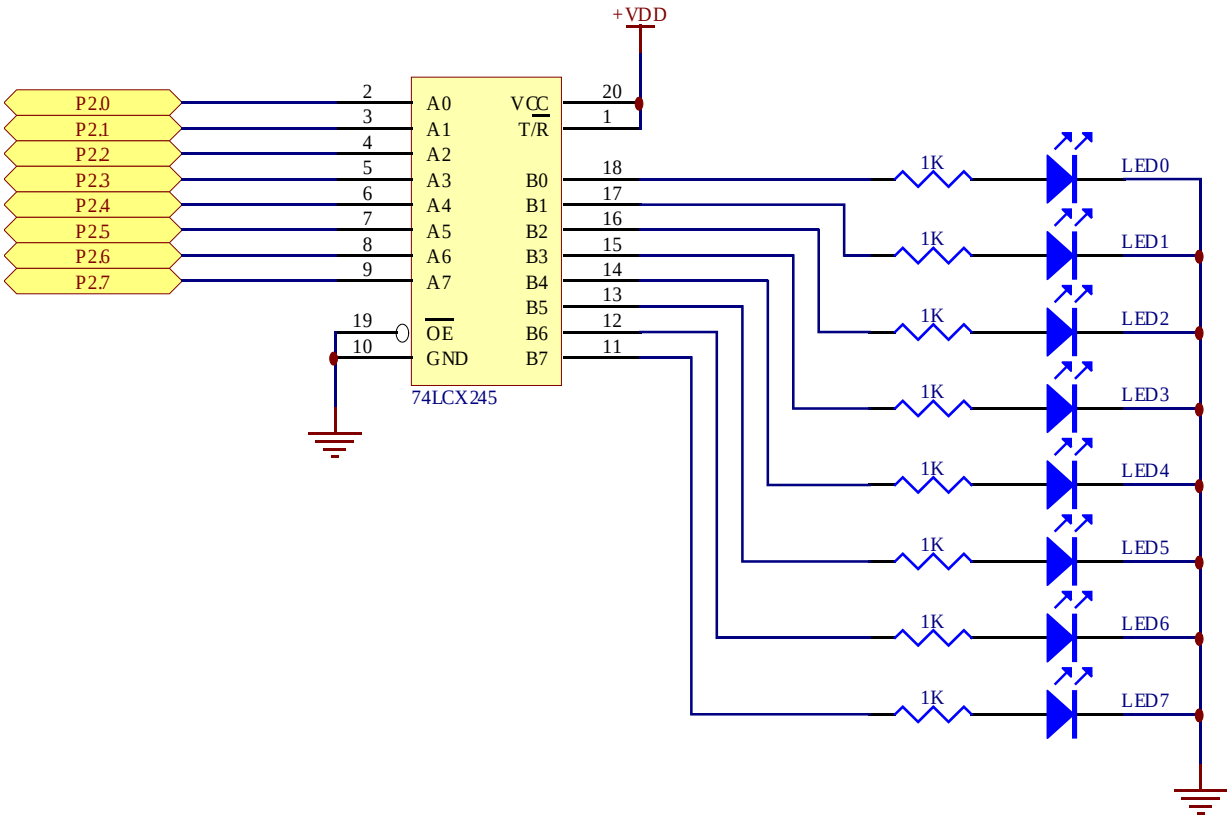
Figure displays device's position on Board ET-NXP ARM KIT(LPC1768).

- **No.1**: It is Connector UART0(RS232) for usage and Download Hex File into CPU.
- **No.2**: It is Connector UART2(RS232) for usage.
- **No.3**: It is Socket to insert memory card, it is compatible with Micro SD Card.
- **No.4**: It is LED[0..7] to test Logic Output of P2[0..7].
- **No.5**: It is Connector GPIO(P2[0..7]).
- **No.6**: It is Connector Power Supply of board that uses +5VDC.
- **No.7**: It is LED to display status of Power +VDD(+3V3).
- **No.8**: It is connector USB Host.
- **No.9**: It is Connector USB OTG.
- **No.10**: It is Connector USB Device.

- **No.11**: It is Jumper(UMODE) to choose operation mode of USB Device connection.
- **No.12**: It is Jumper(USB) to choose USB Modes between Device/OTG/Host.
- **No.13**: Connector Ethernet LAN RJ45.
- **No.14:** It is Connector JTAG ARM for Real Time Debug.
- **No.15**: It is Crystal 32.768KHz to be Time Base for RTC internal MCU.
- **No.16**: It is Crystal 12MHz to be Time Base of MCU.
- **No.17**: It is MCU No.LPC1768 (100Pin LQFP).
- **No.18**: It is SW RESET.
- **No.19**: It is SW ISP LOAD or P2.10/EINT0.
- **No.20**: It is VR to adjust 0-3V3 Voltage to test A/D(P1[31]/AD0[5]).
- **No.21**: It is Buzzer to generate sound.
- **No.22:** It is 5 directional Joy Switch.
- **No.23**: It is Connector CAN2 or GPIO P0[4..5].
- **No.24**: It is Connector D/A or GPIO P0.26.
- **No.25**: It is Connector GPIO P4.29.
- **No.26**: It is Connector CAN1 or GPIO P0[0..1].
- **No.27**: It is Connector I2C1-Bus or GPIO P0[19..20].
- **No.28**: It is Connector I2STX or GPIO P2[11..13].
- **No.29**: It is Connector I2SRX or GPIO P0[23..25].
- **No.30**: It is 320x320 Dot TFT LCD with Touch Screen Sensor.

How to drive Circuit LED Display

LED Display of board is connected as Source Current and is compatible with +3.3V Power Supply; in this case, it runs by Logic "1"(+3V3) and stops running by Logic "0"(0V). The operation is controlled by 8 GPIO that are P2[0..7]. This circuit is used to test operation of Output.



If user wants to use this operation, it needs to set function of P2[0..7] to be GPIO Output Port first and then controls the preferred Logic for P2[0..7] as the example below;

```
// Config Pin GPIO = P2[0..7] Drive LED
```

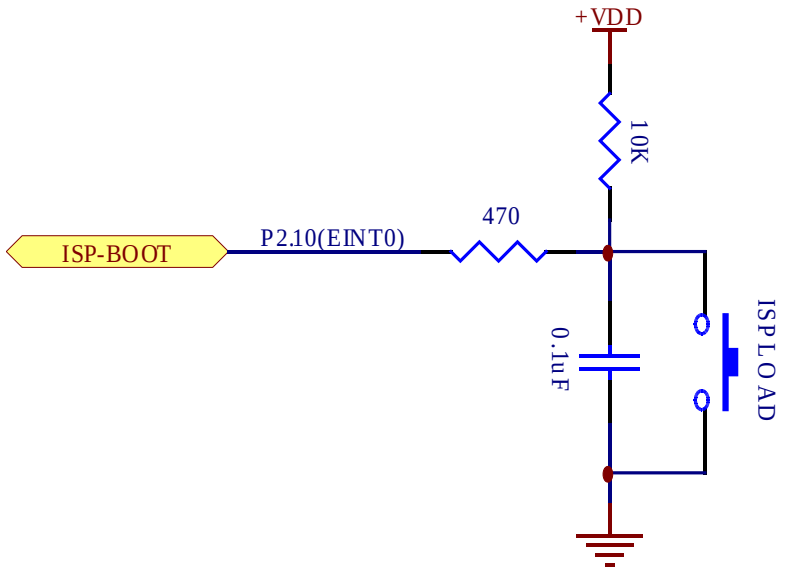
```
LPC_PINCON->PINSEL4 &= ~(0xFFFF); // Reset P2[0..7] =
GPIO
LPC_GPIO2->FIODIR   |=   0xFF;         // P2[0..7] =
Outputs
LPC_GPIO2->FIOCLR   =   0xFF;          // Turn-OFF all
LED
.
.
LPC_GPIO2->FIOSET   = (1<<0);          // ON  LED[0]
LPC_GPIO2->FIOCLR   = (1<<0);          // OFF LED[0]
LPC_GPIO2->FIOPIN   ^= (1<<0);         // Toggle LED[0]
```

Example of setting value of P2[0..7] to be Output LED

How to use Circuit Push Button Switch

This circuit uses Circuit Push Button Switch with Circuit Pull-Up that is compatible with +3.3V Power Supply. If this Switch is not pressed, it makes Logic status "1" but if the Switch is pressed, it makes Logic status "0"; in this case, it is used to test the operation of Input Logic and it uses P2.10 to connect. There are 3 functions as follows;

- ISP Download through RS232(UART0) by using with Switch RESET
- Test Input of P2[10]
- Test Interrupt of EINT0




```
LPC_PINCON->PINSEL4 &= ~(0x03<<20);     // Reset P2.10 =
GPIO
LPC_GPIO2->FIODIR   &= ~(1UL<<10);      // P2.10 = Input
.
.
if ((LPC_GPIO2->FIOPIN >> 10) & 0x01)   //SW = Release
{
  ...
}
else                                    // SW = Press
{
  ...
}
```

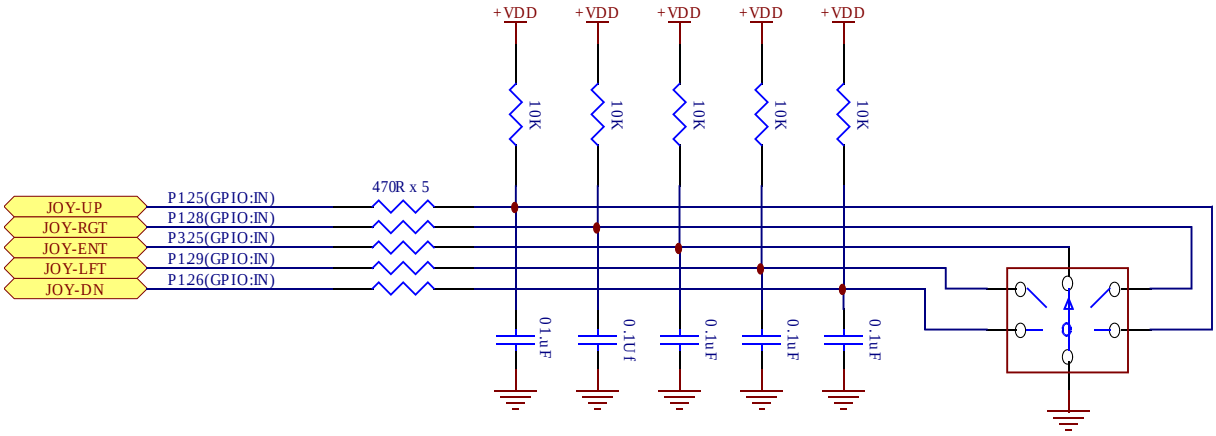
Example of setting values of P2.10 to be Input Switch

How to use Circuit Joy Switch

This circuit uses 5 directional Joy Switch and its structure is Push Button with Circuit Pull-Up that is compatible with +3.3V Power Supply. If this Switch is not pressed, it makes Logic status "1" but if the Switch is pressed, it makes Logic status "0"; in this case, it is used to test the operation of Input Logic. Moreover, it can be modified for other application by connecting signal through GPIO Input as follows;

- Up Position uses P1.25 to be GPIO Input.

- Down Position uses P1.26 to be GPIO Input.
- Right Position uses P1.28 to be GPIO Input.
- Left Position uses P1.29 to be GPIO Input.
- Center Position uses P3.25 to be GPIO Input.



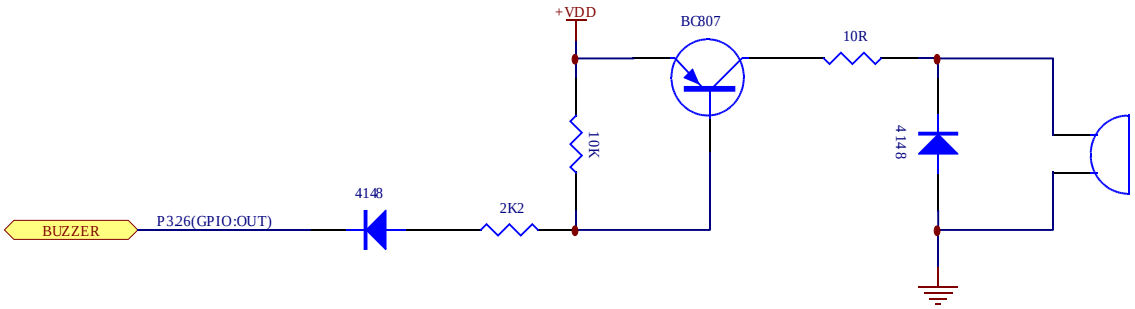

```
//Joy Switch
//P1.25,P1.26,P1.28,P1.29,P3.25 = Joy Switch
LPC_PINCON->PINSEL3 &= ~(0x03<<18);              //P1.25 = GPIO
LPC_PINCON->PINSEL3 &= ~(0x03<<20);              //P1.26 = GPIO
LPC_PINCON->PINSEL3 &= ~(0x03<<24);              //P1.28 = GPIO
LPC_PINCON->PINSEL3 &= ~(0x03<<26);              //P1.29 = GPIO
LPC_GPIO1->FIODIR   &= ~((1UL<<25)|(1UL<<26)|
                         (1UL<<28)|(1UL<<29));
    //P1.25,26,28,29=In

LPC_PINCON->PINSEL7 &= ~(0x03<<18);              //P3.25 = GPIO
LPC_GPIO3->FIODIR   &= ~(1UL<<25);               //P3[25]= Input
.
.
//Joy Up = P1.25
if ((LPC_GPIO1->FIOPIN >> 25) & 0x01)            // SW = Release
{
  ...
}
else                                             // SW = Press
{
  ...
}

//Joy Down = P1.26
if ((LPC_GPIO1->FIOPIN >> 26) & 0x01)            // SW = Release
{
```

```
  ...
}
else                                                  // SW = Press
{
  ...
}

//Joy Right = P1.28
if ((LPC_GPIO1->FIOPIN >> 28) & 0x01)               // SW = Release
.
.
.
.
.
//Joy Center = P3.25
if ((LPC_GPIO3->FIOPIN >> 25) & 0x01)               // SW = Release
{
  ...
}
else                                                  // SW = Press
{
  ...
}
```

Example of setting values for Input Joy Switch

How to use Circuit Sound Generator

Circuit Sound Generator uses Mini Speaker with Circuit NPN Transistor to drive current to the speaker. It is compatible with +3.3V Power Supply; in this case, it runs by Logic "1" and stops running by Logic "0". It sends Signal Logic that is various frequencies to the speaker to generate various ranges of sound frequencies as preferred; in this case, it is controlled by P3[26].



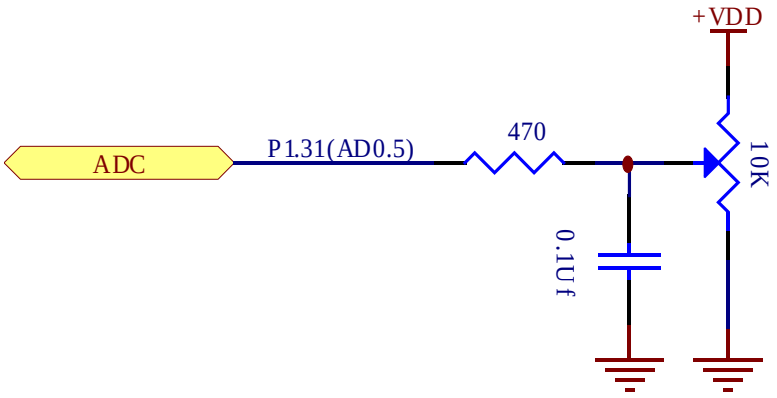
If user wants to use this operation, it needs to set function of P3[28] to be GPIO Output Port first and then controls the Logic for P3[28] ON/OFF to be the preferred frequency as shown in the example below.

```
//Config Pin GPIO = P3[26] Drive Mini Speaker Generate Beep
LPC_PINCON->PINSEL7 &= ~(3 << 20);         // Reset P3.26 =
GPIO
LPC_GPIO3->FIODIR   |=  (1UL<<26);         // P3[26] = Output

// Loop Generate Beep on Speaker(P3.26)
while(1)                                   // Loop Continue
{
  for (i = 0; i < 500; i++)                      // Start Beep
Pulse
  {
    LPC_GPIO3->FIOPIN ^= (1 << 26);        // Toggle P3[26]
    delay(5000);
  }

  delay(10000000);                         // Stop Beep Pulse
}
```

Example of setting values of P3.26 to be Output to drive the Buzzer

How to use Circuit Adjustable Voltage (0-3V3)

Circuit Adjustable Voltage uses VR that is compatible with +3.3V Power Supply. It uses Output Voltage in the range of 0V to +3.3V according to the adjustment of Resistor. This Output value will be inputted to Pin P1[31] to generate Input Voltage for testing the operation of Circuit A/D(P1[31]).



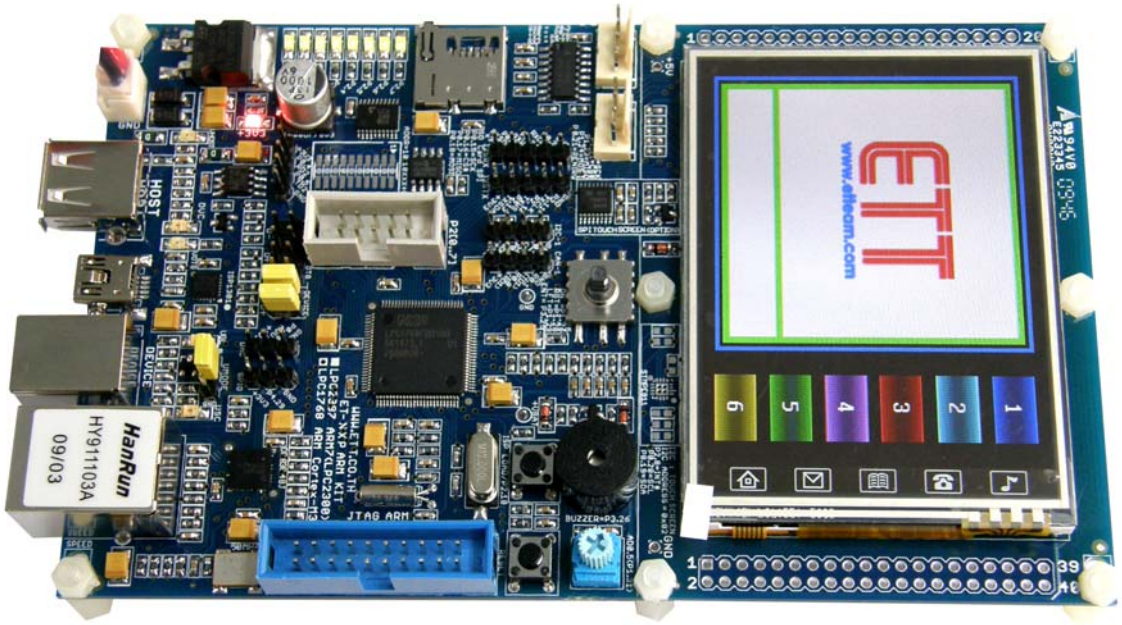

```
LPC_PINCON->PINSEL3  &= ~(3UL<<30);        // Reset P1.31 =
GPIO
LPC_PINCON->PINSEL3  |=  (3UL<<30);        // Config P1.31 =
AD0.5
LPC_SC->PCONP        |=  (1UL<<12);        // Enable power to
ADC
LPC_ADC->ADCR        =   (1UL<< 5) |       // select AD0.5 pin
                          (1UL<< 8) |            // ADC clock
is 18MHz/2
                          (1UL<<21);             // enable ADC

unsigned int val;
.
.
while(1)
{
  LPC_ADC->ADCR |=  (1<<24);                 // start conversion
  while (!(LPC_ADC->ADGDR & (1UL<<31)));     // Wait Conversion
end
  val = ((LPC_ADC->ADGDR >> 4) & 0xFFF);     // read converted
value
  LPC_ADC->ADCR &= ~(7<<24);                 // stop conversion
  .
  .
  .
}
```

Example of setting values for P1.31 to be Analog Input AD0.5

How to use Graphic TFT LCD

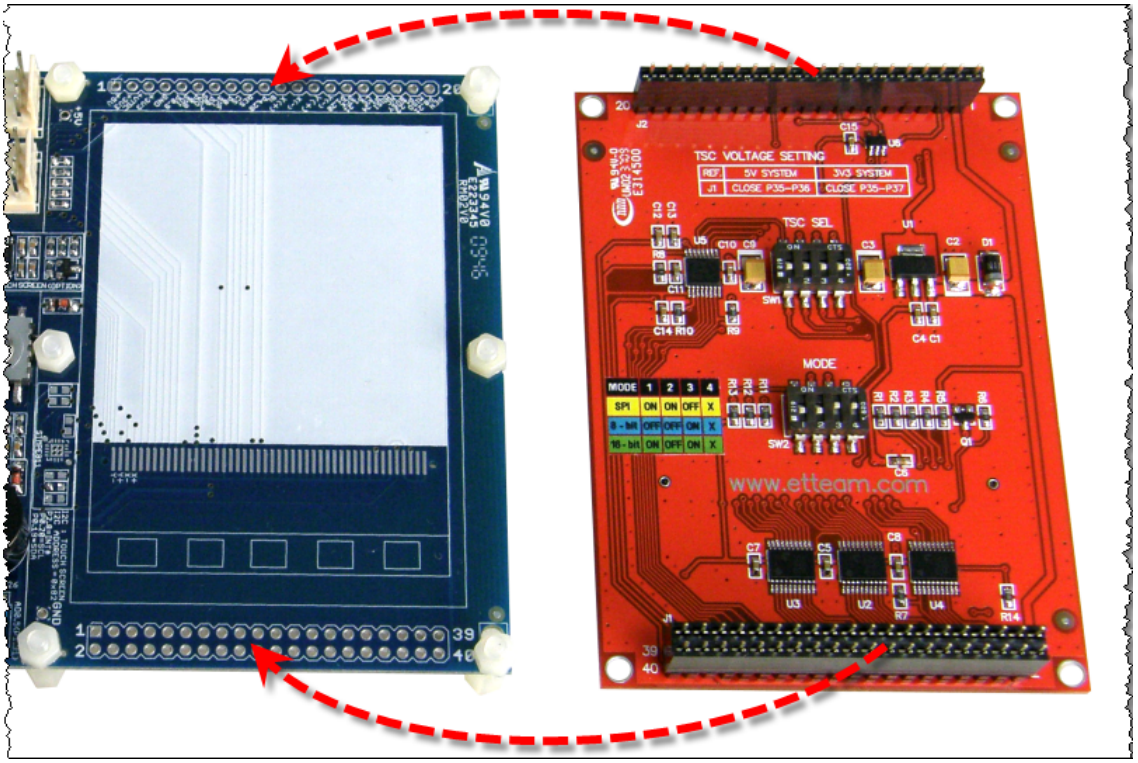
There are 2 types to connect circuit of Board ET-NXP ARM KIT(LPC1768) with 3.2" Graphic TFT LCD as described below;

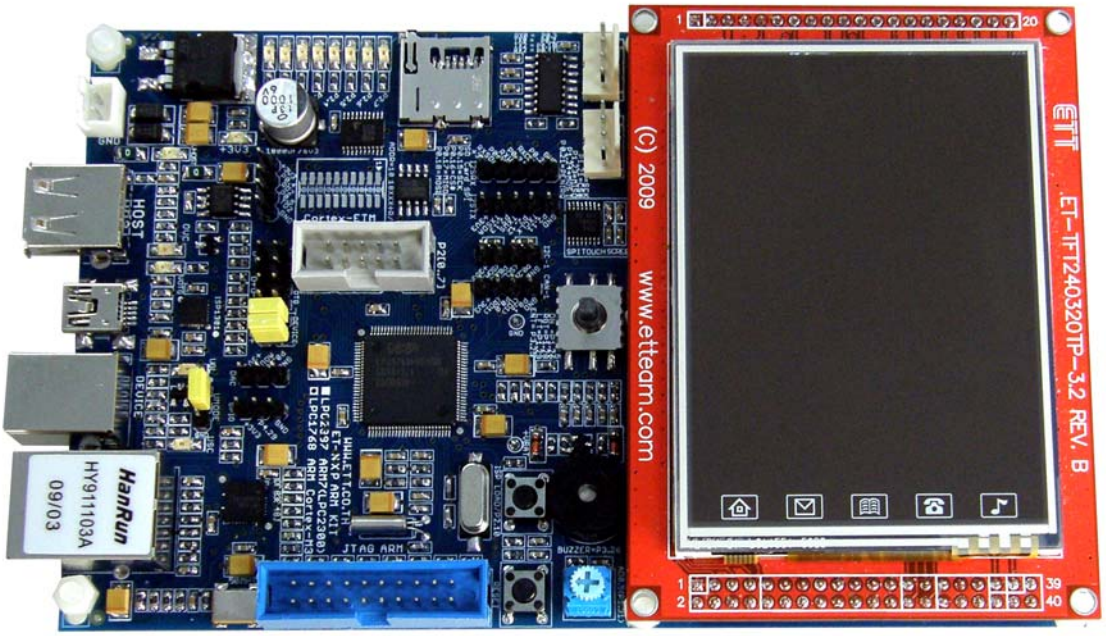
- It permanently installs Module LCD on Board by using TFT LCD "KWH032GM02-F05" and it connects signal with TFT LCD in SPI mode; moreover, this TFT LCD version has included Sensor of Touch Screen completely. The device of Board ET-NXP ARM KIT(LPC1768) that is used to read Sensor of Touch Screen is designed to choose Chip numbers as preferred; in this case, it uses Chip No.STMPE811 for I2C Interface or it uses Chip ADS7846 for SPI Interface (it depends on chip type that is installed in board in the process of making board).



- It installs Board Display "ET-TFT240320TP-3.2 REV.B" from ETT that has already been installed TFT LCD "KWH032GM02-F05" with Chip ADS7846 to read Touch Sensor internal board completely. It is installed through Connector; moreover, it is able to add or remove the device from board easily. In

this case, it needs to set the format of Interface with board to be SPI.





How to connect TFT LCD "KWH032GM02-F05"

TFT LCD "KWH032GM02-F05" is interfaced as SPI Mode by using SSP1 of MCU to communicate; in this case, it connects signals as follows;

- CS GLCD uses P0.6 to be GPIO Output.
- SCL GLCD uses P0.7 to be SCK1 of SSP1.
- SDO GLCD uses P0.8 to be MISO1 of SSP1.
- SDI GLCD uses P0.9 to be MOSI1 of SSP1.
- BL GLCD uses P4.28 to be GPIO Output.

How to connect Touch Screen Sensor by ADS7846

If Touch Screen uses Chip ADS7846, it is SPI Interface and it uses SSP0 of MCU to communicate. It connects signals as follows;

- DCLK ADS7846 uses P1.20 to be SCK0 of SSP0.
- CS ADS7846 uses P1.21 to be GPIO Output.
- DOUT ADS7846 uses P1.23 to be MISO0 of SSP0.
- DIN ADS7846 uses P1.24 to be MOSI0 of SSP0.
- PENIRQ ADS7846 uses P0.21 to be GPIO Input.

How to connect Touch Screen Sensor by STMPE811

If Touch Screen uses Chip STMPE811, it is I2C Interface that has Address position of Device for I2C Interface as 0x82. It uses I2C1 of MCU to communicate and it connects signals as follows;

- SDAT STMPE811 uses P0.19 to be SDA1 of I2C1.
- SCLK STMPE811 uses P0.20 to be SCL1 of I2C1.
- INT STMPE811 uses P2.8 to be GPIO Input.

```
/* Config P1[20..24] to SSP0 For Read Touch LCD(ADS7846) */
LPC_PINCON->PINSEL3 &= ~(3UL<<10);    // Reset P1.21 Mode =
GPIO
```

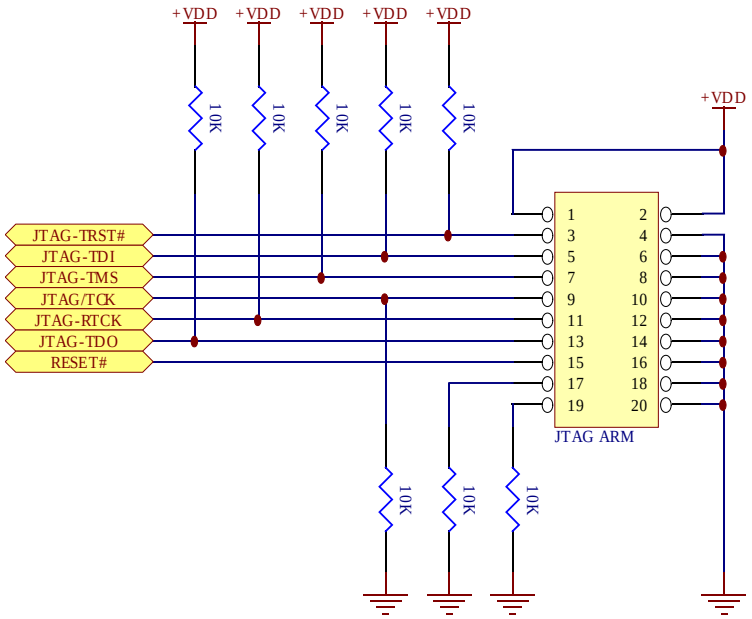
```
LPC_GPIO1->FIODIR   |=  (1UL<<21);    // P1.21 = ADS7846
CS(Output)
LPC_GPIO1->FIOPIN   |=  (1UL<<21);         // P1.21 = High

LPC_PINCON->PINSEL1 &= ~(3UL<<10);    // Reset P0.21 Mode =
GPIO
LPC_GPIO0->FIODIR   &= ~(1UL<<21);    // P0.21 = PENIRQ(Input)

//Config SSP0 Pin Connect
LPC_PINCON->PINSEL3 |=  (3UL<<8);     // Select P1.20 =
SCK0(SSP0)
LPC_PINCON->PINSEL3 |=  (3UL<<14);         // Select P1.23 =
MISO0(SSP0)
LPC_PINCON->PINSEL3 |=  (3UL<<16);         // Select P1.24 =
MOSI0(SSP0)

LPC_SC->PCONP       |=  (1<<21);      // Enable power to SSPI0
block
LPC_SC->PCLKSEL1    &= ~(3<<10);           // PCLKSP0 = CCLK/4
(18MHz)
LPC_SC->PCLKSEL1    |=  (1<<10);           // PCLKSP0 = CCLK
(72MHz)
LPC_SSP0->CPSR       =   72;               // 72MHz / 72 =
1MHz(max 2MHz)

LPC_SSP0->CR0        =  (   0 << 7) |      // CPHA = 0
                        (   0 << 6) |      // CPOL = 0
                        (   0 << 4) |      // Frame format =
SPI
                        ((8-1)<< 0);  // Data size = 8 bits
LPC_SSP0->CR1        =  (   1 << 1);       // Enable SSP0

/* Config P0.6,P0.7,P0.8,P0.9 to SSP1 For Control GLCD */
LPC_PINCON->PINSEL9 &= ~(3 << 24);    // Reset P4.28 Mode =
GPIO
LPC_GPIO4->FIODIR   |=  (1UL<<28);         // Pin P4.28 =
Output(BL)
LPC_GPIO4->FIOPIN   &= ~(1UL<<28);         // Turn-OFF GLCD
Backlight

LPC_PINCON->PINSEL0 &= ~(3UL<<12);    // Reset P0.6 Mode = GPIO
LPC_GPIO0->FIODIR   |=  (1 <<  6);         // P0.6 = GPIO
output(CS GLCD)
LPC_GPIO0->FIOSET    =  (1 <<  6);         // Set P0.6 = High

LPC_PINCON->PINSEL0 &= ~(3UL<<14);    // Reset P0.7 Mode = GPIO
LPC_PINCON->PINSEL0 |=  (2UL<<14);    // Select P0.7 =
SCK1(SSP1)
LPC_PINCON->PINSEL0 &= ~(3UL<<16);    // Reset P0.8 Mode = GPIO
LPC_PINCON->PINSEL0 |=  (2UL<<16);    // Select P0.8 =
MISO1(SSP1)
```

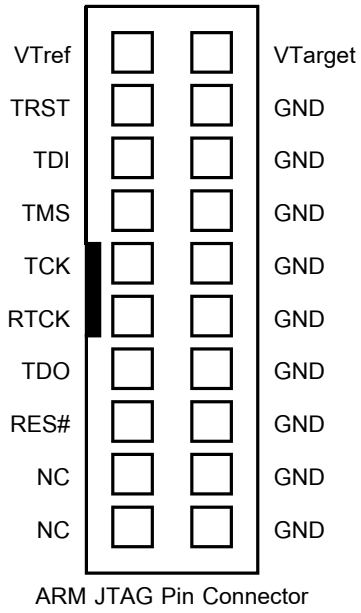
```
LPC_PINCON->PINSEL0 &= ~(3UL<<18);    // Reset P0.9 Mode = GPIO
LPC_PINCON->PINSEL0 |=  (2UL<<18);    // Select P0.9 =
MOSI1(SSP1)

LPC_SC->PCONP       |=  (1 << 10);         // Enable power to
SSP1 block
LPC_SC->PCLKSEL0    |=  (2 << 20);         // SSP1 clock =
CCLK/2 (36MHz)
LPC_SSP1->CPSR       =  2;                 // Clock Rate =
18MHz

LPC_SSP1->CR0        =  (1<<7) |       // CPHA = 1
                        (1<<6) |       // CPOL = 1
                        (0<<4) |       // Frame format = SPI
                        ((8-1)<< 0);   // Data size = 8 bits
LPC_SSP1->CR1        =  (1<<1);        // Enable SSP1
```

Example of setting Pin for GLCD and Touch Screen

How to use JTAG ARM

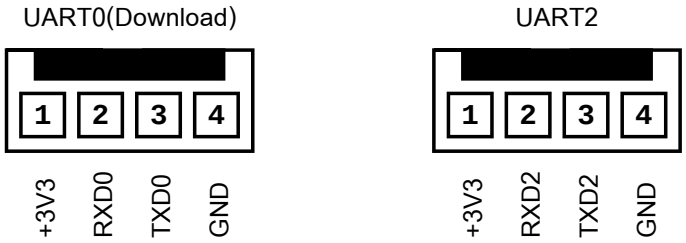
JTAG or JTAG ARM is Connector IDE 20PIN to interface with JTAG Debugger. It arranges circuit and signals according to the standard of JTAG as follows;





Port RS232

It is Signal RS232 that has already been converted by Circuit MAX3232; in this case, there are 2 channels; UART0 and UART2. Both channels are able to connect with Signal RS232 to send/receive data. Moreover, UART0 can be used as ISP Download to download Hex File into MCU as well; in this case, it needs to use with SW ISP LOAD and SW RESET to reset CPU to start running in Boot-Loader Mode to download Hex File into CPU (read more details from "Download Hex File to MCU of Board")



- UART-0 uses Pin from P0.2(TXD0) and P0.3(RXD0).
- UART-2 uses Pin from P0.10(TXD2) and P0.11(RXD2).

Due to the Hardware UART System of LPC1768/LPC2387 can set many connecting points of pin to connect; for example, UART2 can choose either Pin P0[10] and P0[11] or P2[8] and P2[9] as required. Board ET-NXP ARM KIT chooses Pin P0[10] and P0[11] to be the connecting point with UART2; so, user needs to set the command to choose pin correctly. Be careful about using UART, the Default value of UART2 is disabled; so, user needs to enable the operation of Circuit UART2 before using the command Initial for UART. Otherwise, user is unable to command any UART. The example Code of setting the UART value in the initial part is shown below;

```
// Config UART0 Connect to P0[2]:P0[3]
LPC_PINCON->PINSEL0 &= ~(0x03<<4);              // Reset P0.2 = GPIO
LPC_PINCON->PINSEL0 |=  (0x01<<4);              // Config P0.2 = TxD0
LPC_PINCON->PINSEL0 &= ~(0x03<<6);              // Reset P0.3 = GPIO
LPC_PINCON->PINSEL0 |=  (0x01<<6);              // Config P0.3 = RxD0

// Config UART2 Connect to P0[10]:P0[11]
LPC_PINCON->PINSEL0 &= ~(0x03<<20);             // Reset P0.10 = GPIO
LPC_PINCON->PINSEL0 |=  (0x01<<20);             // Config P0.10 = TxD2
LPC_PINCON->PINSEL0 &= ~(0x03<<22);             // Reset P0.11 = GPIO
LPC_PINCON->PINSEL0 |=  (0x01<<22);             // Config P0.11 = RxD2
PCONP              |= 0x01000000;               // UART2 Power-ON
```

Example of setting Pin for UART0 and UART2

Figure below displays the Cable that is connected RS232 between Com Port of computer PC and Connector UART0 and UART2 of Board ET-NXP ARM KIT.

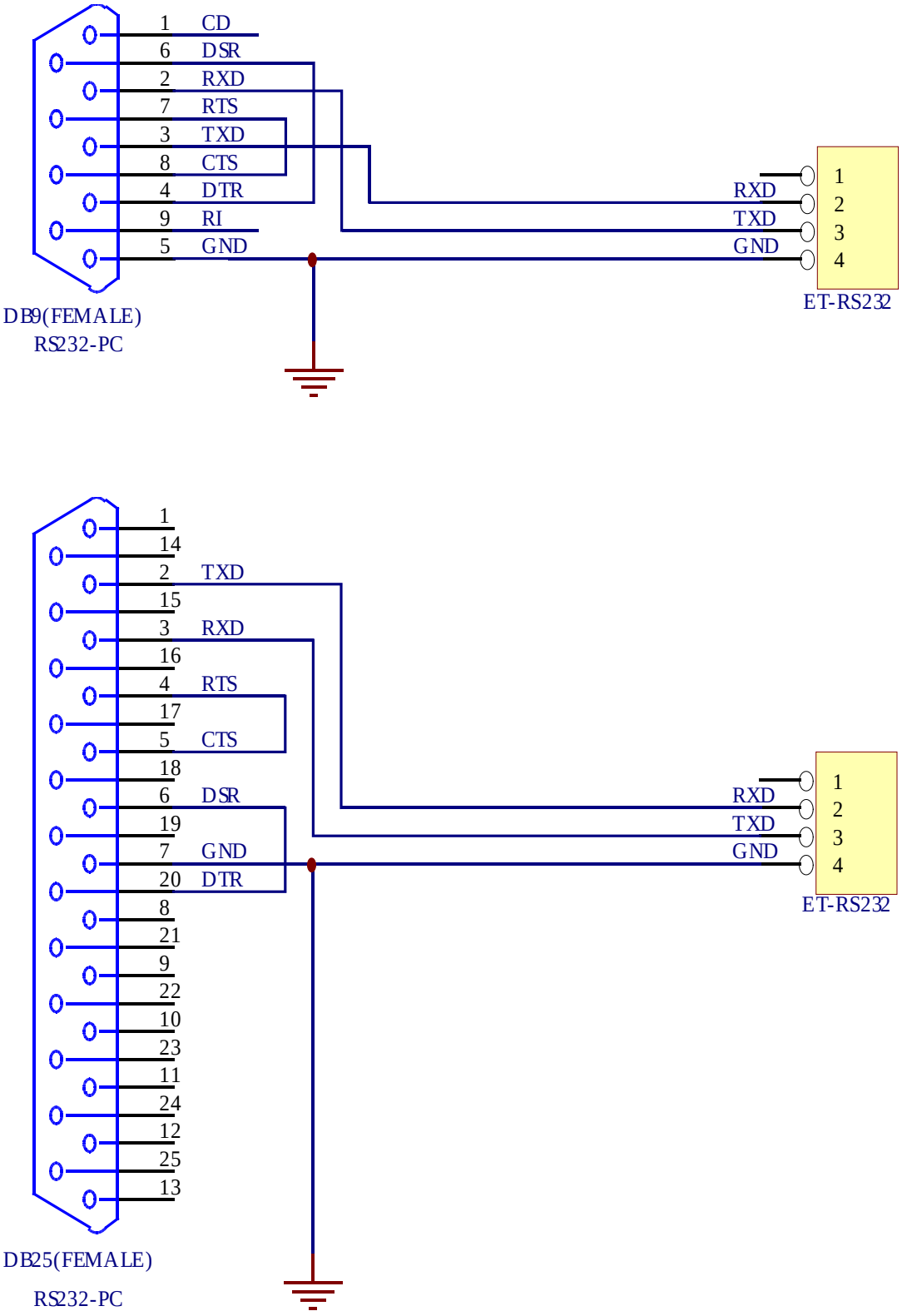


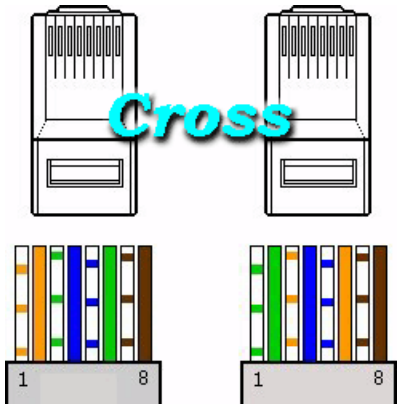
Figure displays Circuit of cable for RS232.

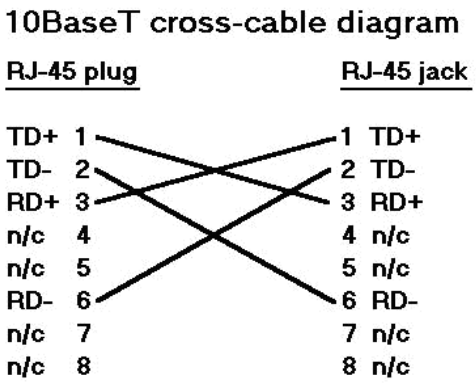
Ethernet LAN

It uses the standard Connector Ethernet RJ45 to connect the Network System and Board ET-NXP ARM KIT(LPC1768). This circuit uses Pin P1[0,1,4,8,9,10,14..17] and Chips Physical Ethernet No.DP83848 to be Driver for connection.

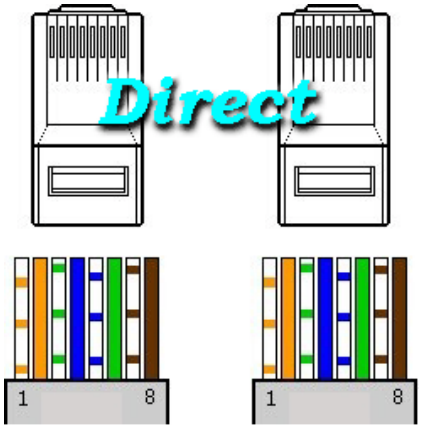
There are 2 methods to connect Cable Ethernet LAN of Board with the Network System; Direct Line Interface and HUB Interface.

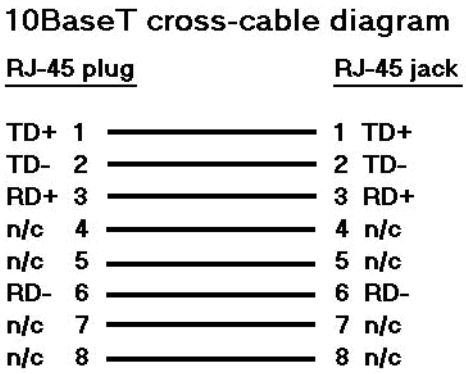
- **Case 1**: It directly connects to computer and Cable LAN is connected as Cross type.





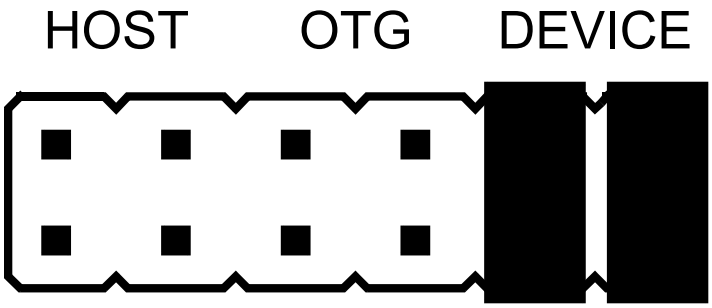
- **Case 2**: It is connected through HUB of computer Server and it is connected as Direct type.



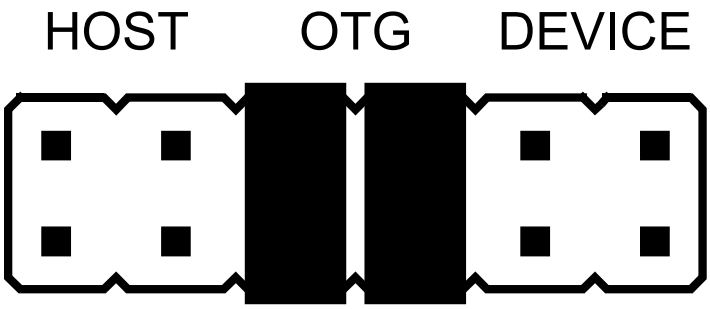


How to use USB

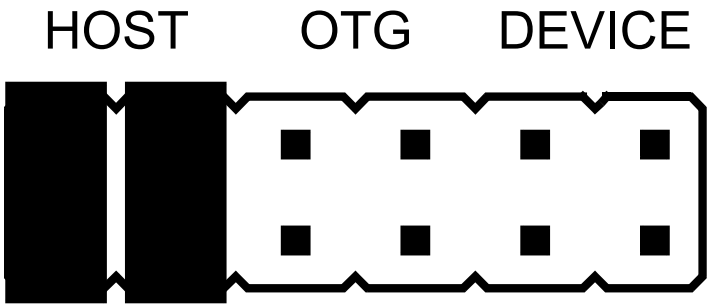
Board ET-NXP ARM KIT(LPC1768) has Port that can be connected with USB Device either USB Host or USB OTG(On-The-Go), depends on writing program to set function of USB internal MCU of LPC1768. In the part of Hardware, user needs to set Jumper to choose the connection between Signal USB of MCU LPC1768 and Circuit of USB Port; in this case, it needs to set the values according to the real usage. There are 3 types of USB Connection as follows;



It chooses USB Mode to be USB DEVICE.



It chooses USB Mode to be USB OTG.



It chooses USB Mode to be USB HOST.

USB Device Mode

This operation mode uses 5 Cables to connect and it needs to program function of each pin to connect with USB Bus as follows;

- USB D(+) uses P0.29 for Function USB_D+ of USB Device Mode.
- USB D(-) uses P0.30 for Function USB_D- of USB Device Mode.
- USB CONNECT uses P2.9 for Function USB_CONNECT(USC LED) of USB Device Mode.
- USB UP LED P1.18 ในหน้าที่ USB_UP_LED(UGL LED) ของ USB Device Mode
- USB UP LED uses P1.18 for Function USB_UP_LED(UGL LED) of USB Device Mode.
- USB VBUS จะใช้ P1.30 ในหน้าที่ USB VBUS ของ USB Device Mode
- USB VBUS uses P1.30 for Function USB VBUS of USB Device Mode.

If it is USB Device, there is Jumper UMODE to choose the connection with USB Host either Direct Connect or Soft Connect by using P2.9(USB_CONNECT) to be Pin Control of the connection. If it chooses Soft Connect, it needs to set Jumper UMODE to the side of P2.9 and then write program to set function of P2.9 to control the connection between USB Device and Bus. However, if user does not choose Soft Connect, it needs to set Jumper UMODE to the side of GND to enable the connection between USB Device and Bus all the time. In this case, there is LED USC to display status of signal; this LED USC is ON when the signal that controls the connection of USB Device is in the status of Active.

This USB Device Mode has 2 LED to display operating status of USB as follows;

- **USC**: It displays operating status of signal that controls Connect Bus and it will be ON when the Connect Bus is enabled.
- **UGL**: It displays operating status when the connection between USB Device and Host Bus is successful.

USB OTG Mode (USB On-The-Go)

This operation mode uses 5 Cables to connect and it uses Chip ISP1301 to be USB OTG Transceiver. It needs to program function of each pin to connect with USB Bus as follows;

- USB D(+) uses P0.29 for Function USB_D+ of USB OTG Mode.
- USB D(-) uses P0.30 for Function USB_D- of USB OTG Mode.
- USB SDA uses P0.27 for Function USB_SDA of USB OTG Mode.
- USB SCL uses P0.28 for Function USB_SCL of USB OTG Mode.
- USB INT uses P0.22 for Function GPIO Input.

This USB OTG Mode has 2 LED to display operating status of USB as follows;

- **VOTG**: It displays operating status of VBUS of USB Vbus.
- **UGL**: It displays operating status when USB Bus and external device are connected successfully.

USB Host Mode

This operation mode uses 5 Cables to connect and it uses Chip TPS2055 or TPS2031 to controls VBUS of Host; moreover, it also is Host Over Current Protection. It needs to program function of each pin to connect with USB Bus as follows;

- USB D(+) uses P0.29 for Function USB_D+ of USB Host Mode.
- USB D9(-) uses P0.30 for Function USB_D- of USB Host Mode.
- USB OVRCR uses P1.27 for Function USB_OVRCR of USB Host Mode.
- USB PPWR uses P1.19 for Function USB_PPWR of USB Host Mode.
- USB UP LED uses P1.18 for Function USB_UP_LED(UGL LED) of USB Host Mode.

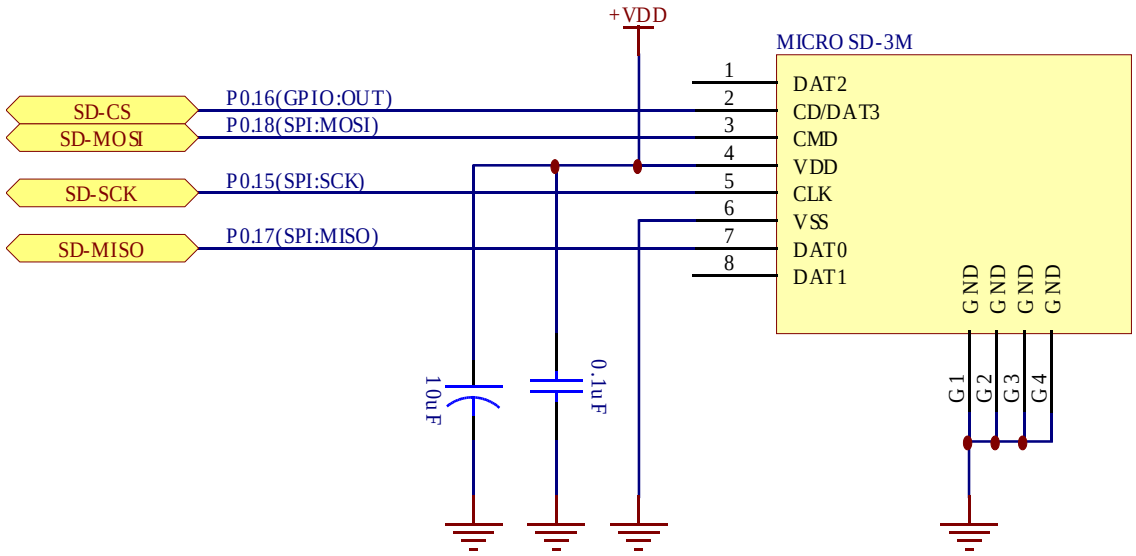
This USB Host Mode has 3 LED to display operating result of USB as follows;

- **VHOST**: It displays VBUS status of USB Host Bus and it will be ON when the circuit supplies VBUS to Host Port.
- **OVC**: It displays operating status when it pulls current from USB Host Port higher than the specified value. When this LED is ON, Output Logic "0" is sent to OVRCE(P1.27) of MCU to notify MCU to know.
- **UGL**: It displays operating status when USB Host Bus and external device are connected successfully.

Micro-SD Card

Board ET-NXP ARM KIT(LPC1768) supports the connection with Micro-SD Card in the format of SPI Interface and it uses Pin P0[15..18] to connect with card. When user wants to command the card, it is able to program Pin I/O of P0[15..18] to operate in SPI Mode and it needs to set the function of Pin P0[15..18] of MCU as follows;

- CLK uses P0.15 for Function SCK of SPI.
- CD/DAT3 uses P0.16 for Function GPIO Output.
- DAT0 uses P0.17 for Function MISO of SPI.
- CMD uses P0.18 for Function MOSI of SPI.




```
//Config P0.15,P0.16,P0.17,P0.18 = SPI Interface
LPC_SC->PCONP       |=  (1 << 8);          //Enable power to
SPI
LPC_SC->PCLKSEL0    &= ~(3<<16);
     //PCLK_SPI=CCLK/4(18MHz)
LPC_SC->PCLKSEL0    |=  (1<<16);
     //PCLK_SPI=CCLK(72MHz)
LPC_SPI->SPCCR = 180;                       //72MHz/180=400kBit

// SSEL is GPIO, output set to high.
LPC_GPIO0->FIODIR  |=  (1<<16);             //P0.16 is output
LPC_GPIO0->FIOPIN  |=  (1<<16);                  //set P0.16 =
high
LPC_PINCON->PINSEL1 &= ~(3<<0);             //P0.16 = GPIO

// SCK, MISO, MOSI are SSP pins.
LPC_PINCON->PINSEL0 &= ~(3UL<<30);          //P0.15 cleared
LPC_PINCON->PINSEL0 |=  (3UL<<30);               //P0.15 SCK
LPC_PINCON->PINSEL1 &= ~((3<<2)|(3<<4));    //P0.17, P0.18
cleared
LPC_PINCON->PINSEL1 |=  ((3<<2)|(3<<4));    //P0.17 MISO,P0.18
MOSI

//Config SPI = Master,8Bit,CPOL=0,CPHA=0
LPC_SPI->SPCR &= ~(1<<3);                   //CPHA = 0 Rising
Clock
LPC_SPI->SPCR &= ~(1<<4);                   //CPOL = 0
LPC_SPI->SPCR |=  (1<<5);                   //MSTR = 1 = Master
SPI
LPC_SPI->SPCR &= ~(1<<6);                        //LSBF = 0 =
MSB First
```

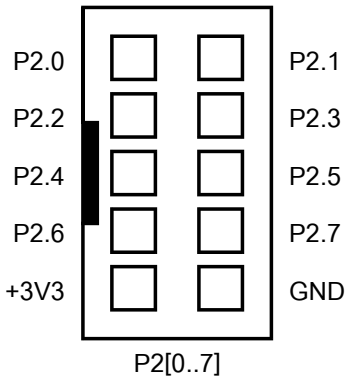
```
LPC_SPI->SPCR &= ~(1<<7);                    //SPIE = 0 = Disable
INT

LPC_SPI->SPCR &= ~(15<<8);                   //BIT = 0000(Bits
Format)
LPC_SPI->SPCR |=  (1<<11);                   //BIT = 1000(8 Bit
Data)
LPC_SPI->SPCR |=  (1<<2);                    //Enable SPI
```

Example of setting Pin for SD Card

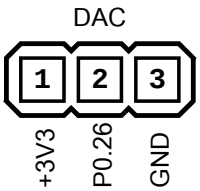
Connector Port I/O of Board

Port I/O of CPU is arranged at connectors, so user can choose them as preferred; in this case, there are 8 sets as shown below;

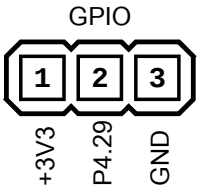
- Has 2 sets of Connector IDE 10Pin; in this case, there are 8Bit per each set; P2[0..7]. Signal are arranged as below;



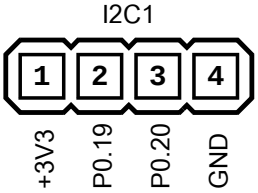
- Connector DAC is Header 1x3 that is used to be the connecting point P0[26]; in this case, it can be used either general GPIO or D/A(Aout) as required.
  - P0.26 = AOUT or D/A



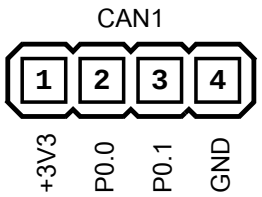
- Connector GPIO is Header 1x3 that is used to be the connecting point P4[29]; in this case, it can be used either general GPIO or other functions according to the Config value of P4[29] as required.
  - P4.29 = GPIO



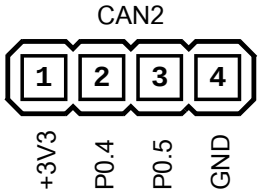
- Connector I2C-1 is Header 1x4 that is used to be the connecting point P0[19..20]; in this case, it can be used either general GPIO or I2C Bus as required.
  - P0.19 = SDA1
  - P0.20 = SCL1



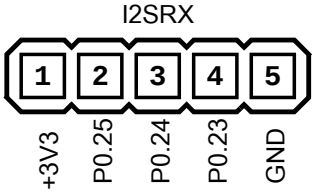
- Connector CAN-1 is Header 1x4 that is used to be the connecting point P0[0..1]; in this case, it can be used either general GPIO or Can Bus(CAN-1) as required.
  - P0.0 = RD1
  - P0.1 = TD1



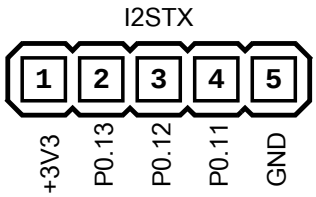
- Connector CAN-2 is Header 1x4 that is used to be the connecting point P0[4..5]; in this case, it can be used either general GPIO or Can Bus(CAN-2) as required.
  - P0.4 = RD2
  - P0.5 = TD2



- Connector I2SRX is Header 1x5 that is used to be the connecting point P0[23..25]; in this case, it can be used either general GPIO or I2SRX as required.
  - P0.23 = RXCLK
  - P0.24 = RXWS
  - P0.25 = RXSDA



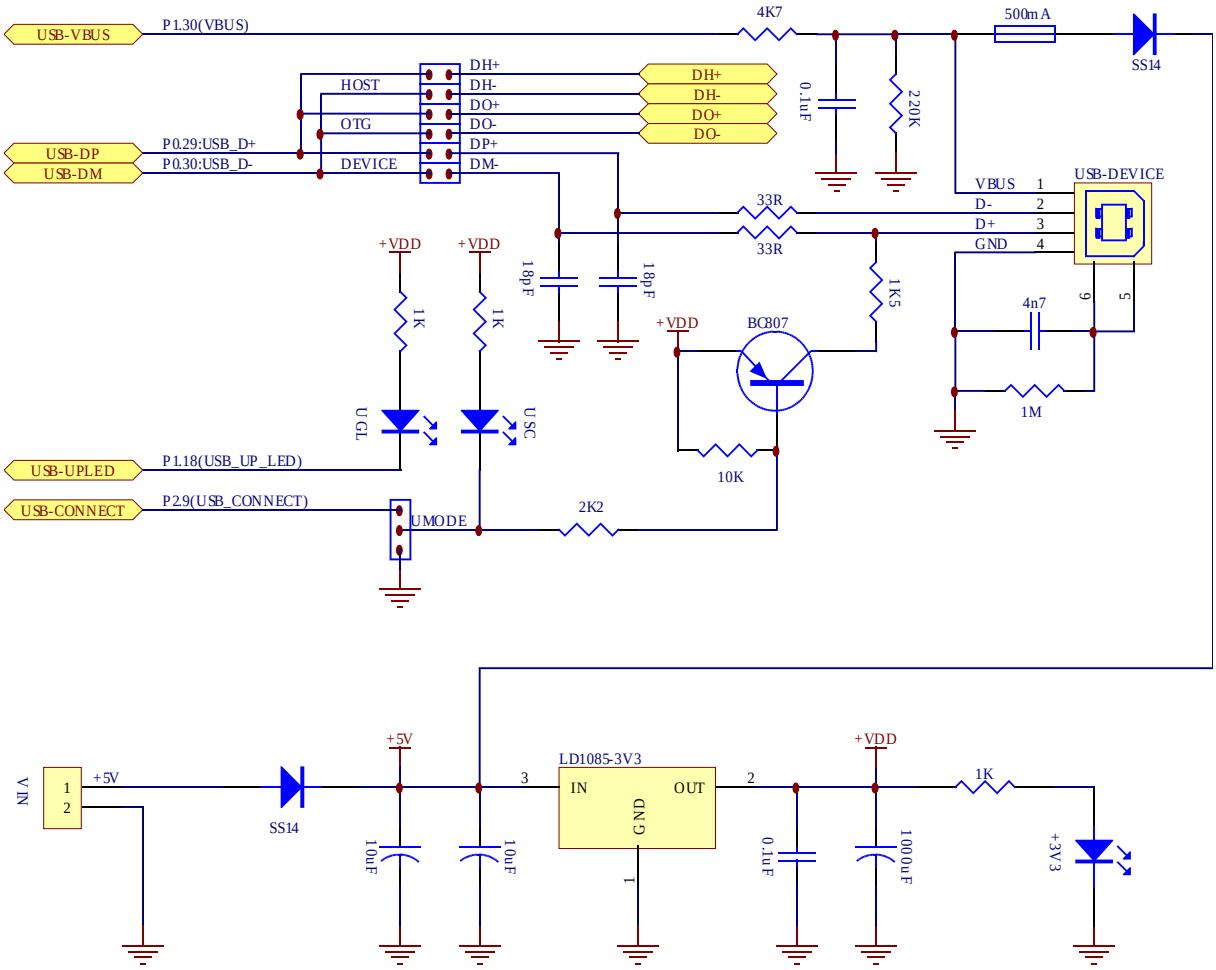
- Connector I2STX is Header 1x5 that is used to be the connecting point P2[11..13]; in this case, it can be used either general GPIO or I2STX as required.
  - P2.11 = TXCLK
  - P2.12 = TXWS
  - P2.13 = TXSDA



Circuit Power Supply

Circuit Power Supply is compatible with +5VDC; in this case, user can choose source either from Connector or from USB Device to interface Power Supply to board as required. This Power Supply is connected to Circuit +3V3/3A Regulate.

The Circuit Power Supply that is the part of 3.3V Regulate supplies power to CPU and all of Circuit I/O of board, except Backlight of LCD and Buzzer/Speaker because it directly uses +5VDC from Power Supply.



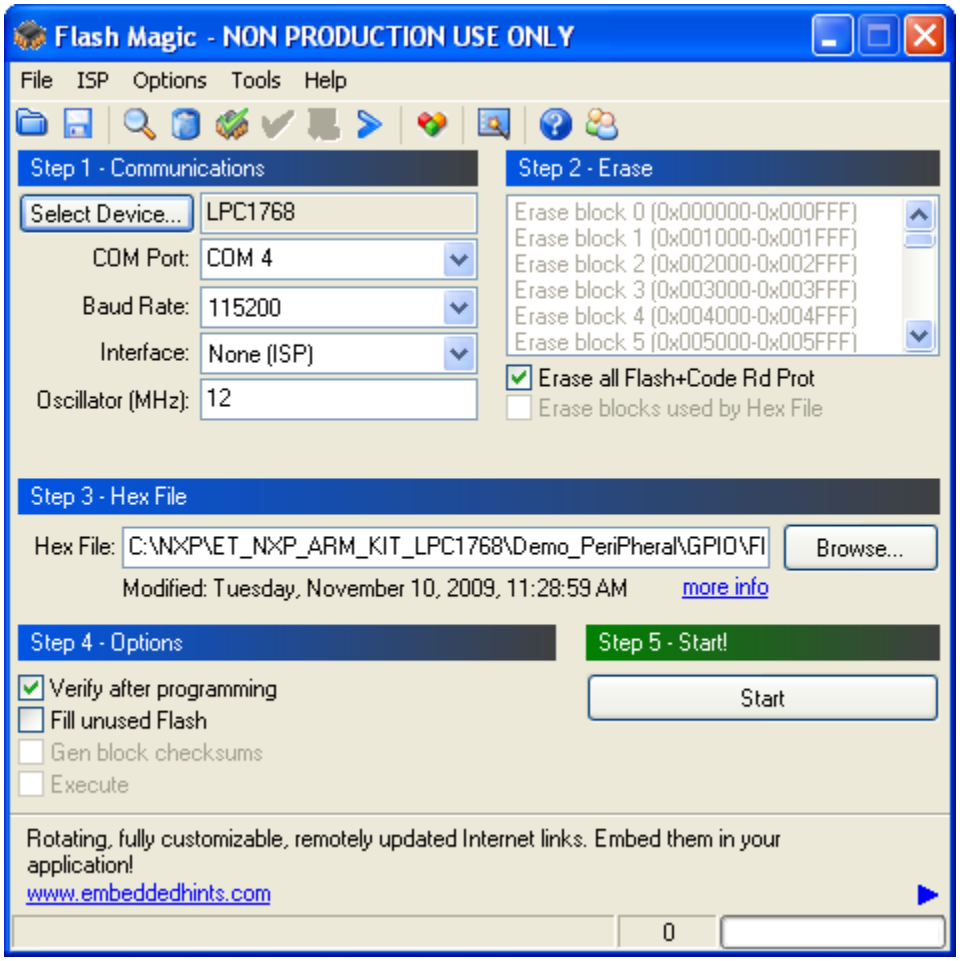
How to download Hex File to MCU on Board

The method to download HEX File into Flash Memory of MCU on board is to use Program Flash Magic of **"Embedded System Academy,Inc"** and it is connected with MCU through Serial Port of computer PC. This program can be downloaded free from website: www.esacademy.com.

Procedures of downloading HEX File to MCU

1. Connect Cable RS232 between RS232 Serial Port Communication of PC and Board UART0.

2. Supply power into board; user can see status of LED PWR to be ON.
3. Run Program Flash Magic; if it is Version 5.39.1797, it will display operating results as below;



4. Start setting initial values into program as required; if using with LPC1768 of Board ET-NXP ARM KIT(LPC1768) from ETT, it chooses and sets values into program as follows;
   - Choose COM Port according to the real COM Port number that is actually is connected on board (this example is COM4)
   - Should set Baud Rate in the range of 2400-115200; if it sets Baud Rate too high, it maybe error. So, it is better to reduce Baud Rate lower, this example is 115200.

- Set **Device** as **LPC1768.**
- Set **Interface** as **None ISP.**
- Set Crystal Oscillator according to the real value that is actually is used on board with the unit of MHz; in this case, it uses 12.000MHZ, so it is set as 12.
- Press Switch ISP LOAD and Switch RESET on Board "ET-NXP ARM KIT" to reset MCU to run in Boot Loader as described below
    - Press and hold Switch ISP LOAD for a while.
    - Press Switch RESET and Switch ISP LOAD is still pressed.
    - Release Switch RESET but Switch ISP LOAD is still pressed.
    - Finally, release Switch ISP LOAD.

5. Choose the format of erasing data as **"Erase all Flash + Code Rd Prot".**
6. Choose **Option** as **"Verify after programming"**.
7. Click "**Browse**" to choose the preferred HEX File for downloading.
8. Click "**Start**", it makes Program Flash Magic start downloading data into MCU instantly and user can see the operating results through Status Bar. In this case, user needs to wait until all operation of program is complete.
9. When the program run successfully, press Switch RESET on board and it makes MCU start operating according to the downloaded program instantly.