

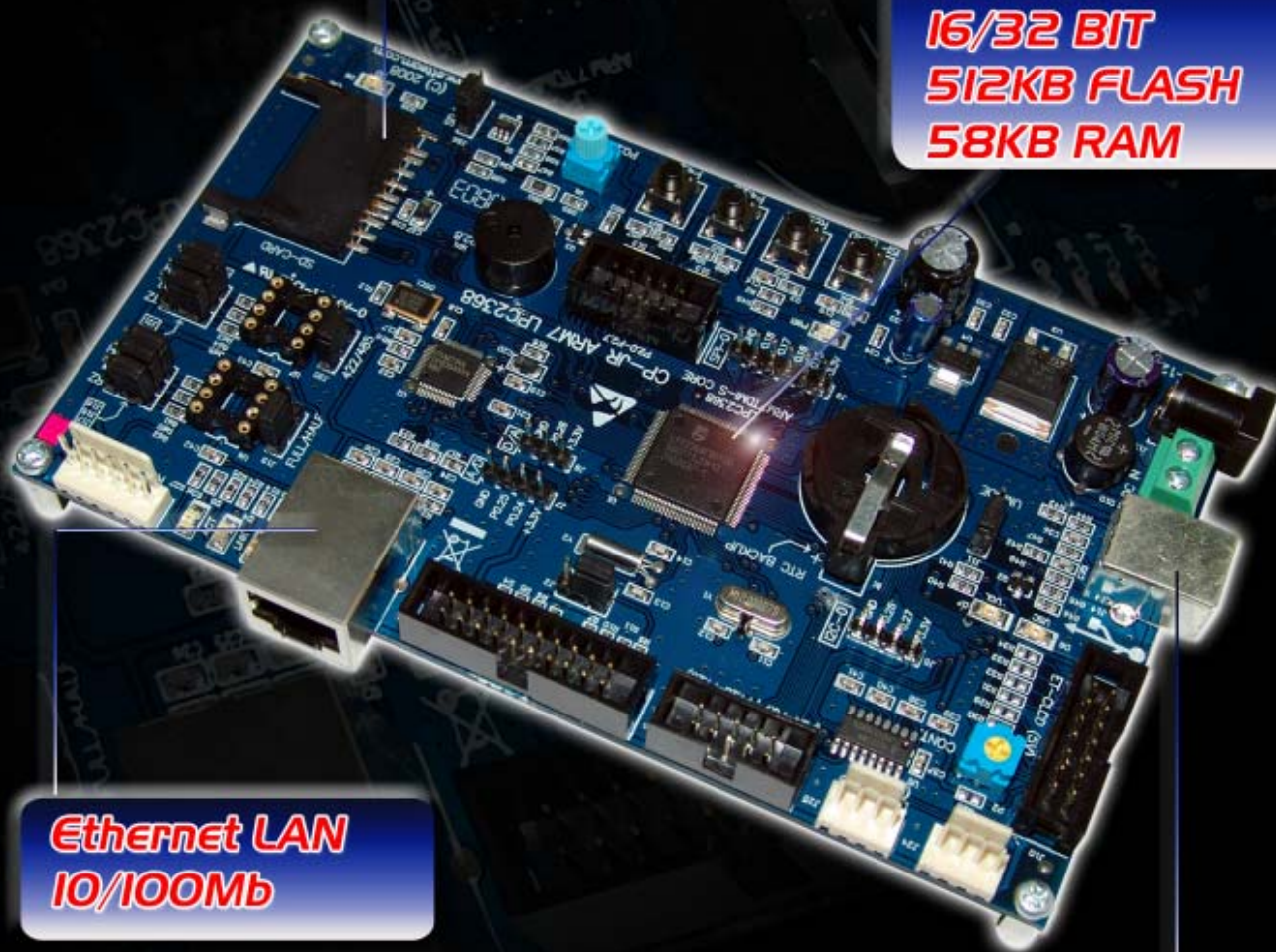
# คู่มือการใช้งาน User's manual CP-JR ARM7 LPC2368

## ARM7



**SD/MMC Card  
Connecotor**

**LPC2368  
16/32 BIT  
512KB FLASH  
58KB RAM**



**Ethernet LAN  
10/100Mb**

**USB 2.0  
Full Speed**

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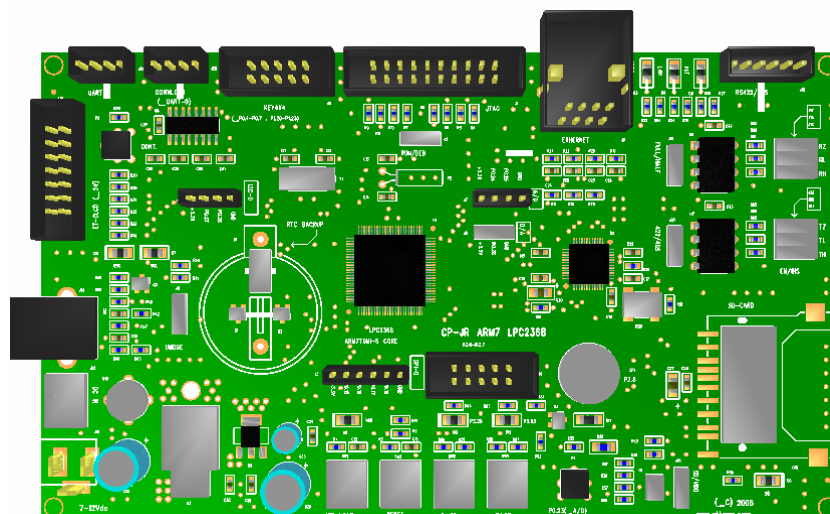
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**CP-JR ARM7 LPC2368**

**CP-JR ARM7 LPC2368** is ARM7TDMI-S Core Board Microcontroller that uses 16/32-Bit 100 Pin (LQFP) Microcontroller No.LPC2368 from Philips (NXP). All resources inside LPC2368 is quite perfect, so it is the most suitable to learn and study because if user can learn and understand the applications of all resources inside MCU well, it makes user can modify, apply and develop many excellent applications in the future. Because Hardware system of LPC2368 includes the necessary devices within only one MCU such as USB, Ethernet, SD/MMC Memory Card, ADC, DAC, Timer/Counter, PWM, Capture, I2C, SPI, UART, and etc.

So, ETT Team tries to find out and research the detailed information of LPC2368 and design it to be Board Microcontroller version "CP-JR ARM7 LPC2368". We hope that user will buy this device to learn, modify, and develop application in the future as desired under the reasonable price. The main purpose of designing this Board CP-JR ARM7 LPC2368 is to be able to support both users who want to learn, study or try device and including person who want to really modify and develop devices. The structure of board consists of the basic components that are necessary to learn and test such as LED to display Output Logic, Push Button Switch to test Logic Input, Volume

to adjust voltage to test A/D, and Mini Speaker to generate various Beep sound. Moreover, it provides other devices in the high level to support the applications such as Port USB, SD/MMC Memory Card, Port Ethernet LAN, Dot-Matrix LCD, RS232, RS232, RS422/485. Furthermore, there is available GPIO; it makes user can design and use it with other devices as desired. So, CP-JR ARM7 LPC2368 is one of the most interesting multi-purpose boards.

## Specifications of Board

1. Use 16/32 Bit ARM7TDMI-S MCU No.LPC2368 from Philips (NXP)
2. Has 512KB Flash Memory and 58KB Static RAM internal MCU
3. Use 12.00MHz Crystal, so MCU can process data with the maximum high speed at 72MHz when using it with Phase-Locked Loop (PLL) internal MCU.
4. Has RTC Circuit (Real Time Clock) with 32.768KHz XTAL and Battery Backup
5. Support In-System Programming (ISP) and In-Application Programming (IAP) through On-Chip Boot-Loader Software via Port UART-0 (RS232)
6. Has circuit to connect with standard 20 Pin JTAG ARM for Real Time Debugging
7. 7-12 VAC/DC Power Supply uses Connector type as Terminal and DC-Jack with Bridge Rectifier Circuit, +5V/800mA Regulate and +3V3/3A Regulate
8. Has standard 2.0 USB as Full Speed inside (USB Function has 32 End Point)
9. Has circuit to connect with Ethernet LAN 10/100Mb by using 1 Channel standard RJ45 Connector
10. Has 1 Channel Circuit to connect with SD Memory Card or MMC Memory Card
11. Has RS232 Communication Circuit by using 2 Channel 4-PIN ETT standard Connector
12. Has RS422/485 Serial Communication Circuit by using 1 Channel 6-PIN ETT standard Connector

13. Has Circuit to connect with Dot-Matrix LCD with circuit to adjust its contrast by using 14 PIN ETT standard Connector
14. 3 sets of Push Button Switch with RESET Switch
15. Has 2 LED Circuits to display status of testing Output
16. Has circuit to generate 0-3V3 Voltage by using an adjustable Resistor Circuit for testing A/D
17. 1 Mini Speaker to generate Beep sound
18. Available 25 Bit GPIO for various applications such as A/D, D/A, I2C, SPI and Input/Output
  - Header 10Pin IDE (P2[0..7]) for GPIO or Full-Duplex Serial UART
  - Header 10Pin IDE (P0[4..7],P1[20..23]) for GPIO or 4x4 Matrix Key
  - 3 Pin Header(P0[26])for GPIO or D/A
  - 4 Pin Header(P0[24..25]) for GPIO or A/D
  - 4 Pin Header(P0[27..28]) for GPIO or I2C Bus
  - 6 Pin Header(P0[15..18] for GPIO or SPI Bus



## Structure of Board CP-JR ARM7 LPC2368

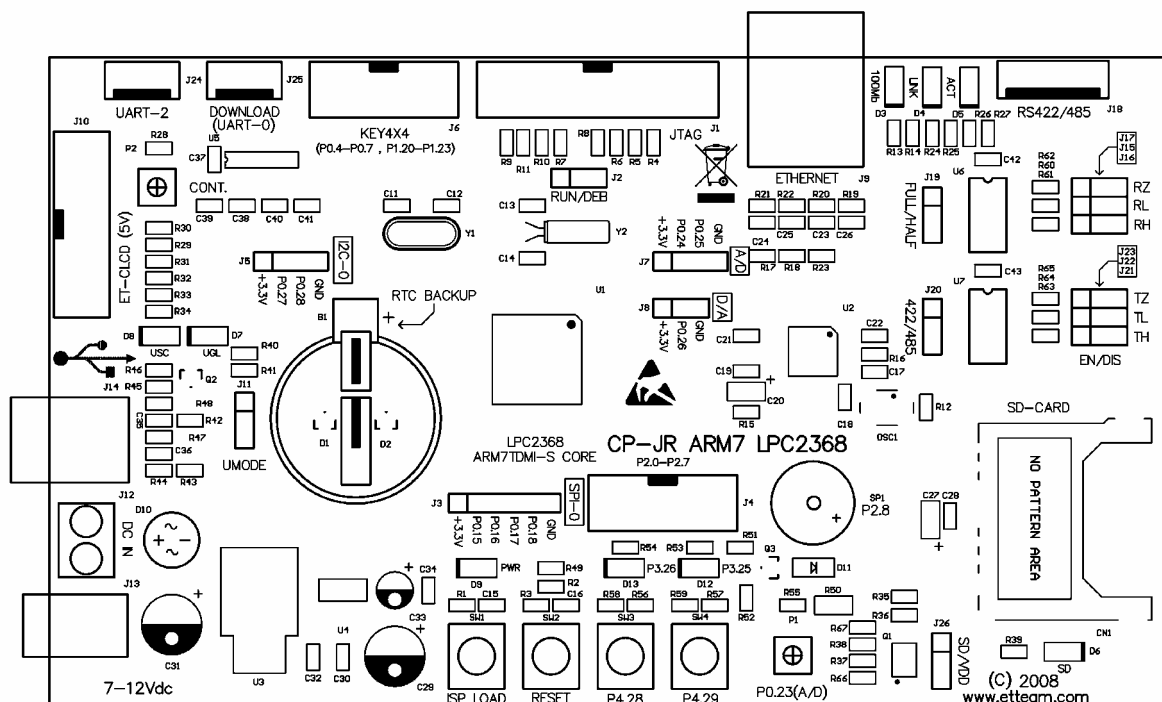
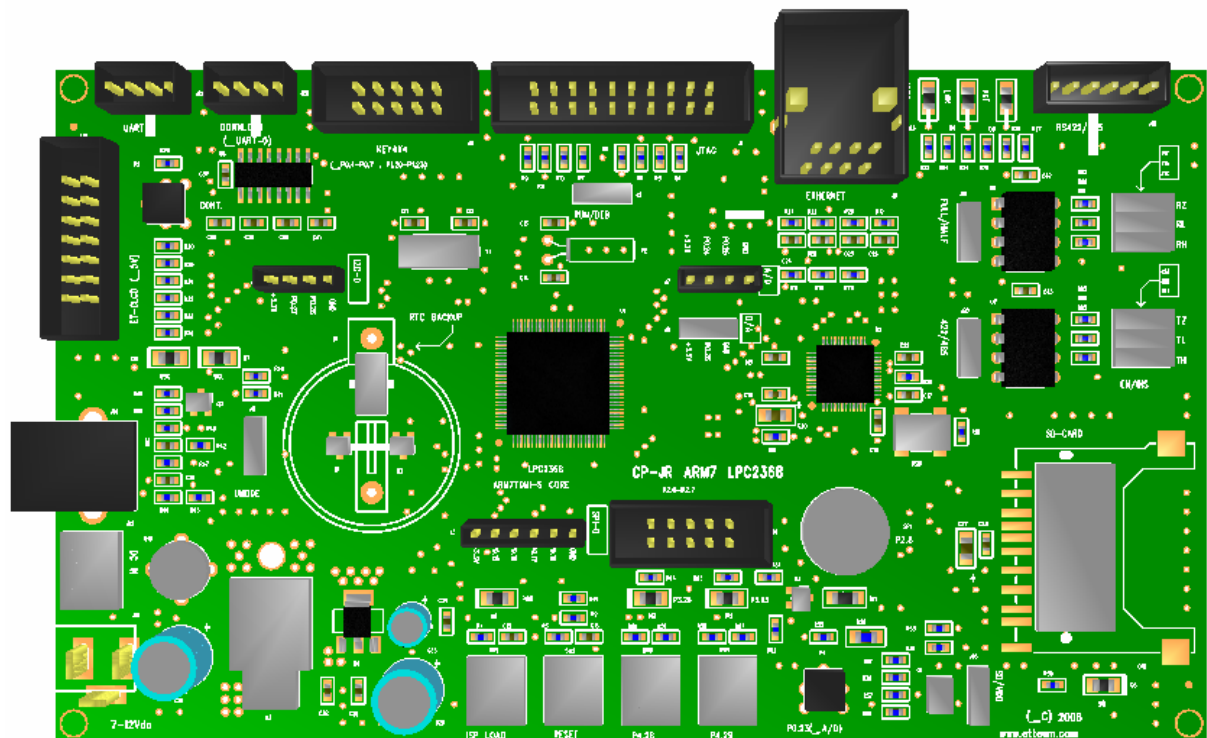


Figure displays the structure of Board CP-JR ARM7 LPC2368.

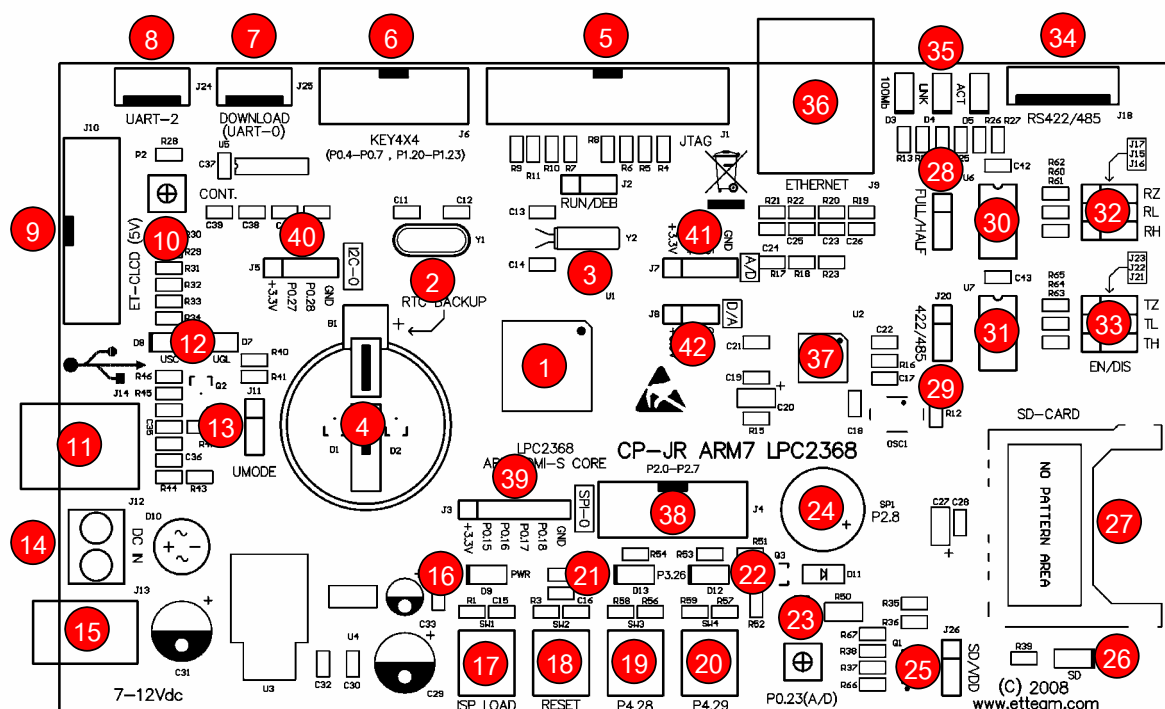


Figure displays position of devices on Board CP-JR ARM7 LPC2368.

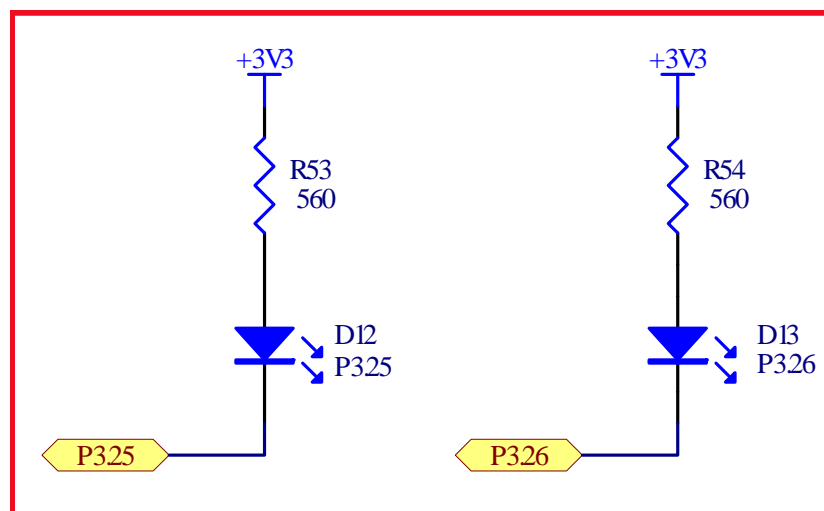
- **No.1** is MCU No.LPC2368 (100Pin LQFP).
- **No.2** is 12MHz Crystal to be Time Base of MCU.
- **No.3** is 32.768 KHz Crystal to be Time Base of RTC internal MCU.
- **No.4** is 3V Battery for Backup of RTC.
- **No.5** is JTAG ARM Connector for Real Time Debugging.
- **No.6** is GPIO (P0[4..7],P1[20..23]) Connector for Keyboard Matrix 4x4 or GPIO.
- **No.7** is UART-0(RS232) Connector to use and Download Hex File into CPU
- **No.8** is UART-2(RS232) Connector to use.
- **No.9** is Character LCD Connector; it can be used with +5V Supply LCD.
- **No.10** is VR to adjust the contrast or brightness of Character LCD.

- **No.11** is USB Connector to connect with USB Hub version 2.0.
- **No.12** is LED to display status of operation and the USB connection.
- **No.13** is Jumper to select Mode of USB Connection.
- **No.14** and **No.15** is Power Supply Connector of board; it can be used with 7-12V AC/DC.
- **No.16** is LED to display status of Power +VDD (+3V3).
- **No.17** is SW1 that is ISP LOAD or P2.10/EINT0.
- **No.18** is SW2 or RESET Switch.
- **No.19** and **No.20** is SW3 and SW4 to test Logic Input of P4[28] and P4[29].
- **No.21** and **No.22** is LED to test Logic Output of P3[25] and P3[26].
- **No.23** is VR to adjust 0-3V3 Voltage for testing A/D (P0[23]/AD0[0]).
- **No.24** is Mini Speaker to generate various frequencies.
- **No.25** is Jumper to select Power Supply for SD/MMC Memory Card.
- **No.26** is LED to display status of Power Supply of SD/MMC Memory Card.
- **No.27** is socket to insert Memory Card; it can be used with both SD Memory Card and MMC Memory Card.
- **No.28** and **No.29** is Jumper to select operation of RS422/485.
- **No.30** is IC Line Driver of RS422 Receive; it can be used with 75176 or MAX3088.
- **No.31** is IC Line Driver of RS422 Transmit and RS485 Transceiver; it can be used with No.75176 or MAX3088.
- **No.32** and **No.33** is Jumper to set Enable/Disable Fail-Save Resistor and Terminate Resistor of RS422 Receive, RS485 Transmit (RS485 Transceiver).

- **No.34** is RS422/485 Connector.
- **No.35** is LED to display status of Ethernet LAN.
- **No.36** is RJ45 Ethernet LAN Connector.
- **No.37** is IC Physical Ethernet Driver No.DP83848.
- **Connector 38** is GPIO (P2[0..7] Connector for Full-Duplex UART1 or GPIO.
- **No.39** is SPI0-Bus Connector or GPIO P0[15..18].
- **No.40** is I2C-Bus Connector or GPIO P0[27..28].
- **No.41** is A/D Connector or GPIO P0[24..25].
- **No.42** is D/A Connector or GPIO P0.26.

## Applications of LED Display

LED Display circuit of Board will be connected as Sink Current type and it is used with +3.3V Power Supply. In this case, it runs with Logic "0" (0V) and stops running with Logic "1" (+3.3V). It is controlled by 2 GPIOs that are P3[25] and P3[26]. This circuit is used to test operation of Output.



If we want to use this function, we must set function of P3[25] and P3[26] to be Output Port first and then control the desired Logic for P3[25] and P3[26] as example below.



```
// Config Pin GPIO = P3[26:25] Drive LED
PINSEL7  &= 0xFFC3FFFF;      // Config P3[26:25] = GPIO Function
PINMODE7 &= 0xFFC3FFFF;      // Enable Pull-Up on P3[26:25]
FIO3DIR  |= 0x02000000;      // Set P3[25] = Output
FIO3DIR  |= 0x04000000;      // Set P3[26] = Output

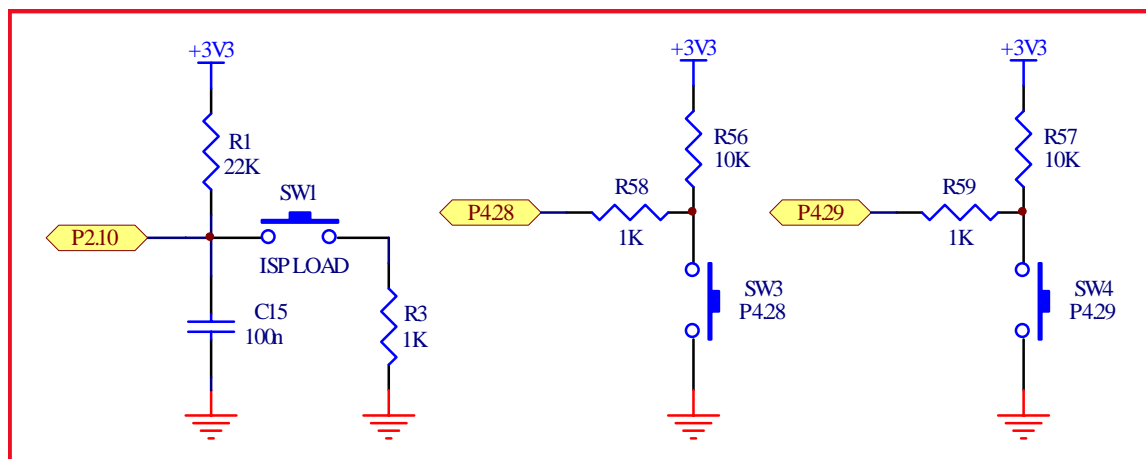
FIO3CLR  = 0x02000000;      // LED(P3[25]) = ON
FIO3CLR  = 0x04000000;      // LED(P3[26]) = ON

FIO3SET  = 0x02000000;      // LED(P3[25]) = OFF
FIO3SET  = 0x04000000;      // LED(P3[26]) = OFF
```

## Application of Push Button Switch

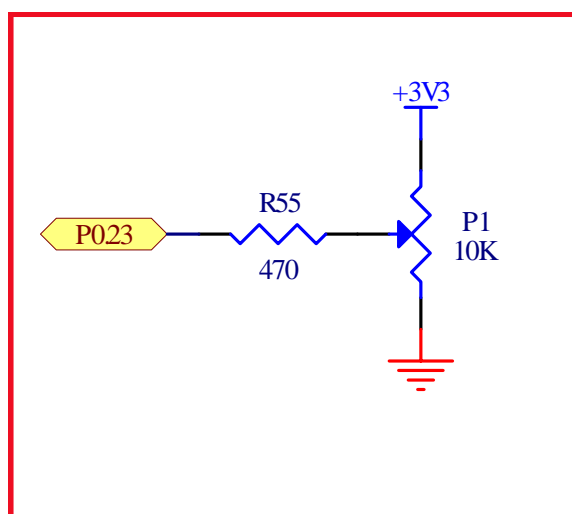
This circuit uses Push Button Switch Circuit with Pull-Up circuit; in this case, it can be used with +3.3V Power Supply. If Switch is not pressed, its status is Logic "1"; on the other hand, if Switch is pressed, its status is Logic "0". It is used to test operation of Input Logic; moreover, this circuit has 3 sets as follows;

- SW1 (P2[10]) for ISP Download and test Input or Interrupt(EINT0)
- SW3 (P4[28]) to test Logic Input
- SW4 (P4[29]) to test Logic Input



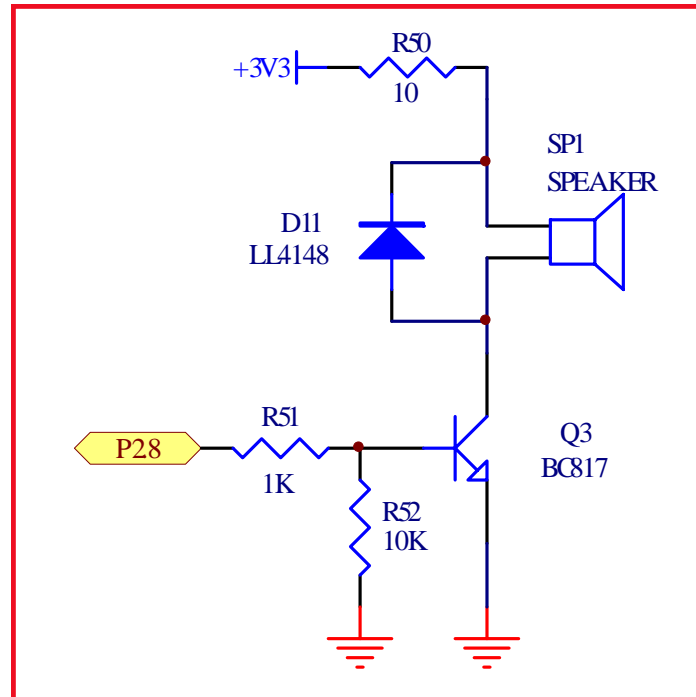
## Applications of Voltage Divider (0-3V3)

The Voltage Divider Circuit uses Adjustable Variable Resistor (VR) and it can be used with +3.3V Power Supply. In this case, its Output is voltage in the range of 0V to +3.3V depend on the adjusting VR. The Output will be inputted into Pin P0[23] to generate Input voltage for testing operation of A/D (P0[23]) circuit.



## Application of Sound Generator

Sound Generator Circuit uses Mini Speaker with NPN Transistor circuit to drive current into speaker and can be used with +3.3V Power Supply. In this case, it runs with Logic "1" and stop running with Logic "0". If we want to use this function, we must send signal Logic that is various frequencies into speaker to generate various frequency ranges as desired; in this case, it is controlled by P2[8].



If we want to use this function, we must configure function of P2[8] to be Output Port first and then control Logic for P2[8]ON/OFF to be the desired frequencies as example below.

```
// Config Pin GPIO = P2[8] Drive Mini Speaker Generate Beep
PINSEL4  &= 0xFFFFCFFF;           // Config P2[8] = GPIO Function
FIO2DIR  |= 0x00000100;           // Config P2[8] = Output

// Loop Generate Beep on Speaker(P2.8)
while(1)                               // Loop Continue
{
    for (i = 0; i < 500; i++)          // Start Beep Pulse
    {
        FIO2SET   = 0x00000100;        // P2[8] = "1" (ON Speaker)
        delay(5000);
        FIO2CLR   = 0x00000100;        // P2[8] = "0" (OFF Speaker)
        delay(5000);
    }

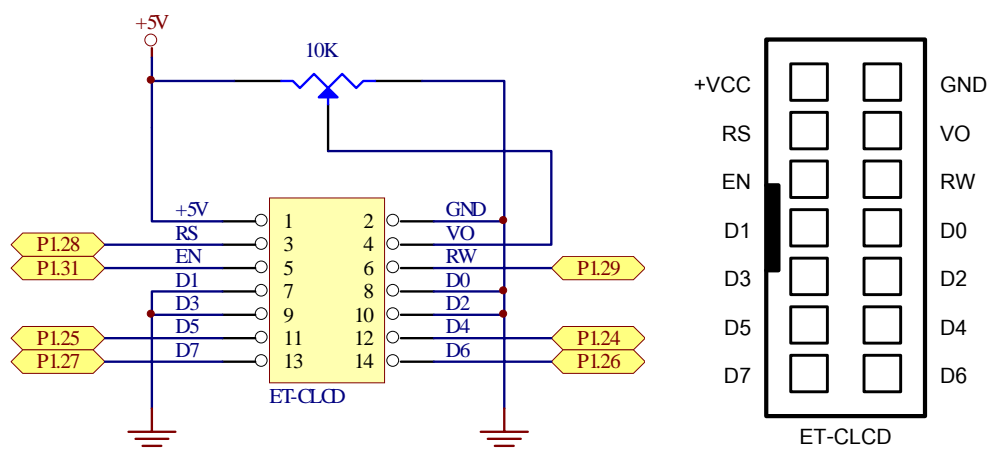
    delay(10000000);                  // Stop Beep Pulse
}
```

## Application of Character LCD

The LCD Connection can be used with Character Dot-Matrix LCD only. It connects circuit as 4 BIT Data and signals that are connected with LCD will be signal from P1[24..29] and P1[31] about 7 Bit. The method to connect signal cable from Connector of Port LCD to LCD Display is to use the signal name to be the reference, so we must connect all 14 signal cables according to its names as below.

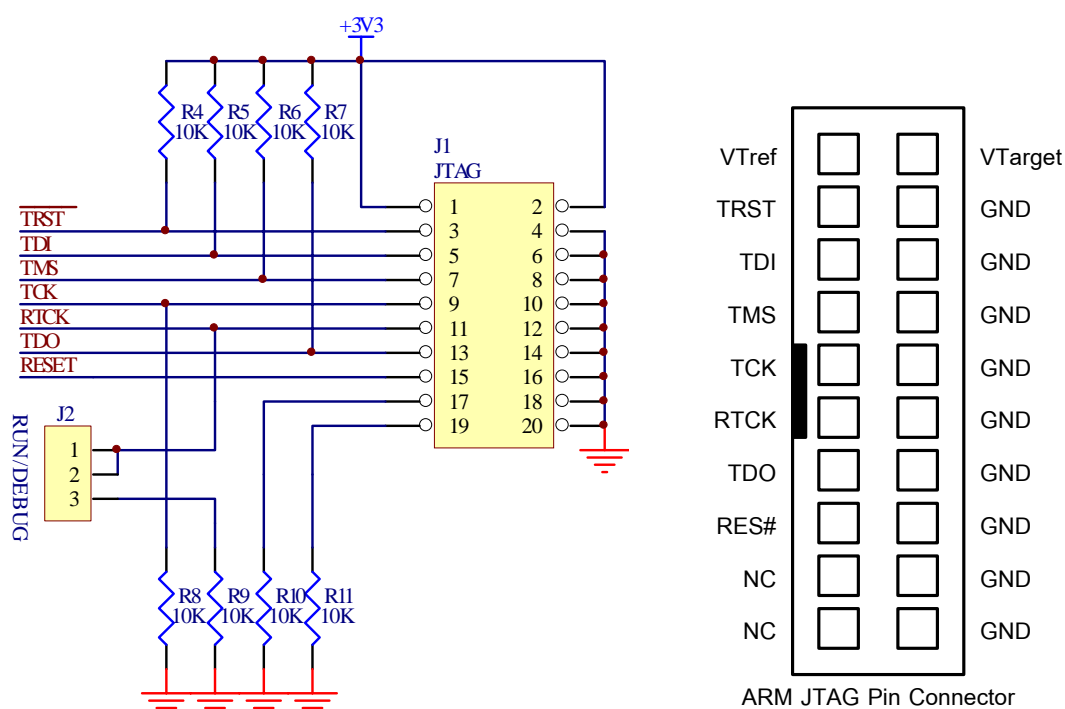
The method to connect signal cable with LCD is shown as below;

- DB4 = P1[24]
- DB5 = P1[25]
- DB6 = P1[26]
- DB7 = P1[28]
- RS = P1[28]
- RW = P1[29]
- EN = P1[31]



## Application of JTAG ARM

JTAG or JTAG ARM is 20 Pin IDE Connector to interface with JTAG Debugger. Its circuit and signal is arranged under the standard of JTAG as shown below.



If connecting with JTAG to Download Code of Debug, we must set Jumper J2(RUN/DEB) on DEB side; however, after we have already developed program, we must always set Jumper J2(RUN/DEB) on RUN side again.

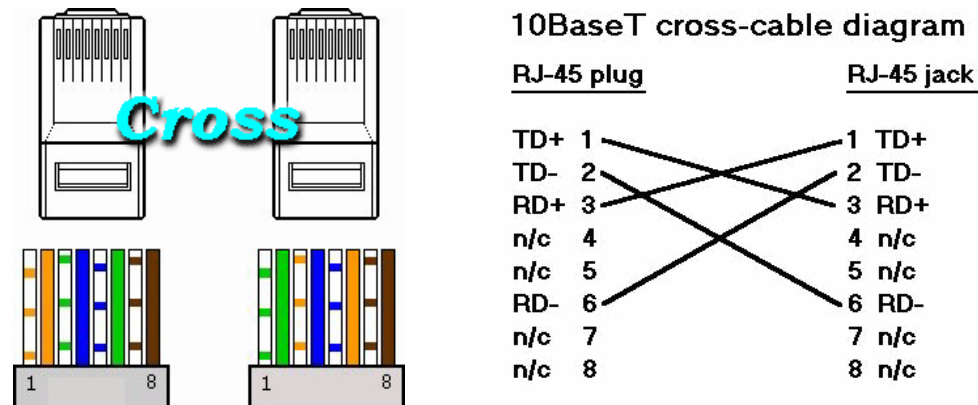
## Ethernet LAN

The method to connect signal between network and Board CP-JR ARM7 LPC2368 is to use standard RJ45 Ethernet Connector. This circuit uses signal Pin P1[0,1,4,8,9,10,14..17] for the connection; moreover, it uses Chips Physical Ethernet No.DP83848 to be Driver.

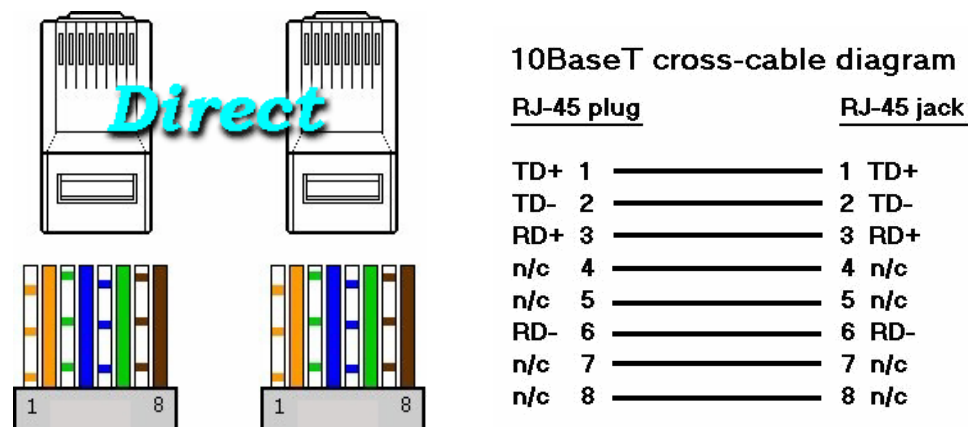


There are 2 methods to connect Ethernet LAN cable of board with Network; Direct Line and Through Hub.

- The first case; it connects with computer directly; LAN cable must be connected as Cross type.



- The second case; it connects signal through Hub of computer Sever and its cables must be connected as Direct type.



## SD/MMC Memory Card

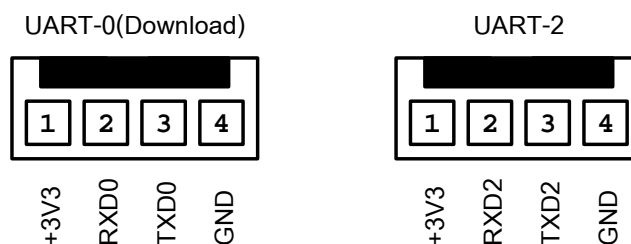
It supports the connection with SD Memory Card and MMC Memory Card; in this part, there is LED SD to display status of Power Supply for the Memory Card.

Power Supply of Memory Card can be selected by Jumper J26(SD/VDD); so we can select to use Power Supply either from +VDD of Board or from the control of signal Pin MCIPWR. Normally, we set Jumper J26(SD/VDD) on SD side to use Power Supply of Memory Card from the control of MCIPWR. All circuits to connect with Memory Card uses signal pins from MCU as follows;

- MCIDAT0 uses P0.22.
- MCIDAT1 uses P2.11.
- MCIDAT2 uses P2.12.
- MCIDAT3 uses P2.13.
- MCICMD uses P0.20.
- MCICLK uses P0.19.
- MCIPWR uses P0.21.
- CD uses P0.8 (GPIO) to test Insert Memory Card.
- WP uses P0.9 (GPIO) to test the setting of Write Protect of Memory Card.

## Application of RS232

**Port RS232** is signal RS232 that has been done by MAX3232 Converter circuit completely. There are 2 channels that are UART-0 and UART-2. Both channels can be connected with signal RS232 to transmit/receive data. Moreover, UART-0 can be used to be ISP Download function to Download Hex File into MCU; in this case, it must be used with SW1 (ISP LOAD) and SW2 (RESET) to reset CPU to start running in Boot-Loader Mode to Download Hex File into CPU (see more information in "Download Hex File into MCU of Board").



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

Because Hardware UART of LPC2368 can configure many points of signal Pin to connect; for example, UART-2 can use signal Pin P0[10] and P0[11] or signal Pin P2[8] and P2[9]. Board CP-JR ARM7 LPC2368 selects signal Pin P0[10] and P0[11] to be the connecting point with UART-2; so, we must set command to use signal Pin correctly. Be careful if we use UART because the Default value of UART-2 is disabled, so we must enable operation of UART-2 Circuit before command to Initial values for UART, otherwise we can not command UART. The example Code to configure initial values for UART is shown below.

```
// Config UART-0 Connect to P0[2]:P0[3]
PINSEL0 &= 0xFFFFF0F;          // Reset P0.2,P0.3 Pin Config
PINSEL0 |= 0x00000010;         // Select P0.2 = TxD(UART-0)
PINSEL0 |= 0x00000040;         // Select P0.3 = RxD(UART-0)

// Config UART-2 Connect to P0[10]:P0[11]
PINSEL0 &= 0xFF0FFFFFF;        // Reset P0.10,P0.11 Pin Config
PINSEL0 |= 0x00100000;         // Select P0.10 = TxD(UART-2)
PINSEL0 |= 0x00400000;         // Select P0.11 = RxD(UART-2)
PCONP  |= 0x01000000;          // UART2 Power-ON
```

The cable that is used to connect RS232 between Comport of computer PC and UART-0 Connector and UART-2 Connector of Board CP-JR ARM7 LPC2368 is shown below.

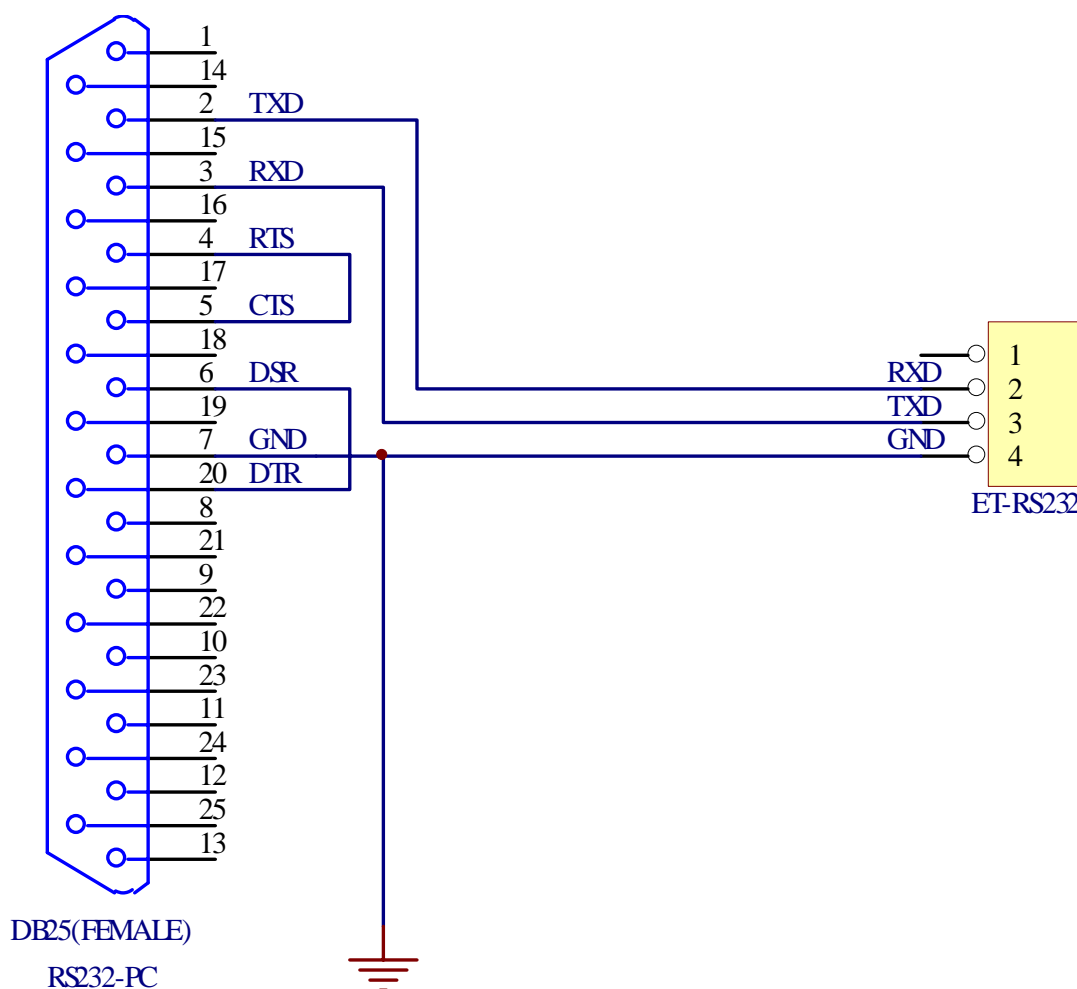
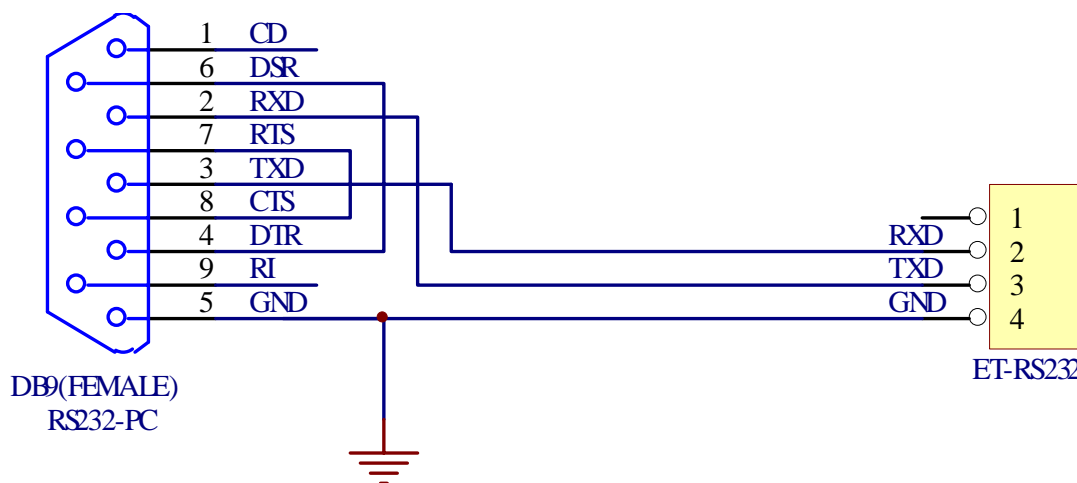


Figure displays the Cable circuit for RS232.

## Application of RS422/485

For RS422/485 Communication Circuit of Board CP-JR ARM7 LPC2368 uses UART-3 and then use signal Pin P0[0] and P0[1] to be the connecting point. We can use this circuit to configure operation of Line Driver Circuit to be either RS422 (Full Duplex) or RS485 (Half-Duplex). If it is RS422, it can transmit and receive data simultaneously as bidirectional as RS232 but this function is longer distance. On the other hand, if it is RS485, we can configure its format of communication to be either Half-Duplex or Full Duplex; in this case, if it is RS485 (Full-Duplex), it is similar to RS422 but we must control ON/OFF circuit of the transmitter; on the other hand, if it is RS485 (Half-Duplex), it will alternate function between receiver and transmitter by using signal P1[19] to be Output Port function for setting the direction of data. If status of P1[19] is Logic "1", it configures the direction of data to be transmitter but if status of P1[19] is Logic "0", it configures the direction of data to be receiver. The IC Line Driver of circuit can select either No.75176 or MAX3088; if using 75176, the maximum point that can be connected signal of RS485 as Multi-Drop type is 32 points; but if using MAX3088, the maximum point that can be connected as Multi-Drop type is 256 points. The connector of RS422/485 is CPA-6 Connector that has arranged as shown below.

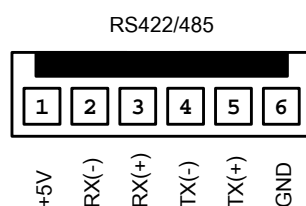


Figure displays position of signal Pin when using it to be RS422.



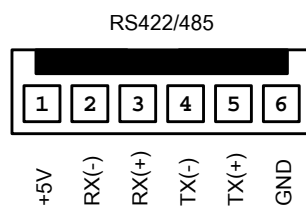


Figure displays position of signal Pin when using it to be RS485 (Full-Duplex).

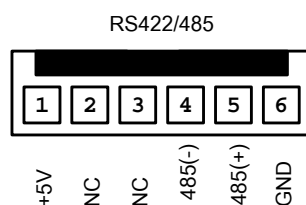
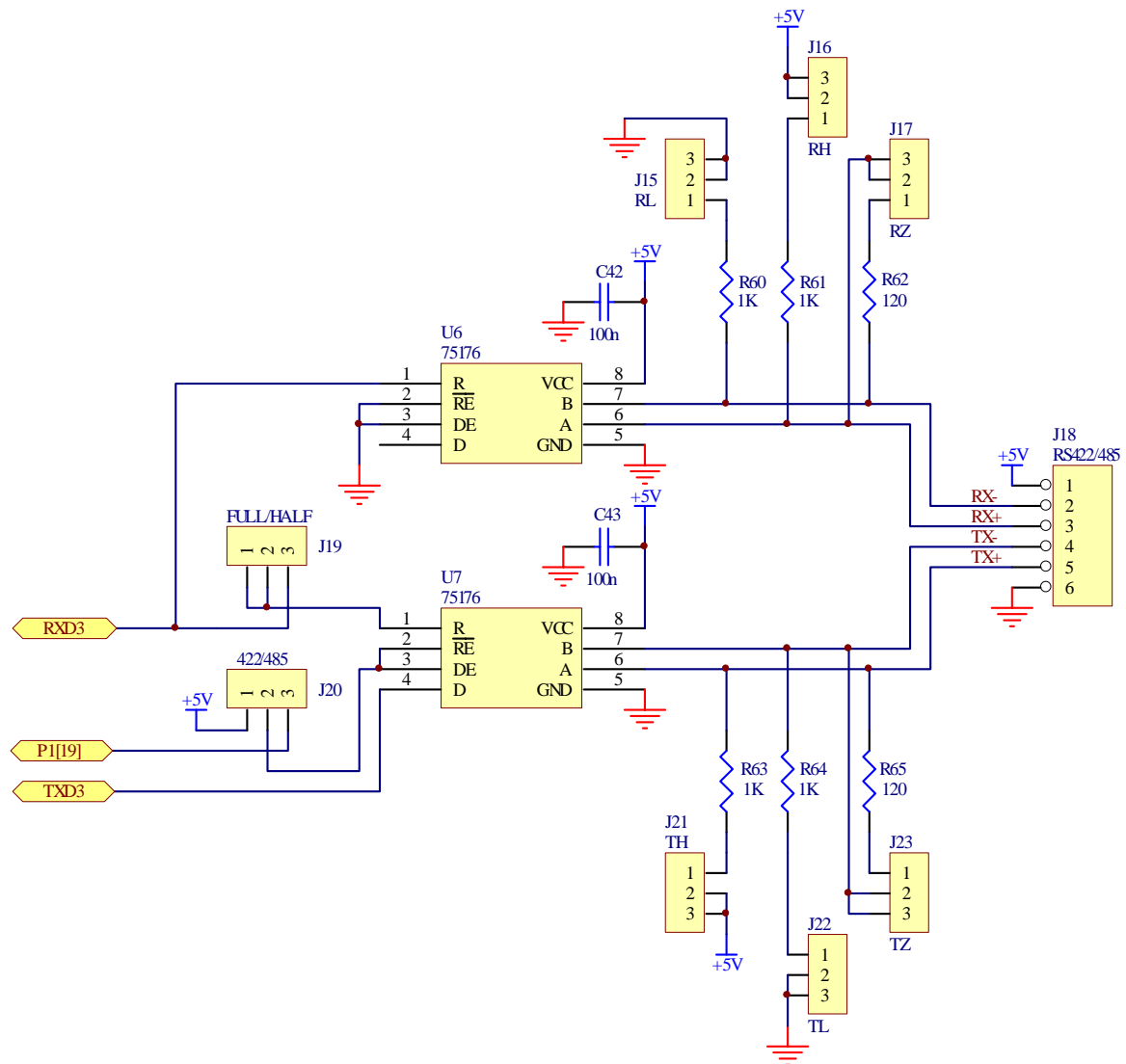


Figure displays position of signal Pin when using it to be RS485 (Half-Duplex).



**Figure displays circuit of RS422/485.**

If we want to use it to be RS422, we must install 2 IC Line Driver Circuits and set Jumper J19 and J20 to be RS422 (Full Duplex) as follow; set Jumper J19 (FULL/HALF) on FULL side and then set Jumper J20 (422/485) on 422 side.

If using RS485 (Full Duplex), we must install 2 IC Line Driver as same as RS422; but in this case, we must set Jumper J19 and J20 to be RS485 (Full Duplex) as follows; set Jumper J19 (FULL/HALF) on FULL side and then set Jumper J20 (422/485) on 485 side. The

operation is similar to RS422 because it can simultaneously transmit and receive data as bidirectional type like RS422 but it can be connected as Multi-Drop type. The circuit can receive data all the time through IC Line Driver of U6 and IC Line Driver U7 will transmit data. In this case, it can control ON/OFF operation of transmitting data by signal from P1[19]; if status of P1[19] is Logic "1", it enables operation of transmitting data but if status of P1[19] is Logic "0", it disables operation of transmitting data. When the operation of transmitting data is disabled, its status is similar to removing cable of the transmitter from circuit, so signal on the transmitter does not crash data of other devices. We must write program to control all devices to transmit only one data into a line once.

If using RS485 (Half-Duplex), we must install only one IC Line Driver at position U7; in this case, we must set Jumper J19 and J20 to be RS485 (Half Duplex) as follows; set Jumper J19 (FULL/HALF) on HALF side and then set Jumper J20 (422/485) on 485 side. Moreover, we must interface cable of CPA-6(J18) Connector at the position TX(-) and TX(+); in this case, function of TX(-) is RS485(-) and function of TX(+) is RS485(+). Direction and function of this signal RS485 depends on status Logic of P1[19] that is Pin Output Port and its function is Direction Control.

The method to set Jumper of Fail-Save Resistor and Terminate Resistor is describes as follows; if Board is generally installed in the beginning position and destination of these Jumper Cables, we must enable and then set Jumper(EN/DIS) of RZ, RL, RH, TZ, TL and TH on EN side or always Enable. The Fail-Safe Resistor (RL, RH, TL and TH) makes status Logic in the signal cable is in the correct IDLE status while not receiving and transmitting any data. For the Terminate Resistor (RZ and TZ) will compensate the resistance or Impedance that is occurred in the line if it is very long line.

Code for writing program to configure operation of UART-3 of RS422/485, we must use P0[0] and P0[1]

to be the connecting Pin and then use P1[19] to control the direction of receiving and transmitting data of RS485. Be careful, the Default value of the UART-3 Circuit in LPC2368 is normally disabled; so, if we want to enable operation of this circuit, we must not forget to write command to enable operation of UART-3 before setting configurations into circuit. The method to enable operation of UART-3 is to be controlled by Bit in Register PCOMP as example below.

```
// Config UART-3(RS422/485) Connect to P0[0]:P0[1]
PINSEL0 &= 0xFFFFFFFF0;           // Reset P0.0,P0.1 Pin Config
PINSEL0 |= 0x00000002;           // Select P0.0 = TxD(UART3)
PINSEL0 |= 0x00000008;           // Select P0.1 = RxD(UART3)
PCOMP    |= 0x02000000;           // UART3 Power-ON

// Config P1.19 = Output Control Direction RS485
// P1.19 = "0" = Received RS485
// P1.19 = "1" = Transmit RS485
PINSEL3 &= 0xFFFF3FFF;           // P1.19 = GPIO
IODIR1   = 0x00080000;           // Pin Control Direction RS485 = Output

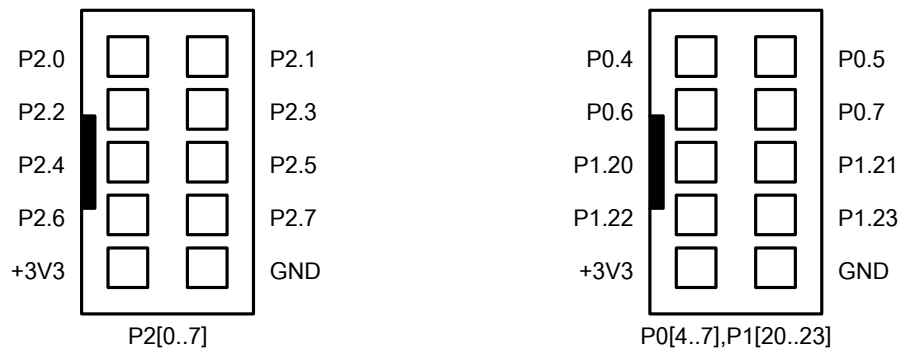
// Select Direction RS485 = Receive
IOCLR1   = 0x00080000;           // RS485 Direction = 0 (Receive)

// Select Direction RS485 = Transmit
IOSET1   = 0x00080000;           // RS485 Direction = 1 (Transmit)
```

## Port I/O Connectors of Board

For Port I/O Connector of CPU is arranged outwards, so it makes user be able to connect as desired; in this case, there are 6 sets as follows;

- 2 Sets of IDE 10 Pin Connector; each set has 8 Bit that is P2[0..7] and KEY4X4 (P0[4..7],P1[20..23]). Its signal arrangement is shown below.



- SPI-0 Connector is 1x6 Header that is connecting point P0[15..18] for using it to be general GPIO function or SPI Bus function as desired.
  - P0.15 = SCK/SCK0
  - P0.16 = SSEL/SSEL0
  - P0.17 = MISO/MISO0
  - P0.18 = MOSI/MOSI0
- I2C-0 Connector is 1x4 Header that is connecting point P0[27..28] for using it to be general GPIO function or I2C Bus function as desired.
  - P0.27 = SDA0
  - P0.28 = SCL0
- A/D Connector is 1x4 Header that is connecting point P0[24..25] for using it to be general GPIO function or A/D function as desired.
  - P0.24 = AD0.1
  - P0.25 = AD0.2
- D/A Connector is 1x3 Header that is connecting point P0[26] for using it to be general GPIO function or D/A(Aout) function as desired.
  - P0.26 = AOUT or D/A

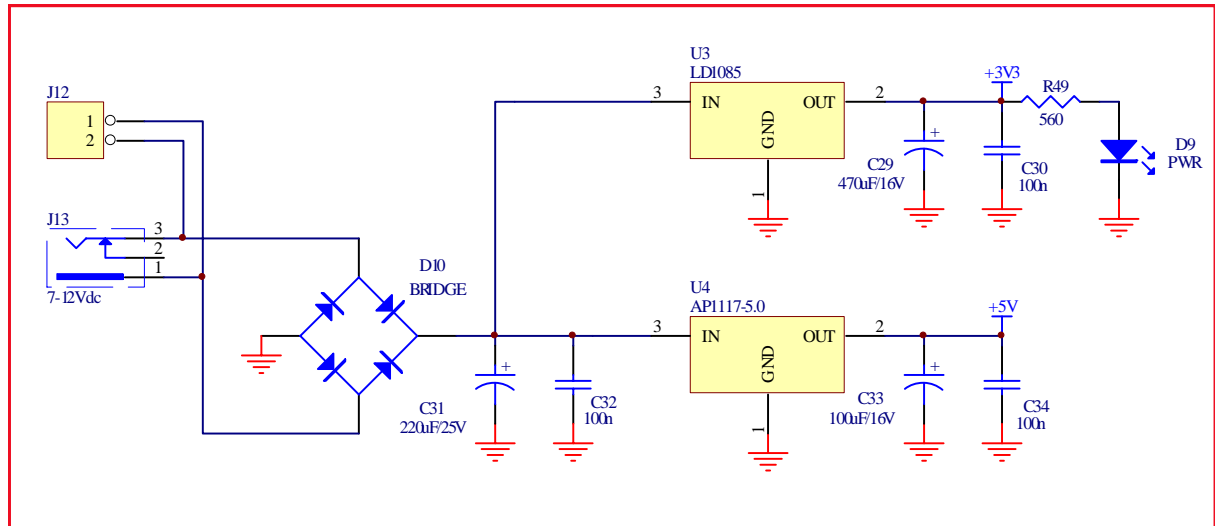
## Power Supply Circuit

Power Supply Circuit can be used with 7-12V AC/DC; in this case, we can interface Power Supply into board at the connecting point that is Terminal or Jack-DC as desired. This connecting Power Supply



will be sent to Bridge Rectifier Circuit and +3V3/3V Regulate and +5V/800mA Regulate.

Power Supply Circuit in the part of 3.3V Regulate Circuit will supply power into CPU and all I/O Circuit of Board, except Character LCD and Line Driver Circuit of RS422/485 because both devices use +5VDC Power Supply from Regulate Circuit.

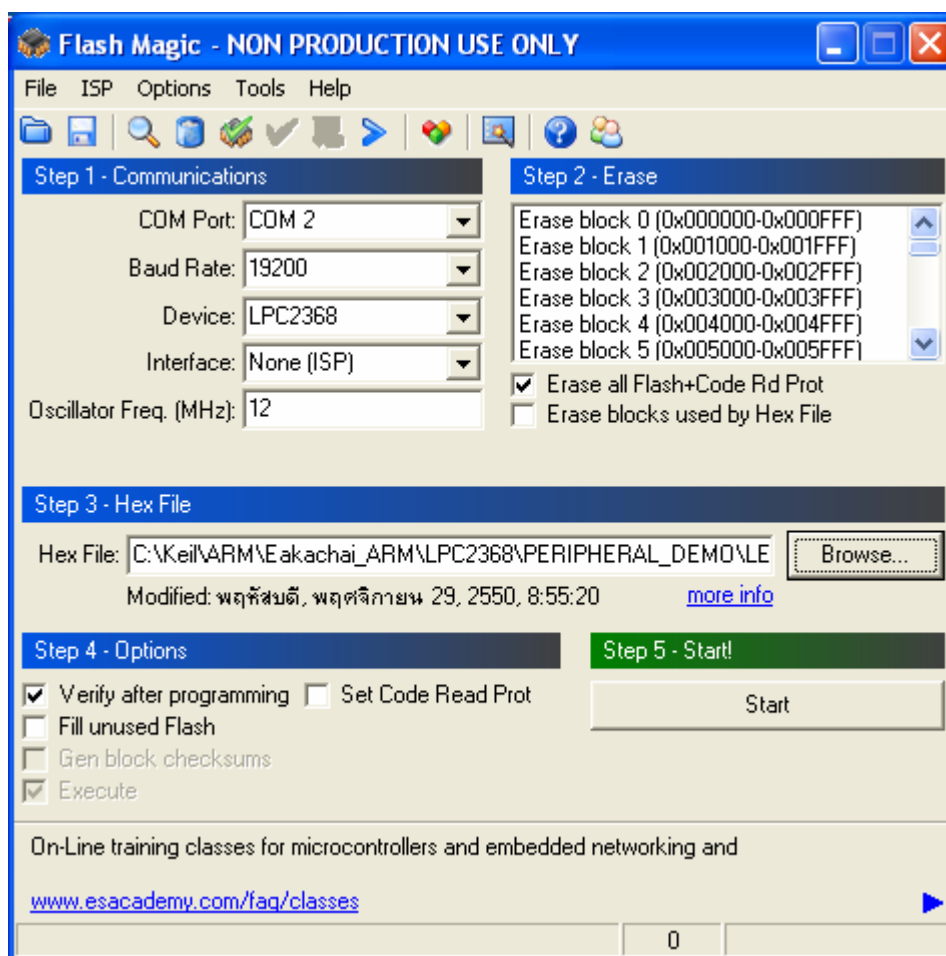


## How to Download Hex File into MCU of Board

The method to download Hex File into Flash Memory of MCU in Board is to use Program Flash Magic of "Embedded System Academy, Inc" that is connected with MCU through Serial Port of computer PC. This program can be downloaded free without any charge from website [www.esacademy.com](http://www.esacademy.com).

## Proceeding to Download Hex File into MCU

1. Interface RS232 Cable between RS232 Serial Port of PC and Board UART-0.
2. Supply power into board; in this case, we can see red LED PWR is in status ON.
3. Run Program Flash Magic; if it is version 4.02.260, it will display result as shown below.



4. Start setting the initial values into program as desired; in this case, it is used with LPC2368 of Board CP-JR ARM7 LPC2368 of ETT, so we configure values into program as follows;

- 2.1 Select COM port corresponding with the COM Port Number that is used (in the example, it is COM2).
- 2.2 Set Baud Rate in the range 2400-115200; if setting very high Baud Rate and Error is occurred, please reduce Baud Rate. In this example, it uses Baud Rate 19200.
- 2.3 Set Device to be LPC2368.
- 2.4 Set Interface to be None ISP.
- 2.5 Set Crystal Oscillator with MHz corresponding with the value internal

Board. In this case, it is 12.000MHz, so we must set to be 12.

2.6 Press ISP LOAD Switch and RESET Switch on Board "CP-JR ARM7 LPC2368" to reset MCU to run in Boot Loader following the processes;

- Press ISP LOAD Switch and hold
- Press RESET Switch while ISP LOAD Switch is being held.
- Remove RESET Switch but ISP LOAD Switch is being held.
- Lastly, remove ISP LOAD Switch.

5. Select format of erasing data to be **"Erase all Flash + Code Rd Prot"**.

6. Set Option to be **"Verify after programming"**.

7. Click **"Browse"** to select HEX File for downloading.

8. Click **"Start"**, Program Flash Magic will start downloading data into MCU instantly. In this case, we can see the status operation at Status Bar and we must wait for the operation until it is completely.

9. When the operation of program is complete, press RESET Switch on Board and MCU will start running follow the downloaded program instantly.