

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
4 June 2009 (04.06.2009)

PCT

(10) International Publication Number  
**WO 2009/069969 A2**

(51) International Patent Classification:  
**H01R 12/16** (2006.01)

(21) International Application Number:

PCT/KR2008/007050

(22) International Filing Date:

30 November 2008 (30.11.2008)

(25) Filing Language:

Korean

(26) Publication Language:

English

(30) Priority Data:

10-2007-0124034

30 November 2007 (30.11.2007) KR

10-2007-0124068

2 December 2007 (02.12.2007) KR

10-2007-0127269

10 December 2007 (10.12.2007) KR

10-2008-0012013 8 February 2008 (08.02.2008) KR

10-2008-0012016 9 February 2008 (09.02.2008) KR

10-2008-0120202

29 November 2008 (29.11.2008) KR

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(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

(54) Title: A TYPE SYMMETRIC USB RECEPTACLE

(57) Abstract: The present invention relates to the symmetric A type usb receptacle which is easily connected with usb plug regardless of the relative orientation of the receptacle and plug. This is achieved by adding electrical contacts symmetrically and electronic sensor circuit which can detect the relative orientation of the receptacle and plug. The sensor circuit contains microcontroller and analog multiplexer to route the usb signal path. The present invention contains symmetric contact portion, sensor portion to detect which surface of the symmetric contact portion is connected to the usb plug, the control portion to route the usb signal path through the detected contacts.



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## Description

### A TYPE USB RECEPTACLE

#### Technical Field

- [1] The present invention relates to the A type USB receptacle. The cross section of A type usb plug of usb peripheral device is rectangle and it is difficult to recognize the direction of the rectangle by just touching so it is required to check the direction of it by looking at the cross section of the rectangle. But if there is no enough illumination or the receptacle is installed on the back of PC then we must watch the receptacle carefully with electric light and mirror. There is an invention(US 7,160,125 B1, reversible universal serial bus (usb) device and connector) to solve this problem, But said US invention contains mechanical part (which is wearable and unstable due to vibration or mechanical shock) to detect the orientation of plug.

#### Disclosure of Invention

##### Technical Problem

- [2] The object of present invention is to provide A type usb receptacle which is pluggable regardless of the orientation of the usb plug

##### Technical Solution

- [3] The above object of present invention can be achieved by adding the electrical contacts symmetrically and sensor circuit to usb A type receptacle.
- [4]

##### Advantageous Effects

- [5] A type USB plug can be easily and instantly connected with the receptacle of present invention regardless of the orientation of plug so it can be used for children, elders or blind person. And it can be used for the computer of emergency room or military.
- [6]

#### Brief Description of Drawings

- [7] Fig.1 is the side view of the conventional A type usb receptacle and usb plug
- [8] Fig.2 is the side view of the A type usb symmetrical receptacle of present invention.
- [9] Fig.3 is the perspective view of Fig.2.
- [10] Fig.4 is the front view of the A type usb symmetrical receptacle.
- [11] Fig.5 is the composition diagram of present invention.
- [12] Fig.6 is more specific diagram of Fig.5.
- [13] Fig.7 is the flow chart of microcontroller.
- [14] Fig.8 is the example of circuit to measure the current.
- [15] Fig.9 is the A type usb symmetrical receptacle for usb3.0.
- [16]

- [17] <symbols in Drawings>
- [18] re : conventional A type usb receptacle
- [19] pg1,pg2,PG1,PG2 : A type usb plug
- [20] d,u : conducting terminals
- [21] c1,e1,e2 : conducting terminals of usb plug
- [22] rc : A type usb receptacle of present invention
- [23] cnt,cnt0,cnt1,cnt2 : circuit portion
- [24] cv : conducting sleeve of usb plug
- [25] mxu,mxd,mxp : analog multiplexer
- [26] cu,cd,cp : control signal
- [27] ssu,ssd : additional conducting terminal for usb3.0
- [28]

### **Best Mode for Carrying out the Invention**

- [29] embodiment1
- [30] Fig.1 is the side view of the conventional usb receptacle (re) and the usb plugs(pg1,pg2). The 1st plug (pg1) can be connected to the receptacle (re) but the 2nd plug (pg2) can not be connected because its orientation is not aligned to the receptacle. In other words, the 2nd plug(pg2) must be rotated by 180 degree in order to align its orientation to the receptacle(re). The conducting terminals(c1) of the 1st plug(pg1) connected to the receptacle (re) touches with the conducting terminals(d) of the receptacle(re). The conducting terminals(d) of the receptacle(re) are connected to the host controller of circuit of PC and the conducting terminals(c1) of plug(pg1) are connected to the peripheral device.
- [31] The Fig.2 is the side view of receptacle(rc) of present invention. Fig.2 shows the conducting terminals(u) on the upper side and the conducting terminals(d) on the lower side of the receptacle(re).It means that the plugs (PG1, PG2) can be connected regardless of its orientation(0 and 180 degree rotated states of plug are equal orientation with respect to the receptacle of present invention). In Fig.2, if the plugs(PG1,PG2) are connected to the receptacle(rc) then the conducting terminals(e1) of the 1st plug (PG1) touches with the conducting terminals(d) of the lower side of the receptacle (rc) and the conducting terminals(e2) of the 2nd plug (PG2) touches with the conducting terminals(u) of the upper side of the receptacle (rc)
- [32] The Fig.3 is the perspective view of receptacle(rc) and the 1st plug(PG1) of Fig2 and the Fig.4 is the front view of the receptacle(rc) of Fig.2. In Fig.4, the conducting terminals of upper side and the lower side are symmetric with respect to the 180 degree rotation In Fig.4, '\_u' and '\_d' represent the upper and lower side respectively. For example, D-\_u, D-\_u represent D- terminal of lower side and D- terminal of upper side

respectively.

- [33] Fig.5 shows the composition of symmetric receptacle of present invention. As shown in Fig.5, the symmetric receptacle of present invention includes
- [34] the upper surface portion (including upper conducting terminals GND\_u,D+\_u,D-\_u,Vbus\_u),
- [35] lower surface portion (including lower conducting terminals GND\_d,D+\_d,D-\_d,Vbus\_d),
- [36] and circuit portion(cnt)(including sensor portion,analog multiplexers, and control portion).
- [37] The sensor portion detects which side (upper side or lower side of the symmetric receptacle) touches the conducting terminal of usb plug. The control portion controls the sensor portion and analog multiplexers so that the usb signal can flow through the touching side of the symmetric receptacle.
- [38] The circuit portion(cnt) can be installed on the PCB near to the host controller or installed inside of the receptacle module(rc) as shown cnt1 in Fig.2. It is also possible to install the circuit portion(cnt) inside of the host controller as shown cnt0 in Fig.2. In other words, the location of the circuit portion is not restricted.
- [39] The Fig.6 is the more specific description of Fig.5. In Fig.6, the circuit portion(cnt) includes the microcontroller or sequential circuit(mic) and the analog multiplexers (mxu,mxd,mxp). The analog multiplexers are classified as following:
- [40] the upper analog multiplexer(mxu) connected to the conducting terminal(u) on the upper side of receptacle;
- [41] the lower analog multiplexer(mxd) connected to the conducting terminal(d) on the lower side of receptacle; and
- [42] the host analog multiplexer(mxp) connected to host controller.
- [43]
- [44] The lines(d,u,p) in Fig.6 represent the set of 4 conducting terminals (GND,D-,D+,Vbus) of lower side ,upper side and host controller respectively. The power supply for microcontroller(mic) and the analog multiplexers can be utilized from the independent power or the usb power(GND,Vbus).
- [45] The microcontroller(mic) outputs the control signal(cu,cd) to the analog multiplexers(mxu, mxd) on order to connect the conducting terminal of upper or lower side of receptacle to I/O ports of microcontroller and recognize which side of receptacle is connected to the conducting terminals of usb plug by outputting the test signal and reading signal from its input ports. If the recognition is successful then the microcontroller outputs the control signals (cu,cd,cp)to the analog multiplexers(mxu, mxd ,mxp) in order to connect the touching side of receptacle to the host controller.
- [46] Some usb peripheral device like memory stick has no conducting sleeve (cv in Fig.2

and Fing.3) and some usb peripheral device like electric fan has dummy D-, D+ terminal (dummy terminal means the terminal isolated from circuit). Therefore The state of conducting terminals of upper or lower side of the symmetric receptacle is one of the following 4 states:

[47]

[48] Table 1

[Table 1]

[Table ]

| State                                                                                                                                                                | State id |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Nothing is touching the conducting terminals of the receptacle                                                                                                       | T0       |
| Conducting sleeve(cv) of usb plug is touching the conducting terminals of the receptacle. (the conducting terminals are shorted each other by the conducting sleeve) | T1       |
| Conducting terminals of usb plug with dummy D+ and D- terminal is touching the conducting terminals of the receptacle.                                               | T2       |
| Conducting terminals of ordinary usb plug (ordinary means that the D+, D- terminals are not dummy ones) is touching the conducting terminals receptacle              | T3       |

[49]

[50]

[51] Therefore the combination of the 2 states of the upper and lower side of the symmetric receptacle is one of the following:

[52]

[53] Table 2

[Table 2]

[Table ]

| State of upper side state of lower side | T0 | T1 | T2 | T3 |
|-----------------------------------------|----|----|----|----|
| T0                                      | S0 | X  | S1 | S2 |
| T1                                      | X  | X  | S3 | S4 |
| T2                                      | S5 | S6 | X  | X  |
| T3                                      | S7 | S8 | X  | X  |

[54]

[55] The states S0~S8 in the above table 2 represent possible state and 'X' represent

impossible state. For example, S0 represents the state in which any usb plug is not connected and S4 represents the state in which the state of upper side of receptacle is T3 and the state of lower side of receptacle is T1.(i.e., upper side is touching the conducting terminals of usb plug and the lower side is touching the conducting sleeve of usb plug) The correspondence between the operation of microcontroller and the state of the receptacle is following:

[56]

[57] Table 3

[Table 3]

[Table ]

| State of Lower side | State of upper side | State of symmetric receptacle | Summary of state                                                          | Operation of micro-controller                                                            |
|---------------------|---------------------|-------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| T0                  | T0                  | S0                            | No plug is connected to the receptacle                                    | Continue to check whether the plug is connected                                          |
| T0                  | T2                  | S1                            | Upper side of receptacle is touching the conducting terminals of usb plug | Connect the conducting terminals of the upper side of receptacle to the host controller. |
| T0                  | T3                  | S2                            |                                                                           |                                                                                          |
| T1                  | T2                  | S3                            |                                                                           |                                                                                          |
| T1                  | T3                  | S4                            |                                                                           |                                                                                          |
| T2                  | T0                  | S5                            | lower side of receptacle is touching the conducting terminals of usb plug | Connect the conducting terminals of the lower side of receptacle to the host controller. |
| T2                  | T1                  | S6                            |                                                                           |                                                                                          |
| T3                  | T0                  | S7                            |                                                                           |                                                                                          |
| T3                  | T1                  | S8                            |                                                                           |                                                                                          |

[58] Fig.7 shows the flow chart of microcontroller(mic) of circuit portion (cnt). The detail step number and its description of the flow chart with the symbols in Fig.6 is following:

[59]

[60] (1)microcontroller outputs control signal(cu,cd,cp) to analog multiplexers(mxu,mxd,mxp) to disconnect the connection between the host controller and the conducting terminals of receptacle and goes to step(2)

[61] (2) microcontroller outputs control signal(cu,cd)to analog multiplexers (mxu,mxd) to connect the conducting terminals of upper side of receptacle with the I/O ports of microcontroller and outputs the test signal to the output ports of microcontroller and reads signal from the input ports of microcontroller and recognize the state of the upper side

of receptacle by interpreting the read signal and goes to the step(3).(It is recommended to read analog voltage from the input port and convert the read value with a analog digital converter.)

- [62] (3)microcontroller outputs the control signal (cu.cd) to analog multiplexers (mxu,mxd) to connect the conducting terminals of lower side of receptacle with the I/O ports of microcontroller and outputs the test signal to the output ports and reads signal from the input ports and recognizes the state of the lower side of receptacle by interpreting the read signal and goes to the step(4).
- [63] (4)Find the state(S0~S8 in Table3) of receptacle from the states of each side of receptacle(T0~T3) determined by the above step(2) and (3) and find the operation which is assigned to the found state by the table 3 and executes the found operation.
- [64] In other words, If an usb plug is connected with the receptacle then microcontroller outputs the control signal(cu.cd,cp) to the analog multiplexers to connect the conducting terminals of usb plug with the host controller and goes to the step(5).
- [65] If no ubs plug is connected with the receptacle then goes to step(2) and readptes the above steps.
- [66] (5)Check whether the usb plug is disconnected from the receptacle. If the plug is disconnected then goes back to the step(1) and repeats the above steps. If the plug is not disconnected then repeats the step(5).
- [67]
- [68] The disconnection between the usb plug and the receptacle can be detected by measuring the current through the power pin(Vbus). If the measured current is 0 then disconnection is happened. Fig.8 shows an example of the circuit to measure the current. There is a small resistor(R) between the power pin(p1) of host controller and the power pin(u1) of usb plug and the voltage drop between 2 pins(u1,p1) is propersional to the current through the resistor(R).
- [69]
- [70] In the above step(2) and (3), the method to recognize the state of upper (or lower) side of receptacle is following:
- [71] The microcontroller outputs control signal(cu) to analog multiplexer (mxu) to connect power pin (Vbus\_u) of upper side of receptacle with the output port of microcontroller(mic) and to connect ground pin(GND\_u) of upper side of receptacle with the input port of microcontroller(mic) where the input port of microcontroller is recommended to be connected with ground with pull down resistor. And the mic ro-controller outputs 5 volt or 3 volt.(this 5 or 3 volt is an example of logic high(1)) and reads the voltage from input port. It is recommended to read analog voltage value with analog digital converter in order to read more accurate voltage value.
- [72] If the read voltage is 0 then there is nothing touching the conducting terminals of the

receptacle and this state is T0 in table1.

- [73] If the read voltage is positive then conducting sleeve or conducting terminals of usb plug is touching the conducting terminals of receptacle. (the positive read voltage means that the power pin of upper side of receptacle is connected to the ground pin of upper side of receptacle through the conducting sleeve or the circuit of usb plug) This state is one among T1, T2, T3 in table 1. The method to determine the state from T1,T2,T3 is following:

[74]

- [75] The microcontroller outputs control signal(cu) to analog multiplexer (mxu) to connect power pin (Vbus\_u) and ground pin(GND\_u) of upper side of receptacle with the output ports of microcontroller(mic) respectively and to connect usb data pins(D+\_u,D-\_u) with the input ports of microcontroller (mic) respectively. The input ports of microcontroller(mic) is recommended to be connected with the ground with pull down resistor. It is also recommended to insert small resistor between the ground pin(GND\_u) and the output port of microcontroller.(This resistor prevents the short between the power pin(Vbus\_u) and the ground pin(GND\_u) if the conducting sleeve is plugged and touching them) Then the microcontroller outputs the 5 volt to the power pin(Vbus\_u) and outputs 0 volt to the ground pin (GND\_u)and read voltage from the usb data pins(D+\_u,D-\_u).

- [76] If the conducting sleeve is plugged then the read voltages are (positive and positive) because the usb data pins(D+\_u,D-\_u) are connected with the power pin(Vbus\_u) through the conducting sleeve.

- [77] If read voltages are (0 and positive) or (positive and 0) then the ordinary usb peripheral device is plugged to the receptacle.(ubs specification document has it that the usb peripheral device must outputs (0 volt and 3.3 volt) or (3.3 volt and 0 volt) through the data pins D+ and D- in order to inform its speed(low, full, high) to the host controller).

- [78] If the read voltages are (0 and 0) then the data pins(D+\_u,D-\_u) are isolated and it means that plugged usb peripheral has the dummy data pins like the electric fan. The summary is following:

[79]

- [80] Table 4

[Table 4]

[Table ]

| State                                            | read voltage from<br>ground pin(GND_u)<br>after outputting the 5<br>volt through power pin<br>(VBus_u) | Read voltage from<br>D+_u and D-_u<br>after outputting 5<br>volt and 0 volt to<br>VBus_u and<br>GND_u re-<br>spectively |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| T0 (nothing is plugged)                          | 0                                                                                                      |                                                                                                                         |
| T1 (conducting sleeve is plugged)                | positive                                                                                               | (Positive,<br>positive)                                                                                                 |
| T2 (usb plug with dummy D+,D- pin is<br>plugged) | Positive                                                                                               | (0,0)                                                                                                                   |
| T3 (ordinary ubs plug is plugged)                | positive                                                                                               | (0 and positive) or<br>(positive and 0)                                                                                 |

[81]

[82]       embodiment2

[83]       There are 4 conducting terminals in usb 2.0 receptacle but 5 more terminals(1 for ground pin and 4 for data pins SSRX+, SSRX-, SSTX+, SSRX-) are added to the usb 3.0 receptacle. The symmetric receptacle of present invention can be used with the usb 3.0 peripheral device by adding 8 terminals symmetrically as shown in Fig.9. In other words, 4 terminals(ssu) are added on the upper side of receptacle and 4 terminals(ssd) are added on the lower side of receptacle symmetrically . By increasing the channel number of analog multiplexers from 4(VBus, D+,D-,GND) to 8 (VBus, D+,D-,GND, SSRX+, SSRX-, SSTX+, SSRX-), the symmetric receptacle of present invention can be used with the usb 3.0 device.

[84]

[85]

## Claims

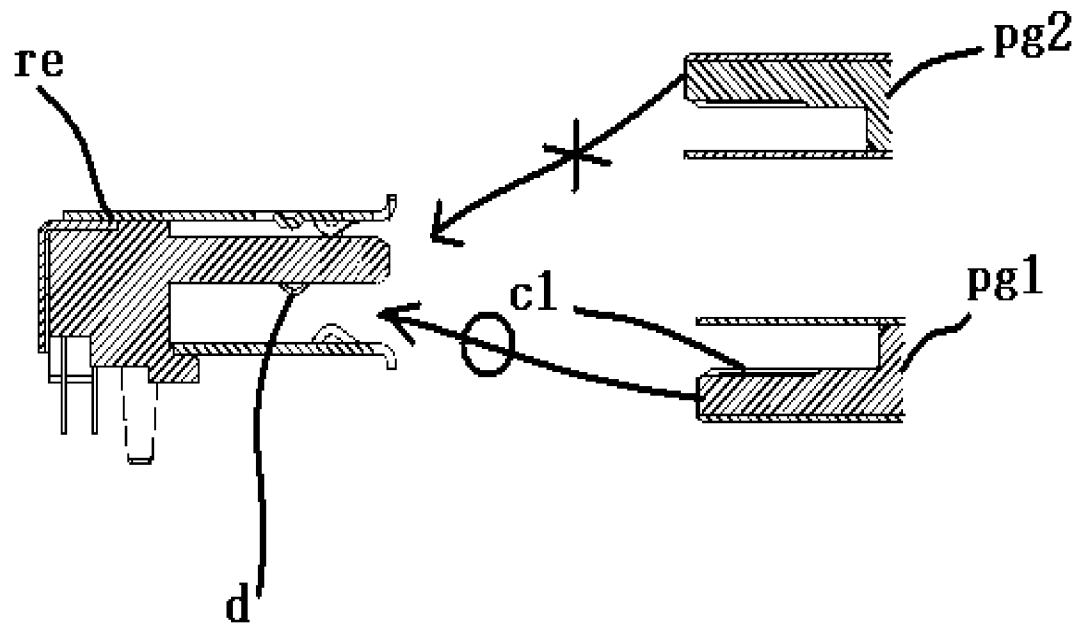
- [1] A type usb receptacle comprising:  
 an upper side portion having conducting terminals(Vbus,GND,D+,D-) of usb receptacle;  
 a lower side portion having conducting terminals(Vbus,GND,D+,D-) which is 180 degree rotationally symmetric to the upper side portion with respect to the center of receptacle;  
 a circuit portion recognizing the position of the usb plug and connecting the host controller with the usb plug.
- [2] A type usb receptacle comprising of claim 1, wherein said circuit portion comprising:  
 A microcontroller;  
 Analog multiplexers for controlling the connections among upper side portion, lower side portion, host controller, and microcontroller wherein the microcontroller recognizes the location of usb plug by outputting control signal to analog multiplexers ,outputting test signal to its output ports and reading voltage from its input ports.
- [3] A type usb receptacle comprising of claim 2, wherein said microcontroller has the operation flow chart in Fig.7.
- [4] A type usb receptacle comprising of claim 3, wherein said microcontroller of the step(2) or step(3) of flow chart of Fig.7,  
 The microcontroller recognizes the state of upper or lower side portion by outputting control signal(cu,cd) to analog multiplexers(mxu, mxd) to connect its I/O ports with the conducting terminals of one of the upper or lower side portion and  
 outputting test signal to its output ports and  
 reading its input ports
- [5] A type usb receptacle comprising of claim 3, wherein said microcontroller of the step(5) of flow chart of Fig.7,  
 The microcontroller detects the disconnection of usb plug by measuring the current through the power pin of upper or lower side portion.
- [6] A type usb receptacle comprising of claim 4, wherein said microcontroller recognizes the state in which nothing is touching the conducting terminals of upper or lower side portion if the measured voltage from the ground pin of one of upper or lower side portion is 0 where the measuring steps are as following:  
 Microcontroller outputs 5 volt to its output ports which is connected with the power pin of one of upper or lower side portion through analog multiplexer;

Microcontroller read voltage from its input port which is connected to ground pin of one of upper or lower side portion where the ground pin is connected to ground with pull down resistor;

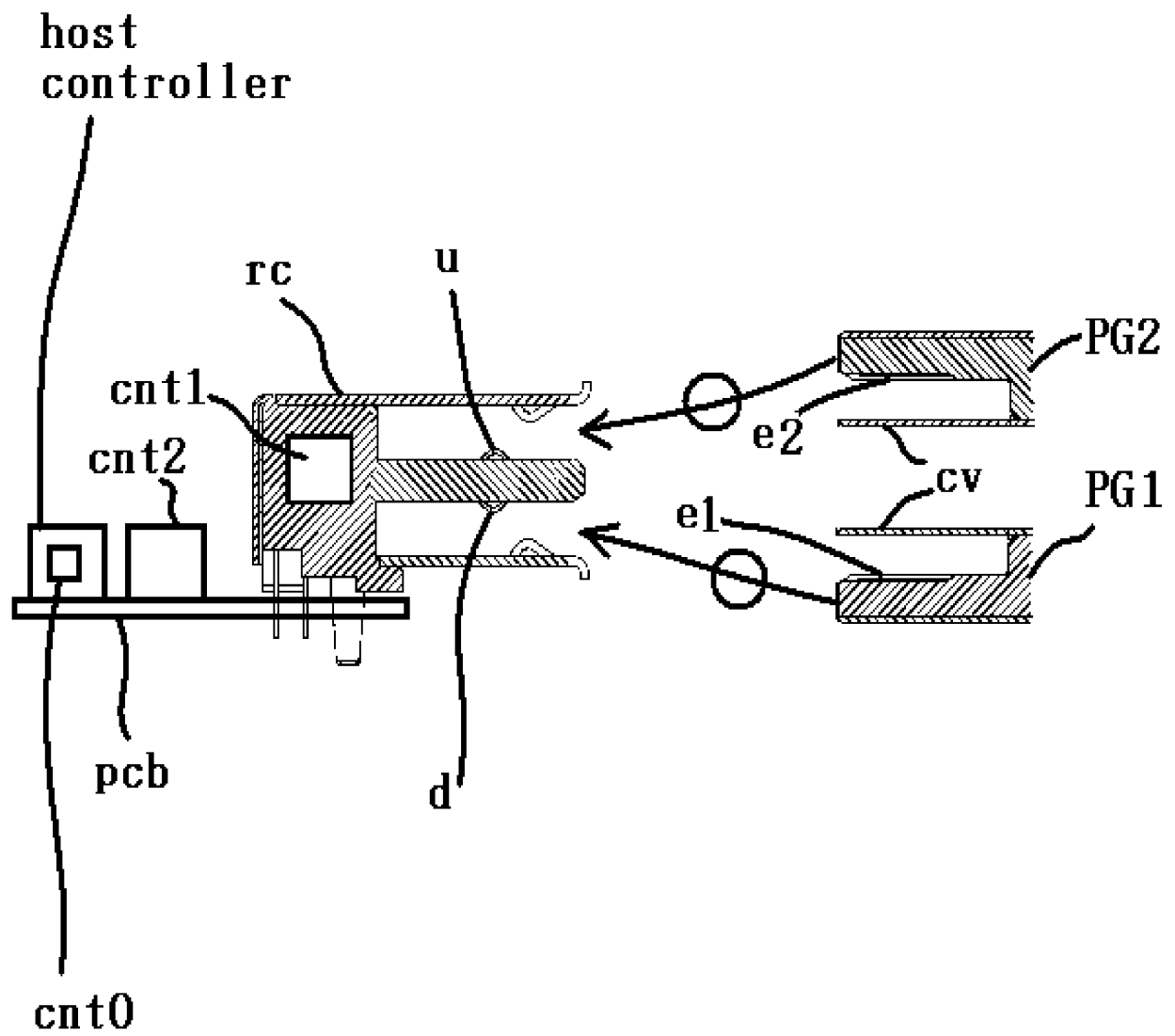
- [7] A type usb receptacle comprising of claim 4, wherein said microcontroller recognizes
- the state in which the conducting sleeve is touching the conducting terminals of one of upper or lower side portion and
- the other state in which conducting terminals of usb plug are touching the conducting terminals of one of upper or lower side portion
- by measuring the voltage from D+,D- pin of one of upper or lower side portion where the measuring and recognizing steps are as following:
- microcontroller outputs 5 volt to its output port which is connected with the power pin of one of upper or lower side portion through analog multiplexer;
- microcontroller outputs 0 volt to its output port which is connected with the ground pin of one of upper or lower side portion through analog multiplexer where the short protecting resistor is inserted between the output port and the ground pin;
- microcontroller reads voltage from its input ports which are connected to D+,D- pin of one of upper or lower side portion respectively where the input ports are connected to ground with pull down resistors;
- if the measured voltages are all positive then microcontroller recognizes that conducting sleeve of usb plug is touching the conducting terminals of one of upper or lower side portion and
- if the measured voltages are 0 and positive then microcontroller recognizes that conducting terminals of usb plug are touching the conducting terminals of one of upper or lower side portion

- [8] A type usb receptacle comprising of claim 1, wherein said conducting terminals include conducting terminals(SSRX+, SSRX-, SSTX+, SSRX-) which are added in usb 3.0.

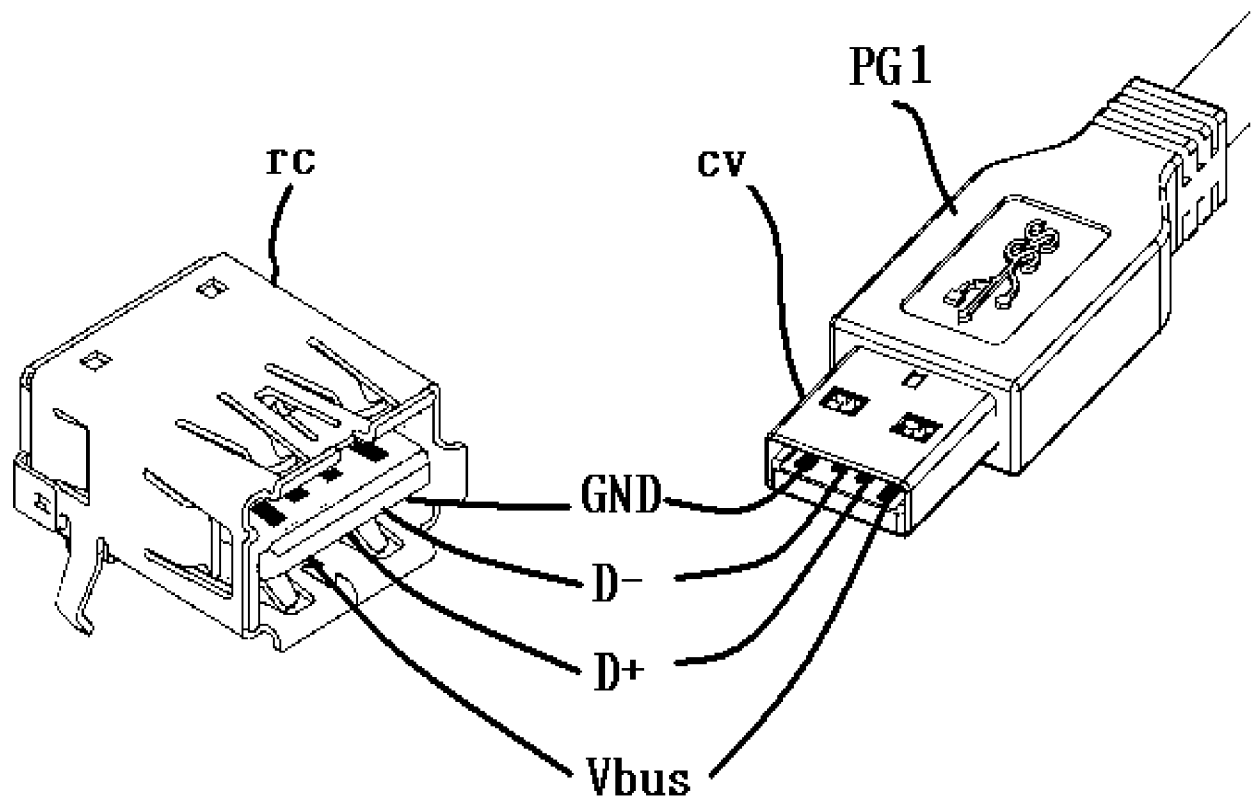
[Fig. 1]



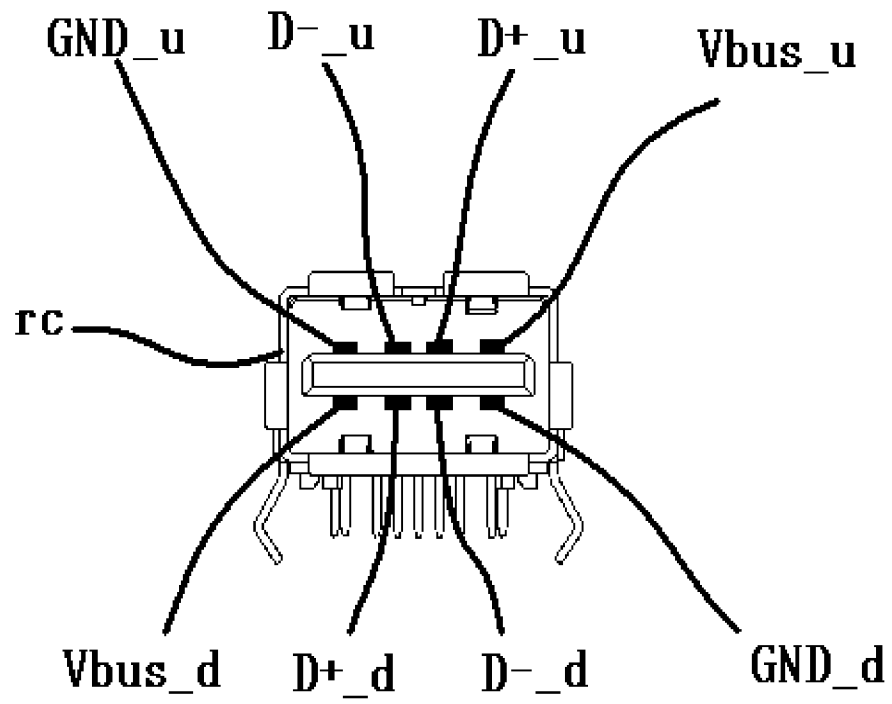
[Fig. 2]



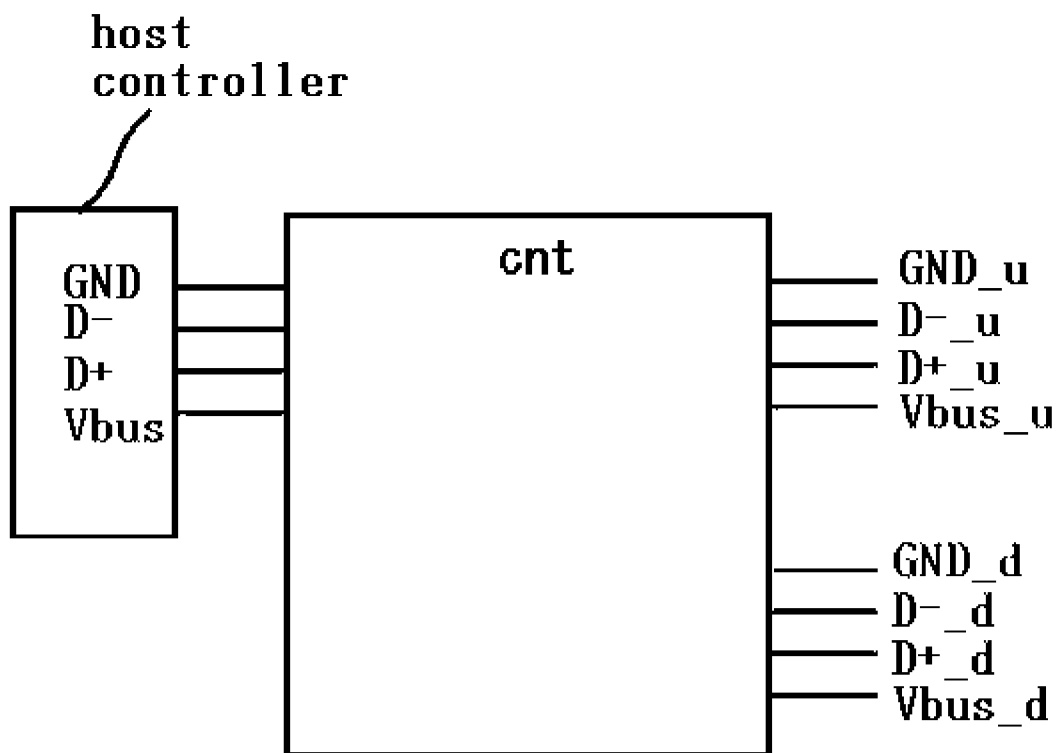
[Fig. 3]



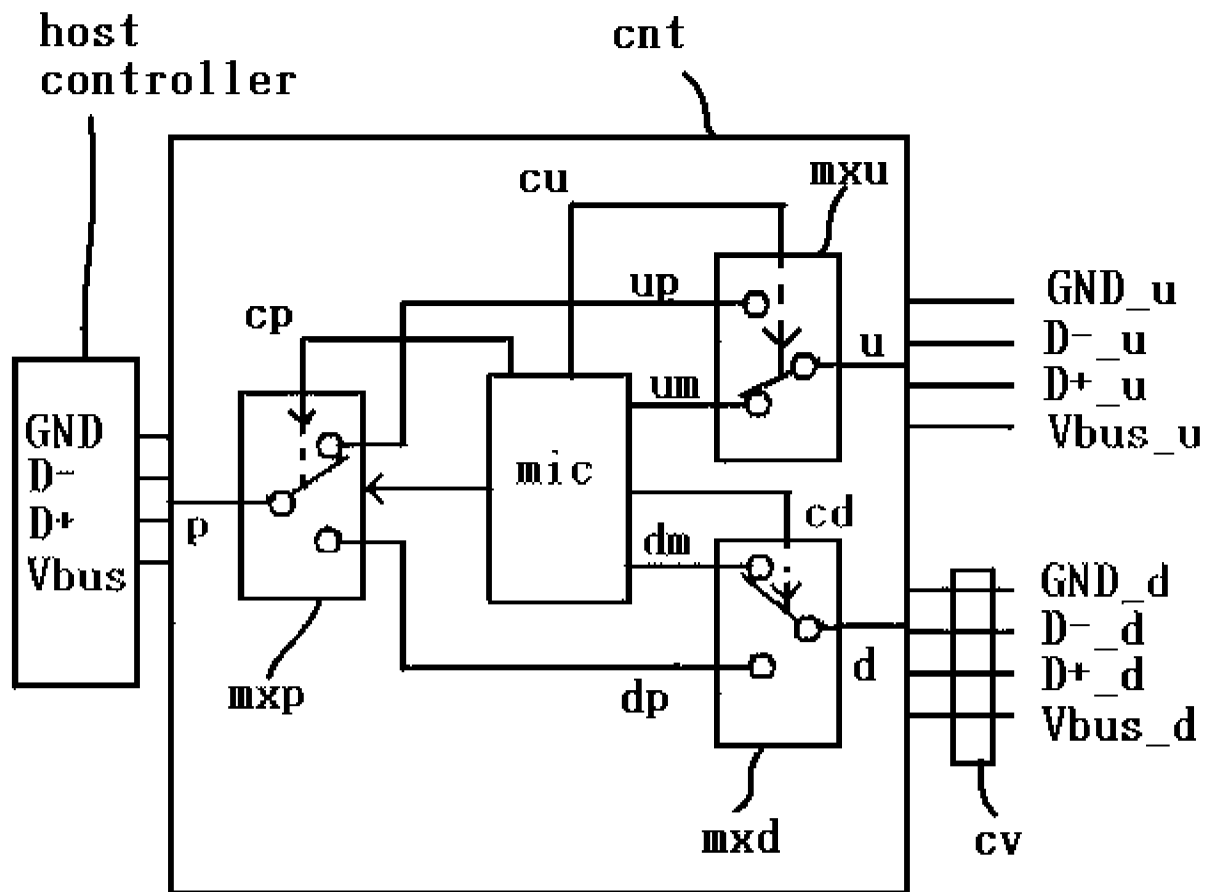
[Fig. 4]



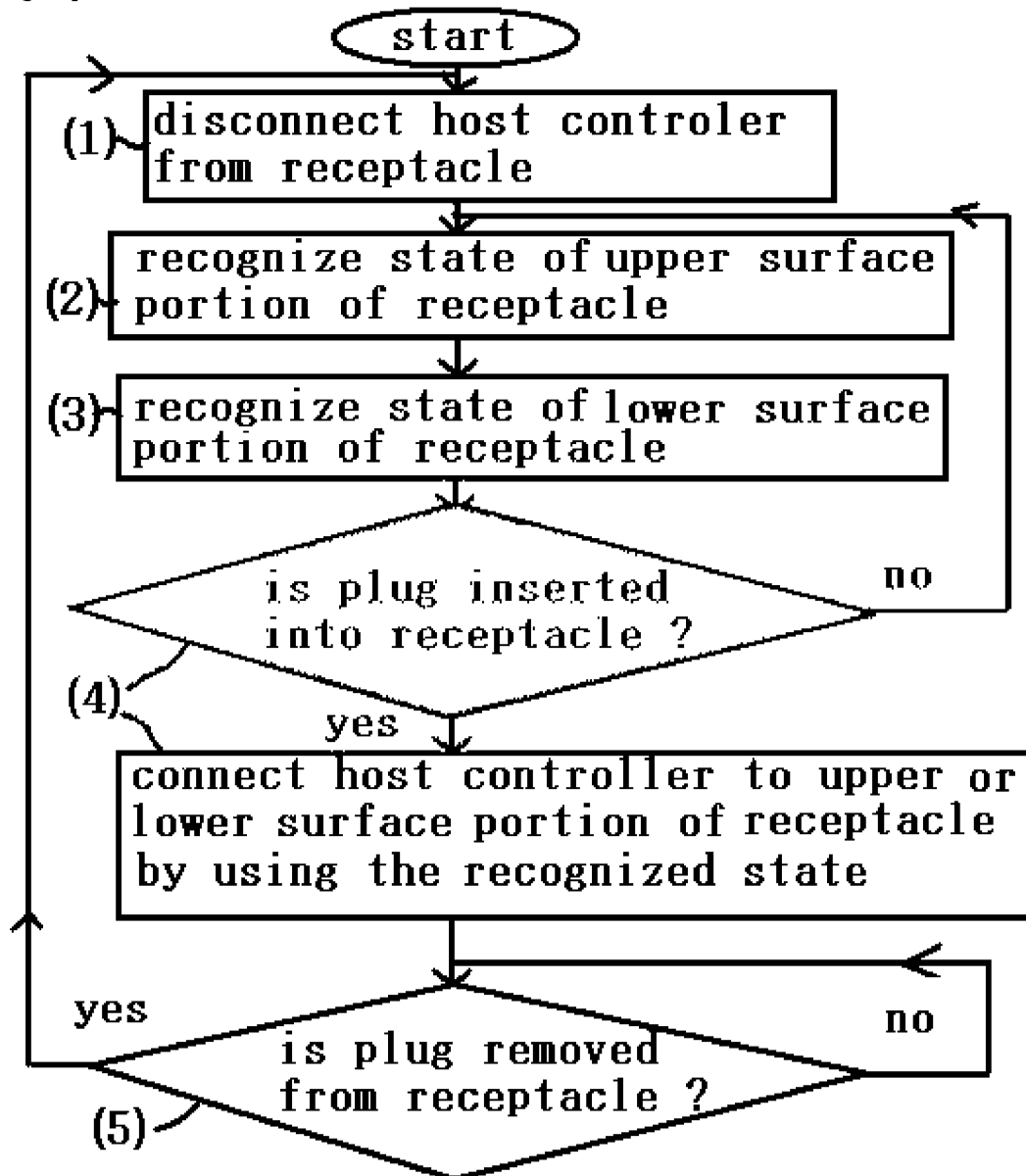
[Fig. 5]



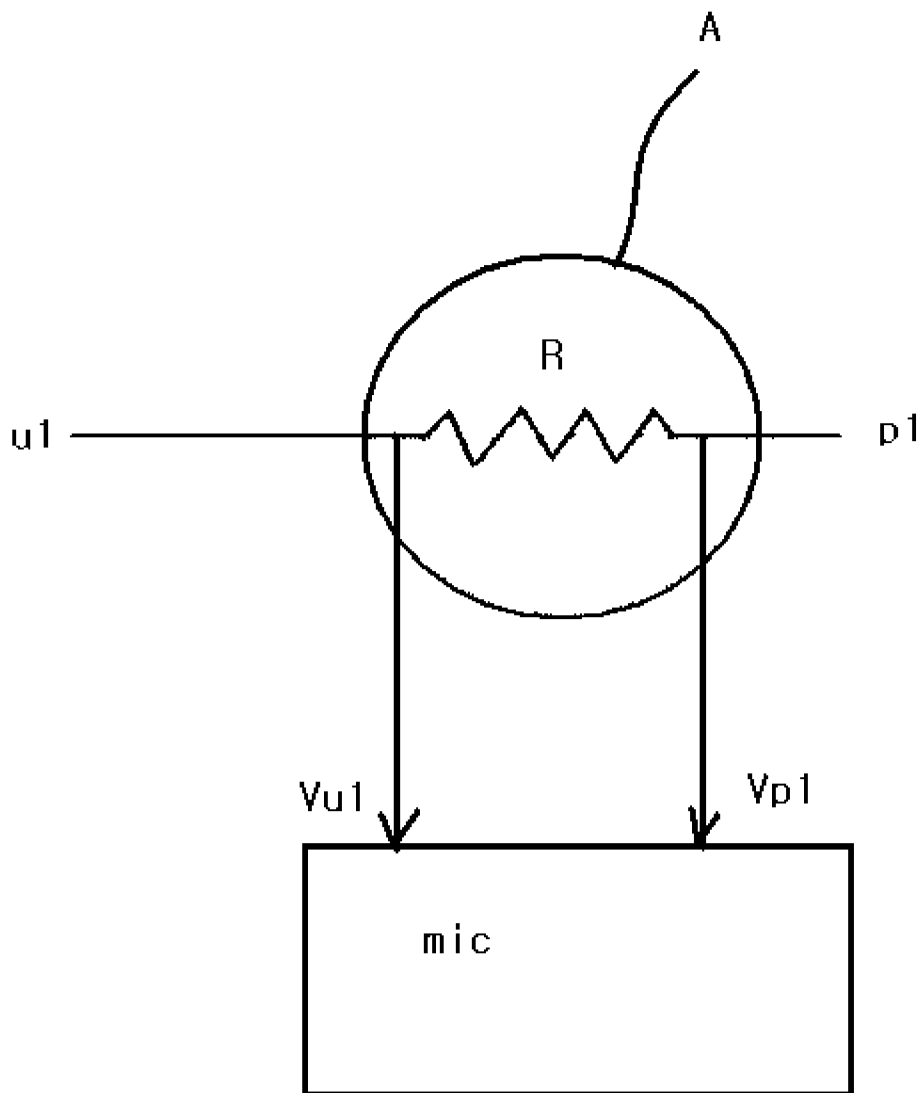
[Fig. 6]



[Fig. 7]



[Fig. 8]



[Fig. 9]

