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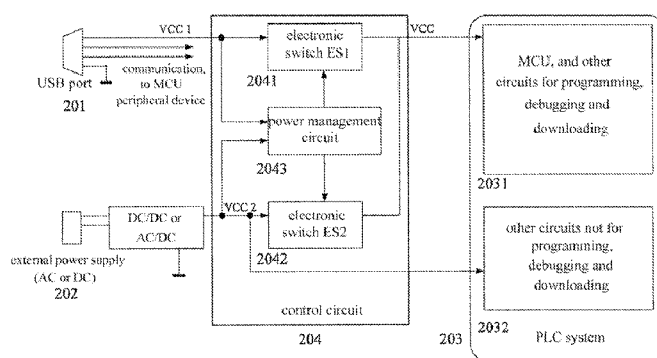


FIG. 2

(57) **Abstract:** A power supply control circuit (204) is provided. The power supply control circuit (204) comprises: a first switch (2041), for receiving power from a Universal Serial Bus (USB) port (201) and outputting power to a core circuit (2031) of a Programmable Logic Controller (PLC) system (203); a second switch (2042), for receiving power from an external power supply (202) and outputting power to the core circuit of the PLC system; and a power management circuit (2043), for controlling the first switch and the second switch to be on and off according to a power input status of the USB port and a power input status of the external power supply, wherein the power management circuit controls the first switch to be on and the second switch to be off when there is no power input from the external power supply and there is a power input from the USB port. An external power supply is not needed to be connected to the PLC system when users need to download programs or perform some simple programming and debugging. The users can make connection to the PLC through a personal computer (PC) using the USB and the PLC is powered to perform some main functions.

CIRCUIT AND METHOD FOR POWER SUPPLY CONTROL

Field of the invention

5 The present invention relates to a circuit and a method for power supply control, and more specifically, to a power supply control circuit and a method for downloading and debugging by supplying power to PLC through USB.

Background

10 Nowadays, many PLCs (Programmable Logic Controller) employ USB ports for programming and debugging the user applications of the PLC. In general, a PLC is supplied by an external power supply in normal operation or programming. Users have to power PLCs through external power supply when they want to program, download or debug PLC
15 applications. The reason is that PLCs in normal operation requires more current than an USB can supply, despite for an MCU (Microprogrammed Control Unit) only, which is in a PLC, a current supplied from an USB would be sufficient.

Therefore, the present application proposes a method for powering only the MCU in the PLC for programming, debugging and downloading by cutting off other circuits using electronic
20 switches.

Figure 1 shows a circuit diagram for powering a PLC system of the prior art. As shown in Figure 1, all circuits of a PLC system 103 are powered by an external power supply 102 only. Thus, users have to connect external power supply to a PLC system even if they just want to
25 download user applications through an USB port.

Summary of the Invention

Other aspects and advantages of the present invention will be explained in the descriptions below, and other parts can be easily seen from the descriptions or from the practice of the
30 present invention.

The present invention uses an USB cable to power a PLC to perform downloading and simple programming/debugging.

The present invention makes it easier for users to use PLCs.

As for the prior art, users have to connect external power supply to a PLC system even if they just want to download user applications through an USB port.

The method according to the present invention does not require an external power supply to be connected to a PLC system when the user needs to download programs or perform some simple programming and debugging. The users can connect a PLC to a programming/ debugging device (e.g. a PC and etc.) with an USB, and the PLC will be powered to perform some main functions, e.g. downloading, programming, debugging and etc.

When a PLC is powered through an USB, the method according to embodiments of the present invention cuts off power of some parts of the system with electronic switches, to ensure sufficient power supply to core circuits from the USB power supply.

The present invention provides a power supply control circuit, comprising: a first switch, for receiving power from an USB port, and outputting power to a core circuit of a Programmable Logic Controller PLC system; a second switch, for receiving power from an external power supply, and outputting power to the core circuit of the PLC system; power management circuit, for controlling the first switch and the second switch to be on and off according to a power input status of the USB port and a power input status of the external power supply, wherein the power management circuit controls the first switch to be on and the second switch to be off when there is no power input from the external power supply and there is a power input from the USB port.

The present invention provides a power supply control method, comprising: powering a core circuit of a PLC system through an USB port and cutting off power to other circuit of the PLC system, when there is no power input from an external power supply and there is a power input from the USB port.

Brief description of the drawings

The above and other purposes, features and advantages of the present invention will be better understood by detailed descriptions of the preferred embodiments of the present invention in accompany with drawings, wherein same references indicate units with same structure, and wherein:

Figure 1 shows a prior art circuit diagram for powering a PLC system; and

Figure 2 shows a power supply control circuit diagram for powering a PLC system according to the embodiment of the present invention.

Detailed description of the preferred embodiments

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The present invention will be fully described hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. On the contrary, these embodiments are provided so that the present disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, components may be exaggerated for the sake of clarity.

15

It should be understood that when an element is referred to as being "connected to" or "coupled to" another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being "directly connected to" or "directly coupled to" another element, there are no intervening elements present. Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

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It will be understood that, although the terms first, second, third etc. may be used herein to describe various elements, components and/or sections, these elements, components and/or sections should not be limited by these terms. And these terms are only used to distinguish one element, component, or section from another element, region or section. Thus, a first element, component or section discussed below could be termed a second element, component or section without departing from the teachings of the present invention.

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The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It should be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features,

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integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Figure 2 shows a power supply control circuit diagram for powering a PLC system according to the embodiment of the present invention.

As shown in Figure 2, the present invention employs an USB port 201 to power a main circuit of a PCL system 203, in addition to powering the PLC system 203 through an external power supply 202.

In Figure 2, the PLC system 203 is divided into 2 groups:

a) In group 1, a core circuit 2031 can be powered by the external power supply 202 or the USB 201, and circuits in group 1 include MCU and circuits for programming, debugging and downloading, e.g. an MCU and/or a memory. In addition, it can further include a small current light/LED, and/or port and etc.

b) In group 2, another circuit 2032 is only powered by the external power supply 202, and circuits in group 2 include circuits not for programming, debugging and downloading, e.g. I/O, and/or status light/LED, and/or communication ports and etc.

A control circuit 204 powers the PLC system 203 by controlling one or two of the external power supply 202 and the USB port 201. The control circuit 204 includes: a switch ES1 2041, a switch ES2 2042, and a power management circuit 2043. The switches ES1 and ES2 can be implemented by diodes, transistors, MOSFETs, and even integrated circuits.

The power management circuit 2043 controls switches 2041 and 2042 to switch on and off.

As shown in Figure 2, VCC1 is electric power from the USB port 201; and VCC2 is electric power from the external power supply 202. Electric power VCC1 from the USB port 201 is connected to the switch 2041 and the power management circuit 2043 respectively; and electric power VCC2 from the external power supply 202 is connected to the switch 2042, the power management circuit 2043 and other circuits 2032 of the PLC system 203 respectively. Other circuits 2032 of the PLC system 203 is directly powered by the electric power VCC2 from the external power supply 202. And the core circuit 2031 of the PLC system 203 is powered by electric power VCC output from switches 2041 and 2042.

a) The power management circuit 2043 controls the switch ES1 to switch off and the switch ES2 to switch on when VCC2 is available and VCC1 is unavailable. At this point, the PLC system 203 is only powered by the external power supply 202.

b) The power management circuit 2043 controls the switch ES1 to switch off and the switch ES2 to switch on when both VCC2 and VCC1 are available. At this point, the PLC system 203 is only powered by the external power supply 202.

c) The power management circuit 2043 controls the switch ES1 to switch on and the switch ES2 to switch off when VCC2 is unavailable and VCC1 is available. At this point, the core circuit 2031 of the PLC system 203 is powered only by electric power VCC1 from the USB port 201 such that users can perform main functions of programming, debugging,
5 downloading and etc. Other circuit 2032 of the PLC system 203 is off, and in a non-operating status.

d) The power management circuit 2043 controls both the switch ES1 and the switch ES2 to switch off when neither VCC2 nor VCC1 is available. At this point, the PLC system 203 is completely non-operating.

10 The power management circuit 2043 in the PLC is designed to:

1) The PLC system 203 is completely in normal operation when the electric power input from external power supply 202 is powered on, that is to say, circuits 2031 and 2032 are normally powered by the external power supply 202.

2) Only the core circuit 2031 (CPU, USB communication, 485/232, Ethernet, and all or part
15 of LED) is powered through USB 201 power input and I/O and some communication will be cut off, when the electric power input from external power supply 202 is cut off.

It can be seen according to the embodiment of the present invention that, the following benefits can be brought to users by the present invention:

The users do not need to connect the power supply to the PLC system, when they need to
20 download program, or perform some simple programming and debugging. They can connect the PLC to a programming/ debugging device (e.g. a PC and etc.) using the USB, and the PLC can be powered on for certain main functions, e.g. downloading, programming, debugging and etc.

When the external power supply is connected, all circuits are switched on, and PLC is in
25 normal operation.

When the external power supply is cut off and the USB power supply is powered on, MCU parts of the PLC system is switched on, and users can perform programming, debugging, and downloading, while some other circuits are cut off to ensure sufficient power supply to core circuits from the USB power supply.

30 The system stops when all power supplies are cut off.

Although the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it should be understood that the invention is

not limited to the disclosed embodiment, and various modifications are available for the forms and details of the present invention, without departing from the spirit and scope of the present invention which are defined in the claims below.

CLAIMS

1. A power supply control circuit, comprising:

a first switch, for receiving power from an USB port, and outputting power to a core circuit
5 of a Programmable Logic Controller PLC system;

a second switch, for receiving power from an external power supply, and outputting power to
the core circuit of the PLC system;

power management circuit, for controlling the first switch and the second switch to be on and
off according to a power input status of the USB port and a power input status of the external
10 power supply,

wherein the power management circuit controls the first switch to be on and the second
switch to be off when there is no power input from the external power supply and there is a
power input from the USB port.

2. The power supply control circuit according to claim 1, wherein the power management
circuit controls the first switch to be off and the second switch to be on as long as there is
power input from the external power supply.

3. The power supply control circuit according to claim 2, wherein the power management
circuit controls both the first switch and the second switch to be off when neither power
20 input from the external power supply nor the power input from the USB port exists.

4. The power supply control circuit according to claim 3, wherein the external power supply
also outputs power to other circuits of the PLC system.

5. The power supply control circuit according to claim 4, wherein the first switch and the
second switch are electronic switches.

6. The power supply control circuit according to claim 5, wherein the core circuit is a circuit
30 for performing programming, debugging, and downloading operations.

7. A power supply control method, comprising:

powering a core circuit of a PLC system through an USB port and cutting off power to other circuits of the PLC system, when there is no power input from an external power supply and there is a power input from the USB port.

- 5 8. The power supply control method according to claim 7, wherein all circuits of the whole PLC system are powered by the external power supply, as long as there is power input from the external power supply.
- 10 9. The power supply control method according to claim 8, wherein the power supply of the whole PLC system is cut off, when neither power input from the external power supply nor the power input from the USB port exists.
10. The power supply control method according to claim 9, wherein the core circuit is a circuit for performing programming, debugging, and downloading operations.

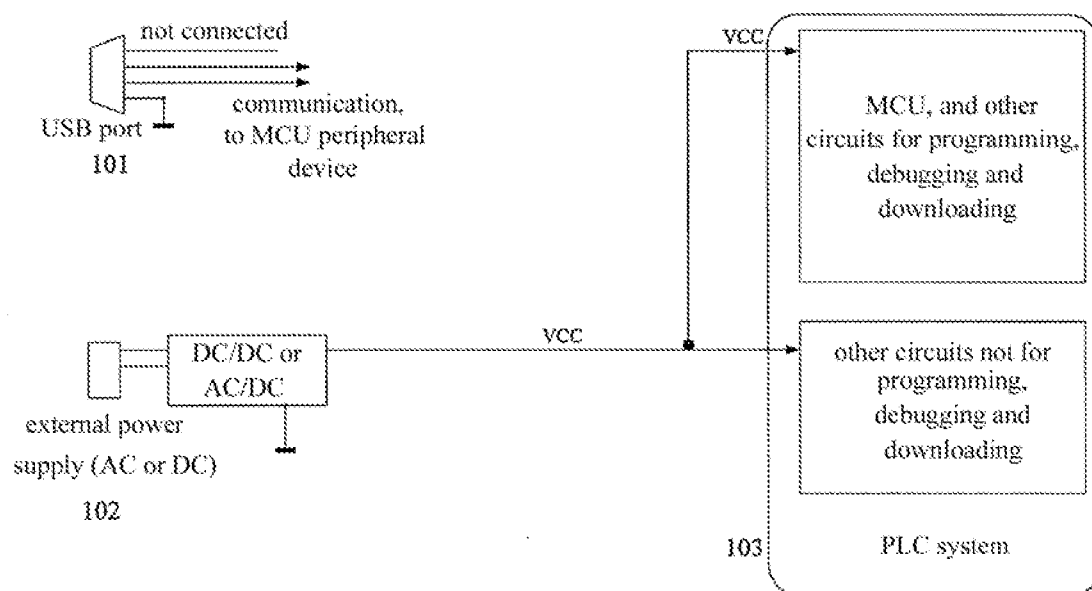


FIG. 1

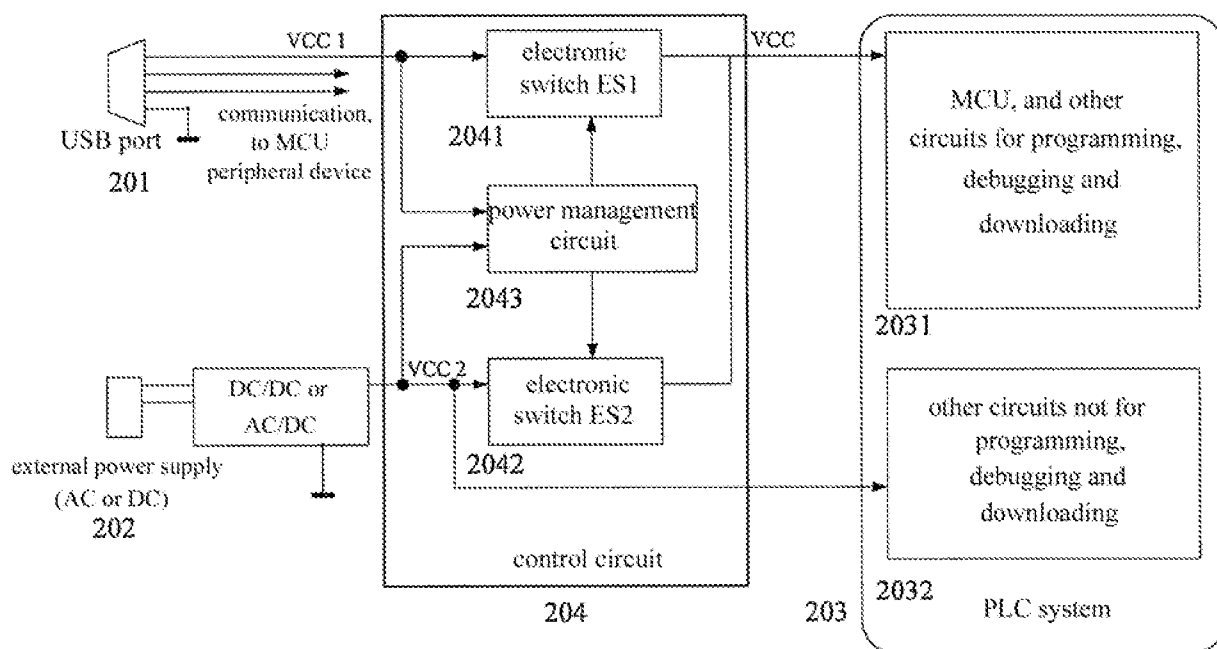


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/075441

A. CLASSIFICATION OF SUBJECT MATTER

G06F 1/26 (2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:G06F 1, H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT,WPLEPODOC: USB, power, switch+, PLC, programmable w logic w controller

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7457645 B2 (LG ELECTRONICS INC) 25 Nov. 2008 (25.11.2008) see col.2, line 23 to col.4, line 18 of the description, Fig.2 and Fig.3	1-6
X	US 7457645 B2 (LG ELECTRONICS INC) 25 Nov. 2008 (25.11.2008) see col.2, line 23 to col.4, line 18 of the description, Fig.2 and Fig.3	7-10
Y	US 2008/0290732 A1 (PREMIER IMAGE TECHNOLOGY (CHINA) LTD, ET.AL) 27 Nov. 2008 (27.11.2008) see paragraphs [0016]-[0025] of the description, Fig.1	1-6
Y	US 2005/0174710 A1 (SONY CORP)11 Aug. 2005 (11.08.2005) see paragraphs [0025]-[0042] of the description, Fig.2	1-6

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
“A” document defining the general state of the art which is not considered to be of particular relevance	“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
“E” earlier application or patent but published on or after the international filing date	“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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“O” document referring to an oral disclosure, use, exhibition or other means	
“P” document published prior to the international filing date but later than the priority date claimed	

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US 7457645 B2	25.11. 2008	US 2005050234 A1	03.03.2005
		CN 1599502 A	23.03.2005
		KR 20050022547 A	08.03.2005
		CN 1286340 C	22.11.2006
		KR 100574555 B1	27.04.2006
US 2008/0290732 A1	27.11.2008	CN 101312303 A	26.11.2008
		US 7723870 B2	25.05.2010
		CN 101312303 B	02.06.2010
US 2005174710 A1	11.08.2005	WO 03079673 A1	25.09.2003
		JP 2003280771 A	02.10.2003
		EP 1487197 A1	15.12.2004
		KR 20050016304 A	21.02.2005
		JP 3674855 B2	27.07.2005
		CN 1643900 A	20.07.2005
		CN 1292586 C	27.12.2006
		US 2008055104 A1	06.03.2008
		US 7550877 B2	23.06.2009