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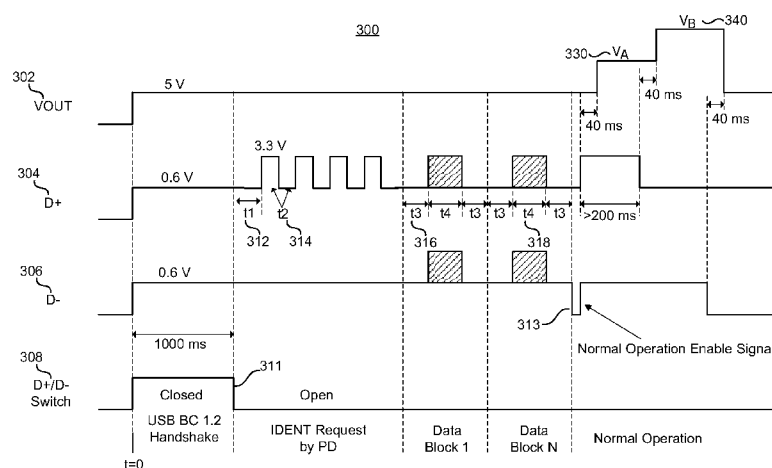
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14/261,873 25 April 2014 (25.04.2014) US(71) Applicant: **POWER INTEGRATIONS, INC.** [US/US];
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Jose, California 95125 (US).(74) Agents: **GO, James Y.** et al.; Blakely Sokoloff Taylor &
Zafman LLP, 1279 Oakmead Parkway, Sunnyvale, Califor-
nia 94085 (US).(81) Designated States (unless otherwise indicated, for every
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UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
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MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
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(54) Title: USB CHARGING WITH DATA COMMUNICATION

**FIG. 3**(57) **Abstract:** A process is disclosed for communicating digital data between a powered device and a charging device via a universal serial bus (USB). The process includes conducting a handshaking period between the powered device and the charging device via the USB. The powered device initiates a mode of normal operation of the charging device after an end of the handshaking period. The charging device communicates digital data (e.g., available power levels) between the powered device and the charging device during a time period that starts with the end of the handshaking period and ends with a beginning of the mode of normal operation.

USB CHARGING WITH DATA COMMUNICATION

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application No. 61/817,094, filed April 29, 2013 and to U.S. Patent Application No. 14/261,873, filed April 25, 2014.

TECHNICAL FIELD

[0002] This disclosure is related to providing power to devices over a standard data bus. Specifically, it is related to data communication between a charging device, including a power supply, and a powered device over a cable that provides power to the powered device.

BACKGROUND

[0003] Standards have been adopted to provide power to a mobile powered device (PD) through a Universal Serial Bus (USB) cable. The PD typically includes a rechargeable battery, and the power supply typically charges the battery in addition to providing power to operate the device. The power supply is often known as a charging device. A standard for providing power to a PD is the USB Battery Charging Specification 1.2 that defines signals and protocols that allow the charging device and the PD to communicate for the purpose of differentiating between a Standard Downstream Port (SDP), a Charging Downstream Port (CDP) or a Dedicated Charging Port (DCP). In some applications it may be desirable for the PD to obtain additional information from the charging device that may not be addressed in the charging specification, while maintaining compliance with the specification.

BRIEF DESCRIPTION OF DRAWINGS

[0004] Non-limiting and non-exhaustive embodiments of the present invention are provided in the following figures, wherein like reference numerals refer to like parts throughout the various views unless otherwise specified.

[0005] FIG.1 is a block diagram illustrating a powered device coupled to a charging device by a USB plug, in accordance with the teachings of the present disclosure.

[0006] FIG.2 is pinout diagram illustrating the interconnections of the USB socket and plug.

[0007] FIG.3 is an example timing diagram illustrating a process of communicating digital data between a powered device and a charging device, in accordance with the teachings of the present disclosure.

[0008] FIG. 4 is a functional block diagram illustrating an example charging device, in accordance with the teachings of the present disclosure.

[0009] FIG. 5 is a flowchart illustrating an example process for a powered device to communicate with the charging device, in accordance with the teachings of the present disclosure.

[0010] Corresponding reference characters indicate corresponding components throughout the several views of the drawings. Skilled artisans will appreciate that elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions of some of the elements in the figures may be exaggerated relative to other elements to help to improve understanding of various embodiments of the present invention. Also, common but well-understood elements that are useful or necessary in a commercially feasible embodiment are often not depicted in order to facilitate a less obstructed view of these various embodiments of the present invention.

DETAILED DESCRIPTION

[0011] In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, to one having ordinary skill in the art that the specific detail need not be employed to practice the present invention. In other instances, well-known materials or methods have not been described in detail in order to avoid obscuring the present invention.

[0012] Reference throughout this specification to "one embodiment", "an embodiment", "one example" or "an example" means that a particular feature, structure or characteristic described in connection with the embodiment or example is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment", "in an embodiment", "one example" or "an example" in various places throughout this specification are not necessarily all referring to the same embodiment or example. Furthermore, the particular features, structures or characteristics may be combined in any suitable combinations and/or subcombinations in one or more embodiments or examples. Particular features, structures or characteristics may be included in an integrated circuit, an electronic circuit, a combinational logic circuit, or other suitable components that provide the described functionality. In addition, it is appreciated that the figures provided herewith are for explanation purposes to persons ordinarily skilled in the art and that the drawings are not necessarily drawn to scale.

[0013] FIG.1 is a functional block diagram illustrating a powered device (PD) 102 coupled to ac-to-dc power supply charging device 104 by a Universal Serial Bus (USB) cable 110. PD 102 contains a USB socket 108. Charging device 104 also contains a USB socket 108. USB socket 108 is configured to receive VBus, D+, D-, and ground signals through the USB cable 110 when the plug is inserted into the socket.

[0014] FIG.2 is a pinout diagram of the USB plug and socket. Plug 206 contains VBus, D+, D-, and ground pins. Socket 208 contains VBus, D+, D-, and ground pin. In one implementation, the USB plug and socket may also contain an additional ID pin (not shown) to determine the type of USB plug. In operation, plug 206 connects to socket 208 with the matching pin. Power is transferred from the charging device 104 to PD 102 through the Vbus and a return path to a ground pin. In one example, the charging device 104 may supply 5 watts of power, or 5 volts at 1

ampere. PD 102 may communicate with the charging device by using the D+, and D- pins. The signals D+/D- are in reference to the ground pin of the USB plug and socket.

[0015] The example timing diagram 300 of FIG. 3 shows signals on a Universal Serial Bus (USB) that add communication between a charging device 104 and a PD 102 while keeping compliance with existing USB Battery Charging Specification 1.2. The communication uses existing USB data lines D+ 104 and D- 106. The USB data lines can be used to exchange proprietary data, such as, to identify an authorized adapter or to communicate available output voltage(s), current(s), power or special functions, in accordance with embodiments of the present disclosure. The proprietary data are exchanged in intervals t1,t2,t3,t4 and are bounded by the end of an initial handshake period and the beginning of a default operation enable signal. The specific time periods shown in FIG. 4 are only one possible implementation of an embodiment of the present disclosure.

[0016] After initial contact at t=0 between the USB socket (typically USB Type A in the charger) and a USB cable the charging device closes a switch between D+/D- 308 (short circuit) for 1000 milliseconds. This provides full backwards compatibility to the existing USB Battery Charging specification 1.2. During this initial handshaking period, the USB BC 1.2 handshake (Data Contact Detect, 1st and 2nd Detection) takes place. The handshaking period includes determining if the attached charging device is a standard downstream port (SDP), Charging Downstream Port (CDP), or a dedicated charging port (DCP). No digital communication occurs with a DCP.

[0017] After the end 311 of the handshaking period, the switch between D+/D- 308 is opened and the charging device starts (or continues) monitoring both data lines. In the illustrated example, the beginning 313 of the normal mode of operation does not commence until an enable signal has been detected by the charging device.

[0018] In the example of FIG. 3, the enable signal is a logic low signal on D- 306. In another example, the enable signal could be a signal pattern on D+ 304 and/or D- 306. Once the D+/D switch 308 is opened the PD 102 will send a special IDENT request to the charging device, in accordance with an embodiment of the present disclosure.

[0019] In the example of FIG. 3 the IDENT request is a sequence of four voltage level toggles on D+ 304. In the voltage levels shown, D+ 304 use existing USB voltage levels 3.3 V. The IDENT signal could also use different voltage levels or patterns. The IDENT request signal could also be sent via D- 306 or on both data lines

either in phase or out of phase. In one example, the charging device may identify the specific PD (e.g., manufacturer and/or model no.) based on the IDENT request signal. In another example, the charging device may identify a class of the powered device (e.g., 5W smart phone, 10W tablet, etc.). In one embodiment, the charging device may only provide power to the powered device if the powered device is an approved specific and/or class of a device. In yet another example, the powered device may send the IDENT request to the charging device to indicate that the powered device is capable of communicating additional digital data before the start of normal operation.

[0020] Once the charging device has detected the IDENT request signal it will start sending predefined data using predefined timing(s) such as the examples of t1 312, t2 314, t3 324, t4 318. As mentioned above, the charging device may determine that the powered device is capable of communicating digital data prior to the start of normal operation in response to the IDENT request. Thus, if no IDENT request is received, or if an IDENT request is received, but the powered device is not an approved device, then the charging device may refrain from sending the digital data. Even still, in another example, the charging device may refrain from providing power to the powered device if the powered device is not an approved device. In yet another example, the content of the digital data communicated by the charging device may be dependent what type of powered device is identified.

[0021] The predefined timing of t1 312 may command the charging device to send digital data in a time interval of t3 316. The predefined timing of t2 314 may vary from a first voltage toggle to the next voltage toggle. These predefined digital data may be proprietary digital data established between a manufacturer of the PD and the manufacturer of the charger. In the example of FIG. 3, the digital data are sent in blocks of two bits using existing USB voltage levels of 0.6 V and 3.3 V. For example, the first digital data block could provide authentication information. The second digital data block could provide information on available output voltage(s). Subsequent digital data blocks could provide information on available output current and output power at a given output voltage. Additional digital data blocks also could provide information on special functions or information such as for example a thermal shutdown threshold, or for example a manufacturing date. The digital data blocks may be transmitted in any order in accordance with embodiments of the present disclosure.

[0022] Once the predefined data have been received by the PD 102, the PD 102 may commence with default operation by providing an enable signal to the charging

device 104. In the example of FIG. 3, the enable signal is a logic low signal on D- 306. After the charging device has detected the enable signal, the mode of normal operation commences. This could be for instance a default operation at 5 V. Alternatively, it could accept commands to change the output voltage, current, or power by means of voltage levels such as V_A 330 and V_B 340 presented by the PD 102 over the data lines D+/D-.

[0023] In other words, it is not necessary for the PD 102 to provide an enable signal to the charger for the PD 102 to receive power from the charging device 104. The charging device 104 continues to provide 5 V to the PD in the absence of an enable signal unless the PD 102 commands the charger to change the output voltage. As an alternative to an enable signal that marks the start of normal operation, the PD 102 may command the charging device 104 to change the output voltage, current, or power after the PD 102 receives digital data from the charging device that communicates the capabilities of the charger to the PD 102.

[0024] FIG.4 is an example functional block diagram illustrating the charging device 400, in accordance with the teachings of the present disclosure. Charging device 400 is one possible implementation of charging device 104 of FIG.1. The illustrated example of the charging device 400 includes a control unit 420, input power connector 411, power converter 407, and a USB socket 408. Control unit 404 includes a state machine 410, hardware 412, USB communication 414, firmware 416, bus 417, and memory 418.

[0025] Charging device 400 may be capable of bidirectional communication of USB signals D- 404 and D+ 406 to the PD through the USB socket 408. Control unit 420 processes the request from the PD. Control unit 420 may respond with the requested digital data for the PD. Control unit 420 may also control power converter 407. Power converter 407 receives power from an input power connector 411. Power converter 407 supplies power to the PD through V_{BUS} 405 and ground 401 terminals. The voltage V_O 424 and current I_O 422 on V_{BUS} 405 may vary depending on the voltage control signal U_{VC} 409.

[0026] Control unit 420 includes a USB communication module 414 for performing the digital communication processes (e.g., process 500) described herein. USB communication module 414 is illustrated separately and separate from state machine 410 for clarity, but may be a single unit and/or implemented in the state machine 410. State machine 410, as well as USB communication module 414 can, but

need not necessarily include, one or more microprocessors, embedded processors, controllers, application specific integrated circuits (ASICs), advanced digital signal processors (ADSPs), and the like. The term state machine describes the functions implemented by the system rather than specific hardware. Moreover, as used herein the term "memory" refers to any type of computer storage medium, including long term, short term, or other memory associated with charging device 400, and is not to be limited to any particular type of memory or number of memories, or type of media upon which memory is stored. In one embodiment, state machine 410 includes a processor that executes instructions included in the software stored in memory 418 and/or firmware 416.

[0027] The processes described herein may be implemented by various means depending upon the application. For example, these processes may be implemented in hardware 412, firmware 416, software stored in memory 418, or any combination thereof. For a hardware implementation, the state machine 410 may be implemented within one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, electronic devices, other electronic units designed to perform the functions described herein, or a combination thereof.

[0028] For a firmware and/or software implementation, the processes may be implemented with modules (e.g., procedures, functions, and so on) that perform the functions described herein. Any computer-readable medium tangibly embodying instructions may be used in implementing the processes described herein. For example, program code may be stored in memory 418 and executed by a processor. Memory 418 may be implemented within or external to the processor. In one embodiment, memory 418 may also be used for one time programming (OTP). Thus, memory 418 may be programmed by, for example, a manufacturer to store adapter specific information such as authentication information, power levels, etc. during production line testing.

[0029] If implemented in firmware and/or software, the functions may be stored as one or more instructions or code on a computer-readable medium. Examples include non-transitory computer-readable media encoded with a data structure and computer-readable media encoded with a computer program. Computer-readable media includes physical computer storage media. A storage medium may be any available medium that can be accessed by a computer.

[0030] Descriptions of state machine 410, hardware 412, and/or USB communication module 414 may be generated and compiled for incorporation into other integrated circuits. For example, behavioral level code describing USB communication module 414, or portions thereof, may be generated using a hardware descriptive language, such as VHDL or Verilog, and stored to a machine-readable storage medium. Furthermore, the behavioral level code can be compiled into register transfer level (“RTL”) code, a netlist, or even a circuit layout and stored to a machine-readable storage medium. The behavioral level code, the RTL code, the netlist, and the circuit layout all represent various levels of abstraction to describe USB communication module 414. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, Flash Memory, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium. Combinations of the above should also be included within the scope of computer-readable media.

[0031] FIG. 5 is a flowchart illustrating an example process 500 for a PD 102 to communicate with the charging device as described in FIG. 4. At block 500, PD 102 connects to the charging device 104 through the USB cable. At block 504, the USB BC 1.2 handshake protocol begins. With the end of the handshaking period, the D+/D- switch 308 is opened, example process 500 proceeds to process block 506. At process block 506, the PD 102 sends an IDENT request to the charging device 104. The charging device identifies the specific PD based on the IDENT request pattern. At process block 508, the charging device 104 sends a pre-defined number of data blocks to the PD 102 based on the IDENT request pattern. At conditional block 510, the PD may enable normal operation after the request has been received by setting D- low. If the D- signal is not low, conditional block 510 proceeds to process block 511 and the PD 102 may request additional digital data. Process block 511 loops back to process block 508. If the D- signal is high, conditional block 510 proceeds to process block 511 and the mode of normal operation of the PD 102 ensues.

CLAIMS

What is claimed is:

1. A method of communicating digital data between a powered device and a charging device via a universal serial bus (USB), the method comprising:
 - conducting a handshaking period between the powered device and the charging device via the USB;
 - initiating a mode of normal operation of the charging device that includes the charging device providing power to the powered device from a power supply included in the charging device via the USB after an end of the handshaking period; and
 - communicating the digital data between the powered device and the charging device via the USB during a time period that starts with the end of the handshaking period and ends with a beginning of the mode of normal operation.
2. The method of claim 1, wherein the handshaking period includes detecting attachment of the powered device with the charging device via the USB.
3. The method of claim 1, wherein the handshaking period includes the powered device determining whether the charging device is a port selected from the group consisting of a standard downstream port (SDP), a charging downstream port (CDP), and a dedicated charging port (DCP).
4. The method of claim 1, wherein initiating a mode of normal operation of the charging device includes receiving an enable signal from the powered device via the USB.
5. The method of claim 1, wherein the USB includes a first data conductor, a second data conductor, a first power conductor, and a second power conductor, the method further comprising the charging device shorting the first data conductor and the second data conductor together during the handshaking period.
6. The method of claim 1, wherein the digital data includes authentication information to allow the charging device to provide the power to the powered device.

7. The method of claim 1, wherein communicating the digital data includes:
- receiving a pattern of voltage level toggles on at least one data conductor of the USB from the powered device after the end of the handshaking period; and
 - beginning the communicating of the digital data in response to the received pattern of voltage level toggles.
8. The method of claim 7, further comprising identifying the powered device in response to the pattern of voltage level toggles.
9. The method of claim 1, wherein communicating the digital data includes the charging device communicating one or more voltage levels that the power supply is capable of outputting to the powered device via the USB.
10. The method of claim 1, wherein communicating the digital data includes the charging device communicating one or more current levels that the power supply is capable of outputting to the powered device via the USB.
11. The method of claim 1, wherein communicating the digital data includes the charging device communicating one or more power levels that the power supply is capable of outputting to the powered device via the USB.
12. A non-transitory machine-readable medium including program code stored thereon for communicating digital data between a powered device and a charging device via a universal serial bus (USB), the program code comprising instructions to:
- conduct a handshaking period between the powered device and the charging device via the USB;
 - initiate a mode of normal operation of the charging device that includes the charging device providing power to the powered device from a power supply included in the charging device via the USB after an end of the handshaking period; and
 - communicate the digital data between the powered device and the charging device via the USB during a time period that starts with the end of the handshaking period and ends with a beginning of the mode of normal operation.
13. The medium of claim 11, wherein the handshaking period includes the detection of

the attachment of the powered device with the charging device via the USB.

14. The medium of claim 11, wherein the handshaking period includes determining whether the charging device is a port selected from the group consisting of a standard downstream port (SDP), a charging downstream port (CDP), and a dedicated charging port (DCP).

15. The medium of claim 11, wherein the instructions to initiate the mode of normal operation of the charging device includes instructions to receive the enable signal from the powered device via the USB.

16. The medium of claim 11, wherein the USB includes a first data conductor, a second data conductor, a first power conductor, and a second power conductor, the medium further comprising instructions to short the first data conductor and the second data conductor together during the handshaking period.

17. The medium of claim 11, wherein the instructions to communicate the digital data includes instructions to:

receive a pattern of voltage level toggles on at least one data conductor of the USB from the powered device after the end of the handshaking period; and
begin the communicating of the digital data in response to the received pattern of voltage level toggles.

18. The medium of claim 17, further comprising instructions to identify the powered device in response to the pattern of voltage level toggles.

19. The medium of claim 11, wherein the digital data includes authentication information to allow the charging device to provide the power to the powered device.

20. The medium of claim 11, wherein the instructions to communicate the digital data includes instructions to communicate one or more voltage levels that the power supply is capable of outputting to the powered device via the USB.

21. The medium of claim 11, wherein the instructions to communicate the digital data

includes instructions to communicate one or more current levels that the power supply is capable of outputting to the powered device via the USB.

22. The medium of claim 11, wherein the instructions to communicate the digital data includes instructions to communicate one or more power levels that the power supply is capable of outputting to the powered device via the USB.

23. A charging device, comprising:

- a Universal Serial Bus (USB) port;

- a power supply converter coupled to the USB port;

- a USB communication module configured to direct the charging device to:

- conduct a handshaking period between the powered device and the charging device via the USB port;

- initiate a mode of normal operation of the charging device that includes the charging device providing power to the powered device from the power supply via the USB port after an end of the handshaking period; and

- communicate the digital data between the powered device and the charging device via the USB port during a time period that starts with the end of the handshaking period and ends with a beginning of the mode of normal operation.

24. The charging device of claim 21, wherein the USB module is further configured to direct the charging device to:

- receive a pattern of voltage level toggles on at least one data conductor of the USB from the powered device after the end of the handshaking period; and

- begin communicating the digital data in response to the received pattern of voltage level toggles.

25. The charging device of claim 21, wherein the digital data includes authentication information to allow the charging device to provide the power to the powered device.

26. The charging device of claim 21, wherein the USB communication module is further configured to direct the charging device communicate one or more voltage levels that the power supply converter is capable of outputting to the powered device via the USB.

27. The charging device of claim 21, wherein the USB communication module is further configured to direct the charging device communicate one or more current levels that the power supply converter is capable of outputting to the powered device via the USB.

28. The charging device of claim 21, wherein the USB communication module is further configured to direct the charging device communicate one or more power levels that the power supply converter is capable of outputting to the powered device via the USB.

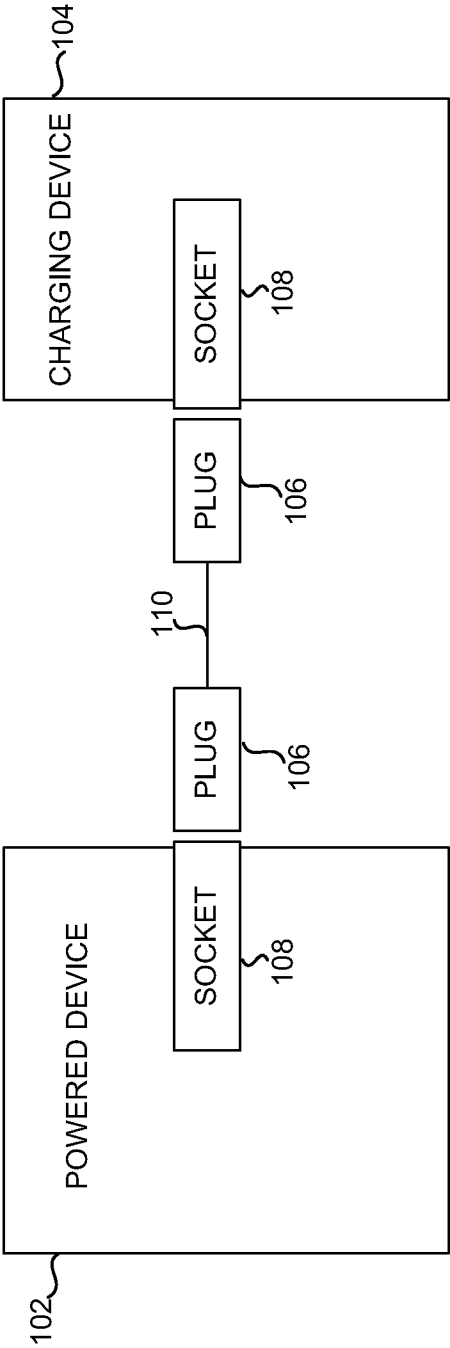


FIG. 1

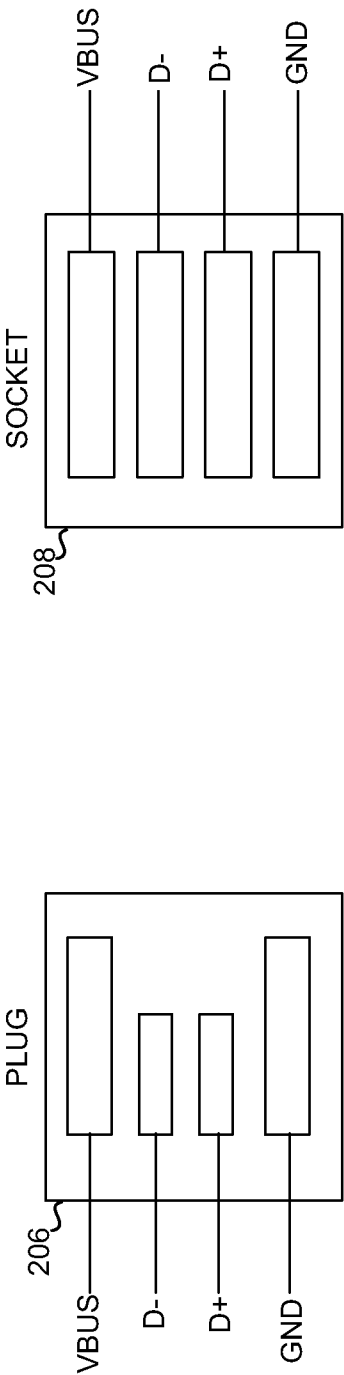


FIG. 2

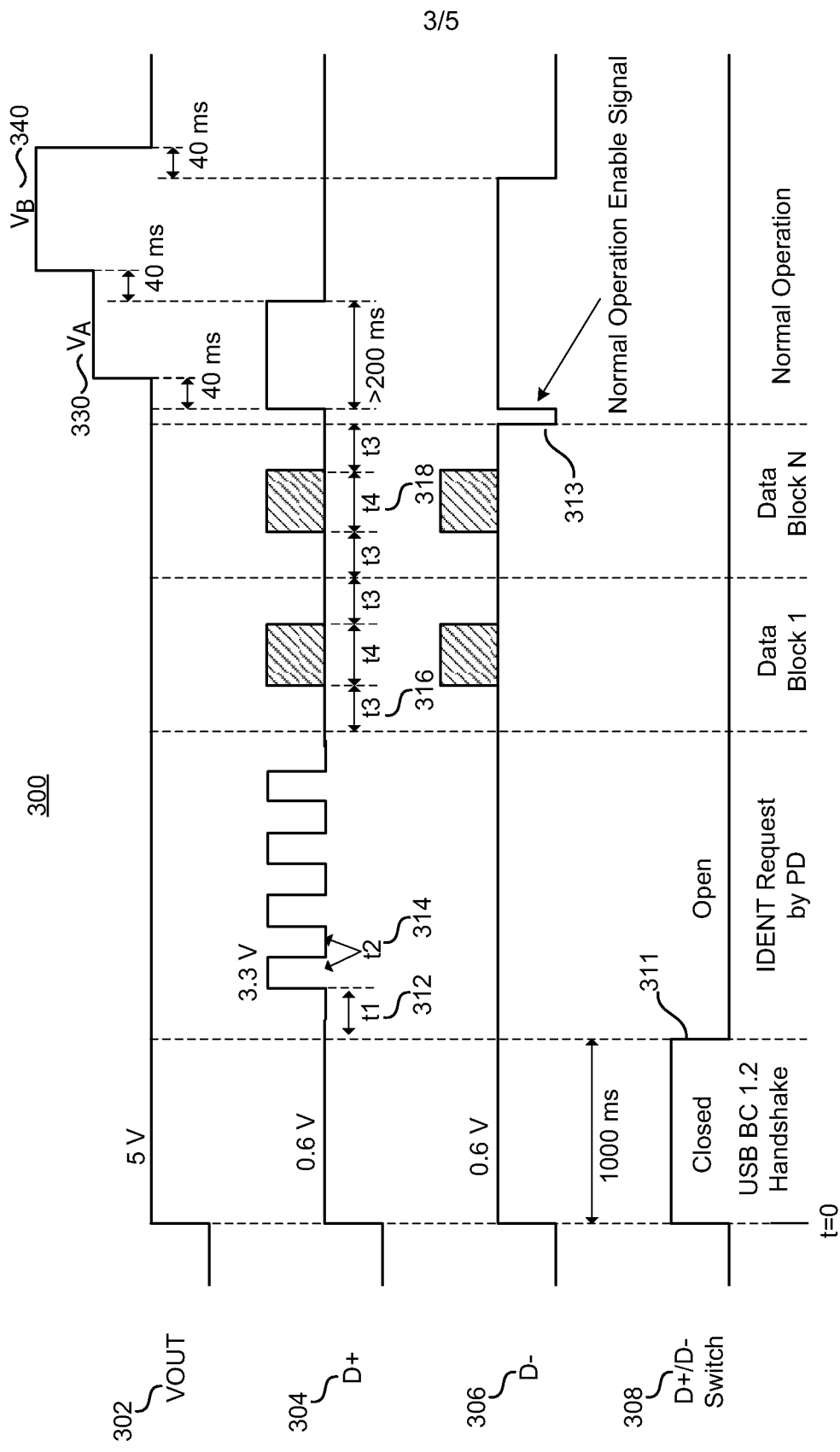


FIG. 3

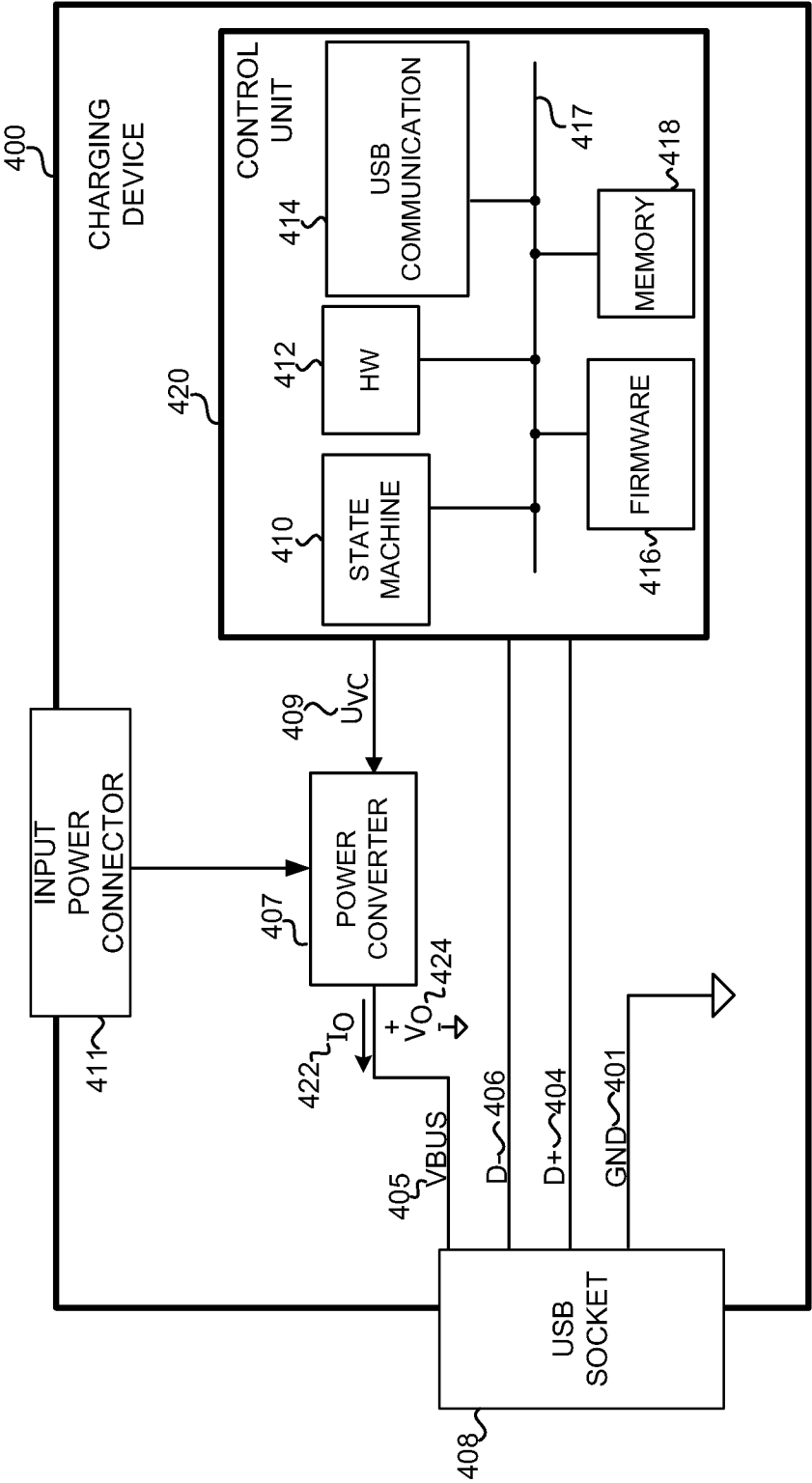
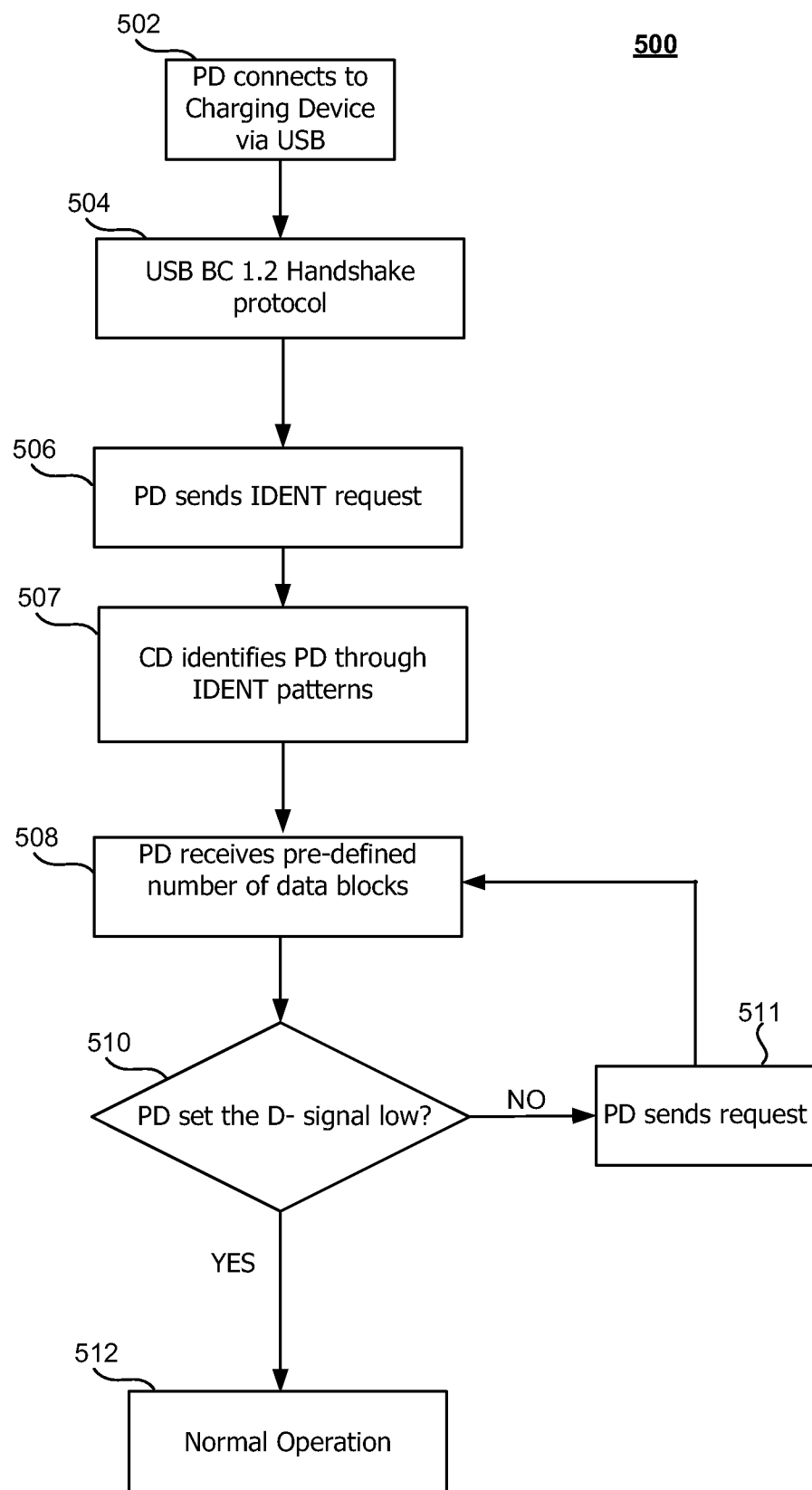


FIG.4

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**FIG.5**

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2014/035728

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F13/42
ADD.

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)
G06F

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	"UNIVERSAL SERIAL BUS SPECIFICATION REVISION 2.0", UNIVERSAL SERIAL BUS SPECIFICATION,, no. REV. 2.0, 27 April 2000 (2000-04-27), pages 1-622, XP001544046,	1-4, 6-15, 17-28
Y	paragraph [9.1.2]; figures 9-1 -----	5,16
Y	REMPLE TERRY: "Battery charging specification", 20090415 , no. Revision 1.1 15 April 2009 (2009-04-15), pages I-VI,1, XP002676116, Retrieved from the Internet: URL:http://www.usb.org/developers the whole document ----- -/--	5,16



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

1 July 2014

Date of mailing of the international search report

08/07/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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Fax: (+31-70) 340-3016

Authorized officer

Ghidini, Mario

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/035728

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Len Sherman: "The Basics of USB Battery Charging: a Survival Guide", 9 December 2010 (2010-12-09), XP055047785, Retrieved from the Internet: URL: http://www.maximintegrated.com/app-not es/index.mvp/id/4803 [retrieved on 2012-12-13] the whole document -----	1-28
A	EP 2 584 471 A1 (HUAWEI DEVICE CO LTD [CN]) 24 April 2013 (2013-04-24) the whole document -----	1-28
A	EP 2 387 125 A2 (GIGA BYTE TECH CO LTD [TW]) 16 November 2011 (2011-11-16) the whole document -----	1-28

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/035728

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
EP 2584471	A1	24-04-2013	CN	103064489 A		24-04-2013
			EP	2584471 A1		24-04-2013
			JP	2013140562 A		18-07-2013
			US	2013103966 A1		25-04-2013
			WO	2013056683 A1		25-04-2013

EP 2387125	A2	16-11-2011	EP	2387125 A2		16-11-2011
			JP	5330348 B2		30-10-2013
			JP	2011244679 A		01-12-2011
			TW	201141003 A		16-11-2011
			US	2011279093 A1		17-11-2011
