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(54) **ACCESSORY IDENTIFIER IN AN ELECTRONIC DEVICE**

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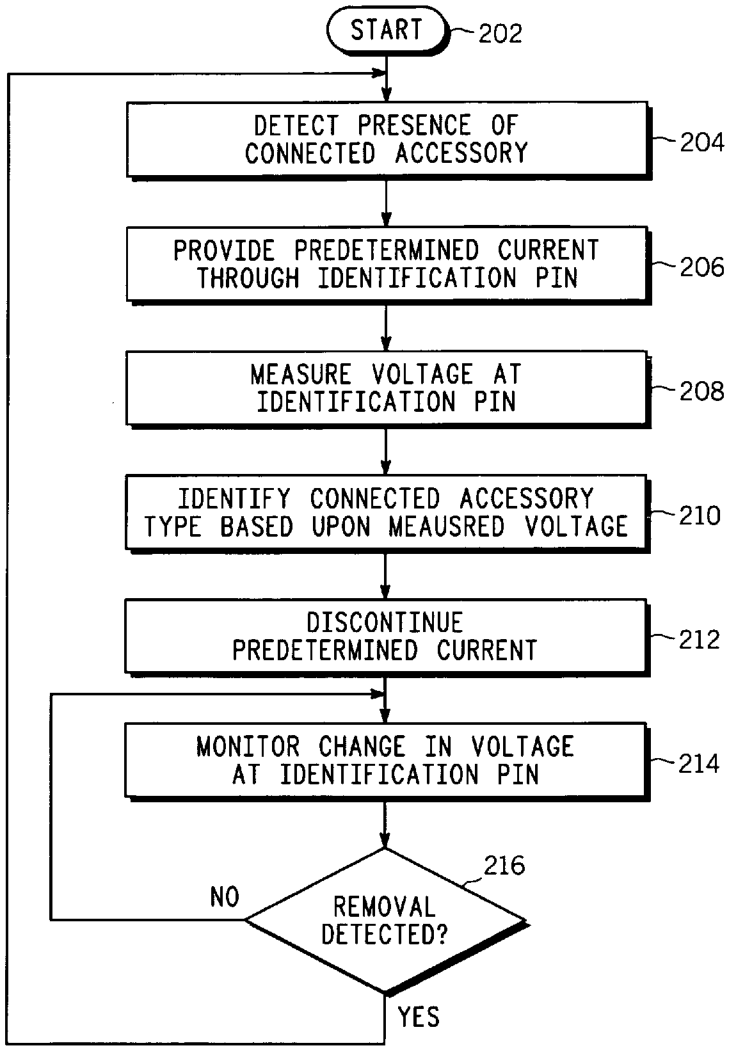
(57) **ABSTRACT**

An apparatus **(100)** and a method **(200)** for an accessory identifier for identifying a connected accessory type from three or more accessory types **(102, 104, 106)** are provided. Each of the three or more accessory types **(102, 104, 106)** has a unique identifier resistor **(108, 110, 112)**, which is accessible through an identification pin **(114, 116, 118)** and is linearly related to each other in resistance value. Using a voltage source **(120)**, presence of the connected accessory **(102)** is detected **(204)** by monitoring a voltage change at the source pin (**126**). Once the presence is detected, a predetermined current is sent through the source pin **(126)** and the resulting voltage at the source pin **(126)** is measured **(208)**, and based upon the measured voltage, the connected accessory type **(102)** is identified **(210)**.



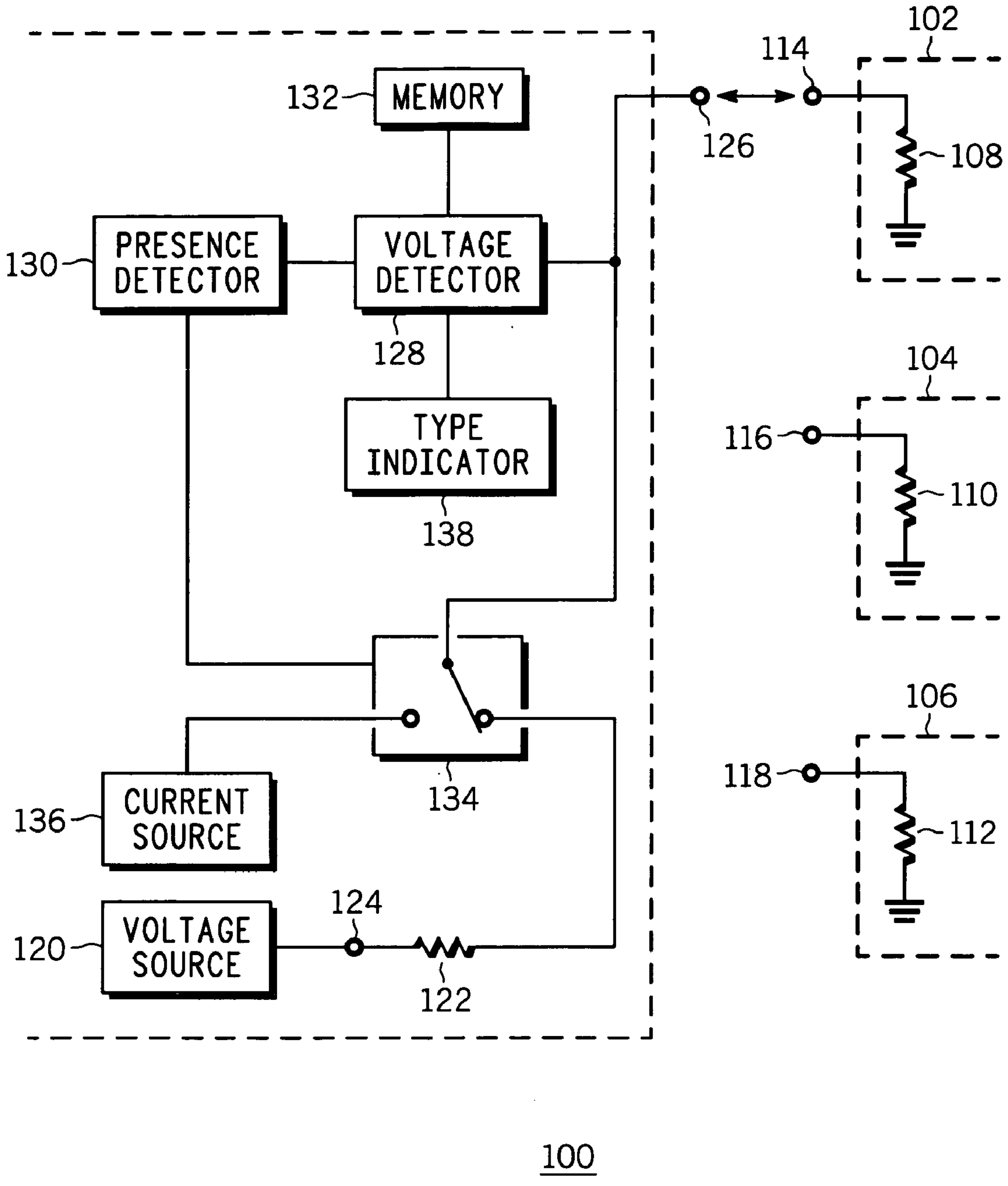

102
114
126
108
132
MEMORY
130
PRESENCE DETECTOR
VOLTAGE DETECTOR
128
104
TYPE INDICATOR
116
110
138
106
118
134
112
136
CURRENT SOURCE
124
120
VOLTAGE SOURCE
122
100

FIG. 1

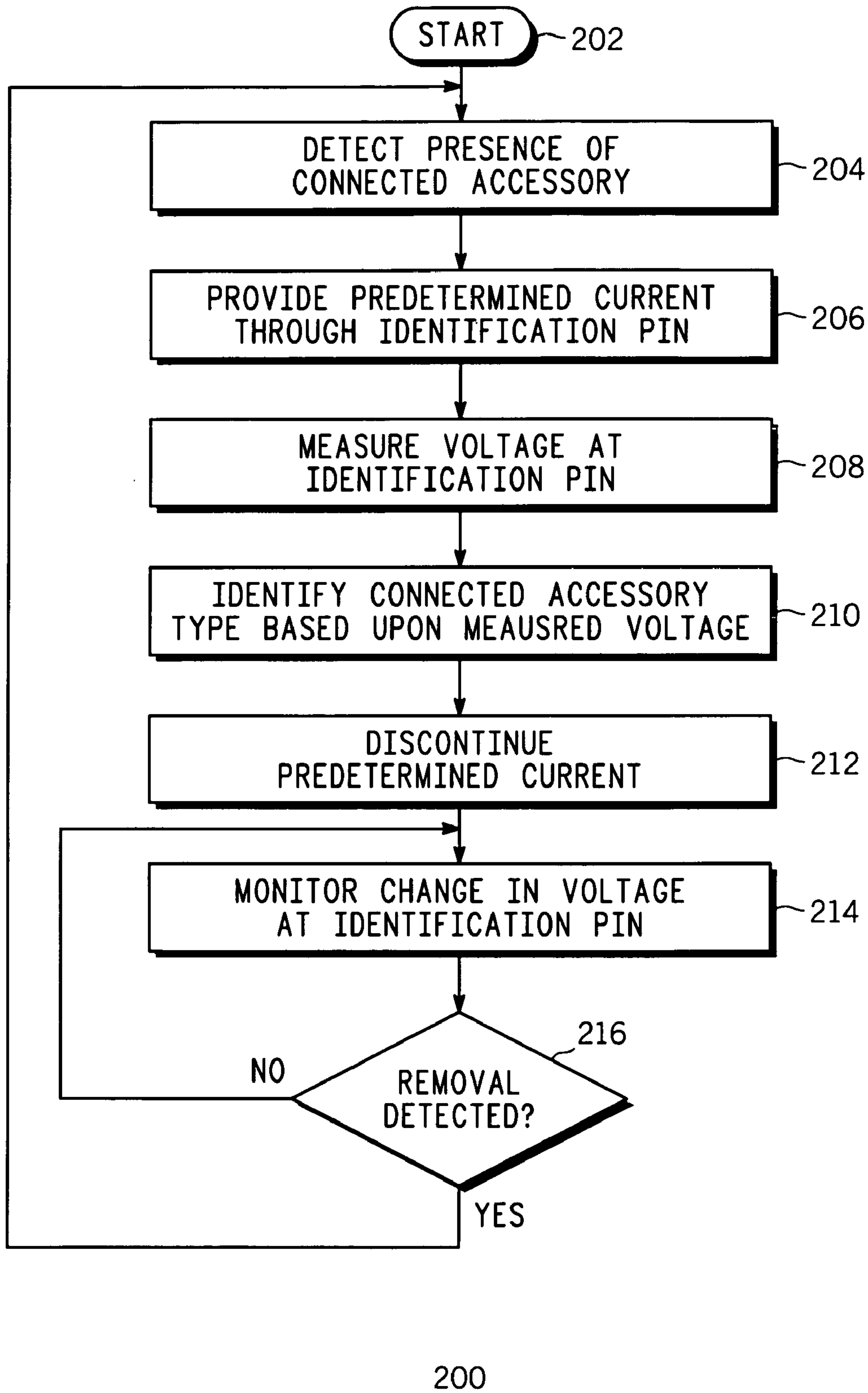

START
202
DETECT PRESENCE OF CONNECTED ACCESSORY
204
PROVIDE PREDETERMINED CURRENT THROUGH IDENTIFICATION PIN
206
MEASURE VOLTAGE AT IDENTIFICATION PIN
208
IDENTIFY CONNECTED ACCESSORY TYPE BASED UPON MEAUSRED VOLTAGE
210
DISCONTINUE PREDETERMINED CURRENT
212
MONITOR CHANGE IN VOLTAGE AT IDENTIFICATION PIN
214
REMOVAL DETECTED?
216
NO
YES
200

FIG. 2

ACCESSORY IDENTIFIER IN AN ELECTRONIC DEVICE

FIELD OF THE INVENTION

[0001] The present invention generally relates to a data bus connection, and more specifically to detection and identification of an accessory attachment through the data bus connection.

BACKGROUND OF THE INVENTION

[0002] Portable electronic devices, such as personal digital assistants ("PDAs"), personal computers ("PCs") and cellular telephones, are generally capable of accepting external accessories such as, but not limited to, a camera, a speaker phone, and a battery charger. An electronic device, which supports the "Mini USB Analog Carkit Interface Specification" ("CEA-936") published by Consumer Electronics Association, Dec. 1, 2002, is required to detect presence of an accessory at all times through an identification ("ID") pin of a connector that accepts the accessory. In addition, the ID pin is also used to identify the type of the accessory attached to the electronic device. Presently, the identification of accessory types is implemented by using a regulated voltage and precision resistors to make a precise measurement of the ID pin voltage. The measured ID pin voltage is then used to determine what accessory is currently attached to the electronic device. However, the use of a regulated voltage and precision resistors adds overall cost to the electronic device in terms of number of parts required for the implementation or as an integration cost for the required parts.

[0003] Presently, different resistance values to ground are commonly used in external bus designs for detection and identification of accessories. However, because the CEA-936 interface is designed to be compatible with the existing Universal Serial Bus ("USB") interface, the range of identification resistors becomes very limited, typically in excess of 100 kΩ, which necessitates tighter tolerance and higher precision methods for detecting and identifying accessories. Further, because the electronic device is required to detect presence of an accessory at all times through the ID pin, the design using different resistance values to ground for detection and identification of accessories carries the burden of higher current drain due to the fact that the regulated supply must be on at all times.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] **FIG. 1** is a block diagram of an accessory identifier in accordance with the preferred embodiment; and

[0005] **FIG. 2** is a flowchart for an accessory identifier in accordance with the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0006] The accessory identifier provides an apparatus and a method in an electronic device for detecting and identifying an attached accessory from various attachable accessories. Each of the attachable accessories has a unique resister, or an identification resister, connected between an identification pin of the attachable accessory and ground. In a detection mode, the electronic device applies a predeter- identification pin of an attachable accessory at a receiving end upon attachment. A change in voltage at the receiving end is monitored to detect presence of the attachable accessory. If there was no attachment, the voltage at the receiving end would be the full predetermined voltage of the voltage source because it is an open circuit. However, if there was an accessory attached, then the pullup resister and the identification resister of the attached accessory would form a voltage divider, and the voltage at the receiving end would be proportionate to a resistance ratio of the pullup resister and the identification resister. In the detection mode, it suffices to notice a change in voltage from the predetermined voltage at the receiving end of the pullup resister to determine the attachment or removal of an accessory. Once the presence is detected, the electronic device then identifies the attached accessory based upon the identification resistor. Instead of continuing to use the voltage divider, which would require a regulated voltage source and exponentially increasing identification resistor values to differentiate types of accessories, an identification mode based upon a current source is used. By providing a predetermined current to the identification resistor, resistance values used to differentiate accessories can be linearly spaced instead of exponentially spaced as in the voltage divider method, and the regulated voltage source is no longer required.

[0007] **FIG. 1** is a block diagram of an accessory identifier **100** in accordance with the preferred embodiment. The accessory identifier **100** is configured to identify a connected accessory type **102** from three or more accessory types (only three accessory types **102**, **104**, and **106** are shown). Each accessory type **102**, **104**, and **106** has a unique identification resister **108**, **110**, and **112** accessible through an identification pin **114**, **116**, and **118**. The accessory identifier **100** has a voltage source **120**, which is connected to a source resister **122** at its source end **124**, and is configured to apply a predetermined voltage at the source end **124**. The source resister **122** is also coupled to a source pin **126**, which is designed to connect to the identification pin **114**, **116**, or **118** when an accessory is attached. A voltage detector **128** is coupled to the source pin **126**, and is configured to monitor the voltage at the source pin **126**. A presence detector **130** is coupled to the voltage detector **128** to detect presence of the connected accessory **102** based upon a change in the measured voltage at the source pin **126**. When there is no accessory connected, the source resister **122** is an open circuit and the voltage at the source pin **126** is the predetermined voltage supplied by the voltage source **120**. However, when there is an accessory attached, such as the connected accessory **102**, the source resister **122** and the identification resister **108** function as a voltage divider, and the voltage at the source pin **126** is less than the predetermined voltage of the voltage source **120**. The voltage detected at the source pin **126** may be stored in a memory **132**, which is coupled to the voltage detector **128**. The presence detector **130** may compare the stored voltage against the measured voltage at the source pin **126** to detect a change in voltage and to determine when the connected accessory **102** has been removed.

[0008] Once the presence of a connected accessory **102** is detected, a mode switch **134**, which is coupled to the presence detector **130**, disconnects the source resister **122** from the source pin **126**, and connects a current source **136**

resistor **108** of the connected accessory **102**. Because the predetermined current is a known fixed value, the resistance of the identification resistor **108** can be calculated based upon the measured voltage at the source pin **126**. A type indicator **138**, which is coupled to the voltage detector **128**, is configured to identify the identification resistor **108** based upon the measured voltage. Further, based upon the identity, or the resistance value, of the identification resistor **108**, the type indicator **138** is configured to determine the type of the connected accessory **102**. By using the current source **136** to generate voltage across an identification resister **108**, **110**, or **112**, resistance values for the identification resisters **108**, **110**, and **112** can be linearly spaced to provide sufficiently different voltages at the source pin **126** to determine the type of the connected accessory. In a voltage divider method, using the voltage source **120** and the voltage detector **128** to determine the type of the connected accessory based on the divided voltage at the source pin **126**, the resistance values used for the identification resistors need to be spaced exponentially to produce sufficient voltage difference among the accessory types. For example, setting the voltage source **120** to be 2 V, the source resister **122** to be 100 kΩ, and the first identification resistor for the first accessory type to be 100 kΩ producing 1 V at the source pin **126**, then the subsequent resistors for different accessory types and the resulting voltages at the source pin **126** would be as follows: 200 kΩ producing 1.33 V; 400 kΩ producing 1.6 V; 800 kΩ producing 1.78 V; 1600 kΩ producing 1.88 V; 3200 kΩ producing 1.94 V. As shown, the voltage difference between accessory types rapidly diminishes as the number of types increase. To measure the diminishing differences, the voltage divider method would require a high precision voltage source and high precision voltage detector as well as high precision resistors for the identification resistors. However, in a current source method using the current source **136**, the resistance values used for the identification resistors can be spaced linearly to produce sufficient voltage difference among the accessory types. For example, setting the current source **136** to provide 5 μA and the first identification resistor for the first accessory type to be 100 kΩ producing 0.5 V at the source pin **126**, then to produce a voltage difference of 0.1 V in the subsequent accessory types, the resistors for the subsequent accessory types and the resulting voltages at the source pin **126** would be as follows: 120 kΩ producing 0.6 V; 140 kΩ producing 0.7 V; 160 kΩ producing 0.8 V; 180 kΩ producing 0.9 V; 200 kΩ producing 1.0 V; 220 kΩ producing 1.1 V; 240 kΩ producing 1.2 V; 260 kΩ producing 1.3 V; 280 kΩ producing 1.4 V; 300 kΩ producing 1.5 V; and may extend up to the maximum detectable voltage. By using the current source **136**, the voltage difference among the accessory types does not diminish as the number of accessories increase. Further, the current source method does not require high precision voltage source, high precision voltage detector, or high precision resistors for the identification resistors. Alternatively, the current source **136** may vary the current until a predetermined voltage is measured at the source pin **126**, and then the current required to produce the predetermined voltage may be correlated to determine the type of the connected accessory **102**.

[**0009**] To reduce power consumption, once the connected accessory **102** is identified, the mode switch **134** disables the

accessory **102** can be detected by detecting a change in voltage at the source pin **126**.

[**0010**] **FIG. 2** is a flowchart **200** of an accessory identifier in accordance with the preferred embodiment. The process begins in block **202**, and presence of a connected accessory type **102** is detected in block **204**. The presence of the connected accessory type **102** may be accomplished by monitoring voltage change at the identification pin **114**, which is connected to the source pin **126**. Once the presence is detected, a predetermined current from the current source **136** is provided through the identification pin **114** in block **206**. The predetermined current generates voltage across the identification resister **108**, and the generated voltage is measured at the identification pin **114** in block **208**, and based upon the measured voltage, the connected accessory type **102** is identified in block **210**. Alternatively, the current source **136** may vary the current until a predetermined voltage is measured at the source pin **126**, and then the current required to produce the predetermined voltage may be correlated to determine the type of the connected accessory **102**. Once the connected accessory type **102** is identified, the predetermined current is discontinued in block **212**, which reduces power consumption, and the monitoring of a change in voltage at the identification pin **114** is resumed in block **214**. If the removal is detected in block **216**, then the process loops back to block **204**, and begins again to detect for presence of a connected accessory. Otherwise, the monitoring of a change in voltage at the identification pin **114** is continued in block **214**.

[**0011**] While the preferred embodiments of the invention have been illustrated and described, it is to be understood that the invention is not so limited. Numerous modifications, changes, variations, substitutions and equivalents will occur to those skilled in the art without departing from the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. An accessory identifier configured to identify a connected accessory type from three or more accessory types, each of the three or more accessory types having a unique identifier resistor accessible through an identification pin, the accessory identifier comprising:

a source pin configured to connect to the identification pin of any one of the three or more accessory types;

a current source switchably coupled to the source pin, the current source configured to provide a predetermined current to the unique identifier resistor of the connected accessory type of the three or more accessory types;

a voltage detector coupled to the source pin, the voltage detector configured to measure a voltage at the source pin; and

a type indicator coupled to the voltage detector, the type indicator configured to identify the connected accessory type of the three or more accessory types based upon the measured voltage,

wherein the unique identification resister of each of the three or more accessory types is linearly related in

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