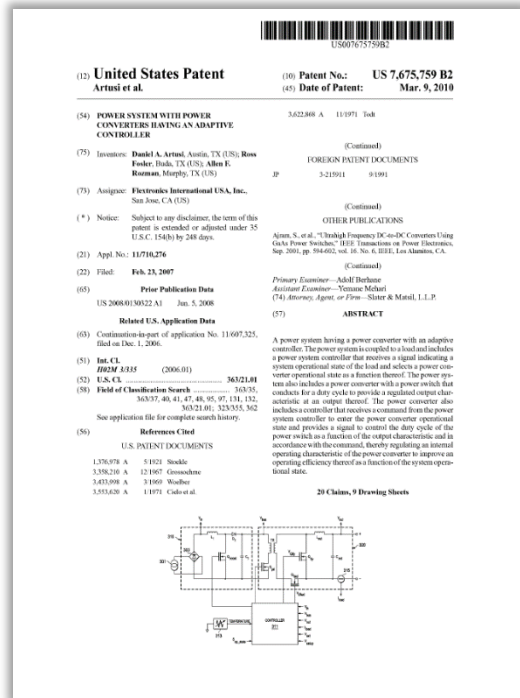




Title: POWER SYSTEM WITH POWER CONVERTERS HAVING AN ADAPTIVE CONTROLLER

Priority Date: Dec. 01, 2006

Filed Date: Feb. 23, 2007

Issued Date: Mar. 09, 2010

Expiration Date: Aug 06, 2027

Inventors: Daniel A. Artusi; Ros Fosler; Allen F. Rozman

Claims: 1, 2, 3



- All the claim elements identified herein are literally and equivalently present in the Accused Instrumentalities.
- For clarity, the portion of a cited reference that is relied upon for support may also be reproduced in the chart. Also, earlier, later or otherwise different versions of the reference may be available but not specifically cited.
- The portion of the Accused Instrumentality covered by a claim element is typically identified by an arrow and/or outlined in color. Such identification is exemplary, not exclusive or exhaustive. The Asserted Claims are open ended, not close ended or improperly restricted. Additional portions of the Accused Instrumentality might also be covered by the claim element but might not be identified in the chart.
- All quantitative figures, qualitative figures and data cited in the chart are subject to measurement and/or computational variation.

Claim 1

A **(PC) power converter** coupled to a **(PSC) power system controller** configured to receive a **(S) signal** indicating a **(OP) system operational state** of a **(LD) load** coupled thereto, comprising:

- a **(PS) power switch** configured to conduct for a **(DC) duty cycle** to provide a **(OC) regulated output characteristic** at an **(OUT) output** thereof; and
- a **(CON) controller** configured to receive a **(COM) command** from said **(PSC) power system controller** to enter a **(PCOP) power converter operational state** as a function of said **(S) signal** indicating said **(OP) system operational state**,

said **(CON) controller** further configured to provide a **(OS) signal** to control said **(DC) duty cycle** of said **(PS) power switch** as a function of said **(OC) output characteristic** and in accordance with said **(COM) command**, thereby regulating an **(IOC) internal operating characteristic** of said **(PC) power converter** to improve an **(EFF) operating efficiency** thereof as a function of said **(OP) system operational state**.

Claim 2

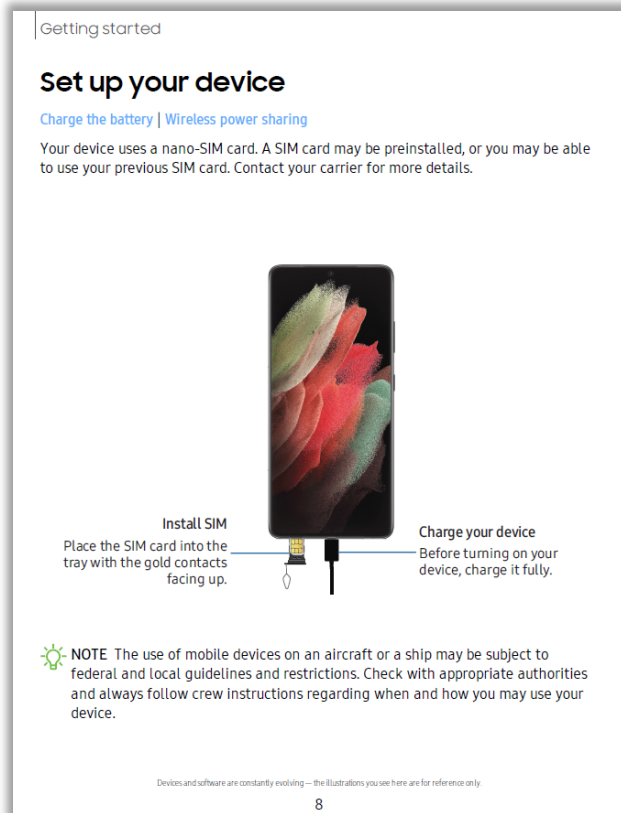
The **(PC) power converter** as recited in claim 1 wherein said **(PC) power converter** is configured to enter said **(PCOP) power converter operational state** within a **(TTIM) transition time** from another **(PCOP0) power converter operational state**.

Claim 3

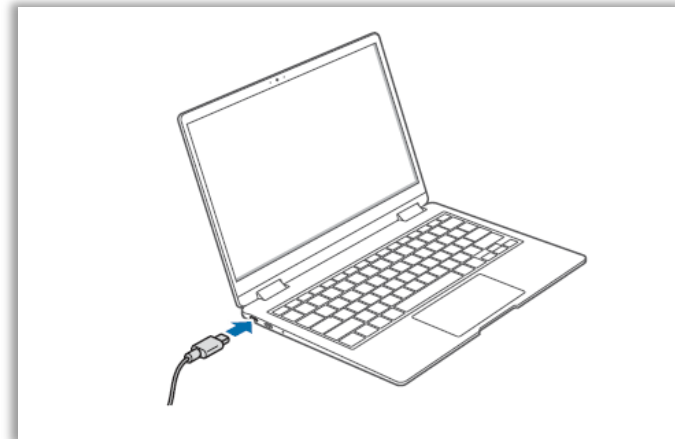
The **(PC) power converter** as recited in claim 1 wherein said **(PSC) power system controller** is configured to receive a **(DET) signal** indicating a **(STAT) power converter status** of said **(PC) power converter**, said **(PCOP) power converter operational state** being a function of said **(STAT) power converter status**.

Claim 1

A **(PC) power converter** coupled to a **(PSC) power system controller** configured to receive a **(S) signal** indicating a **(OP) system operational state** of a **(LD) load** coupled thereto, comprising:



Samsung Electronics America, Inc., User Manual for Samsung Galaxy S21 5G, S21+ 5G, and S21 Ultra 5G at p. 8 (2021).



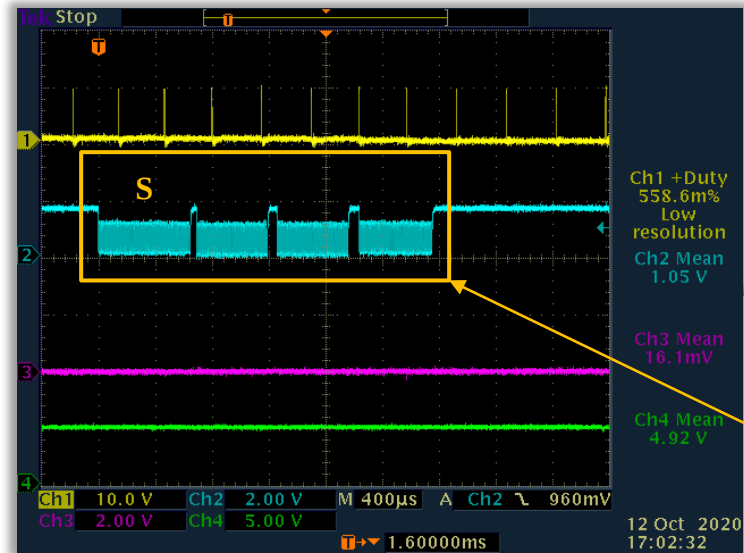
Samsung Electronics Co., Ltd., Users Guide for Samsung EP-TA865 at p. 71.

These are typical examples of Samsung generally instructing users of its power converters to couple them to loads.



Claim 1

A (PC) power converter coupled to a (PSC) power system controller configured to receive a (S) signal indicating a (OP) system operational state of a (LD) load coupled thereto, comprising:

PSC
LD

The iW657P is a USB Power Delivery (USB PD) interface controller which handles the communication between a Power Adapter and Mobile Device (MD). The controller enables the mobile device to alter the V_{BUS} voltage from the default 5V and/or maximum current limitation (e.g. 3A) for higher power output or better efficiency. The iW657P supports USB PD 3.0, including Programmable Power Supply (PPS) support, while being backwards compatible with USB PD 2.0. The device also supports Qualcomm® Quick Charge™ 4+ technology. The iW657P enables the use of advanced USB Type-C™ connector technology with CC1/CC2 pins for MD attach/detach detection and V_{CONN} support for Electronically Marked Cable (EMC) rated current reading. The iW657P also integrates a high current charge-pump circuit to drive an external NFET V_{BUS} disconnect switch.

PSC

The iW657P resides on the secondary side of an AC/DC power supply and negotiates voltage and current settings with the primary-side controller, depending on the requests from the MD. The iW657P uses Dialog's proprietary secondary-to-primary digital communication technology and when paired with one of Dialog's primary-side **RapidCharge™** controllers, such as the iW1791 or iW1799, the iW657P eliminates the need for a discrete decoder on the primary side by using one optocoupler to transmit all necessary information for rapid charging to the primary side. This includes output voltage requests, output current limits, output voltage undershoot, output over-voltage, and fault and reset signals. The iW657P incorporates Dialog's proven and reliable DLNK technology to communicate from the secondary to the primary and also has a built-in optocoupler LED driver to minimize the bill of material cost.

S

OP

VBUS_OUT= 5V (no load), then transitions to 9V (no load)

OP



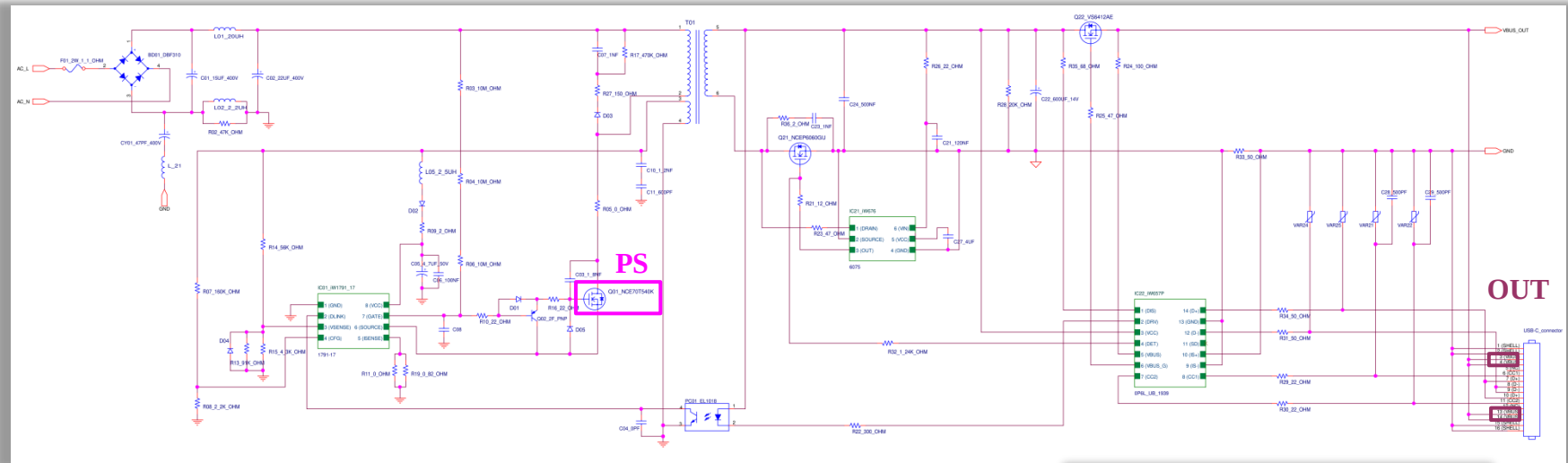
Source(s): [2]

This burst of data was fed to CC1 by the external PD3.0 emulator, immediately after pressing its trigger button that sends the charger a request for 9V output at VBUS_OUT.

Shown at 20ms/div scale in order to capture the entire transition from 5V to 9V at VBUS_OUT.

Claim 1

a **(PS) power switch** configured to conduct for a **(DC) duty cycle** to provide a **(OC) regulated output characteristic** at an **(OUT) output** thereof; and



4.5 Configuration Channel (CC)

4.5.1 Architectural Overview

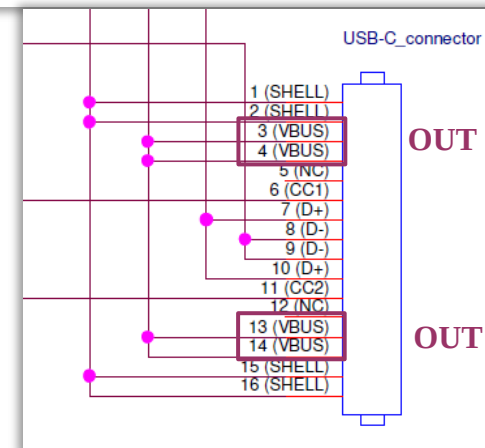
For the USB Type-C solution, two pins on the connector, CC1 and CC2, are used to establish and manage the Source-to-Sink connection. When the device is connected through a hub, the connection between a Sink (UFP) on the hub and the Source (host port) and the connection between the Sink (device port) and a Source (DFP on the hub), are treated as separate connections. Functionally, the configuration channel is used to serve the following purposes.

- Detect attach of USB ports, e.g. a Source to a Sink
- Resolve cable orientation and twist connections to establish USB data bus routing
- Establish data roles between two attached ports
- Discover and configure VBUS: USB Type-C Current modes or USB Power Delivery

OC

The iW1791 is a high performance AC/DC power supply controller for rapid charge applications that supports high resolution voltage/current control. It uses Dialog's **PrimAccurate™** technology to minimize external component count and simplify system design. The device operates in quasi-resonant mode to provide high efficiency and it also provides a number of key built-in protection features. The iW1791 can achieve tight multi-level constant voltage and multi-level constant current regulation without a traditional secondary feedback circuit. It also eliminates the need for loop compensation components while maintaining stability over all operating conditions.

Source(s): [1]; [4]

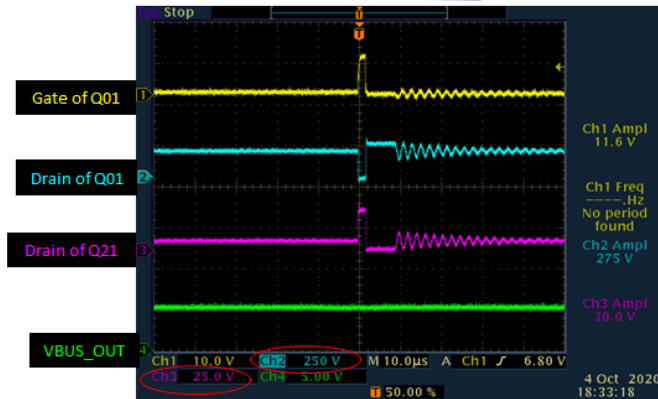


Claim 1

a (PS) power switch configured to conduct for a (DC) duty cycle to provide a (OC) regulated output characteristic at an (OUT) output thereof; and

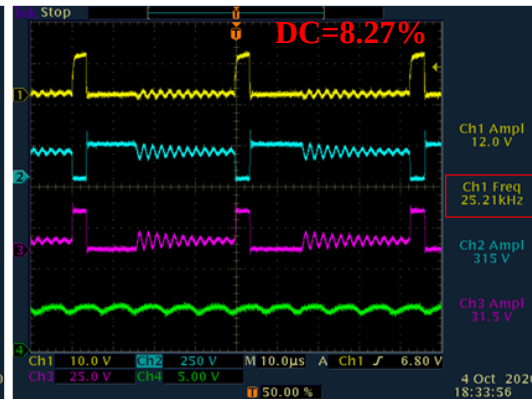
OC

VBUS_OUT=5V, no load



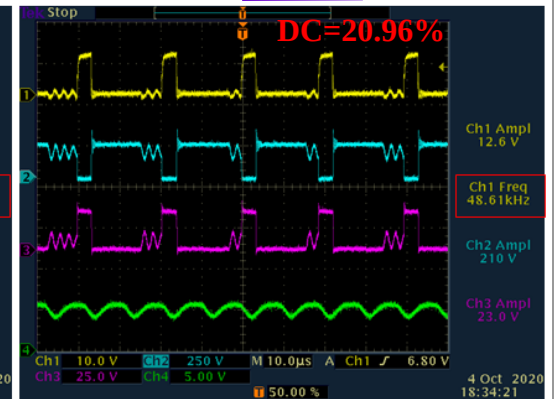
OC

VBUS_OUT=5V, 1A load



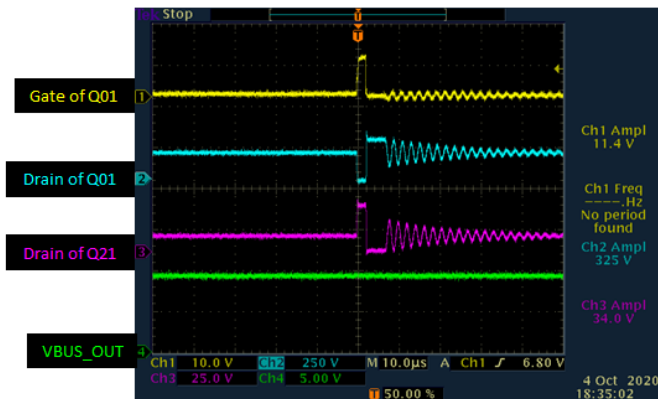
OC

VBUS_OUT=5V, 2A load



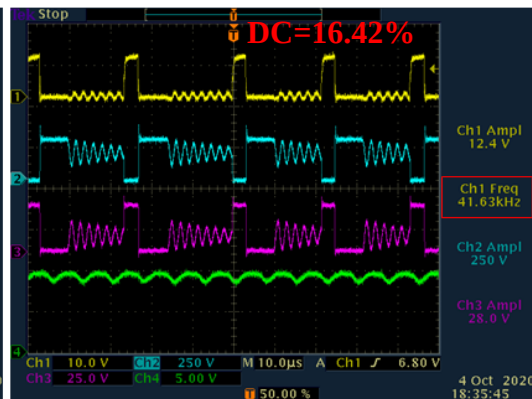
OC

VBUS_OUT=9V, no load



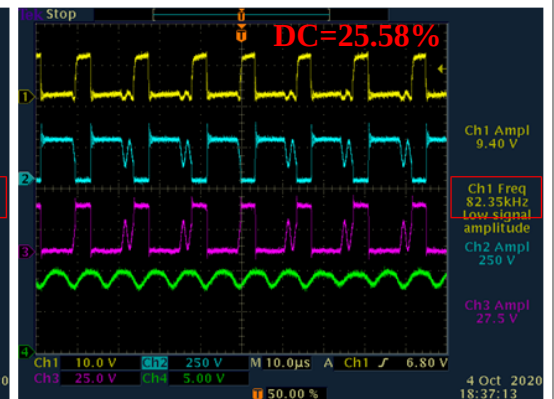
OC

VBUS_OUT=9V, 1A load



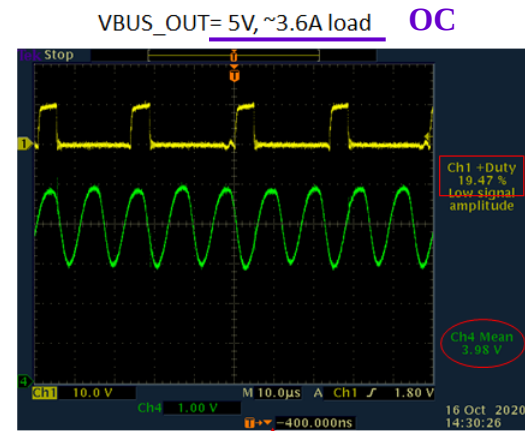
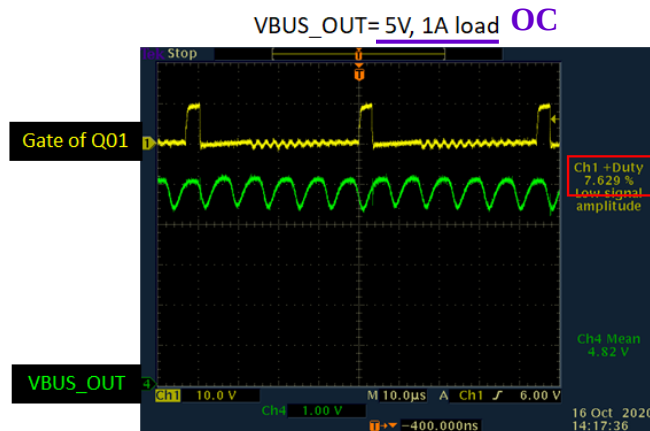
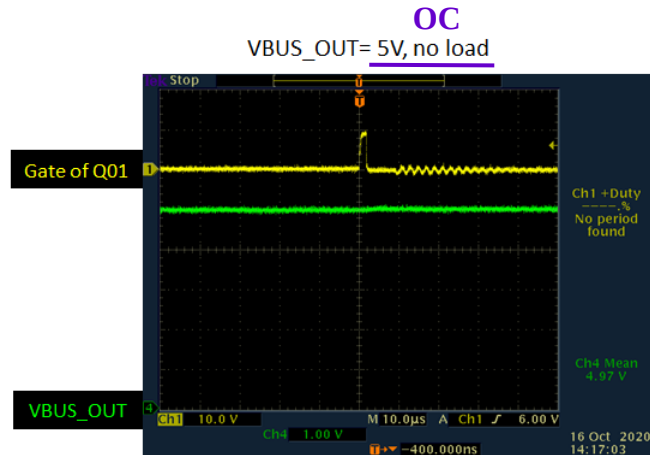
OC

VBUS_OUT=9V, 2A load



Claim 1

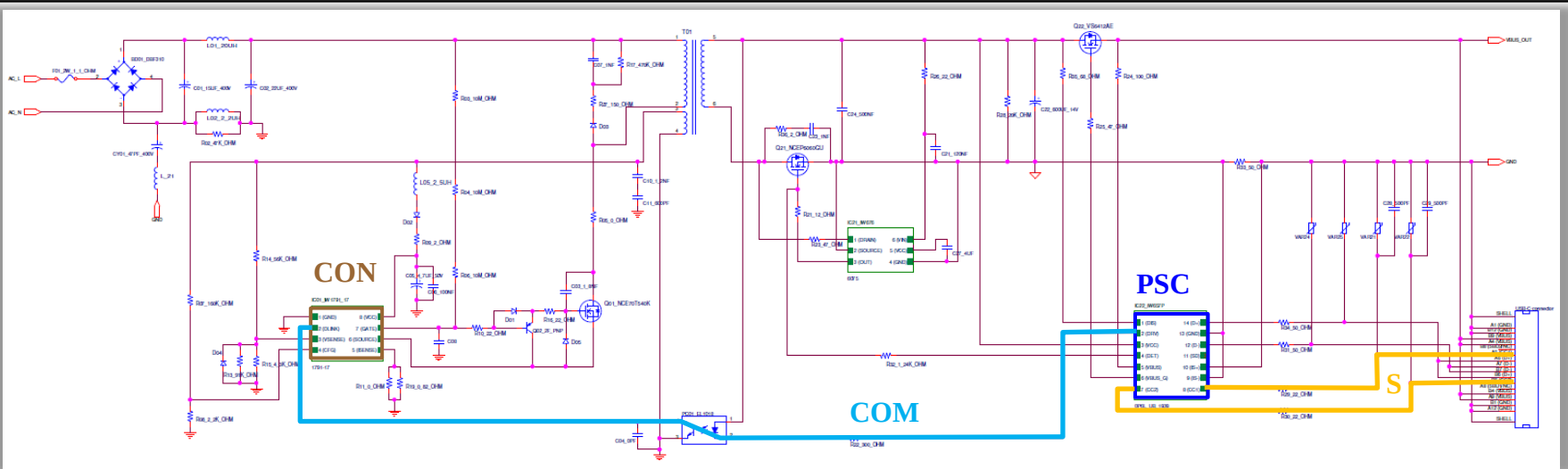
a (PS) power switch configured to conduct for a (DC) duty cycle to provide a (OC) regulated output characteristic at an (OUT) output thereof; and



Note: The charger will hold up the VBUS_OUT voltage at ~4.5V under a 3.5A load but the charger shuts down when the load is increased beyond that. This O-scope capture was taken as the charger was going into one of those over-current protection shutdowns when the load was increased to ~3.6A. Immediately after this capture, the VBUS_OUT voltage drops to 0V.

Claim 1

a (CON) controller configured to receive a (COM) command from said (PSC) power system controller to enter a (PCOP) power converter operational state as a function of said (S) signal indicating said (OP) system operational state,



Pin Number	Pin Name	Type	Pin Description
1	GND	Ground	Ground.
2	DLNK	Analog Input	Digital communication link signal. Used for secondary-side to primary-side communication for all rapid change information, which includes <u>output voltage requests</u> , <u>output current limits</u> , output voltage undershoot, and over-voltage protection.
3	V _{SENSE}	Analog Input	Auxiliary voltage sense. Used for primary-side regulation and secondary-to-primary communication through main transformer.
4	CFG	Analog Input	Used for CDC configuration and auxiliary winding open protection.
5	I _{SENSE}	Analog Input	Primary-side current sense. Used for cycle-by-cycle peak-current control and limit in primary-side CV/CC regulation.
6	SOURCE	Power Input	Connect to the source of external power MOSFET. Inside the IC, it is connected to internal MOSFET and startup V _{CC} charge circuit.
7	GATE	Output	Gate drive for external MOSFET switch.
8	V _{CC}	Power Input	IC power supply.

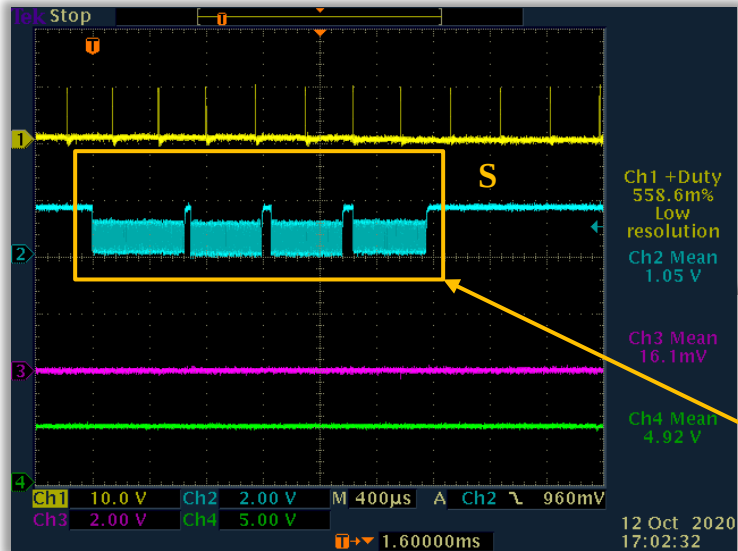
Source(s): [2]; [3]

The **Uw657P** is a USB Power Delivery (USB PD) interface controller which handles the communication between a Power Adapter and Mobile Device (MD). The controller enables the mobile device to alter the V_{BUS} voltage from the default 5V and/or maximum current limitation (e.g. 3A) for higher power output or better efficiency. The Uw657P supports USB PD 3.0, including Programmable Power Supply (PPS) support, while being backwards compatible with USB PD 2.0. The device also supports Qualcomm® Quick Charge™ 4+ technology. The Uw657P enables the use of advanced **USB Type-C™ connector technology with CC1/CC2 pins for MD attach/detach detection** and V_{CONN} support for Electronically Marked Cable (EMC) rated current reading. The Uw657P also integrates a high current charge-pump circuit to drive an external NFET V_{BUS} disconnect switch.

The **iW657P** resides on the secondary side of an AC/DC power supply and negotiates voltage and current settings with the primary-side controller, depending on the requests from the MD. The **iW657P** uses Dialog's proprietary secondary-to-primary digital communication technology and when paired with one of Dialog's primary-side **RapidCharge™** controllers, such as the **iW1791** or **iW1799**, the **iW657P** eliminates the need for a discrete decoder on the primary side by using one optocoupler to transmit all necessary information for rapid charging to the primary side. This includes output voltage requests, output current limits, output voltage undershoot, output over-voltage, and fault and reset signals. The **iW657P** incorporates Dialog's proven and reliable **DLNK** technology to communicate from the secondary to the primary and also has a built-in optocoupler LED driver to minimize the bill of material cost.

Claim 1

a **(CON) controller** configured to receive a **(COM) command** from said **(PSC) power system controller** to enter a **(PCOP) power converter operational state** as a function of said **(S) signal** indicating said **(OP) system operational state**,



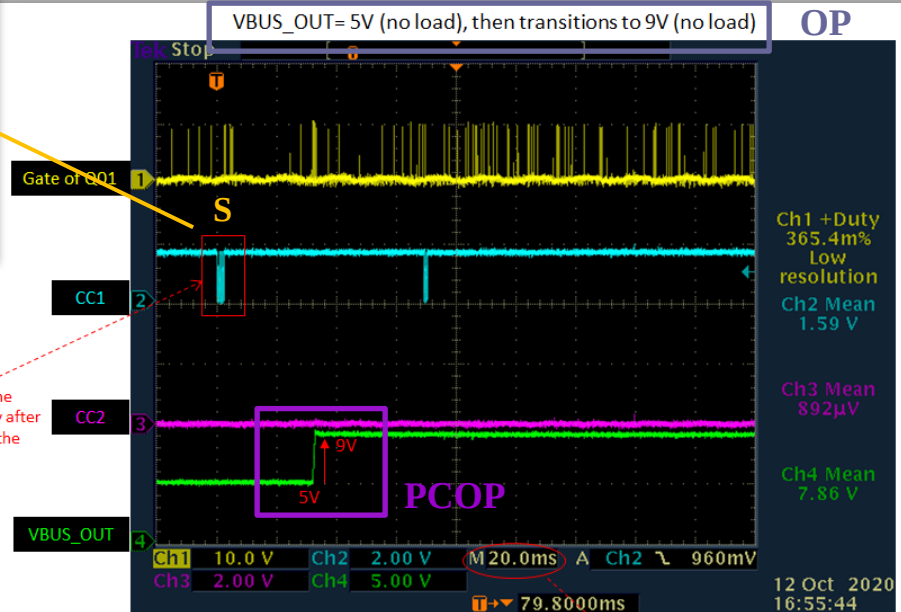
The iW657P resides on the secondary side of an AC/DC power supply and negotiates voltage and current settings with the primary-side controller, depending on the requests from the MD. The iW657P uses Dialog's proprietary secondary-to-primary digital communication technology and when paired with one of Dialog's primary-side **RapidCharge™** controllers, such as the iW1791 or iW1799, the iW657P eliminates the need for a discrete decoder on the primary side by using one optocoupler to transmit all necessary information for rapid charging to the primary side. This includes output voltage requests, output current limits, output voltage undershoot, output over-voltage, and fault and reset signals. The iW657P incorporates Dialog's proven and reliable DLNK technology to communicate from the secondary to the primary and also has a built-in optocoupler LED driver to minimize the bill of material cost.

COM

The iW1791 is optimized to work with Dialog's secondary-side controllers that use the proprietary digital link (DLNK) technology. The iW1791 and DLNK-based secondary-side controller chipset together can implement various rapid charge protocols, such as USB Power Delivery (USB PD), Qualcomm® Quick Charge™ 2.0 and 3.0 (QC2.0 and QC3.0) technologies, etc. to achieve fast and smooth voltage transitions upon request by mobile devices (MD). The iW1791 and compatible secondary-side controller from Dialog use the DLNK communication protocol for output voltage requests, output current limits, output voltage undershoot and over voltage information from the secondary to the primary.

Source(s): [2]; [4]

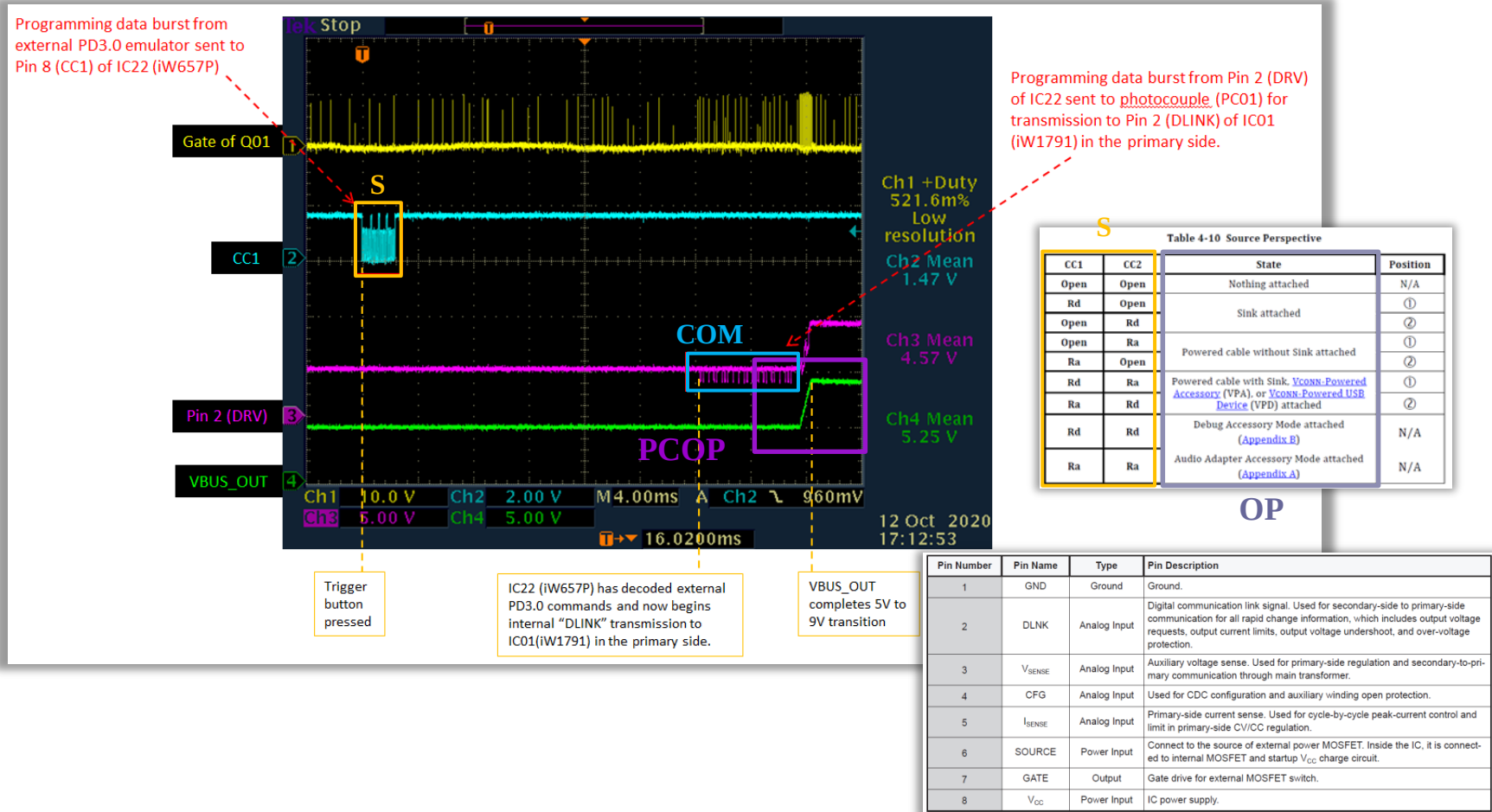
This burst of data was fed to CC1 by the external PD3.0 emulator, immediately after pressing its trigger button that sends the charger a request for 9V output at VBUS_OUT.



Shown at 20ms/div scale in order to capture the entire transition from 5V to 9V at VBUS_OUT.

Claim 1

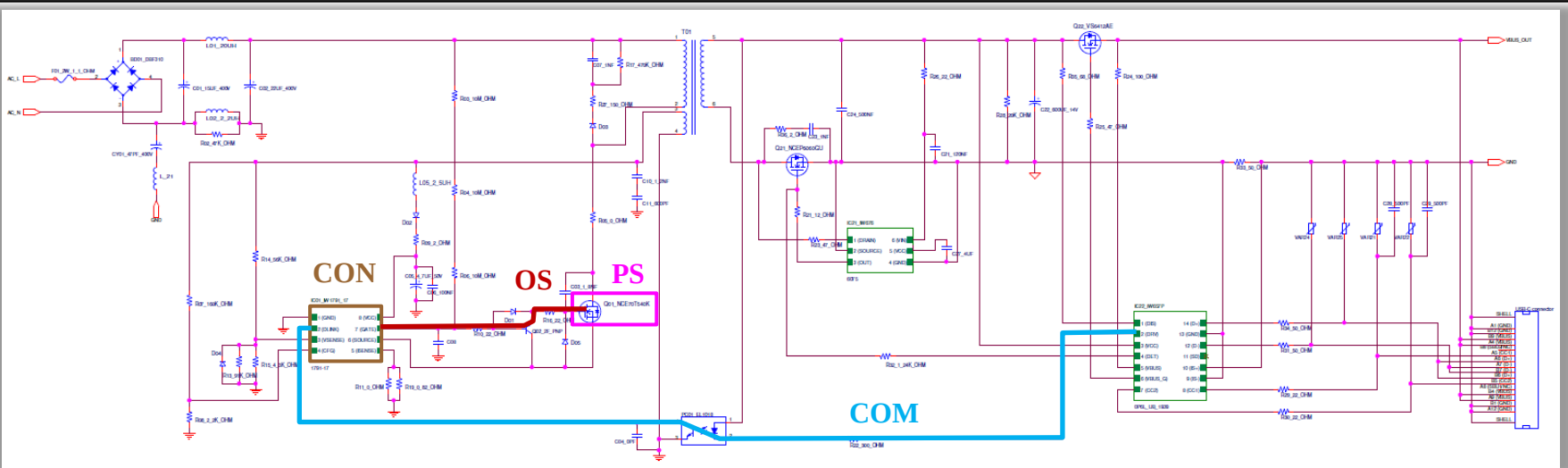
a (CON) controller configured to receive a (COM) command from said (PSC) power system controller to enter a (PCOP) power converter operational state as a function of said (S) signal indicating said (OP) system operational state,



Source(s): [1]; [3]

Claim 1

said **(CON) controller** further configured to provide a **(OS) signal** to control said **(DC) duty cycle** of said **(PS) power switch** as a function of said **(OC) output characteristic** and in accordance with said **(COM) command**,



Pin Number	Pin Name	Type	Pin Description
1	GND	Ground	Ground.
2	DLNK	Analog Input	Digital communication link signal. Used for secondary-side to primary-side communication for all rapid change information, which includes output voltage requests, output current limits, output voltage undershoot, and over-voltage protection.
3	V _{SENSE}	Analog Input	Auxiliary voltage sense. Used for primary-side regulation and secondary-to-primary communication through main transformer.
4	CFG	Analog Input	Used for CDC configuration and auxiliary winding open protection.
5	I _{SENSE}	Analog Input	Primary-side current sense. Used for cycle-by-cycle peak-current control and limit in primary-side CV/CC regulation.
6	SOURCE	Power Input	Connect to the source of external power MOSFET. Inside the IC, it is connected to internal MOSFET and startup V _{CC} charge circuit.
7	GATE	Output	Gate drive for external MOSFET switch.
8	V _{CC}	Power Input	IC power supply.

- Proprietary optimized load adaptive maximum constant frequency PWM switching with quasi-resonant operation achieves best size, efficiency, and common mode noise

The iW657P resides on the secondary side of an AC/DC power supply and negotiates voltage and current settings with the primary-side controller, depending on the requests from the MD. The iW657P uses Dialog's proprietary secondary-to-primary digital communication technology and when paired with one of Dialog's primary-side **RapidCharge™** controllers, such as the iW1791 or iW1799, the iW657P eliminates the need for a discrete decoder on the primary side by using one optocoupler to transmit all necessary information for rapid charging to the primary side. This includes output voltage requests, output current limits, output voltage undershoot, output over-voltage, and fault and reset signals. The iW657P incorporates Dialog's proven and reliable DLNK technology to communicate from the secondary to the primary and also has a built-in optocoupler LED driver to minimize the bill of material cost.

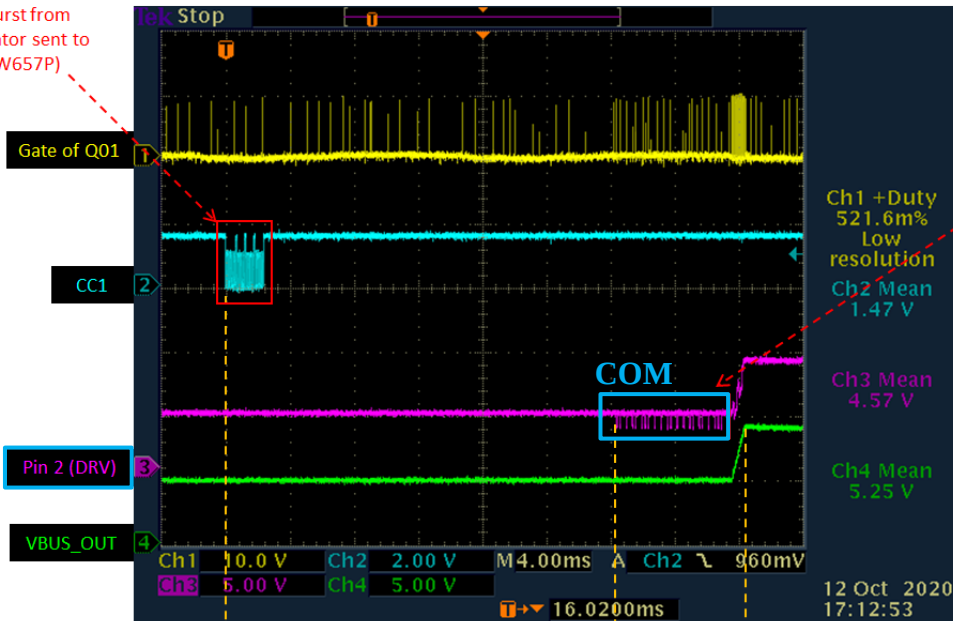
The iW1791 is optimized to work with Dialog's secondary-side controllers that use the proprietary digital link (DLNK) technology. The iW1791 and DLNK-based secondary-side controller chipset together can implement various rapid charge protocols, such as USB Power Delivery (USB PD), Qualcomm® Quick Charge™ 2.0 and 3.0 (QC2.0 and QC3.0) technologies, etc. to achieve fast and smooth voltage transitions upon request by mobile devices (MD). The iW1791 and compatible secondary-side controller from Dialog use the DLNK communication protocol for output voltage requests, output current limits, output voltage undershoot and over voltage information from the secondary to the primary.

Source(s): [2]; [3]

Claim 1

said (CON) controller further configured to provide a (OS) signal to control said (DC) duty cycle of said (PS) power switch as a function of said (OC) output characteristic and in accordance with said (COM) command,

Programming data burst from external PD3.0 emulator sent to Pin 8 (CC1) of IC22 (iW657P)



Trigger button pressed

IC22 (iW657P) has decoded external PD3.0 commands and now begins internal "DLINK" transmission to IC01(iW1791) in the primary side.

VBUS_OUT completes 5V to 9V transition

Programming data burst from Pin 2 (DRV) of IC22 sent to photocoupler (PC01) for transmission to Pin 2 (DLINK) of IC01 (iW1791) in the primary side.

Pin Number	Pin Name	Type	Pin Description
1	DIS	Analog Output	Discharging circuit. Used for fast discharging of output capacitor.
2	DRV	Analog Output	External circuit drive. Can be used to drive optocoupler LED with automatic current limiting for transmitting signals to primary side.
3	V _{CC}	Power Supply	IC power supply.
4	DET	Analog Input	AC unplug detect.
5	V _{BUS}	Analog Input/ Output	Monitor V _{BUS} voltage after N-FET switch.
6	V _{BUS_S}	Analog Input/ Output	Connect to external N-FET gate pin for gate-source voltage control.
7	CC2	Analog Input/ Output	Configuration Channel 2.
8	CC1	Analog Input/ Output	Configuration Channel 1.

Pin Number	Pin Name	Type	Pin Description
1	GND	Ground	Ground.
2	DLNK	Analog Input	Digital communication link signal. Used for secondary-side to primary-side communication for all rapid change information, which includes output voltage requests, output current limits, output voltage undershoot, and over-voltage protection.
3	V _{SENSE}	Analog Input	Auxiliary voltage sense. Used for primary-side regulation and secondary-to-primary communication through main transformer.
4	CFG	Analog Input	Used for CDC configuration and auxiliary winding open protection.
5	I _{SENSE}	Analog Input	Primary-side current sense. Used for cycle-by-cycle peak-current control and limit in primary-side CV/CC regulation.
6	SOURCE	Power Input	Connect to the source of external power MOSFET. Inside the IC, it is connected to internal MOSFET and startup V _{CC} charge circuit.
7	GATE	Output	Gate drive for external MOSFET switch.
8	V _{CC}	Power Input	IC power supply.

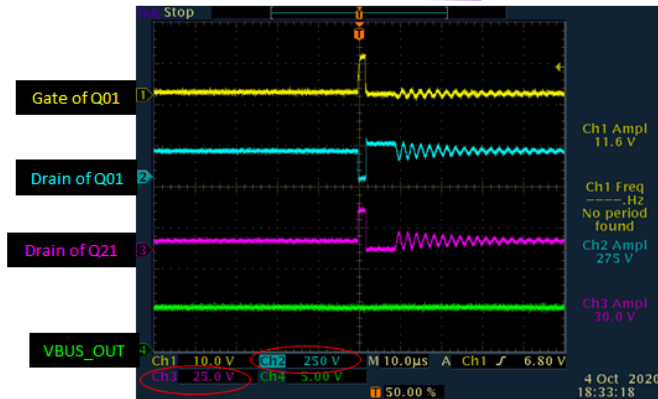
Source(s): [2]; [3]

Claim 1

said **(CON) controller** further configured to provide a **(OS) signal** to control said **(DC) duty cycle** of said **(PS) power switch** as a function of said **(OC) output characteristic** and in accordance with said **(COM) command**,

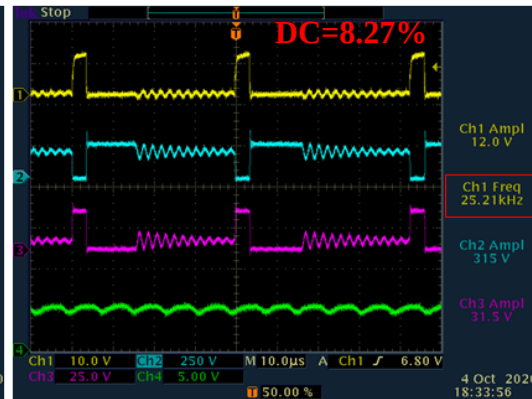
OC

VBUS_OUT=5V, no load



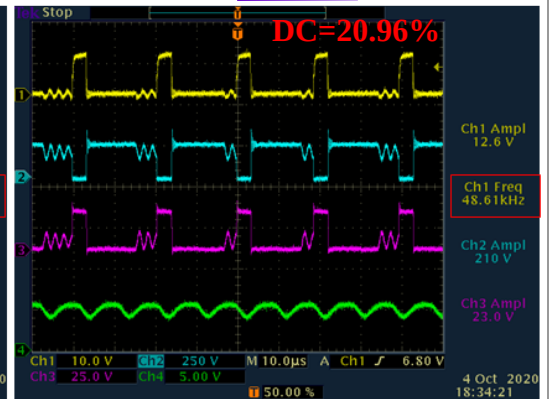
OC

VBUS_OUT=5V, 1A load



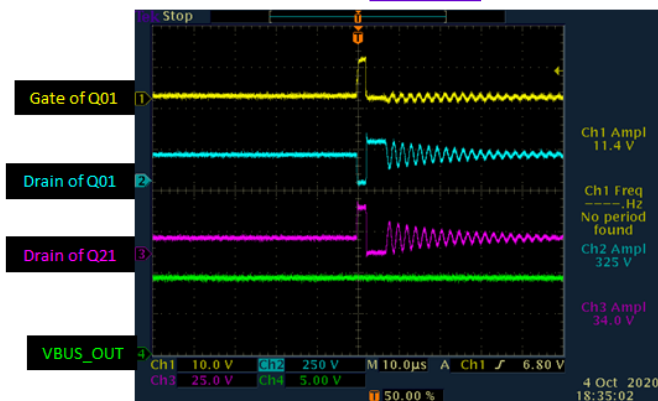
OC

VBUS_OUT=5V, 2A load



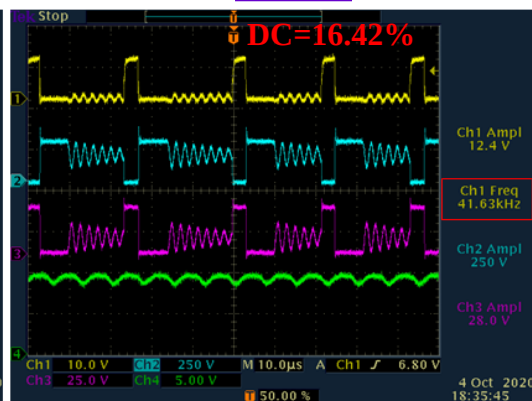
OC

VBUS_OUT=9V, no load



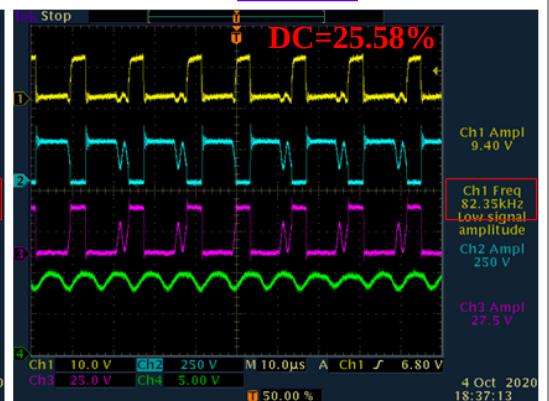
OC

VBUS_OUT=9V, 1A load



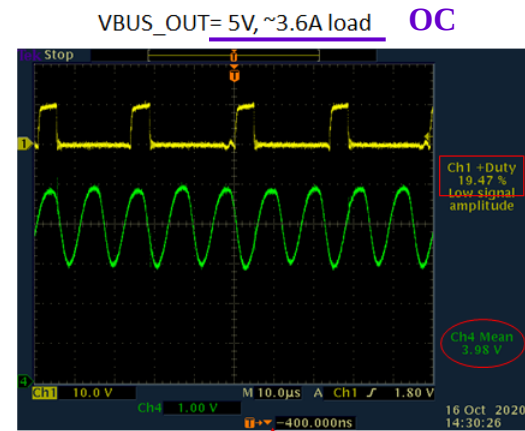
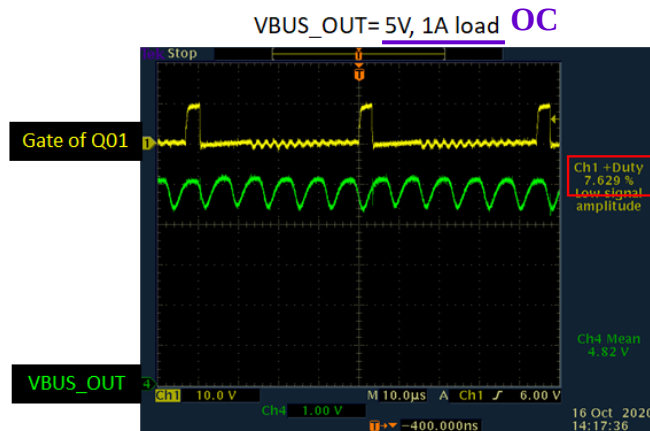
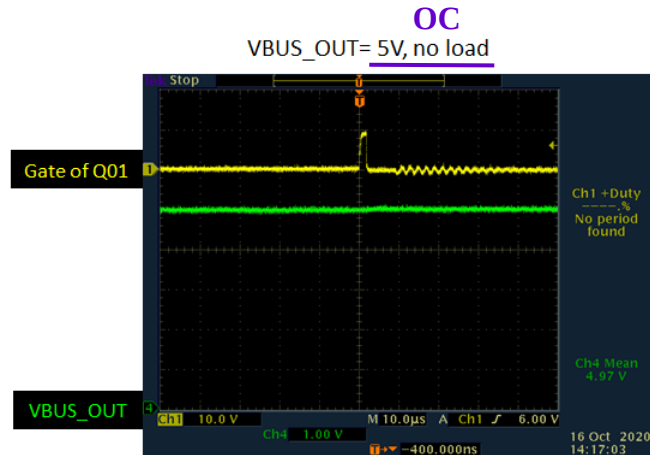
OC

VBUS_OUT=9V, 2A load



Claim 1

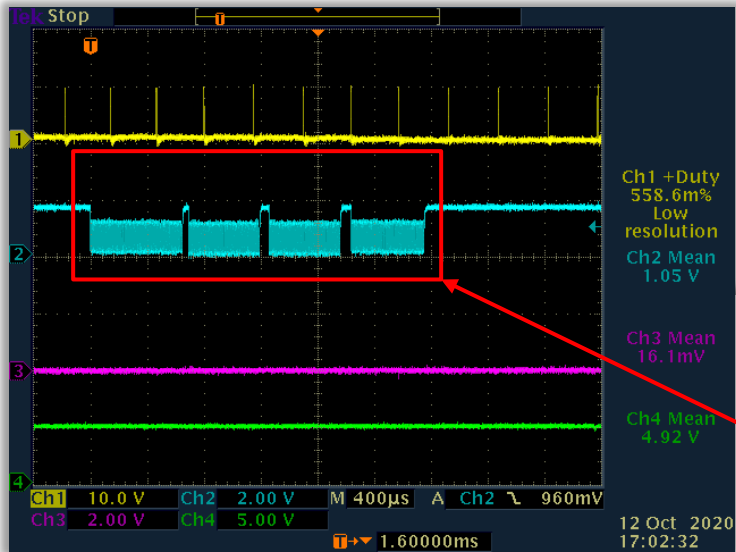
said (CON) controller further configured to provide a (OS) signal to control said (DC) duty cycle of said (PS) power switch as a function of said (OC) output characteristic and in accordance with said (COM) command,



Note: The charger will hold up the VBUS_OUT voltage at ~4.5V under a 3.5A load but the charger shuts down when the load is increased beyond that. This O-scope capture was taken as the charger was going into one of those over-current protection shutdowns when the load was increased to ~3.6A. Immediately after this capture, the VBUS_OUT voltage drops to 0V.

Claim 1

thereby regulating an **(IOC) internal operating characteristic** of said **(PC) power converter** to improve an **(EFF) operating efficiency** thereof as a function of said **(OP) system operational state**.



The iW657P resides on the secondary side of an AC/DC power supply and negotiates voltage and current settings with the primary-side controller, depending on the requests from the MD. The iW657P uses Dialog's proprietary secondary-to-primary digital communication technology and when paired with one of Dialog's primary-side **RapidCharge™** controllers, such as the iW1791 or iW1799, the iW657P eliminates the need for a discrete decoder on the primary side by using one optocoupler to transmit all necessary information for rapid charging to the primary side. This includes **output voltage requests, output current limits, output voltage undershoot, output over-voltage, and fault and reset signals**. The iW657P incorporates Dialog's proven and reliable DLNK technology to communicate from the secondary to the primary and also has a built-in optocoupler LED driver to minimize the bill of material cost.

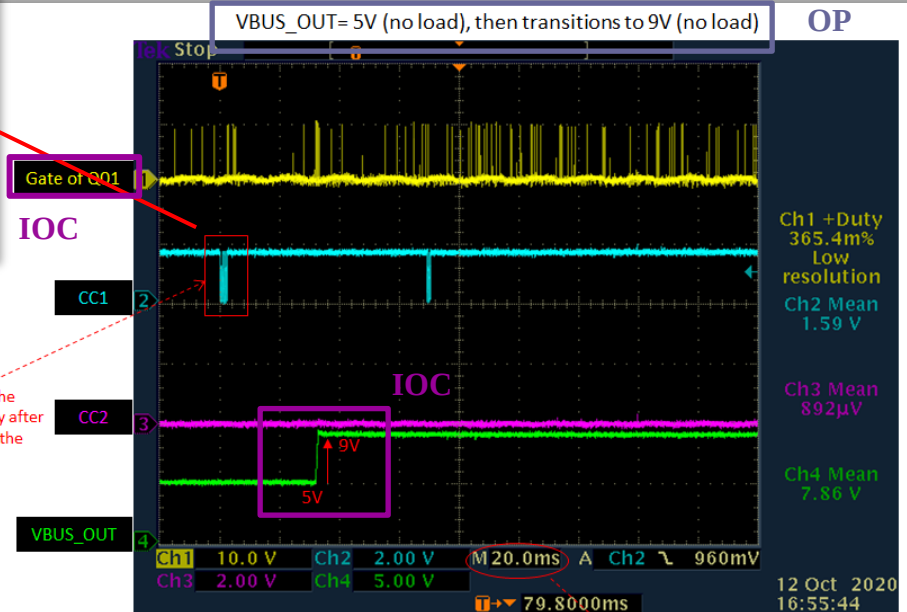
OP

The iW1791 is optimized to work with Dialog's secondary-side controllers that use the proprietary digital link (DLNK) technology. The iW1791 and DLNK-based secondary-side controller chipset together can implement various rapid charge protocols, such as USB Power Delivery (USB PD), Qualcomm® Quick Charge™ 2.0 and 3.0 (QC2.0 and QC3.0) technologies, etc. to achieve fast and smooth voltage transitions upon request by mobile devices (MD). The iW1791 and compatible secondary-side controller from Dialog use the DLNK communication protocol for output voltage requests, output current limits, output voltage undershoot and over voltage information from the secondary to the primary.

IOC

Source(s): [2]; [4]

This burst of data was fed to CC1 by the external PD3.0 emulator, immediately after pressing its trigger button that sends the charger a request for 9V output at VBUS_OUT.



OP

IOC

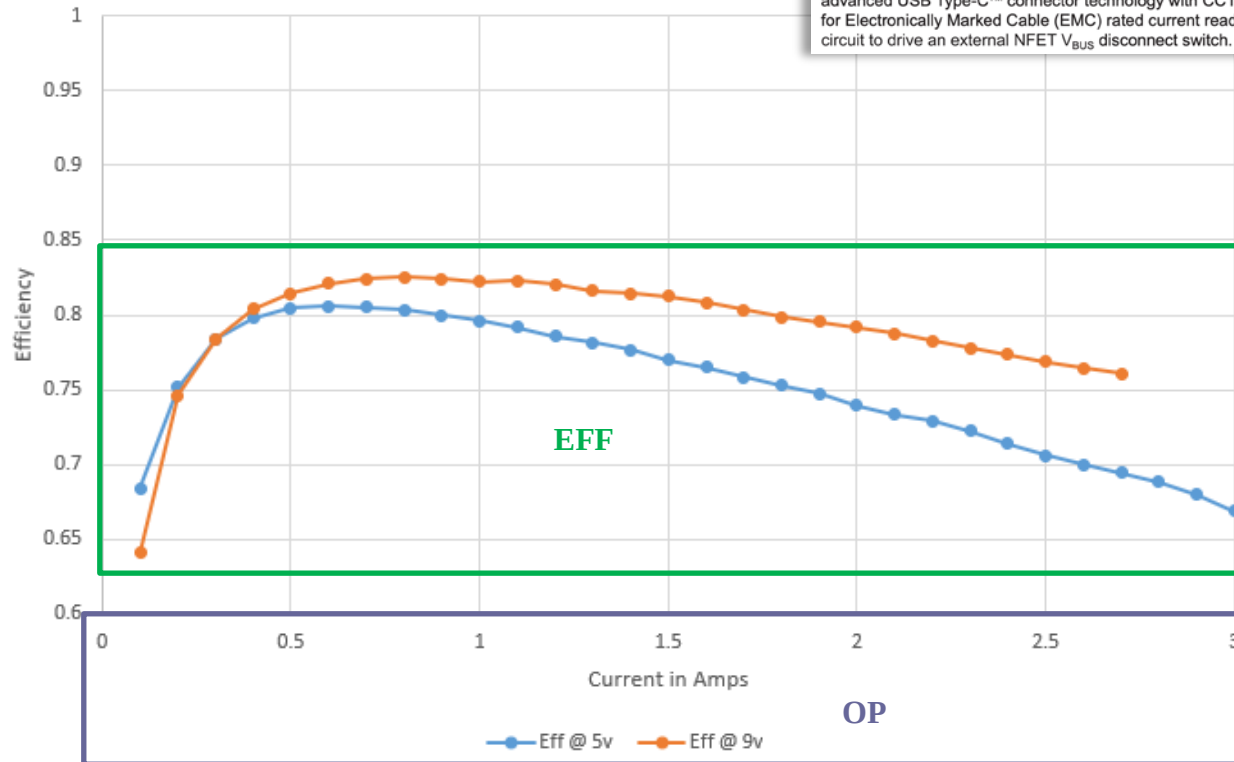
IOC

Shown at 20ms/div scale in order to capture the entire transition from 5V to 9V at VBUS_OUT.

Claim 1

thereby regulating an **(IOC) internal operating characteristic** of said **(PC) power converter** to improve an **(EFF) operating efficiency** thereof as a function of said **(OP) system operational state**.

Samsung EP-TA800
Efficiencies at 5v and 9v

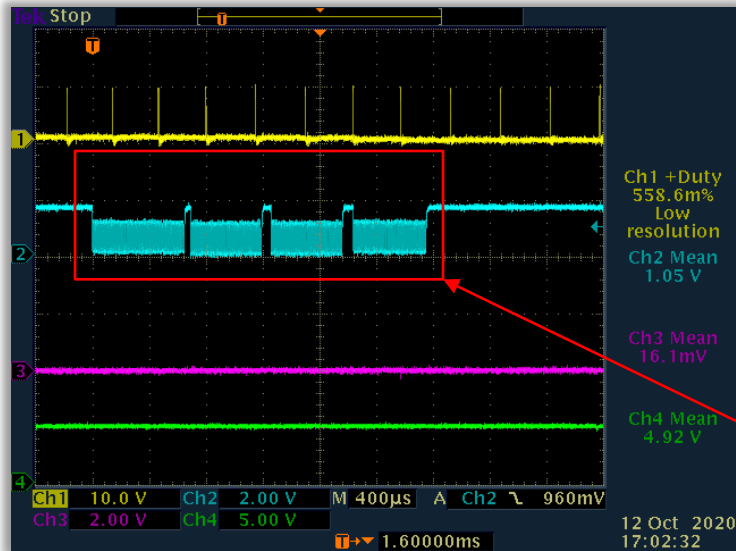


The iW657P is a USB Power Delivery (USB PD) interface controller which handles the communication between a Power Adapter and Mobile Device (MD). The controller enables the mobile device to alter the V_{BUS} voltage from the default 5V and/or maximum current limitation (e.g. 3A) for higher power output or **better efficiency**. The iW657P supports USB PD 3.0, including Programmable Power Supply (PPS) support, while being backwards compatible with USB PD 2.0. The device also supports Qualcomm® Quick Charge™ 4+ technology. The iW657P enables the use of advanced USB Type-C™ connector technology with CC1/CC2 pins for MD attach/detach detection and V_{CONN} support for Electronically Marked Cable (EMC) rated current reading. The iW657P also integrates a high current charge-pump circuit to drive an external NFET V_{BUS} disconnect switch.

Source(s): [2]

Claim 2

The **(PC) power converter** as recited in claim 1 wherein said **(PC) power converter** is configured to enter said **(PCOP) power converter operational state** within a **(TTIM) transition time** from another **(PCOP0) power converter operational state**.

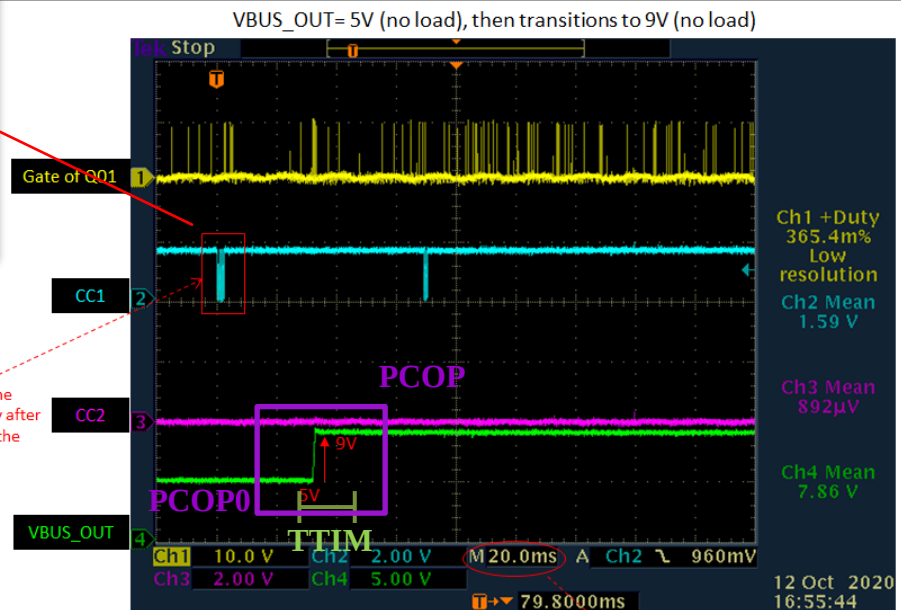


The iW1791 is optimized to work with Dialog's secondary-side controllers that use the proprietary digital link (DLNK) technology. The iW1791 and DLNK-based secondary-side controller chipset together can implement various rapid charge protocols, such as USB Power Delivery (USB PD), Qualcomm® Quick Charge™ 2.0 and 3.0 (QC2.0 and QC3.0) technologies, etc. to achieve fast and smooth voltage transitions upon request by mobile devices (MD). The iW1791 and compatible secondary-side controller from Dialog use the DLNK communication protocol for output voltage requests, output current limits, output voltage undershoot and over voltage information from the secondary to the primary.

TTIM

Source(s): [4]

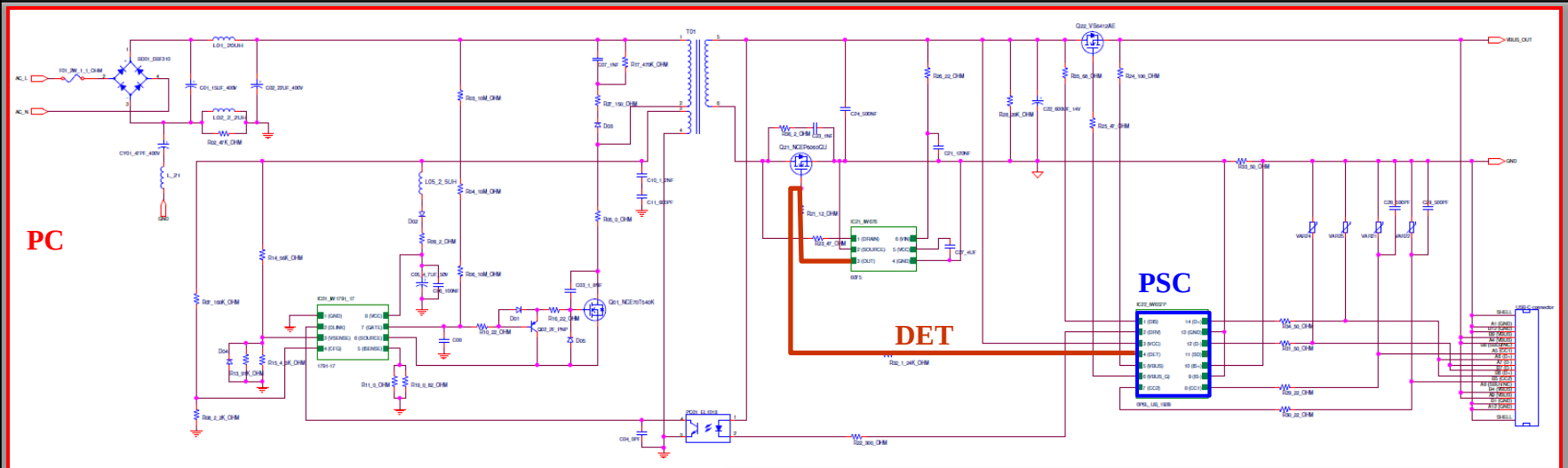
This burst of data was fed to CC1 by the external PD3.0 emulator, immediately after pressing its trigger button that sends the charger a request for 9V output at VBUS_OUT.



Shown at 20ms/div scale in order to capture the entire transition from 5V to 9V at VBUS_OUT.

Claim 3

The **(PC) power converter** as recited in claim 1 wherein said **(PSC) power system controller** is configured to receive a **(DET) signal** indicating a **(STAT) power converter status** of said **(PC) power converter**,



DET

Pin Number DFN-14	Pin Name	Type	Pin Description
1	DIS	Analog Output	Discharging circuit. Used for fast discharging of output capacitor.
2	DRV	Analog Output	External circuit drive. Can be used to drive optocoupler LED with automatic current limiting for transmitting signals to primary side.
3	V _{CC}	Power Supply	IC power supply.
4	DET	Analog Input	AC unplug detect. STAT
5	V _{BUS}	Analog Input/ Output	Monitor V _{BUS} voltage after N-FET switch.
6	V _{BUS_G}	Analog Input/ Output	Connect to external N-FET gate pin for gate-source voltage control.
7	CC2	Analog Input/ Output	Configuration Channel 2.
8	CC1	Analog Input/ Output	Configuration Channel 1.
9	IS-	Analog Input	Output current sensing terminal - (for current sensing resistor).
10	IS+	Analog Input	Output current sensing terminal + (for current sensing resistor).

Source(s): [2]

Claim 3

said **(PCOP) power converter operational state** being a function of said **(STAT) power converter status**.

Pin Number DFN-14	Pin Name	Type	Pin Description
1	DIS	Analog Output	Discharging circuit. Used for fast discharging of output capacitor.
2	DRV	Analog Output	External circuit drive. Can be used to drive optocoupler LED with automatic current limiting for transmitting signals to primary side.
3	V _{CC}	Power Supply	IC power supply.
4	DET	Analog Input	AC unplug detect. STAT / PCOP
5	V _{BUS}	Analog Input/ Output	Monitor V _{BUS} voltage after N-FET switch.
6	V _{BUS_G}	Analog Input/ Output	Connect to external N-FET gate pin for gate-source voltage control.
7	CC2	Analog Input/ Output	Configuration Channel 2.
8	CC1	Analog Input/ Output	Configuration Channel 1.
9	IS-	Analog Input	Output current sensing terminal - (for current sensing resistor).
10	IS+	Analog Input	Output current sensing terminal + (for current sensing resistor).

Note: If an AC unplug detect is observed the **PCOP of the system is unpowered**.

Source(s): [2]

Sources and citations

1. Universal Serial Bus Type-C Cable and Connector Specification, Release 2.0, August 2019;
2. Dialog Semiconductor iW657P USB Power Delivery 3.0 Controller with Integrated Current Sense Supports Qualcomm Quick Charge 4+, Product Summary Rev. 1.0 30-Mar-2020;
3. Dialog Semiconductor iW1791 AC/DC Primary Side Rapid Charge PWM Controller with High Resolution Voltage/Current Control, Product Summary Rev. 1.51 05-OCT-2018;
4. Dialog Semiconductor iW1791 AC/DC Primary Side Rapid Charge PWM Controller with High Resolution Voltage/Current Control, Product Summary Rev. 1.6 05-May-2020;

Note: The citations may pertain to only specific document excerpts and not the schematics or other data.