USB Power Delivery Controller for AC/DC Power Adapters

1 Description

The iW656 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 through the USB PD 2.0 protocol with the USB Type-C™ connector. The iW656 is compatible with USB Type-C Specification Rev. 1.2 with CC1/CC2 pins for MD attach/detach detection. The iW656 also integrates a high current charge-pump circuit to drive an external NFET V_{BUS} switch.

The iW656 resides on the secondary side of an AC/DC power supply and negotiates voltage and current settings depending on the requests from the MD. The iW656 uses Dialog's proprietary secondary-to-primary digital communication technology and when paired with Dialog's primary-side *RapidCharge™* controllers, such as iW1781, the iW656 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 iW656 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 power supply designed with the iW656 is fully protected. Using over-voltage protection on the D+/D-/CC1/CC2 pins, the iW656 helps to address soft short issues in cables and connectors caused by poor or loose connections between the cable connector and the socket, contamination in the USB connector, or a worn out cable. Additionally, proprietary short circuit protection on the V_{BUS} NFET ensures safe operation in the event of a short on the output, while the SD pin can be used with an external NTC resistor for protection from over-temeperature faults.

The iW656 also optionally supports legacy D+/D- communication protocols including Samsung Adaptive Fast Charge (AFC), Qualcomm® Quick Charge™ 2.0 and 3.0 (QC2.0/QC3.0) and USB BC1.2. The AFC/QC2.0/QC3.0 protocol can be disabled by simple power supply circuit configuration.

2 Features

- Supports USB PD 2.0
  - » Integrated CC transmitter/receiver supports BMC communication
- Supports up to 7 Power Data Objects (PDOs)
- Supports wide output voltage range from 3 to 20V
- Supports direct charge through Vendor Defined Message (VDM)
- Compatible with USB Type-C specification Rev 1.2 for MD attach/detach detection
- Integrated charge pump supports single NFET V_{BUS} switch
- Proprietary V_{BUS} NFET short protection to protect V_{BUS} switch from damage due to an output short circuit
- Proprietary secondary-to-primary digital communication eliminates discrete decoders on the primary side and simplifies system designs
- D+/D-/CC1/CC2 over-voltage protection (OVP) address soft short issues in the output cables and connectors
- Programmable active fast discharge from a high voltage V_{BUS} level to 5V at MD unplug or upon request with built-in switch or external switch
- Intelligent low-power mode helps achieve < 20mW overall system no-load power consumption during 5V steady-state operation
- Optionally supports AFC/QC2.0/QC3.0 fast charging technologies for output voltage and current negotiation
- 12-pin 3x3mm TDFN package

3 Applications

- Rapid-charging AC/DC adapters for smart phones, tablets and other portable devices

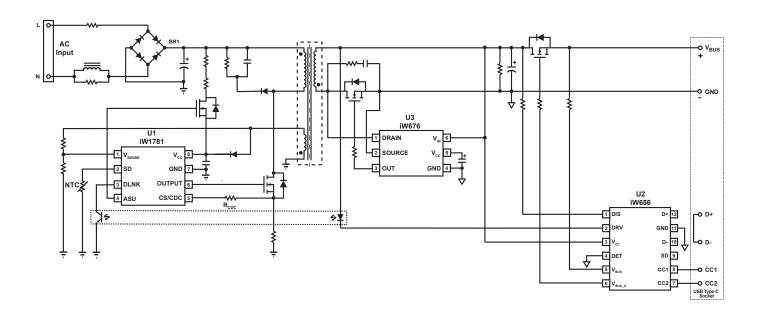Qualcomm® Quick Charge™ 2.0 and 3.0 are products of Qualcomm Technologies, Inc.

Product Summary   **Rev. 1.0**   **09-Jan-2018**

Figure 3.1 : iW656 Typical Application Circuit with AFC/QC2.0/QC3.0 Disabled.
(Using iW1781 as Primary-Side Controller and iW676 as Synchronous Rectifier Controller.)
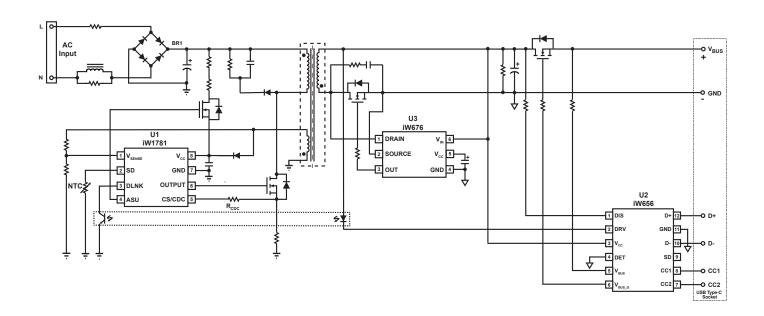

Figure 3.2 : iW656 Typical Application Circuit with AFC/QC2.0/QC3.0 Enabled.
(Using iW1781 as Primary-Side Controller and iW676 as Synchronous Rectifier Controller.)

4 Pinout Description

iW656

Figure 4.1 : 12-Lead TDFN 3x3mm Package

Pin Number TDFN-12	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	Connected to GND for standard PD applications.
5	V_{BUS}	Analog Input/ Output	V_{BUS} voltage monitoring after V_{BUS} switch.
6	V_{BUS_G}	Analog Input/ Output	N-FET V_{BUS} switch driver. 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	SD	Analog Input/ Output	External shutdown control. Can be configured for external over-temperature protection (OTP) by connecting an NTC resistor from this pin to Ground.
10	D-	Analog Input/ Output	USB D- signal.
11	GND	Ground	Ground.
12	D+	Analog Input/ Output	USB D+ signal.

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5 Absolute Maximum Ratings

Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded.

Parameter	Symbol	Value	Units
V_{CC} voltage	V_{CC}	-0.3 to 30	V
DIS voltage	V_{DIS}	-0.3 to 30	V
DRV voltage	V_{DRV}	-0.3 to 30	V
V_{SD} voltage	V_{SD}	-0.3 to 7	V
D- voltage	V_{D-}	-0.3 to 7	V
D+ voltage	V_{D+}	-0.3 to 7	V
CC1 voltage	V_{CC1}	-0.3 to 30	V
CC2 voltage	V_{CC2}	-0.3 to 30	V
V_{BUS} voltage (I_{VBUS} < 10mA)	V_{BUS}	-0.7 to 30	V
V_{BUS_G} voltage	V_{BUS_G}	-0.7 to 35	V
DET voltage	V_{DET}	-0.7 to 30	V
Peak current at DIS pin (V_{DIS}= 12V)	I_{DIS}	600	mA
Maximum junction temperature	T_{JMAX}	150	°C
Operating junction temperature	T_{JOPT}	-40 to 150	°C
Storage temperature	T_{STG}	-65 to 150	°C
ESD rating per JEDEC JESD22-A114 (D+, D-, CC1, CC2)		±8,000	V
ESD rating per JEDEC JESD22-A114 (all other pins)		±2,000	V

Notes:

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, so functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
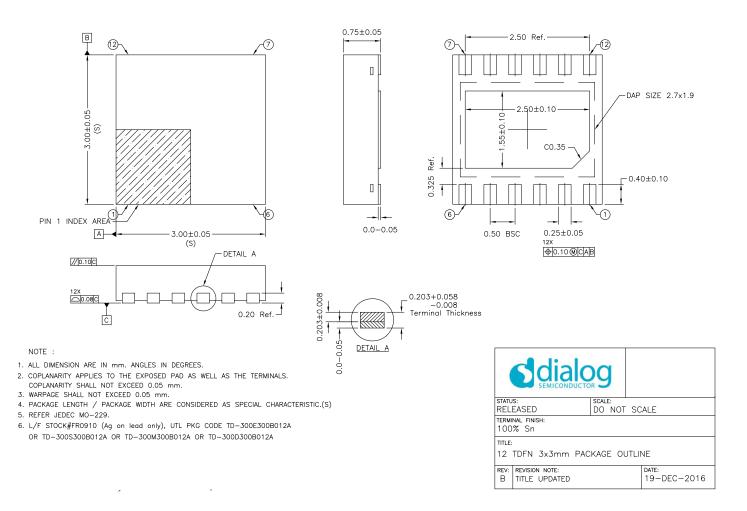
6 Physical Dimensions

NOTE :

1. ALL DIMENSION ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS. COPLANARITY SHALL NOT EXCEED 0.05 mm.
3. WARPAGE SHALL NOT EXCEED 0.05 mm.
4. PACKAGE LENGTH / PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC.(S)
5. REFER JEDEC MO-229.
6. L/F STOCK#FR0910 (Ag on lead only), UTL PKG CODE TD-300E300B012A OR TD-300S300B012A OR TD-300M300B012A OR TD-300D300B012A

STATUS: RELEASED	SCALE: DO NOT SCALE
TERMINAL FINISH: 100% Sn	
TITLE: 12 TDFN 3x3mm PACKAGE OUTLINE	
REV: B	REVISION NOTE: TITLE UPDATED	DATE: 19-DEC-2016

Figure 6.1 : 12-Lead TDFN 3x3mm Package

7 Ordering Information

Part Number[1]	TA Maximun Power (W)	PDO	VID	PID	bcd-Device	XID	Protocol Supported	k_{CC} for default system output current[2]	Primary-Side Controller	Package	Descrip-tion
iW656-15-04	15	5V/3A, 9V/1.65A	0x2DCF	0x656	0x04	5290	PD2.0	0.495	iW1781 or iW1791	TDFN12, 3x3	Tape & Reel[3]
iW656-18-00	18	5V/3A, 5.5V/3A, 6V/3A, 7V/2.55A, 8V/2.25A, 9V/2A, 10V/1.8A	0x2DCF	0x656	0x00	5290	PD2.0/ QC2.0/AFC	0.495	iW1781 or iW1791	TDFN12, 3x3	Tape & Reel[3]
iW656-18-30	18	5V/3A, 5.5V/3A, 6V/3A, 7V/2.55A, 8V/2.25A, 9V/2A, 5-10.6V/ 0.4-2A (VPDO)	0x2DCF	0x656	0x30	5290	PD2.0/ QC2.0	0.495	W1781 or iW1791	TDFN12, 3x3	Tape & Reel[3]
iW656-21-01	21	5V/3A, 5.5V/3A, 6V/3A, 6.5V/3A, 7V/3A, 8V/2.6A, 9V/2.3A	0x2DCF	0x656	0x01	5290	PD2.0/ QC2.0	0.495	iW1781 or iW1791	TDFN12, 3x3	Tape & Reel[3]
iW656-24-03	24	5V/3A, 5.5V/3A 6V/3A, 6.5V/3A 7V/3A, 8V/3A, 9V/2.65A, 12V/2A, 15V/1.6A	0x2DCF	0x656	0x03	5290	PD2.0/ QC2.0	0.495	iW1781 or iW1791	TDFN12, 3x3	Tape & Reel[3]
iW656-24-31	24	5V/3A, 6V/3A, 7V/3A, 8V/3A, 9V/2.65A, 12V/2A, 15V/1.6A, 5-10.6V/ 0.4-2.6A (VPDO)	0x2DCF	0x656	0x31	5290	PD2.0/ QC2.0/AFC	0.495	iW1781 or iW1791	TDFN12, 3x3	Tape & Reel[3]
iW656-27-21	27	5V/3A, 7V/3A, 9V/3A, 12V/2.25A	0x2DCF	0x656	0x21	5290	PD2.0/ QC3.0	0.417	iW1781 or iW1791	TDFN12, 3x3	Tape & Reel[3]
iW656-30-05	30	5V/3A, 9V/3A, 15V/2A, 20V/1.5A	0x2DCF	0x656	0x05	5290	PD2.0/ QC2.0	0.525	iW1781	TDFN12, 3x3	Tape & Reel[3]
iW656-45-08	45	5V/3A, 9V/3A, 15V/3A, 20V/2.25A	0x2DCF	0x656	0x08	5290	PD2.0/ QC2.0	0.417	iW1781	TDFN12, 3x3	Tape & Reel[3]

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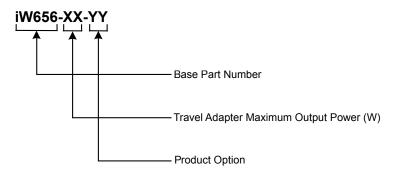
Note 1: For availability of additional part numbers, please contact Dialog; see Section 7.1 "Part Number Code Description" for details.
Note 2: After Type-C™ plug-in is detected, iW656 sends a DLNK message to the primary-side to set the k_{CC} value to this value.
Note 3: Tape & Reel packing quantity is 3,000/reel. Minimum packing quantity is 3,000.

7.1 Part Number Code Description

iW656-XX-YY

Base Part Number

Travel Adapter Maximum Output Power (W)

Product Option

USB Power Delivery Controller for AC/DC Power Adapters

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Contacting Dialog Semiconductor

United Kingdom (Headquarters)
Dialog Semiconductor (UK) LTD
Phone: +44 1793 757700

Germany
Dialog Semiconductor GmbH
Phone: +49 7021 805-0

The Netherlands
Dialog Semiconductor B.V.
Phone: +31 73 640 8822

Email
info_pcbg@diasemi.com

North America
Dialog Semiconductor Inc.
Phone: +1 408 845 8500

Japan
Dialog Semiconductor K. K.
Phone: +81 3 5769 5100

Taiwan
Dialog Semiconductor Taiwan
Phone: +886 281 786 222

Web site:
www.dialog-semiconductor.com

Hong Kong
Dialog Semiconductor Hong Kong
Phone: +852 2607 4271

Korea
Dialog Semiconductor Korea
Phone: +82 2 3469 8200

China (Shenzhen)
Dialog Semiconductor China
Phone: +86 755 2981 3669

China (Shanghai)
Dialog Semiconductor China
Phone: +86 21 5424 9058

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