dialog
SEMICONDUCTOR

Mobile

January 2020

LEADER IN POWER SOLUTIONS FOR SMARTPHONES

Dialog's power management solutions are optimized to meet the challenging needs of today's smartphones. Tight space constraints, thermal challenges and ever changing power requirements are effectively addressed through Dialog's portfolio of highly integrated, highly efficient and easily configurable PMICs.

Dialog also offers innovative, highly efficient and high-density charging solutions that reduce heat dissipation for any rapid charging technology.

Development Support

Throughout the customer product development period, Dialog provides quick and expert application support. Dialog's local field application engineers are always on hand to provide dedicated advice and guidance during the critical design phase.

Contents

Power Management ICs (PMICs)

Highly integrated, efficient and scalable power management ICs (PMICs) and sub-PMICs for powering SOCs

Charging ICs

High efficiency companion charger ICs, requiring no external inductors

Haptics

Low-power, wide-bandwidth haptic driver for vibrations and clicks using ERM (eccentric rotating mass motor) and LRA (linear resonant actuator) applications

AC/DC RapidCharge™ adapter solutions

Higher power density in smaller travel adapters without incurring thermal issues

Custom Mixed-Signal Solutions

Market leading Custom PMICs and Mixed-Signal ASICs deliver customized solutions to optimize efficiency, size, performance and system cost

Capacitive Dividers

The industry's first and highest efficiency Switch Cap Converters with extremely small footprint enabling 2S to 1S voltage conversions without requiring inductors

Custom Mixed-Signal Solutions

Dialog Semiconductor, a market leader in custom Power Management ICs (PMICs) and Mixed-Signal ASICs, has a proven track record and long history in its close collaboration with industry leaders to deliver customized, high-performance solutions. The company's exemplary record has resulted in multi-generational partnerships which have firmly established Dialog as a trusted partner of choice.
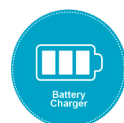
Integrate to Differentiate

Dialog enables many of the most unique and advanced electronics products on the market today.   Its broad, mixed-signal portfolio ranges from advanced power conversion topologies, battery chargers, audio solutions, digital and analog interfaces to linear analog and signal conditioning technologies. Dialog's digital capabilities include embedded computing as well as memory to empower next generation solutions. Advanced packaging technologies co-developed with the company's packaging experts and vendor partners continue to deliver leading edge solutions in the mixed-signal market.
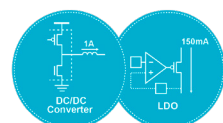
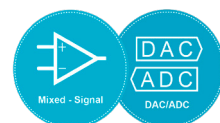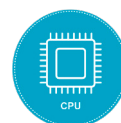| Power Management	Battery Chargers	Audio	Interface	Linear Analog & Signal Conditioning	Computing
• DC/DC Converters – Buck – Boost – Buck-Boost • Hybrid Converters • Switch-Cap Converters • LDOs	• Linear Charging • Switchmode Charging • Direct Charging • Current Doublers/ Voltage Dividers • Power Path Management	• Audio Amps • Audio Codecs • Audio Processors • Integrated Power and Audio Solutions	• USB Phy • Type-C Controller • I2C/I3C • SPI • UART • Display Drivers	• ADC • DAC • Op-Amps • Comparators • References • Sensor Interface • Integrated Motor Drivers	• CPU/MCU – ARM – 8051 – DSP – Custom • Memory – Flash – OTP – MTP

Time-to-Market

Dialog is now the leading pure play provider of advanced Power Management ICs. This level of success was achieved through absolute attention to detail. Dialog ensures that all IP is proven to perform as designed. Its accumulated library of leading-edge technologies enables Dialog to execute flawlessly and deliver "First Time Right" solutions.

Operational Excellence

Dialog's long-standing relationships with world-class manufacturing partners for wafer fabrication back-end assembly and test provide access to advanced mixed signal process nodes. Expertise in mixed-signal ASIC design and development from concept to production guarantees the highest levels of quality.

Dialog's unparalleled high-volume production ramp capability (from zero to 80 M units within a quarter) empowers its customers to rapidly deliver new products to market. The internal supply chain team at Dialog has delivered 99%+ on-time-delivery (OTD) while working closely to react to today's dynamic and volatile market conditions.
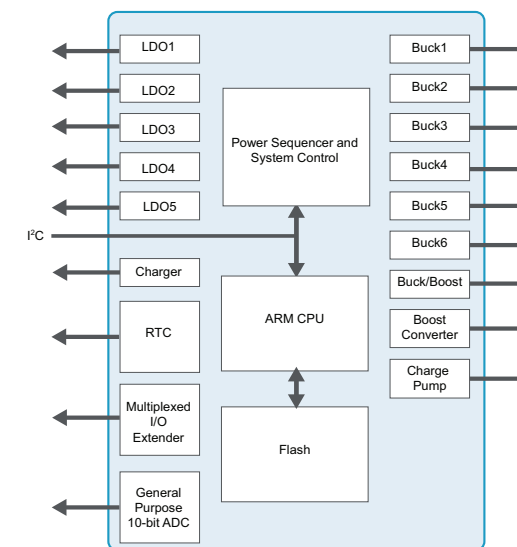
A representative example of a high-performance Custom ASIC in production

Power management ICs

Highly integrated solutions offer space saving and cost-effective smartphone solutions

The integration of multiple switching regulators and LDOs meets the diverse power management needs of advanced SOCs and conserves valuable board space. Additionally, these highly integrated solutions deliver higher reliability, reduced complexity and provide layout flexibility.

Flexible and configurable for multiple SOC platforms

Dialog's comprehensive solutions meet the challenges of powering today's advanced application processor and modem SOCs with diverse voltage and current needs, multiple channels, power sequencing requirements and the ability to scale to higher power needs.

PMIC and sub-PMIC families meet wide-ranging needs in today's applications

In addition to highly integrated PMIC solutions with integrated multiple buck regulators and LDOs, Dialog offers a family of high-current sub-PMICs that satisfy the high-current needs of the latest SOCs. These sub-PMICs offer multi-phase, high-current (up to 20 A) buck regulators in a compact footprint with advanced power management features.

System PMIC Product Portfolio

Product	Package	Input Voltage (V)	Regulators	LDOs	ADC	USB charger	RTC	Interface	GPIOs	Backup charger	LED boost	Watchdog	Audio Amplifier (Class G, Class D)	Audio Codec
DA9021	WLCSP	2.8 to 5.5	3	5	Y	Y	Y	I²C, SPI	9	-	-	-	-	-
DA9022	WLCSP	2.8 to 5.5	3	5	Y	Y	Y	I²C, SPI	9	-	-	-	-	-
DA9053	VBGA	2.8 to 5.5	4	10	Y	Y	Y	I²C, SPI	16	Y	Y	Y	-	-
DA9061	QFN	2.7 to 5.5	3	4	-	-	-	I²C	5	-	-	Y	-	-
DA9062	QFN	2.8 to 5.5	4	4	-	-	Y	I²C	5	Y	-	Y	-	-
DA9063	BGA	2.8 to 5.5	6	11	Y	-	Y	I²C, SPI	16	Y	-	Y	-	-
DA9066	WLCSP	2.5 to 4.4	6	20	Y	-	Y	I²C	1	Y	-	Y	G, D	Y
DA9068	WLCSP	2.8 to 4.5	8	25	Y	-	Y	I²C	1	Y	-	Y	-	-

Sub-PMIC Product Portfolio

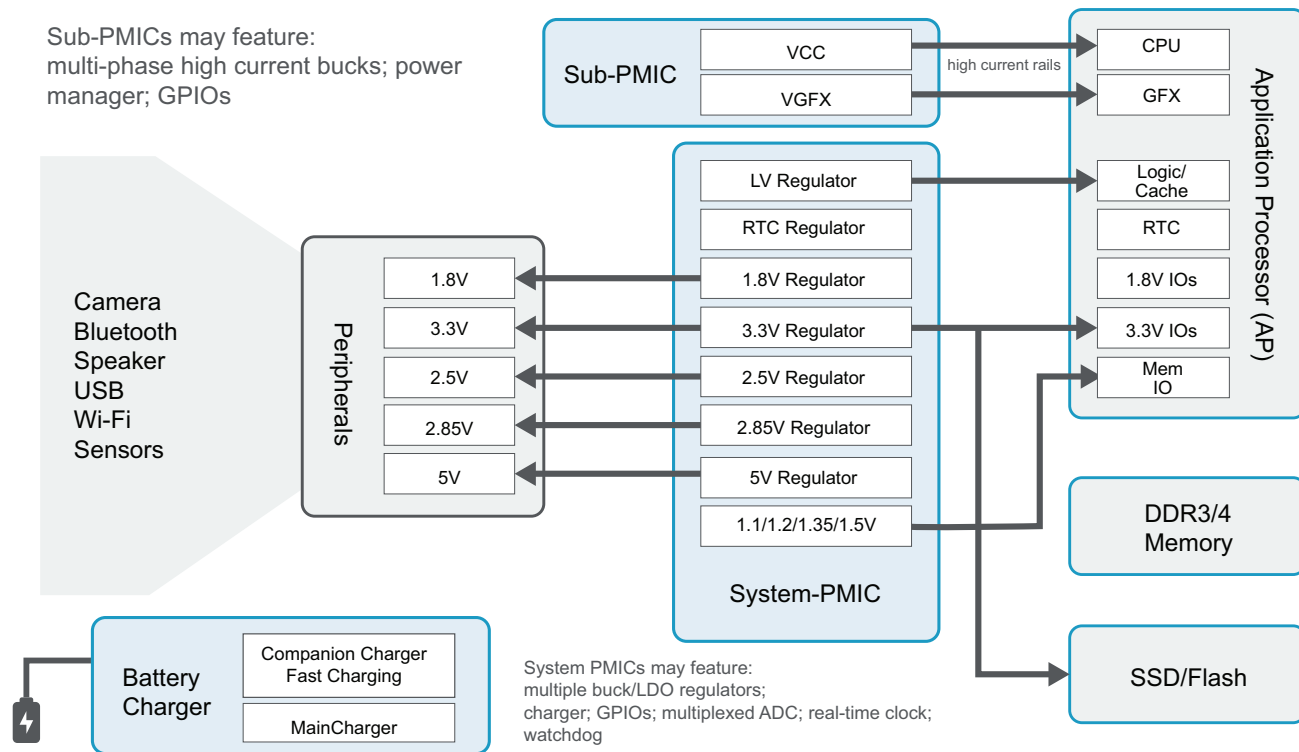| Product	Package	Input Voltage (V)	Regulators	Interface	GPIOs
DA9121	WLCSP	2.5 to 5.5	One dual-phase buck (10A)	I²C	5
DA9122	WLCSP	2.5 to 5.5	Two single-phase bucks (5A each)	I²C	5
DA9211	WLCSP	2.8 to 5.5	One quad-phase buck (12A)	I²C, SPI	5
DA9212	WLCSP	2.8 to 5.5	Two dual-phase bucks (6A each)	I²C, SPI	5
DA9213	WLCSP	2.8 to 5.5	One quad-phase buck (20A)	I²C, SPI	5
DA9214	WLCSP	2.8 to 5.5	Two dual-phase bucks (10A each)	I²C, SPI	5
DA9215	WLCSP	2.8 to 5.5	One triple-phase buck (15 A) and one single-phase buck (5A)	I²C, SPI	5
DA9217	WLCSP	2.5 to 5.5	One dual-phase buck (6A)	I²C	5
DA9220	WLCSP	2.5 to 5.5	Two single-phase bucks (3A each)	I²C	5
DA9230	WLCSP	2.5 to 5.5	One 300mA with low Iq	I²C	1
DA9231	WLCSP	2.5 to 5.5	One 300mA buck plus one 100mA LDO / Load Switch	I²C	1

Easy development with SmartCanvas™ and Power Commander user interface

The Dialog SmartCanvas and Power Commander software equips hardware and software developers with a powerful graphical interface for viewing and controlling Dialog system PMICs, sub-PMICs, chargers, and DC/DC converters. The benefits include:

- Any start-up sequence can be quickly tested in real-time
- Easy setup of the fully-programmable sequencer for bucks, LDOs, GPIOs, and system control signals
- Configuration of up to three power domains which are selectable via the sequencer, by GPIOs, or by software
- Fast debugging using the I²C interface for full visibility of the PMIC status
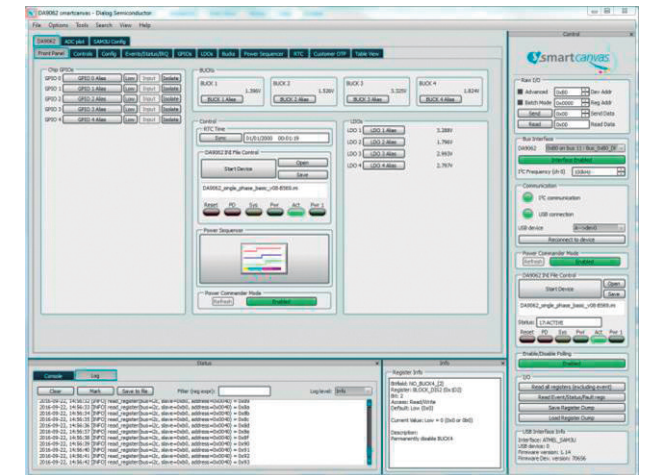
Complete solutions for smartphone devices:

Sub-PMICs may feature:
multi-phase high current bucks; power
manager; GPIOs

Camera
Bluetooth
Speaker
USB
Wi-Fi
Sensors

System PMICs may feature:
multiple buck/LDO regulators;
charger; GPIOs; multiplexed ADC; real-time clock;
watchdog

Switched Capacitor DC-DC Converters

Dialog Semiconductor is first in the industry to launch DA9313, an ultra-efficient Buck Converter that does not require the use of inductors. This differentiated technology is leading the way in optimizing next-generation mobile devices.

This family of devices - also referred to as Switched Cap Dividers - can offer up to 98% efficiency at high power levels. The combination of "almost loss-less" conversion and high power density make it ideally suited to power the emerging design trends in Smartphones. Major benefits of this unique technology include direct charging of single cell Lithium Ion batteries - enabling usage of standard 3A low-cost USB cables to deliver up to 6A of charging current, 75% reduced routing losses and more than 50% reduction in PCB board area – all within a package height of less than 1mm.

The DA9313 – Dialog's 1st-Gen offering - can provide up to 10A of current in a 10mm2 offering with an extremely flat efficiency curve at a peak efficiency of 98.2% over a wide range of output current loads. It can also operate in a Master-Slave configuration to deliver up to 20A. The DA9313 also offers enable and power-good functions and can be configured to operate in a fixed-frequency mode.

The next-generation of this unique technology is in development and will be introduced to key customers during the 1st half of 2019 and to the broader market in late 2019.

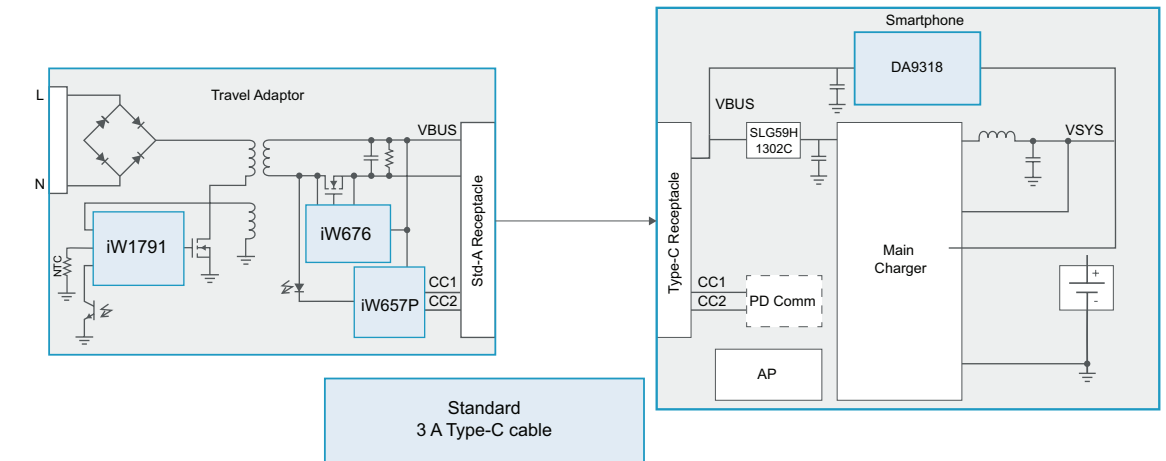| Product	Input Voltage	Output Voltage	Current	Interface	Package
DA9313	5-105V	Vout = ½ Vin	10A	I2C	43 ball WLCSP
			(20A in Master-Slave)		

Eff Curve

Power Converter - Efficiency
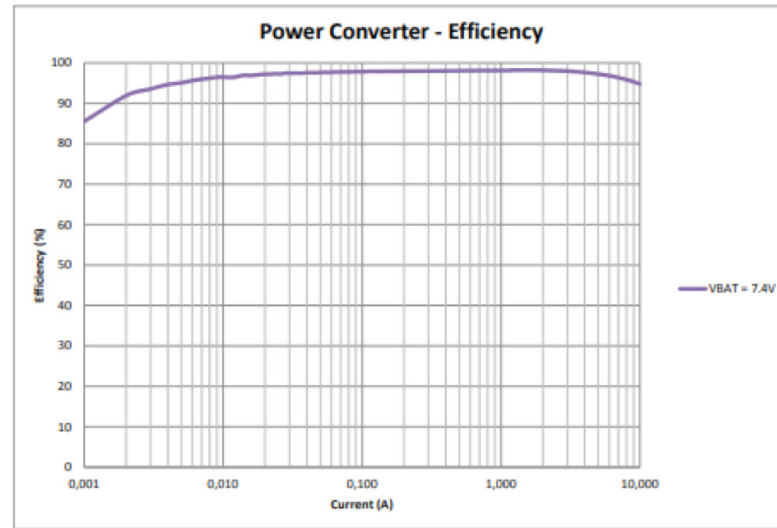
Smartphone charging ICs

Dialog offers a high-efficiency companion charger solution for rapid charging delivering up to 2.5 A charging current, and direct charging solutions that can deliver up to 6 A charging current to the battery using a standard 3 Amp USB cable. Dialog's highly efficient inductor-less switched capacitor DC/DC converter enables 1S mobile devices to migrate to 2S battery configuration without any changes in the regulated voltage rails.

The DA9318 is a high-voltage inductor-less current doubler powering up to 44 W, with integrated protection features and incredible power efficiency of up to 98%, and has an input voltage range of 5.5 V to 10.5 V.

The DA9155M is a 2.5 A companion charger with 92% peak efficiency for 1S battery applications, and has an input voltage range of 4.3 V to 13.5 V for all rapid charging technologies.

| Product	Package	Input Voltage (V)	Output Voltage (V)	Maximum Output Current (A)	Interface	Over-temperature Protection	Over-current Protection	Input Voltage Protection	Battery voltage Protection	Input-to-output Voltage Protection	Safety Timer	Watchdog	Current Sensing	Travel Adapter Detection	ADC
DA9318	WLCSP	5.5 to 10.5	$V_{IN}/2$	L(8), M(10)	I²C	Y	Y	Y	Y	Y	Y	Y	Y	Y	8-bit
DA9155M	WLCSP	4.3 to 13.5	6	2.5	I²C	Y	Y	Y	Y	Y	Y	-	-	-	-

Highly integrated, configurable and scalable solutions that are compact and efficient to fully meet the power management needs of today's smartphones.

AC/DC RapidCharge™ controller solutions

As the leader in AC/DC RapidCharge solutions, Dialog supports more fast-charging protocols than any other supplier, including USB Power Delivery 3.0 (USB PD 3.0); Qualcomm® Quick Charge™ 4+, 3.0 and 2.0 technologies; Samsung Adaptive Fast Charging (AFC); direct charge; and other proprietary OEM protocols.

- USB Power Delivery 3.0
- Qualcomm® Quick Charge™ 4+
- Qualcomm® Quick Charge™ 3.0
- Qualcomm® Quick Charge™ 2.0
- Samsung Adaptive Fast Charging
- Direct Charge
- Other Proprietary OEM Protocols

USB Power Delivery

Qualcomm Quick Charge 4+

Qualcomm Quick Charge 3.0

Qualcomm Quick Charge 2.0

dialog SEMICONDUCTOR

rapidcharge

OEM #1 OEM #2
OEM #3 OEM #4
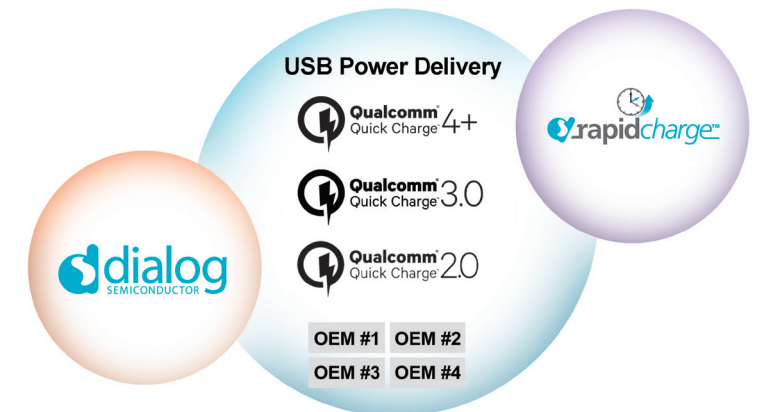
Qualcomm® Quick Charge™ is a trademark of Qualcomm® Technologies Inc.

15

# iW662+iW1796 – low BOM cost 27W Qualcomm® Quick Charge™ 3.0 adapter solution

- iW662 secondary-side synchronous rectifier and RapidCharge™ interface controller in one IC
- iW1796 PrimAccurate™ primary-side controller
  No start-up DFET
- iW662 and iW1796 use Dialog's XM-Comm communication technology
  Eliminates need for optocoupler
- High power density for small form-factor up to 27W
- Low no-load power consumption < 20mW with fast dynamic load response
- Double-layer cable protection
  D+/D- over-voltage protection (iW662)
  Advanced fault control technology addresses soft shorts in cables and connectors (iW1796)
- Small, SOT23-6 package (iW1796)
- Optional support for Qualcomm® Quick Charge™ 2.0 and other RapidCharge™ protocols

No Optocoupler!
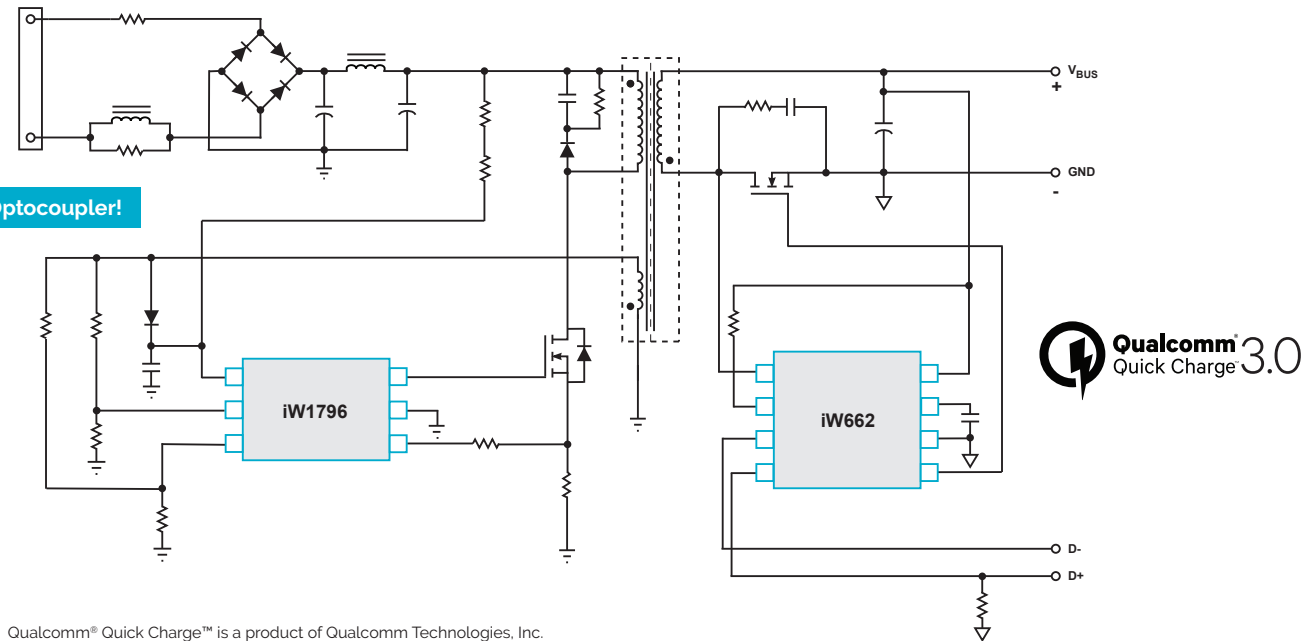
Qualcomm® Quick Charge™ is a product of Qualcomm Technologies, Inc.

iW662+iW1798 – high-power 45W Qualcomm® Quick Charge™ 3.0 adapter solution

- iW662 secondary-side synchronous rectifier and RapidCharge™ interface controller in one IC
- iW1798 PrimAccurate™ primary-side controller
  No start-up DFET
- iW662 and iW1798 use Dialog's XM-Comm Communication technology
  Eliminates need for optocoupler
- High power density for small form-factor up to 45W
- Low no-load power consumption < 20mW with fast dynamic load response
- Double-layer cable protection
  D+/D- over-voltage protection (iW662)
  Advanced fault control technology addresses soft shorts in cables and connectors (iW1798)
- Optional support for Qualcomm® Quick Charge™ 2.0 and other RapidCharge™ protocols

No Optocoupler!
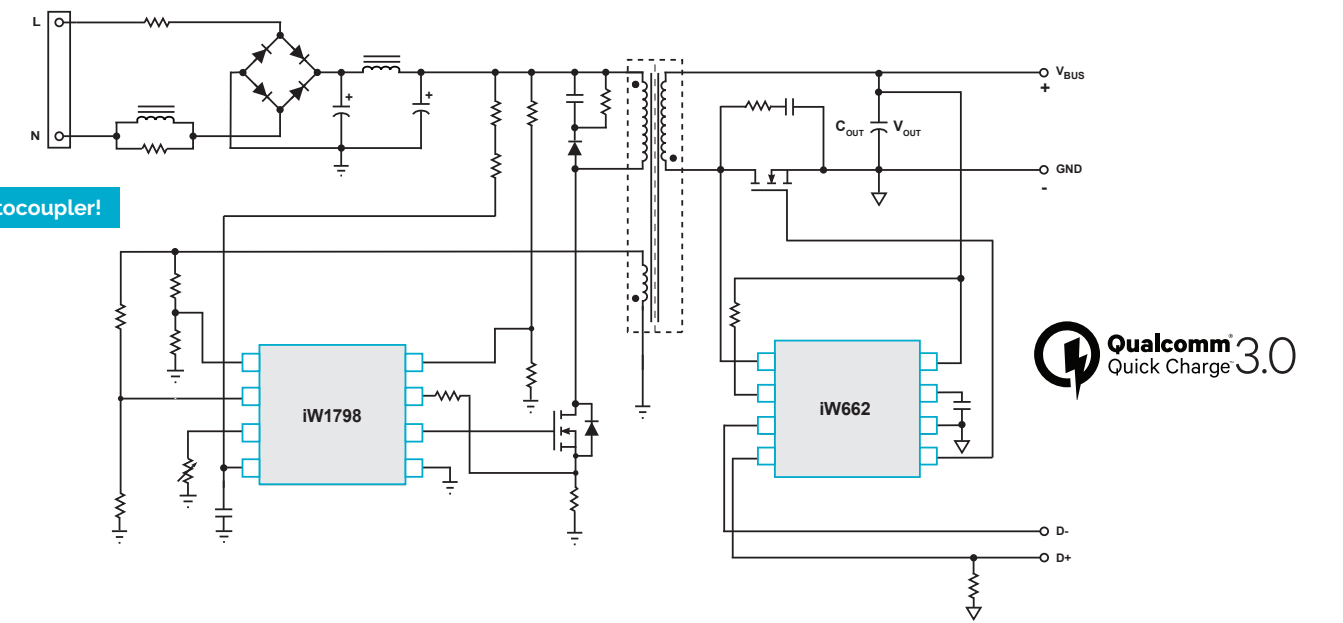
Qualcomm® Quick Charge™ is a product of Qualcomm Technologies, Inc.

iW657P+iW1799+iW676 – complete system solution for USB Power Delivery 3.0 travel adapters

- **USB-IF PD certified (USB PD 3.0 + PPS)**
- **Compatible with USB Type-C™ Rev. 1.2**
- **Secondary-side NMOS V$_{BUS}$ switch lowers system cost**
- **V$_{CONN}$ support**
- **Low no-load power consumption < 20mW with fast DLR (dynamic load response)**
- **Optional V$_{IN}$ OVP or X-cap discharge (iW1799)**
- **High power density for small form-factor up to 45W**

- **Robust protection features**
  Over-voltage protection
  Over-current protection
  Output short protection
  Over-temperature protection
  Active discharge
  V$_{BUS}$ switch output short protection
  AC unplug detection for direct charge (iW1799)
  D+/D-/CC1/CC2 over-voltage protection (iW657P)
  Integrated current sense (iW657P)

- **Optional support for:**
  Qualcomm® Quick Charge™ 4+
  Direct Charge
  Other RapidCharge™ protocols
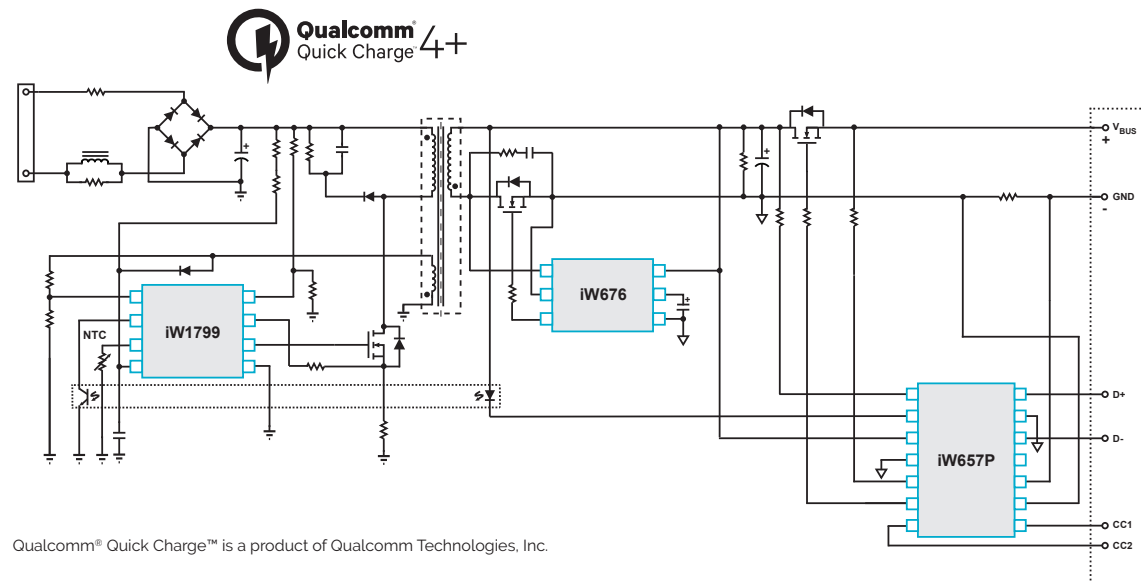
Qualcomm® Quick Charge™ is a product of Qualcomm Technologies, Inc.

AC/DC RapidCharge™ adapter solutions

| Primary Side | Secondary Side | RapidCharge Protocol | | | | | Output Power (max.) | Output Voltage | Secondary-to- Primary Communication | | Additional Features |
| | | Qualcomm® Quick Charge™ | | | Direct Charge | USB Power Delivery 3.0 | | | | | |
		2.0	3.0	4+					DLNK[1]	XM-Comm[2]	
iW1782	iW636	☑	☑				36 W	3.6 V – 12 V	☑		• D+/D- over-voltage protection (iW636) • iW673 SR for 90% efficiency
iW1790/ iW1796	iW660/ iW662	☑	☑				27 W	3 V – 12 V		☑	• D+/D- over-voltage protection (iW660, iW662) • Integrated SR for lower BOM and 90% efficiency (iW660,iW662)
iW1791/ iW1797	iW656P/ iW657P	☑	☑	☑	☑	☑	27 W	3.3 V – 21 V	☑		• USB-IF PD certified (USB PD 3.0 + PPS) • D+/D-/CC1/CC2 over-voltage protection (iW656P, iW657P) • Integrated current sense (iW657P) • iW676 SR for > 90% efficiency
iW1798	iW660/ iW662	☑	☑				45W	3.6V - 12V		☑	• D+/D- over-voltage protection (iW660, iW662) • Integrated SR for lower BOM and 90% efficiency (iW660, iW662)
iW1799	iW656P/ iW657P	☑	☑	☑	☑	☑	45W	3.3V - 21V	☑		• USB-IF PD certified (USB PD 3.0 + PPS) • D+/D-/CC1/CC2 over-voltage protection (iW656P, iW657P) • Integrated current sense (iW657P) • iW676 SR for > 90% efficiency

(1) DLNK is Dialog's digital communication from secondary to primary side via an optocoupler.

(2) XM-Comm is Dialog's proprietary digital communication via the main power transformer that eliminates the need for an optocoupler.

Qualcomm® Quick Charge™ is a product of Qualcomm Technologies, Inc.

iW1602+iW676 AC/DC high power density travel adapter solution

Dialog's iW1602+iW676 chipset offers an unmatched combination of high efficiency, low standby power and fast dynamic load response DLR[1] enabling smartphone manufacturers to pack more power (higher power density) into smaller travel adapters without incurring thermal issues.

❧ iW1602 primary-side controller
PrimAccurate™ primary-side current sensing eliminates secondary-side sense resistor

Configurable light load operation mode optimizes for low no-load power consumption and fast DLR

Up to 30 W output

❧ iW676 secondary-side active voltage position (AVP) controller
Built-in synchronous rectifier

Enables < 30 mW no-load power consumption and fast DLR

❧ Low BOM cost
80 mV ripple with single 470 µF output cap

Low cost slow diodes

SOT23 package

❧ Ideal for compact, high power density 5 V, 2 A 10 W smartphone adapters/chargers

❧ Double-layer cable protection
Dedicated pins for external over-voltage protection with latch (iW1602)

SmartDefender™ advanced hiccup technology (iW1602)

❧ Robust protection features
Output short circuit protection

Output over-voltage protection

Output over-current protection

Over-temperature protection

(1) DLR: Dynamic Load Response - defined as V_{OUT} voltage deviation for load step from low to high output current.
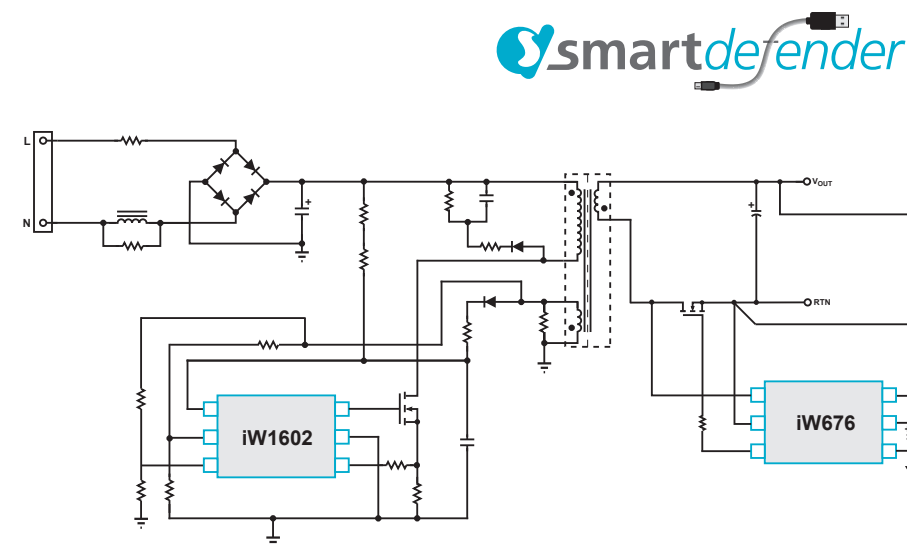
AC/DC secondary-side ICs

Product	Voltage Position Controller	Synchronous Rectifier Controller	Quiescent Current	Features	Package
iW673		☑	< 450 µA at no load		SOT23-6
iW676	☑	☑	< 650 µA at no load	25 V Output, optimized for lowest BOM cost in applications up to 12 V Optimized for direct charging applications down to 3 V	SOT23-6
iW873		☑	< 450 µA at no load	Integrated 60 V Power MOSFET	SO-8

Digital synchronous rectifiers replace Schottky diode for higher efficiency, ultra-compact power adapters – iW673, iW676
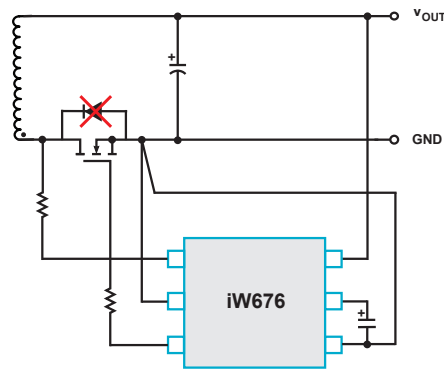
Features and Benefits

- **Eliminates parallel Schottky diode for lower BOM cost**
- **Added benefits of iW676**

    25 V output, optimized for lowest BOM cost in applications up to 12 V

    Optimized for direct charging applications down to 3 V

    Incorporates AVP (Active Voltage Positioning) for fast dynamic load response

Haptics

Haptics technology recreates the sense of touch to the user by applying forces and vibrations in the form of touch feedback in displays, touch surfaces and buttons.

The DA728x - High definition, low power and flexible:

The DA728x family of High-Definition (HD) Haptic Drivers, combine custom drive sequences, on- and off resonance, at up to 1kHz. The device can drive both ERM and LRA (narrow and wideband) actuators and track resonance up to 300Hz to drive the most complex click/vibration touch effects in a wide range of applications.

Saving power when idle:

As haptic drivers spend the majority of their time in standby/idle mode, the DA728x family was designed to utilize very low idle current consumption (360nA) to maximize battery life.

The DA7282 has an additional standby mode where current consumption drops to 5nA, making it an ideal driver for systems where the highest priority is current consumption when not in use.

The DA728x family combines very low idle current consumption with low-latency trigger inputs to minimize system power consumption. Integrated trigger inputs allow haptic operation without waking the application processor, and latency times at sub-1ms give real switch behavior - 10x better than any other solution available today.

Simplifying usage in touchscreen and capacitive touch systems:

Product	Market Focus	Control Method	# of input trigger pins	Lowest power mode	I²C Addresses
DA7280	General Market	I²C, PWM, GPI	3	360nA Idle	1
DA7281	Multi-LRA Systems	I²C, PWM, GPI	1	360nA Idle	4
DA7282	Wearables	I²C, PWM, GPI	3	5nA Standby	1

DA728x Family Overview

- **Wideband LRA driver: 25Hz to 1kHz with resonant mode Frequency tracking support up to 300Hz**

  Drives LRAs off-resonance for custom effects, or dual resonant systems for two-dimensional vibration

- **Up to 500mA output current**

  Drive large or small LRAs and ERMs for the best haptic experience

- **360nA idle power mode with full I²C control and memory retention**

  Ultra-low power consumption means longer battery life

  Only 0.75ms latency when responding from ultra-low idle power state

- **On-the-fly diagnostics**

  Detect issues with the LRA/ERM Automatically and generate interrupts

- **Three methods of drive for ease of use**

  I²C, PWM and General Purpose Inputs (GPIs)

- **5nA standby mode enabled in the DA7282**
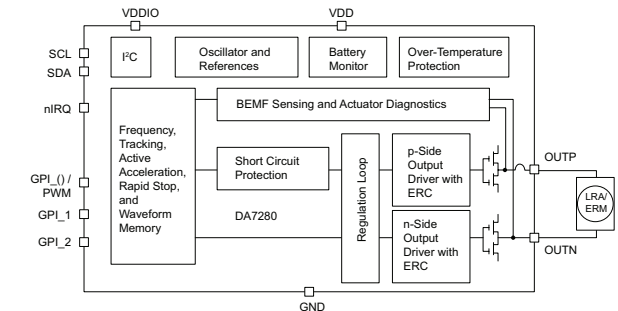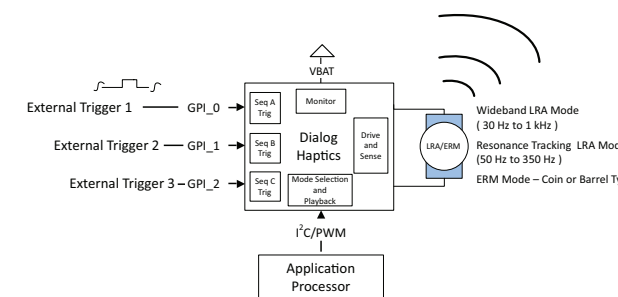
Dialog Semiconductor Worldwide Sales Offices -   🌐 www.dialog-semiconductor.com   ➤ info@diasemi.com

United Kingdom
📞 +44 1793 757 700

The Netherlands
📞 +31 73 640 8822

Japan
📞 +81 3 5769 5100

Hong Kong
📞 +852 3769 5200

China (Shenzhen)
📞 +86 755 2981 3669

Germany
📞 +49 7021 8050

North America
📞 +1 408 845 8500

Taiwan
📞 +886 2 80718888

Korea
📞 +82 2 3469 8200

China (Shanghai)
📞 +86 21 5424 9058