



# AUTOMOTIVE

## USB TYPE-C® CHARGING SOLUTIONS



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USB-C (technically known as USB Type-C) is the latest standard for USB connectors, ports, and cables that provides connectivity to multiple end devices. The USB Type-C connector is a reversible, 24-pin, double-sided connector that is able to transmit data ten times faster than USB2.0 and can deliver up to 100 watts (20 volts, 5 amperes) of power, enabling fast charging.

Diodes' automotive-compliant solutions for USB Type-C include Downstream Facing Port Controller, wide input DC-DC converters, overvoltage protection devices and a wide portfolio of single, dual and multi-channel data protection devices.

Diodes' automotive-compliant (Q-suffix) products are AEC-qualified, manufactured in IATF 16949 certified sites and support PPAP documentation.



### 5V V<sub>BUS</sub> DC-DC BUCK CONVERTER – AP64350Q/AP64351Q/AP64352Q

The AP64350Q/351Q/352Q are high efficiency 3.5A synchronous DC-DC buck converters designed for low EMI.

They interface with the AP25810LQ to adjust the current and voltage of V<sub>BUS</sub> across the whole range of the battery voltage, including load dump conditions.

Also available are the AP63356Q/57Q, which are 32V, 3.5A, high-efficiency, automotive-compliant, DC-DC converters packaged in the tiny V-DFN3020-13 (SWP).



- Wide 3.8V to 40V V<sub>IN</sub> range allows operation across whole battery voltage range
- Synchronous DC-DC conversion delivers improved efficiency
- 22μA quiescent current
- Adjustable switching frequency (AP64350Q/352Q) with external clock synchronization
- Ringing-resistant switching node delivers best-in-class EMI performance

### USB-C DOWNSTREAM FACING PORT (DFP) CONTROLLER – AP25810LQ

The AP25810LQ device is a USB Type-C DFP controller with an integrated 3A rated USB power switch.

The AP25810LQ device applies power to V<sub>BUS</sub> and communicates the selectable current-sourcing capability to the UFP via the CC line. It is available in the thermally enhanced U-QFN3040-20 (SWP) package with side wall plating.



- USB Type-C DFP controller (Rev 1.2 compliant)
- 3A 35mΩ R<sub>DS(ON)</sub> V<sub>BUS</sub> power switch
- Load detection to enable power management
- STD/1.5A/3A capability advertisement on CC line
- Dedicated supply for charging, V<sub>conn</sub> and device power
- Selectable 3.4A/1.67A current limit (± 7.5% accuracy)

### 4-CHANNEL OVP FOR CC AND D<sub>±</sub>/SBU – DPO2039DABQ

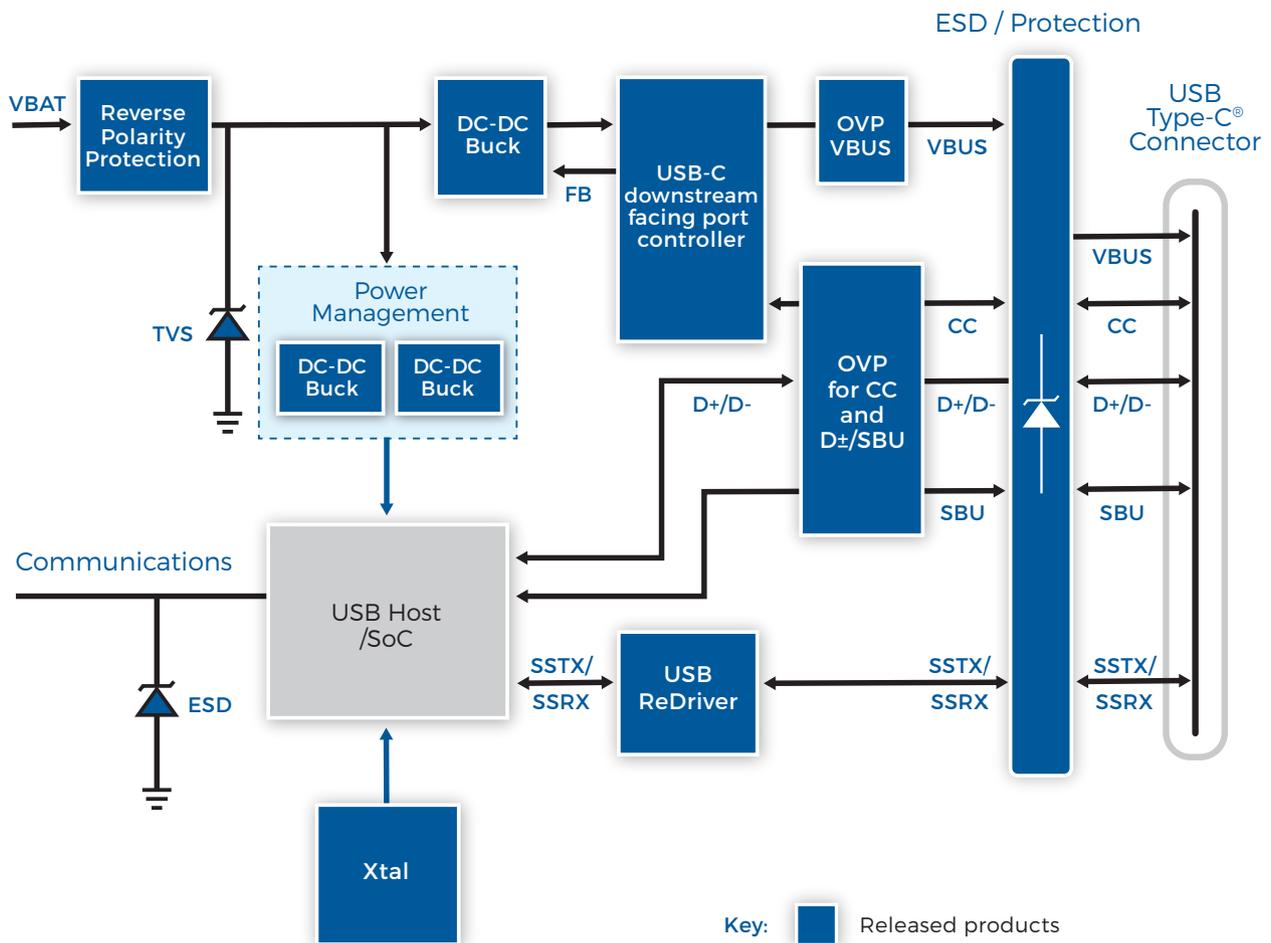
Due to its high power and compact size, USB Type-C is vulnerable to overvoltage / current surge caused by an unexpected short to V<sub>BUS</sub> event.

These shorts could damage the device and lead to system failure. Protection, such as that provided by the DPO2039DABQ, must be incorporated into the USB Type-C system.



- Operating voltage range: 2.7V to 5.5V
- 4-Channel overvoltage protection with auto-recovery
- IEC61000-4-2 ESD protection on CC and D<sub>±</sub>/SBU pins
- Protects against short to V<sub>BUS</sub>
- Protects against overtemperature
- Active low fault flag

## USB TYPE-C DOWNSTREAM FACING PORT (DFP) CHARGING AND PROTECTION SOLUTION



## REVERSE POLARITY PROTECTION

Reverse polarity protection (RVP) is implemented to protect electronic control units (ECU) from accidental reverse connection of the battery terminals.

RVP can be implemented using N-channel MOSFETs, P-channel MOSFETs or rectifiers, such as Diodes Incorporated's proprietary Super Barrier Rectifier® (SBR).



- N-channel MOSFET (DMN/DMTHxxxxxQ) – provides the lowest  $R_{DS(ON)}$  and therefore lowest power dissipation, but is more complex and expensive to implement
- P-channel MOSFET (DMPxxxxxQ) – has a higher  $R_{DS(ON)}$  than a comparable N-channel MOSFET, but is a simpler and lower cost solution to realise.
- SBR (SBRxxxxxQ) – lower  $V_f$  than a standard diode, with lower costs than a MOSFET solution, but at much higher power dissipation

## POWERLINE AND DATA LINE PROTECTION

Diodes Incorporated offers a broad range of unidirectional and bidirectional Transient Voltage Suppressors (TVS) designed to protect power lines from overvoltage threats, such as electrically fast transients, and data lines from ESD discharge.



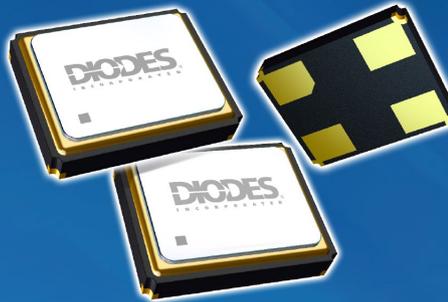
- Powerline Protection (SMAJ/SMBJ/SMCJxxxxQ) – 400W to 3000W unidirectional and bidirectional TVS
- Dataline Protection (DESDxxxxQ/DxVxxxxQ) – unidirectional and bidirectional low capacitance data protection TVS available in single, dual or quad configuration

## CRYSTAL

Diodes Incorporated has a broad portfolio of automotive-compliant crystals.

They are available in different pack sizes, ranging from 2.0 x 1.6 to 5.0 x 3.2mm sizes with frequencies ranging from 8 to 125MHz.

The latest XRQ series offers superior long-term drift and ESR for better performance.



- AEC-Q200 Grade 3, grade 2, and Grade 1
- 5.0 x 3.2, 3.2 x 2.5, 2.5 x 2.0, and 2.0 x 1.6 seam sealed packages
- XRQ exceeds MIL-STD-202 Method 213 and JIS-C0044 standards

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