

Energy Storage Systems Boost Electric Vehicles' Fast Charger Infrastructure

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Agenda



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ESS Technologies

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ADI Power Solutions for SiC

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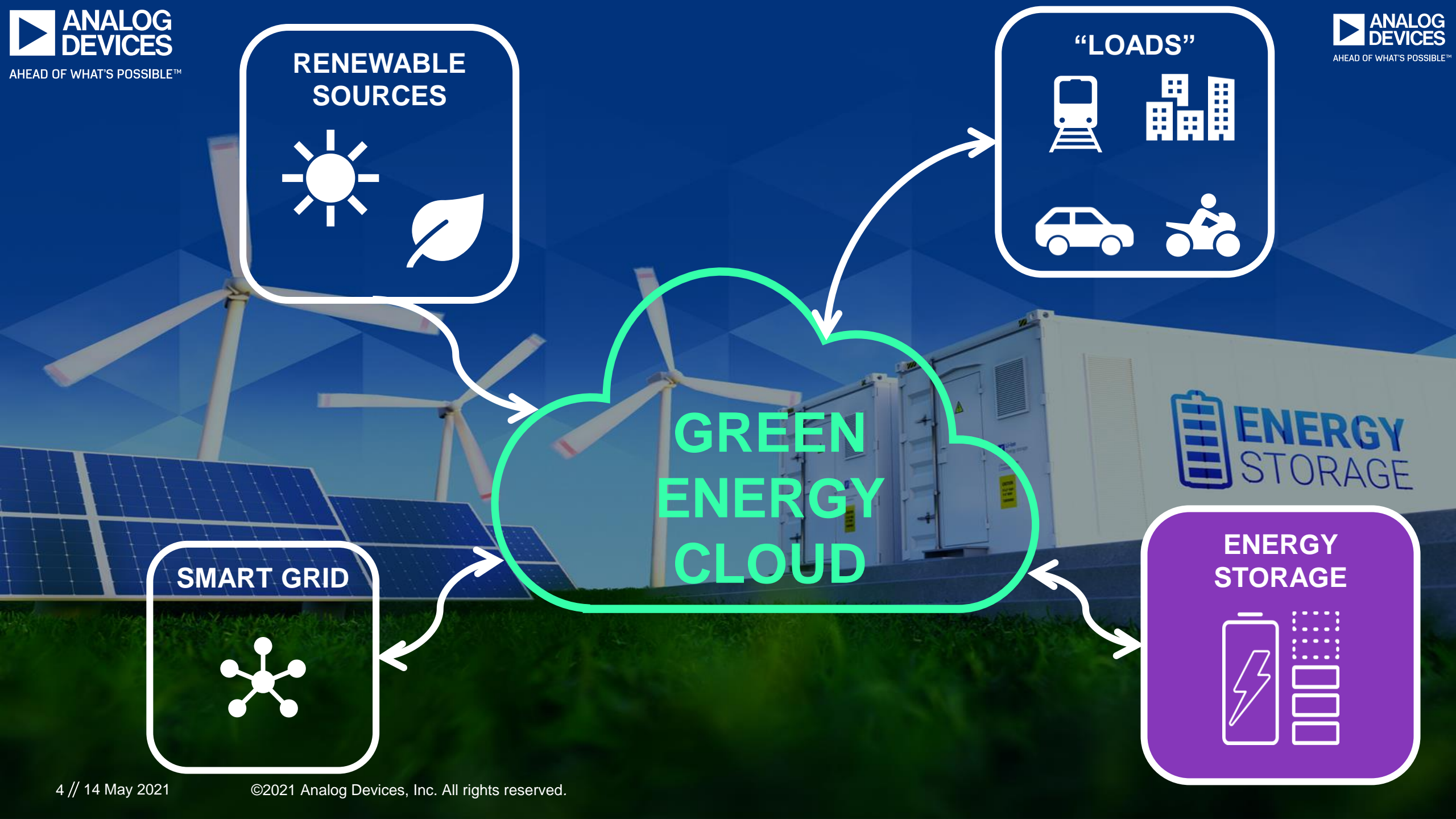
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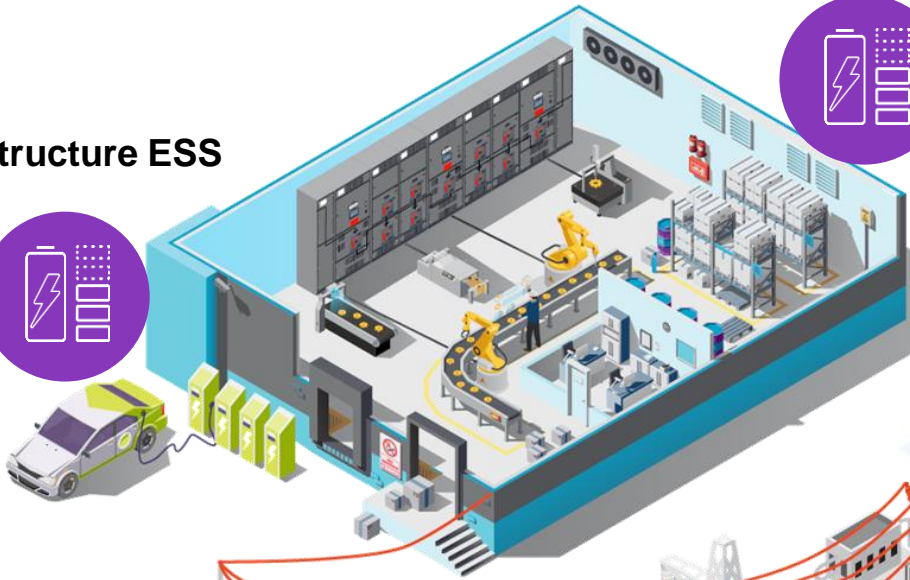
ESS Technologies



ESS Integration in the Smart Grid

EV Charging Infrastructure ESS

Grid Stability
Boost the Charge
V2G



Industrial ESS

Self Consumption
Peak Shaving
Energy Bill Optimization
Backup



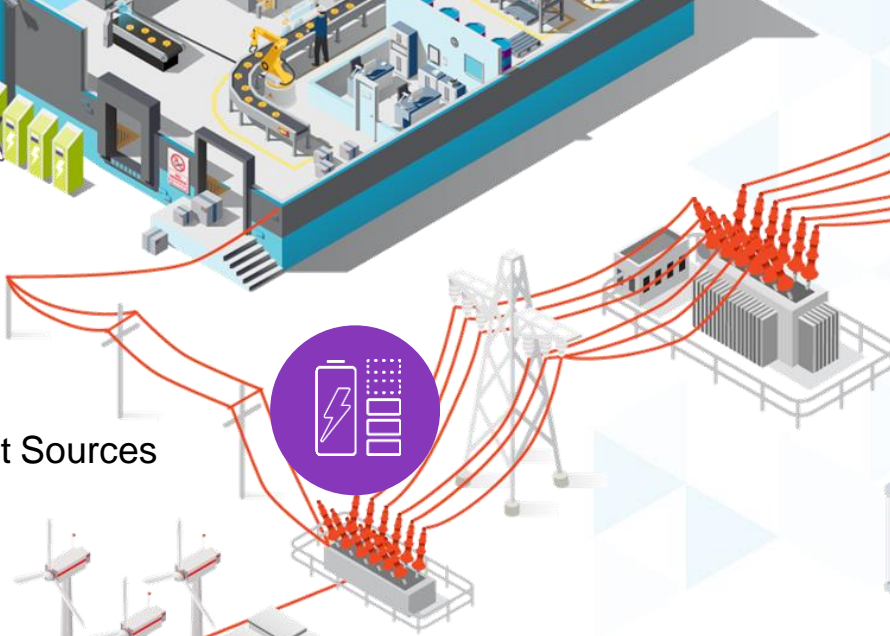
ESS for T&D

Energy shifting
Investment deferral



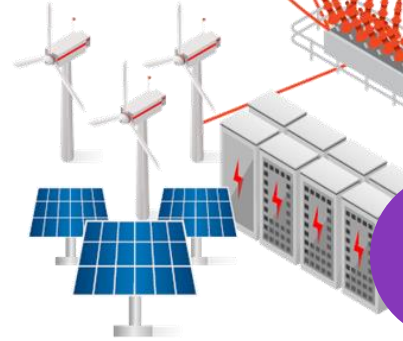
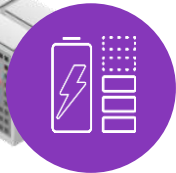
Grid & Power Plants ESS

Frequency Regulation
Dynamic Adaption to Intermittent Sources
and Loads
Backup



Renewables ESS

Renewables Integration = Store and Use
Reduce Renewable Energy Curtailment
Grid Stability

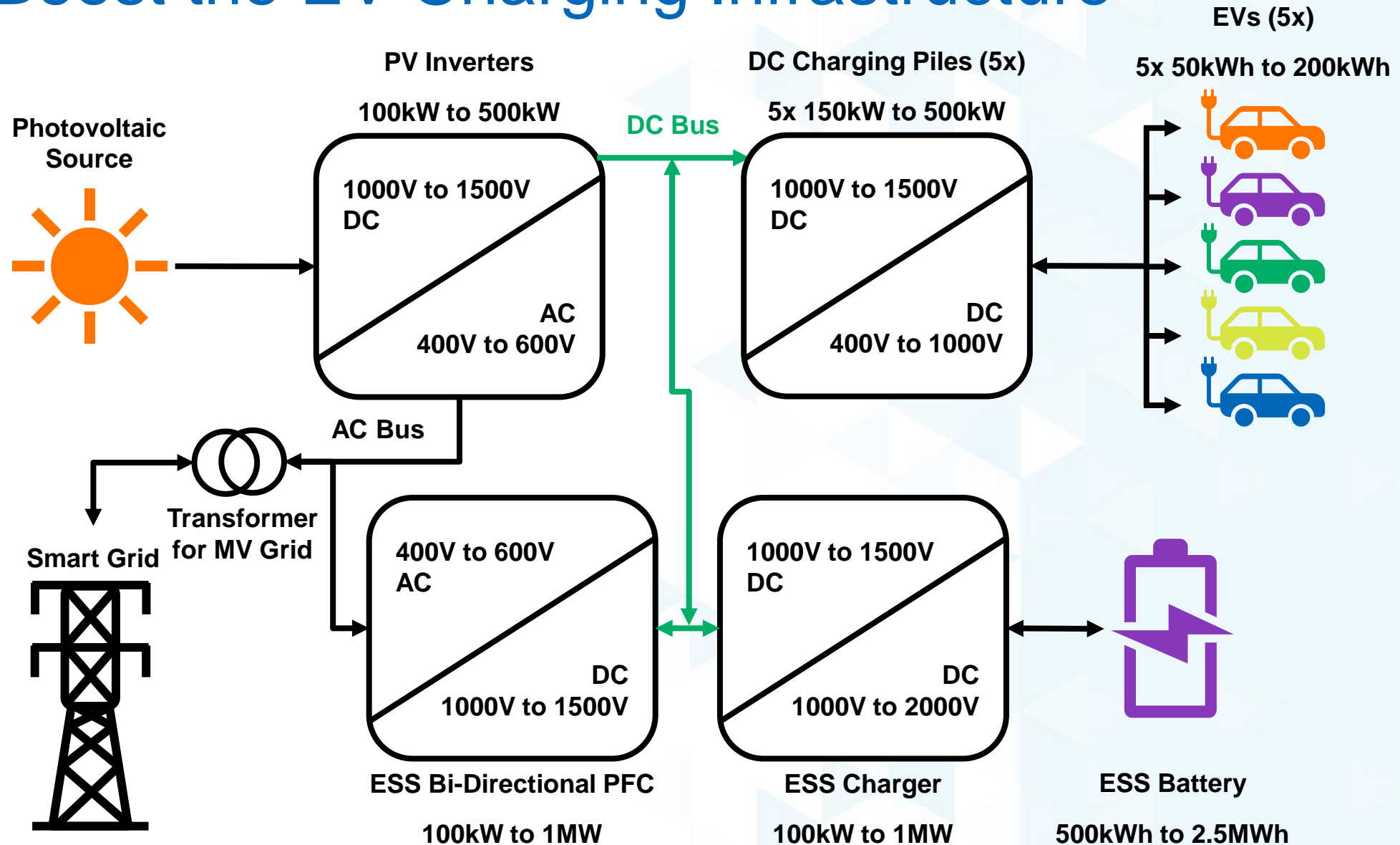


Residential ESS

Self Consumption
PV + EV CHG Integration
Backup

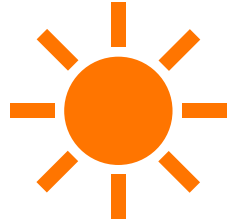


ESS Boost the EV Charging Infrastructure



ESS Boost the EV Charging Infrastructure

Photovoltaic Source



- ▶ **Energy Storage acting as a Buffer and Booster.**

- ▶ The energy generated by renewables can be directly used to charge the EVs or stored into the ESS or sent back into the grid to **maintain stability/frequency.**

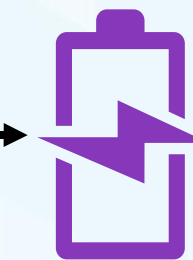
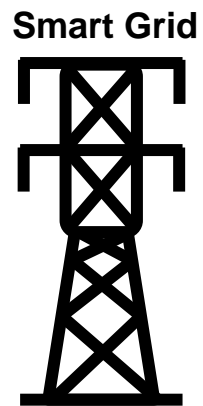
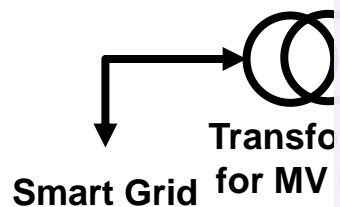
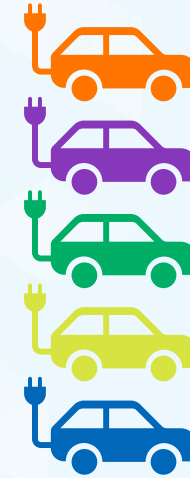
- ▶ The ESS can boost the EV charging by having the **most efficient and fastest DC charging path.**

Eventually, a direct link with an optimized DC/DC converter can be placed between the ESS and the EV chargers.

- ▶ **ESS can empower the Vehicle to Grid (V2G)** by storing the EV energy and sending to the Grid when needed.

EVs (5x)

5x 50kWh to 200kWh



ESS Battery

500kWh to 2.5MWh

ADI Technologies for Energy Storage

Battery Management Technology



Power Conversion



Battery Chemistry and Health



Temp/Smoke/Gas Sensing



Metering and Electrical N/W Monitor



ADI BMS & Power Solutions for ESS

BESS Rack(s)

1500Vdc
AC/DC + DC/DC

Rack BMS
Controller

5 to 20kWh
Battery Module

5 to 20kWh
Battery Module

5 to 20kWh
Battery Module

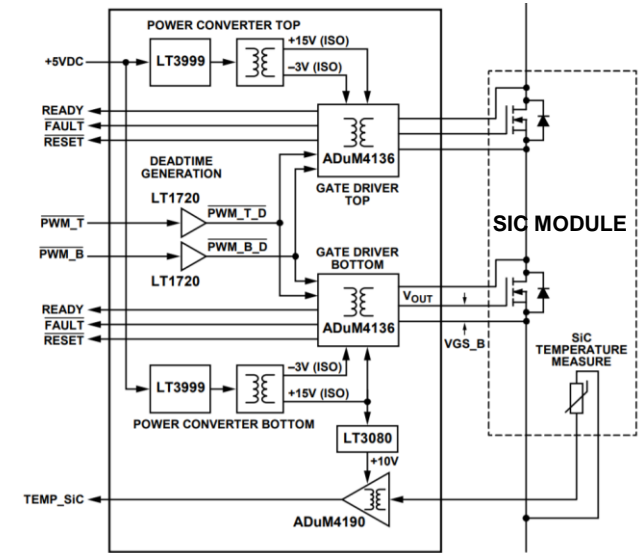
5 to 20kWh
Battery Module

5 to 20kWh
Battery Module



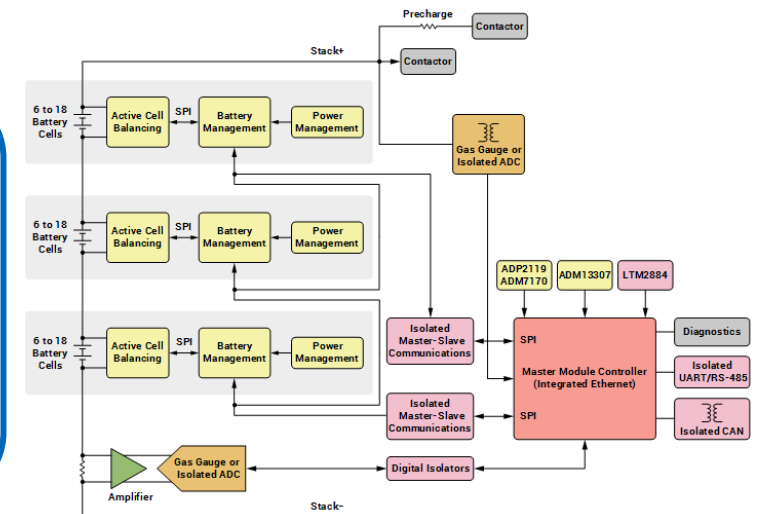
1500Vdc AC/DC and DC/DC Converters

Highest power density solutions
Isolated gate drivers for SiC
isoPower extreme integration



BMS and Solutions Functional Safety

Best AFE Accuracy → Longest ESS Lifetime
Integration and scalability
System Reference Platforms



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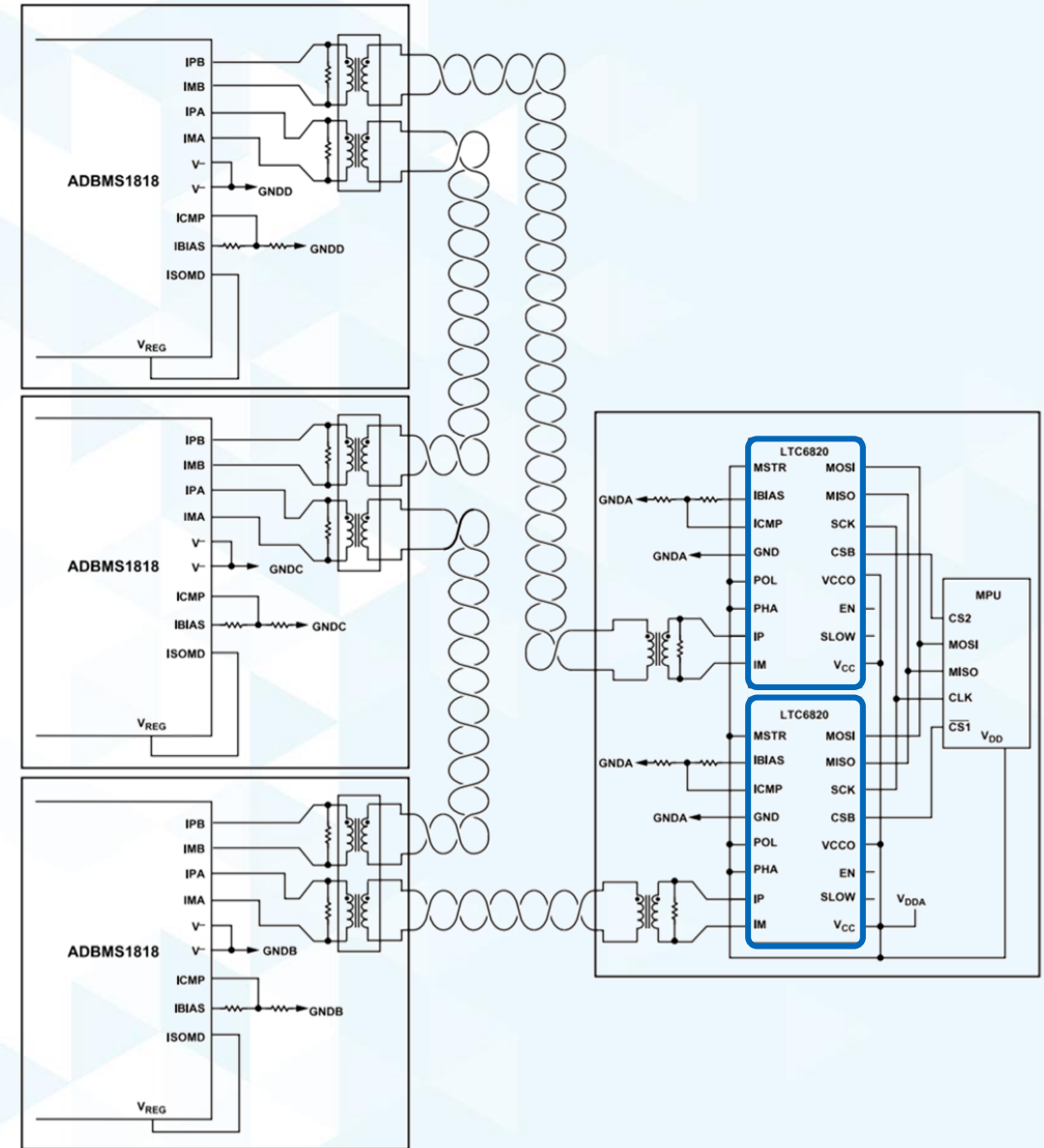
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ADI BMS Solutions for ESS

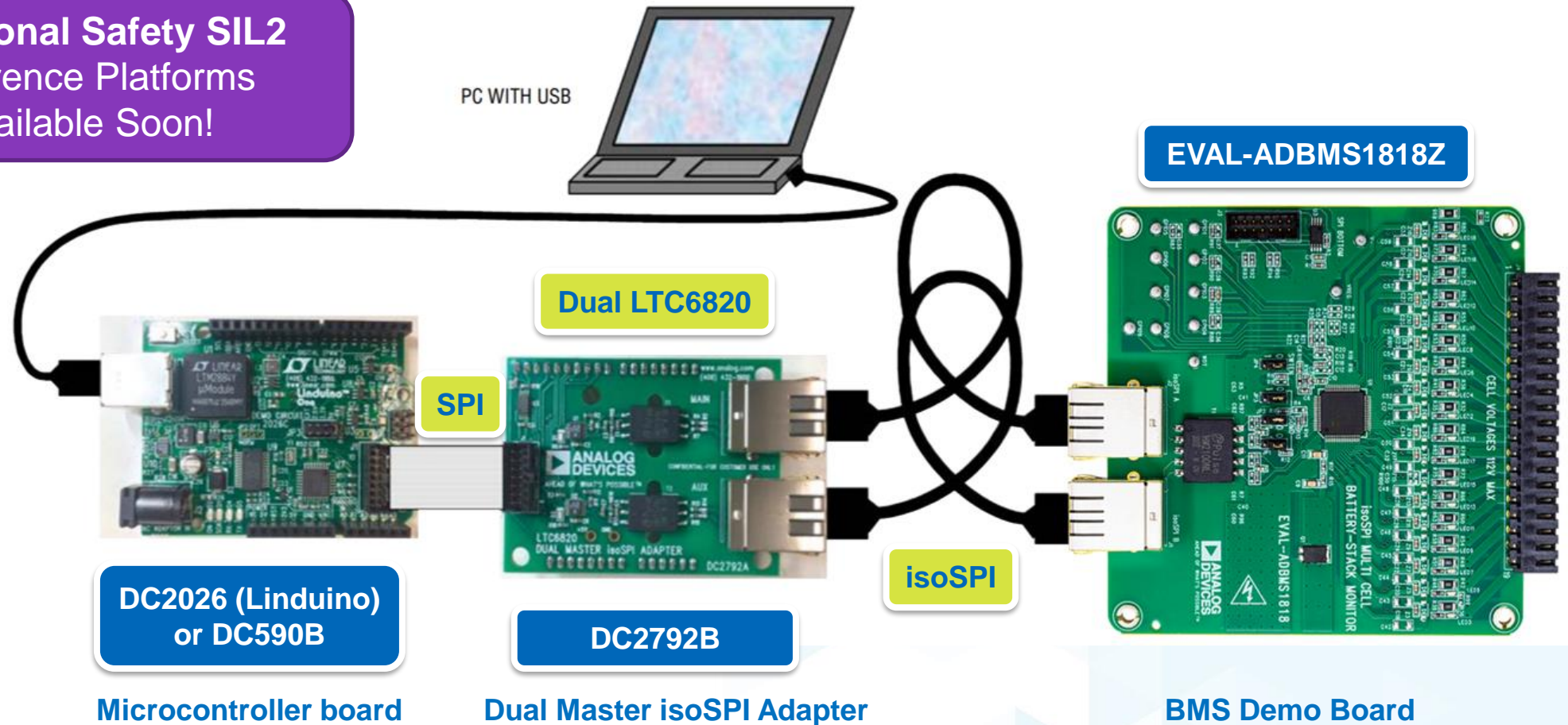
LTC6820 – isoSPI™ Transceiver

- ▶ Supports all ADI isoSPI™ Devices
- ▶ **High Datarate Isolated Data Communication**
 - Master Mode: 2Mbps
 - Slave Mode: 1Mbps
- ▶ **Galvanic isolation using standard transformers**
- ▶ **Bidirectional Interface Over a low-cost Single Twisted Pair**
 - Supports cable lengths up to 100 Meters
- ▶ Very low EMI susceptibility and emissions
- ▶ **Ultralow, 2μA Idle Current**
- ▶ Automatic Wake-Up Detection
- ▶ **2.7V to 5.5V Power Supply**
- ▶ 16-Lead MSOP Package



ADBMS1818 Evaluation Platform

Functional Safety SIL2
Reference Platforms
Available Soon!



<https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/EVAL-ADBMS1818.html#eb-overview>
<https://wiki.analog.com/resources/EVAL/EVAL-ADBMS1818>

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ADI Power Solutions for SiC

ADuM4136 for SiC Half Bridge Driver Platform

▶ The Best Reference Design for driving SiC MOSFET Half-Bridges

- > 99% efficiency @ 200 kHz

▶ ADuM4136 ISO Gate Driver

- >100 kV/μs CMTI Enabling Fastest SiC FETs Switching Speed
- 9A Peak Short Circuit Output Current for Driving SiC Power Modules

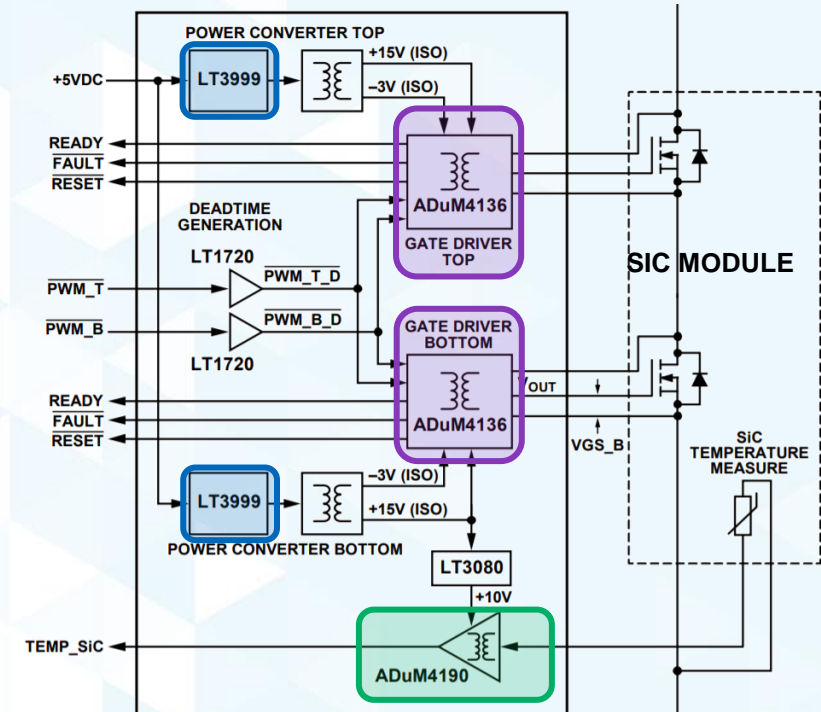
▶ LT3999 Power Management IC

- Superb EMI Rejection with Highest Efficiency

▶ ADuM4190 Isolated Amplifier

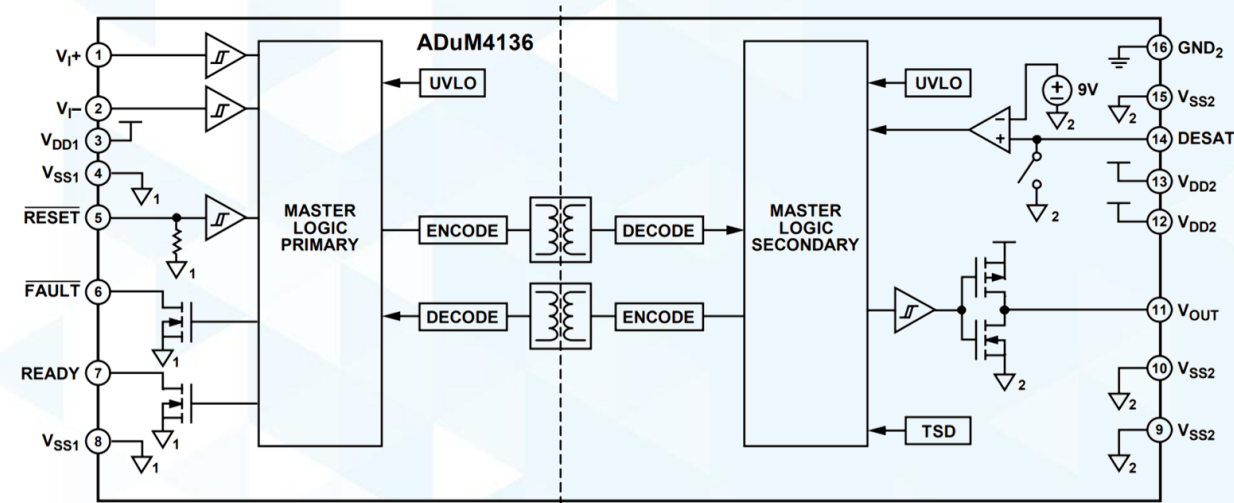
- Fast and Accurate Feedback for Temperature Measurement

<https://www.analog.com/media/en/technical-documentation/application-notes/AN-2016.pdf>



ADuM4136 Isolated Gate Driver

- ▶ **Enables high-speed & high power SiC switching applications**
 - 9A pk short circuit current drive strength
 - Common Mode Transient Immunity (CMTI) > 100 kV/μs
- ▶ **Low dead-time operation**
 - Ultra-low propagation delay skew of 15 ns
- ▶ **Fault detection, reporting and shutoff < 3 μs**
 - Robust DESAT based short-circuit protection
- ▶ **Reinforced isolation for 750V SiC FETs**
 - VDE-0884-11 compliance at VIORM = 849 Vpk
 - UL1577 compliance at 5 kV AC withstand for 1 min
- ▶ **Supports both bipolar and unipolar gate drive operation**
 - Wide voltage range acceptance
 - 12.25 to 30V on positive rail
 - 0-15V on negative rail



NOTES
1. GROUNDS ON PRIMARY AND SECONDARY SIDE ARE ISOLATED FROM EACH OTHER.

- ▶ **Propagation delay and channel to channel matching a 10× improvement over what is available from optocouplers**

ADuM4135, ADuM4146 and ADuM4177

▶ ADuM4135

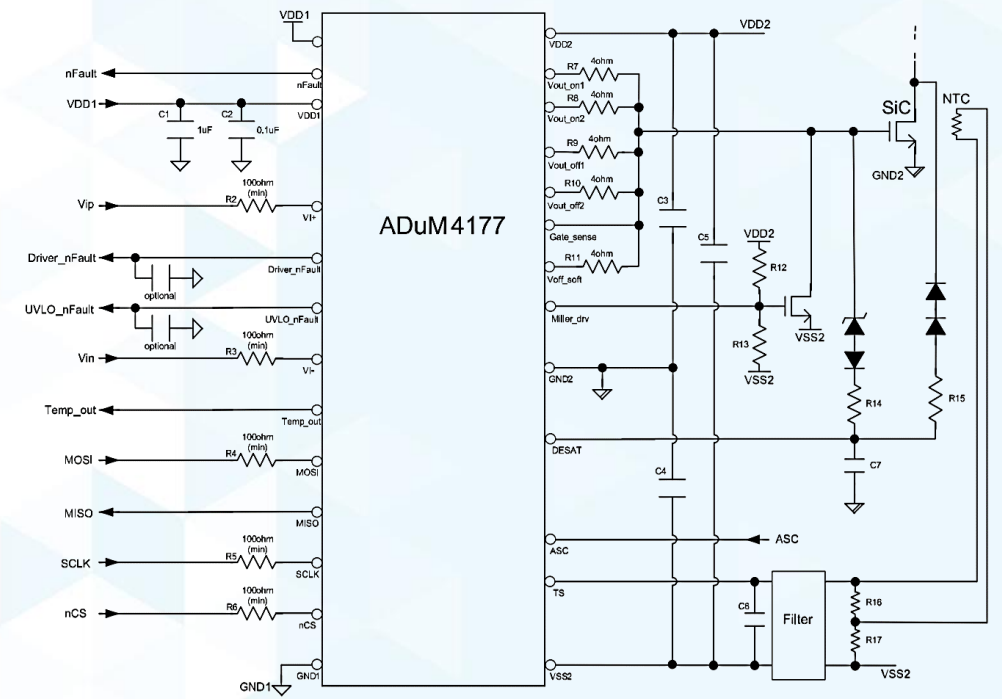
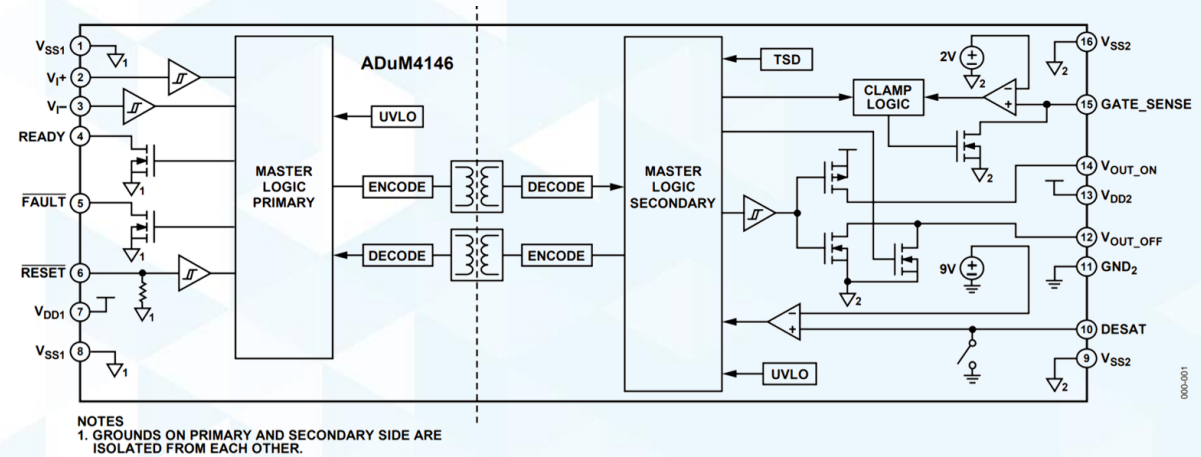
- All ADuM4136 features apply to the ADuM4135
- Split gate output
- **Independent ON/OFF drive strength control**
- Integrates a Miller clamp

▶ ADuM4146

- Pin-pin compatible with ADuM4135
- **Reinforced isolation suitable for 1200-1700 V rated FETs**
- VDE-0884-11 compliance at VIORM = 2120 Vpk, UL1577 compliance at 8 kV AC withstand for 1 min

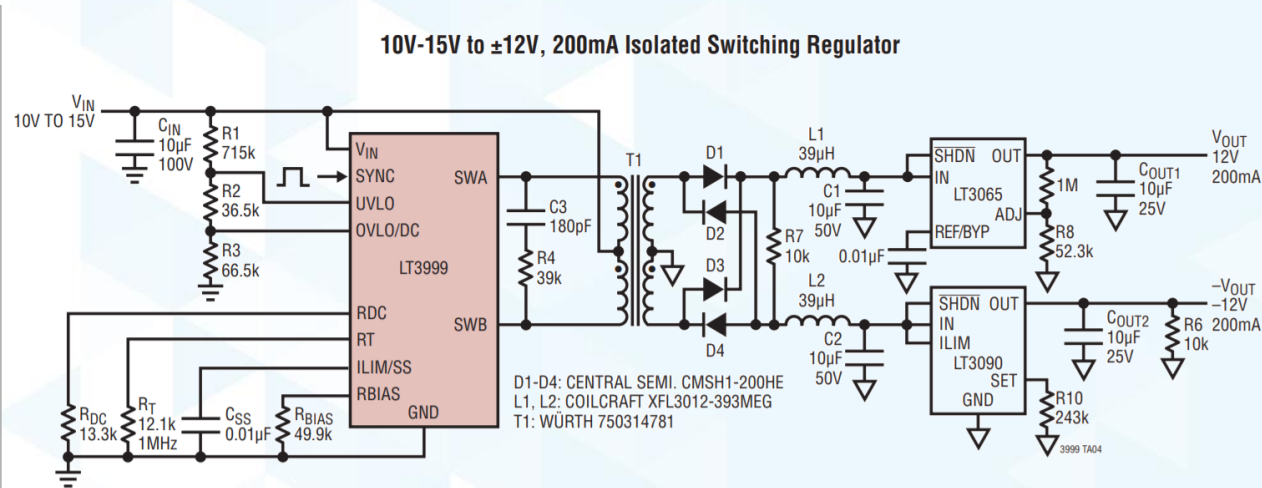
▶ ADuM4177

- Automotive qualified SiC programmable iso gate driver
- **30A peak output current**
- **SPI programmable**
- Fast Desat detection and protection (sub 1us)

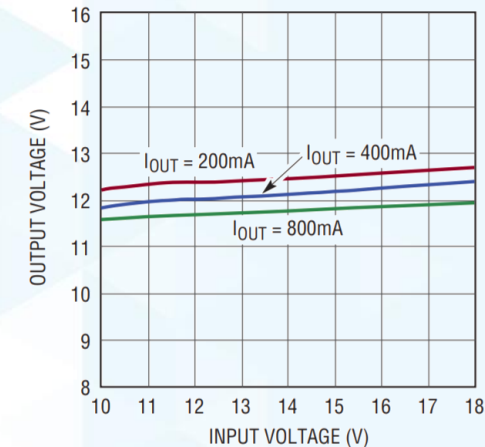


LT3999 Push-Pull DC/DC driver

- ▶ **Wide input operating range**
 - V_{IN} from 2.7V to 36V
- ▶ **Integrates dual 1A switches with programmable current limit**
 - Targeted for power levels up to 15W
- ▶ **Adjustable Duty Cycle control 20% to 50%**
 - Programmed by a resistor on the RDC pin and the OVLO/DC voltage
- ▶ **High Frequency range 50kHz to 1MHz**
- ▶ **Protection features**
 - Programmable OVLO and UVLO
 - Thermal shutdown implemented
- ▶ **Low Noise Topology**
- ▶ **Programmable soft start capability**
- ▶ **Cross-conduction prevention circuitry onboard**



LT3999 Line Regulation with Duty Cycle Control



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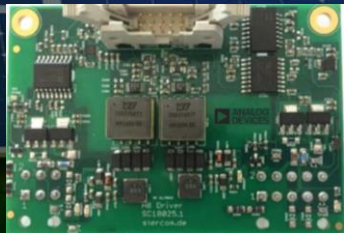
References and Q & A

References



BMS and Solutions Functional Safety

Best AFE Accuracy → Longest ESS Lifetime
Integration and scalability
System Reference Platforms



1500Vdc AC/DC and DC/DC Converters

Highest power density solutions
Isolated gate drivers for SiC
isoPower extreme integration

- ▶ **Energy Storage Systems Boost Electric Vehicles' Fast Charger Infrastructure**
 - <https://www.analog.com/en/technical-articles/energy-storage-systems-boosting-the-electric-vehicles-fast-charger-infrastructure.html>
- ▶ **ADBMS1818**
 - <https://www.analog.com/en/products/adbms1818.html#product-overview>
- ▶ **LTC6820**
 - <https://www.analog.com/en/products/ltc6820.html>
- ▶ **Using the ADuM4136 Isolated Gate Driver and LT3999 DC-to-DC Converter to Drive a 1200 V SiC Power Module**
 - <https://www.analog.com/media/en/technical-documentation/application-notes/AN-2016.pdf>
- ▶ **ADuM4136**
 - <https://www.analog.com/en/products/adum4136.html>
- ▶ **ADuM4135**
 - <https://www.analog.com/en/products/adum4135.html#product-overview>
- ▶ **ADuM4146**
 - <https://www.analog.com/en/products/adum4146.html>
- ▶ **ADuM4177**
 - <https://www.analog.com/en/products/adum4177.html>
- ▶ **LT3999**
 - <https://www.analog.com/en/products/lt3999.html>
- ▶ **ADuM4190**
 - <https://www.analog.com/en/products/adum4190.html>

Q & A

