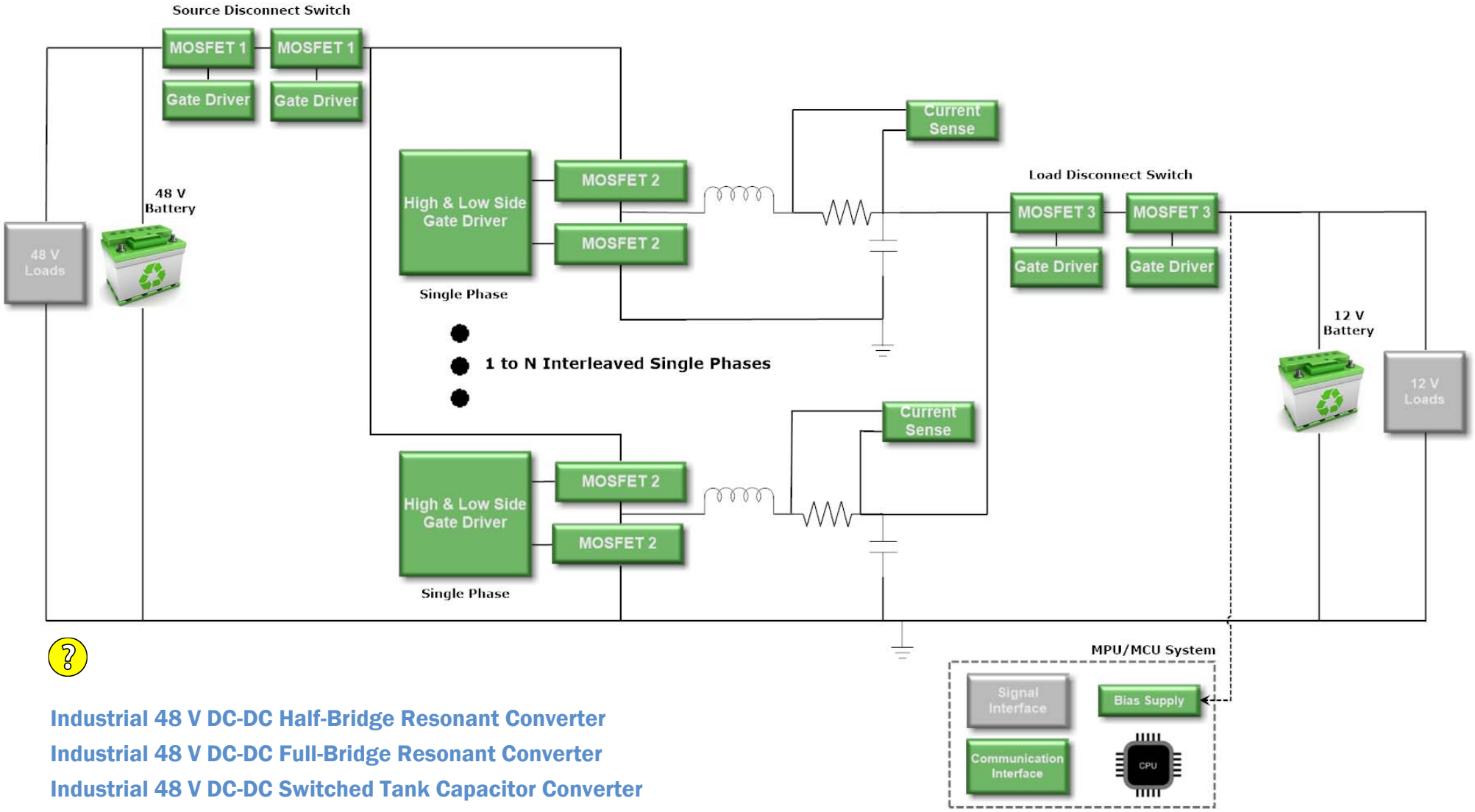
48 V - 12 V DC-DC Bi-Directional Converter
Automotive Solution



Industrial 48 V DC-DC Half-Bridge Resonant Converter

Industrial 48 V DC-DC Full-Bridge Resonant Converter

Industrial 48 V DC-DC Switched Tank Capacitor Converter

Industrial 48 V DC-DC Non-Isolated Converter - Fully Integrated (Option #1)

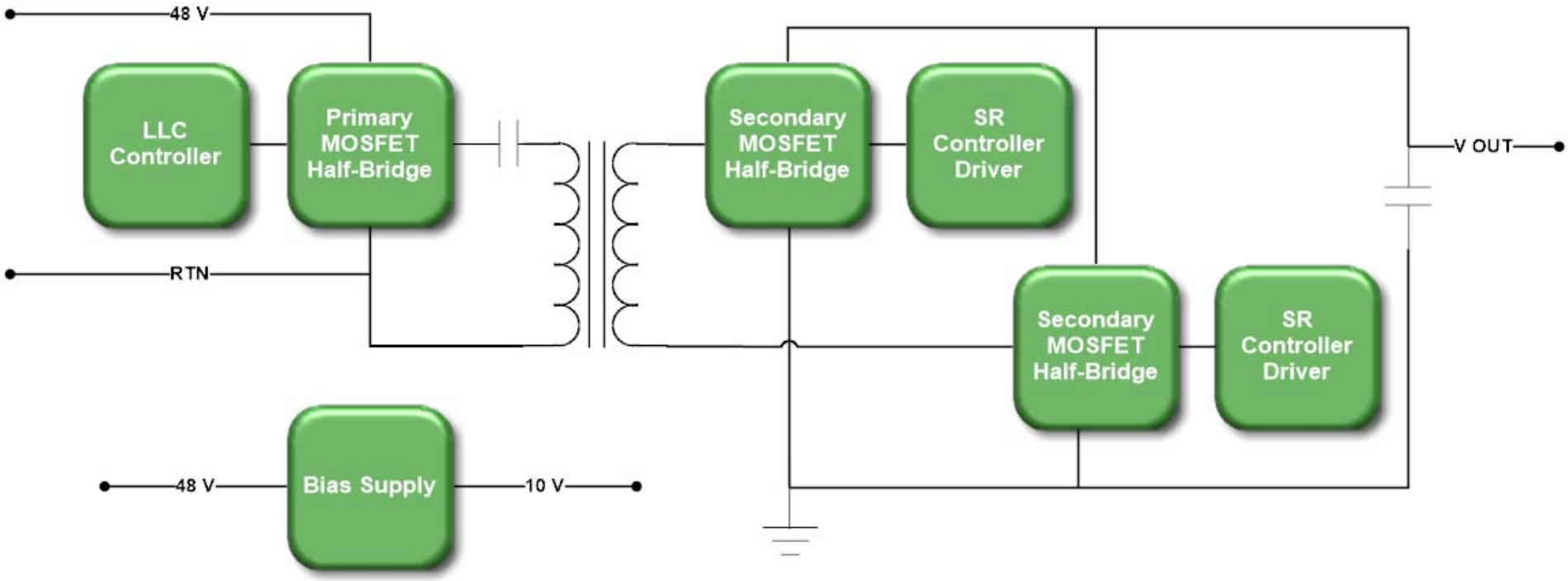
Industrial 48 V DC-DC Non-Isolated Converter - Scalable Power Stage (Option #2)

Solution Description

Product Recommendation Table

Interactive Block Diagram Tool (onsemi.com)

48 V DC-DC Half-Bridge Resonant Converter
Industrial Solution



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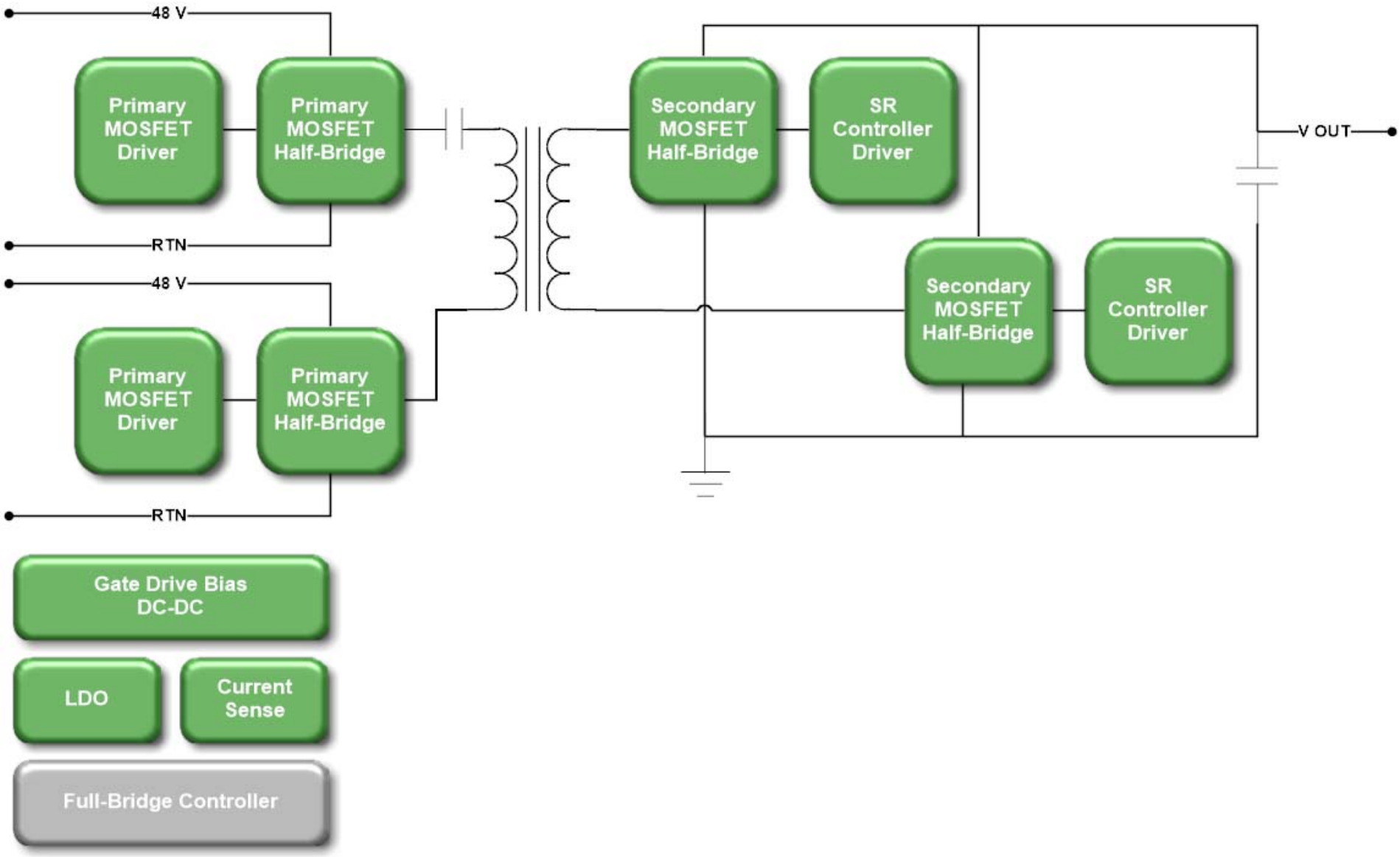
48 V DC-DC Full-Bridge Resonant Converter
Industrial Solution



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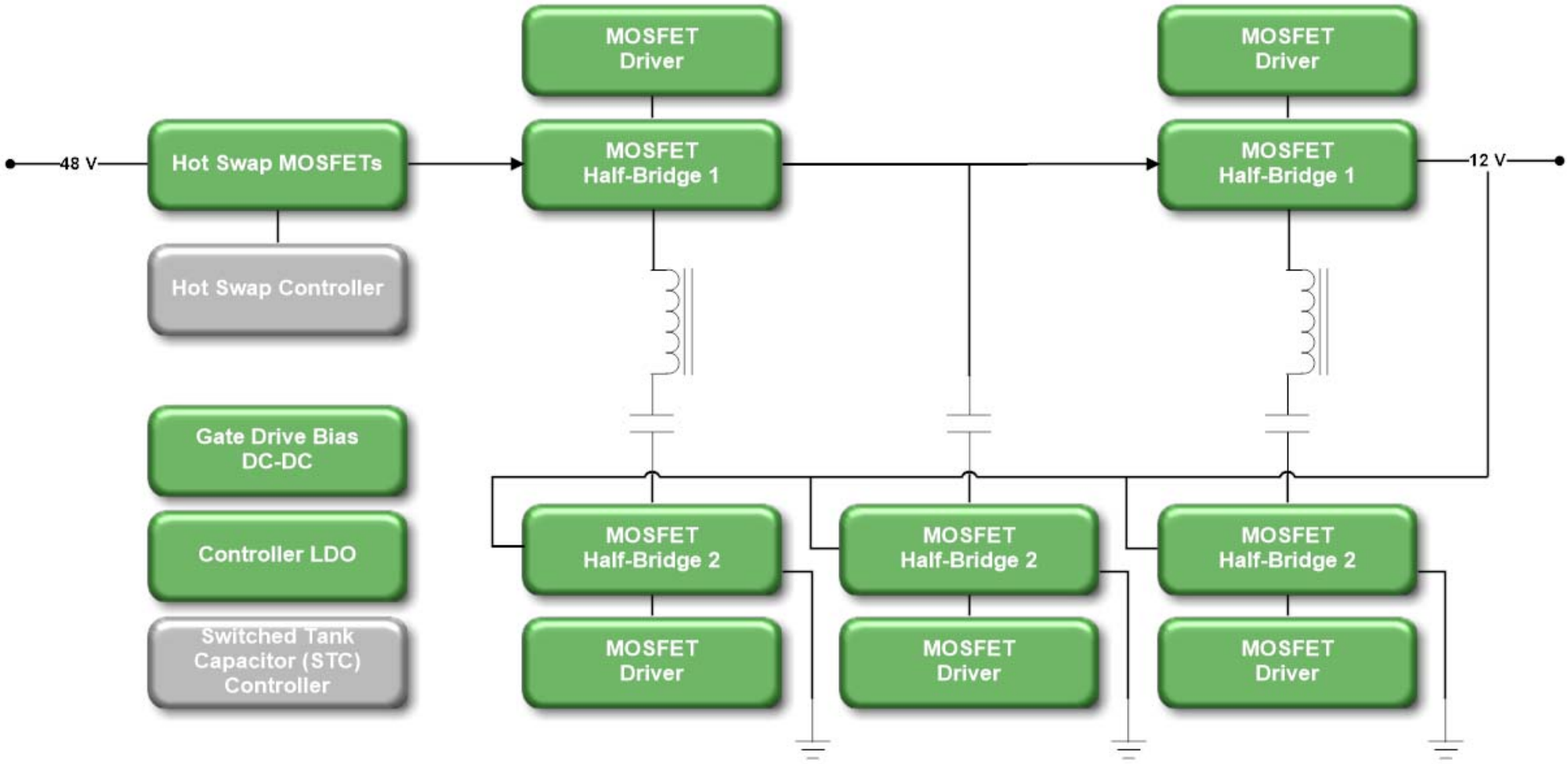
48 V DC-DC Switched Tank Capacitor Converter Industrial Solution



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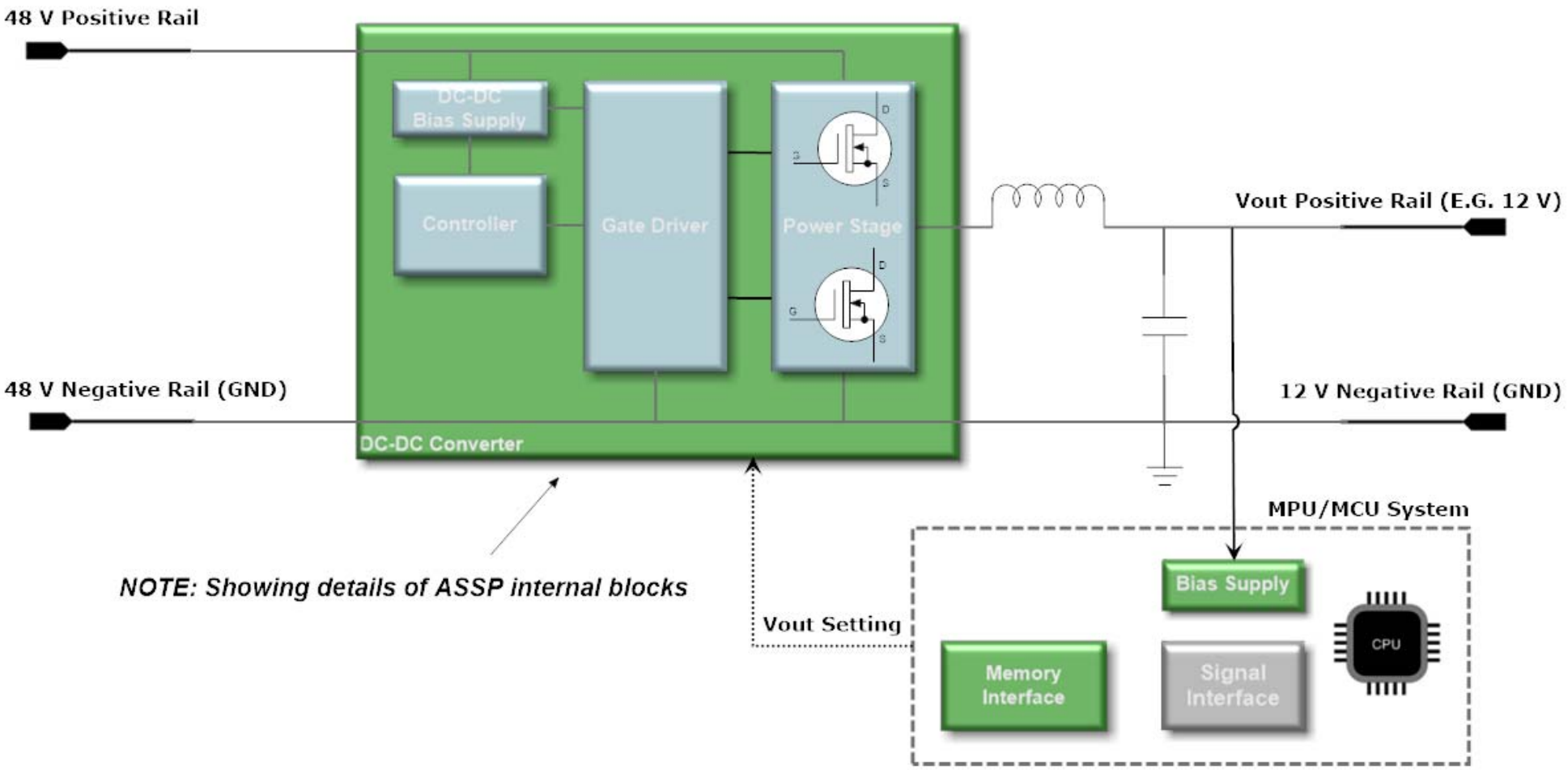
48 V DC-DC Non-Isolated Converter - Fully Integrated (Option #1)
Industrial Solution



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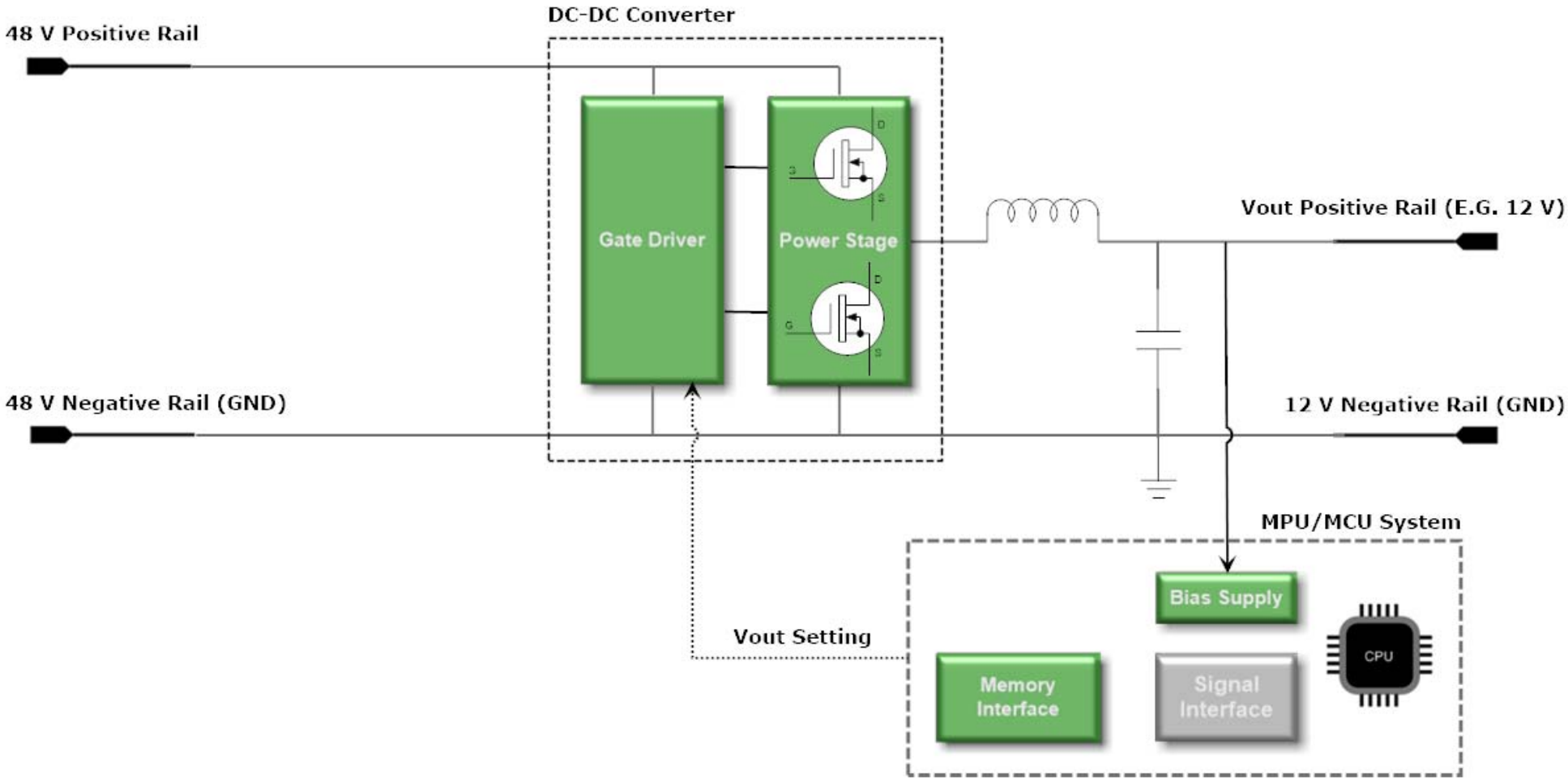
48 V DC-DC Non-Isolated Converter - Scalable Power Stage (Option #2) Industrial Solution



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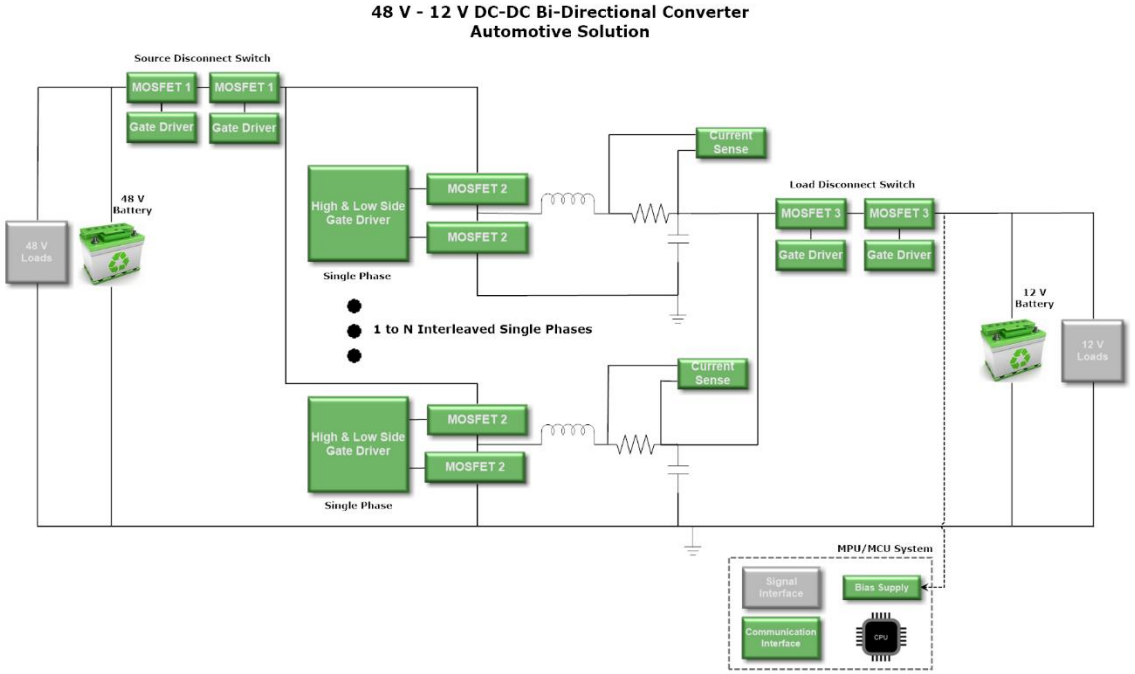
Block Diagram of the Month – Introduction:

Introducing the latest Block Diagram of the Month – The 48 V Bus Conversion for Industrial and Automotive Applications. The industrial and automotive market segments are transitioning from the use of a traditional 12 V power bus to a 48 V power bus. This increase in system voltage is driven by electronic systems that require more operating power due to increased complexity and enhanced functional requirements. The corresponding increase in electrical content can result in systems with decreased efficiency, higher cost and compromised performance due to overloading if a 12 V power bus is used. A 48 V power bus provides an optimal solution exhibiting lower cost, smaller size and lighter weight with the capability to deliver the required high power levels. Compared to a 12 V bus rail, current amplitudes in a 48 V system are lowered by a factor of 4 translating into reduced power losses equivalent to a factor of 16. In addition, DC-DC converters are utilized to operate lower power devices integrated in the 48 V system. Competitive solutions from the ON Semiconductor product portfolio are captured in the product table for common topologies of the industrial 48 V DC-DC converters and the automotive 48 V to 12 V bi-directional converter inherent in mild hybrid electric vehicle architectures.

Automotive 48-12 V Bi-Directional Converter:

The 48 V to 12 V bi-directional converter is used to provide power to the 48 V and 12 V loads that are connected to the 48 V Li-ion battery and traditional 12 V lead acid battery installed in mild hybrid electric vehicles. The bi-directional converter is configured in a synchronous buck-boost configuration to transfer energy between the 48 V and 12 V batteries depending on the operating conditions of the vehicle. The bi-directional design allows for two batteries to share stored energy with each other. The high power loads characteristic of hybrid vehicles are powered from the 48 V battery while the traditional lower power loads typical in internal combustion engine vehicles are powered from the 12 V battery.

The bi-directional converter is constructed using a combination of gate drivers, MOSFETS and current sense amplifiers in identical interleaved phases. The interleaved phases are connected in parallel to deliver the required current to the loads attached to both batteries. The converter specifications are dependent on the vehicle type and typically range from 1–3 kW with a minimum of 95% efficiency requirement. The MOSFETS function as a source disconnect switch for the 48V battery and as a load disconnect switch for the 12 V battery. One set of high and low side MOSFETS are configured in a half bridge configuration connected to the inductor to facilitate synchronous operation of the buck-boost converter. The use of low Rds-on MOSFETS in the buck-boost stage translate into lower power losses and increased power efficiency of the system. The direction of the current flow and function as either a buck or boost converter is dictated by the activation of the high side and low side MOSFETS of the buck-boost stage. The current sense amplifier in each interleaved phase functions to measure the magnitude of the inductor current.



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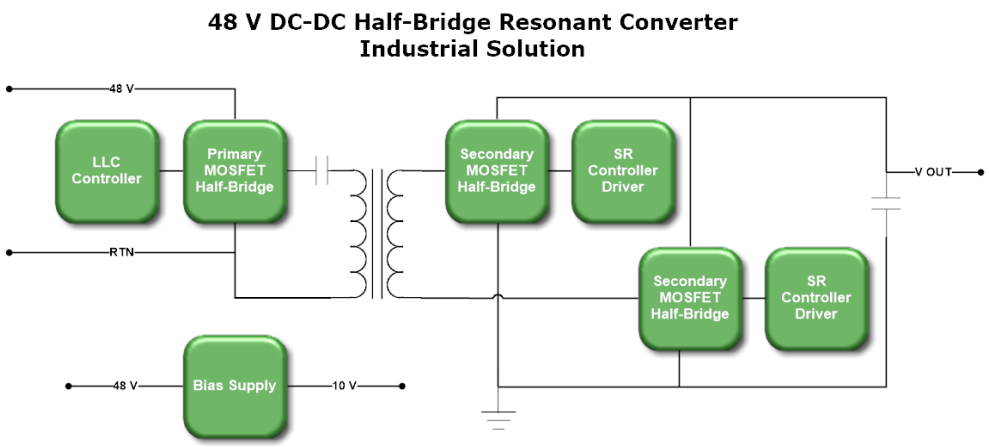
48 V DC-DC - Half-Bridge Resonant Converter:

This is a compact solution offering galvanic isolation using a transformer and is able to cover a wide power range up to several hundreds of watts. On the primary side it features an LLC controller, a half-bridge MOSFET structure and the necessary bias supply. The secondary side exploits a synchronous rectification for a best in class overall efficiency when high currents are needed.

A DC-DC LLC resonant converter is a switching converter that includes a "resonant tank" circuit shaping power flow, transforming the input DC voltage into an intermediate (quasi-)sinusoidal voltage. The intermediate voltage is then fed to a transformer and rectified to a DC output. The (quasi-)sinusoidal voltage is obtained from a switched square-wave applied to the resonant tank tuned to its fundamental harmonic.



The controllers proposed, NCP1395 and NCP1397, are high performance and can be utilized in several half bridge topologies such as LLC, series resonant and parallel resonant. They integrate 600 V gate drivers, simplifying PCB layout and reducing external component count. In addition, both devices embed a Voltage Controlled Oscillator (VCO) which can reach 1 MHz operating frequency (500 kHz in NCP1397). A number of extra protection features are available with configurable settings to suit any application. These include: auto-recovery or fault latch-off, brown-out, open opto-coupler, soft-start, short-circuit protection and adjustable dead time.

At the secondary side the FAN7688 is available in the ON Semiconductor product portfolio. It is an advanced Pulse Frequency Modulated (PFM) controller for LLC resonant converters with Synchronous Rectification (SR) offering best in class efficiency for isolated DC-DC converters. A current mode control technique based on charge control provides a better control-to-output transfer function of the power stage simplifying the feedback loop design while allowing true input power limit capability. At the same time a dual edge tracking adaptive dead time control minimizes the body diode conduction period, hence maximizing efficiency.

Suggestions for the MOSFET power stages and bias supply are available in the product table.

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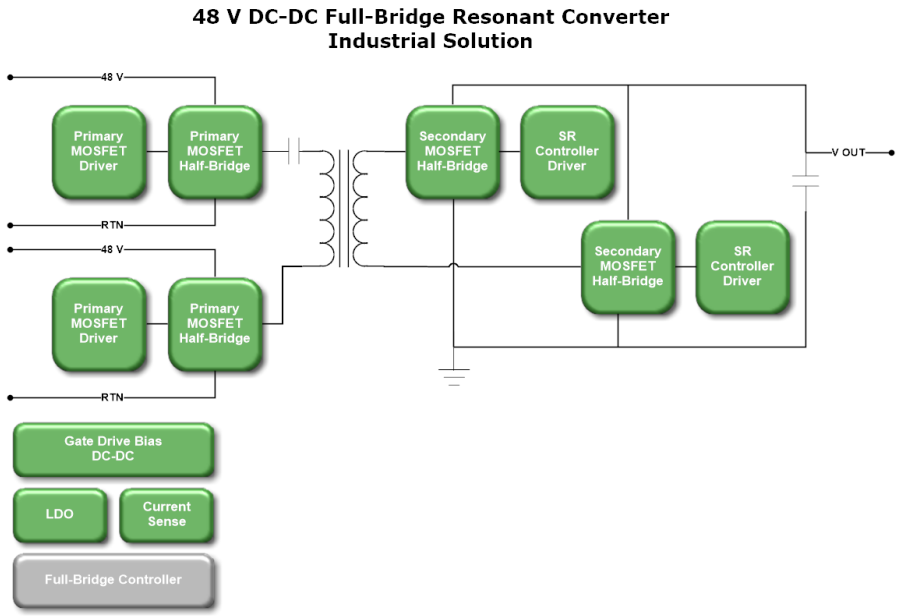
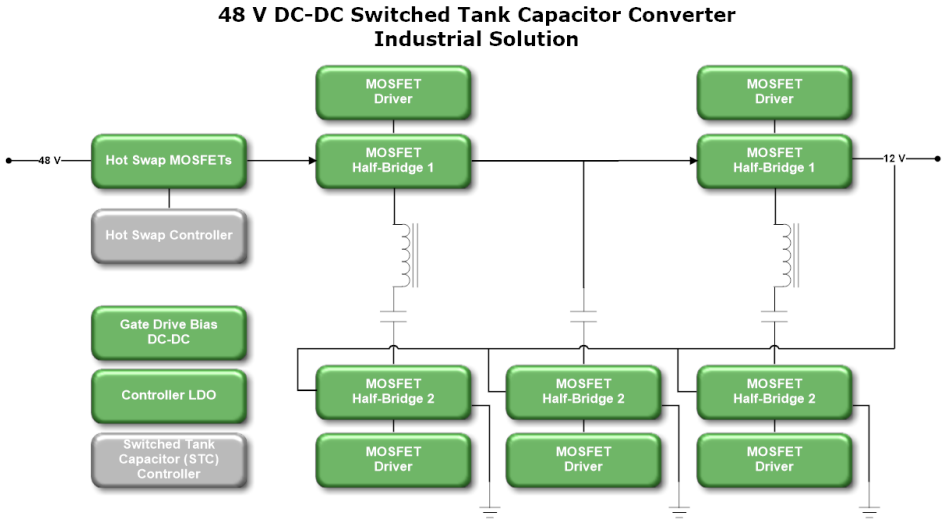
48 V DC-DC - Full-Bridge Resonant Converter:

If higher power ratings are required a full-bridge architecture can be utilized. The concept is similar to the half-bridge and implements electrical isolation. The topology is chosen to implement synchronous rectification at the secondary side in order to get the best system power transfer efficiency and output voltage control. A series of solutions for gate drivers bias supply, Low Drop Out regulators (LDO) and current sensing operational amplifiers are listed in the product table.



48 V DC-DC - Switched Tank Capacitor:



This non isolated solution is becoming popular in cloud computing applications. Bringing 48 V directly to the blade server PCB reduces copper usage in the data center and can improve system efficiency. The Switched Tank Capacitor can be employed to convert 48 V-12 V in a small footprint and at efficiencies exceeding 99%.

The Switched Tank Capacitor topology is perhaps best described as two cascaded divide-by-two charge pumps with a central clamp. The charge pumps are operated at or near the resonant frequency of the LC which ensures soft switching of the MOSFETs. Thus the topology is unregulated, and the resultant output voltage from a 40-60 V source can be between 10 V and 15 V.

The purpose of the hot-swap is to ensure a controlled and safe ramp-up on power-up and also to protect from over-current and short circuit situations. The Switch Tank Capacitor controller drives soft start and stop of the Switched Tank Capacitor, manages faults, generates driver PWMs and sets dead time and clocks. The MOSFET drivers accept separate PWM inputs for the high-side and low-side MOSFETs. In a 48 V-12 V application, 40 V MOSFETs are generally required for half-bridge 1, while 25 V or 30 V MOSFETs can be used for half-bridge 2.

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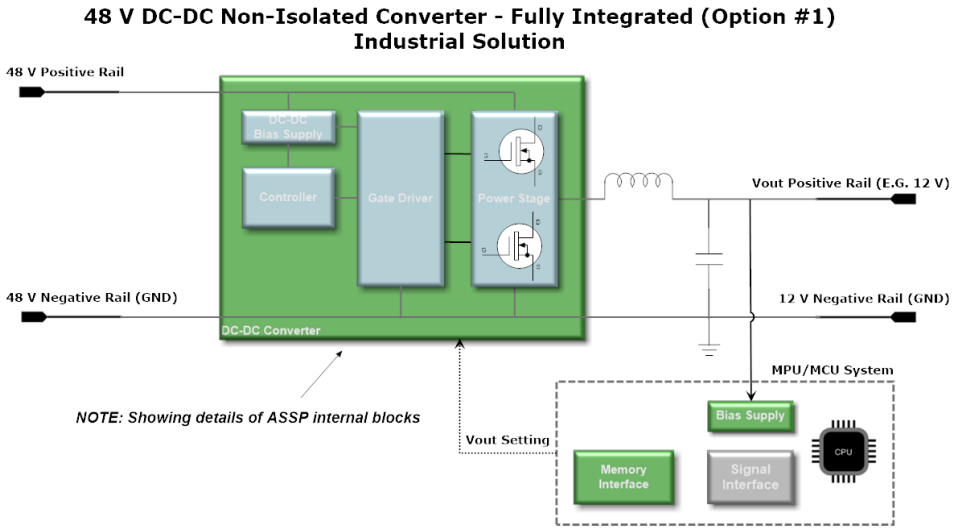
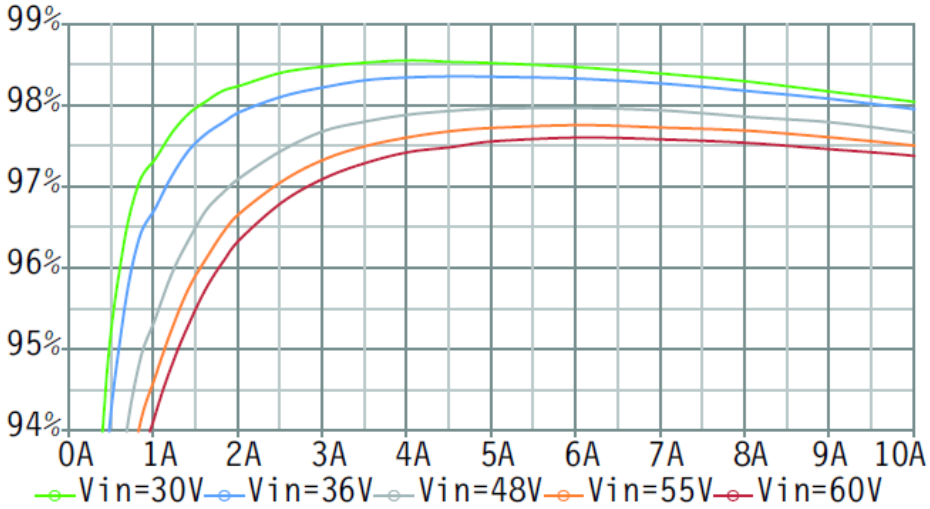
48 V DC-DC Conversion non-isolated:

This topology uses a step-down buck converter to produce a lower voltage rail (Vout in the diagram) to power electronics targeted for this rating. This conversion can be performed with top notch and high level of integrated solutions down to a single package. In addition, more linear regulators or buck converters (Point of Load - PoL) can be connected to the lower voltage bus to derive logic level voltages such as 5 V. For all rails, current capability can be scaled according to the circuitry needs. The output voltage (Vout) is regulated at power up autonomously to a defined target voltage (E.g. 12 V).

In some cases, a Micro Processor Unit (MPU) or Micro Controller Unit (MCU system) will perform additional tasks. One possibility is setting the regulated voltage (Vout) to a different level than the power-up default. The diagram references some examples of memory interfaces and expansions that may be useful for the application.

For the DC-DC block, two implementations are proposed which depend on the output current requirements. The first one is a fully integrated solution in which all the necessary conversion circuitry such as the controller, bias electronics, gate drivers and power stage are contained in a single small package (PQFN 6 mm x 6 mm). These solutions cover a current range up to 10 A continuous (DC).





Despite the compactness of the solution, the efficiencies are high and can be referenced from the FAN65008B datasheet.

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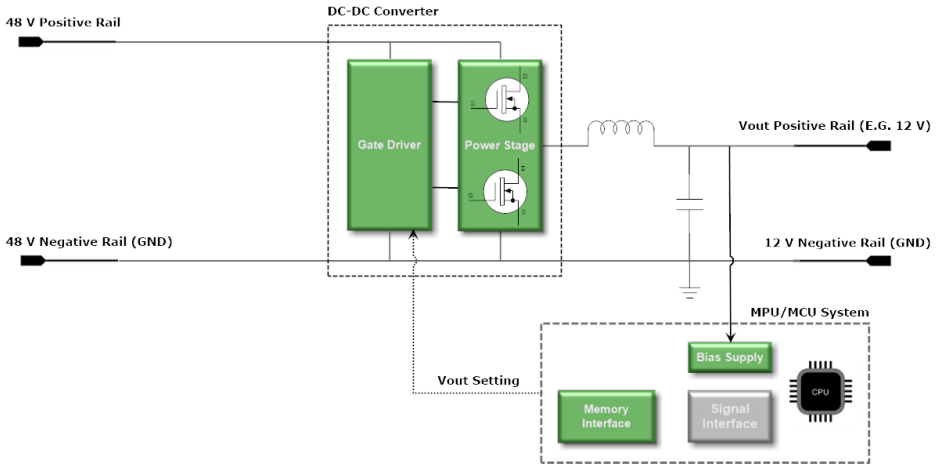
The second implementation takes into account the possibility of an even more flexible or wider application power range, in terms of a separate controller and power stage. In addition, the controller features a gate driver for optimized board spacing.

48 V DC-DC Non-Isolated Converter - Scalable Power Stage (Option #2)
Industrial Solution



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48 V DC-DC Conversion

Suggested Block	Option	WPN	Why Select?	WPN Desciption	ON Target?
48 V DC-DC Converter Bi-Directional- Automotive					
MOSFET 1 - Source Disconnect Switch	1	FDBL86363-F085	Low $R_{DS(ON)}$, UIS Capability, AECQ-101 Qualified	N-Channel PowerTrench® MOSFET, 80V, 240A, 2.0mΩ	Y
Gate Driver - Source/Load Discconnect Switch	1	FAN7171_F085	Capability to drive high-speed MOSFETs and IGBTs that operate up to +600V	625V, 4A, SOIC-8, High-Side Gate Drive IC	Y
High & Low Side Gate Driver	1	NCV51511	AEC Qual up to 150°C Tj, HS robustness against negative transients, Bootstrap Supply Voltage Range up to 100V	100V High Frequency, High and Low Side Gate Driver	Y
MOSFET 2	1	FDMS86368-F085	Low RDS (ON) , UIS Capability, AECQ-101 Qualified	N-Channel PowerTrench® MOSFET 80V, 80A, 4.5 mΩ	Y
MOSFET 3 - Load Disconnect Switch	1	FDBL9406-F085	Low RDS (ON) , UIS Capability, AECQ-101 Qualified	N-Channel PowerTrench® MOSFET, 40 V, 240 A, 1.2 mΩ	Y
Current Sense	1	NCV213RSQT2G	Wide Common Mode Input Range: -0.3 to 26V, Low Offset Voltage: ±100 µV maximum, Low Offset Drift: 0.5 µV/°C maximum, Supply Voltage: 2.2 to 26V	Current Sense Amplifier, 26V, Low-/High-Side Voltage Out, Bidirectional Current Shunt Monitor	Y
Bias Supply	1	NCV890430	+/- 2% output accuracay, fixed output voltage and low shutdown current	Automotive 0.6 A 2 MHz 100% Duty Cycle Step-Down Synchronous Regulator	N
Communication Interface	1	NCV7344	CAN/CAN-FD: Based on chosen protocol	CAN FD Transceiver, High Speed, Low Power	Y
Communication Interface	2	NCV7357	CAN/CAN-FD: Based on chosen protocol	CAN FD Transceiver, High Speed	Y
Communication Interface	3	NCV7327	LIN: Based on chosen protocol	Stand-alone LIN Transceiver	Y
Communication Interface	4	NCV7329	LIN: Based on chosen protocol	LIN Transceiver, Stand-alone	Y
48 V DC-DC Half-Bridge Resonant Converter					
LLC Controller (w/Drivers)	1	NCP1397	High performance with integrated drivers	Controller, High Performance, Resonant Mode, with Integrated High Voltage Drivers	Y
LLC Controller	2	NCP1395	Wide frequency operation - pairs with FDMF8811	Controller, High Performance Resonant Mode	Y
Primary MOSFET Half-Bridge	1	FAN8811TMPX	Wide supply voltage range, 2ns delay matching, fast propagation delays	High-Frequency, High Side and Low Side Gate Driver IC	Y
Primary MOSFET Half-Bridge	2	FDMF8811	High level of integration	High Performance 100V Bridge Power Stage (BPS) Module	N
Primary MOSFET Half-Bridge	3	FDMT800100DC	Very low RDSon 100V MOSFET in dual-cool package	N-Channel Dual Cool™ 88 PowerTrench® MOSFET 100V, 162A, 2.95mΩ	Y
Primary MOSFET Half-Bridge	4	FDMT800120DC	Very low RDSon 120V MOSFET in dual-cool package	N-Channel Dual CoolTM 88 PowerTrench® MOSFET 120V, 128A, 4.2mΩ	Y
Primary MOSFET Half-Bridge	5	FDBL0260N100	Even lower RDSon TOLL package	N-Channel PowerTrench® MOSFET, 100V, 200A, 2.6mΩ	Y
SR Controller Driver	1	FAN7688SJX	Wide Operating Frequency, Light load efficiency, protection functions	Advanced Secondary Side LLC Resonant Converter Controller with Synchronous Rectifier Control	Y
SR Controller Driver	2	FAN6248HCMX	Wide Operating Frequency, Anti shoot through, Light load detection	Advanced Synchronous Rectifier Controller for LLC Resonant Converter	Y
SR Controller Driver	3	NCP4306	Low UVLO,tiny package (also has dV/dt detector for USB/PD or QC3 application)	Secondary Side Synchronous Rectification Driver for High Efficiency SMPS Topologies	Y
Secondary MOSFET Half Bridge	1	NTTFS1D2N02P1E	25VDS for Low output voltage application	MOSFET - Power, Single N-Channel, Power33, 25V, 1.0mΩ, 180 A	Y
Secondary MOSFET Half Bridge	2	NTMFS5C426NT1G	30VDS for Low output voltage application	Single N−Channel Power MOSFET 30V, 136A, 2.1mΩ	Y
Secondary MOSFET Half Bridge	3	NTMFS4C03NT1G	40VDS for 12V output application	Single N-Channel Power MOSFET 40V, 235A, 1.3mΩ	N
Bias Supply	1	NCP781	Wide voltage range regulator, high voltage, for powering mainly controller and driver	NCP781: Linear Voltage Regulator, 100 mA, 150 V, High PSRR	Y
Bias Supply	2	FAN65004B	High level of integration - wide input range - if high current is required	Synchronous PWM BuckRegulator, Voltage Mode,High Performance, 65 V, 6 A	Y
Bias Supply	3	NCP4060	High level of integration - wide input range - if high current is required	NCP4060: 80V, 6A Synchronous Step Down Converter in a compact 6mm by 6mm package	Y
48 V DC-DC Full-Bridge Resonant Converter					
Primary MOSFET Driver	1	FAN8811TMPX	Wide supply voltage range, 2ns delay matching, fast propagation delays	High-Frequency, High Side and Low Side Gate Driver IC	Y
Primary MOSFET Driver	2	NCP81075	Wide supply voltage range, fast propagation delays, integrated booststrap	High Side and Low Side Gate Driver, High-Frequency, 180 V, 4A capability	Y
Primary MOSFET Half-Bridge	1	FDMF8811	High level of integration	High Performance 100V Bridge Power Stage (BPS) Module	N
Primary MOSFET Half-Bridge	2	FDMT800100DC	Very low RDSon 100V MOSFET in dual-cool package	N-Channel Dual Cool™ 88 PowerTrench® MOSFET 100V, 162A, 2.95mΩ	Y
Primary MOSFET Half-Bridge	3	FDMT800120DC	Very low RDSon 120V MOSFET in dual-cool package	N-Channel Dual CoolTM 88 PowerTrench® MOSFET 120V, 128A, 4.2mΩ	Y
Primary MOSFET Half-Bridge	4	FDBL0260N100	Even lower RDSon TOLL package	N-Channel PowerTrench® MOSFET, 100V, 200A, 2.6mΩ	Y
LDO	1	NCP718	300 mA capability	LDO Regulator, 300 mA, Wide Vin, Ultra-Low Iq	Y
LDO	2	NCP715	50 mA capability, lower Iq	LDO Regulator, 50 mA, Ultra-Low Iq	Y
Current Sense	1	NCS210R	Gain of 200	Current Sense Amplifier, 26V, Low-/High-Side Voltage Out, Bidirectional Current Shunt Monitor	Y
Current Sense	2	NCS211R	Gain of 500	Current Sense Amplifier, 26V, Low-/High-Side Voltage Out, Bidirectional Current Shunt Monitor	Y
Current Sense	3	NCS213R	Gain of 50	Current Sense Amplifier, 26V, Low-/High-Side Voltage Out, Bidirectional Current Shunt Monitor	Y
Current Sense	4	NCS214R	Gain of 100	Current Sense Amplifier, 26V, Low-/High-Side Voltage Out, Bidirectional Current Shunt Monitor	Y
SR Controller Driver	1	FAN7688SJX	Wide Operating Frequency, Light load efficiency, protection functions	Advanced Secondary Side LLC Resonant Converter Controller with Synchronous Rectifier Control	Y
SR Controller Driver	2	FAN6248HCMX	Wide Operating Frequency, Anti shoot through, Light load detection	Advanced Synchronous Rectifier Controller for LLC Resonant Converter	Y
SR Controller Driver	3	NCP4306	Low UVLO,tiny package (also has dV/dt detector for USB/PD or QC3 application)	Secondary Side Synchronous Rectification Driver for High Efficiency SMPS Topologies	Y
Secondary MOSFET Half Bridge	1	NTTFS1D2N02P1E	25VDS for Low output voltage application	MOSFET - Power, Single N-Channel, Power33, 25V, 1.0mΩ, 180 A	Y
Secondary MOSFET Half Bridge	2	NTMFS5C426NT1G	30VDS for Low output voltage application	Single N−Channel Power MOSFET 30V, 136A, 2.1mΩ	Y
Secondary MOSFET Half Bridge	3	NTMFS4C03NT1G	40VDS for 12V output application	Single N-Channel Power MOSFET 40V, 235A, 1.3mΩ	N
Gate Drive Bias DC-DC	1	NCP781	Wide voltage range regulator, high voltage, for powering mainly controller and driver	NCP781: Linear Voltage Regulator, 100 mA, 150 V, High PSRR	Y
Gate Drive Bias DC-DC	2	FAN65004B	High level of integration - wide input range - if high current is required	Synchronous PWM BuckRegulator, Voltage Mode,High Performance, 65 V, 6 A	Y
Gate Drive Bias DC-DC	3	NCP4060	High level of integration - wide input range - if high current is required	NCP4060: 80V, 6A Synchronous Step Down Converter in a compact 6mm by 6mm package	Y

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48 V DC-DC Conversion

Suggested Block	Option	WPN	Why Select?	WPN Desciption	ON Target?
48 V DC-DC Switched Tank Capacitor Converter					
Hot-Swap MOSFETs	1	NTTFS6H850NL	Low RDSon, Low QG, small footprint (3x3mm), logic level capable	Single N−Channel Power MOSFET 80V, 108A, 8.66mΩ	Y
Hot-Swap MOSFETs	2	NTMFS6H801N	Low RDSon, Low QG, logic level capable, small footprint (5x6mm),	Single N-Channel Power MOSFET 80V, 153A, 2.8mΩ	Y
MOSFET Driver	1	FAN8811TMPX	Wide supply voltage range, 2ns delay matching, fast propagation delays	High-Frequency, High Side and Low Side Gate Driver IC	Y
MOSFET Driver	2	NCP81075	Wide supply voltage range, fast propagation delays, integrated booststrap	High Side and Low Side Gate Driver, High-Frequency, 180 V, 4A capability	Y
MOSFET Half-Bridge 1	1	NTTFS002N04CLTAG	For ~500W application	Power MOSFET, 40V, 2.2mOhm, 142A, Single N-Channel	Y
MOSFET Half-Bridge 1	2	NTTFS5C454NL	For ~250W applications	Single N-Channel Power MOSFET 40V, 85A, 3.8mΩ	Y
MOSFET Half-Bridge 1	3	FDMD8240L	Dual MOSFET for high power density	Dual N-Channel Power Trench® MOSFET 40V, 98A, 2.6mΩ	Y
MOSFET Half-Bridge 2	1	FDPC3D5N025X9D	Dual MOSFET for high power density	25V Symmetric Dual N-Channel PowerTrench® Power Clip MOSFET	Y
MOSFET Half-Bridge 2	2	NTTFS4H05N	Single MOSFET for best thermal conductivity	Single N−Channel Power MOSFET 25V, 94A, 3.3mΩ	Y
MOSFET Half-Bridge 2	3	NTTFS4C05N	Single MOSFET for best thermal conductivity	Power MOSFET 30V 75A 3.6 mOhm Single N-Channel u8FL	N
Controller LDO	1	NCP718	300 mA capability	LDO Regulator, 300 mA, Wide Vin, Ultra-Low Iq	Y
Controller LDO	2	NCP715	50 mA capability, lower Iq	LDO Regulator, 50 mA, Ultra-Low Iq	Y
Gate Drive Bias DC-DC	1	NCP781	Wide voltage range regulator, high voltage, for powering mainly controller and driver	NCP781: Linear Voltage Regulator, 100 mA, 150 V, High PSRR	Y
Gate Drive Bias DC-DC	2	FAN65004B	High level of integration - wide input range - if high current is required	Synchronous PWM BuckRegulator, Voltage Mode,High Performance, 65 V, 6 A	Y
Gate Drive Bias DC-DC	3	NCP4060	High level of integration - wide input range - if high current is required	NCP4060: 80V, 6A Synchronous Step Down Converter in a compact 6mm by 6mm package	Y
48 V DC-DC Non Isolated Converter - Fully Integrated (Option # 1)					
DC-DC Bus Converter	1	FAN65004B	High level of integration - wide input range - high current capability step-down - 6 A DC	Synchronous PWM BuckRegulator, Voltage Mode,High Performance, 65 V, 6 A	Y
DC-DC Bus Converter	2	FAN65005A	High level of integration - wide input range - high current capability step-down - 8 A DC	Synchronous PWM BuckRegulator, Voltage Mode,High Performance, 65 V, 8 A	Y
DC-DC Bus Converter	3	FAN65008B	High level of integration - wide input range - high current capability step-down - 10 A DC	Synchronous PWM BuckRegulator, Voltage Mode,High Performance, 65 V, 10 A	Y
DC-DC Bus Converter	4	NCP4060	High level of integration - wide input range up to 80V - high current capability step-down - 6 A DC	80V, 6A Synchronous Step Down Converter in a compact 6mm by 6mm package	Y
Memory Interface	1	N24RF64E	EEPROM - RFID - NFC with I2C Interface	Dual Interface RFID 64 Kb EEPROM Tag ISO 15693 RF, I2C Bus, Energy Harvesting	Y
Memory Interface	2	CAT25256	EEPROM Serial 256-Kbytes - SPI Interface	EEPROM Serial 256-Kb SPI low power CMOS	N
Bias Supply - MPU/MCU System	1	NCP3170	High level of integration - current mode - mid to high frequency - 3 A DC	4.5V to 18V, Buck Regulator, Switching, PWM, 3.0 A	Y
Bias Supply - MPU/MCU System	2	NCP3101	High level of integration - voltage mode - mid frequency - 6 A DC	2.7V to 27V, 6 A Highly efficient, DC/DC Converter in 6x6mm QFN package	N
Bias Supply - MPU/MCU System	3	NCP3284	High level of integration - very high current capability if required - 30 A DC	4.5V to 18V, 30A Highly efficient, DC/DC Converter in thermally enhanced 5mm by 6mm package	Y
48 V DC-DC Non Isolated Converter - Scalable Power Stage (Option # 2)					
Controller with Gate Driver	1	NCP1034	Wide input voltage to be used with +48V or +60V input, capability of using larger FETs	100 V Synchronous Buck Controller	N
Power Stage - MOSFET	1	NTD3055	Low RDSon MOSFET for Converters application - optimized here for high side	Single N-Channel Power MOSFET 60V, 12A, 94mΩ	N
Power Stage - MOSFET	2	NTD24N06	Low RDSon MOSFET for Converters application - optimized here for low side	Single N-Channel Power MOSFET 60V, 24A, 42mΩ	N
Power Stage - MOSFET - DUAL	3	NTMFD5C680NL	Low RDSon MOSFET for Converters application in dual package	Dual N-Channel Power MOSFET 60V, 26A, 28mΩ	Y
Memory Interface	1	N24RF64E	EEPROM - RFID - NFC with I2C Interface	Dual Interface RFID 64 Kb EEPROM Tag ISO 15693 RF, I2C Bus, Energy Harvesting	Y
Memory Interface	2	CAT25256	EEPROM Serial 256-Kbytes - SPI Interface	EEPROM Serial 256-Kb SPI low power CMOS	N
Bias Supply - MPU/MCU System	1	NCP3170	High level of integration - current mode - mid to high frequency - 3 A DC	4.5V to 18V, Buck Regulator, Switching, PWM, 3.0 A	Y
Bias Supply - MPU/MCU System	2	NCP3101	High level of integration - voltage mode - mid frequency - 6 A DC	2.7V to 27V, 6 A Highly efficient, DC/DC Converter in 6x6mm QFN package	N
Bias Supply - MPU/MCU System	3	NCP3284	High level of integration - very high current capability if required - 30 A DC	4.5V to 18V, 30A Highly efficient, DC/DC Converter in thermally enhanced 5mm by 6mm package	Y

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