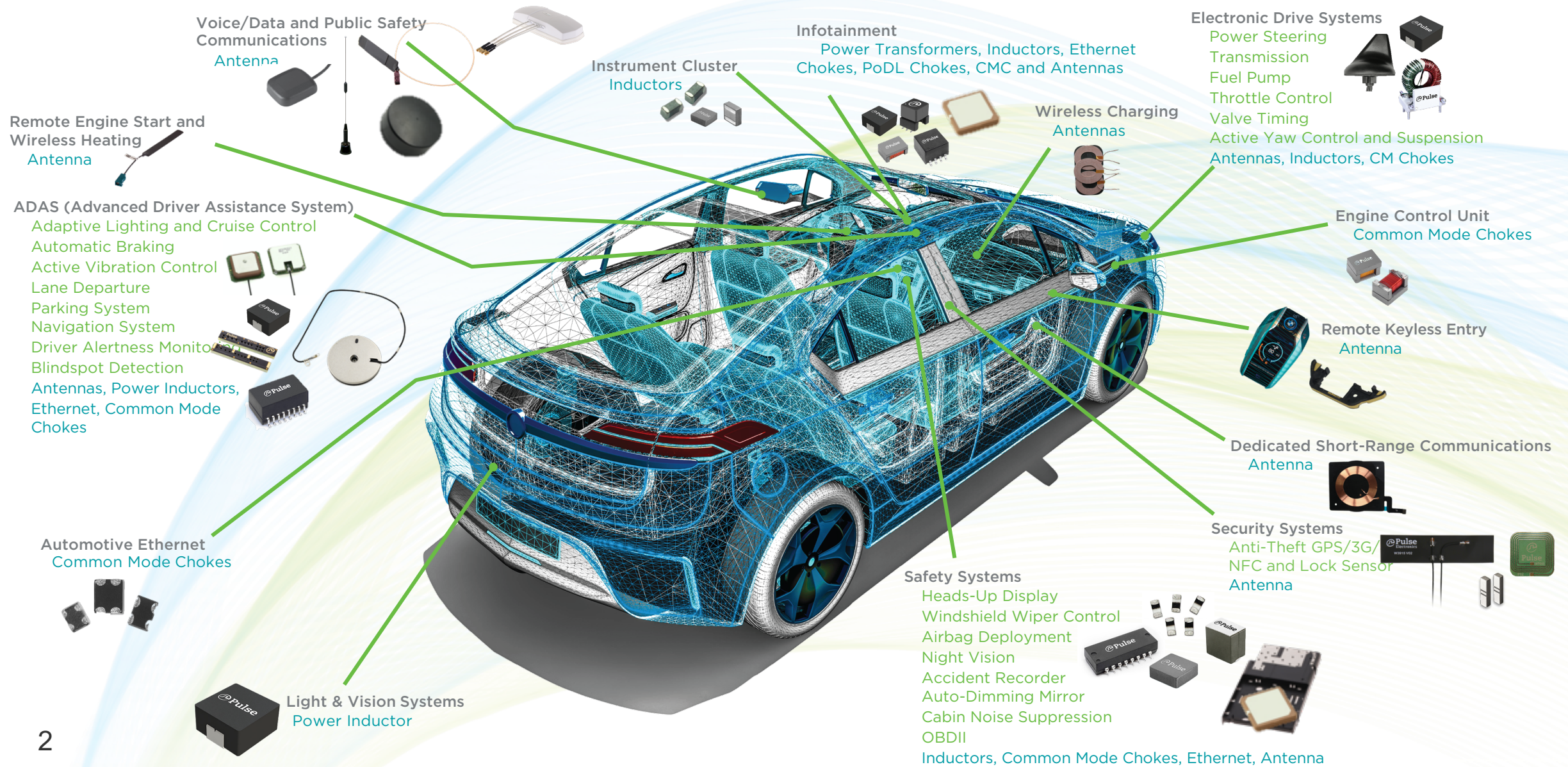


# Pulse Electronics Automotive Product Overview

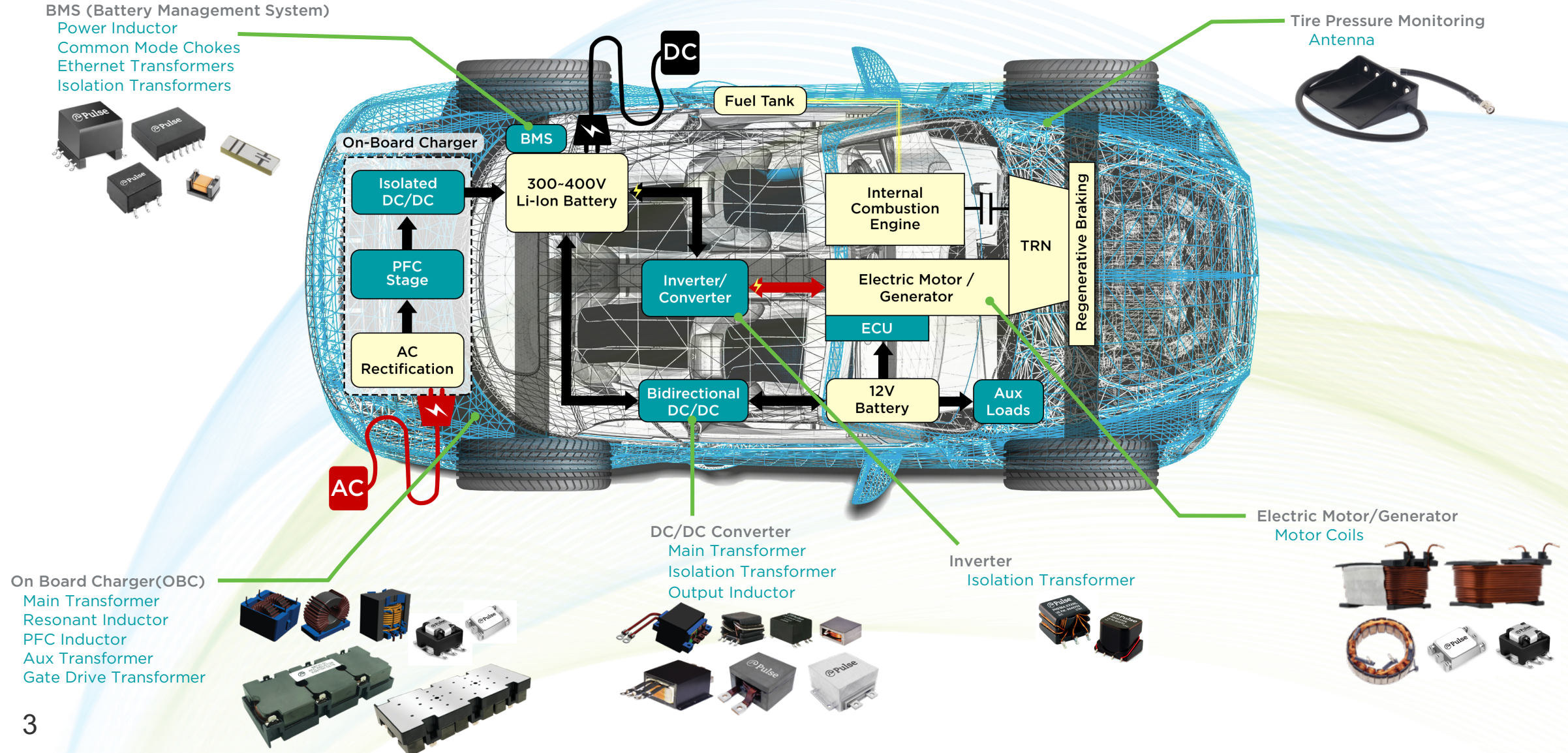
January 26, 2021



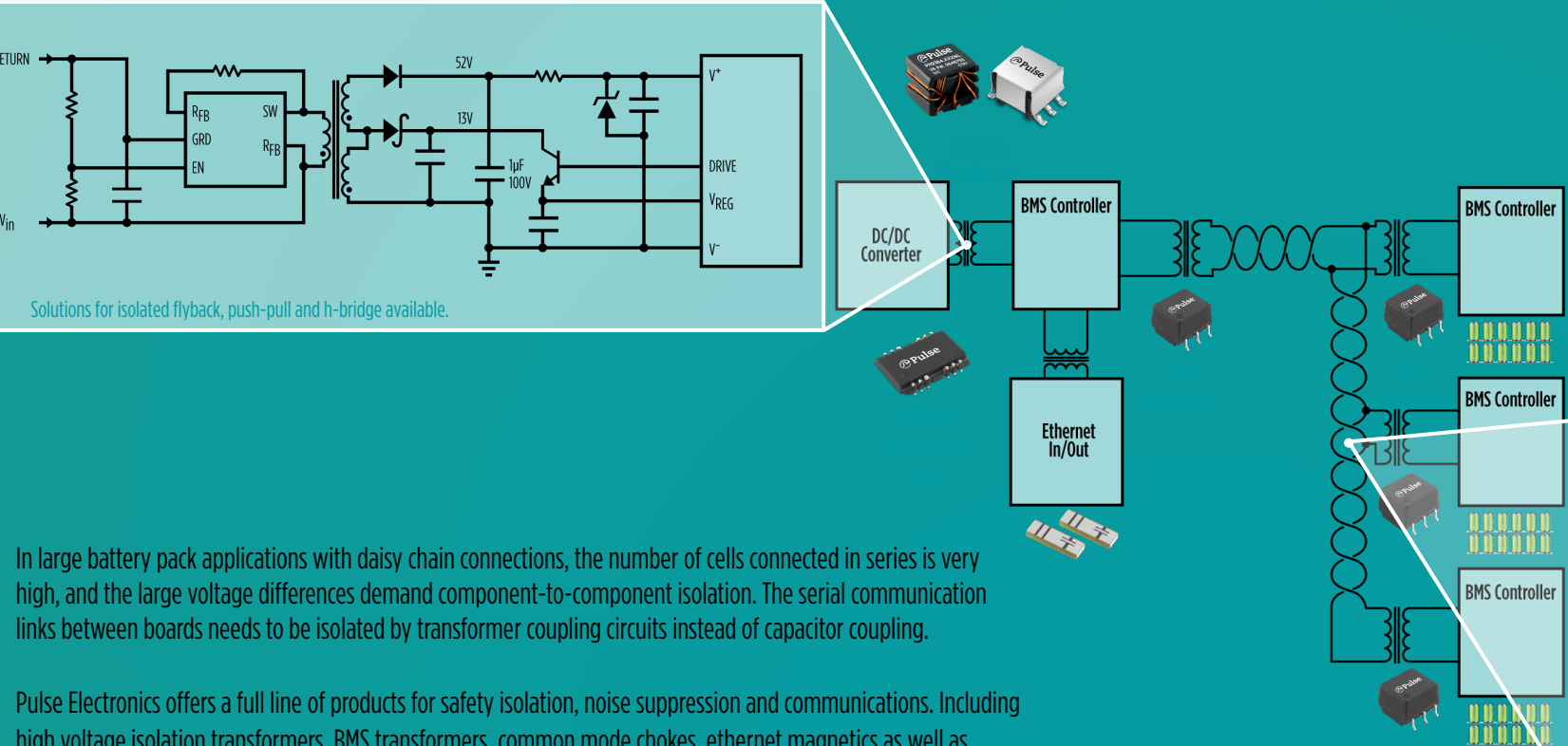




# Automotive Drive Train



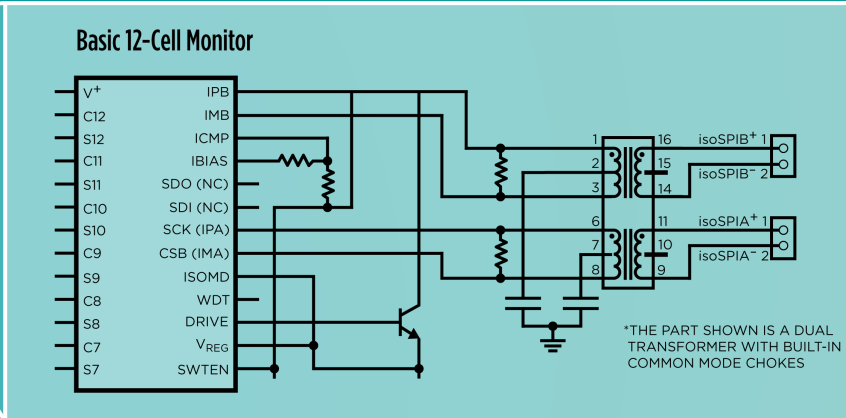
# Battery Management System (BMS)



Solutions for isolated flyback, push-pull and h-bridge available.

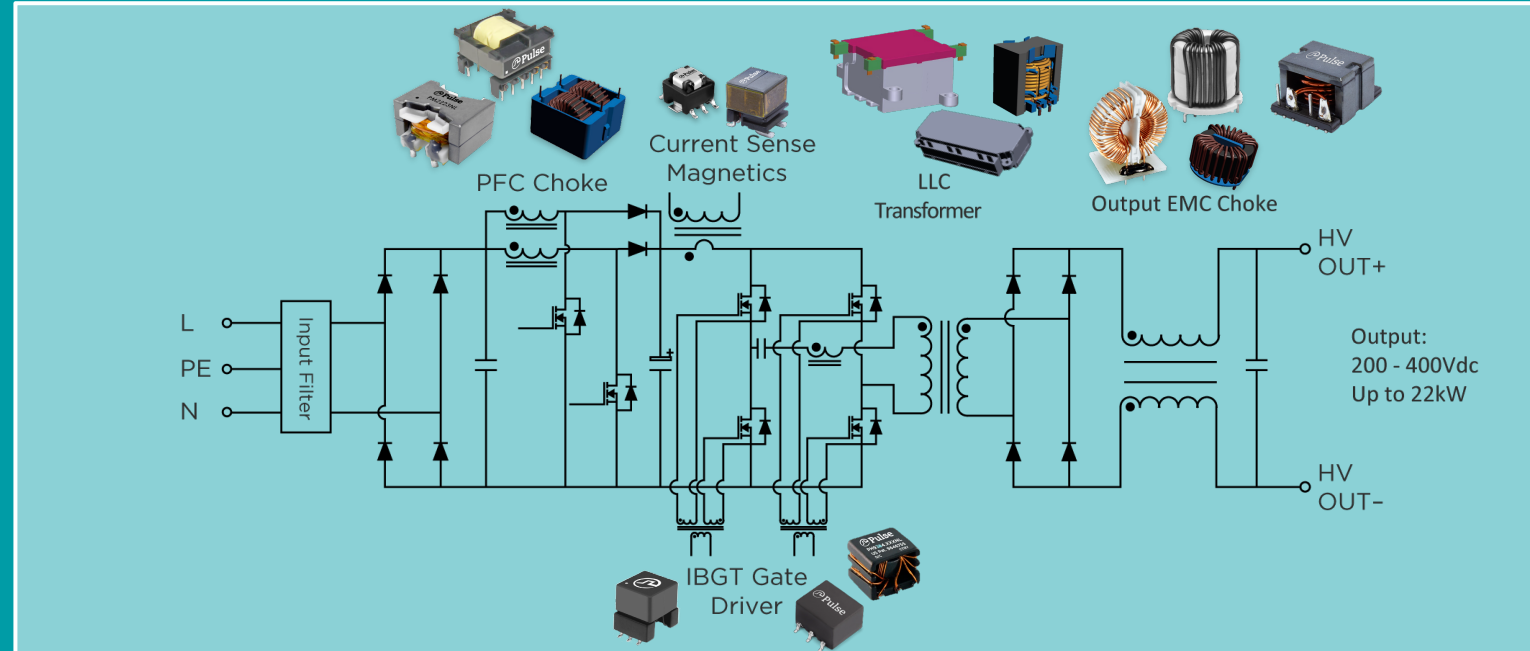
In large battery pack applications with daisy chain connections, the number of cells connected in series is very high, and the large voltage differences demand component-to-component isolation. The serial communication links between boards needs to be isolated by transformer coupling circuits instead of capacitor coupling.

Pulse Electronics offers a full line of products for safety isolation, noise suppression and communications. Including high voltage isolation transformers, BMS transformers, common mode chokes, ethernet magnetics as well as wireless antenna options.



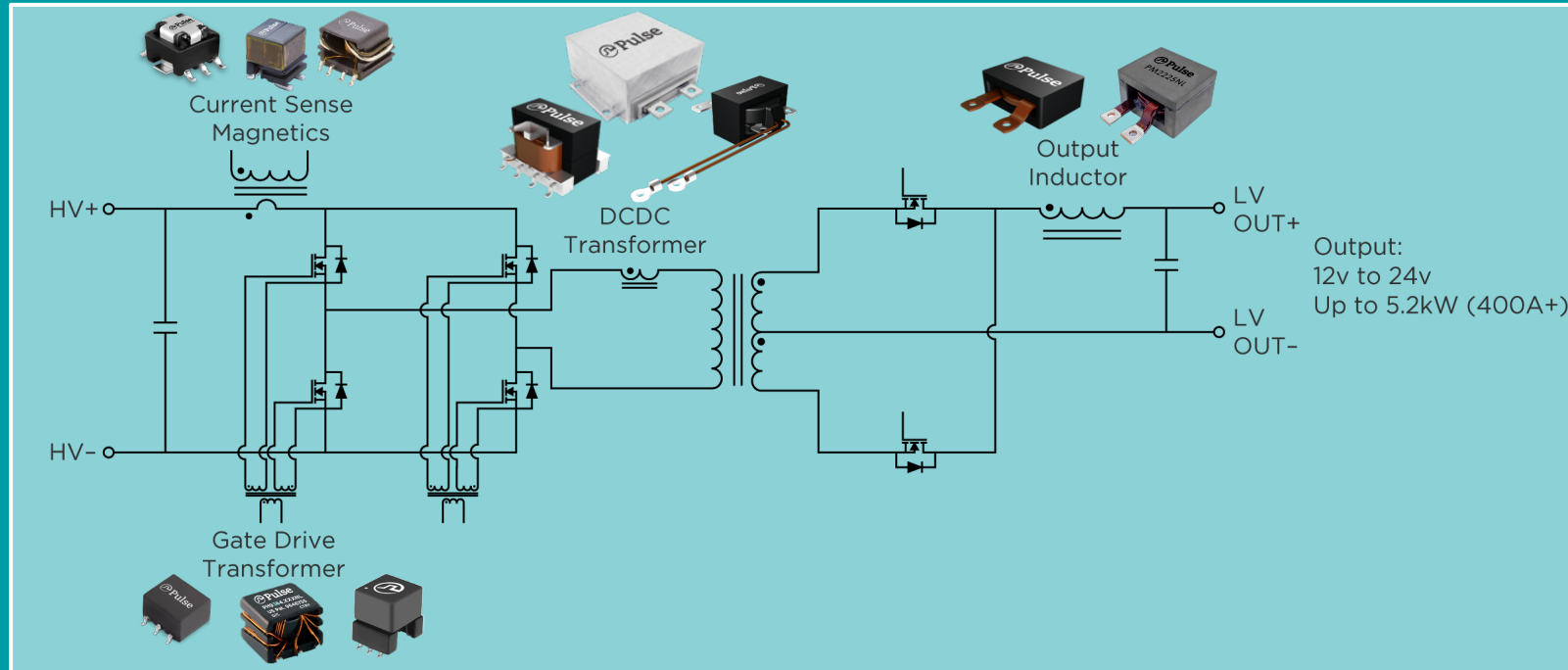


# On-Board Charger (OBC)



The On-Board Charger (OBC) is a sophisticated high voltage power supply that converts the AC power from the charging source to the DC voltage required to charge battery packs in an EV or HEV vehicle.

Efficiency of the system is critical to minimize charging times and ensuring operation within thermal limits. The power magnetics within the system are a combination of off-the-shelf standard magnetics and highly engineered customized solutions to maximize performance.



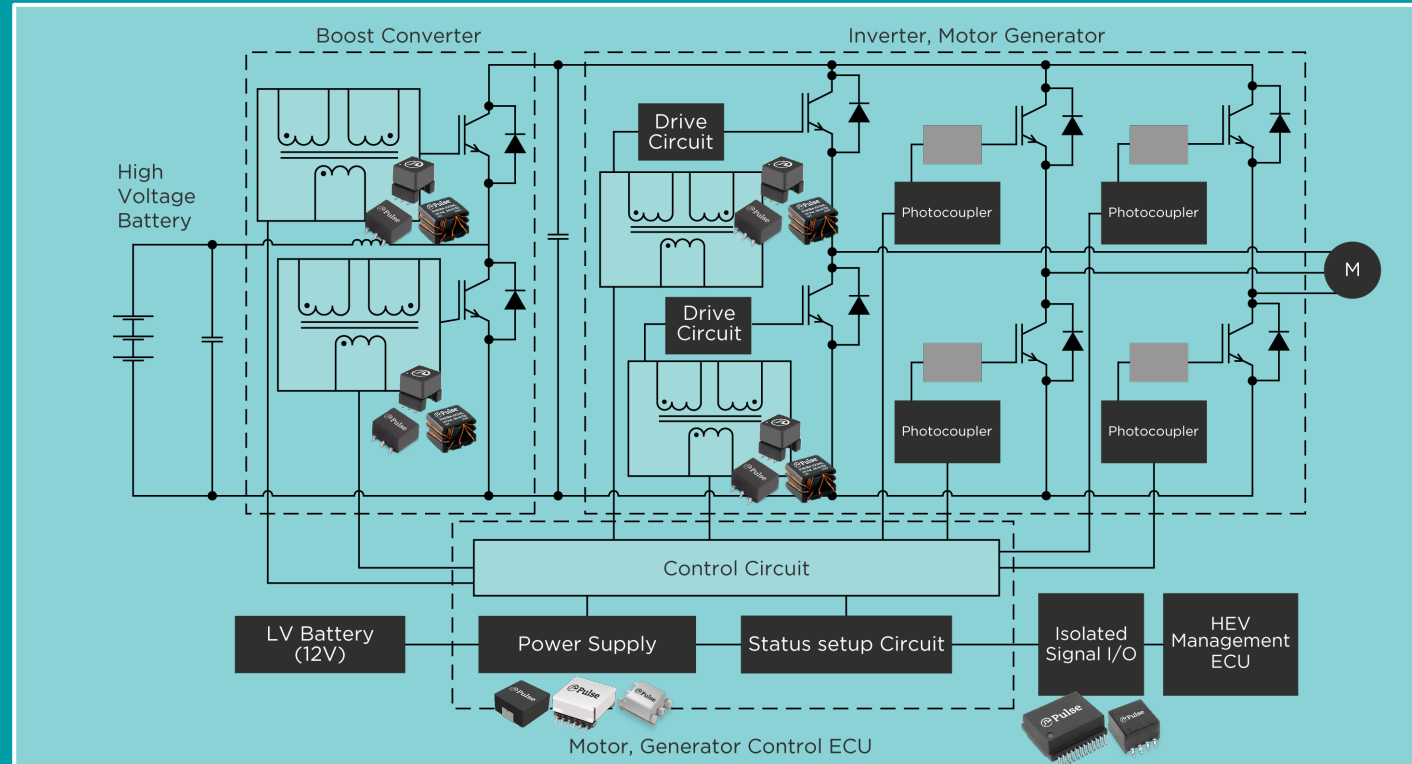
The high-power DC-DC converter is used to change the high-voltage (200-800Vdc) from the battery pack to the lower voltage (12v-48v) that is used to power the automotive sub-systems.

As in the OBC, efficiency of the system is critical to ensure maximum battery utilization. Isolation within the DC-DC converter is also critical to ensure that sensitive low voltage systems are not damaged and to ensure user accessible systems are safe.

Pulse designs and manufactures a wide range of lower power catalog components (current sensing and isolation transformers) and high-power customized components (DCDC transformer and output inductor)



# High Voltage Inverter



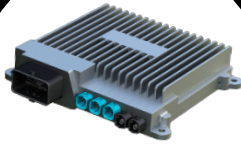
The inverter uses high power IGBTs or switches to change the high dc voltage battery pack energy into an AC signal to drive and control the AC motor. Through regenerative braking the inverter can also use the braking energy to charge the battery pack. The inverter is critical to vehicle operation and handles significant amounts of power (Up to 100kW) and it is necessary to isolate multiple high voltage nodes to ensure safe operation.

Pulse designs and manufactures UL approved isolation transformers as well as the magnetics used in the auxiliary power supply and signal I/O.

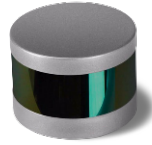
From kbps to Gbps, signal magnetics for In-Vehicle Networking



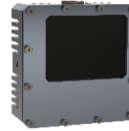
Data Control  
Module



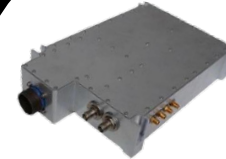
ADAS



Lidar



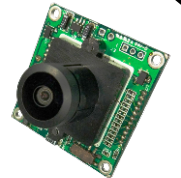
Radar



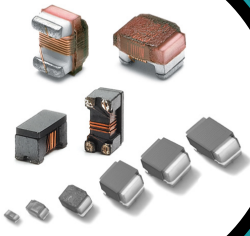
GPS



Infotainment  
Head Unit

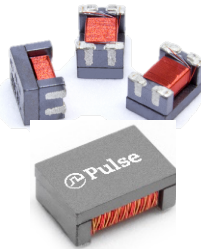


Cameras



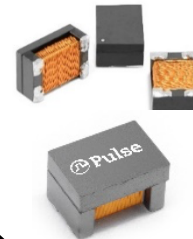
**RF / EMC / EMI**

- ❖ Multi-Layer wire wound
- ❖ Ceramic/Ferrite Wire wound
- ❖ EMI Beads



**Common Mode Chokes  
Automotive Ethernet**

- ❖ 100/1000BaseT1/dual-speed
- ❖ PoDL up to 470mA
- ❖ 10BaseT1S



**Common Mode Chokes**

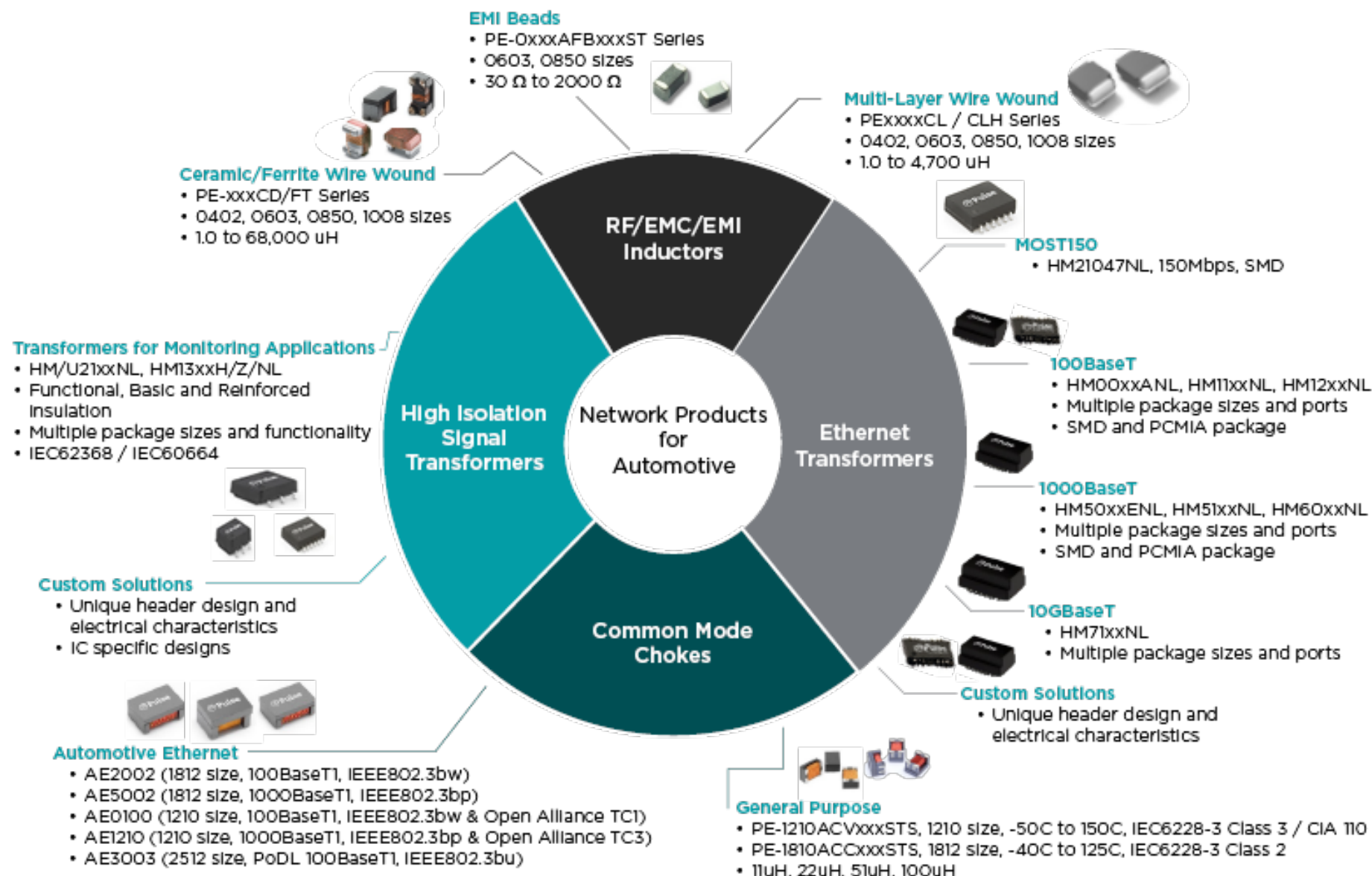
- ❖ FlexRay, LIN, CAN
- ❖ CAN-FD
- ❖ A2B



**Ethernet transformers**

- ❖ 100BaseT
- ❖ 1000BaseT
- ❖ 10GBaseT

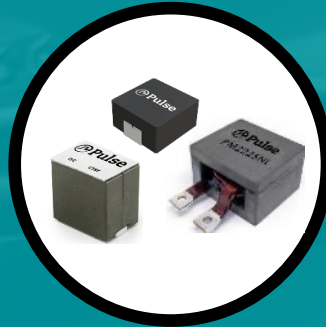




From mW to kW, Power Magnetics for Transportation

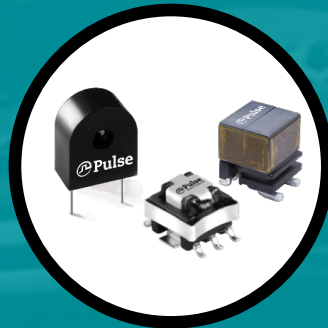
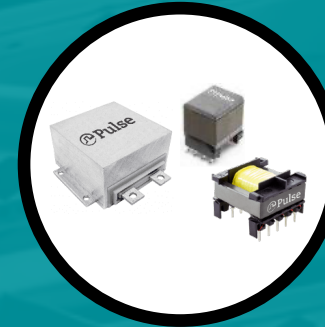
## Power Inductors

- ❖ Power Bead Inductors (Up to 120Apk)
- ❖ Molded Powder Inductors (Up to 118Apk)
- ❖ Composite Core Inductors (Up to 38Apk)
- ❖ Shielded & Unshielded Drum (Up to 30Apk)
- ❖ Toroid Inductors (Up to 40Apk)
- ❖ High Power Inductors (Up to 220Apk)



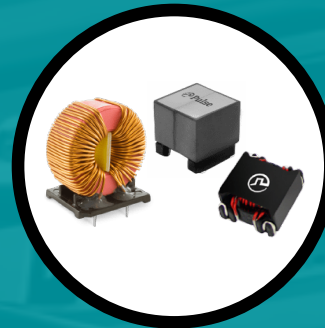
## Power Transformers

- ❖ Multiple Topologies
- ❖ Wirewound Transformers (2W to 1KW)
- ❖ Planar Transformers (30W to 3.3kW)
- ❖ High Isolation Transformers (up to 5kVrms)
- ❖ Custom transformers available



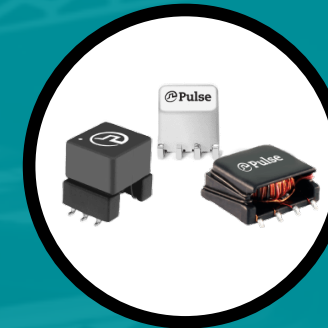
## Current Sense Magnetics

- ❖ Functional, Basic and Reinforced Insulation (Up to 4000Vrms Isolation)
- ❖ Multiple platforms from 4A to 38A



## Common Mode Chokes

- ❖ Up to 38Arms
- ❖ Up to 2500 Vrms Isolation
- ❖ Multiple package sizes available

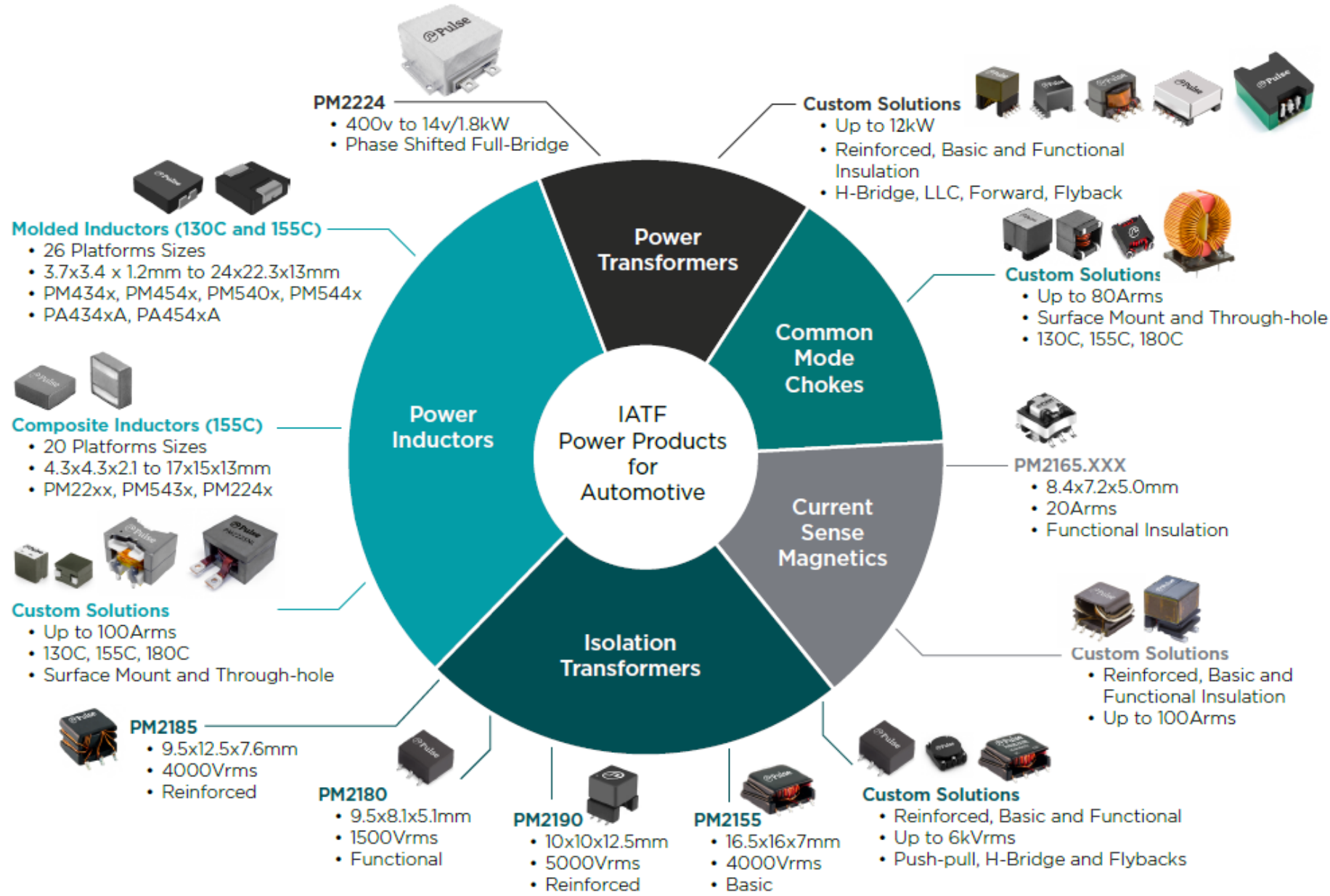


## Isolation Transformers

- ❖ Functional, Basic and Reinforced Insulation (Up to 5000Vrms)
- ❖ Multiple turns ratios and volt-usec ratings

Surface Mount (SMT), Through-hole (THT) and Pin In Paste (PIP) Solutions





# Pulse – Automotive PBU Products

Inverters, [Circuit Breakers](#), Coils & More



## Power Supplies & Inverter

Power transformer, Chokes, CMC  
Specific inductive components  
(no Catalogue components)



## Circuit Breakers

MCB, MCCB, ACB, Rogowski coils, energy  
transformer, specific design system  
consisting of multiple coils



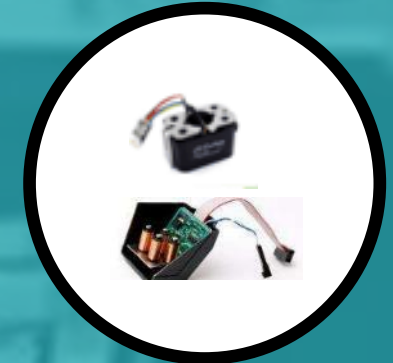
## Motor Coils & Assemblies

Segment coils for internal and external  
rotors & complete Stator / Rotor / Motor  
Assemblies



## Onboard Charger

Customer specific main transformers,  
PFC's, Inductors, CMC's, etc.



## Valve Actuators

Customer specific Valve Actuators



## Drives and Metering industry

Current transformers for devices  
incl. specific housings and design



## Solenoids

Solenoids, with and without armature  
specific design and tools



## Ignition Coils

High voltage ignition coils for  
burner applications



## Cable Systems

For Robotics, Construction machinery,  
Agricultural machinery, Rail vehicles,  
Communal vehicles



## Power Supplies

For Medical equipment, Smart  
Home, Sanitary, Industry

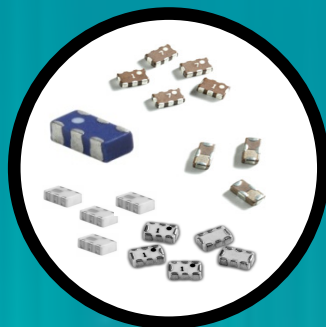


## Antennas of Everything



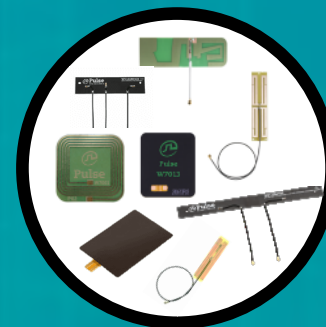
### Embedded

Ceramic, Helical, LDS, Composite, Stamped Metal and FluidANT antennas for effective miniaturization and simplicity.



### IPD RF Components

Filters, Baluns, Couplers and Diplexers to minimize noise and attenuation.



### Internal (FPC/PCB/NFC/WPC)

Pre-optimized performance with common plastic housing. Compact dimensions and adhesive mount. Thin NFC antennas for payment and sharing.



### External/ In-Building

Reliable blade/ stick antennas for routers and cutting-edge design and performance proven DAS antennas for in-building wireless and public-safety.



### Vehicular

Diverse line of outdoor automotive antennas. Ruggedized, tamper-proof and aesthetically pleasing.



### Outdoor

Weather proof portable and fixed outdoor antennas for portable radio and data collecting purposes.



### Cables, Connectors and Mounts

Support NMO and various mounting types with custom cable types and connector selections.



### Engineering and Manufacturing Capabilities

R&D, LDS Manufacturing, Customized RF Design, RF Testing, PTCRB/Approval Testing, Tuning and Matching