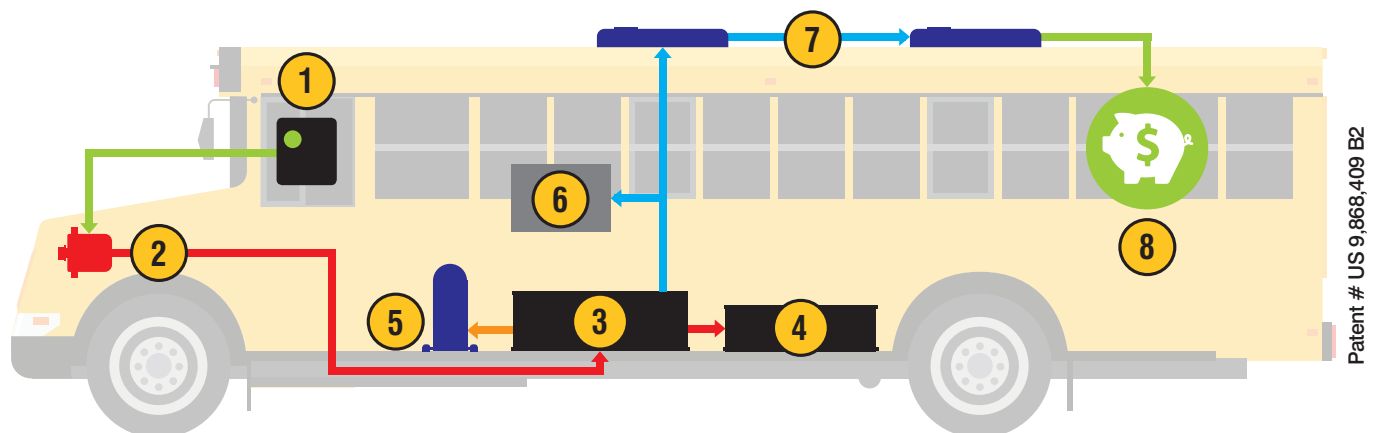




REVOLUTION

ZERO EMISSION IN THE SCHOOL ZONE

Designed for the 12-year life of the school bus, REVOLUTION combines Vanner's proven solid-state power technology with electrical scroll compressor air conditioning to produce an economic and reliable emission reduction system for school bus fleets, without the need for expensive battery charging infrastructure required with battery-electric buses. With its simple one-button operation, REVOLUTION allows the driver full use of the air conditioner, wheelchair lift, and all 12 V accessories with the engine on or off. In addition to the health benefits and the fuel savings, lower maintenance costs can be realized due to the elimination of the belt-driven air conditioner compressors and the under the hood refrigerant lines that crack and leak due to excessive heat and vibration. REVOLUTION's modular design and safe, low-voltage technology allows for efficient servicing by in-house technicians.



REVOLUTION SYSTEM COMPONENTS AND SOLID-STATE POWER FLOW

- | | |
|---|---|
| <ul style="list-style-type: none"> 1 SIMPLE ONE-BUTTON OPERATION 2 9KW / 48VDC BRUSHLESS C.E. NIEHOFF GENERATOR 3 VANNER POWER MODULE (VPM) CONVERTS 48 V TO 220 Vac AND 12 Vdc 4 48V LI-ION AUXILIARY BATTERY FOR MAXIMUM ENGINE-OFF OPERATION TIME 5 SCROLL HERMETIC ELECTRIC COMPRESSOR POWERED BY 220 Vac | <ul style="list-style-type: none"> 6 BUS ACCESSORIES ARE POWERED WITH 12 Vdc WITH ENGINE ON OR ENGINE OFF 7 AIR CONDITIONING COMPONENTS ARE POWERED WITH 12 Vdc WITH ENGINE ON OR ENGINE OFF 8 ELIMINATES SCHOOL ZONE EXHAUST EMISSIONS AND REDUCES MAINTENANCE COSTS WHILE SAVING FUEL AND MONEY |
|---|---|

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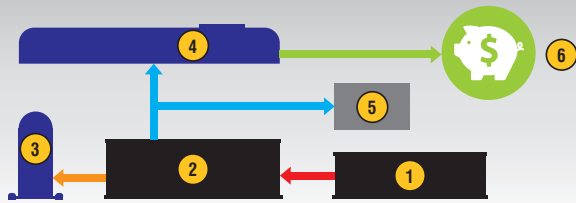
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REVOLUTION OVERVIEW

REVOLUTION'S PATENTED DESIGN GENERATES VARIABLE AC VOLTAGE (208 Vac to 230 Vac) and FREQUENCY (50 Hz to 60 Hz) TO OPERATE THE AIR CONDITIONING IN THE MOST EFFICIENT STATE, WHILE MAXIMIZING PERFORMANCE AND OPERATION TIME WITH THE ENGINE OFF.

ENGINE-OFF MODE



- 1 48 Vdc POWER IS DRAWN FROM THE VANNER BATTERY MODULE (VBM)
- 2 VANNER POWER MODULE (VPM) CONVERTS 48 Vdc POWER TO 220 Vac AND 12 Vdc
- 3 SCROLL ELECTRIC COMPRESSOR IS POWERED BY 220 Vac FROM THE VPM
- 4 ELECTRICAL AIR CONDITIONING CONTROL COMPONENTS ARE POWERED WITH 12 Vdc
- 5 BUS ACCESSORIES ARE POWERED WITH 12 Vdc
- 6 ZERO EMISSION IMPROVES AIR QUALITY, WHILE SAVING FUEL AND MONEY

REVOLUTION FEATURES

- Air conditioning evaporators can be roof, ceiling, or wall mounted
- Air conditioning condensers can be roof or skirt mounted
- Electrical scroll compressor is hermetically sealed and maintenance-free
- 9 kW C.E.Niehoff generator to power air conditioning and recharge auxiliary batteries when driving
- Vanner Power Module (VPM) provides solid-state power conversion, battery charging, and air conditioning power control
- Vanner Battery Module (VBM) is a 48 V / 2k WHr Li-Ion auxiliary battery with built-in BMS

BENEFITS

- Zero emissions in the school zone improves air quality and eliminates engine noise, providing a cleaner, safer environment
- Eliminates the cost of additional infrastructure for battery charging and range anxiety associated with battery-electric buses
- Provides the same accessory electrification as battery-electric buses at a fraction of the cost
- Idle reduction and engine-off operation reduces maintenance costs and fuel usage
- One-button operation and system status indicators makes operation simple and easy
- Lower engine hours reduces maintenance downtime, extends maintenance intervals, and prolongs engine life
- Revolution power components are designed for maintenance-free operation for the 12-year life of the bus

SAFETY

- OEM alternator, starter, and battery are not modified. Vehicle can be driven if Revolution system is inoperable.
- If there is a breakdown, pupils can remain on the bus comfortably in hot weather for up to an hour with engine-off function
- Low voltage DC system, allows school district mechanics to work on vehicle without special high-voltage training

OVER 3,500 ELECTRIFIED DIESEL, BATTERY-ELECTRIC, AND FUEL CELL SYSTEMS IN DAILY OPERATION SINCE 2012

Vanner has been recognized as an accessory electrification and power management leader in the bus and coach industry for more than 40 years. We commercialized accessory electrification with the legendary Hybrid Beltless Alternator (air-cooled solid-state converter) for hybrids, battery and fuel cell buses and coaches, as well as our Increased Accessory Power II (IAP II) – a total accessory electrification system for the Allison H 40/50 EP Hybrid. What's more, since 2012 more than 3,500 diesel, hybrid, and fuel cell buses in operation have been electrified using Vanner's products. It's your move. Go with a proven leader. Go with Vanner!



C.E. Niehoff & Co.
CHARGING AND POWER MANAGEMENT SYSTEMS

Vanner is proud to partner with C.E. Niehoff to provide rugged and reliable power for the Revolution System. The Revolution generator is available from Vanner or your local C.E. Niehoff alternator distributor.

**JOIN THE REVOLUTION TO REDUCE HARMFUL SCHOOL ZONE EMISSIONS
FOR MORE INFORMATION, VISIT REVOLUTIONBUS.COM TO LEARN MORE**

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Product designs and specifications described in this literature are subject to change without notice.



Patent # US 9,868,409 B2