High Voltage DC-DC Converter

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Introduction

Thank you for purchasing Vanner’s High Voltage DC-DC Converter. We are confident that you will be very pleased with its performance because Vanner products are designed and manufactured by skilled professionals using the highest standards in workmanship. With minimum maintenance and care, you can be assured of many years of trouble free service.

General Description

The Vanner High Voltage DC-DC Converter (commonly referred to as HBA in this document) is an efficient and highly reliable method of converting high dc voltage present in hybrid drive systems to low dc voltage (24V) for auxiliary batteries and loads. The converter is designed to be a direct replacement for a belt driven alternator to increase reliability and reduce maintenance costs.

The converter is J1939 CAN (Controller Area Network) enabled and is fully configurable and controllable over a J1939 compliant network but is also capable of autonomous operation. The converter is designed to monitor and report the status of several critical functions and provides real-time fault signals over the CAN bus to the vehicle electrical system controller.

A typical system includes a high voltage energy source (500 – 780VDC), a Vanner HBA and a low voltage battery bank for auxiliary loads. The HBA is provisioned with a two pin sealed connector for integration into the vehicle’s high voltage interlock system and a fourteen pin sealed circular connector for CAN and vehicle I/O.

Paralleling: The outputs of two HBA’s may be connected in parallel to double the output capacity of the 24V charging system. The model numbers for dual configuration are HBA400-28-CAN-DUAL and HBA500-28-CAN-DUAL.
## Specifications

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<td><strong>Weight (lbs.)</strong></td>
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</table>
Dimensional Specifications
(All Dimensions are in Inches)
Operation

Converter Start Up/Normal Operation

In order for the HBA to start successfully, the following conditions must be met;

1. The low voltage battery shall be between 16 – 32 VDC.
2. The high voltage battery shall be between 500 – 800 VDC.
3. The converter shall receive a 24V enable signal. For example, the 24V signal may come from the engine oil pressure switch.
4. Upon starting the ICE (Internal Combustion Engine), the converter shall receive an engine RPM message via the CAN Bus. The engine speed must be equal to or greater than 400 RPM for 0.1 seconds. (The converter will shut down if the engine speed is less than 350 RPM for 4.0 seconds or there is a loss of the 24V enable signal.)

Note: An optional “CAN Bus ON/OFF Command” configuration is available. See “Detailed CAN Specification” section.

Normal Operation

The HBA can provide up to full rated output (250 or 300 amps) of continuous current and maintain 29 volts out across a DC input range of 550 – 800 volts. It can maintain this output in ambient temperature conditions of -40° to +60°C.

HV Battery Under Voltage Condition – 250A Unit

The DC to DC converter will begin to current limit if the input voltage drops below 550V. It will current limit linearly from 250A – 0A between 550V and 500V. The converter will shut down completely if the input voltage drops below 500V. Once the input voltage is equal to or greater than 550V, the converter will restart automatically.

HV Battery Under Voltage Condition – 300A Unit

The DC to DC converter will begin to current limit if the input voltage drops below 600 volts. It will current limit linearly from 300A – 250A between 600V and 550V. The converter will continue to current limit linearly from 250A – 0A between 550V and 500V. The converter will shut down completely if the input voltage drops below 500 volts. Once the input voltage is equal to or greater than 550V, the converter will restart automatically.

HV Battery Over Voltage Condition

The DC to DC converter will perform a soft shutdown if the input voltage is above 800V and below 850V. It will restart automatically once the input voltage drops below 750V.

If the input voltage exceeds 850V, the converter will “permanently” shutdown. The unit will not restart automatically if the input voltage drops below 750V, the ignition switch must be cycled off and on. (Note: An optional “CAN Bus ON/OFF Command” configuration is available but is currently disabled. See “Detailed CAN Specification” section.)

LV Battery Conditions

The low voltage battery must be greater than 16V but less than 32V for the HBA to start.

If the low voltage battery drops below 15V or goes above 32V, the HBA will perform a soft shutdown. The converter will restart automatically if the voltage returns to the normal operating range of 16 – 32V.
Overload Condition
The HBA is current limited to its rated output current (250 or 300 amps). If the load is above rated current, the output voltage will be reduced to 20V. If the load continues to increase and the output voltage drops below 20V, the output voltage will be clamped at 15V with a maximum output current of 90A. (Note: The output voltage is reduced from 29V gradually to 20V if the load continues to increase.)

Output Short Circuit Protection
There are three ways that the output of the HBA is protected from short circuits.
1. The output current increment is monitored and if the rate is above 10A / 100µs, the converter will perform a soft shutdown.
2. A comparator will generate an over-current signal if the current in the high voltage side of the transformer reaches 70A. The converter software will detect this signal and the converter will perform a soft shutdown.
3. Hardware will detect an over current condition. Once the current in the high voltage side of the transformer reaches 90A, the converter will perform a soft shutdown.

The converter will automatically restart upon removal of the fault condition.

Thermal Protection
The temperatures of critical components within the HBA are continuously monitored. The highest temperature of these components will be used for temperature control.

During light load conditions (less than 80% of nominal current) the cooling fan will be turned on at 75°C and turned off at 70°C.

During high load conditions (greater than 80% of nominal current) the cooling fan will be turned on at 70°C and turned off at 65°C.

The HBA will shut down if any of the following conditions exist:
• temperature on the low voltage power stage reaches 82°C, or
• * temperature on the high voltage power stage reaches 98°C, or
• * temperature on the control board reaches 98°C

The HBA will restart automatically if all of the following conditions exist:
• temperature on the low voltage power stage drops below 78°C, and
• temperature on the high voltage power stage drops below 92°C, and
• temperature on the control board drops below 92°C

* The output of the converter will current limit if the temperature on the high voltage power stage and control board is below 98°C but above 92 degree C. The output current will be incrementally reduced to avoid thermal shutdown conditions.
Installation Instructions

These symbols are used to note procedures that if not closely followed could lead to loss of life or damage to equipment or property due to electrocution.

⚠️ Electrocution hazard exists

🔥 Fire hazard exists

⚠️ A potentially dangerous condition

💥 Explosive hazard exists

警告 Corrosive hazard exists

⚠️ **Do not exceed the specified torque of 100 lb-in** when connecting cables to the terminal posts (±24 and ±600V) during installation of the HBA. Torque values higher than specified may damage the product, reduce performance, and/or create hazardous conditions. Products damaged by improper torque are not covered by the warranty.

⚠️ **Do not connect more than one conductor per terminal post on Vanner HBA.** Multiple wires and cables may overstress internal components, resulting in poor performance or creating hazardous conditions. Products damaged by the installation of multiple conductors per post are not covered by the warranty.

⚠️ ⚠️ ⚠️ **Fault protection devices must be installed between the HBA and the power source (battery).** A fault protection device would be any fuse or circuit breaker properly rated for the maximum DC current obtainable. This advisory is in accordance with SAE, NEC and UL, for mobile power applications. Install per applicable codes or within 18" of the battery. See Wire and Fuse Sizing Chart on page 13 of this manual or contact Vanner at 1-800-227-6937 or pwrsales@vanner.com if assistance is needed in sizing fault protection devices.

⚠️ ⚠️ ⚠️ ⚠️ **Caution:** This equipment tends to produce arcs and sparks during installation. To prevent fire or explosion, compartments containing batteries or flammable materials must be properly ventilated. Safety goggles should always be worn when working near batteries.

⚠️ **Mounting Location** –The HBA must be mounted on a flat horizontal surface suitable for support during application. The HBA must be mounted under a cover to protect it from direct exposure to the elements, i.e., rain, sun, sleet/snow. Do not mount in a zero-clearance compartment that may result in overheating. Care should also be taken when selecting a mounting location to ensure the fan inlet and outlet locations are not blocked. A minimum of four inches should be allowed at fan inlet and outlet. Locate the HBA so that contact by unauthorized personnel is unlikely.
Mounting Dimensions
(Bottom View – Dimensions are in Inches)

Environmental Protection
Although your HBA has been designed to an IP55 rating, it must be mounted under a cover to protect it from direct exposure to environmental elements such as sun, rain, sleet and snow. The converter has also been designed for exposure to direct pressure spray, but continual exposure to direct pressure spray may reduce the serviceable life. Any damage due to water contamination is covered by Vanner only through the terms of our factory warranty.

Wiring Sequence
High Voltage Input: The HBA’s high voltage input is internally protected for reverse polarity.

Low Voltage Output: The HBA will be damaged if the low voltage output cables are terminated backwards. To protect the positive cable, it shall be fused as close to the battery as practical.
Wiring Input/Output Definitions

High Voltage Lug Box

CAN and Ignition I/O
See Wiring Diagram for Pin Designations

Low Voltage Output Terminals

Low Voltage Output Terminal Designations
High Voltage Input and Interlock Designations

High Voltage Lug Box Provisioned with a 1.85" Diameter Hole for a Threaded Connector, PG-36 Size Threads

HVIL Connector (High Voltage Interlock) Molex Panel Mounted Plug, Part #19429-0033 Mates with Molex Receptacle, Part #19418-0007 and Molex 14-16 AWG Socket, Part #19420-0009

Limit Switch for HVIL, Detects When Cover has Been Removed
HBA Wiring Diagram w/Vanner 70 Series Equalizer

[Diagram showing the wiring connections for a high voltage DC-DC converter with Vanner 70 Series Equalizer]
I/O Definitions and Functionality (Pins E through P are Optional)

A. **+24V Enable Input**
   This input “wakes up” the HBA.

B. **CAN Shield**
   This connection is used to make the shield on the CAN cable common. This is required for electrical noise considerations in vehicle electrical systems.

C. **CAN Low**
   This is the low signal connection for the vehicle’s CAN bus. The HBA will communicate faults to the vehicle’s electrical system controller via the CAN bus.

D. **CAN High**
   This is the high signal connection for the vehicle’s CAN bus. The HBA will communicate faults to the vehicle’s electrical system controller via the CAN bus.

E through P - TBD

**Note:** The HBA I/O is a panel mounted Deutsch connector P/N: HDP24-18-14PN. The mating connector is Deutsch P/N: HDP26-18-14SN with Deutsch P/N: 1062-16-0622 socket contacts.
### Wire Size and Temperature Rating

Cables connecting the HBA to the low voltage batteries must be sufficiently sized to prevent unwanted voltage drops. The temperature rating of the wire should be a minimum of 90ºC.

Vanner recommends the following wire and fuse sizes for the 250A and 300A HBA's. To protect the positive cable, it shall be fused as close to the battery as practical.

**HBA Low Voltage Output Wire and Fuse Size Chart**

<table>
<thead>
<tr>
<th>Wire Size AWG</th>
<th>Ring Terminal Panduit</th>
<th>Fuse F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>#4/0</td>
<td>*LCD4 0-56000-CUST</td>
<td>400 amp</td>
</tr>
</tbody>
</table>

* The Panduit part number recommended is a right angle terminal that enables the installer to route the 4/0 cable along the side of the HBA. Factory installed tie wrap bases are present on the side of the HBA for strain relief.

Crimp the ring terminals using Panduit CT-930 manual/hydraulic crimping tool.  
Use Panduit die CD-920-4/0 die. (Purple P54).  
Panduit Customer Service Center: 800-777-3300 or 708-532-1800
Testing and Troubleshooting

CAUTION

Servicing of electrical systems should only be performed by trained and qualified technical personnel.

Equipment Required

VoltMeter having 0.01 volt resolution. (Fluke Model 87 Multimeter recommended).
Clamp-on current meter (Fluke Model 36 Clamp-on Meter recommended).
Optional; Vanner laptop provisioned with Vanner Dashboard software
USB to CAN adapter module. (PEAK System’s PCAN-USB IPEH-002021)

Note: There are two kits available for purchase from Vanner that include the Dashboard software,
USB to CAN adapter module and a harness to connect to the vehicle. The Vanner part numbers for
the kits are VANN-BUS SMK-1939 and VANN-BUS SMK-DP. The vehicle harness in the 1939 kit has
a standard three position J1939 Deutsch connector. The vehicle harness in the DP kit has a nine
position circular Deutsch connector that mates with the vehicles diagnostic port connector.

Test Procedure for HBA

The HBA is working properly if:
1. The 24 volt DC loads are being operated continuously and are within the rated capacity of the
   HBA and;
2. The power drawn from the high voltage battery is within its rated capacity.

HBA Test Procedure:

1. Field-test the HBA while fully connected to the vehicle high and low voltage batteries.
2. The low voltage battery must measure between 16 and 32 volts. If the low voltage battery is below
   16 volts, apply a 24 volt battery charger to the batteries.
3. The high voltage battery must measure between 500 and 780 volts for the HBA to start properly.
4. Start the vehicle normally while monitoring the HBA status with a laptop provisioned with Vanner’s
   Dashboard software. The laptop must be connected to the vehicle CAN Bus utilizing a USB to CAN
   adapter module. Reference PEAK System’s PCAN-USB IPEH-002021.
5. The HBA will turn on automatically upon receiving the engine RPM signal or CAN On/Off command
   via the CAN bus and a +24V enable signal. For engine RPM, the engine speed must be equal to or
   greater than 400 RPM for 0.1 seconds. (The converter will shut down if the engine speed is less than
   350 RPM for 4.0 seconds or there is a loss of the enable signal.)
6. The Vanner Dashboard software monitors the following data which can be observed on the laptop;
   High Input Voltage  High Input Current  Low Output Voltage  Low Output Current
   Engine RPM  Heartbeat  Power Stage Temps.  Control Board Temp
7. Upon normal system startup, the output voltage will increase to 28.5 volts and the output current will increase indicating charging of the low voltage batteries and providing power for auxiliary loads. (See screen snapshot below of a system under normal operating conditions.)

8. If the Vanner Dashboard software isn’t utilized or available, proper start up can be validated by measuring the low voltage output terminals with a Voltmeter. Upon start up, the voltage will increase from the low voltage battery nominal value up to \( \approx 28.5 \) volts. **Note:** The measurement is dependent on the voltage drop in the cables/bolted connections between the HBA output terminals and the battery terminals.

9. A clamp on style current meter can be used to validate the output current of the HBA.

10. The high voltage terminals are inaccessible for measurement. A high voltage interlock circuit is implemented for safety purposes to prevent an accidental and potentially lethal shock to personnel. The high voltage input to the HBA can only be read via the Dashboard software.
Trouble Shooting an HBA No-Start Situation

In the event the Vanner HBA does not start, the following need to be reviewed/validated:

1. Is the high voltage battery within the acceptable input range? 550 - 780VDC
2. Is the low voltage battery within the acceptable range? 20 – 32VDC
3. Is low voltage present at the output terminals of the HBA upon closing the battery disconnect switch?
4. If not, verify fuse F3 is installed and hasn’t cleared.
5. Upon startup of the engine, does the low voltage battery remain within the acceptable range? If the health of the low voltage batteries is questionable, the voltage may collapse below 20 volts before the HBA starts. There is an approximate 2 - 3 second delay from the time the engine starts to the start of the HBA.
6. Is the enable signal present? +24VDC
7. If the enable signal is present, is the wire in the proper location of the mating I/O connector?
8. Is the engine rpm data being transmitted properly via the CAN Bus? PGN 61444
9. Is the engine rpm greater than 400 rpm?
10. If the answers to 5 and 6 are yes, are the CAN signal wires (HI, LO and Shield) in the proper locations of the mating connector?

HBA Status and Fault Indication Definitions

The HBA monitors several status and fault conditions. If any faults occur, they are reported via CAN bus and can be observed with the Dashboard software. Referencing the screenshot on page 16, the HBA status and fault indications and their definitions are as follows;

**DC/DC Converter ON:** Green indication that HBA has turned on successfully

**DC/DC Converter OFF:** Red indication that HBA is off. If the reason is due to a fault, that condition will be indicated by a red icon.

**Engine RPM/ Low or CAN Data Loss:** The HBA will perform a soft shutdown if the engine speed drops below 350 RPM for four seconds or there is a loss of CAN communication. The HBA will restart automatically when the engine speed exceeds 400 RPM for 0.1 seconds or CAN communication is restored.

**HVPS (High Voltage Power Stage) Imbalance Fault:** Internal circuitry detects if the voltage differential between the center point to negative and center point to positive is excessive, > 200V. If an imbalance fault is detected, the HBA will “permanently” shut down. The unit will not restart automatically if the imbalance condition clears, the ignition must be cycled off and on. In the event the imbalance fault does not clear after cycling the ignition, the unit should be replaced and the failed unit returned to Vanner for evaluation.

**Over Temperature Fault:** The HBA will perform a soft shutdown if any of the following conditions exist: the temperature on the low voltage power stage reaches 82°C, or the temperature on the high voltage power stage reaches 98°C, or temperature on the control board reaches 98°C. The HBA will restart automatically if all of the following conditions exist: the temperature on the low voltage power stage drops below 78°C, and the temperature on the high voltage power stage drops below 92°C, and the temperature on the control board drops below 92°C

**Input Overvoltage Fault:** The HBA will perform a soft shutdown if the input voltage is above 800V and below 850V. It will restart automatically once the input voltage drops below 750V. If the input voltage exceeds 850V, the converter will “permanently” shut down. The unit will not restart automatically if the input voltage drops below 750V, the ignition switch must be cycled off and on.
HBA Status and Fault Indications Cont’d

**Input Under Voltage Fault:** The HBA will perform a soft shut down if the input voltage drops below 500V. Once the input voltage is equal to or greater than 550V, the converter will restart automatically.

**Output Overvoltage Fault:** The HBA will perform a soft shutdown if the low voltage battery exceeds 32V. The HBA will restart automatically if the voltage returns to the normal operating range of 16 - 32V.

**Output Under Voltage Fault:** If the low voltage battery drops below 15V, the HBA will perform a soft shutdown. The converter will restart automatically if the voltage returns to the normal operating range of 16 – 32V.

**Output Overload Fault:** The HBA is current limited to 250A or 300A. If the load is above 250A or 300A, the unit will begin current limiting and gradually reduce the output voltage. Once the HBA output voltage decreases to a value less than or equal to the battery voltage, the batteries will begin to assist in supporting the load. If the load continues to increase and the output voltage drops to 20V, the current will begin to fold back. If the output or battery voltage is reduced to 16V, the HBA will turn off. The HBA will restart automatically if the loads are reduced and the battery voltage returns to the normal operating range of 16 - 32V.

**Over Maximum Current Fault:** The HBA will perform a soft shutdown if the current flowing through an internal power stage current transformer exceeds 90A. The HBA will restart automatically if the current returns to a value below 90A.

**+12V Power Supply Failure Fault:** The HBA will perform a permanent shutdown in the event of a +12V power supply failure. The unit should be replaced and the failed unit returned to Vanner for evaluation.

**LV Gate Drive +12V Failure:** The HBA will perform a permanent shutdown in the event of a LV Gate Drive +12V power supply failure. The unit should be replaced and the failed unit returned to Vanner for evaluation.

**Vanner Repair Service**

Vanner offers a quick turnaround factory repair service. Send the unit to the address on last page with a note instructing us to repair it. Include your name, phone number, shipping address (not a P.O. Box Number), and your purchase order number.
Vann-Bus Battery Management

**Vanner 80 Series Equalizer and Sensors**

A vehicle with 12 and 24 volt loads may be provisioned with the following Vanner parts to permit dynamic voltage regulation of the HBA.

1. **80 Series Equalizer**

   When connected to the I/O of the current and voltage/temperature sensors listed below, the 80 series equalizer utilizes Vanner's MBBM (Model Based Battery Monitoring) algorithm to determine the SOH (State of Health) and SOC (State of Charge) of the 12 and 24 volt batteries.

   The equalizer will communicate the appropriate voltage requirement, based on the battery manufacturers data, to the HBA which will adjust its output accordingly. The voltage requirement communicated to the HBA is based on the voltage at the battery terminals, therefore, voltage drop contributed by the cables and bolted connections is taken into consideration.

   **Note:** The appropriate battery model must be loaded in the equalizer for maximum accuracy of the SOH and SOC calculations. Please contact Vanner for a library of batteries that are modeled to ensure the proper equalizer part number is ordered or the proper battery profile is loaded in memory.

2. **Dual Current Sensor (80A/600A)**

   The dual current sensor, VSS-C80/600, monitors the current flowing into and out of the 24V battery.

3. **Single Current Sensor (80A)**

   The single current sensor, VSS-C80, monitors the current flowing into and out of the 12V battery.

4. **Voltage and Temperature Sensor**

   The voltage and temperature sensor, VSS-VT, monitors the 12V battery voltage as well as the temperature. It is mounted to the positive terminal of the 12V battery.

   See page 21 for the HBA/Equalizer wiring diagram with the addition of the sensors and their pinout definitions.

**Operational Theory**

There are two operating modes for the HBA, standalone and battery management. If battery management is turned off or CAN messages from the equalizer/battery monitor are not received, the HBA defaults to standalone mode and regulates the output voltage locally at a fixed value. **Note:** the factory default is 28.5V but is user configurable via the dashboard interface.

In battery management mode, the output voltage reference is adjusted to regulate the output voltage remotely at the battery. The reference is adjusted at a rate of 0.1V/second. The upper limit of the reference voltage is 1.0V above the standalone output voltage.

If the battery SOC is 100% or the battery status is quiescent, the remote voltage is set to the float voltage value. Otherwise it is set to the absorption voltage value. The float voltage and absorption voltage are adjusted automatically with temperature according to a pre-defined curve.
Enabling Battery Management

Battery management is enabled through Vanner’s dashboard interface. At the HBA startup screen, verify the “Battery Management” status is “On”. If it is off, select the “Set Output Voltage” icon to turn it on.

**Note**: The default factory setting is “On”. Battery Management only works if an 80 series equalizer and sensors are installed.

Note the low voltage battery status information displayed in the lower right corner of the screenshot below. The battery terminal voltage, state of health (SOH), state of charge (SOC) are all displayed as well as the charging modes, Charge/Quiescent/Discharge. Also note the difference in the battery voltage (27.84) and HBA voltage (28.4). This difference (.56V) reflects the voltage drop in the cable/bolted connections between the HBA output terminals and the battery terminals at the indicated load of 125.9 amps.

**Screenshot of HBA Dashboard with Battery Management turned on**
HBA Wiring Diagram w/Addition of Vann-Bus Sensors
Pinouts for 80 Series Equalizer and Vann-Bus Sensors

### Voltage/Temperature Sensor Pinouts (VSS-VT)

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<thead>
<tr>
<th>Sensor Pin #</th>
<th>Description</th>
<th>Equalizer Pin Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+5V Input</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>H</td>
</tr>
<tr>
<td>3</td>
<td>Temperature Sense</td>
<td>L</td>
</tr>
<tr>
<td>4</td>
<td>Fused +12V (From Bus Bar)</td>
<td>N</td>
</tr>
</tbody>
</table>

### 80A Single Current Sensor Pinouts (VSS-C80)

<table>
<thead>
<tr>
<th>Sensor Pin #</th>
<th>Description</th>
<th>Equalizer Pin Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+5V Input</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>H</td>
</tr>
<tr>
<td>3</td>
<td>Current Sense</td>
<td>K</td>
</tr>
<tr>
<td>4</td>
<td>Spare</td>
<td>-</td>
</tr>
</tbody>
</table>

### 80/600A Dual Current Sensor Pinouts (VSS-C80/600)

<table>
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<tr>
<th>Sensor Pin #</th>
<th>Description</th>
<th>Equalizer Pin Letter</th>
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<tbody>
<tr>
<td>1</td>
<td>+5V Input</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
<td>H</td>
</tr>
<tr>
<td>3</td>
<td>Current Sense, Low</td>
<td>J</td>
</tr>
<tr>
<td>4</td>
<td>Current Sense, High</td>
<td>G</td>
</tr>
</tbody>
</table>
Dual HBA's - General Description

Paralleling Two HBA's

Two versions of HBA's, HBA400-28-CAN-DUAL and HBA500-28-CAN-DUAL, have been developed to load share when the outputs are connected in parallel. Two HBA400-28-CAN-DUAL HBA's connected in parallel provide 500A of 28V charging current and two HBA500-28-CAN-DUAL HBA's connected in parallel provide 600A of 28V charging current.

When connected in parallel, one unit is designated as the "Primary" (Master) unit and the other as "Secondary" (Slave) by installing external jumpers in the circular I/O connector. To designate a unit as the Primary, install a jumper between pins "M" and "N". To designate a unit as the Secondary, install a jumper between pins "A" and "N". (See wiring diagram on next page.)

The two units communicate with each other via the vehicle CAN network with the Primary unit providing voltage and control loop logic information for the Secondary unit. Any imbalances introduced to the system, i.e. rapid load changes, are automatically compensated for to ensure equal load sharing.

System Response to Vann-Bus Dynamic Voltage Regulation

If the 28V batteries are in a discharged state, the output voltage of the Primary unit will increase to a value prescribed by the battery monitoring software. Since its reference voltage will be higher than the Secondary unit, it will provide the majority of the load. The Primary unit will request a higher output voltage from the Secondary unit causing its output voltage to increase at a rate of 10mV/s. Once the voltage differential between the two units is approximately ≤ 0.5V, the Secondary unit will begin to provide more current. Once the voltage differential is approximately ≤ 0.1V, the units will load share evenly.

After the batteries reach a quiescent state, the output voltage of the Primary unit will reduce to a value prescribed by the battery monitoring software. Since the reference voltage of the Secondary will be higher, it will provide the majority of the current. The output voltage of the Secondary unit will begin to reduce at a rate of 10mV/s. Once the voltage differential is approximately ≤ 0.1V, the units will load share evenly.

Note: The maximum and minimum output voltages of the HBA's can be set via Vanner's Dashboard Interface Software.

System Response to a Failed Converter, Fault Condition or Loss of +24V Enable Signal

If either unit shuts down due to a failure, fault condition or loss of +24V enable signal, the operational unit will remain on and provide current up to 250A or 300A. If the load is above 250A or 300A, the operational unit will begin current limiting and gradually reduce the output voltage. Once the HBA output voltage decreases to a value less than or equal to the battery voltage, the batteries will begin to assist in supporting the load. If the load continues to increase and the output voltage drops to 20V, the current will begin to fold back. If the output voltage is reduced to 16V, the HBA will turn off.

If certain fault conditions clear or the +24V enable signal is restored, the HBA will restart automatically.

Note: Some fault conditions, once cleared, require cycling the ignition/+24V enable signal before the HBA will restart.

System Response to Loss of CAN Communication

If either unit loses CAN communication both will continue to run, however, their voltage and current loop controls will function independently of each other. Once CAN communication is restored, voltage and control loop controls will be maintained by the Primary unit.
CAN Bus Specification

High Voltage DC/DC Converter CAN Communication Specification

A comprehensive CAN communication specification is available for the HBA. Please contact Vanner's engineering department to ensure you have the latest revision.