Imperium ™ Products
“Power to Command”

High Voltage / High Current Connector Systems
Imperium Connector Overview

› Target Amperage Rating
  – 230A to 400A “continuous” at 70 C
  – Actual ratings influenced by application and duty cycle
    • 8mm pin size, 1/0 wire
    • 11mm pin size, 3/0 wire

› Sealed and Shielded
  – IP6K9K Mated

› Voltage rating
  – 1000 VDC

SERIES:
171466-1*** Cable Harness (Single Ended)
171466-2*** Cable Harness (Double Ended)
171467-**** Bulkhead Mount Header Assembly
171466-9*** Cable Harness Component Kit

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High Voltage Battery Packs
- Integrated Interlock Signal
- Double-Locking Safety Latch
- Integrated Interlock Signal
- 11mm pin size, 400A
- 8mm pin size, 250A

High-Power Inverters
- High Voltage 2-terminal Input Current
- Motor Phase Current (3-terminal version)

DC-DC Converters
- 2-terminal input current
- MAXLOC single-terminal output

Motor Phase Lead Connections

Harness Assemblies
- Molex supplies flexible & shielded interconnecting harnesses with Imperium or MAXLOC connectors
Innovative bulkhead header shield termination for lowest possible shield impedance.

Fully shielded power contacts from cable to bulkhead.

Insert molded header for robust contact retention and sealing.

Bus bar mount from back of header.

Perimeter seal mounts directly to bulkhead reducing potential for tearing.
Molex Advantages - Header Seal Design

- Exposed shield – potential for corrosion
- Potential water penetration when using sheet metal
- Additional shield Assy required during mfg
- Must attach bus bar horizontally
- Tight machine tolerances – difficult to manufacture
- Potential for seal rolling/pinching during insertion

Competitor

Molex
Imperium™ Terminals

- Unique single piece contact design
  - No moving parts
  - High long term reliability
- Large cross section
- Pure copper for high conductivity
- Contact resistance in the 50 micro Ω range
- Robust hex crimped or vibration welded to wire
- Silver plated and lubed
- Anti overstress spring to maintain normal force
- Low cost since not machined
- Busbar attachable
Imperium™ Terminals

- Flexible terminal geometry
- Can be integrated into a variety of housing styles and applications.
- Pluggable gland design with our MAXLOC product.
- Molex can modify geometry to match application.
- Terminals available in 8mm and 11mm pin diameter today but scalable to other sizes as well.
- Also developing a high cycle hyperboloidal version for 3K to 5K insertion cycles.

Female cable bolt-on

Female bolt-down to busbar

Male Crimp

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Imperium™ Terminals

- High Cycle/Low mating force version in development
- Mating cycles in the thousands
- Designed to mate with Imperium male
- 32 wire contact hyperboloid contact
- 8mm diameter up to 230A at 70C
- Excellent for High Shock/Vibe
- 11 Newton mating force per contact
- Planned terminal diameter families
  - 4-5 mm 80-100A
  - 6 mm 150A
  - 8.0 mm 200-250A
  - 11.0 mm 400A
  - Up to 14 mm 500A

Female High-Cycle Low-Insertion-Force

Example Hyperboloid terminal

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Features

- Connects cable shield to enclosure
- Mounts from outside of enclosure
- Shield Ring held tight by grommet
- Sealed IP67 & IP69K & IP68
- Strain relief
- 1 AWG, 1/0 to 4/0 cable
- Die cast construction
- Cost effective
- Nickel plated to address galling
- Positive stop for compression nut
- Center and offset lug pull thru
- Multi-hole grommets can be used for multi-conductor cable for smaller wire sizes.
- 2 grommet material choices.

Benefits

- Shields EMI/RFI
- Easy to assemble onto cable
- Fast installation on the assy. line
- Sealing allows use in wide variety of applications.
- Single foot print for multiple cables.
- Low cost - high performance
- Anti back-off of compression nut.
- Allows lugs to be pulled through body
Imperium Pluggable MAXLOC

- Fully sealed and shielded pass through, just like MAXLOC Plus, except it’s a connector!
- New type of pluggable connector
  - Uses Imperium pin and socket
    - Replaces battery lug
    - Available with Hyperboloid H-C/L-I-F terminal
- Supports 1 AWG - 3/0 shielded wire

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Imperium Pluggable MAXLOC

Crimped Barrel or Ultra-Sonic Welding for Plug to Cable

Cross Section

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Multi-MAXLOC Mounting Options
Power-Module Application

- Imperium Receptacle:
  - Attach female contact to bus bar or IGBT module
  - Mates using either Imperium Connector or MAXLOC design

- Mating Harness:
  - Pluggable MAXLOC or Imperium connector attached to cable.
Features:

- Uses a cost effective pass-through for large wire applications, 1awg-4/0
- Amp rating up to 400 amp continuous, 500 amp intermittent.
- Ease of manufacturing
  - "Permanent" pluggable solution
  - Assembly does not require second access door to connect power contact
  - Does not require HVIL on connector due to bolted design
    - HVIL could be integrated into device, via secondary access panel
    - Similar solution as most electric motors
Imperium™ Product Options

- 3 circuit Wire to Bulkhead
- 2 and 3 circuit Wire to Wire
- Right angle wire exit
  - With mate assist
- 1 AWG wire version
- 100 to 200 amps
  - 4AWG to OAWG
- 300 to 400 amps
  - 2/0 to 4/0
- Versions without shielding, sealing

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Custom Applications - Sensors

- MAXLOC pluggable
- 11mm diameter Imperium™ male
- Bolt down female terminal
- Custom housing with integrated current sensor
- Mounts onto IGBT bus bar
- Multiple terminal designs possible
- Uses MAXLOC cable gland
Target Markets & Applications

› Electric Vehicle (EV)/Hybrid Vehicle (HV)/Plug in hybrid (PHEV)
  – Toyota Prius, Nissan Leaf, Tesla, Fisker, Siemens, Renault, Bosch

› Agriculture and Construction Equipment
  – John Deere, CAT, Case New Holland, AGCO, Fendt, Parker Hannifin
  – Custom Imperium solutions targeted in this space due to inverter size

› Medium Duty and Heavy Duty Commercial Vehicles
  – Smith Electric, SEVCON, Navistar, Allison Transmission, ZF Hybrid Transmission, BAE, JCI, Eaton, Cummins, Paccar (Peterbuilt), etc.

› Hybrid Bus Applications
  – New Flyer, Novabus (Volvo), Gilig, Allison Transmission, BAE

› Military Applications
  – Oshkosh, Raytheon, Saft, BAE

› Recreational Vehicles
  – Polaris, Seadoo (BRP)
Next Gen Inverter Applications
Tractor-to-Implement Applications

- High Current
- Low Voltage (56V)
- 150A and 300A versions
- Makes use of e-Power instead of hydraulics
- Can utilize Imperium base contact set.
New Flyer, Novabus and BAE Systems build hybrid buses

Allison transmission & ZF build hybrid drivetrains
CV Hybrid Utility Applications

Odyne/JCI builds hybrid utility vehicles

Odyne Systems of Waukesha awarded plug-in hybrid system contract

Odyne Systems of Waukesha has received a contract to supply its plug-in hybrid system technology to about 120 large plug-in hybrid trucks to utilities under a $45 million contract with the research arm of the utility industry.

The Electric Power Research Institute in Palo Alto, Calif., awarded the funding to Odyne as part of a federal Department of Energy initiative supporting electric vehicle commercialization. The South Coast Air Quality Management District in southern California is also a partner in the project.

Johnson Controls’ power solutions business, based in Glendale, said it will supply advanced lithium-ion batteries for the Odyne system.

The contract marks a "significant" step toward high-volume production of hybrid systems that are built onto the chassis of a diesel utility truck, said Joe Dalum, president of Odyne.

A ComEd digger derrick truck is shown plugged into an Odyne Systems hybrid power system. Courtesy of Odyne Systems of Waukesha, June 6, 2013.
Molex can build and assemble complete harness/connector systems in a variety of styles.

Crimp Tooling for Lugs & Terminals is in our Juarez plant now.

Ultra-Sonic welding
- Working on new terminal now with multiple vendors.
- Most reliable connection available.
- Low cost.
- Molex will offer this option.
Imperium™ Cable Assembly Steps

- Prepare cable - Strip/Retain and cut (A)
- Insert Top Cover onto cable (B)
- Insert Cable seal onto cable (C)
- Insert Shield inner and outer ferrule onto cable and seat them with shield ferrule terminator tool. (D and E)
- Crimp Terminal (F)
- Insert terminated cable into receptacle subassembly (X2). (G)
- Seat Top Cover onto receptacle subassembly. (X2) (H)
Molex will offer application tooling to support assembly.

PPHHLS -19286-1000
- $6000.00 USD per unit
- 6 weeks leadtime

Bench Mount 19286-0051
- $1400.00 USD per unit
- 6 weeks leadtime

Crimp Dieset- 19290-0080 for 1/0 and 19290-0100 for 1 awg
- $700.00 USD per unit
- 6 weeks leadtime

Shield Ferrule Terminator 62203-0600
- $6000 to $8000 estimated cost.
- 6 to 8 week leadtime.
Potential Bus Bar Applications

- Molex Laminated Bus Bars
  - Reduce Weight and Space
  - Increase Reliability & Endurance
  - Form Factor (TM, Stiffening, Mount Platform)
  - Reduce Noise
  - Provide Interconnect Flexibility
  - Enhance Appearance and Environmental Compliance
**Potential Bus Bar Applications**

**Energy Management**

- Solar Energy Systems
- Wind Generators
- Fuel Cells
- Hydro-Electric
- Turbine Generators
- AC to DC Converters
- DC to AC Inverters
- DC to DC Converters
Thank You
Additional Information
Initial testing, based on Champlain FX 1/0 cable rating based on T-rise testing.
Terminal Temperature Rise

Imperium - Temperature Profile - Group 1 Samples

Absolute Temperature (°C)

Grp#_Sample#_Ckt#
- 1_1_1
- 1_1_2
- 1_2_1

Initial Screen testing, based on Champlain FX 1/0 cable

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Terminal Voltage Drop

Imperium 2-Ckt. Sealed Connector, 1/0 AWG Wire, Voltage Drop Vs. Current

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Contact Stability Screen Test

Imperium 2-Circuit Sealed Connector - 18-Day Voltage Drop at 250 Amps

- Steady State
- 96 Hours
- Current Cycling
- 167 Cycles (10 Days)
- 60 minutes On, 30 Minutes Off
- Steady State
- 96 Hours

Initial Screen testing, based on Champlain FX 1/0 cable

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