Amphenol® High Performance Line Replaceable Module (LRM) Interconnects

12-037

Amphenol solves board mount connector requirements by offering their LRM Line Replaceable Module Interconnects with the widest design flexibility - combinations of module and backplane inserts - thousands of combinations are possible, tailored to meet customer needs.

Amphenol provides the high level of design versatility that engineers need for board level interconnects in avionics. High speed integrated circuitry with increased contact density demands this flexibility. Amphenol lives up to its reputation for leading in innovative solutions.

LRM interconnects can be designed in One Bay ... Two Bay ... Three Bay ... or more configurations with many shell designs available.

The B3 Brush contact is the standard contact for the LRM due to its low mating force, stable electrical performance and extended service life. Standard “symmetrical” arrangements consist of contact counts of 80 ... or 108 ... or 152 ... or 180 within each insert.

Staggered grid patterns, or more compact GEN-X patterns, are used to fill the insert cavities with brush contacts. A multitude of LRM designs are possible with the use of other configurations of brush contact inserts.

Design flexibility is expanded even more with the ability to add combinations of other types of contacts: power, high speed coax, triax, differential pairs, and quadratic contacts, fiber optic MT ferrules, high speed differential pairs, or high power RADSOK® sockets. Flex circuit terminations are also available.

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Amphenol Corporation
Amphenol Aerospace
40-60 Delaware Avenue, Sidney, New York 13838-1395
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Website: www.amphenol-aerospace.com

For High Speed, Reliable Data Transfer
Amphenol® High Performance Line Replaceable Module (LRM) Interconnects

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Amphenol LRM Interconnect Solutions

Amphenol® LRM Surface Mount Connectors meet the high density needs of today’s integrated electronic modules. Amphenol goes beyond the usual board level product offering; and that is what you would expect from a worldwide interconnect product leader. Design versatility and product reliability makes Amphenol the premier choice for the system designer in solving board interconnect requirements.

Amphenol Ruggedized VME64x Connectors

Amphenol has designed a ruggedized VME64x connector that supersedes the standard VME64x. Metal shells, ESD protection and a robust contact system makes this a superior choice for harsh environments requiring Level 2 (Fight) line maintenance.

Module and Backplane Connectors with Power and Brush Contacts, High Speed Shielded Contacts, Fiber Optics and Flex Circuitry. Plus Ruggedized VME64x Interconnects.

Amphenol Backplane Capabilities

Amphenol Backplanes incorporate a wide range of interconnects. LRM surface mount connectors with brush contacts or combinations of brush, coax, and fiber optics can be integrated into a backplane. SEM-E and custom form factors are available.

For further information, contact Amphenol Aerospace by phone at 800-678-0141 or 607-563-5811, or visit our website, www.amphenol-airlbs.com.
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Amphenol® Line Replaceable Module (LRM) Interconnects

**Modular Avionics Architectural Possibilities and Advantages offered by Amphenol Aerospace:**

- LRM Surface Mount Connectors featuring the Amphenol Bristle® Brush® contact technology.

- Amphenol’s LRM connector family offers the versatility to facilitate custom combinations of digital, fiber optics, RF, power and special high speed inserts to meet individual customer requirements.

- Staggered Grid LRM
  - Staggered grid Airflow-thru LRM - allow for wider board packages and airflow cooling
  - GEN-X LRM - for extreme densities of brush contacts
  - Ruggedized VME64x Interconnects

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LRM Surface Mount Connectors
featuring the B³ Bristle® Brush® contact

The LRM connector series are high performance, high density interconnects, specifically designed to connect printed circuit boards. The Amphenol Brush or B³ contact technology is the foundation of the LRM connector series.

Features, benefits and options of LRM connectors with B³ brush contacts include:

• GEN-X contact pattern - has .075 inch spacing along the row with .060 inch between rows, offset .0375 inch between rows on the mating face.
• Staggered grid contact pattern - has .100 inch spacing along the row with .050 inch between rows, offset .050 inch between rows on the mating face.
• Staggered grid Airflow-thru contact pattern - for wider or oversized board packages between 0.235 and 0.425 inches. Wider spacing in center also provides for more airflow cooling of the connector inserts.
• Backplane design versatility:
  • Available with through-hole solder posts or with compliant pins for solderless applications
  • Compliant/solderless backplane contacts are front replaceable
• ESD Protection - Staggered grid and GEN-X LRM connectors are typically provided with ESD (Electrostatic Discharge) protection. They utilize the Faraday Cage principal to shunt electrostatic discharge events to the conductive enclosure on which the connector is mounted, thus never allowing the high voltage, high current discharge event to reside on any contacts. See page 20 for more information on ESD protection.
• Wide range of PCB/heat sink accomodations with standard surface mount tails or optional flex-circuit termination
• Polarization keys - up to 4096 possible keying positions
• Vibration: Superior intermittancy-free performance under vibration
• Dielectric withstanding voltage: Staggered grid and GEN-X styles: 100 volts at sea level (due to the incorporation of ESD shield)
• Temperature range:
  • Suitable for vapor phase soldering
  • Normal operating temperature is –65°C to +125°C
• Current rating: 3.0A derated to 1.5A typical (dependant on loading)
• Brush contact provides low mating and unmating forces:
  • 1.5 oz. per contact (typical)
  • 70% to 90% lower than conventional pin and socket contacts
• Brush contact provides superior electrical characteristics:
  • Redundant current paths
  • Minimized constrictive resistance
  • Uniform current densities
  • Stable time/life contact resistance
  • Gas tight and electrical contact site integrity
• Brush contact proven durability: 20,000 cycles of mating and unmating

Amphenol offers configurations of LRMs that combine the B³ contact in some inserts along with other types of contacts in other inserts. Amphenol design engineers take pride in developing optimized interconnect solutions to meet each customer’s specific interconnect needs.

Bristle Brush Contacts are utilized in LRM connectors because they offer low mating force, extended service life and stable electrical performance in harsh vibration/fretting conditions.
Bristle Brush Contact Advantages
the superior choice for board level interconnects

The Bristle Brush contact has been proven in military avionics packages and meets the requirements of MIL-DTL-55302. It provides high density in tighter spacing which is a main concern for integrated electronics in aircraft systems.

Brush vs. Conventional Contacts

Brush Contact Innovation
- Multiple contact interfaces
  Strands of high tensile strength wire are bundled together to form brush-like contacts. By intermeshing two multi-strand wire bundles, an electrical connection is made.
- Provides redundant current paths, 14-70 (points of contact) per mated contact with a gas tight junction.
- Very smooth (low friction) interface

Conventional Pin/Socket
- Machined surface finish on both parts
- Higher friction and wear
- Limited number of contact sites

Amphenol Brush Contacts Provide:
- Low mating forces (70% to 90% lower than conventional pin and socket contacts)
- Easy mating/unmating makes high circuit counts practical (25 lbs. typical for 400 contacts)
- Multiple points of contact = superior electrical capability
  - Stable, low resistance - 20 milliohms max.
  - Redundant current paths
  - Proven electrical and gas tight contact sites
- Severe environment protection
- High current rating
- Long contact life (100,000 cycles of mating and unmating without performance degradation)
- Documented intermittency-free performance - no 10 nano second discontinuities during 50,000,000 cycles of 0.010 displacement
- Overall cost effectiveness (life cycle cost)
- Protection against micro-arching
- No degradation in a fretting/micro-motion environment

Amphenol rectangular products group, including low mating force PCB connectors, LRM connectors and the OBIS Backplane with brush contacts and MT ferrule fiber optics.
Amphenol LRM Product Evolution

Amphenol has been committed to keeping up with the ever-changing demands of the rectangular connector marketplace. Starting with the development of the B3 contact, incorporated into the low mating force PCB connectors, and then later the development of the line replaceable module (LRM), Amphenol has led the way in the avionics packaging industry for high quality rectangular products. The following shows the rectangular product evolution.

**Low Mating Force Connector with Bristle Brush Contacts**
- Developed in the 1980’s to provide solutions to problems caused by the high mating and unmating forces of conventional pin and socket contact pairs.
- 4 Body styles: mother board (MB), daughter board (DB), PC connector, input/output connector
- Molded of thermoplastic material
- 2, 3 and 4 row configurations, 10 to 100 contacts per row in one contact row increments
- .100 inch center to center contact spacing, square grid
- Qualified to MIL-DTL-55302/166, /167, /168, /170

**Line Replaceable Module (LRM) Connectors with Chevron Grid**
- Developed to meet the avionics packaging requirements for a surface mount, high contact density PCB connector in a SEM-E form factor.
- 150+180 contact insert pattern grid in 6 rows: 0.075 inch spacing along the row with 0.075 inch between rows, rows offset 0.025 inch
This is an older design of the LRM and is typically not used today. Staggered and GEN-X designs have replaced the Chevron design (Consult Amphenol for further details)

**LRM Connectors with Staggered Grid**
- Advanced design to provide higher contact density for high speed integrated circuitry in SEM-E and custom form factors.
- 180 contact insert pattern grid in 8 rows: 0.100 inch spacing along the row with 0.050 inch between rows, rows offset 0.050 inch
- Options include various shell designs options to accommodate a wide range of PC board/heat sink combinations
- Solder tail, wire wrap or compliant contact availability
- Amphenol ESD protection
- Designed for level 2 (flight line) maintenance
- Provides routing channels for backplane

Amphenol Staggered Grid Connectors are the connector of choice for the F-16 and F-22 Aircraft. The following were the criteria that determined the selection of the connector for the F-16, F-22 and F-35 aircraft:
- Reliability: Fretting corrosion, Micro-arching
- ESD Protection
- Low cost solution

Staggered Grid LRM was chosen for the F-16 and F-22 Aircraft
Certainly not standing still, Amphenol continued to expand their product offering to provide even more contacts in a package, with high speed contact combinations for the most efficient data transfer.

**LRM Connectors with GEN-X Grid**
- Higher contact density and improved electrical performance
- All the features of the 180 contact pattern, including ESD protection
- Available in SEM-E and custom form factors
- 236 contact pattern grid in 8 rows: 0.075 inch spacing along the row with 0.060 inch between rows, rows offset 0.0375 inch

**LRM Staggered Grid Airflow-thru Connectors**
- LRM Staggered Airflow-thru inserts are available for wider boards up to 0.425 in. These accommodate standard B³ tails in staggered pattern, but with increased spacing in the center, and they also provide more airflow cooling of inserts.

**LRM Connectors with Fiber Optics**
- Custom combinations of digital contacts and fiber optic termini were offered as the product line further developed in the ‘90’s.
- Configurations included:
  - MIL-T-29504/4, /5, /14 & /15 termini
  - MT ferrule arrangements (2-24 fiber lines per ferrule)

**LRM Connectors to Accommodate RF Contacts**
- LRM inserts are available with RF contacts:
  - Size 16 M39029/79 & /80 shielded contacts
  - Size 12 coax for DC-2 GHz and size 8 coax for DC-32 GHz
  - GPPO coax contacts

**LRM Power Supply Modules**
- Custom designs of LRM modules have been developed with 270VDC sections which are capable of providing corona-free operation at 100,000 ft. They utilize size 22D contacts and are available in both crimp and compliant pin terminations.

**Board Level Interconnects of 2006 and Beyond**
**LRMs with a wide range of contact options, even higher contact densities and special shell configurations.**
More and more the customer has demanded a high level of flexibility, with designs that incorporate special features going beyond the standard LRM configurations such as:
- High speed shielded contacts - coax, triax, twinax, differential twinax, and quadraax contacts available in inserts of the LRM
- Combinations of power contacts, standard brush, high power, differential pair brush, and fiber optic termini
- A new design has been developed that utilizes the RADSOK® high amperage socket contact within inserts of the LRM
- Incorporation of Flex Circuits for more versatility of PC board terminations
- Custom shells with multiple bay configurations, with special keying components or special guide/ground pins
- Backplane shell grounding capabilities

See pages 20-23 for further descriptions of these optional designs.
Amphenol’s Design Engineering and Manufacturing Expertise

We take pride that Amphenol Aerospace is the undisputed leader in interconnect systems for aerospace/harsh environment applications. Such applications require a high degree of engineering sophistication and precision manufacturing capability that only a company that has been in the interconnection product design and manufacturing business for over 50 years can offer.

We have earned the reputation as the leader in the military electrical connection arena especially for military cylindrical connectors, and are fast becoming the leader for rectangular and surface mount interconnects. Our LRM and VME64x* products are used on major programs that include the following and more:

- F-35
- F-16
- F-15
- F/A-22
- F/A-18
- B2
- JTRS
- EH101
- Sincgars
- ATACMS
- M1 Tank
- Gripen
- F-117
- Harpoon
- LANTRIN
- AH-64 APACHE
- ASRAAM
- ATFLIR

Expert design and applications engineering provides solid modeling and full Pro-Engineer® capabilities to develop new interconnection designs and perform structural analysis. Marketing product managers team with skilled engineers and production specialists in a customer-driven approach to produce the end result: defect-free parts, cost effectiveness, shorter lead and delivery times, and satisfied customers.

The eye diagram shown right is from CST Microwave Studio® signal integrity modeling and simulation software at Amphenol. This state-of-the-art technology allows characterization of current connector designs and rapidly aids in the development of new high speed signal designs. It consists of a 3D, full-wave electromagnetic field solver for simulating electrical performance, producing SPICE models and eye diagrams.

Amphenol’s capability for testing of it’s wide range of cylindrical and rectangular connector products also includes vibration and shock testing, humidity, engagement/separation force evaluation, durability testing, as well as salt spray/fog, corona, ESD, optical performance testing and altitude simulation.

* VME64x products are covered on pages 27 and 28.
Amphenol Leads in Board Level Product Manufacturing Technology

Amphenol Aerospace is highly integrated to design, manufacture, assemble and ship an extensive variety of line replaceable module and backplane connectors. They also supply a wide range of heatsink hardware associated with this type of connector. The photo on right shows several heatsink forms used in the manufacture of LRM interconnects.

Manufacturing equipment photos shown below demonstrate Amphenol’s high technology capability. Focus is always on cost effective production and continuous improvement of processes. Manufacturing capabilities include state-of-the-art robotically controlled milling machines and CNC machining, as well as impact and extruding, plating, screw machining, and process control.

Amphenol divisions work together to provide a very broad manufacturing capability for board level interconnects:

- Amphenol Aerospace (AAO)* has leading expertise in the production of line replaceable module interconnects, VME64x interconnects and low mating force brush connectors.
- Amphenol Backplane Systems (ABS)** has leading expertise in the manufacture of custom backplane assemblies - high density, ruggedized, board to backplane interconnects.
- Amphenol Advanced Circuit Technology (ACT)*** has leading expertise in the manufacture of flex circuitry products used in connector-to-board attachment.

These companies of Amphenol Corporation combine to provide design, applications engineering, fabrication, value-added assembly and testing to meet customer requirements as well as to develop products for emerging technologies.

* This catalog covers only a portion of the rectangular interconnect products offered by AAO division. Go online at www.amphenol-aerospace to see the wide range of cylindrical and other interconnect products offered by AAO.

** For more information on backplane assemblies see page 31 and go online at www.amphenol-abs.com.

*** For more information on flex circuit products see page 23 and go online at www.act-flexcircuit.com.
The following is the LRM Module Connector identification and naming convention. The illustration is a double bay module with staggered pattern grid.
The following diagram shows an LRM Backplane connector, exploded, to show how it fits together. This is a double bay backplane with staggered grid pattern.

- **BACKPLANE CONNECTOR SHELL**
  (TYPICAL CONTAINMENT OF 2 BAY INSERT ASSEMBLY SHOWN)

- **STAGGERED STYLE INSERT ASSEMBLY**
  (960 BRUSH CONTACTS SHOWN)

- **BACKPLANE PCB**

- **BRUSH PINS**
Staggered Grid LRM Contact Pattern, Staggered Grid Airflow-thru Contact Pattern

The LRM Staggered pattern allows for surface mount leads on a .025 inch center line. The first diagram and photo represent the standard LRM connector using staggered grid and standard brush contacts; for example: 1 bay (180 contacts total), 2 bay (360 contacts total), 3 bay (540 contacts total). See pages 12-13 and 20-22 for other arrangements (beyond the standard arrangements of brush contacts) in LRM insert bays.

The photo and diagram below represent the staggered grid airflow-thru contact pattern. Designed to meet wider board requirements, the center spacing is wider, but the .025 spacing between contacts stays the same.
Comparison - Staggered Grid LRM vs. Staggered Grid Airflow-Thru LRM

Staggered Grid (Standard)

Staggered Grid for Standard Board Thickness

Staggered Grid Airflow-Thru

Staggered Air-flow for Wider Board Thickness
Staggered Grid LRM interconnects can be designed in one bay, two bay three bay configurations or special additional bay arrangements. The typical arrangements shown here are depicted in one bay drawings. Amphenol’s design flexibility allows for combinations of bays and combinations of contact types. The typical patterns represent the versatility that can be arrived at in arranging numbers of contact cavities and combinations of brush, fiber optics, RF, power and special high speed inserts within a typical bay. Consult Amphenol Aerospace for assistance in designing the LRM that best meets your specific application needs. See page 35 for an aid in selection and ordering.

80 brush contacts

108 brush contacts

152 brush contacts

180 brush contacts

108 brush contacts plus 6 sz. 12 power or coax contacts

108 brush contacts plus 8 coax contacts

80 brush contacts plus 10 coax contacts

80 brush contacts plus 12 sz. 12 power or coax contacts

152 brush contacts plus 2 sz. 12 power or coax contacts

152 brush contacts plus 4 sz. 16 power or coax contacts

152 brush contacts plus 2 sz. 12 power or coax contacts

108 brush contacts plus 270 VDC power input

80 brush contacts plus 270 VDC power input

22 sz. 12 power contacts

Example of a 2 bay arrangement with inserts of staggered brush contacts and inserts for size 12 coax contacts in a backplane.
Staggered Grid LRM typical arrangements

144 brush contacts plus 4 fiber optic termini

Example of a 3 bay staggered special arrangement in a module.

108 brush contacts plus 4 coax contacts and 4 fiber optic termini

Example of a 2 bay staggered arrangement in a module.

80 brush contacts plus 6 coax contacts

Example of a staggered grid airflow-thru insert with 152 brush contacts.

108 brush contacts plus 2 fiber optic MT ferrules

Staggered Grid Airflow-thru Typical Arrangements

8 brush LVDS differential pairs plus 2 fiber optic MT ferrules

Currently the typical Airflow-thru arrangements are with brush contacts. All of the arrangements shown on pages 12 and 13 for staggered grid represent are typical of what has been developed for customer requirements, but other designs are possible. Please call Amphenol for assistance with your specific contact arrangement needs. See page 35 for an aid in selection and ordering of LRM and LRU interconnects.

16 LVD pairs
Staggered Grid LRM termination options

The following is a guide to the part number suffixes to be used when ordering LRM Connectors. Due to the complexity and number of variations within the part numbering, it is necessary to consult Amphenol Aerospace for assistance when building these part numbers. See page 35 for an aid in selection and ordering, and call Amphenol at 607-563-5011 for technical support.

10-507 ..... Designates Amphenol LRM Connectors

XXX-X ..... Module Insert Arrangement Number - To be assigned by Amphenol.

( ) ............ Heatsink Thickness Suffix for Modules

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Description</th>
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<tr>
<td>1</td>
<td>.125 ± .005</td>
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<tr>
<td>2</td>
<td>.100 ± .005</td>
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<tr>
<td>3</td>
<td>.075 ± .005</td>
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<tr>
<td>4</td>
<td>.062 ± .005</td>
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( ) ............ Board Package Thickness Suffix for Modules

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<th>Suffix</th>
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<th>Description Airflow-thru Staggered*</th>
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<td>1</td>
<td>Surface Mount / .090 – .130 Package</td>
<td>Surface Mount / .265 – .305 Package</td>
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<tr>
<td>2</td>
<td>Surface Mount / .130 – .190 Package</td>
<td>Surface Mount / .305 – .365 Package</td>
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<td>Surface Mount / .190 – .250 Package</td>
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</tr>
<tr>
<td>4</td>
<td>Surface Mount / .060 – .100 Package</td>
<td>Surface Mount / .235 – .275 Package</td>
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<tr>
<td>5</td>
<td>Surface Mount / .100 – .160 Package</td>
<td>Surface Mount / .275 – .335 Package</td>
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* .175 is added for increased center spacing in the airflow-thru staggered style

( ) ............ Termination Style Suffix for Backplanes

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( ) ............ Termination Stickout Suffix for Backplanes

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<tr>
<td>C</td>
<td>.157 ± .020 (Compliant, No Wrap)</td>
</tr>
<tr>
<td>D</td>
<td>.217 ± .020 (Compliant, 1 Wrap)</td>
</tr>
<tr>
<td>E</td>
<td>.317 ± .020 (Compliant, 2 Wrap)</td>
</tr>
<tr>
<td>F</td>
<td>.417 ± .020 (Compliant, 3 Wrap)</td>
</tr>
</tbody>
</table>
Staggered Grid LRM typical performance, materials list

Table 1 below identifies the typical electrical, mechanical and environmental performance of an Amphenol 2 bay LRM connector assembly with 360 brush contacts in staggered grid. This data was program specific and does not reflect actual performance limitations. Table II below provides a materials list for the components of staggered grid LRM connectors.

### TABLE I: PERFORMANCE

#### ELECTRICAL PERFORMANCE

<table>
<thead>
<tr>
<th>Electrical Parameters</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current carrying capability</td>
<td>10°C temperature rise at 2A and 30°C rise at 3A</td>
</tr>
<tr>
<td>Contact resistance</td>
<td>30 milliohms max. per contact, 25 milliohms max. average</td>
</tr>
<tr>
<td>Dielectric withstanding voltage at sea level</td>
<td>100 VRMS, 60 Hz</td>
</tr>
<tr>
<td>Dielectric withstanding voltage at altitude</td>
<td>100 VRMS, 60 Hz at 70,000 ft.</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>1000 megohm minumum at 100V d.c.</td>
</tr>
<tr>
<td>Electrostatic Discharge Protection</td>
<td>± 25,000 minimum air and direct discharge (see pg. 24 for details)</td>
</tr>
</tbody>
</table>

#### MECHANICAL PERFORMANCE

<table>
<thead>
<tr>
<th>Mechanical Parameters</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact retention (solder type backplane assembly)</td>
<td>Maximum displacement of 0.010” at 1 poind load</td>
</tr>
<tr>
<td>Mating and unmating forces</td>
<td>Maximum 40.0 pounds mating and unmating</td>
</tr>
<tr>
<td>Vibration (Sinusoidal, 20g peak max.)</td>
<td>No electrical discontinuity &gt;1 µS</td>
</tr>
<tr>
<td>Vibration (Random, 11.6g RMS max.)</td>
<td>No electrical discontinuity &gt;1 µS</td>
</tr>
<tr>
<td>Shock (50g max. shock pulse)</td>
<td>No electrical discontinuity &gt;1 µS</td>
</tr>
<tr>
<td>Solderability</td>
<td>Minimum 95% solder coverage</td>
</tr>
<tr>
<td>Resistance to soldering heat</td>
<td>260°C dip for 10 seconds</td>
</tr>
</tbody>
</table>

#### ENVIRONMENTAL PERFORMANCE

<table>
<thead>
<tr>
<th>Environmental Parameters</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature life</td>
<td>250 hours at 125°C maximum</td>
</tr>
<tr>
<td>Connector durability</td>
<td>500 cycles mating and unmating</td>
</tr>
<tr>
<td>Salt fog exposure</td>
<td>48 hours maximum direct exposure (5% NaCl)</td>
</tr>
<tr>
<td>Thermal shock</td>
<td>500 cycles at +125°C / –65°C</td>
</tr>
<tr>
<td>Humidity exposure</td>
<td>240 hours at 90 - 98%</td>
</tr>
<tr>
<td>Contamination exposure</td>
<td>Sand and dust per MIL-STD-202 Method 110</td>
</tr>
<tr>
<td>Resistance to solvents</td>
<td>Boiling Trichloroethylene fumes and solution</td>
</tr>
</tbody>
</table>

### TABLE II: MATERIALS LIST

<table>
<thead>
<tr>
<th>Part</th>
<th>Material / Finish Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush wires</td>
<td>Beryllium copper per ASTM B197; finish is gold per ASTM B488 over nickel per AMS-QQ-N-290. (The exposed ends of the brush wires need not be plated).</td>
</tr>
<tr>
<td>Module contacts</td>
<td>Beryllium copper per ASTM B34 C17500, or C17510 except temper HTC; finish on contact body is matte tin-lead per ASTM B579; finish on termination end is 60/40 or 63/37 tin-lead dip per J-STD-004, -005 and -006.</td>
</tr>
<tr>
<td>Backplane contacts</td>
<td><strong>Contact barrel:</strong> brass per ASTM B4531/B453M-01 similar to UNS C33500; finish is tin-lead per SAE-AMS-P-81728 (min. 15% ±5% lead) over nickel. <strong>Contact tail:</strong> beryllium copper per ASTM B-534 alloy 17510 HT; finish is gold per ASTM B-488 over nickel per AMS-QQ-N-290. <strong>Contact sleeve:</strong> stainless steel per AMS 5514; finish is black oxide per MIL-DTL-13924 and conformally coated per MIL-I-46058.</td>
</tr>
<tr>
<td>Backplane contacts (PCB termination)</td>
<td><strong>Contact body:</strong> brass similar to UNS C33500; finish is gold over nickel; termination end is 60/40 or 63/37 tin lead dip. <strong>Contact sleeve:</strong> stainless steel per AMS 5514; finish is black oxide per MIL-DTL-13924 and conformally coated per MIL-I-46058.</td>
</tr>
<tr>
<td>Insulators</td>
<td>Polyphenylene Sulfide or Liquid Crystal Polymer per MIL-M-24519</td>
</tr>
<tr>
<td>Organizer</td>
<td>Polyphenylene Sulfide or Liquid Crystal Polymer per MIL-M-24519</td>
</tr>
<tr>
<td>Shells</td>
<td>Aluminum alloy 6061-T6 per AMS 4150; finish is electroless nickel per SAE AMS 2404.</td>
</tr>
<tr>
<td>ESD shells</td>
<td>Aluminum alloy 6061-T6 per AMS 4150; finish is hardcoat anodize per MIL-A-8625 with epoxy final coat. Ground tabs are chromate treated (irridite).</td>
</tr>
<tr>
<td>Polarization keys</td>
<td>Stainless steel per AMS 5640; finish is black oxide per MIL-DTL-13924. Key retaining ring is Polyamide (nylon 12) with 50% glass filled fibers.</td>
</tr>
<tr>
<td>Guide pins</td>
<td>Beryllium copper alloy per ASTM B196, finish is gold per ASTM B 488 over nickel per AMS-QQ-N-290.</td>
</tr>
</tbody>
</table>
Comparison - Staggered Grid LRM vs. GEN-X LRM

Staggered Grid Contact Density

Staggered Grid Module Termination

GEN-X Contact Density

GEN-X Module Termination

Two Surface Mount Planes

Four Surface Mount Planes
Comparison - Staggered Grid LRM vs. GEN-X LRM, cont.

Staggered Grid Tail to Tail Placement

Staggered Grid LRM has 0.025 tail to tail centerline spacing

GEN-X Tail to Tail Placement

GEN-X LRM has 0.0375 tail to tail centerline spacing

GEN-X Uses Rigid-Flex PCB Attachment
The LRM GEN-X pattern allows for surface mount leads on a .035 inch center line, yet provides higher contact density than the Staggered grid pattern. The diagram and photo represent the standard LRM connector using GEN-X grid and standard brush contacts; for example: 1 bay (236 contacts total), 2 bay (472 contacts total), 3 bay (708 contacts total).

All options and features of the staggered grid LRM connectors are also available in the GEN-X LRM connectors including accommodation of other types of contacts and ESD protection. See next page for GEN-X typical patterns.

Example of a 3 bay GEN-X arrangement in a backplane.
GEN-X Grid LRM

typical arrangements

GEN-X Grid LRM interconnects can be designed in one bay, two bay, three bay configurations or special additional bay arrangements. The typical arrangements shown here are depicted in one bay drawings. Multiple combinations of contact types (brush, fiber optics, RF, power and special high speed inserts) and number of bays are possible. Consult Amphenol Aerospace for assistance in designing the LRM that best meets your specific application needs. See page 35 for an aid in selection and ordering of LRM and LRU interconnects.

Example of a 2 bay GEN-X arrangement in a module.

- 118 brush contacts
- 236 brush contacts
- 140 brush contacts plus 2 fiber optic MT ferrules
- 219 brush contacts plus 2 sz. 16 power or coax contacts
- 170 brush contacts plus 6 sz. 16 power or coax contacts
- 170 brush contacts plus 4 fiber optic termini and 2 sz. 16 contacts
Fiber optic high speed transmission is available within LRM connectors for use in advanced avionics systems. Optical performance of fiber optic termini within the LRM connectors are the same as termini used in cylindrical connectors. Insertion losses range from .3dB to <1.5dB depending upon launch conditions, fiber NA, fiber size and the type of termination. LRM connectors are available with fiber optic termini in the following configurations:

- Modified MIL-T-29504/4, /5, MIL-T-14 & MIL-T-15 termini - Size 16, straight and 90 degree styles.
- MT ferrule (2-24 fiber lines per ferrule)
- Hybrid arrangements with fiber optics and other contact types

**Staggered Grid Patterns with Fiber Optics**
(These drawings are also shown with other staggered grid patterns on pages 12 and 13).

- 8 brush differential pairs plus 2 fiber optic MT ferrules
- 108 brush contacts plus 2 fiber optic MT ferrules
- 6 fiber optic MT ferrules
- 144 brush contacts plus 4 fiber optic termini
- 108 brush contacts plus 4 coax contacts plus 4 fiber optic termini

**GEN-X Patterns with Fiber Optics**
(These drawings are also shown with other GEN-X patterns on page 19).

- 140 brush contacts plus 2 fiber optic MT ferrules
- 170 brush contacts plus 4 fiber optic termini plus 2 sz. 16 contacts

For more information on Amphenol fiber optic connectors, ask for Amphenol catalog 12-352.
LRM Interconnect Options
RF modules, high speed shielded coaxial contacts, high speed differential contacts

LRM inserts have been designed to accommodate the following RF contacts and high speed coaxial contacts:
- Size 16 M39029/79 & /80 shielded contacts
- Size 12 coax for DC-65 GHz
- Size 8 coax for DC-32 GHz
- Hybrid arrangements with RF or high speed shielded contacts and brush contact combinations

Staggered Grid Patterns with RF/Coaxial Contacts
(These drawings are also shown with other staggered grid patterns on pages 12 and 13).

- 108 brush contacts plus 8 coax contacts
- 80 brush contacts plus 10 coax contacts
- 80 brush contacts plus 6 coax contacts
- 108 brush contacts plus 4 coax contacts plus 4 fiber optic termini
- 152 brush contacts plus 2 coax contacts
- 152 brush contacts plus 4 sz. 16 coax contacts

Amphenol has also developed inserts with brush differential pair contacts that are matched impedance 100 ohm. These support data rates with excess of 1.2 Gbps.

Staggered Grid Patterns with LVDS Differential Pairs
(These drawings are also shown with other staggered grid patterns on page 13).

- 8 brush differential pairs plus 2 fiber optic MT ferrules
- 16 LVDS differential pairs

RF Module and Backplane with Size 8 Coaxial Contacts

Staggered Grid Module with Cavities for Size 12 Coaxial Contacts

GEN-X Patterns with RF/Coaxial Contacts
(These drawings are also shown with other GEN-X patterns on page 19).

- 219 brush contacts plus 2 sz. 16 coax contacts
- 170 brush contacts plus 6 sz. 16 coax contacts

Module and Backplane with LVDS Differential Pair Contacts
LRM Interconnect Options
power supply modules for high voltage, other high power/high amperage contacts

Power Supply Modules
Amphenol has designed several custom 270VDC sections which are capable of providing corona-free operation at 75,000 ft. They utilize size 22D contacts and are available in both crimp and compliant pin terminations.
Amphenol has developed the patterns shown below that incorporate 270 VDC power modules.
(These drawings are also shown with other staggered grid patterns on page 12).

![Power Supply Modules](image1)

LRM Connectors with RADSOK Contacts
High Amperage RADSOK® socket contacts have been designed into LRM connectors in response to customer needs for passing of larger amounts of current with lower mating forces which standard contacts will not handle.
The connector design shown at right has 8 groups of 3 bussed RADSOK 3.6mm sockets (24 contacts total). Each group of 3 is expected to handle a maximum of 140A. Mating pins for the RADSOK sockets are press-fit into aluminum bus bars behind the motherboard connector.

The RADSOK® socket cylinder within female contact has several equally spaced longitudinal beams twisted into a hyperbolic shape. As the male pin is inserted, axial members in the female half deflect, imparting high current flow across the connection with minimal voltage loss. The hyperbolic, stamped grid configuration ensures a large, coaxial, face-to-face surface area engagement.
For more information on Amphenol RADSOK® connectors, see the Amphenol Industrial Operations catalog SL-391 on-line at www.amphenol-industrial.com.

See photo on next page of this design in an actual module and backplane interconnect pair attached to a PC board with flex.
LRM Interconnect Options
flex circuitry, backplanes with compliant pins, I/O modules with PC tails

**Flex Circuitry Used on LRM Connectors**
Flex termination can be an integral part of the LRM connector insert as shown on top right photo or it can be used to attach the connector to the printed circuit board, as shown on next photo below.
When used for attachment to PC boards the flex circuitry is designed to meet specific length, current carrying capacity and to fit the precise geometric shape of the connector to board package. Amphenol ACT (Advanced Circuit Technologies) designs and manufactures the flex circuitry. Sculptured® Flexible Circuits have built-in terminations which eliminate the failures associated with crimped or soldered-on contacts, as well as geometrically fitting the tight space requirements within a package. Flex material is strong and rigid, yet highly flexible.
For more information on flex circuit products go to website: www.act-flexcircuit.com.

**Compliant Pins**
Compliant pin contacts are available for LRM backplane connectors. These are a press fit type contact which provide reliable, reduced cost, solderless mounting to printed circuit boards. Connectors are sold completely assembled with compliant pins and they accommodate boards with minimum of 0.125 inch thickness and 0.025 ±.002 plated through holes.

**PC Tail Contacts**
LRM modules can be designed with PC tail contacts for solder mounting on printed circuit boards. These are called I/O (input-output) LRM modules and have staggered grid pattern.
Amphenol Electrostatic Discharge (ESD) Protection

Amphenol has developed cylindrical and rectangular connectors which protect sensitive components from Electrostatic Discharge (ESD) without diodes, varistors, gas tubes, or “experimental” semiconductive materials. These connectors utilize the Faraday Cage principal to shunt electrostatic discharge events to the conductive enclosure on which the connector is mounted, thus never allowing the high voltage, high current discharge event to reside on any contacts.

The ESD protected connectors have the same physical envelope as their standard counterparts, and do not require special mounting or terminating techniques. All of the contacts remain fully functional, and electrical characteristics such as capacitance are not affected.

LRM Connectors with ESD protection have the following features and benefits:

- Connector envelope is identical to unprotected design for most applications
- Exceeds protection requirements of IEC 801-2 and MIL-STD-1686:
  - Ensures that all components within a conductive enclosure will be subjected to a maximum of 10V during electrostatic discharges between –26 KV and +26 KV
  - Voltage observed on contacts during ESD events: <10V (at 1 megohm)
  - Current observed on contacts during ESD events: < 100 milliamperes (at 2 ohms)
  - Response time is instantaneous (voltage and current are maximum values)
  - Maximum ESD voltage - tested to ±26KV
- No capacitive loading
- Eliminates the need for discrete components (such as diodes) and maximizes printed circuit board real estate for equipment housed in conductive enclosures which require ESD protection as freestanding units
- Operating voltage of connectors not effected for most designs
- Pulse life - infinite

The Amphenol Ruggedized VME64x connectors (see pages 27 and 28) are standard with ESD protection, offering all the above features and benefits.

There are many drop-in replacement ESD protected connectors for retrofitting existing programs which have conductive enclosure and require ESD protection as free-standing equipment.

What is Electrostatic Discharge (ESD)?
Electrostatic Discharge is the rapid transfer of a static electric charge from one body to another. A static electric charge consists of either a surplus or depletion of electrons on a body, which gives that body a potential or voltage relative to ground (or another body). The discharge is extremely fast (less than 1 nanosecond risetime) and the current flow may exceed 100 amps!

Static electricity is normally the result of two materials transferring charges when rubbed or separated, such as shoes scuffing across a dry carpet, or sheets of untreated plastic being separated. This phenomena is commonly referred to as the triboelectric effect.

The voltage developed due to the triboelectric effect depends on the materials involved, the quantity and type of contact, and relative humidity. In a dry environment a person can accumulate a charge of up to 25 KV. In a moist environment a person’s potential is reduced due to the effect of moisture on the insulating properties of materials.

What is a Faraday Cage?
A Farady cage is a conductive enclosure. It may be solid in form such as a sheet-metal encloser, or it may be full of apertures, such as a wire cloth box. When a charge is placed on a faraday cage the electrons which make up the charge, having like polarity, try to position themselves as far as possible from each other. This places the electrons on the outer surface of the enclosure, leaving the inner surface uncharged. The charge on the outer surface does not induce a charge on any neutral object inside of the faraday cage, and therefore does not try to transfer itself onto the internal object. Neutral objects (such as IC’s) inside of a faraday cage are thereby protected from ESD activity external to the faraday cage.

The voltage and current observed on neutral objects within a faraday cage during ESD events are due to the secondary effects of ESD. These include Electromagnetic Interference (EMI), magnetic and electrical field coupling. The faraday cage of the Amphenol ESD protected connectors has been designed to minimize these effects.

The Faraday cage on Amphenol ESD protected connectors intercepts electrostatic discharges from the contacts in the unmated state, while maintaining each contact’s isolation when the connector is mated.

ESD testing on LRM Rectangular Connector (Actual photo)

Publication L-2075, “ESD Attenuation Test Procedure for Connectors with Faraday Cage Protective Structures” is available as a reference document. Contact Amphenol Aerospace for any further information on ESD protection connectors.
Test Probe Kit - For use with Amphenol Brush Contacts in LRM Connectors

Amphenol supplies a test probe kit especially designed for probing brush contacts to insure that they are properly wired within a connector. It consists of a plastic holder, insert, and two contacts which are usable for either the backplane or module connector. It is suggested that the user buy two kits if they are using connectors of two genders. The kits are not convertible after assembly.

Instructions for use of Backplane Test Probe -
Slide the insert back over the wire, and crimp contact on. Follow crimping procedure below. Then snap the insert contact assembly into the holder.

Instructions for use of Module Test Probe -
Slide holder over wire, and then crimp contact. Follow crimping procedure below. Slide the insert on the contact and seat it against the shoulder. Slide the holder forward and snap it onto the insert.

Crimping Procedure -
Using accepted industry procedures, strip wire end to be terminated 1/8 to 5/32 inches. Care should be taken not to nick wire strands. Assemble the M22520/2-01 crimp tool and M22520/2-27 positioner and place tool selector in correct setting for wire size. Selected wire size must not have an insulation diameter greater than .062 for the module probe and not greater than .038 for the backplane probe.

\[
\begin{array}{cccc}
\text{AWG} & 22 & 24 & 26 & 28 \\
\text{SEL} & 5 & 4 & 3 & 2 \\
\end{array}
\]

Insert stripped wire end into contact wire well. Strands should be visible in wire well inspection hole. Bottom contact and wire assembly in positioner and close handles of crimp tool to complete crimp. Handles will not open unless full crimping cycle has been completed.

Part number for ordering test probe kit is 11-10400-23.

\textbf{ATTENTION:}
Probing brush contacts with anything other than a brush contact may damage or degrade the brush contact performance.
LRM Accessories and Tools, cont.

Brush Contact Removal, Replacement and Insertion for Backplane Staggered Grid Connectors:
Contacts with solder tails within backplane LRM connectors with staggered grid are not removable or replaceable. User must replace the insert assembly.
Compliant tail type contacts within backplane LRM connectors with staggered grid are removable and replaceable.
Instructions for removal of compliant contacts: From the back of PC board side, push contact out through the front of the connector assembly with contact removal tool #10-507941-1.
Instruction for replacement/insertion of compliant contacts: Using tweezers or fingers, carefully place the replacement contact, tail first, into the appropriate contact cavity in the front of the connector. Tweezer tip must not enter sleeve. Push contact into the cavity with a flat edged rod of suitable diameter to cover entire contact sleeve circumference until contact sleeve is flush with adjacent contacts. Do not push against wires or bend sleeve.

270 VDC Power Module Removal, Replacement and Insertion for Backplane Staggered Grid Connectors:
270 VDC power modules can be removed and replaced within the power insert of an LRM connector.
Instructions: Using removal tool #10507924-1 with plunger retracted, push tool down over the power module from the mating end until retention tines are released. Use plunger end of tool to push power module out of the rear the connector.
The power module may be re-installed by hand by pushing it from the rear of the connector. Push it forward until the retention clips snap into the power insert cavity of the shell.
The size 22D power contacts within the power modules are installed and removed with tool M81969/14-01.

For Module Staggered Grid Connectors:
Contacts within module LRM connectors with staggered grid are not removable or replaceable. User must replace the insert assembly.
Amphenol Aerospace developed the Ruggedized VME64x in response to the military trend towards VME64x and the utilization of COTS Boards and Chassis. Many different companies manufacture “Ruggedized VME cards”, but they still use the standard VME COTS (Commercial Off The Shelf) connector interface. In a harsh military environment the COTS VME connector interface can fail, negating all of the ruggedization on the cards.

The Amphenol Ruggedized VME64x interconnect has a more rugged interface than standard connectors for improved vibration durability. It meets the needs for a more rugged interconnect for harsh environments requiring Level 2 maintenance. Military and commercial aviation, military vehicles and GPS systems are examples of markets that need the ruggedized VME64x connector solution from Amphenol.

The Amphenol Ruggedized VME64x connector mounts to standard VME64x cards and backplanes, but it does not mate to other types of VME commercial connectors.

Features and benefits include:

- Metal shells - mount directly to the standard VME card mounting holes, providing support and protection to the inserts in the module and additional stiffness to the backplane
- The metal shells create a faraday cage around the contacts, preventing ESD (Electrostatic Discharge) into the contacts (module only)
- An adapter is available that will easily mount the Amphenol Ruggedized VME64x connector to a standard COTS VME64x
- Robust contact system
- 3 module inserts in one unified shell; each can have different interconnect combinations:
  - P1, P2 and 2mm electrical P0
  - P1 and P2 combination
  - P1, P2 and fiber optic MT ferrules in the P0 position
- Inserts are designed to customer specifications
- Optional solderless termination on the backplane connector is available

Amphenol’s ruggedized VME64x module and backplane connectors were developed to meet more rugged harsh environment applications.

Ruggedized VME64x module and backplane connectors on a circuit board.
Ruggedized VME64x Brush Contact Adapter, VME P0/J0 Fiber Optic Interconnect

“Cocooning” of COTS components has been successful in military applications. Amphenol supplies an adapter interconnect system for “cocooning” of COTS VME64x daughtercards.

The ruggedized VME64x adapter system provides the durable brush contact as the primary interface, and integrates the three connectors into a singular metal shell, providing passive ESD protection to the module connector. The back of the module connector mates to standard COTS VME64x daughtercards, isolating them from harsh environments.

Amphenol provides a fiber optic interconnect for attachment to standard VME-64x cards and backplanes for the P0 and J0 locations of the boards. It uses “MT” ferrules and it is used in place of P0/J0 electrical applicable connectors.

Performance features include:

- Tested to IEEE 1156.1-1993 paragraphs
- Operating temperature from −55°C to +125°C
- Shock: 100g, 6ms, 1/2 sine, 18 pulses
  Shock: 30g, 6ms, 1/2 sine, 18 pulses
- Sine vibration: 10g, 40 min./axis, 3 axis
- Random vibration: 0.15g² Hz, 40 min./axis, 2 axis
- ESD: 15KV/150 pF

Amphenol’s VME P0/J0 fiber optic connectors are used in military and commercial aviation, military vehicles and GPS systems. They are designed to customer specifications. Consult Amphenol Aerospace for further information.
Other Amphenol Board Level Interconnects
low mating force brush connectors, rack & panel connector with brush contacts

Low Mating Force Brush Connectors
For lower density needs than LRM interconnects, the Amphenol family of rectangular connectors with brush contacts meet many market applications: medical equipment, GPS systems, telecommunications, factory automation, military aviation and military vehicles. Military versions meet MIL-C-55302/166 through /172. Connector configurations are capable of supporting data rates up to 400 Mbps.

As mentioned earlier in this catalog, the low mating force brush connectors were Amphenol's first development of connectors that used the bristle brush contact - providing low mating/unmating forces (70% to 90% reduction from conventional pin and socket contacts). The features and advantages of brush contacts are discussed on pages 3 and 4 of this catalog.

For mounting to printed circuit boards or discrete wires, the following body styles are offered within the low mating force brush rectangular family: mother board styles, daughter board styles, input/output styles, PC styles and small 10-contact arrangement styles with option of multi-colored moldings for color coding applications. Brush contact styles used include straight, 90 degree, PCB stud, wire wrap and crimp. Hybrid arrangements are possible with brush/power/coax and fiber optics.

For more information on Amphenol Low Mating Force Brush connectors, see catalog 12-035 on-line at www.amphenol-aerospace.com.

Ruggedized, Non-Floating Rack & Panel Connectors
Amphenol offers a rack and panel connector which was designed to meet the requirements of ruggedized, modular radio applications.

Performance features include:

- Exceeds many MIL-DTL-38999 performance requirements
- Utilizes Amphenol's low mating force brush contacts
- 0.100" x 0.100" square grid footprint
- Load bearing shells (supports module to rack interface)
- Tapered connector mating surfaces provide near zero X-Y plane movement between mated connectors.
- EMI/ESD protection in both connector halves:
  - EMI at mounting surfaces and connector interface (38999 III level)
  - ESD features allow use of Class 3 hardened chips (4KV max. voltage)
- Signal speeds to 3.125 Gbps - (per differential pair and based on intelligent assignment of ground/signal pairs)
- Capable of 500 mating cycles
- Water tight seals both at connector interface and to mounting surfaces
- "Hybrids" available - combining signal contacts with power or RF contacts
Other Amphenol Board Level Interconnects
SIM modular connectors, printed circuit board terminal blocks, wiring interface modules

SIM Modular Connectors from Amphenol Air LB
SIM rectangular interconnects were developed by Amphenol Air LB division as an alternative to MIL-DTL-38999 circular connector where space and modularity were critical. SIM modulars are receptacle shells that can be stacked, flanged receptacle shells and free plug shells. They meet the EN 4165 spec. They meet or exceed all the MIL-DTL-38999 mechanical, electrical, environmental sealing and EMI shielding performances.
SIM modular connectors incorporate MIL-C-39029 Series 2 or Series 3 contacts in sizes 22, 20, 16 and 12. They can be equipped with printed circuit, coax, twinax, triax, quadrax contacts, or fiber optic termini up to a size 8. Also they can be mounted on backplanes using press-fit compliant contacts.
SIM modular connectors are used in military and aerospace applications: fighter jets, tanks, helicopters and missile systems. For more information on SIM Modular connectors go on-line to www.amphenol-airlb.com.

Printed Circuit Board Terminal Blocks from Amphenol Pcd
Amphenol Pcd division supplies wire-to-board discrete-wire connections in a variety of styles:
- Pluggable terminal blocks and headers in 3.5mm/.150" pitches in straight, angled, with locking ears, 2-tier, 3-tier, and low profile styles
- FlexiPlug® hybrid pluggable blocks which combine U.S. style standard screw-drive barrier block wire terminations with a European-style pluggable block nose
- Fixed terminal blocks in 5.0mm, 200°, 250°, 375° pitches in standard profiles, multi-tier, spring-clamp, high current and high voltage styles
- Edgocard Connectors that are screw-terminal style in different size pitches
- Custom designed terminal blocks: with ear mounting options, DIN-rail mounting options, and others

Terminal blocks are used typically in industrial applications such as process control, instrumentation, audio/video, HVAC, datacom and security. They are UL, CSA and TUV approved, and have UL94VO flame rating. For more information on printed circuit board terminal blocks go to the Pcd Industrial Interconnect catalog, on-line at www.amphenol-pcd.com.

Wiring Interface Modules from Amphenol Pcd
Amphenol Pcd division also supplies an industrial board level interconnect which expands the traditional terminal block I/O functions by incorporating the blocks, high-density connectors and often additional components into a rail-mounted printed board assembly. This replaces discrete terminations with a single pluggable unit. Connectors can be D-Sub, ribbon cable, RJ style, Centronic or DIN types. Also diodes, LEDs, resistors, capacitors, relays or fuses can be included in the unit. For more information go on-line to www.amphenol-pcd.com.
Other Amphenol Board Level Interconnects
Backplane Assemblies

Backplane Assemblies - Electrical
Amphenol Backplane Systems division of Amphenol Aerospace is the leading manufacturer of custom backplane assemblies for the military and aerospace markets. Consult Amphenol Backplane Systems (ABS) for:

- Electrical Backplanes -
  Large panel sizes with high layer counts, and features such as high aspect ratio plating, small diameter plated-through holes, and controlled impedance.

Backplane Assemblies - Optical and Hybrid Optical
Consult Amphenol Aerospace, Sidney, NY for:

- Optical Backplanes -
  Fiber termination with Multi-Terminal (MT) optical ferrules. Ribbon cable sorting allows programming flexibility; thus rendering the entire system easily upgradeable.

- Hybrid Optical Backplanes -
  Integrated electrical and optical systems in one discrete package for advanced avionics systems requiring high speed optical/digital signal processing.

Backplane products are used on programs such as:

- F-35 Joint Strike Fighter
- F-22 Raptor
- MIDS Radio
- AH-64 Apache
- SPY-3
- THAAD Radar

Almost any connector in the market can be integrated into a backplane. SEM-E and custom form factors are available. Backplanes can incorporate LRMs with brush contacts, VME64x interconnects, rectangular ARINC (filtered and non-filtered) connectors, or UHD or NAFI fork and blade rectangular connectors. Cylindrical MIL-DTL-38999 (filtered and non-filtered) connectors can be integrated into a backplane as well.

Amphenol Backplane capabilities include other options:

- Press-fit compliant pin contacts
- Flex circuitry can be used to attach cylindrical connectors to backplanes
- Large format surface mount and soldering
- Through-hole soldering
- Conformal coating
- I/O solutions and cabling
- VME & compact PCI buss
- Cabling and higher level assembly

ABS has advanced testing capabilities and offers chassis assembly capabilities. ABS mil-spec qualifications include MIL-C-28859 for components and MIL-A-28870 for assembled backplanes. For more information on backplanes systems from Amphenol Backplane Systems and Amphenol Aerospace go to websites: www.amphenol-abs.com or www.amphenol-aerospace.com.
Other Amphenol Board Level Interconnects
UHD connectors (fork & blade contacts)

UHD Series with Fork and Blade Contacts
Amphenol’s wide range of board level interconnects also includes high density UHD (Ultra High Density) Series module and backplane connectors. These utilize fork and blade contacts in a staggered grid pattern for attachment to printed circuit boards. The staggered pattern is 80 contacts per inch, .025 pitch in 8 rows. They are SEM-E format and are qualified to: EIA 15-763, DESC 89065, IEEE 1101.1 to 1101.9. SU configurations are also available.

The UHD module connectors have surface mount blade contacts and the mating UHD backplane connectors have solderless press-fit tuning fork contacts. There are a wide range of high contact density patterns and the length and style can be tailored to meet customer requirements.

They are rigid pin terminated to the board or flex terminated to the board. Coax, fiber optics and power contacts can also be integrated into the connector configuration. Other options include EMI shielding and UHD interconnects can be provided in a stacking configuration. Module covers can be integrated into the connector system. Extender board connector configurations are also available so that customers can have access to probe and test modules that are electrically connected to the backplane.

Standard configurations of UHD connectors are:

- 372 pin
- 300 pin multi-purpose (fiber optic, coax, power contacts can be intermixed
- 296 pin with 270V power contacts
- 292 pin with coax
- 396 pin Futurebus + SEM-E
- 556 pin Futurebus + 10 SU (designs up to 680 contacts)

UHD Series connectors are provided by Amphenol Backplane Systems division of Amphenol. These connectors are a proven interconnect solution for advanced, high-reliability packaging requirements in markets of military and commercial aviation, space applications, shipboard applications, military vehicles, C4I electronics and ordnance. For more information see catalog 12-036 on-line at www.amphenol-abs.com.
Other Amphenol Board Level Interconnects
NAFI connectors (fork & blade contacts), I/O NAFI (rear removable crimp contacts)

NAFI Series with Fork and Blade Contacts
Amphenol NAFI daughtercard and backplane connectors are another board level interconnect solution from Amphenol Backplane Systems. They provide a wide range of medium contact density patterns and meet MIL-C-28754 standards. Daughtercard termination is through-hole, using nickel/gold solder plated contacts. The mating interface is a blade contact which can be either parallel or perpendicular to the daughtercard.

The M Series of NAFI connectors are for through hole interconnection to printed circuit boards with rigid pin termination. Connector lengths and body styles can be tailored to meet specific needs. They are available with 2, 3, 4 and 5 rows of contacts, .100 X .100 pitch. Standard NAFI-style features such as guide pins and D-and V-shaped polarizing keys are available.

The FM Series of NAFI connectors are for surface mount interconnection to printed circuit boards with flex circuit termination. Up to 5 rows of contacts can be configured. The standard NAFI interface is maintained while the flexible circuit traces provide the link to the module. The flexible circuit termination allows for hand soldering or various automated surface mount soldering processes. To meet customer needs, connector lengths and body styles can be tailored, and the flex circuitry lengths and configurations also are designed per customer specifics.

I/O NAFI Series with Rear Removable Crimp Termination
Amphenol also provides an I/O NAFI interconnect that allows for terminating #22 and #26 gauge stranded wires to a backplane. It is available with 24, 36, 40 or 120 rear removable crimp-style blade contacts and includes captive hardware and polarizing features. The receptacle (tuning fork) connector can be placed where needed on either side of the backplane.

NAFI interconnects are used in military and commercial aviation, in space applications, shipboard and in military vehicles. For more information see catalog 12-036 from Amphenol Backplane Systems, on-line at www.amphenol-labs.com.
Other Amphenol Interconnects for PC Board Attachment - cylindrical connectors with PC tail or compliant pin contacts

Cylindrical Connectors with PC Tail Contacts
Amphenol Aerospace is the leader in interconnect systems for aerospace/harsh environment applications. MIL-DTL-38999, MIL-C-26482, MIL-5015 as well as proprietary cylindricals can incorporate pc tail contacts. Jam nut (D hole) or panel mount (four hole) styles are solder mounted to printed circuit boards. PCB contacts are available in sizes 16, 20 and 22D.

Considerations must be made for length of PCB tails and any mechanical methods needed to stabilize the board. Commonly used tail diameters and tail stick-out dimensions are given in catalog 12-170, Amphenol Cylindrical Connectors for PCB Application. PCB contacts are available in coax, twinax, triax and quadrax types. Cylindrical connectors can be attached to boards with flex termination which creates a self-locking terminal pad and eliminates the need for an additional interconnect to the PC board.

Alignment Discs on PC tail connectors provide simplified installation of contacts to PCB boards.

Cylindrical Connectors with Flex Circuitry. Flex is designed to geometrically fit the shape of the connector to board package. It is strong and rigid, yet the circuit body is highly flexible.

Cylindrical Press Fit Connectors with Compliant Pins
MIL-DTL-38999 connectors can be supplied with compliant pin contacts for solderless mounting on printed circuit boards. Compliant pins engage the plated through holes in the PC board without the need for soldering which provides for high speed, low cost board assembly. They accommodate boards with minimum of 0.090 inch thickness and 0.040 ±.003 plated through holes. Both pin and socket contacts are available in any MIL-DTL-38999 Series I, II or III insert pattern having contact size 16, 20 or 22D. Connectors are sold completely assembled or are available fully pre-assembled on a blackplane assembly.

For more information see Amphenol product data sheet 188 and catalog 12-170. Both are on-line at www.amphenol-aerospace.com.
Aid in selection and ordering of LRM and LRU interconnects from Amphenol

The following are questions to be considered when inquiring about Amphenol LRM/LRU Interconnects. The answers to these questions will help the Amphenol marketing and engineering team to determine the best board level interconnect to meet your particular needs.

You can copy this page and write your comments on it, and then fax it back to Amphenol Aerospace, Sidney, NY. Include your name and company information at the bottom. Fax number: 607-563-5351, Attn: LRM product marketing. Or call Amphenol at 607-563-5011 and ask for technical information on LRM products.

**Footprint Required:**
Staggered, GEN-X, NAFI, UHD, Chevron, VME or other: ________________________________________________
___________________________________________________________________________________________

**Contacts Required:**
Digital: ______________________________________________________________________________________
Fiber Optic: __________________________________________________________________________________
Power: _____________________________________________________________________________________
RF: ______________________________________________________________________________________
LVDS: ______________________________________________________________________________________

**Module Requirements:**
Heatsink Thickness: _____________________________________________________________________________
Total Board Package Thickness: _________________________________________________________________
Pitch (module to module): ______________________________________________________________________
Straddle Mount, Clamshell or Right Angle: _________________________________________________________
Cover Attachment: ____________________________________________________________________________
Keying: _____________________________________________________________________________________

**Backplane Requirements:**
Termination Style: ____________________________________________________________________________
Termination Stickout (Compliant or Solder): _________________________________________________________
Shell Grounding: ______________________________________________________________________________

**Function Requirements:**
Operating Voltage: ___________________________
Operating Temperature: _______________________
Current Rating: ______________________________
Ambient Temperature: _________________________
Mating Cycles: ______________________________
ESD: Yes or No _____________________________
Float: Yes or No ______________________________
Humidity Conditions: _________________________
Level of Corrosion Resistance: _________________
Vibration Requirements: ______________________
Shock Requirements: _________________________
EMI/EMP: _________________________________
Altitude: __________________________________
Durability: _________________________________
Salt Fog: ___________________________________

Please fill out information below. Thank you for writing clearly. Fax to 607-563-5351, attention: LRM product marketing.

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